BROADENING THE VIEW OF "LIMITING FACTORS" VS. "PROCESS-BASED" RESTORATION

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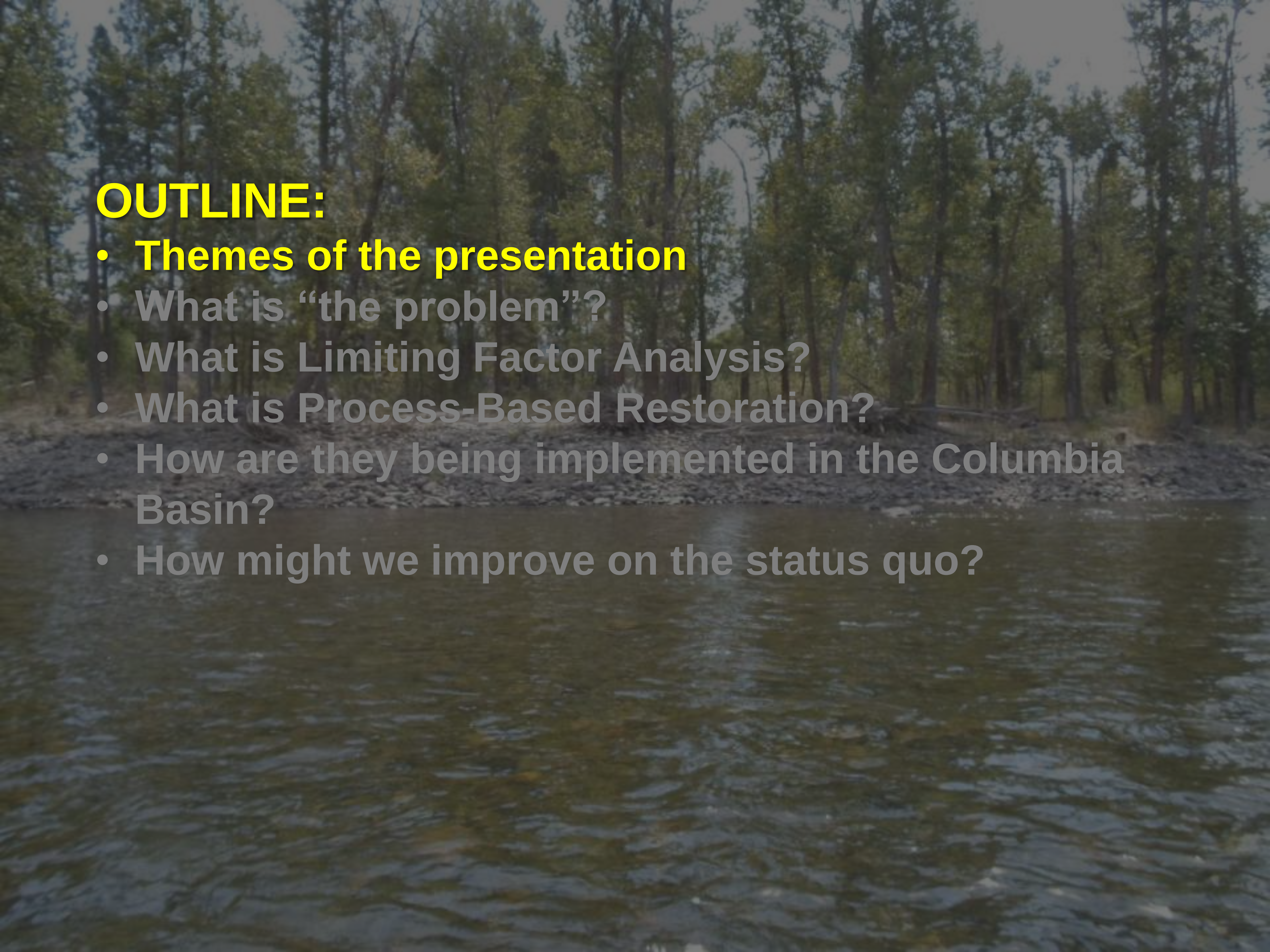
OUTLINE:

- Themes of the presentation
- What is “the problem”?
- What is Limiting Factor Analysis?
- What is Process-Based Restoration?
- How are they being implemented in the Columbia Basin?
- How might we improve on the status quo?



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1. Two approaches to restoration planning (LFA and PBR): different, but complementary
2. Recovery of **processes** vs. construction of **forms**
3. Processes occur over a range of spatial and temporal scales (regional to local, long-term to short-term)
4. Restoration occurs in both natural and human landscapes: thus, we must recognize social "processes"
5. Integrating these components is possible, beneficial, and probably necessary for restoration success

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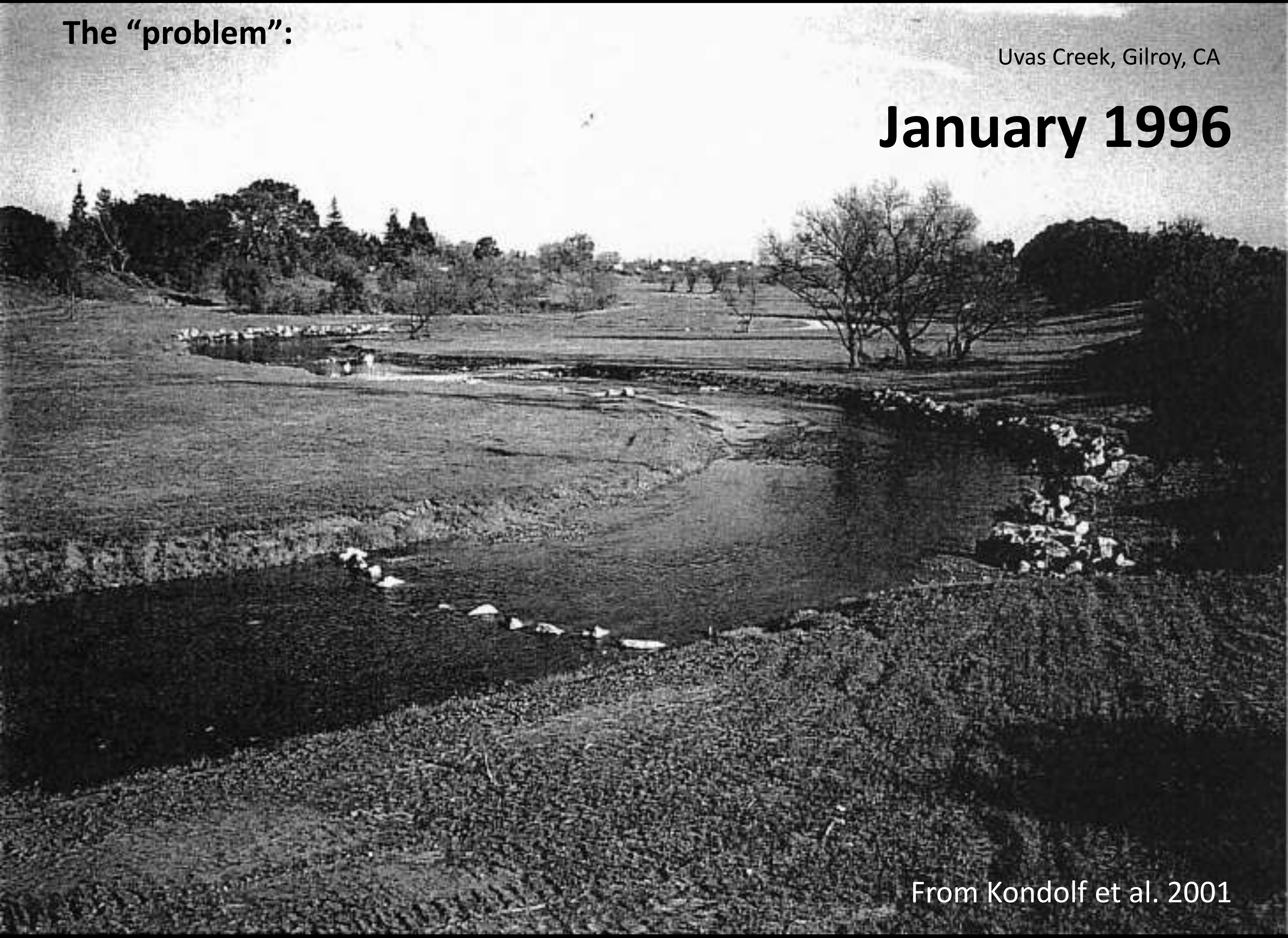
The "problem":

The “problem”: site-specific, symptomatic actions

The “problem”:



The “problem”: site-specific solutions without watershed context or process understanding

Uvas Creek, Gilroy, CA

June 1997

From Kondolf et al. 2001

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United States
Department of
Agriculture

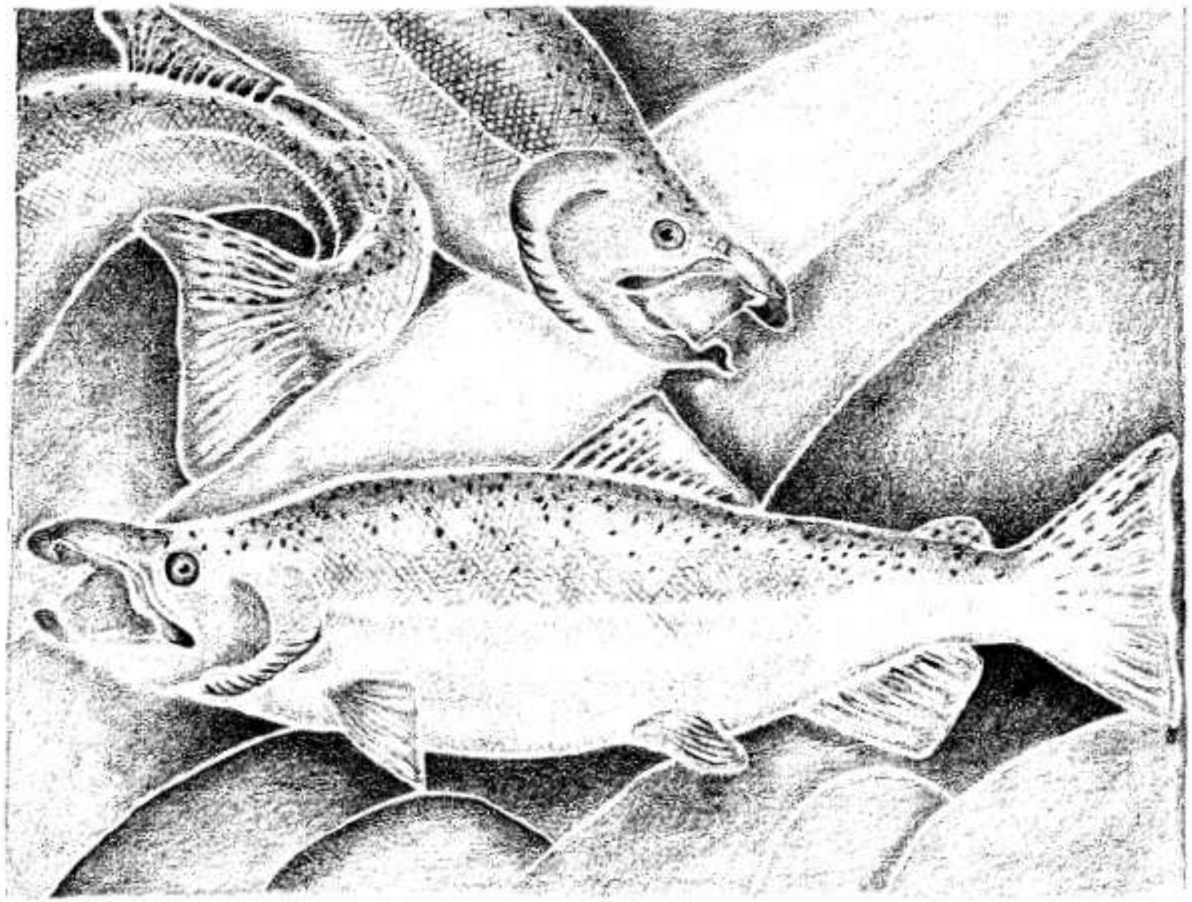
Forest Service

Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-245
September 1989

Identification of Physical Habitats Limiting the Production of Coho Salmon in Western Oregon and Washington

Gordon H. Reeves, Fred H. Everest, and Thomas E. Nickelson



“An analysis of factors limiting production of salmonids in streams must be completed before any habitat-enhancement program is begun. This paper outlines the first formal procedure for identifying physical habitats limiting production of coho salmon.”

