

# Toward an Integrated Adaptive Management Program for Restoration of the Columbia River Estuary Ecosystem

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# Thesis and Main Points

- ▶ Thesis = Integration of AM programs would help restore the ecosystem and the functions and natural resources it supports
- ▶ Outline:
  - Define AM
  - Review AM status on CRE
  - Theory
  - Elements
  - Tools we have
  - EP and COE Programs
  - Recommendations

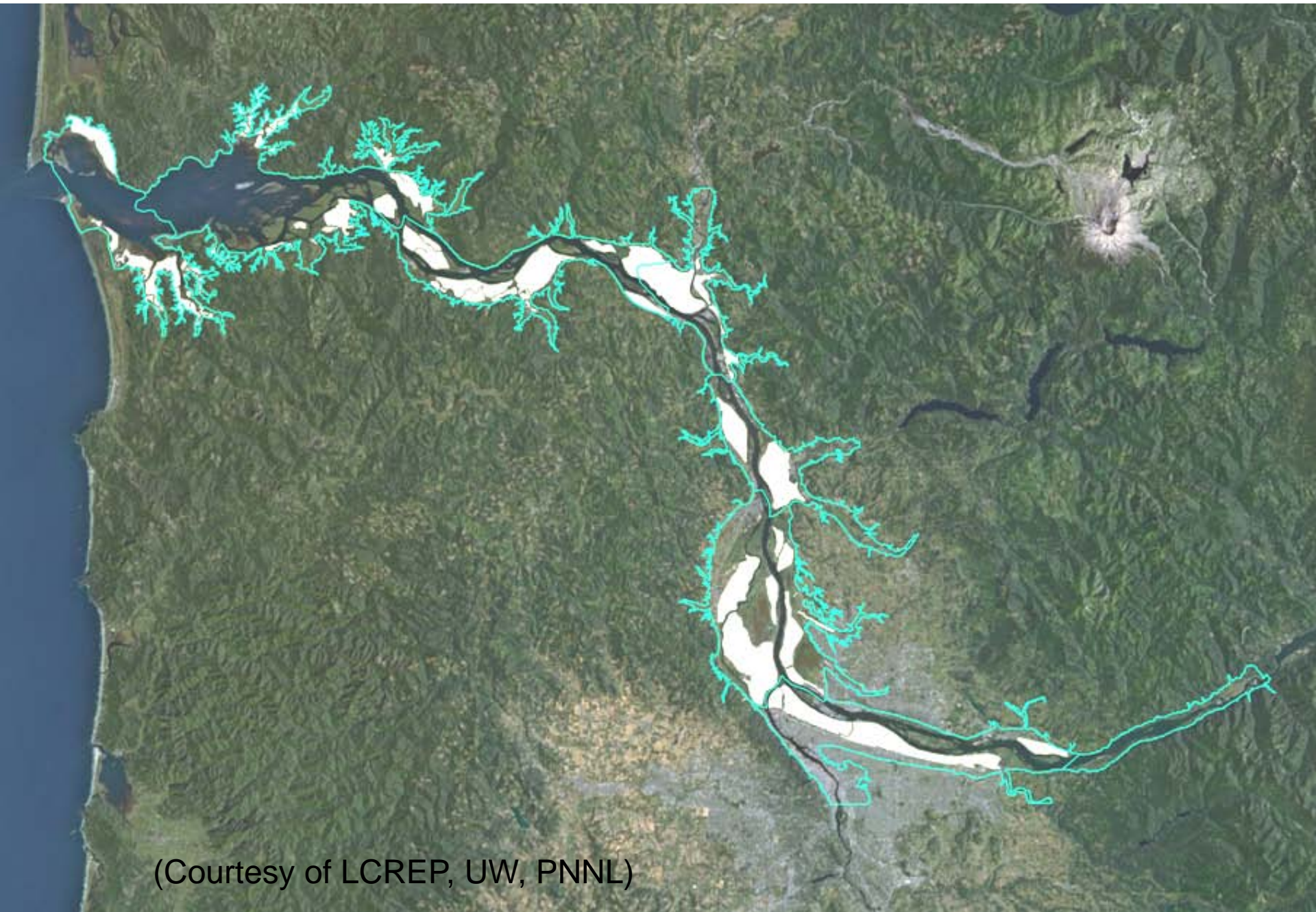


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# AM Defined and Some Objectives

- ▶ *Learn by doing* in a structured process to address key uncertainties facing critical decisions
- ▶ Critical decisions with significant uncertainty
- ▶ Objectives:
  - Improve performance toward goals
  - Reduce uncertainties about management actions
  - Drive decision
  - Save cost
  - Disseminate learning
  - Develop trust
  - Develop credibility
- ▶ Requires long-term commitment and resources



(Courtesy of LCREP, UW, PNNL)





(a)

# Examples of Real Uncertainties Affecting Restoration Success in the CRE

(\* = research underway)

- changes in hydrology and hydrodynamics from river regulation and climate change\*
- potential flooding of adjacent properties
- elevation distributions of major tidal wetland plant species\*
- colonization of restored sites by invasive species\*
- changes in land use adjacent to restored sites\*
- juvenile salmon use of a restored wetland sites\*
- salmon resilience

# Situation of AM on the Columbia River Estuary

- ▶ ISAB harvest management recommendations (2005)
- ▶ COE AM plan for channel deepening (2007)
- ▶ FCRPS Biological Assessment, AM (2007)
- ▶ Draft Portland District COE Internal Guidance for AM and ecosystem recovery (2008)
- ▶ 2008 Biological Opinion for salmon recovery (BPA, COE, NOAA)
- ▶ National COE guidance on AM (2009)
- ▶ FCRPS AM Implementation Plan (2009)



# Stakeholders in the Estuary

- ▶ Mission and vision of agencies and groups to restore/preserve the ecosystem and natural resources, for example...
  - BPA
  - COE
  - Tribes
  - LCREP
  - Columbia Land Trust
  - CREST
  - State and federal natural resources agencies
  - EPA
  - Watershed Councils
  - Fishing interests
  - Landowners
  - Ports and harbors
  - Other stakeholders
- ▶ Unclear if these are competing or complimentary
- ▶ One ecosystem with one natural resources set = coordination at some level is required to maximize results, and minimize costs

# What are the Primary Needs?

- ▶ How to prioritize actions... *what actions to take, where and when*
- ▶ How to minimize cost and risk
- ▶ How to verify actions are having desired effect
- ▶ What information is needed to better prioritize and conduct actions?
- ▶ Who makes decisions and when?
- ▶ Who are the stakeholders, and what is their role?
- ▶ Salmon recovery and ecosystem restoration (Expert Regional Technical Group, ERTG)

# Critical Elements

## ▶ Goal

- driven by a vision

## ▶ Model

- organize understanding
- highlight uncertainties
- predict outcomes from alternative actions

## ▶ Evaluation Framework

- Monitoring
- Research
- Analysis and dissemination of results
- Recommendations

