

Water Disposal in Northeastern British Columbia

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Introduction

Water is a vital commodity and certain to become increasingly important as demand grows and the number of clean sources shrinks. British Columbia has an abundance of clean freshwater not only in its' plentiful rivers and lakes, but also in its' groundwater. Both types of this valuable resource are potentially susceptible to contamination from waters produced as a result of hydrocarbon production. Problems can be avoided with appropriate disposal well procedures.

Discussion

Water that is produced incidental to oil and gas production is typically re-injected back into isolated formations using dedicated water disposal wells. Sometimes this is done purely to avoid contaminating the surface with oily and brackish water. Often it serves the dual purpose of waste removal and pressure maintenance of depleting hydrocarbon reservoirs. If done correctly, subsurface water disposal can be done without damaging either surface or ground water. An understanding of the practice is necessary to ensure that proper procedures are followed, and to mitigate possible contamination of uphole potable or near-potable water reservoirs. Many factors must be taken into account when planning a water disposal well, including porosity and permeability of the proposed disposal zone, nearby abandoned wells, faulting, sealing and remaining hydrocarbon production potential.

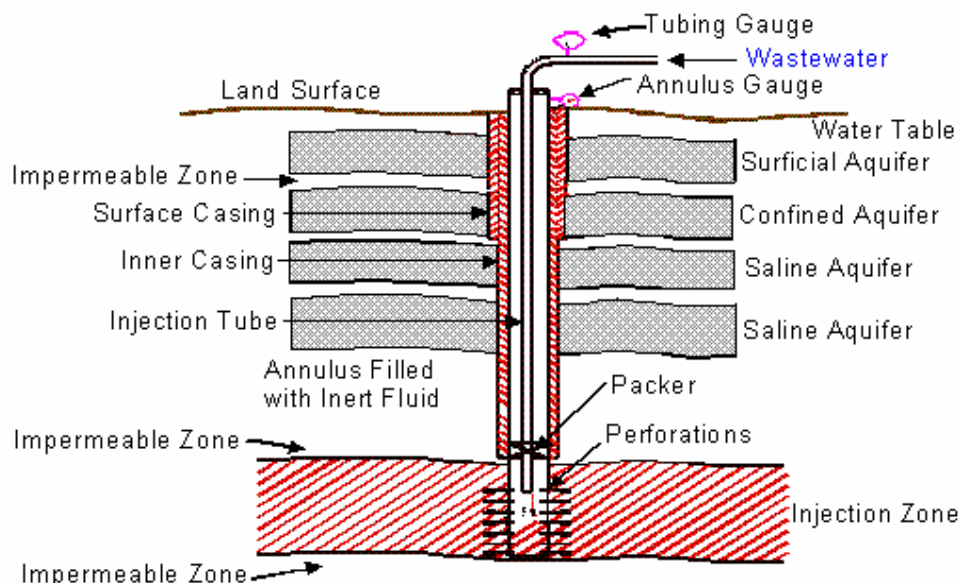


Figure 1: Construction Plan of a Disposal Well Courtesy of: U.S.E.P.A. <http://www.frtr.gov/matrix2/section4/D01-4-54.html>

A water disposal well must be built so that water injected remains in the injection zone (see Figure 1). To achieve that goal a zone must be chosen that has adequate storage volume to hold anticipated volumes. Permeability has to be high enough to allow injection without danger of fracturing the formation and causing the disposal water to flow into overlying formations. Surface casing must be set to below the depth of the deepest useable aquifer and cemented to surface. The injection string must also be cemented, at least well enough to isolate the injection interval. The injection zone can be open-hole as shown in Figure 1, or disposal can take place through perforations. A packer is used to isolate the annulus between the tubing and casing from formations above the injection interval.

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Work is underway at MEMPR to compile and interpret data on existing and potential water disposal sites. One component of this task is the mapping of Triassic formations (Figure 2) to delineate reservoirs that would be suitable for water disposal, or possibly CO2 sequestration. Other horizons that will be mapped include porous and potentially hydrologically isolated formations in the Lower Cretaceous and Middle Devonian.