“The following key is designed to help fishery managers identify factors limiting the production of juvenile coho salmon *(Oncorhynchus kisutch* (Walbaum)) in streams of coastal and interior (west of the Cascade Range) Oregon and Washington. The key…is designed to identify potential physical limitations to fish production that may be moderated or removed by habitat rehabilitation or enhancement programs.”

“The model assumes that when the habitat needed by a species during a particular season of the year is in short supply, a bottleneck is created and the species will suffer extensive density-dependent mortality. If the population is reduced to a level such that subsequent habitats are underseeded, the habitat producing the bottleneck is identified as the limiting habitat.”

Reeves et al. 1989

“We recognize that factors other than physical features, such as nutrients and food availability, may limit production of juvenile salmonids. We feel, however, that neither the procedures for identifying such limitations nor the techniques for eliminating them are well developed and therefore they are not yet useful to fishery managers.”

"We recognize that factors other than physical features, such as nutrients and food availability, may limit production of juvenile salmonids. We feel, however, that **neither the procedures for identifying such limitations nor the techniques for eliminating them are well developed and therefore they are not yet useful to fishery managers."**

(…as of 1989)

Summary of Limiting Factors Analysis:

APPROACH: What physical habitat is in short supply? Rebuild it.

PRO:

- Intuitive
- clear chain of cause-and-effect
- directly responsive to the perceived "problem" (i.e., low numbers of fish)

CON:

- limited physical habitat may not be the worst/only problem (this limitation was recognized by the developers) (but forgotten by practitioners?)
- invites symptomatic fixes
- silent on whether/how habitat features can persist over time

→ LFA can disclose critical problems, but it has the potential to produce solutions overly limited in both space (i.e., building reach-scale habitat "features") and time (i.e., features not sustained long-term by watershed and in-stream processes)


FIELD OF DREAMS


If you build it, they will come

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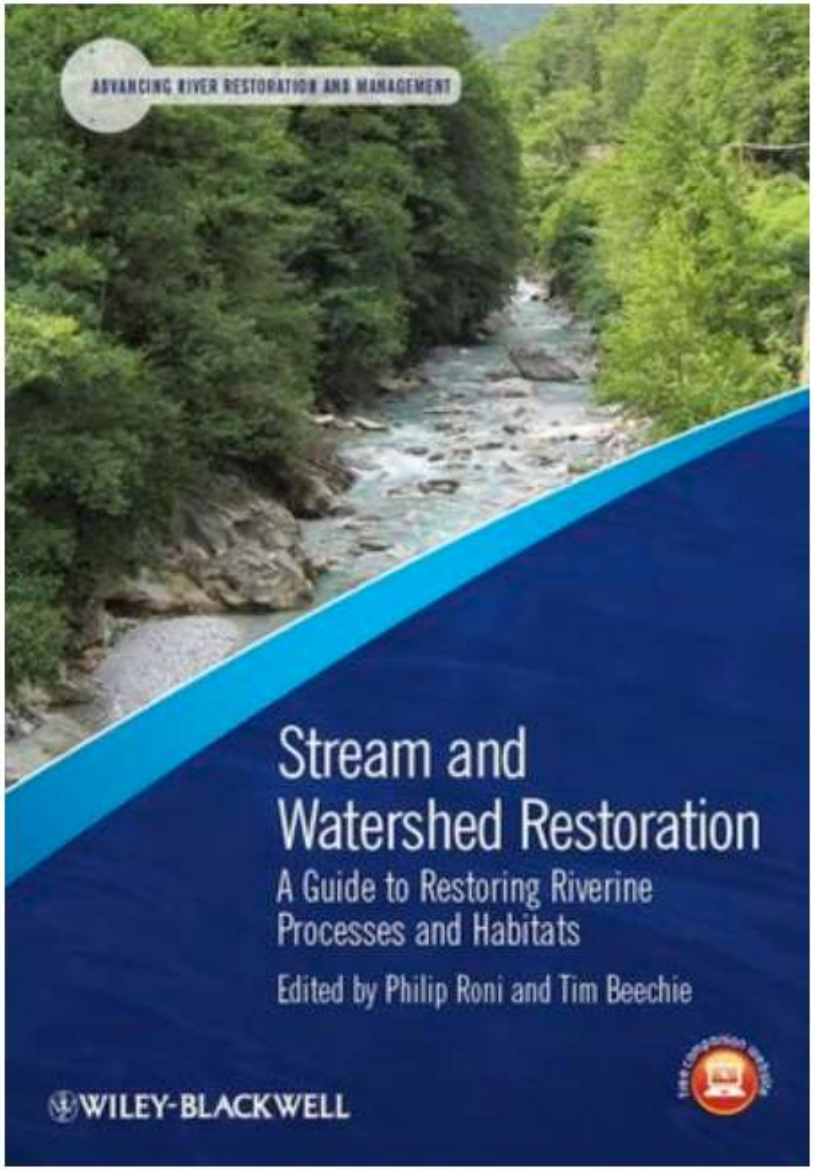
Correcting the ***<u>causes</u>*** of stream degradation: Process-based restoration

Process-based restoration, then, focuses on correcting anthropogenic disruptions to [watershed and riverine] processes, such that the river-floodplain ecosystem progresses along a recovery trajectory with minimal corrective intervention…”

Beechie et al. 2010

Beechie, T.J., Sear, D.A., Olden, J.D., Pess, G.R., Buffington, J.M., Moir, H., Roni, P., Pollock, M.M. Process-based principles for restoring river ecosystems (2010) BioScience, 60 (3), pp. 209-222.



Stream and Watershed Restoration: A Guide to Restoring Riverine Processes and Habitats (2013)

Principle 1: Target the root causes of habitat and ecosystem change.

Principle 2: Tailor restoration actions to local potential.

Principle 3: Match the scale of the restoration to the scale of the problem.

Principle 4: Be explicit about expected outcomes.

Principle 1: Target the root causes of habitat and ecosystem change.

For example….

SYMPTOM → RESPONSE (*not* "process-based restoration")

Few pools → build LWD structures

Eroding banks → armor the bank

Instead, consider:

CAUSE → SYMPTOM → RESPONSE

High sediment loads → few pools → reduce sediment inputs

Levee confinement → eroding banks → setbacks, riparian zone

Principle 2: Tailor restoration actions to local potential (don't make a ditch into a Chinook spawning channel).

"Restoration designs and techniques should be tailored to local physical and biological potential, which are controlled by processes operating at regional, watershed, reach, and site scales…Restoration targets consistent with natural potential can be identified through historical analysis and by **assessing disruptions to the primary driving processes**."

So—assessments to support restoration need to address:

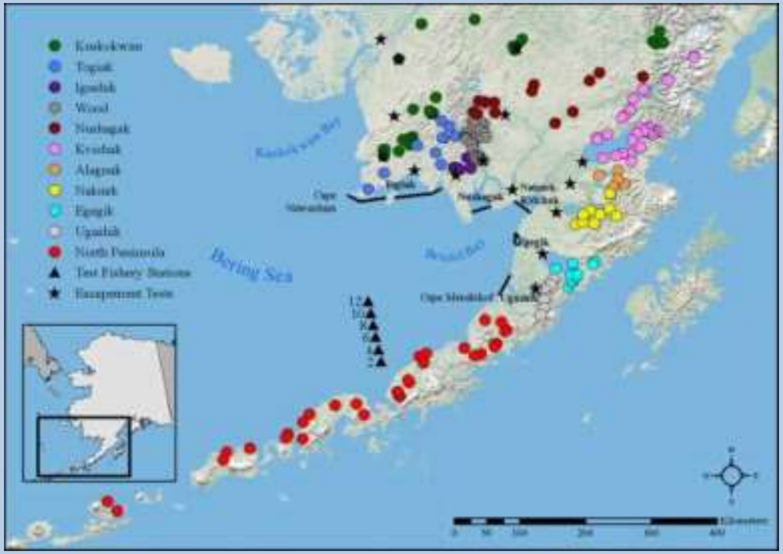
- **Processes at multiple scales**
- **Historical processes and conditions**
- **How those processes have been disrupted**

Principle 3: Match the scale of the restoration to the scale of the problem.

When disrupted processes causing degradation are at the reach scale (e.g., channel modification), restoration actions at individual sites can effectively address root causes.

BUT--when causes of degradation are at the watershed scale (e.g., increased runoff and erosion due to impervious surfaces), many individual site-scale (and broader) actions will be needed.

For example, recovery of wide-ranging fishes (e.g., Pacific or Atlantic salmon) requires restoration planning and implementation at the scale of population ranges.



Principle 4: Be explicit about expected outcomes.

Process-based restoration is a long-term endeavor and there are often long lag times between implementation and recovery.

Ecosystem features will also continuously change through natural dynamics, and biota may not improve dramatically with any single individual action.

Hence, quantifying the restoration outcome is critical to **setting realistic expectations for river restoration**.

Consequences of embracing the 4 principles of Process-Based Restoration:

1. Every location in a channel network is a product of its specific combination of **local, watershed, and regional conditions** (Principle 2).

2. These drivers of habitat conditions are multi-scalar, so both **analyses and solutions must be multi-scalar as well** (Principles 1 & 3).

3. Changes to watershed processes **take time** to be expressed by changes to instream conditions (Principle 4).

4. Modifying/restoring watershed processes typically must occur on a **human-occupied landscape**, and this dimension must be incorporated into restoration planning (Principle 3).