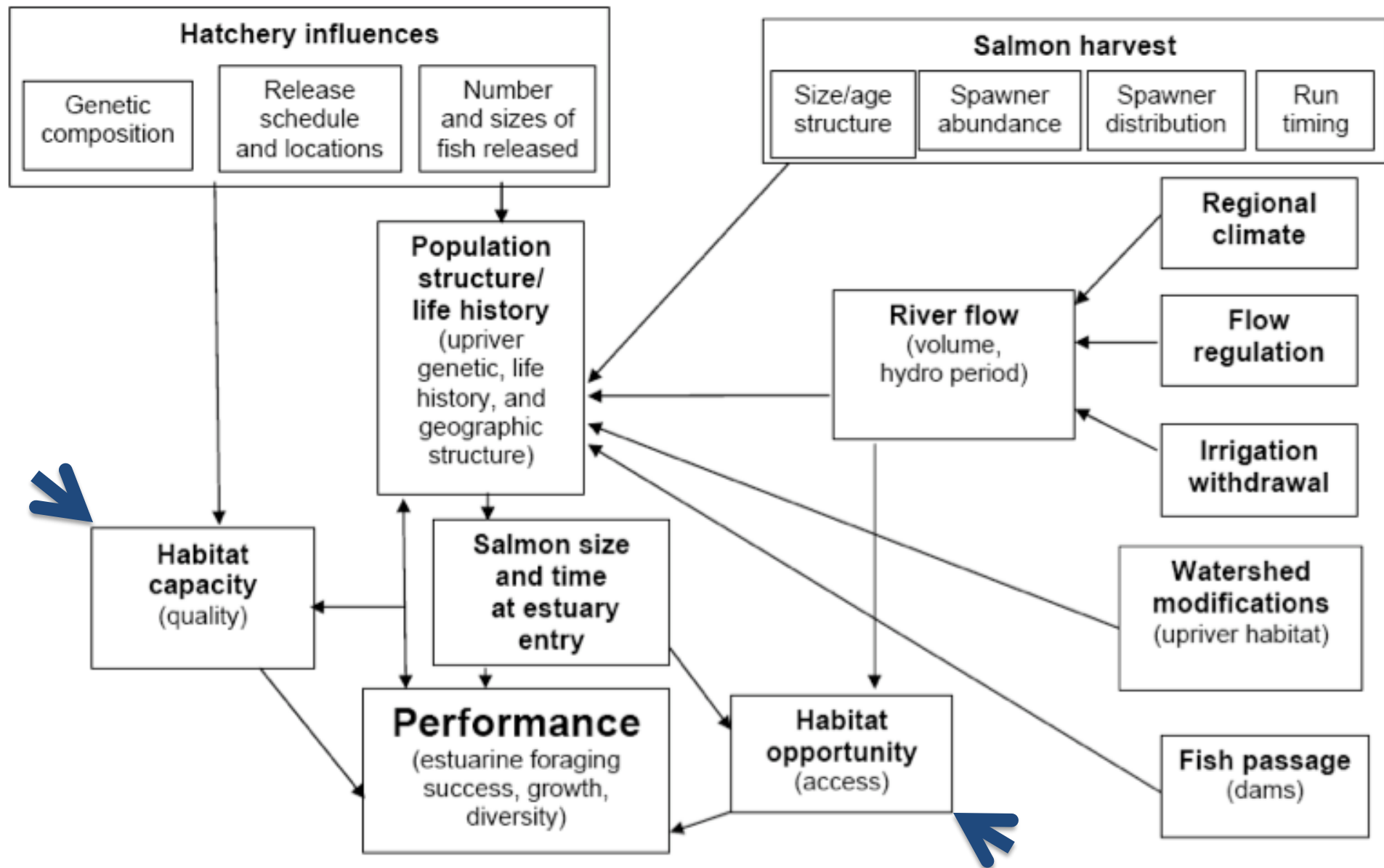
# Some Definitions

- ▶ Goal = the projected state intended for a system
- ▶ Strategy = a plan of action designed to achieve a goal
- ▶ Objective = specific task to be accomplished
- ▶ Management action = physical or other effort
- ▶ Performance metric = parameter used to indicate effect of actions
- ▶ Performance criterion = threshold value for the performance metric indicating task is accomplished
- ▶ Trigger = threshold value that initiates an action or decision
- ▶ Decision makers = those who decide what management actions to take and when
- ▶ Stakeholders = individuals and organizations that have a legitimate interest in the system

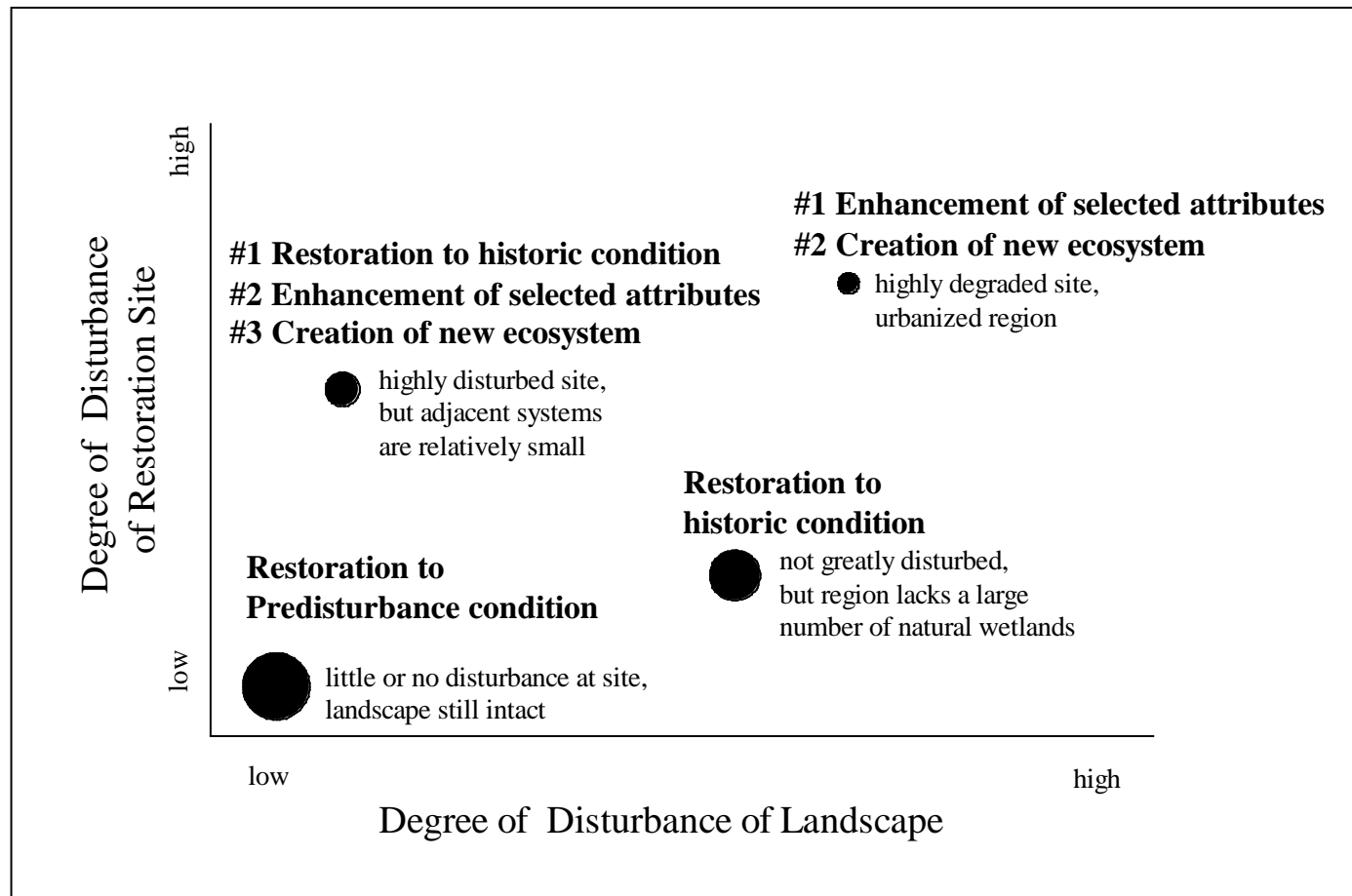
# Models

(much of this from K. Lee 1993)

- ▶ Provide a consistent framework for comparing alternative courses of actions
- ▶ Capture and organize system knowledge
- ▶ Help identify critical uncertainties, and prioritize them for research
- ▶ Provide a 'paper trail' for managers making decisions
- ▶ Help people work out a 'shared view' of what is being managed and how managing should be done
- ▶ Allow humans to pursue their assumptions
- ▶ Are always wrong, but sometimes useful
- ▶ CRE restoration needs an *Organizing Model*



