

## Wastewater Disposal in the Montney Play Fairway of NE British Columbia – Assessment and Recommendations

Brad J. Hayes<sup>1</sup>, Howard Anderson<sup>1</sup>, Mark Cooper<sup>2</sup>, Pat McLellan<sup>3</sup>, Ben Rostron<sup>4</sup>, Jason Clarke<sup>1</sup>  
<sup>1</sup>Petrel Robertson Consulting Ltd., <sup>2</sup>Sherwood Geoconsulting Ltd., <sup>3</sup>McLellan Energy Advisors, <sup>4</sup>University of Alberta

### Introduction

Flowback from hydraulic fracturing and subsequent hydrocarbon production brings water to the surface that contains spent frac fluids and saline formation fluids from deep reservoirs. These cannot be allowed to contaminate fresh surface water or shallow groundwater zones, so provincial regulations dictate safe disposal in deep formations far below potable groundwater.

As tight Montney gas and liquids production ramps up in northeastern British Columbia, operators have developed a variety of strategies to deal with flowback and produced waters. Recycling frac flowback fluids reduces consumption of potable surface and shallow groundwater, and also minimizes disposal volumes. Substantial deep disposal must still take place, however, particularly when drilling and completion schedules do not allow timely re-use of available flowback and produced fluids.

As disposal aquifers reach capacity, robust controls must be put into place to avoid breaching reservoir containment, with potentially negative consequences such as water contamination or induced seismicity. New disposal locations must be identified and located to maximize their future capacity while minimizing risks.

### Project Elements

More than 175 deep disposal wells have been drilled in the Montney Play Fairway of northeastern BC, although many of the older ones serviced conventional plays in the past and have been abandoned. Detailed operational review of disposal well histories reveal a great deal about aquifer quality, continuity and compartmentalization – and provide guidance on predicting behaviour of current and future planned disposal wells.

To better understand both historical and future disposal well behaviour and potential limits, we completed an intensive regional assessment including the following elements:

- Detailed stratigraphic correlation and reservoir characterization of seven major disposal intervals across the Montney Play Fairway;
- Structural characterization of the entire Play Fairway area, identifying major faults and other tectonic elements that influence local stress regimes and disposal well performance;
- Reservoir fluid and pressure characterization in major disposal aquifers to guide understanding of original reservoir conditions and potential fluid compatibility issues;



- Geomechanical analysis of major disposal aquifers, including characterization of stress regimes regionally and locally, and observed and potential behaviours of disposal aquifer lithologies, as a guide to interpreting containment risks;
- Detailed reservoir engineering review of disposal well performance, with a focus on wells where reservoir pressures forced suspension of disposal activities;
- Consultation with Montney operators and BC Oil & Gas Commission staff regarding best practices and case histories

## Assessment

We reviewed all disposal wells in the Montney play fairway of northeastern B.C., determining the primary disposal zone (Figure 1), summarizing the disposal history, and compiling available data on reservoir fluids and pressures.

