Advances in Monitoring of Large-Scale Restoration Efforts: Implications for River Corridor Planning in Salmon Recovery

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Natural Systems Design

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Aquatic Species Restoration Plan for the Chehalis Basin

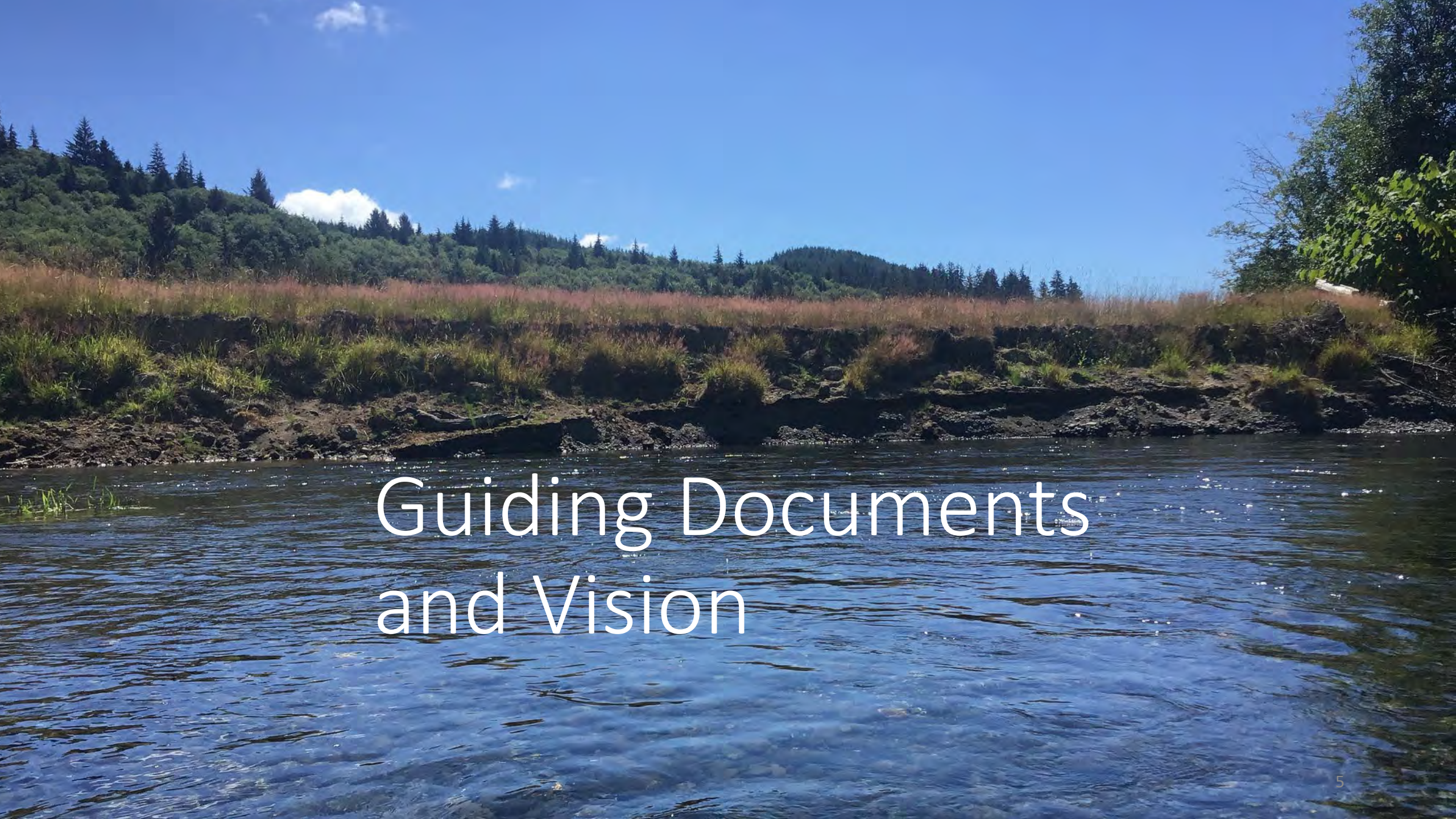
- Unprecedented level of restoration
- Basin-wide effort- several sub-basins
- 10 Ecological diversity regions

Goal for the Monitoring…

Develop a monitoring program that evaluates ASRP effectiveness and whether the current level of effort is sufficient to meet the goals and objectives of the plan.

Overview

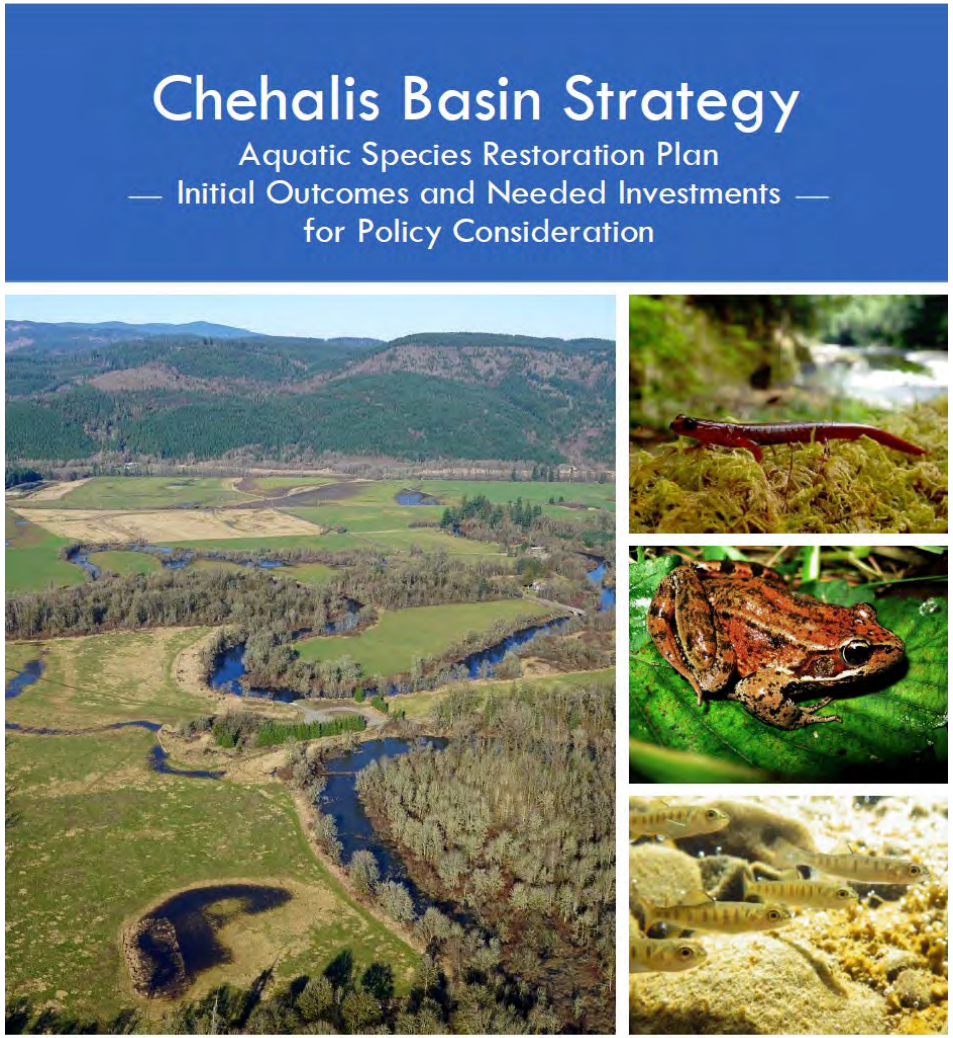
- Guiding Documents and Vision
  - Focus Areas
  - Information Needs
  - Sampling Programs
- Framework Elements
- Detail on Sampling Programs
- Next Steps