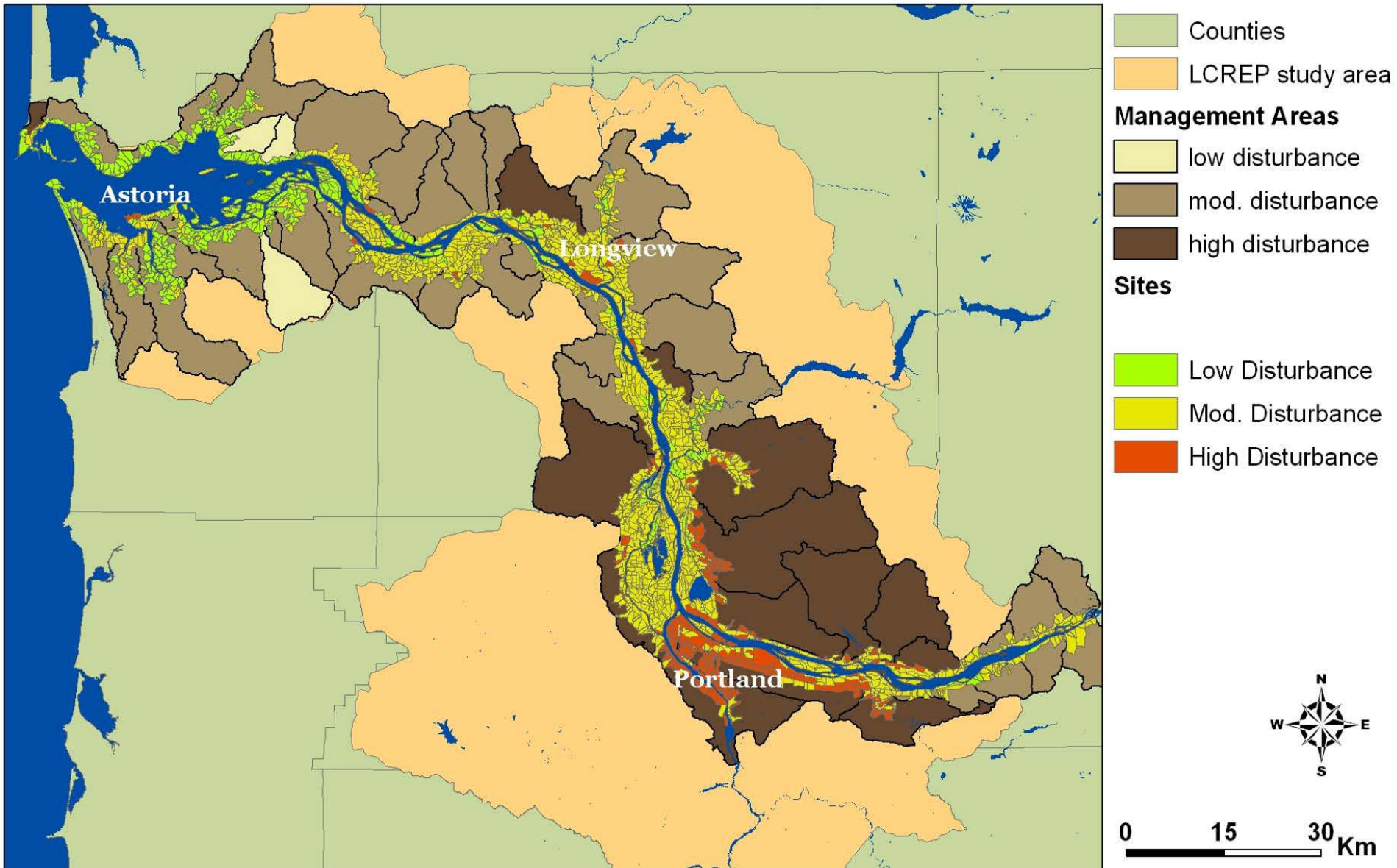
# Basis of Prioritization in Ecological Theory



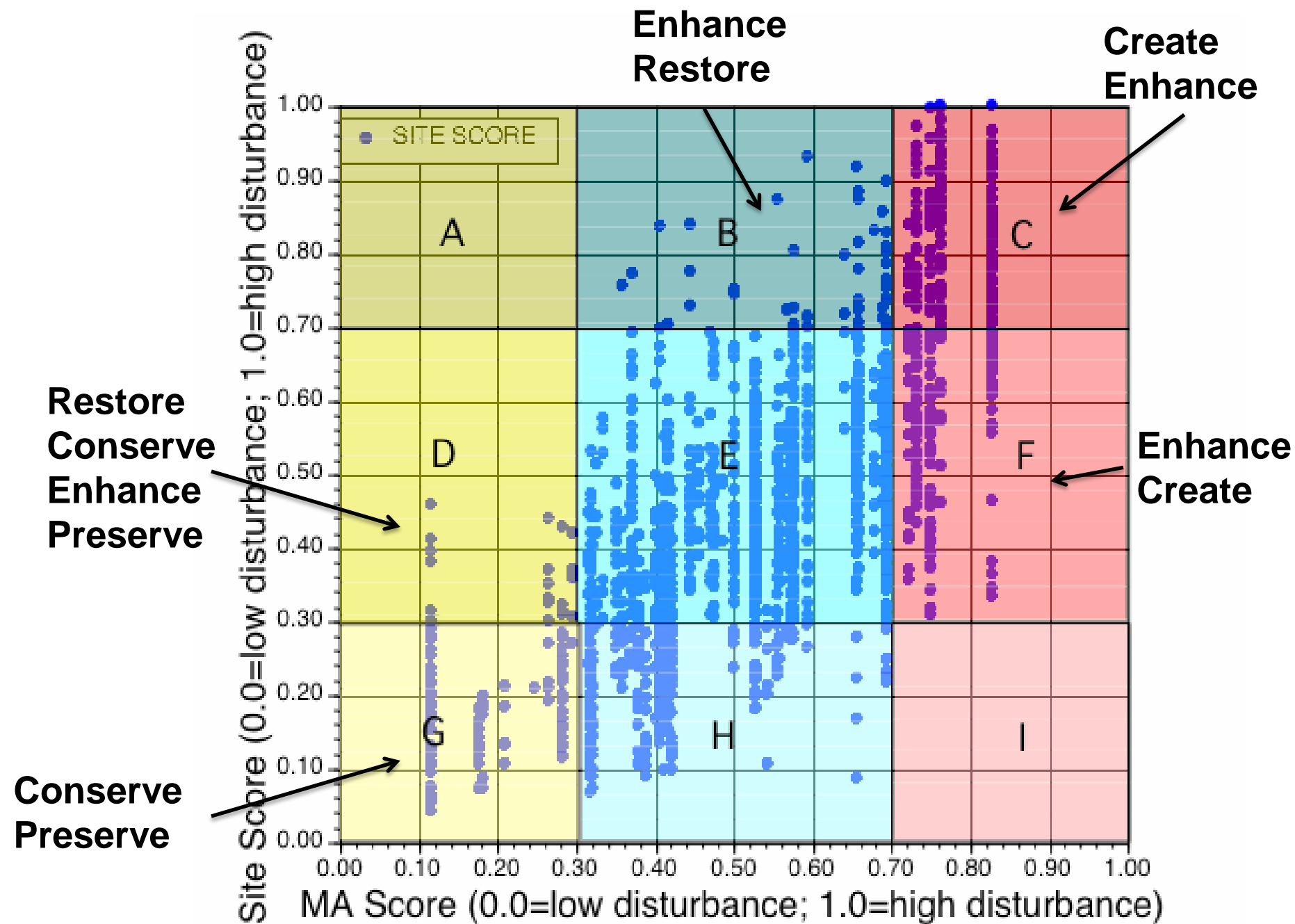
- Shreffler & Thom, 1993. Report to Washington DNR, Olympia, WA.
- Thom et al., 2005. *Restoration Ecology* 13(1):193-203.
- cf. National Research Council, 1992. *Restoring Aquatic Ecosystems*.

