

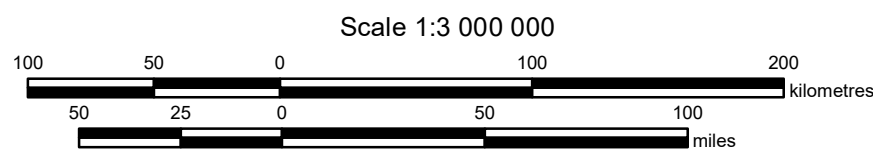
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Map 647

Distribution of Hydraulic Head in the Exshaw-Banff Hydrostratigraphic Unit

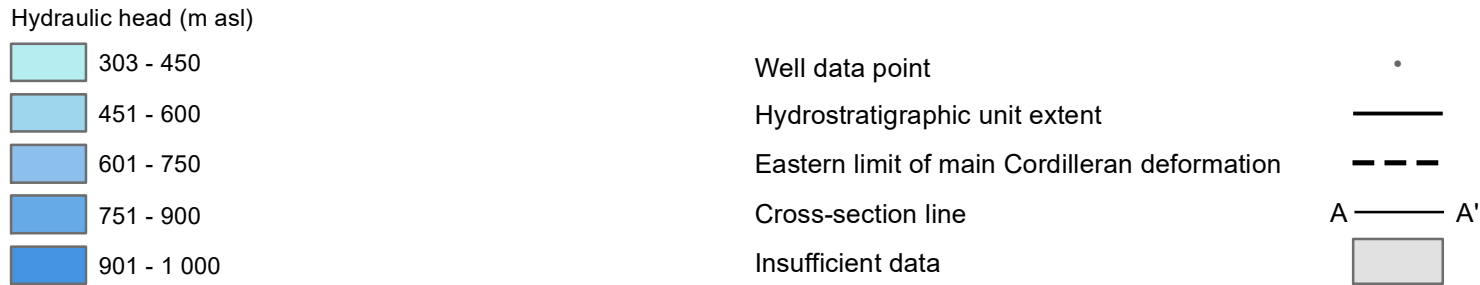
Hydrogeology by: J. Brinsky



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



SYMBOL LEGEND



This map depicts the distribution of hydraulic head in the Exshaw-Banff hydrostratigraphic unit (HSU). The horizontal and vertical extent of the unit was adopted from the 3D Geological Framework of Alberta, Version 3 (Alberta Geological Survey, 2021). The relationship of the Exshaw-Banff 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 pressure data from 341 drillstem tests from oil and gas wells. 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. Where data density was insufficient to generate a hydraulic head grid, data points are plotted with hydraulic head labels only. Residual values are plotted at each location (Figure 3) to indicate where underprediction or 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 Exshaw-Banff HSU are shown in Figures 5 and 6. Figure 5 illustrates the distribution of total dissolved solids in the Exshaw-Banff HSU. Figure 6 shows the water driving force (WDF) vector map for the Exshaw-Banff HSU. The WDF vector map allows identification of areas where the buoyancy effect of formation water density and the slope of the HSU has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). Buoyancy appears to have some influence in the north-central portion of the Exshaw-Banff HSU, where larger angles (dark orange areas) between the WDF vector and hydraulic gradient vector are observed.

