





The regional bedrock aquifer is located in the Paleocene Paskapoo Formation, which is a non-marine unit comprised of sandstone, sandy mudstone and siltstone. The Paskapoo Formation is the most important groundwater supply in the province, as well as the most important aquifer system in the Canadian Prairies. However, in the Fox Creek area, water use is essentially restricted to the O&G industry, except for the Town of Fox Creek itself. The region is essentially forested and contains many wetlands. No farms are present within the selected watershed.

### **Work to be carried out**

The Fox Creek project will comprise fieldwork, laboratory analyses, data interpretation, and numerical modelling and will likely include the following activities:

- expansion of the hydrogeological characterization of the non-saline aquifers recently completed by the Alberta Geological Survey (Smerdon et al., 2019) using existing shallow wells and newly-drilled observation wells
- development of a coupled surface water / groundwater model
- baseline groundwater geochemical study
- identification of source (thermogenic or microbial) and provenance (geological unit) of hydrocarbons present in groundwater and rocks, if any, in part based on available composition and isotopic signature of mud gas from this area from historical wells and new data
- snow study including thickness of the snowpack, its density and its geochemistry
- literature review of the current status of different wetland classes and key wildlife habitat and of the current understanding of disturbance impacts in central-northern Alberta
- geomechanical study of shallow units using CPTs (cone penetration tests)
- assessment of geomechanical and hydrogeological properties using core samples
- study of the mechanisms that could induce pressure changes in shallow aquifers in association with hydraulic fracturing and re-injection through the development of a 3D geomechanical model using multiple sources of data (borehole deformation, well logs, passive seismic, etc.)
- evaluation of potential ecological stress and the assessment of landscape changes over time using satellite imagery
- spectral characterization of shallow fresh water bodies, wetlands, and outcrops, with synergies developed with SAR (synthetic aperture radar) datasets
- mapping of potential impacts and resulting changes on ecosystem services at the landscape scale
- study of functional and structural recovery of forest subsequent to O&G activities
- study on how to improve the process of cumulative effects assessment that is being carried out during environmental assessments (EAs) through a literature review and interviews with consultants doing EAs to identify main obstacles.
- definition of the local stratigraphy based on the lithostratigraphic logging of cores from new observation wells drilled in the study area
- petrographic characterization from historical wells of organic matter types and thermal maturity of known source rocks from the Duvernay shale to the Paskapoo coals.

## Conclusion

Extensive oil and gas activities have taken place in the Fox Creek area since the 1950s, affecting the landscape ecosystem services, mainly through the degradation or removal of forest cover by non-permanent disturbances (e.g. resource exploration activities) and/or permanent disturbances (e.g. construction of infrastructure). Water resources have been poorly characterized at this scale, and data on groundwater are scarce. This project aims to assess the cumulative environmental effects of these industrial activities by studying surface water, groundwater and snow quality, intermediate zone integrity, atmospheric emissions, forest recovery, and changes in the landscape (including wetlands, lakes and lineaments) and plant community and growth (including lichen) that affect, among other things, the caribou habitat.

## References

- ECCC. 2012. <https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/woodland-caribou-boreal-population-2012.html>
- Smerdon, B.D., Klassen, J., Gardner, W.P. 2019. Hydrogeological characterization of the Upper Cretaceous–Quaternary units in the Fox Creek area, west-central Alberta. Alberta Energy Regulator (AER) & Alberta Geological Survey (AGS) Report 98, 42 pages