Hydrogeological and geological characterization of the Calgary-Lethbridge Corridor to support a management approach for groundwater

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Provincial Groundwater Inventory Program

A partnership with Alberta Environment & Parks since 2008

- Characterize Alberta’s groundwater resources
  - Regional-scale mapping and inventory
  - Basis for water management

- Ensure geoscience is meaningful at the ‘regional’ scale
  - Land-use planning regions
South Saskatchewan Regional Plan
Develop a digital hydrostratigraphic framework

Defined by 8 sub-basins and deformation belt to the west

21,159 km²
3 HSU's developed for unconsolidated sediments

Each bedrock formation defined as an HSU

Updated bedrock topography and paleovalleys
Delineate groupings of unconsolidated sediments with common texture

- Laterally-connected fine- or coarse-grained units
- Can be recognized at a regional scale (> 1 km)
Unconsolidated HSUs
Unconsolidated HSUs

- **S2**: Surface sand to sand and gravel, silty sand
- **C**: Intervening fine-grained unit including clay, silt or diamicton
- **S1**: Basal sand and gravel, silty sand

Image at 30 x vertical exaggeration
Regional Hydrogeological Understanding

Hydrogeology
- Groundwater level (e.g. water table)
- Groundwater quality
- Recharge/Discharge

Geology
- 3D framework
- Unconsolidated units
- Bedrock units
Water Supply Wells

- E.g. Domestic, stock, municipal, etc.
- NOT observation, test holes, dewatering, etc.
- Allocation to several different geological units
- Useful to see water sources
Regional confining layer but also local aquifer

Can be > 50 m thick in paleovalleys
Recognized as aquifers in the region

Can be shallow or deep
Some intersection with modern Bow River valley
- Spatially variable connection of paleochannel and river
- HSU’s provide a framework for mapping gaining/losing reaches
Bedrock Units

- More widespread aquifer potential across region
- Spatially variable hydraulic properties
Distribution of Permeable Bedrock

- Identify major sandstone trends → aquifer potential
Identify major sandstone trends → *aquifer potential*

Locate where permeable bedrock could intersect rivers

Framework for mapping gaining/losing reaches at regional scale
Potential Recharge/Discharge Areas

- Potentiometric surfaces developed from water well database
- Analysis of hydraulic head difference
- First-order mapping of groundwater and surface water interaction
- Shallow depths (<150 m): sandstone mapping complements existing water well data

- Deeper depths (>150 m): sandstone mapping provides info where data may be lacking
Versatile Soil Moisture Budget Model (VSMB)

1D simulation of recharge

Used in Canadian Prairies by ARD/ACIS and UofC

Different simulations for different conditions

- 2 soils (sandy loam/silty clay)
- 2 vegetation (grass/wheat)
- 3 ET routines
- 4 weather stations

Precipitation → Snow → Evapotranspiration → Runoff

Recharge
CLC Recharge

- Strong seasonal and annual variation
- Depression focused recharge important (UofC)
Hydrogeology

Precipitation

Snow

Runoff

Evapotranspiration

Recharge

Water Supply Wells in each Hydrogeologic Unit (no. of wells):
- HSU 82 (47)
- HSU C (719)
- HSU D (646)
- Pembina/Florrence Hills HSU (3733)
- Scollard/Willow Creek HSU (8581)
- Battle HSU (27)
- Horseshoe Canyon/St. Mary River HSU (11034)
- Boreas HSU (400)
- Undifferentiated Battle River HSU (46)
- Foremost HSU (4)

Elevation (in m a.s.l.):
- 1620
- 760

Map showing different geologic units and elevations.
Better understanding of regional hydrogeology

- Helpful in defining formal aquifers and groundwater management units
- Useful in mapping groundwater-surface water interaction
- Identify gaps in groundwater monitoring network

Geoscience supports groundwater management approach in the SSRP
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**Regional Geological and Hydrogeological Characterization of the Calgary-Lethbridge Corridor in the South Saskatchewan Regional Planning Area**

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**Citation and Related Publications**

MAP 579 - Surficial Geology of the Calgary-Lethbridge Corridor (NTS 820, 82F, 82G, 82T and 82H)

DIG 2016-0014 - Surficial Geology of the Calgary-Lethbridge Corridor (GIS data, line features)

DIG 2016-0013 - Surficial Geology of the Calgary-Lethbridge Corridor (GIS data, polygon features)

DIG 2016-0036 - Calgary-Lethbridge Corridor Hydrostratigraphic Model - Bedrock Topography, Southwestern Alberta (gridded data, ASCII format)

DIG 2016-0051 - Paleovally and Thawenis of the Calgary-Lethbridge Corridor (GIS data, line features)

INF 130 - Bedrock Topography of the Calgary-Lethbridge Corridor

DIG 2016-0037 - Calgary-Lethbridge Corridor Hydrostratigraphic Model - Sediment Thickness, Southwestern Alberta (gridded data, ASCII format)

DIG 2016-0049 - Total Dissolved Solids Concentration in the Scollard/Willow Creek Hydrostratigraphic Unit in the Calgary-Lethbridge Corridor (gridded data, ASCII format)

DIG 2016-0050 - Total Dissolved Solids Concentration in the Horsethief Canyon/ St. Mary River Hydrostratigraphic Unit in the Calgary-Lethbridge Corridor (gridded data, ASCII format)

DIG 2016-0055 - Calgary-Lethbridge Corridor Hydrostratigraphic Model - Top of the Battle Hydrostratigraphic Unit, Southwestern Alberta (gridded data, ASCII format)

**Report and digital data**

- Geological surface
- Groundwater information

[http://ags.aer.ca/](http://ags.aer.ca/)