<u>Origin and Purpose of the IEc Economics Report and Toolbox</u>

November, 2025

The attached two documents created by Industrial Economics were contracted by the Washington State Conservation Commission in partnership with Washington Department of Ecology under a USEPA National Estuary Program grant focused on restoring and improving riparian lands in and along Puget Sound streams and rivers, promoting innovative and sustainable approaches for riparian management, and developing concepts of incentives that will advance the pace of riparian restoration in Puget Sound.

This analysis seeks to further the understanding of the economics related to riparian incentives, specifically payments made to landowners to motivate participation in voluntary incentive programs. Incentive payments may include compensation for costs of participation, as well as additional payment offered above and beyond monetary costs experienced by landowners. This report provides insight into how to incorporate the costs experienced by landowners (e.g. cost of lost income from loss of agricultural production) and the ecosystem services values provided to the public through riparian restoration on private lands into riparian management programs.

The scope of work asked for two products: 1) a synthesis of the economic theory, legal, and policy frameworks, and incentive program elements that lead to greater (or lesser) participation in riparian restoration programs; and, 2) a simple toolbox that uses the lessons learned in item 1 to provide a suggested process for design of future incentive programs at various geographic scales, the outcome of which will encourage higher participation rates than experienced currently.

The documents do not provide incentive values for any specific geography. One of the challenges in Washington State is that land values, agricultural commodities, and riparian restoration priorities vary widely, so broad application of a generalized rate leads to uneven participation. Rather, the cost types and trade-offs for more localized incentive program design are provided along with suggested data sources, as are some initial thoughts on how to consider the public's return on investment with the goal of maximizing private participation and achieving regional natural resources goals, including salmon recovery, orca survival, and watershed health.

IEc

Economic Incentives for Riparian Conservation

Final Report | August 29, 2025

INDUSTRIAL ECONOMICS, INCORPORATED

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Acronyms

ACEP-ALE – Agricultural Conservation Easement Program - Agricultural Land Easements

AUM – Animal Unit Months

BEF – Bonneville Environmental Foundation

BMP – Best/Beneficial Management Practice

CCA – Climate Commitment Act

CCRP – Continuous Conservation Reserve Program

CD – Conservation District

CMZ – Channel Migration Zones

CPDS – Conservation Practice Data System

CREP – Conservation Reserve Enhancement Program

CRP – Conservation Reserve Program

CSP – Conservation Stewardship Program

CWA – Clean Water Act

CWSRF – Clean Water State Revolving Fund

DIP – District-Implemented Project

DNR – Washington State Department of Natural Resources

EAGL – Ecology Administration of Grants and Loans

EBI – Environmental Benefits Index

EQIP – Environmental Quality Incentives Program

ESA – Endangered Species Act

FbD – Floodplains by Design

FREP – Forestry Riparian Easement Program

FSA – Farm Service Agency

FY – Fiscal Year

GAO – Government Accountability Office

GDP – Gross Domestic Product

GHG – Greenhouse Gas

GMA – Growth Management Act

ISP – Individual Stewardship Plan

LIO – Local Integrating Organizations

LWG – Local Working Groups

NASS – National Agricultural Statistics Service

NGO – Nongovernmental Organization

NOAA – National Oceanic and Atmospheric Administration

NRC – National Research Council

NRCS – Natural Resources Conservation Service

NRI – Natural Resource Investments

OWEB – Oregon Watershed Enhancement Board

PES – Payment for Environmental Services

PIP – Practice Inventive Payment

PSAR – Puget Sound Acquisition and Restoration

PSP – Puget Sound Partnership

RCO – Washington State Recreation and Conservation Office

RCW – Revised Code of Washington

RDE – Riparian Data Engine

RGP – Riparian Grant Program

RHOSP - Rivers and Habitat Open Space Program

RMA – Risk Management Agency

RMZ – Riparian Management Zone

SCC – State Conservation Commission

SCD – Spokane Conservation District

SFF – Sustainable Farms and Fields

SIP – Sign-up Incentive Payment

SMA – Shoreline Management Act

SMP – Shoreline Master Program

SPTH – Site Potential Tree Height

SRFB – Salmon Recovery Funding Board

SRR – Soil Rental Rates

STAC – State Technical Advisory Committees

STIR – Soil Tillage Intensity Rating

TMDL – Total Maximum Daily Load

USDA – United States Department of Agriculture

USEPA – United States Environmental Protection Agency

USPAP – Uniform Standards of Professional Appraisal Practice

VSP – Voluntary Stewardship Program

WDFW – Washington Department of Fish and Wildlife

WPCA – Water Pollution Control Act

WSU – Washington State University

WTA – Willingness to Accept

WTP – Willingness to Pay

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Finally, we would like to express appreciation for the contributions of the subject matter experts with invaluable local knowledge that we interviewed in the development of this report. Their perspectives helped to refine the recommendations, and to highlight context-specific considerations.

CHAPTER 1 | Introduction

1.1 Background and Objectives

Riparian zones – lands adjacent to rivers, streams, and wetlands – play a critical ecological role linking terrestrial and aquatic systems. They provide a wide range of ecosystem services, including water quality protection, habitat connectivity, erosion control, flood attenuation, and climate resilience (e.g., Naiman et al., 2005).[1] In the Puget Sound region, restoring and protecting riparian areas is central to regional environmental goals, including salmon recovery, orca survival, and watershed health (Puget Sound Partnership [PSP], 2022).

Despite their importance, riparian zones are vulnerable to degradation. Based on the Washington Department of Natural Resources hydrography data and land ownership data, approximately 44% of the stream miles in the Puget Sound region run through private land.[2] As a result, protection of these areas often relies on landowner cooperation. Where regulatory approaches are politically infeasible, difficult to enforce, or insufficiently tailored to local contexts, voluntary incentive programs offer a practical alternative for achieving conservation goals (Brouhle et al., 2004).

Voluntary incentive programs are policy mechanisms that encourage landowners to adopt conservation practices in exchange for monetary compensation and/or technical assistance. These programs, which may take the form of conservation easements, cost-share arrangements, or performance-based payments, are often framed as contracts that specify particular land management commitments over a defined time horizon. The central challenge in designing a successful incentive program is to develop contracts that are mutually agreeable to both the landowner and contracting agency, which is complicated by limited data and significant uncertainties (Ferraro, 2008). Program design requires consideration of the factors that influence both landowner participation and cost-effective use of public funds (i.e., achieving ecological benefits from the investments).

> **VOLUNTARY INCENTIVE PROGRAMS** are generally defined as structured initiatives, often offered by government agencies or organizations, to motivate a desired action or behavior. Economic incentive programs are one type of voluntary incentive program and include cost-share payments, grants, loans, and tax credits.
>
> We refer to **INCENTIVE PAYMENTS** throughout this report to refer to the payments made to landowners to motivate participation in voluntary incentive programs. These incentive payments may include both compensation for costs of participation, as well as additional payment offered above and beyond monetary costs experienced by landowners to motivate participation.

In Washington, riparian conservation occurs within a complex policy environment shaped by federal mandates (e.g., Clean Water Act [CWA], Endangered Species Act [ESA]), state laws (e.g., Growth Management Act [GMA], Forest Practices Act,

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[1] Ecosystem services are generally defined as the benefits humans receive from the environment.

[2] IEc GIS analysis relying on data from Puget Sound Partnership of the Puget Sound Drainage Basin (https://data-wa-psp.hub.arcgis.com/datasets/56bf0a382a314fb892cab4eb827434a3_0/explore?location=47.144685%2C-121.199821%2C6.87), the Washington Department of Natural Resources Hydrography data (https://geo.wa.gov/datasets/wadnr::dnr-hydrography-watercourses-forest-practices-regulation/about) and GIS land ownership data from Atterbury Consultants (provided to IEc on February 26, 2024).

Water Pollution Control Act [WPCA]), and localized implementation by counties, conservation districts (CDs), Tribes, and Non-governmental Organizations (NGOs). In addition, Tribal Treaty Rights and the landmark 1974 *Boldt decision* (United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974)) require the state to protect salmon habitat, further elevating the importance of healthy riparian habitat as a matter of treaty compliance and co-management responsibilities. While a range of state and federal voluntary incentive programs exist to encourage private landowners in the Puget Sound region to conserve and restore riparian zones on their property, participation remains uneven across jurisdictions and landowner groups.

This report builds directly on two recent efforts to evaluate and strengthen Washington's approach to riparian conservation. The first, conducted by Plauché & Carr LLP and Industrial Economics, Inc. (IEc, 2022), evaluated the effectiveness of existing voluntary and regulatory programs in protecting riparian areas statewide. The second, led by Earth Economics (2024), synthesized lessons from leading riparian incentive programs across the country, with an emphasis on design features that make programs more or less attractive to private landowners. While these studies provide valuable background, they also identify several persistent knowledge gaps, including how to determine payment adequacy, account for differences among landowners, and integrate cost-effectiveness criteria.

To extend and operationalize the insights from these efforts, the Washington State Conservation Commission (SCC) engaged IEc to develop an actionable report offering tools and recommendations focused on understanding payments to landowners to accelerate voluntary riparian habitat conservation in the Puget Sound region.

1.2 Scope and Organization of This Review

This literature and policy review represents the first step in developing a report to guide the design of voluntary conservation incentive programs for riparian conservation in the Puget Sound region. Its purpose is to synthesize program documentation, legal and institutional frameworks, as well as relevant theoretical and empirical findings from economics and other social sciences (both peer-reviewed and grey literature), to inform development of the economic incentives toolbox.

The remainder of this review is organized as follows:

- **Chapter 2 (Economic Theory and Conceptual Framework)** introduces the economic rationale for voluntary riparian conservation programs, including the misalignment between public ecological benefits and private landowner conservation costs. It then describes the key issues associated with designing effective voluntary incentive programs when both costs and benefits are subject to a high degree of uncertainty.
- **Chapter 3 (Legal and Policy Landscape)** describes the federal and state statutes and regulations within which voluntary incentive programs for riparian conservation are implemented. It then describes the relevant existing state and federal incentive programs in terms of their payments to landowners and ecological targeting criteria, and it concludes with a discussion of potential legal and reputational risks associated with implementing incentive programs.
- **Chapter 4 (Lessons from Existing Programs)** summarizes the approaches existing programs have taken for structuring payments to landowners and ecological targeting, as well as how these approaches influence program participation and insight from program managers regarding how to attract more

participation. It also describes the tradeoffs implied by different design choices, framed as opportunities to design targeted programs.

- **Chapter 5 (Description of Economic Incentives Toolbox)** briefly summarizes the overarching takeaways from this review in terms of defining the parameters for the accompanying economic incentives toolbox.
- **Chapter 6 (Key Recommendations)** distills the important considerations for program managers related to establishing an effective payment for promoting participation in voluntary incentive programs, as well as opportunities for additional research.

CHAPTER 2 | Economic Theory and Conceptual Framework

Healthy riparian areas have features (e.g., natural growth, meandering banks), which perform ecological functions (e.g., stream temperature regulation, contribution of large woody debris) that jointly contribute to a range of ecosystem services compared to degraded riparian areas, including terrestrial and aquatic habitat quality and connectivity, erosion and flood mitigation, general water quality, aesthetics, and groundwater discharge (e.g., Riis et al., 2020; NRC, 2002; Washington Department of Fish and Wildlife [WDFW], 2008).[3] Studies consistently demonstrate that the general public holds significant value (expressed as willingness to pay [WTP]) for restoring and conserving riparian zones to maintain and improve delivery of these services (e.g., Holland and Johnston, 2017; Trenholm et al., 2013). However, while the benefits are enjoyed by the general public, the costs of establishing and maintaining healthy riparian areas are borne primarily by individual landowners (Schueler, 2000). From an economics perspective, this misalignment of public and private incentives reflects a classic market failure (e.g., Hanley et al., 2007), leading riparian ecosystem services to be underprovided. Within this section we describe the conceptual foundation for designing effective voluntary conservation programs under real world constraints to promote riparian zone protection and restoration on privately owned land.

A common approach to addressing the market failure is to provide financial incentives (i.e., payments) to private landowners who are willing to adopt or maintain conservation practices that result in enhanced provision of riparian ecosystem services. By using public funds to offset the private costs of conservation to landowners (e.g., foregone revenue, management effort), private land use and management decisions can more accurately reflect public values. Due to differences in the benefits and costs associated with riparian zone conservation across the landscape and among different landowner types, however, it is not always guaranteed that the public benefits of conservation will exceed the costs. Theoretically, conservation is only beneficial to society in riparian zones where the public ecosystem service benefit exceeds the conservation costs to landowners (Exhibit 1).

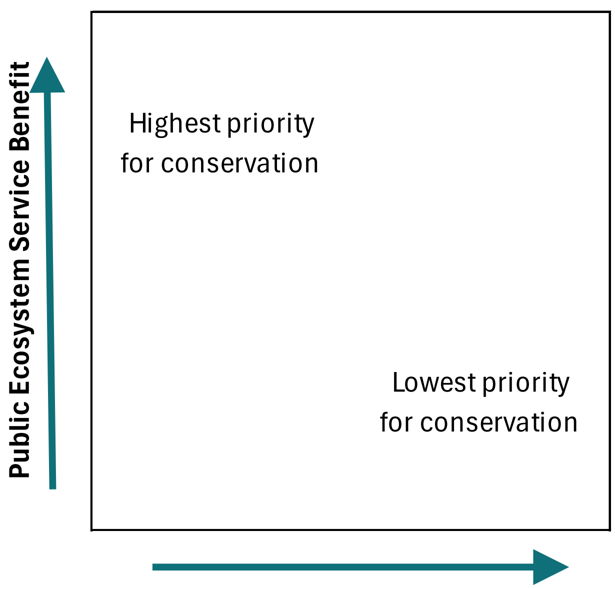

Exhibit 1. "Efficiency" in program design involves enrolling riparian areas where the ecosystem service benefits exceed the costs of conservation

For example, consider a riparian zone on land that is unsuitable for cultivation or other income-producing uses (e.g., a rocky, flood-prone strip along a steep streambank). Because the land has little income-generating use potential, the cost (or foregone benefit) to the landowner of placing the area in conservation is likely low. However, if the stream length also has a lesser ecological value (e.g., due to upstream degradation or downstream barriers) then ecosystem service benefits

[3]In practice, ecosystem services serve as an operational framework for articulating (and ideally, measuring) these ecological benefits.

of enrolling it in a conservation program may also be relatively low.

Conversely, the cost of conservation for a riparian zone adjacent to intensively farmed cropland may be quite high (e.g., because enrolling the land in a conservation program would mean forgoing crop revenues). However, if that stretch of riparian land plays a critical role in filtering agricultural runoff, stabilizing banks, and reconnecting fragmented habitat corridors, then the ecosystem service benefits may exceed the high costs of conservation. These examples highlight the need to understand both the costs and benefits to design an effective incentive program.

In practice, both costs and benefits are never known with certainty. Conservation decisions must therefore be made under conditions of "imperfect information."[4] For example, analyses of early incentives programs offering standardized payments to landowners (e.g., based on average, county-level farm income per acre) found that landowners tended to enroll lands with below-average production value, thereby receiving payments that meet or exceed their minimum willingness to accept (WTA). **That is, when compensation is set at the average expected returns (e.g., income per acre), those who participate tend to have land that has lower-than-average returns because the landowners gain more from the payment than from maintaining the land in agricultural production. Similarly, landowners with higher-than-average returns are less likely to participate because the payment falls short of their expected losses (Shoemaker, 1989).**[5]

However, the relationship between private land value and public ecosystem benefits is not necessarily linear or consistent. In some cases, lands with low agricultural value (e.g., wetlands or flood-prone areas) may provide high ecosystem service benefits, while in others, conservation of high-value cropland may be especially beneficial due to its role in filtering runoff, stabilizing banks, or enhancing habitat connectivity in fragmented landscapes. As a result, standardized payments may produce a low benefit-cost ratio if enrolled lands offer limited ecological value or lead to under-enrollment in high-value ecological sites if payments are too low to offset private costs.

Conversely, a cost-effective incentive program prioritizes enrollment of lands that generate a high return on investment (Exhibit 1). In practice, this involves prioritizing sites that offer the greatest ratio of public ecosystem service benefits to landowner conservation costs and offering payments that approximate landowners' minimum WTA as accurately as feasible. The remaining sections in this chapter describe the components of landowner WTA (the private conservation costs), the public ecosystem service benefits, and well-accepted approaches for incorporating this information into voluntary incentive program design. In subsequent chapters, we discuss specific programs.

2.1 Private Conservation Costs (Landowner Willingness to Accept)

Private landowners may face a range of costs associated with enrolling in a voluntary riparian conservation program that vary depending on land characteristics, program design, and individual landowner circumstances. Landowners are most likely to accept a payment if they feel it compensates them for all expected costs of

[4] See Akerlof (1970) for foundational theoretical work on this topic.

[5] Chapter 6, Recommendation 1: Payment should reflect site-specific land use and characteristics.

participation in the program (i.e., if it meets or exceeds their minimum WTA). This includes both monetary and non-monetary costs potentially experienced by the landowner for participating, including the following:

- **Opportunity costs (e.g., reduced income or land value):** The "opportunity cost" of conservation is the value of foregone alternative uses of the land. For agricultural landowners, this may include lost revenue from crops, pasture, or timber production (Claassen et al., 2008). Additionally, enrolling in a conservation program may reduce the market value of all land types by constraining future land use and development options (Plantinga et al., 2002).
- **Program implementation costs:** These costs are highly variable by program, but may include the time and effort required to enroll in the program, any necessary upfront capital investments (e.g., planting native vegetation, installing livestock fencing), and any ongoing labor and maintenance requirements (Suter et al., 2008; IEc, 2022). Some programs may additionally impose periodic inspections or require documentation to verify compliance, which may result in both direct monetary costs and administrative burdens for landowners. Implementation costs are a particular issue for smaller landowners who may lack the necessary time, equipment, or technical support (Ma et al., 2012; Baumgart-Getz et al., 2012). Staff from the Washington Department of Ecology additionally note that many landowners may also lack the physical ability to complete installation and maintenance activities themselves.[6]
- **Nonmonetary costs:** Landowners may experience or anticipate additional nonmonetary costs associated with program enrollment shaped by individual attitudes, values, and identities (Ahnström et al., 2008; Bennett et al., 2014; Barnes et al., 2020).[7]
    - Some landowners place a high value on feelings of autonomy, which may be affected by certain program monitoring requirements (Ma et al., 2012; Baumgart-Getz et al., 2012).
    - Landowners who do not identify as "conservationist" may be less inclined to enroll, while those motivated by stewardship ethics, community standing, or land legacy may view participation favorably even at lower compensation levels (Ryan et al., 2003; Greiner and Gregg, 2011).[8]
    - Some may have a negative view of riparian conservation, particularly if it is viewed as taking productive land out of agriculture or undermining the viability of the local agricultural economy (Barnes et al., 2019; Thapa et al., 2024).
    - Landowners may anticipate potential risks associated with future compliance issues or uncertain future payments due to potentially evolving program requirements (Barnes et al., 2019; Chapman et al., 2019).
    - Landowners may worry that creating or improving habitat could attract protected species, potentially triggering additional land use restrictions or regulatory scrutiny (e.g., if the buffer areas eventually result in local Critical Area Ordinances, as stipulated in the Growth Management Act [GMA]).[9]

[6] Information provided by the Washington Department of Ecology to IEc on August 15, 2025.

[7] For simplicity we refer generally to nonmonetary costs, but some landowners may actually derive nonmonetary benefits from program enrollment (e.g., those with a strong stewardship ethic).

[8] These studies generally consider "conservationist" landowners to be those who feel it is important to protect the environment and conserve land for future generations.

[9] RCW 36.70A.030

- Conservation behavior is socially embedded (Baumgart-Getz et al., 2012). Landowners may be more likely to participate when they observe trusted peers doing the same, hear local testimonials, or feel that enrollment signals leadership or community standing.
- Landowners may exhibit what economists refer to as “present bias” (i.e., heavily discounting future benefits and costs), which may influence WTA as costs are borne upfront while benefits take time to accrue (Suter et al., 2008; IEc, 2022).

Opportunity costs and program implementation costs are naturally expressed in monetary terms. While program managers may have a good sense of implementation costs, opportunity costs may be difficult for a program manager to reliably estimate across individual landowners. Landowners themselves have the best knowledge of their opportunity costs, although it may not be in their best interest always to share this information (e.g., Ferraro et al., 2008). The existence of additional non-monetary costs further complicates the ability of program managers to reliably estimate landowner WTA.

Additionally, while enrollment in a riparian conservation program is likely to generate net costs for most landowners, certain landowners may receive a net benefit from enrollment. For example, research demonstrates that moderate riparian tree cover can enhance property values on residential riverfront parcels. Phillips, Boyle, and Swedberg (2025) found that property values increased as riparian tree cover increased, peaking at around 40-43% tree cover, and declining only when cover exceeded 85%. Fully forested buffers (100% cover) were associated with lower property values relative to partially vegetated buffers or open views. Therefore, the findings suggest that well-designed buffers that balance vegetation with visibility may reduce or eliminate costs for some residential landowners and may offer amenity value.

Finally, while some landowners may be concerned about the potential for the buffer to generate additional regulatory restrictions, as noted above, some may anticipate the buffer will support their ability to comply with existing regulations, for example nonpoint source pollution controls under the Water Pollution Control Act.

2.2 Public Ecosystem Service Benefits (Public Willingness to Pay)

PUBLIC BENEFITS, in the context of this study, reflect the value that the public holds for real ecological gains resulting from riparian buffer implementation. We use the term “public benefits” as a comparison point to the “private costs” of conservation activity. The public benefits are also often referred to as “returns on investment” or “ecosystem service benefits” in the literature on this topic. The economic measure of public benefits is willingness to pay (WTP).

As described above and depicted in Exhibit 1, incentive programs are most effective when enrollment targets parcels where the net public benefit (i.e., the benefit-cost ratio) is maximized. In this section we describe how an ecosystem service valuation approach could be applied to estimate the public benefits from riparian conservation investments in monetary terms, with relevant examples from the literature.[10] While the examples studies provide general evidence of the public benefits that arise from these programs, we pair the discussion with an assessment of the applicability of these methods to individual parcel-scale analyses. As a result, we ultimately recommend an approach to understanding whether enrolling a particular parcel is

[10] This study does not review or offer recommendations relating to optimal design of riparian buffers to achieve ecological outcomes. Interested readers can see, for example, WDFW’s Riparian Ecosystems, Volume 2: Management Recommendations.

likely to generate net public benefits that do not rely on monetary valuation within a given parcel or watershed (see Section 5.5).

Decades of natural and social science research have coalesced into a set of general best practices for ecosystem service valuation, summarized briefly in the text box.[11]

ECOSYSTEM SERVICE VALUATION involves collaboration between natural scientists and economists performing a series of linked steps:

STEP 1: SCOPING to identify which ecosystem services are likely to be meaningfully affected by the proposed activity (in this case, installation of a riparian buffer) and which expected changes are likely to meaningfully affect human wellbeing.

STEP 2: QUANTIFY THE ECOSYSTEM SERVICE CHANGES in specific units that have relevance to the general public. Numeric scales are ideal, but categorical scales (e.g., low, medium, high) with well-defined thresholds can be used if necessary. This step is best performed by ecologists.

STEP 3: MONETIZE THE ECOSYSTEM SERVICE CHANGES using appropriate methods, which will vary by service and resource availability. While primary valuation studies generate more accurate estimates, in practice it is often necessary to utilize estimates derived in other contexts. This step is best performed by economists.

The scoping phase consists of determining a set of ecosystem services to focus the analysis, based on which are likely to be meaningfully affected by the intervention (in this case, riparian buffer installation and maintenance). The specific ecosystem services associated with restoration of a particular watershed may vary, but services associated with improved fish (through functions like shade, temperature regulation, erosion control, and woody debris recruitment) and wildlife (through direct riparian corridor habitat restoration) species and general water quality (reduced sediment and nutrient load) can generally be expected (e.g., Opperman and Merenlender, 2004; WDFW, 2008; Shaw, 2018; Riis et al., 2020). While this provides a starting point, a full scoping exercise would involve consultation with local experts and stakeholders.

The second step is to quantify expected changes to ecosystem services as a result of the restoration. Some researchers, for example, have developed models capable of predicting specific effects on species (including salmon) associated with riparian restoration (e.g., Justice et al., 2016; Fullerton et al., 2022). While such approaches may be informative at a watershed scale, untangling the contribution of individual restoration sites, as would be necessary to inform individual incentive contracts, is complicated by a number of factors such as:

- **Ecological thresholds and nonlinearities**. Riparian buffers below a minimum width may be ineffective in filtering nutrient runoff, while buffers above a certain threshold may provide disproportionately greater habitat value for species movement (e.g., Mayer et al., 2007). Some watershed-level approaches consider ecological benefits associated with implementing variable buffer widths and management strategies compared to adopting uniform standards (e.g., Graziano et al., 2022)
- **Spatial dependencies (continuity and broader geospatial context)**. The effectiveness of conservation on a particular parcel often depends on land use upstream or adjacent to the site. For example, the cumulative benefits of a riparian buffer may be amplified when implemented in coordination with

[11] For additional context, detailed information about each step, and references to additional resources see the Federal Resource Management and Ecosystem Services Guidebook maintained by the National Ecosystem Services Partnership.

upstream practices that reduce sediment and nutrient loads (Hickey and Doran, 2004) and riparian habitat may play a more crucial role in biodiversity protection within more developed areas (Bennet et al., 2014). Conversely, fragmented or isolated riparian protection efforts may offer limited benefits due to hydrological or ecological disconnection.

- **Synergies across restoration programs**. Conservation and restoration outcomes are often jointly determined by a portfolio of approaches (e.g., successful salmon restoration depends on riparian restoration, addressing instream barriers, stormwater and pollution management, hatcheries, and fishery management). As a result, it is difficult to disentangle the incremental effect of a particular program.
- **Temporal dynamics**. Many benefits of riparian restoration emerge over time. For instance, streambank stabilization, nutrient cycling, and habitat improvements often require several years to fully develop (e.g., Stutter et al., 2019). Additionally, the effectiveness of restoration efforts may change over time, for example due to changing climatic conditions, creating additional costs and risks of delaying action.

Where the relevant ecosystem service changes can be quantified, the final step is to monetize the benefits. Because traditional markets do not exist for many of the ecosystem services provided by riparian buffers, estimating their value in monetary terms requires specialized tools and techniques known collectively as nonmarket valuation methods. There are two general categories of nonmarket valuation methods:

- **Stated preference methods**, as mentioned in Section 2.1 in the context of landowners' WTA to convert land into conservation, are also widely used to estimate public ecosystem service benefits by directly eliciting WTP through surveys that ask individuals about their preferences for environmental changes or programs, such as preserving or restoring riparian zones, at different costs. Decades of stated preference research have resulted in a set of widely accepted best practices for the design of surveys that enhance the credibility of resulting WTP estimates when followed carefully (Johnston et al., 2017).
- **Revealed preference methods** infer WTP from observing actual behavior in markets that are somehow related to the nonmarket good. Examples include hedonic pricing models, which measure how property values differ with proximity to varying levels of ecosystem services, and travel cost models, which estimate recreational values based on the travel costs actually incurred by visitors to access natural areas that provide varying levels of amenities.

Nonmarket valuation methods have been applied to estimate public WTP for a wide range of ecosystem services in a variety of ecological contexts, including riparian restoration.[12] Public WTP for water quality improvements and species habitat and abundance improvements are particularly well-established (for example, see Johnston et al., 2020 and Lewis et al., 2024 for reviews of water quality and species valuations, respectively). Of particular relevance in the context of riparian conservation in Washington, a recent study by Lewis et al. (2022) found that a relatively small (less than one percent) increase in Coho salmon abundance generates over $63 million in public benefits to residents of the Pacific Northwest.

WTP for ecosystem services varies with a number of factors, including baseline environmental quality, scale and scope of the change (e.g., change in salmonid abundance across a particular geographic area) and household characteristics (e.g., income, environmental attitudes, proximity to the ecosystem services). Nonetheless, it is

[12] A recent quantitative review of the literature estimates that over 6,000 unique peer-reviewed ecosystem service valuation studies have been published between 1990 and 2023 (Stanford et al., 2025).

common in practice to apply estimates from existing valuation studies to new contexts, ideally making appropriate adjustments to account for differences in such factors, a practice known as "benefit transfer." Limitations to reliable ecosystem service valuation therefore may occur both due to gaps in the relevant valuation literature, as well as from limitations in information to reliably estimate the ecosystem service changes associated with restoring individual parcels.

Despite existing challenges for monetizing the benefits associated with individual parcel restorations, ecosystem service valuation can provide contextual information about the scale of restoration spending that may be justified based on public benefits at more aggregate scales (e.g., watershed). A limited number of studies have estimated public WTP for specific bundles of ecosystem services provided by riparian conservation or restoration. Three provide enough detail to develop estimates that are standardized in terms of annual WTP per household per acre of riparian zone protection and/or restoration (Exhibit 2). The studies suggest that on average, the value of protecting and/or restoring riparian ecosystem services by implementing a large-scale buffer program is between one and eight cents per household per acre of buffer.[13] Multiplying those values by the number of households within a watershed can provide a rough (order-of-magnitude) sense for the level of conservation cost per acre that is likely to generate a net public benefit, with some caveats noted below.

Exhibit 2. Summary of studies estimating public WTP for riparian ecosystem services

Study	Riparian Program Description	Site	Sampled Population	Average Annual Total and Standardized WTP (2024 USD)
Trenholm et al., (2013)	Establish 30-meter buffer program on 7,400 acres of private forest, agricultural, and residential land	Canaan-Washademoak watershed (southern New Brunswick, Canada)	Households within the watershed; households elsewhere in southern New Brunswick	$60.27 per household total (averaged across the sampled populations) $0.01 per household per acre (averaged across the sampled populations)
Holland and Johnston (2017)	Enhance development setbacks to restore natural riparian vegetation on 500 acres	Three watersheds in southern Maine (Merriland, Branch Brook, Little River	Households within the watersheds	$17.78 per household total (averaged across the watersheds) $0.04 per household per acre (averaged across the watersheds)
Lewis et al. (2017)	Establish a 100 ft riparian zone along 50+ miles of stream banks in the watershed (approx. 1,200 acres)	Clear Creek watershed (northwest Arkansas)	Households within the watershed	$101.29 per household total $0.08 per household per acre

First, WTP is highly context dependent, as suggested by the range of values for riparian conservation found in the literature. Differences in ecological context (e.g., baseline condition, ecosystem services affected) and social context (e.g., population demographics and preferences, proximity to the resource) can have a considerable influence on the magnitude of WTP values. Applying existing values from the literature to Washington watersheds would require adjusting for as many of these contextual factors as possible. While theoretically

[13] These values are presented for illustrative purposes. Their applicability to specific Washington watersheds has not been assessed.

possible, the most defensible benefit transfer approach (based on a meta-analysis of existing studies) would require a greater number of source studies to produce reliable results.

Second, reliance on monetary valuation may overemphasize restoration of watersheds or reaches with explicit and intensive human uses that are captured in the WTP values. However, critical components of value may not be reflected in these estimates. In particular, monetary valuation does not account for Tribal values, which are of fundamental importance to the benefits of riparian conservation. As a result, even precise monetary valuation would represent a lower bound on actual program benefits. Additionally, Tribal values may vary across space differently than values held by the general public.

Finally, we reiterate that the same issues related to accurately estimating ecosystem service changes associated with individual parcel restorations apply such that downscaling a watershed-level estimate of WTP is not advisable. That is, the per acre WTP values presented in Exhibit 2 do not capture parcel-scale variation and are therefore usually not sufficient for evaluating individual contracts.

This section of the report explains the complexity in developing reliable, parcel-specific estimates of the economic value that riparian buffers provide to the public for comparison with the private landowner costs. Although this literature review synthesis does not include characterizing all ecological functions and services provided by riparian buffers, program managers and regional experts generally have an in-depth understanding of the ecological services at specific sites, based on observable site characteristics. Section 5.2 of this report offers a simple and intuitive approach that relies on key ecological indicators and the expertise of watershed managers and scientists to better integrate the relative public benefit of riparian buffers into decision-making. This method supports more informed comparisons with implementation costs, especially in situations where assigning a direct monetary value to ecological benefits is not practical. Ultimately, a regional riparian buffer prioritization method that ranks sites based on ecological need and value would best complement this analysis.

Our outreach indicated that CDs rely upon a variety of approaches to target and prioritize buffer locations. While some CDs have watershed- or reach-scale plans that identify priority reaches where buffers are most needed, others may rely more on landowner-driven enrollment or case-by-case participation. While the scope of this report did not involve systematically surveying CD approaches to prioritize sites across the Puget Sound region, this represents a valuable avenue for future research inform efforts to develop a systematic prioritization approach.

2.3 Program Design Under Real-World Constraints

In a world of perfect information, efficiency-minded program managers would compare landowner WTA against public WTP and prioritize contracts offering the highest return on investment (i.e., maximum WTP/WTA ratio, as depicted in Exhibit 1). As described above, however, program managers are faced with significant difficulty obtaining reliable estimates for both landowner WTA and public WTP. Moreover, agencies may wish to incorporate broader policy goals beyond economic efficiency (e.g., geographic representation, equity among landowners, community engagement, accelerated pace, regulatory expectations). Accordingly, this section focuses on defining in general terms the most common approaches to improving program design by reducing uncertainties. We supplement this conceptual discussion in subsequent chapters by considering the approaches taken within specific voluntary incentive programs.

