

# WATERSHEDS 101

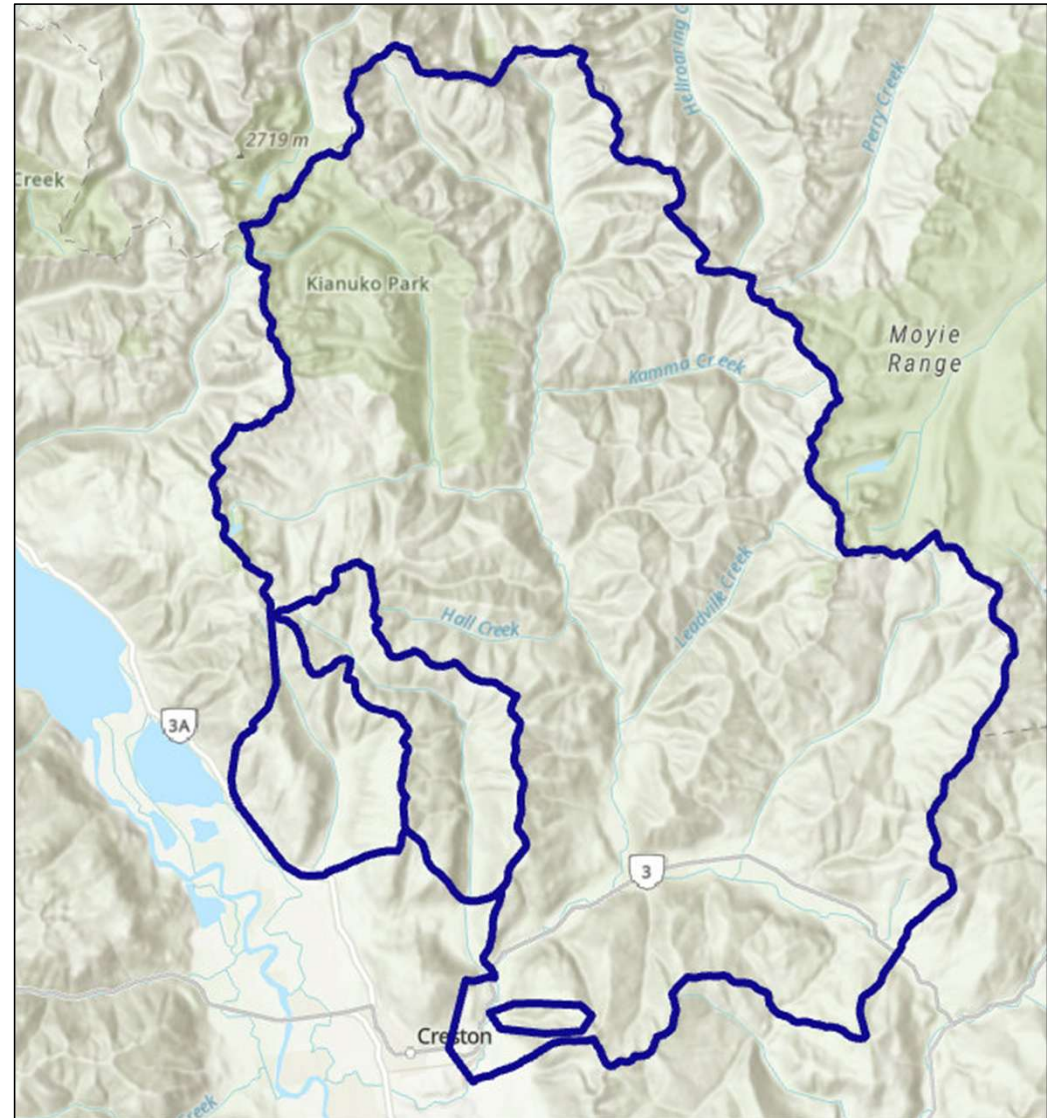
**Watershed:** area where rain and snow drain into a single river or stream (and its connected aquifer(s))

