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Scoping Analysis of the Basal Belly River Formation for Water Supply, in the East Duvernay Play Area, Alberta

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Summary

The water supply potential for the basal Belly River Formation was estimated using data from a six township area (T. 32, R. 22 W4M – T. 35, R. 23 W4M) that included the towns of Trochu and Three Hills, southeast of the city of Red Deer. The primary aquifer is a basal sandstone unit (bBRs) that is likely in the allostratigaphic units 2 and 3, described by Al-Rawahi (1993) as shoreface delta front and channel fill sandstones. Logs in the study area show that the basal sandstone unit varies in thickness from 6m to 24 m with a porosity that ranges from 15% to 24%. In the Davey, Innisfail and Tindastoll fields, located between Bowden and Innisfail, and west of the study area, the bBRs occurs in a roughly northwest to southeast trending channel belt that is about 20 km (two townships) in width. Pressure transient analysis of drilllstem tests of the bBRs shows that the permeability varies considerably from 16 mD to 731 mD

Drillstem tests are the sole source of pressure and temperature information for the basal Belly River sandstone aquifer and the DSTs were downloaded from the HYDROLYTX database. The bBRs is substantially underpressured with pressure to depth (P/D) ratios that range from 4 kPa/m to 6 kPa/m. The average pressure for the study area is 3400 kPa at 740 m. At this depth the average reservoir temperature is 25° C. The salinity of the bBRs formation water ranges from 6000 mg/l to 10 000 mg/l. The total compressibility of the bBRs aquifer is 9.43 x 10^{-7} kPa^{-1}, the specific storage of the confined aquifer is 5.87 x 10^{-6} and the storativity is about 1.06 x 10^{-4} m.

Head values, downloaded from the AWWID database in HYDROLYTX, indicated that the aquifers above a depth of 250m were part of an unconfined gravity-driven flow system with a northeast to southwest trending recharge area to the west of the study area and a discharge area to the north and east that follows the Red Deer River. In the study area, the bBRs aquifer head contours are about 300 m lower in value than in the shallow gravity-driven system and define a flow pattern that is roughly from the northeast to the southwest. The flow pattern in the study area for the fresh shallow gravity driven system is from the west to the east, toward the Red Deer River and therefore, quite different from that in the deeper confined bBRs aquifer.

Several analytical reservoir models were run, using the IHS WellTest program, to determine if there was sufficient deliverability in the bBR aquifer to meet the needs of a massive hydraulic fracture (MHF) program. The program would require 40 000 m^3, of lower salinity water, per well, to stimulate approximately 20 initially, increasing to 100 wells per year in a full development scenario. Modelling was done with 2000 m horizontal water supply wells. Results from the model with three production blocks, each containing 2 wells (6 wells total), in a 100 mD bBRs

aquifer are given here. The two outside blocks had 3 no-flow boundaries and one infinite boundary. The middle block was fully bounded. A drilling and completion program was developed for the water field, based on a water demand of 800 000 m^3/yr. The wells in adjacent production blocks were spaced 3 Twp. (28968 m) apart. All six wells would be on production at the start of the 25 yr. project life. Figure 1 shows that the bBRs water field could support a 20-well frac program until mid-way through the 17th year. After this, increasing volumes of surface water would be required to meet the demands of the program. It is unlikely that the water field could support a program that completed and fracced 100 wells per year.

Conclusions

- The basal Belly River Formation is a confined aquifer that is separate from the shallow fresh groundwater system above 250m.

- Modeling shows that the basal Belly River aquifer could meet the water requirements of a program, in which only 20 wells per year could be fraced.

References

Al-Rawahi, Z.S., 1993, Sedimentology and Allostratigraphy of the Basal Belly River Formation of Central Alberta, MSc Thesis, McMaster University.

Figure 1