2.3.1 Understanding Landowner Willingness to Accept

On the conservation cost side, Ferraro (2008) identifies two practical approaches for aligning landowner payments more closely to landowner WTA: direct information gathering and competitive auctions.[14] Additionally, the literature identifies a third method used to directly elicit information on WTA through stated preference surveys. Each approach has strengths and limitations. The first approach relies on gathering observable information on landowner or parcel characteristics (e.g., crop or soil type, assessed land values, expected ability to offset lost production), potentially with support from intermediaries with local field knowledge (e.g., conservation districts). This information can then be leveraged to set eligibility rules or contract prices (Ferraro, 2008). Approaches to modeling landowner WTA from existing data range from simple rules of thumb to sophisticated exercises (Naidoo and Adamowicz, 2006).

The direct information gathering approach generally does not incorporate nonmonetary factors that can positively or negatively influence WTA, such as preferences for autonomy or environmental stewardship, as these motivations are not directly unobservable.[15] As only landowners themselves have knowledge of the specific nonmonetary factors influencing their WTA, these factors can only be self-reported. To address this limitation, researchers have used stated preference methods to estimate landowner WTA to convert land into conservation. Similar to stated preference surveys used to estimate WTP, in this case landowners are presented hypothetical scenarios that vary payment amounts, contract lengths, land use restrictions, and other features. By analyzing landowner responses, researchers can estimate the distribution of WTA across landowners and identify the factors that most influence enrollment decisions. This approach is especially useful in the design phase of new or expanded programs, when empirical enrollment data may be limited or unavailable.

A common output from this research is a supply curve for enrollment, which describes the proportion of landowners willing to participate at different payment levels. Supply curves provide a simple, intuitive tool for visualizing variation in WTA and forecasting participation under alternative payment structures. They can also support budget planning by helping agencies estimate how many acres can be enrolled at a given payment rate. While this report does not develop supply curves directly, they are used in the literature in the context of land supply in conservation and auction-based revealed preference studies of ecosystem services.[16]

Several studies illustrate the use of stated preference in different agricultural contexts. Ma et al. (2012) employed a survey of Michigan farmers to show that willingness to consider participating in payment-for-environmental-services programs depends strongly on farm and farmer characteristics, whereas actual enrollment decisions are more responsive to payment levels and contract terms. Luther et al. (2022) combined survey data with modeling to estimate the potential cropland supply for conversion to in-field prairie strips in

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[14] The authors identify a third approach, screening contracts, which can be theoretically designed to induce landowners to self-select into the most appropriate contract category. Designing screening contracts that achieve that objective in practice, however, is exceedingly difficult and as a result are almost never implemented (Ferraro, 2008).

[15] Chapter 6, Recommendation 8: Consider landowner-led signals of WTA.

[16] For land supply in conservation, see Plantinga, A. J., Alig, R., & Cheng, H. T. (2001). The supply of land for conservation uses: evidence from the conservation reserve program. *Resources, Conservation and Recycling*, *31*(3), 199-215; for auction-based revealed preference, see Jack, B. K., Leimona, B., & Ferraro, P. J. (2009). A revealed preference approach to estimating supply curves for ecosystem services: use of auctions to set payments for soil erosion control in Indonesia. *Conservation Biology*, *23*(2), 359-367.

the Midwest, demonstrating how supply curves can be derived from landowner responses to hypothetical incentives.

The alternative to direct observation and stated preference methods is reverse auctions, which use competitive bidding to elicit individual landowners' WTA for enrolling land in a program. Bids theoretically "reveal" the preferences of the landowner for enrolling, while taking into consideration all monetary and nonmonetary costs. By ranking bids and selecting the lowest-cost offers, auctions have been shown to reduce program costs and improve efficiency in allocating funds (e.g., Latacz-Lohmann and Schilizzi, 2005; Stoneham et al., 2003; Claassen et al., 2008). Multiple possible bidding structures exist, with the goal of inducing landowners to directly reveal their WTA without costly information gathering.

2.3.2 Incorporating Public Benefits

On the benefit side, programs rarely have sufficient information to tailor payments to the ecosystem service value (i.e., public WTP) generated by each parcel for all of the reasons described above. Instead, most programs are practice-based (i.e., payments are linked to a particular practice, such as maintaining a fixed buffer width) under the assumption that these practices are positively correlated with desired ecological outcomes. While this approach is pragmatic, its effectiveness depends on the strength and consistency of the relationship between the required practice and the resulting ecosystem service benefits, which is variable across space and subject to ecological complexities (Jack et al., 2008).

Some programs attempt to account for these sources of variation in ecosystem service outcomes. One approach is to incorporate observable parcel characteristics which are known to drive variation in ecosystem service outcomes (e.g., proximity to important waterbodies, connectivity with existing wildlife habitat, landcover composition) (U.S. Department of Agriculture [USDA], 2025c). Another approach is to offer performance "bonuses" (i.e., additional payment) or tiered payments for enrolling larger areas or participating alongside neighboring landowners (e.g., USDA, 2022), attempting to account for spatial dependencies or threshold effects even when the exact functional relationships remain uncertain. Post-implementation compliance monitoring and adaptive management can, in principle, improve performance over time, but they introduce additional complexity and cost (e.g., Lutter et al., 2018).

While not strictly a voluntary incentive program, New York State's Trees for Tribs program applies an ecological scoring criteria to identify riparian zones to target with plantings (Conley et al., 2018). The GIS-based approach incorporates indicators for species presence, hydrologic characteristics, water quality, connectivity, and landcover to derive scores for individual reaches. The scores effectively identify priority reaches for conservation based on expected contribution to overall ecological goals.

Ultimately, costs associated with reducing information uncertainties, persistent ecological complexity, dynamic ecological dependencies, and changing social dynamics all limit the precision with which conservation incentives can be targeted. These realities are especially salient in watersheds with many small diverse landowners or high ecological variability, where fixed transaction costs and modeling challenges are more pronounced (Jack et al., 2008). Additionally, a design that performs well and meets participant needs in one setting (e.g., among small residential landowners) may not be the best design in another context (e.g., among large-scale agricultural producers) (Whitten and Shelton, 2005). Effective program design, therefore, requires explicit recognition of tradeoffs and a pragmatic approach to balancing efficiency with feasibility.

CHAPTER 3 | Legal and Policy Landscape

3.1 Overview of Regulatory Framework

Voluntary riparian incentive programs in Washington function within a complex regulatory and policy environment that shapes their necessity, design, and implementation. Some statutes impose mandatory protections for riparian areas, such as land use restrictions or harvest buffers, while others offer jurisdictions or landowners flexible, non-regulatory approaches. As a result, voluntary conservation programs serve two critical roles: (1) **filling protection gaps** where regulatory requirements are limited, nonbinding, or unevenly applied, and (2) **offsetting private economic costs** associated with compliance requirements that reduce the value or income potential of working lands.

Importantly, the legal and policy landscape in Washington is also shaped by Tribal Treaty Rights and the landmark *United States v. Washington* decision in 1974, known as the *Boldt decision*, which affirmed the co-management authority of Tribes over salmon fisheries and guaranteed them a meaningful share of harvestable fish (United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974)). These legal obligations require the state to protect salmon habitat, including riparian areas, as a matter of treaty compliance and not just environmental policy. The continuing decline of salmon populations underscores the urgency of habitat restoration and has heightened expectations for voluntary programs to deliver measurable ecological outcomes (Treaty Indian Tribes in Western Washington, 2011).

The regulatory and policy framework shaping riparian conservation in Washington is also defined by several key statutes and authorities, including:

- **Growth Management Act (GMA, Revised Code of Washington [RCW] 36.70A):** The GMA requires local governments to protect environmentally critical areas, including streams, wetlands, and riparian corridors, as part of their comprehensive land use plans. For agricultural lands, the statute authorizes alternative non-regulatory pathways through the Voluntary Stewardship Program (VSP) for certain counties. In jurisdictions that pursue voluntary mechanisms, riparian incentive programs are often the primary means of achieving environmental protection objectives (IEc, 2022). In this context, voluntary action is essential where land use regulation defers to local incentive-based planning.

- **Water Pollution Control Act (WPCA, RCW 90.48):** The WPCA grants the Washington Department of Ecology with the authority to protect and manage water quality in the state, including the regulation of both point and non-point sources of pollution. The WPCA defines pollution as inclusive of contamination or other alteration of physical, chemical or biological properties of waters of the state. This includes changes to temperature (RCW 90.48.020). Within riparian areas, clearing or alteration of vegetation has been found to influence sediment, turbidity, and temperature and has been subject to regulation under the WPCA, including issuing penalties and ordering corrective actions (IEc, 2022).

- **Shoreline Management Act (SMA, RCW 90.58):** The SMA mandates the protection of shoreline ecological functions through local Shoreline Master Programs (SMPs). SMPs often require vegetation buffers along rivers and lakes, but the scope and enforcement of the buffers varies by jurisdiction and land use. Additionally, the SMA does not compel revegetation of land cleared prior to the promulgation of the SMA. Voluntary restoration is frequently needed to achieve functional riparian conditions beyond regulatory minimums, particularly on agricultural or undeveloped lands (IEc, 2022). In this context, voluntary actions supplement baseline protections and enable broader ecological restoration.

- **Clean Water Act (CWA, 33 U.S.C § 1251 et seq.):** Under Section 319 and through the development of Total Maximum Daily Load (TMDL) plans, the CWA promotes riparian protection as a nonpoint source pollution strategy. These provisions do not impose direct regulatory obligations on individual landowners, but they establish goals that depend on voluntary implementation of Best Management Practices (BMPs), such as streamside planting, fencing, and runoff reduction (IEc, 2022; Earth Economics, 2024; USEPA, 2024). In this context, voluntary action is a primary mechanism for achieving water quality goals on private working lands.

- **Endangered Species Act (ESA):** The ESA shapes restoration priorities in watersheds supporting listed salmonid species through tools such as critical habitat designations, recovery plans, and permitting requirements. While it does not impose direct obligations on most private landowners, the ESA's influence on regional conservation goals creates strong demand for voluntary actions that contribute to species recovery (IEc, 2022). In this context, voluntary action advances recovery objectives by targeting high-priority riparian areas.

- **Forests and Fish Law / State Forest Practices Act (RCW 76.09):** Washington's Forest Practice Rules require private and state forest landowners to protect aquatic habitat through mandatory riparian buffer zones (Riparian Management Zones, or RMZs). These rules restrict timber harvest along streams and wetlands, often reducing landowner revenue. Voluntary conservation tools such as conservation easements may be used to address these economic tradeoffs and secure long-term protection, mitigating opportunity costs associated with regulatory compliance (IEc, 2022).

- **Conservation Districts (RCW 89.08):** Washington law enables the formation of CDs to deliver technical assistance and implement voluntary conservation efforts. These districts serve as partners that facilitate landowner participation and coordinate funding and implementation at the local level (IEc, 2022).

In some landscapes, such as working agricultural lands or rural counties using the GMA's rural planning provision, voluntary approaches are often primary tools for achieving riparian protection. The voluntary methods complement regulatory requirements by: a) facilitating compliance; b) extending conservation and restoration beyond minimum legal requirements; and c) addressing degraded conditions at sites where restoration is not otherwise required by regulation. The effectiveness of these programs often hinges on how landowners perceive the intersection of legal requirements and incentive offerings, a topic explored further in later sections. Understanding these interactions is central to evaluating how incentives can effectively motivate landowners and align with broader habitat conservation goals. These state and federal statutes operate alongside foundational Tribal legal rights, which impose distinct obligations on the state and elevate the urgency of restoring riparian habitat in salmon-bearing watersheds.

3.2 Key Federal, State, and Local Programs Supporting Voluntary Conservation

Washington State supports a diverse suite of voluntary conservation programs aimed at encouraging riparian restoration and conservation. These programs differ in scope, payment structure, eligibility requirements, and administrative complexity. Together, they offer landowners multiple pathways to participate in habitat recovery while maintaining productive operations. Exhibit 3 provides an overview of major federal, state, and local programs relevant to riparian conservation. The descriptions in Exhibit 3 are intended to be broadly informative about program design features and participation considerations, although not all programs are currently active or available in the Puget Sound region.

Exhibit 3. Key Existing Federal, State, and Local Programs Supporting Voluntary Conservation

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
Conservation Reserve Program (CRP) General Enrollment - United States Department of Agriculture (USDA) Farm Service Agency (FSA) Reference: USDA FSA (2025a, 2025b, 2025c)	Landowners voluntarily submit competitive bids during designated general enrollment periods to retire eligible cropland from production for 10–15 years and establish long-term vegetative cover such as native grasses or trees. Eligible land must have been cropped at least four out of the six years from 2012 to 2017, be capable of supporting agricultural production, and meet one of three criteria: (1) an erosion index of 8 or greater, (2) enrollment as expiring CRP acreage, or (3) location within a national or state conservation priority area. Offers are ranked using the Environmental Benefits Index (EBI), which evaluates expected environmental outcomes including habitat, water quality, air quality, and erosion control.	Participants receive annual rental payments based on county-level Soil Rental Rates (SRRs), calculated using USDA National Agricultural Statistics Service (NASS) cash rent data and prorated to 85% for general sign-up. Cost-share assistance is available for up to 50% of the costs of establishing approved vegetative cover. Participants may offer a lower rental rate than the SRR maximum to increase their bid's EBI score, but no additional incentive payments are provided under general enrollment.	Offers are evaluated using the EBI, which considers the quality of proposed wildlife habitat, water quality benefits through erosion and runoff reduction, on-site erosion control, air quality benefits from reduced wind erosion, and the longevity of benefits beyond the contract period. Cost-effectiveness is also factored in, with lower bids receiving higher scores. Only bids that exceed the national EBI threshold for a given enrollment round are accepted.
CRP Continuous Enrollment - USDA FSA Reference: USDA FSA (2025a, 2025d)	In the Continuous Conservation Reserve Program (CCRP) Landowners and agricultural producers may voluntarily enroll eligible cropland or marginal pastureland at any time—without competitive bidding—to implement approved conservation practices for a 10– to 15-year term. Practices commonly used in riparian contexts include filter strips (Conservation Practice [CP] 21) and riparian buffers (CP22). Land must have been cropped at least four out of the six years from 2012 to 2017 and be legally and physically capable of being planted to a commodity crop. Marginal pastureland must be suitable for the proposed buffer practice. Enrolled participants must maintain the	Participants receive annual rental payments based on site-specific Soil Rental Rates (SRRs), calculated using USDA NASS data and set at 90% of the county average cash rent for the soil type. Additional incentives include a Signup Incentive Payment (SIP) equal to 32.5% of the first year's rental payment, paid at contract approval, and a Practice Incentive Payment (PIP) covering up to 50% of eligible installation costs. Cost-share assistance reimburses up to 50% of practice establishment expenses. For high-priority water quality practices like CP21 and CP22, a 20% additional payment is added to the annual rental rate. These payments help offset the costs of establishing and	Eligible land must support one or more of the approved CCRP practices and provide resource benefits related to water quality, erosion control, or wildlife habitat. Unlike General CRP, offers are not ranked using the EBI; instead, they are accepted on a rolling basis contingent on statutory acreage caps, practice-specific technical suitability, and FSA approval. Continuous enrollment is particularly targeted at high-impact resource concerns such as nutrient runoff and sedimentation in impaired watersheds.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
	vegetative practice for the duration of the contract. Technical assistance is available through NRCS, state agencies, and local conservation districts.	maintaining conservation buffers on enrolled land.	
Conservation Reserve Enhancement Program (CREP) – USDA FSA, in partnership with state governments, Tribes, and other entities. In Washington, CREP is jointly administered by USDA FSA, SCC, and local CDs. Reference: USDA FSA (2021)	Landowners voluntarily retire eligible cropland adjacent to salmon-bearing streams and plant native riparian vegetation, such as trees, shrubs, and grasses, to improve water quality, reduce erosion, and restore fish habitat. Enrollees must commit to maintaining the buffer for 10 to 15 years under a binding conservation contract. In Washington, participants receive five years of post-planting maintenance and technical support coordinated by Conservation Districts or SCC. Eligible land must have a qualifying cropping history (cropped 4 of 6 years from 2012–2017) and be adjacent to a stream or waterbody eligible under the Washington CREP agreement.	Participants receive annual rental payments based on SRRs calculated at the county level, generally at or near 100% of average cash rent for the soil type. Enrollees also receive a SIP equal to 32.5% of the first year's annual payment upon enrollment. A Practice Incentive PIP—typically up to 40%—is also available to help offset the cost of establishing approved practices. Washington's CREP further supplements federal funding to offer 100% cost-share for buffer installation and establishment. Additional payments may be available for specific practices, such as installing woody vegetation.	CREP in Washington specifically targets salmon-bearing streams and associated riparian zones. Land must be technically suitable for buffer practices that improve stream function, water temperature regulation, sediment control, and fish habitat. Unlike General CRP, CREP does not use a competitive EBI. Eligibility is determined by land use history, proximity to designated waterbodies, and alignment with program conservation goals.
Environmental Quality Incentives Program (EQIP) – USDA Natural Resources Conservation Service (NRCS) Reference: USDA NRCS (2025a)	Landowners and producers voluntarily implement site-specific conservation practices to address priority resource concerns on working agricultural or forest lands. In the riparian context, eligible practices often include streambank stabilization, riparian buffer planting, livestock exclusion fencing, off-channel watering systems, and erosion control measures. EQIP contracts are tailored to individual producer goals and typically span 1 to 5 years. Land does not need to be retired; practices are integrated into active land use.	EQIP provides cost-share assistance based on the estimated cost of implementing NRCS-approved conservation practices. Standard contracts reimburse up to 75% of installation costs, with up to 90% available for historically underserved producers (e.g., limited resource, socially disadvantaged, beginning farmers). Payments are based on NRCS technical cost estimates and vary by region and practice. EQIP also offers incentive payments and advance payment options in some cases but does not provide annual rental payments.	Applications are ranked using a structured scoring system designed to prioritize projects that address locally identified natural resource concerns, such as water quality, soil erosion, habitat quality, and drought resilience. In Washington, the State Conservationist, in collaboration with State Technical Advisory Committees (STACs) and Local Working Groups (LWGs), establish these priorities. Applications are scored using the automated Conservation Assessment Ranking Tool, which helps assess site vulnerabilities, existing conditions, and planned conservation practices to ensure ranking aligns with

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
			program goals and priorities. Riparian projects often rank highly where salmonid recovery or water quality protection are established as local priorities.
Conservation Stewardship Program (CSP) – USDA NRCS Reference: USDA NRCS (2025b)	CSP supports agricultural and forest landowners who commit to maintaining existing conservation practices and adopting new enhancements across their entire operation. Eligible participants must meet or exceed the stewardship threshold for at least two natural resource concerns at the time of enrollment and agree to meet an additional threshold by the end of a five-year contract. Land must already be in production (cropland, pasture, rangeland, or non-industrial forestland), and the entire operation—not just a single field—must be enrolled.	Participants receive annual payments that include: (1) base payments for maintaining existing conservation efforts, and (2) additional payments for implementing new conservation enhancements or bundles. Bundles—suites of enhancements targeting multiple resource concerns—yield higher payment rates. Supplemental payments are available for advanced grazing management and resource-conserving crop rotations. While rates vary, typical payments range from \$15 to \$40 per acre per year, with minimum payments applying to most contracts. Contracts may be renewed competitively after five years.	Applicants must meet stewardship thresholds for at least two priority resource concerns (e.g., soil erosion, water quality, wildlife habitat) at enrollment and agree to exceed an additional threshold during the contract. NRCS planners assess resource concerns and help tailor enhancements. Applications are competitively ranked within local pools based on their contribution to national, state, and local conservation priorities.
Riparian Grant Program (RGP) – SCC, implemented through local CDs Reference: SCC (2024a, 2024b)	Eligible landowners (including private, tribal, public, and nonprofit entities) partner with Conservation Districts to implement riparian restoration and protection projects. These projects include planting native riparian vegetation, installing exclusion fencing and off-channel watering systems, and conducting maintenance and monitoring. Participants must meet minimum buffer widths defined by NRCS standards and can restore buffers up to Site Potential Tree Height (SPTH). Contracts are for 10 or 15 years, and existing riparian buffers are not eligible.	Landowners receive annual tiered incentive payments ranging from \$300 to \$1,000 per acre, based on the width of the buffer and total acres enrolled. Payments are not tied to land retirement but compensate for restoration and management efforts. The program does not require a landowner cost-share. SCC also funds implementation, maintenance, technical assistance, planning, design, outreach, and monitoring, supported through Climate Commitment Act (CCA) funds.	All stream types are eligible, regardless of salmonid presence. Projects must meet NRCS practices and standards for riparian restoration, and existing buffers are ineligible to ensure additionality. Prioritization may be guided by local or regional conservation goals identified by CDs. The program supports restoration that improves ecological integrity, water quality, native species habitat, and overall riparian resilience.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
Natural Resource Investments (NRI) – SCC Reference: SCC (2023a, 2024)	The NRI program supports private landowners in implementing structural BMPs that protect or enhance natural resources. Landowners can either (1) install practices themselves with reimbursement under a cost-share agreement or (2) participate in District-Implemented Projects (DIPs), where CDs assume responsibility for planning, permitting, and implementation. Eligible actions include riparian planting, exclusion fencing, erosion control, manure management, and other capital BMPs with a design life of more than one year. All practices must meet NRCS standards or be approved by SCC or a licensed engineer and must be documented in the Conservation Practice Data System (CPDS). Work must begin within 120 days of award.	NRI offers reimbursement-based capital funding. Landowner-implemented projects may receive up to $100,000 per fiscal year, with up to 25% of the award usable for technical assistance (e.g., design, permitting, project management). In DIPs, no landowner match is required. Funding covers direct costs such as labor, materials, equipment, and contractor fees. Equipment may be reimbursed if directly tied to an approved BMP and becomes a property-tied asset (e.g., manure spreader). Projects must meet the definition of a capital project under state budget guidelines.	NRI does not use a formal ecological scoring index but prioritizes projects that lead to measurable natural resource improvements. Eligible outcomes include reduced sediment, nutrient, or pathogen loading; improved riparian habitat (especially for salmonid recovery); support for total maximum daily load (TMDL) implementation; and restoration of waterbodies listed as impaired under Section 303(d) of the CWA. Projects must align with local conservation district priorities and may be encouraged in areas tied to watershed plans, 303(d) listings, or salmon recovery goals. All projects must comply with cultural resources review requirements under Executive Order 21-02.
Voluntary Stewardship Program (VSP) – SCC, implemented at the county level through watershed work groups and CDs. Reference: SCC (2024d, 2024e)	VSP supports agricultural landowners in voluntarily implementing conservation practices that protect critical areas—such as riparian zones, wetlands, fish and wildlife habitat—without imposing new land-use restrictions. Landowners work with technical providers (typically CDs) to develop Individual Stewardship Plans (ISPs) that identify site-specific BMPs, such as planting riparian vegetation, installing livestock exclusion fencing, or improving nutrient management. While participation is entirely voluntary, actions taken under VSP contribute to county-wide watershed goals for protecting critical areas. The program was created as an alternative pathway under Washington's GMA, allowing counties	VSP does not offer direct payments or financial incentives to landowners. Instead, the program funds outreach, technical assistance, and monitoring at the county level. Conservation practices identified in ISPs may be implemented using external cost-share or incentive programs (e.g., EQIP, NRI, RGP). VSP funding supports administrative coordination, plan development, and progress tracking rather than direct compensation.	County work plans must demonstrate that voluntary actions under VSP collectively protect or enhance the function and value of critical areas affected by agriculture, including riparian buffers, wetlands, floodplains, and habitat for threatened or endangered species. Each county's plan is monitored using science-based indicators and is subject to five-year reporting cycles. Adaptive management is used if monitoring results show that conservation goals are not being met. There is no formal scoring system for individual ISPs, but counties must show collective progress.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
	to meet critical area protection requirements through voluntary, incentive-based approaches instead of regulatory restrictions.		
Targeted Riparian Buffer Incentives Pilot Project – SCC in partnership with Skagit Watershed Council and Skagit CD Reference: Peak Sustainability Group (2023)	The pilot offered short-term (five-year) contracts to agricultural landowners in the Skagit watershed to voluntarily restore riparian areas by planting and maintaining native vegetation. Participants were required to implement buffer restoration according to site-specific plans and to ensure plant establishment and basic maintenance throughout the contract period. No land retirement or permanent easement was required, and practices could be tailored to landowner preferences and site conditions. Collective enrollment by neighboring landowners was encouraged to enhance buffer connectivity.	Participants received an upfront base incentive of $1,500 per acre upon contract initiation. A performance-based additional payment of $1,000 per acre was available for successful vegetation establishment verified by Year 3. An additional $500 per acre was offered for collective enrollment with adjacent landowners. To support ongoing maintenance, participants also received $350 per acre annually for five years. Payments were designed to be flexible and layered to overcome participation barriers and reward ecological outcomes.	The pilot focused on priority riparian areas within the Skagit watershed, particularly lands adjacent to salmon-bearing streams or where buffers were degraded or absent. While no formal ecological scoring system was used, site selection was informed by restoration potential, water quality benefits, and opportunities to increase habitat connectivity. Technical support was provided by the Skagit CD to guide restoration plans and ensure ecological viability.
Commodity Buffer Program – Spokane Conservation District (SCD) Reference: SCD (2024, 2025a) Interview with Walt Edelen	The Commodity Buffer Program encourages agricultural producers, ranchers, and Tribes in Spokane County to install and maintain riparian buffers that meet width and composition requirements based on stream order and tillage intensity, as determined by the NRCS Soil Tillage Intensity Rating (STIR). Buffers can be either grass-only filter strips or native riparian forests that incorporate grasses, trees, and shrubs. Minimum and maximum buffer widths vary by STIR and waterway type. Buffers must meet NRCS practice standards. Grazing and haying are restricted until after July 1st to protect wildlife. Existing buffers may qualify if they comply with program	Participants receive annual payments over a three-year contract period, with payment amounts based on the value of adjacent crops using USDA Risk Management Agency (RMA) projected prices. A customized pricing model ensures that compensation is at or above the production value of the enrolled land. Payments generally range from $300 to $350 per acre, with a guaranteed minimum of $200/acre/year. Additional incentive payments are available for planting woody vegetation (10% added for every 10 feet of trees and shrubs) and for extending maintenance beyond the standard three-year term. SCD fully covers installation and	The program targets lands adjacent to streams or waterbodies where riparian vegetation can improve water quality by reducing sediment, nutrients, pesticides, and bio-solids in runoff. While no formal scoring system is used, buffer widths and priorities are determined by a site-specific matrix combining STIR values and stream order. The program emphasizes both environmental benefits and compatibility with productive agriculture and does not restrict participation based on salmon presence or specific habitat criteria.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
	specifications. Contracts typically last three years, with re-enrollment possible depending on funding. SCD provides technical assistance, including buffer design and oversight, while landowners are responsible for installation.	maintenance costs; landowners incur no out-of-pocket expenses.	
Hangman Creek Riparian Restoration Pilot – SCD in partnership with Washington State Department of Ecology Reference: SCD (2025b) Interview with Walt Edelen	The pilot invites landowners in the Hangman Creek watershed to voluntarily enroll agricultural, pasture, or marginal riparian land into 15-year easement contracts. Enrolled land must be taken out of production and restored with native herbaceous and woody vegetation to stabilize streambanks, reduce erosion, and improve aquatic habitat. Participants do not need to conduct any planting or maintenance themselves; all installation and buffer upkeep are handled by SCD's riparian crews, offering a fully turn-key restoration process.	Enrolled landowners receive annual payments for the 15-year duration of the contract: up to $350 per acre for cropland and up to $250 per acre for pasture. The average annual payment across contracts is approximately $3,500. There are no out-of-pocket costs to participants—SCD funds all planting, maintenance, and administration through Department of Ecology support.	Eligible land must be located within the Hangman Creek watershed and must be designated a priority site by the Department of Ecology and have been previously contacted by the Department of Ecology. The program aims to reduce sediment and nutrient loading and enhance riparian and aquatic habitat. Although there is no formal scoring system, site assessments by SCD help target areas with the greatest ecological need.
Sustainable Farms and Fields (SFF) – SCC Reference: SCC (2023b. 2023c)	SFF supports producers in voluntarily implementing climate-smart agricultural practices that reduce greenhouse gas emissions and increase carbon sequestration. Eligible applicants—such as conservation districts, Tribes, universities, or local agencies—apply on behalf of landowners and must ensure that projects align with NRCS standards or SCC-approved practices. Landowners must track greenhouse gas (GHG) outcomes using approved tools and maintain practices for their NRCS-design lifespan. On-the-ground	SFF provides flexible financial support through cost-share grants, with a general funding cap of $100,000 per landowner or operator per year, although waivers may be granted for larger projects. Funding can cover a wide range of eligible expenses, including on-the-ground implementation, equipment purchases, and shared-use programs. Projects that demonstrate regional innovation or are intended for demonstration purposes may be eligible for up to 100% funding. Technical assistance costs are also eligible, typically up to 25% of the total project budget. While SFF does not	Projects are prioritized based on expected GHG benefits, creation of riparian buffers or pollinator habitat, and support for historically underserved producers. Scoring metrics are updated annually. Additional considerations include geographic/commodity distribution.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
	projects must undergo SCC's cultural resource review process.	currently offer annual incentive payments tied to carbon sequestration, the program is actively developing options to support such payments in the future.	
Forestry Riparian Easement Program (FREP) – Washington State Department of Natural Resources (DNR) Reference: *https://www.dnr.wa.gov/programs-and-services/forest-practices/small-forest-landowners/forestry-riparian-easement-program* Interview with KelliAnne Ricks	FREP compensates small forest landowners who, in compliance with Washington's Forests and Fish Rules, leave trees unharvested in riparian areas following a timber harvest. To qualify, landowners must retain the required riparian buffer zones adjacent to streams, rivers, lakes, ponds, wetlands, or unstable slopes. The program grants a 40-year conservation easement on the qualifying trees (not the land), ensuring they are left in place to provide ecological benefits. These buffers contribute to streambank stability, habitat structure, sediment filtration, and other key functions for aquatic and riparian ecosystems.	FREP provides a one-time lump-sum payment equal to 90% of the appraised stumpage (market) value of the qualifying trees left unharvested. The value is determined through a timber cruise and appraisal conducted by DNR after the harvest is completed. Compensation is contingent on available funding and begins once the easement acquisition is finalized. The easement does not grant public access, and there is no cost-share or out-of-pocket requirement for the landowner.	The program targets riparian buffers that provide essential ecological functions such as shade (to regulate stream temperature), large woody debris input, floodplain integrity, and habitat for fish and wildlife species. Eligible properties must be in compliance with state forest practices rules, and buffers must consist of qualifying vegetation that would otherwise have economic value. Priority is typically based on alignment with Forests and Fish regulatory standards rather than an independent scoring system.
Rivers and Habitat Open Space Program (RHOSP) – DNR Reference: https://www.dnr.wa.gov/programs-and-services/forest-practices/small-forest-landowners/rivers-and-habitat-open-space Interview with KelliAnne Ricks	Landowners voluntarily grant permanent conservation easements on forestlands that either lie within mapped Channel Migration Zones (CMZs) or contain critical habitat for state-listed threatened or endangered species, as designated by the Forest Practices Board. Easements prohibit development and commercial timber harvest within the eligible areas but do not convey public access. To participate, landowners must provide DNR with legal access for easement administration, and all legal interest holders must consent to the easement. Eligible lands must be enrolled as "designated forest land" or "current use	Landowners receive a one-time lump-sum payment reflecting the fair market value of the conservation easement, as determined by an independent appraisal. The easement compensates for the value of forgone development or harvest opportunities in perpetuity. There is no provision for cost-share or maintenance funding, and payments are issued only once per acquisition. Landowners may also choose to donate an easement without compensation.	RHOSP prioritizes sites with high ecological value for salmon recovery and habitat conservation. Eligible properties must be located in designated CMZs or contain critical habitat for state-listed species such as the marbled murrelet or northern spotted owl. A state-level selection committee ranks applications based on ecological value, species supported, water quality benefits, habitat connectivity, and feasibility of long-term conservation. Projects are funded in rank order as resources allow.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
	forest land" under state tax statutes and be free of hazardous conditions that could undermine conservation outcomes.		
Agricultural Conservation Easement Program - Agricultural Land Easements (ACEP-ALE) – USDA NRCS in partnership with eligible entities (e.g., land trusts, tribes, CDs, and state or local governments) Reference: https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/washington/washington-acep-ale https://www.nrcs.usda.gov/sites/default/files/2023-10/FY24%20ACEP-ALE%20Kickoff%20Workshop.pdf	ACEP-ALE enables eligible entities to purchase permanent conservation easements from landowners who agree to limit non-agricultural development on working farms and ranches while maintaining agricultural production. Participating landowners retain ownership and the right to continue agricultural operations but must permanently extinguish development rights. In Washington, riparian buffers may be included within easement boundaries if they support both conservation and agricultural viability. Eligible land must be under threat of conversion to non-agricultural use and meet NRCS criteria for prime farmland, unique farmland, or grassland of special environmental significance. Entities must work under a cooperative agreement with NRCS and assume long-term stewardship responsibilities.	NRCS provides financial assistance to the eligible entity covering up to 50% of the fair market value of the easement (up to 75% for grasslands of special environmental significance). Appraisal is based on Uniform Standards of Professional Appraisal Practice (USPAP) and NRCS guidelines for agricultural land valuation. NRCS may also reimburse up to 75% of allowable technical and closing costs. The landowner may receive additional compensation from the partner entity. Payments are one-time, and the program does not include annual rental payments or maintenance cost-share.	While ACEP-ALE focuses on protecting working agricultural land, NRCS considers ecological co-benefits in its selection and ranking process. In Washington, parcels that include riparian areas or habitat for at-risk species—such as salmon-bearing streams—may receive higher ranking if those areas support both agricultural productivity and ecosystem function. Additional factors considered include proximity to other conserved lands, contribution to broader conservation corridors, and alignment with local and regional conservation goals.
Water Quality Combined Funding Program – Washington State Department of Ecology Reference: Washington State Department of Ecology. (2024)	The program supports a wide range of water quality improvement projects, including the implementation of certain BMPs, including riparian fencing, planting, and streambank stabilization. Eligible applicants – such CDs, local governments, tribes, and nonprofit organizations – are encouraged to develop and implement projects that address nonpoint source pollution and enhance water quality. Projects must be well-planned	The program offers both grants and low-interest loans, with funding levels varying based on the state budget and specific project needs. Grants can cover up to 100% of eligible project costs, though some funding sources may require matching funds of up to 25%. The financial assistance is typically provided as a one-time payment, based on the total eligible implementation costs outlined in the approved project	Projects are evaluated through a competitive process based on factors such as water quality improvement potential, readiness to proceed, cost-effectiveness, and alignment with state and federal priorities. Ecological criteria include the project's ability to address nonpoint source pollution, restore critical habitats like salmon-bearing streams, and support TMDL implementation. Scoring ensures funds go

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
	and ready for implementation, with detailed technical applications submitted through the Ecology Administration of Grants and Loans (EAGL) system. The program additionally provides "Ecosystem Service Incentives" for certain projects implementing a riparian buffer one site potential tree height in width or riparian planting of the core zone.	budget. Funding sources within the program include the Clean Water State Revolving Fund (CWSRF), Centennial Clean Water Program, and Clean Water Act Section 319 Nonpoint Source Grants, among others.	to projects with strong potential for environmental impact.
Floodplains by Design (FbD) – Washington State Department of Ecology in partnership with Bonneville Environmental Foundation (BEF) Reference: https://floodplainsbydesign.org/ https://ecology.wa.gov/water-shorelines/shoreline-coastal-management/hazards/floods-floodplain-planning/floodplains-by-design	FbD supports large-scale, collaborative projects that integrate flood risk reduction with riparian and floodplain restoration. While individual landowners cannot apply directly, they may participate through sponsor-led initiatives – typically led by local governments, Tribes, or nonprofits – that involve riparian planting, setback levees, reconnecting side channels, and habitat restoration. Projects often include agricultural viability, open space preservation, and water quality improvements as co-benefits.	FbD awards competitive, reimbursement-based grants to eligible entities. Funding is typically structured as capital project support, covering eligible design, permitting, and implementation costs. Awards are often multimillion dollars and span multiple years. Co-funding or leveraging other public/private sources is encouraged. Funding is partially supported by Washington's CCA, which requires Tribal outreach and consultation.	Projects are prioritized based on their potential to deliver integrated benefits – such as flood risk reduction, salmon habitat restoration, and resilience to climate impacts. Proposals are evaluated on ecological outcomes, community partnerships, cost-effectiveness, and readiness. Preference is given to projects that address degraded floodplains critical to salmon recovery, improve natural river functions, and serve overburdened or climate-vulnerable communities.
Salmon Recovery Funding Borad (SRFB) Puget Sound Acquisition and Restoration (PSAR) – Washington State Recreation and Conservation Office (RCO) co-managed with Puget Sound Partnership (PSP) Reference: RCO (2025) Interview with Kathryn Moore	Applicants – including Tribes, local governments, nonprofits, and private landowners – may undertake voluntary projects to restore, enhance, or protect salmon habitat. Eligible activities include riparian planting, removal of fish barriers, in-stream and estuarine restoration, and land acquisition for permanent protection. Projects must align with local salmon recovery strategies and watershed-level priorities developed by lead entities.	SRFB grants are awarded annually; PSAR grants biennially. Both provide capital funding through a competitive process. SRFB funding is sourced from state bonds and federal National Oceanic and Atmospheric Administration (NOAA) grants; PSAR funds come from state capital budgets. Projects are typically reimbursed for 100% of eligible costs, with no match required in most cases—though specific riparian planting and acquisition projects may have a 15–35% match depending on project type and buffer width. Design-only	Projects must address habitat priorities identified in regional recovery plans or lead entity strategies. Proposals are evaluated for technical merit, benefit to listed salmon species, and likelihood of success. In Puget Sound, PSAR projects are further prioritized by the PSP to ensure alignment with the Chinook Recovery Plan and delisting criteria. Local lead entities develop ranked project lists based on ecological need, readiness, and cost-effectiveness.

