

## Tools for understanding groundwater connectivity for salmon and people



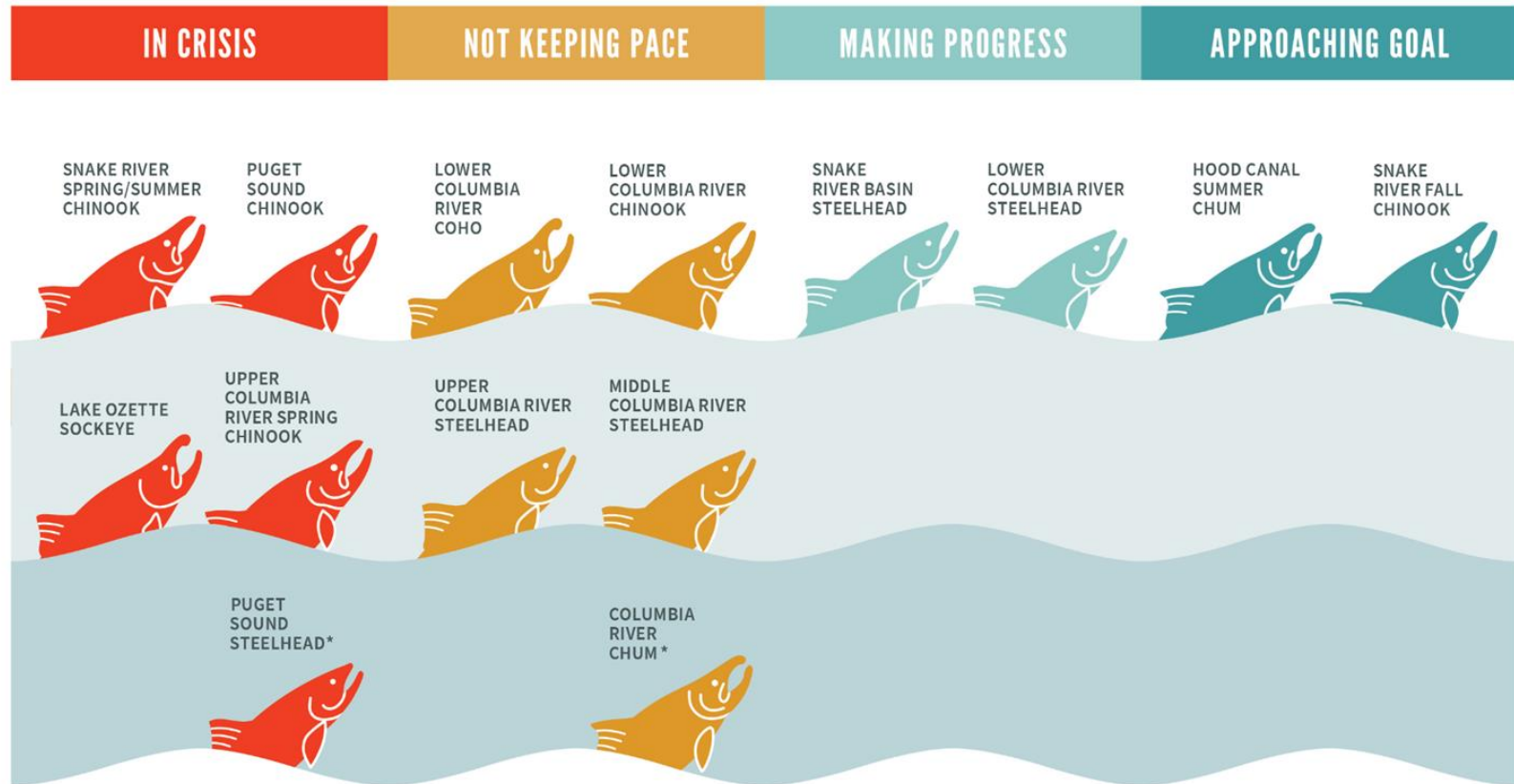
*Primary science partners: Kachemak Bay National Estuarine Research Reserve and the University of South Florida, School of Geophysical Sciences, with support from many locally engaged community partners*

