Integrating Multiple Data Streams to Refine a Conceptual Site Model

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SMA Saskatchewan Mining Association

SMA Environmental Forum

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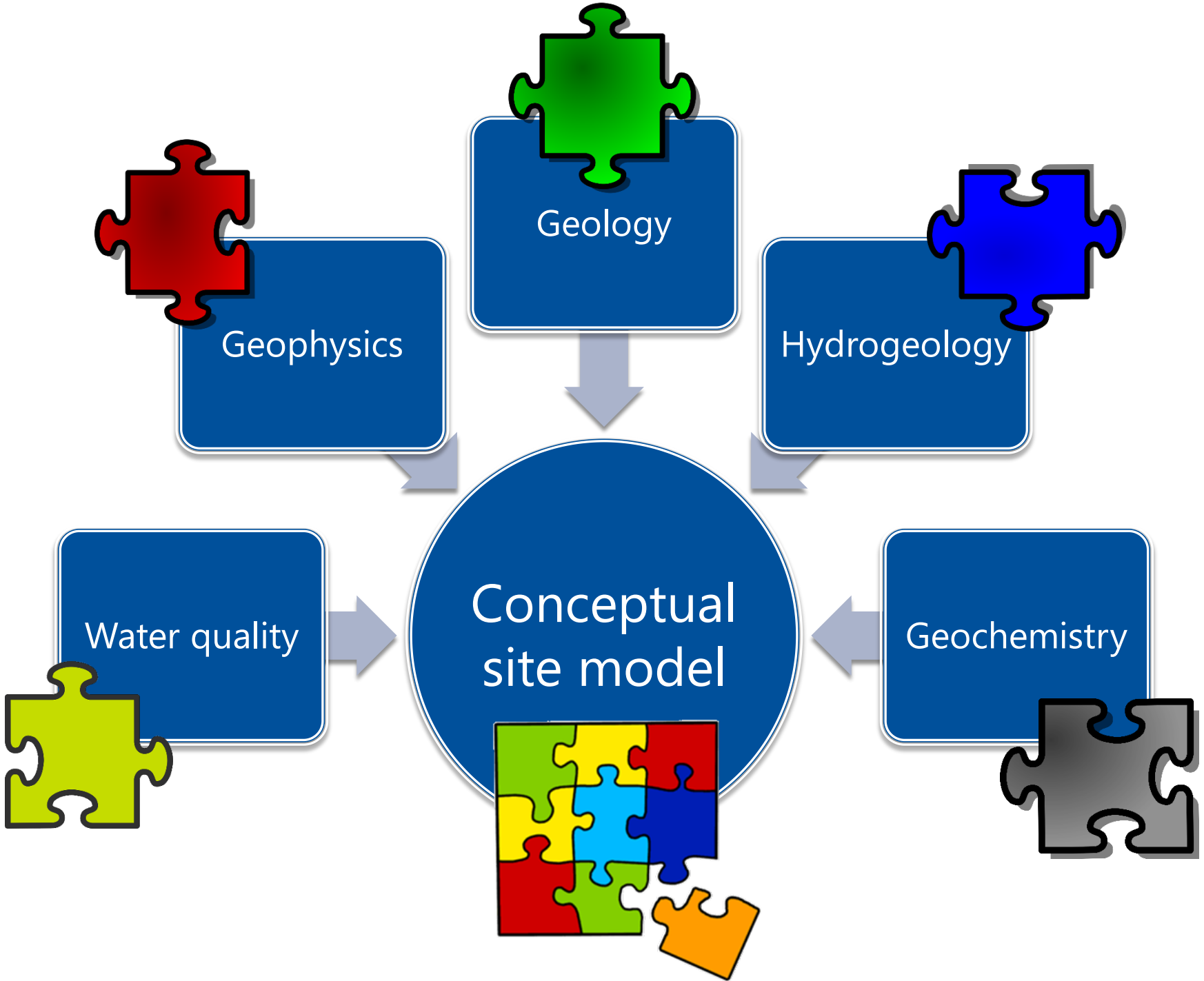
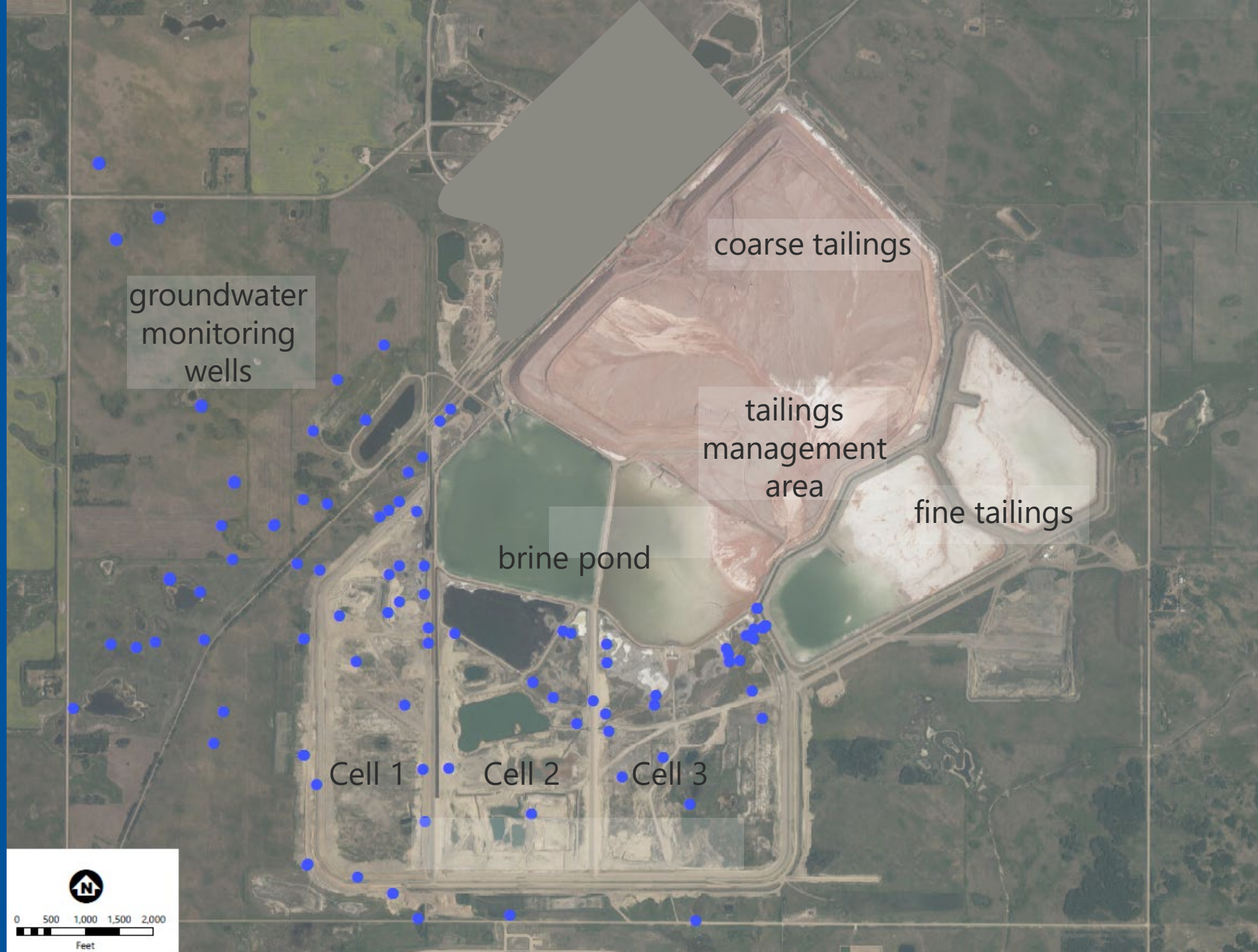
Piecing it together

