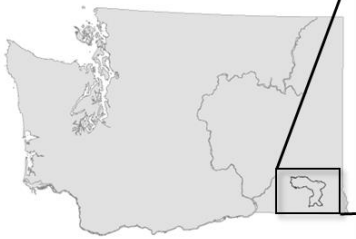
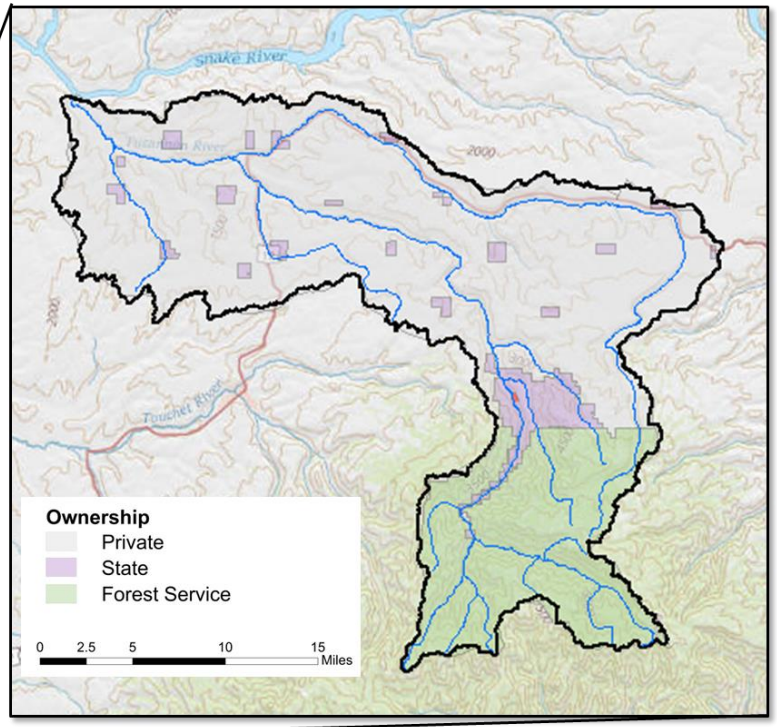
Tucannon River Monitoring





Tucannon Landowners

Eco Logical Research, Inc.

Natural Systems Design

South Fork Research, Inc.

North Arrow Research

U.S. Forest Service

Bonneville Power Administration

National Oceanic and Atmospheric Administration, U.S. Department of Commerce

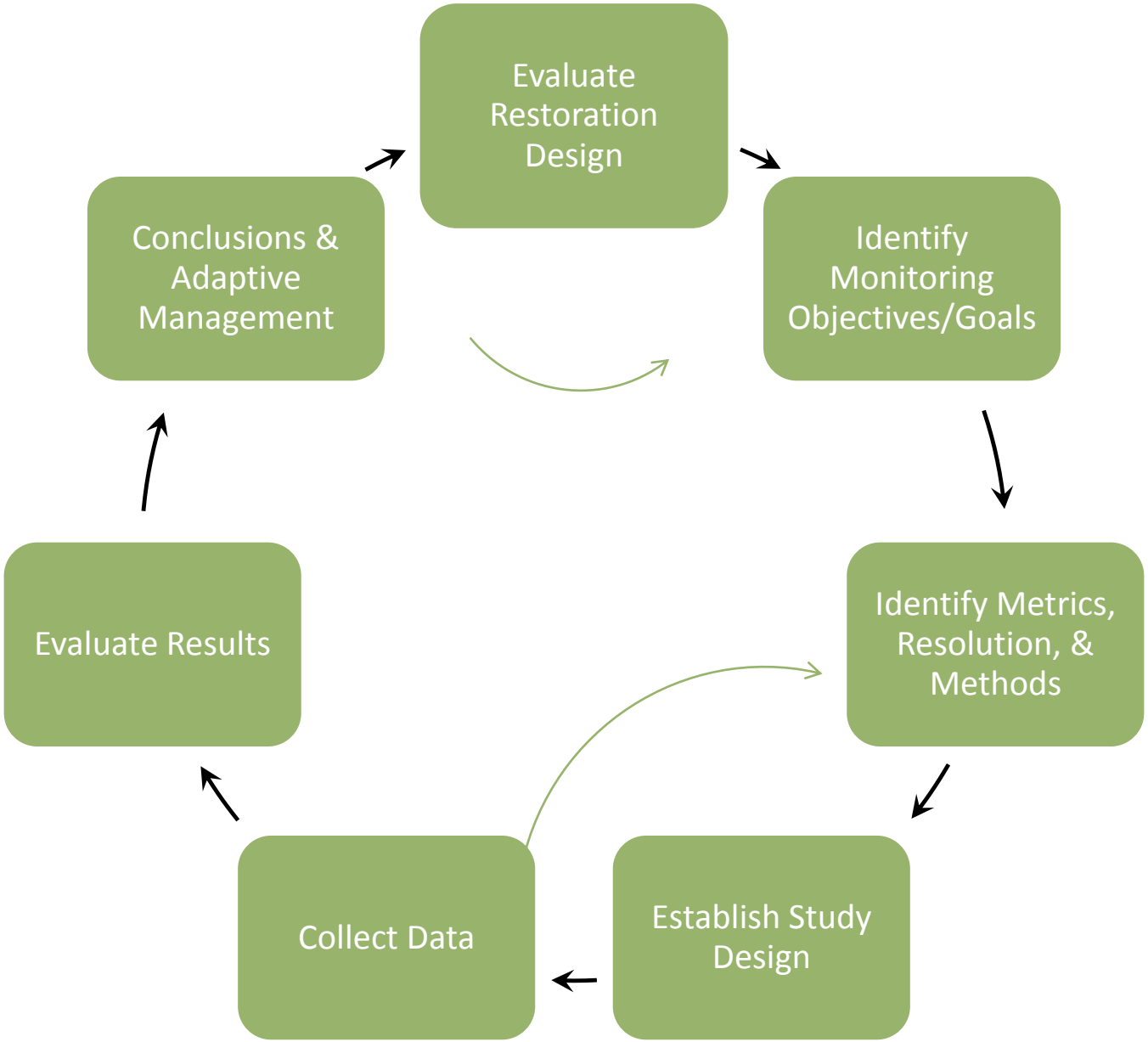
Snake River Salmon Recovery

Washington Department of Fish and Wildlife

Utah State University
Ecogeomorphology & Topographic Analysis Laboratory

Confederated Tribes of the Umatilla Indian Reservation

Monitoring Framework



Evaluate Restoration Design

Target Species: Spring Chinook
Other Species: Steelhead, Bull Trout
Life Stage: Egg to Smolt*
Temporal Use:

- Juvenile Rearing
- Overwinter
- High/Low Flows

Limiting Factors

- Channel Complexity
- Floodplain Confinement

Primary Restoration Actions to Address Factors:

- Levee Removal
- LWD
- Create/Enhance Side Channels

*Can't ignore other life stages

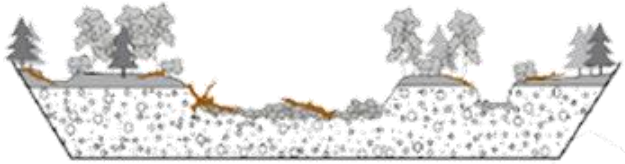
Evaluate Restoration Design

Envisioned Condition

- Dynamic, Multi-threaded Channel
- Floodplain Inundation at High Flows
- Complexity from Bar and Pool Formation
- Natural LWD Recruitment

Expected Outcomes (general*)

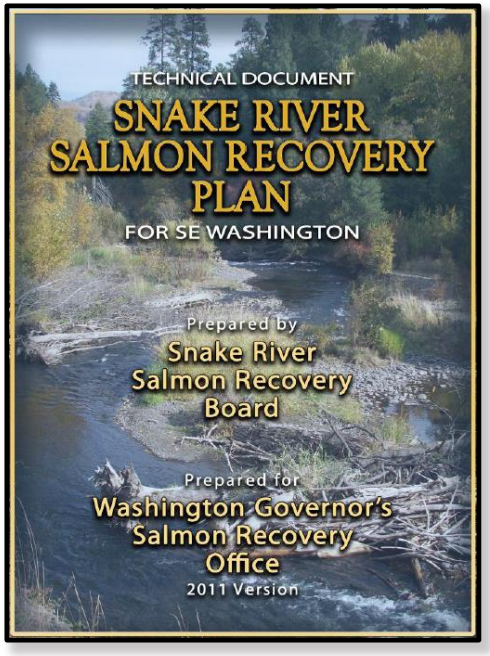
- Levee removal
  - Floodplain access
  - Near channel riparian regeneration
- LWD
  - Sediment entrainment & bar formation
  - Scour pools
  - Hyporheic exchange
  - Side channel creation
  - Flow attenuation
  - Push water onto floodplain



