Hydrostratigraphy of the Interlobate Orangeville Moraine, Southwestern Ontario, Canada

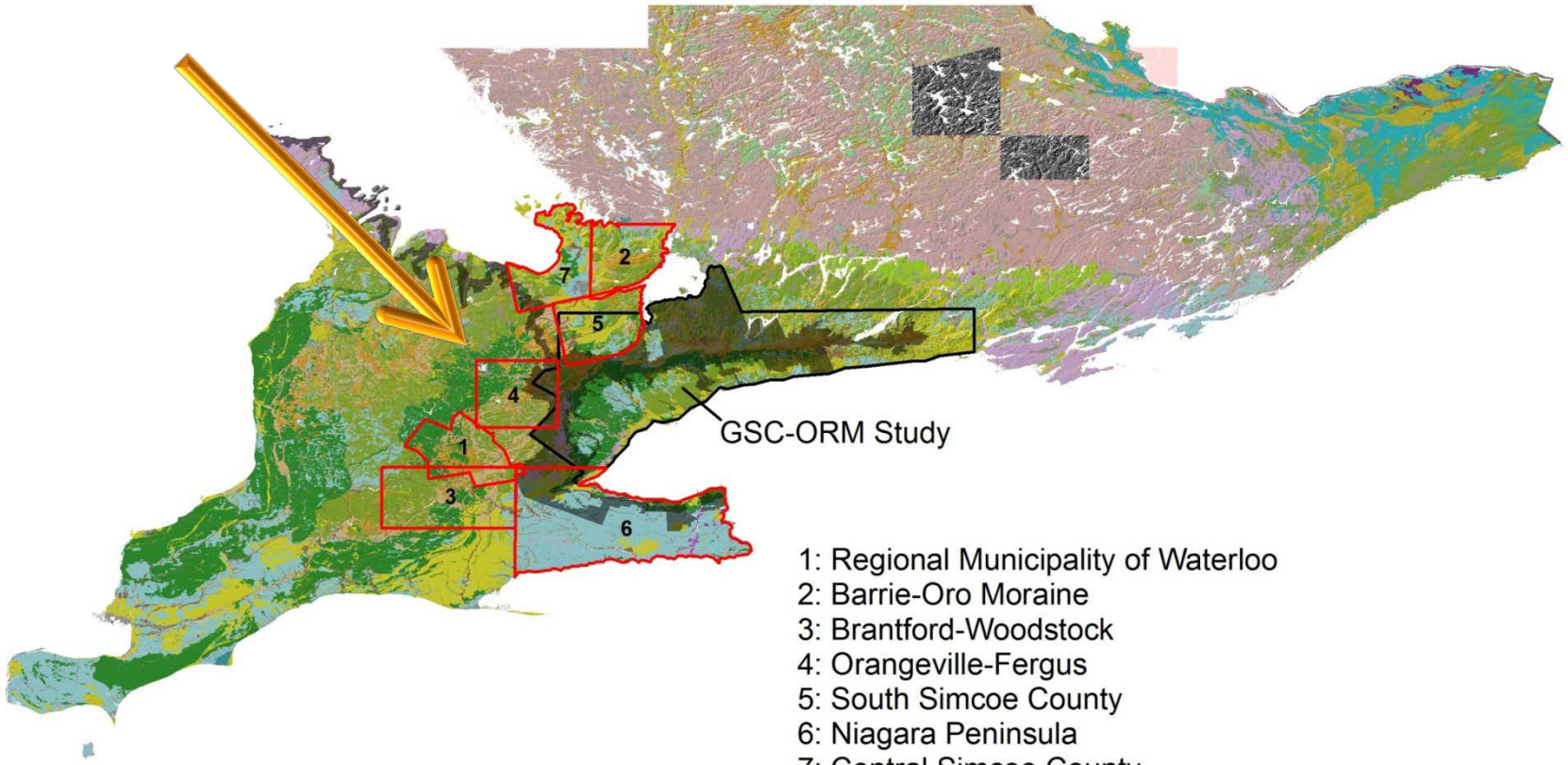
Abigail Burt
Ontario Geological Survey

Today's Talk

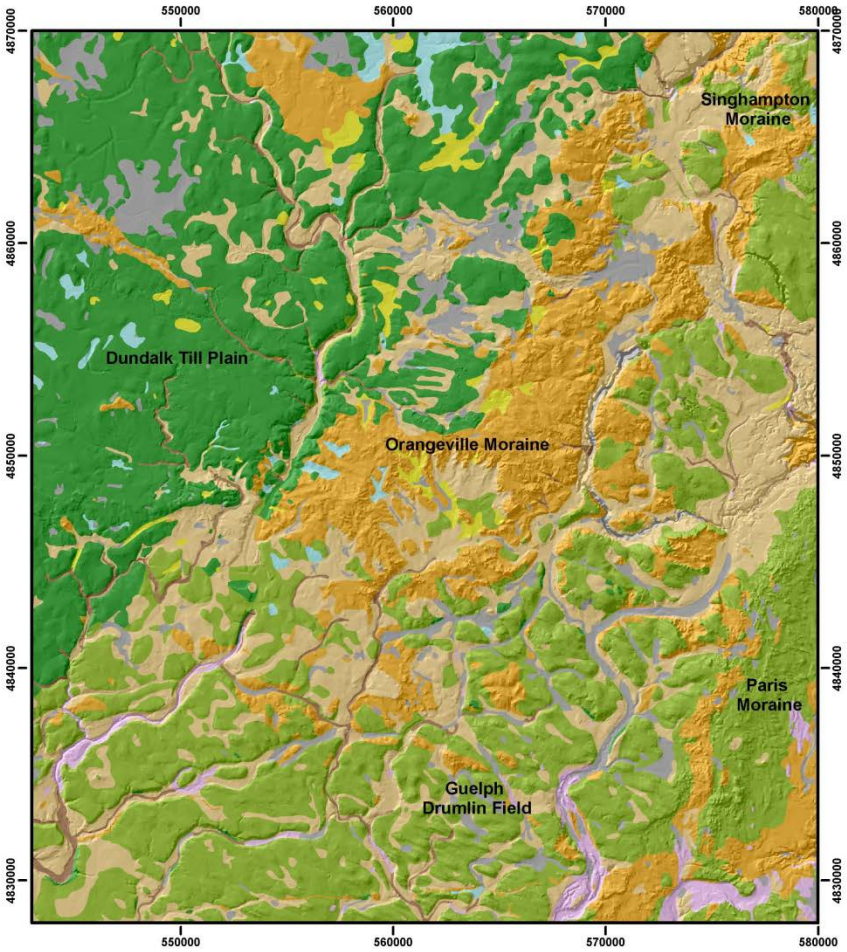
- Introduction to the Orangeville Moraine area
- Building a model
  - Data sources
  - Conceptual framework
- Hydrostratigraphy of the Orangeville Moraine area
- Grande Finale – what would ***YOU*** like to see???
  - Vulnerability maps
  - Regional Context

