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Fishways, Flow, and Screening Proposed Rule

Cost Benefit Analysis

Final Report | September 22, 2023

prepared for:

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LIST OF ACRONYMS AND ABBREVIATIONS

APPS	Aquatic Protection Permitting System
CBA	Cost-Benefit Analysis
FTE	Fulltime Equivalent Employee
HPA	Hydraulic Project Approval
RCW	Revised Code of Washington
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WTP	Willingness-to-pay

EXECUTIVE SUMMARY

This report evaluates the costs and benefits of a Washington State Department of Fish and Wildlife (WDFW) proposed rule that codifies existing design standards for diversion screens and fish passage, requires consideration of climate adapted design standards for culverts and crossings, and outlines procedures for achieving compliance. While this Cost Benefit Analysis (CBA) was not legally required for this rulemaking as described under Revised Code of Washington (RCW) 34.05.328(5), WDFW elected to develop this analysis to provide more information on the likelihood that the benefits of the rule outweigh its costs.

BACKGROUND

Governor Inslee's Southern Resident Orca Task Force identified lack of prey as a major threat to recovery of the Southern Resident orcas within its 2018 report, and recommended that WDFW create rules describing how 77.57 RCW (the Fishways, Flow, and Screening statues) will be implemented and enforced as one part of broader recovery efforts.[1] WDFW's fish passage and screening authority has existed for many decades; however, WDFW has never created a rules chapter describing implementation of the authority. This rulemaking seeks to fill that gap.

In addition to clarifying fish passage and screening design standards, the proposed rule incorporates a requirement for new and replacement water crossing designs to account for projected changes to hydrology as a result of climate change, so that water crossing structures built today will be capable of accommodating stream conditions and providing fish passage throughout their designed lifespan.

Finally, while RCW 77.57 establishes WDFW's authority to correct structures that are inadequate in terms of fish passage or protection, some of the compliance actions contained in the statute are not considered practical by today's standards and there needs to be a strategic approach to achieving compliance with this law.[2] Accordingly, the proposed rule includes a process and options for WDFW to support and achieve compliance.

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[1] Cascadia Consulting Group. 2018. "Southern Resident Orca Task Force: Report and Recommendations." Accessed October 20, 2022 at: https://www.governor.wa.gov/sites/default/files/OrcaTaskForce_reportandrecommendations_11.16.18.pdf

[2] Throughout this report, we refer to the dams, diversions, fish passage improvement structures, culverts, and crossings that would be subject to regulation under the proposed rule collectively as "structures."

SUMMARY OF PROPOSED RULE

The proposed rule includes three major components as follows:

- Clarifying the applicability of existing fish passage and screening standards, described in WDFW's assessment guidance document and partially codified in the state Hydraulic Code Rules (Chapter 220-660 WAC), including to screening of artificial waterways where fish life concerns exist;
- Requiring new and replacement water crossing structure (i.e., culvert and bridge) designs to consider future bankfull width and 100-year peak flows in parts of the state where they are projected to increase as a result of climate change; and
- Outlining a protocol designed to improve compliance with the existing fish passage and safety standards, effectively operationalizing WDFW's existing authority to identify and correct noncompliant structures.

SUMMARY OF REGULATORY BASELINE

Although there are a large number of privately owned fish passage structures, diversions and fish screens, and culverts and stream crossings across Washington (over 50,000 according to WDFW data),[3] many of these structures would not be affected by the proposed rule for the following reasons:

- Exemptions apply to structures on non-fish bearing streams, on tribal land, obstructions that are federally owned or subject to federal laws that preempt RCW 77.57, agricultural drainage system components installed on or before May 20, 2003, and lawful diversions installed on or before June 11, 1947 in waters containing game fish exclusively.
- The design standards for fish passage and screening incorporated into the proposed rule are already required for most structures under the Hydraulic Code Rules (Chapter 660-220 WAC). Thus, any owners of structures that comply with these existing regulations (e.g., via the HPA permitting process) would not be affected by the proposed rule.
- WDFW already possesses the statutory authority to enforce existing fish passage and screening standards by making the necessary correction and imposing a lien on the structure owner's property (RCW 77.57.040 and RCW 77.57.060).
- WDFW's design standards for climate adapted culverts and stream crossings incorporated into the proposed rule are already made available to the regulated community via the Culverts and Climate Change web tool. While not a baseline regulatory requirement, owners of culverts and stream crossings have a vested interest in ensuring these structures are resilient to the future effects of climate

[3] The true number of structures on the landscape is unknown. WDFW's Fish Passage Barriers Inventory represents the best available data for conducting the CBA, but it is known to be incomplete.

change. Therefore, a portion of these owners are likely to comply with the design standards in the baseline, regardless of WDFW's proposed rule.

Despite the existing baseline requirements for fish passage and screening, WDFW is aware that a subset of the regulated population is not currently complying with or not aware of the existing regulatory requirements. WDFW will help the regulated community understand how to voluntarily comply through education and technical assistance. WDFW's intentions are to strategically consider existing non-compliant structures and approach compliance reasonably by considering the nature of fish resources impacted as well as the quality and quantity of habitat to be gained. Thus, the focus of WDFW's proposed rule is on supporting and enforcing compliance across this population.

CHANGES IN BEHAVIOR GENERATED BY THE PROPOSED RULE

Given the existing requirements and practices in developing and upgrading fish passage and screening structures in the baseline, this analysis finds that the proposed rule is most likely to affect behavior and, therefore, potentially generate costs and benefits under the following circumstances:

- *The proposed rule informs the structure owner of the design standards for fish passage and screening structures.* Although these design standards are a baseline legal requirement for most structures even absent the proposed rule, a subset of owners may be unaware of the requirement. The proposed rule may therefore alert owners of these requirements (and the agency actions for noncompliance), triggering costs and benefits. While most of the costs can be attributed to existing legal requirements (and not newly mandated by the proposed rules), they are assessed here for a comprehensive review of potential impacts.
- *WDFW identifies a noncompliant structure and makes a correction request.* Despite baseline regulatory requirements, owners may knowingly not comply, for cost or other reasons. While WDFW currently has authority to enforce compliance, it has not asserted this authority when owners have been resistant in the past. Under the proposed rule, however, WDFW reasserts its authority and process for enforcing compliance. Thus, for structures that are not in compliance and are determined by WDFW to be priority projects, the proposed rule would affect behavior and generate costs and benefits.
- *Culvert or crossing structure would not meet climate adapted standards.* For owners intending to replace (or build) a water crossing structure and not account for future climate change effects via WDFW's guidance, the proposed rule will require consideration of future climate impacts in the design. Under this circumstance, the rule may affect the planned design in such a way that total costs are increased. However, it is also possible that the proposed rule generates avoided costs in the long run, as structures not adapted to future climate change are more likely to require repair and premature replacement.

COSTS

This analysis focuses on annual costs rather than present value costs because the rulemaking does not specify a particular sunset, and the timeframe over which the rule will generate behavioral changes that lead to costs and benefits is uncertain. Ultimately, WDFW will implement the process outlined in the rule to address fish passage barriers over an indefinite time period until habitat restoration objectives are met.

This analysis finds that the proposed rule will generate costs on the order of $7.4 million annually, consisting of implementation costs to WDFW and compliance costs for structure owners. Annual implementation costs to WDFW account for roughly ten percent of total estimated costs, including staff time dedicated to implementing and enforcing the proposed rule (approximately $680,000) and the cost of adding functionality to the existing permitting system to simplify tracking of compliance action plans and memorandums of agreement generated by the rule (approximately $65,000).

Compliance costs of the rule include all aspects of bringing a noncompliant structure into compliance (e.g., design, engineering, permitting, construction). For individual structures, compliance costs will range widely, depending on structure characteristics, site characteristics, and the nature of the violation. Based on a conservative estimate (i.e., more likely to overstate than understate costs) for average compliance cost by structure type, we estimate total annual compliance costs of $6.6 million (Exhibit ES-1).

We also evaluated the incremental cost of adopting a climate adapted crossing design above and beyond the cost of replacing a crossing to comply with fish passage standards. Outreach efforts generally indicated that existing culvert and crossing design processes tend to already incorporate climate adaptation. In addition, the requirement only applies in areas of the state expected to experience more than minor increases to bankfull width and future peak flow. Furthermore, the rule requires only that the owner *consider* information about expected future hydrological changes in overall crossing design. We conclude that there is no probable net cost to the climate adapted crossing aspect of the rule.[4]

EXHIBIT ES-1. EXPECTED COMPLIANCE COSTS, ANNUAL COMPLIANCE ACTIVITY, AND TOTAL EXPECTED ANNUAL COSTS

PROJECT TYPE	COST RANGE (USD)	AVERAGE[1] COST (USD)	PROBABLE COMPLIANCE ACTIVITY LEVELS	EXPECTED ANNUAL COST[2] (USD)
Diversion Screening (small)	100-10,000	5,100	5	26,000
Diversion Screening (large)	52,000-4.4M	2.2M	1-2	3.3M
Dam Removal	65,000-5.5M	2.8M	0-1	1.4M

[4] Rare circumstances could exist where the requirement generates significant costs (e.g., if a design change from the rule triggers utility relocation)

PROJECT TYPE	COST RANGE (USD)	AVERAGE[1] COST (USD)	PROBABLE COMPLIANCE ACTIVITY LEVELS	EXPECTED ANNUAL COST[2] (USD)
Fish Passage Improvement Structure	230,000-1.9M	1.1M	0	0
Culvert	45,000-1.2M	620,000	2-4	1.9M
Bridge	65,000-6M+	3M	0	0
Total expected annual compliance costs from WDFW ordered corrections: **$6,600,000**				

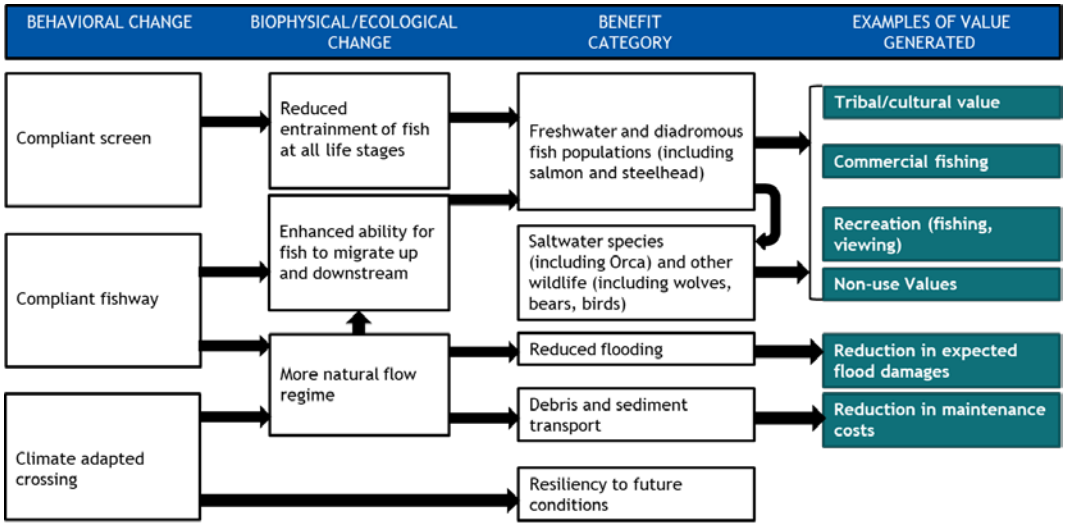
Notes: Cost values are rounded to two significant digits, but the total is calculated using unrounded values.

1. Assumes that project costs are normally distributed, which is a deliberately conservative assumption. The distributions are more than likely right skewed; the true average is likely well below the midpoint.
2. Calculated as Average Cost times midpoint of Probable Annual WDFW Corrections.

BENEFITS

Compliance with the proposed rule enhances the delivery of ecosystem service benefits which generate a value to society in several ways (Exhibit ES-2). Pacific salmon, steelhead, and Southern Resident orca are the species most directly targeted by the rulemaking, but restoring natural flows also has broader impacts on ecological health, including for additional fish species and other wildlife. In addition, right-sizing crossings is likely to reduce flooding, and could reduce maintenance costs associated with debris buildup.

EXHIBIT ES-2. CONCEPTUAL MODEL LINKING BEHAVIORAL CHANGES FROM THE RULE TO ECOSYSTEM SERVICE BENEFITS THAT GENERATE VALUE TO SOCIETY



Research has consistently demonstrated that Washington residents place significant value on recovery of Pacific salmon and Southern Resident orca recovery. Estimates for the value of salmon recovery to residents of Washington range from $136 million to $2.87 billion (see Section 5.2). The value of orca recovery to Washington residents is estimated

at $317 million and $12.6 billion at a national level (see section 5.3). In addition, these species are part of the spiritual and cultural identity of regional tribes. While instream fish safety and passage facilitated by this rule are a critical component of recovery, the specific population change or change in recovery probability attributable to this rule is uncertain. Theoretically, the avoided costs associated reduced flooding and maintenance could be estimated given sufficient site-specific information. However, uncertainty remains around which particular corrections will be undertaken as a result of this rule.

SUMMARY FINDINGS

As described, we identify probable costs of the proposed rule on the order of $7.4 million annually; however, quantifying the incremental benefits attributable to the proposed rule is not feasible due to (1) uncertainty regarding the specific changes on the landscape that would be triggered by the rule (i.e., specific corrections to diversions and fish passage structures); and (2) interdependence between the rule and broader habitat restoration and conservation initiatives across Washington State. Given these uncertainties, we assess the likelihood that probable benefits of the rule outweigh probable costs focusing on what we do know, as follows:

- A key objective of the rule is to contribute to the recovery of Pacific salmon, steelhead, and Southern Resident orca populations.
- Existing economics research and literature demonstrates that the public holds significant value for recovery of these species.
- These species have important tribal and cultural significance in the region.
- Addressing fish passage barriers is a critical component of salmon and orca recovery.
- In implementing the proposed rule, WDFW will target projects of greatest value to fish.
- Beyond contributing to the recovery of salmon, steelhead and orca, the proposed rule will contribute to multiple other categories of ecological, cultural, and socioeconomic benefits of value to people.
- Finally, the rule does not generate new requirements or standards for ensuring adequate fish passage and screening but focuses on establishing a process for WDFW to facilitate voluntary compliance with existing requirements and to enforce compliance where structure owners are resistant.

Based on this information, we conclude that the collective benefits of the rule most likely exceed the costs. Exhibit ES-3 summarizes the probable annual costs and benefits.

EXHIBIT ES-3. SUMMARY OF PROBABLE COSTS AND BENEFITS OF THE PROPOSED RULE

PROBABLE ANNUAL COSTS	BENEFITS
Annual average costs: $7.4 million: • WDFW implementation costs (labor and technology): $750,000 • Direct compliance costs (completing fishway and screen corrections): $6.6 million • Compliance costs may be borne by owners, but most include funding from federal, state, and non-profit agencies through grant and cost share programs.	• **Increased regional Pacific salmon and steelhead populations.** The public places a high value on recovery of Pacific salmon (estimates range from hundreds of millions to billions of dollars) and the species have unquantifiable cultural significance to tribes. Salmon and steelhead contribute to the market economy of the region and provide recreational opportunities. • **Contribution to recovery of Southern Resident orca.** Increased salmon populations improve the prey base for the orcas, for which lack of prey is a primary threat. The public places a high value on recovery ($317M by one estimate). The orcas provide recreational opportunities and have cultural and historical significance in the Pacific Northwest. • **Improved habitat for other fresh and saltwater fish species.** Improved stream conditions and increased salmon population benefit other wildlife. Other species are likely to have significant commercial value and/or recreational value to users. The public also places a high value on biodiversity protection generally. • **Reduced flooding.** Reducing flood risk by correcting structures results in avoided damages to public and/or private property owners. • **Avoided maintenance costs.** Upgraded structures are less likely to require significant ongoing maintenance from improved passage of sediment and debris.

The societal perspective of this CBA is appropriate for assessing the aggregate impact of a proposed rule, ensuring that it is an efficient use of society's limited resources. One key limitation, however, is that it does not account for how the benefits and costs are distributed among members of society. The main and most valuable benefits of the proposed rule are the contributions to successful recovery of Pacific salmon, steelhead, and Southern Resident orca, which are enjoyed widely by society overall, and hold particular value to tribes. In contrast, the compliance costs may be borne by a relatively small group of noncompliant structure owners. In practice, however, structure owners are not likely to bear the full compliance costs. Numerous cost share and grant programs exist to complete fish passage and screening projects. Leveraging these types of funds to complete rule-induced corrections does not change the aggregate social welfare impact of the proposed rule, but it does mitigate the out-of-pocket costs to the structure owners.