# Outline

1. Salmon and groundwater science background
2. Science-based tools
3. Decision-making
4. Training and Education

***“We have the remarkable opportunity to not mess things up here.”***

## Salmon Abundance



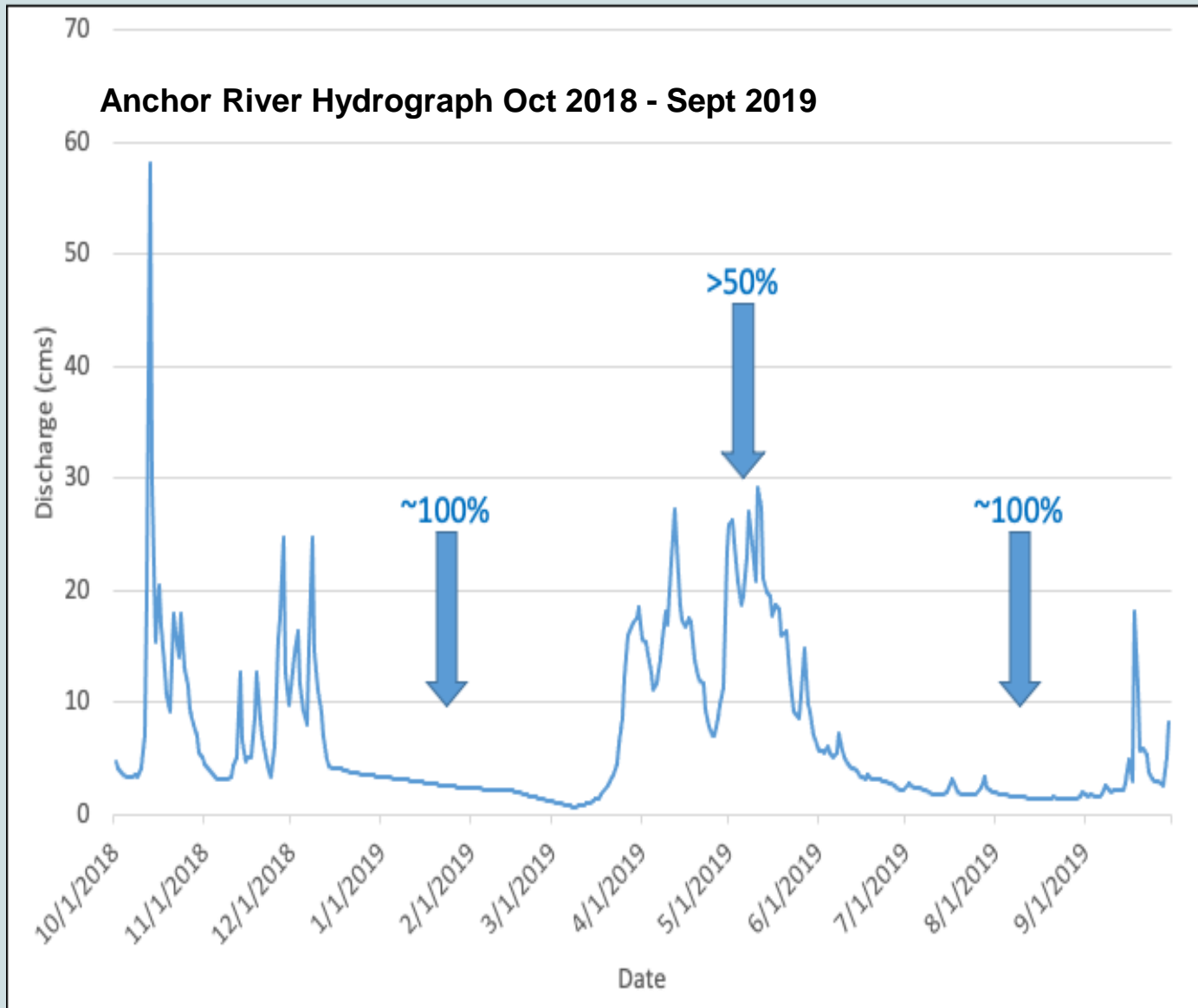
\* Lacks complete data

Data Source: Washington Department of Fish and Wildlife

**In winter, ALL of the water in the river is groundwater**

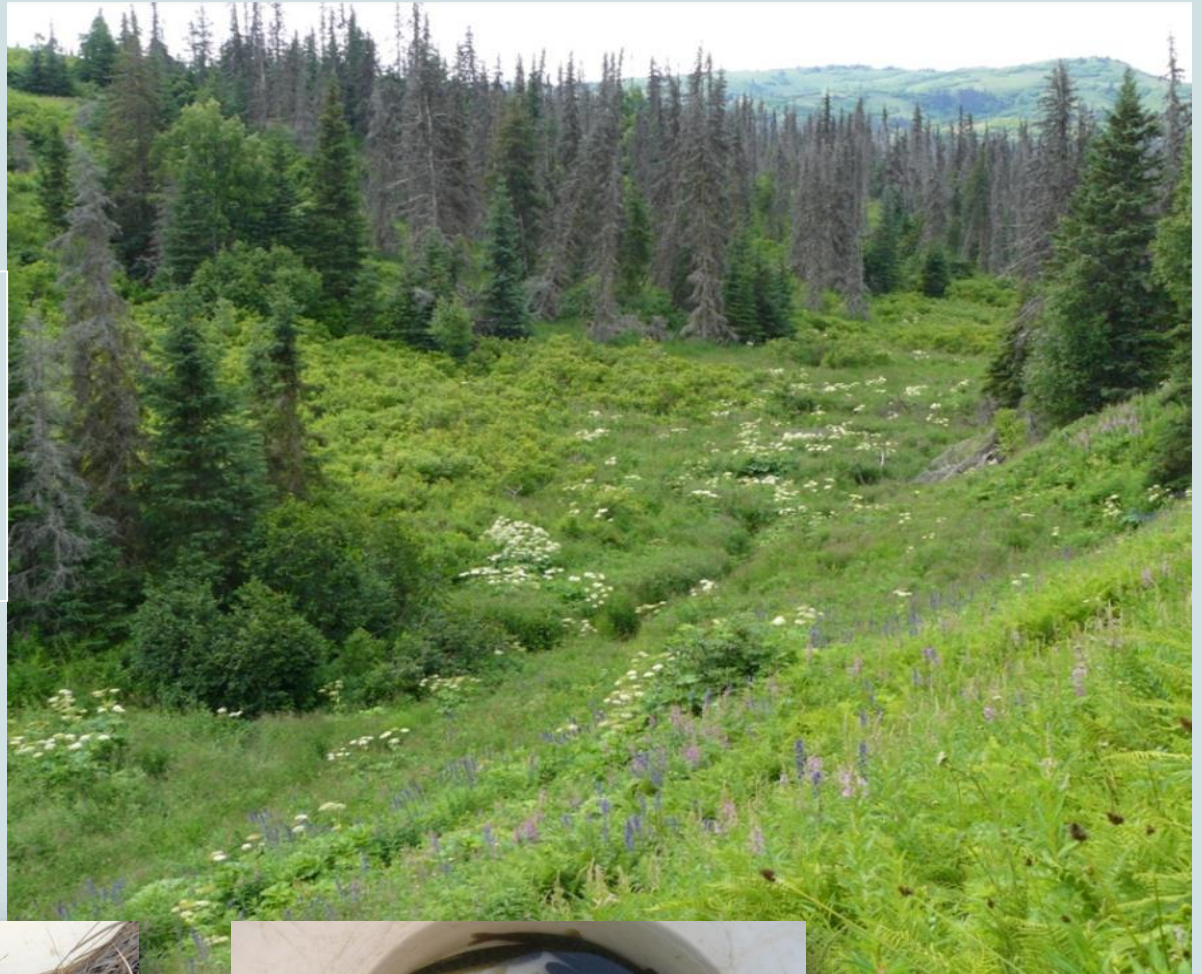


