

# Asking the right questions and getting meaningful answers:

## A monitoring framework for Chinook salmon recovery in the Lake Washington/Cedar/Sammamish Watershed

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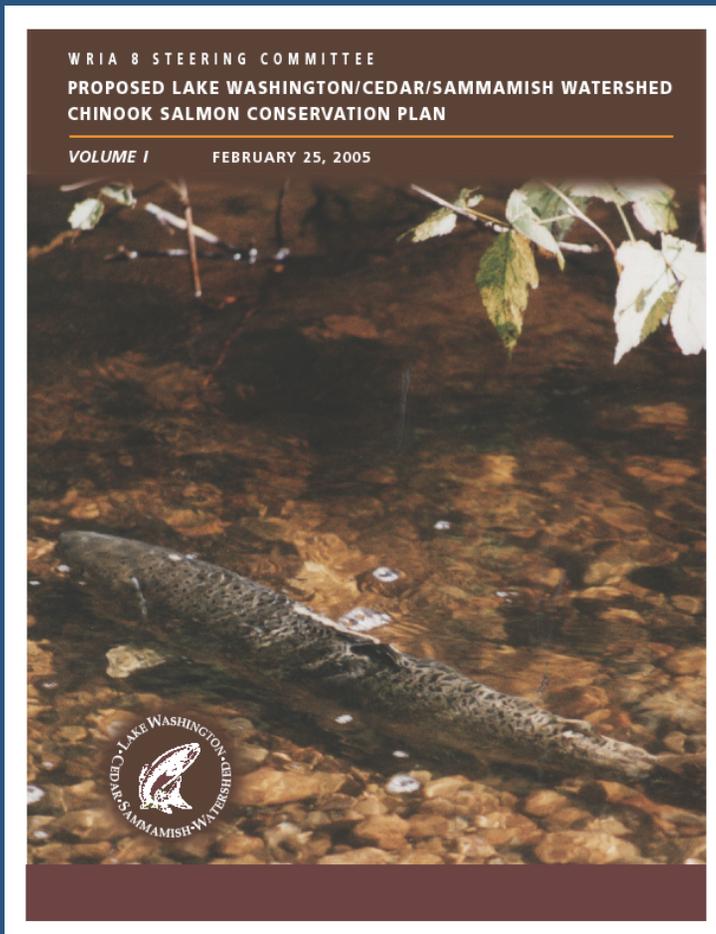
# WRIA 8\*



- Lake Washington
- Lake Sammamish
- Cedar River Basin
- Sammamish River Basin
- Puget Sound Nearshore

\* WRIA = Water Resource Inventory Area

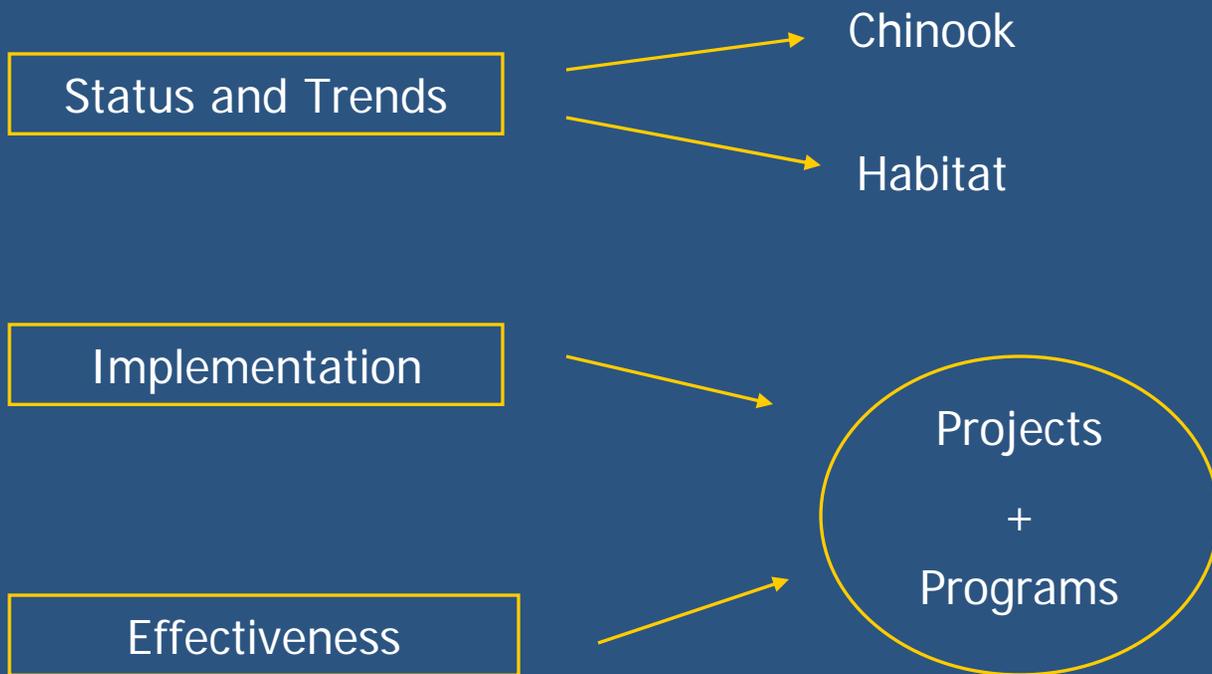
# Monitoring is crucial to measuring our progress



- Plan calls for periodic updates on progress
- State requires annual reporting
- NOAA five-year ESA status review is on the horizon

# What do we need to know?

- Is the watershed producing more or less Chinook?  
(Status and Trends Monitoring)
- Are watershed conditions improving or declining? (Status and Trends Monitoring)
- Are we doing what we said we'd do in our Plan?  
(Implementation Monitoring)
- Is what we said we'd do, doing what we said it would?  
(Effectiveness Monitoring)



- Implementation

- Effectiveness

- Status & Trends (fish)

- Status and Trends (habitat)