Program, Administering Agency, and Reference	Participation Requirements	Payment Structure	Ecological Targeting Criteria
		projects without matches may not exceed $350,000.	

3.3 Program Manager Insights on Effective Elements of Landowner Payment Programs

We interviewed program managers across key programs that include incentives payments for landowners in Washington State. Interviewees identified that programs that offer payments that are nuanced and tailored to site-specific conditions are generally the most effective. For the purposes of this report, we define "effective" programs as those that motivate landowners to participate. We do not evaluate the likelihood of "effective" or "successful" ecological outcomes associated with alternative riparian buffer locations or designs.

The Commodity Buffers Program managed by the Spokane Conservation District (SCD) incorporates numerous site-specific considerations into its payment structure, including crop type, width and composition of riparian buffer, soil tillage intensity rating (STIR) rating, and other factors (personal communication with Walt Edelen, SCD). It further offers a 35% adjustment to the calculated Actual Proven History to reflect that the riparian zone typically represents the highest yielding land on a planted parcel (email communication with Jacob Taylor, SCD on July 15, 2025).[17] Program contracts are established for three years, reflecting the local norm for frequency with which crops are rotated. Collectively, these considerations result in payments that participants feel accurately compensate them for their unique opportunity costs of removing the riparian areas from their planted rotation, as reflected by the high participation rates and wait lists to participate in this program (personal communication with Walt Edelen, SCD). Another program in high demand, the Hangman Creek Pilot Program, offers a flat rate per acre for riparian set-asides. However, this payment is based on the average per-acre payment for the previously described Commodity Buffer Program. While it is a flat rate, it reflects the typical crops and farming practices in the region, allowing it to effectively reflect the opportunity costs incurred by owners (personal communication with Walt Edelen, SCD).[18]

In contrast, programs for which payments do not reflect site-specific considerations have seen lower enrollment. For example, the Conservation Reserve Enhancement Program (CREP) offers annual payments based on soil rental rates (SRRs) at the county level. Although the soil rental rates are based on rates within the local region, they do not reflect the value of the crop otherwise grown on the land, making it difficult to attract participation from landowners farming high yield crops (e.g. berries, orchard fruit) (personal communication with Frank Corey, Whatcom CD, Evan Bauder, Mason CD, and Ryan Williams, Cascadia CD).

The Forest Riparian Easement Program (FREP) compensates small forest landowners for timber left unharvested due to regulatory restrictions, which itself provides a significant incentive for participation that differs markedly from the context of the Commodity Buffers Program, Hangman Creek Pilot Project, and CREP. Nonetheless, it is informative that interviewees identified that the use of estimated timber values rather than actual harvest records leaves many feeling undercompensated for the costs of the riparian buffer displacing managed timberland (personal communication with KelliAnne Ricks, Washington Department of Natural Resources).

Moreover, Washington's Conservation Reserve Enhancement Program (CREP) enrollment data reinforce interviewee observations about payment adequacy. After a period of steady growth from the mid-2000s through 2016, the number of active CREP contracts plateaued and then declined, with participation falling by approximately 22% between 2016 and 2024. This decline coincided with a leveling off—and eventual drop—in annual rental payments per acre (all years adjusted to 2024 dollars), which peaked around 2018 and have since decreased by approximately 29%. The relationship between payment value and number of contracts is illustrated

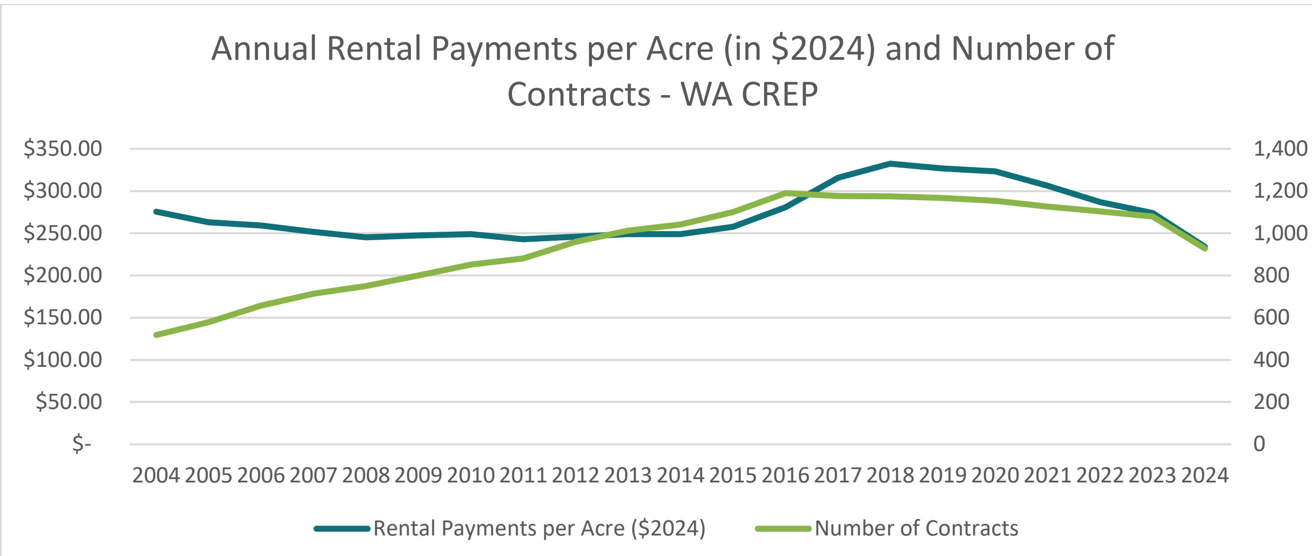
[17] Actual Proven History, or APH, reflects the 5-year average yield from the Farm Service Agency.

[18] Some landowners, potentially representing the higher end of the payment range, feel it is too low.

in Exhibit 4 below. Other participation indicators—including the number of enrolled farms and total acres—followed a similar trajectory as the number of contracts, suggesting a broad contraction in program engagement after around 2016.

The parallel movement of declining payment values and participation levels suggests that current payment structures may not be keeping pace with landowners' opportunity costs—particularly in high-value production areas. Interviewees consistently emphasized that the soil rental rates used to calculate CREP payments often underrepresent the income potential of riparian lands, especially when those lands are among the most productive portions of a farm. This mismatch may be contributing to the recent downturn in CREP enrollment and highlights the importance of localized and flexible payment strategies to sustain landowner interest in voluntary riparian conservation programs.

Exhibit 4. Trends in annual rental payments per acre and number of contracts in WA CREP



Source: USDA FSA Conservation Reserve Program Statistics - https://www.fsa.usda.gov/tools/informational/reports/conservation-statistics/crp.

3.4 Potential Risks to Implementation

As described above, voluntary riparian protection incentive programs in Washington serve primarily to fill regulatory gaps (e.g., where conservation goals articulated in local GMA or Shoreline Management Act (SMA) comprehensive plans are nonbinding) or offset economic losses associated with regulatory compliance (e.g., harvest restrictions contained in Forest Practices Rules). As a result, program requirements tend to be either consistent with regulatory guidelines or are sufficiently and purposely flexible to be consistent with local comprehensive plans. Nonetheless, there are social and economic costs and legal risks of insufficient riparian protection due to Tribal treaty rights, habitat conservation plans under the Endangered Species Act, or requirements embedded in local comprehensive plans adopted under the GMA, which must be consistent with state law and are subject to review for compliance.

Administering agencies are, in effect, entering into public contracts when they disburse funds in exchange for conservation outcomes (Ferraro, 2008). As with other forms of public contracting, these agreements carry an implicit obligation to ensure that public funds are spent in a manner that yields clear public benefit. This notion is embedded in statutory provisions such as RCW 36.70A.720, which governs the VSP. The statute includes language about benchmarks, monitoring, and adaptive management, all of which are designed to ensure that funded actions deliver on their stated objectives. While courts may be unlikely to intervene due to perceived inefficiency, the Washington Constitution's prohibition on gifts of public funds (Article VIII, Section 7) creates a legal backdrop that discourages public expenditures lacking a demonstrable return to the public. In practice, poor or undocumented program performance is more likely to result in reputational harm or loss of public trust, which can be mitigated by developing standardized data collection and compliance protocols (IEc, 2022). Conversely, implementing agencies may face legal risks if they are unable to fulfill any contractual obligations to the landowner (e.g., monitoring, ongoing maintenance), for example due to unexpected funding shortfalls.

In terms of specific programs, voluntary incentive programs that pay landowners to place riparian areas in perpetual easement may pose unique risks. For example, there is an inherent tradeoff in easement design between specificity (which improves enforceability) and flexibility (ability to adaptively manage), which can lead to legal disputes over the interpretation or anticipated burden of easement terms (Rissman, 2010). Some landowners may argue that restrictions are more extensive than originally understood or that compensation was inadequate, leading to claims of unfair treatment or even litigation (Cheever and McLaughlin, 2015). These conflicts can erode trust and divert resources away from conservation work, and can be compounded if a property changes hands. If the terms of an easement are vague, outdated, or poorly enforced, successor landowners may disregard or challenge the terms (Owley, 2011). In extreme cases, landowners may allege that a conservation easement constitutes a form of regulatory taking. These claims, however, which hinge on the argument that the government has effectively stripped a property of its use or value without just compensation, are typically difficult to sustain (Cheever and McLaughlin, 2015).

Finally, efforts to improve the efficiency or cost-effectiveness of voluntary conservation programs have the potential to inadvertently raise equity concerns. Screening criteria that prioritize certain geographies, land types, or landowner characteristics, for example, may disproportionately exclude smaller or historically underserved landowners (Foster, 2023; AFT, 2023). Even when such criteria are targeting ecological return, they may be viewed as unfair, which can limit participation or erode trust in the program. Additionally, if viewed as not reflecting the true costs of participation to landowners, programs risk eroding trust with landowners and reducing motivation to participate.

CHAPTER 4 | Lessons from Existing Programs

4.1 Payment Types Used in Riparian Conservation and Participation Trends

Voluntary riparian conservation programs aim to enhance restoration and associated public benefits of ecosystem services by compensating landowners for costs of conservation. As outlined in Chapter 2, these costs include opportunity costs, implementation burdens, and non-monetary behavioral or administrative frictions such as uncertainty, liquidity constraints, and loss of autonomy. Effective programs typically combine multiple payment mechanisms to address the full range of constraints. However, many rely just on one or two payment types, limiting their ability to meet diverse landowner needs or achieve ecological goals. This section reviews common payment types, summarizing their typical use, insight from the literature on their relative effectiveness, and implications for landowner participation.

4.1.1 Annual Rental Payments

Annual rental payments are a foundational mechanism in many voluntary riparian conservation programs. These payments provide landowners with recurring compensation, typically over 10 to 15 years, in exchange for temporarily removing land from production and establishing riparian buffers. This approach features prominently in federal programs like Conservation Reserve Program (CRP) and CREP, as well as Washington-based initiatives such as SCC's Riparian Grant Program (RGP) and SCD's Commodity Buffer Program and Hangman Creek Pilot, implemented in partnership between SCD and Ecology's Water Quality Program. Payments are generally calculated using SRRs, which estimate the average per-acre cash rental value for each soil type within a county based on USDA's National Agricultural Statistics Service (NASS) data. SRRs are designed to approximate the opportunity cost of land retirement and offer a standardized and transparent basis for compensation.

When calibrated appropriately, annual rental payments have been shown to effectively encourage participation. Claassen et al. (2008) found that program enrollment increases when payments are aligned with landowners' forgone income. Similarly, Khanna et al. (2003) showed that substantial payments are required to attract enrollment from owners of productive cropland, especially in high-return areas. Hellerstein and Malcom (2011) highlighted the participation response to changing commodity prices, noting that static rental rates can lose effectiveness when opportunity costs rise. **These studies collectively underscore that the economic adequacy of payments is a key determinant of whether programs effectively motivate landowner participation, and that locally responsive compensation levels are essential for attracting high-opportunity-cost lands.**[19]

In addition to individual landowner incentives, rental payments can have positive ripple effects on rural economies. Owen (2008) estimated that over $51 million in direct payments through Kentucky's Green River CREP generated more than $83 million in total regional economic output. These funds supported not only participating landowners but also local contractors for fencing, planting, and restoration work. While such payment flows may not entirely offset reductions in agricultural or timber revenue, they provide alternative

[19] Chapter 6, Recommendation 1: Payment should reflect site-specific land use and characteristics.

income streams that can support local service providers. Over the long term, additional ecosystem benefits of the riparian buffer, such as flood mitigation or recreational access, may further contribute to economic resilience.

One notable advantage of annual rental payments is their administrative simplicity. Because payments are formula-based and fixed at the outset of the contract, they provide landowners with clarity, predictability, and ease of understanding. Suter et al. (2008) found that flat-rate structures reduce the complexity of enrollment and mitigate strategic behavior. Their simulations suggest that when paired with modest “bonuses” (i.e., additional payments), flat-rate payments can promote comparable or greater enrollment than more complex payment schemes. This simplicity supports broader engagement, particularly among landowners deterred by complex application processes (Lute et al., 2018; U.S. GAO, 2024).

Despite these strengths, rental payments also face important limitations. First, they may not fully account for non-monetary barriers to participation. **Classen et al. (2008) emphasize that some producers face significant administrative burdens in the form of transaction costs, including the time, paperwork, and conservation planning required to apply for programs, comply with contract terms, and document practices.[20]** These burdens can be especially significant for smaller or resource-limited landowners, reducing program accessibility and enrollment. Second, they often fail to offset income foregone from high-value uses like irrigated agriculture or potential development, particularly in areas where SRRs lag behind market rents (Khanna et al., 2003; Hellerstein & Malcom, 2011). The U.S. Office of Inspector General (2023) similarly noted that lagging SRR adjustments can diminish program competitiveness when commodity prices increase. In addition to barriers for landowners, structural and administrative barriers often exist for government grant programs that complicate funding of long-term rental payments. For example, restrictions exist regarding payments occurring outside of grant performance periods and there are legislative pressures regarding the timing of spending funding.[21]

Another challenge lies in the coarse spatial resolution of SRRs themselves. Because SRRs are calculated at the county level and averaged across soil types, they may obscure substantial variability in land value within a given district. In counties dominated by a single commodity, SRRs may be a reasonable proxy for opportunity costs. But in areas with diverse cropping systems or highly variable lease rates, these averages can misrepresent the true value of individual parcels. Earth Economics (2024) and IEc (2022) both highlight that such misalignment can deter participation by undercompensating landowners with high-value parcels or complicate administration if local program staff seek to tailor payments more precisely.

Finally, rental payments are by design temporary. Although they offer cost-effective, short-term conservation gains, their ecological benefits may be impermanent unless paired with restoration investments, maintenance funding, or follow-on incentives that promote long-term stewardship. Monitoring reports from SCC (2017; 2022) show that ecological performance and landowner retention are significantly higher when contracts are supported by ongoing technical assistance and follow-up funding. **Locally delivered technical assistance, especially through trusted conservation districts, further boosts participation by lowering administrative burden and reinforcing trust (Elsworth, 2015; Chapman et al., 2019). [22]**

[20] Chapter 6, Recommendation 7: Look for opportunities to streamline program administrative requirements.

[21] Information provided by Washington Department of Ecology to IEc on August 15, 2025.

[22] Chapter 6, Recommendation 4: Reduce need to compensate out-of-pocket costs to landowner.

4.1.2 Cost-Share Payments

Cost-share payments are a common incentive structure used to reduce the upfront financial burden of riparian conservation practices. These payments typically reimburse 50% to 90% of the costs associated with eligible activities such as fencing, native vegetation planting, livestock exclusion, or off-stream watering infrastructure. Rather than fully covering expenses, most programs adopt a partial cost-share model to stretch limited public funds across more projects and to ensure that landowners retain a stake in the outcome. This shared-cost approach is intended to promote landowner commitment and discourage low-effort implementation. In some cases, the practices supported—such as livestock exclusion fencing or off-stream watering—may also deliver private benefits to the landowner (e.g., improved herd health, better pasture management). However, the effectiveness of this model depends on context. As several studies note, in high-opportunity-cost areas or where conservation practices yield limited private benefit, partial reimbursement is often insufficient to motivate participation unless paired with income replacement, technical support, or other forms of assistance (Kingsbury & Boggess, 1999; Agriculture and Agri-Food Canada, 2012; IEc, 2022).

This structure features prominently in several riparian conservation programs. Environmental Quality Incentives Program (EQIP) relies heavily on cost-share as its primary incentive mechanism. Continuous Conservation Reserve Program (CCRP) and CREP also include cost-share components that reimburse landowners for the cost of establishing eligible conservation practices, such as fencing, vegetative buffers, and off-stream watering systems, in addition to offering annual rental payments and one-time additional payments (USDA Farm Service Agency [FSA], 2021, 2025a, 2025d). SCC's Natural Resource Investment (NRI) program is a full cost-share program that reimburses landowners for eligible restoration expenses, while RGP uses a hybrid model that combines cost-share payments with annual rental compensation and technical assistance. Regionally recent tailored efforts such as SCC and Skagit County's Targeted Riparian Buffer Incentives Pilot also incorporate cost-share elements as part of broader, stacked incentive packages designed to address diverse landowner needs (Peak Sustainability Group, 2023).

While cost-share can be a useful tool to address initial capital constraints, it is insufficient on its own in high-opportunity-cost contexts. Reimbursing a portion of installation expenses does not address the larger financial burden many landowners face, specifically the income lost when productive land is retired from use. Kingsbury and Boggess (1999) demonstrate that landowners in irrigated or high-value agricultural areas often require payments well beyond partial reimbursement to consider participation. Similarly, IEc (2022) finds that low payment levels and the absence of income replacement are key barriers in Washington State programs where cost-share is used without complementary financial incentives. In these cases, landowners may only participate if they place a high personal value on riparian restoration or receive support through other channels, such as complementary funding programs or technical assistance from CDs.

Additional research further supports the need for integrated and flexible delivery models. Stillwater Sciences (2017) found that ecological outcomes in Oregon CREP sites were closely linked to the adequacy of implementation and maintenance support, reinforcing that cost-share payments must be paired with technical assistance to be effective. Agriculture and Agri-Food Canada (2012) reports that in working landscapes with narrow profit margins, uptake of structural practices like riparian fencing and off-stream watering depends not only on reimbursement rates but also on tailored implementation support. The study concludes that uniform program rules often underperform, and recommends regionally responsive, stacked cost-share designs that reflect local conditions.

These findings are echoed in broader program evaluations. The USDA notes that CREP's cost-share payments are most effective when paired with annual SRR-based payments and sign-up or practice-based "bonuses" (USDA FSA, 2021). Earth Economics (2024) further argues that cost-share is more effective when accompanied by trusted technical assistance and simplified administrative procedures, which can lower behavioral frictions and increase uptake. Local delivery models—such as those facilitated by conservation districts—are especially effective in building trusted relationships that support implementation and ongoing stewardship (Lute et al., 2018; Chapman et al., 2019).

Suter et al. (2008) also shows that cost-share incentives can positively influence landowner participation decisions, though they may be less cost-effective than sign-up bonuses. The authors find that flat-rate payment structures increase enrollment on lower-cost lands, supporting the use of cost-share as part of simplified, fixed-offer incentive packages. Chapman et al. (2019) adds that rigid buffer requirements linked to cost-share incentives may deter participation if they do not align with landowner identities and stewardship values, highlighting the importance of relational and cultural fit in program design. Programs that affirm stewardship identities, support peer learning, and foster local recognition can help sustain participation beyond financial incentives (Bennett et al., 2014; Barnes et al., 2020; Thapa et al., 2024).

4.1.3 One-Time Supplemental Payments

One-time supplemental payments, often referred to as "bonus" payments, provide additional payments above and beyond compensation for costs incurred. The supplemental payments are a targeted tool used in riparian incentive programs to encourage timely enrollment or the implementation of specific conservation practices. Unlike annual rental payments or cost-share reimbursements, these payments are disbursed either upfront or upon the completion of specific milestones, providing immediate financial motivation to participate. Examples include the Signup Incentive Payment (SIP) and Practice Incentive Payment (PIP) available under CCRP and CREP, which compensate landowners for enrolling land and establishing practices such as riparian buffers, fencing, or native vegetation (USDA FSA, 2021, 2025a, 2025d).

Similar structures have been employed in Washington State. SCC's Targeted Riparian Buffer Incentives Pilot Project in Skagit County, for instance, included both individual performance-based supplemental payments and group enrollment incentives designed to promote peer coordination and achieve ecological goals at a watershed scale (Peak Sustainability Group, 2023). Likewise, SCD's Commodity Buffer Program provides upfront supplemental payments to landowners who install woody vegetation and commit to long-term maintenance, encouraging both ecological durability and timely implementation (SCD, 2025a). Additionally, certain Nonpoint Source Activity Projects funded under Washington Department of Ecology's Water Quality Combined Funding Program are eligible for a lump-sum "Ecosystem Service Incentives" supplemental payment of $2,000 per acre (in 2025) for riparian planting of the core zone, as defined by the Clean Water Guidance, or for implementing a riparian buffer one site potential tree height in width.[23]

One-time supplemental payments play an important role in addressing one of the most frequently cited barriers to riparian conservation: capital constraints. Establishing buffers often involves significant upfront costs for site preparation, planting, fencing, and off-stream watering systems. These outlays can deter participation,

[23] Information on the Ecosystem Service Incentives payment is included in Washington Department of Ecology's State Fiscal Year 2025 Funding Guidelines for the Water Quality Combined Funding Program.

particularly among landowners with limited cash flow or access to capital. Supplemental payments provide flexible, early-stage funding that helps reduce financial risk and make enrollment more feasible. **Suter et al. (2008) found that sign-up bonuses were especially effective at increasing participation at a lower cost than raising annual rental payments, supporting their use as a cost-efficient strategy for encouraging early adoption.**[24]

Beyond addressing capital constraints, supplemental payments also contribute to administrative simplicity. Because they are fixed and disbursed in full or in defined stages, the supplemental payments offer a clear, predictable incentive. This simplicity can reduce decision-making friction, especially for landowners new to conservation programs or hesitant about longer-term commitments. When delivered through trusted local entities, such as CDs or field-based staff, supplemental payments also benefit from established relationships that enhance program credibility and ease of enrollment (Lute et al., 2018; Elsworth, 2015).

Peer dynamics can further amplify the effectiveness of one-time supplemental payments. The Skagit pilot found that group-based bonuses incentivized coordinated action and peer outreach, helping to overcome social hesitation and boost conservation at landscape scales (Peak Sustainability Group, 2023). These mechanisms harness social norms and local networks to spread information, reduce anticipated future risks, and elevate conservation as a shared, community-oriented goal. As Chapman et al. (2019) and Wunder et al. (2020) note, such peer effects are particularly powerful when incentives affirm landowners' stewardship identities and relational values.

However, the long-term effectiveness of one-time supplemental payments in motivating landowner participation still depends on the broader context of program design. While they can attract landowners with short planning horizons or immediate financial constraints, sustained engagement may require complementary strategies that align with deeper motivations, such as legacy, ethics, or ecological concern, and provide continued support over time (Chapman et al., 2019; Bennett et al., 2014). Integrating supplemental payments into broader multi-incentive frameworks that include annual payments, cost-share, and technical assistance can help transition initial interest into lasting conservation outcomes.

In summary, one-time supplemental payments are a valuable tool for overcoming initial barriers to participation, particularly capital constraints, administrative hesitancy, and peer-based resistance to change. When embedded in locally delivered and socially supported programs, they can catalyze both individual action and collective momentum toward riparian restoration.

4.1.4 Conservation Easements

Conservation easements offer long-term or permanent protection of riparian areas by compensating landowners in exchange for voluntarily agreeing to restrict certain land uses. These agreements are legally binding and typically prohibit development or conversion to non-conservation uses, while allowing continued agricultural or forestry activities under specified conditions. In Washington, programs such as the Washington State Department of Natural Resources' [DNR's] FREP and Rivers and Habitat Open Space Program (RHOSP), and the USDA's Agricultural Conservation Easement Program - Agricultural Land Easements (ACEP-ALE) provide lump-sum payments based on the appraised value of land or timber in exchange for long-term (e.g., 40 years under FREP) or permanent (e.g., RHOSP and ACEP-ALE) conservation commitments. These programs are

[24] Chapter 6, Recommendation 3: Frontload payment, where feasible.

particularly designed to support durable riparian protection on working lands and may also function as compensatory mechanisms in regulatory contexts, such as under the Forest Practice Rules governing timber harvest buffers.

Compared to rental or cost-share structures, easements offer the strongest assurance of ecological permanence, but their complexity and transaction costs are often higher. They require formal appraisals, legal review, and, in some cases, title clearance or surveys. The enrollment process may also involve longer timelines and more intensive administrative coordination. As a result, uptake is typically limited to landowners who are highly motivated by conservation goals or interested in long-term income stability.

Several studies highlight both the strengths and challenges of conservation easements. Song et al. (2014), using national survey data, found that landowners who enrolled in conservation easements were significantly more likely to engage in long-term forest management planning. This relationship may partially reflect the requirements or structure of the easement itself (e.g., planning as a prerequisite for enrollment or a component of the easement terms) as well as the characteristics of landowners who are predisposed to more formal stewardship. However, the study also found that enrollment did not necessarily lead to increased implementation of active ecological management practices (e.g., thinning, invasive species control), suggesting that easements alone may be insufficient to promote ongoing ecological enhancement. This underscores the value of pairing easements with technical assistance or supplemental practice-based incentives to encourage active land management after enrollment.

Cooper and Jacobson (2009) examined why relatively few CREP participants transition to permanent easements and found that legal and financial complexity was a major barrier. Many landowners, particularly those without prior experience, viewed easements as opaque or inflexible. Concerns about loss of autonomy, irreversibility, and confusion over legal terms often deterred participation. In Pennsylvania, CREP began enrolling buffers in 1999 under 10- to 15-year contracts; many of the earliest contracts were approaching expiration at the time of the study, although none had yet expired. To anticipate what landowners might do, the authors designed a survey to ask about future intentions for their buffers. While most landowners indicated they planned to keep buffers intact after CREP ended, a minority expressed strong interest in converting to permanent easements. The study did not analyze re-enrollment decisions directly, though re-enrollment in CREP was an option available to participants. The survey additionally found that landowners with prior experience in buffer programs were more open to permanent easements, especially when presented as a follow-on option supported by trusted intermediaries. Additionally, the Washington Department of Ecology staff highlighted the risk of losing landowner trust when programs cancel contracts, noting that program participation was reduced after the Natural Resources Conservation Service (NRCS) cancelled CREP contracts in Whatcom County in 2023.[25]

Local delivery and technical assistance play a critical role in overcoming these challenges. In Washington, both FREP and RHOSP rely heavily on local conservation districts and DNR staff to provide personalized support throughout the easement process. This implementation infrastructure helps reduce administrative burden, foster trust, and offer field-based guidance that improves landowner confidence and satisfaction (Lute et al., 2018; Chapman et al., 2019). Programs delivered by known and trusted local actors are more likely to overcome informational and procedural frictions, particularly in rural areas where relational ties matter.

[25] Information provided by the Washington Department of Ecology to IEc on August 15, 2025.

Finally, easement participation is often shaped by landowner identity and values. Many landowners are motivated by more than financial compensation; legacy, stewardship ethics, and the desire to protect land for future generations are common drivers of engagement (Bennett et al., 2014; Barnes et al., 2020). Programs that affirm these values—by recognizing landowner conservation efforts, promoting peer-to-peer outreach, or offering long-term recognition—may deepen commitment and increase uptake. Framing easements as part of a landowner's stewardship legacy, rather than just a legal tool, can help align program offerings with intrinsic motivations and support durable outcomes.

In sum, conservation easements can secure lasting riparian protection and support long-term stewardship goals, but their effectiveness depends on more than financial compensation. Effective programs pair legal and financial clarity with trusted outreach, local technical support, and sequencing strategies that reduce risk and honor stewardship values.

4.1.5 Bid-Based (Reverse Auctions)

Reverse auction programs use competitive bidding to allocate conservation funding, aiming to improve cost-effectiveness by encouraging landowners to reveal their minimum acceptable compensation. The most prominent example is the USDA's General CRP. Under General CRP, landowners submit bids to retire eligible cropland for 10 to 15 years and establish long-term vegetative cover such as native grasses or trees. Bids are ranked using the Environmental Benefits Index (EBI), which aggregates characteristics of proposed contracts (e.g., wildlife habitat, erosion control potential, water quality contribution, cost) into a single index value. (USDA FSA, 2025a, 2025b, 2025c). Accepted bids receive annual rental payments and cost-share assistance for establishing approved practices, though no additional supplemental payments are offered under this enrollment type.