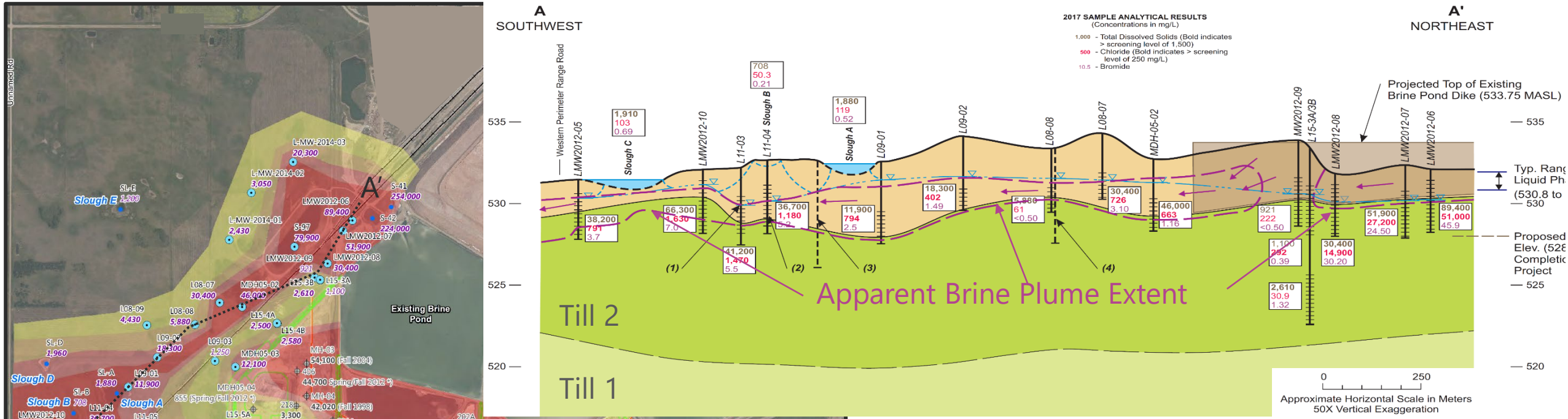


Site background

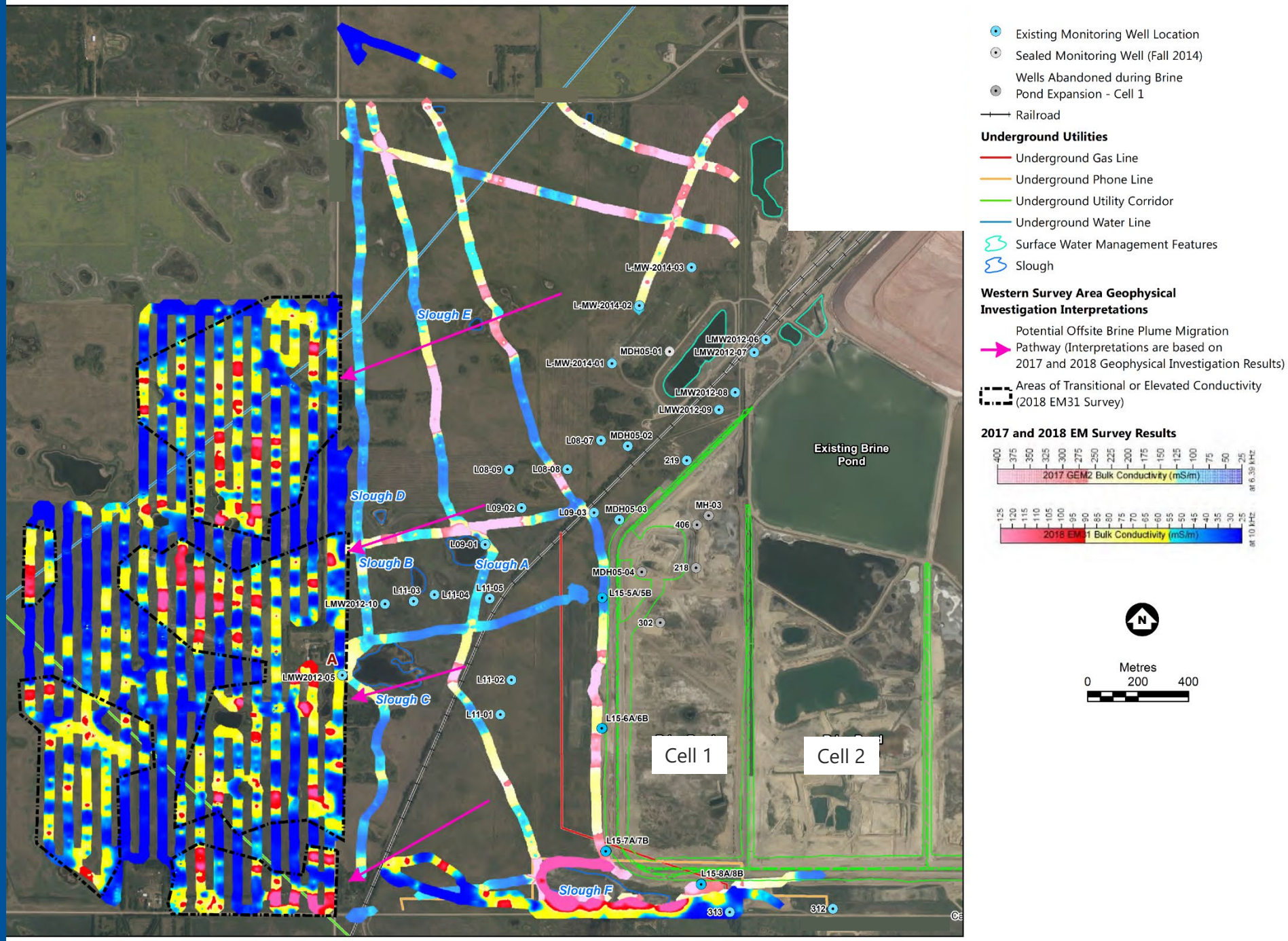
- **Location:** North American prairie
- **Facility:** tailings and Na-Cl-dominated brine storage
- **Aquifer:** surficial deposits over glacial till
- **Environmental concern:** brine migration through shallow aquifer



