Alberta Energy Regulator

AGS ALBERTA GEOLOGICAL SURVEY

Alberta

12 May 2025

Delineating aquifer management units in southern Alberta to support regulatory decisions on groundwater licensing

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Presented by:
Jessica Liggett

Presented to:
GAC-MAC-IAH-CNC 2025 OTTAWA

AB Premier's Mandate Letter to Minister of Environment and Protected Areas (2023)

Reviewing Alberta's water management strategy to increase the availability of water and water licences to Alberta municipalities, businesses and agricultural producers while maintaining the highest standards of water conservation and treatment.

Southern Alberta Groundwater Evaluation (SAGE)

Protection from over-allocation and contamination

- Geological property modelling
- Regional geophysical survey: t-TEM
- Groundwater availability and chemical quality
- SW-GW connectivity

More effective and efficient licensing decisions

- Data availability
- Decision support tools
- Interactive map portal

Southern Alberta Groundwater Evaluation (SAGE)

Protection from over-allocation and contamination

- Geological property modelling
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Make licensing decisions better and faster

- Data availability
- Decision support tools
- Interactive map portal

Aquifer Management Units (AMUs)

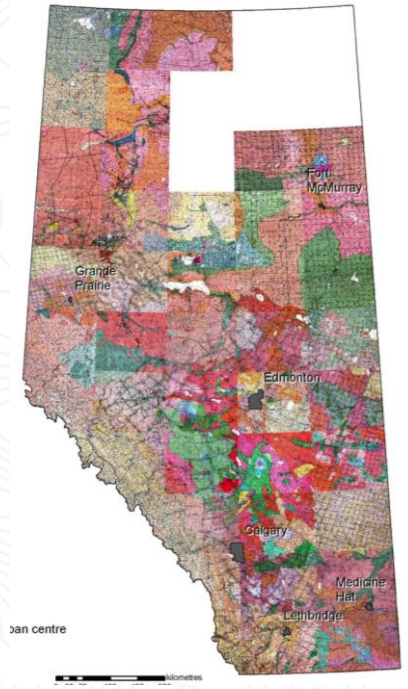
- Mapping
- Characterizing
- Classifying

Groundwater in Alberta

Need a consistent framework

Consolidation of previous work

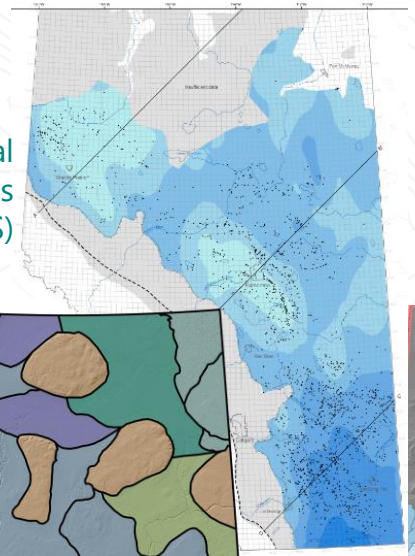
Alberta Research Council groundwater reconnaissance (1968-1982)



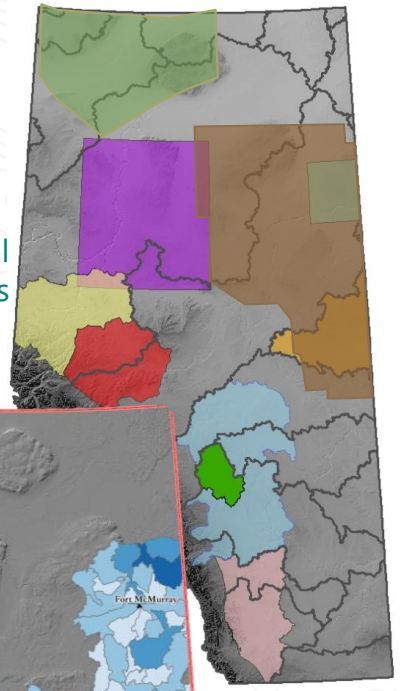
OFR 2009-02

Alberta Geological Survey (2002-present)

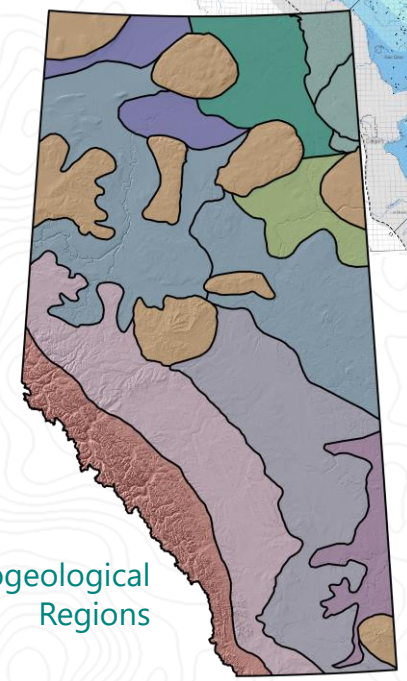
Provincial hydrogeological maps (head and TDS)



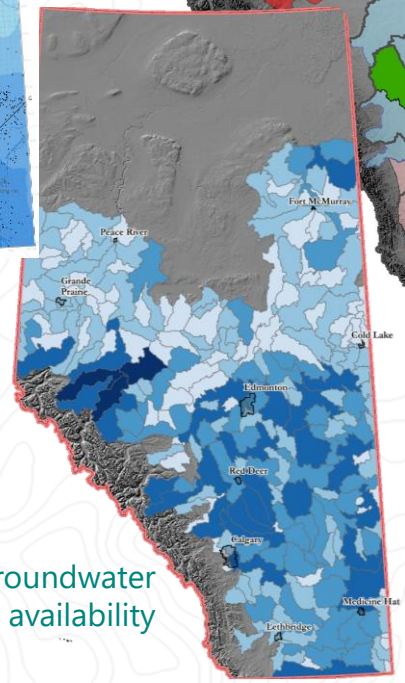
Regional studies



Hydrogeological Regions

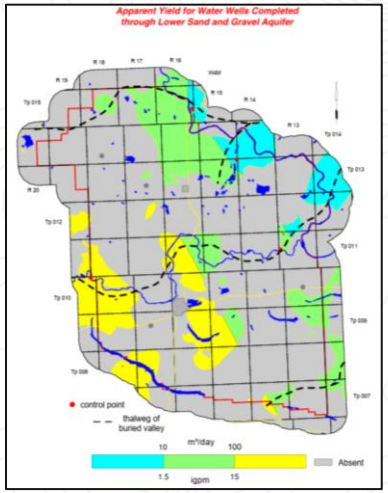


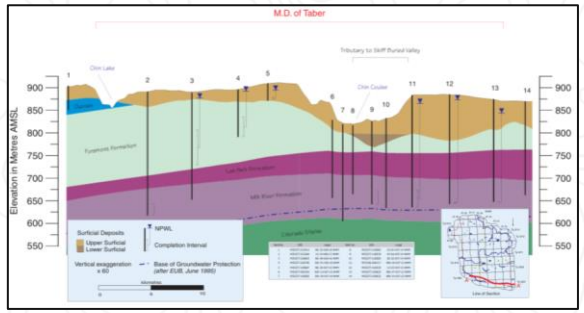
Groundwater availability



https://ags.aer.ca/our-science/water-resources

Non-AGS work (e.g. consultants, academia, GSC)

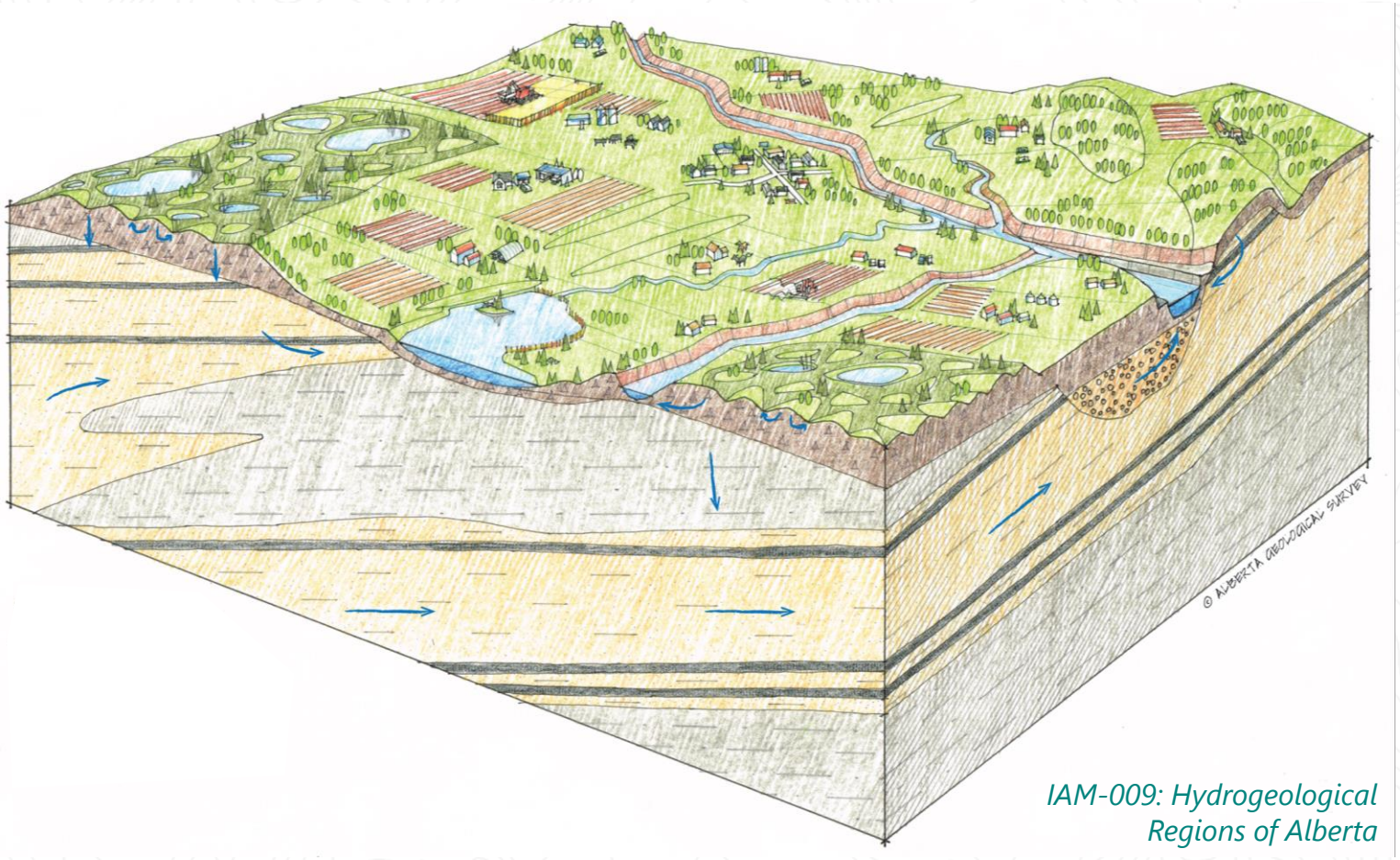




Hydrogeological Consultants Ltd. (2007), Regional Groundwater Assessment: M.D. of Taber