Guiding Documents and Vision

Guiding Documents

- ASRP Vision Statement
- ASRP Phase 1-Approach
- ASRP Phase 1-Expected Outcomes
- ASRP Scientific Foundation Assumptions and Uncertainties
- Over-arching Themes from SRT Site Visits



ASRP Vision Statement

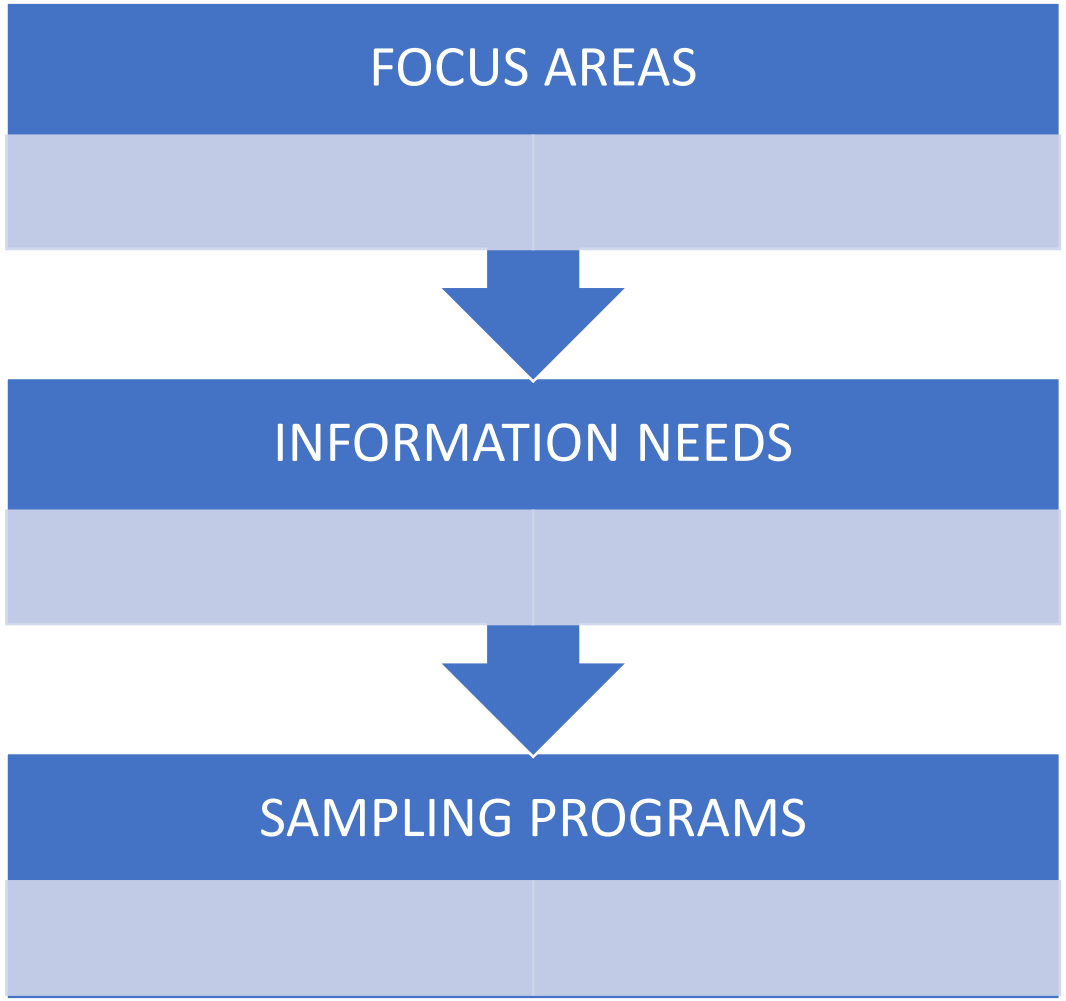
"The vision of the ASRP is to provide for a future where the Chehalis Basin can support healthy and harvestable salmon populations, robust and diverse populations of native aquatic and semi-aquatic species, and productive, self-sustaining ecosystems that are resilient to climate change and anthropogenic stressors, while also honoring the social, economic, and cultural values of the region."

