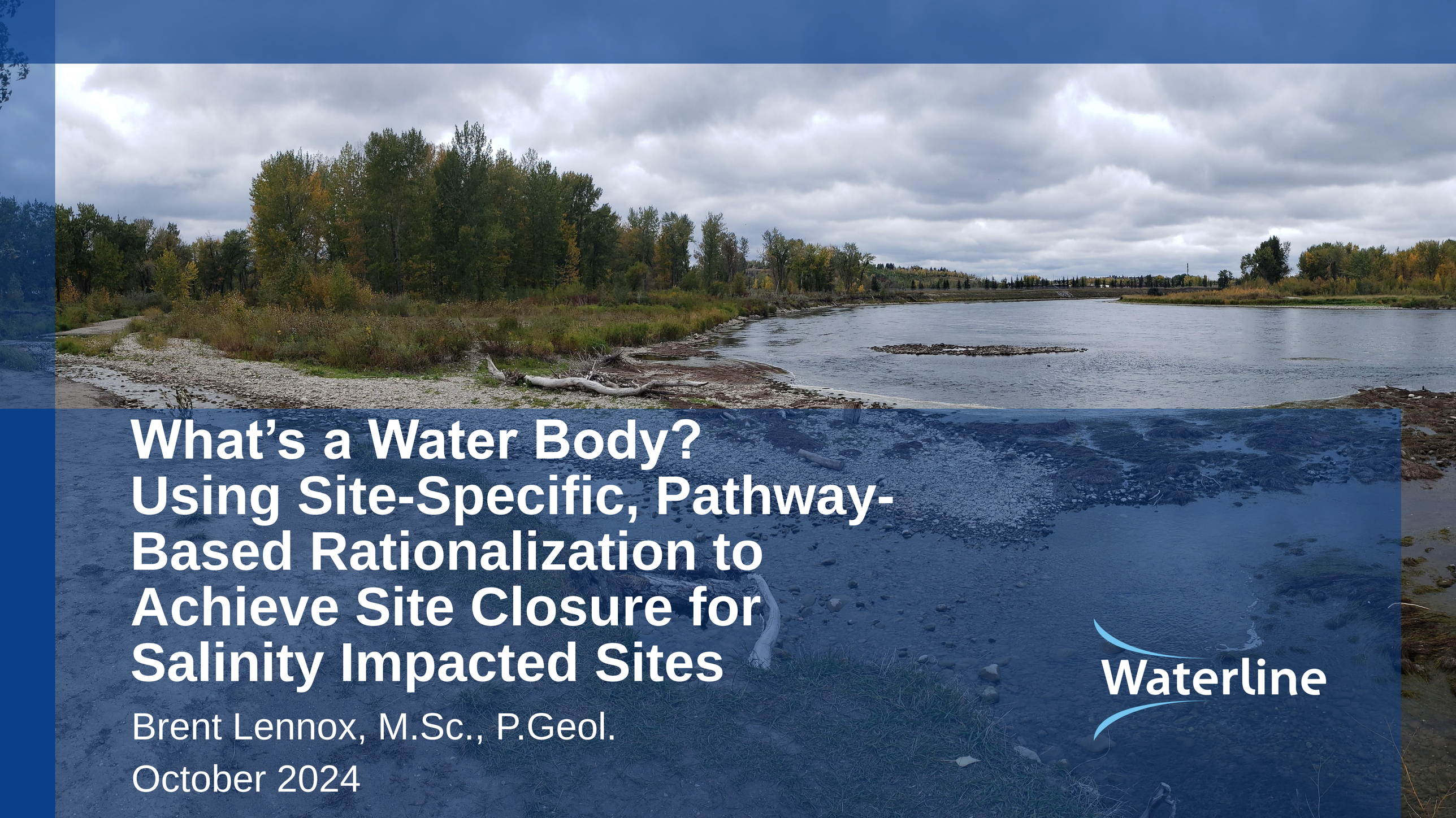


What's a Water Body? Using Site-Specific, Pathway-Based Rationalization to Achieve Site Closure for Salinity Impacted Sites

Brent Lennox, M.Sc., P.Geol.