*More explicit outcomes for individual projects

Identify Monitoring Objectives & Goals

Objectives - Habitat



- Implementation Monitoring
  - Account for Design Implementation
  - Increase spatial resolution of Effectiveness Monitoring

- Watershed Status, Trends & Effectiveness Monitoring

  - Inform Progress Towards Recovery Plan Goals
    - Channel Complexity
      - 1 key LWD piece per channel width
      - Increase pool frequency by 15%
    - Floodplain Confinement
      - Reduce unnatural confinement to <30% river length

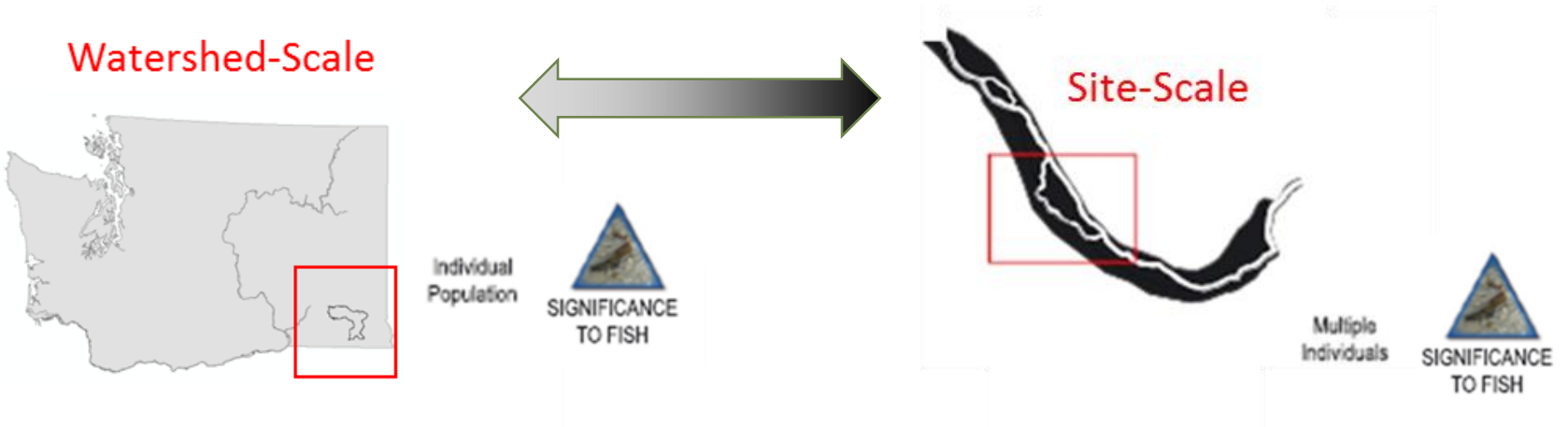
  - Inform Progress Towards Goals Outlined in BiOp
    - 17% improvement in overall habitat conditions

Identify Monitoring Objectives & Goals

Scale of Inference

- Status and Trend Monitoring
  - Tucannon River Watershed
  - Chinook Domain (Mainstem Tucannon River)
    - Focus on Upper Assessment Area (Major Spawning Area)

- Implementation Monitoring
- Project Effectiveness Monitoring
  - Individual Restoration Projects – Site Scale



Identify Metrics, Resolution, & Methods

What should we measure?

- Limiting Factors
  - Channel Complexity
  - Floodplain Connectivity
- Restoration Plan Goals
  - 1 key LWD piece per channel width
  - Increase pool frequency by 15%

- BiOp Goal
  - 17% improvement in overall habitat conditions

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Implementation Monitoring

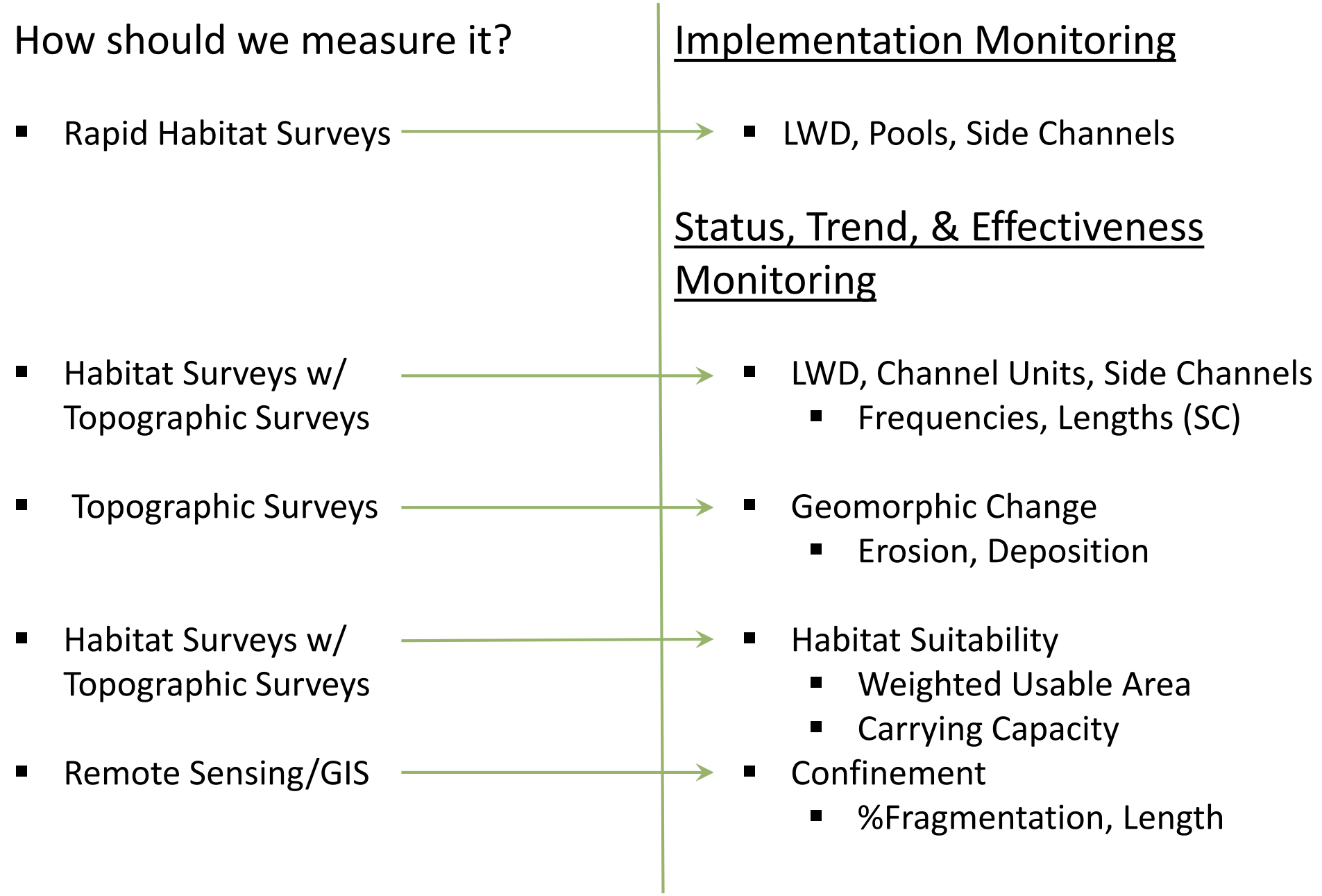
- LWD, Pools, Side Channels

Status, Trend, & Effectiveness Monitoring

- LWD, Channel Units, Side Channels
  - Frequencies, Lengths (SC)
- Geomorphic Change
  - Erosion, Deposition
- Habitat Suitability
  - Weighted Usable Area
  - Carrying Capacity
- Confinement
  - %Fragmentation, Length

Identify Metrics, Resolution, & Methods

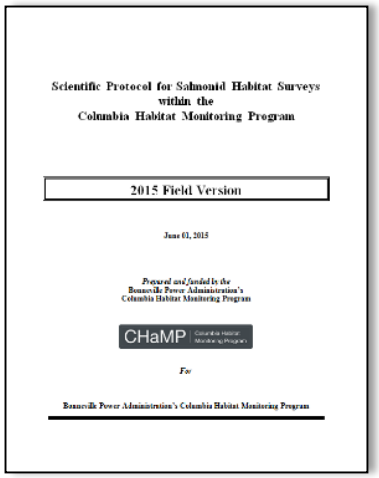
How should we measure it?



Identify Metrics, Resolution, & Methods

How should we measure it?