Estimated at  
~ \$ 1.8 million  
annually  
in WRIA 8

**WRIA 8 Monitoring Framework**

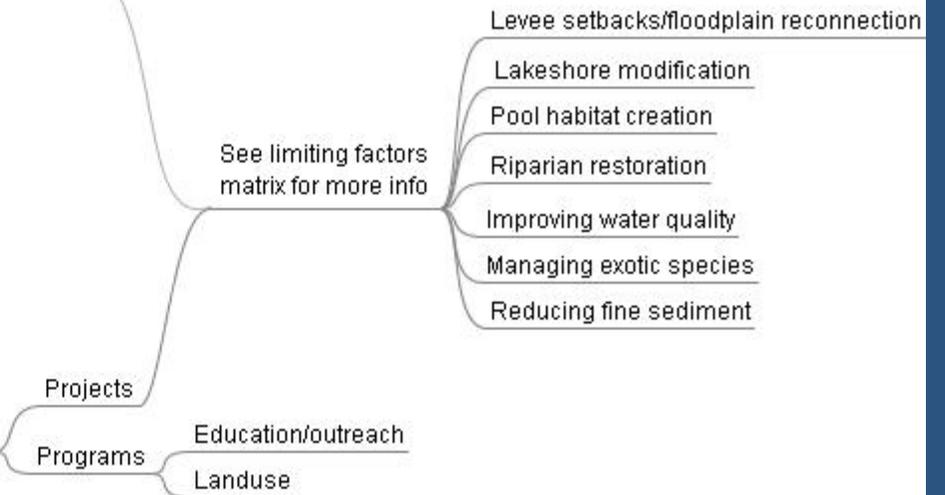
**Status and Trends**



**Implementation**

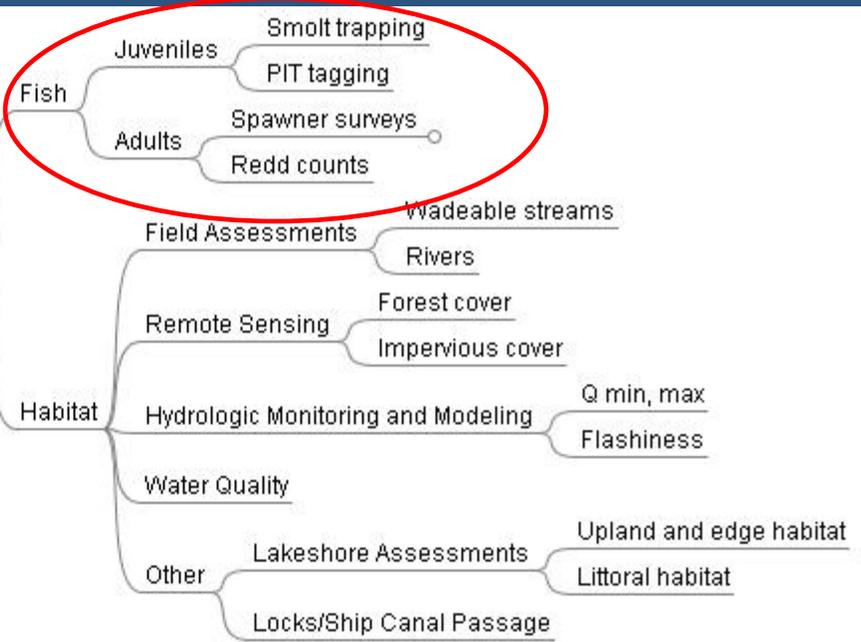


**Direct Effectiveness**

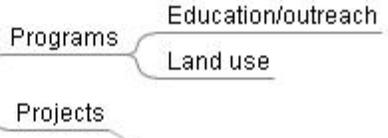


**WRIA 8 Monitoring Framework**

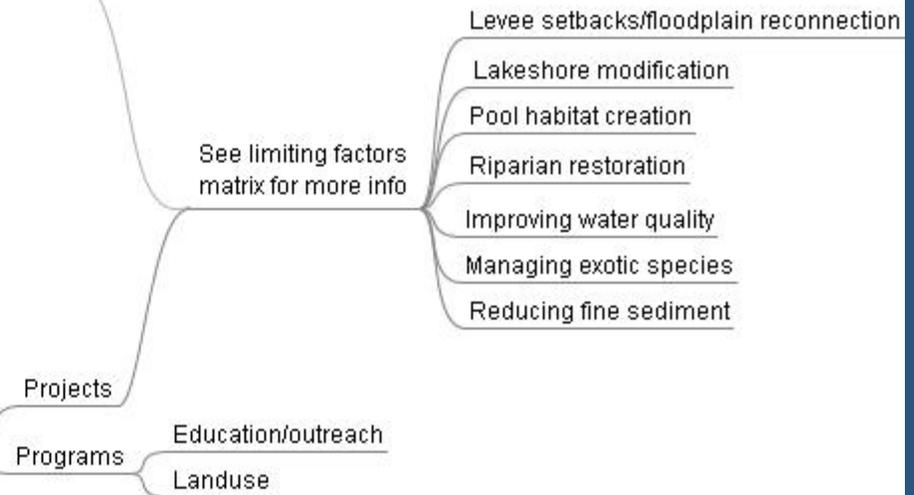
**Status and Trends**



**Implementation**



**Direct Effectiveness**



- Is the watershed producing more or less Chinook? (Status and Trends Monitoring)
- Also called 'fish in – fish out' monitoring
- Considered most crucial information need
- Funded annually by King County, KCD, Seattle, WDFW, MIT, others
- Should be collected in context of NOAA VSP parameters (esp. abundance and productivity)

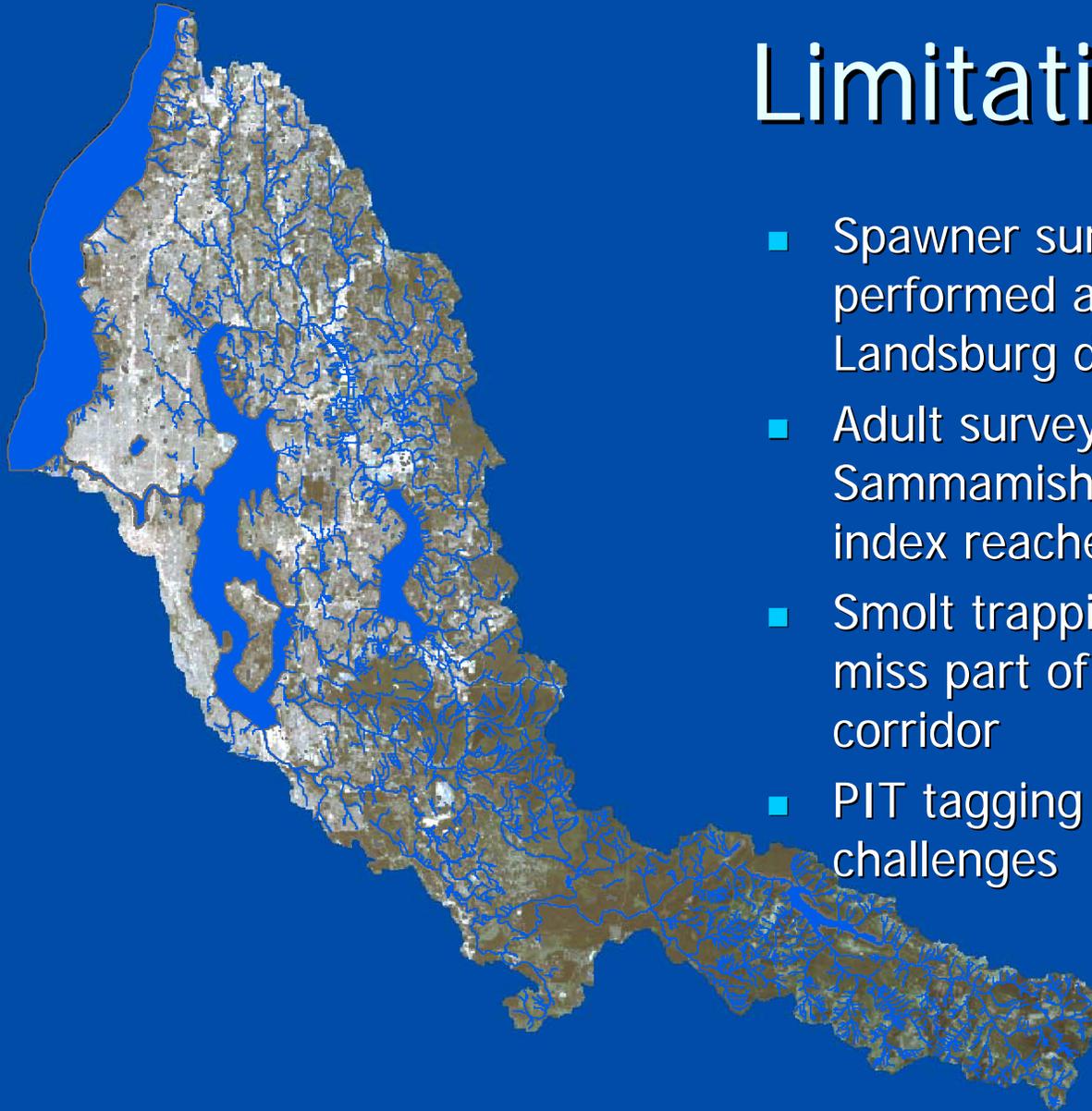


- Is the watershed producing more or less Chinook? (Status and Trends Monitoring)



