

# Environmental and Instream Flows

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- **Concerns to be addressed**
  - Water Quality Issues
  - Instream Habitat Issues
  - Connectivity Issues
- **Ecosystem Functions**
  - Instream Flow maintenance
  - Sediment sorting, retention
  - Entrainment, processing of nutrients
- **Interactions between the above**

# Water Quality Issues

- Summer Temperatures
- Fall Temperatures
- Nutrient loadings
- Dissolved Oxygen
- Excess fine sediment

# Instream Habitat Issues

- Simplified channel structure
  - Incised channels
  - Reduced habitat diversity – fewer pools
- Reduced Cover
- Impaired Ecosystem Functions

# Connectivity Issues

- Numerous road crossings, some water use infrastructure have caused impediments to fish passage.
- Channel incision, channelization reduce connectivity to side channels, flood plains, associated wetlands.

# Ecosystem Functions

- Instream Flow maintenance
- Sediment sorting, retention
- Entrainment, processing of nutrients

# Instream Flow Maintenance

- Coastal Streams are naturally flashy, reflecting meager ground-water supplies/connectivity.
- Summer flows may be low enough to cause conflicts between environmental needs and even modest human uses.
- Reduced summer flows exacerbate habitat and water quality problems

# Sediment Sorting and Retention

- Streams receive inputs of rock and fine sediments from landslides and through channel migration.
- A healthy stream efficiently sorts these by size, according to differences in flow velocity
- A healthy stream deposits silts on its floodplain.

# Entrainment, Processing of Nutrients

- Streams receive nutrient inputs of fallen leaves, salmon carcasses, and so on.
- These wash downstream varying distances before entrainment, use.
- Healthy streams retain more of these materials higher in the watershed, nearer the points of input.

# Interactions

- Reduced summer flows contribute to impaired water quality, reduced connectivity, habitat degradation, and impaired ecosystem functions.
  - Higher summer temperatures
  - Nutrient and Oxygen excess (eutrophication)
- Channel incision contributes to reduced flows, impaired water quality.
  - Seasonally depleted shallow water table
  - Water warms faster on bedrock substrate
  - Less sediment sorting, nutrient entrainment

# A Restoration Approach

- Rational allocation
  - Provide the water needed for human use in the context of maintaining/restoring habitat and ecosystem function
- Restoration of hydrological resilience

# Rational Allocation

- Willingness to negotiate
- Regulatory milieu that encourages, supports negotiation
- Willingness to recognize validity of human use
- Willingness to recognize environmental needs
- Willingness to be frugal
- Willingness to consider alternatives
- Willingness to invest in environmentally friendly solutions.

# Restoration of hydrological resilience

- Stream flow can be materially improved by restoring depositional reaches, headwaters.
  - Reduce channel incision
  - Increase floodplain connection
  - Increase channel complexity
  - Encourage beaver ponds
- These reduce flashiness, support summer flows, improve water quality, make more water available for beneficial uses.

# Restoration Context

- Much such restoration is being done for Salmon habitat improvement.
- This work does support instream flows and water quality.
- However, priorities for salmon habitat restoration often are different from priorities for general instream flow restoration.