# Groundwater and salmon-streamflow



Source: Brigino et al. In Preparation

Millions of juvenile salmon rear in headwater streams that rely on groundwater



# Groundwater = stream temperature moderation



cold water refugia in summer



warm water refugia in winter 7

**ALDERS supply NITROGEN**



**PEATLANDS supply CARBON**





**ALDERS supply NITROGEN**

**PEATLANDS supply CARBON**

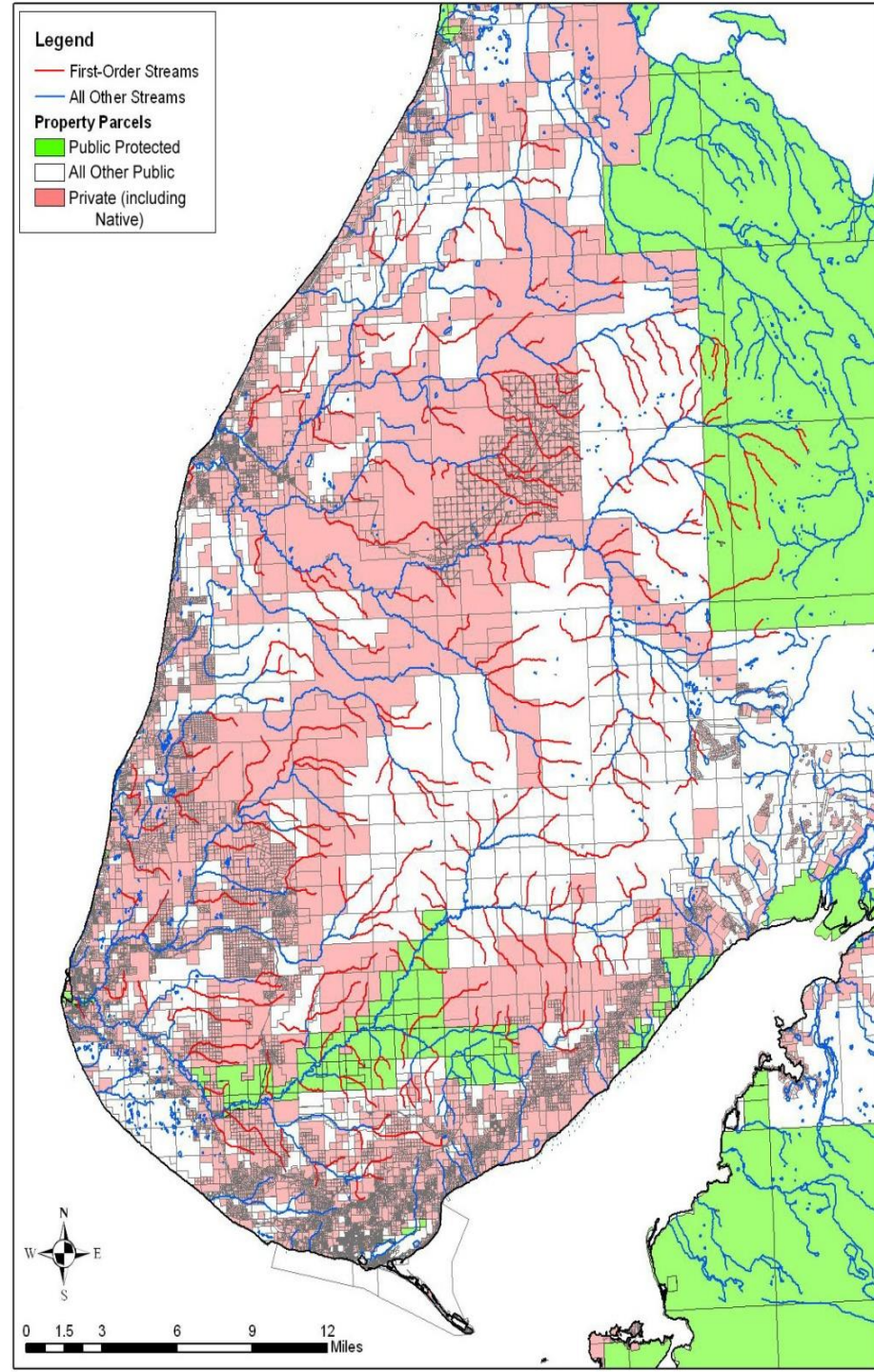


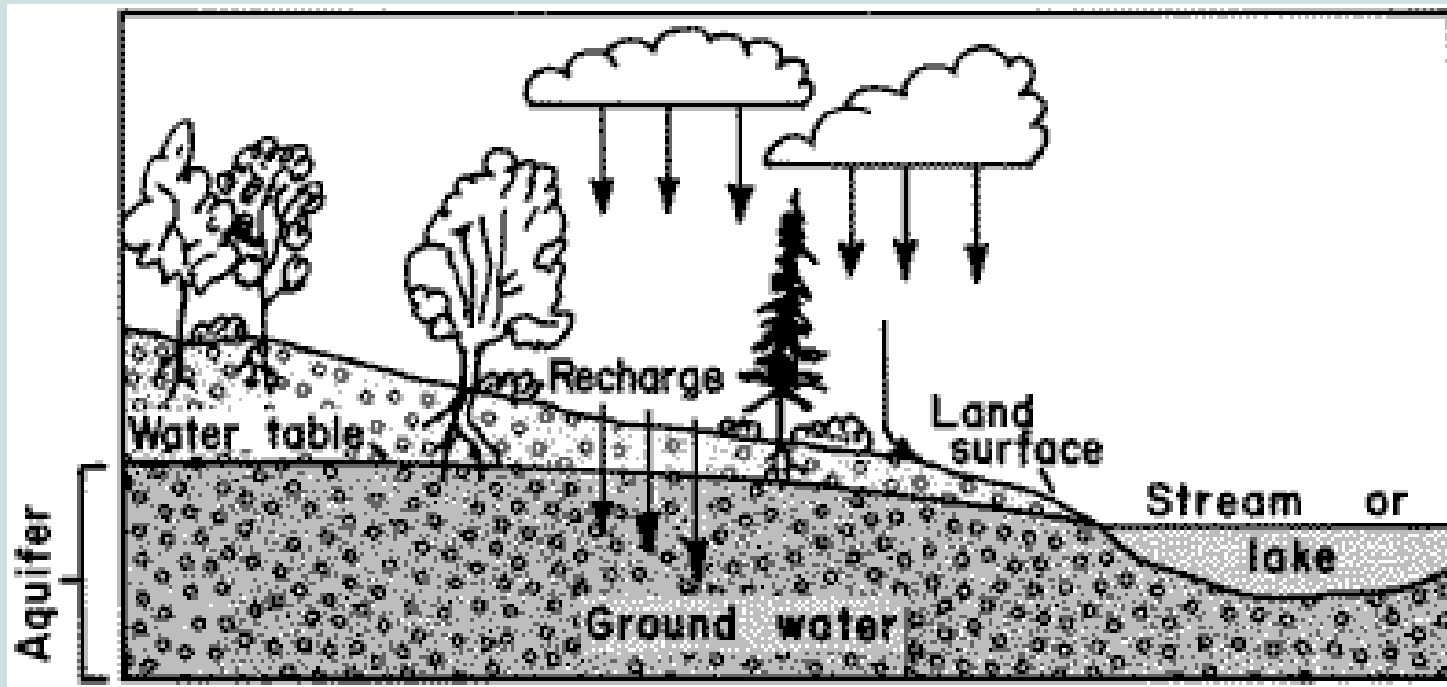
**GROUNDWATER DELIVERS NUTRIENTS TO THE STREAMS**



**BABY SALMON GROW!**

1. Most land on the southern Kenai Lowlands is unprotected (pink and white).
1. Lots of parcelization.
1. Headwater streams (red) where juvenile salmon rear are throughout the watersheds.