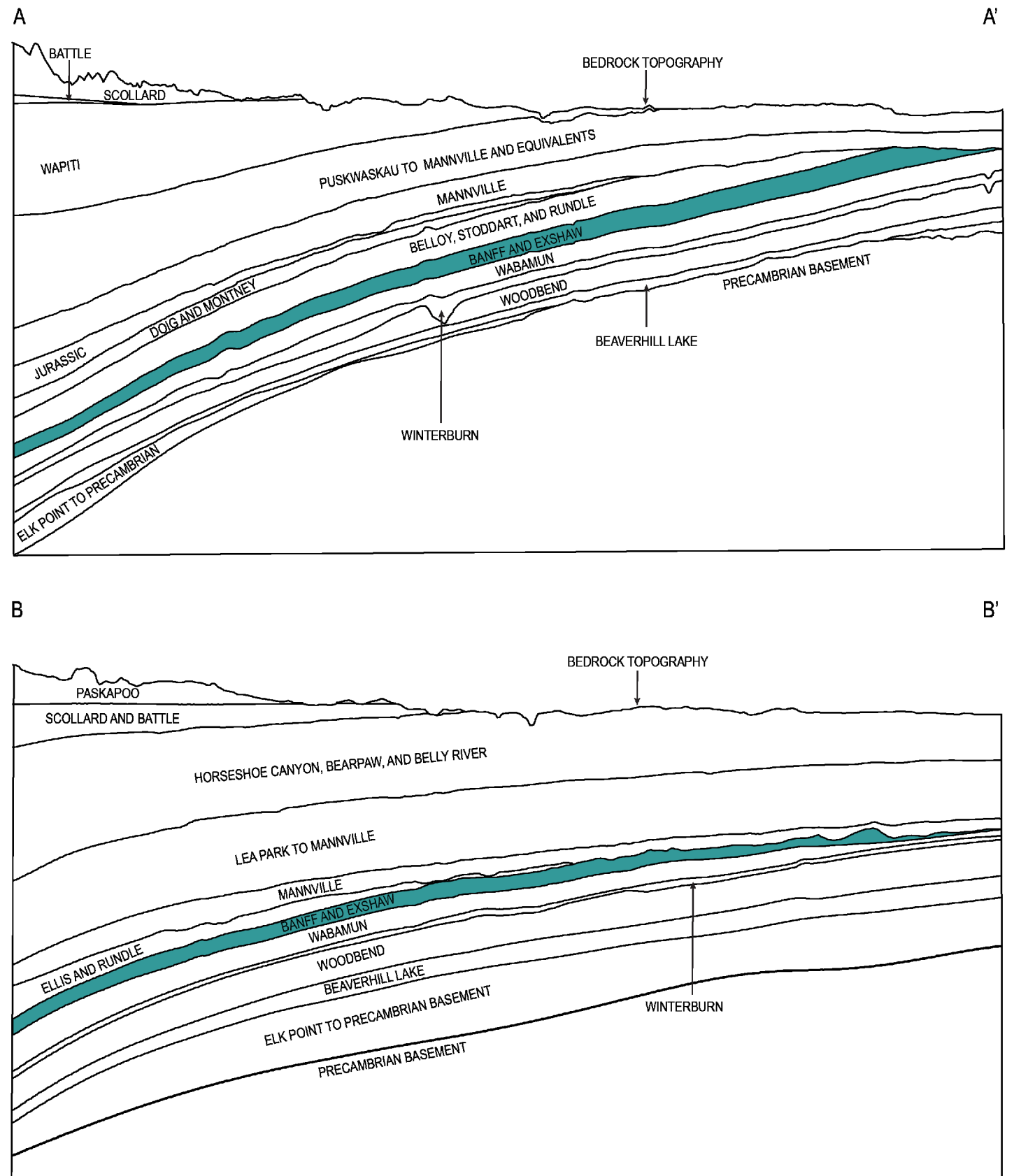


Figure 1. Schematic cross-sections (not to scale) identifying the geometry and variable thickness of the Exshaw-Banff HSU (shown in teal).

Acknowledgements

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

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Recommended Reference Format

