Groundwater in Alberta: What Don’t We Know

Walter Ceroici
Water, Agriculture and the Environment Conference
May 31, 2011
• Groundwater occurrence in Alberta
• Importance of groundwater
• Groundwater contamination
• State of groundwater knowledge in Alberta
• Improving groundwater knowledge
• Groundwater occurrence in Alberta
  • Importance of groundwater
  • Groundwater contamination
  • State of groundwater knowledge in Alberta
  • Improving groundwater knowledge
Hydrogeologic Settings
Bedrock Geology
Alberta Glaciation
Alberta Glaciation
Hydrologic Cycle

Evapotranspiration → Precipitation → Runoff → Throughflow → Groundwater Flow

Percolation → Water Table

Groundwater
Alberta’s Average Annual Water Balance

Precipitation falling on Alberta: 336,569,000,000 m³

Evaporation and Transpiration: 261,191,000,000 m³

Flows entering Alberta: 70,227,000,000 m³

Surface Runoff generated in Alberta: 60,561,000,000 m³

Groundwater recharge: 14,817,000,000 m³

Flows leaving Alberta: 130,788,000,000 m³ (eventually returning to oceans)

Ocean Evaporation
Groundwater Flow

Intergranular Flow

Fracture Flow
Groundwater Flow
Aquifer Types

- Unsaturated zone
- Artesian well
- Water table well
- Flowing artesian well
- Potentiometric surface
- Recharge area for confined aquifer
- Unconfined aquifer
- Confined aquifer
- Confining bed
- Water table

Diagram showing different types of aquifers and their relationship to the water table and potentiometric surface.
• Groundwater occurrence in Alberta
• Importance of groundwater
• Groundwater contamination
• State of groundwater knowledge in Alberta
• Improving groundwater knowledge
Groundwater and the world’s freshwater supply

- Fresh (2.5%)
- Saline (97.5%)

World’s water supply (fresh and saline)

World water supply (fresh only)

- Lakes, rivers, etc. (0.4%)
- Groundwater (30.9%)
- Snow and ice (68.7%)

Credit – Environment Canada
Percentage of population reliant on groundwater
Municipal, domestic and rural only

Source:

Based on 1996 figures.
Groundwater Use in Alberta

Total Water Allocations in Alberta by Source (as of 2009)

Surface Water: 97.0%
Groundwater: 3.0%

Total Licensed Volumes: 9,891,606,000 m³
(9,591,071,000 m³ from Surface Water and 300,535,000 m³ Groundwater)
Groundwater Use

**Domestic Use**
- > 600,000 Albertans rely on groundwater
- 180 municipalities have groundwater supplies
- Usage greatest in central Alberta, and growing
- 500,000 well records

**Industrial Use**
- oil and gas
- forestry operations
- etc.

**Agricultural Use**
• Groundwater occurrence in Alberta
• Importance of groundwater
• Groundwater contamination
• State of groundwater knowledge in Alberta
• Improving groundwater knowledge
Alberta Research Council

Groundwater Yield Maps

• Reconnaissance maps developed in 1960 to 1980s period

• Considered to be cutting edge at the time

• Still used today
Groundwater Mapping

Agriculture and Agri-Food Canada (PFRA) Reports

- county or municipal district scale
- based on water well records

Specific Studies

- Localized studies (e.g., Ft. McMurray area)
- Paskapoo Formation
Importance of the Paskapoo Formation

- Studied by NRC in 2008
- Contains productive sandstone members
- Covers 10% of Alberta by area
- Estimated 103,000 wells
  - 28% of all water wells in Alberta
• Over 250 wells in network

• Water levels have been monitored in some wells since 1950s

• Groundwater chemistry monitoring in selected wells since mid-1980’s
  • Includes analysis for routine parameters, metals
Well # 159, DEVON #2
LSD 8 Sec 12 Twp 51 R 26 W 4M
Groundwater level elevation (m above m.s.l.)

Mean elevation:
Max and Min elevations:
Actual data for the year 2010:
Well elevation: 693.30 m above m.s.l.
Well completion: SLOTTED 4.6 - 7.6 m
• Groundwater occurrence in Alberta
• Importance of groundwater
• Groundwater contamination
• State of groundwater knowledge in Alberta
• Improving groundwater knowledge
Groundwater Contamination

Attenuation Processes (e.g., dispersion, sorption, biodegradation)
Coalbed Methane (CBM) Development

Coalbed Methane Well Density

CBM Wells Drilled or Recompleted
Wells per Township

Data Source: ERCB 8T109 (March 2010)

Government of Alberta

Total Wells: 17337

January 2011
Location of Confined Feeding Operations in Alberta

Approximate extent of Paskapoo Formation
• Groundwater occurrence in Alberta
• Importance of groundwater
• Groundwater contamination
• State of groundwater knowledge in Alberta
• Improving groundwater knowledge
Things are changing fast

- From Alberta Environment
• Outcomes:
  • Safe, secure drinking water supply
  • Healthy aquatic ecosystems
  • Reliable, quality water supplies for a sustainable economy

• An important objective to better understand the state of groundwater quality and quantity

• Promoted partnerships (Alberta Water Council, WPAC, Watershed Stewardship Groups)

• Water conservation
• Improve knowledge of Alberta’s groundwater resources through:
  • Mapping and inventory
  • Expansion of the groundwater observation well network
• Protect groundwater supplies through effective policy for CBM development
• Encourage water conservation and beneficial use
• There needs to be a commitment to improvement of groundwater resources knowledge

• Groundwater monitoring and data management should be a priority

• Groundwater management legislation should be reviewed to ensure that it meets increased demands
• Water for Life renewal (2008)
  • Improve baseline groundwater information
  • Improve groundwater analysis, interpretation and reporting tools

• AENV developing a 10 year Groundwater Strategy and Action Plan
  • Improving knowledge of groundwater resources
  • Groundwater management policies and tools
  • Building capacity
  • Improve stewardship of groundwater resources
Successes

• The GOA/industry “Working Well” workshops initiative very well received

• CBM Baseline water well testing program initiated
  • Requires sampling of domestic water wells within 600 m of a proposed CBM well

• Provincial Groundwater Monitoring Network is being expanded
  • Number of wells increasing
  • Real-time measurements
Successes
Confined Feeding Operations

• NRCB partnering with ARD and University of Saskatchewan to study impacts of manure management on groundwater quality in Alberta

• NRCB, in partnership with GOA and livestock industry, developed an environmental risk screening tool for water
  • Tool used to determine groundwater monitoring requirements at confined feeding operations

• Recently introduced a groundwater risk-based compliance program
• Groundwater vulnerability is an important component of regional land use plans under the LUF.
Alberta Environment / Alberta Geological Survey partnership initiated in 2007 to map groundwater

- From AGS
Airborne Geophysical Survey

- From AGS
Southern Alberta Mapping

- Study area would cover the Bow, Oldman, Milk and South Saskatchewan river basins
- Geological mapping to occur this field season
- Recent airborne geophysical survey work completed and will be used in geological mapping work
- Compilation of hydrologic, hydrogeologic and geologic data will occur

- From AGS
Conclusions

• Groundwater will become increasingly important as access to surface water supplies decreases

• Studying groundwater is expensive, substantial, stable funding is required

• Commitment needed to better understand our groundwater resource and usage to facilitate proper management

• Groundwater protection is a shared responsibility
Thanks to Alberta Environment, and the Alberta Geological Survey for contributing information for this presentation.