- Habitat & Topographic Surveys
  Columbia Habitat Monitoring Program (CHaMP) Protocol


Scientific Protocol for Salmonid Habitat Surveys within the Columbia Habitat Monitoring Program

2015 Field Version

June 01, 2015

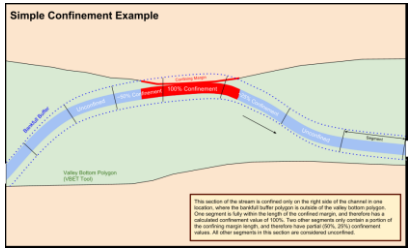
Prepared and funded by the Bonneville Power Administration's Columbia Habitat Monitoring Program

CHaMP

For

Bonneville Power Administration's Columbia Habitat Monitoring Program

- Remote Sensing/GIS
  Integrated Status and Effectiveness Monitoring Program (ISEMP) Confinement Tool



Implementation Monitoring

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- Habitat Suitability
  - Weighted Usable Area
- Confinement
  - %Fragmentation, Length

Identify Metrics, Resolution, & Methods

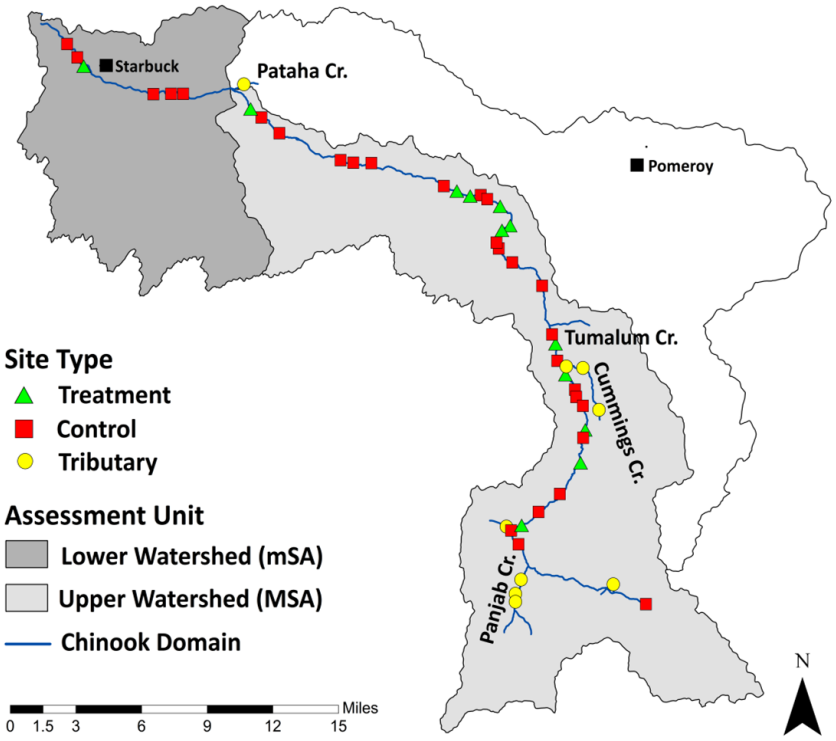
Set Expectations

- LWD
  - Substantial increase in LWD directly after restoration
  - Gradual increase at non-treated (control) sites due to natural recruitment
- Channel Units
  - No immediate increase in pools at treatment sites or control
  - Increase in pool frequencies at treatment sites incrementally given high flow events
- Geomorphic Change
  - Short term dominance of deposition at treated sites then balance between erosion and deposition
  - More overall geomorphic change at treated sites than control sites
- Habitat Suitability
  - Increase in suitability at treated sites given geomorphic change
- Confinement
  - Decreased fragmentation and confinement in restoration areas

Establish Study Design

GRTS - Generalized Random Tesselation Stratified

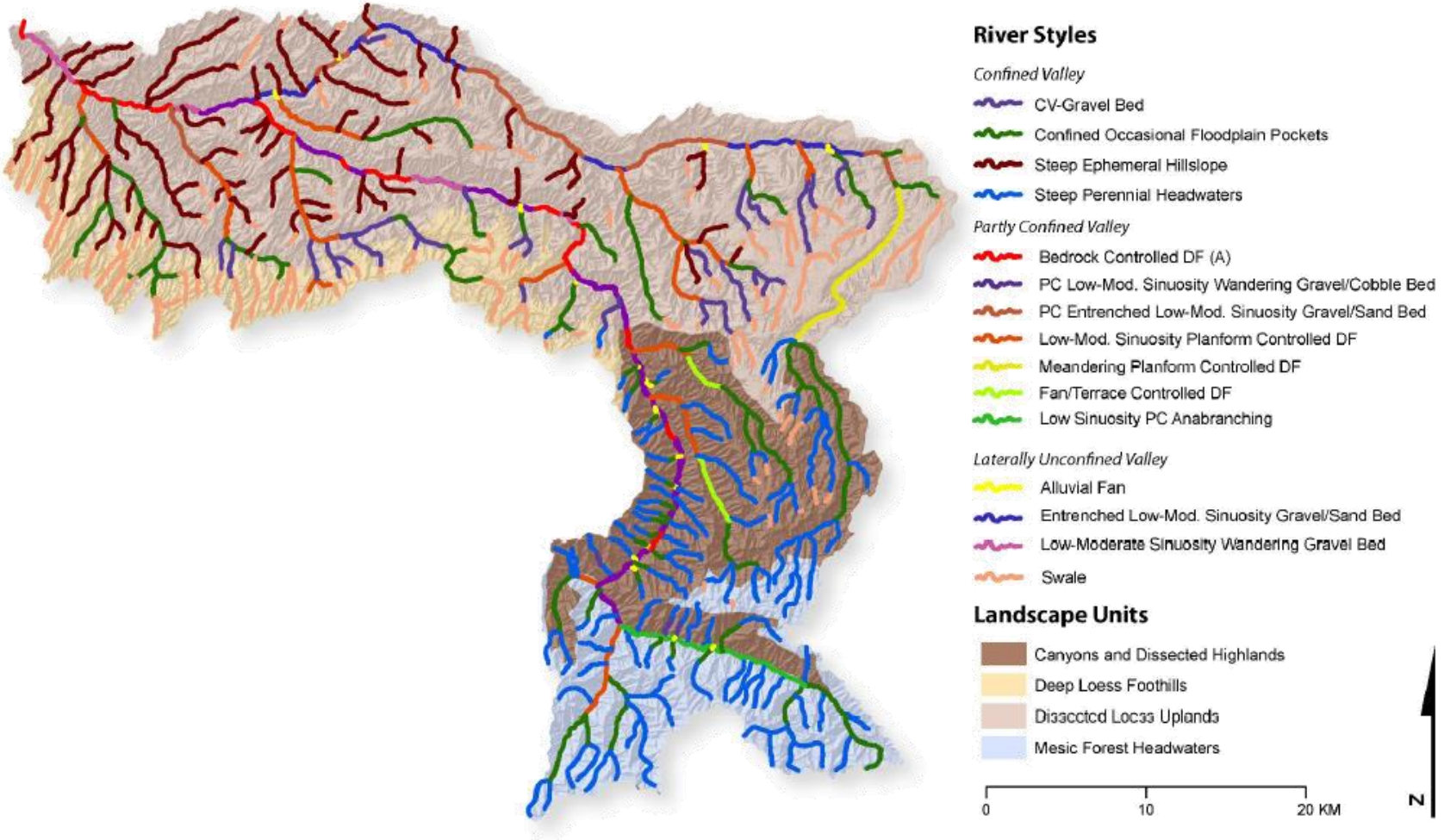
- Spatial Design
  - Control/Treatment Strata on Mainstem
    - 41 Sites (14 Treatment, 27 Control)
    - Paired Treatment/Controls
  - Tributaries
    - 9 Sites
- Temporal design
  - Rotating Panel (Annual, 3-year rotation)
  - Pre-Treatment, Post Treatment
- Response design
  - Habitat Surveys, Topographic Surveys (CHaMP)
- Inference Design
  - GRTS watershed roll up
    - Status, Trend, Treatment Effect
  - Compare Treatment/Controls
    - Effectiveness Monitoring
    - Pre/Post Restoration (BACI)



Establish Study Design

Reach Types – Geomorphic Context

- Compare Treatment/Controls
  - Effectiveness Monitoring
  - Pre/Post Restoration (BACI)



Collect Data

Implementation Logistics

- Communicate With Stakeholders
  - Landowners
    - Site Access
  - Restoration Implementers
    - Timing of Restoration
- Coordinate Data Collection
  - WDFW
  - Eco Logical Research, Inc.
  - Natural Systems Design
  - Umatilla Tribe
  - Snake River Salmon Recovery Board
  - WSU/USU Graduate Students
  - Cramer Fish Sciences

