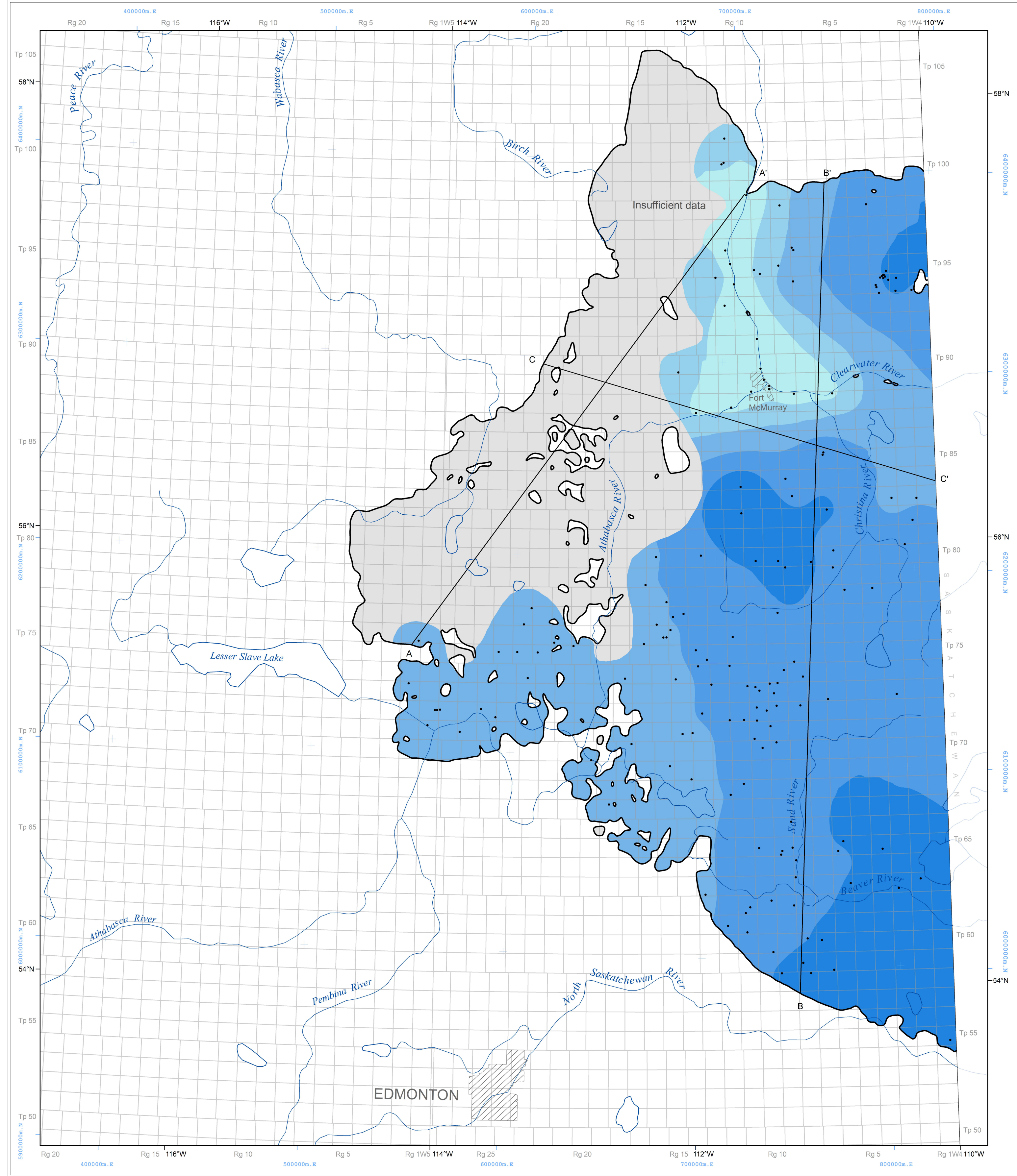
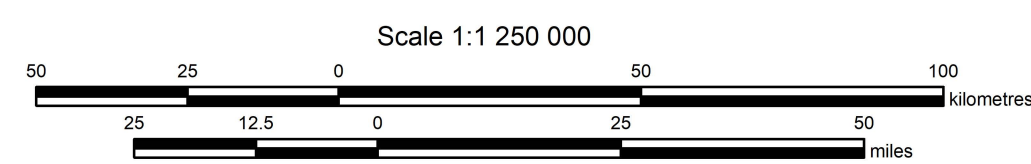