Principal Aquifers of Alberta

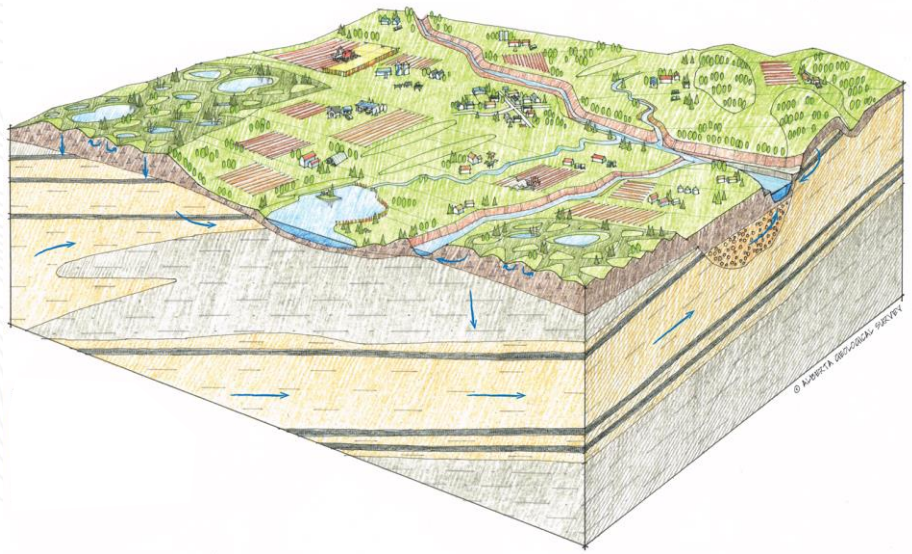
- High-level understanding of hydrogeological setting
- Formation-based, provincial-scale



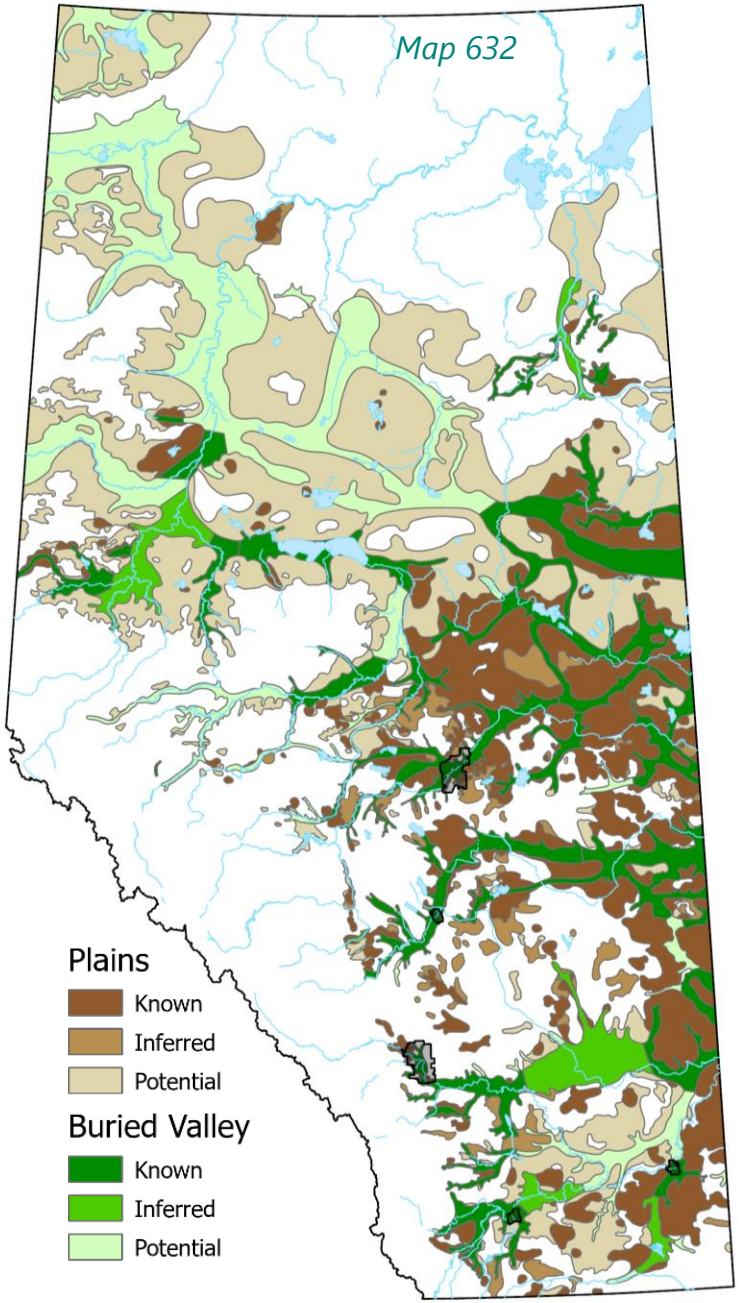
IAM-009: Hydrogeological Regions of Alberta