Consequences of embracing the 4 principles of Process-Based Restoration:

The connection between* (1) the restoration of watershed processes *and* (2) the response of in-stream habitat *can be slow and indirect, and these efforts do not come with a money-back guarantee. This approach is, in its own way, "faith-based restoration" as well: if you restore* processes*, recovery of degraded* habitat *will ultimately occur, and persist.

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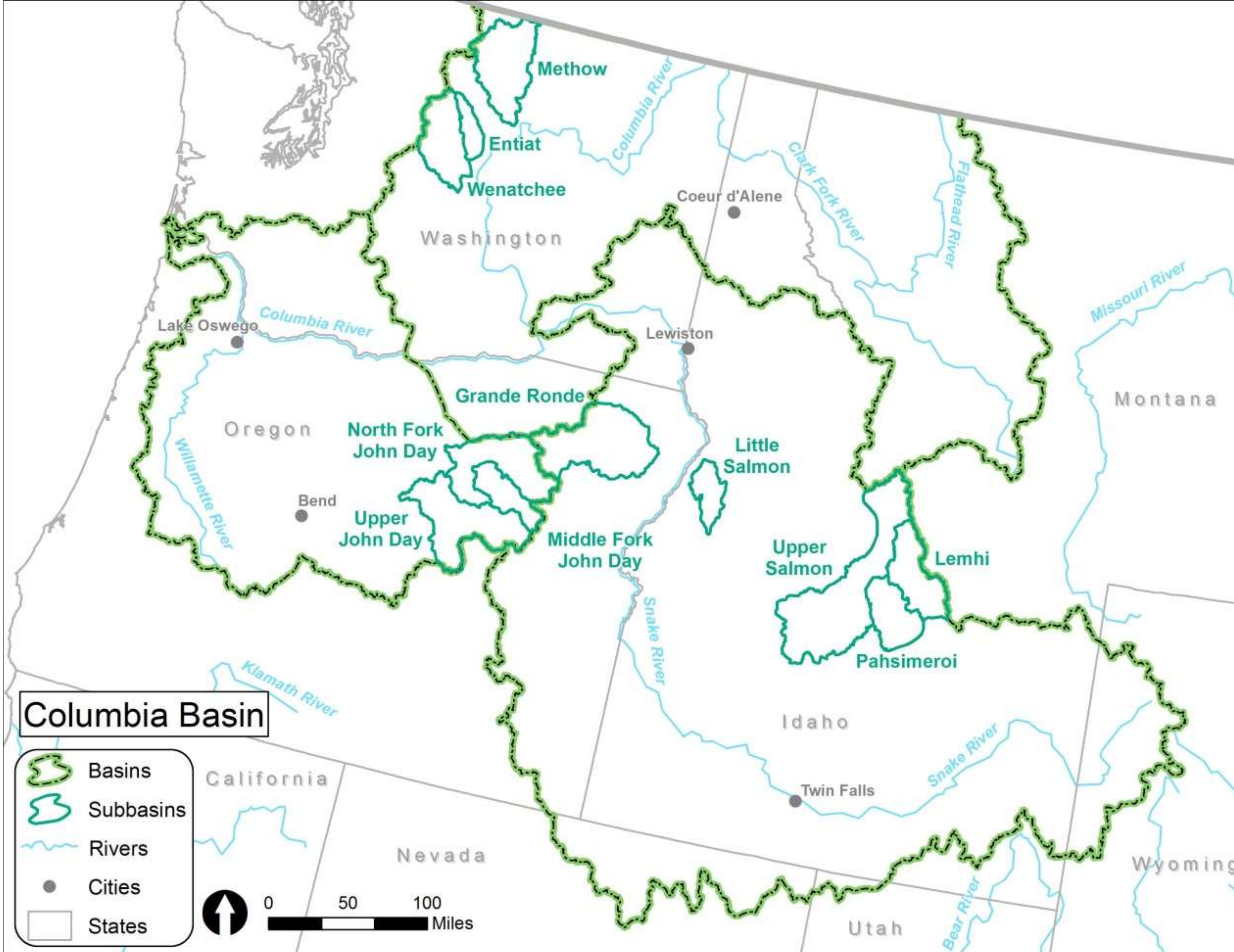


Columbia Basin
Basins
Subbasins
Rivers
Cities
States
0
50
100
Miles
Methow
Entiat
Wenatchee
Columbia River
Clark Fork River
Flathead River
Coeur d'Alene
Washington
Missouri River
Lake Oswego
Columbia River
Lewiston
Grande Ronde
Montana
Oregon
North Fork
John Day
Little
Salmon
Bend
Upper
John Day
Middle Fork
John Day
Upper
Salmon
Lemhi
Willamette River
Snake River
Pahsimeroi
Klamath River
Idaho
California
Snake River
Twin Falls
Nevada
Wyoming
Utah
Bear River

DRAFT

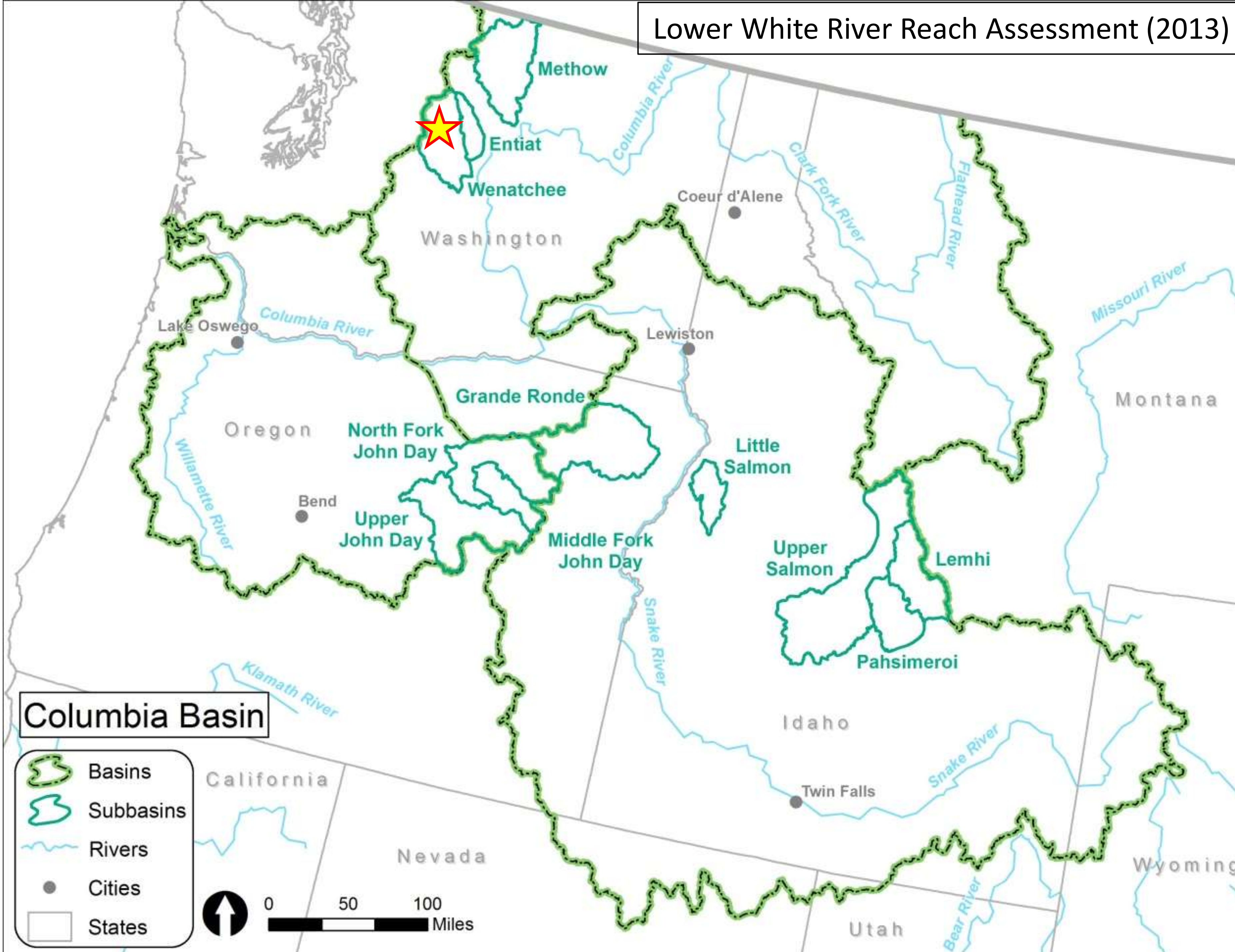
REACH ASSESSMENT: CHANNEL AND FLOODPLAIN HYDROLOGY, GEOMORPHOLOGY, HABITAT, AND VEGETATION

LOWER WHITE RIVER, CHELAN COUNTY, WASHINGTON

Prepared for
Cascade Columbia Fisheries
Enhancement Group

November 2013

Lower White River Reach Assessment (2013)



Executive Summary

The Cascade Columbia Fisheries Enhancement Group (CCFEG) is working with the US Fish and Wildlife Service (USFWS), the Chelan-Douglas Land Trust (Land Trust), and other local stakeholders to enhance native fish habitat on the lower portion of the White River, upstream from its confluence with Lake Wenatchee in Chelan County, Washington.

Habitat enhancement through the restoration of river and floodplain processes provides long-term benefits consistent with the management goals of the Land Trust and CCFEG. In order to effectively target future restoration efforts, CCFEG wants to accomplish these goals:

- Understand the large-scale river and floodplain processes at work in the study area
- Identify and evaluate the key limiting factors affecting these processes **(?)**
- Assess and characterize the potential restoration opportunities that would address those limiting factors