In theory, reverse auctions offer efficiency advantages by targeting conservation funding toward projects with the greatest ecological return per dollar spent. Claassen et al. (2008) argue that tools such as auctions and scoring systems like the EBI can enhance the cost-effectiveness of agri-environmental programs compared to flat-rate or first-come-first-served models. Cramton et al. (2021), using laboratory simulations, further demonstrate that data-informed reference pricing systems – where bids are benchmarked against peer offers – outperform traditional capped-bid formats in promoting truthful bidding and prioritizing high-benefit, low-cost land.

However, empirical studies highlight some practical limitations. Ferris and Siikamäki (2009) point out that the aggregation formula underlying General CRP's EBI may fail to incentivize enrollment on ecologically important but high-opportunity-cost parcels, especially in productive agricultural regions. In addition, Kirwan et al. (2005) estimate that CRP payments exceeded landowners' actual WTA by about 20 percent on average, suggesting that strategic bidding behavior may partially reduce the efficiency gains auctions are intended to deliver. General CRP signups represent the only known application of reverse auctions in the context of conservation on private lands in Washington. While it is not possible based on available data to assess cost-effectiveness in meeting ecological objectives, approximately 75 percent of the 25,000 acres offered by Washington farmers were accepted for enrollment. This falls in the middle of the range compared to acceptance offers across states, which range from 28 to 100 percent, with 80 percent acceptance across all acres nationally.[26]

Additional behavioral and administrative barriers also affect participation. Complex bidding procedures and opaque scoring systems can deter enrollment by landowners who value predictability and administrative simplicity (Lute et al., 2018). Without clear communication and trusted local delivery, these programs may be perceived as high-risk or overly technical. Chapman et al. (2019) and Bennett et al. (2014) also emphasize that relational values and stewardship identities often drive landowner engagement. Auction mechanisms that focus solely on economic optimization may neglect these motivations, limiting participation among landowners who prioritize conservation ethics, peer recognition, or legacy.

To address these limitations, effective reverse auction programs must balance economic efficiency with accessibility and trust. Transparent, well-communicated, and technically sound scoring criteria, locally tailored outreach, and optional technical assistance can help bridge informational gaps and build landowner confidence. Structured evaluation tools—such as tiered scoring systems or bonus points for collective action—may also help improve alignment with ecological goals and social dynamics, even when full auction formats are not viable (Claassen et al., 2008; Wunder et al., 2020).

In sum, while bid-based programs like General CRP can enhance cost-effectiveness under the right conditions, their ability to achieve ecological objectives depends on thoughtful design. Auctions are most effective when paired with clear rules and trusted intermediaries, and accommodate diverse landowner values.

The literature consistently emphasizes that no single payment type is sufficient to overcome the full range of landowner barriers to riparian conservation. Depending on the specific program requirements, landowners may face opportunity costs, implementation costs, and non-monetary costs, which include liquidity constraints, administrative burden, and loss of autonomy. Effective programs address these diverse challenges by combining multiple payment structures: annual rental payments compensate for income loss; cost-share offsets upfront capital expenses; one-time supplemental payments improve cash flow and encourage timely action; conservation easements support long-term stewardship; and bid-based tools can enhance cost-efficiency where conditions allow. Programs that enable payment stacking by layering incentives to match distinct cost types are more likely to achieve broad participation and ecological success (Claassen et al., 2008; IEc, 2022). In addition, program design elements such as administrative simplicity, trusted local delivery, and alignment with stewardship values significantly affect landowner engagement. Ultimately, tailoring payment structures to reflect local context and landowner motivations is key to expanding voluntary participation and securing durable conservation outcomes.

4.2 Ecological Targeting Approaches

When variation exists in the type or magnitude of ecosystem services provided by riparian areas, targeting conservation efforts using ecological criteria enhances cost-effectiveness and overall program efficiency (e.g., Claasen et al., 2008). Rather than treating all riparian lands as equal, targeted incentive programs aim to allocate limited public funds toward sites where restoration or protection yields environmental benefit per dollar spent. This logic is particularly relevant for the design of voluntary programs, where differences in land characteristics,

[26] Acceptance rates for 2024 General CRP Signups are available here: https://www.fsa.usda.gov/tools/informational/reports/conservation-statistics/crp.

opportunity costs, and ecosystem functions can result in wide variation in the return on investment across enrolled parcels (U.S. GAO, 2024; Ferris & Siikamäki, 2009).

Programs use a variety of tools to operationalize ecological targeting, ranging in complexity depending on the scale and objectives of the program. Washington's CREP program, for example, aims to reduce negative impacts of agricultural activity on water quality and salmon habitat. To meet this specific ecological objective, eligibility for the program is limited to watersheds with migratory salmon present, and CDs are encouraged to prioritize projects based on local objectives within their jurisdiction (SCC, 2019). Additional smaller or pilot-scale programs (e.g., Hangman Creek Riparian Restoration Pilot and Skagit CD's Targeted Riparian Buffer Incentives Pilot Project) similarly leverage localized knowledge for prioritization rather than formal scoring criteria, which has been shown to improve ecological outcomes in Oregon (Oregon Watershed Enhancement Board [OWEB], 2015) and Washington (GEI Consultants, 2005). A requirement of the Hangman Creek project was that it was identified by Ecology as a site of concern and contacted by Ecology, as such. In this way, the project paired regulatory process and voluntary programs in achieving the riparian buffer implementation.[27]

Programs that operate on a larger scale, such as CRP, generally rely on a more standardized (though inherently less flexible) approach. Under CRP General Enrollment, landowners submit proposed projects, which are scored and ranked based on the EBI (an index composed of factors intending to capture erosion potential, water quality benefits, habitat suitability, and proximity to priority areas). While the EBI is perhaps the most well-known example of a model-based targeting approach, it has been criticized as overly rigid, not well-aligned with identifying the marginal ecological benefits of specific projects, and placing undue emphasis on cost relative to expected benefits (U.S. GAO, 2024; Ferris & Siikamäki, 2009; Miao et al., 2016).

While straightforward to implement, overly rigid scoring frameworks may also reduce participation and erode trust among landowners (Barnes et al., 2019). Programs that strike a balance between ecological rigor and administrative flexibility, especially when delivered through trusted local intermediaries, may be more effective in attracting participation while still directing funds to ecologically meaningful outcomes (OWEB, 2015; Earth Economics, 2024). More sophisticated modeling approaches for targeting high-return areas for specific ecosystem service gains have been proposed in the literature but not implemented in practice to our knowledge (Khanna et al., 2003; Claassen et al., 2008; Malcher et al., 2023).

4.3 Program Design Considerations

As described, riparian incentive programs can be designed and implemented in a variety of ways. For example, there are multiple approaches to estimating landowner WTA and incorporating ecological outcomes. In this section we consider the implications of different design choices, and discuss conditions where one option may be more desirable than another. By understanding when and where a particular approach works best, programs can tailor interventions to meet local needs, landowner characteristics, and ecological priorities.

For example, in watersheds with relatively low variation in land uses or landowner goals, standardized incentives and uniform program rules may reduce administrative burden without sacrificing performance. In contrast, more diverse or fragmented landscapes may require flexible, layered, or locally customized approaches to effectively engage landowners and achieve desired outcomes in a cost-effective manner.

[27] Information provided by the Washington Department of Ecology to IEc on August 15. 2025.

4.3.1 Estimating Willingness to Accept

Incentive programs must determine how much to pay landowners to encourage enrollment, but true landowner WTA is unobserved. As described in Section 2.3.1, there are three general approaches to estimating landowner WTA used in the literature and in practice (Exhibit 5): modeling based on observable data and characteristics, stated preference survey techniques, and reverse auctions. Reverse auctions, such as those used in General CRP, aim to reveal WTA through competitive bidding. These mechanisms can improve cost-efficiency by directing funds toward lower-cost, higher-benefit projects (Claassen et al., 2008; Cramton et al., 2021). However, they may also deter participation, especially among landowners who are risk-averse, unfamiliar with bidding processes, or distrustful of scoring systems (Kirwan et al., 2005; Lute et al., 2018). In some cases, landowners may tailor their bids based on expectations about acceptance rather than true costs, and limited information on peer offers or scoring criteria can further distort outcomes, leading to inefficiencies.

Importantly, WTA is not uniform and may depend on unobservable landowner traits. As previously described, landowners differ in their income dependencies, land use goals, and conservation values, which influence the level of compensation required. Kline et al. (2000), studying forest owners in Oregon and Washington, found that those motivated by amenity and recreation values required substantially lower payments to protect riparian habitat than those reliant on timber income. Similarly, Yu and Belcher (2011), using contingent valuation in Saskatchewan, found that producers who depended heavily on agricultural income had significantly higher WTA than those with stronger conservation values or long-term stewardship goals. These findings illustrate how personal values and economic reliance shape participation. **From a program design perspective, this variation complicates the use of uniform payments, which may fail to motivate landowners with high opportunity costs or result in lower-cost enrollment where WTA is already low.**[28]

Exhibit 5. Approaches to estimating landowner WTA

Approach/Method	Description	Use Cases	Limitations
Modeling/Direct Observation	Relies on observable landowner and land use characteristics, such as crop or soil type; Difficult to incorporate nonmonetary factors that influence WTA	Set targeted landowner payments that are likely to achieve acceptance while relying only on existing data	Does not incorporate unobservable landowner characteristics
Stated Preference Survey	Directly elicits WTA from a sample of landowners; incorporates both monetary and non-monetary factors that influence WTA	Estimate distribution of WTA across a specific population; useful for understanding expected enrollment rates based on specific payment amounts	Potential for hypothetical bias, can be mitigated with careful survey design; does not facilitate targeted payments
Reverse Auction	Landowners reveal individual WTA through competitive bidding; incorporates both	Administer program funds cost-effectively when expected ecological benefits are relatively	Potential for strategic bidding; may deter enrollment due to perceived lack of transparency (especially when ecological

[28] Chapter 6, Recommendation 1: Payment should reflect site-specific land use and characteristics.

	monetary and non-monetary factors that influence WTA	consistent across potential participants	benefits are highly variable and difficult to compare objectively)

This variability raises important questions about cost-effectiveness. Programs that offer uniform payments may achieve broad participation but do not necessarily enroll lands with the greatest conservation gains. Some lands enrolled in programs may have had intact, high-quality riparian buffer regardless of the program, which would limit value added of the investment. In contrast, focusing on high-impact lands with less conservation-minded owners may deliver greater ecological benefits but require higher payments to overcome resistance. Ultimately, the design of incentive structures depends on the program's objectives, whether to maximize total conservation benefits, reward existing stewardship, or stretch limited funds to enroll the greatest acreage.

In contrast, direct offers based on observable parcel characteristics (e.g., county-level rental rates or buffer widths) simplify administration and improve transparency. These fixed-rate approaches reduce uncertainty for landowners and may be more accessible to smaller or first-time participants. Yet, they carry a higher risk of misalignment, where the payment amounts do not accurately reflect landowner costs, particularly where land values vary widely.

4.3.2 Ecological Targeting vs. Uniform Eligibility

Targeting conservation efforts to areas with the greatest potential for ecological benefit typically improves cost-effectiveness, that is, more ecosystem services gained per conservation dollar spent (Claasen et al., 2008). Programs like CRP General Enrollment use formalized ecological indices (e.g., EBI) to score and rank parcels based on observable characteristics. These tools can support transparent, repeatable decision-making across large areas. However, their structure may be too rigid or poorly calibrated to local conditions, which can deter participation or reduce effectiveness in areas where the scoring fails to align with local ecological priorities (Ferris & Siikamäki, 2009; U.S. GAO, 2024).

In contrast, localized prioritization—such as the watershed-specific targeting used in Washington's CREP or the peer-informed strategies seen in Skagit's Targeted Riparian Buffer Pilot—can adapt to regional ecological goals (e.g., salmon recovery), landowner dynamics, and implementation feasibility. These approaches allow for more flexible and relational engagement but may lack consistency across regions and require greater staff capacity to manage.

4.3.3 Upfront vs. Ongoing Payments

Conservation programs can compensate landowners through upfront supplemental payments, ongoing annual payments, or both. Upfront supplemental payments, such as sign-up or practice installation bonuses, can address common behavioral and financial barriers to participation. They improve liquidity, reduce risk, and provide immediate incentives to act, particularly for landowners who lack access to capital or who face significant initial costs (e.g., fencing, planting, off-stream watering). Studies show that supplemental payments are especially effective at boosting early enrollment and can do so more cost-effectively than raising base rental payments (Suter et al., 2008; IEc, 2022). Experimental evidence from Maryland further supports this approach: Newburn et al. (2024) found that one-time upfront payments outperformed annual payments in encouraging riparian buffer adoption, particularly among landowners with liquidity constraints or short planning horizons.

However, because upfront supplemental payments are typically disbursed early in the contract period, they offer limited leverage for ensuring long-term maintenance or compliance. By contrast, ongoing annual payments, such as those used in CRP and CREP, create a recurring incentive that reinforces stewardship over time and can help ensure that conservation practices remain in place throughout the contract term. Yet these payments may not be sufficient to overcome upfront cost barriers, especially when opportunity costs are high or practice implementation is capital intensive.

Many of the riparian programs that effectively motivate participation blend these approaches. **For example, Washington's CREP, RGP, and Targeted Riparian Buffer Incentives Pilot all combine annual rental payments with upfront supplemental payments and cost-share to provide both liquidity and sustained support (IEc, 2022; Peak Sustainability Group, 2023; Earth Economics, 2024). Newburn et al. (2024) also found that adding site-specific performance bonuses improved ecological cost-effectiveness.**[29]

4.3.4 Flexibility vs. Standardization

Program rules can be designed to offer flexibility, such as allowing variable buffer widths, site-specific practice designs, or alternative livestock access models, or to enforce standardized requirements. Flexible approaches accommodate operational diversity and can boost participation by aligning conservation practices with individual landowner needs and preferences. In Washington, for example, several CD-led programs have adopted flexible buffer guidelines or adaptive fencing strategies to meet producers where they are, improving both enrollment and ecological feasibility (Stillwater Sciences, 2017; King County, 2019; Earth Economics, 2024). Similar lessons emerge from the Willamette Riparian Revegetation Effectiveness Study, which monitored 63 sites across Oregon and found that ecological success was more likely when implementers were empowered to tailor restoration plans, collaborate with local contractors, and adapt to site conditions in real time (OWEB, 2015).

However, flexibility introduces administrative complexity. Tailored practices are harder to score ecologically, may complicate funding formulas, and can lead to inconsistent implementation if not supported by clear guidance and technical assistance. Too much flexibility with respect to buffer widths and design may risk buffers that are not effective at achieving the ecological objectives. Standardized practices, by contrast, offer clarity, ease of administration, and comparability across sites. They are especially useful in large-scale programs where cost-efficiency and uniform ecological metrics are prioritized. Yet overly rigid requirements may alienate landowners whose operational realities do not align with a one-size-fits-all model.

4.3.5 Program Stacking

Allowing landowners to "stack" multiple conservation programs, such as combining EQIP or NRI with CREP, can make complex riparian projects more feasible by offering complementary payments and technical resources. Stacking enables programs to cover different cost categories (e.g., income loss, capital expenses, maintenance), increasing the likelihood of participation and ecological success, particularly in high-opportunity-cost areas or when landowners face multiple barriers that no single program can address (IEc, 2022; Earth Economics, 2024). However, when payment structures are not coordinated across programs, stacking may lead to compensating landowners for losses (e.g., foregone income) that have already been compensated through another program. This risk is especially salient when payments are derived independently or without shared valuation

[29] Chapter 6, Recommendation 9: Offer up-front supplemental payments to incentivize favorable practices and arrangements.

benchmarks, potentially reducing overall cost-effectiveness. Through coordination and clear articulation of program goals and requirements, however, the risk can be minimized.

At the same time, stacking can also introduce confusion and administrative burden when programs are not well-coordinated. Differences in eligibility rules, timelines, documentation requirements, or payment terms across agencies may overwhelm landowners or create conflicting obligations. Elworth (2015) emphasizes the importance of integrated delivery systems, such as local CDs acting as "one-stop shops," to simplify enrollment and guide landowners through stacked program options. Similarly, Mercer et al. (2010) find that administrative complexity, risk aversion, and transaction costs are key barriers to uptake in ecosystem service payment programs. Their review of forest payment for ecosystem services (PES) programs in the U.S. shows that the most successful initiatives reduce paperwork, de-risk participation, and use trusted local intermediaries to communicate program value and coordinate benefits. More broadly, Snider (2000) argues that riparian restoration should be framed as an investment in natural capital rather than a cost, highlighting the long-term public value of ecological infrastructure and reinforcing the need for sustained, coordinated funding streams.

4.3.6 Achieving Long Term Conservation

There are multiple possible approaches to achieving long-term conservation on private lands. At the conclusion of the contract term, there are three potential outcomes: (1) the landowner re-enrolls in a conservation program (temporary or permanent); (2) the landowner maintains the buffer without re-enrollment, either out of choice or through a regulatory mechanism (e.g., Critical Area Ordinance); or (3) the landowner removes the buffer and returns to prior land use. It is uncertain how a given landowner will respond under future conditions.[30] The first two achieve long-term objectives, albeit at potentially different costs, while the third risks unproductive conservation spending if the buffer is removed before ecological outcomes are fully realized.

The most reliable ways to secure long-term conservation are through perpetual easements or fee-simple acquisition (i.e., buyout). Both options typically involve a substantial upfront lump sum payment to the landowner (e.g., based on before-after appraisal for easement compensation, market value for fee-simple). In theory, the lump sum should be equivalent to the present value of annual rental payments made in perpetuity (provided that the rental payments accurately reflect landowner opportunity costs). In some respects, then, buyouts are more attractive because they provide more certainty over shorter term contracts that require re-enrollment. However, easements and acquisitions introduce additional transaction, ownership, and management costs. Additionally, if the landowner would have maintained the buffer absent the acquisition, as has been found to occur in previous studies (see Section 4.1.4), there may not be an ecological benefit associated with the buyout.

Allocating limited conservation budgets toward longer-term solutions may limit the pace of new enrollment, as substantially larger payments are required upfront. That is, for a given conservation budget there is an implicit tradeoff between guaranteeing conservation in the longer-term within a limited spatial extent (through easements or buyouts) versus achieving broader spatial coverage in the near term while accepting some attrition risk (with term contracts). **Land and resource managers may consider acquisition options (purchase of**

[30] Cooper and Jacobson (2007) found landowners were more likely to participate in an easement program if they had previously been enrolled in a temporary contract arrangement such as CREP

property or of development rights) for high-priority sites where regulatory protections do not apply and landowners are hesitant to engage in voluntary programs.[31]

[31] Chapter 6, Recommendation 12: Consider acquisition options.

CHAPTER 5 | Description of Economic Incentives Toolbox

To accelerate voluntary participation in cost-effective riparian protection programs, agencies must design contracts that are both attractive to landowners and fiscally responsible. Striking this balance requires a nuanced understanding of what constitutes fair compensation—sufficient to motivate enrollment while still providing a net public benefit.

Incentive program contracts generally fall into two broad categories based on how payments to landowners are determined: posted-price programs, in which agencies offer standardized contracts; and reverse auctions, where landowners compete to provide conservation at the lowest price they are willing to accept. Within each structure, programs may or may not incorporate ecological targeting (e.g., favoring high-priority parcels) or performance-based supplemental payments (e.g., rewarding specific outcomes such as native vegetation restoration).

These design choices have meaningful tradeoffs. For example, USDA's CRP (general signup) combines bidding with an ecological index that intends to incentivize strong environmental benefits at reasonable cost. While this approach is theoretically appealing, the relative attractiveness of offers is sensitive to the underlying index formula. By contrast, simple flat-rate payments without ecological targeting may be more transparent and simpler to administer but may fail to attract high-value parcels or ensure net public benefit of the investment.

In this chapter we provide general guidance around two key contract design questions. Based on existing programs in Washington state, current data availability, and in light of findings from the literature:

- How should conservation program managers determine payments to landowners that are likely to increase enrollment in voluntary incentive programs?
- How can managers integrate cost-effectiveness criteria to support responsible use of public funds?

To promote enrollment among landowners, it is necessary to offer compensation that meets their minimum WTA. This includes the full range of costs they will incur over the course of the contract. As described in previous chapters, this may include opportunity costs associated with taking land out of production, as well as any implementation and maintenance costs for which the landowner is responsible. Below we provide guidance (methods and data sources) for estimating these costs with an emphasis on landowner opportunity costs, which are more difficult to quantify. **We focus specifically on a model-based approach utilizing available public data, but we note that alternative approaches such as stated preference surveys or reverse auctions can also provide useful information.**[32] For example, consistent rejection of offers developed using this methodology among a particular population suggests the presence of additional nonmonetary barriers that cannot be captured with this approach.

We present a more directive version of the guidance for reference as an "Incentives Toolbox" (henceforth, "Toolbox") in Appendix B. The Toolbox is intended to support CDs, Tribes, lead entities, counties, Puget Sound Local Integrating Organizations (LIOs), and other entities that work directly with landowners or apply for funding through SCC and Ecology-administered grants.

[32] Chapter 6, Recommendation 8: Consider landowner-led signals of WTA.

We pair the guidance for WTA estimation with a general framework for considering whether the total costs of installing a riparian buffer on a particular parcel are likely to provide a return on investment to the public in the form of ecological benefits. The framework intends to promote cost-effective investments without reliance on monetization of ecological benefits, which is complex and impractical on a parcel-by-parcel basis.

5.1 Estimating Landowner Willingness to Accept

This section provides methods and data sources for estimating the three general categories of costs associated with implementing a riparian protection or restoration program on a parcel: landowner opportunity costs, implementation costs, and maintenance costs.

5.1.1 Opportunity Costs

Opportunity cost refers to the foregone net economic value of land when it is enrolled in a conservation program and removed from its current or potential use. For many landowners, especially those managing income-generating land such as crops or pasture, opportunity cost is the most significant financial consideration when deciding whether to participate in riparian conservation.

Accurate estimation of opportunity cost is critical to setting incentives that reflect real tradeoffs and encourage voluntary participation.[33] Below we describe standardized approaches for estimating annual opportunity costs on a per acre basis. We recommend different approaches based on five general land use types (summarized in Exhibit 6). **While standardized approaches are provided here, recognizing the wealth of information held by the relevant program managers and participants, program managers are strongly encouraged to supplement them with local expertise, including from CDs, landowner interviews, or appraisal reports, wherever available.**[34]

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[33] Chapter 6, Recommendation 1: Payment should reflect site-specific land use and characteristics.

[34] Chapter 6, Recommendation 5: Rely on landowner and local expertise to best understand costs.

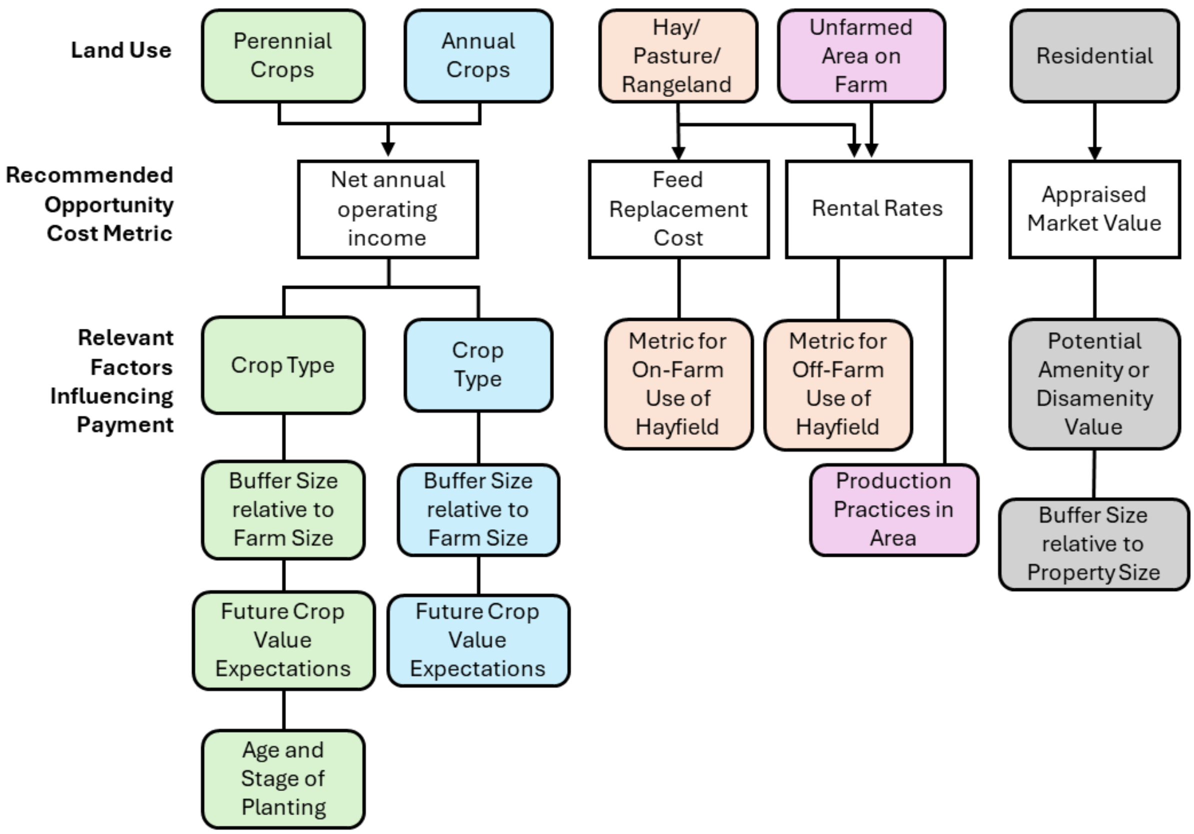

Exhibit 66. Metrics and factors to consider for estimating opportunity costs of different land uses

5.1.1.1 Cropland

The opportunity costs facing owners of productive cropland within the riparian zone will differ primarily by crop type, the size of the buffer relative to the overall farm size, whether the lost production can be offset by planting elsewhere, and the age of the planting at the time of program enrollment (for perennial crops). In the base case, we assume that the buffer represents a small fraction of total farm size (i.e., enrollment in the program does not threaten the viability of the farm but does reduce acres in production) and that the lost production cannot be offset by utilizing idle land elsewhere on the farm or by leasing comparable land. We additionally identify approaches that are appropriate when those assumptions are not true.

Net annual operating income

When crop production in the riparian zone is a fraction of total farm production and cannot be offset by utilizing idle land or leasing comparable land, landowners will see a reduction in net annual operating income (i.e., gross revenue minus variable costs) as a result of program enrollment. This foregone income occurs for the duration of the contract and should be compensated annually. Importantly, it differs by crop type.

Crop-specific enterprise budgets, developed by Washington State University (WSU), represent the most accurate and crop-specific data source for estimating net annual operating income.[35] These budgets provide detailed, per-acre estimates of expected gross revenues and operating (variable) costs for a range of common crops under intensive management (i.e., profit maximizing) conditions. Net annual operating income (per acre)

[35] WSU Crop Enterprise Budgets for many common crops can be obtained here: https://ses.wsu.edu/enterprise_budgets/

is obtained by simply subtracting total operating costs from gross revenues. For crops where production varies due to an establishment period, we recommend applying the estimates associated with full production, which is more likely to overestimate than underestimate the landowner's opportunity cost. Values obtained from crop enterprise budgets can (and should) be updated using available data. Specifically, price data should be replaced with the recent five-year average to account for annual variability (i.e., to avoid under or overpaying based on a particularly favorable or unfavorable market conditions associated with any particular year).[36]

Net annual operating income as calculated above represents the appropriate measure of opportunity cost for all crop types, including perennial crops. In contrast to annual crops, perennial crops (e.g., orchards, vineyards, and perennial berries) typically involve long-term investment in planning, establishment, and specialized infrastructure (e.g., trellises, irrigation). These systems can generate high net returns, but they also require substantial upfront costs and multi-year payback periods. The WSU crop enterprise budgets include these establishment and infrastructure costs as "fixed costs" that are amortized across the crop production period. As a result, the recommended net annual operating income equation (i.e., gross revenue minus operating costs) compensates landowners for establishment and infrastructure costs on an annual basis throughout the contract period.

In cases where the contract is initiated early in the production period, and the landowner incurred establishment and infrastructure costs up front, the landowner may be reluctant for reimbursement of those costs to be spread over the lifespan of the contract. **One option in such cases would be to offer full upfront reimbursement for establishment and infrastructure costs in the form of a one-time payment. In that case, the annual opportunity cost payment should be reduced accordingly.**[37]

For crops that lack an available enterprise budgets or when rapid estimation is needed, net income can be approximated as a percentage of gross revenue, where:

Approximate Net Income = Average Yield x Average Price x Profit Margin

- Average Yield x Average Price represents the gross revenue per acre for the crop in question
- Based on data from the 2022 Census of Agriculture, median producer profit margins in western Washington are approximately 11% of gross receipts, which can be used as a default estimate for the profit margin of perennial crops.

This method is simpler than using the full enterprise budgets but can still provide a useful benchmark.

EXAMPLE CALCULATION

A parcel in western Washington produces 10,000 pounds per acre annually of a perennial crop with an average five-year price of $2 per pound.

Gross revenue: 10,000 x $2 = $20,000/acre/year

Approximate net income: $20,000 x 11% = $2,200/acre/year

[36] Historic county-level prices for most crops can be obtained from the USDA National Agricultural Statistics Service.

[37] Chapter 6, Recommendation 3: Frontload payment, where feasible.

Lease value

In the event that lost crop production within the riparian zone can be offset, we recommend lease value as a more appropriate measure of opportunity cost. If the landowner has access to land with comparable production value (either idle land on their own property or land available for lease by the landowner), it may be reasonable to assume that that production is not displaced. However, the landowner will incur an additional cost equal to the lease value of land taken out of production in one of two ways:

1. If the landowner chooses to retain productive capacity by leasing comparable land, they incur a direct additional cost (lease value) but experience no additional loss to net annual operating income.
2. If the landowner chooses to retain productive capacity by farming comparable but previously idle land, they incur an opportunity cost of potentially leasing that idle land but experience no loss to net annual operating income.

Ideally, a local lease rate for land of comparable productivity should be used. If unavailable, county-level cropland rental rates from USDA National Agricultural Statistics Service can serve as an approximation.[38]

Annualized Market Value

The methods described above assume that riparian buffers affect only a small portion of a farm's productive acreage. However, when buffer installation would eliminate most or all of the land available for cultivation, as may be the case for smaller farms or narrow riparian parcels, the resulting opportunity cost may far exceed typical per-acre income losses. In such cases, buffer establishment may render the entire farming operation economically unviable.

Under these circumstances, the most appropriate estimation approach is to use the annualized market agricultural land value paid out annually during the duration of the program contract. This method captures the total foregone value of the land for farming.

Appraised land values can typically be obtained from county assessor records, which provide baseline valuation data for tax purposes. However, assessor values may not always reflect market conditions or site-specific factors, so independent appraisals by licensed professionals may be necessary in cases where precision is critical, particularly when determining compensation for permanent loss of agricultural viability or for comparing the cost of alternative conservation strategies (e.g., easement or acquisition).

This approach may be especially useful for small farms, or for parcels where buffers occupy such a large share of productive land that remaining acreage cannot sustain operations. The market value of the land is also relevant to determine an attractive payment for a permanent conservation easement when the easement precludes any uses of the riparian buffer. However, in this case the full value (without annualization) would be most appropriate for an easement payment.

Accounting for Fluctuating Opportunity Costs over Time

For all methods of quantifying opportunity costs to agricultural producers, we note that farm income is highly sensitive to commodity price fluctuations, which can outpace or lag behind inflation.[39] When crop prices are high or rising, producers may expect strong future returns and be less willing to take land out of

[38] USDA National Agricultural Statistics Service data can be accessed here: https://quickstats.nass.usda.gov/

[39] Chapter 6, Recommendation 2: Account for fluctuating commodity prices.

production unless offered compensation that reflects those expectations. Conversely, in declining price years, landowners may be more receptive to buffer programs.

The USDA NASS and Economic Research Service (ERS) provide information on long-term trends in land values and commodity prices. Additionally, enterprise budgets often include sensitivity tables showing expected net returns under different price and yield scenarios, which can help benchmark "typical" versus optimistic or pessimistic return assumptions. We recommend referencing the average prices over the past five years (i.e., 5-year averages) to calculate the opportunity costs (e.g., in terms of net annual operating income or rental rates). This avoids tying the foregone benefit of agricultural production to a single year and reduces landowner risk.

Utilizing five-year average prices accounts for price volatility, avoiding biased estimation from reliance on a single year of data, but it does not address producer expectations about future price changes or expectations that farm income will grow in real (inflation-adjusted) terms over the course of the contract. **To address these issues, we suggest escalating payments in future years by three percent annually (a standard approximation for the rate of annual inflation historically).[40]** Mechanically, this is achieved by multiplying the current year payment by 1.03 in each subsequent year. In cases where producer expectations may be for falling commodity prices (e.g., if the price of a particular crop is on a downward trajectory) escalation may not be necessary.