# Prioritization Framework — Tier 1

## Site and Management Area Rankings (2072 Sites)







# Tools - *Site Evaluation Card*

- ▶ Summarizes information on the site location, goals, performance metrics, criteria, recommendations to improve performance, etc.
- ▶ Summarizes results from monitoring (using standardized protocols) in a concise manner
- ▶ ~2-5 pages
- ▶ Relatively easy to fill out and transmit
- ▶ Forms input to regional assessments through meta-analysis

# Tools - Meta Analysis Summary Table

	Photo Point <sup>(a)</sup>	Temperature <sup>(b)</sup>	Sediment Accretion Rate <sup>(c)</sup>	Juvenile Salmon Presence <sup>(d)</sup>
Site A	●	NC	●	●
Site B	●	●	●	●
Site C	○	●	NC	●
Site D	●	●	●	●
Site E	●	●	NC	●
Site F	●	●	○	●
Site G	●	●	●	○

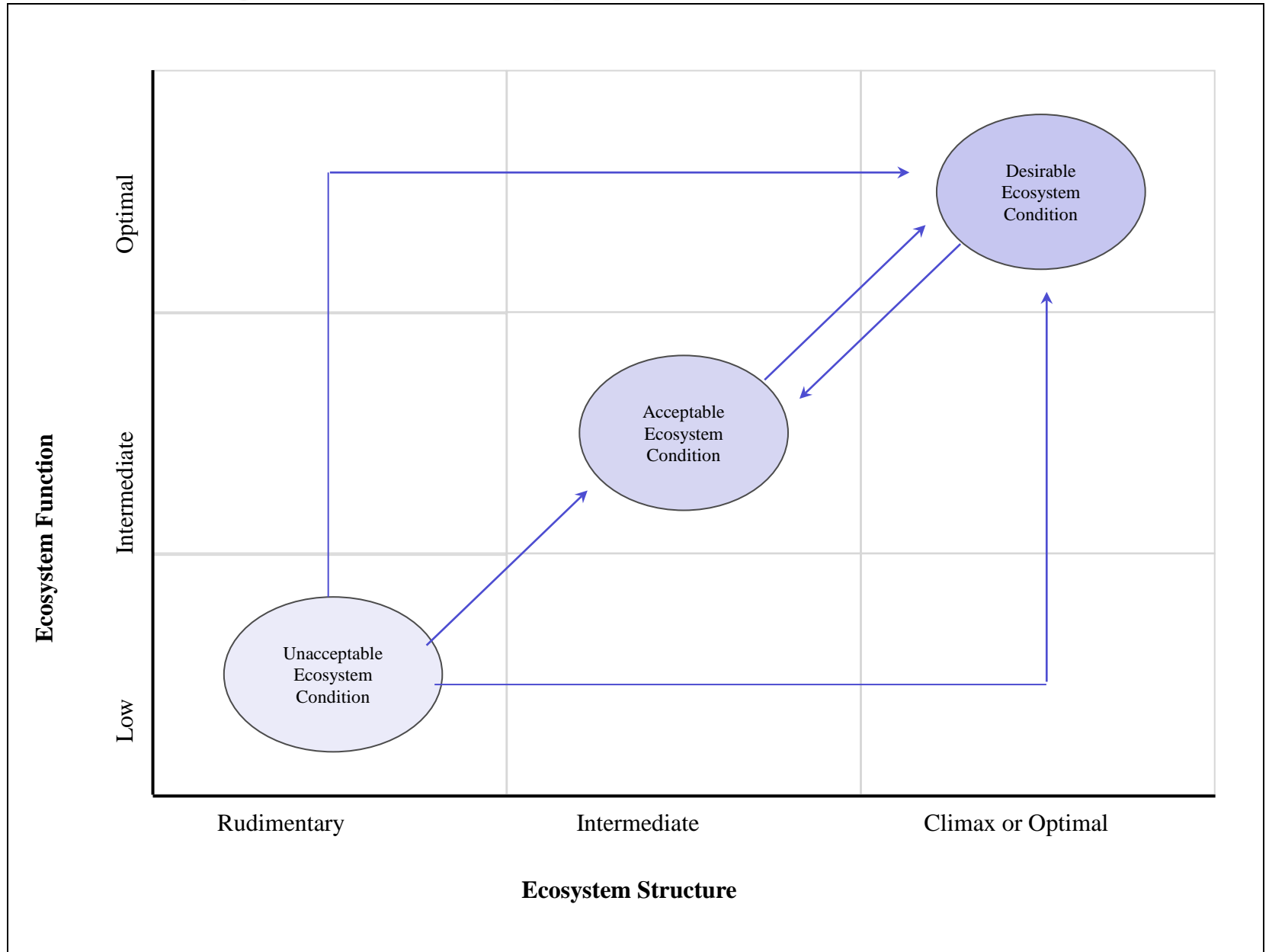
<sup>(a)</sup> Photographs depict greater inundation after restoration compared to before.

<sup>(b)</sup> Temperatures are cooler after restoration than before.

<sup>(c)</sup> Sediment accretion rates are higher in restoration sites than reference sites.

<sup>(d)</sup> Appreciably more juvenile salmon are present after restoration than before.