2017 total dissolved solids (TDS) and chloride plume interpretation

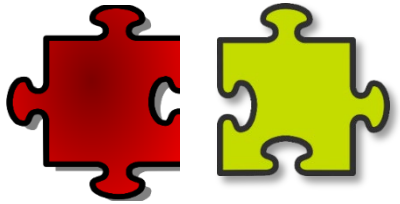


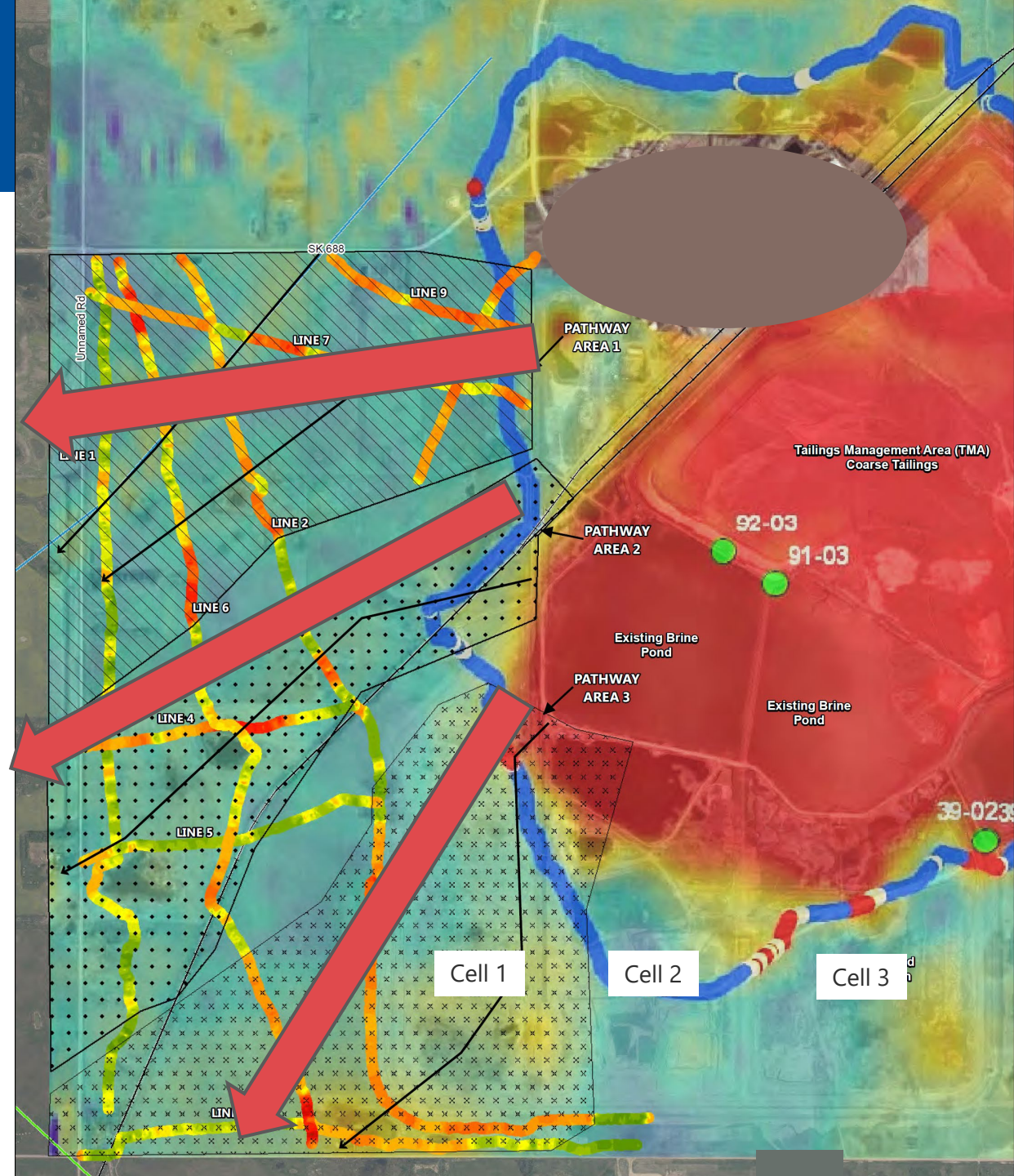
Electromagnetic survey results



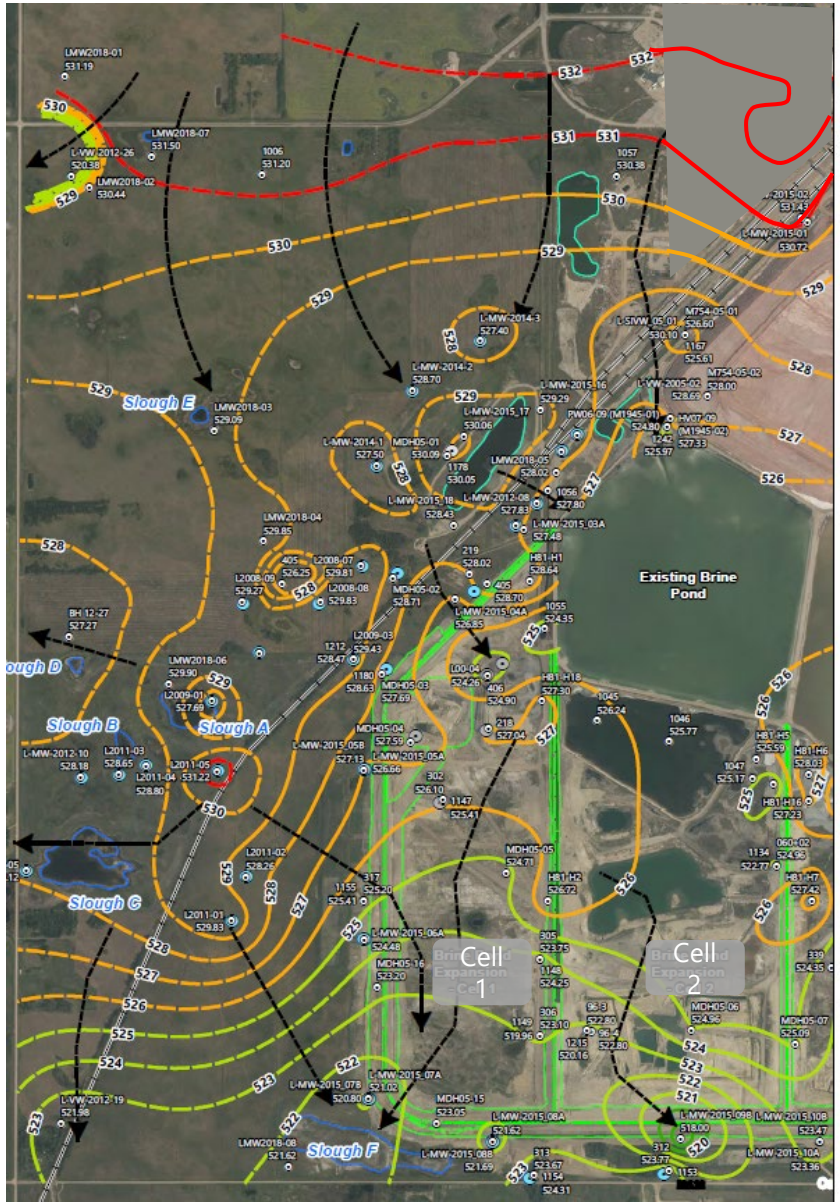
2017 preliminary CSM

- Elevated concentrations of TDS, Cl were observed within upper stratified surficial deposits
- Areas of high conductivity indicated by geophysical EM surveys
- Brine pond appeared to be the source of groundwater impacts
- Three potential migration pathways were interpreted