- Defined using surface topography

**Goal:**

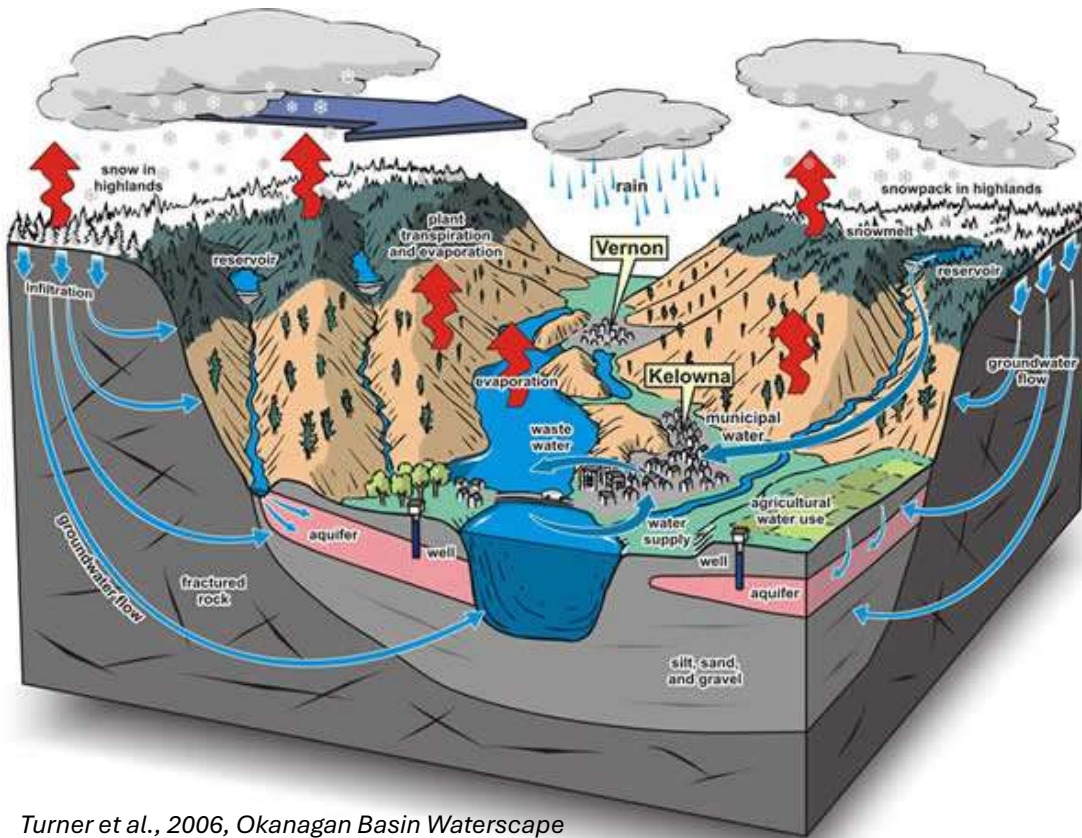
Provide backgrounder on hydrologic processes that occur at the watershed scale, and considerations for management

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Inputs = Outputs ± Change in Storage

$$\text{Precipitation} = \text{Evaporation/Evapotranspiration} + \text{Streamflow} + \text{Groundwater}$$