- ✓ ■ Spawner surveys, redd location, abundance estimates
- ✓ ■ Hatchery vs. wild spawners assessments
- ✓ ■ Juvenile trapping
- ✓ ■ Juvenile tagging to track migration and survival

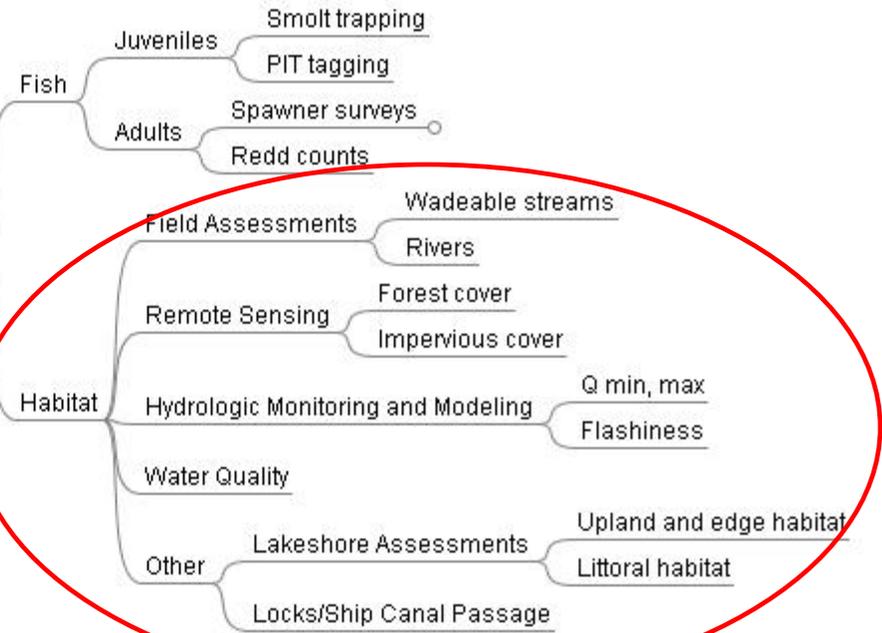
# Limitations



- Spawner surveys are not performed above the Landsburg dam
- Adult surveys of Sammamish population are index reaches
- Smolt trapping locations miss part of the migration corridor
- PIT tagging studies have challenges

**WRIA 8 Monitoring Framework**

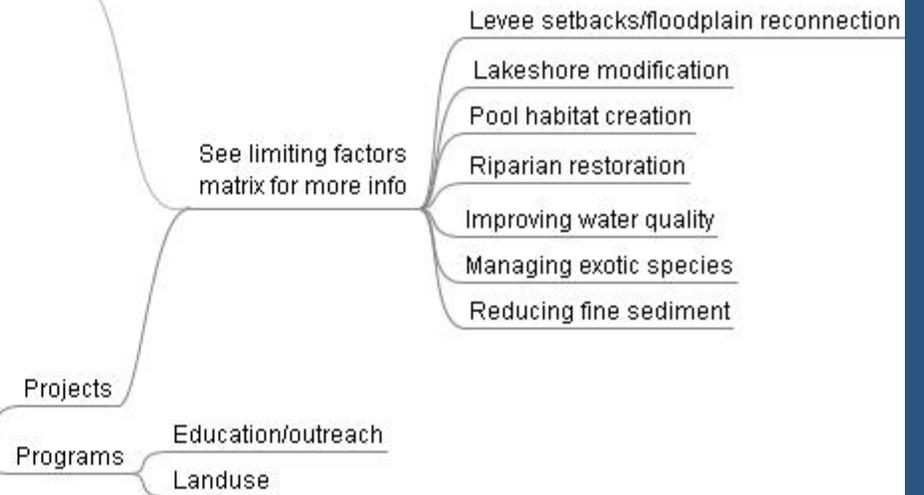
**Status and Trends**



**Implementation**



**Direct Effectiveness**



# Habitat Status and Trends Monitoring

Remote Sensing

Forest Cover

Lakeshore Habitat

Hydrologic Monitoring and Modeling

Water Quantity (Intensity, Duration, Timing)

Groundwater

Field Surveys

Riparian Cover

Riparian Function

LWD

Channel Stability

Pool Habitats

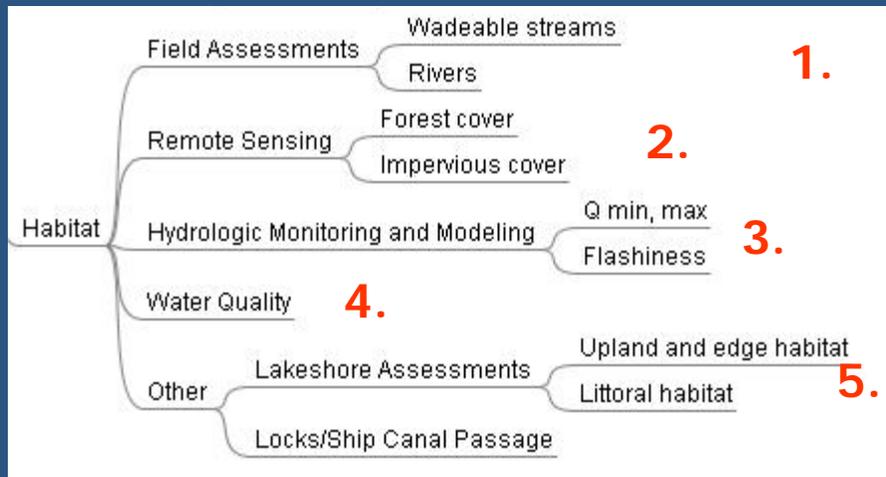
Channel Confinement

Passage through Locks and Ship Canal

Water Quality Monitoring

Water Quality (Sediment, Temperature, Chemistry)

- Are watershed conditions improving or declining? (Status and Trends Monitoring)