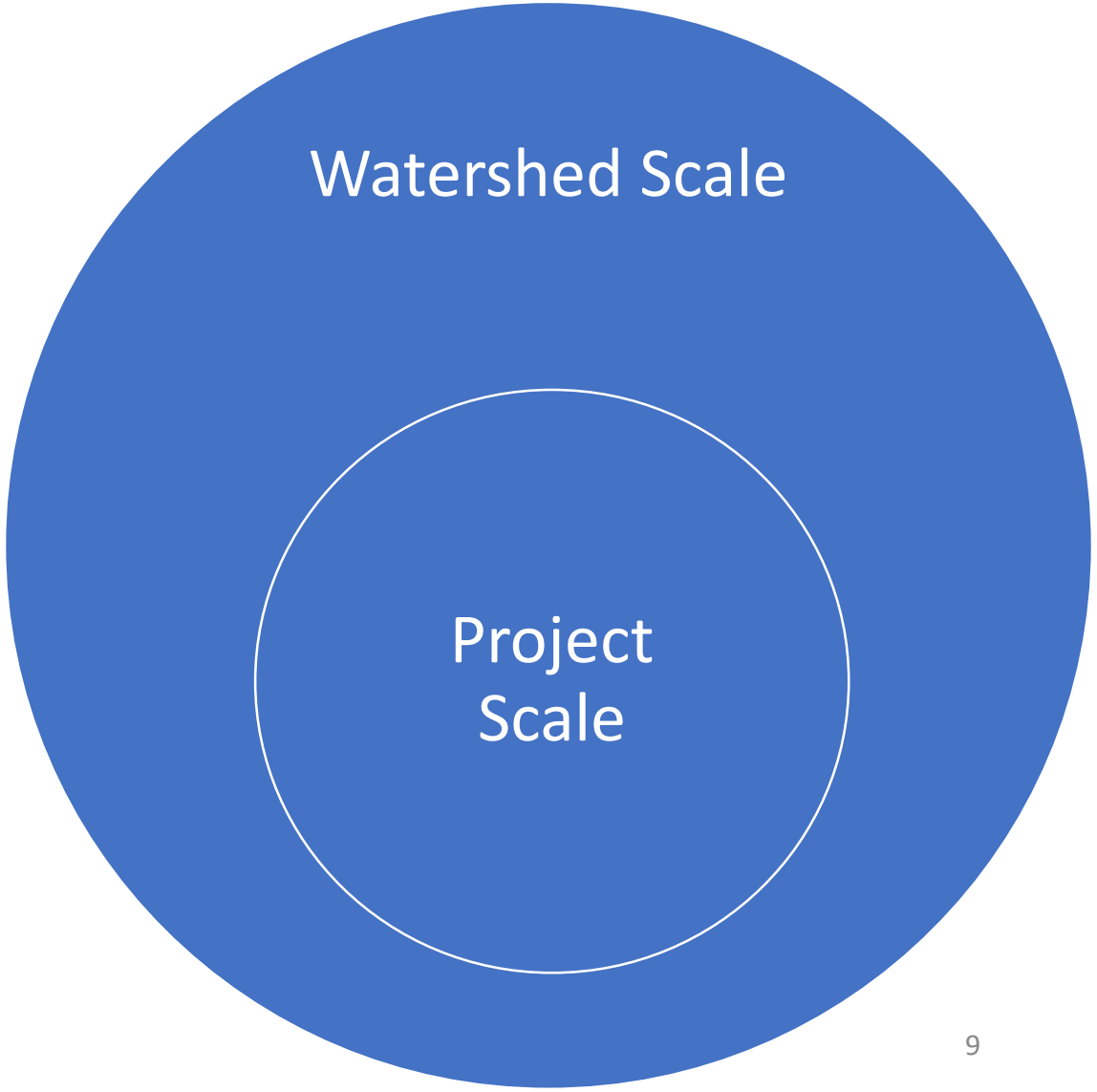
ASRPSC, 2017

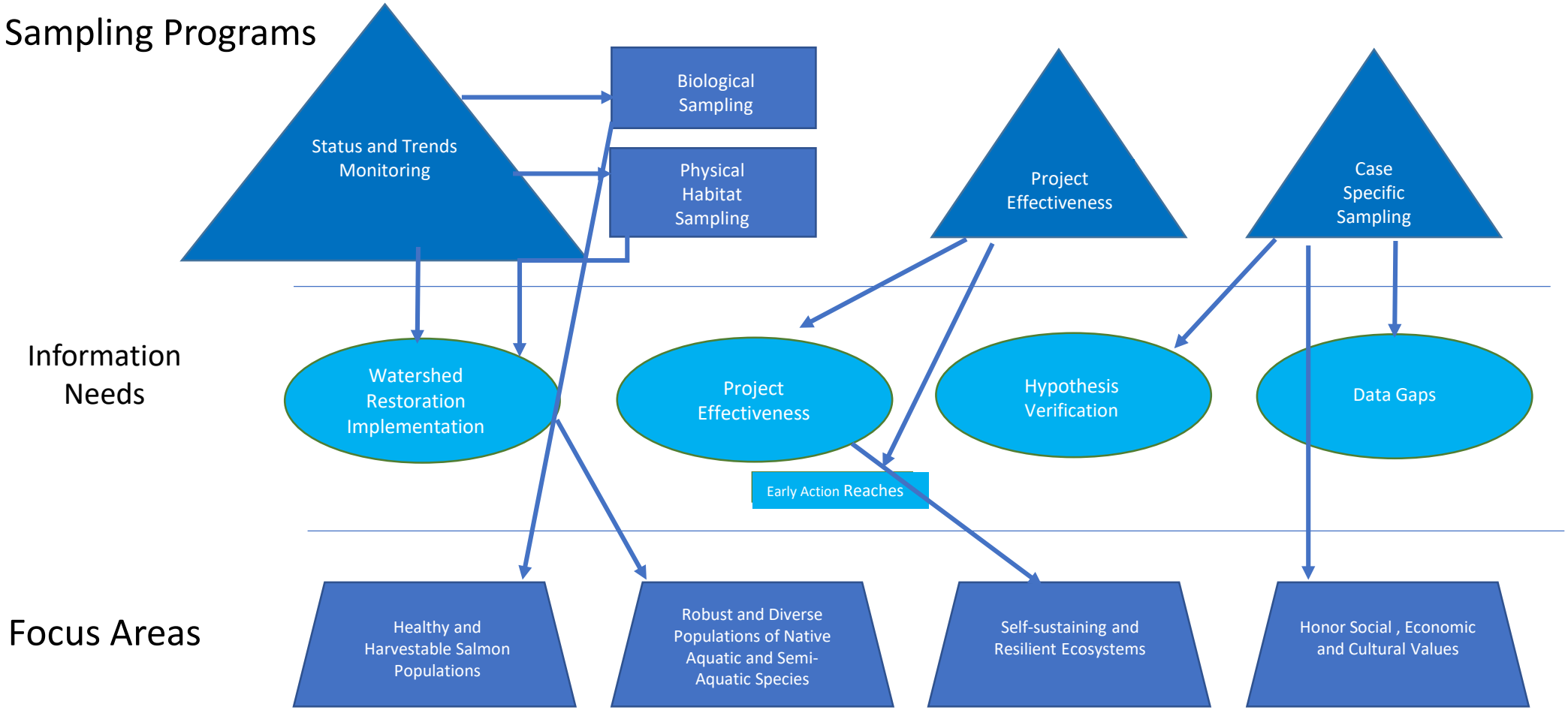
ASRP VISION STATEMENT- FOCUS AREAS

1. Support healthy and harvestable salmon populations
2. Robust and diverse populations of native aquatic and semi-aquatic species
3. Productive, self-sustaining ecosystems that are resilient to climate change and anthropogenic stressors
4. Honoring the social, economic, and cultural values of the region

RESTORATION ELEMENT	INTENDED FUNCTION
High functioning riparian areas	Provide wood, nutrients, shade, stream bank protection, habitat
High functioning floodplain and off channel areas	Improve watershed connectivity, water quality, water storage, habitat
In-channel large wood	Increase roughness, decrease channel incision, improve channel complexity and floodplain connectivity
Fish passage	Increase access to habitat