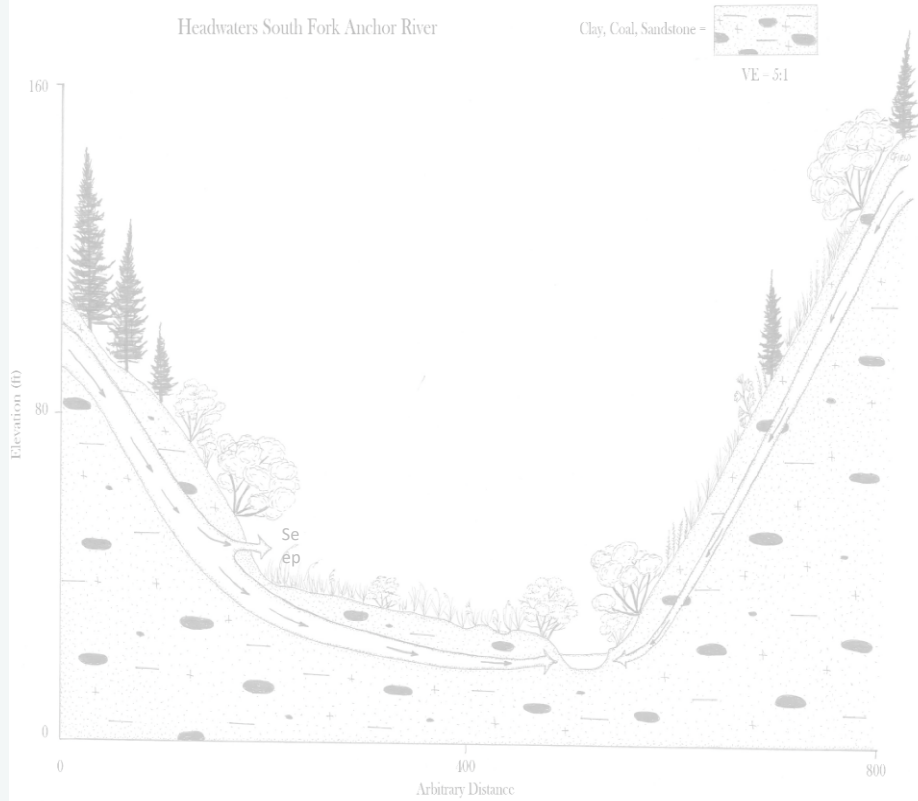




from USGS

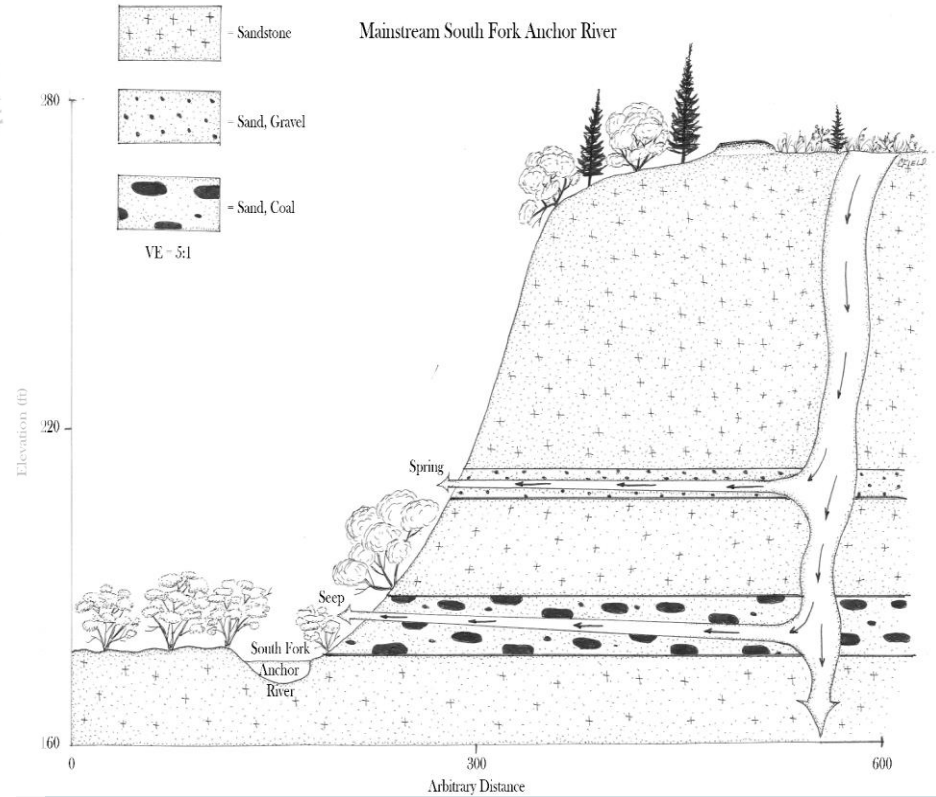
Groundwater connectivity: recharge, storage, conveyance and discharge

Headwaters South Fork Anchor River