Top of till contours and local groundwater flow



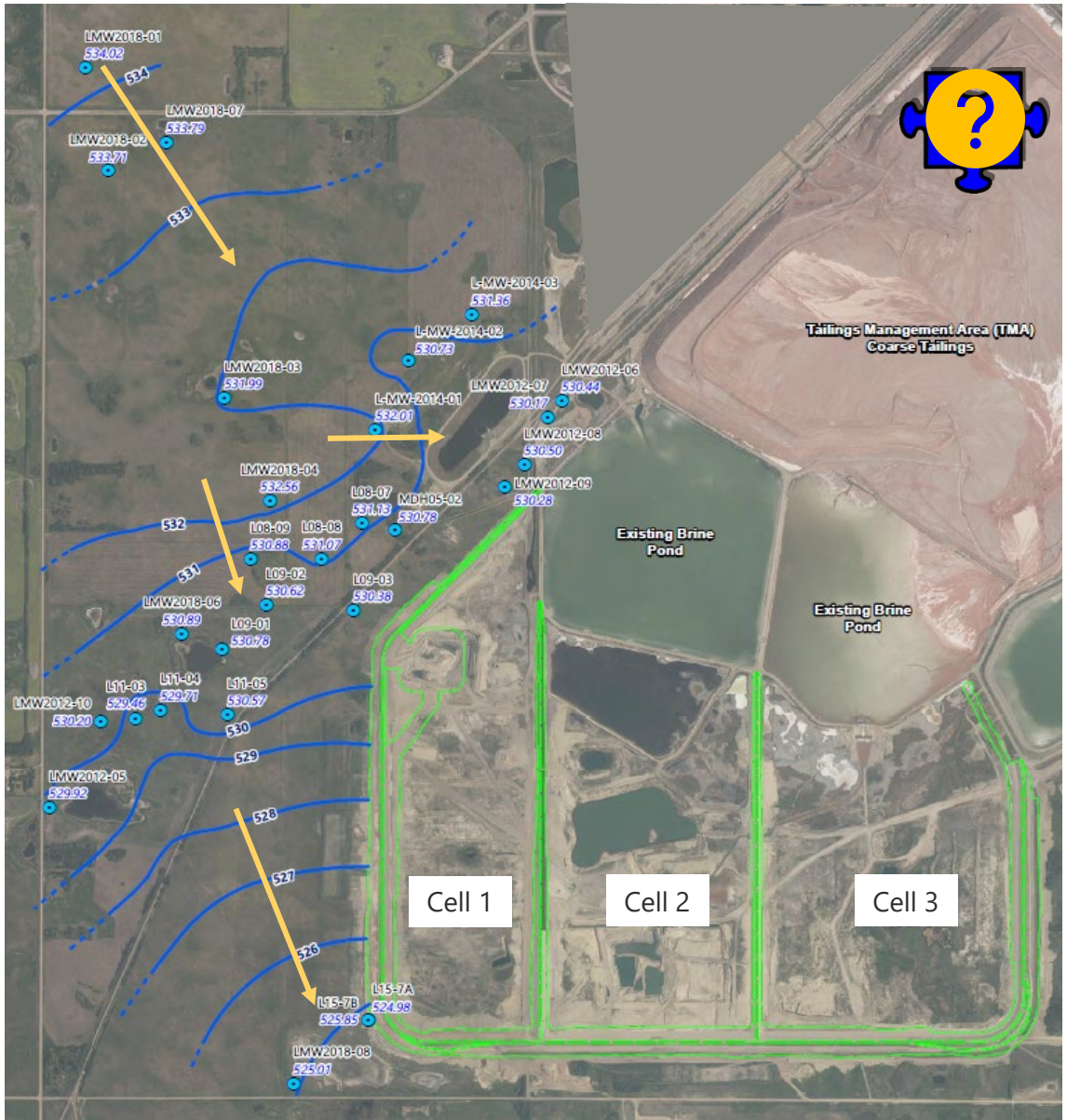
- Till Elevation Data Points
- Existing Monitoring Well Location
- Sealed Monitoring Well (Fall 2014)
- Wells Abandoned during Brine Pond Expansion - Cell 1
- Railroad
- Surface Water Management Features
- Slough
- Interpreted Slope Direction (based on glacial clay till topography)

Top of Till Elevation - Meters above Mean Sea Level (MASL) - 1m Contours

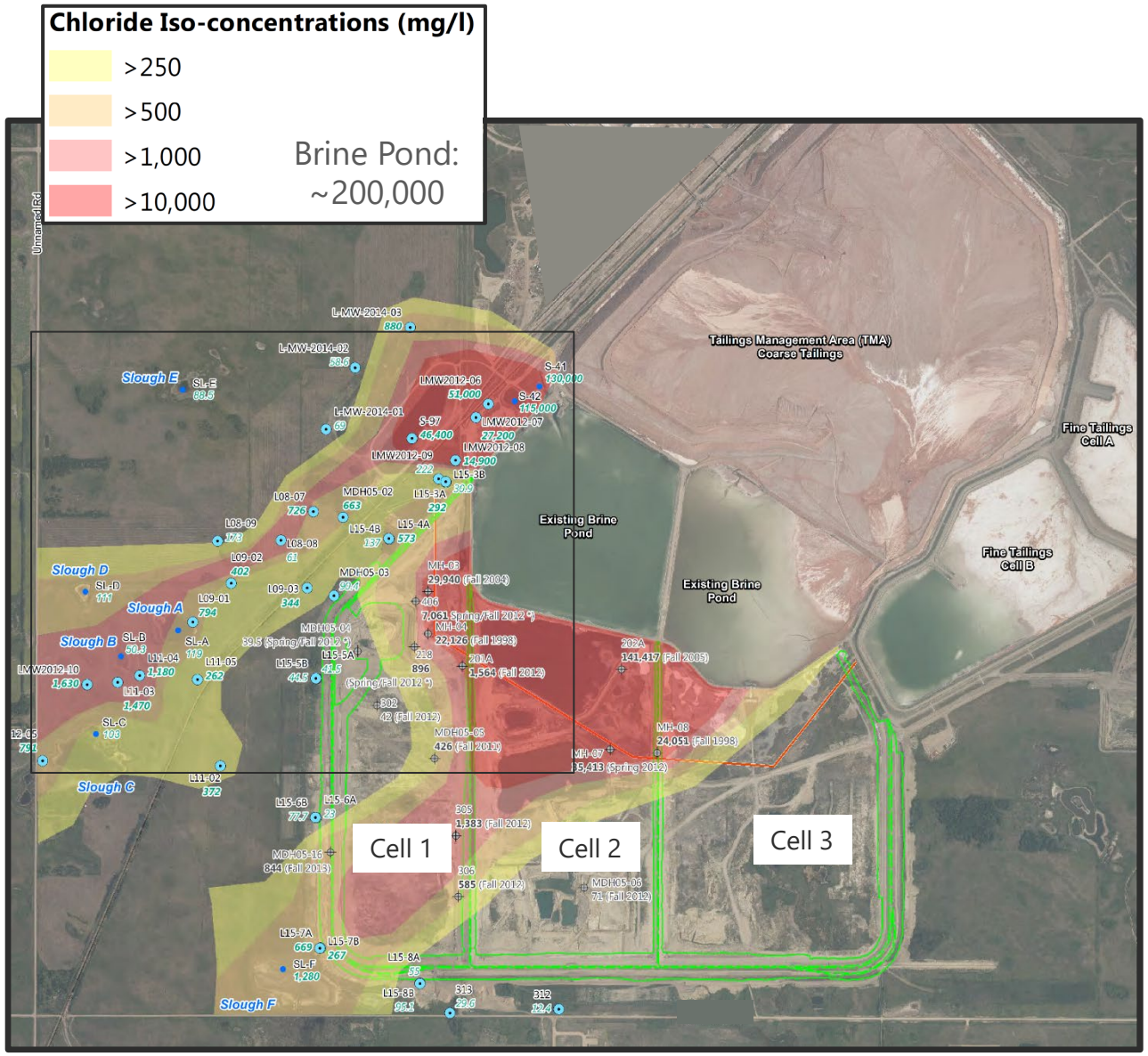
Contours dashed where inferred (sparse elevation data)