Principal Aquifers of Alberta

- New interpretation of existing knowledge and recent data/mapping



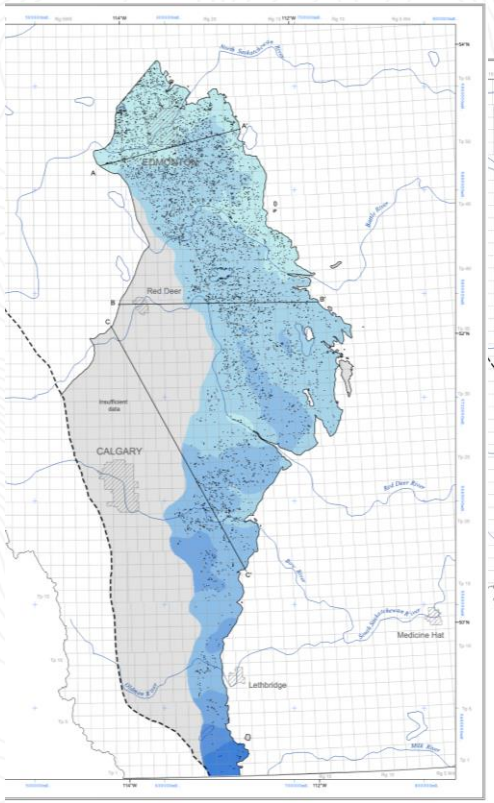
Sediments above bedrock



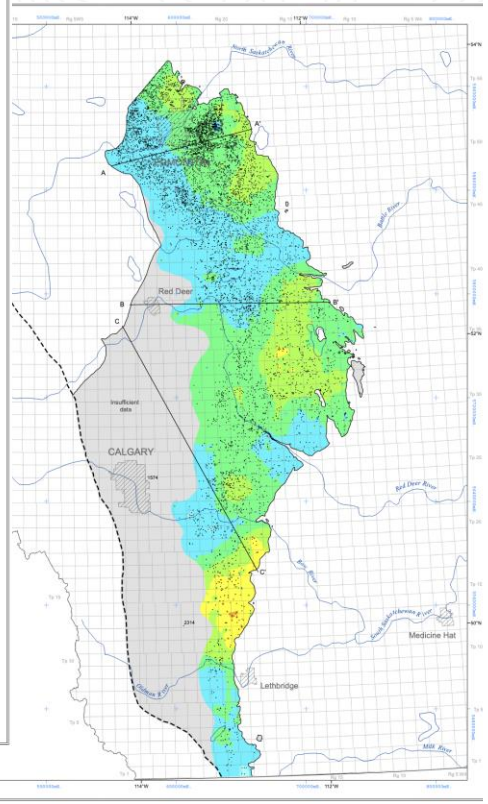
Bedrock

Principal Aquifers of Alberta

- New interpretation of existing knowledge and recent data/mapping

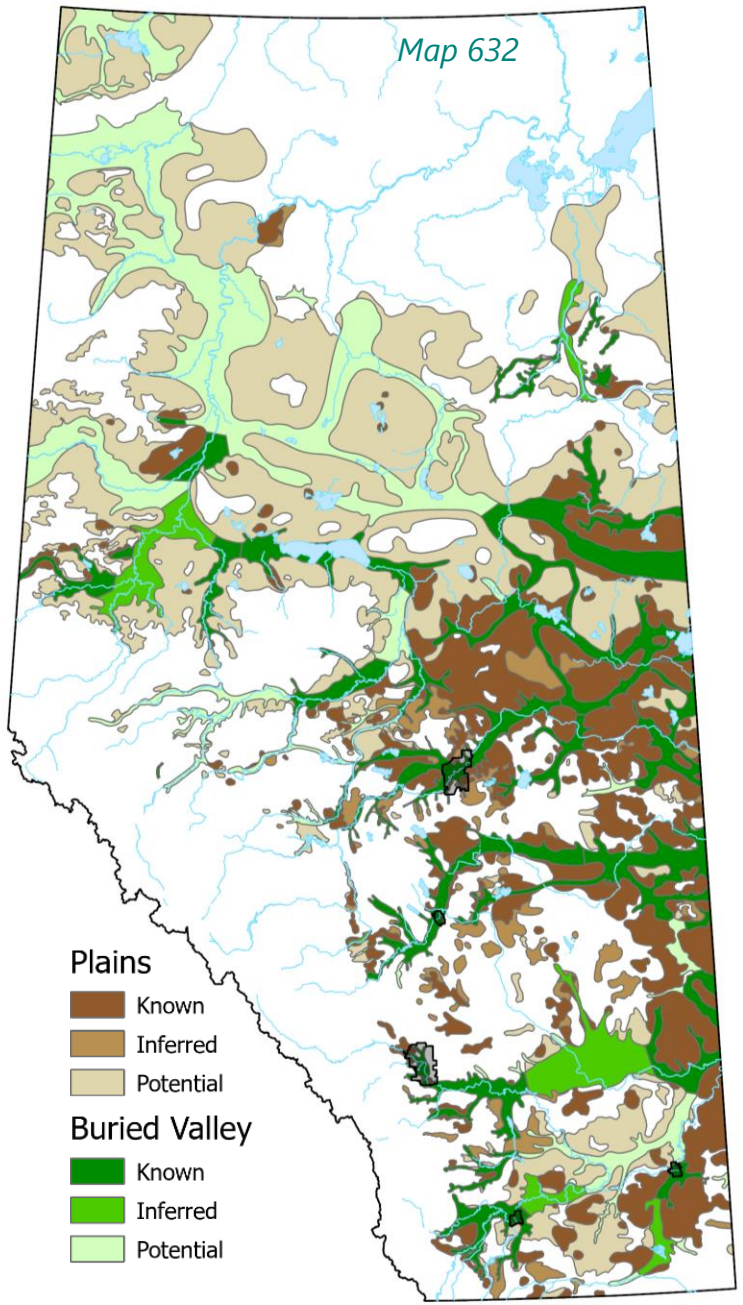


Maps 626 and 625



AGS.AER.C

Sediments above bedrock



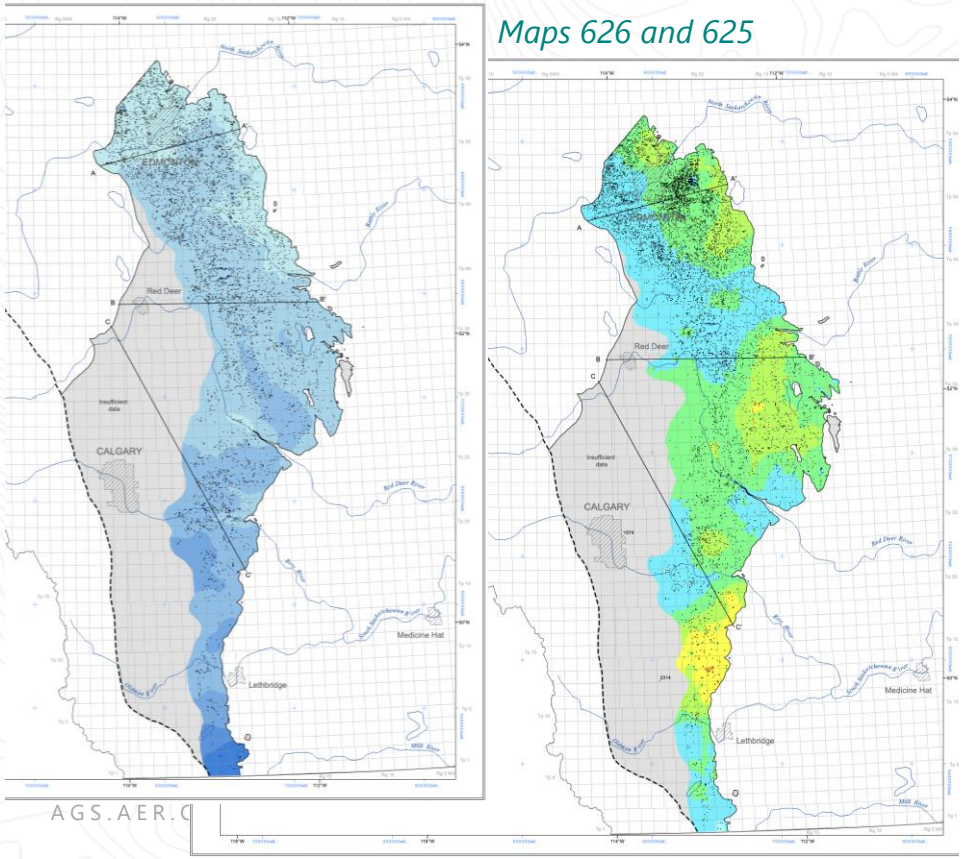
Bedrock

Principal Aquifers of Alberta

Need smaller scale for management

Licensing, cumulative effects

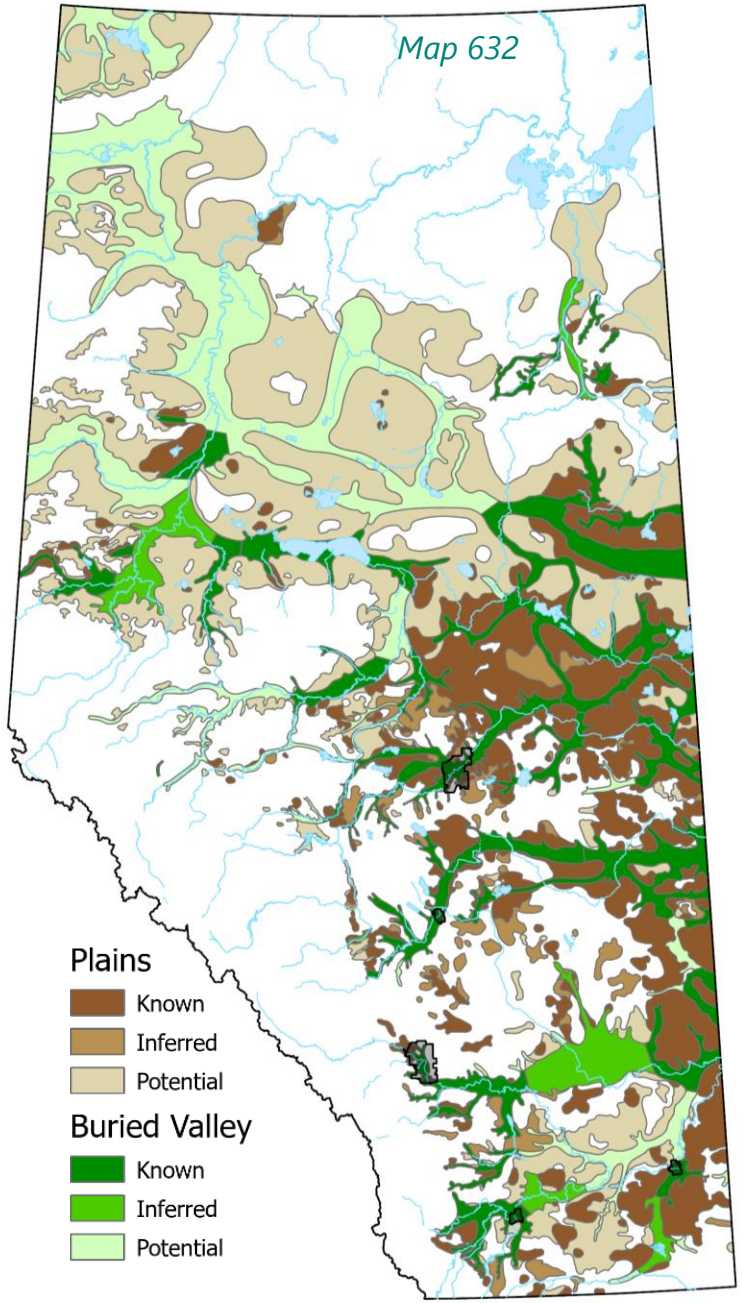
Maps 626 and 625



AGS.AER.C

Sediments above bedrock

Map 632



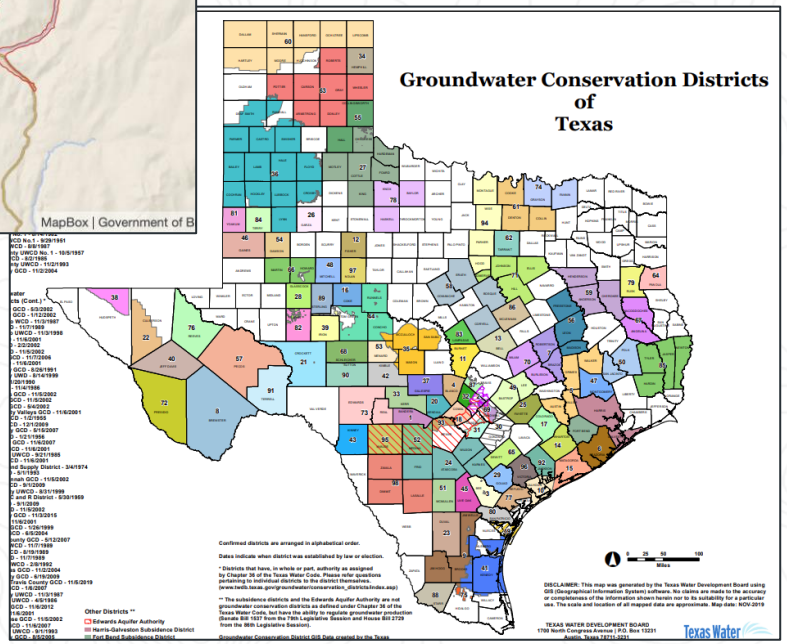
Bedrock

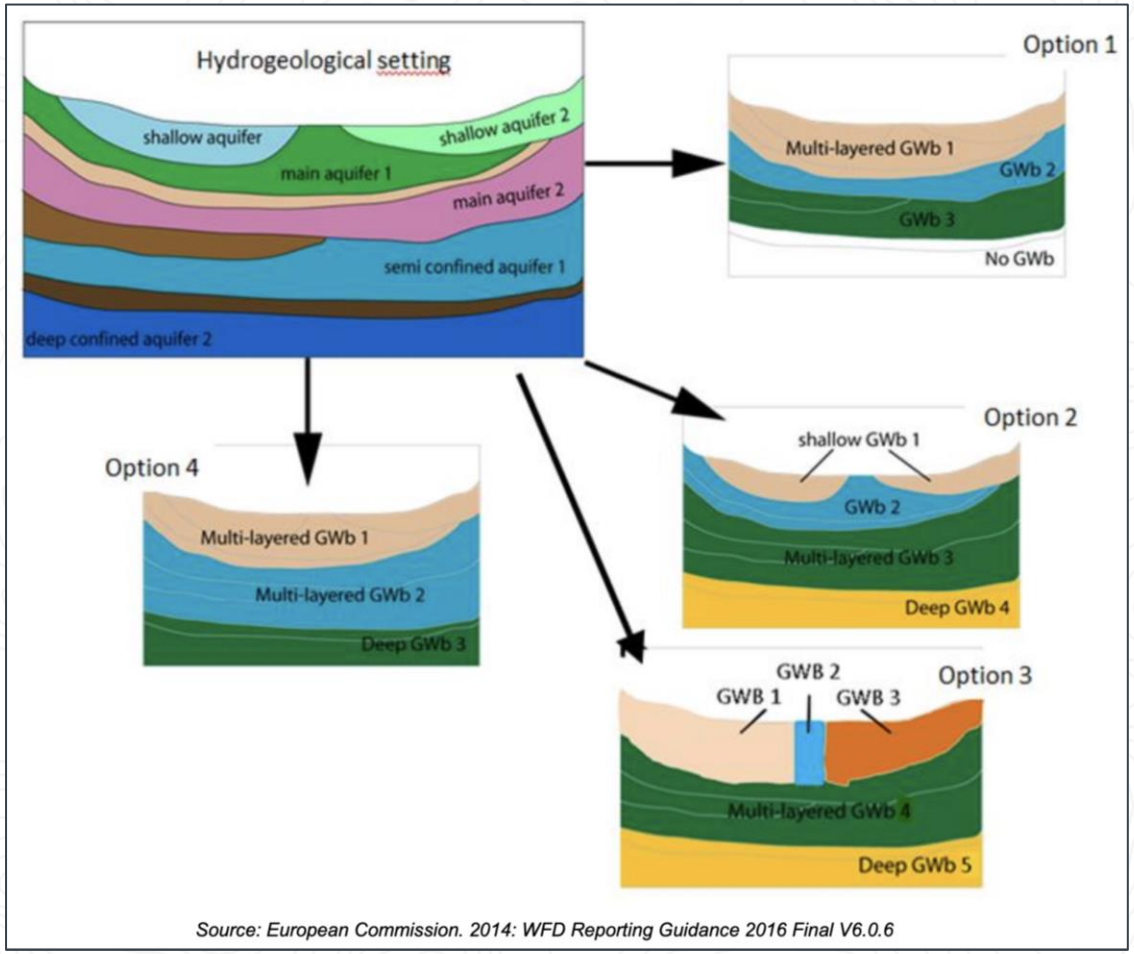
Modified from Map 600

Aquifer Management Units (AMUs)

