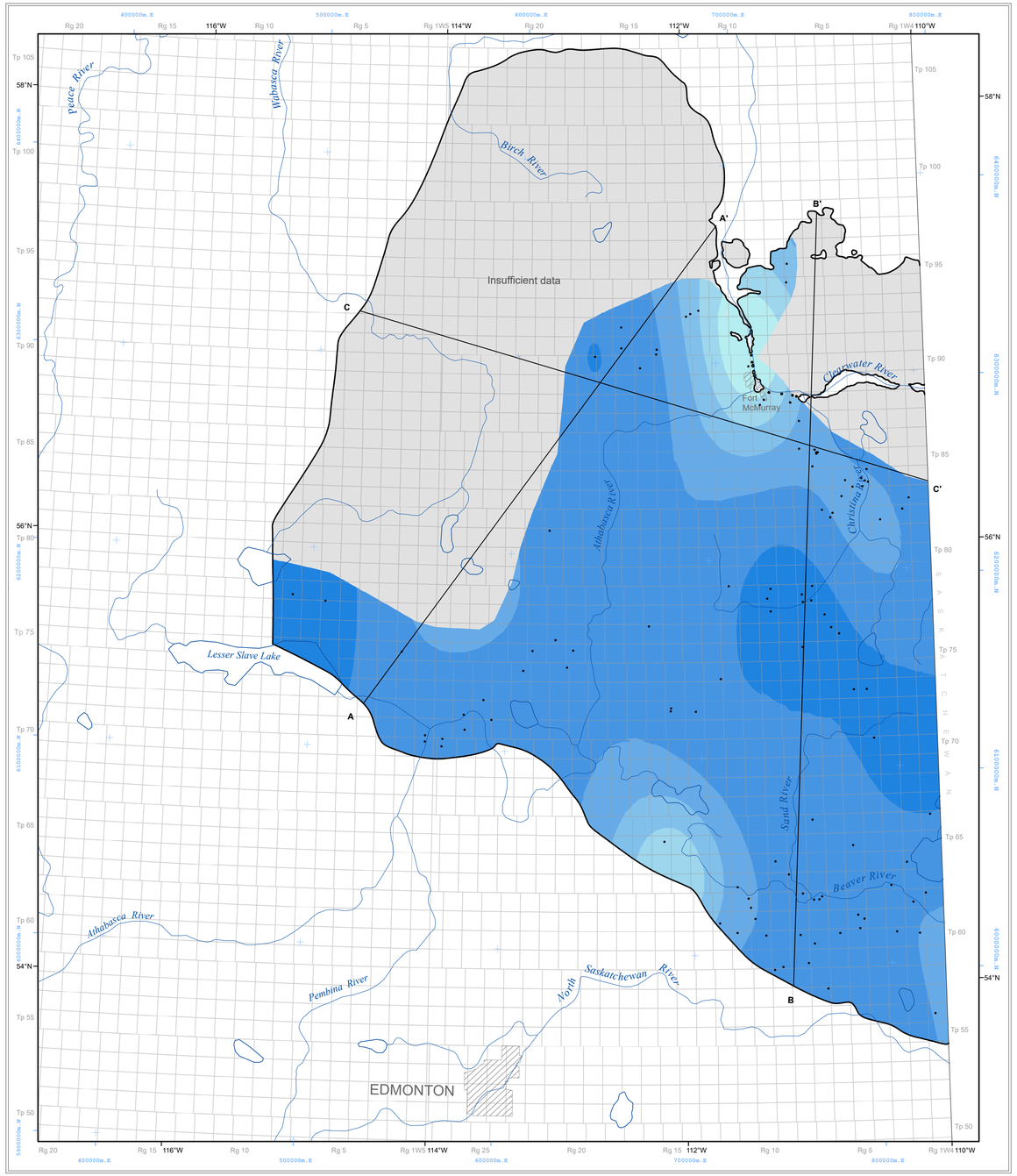
HYDRAULIC HEAD
CLEARWATER HSU



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Map 607

Distribution of Hydraulic Head in the Clearwater Hydrostratigraphic Unit

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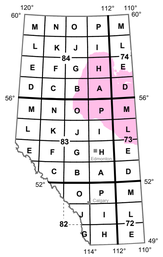
Scale 1:1 250 000

50 25 0 50 100 kilometres
25 12.5 0 25 50 miles

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



Alberta Energy Regulator

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SYMBOL LEGEND

Hydraulic head (m asl)
- 310 - 345
- 346 - 380
- 381 - 415
- 416 - 450
- 451 - 485
- 486 - 510

Well data point
Hydrostratigraphic unit extent
Cross-section line A — A'
Insufficient data

This map depicts the distribution of hydraulic head in groundwater in the Clearwater hydrostratigraphic unit (HSU). More specifically, the map depicts the hydrogeological characteristics of the Clearwater HSU where it predominantly acts as weak aquitard. The dual nature of the Clearwater HSU is discussed in more detail in Bachu and Underschultz (1993). 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 Clearwater 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 a simple kriging technique using equivalent freshwater heads, calculated from publicly available data from 38 water wells and 71 oil and gas wells. A screening process modified from Jensen et al. (2013) was used to ensure that only representative formation pressures from oil and gas wells were used. The final gridded map surface was clipped based on the spatial distribution of representative hydraulic head data and an assessment of plausible data trends. Residual values are plotted at each location (Figure 3) to indicate where underprediction and overprediction occurs compared to the measured hydraulic head values.