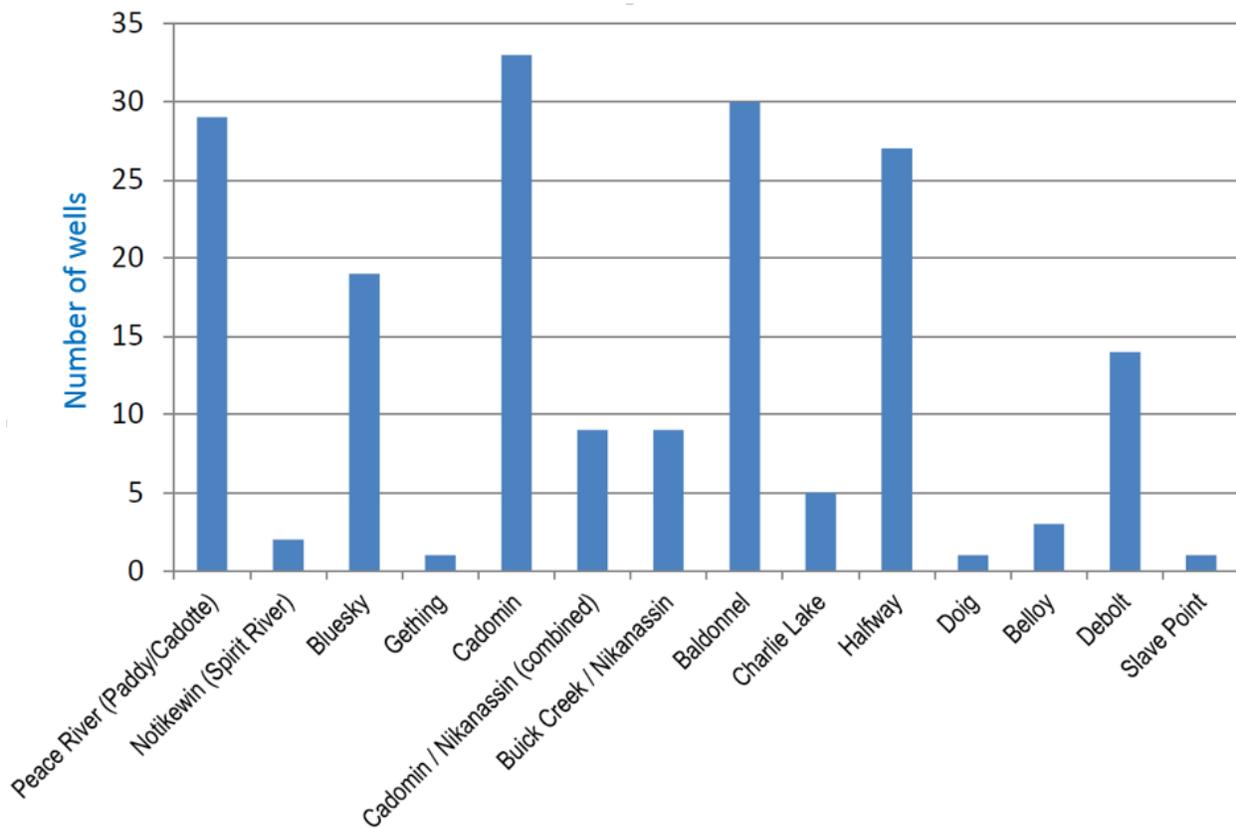


Figure 1. Stratigraphic distribution of disposal wells in BC Montney Play Fairway.

For each major disposal reservoir – Peace River, Bluesky, Cadomin, Buick Creek / Nikanassin, Baldonnel, Halfway, and Debolt – we created gross isopach, net porous reservoir, depth to formation, water chemistry and original reservoir pressure maps (Figure 2).