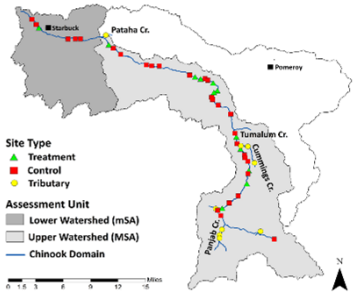
Evaluate Results

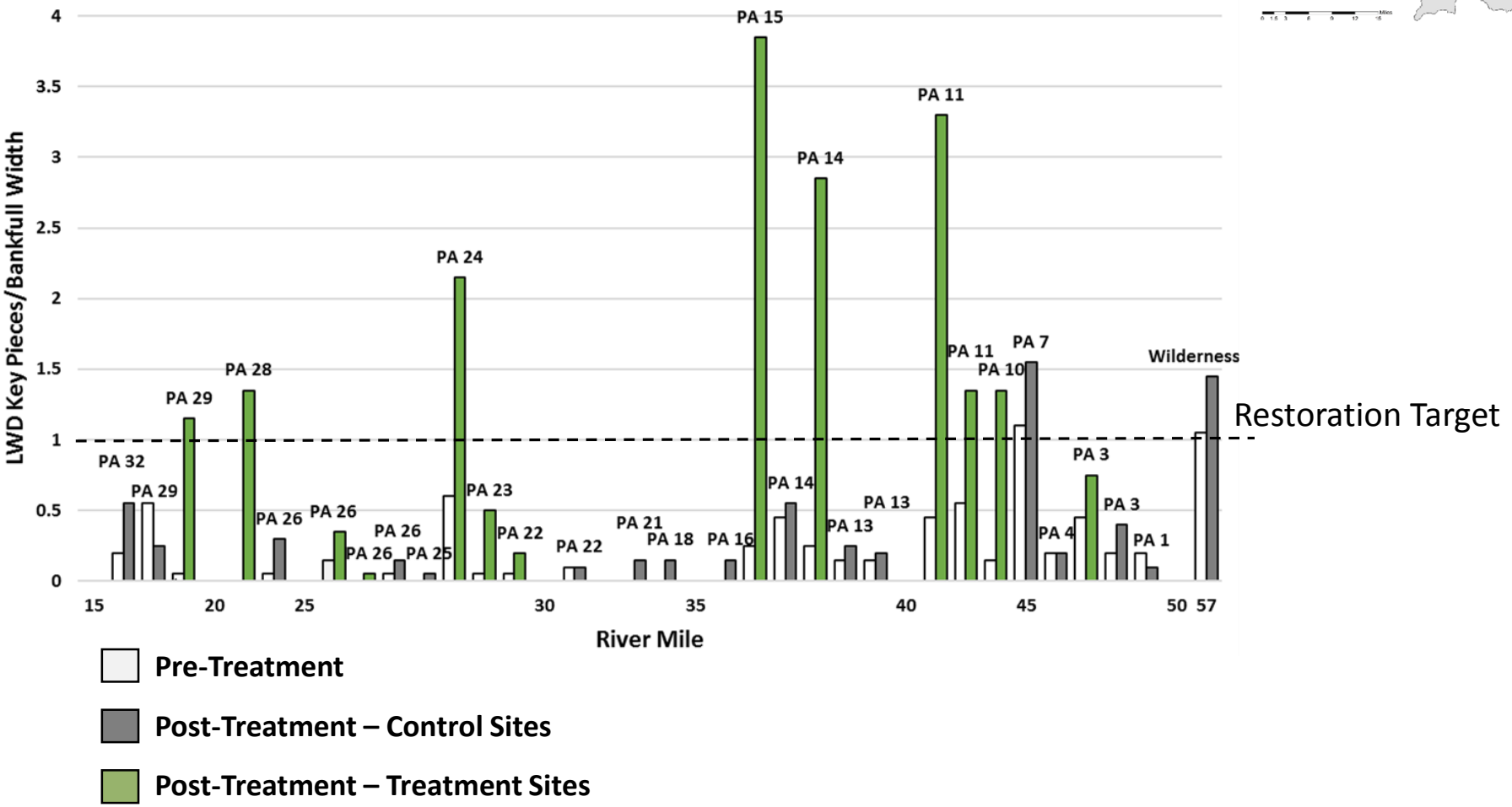
- CHaMP Habitat Surveys
  - LWD
  - Pools

- Topographic Surveys (CHaMP)
  - Tools
    - Geomorphic Change Detection
    - Habitat Suitability Models

Evaluate Results

- CHaMP Habitat Surveys
  - LWD
    - Restoration Plan Goals
      - 1 key LWD piece per channel width





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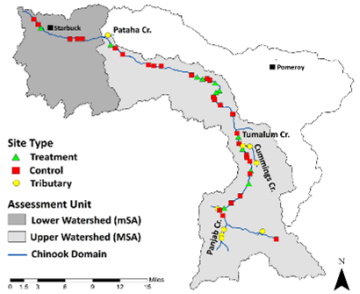
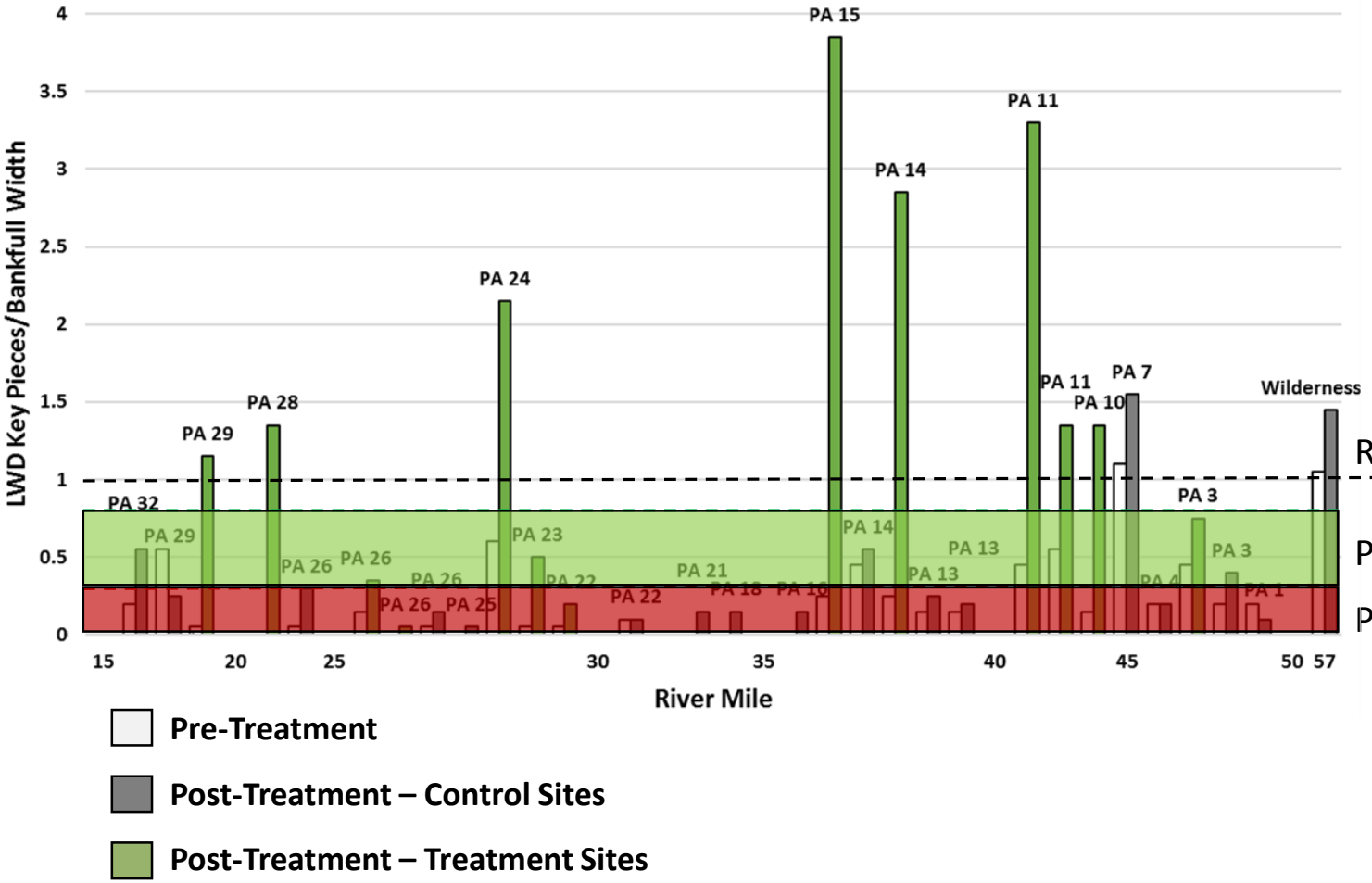
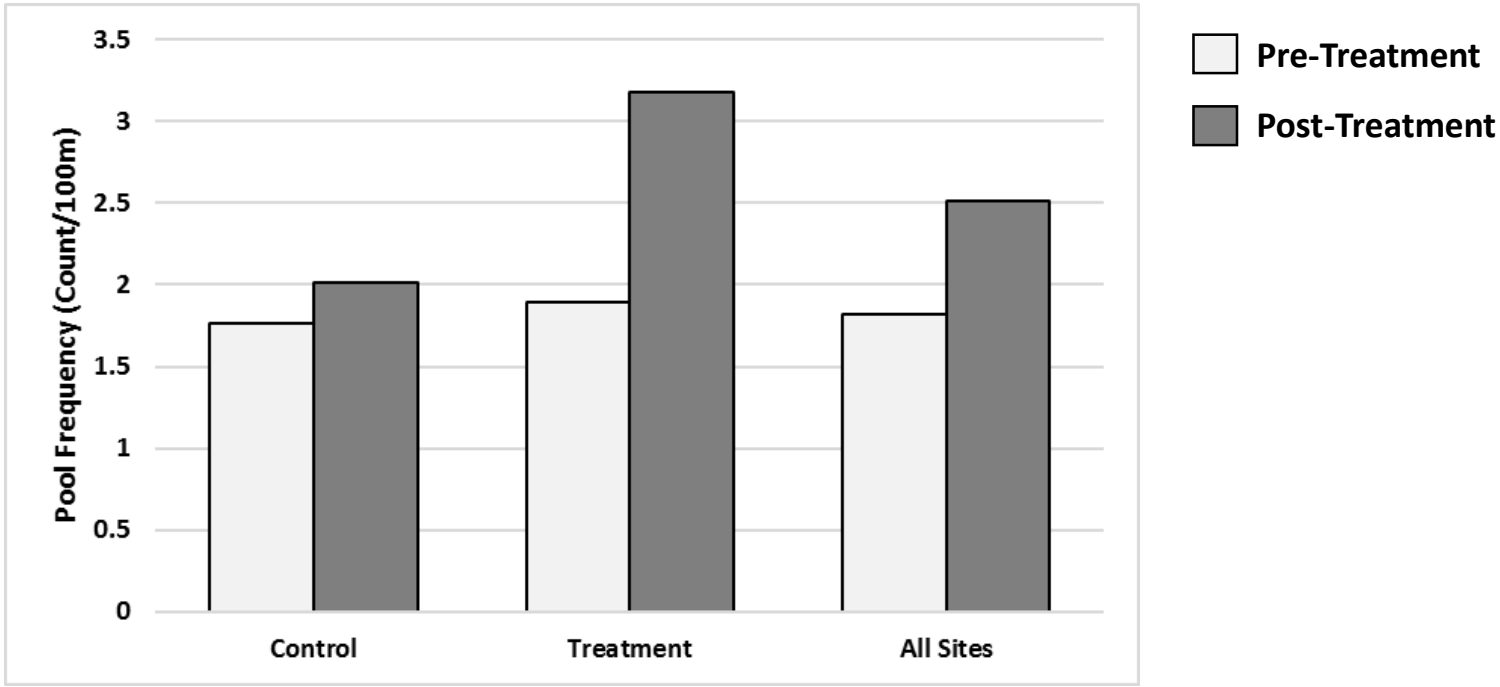