Don't have to follow formation boundaries

E.g. flow system, hydrological boundaries, chemistry, water use, human pressure or issues, administrative



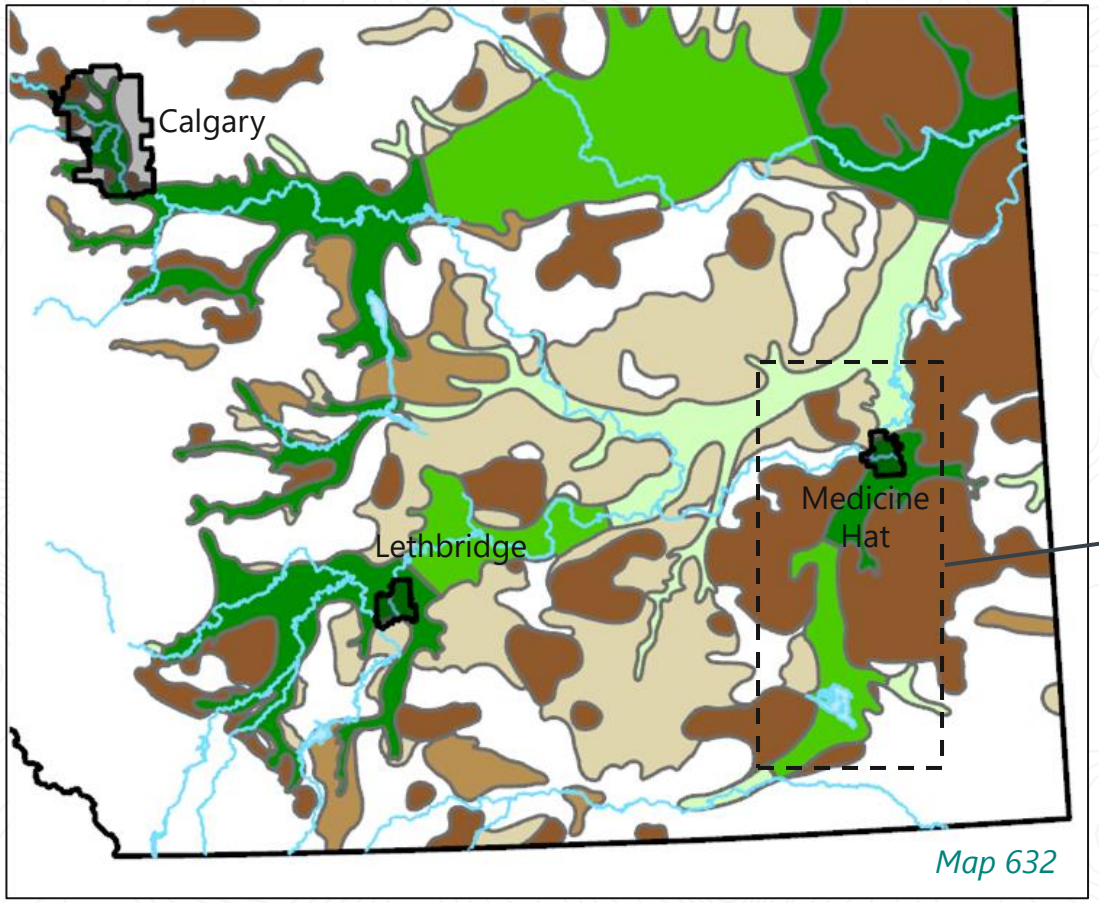


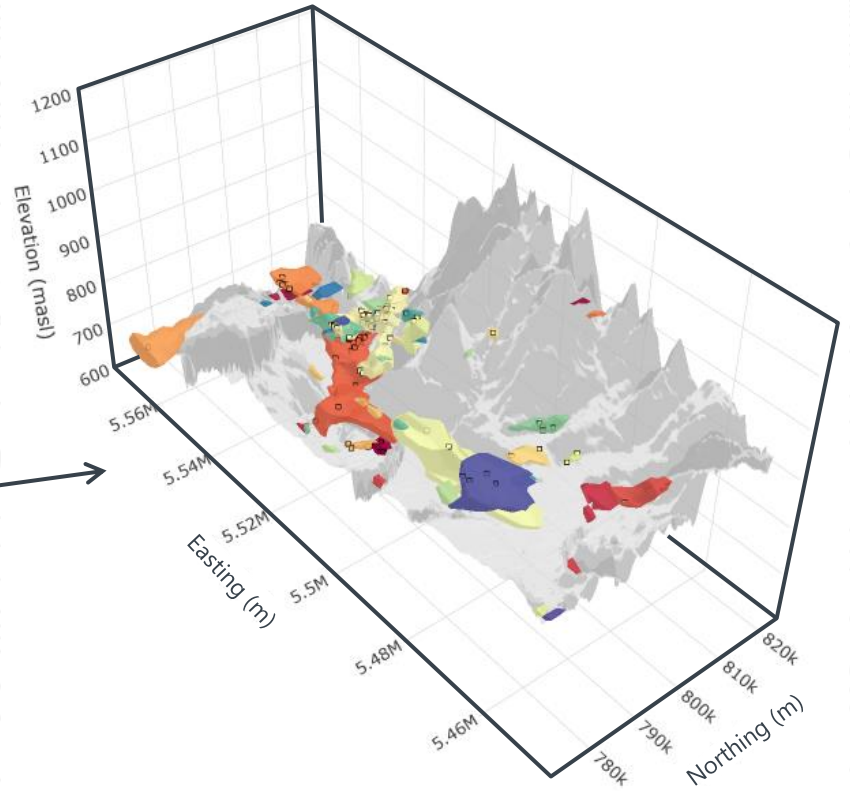
Source: European Commission. 2014: WFD Reporting Guidance 2016 Final V6.0.6

AMU mapping

Sediments Above Bedrock

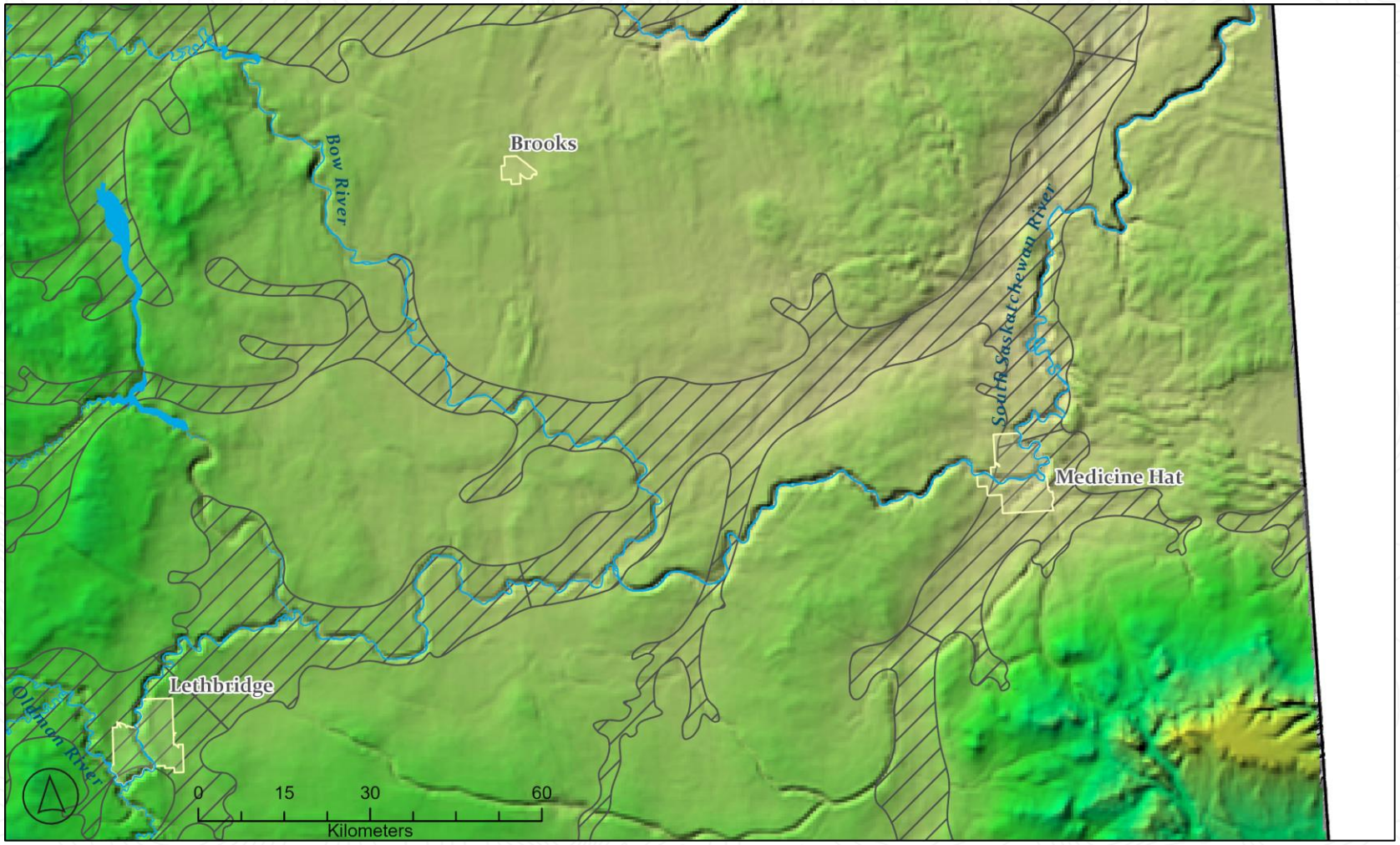
- Probability of sand & gravel
- Water supply well distribution
- t-TEM survey
- Stratigraphic mapping