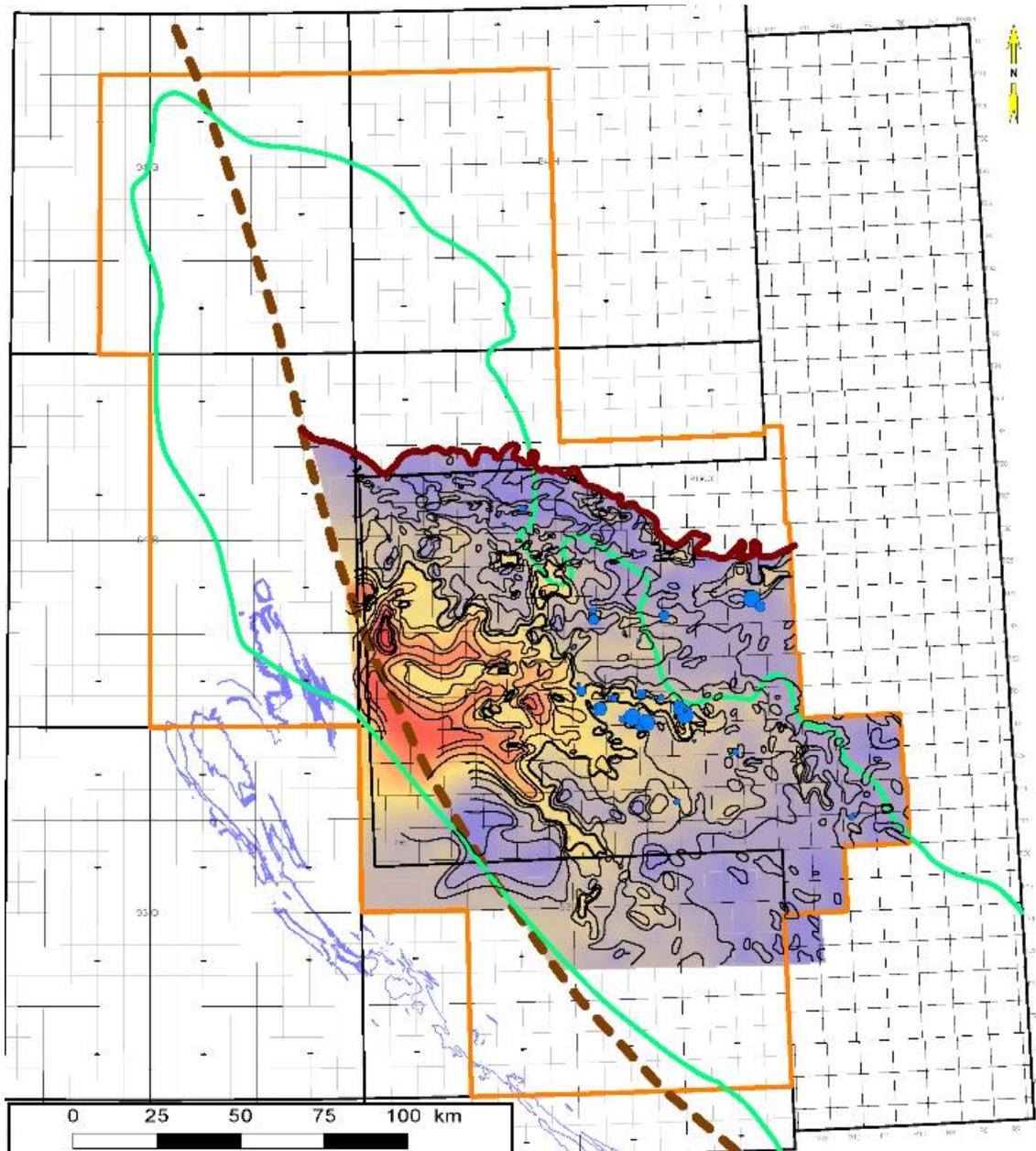


Figure 2. Gross isopach map, Cadomin Formation, highlighting Cadomin disposal wells. Blue bubbles represent disposal locations, and are sized proportionately to disposal volumes.

We completed a comprehensive structural assessment of the Montney play fairway study area, demonstrating a complex tectonic history and numerous structural subdivisions which could influence current stress regimes and potentially disposal zone aquifer behaviours (Figure 3).