Evaluate Results

- CHaMP Habitat Surveys
  - Pools
    - Restoration Plan Goals
      - Increase pool frequency by 15%

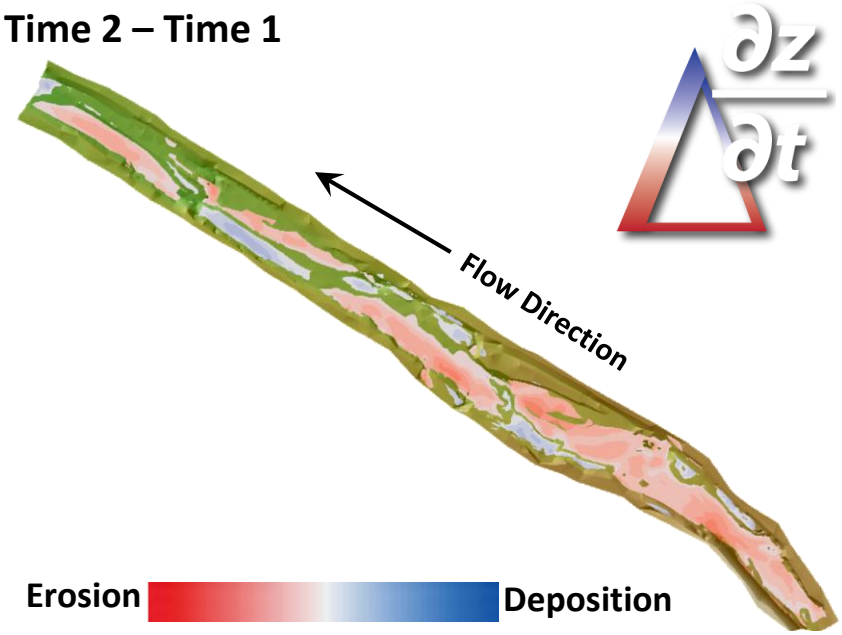


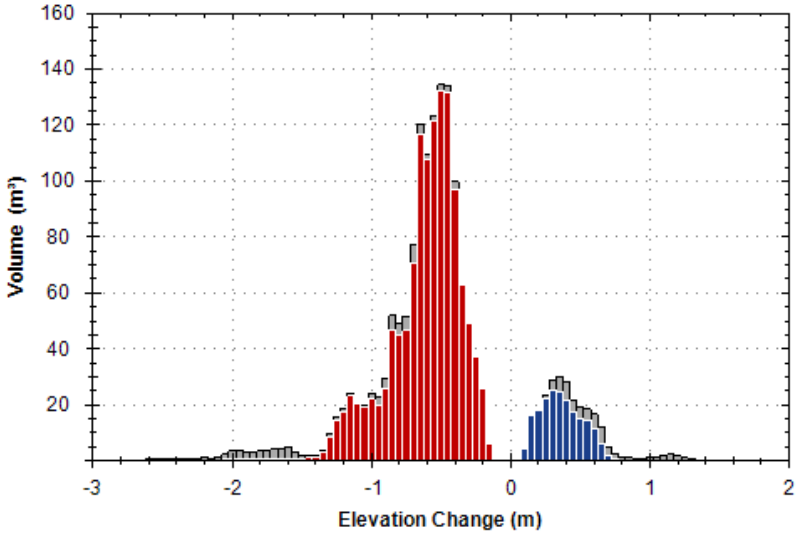
38.5% increase in pool frequency in Upper Watershed

Geomorphic Change Detection (GCD)

Questions To Ask:

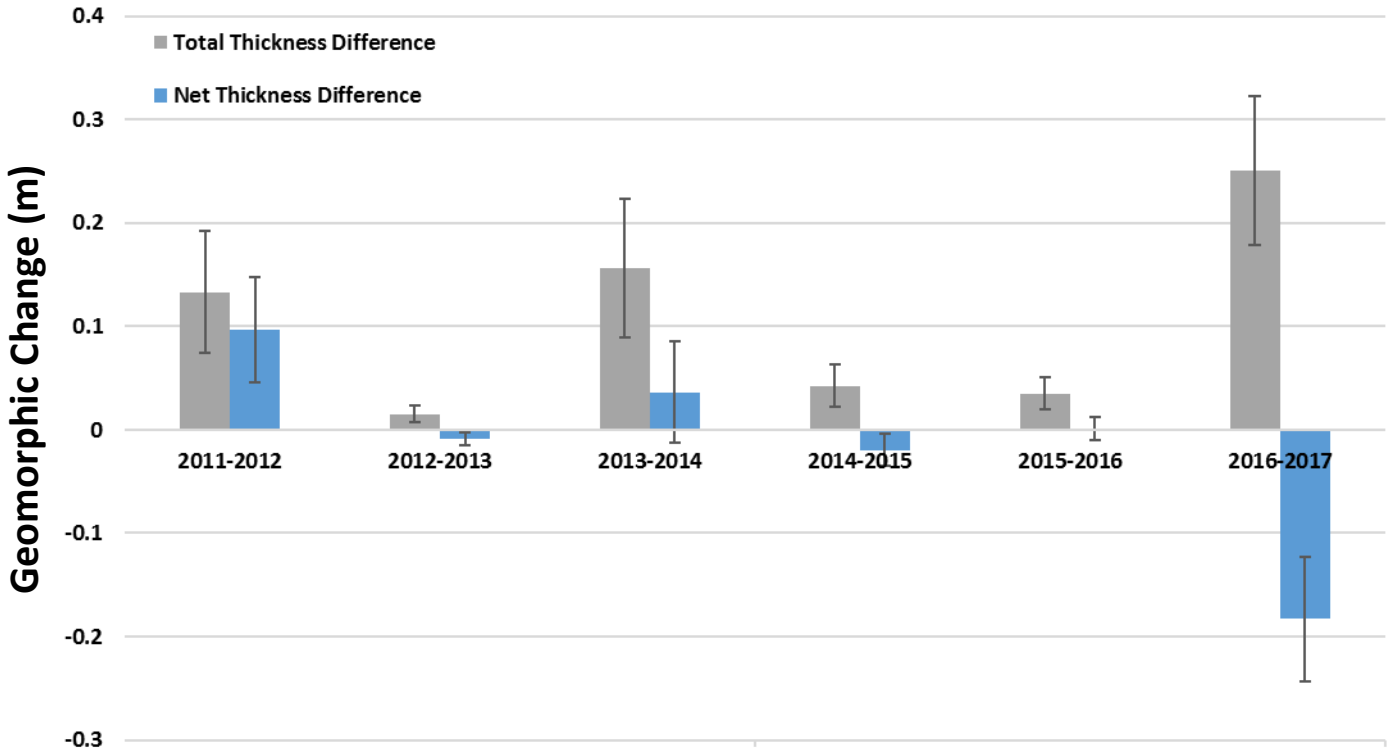
- How much erosion/deposition?
  - Sediment Budget
- How is the river behaving?
  - Channel Dynamics
  - Restoration Design
- Were we able to change behavior?
  - Restoration Effectiveness
- Where did geomorphic changes occur?
  - Structure Effectiveness