HYDRAULIC HEAD
MCMURRAY HSU

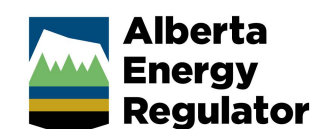
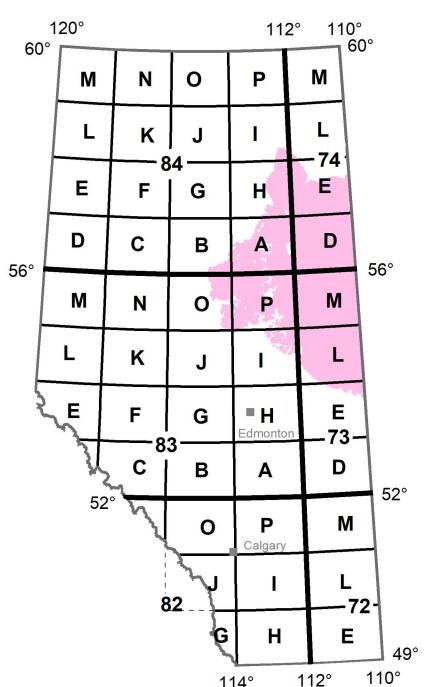


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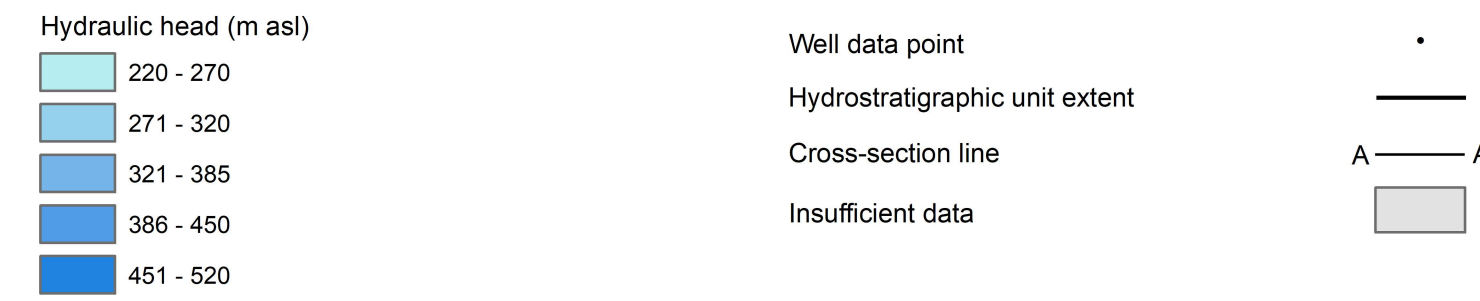
Map 613
Distribution of Hydraulic Head in the McMurray Hydrostratigraphic Unit
Hydrogeology by: N. Nakevska and T.G. Lemay



Projection: 10 Degree Transverse Mercator
Datum: North American Datum, 1983



SYMBOL LEGEND



This map depicts the distribution of hydraulic head in the McMurray hydrostratigraphic unit (HSU). The horizontal and vertical extent of the unit was adopted from the 3D Provincial Geological Framework Model of Alberta, Version 2 (Alberta Geological Survey, 2019a). The relationship of the McMurray HSU with the units above and below as well as its geometry can be seen in Figures 1 and 2.

Methodology

The hydraulic head distribution map is a result of an empirical Bayesian kriging technique using publicly available static water levels from 37 water wells and monitoring wells, and pressure data from 112 drillstem tests from oil and gas wells. Additionally, 12 control points were extracted from the provincial digital elevation model in the vicinity of the Athabasca and Clearwater rivers. A screening process modified from Jensen et al. (2013) was used to ensure that only representative pressures were used to calculate equivalent freshwater hydraulic heads. The final gridded map surface was clipped based on the spatial distribution of representative data. Residual values are plotted at each location (Figure 3) to indicate where underprediction and overprediction occurs compared to the measured hydraulic head values. Using the methodology of Singh et al. (2017) the Cumulative Interference Index (CII) was determined and used to identify and remove tests that have been influenced by production or injection (Figure 4).

