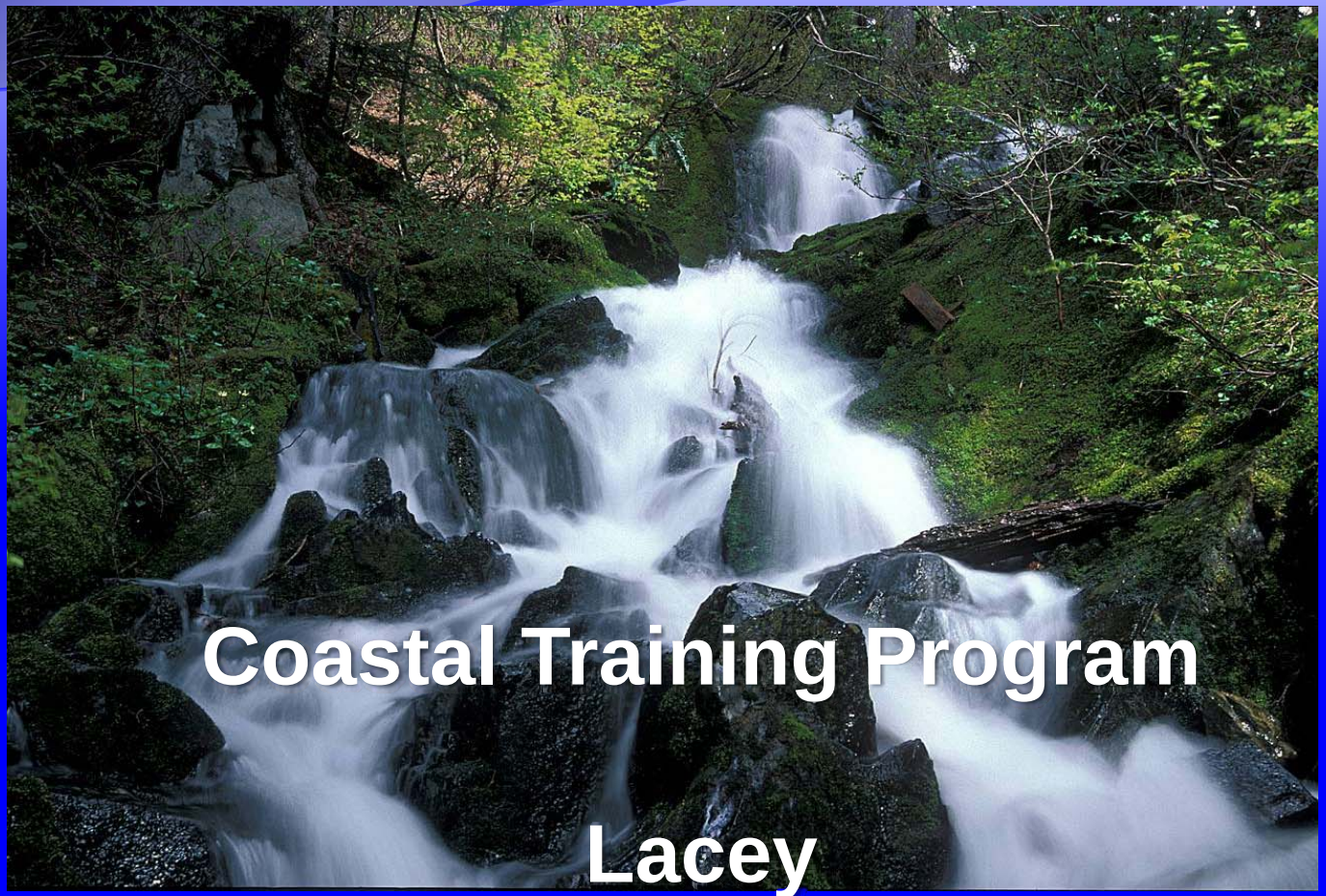
Protecting Aquatic Ecosystems by Understanding Watershed Processes



Coastal Training Program

Lacey

February 17, 2010

Schedule
9:00 am to 3:30 pm

- Intro to class
- Intro to guidance
- Overview of Steps & Appendices
- Example of a Watershed Assessment in Leavenworth
- Break
  - Group Discussion on Planning/Restoration Recommendations

Lunch Break

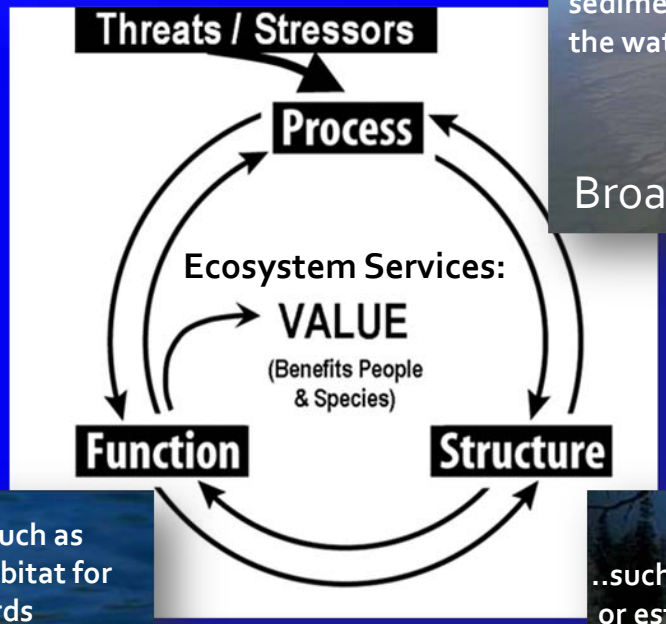
- Introduction to Puget Sound Characterization Project
  - Review of models for assessing Water Flow Processes
- Example of using results to develop a Watershed Based Mitigation Plan for:
  - Lewis County
- Break
  - City of Issaquah
  - Birch Bay
- Summary and Wrap Up

Objectives of Class:

To Understand:

- Benefits of a watershed approach
- Role of watershed processes
  - Focus on water flow processes
- How to apply the results of characterization to local planning

A Watershed or Ecosystem Approach to Planning



Benefits of a Watershed Approach

High

Regulation & Enforcement → Improved land use planning & management → Identify best areas for mitigation and protection

Success of mitigation protection, & restoration measures

Understand processes at a watershed scale

Effort and Focus

Low

Level of Resource Protection →

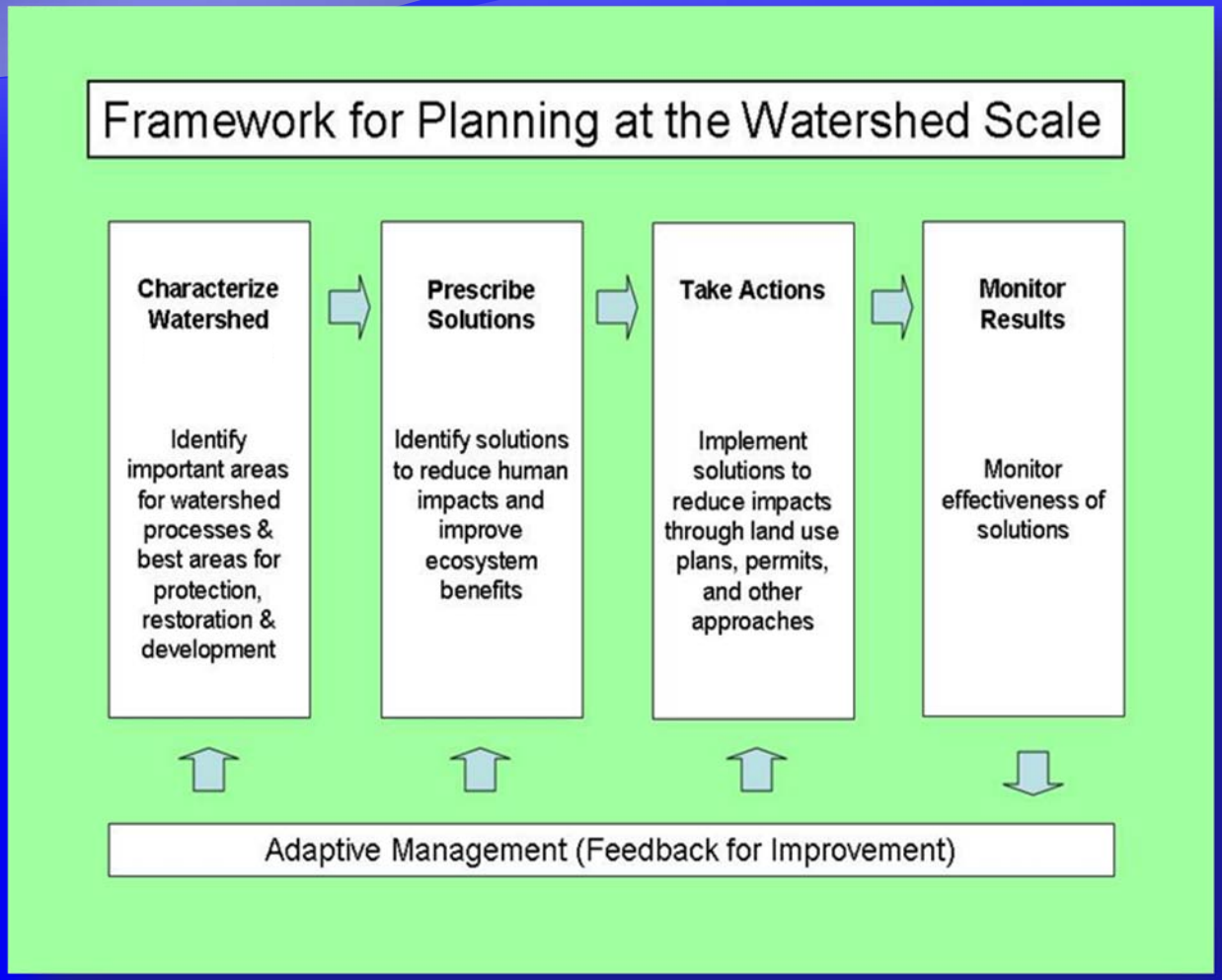
High

Understanding of Important Areas can help…

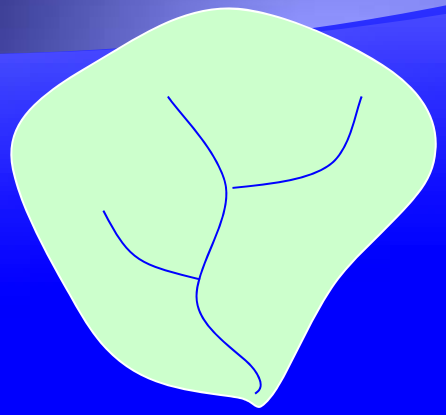
Guide future development

- Avoid creating environmental problems
- Reduce cost of infrastructure
- Streamline permitting
- Support Growth Management and Shoreline Management Planning

Watershed Based Planning Process

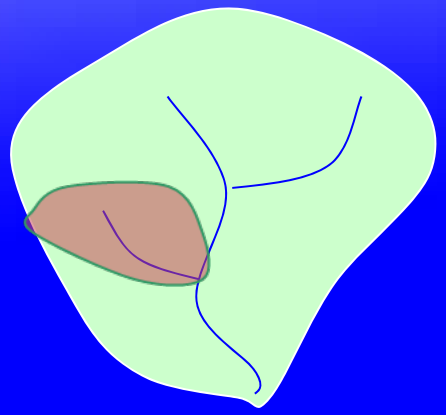


Multiple Scales of Watershed Analysis



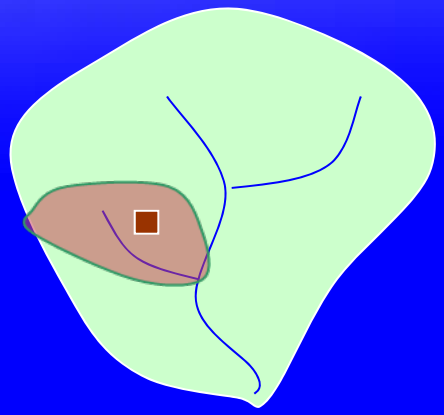
Broad-scale:

- County
- River Basin



Mid-scale:

- Sub-Area
- Watershed

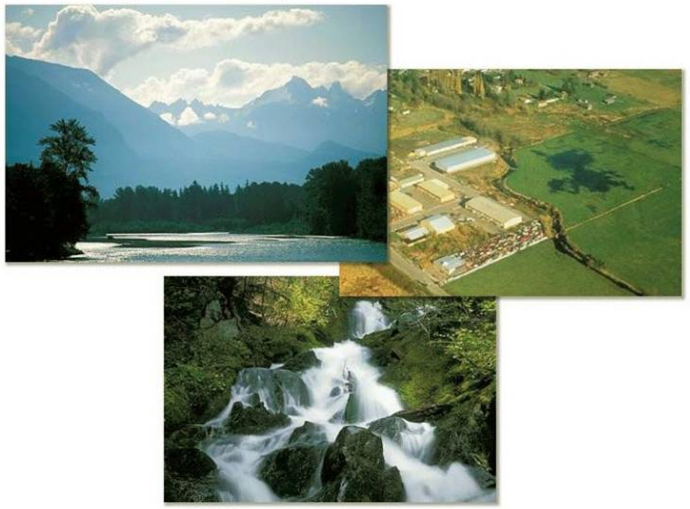


Fine-scale:

- Subdivision or Parcel

Tool box for Watershed Approach

	Tools	Application - Benefit
Broad Scale	DOE Watershed Characterization Guidance	Describe, Identify & Map Processes that drive site functions
Mid - Scale	DOE Characterization Scoring Methods	Identify areas for protection and restoration
Fine Scale	Mitigation Guidance DOE Wet. Assessment DOE Rating System BAS Wet Vol 2	Design Mitigation Assess functions – Assure protection of wet functs & no net loss



Protecting Aquatic Ecosystems by Understanding Watershed Processes

A Guide for Planners

Ecology Publication #05-06-027

Introduction to Department of Ecology's Watershed Guidance

http://www.ecy.wa.gov/programs/sea/pubs/0506027/review.html

2008

Revision Due Out this Spring

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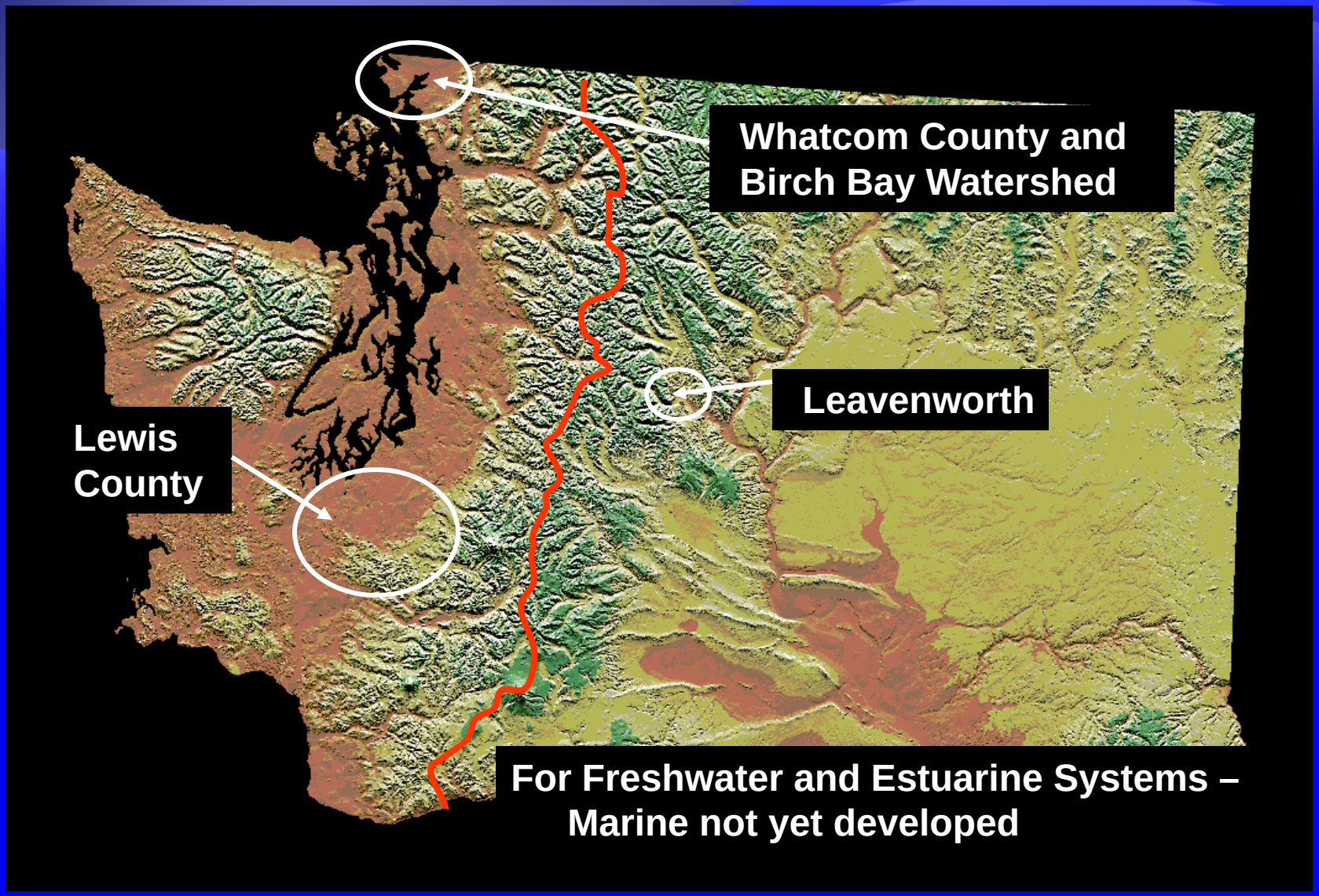
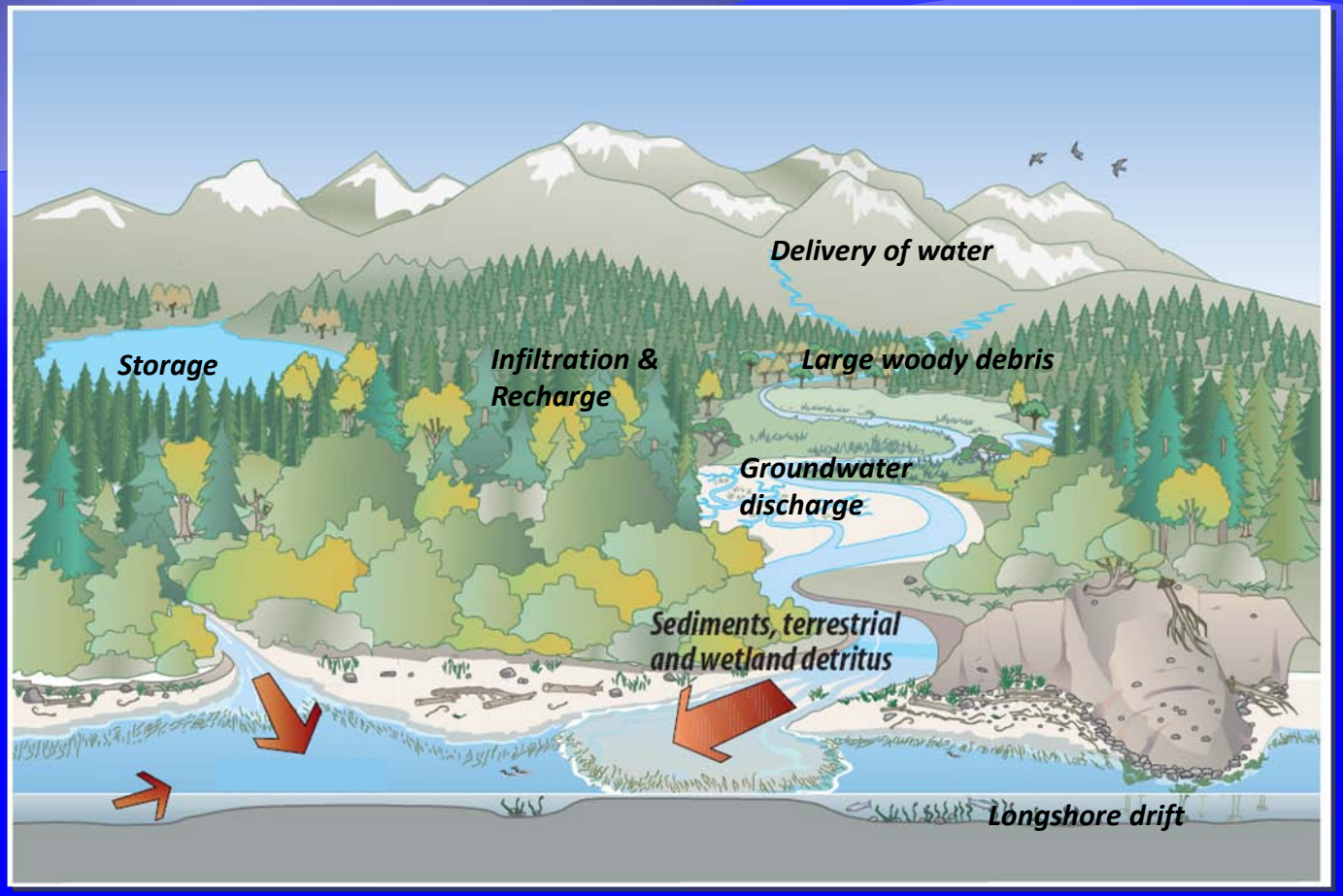
Guidance is For Western Washington



Objectives of Guidance



Identify Important Areas for Supporting Watershed Processes

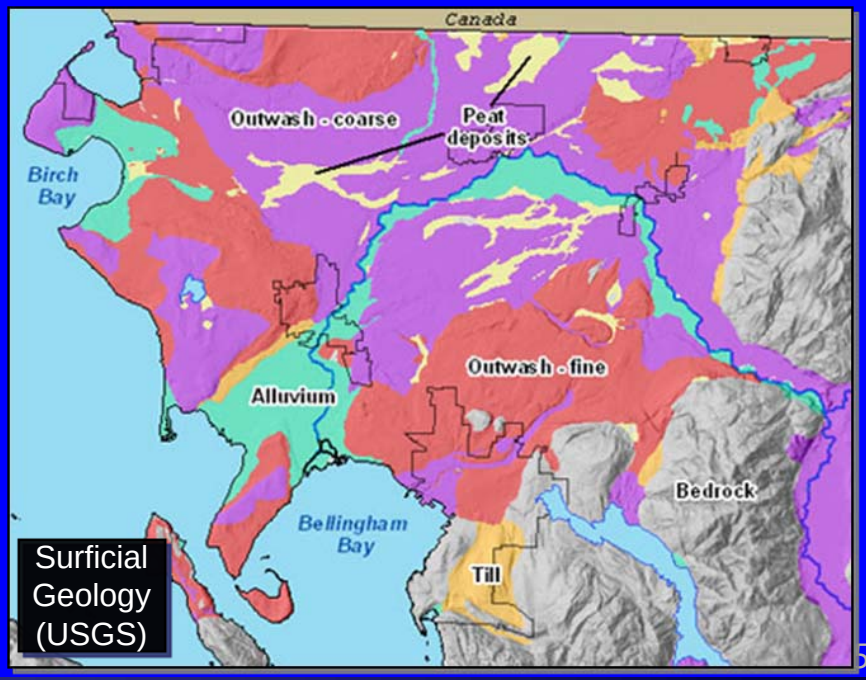
And How Those Areas Have Been Impaired

Identifies the best areas to protect, restore, & develop

This Guidance is based on landscape setting…

Physical characteristics of the landscape:

- Aquatic resources develop and are maintained due to interaction of hydrologic cycle with landscape components including:
  - **Geology**
  - **Soils**
  - **Topography**



Surficial Geology (USGS)

OVERVIEW OF ANALYSIS STEPS

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Appendices

Appendix A: Overview of Appendices.....A-1
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Appendix B: Water.....B-1
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Appendix D: Pathogens.....D-1

Steps	Key Questions	Details
Step 1: Define the purpose of the analysis.	What are the policy or regulatory issues for which you need to understand watershed processes? Who will assist you with the analysis? What resources already exist to help with the analysis?	Pg 6 & 7
Step 2: Delineate the analysis area, hydrologic sub-units and any hydrogeologic units .	What is the contributing basin for the area affected by policy or regulatory decisions? What size of the sub-units meets local planning and permitting needs? Are there different types of precipitation, landform and geology in the analysis areas?	Include surface watershed and contributing area for groundwater (if possible). Determine appropriate size for analysis units.
Step 3: Map the relative level of importance of each sub-unit for each watershed process.	In the absence of human impairment, what areas are important to each watershed process? Where are these different areas located?	Describe relationship between physical characteristics of a watershed and each watershed process.
Step 4: Map the relative level of	Which human activities have impaired each watershed	Describe relationship between

Step 1 – Define Purpose of Analysis

Table 1: Relationship between purpose, analysis area, and watershed processes requiring analysis.

Purpose	Analysis area	Watershed processes
Shoreline Master Program Comprehensive Plan Watershed Plan	Watersheds of jurisdiction	All
Mitigation Plan Conservation Plan Restoration Plan	Watershed of ecosystem or habitat	All
Plans for addressing environmental problems, e.g., TMDLs, shellfish closures, water quality violations, etc.	Watershed affecting area of concern	Processes associated with key issue

- Identify specialists to help in the analysis:
  - hydrologist, geologist, aquatic biologist, GIS analyst

Step 1 – Gather Information

Table 2: Selected sources of existing information and data

Type of information	Studies/plans	Website
TMDL studies and listings	Water bodies exceeding water quality standards (303d list)	http://www.ecy.wa.gov/programs/wq/303d/2002/2004_documents/list_by_category-cat5.html
	TMDL clean up plans	http://www.ecy.wa.gov/programs/wq/tmdl/watershed/index.html
Habitat and water quality monitoring/ assessment reports	Puget Sound Action Team list of reports on marine environments	http://www.psat.wa.gov/Publications/Pub_Master.htm
Watershed planning reports	Ecology list of watershed planning reports	http://www.ecy.wa.gov/watershed/index.html
Studies/environmental reports	Limiting Factors Reports	http://salmon.scc.wa.gov
	Site-specific studies	Literature data bases, tribal websites, agency websites

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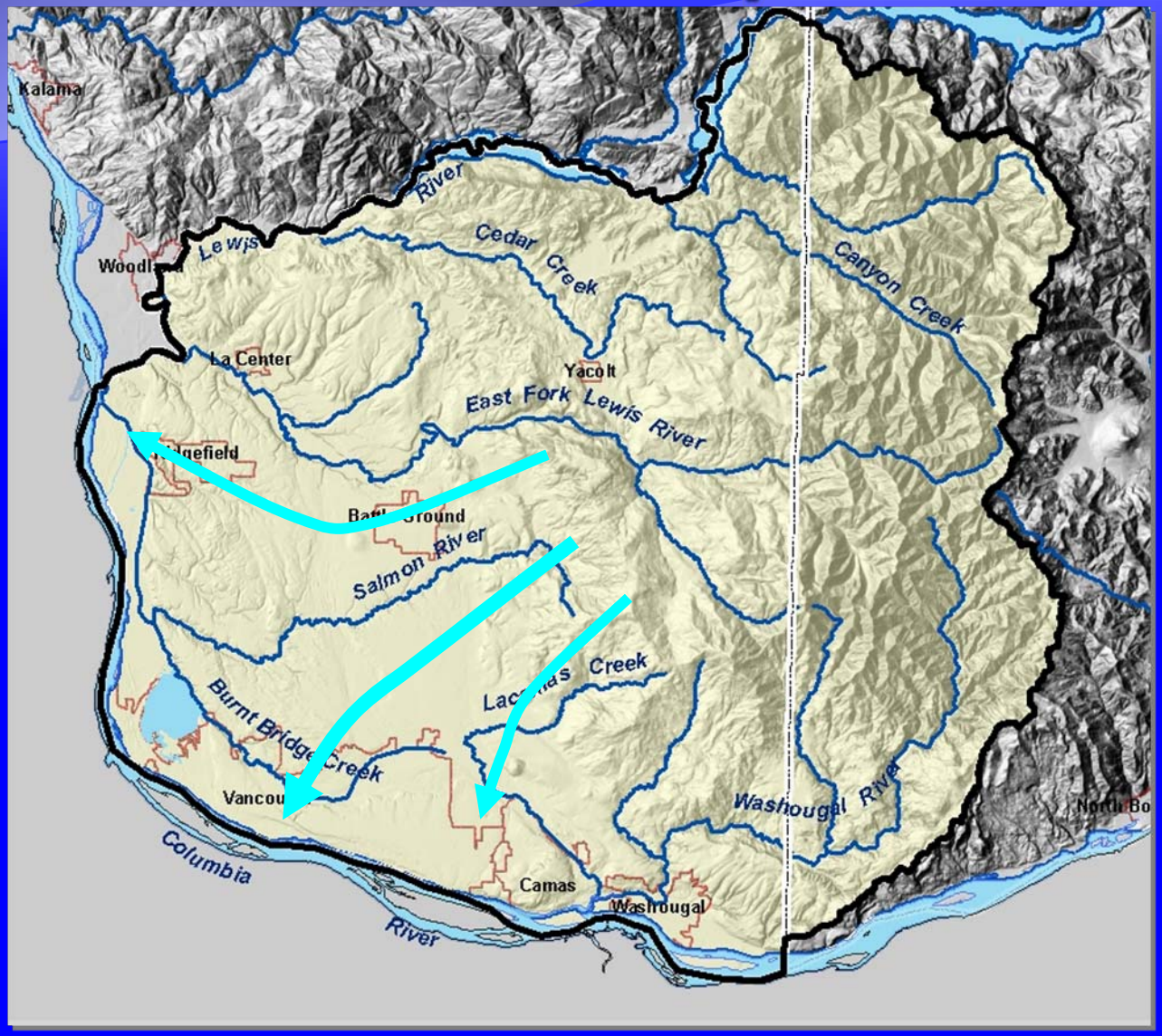
Step 2 – Delineate Analysis Area

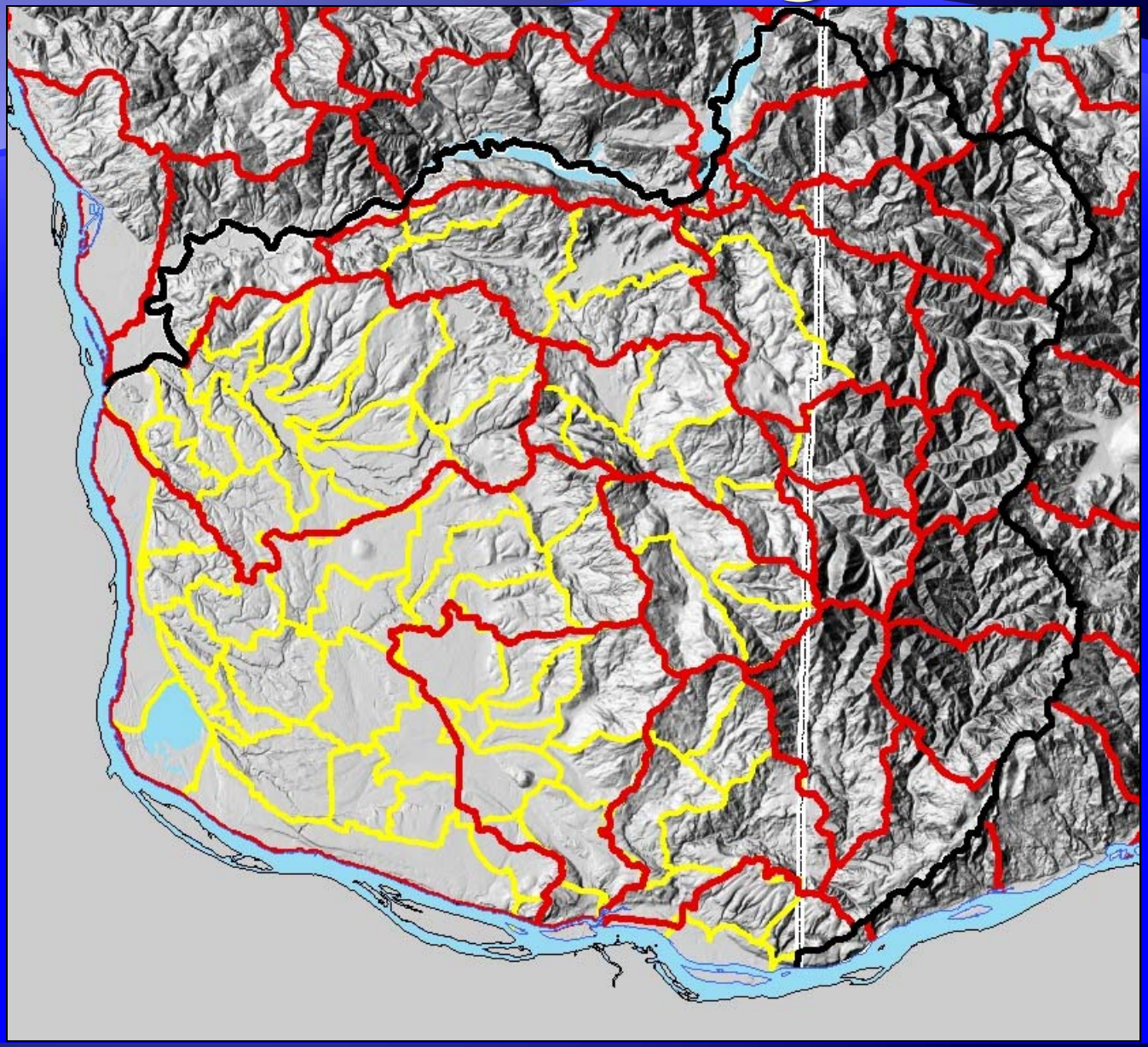


Step 2 – Create Sub-units

Step 2 – HUC's Are Too Large

HUC - Hydrologic Unit Codes - USGS watersheds:

Usually too large for application in local plans



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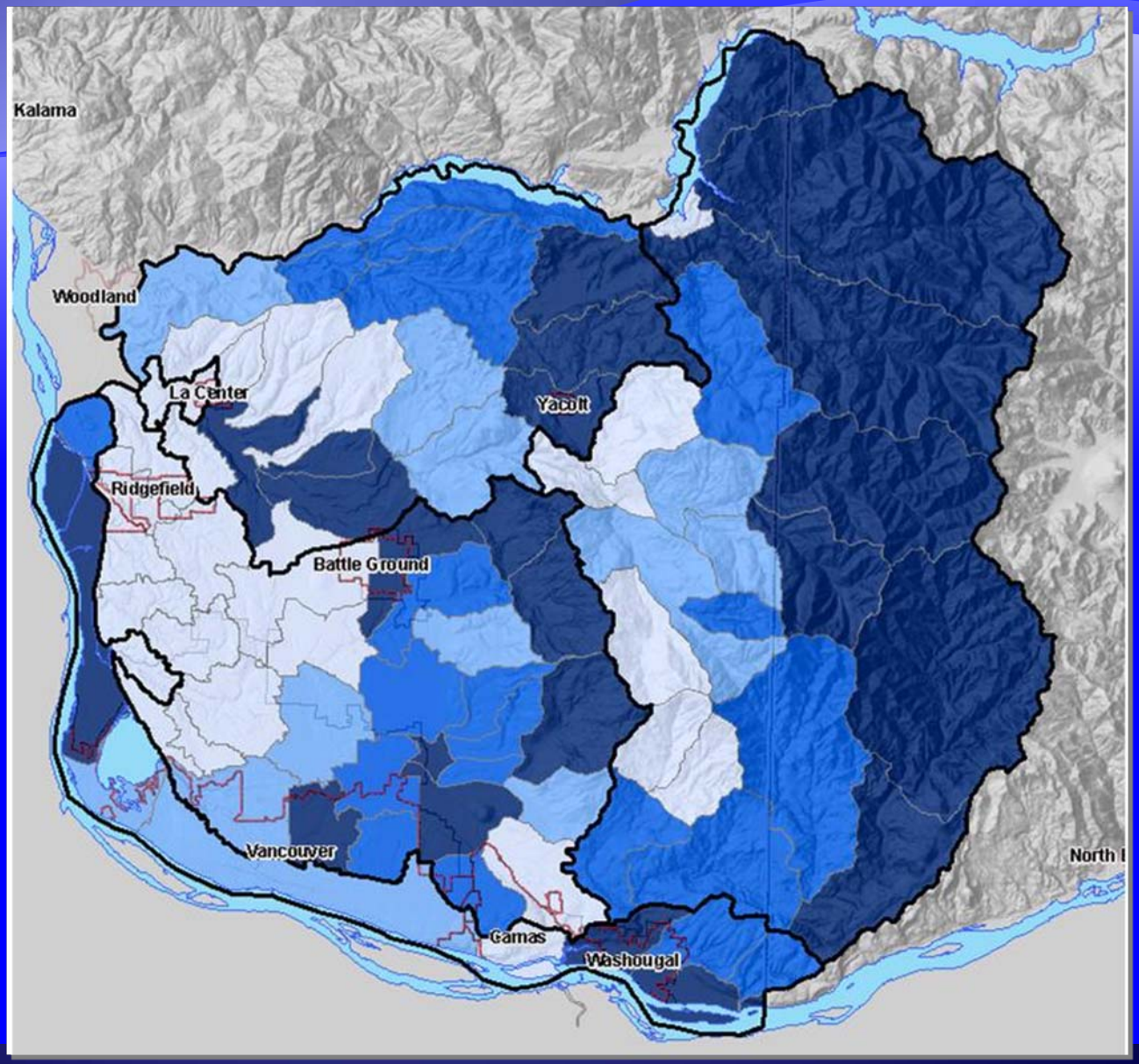
STEP 3 – MAP IMPORTANT AREAS



Step 1: Define the purpose of the analysis.

→

processes?
Who will assist you with the analysis?
What resources already exist to help with the analysis?

Pg 6 & 7

Step 2: Delineate the analysis area, hydrologic sub-units and any hydrogeologic units .

→

What is the contributing basin for the area affected by policy or regulatory decisions?
What size of the sub-units meets local planning and permitting needs?
Are there different types of precipitation, landform and geology in the analysis areas?

→

Include surface watershed and contributing area for groundwater (if possible). Determine appropriate size for analysis units.

Step 3: Map the relative level of importance of each sub-unit for each watershed process.

→

In the absence of human impairment, what areas are important to each watershed process?
Where are these different areas located?

→

Describe relationship between physical characteristics of a watershed and each watershed process.

Step 4: Map the relative level of impairment to each watershed process.

→

Which human activities have impaired each watershed process?
Where have these activities most impaired processes?

→

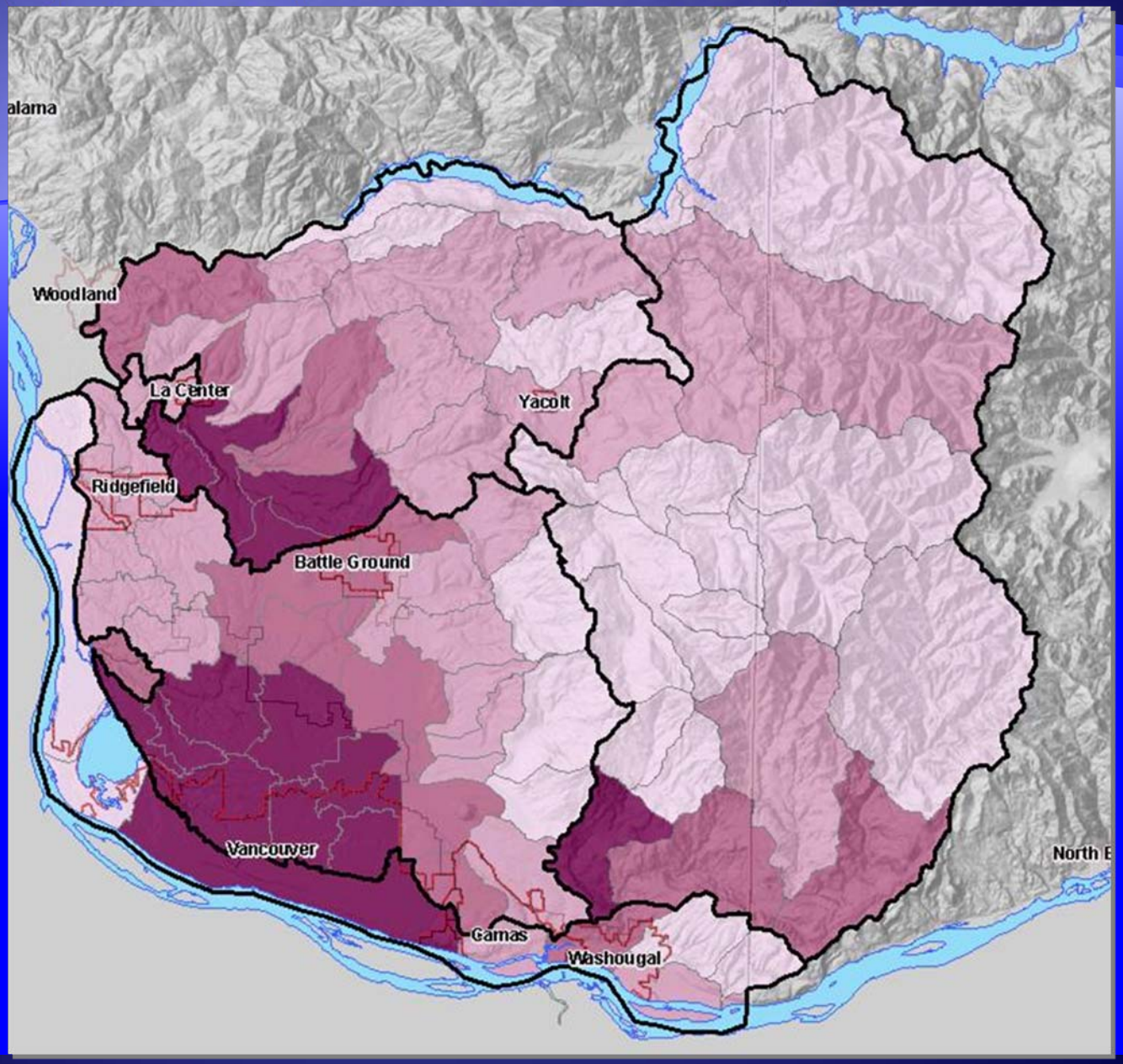
Describe relationship between human activities and each watershed process.

Step 5: Identify the

Where are watershed

Combine Map of Impairments and Map of Important Areas

STEP 4 – MAP IMPAIRMENTS



hydrologic sub-units and any hydrogeologic units .

→

meets local planning and permitting needs?
Are there different types of precipitation, landform and geology in the analysis areas?

→

groundwater (if possible). Determine appropriate size for analysis units.

Pg 6 & 7

Step 3: Map the relative level of importance of each sub-unit for each watershed process.

→

In the absence of human impairment, what areas are important to each watershed process?
Where are these different areas located?

→

Describe relationship between physical characteristics of a watershed and each watershed process.

Step 4: Map the relative level of impairment to each watershed process.

→

Which human activities have impaired each watershed process?
Where have these activities most impaired processes?

→

Describe relationship between human activities and each watershed process.

Step 5: Identify the most suitable areas for protection, restoration & development.

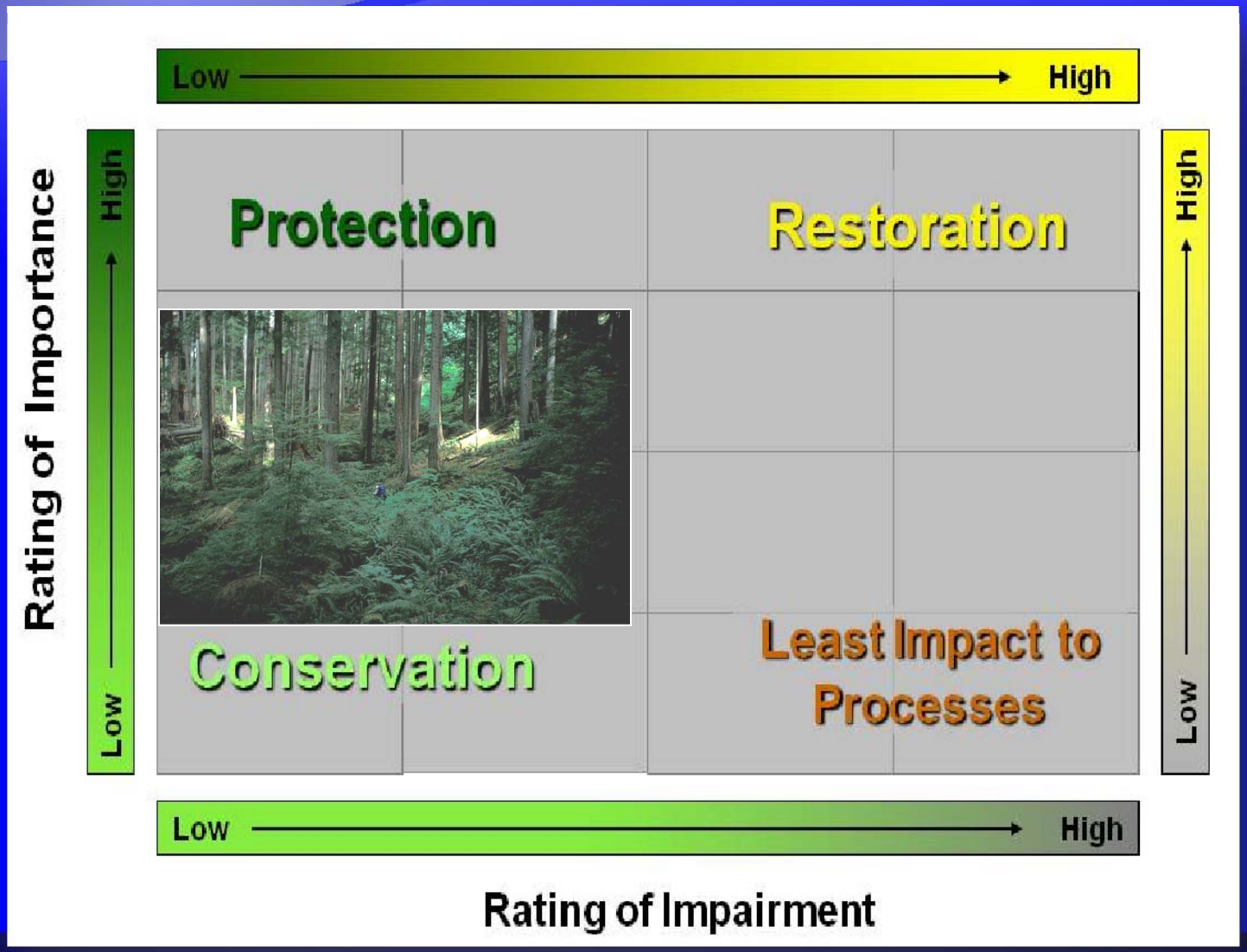
→

Where are watershed processes still intact or minimally impaired?
Where have watershed processes been impaired?