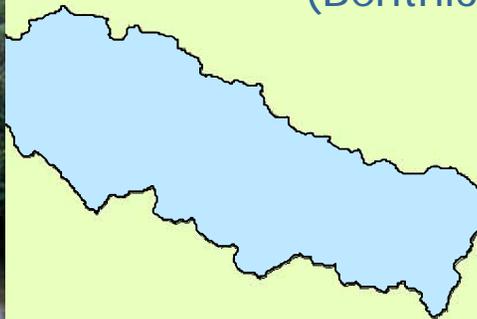
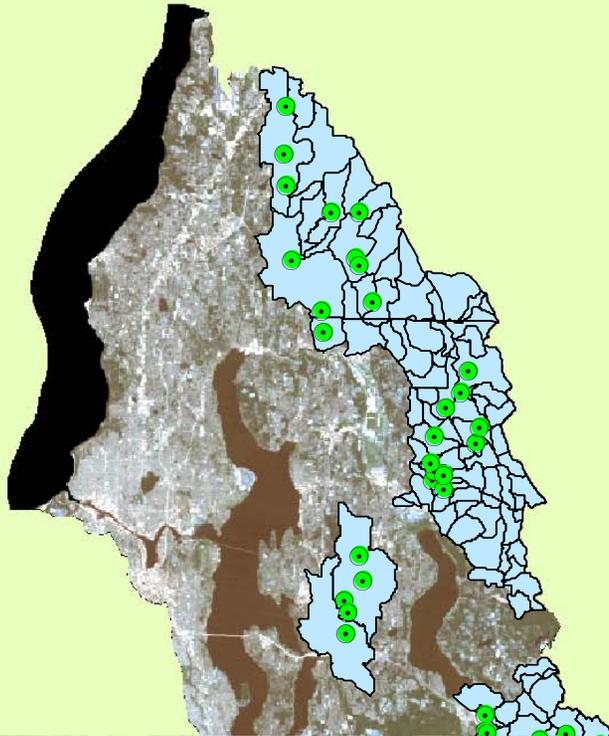
- Follow regional guidelines
- Focus on priority areas
- Use existing data sources to supplement information

## Follow regional guidelines

### Wadeable streams:

Survey protocol based on EPA's EMAP survey – used nationally and regionally; e.g.,

- Pool frequency
- Substrate
- Riparian habitat
- Fish
- (Benthic macroinvertebrates)



## Focus on priority areas

Subbasins prioritized by watershed condition and level of use by Chinook salmon:

1. Core/migratory
2. Satellite
3. Episodic/None

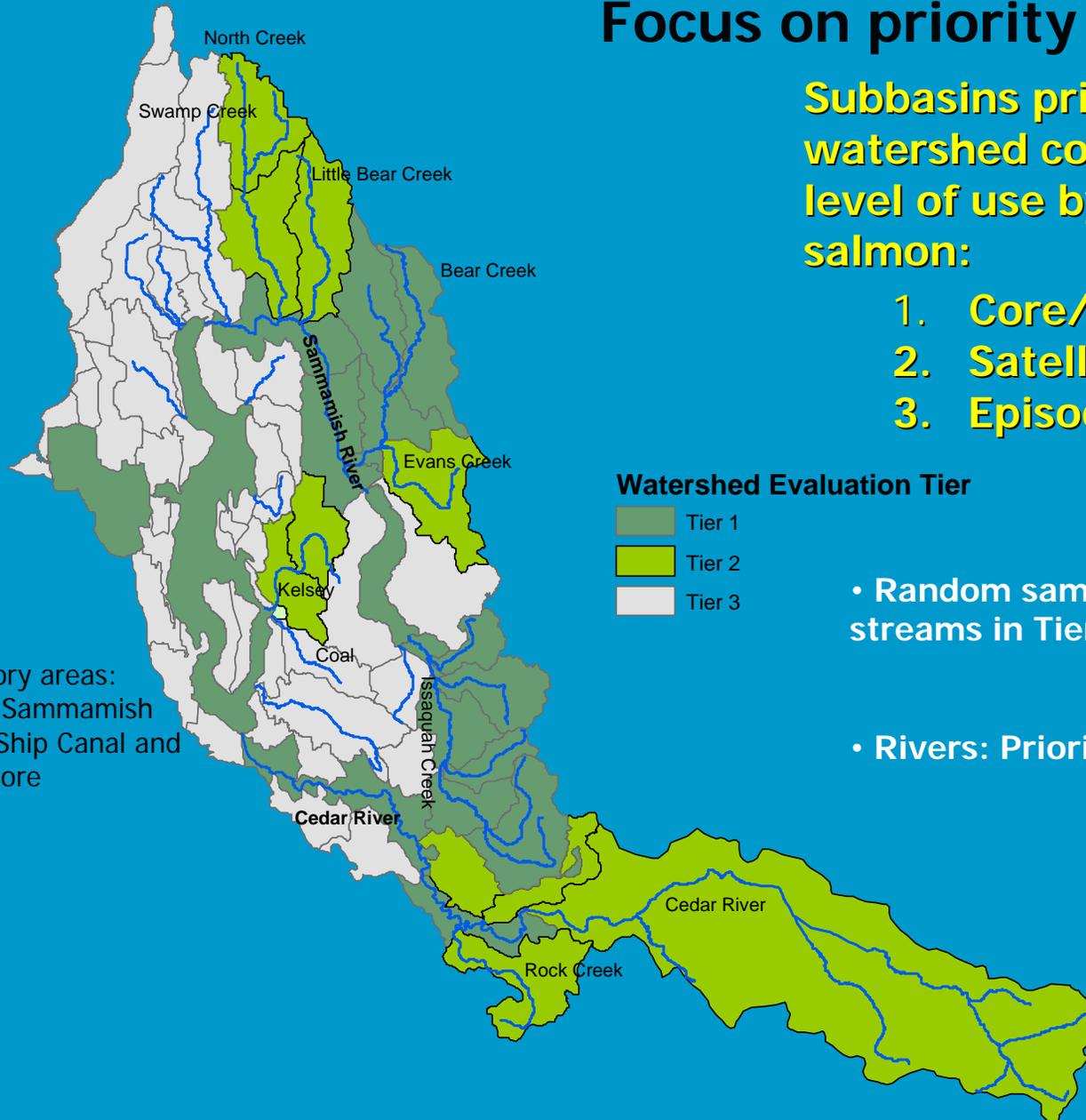
Migratory areas:  
Lakes, Sammamish  
River, Ship Canal and  
Nearshore