Additional formation-scale hydrogeological maps for the McMurray HSU are presented in Figures 5 and 6. Figure 5 shows the distribution of total dissolved solids in the McMurray HSU. Figure 6 shows the water driving force (WDF) map for the McMurray HSU. The WDF vector map allows identification of areas where the buoyancy effect of formation water density has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). Buoyancy does not appear to have a significant effect on groundwater flow in the McMurray HSU.

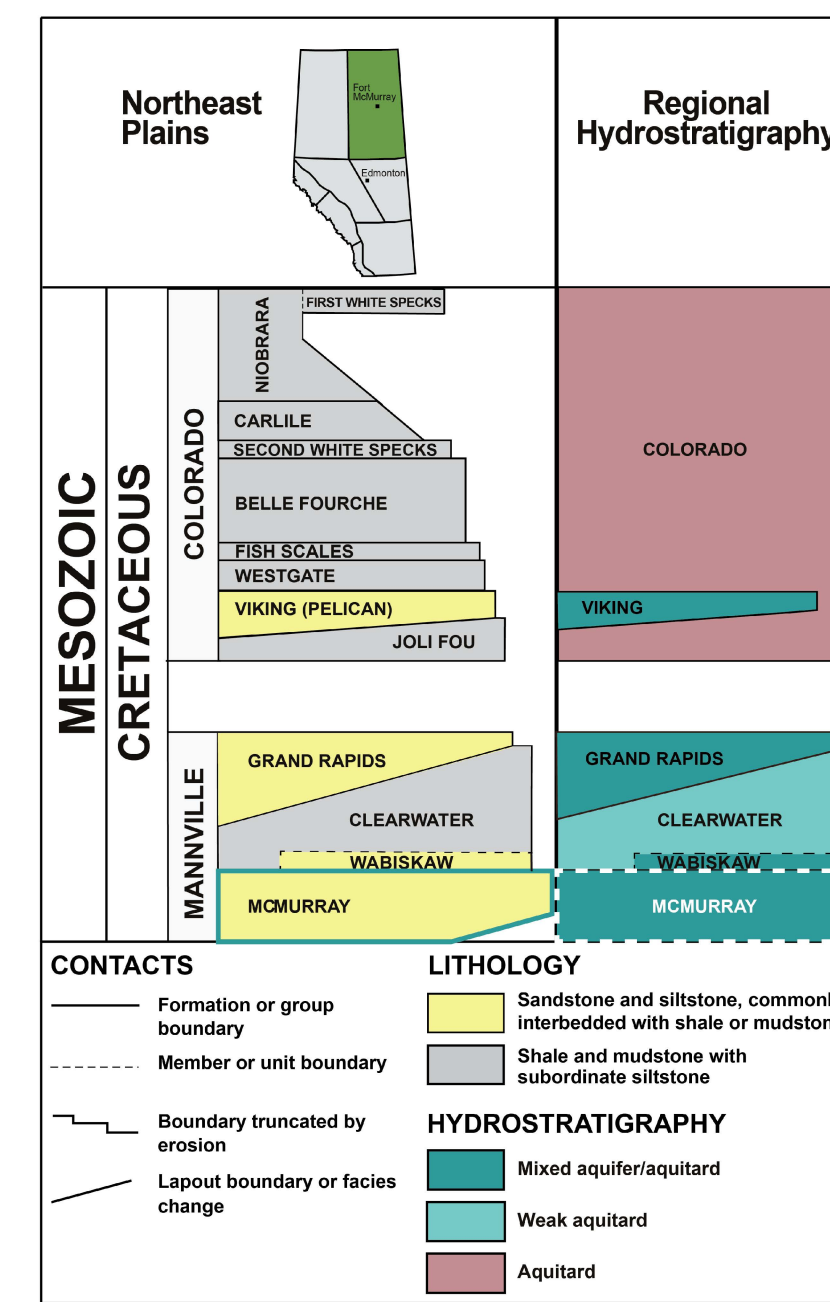


Figure 1. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines highlight the top and base of the McMurray stratigraphic unit. Dashed white lines depict the McMurray HSU within the regional hydrostratigraphy. Strata above the Colorado Group are not shown.