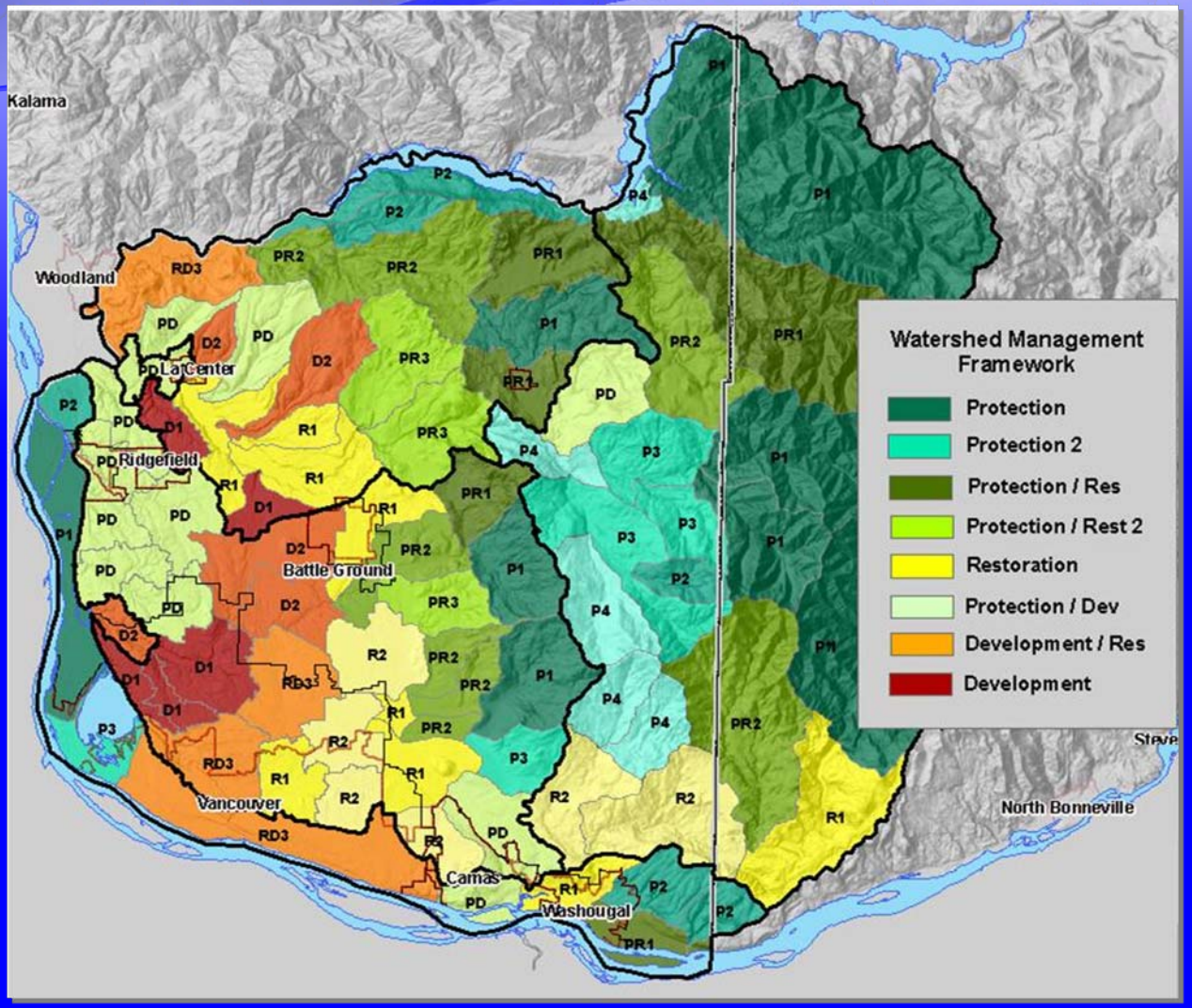
→

Combine Map of Impairments and Map of Important Areas for each watershed process;
Unimpaired □ protection
Impaired □ restoration or development

Step 5 – Locate Areas for Protection and Restoration: Watershed Management Matrix



STEP 5 - LOCATE AREAS FOR PROTECTION AND RESTORATION



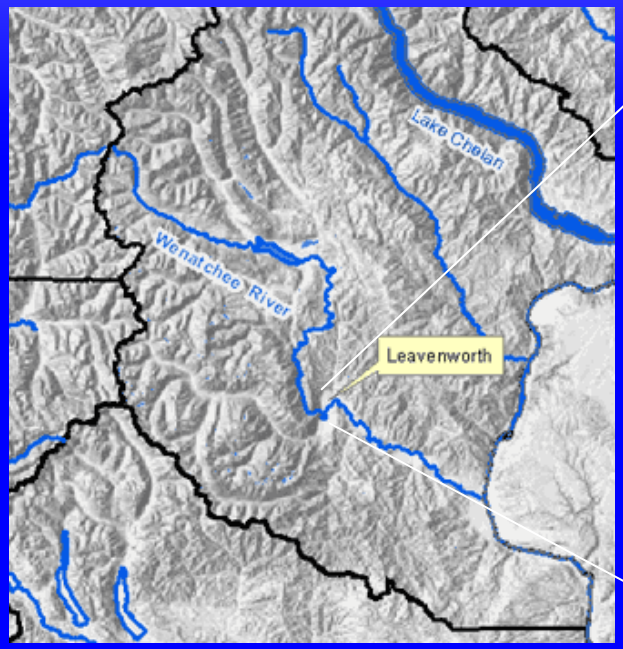
EXAMPLE OF WATERSHED CHARACTERIZATION

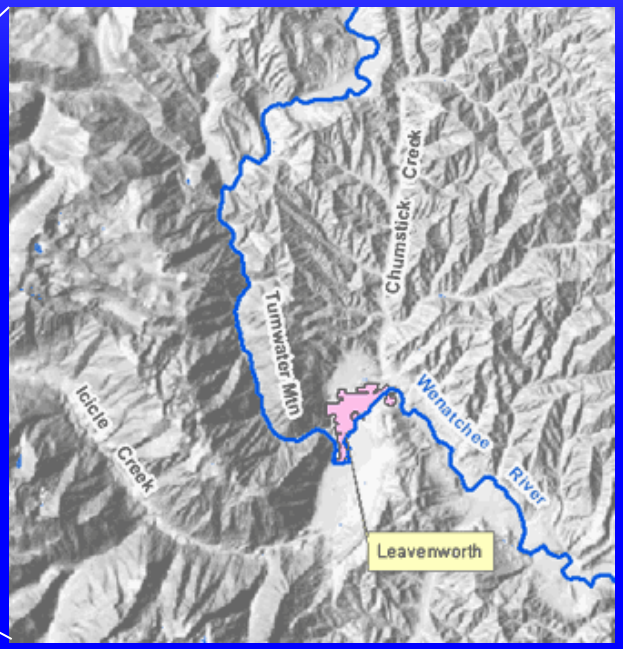
CITY OF LEAVENWORTH

Watershed Analysis at the Sub-basin Scale

Based on
Leavenworth Water Problem Study of 1999

Additional input from Matt Karrer, Hydrologist, US Forest Service

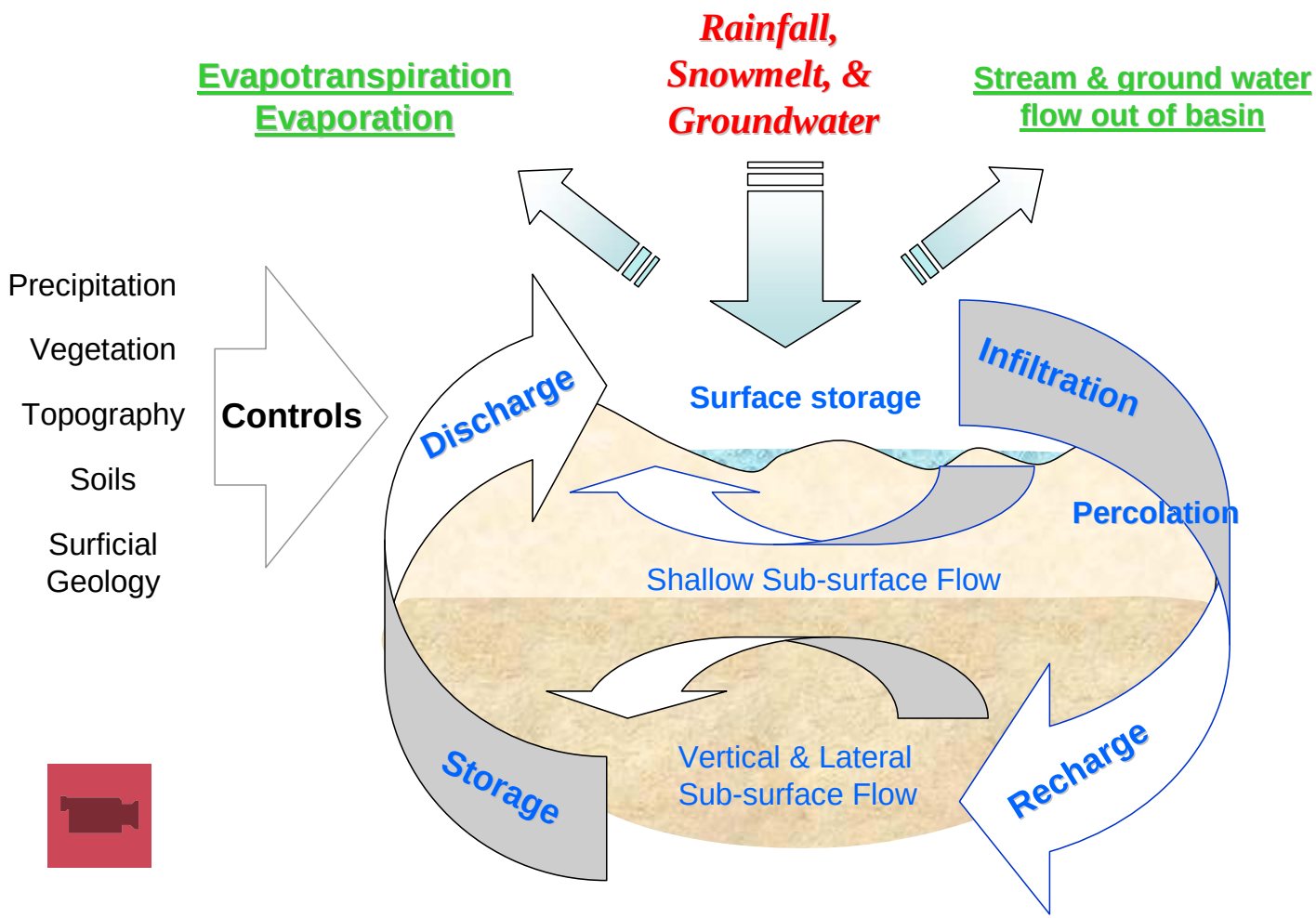




WASHINGTON STATE DEPARTMENT OF ECOLOGY

How Water Moves Through a Watershed

Process: *Delivery* , Movement , & Loss of Water



Methods

Step 1 – Define purpose of analysis

Step 2 – Map analysis area and analysis units

Step 3 – Identify and Map Key Areas

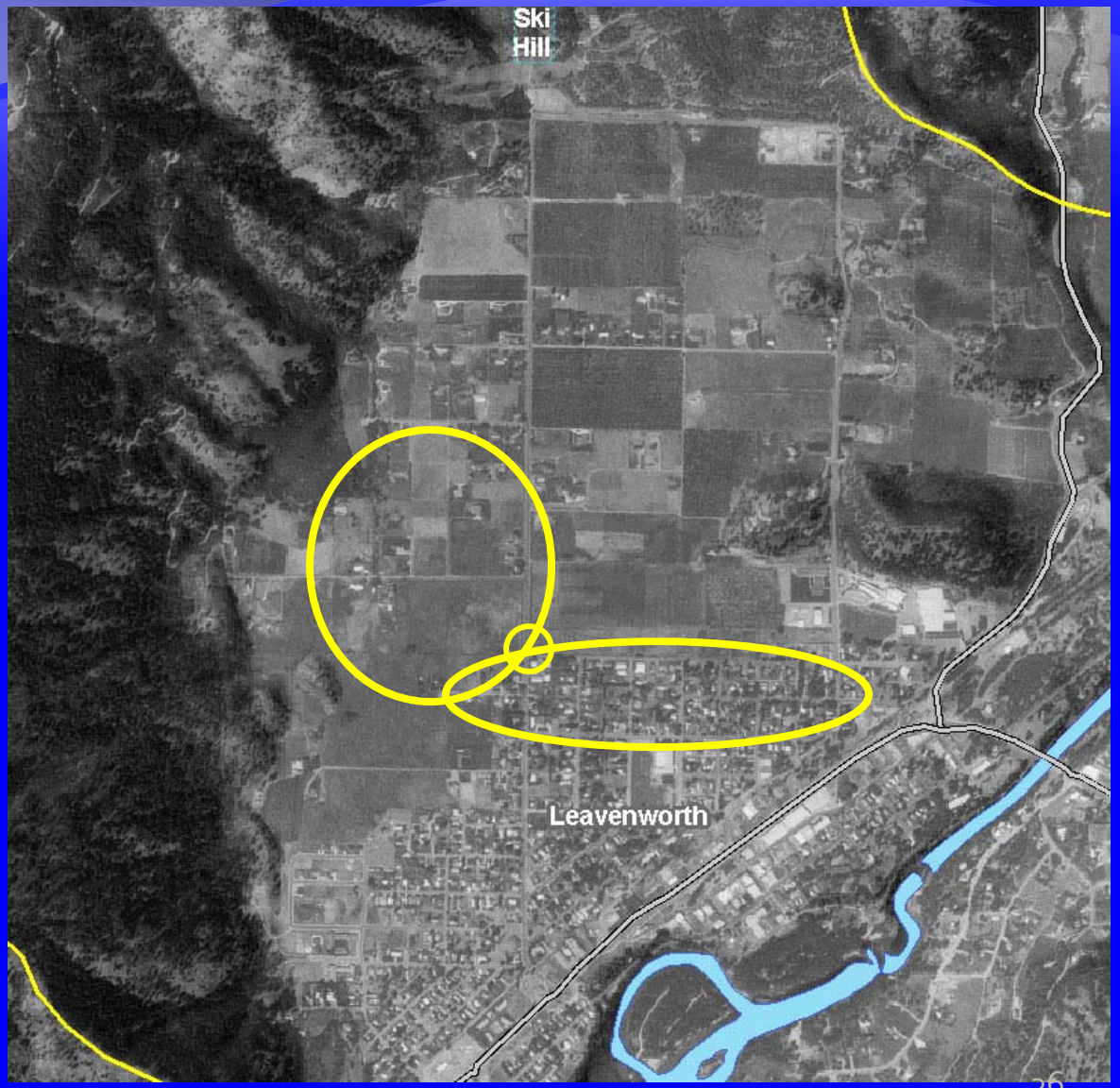
Step 4 – Identify and Map Types of Impairments

Step 5 – Locate areas for protection and restoration

Incorporate Results into Planning

Step 1 – Define Purpose of Analysis

- Flooding problems
  - Sheet flooding
  - Culvert flooding
  - Subsurface flooding of basements
- Previous wetland study (1999)
- Identify local experts

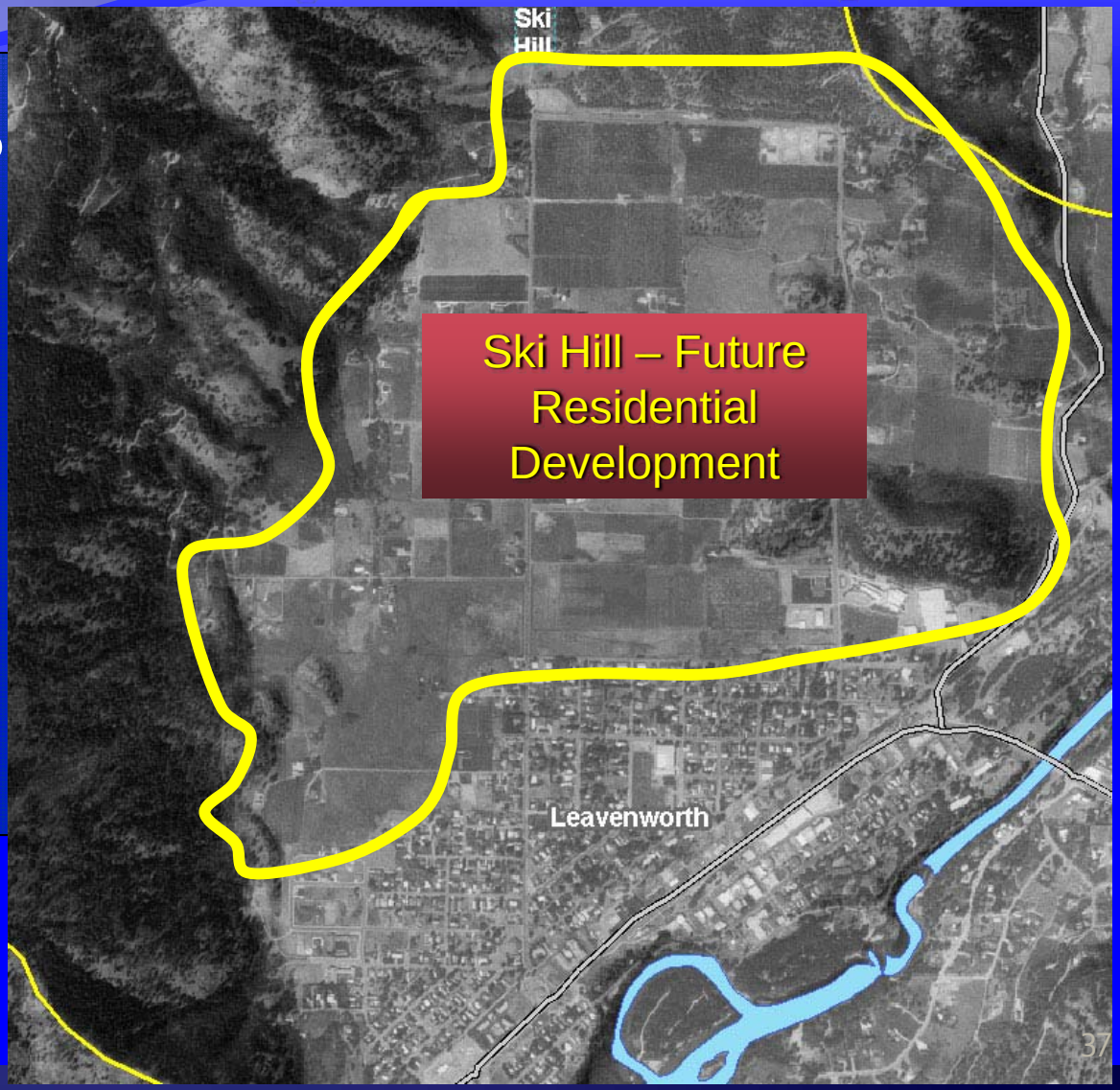


Step 1 – Define Purpose of Analysis

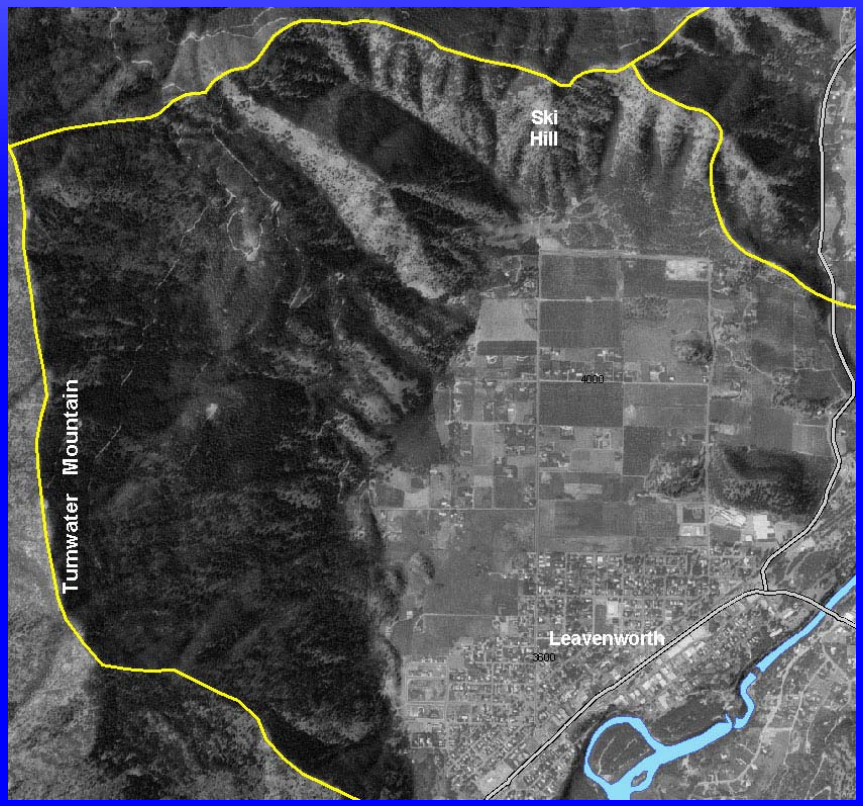
City wants to develop a green infrastructure plan fo residential development in upper Ski Hill.

The plan must show:

- ✓ Areas most suited for development
- ✓ Areas to be protected
- ✓ Area suitable for restoration



Step 2 – Delineate the analysis area

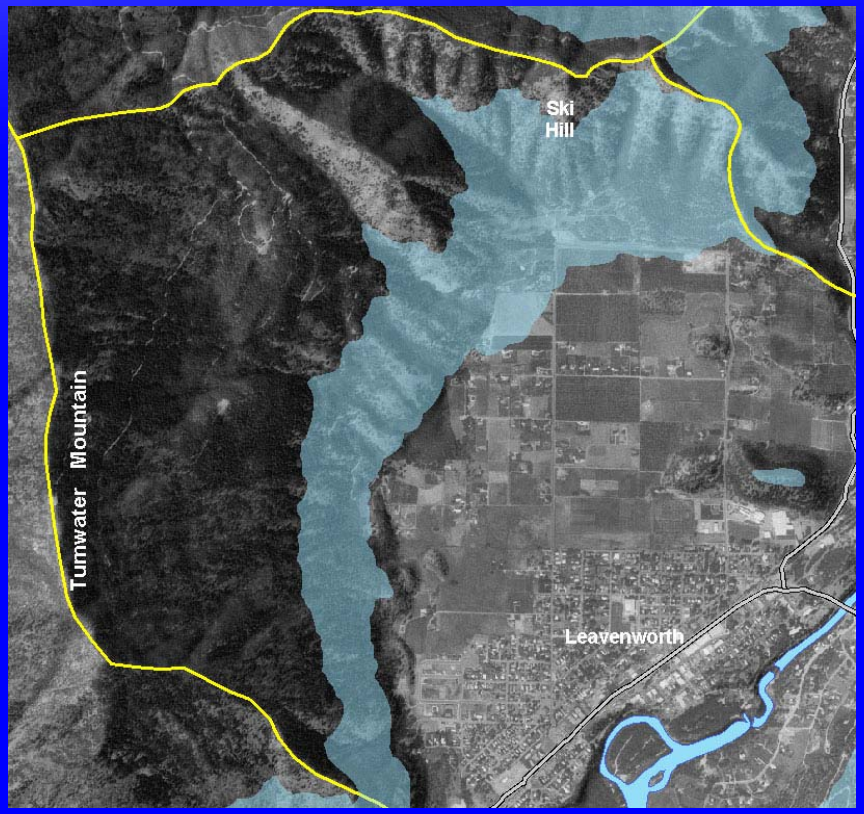


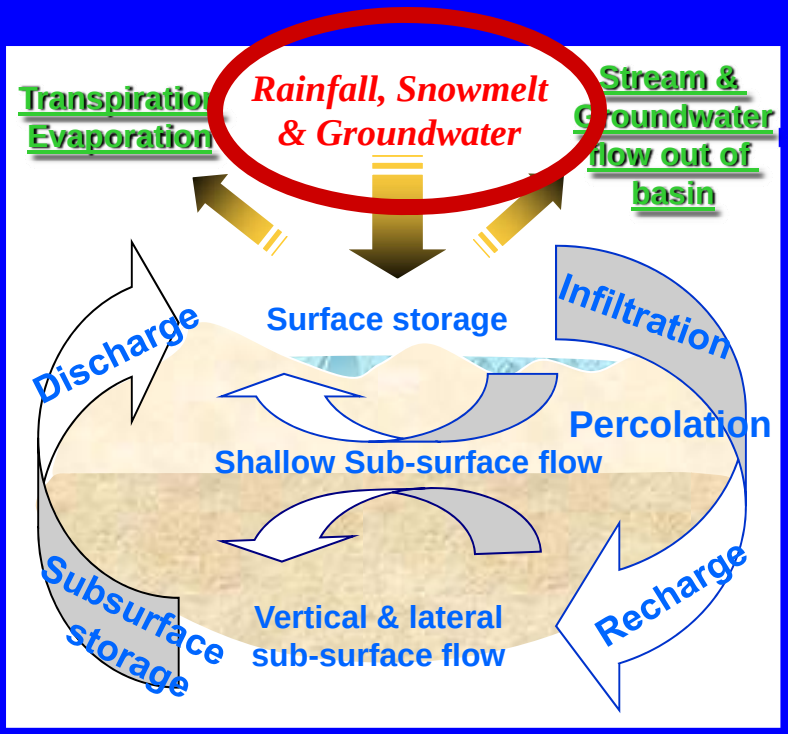
Step 3 – Identify and map important areas – surface water flow

- Rain on Snow
- Surface Storage: depressional wetlands & floodplains
- Recharge
- Storage Capacity
- Discharge Areas

Delivery of Water

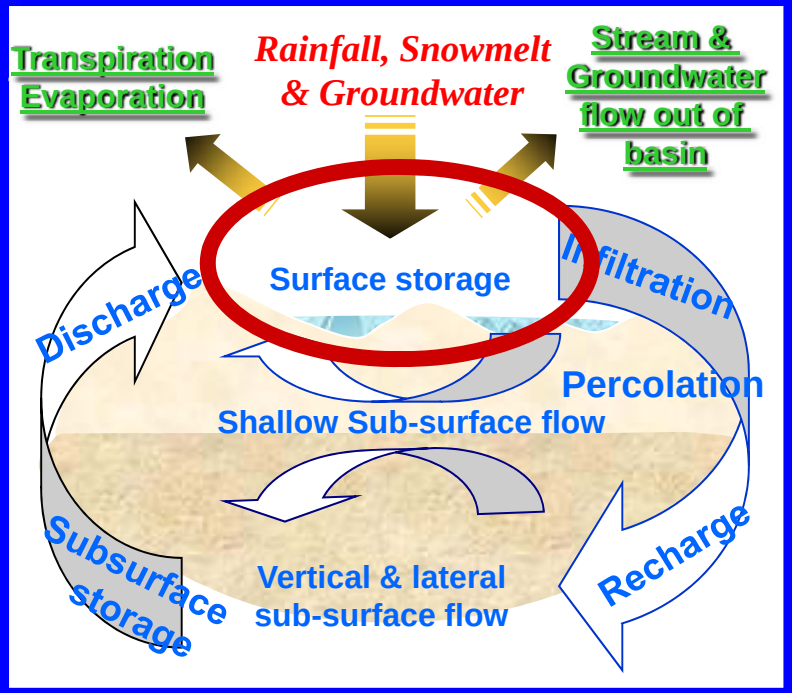
Component of process	Important areas for process
Snowmelt/runoff	Rain-on-snow zone

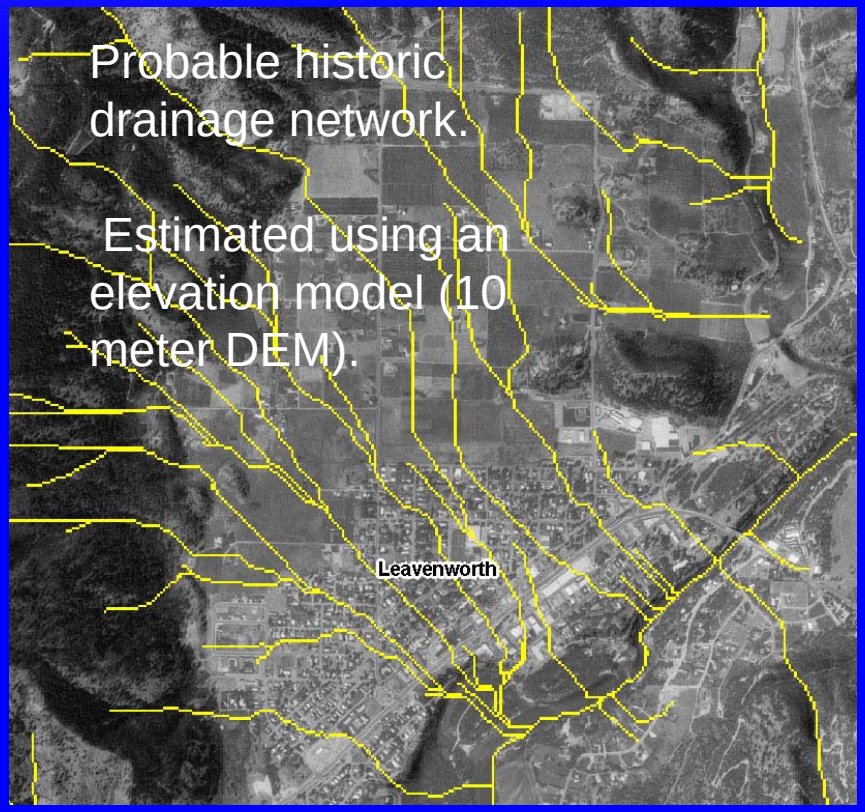




Movement of surface water

Component of process	Important areas for process
Surface storage	Floodplains





Wetlands – Potential & Existing

Potential Wetlands

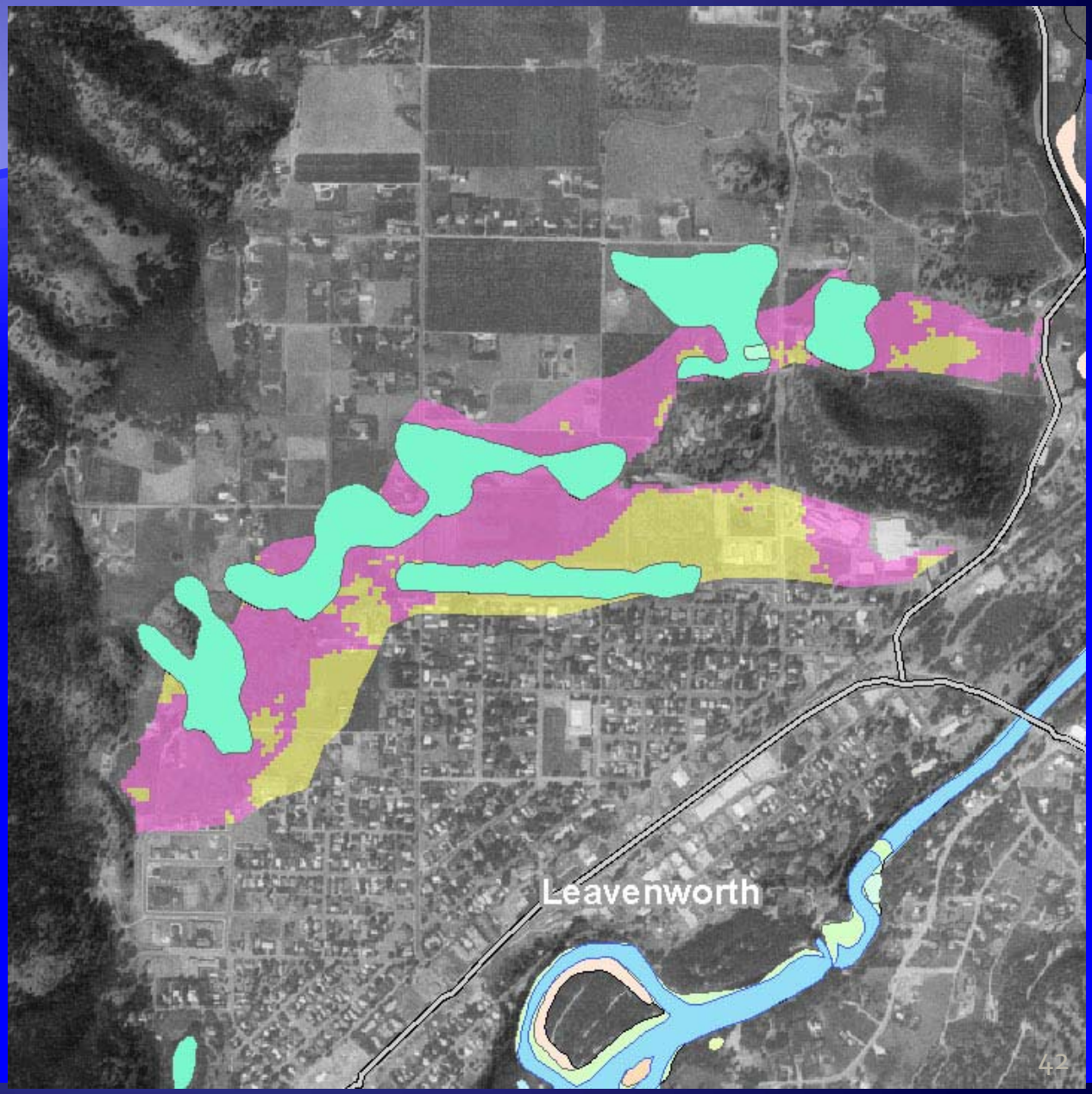
Depressional Wetlands:

Hydric soil & <4% slope

Slope Wetlands:

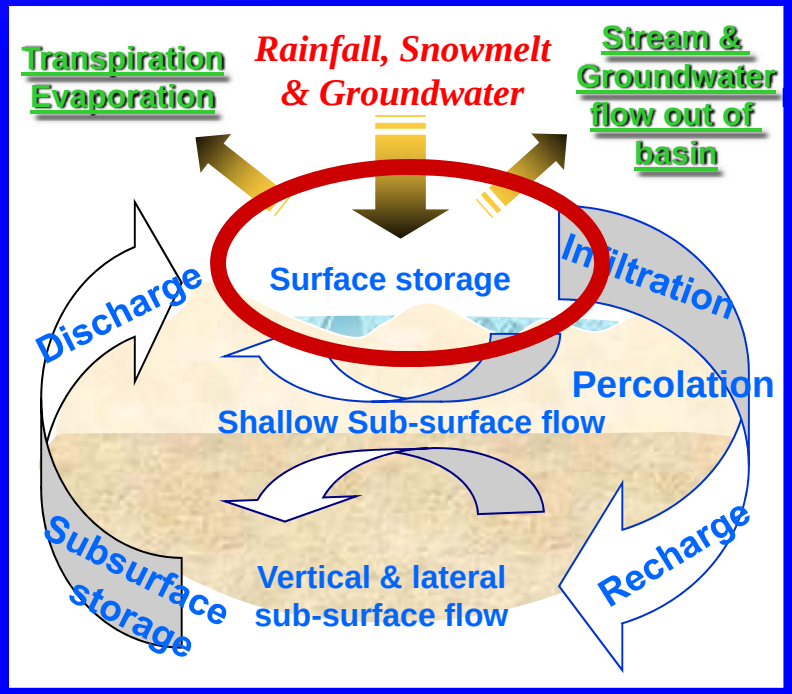
Hydric soil & 4-8% slope

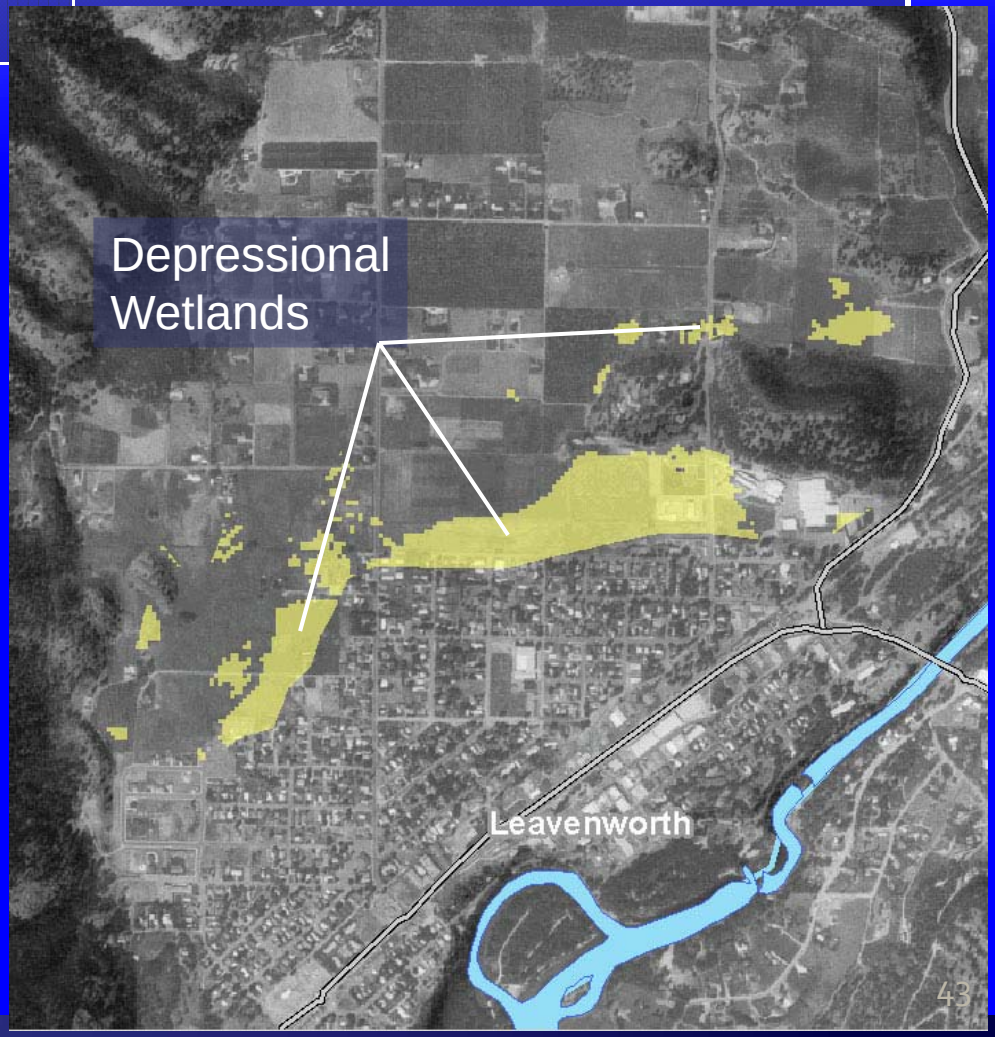
Existing Wetlands



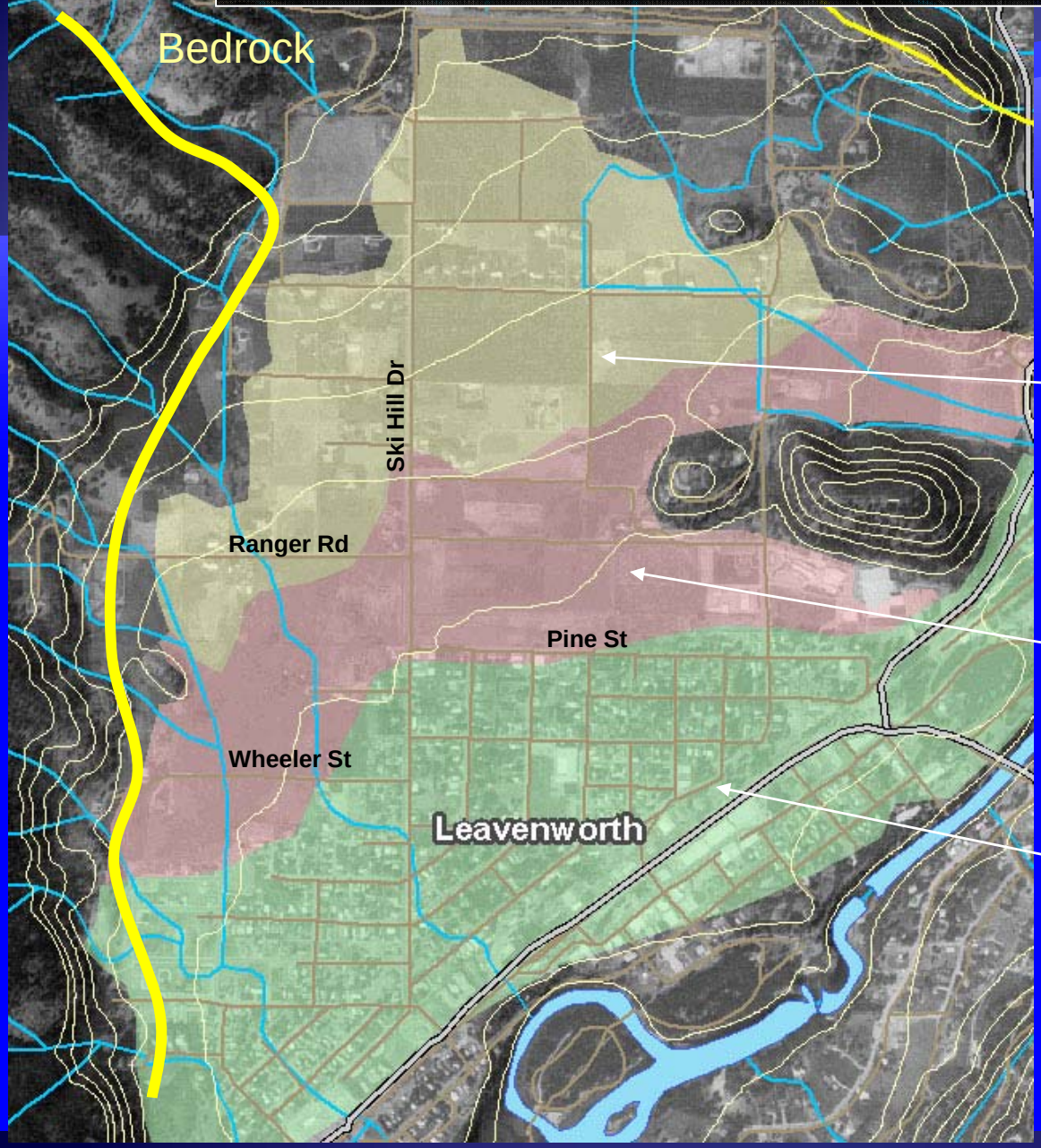
Movement of surface water

Component of Process	Important areas for process
Surface storage	Depressional wetlands





Movement of sub-surface water



Surficial Geology

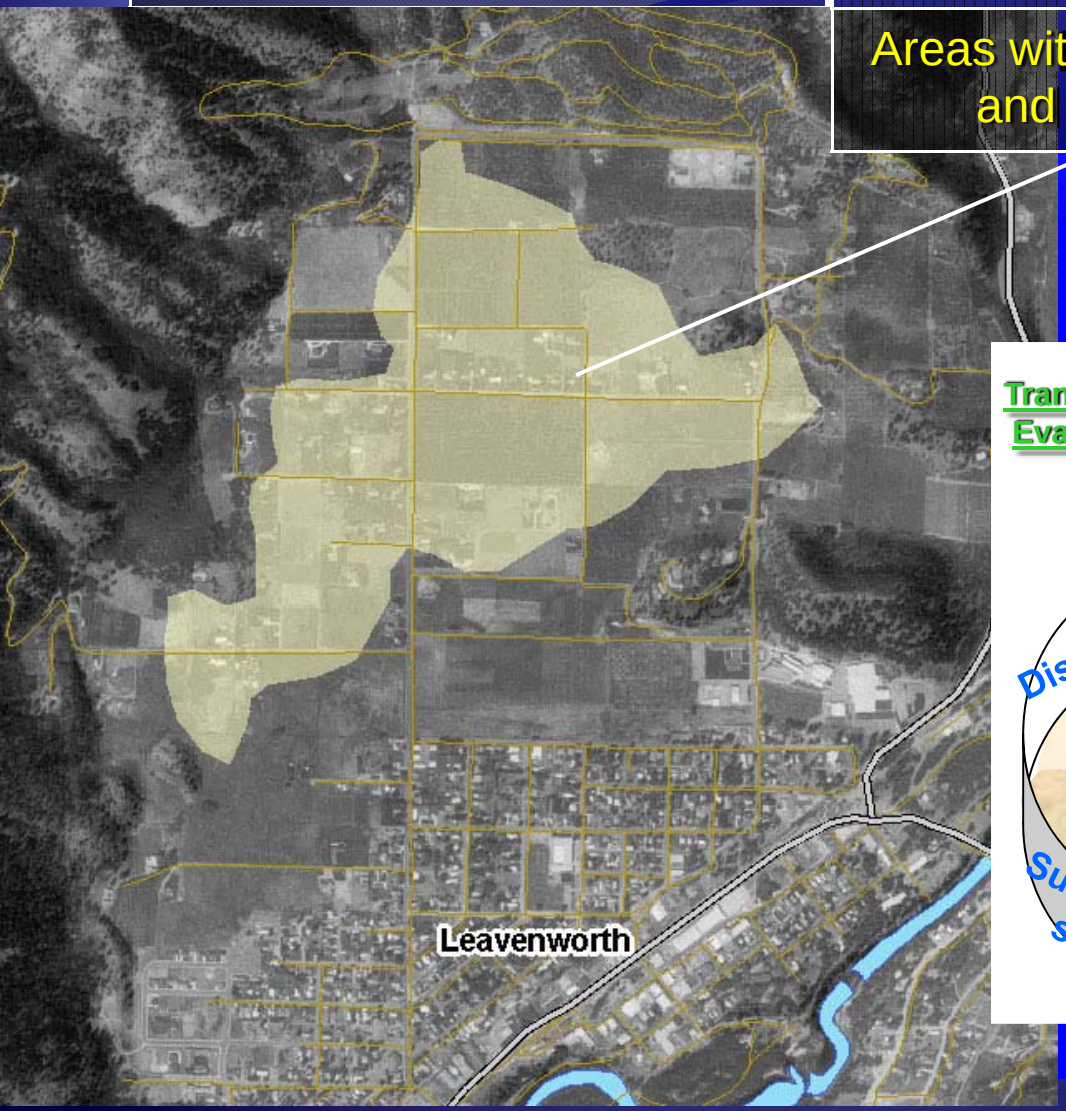
Older Alluvium – courser material

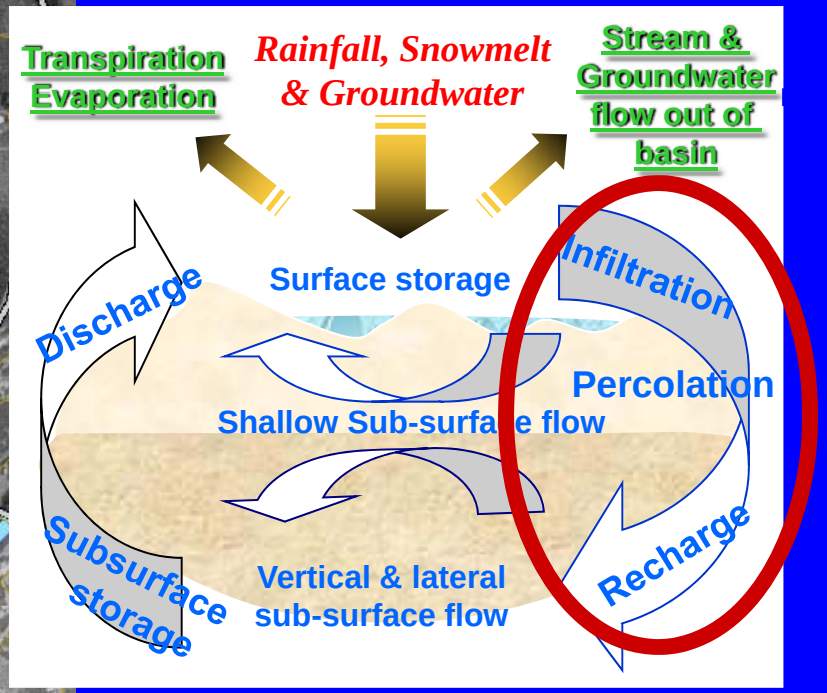
Older Alluvium – finer material

Till

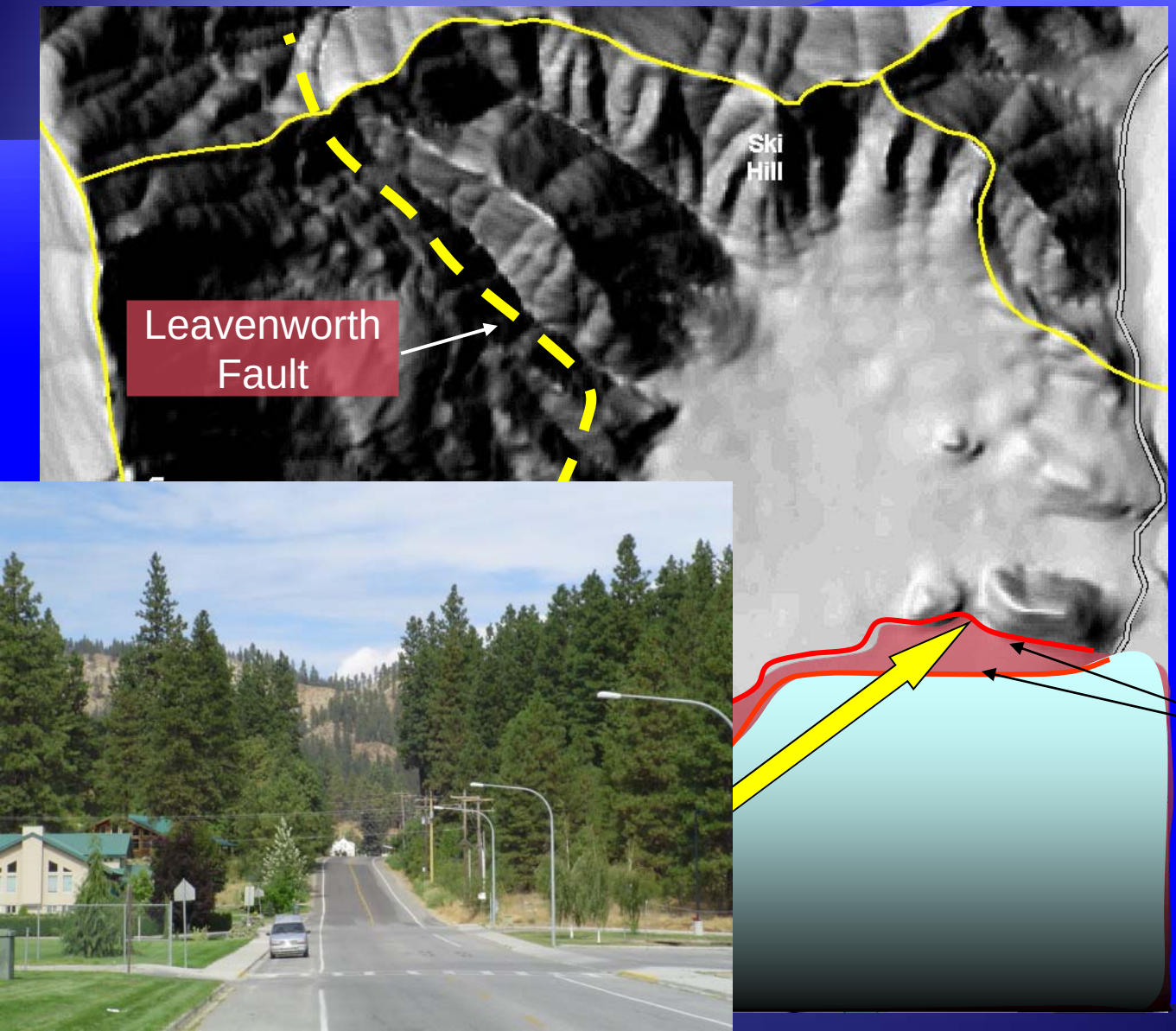
Movement of sub-surface water

Component of Process	Important area for process
	Areas with soils of high infiltration capacity and permeable surficial deposits