CHAPTER 1 | INTRODUCTION

This report evaluates the potential costs and benefits of a Washington State Department of Fish and Wildlife (WDFW) proposed rule that codifies existing design standards for diversion screens and fish passage, requires consideration of climate adapted design standards for culverts and crossings, and outlines procedures for achieving compliance. While this Cost Benefit Analysis (CBA) was not legally required to be completed in accordance with Revised Code of Washington (RCW) 34.05.328(5), it was electively developed to determine whether the benefits of the rule outweigh its costs.[5] The primary sources of information for this analysis include the following:

- Information gathered through outreach to: firms providing the services required by the proposed rule (e.g., design, engineering, construction), other state agencies with regulatory authority over structures that are subject to the proposed rule, and owners (or owner-representatives) of structures that are subject to the proposed rule;
- Information provided by WDFW staff;
- Geospatial data, including WDFW's Washington State Fish Passage GIS layer, WDFW's Culverts and Climate Change web application, federal and tribal land ownership layers, and land use layers; and
- Targeted literature review of peer-reviewed journal articles, relevant state resource management plans and documents, and gray literature.

1.1 BACKGROUND AND OBJECTIVES OF THE PROPOSED RULE

Governor Inslee's Southern Resident Orca Task Force identified lack of prey as a major threat to recovery within its 2018 report.[6] One set of recommendations focused on improving habitat for prey species, and recommendation number three in particular suggested that WDFW create rules describing how 77.57 RCW (the Fishways, Flow, and Screening statues) will be implemented and enforced. Subsequently, the state legislature passed Engrossed Substitute House Bill 1109 on July 28, 2019, directing WDFW to initiate the rulemaking process through changes to the operating budget. WDFW's fish passage and screening authority has existed for many decades; however, WDFW has

[5] RCW 34.05.328 – Significant legislative rules, other selected rules. Accessed December 30, 2022 at: https://apps.leg.wa.gov/rcw/default.aspx?cite=34.05.328

[6] Cascadia Consulting Group. 2018. "Southern Resident Orca Task Force: Report and Recommendations." Accessed October 20, 2022 at: https://www.governor.wa.gov/sites/default/files/OrcaTaskForce_reportandrecommendations_11.16.18.pdf

never created a rules chapter describing implementation of the authority. The proposed rule seeks to fill that gap.

In addition, WDFW intends to incorporate new standards for developing climate adapted water crossings. WDFW has invested in research to understand how streams in Washington are likely to change as a result of climate change.[7] The new standards seek to act upon this knowledge to ensure that culverts and other water crossing structures built today will accommodate stream conditions throughout their designed lifespan. The climate adapted design standard codified in the proposed rule is also in alignment with a cooperative management agreement between WDFW and tribes established in 2019.

Finally, although RCW 77.57 establishes WDFW's authority to correct structures that are inadequate in terms of fish passage or screening, imposing a correction (and potentially a lien on property) through compulsory process is not WDFW's preferred approach. The proposed rule lays out a process for WDFW to work with the regulated community to bring relevant structures into compliance before utilizing the full range of their authority.

To summarize, WDFW's objectives for this rulemaking include:

1. Creating a new chapter to the Washington Administrative Code describing implementation of RCW 77.57 to improve fish passage and safety throughout the state;
2. Incorporating a new climate adapted standard for culverts and other water crossing structures to ensure that they remain functional throughout their designed lifespan; and
3. Outlining a process intended to enhance compliance with the fish passage and screening standards.

1.2 PURPOSE OF THE COST-BENEFIT ANALYSIS

RCW 34.05.328 describes specific requirements that WDFW must address before adopting "legislative rules of the department of fish and wildlife implementing chapter 77.55 RCW," including development of a cost-benefit analysis (CBA). Though the proposed rule is not categorized as a legislative rule implementing RCW 77.55, WDFW determined a CBA would be helpful for understanding and communicating the expected costs and benefits arising from the rulemaking. Accordingly, this analysis provides DFW and the regulated community with information on the costs and benefits triggered by the proposed rule and, as described in RCW 34.05.328(1)(d), evaluates whether,

> "the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and qualitative benefits and costs, and the specific directives of the statute being implemented."

[7] Wilhere, G., et al. 2017. "Incorporating climate change into culvert design in Washington State, USA." Ecological Engineering. http://dx.doi.org/10.1016/j.ecoleng.2017.04.009.

1.3 FRAMEWORK OF THE ANALYSIS

Washington State does not specify guidelines or frameworks for conducting CBAs of regulations. Accordingly, in this CBA we employ well-accepted best practices for regulatory impact analysis as described, for example, in guidance documents developed by the U.S. Office of Management and Budget and the U.S. Environmental Protection Agency.[8,9] Exhibit 1-1 describes the general methodology for the CBA.

EXHIBIT 1-1. METHOLODY FOR THE CBA

To isolate the costs and benefits resulting from the proposed rule, we compare two future scenarios as follows:

1. *The world without the proposed rule.* This represents the regulatory baseline for the analysis (Step 2 in Exhibit 1-1) and reflects the regulatory requirements and voluntary behaviors of WDFW and the regulated community regarding fish passage barriers looking forward absent implementation of the proposed rule.
2. *The world with the proposed rule.* This scenario considers how WDFW and the regulated community will act to address fish passage barriers following implementation of the rule. This scenario incorporates the behavioral changes generated by the proposed rule (Step 3 in Exhibit 1-1).

The difference in the costs and benefits between the two scenarios are the "incremental effects" of the proposed rule. This analysis focuses on evaluating these incremental

[8] Office of Management and Budget. 2003. Circular A-4. To the Head of Executive Agencies and Establishments: Regulatory Analysis. https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/#a

[9] Environmental Protection Agency. 2014. Guidelines for Preparing Economic Analyses. https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses

effects in quantitative terms (e.g., dollars) where possible. Absent information to quantify certain categories of costs and benefits, we describe them qualitatively.

The analysis takes a societal perspective in evaluating costs and benefits (Step 4 of Exhibit 1-1). That is, we consider costs and benefits to all effected entities, including the regulatory authority (WDFW), the regulated community, and more broadly the residents of Washington State.

We measure costs and benefits in terms of the "opportunity cost." Opportunity costs measure the foregone benefits resulting from a reallocation of resources. For example, resources (time and money) spent correcting a fishway would otherwise be put toward an alternative productive use. The loss of that productive use represents an opportunity cost to society, which is proxied by the dollar value of the fishway correction. Additionally, the concept of "willingness-to-pay" (WTP), a measure of opportunity cost, quantifies what individuals or populations are willing to forgo to enjoy a particular benefit. WTP estimates are particularly helpful for understanding the benefits of resources not traded in markets (e.g., increased Southern Resident orca populations).

As previously described, this analysis assesses the rule based on the standard described in RCW 34.05.328, which requires comparing “probable” costs and benefits (Step 5 of Exhibit 1-1). In the most straightforward case, a traditional cost-benefit analysis would forecast a flow of costs and benefits generated by the rule over time and calculate a discounted net present value of the rule. If quantified present value benefits outweigh quantified present value costs, the rule is cost beneficial. However, this assumes all categories of costs and benefits are expressed in monetary terms and integrated into the calculation.

This rule has a complex regulatory baseline, and significant uncertainty exists regarding how many, and which specific structures may be addressed over time due to the rule. Furthermore, as described in Chapter 5, the benefits of the rule, which are focused on restoring fish populations by improving habitat conditions, are inextricably linked to the broader portfolio of restoration activities undertaken in a watershed or along a waterway. Accordingly, the weighing of probable costs and benefits includes comparing estimates of quantified costs (dollars) with qualitative descriptions of benefits.

The comparison of costs and benefits in Chapter 6 includes discussion to provide perspective on the likelihood that the qualitative costs outweigh the quantified benefits. Overall, this analysis relies upon the best available quantitative and qualitative information to determine the likelihood that the non-quantified, probable benefits will be sufficiently large to exceed the probable costs.

1.4 ORGANIZATION OF THIS REPORT

The remaining chapters of this report address the elements of the analysis described in Exhibit 1-1 as follows:

- Chapter 2 describes the elements of the proposed rule.

- Chapter 3 characterizes the baseline for the rule and evaluates how the proposed rule will result in behavioral changes.
- Chapter 4 evaluates the probable costs of the rule.
- Chapter 5 assesses the probable benefits of the rule.
- Chapter 6 develops a qualitative weighing of the probable costs and benefits of the rule, highlighting key areas of uncertainty and describing the distributional impacts.
- Attachment A describes the outreach undertaken to collect information for this report (and for the accompanying Small Business Economic Impact Statement), including a description of interviewees.
- Attachment B includes the topics and questions used to guide the interviews.
- Attachment C summarizes the cost information collected via outreach.
- Attachment D describes the key data sources employed in the analysis.

CHAPTER 2 | PROPOSED RULE DESCRIPTION

WDFW is proposing a new chapter to the Washington Administrative Code (WAC) to describe implementation of the Fish, Flow, and Screening authority (77.57 RCW). One aspect of the rule is to clarify the applicability of existing standards, ensuring that they are applied at all existing and new fishways and diversions governed by 77.57 RCW. The proposed rule achieves this goal by carefully defining "fishway" and "watercourse" (and equivalently, "river" and "stream").

KEY COMPONENTS OF THE PROPOSED RULE

- ✓ Does NOT introduce new standards for fish passage and screening, but does clarify their applicability where fish life concerns exist
- ✓ Changes consideration of future climate conditions for water crossing designs from a recommendation to a requirement
- ✓ Establishes a protocol for WDFW to enforce the existing regulations regarding fish passage and protection

In addition, the proposed rule requires new and replacement water crossing designs to consider future projected bankfull width and 100-year peak flows. Climate change affects stream width and flows differently throughout Washington; thus, the consideration of future change is project- and site-specific.

Finally, the rule defines a process for WDFW to encourage voluntary compliance and enforce compliance among owners, where necessary. In this chapter, we describe how the proposed rule differs from the baseline requirements in Washington regulating fish passage and screening, design of fishways and water diversions, and enforcement (i.e., the "incremental effects" of the proposed rule), and present conceptual models identifying the circumstances under which the proposed rule is likely to generate costs and benefits.

2.1 APPLICABILITY OF FISH PASSAGE AND SCREENING STANDARDS

The proposed rule does not introduce new or different standards for WDFW's use in assessing adequacy of fish passage at a given structure or for diversion screening. The existing standards for compliant structures are currently described in in the WDFW Fish Passage Inventory, Assessment, and Prioritization Manual and also partially codified in the state Hydraulic Code Rules (WAC 220-660). The existing Hydraulic Code Rules apply to new or permitted hydraulic projects that "use, divert, obstruct, or change the

natural flow or bed of any salt or fresh waters of the state."[10] The Hydraulic Code was designed to ensure construction projects are completed in a manner that protects fish and their aquatic habitats, and is implemented through the Hydraulic Project Approval (HPA) process. It also includes design standards about fish passage and protection but does not apply to structures not actively being built, replaced, or rehabilitated. This leaves out a subset of structures which fall under WDFW's Fishway, Flow, and Screening statutory authority (77.57 RCW) but are not subject to the Hydraulic Code. Diversion devices in wholly artificial waterways and existing, defunct structures would fall under the statutory authority of 77.57 RCW.

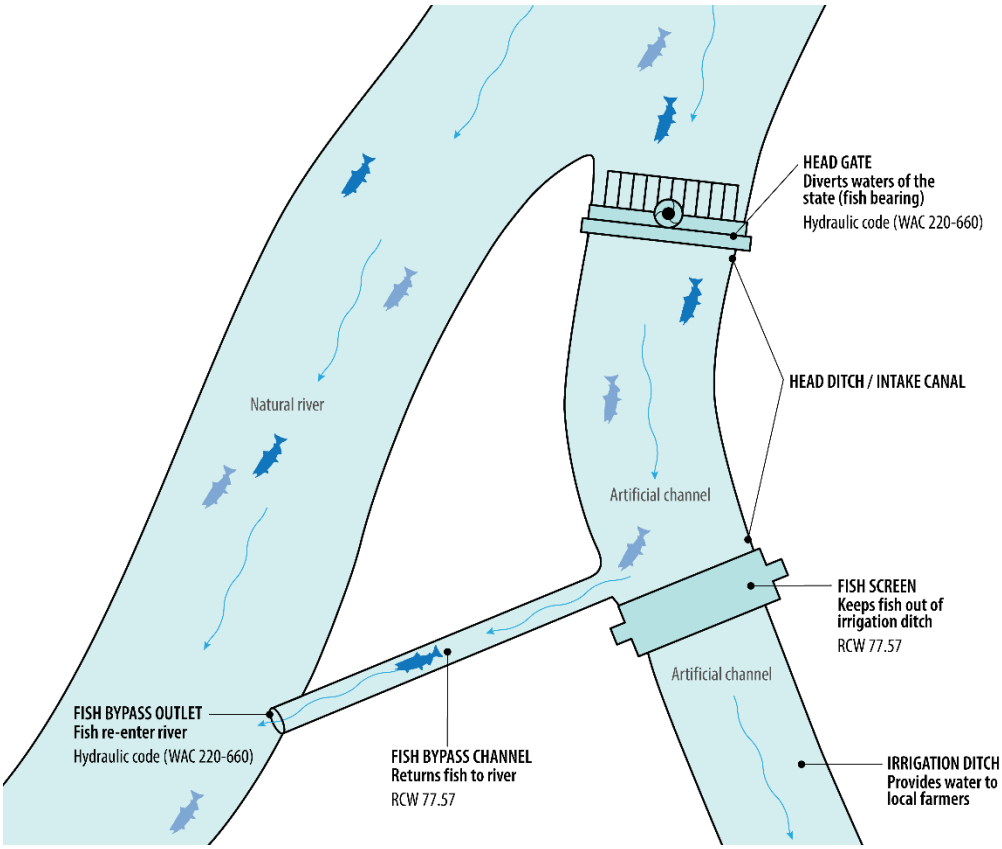
The proposed rule clarifies that the existing standards for adequate fish passage and protections apply to the full set of structures subject to 77.57 RCW based on the following:

1. Defining "fishway" to include fish passage improvement structures (e.g., fish ladders) and all structures that span over, through, or under a watercourse;
2. Defining "diversion structure" to include any structure that facilitates water withdrawal from a watercourse; and
3. Defining "watercourse", "river", or "stream" to include all surface-water-connected wetlands that provide or maintain habitat that supports fish life.

The main implication of this clarification is that all aspects of water diversions that incorporate an artificial waterway will be subject to the fish passage and screening standards (e.g., the fish screen and fish bypass channel in Exhibit 2-1). Outside of the artificial waterways, most other structures on the landscape are already subject to the standards included in the proposed rule through the state Hydraulic Code.

[10] WAC 220-660-010. Hydraulic Code Rules—Purpose. Accessed November 11, 2022 at: https://app.leg.wa.gov/WAC/default.aspx?cite=220-660-010

EXHIBIT 2-1. WATER DIVERSION DESIGN INCORPORATING AN ARTIFICIAL WATERWAY



2.2 CLIMATE ADAPTED CROSSINGS REQUIREMENT

The proposed rule requires that new and replacement water crossing designs consider future climate conditions. Two details effectively limit the potential impact of this requirement:

- Existing structures are exempt from the requirement as long as they were lawfully constructed and are functioning as originally intended (i.e., WDFW has not determined that fish passage is inadequate).
- The requirement is for crossing designs to *consider* future conditions, but there is not specific guidance about how the design should ultimately be affected. WDFW provides flexibility for biologists and structure owners to determine appropriate consideration of future climate.

Existing design standards for water crossing structures are codified in WAC 220-660. The existing code requires bridge designs capable of passing 100-year flood flows and accounting for expected lateral stream migration. For culverts, the existing code requires a stream simulation design with the bed width determined by any WDFW-approved design methodology or with an approved alternative plan on a case-by-case basis.

The proposed rule requires consideration of projected future bankfull width and future 100-year peak flow. Projected changes to bankfull width and peak flows can be obtained

using the Culverts and Climate change web application located on the WDFW website,[11] or any comparable method. For a user-provided point on the landscape (i.e., a culvert or crossing site), the tool calculates the upstream watershed and outputs an expected percentage change to bankfull width and 100-year peak flows based on hydrologic analysis of ten climate model projections.[12,13]

Importantly, climate impacts vary across the state. Some areas are expected to experience large increases to bankfull width and peak flow, while others are expected to experience decreases. If the tool projects anything less than a five percent increase, no further consideration of climate is required. For sites expected to experience an overall decrease to bankfull width and peak flow, the projected values cannot be used to under-build for today's conditions. For sites expected to experience greater than five percent increases to bankfull width and peak flow, the projected values for those parameters should be considered in developing the structure design. The proposed rule requires only consideration of this information and does not require implementation of any specific design to account for future climate conditions.

Culverts and crossings installed prior to the adoption of the proposed rule will not be subject to the climate adaptation requirement, as long as they are functioning as originally intended, and meet the existing fish passage requirements. For example, existing bridges are unlikely to be affected as bridges typically provide adequate fish passage and therefore would not trigger the requirement to consider future climate conditions until they are rehabilitated or replaced.

Additionally, outreach to professional firms performing the design and engineering of culverts and bridges generally indicated some degree of baseline consideration for future climate impacts. Some firms reported already using the Culverts and Climate Change tool, while others applied some rule of thumb, such as the Washington State Department of Transportation (WSDOT) standard of increasing current bankfull width by 20 percent and adding two feet. Such rules of thumb may meet the climate adapted standard in the proposed rule for some, but not all cases.