AMU mapping

Sediments Above Bedrock

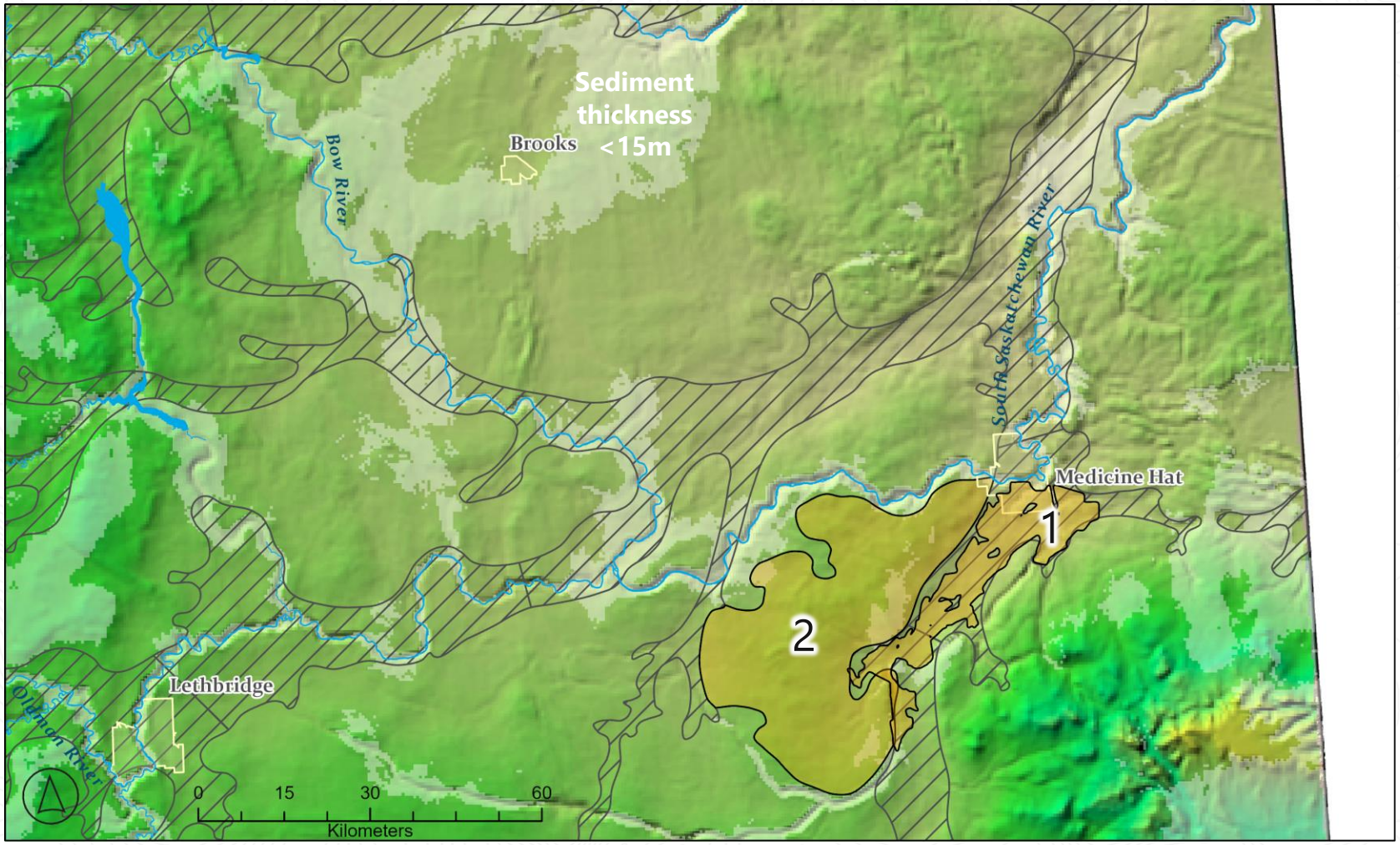


- Probability of sand & gravel
- Water supply well distribution
- t-TEM survey
- Stratigraphic mapping

Buried valleys (hatched area) on bedrock topography

AMU mapping

Sediments Above Bedrock



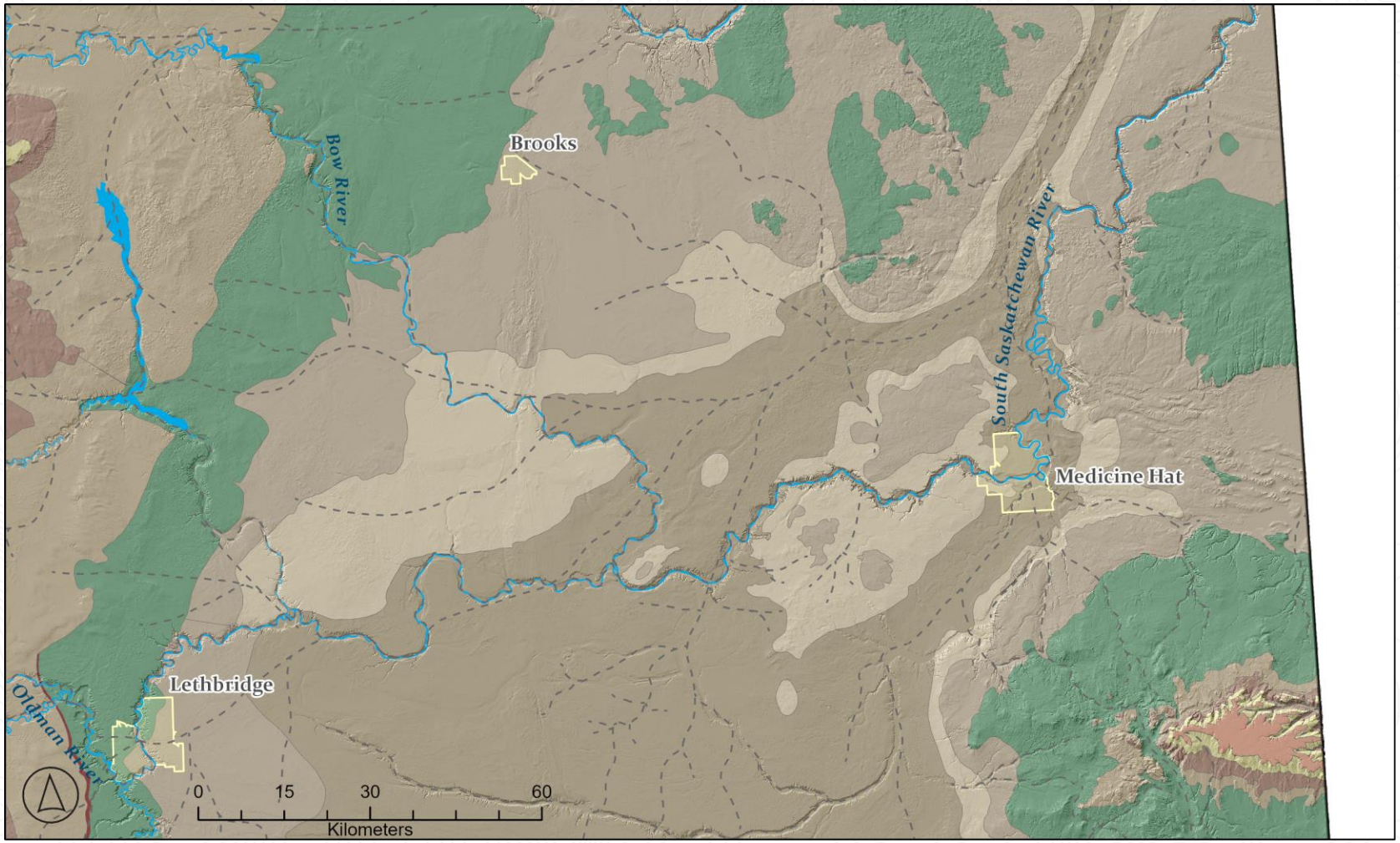
Draft AMUs

1. Buried Valley - Medicine Hat South
2. Uplands aquifer - SW Medicine Hat

Buried valleys (hatched area) on bedrock topography

AMU mapping

Bedrock

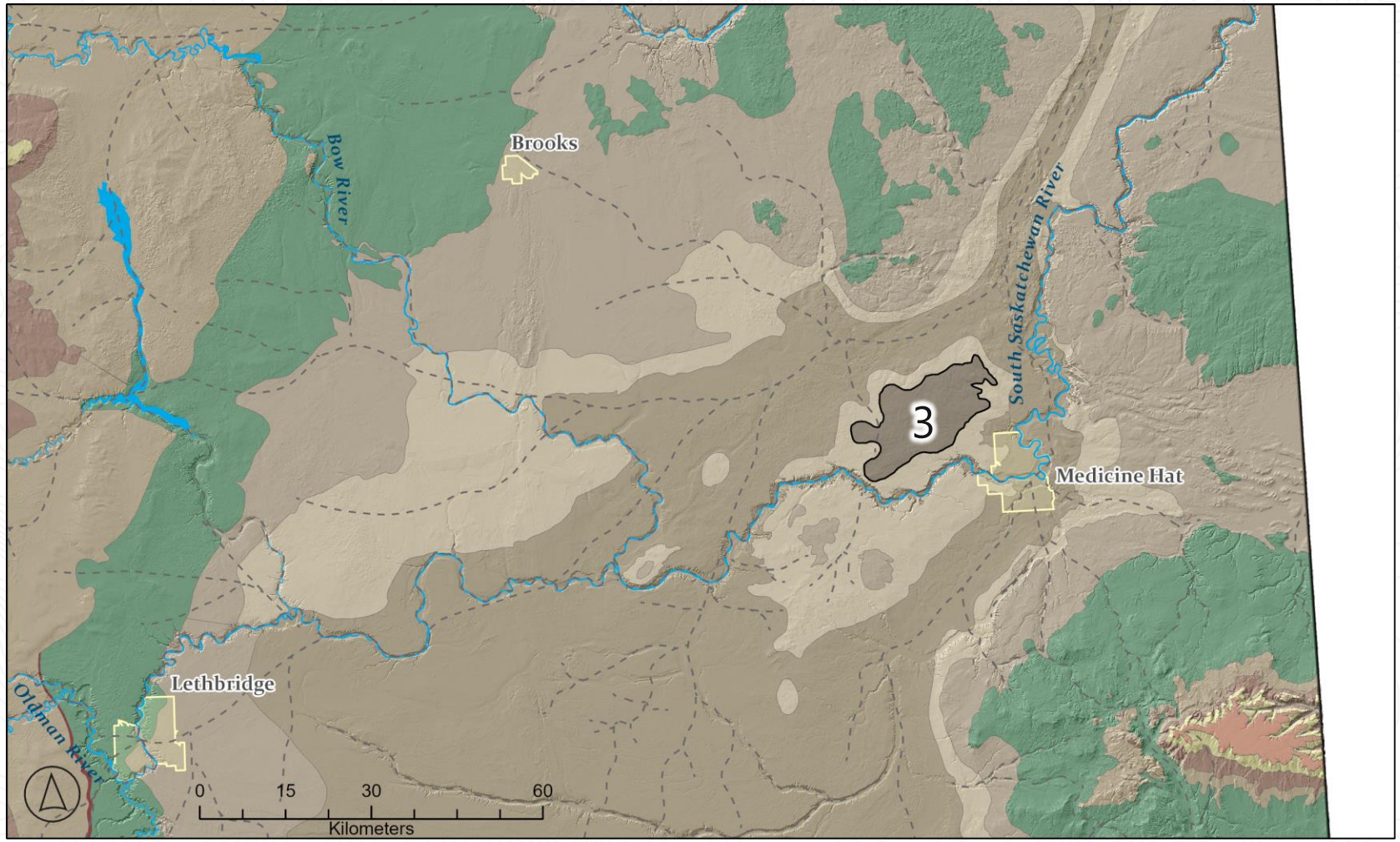


- Geological Framework of Alberta
- Flow systems and hydrologic boundaries
- Well supply well distribution
- Groundwater quality distribution
- Shale volume and porosity modelling