October 2024

Waterline

Outline

Interactive Phone Activity

- Focus is on Alberta upstream oil and gas but has some universal applications

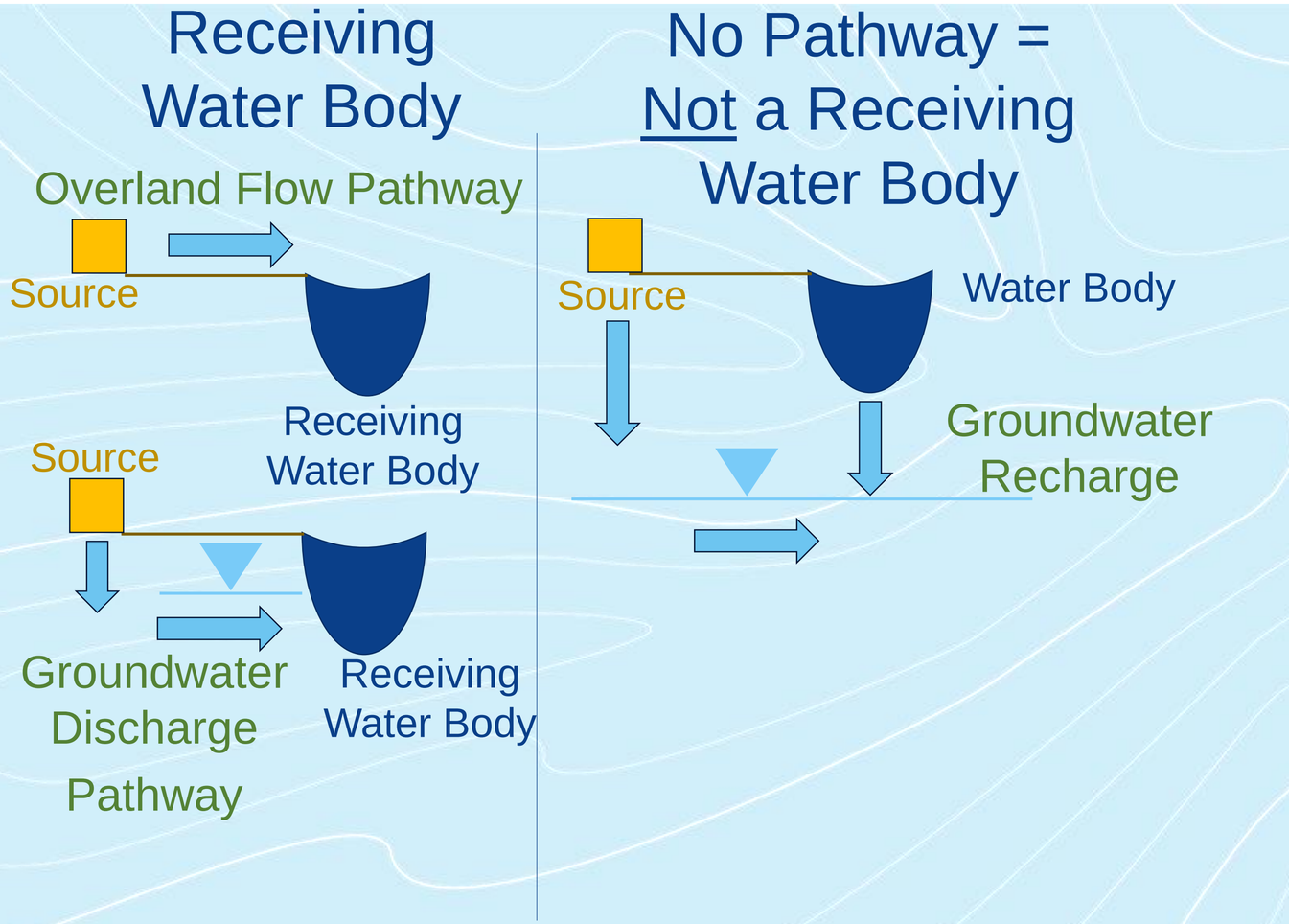
Concepts

Regulatory Guidance

Real-World Examples

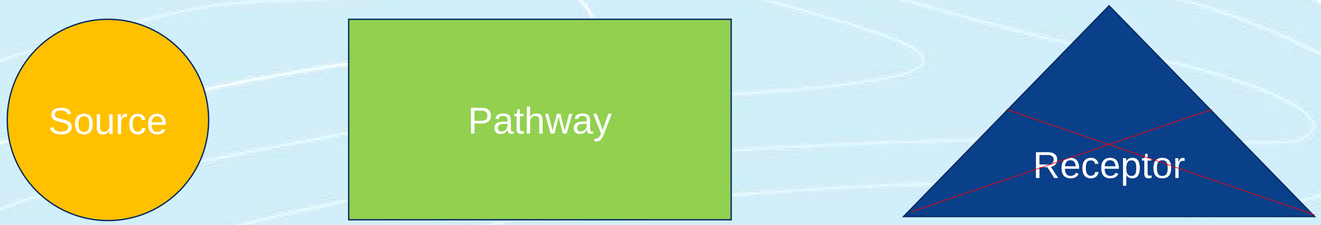
Receiving Water Body Concept

- Is the closest regionally mapped water body a receiving water body?
  - i.e., Is there a pathway between site impacts and the water body?

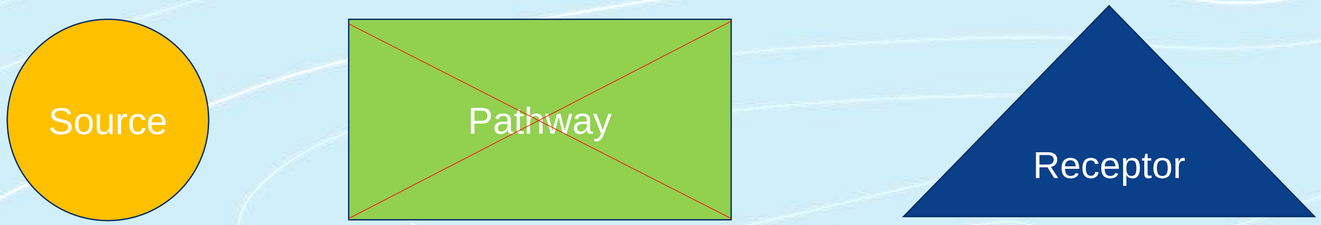


No Pathway = Negligible Risk

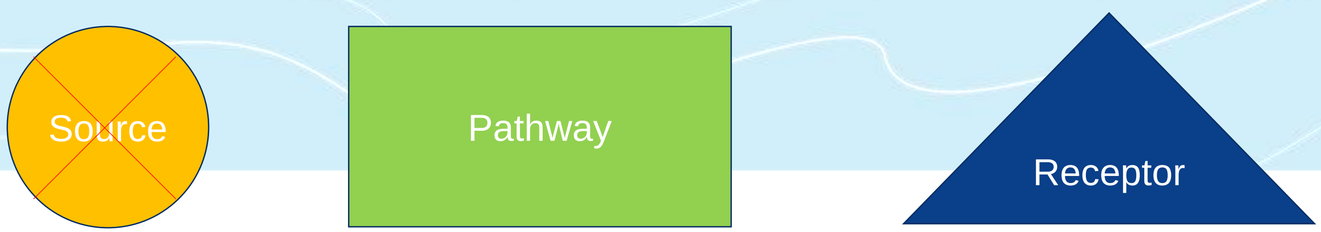
- Conceptual Site Model (Source, Pathway Receptor) thinking is needed
- There is negligible environmental risk if:
    1. The impacts will never reach the receptor