Adjusting Historic Data Sources to Current Dollar Year

When relying on historical data to estimate opportunity costs (e.g., a crop enterprise budget developed in a prior year), effort should be made to adjust dollar values to reflect current conditions. As an approximation, the approximate historic annual inflation rate described above (three percent) can be applied (e.g., to adjust a value expressed in 2020 dollars to 2024 dollars, multiply by 1.03^4. For a more accurate adjustment, a standard approach is to apply an appropriate index.[41] To perform the same adjustment based on an index, multiply by the following ratio: Index_2024 / Index_2020 (using the GDP Price Deflator, 125.2/105.3 = 1.19).

5.1.1.2 Hay, Pasture, Rangeland, and Unfarmed Areas

Estimating opportunity costs for pasture, hay field, and rangeland differs slightly from other cropland, as these lands are often used to feed livestock rather than generate direct crop revenue.[42] Agricultural lands within the riparian zone not utilized for crop production typically fall under one of the following categories:

- as pasture or range for grazing livestock,
- to grow hay as an on-farm source of feed for livestock,
- leased to another farming operation, or
- currently idle (unfarmed).

[40] Chapter 6, Recommendation 6: Consider escalating payments over time to account for inflation.

[41] For general inflation (e.g., prices) a commonly used index is the GDP Price Deflator. For agricultural costs, such as those included in crop enterprise budgets, an Agricultural Producer Prices Paid index is more appropriate.

[42] Here we refer to hayfields that are specifically utilized as on-farm feed sources. Hayfields explicitly managed to produce hay as a marketable commodity should be treated as crops.

We recommend different methods to calculate opportunity costs depending on whether the land is being actively used by the landowner as pasture, rangeland, or on-farm feed (versus sitting idle or generating lease income) and whether any displaced use can be offset by utilizing comparable idle land or leasing comparable land.[43]

Lease Value

Lease value is the appropriate opportunity cost under the following circumstances. First, this is a relevant measure of opportunity cost where the landowner is utilizing land in the riparian zone for grazing or growing hay for on-farm use, but comparable land is available elsewhere on the farm or by leasing comparable land. As with lost cropland production that can be offset, the landowner will incur an additional cost equal to the lease value of land taken out of production in one of two ways:

- If the landowner chooses to retain the current use by leasing comparable land, they incur a direct additional cost (lease value) but experience no loss in use.
- If the landowner chooses to retain the current use by farming comparable but previously idle land, they incur an opportunity cost of potentially leasing that idle land but experience no loss in use.

Additionally, lease value is the appropriate measure of opportunity cost if the riparian zone is currently leased to another agricultural producer. This is because enrollment in a protection program would cause direct loss of lease payments to the landowner.

Finally, for unfarmed (idle) areas of the farm, lease value considers the potential for future productive uses. While unfarmed land may not currently generate income, it can still hold operational or strategic value to landowners. These areas may serve as buffer zones for equipment access, irrigation control, or future cultivation plans. Accordingly, estimating opportunity costs for these lands should consider both their current utility and potential future use.

County-level soil rental rates can serve as a proxy for the average per-acre value of idle farmland in the area. Although the land is not under cultivation, these rates reflect its underlying agricultural value and provide a baseline estimate of foregone potential income. Alternatively, cash rental rates for pasture and cropland, available through USDA NASS, provide county-wide estimates for lease value. These reflect average per-acre lease values based on regional productivity and land use patterns. Ideally, however, local lease rates for land of comparable productivity should be used.

In addition to lease values, it may be important to evaluate how the area supports current farm operations. If removing access to an idle strip of land requires re-routing equipment, adjusting irrigation systems, or alters livestock movement patterns, it may impose indirect costs that could influence landowner acceptance of the contract, even if these are difficult to quantify precisely.

Feed Replacement Costs

For land in the riparian zone used as a feed source (e.g., pastureland used for grazing), opportunity cost is best represented by the cost of replacing lost forage with purchased feed, typically hay. This method converts lost grazing potential, measured in Animal Unit Months (AUMs), into an equivalent tonnage of hay needed to maintain livestock.

As a rule of thumb:

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[43] In rare cases where buffer installation removes most usable pasture on small operations, annual market value methods may be used to reflect the total loss of agricultural utility. As the method is identical to the annualized market value approach for cropland, we do not repeat the discussion here.

- 1 AUM is approximately 1.37 tons of hay (after adjusting for harvest and grazing efficiencies)[44]
- Pasture typically yields 1.25 to 2.0 AUMs per acre in Western Washington. Average AUMs per acre at the county level, variable by land type, can be obtained from the NRCS Web Soil Survey.[45]

At a hay price of $180/ton, the resulting feed replacement cost ranges from $270/acre (1.25 AUM x 1.37 ton x $180) to $421/acre (2.0 AUM x 1.37 ton x $180).

Note that while additional costs for hay transport and handling may apply, this method better reflects the true economic loss to farms that rely on pasture for internal feed supply.

5.1.1.3 Residential Land

Opportunity costs for residential parcels typically do not reflect lost income but rather changes in property value due to changes in aesthetics or uses of the land. These costs are often subjective but can be significant, especially where buffers affect views, usable yard space, or privacy and safety.

In general, the key drivers of residential opportunity costs include the following:

- Loss of water views due to vegetation density or buffer design;
- Reduced usability of the land for recreation or landscaping;
- Potential risks from increased vegetation cover (e.g., trespassing, wildlife); and
- Development restrictions (e.g., inability to build additions or subdivide lots).

EXAMPLE CALCULATION

A 1-acre parcel is appraised at $80,000/acre (land value only). A proposed 0.25-acre riparian buffer is expected to reduce space and restrict views. The rest of the land remains buildable but the owner is hesitant. The 5-year average mortgage rate is assumed to be 6 percent. The estimated annual opportunity cost is:

$80,000 x 0.25 x 0.06 = $1,200

Conversely, residential landowners could derive amenity value from the presence of a natural riparian buffer strip (e.g., natural views, wildlife habitat, localized flood attenuation). Any opportunity cost, therefore, may be fully or partially offset by amenity values. Therefore, we recommend two methods:

- In cases where landowners are receptive to installation of a riparian buffer without compensation, it is likely that the amenity values or stewardship mindset of the landowner exceed any opportunity costs.
- In other cases, we recommend offering a payment up to the annualized market value of the land being placed into protection.

Annualized Market Value

An approximate estimate for the total market value of the land can be obtained from assessed values (which typically distinguish between the value of land and improvements). Land value per acre can be obtained by dividing the value of land by the acreage of the parcel. Note that the land value metrics should reflect market values (an estimate of what the land would sell for in the open market). However, land appraised for tax

[44] 1 AUM = 780 pounds dry matter consumed (Meehan, Sedivec, Printz, & Brummer, 2022) / 30% grazing efficiency (Morris, 2012) or 2,600 pounds of dry matter yield x 90% haying efficiency = 2,340 pounds of dry matter (1.17 ton) / (1 – moisture content of hay ~15% (Meehan, Sedivec, Printz, & Brummer, 2022)) = 1.37 ton of hay equivalent.

[45] The NRCS Web Soil Survey can be accessed here: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

purposes may underestimate the full market value. For this reason, it is best to obtain a professional site-specific appraisal of the market value of land.

Once an appropriate market value has been determined, the value can be annualized using a discount rate that reflects the opportunity cost of capital. For residential land, the five-year historic average 30-year mortgage rate is an appropriate proxy for the discount rate.

$$\text{Annualized market value} = \text{total market value} \times \text{discount rate}$$

This approach treats the land value as a perpetuity, assuming the land could be sold or rented indefinitely, and estimates its equivalent annual value to the landowner. The annualized market value then forms the basis of the annual payment to the landowner for the duration of program participation.

5.1.1.3 Additional Considerations that Influence Opportunity Costs

The opportunity cost models we provide are based on applying consistent, standardized methods that account for land use type, foregone revenue, and typical program timelines. However, several external factors beyond the scope of our payment calculation models may influence a landowner's perception of a payment's adequacy or attractiveness. While these considerations are not explicitly included in our formulas, they should be recognized and, where possible, addressed through program design, communication, or payment flexibility.

Additional considerations that may influence landowner decision-making include:

- **Attitudes and perceptions**: Landowners of all types may derive value from enrolling in a conservation program such that they are willing to accept payments below their opportunity costs. For these landowners, our model is likely to overestimate payments. Survey-based stated preference methods can be helpful for understanding the role of this effect within a particular population.
- **Expectations of future crop value trends**: While our payment model uses five-year average crop prices to smooth out short-term volatility, individual landowners may anticipate significant price increases for specific crops (e.g., due to market trends, new infrastructure, or climate effects). In such cases, the average may underrepresent the perceived opportunity cost, and the offered payment may appear too low. At the same time, a conservation contract may be attractive because it reduces annual farm-level income volatility by offering a certain payment.
- **Possibility of future regulation**: Landowners who believe that future regulations may restrict certain land uses (e.g., riparian zones or flood-prone areas) might see current incentive programs as an opportunity to secure payment for actions they may be required to take later anyway. This can increase their willingness to participate, even if payments are lower than their full opportunity cost. Conversely, they may see enrollment as a trigger for future regulation (e.g., due to a Critical Area ordinance), in which case their perceived opportunity costs may extend beyond the contract term.
- **Long-term enrollment or permanent easements**: Our standard payment framework assumes time-limited program participation (e.g., 15 years). However, if a program requires permanent or intergenerational conservation (e.g., perpetual easements or buffer zones), it may be more appropriate to offer an upfront payment based on the land's fair market value rather than annualized revenue replacement.
- **Limited access or use within the riparian buffer**: Our payment assumptions are based on full conservation use with no ongoing access to the buffer area. However, if programs allow for minimal, non-damaging access (e.g., such as routing irrigation infrastructure through the buffer or permitting recreational use on residential land) landowners may view participation more favorably. Where feasible, this can either reduce the payment needed to secure participation or increase enrollment rates without additional cost.

5.2 Implementation Costs

Implementation costs refer to the one-time, upfront expenses incurred by landowners when establishing riparian buffers or fulfilling conservation program requirements. These costs include materials, labor, equipment, and technical services. Practices such as fencing, planting native vegetation, and preparing degraded sites can require significant capital or technical capacity. For many landowners, especially those with capital constraints or limited access to support, these costs can deter participation even when long-term ecological or economic benefits are understood.

We generally recommend that programs consider directly undertaking or paying for implementation and establishment costs for the riparian buffer.[46] However, where the program requires landowners to undertake implementation and to be compensated by the program, this section outlines methods to reasonably estimate implementation costs based on publicly available data and common riparian buffer installation/implementation activities. The Toolbox provides links to key data sources and helps users identify cost categories and relevant practices based on program requirements. **Final cost estimates should be developed using local expertise and actual design or implementation information whenever possible.**[47]

5.2.1 Key Implementation Practices and Costs

Drawing from enrollment data for Washington's most frequent NRCS programs (CRP, Conservation Stewardship Program [CSP], and EQIP), the practices described in Exhibit 7 are the most frequently used for riparian conservation.

Exhibit 77. NRCS Practice Scenarios for Washington (2025) Relevant to Riparian Buffer Establishment

Practice	NRCS Code	Description	Typical Components	Unit of Measurement
Riparian Forest Buffer	391	Establishing woody vegetation along riparian areas	Live stakes, hand planting, layout, mulch, initial irrigation	Cost per acre
Tree/Shrub Establishment	612	Planting bareroot seedlings or containerized plants	Seedlings, mulch, stakes, labor	Cost per acre
Tree/Shrub Site Preparation	490	Clearing and preparing land prior to planting	Invasive removal, tilling, herbicide application	Cost per acre
Fence	382	Livestock exclusion or wildlife protection	Posts, wires, gates, fasteners, labor	Cost per linear foot
Access Control	472	Restricting equipment or livestock access to sensitive areas	Signage, fencing, gating, labor	Cost per acre or linear foot

Source: Natural Resource Conservation Service, Washington Practice Scenarios – Fiscal Year 2025 (fy25-wa-scenarios.pdf)

The types and quantities of required practices will vary by site conditions (e.g., slope, vegetation cover, water access), land use history, and landowner goals. For instance, heavily grazed parcels may require more intensive

[46] Chapter 6, Recommendation 4: Reduce need to compensate out-of-pocket costs to landowner.

[47] Chapter 6, Recommendation 5: Rely on landowner and local expertise to best understand cost.

planting or fencing, while forested riparian areas may need only limited site prep. Accurately reflecting these variations often requires local knowledge and input from technical assistance providers.

5.2.2 Datasets and Estimation Approach

The FY25 Washington NRCS Practice Scenarios provide a helpful reference for initial, order-of-magnitude information on implementation cost estimates. This resource includes a broad list of practices relevant to riparian conservation in Washington, each with multiple cost scenarios tailored to different site conditions and implementation methods. Each scenario includes:

- Standard NRCS practice codes aligned with federal and state conservation programs.
- Per-unit estimates that reflect average expenses for labor, material, and equipment.
- Scenario-level descriptions that distinguish between site conditions.

The Toolbox includes links to the NRCS Washington Practice Scenarios document to support users in identifying applicable practices and scenario-level cost estimates.

However, while the NRCS scenarios offer a starting point, they are based on statewide averages and do not account for geographic and site-specific variability. Interviews with CDs highlighted that these figures often fall short of real implementation costs, especially in regions with high labor costs, contractor shortages, or complex logistics.

For more accurate estimates, users are strongly encouraged to use site-specific implementation plans or design specifications where available, including consulting contractor bids, invoices, or historical project records, and drawing on local knowledge (e.g., CDs) and recent experience to better quantify implementation costs.[48]

5.3 Maintenance Costs

Maintenance costs refer to the recurring annual expenses required to sustain the ecological function and program compliance of riparian buffers and other conservation practices. These costs typically include tasks such as replanting dead vegetation, controlling invasive species, maintaining fencing, and conducting routine habitat management. While often lower than initial implementation costs, maintenance represents a long-term commitment that can pose substantial burdens for landowners, particularly those lacking time, labor, or technical assistance.

We generally recommend that programs consider directly undertaking or paying for any maintenance requirement in the buffer during the contract period.[49] However, where the program requires landowners to undertake maintenance activities and to be compensated by the program, this section outlines methods to reasonably estimate maintenance costs.

5.3.1 Key Maintenance Practices and Costs

Drawing on enrollment data for NRCS programs in Washington, Exhibit 8 describes maintenance activities commonly associated with riparian buffers. These data are available from the Natural Resources Conservation Service Conservation Stewardship Program Renewals for Washington State in Fiscal Year 2025.

[48] Chapter 6, Recommendation 5: Rely on landowner and local expertise to best understand costs.

[49] Chapter 6, Recommendation 4: Reduce need to compensate out-of-pocket costs to landowner.

Exhibit 88. NRCS Conservation Stewardship Program Practice Costs in Washington State

Practice	NRCS Code	Description	Typical Maintenance Activities	Unit of Measurement
Riparian Forest Buffer	391	Woody vegetation planted along riparian corridors	Weed control, replanting, mulch, irrigation	Cost per acre per year
Upland Wildlife Habitat Management	645	Habitat enhancement for upland wildlife	Invasive species control, replanting, structural maintenance	Cost per acre per year
Herbaceous Weed Treatment	315	Control of herbaceous invasive or noxious weeds	Herbicide application, mechanical treatment	Cost per acre per year
Brush Management	314	Removal of woody vegetation to restore habitat or access	Cutting, stump treatment, follow-up re-entry	Cost per acre per year
Irrigation Water Management	449	Efficient water application to maintain vegetation health	Equipment checks, seasonal adjustments, repairs	Cost per acre year
Fence	382	Livestock or wildlife exclusion infrastructure	Inspection, wire/gate repairs, vegetation clearing	Cost per linear foot per year
Access Control	472	Preventing access to sensitive conservation areas	Gate maintenance, signage, monitoring	Cost per acre or linear foot per year

Source: Natural Resource Conservation Service, Conservation Stewardship Program Renewals – Fiscal Year 2025 (fy25-wa-csp-renewals.pdf)

Importantly, if using past project data is used to estimate costs, be sure to adjust the past cost estimates for inflation. Similarly, if estimating future maintenance payments over time, it is best to consider the influence of inflation on the costs so that it can be captured in the payment. Based on historical data, a reasonable annual inflation adjustment for maintenance cost payments over time is 3%.

5.3.2 Datasets and Estimation Approach

As noted above, a reference for estimating annual maintenance costs is the USDA NRCS FY25 Conservation Stewardship Program (CSP) Renewal Payment Rates for Washington. These payments are designed to reflect the average cost of maintaining practices over a five-year CSP renewal contract and include labor, materials, and equipment use.

To derive an annualized estimate, divide each unit-based, 5-year CSP payment rate by five. These data provide an order-of-magnitude estimate for annual maintenance costs by activity. However, the payment rates are statewide averages and do not reflect site-specific conditions. As with implementation costs, CD staff indicate that NRCS rates often understate real costs. **Again, users should supplement NRCS values with actual invoices, local staff knowledge (e.g., CD), or contractor estimates, where feasible.**[50]

5.4 Administrative Costs

Administrative costs refer to the time, effort, and coordination required to enroll in a conservation program, comply with documentation requirements, and maintain eligibility over time. These tasks can be especially

[50] Chapter 6, Recommendation 5: Rely on landowner and local expertise to best understand costs.

burdensome for small-scale or first-time participants, who may lack the capacity to navigate mapping, reporting, and verification protocols without assistance. Even for experienced landowners, these tasks may require time and deter program uptake. **Program managers should recognize when administrative program requirements (e.g., mapping, documentation, monitoring, reporting, legal review) result in substantive demands on landowner time and effort, and consider where streamlining requirements and offering technical support will mitigate the administrative burden of participation.**[51]

[51] Chapter 6, Recommendation 7: Look for opportunities to streamline program administrative requirements.

5.5 Understanding Cost-Effectiveness

Once the cost of enrolling a particular parcel has been determined, it is important to consider whether the public benefit outweighs the cost (i.e., whether the conservation investment is likely to represent a beneficial use of public funds). Even when riparian restoration is expected to generate net public benefits on a large (e.g., watershed) scale, the contribution of individual parcels can be variable and uncertain.

Understanding the cost-effectiveness of riparian buffer implementation is important even when specific, monetized values of ecological benefits are unknown or uncertain. In such cases, cost-effectiveness can be assessed in relative terms by comparing the magnitude of expected costs of establishing and maintaining the buffer with the expected public benefits, characterized qualitatively or through indicators of public value (e.g., ecological characteristics, threats and stressors, proximity to human uses, and broader contextual factors). While precise monetary valuation may not be feasible, especially given the public, non-market nature of many ecological functions and ecosystem services, it is still possible to evaluate where higher ecological returns are likely relative to the costs incurred.

Given those practical constraints, we offer a simple and intuitive approach to explicitly consider the likelihood that a given extent of riparian buffer will generate a net public benefit. In the absence of detailed, site-specific modeling, this approach relies on available information about key cost drivers (as described in previous sections) and ecological indicators to assess the relative costs and ecological benefits of riparian buffer implementation. This encourages program managers to understand cost and benefit comparisons in general, relative terms (i.e., low, medium, high) based on readily identifiable site characteristics. It is grounded in principles of benefit-cost analysis, adapted to reflect the high degree of uncertainty.

We acknowledge two primary sources of uncertainty in estimating the public benefits associated with riparian buffer implementation.

- First, there is inherent ecological uncertainty regarding the extent and nature of changes resulting from the transition from the baseline land use (e.g., perennial crops) to a vegetated riparian buffer. These changes may vary considerably depending on site-specific factors such as hydrology, species assemblages, soil characteristics, vegetation type, buffer width, and adjacent land management practices.
- Second, there is economic uncertainty in assigning monetary values to those ecological changes. The valuation of ecosystem services, particularly those that are non-market and public in nature, is complex and often context dependent.

This framework enables a comparative assessment of cost-effectiveness where full ecological and economic modeling is impractical, following three steps:

STEP 1. Classify costs as likely low, medium, or high based on key cost drivers.
STEP 2. Classify ecological values as likely low, medium, or high based on key ecological indicators and additional site-specific considerations.
STEP 3. Rate cost-effectiveness potential based on the cost-effectiveness matrix (figure below), which determine on a scale of 1 to 5 the relative likelihood that the riparian buffer investment generates net public benefits.

This structure supports transparent decision making that acknowledges uncertainty, enabling program managers to prioritize enrolling sites with the highest likelihood of providing net public benefits. Importantly, it does so without requiring monetary estimates of ecological outcomes. **Additionally, the framework is well-suited to integrate new data and information about the costs and benefits of enrolling riparian zones in conservation programs as it becomes available. For example, detailed information about the distribution**

of conservations costs per acre should emerge as managers implement incentive programs across different watersheds. Similarly, detailed information about the distribution of expected ecological benefits follows directly from the efforts in Washington to establish riparian restoration prioritization processes.[52]

5.5.1 Classifying Cost per Acre

The relevant cost for applying within this framework is the standardized total cost of conserving a parcel. It should include the full lifecycle costs of the project (i.e., landowner opportunity costs, project implementation and maintenance costs) expressed annually (to standardize across contracts of differing lengths) and in terms of a standard size unit (e.g., acres) to account for projects that vary in size. Note that this value may differ from the payment offered to landowners, as landowner payments may not include project implementation and maintenance costs if those aspects are to be undertaken directly by the agency.

If a local implementing agency already possesses detailed knowledge about the distribution of conservation costs within the relevant geography, categorical mapping to low, medium, and high is straightforward. In the absence, total cost can be classified by assessing relevant "cost drivers" (i.e., factors that influence the magnitude of costs associated with conserving a parcel). Examples include opportunity cost drivers (e.g., crop type and value), implementation complexity (e.g., level of site preparation required), ongoing maintenance needs (e.g., expected maintenance intensity), and other participation costs (e.g., landowner willingness). In addition to the cost drivers identified in the Toolbox, project managers should weigh any additional known cost drivers, as relevant. If most drivers are low, classify the site as "Low Cost." If most drivers are high, classify the site as "High Cost." If most drivers are moderate or are mixed across all drivers, classify the site as "Medium Cost." Over time, as cost estimates relevant to specific contracts are developed, a quantitative cost distribution will emerge, allowing for more objective classification.

5.5.2 Classifying Potential Public Benefits

Ideally, managers would have the ability to directly compare the total costs of conserving a parcel (i.e., the landowner opportunity costs, implementation and maintenance costs) with the expected public benefits of conserving the parcel in monetary terms (i.e., WTP). However, estimating the monetary value of public benefits from enrolling an individual parcel in a riparian conservation program is exceedingly complex and may not accurately quantify public benefits for several reasons, including the following:

- A high degree of variation in ecological context (e.g., baseline condition, species affected) and social context (e.g., population demographics and preferences, proximity to the resource), which can have a large influence on the magnitude of WTP values.
- Existing WTP estimates do not capture parcel-scale variation. Estimates of public WTP are typically derived at the watershed scale. While possible to standardize these values (e.g., express as WTP per acre), variation in how parcels contribute to the total value suggests that applying an average WTP value to each acre within a watershed would not promote cost-effectiveness of projects implemented at the parcel-scale.
- Interdependencies and temporal considerations. Conservation and restoration outcomes are often jointly determined by a portfolio of approaches (e.g., successful salmon restoration depends on riparian restoration, addressing instream barriers, stormwater and pollution management, hatcheries, fishery management). As a result, it is difficult to disentangle the incremental effect of a particular program. Additionally, there is a temporal lag between implementation of a riparian restoration and realization of benefits (e.g., as vegetation matures over time). Finally, the effectiveness of restoration efforts may

[52] Chapter 6, Recommendation 10: Track buffer cost and other program data.

change over time (e.g., due to climatic factors). Combined with the time it takes for the restoration to achieve benefits, this creates additional costs and risks of delaying action.

- Reliance on monetary valuation may overemphasize restoration of watersheds or reaches with explicit and intensive human uses. In particular, monetary valuation does not account for Tribal values, which could represent an important component of the total value of riparian conservation and may differ spatially from areas valued by the general public. Even precise monetary valuation, therefore, would represent a lower bound on actual program benefits.

In the absence of site-specific ecological and economic modeling or an explicit prioritization of individual reaches, we recommend relying on readily observable "indicators" (i.e., drivers of ecological value) to classify a parcel as likely to generate low, medium, or high public benefits from enrollment in a riparian protection program. These indicators include ecological characteristics (e.g., presence of fish species, habitat accessibility, existing riparian zone quality), threats and stressors (e.g., temperature and water quality impairments, presence of invasive species), connections to human use (e.g., proximity to drinking water intakes or areas used for boating, fishing, or swimming), and broader contextual factors (e.g., probability of conversion to development, contiguity with existing protected habitats). Program managers should consider additional indicators beyond those presented in the Toolbox, as appropriate. As with costs, if most indicators are high, classify the site as "High Public Benefit." If most indicators are moderate or are mixed across all indicators, classify the site as "Medium Public Benefit." **If an explicit prioritization method is developed in the future (or available for a particular geography), more objective classification of potential public benefits can be adopted.**[53]

Several statewide spatial datasets exist that could inform classification. the Riparian Data Engine (RDE) recently released by Washington Department of Fish and Wildlife provides a user-friendly interface for interacting with many of them, including layers to characterize salmonid presence, habitat suitability, temperature impairment, hydrological characteristics, land cover in the riparian zone, as well as up and downstream land use and instream barriers.[54] The RDE is a flexible tool that can be utilized in a number of different ways. For example, a user might start their analysis by filtering the statewide stream layer to focus on the relevant watershed, then identify potential reaches to target based on general land use designations (e.g., agriculture). From there, general prioritization might proceed by

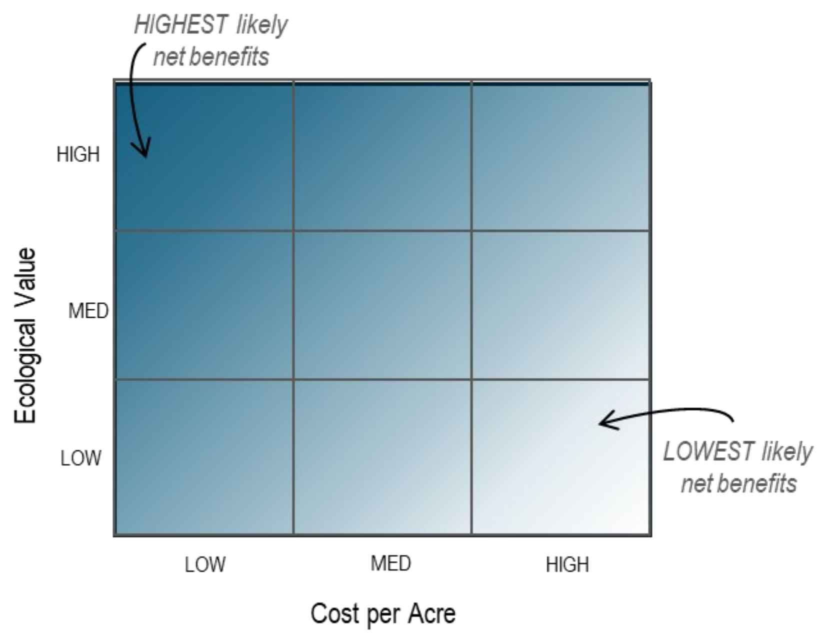

Exhibit 9. The cost-effectiveness framework allows managers to identify the relative likelihood that enrolling a particular parcel will generate net public benefits

[53] Chapter 6, Recommendation 11: Establish priority sites for riparian conservation to focus effort on targeted landowner incentives.

[54] To access the Riparian Date Engine visit https://ripariandata.wdfw.wa.gov.

identifying the subset of reaches which support salmon and are currently temperature impaired. Additional criteria can be utilized, such as the current level of tree cover, to further refine priorities. Users can export results from the RDE for direct mapping of parcels to categorical priorities. Exported results can also potentially be combined with additional datasets that may not be included in the RDE (e.g., data with a local or regional focus) to further inform classification.

5.5.3 Rate Cost-Effectiveness Potential

Once a program manager has classified a parcel in terms of the cost per acre and potential public benefits, they can use the cost-effectiveness matrix (Exhibit 9) to rate the cost-effectiveness potential of contracting with the landowner (darker shades indicate higher likelihood that the opportunity generates a net public benefit).

Importantly, the scale does not identify whether or by how much the benefits of enrolling a parcel exceed the cost (i.e., a high cost parcel with low expected ecological value may still generate net public benefits). The scale instead reflects a relative cost-effectiveness measure. Thus, it is most useful for comparing the cost-effectiveness of potential riparian buffer sites or for targeting outreach to landowners where net benefits are most likely to be highest.

CHAPTER 6 | Key Recommendations

This chapter summarizes our key recommendations for the design of landowner payment programs aimed at supporting riparian buffer implementation. Drawing from literature review, insights provided by program managers, and consideration of practical constraints, these recommendations are intended to accelerate the adoption of voluntary incentive programs for riparian conservation.

1. **Payment should reflect site-specific land use and characteristics:** Offer parcel-specific opportunity costs in calculating a payment based on the framework and methods described in the accompanying Toolbox; rely upon local expertise and insight where feasible. (Chapter 2 Introduction, Sections 4.3.1 and 5.1.1)

2. **Account for fluctuating commodity prices:** Because agricultural commodity prices fluctuate from year to year, we recommend referencing the averages over the past five years (i.e., 5-year averages) to calculate the opportunity costs (e.g., in terms of net annual operating income or rental rates). This avoids tying the foregone benefit of agricultural production to a single year and reduces landowner risk. (Section 5.1.1.1)

3. **Frontload payment, where feasible:** While we provide methods for quantifying annual payments reflecting the flow of costs to the landowner overtime, we recommend program managers consider frontloading the payment as much as possible. In particular, for perennial crops early in the production stages, program managers may consider compensating the landowner for the crop establishment and infrastructure costs up front rather than as part of the annual payment over the lifespan of the contract. (Sections 4.1.3 and 5.1.1.1)

4. **Reduce need to compensate out-of-pocket costs to landowner:** Programs should directly cover costs of buffer implementation and annual maintenance where possible, rather than integrating those costs into landowner payments. (Sections 4.1.1, 5.2, and 5.3)

5. **Rely on landowner and local expertise to best understand costs:** While existing datasets provide useful insight (e.g., NRCS conservation practice cost data) in determining buffer implementation and maintenance costs, we recommend using site-specific implementation plans or design specifications where available (e.g., consulting contractor bids, invoices, historical project records of actual costs) and drawing on local knowledge to most accurately quantify these costs. (Sections 5.1.1, 5.2.2, and 5.3.2)

6. **Consider escalating payments over time to account for inflation:** For compensating for future opportunity costs and maintenance costs over time, consider the influence of inflation on the payment. Based on historical data, a reasonable annual inflation adjustment is 3%. (Section 5.1.1.1)

7. **Look for opportunities to streamline program administrative requirements:** Programs should aim to minimize administrative burdens on landowners, including responsibilities for mapping, documentation, monitoring or reporting, and offer technical assistance wherever possible. This may include leveraging expertise of CDs and watershed management groups to alleviate the burden on landowners. (Sections 4.1.1 and 5.4)

8. **Consider landowner-led signals of WTA:** In cases where offers to landowners are consistently rejected, consider soliciting bids from individual landowners (reverse auctions) or surveying the

relevant population (stated preference) to capture nonmonetary drivers of WTA. (Section 2.3.1 and Chapter 5 Introduction)

9. **Offer up-front bonus payments to incentive favorable practices and arrangements:** The literature identifies that performance bonuses, for example for enrolling larger areas or participating alongside neighboring landowners, have proven effective incentives. (Section 4.3.3)
10. **Track buffer cost and other program data:** Develop a centralized repository for program data to gain insight into how payments influence enrollment. (Section 5.5)
11. **Establish priority sites for riparian conservation to focus effort on targeted landowner incentives:** Develop a regional riparian buffer prioritization method or tool that rates or ranks riparian sites or watersheds based on ecological need and value to complement the cost analysis. (Section 5.5.2)
12. **Consider acquisition options:** For high-priority sites where regulatory protections do not apply and landowners are hesitant to engage in voluntary programs, consider purchasing properties or development rights. (Section 4.3.6)

Through the course of this work, and with the benefit of constructive comments provided on earlier drafts by staff at the State Conservation Commission, the Department of Ecology, the Department of Fish and Wildlife and others, we highlight several promising directions for future research that build upon and extend the themes addressed in this study. In particular, we identify the following areas as both related and useful for advancing understanding and informing continued development and improvement of voluntary programs for riparian conservation in Washington:

- Define the influence of alternative buffer design (widths, vegetation types, BMPs for management) on nature and extent of ecological benefits. This includes understanding minimum requirements for achieving the targeted ecological outcomes.
- Engage in targeted collection of data from local sources, including conservation districts, on implementation and maintenance costs. This includes both time and equipment investments for different types of buffers.
- Develop a structured prioritization or ranking approach to identifying targeted sites for restoration based on ecological importance. This relates to Recommendation 11. We note in the report that WDFW began development of a mapping tool. Cross-agency work would be beneficial to identify site-specific criteria to better target voluntary incentive program involvement. This may build on information that CDs use to prioritize restoration activities.
- While this study focused on voluntary incentive programs that involve payments to landowners, additional research on the feasibility of acquisition programs and purchase of development rights may be beneficial. This is highlighted briefly in Section 4.3.6.
- Explore opportunities for landowner feedback on programs, including related to decisions regarding participation and experience upon participating.
- Collect data on landowner behavior after the program contract period ends, including likelihood of maintaining the riparian buffer and of re-enrollment in voluntary riparian conservation programs.