Additional formation-scale hydrogeological maps for the Clearwater HSU are shown in Figures 4, 5, and 6. 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). Figure 5 shows the distribution of total dissolved solids in the Clearwater HSU. Figure 6 illustrates the water driving force (WDF) vector map. The WDF vector map allows identification of areas where buoyancy differences from changes in formation water density and/or temperature have the potential to affect 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 Clearwater HSU.

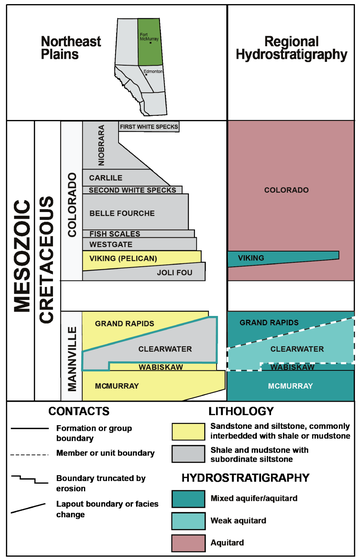


Figure 1. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines highlightf the Clearwater stratigraphic unit, exclusive of the Wabiskaw Member. Dashed white lines depict the Clearwater HSU within the regional hydrostratigraphy. Strata above the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

Acknowledgements

Data processing support by S. Stewart. Base data from the Atlas of Canada (Natural Resources Canada, 2012) and Spatial Data Warehouse, Ltd.

References

Alberta Geological Survey (2019a): 3D Provincial Geological Framework Model of Alberta, version 2; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Model 2018-02.

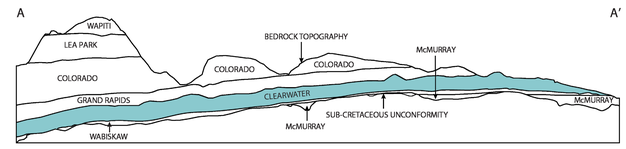
Alberta Geological Survey (2019b): Alberta Table of Formations; Alberta Energy Regulator, URL <https://ags.aer.ca/publication/alberta-table-formations> [May 2021].

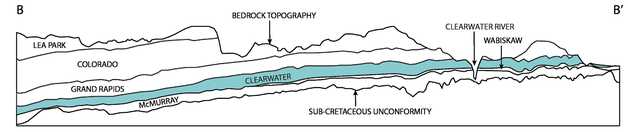
Jensen, G., Rostron, B., Palombi, D. and Melnik, A. (2013): Saskatchewan Phanerozoic Fluids and Petroleum Systems project: hydrogeological mapping framework; *in* Summary of Investigations 2013, v.1, Saskatchewan Geological Survey, Saskatchewan Ministry of the Economy, Miscellaneous Report 2013-4.1, Paper A-5,10 p.

Lemay, T.G. and Singh, A. (2021): Distribution of total dissolved solids in the Clearwater hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 606, scale 1:1 250 000.

Natural Resources Canada (2012): CanVec digital topographic data; Natural Resources Canada, Earth Sciences Sector, URL <https://open.canada.ca/data/en/dataset/8ba2aa2a-7bb9-4448-b4d7-f164409fe056> [September 2020].

Singh, A., Palombi, D., Nakevska, N., Jensen, G. and Rostron, B. (2017): An efficient approach for characterizing basin-scale hydrodynamics; Marine and Petroleum Geology, p. 332-340, URL <http://dx.doi.org/10.1016/j.marpetgeo.2017.02.015>.





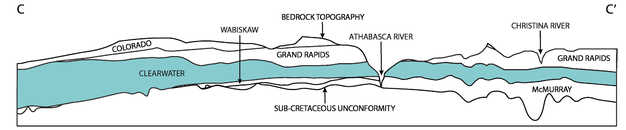


Figure 2. Schematic cross-sections identifying the geometry and variable thickness of the Clearwater HSU (not to scale).

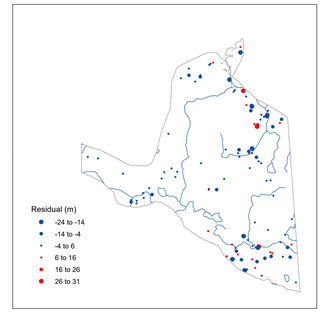


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

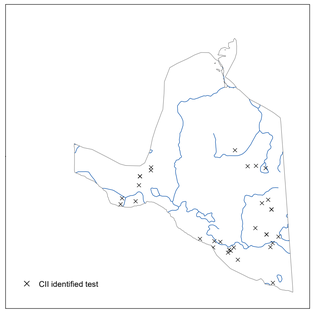


Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

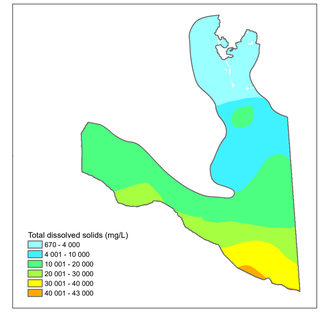


Figure 5. Distribution of total dissolved solids in the Clearwater HSU (Lemay and Singh, 2021). The map extent is based on the spatial distribution of TDS data and may differ from the extent of the main map.

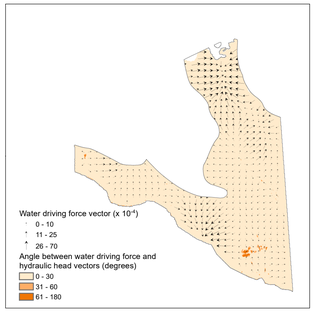


Figure 6. Water driving force map of the Clearwater HSU. The map only covers the area where hydraulic head and TDS gridded surfaces overlap.

Recommended Reference Format

Singh, A. and Lemay, T.G. (2021): Distribution of hydraulic head in the Clearwater hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 607, scale 1:1 250 000.

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