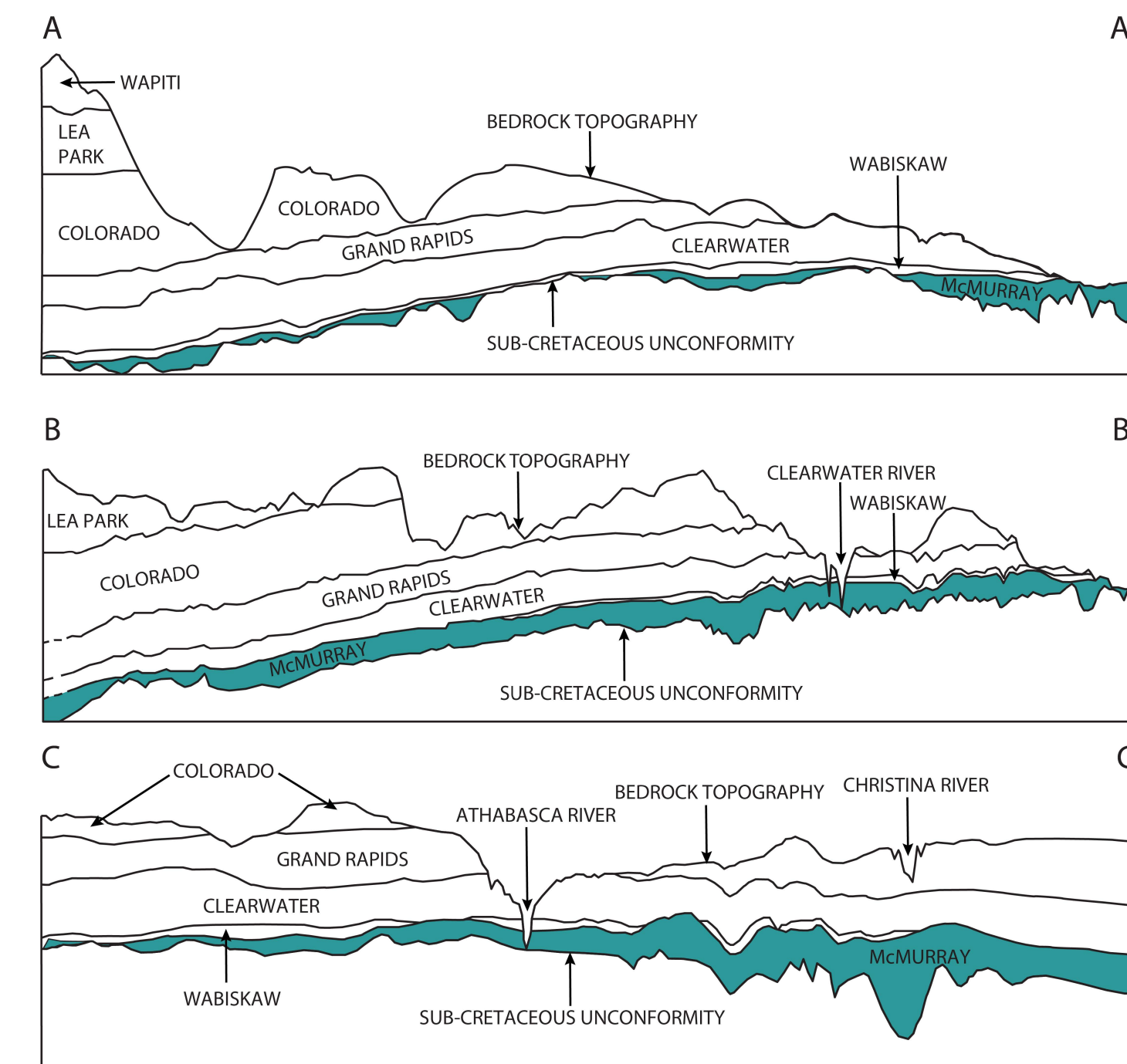


Figure 2. Schematic cross-sections identifying the geometry and variable thickness of the McMurray HSU (not to scale). Dashed lines in the southern extent of cross-section B-B' indicate that the Grand Rapids, Clearwater, and McMurray formations transition into equivalent strata to the south.