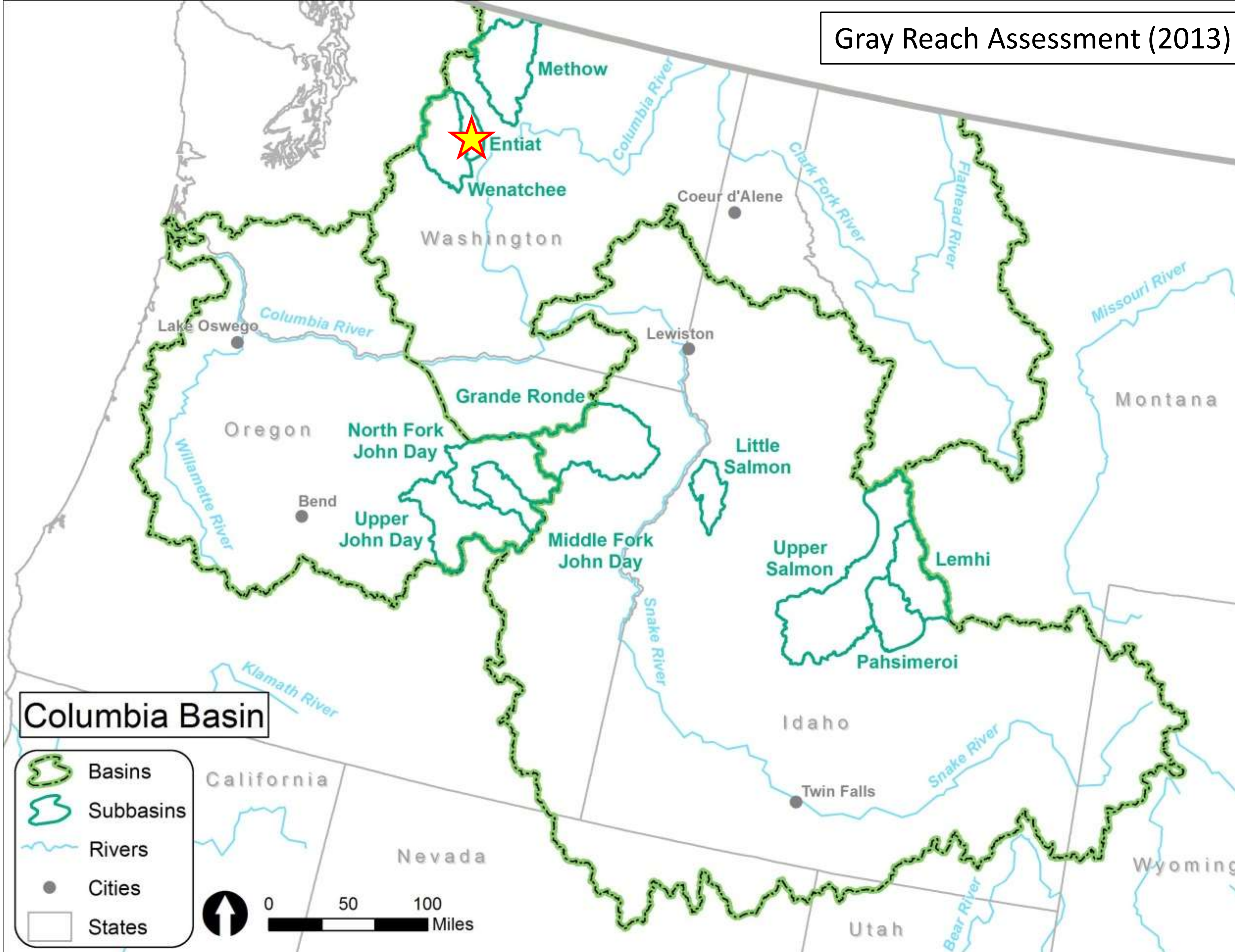
RECLAMATION
Managing Water in the West

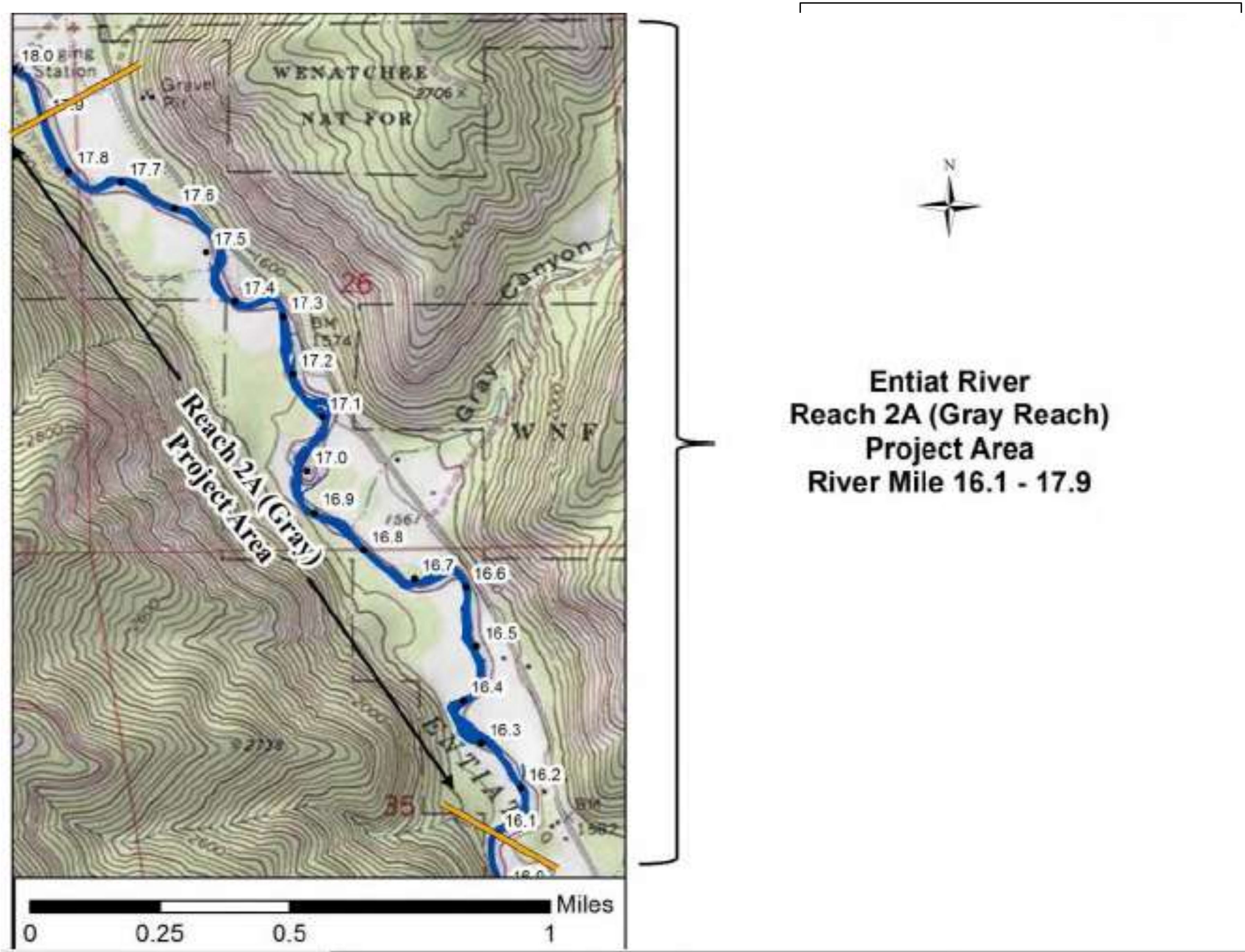
FINAL
Gray Reach Assessment
Entiat River, Chelan County, Washington

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

May 2013

Gray Reach Assessment (2013)





18.0
Station
Gravel Pit
WENATCHEE
NAT FOR
2706
17.8
17.7
17.6
17.5
17.4
17.3
BM 1574
17.2
17.1
17.0
16.9
16.8
16.7
16.6
16.5
16.4
16.3
16.2
16.1
26
35
Gray Canyon
W N F
ENTIAT
Reach 2A (Gray) Project Area
N
Miles
0
0.25
0.5
1
Entiat River
Reach 2A (Gray Reach)
Project Area
River Mile 16.1 - 17.9

Limiting Factors

Limiting factors are defined as those conditions or circumstances that limit the successful growth, reproduction, and/or survival of select species of concern. This report focuses exclusively on physical conditions for Upper Columbia River steelhead (*Oncorhynchus mykiss*) and Upper Columbia spring Chinook salmon (*O. tshawytscha*), both of which are listed under the ESA.

In this reach assessment, LF's were identified as:

1. Lack of overwintering juvenile rearing habitat
2. Lack of instream structure
3. Loss of well-established riparian vegetation and cover
4. (Excess fine sediment)
5. (Fluctuating summer water temperature)

Next Steps

This reach assessment is intended to be used as one tool among many to help guide river process rehabilitation and habitat improvement in the Gray Reach of the Entiat River. The actions outlined in this report represent appropriate actions for the river, but are not an exhaustive assessment of all possible actions that can be used to achieve habitat benefits.

- Step 1 – Identify physically appropriate actions (this assessment).
- Step 2 – Identify from those actions that are physically appropriate, which provide the greatest biological benefit (RTT and local partner review).
- Step 3 – Identify from those actions that are physically appropriate and of significant biological benefit which are socially acceptable and of benefit to individual landowners (sponsor support and project development).

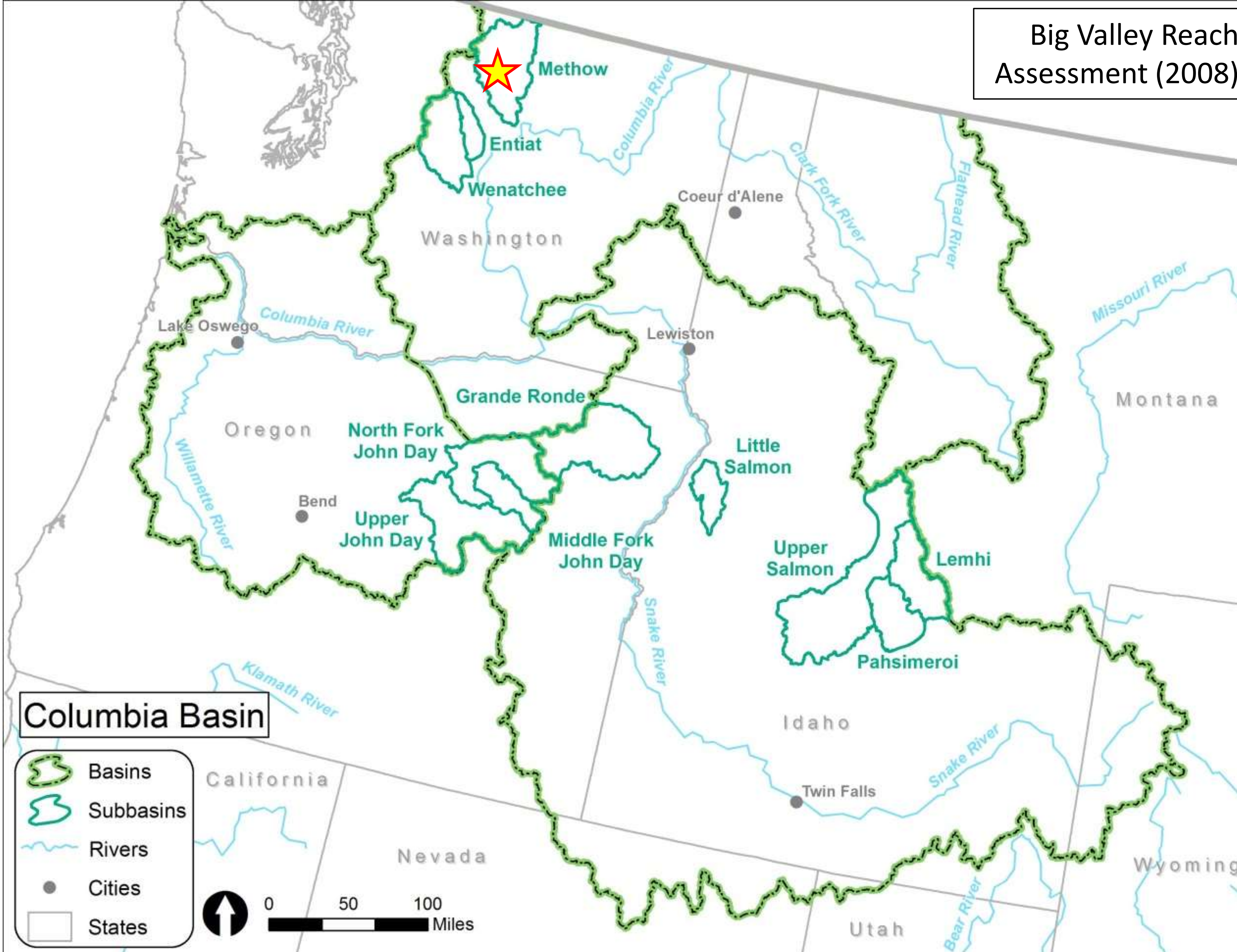
Big Valley Reach Assessment (2008)