FOCUS AREAS
INFORMATION NEEDS
SAMPLING PROGRAMS


Watershed Scale
Project Scale

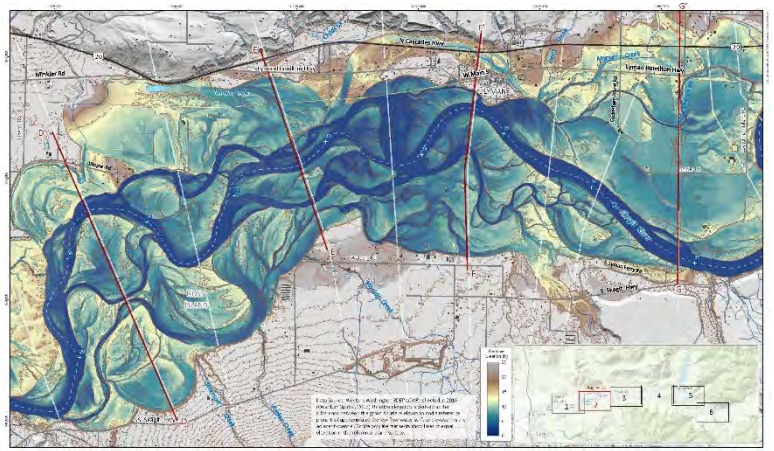

Sampling Programs
Status and Trends Monitoring
Biological Sampling
Physical Habitat Sampling
Project Effectiveness
Case Specific Sampling
Information Needs
Watershed Restoration Implementation
Project Effectiveness
Hypothesis Verification
Data Gaps
Early Action Reaches
Focus Areas
Healthy and Harvestable Salmon Populations
Robust and Diverse Populations of Native Aquatic and Semi-Aquatic Species
Self-sustaining and Resilient Ecosystems
Honor Social , Economic and Cultural Values

Framework Elements

Framework Elements – Concepts inherent across sampling programs

M and AM Subcommittee

- Similar Protocols and Data Compatibility
- Use of Remote Sensing Data
- Quality Assurance and Data Management



Framework Elements – Concepts inherent across sampling programs

Design Teams and Agencies

- Restoration Project Template
- Native and Exotic Species Screen
- Implementation Monitoring

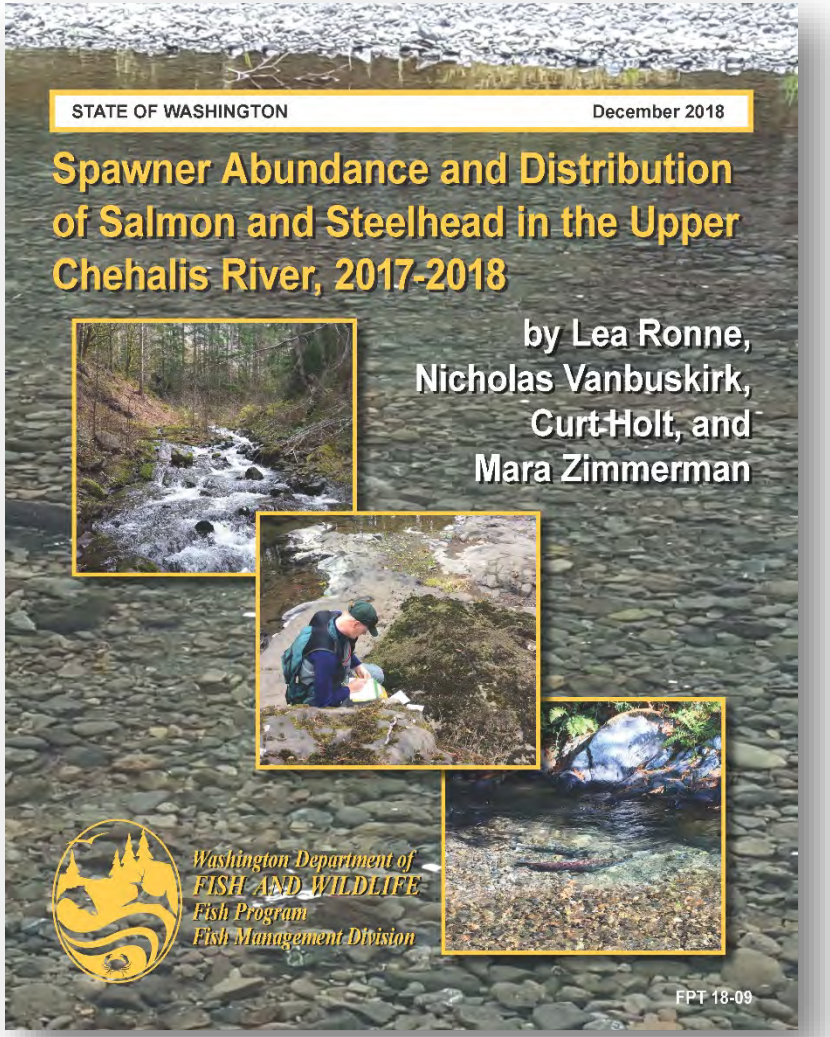
Framework Elements – Concepts inherent across sampling programs

Office of the Chehalis Basin

- Consolidation of Existing Data
- Tracking of Restoration and Monitoring Activities