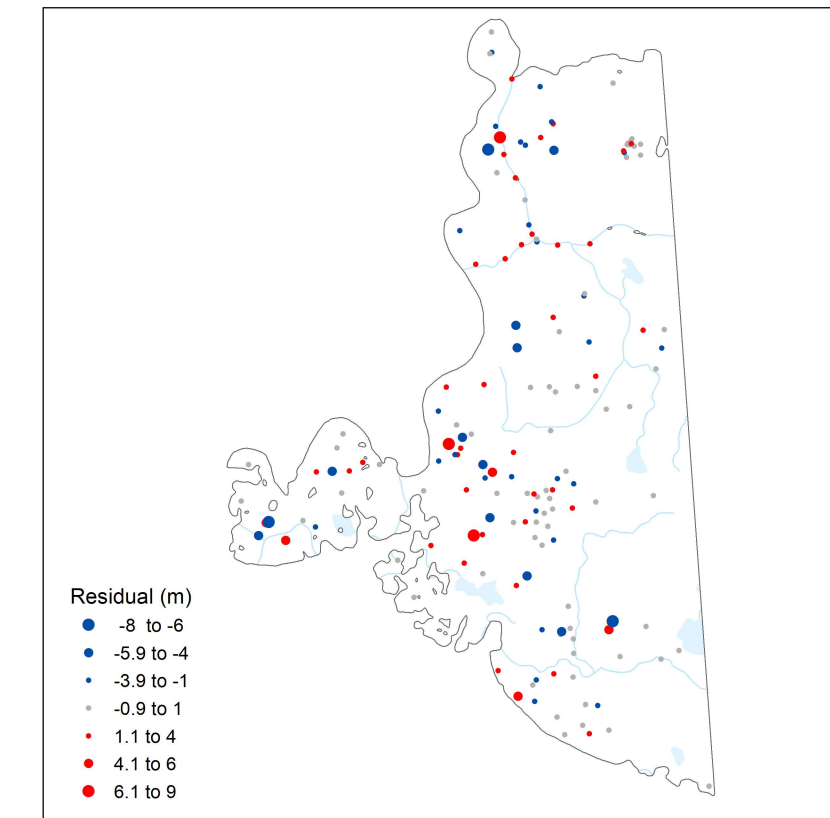


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

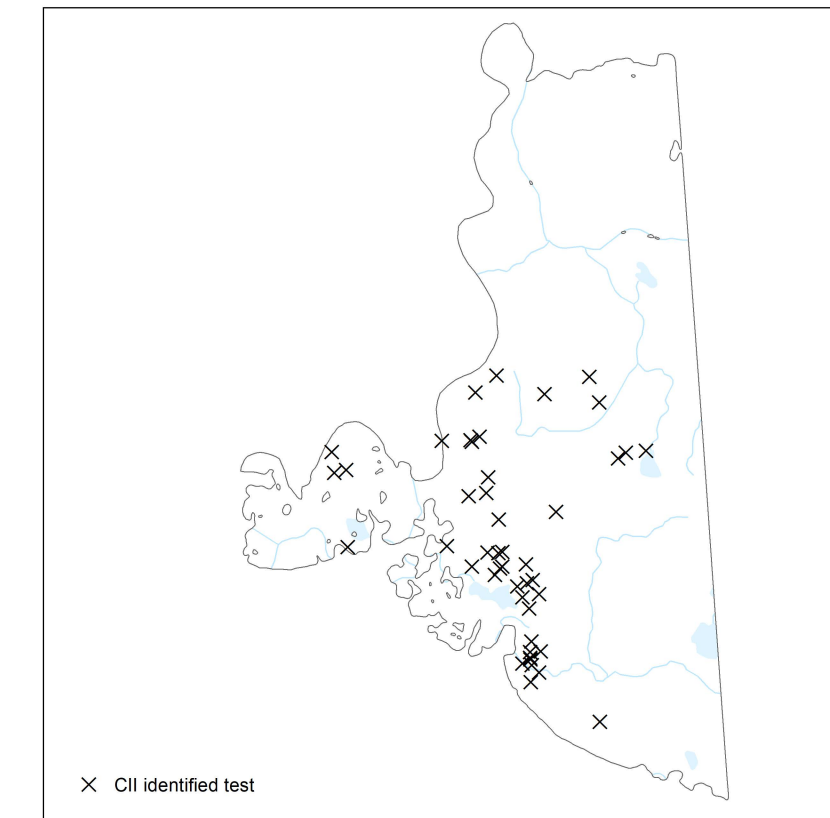


Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

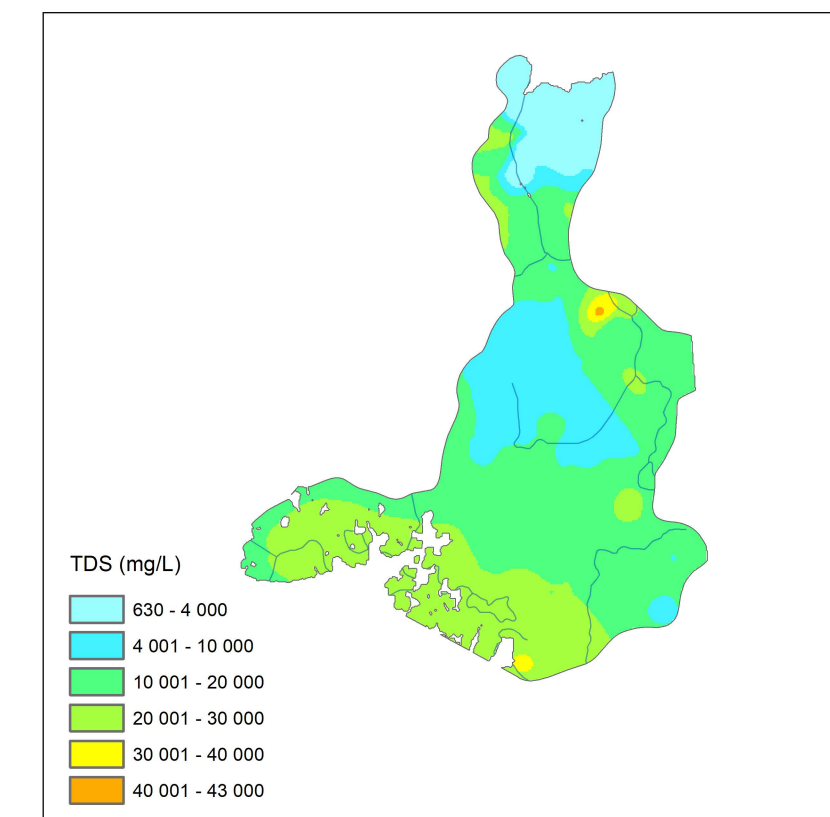


Figure 5. Distribution of total dissolved solids (TDS) in the McMurray HSU (Lemay and Nakevska, 2020). The