### Watershed Evaluation Tier

- Tier 1
- Tier 2
- Tier 3

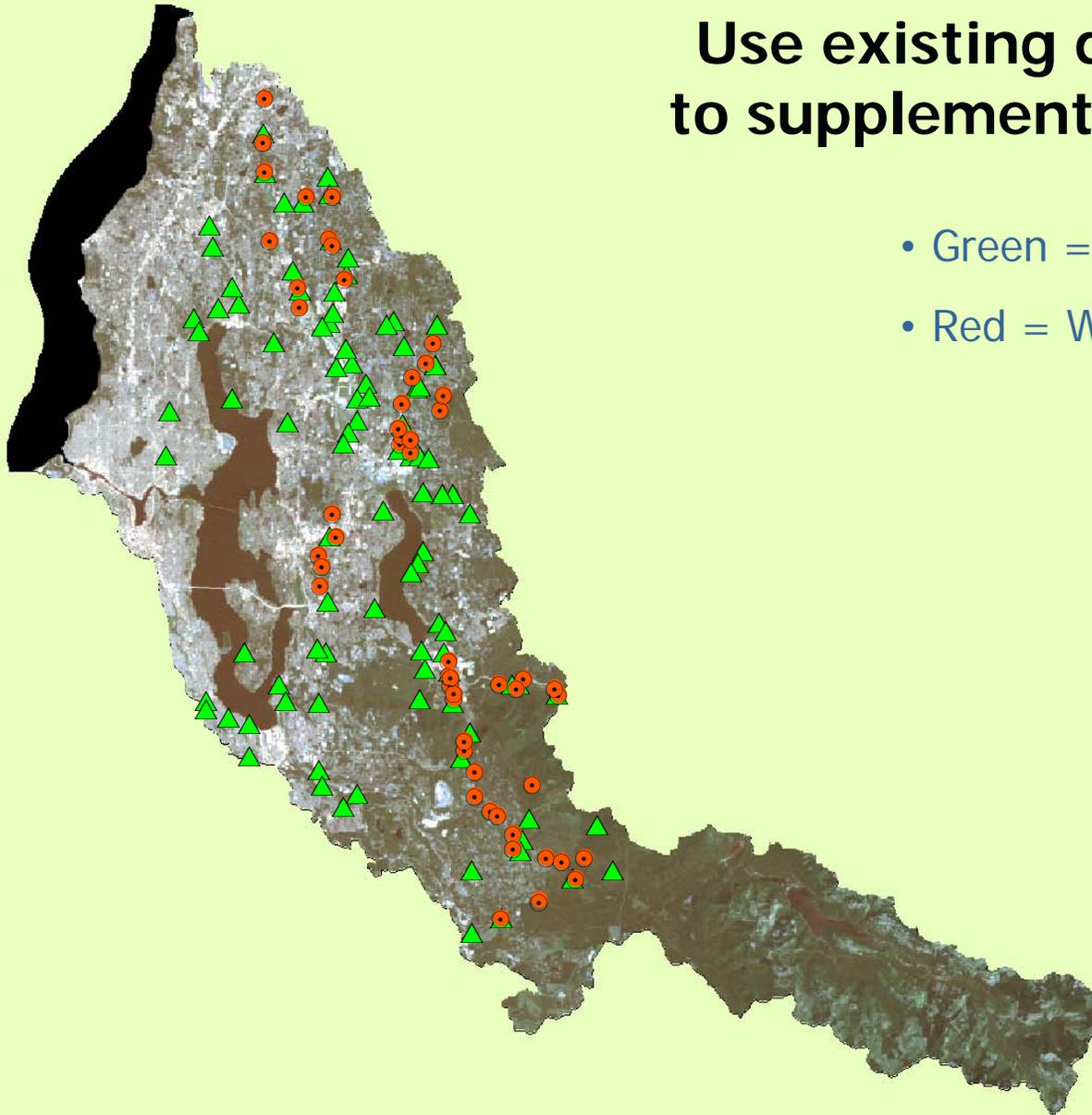
- Random sample of wadeable streams in Tier 1 and Tier 2 areas

- Rivers: Priority on Cedar River



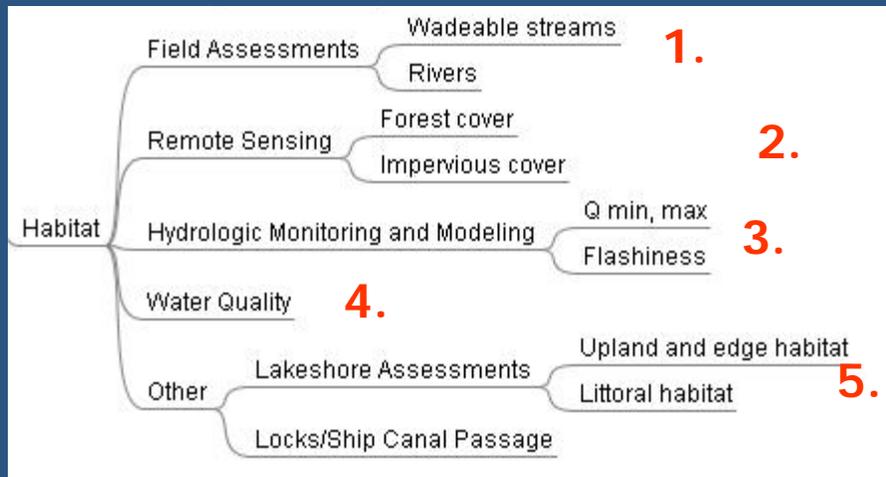
## Use existing data sources to supplement information

- Green = BIBI\* sites
- Red = WRIA 8 WS sites



\* BIBI = Benthic Index of Biotic Integrity

- Are watershed conditions improving or declining? (Status and Trends Monitoring)



- Follow regional guidelines
- Focus on priority areas
- Use existing data sources to supplement information

# Use existing data sources to supplement information



NOAA Coastal Services Center  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

  
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Land Cover Analysis
<b>C-CAP</b>
History
Data Production
Classification Scheme
Change Analysis
Trend Analysis
Data
Applications
Frequently Asked Questions

## Land Cover Analysis

### NOAA Coastal Change Analysis Program

The Coastal Change Analysis Program (C-CAP) is a nationally standardized database of land cover and land change information, developed using remotely sensed imagery for the coastal regions of the U.S. C-CAP products inventory coastal intertidal areas, wetlands, and adjacent uplands with the goal of monitoring these habitats by updating the land cover maps every five years.

The development of standardized regional land cover information enables managers to coordinate the planning of shared resources, facilitating an ecosystem approach to environmental issues that transcends local and state regulatory boundaries. C-CAP has recently released two time periods of mapping for all of the Conterminous United States (CONUS), and is now working to update these products. The goal is to have this 2005/08 update complete by 2010, so that we can then start on the next update cycle.

The time series seen here depicts changes in Mt. Pleasant (a suburb of Charleston), South Carolina. From 1972 to 2000, Mt. Pleasant saw a 250 percent increase in development and a 160 percent increase in grassland. Most of this development was in areas where forests formerly stood. In many cases, development now abuts the marsh edge, leaving little buffer around these natural features.