2. There is not a pathway between identified impacts and the receptor

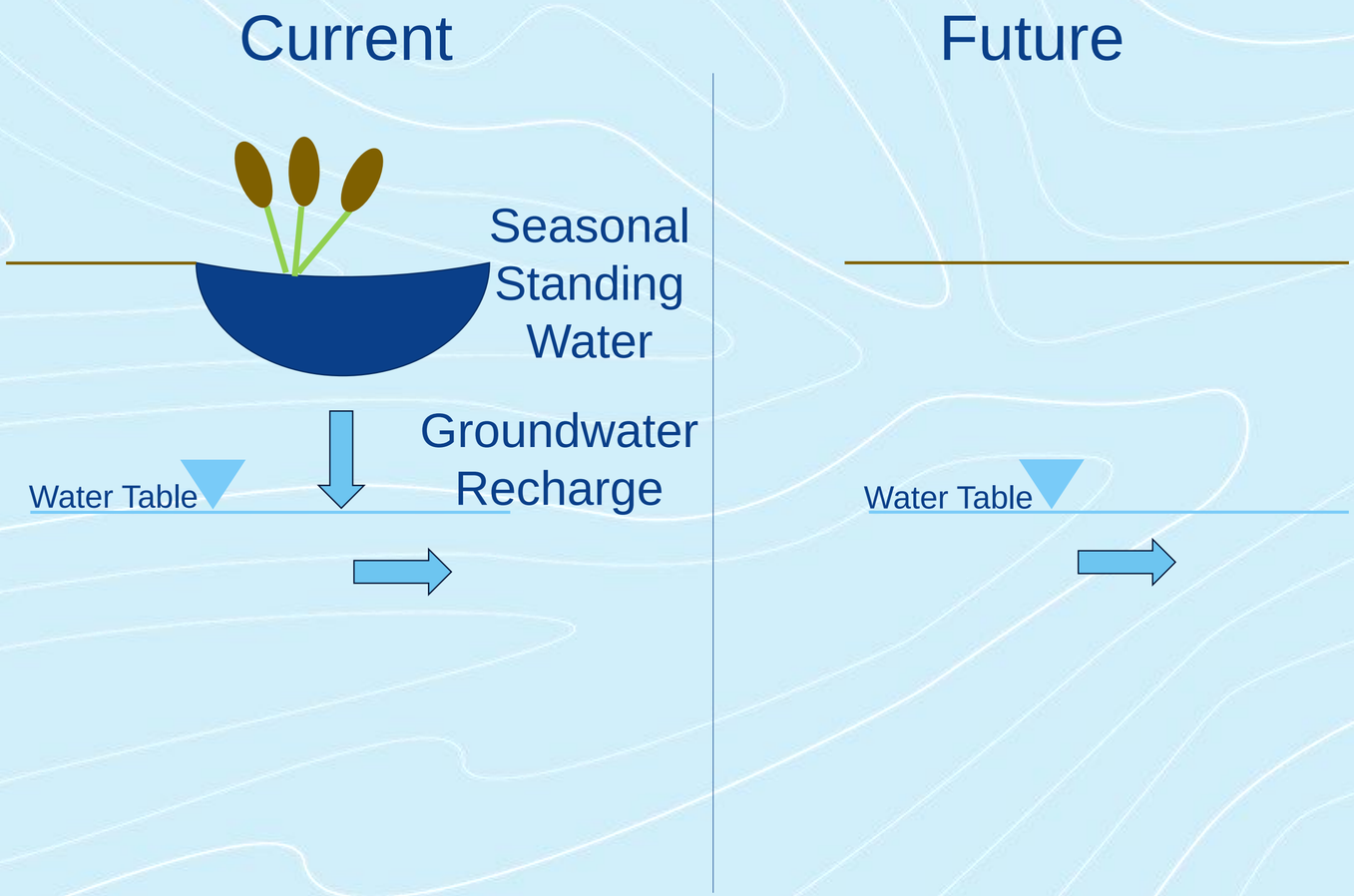


3. There are no identified sources in a Phase I ESA and it is confirmed by a Phase II ESA



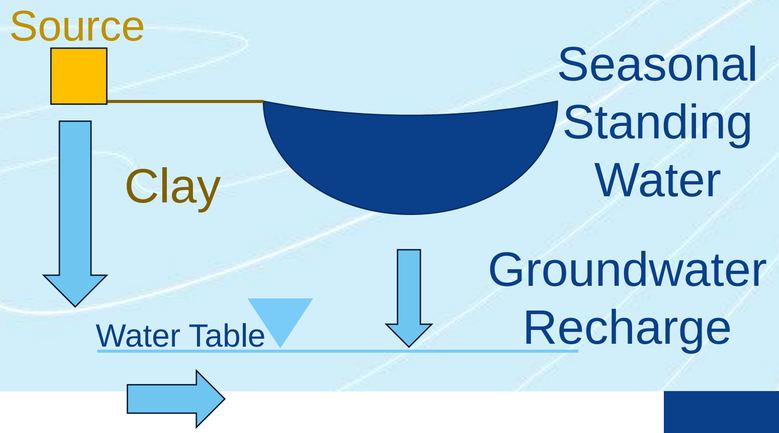
Is a Typical Man-Made Ditch a Receiving Water Body?