Buried valley thalwegs (dashed lines) on Map 600 bedrock geology and land surface hillshade

AMU mapping

Bedrock



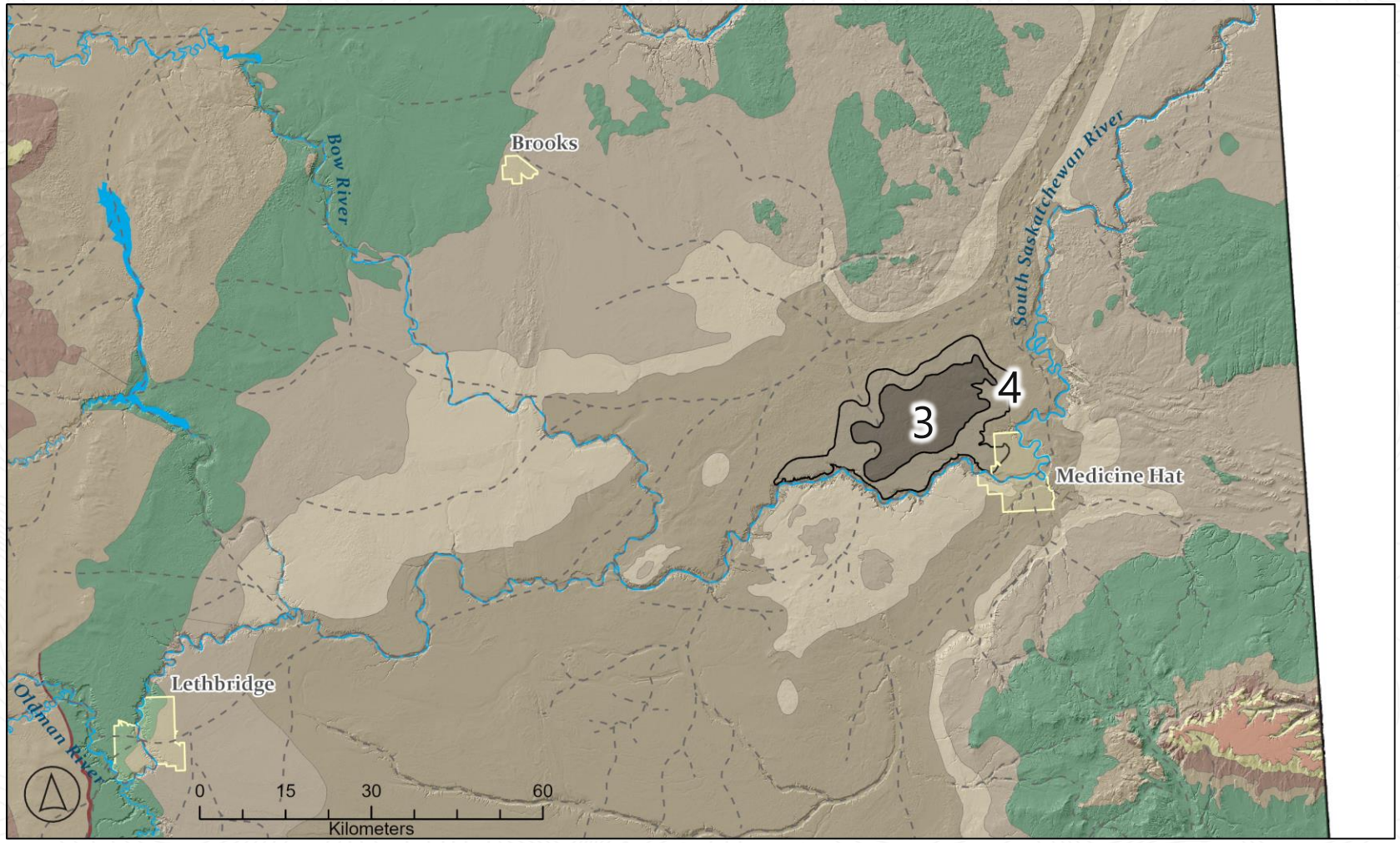
Draft AMUs

3. Dinosaur Park – Medicine Hat Remnant

Buried valley thalwegs (dashed lines) on Map 600 bedrock geology and land surface hillshade

AMU mapping

Bedrock



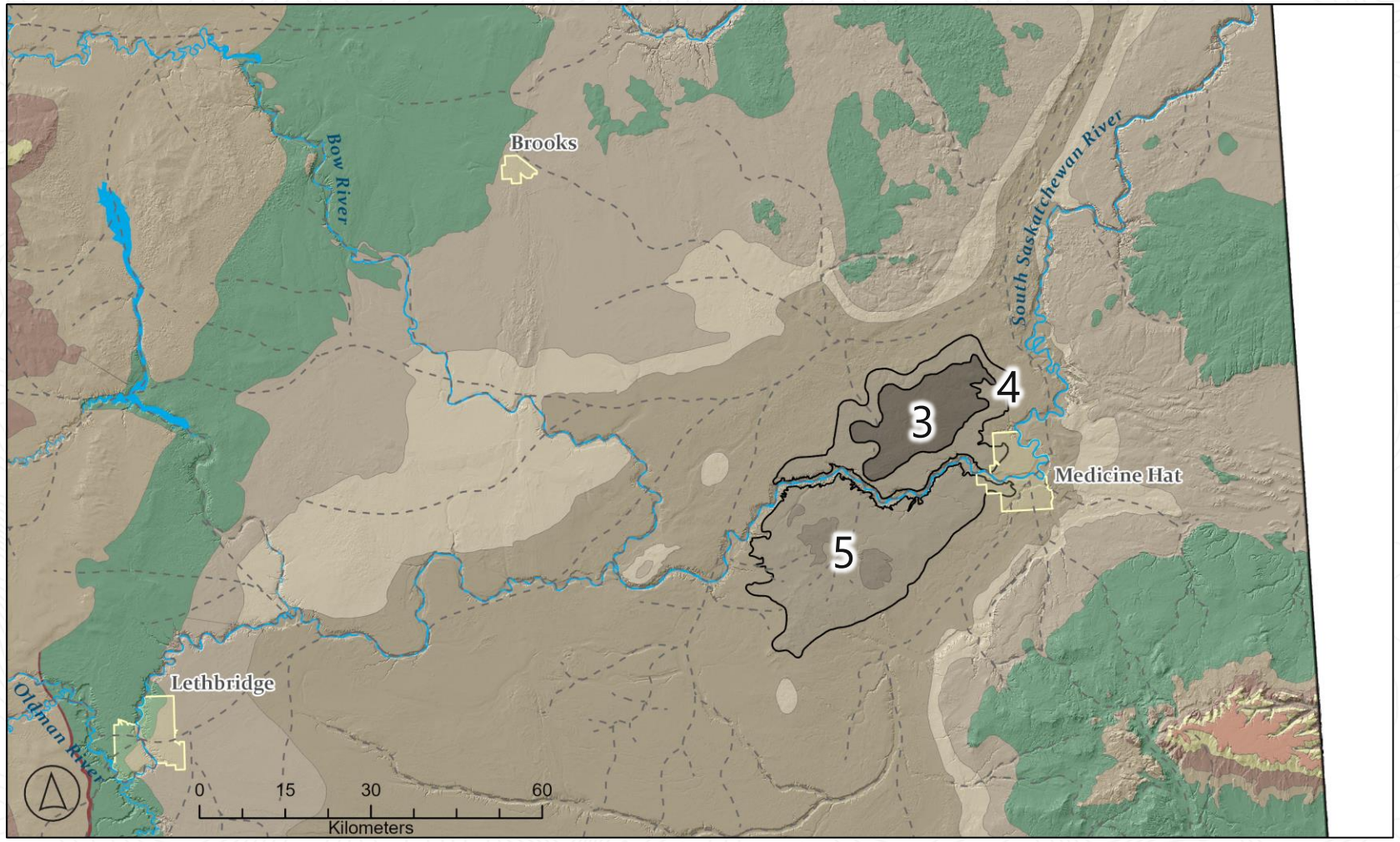
Draft AMUs

3. Dinosaur Park – Medicine Hat Remnant
4. Oldman – Medicine Hat Remnant North

Buried valley thalwegs (dashed lines) on Map 600 bedrock geology and land surface hillshade