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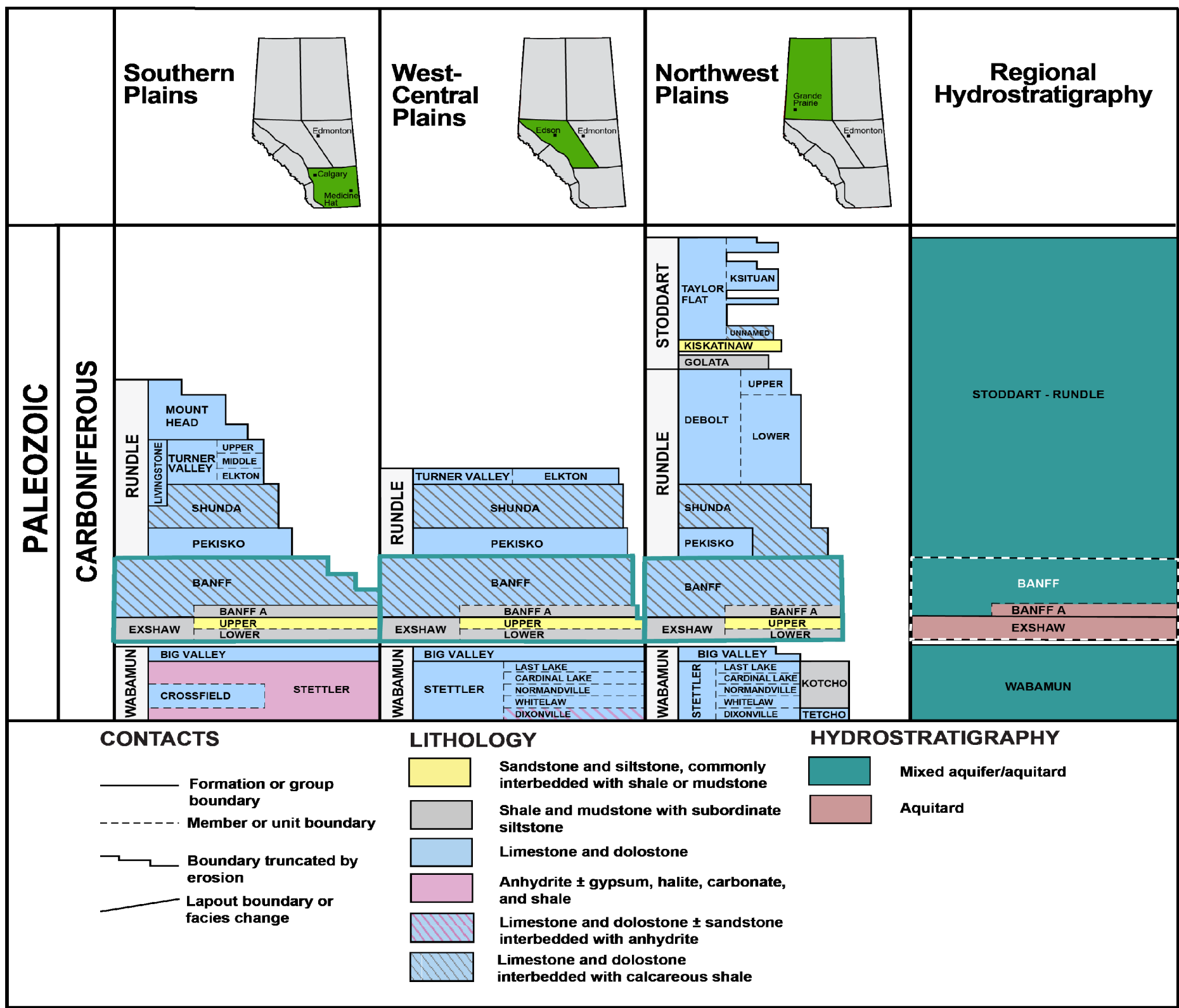


Figure 2. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019). Solid teal lines depict the top and base of the stratigraphic units combined for mapping the Exshaw-Banff HSU. Dashed white lines depict the Exshaw-Banff HSU within the regional hydrostratigraphy. Strata above the Stoddart Group and below the Wabamun Group are not shown.