Geomorphic Change Detection (GCD)

- How is the river behaving?
  - Channel Dynamics
  - What restoration design(s) would best capitalize on these dynamics?



$$\textbf{Total}\ Thickness\ Difference(m) = \frac{Volume\ \Delta\ (m^3)}{Area\ (m^2)}$$

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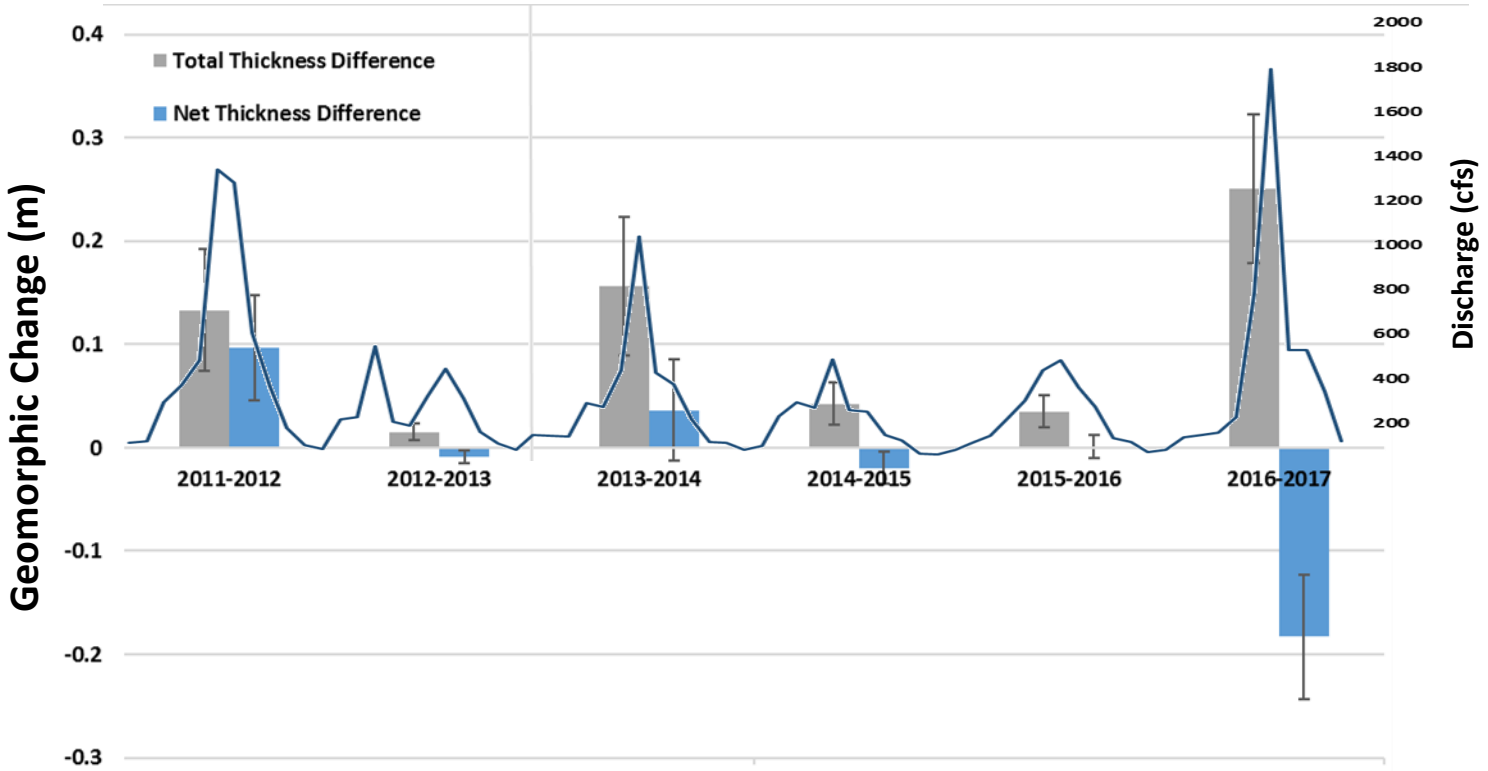

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- Where we able to change the behavior?
  - Restoration Effectiveness
- Where did change occur?
  - Structure Effectiveness

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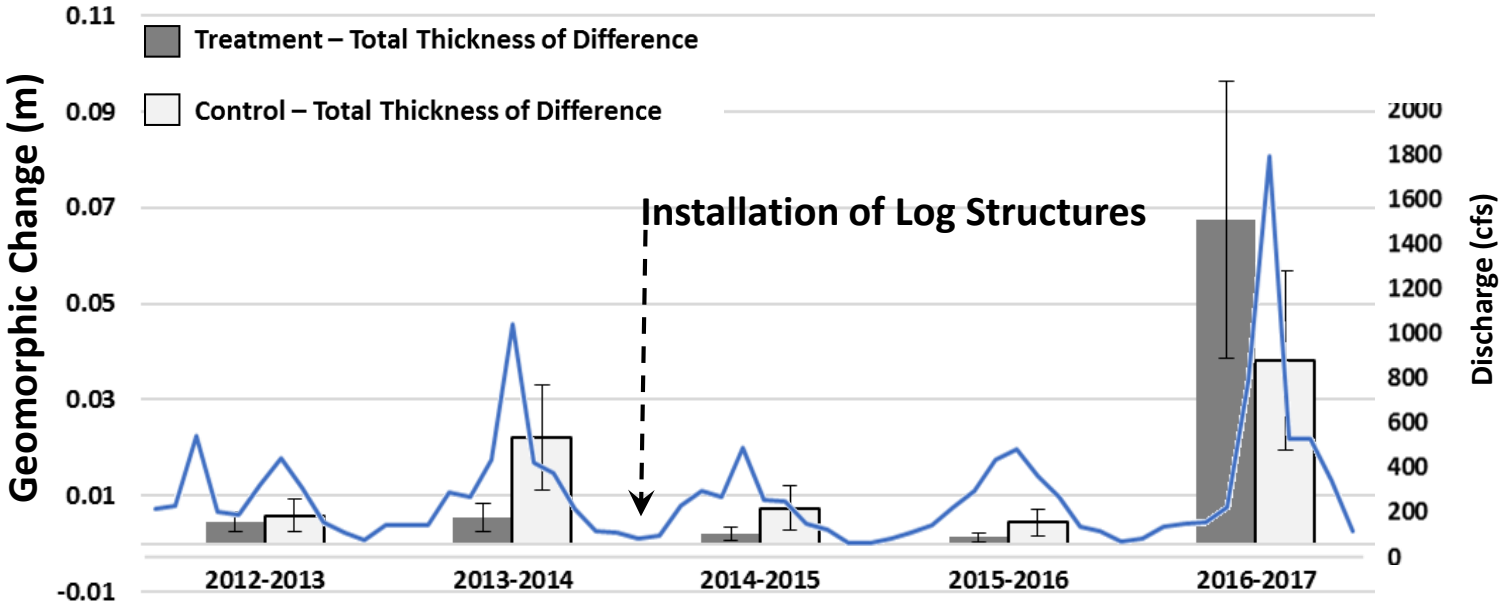
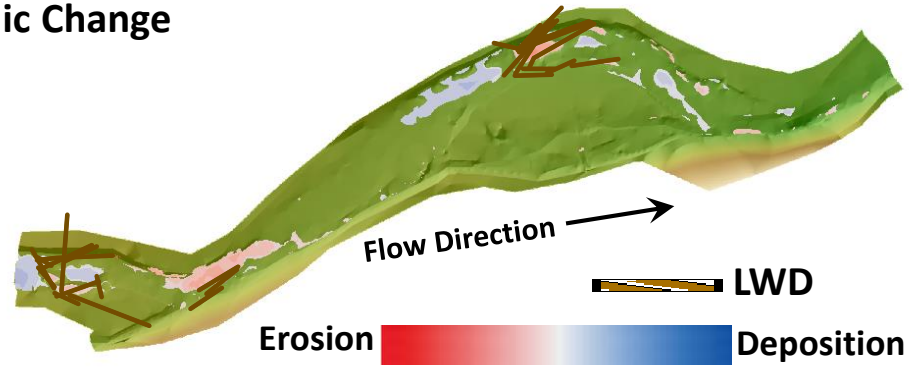
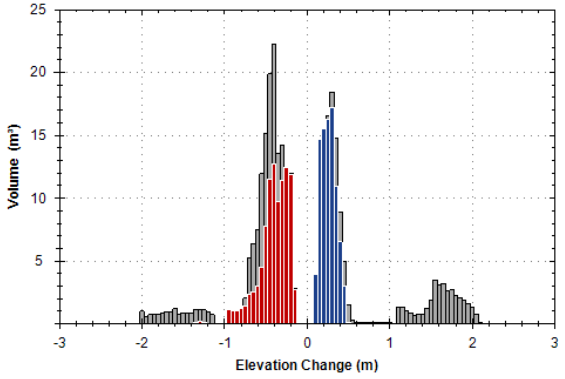


