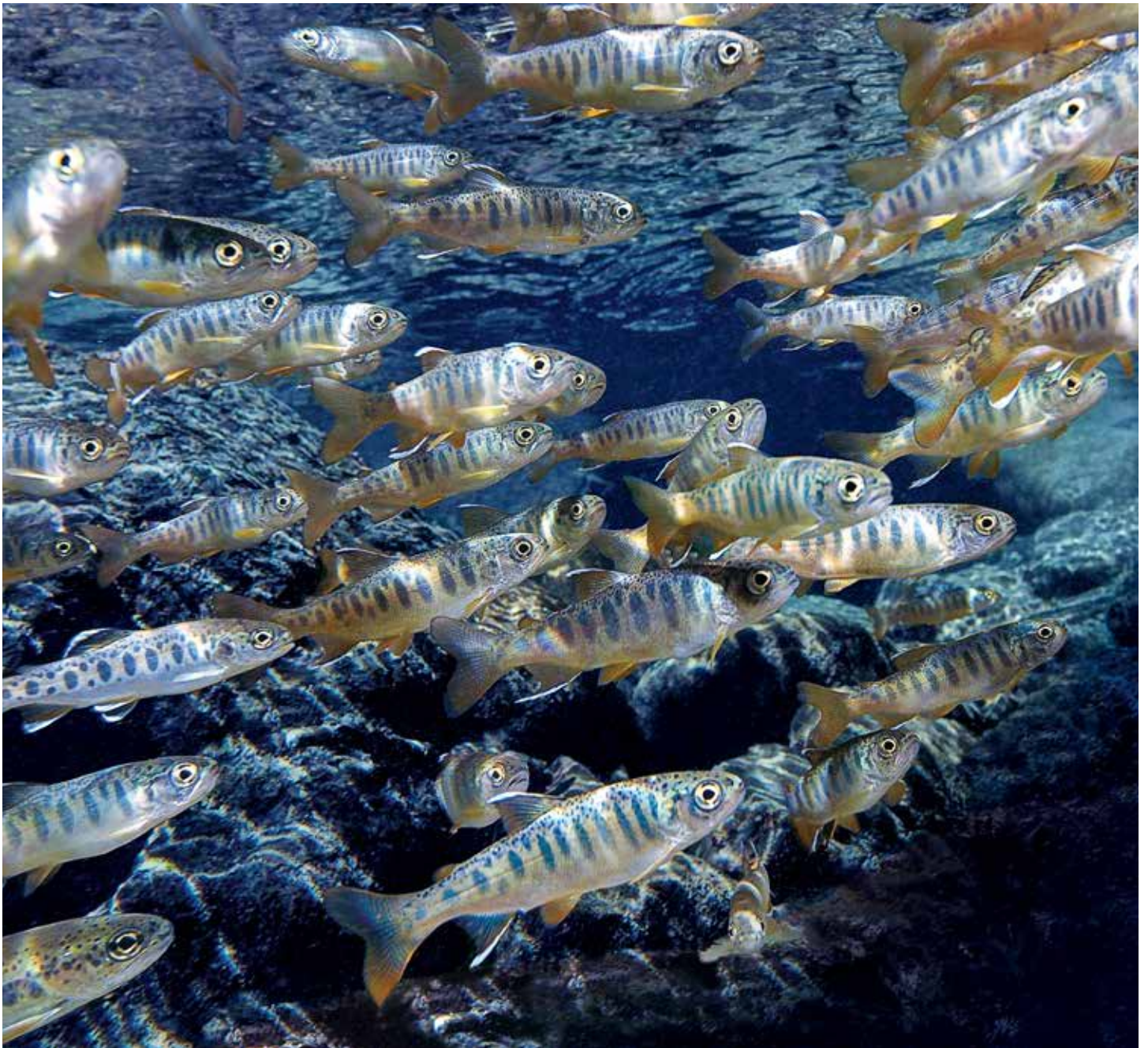




Strategic Action Plan for Coho Salmon Recovery

~ The Siuslaw River ~





Coastal coho juveniles by John McMillan. Cover photo: coho by Tom & Pat Leeson and NF Siuslaw by Kate Harnedy. Back cover by Alamy.

Contributors and Acknowledgements

The Siuslaw Coho Partnership is a committed group of public and private partners dedicated to the broad sense recovery of Siuslaw coho salmon. This Strategic Action Plan (SAP) was developed by a “core planning team” of these partners, which included:

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This plan represents a cooperative effort on behalf of all of these partners to assimilate, focus, and build on the vast body of knowledge available on the Siuslaw watershed to accelerate the strategic protection and restoration of critical coho habitats. The SCP deeply appreciates the hard work of all of those who preceded us in this effort, who dedicated their careers to better understanding the Siuslaw watershed and its extraordinary population of Oregon Coast (OC) coho.



Acronyms

AQI	Aquatic Inventories Project
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practice
CTCLUSI	Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
GIS	Geographic Information Systems
HLFM	Habitat Limiting Factors Model
IP	Intrinsic Potential
KEAs	Key Ecological Attribute
HUC	Hydrologic Unit Code
LSR	Late Successional Reserve
LWD	Large Woody Debris
LiDAR	Light Detection and Ranging
m	Million
NFWF	National Fish and Wildlife Foundation
NGOs	Non-Governmental Organizations
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OC	Oregon Coast
OCCCP	Oregon Coast Coho Conservation Plan
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
OPRD	Oregon Parks and Recreation Department
OWEB	Oregon Watershed Enhancement Board
RM	River Mile
RMP	Resource Management Plan
SAP	Strategic Action Plan
SCP	Siuslaw Coho Partnership
SNF	Siuslaw National Forest
SONCC	Southern Oregon/Northern California Coast coho salmon
SWC	Siuslaw Watershed Council
SWCD	Soil and Water Conservation District
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
WSC	Wild Salmon Center

Contents

Contributors and Acknowledgements.....	i
Acronyms.....	ii
List of Figures	v
List of Tables.....	vi
Executive Summary	vii
1. Introduction: Why Coho?	1
1.1 A Keystone Species.....	1
1.2 An Indicator of Watershed Function.....	2
1.3 A Threatened Species	2
1.4 A Unique Opportunity for Recovery	3
2. Overview of the Siuslaw Coho Partnership and Scope of This Plan.....	4
2.1 Our Vision of Recovery.....	6
2.2 SAP Implementation: Long-Term Outcomes & Short-Term Goals.....	6
2.3 Scope of this Strategic Action Plan	7
2.4 Guiding Principles for Plan Development.....	8
3. The Siuslaw River Watershed.....	10
3.1 Physical Geography.....	10
3.2 Hydrology and Water Resources	11
3.3 Biotic Systems	14
3.4 Indigenous Communities.....	15
3.5 European Settlement and the Rise of a Resource-Extraction Economy.....	16
3.6 Present-day Communities of the Siuslaw Watershed.....	19
3.7 The Siuslaw Economy Today.....	20
3.8 Advancing the Restoration Economy	20
4. Siuslaw Basin Coho and their Habitat Needs.....	23
4.1 The Coho Life Cycle	23
4.2 Watershed Components and Coho Habitat Types	25
4.3 Wild Coho Distribution, Abundance, and Production	31
4.4 Hatchery Production and Releases	34

5.	Impaired Watershed Processes and Resulting Stresses on Coho Habitats	35
5.1	Modified Watershed Processes in Upland, Tributary, and Off-channel Habitats.....	35
5.2	Watershed Processes in Mainstem, Estuary, and Off-channel Habitats	39
6.	Development of the Siuslaw River Strategic Action Plan	40
6.1	Visioning.....	40
6.2	Creating the Siuslaw Common Framework.....	40
6.3	Ranking the Sub-Watersheds.....	40
6.4	Evaluating Habitat Stresses	41
6.5	Locating and Prioritizing Projects.....	41
6.6	Monitoring and Indicators	44
6.7	Estimating Costs	44
6.8	Community Outreach	44
7.	The Strategic Framework: Restoration Strategies and Key Geographies.....	45
7.1	The High-Ranked Sub-Watersheds.....	45
7.2	Habitat Stresses, Limiting Factors, and the Anchor Habitat Approach	49
7.3	Strategies to Conserve Critical Coho Habitats in the Siuslaw Watershed.....	51
8.	The SCP Implementation Plan: Goals and Actions (2019-2025).....	64
9.	Funding Needs: Estimated Costs	77
10.	Evaluation and Adaptive Management	84
10.1	The Monitoring Framework.....	84
10.2	Data Gaps and Priorities for Data Collection.....	88
10.3	Sustainability.....	88
11.	References	89
	Appendices.....	91

List of Figures

- Figure 2-1. Recent watershed improvement projects.
- Figure 3-1. Siuslaw watershed geology.
- Figure 3-2. Comparison of historic and current tidal wetland habitat.
- Figure 3-3. Land cover in the Siuslaw watershed.
- Figure 3-4. Land ownership in the Siuslaw watershed.
- Figure 3-5. Lane County employment (2014).
- Figure 3-6. Restoration investment.
- Figure 3-7. Average number of jobs created per \$1 million of investment by sector.
- Figure 4-1. The coho salmon life cycle.
- Figure 4-2. Components of a watershed.
- Figure 4-3. The Siuslaw watershed.
- Figure 4-4. Coho distribution in the Siuslaw watershed.
- Figure 4-5. Estimated Siuslaw commercial harvest of coho salmon (1892 to 1956).
- Figure 4-6. Siuslaw coho salmon sport harvest (1978 to 2015).
- Figure 4-7. Annual estimates of mid-coast stratum wild coho population abundance, 1990-2017.
- Figure 4-8. Wild Siuslaw coho salmon abundance estimates, 1990 to 2017.
- Figure 4-9. Siuslaw coho salmon hatchery smolt releases, 1980 to 2000.
- Figure 5-1. Modeled historic surface water temperatures in the Siuslaw watershed.
- Figure 5-2. Projected surface water temperature changes in the Siuslaw watershed (2040).
- Figure 5-3. Floodplain function and channel interaction.
- Figure 7-1. High-ranked sub-watersheds in the Siuslaw watershed.
- Figure 7-2. Modeled anchor habitats in the high-ranked sub-watersheds.
- Figure 7-3. Stream reaches identified in the high-ranked sub-watersheds as priorities for LWD installation.
- Figure 7-4. Stream reaches in the high-ranked sub-watersheds identified by the core planning team and in the model as high priority for riparian enhancement.
- Figure 7-5. High-priority locations for habitat restoration by project type in the Upper and Lower North Fork Siuslaw and Bernhardt Creek/Siuslaw mainstem watersheds.
- Figure 7-6. High-priority locations for habitat restoration by project type in the Knowles Creek watershed.
- Figure 7-7. High-priority locations for habitat restoration by project type in the Upper Wolf Creek, Dogwood Creek/Siuslaw mainstem, and Siuslaw Falls/Siuslaw mainstem watersheds.
- Figure 7-8. High-priority locations for habitat restoration by project type in the Upper and Lower Deadwood Creek, Upper Indian Creek, and Triangle Lake-Lake Creek watersheds.
- Figure 7-9. Timber stands with the highest potential to deliver large wood into identified anchor habitat locations (Tier 1 sites) and non-anchor habitat locations (Tier 2 sites).

- Figure 8-1. Priority sub-watersheds for restoration projects in the Siuslaw Basin (2019-2025).
- Figure 8-2. Location of restoration projects in the Deadwood Creek sub-watershed.
- Figure 8-3. Location of restoration projects in the Dogwood Creek sub-watershed.
- Figure 8-4. Location of restoration projects in the Upper and Lower North Fork Siuslaw River and lower Bernhardt sub-watersheds.
- Figure 8-5. Location of restoration projects in the Upper Indian Creek sub-watershed.

List of Tables

- Table 7-1. Major Stresses by Habitat Component in High-Ranked Sub-watersheds.
- Table 7-2. Miles of Stream Proposed as High Priority for LWD by Sub-watershed.
- Table 7-3. Miles of Riparian Habitats Proposed for Enhancement by Sub-watershed.
- Table 7-4. Miles of Channel and Acres of Floodplain Reconnected by Sub-watershed.
- Table 7-5. Acres of Tier 1 and Tier 2 Timber Stands by Sub-watershed.
- Table 8-1. Cumulative Objectives by Strategy and Priority Sub-watershed (2019-2025).
- Table 8-2. Habitat Restoration Project Implementation Schedule by Sub-watershed and Biennium.
- Table 9-1. Project Implementation Costs in the Deadwood Creek Sub-watershed (Goal 1).
- Table 9-2. Project Implementation Costs in the Dogwood Creek Sub-watershed (Goal 2).
- Table 9-3. Project Implementation Costs in the North Fork Siuslaw Sub-watershed (Goal 3).
- Table 9-4. Project Implementation Costs in the Upper Indian Creek Sub-watershed (Goal 4).
- Table 9-5. Summary of Estimated Costs by Restoration Type in the Priority Sub-watersheds (2019-2025).
- Table 10-1. Siuslaw Strategic Action Plan Monitoring Framework.



Photo: Eiko Jones

Executive Summary

The Siuslaw River once supported one of the largest runs of wild coho salmon (*Oncorhynchus kisutch*) along the Oregon coast. Over 150 years of resource use and development in the Siuslaw River watershed have contributed to a long and steady decline in the population. Climate change and an uncertain trend in watershed health now raise concern among managers that the Siuslaw population – like other populations on the Oregon coast – may not remain viable in the decades to come. This plan represents the culmination of a three-year collaboration among local stakeholders to identify and locate restoration projects that will enhance the health of the Siuslaw River and secure the long-term viability of its once-robust coho population.

In 2015, the Siuslaw Coho Partnership (SCP) convened to develop a Strategic Action Plan (SAP) for the recovery of the Siuslaw's wild coho population. Developed in partnership with a broader coast-wide effort known as the "Coast Coho Salmon Business Plan," the SCP's goal in developing the SAP was to guide habitat restoration work in the Siuslaw watershed through a process that merges the best available science with local

knowledge of the watershed. In addition, the SCP sought to coordinate work in the watershed and leverage funding to accelerate the implementation and effectiveness of on-the-ground habitat restoration projects. The SCP approached this effort guided by an inclusive vision to integrate science-driven watershed restoration priorities with social and economic goals that could promote healthy local communities and respect the rights and interests of private landowners.

While watershed-scale plans are increasingly moving away from a single-species approach, the SCP focuses on coho recovery for several reasons: first, coho salmon are considered a "keystone" species, with numerous other plant and animal species relying on them during some part of their life cycle. Second, coho spend 12-18 months in freshwater, making them an excellent indicator of the health of a watershed year-round. Third, they are listed as a "threatened" species under the federal Endangered Species Act (ESA), which may have adverse social and economic effects locally.

The Siuslaw coho population is one of 21 independent populations that comprise the

Oregon Coast (OC) Coho Salmon “evolutionarily significant unit” (ESU). Young OC coho salmon spend roughly eighteen months in freshwater before migrating to the sea. During this freshwater residency, they rely heavily on instream pools and off-channel habitats that are connected to mainstem and tributary channels. These off-channel habitats include alcoves, beaver ponds, side channels, and tidal and freshwater wetlands. In addition to providing food resources, these habitats generate clean, cool water in the summer, and serve as refuge areas from high velocity flows in winter.

The watershed processes that produce and maintain these habitats in the Siuslaw Basin have undergone significant changes since European settlement of the region began in the mid-19th century. Impacts from resource extraction and other land use activities like unsustainable timber harvesting, splash damming, overharvesting of fisheries, and road building, as well as agricultural and residential development in floodplains have altered the ‘key ecological attributes’ (KEAs) of the watershed that are essential to the production of high-quality coho habitats. The modified

The Siuslaw coho population declined from estimated historical runs of 260,000 down to a low of 500 in 1997.

KEAs that most severely limit coho production include: reduced tributary habitat complexity, reduced lateral connectivity between channels and floodplains, reduced riparian (streamside) function, reduced beaver ponds, and impaired water quality in the Siuslaw’s tributaries and mainstem (most notably elevated summer temperatures and sedimentation.)

These changes in the Siuslaw watershed reflect, to a large extent, broader changes that have taken place throughout the range of OC coho. Intensive harvest by commercial and recreational fisheries into the mid-20th century, coupled with fish releases from large hatchery programs, exacerbated these declines in watershed function.

The impact of these changes on the abundance of coho across both the ESU and the Siuslaw has been profound. State and federal scientists estimate that annual runs of one to two million coho salmon once sustained the ESU, but dropped to a low of about 15,000 in 1983. Likewise, the

Sweet Creek Falls. Photo: Greg Vaughn.



Siuslaw coho population declined from estimated historical runs of 260,000 down to a low of just 500 in 1997.

The dramatic reduction in OC coho abundance and productivity – including in the Siuslaw watershed – led to the listing of the ESU under the ESA in 1998. Concerns among federal managers that OC coho habitat was not sufficiently protected contributed significantly to the listing decision, as well as to subsequent decisions that the ESU remains in danger of extinction. This SAP supports implementation of two plans that resulted from the federal ESA listing: the “Oregon Coast Coho Conservation Plan (OCCCP) for the State of Oregon,” published in March 2007, and the “Final ESA Recovery Plan for Oregon Coast Coho Salmon” published by the National Marine Fisheries Service in December, 2016. These state and federal plans describe conservation and recovery goals for the ESU, as well as broad strategies to restore the ESU to the point where ESA protection is no longer necessary.

The SAP aims to advance the state and federal plans in a manner that aligns with local social, economic, and ecological priorities. To accomplish this goal, the SCP developed a science-based Strategic Framework to guide the identification of site-specific restoration projects. The framework emphasizes the restoration of critical coho habitats by repairing the watershed processes that generate them. This process-based approach relies heavily on an anchor habitat strategy, and seeks to identify, protect, and restore the stream reaches most capable of supporting coho across the full spectrum of their freshwater residency, including egg incubation, rearing, smolting, and spawning.

The primary conservation strategies presented in the Strategic Framework to conserve anchor habitats (and other critical habitats) include: installing large woody debris to promote instream complexity and floodplain interaction; enhancing riparian function; reconnecting disconnected floodplains and tidal wetlands; and upgrading working lands infrastructure (culverts, tidegates, roads, etc.) to reconnect tributaries and tidal channels and improve water quality. In addition, the Strategic Framework underscores the essential strategy of building collaborative relationships with landowners and managers to protect critical upland habitats.

The Strategic Framework recognizes 11 sub-watersheds as exhibiting the highest resto-



ration potential, and the greatest capacity to substantially increase Siuslaw River coho production in the short term at the least cost. These include: Bernhardt Creek, Dogwood Creek, Knowles Creek, Lower Deadwood Creek, Upper Deadwood Creek, Lower North Fork Siuslaw River, Upper North Fork Siuslaw River, Siuslaw Falls, Triangle Lake, Upper Indian Creek, and Upper Wolf Creek.

Over time, the SCP is confident that the implementation of this Strategic Framework (i.e. local partners collaborating on the strategies and in the locations listed above) can produce the following long-term outcomes:

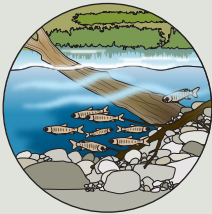
LONG-TERM OUTCOMES	
1	An increase in the quality and quantity of summer and winter rearing habitats in selected sub-watersheds sufficient to anchor population viability.
2	A connected assemblage of diverse habitats sufficient to foster a broad expression of life-history strategies in the Siuslaw coho population.
3	A healthy watershed restoration economy that is viewed as an important source of income in the Siuslaw watershed.

Following a description of the Strategic Framework, the SAP lays out a short-term work plan for the SCP that describes the initial suite of projects to improve coho production. This work plan describes the specific goals and objectives that the SCP seeks to achieve in its first six years of SAP implementation, as well as the

Between 2019 and 2025, the SCP will coordinate restoration projects focused on 6 of the SAP's 11 high priority watersheds (in bold).

Bernhardt Creek	Lower North Fork Siuslaw
Dogwood Creek	Upper North Fork Siuslaw
Knowles Creek	Siuslaw Falls
Lower Deadwood Creek	Triangle Lake
Upper Deadwood Creek	Upper Wolf Creek
Upper Indian Creek	

By 2025 SCP will:



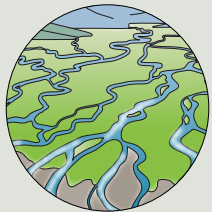
Large Woody Debris (LWD): Add LWD to **75 miles** of identified anchor habitats and other tributary reaches to increase instream complexity and restore stream interaction with off-channel habitats.



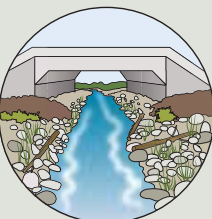
Riparian: Enhance **47 miles** of riparian (streamside) vegetation to increase shade, improve water quality, and promote long term large wood recruitment.



Floodplain: Reconnect and protect **506 acres** of disconnected floodplains to increase the availability of off-channel rearing habitats.



Tidal wetlands: Reconnect **30 miles** of instream and slough habitat to increase the availability of estuarine rearing habitats.



Infrastructure: Upgrade working lands infrastructure (stormproof **16 miles** of forest roads, replace **8 culverts**, and upgrade **2 tidegates**) to improve water quality and increase habitat availability.

Artwork by Elizabeth Morales.

corresponding costs of project implementation. Between 2019 and 2025, the SCP intends to focus implementation on six of the eleven high-ranked sub-watersheds, including: Upper Deadwood Creek, Lower Deadwood Creek, Dogwood Creek, Upper North Fork Siuslaw, Lower North Fork Siuslaw, and Upper Indian Creek. Across these sub-watersheds, the SCP intends to treat 75 miles of instream habitat with large wood, enhance 47 miles of riparian area, reconnect 506 acres of floodplain habitats, reconnect 30 miles of instream and slough habitat, and upgrade 16 miles of forest roads.

The SCP estimated the costs of all of the projects presented in its six-year work plan. To achieve the restoration objectives summarized above, the plan proposes projects with a total estimated cost of \$16.3 million (m). Broken down by project type, these costs may be summarized as follows: \$5.4m for riparian enhancement; \$4.2m for the installation of large wood in streams (and related stream complexity measures); \$2m for tidegate replacement/upgrade; \$1.6m for floodplain and off-channel reconnection (in addition to large wood installation which also promotes floodplain connectivity); \$1.4 for culvert replacement projects; \$868,000 for acquisition and easements (willing landowners only); and \$800,000 for forest road upgrade or removal.

The SCP recognizes that this plan, like all plans, has been generated with imperfect information and uncertainty about how global climate change will challenge many of the assumptions made about future watershed conditions and how aquatic systems may respond to restoration actions. Thus, **adaptive management** is essential to the long-term success of this plan and the SCP's ability to reach its stated goals. The SCP developed a monitoring framework to evaluate both the rate at which the SAP is being implemented, as well as the degree to which it is producing the desired results at a meaningful scale. The monitoring framework also presents several important data gaps, which – once filled – may redirect the SCP's efforts.

The SCP envisions our effort to rebuild salmon runs in the Siuslaw River Basin as a community endeavor. The SCP invites all interested individuals and organizations to reach out to us with questions, comments, and suggestions by contacting the Siuslaw Watershed Council.

Introduction: Why Coho?

The Siuslaw River once supported one of the largest wild coho runs along the Oregon coast. Over the last 150 years, both the quality of critical coho habitats and the watershed processes that generate and maintain these habitats have declined due to the impacts of resource extraction and other land use. These impacts have contributed to the decline of the Siuslaw River's coho run, and raised uncertainty that the basin's habitat conditions will sustain healthy coho runs into the future.

Based on our current knowledge, the approach to ensure the long-term health of the Siuslaw coho population mirrors the one required to recover most of Oregon's coast coho populations: we must protect and restore freshwater and estuarine rearing habitats to increase the survival of juveniles. To re-establish a healthy Siuslaw coho population that is viable over the long term, local partners aim to strategically restore critical habitat and other degraded habitats while

protecting those that remain intact. Importantly, the benefits of coho conservation extend beyond just the recovery of a threatened species; strategic protection and restoration will support numerous other species. Ultimately, it will also enhance the livability of our communities and stimulate our local economies.

1.1 A Keystone Species

Coho salmon are a “keystone” species; a wide variety of terrestrial and aquatic plants and animals rely on coho for their survival. All life stages of coho (eggs, juveniles, smolts, and adults) are directly consumed by aquatic and terrestrial organisms—from otter and black bear, which consume returning adults, to the smallest aquatic invertebrates that shred the carcasses of decaying fish after they have spawned. Even forest and plant communities directly benefit from the deposition of marine-derived nutrients from decaying fish. Returning adults that have taken up phosphorous and other nutrients from the ocean release them to the watershed through decay after they spawn. **If wild coho runs are further degraded or lost, the health of the watershed as a whole will suffer.**

Spawning coast coho. Photo: Jim Yuscavitch.



Because of the species' unique life history, which includes spending 12-18 months maturing in freshwater, coho use a wide range of habitat types. Coho use mainstem river channels for upstream and downstream migration, tributaries for spawning and rearing, and estuaries for migration and rearing. Off-channel areas in mainstem and tributary reaches, like alcoves, wetlands, side-channels, and beaver ponds, provide especially important habitat for coho, serving as cold-water refuge when temperatures spike in the summer and places to escape the high flows of winter. Since other salmon and trout species also use these habitats during their freshwater residency, the protection and restoration of these habitats benefit all of the Siuslaw's populations of Chinook and chum salmon, steelhead and cut-throat trout, and other non-salmonid species.

Finally, the terrestrial features that give rise to aquatic habitats, like upland forests, riparian (streamside) zones and floodplains, provide food, cover, and nesting habitat for many birds and other wildlife. As we restore these terrestrial habitats for coho, we support the range of native flora and fauna present in the Siuslaw ecosystem.

1.2 An Indicator of Watershed Function

Numerous watershed processes produce and maintain the diverse network of instream and off-channel habitats that coho need to survive and thrive. For example, as described above, off-channel habitats are essential to coho, providing refuge from seasonal spikes in temperatures and flows. The complex interaction of watershed processes – including flow, sediment transport, large wood delivery, riparian function, channel migration, floodplain-channel interaction, and other processes – governs the location, extent, and quality of these off-channel habitats. The widespread occurrence of these off-channel habitats signals that watershed processes are functioning well and able to produce and maintain the healthy habitats that coho require to persist. Conversely, when these habitats do not exist (especially in locations that have the geomorphic features – like low channel gradients and open valleys – necessary to support them), it is likely that critical watershed processes have been lost or impaired.

The loss of watershed processes impacts not only coho and other salmonids, but also the livability of coastal communities. The same processes that generate coho habitat also produce “ecosystem services” required by humans. For example, a healthy, vegetated riparian area will filter harmful contaminants out of the water, regulate stream flow, sequester carbon, and buffer streambanks from high flows that can cause erosion. When the riparian area is degraded through activities, such as the clearing of native vegetation or livestock grazing, it can lead to increased flooding, streambank erosion, and reduced water quality. Thus, restoring and maintaining the habitat-forming watershed processes that promote healthy runs of coho can also benefit landowners and communities.

1.3 A Threatened Species

The Siuslaw coho population is one of 21 **independent coho populations** within the Oregon Coast (OC) coho salmon **evolutionarily significant unit (ESU)**. The OC coho ESU is listed as “threatened” under the federal Endangered Species Act (ESA). The listing is due primarily – though not entirely – to habitat loss, and uncertainty concerning trends in freshwater and estuarine habitat quality. Reviews by the National Marine Fisheries Service (NMFS) and its Northwest Fisheries Science Center (NWFSC) in 2011 and 2015 found that the long-term decline in OC coho salmon productivity reflected deteriorating conditions in freshwater habitat, and that the remaining habitat may not be adequate to sustain species productivity during cycles of poor ocean conditions (NWFSC 2015; Stout et al. 2012). The National Marine Fisheries Service completed a recovery plan for OC coho in 2016.

Independent Population: A collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year period is not substantially altered by exchanges of individuals with other populations (migration). Functionally independent populations are net donor populations that may provide migrants for other types of populations. This category is analogous to the independent populations of McElhany et al. (2000).

Evolutionarily Significant Unit: An ESU is a group of Pacific salmon that is discrete from other groups of the same species and that represents an important component of the evolutionary legacy of the species. Under the Endangered Species Act, an ESU is treated as a species.

1.4 A Unique Opportunity for Recovery

While the OC coho ESU is currently listed as threatened under the federal ESA, it represents a unique opportunity for recovery. The status of the species has improved since its crash in the late 1990s, which led to its listing as threatened, and recent years have boasted some of the strongest runs in decades. Like the Siuslaw watershed, much of the broader OC Coho ESU retains the building blocks of good quality habitat, which – when coupled with rebounding populations – indicates that recovery of the species may be possible. Strategic investment in the restoration of key habitat-forming watershed processes will further improve the coho population in the Siuslaw watershed, leveraging these building blocks of existing habitat to maximize benefits to the fish and local communities.

If we are to recover coho, locally led restoration partnerships must take the broad recommendations contained in the federal recovery plan and translate them into strategically placed, well-coordinated on-the-ground projects. This is the purpose of this Strategic Action Plan (SAP). By merging the best available science with local knowledge of the watershed, this SAP seeks to pinpoint the specific projects that, if implemented, can enhance watershed function and ensure the long-term health of the Siuslaw River coho population.

This type of locally led planning is essential to the recovery of OC coho. In 2014, a small team of public and private agencies as well as non-governmental organizations (NGOs) convened to provide technical and financial support to local partnerships that seek to: (1) improve how restoration projects are selected, and (2) accelerate their implementation. This “Coast Coho Partnership” – which included the Oregon Watershed Enhancement Board (OWEB), Oregon Department of Fish and Wildlife (ODFW), National Marine Fisheries Service (NMFS), NOAA Restoration Center, National Fish and Wildlife Foundation (NFWF), and Wild Salmon Center (WSC) – identified two priority structural needs to support locally led habitat restoration: First, a replicable, coho-specific prioritization model was needed to assist local teams in selecting habitat protection and restoration actions. Second, greater coordination of funders was needed to increase

Removal of OC coho from federal protection under the ESA would be a first; to date, no Pacific salmon species has been removed (“de-listed”) under the ESA.

the resources available for locally led implementation of the completed plans.

To meet these needs, the Coast Coho Partnership adopted a model employed successfully by NFWF, called a species business plan. The business plan model provides support to local partners to develop a plan that indicates the primary factors limiting a species’ production in a watershed, and the specific projects that local partners propose to address those limiting factors. This information is captured in a strategic action plan, like this one for Siuslaw River coho. The highest-priority projects contained in the local plan are bundled into a business plan, which is then used to promote and market the projects for funding.

The Coast Coho Partnership will release the first version of the “Business Plan for Oregon’s Coast Coho” (Business Plan) following completion of this Siuslaw River SAP and two other SAPs now underway for coho populations in the Nehalem and Elk River watersheds.

COHO BUSINESS PLAN GOALS	
1	Promote the conservation and recovery of coast coho in Oregon, and describe the essential role of voluntary habitat protection and restoration efforts.
2	Identify the highest-priority projects required at the population (watershed) scale to advance regional recovery goals.
3	Aggregate the cumulative costs and anticipated benefits of these projects to clearly describe what funders can expect to gain from their restoration investments.

Overview of the Siuslaw Coho Partnership and Scope of This Plan

The process to develop this SAP began in 2015 when several local, state, and federal partners involved in Siuslaw coho habitat restoration convened as “the Siuslaw Coho Partnership” (SCP). Since its inception, the SCP has added several new partners representing local, state, and federal agencies, tribes, and NGOs. Today it continues to grow in scope and bring in new partners. The full partnership currently consists of the following members:

- Siuslaw Watershed Council
- U.S. Forest Service
- U.S. Bureau of Reclamation
- Bureau of Land Management
- Siuslaw Soil and Water Conservation District
- Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians
- Confederated Tribes of the Siletz Indians
- Oregon Department of Fish and Wildlife
- National Oceanic and Atmospheric Administration
- Natural Resource Conservation Service



McLead Creek, Upper North Fork Siuslaw

The SCP convened to develop this SAP with three shared objectives:

1. Clarify restoration priorities and enhance coordination;
2. Increase community awareness of, and support for, coho conservation; and
3. Accelerate the rate of restoration to both promote species health and advance local economic goals.

This SAP represents the culmination of a two-year planning process that helped the SCP achieve its first objective, while laying a foundation to achieve the second and third objectives. Implementation of this plan will help the partners grow an already effective and collaborative habitat enhancement program in the Siuslaw watershed. Figure 2-1 shows a sampling of restoration projects successfully implemented on public and private lands within the Siuslaw watershed over the last two decades. The SAP builds on the success of these and other restoration efforts in the Siuslaw Basin.

Two important groups played critical initial roles in helping the SCP develop this SAP and will continue to support implementation efforts.

Core Planning Team. The SCP’s core planning team, a group of SCP members with substantial knowledge of basin resources, took the lead in developing this SAP based on guidance provided by the larger group. Core planning team participants included the Siuslaw Watershed Council, Siuslaw Soil and Water Conservation District (Siuslaw SWCD) Siuslaw National Forest (SNF), Bureau of Land Management Northwest Oregon District (BLM), Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (CTCLU-SI), National Marine Fisheries Service (NMFS), and Oregon Department of Fish and Wildlife (ODFW).

Siuslaw Watershed Council. The Siuslaw Watershed Council (SWC) has served as the convener of the SCP since its inception and will serve as the steward of this SAP in the years to come.

The core planning team developed this SAP document using scientific data and modeling combined with professional experience gained from working in the watershed for decades. The SCP hopes to add new members over the

coming years as new organizations develop, and/or community interest in restoration grows and existing organizations look to partner with the SCP. In the near term, the SCP is eager to involve land trusts and private forestry organizations in the partnership, and is making efforts to involve those organizations at the time of this publication. The process to add new members will be guided by governance documents which are now being finalized.

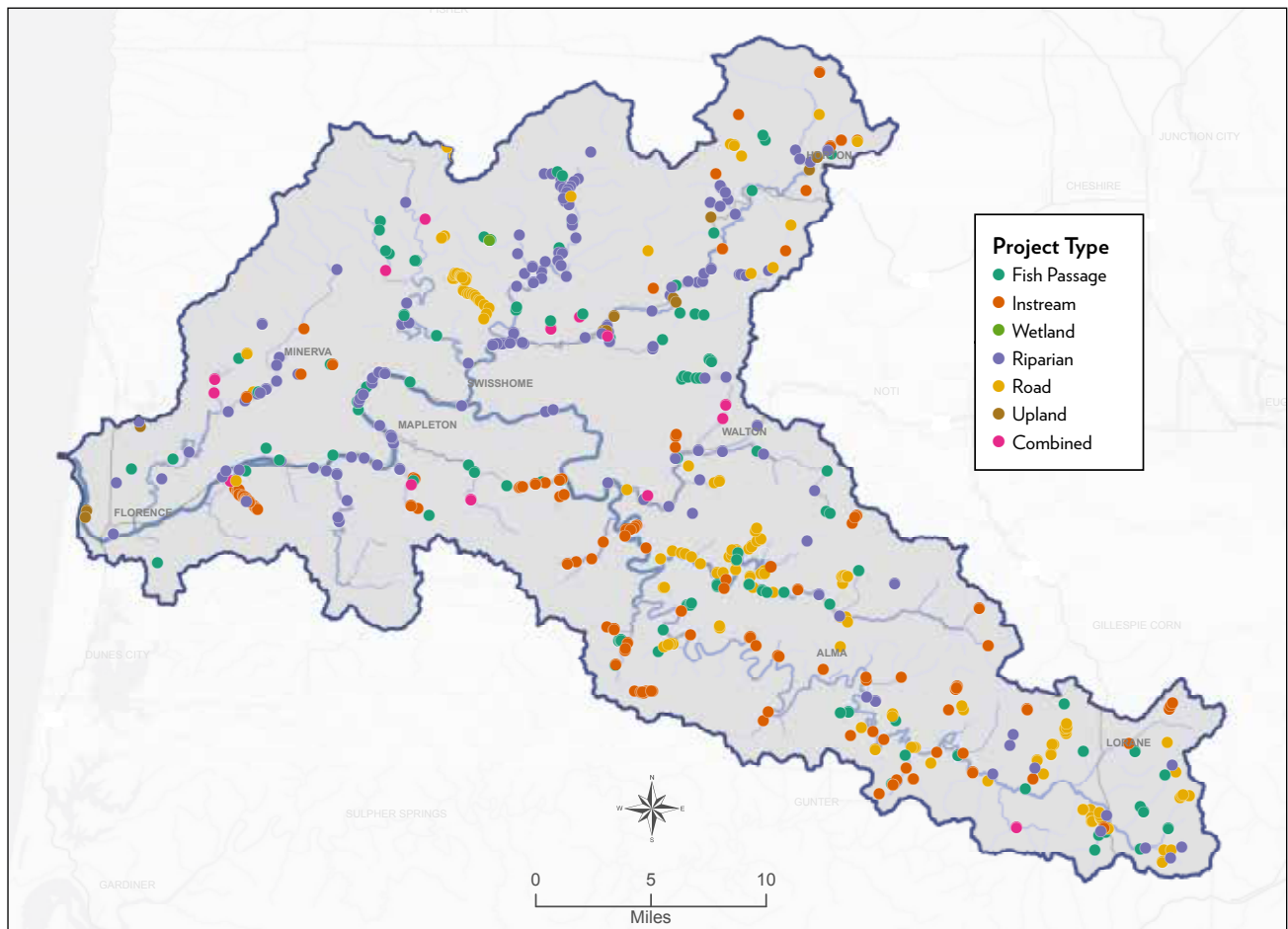
Both the SWC and the SCP's core planning team view this SAP as a living document. As the actions contained within the plan are implemented, there will be lessons learned along the way that inevitably alter priorities and change how, when, and where specific projects reach the ground. The capacity to ensure the long-term health of wild coho in the Siuslaw rests on the ability to adaptively manage in the face of a changing climate and potentially unpredictable watershed responses. Furthermore, it is important to recognize that the SCP's priorities need to remain flexible through time as more science



Recent riparian planting and large wood installation on Bear Creek is intended to stop bank erosion, and restore instream and off-channel rearing habitats.
Photo: Seth Mead.

becomes available to inform restoration investment priorities. It's also important to recognize that external factors like funding and stakeholder support may influence the SCP's priorities over the long term.

Figure 2-1. Public and private partners have undertaken dozens of watershed restoration projects since 2000.



2.1 Our Vision of Recovery

The SCP began the development of this Siuslaw strategic action plan by discussing shared partnership values and priorities that would guide the planning process. They then crafted a long-term vision statement for the SCP that reflects these shared values. This vision statement is shown in the adjacent text box.

To achieve this vision, the SCP recognizes that the watershed processes that generate and maintain critical coho habitats must be protected where they are intact, and restored where they are broken. In the federal coho recovery plan, these watershed processes are described as “key ecological attributes” (KEAs), a term used to describe the most important features of a watershed to support a healthy target species (in this case, coast coho). For the Siuslaw coho population, the most important KEAs include:

- instream complexity of priority tributary and mainstem reaches;
- water temperatures in the Siuslaw River mainstem and tributaries;
- riparian function along tributaries (stream temperature regulation, wood recruitment, sediment and nutrient retention, food source production (insects), etc.);
- lateral connectivity of mainstem and tributary channels with associated floodplains;
- connectivity of freshwater and tidal wetlands; and
- longitudinal (upstream-downstream) connectivity within potential coho-bearing tributaries.

2.2 SAP Implementation: Long-Term Outcomes & Short-Term Goals

Actions that improve these KEAs in the Siuslaw watershed advance strategies called for in the Recovery Plan for Oregon Coast Coho Salmon; however, restoring the KEAs will be a long-term endeavor. It will require decades of work on the ground.