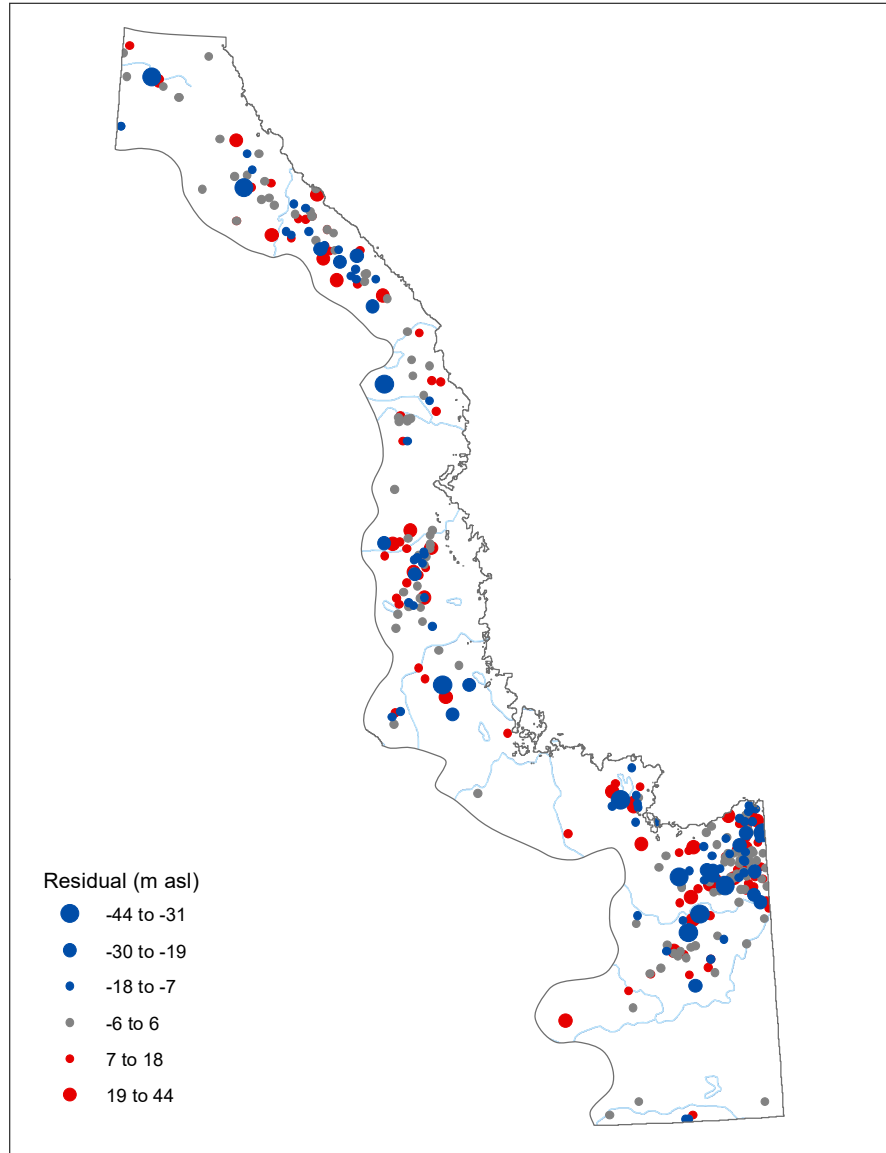


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the measured residuals.