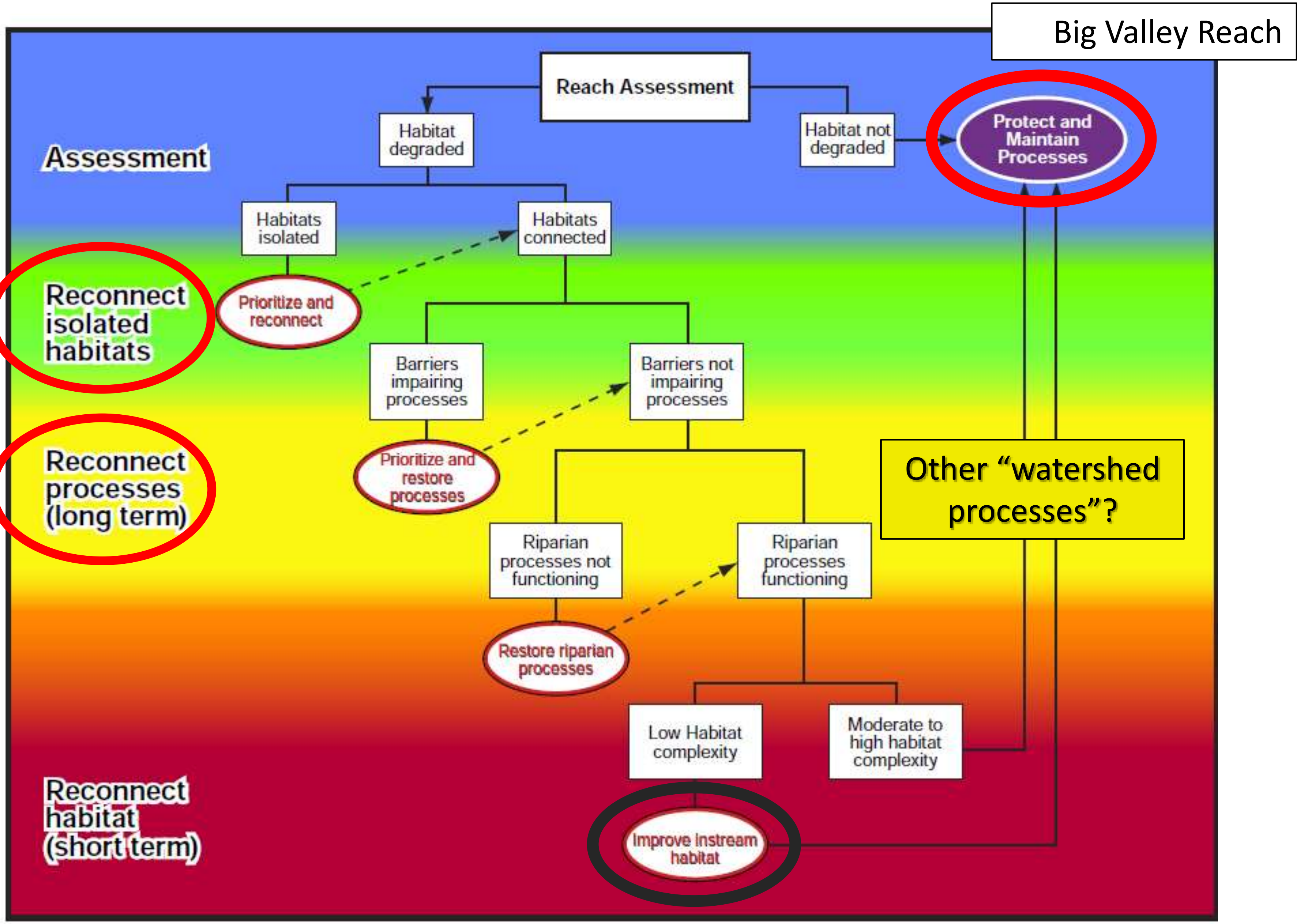
RECLAMATION
Managing Water in the West

Big Valley Reach Assessment
Methow River
Okanogan County, Washington

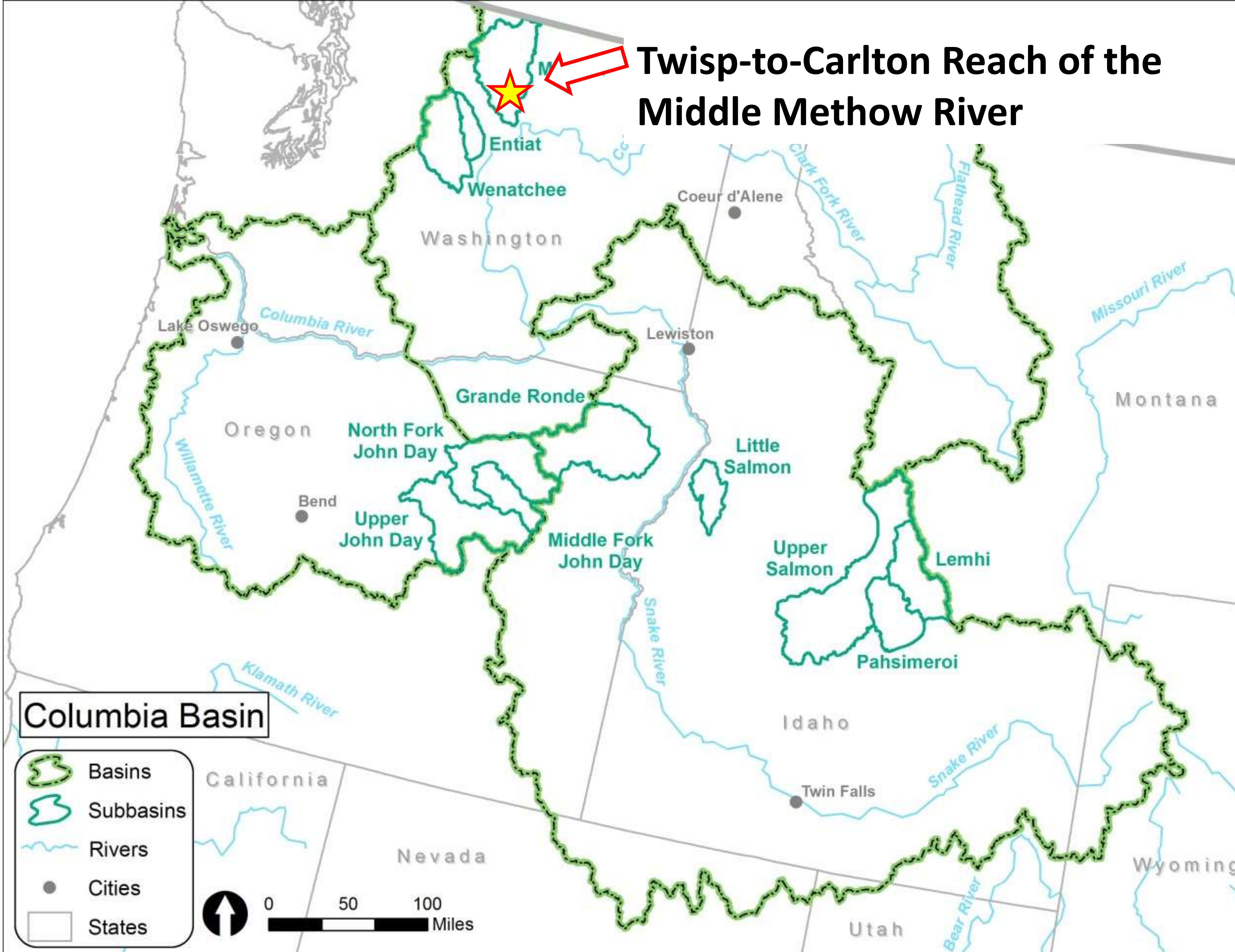
U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region