- Will be recontoured once the road is reclaimed
- A groundwater recharge feature
- Not a receiving water body



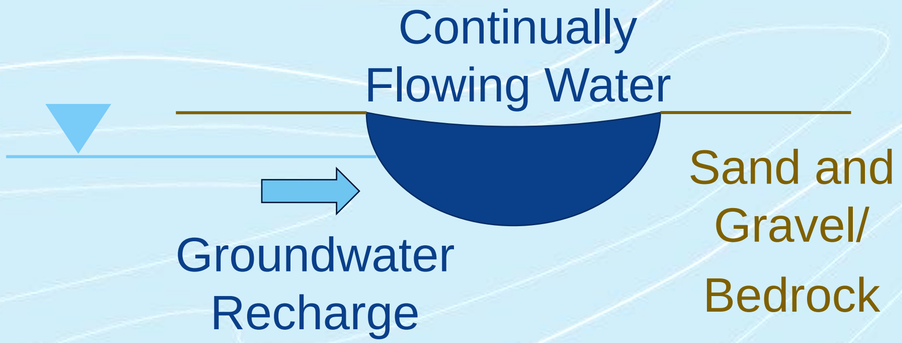
Typical Ephemeral Drainage Pathways

- Seasonally has intermittent, flowing water during the Spring freshet
- Often have discontinuous, standing water for the remainder of the year
- Often are underlain by fine-grained, low K sediments
- Typically a groundwater recharge feature (i.e., no pathway from the source to the ephemeral drainage pathway)



Typical Permanent Surface Water Bodies

- Continually flowing throughout the year
- Potential for groundwater discharge and a significant groundwater pathway is higher
- More often is surrounded by coarse-grained horizons and/or bedrock
- Likely receiving water bodies for most contaminated sites investigations, as there is typically a pathway between identified impacts and the receptor



Freshwater Aquatic Life (FAL) Regulatory Guidance for Salinity

Category	Alberta	Saskatchewan
Regulatory Approaches	• Minor exceedance justifications • Predominately relies on the SubSoil Salinity Tool • Numerical modelling guide	• More “generic” guidance/rules of thumbs for the FAL pathway (Directive PNG045) • Also site-specific rationalizations (e.g., SubSoil Salinity Tool)
Pathway-Based Rationalizations Accepted?	• Yes, but limited guidance on routine Tier 2 approaches using pathway-based rationalizations	• Yes, with guidance on routine approaches on pathway-based rationalizations (Directive PNG045)
Point of Compliance	• Where groundwater discharges into a FAL receptor	• The water body itself
Surface Water Body Mixing Term	• Does not consider mixing in a surface water body	• Considers mixing of groundwater in a surface water body
Seasonal vs. Permanent	• Seasonal and permanent water bodies are considered to be receiving water bodies • Limited generalized guidance about the definition of seasonal vs. permanent water bodies from a contaminated sites perspective	• Seasonal water bodies may be excluded from consideration except when they are connected to permanent water bodies • Need to consider permanent water bodies

Freshwater Aquatic Life (FAL) Regulatory Guidance for Salinity

- Pros and cons of the PNG045 Saskatchewan guidance vs. Alberta

Pros	Cons
Practical, relatively simple	Assumes a small (<25 m) impacted area
Can be applied by most practitioners using generic guidance	Less conservative (e.g., ephemeral water bodies with relatively greater groundwater contributions)
Avoids access issues to verify groundwater-surface water interactions at water bodies that may be on another property and 100s of metres from the site	Focus on connection between ephemeral and permanent water bodies. Is it the right focus?
Lower assessment costs and more sites progressing to closure	Engineered and administrative mitigation measures may not be a long-term solution for plumes with long timespans

- Can we find the perfect balance between realism vs conservatism/generic vs. site-specific regulatory for salinity-impacted sites?

Alberta Water Bodies

- High level numbers for perspective sharing
- Tables below give the percentage of water bodies within 300 m and 100 m of abandoned and suspended wells in all of Alberta, where the following was considered:
  - 200 m buffers around the oil and gas well to approximate the lease
  - Does not consider downslope or cross-slope locations

WATER BODIES WITHIN 100 m		
CATEGORY	TOTAL	PERCENTAGE
WELLS	406,905	
PERMANENT	**51,984**	**13%**
EPHEMERAL	146,650	36%
WETLANDS	294,552	72%
ANY WATER	333,446	82%

WATER BODIES WITHIN 300 m		
CATEGORY	TOTAL	PERCENTAGE
WELLS	406,905	
PERMANENT	93,437	22.96%
EPHEMERAL	**222,400**	**54.66%**
WETLANDS	**342,683**	**84.22%**
ANY WATER	376,953	92.64%

- Whether we consider wetlands or ephemeral water bodies is an important consideration for many sites

Notes:

- Ephemeral water bodies include water types such as recurrent lakes, recurrent oxbows, etc.
- Any water includes permanent, ephemeral, and wetlands
- Datasets include Altalis water bodies data, Alberta merged wetland inventory,

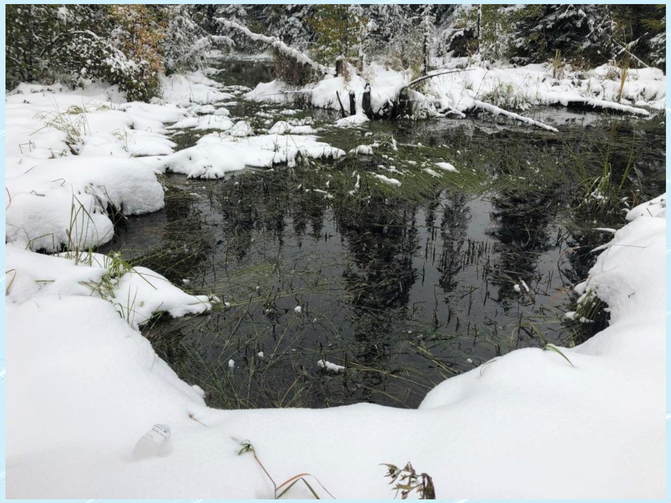
Perspectives on Current Alberta Guidance