This SAP provides a strategic framework that advances efforts to achieve the SCP’s long-term vision. It presents the highest-priority restoration strategies (in Chapter 7) as well as extensive lists of specific projects and project locations (in the Appendices). These project lists are intended to describe the “universe of projects” that partners will

Our Vision to Recover a Threatened Species

The Siuslaw Coho Partnership envisions a future where collaboration among residents drives thriving local communities that exist in balance with the region’s highly productive Siuslaw River watershed. In addition to providing critical services that promote a high quality of life for local residents (like drinking water, flood storage, and nature-based recreation), the Siuslaw watershed will continue to generate some of the largest, most diverse coast coho (and other) salmon runs on the Oregon coast. Healthy salmon habitats – and the numerous plant and animal species that rely on them – will foster social and economic well-being in the Siuslaw Watershed and promote resilience to changing watershed conditions.

choose from as they seek to protect and restore the KEAs. The types of actions presented in the plan, as well as their proposed locations, were generated and prioritized through a combination of modeling and the expert opinions of local managers.

Over the long term, through the continued implementation of these projects and others added along the way, the SCP seeks to achieve three major outcomes. If the SCP can generate these outcomes, we can achieve the vision of a healthy coho population existing alongside vibrant, resilient communities.

While the projects presented in this SAP have been ranked using objective criteria that reflect

LONG-TERM OUTCOMES	
1	An increase in the quality and quantity of summer and winter rearing habitats in selected sub-watersheds sufficient to anchor population viability.
2	A connected assemblage of diverse habitats sufficient to foster a broad expression of life-history strategies in the Siuslaw coho population.
3	A healthy watershed restoration economy that is viewed as an important source of income in the Siuslaw watershed.

the best available science, ultimately the selection and sequencing of projects over the long term will be driven by countless external factors, including landowner willingness, permitting constraints, and funding availability. Chapter 8 presents the SCP's six-year implementation plan, which takes into account these "real world" considerations. By 2025, the SCP will seek to accomplish the following goals across six priority watersheds (Upper and Lower Deadwood Creek, Dogwood Creek, Upper and Lower North Fork Siuslaw, and Upper Indian Creek watershed.)

SHORT-TERM GOALS	
1	Install LWD in 75 miles of tributary habitats.
2	Enhance 47 miles of riparian habitats.
3	Reconnect 506 acres of floodplain habitats.
4	Reconnect 30 miles of instream and slough habitats.
5	Upgrade 16 miles of forest roads.
In addition to these on-the-ground restoration goals, the SCP will also seek to accomplish socio-economic goals:	
6	Engage all public and private landowners with lands in the high-ranked sub-watersheds containing habitats identified as high priority for protection or restoration.
7	Create and support 20 local jobs and generate \$10m in economic output to the local restoration economy by hiring local contractors and promoting local businesses.

2.3 Scope of this Strategic Action Plan

The SAP focuses on physically improving critical habitats for coho in the Siuslaw watershed. It recognizes that the SCP's ability to achieve the larger outcomes identified above (enhanced coho habitat quality and quantity, a connected assemblage of diverse habitats, and a robust local restoration economy) will be influenced by a variety of threats that cannot be fully prevented or ameliorated by habitat protection and restoration. Participants on the core planning team considered many of these threats, including predator management (sea lions, cormorants, etc.),



Spawning coho. Photo: Jim Yuscavitch.

the sufficiency of state water quality rules, fire prevention and response, and fisheries management, but opted to **limit the scope of this plan to priorities that the partnership has greater control over: namely, where, when, and how coho habitats can and should be restored in the watershed.** The SCP encourages reviewers of this plan to consider the policies governing land use and species/habitat management in the Siuslaw alongside this plan's restoration goals, and to use existing venues to promote policies that align with our shared vision of coho recovery.

In addition to limiting the scope of this plan to strategies which physically improve critical habitats, the SCP underscores that **implementation of this plan is entirely voluntary.** While maps contained in this plan do identify instream and upland habitats on some private lands as a high priority for restoration, implementation of actions on these lands is entirely voluntary. The identification of high-quality habitats on both public and private lands will guide the SCP's outreach to landowners, but participation in the implementation of this plan is entirely voluntary and no new actions will be required of public or private landowners. Accordingly, **this SAP does not propose any new regulations or the modification of existing regulations.**

This SAP does not propose any new regulations or the modification of existing regulations. Implementation of this plan is entirely voluntary.

2.4 Guiding Principles for Plan Development

The Siuslaw Coho SAP was developed as one of three pilot SAPs funded by OWEB and NOAA Restoration Center to design and test a flexible methodology to identify and prioritize coho habitat restoration projects at the population scale. Staff from the WSC (Portland, OR) facilitated the SAP development process, which was overseen and advised by the full Coast Coho Partnership.

The SAP process was specifically designed to promote focused and coordinated implementation by narrowing down anchor habitats, locations in the population area where protection and restoration projects can yield the greatest benefit to coho, and by identifying site-specific restoration actions. Chapter 6 and accompanying appendices detail this SAP development process. Generally, the process was guided by the following principles:

- **Adopt the common framework and modify for the Siuslaw Watershed.** Prior to initiating the three pilot SAPs, the Coast Coho Partnership developed a common set of terms and definitions to use in each plan. The purpose of this “common framework” is to ensure consistency in how coho ecosystems are described and evaluated. Based on the Open Standards model, the common framework defines the habitat components (types) used by coast coho, the key ecological attributes (KEAs) necessary to ensure coho viability in each component, and potential indicators through which the KEAs can be evaluated. At the start of the Siuslaw SAP process, the SCP modified the common framework for use in the watershed. The resulting “Siuslaw Common Framework” can be found in Appendix 1.
- **Focus on protecting and restoring watershed function first.** While this SAP contains numerous habitat restoration projects that are designed to provide a short-term increase in production, the plan emphasizes the protection and restoration of watershed processes. A focus on enhancing natural watershed processes will promote landscape resilience and the restoration of critical habitats needed to sustain coho viability over the long term, while complementing other habitat restoration work in the short term.

Climate Change

“The ESU remains particularly vulnerable to near-term and long-term climate effects because of the long-term loss of high quality rearing habitat. In the short term, the ESU could rapidly decline to the low abundance seen in the mid-1990s when ocean conditions cycle back to a period of poor survival for coho salmon. In the long term, global climate change could lead to a downward trend in freshwater and marine coho salmon habitat compared to current conditions.” - NMFS 2016

Process-based restoration also provides the greatest possible buffer to changing watershed conditions driven by climate change. As described in the federal Oregon coast coho salmon recovery plan, “while considerable uncertainty exists about the magnitude that most of the specific effects of climate change will have on the coho salmon habitat, NMFS and the NWFSC remain concerned that most changes associated with climate change could result in poorer and more variable habitat conditions for Oregon Coast coho salmon in freshwater, estuarine, and marine environments” (NMFS 2016).

- **Focus initial restoration efforts within those watersheds currently demonstrating the highest ecosystem function.** The SCP ranked the health and production potential of each 6th field HUC sub-watershed, and focused the plan on the most productive and least degraded sub-watersheds. By enhancing the long-term function of these more intact sub-watersheds, the SCP is confident that it can maintain and promote population resilience over the long term.
- **Focus on major stresses.** Each high-ranked sub-watershed (i.e., those areas in which local partners agree to focus and coordinate restoration projects) underwent an assessment of habitat stresses to ensure projects selected in each tributary had the highest likelihood of maximizing the watershed’s production potential. Goals and objectives determined by the SCP aim directly at reducing the highest priority stresses agreed upon by the core planning team. See Table 7-1.



- **Focus on a limited set of the most important coho habitat indicators.** The Oregon Coast Coho Salmon Recovery Plan (NMFS 2016) details the habitat stresses that limit coho production at the ESU and population scales. Drawing from the common framework, the SAPs adopt a limited set of indicators that assist managers in assessing the extent of these stresses. These indicators represent “the needles that need to move” to recover OC coho. All of the actions contained in the SAP aim to reduce the major stresses identified by the core planning team and improve the selected indicators.
- **Prioritize projects with objective scoring criteria.** Finally, SAPs use a suite of criteria to evaluate and prioritize proposed projects within the high-ranked sub-watersheds. The criteria focus primarily on the extent to which a project enhances ecosystem function and addresses primary stresses. In addition, three social and economic criteria are also considered: (1) a project’s educational value, (2) its demonstration value (of new or innovative conservation techniques), and (3) its “working lands” value (i.e. the extent to which it creates both durable conservation outcomes and benefits to a landowner.)
- **Promote Adaptive Management.** This plan presents a variety of projects that were developed in large part around an anchor habitat strategy, in which managers seek to protect and restore the watershed processes

that are most likely to promote high-quality habitats in the locations deemed most suitable for use across multiple coho life stages. This strategy does not capture all of the coho habitat available in the watershed, however. As managers continue to learn more about how and where coho use different habitats, and gauge the effectiveness of different restoration techniques in those habitats, the SCP may amend the priorities presented in this plan.

In addition, it should be emphasized that climate change is likely to drive unforeseen changes in watershed function and habitat availability over the life of this plan. According to NMFS, “the ESU remains particularly vulnerable to near-term and long-term climate effects because of the long-term loss of high-quality rearing habitat. In the short term, the ESU could rapidly decline to the low abundance seen in the mid-1990s when ocean conditions cycle back to a period of poor survival for coho salmon. In the long term, global climate change could lead to a downward trend in freshwater and marine coho salmon habitat compared to current conditions” (NMFS 2016). As the effects of climate change become more pronounced and better understood, managers will re-prioritize actions.

The Siuslaw River Watershed

The Siuslaw River watershed is a remarkably rich and productive ecosystem that, historically, produced one of the largest runs of coho salmon on the Oregon Coast, as well as runs of Chinook and chum salmon, steelhead and cutthroat trout.

This chapter describes the conditions in the Siuslaw River watershed that once supported the great runs of coho and other salmonids, as well as how these resources supported indigenous communities and promoted European settlement. Discussions in this chapter provide context for information presented later in Chapter 4, Siuslaw Basin Coho and their Habitat Needs, and Chapter 5, Impaired Watershed Processes and Resulting Stresses on Coho Habitats.

Chapters 3, 4, and 5 use terminology developed in the common framework. The most often-used terms are defined in the box below. The full Siuslaw common framework can be found in Appendix 1.

3.1 Physical Geography

The Siuslaw River begins in the rain-drenched coniferous forests of the Oregon Coast Range and fertile Lorane Valley, west of the city of Eugene. From its headwaters, the river stretches approximately 109 miles, winding its way through low mountain forests, valley bottomlands scattered with wetlands, sand dunes, and an extensive estuary before meeting the Pacific Ocean near the city of Florence. The river basin covers a total of 504,000 acres (773 sq. miles). The watershed borders the Alsea River system to the north, the Willamette River system to the east, and the Smith River, a tributary of the Umpqua River, to the south.

The Siuslaw River basin lies in the Coast Range ecosystem and is characterized by four distinct geographic landforms:

- **The eastern headwaters** drain a north-northwest to southeast trending ridgeline that separates the Siuslaw watershed from the Willamette River drainage. The area displays low, rounded hills and broad slightly undulating valleys, including the Lorane Valley.

Common Framework Terminology

Key Ecological Attribute: Key Ecological Attributes, or “KEAs”, are characteristics of watersheds and specific habitats that must function in order for coho salmon to persist. KEAs are essentially proxies for ecosystem function. If KEAs like habitat connectivity, instream complexity, water quality, riparian function, and numerous others are in good condition then sufficient high quality habitats likely exist within a watershed to maintain viable coho populations.

Stresses: Stresses are impaired attributes of an ecosystem. Stresses are equivalent to altered or degraded KEAs. They are not threats, but rather degraded conditions or “symptoms” that result from threats. In the common framework, stresses represent the physical challenges to coho recovery, such as decreased flows or reduced off-channel habitats.

Threats: Threats are the human activities that have caused, are causing, or may cause the stresses that destroy, degrade, and/or impair KEAs. The common framework includes a list of threats with definitions and commonly associated stresses. This list is based on threats listed (sometimes using different terms) in existing coho recovery plans. The definitions are based on previous classifications (IUCN 2001; Salafsky et al. 2008) with minor modifications reflecting the work of the Coho Partnership.

Habitat Components: Habitat components are the types of habitats that are essential to support the (non-marine) life cycle of coho salmon. The Siuslaw common framework identifies and defines these habitat types, which are presented in Chapter 4.

- **The middle reaches** of the river system flow through a mix of forest lands, including the Siuslaw National Forest, BLM, Oregon and California Railroad Revested Lands (O&C lands), private inholdings, and industrial timberlands. Several highly dissected tributaries to the Siuslaw River drain these steep, forested uplands, with small farms dotting the valley bottoms along the Siuslaw River and tributary streams.
- **Near the town of Mapleton**, the river begins to slow as it drops in elevation and mixes with tidal-influenced flow from the Pacific Ocean. The tidal reach of the Siuslaw River extends inland about 26 miles (Ecotrust 2002), and the river gradually widens as it makes its way through a broad floodplain with numerous wetlands and tidal islands. Actual saltwater intrusion extends 17-22 miles upriver during low flow summer months, and only 5-7 miles during the higher winter flows. Along the North Fork of the Siuslaw, tidal influence is generally thought to extend to river mile (RM) 7-10 (Ecotrust 2002).
- **The lower Siuslaw River** flows through the coastal plain portion of the Siuslaw watershed near Florence. The area is characterized by sand dunes and low-lying areas, with a mosaic of pine woodlands, wetlands, and lakes. The river joins the Pacific Ocean just north of Florence.

3.2 Hydrology and Water Resources

The highly dissected Siuslaw River system includes approximately 5,250 total miles of streams that gather precipitation from the landscape. The river system includes 1,207 miles of low gradient streams and unconfined or moderately confined floodplains, 807 miles of moderate gradient confined streams, and 3,190 miles of steep/very steep headwaters or steep narrow valley/bedrock canyon streams (Ecotrust 2002). The Siuslaw River basin is a fourth-field (HUC 17100206) watershed, with Lake Creek as the major tributary. Drainage densities in the basin exceed 5.0 miles/mi².

The basin also contains numerous wetlands and several lakes. Substantial freshwater wetlands remain in the Lorane and upper Lake Creek valleys, and scattered small wetlands are found in the North Fork, Indian Creek, and other



Little Lake in Triangle Lake watershed.

valleys of the lower Siuslaw watershed. National Wetland Inventory maps (Cowardin et al. 1979) indicate that most riverine nontidal wetlands in the lower Siuslaw watershed are palustrine emergent. Lakes in the basin include Munsel, Ackerley, Clear, and Collard Lakes in the lower Siuslaw Basin, which together cover approximately 20 acres in the Florence sub-watershed. Triangle Lake, a 290-acre lake with outflow to Lake Creek, sits in the extreme northeastern part of the basin and was formed by a landslide blocking a narrow canyon during the Pleistocene Epoch 2 million to 11,700 years ago. The lake is 97 feet deep along the western edge near the outlet, but is a small proportion of its former area, and is slowly filling with valley alluvium (Atlas of Oregon Lakes).

Stream flows in the Siuslaw River watershed reflect the area's coastal climate and strong marine influence, and the topography of the east-west orientated Siuslaw Basin has a significant effect on precipitation distribution. Along the coastline, precipitation is 60-80 inches annually, increasing to 120 inches or more through the Coast Range. The upper basin is significantly drier, with 55 inches of annual precipitation recorded near the town of Lorane, on the southeastern edge of the watershed.

Stream flows in the basin quickly rise with winter rain, and drop to very low levels in summer, with ratios of highest to lowest flow of 35 to 1. Peak runoff is flashy and highly variable, varying from 280 cfs/ mi² in Esmond Creek to 48 cfs/ mi² in the Siuslaw River near Lorane. Flood history shows that the highest recorded floods of 1964, 1972, and 1996 measured 28-29 feet

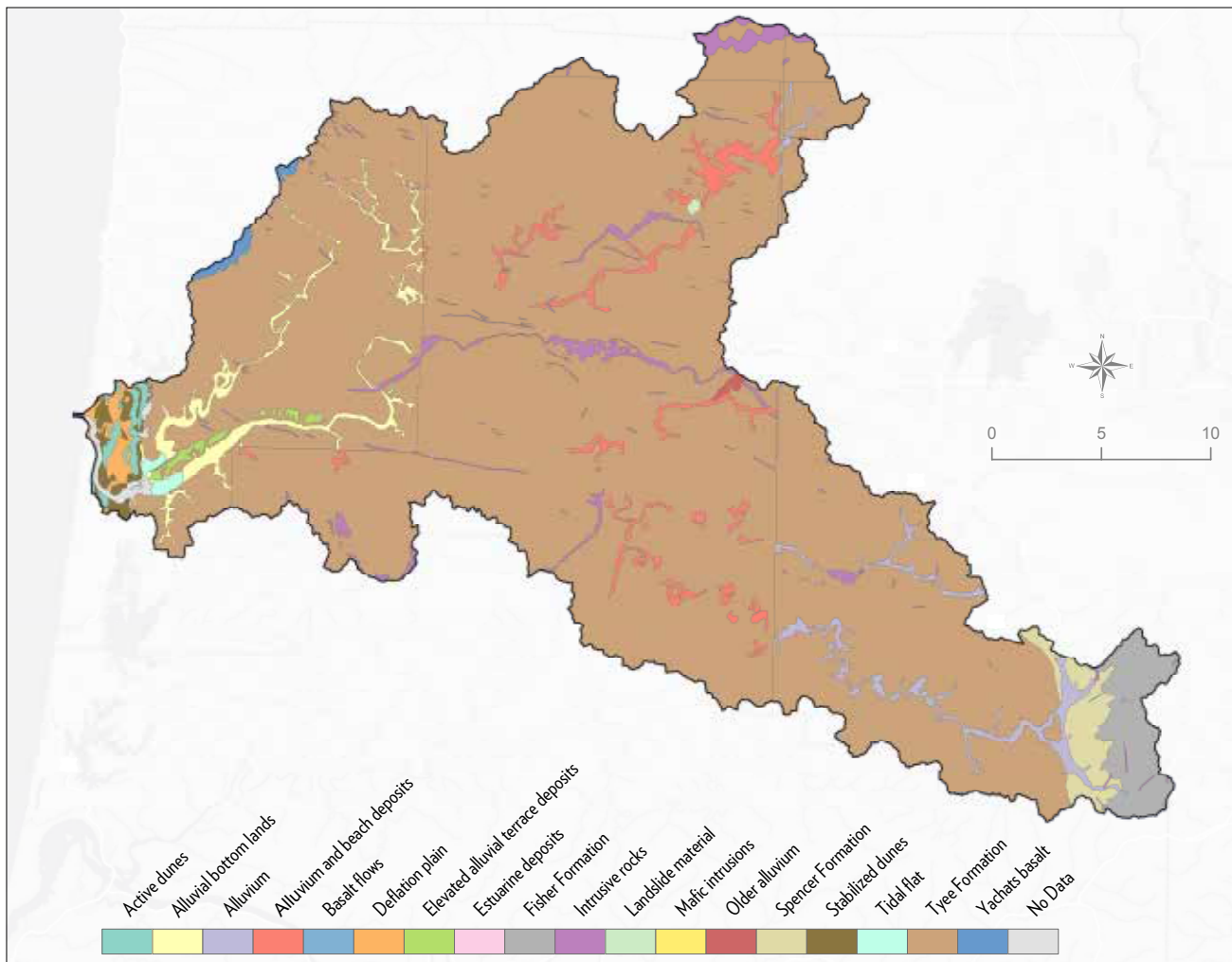


Figure 3-1. The geology of the Siuslaw watershed is primarily Tyee sandstone, which is the dominant surface geology of the central Oregon coast. Tyee sandstone weathers easily, promoting mass wasting (landslide) events that are an important contributor of gravel and large wood to area streams.

(from watermarks at the USGS Mapleton gage) with estimated return intervals in the range of 50+ years. Mean annual discharge of the Siuslaw (USGS Mapleton stream gage) averages about 1.5 million acre-feet, with December being the highest flow month and August the lowest flow month. Ecotrust (2002) found a strong relationship between peak runoff (flow/area), stream gradient, area of wetlands, and forest land use (decrease of forest cover). Runoff was greater with steeper streams and young forest age classes, while watersheds with larger wetland areas had an attenuating effect (lower peak runoff). No correlation was found between road density and runoff rates.

Flashy peak flows are promoted by an underlying sandstone geology that is impermeable to water movement, while allowing shallow porous

soils on steep slopes to drain quickly. The randomness in distribution of storm cells influenced by topography may also play a part in the uneven precipitation and runoff response. The Siuslaw Basin is below the elevations necessary to accumulate snow in the winter, other than rare rain-on-snow in the highest elevations, and is a rain hydro-region. Valley form, width and availability of connected floodplains and wetlands play a role in retaining water longer into the dry season. Excepting Upper Lake Creek/Triangle Lake, and the Lorane Valley at the eastern border of the watershed and the lower estuary, the remaining narrow valleys that make up the largest proportion of the watershed do not favor sizable floodplains or wetlands. See Figure 3-1.

The Siuslaw River estuary is typical of Oregon estuaries with a drowned river mouth resulting

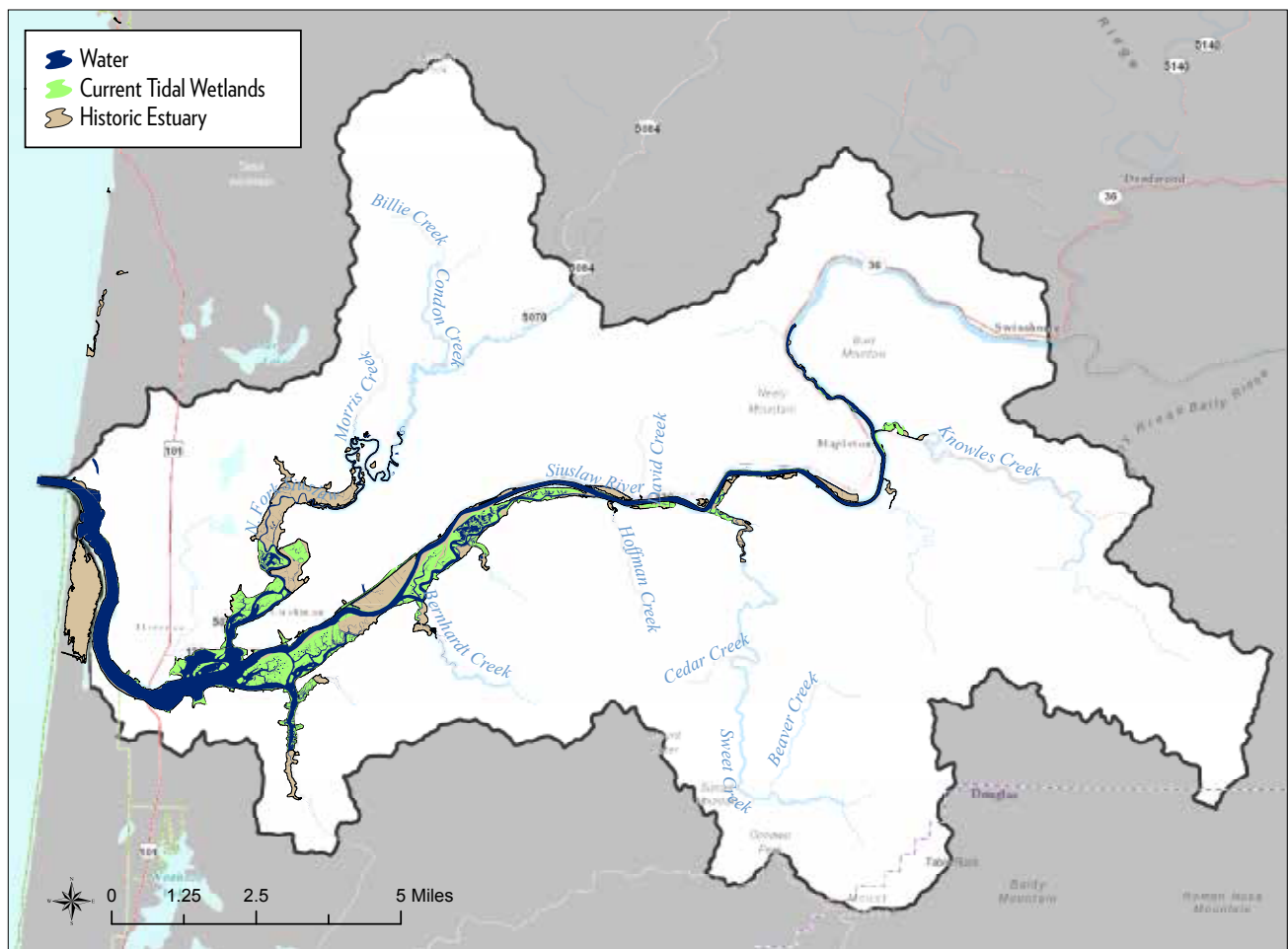


Figure 3-2. Comparison of historic and current tidal wetland habitat. Brophy (2005) identified 2,970 acres of current and historic tidal wetlands in the Siuslaw River estuary. Roughly 60% of these have been lost to agricultural, residential, and urban development. Ongoing reconnection and restoration of these historic tidal wetlands will benefit Siuslaw coho and other wild salmonids.

from sea level rise and past tectonic subsidence. Dredging in the estuary has altered channel form in several areas. There are broad tidal flats, with sediment deposition during high river flows that has led to expansion of tidal marsh in the lower estuary since the 1850's (Brophy 2005). The Siuslaw River estuary currently encompasses at least 4,200 acres beginning at the mouth, and extending to Hoffman Creek at RM 13 (Cortright et al. 1987). Head of tide on the Siuslaw River is near RM 23, and near RM 10.5 on the North Fork Siuslaw. Wetlands over two acres in size are not found past RM 19 on the Siuslaw River or RM 6 on the North Fork Siuslaw (Brophy 2005). See Figure 3-2.

Estuarine wetlands consist of open water/unconsolidated bottom, sub-tidal aquatic beds, eelgrass, intertidal marsh and aquatic beds, tidal flats, modified marsh (filled/diked wetlands), and dredge material deposits. **These tidal wet-**

land types are considered to be high priority for restoration (Brophy 2009). Approximately 35 percent of the estuary is classified as subtidal and the remaining as intertidal. Brophy (2005) identified 2,970 acres of current and historic tidal wetlands in the Siuslaw River estuary. A tidal wetland is a vegetated wetland that is periodically inundated by tidal waters, generally daily at high tide or monthly during spring tides, but at least annually (Brophy 2005). The tidal wetlands can be divided by vegetation into tidal marsh, which is dominated by grasses, sedges and rushes, and tidal swamp, which is dominated by shrubs and trees. More than 60 percent of the original tidal wetlands are no longer present because of dike construction, site alterations (filling, road crossings, ditching or grazing), culverts restricting tidal flow, and dredging (Ecotrust 2002; Brophy 2005). Figure 3-2 indicates the extent of tidal wetlands loss.

3.3 Biotic Systems

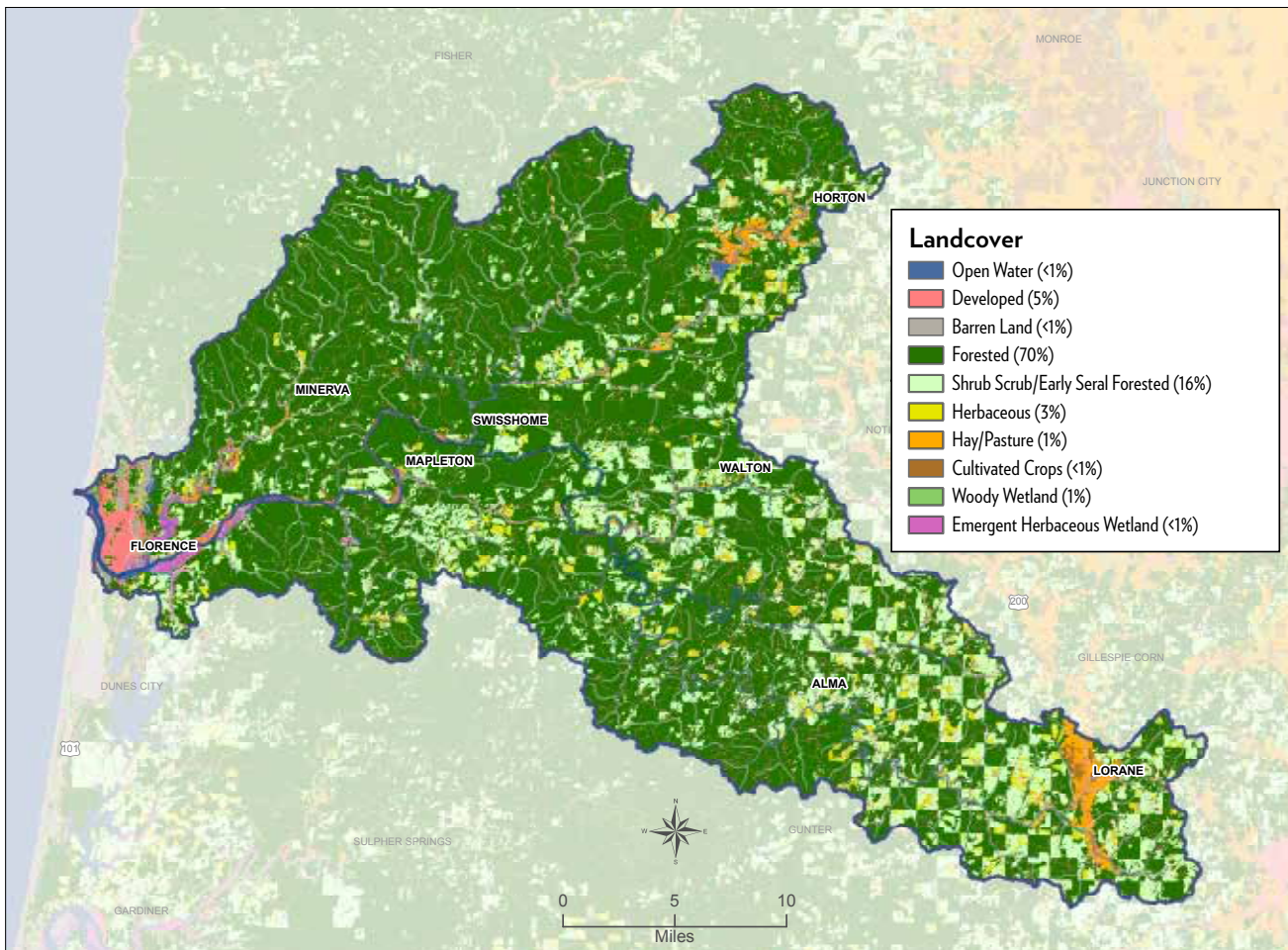
Most of the Siuslaw watershed is part of the Pacific Coast Coniferous Forest Ecosystem (Bailey 1994). Common tree species throughout the watershed include conifers such as Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), and Sitka spruce (*Picea sitchensis*). Hardwoods include red alder (*Alnus rubra*), and bigleaf maple (*Acer macrophyllum*). Red alder occupies recently disturbed areas and impacted areas from fires, floods, landslides or logging. The tree is found along many valley floodplains and toe-slopes. The eastern, upper portion of the Siuslaw Basin lies in the Western Hemlock Zone where Western Hemlock is historically the climax tree species. Douglas-fir is the current dominant tree species because of disturbances, especially fire and timber harvest, over the last 150 years. Drier environments with salal and rhododendron understories are prevalent in the eastern portion of the watershed. The western portion of the basin, including

lowlands and tidewater areas, lies within the fog belt and is characterized by the Sitka spruce plant series.

Prior to European settlement in the 1880's, the Siuslaw River valley was a mosaic of complex braided channels, tidal swamps, and freshwater wetlands further upstream. The historic tidal swamps were dominated by Sitka spruce, but Crabapple swamp and shore pine swamp were also found in the Siuslaw River estuary (Brophy 2005). Old-growth cedar, Sitka spruce, and hardwoods (black cottonwood and maple) were also present along the lower valley tributaries.

After a century of logging and large fires (originating around 1850 in the upper Siuslaw Basin), the coniferous forest vegetation is now a heterogeneous mixture of patch sizes and young-to-mature seral stages, with a large proportion less than 80 years of age. Old growth forest is extremely fragmented after years of intensive logging and disturbance, being limited to isolated patches, mostly on federal lands. See Figures 3-3 and 3-4.

Figure 3-3. Land cover in the Siuslaw Watershed.



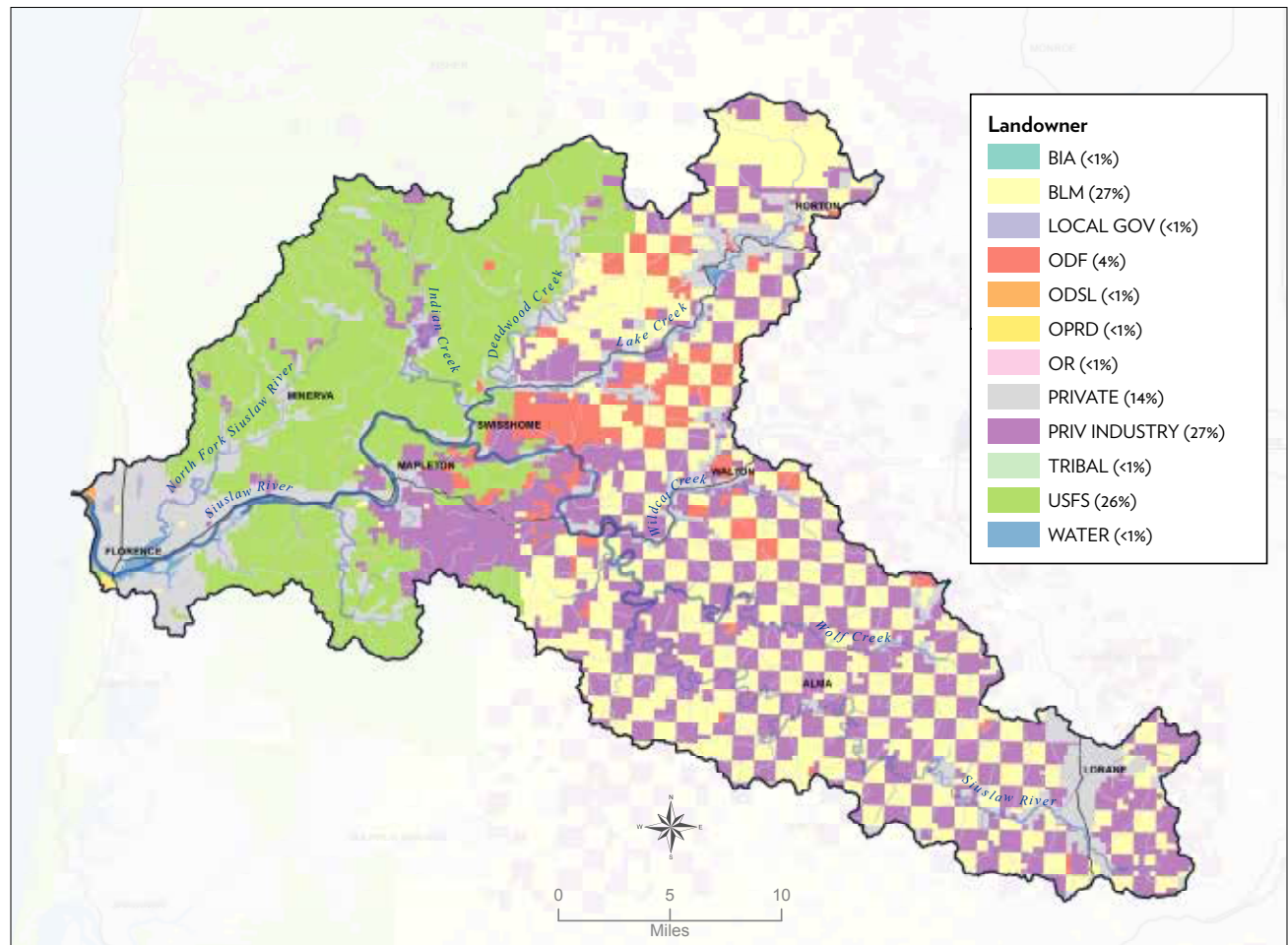
Greater conservation of old growth has occurred since the formation of Late Successional Reserves on federal lands under the Northwest Forest Plan in the mid-1990s. The younger stands in the reserves have also been thinned to allow a variety of tree species and to promote late-successional structure characteristics. Riparian buffers along streams on federal lands have received greater protection, especially the near-stream zone.

3.4 Indigenous Communities

Before European settlers arrived in the 1880s, the Siuslaw River watershed was the home of The Native Siuslaw People for whom the river eventually became named; the original name of the river was 'iktat'uu, as the Siuslaw People called it. The Siuslaw Tribe managed the watershed for hundreds of generations and thousands of years. Their culture evolved from an observation and a stewardship of their lands and waters, utilizing ceremonies and gathering techniques that

encouraged balance and abundance for future generations. Great care and respect was given to all species, but the Salmon held special prestige within the Tribe. Salmon was the main food staple of many native bands; the term 'Salmon People' resonated with many tribal communities on the Pacific Northwest Coast, including the Siuslaw and its native inhabitants. Each year, when the Salmon would begin coming up the river, a Salmon Ceremony took place. All fishing stopped at the catching of the first Salmon so it could be given to the people, specifically the people who earned it. Parts of the Salmon were given out in order of importance to those who had done good things for their village: first the Heart, then the Cheeks, the Collar, the Steaks, etc. The bones were then laid back to rest into the waters in which they came, a show of respect to the Salmon People relatives. Part of returning the remains to the river was also to ask the Salmon People to come again. Once the Salmon Ceremony was concluded, then, and only then, could the tribe continue fishing.

Figure 3-4. Land ownership in the Siuslaw Watershed. Please see the list of acronyms on page ii for landowner names.





Members of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians continue to emphasize Traditional Ecological Knowledge. Photo: CTCLUSI.

Another important subsistence food was the Pacific lamprey, a high caloric fish that is thought to have been the leading animal biomass in the river system. Salmon and lamprey were dried and smoked to be stored for the winter months by the Siuslaw people. The lifecycle of lamprey has a direct impact on salmon in the river; ammocoetes, or juveniles, serve as food for salmon, whereas adults cause a threat by ‘parasitism’. Like coho, Pacific lamprey have also been on the decline. Causes for the decline of lamprey are still uncertain, though predation by non-native invasive fishes, erosion and sedimentation, and channelization and passage barriers are likely factors.

The Siuslaw People, now confederated with their southerly neighbors, the Coos and Lower Umpqua Tribes and known collectively as the Confederated Tribes of the Coos, Lower Umpqua, & Siuslaw Indians, continue to actively seek partnerships and land acquisitions within their ancestral territories to continue their legacy and responsibility to these lands and waters as stewards.

3.5 European Settlement and the Rise of a Resource-Extraction Economy

During the 1840s, Hudson’s Bay Company explorers, including Alexander McLeod, were some of the first Euro-Americans in the Siuslaw Basin. The company trapped beaver up the Siuslaw

River and the North Fork Siuslaw River. Excessive trapping into the 20th century led to a substantial decline in the Siuslaw beaver population, greatly reducing the number of beaver ponds, which historically provided excellent summer and winter rearing habitat for juvenile coho.

Settlement and Agriculture

In 1875, the Oregon legislature opened up the Siuslaw Basin for settlement. Settlers received free land through the Donation Land Act of 1850, or for \$1.25 per acre for the purchase of 160 acres through the 1862 Homestead Act. The Lorane Valley, with a gently rolling terrain covered with prairie grass or oak savanna, was conducive to agricultural production. The rugged western portion of the basin, with its dissected topography and narrow valley bottoms, required settlers to clear timber and vegetation before planting crops. In the tidally influenced lower watershed, timber was harvested in valley bottoms and lands drained for subsistence farming. This included **widespread levee construction, ditching and filling of wetlands, and channelizing streams and moving them to the edges of valleys.** Later, tidegates were constructed in the wetter intertidal zone to farm the cyclically flooded areas.