2.3 IMPLEMENTATION PROCESS

The proposed rule seeks to facilitate voluntary compliance with existing fish passage standards through three main avenues: (1) by raising awareness of the issue through the rulemaking process itself; (2) by providing technical assistance and directing owners toward grant and other cost-sharing opportunities; and (3) by WDFW exercising its full legal authority in rare cases when owners do not comply willingly. For example, when WDFW imposes a fish passage or water diversion correction, consistent with 77.57

[11] The tool can be accessed at: https://wdfw.wa.gov/species-habitats/habitat-recovery/fish-passage/climate-change

[12] Wilhere, G., et al. 2017."Incorporating Climate Change into the Design of Water Crossing Structures – Final Project Report". Washington Department of Fish and Wildlife.

[13] Wilhere, G. et al. 2017. "Incorporating climate change into culvert design in Washington State, USA." Ecological Engineering.

RCW, costs incurred by WDFW to bring a site into compliance with the fish passage and screening standards would then constitute the value of a lien on the structure or the property on which it is located, with some exceptions. By creating voluntary compliance and technical assistance avenues, the rule seeks to minimize the likelihood of incidents were WDFW would have no choice but to resort to the existing statutory remedies.

The specific implementation and enforcement protocols are similar to those employed in the Hydraulic Code compliance program, essentially outlining a series of steps for WDFW to operationalize the authority granted in 77.57 RCW to ensure compliance with fish passage standards. The compliance and enforcement provisions included in the proposed rule are as follows:

- A technical assistance visit, requested by either the owner or WDFW. If the technical assistance visit identifies inadequate fish passage or protection, WDFW will develop a voluntary correction request or mandatory notice to comply, depending on the circumstances.
- A compliance inspection site visit may be conducted if WDFW becomes aware of a non-compliant structure, considering the nature of the fish resources impacted by the existing non-compliant structure as well as the quality and quantity of habitat to be gained. WDFW may issue a correction request or a notice to comply at a compliance inspection site visit.
- In either a technical assistance visit or a compliance inspection visit, WDFW will only issue a mandatory notice to comply without first issuing a correction request if there is a history of similar violations by the owner of the diversion or structure, or a probability of causing more than minor harm to fish life.
- Failure to respond to the correction request triggers WDFW to issue a notice to comply.
- Failure to comply with the notice to comply can result in criminal enforcement actions, such as an action to classify noncompliant structure as a public nuisance, resulting in injunctive action, or misdemeanor charges under RCW 77.57.
- As a final resort, WDFW can impose the correction as permitted in the existing statutory remedies. In some cases, WDFW may place a lien on the structure or the owner's property to recoup the cost.

2.4 UNIVERSE OF REGULATED STRUCTURES

The proposed rule targets structures on the landscape posing a threat to fish passage and safety. WDFW maintains a geodatabase of known fish passage barriers (henceforth, the "Inventory") that provide insight regarding the scope and scale of the barriers across Washington State.[14] The Inventory is not a comprehensive assessment of structures but rather is a living database that is updated on an ongoing basis as barrier inventorying

[14] WDFW Open Data. Fish Passage Barriers Inventory. Accessed September 2022 at: https://data-wdfw.opendata.arcgis.com/documents/wdfw::fish-passage-barriers-inventory-zipped-file-geodatabase/about

efforts progress. The full extent of existing structures is unknown. The Inventory contains useful information about each known structure (e.g., location, ownership type), but the readily accessible information is insufficient to identify which structures are most likely to be affected by the proposed rule.

We consider additional data sources as needed and appropriate in this analysis. For example, data provided by Washington State Department of Ecology suggests that the Inventory grossly underestimates the total number of diversions in the state. Washington State Department of Ecology, for example, has identified 49,430 points of water surface diversion, compared to the 1,550 diversions contained in the Inventory.[15] However, aside from county-level distribution of the diversions, limited data are available.[16]

Given these limitations, we rely upon the Inventory to provide contextual information and to characterize the types of structures most likely to be affected by the proposed rule. The Inventory identifies five types of structures potentially subject to the rule as follows:[17]

- Dams;
- Diversions;
- Fish passage improvement structures;
- Culverts;
- Non-culvert crossings (e.g., bridges, conduits, fords).

There are a total of 50,367 structures in these categories within the Inventory (Exhibit 2-2).

However, the rule incorporates specific exemptions either because they fall outside of WDFW authority or because the structures pre-date a regulatory authority (i.e., they are grandfathered). The following categories of structures are exempt from all provisions of the proposed rule:

- Those on non-fish bearing lakes, streams, or rivers;
- Those on federal or tribal owned land;
- Obstructions that are federally owned or subject to federal laws that preempt RCW 77.57;

[15] Email communication with WDFW staff on December 19, 2020.

[16] For many structures in the Inventory, there is a link to a pdf document which often provides detailed information about the structure (e.g., dimensions, compliance status). However, given the size of the Inventory and that these data are not collected and coded in a database, this analysis was not able to utilize the information provided in these documents.

[17] Within the Inventory, fish passage improvement structures are categorized as "fishways." However, the definition of fishways in the proposed rule includes fish passage improvement structures, culverts, and non-culvert crossings (see Section 2.x.x). To minimize confusion, we generally adopt the language used in the Inventory for this section, except that we use "fish passage improvement structures" in place of "fishways."

- Agricultural drainage system components installed on or before May 20, 2003;[18] and
- Lawful diversions installed on or before June 11, 1947 in waters containing game fish only.[19]

EXHIBIT 2-2. NUMBER OF EXEMPT AND NONEXEMPT STRUCTURES IN THE WDFW INVENTORY

	DAMS	DIVERSIONS[1]	FISH PASSAGE STRUCTURES	CULVERTS	CROSSINGS	TOTAL
Total	2,046	1,550	944	38,818	7,009	50,367
Exempt	429	450	274	12,718	1,782	15,653
Nonexempt	1,617	1,100	670	26,100	5,227	34,714

Note: The true number of nonexempt structures on the landscape is unknown and may be much higher. However, as described in Sections 5 and 9, only a portion would be impacted by the proposed rule.
1. As noted in the text, Washington State Department of Ecology estimates the total number of diversions may be several orders of magnitude higher. However, data is insufficient to confirm applicability of screening requirements, and to identify exemptions or ownership type.

Of the relevant structures in the Inventory, one or more exemption applies to 15,653 structures (31 percent). Of the 34,714 remaining structures, a substantial portion (75 percent) are culverts, 15 percent are other types of crossings, 5 percent are dams, 3 percent are diversions, and 2 percent are fish passage improvement structures.[20]

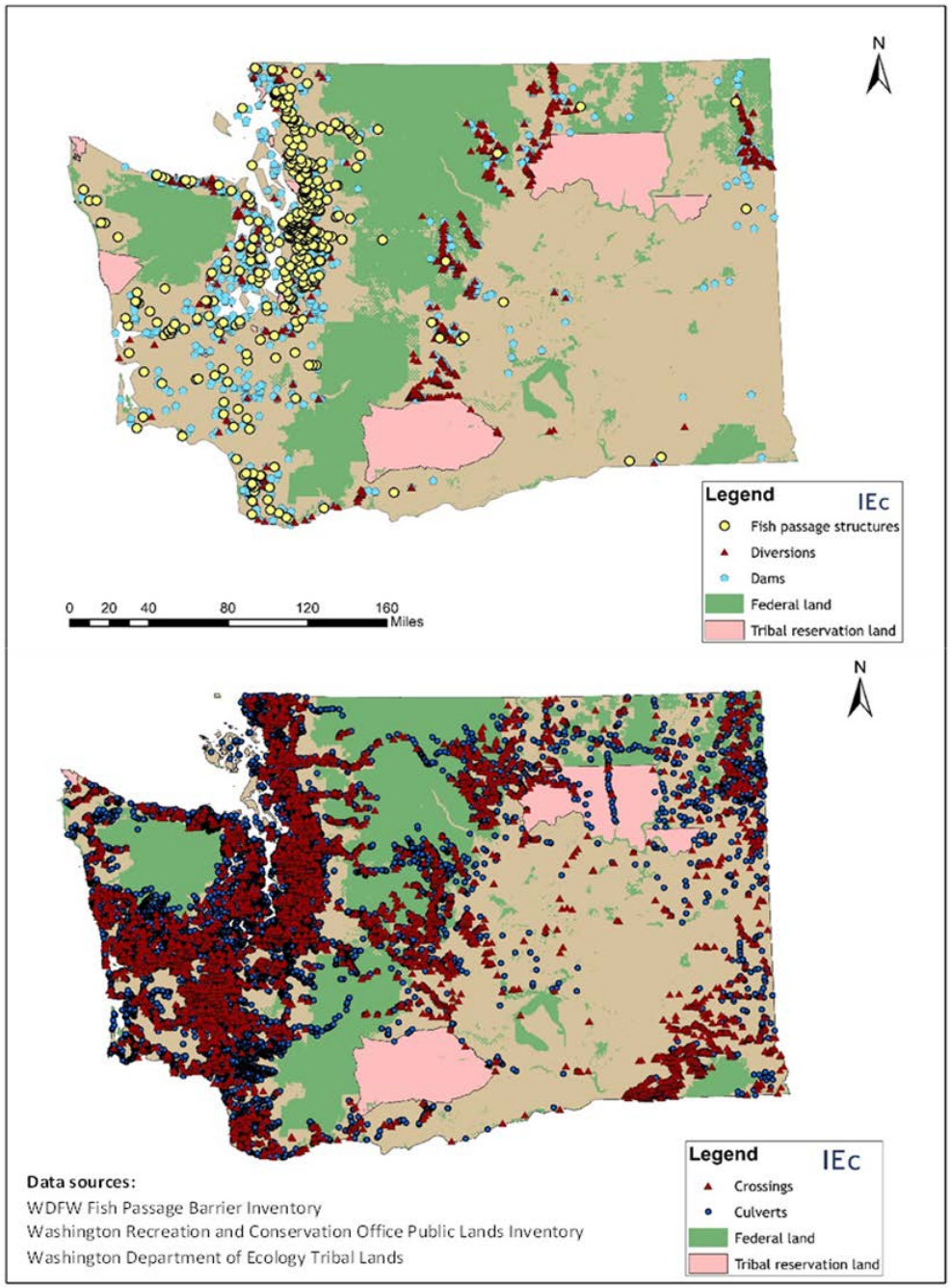
Exhibit 2-3 presents the spatial distribution of nonexempt structures contained in the Inventory. The distribution reflects an interaction between the fish bearing status of streams with land use and development patterns (plus any exemptions). Generally, this results in a concentration of structures in western Washington. Dams and diversions impacting fish life are especially sparse in the southeastern quadrant of the state, and large swaths of that region are also devoid of relevant culverts and crossings. Importantly, Exhibit 2-3 represents only the relevant structures that have been inventoried by WDFW.

[18] These structures are identified as "Other" in the Inventory, which we excluded from this analysis due to the varied types of structures contained within that category.

[19] Date of installation is not provided in the Inventory. However, outreach to stakeholders indicated that the majority of agricultural diversions were installed prior to this date.

[20] The structure categories are not mutually exclusive. For example, a dam may be associated with a diversion, a fish passage structure, or both.

EXHIBIT 2-3. SPATIAL DISTRIBUTION OF NONEXEMPT STRUCTURES IN THE INVENTORY



As previously noted, these structures are largely already subject to the fish passage standards and the rule does not introduce new requirements. However, despite the existing requirements, WDFW is aware of the presence of non-compliant structures on the landscape, including where landowners have willfully resisted complying. WDFW intends to use the rule to increase voluntary compliance, and to force compliance where voluntary options are not successful, or where the circumstances warrant prompt coercive measures.

CHAPTER 3 | REGULATORY BASELINE AND BEHAVIORAL CHANGES RESULTING FROM THE RULE

To determine the incremental costs and benefits triggered by the proposed rule, we compare the baseline scenario (the world without the rule) with the proposed rule scenario (the world with the rule) looking forward. This chapter first describes the regulations and behaviors of the regulated community in the baseline scenario. It then considers expected changes in behavior that would not be expected to occur but for the proposed rule. We describe the costs and benefits generated by these changes in behavior in Chapters 4 and 5.

3.1 BASELINE FOR THE ANALYSIS

The baseline for this rulemaking is complex given (1) existing regulatory requirements for ensuring adequate fish passage and screening, including WDFW's longstanding authority to regulate fish passage and impose corrections on certain barriers; and (2) uncertainty regarding how many and which barriers are likely to be prioritized for correction even absent the proposed rule.

Baseline Regulatory Requirements for Fish Passage[21]

Regardless of the proposed rule, WDFW already holds authority to evaluate most of the structures that will be subject to the rule for adequate fish passage and screening, and to require corrections where needed. This includes authority for WDFW to implement needed corrections and place a lien on the owner's personal property to recover the expenses associated with the correction, (77.57 RCW). WDFW indicates that, based on experience addressing fish passage barriers over time, the majority of structure owners voluntarily comply with the fish passage and screening standards in the baseline. In these cases, the baseline behavior of the owners would be in compliance with the proposed rule and the proposed rule will not generate additional costs and benefits. Additionally, the design standards for fish passage and screening incorporated into the proposed rule are already required for most structures under the Hydraulic Code Rules (Chapter 660-220 WAC). Thus, any owners of structures that comply with these existing regulations (e.g., via the HPA permitting process) would not be affected by the proposed rule.

[21] As described in Section 2.4, the rulemaking does not pertain to structures on non-fish bearing streams, on tribal land, obstructions that are federally owned or subject to federal laws that preempt 77.57 RCW, or certain agricultural systems and diversions.

Baseline Practices for Climate Adapted Crossings

WDFW's design standards for climate adapted culverts and water crossings are currently available to the regulated community via the Culverts and Climate Change web tool.[22] For a user-provided point on the landscape (i.e., a culvert or crossing site), the tool calculates the upstream watershed and outputs an expected percentage change to bankfull width and 100-year peak flows based on hydrologic analysis of ten climate model projections.[23,24]

While not a baseline regulatory requirement, owners of culverts and stream crossings have a vested interest in ensuring these structures are resilient to the future effects of climate change. Additionally, outreach to professional firms performing the design and engineering of culverts and bridges generally indicated some degree of baseline consideration for future climate impacts. Some firms reported already using the Culverts and Climate Change tool, while others applied some rule of thumb, such as the Washington State Department of Transportation (WSDOT) standard of increasing current bankfull width by 20 percent and adding two feet. Such rules of thumb may meet the climate adapted standard in the proposed rule for some, but not all cases. Therefore, there is a large degree of compliance with this requirement in the baseline, regardless of WDFW's proposed rule.

Prioritizing Fish Passage Barriers and Screening Corrections

Many priority fishway and screen corrections with willing owners would occur absent the rule; however, it is uncertain which structures these would be and how the corrections would be made over time. Despite the existing baseline requirements for fish passage and screening, WDFW is aware that a subset of the regulated population is not currently complying with, or not aware of, the existing regulatory requirements. WDFW will continue to work with the regulated community to enhance voluntarily compliance through education and technical assistance even absent the proposed rule (i.e., under the baseline scenario).

WDFW's intentions are to strategically consider existing noncompliant structures and approach compliance reasonably by considering the nature of fish resources impacted by existing noncompliant structures as well as the quality and quantity of habitat to be gained. The process of prioritizing fish passage barriers and screens for correction is an ongoing initiative and will occur regardless of the proposed rule. However, to date WDFW has generally not exercised the full extent of its authority to impose a correction when the owner has been unwilling. It is uncertain which structures and sites will be targeted for correction over time, and which of these targeted corrections will require agency enforcement actions.

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[22] The tool can be accessed at: https://wdfw.wa.gov/species-habitats/habitat-recovery/fish-passage/climate-change

[23] Wilhere, G., et al. 2017."Incorporating Climate Change into the Design of Water Crossing Structures – Final Project Report". Washington Department of Fish and Wildlife.

[24] Wilhere, G. et al. 2017. "Incorporating climate change into culvert design in Washington State, USA." Ecological Engineering.

3.2 CHANGES IN BEHAVIOR GENERATED BY THE PROPOSED RULE

Given the existing requirements and practices in developing and upgrading fish passage and screening structures in the baseline, the focus of the proposed rule is on WDFW's planned process for supporting voluntary compliance and for enforcing compliance, when necessary. However, not every noncompliant structure will be affected and it is uncertain which structures will be prioritized by WDFW for correction.