August 2008

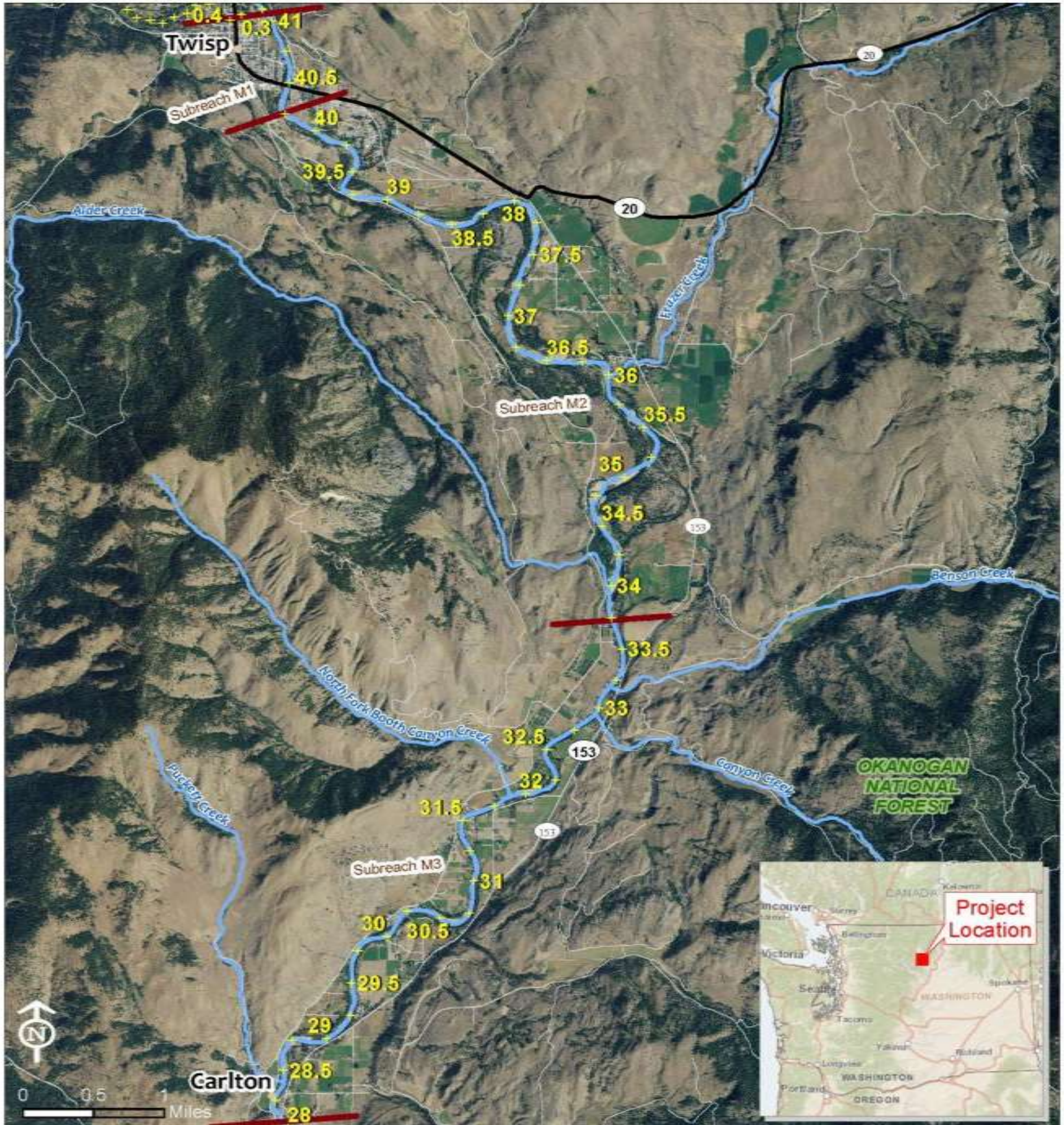

Big Valley Reach Assessment (2008)
Columbia Basin
Methow
Entiat
Wenatchee
Columbia River
Clark Fork River
Flathead River
Coeur d'Alene
Washington
Missouri River
Lake Oswego
Columbia River
Lewiston
Montana
Grande Ronde
Oregon
North Fork John Day
Little Salmon
Willamette River
Bend
Upper John Day
Middle Fork John Day
Upper Salmon
Lemhi
Snake River
Pahsimeroi
Klamath River
Idaho
Snake River
Twin Falls
California
Nevada
Wyoming
Utah
Bear River
Basins
Subbasins
Rivers
Cities
States
0
50
100
Miles



Big Valley Reach
Reach Assessment
Assessment
Habitat degraded
Habitat not degraded
Protect and Maintain Processes
Habitats isolated
Habitats connected
Reconnect isolated habitats
Prioritize and reconnect
Barriers impairing processes
Barriers not impairing processes
Reconnect processes (long term)
Prioritize and restore processes
Other “watershed processes”?
Riparian processes not functioning
Riparian processes functioning
Restore riparian processes
Low Habitat complexity
Moderate to high habitat complexity
Reconnect habitat (short term)
Improve instream habitat



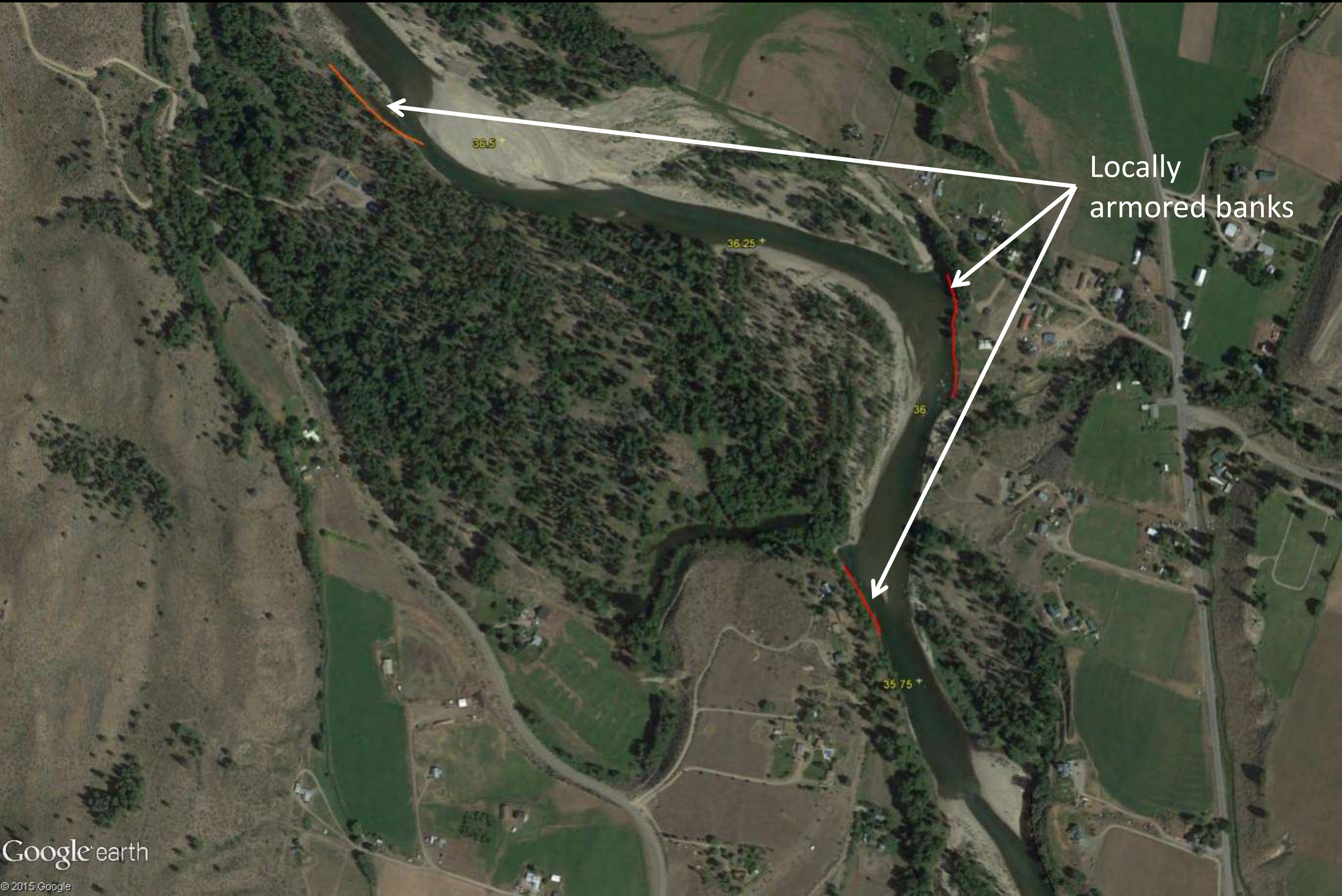
Twisp-to-Carlton Reach of the Middle Methow River
Entiat
Wenatchee
Washington
Coeur d'Alene
Clark Fork River
Flathead River
Missouri River
Lake Oswego
Columbia River
Lewiston
Grande Ronde
Montana
Oregon
North Fork John Day
Little Salmon
Willamette River
Bend
Upper John Day
Middle Fork John Day
Upper Salmon
Lemhi
Snake River
Pahsimeroi
Klamath River
Columbia Basin
Idaho
Basins
Subbasins
Rivers
Cities
States
California
Snake River
Twin Falls
Nevada
0
50
100
Miles
Wyoming
Utah
Bear River



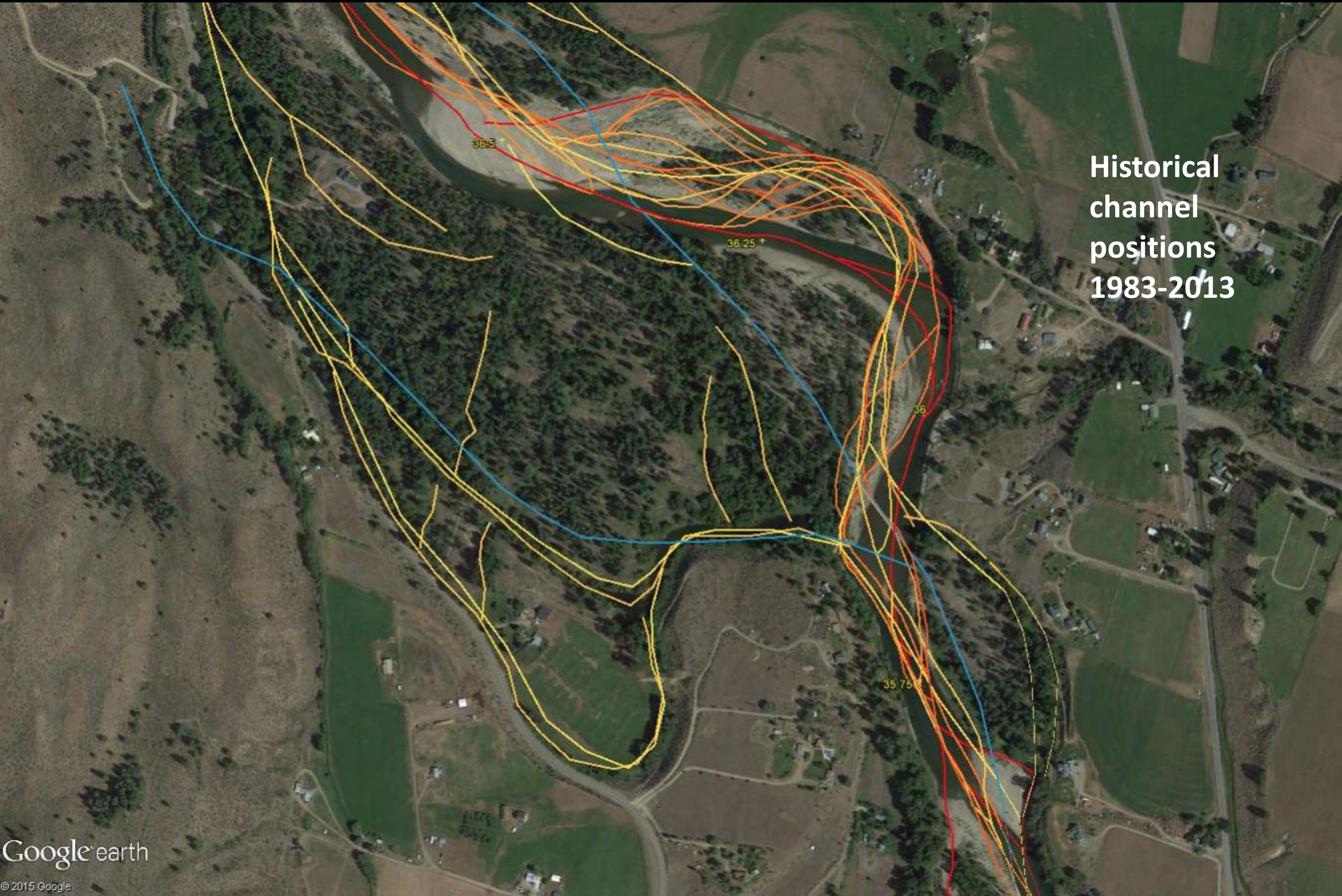
Twisp
Subreach M1
Subreach M2
Subreach M3
Carlton
Alder Creek
Frazer Creek
Benson Creek
North Fork Booth Canyon Creek
Canyon Creek
Puckett Creek
OKANOGAN NATIONAL FOREST
20
153
0.4
0.3
41
40.5
40
39.5
39
38
38.5
37.5
37
36.5
36
35.5
35
34.5
34
33.5
33
32.5
32
31.5
31
30
30.5
29.5
29
28.5
28
0 0.5 1
Miles
Project Location
CANADA
WASHINGTON
OREGON
Vancouver
Victoria
Seattle
Tacoma
Bellingham
Surrey
Kelowna
Spokane
Yakima
Richland
Longview
Portland