Geomorphic Change 2014-2017





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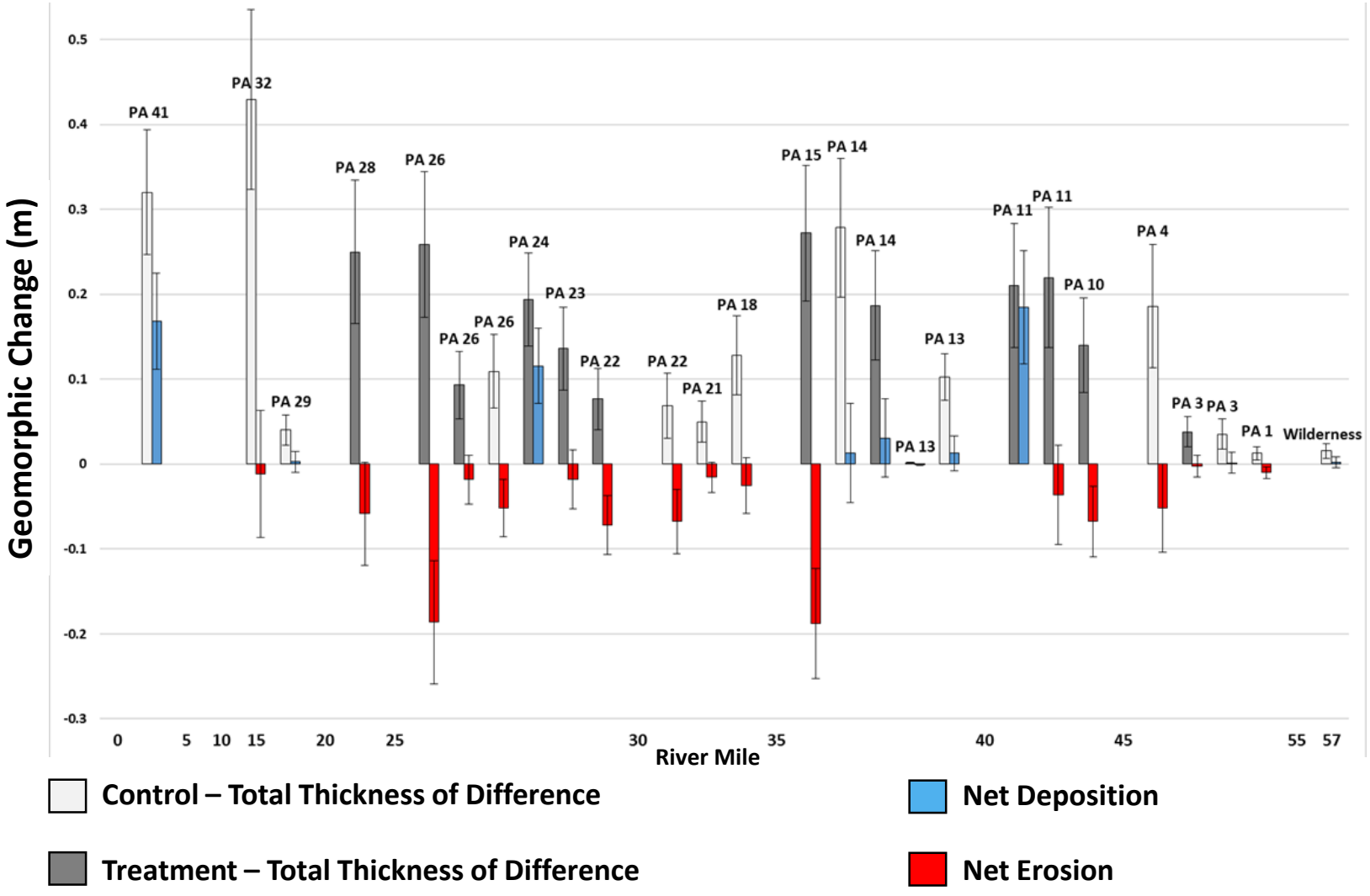

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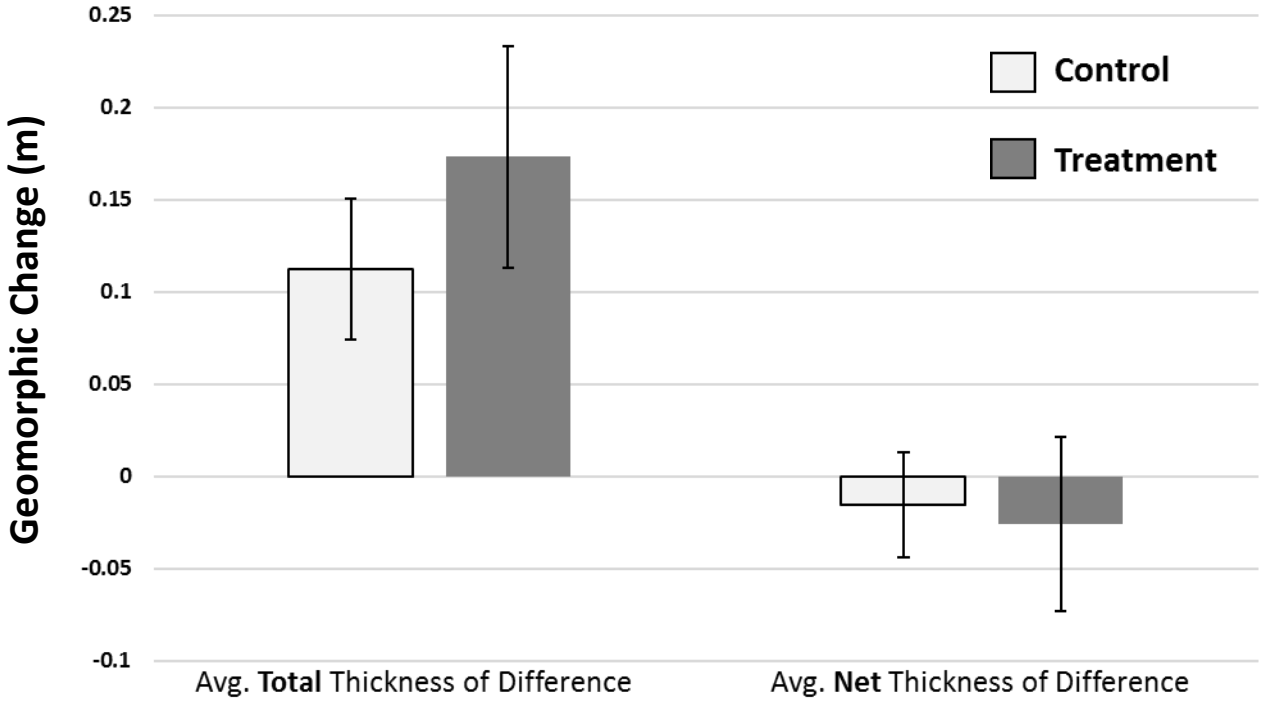