The earliest settlers faced hardship and struggled to grow enough food to get them through the winter. Many families grew potatoes and corn in the sandy soils along the riverbanks. As

more land was cleared, pastures were established and cattle were raised for meat and milk. When settlers arrived, there were no roads in much of the watershed. The river was the means of transportation and getting products to market was challenging. Most of the milk was fed to hogs after the cream was separated from it. Cream was churned into butter and there soon became a market for it. As transportation improved with new roads and electricity became available, refrigeration made it possible for whole milk to reach markets in urban areas. New dairies sprang up throughout the watershed. More bottom ground was cleared, drainage ditches were dug, tidal areas were diked and every bit of land that could grow grass was utilized. It wasn't long before every farm was an established dairy.

Because the climate is not conducive for growing grains, silage and hay was the main winter forage. Much of the wetter areas were planted to reed canary grass because of its abundant growth and ability to tolerate wet conditions. For many years farmers were able to make a good living from the land to support their families. Rising transportation and feed costs began to take a toll on profits, however, and dairies began to decline. Farmers either sold out or changed their operations to raising beef cattle. Today there are no dairies left in the Siuslaw watershed and raising beef cattle is the primary agriculture practice. Much of the bottomland continues to be very productive pasture. However, some of the marginal areas, or where maintenance is lacking, are reverting to blackberries, trees and/or back to estuarine habitat.

Many dairy farms of the turn of the century transitioned to beef cattle.



In use from the 1880-1930s, steam donkeys greatly improved the efficiency of logging in coastal watersheds. Photo: Florence Pioneer Museum.

Timber Harvest

Logging began with the arrival of settlers in the mid-1800s and expanded with improvements in transportation to potential markets. Construction of a rock jetty began in 1892, providing access to the mouth of the Siuslaw River for navigation and increasing transportation from the area to potential markets along the west coast. By 1897, four lumber mills existed on the river, with a 200,000 board foot capacity per day. Lumber was shipped from the Port of Siuslaw by Schooner south to San Francisco.

The Siuslaw National Forest was established on March 2, 1907 when President Theodore Roosevelt signed an Executive Order, adding 16 million acres to the nation's forest reserves. Most logging continued to occur on private lands in valley bottoms until about 1925. Initially, because of the difficulty developing and maintaining roads, streams were the highway for moving logs. Many valley bottom areas were cleared to allow for the easier transport of timber down these fluvial highways, which has lasting impacts today.

The transportation system expanded in 1914 with the arrival of the railroad from Florence to Eugene, and in the 1930s with the addition of logging trucks. During this time, streams remained the primary route to transport logs,

and riparian areas along streams were logged in order to more easily float the logs downstream to Florence, where they were collected and shipped. Stream clearing of large wood and debris also allowed the cut timber, fallen into the channel, to move downstream with high water. Splash-dam releases were a common practice. This involved building wood crib dams, moving or dropping logs behind the dam, and then releasing the water and logs all at once, often by opening a gate, when stream flows were sufficient. Dynamite was used to free obstructions in the streams and logjams that hung up along narrow canyon walls or pinch points. To catch logs, a giant log boom was placed across the Siuslaw River, about seven miles below the head of tide. More than 20 splash dams once existed along the major tributaries of the Siuslaw River (Miller 2010). From 1889 through the 1920s, logs were driven downstream on the mainstem Siuslaw River from as high as Mound at RM 85, on Wildcat Creek for 7.5 miles, and for about 15 miles on the North Fork Siuslaw River and Indian, Deadwood and Lake Creeks (ODSL 1983). Splash dams and drives also occurred on Knowles Creek, Lower Sweet Creek, and the lower portion of the creek flowing into South Slough.

Until the 1930s, timber was dragged and decked in canyons by steam donkey logging systems, and crawler tractors moved the logs to the river. The tractors commonly operated in stream channels and on stream banks, degrading streams and removing gravels important to salmonids and many other aquatic organisms. Small mills operated within the Siuslaw Basin's major tributaries, and sometimes even dammed the mainstem tributaries (Deadwood Creek, for example.) Earthen dams, 50 to 80 feet in height, across tributary streams created holding ponds for logs to be processed in the mill. These smaller mills typically operated from 2 to 15 years. When the mills closed, the dams were blown up and debris in the pond washed downstream. Milling operators also discarded side-cuts and organic debris directly into the streams.

Logging in the upper Siuslaw watershed began in the 1940s when improved road-building techniques allowed harvested timber to be transported to mills by logging trucks. Wood products from the Siuslaw Basin were shipped all over the United States by rail in the 1940s. During this time, Florence had at least 17 mills.

Logging camp in the Siuslaw watershed. Photo: Florence Pioneer Museum.



Salmon Harvest

In the early 1900s, the salmon runs returning to the Siuslaw River were some of the largest in the Pacific Northwest. These prolific runs supported the area's fishing industry, as well as three salmon canneries on the lower Siuslaw River from the 1880s until the early 1900s (Ecotrust 2002). As discussed later in Chapter 4, hundreds of thousands of adult coho salmon returned each year to the Siuslaw River basin in the late 1800s and early 1900s. Annual catch records indicate that approximately 80,000 coho salmon were caught from the Siuslaw River each year between 1892 and 1910.

The early cannery industry, however, was short lived; coho runs to the Siuslaw River began to decline during the late 1890s. With salmon levels too low to support commercial operations, the canneries closed by 1914.

Causes of the decline of the Siuslaw coho salmon runs included over-harvest primarily through gill netting, as well as habitat loss and degradation. Commercial salmon fishing continued, however, on the Siuslaw River. In an effort to save remaining runs, fishermen sought to eliminate seal populations, even using dynamite at the mouth of the river. Restrictions on fishing methods and limits were imposed by the Oregon State Fish Commission beginning in 1939. Commercial salmon fishing on the Siuslaw River continued until 1956, when it was permanently banned. Sport harvest of coho continued after the commercial ban, however, and continues to support a small fishing industry today.

3.6 Present-day Communities of the Siuslaw Watershed

Today, approximately 16,000 people reside throughout the Siuslaw watershed. Nearly 12,000 of these residents live on the coast, in or near the city of Florence. Another 2,000 people live in Mapleton and Swisshome areas, and on farms and small land holdings along the Siuslaw River corridor and side drainages. In the mid-to-upper watershed, approximately 2,000 residents are fairly evenly divided between the communities of Deadwood, Triangle Lake, Blachly, and Lorane.

The Siuslaw watershed lies predominately in Lane County, with minor portions of the watershed in Douglas and Lincoln counties. The



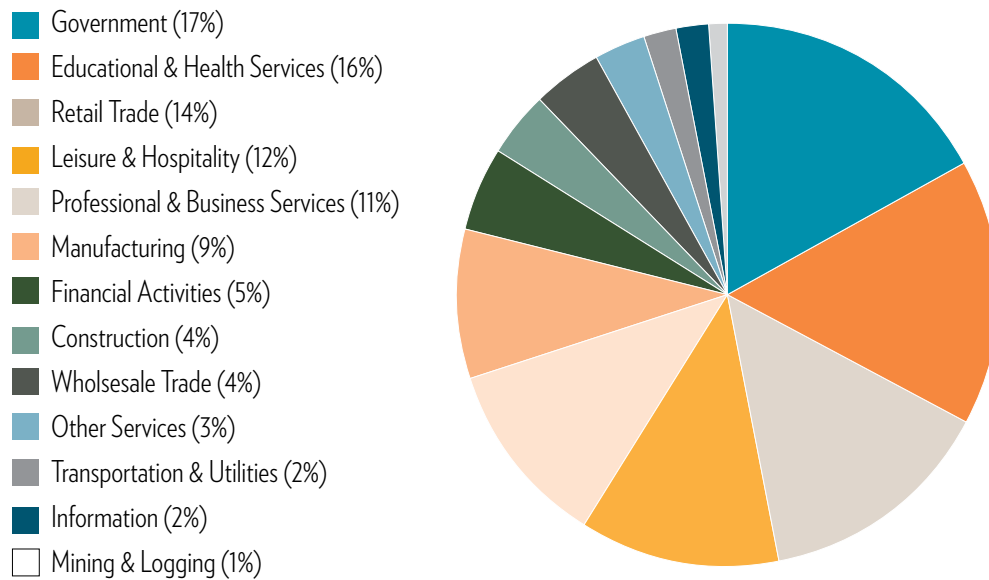
Florence cannery. Photo: Florence Pioneer Museum.

watershed's population makes up only a small percentage of the larger Lane County population, which includes the urban Eugene/Springfield area and contained a total of 362,895 residents in July 2015. The population density of the Siuslaw watershed is also much lower than Lane County's median population density of 77 people per square mile. In comparison, the Siuslaw watershed has a population density of approximately 20 people per square mile, but outside of the city of Florence, the density drops to approximately 5 or 6 residents per square mile. The median resident age is 39 years in Lane County, but varies widely in the Siuslaw watershed; the median age in the city of Florence, which has a large retirement community, is 59.4 years. Race in Lane County is 90 percent white, with the minority comprised of Hispanic, American Indian, Asian, African American, and Native Hawaiian ethnicities.

Loading salmon for the cannery. Photo: Florence Pioneer Museum.



Figure 3-5. Lane County Employment (Oregon Employment Department 2014).



3.7 The Siuslaw Economy Today

The former mainstays of the Siuslaw Basin's economy—logging, agriculture, and fishing—remain important to the local economy, but job opportunities in these areas have declined significantly over the past 30 years. The loss of family-wage jobs associated with past fishing and timber harvest, as well other job losses after the 2008 recession, has left many residents in the rural Siuslaw watershed in poverty. Some residents are now employed in the growing retirement and tourism industries, mostly around the city of Florence. Other residents have left the area or commute into urban centers for work. With this economic backdrop, many students in outlying areas are not motivated to succeed in school and the drop-out rate is high. The downturn of the natural resource-dependent industries has also led to the loss of revenues from fishing vessels for the Port of Siuslaw, and tax revenues for the city and county. Likewise, timber receipts from federal land to support schools, infrastructure, and county services have similarly declined (Ackerman et. al. 2016) and may soon be eliminated entirely.

As a result of these conditions, the local income of residents in the Siuslaw Basin is generally lower than in Lane County's urban centers. The median household income in Lane County is \$44,103, but is only \$32,203 in Florence and \$33,795 in the Middle Siuslaw-Triangle Lake

area. Current Lane County employment is shown in Figure 3-5. Government, educational and health services, business services and retail trade are the largest employers. Peace Health Medical Group is the largest private employer in Lane County.

Projected future growth in Lane County's economy through 2023 is predicted to shift towards social and health services, mining, logging, construction, manufacturing, and information services (Oregon Employment Department 2014).

3.8 Advancing the Restoration Economy

Opportunities for economic growth in the Siuslaw Basin have ebbed and flowed since European settlement, thriving during the success of the salmon canneries and again at the height of the timber industry, but falling with their respective declines. This SAP lays out a framework to ensure the long-term viability of coho salmon in the Siuslaw Basin. The plan's implementation also provides a unique opportunity to contribute to the economic well-being of the community. This section explores how investments in habitat restoration projects in the Siuslaw watershed can advance a local restoration economy that supports local jobs, business, and industry.

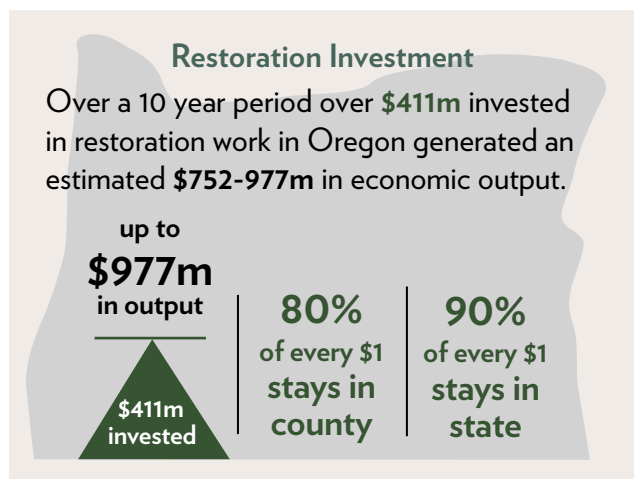


Figure 3-6: Restoration Investment in Oregon (Kellon 2012).

Restoration investments benefit the local economy

While the concept of a restoration economy is relatively new, research in the past few years has begun to quantify the impacts of restoration investments on local economies. Studies completed across the country have found that the restoration economy has directly generated \$9.5 billion in economic output nationwide, with an additional \$15 billion in economic output through indirect linkages and increased spending by employees (BenDor et al. 2015). Closer to home, these analyses show promise for Oregon's rural communities where, on average, \$0.80 of every \$1.00 invested in restoration projects stays within the county, and \$0.90 of every \$1.00 spent invested stays in Oregon (Kellon 2012). The Ecotrust study found that between 2001 and 2010, \$411.4 million invested in restoration work in Oregon generated an estimated \$752.4 to \$977.5 million in economic output.

In 2010, the University of Oregon completed a Restoration Economy study with similar results; for every \$1 million invested in restoration, the economic output was between \$2.2 and \$2.5 million (Nielsen-Pincus and Moseley 2010). They found that output multipliers for restoration projects range from 1.9 to 2.4, meaning that for every \$1.00 spent on forest and watershed restoration projects in Oregon, \$0.90 to \$1.40 is generated in additional economic activity. This is a result of restoration investments being multiplied throughout the local economy as project materials and services are purchased from local suppliers, and new jobs provide wages that are spent in local stores, restaurants, and service industries

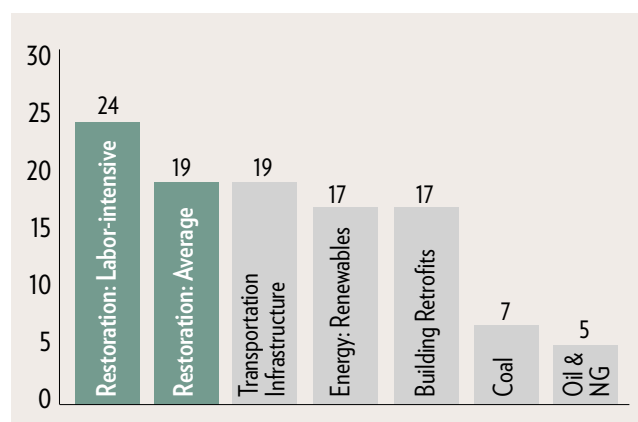
(Nielsen-Pincus and Moseley 2010). The study found that equipment-intensive restoration projects (such as culvert replacements, earth moving projects, or large wood placements) tend to have greater economic output because of the additional jobs created to meet the need for equipment maintenance (Nielsen-Pincus and Moseley 2010; BenDor et al. 2015).

Restoration investments create local jobs

Investment in restoration demands a local labor force. This is especially meaningful in rural communities, where job opportunities are often limited as a result of businesses being concentrated in urban centers. The restoration economy is unique in that the demand for project labor focuses almost exclusively on rural or remote area work forces. The number of jobs created fluctuates depending on the type and scale of the restoration project; some actions are more labor intensive and, therefore, require more workers. Ecotrust found that between 2001 and 2010, the total investments in 6,740 restoration projects completed in Oregon supported between 4,628 and 6,483 jobs. Of those jobs created throughout the state, approximately 355 jobs were created in Lane County and 426 in Douglas County (Kellon 2012).

Generally, restoration practitioners in Oregon prefer to hire locally and contract between 95 percent and 99.5 percent Oregon-based businesses (Nielsen-Pincus and Moseley 2010). The bulk of the work contracted to out-of-state services tends to be for highly specialized tasks that are outside of the expertise of local Oregon contractors. This strong local bias in the restoration economy is due in part to the large role that non-

Figure 3-7. Average number of jobs created per \$1 million of investment by sector (Kellon 2012).





Barrier culvert removal project, Morris Creek. Photo: Seth Mead.

profit and nongovernmental organizations play, their flexibility in contracting, and their dedication to local communities and economies.

As shown in Figure 3-6, the restoration industry is competitive with other industries in the state of Oregon, and is nearly equal with job creation in the transportation and infrastructure sectors (Kellon 2012). The University of Oregon found that between 15.7 and 23.8 jobs are created per \$1 million of public investment in restoration. This results in an additional 1.7 to 2.6 times the amount of economic activity, as every dollar cycles through Oregon's economy (Nielsen-Pincus and Moseley 2010). This figure accounts for both direct employment (e.g., project managers, contracted employees) supported by the restoration investment, and indirect employment (e.g., maintenance workers, local business staff) that results from increased economic output from the initial investment.

These results are consistent with national estimates for the restoration economy that suggest the creation of as many as 33 jobs per \$1 million invested in restoration, with an employment multiplier of 1.5 to 3.8 (the number of jobs created for every restoration project). Furthermore, national research shows that restoration projects also tend to create localized employment benefits, creating well-paying local jobs similar to the construction industry. There are significant inter-annual fluctuations and seasonality in the habitat restoration economy, however, with restrictions on when projects can occur, such as Oregon's summer "instream work window" (BenDor et al. 2015).

Restoration Investments are Investments in Our Community

Investments in restoration projects that provide living-wage jobs for local residents and boost local economies also help build communities that are desirable places to live. The value of the investments accrue over time. They provide recreational opportunities, improve water quality, and help restore other ecosystem functions that are fundamental to our health and quality of life.

This SAP provides a Strategic Framework for increased investment in restoration projects throughout the Siuslaw Basin. This increased investment will provide a multitude of benefits to coho salmon and the many other species that rely on a resilient, complex, and dynamic environment. Restoration investments will increase employment opportunities and stimulate the economies to benefit the communities that call this watershed home.

Trees planted to enhance riparian zones and other upland areas are often "tubed" to prevent foraging by beavers, Elk, and other animals. Photo: Seth Mead.



Siuslaw Basin Coho and their Habitat Needs

Coho seek out different types of habitat during their residency in the Siuslaw Basin. The availability of key habitat conditions to support coho during different life stages—as eggs in the gravel, small juveniles in tributary streams, and then as larger migrating fish—is essential to their ability to survive and produce. This chapter describes the habitat types that support coho during different life stages. It also summarizes coho distribution, abundance, and hatchery production in the watershed.

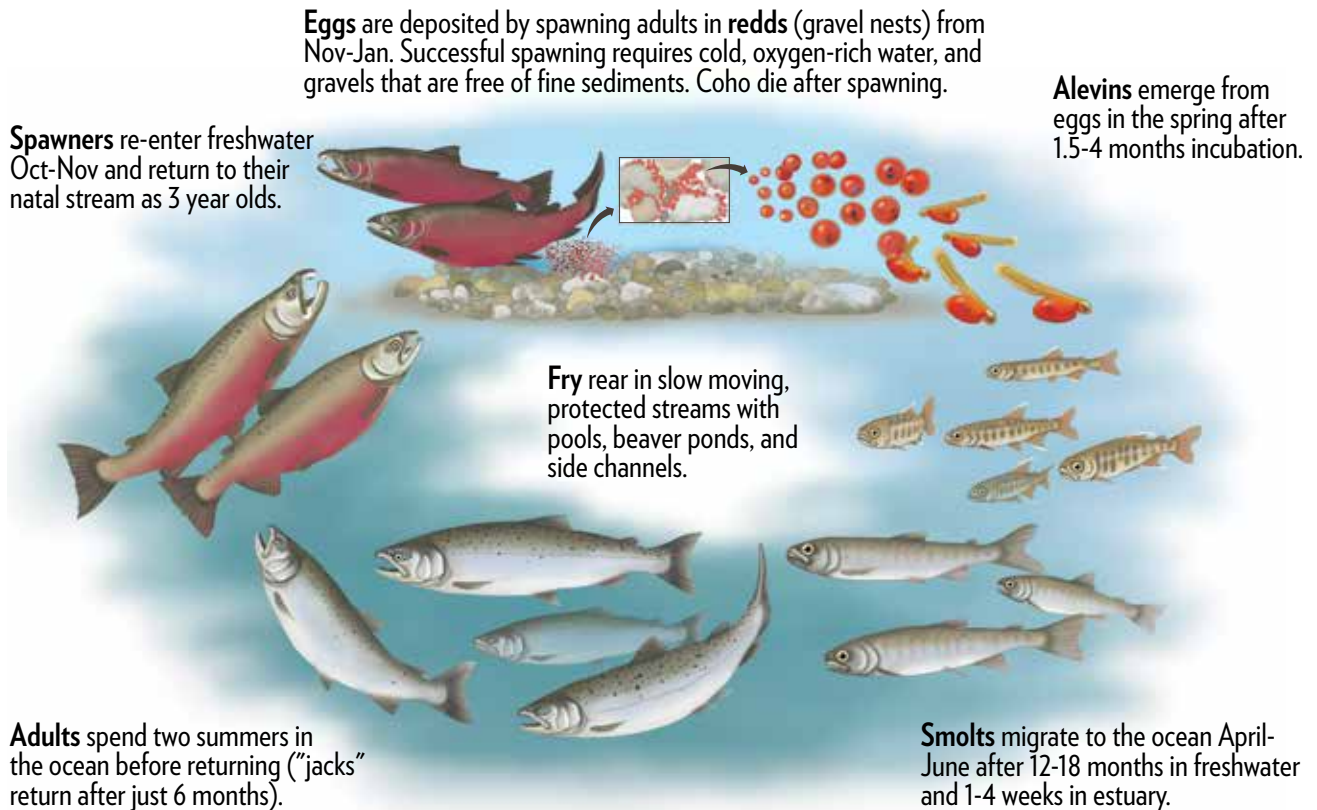
4.1 The Coho Life Cycle

Coho salmon generally return to the Siuslaw River from the Pacific Ocean as 3-year-old adults, arriving at the river's mouth from September to November and migrating to their natal streams. The returning coho typically spawn in small tributary streams between November

and January before dying. They lay their eggs in gravel nests, known as “redds,” in reaches with suitable substrate and water velocity, depth, and temperature.

Spring marks the beginning of a new coho life cycle. After an incubation period of 1.5 to 4 months as eggs, “alevins” (newly hatched fry still attached to a yolk sac) emerge from the gravel between March and May. Most coho remain in their natal stream through their first year, feeding largely on insects. During their freshwater juvenile life stage, the fish seek out quiet areas such as side channels, alcoves, and scour pools resulting from log jams and boulders, and backwater pools created by beaver dams. The shelter and calm water provided by these and other off-channel areas is particularly important for the survival of juvenile coho in the winter, when high water flows and velocities are common and food supplies limited (ODFW 2007). These complex habitats also provide critical cold-water refuge in the summer months, when low water and high stream temperatures are prevalent in many parts of the system. In summary, **the distribution of low gradient stream reaches with suitable flow, temperature, cover, and forage is essential for the survival of juvenile coho** (NMFS 2016).

Figure 4-1. The coho salmon life cycle. Artwork by Elizabeth Morales.





Spawning adult coho. Alternative life-history pathways contribute to the species' resilience and ability to adapt in a changing environment. Photo: Eiko Jones.

Most juvenile coho begin moving to the estuary and ocean after 12 to 18 months in freshwater rearing areas, typically migrating in the spring from as late as March into June. Smolts (juvenile salmon undergoing physiological changes to adapt from freshwater to a saltwater environment) rear in estuary reaches for a period of days or several weeks to a month, feeding, growing and adapting to saltwater, before moving on to the nearshore ocean environment (NMFS 2016).

It's important to note, however, that not all coho follow this general life-history strategy. Research shows that substantial numbers of coho leave their natal streams much earlier (as fry) and emigrate downstream into tidally influenced lower river wetlands and estuary habitats (Chapman 1962; Koski 2009; Bass 2010; in NMFS 2016). A NMFS biological review team of scientists reported at least three discrete life-history strategies involving coast coho fry and presmolt migrations into lower river habitats: (1) late fall migration into side-channel or pond habitats connected to lower mainstem reaches from mainstem summer rearing habitats, (2) lower mainstem and estuarine summer rearing followed by upstream migration for overwintering, and (3) lower mainstem and estuarine rearing followed by subyearling outmigration to ocean (Stout et al. 2012). **These alternative life-history pathways contribute to the species' resilience and ability to adapt in a changing environment.**

While in the lower rivers, these “nomads” seek out tidal wetland habitats with many of the same qualities as those rearing areas found in the upper watershed—quiet areas that provide cold water, shelter, and abundant food. Small freshwater tributaries in the lower watershed can provide particularly important habitat to support the diverse life-history strategies. When the mainstem corridors heat up in the summer, small cold-water seeps and tributaries become life boats where juveniles can escape potentially lethal high water temperatures in the mainstem and larger tributaries.

Once OC coho salmon enter the Pacific Ocean, they travel along a narrow coastal band from Oregon north to Alaska. Upon reaching these northern waters, they migrate into the open ocean before turning back to the south and migrating home to their natal streams. During this migration, coho migrate through variable nearshore ocean currents that provide cool, nutrient-rich water (through upwelling) that stimulates production of food (Hall et al. 2012, in NMFS 2016). While in the ocean, coho are subject to predation and fishing pressure. Coho normally spend two summers at sea before returning as three-year-old adults, except for some precocious males (jacks) that return to spawn after only six months. The return of coho spawners to the Siuslaw River starts in October or November, coinciding with fall freshets (heavy rainfall) that trigger upriver movement.

4.2 Watershed Components and Coho Habitat Types

Coho salmon seek out different habitat types during their various life stages that contain key physical attributes that help sustain them. The habitat types vary in salinity, hydrology, geomorphology, stream size and type, and biological attributes essential for survival. These habitat elements are shaped and maintained by combined watershed processes that together influence hydrologic, sediment, riparian, channel, biological, floodplain, and estuarine habitat functions (see Figure 2-2).

A measure of intrinsic potential (IP) is often used to describe potential high quality coho rearing habitat, such as for juvenile coho salmon, based on stream attributes including mean annual flow, channel size, gradient, and valley constraint. Generally, coho prefer low gradient, unconfined reaches with an IP of greater than 0.75 (Burnett 2007). The majority of high intrinsic potential (HIP) off-channel areas are low in the watershed, but many have been blocked or disconnected by levees or tidegates. Low gradient pool/riffle reaches, sometimes called “flats,” remain within most tributaries, but some may be isolated by down-

stream barriers to fish passage, such as inadequate or undersized culverts.

Several physical biological features form high quality and quantity coho habitats: stream corridors with unimpeded passage; connected side channels; connected floodplains; off-channel habitats (overflow channels, tidal marshes and swamps, alcove or ponds); groundwater channels; seasonally flooded wetlands; low gradient pool/riffle sequences; suitable-sized gravel substrate free of excess fine sediment; backwater pools and beaver ponds; abundant large wood; extensive riparian vegetation armoring streambanks and providing shade to maintain cool summer stream temperatures; suitable streamflows and duration; excellent water quality; and abundant forage (aquatic invertebrate and fish species that support growth and maturation) (Lestelle 2007).

The common framework (see Chapter 2) categorizes this complex, inter-connected system according to several components, defined in this chapter. Chapter 5 discusses how the watershed processes operating within these components produce and maintain the specific habitats that coho rely on.

Adult coast coho use the mainstem river channel to migrate upstream to their natal tributaries, where they will spawn and die. Juveniles use the mainstem to migrate down to the ocean, accessing tributary, off-channel, and estuarine habitats as they go. High flows in winter and hot water in the summer are the major stresses that juveniles encounter on their downstream migration. Cold water tributaries and off-channel habitats provide important sources of refuge from these and other stresses.





- **Tributaries** include all 1st to 3rd order streams with drainage areas greater than 0.6 square kilometers. This includes fish-bearing and non-fish-bearing, intermittent streams; the full aquatic network includes headwater areas, and riparian and floodplain habitats. Tributaries support spawning, incubation and larval development, fry emergence, and juvenile rearing.

- **The Mainstem River** includes portions of rivers above head of tide (Coastal and Marine Ecological Classification Standard [CMECS] definition); typically 4th order, downstream of coho spawning distribution, non-wadeable. The mainstem river component also includes associated riparian and floodplain habitats. Mainstem areas support upstream migration for adults and downstream migration and rearing for juveniles.



Adult coho spawn and juveniles rear in low gradient tributaries like the reach above. While steeper tributaries like the reach shown below may not provide as much spawning and rearing habitat due to higher water velocities, they are often a critical source of cold, clean water that juveniles rely on, especially in the summer.



Wildcat Creek

- **Freshwater Non-Tidal Wetlands** include those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support – and under normal circumstances do support – a prevalence of vegetation typically adapted for life in saturated soil conditions. Habitats include depressions, flat depositional areas that are subject to flooding, broad flat areas that lack drainage outlets, sloping terrain associated with seeps, springs and drainage areas, bogs, and open water bodies (with floating vegetation mats or submerged beds). This component is restricted to those wetlands that are hydrologically connected to coho streams. (Estuarine associated wetlands are addressed in the estuarine section.) Wetlands are essential to capturing sediment and other contaminants before they enter surface waters, and to maintaining and regulating cold water flows.
- **Off-channel areas** include locations other than the main or primary channel of mainstem or tributary habitats that provide a velocity and/or temperature refuge for coho. Off-channel habitats include alcoves, side



Off-channel habitats like these found along Fiddle Creek are essential for rearing coho. Photo: Seth Mead.

channels, oxbows, and other habitats off of the mainstem or tributary. As described above, these off-channel habitats are essential to the survival of juvenile coho, providing refuge from high flows in winter and high water temperatures in summer.

Freshwater wetlands like these near the North Fork Siuslaw River supply tributaries with cold, clean water through underground seeps.



- **Estuaries** include areas historically available for feeding, rearing, and smolting in tidally influenced lower reaches of rivers that extend upstream to the head of tide and seaward to the mouth of the estuary. Head of tide is the inland or upstream limit of water affected by a tide of at least 0.2 feet (0.06 meter) amplitude (CMECS). This includes tidally influenced portions of rivers that are considered to be freshwater (salinity less than 0.5 parts per thousand). Estuaries are considered to extend laterally to the uppermost extent of wetland vegetation (mapped by CMECS). Habitats include saltmarsh, emergent marsh, open water, subtidal, intertidal, backwater areas, tidal swamps, and deep channels. This includes the ecotone transition zone between saltwater and freshwater and the riparian zone. The Siuslaw estuary extends from the Siuslaw River mouth to approximately the North Fork Siuslaw River and includes associated off-channel areas.
- **Uplands** include all lands that are at a higher elevation than adjacent water bodies and alluvial plains. They include all lands from



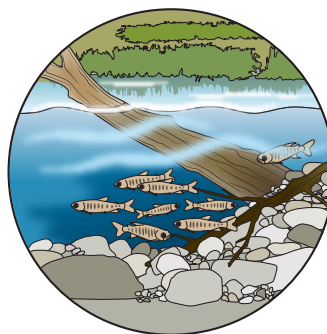
where the floodplain/riparian zones terminate and the terrain begins to slope upward forming a hillside, mountain-side, cliff face, or other non-floodplain surface.

- **Lakes** include inland bodies of standing water. Habitats include deep and shallow waters in the lakes, including alcoves, and confluences with streams.

Tidal wetlands like these in the Siuslaw estuary are the critical final stop for coho to rear and grow before entering the ocean.



Figure 4-2. Components of a Watershed. The map below is a conceptual illustration (not a map of the Siuslaw) intended to show: 1) the major “habitat components” of a coastal watershed; and 2) selected “key ecological attributes” (KEAs) that are critical to the health of these components. This is not intended to provide an in-depth explanation of the habitat needs of coast coho, but simply highlight several KEAs that this plan is focused on restoring.

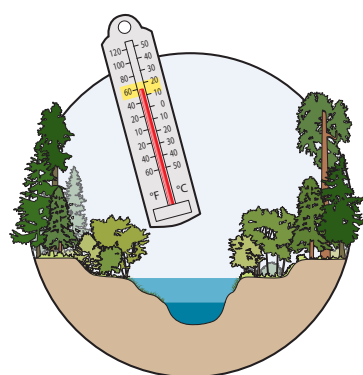
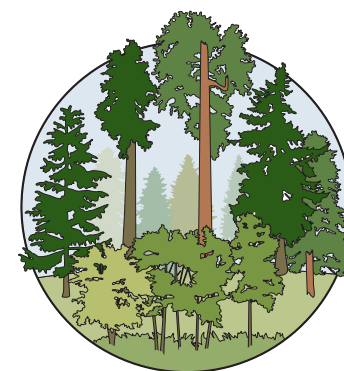


Instream Complexity:

Lack of instream complexity is the primary factor limiting Siuslaw coho (and many other coast coho populations). The loss of features that provide in-stream complexity – like large wood, pools, connected off-channels, alcoves, and beaver ponds – limit the survival of juvenile coho in both summer and, especially, winter.

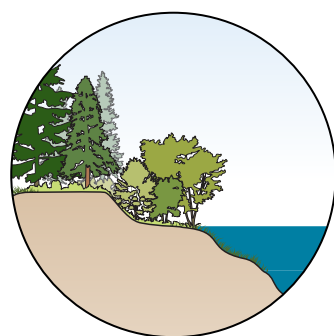
Structural Diversity:

Healthy upland forests contribute large wood, gravel, and other inputs to streams, which enhances the channel’s biological and structural complexity. The range and distribution of forest stand size, type, age, and composition determines the extent to which forests can provide the inputs to streams that build coho habitat.



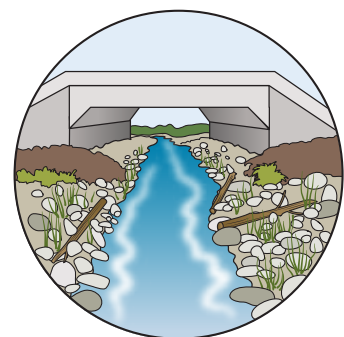
Water Quality:

In tributary, mainstem, off-channel, and estuarine habitats, degraded water quality also limits the Siuslaw coho population. Elevated water temperatures (especially in the mainstem Siuslaw) and sediments are the primary water quality issues confronting coho.



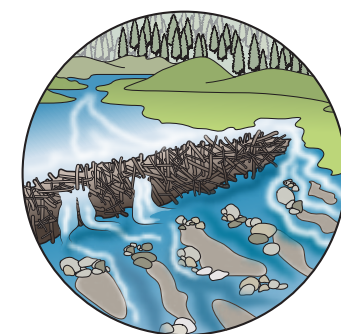
Riparian Function:

Streamside vegetation along tributaries, off-channel areas, wetlands, and mainstem channels creates shade, provides food and cover for juveniles, filters out pollutants, and provides large wood to the channel. Riparian function in the Siuslaw is heavily degraded contributing to elevated water temperatures, reduced instream complexity, and reduced lateral connectivity.



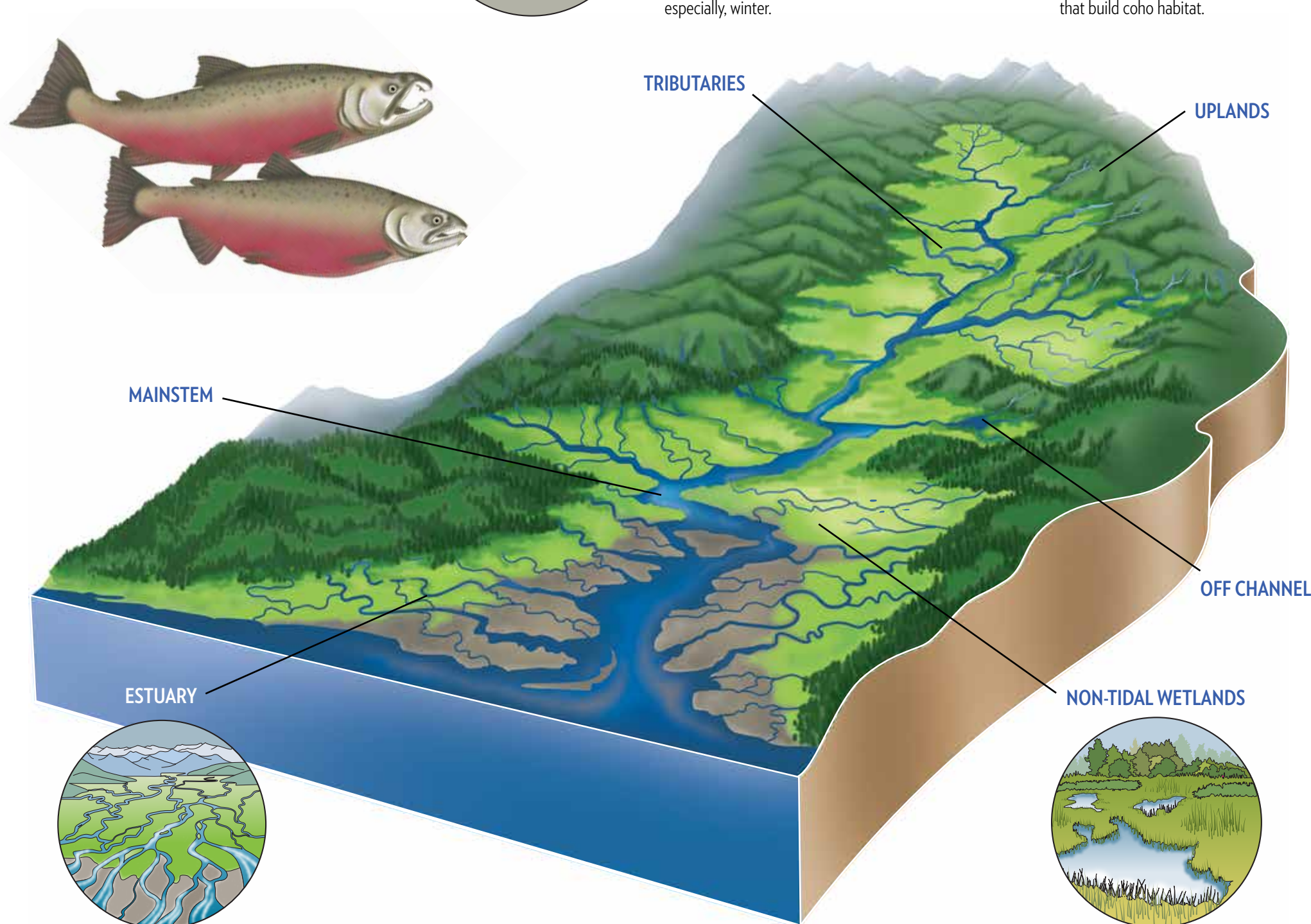
Longitudinal Connectivity:

Inadequate culverts in tributaries and tidegates in estuaries often restrict access for both adult and juvenile coho to prime spawning and rearing areas. Longitudinal connectivity refers to the degree to which coho are able to migrate unimpeded up and down stream channels and sloughs.