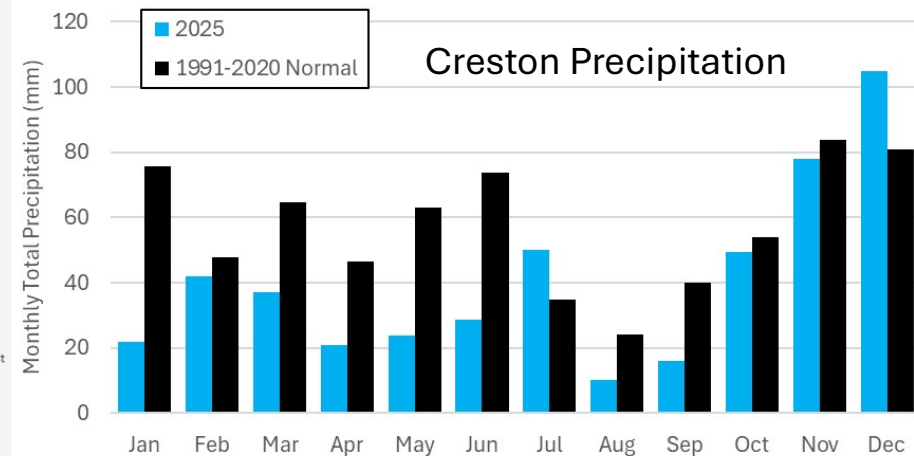
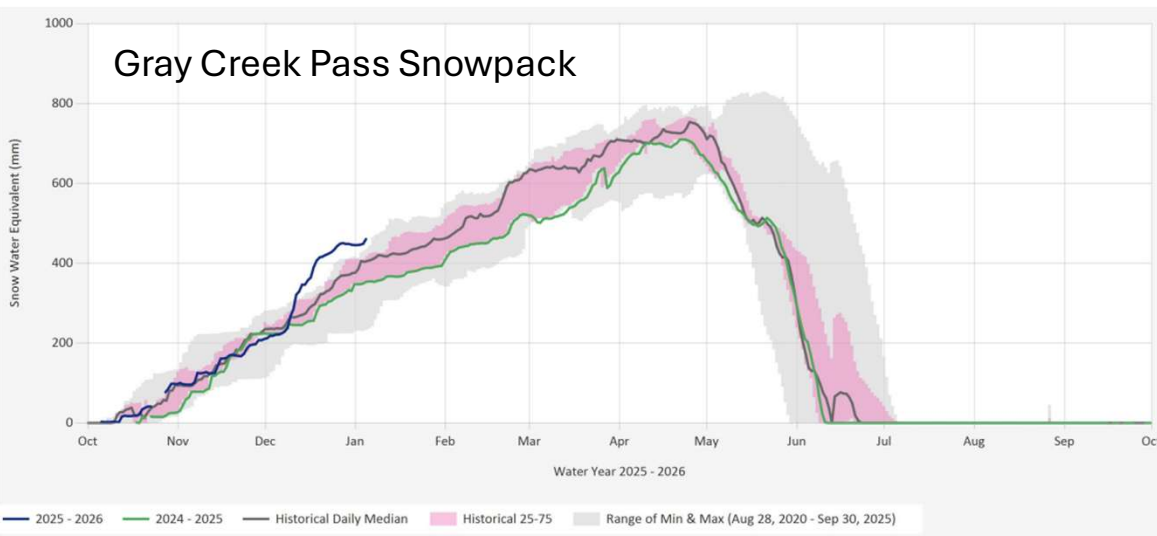
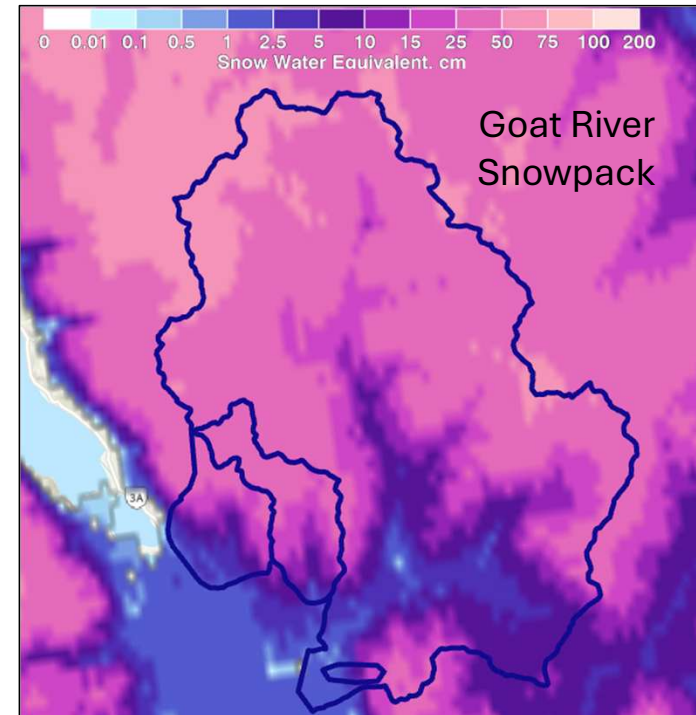


Turner et al., 2006, Okanagan Basin Waterscape

- Surface and subsurface pathways are interconnected
- Water flows more quickly through surface and shallow pathways, and more slowly through deeper pathways
- All water spends some time at the surface AND below ground
  - Subsurface water can come back to the surface multiple times over its flowpath
- Storage: groundwater, large lakes, glaciers
- Consider how each component changes over **time** and over the watershed **area**