- Pathway-based rationalizations for FAL pathways often not applied (or variably applied) in the environmental industry in Alberta due to:
  - Uncertainty about whether the closest regionally mapped ephemeral water body or wetland is a receiving water body or not
  - Scale of contamination may not justify the expense of understanding whether a water body is receiving or not on a site-specific basis

- However, some sites justify additional conceptual site model development and investigation, as outlined in the following examples

Site #1 Example: Photographs

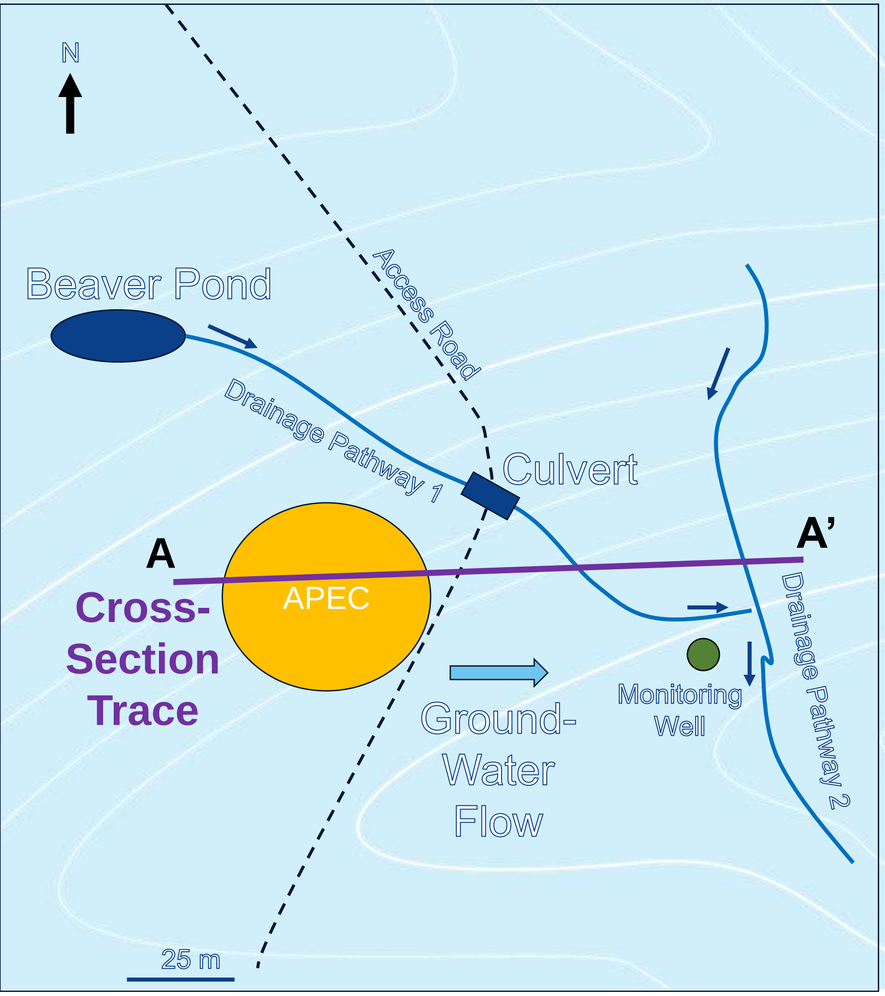
Beaver Pond (Upgradient)



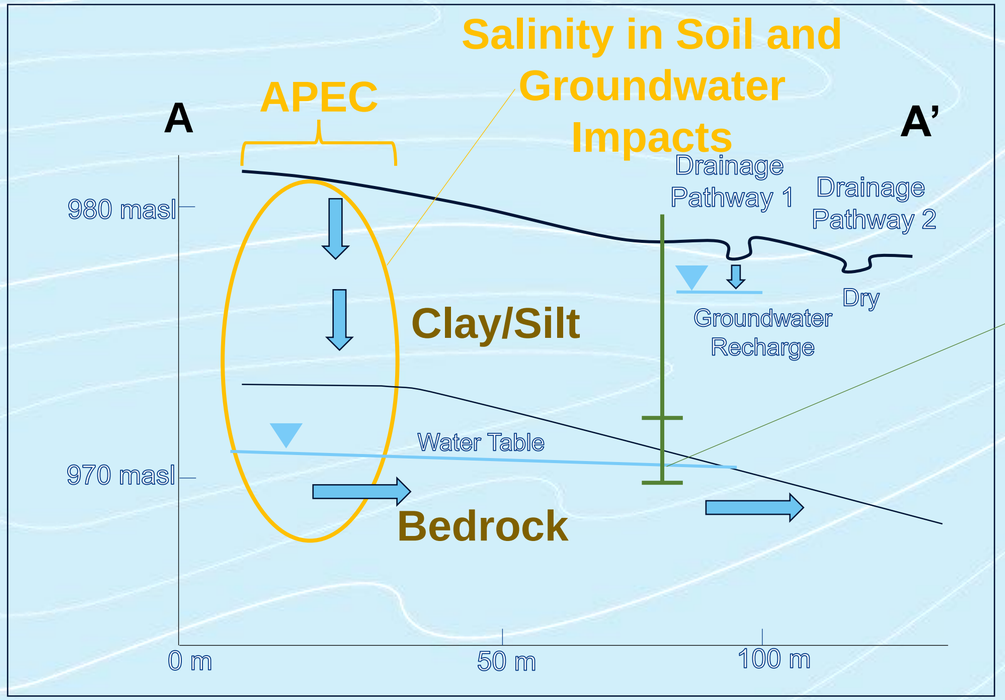
Culvert at the Middle of the Site

Site Overview
(Drainage Pathway is Difficult to Distinguish)