Twisp-to-Carlton Reach RM 36.5: Protection of (largely) intact processes

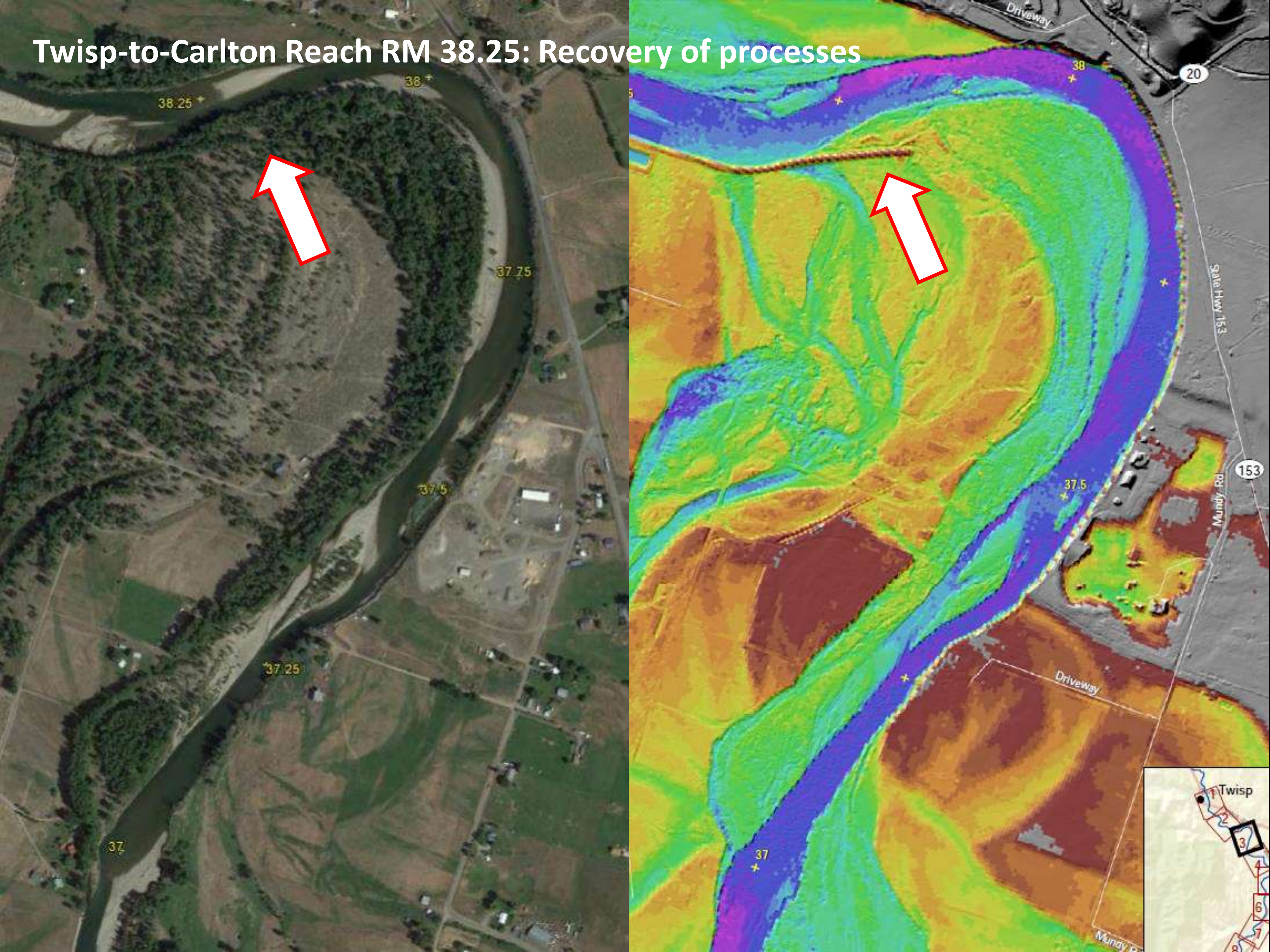
Twisp-to-Carlton Reach RM 36.5: Protection of (largely) intact processes