AMU mapping

Bedrock



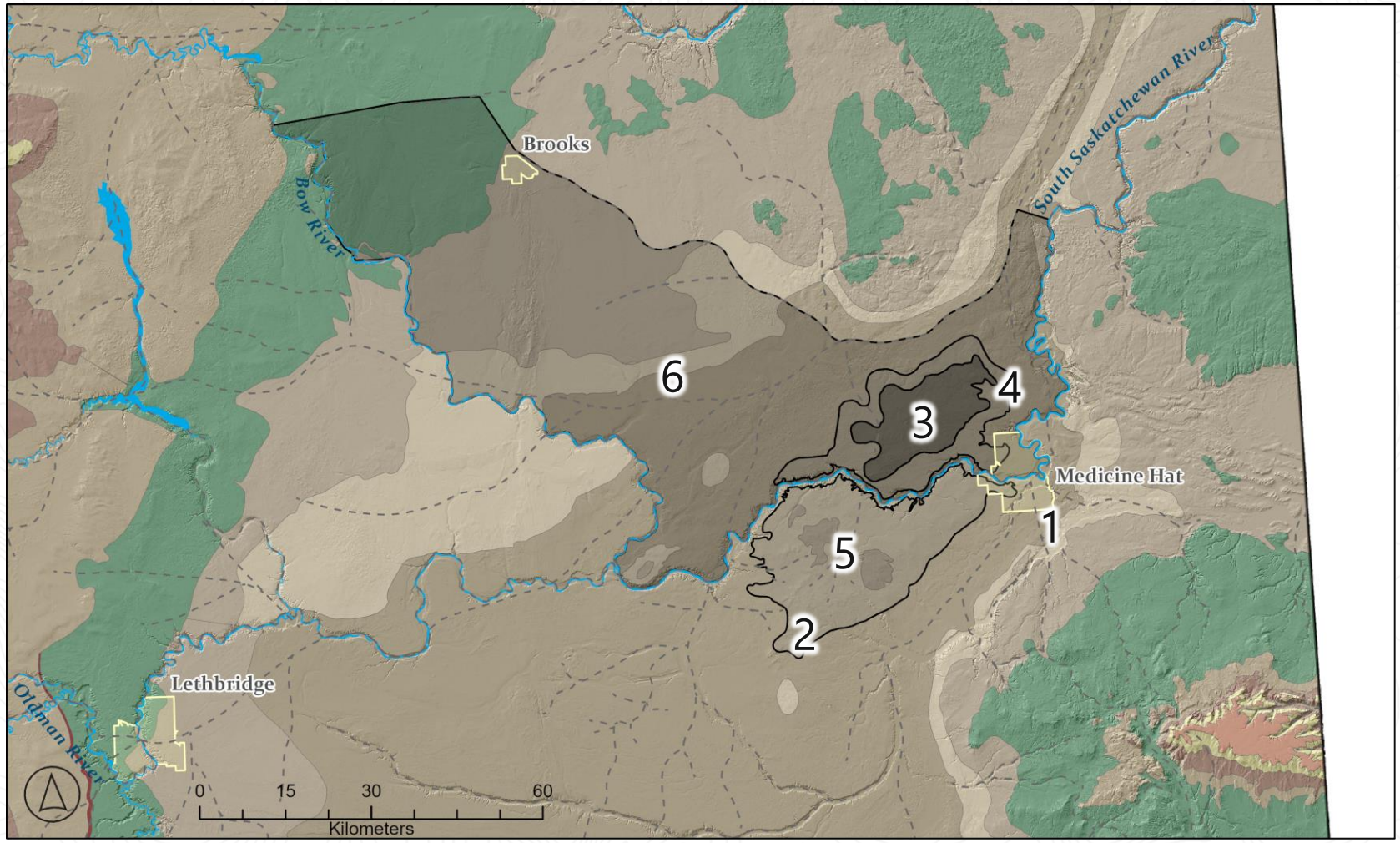
Draft AMUs

3. Dinosaur Park – Medicine Hat Remnant
4. Oldman – Medicine Hat Remnant North
5. Oldman – South Medicine Hat Remnant South

Buried valley thalwegs (dashed lines) on Map 600 bedrock geology and land surface hillshade

AMU mapping

Bedrock



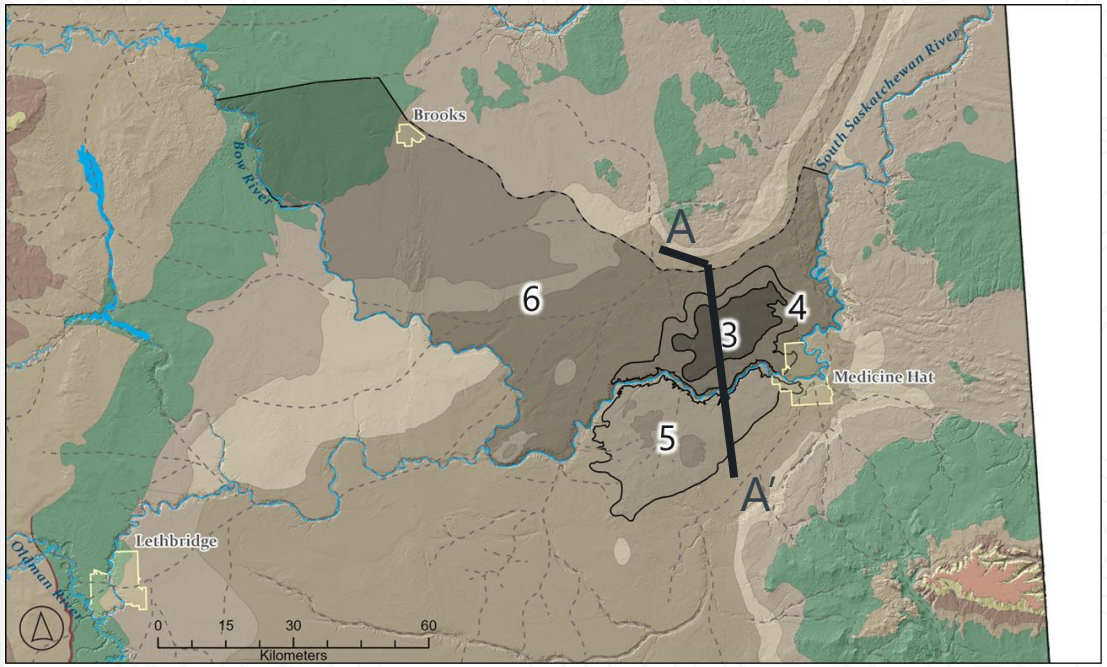
Draft AMUs

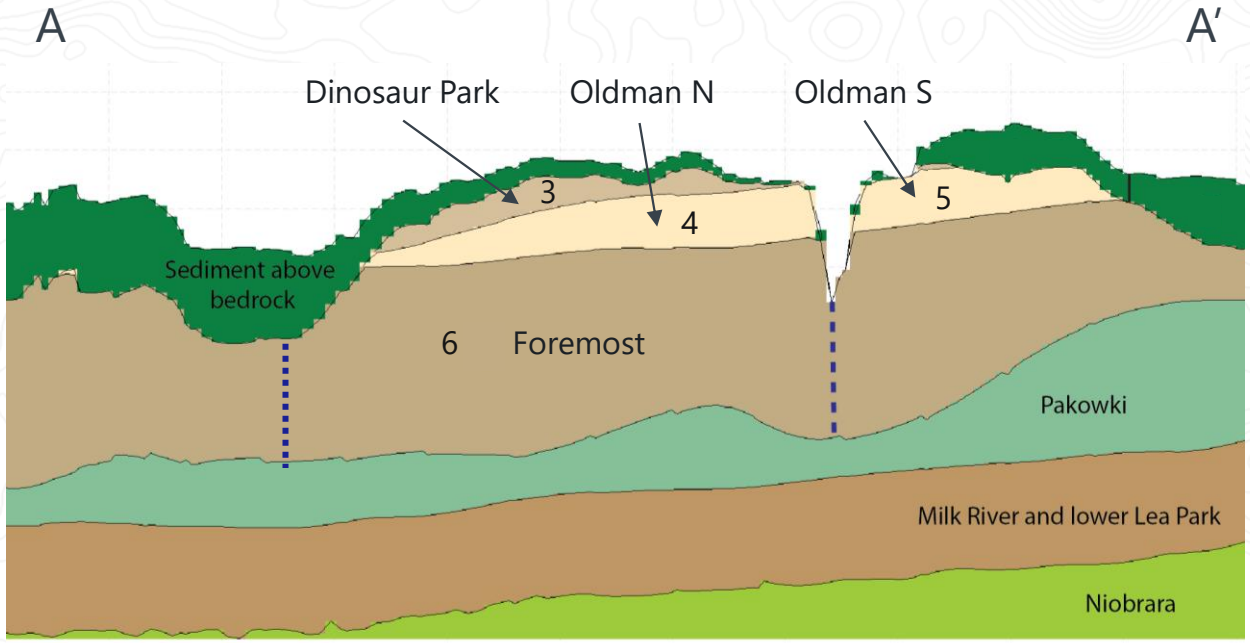
3. Dinosaur Park – Medicine Hat Remnant
4. Oldman – Medicine Hat Remnant North
5. Oldman – South Medicine Hat Remnant South
6. Foremost – Medicine Hat/Brooks

Buried valley thalwegs (dashed lines) on Map 600 bedrock geology and land surface hillshade