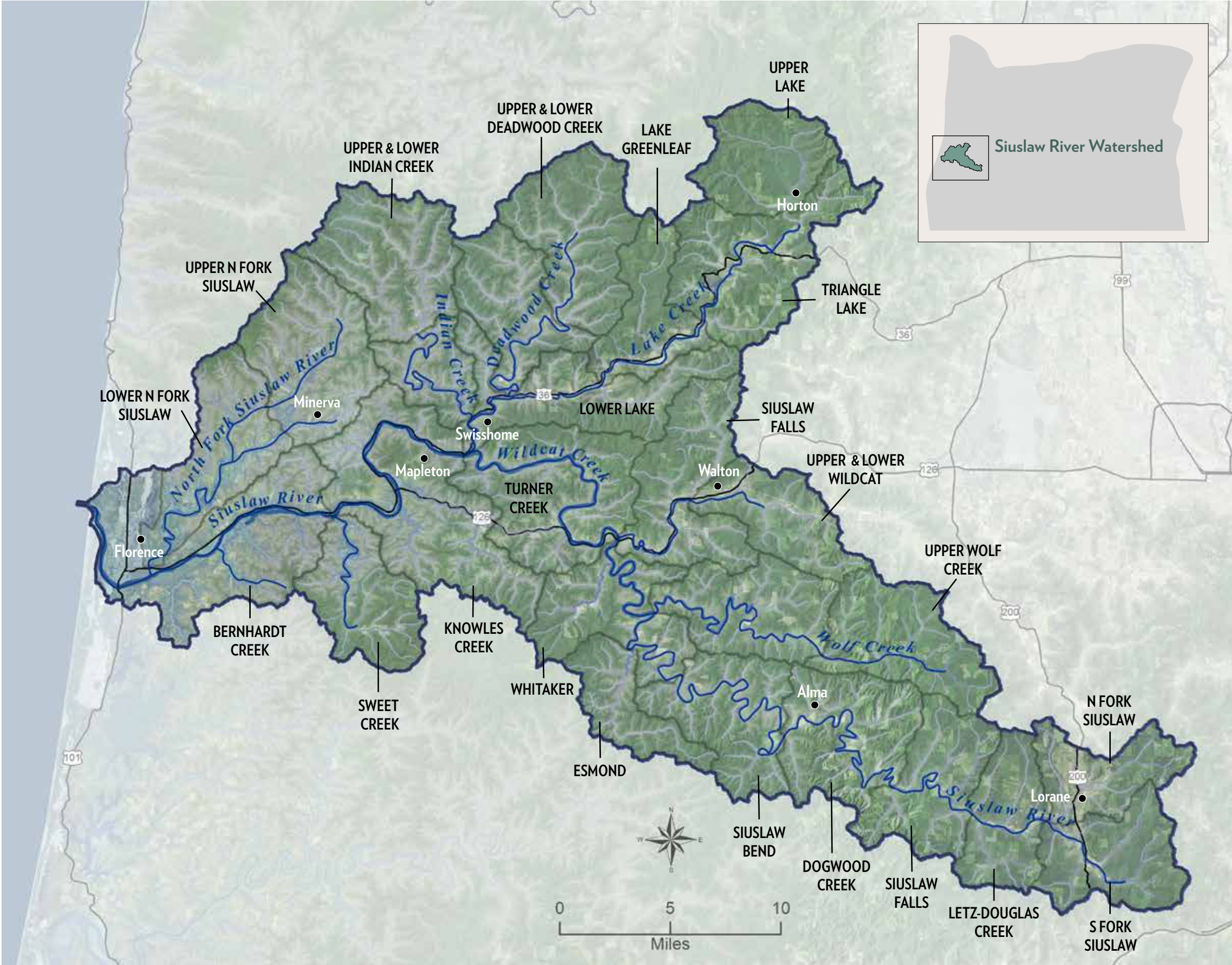
Beaver Ponds:

Beaver ponds are a critical attribute of healthy coho watersheds. Impounded water behind beaver dams provides juvenile coho refuge from both high flows in winter and elevated water temperatures in summer. The number of beavers has declined substantially in the Siuslaw, significantly reducing available off-channel habitats.



Artwork by Elizabeth Morales.

Figure 4-3. The Siuslaw River Watershed.



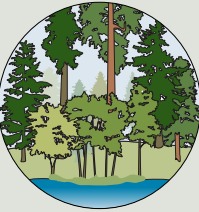
Between 2019 and 2025, the SCP will coordinate restoration projects focused on 6 of the SAP’s 11 high priority watersheds.

- | | |
|----------------------|--------------------------|
| Bernhardt Creek | Lower North Fork Siuslaw |
| Dogwood Creek | Upper North Fork Siuslaw |
| Knowles Creek | Siuslaw Falls |
| Lower Deadwood Creek | Triangle Lake |
| Upper Deadwood Creek | Upper Wolf Creek |
| Upper Indian Creek | |

By 2025 SCP will:



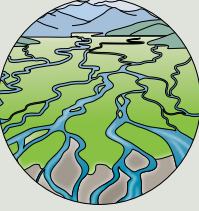
Instream: Add LWD to **75 miles** of identified anchor habitats and other tributary reaches to increase instream complexity and restore stream interaction with off-channel habitats.



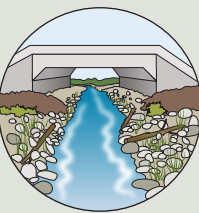
Riparian: Enhance **47 miles** of riparian (streamside) vegetation to increase shade, improve water quality, and promote long term large wood recruitment.



Floodplain: Reconnect and protect **506 acres** of disconnected floodplains to increase the availability of off-channel rearing habitats.



Tidal wetlands: Reconnect **30 miles** of slough and tributary channels to increase the availability of estuarine rearing habitats.



Infrastructure: Upgrade working lands infrastructure (stormproof **16 miles** of forest roads, replace **8 culverts**, and upgrade **2 tidegates**) to improve water quality and increase habitat availability.

4.3 Wild Coho Distribution, Abundance, and Production

Coho continue to range throughout much of their probable historical distribution in the Siuslaw Basin, with all life-history strategies most likely still expressed within the population. Figure 4-4 shows the current extent of coho distribution. The proportion of survey reaches in the Siuslaw Basin that wild coho occupied was 86 percent in 2015, with a five-year average of 80 percent (Sounhein et. al. 2015).

Natural Abundance and Production

In the early 1900s, the Siuslaw River basin supported some of the largest coastal salmon runs in the Northwest. Estimated total run sizes for coho salmon in the late 1800s and early 1900s, based on extrapolations from canary pack records, suggest that the Siuslaw River returns may have been as high as 547,000 coho (Meengs and Lackey 2005). Assuming a catch efficiency of 50 percent, early years of European settlement probably averaged near 160,000 returning coho. As shown in Figure 4-4, coho salmon harvest in the Siuslaw River basin gradually declined from an annual high of 117,000 in 1892 and 102,000 in

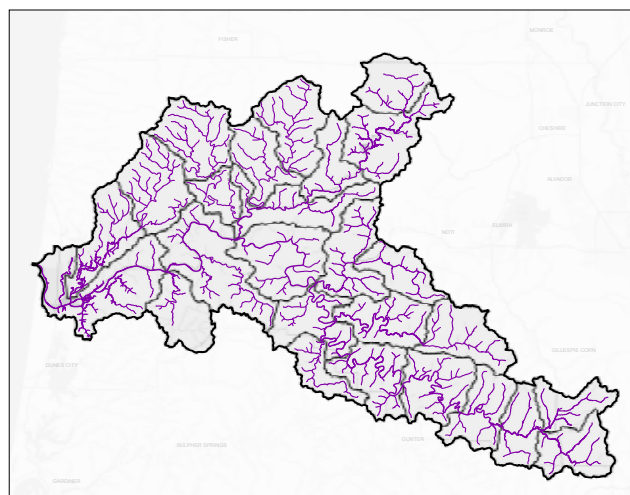


Figure 4-4. Coho distribution in the Siuslaw Watershed. In 2015, wild coho occupied 86% of reaches surveyed.

1907, to around 100,000 for several years before 1910 (Mullen 1960). This level of harvest was not sustainable, and a precipitous drop in run size occurred through the middle of the 20th century, often falling below 30,000 annually.

Several factors contributed to the decline of the Siuslaw coho runs, including overharvest, primarily through gill netting, as well as habitat loss and degradation. As discussed in Chapter 3,

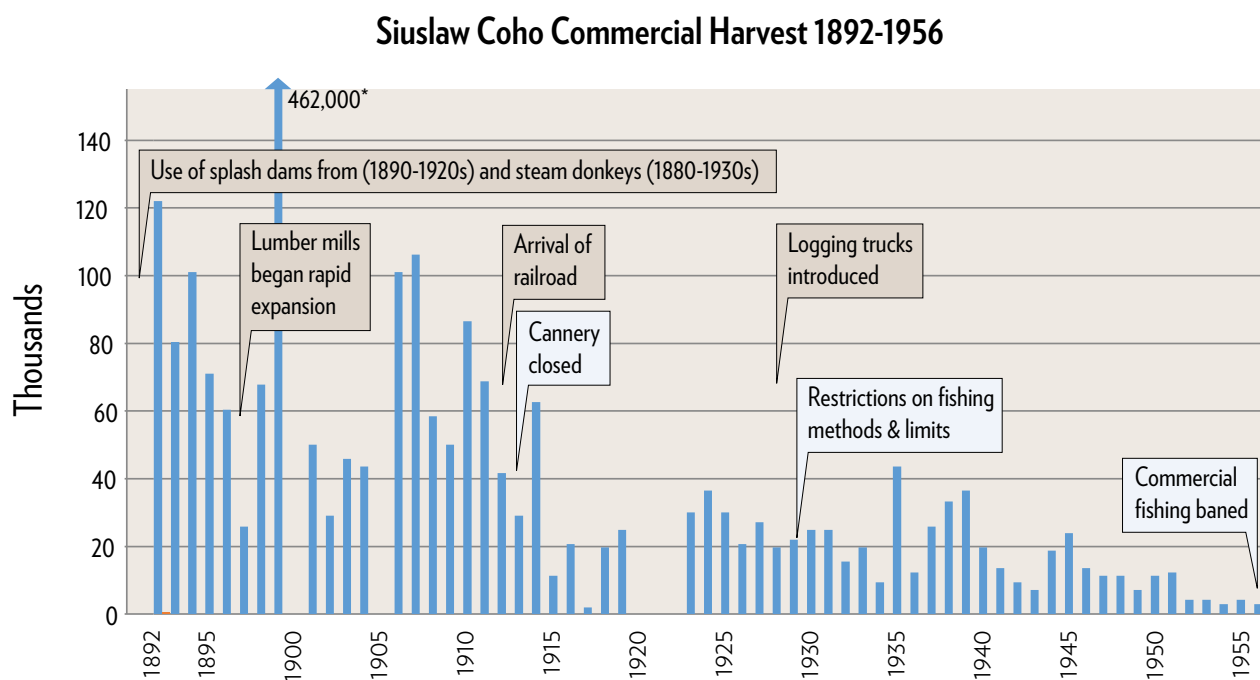


Figure 4-5. Estimated Siuslaw commercial harvest of coho salmon (1892 to 1956).

*There is professional disagreement about this 1899 cannery record indicating a harvest of 462,000 fish, given that the surrounding years are substantially lower. If correct, it is hypothesized that there would have been an unusually high harvest rate, at least 80%, rather than a more normal 50% harvest (Meengs and Lackey 2005).

commercial salmon fishing continued on the Siuslaw River until 1956 when it was permanently banned; however, sport harvest of coho persisted.

By the mid-1990s, coho salmon returns in the Siuslaw River were less than one-percent of the historical runs, and recreational coho fisheries were closed in 1993. Abundance dropped below 1,000 adults in 1997 and 1998, when a large El Niño event adversely affected the entire OC coho salmon ESU (ODFW 2017b). This decline triggered the federal listing of OC coho as a threatened species under the ESA in 1998 (NMFS 2016).

Siuslaw sport catch records, shown in Figure 4-5, reflect these declines, as well as subsequent spikes in harvest during 1991 and 2014 when a highly productive ocean led to short-lived re-openings of the sport fishery. The most recent sport fishery, which was established in 2011 under conservative harvest quotas, closed again in 2016-17 due to a decline in ocean productivity and low forecasted returns. Note: all wild coho fisheries are managed to not exceed the allowable impacts set by the Pacific Fishery Management Council and identified in Amendment 13 of the Pacific Coast Salmon Plan (PFMC 2003). The small numbers harvested from 1993 to 2009 are estimates from catch cards and reflect sport harvest resulting from anglers' identifying the species incorrectly.

Today, while coho abundance is down considerably since the late 1800s, the Siuslaw watershed continues to generate more coho on average than neighboring population areas (Meengs and Lackey 2005). Figure 4-7 shows the abundance of wild coho populations within the Mid-Coast Stratum from 1990 through 2014. The year 2002 showed the highest abundance for all of the OC coho salmon populations seen in decades, including the Siuslaw population; followed by 2014, when good ocean conditions led to another significant increase in abundance (ODFW 2017b).

Spawning surveys for coho salmon show large variations in returns through the years. While the surveys have been conducted along the Oregon coast since the 1940s, an improved stratified random sampling program initiated in the 1990s has improved abundance estimates of naturally spawning OC coho (Sounhein et. al. 2015). As shown in Figure 4-8, these surveys suggest that the abundance of wild adult coho salmon spawning naturally in the basin has varied significantly between years since the sampling program was initiated. During the period, the highest naturally spawning abundance was 55,445 coho (in 2002), the low was 501 (1997), and the average for the 28-year period was just over 13,000 (Sounhein et al. 2017).

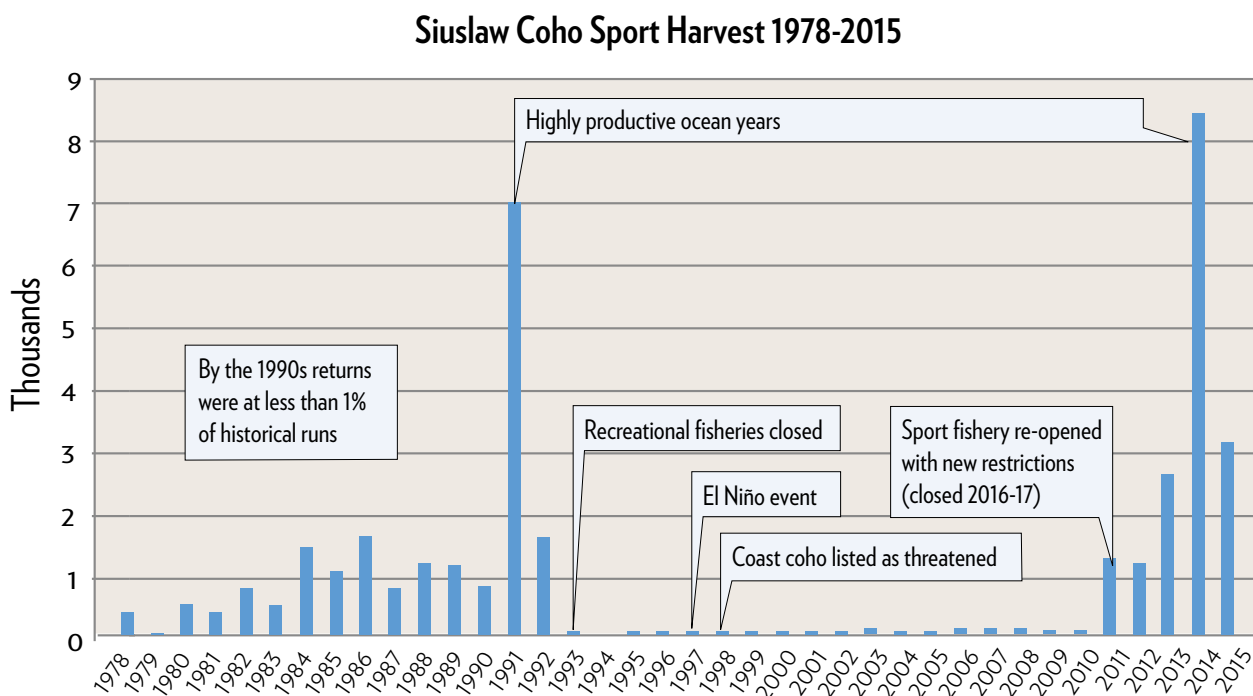


Figure 4-6. Siuslaw coho salmon sport harvest (1978 to 2015). Stats from 1993 to 2010 represent illegal catch.

Coho Abundance by Region 1990-2017

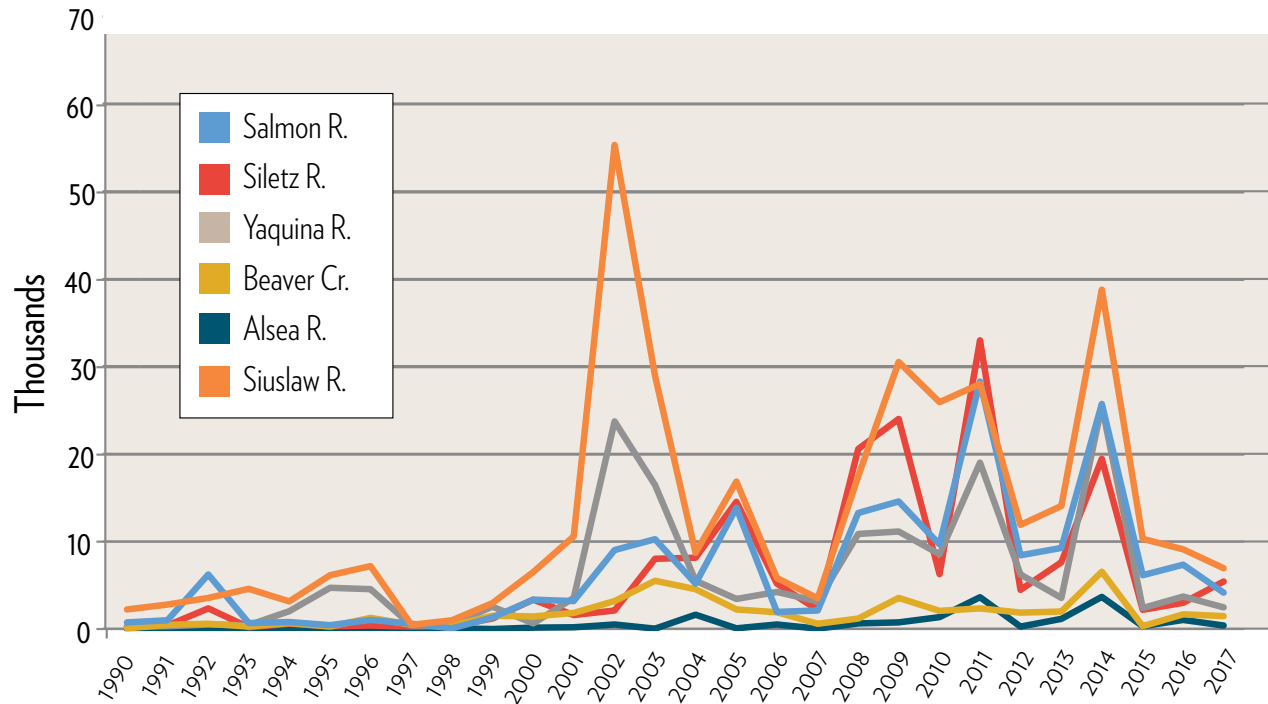


Figure 4-7. Annual estimates of mid-coast stratum wild coho population abundance, 1990–2017 (ODFW 2018). Today, while coho abundance is down considerably since the late 1800s, the Siuslaw watershed continues to generate more coho on average than neighboring population areas (Meengs and Lackey 2005).

Siuslaw Coho Abundance 1990-2017

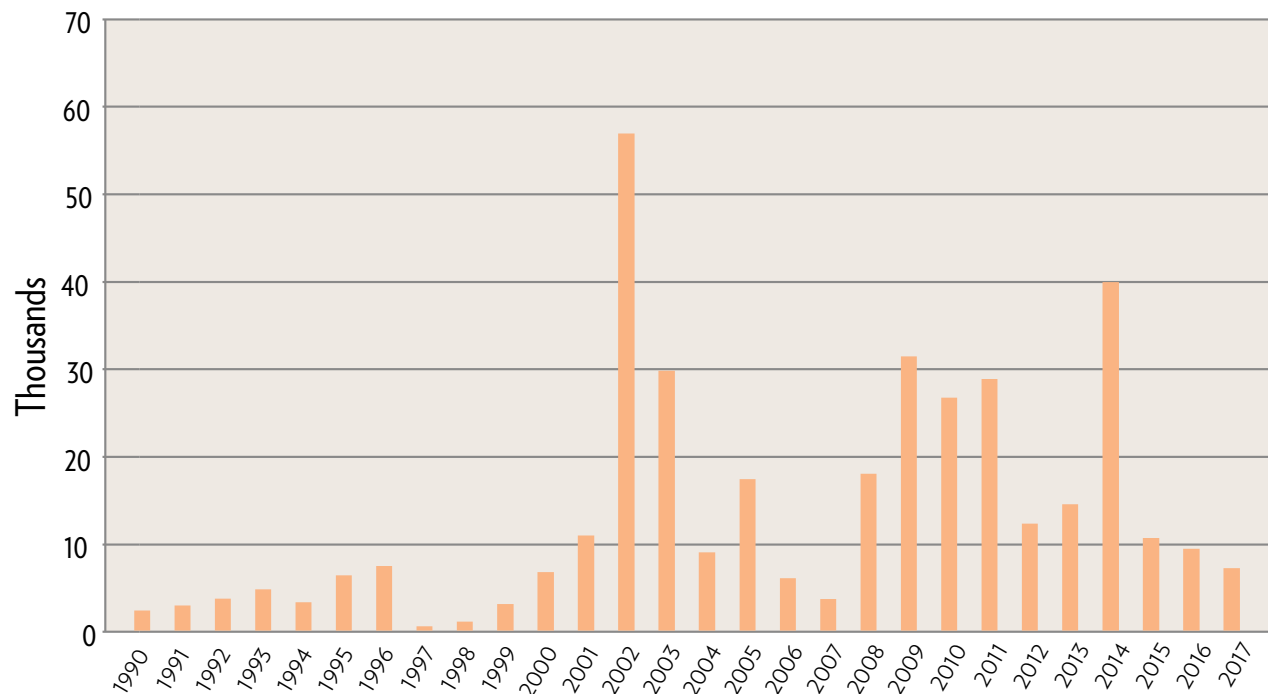


Figure 4-8. Wild Siuslaw coho salmon abundance estimates, 1990 to 2017 (Sounhein et al. 2017).

Due largely to poor ocean conditions, wild coho populations have declined sharply in the Siuslaw in recent years with estimated wild coho spawners declining from almost 39,000 in 1984 to just under 7,000 in 2017, the lowest level recorded since 2007. Other coastal Oregon watersheds have exhibited even sharper declines recently, matching lows from 1999. Despite this variability, the Siuslaw basin indicates an increasing coho salmon population trend since the 1997 low (Sounhein et. al. 2017).

4.4 Hatchery Production and Releases

Hatchery programs began in the late 1890s in response to the decline in Siuslaw coho salmon runs. Hatcheries were constructed and operated on Sweet Creek and Knowles Creek in the Mapleton area before 1900; however, little is known about the length of operation or release of salmon from these facilities.

More recently, coho hatchery releases into the Siuslaw Basin have been very limited. As shown in Figures 4-9, coho salmon fry releases in the basin occurred from 1980 through 2000 (ODFW 2004). In 1994, the ODFW Salmon Trout Enhancement Program (STEP) also began a small-



Wild coho smolt. The release of hatchery smolts in the Siuslaw ended in 2000. Photo: Seth Mead.

scale program that released fry into Munsel Lake, although the program has not released any fish since 2012. The primary intent of this small program was to engage the public in salmon management and educate participants about salmon biology and ecology (ODFW, personal communication).

Siuslaw Hatchery Smolt Releases 1980-2000

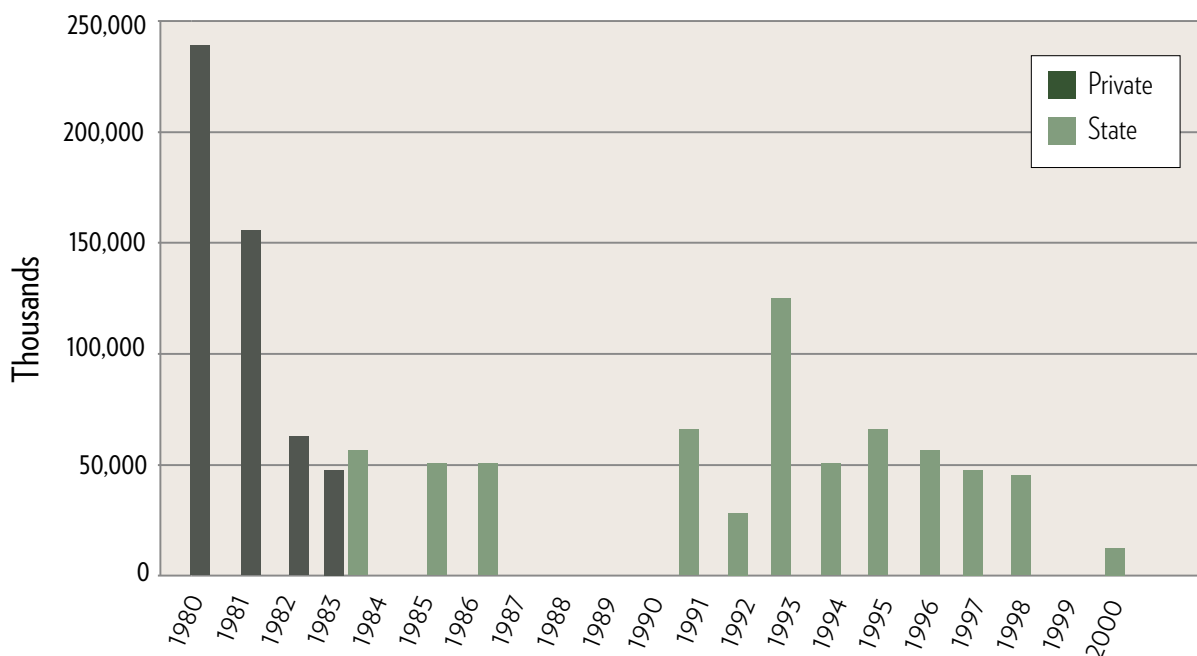


Figure 4-9. Siuslaw coho salmon hatchery smolt releases, 1980-2000. The releases of hatchery smolts into the basin ended in 2000.

Impaired Watershed Processes and Stresses on Coho Habitats

The watershed processes that create and maintain coho habitats have been considerably altered in the last 150 years. This has been due largely to the resource extraction activities and other land use described in Chapter 3, including the creation and use of splash dams to transport timber downstream. Together, these resource extraction activities have reduced the quality and quantity of coho habitat in the Siuslaw watershed and, coupled with historical overharvest of the fish, severely diminished the viability of the Siuslaw OC coho population.

The core planning team identified the following coho habitat-forming watershed processes as the highest priority for protection and restoration:

- flows (hyporheic and base flows)
- large woody debris delivery
- channel migration
- floodplain function/channel interaction (including estuaries)
- riparian community diversity and function
- bedload transport and gravel supply
- suspended sediment production
- longitudinal connectivity
- estuarine mixing

Splash dam. Photo: Wikipedia Commons.



The discussion below characterizes how these watershed processes have been altered in the Siuslaw Basin, according to the watershed components identified in the Siuslaw common framework.

5.1 Modified Watershed Processes in Upland, Tributary, and Off-channel Habitats

According to NMFS (2016), properly functioning tributaries include the following characteristics: low gradient pool/riffle sequences, suitable gravel substrate free of excess fine sediment, instream habitats with plunge pools, lateral scour pools, trench pools, dammed pools, alcoves, backwater pools and beaver ponds, edge habitats, abundant large wood, and strong connections to floodplains. Extensive riparian vegetation stabilizing streambanks and providing shading for cool summer stream temperatures is also essential for coho. The ability of tributary habitats in the Siuslaw watershed to create and maintain these habitat characteristics through watershed processes is discussed below.

Headwater Tributaries

Tributary streams in the upper Siuslaw watershed most often occur in steep, forested habitats with narrow valley bottoms. The region is generally underlain with shallow soils that are susceptible to erosion if the vegetation is removed. Steep headwalls are vulnerable to failure and occur within steep bowl-shaped topography. Mass wasting, debris flows or landslides, are episodic events generally associated with high precipitation that occurs during winter storms. Mass wasting occurs naturally, but the rate has increased more than twofold since European settlement. Major contributors include improper road construction and harvesting on steep slopes or within unstable areas (Miller and Burnett 2007). Declining root strength up to ten years after regeneration harvest can leave harvested areas vulnerable to landslides (Ziemer and Swanston 1977).

Mass wasting can contribute large quantities of sediment to tributaries in the Siuslaw watershed, and is considered to be a dominant process that historically delivered large wood and gravel into stream systems (Swanson et al. 1982). The increased rate of mass wasting and debris flows from intense timber harvest activities from 1950 – 1980's overwhelmed many tributary channels



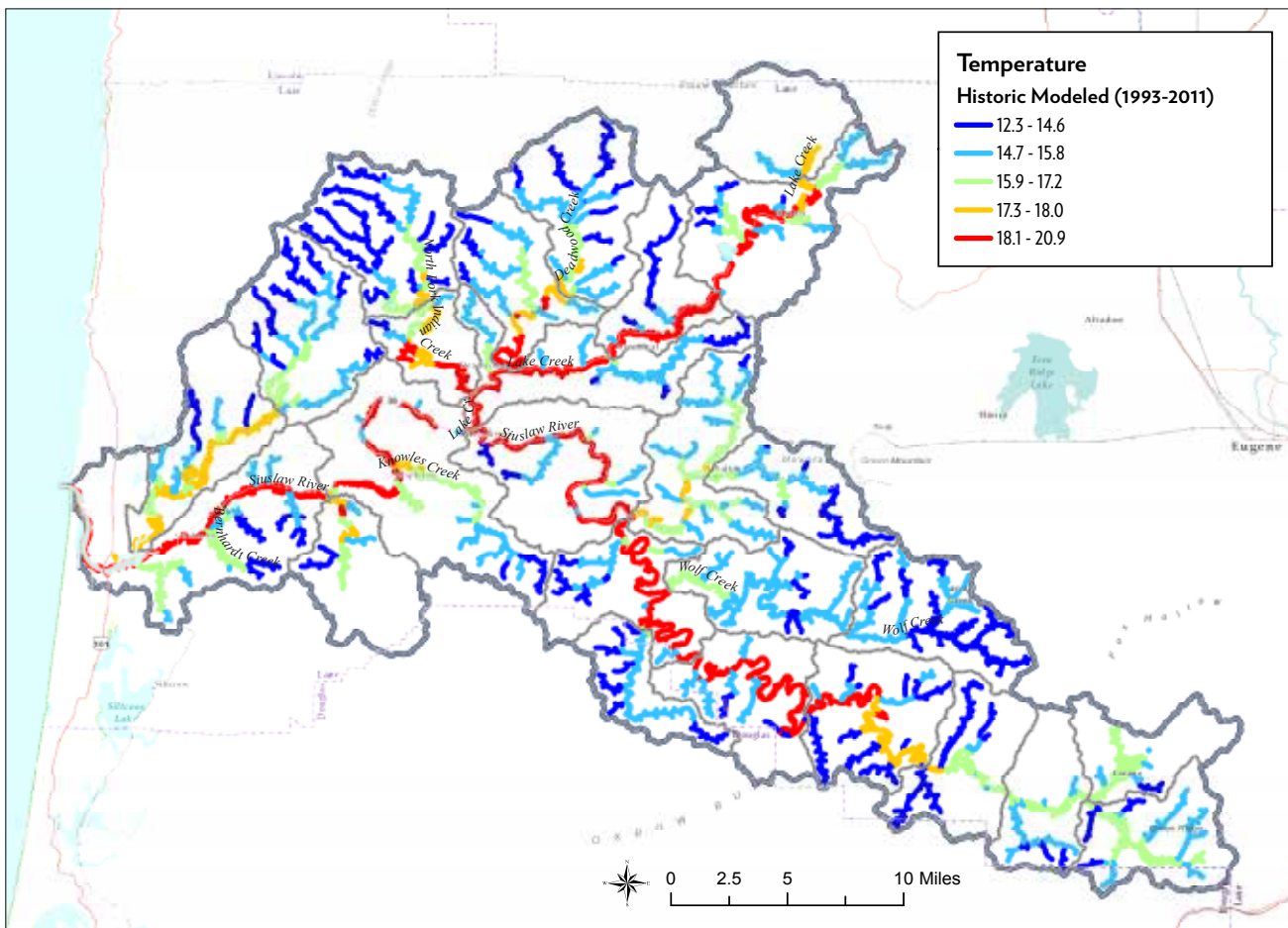
North Fork Siuslaw
A lack of riparian vegetation leads to bank erosion and channel incision.

and destroyed spawning/rearing habitat. Human-caused acceleration of erosion and mass wasting may now be on the decline, although sediment contributions vary based on land ownership and the land management plans and policies in place to regulate timber harvest and other land uses.

Fluvial erosion from the bed and banks of tributary streams, especially during flood events, also causes relatively large amounts of sediment to be transported downstream. The mobilization of bedload sediments and gravels depends on the source area and whether sufficient stream flow exists to cause bed shear. Overall, suspended sediment production has greatly increased since historic times in the Siuslaw watershed due to the clearing of riparian trees on streambanks; splash dam logging; regeneration harvests, especially on steep, unstable slopes; and road building, particularly legacy roads which employed side-cast rather than full-bench construction techniques.

Ongoing and legacy roadbuilding and timber harvest have increased fine sediment levels, reduced levels of instream large wood, and changed watershed hydrology and geomorphic sediment routing regimes. Where large wood is absent, there is less pool habitat and cover is lacking, reducing the quantity and quality of coho salmon rearing habitat in both summer and winter. Fish

Figure 5-1. Modeled historic water temperatures in August indicate that the mainstem Siuslaw was often inhospitable to rearing coho, though the extensive tributary network provided considerable cold water habitat.



passage, for some or all life stages, is blocked in many stream tributaries by improperly designed or failing culverts. Scouring of instream gravel by past splash dam logging or increased fine sediment from nonpoint sources, such as roads, has reduced or compromised spawning and rearing habitat. High-value rearing habitat has also been significantly reduced by the loss of beaver ponds (Stout et al. 2012).

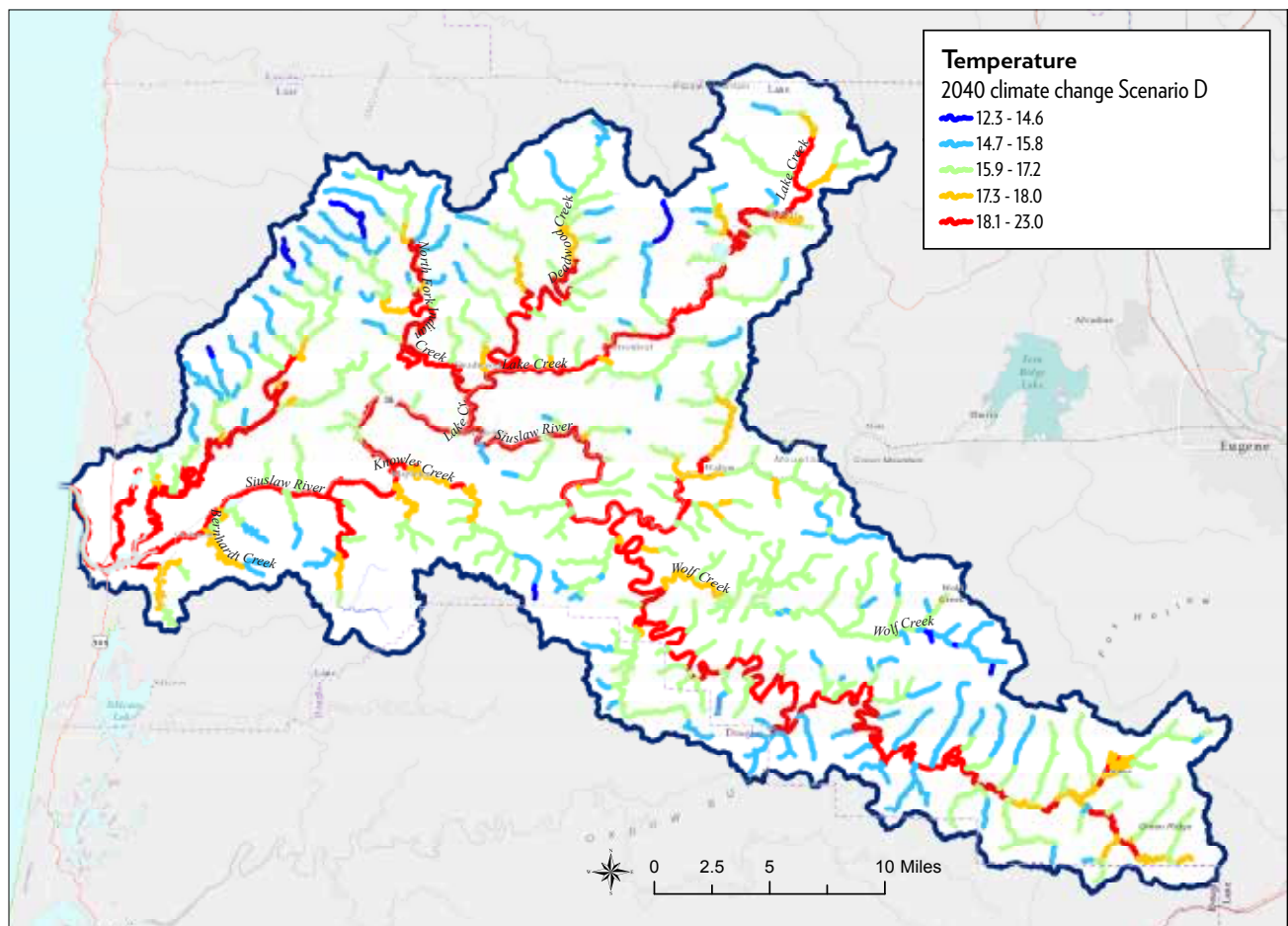
Water quantity and quality issues in headwater tributaries due to channel modification and lack of riparian cover have degraded habitats for coho salmon. The duration and magnitude of low and high water events have been altered by changes in channel morphology, especially down-cut (incised) channels that have been disconnected from their floodplains. In addition to limiting habitat availability, the removal of beaver dams and large wood, which historically created instream pools and extensive networks of wetlands and off-channel habitat, has further impaired watershed processes in tributaries.

Water that is slowly released from this complex system of in-channel and floodplain storage areas is essential to maintaining suitable flows and temperatures downstream. Reductions in floodplain connectivity and instream complexity in the headwaters have, therefore, had major cumulative effects on temperatures in the Siuslaw mainstem (Figure 5-1). These conditions, coupled with riparian shade that is often below effective levels, has led to high, sub-lethal and lethal temperatures to juveniles in many tributary and mainstem reaches. Water withdrawals may further depress already low summer stream flows. Water temperatures in several Siuslaw River tributaries are expected to increase in the future with predicted climate change (Figure 5-2).

Lower Tributaries

Tributaries in the lower watershed have been similarly disconnected from their floodplains, and habitats have declined in many of the same ways as those in headwater systems. One important

Figure 5-2. Projected surface water temperatures for 2040 indicate that several major tributaries in the Siuslaw will be too hot to support rearing coho in August.



difference, however, is the effect of splash damming that occurred in the lower tributaries largely between 1890 and 1920, which left behind a legacy of destruction far beyond that found in most headwater tributaries. The flood-like waves of wood and water from splash damming had the effect of creating multiple 100- to 500-year flood events, scouring many lower tributaries (and parts of the upper mainstem) down to bedrock. Today, the resulting lack of gravel and wood in the lower tributaries severely limits the availability of spawning and rearing habitat for Siuslaw coho, while the resulting altered hydrology exacerbates the impacts of high flows in winter (velocity) and low flows in summer (temperature).