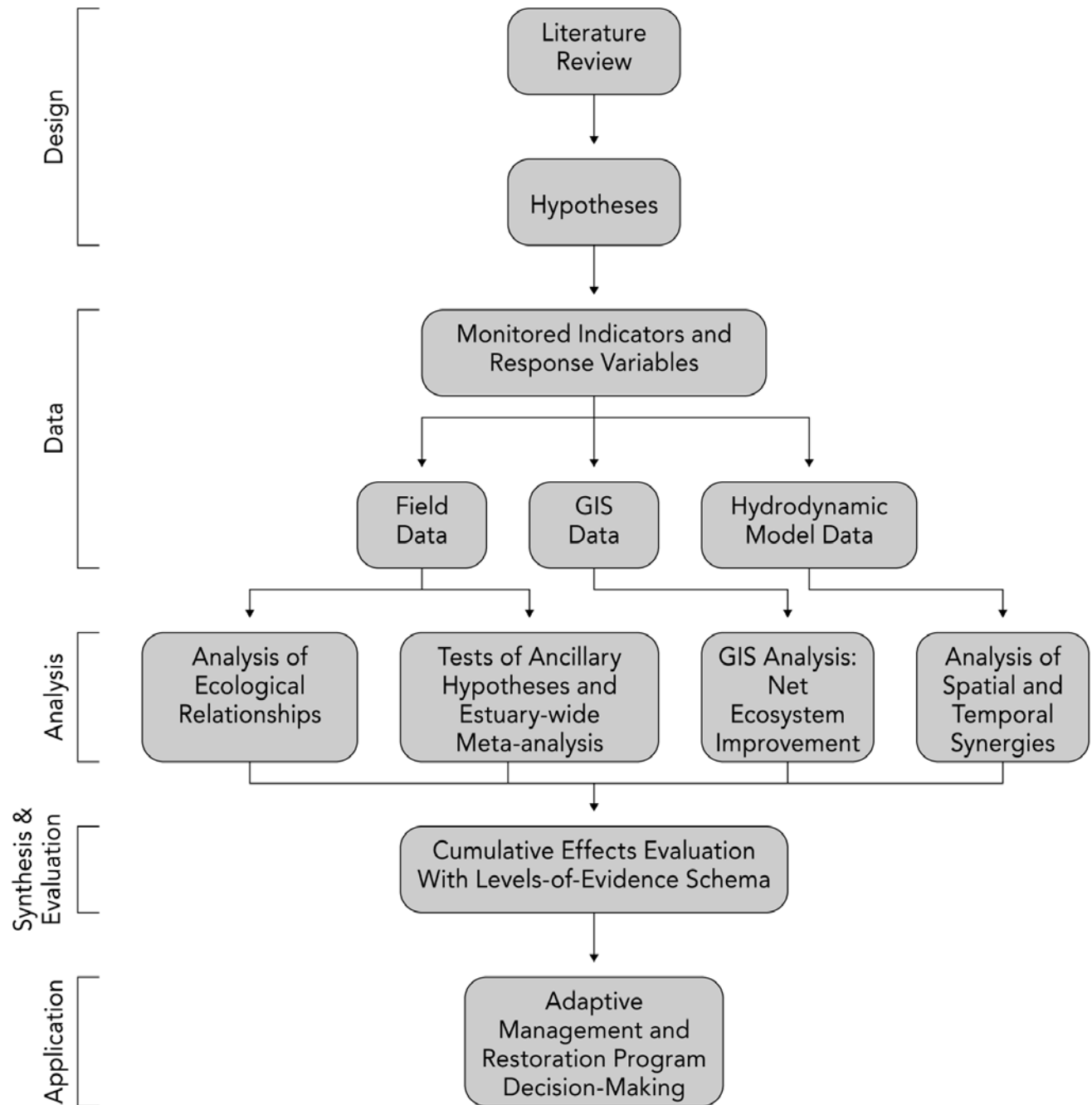
# Tools - System Development Matrix



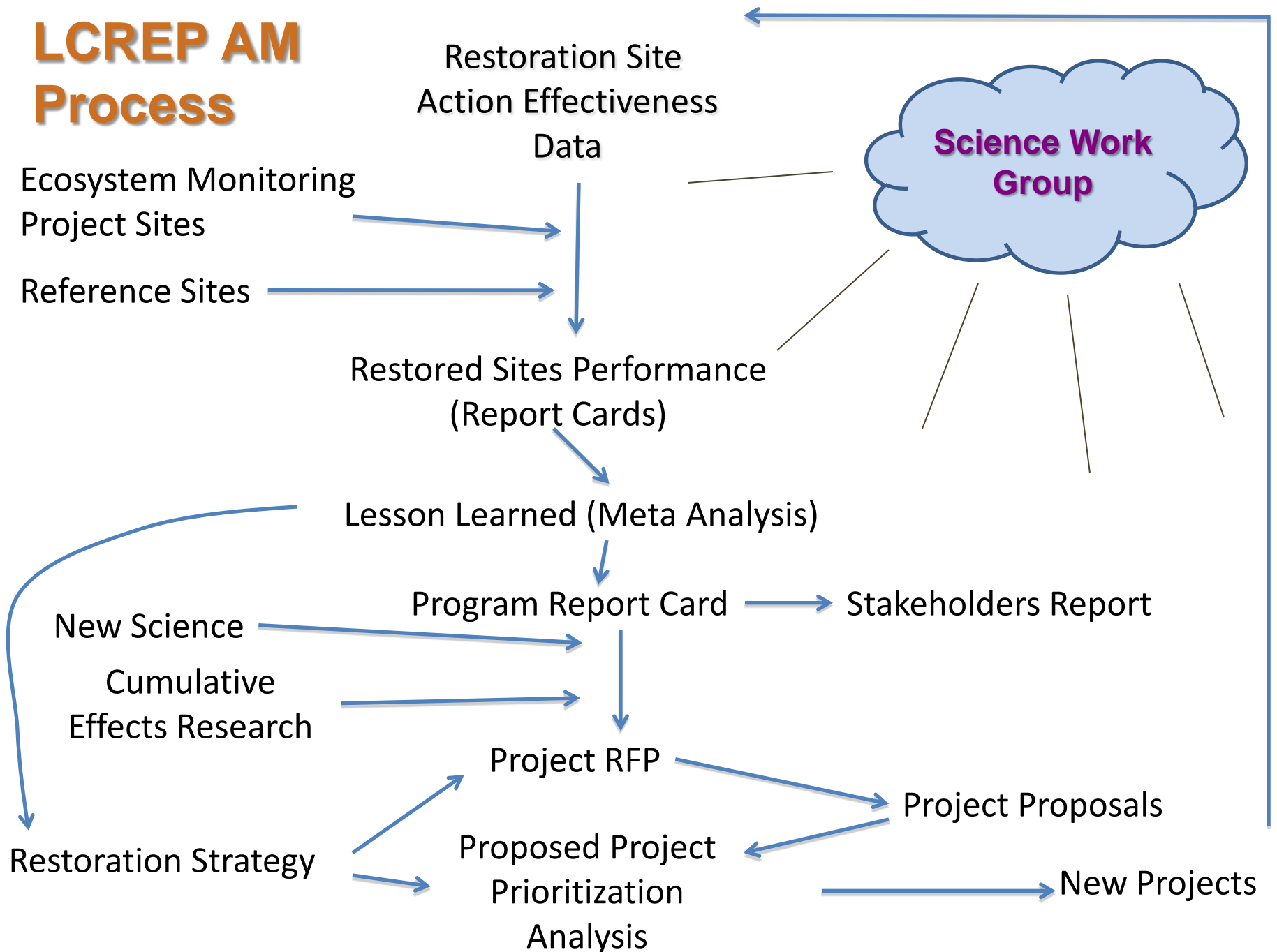
# System Development Matrix

Increase in Juvenile Salmon Population Size (N) in millions	2.80-4.18	<p><b><u>Unexpected</u></b>  <i>Status:</i> Population growth &amp; size not related to habitat, or responds to much smaller habitat actions. Other factors affecting population.  <i>Actions:</i> Re-evaluate program model and actions; examine effects of other factors.</p>	<p><b><u>Over-restoring</u></b>  <i>Status:</i> Population growth &amp; size responding more strongly than expected to habitat actions.  <i>Actions:</i> Maintain habitat size and quality; consider reducing habitat action target.</p>	<p><b><u>Expected</u></b>  <i>Status:</i> Population growth &amp; size responding as expected to habitat actions.  <i>Actions:</i> Maintain habitat size and quality.</p>
	1.40-2.79	<p><b><u>Unexpected</u></b>  <i>Status:</i> Population growth &amp; size not related to habitat, or responds to smaller habitat actions. Other factors affecting population.  <i>Actions:</i> Re-evaluate program model and actions; examine effects of other factors.</p>	<p><b><u>Expected</u></b>  <i>Status:</i> Population growth &amp; size responding as expected to habitat actions.  <i>Actions:</i> Continue to increase habitat actions.</p>	<p><b><u>Under-restoring</u></b>  <i>Status:</i> Population growth &amp; size responding less than expected to habitat actions. Other factors affecting population.  <i>Actions:</i> Increase habitat actions; re-evaluate program model and actions; examine effects of other factors.</p>
	0-1.39	<p><b><u>Expected</u></b>  <i>Status:</i> Population growth &amp; size not changed substantially; habitat actions size too small. Too early for response.  <i>Actions:</i> Increase habitat actions.</p>	<p><b><u>Under-restoring</u></b>  <i>Status:</i> Population growth &amp; size responding less than expected to habitat actions. Habitat actions size too small. Wrong habitat actions. Other factors affecting population. Too early for response.  <i>Actions:</i> Increase habitat actions; re-evaluate program model and actions; examine effects of other factors.</p>	<p><b><u>Unexpected</u></b>  <i>Status:</i> Population growth &amp; size responding much less than expected to habitat actions. Habitat actions size too small. Wrong habitat actions. Other factors affecting population. Too early for response.  <i>Actions:</i> Increase habitat actions; re-evaluate program model and actions; examine effects of other factors.</p>
	<33%	34-66%	67-100%	
<b>Habitat Action Size or Estimated Salmon Survival Benefit (% of area or score to meet 100% salmon survival target)</b>				