Movement of sub-surface water – vertical and lateral flow

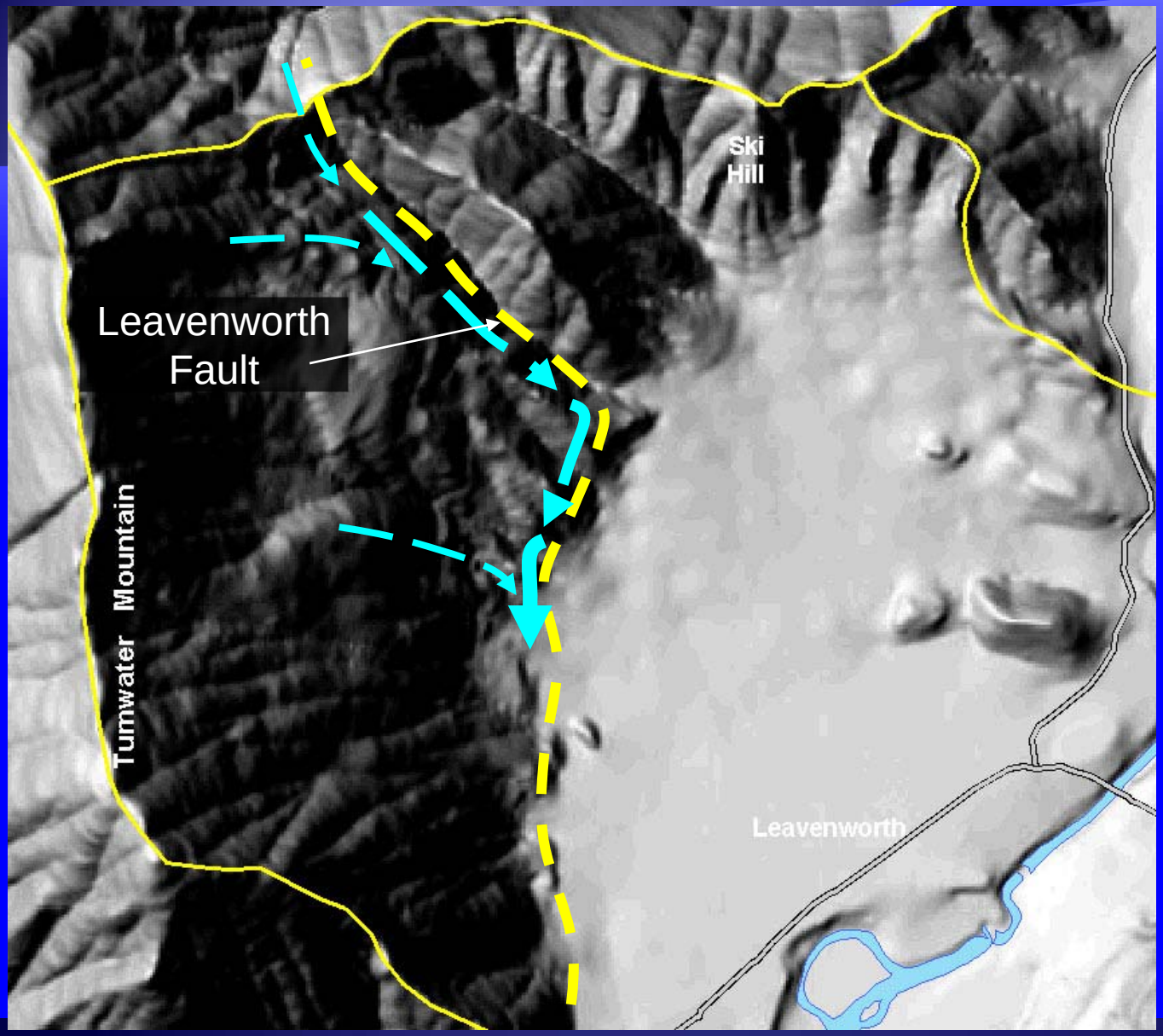


Leavenworth Fault – represents a major shear zone

Glacier advances

General Location of Moraines

Movement of sub-surface water – vertical and lateral flow

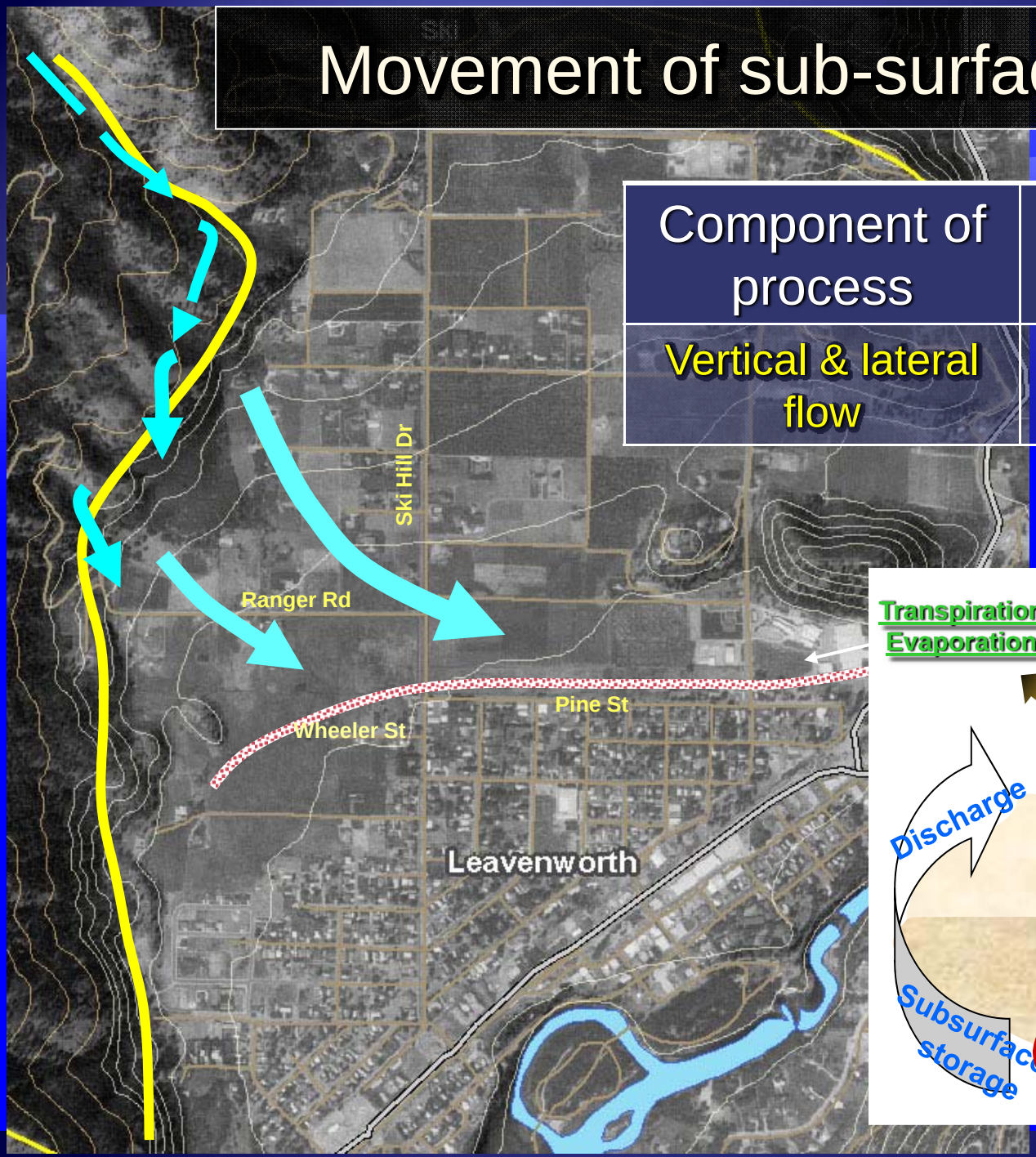


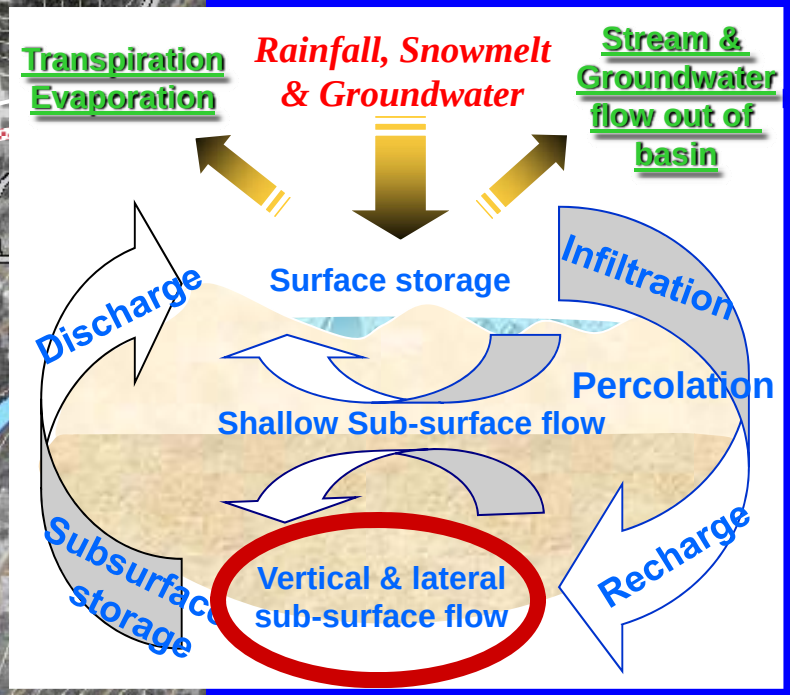
The fault acts like a "culvert" and collects groundwater from several subbasins

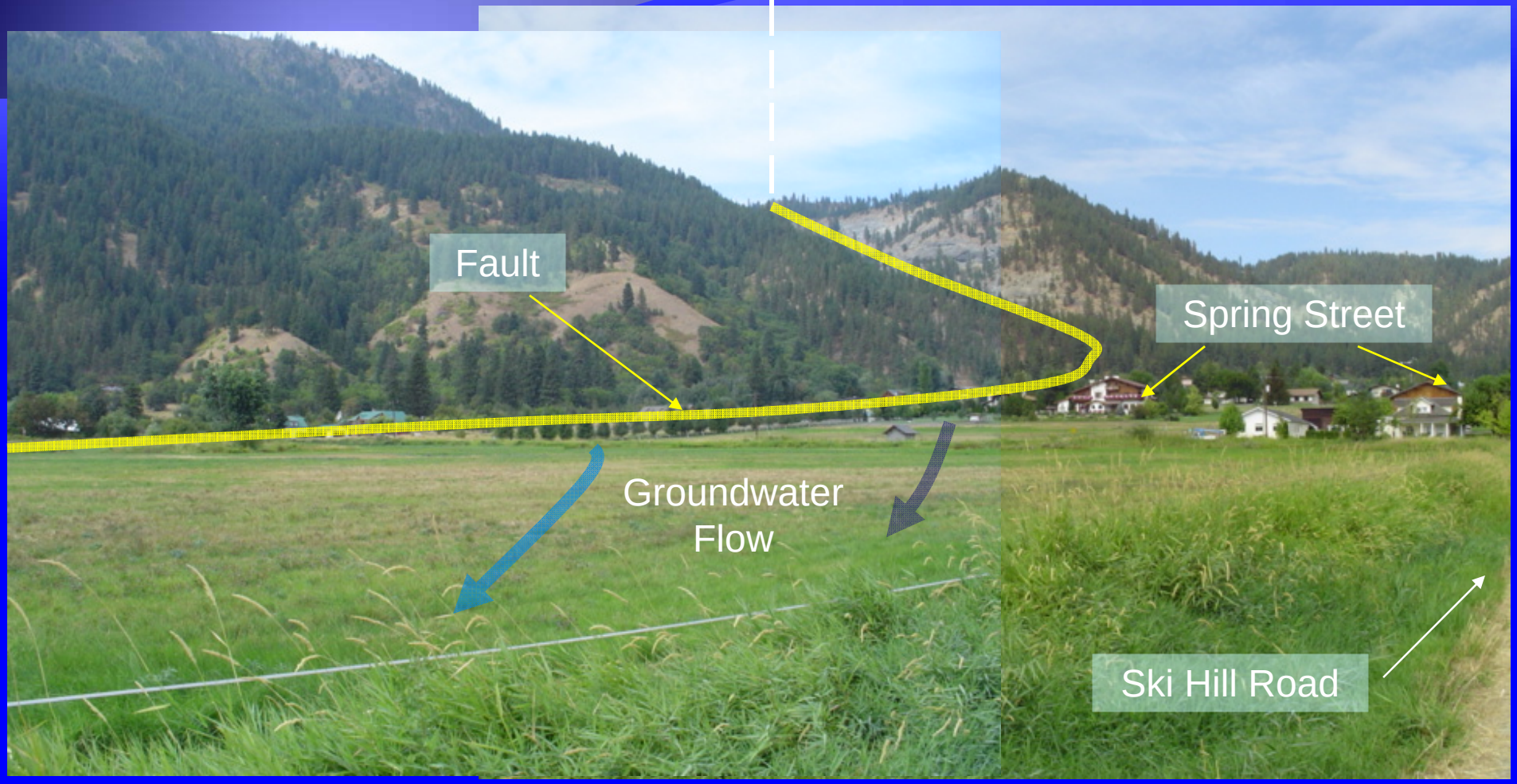
Increases water to lower basin

Movement of sub-surface water

Component of process	Important areas for process
Vertical & lateral flow	Determined locally

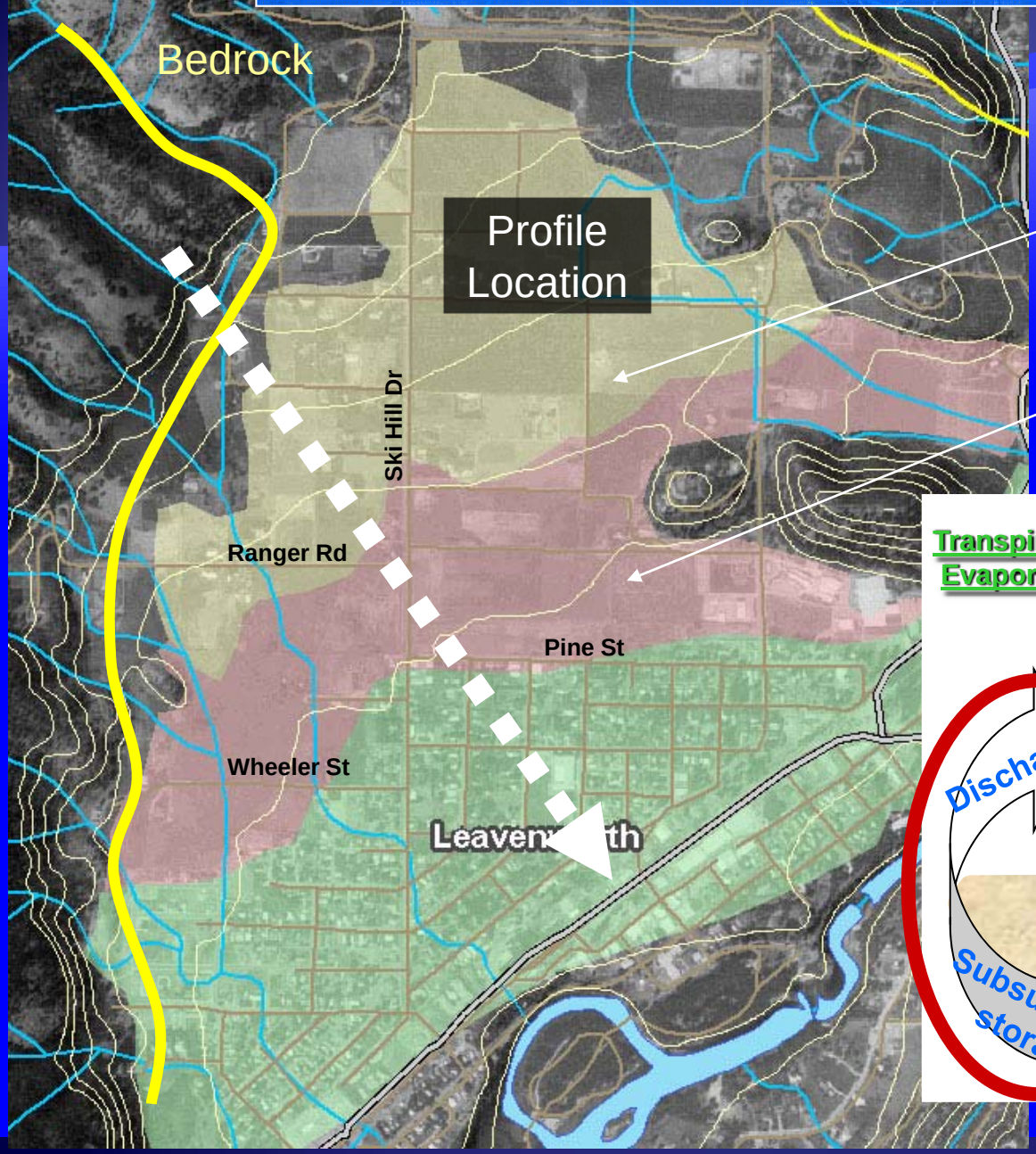






View Northwest from Ski Hill Road Towards Tumwater Mnt.

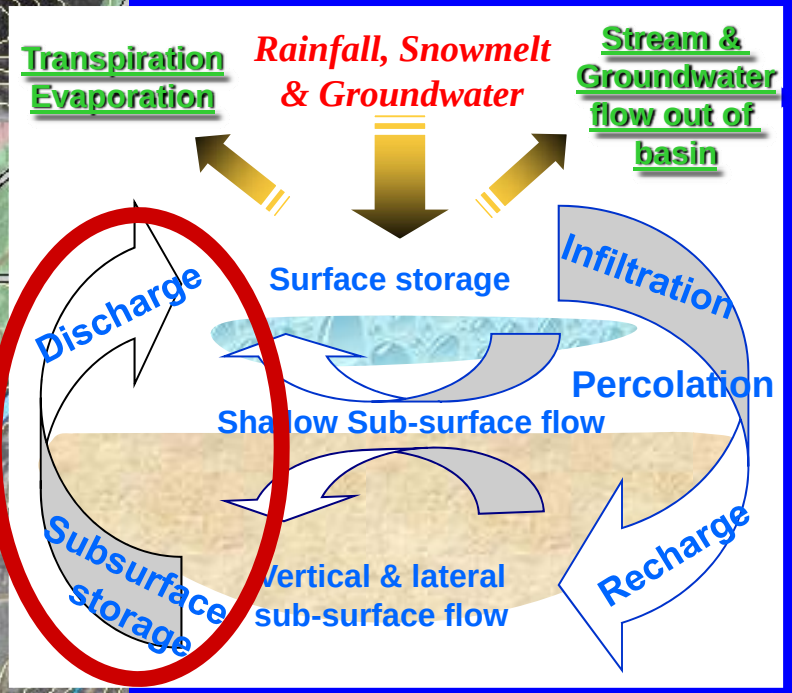
Movement of sub-surface water



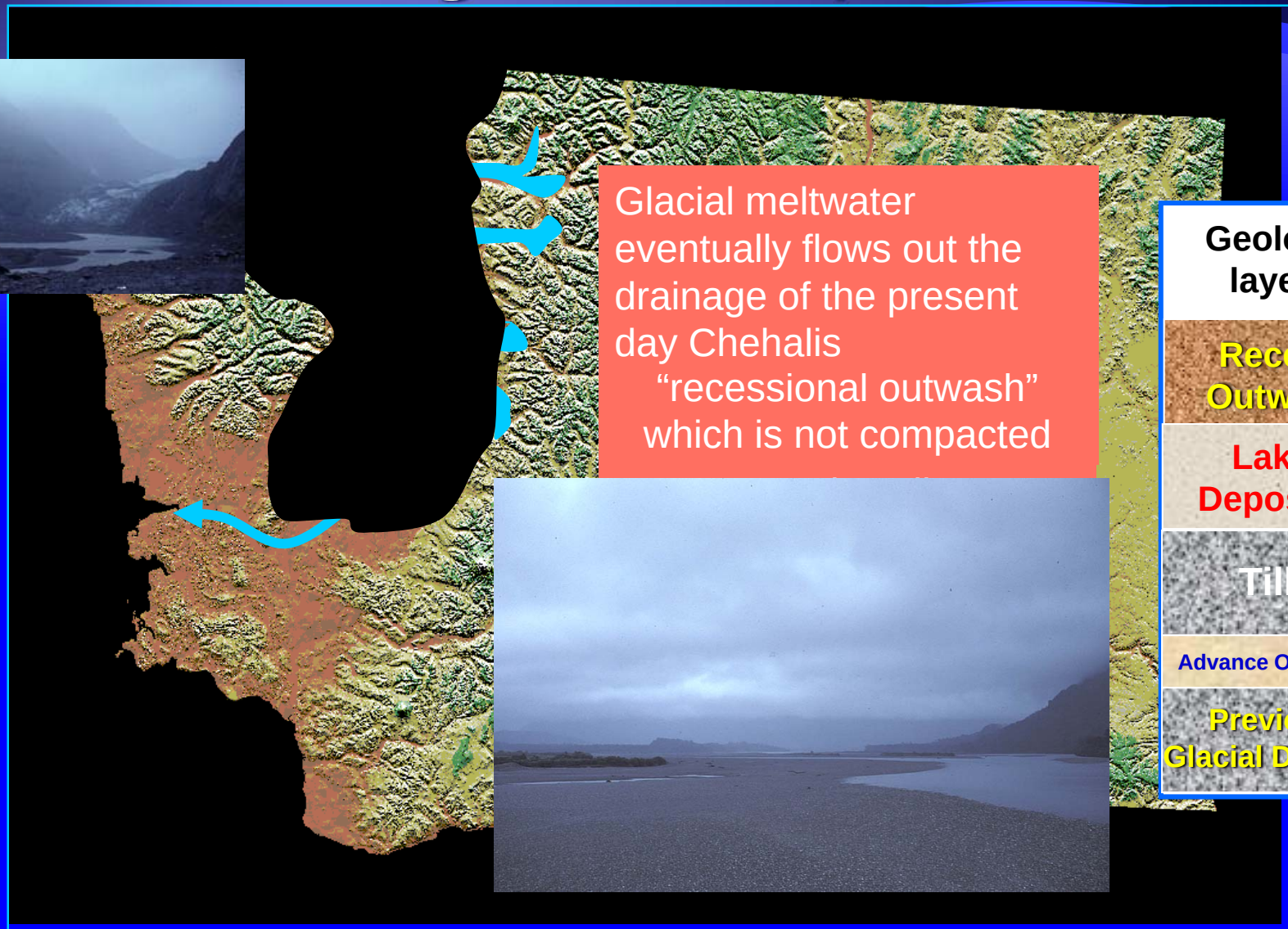
Surficial Geology

Older Alluvium – storage

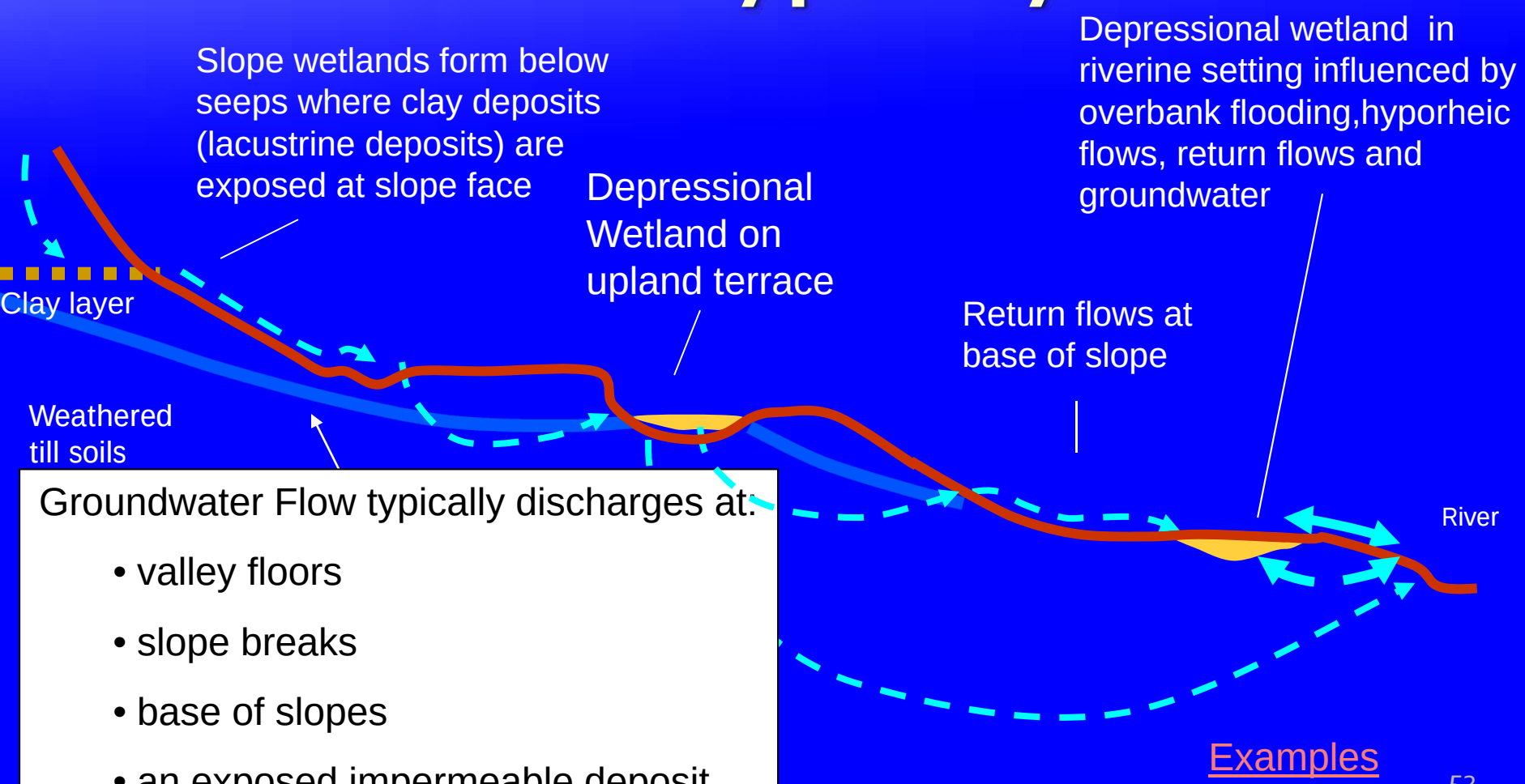
Older Alluvium – discharge



Understanding Glacial Deposts



Where Water Typically Surfaces



Groundwater Flow typically discharges at:

- valley floors
- slope breaks
- base of slopes
- an exposed impermeable deposit

Examples

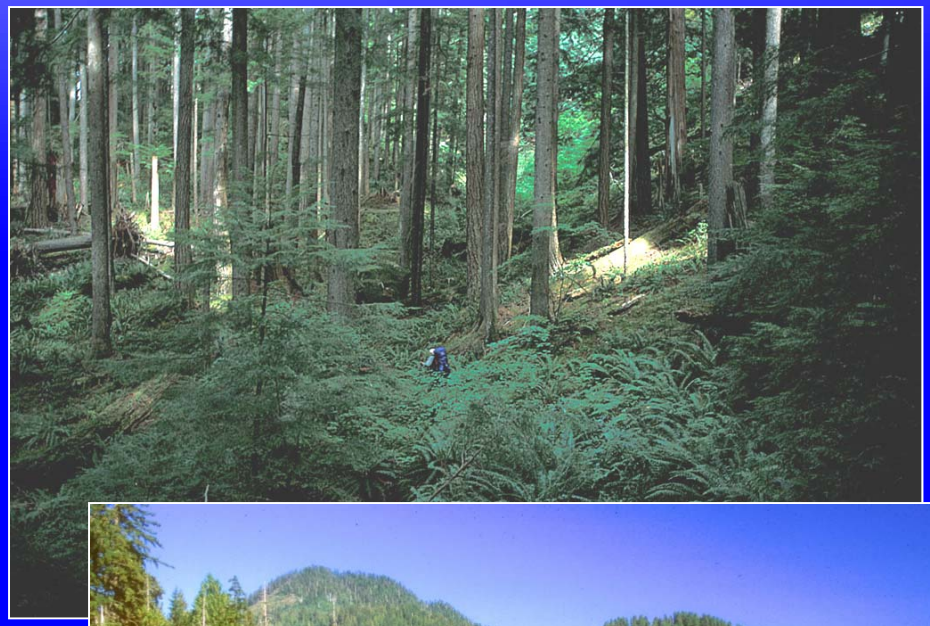
Example of Return Flow

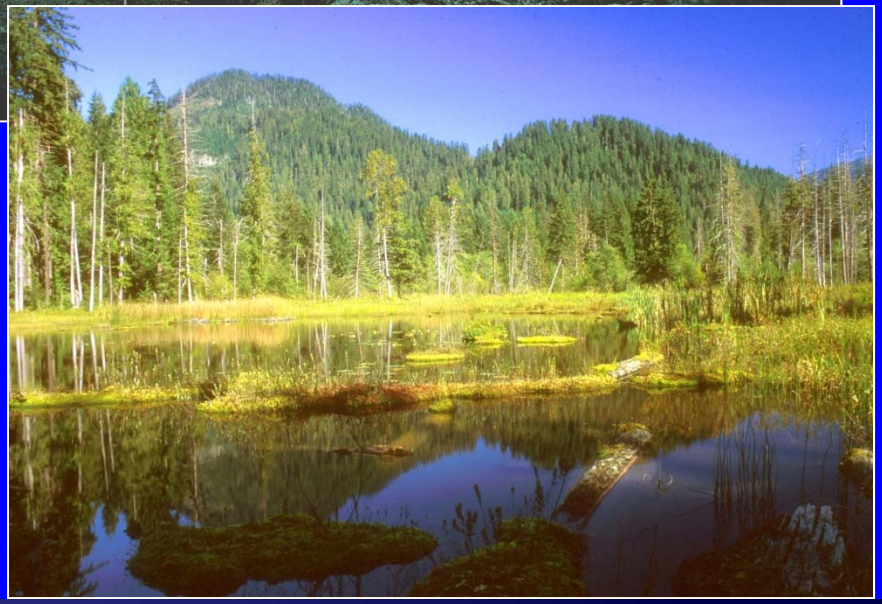
Return Flow at the base of a slope in rural setting

Under natural conditions subsurface flows predominate in the Pacific Northwest

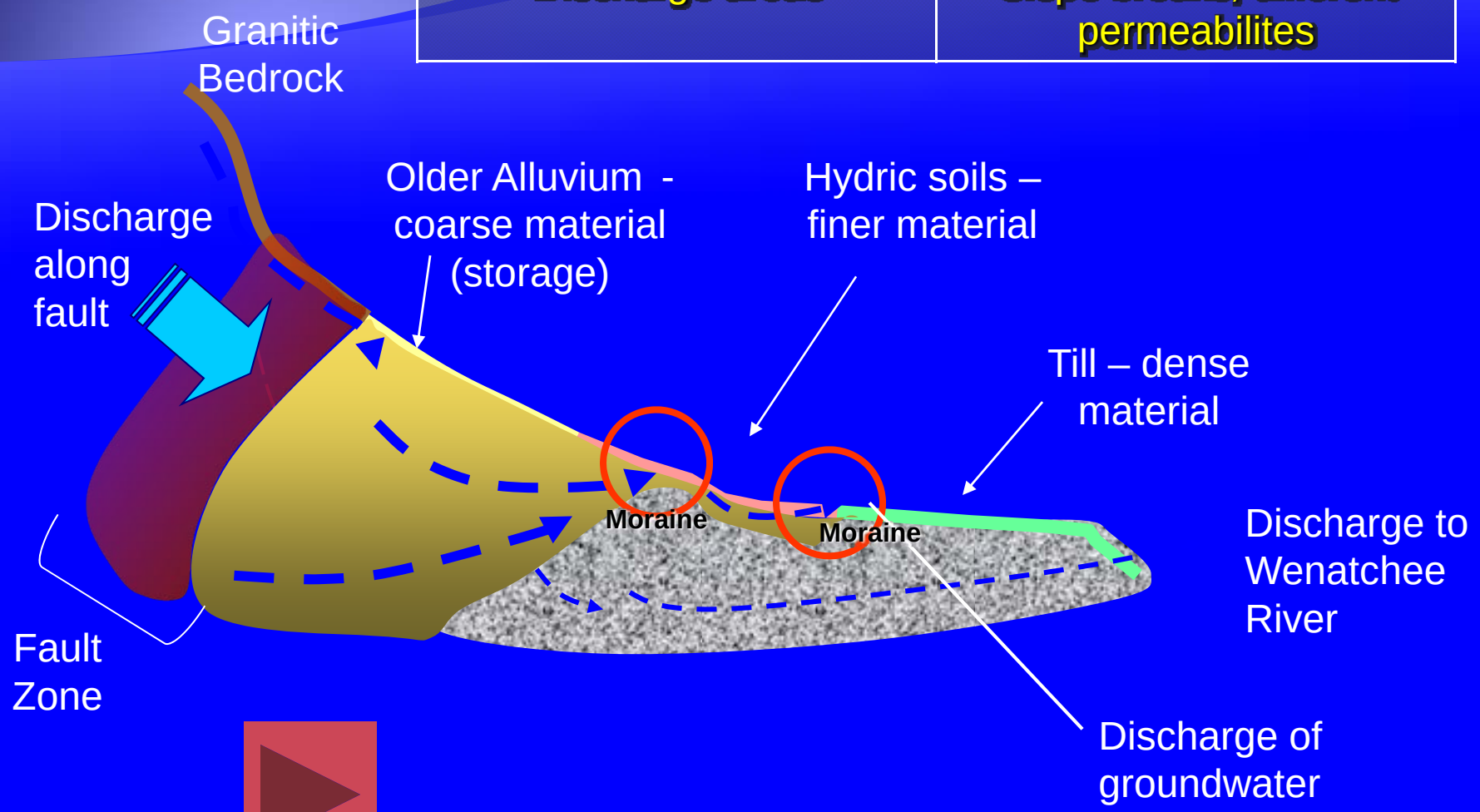
"In most humid regions, infiltration capacities are high because vegetation protects the soil from rain-packing and dispersal, and because the supply of humus and the activity of microfauna create an open soil structure."

Dunne & Leopold 1978





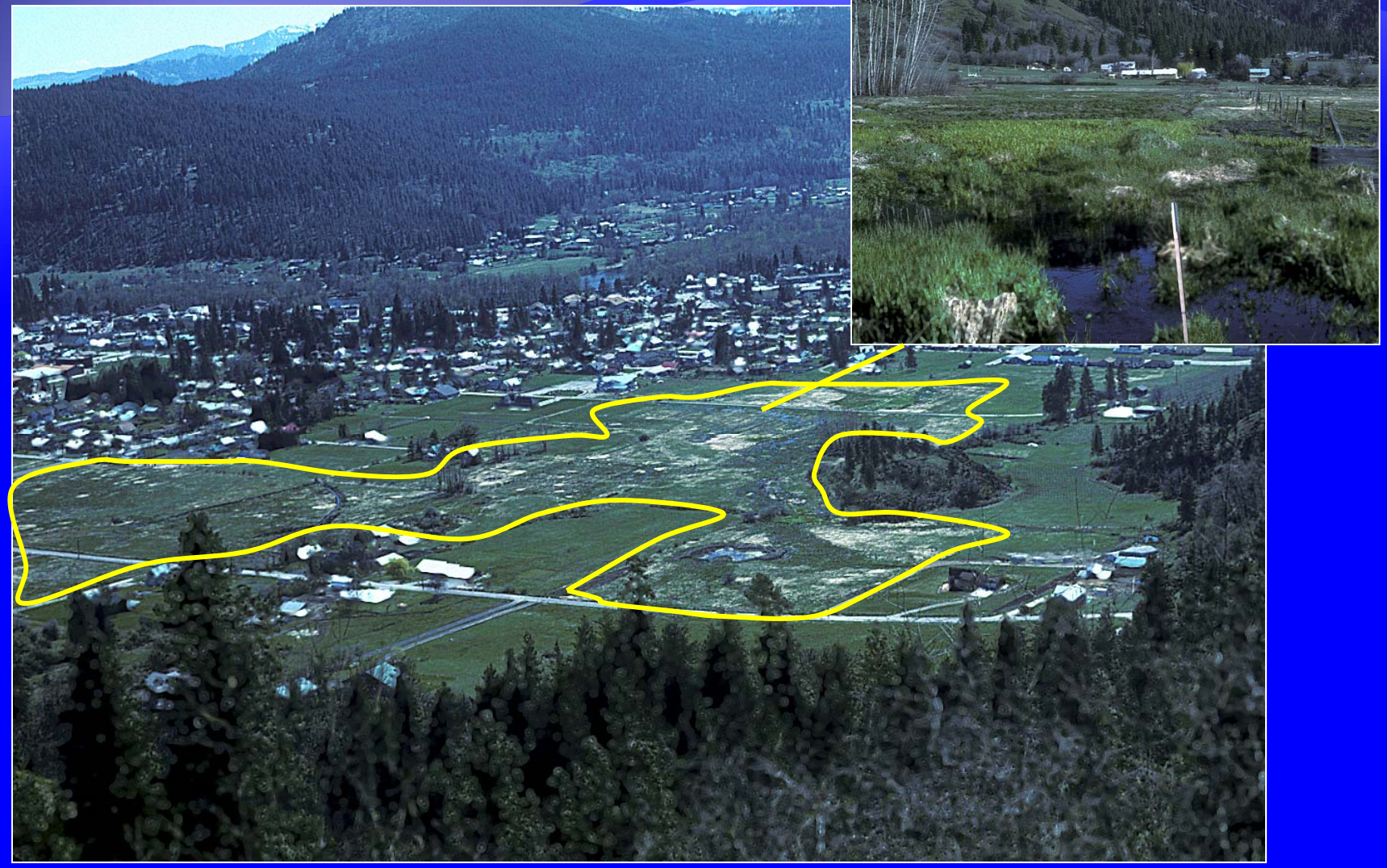
Component of process	Important areas for process
Subsurface storage	Permeable deposits
Discharge areas	Slope breaks, different permeabilites



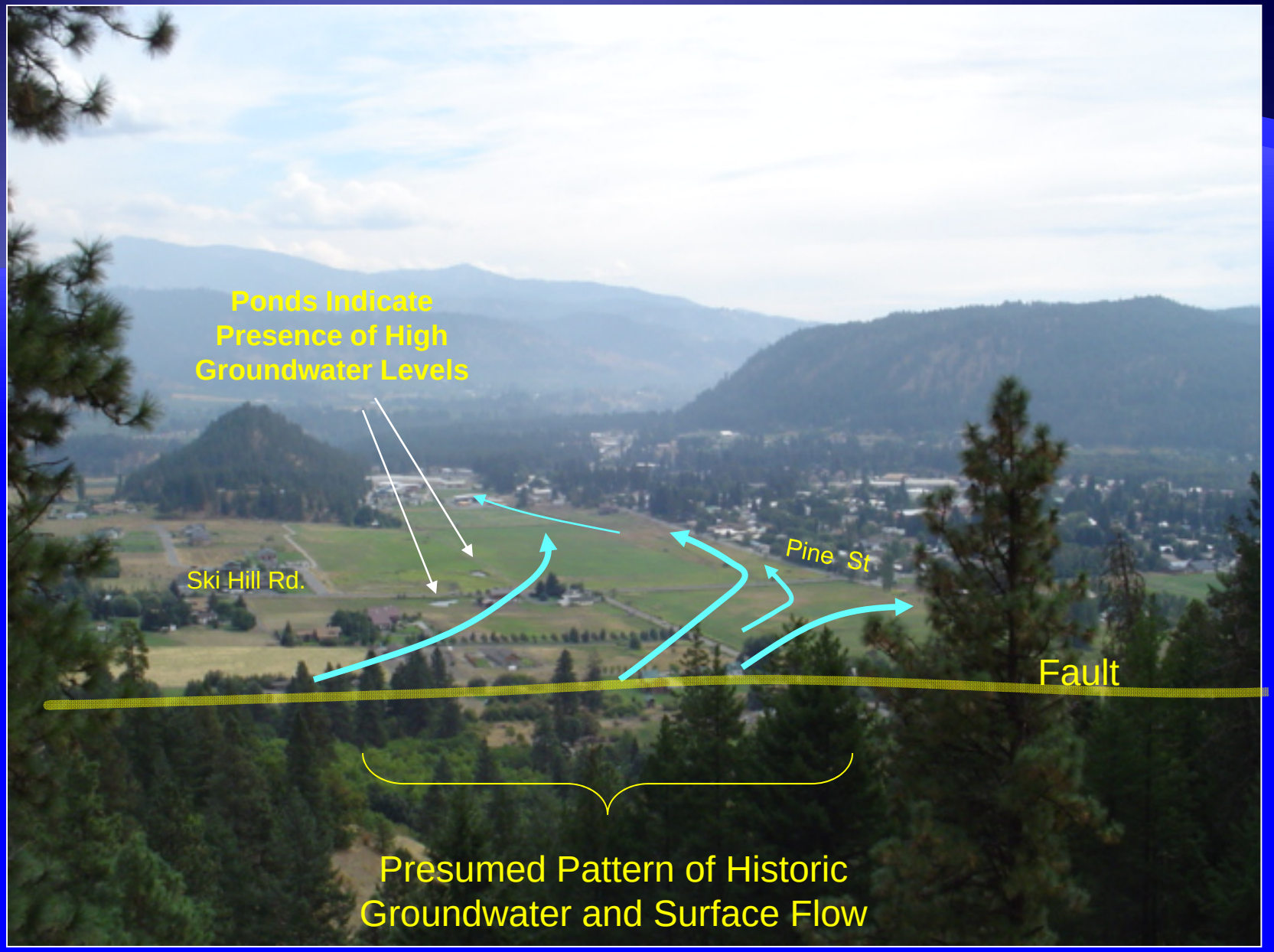
Upper Ski Hill – Area of Older Alluvium

View East Towards Chumstick River Valley

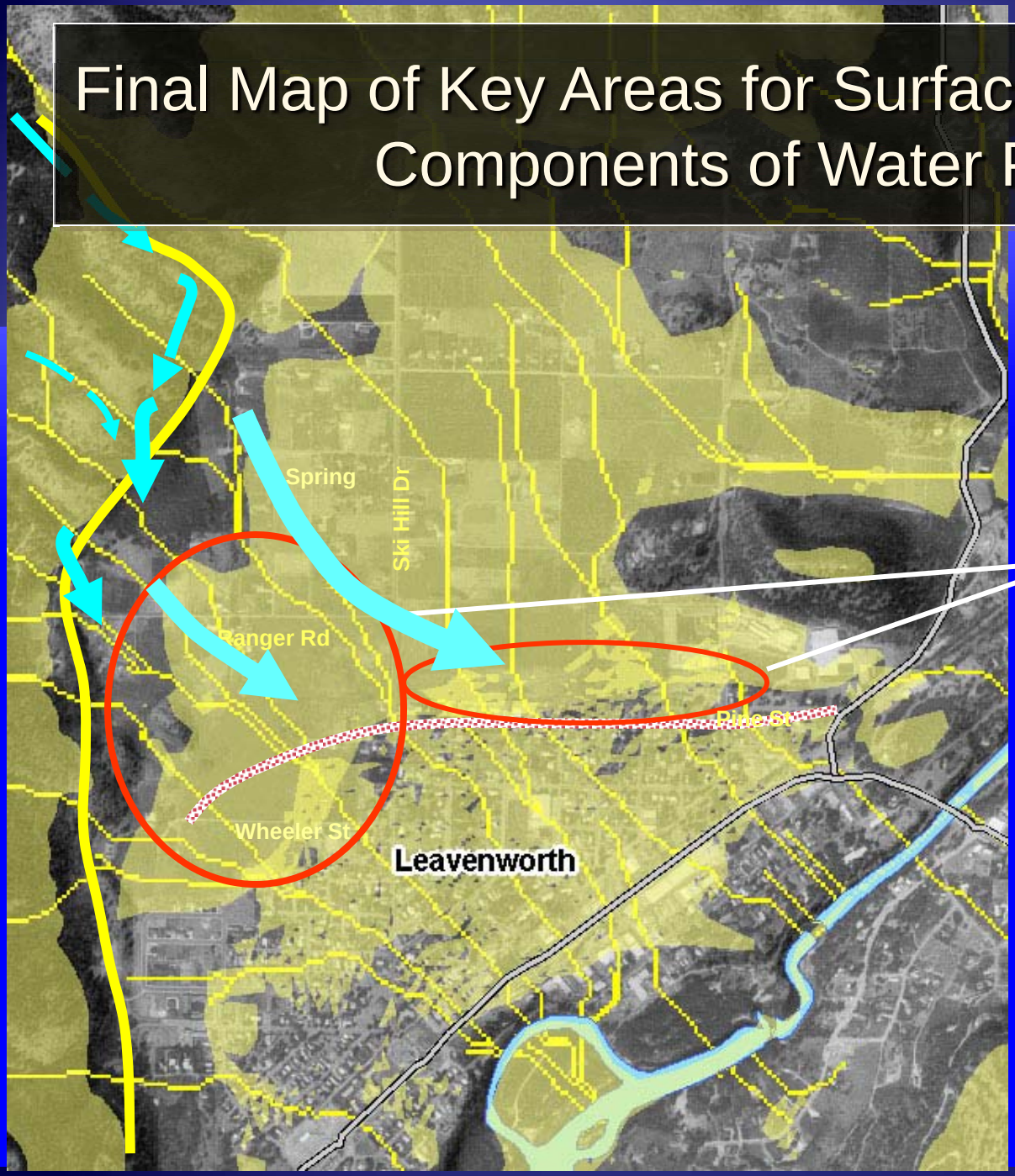
Area of Greater Groundwater Discharge



View SE Towards Ranger & Wheeler Rd & Town of Leavenworth


Ponds Indicate
Presence of High
Groundwater Levels
Ski Hill Rd.
Pine St
Fault
Presumed Pattern of Historic
Groundwater and Surface Flow