Road building parallel to streams in flood-prone areas has further encroached on or isolated former floodplains, which are now terraced. Road density, surfacing, and placement in the riparian zone increase the amount of sediment entering the channel (where ditch lines are connected or where there are embankment erosion/failures or sidecast failures) and alter hydrology. Poorly designed legacy road crossings are often partial to full migration barriers for coho salmon. Removal of riparian trees and an inadequate buffer strip often compromises bank stability, reduces large wood delivery to stream channels, and decreases effective forest shade. Shade loss is a concern because of the negative effects to

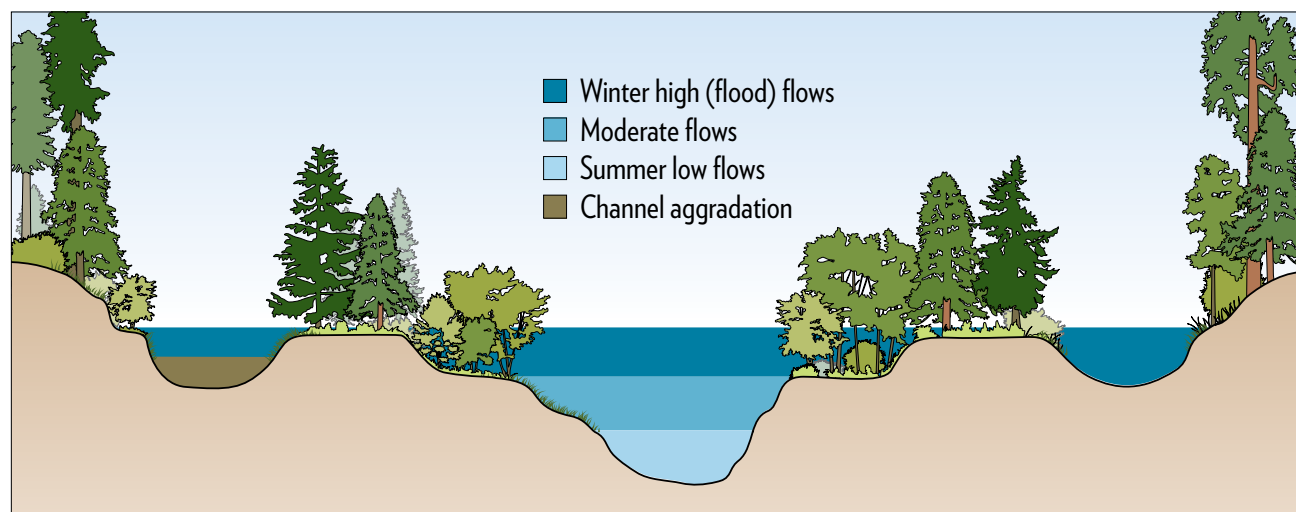


Tidegates like this one play an important role in supporting agriculture in the tidally connected areas of the lower river. Many tidegates are being replaced to improve fish passage and water quality behind the gate.

water quality, especially increased stream temperatures and reduced dissolved oxygen levels during summer low flow periods. Land clearing for agricultural uses, water withdrawals, and insufficient best management practices (BMPs) have exacerbated water quality challenges, including high stream temperatures, oxygen depletion, and nutrient loading.

In summary, the modification of watershed processes in tributaries has affected lateral connectivity with floodplains. This has subsequently reduced the extent and quality of floodplain, riparian, edge and off-channel habitat available

Figure 5-3. Floodplain function and channel interaction. Historically, the floodplains along mainstem and tributary channels in the Siuslaw contained braids of abandoned channels. In the high flows of winter, banks would over top and activate these secondary channels. These inundated areas provided critical over-wintering habitats for juvenile coho seeking to escape the high water velocities that occur in winter floods. Many of these floodplain/off-channel habitats have been lost in the Siuslaw due to road building, agricultural development, residential construction, and/or down-cutting (channel incision). Reconnecting these side channels and other off-channel habitats where possible provides an excellent opportunity to restore historic coho habitat. Artwork by Elizabeth Morales.



to juvenile coho. It has also limited instream pool habitat quality and frequency, and the volume of wood in stream channels, while impairing flows and water quality. Together, these impacts have limited juvenile coho abundance and distribution throughout much of the tributary system, while reducing their ability to complete the freshwater phase of their life cycle.

5.2 Modified Watershed Processes in Mainstem, Estuary, and Off-channel Habitats

Estuarine habitats are essential to facilitate the physiological changes that occur in adult and juvenile coho as they migrate between salt and freshwater. Suitable tidal exchange, water flow, salinity, and water quality is required to support the acclimation of downriver migrating coho smolts. Juvenile growth and maturation also require good to excellent water quality, forage, and natural cover. Forage includes aquatic invertebrate and fish species that support growth and maturation. Natural cover includes aquatic vegetation, side channels, undercut banks, brush and trees providing shade, large wood and log jam complexes, large rocks and boulders, beaver ponds, and freshwater wetlands (NMFS 2016). Key off-channel estuarine habitats include sloughs, side channels, overflow channels, tidal marshes and swamps, alcove or ponds, ground-water channels, and seasonally flooded wetlands (Lestelle 2007).

The modification of watershed processes has substantially reduced the quality and area of estuarine rearing habitat for coho salmon. A variety of anthropogenic practices – including agriculture, urbanization, and rural residential development – have led to the construction of barriers that have substantially reduced the availability of tidally connected off-channel habitats, both spatially and temporally. Channel form and connections to side channels, overflow channels, tidal marshes and swamps, alcoves, backwater ponds, and floodplains have been heavily altered or disconnected in the tidally influenced areas of the Siuslaw River and estuary. Several reaches of the main channel have been constrained by riprap or revetments, including near the river mouth through downtown Florence and along Highway OR 126. Many side channels have been hydrologically modified or obstructed by the in-



Tidally influenced wetlands like these along lower Beaver Creek provide critical off-channel rearing habitats for juvenile coho. Photo: Doug Cottam, ODFW.

stallation of tidegates, the construction of levees, and the relocation, filling and dredging of tidal channels. Many tidal marshes and swamps have been partially or completely drained or disconnected from the Siuslaw River.

Large wood delivery has decreased along the lower mainstem Siuslaw River due to land clearing and development, riparian harvest, salvage operations, intentional river cleaning, and the creation of road/stream barriers that prevent the movement of floatable debris during high flows. Forest shade has substantially decreased along the Siuslaw mainstem and side channels due to land clearing for agriculture and cutting of riparian trees. This has led to a low density and wide spatial distribution of remaining riparian forest, which is now largely dominated by early successional disturbance species such as red alder.

Channel migration has been retarded in certain reaches by bank hardening with rip rap, or has been promoted in other reaches by the removal of riparian trees, which reduced bank stability and increased lateral channel movement. The removal of riparian trees in the stream corridor and building of roads in floodplains have also reduced shade, edge habitat, and wood recruitment. Land clearing for agriculture and insufficient application of BMPs have led to water quality issues, including increased water temperatures, late summer oxygen depletion, and nutrient loading. Invasive species are also a concern as they often disrupt native plant communities and degrade edge habitats.

Development of the Siuslaw River Strategic Action Plan

This chapter overviews the major steps used to generate this strategic action plan for the Siuslaw River basin following a process set by the Coast Coho Partnership. The approach is based on OWEB guidance provided in the 2017 document, *Components of a Strategic Action Plan for Participation in the Focused Investment Partnerships Program*.

As described in Chapter 2, the Siuslaw SAP is one of three pilot SAPs that contain a prioritized list of habitat protection and restoration projects to support the recovery of an independent coast coho population. The highest-priority projects described in these three plans have been collected in the Oregon Coast Coho Business Plan. The public-private Coast Coho Partnership is overseeing development of the Business Plan, and using it as a marketing tool to recruit partners to fund the highest-priority projects in the SAPs. Development of the Siuslaw River SAP was facilitated by the Wild Salmon Center, with technical support provided by the other members of the Coast Coho Partnership and project consultants.

6.1 Visioning

The Siuslaw SAP process began with a discussion of shared partnership values and priorities

Replacement of culverts with bridges helps both adult and juvenile coho access critical spawning and rearing areas upstream. Photo: Seth Mead.



to guide the planning process and inform development of a long-term vision statement for the SCP. The exercise explored ways in which coho conservation aligns potentially competing social, economic, and ecological priorities among local stakeholders. The resulting vision statement not only guided development of the SAP, but has also informed the longer-term role of the SCP within the Siuslaw watershed community. In addition to a vision statement, the discussion yielded guiding principles for the planning process, as well as three outcome statements to clearly define the SCP's long-term coho conservation priorities. These vision and outcome statements are presented in Chapter 2.

6.2 Creating the Siuslaw Common Framework

The SCP developed the Siuslaw common framework based on a “common framework” model in the Coast Coho Business Plan. The Coast Coho Partnership developed the common framework to establish a consistent language that could be used in both the SAPs and future coast coho conservation efforts. Following the Business Plan model, the SCP reviewed and tailored the framework to incorporate social and ecological conditions unique to the Siuslaw.

The Siuslaw common framework classifies habitat types (called “components”); identifies the “key ecological attributes” (KEAs) of each component for Siuslaw coho; describes potential indicators for each KEA; and lists the stresses and threats that could undermine population viability over the long term. Terminology adopted through this framework is included throughout this plan, and key terms are defined in Chapters 3 and 4. The full Siuslaw common framework is contained in Appendix 1.

6.3 Ranking the Sub-Watersheds

The SCP selected areas in the Siuslaw watershed where restoration efforts should begin. This winnowing-down approach is consistent with the Coho Business Plan effort, which emerged, in part, from recognition by both restoration practitioners and funders of the immense challenge they face in quantifying the benefits of habitat restoration, beyond just the project scale. This challenge is due in large part, though not entirely, to the fact

A “6th Field” is a geographic scale established under a hierarchical classification system developed by the USGS that divides river basins into hydrologic unit codes or “HUCs.” Commonly referred to as a “sub-watershed,” a 6th field HUC is typically between 10,000-40,000 acres or 15-60 square miles.

that restoration practitioners often work in large geographies and lack the capacity to implement projects at a rate or with a degree of coordination necessary to produce measurable impacts at the watershed scale. Because of these and other factors, there is often insufficient restoration activity to yield a discernible response at a meaningful scale (a 6th field watershed, for example).

The SCP seeks to address this challenge by focusing implementation of this SAP in a limited number of “high-ranked” sub-watersheds. The criteria and scores used to guide selection of the high-ranked sub-watersheds are described in Appendix 2. Generally, the process was guided by a stronghold approach, based on two assumptions. First, that in the long run, the most cost-effective strategy is to protect habitats that are in good or excellent condition, and second, that expanding these areas of functioning habitat is more likely to provide the desired results and show a more immediate return on investment than starting in more highly degraded systems. The approach recognizes that the stresses on highly modified systems are either so numerous (e.g., in urbanized areas) or take so long to reverse (e.g., severe channel entrenchment) that the success of restoration in these watersheds is often uncertain. Accordingly, this plan gives priority to sub-watersheds that are relatively intact and demonstrate greater ecosystem function than more degraded systems.

6.4 Evaluating Habitat Stresses

The SCP’s core planning team evaluated conditions within each of the 11 high-ranked sub-watersheds and identified the major habitat stresses limiting coho production based on available information. The team agreed upon the major stresses following interviews with ODFW, other agency field staff, and various nonprofit and governmental restoration practitioners, and a review of existing information, including habitat and water quality data, salmonid population data, and watershed plans and assessments. Much of this information is summarized in the

Literature Review in Appendix 3. The Annotated Bibliography in Appendix 4 describes the source documents used in the sub-watershed assessment process. Table 7-1 summarizes the major stresses identified by the core planning team for each habitat component in the high-ranked sub-watersheds. The SCP anticipates that stresses may change over time as restoration proceeds and as new data and methods are considered through the adaptive management program described in Chapter 10.

6.5 Locating and Prioritizing Projects

With the priority sub-watersheds determined and major stresses agreed upon for each area, the core planning team undertook a multi-step process to determine site-specific protection and restoration actions. The first step was an expert opinion process in which facilitators projected maps and aerial images of each of the high-ranked sub-watersheds and “walked” participants down each perennial tributary and main-stem reach present in the sub-watershed. Team members who were uniquely familiar with a high-ranked sub-watershed discussed protection and restoration priorities and opportunities along each reach. Where there was consensus among the team, facilitators recorded project recommendations. These recommendations were presented at both the tributary and reach scale depending on participants’ knowledge of the system. It is important to note that this step did not consider whether a project was socially feasible and/or had the support of the landowner(s). Instead, the purpose was simply to identify locations where limiting factors could/should be addressed through a protection or restoration project. Team members often recommended particular projects based on existing plans or assessments, especially on BLM and USFS lands where such assessments were more likely to have been completed.

Prioritization Criteria

The process above yielded over 100 potential projects across the 11 high-ranked 6th field sub-watersheds. Projects advanced five conservation strategies, including enhancing instream complexity, restoring fish passage, reconnecting floodplains (including restoring off-channel habitat), enhancing riparian function, and protecting critical habitats through land acquisitions and easements.

The core planning team prioritized projects using several criteria that evaluated: (1) the relative importance of the location in which the project is to be implemented, and (2) the relative importance/benefit of the project. Criteria included the following:

- Importance of the location where restoration is occurring: Criteria evaluate life stages utilizing the site; habitat value; and restoration potential (measured by Intrinsic Potential). Additional “bonus” points were also provided to any sites that contained unique conditions or habitat types (e.g., a tidal spruce swamp) or was a known source of temperature refugia.
- Importance of the project: Criteria evaluate limiting factors being addressed; watershed processes that benefited from the project type; anticipated longevity of the project; and assurance of success. Bonus points were given to any projects that benefited working lands and/or had a significant focus on landowner and/or public education.

The scoresheet used to apply these criteria – along with a worksheet to quantify ecosystem processes benefited by different project types – is provided in Appendix 5. In addition to using this scoresheet to prioritize the projects generated for this SAP, the SCP will use the scoresheet as a tool to evaluate future project opportunities and their consistency with the goals of the SAP. Project scores by criteria and other project information are shown in the Siuslaw SAP Project Summary and Rankings spreadsheet, contained in Appendix 6.

Netmap as a Tool to Test and Refine Project Locations

Following this initial prioritization process, the SCP commissioned TerrainWorks to evaluate the core planning team’s findings using its Netmap tool to model the optimal locations for numerous restoration strategies. Netmap develops a ‘virtual watershed’ based on a LiDAR-generated digital elevation model (DEM) (merged with 10 meters DEMs where LiDAR is unavailable) and enumerating multiple aspects of watershed landforms and processes, and human interactions within them over a range of scales (Benda et al. 2015; Barquin et al. 2015). NetMap’s virtual watershed contains six analytical capabilities to facilitate optimization analyses: (1) delineating watershed-scale synthetic river networks using the merged LiDAR and 10m DEMs; (2) connecting river networks and terres-

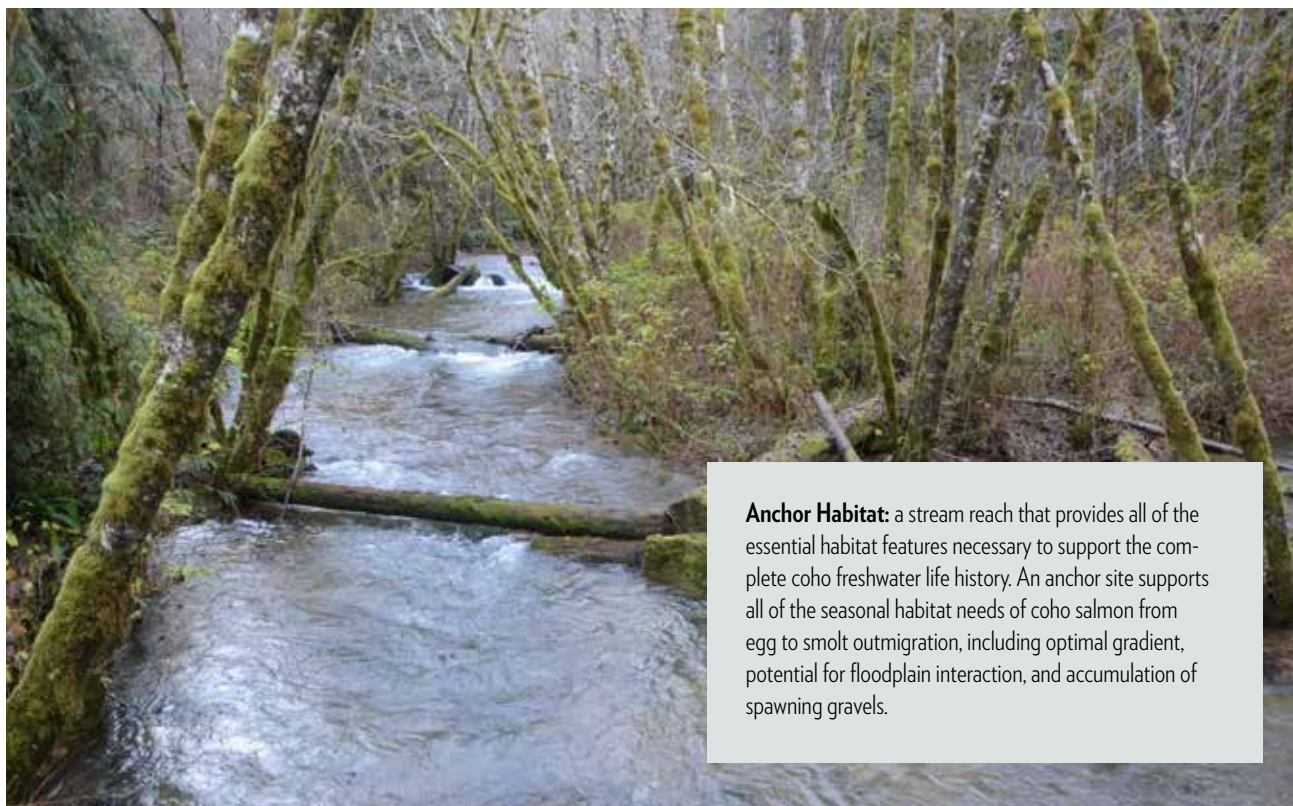
trial environments, and with other parts of the landscape; (3) routing of watershed information downstream (such as sediment) and upstream (such as fish); (4) sub-dividing landscapes and land uses into smaller areas to identify interactions and effects; (5) characterizing landforms; and (6) attributing river segments with key stream and watershed information.

This exercise had three goals: The first goal was to provide an objective evaluation of the locations determined as priorities for restoration by the core planning team. Where project sites recommended by the team were not selected by the model, the team determined the cause of the inconsistency and, in some cases, refined or added project sites. In others, the model was recalibrated to better reflect actual known site conditions. In effect, the Netmap analyses provided a check on “at-the-table bias” and provided further justification for selected project locations.

The second goal of running Netmap was to provide managers with modeled priority sites in cases where information or participant expertise was limited, and team members were unable to recommend specific project locations. In these cases, a modeled priority site was adopted as the project site by the team and incorporated into the SAP, or identified to be used as a starting point for managers in the field to consider when locating future restoration project sites. In the latter case, the project location remains broadly defined in the SAP (e.g., an entire tributary, rather than a particular reach).

The third goal of using Netmap was to provide a long-term modeling tool and data layers for future prioritization exercises. The USFS and SWC both retain a license to use the Siuslaw Netmap data, as well as access to the Netmap software. The complete Siuslaw Netmap analysis can be found in Appendix 11.

TerrainWorks’ analyses included a range of outputs that were considered during the process (including runs that prioritized sites for riparian restoration, beaver re-introduction, thermal refugia protection, road maintenance/decommissioning, and fish passage improvement). In addition, the team also used Netmap as part of an extensive analysis to identify anchor habitats and prioritize upland timberlands for protection. Because these analyses are the basis of numerous projects selected for this SAP, the methods are summarized below.



Anchor Habitat: a stream reach that provides all of the essential habitat features necessary to support the complete coho freshwater life history. An anchor site supports all of the seasonal habitat needs of coho salmon from egg to smolt outmigration, including optimal gradient, potential for floodplain interaction, and accumulation of spawning gravels.

Identifying Anchor Habitats

To further refine locations for habitat protection and restoration, the SCP adopted an “**anchor habitat**” approach. An anchor habitat is a stream reach that provides all of the essential habitat features necessary to support the complete coho freshwater life history. An anchor site supports all of the seasonal habitat needs of coho salmon from egg to smolt outmigration, including optimal gradient, potential for floodplain interaction, and accumulation of spawning gravels. Thus, the protection and restoration of these sites – or sites exhibiting a high potential to be anchor habitats – provides the greatest opportunity to increase coho production. Current and potential anchor sites, therefore, represent excellent sites in which to augment instream complexity, reconnect floodplains, restore off-channel habitats, and protect upland areas for large wood and gravel recruitment.

The SCP identified coho anchor habitats in the Siuslaw Basin’s high-ranked sub-watersheds by using the Netmap tool to model several watershed parameters. These parameters were correlated with anchor habitats that were identified through extensive physical habitat and population surveys. Generally, these parameters included: channel gradient, temperature, floodplain

width and connectivity, and valley constraint. Appendix 7 contains more details on the anchor habitat identification methodology. Figure 7-2 presents the modeled anchor habitats in the high-ranked sub-watersheds.

The core planning team used the results from the anchor habitat identification process to guide the selection of high-priority locations for short-term instream, wetland, and off-channel restoration. The process also led to an analysis of upland forested areas that could be protected to provide for long-term wood and gravel delivery. The team used Netmap to determine which upslope areas in the Siuslaw watershed have the greatest potential to deliver wood and gravel into identified anchor habitats. To analyze the likelihood that a location had a high probability of sliding and delivering these inputs into an anchor, Netmap results were combined with Landscape Ecology, Modeling, Mapping & Analysis (LEMM A) 2012 Structure Data to identify high probability debris flow / shallow landslide areas capable of delivering late seral vegetation on private lands directly into and upstream of anchors.

Results generated by the analysis of upslope areas in the Siuslaw watershed identified 1,651 acres across 270 sites where the protection of standing timber is likely to generate the greatest

long-term benefit to instream habitat quality. Allowing watershed processes to deliver wood and gravel to the locations where these inputs can have the greatest benefit represents a powerful restoration tool. If implemented, this strategic and cost-effective approach greatly enhances the likelihood of maintaining a viable Siuslaw coho population over the long term. The locations of these upland sites are presented in Chapter 7, Goal 6.

6.6 Monitoring and Indicators

The SCP developed a list of indicators that can be used to monitor the pace and effectiveness of SAP implementation. This action is a modest, but essential, step towards addressing one of the main concerns leading to the development of the Coast Coho Business Plan and its constituent SAPs: that managers were struggling to detect the cumulative benefits of restoration at a sub-watershed or population scale. During development of the “Siuslaw framework” the SCP identified a list of indicators that they hoped to improve through SAP implementation. This list was revisited and revised at the conclusion of the SAP process to incorporate information generated and lessons learned during the process. Chapter 10 presents the final list of indicators for the Siuslaw SAP and the associated monitoring required to assess those indicators.

Screw traps are used to capture and count juvenile coho migrating downstream. This allows managers to monitor abundance and assess the benefits of habitat restoration projects. Photo: WSC.



6.7 Estimating Costs

The Siuslaw Coho Partnership’s final step in drafting the Siuslaw SAP was to estimate the anticipated costs of projects selected for the plan. Costs were generated by reviewing the OWEB Oregon Watershed Restoration Inventory (OWRI) database and by reviewing costs from projects that have been implemented in the Siuslaw River area by local partners. The OWRI database was queried to focus on projects that were implemented within the Oregon Coast Coho ESU from 2010 to 2014. Project costs are presented in Chapter 9.

6.8 Community Outreach

Community outreach played a critical role throughout the planning process. The Siuslaw Coho Partnership includes local, state, and federal partners, tribes, and NGOs. Throughout the SAP development process, participants on the core planning team maintained consistent communication with the boards and managers of the groups they represented in the process. This ensured broad outreach to community stakeholders and an opportunity for input at key junctures in the process. This feedback loop ensured that questions and concerns raised by local stakeholders were considered and acted upon during plan development, limiting any surprises upon release of the draft plan to the community. Public review of the plan took place through an open house convened by SWC, and then during a public 45-day plan review period during which time members of the public could offer comment to the plan, which was available on the SWC website.

Additionally, the SCP contracted with Solid Ground Consulting (Portland, OR) to conduct interviews with stakeholders to SAP implementation to provide feedback on the plan, and the SCP’s vision and goals. Solid Ground Consulting also created a Communication Plan to help the SCP further engage stakeholders in restoration projects across the watershed. This will increase the capacity of the SCP to collaborate with willing private landowners in the future. Results of the interview process and the communications plan are located in Appendix 11.

The Strategic Framework: Restoration Strategies and Key Geographies

The previous chapter provided an overview of the process used to determine the types of habitat restoration that should occur in high-priority stream reaches, and how the core planning team selected and prioritized specific projects for implementation. Chapters 7 and 8 describe the results of this process. First, this chapter presents the “Strategic Framework,” which the SCP will use to guide its habitat restoration priorities over the long term, including landowner outreach, project implementation, and habitat monitoring.

The Strategic Framework described in this chapter begins with a description of the sub-watersheds that have been selected as highest priority for restoration, and the locations of critical instream and upland habitats within these sub-watersheds. Following this overview of the plan’s geographic priorities, the Strategic Framework presents: 1) the major protection and restoration strategies that the SCP intends to advance, and 2) the priority areas where these strategies are proposed for implementation. Implementation of projects in these locations will ultimately depend on the willingness of landowner(s), both public and private, to participate in the Siuslaw watershed restoration effort.

Chapter 8 drills down further, presenting reach-scale projects that SCP proposes for implementation in the short term (2019-2025.)

7.1 The High-Ranked Sub-Watersheds

Through the process described in Chapter 6, the SCP identified 11 sub-watersheds in which to focus habitat protection and restoration projects over the next two to three decades. The following section lists the selected sub-watersheds and provides some comments on what factors (in addition to the selection criteria described in chapter 6) make them unique, and important for coho. Figure 7-1 provides a map of these “high-ranked sub-watersheds.”



An outcropping of Tyee Formation in the Lower North Fork Siuslaw watershed.

Bernhardt Creek: Although its spawning reaches are not as productive for coho as those in other high-ranked sub-watersheds, the Bernhardt Creek watershed rates high due to the importance of estuarine habitats for coho, as well as associated freshwater wetlands. The Lower Bernhardt Creek watershed contains an extensive wetlands network, which provide critical rearing habitat for juveniles migrating not only from local creeks, but from tributaries throughout the entire Siuslaw system. These tidal wetlands provide the last resting spot for many Siuslaw coho to feed and grow before they enter the Pacific Ocean. Restoration projects like those completed on Karnowski Creek illustrate the high potential for habitat improvements in and around the tidal zone to also support zero-age coho, an important alternative life history strategy.

Lower North Fork Siuslaw River: The Lower North Fork is unique in that it contains a mix of sandstone and hard-rock (basalt) geology. (Most of the Siuslaw is Tyee Formation sandstone, see Figure 3-1). Its lower reaches contain large tidal flats, and – similar to lower Bernhardt – coho utilize the existing network of tidal wetlands and sloughs. Consequently, both habitat types are priorities for reconnection and restoration under this plan. According to SWC monitoring, tributaries within the basalt outcrop areas – like Condon, Uncle, and Billy Creeks – boast some of the highest rearing juvenile densities in the watershed. While not specifically highlighted in this plan, there are numerous potential high-priority acquisition/conservation parcels available within this 6th field HUC watershed.



Upper North Fork Siuslaw River: Like Upper Deadwood Creek (below), the Upper North Fork is largely intact, provides considerable refugia for summer and winter rearing, and is managed as Late Successional Reserve (LSR). Accordingly, most of the watershed is recognized by the USFS Northwest Forest Plan as a “key watershed.” McLeod Creek, Porter Creek, Elma Creek, and the upper mainstem North Fork are the main coho producers, and Chinook salmon and steelhead trout make extensive use of the mainstem. Over the last 20 years the Siuslaw NF and its partners have concentrated a large amount of restoration work in these and other areas of the watershed. With a few exceptions, the majority of the essential available restoration projects have been completed. With the implementation of the projects identified in Chapter 8, work in the Upper North Fork Siuslaw will be considered completed for the next two decades or so.



Knowles Creek: Most of the Siuslaw’s high-ranked sub-watersheds have extensive reaches of actual and potential anchor habitat. Knowles is the exception, but according to spawning surveys undertaken by USFS and ODFW and rearing assessments conducted by SWC, Knowles Creek is one of the largest coho-producing systems in the Siuslaw. Although the upper watershed is largely protected as LSR, Knowles Creek is highly unstable and recent landslides have delivered large loads of spawning gravel into the system. Extensive habitat restoration (primarily LWD installation) has captured these gravels and created large reaches of outstanding spawning habitat, while also creating high quality winter habitat. The system’s capacity to trap gravel and create spawning habitats underscores the importance and potential benefits of re-introducing wood into the Siuslaw system.



Upper Indian Creek: Like Deadwood Creek and the Upper North Fork Siuslaw, Upper Indian Creek contains some of the most intact coho habitat in the Siuslaw watershed and is recognized by USFS as a “key watershed.” Rogers Creek, Maria Creek, and the North Fork are currently the most productive tributaries based on juvenile and spawning data collected. Long low gradient tributaries with access to floodplains are the keys to providing that habitat. Restoration opportunities have great potential to dramatically improve habitat conditions.

Lower Deadwood Creek: Lower Deadwood Creek boasts wide floodplains with high reconnection and restoration potential in its lower reaches. With a long, low gradient, the West Fork Deadwood is the major salmon producer in the watershed, generating an abundance of both coho

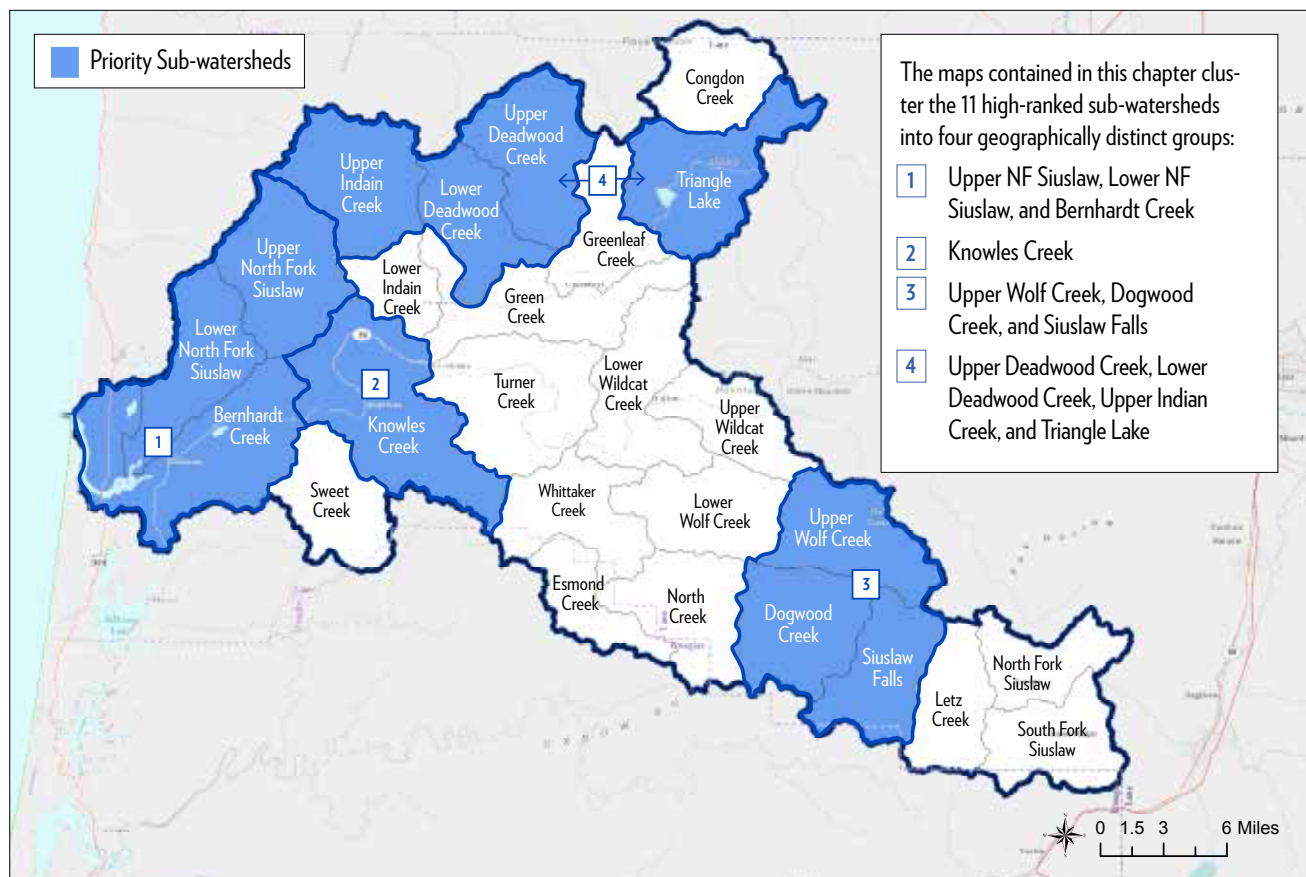


Figure 7-1. High-ranked sub-watersheds in the Siuslaw Watershed. The maps included in this chapter cluster these 11 watersheds into four groups.

and Chinook. Extensive federal ownership in the watershed provides the opportunity to protect and augment long-term refugia for both summer and winter rearing. Over the past two decades private landowners in the Lower Deadwood and Upper Deadwood (below) watersheds have been the most supportive and active participants in restoration in the whole Siuslaw Basin.

Upper Deadwood Creek: The Upper Deadwood Creek watershed contains an extensive network of intact and highly productive habitats, and is largely under federal ownership (identified by USFS as a “core refuge area”). The SCP plans to “build from strength” in Upper Deadwood Creek and leverage the extensive refugia present by working with an engaged landowner community to reconnect floodplains in the upper and lower mainstem. The system has responded well to recent restoration efforts.

Triangle Lake: While managers are eager to better understand the degree to which adult coho migrate above Lake Creek Falls, the sub-watershed contains highly productive tributaries with

extensive reaches of current and potential anchor habitats and high IP. Gravel-rich tributaries like Schwartz Creek contain high spawning densities, and according to one member of the core planning team, “Triangle Lake functions like a huge beaver pond,” providing a remarkable abundance of rearing habitat for downstream migrating juveniles.



Upper Wolf Creek, Dogwood Creek, and Siuslaw Falls: Upper Wolf Creek, Dogwood Creek, and the Siuslaw River Falls subwatersheds are grouped here because of their similar attributes and geographic connectivity. Clustered in the southeast arm of the upper Siuslaw watershed, these watersheds contain wide valley, low gradient tributaries that provide extensive current and potential anchor habitats. Tributaries in these watersheds produce cold water that provides thermal refugia, which is essential to migrating juveniles when the mainstem Siuslaw heats up in the summer. Because of their geomorphology, all three watersheds indicate high restoration potential through beaver recruitment (especially Wolf and Dogwood), LWD installation, and other measures that enhance instream complexity and floodplain connectivity. Siuslaw River Falls and Dogwood Creek watersheds also present a unique opportunity to demonstrate how to restore habitats in the upper Siuslaw mainstem, in conjunction with industrial timber owners. Because of their capacity to provide cold water, these tributaries promote the Siuslaw coho population's potential resilience to climate change.

A Note on the High-Ranked Sub-Watersheds

It should be noted that the SCP's purpose for ranking the sub-watersheds is not to characterize one watershed as more or less important than another but rather to facilitate a geographic focus for SAP implementation. Such focus is necessary for managers to be able to detect a positive signal (i.e. a quantifiable benefit) from implementation of the habitat protection and restoration projects contained in this plan. As discussed previously, conservation practitioners and funders have struggled to show the ecosystem benefits of habitat restoration above the reach scale partly because investments have been spread across large geographic regions. By selecting a subset of watersheds in which to focus and coordinate implementation, the SCP hopes to implement protection and restoration projects at a pace and scale sufficient to demonstrate a quantifiable ecosystem benefit. The indicators that the SCP will evaluate to detect these benefits over time are described within a monitoring framework, presented in Chapter 10.

While this SAP identifies several sub-watersheds in which to focus investment, the SCP encourages all stakeholders in the Siuslaw Basin to



recognize the contributions of the lower-ranked sub-watersheds to the basin-wide dynamics that make the Siuslaw Basin such a productive coho system. To that end, the SCP members agree that focusing implementation in the high-ranked sub-watersheds does not restrict any of the participating partners from undertaking projects in sub-watersheds that have not been identified as high-ranked. In fact, projects undertaken outside of the high-ranked sub-watersheds may still promote SAP implementation by demonstrating the application of new conservation incentives, engaging a locally influential landowner (or one with extensive holdings in the high-ranked sub-watersheds), and/or advancing a large-scale project with potential watershed-wide benefits.

The USFS uses a "Watershed Condition Framework" to drive its implementation of watershed restoration activities. This framework is based upon the premise of concentrating restoration work in Focus 6th Field watersheds to complete all identified essential projects in that 6th field prior to moving on to the next highest priority 6th field watershed. This framework also recognizes that often there are opportunistic projects that come up in non-priority 6th field watersheds, that unless acted upon quickly, the opportunity may disappear to do substantial restoration of an area. Consequently the framework establishes a guideline for funding of restoration projects. That guideline states that at least 80 percent of the restoration funding should be used in the focus watersheds and up to 20 percent of the restoration funding could be used in non-focus watersheds. During the SAP process, the partners discussed this funding strategy and agreed that those percentages seemed like a reasonable investment strategy for allocating any restoration funding received through this effort.

7.2 Habitat Stresses, Limiting Factors, and the Anchor Habitat Approach

According to the Oregon Coast Coho Salmon Recovery Plan, “loss of **stream complexity**, including connected floodplain habitat, is the primary limiting factor for many coho salmon populations and overwinter rearing of juvenile coho salmon is especially a concern. This instream habitat is critical to produce high enough juvenile survival to sustain productivity, particularly during periods of poor ocean conditions” (NMFS 2016). The ODFW defines stream complexity as “habitat of sufficient quality to produce over-winter survival at rates high enough to allow coho spawners to replace themselves at full-seeding during periods of poor ocean conditions (3% smolt to adult survival)” (ODFW 2007). High quality over-winter rearing habitat for juvenile coho salmon typically includes features such as large wood, pools, connected off-channel alcoves, side channels, beaver ponds, lakes, connected floodplains, and wetlands (ODFW 2007; NMFS 2016).

Major Stresses

As discussed in Chapter 5, **the lack of instream complexity is the primary factor limiting coho production in the Siuslaw watershed**. Not surprisingly, the SCP identified **reduced wood delivery, lack of pools, bed coarsening, decreased lateral connectivity, and/or decreased beaver ponds** as major stresses in the majority of the high-ranked sub-watersheds (see Table 7-1). Accordingly, the restoration strategies presented in this chapter focus largely on restoring instream complexity. The strategies include protecting key upland timber stands (to promote long-term instream wood recruitment); installing LWD; restoring riparian habitats; reconnecting instream and floodplain habitats; and reconnecting tidal and non-tidal wetlands.

Reduced water quality – especially increased water temperature and sedimentation – is the secondary factor limiting coho production in the Siuslaw Basin, and was identified as a major stress in several of the high-ranked sub-watersheds. Improving (reducing) water temperatures during summer rearing would contribute to improved egg-to-smolt survival and could promote life-history diversity. The restoration strategies presented below directly and indirectly reduce water temperatures and sedimentation.

LIMITING FACTORS FOR SIUSLAW COHO

Primary

Lack of instream complexity

Secondary

Reduced water quality (increased water temperature & sedimentation)

The Anchor Habitat Approach

To assist in prioritizing locations for upland habitat protection, instream restoration, and floodplain/off-channel reconnection, the SCP identified anchor habitats within each of the Siuslaw’s high-ranked sub-watersheds. These areas are shown in Figure 7-2. As discussed in Chapter 6, anchor habitats provide all of the essential habitat features necessary to support the complete coho freshwater life history. Thus, the protection and restoration of these sites provides the greatest opportunity to deliver a sustained increase in coho production. Projects that improve key habitat features by augmenting instream complexity, reconnecting floodplains, restoring off-channel habitats, and otherwise improving habitats in these areas will generally provide the highest return for the coho population. In short, this anchor habitat strategy gives SCP partners a high degree of confidence that the strategies presented in this chapter represent the best opportunities to generate the greatest return on future restoration investments.