Recharge-Discharge—Hillslopes  
 Time Scale: Days-Years

Mainstream South Fork Anchor River

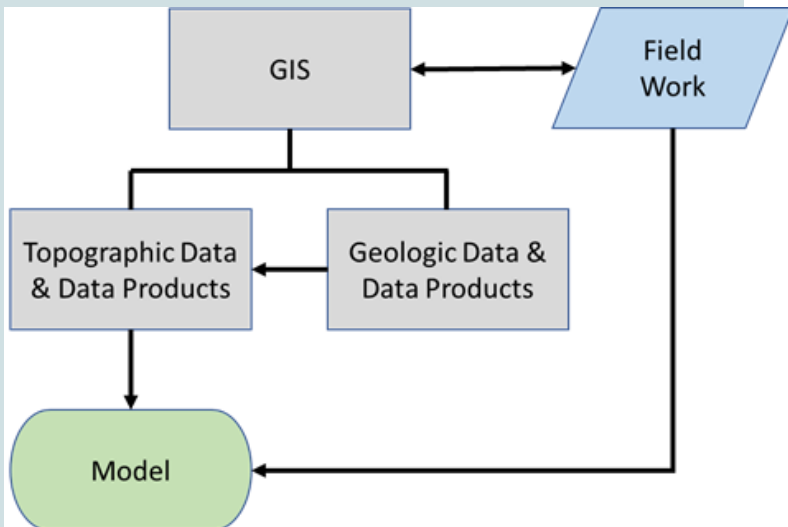
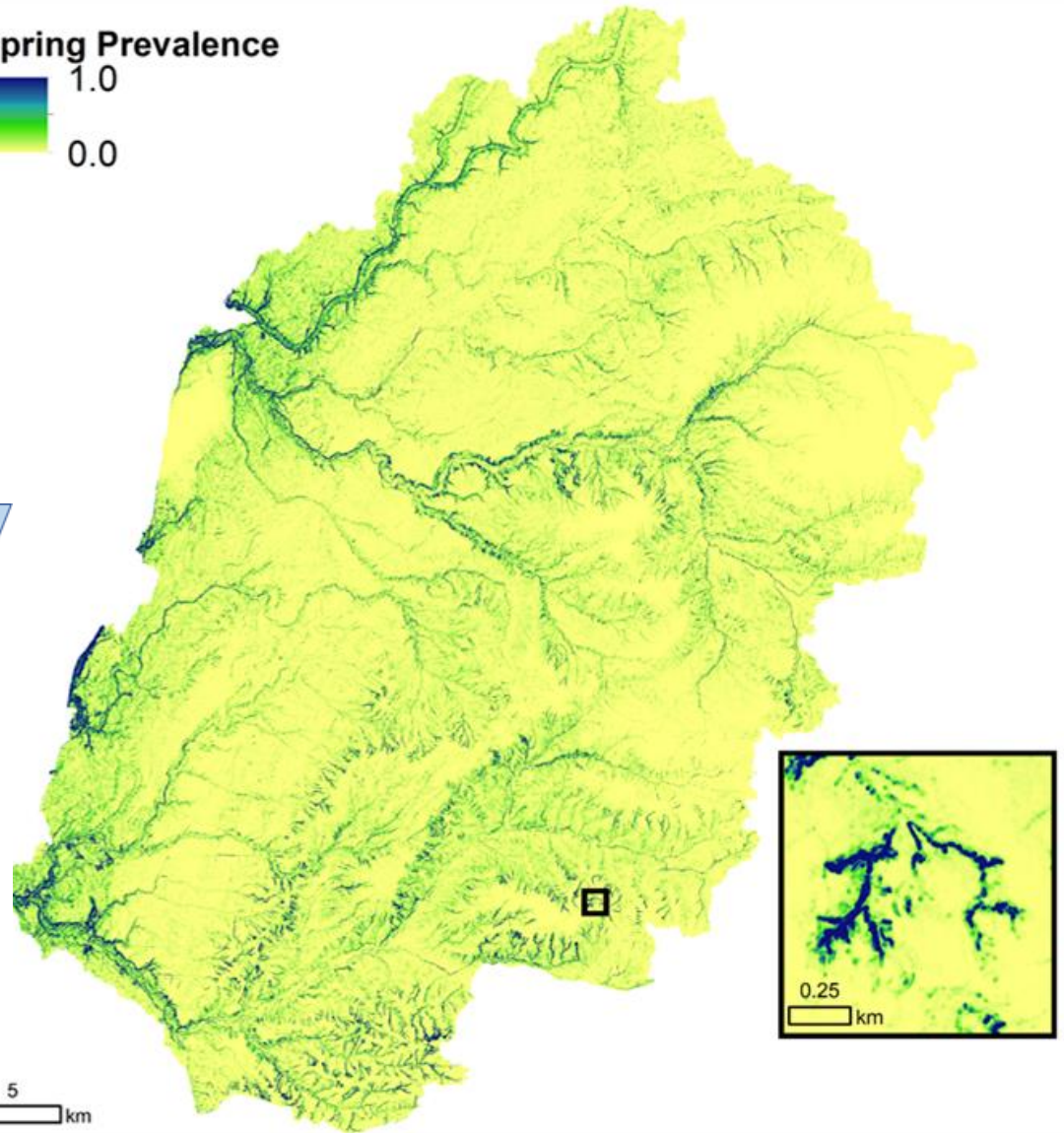
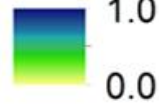