# Tools- Cumulative Effects Analysis



# LCREP AM Process



# Portland District Adaptive Management Plan

- ▶ One of several products developed through the Cumulative Effects Project,
  - Adaptive management plan
  - Standardized mentoring protocols
  - Meta-analysis
  - Cumulative effects framework
- ▶ Originally and necessarily Corps centric
  - Specific to Corps LCRE ecosystem restoration authorities
  - Utilizes specific authority to use CRFM funds to study LCRE
- ▶ Present plan is to work with regional partners to evolve this into a regional adaptive management plan
  - Have started discussions with regional partners, LCREP, CREST, CLT, and BPA
  - Must continue working with all regional partners and “make it so”



# Primary Management Products

- ▶ Annual Adaptive Management Report
  - Summarizes results relative to goal and objectives
  - Provides recommendations for improved success
  - Assesses long-term strategy
  - Advances the organizing models
  - Advises on critical research and monitoring needs
- ▶ Decision Process meeting
  - Evaluate results
  - Develop next years' actions
- ▶ Action Plan Implementation

# Summary

1. View the AM program as the primary ‘tool’ within an overall strategy to help meet a goals
2. Integrate all ecosystem and natural resource AM plans and strategies into one program
  1. Hydrological controls must be part of this
3. Focus on the annual AM report, which includes the overall strategy review
  1. Continuously improve the location, type and size of actions
  2. Make this a ‘best seller/must read’
4. Coordinate and fund effectiveness monitoring, along with uncertainties research, reference sites, habitat monitoring, data base management, communication



# ***An Ecosystem-Based Approach to Habitat Restoration... (Johnson et al. 2003)***

- ▶ Establish a coordinating body for restoration activities
- ▶ Resolve critical uncertainties on salmon in the CRE
- ▶ Intensify habitat mapping and inventory
- ▶ Prioritize projects that promote long-term sustainability of ecosystem structure and function at landscape scale
- ▶ Give credit to projects in TFW portion of CRE
- ▶ Establish a trust fund for projects
- ▶ Develop protocols to perform effectiveness monitoring
- ▶ Establish a data system
- ▶ Collaborate to implement habitat restoration in the CRE
- ▶ Perform true AM

# Thank You



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# EXTRA SLIDES



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# AM Regional Integrated

- ▶ Focus on annual AM report
  - Reports and assessment of actions/effectiveness
    - Rolls up all programs (federal, state, local)
    - Reiterates goals, objectives, criteria, triggers
    - Project Report cards
    - Meta analysis – need ref sites
    - New science
    - Cycle back to goals/performance criteria/objectives
    - Lessons learned
    - Remaining uncertainties
    - Recommendations
  - Evaluation of Integrated Strategy
    - Cumulative effects analysis
    - Evaluation from organizations
  
- ▶ Make it a “best seller/must read/one stop shop”



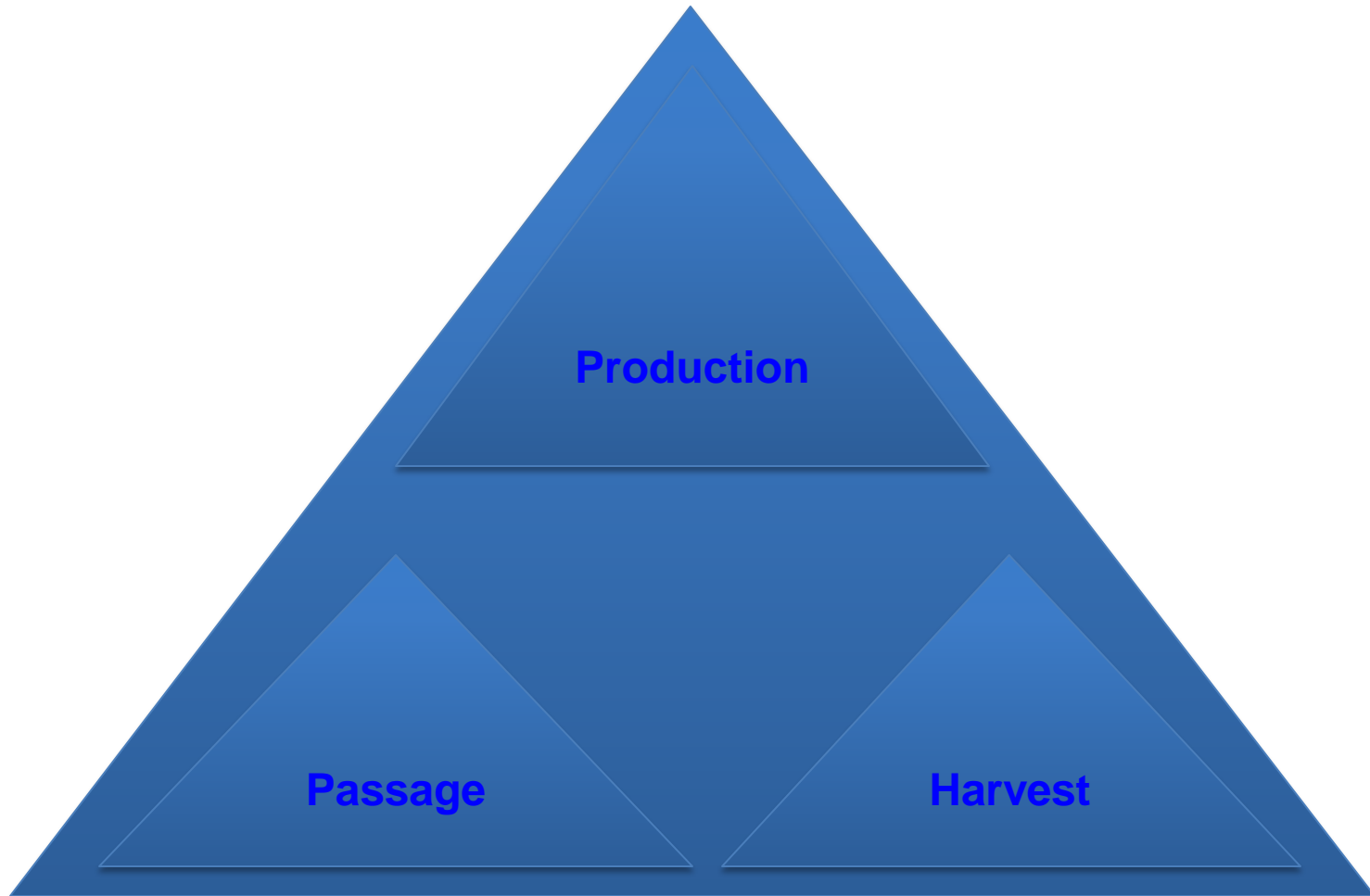
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# Models and Decision Making

- ▶ Link management actions to outcomes
- ▶ Conceptual
- ▶ Numerical
- ▶ Formalize what is known and what is not known
- ▶ Highlight critical uncertainties
- ▶ Evaluate tradeoffs of scenarios using models
- ▶ Structured Decisions
  - “Smart Choices” (Hammond, Keeney and Raiffa 1999)