Stream Complexity (high quality over-wintering habitat):

habitat of sufficient quality to produce over-winter survival at rates high enough to allow coho spawners to replace themselves at full-seeding during periods of poor ocean conditions (3% smolt to adult survival) (OCCCP 2007).



Table 7-1. Major Stresses by Habitat Component in High-Ranked Sub-watersheds.

Name	Mainstem	Tributaries	Off-channel & Wetlands	Upland	Estuary	Lakes
Knowles Creek	• Decreased lateral connectivity • Increased water temperature	• Increased sediment • Increased water temp. • Altered riparian function	• Decreased beaver ponds	• Forest fragmentation (reduced LWD yield)		
Upper Indian Creek	• Increased water temperature • Decreased lateral connectivity • Reduced wood input (esp. mainstem) • Bed coarsening	• Increased sediment • Altered riparian function (esp. West Fork and upper Indian) • Reduced wood inputs	• Decreased beaver ponds (non-fed lands)	• Forest fragmentation (reduced LWD yield)		
Upper Deadwood Creek	• Increased water temperature • Decreased lateral connectivity • Reduced wood input (esp. mainstem) • Bed coarsening	• Altered riparian function • Invasive species (knotweed) • Reduced wood inputs • Bed coarsening	• Decreased beaver ponds			
Bernhardt Creek	• Decreased lateral connectivity • Altered riparian function	• Altered riparian function			• Reduced tidal wetland connectivity	
Lower NF Siuslaw River	• Decreased lateral connectivity • Increased water temperature • Altered riparian function	• Decreased longitudinal connectivity • Increased water temp. • Altered riparian function		• Forest fragmentation (reduced LWD yield)	• Reduced tidal wetland connectivity	
Upper NF Siuslaw River	• Lack of pools (limited complexity/depth) • Decreased lateral connectivity (McLeod to Wilhelm)	• Lack of pools (limited complexity or depth)	• Decreased beaver ponds			
Triangle Lake	• Increased water temperature • Decreased lateral connectivity • Altered riparian function (above lake)	• Lack of pools (limited complexity or depth)	• Decreased beaver ponds (non-fed lands)			• Invasive species (bass)
Lower Deadwood Creek	• Reduced instream complexity • Increased water temperature • Decreased lateral connectivity • Bed coarsening	• Altered riparian function • Invasive species (knotweed)				
Dogwood Creek	• Increased water temperature • Decreased lateral connectivity • Bed coarsening • Reduced wood inputs	• Lack of pools (limited complexity or depth) • Reduced wood inputs • Increased velocity	• Decreased beaver ponds			
Upper Wolf Creek	• Increased water temperature • Lack of pools (limited complexity/depth) • Decreased lateral connectivity • Bed coarsening • Reduced wood inputs	• Lack of pools (limited complexity or depth) • Reduced wood inputs • Increased velocity	• Decreased beaver ponds			
Siuslaw – Siuslaw Falls	• Increased water temperature • Decreased lateral connectivity • Bed coarsening	• Lack of pools (limited complexity or depth) • Reduced wood inputs • Increased velocity				

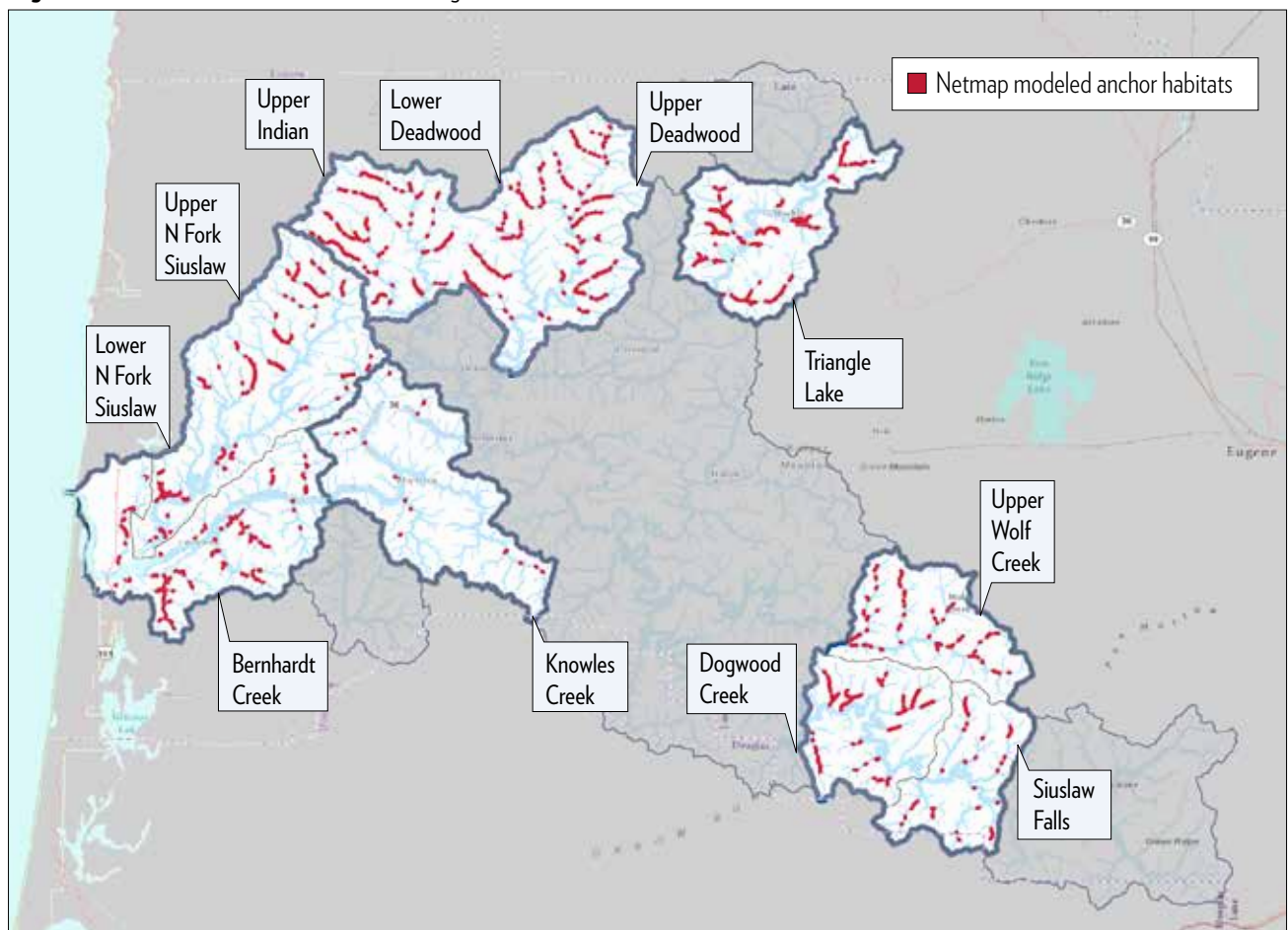
7.3 Strategies to Conserve Critical Coho Habitats in the Siuslaw Watershed

During the life of this plan, the SCP will advance several strategies to repair watershed function and reduce the major stresses limiting coho production described above. Each of these strategies is described briefly below with maps and summary tables that indicate where the SCP recommends employing these strategies and the extent of habitat (acres, miles, etc.) recommended for treatment. Furthermore, Traditional Ecological Knowledge contributed by the SCP's Tribal partners, will be incorporated into these strategies, thus integrating indigenous stewardship and holistic management practices with contemporary scientific knowledge and technology. Note that the maps contained in this section cluster the 11 high-ranked sub-watersheds into four geographically distinct groups:

- 1) Upper Deadwood Creek, Lower Deadwood Creek, Upper Indian Creek, and Triangle Lake;
- 2) Upper Wolf Creek, Dogwood Creek, and Siuslaw Falls;
- 3) Upper North Fork Siuslaw, Lower North Fork Siuslaw, and Bernhardt Creek; and
- 4) Knowles Creek.

The Strategic Framework presented in this chapter is intended to guide landowner outreach, project implementation, and habitat monitoring over the long term (two or more decades). As stated previously, the strategies presented here (and the specific projects presented in Chapter 8) do not represent all of the restoration opportunities present in the Siuslaw watershed. They simply represent those that the SCP believes have the highest likelihood of improving watershed function and increasing coho habitat productivity over the long term. As these strategies are implemented over time, this Strategic Framework will be evaluated and priorities may change as new data becomes available. This approach is discussed further in Chapter 10: Evaluation and Adaptive Management.

Figure 7-2. Modeled anchor habitats in the high-ranked sub-watersheds.



Strategy 1: INSTALL LARGE WOOD

Add LWD to identified anchor habitats and other reaches to increase instream complexity and restore stream interaction with off-channel habitats.

While ensuring LWD delivery through natural watershed processes is the most cost-effective method of maintaining instream complexity over the long term, the strategy is limited in the short term because landslides and blowdown of old riparian stands are uncommon and unpredictable. Accordingly, restoration practitioners rely heavily on the installation of large wood and boulders to jump start instream complexity and restore the stream's connection with its floodplain and associated off-channel habitats. Increasing the number and volume of large wood structures in a stream increases pool area and depth, slows

water velocity, traps and sorts gravel and fine sediments, and facilitates floodplain inundation. Large wood also provides habitat and nutrients for aquatic invertebrates, increasing the food supply for fish and wildlife. Beavers need large wood to anchor dams in larger streams and may also utilize small wood that is trapped in LWD structures, fostering development of beaver ponds and associated off-channel rearing habitats.

Table 7-2 summarizes the linear miles of stream that were identified as anchor habitats in each of the high-ranked sub-watersheds, as well as the miles of stream that were identified as high priority for LWD installation by managers on the core planning team. In tributaries where the two locations do not overlap, managers will ground truth the anchor habitat locations to guide the final selection of wood placement. The majority of LWD projects will also incorporate conifer or shrub understory planting to provide future LWD recruitment.

Adult coho spawn in a reach of Fiddle Creek recently restored with large wood. Fiddle Creek is an important spawning and rearing tributary for the neighboring coastal lakes population. Photo: Seth Mead.



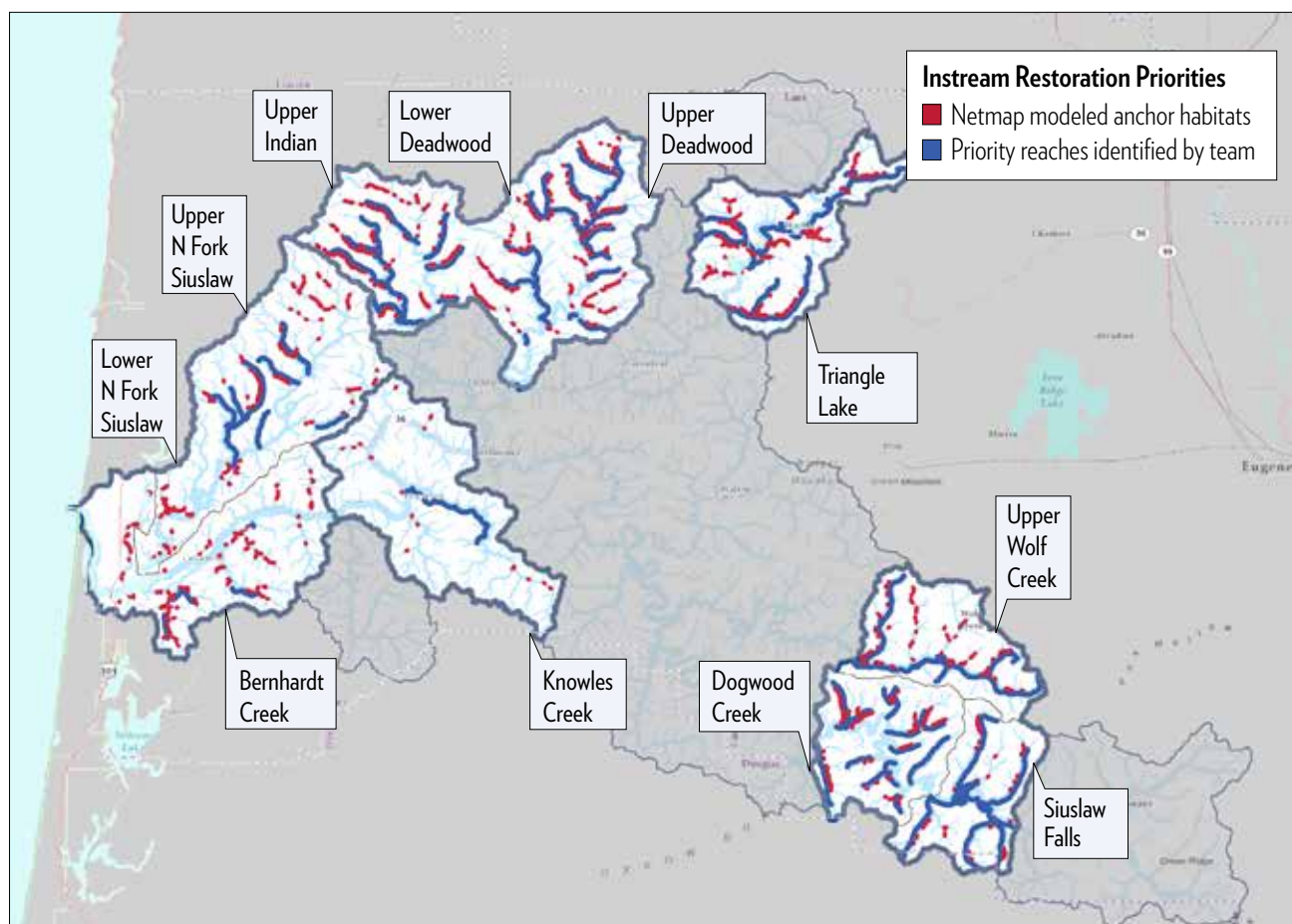


Figure 7-3. Stream reaches identified in the high-ranked sub-watersheds as priorities for LWD installation.

Table 7-2. Proposed High Priority for LWD (miles per sub-watershed).

SUB-WATERSHED	Netmap Modeled Anchor Habitats	Team Identified Priority Reaches
Bernhardt Creek-Siuslaw River	10.9	4.0
Lower North Fork Siuslaw River	6.2	11.5
Triangle Lake-Lake Creek	15.8	30.4
Upper Indian Creek	11	22.7
Upper Deadwood Creek	9.3	23
Dogwood Creek-Siuslaw River	8.5	14.1
Upper North Fork Siuslaw River	5.5	7.2
Upper Wolf Creek	5.6	18.6
Lower Deadwood Creek	4.4	13.0
Siuslaw Falls-Siuslaw River	3.4	17.6
Knowles Creek-Siuslaw River	1.1	9.8
Total	81.7	171.9



Strategy 2: ENHANCE RIPARIAN VEGETATION

Plant riparian vegetation to reduce stream temperatures and/or ensure future LWD recruitment into anchor habitats.

Riparian (streamside) vegetation plays an essential role in producing and maintaining coho habitat. Riparian vegetation along tributaries, off-channel habitats, and some mainstem and wetland habitats can provide shade to reduce stream temperature, create cover for coho rearing, provide a source of food and nutrients (forage), help stabilize sediment supply, filter out pollutants (e.g. pesticides and excessive nutrients), and provide a source of stream complexity. Not surprisingly, the loss and degradation of riparian function has contributed significantly to both the primary limiting factor to Siuslaw coho production (lack of stream complexity) and the secondary limiting factor (reduced water quality,

especially elevated temperature and sediment). Projects recommended to advance this strategy (shown in Appendix 9, Table A2) may focus on riparian enhancement for the purpose of maintaining water temperature, providing wood for long-term recruitment, or both. Enhancement projects may include the removal and ongoing prevention of invasive species like Japanese knotweed, Himalayan blackberry, or reed canary grass.

Figure 7-4 shows the stream reaches in the high-ranked sub-watershed that were identified as high-priority areas for riparian habitat enhancement. Table 7-3 identifies the miles of riparian habitat proposed for enhancement in the areas over the life of this plan. Column 2 in Table 7-3 indicates the extent of riparian area identified by the Netmap model, and column 3 represents locations identified by managers on the core planning team. The short-term riparian restoration priorities presented in Chapter 8 include areas deemed as priorities by the model and local managers.

Healthy riparian zones are essential to maintaining cold water, recruiting large wood to the stream, and filtering out fine sediments and other contaminants.



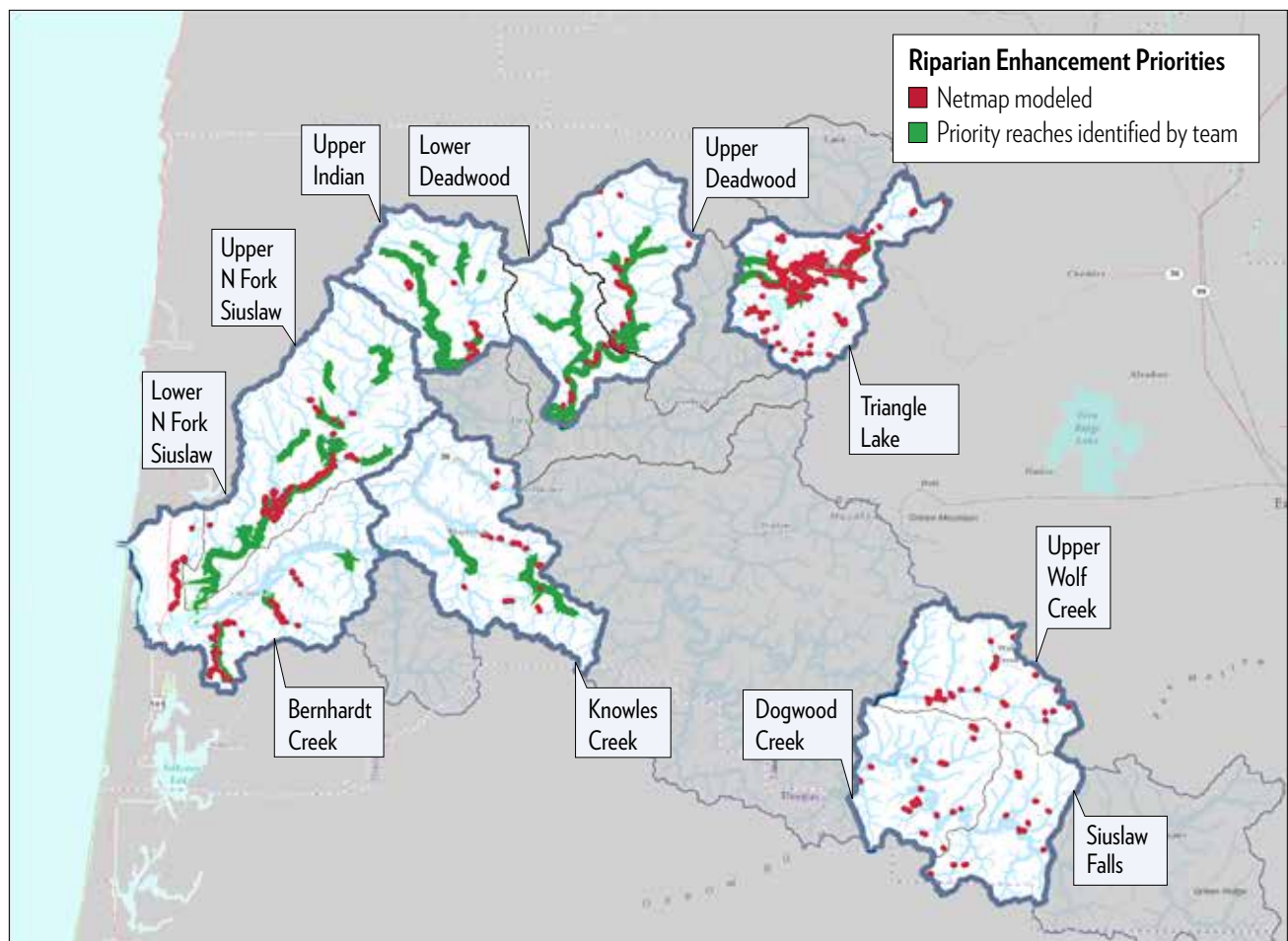
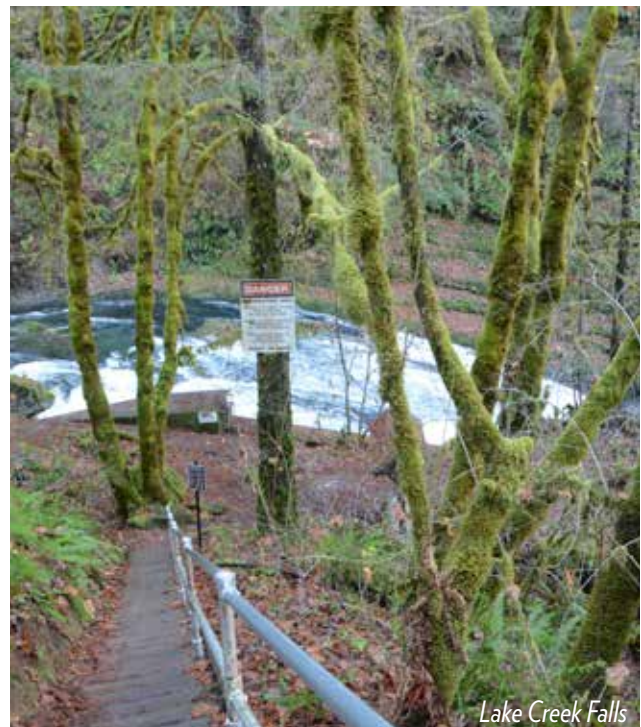


Figure 7-4. Stream reaches in the high-ranked sub-watersheds identified by the core planning team and in the model as high priority for riparian enhancement.

Table 7-3. Riparian Habitats Proposed for Enhancement (miles by sub-watershed).

SUB-WATERSHED	Netmap Modeled Priorities	Team Identified Priority Reaches
Bernhardt Creek-Siuslaw River	8.9	23
Dogwood Creek-Siuslaw River	1.6	0
Knowles Creek-Siuslaw River	2.0	16.6
Lower Deadwood Creek	1.2	11.8
Lower NF Siuslaw River	6.7	2.8
Siuslaw Falls-Siuslaw River	0.9	0
Triangle Lake-Lake Creek	33	14.2
Upper Deadwood Creek	2.3	18.0
Upper Indian Creek	1.8	18.3
Upper NF Siuslaw River	1.9	19.7
Upper Wolf Creek	2.6	0
Total	62.9	117.4



Strategy 3: RECONNECT FLOODPLAINS

Reconnect and protect disconnected floodplains to promote the availability of off-channel rearing habitats.

Lateral connectivity between the channel and its floodplain plays an essential role in generating high quality coho habitat. The periodic inundation of the floodplain and the resulting exchange of water, sediment, organic matter, nutrients, and organisms maintains essential off-channel habitats, which provide refuge for juveniles from high flows in winter and increased water temperatures in summer. Figures 7-4 through 7-7 identify the high-priority areas to restore floodplain connectivity. Lateral reconnection projects may include LWD installation, levee removal, beaver recruitment, and other approaches that promote greater interaction between a channel and its floodplain.

Strategy 4: RECONNECT TIDAL WETLANDS

Reconnect tidal channels to promote the availability of estuarine rearing habitats.

Estuarine habitats are increasingly recognized as vital to the life-history diversity of coho. While residence time varies substantially across life-history types, functioning tidal wetlands provide



biologically productive areas for coho to rear, find refuge, and go through physiological changes before migrating to the ocean. Specific estuarine habitat types include saltmarsh, emergent marsh, open water, subtidal, intertidal, backwater areas, tidal swamps, and deep channels. The habitat includes the ecotone between saltwater and freshwater and the riparian zone. Less than 40 percent of the Siuslaw River's historical tidal wetlands remain due to dike construction, site alterations (filling, road crossings, ditching or grazing), culverts restricting tidal flow, and dredging (Ecotrust 2002; Brophy 2005).

Figure 7-5 maps the locations of the high-priority tidegate projects. The length of upstream habitat reconnected is shown in Table 7-4.

Strategy 5: UPGRADE INFRASTRUCTURE

Upgrade tidegates, culverts, and other working lands infrastructure to increase longitudinal connectivity of instream habitat, while improving water quality.

The network of unpaved forest roads in the Siuslaw watershed diminishes water quality due to the delivery of fine sediments and the loss of riparian zones, which may increase water temperature. Undersized and/or perched culverts below both improved and unpaved roads frequently impede access to upstream habitats for both rearing and migrating coho. Figures 7-4 through 7-7 show the high-priority road and fish passage improvement projects in the watershed.

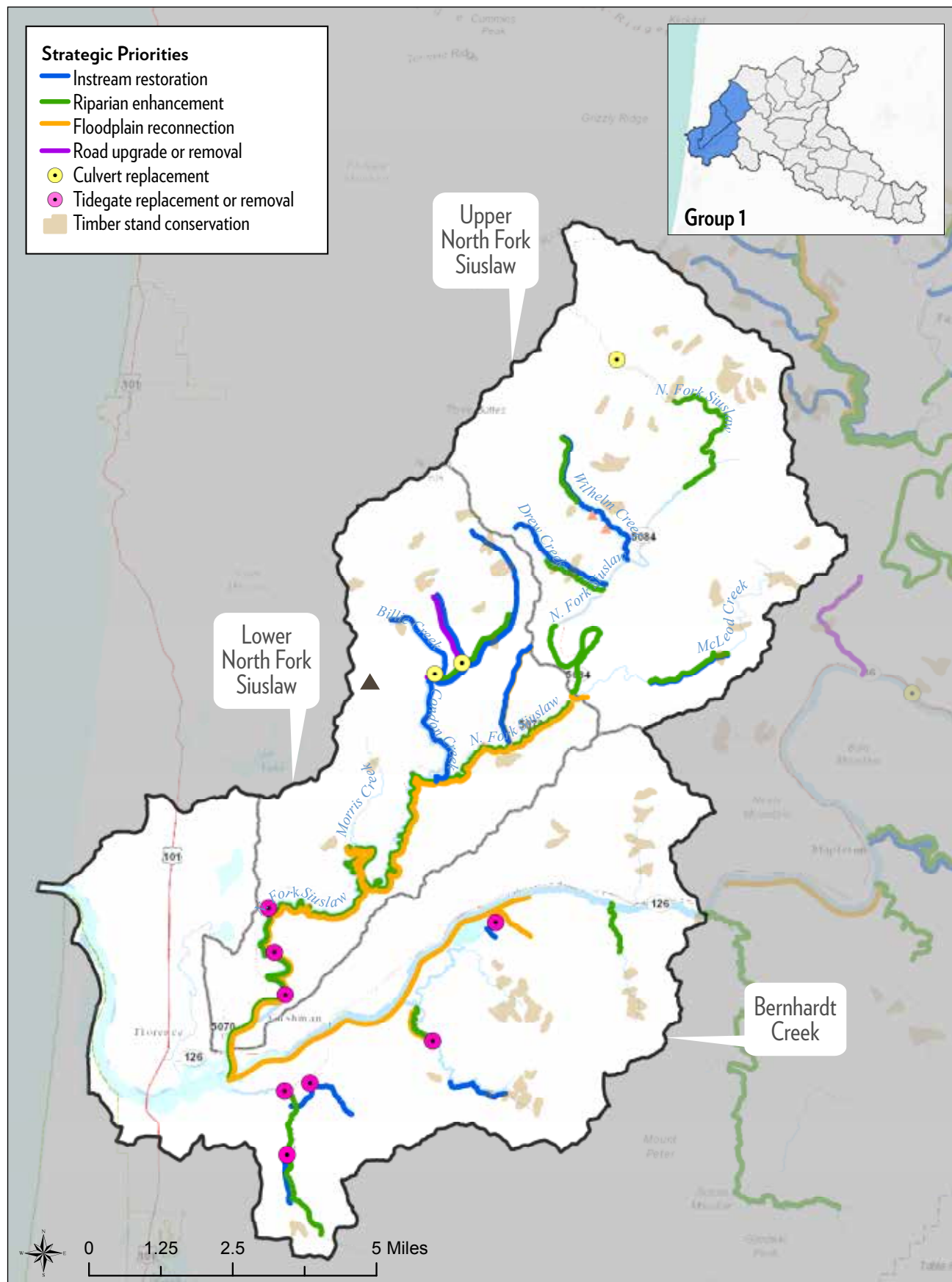
Table 7-4 summarizes the acres of floodplain identified as high priority for reconnection (strategy 3: lateral reconnection), as well as the miles of instream habitat to be reconnected through culvert and tidegate upgrade or replacement (strategies 4 and 5: longitudinal reconnection). Note that this table does not indicate the potential floodplain reconnection benefits of tidegates because these benefits ultimately depend on how a gate is managed. Tidegate benefits are shown only as the length of channel anticipated to be reconnected (column 3). In addition, the miles of channel shown as reconnected from both proposed culvert and tidegate replacements (columns 3 and 4) are conservative estimates, reflecting only the miles of stream that are the same order of that in which the gate or culvert resides.



Table 7-4. Miles of Channel and Acres of Floodplain Reconnected by Sub-Watershed.

SUB-WATERSHED	Strategy 3	Strategies 4 and 5	
	Acres of floodplain reconnected	Miles of channel reconnected above replaced tidegates	Miles of channel reconnected above replaced culverts
Bernhardt Creek-Siuslaw River	200 (tidal)	9.78	
Dogwood Creek-Siuslaw River	0		3
Knowles Creek-Siuslaw River	435		16.7
Lower Deadwood Creek	46		1.8
Lower NF Siuslaw River	252 (225 tidal)	15.47	8.9
Siuslaw Falls-Siuslaw River	0		
Triangle Lake-Lake Creek	0		12.7
Upper Deadwood Creek	97		
Upper Indian Creek	40		
Upper NF Siuslaw River	1.4		3.7
Upper Wolf Creek	0		
Total	1071.4 (425 tidal)	25.3	46.8

Figure 7-5. High-priority locations for habitat restoration by project type in the Upper and Lower North Fork Siuslaw and Bernhardt Creek/Siuslaw mainstem watersheds.



Strategic Priorities

- Instream restoration
- Riparian enhancement
- Floodplain reconnection
- Road upgrade or removal
- Culvert replacement
- Tidegate replacement or removal
- Timber stand conservation

Group 2

Knowles Creek

Mapleton

Swiss

Neely Mountain

Bald Mountain

5084

36

40

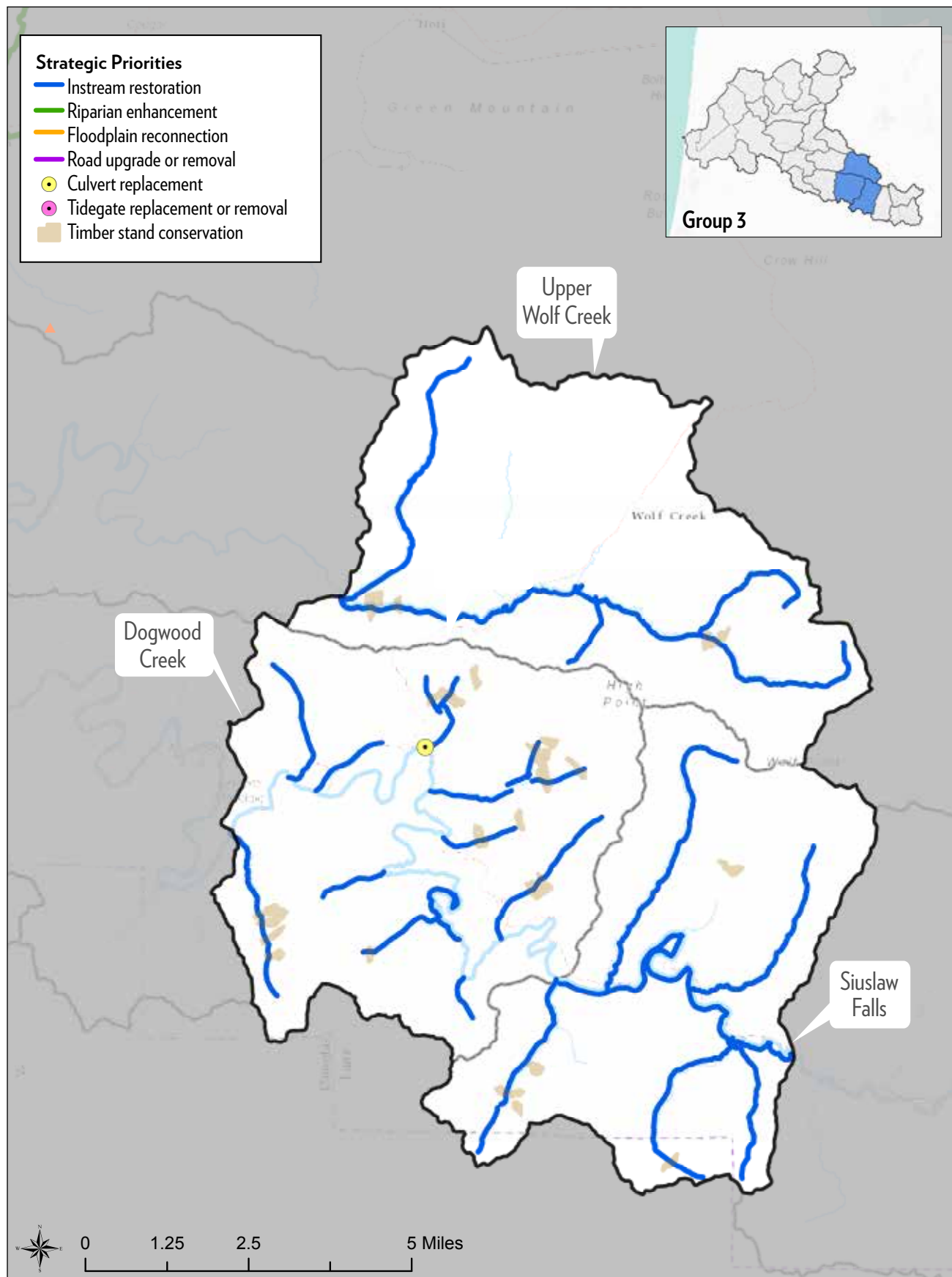
36

126

0 1.25 2.5 5 Miles

North arrow

Figure 7-7. High-priority locations for habitat restoration by project type in the Upper Wolf Creek, Dogwood Creek/ Siuslaw mainstem, and Siuslaw Falls/ Siuslaw mainstem watersheds.



This map displays four distinct watersheds, each outlined in black and labeled with a callout box. The watersheds are color-coded: Upper Indian Creek (purple), Upper Deadwood Creek (orange), Lower Deadwood Creek (green), and Triangle Lake-Lake Creek (blue). The map includes a scale bar (0 to 5 miles) and a north arrow. An inset map in the top left corner shows the location of Group 4 watersheds within a larger regional context. The background is a light gray map showing topographic features and roads.

Strategy 6: ENGAGE LOCAL LANDOWNERS

Engage public and private forest landowners to identify opportunities to protect standing timber within non-fish bearing, debris-flow prone tributary corridors that can deliver large wood into identified anchor habitats.

The most cost-effective habitat conservation strategy to promote coho recovery is to protect existing watershed processes that are able to produce and maintain high quality habitat over the long term. Historically, complex instream habitats were maintained in the Siuslaw River and its tributaries through the delivery of large wood and gravel from both riparian areas and landslides / debris flows originating on steep slopes. Although much of the old growth timber that may have been delivered to the Siuslaw and its tributaries has been removed in these areas, some isolated pockets of large, old timber do remain. Many of these stands can be found on federal lands, which are generally managed as Late Successional Reserves (LSRs) and protected. Other stands may be found in riparian management areas (RMAs) that are protected to varying degrees depending on ownership. Stands outside of LSRs and RMAs are largely managed for timber production, however, jeopardizing the potential of some older age stands present in the uplands to generate long-term coho habitat.

Through the analysis described in Chapter 6, the SCP identified the locations of mature and old growth stands in the uplands that are most likely to deliver large wood and gravel to the Siuslaw stream network over the long term. Figure 7-9 maps the locations where mass wasting events like shallow landslides and debris torrents are most likely to deliver large wood either *directly into identified anchor habitat locations* (tier 1 sites) or into non-anchor areas (tier 2). Table 7-5 summarizes the acreage identified as tier 1 and tier 2 stands.

The purpose of this analysis is to begin a dialogue with forest resource managers on both public and private lands regarding ways to protect these sites, which provide a unique opportunity to cost effectively maintain watershed function and generate high value coho habitats over the long term. The SCP recognizes that a percentage of these areas may already be protected through



Lower North Fork Siuslaw.

regulations established under the state Forest Practices Act and other forest management policies. Likewise, a percentage of these stands may already be managed for species protection under a long-term harvest rotation. The SCP does not call for additional restrictions to be placed on the lands identified in this analysis, but intends to use the analysis as a starting point for a discussion with public and private resource managers about whether and how the lands identified here can be conserved through voluntary, landowner-supported approaches.

Figure 7-9 also contains other high-priority parcels identified by the core planning team as priorities for long-term protection through acquisition or other means. Table A6 in Appendix 9 lists these projects in order of priority.

Large woody debris in the Upper North Fork Siuslaw.



Figure 7-9. Timber stands with the highest potential to deliver large wood into identified anchor habitat locations (Tier 1 sites) and non-anchor habitat locations (Tier 2 sites).

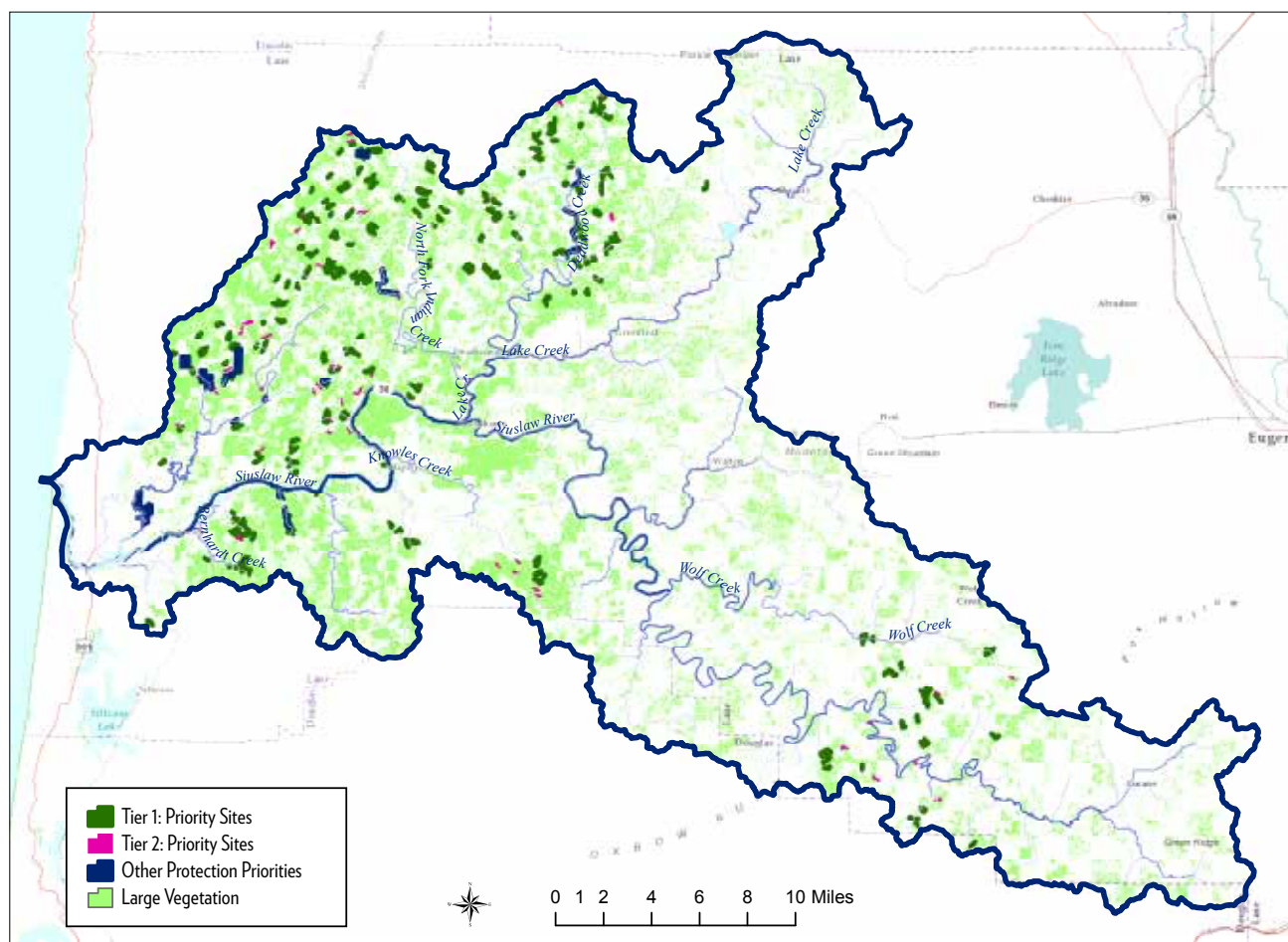


Table 7-5. Acres of Tier 1 and Tier 2 Timber Stands by Sub-Watershed.