Site #1 Example: Site Plan and Cross-Section



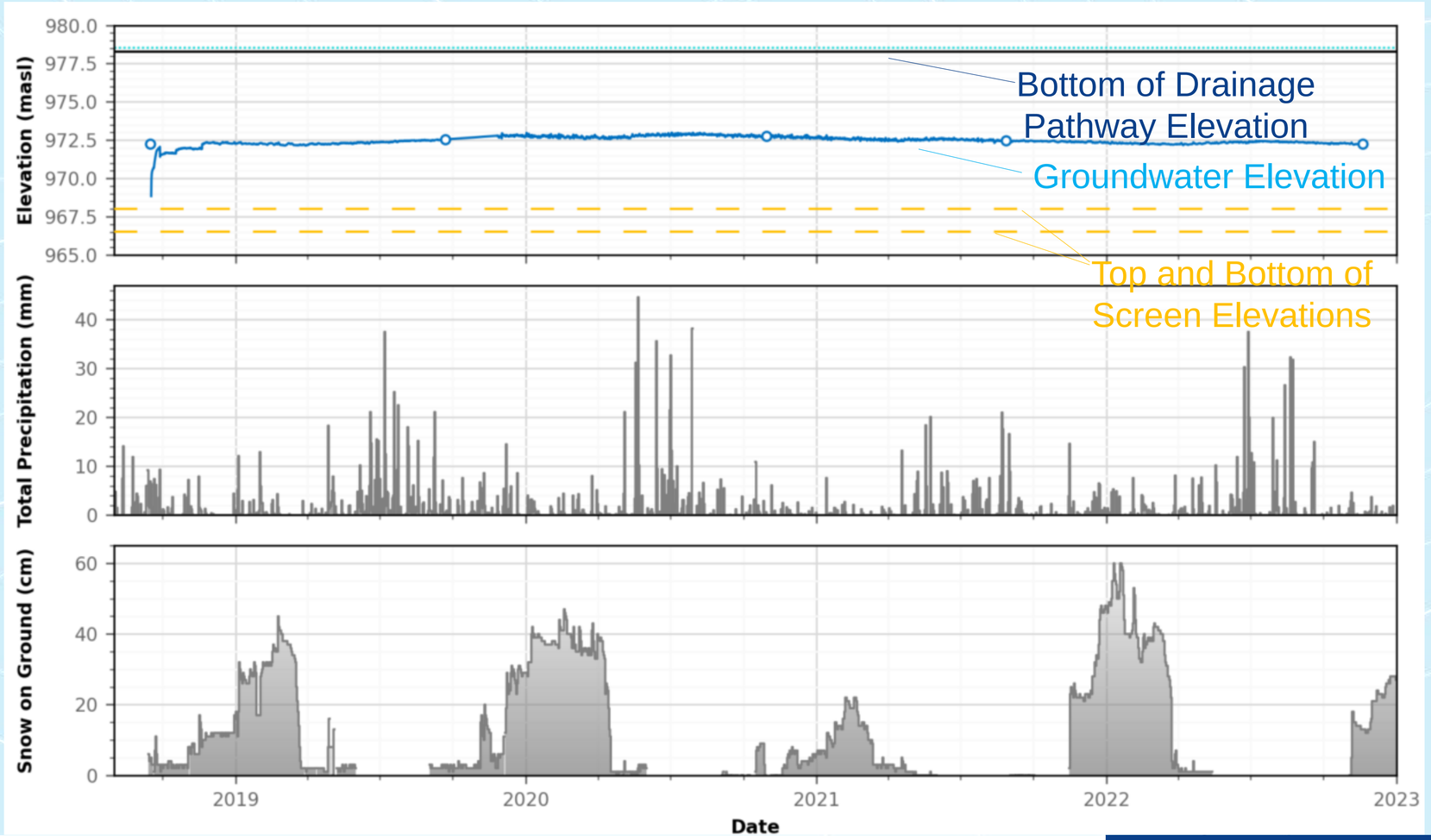
- No pathway between identified impacts and on-lease drainage pathways



Monitoring Well (Hydrograph)

Site #1 Example: Monitoring Well Hydrograph

- Deep water table not sensitive to precipitation events or Spring freshet
- Water table never intersects the drainage pathway