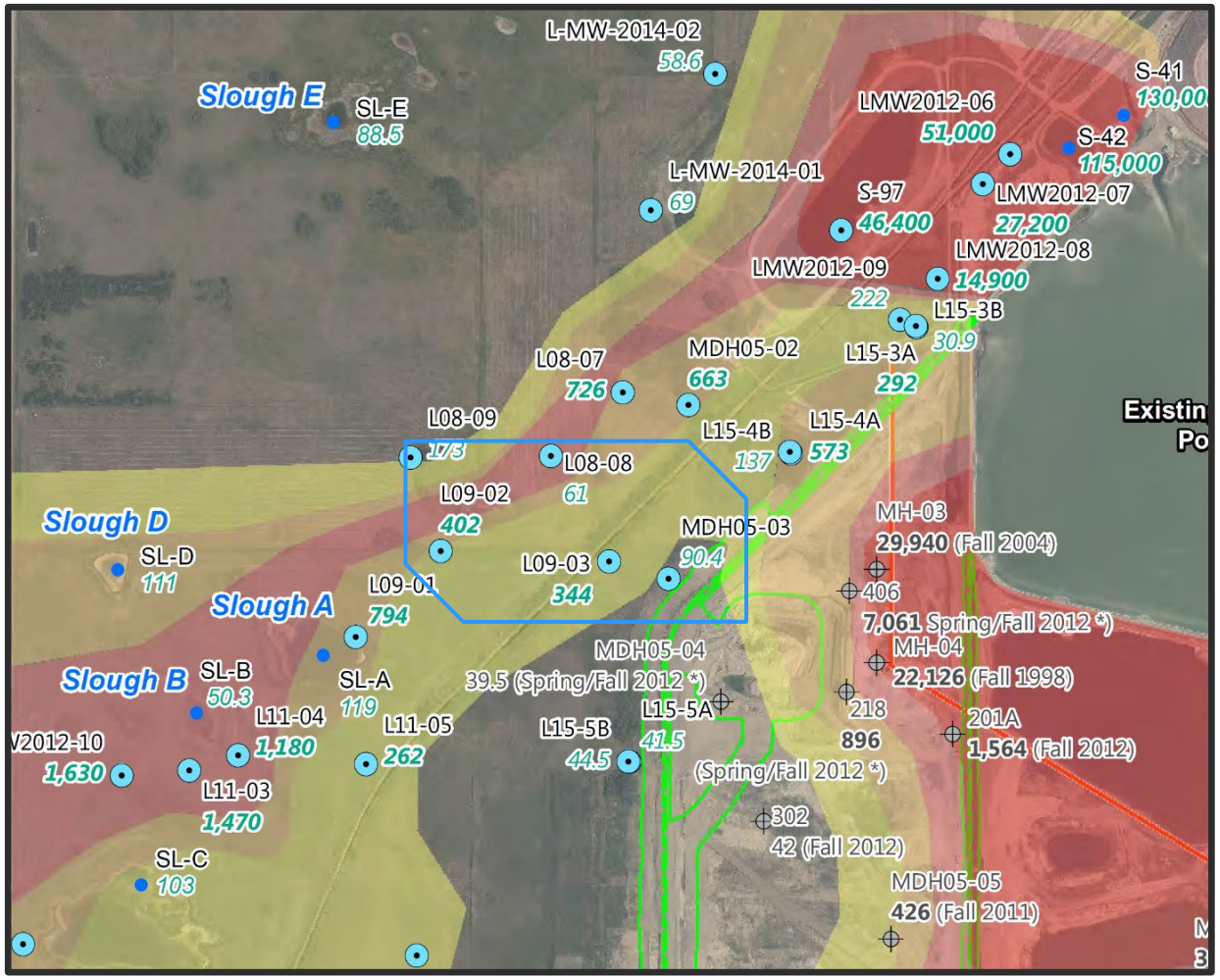
- 515 - 520
- 520 - 525
- 525 - 530
- 530 - 535

Metres
0 200 400



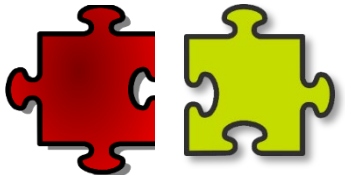
A closer look at chloride





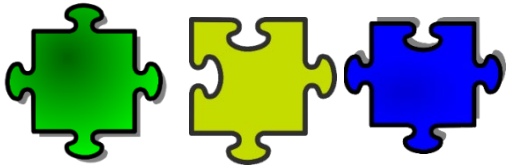
Disconnect in CSM

ON ONE HAND…



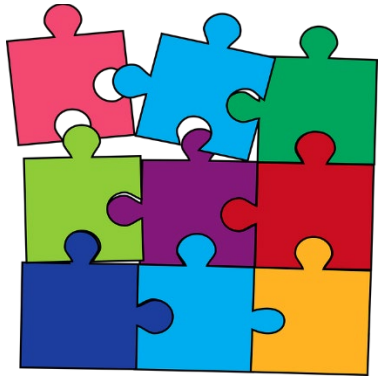
- TDS plume suggests brine pond leak to W-SW
- Potential pathways/conduits suggested by geophysical results

BUT…



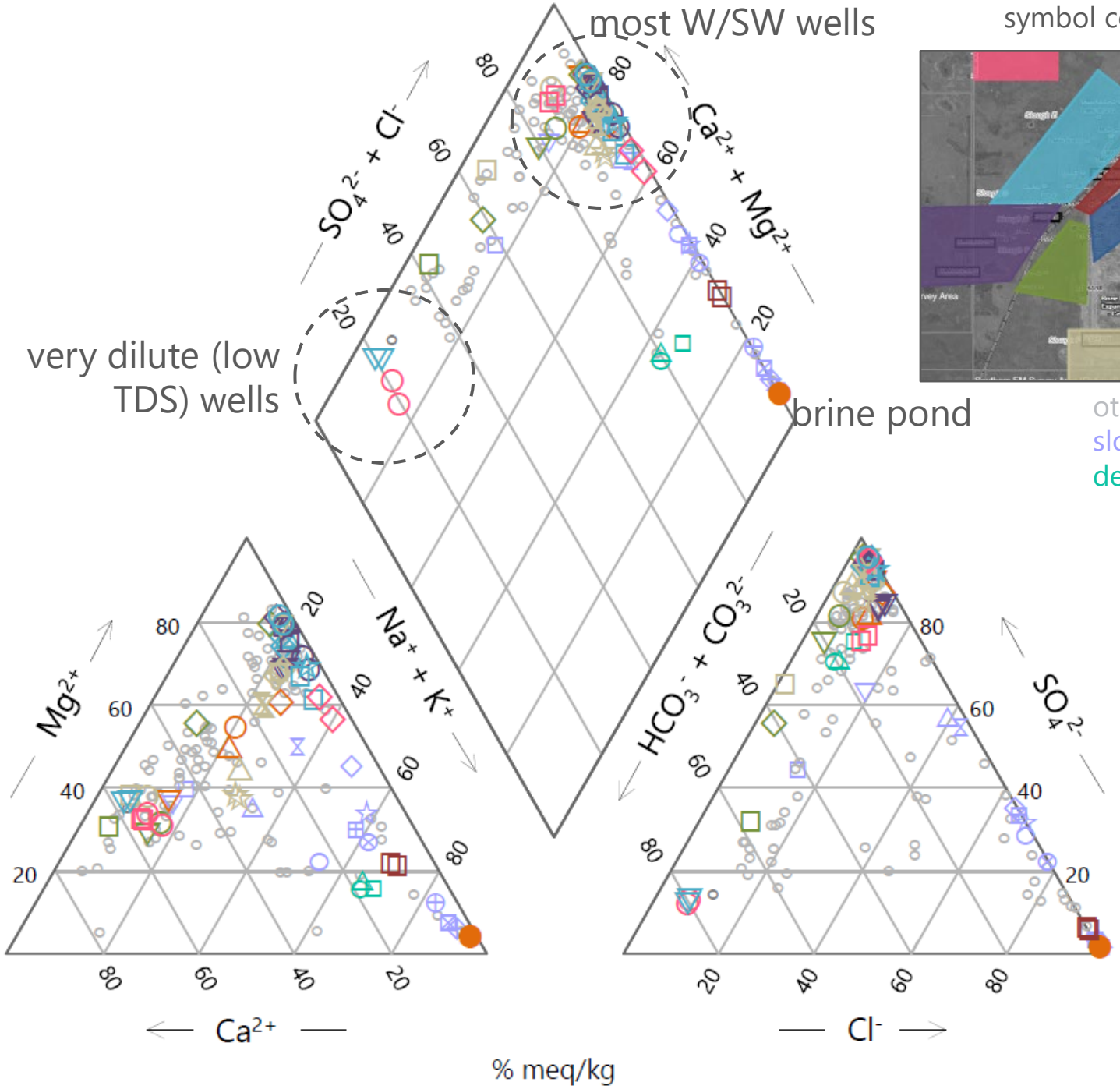
- Till elevations and groundwater contours suggest general N → S transport
- Area of low Cl where CSM plume narrows