SUB-WATERSHED	Tier 1 Sites		Tier 2 Sites	
	Number of Sites	Acres	Number of Sites	Acres
Bernhardt Creek-Siuslaw River	37	192	9	78
Dogwood Creek-Siuslaw River	21	116	5	51
Knowles Creek-Siuslaw River	27	165	24	219
Lower Deadwood Creek	22	178	4	63
Lower North Fork Siuslaw River	19	117	7	66
Siuslaw Falls-Siuslaw River	5	26	1	11
Triangle Lake - Lake Creek	1	2	0	0
Upper Deadwood Creek	44	234	14	128
Upper Indian Creek	57	392	15	158
Upper North Fork Siuslaw River	31	202	11	136
Upper Wolf Creek	6	27	1	9
Total	270	1,651	91	919

The SCP Implementation Plan: Goals and Actions (2019-2025)

During the course of developing the Strategic Framework described in Chapter 7, the SCP identified over 100 project priorities, which the core planning team ranked using the criteria described in Chapter 6. These projects are listed in the tables contained in Appendix 9. The following chapter presents the highest-priority projects from these lists that the SCP believes are ready to proceed. A project's inclusion in this chapter indicates that the core planning team is confident that a project has both landowner and community support, coupled with a high likelihood that it can be permitted and funded.

Projects are presented in this chapter according to six-year goals established for several priority sub-watersheds. The sub-watersheds selected are a subset of the high-ranked sub-watersheds presented in Chapter 7, and represent those areas that are both a high restoration priority and have multiple projects that are ready to proceed. In short, these areas represent the convergence of need, opportunity, and high expected benefits relative to the costs. These priority sub-watersheds are shown in Figure 8-1.

The SCP selected a six-year timeline specifically to align with OWEB's Focused Investment Partnership (FIP) grant program, which the SCP will seek to accelerate SAP implementation. Securing OWEB FIP funding will be critical for successful execution of the SAP, by providing a stable source of funding to initiate the effort, as well as the means to leverage substantial matching funds. The goals presented for each priority sub-watershed reflect the extent of project implementation that the SCP believes it can accomplish through an OWEB FIP grant, supplemented with additional funds leveraged through this SAP from NOAA, NFWF, and other public and private sources.

Achievement of the short-term goals presented in this plan will begin to alleviate many of the major habitat stresses that have been identified as limiting coho production in the priority



LONG-TERM OUTCOMES

- | | |
|---|---|
| 1 | An increase in the quality and quantity of summer and winter rearing habitats in selected sub-watersheds sufficient to anchor population viability. |
| 2 | A connected assemblage of diverse habitats sufficient to foster a broad expression of life-history strategies in the Siuslaw coho population. |
| 3 | A healthy watershed restoration economy that is viewed as an important source of income in the Siuslaw watershed. |

sub-watersheds (See Table 6-1.) As these goals are achieved and partners turn their attention to other priority sub-watersheds over time, the SCP is confident that it can attain the long-term outcomes described in this plan's introduction.

Table 8-1 provides a summary of the area proposed for – or affected by – restoration projects in the priority sub-watersheds that the SCP selected as focus areas for restoration between 2019 and 2025. The numbers in the table represent the total of all of the objectives contained in this chapter. (Note the number in the goal statements represents the total length of channel, tributaries and mainstem that will be treated through one of the restoration strategies described in Chapter 7.) The goals do not equal the total of the objectives because some reaches receive multiple types of restoration.

Figure 8-1. Priority sub-watersheds for restoration projects in the Siuslaw Basin (2019-2025).

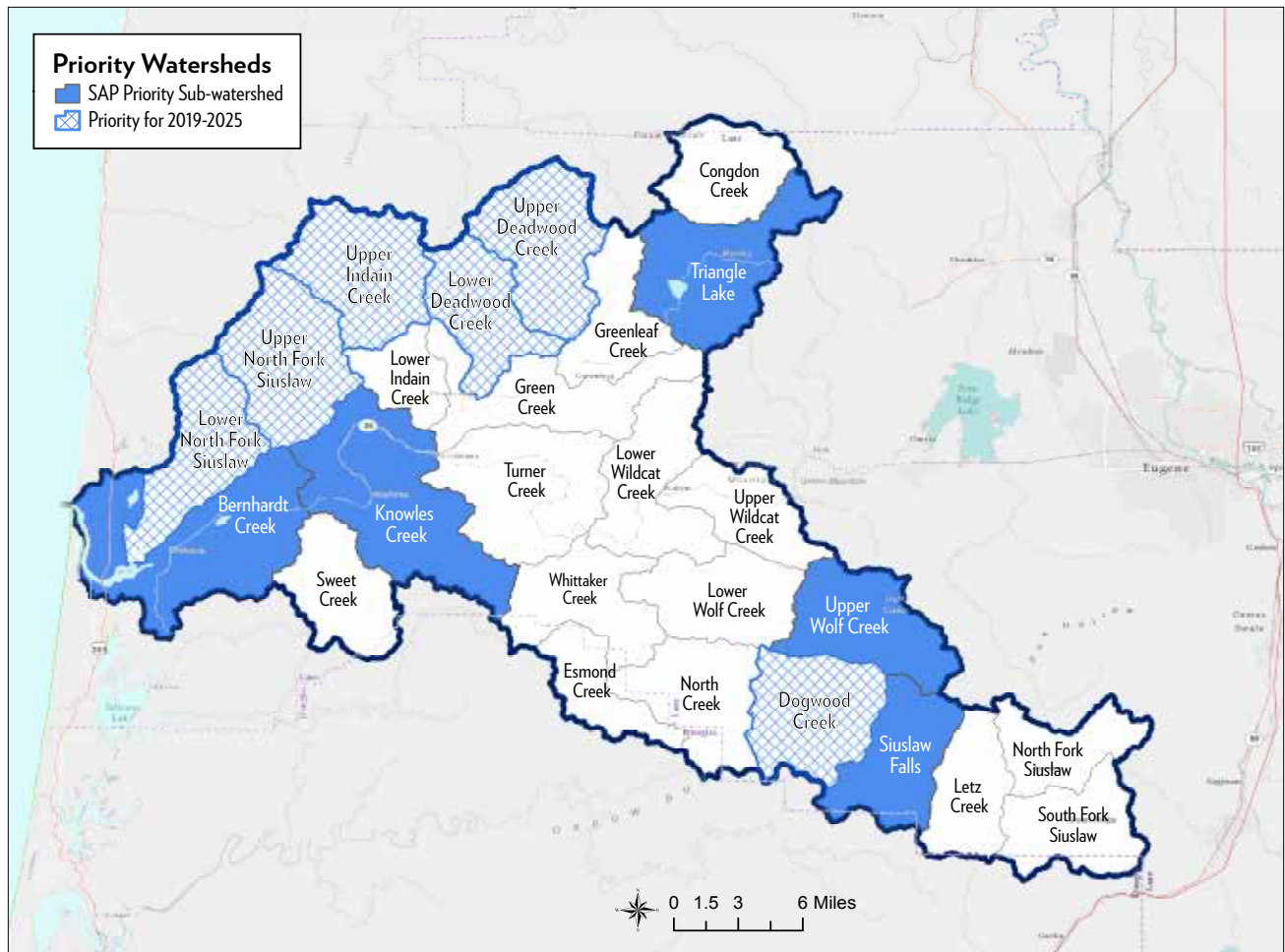


Table 8-1. Cumulative Objectives by Strategy and Priority Sub-Watershed (2019-2025).

SUB-WATERSHED	Restoration Strategy and Objectives				
	LWD Installation (miles)	Riparian Enhancement (miles)	Floodplain Reconnection (acres)	Instream/slough Reconnection (miles)	Road Upgrade (miles)
Deadwood Creek (Upper and Lower)	31	27	107	2	10
Dogwood Creek / Siuslaw River	15	0	0	0	0
North Fork Siuslaw (Upper and Lower, Lower Bernhardt)	13	5	317	25	2
Upper Indian Creek	16	15	82	3	4
Total	75	47	506	30	16

DEADWOOD CREEK

Goal 1. Restore instream, riparian, and floodplain habitats along 63 miles of tributaries.

Objective 1.1. Add LWD to 31 miles of anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats in Upper Deadwood drainage.

Projects

- 1.1 – A Add LWD to 2 miles to West Headwaters Creek
- 1.1 – B Add LWD to 7 miles of the Upper Deadwood mainstem above Rock Creek (focus above Panther Creek)
- 1.1 – C Add LWD to 2 miles of Buck Creek, near confluence with Upper Deadwood
- 1.1 – D Add LWD to 2 miles of Elk Creek, near confluence with Upper Deadwood
- 1.1 – E Add LWD to 2 miles of Fawn Creek, near confluence with Upper Deadwood
- 1.1 – F Add LWD to 6 miles of Panther Creek, near confluence with Upper Deadwood (includes 1.5 miles in lower North Fork Panther)
- 1.1 – G Add LWD to 1 mile of Lower Deadwood Creek
- 1.1 – H Add LWD to 1 miles of Misery Creek
- 1.1 – I Add LWD to lower 6 miles of West Fork Deadwood Creek
- 1.1 – J Add LWD to 2 miles of Raleigh Creek

Objective 1.2. Enhance 27 miles of riparian vegetation to reduce stream temperatures and promote future LWD recruitment into anchor habitats.

- 1.2 – A Enhance 1 mile of riparian habitats along Elk Creek, from the confluence with Upper Deadwood upstream
- 1.2 – B Enhance 1 mile of riparian habitat at the mouth of Panther Creek
- 1.2 – C Enhance 8 miles of riparian habitats on legacy farms on the mainstem of Deadwood Creek

- 1.2 – D Enhance 2 miles of riparian habitat on Bear Creek
- 1.2 – E Enhance 2 miles of riparian habitats on Misery Creek (tribal property downstream through private lands)
- 1.2 – F Enhance 10 miles of riparian habitats in lower Deadwood Creek
- 1.2 – G Enhance riparian habitat in lower 3 miles of West Fork Deadwood Creek

Objective 1.3. Reconnect 107 acres of disconnected floodplains to promote the availability of off-channel rearing habitats.

- 1.3 – A Reconnect 107 acres of floodplains on Upper Deadwood Creek for approximately 1 mile upstream Rock Creek

• **Objective 1.4.** Reconnect 2 miles of instream spawning and rearing habitat.

- 1.4 – A Remove one fish passage barrier culvert on a tributary to Misery Creek

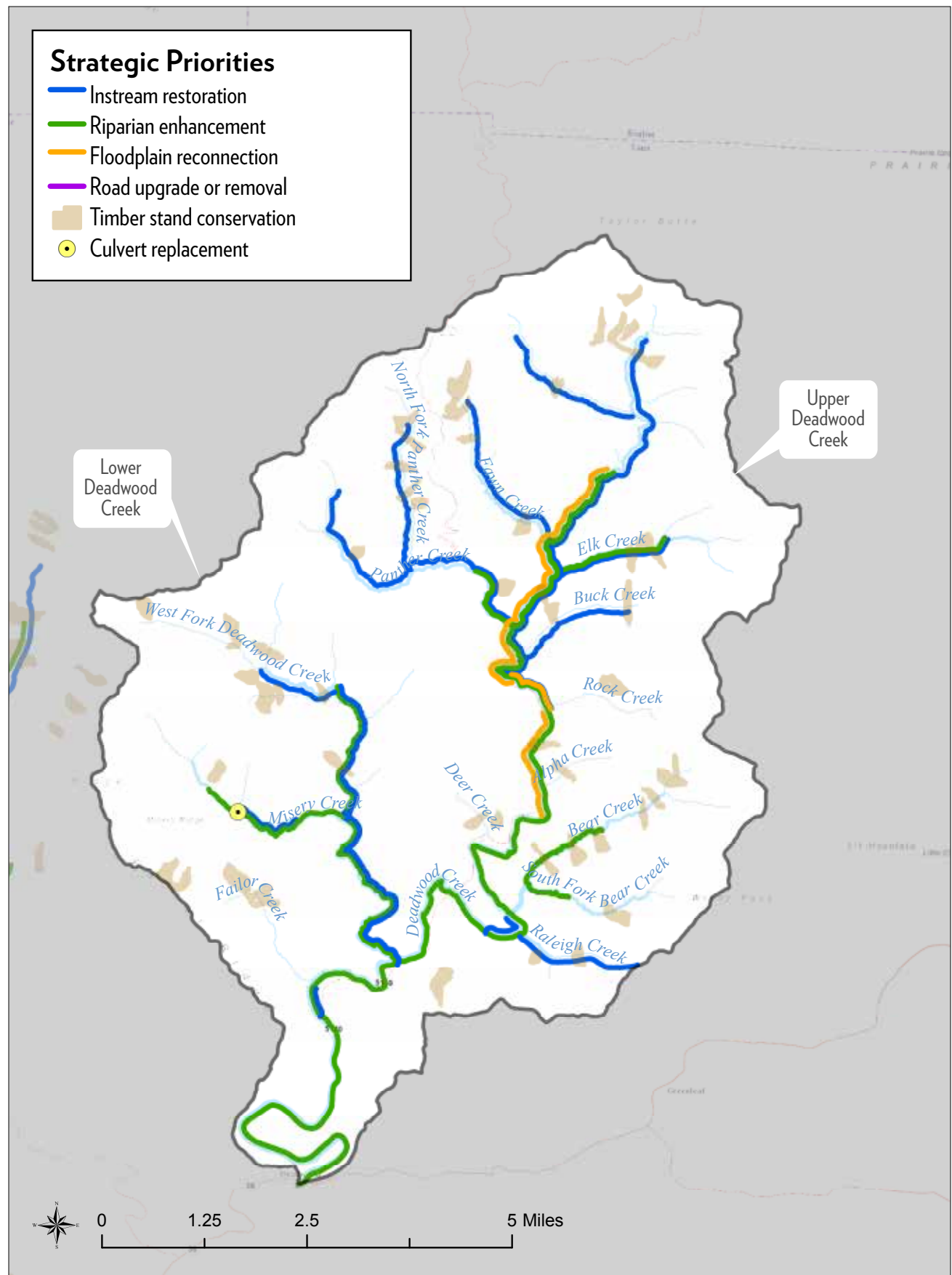
Objective 1.5. Upgrade 10 miles of forest roads

- 1.5 – A Stormproof 10 miles of forest road on Deadwood Creek

Culvert to be replaced on Deadwood Creek.



Figure 8-2. Location of restoration projects in the Deadwood Creek sub-watershed.



DOGWOOD CREEK

Goal 2. Restore 15 miles of instream habitat.

Objective 2.1. Add LWD to 15 miles of anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats.

Projects

- 2.1 – A Add LWD to 3.5 miles of Dogwood Creek and tributary
- 2.1 – B Add LWD throughout 3.1 miles of Haight Creek (two phases)
- 2.1 – C Add LWD to 3.0 miles of Camp Creek
- 2.1 – D Add LWD to 1.5 miles of Conger Creek (two phases)
- 2.1 – E Add LWD to 1.2 miles of Holland Creek (two phases)
- 2.1 – F Add LWD to 1.5 miles of Doe Hollow Creek
- 2.1 – G Add LWD to 0.7 mile of Jeans Creek
- 2.1 – H Add LWD to 0.5 miles of Frying Pan Creek

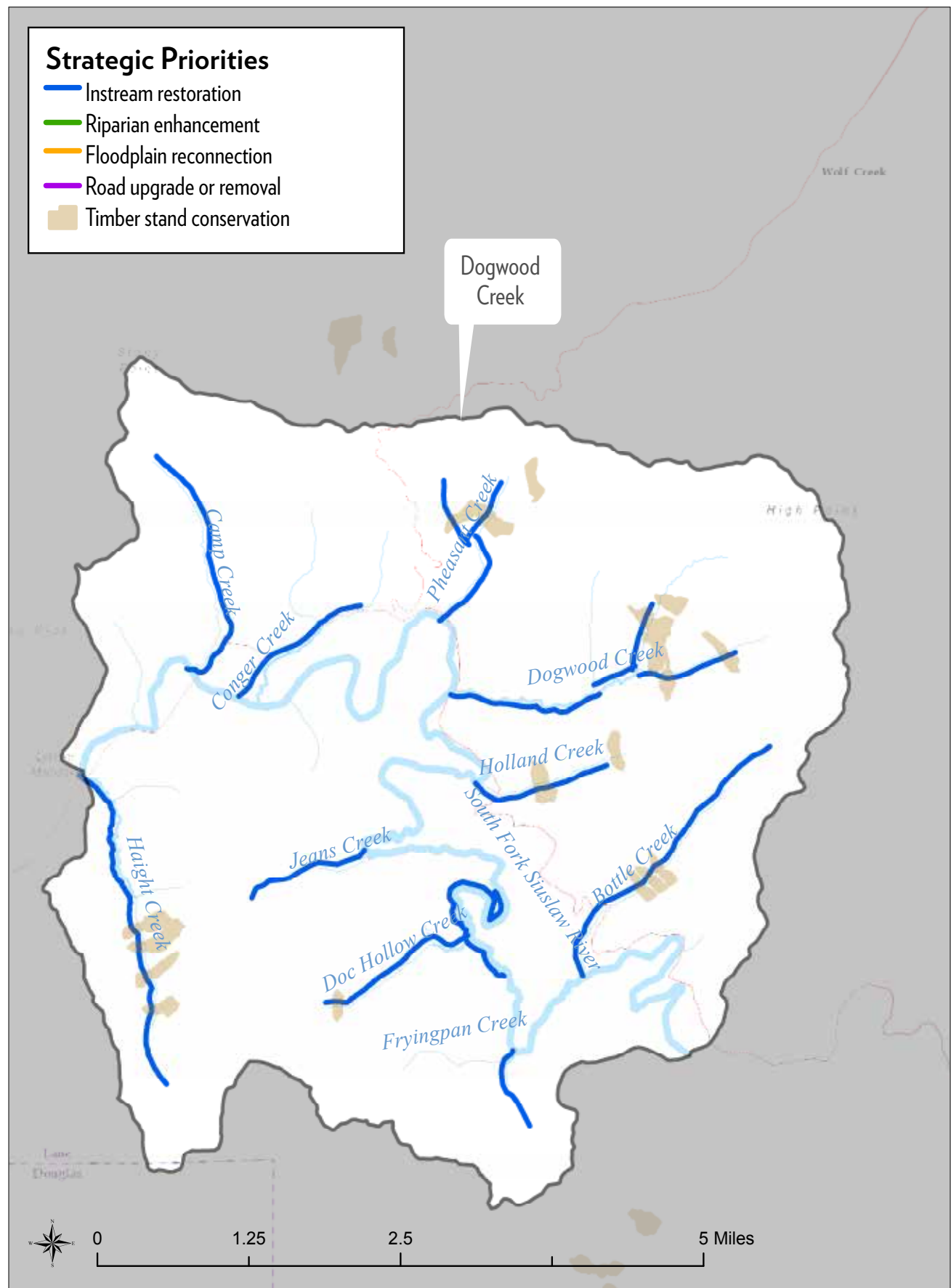


Deadwood Creek

Bear Creek Coastal Lakes drainage. Photo: Seth Mead.



Figure 8-3. Location of restoration projects in the Dogwood Creek sub-watershed.



NF SIUSLAW/LOWER BERNHARDT

Goal 3: Restore instream, riparian, and floodplain habitats along 23 miles of mainstem and tributary channels.

Objective 3.1. Add LWD to 13 miles of anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats.

Projects

- 3.1 – A Add LWD to 2 miles of Billie Creek (additional 2 miles pending acquisition)
- 3.1 – B Add LWD to 2 miles of Condon Creek
- 3.1 – C Add LWD to the lower 2 miles of Russell Creek
- 3.1 – D Add LWD to 1 mile of lower Uncle Creek
- 3.1 – E Add LWD to 2 miles of McLeod Creek (pending acquisition)
- 3.1 – F Add LWD to 1 mile of lower Drew Creek downstream of Right Fork Drew Creek
- 3.1 – G Add LWD to 3 miles of Wilhelm Creek

Objective 3.2. Enhance 5 miles of riparian vegetation to reduce stream temperatures and promote future LWD recruitment into anchor habitats.

- 3.2 – A Enhance riparian zones on 2 miles of Condon Creek
- 3.2 – B Enhance 2 miles of riparian habitats on Lower North Fork Siuslaw (pending acquisition)
- 3.2 – C Enhance 1 mile of riparian habitat on Wilhelm Creek

Objective 3.3. Reconnect 317 acres of disconnected floodplains along 5 miles to promote the availability of off-channel rearing habitats.

- 3.3 – A Reconnect 7 acres off-channel rearing areas along two miles of lower Russell Creek/North Fork Siuslaw confluence
- 3.3 – B Reconnect 10 acres of floodplain along .5 miles at the confluence of Lower North Fork and McLeod Creek

- 3.3 – C Reconnect 100 acres of floodplain and off-channel rearing areas along 1 mile of Lower North Fork Siuslaw (pending acquisition)
- 3.3 – D Reconnect 200 acres of former tidal wetland to tidal influence, restoring a suite of estuarine habitats along 1.3 miles of the Siuslaw River in the Lower Bernhardt sub-watershed

Objective 3.4. Reconnect 25 miles of instream and slough habitats.

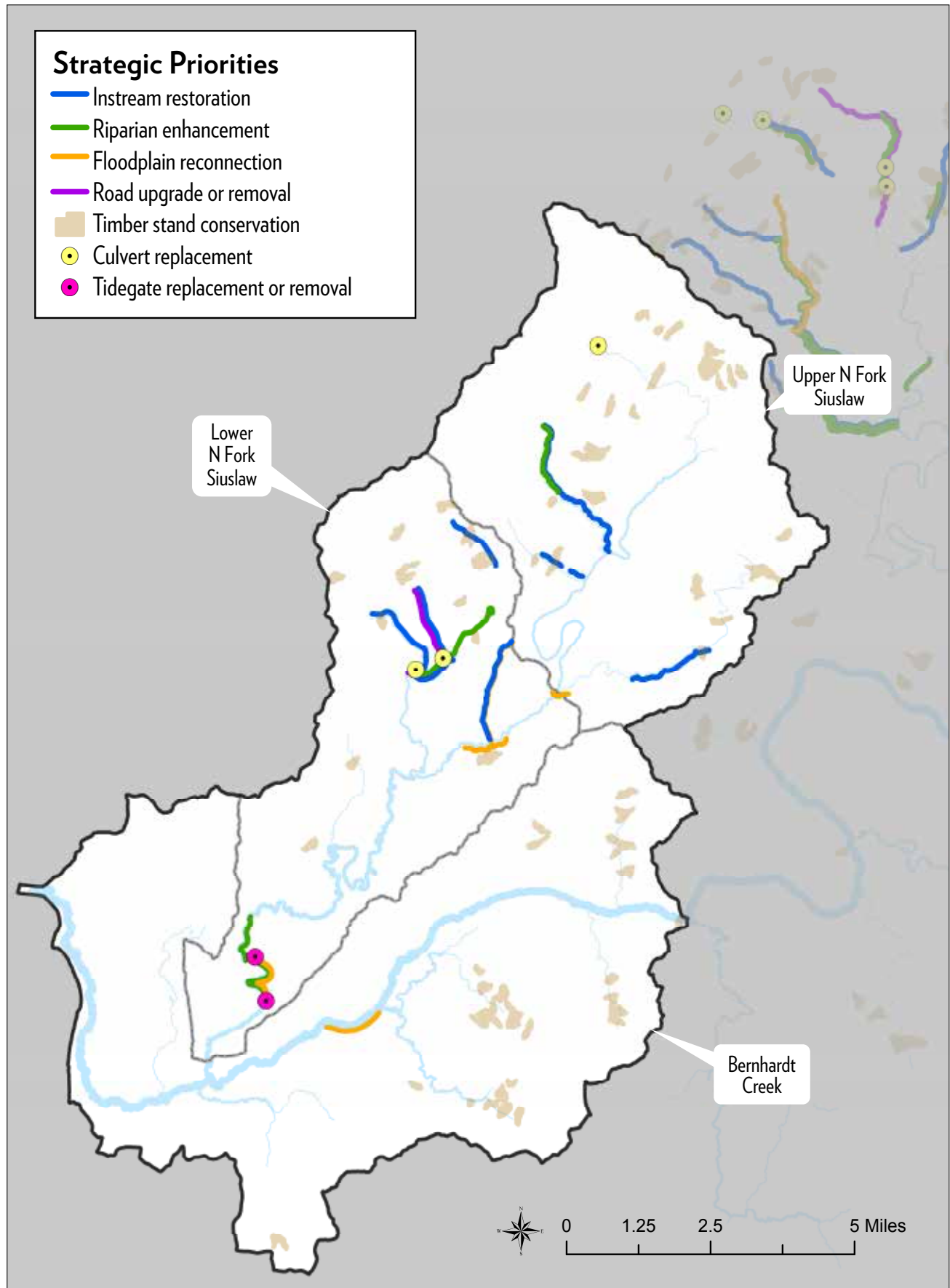
- 3.4 – A Replace the Uncle Creek culvert (3.3 miles)
- 3.4 – B Remove tidegate on North Fork bend – South (pending acquisition, 12 miles)
- 3.4 – C Remove tidegate on North Fork bend – North (pending acquisition, 1.7 miles)
- 3.4 – D Remove passage barrier near confluence with Billie Creek (5 miles)
- 3.4 – E Replace culvert below Sam's Creek on Upper North Fork (3 miles)

Objective 3.5. Upgrade 2 miles of forest roads.

- 3.5 – A Stormproof 2 miles of forest roads along Uncle Creek



Figure 8-4. Location of restoration projects in the Upper and Lower North Fork Siuslaw River and lower Bernhardt sub-watersheds.



UPPER INDIAN CREEK

Goal 4. Restore instream, riparian, and floodplain habitats along 35 miles of tributaries.

Objective 4.1. Add LWD to 16 miles of anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats.

Projects

- 4.1 – A Add LWD to 2 miles of Long Creek
- 4.1 – B Add LWD to 2 miles of Herman Creek
- 4.1 – C Add LWD to 2 miles of Maria Creek
- 4.1 – D Add LWD to 3 miles of Rogers Creek
- 4.1 – E Add LWD to 1 mile of Upper Indian Creek
- 4.1 – F Add LWD to 6 miles West Fork Indian Creek

Objective 4.2. Enhance 15 miles of riparian vegetation to reduce stream temperatures and promote future LWD recruitment into anchor habitats.

- 4.2 – A Enhance riparian habitats on 10 miles of West Fork Indian Creek
- 4.2 – B Enhance riparian habitats on 2 miles of

North Fork Indian Creek

- 4.2 – C Enhance riparian habitats on 1 mile of Upper Indian Creek
- 4.2 – D Enhance riparian habitats on 1 mile mainstem Indian (near Gibson Creek)
- 4.2 – E Enhance riparian habitats on 1 mile Herman Creek

Objective 4.3. Reconnect 82 acres of disconnected floodplains along 1.5 miles of the West Fork Indian Creek to promote the availability of off-channel rearing habitats.

- 4.3 – A Reconnect 82 acres of floodplain along 1.5 miles of West Fork Indian Creek

● **Objective 4.4.** Reconnect 3 miles of instream habitats.

- 4.4 – A Replace two culverts on unnamed tributaries near confluence with North Fork Indian Creek (1.5 miles)
- 4.4 – B Replace two culverts on unnamed tributaries near confluence with Upper Indian Mainstem (1.5 miles)

Objective 4.5. Upgrade 4 miles of forest roads

- 4.5 – A Stormproof 4 miles of road on North Fork Indian Creek (Mann Creek)



Figure 8-5. Location of restoration projects in the Upper Indian Creek sub-watershed.

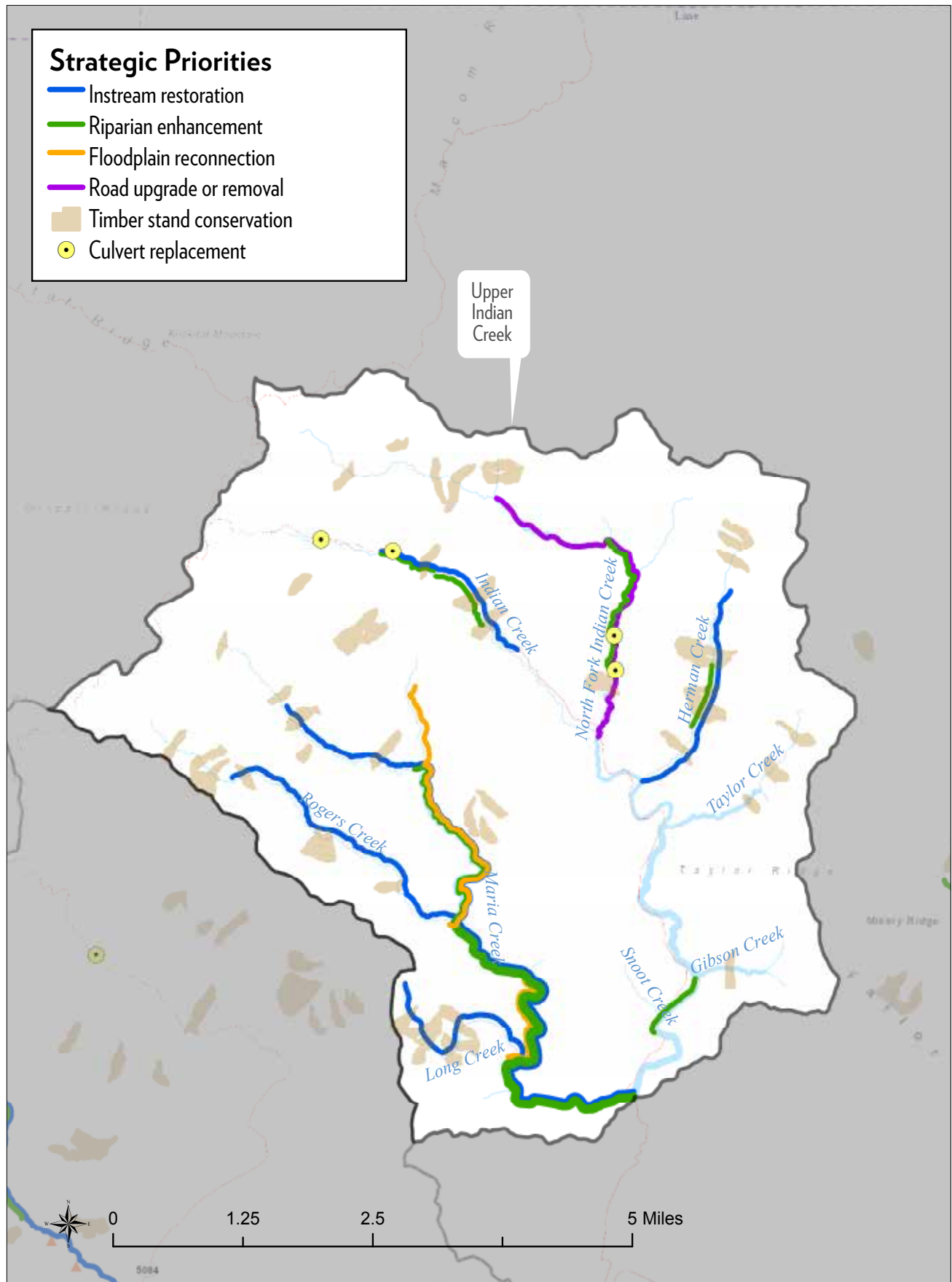


Table 8-2. Habitat Restoration Project Implementation Schedule by Sub-watershed and Biennium.

SUB-WATERSHED	Project	2018-2021*	2022-2023	2024-2025
North Fork Siuslaw River	Uncle Creek culvert	X		
	Drew Creek LWD	X		
	Wilhelm Creek LWD	X		
	Lower North Fork/McLeod floodplain	X		
	Billie Creek LWD	X		
	Condon Creek LWD	X		
	Wilhelm Creek riparian	X		
	Russell Creek LWD	X		
	Uncle Creek LWD	X		
	Uncle Creek road upgrade/removal	X		
	Condon Creek riparian	X		
	Condon Creek bridge		X	
	Sam's Creek culvert		X	
	Russell Creek floodplain			X
	McLeod Creek LWD			X
	Tidegate on North Fork bend - South			X
	Tidegate on North Fork bend - North			X
	Lower NF floodplain reconnect/riparian			X
Upper Indian River	Long Creek LWD	X		
	Herman Creek LWD	X		
	Maria Creek LWD	X		
	Rogers Creek LWD	X		
	Upper Indian Creek LWD	X		
	West Fork Indian Creek LWD	X		
	West Fork Indian riparian	X		
	Upper Indian riparian	X		
	Unnamed Tributaries of NF Indian culvert	X		
	North Fork Indian riparian		X	
	Mainstem Indian riparian		X	
	Herman Creek riparian		X	
	Unnamed Tributaries of Upper Indian culvert		X	
	North Fork Indian Creek road upgrade		X	
	West Fork Indian Creek floodplain			X
	North Fork Indian Creek Road (Mann Creek)			X

* The first column represents two bienniums to capture projects that will be implemented in 2018 and 2019 using funding received outside of the Focused Investment Partnership grant.

SUB-WATERSHED	Project	2018-2021	2022-2023	2024-2025
Dogwood Creek	Dogwood Creek LWD	X		
	Haight Creek LWD	X		
	Camp Creek LWD		X	
	Conger Creek LWD		X	
	Holland Creek LWD		X	
	Doe Hollow LWD		X	
	Haight Creek LWD (helicopter)			X
	Conger Creek LWD (helicopter)			X
	Holland Creek LWD (helicopter)			X
	Jeans Creek LWD (helicopter)			X
	Frying Pan Creek LWD (helicopter)			X
Deadwood Creek	West Headwaters Creek LWD		X	
	Upper Deadwood LWD		X	
	Buck Creek LWD		X	
	Elk Creek LWD		X	
	Fawn Creek LWD		X	
	Panther Creek LWD (incl. North Fork)		X	
	Elk Creek riparian		X	
	Panther Creek riparian		X	
	Mainstem legacy farm riparian		X	X
	Upper Deadwood floodplain reconnect		X	X
	Misery Creek LWD, culvert, and riparian		X	X
	Bear Creek riparian (upper Deadwood)			X
	Lower Deadwood LWD			X
	West Fork Deadwood LWD			X
	Raleigh Creek LWD			X
	West Fork Deadwood riparian			X
	Deadwood Creek forest road			X

Goal 5. By 2025, engage all public and private landowners with lands in the high-ranked sub-watersheds containing habitats identified as high priority for protection or restoration.

Goal 6. Create and support 20 local jobs and generate \$10m in economic output to the local restoration economy by hiring local contractors and promoting local businesses.

Objective 5.1. By 2020, meet with all landowners in the 2019-2025 priority sub-watersheds (North Fork Siuslaw, Upper Indian Creek, Dogwood Creek, and Deadwood Creek) with lands containing tier 1 and tier 2 timber stands.

Projects

- 5.1 – A Engage all public and industrial landowners (see SWC list)
- 5.1 – B Engage all non-industrial private landowners (see SWC list)

Objective 5.2. By 2022, meet with all landowners in the remaining priority sub-watersheds (Bernhardt Creek, Knowles Creek, Siuslaw Falls, and Upper Wolf Creek) that own lands on priority reaches (as described in Chapter 7).

- 5.2 – A Engage all public and industrial landowners (see SWC list)
- 5.2 – B Engage all non-industrial private landowners (see SWC list)

Objective 6.1. By 2024, support 20 local jobs and generate \$10,000,000 in economic output to the local restoration economy through restoration investments made in the North Fork Siuslaw, Upper Indian Creek, Dogwood Creek, and Deadwood Creek sub-watersheds.

Projects

- 6.1 – A Use the EWP calculator to make annual estimates of the economic impact of restoration investments
- 6.1 – B Develop and maintain a list of local restoration project contractors and distribute to partners
- 6.1 – C Distribute packets to out-of-basin contractors encouraging them to patronize local businesses and services (e.g hotels, nightly rentals, RV parks/campgrounds, restaurants, mechanics, hardware stores grocery stores etc.

Benders Landing, North Fork Siuslaw.



Funding Needs: Estimated Costs

This chapter estimates the costs associated with executing the SCP implementation plan proposed in Chapter 8. Tables 9-1 through 9-4 provide the estimated costs to implement all of the projects contained in Chapter 8 according to the SCP's six-year goals established for the priority sub-watersheds. Table 9-5 summarizes the overall estimated costs according to restoration project type in each of these priority sub-watersheds.

These estimated costs shown in Tables 9-1 through 9-4 are summarized by sub-watershed goal and associated objective, and project type. The tables also identify the lead implementers and describe the stream reaches and proposed action associated with each project. These costs were generated through a review of the OWEB Oregon Watershed Restoration Inventory (OWRI) database, as well as the costs associated with implementing similar projects in the Siuslaw River area by the Siuslaw SWCD, USFS, BLM, and the SWC. The OWRI database was queried to focus on projects that were implemented within the OC Coho ESU from 2010 to 2014. Several

data points for maximum costs were left out of the OWRI results because they were not relevant to the Siuslaw River watershed.

Where projects were far enough along in the planning process to have verified cost estimates, these cost estimates were used in the cost summary (see Table 9-5). Where project-specific costs estimates were not available, estimates were made based on project type. For floodplain reconnection and off-channel restoration projects, estimates from other projects with a similar level of complexity were scaled to the size of the proposed project. For instream complexity projects, estimates were generated by multiplying mileage calculated from GIS by an average cost per mile. For riparian enhancement projects, estimates were made by multiplying acreage by a mid-range cost per acre estimate. The riparian enhancement acreages were estimated by multiplying stream miles (calculated using GIS) proposed for treatment times 50 feet, which approximates the average buffer width treated watershed-wide over the last several years. Riparian enhancement and instream complexity estimates were increased by approximately three percent each biennium to adjust for inflation.



Table 9-1. Project Implementation Costs in the Deadwood Creek Sub-watershed (Goal 1).