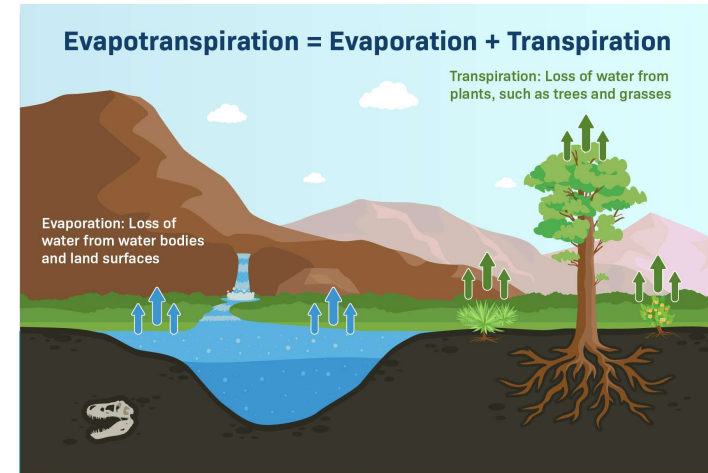
## INPUTS: Precipitation

- Rain and snow
  - Rain immediately available
  - Snow stored until it melt
- Summer rainstorms are very localised
- More snow at higher elevations
  - Groundwater recharges primarily from snowmelt
- Climate change will alter timing, amount and type of precipitation
  - Less snow at mid-elevations
  - More intense fall rainstorms

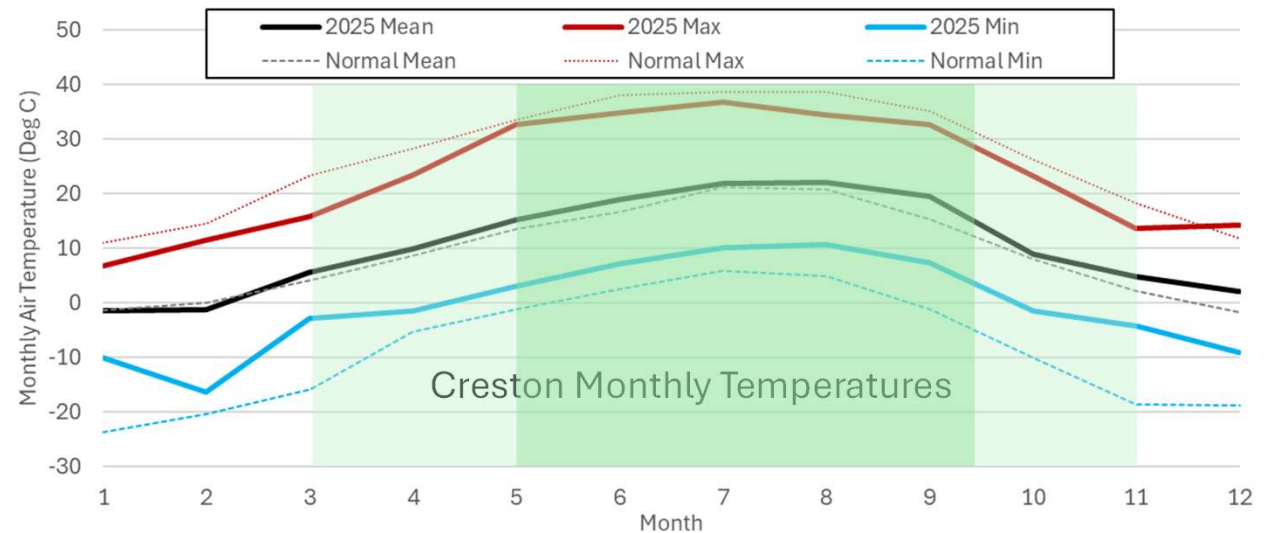


## OUTPUTS: Evaporation/Evapotranspiration

- Open water evaporation driven primarily by air temperature and wind
- Evapotranspiration by plants driven by air temperature and soil moisture availability
- Cooler at higher elevations, warmer at lower elevations
- Peak in late summer, when least precipitation is available
- Increased by irrigation
- Air temperature will increase with climate change
  - How will vegetation will change?