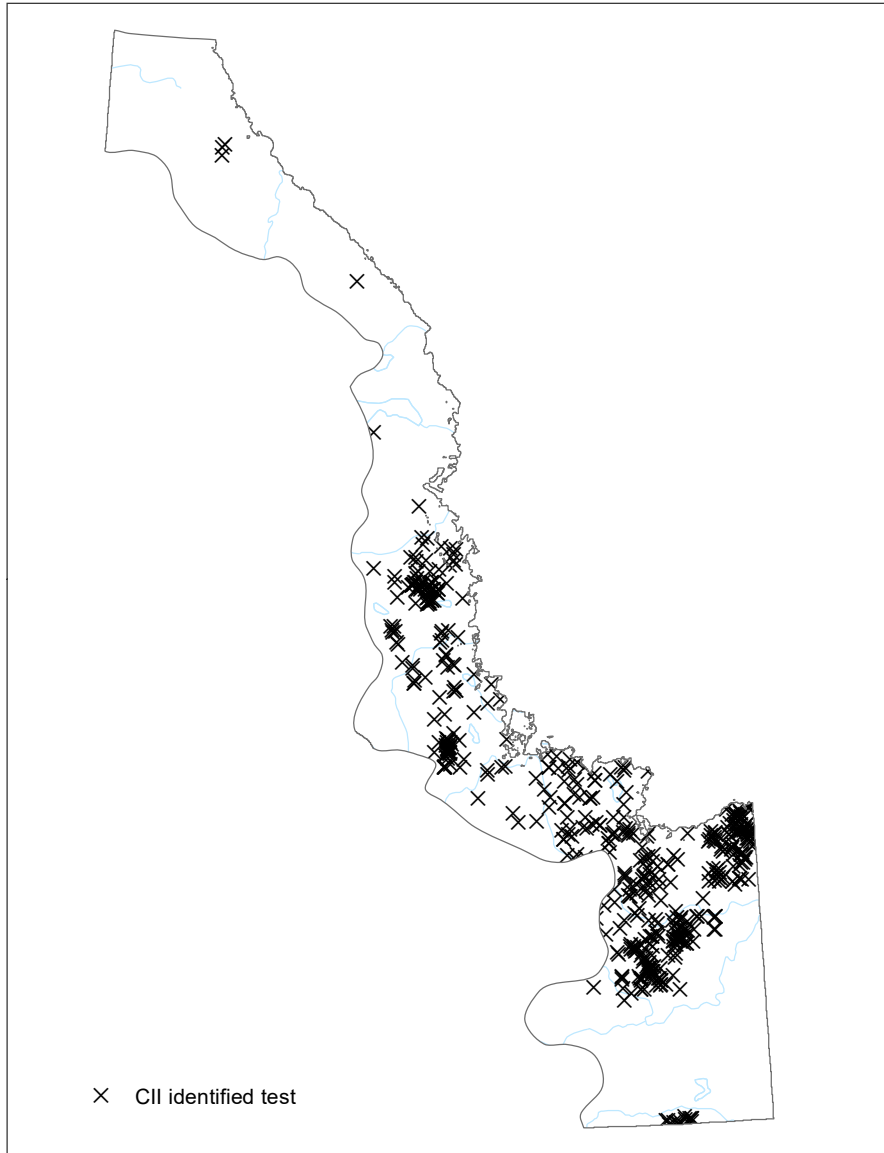


Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

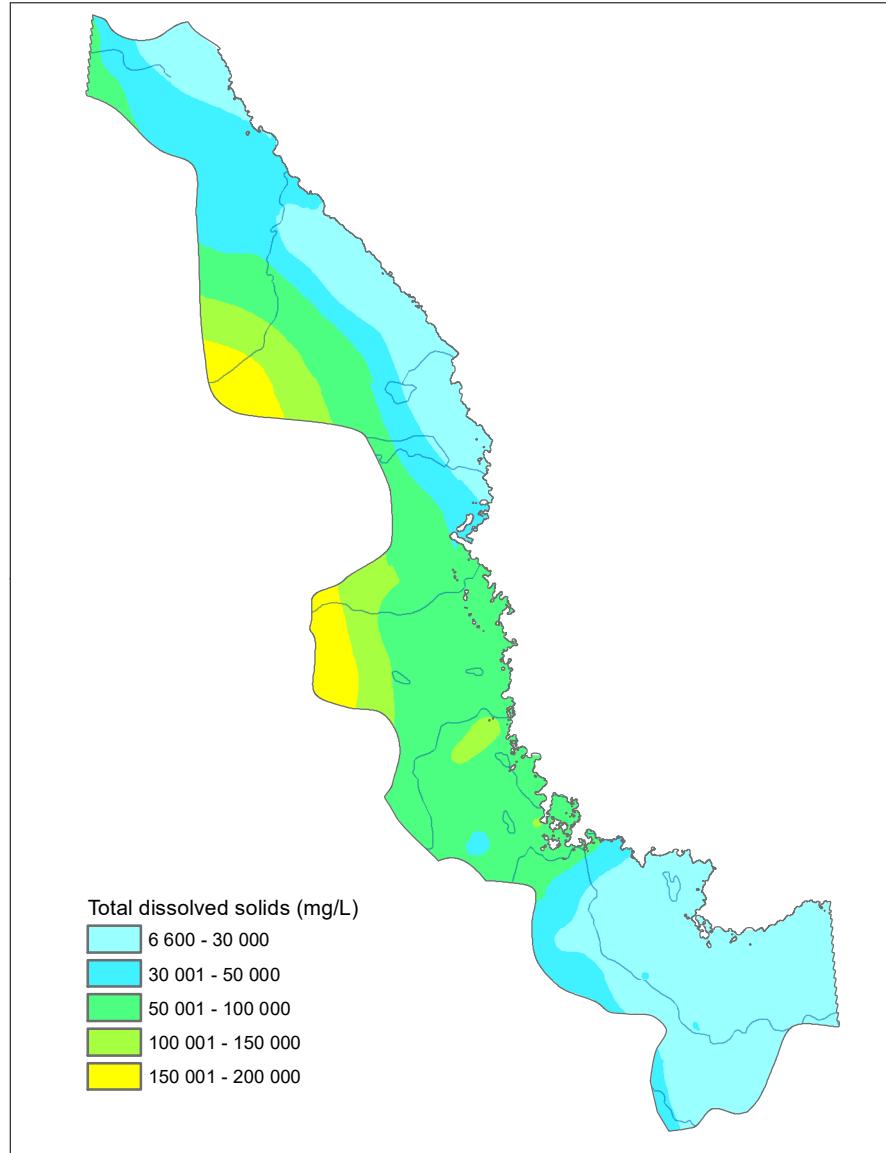


Figure 5. Distribution of total dissolved solids in the Exshaw-Banff HSU (Brinsky, 2024). The map extent is based on the spatial