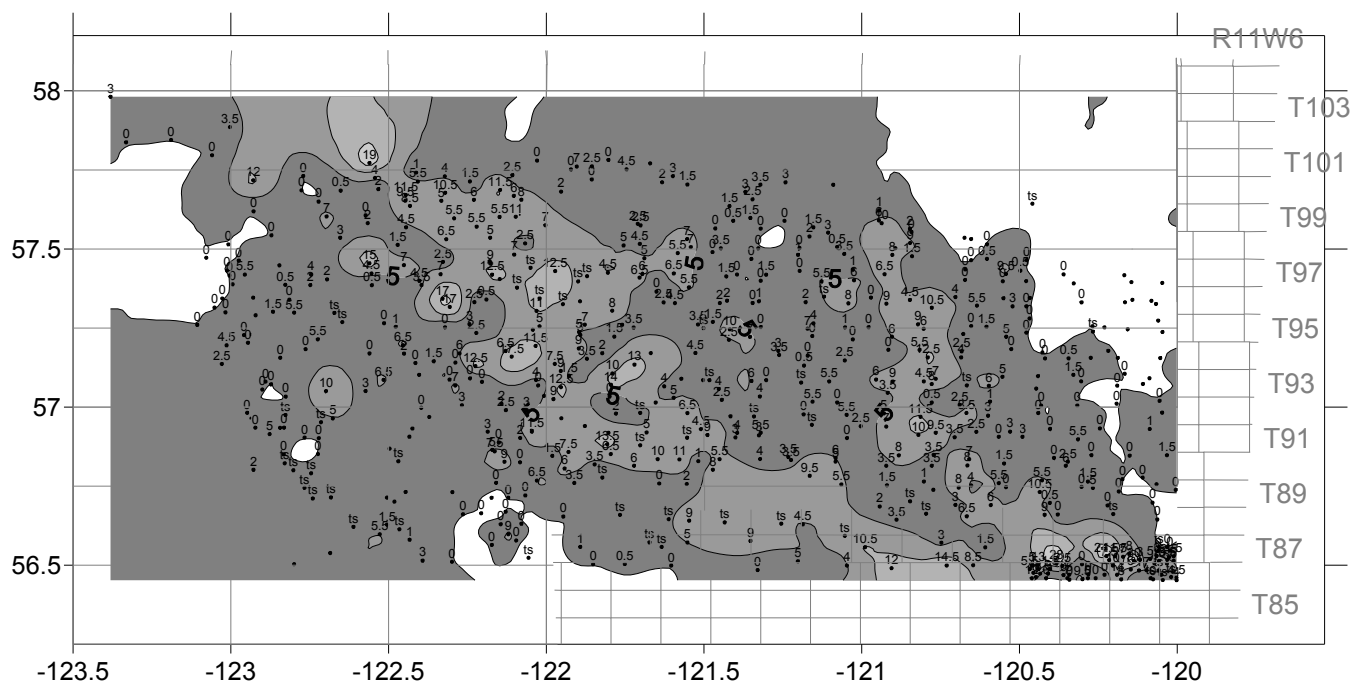


Figure 2: Halfway Formation Porosity

This is a preliminary map of Halfway Formation porosity (metres) based upon approximately 600 data points distributed across the northeastern part of the province, and within the limits of Triassic sedimentation.