(Image by LabXchange © The President and Fellows of Harvard College)



## OUTPUTS: Streamflow and Groundwater

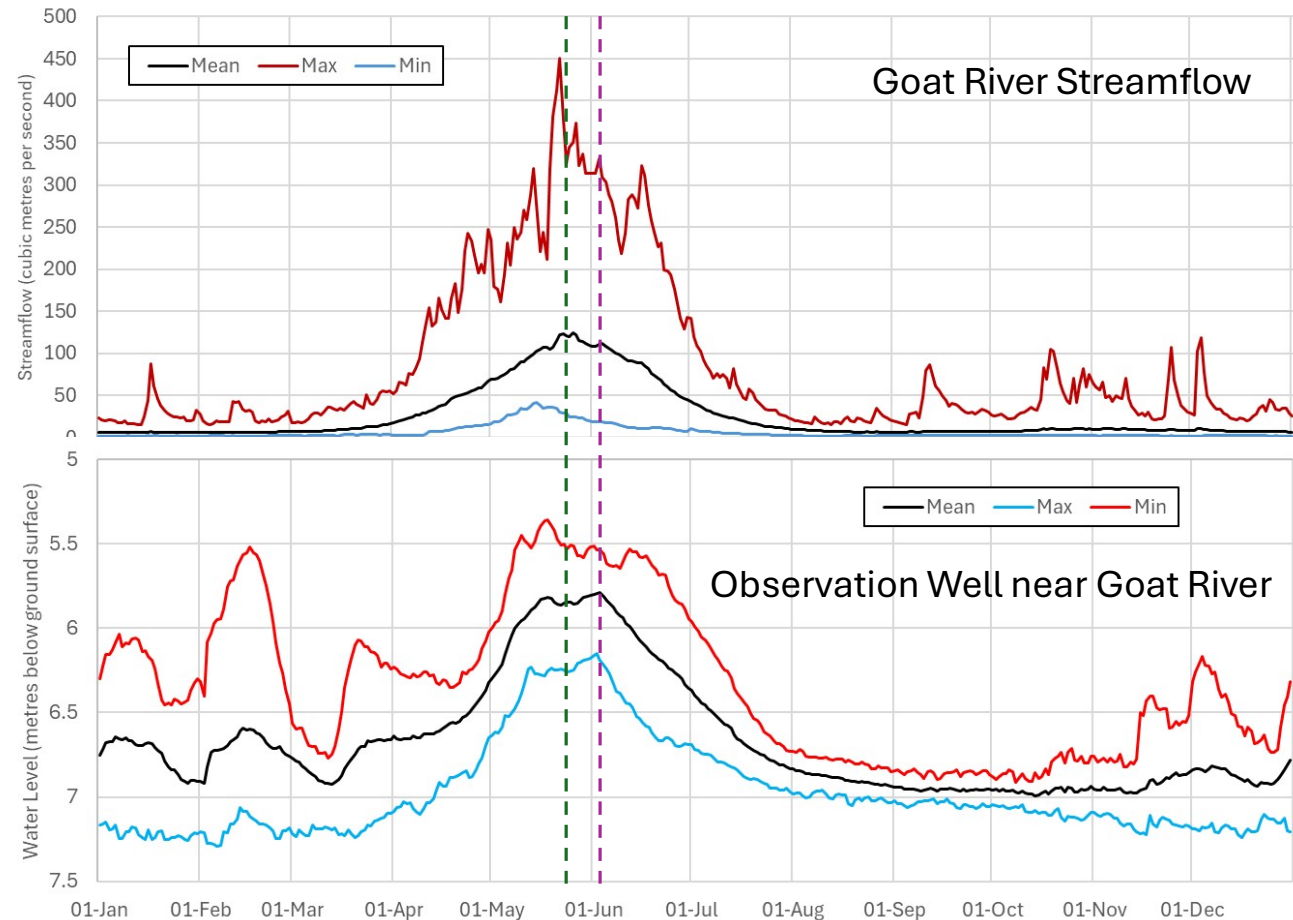
- Both driven by gravity and gradients (high to low)
  - Topography and geology/geomorphology
  - Seasonality

### Streamflow

- Measured at the lowest point in the watershed.
- Seasonality due to delivery of precipitation + E/ET, and water present in shallower and deeper flowpaths (baseflow)