Science and Review Team

- Review and recommend improvements

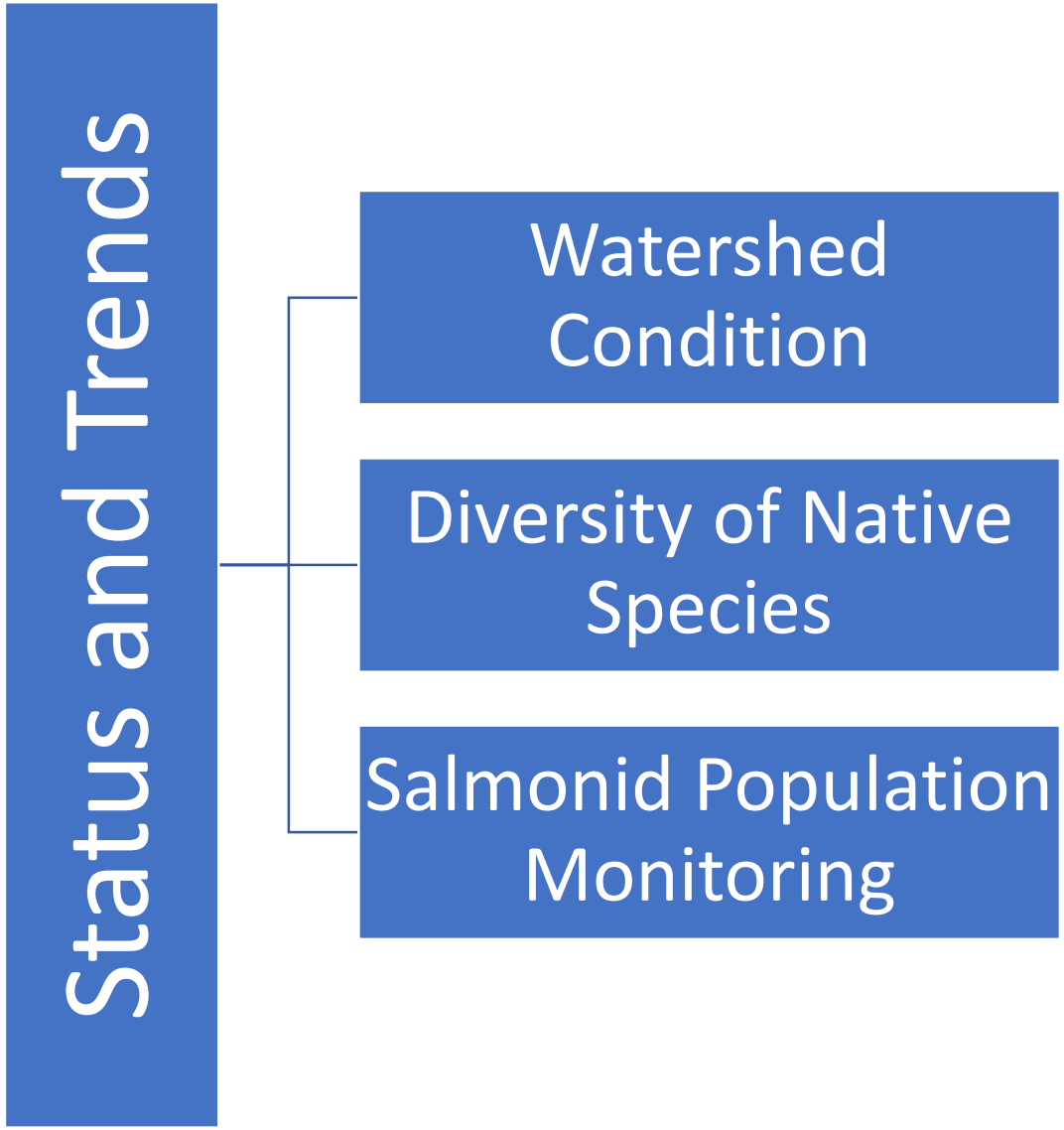


Details on Sampling Programs

Status and Trends

Project Effectiveness

Hypothesis Testing

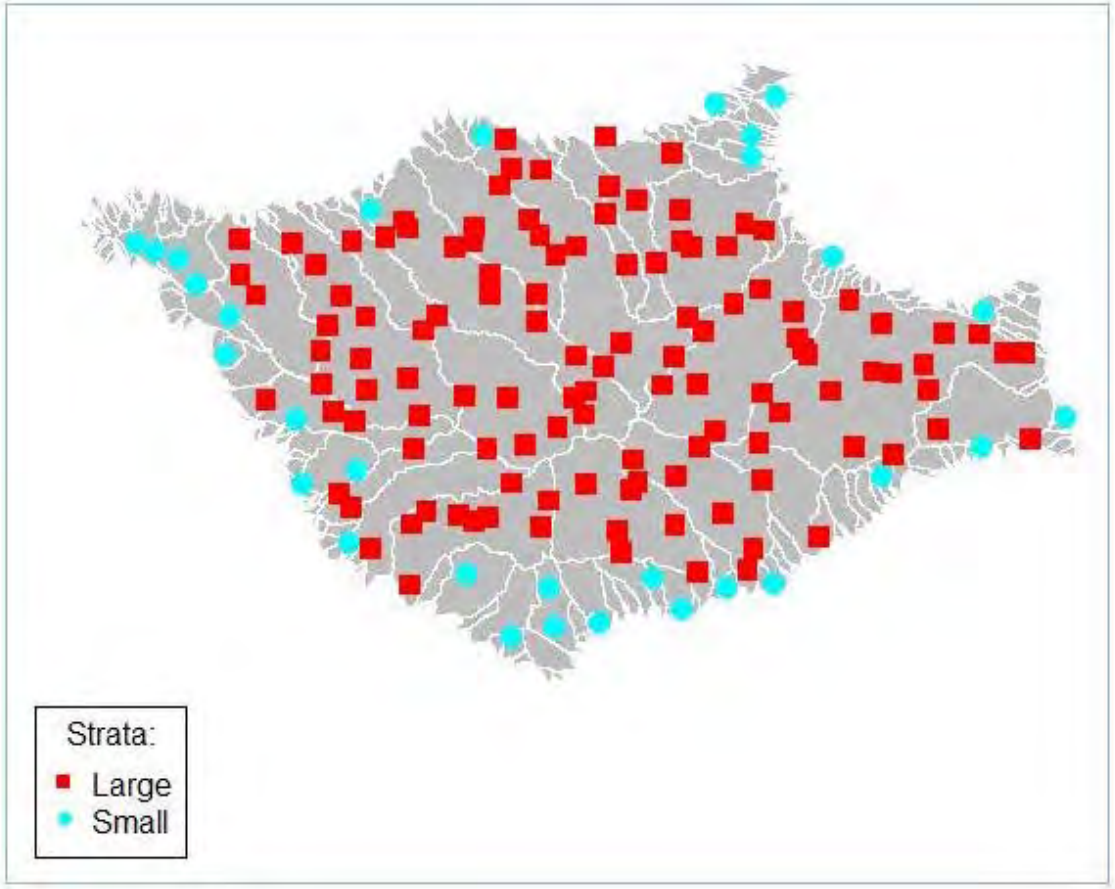

Status and Trends
Watershed Condition
Diversity of Native Species
Salmonid Population Monitoring

Status and Trend – Watershed Condition

Provide basin trends and context of larger-scale watershed condition to use in interpreting reach- or site-scale results.

"Cloud of reference points"

Spatial Designs & Parameters



Status and Trend – Watershed Condition

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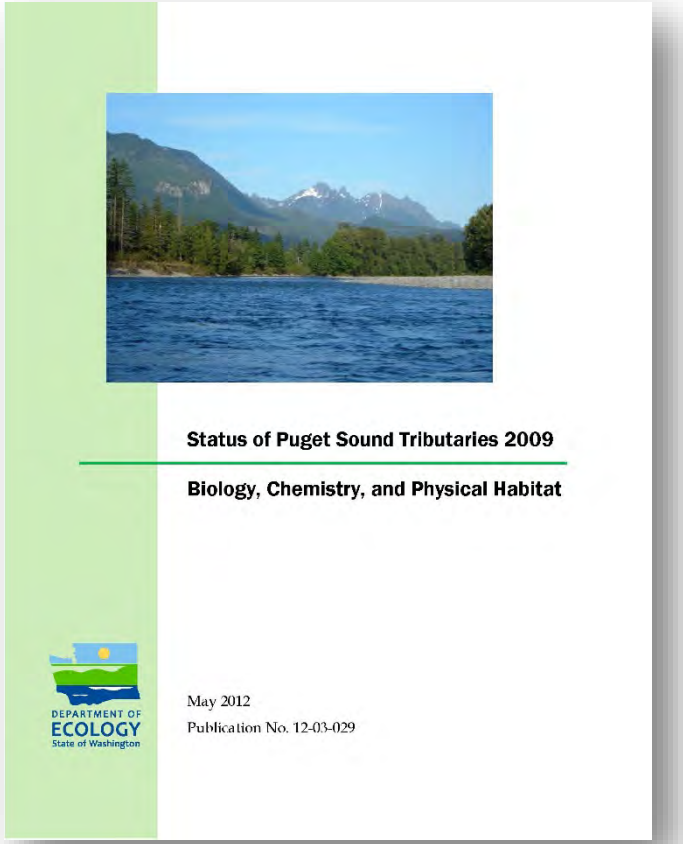
"Cloud of reference points"