Final Map of Key Areas for Surface and Sub-surface Components of Water Process

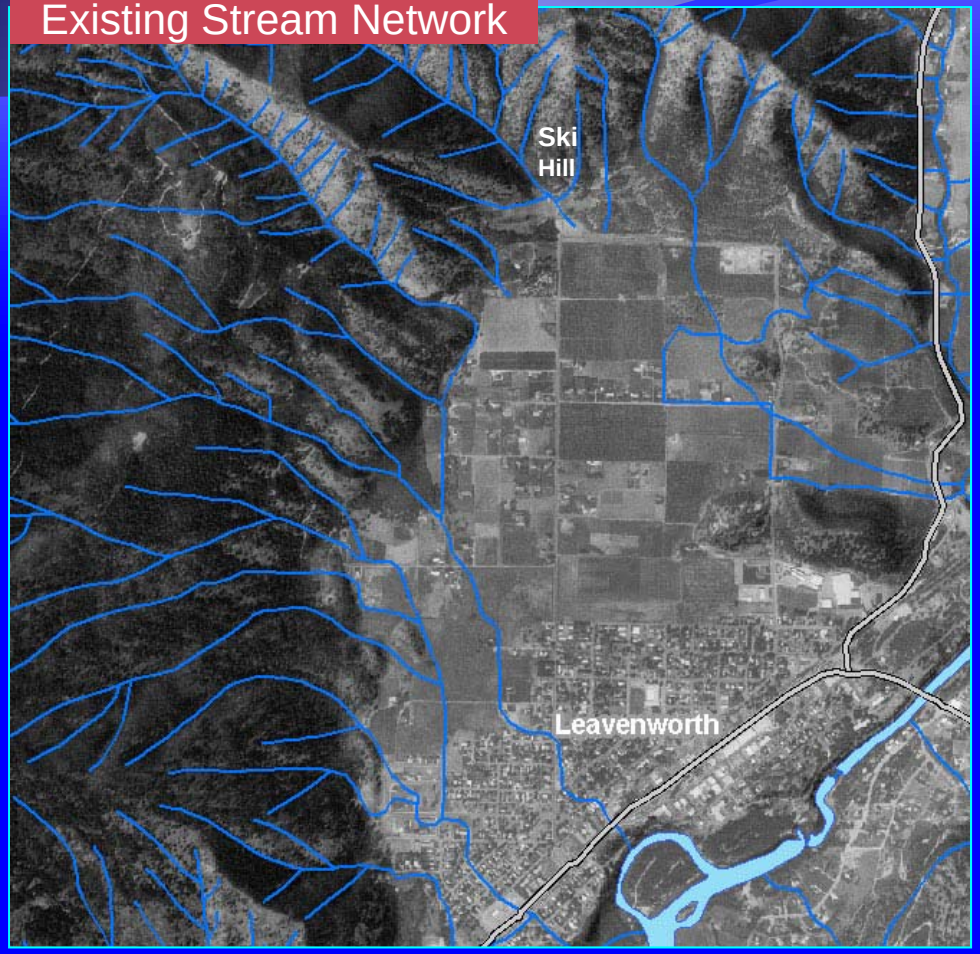


Probable areas of highest discharge

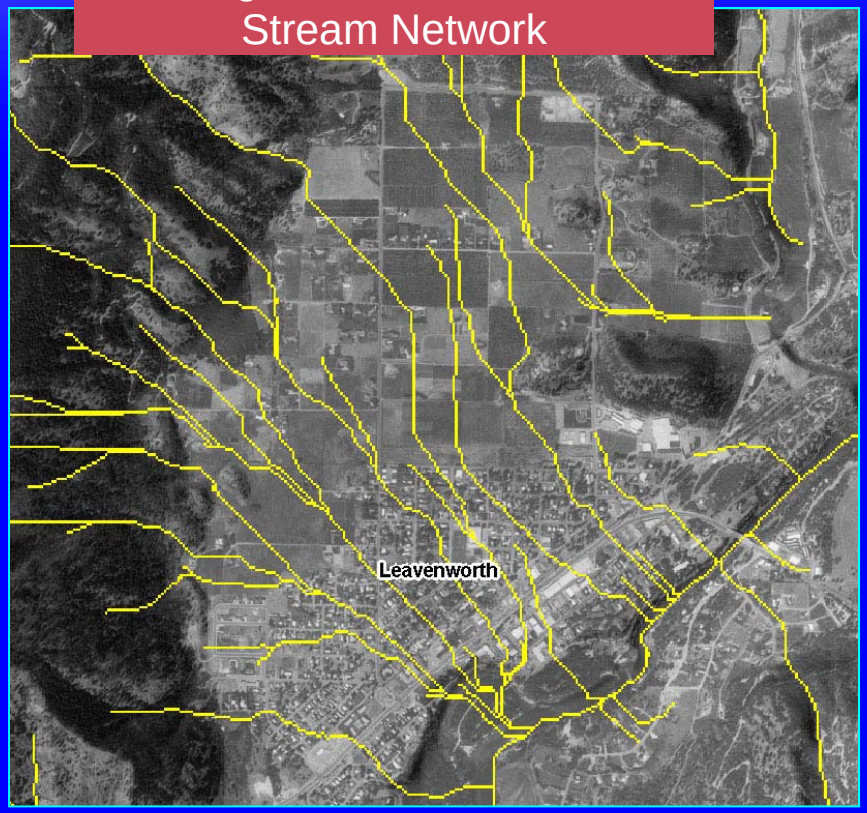
Step 4 – Identify and map types of Impairments

Indicators of Impairment to Surface Water Runoff
Loss of Stream Floodplain:

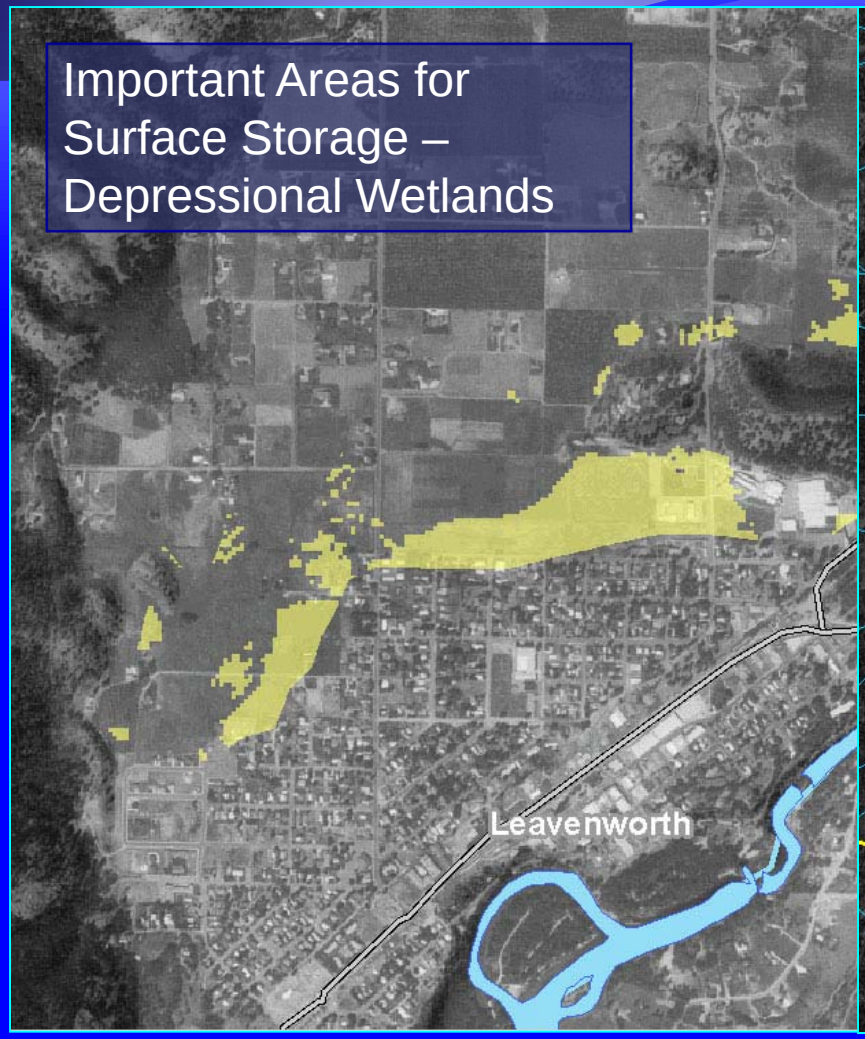
Existing Stream Network

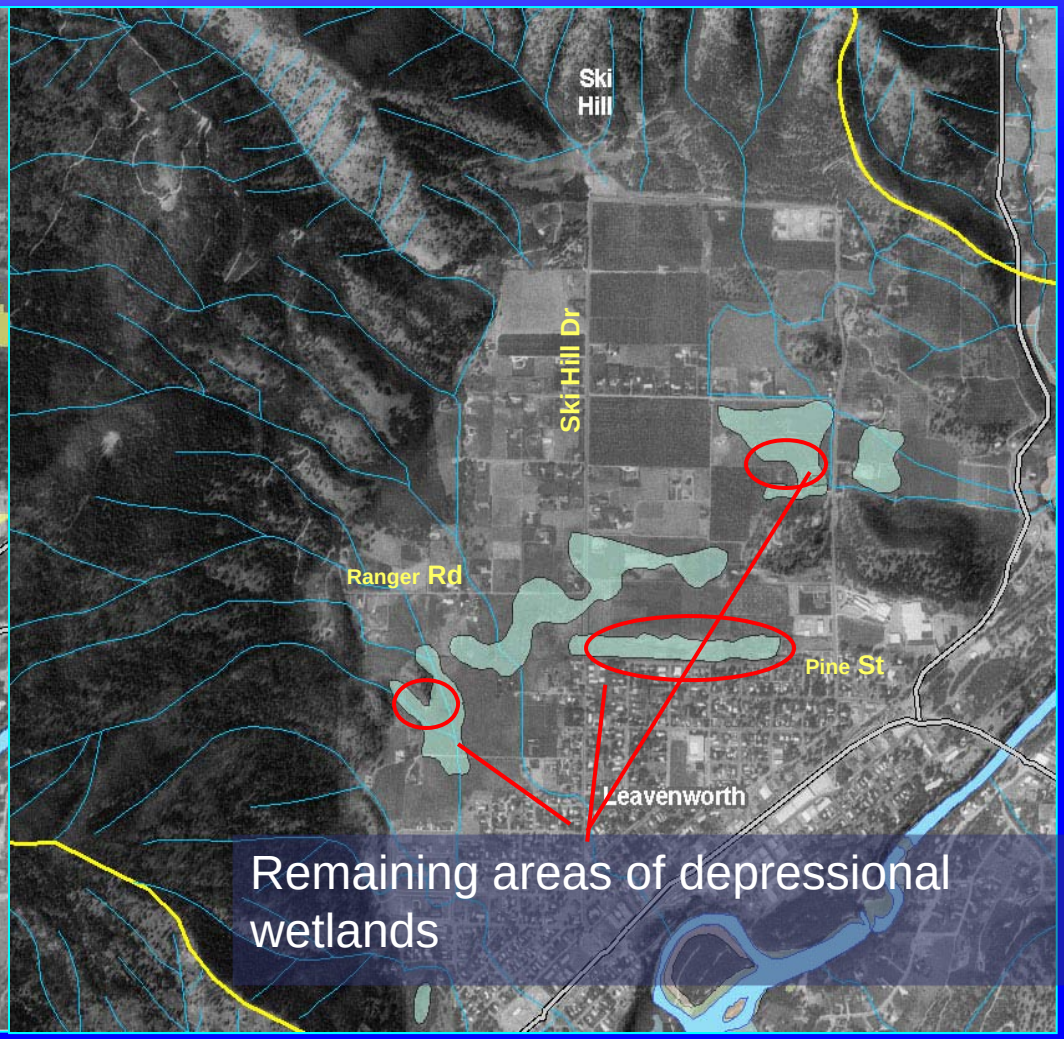


Important Areas for Surface Storage – Probable Historic Stream Network



Indicators of Impairment to Surface Water Runoff
Loss of Surface Storage:



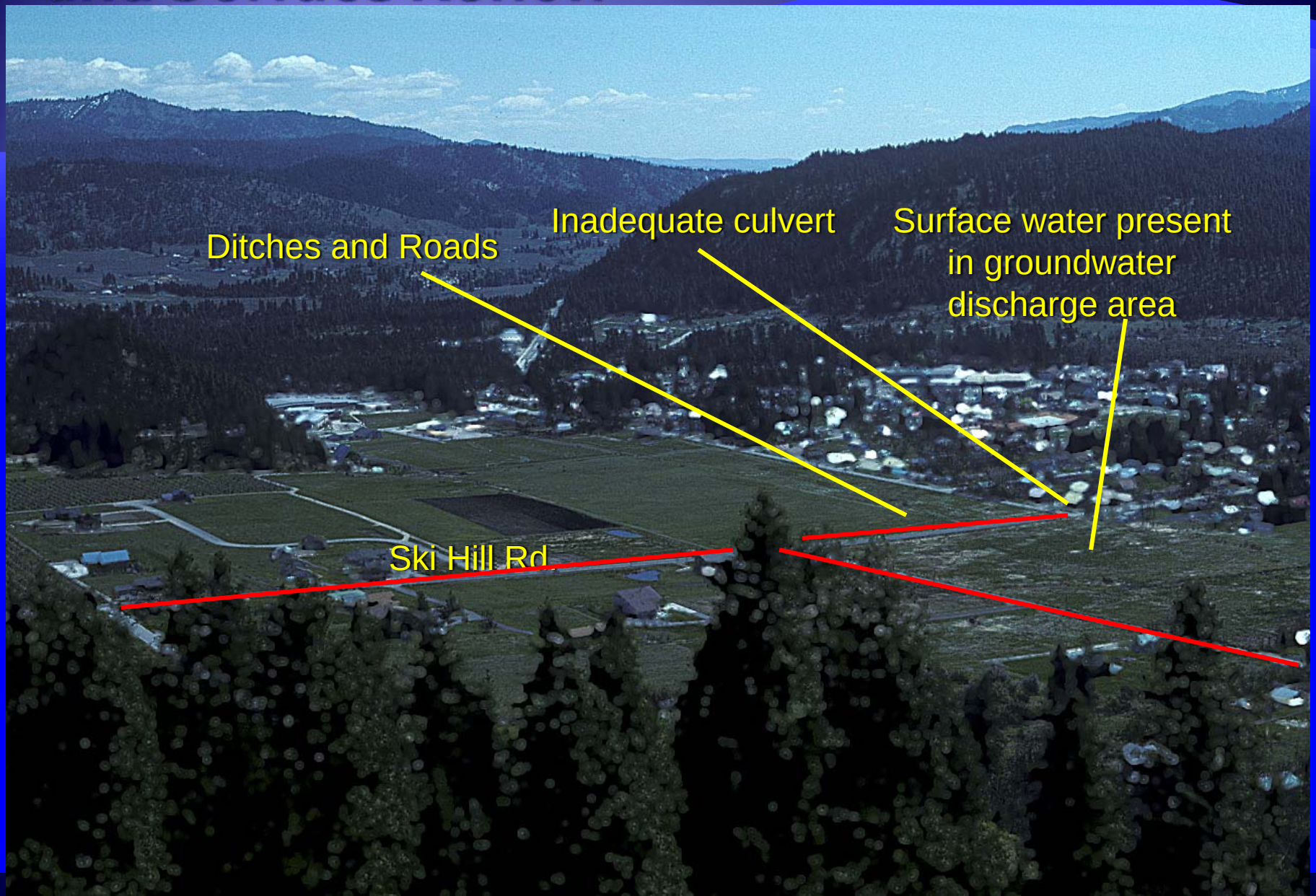


Impairment of Groundwater Flows

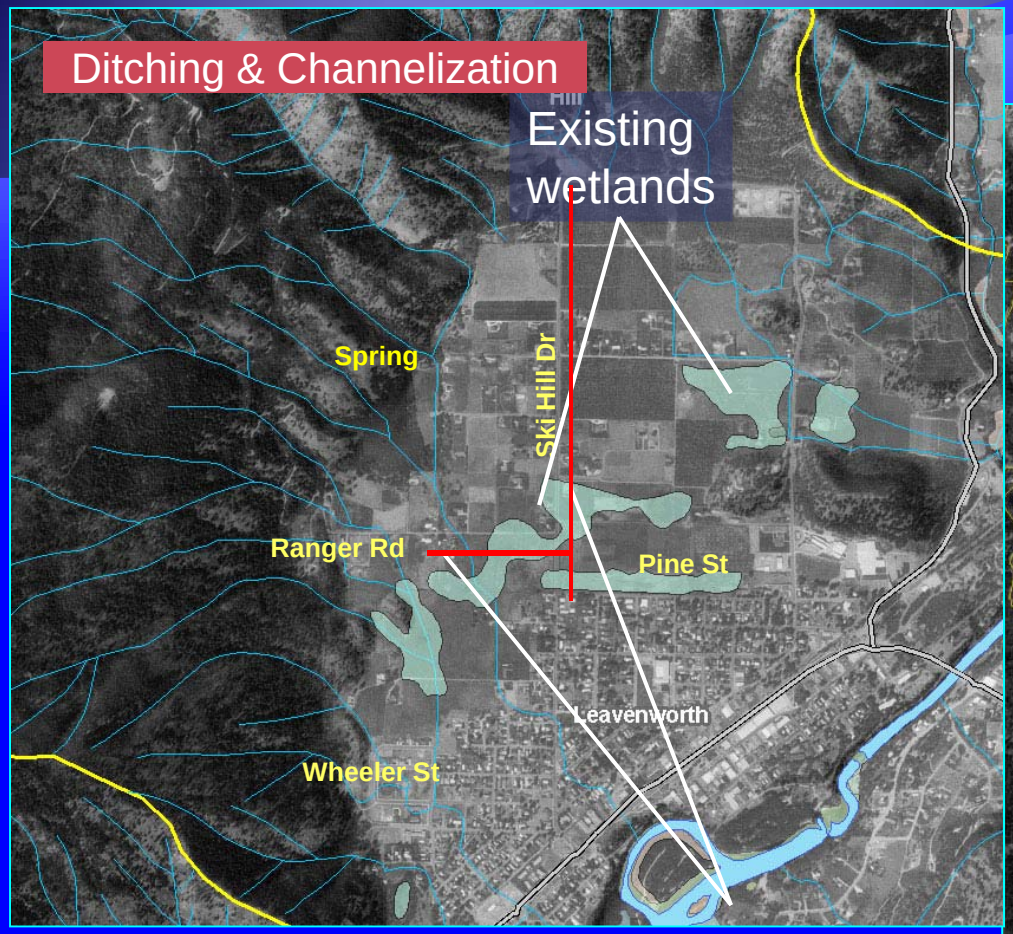
Ski Hill
Road Ditch

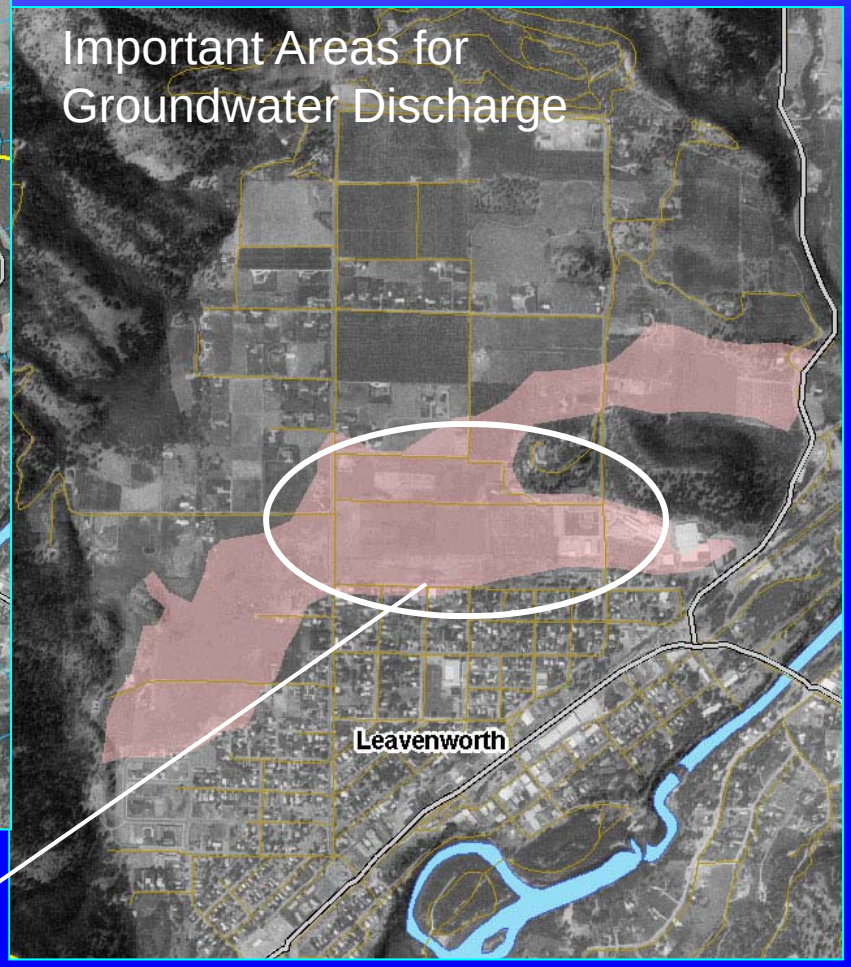
Northeast Corner of Intersection of Pine and Ski Hill Road

Impairment of Groundwater Movement and Surface Runoff

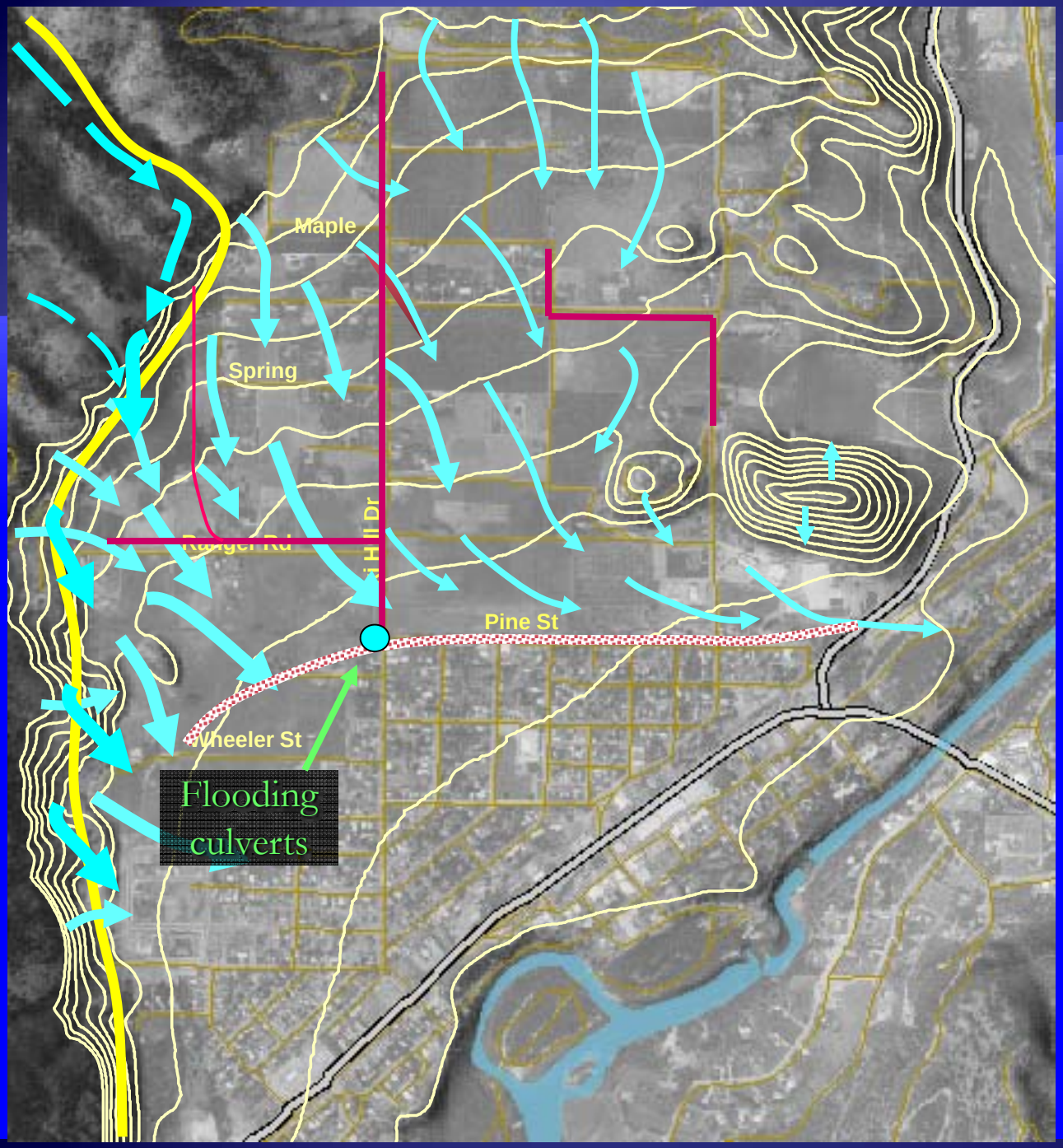


Indicators of Impairment to Groundwater Movement
Decrease in Groundwater Discharge to Aquatic Resources





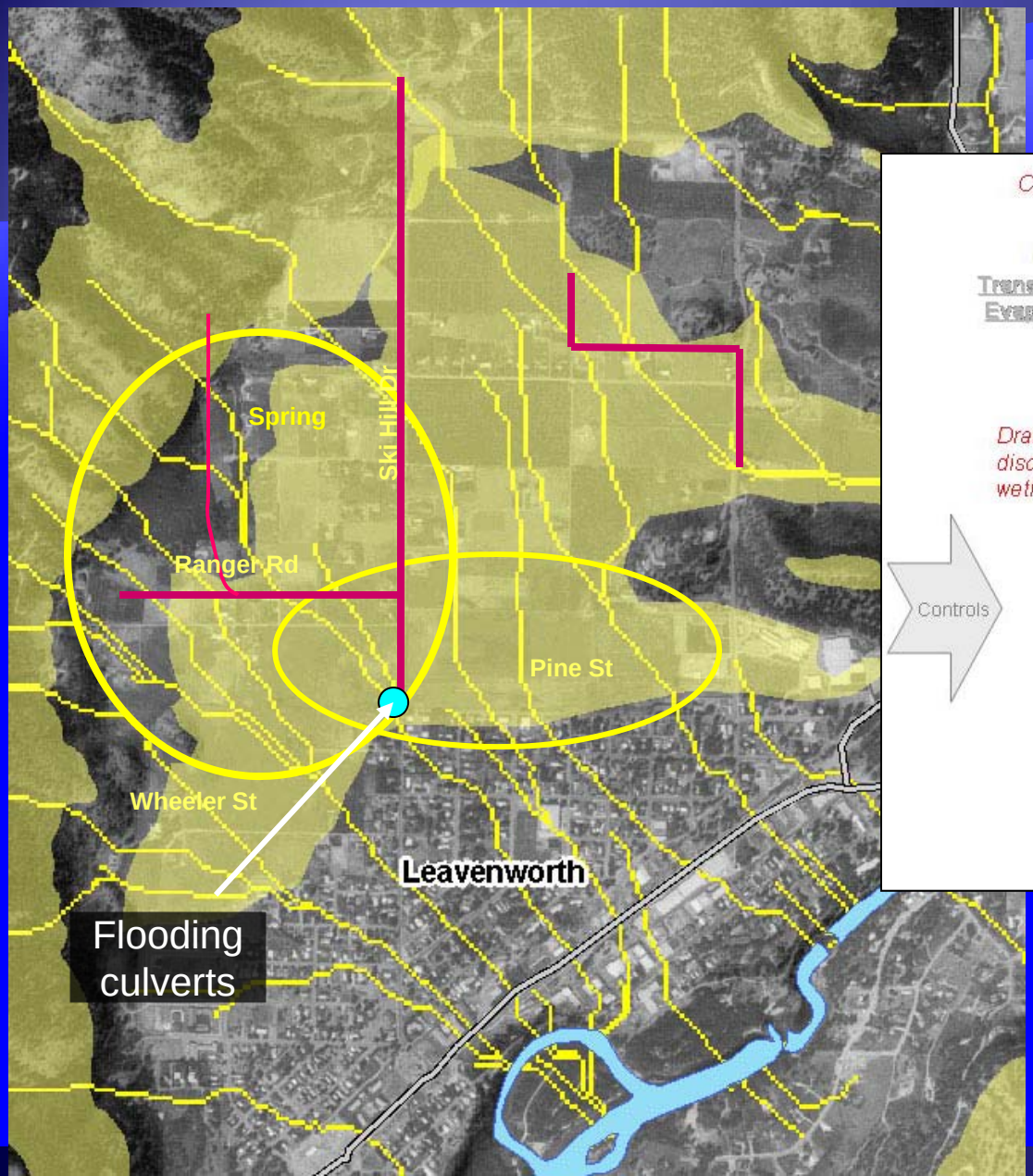
Historic groundwater flow patterns altered by ditches reducing natural discharge to east of Ski Hill Road

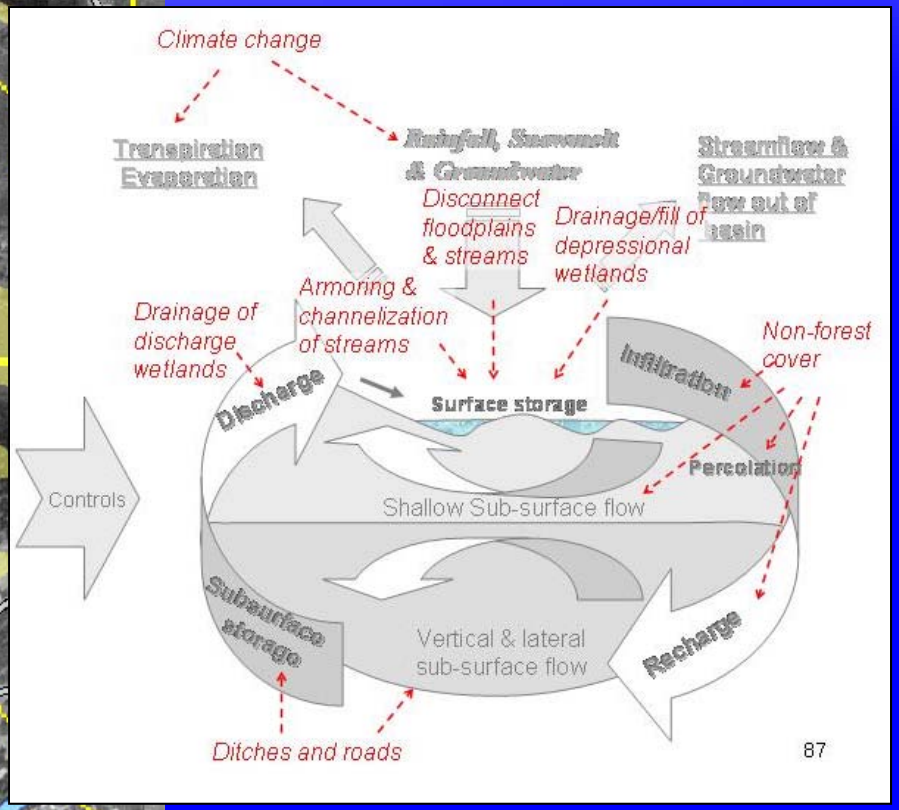


Analyzing Changes to Water Flows

Ditches intercept groundwater and bring it to surface. This increases the flooding problems.

Final Impairment Map

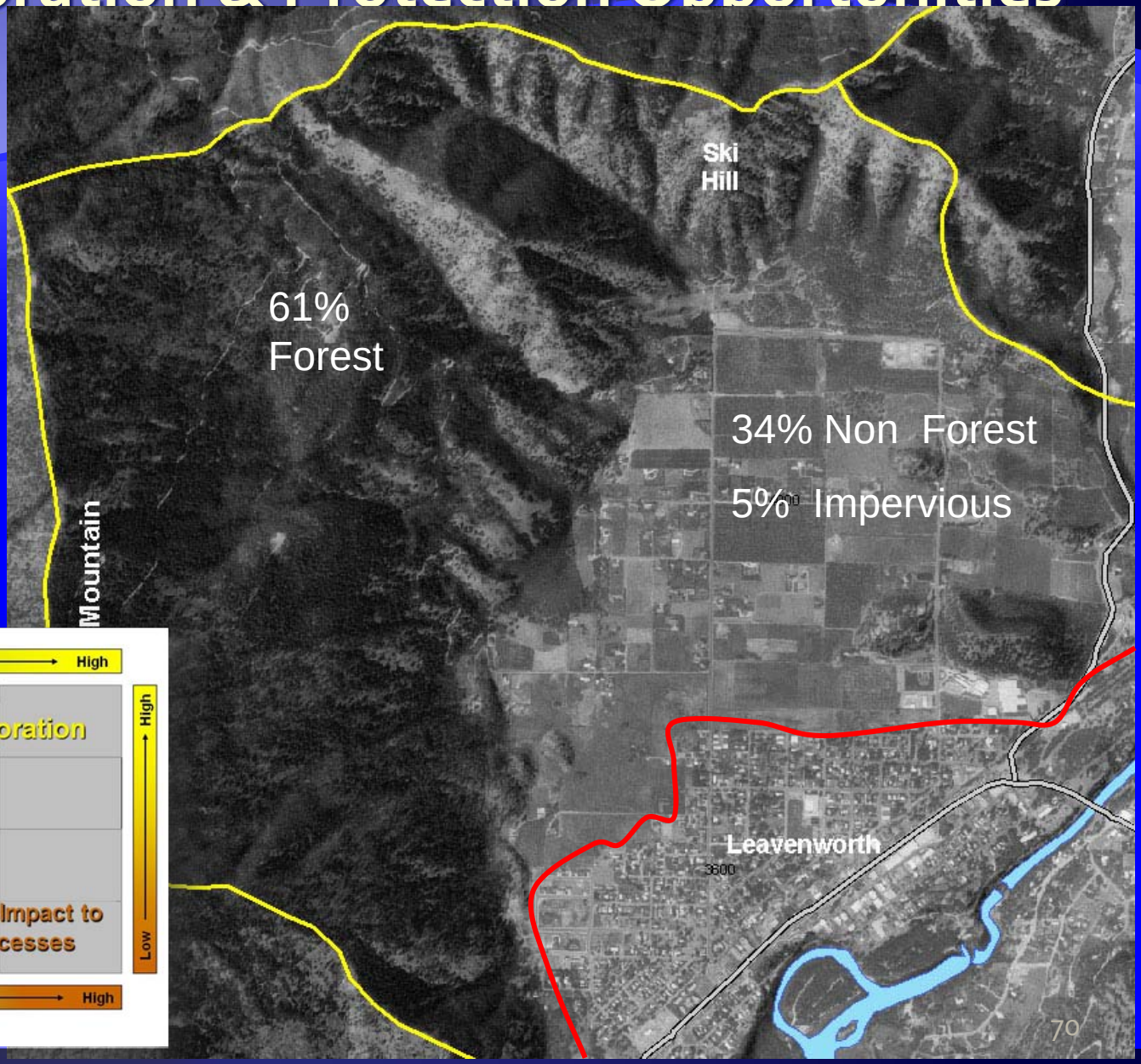


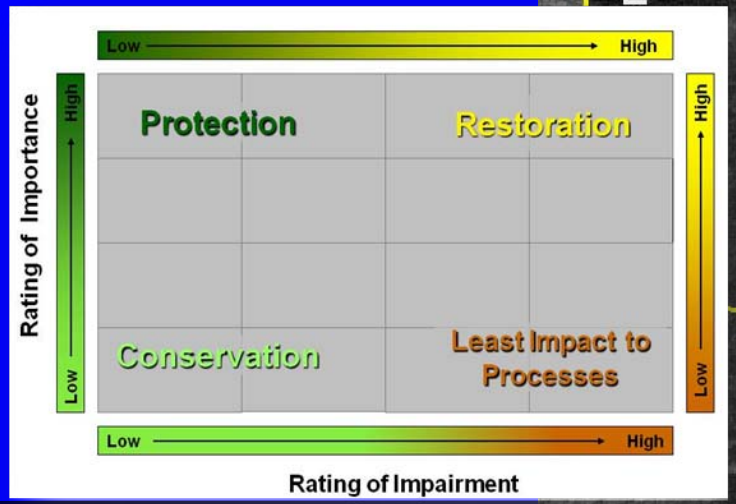


STEP 5 – LOCATE AREAS FOR PROTECTION & RESTORATION

GROUP ACTIVITY
DEVELOP RESTORATION AND PROTECTION PLAN BASED ON CHARACTERIZATION RESULTS

Evaluate Restoration & Protection Opportunities

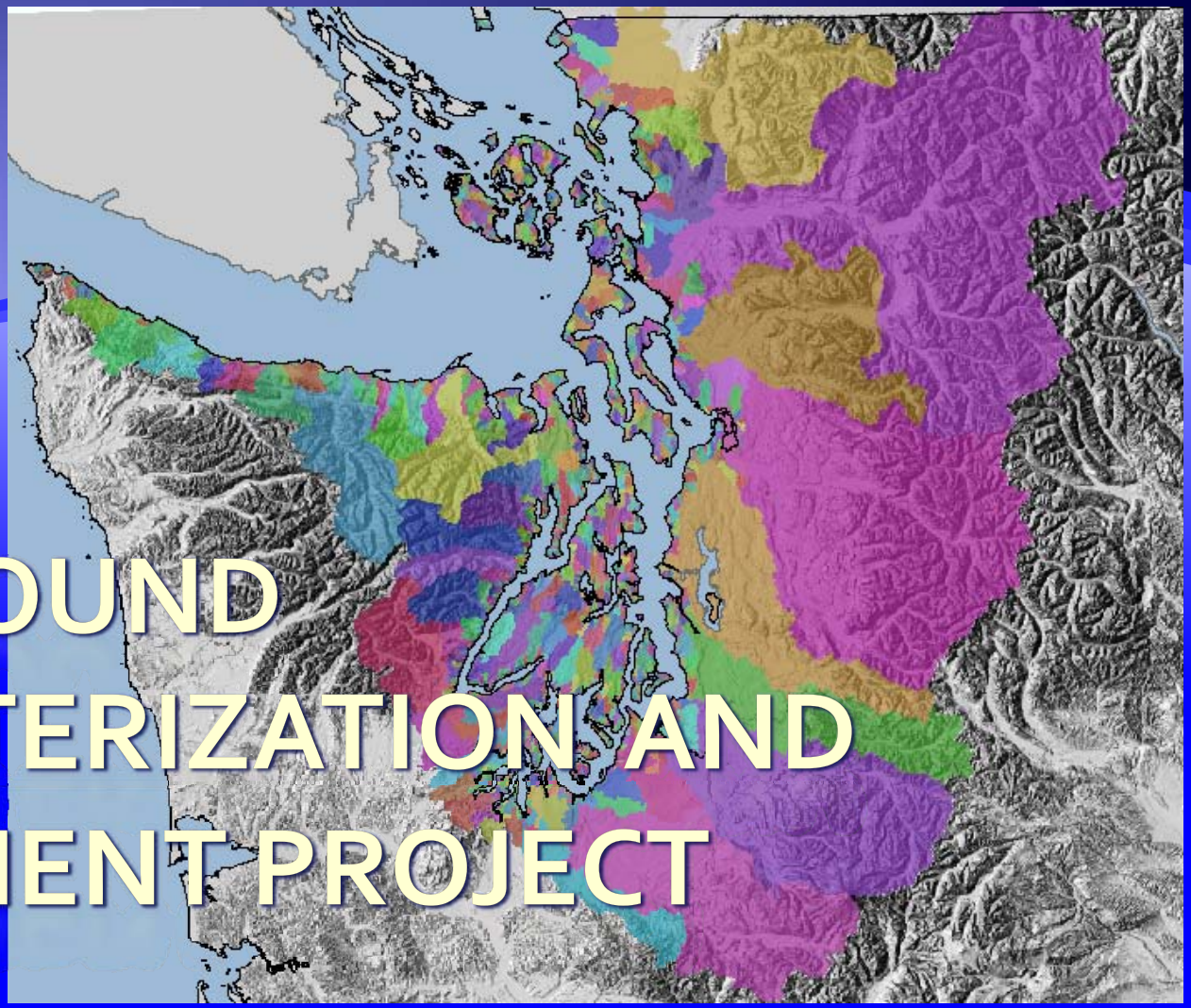




To Address the Flooding Problem, Answer the Following Questions

- Which areas should be protected (i.e. critical to maintaining processes)
- Which areas should be restored & why?
- What type of restoration plan would you implement?
- Where would you site future development (type, configuration, design)?
- What type of development measures/standards would you require?