# Columbia Basin System Planning (NWPPCC) 'Model' (from K. Lee 1993)





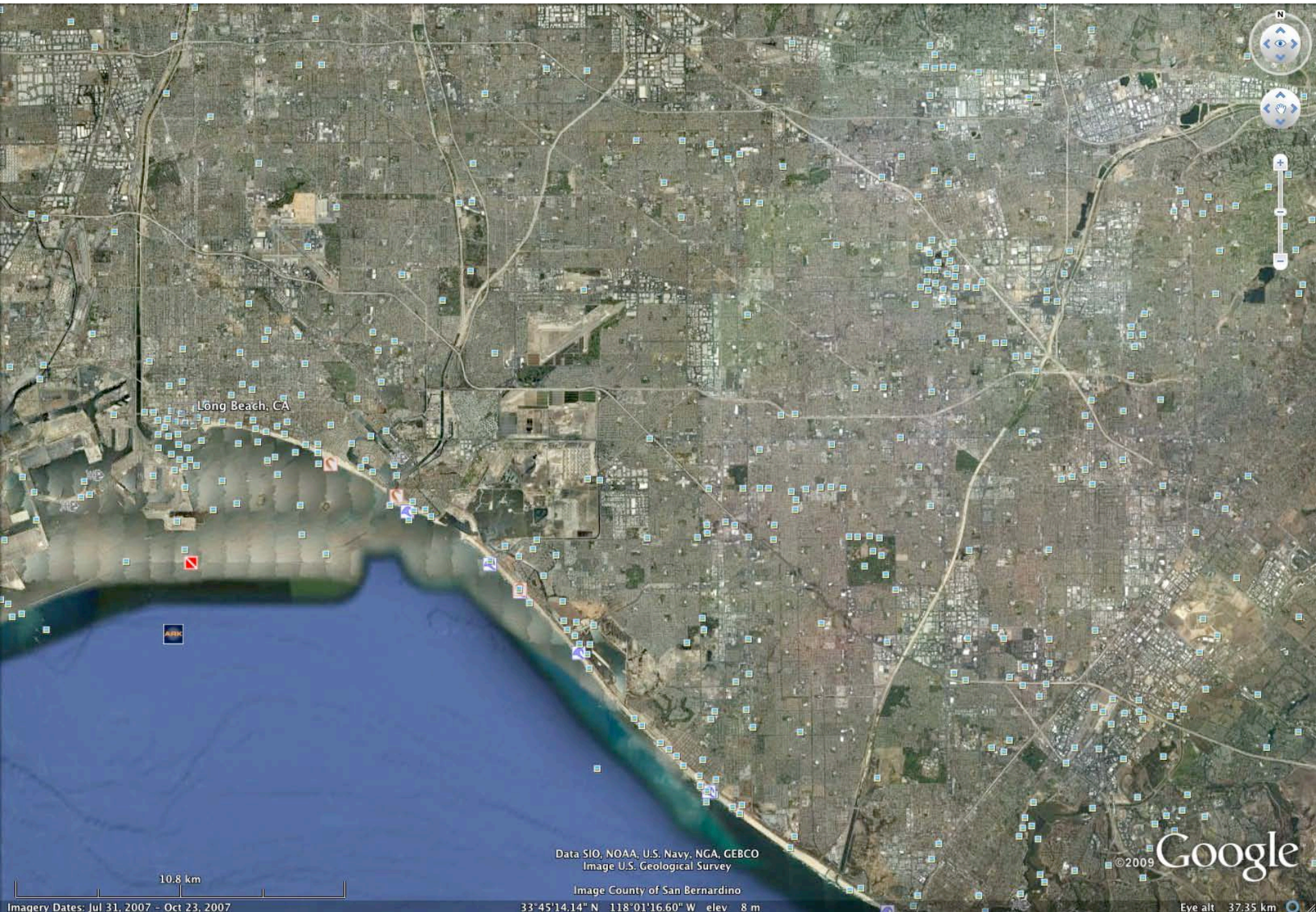
# Thought experiment

- ▶ Extremes -
  - Creation = hatchery production
  - Restoration = returning ecosystem to natural/undisturbed state, including populations of fish and wildlife
- ▶ Pave over estuary and create fish
  - Slide of LA/LB flood control rivers
- ▶ Restore selected attributes of ecosystem, and enhance populations of interest
  - Riparian zone in Morro Bay Chorro Creek
- ▶ Various actions should be applied as appropriate



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Long Beach, CA

Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image U.S. Geological Survey

Image County of San Bernardino

33°45'14.14" N 118°01'16.60" W elev 8 m

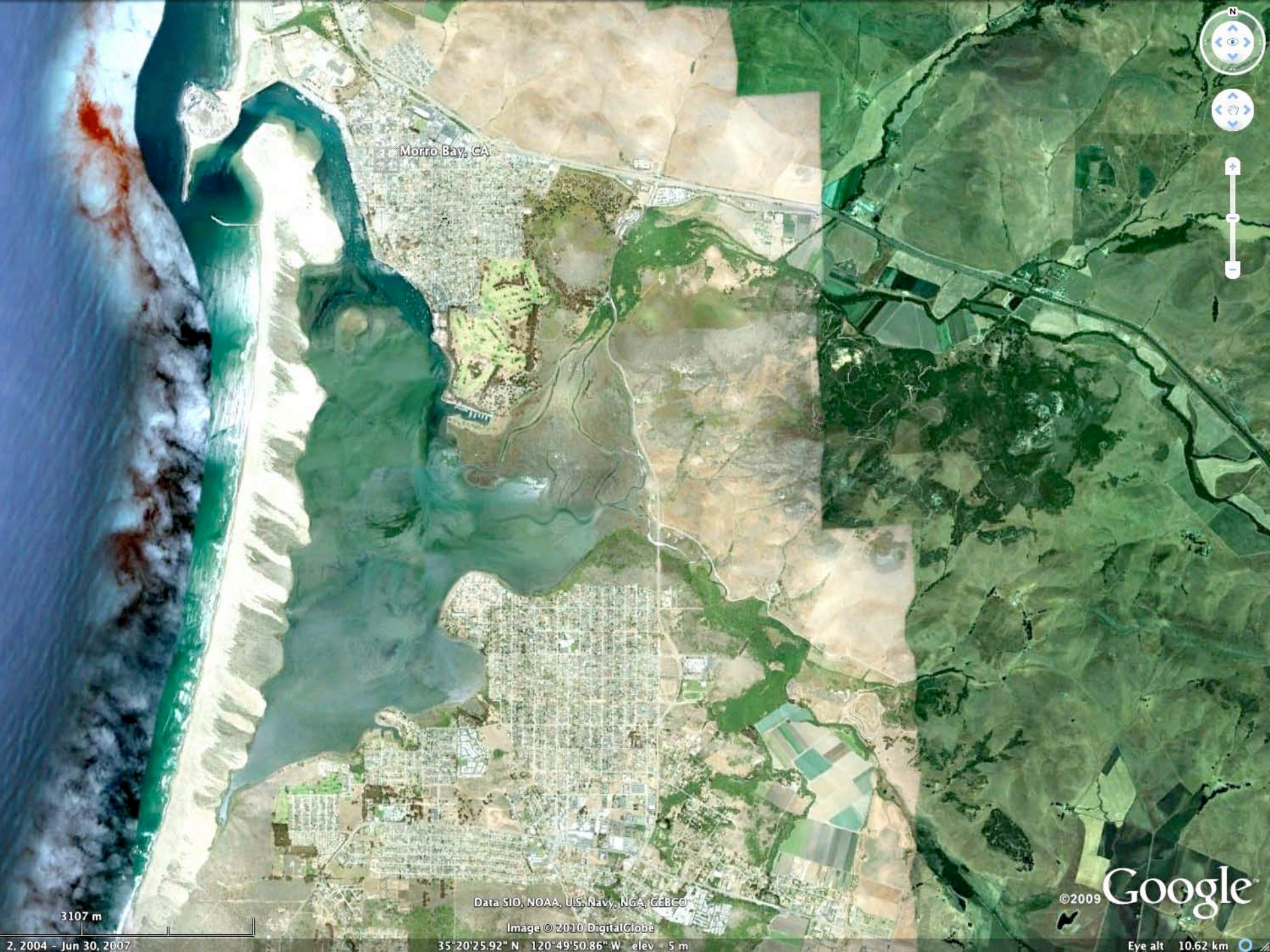
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10.8 km