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Appendix A | Annotated Bibliography[55]

Study	Location	Topics	Notes
Agriculture and Agri-Food Canada. (2012)	Canada (nine agricultural watersheds across British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario)	Economic viability of Beneficial Management Practices (BMPs), especially riparian fencing and off-stream watering, from both farm-level and societal perspectives.	This report frames BMP adoption as a classic case of public-private benefit misalignment: landowners incur costs, while environmental gains flow to the broader public. Structural practices like riparian fencing and off-stream watering frequently generate low or negative private returns unless public subsidies are provided. Findings from the WEBs case studies show that stacked cost-share funding and tailored implementation support are crucial for adoption, especially where farms face narrow margins. Uniform program rules were flagged as ineffective, as BMP performance and profitability vary across landscapes and farm systems. This suggests the need to align payments with actual producer costs, prioritize practices with high ecological return, and design flexible, regionally responsive programs that pair financial and technical assistance.
Ahnström et al. (2009)	International (focus on Europe and North America)	Farmer attitudes; conservation behavior; social norms; policy design; adoption barriers.	This review synthesizes research on farmers' attitudes toward conservation and the contextual factors shaping adoption. The authors find that financial incentives alone rarely drive participation. Instead, decisions reflect a mix of values, social norms, trust in institutions, and alignment with farm operations. Economic rationality is often outweighed by concerns about autonomy, identity, and peer expectations. For program design, the findings emphasize that socially embedded factors matter. Programs that recognize farmer identities, support peer learning, and build trust through local intermediaries are more effective than those focused solely on payment size. Messaging rooted in local values and stewardship ethics can further boost uptake.
Barnes et al. (2019)	Western Great Plains (Kansas, Oklahoma, Texas)	Landowner motivations; behavioral economics; CRP participation and retention; stewardship behavior; program design.	Uses behavioral economics and conservation psychology to explore CRP landowner motivations. Finds that while financial incentives drive initial participation, long-term stewardship is more influenced by intrinsic values (e.g., land ethic, identity, connection to place). Barriers include inflexible rules, burdensome processes, and inconsistent agency communication. Trust in advisors and respect for landowner expertise are essential. Recommends reducing administrative friction, improving flexibility (e.g., integrated grazing), enhancing communication, and leveraging peer learning. Emphasizes tailoring programs to landowner values, supporting trusted intermediaries, and aligning payments with broader stewardship goals.
Barnes et al. (2020)	Southern Great Plains	Post-CRP land use decisions; behavioral economics; stewardship persistence; re-enrollment barriers.	Explores why landowners continue, discontinue, or modify conservation practices after CRP contracts end. Finds that intrinsic motivations (e.g., land ethic, autonomy, trust in staff) are stronger predictors of post-contract stewardship than financial incentives. CRP payment structures attracted marginal lands but failed to retain land in conservation when payments lagged behind rising land values. Inflexible rules (e.g., grazing bans, vegetation mandates) and administrative burdens reduced interest in re-enrollment. Recommends

[55] This annotated bibliography was developed as an interim product. As a result, it reflects literature reviewed as of June 9, 2025 on the topic of voluntary incentive conservation program design but does not include all literature cited in this report.

Study	Location	Topics	Notes
			designing programs that allow adaptive management, recognize landowner identities, and minimize complexity to support voluntary long-term conservation beyond contract periods.
Baumgart-Getz et al. (2012)	United States	Best management practices (BMPs); adoption drivers; meta-analysis; social factors; conservation behavior.	This meta-analysis synthesizes 46 U.S. studies on agricultural BMP adoption from 1982 to 2007, identifying the most influential factors affecting uptake. The authors find that access to high-quality information, financial capacity, and involvement in local networks or agency relationships have the strongest positive impacts on adoption rates. In contrast, commonly studied variables such as environmental awareness, attitudes, and demographics often yield inconsistent or statistically insignificant results across studies. The analysis reinforces that effective conservation program design should prioritize outreach infrastructure, peer and institutional networks, and financial support mechanisms. It also highlights methodological inconsistencies in how adoption studies measure social and attitudinal factors. These findings support integrating social learning and institutional trust into incentive program delivery to improve participation, rather than relying solely on economic motivators or one-size-fits-all demographic assumptions.
Bennet et al. (2004)	Southeastern Australia (Victorian wheat–sheep belt)	Riparian corridors; landscape-scale conservation; habitat connectivity; biodiversity benefits; spatial targeting	This study uses extensive field surveys and spatial analysis to evaluate how riparian vegetation contributes to woodland bird conservation across fragmented agricultural landscapes. The authors find that riparian zones provide disproportionately high conservation value relative to their area, acting as critical habitat and movement corridors in otherwise cleared landscapes. Riparian vegetation supported more species and higher bird abundance than equivalent areas of non-riparian woodland. Although the study does not focus on economic incentives, the findings have clear implications for conservation program design. They suggest that prioritizing riparian zones in incentive programs—particularly in heavily modified environments—can deliver outsized biodiversity gains. The paper strengthens the ecological justification for riparian buffer investments and supports targeting strategies that maximize landscape-scale benefits.
Brouhle, et al. (2004)	United States	Voluntary approaches; environmental policy; economic theory; program participation and effectiveness	Provides an overview of the theoretical and empirical rationale for using voluntary approaches in U.S. environmental policymaking. Discusses potential advantages—such as flexibility, cost-effectiveness, and innovation—as well as limitations, including free-riding, selection bias, and monitoring difficulties. Highlights the importance of participant heterogeneity, credible threats of regulation, and information availability in shaping the effectiveness of voluntary programs. Emphasizes the need for rigorous program design and evaluation.
Chapman et al. (2019)	Snohomish County, Washington	Farmer participation; relational values; cultural fit; CREP; program design; qualitative interviews.	This study explores how relational values—such as place attachment, aesthetics, and stewardship identity—influence landowner decisions about participating in CREP. Through interviews with farmers in Snohomish County, the authors show that standard economic incentives often fail when program requirements conflict with cultural or identity-based values. Rigid buffer designs and lack of landowner input were frequently cited as barriers, even when payment levels were adequate. Participation improved when programs were co-designed, flexible, and framed as an extension of farmers' stewardship ethics.

Study	Location	Topics	Notes
			The key takeaway is that effective riparian incentives must balance compensation with cultural alignment, emphasizing adaptive design, trust, and narrative framing that respects landowner identities.
Cheever and McLaughin (2015)	United States	Conservation easement law; legal framework; landowner restrictions; tax incentives; program design	Provides a comprehensive legal overview of conservation easements in the U.S., tracing their development from common law principles to the current mosaic of state and federal statutes. Emphasizes how a “simple concept”—landowners voluntarily limiting development—has evolved into a highly complex and state-specific legal instrument. Discusses key features of easements, including duration (perpetual vs. term), enforceability, public benefit requirements, and tax implications. Highlights challenges for consistency and transparency in easement transactions and management. Suggests that while easements are flexible tools, their legal complexity and variability may create uncertainty for landowners and agencies alike.
Claassen et al. (2008)	United States	Payment design theory; CRP and EQIP; targeting; cost-effectiveness; auctions; Environmental Benefits Index; incentive efficiency.	This study examines the alignment between economic theory and the real-world design of U.S. agri-environmental programs. It highlights how tools such as auctions, scoring systems (e.g., EBI), and spatial targeting can enhance environmental outcomes per dollar spent. However, the authors find that many programs, including EQIP, deviate from these theoretical ideals by relying on flat-rate payments or inconsistently applied scoring criteria. Complexity and opacity in bid ranking systems can deter landowner participation, limiting program reach. The study suggests that tiered or scored payment systems can improve ecological return, but must be transparent and simple to engage landowners effectively. Where full auctions are not viable, structured evaluation tools and targeted outreach can still enhance cost-efficiency.
Cooper and Jacobson (2009)	Northeastern and Mid-Atlantic U.S. (Pennsylvania and surrounding states)	CREP; conservation easements; landowner willingness; long-term riparian protection; legal and financial barriers; sequencing incentives.	This study examines why relatively few CREP participants transition to permanent conservation easements. Survey findings show that while prior program experience and conservation values encourage openness to easements, concerns about control, complexity, and lack of understanding of easement terms are major deterrents. Easements are perceived as legally and financially opaque, especially by landowners unfamiliar with long-term restrictions. Experience with CREP increases interest, suggesting that voluntary buffer programs can serve as gateways. Key lessons include presenting easements as optional follow-ons for highly engaged landowners, providing tailored education, and partnering with trusted local organizations to build confidence in permanent streamside protection.
Cramton et al., (2021)	United States (laboratory simulation study)	CRP auctions; experimental economics; payment structure design; cost-effectiveness; incentive optimization.	Uses lab-based simulations to test how different auction mechanisms affect enrollment, cost, and ecological return. Compares traditional capped-bid formats with reference pricing systems that benchmark acceptable bids using peer distributions. Finds that reference pricing improves truthful bidding and cost-effectiveness by enrolling low-cost, high-benefit lands, whereas fixed caps risk under- or over-subscribing. Recommends adaptive, data-driven payment evaluation systems. Supports use of bonus tiers, reference-based selection, or performance-linked ranking systems to enhance participation and ecological outcomes in constrained funding environments.

Study	Location	Topics	Notes
Earth Economics (2024)	Washington State; includes examples from Oregon and New York	Riparian incentive program design; payment structures; participation barriers; opportunity costs; behavioral economics; program recommendations.	Highlights forgone agricultural income as the central barrier to riparian participation, with behavioral frictions like liquidity constraints and transaction costs compounding the issue. Finds that layered incentives (e.g., annual payments, bonuses, cost-share) are more effective than cost-share alone. Temporary easements are generally preferred to permanent ones. Emphasizes importance of trusted local delivery, simplified enrollment, technical assistance, and interagency coordination. Critiques rigid buffer standards and underused tax incentives. Recommends flexible, performance-based agreements and site-specific buffer plans. Includes lessons from CREP, VSP, SCC pilots, NYC Watershed, and Eugene's Voluntary Incentive Program (VIP) in Oregon. Calls for better outreach, monitoring, and program alignment.
Eigenraam et al. (2006)	Victoria, Australia	Market-based instruments; reverse auctions; payment for ecosystem services; multi-objective environmental policy	Evaluates the EcoTender pilot, a reverse auction used to allocate funding for projects delivering multiple environmental outcomes (e.g., water quality, biodiversity, salinity control). Landowners submitted bids outlining their expected payments for implementing conservation activities, and bids were evaluated based on modeled environmental outcomes and cost-effectiveness. The pilot demonstrated the feasibility of using multi-criteria ecological indices in auction design and found that bundling outcomes improved targeting efficiency. Emphasizes the importance of spatially explicit environmental modeling, transparent selection criteria, and clear landholder communication. Provides early evidence that well-designed auctions can cost-effectively deliver multiple ecosystem services.
Elworth et al. (2015)	United States (multiple watershed case studies).	Watershed governance; program delivery; institutional capacity; collaborative planning; implementation infrastructure.	This report synthesizes lessons from effective watershed conservation projects across the U.S., emphasizing that durable organizational capacity, rather than payment levels alone, drives successful program outcomes. Elworth identifies three core institutional attributes that support effective conservation: collaborative local planning, long-term staffing and technical assistance, and clearly defined governance structures. These elements build trust, sustain partnerships, and support adaptive implementation over time. Importantly, the report argues that even well-funded programs can underperform when delivery systems are weak, lacking trusted local leadership, baseline data, or stakeholder buy-in. In contrast, projects with modest incentives but strong local infrastructure achieved more durable outcomes. This underscores that riparian incentive programs must invest in institutional continuity and community engagement alongside payment design. Social capital, staffing stability, and local trust are foundational to long-term conservation success.
Ferraro (2008)	Global; conceptual and applied PES examples (e.g., Costa Rica, Ecuador, U.S.)	Payments for environmental services (PES); contract design; information asymmetries; targeting; adverse selection	Explores how asymmetric information between buyers (e.g., governments or nongovernmental organizations [NGOs]) and sellers (landowners) affects the efficiency of PES programs. Highlights the risk of adverse selection when payments are not well-targeted—i.e., paying landowners who would have conserved without compensation. Recommends using screening, targeting, and conditional payment strategies to better align incentives and environmental outcomes. Provides a conceptual framework for designing contracts that balance simplicity, administrative cost, and ecological effectiveness. Discusses the tradeoffs between easily implemented contracts and those that

Study	Location	Topics	Notes
			screen for additionality, stressing the importance of adaptive, evidence-based program design.
Ferris and Siikamäki (2009)	United States	CRP and Wetland Reserve Program (WRP) design; cost-effectiveness; environmental targeting; opportunity cost; auction-based payments.	Synthesizes CRP and WRP through an environmental economics lens, highlighting the need to align payments with both landowner opportunity costs and ecological benefit. Critiques CRP's Environmental Benefits Index (EBI) for sometimes failing to incentivize enrollment on high-opportunity-cost or high-ecological-value land. Notes that auction mechanisms can under-compensate landowners in productive regions. WRP's fixed payment structure is more straightforward but lacks flexibility and broad applicability. For this study, key takeaways include the importance of setting minimum payment thresholds, improving ecological scoring alignment with marginal benefits, and designing flexible contracts to appeal to diverse landowner profiles.
Foster (2023)	United States (focus on Iowa; national USDA program context)	Conservation program equity; USDA conservation funding; Environmental Justice; equity indicators; program design.	Assesses equity in USDA conservation funding using NRCS financial assistance data and Environmental Justice (EJ) indicators. Finds that counties with higher proportions of socially disadvantaged farmers received lower per-farmer funding on average. Identifies barriers such as lack of trust in agencies, lower awareness, and administrative burden. Recommends targeting outreach and support, simplifying application processes, and increasing partnerships with trusted local organizations. Emphasizes the role of equity in expanding participation and improving conservation outcomes in underserved communities.
GEI Consultants. (2005)	Washington State	Buffer width; cost-effectiveness; ecological function; voluntary vs. regulatory approaches; flexible buffer design.	This study compares the ecological outcomes and costs of implementing riparian buffers using voluntary, site-specific designs versus fixed-width regulatory models. Using cost-effectiveness analysis, it finds that narrower, flexible buffers (10–33 feet) can achieve significant ecological benefits—such as temperature regulation and sediment filtration—at much lower costs than wide, fixed-width buffers (100–300 feet). In high-value agricultural areas, the opportunity costs of large buffers are prohibitive, with regulatory designs imposing costs up to $200,000 per 100 acres. The report concludes that voluntary, incentive-based approaches with tailored buffer widths are more economically efficient and ecologically sufficient for meeting water quality objectives. The findings support the use of flexible, site-specific buffer designs and voluntary incentives as cost-effective strategies for riparian restoration.
Graziano et al. (2022)	United States (review-based)	Riparian buffer function; biodiversity; ecosystem services; riverscape management; policy integration	Synthesizes ecological evidence and policy considerations to argue that riparian buffers are keystone landscape features delivering high-value ecosystem services, including water filtration, habitat connectivity, flood control, and climate regulation. Emphasizes that policy frameworks often undervalue or inconsistently implement buffer protections, leading to fragmented conservation efforts. Advocates for integrating riparian buffer conservation into broader landscape-scale planning and water policy reforms. While not focused on incentive design per se, the study supports targeting riparian zones in conservation programs as cost-effective, multifunctional investments and highlights gaps in policy coordination and enforcement that voluntary programs might help address

Study	Location	Topics	Notes
Greiner and Gregg (2011)	Northern Australia	Landowner motivations; intrinsic vs. financial incentives; barriers to adoption; behavioral economics; policy design	Surveys of grazers in northern Australia and finds that intrinsic motivations (e.g., conservation ethic, lifestyle goals) are major drivers of conservation practice adoption, often outweighing financial incentives. Identifies strong correlations between motivational profiles and anticipated barriers (e.g., risk, complexity) and receptivity to different policy tools. Suggests that programs risk crowding out stewardship behavior when they over-rely on monetary incentives without aligning with landowners' aspirations. Recommends policy approaches that leverage intrinsic motivations, reduce potential constraints, and recognize heterogeneity across landowners. Provides empirical support for incorporating behavioral dimensions into conservation incentive program design.
Hellerstein and Malcom (2011)	United States	Opportunity cost modeling; CRP participation; market-responsive payments; commodity price elasticity.	Uses economic simulations to show how rising commodity prices increase landowners' opportunity costs and reduce CRP participation. Demonstrates that static rental rates become inadequate during agricultural booms, leading to weaker environmental outcomes as only marginal land remains enrolled. Estimates that a 60% increase in payments would be needed to maintain participation under high-price scenarios. Highlights the elasticity of enrollment and the need for adaptive payment systems. For this study, key lessons include adjusting payments to track market conditions, using forward-looking land value metrics, and targeting high-quality riparian land with differentiated incentives to preserve environmental value.
Hickey and Doran (2004)	Literature review (North America focus)	Riparian buffer effectiveness; nutrient removal; buffer width; landowner constraints; tradeoffs	Reviews empirical studies on vegetative buffer strips and finds that nutrient removal effectiveness is highly dependent on buffer width, with significant benefits generally requiring buffers wider than 30 meters. This creates a tradeoff between ecological effectiveness and landowner willingness to remove land from production. The study underscores a mismatch between the buffer widths needed for water quality protection and what is typically feasible on working farms (1–10 meters). Highlights a key challenge for incentive programs: balancing ecological goals with landowner constraints. Suggests that more empirical research is needed to validate the water quality benefits of narrower buffers commonly implemented under voluntary conservation programs.
Holland and Johnston (2017)	Northeastern United States (case study in Maine)	Spatial heterogeneity in environmental valuation; benefit transfer; targeting ecosystem service investments	Develops and applies a modeling approach to account for spatial variation in willingness to pay for environmental improvements. Demonstrates that using optimized spatial weights (rather than arbitrary distance bands) improves welfare estimates and cost-effectiveness of spatially targeted conservation. Highlights importance of accounting for heterogeneity in both ecological benefits and public values when designing riparian or ecosystem service programs. Relevant for refining ecological targeting and prioritization methods in voluntary conservation programs.
IEc (2022)	Washington State	Riparian incentive program effectiveness; participation barriers; payment design; cost-effectiveness; recommendations for SCC.	Uses economic principles of opportunity cost and cost-effectiveness to assess why some programs succeed and others underperform. Finds that layered payments (e.g., base rental, width bonuses, cost-share) improve uptake, while low rates and rigid criteria deter participation. Highlights CREP and NRI as models due to their flexibility, technical support, and Conservation District delivery. Recommends expanding eligibility (e.g., to non-fish-bearing streams), allowing site-specific

Study	Location	Topics	Notes
			buffers and flexible contracts, and investing in outreach and post-contract support. Calls for a centralized participation database and performance-based bonuses. Cites Skagit County's buffer-width payments and PSAR as promising models.
Jack et al. (2008)	Global (review of incentive-based conservation mechanisms)	Payment design; ecosystem services; participation incentives; program effectiveness; lessons from PES and agri-environment schemes.	Synthesizes empirical evidence from diverse PES and agri-environmental schemes to identify design features associated with effective outcomes. Emphasizes that payment programs must address both opportunity costs and behavioral barriers such as risk, liquidity constraints, and information gaps. Finds that program performance improves when payments are aligned with landowner motivations, when participation is voluntary, and when delivery is locally adaptive. Critiques one-size-fits-all approaches and calls for context-specific, flexible design. Discusses tradeoffs among targeting efficiency, simplicity, and equity. Highlights importance of credible monitoring, clear contracts, and trusted intermediaries.
Khanna et al. (2003)	Illinois	Cost-effectiveness; spatial targeting; CREP program design; ecosystem services; land retirement optimization	This study uses spatial economic modeling to assess the cost-effectiveness of Illinois CREP. It demonstrates that voluntary, uniform-payment enrollment can be inefficient, as landowners may not enroll the parcels with the highest ecological value. By modeling targeted scenarios that maximize sediment and nutrient reductions per dollar spent, the authors show that optimized land selection can achieve greater environmental outcomes at lower cost. For this study, this suggests the value of integrating spatial prioritization and ecosystem service modeling into payment design, with tools that link incentive levels to site-specific ecological returns.
King County (2019)	King County, Washington	Riparian buffer width; agricultural constraints; landowner willingness; restoration design flexibility; salmon recovery	This county report analyzes agricultural landowner perspectives on riparian buffer adoption, particularly concerning standard buffer widths (e.g., 150 feet) and their compatibility with active farming. While not framed in formal economic terms, the findings reflect a cost-benefit orientation: many farmers see rigid buffer rules as reducing farm viability without sufficient offsetting benefits. Issues cited include crop shading, drainage challenges, and flood risks. Landowners showed greater support for variable-width buffers tailored to farm layout and site hydrology. The key takeaway is the importance of flexible, site-specific restoration prescriptions and payment models that account for localized production costs and operational impacts.
Kingsbury and Boggess (1999)	Oregon	Willingness to accept (WTA); contingent valuation; CREP participation; opportunity cost; behavioral barriers; contract design.	This early stated preference study uses contingent valuation and random utility modeling to assess Oregon landowners' willingness to accept payments for CREP enrollment. It finds that average WTA values often exceeded program payments at the time, particularly for irrigated lands, due to high opportunity costs. Non-monetary factors such as contract flexibility, regulatory concerns, and trust also strongly influenced participation decisions. Conservation-oriented landowners and those familiar with federal programs were more likely to participate, while distrust and inflexibility were deterrents. The key lesson is to calibrate payments to land productivity and pair them with transparent, flexible contract terms and community-based outreach to address landowner concerns and improve program uptake.
Kirwan et al. (2005)	United States	Conservation auctions; willingness to accept	Empirically estimates the gap between CRP payments and landowners' true willingness to accept, finding that on average, CRP

Study	Location	Topics	Notes
		(WTA); payment efficiency; auction design; CRP incentives.	overpaid by about 20%. Highlights inefficiencies due to asymmetric information and strategic bidding behavior, particularly under CRP's auction-based enrollment and EBI scoring. Suggests that environmental targeting tools are subject to manipulation and that auctions may not achieve optimal cost-effectiveness. Cautions against overreliance on auctions and encourages exploring alternative structures like transparent scoring, fixed payments with performance bonuses, or outcome-based incentives to improve fiscal efficiency and ecological targeting.
Kline et al. (2000)	Pacific Northwest (Oregon and Washington)	Willingness to accept (WTA); landowner segmentation; timber vs. amenity objectives; opportunity cost variation.	This study estimates WTA among private forest landowners for riparian habitat protection, using a revealed preference framework that accounts for landowner motivations. It finds significant heterogeneity: owners motivated by recreation require much lower compensation than those reliant on timber income. Uniform payments are shown to be inefficient depending on land use type. The key lesson is to segment landowners by objective and tailor both payments and messaging. Highlighting stewardship and recreation benefits may increase participation among amenity-driven owners, while income-oriented landowners may require higher or performance-linked payments to participate.
Latacz-Lohmann and Schilizzi (2005)	Global review	Conservation auctions; auction theory; information asymmetry; cost-effectiveness; participation incentives.	Reviews the theoretical foundations and empirical performance of conservation auctions, focusing on their potential to reveal landowners' opportunity costs and improve cost-efficiency in environmental contracting. Discusses tradeoffs between auction formats (sealed-bid, discriminatory vs. uniform pricing), the role of informational asymmetries, and potential participation deterrents due to complexity or strategic behavior. Argues that while auctions can improve allocation efficiency under ideal conditions, real-world frictions often undermine theoretical gains. Highlights the importance of auction design (e.g., reserve prices, quality-weighted scoring) and cautions that transaction costs and participation barriers must be carefully managed to avoid reduced enrollment or inequitable outcomes. Recommends combining auctions with advisory support and simplified procedures to improve accessibility and ecological performance.
Lewis et al. (2017)	Arkansas	Riparian buffer valuation; willingness to pay (WTP); water quality benefits; stated preference methods.	Uses a choice experiment to estimate the WTP of Clear Creek Watershed residents for various riparian buffer attributes (e.g., native vs. non-native vegetation, public access, width). Finds significant WTP for wider buffers and native vegetation, suggesting that riparian programs may generate broad public support. Results show spatial heterogeneity in preferences and underscore the potential for public values to inform riparian policy and incentive design.
Lute et al. (2018)	Nebraska (Great Plains)	Landowner motivation; CRP; practitioner–landowner relationships; stewardship; administrative burden.	This mixed-methods study investigates landowner and conservation practitioner perspectives on CRP participation in Nebraska. It finds a disconnect between how practitioners and landowners perceive conservation motivations: while practitioners assume profit drives participation, many landowners value ecosystem services (e.g., pollinators, wildlife) and express stewardship-oriented motivations. Both groups identify complexity of rules and administration as a key barrier to participation. CRP rule rigidity and lack of relational outreach hinder effectiveness. Contrary to practitioner assumptions, demographic factors (e.g., age, farm type) did not significantly

Study	Location	Topics	Notes
			influence participation decisions. The study highlights the need for improved communication and trust-building between practitioners and landowners and suggests that acknowledging non-financial motivations may broaden and sustain engagement.
Lutter et al. (2018)	Pennsylvania private lands enrolled in Working Lands for Wildlife	Outreach strategies; behavioral economics; conservation adoption; monitoring feedback; technician engagement; randomized controlled trial.	This behavioral study uses a randomized controlled trial to evaluate how different outreach methods influence conservation action. Landowners who received in-person visits from conservation technicians—delivering site-specific biological monitoring results—were significantly more likely to adopt recommended practices such as delayed mowing and invasive species removal. Mailed outreach had minimal effect, highlighting the power of personal engagement. The results suggest that trust and interpersonal interaction can outperform financial incentives alone. The key insight is that building technician capacity and delivering tailored feedback through trusted messengers can significantly boost program effectiveness and landowner follow-through.
Ma et al. (2012)	United States (national survey)	Program participation drivers; cost-share; conservation easements; forest certification; landowner segmentation.	This study uses data from the National Woodland Owner Survey to examine which family forest owners participate in conservation programs and why. Larger parcel size was strongly associated with participation across cost-share, certification, and easement programs. However, income and age were not significant predictors, challenging assumptions about targeting lower-income or older landowners. Access to forest management information played a mixed role, depending on the program type and source of outreach. Participation in one program increased likelihood of participation in others (e.g., certification more likely among cost-share participants). The authors recommend segmenting audiences by landownership size, land use goals, and motivations when designing outreach and eligibility requirements. Highlights the limits of one-size-fits-all recruitment and underscores the distinct behavioral dynamics surrounding easement decisions compared to other conservation tools.
Malcher et al. (2023)	Australia	Riparian buffer width; tradeoff modeling; ecosystem service valuation; opportunity costs; economic-ecological optimization.	This paper develops a quantitative framework for assessing tradeoffs between ecological benefits and economic costs associated with different riparian buffer widths on agricultural land. Using bioeconomic modeling and empirical field data, the authors demonstrate that wider buffers deliver disproportionate ecological gains (e.g., for habitat quality, nutrient retention), but at increasing opportunity costs for farmers. The study introduces a flexible decision-support tool that allows planners to identify buffer widths that optimize ecological outcomes within defined budget or land-use constraints. It highlights the value of site-specific ecological and economic data in tailoring incentives and designing scalable restoration strategies. The framework can inform outcome-based or tiered payment structures that link compensation to ecological performance.
Mercer et al. (2010)	United States	Payments for ecosystem services; forest conservation; participation barriers; program intermediaries; administrative burden.	This report inventories PES programs across the U.S. focused on forest carbon, water quality, and biodiversity, identifying payment levels, participation rates, and implementation barriers. Although PES theory is well established, the authors find that uptake remains limited due to transaction costs, risk aversion, administrative complexity, and uncertainty about payment durability. Programs that performed best simplified enrollment, reduced landowner risk, and offered co-benefits like technical assistance and local recognition. The study reinforces that effective riparian incentive programs must reduce administrative burden, communicate clear value to landowners, and leverage trusted

Study	Location	Topics	Notes
			local intermediaries. Streamlining access, de-risking participation, and bundling ecosystem co-benefits may enhance uptake in competitive land use contexts.
Miao et al. (2016)	United States	CRP cost-effectiveness; crop insurance interactions; fiscal externalities; environmental targeting; program evaluation.	Analyzes CRP's cost-effectiveness while accounting for avoided crop insurance subsidies, which are often excluded from traditional evaluations. Finds that land retirement through CRP reduces exposure to federal disaster payouts, enhancing program fiscal efficiency. Critiques the Environmental Benefits Index (EBI) for failing to reflect these co-benefits, arguing for an expanded accounting framework. The finding suggests incorporating avoided public costs (e.g., flood risk reduction) into payment design and scoring criteria, and coordinating with complementary programs to maximize cost-effectiveness and ecological returns. Highlights the value of stacked benefits in riparian restoration justification.
Naidoo and Adamowicz (2006)	Paraguay	Opportunity cost modeling; conservation targeting; spatial planning; agricultural expansion; PES cost-effectiveness.	Develops a spatially explicit model to estimate opportunity costs of land conservation in landscapes transitioning from forest to agriculture. The model integrates land-use change probabilities with economic returns from agriculture to calculate land values, expressed as net present value. Applied to eastern Paraguay, it identifies areas where conservation would forgo high-value agriculture and others where costs are relatively low. Highlights the importance of incorporating opportunity cost heterogeneity into conservation planning. Shows that targeting based solely on ecological criteria may be inefficient, and that integrating economic data improves the cost-effectiveness of reserve selection and payment-for-ecosystem-service (PES) programs in dynamic landscapes.
Naiman et al. (2005)	Pacific Northwest and global case studies	Riparian ecosystem function; heterogeneity; restoration design; disturbance regimes; biodiversity	This chapter synthesizes ecological theory and empirical evidence demonstrating that spatial and temporal heterogeneity is central to the structure and function of riparian ecosystems. The authors highlight how hydrologic regimes, disturbance patterns, and biological interactions generate natural variation in riparian form and function—variation that supports biodiversity, resilience, and nutrient cycling. The paper cautions against oversimplified restoration approaches that ignore this variability and recommends that riparian conservation efforts embrace heterogeneity as a design principle. Implications for incentive programs include the need to allow site-specific flexibility, promote dynamic rather than static buffer goals, and invest in long-term ecological monitoring to account for change over time. The chapter provides a strong ecological rationale for tailoring buffer widths and management to local geomorphic and ecological conditions rather than relying on uniform standards.
Newburn et al. (2024)	Maryland	Incentive design; riparian buffer adoption; discrete choice experiments; upfront vs. annual payments; performance-based bonuses; behavioral economics.	This study uses experimental economics to test how alternative financial incentives affect landowner preferences for riparian buffer enrollment. Survey-based choice experiments and pilot trials show that one-time upfront payments are more effective than annual payments, particularly for landowners with short planning horizons or liquidity constraints. Site-specific performance bonuses improved cost-effectiveness and ecological targeting. Carbon offset payments were less compelling to landowners. Findings stress that simplicity, trust, and alignment with landowner values matter as much as payment size. The study supports behaviorally informed payment models with flexible, upfront options and site-specific bonuses to boost participation and ecological return.