Twisp-to-Carlton Reach RM 36.5: Protection of (largely) intact processes

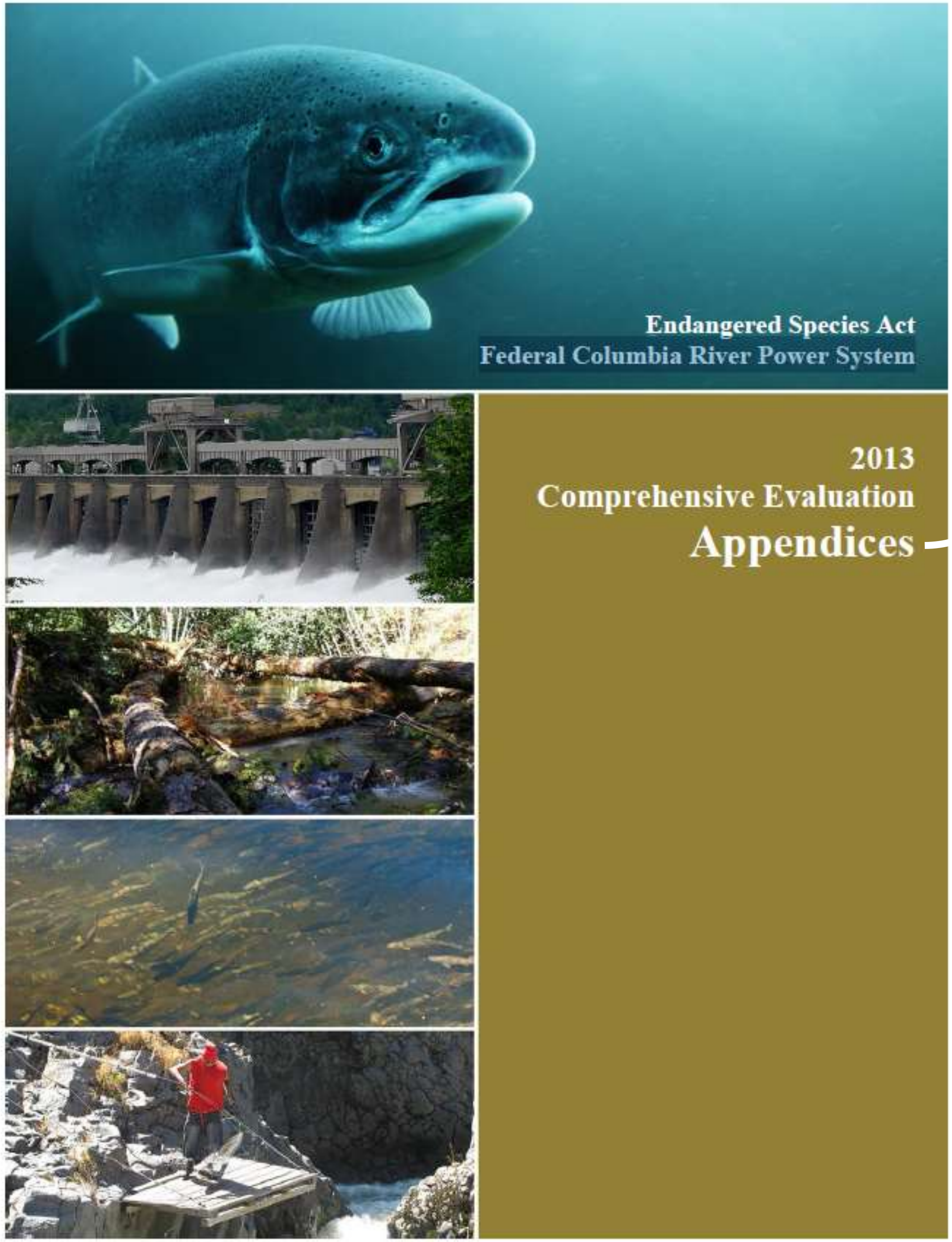


Twisp-to-Carlton Reach RM 38.25: Recovery of processes



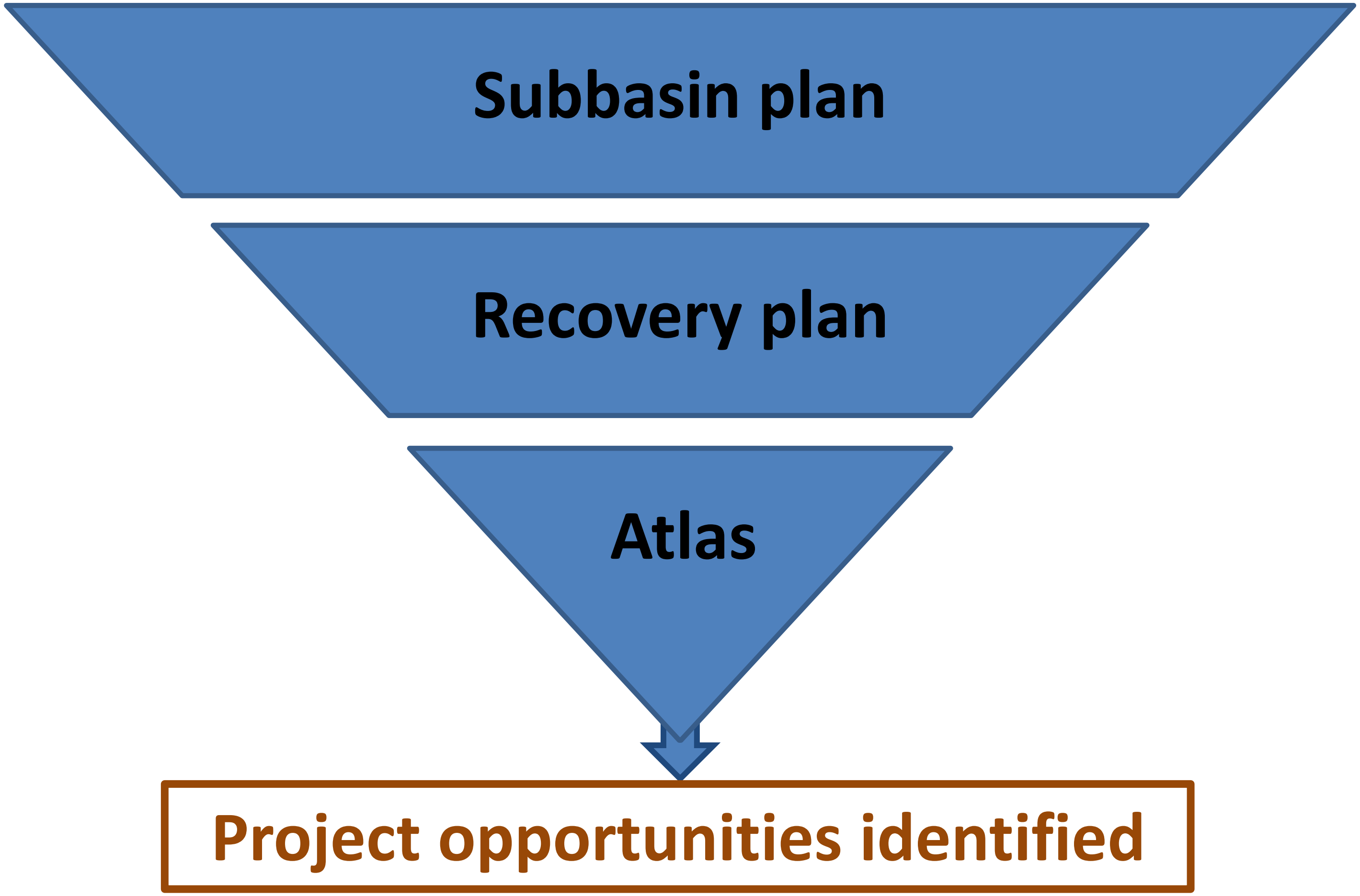

RM 38.25 levee

Twisp-to-Carlton Reach RM 35.20: Site-specific impairment

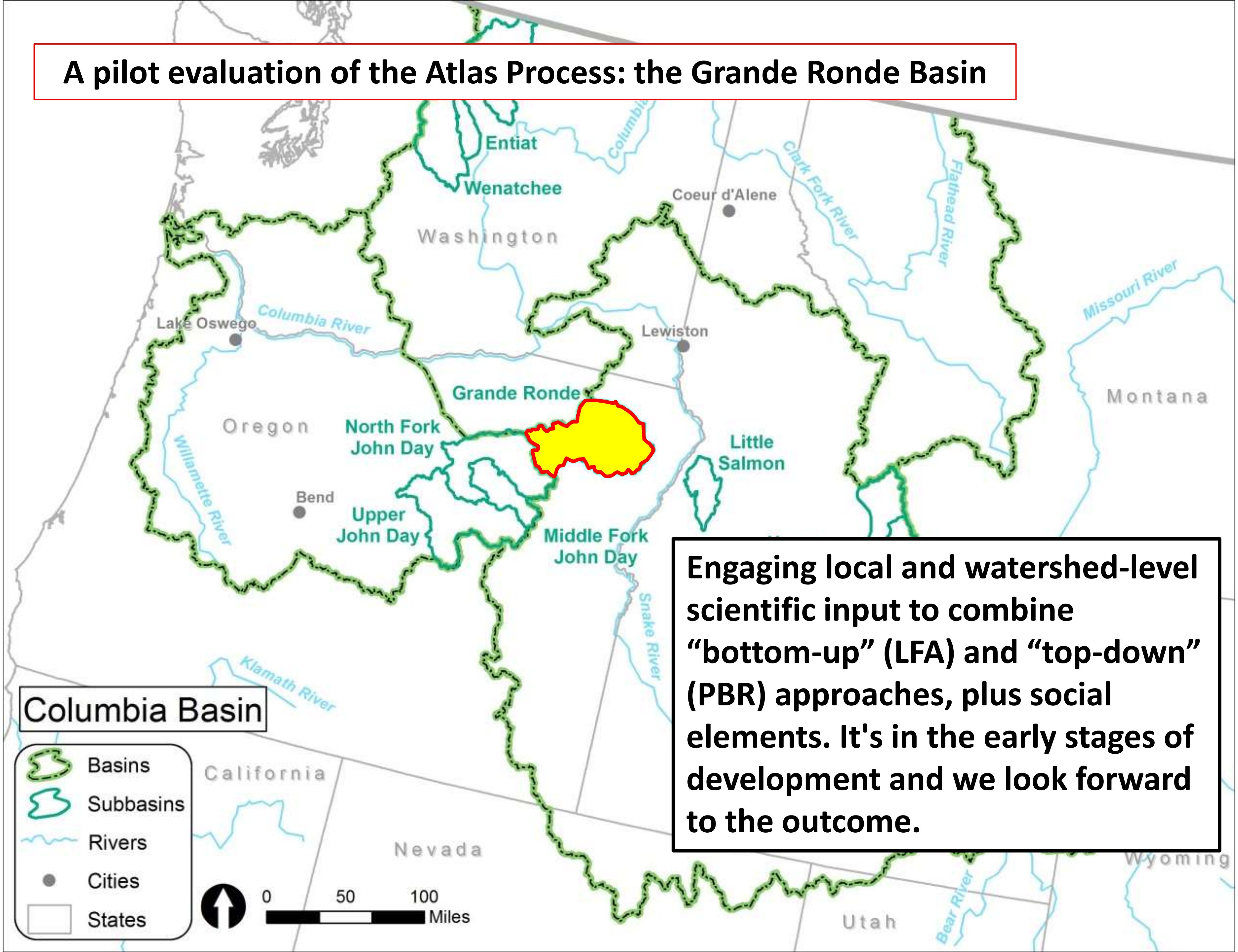


The "Atlas Process"

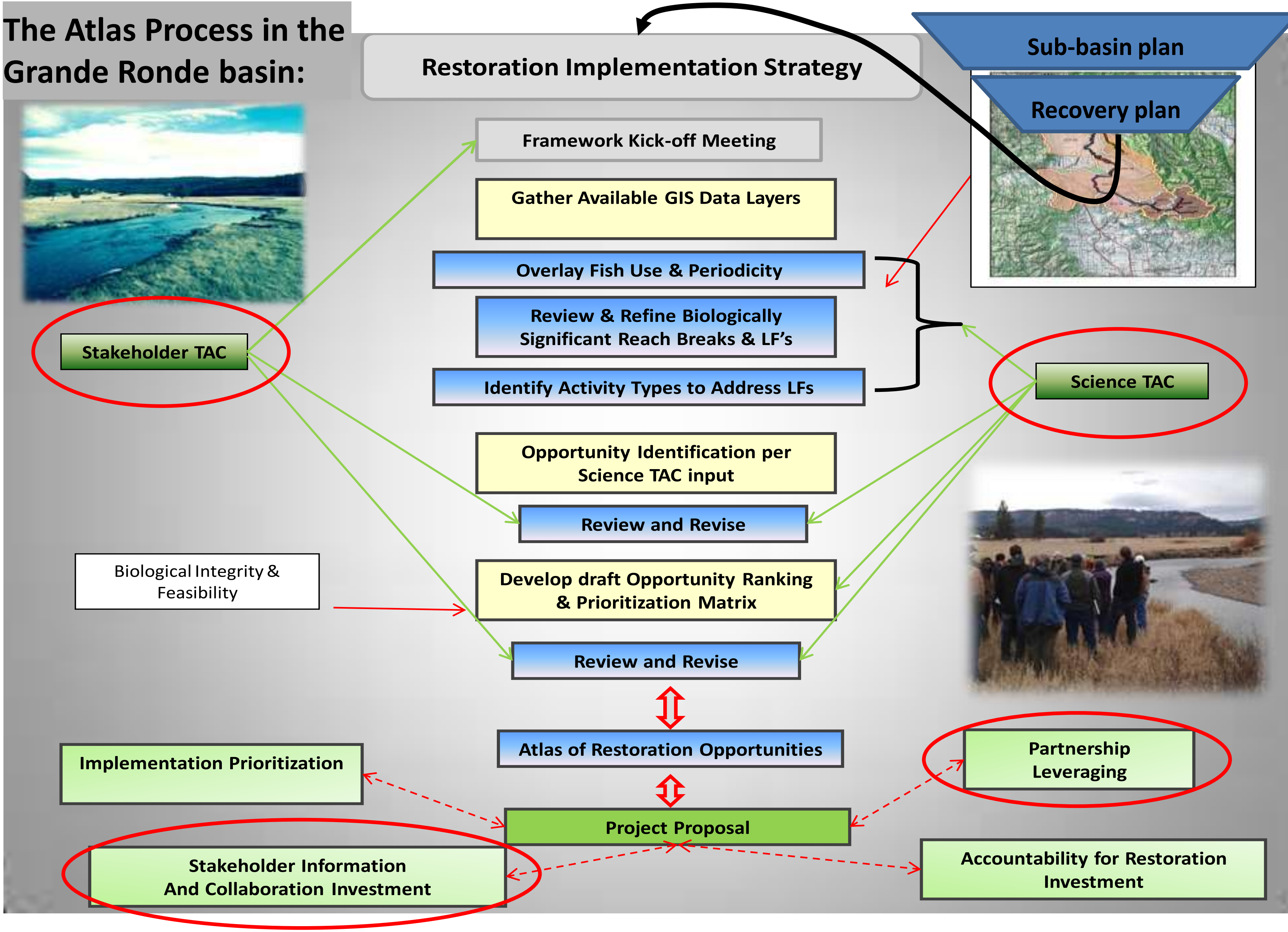
The approach: Atlas gathers available basin-scale data, and then uses successive levels of data refinement to identify specific opportunities for future restoration projects.



A pilot evaluation of the Atlas Process: the Grande Ronde Basin



Engaging local and watershed-level scientific input to combine "bottom-up" (LFA) and "top-down" (PBR) approaches, plus social elements. It's in the early stages of development and we look forward to the outcome.



The Atlas Process in the Grande Ronde basin:
Restoration Implementation Strategy
Sub-basin plan
Recovery plan
Framework Kick-off Meeting
Gather Available GIS Data Layers
Overlay Fish Use & Periodicity
Review & Refine Biologically Significant Reach Breaks & LF's
Identify Activity Types to Address LFs
Stakeholder TAC
Science TAC
Opportunity Identification per Science TAC input
Review and Revise
Biological Integrity & Feasibility
Develop draft Opportunity Ranking & Prioritization Matrix
Review and Revise
Atlas of Restoration Opportunities
Implementation Prioritization
Partnership Leveraging
Project Proposal
Stakeholder Information And Collaboration Investment
Accountability for Restoration Investment

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Towards a comprehensive restoration strategy

1. **Comprehensive restoration planning should include “bottom-up” assessment (LFA), “top-down” analysis (PBA), and full engagement with the social landscape**
2. **Ideally this approach should be applied in areas with:**
   - ✓ Adequate funding (it’s not necessarily cheap)
   - ✓ Engaged collaborators (it’s not necessarily easy)
   - ✓ A large landscape area (ill-suited to severe constraints)

Towards a comprehensive restoration strategy

3. Potential applications elsewhere (e.g., the Klamath Basin):
   - ✓ Ideal big landscape
   - ✓ Extensive scientific analyses and studies
   - ✓ Large, established stakeholder forums
   - ✓ Federal & state funding

Klamath Wetland Restoration Project with
The Nature Conservancy,
Cardno (2014)


Our thanks to colleagues at Cardno,
NMFS, and the Bureau of Reclamation