Hydrogeology and Management of Water Issues in the Development of Shale Gas in the Horn River Basin in northeastern British Columbia

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Summary

Innovative drilling, well completions and stimulation technologies are making the economic development of natural gas resources from shale deposits a reality in north-east British Columbia.

In this region, fracturing jobs are being executed on a previously unheard of scale; therefore, the water required has created a new water management challenge for operators. Fracturing conventional oil and gas wells in the Western Canadian Sedimentary Basin (WCSB) requires only modest amounts of fluid (180 m3 for a 60 ton frac); whereas the large frac jobs for horizontal shale gas wells commonly require over 100,000 m3/well of water. In the Horn River Basin, it's estimated hundreds of horizontal wells will be drilled, which indicates the need for large volumes of water and the implementation of strategic water management systems. It is important that operators begin the careful evaluation and development of surface and ground water resources in order to develop environmentally sustainable and cost effective access to water supplies.

The author will discuss the issues in the water management cycle, including:

- Water Supply
- Water Storage
- Water Treatment
- Water Re-Use and Disposal

The vast amount of oilfield data generated in the Horn River Basin has provided an opportunity for the hydrogeologist to prepare a hydrostratigraphic understanding of the region, and a basis for screening potential target aquifers at the pre-feasibility level. The author will discuss the hydrogeological characteristics of the geological zones of interest, and the advantages and disadvantages of each from a developmental and environmental perspective.

Flowback of 20-30% of the injected frac fluid creates a need to manage the large volumes of total dissolved solids (TDS) water in an environmentally safe manner. Re-use of flowback and produced water becomes an attractive alternative to many operators. When TDS values are high, water treatment may be necessary to bring the water quality into a range that can be re-used for fraccing or be appropriately disposed of in suitable non-potable aquifers.

Shale gas developers are considering extensive treatment options, but also other innovative technologies, to effectively use existing water supplies, including aquifer storage and recovery (ASR). ASR involves the development of non-potable aquifers as both a source of frac water, and as a potential storage or disposal zone for flowback and produced water.

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References

Hartling, A, 2008, “Carbon Capture and Storage in British Columbia”, Ministry of Energy, Mines and Petroleum Resources, 7pp

Janicki, F, (2008), “Northeastern British Columbia Disposal Well Studies, Geoscience Report 2008, British Columbia”, Ministry of Energy, Mines and Petroleum Resources, pages 33-39

Oil and Gas Commission – Informational Letter #OGC 03-12, “New Legislation For Water Source Wells

Hickin, A.S.,(2009), “The Role of Quaternary Geology in Northeastern British Columbia’s Oil and Gas Industry: A Summary”, Geoscience Reports @009”. BC Ministry of Energy , Mines and Petroleum Resources, pages 25- 37

Bachu, S., (2002), “Suitability of the Subsurface in Northeastern British Columbia for Geological Sequestration of Anthropogenic Carbon Dioxide”, Alberta Geological Survey, 87 pp

Bachu, S. (1999), “Flow Systems in the Alberta Basin: Patterns, Types and Driving Mechanisms”. Bulletin of Canadian Petroleum Geology, Vol. 47, No. 4, (December, 1999), P455-474

Hitchon, B., Bachu, S. and J.R Underschultz, (1990), “Regional Subsurface Hydrogeology, Peace River Arch Area, Alberta and British Columbia”, Bulletin of Canadian Petroleum Geology, Vol 38A (1990) P. 196-217

Bachu, S., (1997), Flow of Formation Waters, Aquifer Characteristics , and Their Relations to Hydrocarbon Accumulations, Northern Alberta Basin”. AAPG Bulletin, V.81, No.5 (May 1997), P712-733

Tim Pope, Schlumberger Stimulation Domain Manager, (2010) personal communication

Richard Marcinew, Schlumberger Geomarket Technical Engineer, (2010) personal communication

Rimassa, S., and Paul Howard., (2008), “Slickwater Design Guidelines”, Schlumberger NSA Stimulation Client Support – Tech Memo, 19pp

Campbell Geoscience Ltd (1984) Hydrogeology of the Wapiti Formation in the Valhalla –LaGlace Area, Report for Confidential Client.

Sub-Tech Ltd. (1985) Hydrogeology and Testing of the Cardium Formation in the Valhalla –Laglace Area, Reports for Confidential Clients

Campbell, K., (2009) “Application of Seismic Technology to Develop Hydrogeological Model in Petrel” WaterTech Conference, Banff, 2009.

US Dept of Energy, (2009) “Modern Shale Gas Development in United States – A Primer”

British Columbia, Energy, Mines, and Petroleum Resources (2006), “Conventional Natural Gas Play Atlas Northeast British Columbia”, Petroleum Geology Publication 2006-01