Recharge-Discharge—Aquifers  
 Time Scale: Years-Millenia

# Modelling groundwater aquifers, discharge and recharge



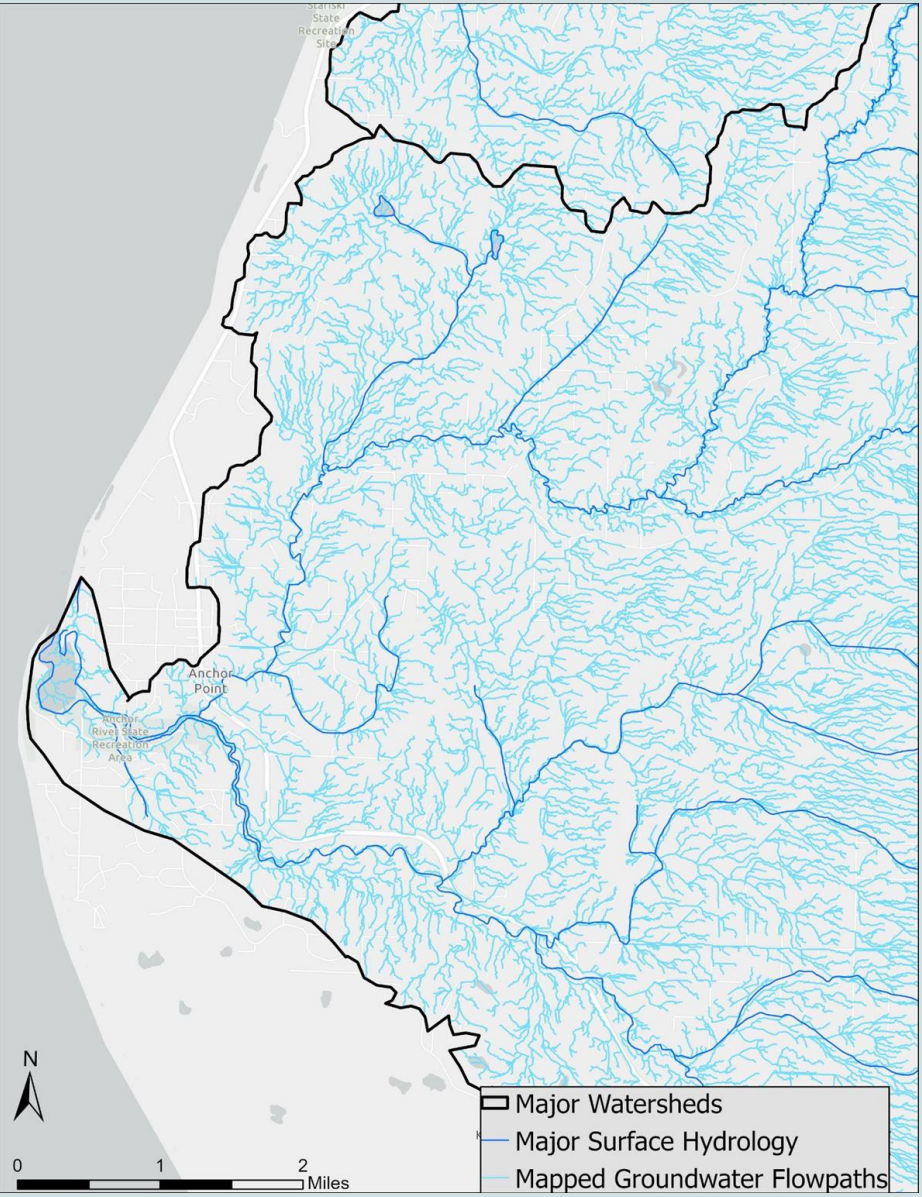
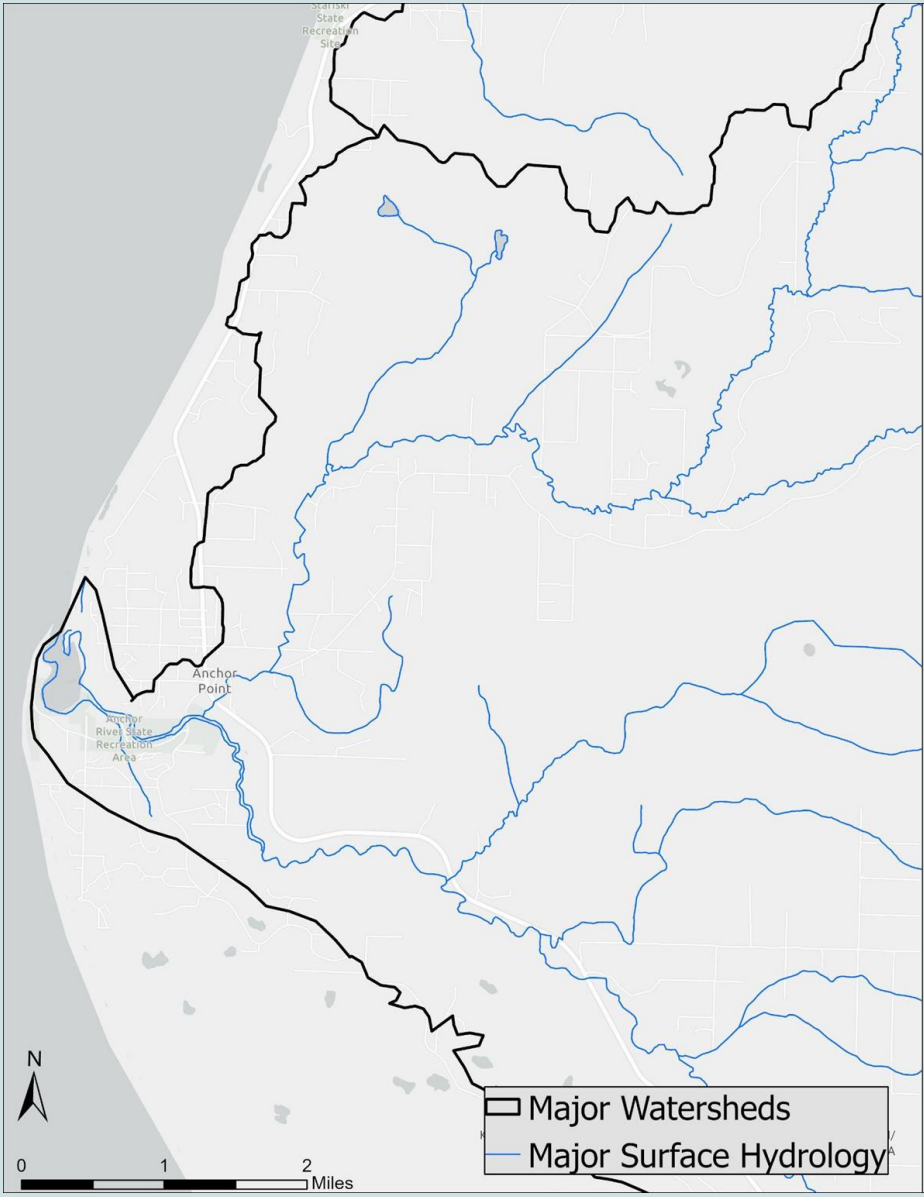
Spring Prevalence