Habitat Suitability Models

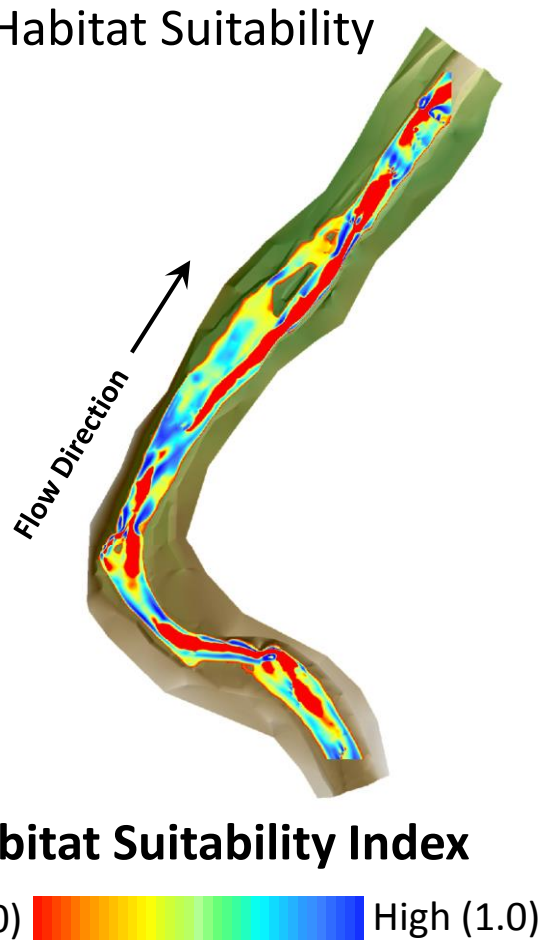
- How do changes in conditions influence habitat suitability?
  - Restoration Effectiveness

Site Summary Metrics:

- Weighted Usable Area (WUA)

$$WUA = \sum_{i=1}^{n} Suitability_i * Area_i$$

- Normalized WUA
  - WUA/Area
  - Standardized, easier to compare among sites/basins
- Carrying Capacity
  - Based on territory size



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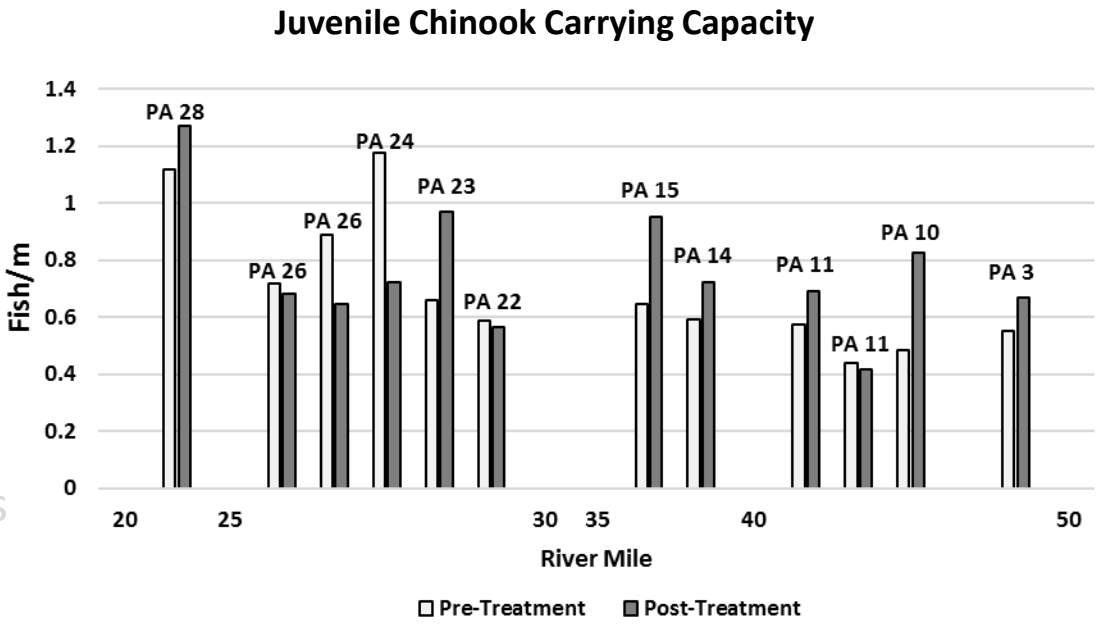

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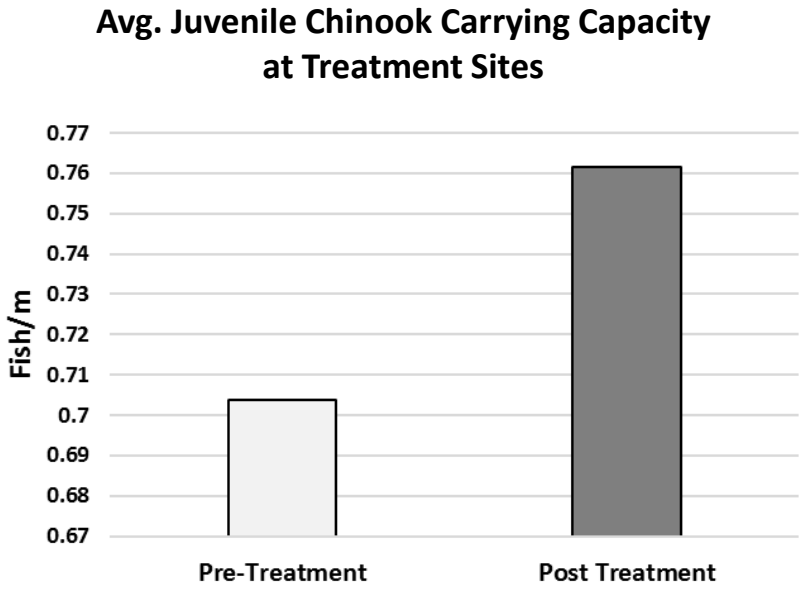
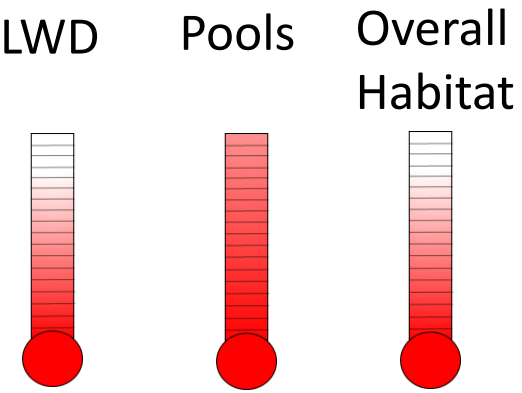


8.2% increase in capacity at treatment sites

Conclusions & Adaptive Management

- Restoration Plan Goals
  - 1 key LWD piece per channel width
  - Increase pool frequency by 15%
- BiOp Goal
  - 17% improvement in overall habitat conditions

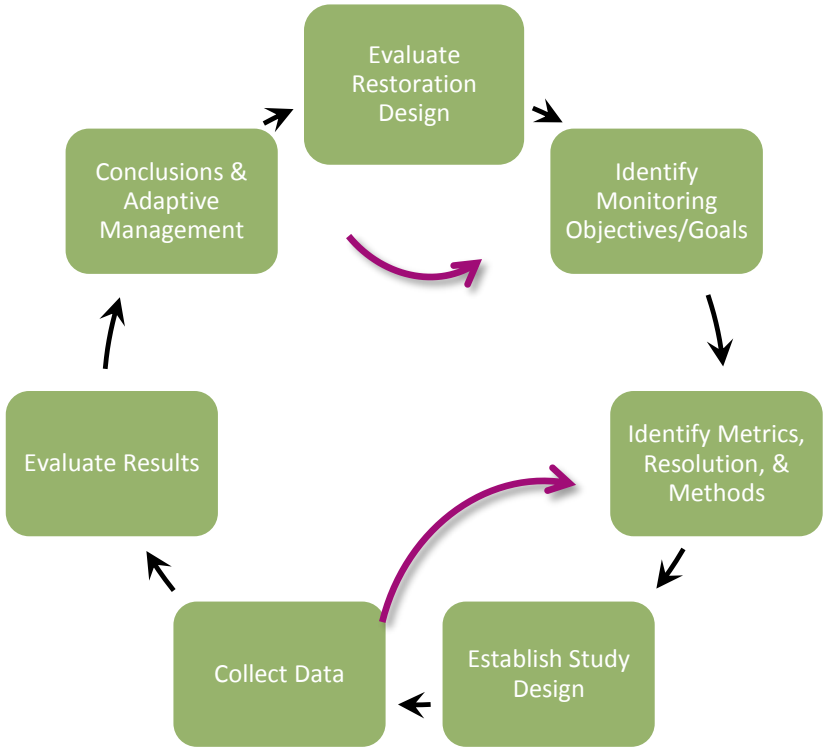


Preliminary Conclusions

- Trajectory is toward Restoration Plan Goals
- Need to see additional habitat improvements to meet BiOp goals
- Monitoring needs to be long term to be conclusive
- What are we missing?

Adaptive Management

- Use results to prioritize new projects
- What projects could use additional supplements to original design and why?



Lessons Learned

- Restoration/Recovery Goals can be vague
  - Work with managers to clearly define goals and how to measure them
    - What does 17% improvement in overall habitat conditions mean?

- Work with restoration implementers to clearly define project objectives
  - Develop hypotheses (project level or even structure level)
    - What does habitat complexity mean and how do you measure it?

  - Provide constructive feedback on restoration outcomes
    - Were objectives met?

- Coordination among stakeholders is key

- Develop an Adaptive Management Plan for guidance
  - Restoration Design
  - Monitoring Objectives