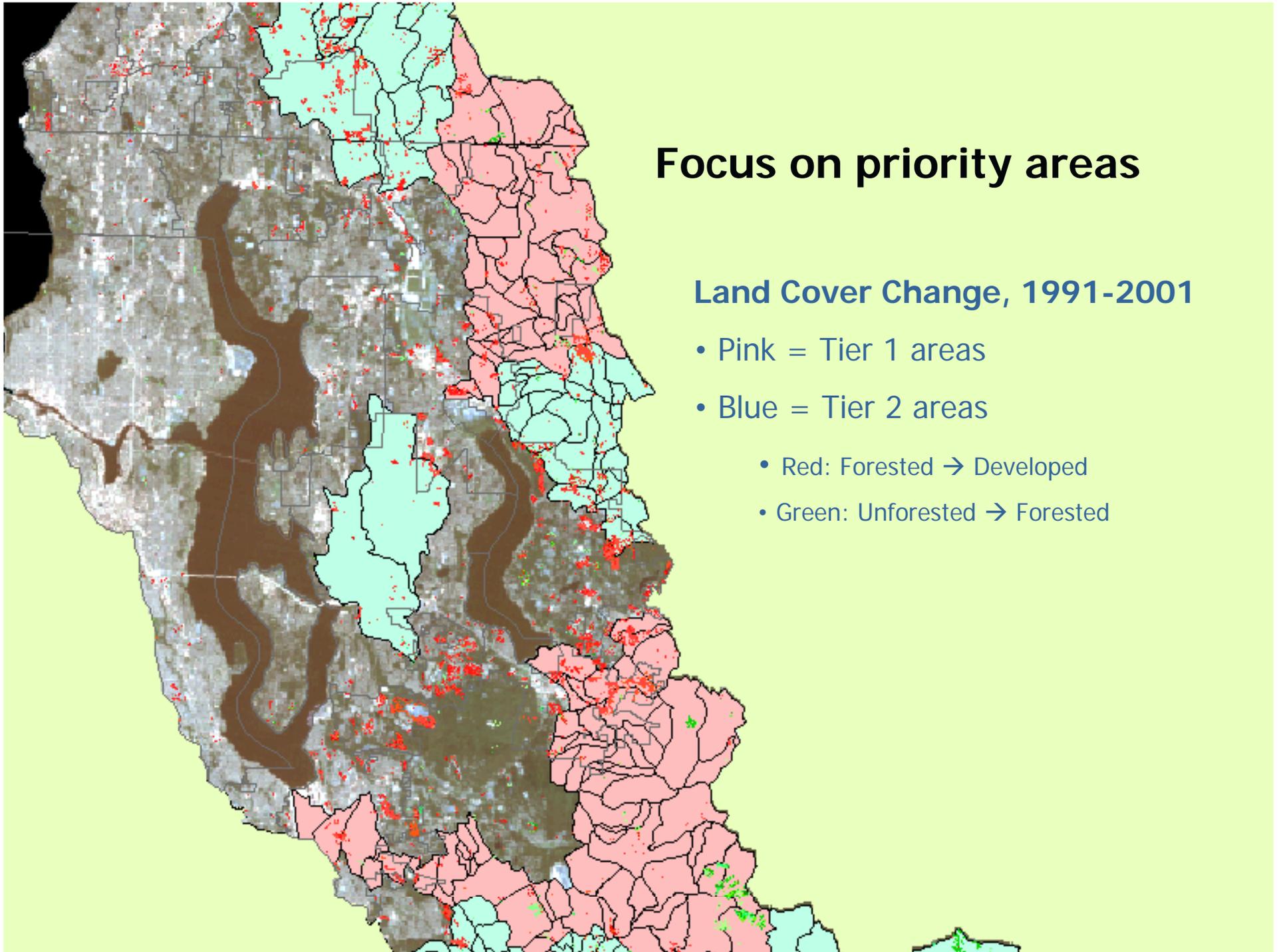


1972 1986 1990 1995 2000

Land Cover Classes

Developed - High Intensity	Pelvicine Forest
Developed - Low Intensity	Pelvicine Scrub/Shrub
Cultivated Land	Pelvicine Emergent Wetland
Grassland	Submarine Emergent Wetland
Deciduous Forest	Unconsolidated Shore
Evergreen Forest	Bare Land
Mixed Forest	Water

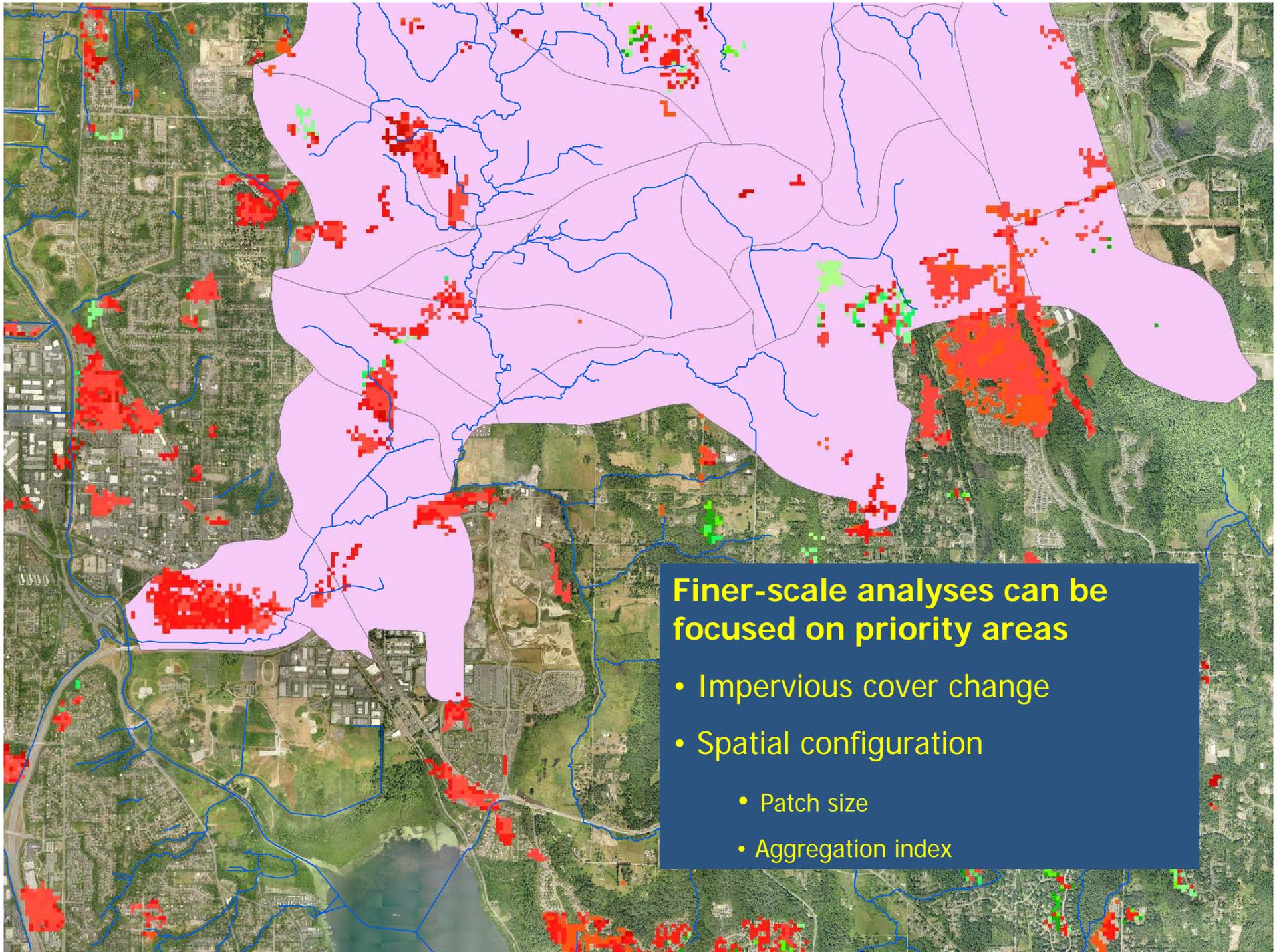
- 1991, 2001 classified
- 2006 available in May or June



## Focus on priority areas

### Land Cover Change, 1991-2001

- Pink = Tier 1 areas
- Blue = Tier 2 areas
- Red: Forested → Developed
- Green: Unforested → Forested