distribution of TDS data and differs from the extent on the main map.

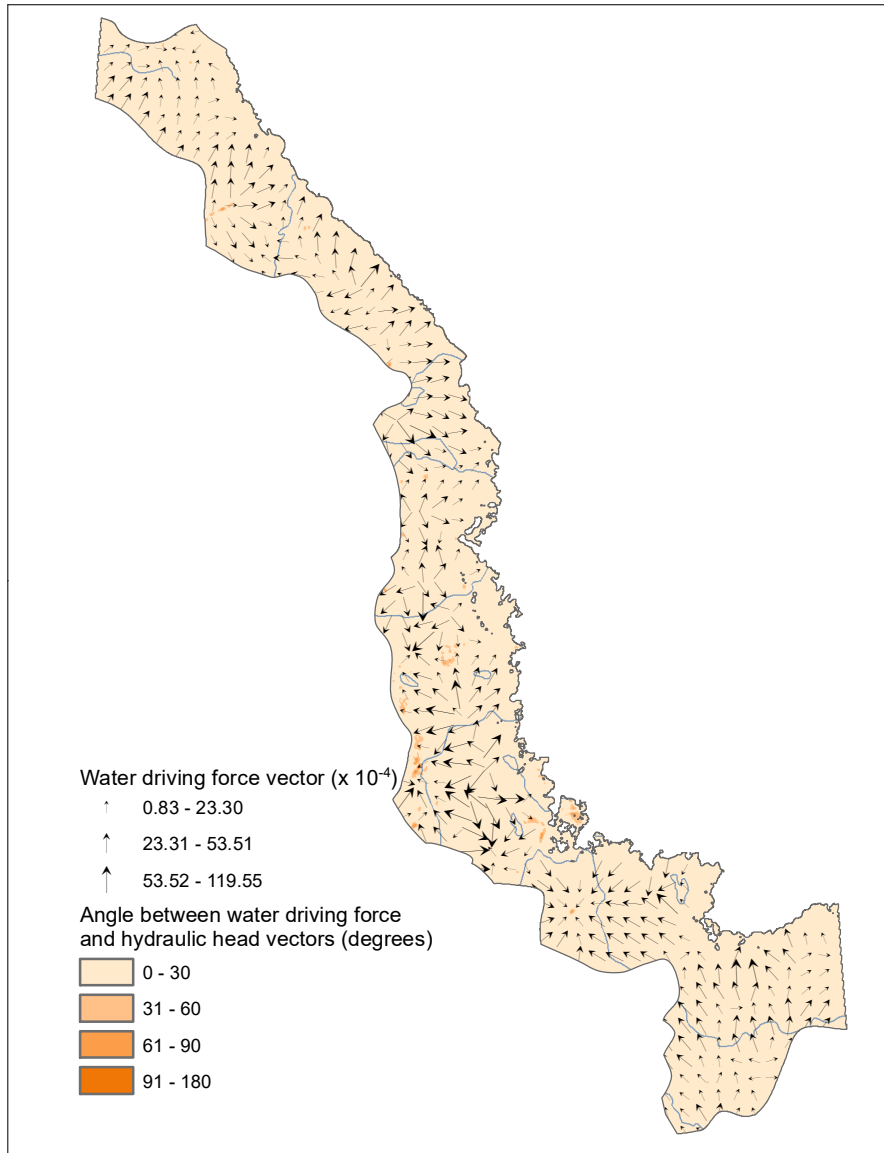


Figure 6. Water driving force vector map of the Exshaw-Banff HSU. The map covers only the area where the hydraulic head and TDS gridded surfaces overlap.