LUNCH



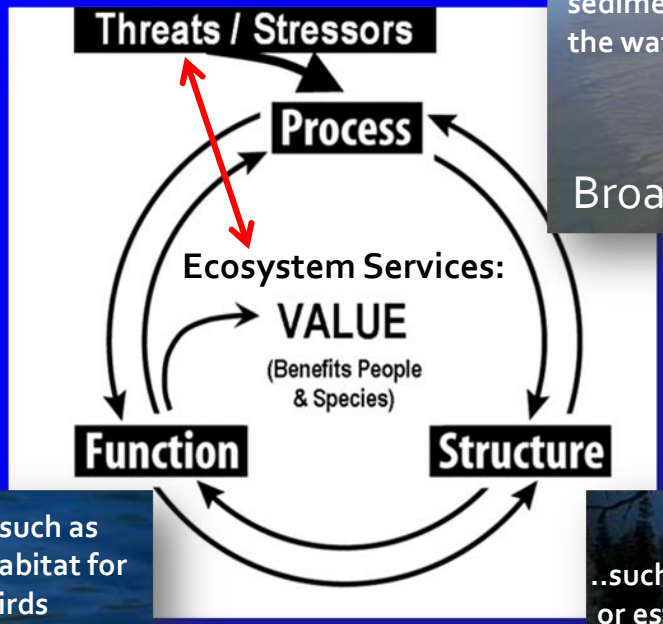
PUGET SOUND CHARACTERIZATION AND ASSESSMENT PROJECT

PURPOSE, OBJECTIVES AND INTRO TO MODELS

DEPARTMENT OF ECOLOGY
State of Washington

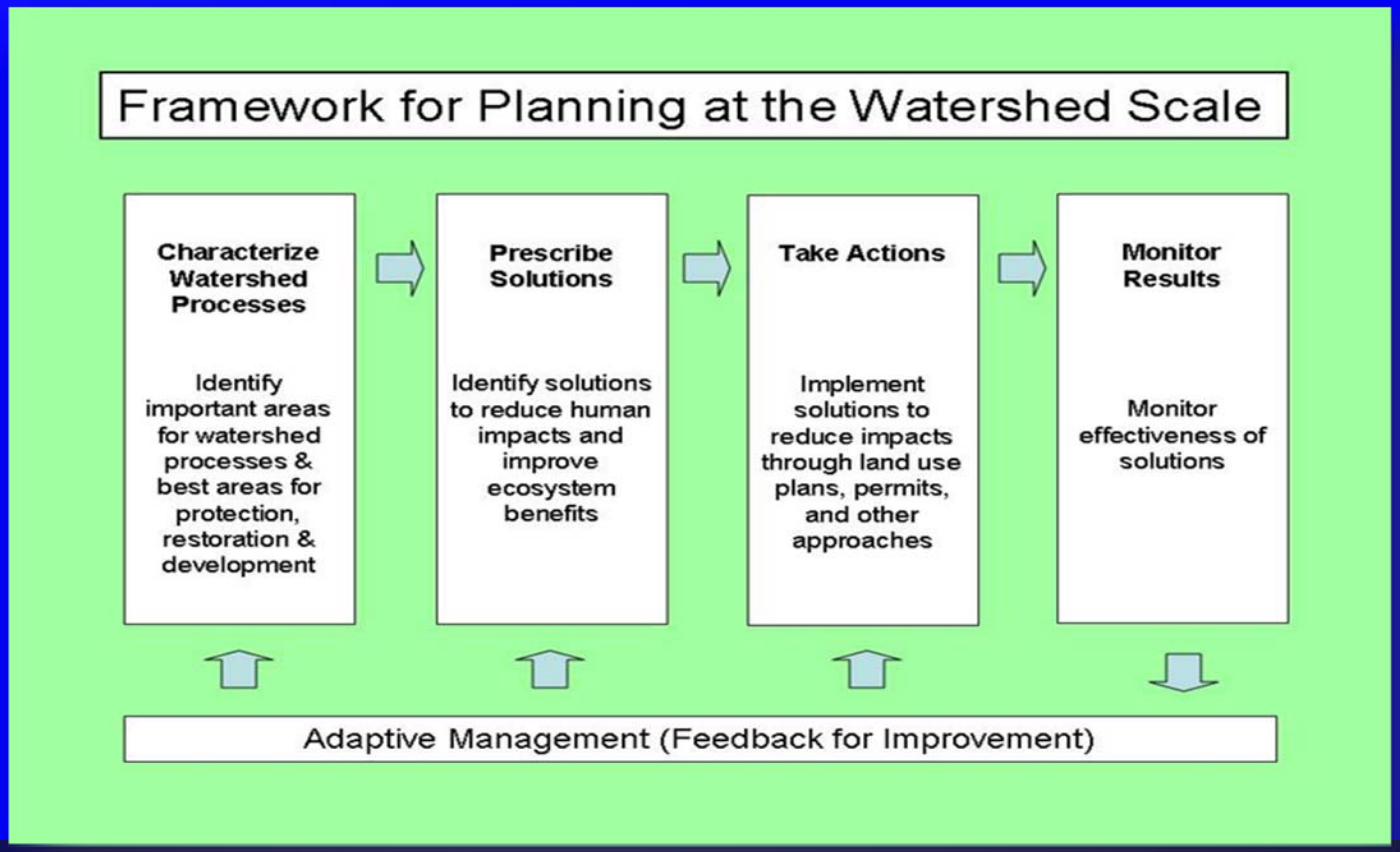
Purpose

- Sound-wide assessment of:
  - Freshwater processes
  - Nearshore processes
  - Wildlife habitat



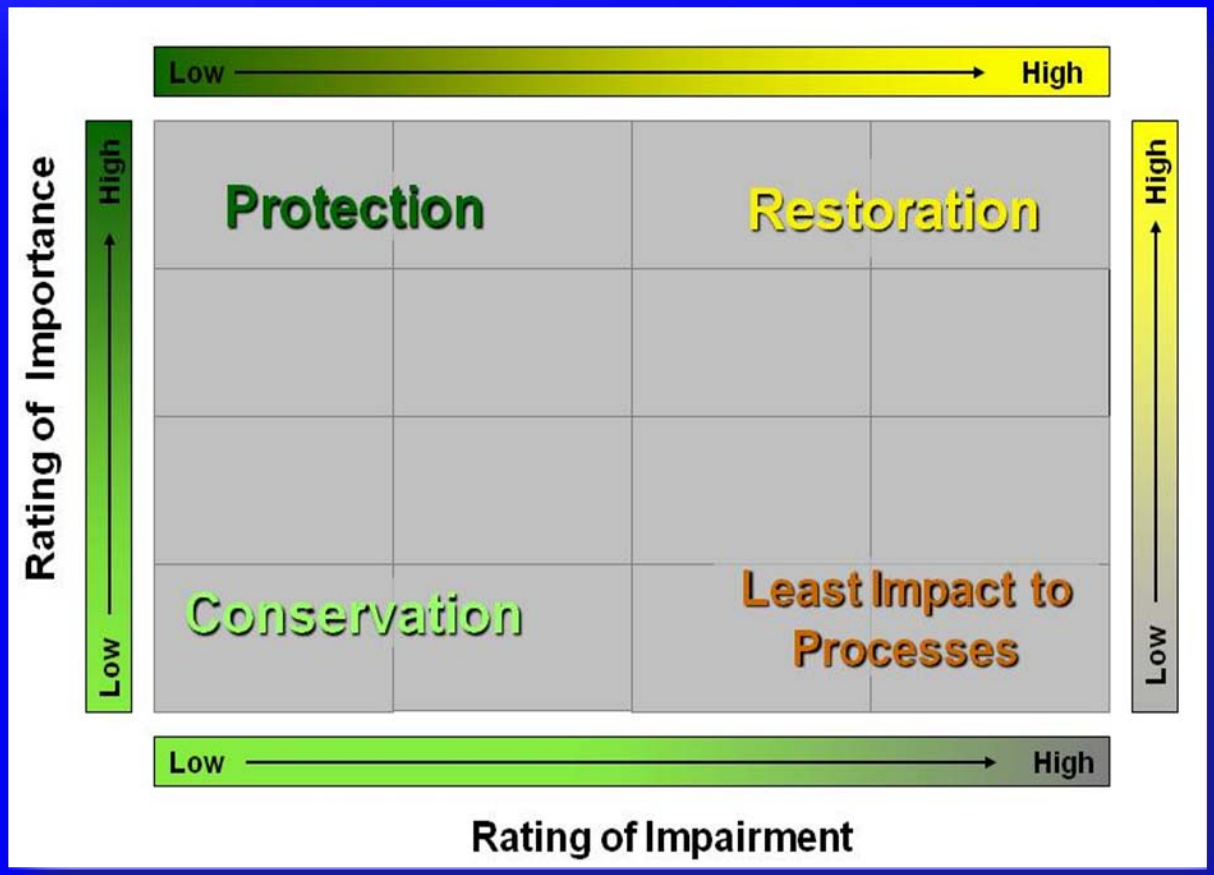
Objectives

- Help bridge "the gap" between science and its application
- Work within a watershed planning framework



Objectives

- Identify and prioritize areas for protection, restoration and development



Objectives

- Produce and display data in manner useful to local government, tribal, NGO & agency planning

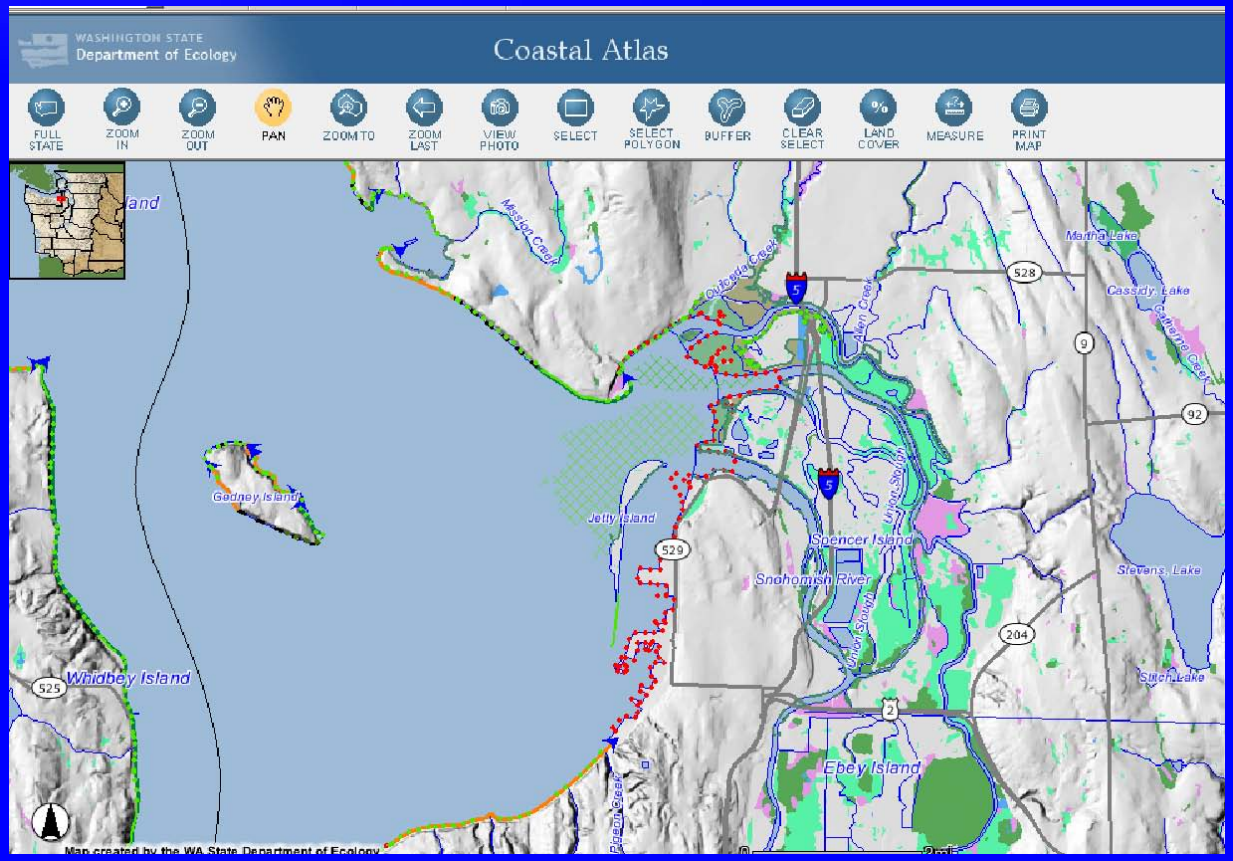
SMP updates

GMA updates

Specific Plans

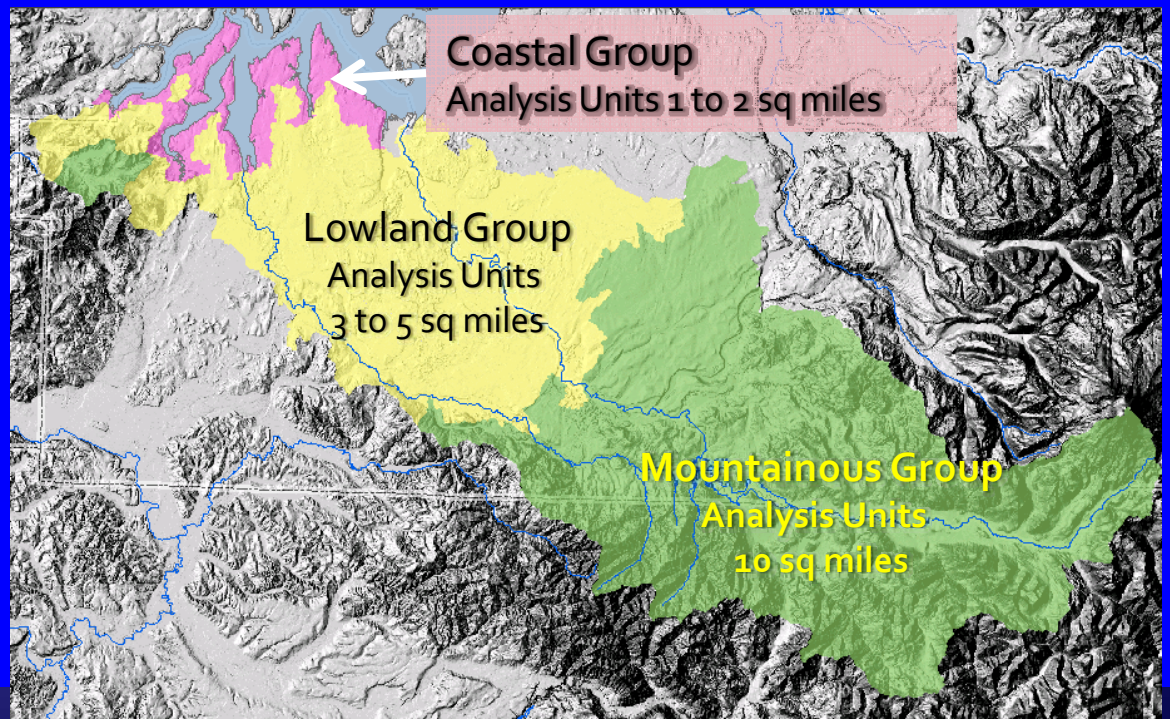
Acquisition and Restoration Actions

Alternative Mitigation (Banks, In-Lieu Fee progams)



Products – Phase 1

- Watershed Condition Index for water flow processes
- Provided for three landscape groups within each WRIA
- Due Spring 2010



Products – Phase 2

- Integrate other process models:
  - Fish and Wildlife Index
  - Water Quality Models (stormwater, nutrients)
  - PSNERP Change Analysis
- Conduct 2 or 3 characterizations at finer scale
  - (e.g. "specific plan" scale such as Birch Bay)
- Spring 2010 – June 2011

Introduction to Models

- Logic model - Indicators (variables) are combined using logic statements (and, or, if…then)
- Mechanistic model - Indicators (variables) are combined in equations using mathematical operators
- Methods are a collection of models

Limitation of Rapid Assessment Models

Variables can only represent fixed structural characteristics of a wetland or landscape.

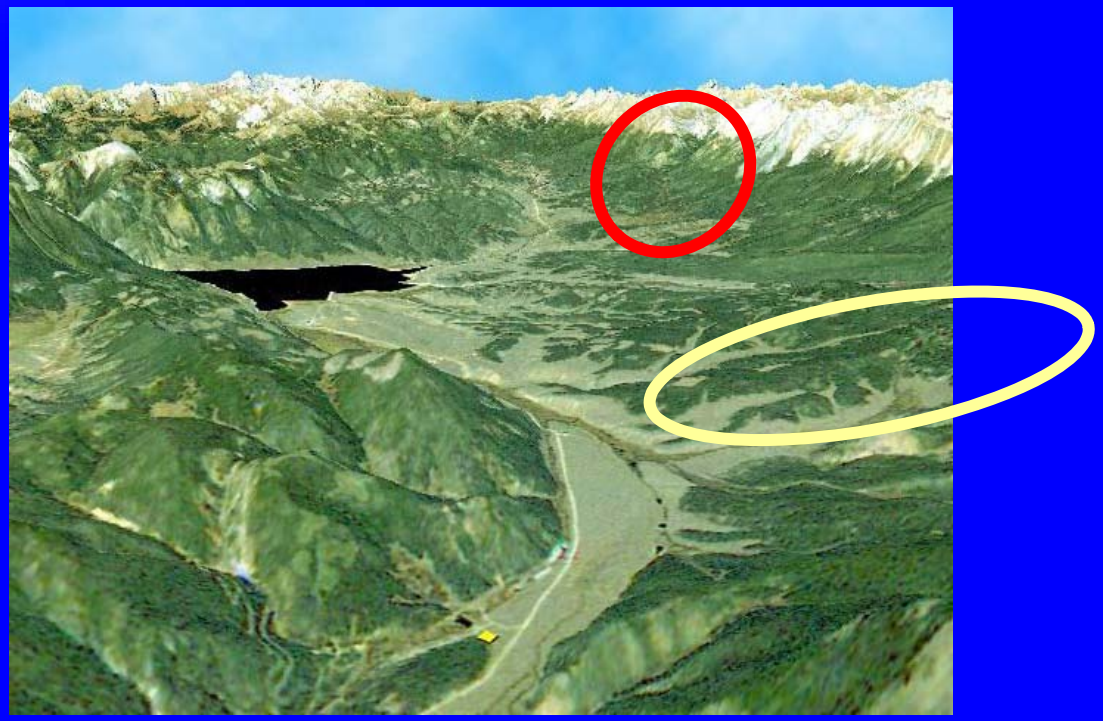
- Rainfall
- soil type
- % forest cover

Not a mathematical representation of dynamic processes:

- rates of flow, etc.

Process – Scoring Movement of Water in a Sub-basin

- Score = Surface Water + Groundwater + Evapotranspiration



Purpose: Compare importance of sub-basins in the entire watershed and rank them.

Assessment of Water Processes
Model 1: Importance

Important Area for Water Process =

Delivery + **Movement** + **Loss**

Surface Storage + **Recharge, Subsurface Flow, & Discharge**

P - Precipitation

HU2 - Depressional Wetlands

HU5 - Recharge

All areas assumed to be forested & have equal evapotranspiration

HU1 – Snow & rain-on-snow area

HU3 – Unconfined Floodplains

HU4 – Moderately Confined Floodplains

HU6 – Slope Wetlands

HU7 – High Perm Floodplains

$$W_{H1}\left[\frac{P + HU1}{\text{Highest sum}}\right] + W_{H2}\left[\frac{HU2}{\text{Highest Sum}} + \frac{HU3 + HU4}{\text{Highest Sum}}\right] + W_{H3}\left[\frac{HU5}{\text{Highest Sum}} + \frac{HU6 + HU7}{\text{Highest Sum}}\right]$$

Max Score = 1 | Max Score = 1 | Max Score = 1

Model 1

Assessment of Water Processes
Model 2: Impairment

Impairments to Water Process =

Delivery + **Movement** + **Loss**

Timing + **Overland Flow, Surface Storage** + **Recharge, Subsurface Flow, Storage & Discharge** + **Evapo-transpiration**

HI-1 – Forest Loss

HI-2 – Impervious cover

Depressional Wetland Loss

HI-3 – Urban

HI-4 – Rural

Floodplain Loss

HI-5 – Unconfined

HI-6 – Moderately confined

HI-7 – Loss of Recharge

Lateral Flow

HI-8 – Road density

Discharge – Wells, Floodplain, & Slope Wetland Loss

HI-9 – Well density

HI-10 /11 – High perm floodplain in urban/rural

HI-12/13 – Slope wetlands in urban/rural

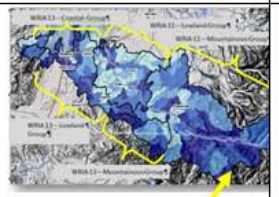
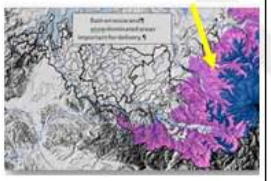
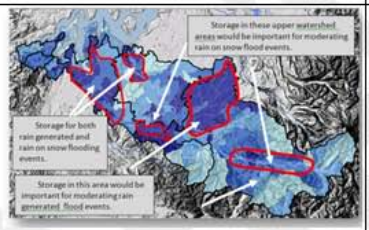
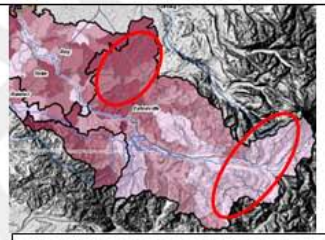
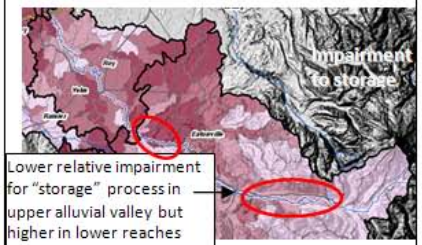
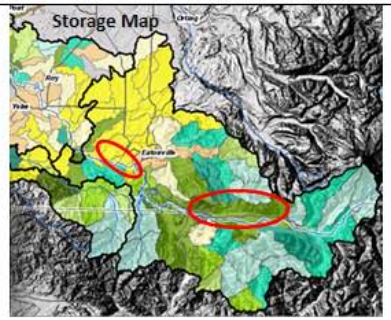
HI-14 – Impervious cover

$$W_{H1}\left[\frac{HI\text{-}1}{\text{Highest Sum}}\right] + W_{H2}\left[\frac{HI\text{-}2}{HS} + \frac{HI\text{-}3 + HI\text{-}4}{\text{Highest Sum}} + \frac{HI\text{-}5 + HI\text{-}6}{\text{Highest Sum}}\right] + W_{H3}\left[\frac{HI\text{-}7}{HS} + \frac{HI\text{-}8}{\text{Highest Sum}} + \frac{HI\text{-}9 + HI\text{-}10 + HI\text{-}11 + HI\text{-}12 + HI\text{-}13}{\text{Highest Sum}}\right] + W_{H4}\left[\frac{HI\text{-}14}{\text{Highest Sum}}\right]$$

Max Score = 1 | Max Score = 1 | Max Score = 1 | Max Score = 1

Model 2

Synthesis of Results

Watershed Issue		Process Component & Landscape Group	Process Component & Landscape Group	Impairment	Actions
Lowland Flooding: Rain-on-Snow events		Delivery in Mountainous Group	Storage in Lowland Group		
	Look for:	Analysis Units ranking high for delivery + greatest area of "rain-on-snow" and "snow dominated" zones. See Figure 8	Analysis units ranking high for storage in upper and mid portions of watershed and located downstream of delivery areas in column 2. See Figure 9	High impairment for delivery and low for storage areas See Figure 13	Protect floodplain and depression areas in upper/mid watershed and restore forested cover in mountainous group . See Figure 18
				High impairment for storage and low for delivery areas See Fig. 13	Restore depressional and wetland storage in upper/mid watershed. See Figure 18.
		 Important areas for rain on snow and snow dominated processes in upper watershed of WRIA 11 & 13 		 Overall impairment map above shows high impairment in the rain dominated delivery area and low impairment in the "rain on snow" delivery area.  Lower relative impairment for "storage" process in upper alluvial valley but higher in lower reaches	 The upper alluvial valley requires a "protection" (darker geen areas) management strategy due to relatively low impairment and high important and location higher in the watershed. The lower alluvial valley requires a "restoration" (bright yellow) management strategy as does the rain dominated delivery area.

INTRODUCTION TO MODELING

APPLYING CHARACTERIZATION TO MITIGATION PLANNING IN THE CHEHALIS BASIN

Step 1 – Define the Purpose

Why do you need to understand watershed processes?
Who will assist you with the analysis?
What resources already exist to help with the analysis?

→ Step 1: Define the purpose of the analysis

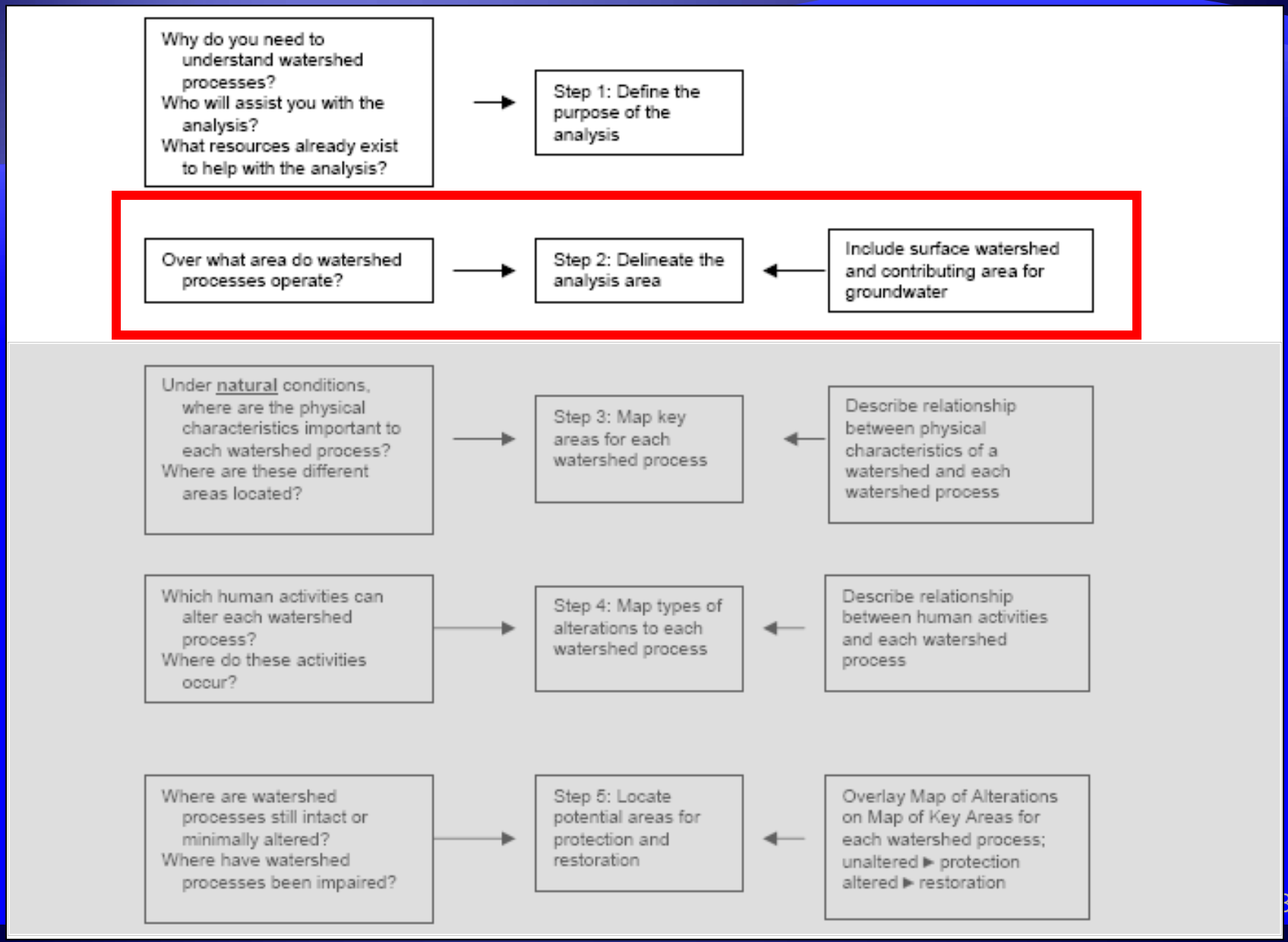
Over what area do watershed processes operate? → Step 2: Delineate the analysis area ← Include surface watershed and contributing area for groundwater

Under natural conditions, where are the physical characteristics important to each watershed process?
Where are these different areas located? → Step 3: Map key areas for each watershed process ← Describe relationship between physical characteristics of a watershed and each watershed process

Which human activities can alter each watershed process?
Where do these activities occur? → Step 4: Map types of alterations to each watershed process ← Describe relationship between human activities and each watershed process

Where are watershed processes still intact or minimally altered?
Where have watershed processes been impaired? → Step 5: Locate potential areas for protection and restoration ← Overlay Map of Alterations on Map of Key Areas for each watershed process; unaltered ▶ protection altered ▶ restoration

Step 2 – Delineate Analysis Area



Delineate Landscape Groups

Based on Similar:

Precipitation Type

Geology

Landform

Groundwater Patterns

Criteria for Landscape Groups

- Mountainous
  - Generally > 500 feet elevation
    - Comprised of:
      - Bedrock areas
      - Rain-on-snow & snow dominated areas
      - High precip areas
      - High relief topography
  - Analysis Unit size: average of 8-10 sq mi
    - Generally less diverse landcover
    - Not high development pressure

- Lowland
  - Generally < 500 feet elevation
    - Low gradient terrace landform
    - Glacial drift
    - Lower precip / rain dominated
  - Size: 2-5 sq mi (average 3-5 sq mi)
    - More diverse land cover
    - Higher development pressure

- Coastal

  Size: 1-2 sq mi or smaller (average 1 sq mi)
  Glacial drift
  Discharges directly to nearshore

  Stream order: 1st or 2nd and
  Captures small drainages systems that are less complex
  Captures remnant areas between coastal streams

  Exclude major river deltas

  Islands: grouped to ~1 sq mi

Delineate Landscape Groups

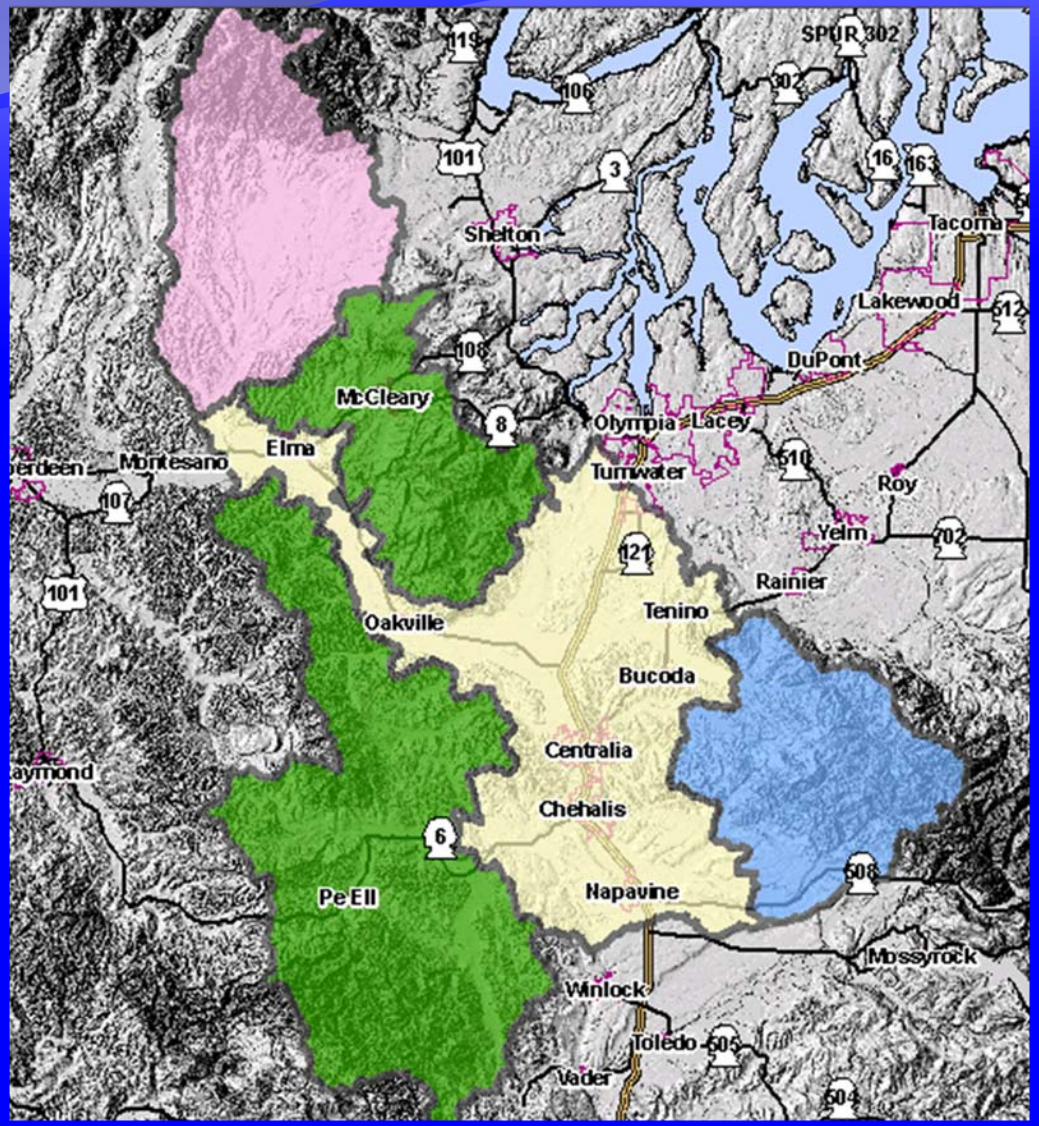
Based on Similar:

Precipitation Type

Geology

Landform

Groundwater Patterns



Step 3 – Assess & Map Key Areas

Why do you need to understand watershed processes?
Who will assist you with the analysis?
What resources already exist to help with the analysis?

→ Step 1: Define the purpose of the analysis

Over what area do watershed processes operate?

→ Step 2: Delineate the analysis area ← Include surface watershed and contributing area for groundwater

Under natural conditions, where are the physical characteristics important to each watershed process?
Where are these different areas located?

→ Step 3: Map key areas for each watershed process ← Describe relationship between physical characteristics of a watershed and each watershed process

Which human activities can alter each watershed process?
Where do these activities occur?

→ Step 4: Map types of alterations to each watershed process ← Describe relationship between human activities and each watershed process

Where are watershed processes still intact or minimally altered?
Where have watershed processes been impaired?

→ Step 5: Locate potential areas for protection and restoration ← Overlay Map of Alterations on Map of Key Areas for each watershed process; unaltered ▶ protection altered ▶ restoration

Models for Scoring

Importance of a sub-basin in the hydrologic process =

Important for delivery +

Importance for surface water +

Importance for groundwater +

Importance in evapotranspiration

Assessment of Water Processes
Model 1: Importance

Important Area for Water Process =

Delivery + **Movement** + **Loss**

Surface Storage + **Recharge, Subsurface Flow, & Discharge**

P - Precipitation

HU2 - Depressional Wetlands

HU5 - Permeability

All areas assumed to be forested & have equal evapotranspiration

HU1 – Snow & rain-on-snow area

HU3 – Unconfined Floodplains

HU4 – Moderately Confined Floodplains

HU6 – Slope Wetlands

HU7 – High Perm Floodplains

$$\frac{P + HU1}{\text{(Highest sum above)}} + C_{H1}\left[\frac{HU2}{\text{Highest Sum}} + \frac{HU3 + HU4}{\text{Highest Sum}}\right] + C_{H2}\left[\frac{HU5}{\text{Highest Sum}} + \frac{HU6 + HU7}{\text{Highest Sum}}\right]$$

Max Score = 1 | Max Score = 1 | Max Score = 1

Model 1

Example of Scoring for Importance Surface Water Variables

$$\frac{\text{Area of Wetlands}}{\text{Area of Sub-basin}} = \text{\% of wetlands in sub-basin}$$

Scoring Based on Total Range of Wetlands in Analysis Area for a Landscape Group. For Example:

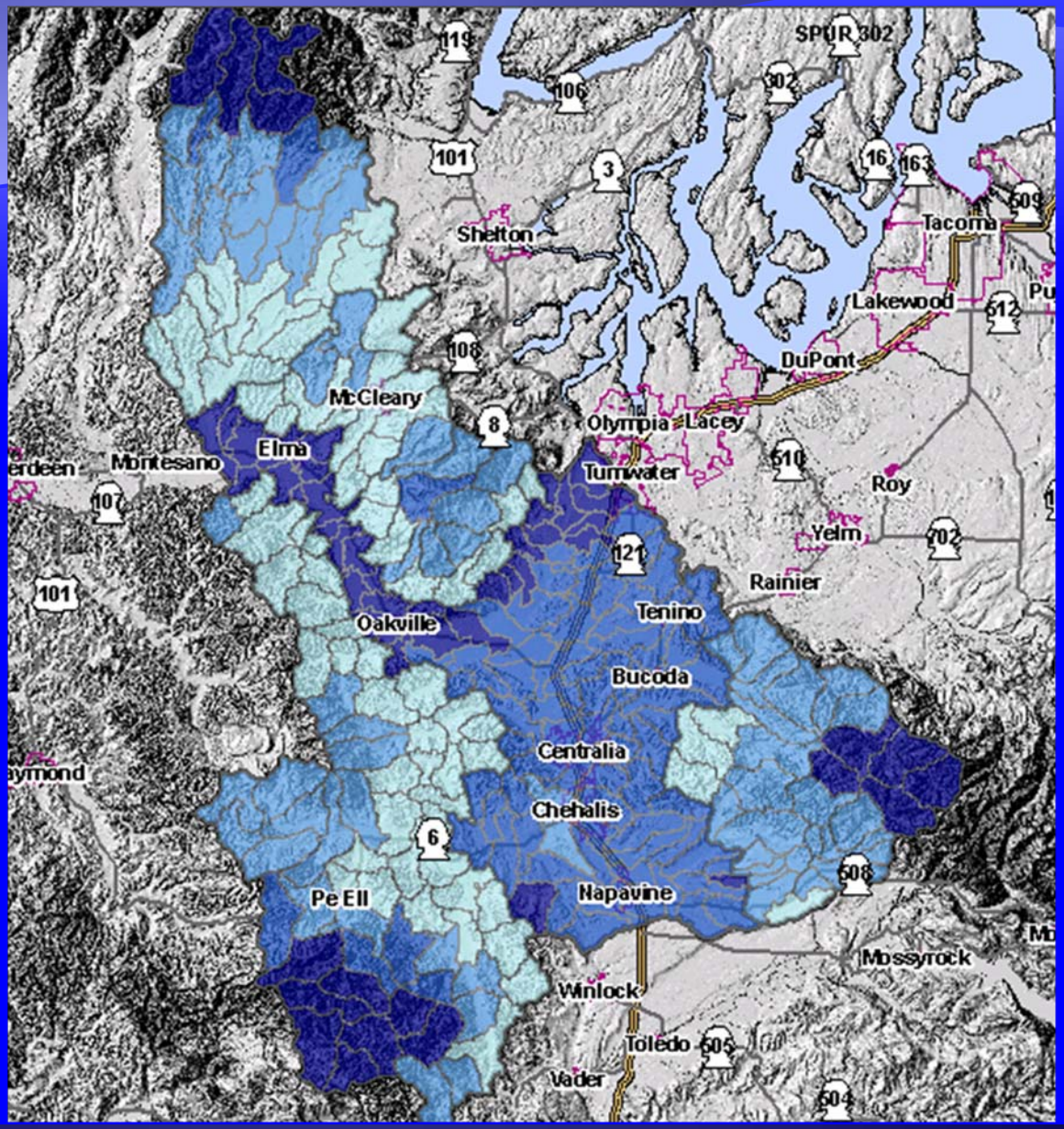
5% = 0.2

10% = 0.4

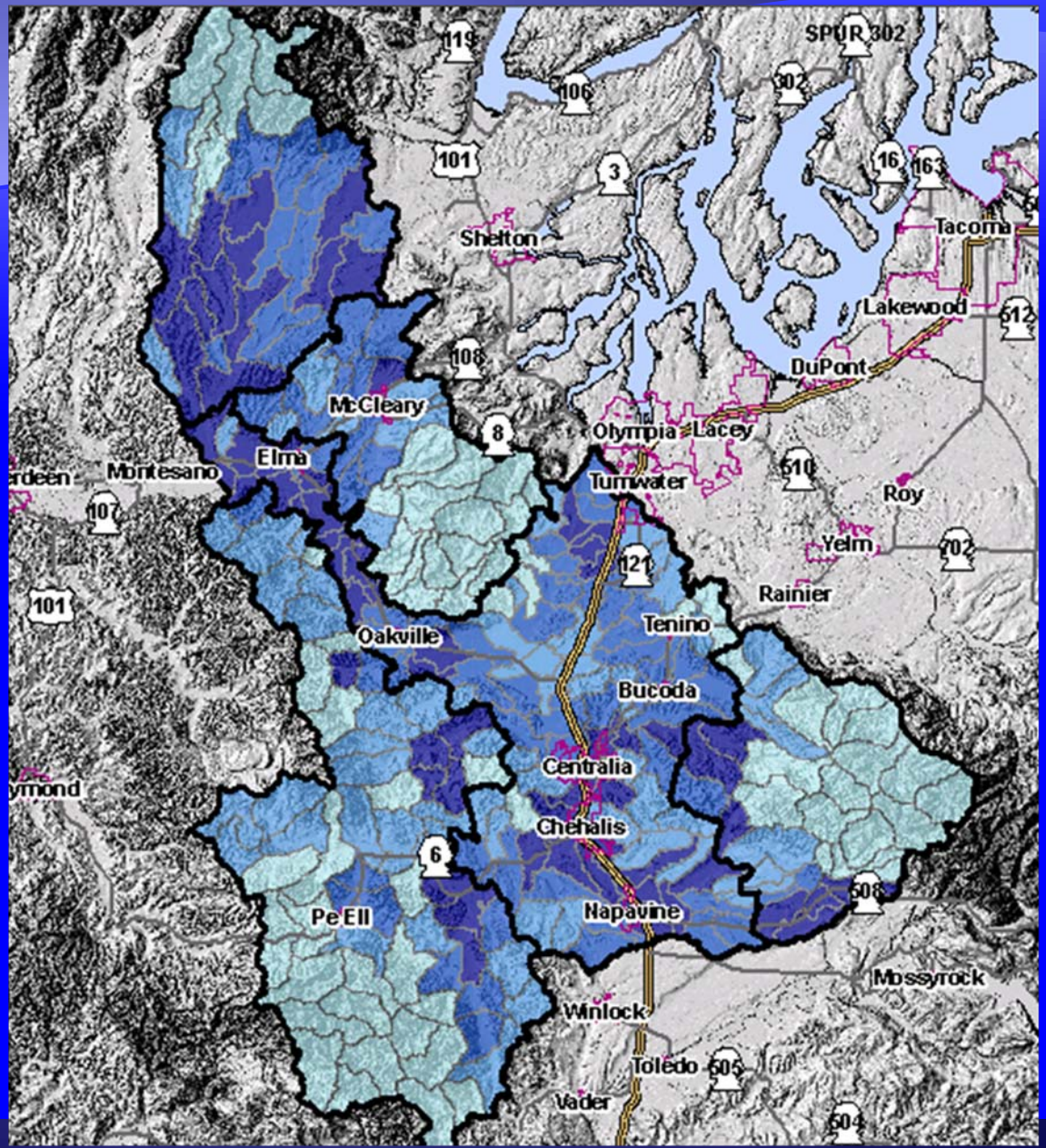
20% = 0.8

25% = 1.0

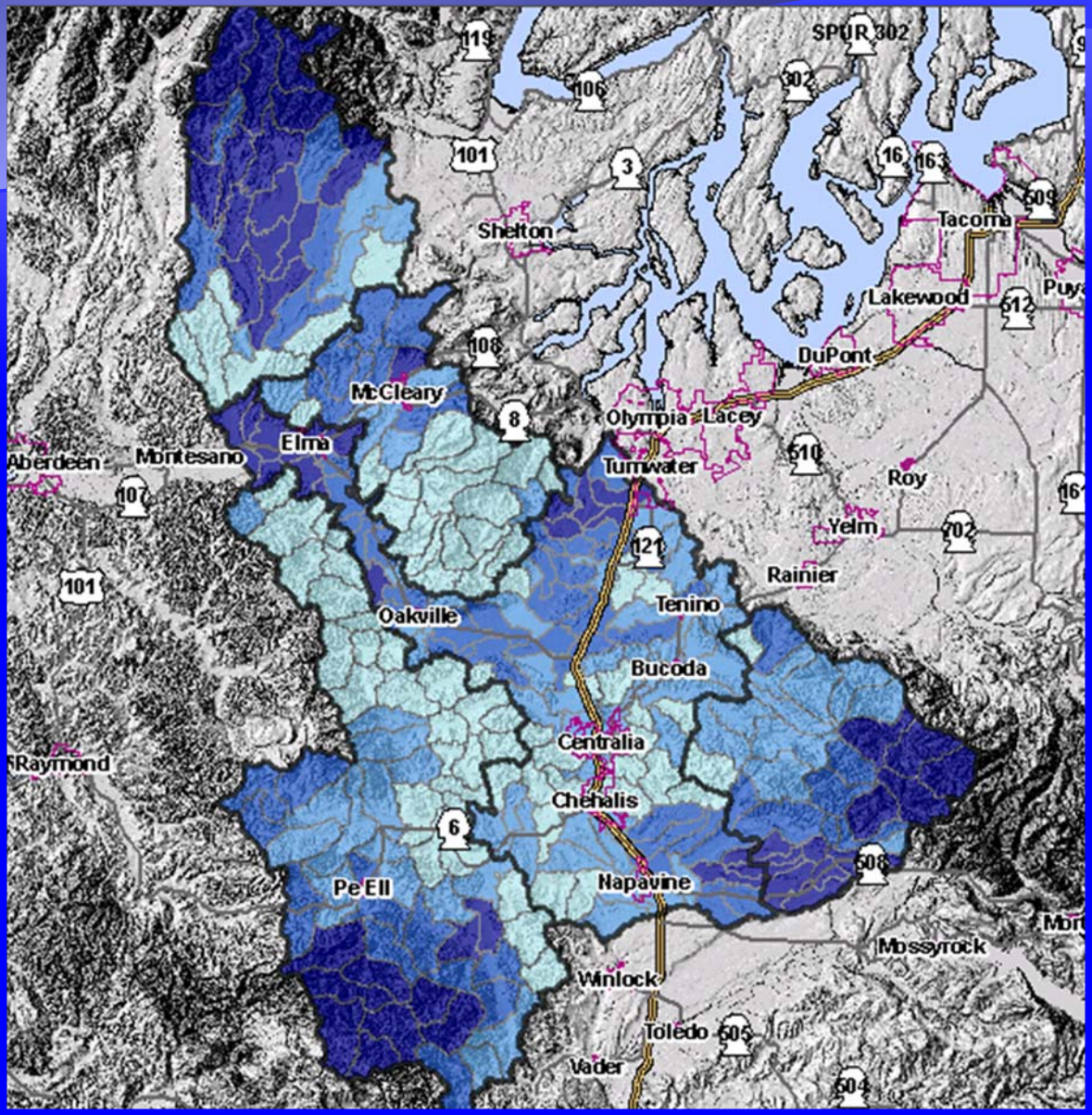
Results of Importance of Delivery



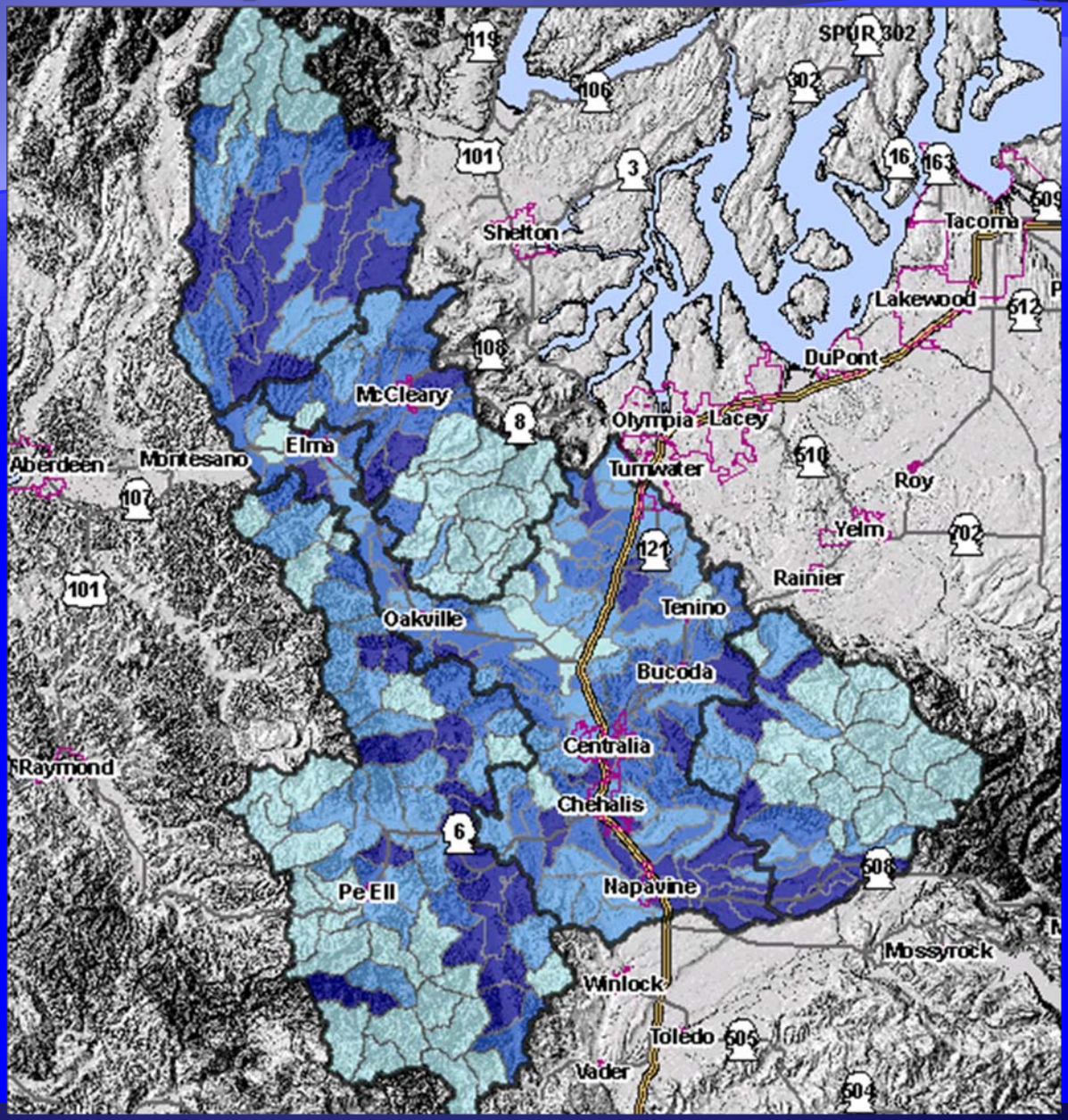
Results of Importance of Storage



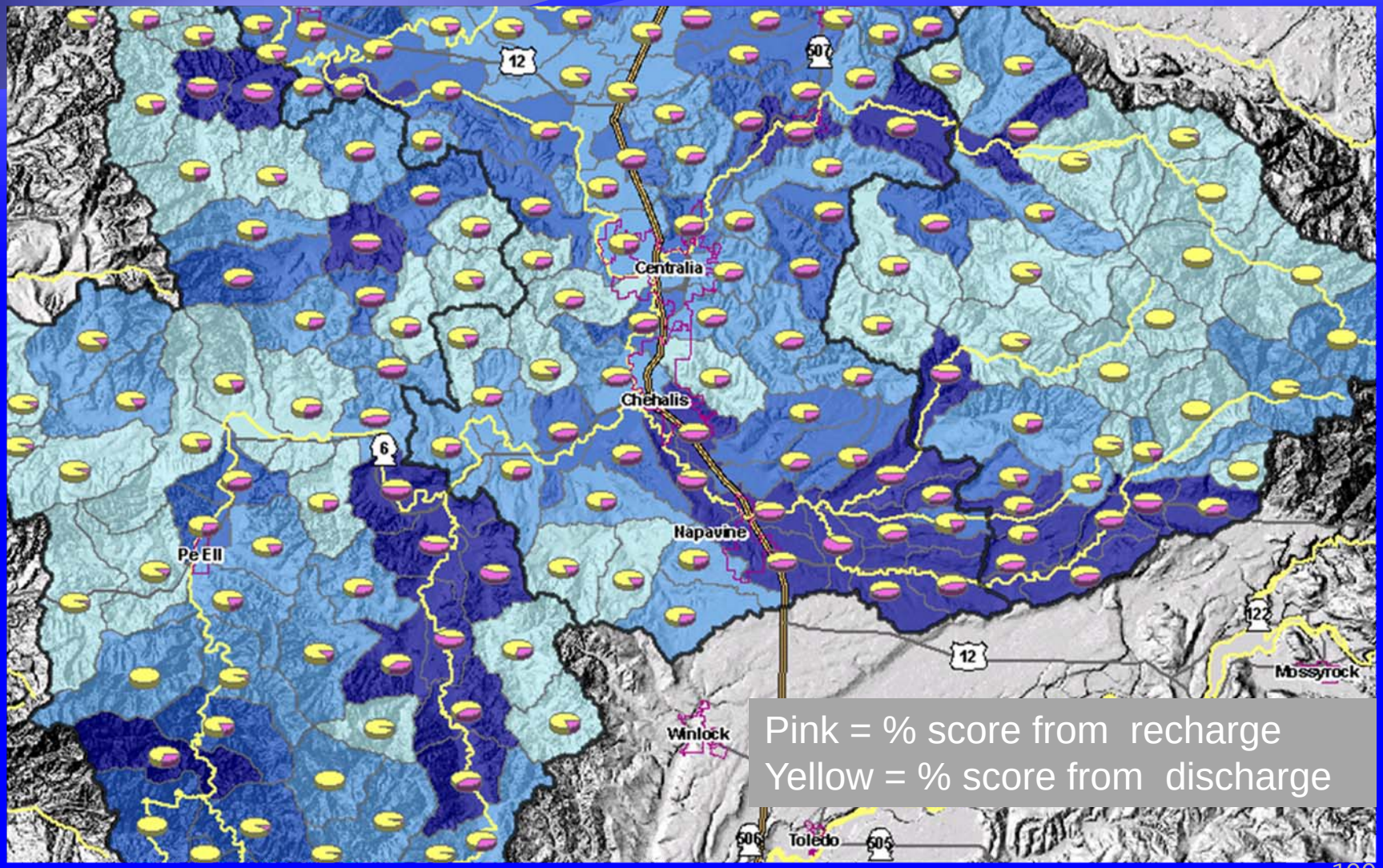
Results of Importance of Recharge



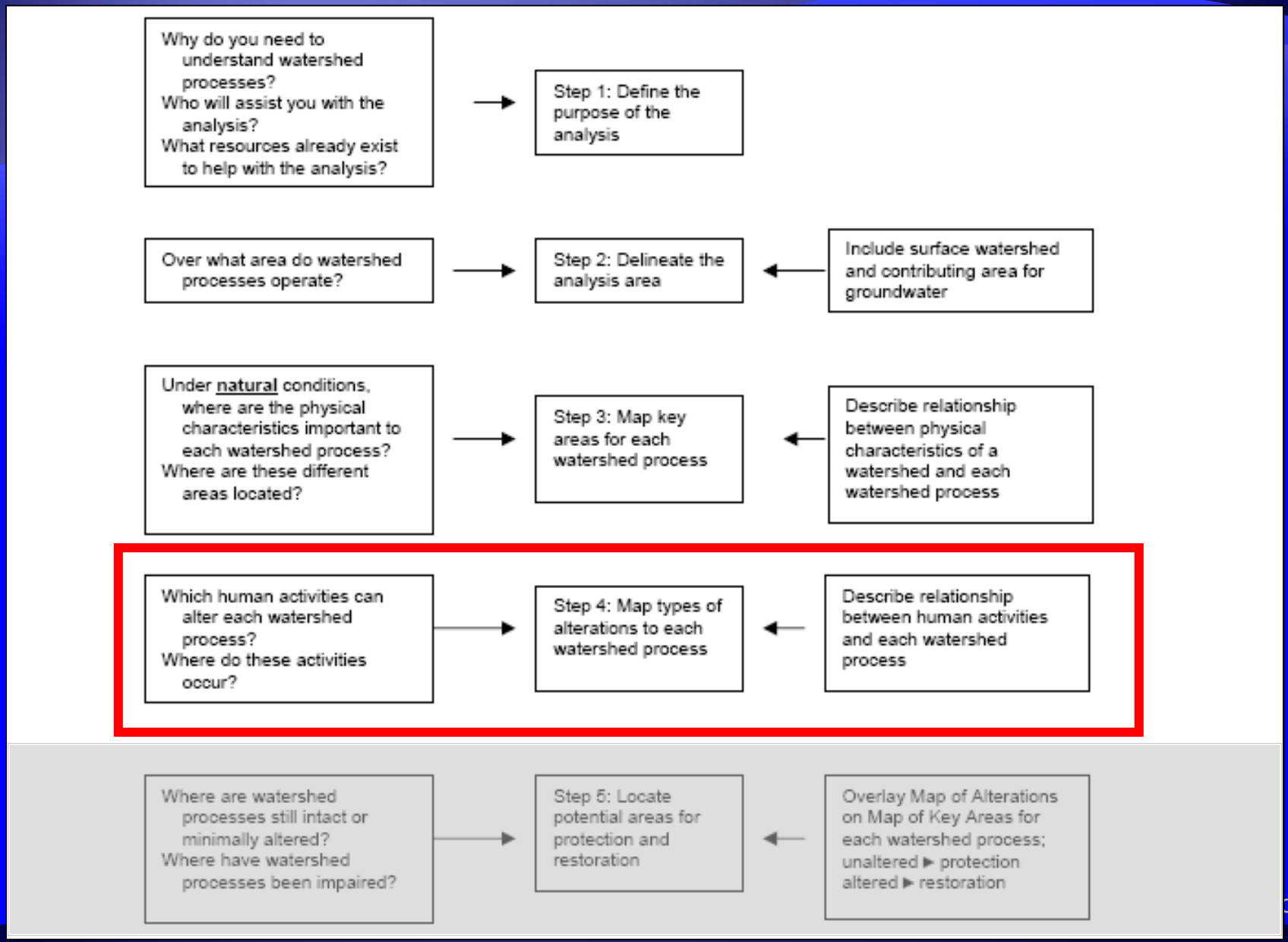
Results of Importance of Discharge



Results of Importance of Recharge and Discharge (overall results for groundwater)