This analysis finds that the proposed rule is most likely to affect behavior and, consequently, to generate costs and benefits under the following circumstances:

- *The proposed rule informs the landowner of the passability and protection standards for fish passage and screening structures.* Although these standards are a baseline requirement for most structures even absent the proposed rule, a subset of owners may be unaware of the requirement. The proposed rule may therefore alert owners of these requirements (and the agency actions for noncompliance), triggering compliance and associated costs.
- *WDFW identifies a noncompliant structure and makes a correction request.* Despite baseline regulatory requirements, owners may knowingly not comply, for cost or other reasons. While WDFW currently has authority to enforce compliance, it has not asserted this authority when owners have been resistant in the past. Under the proposed rule, however, WDFW reasserts its authority and process for enforcing compliance. Thus, for structures that WDFW determines are priority projects for removal or replacement for which owners are not in compliance, the proposed rule would affect behavior and generate costs.
- *Culvert or crossing structure would not meet climate adapted standards.* For owners intending to replace (or build) a water crossing structure and not account for future climate change effects via WDFW's guidance, the proposed rule will require consideration of incorporating future climate impacts in the design. Under this circumstance, the rule may affect the planned design in such a way that total costs are increased. However, it is also possible that the proposed rule generates some avoided costs in the long run, as structures not adapted to future climate change are more likely to require premature repair and replacement.

3.3 CONCEPTUAL MODELS OF RULE IMPACTS

This section explores how the rule may generate the behavioral changes described in Section 3.2. We present conceptual models to more precisely identify circumstances under which the proposed rule may generate changes in behavior that result in costs and benefits.

Generally, the logic of the models flows from the fact that the proposed rule does not impose new standards for fish passage and screening beyond what is already partially codified in the Hydraulic Code and described in WDFW's assessment guidance document. Therefore, the proposed rule only imposes costs on diversions when it requires a correction, or on dams and fish passage structures when it induces a new HPA application, regardless of whether the application is initiated by the owner voluntarily or

as a result of WDFW enforcement actions.[25] The same is true for water crossing structures, though additional costs and benefits may be generated if the rule results in implementing climate adapted designs. Given this, we present separate conceptual models for: (1) dams, diversions, and fish passage improvement structures; and (2) crossings.

Dams, Diversions, and Fish Passage Improvement Structures

Exhibit 3-1 provides a decision tree describing how the proposed rule may affect dams, diversions, or fish passage improvement structures that exists on the landscape. First, exempt structures are not affected. Second, it is possible that an owner would plan to lawfully modify or repair a structure regardless of whether the proposed rule is adopted or not. In this case, the owner would be complying with the proposed rule through the existing HPA permitting process and the proposed rule would not result in behavioral change. Third, some structures are already in compliance (i.e., provide adequate fish passage), and others will not be prioritized by WDFW for correction.

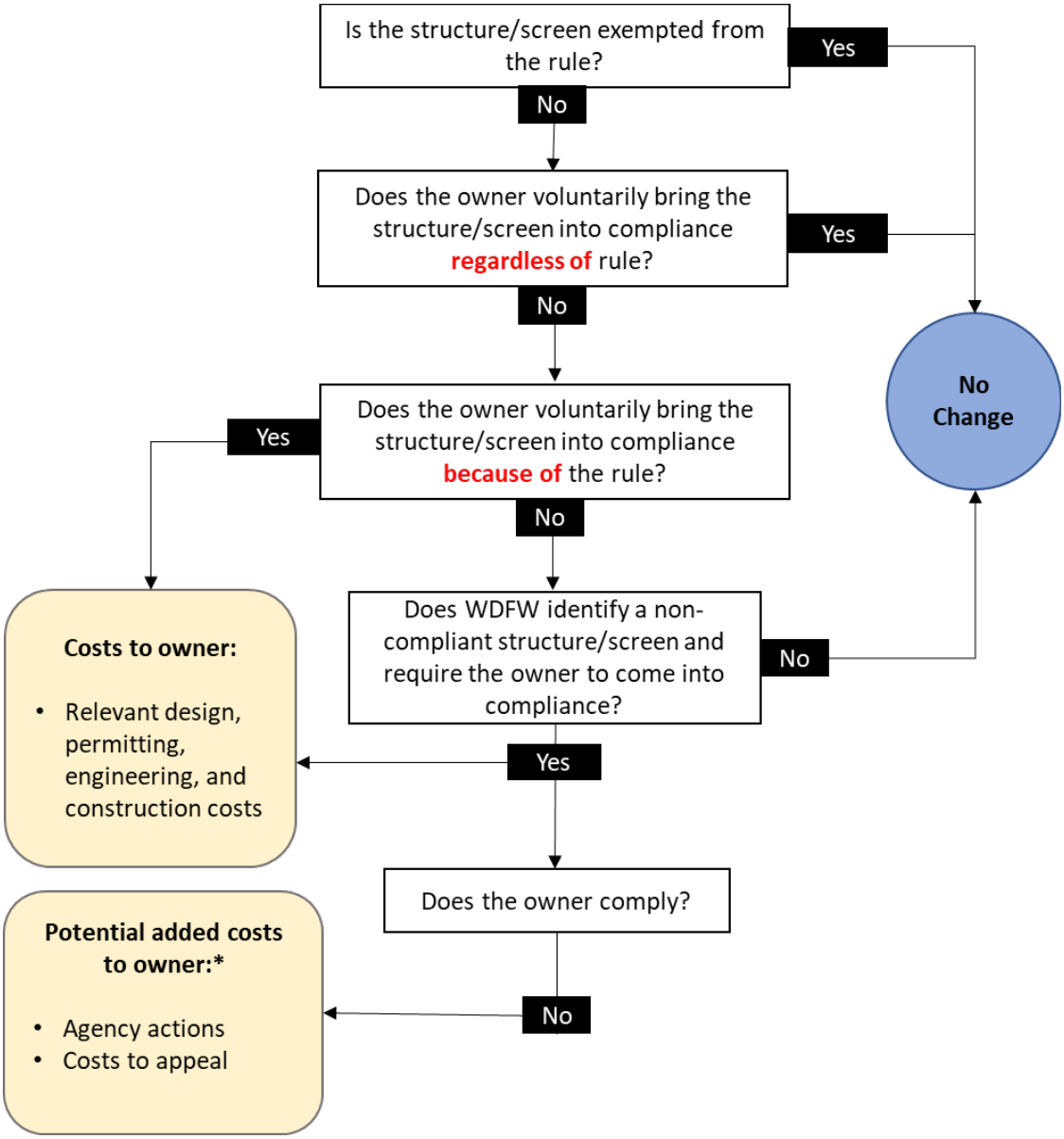
Accordingly, the rule is most likely to generate impacts to dams, diversions, and fish passage improvement structures (and thus create costs and benefits) under the following circumstances:

- *New information that triggers action on the part of owners to bring a structure into compliance.* The proposed rule could raise awareness regarding the requirement for owners to provide adequate fish passage. Costs and benefits would be triggered by the new rule in this case because the compliance action would not have taken place but for adoption of the rule. The costs, which include all aspects of bringing the noncompliant structure into compliance (e.g., permitting, design, construction), may be borne by the owner in whole or in part (if offset by grant or cost share opportunities).
- *Noncompliant structures subject to WDFW inspection.* As reinforced in the proposed rule, WDFW has authority to visit streams across Washington State to identify noncompliant structures and enforce compliance. Upon completion of the rule, WDFW will prioritize sites for inspection and target compliance where needed, resulting in both costs and benefits. Costs to bring these noncompliant structures into compliance (e.g., permitting, design, construction) will ultimately be borne in whole or in part by the owners. Beyond the compliance costs, owners may bear additional costs if they refuse to comply. Potential costs of noncompliance include any costs associated with enforcement actions initiated by WDFW and/or any costs associated with appealing WDFW actions. While costs of noncompliance are not part of the analysis required for the CBA, they are mentioned here to provide a complete picture of the compliance and rule enforcement process given that a focus of the proposed rule is to clarify WDFW's existing authority to address noncompliance through enforcement.

[25] In cases where 77.57 RCW applies but the Hydraulic Code does not (e.g., artificial waterways where fish life concerns exist), WDFW will generate a Memorandum of Understanding (MOU) in place of an HPA application.

The conceptual model reveals two main conclusions. First, only a portion of the noncompliant dams, diversions, and fish passage improvement structures on the landscape will be impacted by the proposed rule. Second, the compliance costs associated with the proposed rule include all aspects of bringing a noncompliant structure into compliance (e.g., permitting, design, construction). As described in Chapter 5 - Costs, the nature and magnitude of these costs will be site specific, depending on the structure type and nature of the violation, among other things.

EXHIBIT 3-1. CONCEPTUAL MODEL OF RULE IMPLEMENTATION PROCESS FOR DIVERSION SCREENS, DAMS, AND FISH PASSAGE STRUCTURES



*While costs of noncompliance are not part of the analysis required for the RFA, they are mentioned here to provide a complete picture of the compliance and rule enforcement process given that a focus of the proposed rule is to clarify WDFW's existing authority to address noncompliance through enforcement.

Water Crossings

The proposed rule affects water crossings similarly to dams, diversions, and fish passage improvement structures in terms of fish passage requirements (i.e., those already codified in the Hydraulic Code and WDFW assessment guidance). Therefore, the two circumstances identified in the previous section apply to water crossings as well. However, the climate adapted standard introduces additional factors leading to one additional circumstance where the proposed rule is most likely to generate an impact (Exhibit 3-2).

Two details from the proposed rule are relevant. First, water crossings installed prior to adoption of the proposed rule are not subject to the climate adapted requirement as long as they are compliant in terms of fish passage and are within their designed lifespan. Second, only culverts and crossings located in areas where future bankfull width and future 100-year peak flows are expected to increase by at least five percent are required to consider incorporating climate projections into the design process.

For water crossings, the rule is most likely to generate costs and benefits in the following circumstance (in addition to those identified in the prior section):

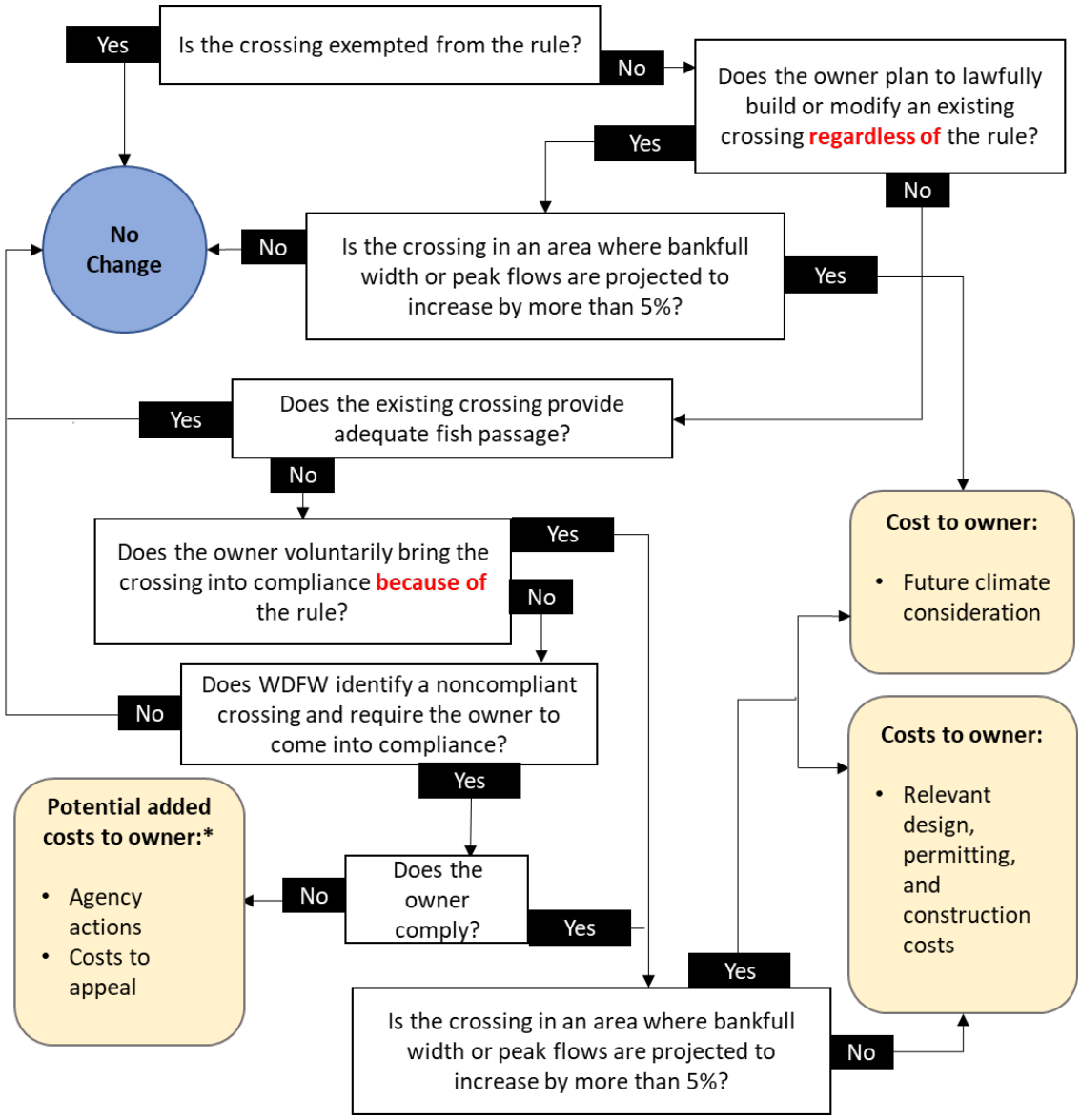
- *An owner would plan to replace (or build) a culvert or crossing regardless of the rule but would not consider future climate change in the design of the structure but for the rule.* While compliance with the fish passage standards would be achieved through the existing HPA program in this case, the incremental cost of designing for future climate would be attributable to the rule in cases where the owner was not planning to do so already. In practice, many owners decide (or are advised) to consider future conditions even absent the proposed rule, so this is expected to be a small category of structures.

This conceptual model reveals that only a portion of the noncompliant water crossings on the landscape require consideration of future climate conditions due to the proposed rule. This is because most of the structures fall under at least one of the following circumstances:

- Structure is exempt;
- Structure will not be prioritized by WDFW for fish passage correction (and therefore the requirement to consider future climate conditions is not triggered);
- Structure already meets the climate adapted standards described by WDFW; or
- Structure would be replaced to WDFW standards regardless of the proposed rule to improve resilience and reduce future climate-related risks.

Furthermore, as the proposed rule requires only that structure owners consider future climate conditions in the design of water crossing structures, the likelihood that the rule will trigger a change in the structure's design is significantly uncertain.

EXHIBIT 3-2. CONCEPTUAL MODEL OF RULE IMPLEMENTATION PROCESS FOR WATER CROSSING STRUCTURES



*While costs of noncompliance are not part of the analysis required for the RFA, they are mentioned here to provide a complete picture of the compliance and rule enforcement process given that a focus of the proposed rule is to clarify WDFW's existing authority to address noncompliance through enforcement.

CHAPTER 4 | COST ANALYSIS

Costs of the proposed rule generally include the costs to WDFW of implementing the rule (i.e., implementation costs) as well as any costs incurred above and beyond the baseline costs to correct noncompliant fishways and screens (i.e., compliance costs). This chapter provides information on these categories of costs. First, we provide information on WDFW's implementation costs, which include the average annual staff and time commitments required to implement and enforce the rulemaking and the cost of enhancing existing permit tracking capabilities. We then provide information on costs of removing or upgrading structures to comply with the fish passage standards and quantify the associated average annual compliance costs based on the numbers and types of structures most likely to be corrected due to the rule. Based on this analysis, the total probable annual costs of the rule are $7.4 million.

4.1 IMPLEMENTATION COSTS

WDFW already has a number of staff working on fish passage and screening regardless of the rulemaking. For example, WDFW staff sit on the Fish Barrier Removal Board,[26] which prioritizes candidate projects and matches project sponsors with funding opportunities. WDFW additionally helps irrigators with fish screens, including assessing existing screens, recommending upgrades, installation, and providing support with finding funding options.

This analysis considers the incremental cost of staff time required specifically for implementation and enforcement of the proposed rule, above and beyond the staff time and effort already dedicated to these initiatives. WDFW estimates that between three and five full-time equivalent (FTE) employees will be dedicated to implementing the rule.

We measure the labor costs in terms of the fully loaded cost of employing the staff dedicated to implementing the proposed rule. Fully loaded costs capture the total cost to WDFW, which includes salary, benefits, and any additional overhead. All staff hours dedicated to rule implementation are included, regardless of whether they are new hires or existing employees, in order to fully capture the opportunity costs of the labor required to implement the rule.

The FTEs are likely to include a mix of biologists, environmental engineers, an appeals coordinator, and a policy lead and trainer. Based on WDFW guidance, annual salaries are likely to range from $59,000 (Fish and Wildlife Biologist 3, Step A) to $100,000

[26] Washington Department of Fish and Wildlife. "Brian Abbott Fish Barrier Removal Board," https://wdfw.wa.gov/about/advisory/fbrb

(Environmental Planner 5/Environmental Engineer 3, Step M).[27] To estimate the fully loaded cost to WDFW, we assume that benefits and overhead are equal to 100 percent of employee salary.[28] The total estimated annual labor cost to WDFW, therefore, ranges from $350,000 to $1 million. As a probable estimate, we utilize the midpoint of the range ($680,000).