Study	Location	Topics	Notes
Office of Inspector General (2023)	United States	CRP payment structure; opportunity cost alignment; adaptive payment policy; enrollment trends.	Evaluates 2021–2022 changes to CRP payments in response to enrollment decline. Emphasizes the need for payment rates to reflect landowners' opportunity costs, which fluctuate with local rental markets and commodity prices. Reviews USDA's adjustments to Soil Rental Rates (SRRs), Practice Incentive Payments (PIPs), and Signing Incentive Payments (SIPs), noting modest enrollment improvements and regional variation in effectiveness. Identifies lag in rate adjustments as a core issue. Recommends dynamic, regularly updated payment models indexed to transparent economic indicators. Fixed-rate structures risk losing competitiveness during market shifts—relevant for programs seeking to remain attractive over time.
Oregon Watershed Enhancement Board (OWEB) (2015)	Willamette Basin, Oregon.	Riparian revegetation; ecological outcomes; site-specific restoration; adaptive management; collaborative implementation.	This multi-year monitoring study of 63 riparian projects highlights the importance of flexible, site-specific restoration approaches and peer learning in improving ecological outcomes. While economic theory is not explicitly discussed, the findings align with ecological economic principles: tailoring implementation, empowering practitioners, and enabling adaptive co-learning improves return on investment. Success was most likely where projects leveraged multiple funding streams (e.g., CREP, SWCD, Clean Water Services), involved local contractors, and avoided rigid buffer templates. The key takeaway is that investments in riparian restoration are more effective when implementers can customize plans, collaborate locally, and adapt based on on-the-ground feedback—suggesting a need for flexible funding and support for innovation.
Owen (2008)	Kentucky (Green River Basin)	CREP; Regional economic impact; input-output modeling; landowner income; permanent easements; rural development.	This study quantifies the economic ripple effects of Kentucky's Green River CREP using input-output analysis. It estimates that over $51 million in direct payments—mainly through rental agreements and permanent easements—generated over $83 million in total economic output, supporting not only landowners but also local contractors for fencing, planting, and restoration. The study emphasizes that CREP income helped stabilize farm revenue and contributed to rural economic resilience. Landowners cited long-term income security and conservation goals as key motivations for enrolling in permanent easements, though concerns about flexibility and land-use restrictions were noted. This case demonstrates how conservation programs can deliver broader community benefits, especially when designed to inject funds into local economies and support permanent land protection.
Owley (2011)	United States	Conservation easements; property law; legal reform	Argues that perpetual conservation easements may not be appropriate in a dynamic ecological and legal context. Critiques the rigid, static nature of perpetual easements and raises concerns about democratic accountability, intergenerational equity, and ecological adaptability. Suggests that long-term but time-limited easements, combined with adaptive legal mechanisms, may offer a more balanced approach to conservation in the face of climate change and evolving land use pressures. Offers a legal perspective distinct from ecological or economic framings.
Peak Sustainability Group (2023)	Skagit County, Washington	Behavioral economics in conservation; incentive design pilots; payment bonuses; CREP alternatives; collective participation strategies.	Pilot tested five targeted incentive strategies, including collective bonuses, threshold-based rewards, CREP payment supplements, buffer width bonuses, and flexible planting options. Grounded in behavioral economics, the approach emphasized reducing complexity, enabling group-based participation, and tailoring incentives to local conditions. Found that simplified processes, technical assistance, and trusted local outreach improved participation. However, concerns about long-term obligations and lack of maintenance support limited

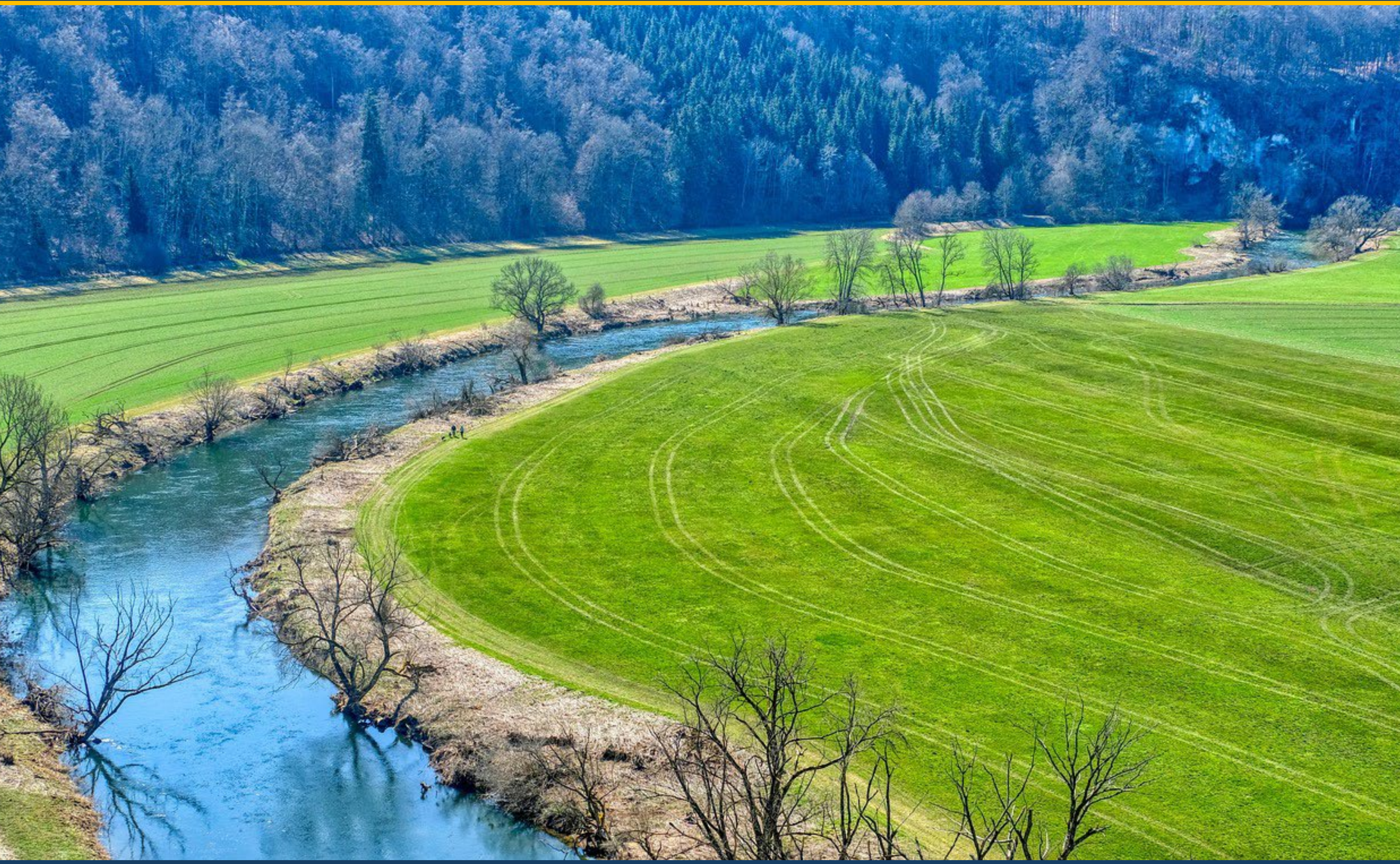
Study	Location	Topics	Notes
			some interest. CREP was criticized for inflexibility and low payments. Recommends expanding flexible, bonus-based models and peer-driven outreach to reduce landowner costs and increase ecological outcomes.
Riis et al. (2020)	Global synthesis	Ecosystem services; riparian vegetation; multifunctionality; biodiversity; climate adaptation; water quality.	This global review synthesizes over 1,200 studies to document the diverse ecosystem services delivered by riparian vegetation. It emphasizes the multifunctionality of riparian zones, which provide provisioning (e.g., fiber), regulating (e.g., nutrient retention, erosion control), cultural (e.g., recreation), and supporting (e.g., habitat connectivity) services. The authors highlight the role of native vegetation in maximizing ecological benefits and stress that narrow or degraded buffers often underperform. The paper calls for integrated policy approaches that recognize riparian areas as high-leverage investments in biodiversity, climate resilience, and water quality. It offers strong justification for spatial targeting of restoration and protecting intact buffers to secure long-term social and ecological returns.
Rissman (2010)	United States (case examples from California, Wisconsin, and across the U.S.)	Conservation easement design; land management flexibility; monitoring and enforcement; adaptive management.	Analyzes how perpetual conservation easements can incorporate flexibility for long-term land management while maintaining enforceable conservation outcomes. Finds that easement agreements increasingly include provisions for allowed land uses, amendment procedures, and adaptive management, though legal, administrative, and funding constraints can limit these innovations. Emphasizes the need to balance permanence with adaptability in dynamic ecological and social systems. Recommends clear documentation of purposes, decision-making procedures, and performance standards to support durable yet responsive conservation outcomes. Suggests that effective stewardship may depend as much on landowner–easement holder relationships and funding for monitoring as on legal structure.
Ryan et al. (2003)	Midwestern United States	Landowner motivations; riparian buffer adoption; conservation behavior; psychological factors; stewardship values.	This study uses qualitative and survey methods to explore what motivates farmers to adopt riparian conservation practices in a Midwestern agricultural watershed. It finds that stewardship ethics, aesthetic appreciation, and desire to protect family land for future generations are more powerful motivators than financial incentives alone. Farmers who adopted riparian practices often cited personal responsibility, environmental concern, and community leadership as key drivers. The research suggests that conservation programs may improve uptake by emphasizing shared values, providing recognition, and fostering a stewardship identity, in addition to offering financial support. It highlights the importance of framing, social norms, and cultural context in influencing participation decisions.
SCC (2017)	Washington State	CREP implementation; riparian vegetation outcomes; maintenance and follow-up; re-enrollment patterns; ecological monitoring; technical assistance.	While not explicitly grounded in economic theory, this monitoring report provides evidence that long-term ecological success under CREP hinges on sustained technical assistance and maintenance—suggesting that effective incentive design must go beyond one-time payments. Sites receiving follow-up support showed high vegetation survival (>90%) and improvements in canopy and bank stability, while those without declined in quality. Counties with strong outreach and simplified administration saw higher re-enrollment rates, reinforcing the role of perceived value and implementation ease in sustaining participation. The findings highlight the need to incorporate

Study	Location	Topics	Notes
			maintenance funding and adaptive guidance into program budgets and to ensure that outreach and technical support are equitably distributed across regions.
SCC (2022)	Washington State	CREP; Monitoring outcomes; re-enrollment; invasive species; buffer maintenance; stream visual assessment; ecological effectiveness; adaptive management.	This report assesses riparian restoration outcomes from CREP projects implemented across Washington in FFY 2022, using field monitoring and the Stream Visual Assessment Protocol (SVAP2). Although economic theory is not directly discussed, the findings reinforce that sustained ecological benefits depend on ongoing maintenance and adaptive management—key considerations for cost-effectiveness. Across 17 monitored sites and 20 SVAP2 evaluations, plant density and canopy cover remained strong (72% on smaller streams), and re-enrollment rates reached 83%, suggesting landowner satisfaction where support was adequate. However, invasive species (e.g., reed canary grass, blackberry) and site-specific issues such as livestock intrusion reduced overall ecological performance. Only 35% of sites met SVAP2 thresholds for "functioning" riparian systems. The report highlights the importance of incorporating post-contract stewardship funding, simplifying re-enrollment procedures, and tailoring maintenance guidance to local conditions to improve long-term program success.
Schueler (2000)	United States	Ecosystem service valuation; public infrastructure; riparian buffers; cost-benefit framing; incentive justification.	This synthesis presents riparian buffers as public infrastructure delivering valuable services like flood control and water purification. It argues that buffers wider than 100 feet are most effective but often underprovided because private landowners bear the costs while society benefits. Schueler advocates for public investment and landowner payments to correct this market failure. He also links buffer programs to avoided public costs (e.g., stormwater treatment) and long-term economic returns. This reinforces the case for using ecosystem service valuation to justify riparian investments, and for integrating buffer incentives into broader infrastructure and capital planning.
Shoemaker (1989)	United States (national scope)	Conservation Reserve Program (CRP); land value capitalization; rental markets; agricultural policy impacts.	This study examines how the CRP influences agricultural land values and rental rates. It finds that CRP payments are capitalized into land values, particularly in areas with high enrollment, leading to increased land prices. The research highlights that landowners may experience higher rents due to CRP-induced land scarcity, while the overall impact on land values depends on factors like program participation rates and regional land market conditions. The study underscores the importance of considering market effects when designing conservation programs.
Snider (2000)	Arizona	Natural capital; ecological economics; ecosystem services valuation; restoration framing; public investment justification.	This conceptual paper frames riparian restoration as an investment in natural capital, emphasizing the long-term value of ecosystem services like flood mitigation, water purification, and habitat provision. Drawing on ecological economics, Snider argues that society, like private firms, must account for depreciation and reinvest in capital—here, ecological infrastructure. The author advocates for natural capital budgeting to evaluate restoration outcomes, suggesting that conventional cost-benefit models often understate ecological returns. Though the paper does not analyze specific payment mechanisms, its insights are highly relevant to public funding strategy. This reinforces the importance of ecosystem service valuation in justifying riparian investments,

Study	Location	Topics	Notes
			broadening the lens beyond short-term project costs to include sustained natural capital gains.
Song et al. (2014)	U.S. Northern Region (multiple states, family forest owners)	Conservation easements; family forest owners; management behavior; stewardship incentives; propensity score matching; land protection vs. active management.	This study uses national survey data and propensity score matching to evaluate whether conservation easements influence landowner behavior. Easement holders were significantly more likely to develop formal forest management plans, indicating stronger engagement in planning. However, easements did not lead to increases in active forest management practices such as thinning or habitat improvements. The findings highlight that while easements help secure land use objectives, they do not guarantee ecological enhancement. This suggests that permanent riparian easements should be paired with technical support or practice-based incentives to promote active stewardship and ensure long-term ecological outcomes.
Stillwater Sciences (2017)	Oregon	CREP; Riparian buffer effectiveness; ecological outcomes; vegetation establishment; livestock exclusion; regional implementation differences; maintenance support.	This monitoring report evaluates vegetation and streambank condition across CREP sites in Oregon, highlighting that strong ecological outcomes depend on site conditions and consistent post-planting support. While not grounded in economic theory, the findings reinforce the value of adaptive management and technical assistance for improving cost-effectiveness. Sites in eastern Oregon showed the greatest gains in native woody cover and bank stability. Conversely, poor outcomes were associated with inadequate livestock exclusion, limited maintenance, or non-adaptive prescriptions. The study supports the importance of localized buffer guidance, enforcement capacity, and flexible design standards to ensure durable ecological performance.
Stoneham et al. (2003)	Victoria, Australia	Conservation auctions; cost-effectiveness; market-based instruments; program design.	Evaluates the BushTender pilot, one of the first real-world applications of conservation auctions for biodiversity outcomes. Finds that auction mechanisms can achieve more conservation per dollar spent compared to fixed-price approaches, as landholders reveal their private costs of conservation. Emphasizes the importance of clear ecological scoring metrics and transparent bid ranking for participant trust. Reports high landholder satisfaction and significant biodiversity gains at lower cost, demonstrating the potential for scalable, performance-based incentive programs.
Stutter et al. (2019)	Europe and international (with emphasis on EU and global literature)	Riparian management effectiveness; multiple benefits; tradeoffs; technical innovations; agricultural water quality policy.	This review synthesizes recent European and international evidence on the effectiveness of riparian management practices—especially vegetated buffer strips—in improving water quality and delivering additional ecosystem services. Outcomes vary widely depending on buffer width, vegetation type, hydrology, and landscape context. The study highlights the difficulty of achieving multiple co-benefits (e.g., biodiversity, flood mitigation) and emphasizes the value of adaptive management, spatial targeting, and integrated design. Though not focused on economics, the paper aligns with key themes in incentive design, including cost-effectiveness, outcome variability, and the importance of monitoring. The authors advocate for payment and regulatory schemes that reflect site-specific hydrological dynamics and support flexible, outcome-oriented policy frameworks.
Suter et al. (2008)	Six U.S. states participating in CREP (with focus on CP22	CREP; Discrete choice modeling; financial incentives; signup bonus (SIP); rental payments;	This study uses discrete choice modeling to evaluate how landowners respond to different CREP incentive types—annual payments, one-time signup bonuses (SIP), and cost-share. Findings show that SIPs are especially effective at increasing participation at lower cost than

Study	Location	Topics	Notes
	riparian buffer practice)	cost-share; landowner behavior; program efficiency.	increasing annual payments, and cost-share incentives also matter but to a lesser extent. Flat-rate payment structures reduce strategic bidding and encourage enrollment on lower-cost, higher-benefit lands. This supports using a mix of upfront and practice-based incentives delivered through simple, fixed offers to boost participation.
Sweeney & Newbold (2014)	United States (National scope)	Riparian buffers; water quality; ecological effectiveness; buffer width; science-policy guidance.	This literature review evaluates over 100 studies to assess the minimum buffer widths needed to protect aquatic ecosystems, concluding that 30 meters (100 feet) of forested buffer are generally necessary to safeguard water quality, habitat structure, and aquatic biota. The review finds that narrower buffers often fail to provide sufficient protection, especially for ecological integrity and biogeochemical processes, and argues for buffer standards to reflect these science-based thresholds. Although the study does not address economic incentives directly, its implications are highly relevant to riparian incentive program design. It provides strong empirical justification for performance-based payment models that reward ecologically adequate buffer widths and support forested vegetation. The authors emphasize that most regulatory and voluntary programs underestimate necessary widths, suggesting that scientifically grounded standards are essential for both effective policy and cost-effective investment.
Thapa et al. (2024)	High Plains Region	CRP participation; Theory of Planned Behavior; behavioral economics; social norms; conservation psychology.	Applies the Theory of Planned Behavior to assess landowner CRP enrollment decisions, finding that peer norms and community legitimacy strongly influence participation. While financial incentives are important, social support was the most significant predictor of enrollment. Programs seen as locally endorsed and socially accepted outperformed those viewed as externally imposed. Highlights the value of pairing economic incentives with peer-based outreach, trust-building, and norm-shaping strategies to improve adoption and legitimacy of riparian conservation programs.
Trenholm et al. (2013)	Eastern Canada (Cornwallis River watershed, Nova Scotia)	Cost-benefit analysis; riparian buffer restoration; water quality; non-market valuation; benefit transfer	Conducts a cost-benefit analysis of implementing riparian buffer zones using biophysical modeling and economic valuation. Water quality benefits were estimated via avoided treatment costs and recreational use value based on benefit transfer. Results show that the net benefits of riparian buffer implementation exceed the costs in several scenarios, particularly when buffers reduce sediment and nutrient loads in drinking water sources. The study highlights the importance of spatial targeting and ecosystem service valuation in justifying riparian conservation investments.
U.S. Government Accountability Office (GAO) (2024)	United States	CRP land selection; ecological targeting; opportunity cost; cost-effectiveness; environmental outcomes.	Assesses USDA's land selection process in CRP and its impact on environmental outcomes. Emphasizes cost-effectiveness principles, advocating for better alignment between payment offers and ecological potential. Critiques overreliance on low-productivity land, which may yield weak ecological returns. Recommends using spatial and ecological modeling to prioritize high-value areas—even if higher payments are needed to secure enrollment. For this study, this underscores the need to link payment design with ecological targeting and to adjust payments upward in high-opportunity-cost areas to achieve greater environmental benefit. Supports integrating ecological scoring into incentive frameworks.

Study	Location	Topics	Notes
Whitten and Shelton (2005)	Australia	Market-based instruments; ecosystem services; riparian incentives; program design; case studies	Reviews practical implementation of market-based instruments (MBIs) for ecosystem services, with emphasis on riparian and biodiversity outcomes. Describes several Australian case studies (e.g., BushTender, EcoTender, River Tender) illustrating the importance of cost-effectiveness, ecological targeting, and contract flexibility. Highlights that successful MBIs incorporate spatial prioritization, performance-based criteria, and landholder engagement. Stresses the need for clear ecological objectives, monitoring frameworks, and institutional capacity. Provides guidance on designing tradable instruments and incentive structures tailored to ecosystem service delivery.
Yu and Belcher (2011)	Saskatchewan, Canada.	Stated preference methods; willingness to accept; wetland and riparian conservation; landowner segmentation; opportunity cost heterogeneity.	This study uses contingent valuation methods to estimate landowners' willingness to accept (WTA) payments for implementing wetland and riparian conservation practices. The authors find significant heterogeneity in WTA values, driven by economic reliance on agricultural income and individual conservation attitudes. Producers with high income dependency on land required larger payments to participate, while those with stronger conservation values or long-term land stewardship goals expressed lower WTA. The findings suggest that flat-rate or uniform incentives may be inefficient in settings with diverse landowner profiles. Tailored offers that reflect economic tradeoffs and behavioral motivations are likely to increase uptake and improve cost-effectiveness. This supports differentiated payment structures that align with landowner typologies and local opportunity costs, as well as outreach strategies that appeal to both economic rationales and conservation-oriented values.



TOOLBOX

Designing Incentive Payments for Riparian Conservation

August 29, 2025

Industrial Economics, Incorporated (IEc)
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Toolbox Contents

Purpose and Uses of Toolbox

This toolbox is designed to provide a practical framework for establishing a payment-to-landowner strategy to encourage voluntary participation in riparian conservation programs. Many of these programs rely on the willingness of private landowners to implement land management practices that protect and enhance riparian ecosystems. However, participation often requires landowners to bear direct and indirect costs—whether through lost revenue or increased labor or maintenance expenses. This toolbox aims to help conservation program managers and project participants recognize, quantify, and fairly compensate for those costs to accelerate riparian conservation objectives.

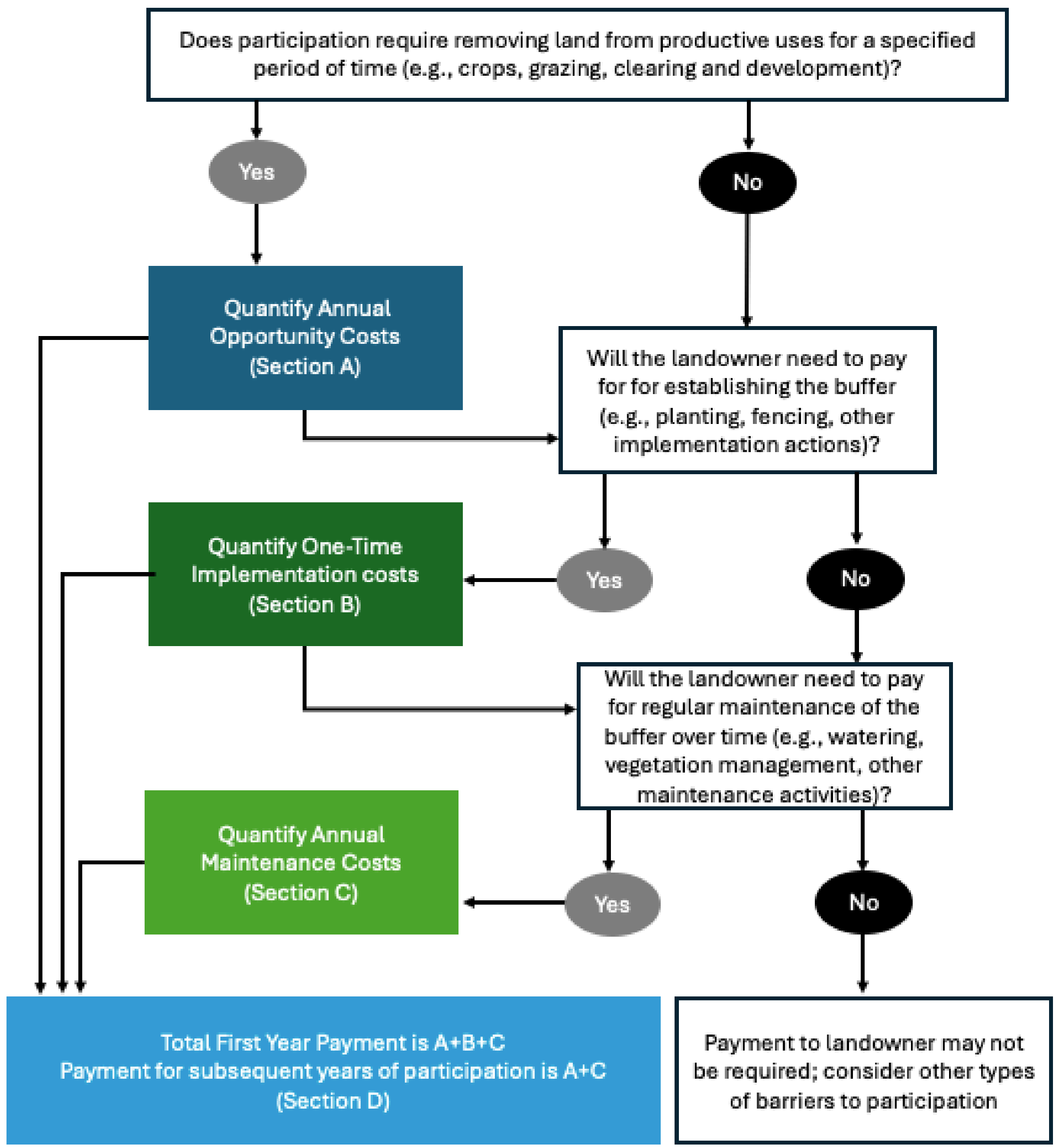
The toolbox outlines the range of costs landowners may face when altering land use or management for conservation purposes. It provides guidance on appropriate methods for estimating these costs, tailored to specific land use types, and identifies relevant data sources that can inform cost assessments. In addition, it provides a structured framework to evaluate the relative cost-effectiveness of enrolling parcels which offer varying levels of public benefit at varying costs. By providing consistent and transparent methodologies, the toolbox supports the development of fair compensation offers that are grounded in the real economic tradeoffs faced by landowners.

Importantly, this toolbox is not a substitute for direct engagement with landowners and local experts. On-the-ground realities and individual circumstances vary widely and can significantly influence the actual costs and benefits of conservation participation. Therefore, the framework presented here is intended to complement, not replace, that engagement. By combining the structure and data offered in this toolbox with meaningful collaboration, program managers can more effectively support landowner participation and advance shared conservation goals.

Throughout the toolbox we refer to relevant sections of the following document (henceforth, the “report”) where interested readers can find additional information about specific topics, including the underlying social science research and more detailed descriptions of how to apply methods in the toolbox:

Industrial Economics, Inc. (IEc). 2025. Economic Incentives for Riparian Conservation. Prepared for Washington State Conservation Commission.

High-level Decision Framework



Section A | Estimating Opportunity Costs

When are opportunity costs relevant?

Estimate opportunity costs when participation in the program requires landowners to remove land from other productive uses for a specified period of time (e.g., 15 years).

Opportunity costs measure the foregone net economic value to the landowner due to the land use change.

For working lands (e.g., cropland, pasture, timber), opportunity cost is typically the most significant cost of participation in voluntary conservation programs.

Opportunity costs are generally paid annually during the participation period. Frontloading the opportunity cost payments, when feasible, may provide added incentives for landowner participation.

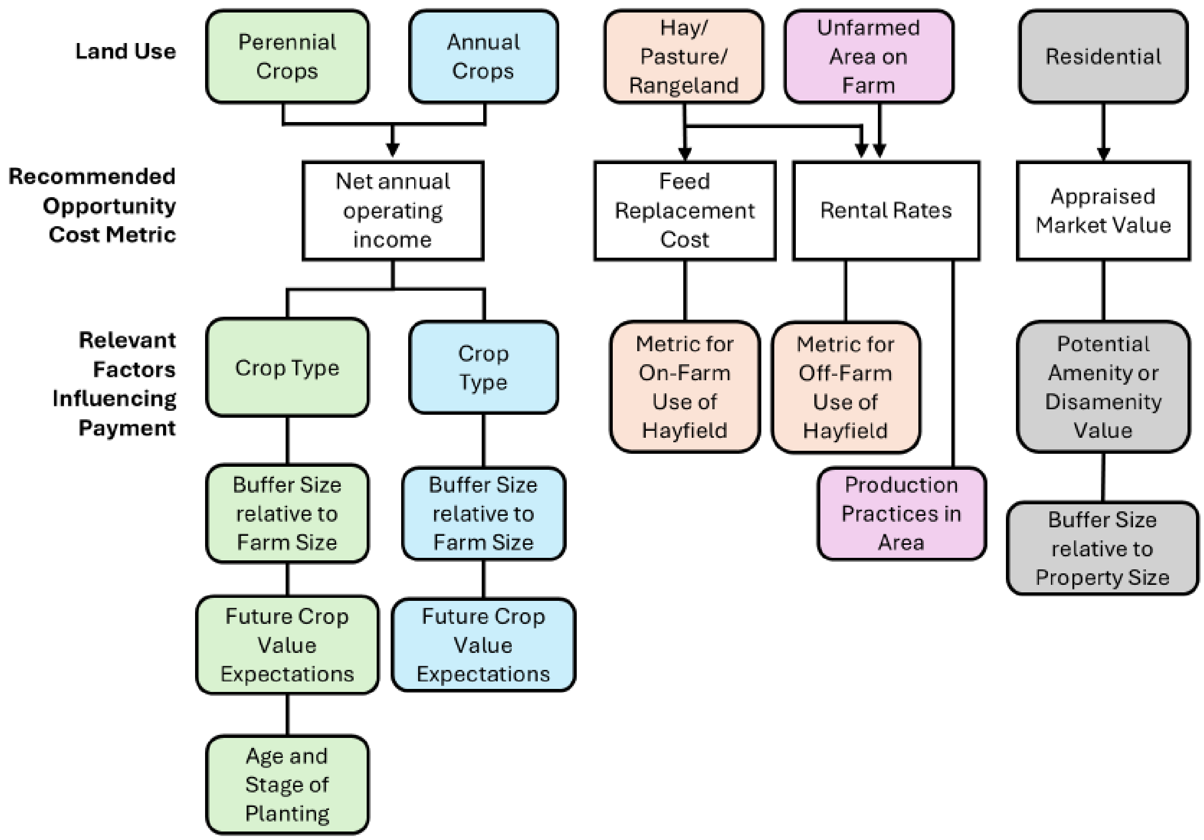
What is the best measure of opportunity cost?

For cropland the best measure of annual opportunity cost is **net annual operating income** (also called net farm income or net return) associated with land to be enrolled in the buffer program. It is the producer earnings after accounting for all costs of producing the crops (i.e., the profitability of the cropland).

For hayfield, pasture, and rangeland, the best measure depends on the use of the hay produced. If the field is used to produce hay as a marketable commodity, it should be treated as cropland. If the field is instead producing hay for use on the farm (or direct grazing of livestock), consider calculating the **feed replacement cost** as the opportunity cost. For leased or unfarmed (idle) areas, we recommend measuring opportunity cost based on **pasture or land rental rates**, as relevant.

For residential land, riparian buffers may be an amenity with little opportunity cost or can represent loss of water views or use of the land area. At the upper limit, we recommend compensating the landowner based on the **appraised market value** of the buffer land. Given participation in the voluntary conservation programs is typically over a defined period, the annual payment during the period of participation should reflect an annualized market value.

Opportunity Cost Metrics and Important Factors to Consider



A.1 Opportunity Cost for Cropland

Site Characteristics	Relevant Opportunity Cost Metric (annual payments)*	Data Required to Calculate Annual Payment
Cropland • Buffer is small fraction of total farm size (does not threaten viability of farm but does reduce acres in production) • Production cannot be offset by utilizing idle land or leasing comparable land	**Net annual operating income** Subtract operating (variable) costs from gross revenues *(average gross revenue – average variable costs)*	• Crop type • Gross revenues per acre per year: ○ Average yield per acre per year (5-year average) ○ Average price per acre per year (5-year average) • Annual operating (variable) costs
Cropland • Production can be offset by utilizing comparable idle land or leasing comparable land	**Lease value** Foregone potential income from leasing idle land or incurred cost of leasing comparable land *(annual lease rate)*	• Annual cost of leasing comparable land ○ If unavailable, soil rental rates or rental rates for cropland (irrigated or non-irrigated)
Cropland • Buffer eliminates most or all of the land available for cultivation, making the farm unviable for commercial cultivation	**Annualized market value of agricultural land** *(market value x discount rate)*	• Appraised market land value • Commercial agriculture loan rate (discount rate proxy)
Cropland • Screening-level analysis when data (e.g., crop enterprise budgets) are not available	**Net annual income** Calculated as a simple percentage of gross revenue *(average yield x average price x average profit margin)*	• Crop type • Gross revenues per acre per year: ○ Average yield per acre per year (5-year average) ○ Average price per acre per year (5-year average) • Average profit margin (e.g., county-level)

* Opportunity costs should be estimated based on the displaced crop(s). Generally, this will be the crop located in the riparian zone, but it may be possible to reconfigure the farm such that production of a lower valued crop is displaced.

Considerations for Estimating Site-specific Opportunity Costs for Cropland

Site specific data preferred: Programs should rely on site-specific data based on landowner and local expert knowledge, wherever feasible. Publicly available data sources (as identified below) provide helpful insight but are limited in terms of their geographic and context specificity.

Annual values for annual payments: Where programs specify a period of participation (15-years), payments should be made annually during the period of participation. Net annual income metrics reflect the average annual opportunity cost.

Appraised market values for land are not annual values but instead are a representation of the discounted flow of annual returns associated with future uses of the land. To include in an annual payment, the appraised market values should be converted to an annualized value and paid over the period of participation.

Compensating for establishment and infrastructure costs (sunk costs): Generally, we assume crops would otherwise be in full production for the duration of the incentives program participation period. Establishment and infrastructure costs are incorporated into the crop budgets utilized to estimate the annual opportunity costs as annual net operating income. That is, the method described above compensates landowners annually for sunk costs. However, if the contract is initiated early in the crop production cycle, program managers may consider instead compensating the full sunk costs (for establishing the crop field) in the form of a one-time, up-front payment, and then compensating annually for remaining opportunity costs.

Screening-level calculation of net annual income: For some crops, particularly annual crops, detailed crop budget data may not be available. Additionally, programs may want to understand at a screening-level, the potential opportunity costs to ag landowners. In these cases, a simple calculation of profitability may be of use. This requires multiplying average gross revenue by the expected profit margin.

Appraised market land values: Note that the land value metrics should reflect market values (an estimate of what the land would sell for in the open market). Not all land appraisals target this value. For example, county assessors appraise land for tax purposes and may underestimate the full market value. For this reason, it is best to obtain a professional appraisal of market value for site-specific information.

Method for Annualizing Market Values for Land

To annualize the appraised market value of the land, multiply the market value by a **discount rate** that reflects the opportunity cost of capital. In the context of the agricultural land, the commercial agriculture loan rate serves as a proxy for the discount rate.

Annualized value = Market Value of Land × Commercial Agriculture Loan Rate

This approach treats the land value as a perpetuity, assuming the land could be sold or rented indefinitely, and estimates its equivalent annual value to the landowner. This annualized value is what should be included in the annual payments.

Sources of Data for Estimating Cropland Opportunity Costs

Washington State University (WSU) Washington Enterprise Budget for Crop Commodities

- Available for many high-value, perennial crops
- Gross revenues per acre
- Variable costs per acre
- Total establishment costs per acre

USDA National Agricultural Statistics Service (NASS) Quick Stats

- Crop yield (county-level)
- Crop price (county-level)
- Average producer profit margin (county-level: reported farm income ÷ total gross revenue)
- PPITW (Prices Paid Index for Commodities and Services, Interest, Taxes, and Wage Rates)

USDA Farm Service Agency Commercial Agricultural Loan Rate for annualizing market values for land

Inflation adjustment: If utilizing data from prior years, values should be adjusted to the current dollar year. Prices can be adjusted using a general inflation index such as the **GDP Price Deflator**, while producer costs are best adjusted using the **PPITW**. Alternatively, all values can be adjusted to current dollars assuming 3 percent inflation annually.