Parameters

Indicator	Forum Attribute	Metric	Units
Instream spatial complexity	Wetted width	X WetWidth	m
	Bankfull Width	X BFWidth	m
	% Pools	PCT Pool	%
	Res. Pool Depth	X PoolUnitDepth	cm
	Res. Pool Depth (alternative)	SD TWDepth	cm
	Res. Pool Depth (alternative)	X TWDepth	cm
Instream LWD	LWD Frequency	LWD Pieces100m	pcs/100 m
	LWD (alternative)	PFC LWD	%
	LWD (alternative)	XFC LWD	%
Instream substrate composition	% Fine Sediment	PCT Fines	%
	% Fine Sediment (alt.)	PCT SandFines	%
	% Fine Sediment (alt.)	X Embed (%)	%
Instream bank conditions	Bank angle (alternative)	X Instability	%
	Bank angle (alternative)	PFC Undercut	%
Riparian condition	Canopy Cover	X ShadeBnk	%

Project Effectiveness Questions & Objectives

1. To what degree are restoration projects achieving their expected outcomes and performance measures?

2. Are the restoration projects implemented in the Chehalis Basin reestablishing physical, chemical and biological processes to sustain the aquatic ecosystem?

3. Can project monitoring results be used to improve the design of future projects?

- Feedback loop to inform design elements

Project Effectiveness Monitoring

ASRP Project Effectiveness Monitoring

- All projects except early action reaches
- Same protocols as Status and Trend monitoring
- Before/After Sample Design
- Project or Reach Scale
- Located at Project Sites

Early Action Reach Monitoring

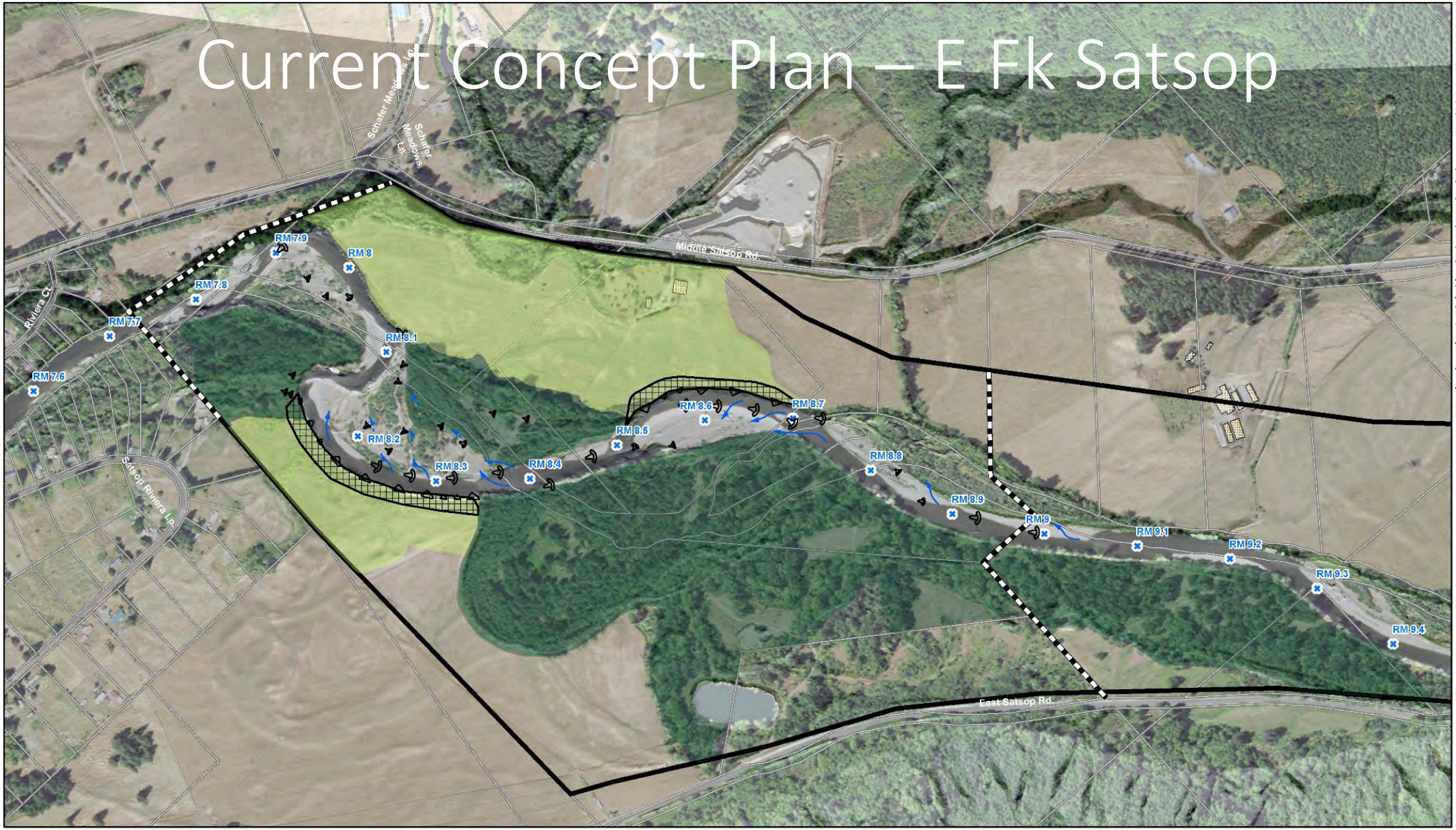
- Only Early Action Reaches
- Subset of Protocols
- Before/After Sample Design
- Project or Reach Scale
- Located at Project Sites

Key Elements of Restoration

- **Engineered Log Jams** (ELJs) within the Channel and Floodplain to Create:
  - Channel stability
  - Flow deflection
  - Pools
  - Side channels/off-channel habitat
- Flood fences/post arrays to trap debris and protect riparian revegetation.
- Riparian planting to promote floodplain forest

Engineered log jam on the Elwha River viewing downstream.
Photo taken ~2018 by T. Abbe

Current Concept Plan – E Fk Satsop



Aquatic Species Restoration Program (ASRP): Chehalis Basin Strategy Early Action Plan

Concept Design: East Fork Satsop River - RM 8 - Sheet 1

Service Layer Credits: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

- Restoration Corridor Extent
- Parcel Boundary
- Subreach Boundary

Planting Operations

- Floodplain Flood Fence Groves
- Conifer Infill/ Planting
- Floodplain Planting

ELJ Structure Types

- Large Apex
- Small Apex
- Large Deflector
- Large Bank
- Small Bank
- Floodplain Roughness Element

0 250 500 Feet

Natural Systems Design

Lambert conformal conic projection, NAD 1983

Mirranda Smith, NSD Date: 12/11/2018 Path: N:\Projects\WSRCO\ASRP\GIS\Satsop\maps\mxd\Satsop_Concept_Map_Decmxd