In addition to staff, WDFW intends to add a module to the existing Aquatic Protection Permitting System (APPS) to simplify tracking of compliance action plans and memorandums of agreement generated by the rule. WDFW estimates that the additional functionality would incur a one-time startup cost of $180,000 plus annual maintenance of $44,000.[29] Annualizing the startup cost across ten years at a discount rate of three percent results in total annual costs for the system of $65,000.

Summing the annual labor cost with the annualized cost of the APPS module yields an estimate for total annual implantation costs to WDFW of $750,000.

4.2 COMPLIANCE COSTS

The range of compliance costs generated by the rule depend substantially upon the site-specific context of corrections triggered by the rulemaking (e.g., type and size of structure, baseline fish passage status). A small unscreened pump intake could require an off the shelf screen costing a few hundred dollars. At the higher end, a culvert may require replacement due to inadequate fish passage and to accommodate future climate conditions. Exhibit 4-1 provides cost ranges for replacing or removing five types of structures; in fact, full replacement or removal may not be necessary in every case.

We collected project cost estimates from seven firms for five types of projects: (1) replacing diversion screens, (2) removing dams, (3) replacing fish passage improvement structures, (4) replacing or removing culverts, and (5) installing bridges. Given the significant range in size of diversion screening projects, we divide screens into small and large. We collected information on permitting, engineering and design, and construction for these projects. Individual (anonymized) firm estimates are provided in Attachment C. Firms ranged from small businesses providing consulting services to national firms managing all phases of large fishway and screening projects. Not all firms were able to provide estimates for each project and/or phase, and some firms combined permitting with design and engineering. For consistency, therefore, the summarized estimates presented in Exhibit 4-1 reflect the combined total compliance costs per project.

[27] Salary estimates obtained from the most recent General Service Salary Schedule for Non-Represented Employees (effective as of July 1, 2022) published by the Washington State Office of Financial Management. Accessed January 11, 2023 at: https://ofm.wa.gov/state-human-resources/compensation-job-classes/compensation-administration/compensation-plan-components/salary-schedules

[28] Baxter, J.R., Robinson, L.A., and J.K. Hammitt. 2017. "Valuing Time in U.S. Department of Health and Human Services Regulatory Impact Analyses: Conceptual Framework and Best Practices." Accessed January 20, 2023 at: https://aspe.hhs.gov/sites/default/files/migrated_legacy_files/176806/VOT.pdf

[29] Personal communication with WDFW staff, January 20, 2023.

EXHIBIT 4-1. COST RANGES FOR REPLACING RELEVANT STRUCTURES

COST CATEGORY	DIVERSION SCREENING (SMALL)	DIVERSION SCREENING (LARGE)	DAM REMOVAL	FISH PASSAGE STRUCTURE	CULVERT	BRIDGE
Permitting, design, and engineering	N/A*	$2,000 - $4M	$15,000 - $4M	$30,000 - $400,000	$5,000 - $400,000	$15,000 - $1M
Construction	$100 - $10,000	$50,000 - $400,000	$50,000 - $1.5M	$200,000 - $1.5M	$40,000 - $800,000	$50,000 - $5M
Total	$100 - $10,000	$52,000 - $4.4M	$65,000 - $5.5M	$230,000 - $1.9M	$45,000 - $1.2M	$65,000 - $6M

Source: Data collected from engineering and consulting firms performing the services (see Attachment C).
* There is no permitting, design, or engineering cost associated with small diversion screens, which tend to be off-the-shelf products.

Interviewed firms provided generally consistent information on cost ranges with some exceptions. For example, one firm provided estimates for diversion screening that were several orders of magnitude larger than others, and another firm did the same for bridges. Differences of these type are most likely indicative of the firm's clientele (e.g., public utility diversions and state highway bridges versus privately owned structures) and the nature of the projects undertaken by the firms.

Compliance costs vary significantly depending on project-specific characteristics, as summarized in Exhibit 4-2). Cost drivers include structural characteristics (type, size, location of the structure), biophysical factors (hydrology, slope, sediment type), and socioeconomic context.

EXHIBIT 4-2. PROJECT-SPECIFIC CHARACTERISTICS DRIVING VARIATION IN TOTAL COST

CATEGORY	DESCRIPTION
Structure characteristics	Structure type, dimensions, roadway design speed, vertical profile, intake speed
Geotechnical factors	Slope, soil/sediment type
Hydrologic characteristics	Stream flow/velocity
Location and surrounding landscape	Presence of utility, ownership of adjacent land
Permitting requirements	Involvement of multiple jurisdictions, environmental concerns
Socioeconomic context	Population density (urban/rural), traffic management during construction

Notes: The influence of these factors on cost are often interactive (e.g., larger structures can trigger additional permitting or require easements).

Other cost drivers are more specific to particular project types. For diversions, the largest driver of variation is the flow rate at the point of diversion or intake. Smaller pump screens, for example, require a self-cleaning apparatus at flows beyond three cubic feet per second, which can increase the cost by several thousand dollars or more. Larger gravity diversion screens need custom fabrication and construction and require more

permitting and complicated installation processes, driving the cost into the tens of thousands or even millions for a small number of very large projects.

Dam removal costs are highly dependent on project scale (i.e., dimensions, primarily a function of bankfull width) and the extent of sediment buildup in the reservoir. If the sediment is determined to contain contaminants, sediment disposal can represent a substantial portion of overall costs.

Costs for culverts and bridges are also highly dependent on scale. Other key factors include the vertical profile and slope of the surrounding road, the designed speed of the roadway, and the need to manage traffic during construction. In addition, owner type is important. Empirical evidence from the region suggests that privately owned culverts tend to be smaller, and replacement costs are lower on or near private forestland compared to public.[30]

In addition to information collected via outreach as summarized in Exhibit 4-1, we reviewed existing literature and studies focused on costs of fish passage projects and identified the following information:

- *NOAA database:* The National Oceanic and Atmospheric Association (NOAA) collects data for projects that received grant funds from the Pacific Coastal Salmon Recovery Fund, including fish screens and culverts.[31] The database identifies 69 completed "fish screen" projects. Median cost for these projects is $72,236 and median is $202,489. The database does not identify culvert replacement as a unique project type. However, a recent study utilized the database to analyze culvert project costs within Washington and Oregon finding that a mean cost of $82,600 among the 1,236 culvert projects analyzed.[32]
- *Dam removal cost studies:* A few studies report dam removal costs. One found a median cost of $150,000 and mean cost of $1.8 million based on a national survey of project managers for 317 completed dam removal projects.[33] Another analyzed a subset of projects contained in American Rivers' database of dam removals in the United States for which cost information was available, reporting a median of $116,283 and a mean of $440,448.[34]

The cost information from the existing literature generally falls within the range for each project type obtained from firms as part of this analysis (Exhibit 4-1). This supports the

[30] Van Deynze, B., et al. 2022. "What influences spatial variability in restoration costs? Econometric cost models for inference and prediction in restoration planning." Biological Conservation.

[31] Pacific Northwest salmon habitat project database, 2022. National Marine Fisheries Service, Northwest Fisheries Science Center. Accessed November 11, 2022 at: https://www.webapps.nwfsc.noaa.gov/pnshp/.

[32] Van Deynze, B., et al. 2022. "What influences spatial variability in restoration costs? Econometric cost models for inference and prediction in restoration planning." Biological Conservation.

[33] Bernhardt E.S., et al. 2007. "Restoring Rivers One Reach at a Time: Results from a Survey of U.S. River Restoration Practitioners." Restoration Ecology.

[34] Blachly, B. and E. Uchida. 2017. "Estimating the marginal cost of dam removal." Environmental and Natural Resource Economics Working Papers. University of Rhode Island.

validity of our estimated cost ranges. Additionally, the literature suggests that the likely compliance costs for most projects will be at the lower end of the range. The mean and median empirical cost estimates for completed screen, dam removal, and culvert replacement projects cited above are all well below the midpoints of the respective ranges in Exhibit 4-1. In addition, where both means and medians are reported, mean project costs exceed medians. These facts both suggest that values at the high end of the range are less common than those at the lower end (i.e., the distribution is skewed right, and higher-cost projects are outliers), consistent with findings in the literature.[35]

We also evaluated the incremental cost of adapting climate adapted crossing designs above and beyond the cost of replacing a crossing to comply with fish passage standards. Firms included in outreach efforts generally indicated two things: (1) any cost differential associated with constructing bridges and culverts on fish bearing versus non-fish bearing streams is negligible, and (2) existing culvert and crossing design processes tend to already incorporate climate adaptation to some degree. As previously noted, some firms are aware of and already using WDFW's Culverts and Climate Change web application, while others use either a rule of thumb for upsizing or the Washington State Department of Transportation (WSDOT) standard of increasing current bankfull width by 20 percent and adding two feet.

The Culverts and Climate Change application predicts increases to future bankfull width and future peak flow will exceed five percent for roughly two-thirds of the state by area, which applies to about 97 percent of known culvert and crossing sites.[36] Some areas have projected increases as high as 42.6 percent for bankfull width and 203.5 percent for peak flow (Exhibit 4-3).

EXHIBIT 4-3. MAGNITUDE OF PROJECTED, CLIMATE-INDUCED CHANGES FROM WDFW'S CULVERTS AND CLIMATE CHANGE WEB APPLICATION

	PORTION OF STATE WITH PROJECTED INCREASE 5% OR HIGHER	MEAN PROJECTED INCREASE (PERCENTAGE)	MEDIAN PROJECTED INCREASE (PERCENTAGE)	MAXIMUM PROJECTED INCREASE (PERCENTAGE)
Bankfull width	0.64	11.6	9.3	42.6
100-year peak flow	0.66	32.5	25.3	203.5

Source: IEc analysis of WDFW Culvert and Climate Change web application, available at: https://wdfw.wa.gov/species-habitats/habitat-recovery/fish-passage/climate-change

[35] Van Deynze, B., et al. 2022. "What influences spatial variability in restoration costs? Econometric cost models for inference and prediction in restoration planning." Biological Conservation.

[36] The spatial correlation between structures and climate impacts arises because both are less likely in high elevation areas of the state.

Existing rules of thumb or the WSDOT standard may align with the Culvert and Climate Change application when projected changes are modest; however, current practices for climate adapted crossings may be insufficient in extreme cases. There is a large degree of site-specificity affecting the incremental cost of upsizing a structure. For example, even minimal upsizing may trigger the need to purchase additional land, raise the vertical profile of the surrounding road, or relocate utilities, all of which can add significant costs. On the other hand, the incremental cost of upsizing may be restricted to the cost of any additional materials required, since permitting, design, and engineering often represent fixed costs.

To summarize, the incremental cost of the climate adaptation requirement ranges from zero in cases where sufficient upsizing would occur absent the rule, to a substantial portion of the overall budget in complex cases where things like raising the roadbed, relocating utilities, or shifting from a culvert to bridge design may be necessary. Regardless, as described above and in Chapter 3, it is unlikely that the proposed rule triggers the incremental cost of considering future climate conditions.

4.3 PROBABLE ANNUAL COMPLIANCE COSTS

The previous section provides reasonable ranges for what it would cost to comply with fish passage standards and climate adapted water crossing standards across different types of projects. However, estimating probable compliance costs of the rules requires understanding the level of compliance activity generated by the rulemaking. That is, how many and what types of structures are likely to experience compliance costs to address inadequate fish passage solely due to the proposed rule?

We estimate the probable annual compliance costs based on the following method:

1. Define the most likely level of compliance activity generated by the rule in an average year (numbers and types of structures for which the rule triggers compliance);
2. Identify the probable costs per project based on the midpoint of the range identified in Exhibit 4-1 for the relevant projects;
3. Calculate total annual compliance costs as a function of the numbers and types of projects per year and average costs.

In applying the midpoint of the cost range, the “probable costs” per structure reflect a conservative assumption (more likely to overstate than understate costs) that the ranges in compliance costs are normally distributed. As previously noted, the distributions are more likely to be right skewed, resulting in average compliance costs that are below the midpoint of the range.

WDFW provided information on the expected levels of compliance activity generated by the rule in a typical year. This implicitly acknowledges that while every project type is possible, certain structure types are more likely than others to be targeted for correction based on both the priority of the project for fish and the likelihood that the structure would comply with existing standards even absent the rulemaking.

As reported in Exhibit 4-4, we find that the probable annual compliance costs of the rule are on the order of $6.6 million.

EXHIBIT 4-4. DERIVATION OF PROBABLE ANNUAL COMPLIANCE COSTS

PROJECT TYPE	COST RANGE (USD)	AVERAGE[1] COST (USD)	PROBABLE COMPLIANCE ACTIVITY LEVELS	EXPECTED ANNUAL COST[2] (USD)
Diversion Screening (small)	100-10,000	5,100	5	26,000
Diversion Screening (large)	52,000-4.4M	2.2M	1-2	3.3M
Dam Removal	65,000-5.5M	2.8M	0-1	1.4M
Fish Passage Improvement Structure	230,000-1.9M	1.1M	0	0
Culvert	45,000-1.2M	620,000	2-4	1.9M
Bridge	65,000-6M+	3M	0	0
Total expected annual compliance costs from WDFW ordered corrections: **$6,600,000**				

Notes: Cost values are rounded to two significant digits, but the total is calculated using unrounded values.

3. Assumes that project costs are normally distributed, which is a deliberately conservative assumption. The distributions are more than likely right skewed; the true average is likely well below the midpoint.
4. Calculated as Average Cost times midpoint of Probable Annual WDFW Corrections.

4.4 TOTAL ANNUAL COSTS

The total probable annual costs are the sum of probable implementation costs ($750,000) and compliance costs ($6.6 million). Summing that with the probable annual compliance cost estimate derived above yields an estimate of $7.4 million for the probable annual cost of the rule.

This analysis focuses on annual costs instead of present value costs as the rulemaking does not specify a particular sunset and information is not available to identify the timeframe over which it is likely that the rule will generate behavioral changes and associated costs and benefits. Ultimately, WDFW will implement the process outlined in the rule to address fish passage barriers over an indefinite time period until habitat restoration objectives are met.

4.5 UNCERTAINTY INFLUENCING COST ANALYSIS

Uncertainty is inherent in any prospective regulatory analysis, and especially pronounced in analyses involving environmental modeling due to the stochastic and complex nature of ecological processes and outcomes. Analysis of this proposed rule is limited by additional uncertainty (driven in large part by data availability), which makes it difficult to assess costs and benefits at the individual correction scale as well as in the aggregate (i.e., rule-level).

First, the anticipated level of compliance activity attributable to the proposed rule, above and beyond the substantial baseline initiatives for addressing fish passage barriers, along

with the nature of the structures addressed, is uncertain. This is the primary uncertainty influencing the cost analysis. The standard for CBA in Washington requires an assessment of "probable costs." To meet this standard, we rely upon the expert judgement and substantial experience of WDFW staff to identify the likely level of compliance-related activity that the rulemaking will trigger in a typical year.

Furthermore, the costs of bringing structures into compliance varies significantly based on site-specific factors, with cost ranging by orders of magnitude. To focus on probable costs and avoid assumptions regarding the likelihood that the rule will focus on outlier projects at either extreme (i.e., low-end or high-end costs), we based our compliance cost analysis on the mid-point of the project cost ranges. As previously mentioned, this reflects a conservative approach given available information indicates costs on average are more likely closer to the low end of our range than the high end.

Overall, the data and assumptions employed in the cost estimate are based upon the best available information and provide a well-reasoned benchmark for determining the likelihood that probable benefits are greater than the probable costs of the rule.

CHAPTER 5 | BENEFITS ANALYSIS

Within the regulatory analysis framework described in Section 1.3, the benefits of the proposed rule are the changes induced by the rule that have a positive impact on social welfare (i.e., people's well-being). Positive effects of the rule include the environmental and ecological improvements most directly targeted by the rulemaking (e.g., improved habitat conditions for fish and improved climate resiliency of water crossings), as well as the consequent environmental and ecological effects of the rule implementation (e.g., improved water quality).

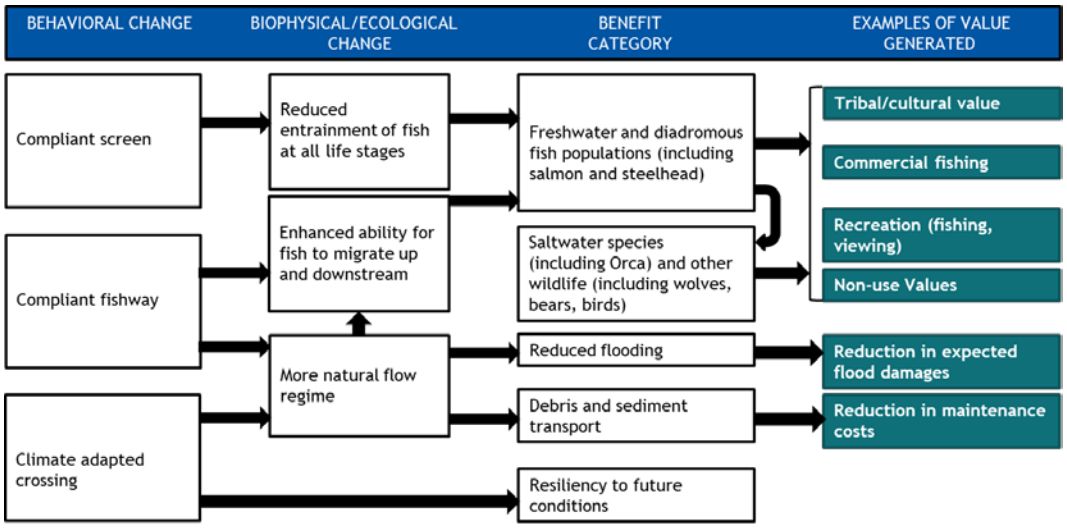
This chapter qualitatively describes the various types of benefits of the proposed rule and provides quantitative information on measures of value, where feasible based on available literature. First, we present a conceptual model linking changes that may be made to instream features as a result of the proposed rule to particular benefit categories and ultimately, ecosystem service values. We then describe each category of benefit individually, focusing on the components of value.

