**Hydrogeological Mapping of Saline Formations in the Fox Creek Area, West-Central Alberta**

**Introduction**

In west-central Alberta, particularly the area centred on the town of Fox Creek, the oil and gas industry is developing unconventional resources plays in the Cretaceous and Devonian formations. Multi-lateral hydraulic fracturing has led to an increase in water demand, which has been sourced from both surface water and shallow groundwater in the early stages of development. However, the Alberta government encourages the development of deep saline formations to supply the industry for decades, meaning the industry should consider deep aquifers. To better determine proven reserves in the Fox Creek area, hydrogeological mapping of saline formations has been completed by the Alberta Geological Survey (AGS). The study area extends from Try 75, Rge 59W, 49N in the northwestern corner to Try 73, Rge 52E, 79N in the southeastern corner (Figure 1).

**Formations Mapped**

This study mapped hydrogeologic properties from the near surface down to the Cambrian-Devonian Sandstone Unit. This included formations spanning from the Wapiiti Formation at depths of less than 50 m to the base of the Cambrian at depths of over 4000 m (Figure 2).

**Data Allocation and Quality Control**

Publicly available water chemistry and pressure data were weighted to formations based on the AGS's 3D Geologic Framework (Figure 3). Once data were allocated, a screening process modified from Jensen et al. (2015) was used to ensure that only representative pressures from drillstem tests (DST) and representative water chemistry data were used. Screened data were mapped in AGS using either Simple Hinging or Inverse Distance Weighting, depending on the spatial distribution of data. Pressure data were evaluated using the techniques from Singh et al. (2017) to determine if production influences on pressures were present.

**Hydrogeological Map Series Example**

For each mapped aquifer, a water recovery map, potentiometric surface map, total dissolved solids (TDS) map, and water diving force (WDF) map were created. Examples from the Cardium aquifer are shown below (Figures 4 to 7).

**Hydrostratigraphic Cross-sections**

Regional hydrostratigraphic cross-sections were generated to illustrate the mapped aquifer zones and distributions of hydraulic head and TDS (Figures 8 and 9).

**Summary**

A technical report and associated digital products will be published on the AGS website in 2017. This regional interpretation has shown:

- Topographically driven flow in the shallower Cambrian aquifers
- Regional pressure, and pressure depth plots (Figure 10) and (Figure 11) were used to examine vertical pressure gradients and to identify connections between formations. These data were also analyzed using Stereonet plots to determine the shear Stress orientation of the Formation water.
- In addition to the hydrogeological mapping, data were also plotted graphically for interpretation. Pressure, elevation, and pressure depth plots (Figure 10 and Figure 11) were used to examine vertical pressure gradients and to identify connections between formations. These data were also analyzed using Stereonet plots to determine the shear Stress orientation of the Formation water.

- Influence of density driven flow in parts of the Devonian formations, causing sluggish flow in the opposite direction of the head gradient, or flow in the opposite direction of the head gradient.
- Increasing calcium composition for near-basement formations.