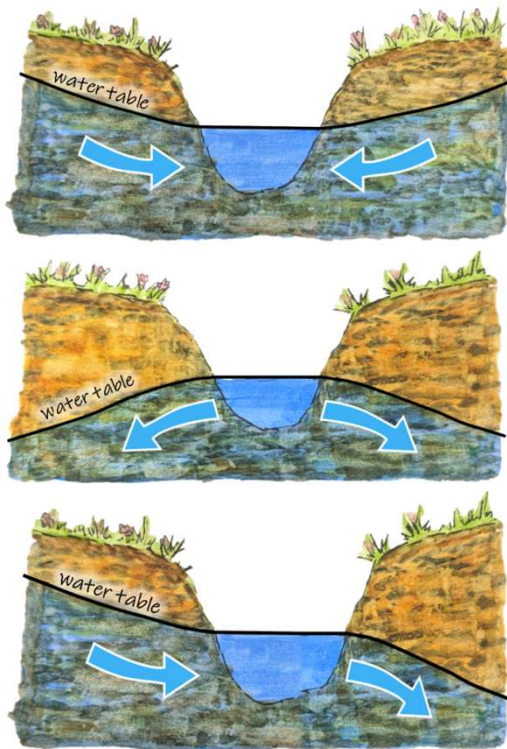
### Groundwater

- Measured at a point but is 3-dimensional flow
- Seasonality – indicates degree of connectivity to surface water