map extent is based on the spatial distribution of TDS data and differs from the extent of the main map.

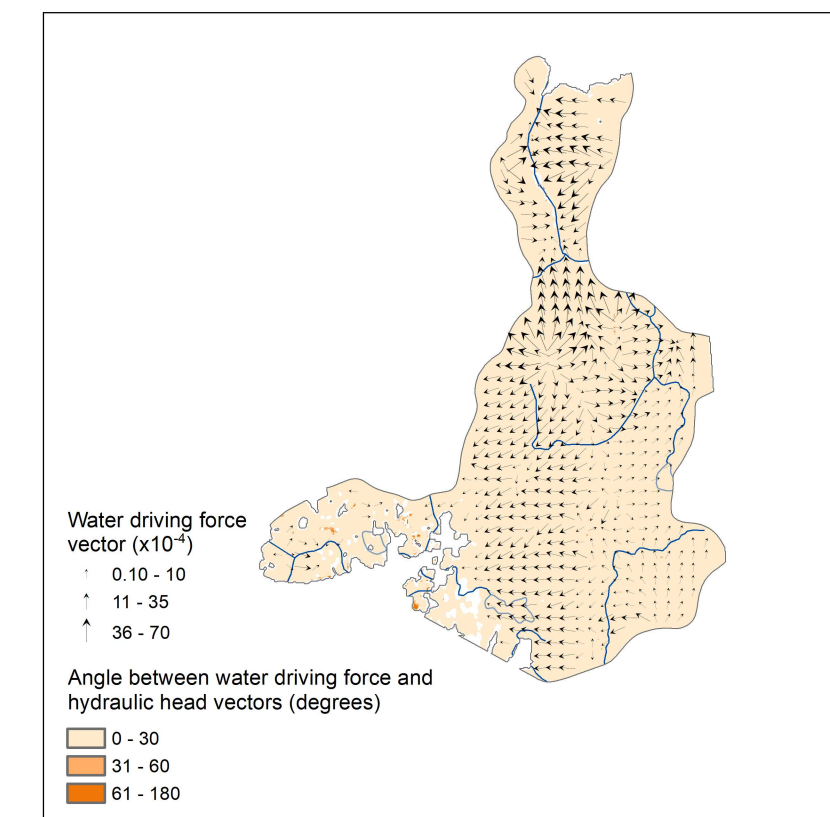


Figure 6. Water driving force map of the McMurray HSU. The map only covers the area where hydraulic head and TDS gridded surfaces overlap.

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