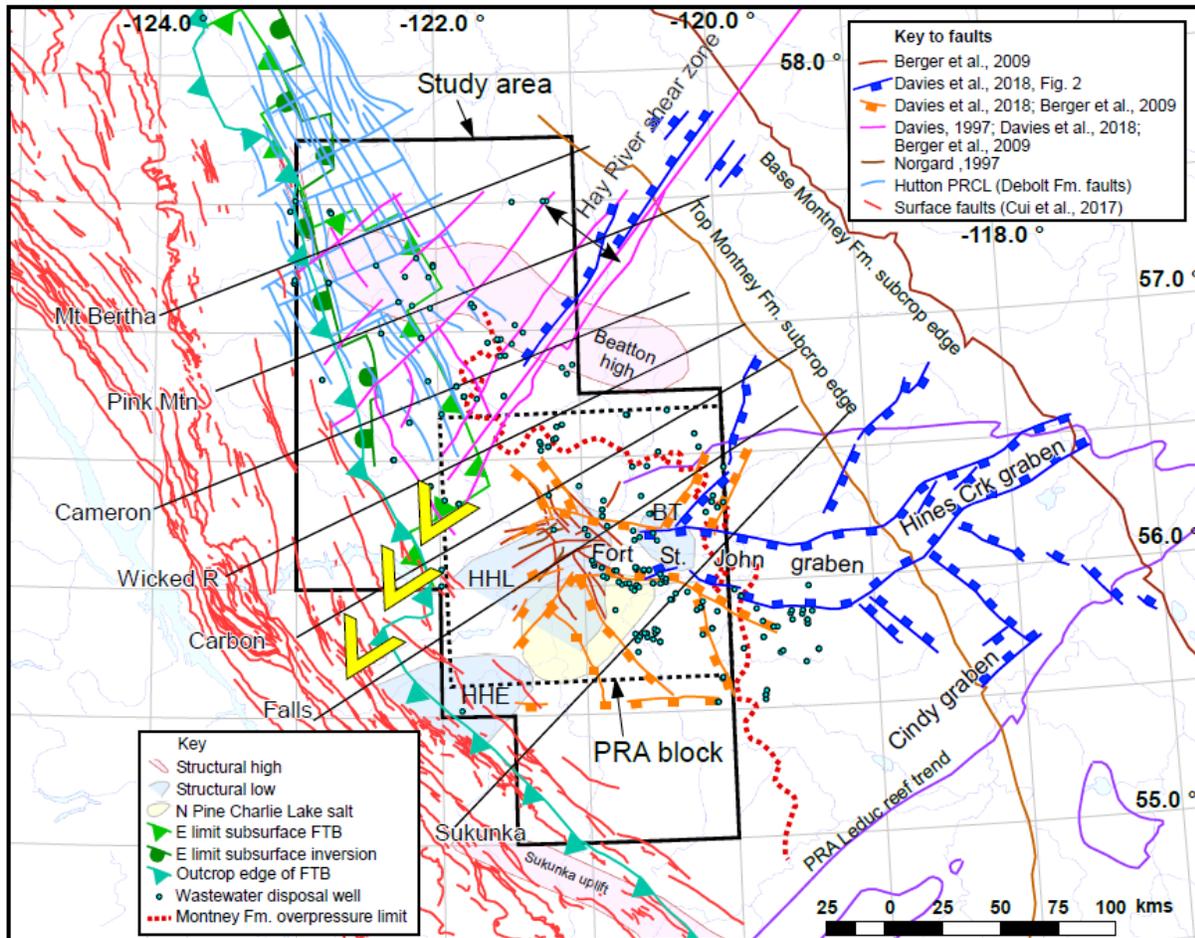


Figure 3. Structural framework, Montney Play Fairway of NEBC.

We gathered horizontal in situ stress orientations and in situ stress magnitudes in or adjacent to wastewater disposal reservoirs. These data were used to assess maximum injection pressures to preclude hydraulic fracturing in vertical and horizontal wells, and to conduct risk assessments for fault re-activation and concomitant earthquakes due to high pressure injection.

## Results

We have created maps for each major disposal unit illustrating areas favourable for waste water disposal across the B.C. Montney Play Fairway based on reservoir characteristics, structural / stress analysis, and performance of existing disposal wells. While there appears to be abundant waste water disposal capacity remaining across the fairway, it is not uniformly distributed. Operators working the northwestern part of the fairway in particular will face disposal challenges as development ramps up to supply LNG exports



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