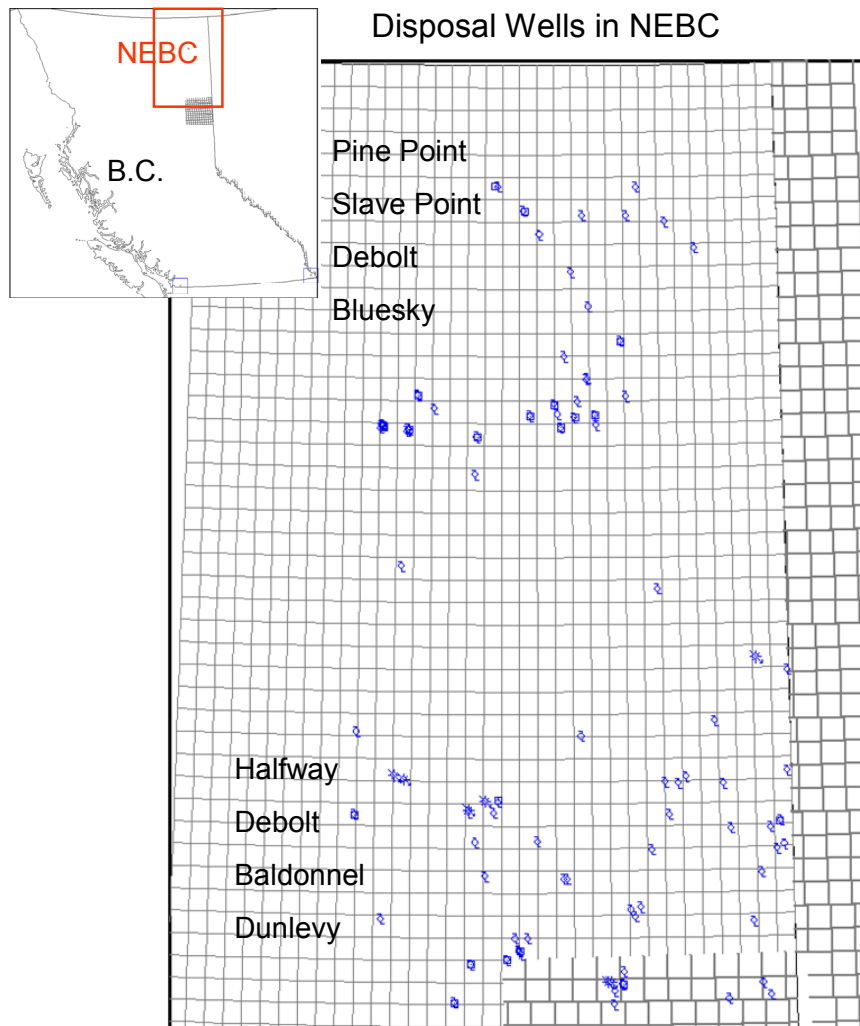


Figure 3: Water Disposal Wells in Northeastern British Columbia

Most disposal wells in the northernmost portion are completed in carbonate formations; Triassic formations become important in the southern regions of the map area.

Some of the other questions that will be investigated, with the goal of providing operators with information on the practice, include:

- Into what zones is water preferentially being disposed?
- For what reasons were particular wells chosen for the purpose?
- What volumes of water are being disposed?
- How good are particular formations for the purpose of disposal?
- Where are particular formations good for water disposal?
- What is the trend in disposal volumes throughout the province?
- Where are the operating/non-operating water disposal wells?
- How effective are converted production wells as disposal wells?

The portion of British Columbia represented by Figure 3 shows eighty-eight water disposal wells as of December 2007. Water-injection wells, which are drilled in pre-determined patterns for pressure maintenance or enhanced recovery, are not included in the figure. Most of the water disposal wells shown above were drilled in the hope of finding economic production of oil and/or gas. When they were found to be uneconomic, the operating company made application to the British Columbia Oil and Gas Commission for conversion to water disposal. Approval was granted under a number of conditions, among others, that the borehole was adequately engineered, adequate injectivity was demonstrated, no public objections were left unanswered and injection pressures did not exceed the fracture limit for the receiving formation.

Most of the disposal wells in the northern portion of the map are completed in middle Devonian carbonate formations such as the Slave Point. In the southern portion many of the wells are completed and disposing water into Triassic sandstones. Only a small number of wells were drilled specifically for water disposal.

British Columbia follows generally the same requirements for water disposal established by Alberta (EUB Directive 051) although it has not formally categorized classes of disposal wells. Alberta has five classes of disposal well: Ia, Ib, II, III, and IV. The lower the class number (i.e. Ia and Ib) the more stringent are the requirements for well construction, reporting and monitoring. Most disposal wells in British Columbia would be considered to be Class II, which is the class used for disposal of oilfield brines. A few acid gas (H₂S plus CO₂) disposal wells operate; they would be considered either Class Ia or Ib.

Summary

Disposal of produced water from oil and gas fields is an important concern. At this time approximately eighty-eight wells in northeastern British Columbia have the status of water disposal, although only a portion of those wells are in current operation, mostly for disposal of oilfield brines. Requirements for well construction, monitoring and reporting vary according to the degree of contamination of disposed water. Contamination of uphole or surface freshwater can occur in a wide variety of ways if due care is not taken. However water disposal can be done without endangering surface or subsurface waters if done correctly.