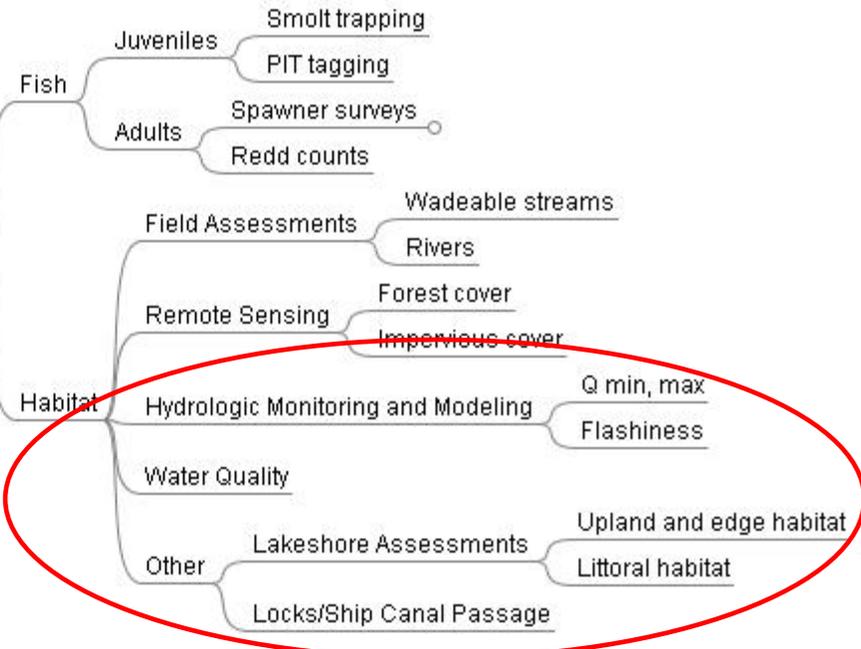


**Finer-scale analyses can be focused on priority areas**

- Impervious cover change
- Spatial configuration
  - Patch size
  - Aggregation index

**WRIA 8 Monitoring Framework**

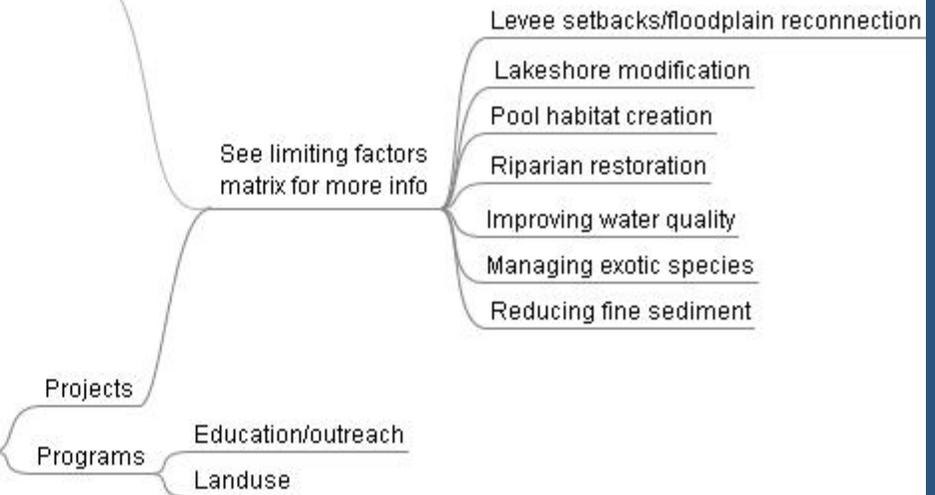
**Status and Trends**



**Implementation**



**Direct Effectiveness**



# Hydrologic Monitoring and Modeling

- DeGasperi et al. 2009
- Brett et al. 2005

Use County gauge data where available

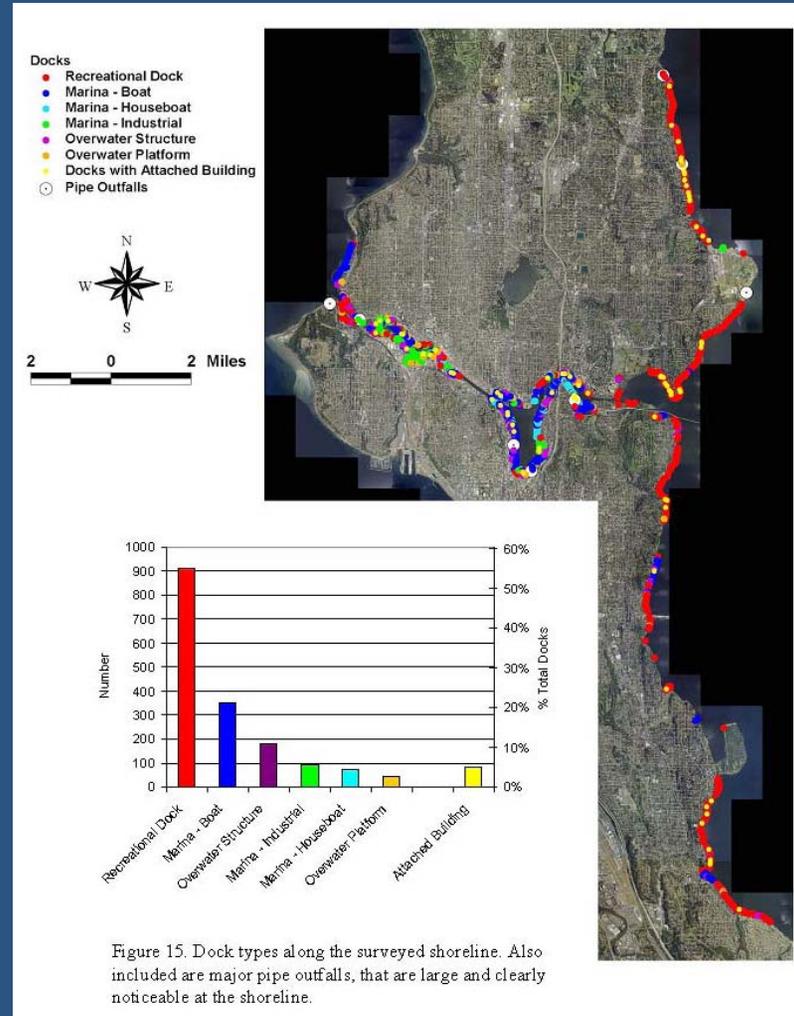
Quantify 'flashiness' metrics, e.g., increases in frequency and range of high pulses during summer and winter

# Water Quality

- Rely on County data where available

# Lakeshore Assessments

- Use protocol similar to Toft et al. 2003
- Since change if it comes will be slow, assessments can be made on a longer time frame.

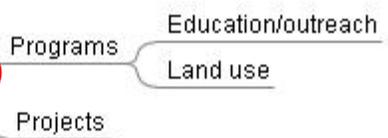


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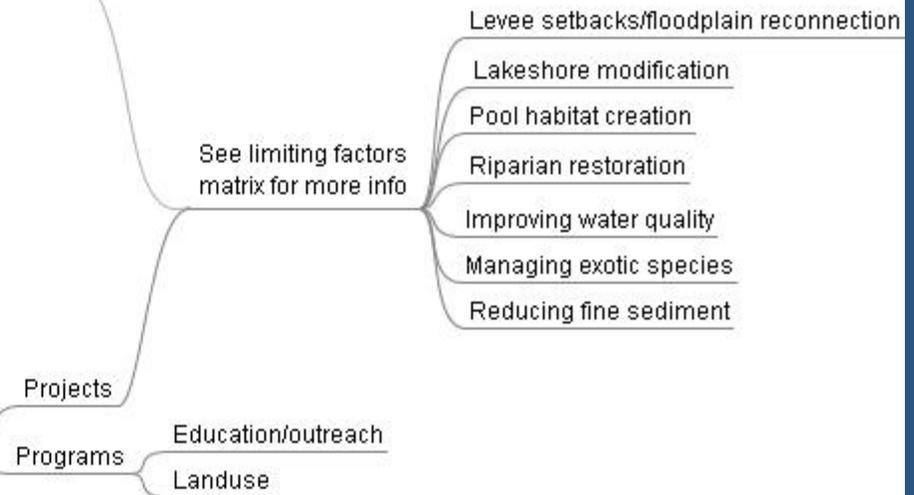
**Status and Trends**