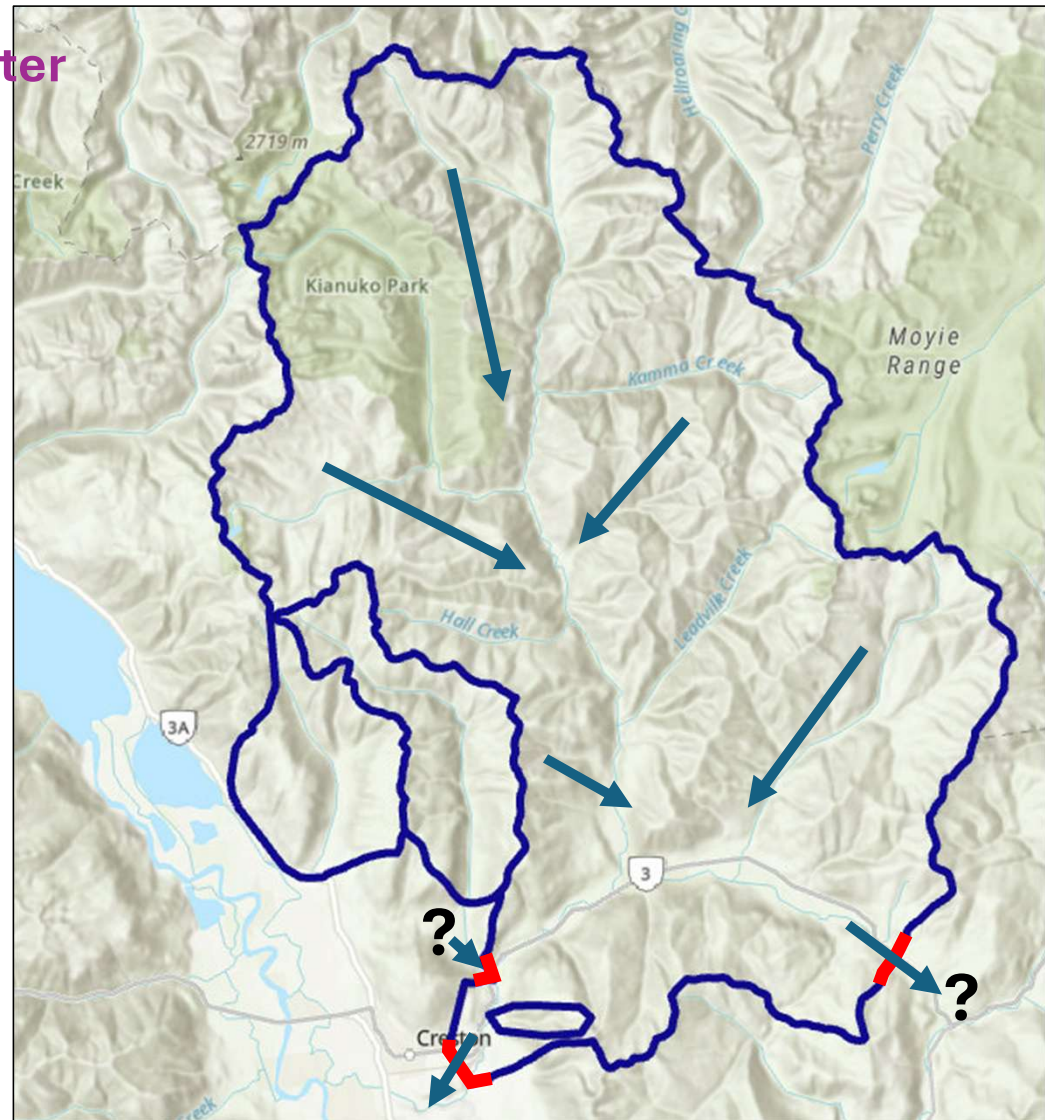


## INPUTS and OUTPUTS: Groundwater

- Driven by gravity and gradients (high to low)

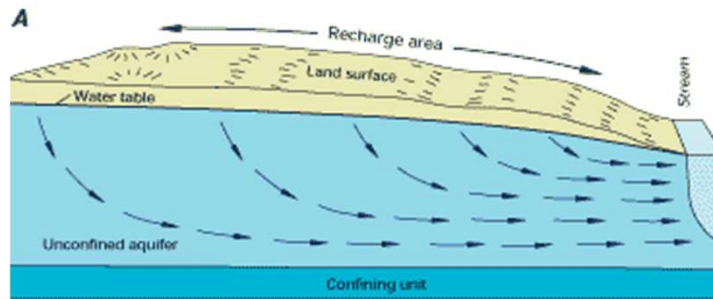


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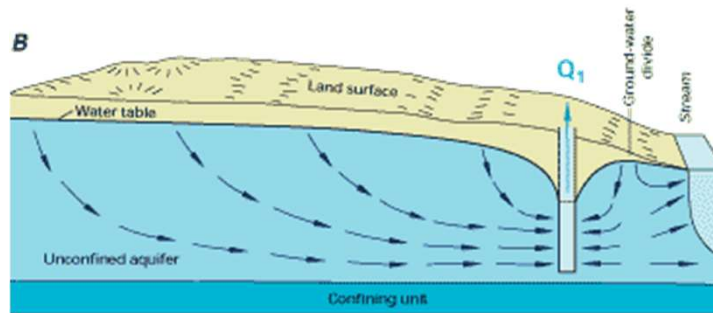


## Human Use - Wells

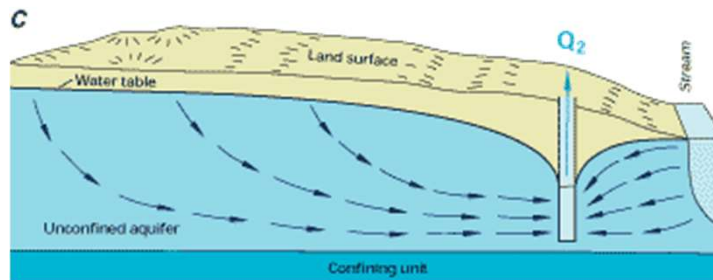
Natural flow pattern to stream



Pumping intercepts some water before reaching stream (lower streamflow)



Pumping intercepts groundwater and also pulls water from stream (lower streamflow)



[https://pubs.usgs.gov/circ/circ1186/html/gw\\_effect.html](https://pubs.usgs.gov/circ/circ1186/html/gw_effect.html)

## Land Cover and Land Use

### Forestry, Wildfire and Insects

- Tree removal/thinning → more snow accumulates → spring peak flow
- Immature trees more “thirsty”? → summer low flow
- Sediment from roads and landslides

### Mining

- Impact depends on footprint and activities
- Water use, storage or re-routing?
- Increased erosion?
- Year-round?
- Changes to water chemistry?

### Agriculture

- Diverts water from streams back to the atmosphere (depends on irrigation efficiency)
- Seasonal, varies year-to-year
- Also consider nutrients and chemicals