Status and Trend – Aquatic Species Diversity

Stream Network Habitat Categories (fish sampling example)		
Large River Net Fishing, Boat or Raft Electrofishing	Medium River Snorkel visual encounter surveys, limited backpack electrofishing	Headwater Stream Backpack Electrofishing

Stillwater Habitat Categories			
Floodplain off-channel (Beaver Ponds)	Glacial Outwash Lakes or Ponds	Landflow Slump or Colluvial Ponds	Montane Lakes or Ponds

Status and Trend – Aquatic Species Diversity

"Aquatic species include native fishes, amphibians, as well as semi-aquatic species that use aquatic habitats throughout the basin for a portion of their life cycle"

Metrics

- Alpha (α), Beta (β), Gamma (γ), diversity
- Evenness
- Differences or similarities in species composition

Status and Trend – Salmon and Steelhead

"Monitoring of salmon and steelhead populations will provide annual trends in salmon and steelhead abundance and harvest, and identify whether trends in abundance are associated with changes in freshwater productivity"

Metrics

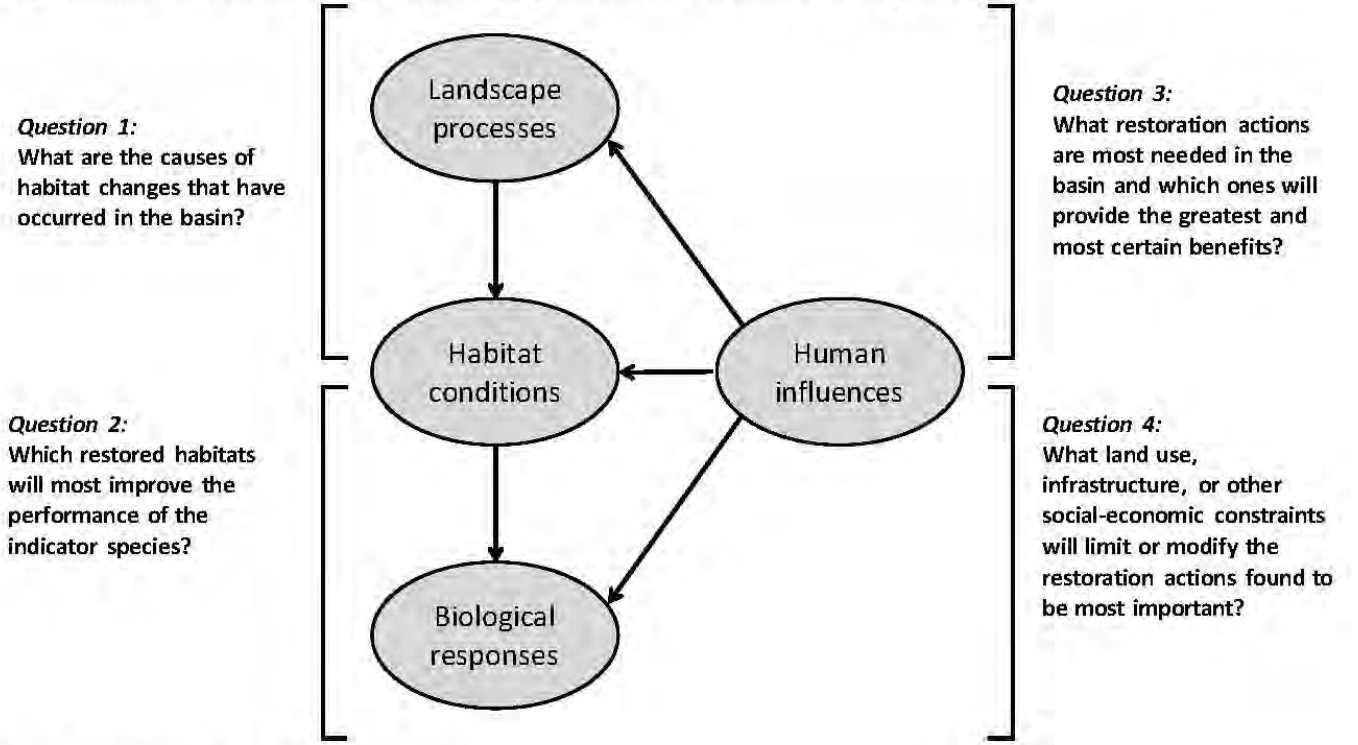
- Harvest
- Smolt to Adult Survival
- Adult to Adult Productivity
- Abundance, Distribution, Diversity,
- Productivity
- Numbers of Hatchery Fish
- Proportion of Hatchery Origin Spawners
- Smolt Abundance
- Smolt Density and Diversity
- Outmigration Timing

Case-Specific Hypothesis Testing

Core Topics

- Water temperature
- Wood
- Off-channel habitat/floodplains
- Exotic species
- Overlooked factors controlling production (e.g. food)

Conceptual Diagram of Process Linkages Between Landscape Processes, Habitats, and Species Performance, and Key Questions to be Addressed in Identifying Restoration Actions to be Implemented