5.1 CONCEPTUAL MODEL OF HOW THE RULE GENERATES VALUE

The proposed rule is expected to induce a behavioral response manifesting in physical changes to in-stream structures. The in-situ physical changes affect ecology and hydrology beyond the project site through often complex pathways, ultimately resulting in changes to specific environmental conditions and ecological resources (e.g., populations of Pacific salmon or Southern Resident orcas).

The diagram in Exhibit 5-1 describes how the proposed rule produces benefits. In general, the proposed rule may induce three types of physical changes to instream features: (1) a noncompliant fish screen is replaced with a compliant fish screen, (2) a noncompliant fishway is modified (or replaced) with a compliant fishway, and (3) water crossings that may not have been designed to accommodate future climate conditions will be re-designed in order to do so. These physical changes result in biophysical and ecological changes, including a reduction in the number of fish becoming entrained into diversions, an enhanced ability for fish to migrate up and downstream, and the restoration of a more natural flow regime.

EXHIBIT 5-1. BIOPHYSICAL AND ECOLOGICAL PATHWAYS LINKING BEHAVIORAL CHANGES FROM THE PROPOSED RULE TO BENEFIT CATEGORIES AND SPECIFIC SOURCES OF VALUE



The biological and ecological changes in turn generate ecosystem service benefits. First, reduced mortality at diversions, coupled with an improved ability to migrate up and downstream, leads to increases in fish abundance. This is especially true for anadromous fish, such as salmon, which rely on movement between fresh and salt water to complete their lifecycle. The fish that directly benefit are prey species for other wildlife and therefore benefit the predator species through trophic effects.

Compliant fishways are often larger than noncompliant fishways, especially when future climate conditions are considered. In addition to the benefits to fish, therefore, the requirements of the proposed rule also contribute to the restoration of a more natural flow regime (which itself contributes directly to fish passage). Pulses of water from storm events are able to move through the watershed at a more natural rate, reducing backup (i.e., flooding) at undersized crossings and improving the movement of debris and sediment through the system. Finally, consideration of future climate conditions supports overall resiliency, increasing the likelihood that benefits will persist even as climate change affects hydrology in the future.

In following subsections, we consider each benefit in terms of how it contributes to social welfare and provide information from existing studies about monetary estimates of value where available and appropriate. The final column of Exhibit 5-1 provides examples of how particular values flow from the ecosystem service benefits. An important takeaway from this section is that while the conceptual model helps to identify outcomes that are likely to be positively impacted by the proposed rule, it is not an empirical model. Quantifying changes to these categories of benefits, and subsequently estimating changes to value, is a complex modeling exercise that is beyond the scope of this report.

5.2 BENEFITS TO PACIFIC SALMON AND STEELHEAD

Washington's lakes, streams, and rivers support many native and nonnative species of freshwater and diadromous fish likely to benefit from implementation of the proposed rule.[37] Due to complex trophic relationships, the net effects are difficult to predict. Increases to some species may come at the expense of others. In addition, not all species hold positive social value (e.g., certain invasive species). Teasing out the net impact of the proposed rule on the total social value of all fish in the state is a complex task that is beyond the scope of this report. We focus instead on the species named in the proposed rule preamble as directly benefiting from the rulemaking.

There are five species of Pacific salmon (Chinook, chum, coho, sockeye, and pink) plus steelhead trout, which are also salmonids. Salmon and steelhead are anadromous, meaning they hatch in freshwater, migrate to the ocean to spend most of their adult lives, then return to freshwater to spawn. Unlike salmon, which spawn only once, steelhead are capable of spawning multiple times in a single lifespan. Because these species rely on upstream and downstream migration, inadequate fishways and diversion screens are a major contributing factor to declines from historical numbers. Chinook and sockeye are currently listed as endangered under the Federal Endangered Species Act, while chum, coho, and steelhead are listed as threatened.[38] Only pink salmon are neither threatened nor endangered.

Salmon and steelhead provide value to society through multiple pathways that are difficult to disentangle. That is, their "total economic value" has multiple components, and individual members of society may value salmon and steelhead for multiple reasons. First are the direct use values for which markets exist, namely commercial harvest. Next are the direct use values for which no markets exist, such as recreational angling. Tribal harvest is unique in that it provides direct use value as both a marketed (commercial fishery) and nonmarketed (subsistence fishery) good. In contrast to the direct uses, which involve extraction, some non-consumptive use values may exist as well, including viewing spring salmon runs by nature enthusiasts. Additionally, the economics literature demonstrates that Pacific salmon and steelhead hold significant passive use (i.e., non-use) values. These types of values (existence, option, and bequest) are common for threatened and endangered species. Studies of the total economic value of salmon attempt to capture all of these components of value collectively, though not individually.

Importantly, Pacific salmon and steelhead are part of the spiritual and cultural identity of regional tribes. As these cultural values cannot be measured in monetary terms, they are not captured in estimates of total economic value for the species. However, it is important to consider the cultural significance of the species in any comparison of costs and benefits of policies affecting the species.

Ideally, quantifying the total economic value of Pacific salmon and steelhead would involve careful estimation of each value component individually using market and

[37] See https://wdfw.wa.gov/species-habitats/species for a list.

[38] We note that there is some variation in the status of geographic subpopulations of each species. See https://wdfw.wa.gov/species-habitats/at-risk/listed for details.

nonmarket economic valuation techniques, recognizing that distinct subpopulations hold distinct values. Given the scale of the task and the complexities involved, most existing valuation studies focus on the collective total economic value held by a population within a particular geography based upon stated preference (i.e., survey) methods. Stated preference methods are designed to elicit a population's willingness-to-pay (WTP) for a carefully described environmental change (in this case, increases to salmon and/or steelhead populations). Exhibit 5-2 summarizes relevant primary studies in terms of the valuation context (e.g., species, magnitude of change), the geographic location, the survey population, and WTP (per household and aggregated across the survey population). Studies included are those appearing in either peer-reviewed journals or the grey literature that estimate the total economic value of Pacific salmon and/or steelhead recovery to residents of Washington state. Of these studies, one also compares average WTP for Washington households to average WTP for households across the United States, demonstrating that Pacific salmon recovery is valued by people who may not directly interact with the species. As previously noted, the values in these studies do not incorporate tribal cultural values.

EXHIBIT 5-2. SUMMARY OF PRIMARY STUDIES ESTIMATING THE TOTAL ECONOMIC VALUE[1] OF PACIFIC SALMON AND/OR STEELHEAD TO WASHINGTON RESIDENTS

STUDY	VALUATION CONTEXT	SITE	SAMPLED POPULATION	ANNUAL WTP PER HOUSEHOLD (2022 USD)	AGGREGATE ANNUAL WTP[2] (2022 USD)
Lewis et al. (2022)	Increase Coho salmon returns by 1,000	All Oregon Coast Coho salmon runs	Pacific Northwest residents (including WA)	0.09-0.22	NA
Lewis et al. (2019)	Increase Coho salmon returns by 100,000 (least aggressive) to 375,000 (most aggressive, includes delisting)	All Oregon Coast Coho salmon runs	Pacific Northwest residents (including WA)	60 (least aggressive); 179 (most aggressive)	NA
ECONorthwest (2019)	Restore wild salmon and improve water quality by removing four dams	Lower Snake River, WA	Active voters in WA	47-64	136-187M (WA state)
Stratus Consulting (2015)	Restoration of salmon at limited (25-50%) or extensive (60%) increase	Elwha River, WA	WA residents	298 (limited); 354 (extensive)	999M (WA state, limited); 1.172B (WA state, extensive)
Bell et al. (2003)	Doubling of local coho runs and harvest	Two estuaries in WA	Residents within 30 miles of estuary	121-188	NA

Layton et al. (1999)	Increase migratory fish populations by 50%	Eastern WA and Columbia River	WA residents	204-390	597M-1.142B (WA state)
Layton et al. (1999)	Increase migratory fish populations by 50%	Western WA and Puget Sound	WA residents	428-588	1.254B-1.724B (WA state)
Loomis (1996)	Increase salmon and steelhead (4 species) from 50,000 to 300,000	Elwha River, WA	Three samples: Clallam County, WA state, national	107 (Clallam); 133 (WA); 124 (national)	390M (WA state); 15.355B (national)

Notes: Dollar values reported in studies are adjusted to 2022 dollars to be comparable with cost estimates gathered in 2022 for this report.

1. Total economic value includes both use and non-use values. However, it does not quantify significance to tribes, which is a potentially large source of additional (nonquantifiable) value.
2. Aggregate values are estimated at the Washington state level and national level where appropriate based on the sampling frame of the original study. Number of households obtained from United States Census Bureau "Quick Facts": 2,931,841 (WA); 124,010,992 (United States).

The literature consistently finds that the public places a high value on recovery of Pacific salmon and steelhead. However, the specific WTP estimates are difficult to compare across studies due to differences in the resources being valued (specific subpopulations of salmon), the study scope (i.e., both the number of species and the magnitude of increases), geographic scale of restoration (e.g., whether the change occurs in a single river system or region-wide), and elicitation methodology. Additionally, studies completed at different points in time may reflect variation in the ecological baseline (i.e., current abundance) or shifting preferences for restoration over time. Each study has advantages and disadvantages, and none perfectly match the context of valuing the changes induced by the proposed rule (i.e., marginal increases to Pacific salmon and steelhead populations attributable to a relatively small number of fishway and screening corrections).

At the low end, the most recent study (ECONorthwest, 2019) estimates the total economic value of restoring wild salmon (and improving water quality) in the Lower Snake River is between $136 million and $187 million.[39] At the high end, Layton et al. (1999) estimate a total economic value of $1.851 billion to $2.866 billion for increasing migratory fish populations by 50 percent throughout the state.[40] Of note, however, this study was completed over twenty years ago and no longer reflects the baseline status of salmon populations and may not accurately represent current preferences of Washington State residents.

In addition to demonstrating significant WTP for Pacific salmon and steelhead recovery generally, a few studies show that residents of the Pacific Northwest (including a sample of Washington residents) hold strong preferences for faster recovery (i.e., restoration

[39] Of note, the results of this study are based upon a single question telephone survey. Best practices for valuing unfamiliar nonmarket goods such as species recovery generally dictates providing sufficient information to ensure respondents understand the valuation context.

[40] Obtained by summing the values for "Eastern Washington and Columbia River" and "Western Washington and Puget Sound".

occurring sooner rather than later). Therefore, the proposed rule may generate additional social welfare by accelerating the recovery timeline.[41,42]

As mentioned, none of the studies identified match the context of this analysis. Significant research has been dedicated to developing and refining techniques to adapt the results of one or more existing valuation studies to a new setting (e.g., for policy analysis), a process known as benefit transfer.[43] One study compares the results of different benefit transfer techniques in the context of Pacific salmon.[44]

A benefit transfer analysis of the existing literature to quantify potential benefits of the proposed rule would require information on how the rule will affect fish abundance. Restoration of salmon populations is not the result of any single project (e.g., a barrier removal) but rather the collective benefit of a portfolio of projects and policies (for example, barrier removals, riparian restoration, harvest management, watershed restoration, agriculture management, and more). *Accordingly, while the proposed rule will play a critical role in reaching salmon recovery in Washington State, the specific population change attributable to the rule is uncertain.*

Given the challenges with quantifying the benefits of the rule in improving salmon populations, Chapter 6 contemplates the magnitude of change in fish populations that would be needed in order for probable benefits of the rule to exceed the probable costs (as quantified in Chapter 4), recognizing that increases to Pacific salmon, steelhead, and other migratory fish do not represent the only benefit of the proposed rule.

5.3 BENEFITS TO SOUTHERN RESIDENT ORCA

Increases to freshwater and diadromous fish populations resulting from the proposed rule would influence populations of many additional species through trophic effects. This is especially true of salmon and steelhead as they migrate between freshwater, saltwater, and the estuaries in between. One estimate links salmon and steelhead to 138 different species ranging from caddisflies and stoneflies (which feed on salmon carcasses), to heron and osprey, to sea lions and harbor seals, to wolves and bears.[45] Assessing potential benefits of the rule to all interrelated species is complex and beyond the scope of this

[41] Lewis, D.J., et al., 2022. "Estimating the value of threatened species abundance dynamics". Journal of Environmental Economics and Management: 117. doi: 10.1016/j.jeem.2022.102639

[42] Lewis, D.J., et al., 2019. "The non-market benefits of early and partial gains in managing threatened salmon". PloS ONE: 14(8). doi: 10.1371/journal.pone.0220260

[43] For example, see: Rolfe, et al. 2015. "Benefit Transfer of Environmental and Resource Values". The Economics of Non-Market Goods and Resources, Vol 14. Springer, Dordrecht.

[44] Weber, M. 2015. "Navigating benefit transfer for salmon improvements in the Western US". *Frontiers in Marine Science*: 2(74). doi: 10.3389/fmars.2015.00074

[45] Cederholm, C.J., et al., 2000. "Pacific Salmon and Wildlife – Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report." Washington Department of Fish and Wildlife, Olympia, Washington. Available at: https://wdfw.wa.gov/sites/default/files/publications/00063/wdfw00063.pdf

report. We focus instead on Southern Resident orcas as improving the prey base for the orcas was a primary objective of the proposed rule.[46]

Southern Resident orcas are currently listed as endangered under the Federal Endangered Species Act and by the State of Washington. They are the only endangered killer whale population, and they are found only along the northern Pacific Coast. The Southern Residents face a variety of threats, with lack of prey chief among them. They eat only fish, primarily Chinook salmon, requiring on average 18-25 adult salmon daily to meet individual energy requirements (about a half million salmon annually to sustain the current Southern Resident orca population).[47] Increasing salmon populations is accordingly considered a vital component of any Southern Resident orca recovery strategy.

Unlike Pacific salmon and steelhead, Southern Resident orcas are not harvested for commercial or recreational purposes. However, the orcas have significant recreational value due to their importance for regional whale watching opportunities. Additionally, Southern Resident orcas are considered a highly recognizable and charismatic endangered species, and passive use values (existence, option, bequest) may comprise a large proportion of their total economic value. Finally, Southern Resident orcas hold unquantifiable cultural significance to particular tribes.

Southern Resident orcas have received limited attention in the economic valuation literature relative to Pacific salmon and steelhead. However, there does exist one study estimating WTP for complete recovery (i.e., delisting) of Southern Resident orcas.[48] The study reports average annual household WTP for Southern Resident orca delisting of $108 for west coast residents (i.e., residents of WA, OR, or CA) and $102 for residents nationwide. Applying these average values to estimates for the number of households yields estimates of total WTP for delisting SRO: $317 million for residents of Washington state and $12.6 billion across the U.S.

As with salmon population benefits, the proposed rule is just one piece of Southern Resident orca recovery efforts. Therefore, it would not be appropriate to attribute the full value of species recovery to the proposed rule. At the same time, salmon recovery via targeted corrections of fishways is a key component of Southern Resident orca recovery. Two of the top three recommendations (out of 49 total) made by the Southern Resident Orca Task Force are related to increasing orca prey (salmon) abundance by removing fish passage barriers.

[46] Cascadia Consulting Group. 2018. "Southern Resident Orca Task Force: Report and Recommendations." Accessed October 20, 2022 at: https://www.governor.wa.gov/sites/default/files/OrcaTaskForce_reportandrecommendations_11.16.18.pdf

[47] "Southern Resident orcas & Chinook salmon." Center for Whale Research. Accessed December 12, 2022 at: https://www.whaleresearch.com/orcassalmon

[48] Wallmo, K., and D.K. Lew, 2015. "Public preferences for endangered species recovery: an examination of geospatial scale and non-market values." Frontiers in Marine Science 2(55). doi:10.3389/fmars.2015.00055

5.4 BENEFITS TO OTHER FISH AND WILDLIFE SPECIES

The benefits described above focus on the effects of the proposed rule on the particular species most directly benefitting from the rulemaking. As mentioned, other fish and wildlife are likely to benefit as well through both direct and indirect (trophic) effects. This analysis does not attempt to list and assess values for all of the potentially affected species. However, we note that the rule most likely generates additional benefits due to positive effects on species including commercial fishing (for non-salmonid species), direct and indirect recreational use values from hunting, angling, birdwatching, and nature viewing unrelated to Pacific salmon, steelhead, or orcas, and passive use values, including improved conditions for biodiversity.