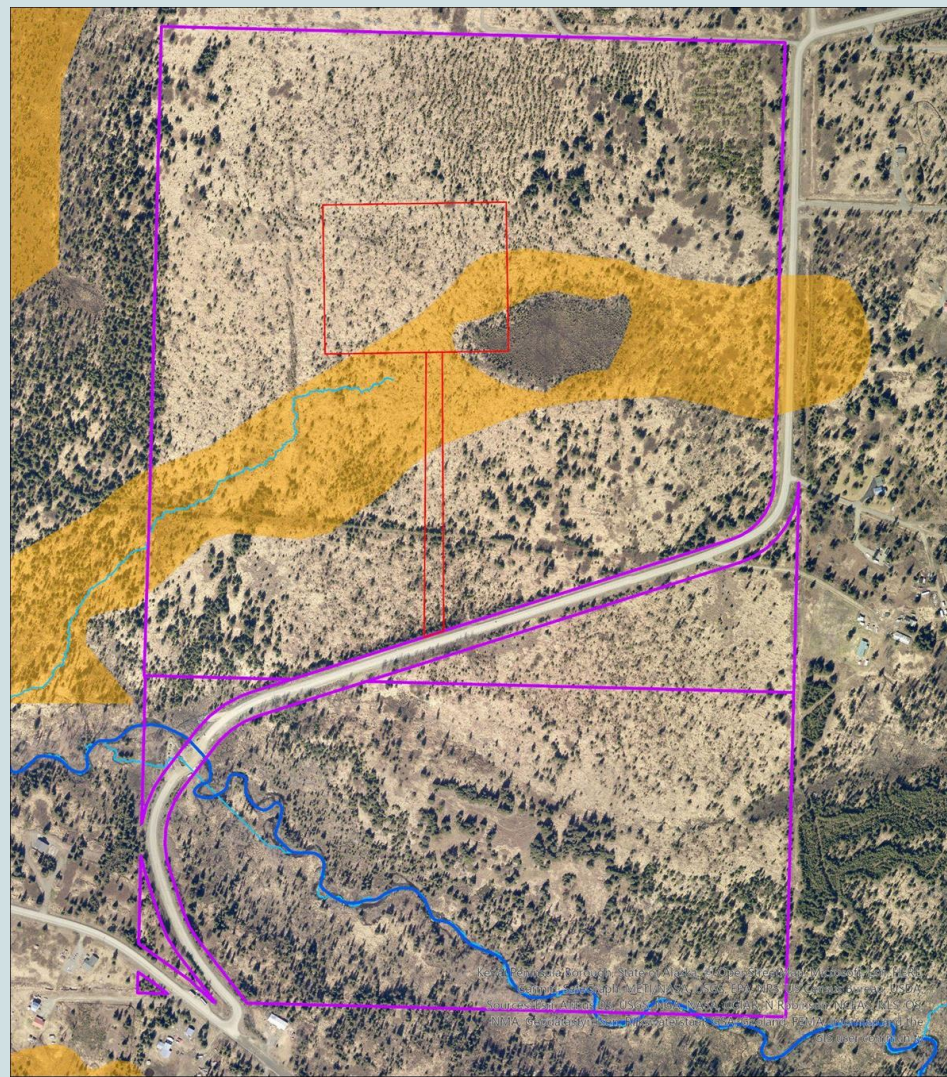


# Tools for decision-makers

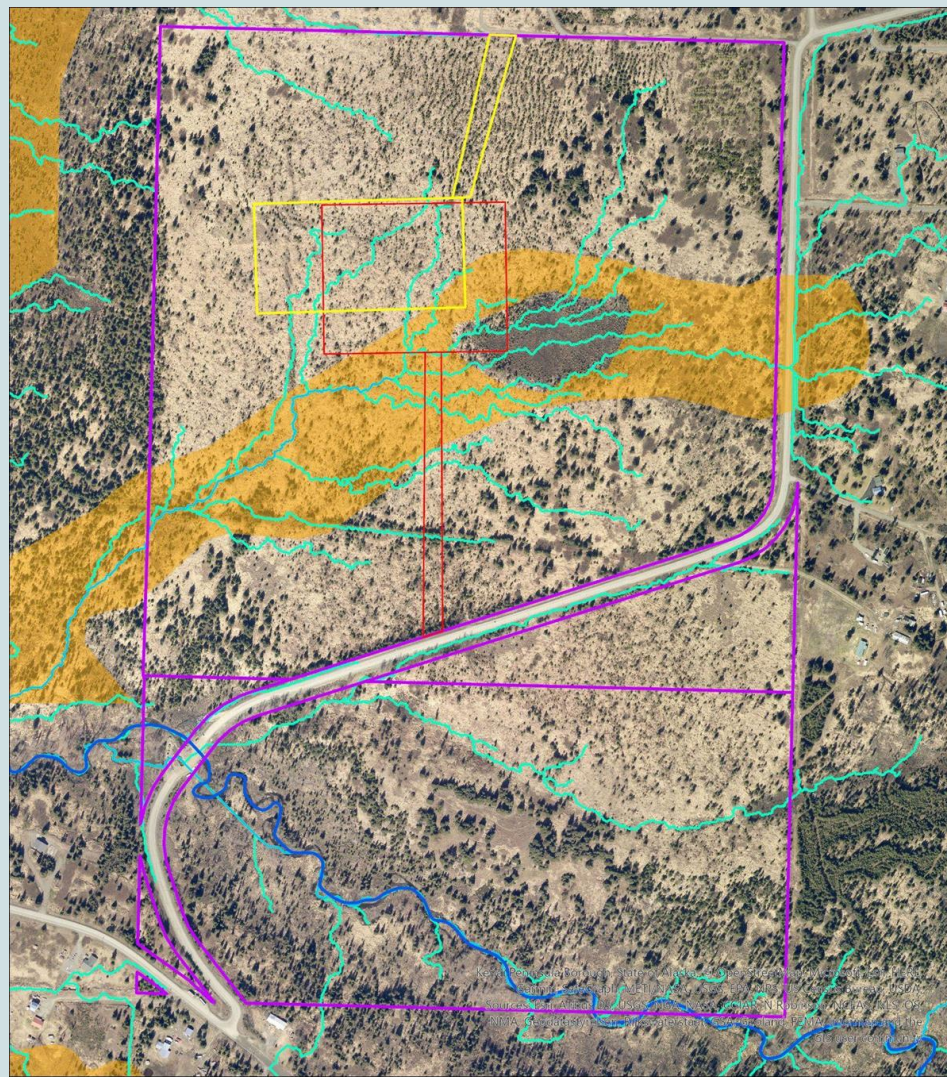


# Tools for decision making: Using shallow groundwater flowpath modelling to avoid disrupting salmon stream connections





- Proposed Footprint
- KPB Parcel
- Anadromous Streams
- Predicted Streams
- Peatland



- Adjusted\_Footprint
- Proposed Footprint
- KPB Parcel
- Anadromous Streams
- Predicted Streams
- Flowpaths
- Peatland



# Engaging with stakeholders



*Questions?*