Project	Lead	Project Type	Stream or Reach	Project	Cost
<i>Objective 1.1. Add LWD to 31 miles of anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats in Upper Deadwood drainage.</i>					
1.1-A	USFS/SWC	Instream Complexity	Trib to Upper Deadwood Creek (West Headwaters)	Add LWD to 2 miles to West Headwaters Creek	\$96,600
1.1-B	USFS/SWC	Instream Complexity	Upper Deadwood Creek mainstem	Add LWD to 7 miles of the Upper Deadwood mainstem above Rock Creek (focus above Panther Creek)	\$308,200
1.1-C	USFS/SWC	Instream Complexity	Buck Creek	Add LWD to 2 miles of Buck Creek, near confluence with U. Deadwood	\$57,800
1.1-D	USFS/SWC	Instream Complexity	Elk Creek	Add LWD to 2 miles of Elk Creek, near confluence with U. Deadwood	\$142,920
1.1-E	USFS/SWC	Instream Complexity	Fawn Creek	Add LWD to lower 2 miles of Fawn Creek, near confluence with U. Deadwood	\$74,800
1.1-F	USFS/SWC	Instream Complexity	Panther Creek	Add LWD to lower 3.5 miles of Panther Creek, near confluence with U. Deadwood	\$333,480
1.1-F	USFS/SWC	Instream Complexity	North Fork Panther Creek	Add LWD to lower 1.5 miles of North Fork Panther Creek	\$81,600
1.1-G	USFS/SWC	Instream Complexity	Lower Deadwood Creek mainstem (3rd order)	Add LWD to 1 mile of Lower Deadwood Creek	\$52,250
1.1-H	USFS/SWC	Instream Complexity	Misery Creek (West Fork Deadwood Creek)	Add LWD in no-name trib to Misery Creek (tribal property downstream through private lands)	\$47,500
1.1-I	USFS/SWC	Instream Complexity	West Fork Deadwood Creek	Add LWD to lower 6 miles of West Fork Deadwood Creek (and channel reconstruction)	\$203,000
1.1-J	USFS/SWC	Instream Complexity	Raleigh Creek	Add LWD to 2 miles of Raleigh Creek	\$52,500
<i>Objective 1.2. Enhance 27 miles of riparian vegetation to reduce stream temperatures and promote future LWD recruitment into anchor habitats.</i>					
1.2-A	SWCD	Riparian enhancement	Elk Creek	Enhance 1 mile of riparian habitats along Elk Creek, from the confluence with Upper Deadwood upstream	\$168,182
1.2-B	SWCD	Riparian enhancement	Panther Creek	Enhance 1 mile of riparian habitat at the mouth of Panther Creek	\$112,121
1.2-C	USFS/SWC	Riparian enhancement	Upper Deadwood Creek mainstem	Enhance 8 miles of riparian habitats on legacy farms on the mainstem of Deadwood Creek	\$941,818
1.2-D	USFS/SWC	Riparian enhancement	Bear Creek	Enhance 2 miles of riparian habitat on Bear Creek	\$253,333
1.2-E	USFS/SWC	Riparian enhancement	Misery Creek (West Fork Deadwood Creek)	Enhance 2 miles of riparian habitats on Misery Creek (tribal property downstream through private lands)	\$230,303
1.2-F	USFS/SWC	Riparian enhancement	Lower Deadwood Creek mainstem (3rd)	Enhance 10 miles of riparian habitats in lower Deadwood Creek	\$1,128,485
1.2-G	USFS/SWC	Riparian enhancement	West Fork Deadwood Creek	Enhance riparian habitat in lower 3 miles of West Fork Deadwood Creek	\$333,939

Project	Lead	Project Type	Stream or Reach	Project	Cost
<i>Objective 1.3. Reconnect 107 acres of disconnected floodplains to promote the availability of off-channel rearing habitats.</i>					
1.3-A	SWCD	Floodplain reconnection / off-channel restoration	Upper Deadwood Creek mainstem	Reconnect floodplains on Upper Deadwood Creek for approximately 1 mile upstream Rock Creek	\$800,000
<i>Objective 1.4. Reconnect 2 miles of instream spawning and rearing habitat.</i>					
1.4-A	USFS/SWC	Fish passage	No name trib to Misery Creek (West Fork Deadwood Creek)	Remove one fish passage barrier culvert on a tributary to Misery Creek (private property upstream of tribal property)	\$120,000
<i>Objective 1.5. Upgrade 10 miles of forest roads</i>					
1.5-A	USFS	Road upgrade / removal	Deadwood Creek watershed	Stormproof 10 miles of forest road on Deadwood Creek	\$1,056,000

Table 9-2. Project Implementation Costs in the Dogwood Creek Sub-watershed (Goal 2).

Project	Lead	Project Type	Stream or Reach	Project	Cost
<i>Objective 2.1. Add LWD to 15 miles of anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats.</i>					
2.1-A	BLM/SWC	Instream Complexity	Dogwood Creek	Add LWD to 3.5 miles of Dogwood Creek and tributary	\$217,000
2.1-B	BLM/SWC	Instream Complexity	Haight Creek	Add LWD throughout 3.1 miles of Haight Creek (two phases)	\$159,200
2.1-C	BLM/SWC	Instream Complexity	Camp Creek	Add LWD to 3.0 miles of Camp Creek	\$186,000
2.1-D	BLM/SWC	Instream Complexity	Conger Creek	Add LWD to 1.5 miles of Conger Creek (two phases)	\$71,000
2.1-E	BLM/SWC	Instream Complexity	Holland Creek	Add LWD to 1.2 miles of Holland Creek (two phases)	\$52,400
2.1-F	BLM/SWC	Instream Complexity	Doe Hollow Creek	Add LWD to 1.5 miles of Doe Hollow Creek	\$93,000
2.1-G	BLM/SWC	Instream Complexity	Jeans Creek	Add LWD to 0.7 mile of Jeans Creek	\$28,000
2.1-H	BLM/SWC	Instream Complexity	Frying Pan Creek	Add LWD to 0.5 miles of Frying Pan Creek	\$20,000

Table 9-3. Project Implementation Costs in the North Fork Siuslaw Sub-watershed (Goal 3).

Project	Lead	Project Type	Stream or Reach	Project	Cost
<i>Objective 3.1. Add LWD to 13 miles of anchor habitats and other priority reaches to increase in-stream complexity and restore stream interaction with off-channel habitats.</i>					
3.1-A	USFS/SWC	Instream Complexity	Billie Creek (Con-don Creek)	Add LWD to 2 miles of Billie Creek (additional 2 miles pending acquisition)	\$59,400
3.1-B	USFS/SWC	Instream Complexity	Condon Creek	Add LWD to 2 miles of Condon Creek	\$66,000
3.1-C	USFS/SWC	Instream Complexity	Russell Creek	Add LWD to the lower 2 miles of Russell Creek	\$66,000
3.1-D	USFS/SWC	Instream Complexity	Uncle Creek (Con-don Creek)	Add LWD to 1 mile of lower Uncle Creek	\$42,900
3.1-E	SWCD	Instream Complexity	McLeod Creek	Add LWD to 2 miles of McLeod Creek (pending acquisition)	\$119,000
3.1-F	USFS/SWC	Instream Complexity	Drew Creek	Add LWD to 1 mile of lower Drew Creek downstream of Right Fork Drew Creek	\$33,000
3.1-G	USFS/SWC	Instream Complexity	Wilhelm Creek	Add LWD to lower 3 miles of Wilhelm Creek	\$102,300
<i>Objective 3.2. Enhance 5 miles of riparian vegetation to reduce stream temperatures and promote future LWD recruitment into anchor habitats.</i>					
3.2-A	SWCD	Riparian enhancement	Condon Creek	Enhance riparian zones on 2 miles of Condon Creek	\$218,182
3.2-B	MRT/SWC	Riparian enhancement	Lower North Fork Siuslaw - mainstem (2nd/3rd)	Enhance 2 miles of riparian habitats on Lower North Fork Siuslaw (pending acquisition)	\$276,364
3.2-C	USFS/SWC	Riparian enhancement	Wilhelm Creek	Enhance 1 mile of riparian habitat on Wilhelm Creek	\$141,818
<i>Objective 3.3. Reconnect 317 acres of disconnected floodplains along 5 miles to promote the availability of off-channel rearing habitats.</i>					
3.3-A	SWCD	Floodplain recon- nection / off-channel restoration	Russell Creek	Reconnect 7 acres off-channel rearing areas (ponds) along 2 miles of lower Russell Creek / North Fork Siuslaw confluence	\$50,000
3.3-B	SWCD	Floodplain recon- nection / off-channel restoration	McLeod Creek	Reconnect 10 acres of floodplain along .5 miles at the confluence of Lower North Fork and McLeod Creek	\$400,000
3.3-C	SWCD	Floodplain recon- nection / off-channel restoration	Lower North Fork Siuslaw - mainstem (2nd/3rd) near Russell Creek	Reconnect 100 acres of floodplain and off-channel rearing areas along 1 mile of Lower North Fork Siuslaw (pending acquisition)	\$400,000
3.3-D	SWCD	Floodplain recon- nection / off-channel restoration	Siuslaw River mainstem in the Lower Bernhardt sub-watershed	Reconnect 200 acres of former tidal wetland to tidal influence, restoring a suite of estuarine habitats along 1.5 miles of the Siuslaw River in the Lower Bernhardt sub-watershed (Waite Ranch)	\$2,500,000

Project	Lead	Project Type	Stream or Reach	Project	Cost
<i>Objective 3.4. Reconnect 25 miles of instream and slough habitats.</i>					
3.4-A	USFS/SWC	Fish passage	Uncle Creek (Condon Creek)	Replace the Uncle Creek Culvert (3.3 miles re-opened)	\$650,000
3.4-B and 3.4-C	MRT	Fish passage (estuarine)	Lower North Fork Siuslaw - mainstem (2nd/3rd)	Remove 2 tidegates on North Fork Bend (13.7 miles; after acquisition)	\$2,000,000
3.4-D	SWC	Fish passage	Condon Creek	Remove passage barrier near confluence with Billie Creek (5 miles)	\$450,000
3.4-E	SWC	Fish passage	Upper North Fork Siuslaw - mainstem (2nd)	Replace culvert below Sam's Creek on Upper North Fork (3 miles)	\$350,000
<i>Objective 3.5. Upgrade 2 miles of forest roads.</i>					
3.5-A	USFS	Road upgrade / removal	Uncle Creek	Stormproof 2 miles of forest roads along Uncle Creek	\$300,000

Table 9-4. Project Implementation Costs in the Upper Indian Creek Sub-watershed (Goal 4).

Project	Lead	Project Type	Stream or Reach	Project	Cost
Objective 4.1. Add LWD to 16 miles of anchor habitats and other priority reaches to increase in-stream complexity and restore stream interaction with off-channel habitats.					
4.1-A	USFS/SWC	Instream Complexity	Long Creek	Add LWD to 2 miles of Long Creek	\$94,300
4.1-B	USFS/SWC	Instream Complexity	Herman Creek	Add LWD to 2 miles of Herman Creek	\$122,600
4.1-C	USFS/SWC	Instream Complexity	Maria Creek	Add LWD to 2 miles of Maria Creek (MBG-managed and USFS lands are priorities)	\$87,800
4.1-D	USFS/SWC	Instream Complexity	Rogers Creek	Add LWD to 3 miles of Rogers Creek	\$159,000
4.1-E	USFS/SWC	Instream Complexity	Upper Indian Creek	Add LWD along 1 mile of Upper Indian Creek (reconnecting floodplain is also included in the costs)	\$198,000
4.1-F	SWCD	Instream Complexity	West Fork Indian Creek	Add LWD to 6 miles West Fork Indian Creek (MBG-managed lands are priority)	\$700,000
Objective 4.2. Enhance 15 miles of riparian vegetation to reduce stream temperatures and promote future LWD recruitment into anchor habitats.					
4.2-A	SWCD	Riparian enhancement	West Fork Indian Creek	Enhance riparian habitats on 10 miles of West Fork Indian Creek	\$900,000
4.2-B	SWCD	Riparian enhancement	North Fork Indian Creek	Enhance riparian habitats on 2 miles of North Fork Indian Creek	\$224,242
4.2-C	SWCD	Riparian enhancement	Upper Indian Creek	Enhance riparian habitats on 1 mile of Upper Indian Creek	\$112,121
4.2-D	USFS/SWC	Riparian enhancement	Mainstem Indian Creek	Enhance riparian habitats on 1 mile mainstem Indian Creek (near Gibson Creek)	\$80,606
4.2-E	SWCD	Riparian enhancement	Herman Creek	Enhance riparian habitats on 1 mile Herman Creek	\$68,182
Objective 4.3. Reconnect 82 acres of disconnected floodplains along 1.5 miles of the West Fork Indian Creek to promote the availability of off-channel rearing habitats.					
4.3-A	SWC	Floodplain reconnection / off-channel restoration	West Fork Indian Creek	Reconnect 82 acres of floodplain along 1.5 miles of West Fork Indian Creek	\$800,000
Objective 4.4. Reconnect 3 miles of instream habitats.					
4.4-A	SWC	Fish passage	North Fork Indian Creek	Replace two culverts on unnamed tributaries near confluence with North Fork Indian Creek (1.5 miles)	\$180,000
					\$180,000
4.4-B	SWC	Fish passage	Upper Indian Mainstem	Replace two culverts on unnamed tributaries near confluence with Upper Indian Mainstem (1.5 miles)	\$200,000
					\$150,000
Objective 4.5. Upgrade 4 miles of forest roads					
4.5-A	USFS/SWC	Road upgrade / removal	North Fork Indian Creek watershed	Stormproof 4 miles of road on North Fork Indian Creek (Mann Creek)	\$500,000

Table 9-5. Summary of the costs for implementation of the high-priority projects in the Siuslaw Basin (2019 to 2025). The estimated total cost for implementation of all the proposed high-priority projects in the Siuslaw Basin from 2019 to 2025 is approximately \$21.4 million. While the project cost estimates in the tables above are based on the actual costs of similar projects, final implementation costs will vary due to a variety of factors. The cost summary presented here is intended to provide reviewers with a sense of the magnitude of the costs likely to be incurred by the Siuslaw Coho Partnership for SAP implementation.

Project Type	Dogwood Creek	Lower Deadwood Creek	Lower NF Siuslaw	Upper Deadwood Creek	Upper Indian Creek	Upper NF Siuslaw River	Total
Acquisition and easements			\$667,928		\$200,000	\$200,000	\$1,067,928
Fish passage (culverts)		\$120,000	\$1,100,000		\$710,000	\$350,000	\$2,280,000
Fish passage (tidegates)			\$2,000,000				\$2,000,000
Floodplain reconnection / off-channel restoration			\$3,350,000	\$800,000	\$800,000		\$4,950,000
Instream Complexity	\$826,600	\$355,250	\$234,300	\$1,095,400	\$1,361,700	\$254,300	\$4,127,550
Riparian enhancement		\$1,692,727	\$494,545	\$1,475,455	\$1,385,152	\$141,818	\$5,189,697
Road upgrade / removal			\$300,000	1,056,000	\$500,000		\$1,856,000
Total	\$826,600	\$2,167,977	\$8,146,773	\$4,426,855	\$4,956,852	\$946,118	\$21,471,175

Evaluation and Adaptive Management

The Siuslaw Coho SAP is a living document. While the Strategic Framework presented in Chapter 7 puts forth the approach for how the SCP will determine project priorities and allocate resources over the long term, the core planning team acknowledges that gaps exist in our collective understanding of the Siuslaw watershed and its coho population. Accordingly, as new information is generated, the SCP will update and revise this plan as needed.

For example, both the Strategic Framework and the short-term project priorities presented in Chapter 8 rely heavily on the “anchor habitat strategy” described throughout this plan. While the core planning team is confident that this approach provides a cost effective and scientifically sound conservation strategy, participants recognize that it does not capture all of the habitats in the watershed that support coho production. Most notably, it may not capture some habitats that are key to the expression of unique life histories (lower basin tributaries for nomadic coho, for example). These life histories may be an important contributor to the population’s overall resilience. As new information becomes available on unique life histories present in the basin, managers may choose to revise the Strategic Framework and re-prioritize projects to address habitat types and locations that are not currently given priority in this plan.

Similarly, climate change is prompting physical changes in the watershed (geomorphology and hydrology, for example) that will likely generate significant biological and ecological responses from the Siuslaw’s plant and animal communities. While modeling exists to help predict changes in variables like air and water temperatures and stream flow, modeled outputs are uncertain and highly variable. As a result, it is difficult to predict how and when changes will occur in the region’s biological systems, and the degree to which these changes will impact coho. The SAP gives priority to projects that maintain and restore natural watershed processes, which the core planning team believes provides the greatest opportunity to buffer against climate



change impacts. It must be emphasized, however, that climate change makes an already dynamic system even more unstable in ways that are not yet fully understood. Partners agree that this SAP must be responsive to these changes as they are observed.

10.1 The Monitoring Framework

The SCP recognizes that an adaptive management approach is essential to the long-term success of this plan, and the SCP’s ability to reach its stated goals. Thus, this section presents a monitoring framework that the SCP will use to evaluate (1) the rate at which the SAP is being implemented and (2) whether implementation is generating the anticipated benefits.

Table 10-1 presents a draft framework that will be further developed over time to address the two monitoring priorities. The framework is constructed around six statements that summarize the cumulative objectives described in Chapter 8 (see Table 8-1). Next to each statement, the table defines two types of monitoring that will be conducted: Implementation monitoring, which will evaluate whether the SAP is being implemented, and effectiveness monitoring, which will help determine whether an action is effective and should be continued.

The columns to the left of each statement in Table 10-1 are associated with implementation monitoring and provide a list of project tracking metrics. These metrics are intended to help the SCP assess the pace and extent of SAP implementation. Broadly, these metrics are intended to answer the question, “Is the SAP being implemented at the desired pace and scale?”

The columns to the right of each statement in Table 10-1 are associated with effectiveness monitoring and define the KEAs that the SCP seeks to improve through SAP implementation. Beside each KEA is one or more indicators of KEA health. By tracking these indicators over time, managers can evaluate whether SAP implementation is having the intended effect(s). In short, these indicators help us answer the question, “Are we moving towards our desired outcomes?”

The KEAs and indicators presented in Table 10-1 were derived from the common framework (described in Chapters 2 and 6), but represent only those deemed by the core planning team as highest priority and most likely to reflect improving (or declining) watershed conditions for coho. For a complete list of KEAs and indicators considered in this process, please refer to the common framework in Appendix 1.

The purpose of the monitoring framework is not to produce a full monitoring plan, but to suggest the skeleton of a plan that can be developed over time. The core planning team acknowledges the considerable limitations on funding available for monitoring and will develop specific plans for each of the KEAs as priorities dictate and funds allow. The core planning team also recognizes the magnitude of the challenge faced in trying to detect habitat responses at the sub-watershed scale from the implementation of the SAP. As stated in the Oregon Coast Coho Conservation Plan (ODFW 2007), “restoration of ecological processes that support high quality habitat requires time and is constrained by patchwork landownership patterns, different regulatory structures, and historical land use practices. Even given an expected increase in the level of non-regulatory participation in habitat improvement work, it will take time to: (1) produce detectable improvements in habitat quality, and (2) restore the biological and ecological processes across the ESU.”

This monitoring framework is intended as a first step toward this lofty – but essential – goal.



Siuslaw Common Framework included the following list of AQL metrics

- Miles of high quality habitat: produce 2,800 smolts/mile.
- % stream reach that is pool habitat
- % of stream reach that is slack-water pool habitat
- % pools greater than 1 meter in depth (pools with LWD pieces > or equal to 3 pieces per pool)
- # of wood pieces per 100m of stream
- # of key wood pieces (>12m long, 0.60 m dbh)
- Volume of LWD per 100 m
- # alcoves per reach

Table 10-1. Siuslaw Strategic Action Plan Monitoring Framework.

SAP Monitoring Framework						
Implementation Monitoring – Is the SAP being implemented?		GOALS	Effectiveness Monitoring – Is SAP implementation having the intended effects? Are we moving towards our stated outcomes?			Lead
Implementation Locations	Project Tracking Metrics		Key Ecological Attribute (component)	Indicator	Monitoring Sites	
Priority reaches in Deadwood, Dogwood, North Fork Siuslaw, and Upper Indian Creek watersheds	- # of miles of anchor habitats treated with LWD - # of miles of non-anchor habitat treated with LWD	Add LWD to 75 miles of identified anchor habitats and other priority reaches to increase instream complexity and restore stream interaction with off-channel habitats.	Habitat complexity (tributaries)	- ODFW and USFS AQL metrics ¹ - % of stream reaches with HabRate model rating of “good” for winter rearing, summer rearing, and spawning/emergence - % of anchor habitats with increasing trends in extent of spawning gravel (m²) - % total channel area represented by secondary channels	AQL survey locations	BLM USFS ODFW
Priority reaches in Deadwood, Dogwood, North Fork Siuslaw, and Upper Indian Creek watersheds	- Acres planted - Acreage acquired or placed under easement - % of high-priority sites planted	Enhance 47 miles of riparian vegetation to reduce stream temperatures and/or ensure future LWD recruitment into anchor habitats.	Temperature (tributaries and mainstem)	- Total # of days where monitoring locations exceed temperature standards (DEQ 7-day running average max) - Number of consecutive days meeting DEQ temperature criteria at sampling locations - Presence of a thermal barrier in the mainstem that prevents migration of fish during warm periods (7 day moving mean of daily summer max temp is > 20°C)	Lower North Fork Siuslaw Triangle Lake Others to be determined	SWC Tribes
			Riparian function (tributaries)	- % of selected riparian areas with conifers > 20” dbh in 164’ buffer - # of conifers >50” dbh - % of 6th fields basins with > 50% of riparian area in late seral - % of conifer present in riparian zones - % of riparian zone native species composition	AQL survey locations Remote sensing	USFS ODFW BLM

Priority locations in Deadwood, Dogwood, North Fork Siuslaw, and Upper Indian Creek watersheds	- Linear extent of levees removed - Acres of floodplain reconnected to channel - Acres of wetlands acquired or placed under easement - Acres of tidal wetland / slough reconnected - Fish passage barriers replaced	<i>Reconnect 306 acres of disconnected floodplains to promote the availability of off-channel rearing habitats.</i> <i>Reconnect 35 miles of instream and slough habitats to promote the availability of spawning and rearing habitats.</i>	Longitudinal connectivity (tributaries) Lateral connectivity (tributaries and mainstem) Landscape array of habitats (wetlands and estuary) Connectivity (estuary)	- % of accessible flood prone area (2x bankfull mean depth). - Miles of stream length with entrenchment ratio > 2.22 (unconfined) - Acres of connected tidal wetland - Acres of wetland relative to historic condition - Acres of wetlands subject to disrupted hydrologic connectivity (CMECS) and Marine Ecological Classification Program (C-CAP) data)	Deadwood, Dogwood, North Fork Siuslaw, and Upper Indian Creek watersheds	SWC
Priority roads identified in Deadwood, Dogwood, North Fork Siuslaw, and Upper Indian Creek watersheds	- Miles of road decommissioned and storm-proofed	<i>Upgrade 16 miles of forest roads.</i>	Sedimentation (tributaries)	- Miles of road hydrologically disconnected from stream network	GRAIP modeling sites	USFS BLM
All high-ranked sub-watersheds	- Percent of landowners contacted - Private landowners voluntarily participating in restoration projects	<i>Engage all public and private landowners with lands in the high-ranked sub-watersheds containing habitats identified as high priority for protection or restoration.</i>	NA	- Number and acres of tier 1 and tier 2 sites protected (Table 7-4)	All high-ranked sub-watersheds	SWC
All high-ranked sub-watersheds	- Total number of restoration projects implemented - Funding leveraged for SAP implementation - Local contractors hired	<i>Create and support 20 local jobs and generate \$ 10m in economic output to the local restoration economy by hiring local contractors and promoting local businesses.</i>	NA	- Estimated jobs created - Estimated economic output	Siuslaw watershed	SWC

Entrenchment indicator references:

Aquatic and Riparian Effectiveness Monitoring Program (AREMP) Staff. 2005. Watershed Monitoring for the Northwest Forest Plan, Data Summary Interpretation 2005, Oregon/Washington Coast Province. USDA Forest Service, Pacific Northwest Regional Office. Bureau of Land Management, Oregon State Office. 4077 SW. Research Way, Corvallis, OR 97333.

http://www.reo.gov/monitoring/watershed/EPA_Watershed_Academy_2005_Fundamentals_of_the_Rosgen_Stream_Classification_System: Excerpts of copyrighted material used with permission from Rosgen, D.L. and H.L. Silvey. 1996. Applied River Morphology. Widdland Hydrology Books, Fort Collins, CO. http://www.epa.gov/watertrain/stream_class/index.htm

10.2 Data Gaps and Priorities for Data Collection

As stated in the introduction to this chapter, the SCP recognizes the uncertainties in identifying conservation priorities for coho. These uncertainties are due largely to: (1) gaps in our current understanding of coho and the habitats they rely on, and (2) the projected impacts of climate change. During the course of developing this SAP, the core planning team identified several data gaps that should be addressed in the short term to begin addressing these uncertainties. These include:

- Identification of the unique life-history strategies present in the population, and the role that expression of these strategies plays in promoting the viability of the population.
- The habitat needs of the different life histories present in the Siuslaw coho population, and an assessment of the KEAs required to maintain them.
- Locations of cold-water refugia in the Siuslaw Basin.
- Routine updates of flow and temperature models generated by USFS.
- Assessments of habitat conditions and/or restoration potential in the following tributaries:
 - Hanson Creek (Bernhardt Creek watershed)
 - Peterson Creek (Bernhardt Creek watershed)
 - Cabin Creek (Upper Wolf Creek watershed)
 - Elkhorn Creek (Upper Wolf Creek watershed)
 - Panther Creek (Upper Wolf Creek watershed)
 - Swamp Creek (Upper Wolf Creek watershed)
 - Bottle Creek (Dogwood Creek watershed)
 - Frying Pan Creek (Dogwood Creek watershed)
 - Conger Creek (Dogwood Creek watershed)
 - Mainstem Siuslaw cascades, fish passage (Dogwood Creek watershed)
 - Knowles Creek temperature; Brush Creek suitability as temperature reference (Knowles Creek watershed)
 - Rice Creek and the tidally influenced section of Hadsall Creek (Knowles Creek watershed)



Juvenile coho. Photo: Lindsey Ray Aspelund.

10.3 Sustainability

The SCP will sustain the ecological outcomes generated through the implementation of this SAP by: (1) developing a coordinated multi-agency/organization monitoring plan based on the monitoring framework above; (2) continuing to undertake habitat assessments and fill the data gaps described above; and (3) building on our strong relationships with local landowners and funding partners to ensure project implementation continues to accelerate.

Towards this third point, the SCP has developed Governance Documents that clarify the roles and responsibilities of SCP members. As described in these documents, the SCP will convene quarterly to discuss emerging science; adjust restoration priorities based on new information and lessons learned; and coordinate outreach and grant writing. One meeting a year will be devoted to a restoration project tour where partners will visit a restoration site to share lessons learned. The Governance Documents can be found in Appendix 10.

In addition, the SCP has recently drafted a plan to strategically engage new stakeholders and funders as a continuation of the capacity building process enabled by the creation of this SAP (see Appendix 11). These two documents establish the foundation for collaboration among SCP members and compelling outreach to landowners and the community at large. Together these consensus-driven documents will help ensure a strategic, effective, and broadly supported restoration effort that can be sustained long into the future.

11. References

1. Ackerman, R., R. Neuenfeldt, T. Eggermont, M. Burbidge, J. Lehrman, N. Wells, and X. Chen. 2016. Resilience of Oregon coastal communities in response to external stressors. University of Michigan, prepared for the Oregon Department of Fish and Wildlife.
2. Atlas of Oregon Lakes. Online: <https://aol.research.pdx.edu/>
3. BenDor, T., T.W. Lester, A. Livengood, A. Davis, and L. Yonavjak. 2015. Estimating the size and impact of the ecological restoration economy. PLoS ONE 10(6): e0128339. <https://doi.org/10.1371/journal.pone.0128339>
4. Bio-Surveys. 2011. Limiting factors and restoration plan: lower, middle, and upper 6th fields Rock Creek basin tributary to the Nehalem River.
5. Brophy, L.S. 2005. Tidal wetland prioritization for the Siuslaw River Estuary. Prepared for the Siuslaw Watershed Council, Mapleton, Oregon. Green Point Consulting. Online: www.GreenPointConsulting.com
6. Brophy, L.S. 2009. Effectiveness monitoring at tidal wetland restoration and reference sites in the Siuslaw River Estuary: A tidal swamp focus. Prepared for Ecotrust, Portland, OR. Green Point Consulting. Online: www.GreenPointConsulting.com
7. Burnett, K.M., G.H. Reeves. D.J. Miller, S. Clarke, K. Vance-Borland, and K. Christiansen. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. USDA, Forest Service, PNW, Corvallis, OR. Ecol. Appl. 2007 Jan; 17(1):66-80.
8. Cortright, R., J. Weber, and R. Bailey. 1987. The Oregon estuary plan book. Oregon Dept. of Land Conservation and Development, Salem, OR. Available online at <http://www.inforain.org/mapsat-work/oregonestuary>
9. Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Biological Services Program, Document FWS/OBS-79/31.
10. Ecotrust. 2002. A watershed assessment for the Siuslaw Basin. Prepared by Ecotrust, Portland Oregon. Prepared for the Siuslaw Watershed Council.
11. IUCN (International Union for Conservation of Nature). 2001. IUCN red list categories and criteria: Version 3.1. IUCN species survival Commission. IUCN, Gland, Switzerland and Cambridge, U.K. ii + 30pp.
12. Kellon, C. 2012. Oregon's restoration economy: investing in natural assets for the benefit of communities and salmon. Ecotrust, Water and Watersheds Program. Online: <https://ecotrust.org/media/WWRI-Restoration-Economy-Brochure.pdf>
13. Lestelle, L.C. 2007. Coho salmon (*Oncorhynchus kisutch*) life history patterns in the Pacific Northwest and California. Final Report. Biostream Environmental, 122 pp.
14. McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFS-42.
15. Meengs, C.C., and R.T. Lackey. 2005. Estimating the size of historical Oregon salmon runs. Reviews in Fisheries Science. (13)1;51-66.
16. Miller, R.S. 2010. Is the past present? Historical splash-dam mapping and stream disturbance detection in the Oregon Coastal Province. Oregon State University. Master of Science in Fisheries Thesis.
17. Miller, D. J., and K. M. Burnett. 2007. Effects of forest cover, topography, and sampling extent on the measured density of shallow, translational landslides, Water Resour. Res., 43, W03433, doi:10.1029/2005WR004807.
18. Mullen, R. E. 1981. Oregon's commercial harvest of coho salmon, *Oncorhynchus kisutch* (Walbaum), 1882- 1960. Oregon Dept. Fish Wildlife. Info. Rep. (Fish) 81-3, Portland, Oregon, 24 pp. (1981a).
19. Nielsen-Pincus, M. and C. Moseley. 2010. Economic and employment impacts of forest and watershed restoration in Oregon. University of Oregon: Ecosystem Workforce Program, Working Paper 24.
20. NMFS (National Marine Fisheries Service). 2016. ESA recovery plan for the Oregon Coast coho salmon (*Oncorhynchus kisutch*) evolutionarily significant unit. National Marine Fisheries Service, West Coast Region, Portland, OR.
21. ODFW (Oregon Department of Fish and Wildlife). 2017. Personal communication with John Spangler, District Fish Biologist, Mid-Coast Fish District, Newport, OR.

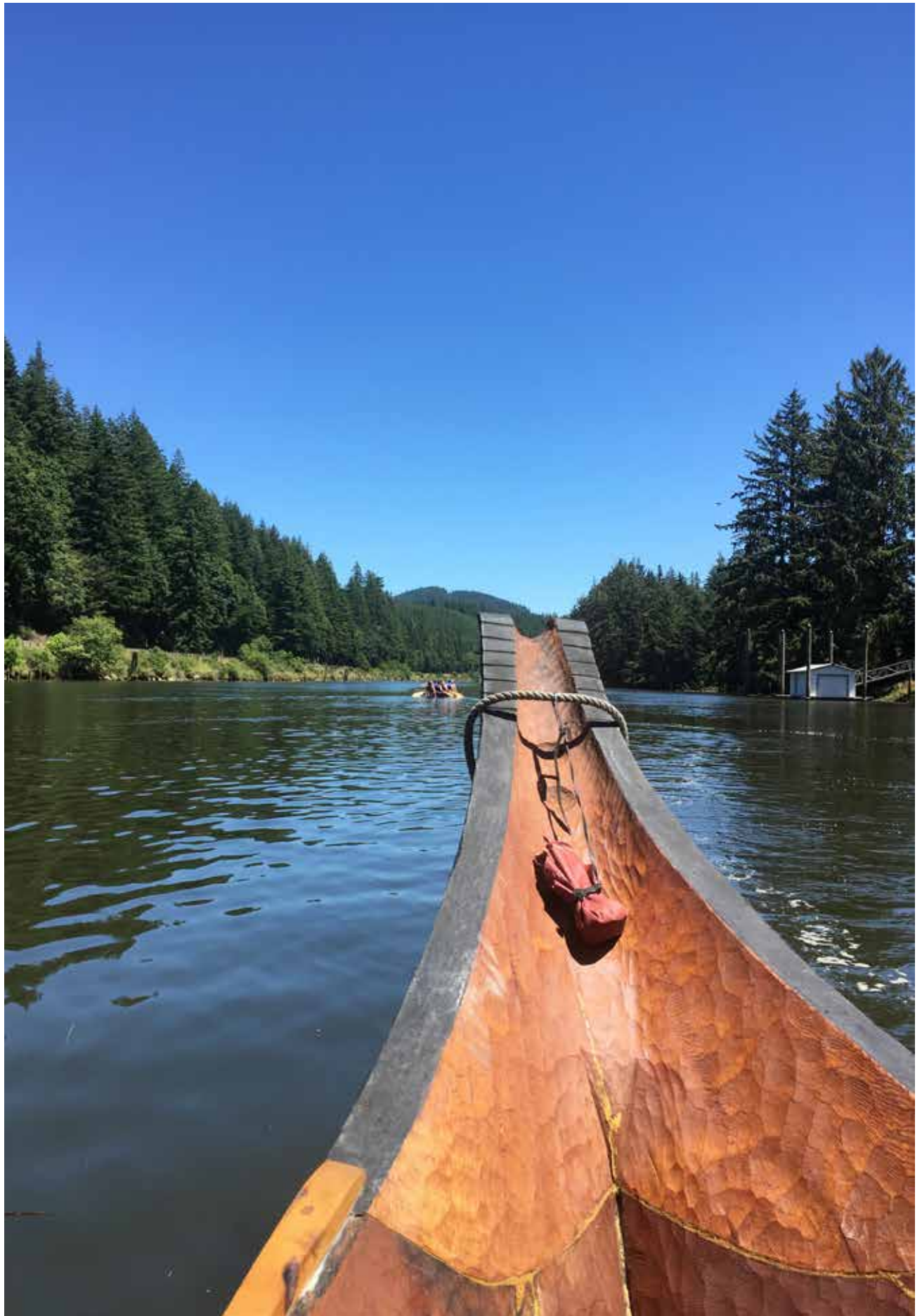
22. ODFW (Oregon Department of Fish and Wildlife). 2017b. Oregon adult salmonid inventory & sampling project. Coho abundance. Online: odfw.forestry.oregonstate.edu/spawn/Cohoabund.htm. Accessed August 4, 2017.
23. ODFW (Oregon Department of Fish and Wildlife). 2004. Oregon plan for salmon and watersheds assessment. Coastal coho hatchery releases. Oregon Department of Fish & Wildlife, Salem Oregon.
24. ODFW (Oregon Department of Fish & Wildlife). 2007. Oregon coast coho conservation plan for the State of Oregon. Oregon Department of Fish & Wildlife, Salem Oregon.
25. ODFW (Oregon Department of Fish & Wildlife). 2015. Juvenile salmonid monitoring in Coastal Oregon and Lower Columbia streams. Monitoring program report number OPSW-ODFW-2016-3. Oregon Department of Fish and Wildlife, Salem, Oregon.
26. ODFW (Oregon Department of Fish & Wildlife). 2018. Juvenile salmonid monitoring in Coastal Oregon and Lower Columbia streams. Monitoring program report number OPSW-ODFW-2018-2. Oregon Department of Fish and Wildlife, Salem, Oregon.
27. ODSL (Oregon Division of State Lands). 1983. Report and recommendation on the navigable waters of Oregon.
28. Oregon Employment Department. 2014. Lane County's state of the workforce. Online: www.laneworkforce.org/state-of-the-workforce-report.
29. OWEB (Oregon Watershed Enhancement Board). 2017. Components of a strategic action plan for participation in the Focused Investment Partnerships Program.
30. PFMC (Pacific Fishery Management Council). 2003. Final Amendment 13 to the Pacific Coast Salmon Plan. Portland, Oregon.
31. Salafsky, N., D. Salzer, A.J. Stattersfield, C. Hilton-Taylor, R. Neugarten, S.H.M. Butchart, B. Collen, N. Cox, L.L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. Conservation Biology 2008 article.
32. Sounhein, B., E. Brown, M. Lewis and M. Weeber. 2015. Status of Oregon stocks of coho salmon. Oregon Department of Fish and Wildlife. 2015.
33. Sounhein, B., E. Brown, M. Lewis and M. Weeber. 2017. Status of Oregon stocks of Coho Salmon, 2016. Monitoring Program Report Number OP-SW-ODFW-2017-3, Oregon Department of Fish and Wildlife, Salem, Oregon.
34. Stout, H. A., P. W. Lawson, D. L. Bottom, T. D. Cooney, M. J. Ford, C. E. Jordan, R. G. Kope, L. M. Kruzic, G. R. Pess, G. H. Reeves, M. D. Scheuerell, T. C. Wainwright, R. S. Waples, E. Ward, L. A. Weitkamp, J. G. Williams, and T. H. Williams. 2012. Scientific conclusions of the status review for Oregon coast coho salmon (*Oncorhynchus kisutch*). U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-118, 242 p.
35. Swanson, F. J., R. L. Fredriksen, and F. M. McCorison. 1982. Material transfer in a western Oregon forested watershed. In Analysis of coniferous forest ecosystems in the western United States. R. L. Edmonds, ed. Hutchinson Ross Pub. Co., Stroudsburg, Pa. p. 233-266.
36. US Census Bureau. 2017. Quick Facts Lane County, Oregon. Online: <http://www.census.gov/quickfacts/table/PST045215/41039>
37. <http://www.city-data.com/city/Florence-Oregon.html>
38. <http://www.city-data.com/city/Middle-Siuslaw-Triangle-Lake-Oregon.html>
39. US Forest Service. 1998. Lower Siuslaw watershed analysis. Siuslaw National Forest.
40. US Forest Service. 1998. Indian Deadwood watershed analysis Siuslaw National Forest.
41. US Forest Service. 1994. North Fork Siuslaw River watershed analysis. Siuslaw National Forest.
42. USDI BLM (Bureau of Land Management). 2008. Upper Siuslaw landscape plan, environmental assessment NO. OR090-07-02. BLM, Eugene, OR.
43. Van de Wetering, Stan and I. Kentta. 2014. Waite ranch pre-restoration fish surveys. Prepared for the Siuslaw Watershed Council, Mapleton, OR, by the Confederated Tribes of Siletz Indians, Siletz, OR.
44. Ziemer, R.R. and D.N. Swanston. 1977. Root strength changes after logging in southeast Alaska. USDA Forest Service, PNW-306.

Appendices

The following appendices are available at siuslaw.org.

1. The Common Framework for the Siuslaw (“The Siuslaw Framework”)
2. Sub-watershed Ranking Methods, Criteria, and Scoresheet
3. Siuslaw Literature Review
4. Siuslaw Annotated Bibliography
5. Project Ranking Criteria and Scoresheet
6. Siuslaw SAP Project Summary and Rankings spreadsheet
7. Anchor Habitat Methods
8. Stresses and Threats Tables from the OC Coho Recovery Plan
9. SCP Governance Documents
10. SCP Draft Outreach Plan
11. Siuslaw Netmap Analysis

Opposite: Traditional Ecological Knowledge in practice on the Siuslaw River. Photo: Ashley Russell, CTCLUSI.





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