Step 4 – Identify and Map Impairments



Assessment of Water Processes
Model 2: Impairment

Impairments to Water Process =

Delivery + **Movement** + **Loss**

Timing + **Overland Flow, Surface Storage** + **Recharge, Subsurface Flow, Storage & Discharge** + **Evapo-transpiration**

HI-1 – Forest Loss

HI-2 – Impervious cover

Depressional Wetland Loss

HI-3 – Urban

HI-4 – Rural

Floodplain Loss

HI-5 – Unconfined

HI-6 – Moderately confined

Recharge

HI-7 – Impervious Cover

Lateral Flow

HI-8 – Road density

Discharge – Wells, Floodplain, & Slope Wetland Loss

HI-9 – Well density

HI-10 /11 – High perm floodplain in urban/rural

HI-12/13 – Slope wetland in urban/rural

HI-14 – Impervious cover

HI-1 Highest Sum + C_{H1} *HI-2 + HI-3 + HI-4 + HI-5 + HI-6 Highest Sum Above* + C_{H2} *HI- 7+ HI-8 + HI-9 + HI-10 + HI-11 + HI-12 + HI-13 Highest Sum Above* + *HI-14 Highest Sum*

Max Score = 1 | Max Score = 1 | Max Score = 1 | Max Score = 1

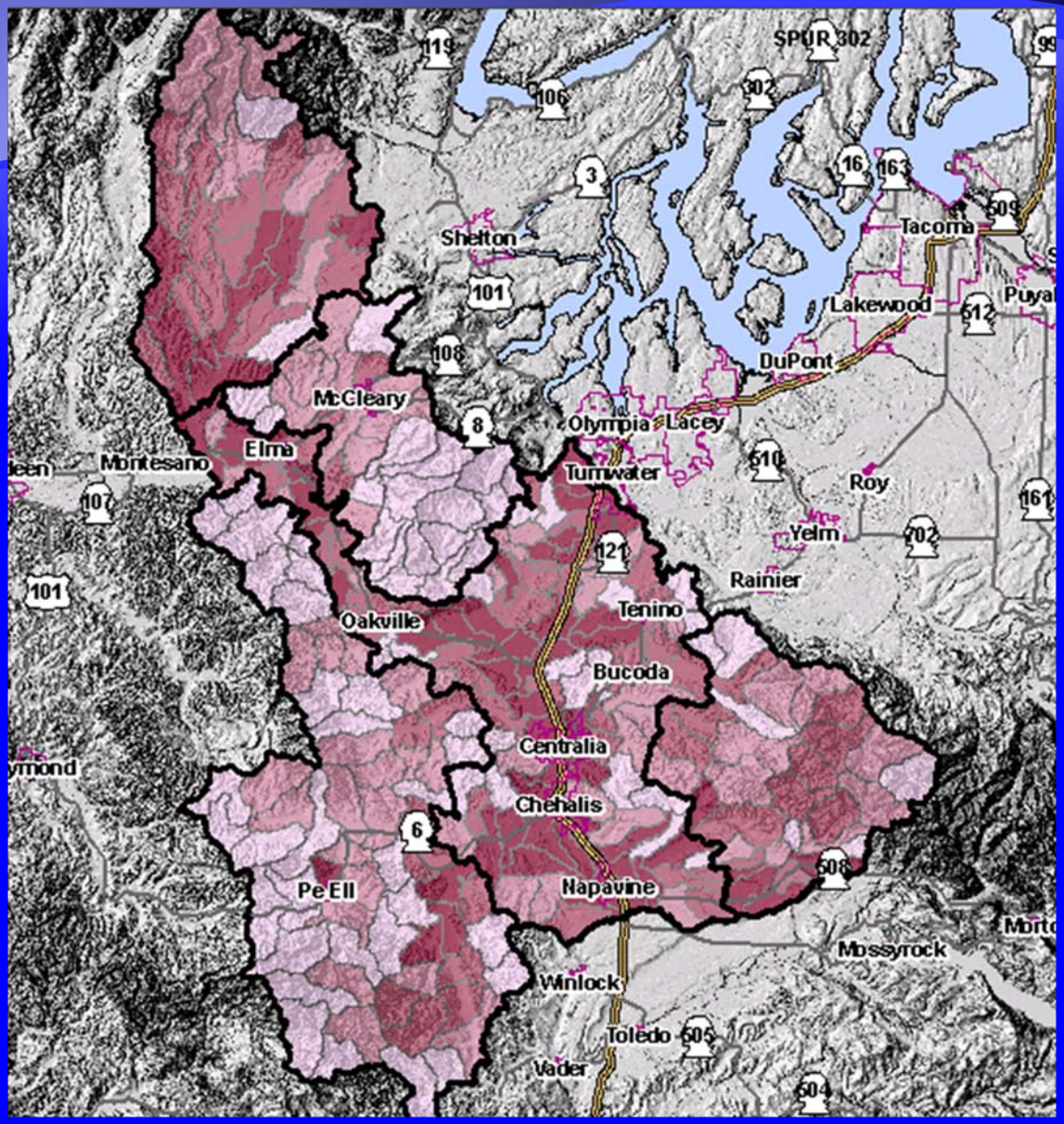
Model 2

Example of Scoring for Impairment Surface Water Variables

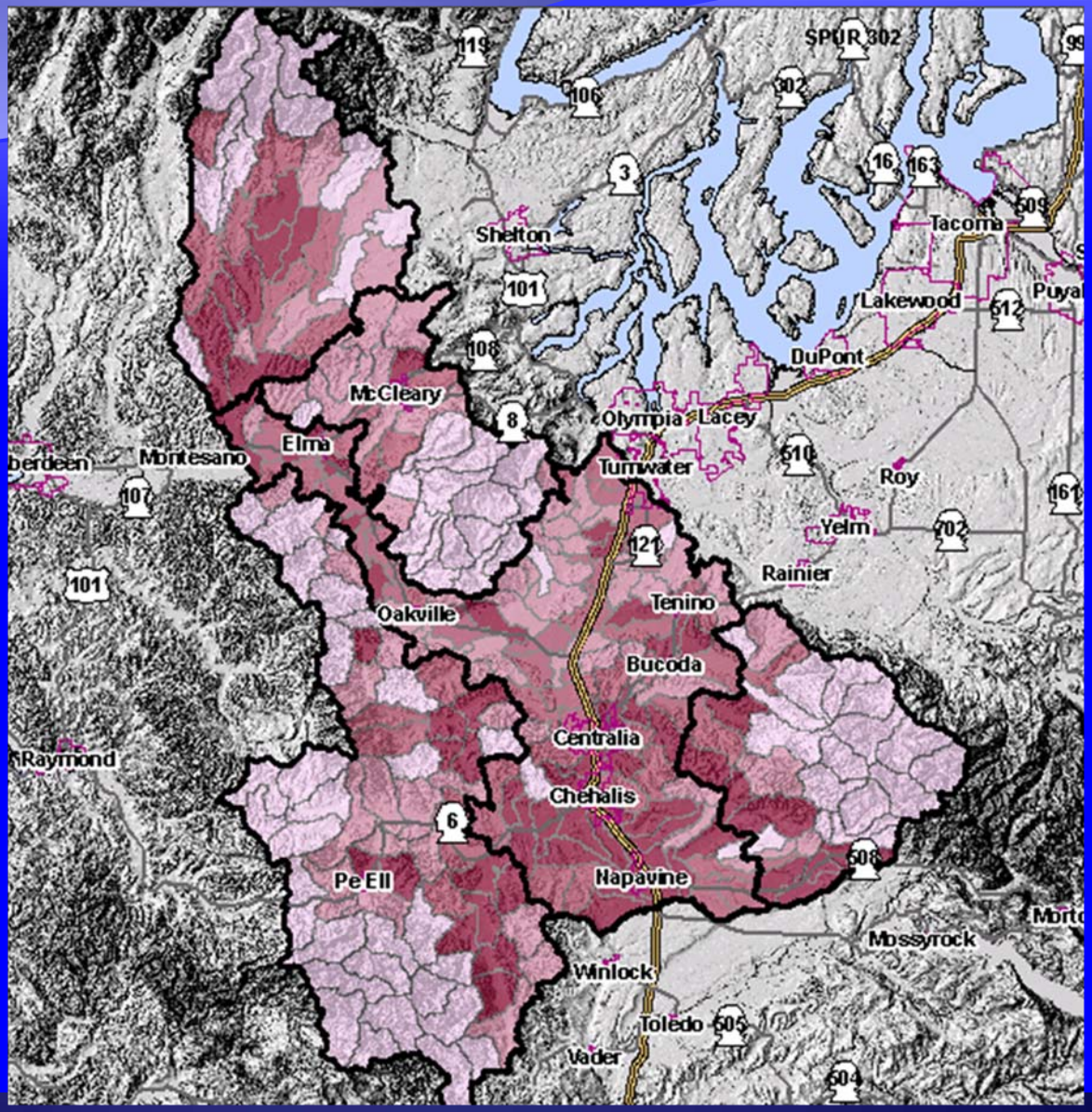
$$\frac{\text{Area of Rural Wetlands}}{\text{Area of Sub-basin}} \times 2 = \text{Score}$$

$$\frac{\text{Area of Urban Wetlands}}{\text{Area of Sub-basin}} \times 3 = \text{Score}$$

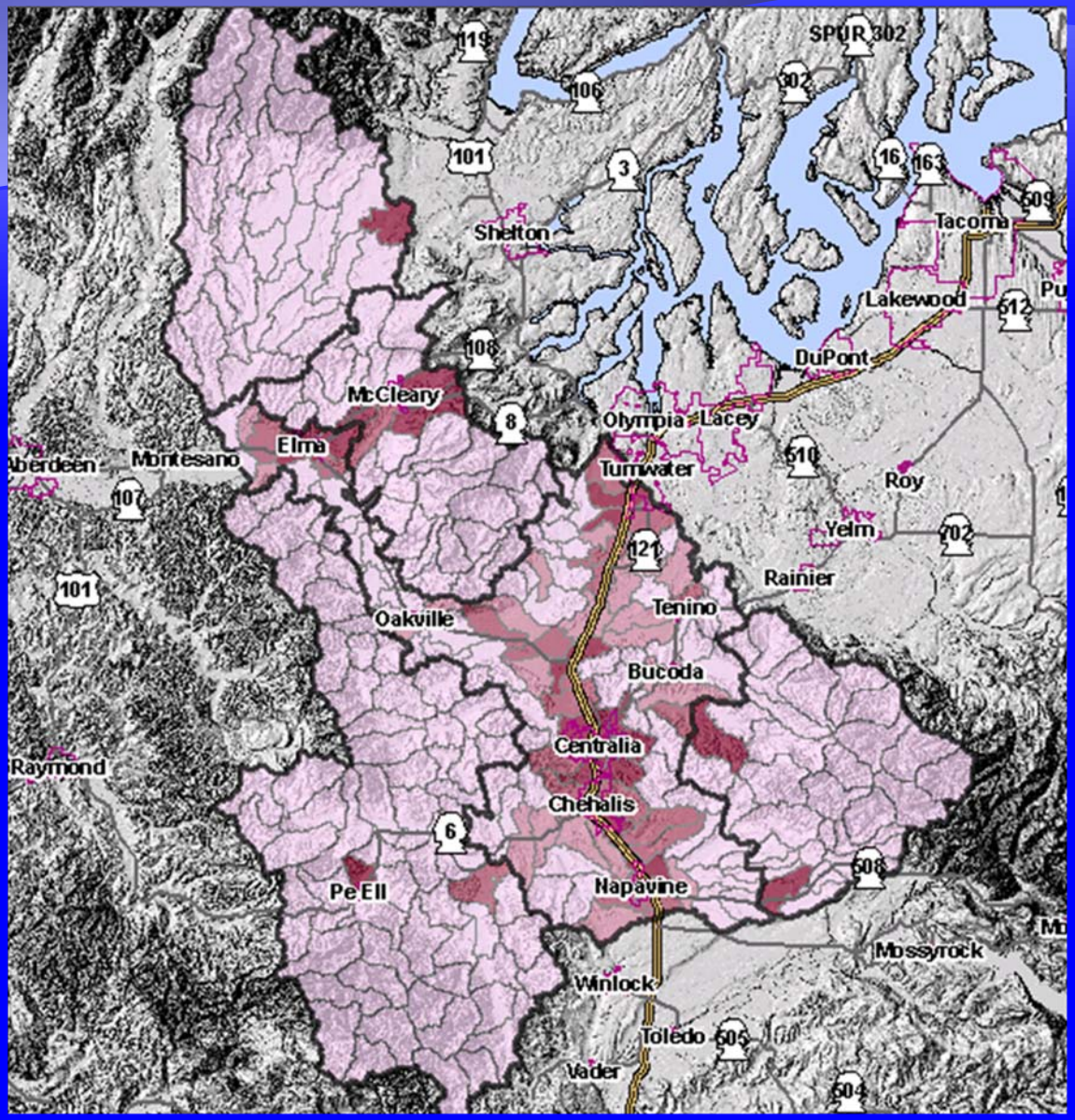
Results of Impairments to Delivery – Forest Loss



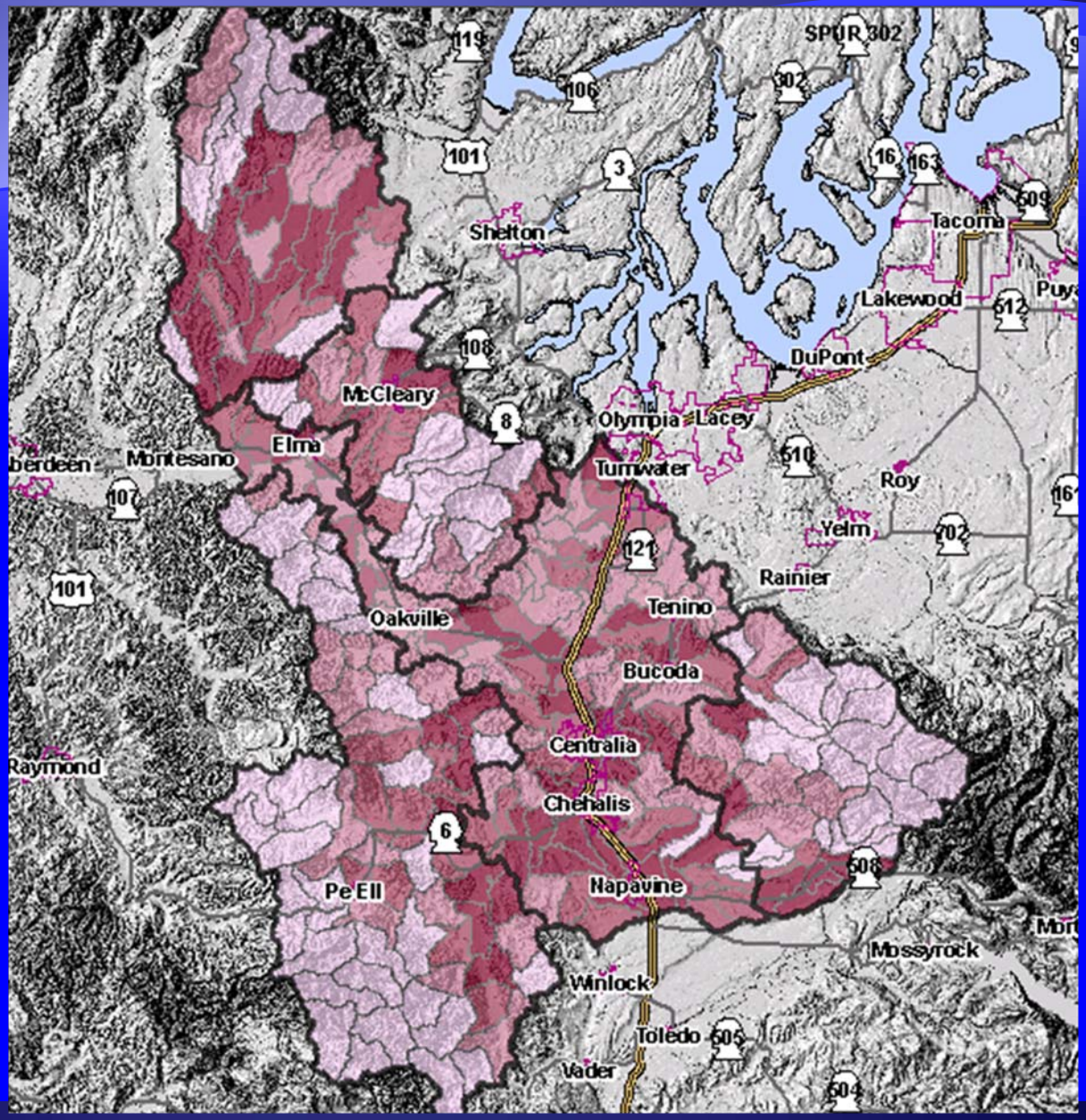
Results of Impairments to Surface Storage



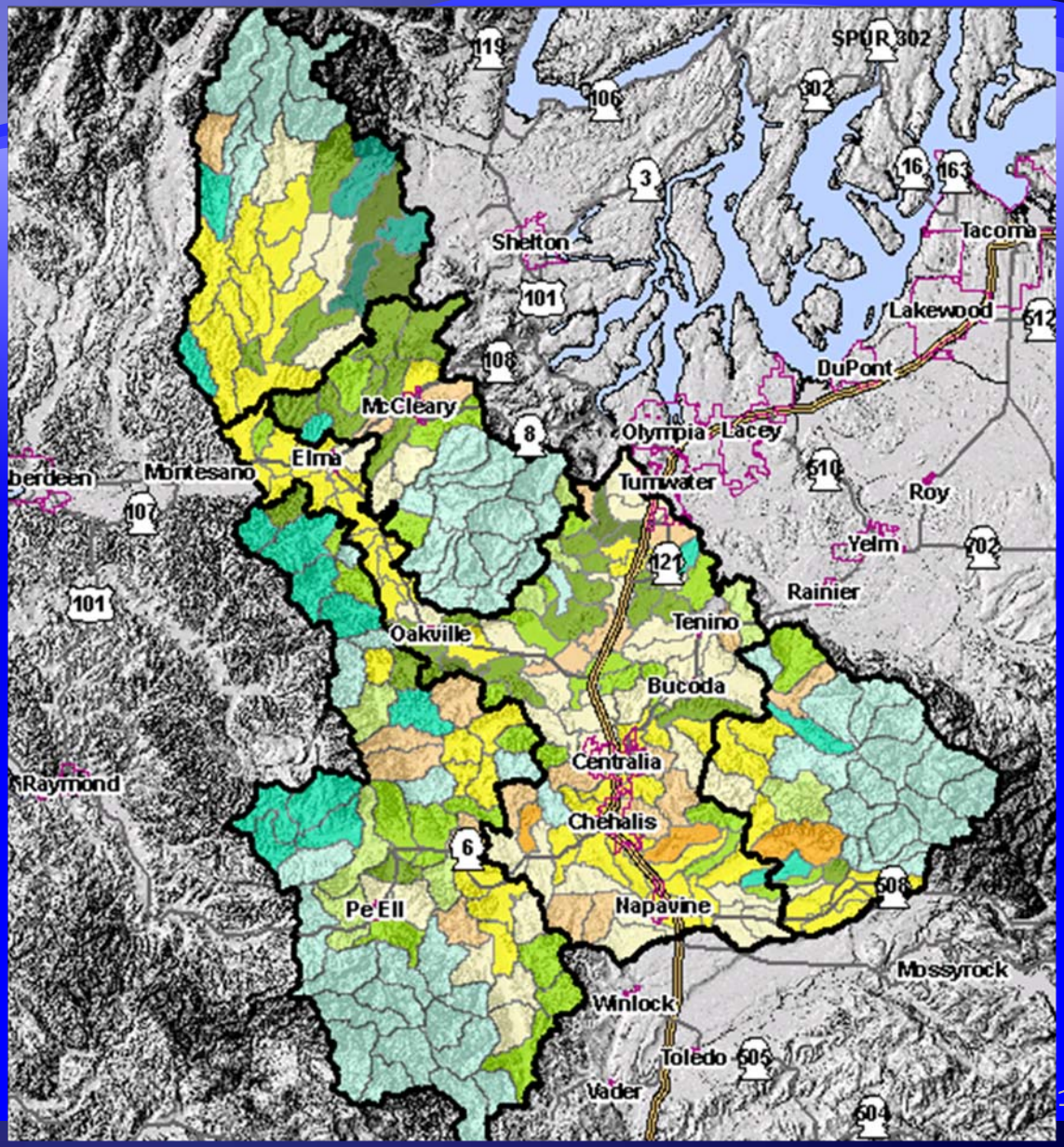
Results of Impairments to Recharge



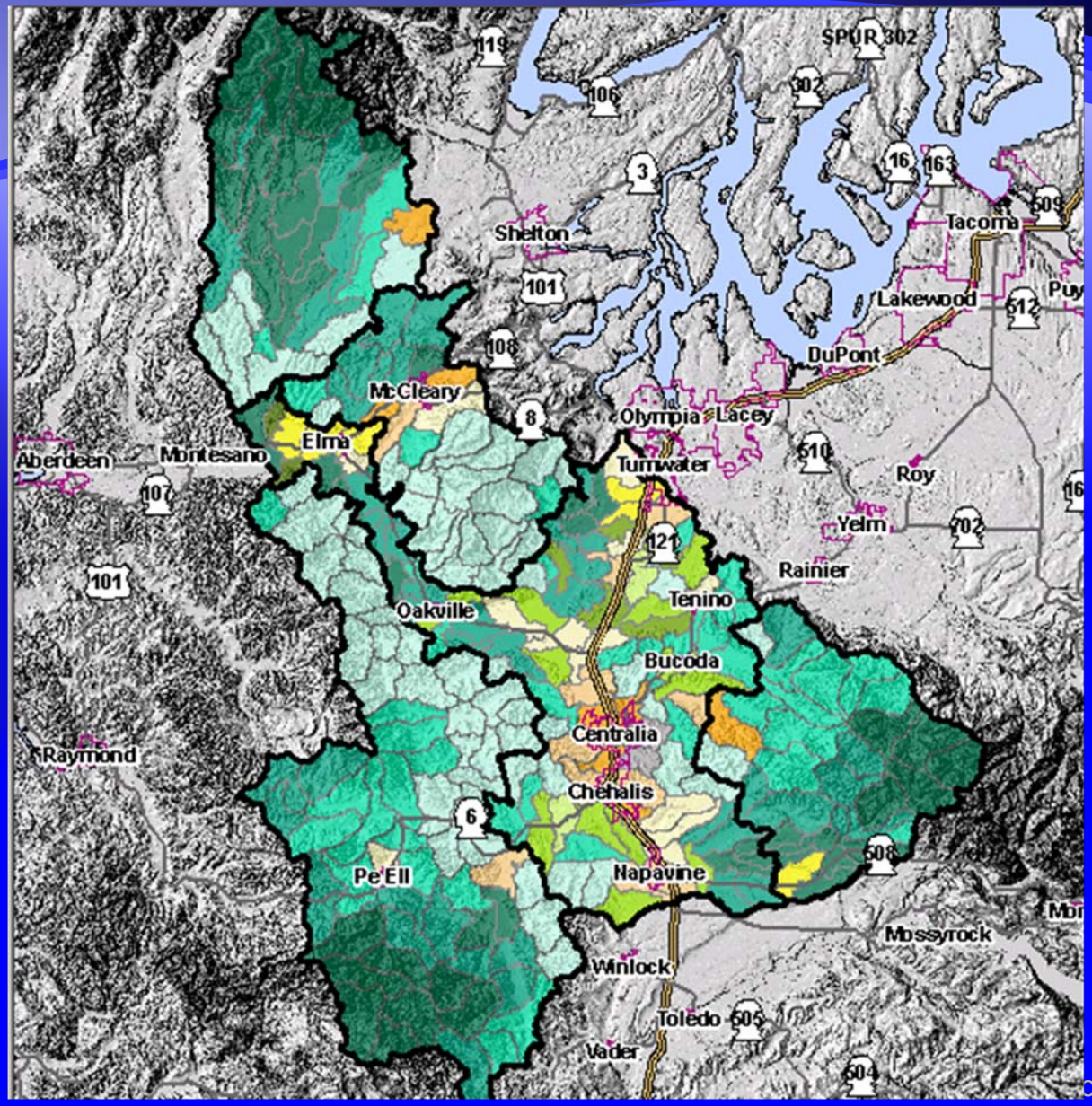
Results of Impairments to Discharge



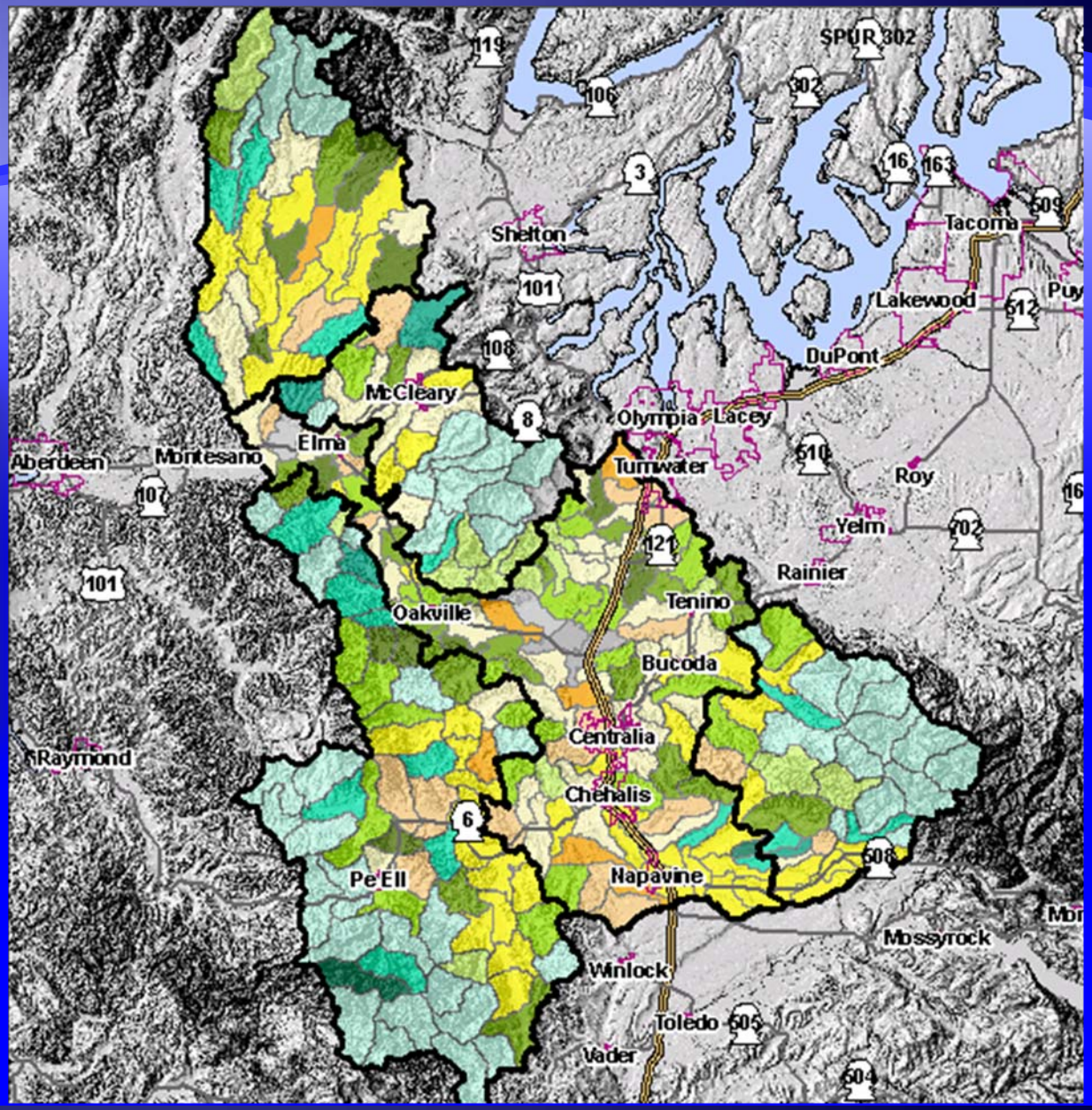
STEP 5 LOCATE AREAS FOR PROTECTION AND RESTORATION – STORAGE



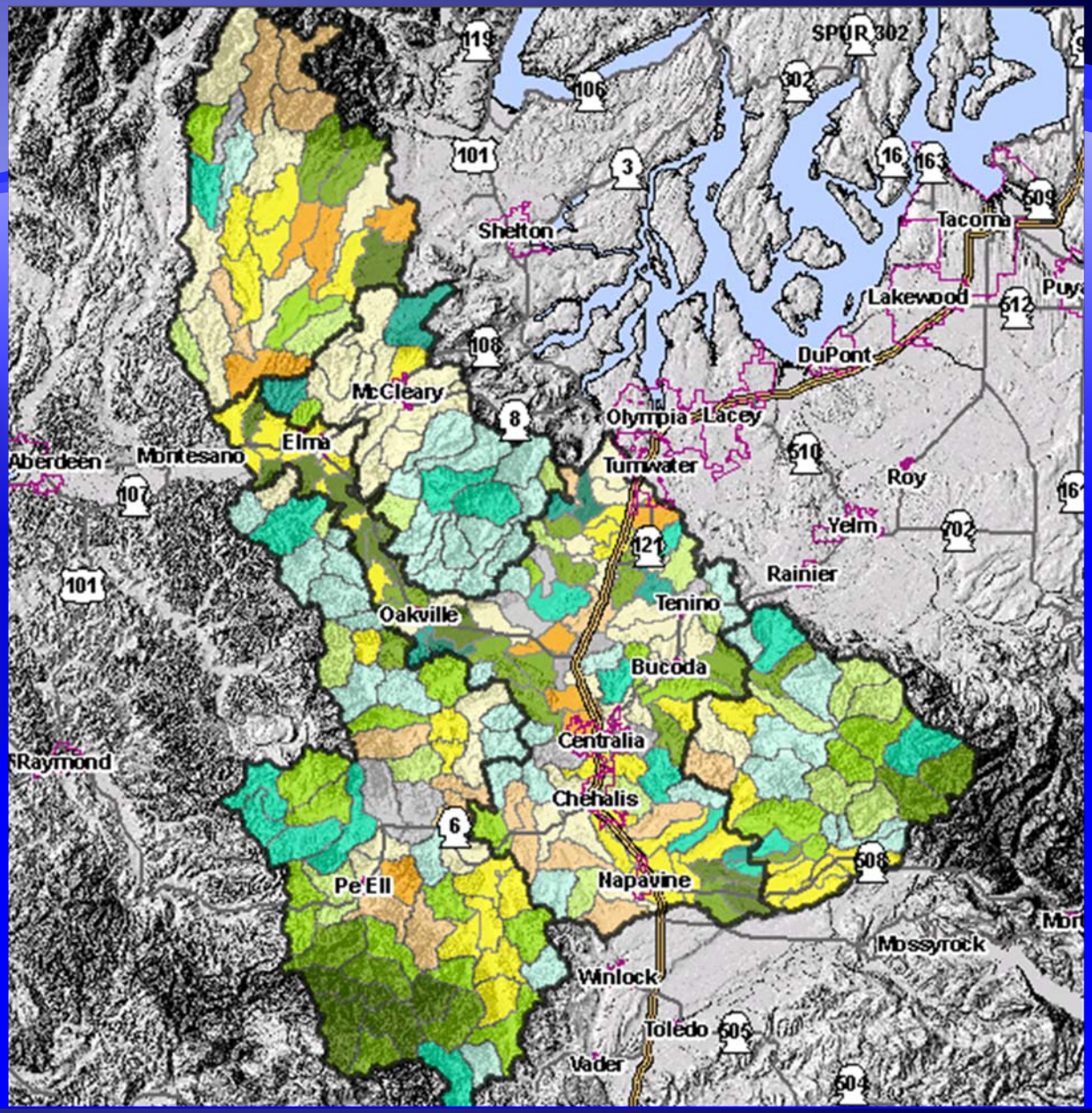
LOCATE AREAS FOR PROTECTION AND RESTORATION – RECHARGE



LOCATE AREAS FOR PROTECTION AND RESTORATION – DISCHARGE



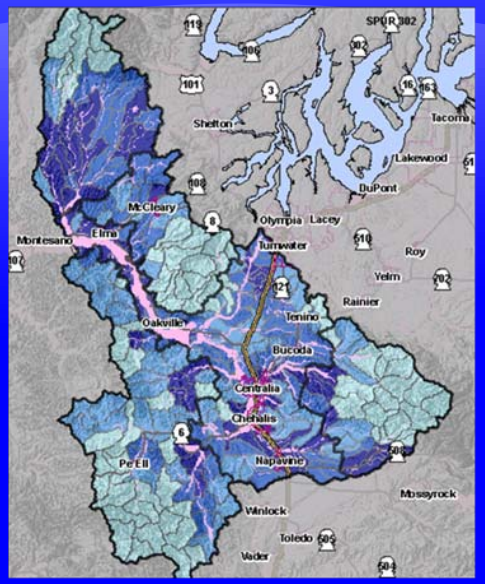
LOCATE AREAS FOR PROTECTION AND RESTORATION – OVERALL



Legend

- Protection 1
- Protection 2
- Protection 3
- Conservation 1
- Restoration 1
- Restoration 2
- Restoration 3
- Limited Impact to Processes
- Protection / Restoration 1
- Protection / Restoration 2
- Protection / Restoration 3
- Conservation 2

Step 5 – Synthesis: Locate Areas for Protection and Restoration: Based on Watershed Issue - Lowland Flooding and Erosion



Watershed Issue		Process Component & Landscape Group	Process Component & Landscape Group	Impairment	Actions
Lowland Flooding: Rain-on-Snow events		Delivery in Mountainous Group	Storage in Lowland Group		
	Look for:	Analysis Units ranking high for delivery + greatest area of "rain-on-snow" and "snow dominated" zones.	Analysis units ranking high for storage in upper and mid portions of watershed and located downstream of delivery areas in column 2.	High impairment for delivery areas and low for storage areas	Protect floodplain and depression areas in upper/mid watershed and restore forested cover in mountainous group.
				High impairment for storage and low for delivery areas	Restore depressional and wetland storage in upper/mid watershed. See .

Step 5 – Synthesis: Locate Areas for Protection and Restoration: Based on Watershed Issue - Lowland Flooding and Erosion

Watershed Issue		Process Component & Landscape Group
Lowland Flooding: Rain-on-Snow events		Delivery in Mountainous Group
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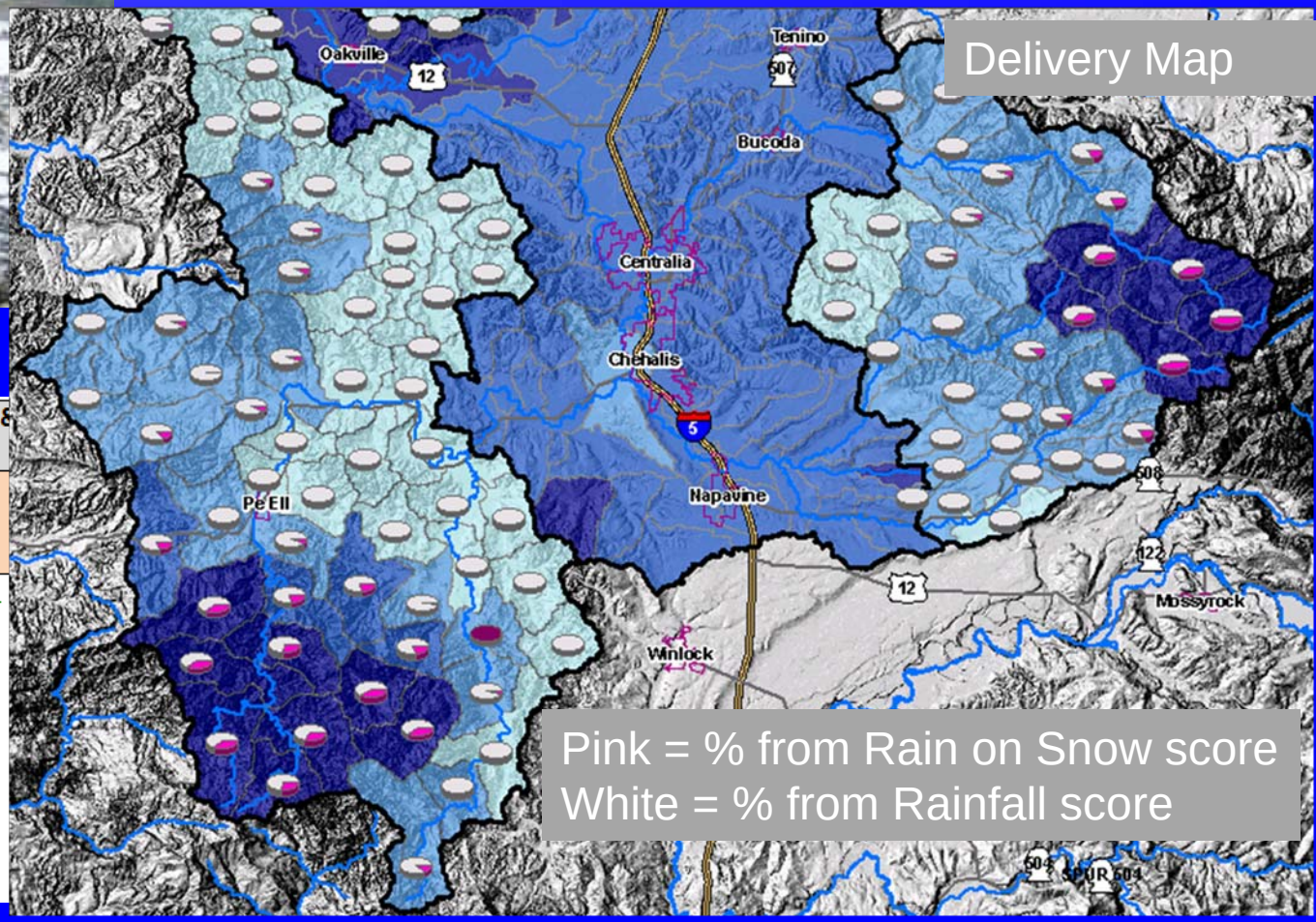
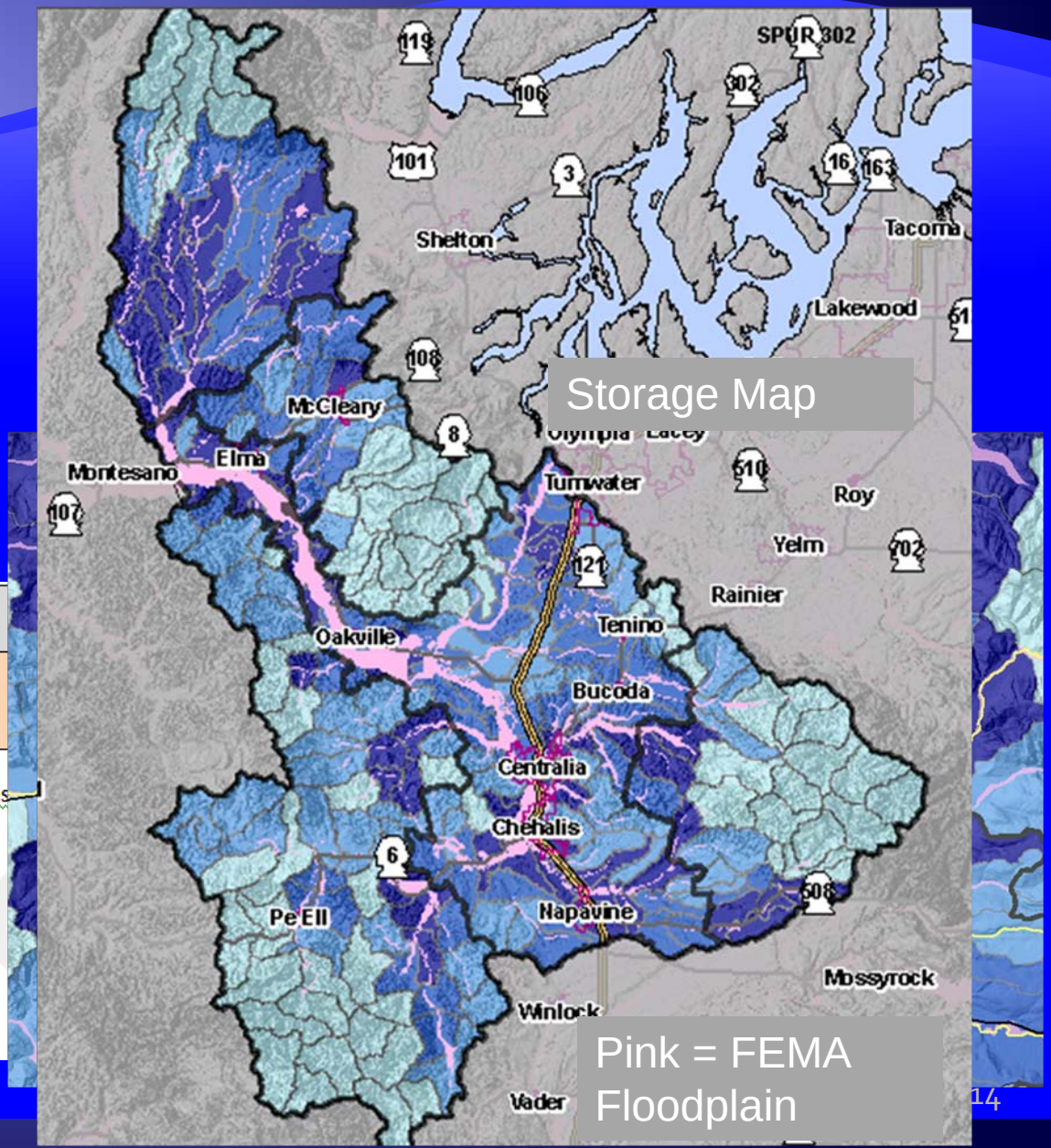
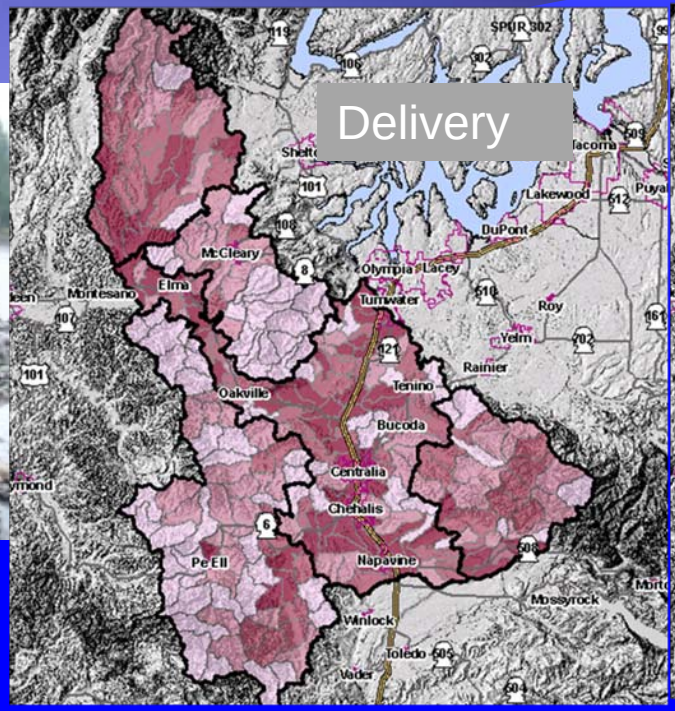


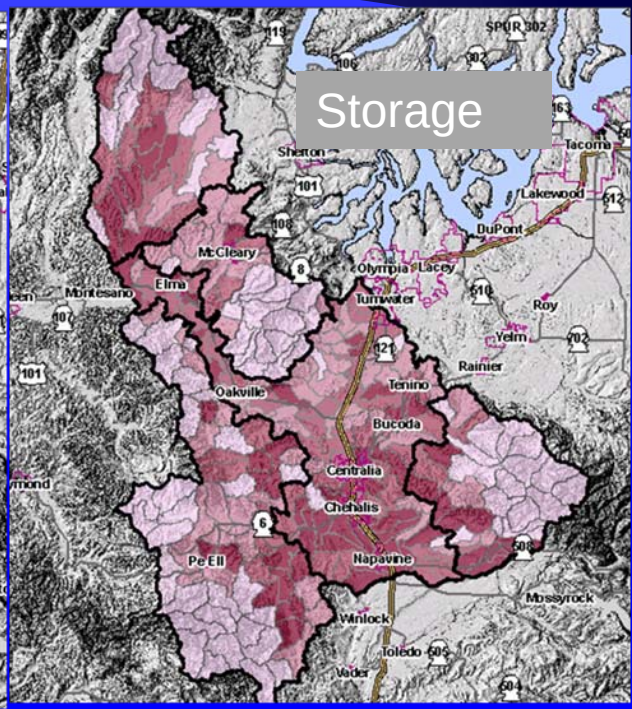
Step 5 – Synthesis: Locate Areas for Protection and Restoration: Based on Watershed Issue - Lowland Flooding and Erosion

	Process Component & Landscape Group	Process Component & Landscape Group
- ts	Delivery in Mountainous Group	Storage in Lowland Group
ok r:	Analysis Units ranking high for delivery + greatest area of "rain-on-snow" and "snow dominated" zones.	Analysis units ranking high for storage in upper and mid portions of watershed and located downstream of delivery areas in column 2.