SO…



- Rethink CSM

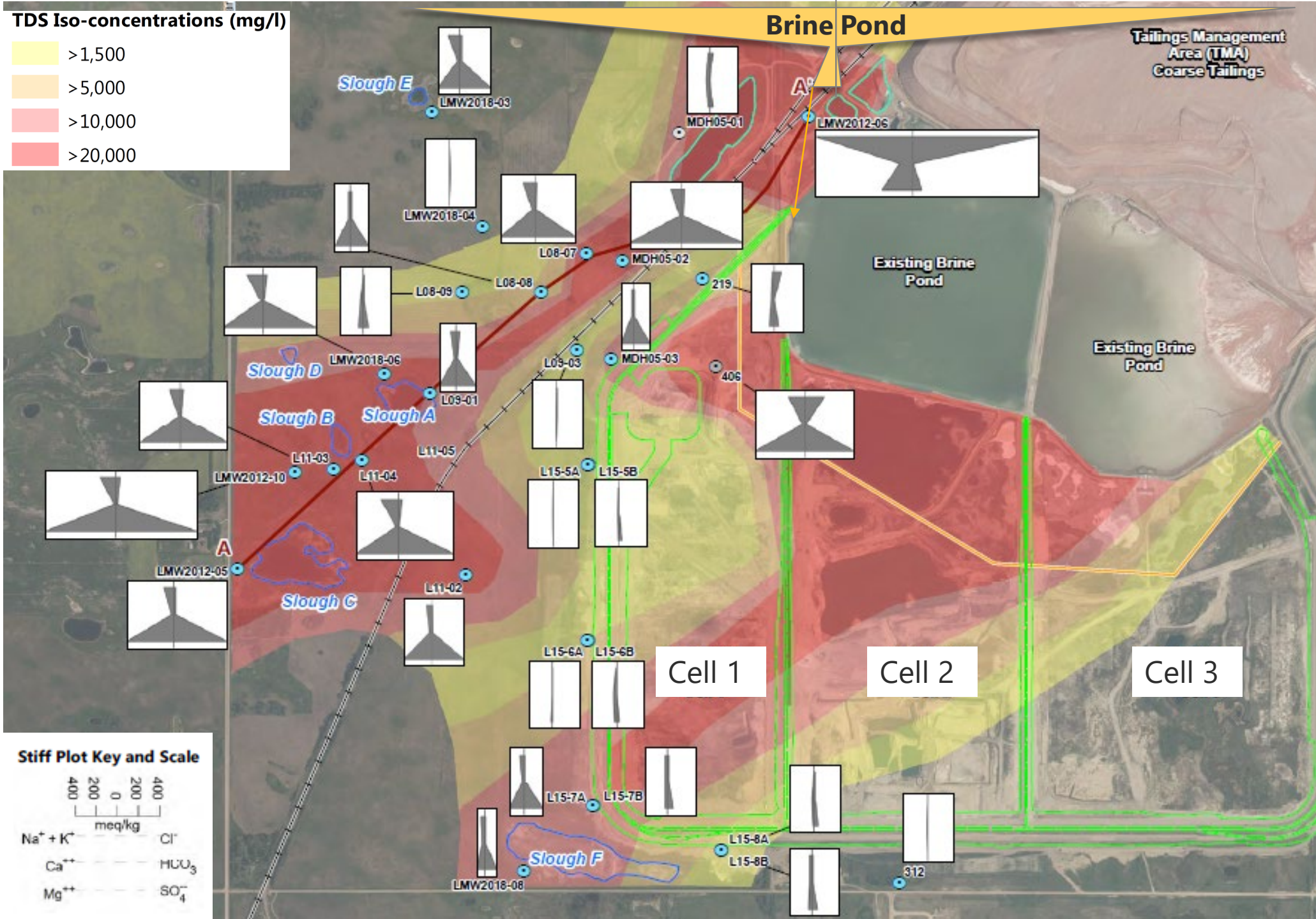
Breaking down TDS into major ions: Piper plots