5.5 REDUCED FLOODING

Benefits of the proposed rule are not limited to biological improvements. The water crossing design guidelines are based on the premise that, while not all aspects of instream fish migration are well understood for all species, fish life concerns are minimized by structures that do not interfere with natural stream conditions.[49] Structures adhering to this guideline tend to be larger than those meeting previous design standards, which improves their ability to pass water in addition to fish. This will be especially true given the requirement in the proposed rule to consider incorporating future projected bankfull width and peak flows.[50] Larger structures are less likely to act as pinch points during times of high flow, which reduces the flood risks. Reduced flood risks can be measured in terms of the expected value of avoided flood-related damages.

In extreme instances, strong pulses can blow out crossings such that they need to be rebuilt from the ground up. In addition to the cost of premature replacement, blowout events can harm human life and other property. All else equal, larger crossings are able to pass flows more freely. The probability of a blowout, therefore, decreases with increased crossing size.

Additionally, the probability of localized nuisance flooding decreases with increased crossing size. Nuisance flooding commonly leads to road closures, inducing travel delays. Society bears a time cost from detouring, and safety concerns arise when emergency crews lack full access to the road system.

The value of these types of avoided cost can be estimated, but it would require site-specific modeling. Conceptually, the value of avoided blowouts would be the reduction in probability of failure multiplied by the damages that would occur, including the cost of replacing the crossing. The value of reduced nuisance flooding would be the reduction in flood events multiplied by the costs incurred during each event. Given the interconnected nature of watersheds, reduced flooding at one site could theoretically increase flooding at

[49] Barnard, R.J., et al., 2013. "Water Crossings Design Guidelines." Washington Department of Fish and Wildlife, Olympia, Washington. http://wdfw.wa.gov/hab/ahg/culverts.htm

[50] The proposed rule is written such that consideration of projected conditions will not result in a reduction in the size of a crossing.

another downstream site (i.e., it the problem could be shifted downstream). Depending on conditions at the two sites, the net effect on benefits could be either positive or negative.

5.6 IMPROVED PASSAGE OF SEDIMENT AND DEBRIS

In addition to passing fish and water more effectively, larger crossing structures pass debris and sediment more effectively and naturally. One potential value is the reduction in maintenance costs from less frequent clearing of water crossing openings. In addition, sediment is more likely to move through the system and be deposited downstream, where it can reduce sediment deficits that are exacerbated by rising seas. In monetary terms, the value is the avoided cost of addressing the deficit manually.

5.7 SUSTAINABLITY AND RESILIENCY

Climate change is projected to alter hydrology and channel morphology significantly in many parts of Washington over the next 50-100 years, which may impact the ability of some structures to continue providing adequate fish passage and flow benefits.[51] Incorporating future projected bankfull width and peak flows into the design of water crossing structures today increases the likelihood that the benefits described above will persist throughout the structures' engineered lifespans. The value of this sustainability or resiliency benefit is equal to any decreases to benefits that would occur in the future as a result of failure to consider future conditions.

[51] Wilhere, G.F., et al., 2017. "Incorporating climate change into culvert design in Washington State, USA." Ecological Engineering. http://dx.doi.org/10/1016/j.ecoleng.2017.04.009

CHAPTER 6 | COMPARISON OF PROBABLE COSTS AND BENEFITS

As described in Chapter 4, we identify probable costs of the proposed rule on the order of $7.4 million annually. Chapter 5 describes that quantifying the incremental benefits attributable to the proposed rule is not feasible due to (1) uncertainty regarding the specific changes on the landscape that would be triggered by the rule (i.e., specific corrections to diversions and fish passage structures); and (2) interdependence between the rule and broader habitat restoration and conservation initiatives across Washington State.

Given these uncertainties, Section 6.1 assesses the likelihood that probable benefits of the rule outweigh probable costs focusing on what we do know, as follows:

- A key objective of the rule is to contribute to the recovery of Pacific salmon, steelhead, and Southern Resident orca populations.
- Existing economics research and literature demonstrates that the public holds significant value for recovery of these species.
- Addressing fish passage barriers is a critical component of salmon and orca recovery.
- In implementing the proposed rule, WDFW will target projects of greatest value to fish.
- Beyond contributing to the recovery of salmon, steelhead and orca, the proposed rule will contribute to multiple other categories of ecological, cultural, socioeconomic benefits of value to people.

Next we discuss the distributional impacts of the proposed rule, emphasizing relevant grant and cost share programs (Section 6.2). By offsetting the disproportionate imposition of costs on a relatively small number of structure owners (relative to benefits that are enjoyed by society broadly), these grant and cost share programs can mitigate undesirable redistributive impacts. Section 6.3 concludes.

6.1 COMPARISON OF COSTS AND BENEFITS

Exhibit 6-1 and the following discussion assess the probable costs against the probable benefits of the proposed rule. The costs include the WDFW effort required to implement and enforce the rule as well as the direct compliance costs of implementing corrections to fishways and screens on the landscape. Based on conservative estimates, the total of these costs is expected to be $7.4 million annually. It is much more difficult to obtain a dollar value estimate for the probable benefits of the proposed rule. The main reason is that

marginal changes to fish abundance and the probability of species recovery attributable to individual corrections (or a set of corrections) are difficult to quantify.

EXHIBIT 6-1. SUMMARY OF PROBABLE COSTS AND BENEFITS OF THE PROPOSED RULE

PROBABLE ANNUAL COSTS	BENEFITS
Annual average costs: $7.4 million: • WDFW implementation costs (labor and technology): $750,000 • Direct compliance costs (completing fishway and screen corrections): $6.6 million • Compliance costs may be borne by owners, but most include funding from federal, state, and non-profit agencies through grant and cost share programs.	• **Increased regional Pacific salmon and steelhead populations.** The public places a high value on recovery of Pacific salmon (estimates range from hundreds of millions to billions of dollars) and the species have unquantifiable cultural significance to tribes. Salmon and steelhead contribute to the market economy of the region and provide recreational opportunities. • **Contribution to recovery of Southern Resident orca.** Increased salmon populations improve the prey base for the orcas, for which lack of prey is a primary threat. The public places a high value on recovery ($317M by one estimate). The orcas provide recreational opportunities and have cultural and historical significance in the Pacific Northwest. • **Improved habitat for other fresh and saltwater fish species.** Improved stream conditions and increased salmon population benefit other wildlife. Other species are likely to have significant commercial value and/or recreational value to users. The public also places a high value on biodiversity protection generally. • **Reduced flooding.** Reducing flood risk by correcting structures results in avoided damages to public and/or private property owners. • **Avoided maintenance costs.** Upgraded structures are less likely to require significant ongoing maintenance from improved passage of sediment and debris.

It is most likely that the benefits described in Exhibit 6-1 exceed the costs. Average annual costs are on the order of millions (estimate of $7.4 million). We rely upon the following information to conclude that the collective benefits of the rule are likely to be greater than the costs:

→ *High economic values of salmon and orca recovery-*

Pacific salmon, steelhead, and Southern Resident orca recovery is highly valued by the public. Estimates for the value of salmon recovery to residents of Washington range from $136 million to $2.87 billion (see Section 5.2). The value of orca recovery to Washington residents is estimated at $317 million and $12.6 billion at a national level (see section 5.3).

→ *Critical role of addressing fish passage barriers and screen in achieving salmon recovery-*

While these economic values of recovery of the species are not solely attributable to the proposed rule, addressing fish passage barriers is a critical component to achieving species recovery and realizing these benefits. The integral role of addressing inadequate fish passage and screening is well-established in the scientific literature and reflected in WDFW guidance and planning

documents.[52,53,54] Of 49 total recommendations in the report by Governor Inslee's Southern Resident Orca Recovery Task Force, two of the top three directly reference fish passage and safety.[55] Restoring fish passage is a federal priority, as well. According to U.S. Transportation Secretary, a recently established federally funded $1 billion grant program to address barriers to anadromous fish migration "… will begin to address the longstanding challenges posed by existing culverts for fishing and Tribal communities."[56]

→ *Tribal cultural and spiritual significance of restoring salmon and orca populations-*

Beyond the quantified economic values to the general population (Washington residents) of species recovery, both salmon and orca are important to the spiritual and cultural identities of regional tribes. While we cannot place dollar values on this benefit, tribal cultural values are a primary driver of salmon conservation and recovery efforts.

→ *Objective of WDFW to use the proposed rule to address projects of greatest importance to fish-*

WDFW will prioritize addressing barriers and screening projects that provide the highest level of benefits to fish, especially ESA-listed species, and Chinook in particular, which are the favored prey of Southern Resident orca. These (and other similar) prioritization criteria are expressed in a current guidance document,[57] and will be considered by WDFW as part of a separate effort to develop an updated barrier removal prioritization strategy.

→ *Improved water quality and stream flow benefit habitat for other species and contribute to thriving ecosystems-*

Other fresh and saltwater fish species and wildlife are likely to be benefit from the habitat improvements. Fish and wildlife species provide commercial (e.g., fishing), recreational (e.g., fishing, hunting, viewing) and ecological value.

[52] For example, see Kemp 2015, Pess et al. 2014, Anderson et al., 2015.

[53] Washington Joint Natural Resources Cabinet. 1999. "Statewide Strategy to Recover Salmon. Extinction is Not an Option."

[54] WDFW. 2021. "Biennial Report on the Development of a Statewide Fish Passage Barrier Removal Strategy."

[55] Cascadia Consulting Group. 2018. "Southern Resident Orca Task Force: Report and Recommendations." Accessed October 20, 2022 at: https://www.governor.wa.gov/sites/default/files/OrcaTaskForce_reportandrecommendations_11.16.18.pdf

[56] United States Department of Transportation. "Biden-Harris Administration Opens Applications for $1 Billion Grant Program to Protect Critical Fish Populations and Support Local Jobs by Removing and Upgrading Culverts." October 6, 2022. Accessed October 7, 2022 at: https://www.transportation.gov/briefing-room/biden-harris-administration-opens-applications-1-billion-grant-program-protect

[57] WDFW. 2019. "Fish Passage Inventory, Assessment, and Prioritization Manual." Olympia, Washington.

→ *Additional unquantified benefits related to reduced risks and maintenance costs-*

Reduced flood damages and maintenance costs (including avoided premature structure replacement) are also likely benefits of upgrading structures.

Finally, while comprehensive modeling and assessment of benefits and costs was not possible for this proposed rule, we consider existing research on the cost-effectiveness of stream barrier removals for fish. Examples are limited, but one recently published study assessed the social benefits and costs of mitigating fish passage barriers within a southeast England basin.[58] Modeling project-level costs, increases to fish species richness and abundance, and public WTP for the biological changes, the researchers found that benefits exceeded costs across the entire range of considered budget scenarios. Significant contextual differences prevent extrapolating this result, but it does add to the weight of overall evidence.

6.2 DISTRIBUTIONAL ANALYSIS

The societal perspective of this CBA is appropriate for assessing the aggregate impact of a proposed rule, ensuring that it is an efficient use of a society's limited resources. One key limitation, however, is that it does not account for how the benefits and costs are distributed among members of society.

As the impact of the rule has been presented above, even if aggregate benefits are likely to exceed aggregate costs, it has an inequitable redistributive effect. The main and most valuable benefits of the proposed rule are the contributions to successful recovery of Pacific salmon, steelhead, and Southern Resident orca, which are enjoyed widely by society overall, including tribes. In contrast, the compliance costs may be borne by a relatively small group of noncompliant structure owners.

In practice, however, structure owners are not likely to bear the full compliance costs. Numerous cost share and grant programs exist to complete fish passage and screening projects. Federal, state, non-profit, and private funds are available through various programs, some of which are highlighted in Exhibit 6-2. Leveraging these types of funds to complete rule-induced corrections does not change the aggregate social welfare impact of the proposed rule, but it does mitigate the out-of-pocket costs to the structure owners.

[58] King, S., O'Hanley, J.R., and I. Fraser. 2021. "How to choose? A bioeconomic model for optimizing river barrier mitigation actions." *Ecological Economics*: 181. https://doi.org/10.1016/j.ecolecon.2020.106892

EXHIBIT 6-2. GRANT PROGRAMS AVAILABLE FOR OFFSETTING COSTS TO OWNERS FOR CERTAIN PROJECT TYPES

PROGRAM NAME	LEVEL AND ADMINISTERING AGENCY	PROGRAM INFORMATION
Fish Barrier Removal Board[1]	State; DFW and Recreation and Conservation Office	Grant program for fish passage projects that remove impediments to salmon and steelhead migration. Up to $40 mil in funding available for 2021-2022.
Family Forest Fish Passage[2]	State; DNR and Recreation and Conservation Office	Funding for private forestland owners to remove culverts/stream crossings that prevent trout, salmon, and other fish from traveling upstream. Structures must be on forestland and on a fish-bearing stream. Up to $5.9 mil in funding for 2022-2023. $5,000 cost-sharing for owners who have harvested in the previous 3 years.
Salmon Recovery Funding Board[3]	State; Recreation and Conservation Office	Funding for salmon habitat protection for existing, high-quality habitat or restoration for degraded habitat. Typical projects replace barriers to fish migration, replant stream banks, remove shoreline armoring, etc. Open to local/state agencies, tribes, private landowners, nonprofits. Applicants can request between $5,000 and $200,000.
Barrier Removal Grants[4]	Federal; NOAA	$65 mil in funding available in 2022 for projects that remove in-stream barriers to fish passage (under Bipartisan Infrastructure Law). Open to institutions of higher education, non-profits, commercial organizations, and state, local, and tribal governments. Award amounts range from $1 mil to $15 mil.
Fish Passage Program[5]	Federal; U.S. Fish and Wildlife Service	Working with private landowners and tribes to remove obsolete/dangerous dams and working with transportation agencies to improve road stream crossings. $200 mil in funding from the Bipartisan Infrastructure Law over the next five years. Six projects in WA have received funding for culvert replacement and fish passage barrier removal.
Watershed and Flood Prevention Operations Program[6]	Federal; USDA Natural Resource Conservation Service	Technical and financial assistance to states, local governments, and tribes (project sponsors) for watershed protection projects. Project sponsors can then leverage NRCS assistance to help landowners implement the projects. Types of projects include fish and wildlife enhancement.
Washington Coast Restoration and Resiliency Initiative[7]	State; Recreation and Conservation Office	Grants of up to $2 million for specific coastal communities to address restoration and resiliency projects. Eligible applicants include cities, counties, conservation districts, private or public corporations, tribes, nonprofits, and state and Federal agencies.
Estuary and Salmon Restoration Program[8]	State; WDFW	Funding and technical assistance for organizations restoring shoreline and nearshore habitats for salmon restoration. Small grants ranging from $30,000 to $150,000 are available for local engagement and restoration projects.
Conservation District Resources[9]	State; Conservation Commission	Various grant and cost-share programs through conservation districts, including reimbursement for cultural resources surveys and monitoring, which may be required for some fishways projects

PROGRAM NAME	LEVEL AND ADMINISTERING AGENCY	PROGRAM INFORMATION

[1] https://wdfw.wa.gov/about/advisory/fbrb; https://ecology.wa.gov/Blog/Posts/September-2021/Up-To-40-million-available-for-streamflow-restora
[2] https://www.dnr.wa.gov/fffpp; https://rco.wa.gov/grant/family-forest-fish-passage-program/
[3] https://rco.wa.gov/grant/salmon-recovery/
[4] https://www.fisheries.noaa.gov/grant/restoring-fish-passage-through-barrier-removal-grants
[5] https://www.fws.gov/program/national-fish-passage; https://www.arcgis.com/apps/dashboards/99040e452de9487f80d9f5748f717880
[6] https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/; https://www.nrcs.usda.gov/wps/portal/nrcs/main/ma/programs/planning/wo/
[7] https://rco.wa.gov/grant/washington-coast-restoration-and-resiliency-initiative/
[8] https://wdfw.wa.gov/species-habitats/habitat-recovery/puget-sound/esrp - esrp-grants
[9] https://www.scc.wa.gov/cd/grants-contracts-and-finance

6.3 OVERALL CONCLUSIONS

This analysis finds that the probable benefits of the proposed rule exceed the probable costs of the rule. The proposed rule does not generate new requirements or standards for ensuring adequate fish passage and screening but focuses on establishing a process for WDFW to facilitate voluntary compliance with existing requirements and to enforce compliance where structure owners are resistant.[59] Probable costs on the order of $7.4 million are driven by spending on the corrections triggered by the rule and the implementation costs to WDFW. Costs of corrections will likely be borne in some part by structure owners, though multiple cost share programs exist that will mitigate the out-of-pocket costs of the rule.