Imagery Dates: Jul 31, 2007 - Oct 23, 2007

Eye alt 37.35 km





Morro Bay, CA

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image © 2010 DigitalGlobe

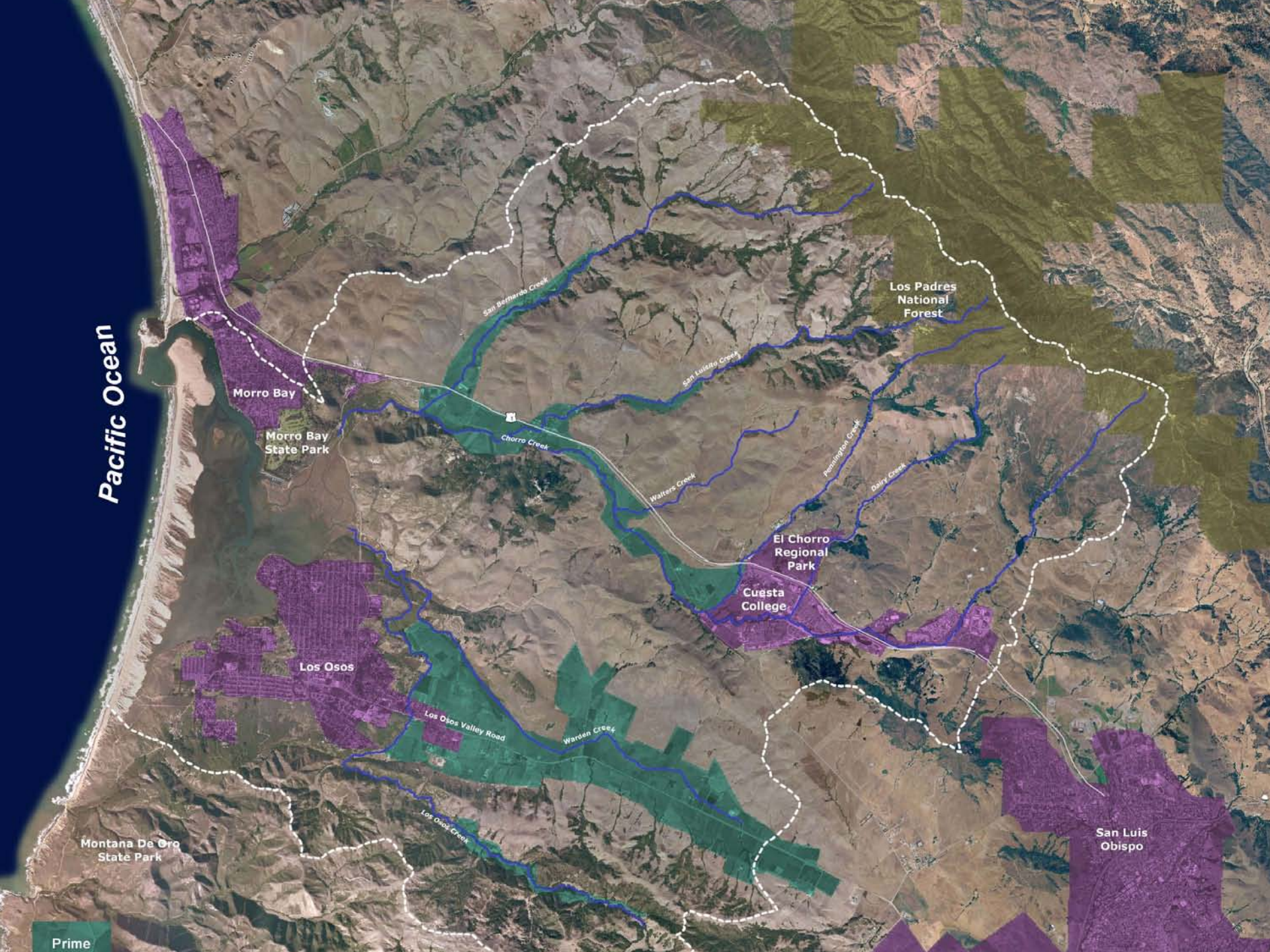
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3107 m

2, 2004 - Jun 30, 2007

35°20'25.92" N 120°49'50.86" W elev 5 m

Eye alt 10.62 km



Pacific Ocean

Morro Bay

Morro Bay State Park

San Bernardo Creek

San Luisito Creek

Los Padres National Forest

Chorro Creek

Walters Creek

Pennington Creek

Dairy Creek

El Chorro Regional Park

Cuesta College

Los Osos

Los Osos Valley Road

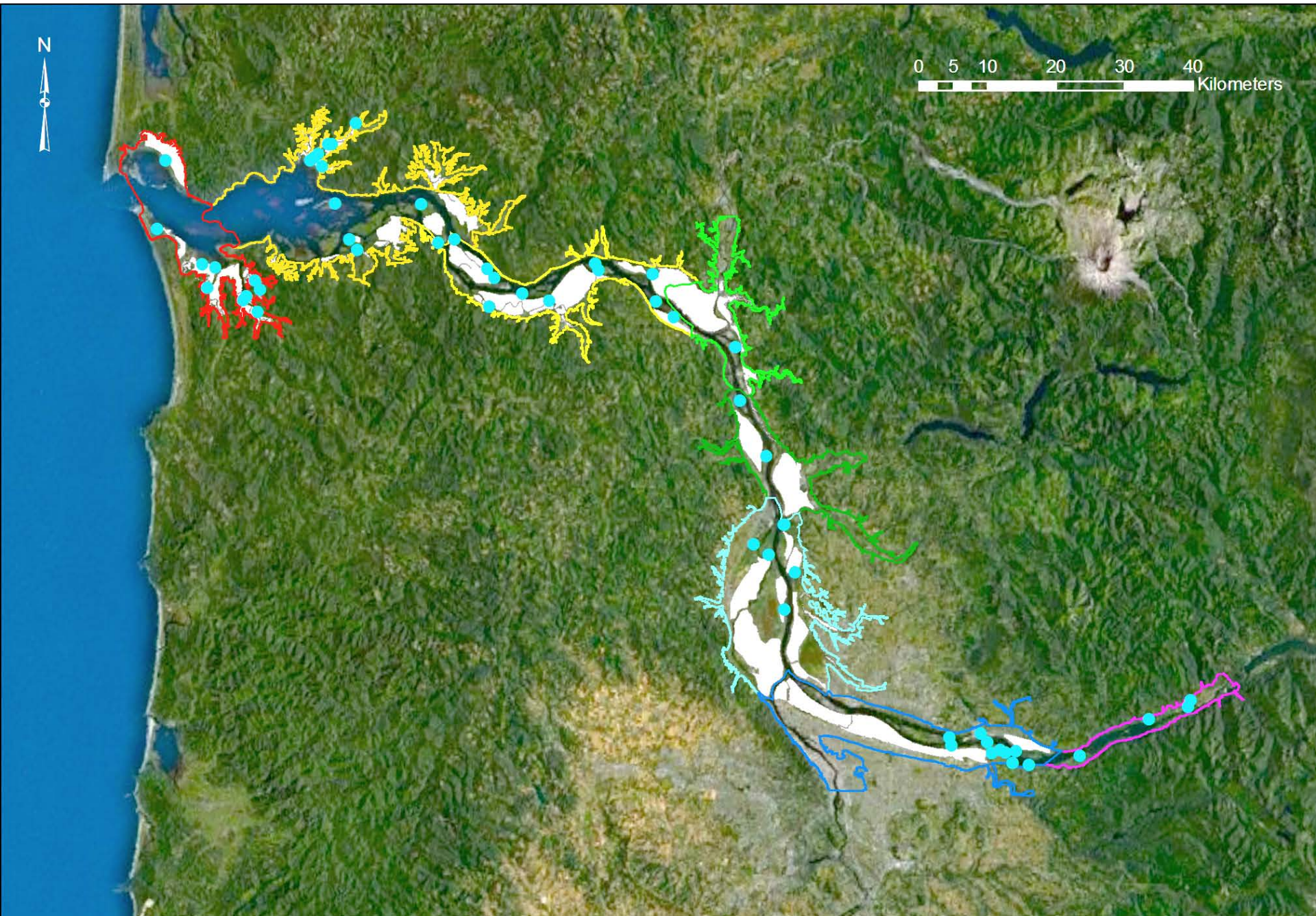
Warden Creek

Los Osos Creek

Montana De Oro State Park

San Luis Obispo

Prime



N

0 5 10 20 30 40 Kilometers