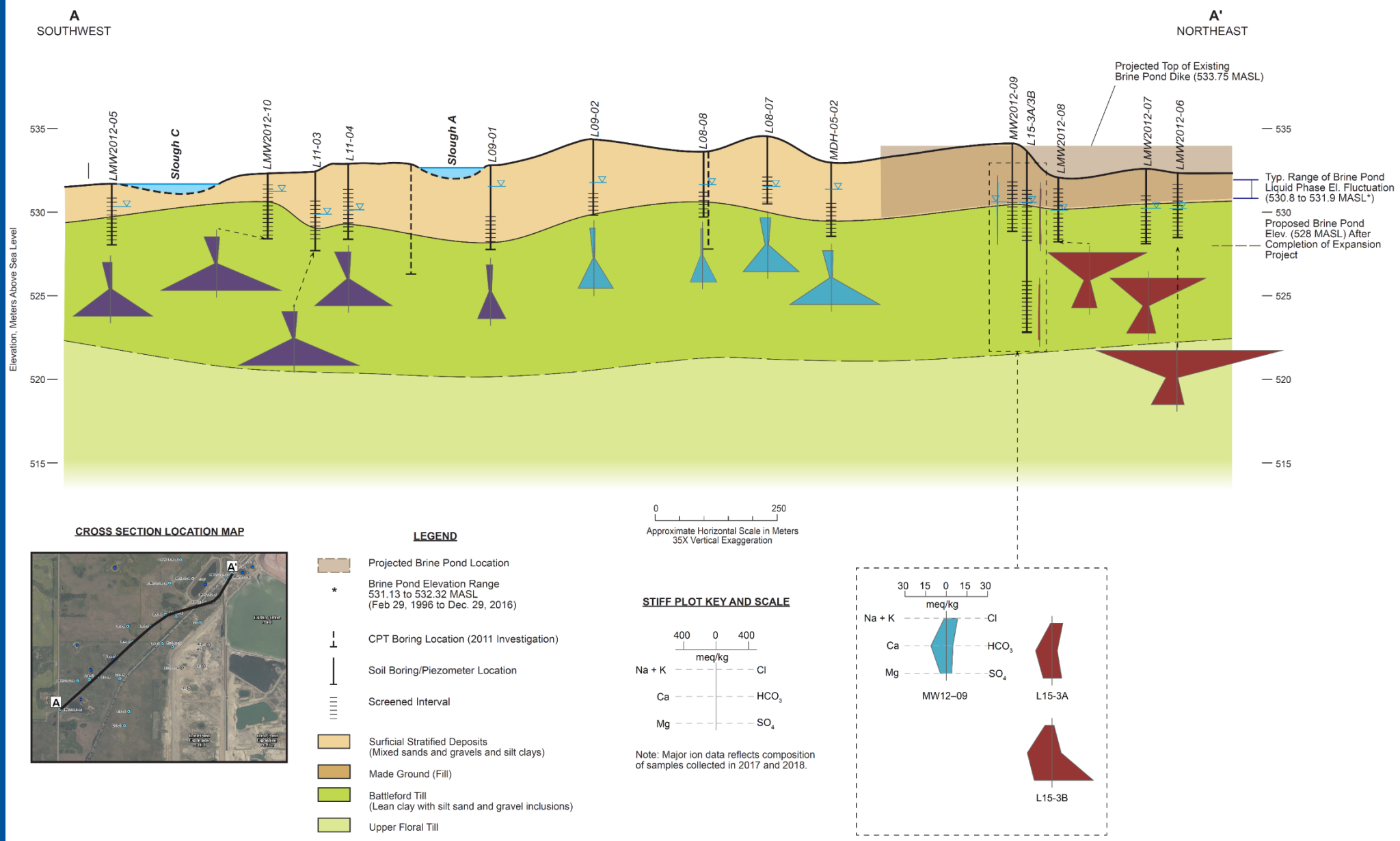
symbol color key

other locations
sloughs
deeper wells

Water chemistry with Stiff Plots

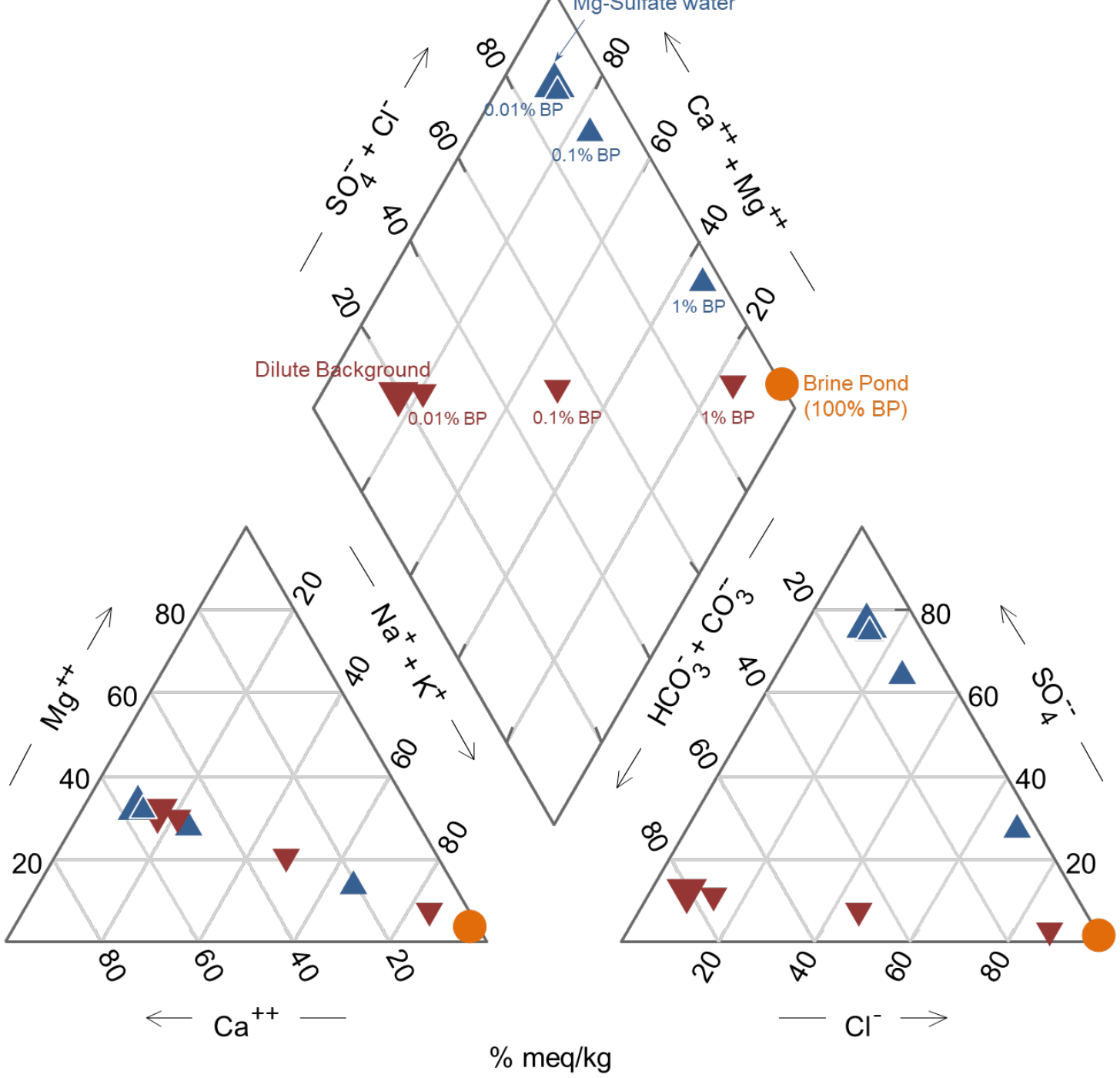


Water chemistry along A-A' cross-section

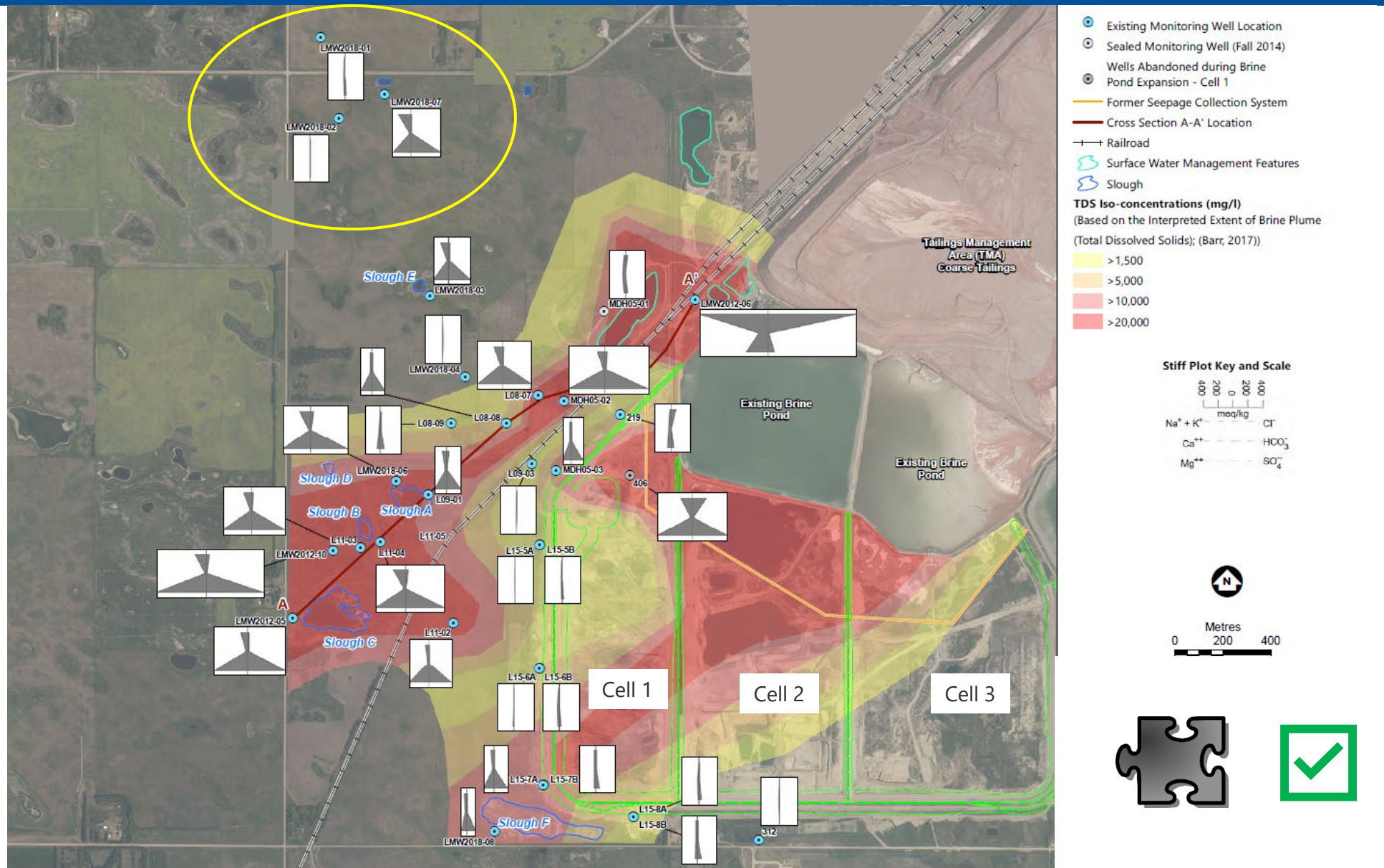


Theoretical mixing compositions

Brine + "background" ≠ high sulfate

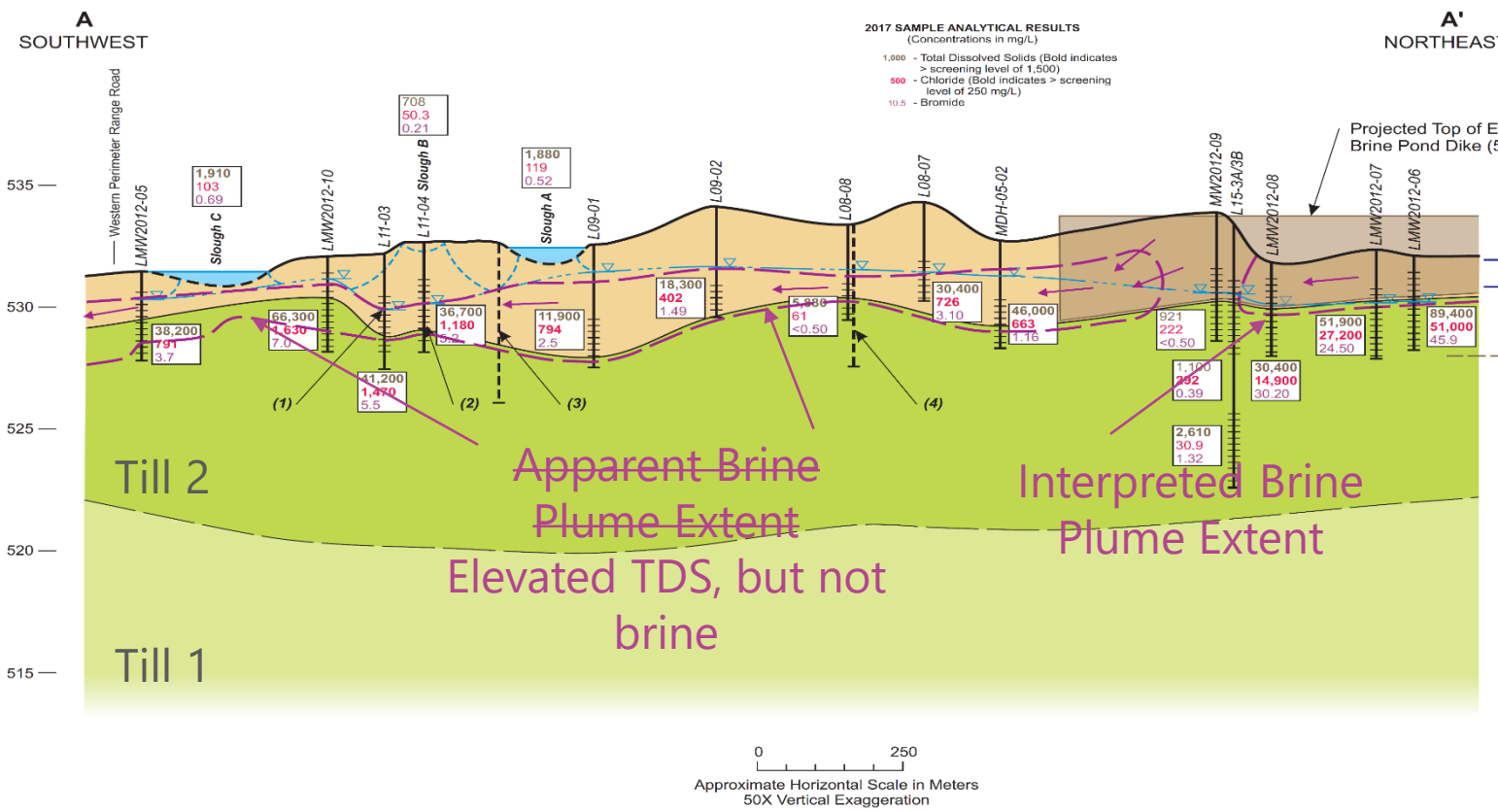


Background wells: high variability includes high sulfate



Is there a brine plume to the west?

- High TDS/conductivity GW west of the brine pond is predominately Mg-SO4, not Na-Cl
- Background GW varies and includes elevated sulfate
- Other indicators:
  - Soil mineralogy includes gypsum
  - Bromide concentrations high inside and along the brine pond, but low in western wells
- **Conclusion:** natural variability and not brine-impacts to the west



Project outcomes

- Updated site CSM was presented to the MOE EPO
- Annual gw/sw monitoring plan was substantively reduced
- Process has facilitated the development of other site-specific brine screening thresholds to differentiate background from brine impacts
- This investigation approach is currently being used to evaluate other areas surrounding the TMA
- Nutrien's resources are better focused on areas that may require attention

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Questions?

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Thank you!!

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