AMU mapping

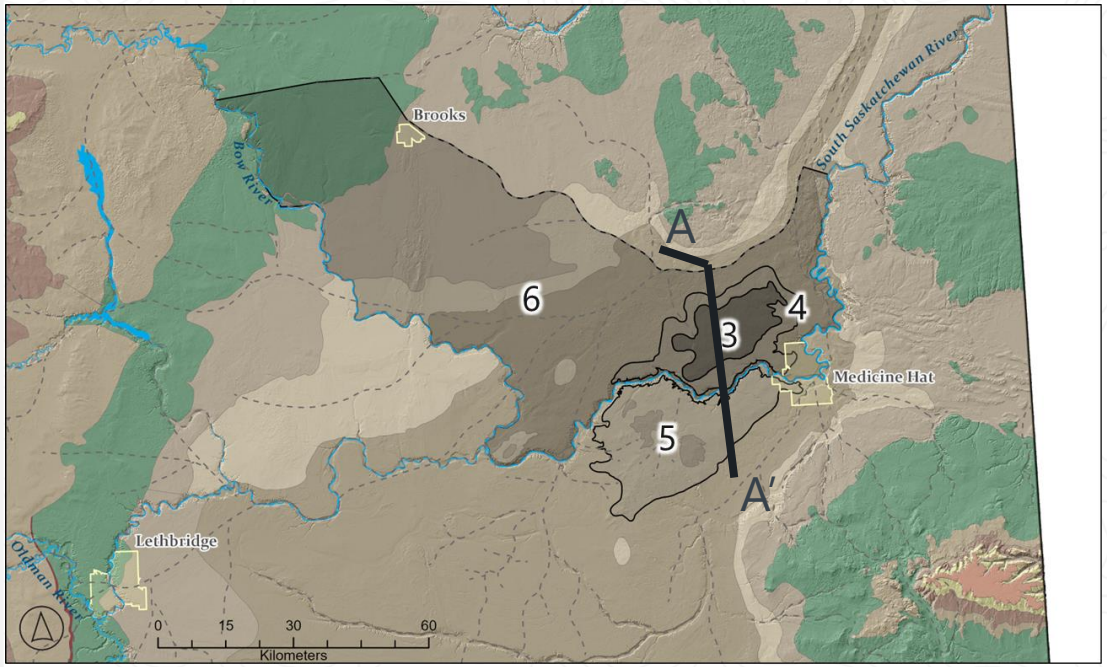
Bedrock

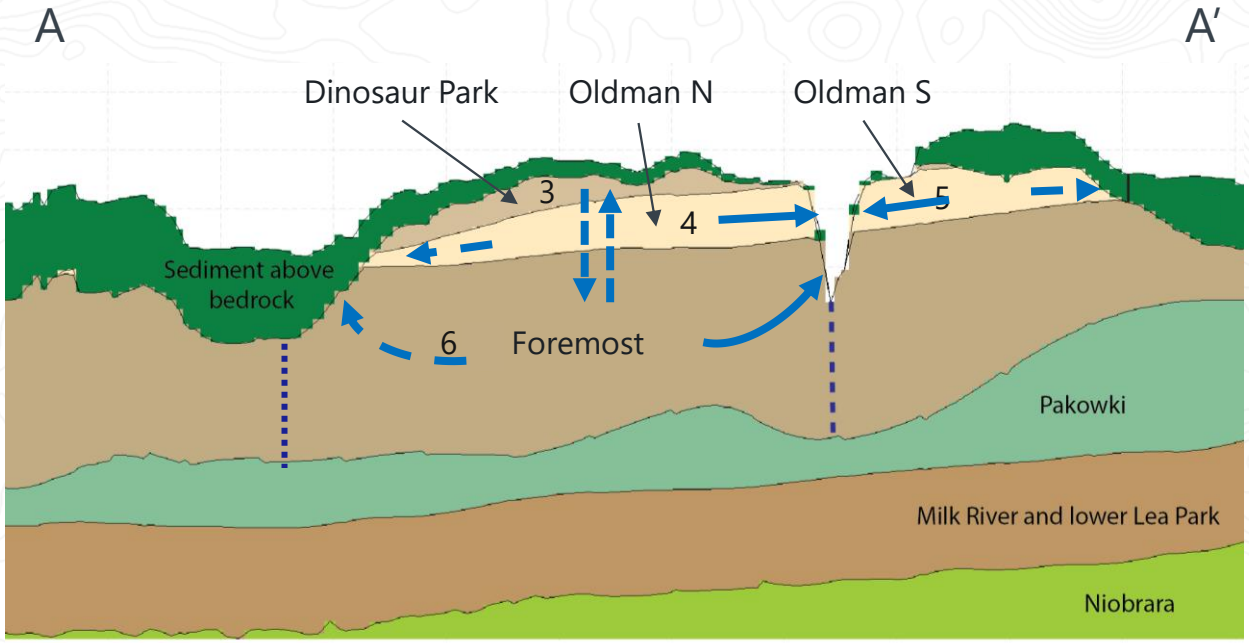




AMU mapping

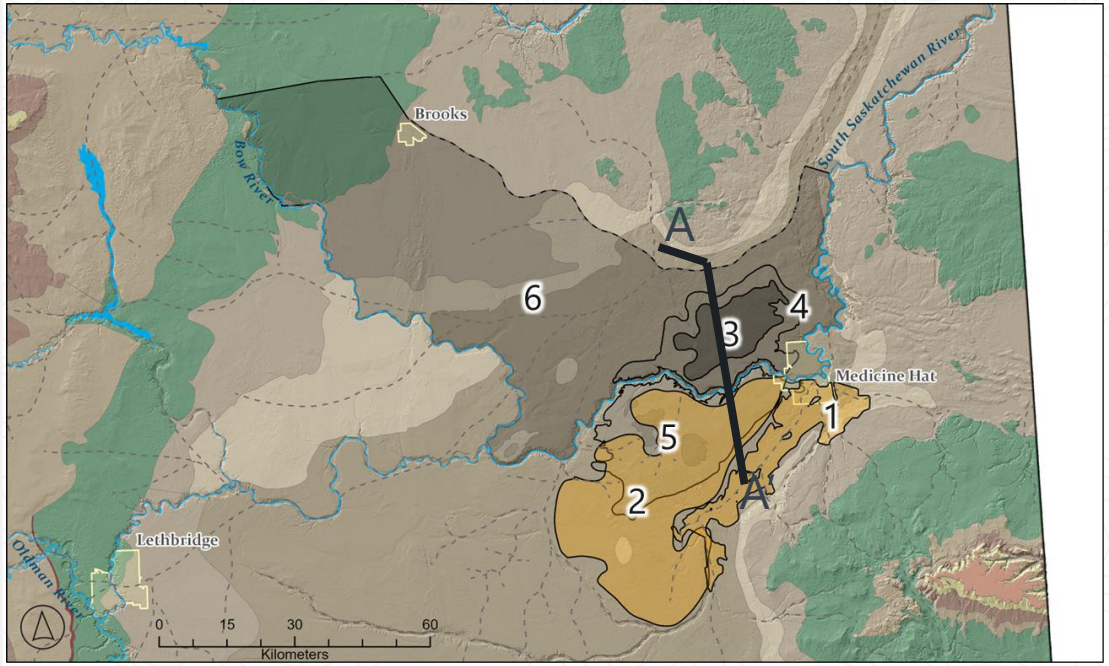
Bedrock

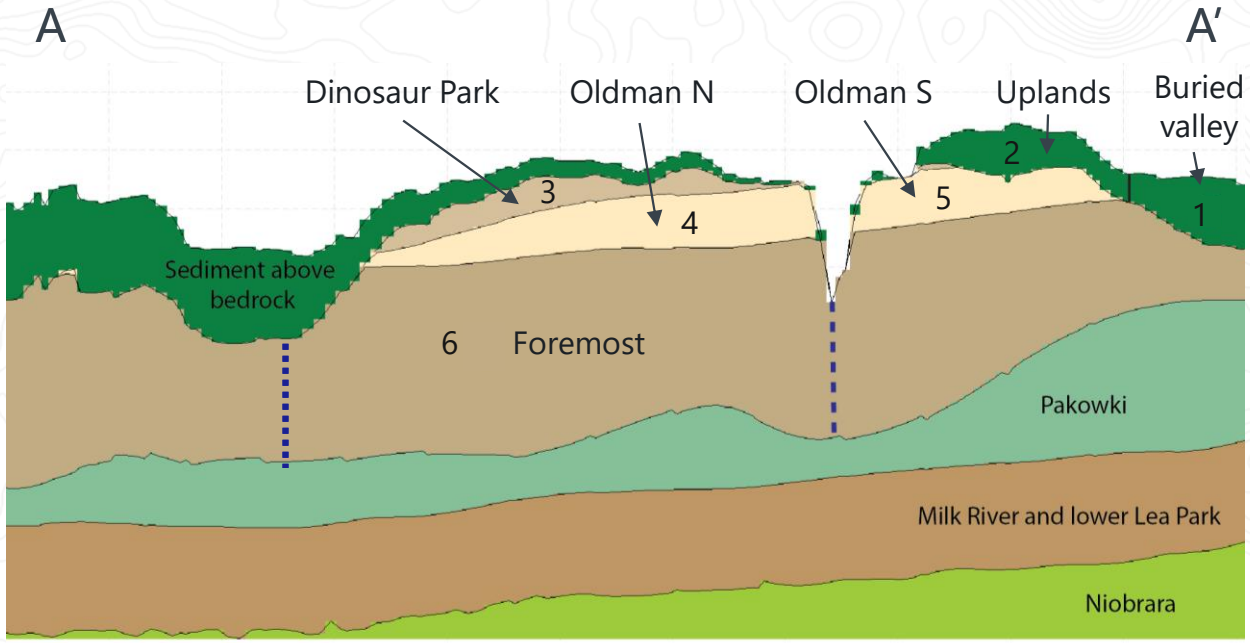




AMU mapping

Bedrock





Objectives

Draft AMU Classification Framework

Diagnostic summary

- Snapshot of
  - Aquifer setting
  - Current conditions
  - Current state of development
- Decision support
  - Identify critical, significant, vulnerable AMUs
- Qualitative/categorical descriptions (with definitions)
- Meaningful name/ID for management decisions

Additional details

- Exhaustive
- Quantitative

Schema

Draft AMU Classification Framework

Diagnostic summary

- AMU name
- Area
- Geological formation
- Lithological description
- Hydrostratigraphic unit type (confinement, continuity)
- Vulnerability (to contamination from surface)
- Productivity
- Water allocation
- Water quality
- Confidence in characterization

Additional details

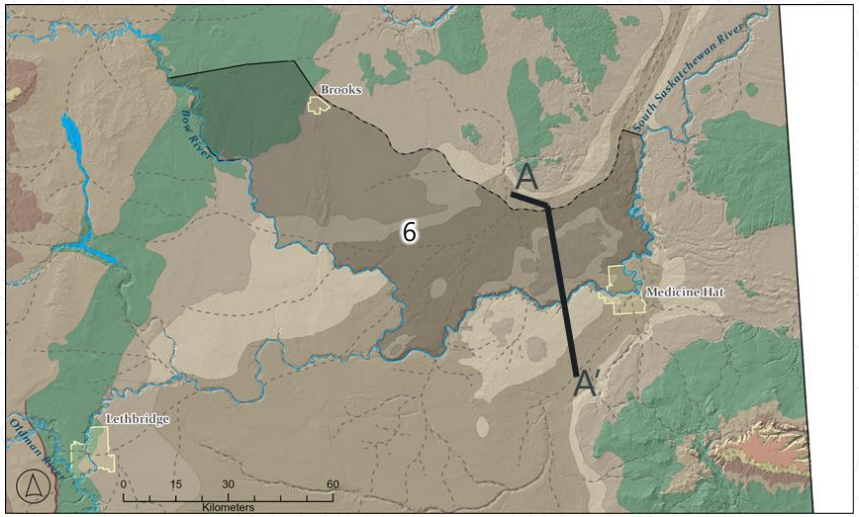
- Aquifer properties, e.g:
  - K, Ss or Sy, n
  - Depth to top of, and thickness of AMU
  - Water levels
  - Recharge
- Wells and licences, e.g:
  - Number of wells and water use types
- Water quality
- Stratigraphic and physiographic position (for sediment aquifers)
- SW-GW connectivity
- Water budget
- Availability of additional studies or models

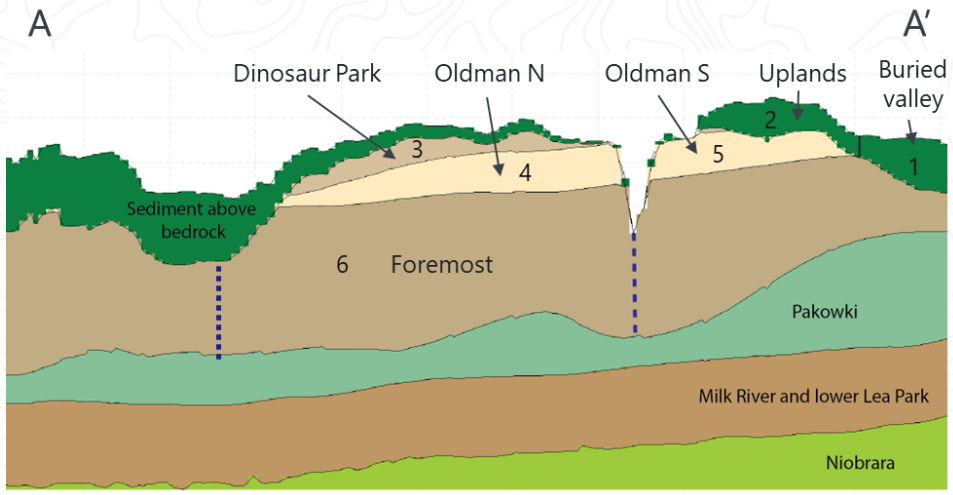
Example

Draft AMU Classification Framework

Diagnostic summary

ID	4
Name	Foremost - Medicine Hat/Brooks
Area	4886 km^2
Geological Formation	Belly River Group - Foremost
Lithological description	Sandstone, siltstone, and quartzite, commonly interbedded with shale or mudstone, and coal
Hydrostratigraphic unit type	Semi-confined (leaky) aquifer
Vulnerability	Low
Productivity	Moderate
Water demand	Moderate
Water quality	Average TDS = 1330 mg/L (N=77) Average hardness = 301 mg/L (N=37)
Confidence in boundaries	Low to moderate
Confidence in characterization	Low





Next steps

1

Review & feedback

- Examples and draft classification framework
- Revisions

2

Inventory of AMU's in SAGE area

- Mapping, characterizing, and classifying

3

Interactive map

- Decision support tool