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# Project Implementation and Effectiveness Monitoring

- Rely on other entities to the greatest extent possible

# Implementation Monitoring

**FLOODPLAIN CONNECTIVITY:** Setback and remove dikes and levees to restore floodplain connectivity. Floodplains provide off-channel and margin refuge habitats, as well as lower velocity areas during periods of high flow. (5 projects)  
**Goal:** 6,800 Linear Feet **Actual:** 4,350 Linear Feet **Progress:** 64% Completed



**HABITAT PROTECTION:** Protect property within the Cedar River basin through easements, acquisitions, or transfer of development rights. These actions will protect floodplain, riparian, and upland watershed processes and enable future restoration efforts. (18 projects)  
**Goal:** 606 Acres **Actual:** 93.2 Acres **Progress:** 15% Completed



**CHANNEL COMPLEXITY:** Add large woody debris to create pools. Channel complexity provides juvenile Chinook with refuge and foraging opportunity, while adult Chinook benefit from areas to rest on their upstream migrations. (5 projects)  
**Goal:** 3,500 Feet **Actual:** 800 Feet **Progress:** 23% Completed



## Habitat Work Schedule

# Effectiveness Monitoring

- Focus monitoring on actions with highest uncertainty
- Use existing efforts to improve our project designs wherever possible
  - SRFB effectiveness monitoring
  - CIP monitoring requirements
  - Other opportunities (support local or regional initiatives)

**WRIA 8 Monitoring Framework**

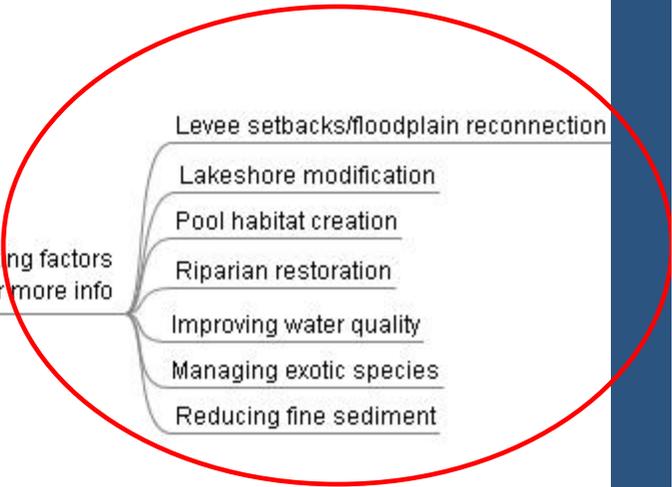
**Status and Trends**



**Implementation**



See limiting factors matrix for more info



**Direct Effectiveness**



# ■ Pacific Coastal Salmon Recovery Fund (NOAA)

TABLE 1: PUGET SOUND RECOVERY DOMAIN

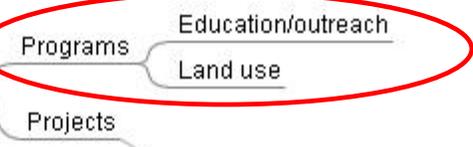
Program	Major Habitat Limiting Factor	PCSRF Treatments Addressing Major Habitat Limiting Factors (from PCSRF database)	Potential Habitat Indicator (from other data sources)
Habitat	Degraded habitat – Estuarine and nearshore marine (ESU: 1,3)	<ul style="list-style-type: none"> <li>Channel modification</li> <li>Creation of new estuarine area</li> <li>Dike breaching/removal</li> <li>Increasing freshwater flow</li> <li>Removal of existing fill material</li> <li>Estuarine and nearshore land acquisition projects</li> </ul>	Change in area, distribution, and type of tidal and submerged wetlands.
	Degraded habitat – floodplain connectivity and function (ESU: 1-3)	<ul style="list-style-type: none"> <li>Wetland creation/ improvement / enhancement, Invasive species removal, vegetation planting</li> <li>Conservation grazing management/ Livestock exclusion</li> <li>Fencing</li> <li>Irrigation practice improvement</li> <li>Water gap development</li> <li>Channel connectivity</li> <li>Riparian and wetland land acquisition projects</li> </ul>	Change in condition of physical habitat - pool density and depth, cover, wood quantity and quality.
	Degraded habitat – channel structure and complexity (ESU: 1-3)	<ul style="list-style-type: none"> <li>Bank stabilization</li> <li>Channel connectivity &amp; reconfiguration</li> <li>Deflectors/barbs</li> <li>Log and Rock control (weir)</li> <li>Vegetation planting and/or removal / control</li> <li>Roughened channel</li> <li>Site and stream channel maintenance</li> <li>Spawning gravel replacement</li> <li>Woody debris placement</li> <li>Fencing</li> <li>Riparian land acquisition projects</li> </ul>	Change in condition of physical habitat - pool density and depth, cover, wood quantity and quality.
	Degraded habitat – riparian areas and LWD recruitment (ESU: 1-3)	<ul style="list-style-type: none"> <li>Conservation grazing management/ Livestock exclusion</li> <li>Irrigation practice improvement</li> <li>Water gap development</li> </ul>	Change in area, distribution, and type of riparian vegetation.

**WRIA 8 Monitoring Framework**

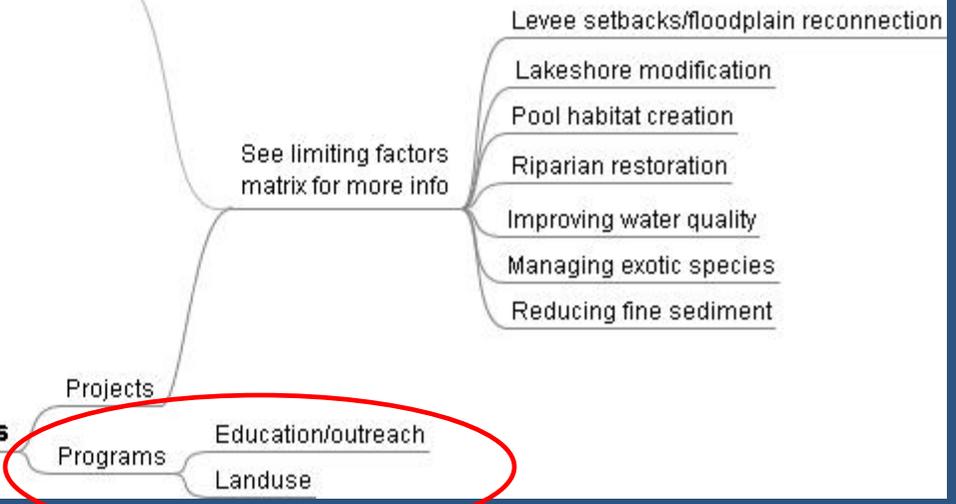
**Status and Trends**



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**Direct Effectiveness**



# Programmatic Effectiveness and Implementation Monitoring

- Implementation: WRIA 8 annual survey
- Effectiveness: suggest third party

**WRIA 8 Monitoring Framework**

**Status and Trends**



**Implementation**



**Direct Effectiveness**