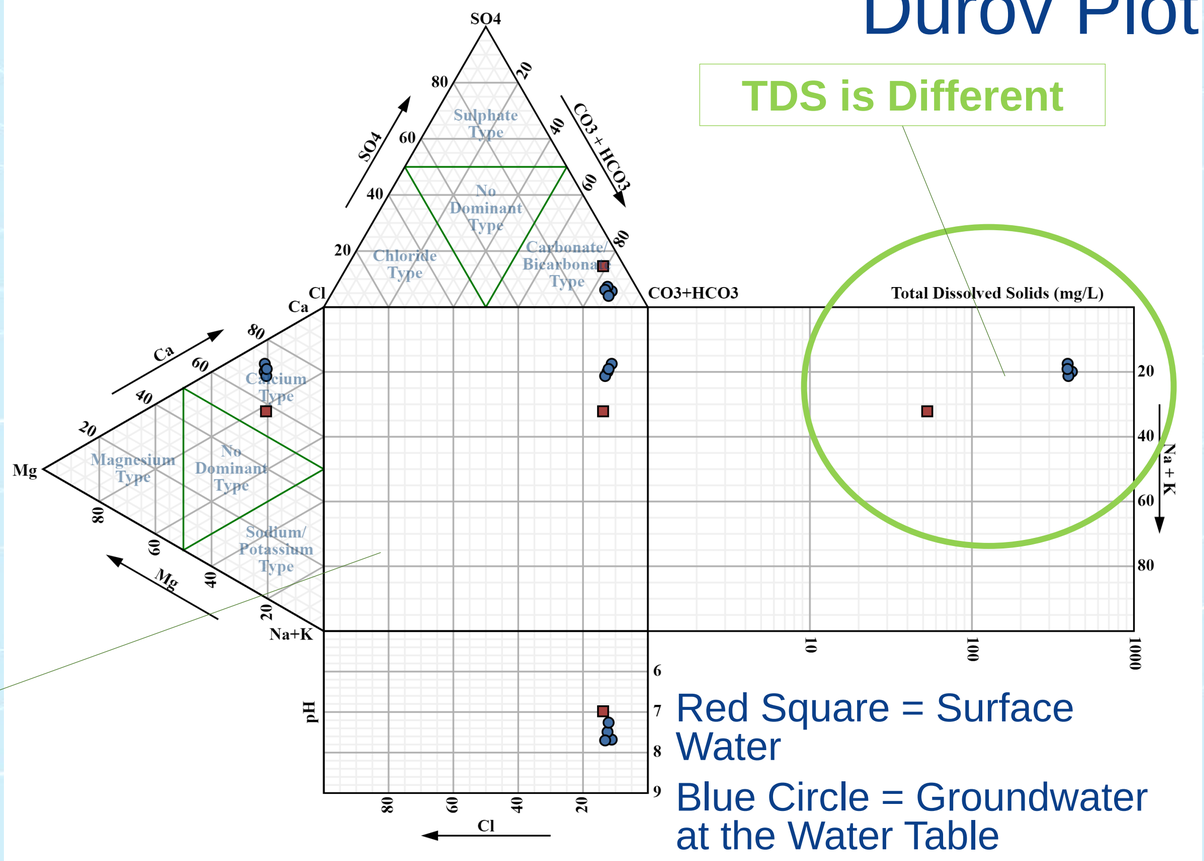
Site #1 Example: Chemistry

Surface Water	Groundwater
Total Dissolved Solids = 25 mg/L	Total Dissolved Solids = 430 mg/L
pH = 9	pH = 7.5
Calcium carbonate water type	Calcium carbonate water type

Major Ion Chemistry is Similar and Typical of Shallow Water

Durov Plot

TDS is Different



Red Square = Surface Water

Blue Circle = Groundwater at the Water Table

Site #2 Example

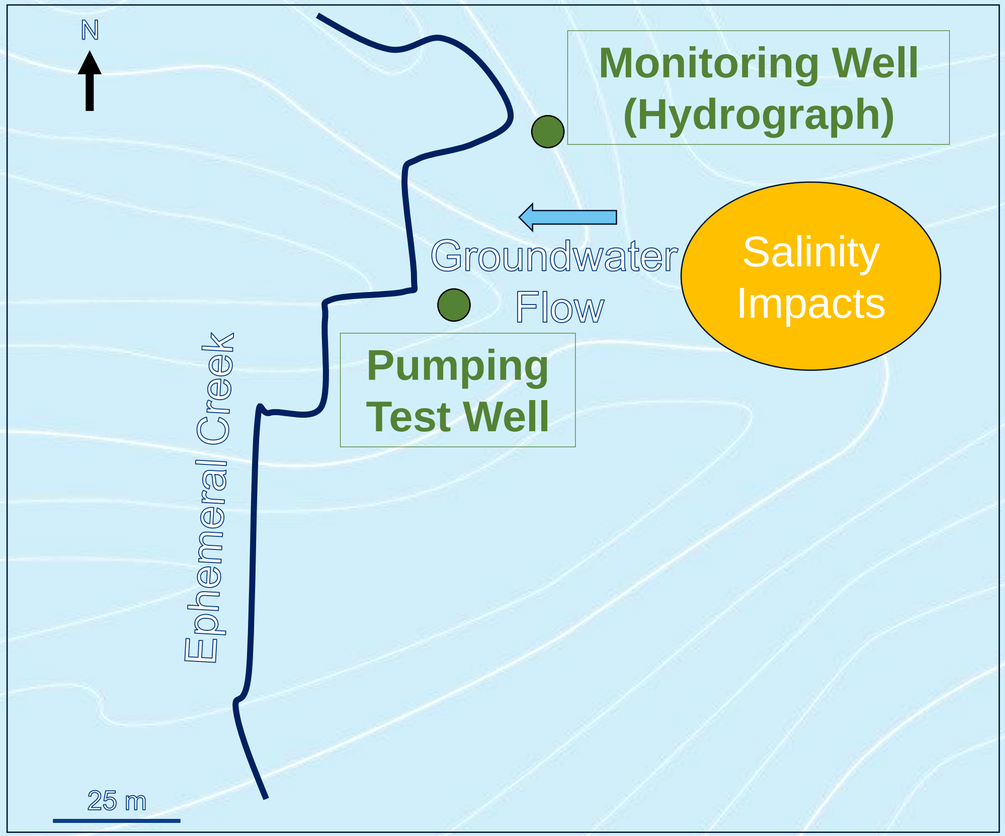
- Ephemeral creek often has seasonal standing water or standing water in the Spring and early Summer

Ephemeral Creek (July 2022)

Ephemeral Creek (May 2024)