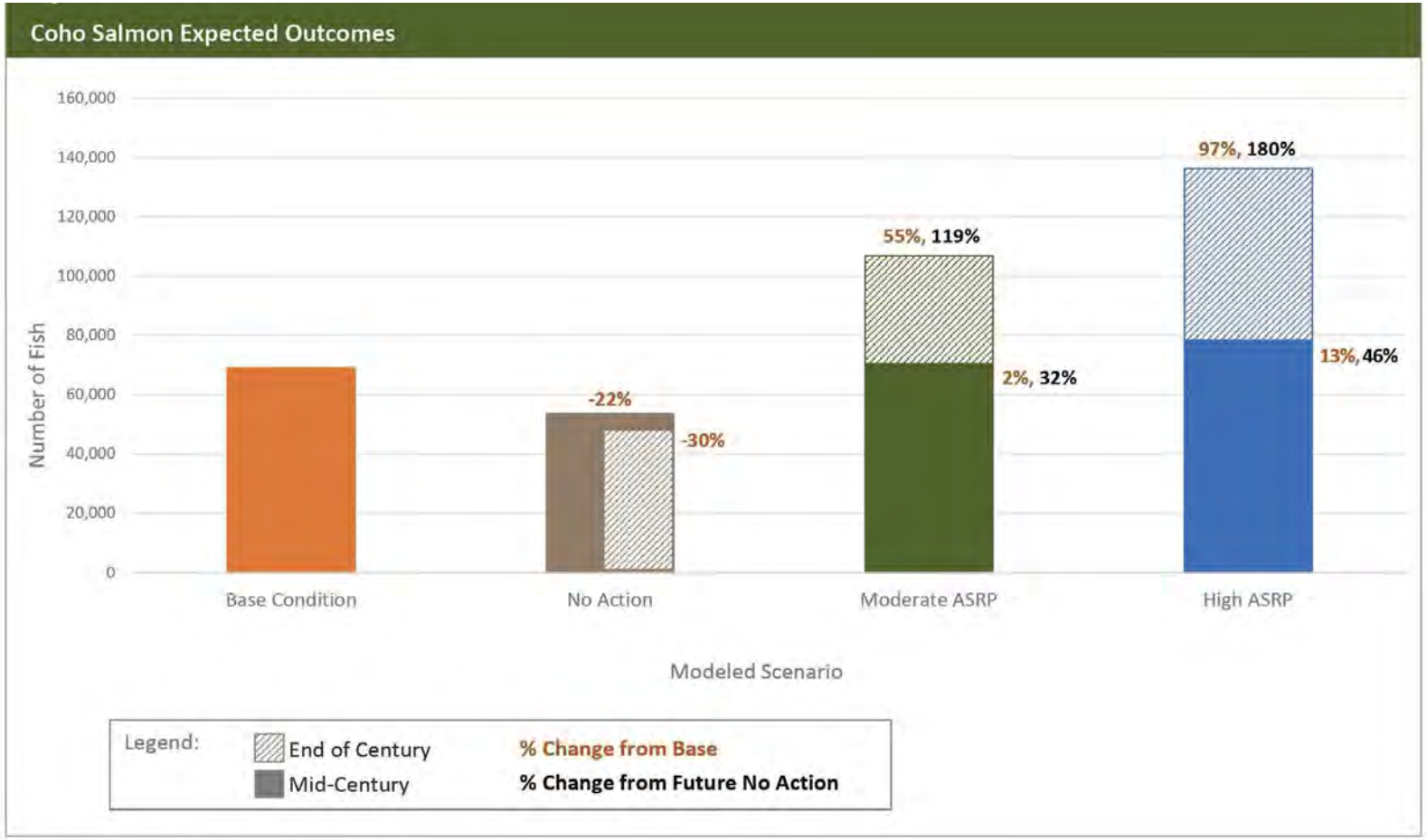


Note: Adapted from Beechie et al. 2013.

Case-Specific Hypothesis Testing

Prioritization

- Reduce Critical Uncertainty
- Benefit the Highest Number of Species
- Improve Future Restoration Efforts



Note: Data from ASRP STRT 2017

Questions?

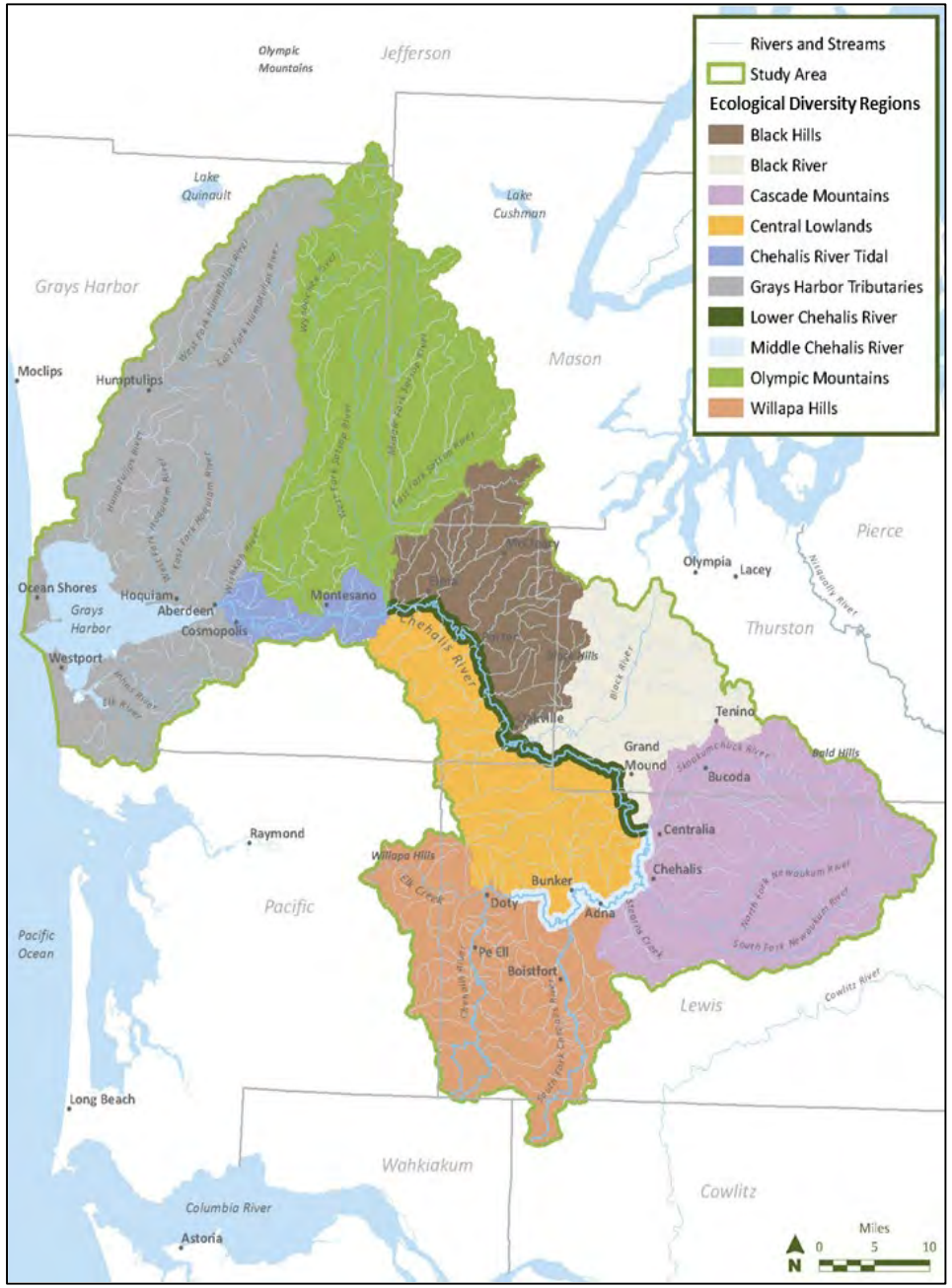
Next Steps

Finalization of Framework
Status and Trends – Watershed Condition Scale
Cost Estimation
Full Plan Development

Ecological Diversity Regions

Areas of homogeneity

Established by the Science Review Team



Early Action Reach Monitoring

Limiting Factors	Targeted Actions	Metrics
Reduced LWD	ELJs	Channel
Incision	ELJs - aggradation	Channel
Loss of Floodplain Connectivity	ELJs – direct flows into side channels	Channel, Floodplain
Bed Mobility	ELJ's- stabilize bed	Channel
Elevated Sediment/Bank Erosion	Structural bank protection, riparian planting	Channel, Riparian
Loss of Riparian Vegetation	Riparian planting	Riparian, Overall
Increase Diversity and Availability of Habitat	All	Biological

Key Elements – Structural Bank Protection

- Complex timber revetments to reduce channel migration rates.
- Array of ELJ flow deflectors.
- Flood fences/post arrays to trap debris and protect riparian revegetation.

Complex timber revetment on South Fork Nooksack. View is downstream. Photo taken ~2012 by T. Abbe

Flood fence revetment taken by Aldrich and DeVries 2017