Opportunity Cost for Hay, Pasture, Rangeland, and Unfarmed Areas of Farm[1]

Site Characteristics	Relevant Cost Metric	Data Required to Calculate Annual Payment
Hayfield, pasture, rangeland • Use can be offset by utilizing comparable idle land or leasing comparable land	**Lease value**	• Rental rates for pasture or cropland (irrigated or non-irrigated)

Hayfield, pasture, rangeland
• Use cannot be offset by utilizing comparable idle land or leasing comparable land
	Feed replacement costs
	
	(hay yield per acre x $/ton for hay)
		• Hay yield (tons) per acre
		  ○ Animal Unit Months (AUMs) per acre
		  ○ Tons of hay per AUM for feeding
		• Cost per ton of hay

Hayfield, pasture, rangeland • Riparian buffer eliminates most or all of the land available for cultivation	**Annualized market value of the hay/pastureland** *(market value x discount rate)*	• Appraised market land value • Commercial agriculture loan rate (discount rate proxy)
Unfarmed (or currently leased) areas	**Soil rental rates (or lease value)**	• Rental rates for idle farmland consider potential future productive use (or actual foregone income if currently leased)

[1] Here we refer to hayfields that are specifically utilized as on-farm feed sources. Hayfields explicitly managed as a marketable commodity should be treated as crops (see previous section).

Considerations for Estimating Site-specific Opportunity Costs for Hay/Pastureland

Site specific data preferred: Programs should rely on site-specific data based on landowner and local expert knowledge, wherever feasible. Publicly available data sources (as identified below) provide helpful insight but are limited in terms of their geographic and context specificity. In particular, feed replacement costs vary significantly by context and site-specific data would be beneficial to avoid underestimating an equitable payment.

Uses of the Hay/Pastureland: Separate metrics are recommended for calculating opportunity costs based on how the land is purposed by the landowner. Rental rates are an approximation of opportunity cost where landowners lease pasture. However, for owner-operated pastureland, those rates may understate opportunity costs as farmers and ranchers rely on the land to feed their own animals. In these cases, we recommend annual feed replacement costs as a means to compensate the landowner for the lost forage. As with cropland, if the riparian buffer eliminates most or all of the productive farmland, we recommend compensating the landowner at its annualized market value.

Annual values for annual payments: As with the cropland opportunity costs, for programs specifying a period of participation (15-years), payments should be made annually during the period of participation. Rental rates are annual values. Appraised market values should be converted to an annualized value and paid over the period of participation as described in Section A.1 (pg. 7).

Appraised market land values: Note that the land value metrics should reflect market values (an estimate of what the land would sell for in the open market). Not all land appraisals target this value. For example, county assessors appraise land for tax purposes and may underestimate the full market value. For this reason, it is best to obtain a professional appraisal of market value for site-specific information.

Productive Uses of Unfarmed/Idle Farmland: We recommend referencing county-specific soil rental rates as the best proxy for the opportunity costs. However, if these areas support current farm operations (e.g., access for equipment or irrigation control or staging areas) there may be additional opportunity costs that are difficult to quantify. We recommend working with the landowner to obtain more specific information on these potential costs.

Sources of Data for Estimating Hay/Pastureland Opportunity Costs

USDA NASS QuickStats:

- Rental rates for pasture and cropland (irrigated or non-irrigated)
  - Select "Survey" in the Program tab
  - Select "Economics" in the Sector tab
  - Select "Expenses" in the Group tab
  - Select "Rent" in the Commodity tab
  - Select appropriate Data Item
  - Select relevant County and data year
- Price per ton of hay

NRCS Web Soil Survey:

- Average AUMs per acre (County-level data, variable by type of land)
  - Reference "Yields of Non-Irrigated Crops – Pasture" for a lower end estimate
  - Reference "Yields of Irrigated Crops – Green Chop" for a higher end estimate

Local Lending Institutions:

- Commercial agriculture loan rates (see also FSA link in previous section)

A.2 Opportunity Cost for Residential Land

Site Characteristics	Relevant Cost Metric	Data Required to Calculate Annual Payment
Residential Land • Buffer displaces some use	**Annualized appraised market value** *(market value x discount rate)*	• Effects on views of river, residential use of buffer area, trespass or privacy concerns, etc. • Appraised market land value • Five-year average mortgage rate (discount rate proxy)
Residential Land • Buffer provides amenity value	**$0**	• Empirical research suggests some residential landowners may value the services provided by the buffer (e.g., aesthetics, wildlife habitat, flood attenuation)

Considerations for Estimating Site-specific Opportunity Costs for Residential Land

Opportunity cost concept for residential land: Residential landowners often do not rely on the land for commercial profit. Therefore, the opportunity costs are not foregone income but instead are the reduced enjoyment, aesthetics, or functional use of the land enrolled in the program. For example, a riparian buffer may result in the loss of water views or reduce the landowners personal use of the land (e.g., for gardening or recreation). Some of these adverse effects may be mitigated based on the design of the buffer.

Amenity value of riparian buffer: In some cases, the riparian buffer may improve landowner experience, for example, if the vegetation provides an appealing aesthetic or attracts wildlife valued for viewing. The buffer may also add a sense of privacy for the landowner. If the landowner considers the buffer a net-benefit, opportunity cost payments may be reduced to a fraction of annualized appraised market value or not be needed at all.

Annual values for annual payments: As with the cropland opportunity costs, for programs specifying a period of participation (15-years), payments should be made annually during the period of participation. Appraised market values should be converted to an annualized value and paid over the period of participation as described in Section A.1 (pg. 7).

Appraised market land values: Note that the land value metrics should reflect market values (an estimate of what the land would sell for in the open market). Not all land appraisals target this value. For example, county assessors appraise land for tax purposes and may underestimate the full market value. For this reason, it is best to obtain a professional appraisal of market value for site-specific information.

Discount rate: Mortgage rates are a reasonable proxy for the discount rate. However, these rates are volatile. We therefore recommend calculating average 30-year mortgage rated over the recent past 5 years.

A.3 Additional Considerations that Influence Opportunity Cost

When developing payment offers for landowners, our calculations rely on consistent, standardized methods that account for land use type, foregone revenue, and typical program timelines. However, several external factors beyond the scope of our payment calculation models may influence a landowner's perception of a payment's adequacy or attractiveness. While these considerations are not explicitly included in our formulas, they should be recognized and, where possible, addressed through program design, communication, or payment flexibility.

Additional considerations that may influence landowner decision-making:

- **Attitudes and perceptions**: Landowners of all types may derive value from enrolling in a conservation program such that they are willing to accept payments below their opportunity costs. For these landowners, our model is likely to overestimate payments. Survey-based stated preference methods can be helpful for understanding the role of this effect within a particular population. See Sections 2.1 and 2.3 of the report for more information.
- **Expectations of future crop value trends**: While our payment model uses five-year average crop prices to smooth out short-term volatility, individual landowners may anticipate significant price increases for specific crops (e.g., due to market trends, new infrastructure, or climate effects). In such cases, the average may underrepresent the perceived opportunity cost, and the offered payment may appear too low. At the same time, a conservation contract may be attractive because it reduces annual farm-level income volatility by offering a certain payment. See Section 5.1.1 of the report for more information.
- **Possibility of future regulation**: Landowners who believe that future regulations may restrict certain land uses (e.g., riparian zones or flood-prone areas) might see current incentive programs as an opportunity to secure payment for actions they may be required to take later anyway. This can increase their willingness to participate, even if payments are lower than their full opportunity cost. Conversely, they may see enrollment as a trigger for future regulation (e.g., due to a Critical Area ordinance), in which case their perceived opportunity costs may extend beyond the contract term. See Sections 2.1 and 3.1 of the report for additional regulatory context.
- **Long-term enrollment or permanent easements**: Our standard payment framework assumes time-limited program participation (e.g., 15 years). However, if a program requires permanent or intergenerational conservation (e.g., perpetual easements or

buffer zones), it may be more appropriate to offer an **upfront payment based on the land's fair market value** rather than annualized revenue replacement. See Section 4.3.6 for more discussion on this topic.

- **Limited access or use within the riparian buffer**: Our payment assumptions are based on full conservation use with no ongoing access to the buffer area. However, if programs allow for minimal, non-damaging access (e.g., such as routing irrigation infrastructure through the buffer or permitting recreational use on residential land) landowners may view participation more favorably. Where feasible, this can either reduce the payment needed to secure participation or increase enrollment rates without additional cost.

Section B | Estimating Implementation Costs

Implementation costs refer to the one-time, upfront expenses incurred by landowners when establishing the riparian buffers or fulfilling conservation program requirements. These costs include materials, labor, equipment, and technical services for activities such as site preparation (e.g., removing infrastructure and equipment) and establishing vegetation, irrigation and water management, and fencing and access control. Relative to opportunity costs, implementation costs are observable and relatively straightforward to estimate.

Considerations for Estimating Implementation Costs

Account for a wide range of potential establishment activities: Costs may include site preparation (e.g., clearing), planting native vegetation, installing irrigation (if needed for establishment), fencing, and erosion control measures.

Limit landowner burden by providing direct implementation support: Where possible, programs should offer to coordinate or directly carry out buffer establishment activities, especially labor-intensive tasks like planting or fencing. Alternatively, offering technical assistance or implementation partners can reduce the time and cost required from the landowner. Costs not incurred by the landowner, should not be included in the up-front payment.

Pay landowner-incurred costs up front: If the landowner is responsible for any portion of establishment costs, payments should be made up front, not reimbursed later, to reduce financial risk and improve adoption.

Use site-specific information for the best understanding of costs: Establishment costs vary widely based on current land use, existing vegetation, soil type, slope, access, hydrology, and program goals (e.g., water quality, salmon habitat), as well as economic factors such as relative labor costs or contractor shortages. Cost assumptions should be informed by site assessments or local conservation staff familiar with on-the-ground conditions.

Consider partnership opportunities: Larger projects or coordinated implementation across multiple properties may reduce per-acre costs through bulk purchasing, shared labor, or equipment use.

Adjust for inflation, if needed: If past project data is used to understand costs, be sure to adjust the past cost estimates for inflation, using 3 percent as an approximate annual rate.

Sources of Data for Estimating Implementation Costs

FY2025 Washington NRCS Practice Scenarios:

- 2025 data source (rely on most recent source available)
- Statewide averages (rely on local data where available)
- Describes costs of practices relevant to riparian conservation in Washington, accounting for different site conditions and implementation methods.
- Aligns with standard NRCS practice codes (see following table) for federal and state conservation programs.

Practice	NRCS Code	Description	Typical Components	Unit of Measurement
Riparian Forest Buffer	391	Establishing woody vegetation along riparian areas	Live stakes, hand planting, layout, mulch, initial irrigation	Cost per acre
Tree/Shrub Establishment	612	Planting bareroot seedlings or containerized plants	Seedlings, mulch, stakes, labor	Cost per acre
Tree/Shrub Site Preparation	490	Clearing and preparing land prior to planting	Invasive removal, tilling, herbicide application	Cost per acre
Fence	382	Livestock exclusion or wildlife protection	Posts, wires, gates, fasteners, labor	Cost per linear foot
Access Control	472	Restricting equipment or livestock access to sensitive areas	Signage, fencing, gating, labor	Cost per acre or linear foot

Inflation Adjustment:

- National Agricultural Prices Paid Index (PPI) published by NASS. More specific PPI may be available from Conservation Districts or WSU Extension.

Section C | Estimating Maintenance Costs

Maintenance costs refer to the recurring, annual expenses required to sustain the ecological function and program compliance requirements of the riparian buffers. These costs typically include tasks such as managing vegetation and routine habitat management, maintaining fencing and access control, and irrigation and water management. Relative to opportunity costs, maintenance costs are observable and relatively straightforward to calculate.

Considerations for Estimating Maintenance Costs

Include full range of routine maintenance activities: Annual costs may include vegetation management, invasive species control, replacement of failed plantings, fence repairs, and irrigation, if needed.

Limit landowner burden through program support or technical assistance: Whenever possible, offer maintenance contracts, conservation crews, or partner organizations to perform routine upkeep, reducing landowner time and cost.

Pay landowner-incurred costs annually: Annual payments should reflect anticipated costs borne by the landowner, ideally made at the beginning of each year if administrative approvals allow.

Base cost estimates on site-specific factors: Maintenance needs vary based on buffer size, vegetation type, soil fertility, slope, weed pressure, wildlife presence, and adjacent land use (e.g., ag runoff, recreational access), and program goals. Input from landowners and local extension/conservation staff can improve accuracy.

Consider changing prices over time: This framework does not attempt to model escalating maintenance costs over time. In many cases, maintenance costs may decline as the buffer matures and becomes more self-sustaining. However, there are also circumstances that may increase costs in later years (e.g., changes in costs of supplies and labor). Programs may choose to update maintenance cost assumptions periodically throughout the course of program participation rather than setting a single flat rate.

Adjust for inflation, if needed: If past project data is used to estimate costs, be sure to adjust the past cost estimates for inflation. Similarly, if estimating future maintenance payments over time, consider the influence of inflation on the payment. Based on historical data, a reasonable annual inflation adjustment is 3 percent.

Sources of Data for Estimating Maintenance Costs

NRCS FY2025 CSP Renewal Payment Rates for WA:

- 2025 data source (rely on most recent source available)
- Statewide averages (rely on local data where available) by practice
- Practices include brush management, weed treatment, fencing, planting, and other relevant maintenance activities (including those in the following table).
- Average costs of maintenance practices over a 5-year CSP renewal contract and account for labor, materials, and equipment use. **The 5-year estimates need to be divided by 5 to estimate annual costs.**

Practice	NRCS Code	Description	Typical Activities	Unit of Measurement
Riparian Forest Buffer	391	Woody vegetation planted along riparian corridors	Weed control, replanting, mulch, irrigation	Cost per acre per year
Upland Wildlife Habitat Management	645	Habitat enhancement for upland wildlife	Invasive species control, replanting, structural maintenance	Cost per acre per year
Herbaceous Weed Treatment	315	Control of herbaceous invasive or noxious weeds	Herbicide application, mechanical treatment	Cost per acre per year
Brush Management	314	Removal of woody vegetation to restore habitat or access	Cutting, stump treatment, follow-up re-entry	Cost per acre per year
Irrigation Water Management	449	Efficient water application to maintain vegetation health	Equipment checks, seasonal adjustments, repairs	Cost per acre year
Fence	382	Livestock or wildlife exclusion infrastructure	Inspection, wire/gate repairs, vegetation clearing	Cost per linear foot per year
Access Control	472	Preventing access to sensitive conservation areas	Gate maintenance, signage, monitoring	Cost per acre or linear foot per year

Inflation Adjustment:

- National Agricultural Prices Paid Index (PPI) published by NASS. More specific PPI may be available from Conservation Districts or WSU Extension.

Section D | Total Payment

Based on the program requirements and the calculation methods described in Sections A, B, and C, quantifying the landowner payments in each year of program participation is a simple exercise.

Year 1 Payment is the sum of…

1. **Annual opportunity cost:** Estimated value of foregone land use or productivity due to buffer (Section A)
2. **One-time implementation costs:** Include only landowner-incurred one-time buffer implementation costs (Section B)
3. **Annual maintenance costs:** Include if there are any above and beyond the implementation costs in year 1 (Section C)
4. **Up-front payments, as applicable:** May include one-time supplemental payments or up-front compensation for any unrecovered crop establishment costs.

Annual Payments for the following years are the sum of…

1. **Annual opportunity cost:** Value of foregone land use or productivity due to buffer (Section A)
2. **Annual ongoing maintenance costs:** Include only landowner-incurred costs of buffer management and maintenance (Section C)

Considerations for Calculating Total Costs Over Time

There is inherent uncertainty in estimating the total payment schedule over the full duration of a riparian buffer agreement. While opportunity costs can be reasonably approximated at the outset, other components, particularly annual maintenance costs, are subject to variability over time. Maintenance needs may decline as the buffer matures but could also increase due to site-specific challenges like invasive species, erosion, or storm damage. In addition, unexpected changes in landowner responsibilities, program requirements, or inflation may further affect the actual costs incurred. For these reasons, while an initial payment schedule can be estimated, it may be necessary for programs to revisit and adjust payment structures over time to reflect evolving conditions, where feasible. If the contract requires fixed terms at the outset, we recommend escalating landowner payments by three percent annually to account for expected inflation.

Additional Implementation Considerations

The proposed payment approach is purposefully simple, focusing on core cost categories to provide a clear and consistent approach for both program managers and landowners. However, programs may choose to enhance landowner engagement and improve equity by incorporating additional features into the payment design. The following options can make the payment structure more attractive and responsive to landowner needs:

- **Recognize non-cash burdens such as administrative effort**: Landowners may face added responsibilities like mapping, documentation, or reporting that don't have a direct financial cost but require time and effort. Programs should aim to minimize these burdens and offer technical assistance wherever possible.
- **Consider front loading payments**: Where feasible, structure payments to be heavier in early years when costs and risks to the landowner are highest (e.g., during buffer establishment and land use transition). This can improve adoption, especially for landowners with limited cash flow.
- **Incentivize desired actions with supplemental payments**: Offer additional payments for actions that go beyond minimum requirements, such as establishing wider buffers, maintaining longer-term commitments, or working in coordination with adjacent landowners to create continuous habitat corridors.
- **Build flexibility into payment timing and requirements**: While some programs may require documentation of landowner-incurred costs before compensating, providing up-front payments or using simplified estimates may reduce participation barriers.
- **Accounting for inflation over the time period of the contract**: Net farm operating income may increase over time such that the opportunity costs exceed landowner payments in future years if the landowner payments are held constant each year. Program managers may consider escalating annual payments over the contract period using an average annual historic inflation rate. The same is true for annual maintenance payments if incorporated into the landowner payment. Inflation rates fluctuate from year to year; however, based on historical data 3 percent is a reasonable average inflation rate assumption.
- **Consider alternatives to the approach presented here, depending on specific goals or conditions:** We believe the model-based approach to estimating landowner opportunity costs presented above can accelerate landowner participation in existing riparian incentive programs by developing more targeted

payments. For additional information about when alternative approaches should be considered (e.g., reverse auctions, stated preference survey techniques), see Section 4.3.1 of the report.

Understanding Cost-Effectiveness

Once the cost of enrolling a parcel has been determined, it is important to consider whether the cost is justified by the expected public benefit (i.e., whether the investment is likely to represent a beneficial use of public funds).[2] Even when riparian restoration is expected to generate net public benefits on a large (e.g., watershed) scale, the contribution of individual parcels is variable and uncertain (see Section 2.2 of the report).

Understanding the cost-effectiveness of riparian buffer implementation is important even when specific, monetized values of ecological benefits are unknown or uncertain. In such cases, cost-effectiveness can be assessed in relative terms by comparing the magnitude of expected costs of establishing and maintaining the buffer with the expected public benefits, characterized qualitatively or through indicators of public value (e.g., ecological characteristics, threats and stressors, proximity to human uses, and broader contextual factors). While precise monetary valuation may not be feasible, especially given the public, non-market nature of many ecological functions and ecosystem services, it is still possible to evaluate where higher ecological returns are likely relative to the costs incurred.

Given those practical constraints, we offer a simple and intuitive approach to explicitly consider the likelihood that a given extent of riparian buffer will generate a net public benefit. In the absence of detailed, site-specific modeling, this approach relies on available information about key cost drivers (as described in Sections A, B, and C of this toolbox) and ecological indicators to assess the relative costs and ecological benefits of riparian buffer implementation. This encourages program managers to understand cost and benefit comparisons in general, relative terms (i.e., low, medium, high) based on readily identifiable site characteristics. This framework enables a comparative assessment of cost-effectiveness where full ecological and economic modeling is impractical.

The general framework is as follows:

STEP 1. Classify costs as likely low, medium, or high based on key cost drivers.

STEP 2. Classify ecological values as likely low, medium, or high based on key ecological indicators and additional site-specific considerations.

STEP 3. Rate cost-effectiveness potential based on the cost-effectiveness matrix (figure below), which determine on a scale of 1 to 5 the relative likelihood that the riparian buffer investment generates net public benefits.

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[2] We define public benefits as reflecting the value that the public holds for real ecological gains resulting from riparian buffer implementation.

STEP 1. Classifying Cost per Acre

The relevant costs to consider for the cost-effectiveness question are the **total annualized costs per acre** associated with the buffer. Note that the total cost of establishing and maintaining the buffer may exceed the magnitude of landowner payments as they may include costs not incurred by the landowner (e.g., buffer establishment or maintenance costs undertaken by an agency).

"Cost drivers" are the factors that influence the magnitude of costs. In the absence of comprehensive cost data (e.g., maximums, minimums, or regional averages for all riparian buffers in a region), it is possible to define *low*, *medium*, and *high* cost categories qualitatively and relatively, based on the presence or intensity of key cost drivers at a site.

The following table provides a rubric for determining how key cost drivers influence the overall relative costs of a given riparian buffer investment. Project managers should also weigh any additional known cost drivers beyond those identified, as relevant. If most drivers are low, classify the site as "Low Cost." If most drivers are high, classify the site as "High Cost." If most drivers are moderate or are mixed across all drivers, classify the site as "Medium Cost."

Example Cost Driver	Low Cost/Acre	Medium Cost/Acre	High Cost/Acre
Opportunity cost of land	Land is fallow, low market value, or otherwise unlikely to be developed or in income-generating use	Moderate value cropland, or land with moderate future development potential	High-value cropland, or land with high future development potential
Implementation complexity	Simple installation (e.g., natural regeneration)	Some buffer establishment needed (e.g., some planting and limited site preparation)	Significant establishment effort (e.g., grading, invasive removal, planting)
Ongoing maintenance needs	Passive/minimal maintenance required	Some limited maintenance required (e.g., weed control)	Intensive, long-term management required to maintain buffer
Participation costs	Willing landowner, limited administrative barriers	Some negotiation with landowner required, some administrative support needed	Low landowner willingness to participate, high administrative cost

STEP 2. Classifying Potential Public Benefits

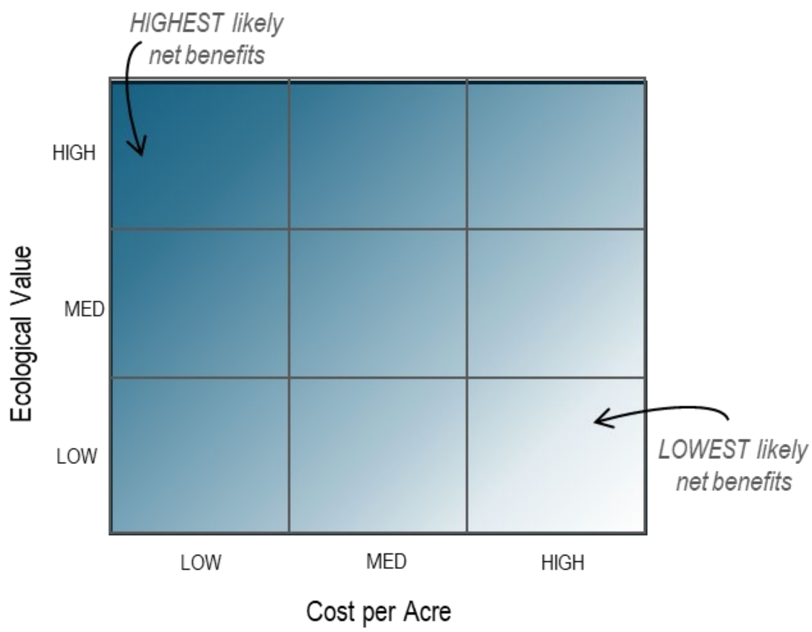
Estimating the monetary value of public benefits from enrolling an individual parcel in a riparian conservation program is exceedingly complex. In the absence of site-specific ecological and economic modeling or an explicit prioritization of individual reaches, we recommend relying on readily observable "indicators" (i.e., drivers of ecological value) to classify a parcel as likely to generate *low*, *medium*, or *high* public benefits from enrollment in a riparian protection program.

The following table provides a rubric for determining how key indicators influence the overall relative public benefits of a given riparian buffer investment. Project managers should also weigh any additional considerations beyond those identified, as relevant. If most indicators are low, classify the site as "Low Public Benefit." If most indicators are high, classify the site as "High Public Benefit." If most indicators are moderate or are mixed across all indicators, classify the site as "Medium Public Benefit."

Example Indicator Categories	Low Public Benefit	Medium Public Benefit	High Public Benefit
Ecological characteristics	Few potential fish species, no known critical habitat for threatened or endangered species, significant downstream barriers, little accessible upstream habitat, existing riparian zone is relatively natural	Some potential fish species, critical habitat for some threatened or endangered species, moderate downstream barriers, moderate accessible upstream habitat, existing riparian zone is somewhat degraded	Significant potential fish species (especially salmonids), critical habitat for multiple threatened or endangered species, few downstream barriers, significant accessible upstream habitat, existing riparian zone is significantly degraded
Threats and stressors	No known temperature or water quality impairments or upland contributing factors (e.g., pesticide/fertilizer use, livestock, erosion-prone soils or tillage practices), limited or no invasive species	Moderate known temperature or water quality impairments or upland contributing factors (e.g., pesticide/fertilizer use, livestock, erosion-prone soils or tillage practices), some invasive species	Multiple or extreme temperature or water quality impairments or upland contributing factors (e.g., pesticide/fertilizer use, livestock, erosion-prone soils or tillage practices), significant invasive species
Connections to human use	Not upstream of human uses (drinking water resource or area used for boating, fishing, or swimming)	Upstream of at least one human use (drinking water resource or area used for boating, fishing, or swimming)	Upstream of multiple or particularly important human uses (drinking water resource or area used for boating, fishing, or swimming)
Contextual factors	Low probability of conversion to developed landcover, does not contribute to contiguous protected habitat	Moderate probability of conversion to developed landcover, some contribution to contiguous protected habitat	High probability of conversion to developed landcover, connects high quality protected habitats

STEP 3. Rate Cost-Effectiveness Potential

Once a program manager has classified a parcel in terms of the cost per acre and potential public benefits, they can use the **cost-effectiveness matrix** below to rate the cost-effectiveness potential of contracting with the landowner on a scale (where darker shades indicate higher likelihood that the contract generates net public benefits).



Importantly, the scale does not identify whether or by how much the benefits of enrolling a parcel exceed the cost (i.e., a high cost parcel with low expected ecological value may still generate net public benefits). The scale instead reflects a *relative* cost-effectiveness measure. Thus, it is most useful for comparing the cost-effectiveness of potential riparian buffer sites or for targeting outreach to landowners where net benefits are most likely to be highest.

Data Source for Ecological Indicators

WDFW Riparian Data Engine:

- Provides a user-friendly interface to interact with multiple relevant statewide spatial datasets
- Allows users to focus on a particular jurisdiction (e.g., watershed or county)
- Capability to filter stream reaches based on land use designations (e.g., agriculture) and ecological criteria (e.g., presence of salmonids, known temperature impairment, level of current tree cover).
- Ability to export results for integration with additional datasets or screening by individuals or institutions with local knowledge.

Examples of Toolbox Use

Estimating Opportunity Costs for a High-Value Crop

Use of Riparian Zone: Cropland (Conventional "Draper" Blueberries)

Riparian Zone Acreage: 10 acres

Total Farm Acreage: 1000 acres

To estimate opportunity cost for cropland, we follow the methods described in A.1 (Opportunity Cost for Cropland).

Riparian zone acreage represents a fraction of total farm acreage, and lost production cannot be offset by moving production elsewhere. Therefore, we estimate annual opportunity cost as foregone net annual operating income. The relevant WSU Crop Enterprise Budget provides estimates for total revenue (as well as the individual components, yield and price), and total variable costs. We first extract those values, assuming "Full Production":

- Gross production (fresh): 4,819.5 lb/acre
- Gross production (processing): 8,950.5 lb/acre
- Price (fresh): $2.25/lb
- Price (frozen): $1.25/lb
- Total variable costs: $13,962.48

The first step is to obtain updated price data, averaged over the past 5 years. We obtain local 5 year price history (2020-2024) for fresh and processed blueberries from USDA NASS Quick Stats database, assuming that the farm is located in Whatcom County. Next we adjust the values to constant 2024 dollars to adjust for inflation, and obtain the averages. We do so using the GDP Price Deflator Index (for example, we multiply the 2023 prices by 1.024, which is the ratio of the 2024 Index value [125.22] and 2023 Index value [122.27]).

	2020	2021	2022	2023	2024	Average
GDP Price Deflator	105.35	110.14	118.02	122.27	125.22	-
Fresh Price (original dollar year)	$2.28	$1.82	$1.68	$2.06	$2.46	-
Processed Price (original dollar year)	$1.00	$0.98	$0.76	$0.50	$0.52	-
Fresh Price (2024 dollars)	$2.71	$2.07	$1.78	$2.11	$2.46	**$2.23**
Processed Price (2024 dollars)	$1.19	$1.11	$0.81	$0.51	$0.52	**$0.83**

Next, we adjust the variable costs for inflation, assuming that they are expressed in the dollar year that the budget was published (2022). For this adjustment, we utilize the PPITW (Prices Paid Index for Commodities and Services, Interest, Taxes, and Wage Rates) from USDA NASS Quick Stats, which has a values of 139.8 (2024) and 137.4 (2022). We perform the calculation as follows to obtain **total variable costs** in 2024 dollars:

$$\$13{,}962.48 \times \frac{139.8}{137.4} = \$14{,}206.37$$

To estimate **total revenue**, we multiply yields (production) from the enterprise budget by the 5-year historic average prices in Whatcom County:

$$4{,}819.5 * 2.23 + 8{,}950.5 * 0.83 = \$18{,}176.40$$

Finally, we subtract total revenue from total variable costs to obtain **annual net operating income** per acre:

$$\$18{,}176.40 - \$14{,}206.37 = \$3{,}970$$

Assuming that all 10 acres within the riparian zone are currently planted with conventional blueberries, the total opportunity cost to the agricultural producer is estimated to be $39,700 (=$3,970 per acre x 10 acres).

Within this example we are implicitly compensating the landowner annually for the amortized value of crop establishment costs. However, if the landowner was entering the contract early in the production cycle and had recently a significant upfront establishment costs, we might consider the following adjustments:

- Make a one-time (upfront) payment to the landowner equal (or close to) the full establishment cost ($8,362 per acre estimated from the crop enterprise budget, or $83,620 across 10 acres).
- In addition, subtract the estimated amortized establishment costs $1,808 per acre (obtained from the crop enterprise budget and adjusted for inflation using the PPITW) from the annual payment. In this case the total annual payment would fall to $21,620 (=10 x [$3,970 - $1,808]).

Estimating Opportunity Costs for Hay/Pastureland

Use of Riparian Zone: The landowner uses the riparian zone for grazing cattle.

Riparian Zone Acreage: 10 acres

Total Farm Acreage: 1000 acres

To estimate the opportunity cost of pastureland, we follow methods described in A.2 (Opportunity Costs for Hay, Pasture, and Unfarmed Areas). As the landowner is utilizing the riparian zone as a direct feed source, we estimate the replacement cost of feed using the following equation: hay yield (tons)/ acre x hay price/ton.

To estimate yield, we obtain a county-specific hay yield (in AUMs) per acre from NRCS Web Soil Survey (for this example, assume 2.0 AUMs/acre). We convert to tons of hay, assuming 1.37 tons/AUM based on values obtained from published literature.[3] Finally, we utilize the average hay price per ton for Washington state from USDA NASS ($180).

Using those values, the full equation for replacement cost of feed per acre becomes:

1.37 tons/AUM x 2.0 AUMs/acre x $180/ton = $493 per acre

Based on 10 acres of offset grazing, the total annual landowner opportunity cost is $4,930 ($493 x 10).

[3] 1 AUM = 780 pounds dry matter consumed (Meehan, Sedivec, Printz, & Brummer, 2022) / 30% grazing efficiency (Morris, 2012) or 2,600 pounds of dry matter yield x 90% haying efficiency = 2,340 pounds of dry matter (1.17 ton) / (1 – moisture content of hay ~15% (Meehan, Sedivec, Printz, & Brummer, 2022)) = 1.37 ton of hay equivalent.

Rating the Relative Cost-Effectiveness of Enrolling a High-Value Crop

To perform this exercise, we develop hypothetical characteristics of the farm described in the initial example where production of blueberries would be displaced by the buffer.

Step 1. We classify cost as HIGH based on the following observable drivers leaning toward the higher end of the distribution.

- Opportunity cost of land: high due to production of high value crops (blueberries)
- Implementation complexity: standard but requires significant site prep due to presence of permanent infrastructure (e.g., trellises)
- Maintenance needs: standard
- Participation costs: crops were recently established, landowner is hesitant as a result

Step 2. We classify ecological value as MEDIUM based on the following observable indicators being largely mixed.

- Ecological indicators: stream is fish-bearing, but salmonids are not present; some downstream and upstream barriers exist; existing streambank is channelized
- Threats and stressors: high pesticide usage; no known temperature impairment
- Human use connections: no known human uses immediately downstream
- Contextual factors: no current opportunity for generating contiguous buffer; low development pressure

Step 3. Based on the cost effectiveness matrix, this project falls toward the lower end in terms of likelihood of generating net public benefits. Importantly, this does not necessarily indicate a bad public investment, but others that rank more highly in terms of ecological value or lower in terms of cost may offer a better return on investment.

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