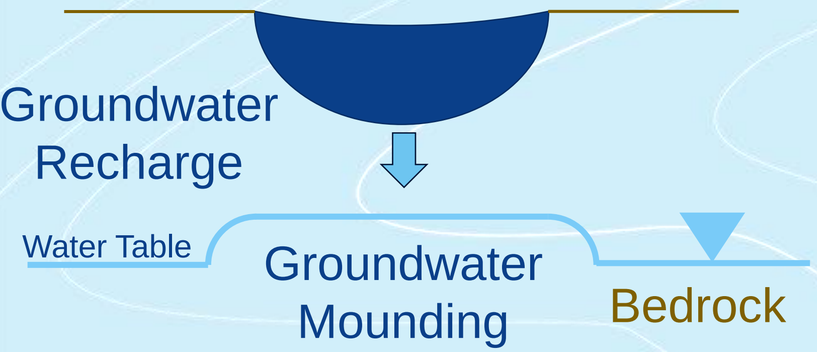
Site #2 Example: Site Plan

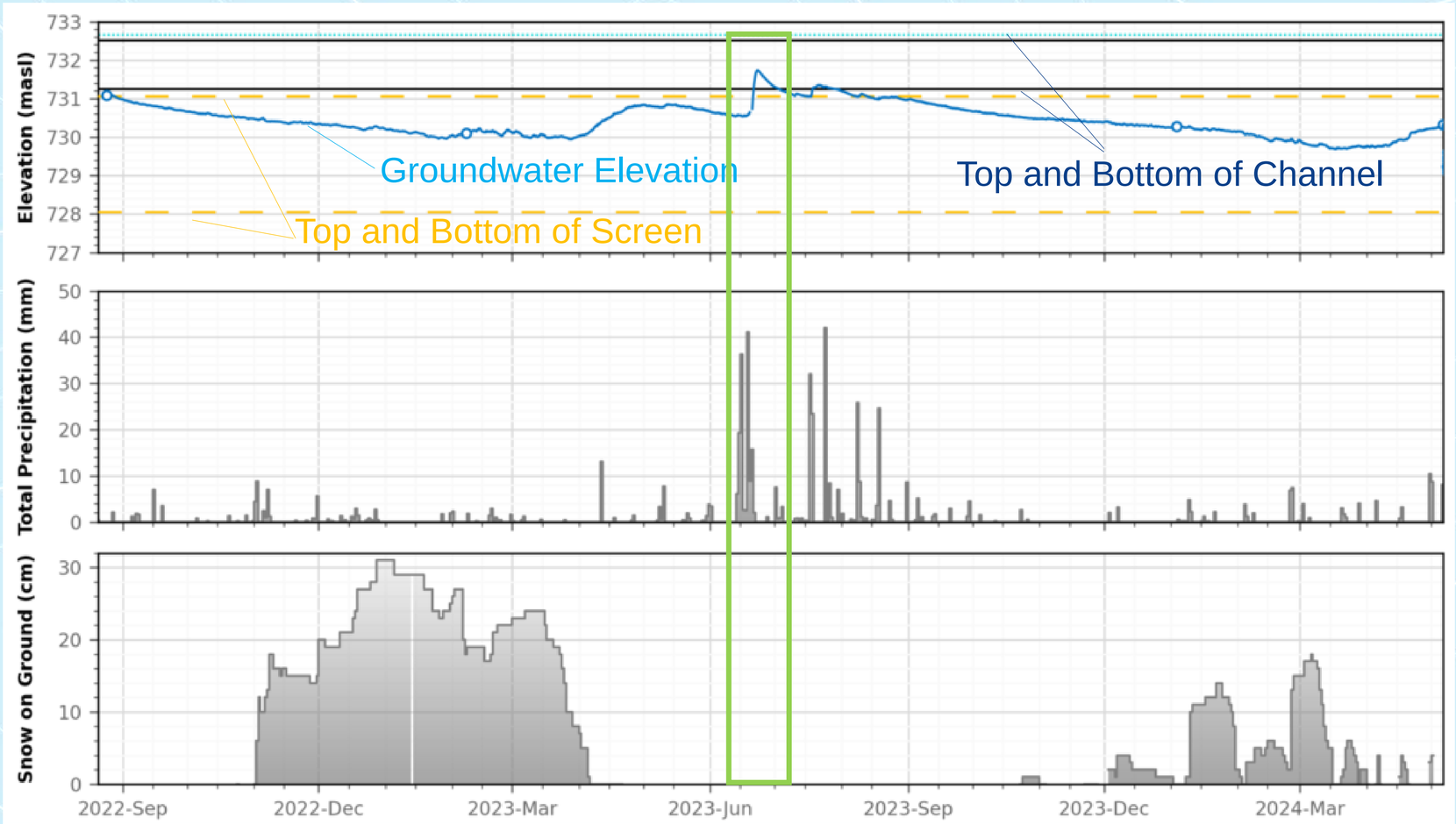
- Governing pathway would be the freshwater aquatic life pathway
- SST cannot be applied if the ephemeral creek is a water body
- Next closest water body is 100s of metres from the site



Site #2 Example: Hydrograph

- Groundwater elevations generally below the bottom of channel elevation
- Not a strong correlation between groundwater levels and precipitation
- Except during extreme precipitation events in the Spring freshet, when groundwater mounding and recharge is occurring





Site #2 Example: Pumping Test

- Pumping could not be sustained for >13 minutes
- The hydraulic conductivity of the screened bedrock was 10^{-8} m/s
- No positive boundary (water level increase during pumping test) was identified, which would indicate connectivity between surface water and groundwater
- Based on the weight of evidence, there is not a pathway between identified impacts and the recurrent creek

Questions?

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