Step 5 – Synthesis: Locate Areas for Protection and Restoration: Based on Watershed Issue - Lowland Flooding and Erosion





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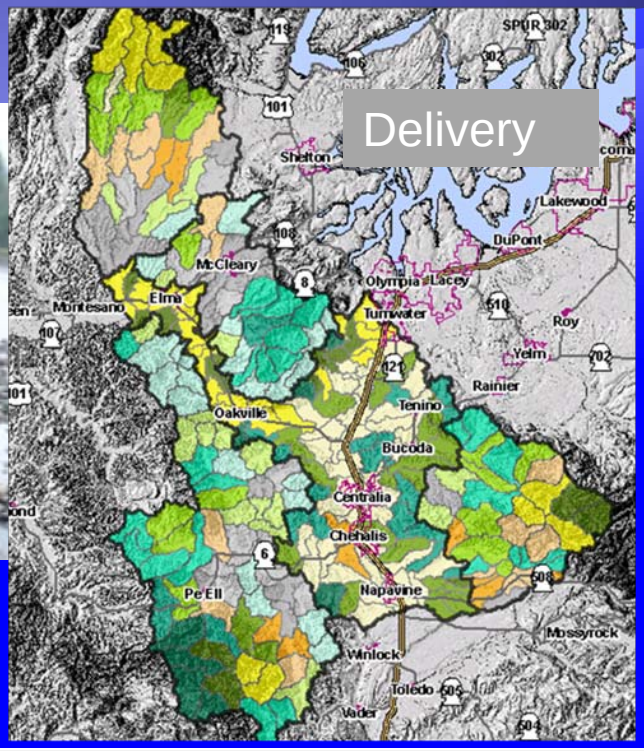
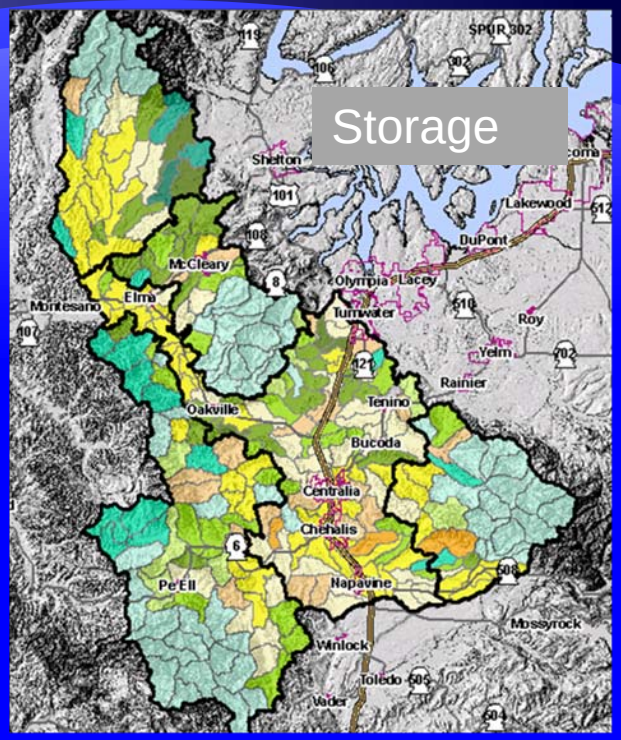
Step 5 – Synthesis: Management Recommendations ?





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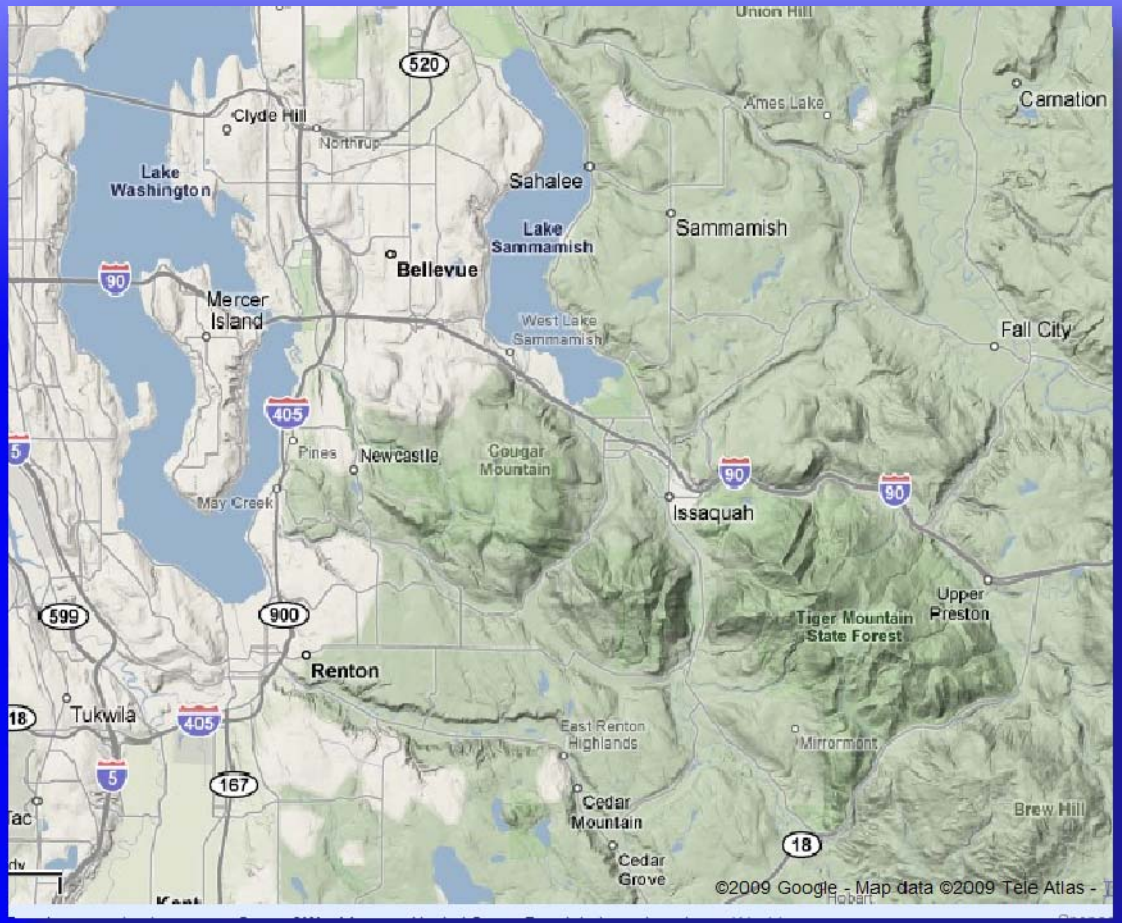
INTRODUCTION TO MODELS

APPLYING THE MODEL RESULTS TO PLANNING & PERMITTING IN ISSAQUAH CREEK WATERSHED



Characterizing the Watershed

King County Developed Basin Plans in 1990

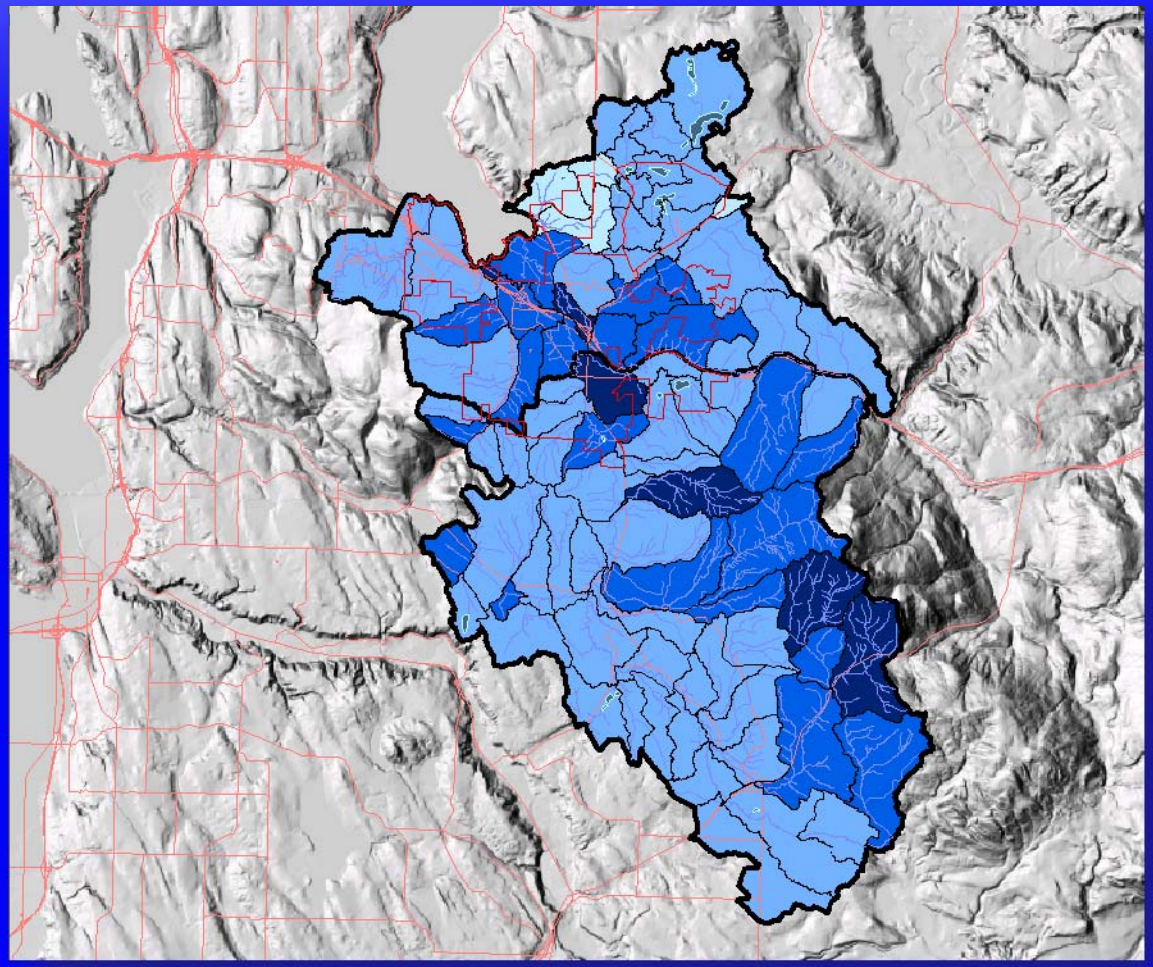
- Goal was to address surface water problems at multiple scales (broad, mid and fine)
- Centered on pragmatic solutions to address underlying causes at the watershed scale
  - Altered hydrology, hydraulics and sediment supply

Recent SMP Characterization (Stanley et al 2005)

- Rating of important areas for water flow process
- Rating of degree of impairment across the watershed

SMP Characterization

Important Areas for Hydrologic Processes

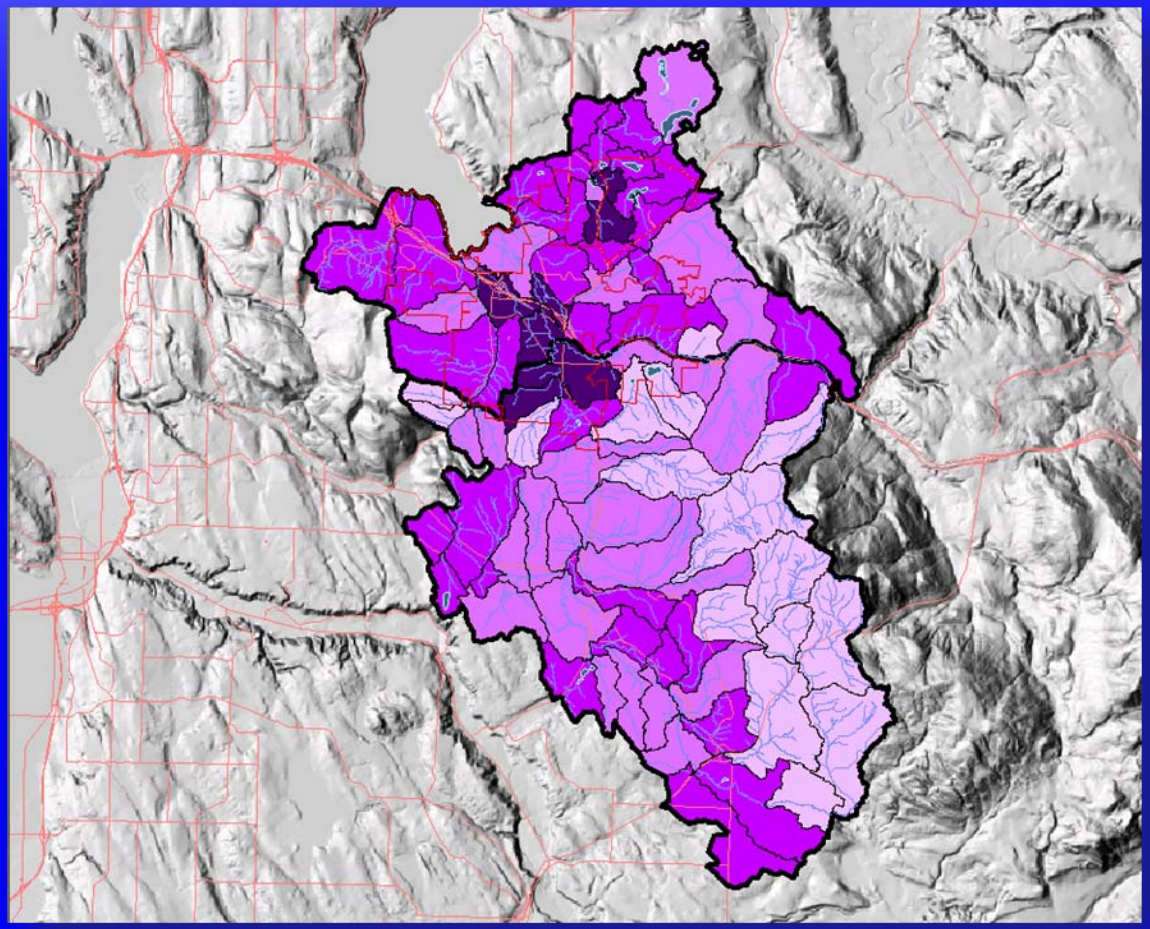


Characterize Watershed Processes

Identify important areas for watershed processes, level of impairment & best areas for protection, restoration & development

SMP Characterization

Level of Impairment

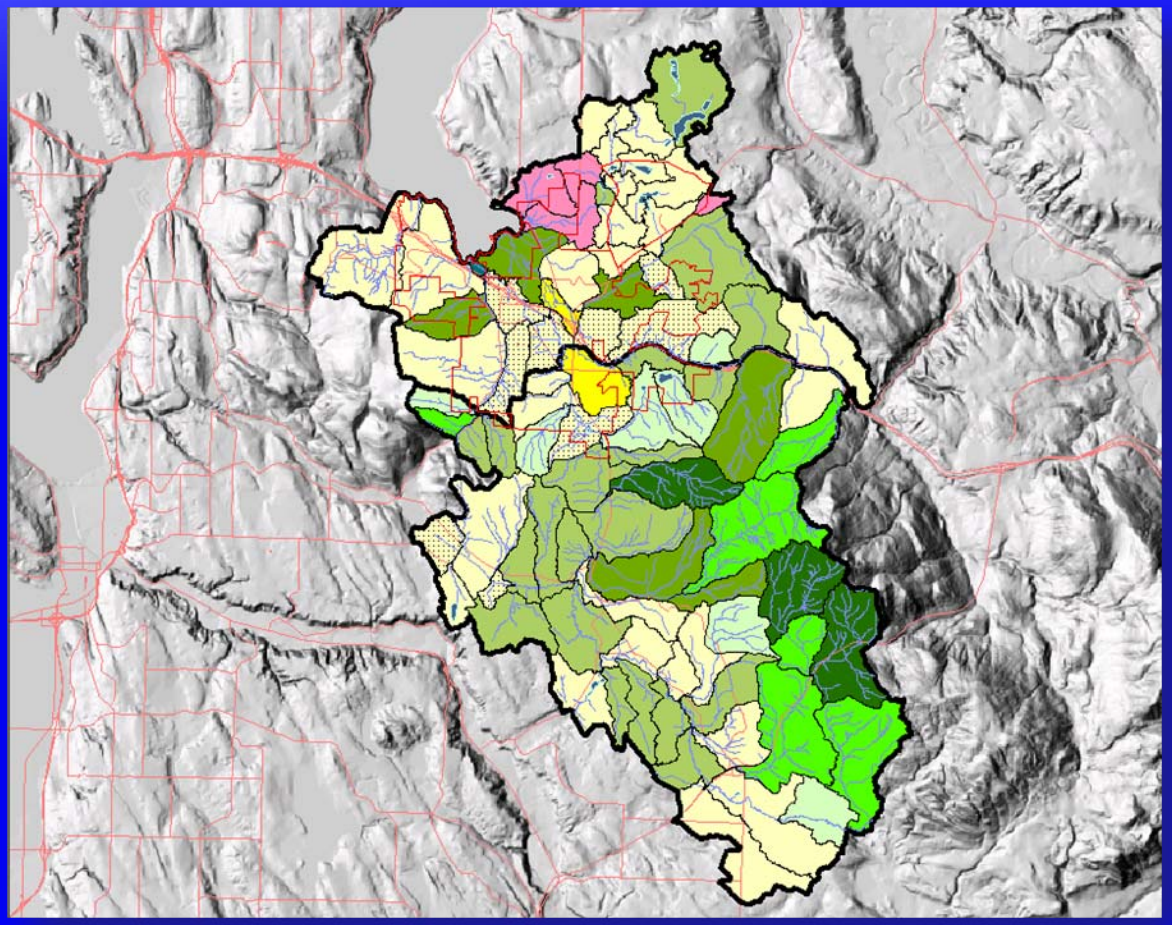


Characterize Watershed Processes

Identify important areas for watershed processes, level of impairment & best areas for protection, restoration & development

Prescribe Solutions –

Potential Areas for Protection and Restoration

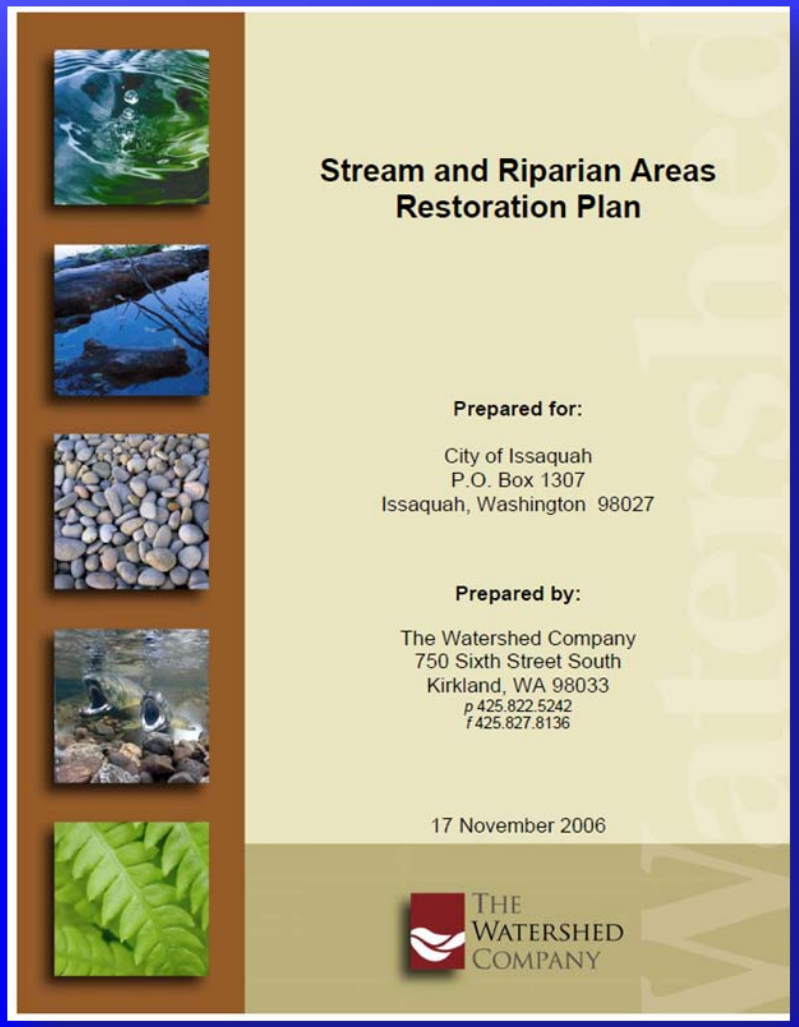


Prescribe Solutions

Identify solutions to reduce human impacts and improve ecosystem benefits

Take Action –

- Restoration of Watershed – City Developed a Restoration Plan as part of SMP



Stream and Riparian Areas Restoration Plan

Prepared for:

City of Issaquah
P.O. Box 1307
Issaquah, Washington 98027

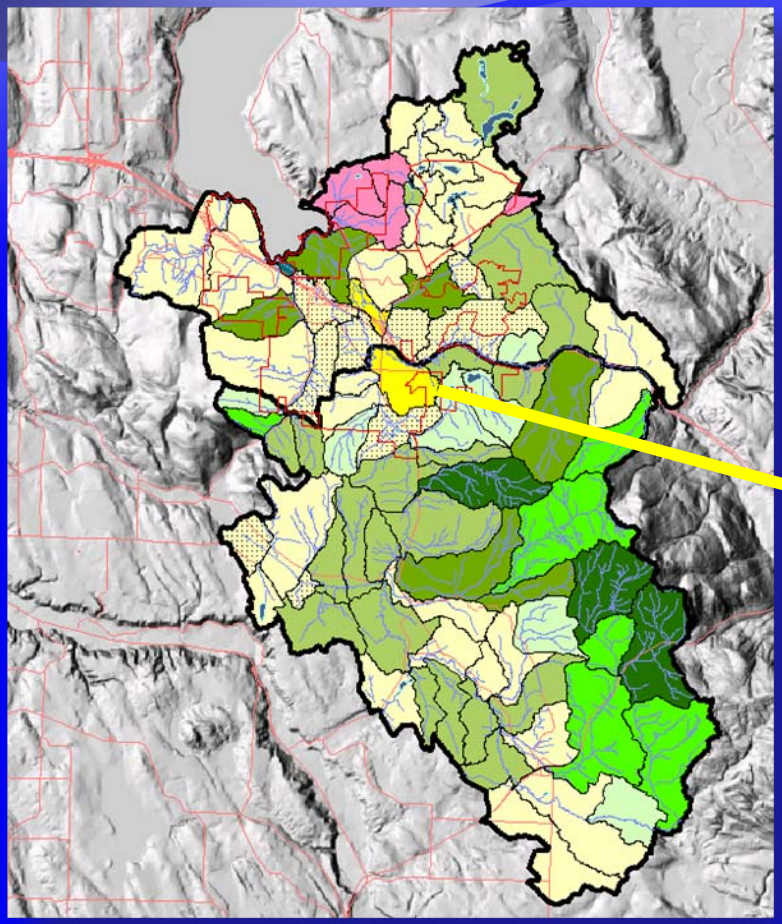
Prepared by:

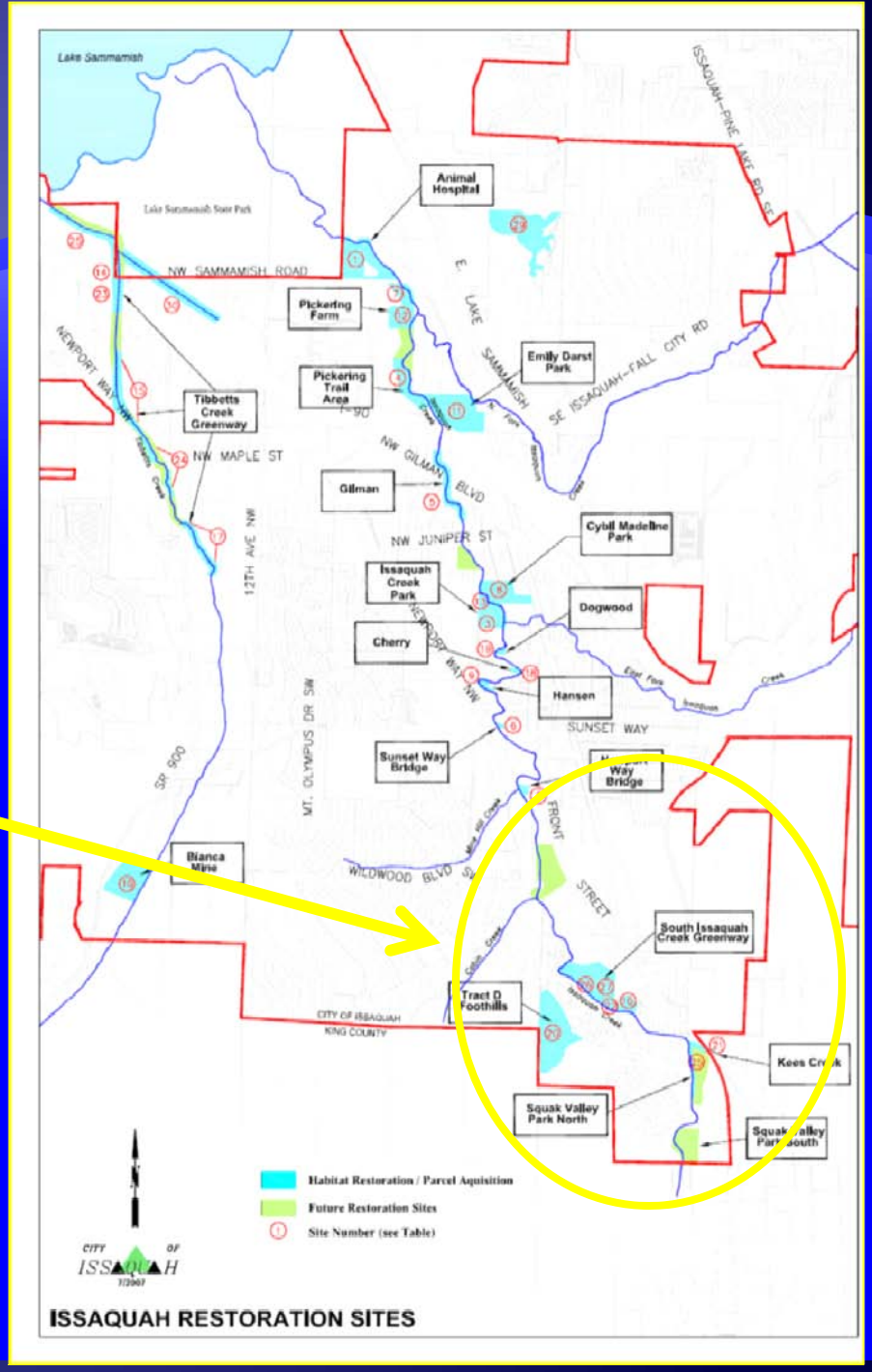
The Watershed Company
750 Sixth Street South
Kirkland, WA 98033
p 425.822.5242
f 425.827.8136

17 November 2006

THE WATERSHED COMPANY

Prioritize Using Characterization





South Issaquah Creek Greenway

Why this Worked

- Planning of the right elements at the right time:
  - Problems had compatible solutions (flooding and habitat need)
  - Solutions had a value for both people and aquatic resources
- Cooperation between County, City, and Non-Profit Groups
- Long term involvement by key individuals from agencies and non-profit groups

INTRODUCTION TO MODELS

APPLYING THE MODEL RESULTS TO PLANNING & PERMITTING IN BIRCH BAY

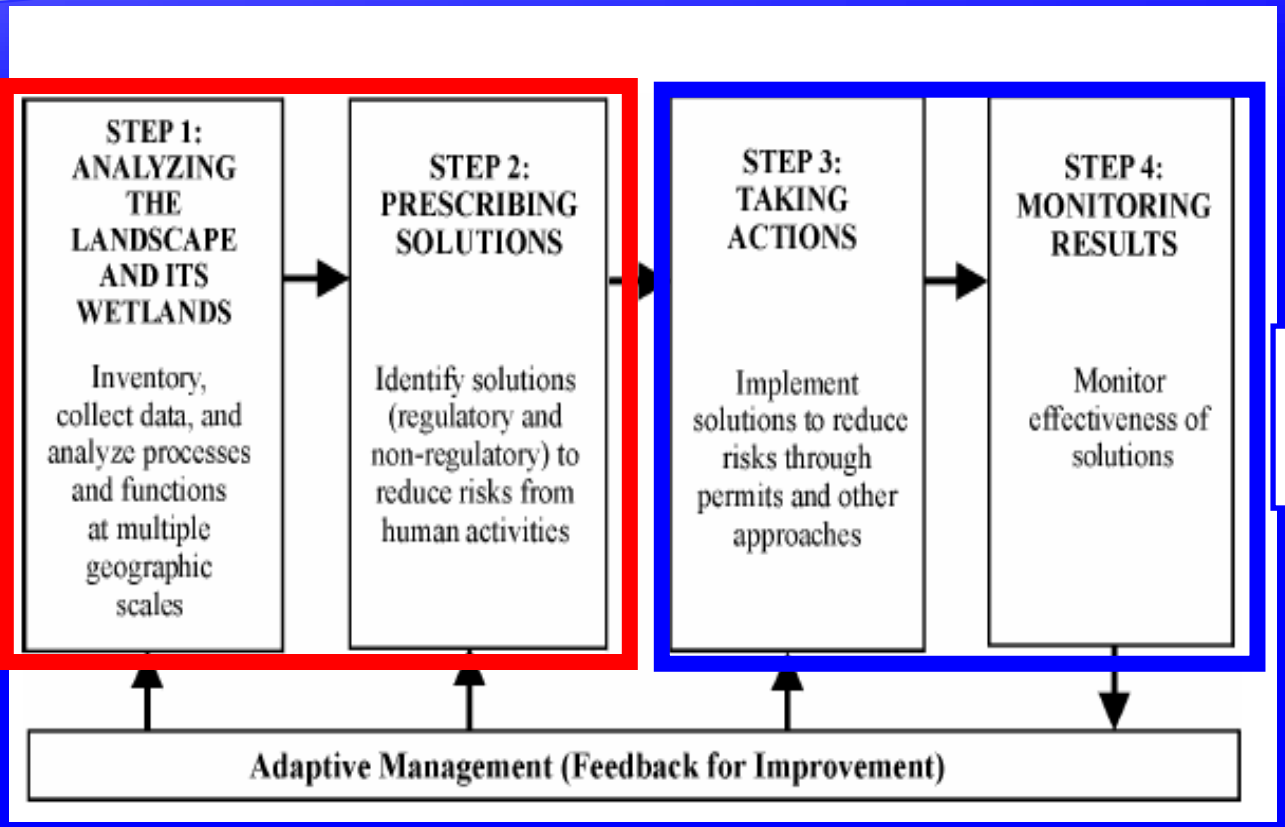
A Watershed Based Management Plan for Birch Bay

A Coordinated Approach

- Whatcom County
- Local Citizen Groups
- WA Dept of Fish & Wildlife
- WA Dept of Ecology
- WA Dept of Transportation
- WA Dept of Community Trade & Economic Development
- Puget Sound Partnership
- Environmental Protection Agency

Watershed Planning Process

Pilot Study (Analysis and Planning)



Future Implementation

Objectives of Watershed Plan

- Identify important ecosystem relationships within the Birch Bay watershed
  - Areas sensitive to changes from land use
  - Areas where protection and restoration can address current problems (reduce risk)

- Provides a framework for coordination of planning activities
  - Comprehensive Plan, Shoreline Management Plan and Critical Areas Ordinance update

Components of the Plan

Inventory of (Step 1)

- Environmental Problems (Risks)
- Wetlands
- Streams and Riparian areas

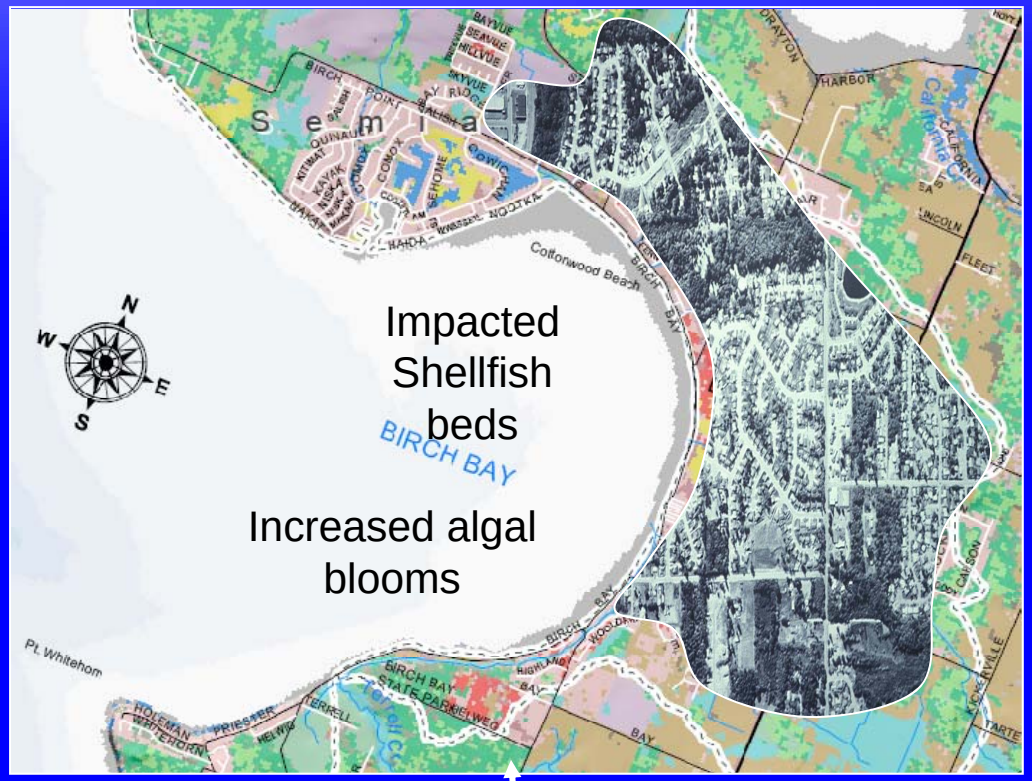
Analysis of (Step 1)

- Water quality and water flow processes
- Wildlife and habitat conditions
- Future development patterns

Synthesis to develop watershed solutions (Step 2)

Step 1 - Inventory of Environmental Problems or "Risks"

- Water quality in Birch Bay
  - Pathogens
  - Nutrients
- Large population increase
- Loss of habitat and wildlife
- Decreased "quality of life" for residents



Potential loss of heron rookery

Step 1 – Analysis

Identify at three scales (broad, mid, fine) in watershed:

- Areas important for maintaining watershed processes and wildlife
- How these important areas have been altered
- Areas for protection and restoration

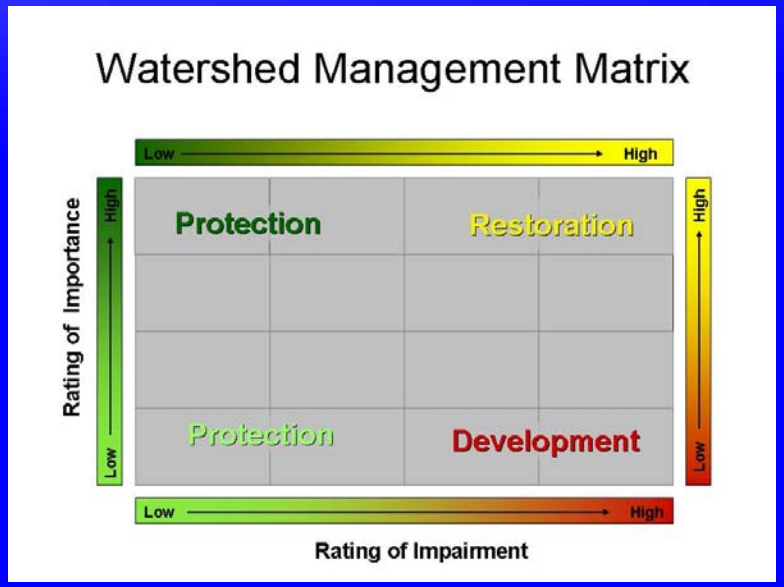
Characterization of Watershed Processes:

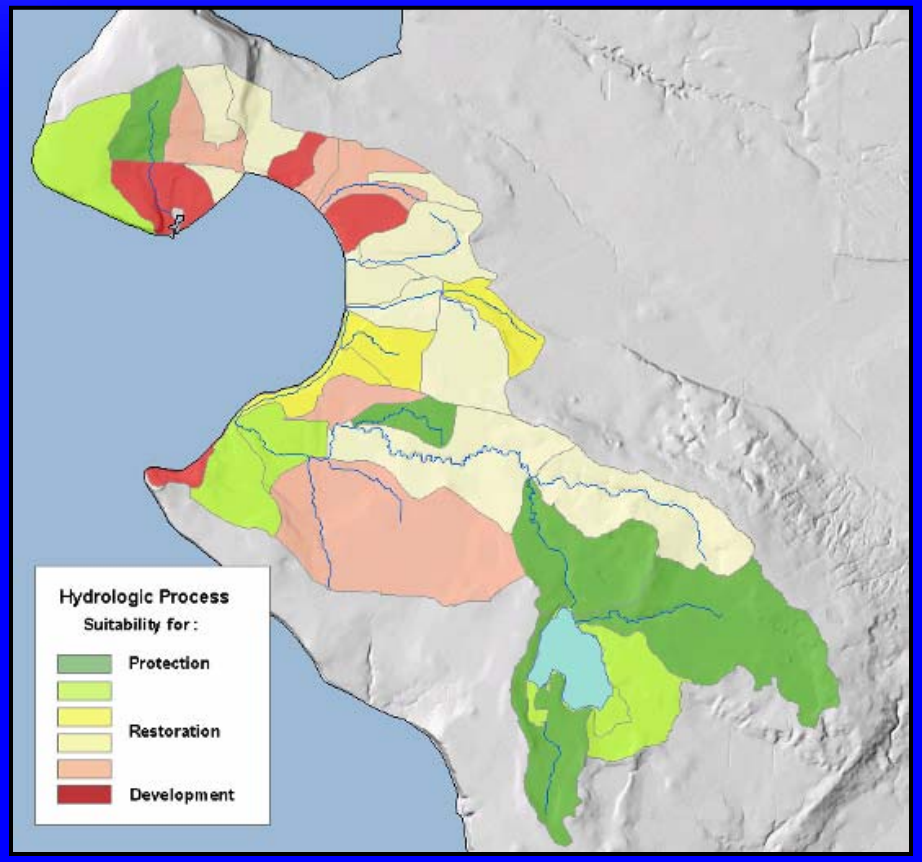
Water Flow

Nutrients

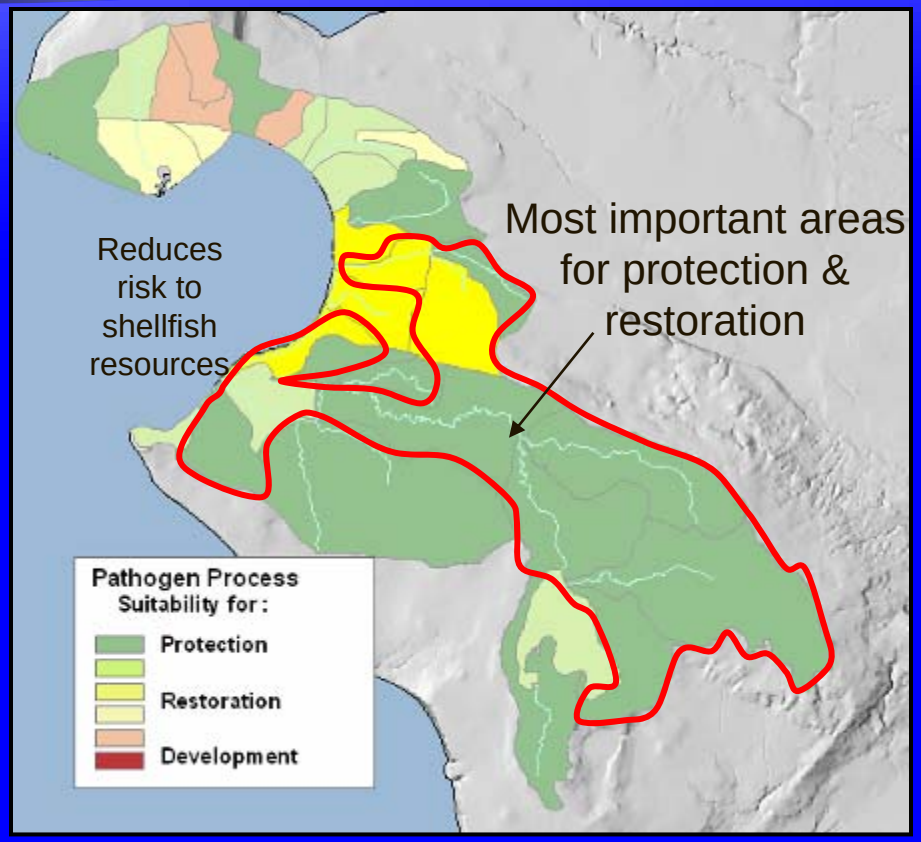
Pathogens

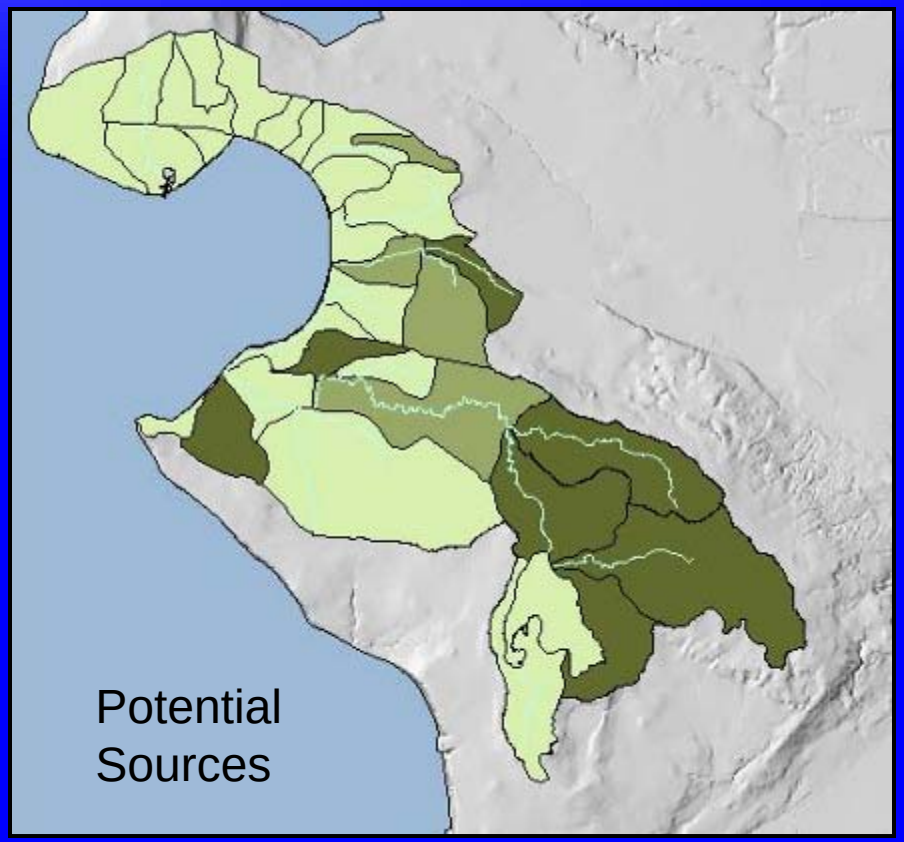
Important Areas for Restoring & Protecting Hydrologic Processes





Important Areas for Pathogen Process Relative to Potential Sources

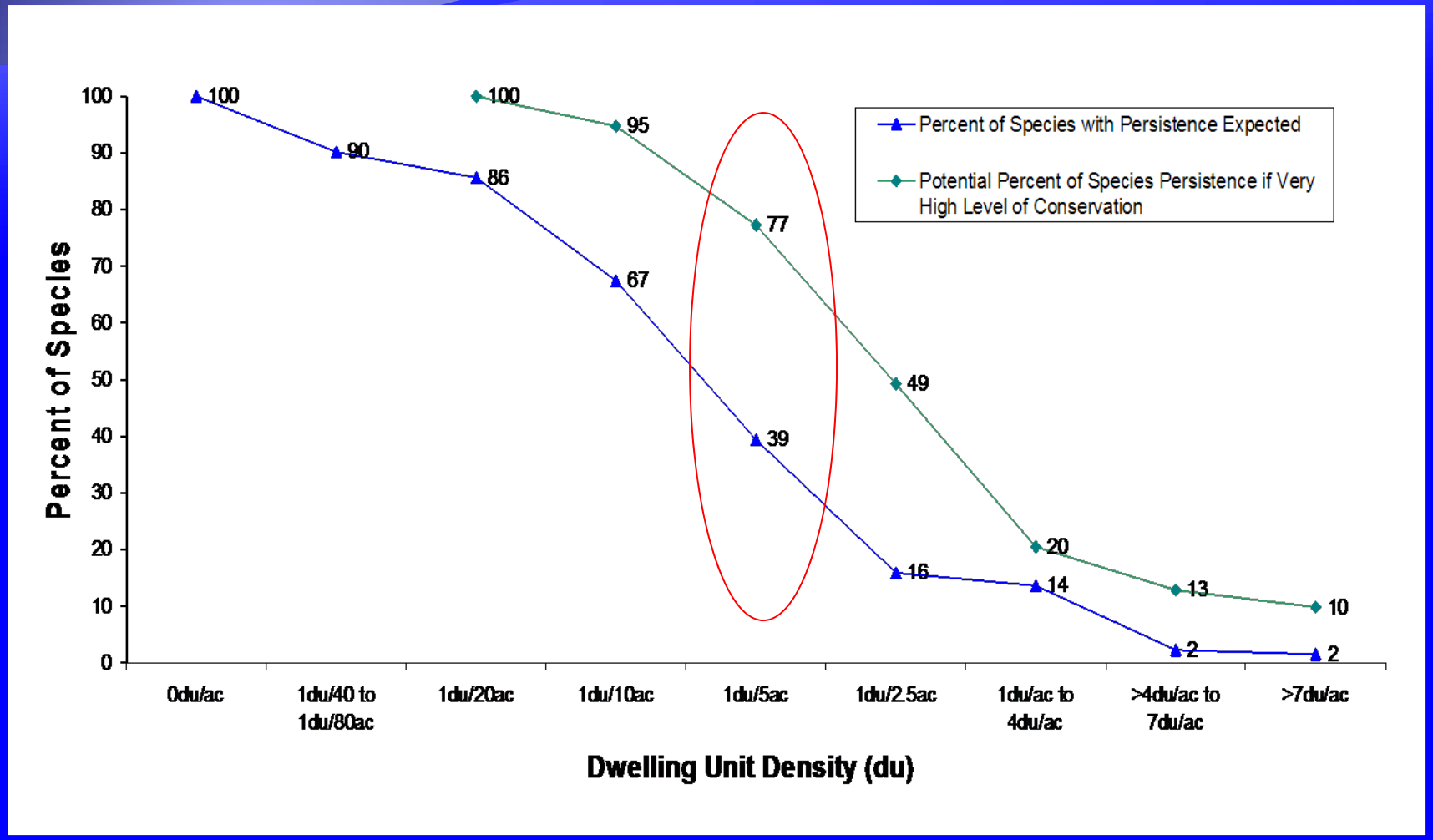




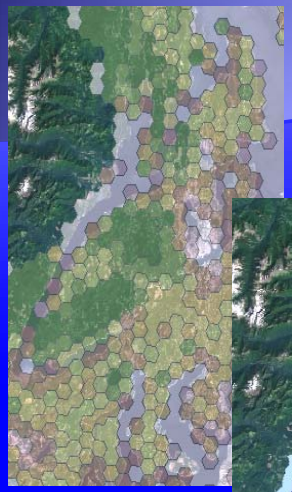
Fish and Wildlife Assessment

	Tools	Application - Benefit
Broad Scale	Local Habitat Assessment	Important places on the landscape
Mid - Scale	Mid-Scale LHA	Representative species' needs
Fine Scale	Local Info	Cluster design, roads

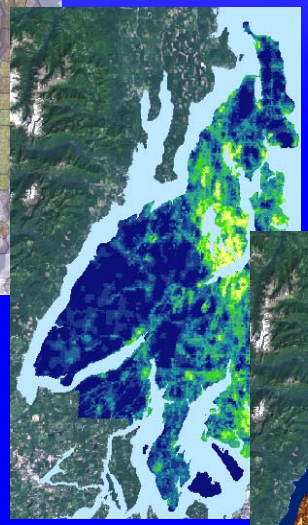
Why Plan for Wildlife?