The rule will help WDFW ensure that the barrier corrections addressed are those of greatest value to fish. Thus, while the rule is most likely to result in only a limited number of additional corrections above and beyond those expected in the baseline, the projects targeted are likely to be important to achieving fish restoration objectives. The linkage between correcting inadequate fishways and screens and recovery of anadromous fish species is well established.[60] While successful salmon and orca recovery relies on a suite of interdependent programs and actions (e.g., riparian buffer, land management), it cannot be achieved without addressing passage barriers. The economics literature identifies values of salmon and orca recovery on the order of hundreds of millions to billions of dollars. Above and beyond these economic values, these species are core to the identity and ways of life of tribes in the Pacific Northwest. Additionally, the rule improves habitat for other co-existing species of commercial, recreational, ecological, and cultural importance.

[59] While the rule also includes the requirement to consider future climate conditions for certain culvert and water crossing projects, as previously described, it is most likely that this component of the rule will generate limited impacts.

[60] For example, see WDFW (2021), National Research Council (2000), and McPhee (2002).

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ATTACHMENT A | OUTREACH SUMMARY AND LIST OF INDIVIDUALS INTERVIEWED IN OCTOBER/NOVEMBER 2022

To support development of this analysis and the accompanying Small Business Economic Impact Statement, the analysis relies on outreach and participation of state and local agencies, firms that provide permitting support, design, engineering, or construction services, grant program administrators, and representatives of private property owners to provide data and information to evaluate the potential compliance costs of the rule. IEc relied upon several sources to identify and obtain contact information for these entities, including WDFW-provided state and local agency contacts, WDFW's database of technical assistance providers, and referrals from interviewees.

IEc conducted interviews with representatives chosen according to a variety of selection criteria. State and local agencies fall into two categories of interviewees. Some state agencies, such as Department of Ecology and Department of Natural Resources were contacted because they were named in WDFW's CR-101 filing for the proposed rule as having similar regulatory authority. Other agencies, such as county and local road and public works departments, were chosen because they are responsible for a considerable number of impacted structures. For these agencies, the number of nonexempt structures was balanced with a desire to achieve wide geographic coverage of the entire state. Department of Transportation was selected for their dual role as regulators with similar authority and as an entity responsible for many impacted structures throughout the state. IEc selected firms providing professional and construction services that cover a wide geographic area (often, statewide) and provide many relevant services (e.g., all phases of barrier removal, diversion screening, culvert and bridge installation and modification). Given the broad scope of the rule, IEc decided that reaching out to private individual owners of structures would be an inefficient strategy for reaching that population. Instead, IEc interviewed Conservation Districts, which regularly interact with private landowners on natural resource and conservation issues. IEc selected Conservation Districts balancing the number of privately owned structures in the districts with a desire to achieve wide geographic representation.

The outreach process consisted of an initial email invitation to participate in an interview. Initial emails often resulted in referrals to more relevant contacts. If IEc did not receive a response, they sent at least one follow up email. In most cases, interviewees were available for a video interview during normal business hours. IEc assumed no response to the follow up as an indication that the recipient did not wish to participate in an interview. In this case we attempted to identify an alternative interviewee from the same category. In some cases, interviewees invited additional interested individuals from their organization to participate in the interview.

Ultimately, IEc reached out to 11 state agency representatives, 5 county representatives, 4 municipal representatives, 4 Conservation District representatives, 1 grant program administrator, and 25 employees of firms providing relevant professional and construction services. As described, outreach efforts did not result in one hundred percent

participation, and some additional interviewees were invited to participate in interviews by one of the interviewees we initially targeted. During October and November 2022 IEc conducted interviews with 12 state agency representatives, 4 county representatives, 5 municipal representatives, 3 Conservation District representatives, 1 grant program administrators, and 8 employees of firms providing relevant professional and construction services (Exhibit A-1).

EXHIBIT A-1. LIST OF INTERVIEWEES

DESCRIPTION OF INTERVIEWEES[1]
Consulting/engineering professional at Aspect Consulting
Consulting/engineering professional at Bridge and Culvert Design
Consulting/engineering professional at Chinook Engineering
Consulting/engineering professional at Ecoassets Environmental
Consulting/engineering professional at Herrera Inc.
Consulting/engineering professional at Marine Surveys and Assessments
Consulting/engineering professional at Talasaea
Consulting/engineering professional at Tetra Tech
Professional at Washington State Department of Natural Resources
Professional at Washington State Department of Ecology
Professional at Washington State Department of Ecology
Professional at Washington State Department of Ecology
Professional at Washington State Recreation and Conservation Office
Professional at Washington State Department of Agriculture
Professional at Washington State Water Resources Association
Professional at Washington State Water Resources Association
Professional at Cascadia Conservation District
Professional at Snohomish Conservation District
Professional at Snohomish Conservation District
Professional at Washington State Department of Transportation
Professional at Washington State Department of Transportation
Professional at Washington State Department of Transportation
Professional at Washington State Department of Transportation
Professional at Washington State Department of Transportation
Professional with Snohomish County
Professional with Snohomish County
Professional with King County
Professional with King County
Professional with City of Bellevue
Professional with City of Bellevue
Professional with City of Bellevue
Professional with City of Walla Walla
Professional with City of Walla Walla

DESCRIPTION OF INTERVIEWEES[1]
Notes: 1. Individuals are not identified by name to protect the privacy of interview participants.

ATTACHMENT B | INTERVIEW GUIDE

INTERVIEW QUESTIONS

INTRODUCTION (FOR ALL INTERVIEWEES)

- IEc is an environmental and economic consulting firm with expertise in developing regulatory analyses for state and federal agencies.
- IEc has been retained by the Washington Department of Fish and Wildlife to develop a Cost Benefit Analysis and a Small Business Economic Impact Statement for a forthcoming proposed rule that would codify existing standards for fish passage, introduce new standards for culverts and crossings, and change compliance and enforcement practices.
- The Cost Benefit Analysis compares the costs and benefits that would result from the rule, while the SBEIS considers whether the rule will disproportionately affect small businesses or impose more than minor costs on them (defined as businesses employing <50 people).
- The proposed rule seeks to improve fish passage conditions throughout the state now and into the future to support anadromous fish populations. It is motivated by Governor Inslee's Task Force dedicated to recovery of Southern Resident Orcas, which identified prey depletion as a main threat.
- For fish passage structures and diversion screens, the proposed rule codifies existing standards. For culverts and crossings, the proposed rule introduces a new requirement to consider future hydrologic conditions in design and construction, based on climate change modeling.
- The proposed rule also expands the tools available to WDFW for achieving voluntary and nonvoluntary compliance with the standards.
- Our analysis is focused on understanding the costs and benefits that are likely to arise if the proposed rule is adopted.
- We are conducting a series of interviews with relevant agencies, firms that perform screening and water crossing design, construction, and installation, and owners of existing diversions and crossings to better understand the standards and compliance behavior as they currently exist, how or if the rule might result in additional costs, and the magnitude of those costs.

FIRMS PROVIDING DESIGN, ENGINEERING, CONSTRUCTION, AND CONSULTING

1. Are you familiar with the proposed rule?
2. What geographic areas does your firm service?
3. Which of the following services does your firm perform?
    a. Diversion screening
    b. Stream barrier removal
    c. Fish passage structure installation and/or modification
    d. Culvert installation and/or modification
    e. Bridge construction and/or modification
4. Are there minimum or maximum sizes for projects your firm will undertake?
5. Who are the typical owners for each type of project?
    a. For private owners, do they tend to be commercial or residential?
        i. What types of businesses have you done work for?
    b. What portion of your work is new construction versus modifying an existing structure?
        i. For existing structures, what portion is driven by the owner seeking modification versus DFW requesting the modification?
6. *If the firm provides culvert and/or bridge services*
    a. One requirement of the proposed rule is to design culverts and crossings for expected changes to bankfull width and peak flow due to climate change, rather than current conditions, using DFW's Culverts and Climate Change web application.
        i. Has your firm been doing this currently to any extent? Using the web application? Some other modeling tool or rule of thumb?
            1. If it is recommended to clients, do they typically listen?
                a. What impacts their decision? (for example, project scale, owner type, etc.)
7. What phases are involved in the process from permit application to final inspection?
    a. Do you provide all of these services?
        i. If no:
            1. Which phases does your firm provide?
            2. Can you give us the names of firms you typically partner with to cover the remaining phases?
    b. What is the range of costs, for all phases your firm provides, for each of the following? (only those that the firm provides)
        i. Diversion screening
        ii. Stream barrier removal
        iii. Fish passage structure installation and/or modification
        iv. Culvert installation and/or modification
            1. On a fish bearing stream vs. non-fish bearing stream

2. For current bankfull width and peak flows vs. projected future bankfull width and peak flows

v. Bridge construction and/or modification
1. On a fish bearing stream vs. non-fish bearing stream
2. For current bankfull width and peak flows vs. projected future bankfull width and peak flows

c. What causes variation in these costs?
i. Project specifications
ii. Geography
iii. Condition of existing structure
iv. Seasonality
v. Others?

d. Can you provide an estimate for the expected lifespan of each project type?

e. Has your firm ever repaired, modified, or replaced an undersized culvert or crossing that was damaged from excessive flooding?
i. Either way, can you provide a range of cost estimates for that service?

f. What grant or loan programs are you aware of that offer cost mitigation opportunities for owners?

8. For costs, we are thinking about the permitting, design, engineering, and construction costs to landowners (the costs we have been asking about here), plus the costs to DFW of administering and enforcing the rule. Can you think of any other categories of costs that might arise as a result of the rule?

9. For benefits, we are thinking about the biological and ecological benefits of restoring fish passage and more natural flows, plus reduced flooding and avoiding unnecessary maintenance or premature replacement of culverts and crossings due to future climate impacts. Can you think of any other categories of benefits that might arise as a result of the rule?

AGENCIES WITH POTENTIALLY SIMILAR STANDARDS

1. Are you familiar with the proposed rule?

2. In what capacity (or through what specific programs) does your agency regulate stream crossing structures, fish passage, or diversion screening?

a. In what ways does that relate to DFW's standards? Similarities? Differences?

3. Can you think of any ways that the proposed rule would affect the way your agency operates?

4. What types of owners of dams, diversions, intakes, culverts, and crossings does your agency typically interact with?

a. For private owners, do they tend to be business or residential?

i. What types of businesses do you interact with?

5. What grant or loan programs are you aware of that offer cost mitigation opportunities for fish passage, barrier removal, or screening projects?
6. For costs, we are thinking about the permitting, design, engineering, and construction costs to landowners (the costs we have been asking about here), plus the costs to DFW of administering and enforcing the rule. Can you think of any other categories of costs that might arise as a result of the rule?
7. For benefits, we are thinking about the biological and ecological benefits of restoring fish passage and more natural flows, plus reduced flooding and avoiding unnecessary maintenance or premature replacement of culverts and crossings due to future climate impacts. Can you think of any other categories of benefits that might arise as a result of the rule?

PUBLIC OR LARGE COMMERCIAL OWNERS

1. What types and how many of each type of structure is your agency/business responsible for?
    a. Diversion screens
    b. Dams or other barriers
    c. Culverts
    d. Crossings
2. Are you familiar with the standards for fish passage and screening set by DFW?
3. Are you aware of the proposed rule and what it does?
4. For culverts and crossings, do expected future climate conditions (for example, projected changes to bankfull width and peak flows) play a role in your decision making?
    a. Will considering future climate conditions save money in the long run? (for example, from maintenance and repair, or reduced flood damage)
5. For costs of the rule, we are thinking about the permitting, design, engineering, and construction costs to landowners (the costs we have been asking about here), plus the costs to DFW of administering and enforcing the rule. Can you think of any other categories of costs that might arise as a result of the rule?
6. For benefits of the rule, we are thinking about the biological and ecological benefits of restoring fish passage and more natural flows, plus reduced flooding and avoiding unnecessary maintenance or premature replacement of culverts and crossings due to future climate impacts. Can you think of any other categories of benefits that might arise as a result of the rule?

GRANT PROGRAMS

We are particularly interested in understanding your program and how it can help offset some of the costs that owners will face as a result of the proposed rule.

1. Please describe the program
    a. What projects are eligible?
        i. Certain types, geographies, etc.
    b. Who is eligible?
        i. Certain types of owners, etc.
    c. Are there some prioritization criteria?
        i. Are certain project or owner types more likely to receive funding?
    d. Are there any costs associated with the application process?
    e. What is the range of assistance provided for different projects?
        i. Diversion screening
        ii. Stream barrier removal
        iii. Fish passage structure installation and/or modification
        iv. Culvert installation and/or modification
        v. Bridge construction and/or modification
    f. How is the program funded?
    g. Is the size of the program expected to change in the future?
    h. What types of entities have received funding in the past?
        i. We are especially interested in characterizing any private businesses
2. What other programs are you aware of that offer cost offsetting opportunities for these types of projects?
3. For costs of the rule, we are thinking about the permitting, design, engineering, and construction costs to landowners (the costs we have been asking about here), plus the costs to DFW of administering and enforcing the rule. Can you think of any other categories of costs that might arise as a result of the rule?
4. For benefits of the rule, we are thinking about the biological and ecological benefits of restoring fish passage and more natural flows, plus reduced flooding and avoiding unnecessary maintenance or premature replacement of culverts and crossings due to future climate impacts. Can you think of any other categories of benefits that might arise as a result of the rule?

ATTACHMENT C | COST ESTIMATES RECEIVED FROM ENGINEERING AND CONSULTING FIRMS (ANONYMIZED)

COST CATEGORY	DIVERSION SCREENING	DAM REMOVAL	FISH PASSAGE STRUCTURE	CULVERT INSTALLATION	BRIDGE CONSTRUCTION
Permitting	NA	$30,000 to $100,000	NA	$10,000 to $50,000	$50,000 to $100,000
Engineering and Design		$30,000 to $100,000		$30,000 to $50,000	$100,000 to $200,000
Construction		$200,000 to $1 mil		$100,000 to $500,000	$1 mil to $5 mil
Permitting	NA	NA	NA	$50,000	$50,000 to $75,000
Engineering and Design					
Construction					
Permitting	$6,000 to $10,000	$6,000 to $10,000	$6,000 to $10,000	$6,000 to $10,000	NA
Engineering and Design	NA	NA	NA	NA	
Construction					
Permitting	$20,000 to $25,000	$15,000 to $20,000	$30,000 to $40,000	$5,000 to $10,000	$15,000 to $20,000
Engineering and Design					
Construction	$50,000 to $400,000	$50,000 to $200,000	$200,000 to $800,000	$40,000 to $120,000	$120,000 to $280,000
Permitting	$15,000 to $50,000	$100,000 to $250,000	$10,000 to $25,000	$5,000 to $25,000	$5,000 to $20,000
Engineering and Design	$25,000 to $150,000	$50,000 to $350,000	$30,000 to $150,000	$20,000 to $75,000	$25,000 to $75,000
Construction	$75,000	$1.5 mil	$250,000 to $1.5 mil	$300,000 to $800,000	$280,000
Permitting	$500,000 to $4 mil	$500,000 to $4 mil	$250,000 to $400,000	$250,000 to $400,000	$400,000 to $1 mil
Engineering and Design					
Construction	NA	NA	NA	NA	NA
Permitting and Design	$2,000 to $10,000	NA	NA	$6,000 to $12,000	NA
Engineering & Construction	NA	NA	NA	NA	NA

ATTACHMENT D | DATA DICTIONARY

DATA ITEM	SOURCE
Estimates for costs associated with all phases of diversion screening, dam removal, fish passage structure installation, culvert and bridge installation in Washington	Personal and email communication with representatives of firms providing these services conducted in October and November 2022
Selected cost information for completed fish screening and culvert projects	Pacific Northwest salmon habitat project database, 2022. National Marine Fisheries Service, Northwest Fisheries Science Center. Accessed November 11, 2022 at: https://www.webapps.nwfsc.noaa.gov/pnshp/
Spatially explicit inventory of known diversions, dams, fish passage improvement structures, culverts, and crossings in Washington State	WDFW Open Data. Fish Passage Barriers Inventory. Accessed September 2022 at: https://data-wdfw.opendata.arcgis.com/documents/wdfw::fish-passage-barriers-inventory-zipped-file-geodatabase/about
Projected changes to bankfull width and 100-year peak flows throughout Washington State	Geodatabase file obtained via email from George Wilhere, Senior Research Scientist at WDFW. The data is documented in Wilhere et al. (2017) and supports WDFW's Culverts and Climate Change web application, available at: https://wdfw.wa.gov/species-habitats/habitat-recovery/fish-passage/climate-change
Boundaries of Tribal Lands in Washington State used to identify exempt structures	Washington State Department of Ecology. ECY_BND_TribalLands feature layer. Accessed September 2022 at: https://fortress.wa.gov/ecy/gisprod/arcgis/rest/services/GIS/ECYAuthoritativeGISDatasets/MapServer/12
Boundaries of federal lands in Washington State used to identify exempt structures	Public Lands Inventory feature layer. Accessed September 2022 at: https://services2.arcgis.com/TGEC20q86HQAeMS6/ArcGIS/rest/services/Public_Lands_Inventory_2/FeatureServer
Total land area in Washington State devoted to agriculture	Washington State Department of Agriculture. Agricultural Land Use. Accessed October 6, 2022 at: https://agr.wa.gov/departments/land-and-water/natural-resources/agricultural-land-use