Hydrogeological Characterization of Basal Paskapoo Sandstones in the Subsurface of West-Central Alberta

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Development of unconventional oil and gas plays in west-central Alberta will impose new water demands in areas with existing domestic and agricultural users.

Deep saline aquifers are viable water sources in some areas, but are of poor quality elsewhere.

AER Play-Based Regulatory framework mandates protection of surface waters and shallow non-saline (potable) aquifers.

Do basal Paskapoo sandstones offer a solution?
- A huge, high-quality aquifer
- Non-saline waters, but too deep for domestic / agricultural water wells in most areas
Integrated Assessment of Water Resources, West-Central Alberta

- Surface waters, shallow non-saline aquifers, and deep saline aquifers
- Built around outlines of Montney and Duvernay unconventional play fairways
- Guiding principle – complete assessment of water resource opportunities will support the best, and most sustainable water solutions

Surface study area (142,000 km²)
Subsurface study area (91,000 km²)
Distribution of Deep Saline Aquifers

- Northern areas have multiple deep saline options for water sourcing and disposal
- Southern areas have few or none
- Alternatives are required!
Bedrock Geology
Shallow Bedrock Hydrostratigraphy

- Shallow section is dominated by aquitards, some featuring local channel aquifers.

- Paskapoo offers high-quality, relatively continuous and mappable aquifer strata.
Paskapoo Stratigraphy

- Stratigraphy defined in outcrop in the east (Red Deer area)
  - Basal Haynes Member features most continuous, high-quality sst aquifer
  - Lacombe Member dominated by fine-grained clastics
  - Good-quality sands in upper Dalehurst (Sunchild) Member present locally in the west

- Mapping and characterization has focused on outcrop and shallow water well data
  - Limited mapping based on petroleum borehole data has been published

Lyster and Andriashek, 2012
AGS Stratigraphic Borehole
16-32-41-26W4

QUATERNARY

MIDDLE
PASKAPOO

Shallow Borehole Coring Program

AGS Stratigraphic Borehole
16-32-41-26W4

BASAL
PASKAPOO

SCOLLARD

Riddell et al., 2009
Water wells penetrate basal Paskapoo only locally.
Water Well Locations

• Basal Paskapoo seen only in water wells near eastern and northern outcrop margins
  • Limited information - approximate location, driller’s lith logs, water flow rates
“Deep” Paskapoo Stratigraphy

Lyster and Andriashek, 2012
Paskapoo Deep Wellbore Control – IAWR Study

- 1847 wells (~4/twp) selected for regional mapping
Basal Paskapoo Sandstone Gross Thickness

**LEGEND**
- Study Area
- Paskapoo Outcrop
- Thrust Faults
- Paskapoo Wells Examined this Study

0 150 300 m
Paskapoo Reservoir Quality

- Abundant medium- and coarser-grained litharenites with excellent primary porosity development.
- General degradation southwestward with increasing burial depth and diagenesis.
Basal Paskapoo Net Porous Sandstone Thickness

- Porous sand cutoffs:
  - Gamma 75 API
  - Porosity 15%

LEGEND
- Study Area
- Paskapoo Outcrop
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Colour Grid

0 50 100 m
Basal Paskapoo Fluid Data

- Most existing publications address entire Paskapoo; data derived primarily from water wells

- Using only petroleum borehole data, >100m deep, and considering only the basal Paskapoo
  - 22 valid DST’s from 20 wells
    - Loosely define two regional water systems
  - 10 valid water analyses
    - 1567-2627 mg/L TDS (non-saline)
  - 15 basal Paskapoo water source wells
    - Most drilled 1960’s/70’s; only two active today
    - Top four producers: 0.43 - 1.40 e⁶m³ (2.7 - 8.8 MMBW)
    - Three of these are in adjacent LSD’s in one section
Basal Paskapoo Gas

- 03/16-12-48-3W5
  - AOF 207 e³m³/d
  - Cum 17.0 e⁶m³ (0.60 BCF)
  - 10.2 e³m³ water

- 83 Paskapoo gas wells (some commingled with Scollard)
  - Best producer 2.43 BCF
  - 11 wells > 0.5 BCF
  - A significant gas resource to be conserved / produced
Next Steps

• Existing regional work highlights the basal Paskapoo as a potential water source to support unconventional oil and gas development in some areas.

• Under current regulations, the basal Paskapoo contains non-saline waters, and therefore is subject to very specific licensing requirements designed to protect non-saline waters.

• Can regulatory requirements be modified to support more efficient access to basal Paskapoo waters?
The Alberta Energy Regulator and Alberta Geological Survey are actively engaged in modeling and characterization work to better understand shallow groundwater resources – the Provincial Groundwater Inventory Program.

Studies are structured after Canadian Council of Academies Expert Panel on Groundwater science requirements for groundwater sustainability.

Industry-supported work that meets these standards can be used by the Regulator in support of PGIP studies.
Next Steps

• A more detailed, comprehensive study proposal is in the works – with the goal of promoting better understanding and regulatory review of the basal Paskapoo

• Stay tuned !!
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