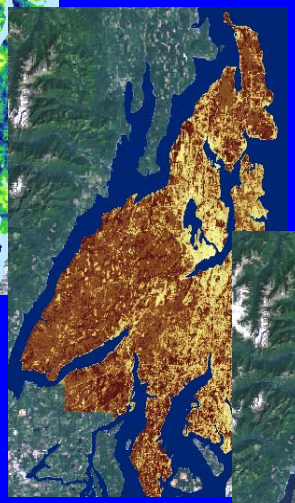
Local Habitat Assessment



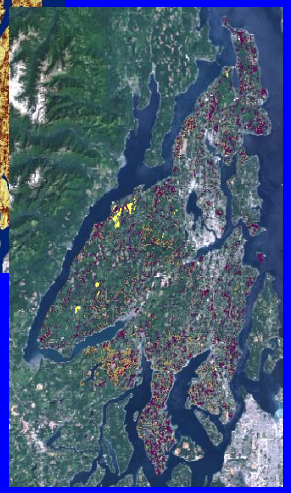
Ecoregional Assessments



Land Conversion



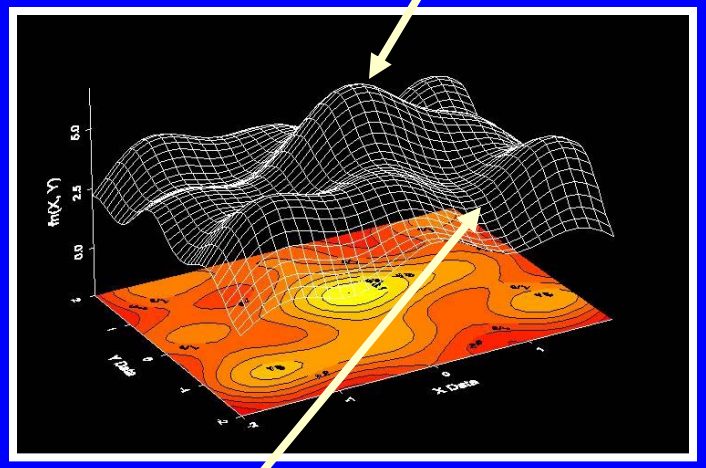
Road Density



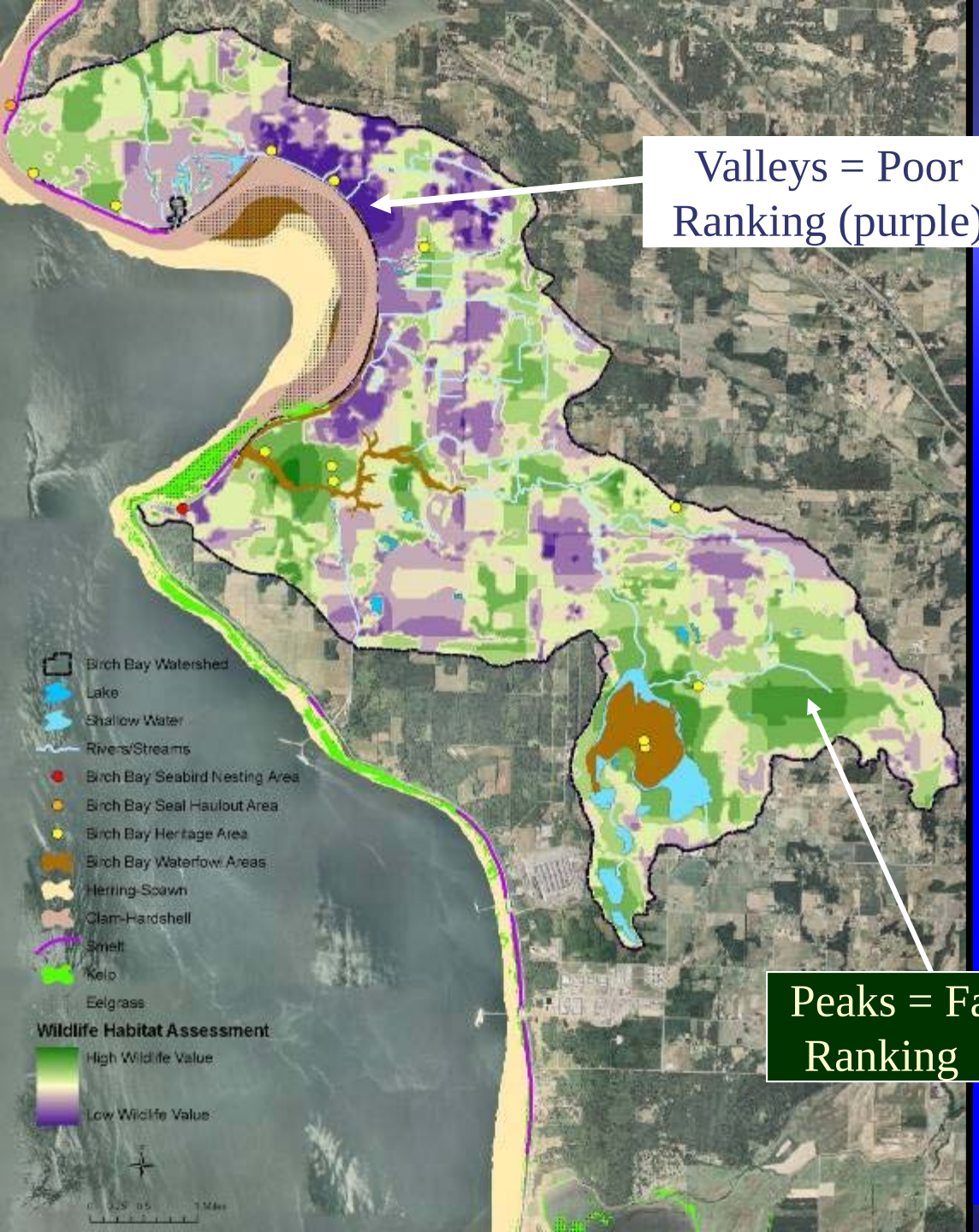
PHS/Heritage data (local empirical data)

=

Peaks = Favorable Ranking



Valleys = Poor Ranking



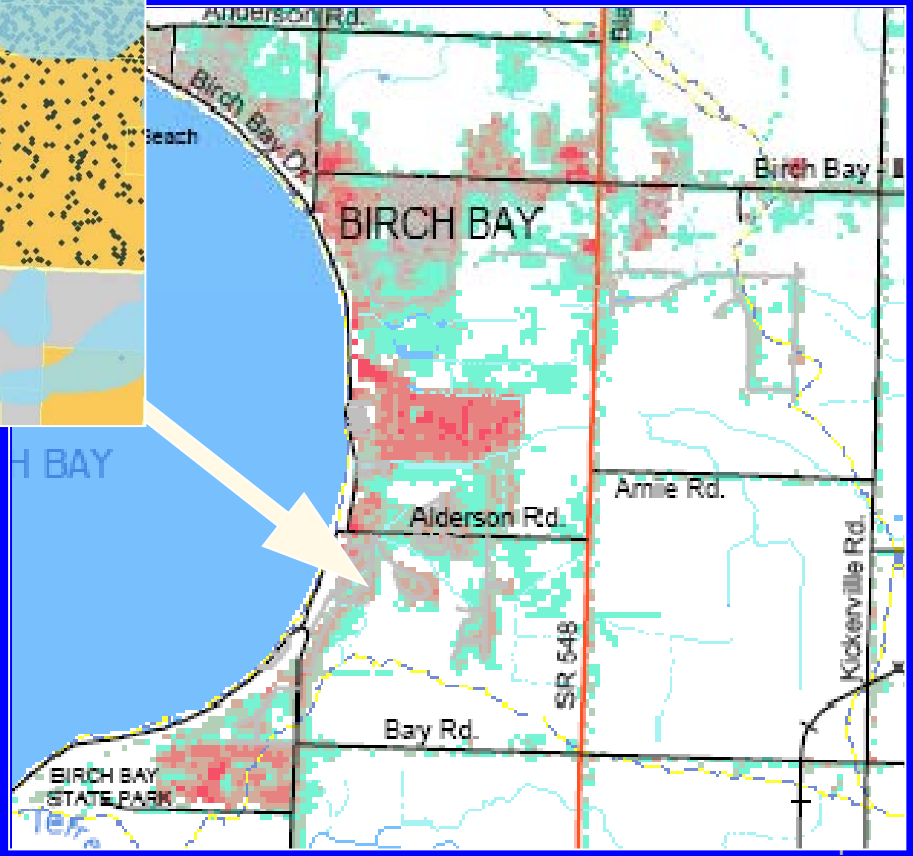
Valleys = Poor Ranking (purple)

Peaks = Favorable Ranking (green)

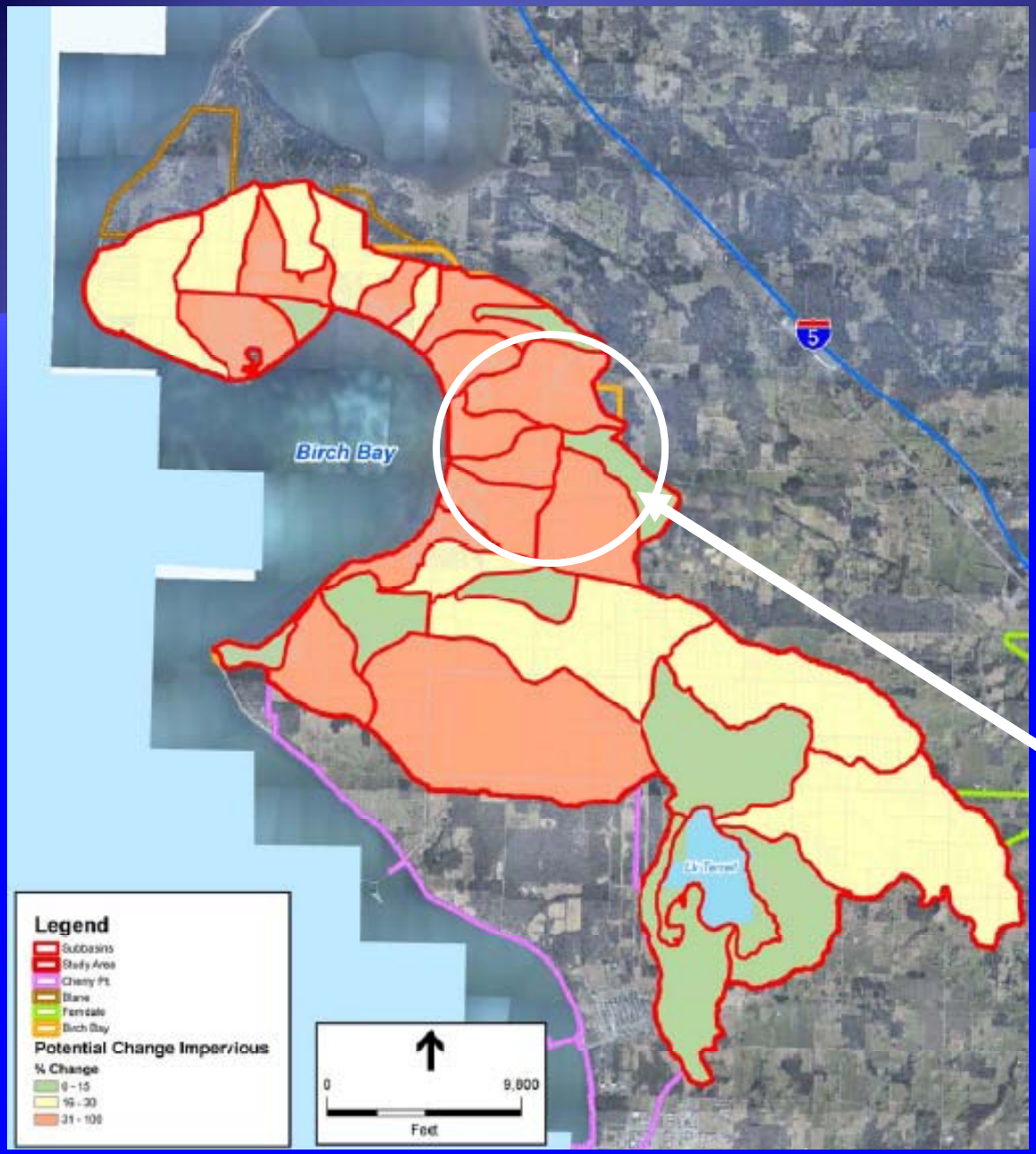
Results of Fish & Wildlife Analysis

Local Habitat Assessment – Broad Scale

Effects of Growth on the System



- Impervious Surface Analysis

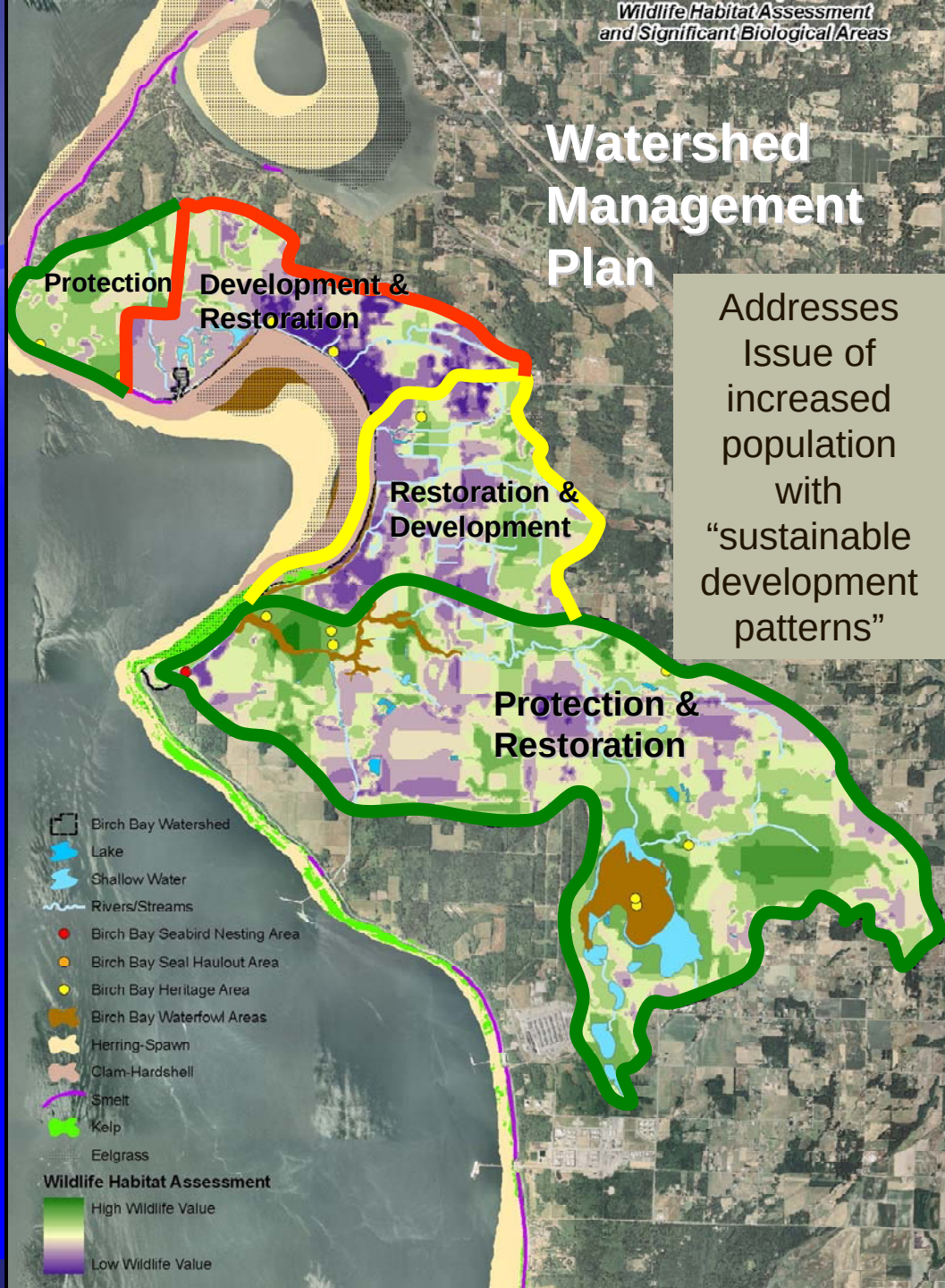


Potential Change in Impervious Cover

Conflicts in Central Sub-basins With Characterization Results

Synthesis: Identifying Solutions (Step 2)

- **Concentrate development** in "red" management units
- Allow use of **mitigation credits** in "yellow and green" zones for impacts in "red zone."
- **Cluster development** in "yellow and green" zones.
- Use **low impact development** measures
- Provide for **habitat protection** overlay



Addresses Issue of increased population with "sustainable development patterns"

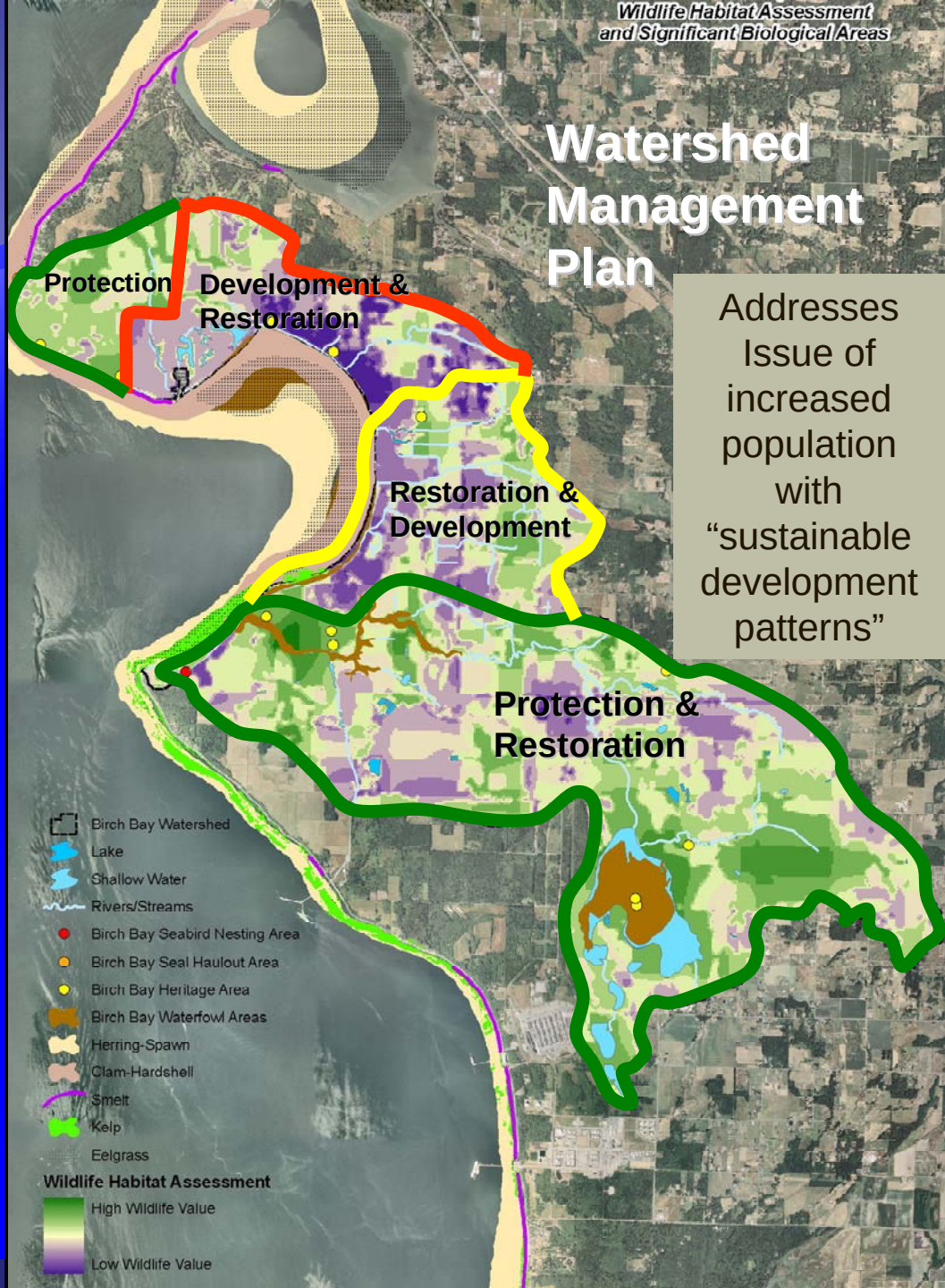
Synthesis of Results

- **Keep large areas** <= 1du/10 ac
- **Habitat Mosaic** - wetlands, open grassy areas, and connectivity areas, <= 1du/20ac
- **Minimize new roads**, traffic softening, signs for crossings
- **Connectivity** – greater than 80% native vegetation cover
- **Flyways** – maintain 0.5 mile wide, no tall buildings or towers, greater than 80% native vegetation cover

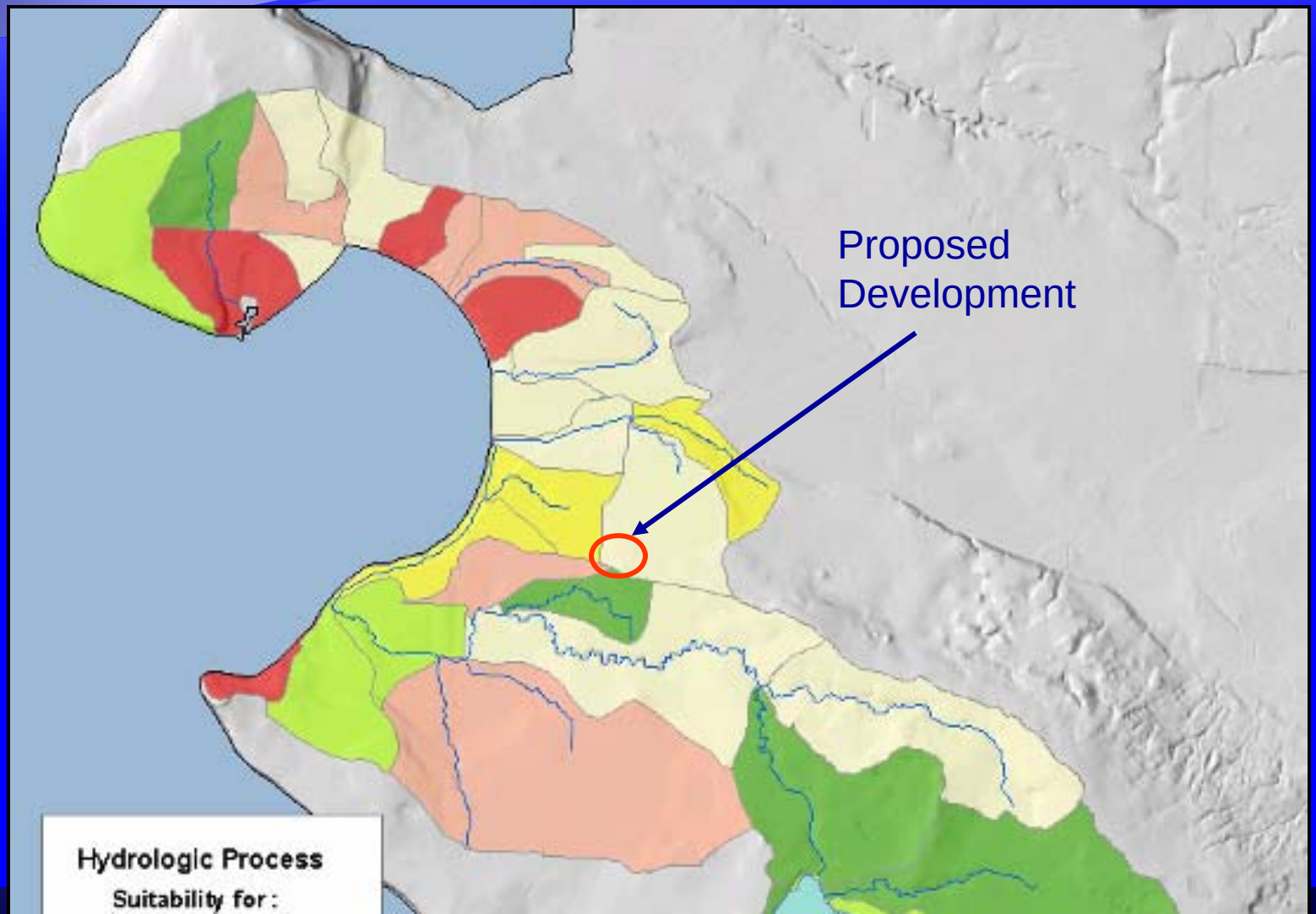
Addresses Loss of habitat and wildlife

Synthesis: Identifying Solutions for Rural Properties

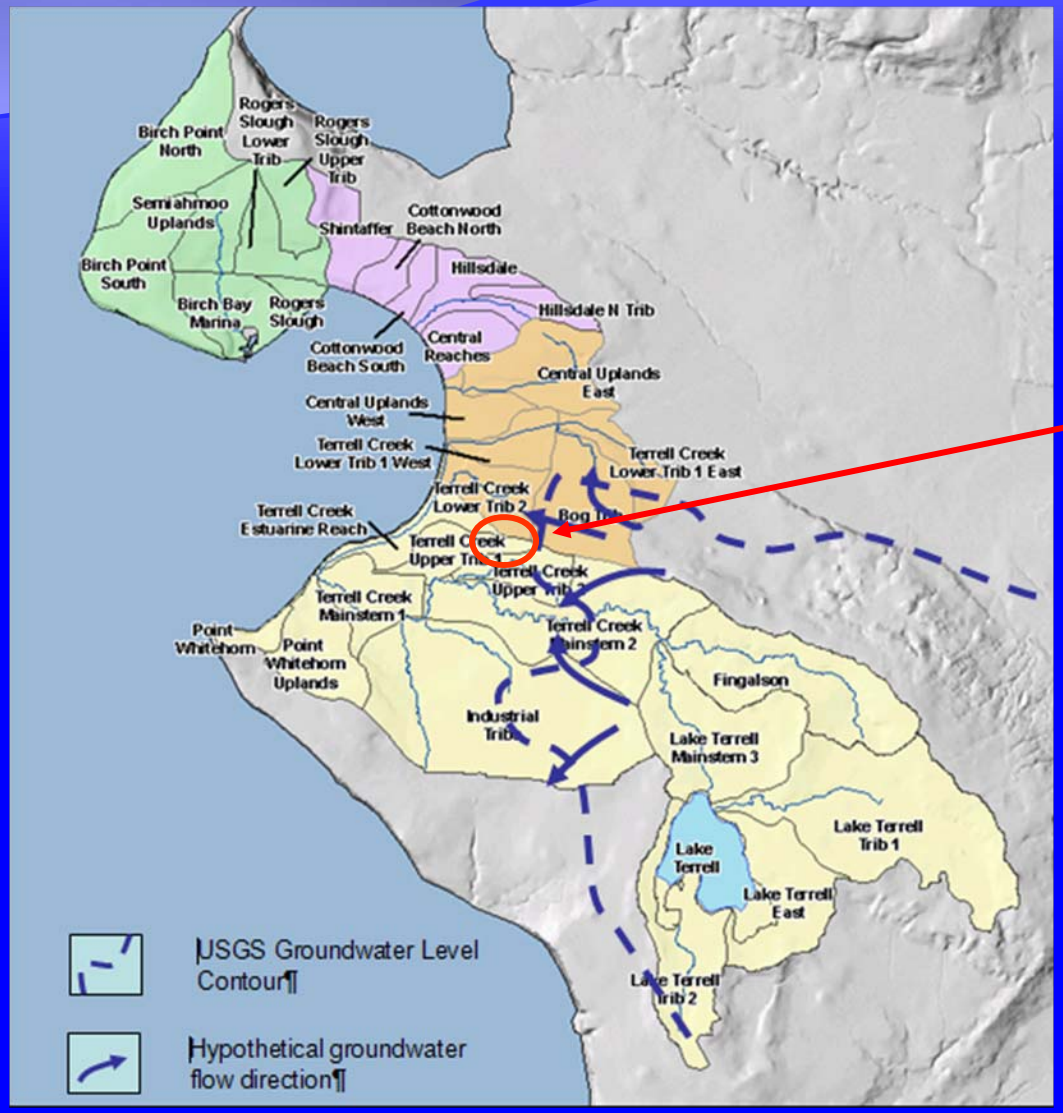
- **Special Development Fees** in "red" management units would be used to help farmers in green zone. Examples include:
  - Implementing Farm Plans in critical areas
  - Planting riparian buffer areas
  - Restoring degraded reaches of creeks
  - Purchasing conservation easements (similar to Wetland Reserve Program)
- Selling Credits to developers for wetlands created on rural properties



Applying Characterization Results at Fine Scale

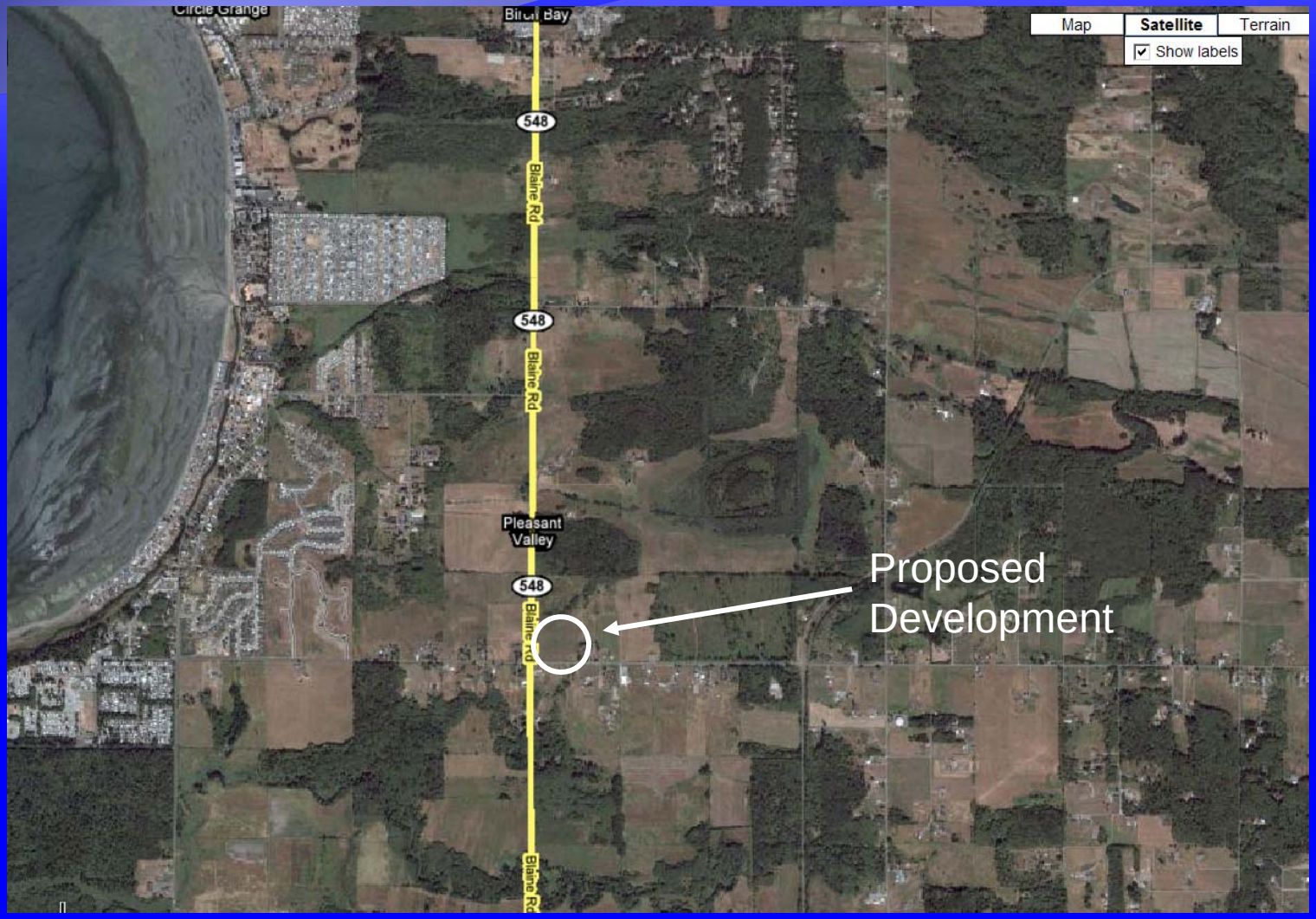


Water Flow Patterns

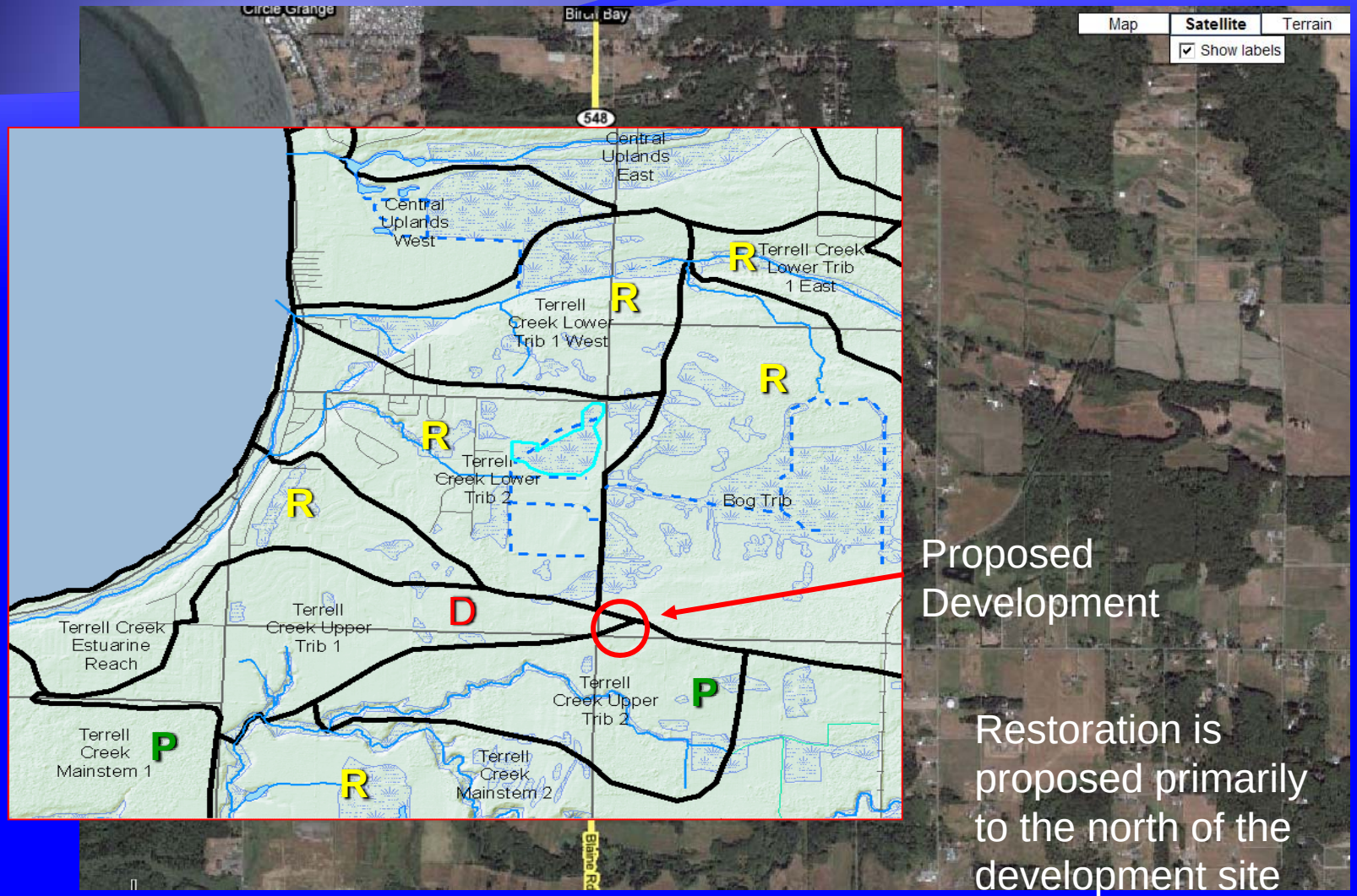


Proposed Development

Surrounding Uses



Wetlands Inventory & Characterization Results



Proposed Development

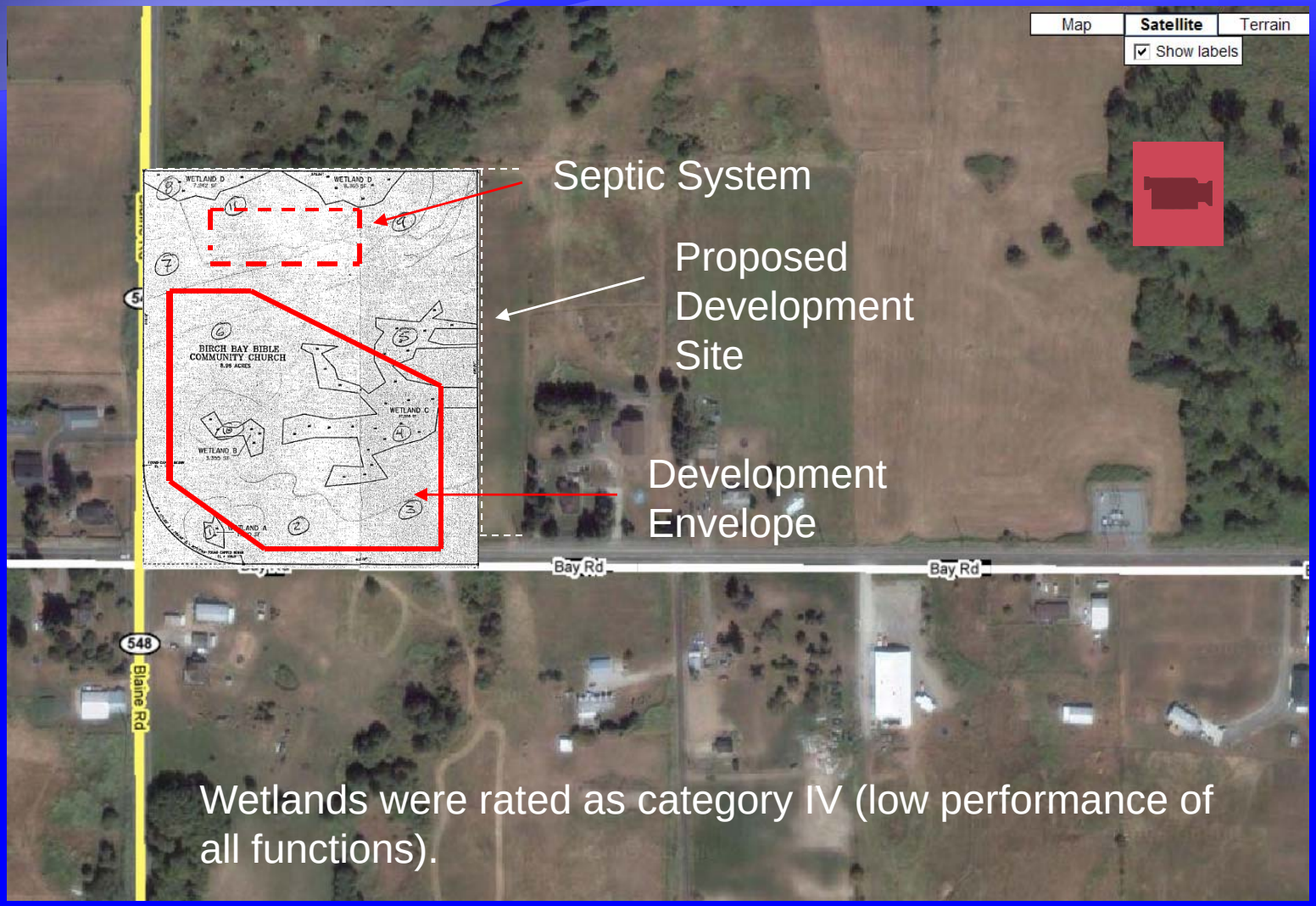
Restoration is proposed primarily to the north of the development site

Surrounding Uses

Bob Tributary

Surrounding Uses

Site Conditions & Development Impacts



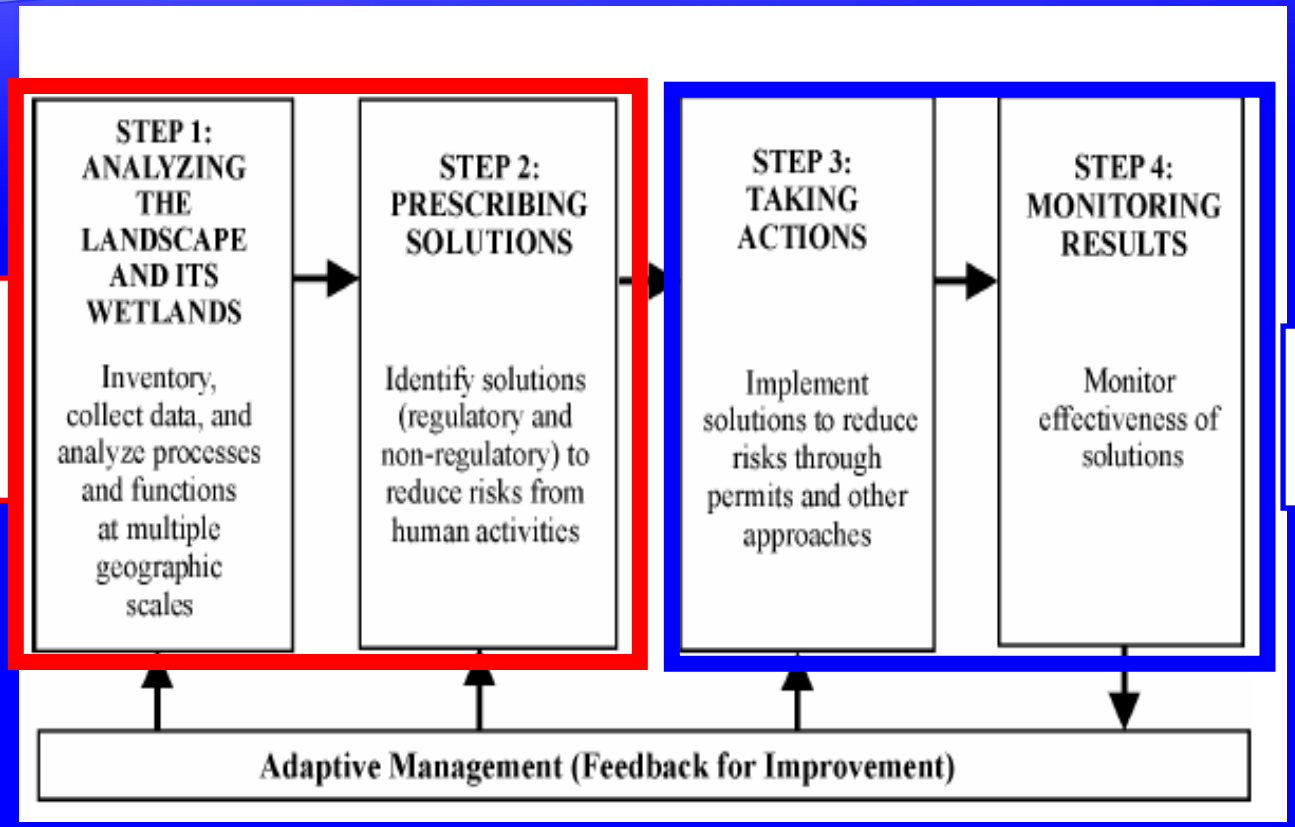
Wetlands were rated as category IV (low performance of all functions).

Recommended Mitigation Based on Watershed Conditions and Analysis

- Offset Area - Restore (rehabilitation and re-establishment) and enhance

Next Steps

Pilot Study (Analysis and Planning)



Future Implementation (if adopted)

SUMMARY & WRAP-UP

WASHINGTON STATE
Department of Ecology

//www.ecy.wa.gov/programs/sea/wetlands

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Air Land Water Toxics Waste

Wetlands

Wetland Mitigation
- Wetland Mitigation Home (coming soon!)
- Wetland Mitigation Banking
- Wetland Mitigation Guidance
- "Mitigation that Works" Stakeholder Forum
- Wetland Mitigation Evaluation Study

Wetland Regulation
- Environmental Permitting Services
- GMA and Local Wetland Regulations
- Isolated Wetlands
- Prior Converted Croplands

Wetland Stewardship

Wetland Tools
- Wetland Delineation
- Wetland Rating Systems
- Best Available Science
- Understanding Watershed Processes
- Project

Training & Education

Other Links
- Wetland Publications
- Frequently Asked Questions (coming soon!)
- Wetland Contacts
- Wetland Listserv
- How to Hire a Qualified Wetland Professional

Ecology Home > Sho

Wetlands: Natu Water Filters

Look around. More like you live, work, or play acres in Washington St land. Wetlands are crit Because of their key ro Ecology is charged with state's remaining wetla

Wetland functions in people, including:

- Flood control
- Ground water re
- Water filtration
- Erosion control
- Wildlife habitat
- Recreation
- Research and e
- Regional econor

The functions that an in location, surrounding to duration of water, and wetland may not perfo wetlands in a watershe

To learn more about w (coming soon!).

Ecology's Role in Managing Wetla

Two state laws, the Sta Shoreline Management

//www.ecy.wa.gov/mitigation/landscapeplan.html

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Air Land Water Toxics Waste

Mitigation That Works

MITIGATION HOME
- Permitting Process
- Guidance and Regulations
- Landscape Planning
- Mitigation Options
- Training

- Mitigation News
- Resources & Publications
- Glossary
- Contacts

Mitigation home > Landscape Planning

Landscape Planning

Land use planning and permit decisions are usually not adequately informed by an understanding of ecosystem processes or watershed conditions. We believe one of the keys to making mitigation work is to move away from the narrow and often confrontational view of site-by-site piecemeal solutions, and towards a broader ecosystem or watershed scale view to achieve a more functional and resilient natural system. Landscape planning is a suggested approach for incorporating this understanding into the local government planning and permitting process.

Purposes
- Sustain and restore aquatic resources.
- Establish a common approach to coordinate planning efforts.
- Involve the community in developing a green infrastructure plan.
- Promote the integration of the Growth Management Act (GMA) and Shoreline Management Act (SMA).
- Assist in preparation of
  - Establishing a fra restoration plan
  - Promoting "no ne

Benefits
- Provides for the compre maintenance of quality
- Guides future developm
  - Identify and avo community to co
  - Provide backgrou plan updates, inc
  - Reduce total dev
- Streamlines permitting
  - Provide a predict
  - Reduce permit re
  - Provide more loc
- Provides flexibility to meet the needs of the community.

Watershed Characterization
In its most basic form, watershed characterization information can help identify areas that are:

- priorities for acquisition (or protection via conservation easements),

Contact:

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Susan Grigsby sgri461@ecy.wa.gov

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