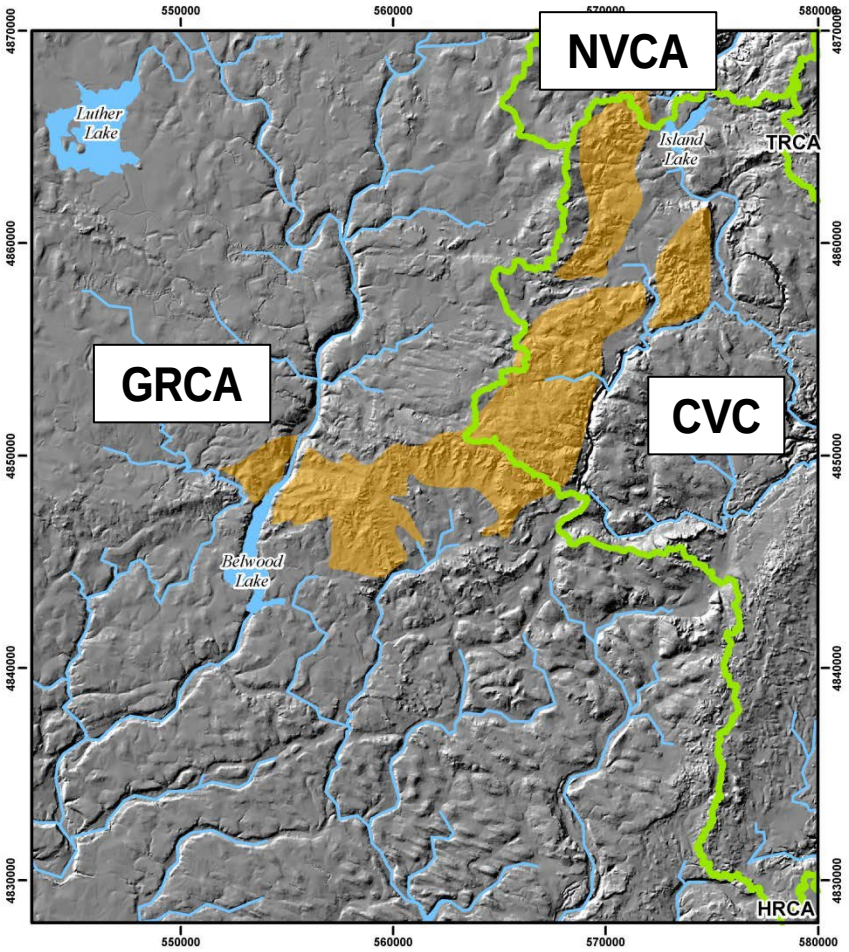
OGS 3-D Sediment Mapping Projects

- Reconstruct the regional Quaternary history
- Construct a 3-D model of key sediment packages
- Characterize the properties of the modelled sediment packages



Surficial Geology

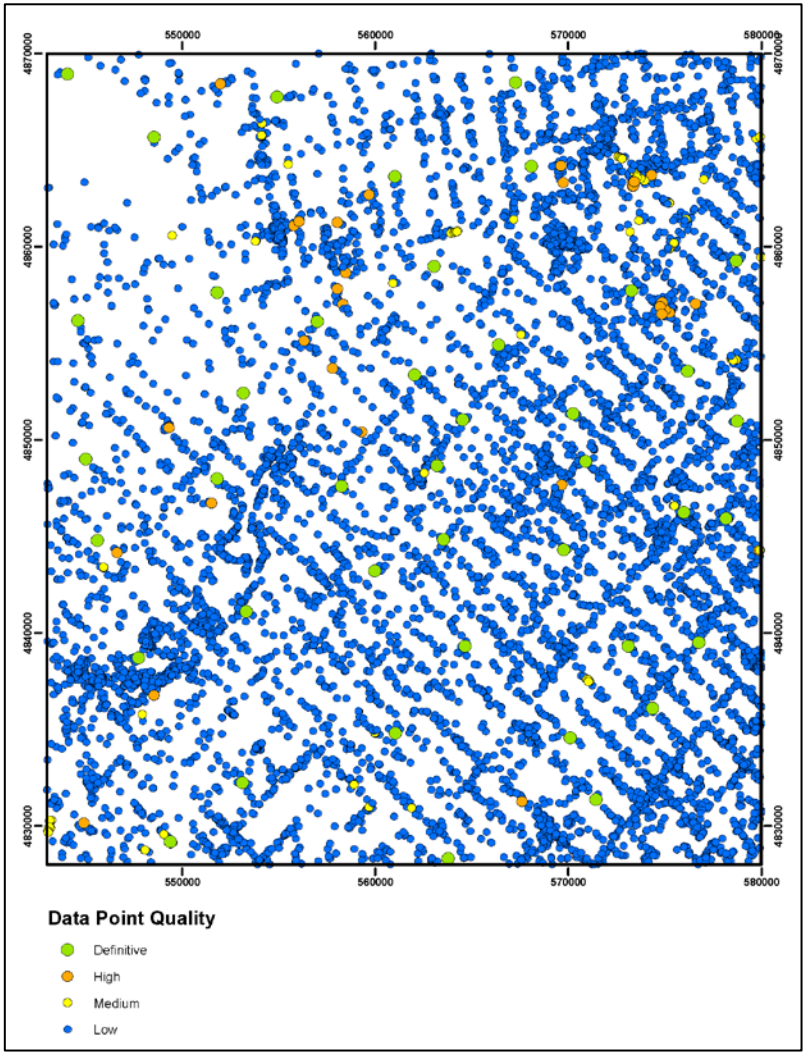




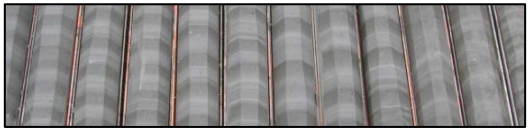
Surficial Geology Legend

- Paleozoic bedrock
- Silt to sand till
- Silt to clay till
- Ice-contact stratified deposits
- Glaciofluvial deposits
- Fine-textured glaciolacustrine deposits
- Coarse-textured glaciolacustrine deposits
- Alluvial deposits
- Organic deposits

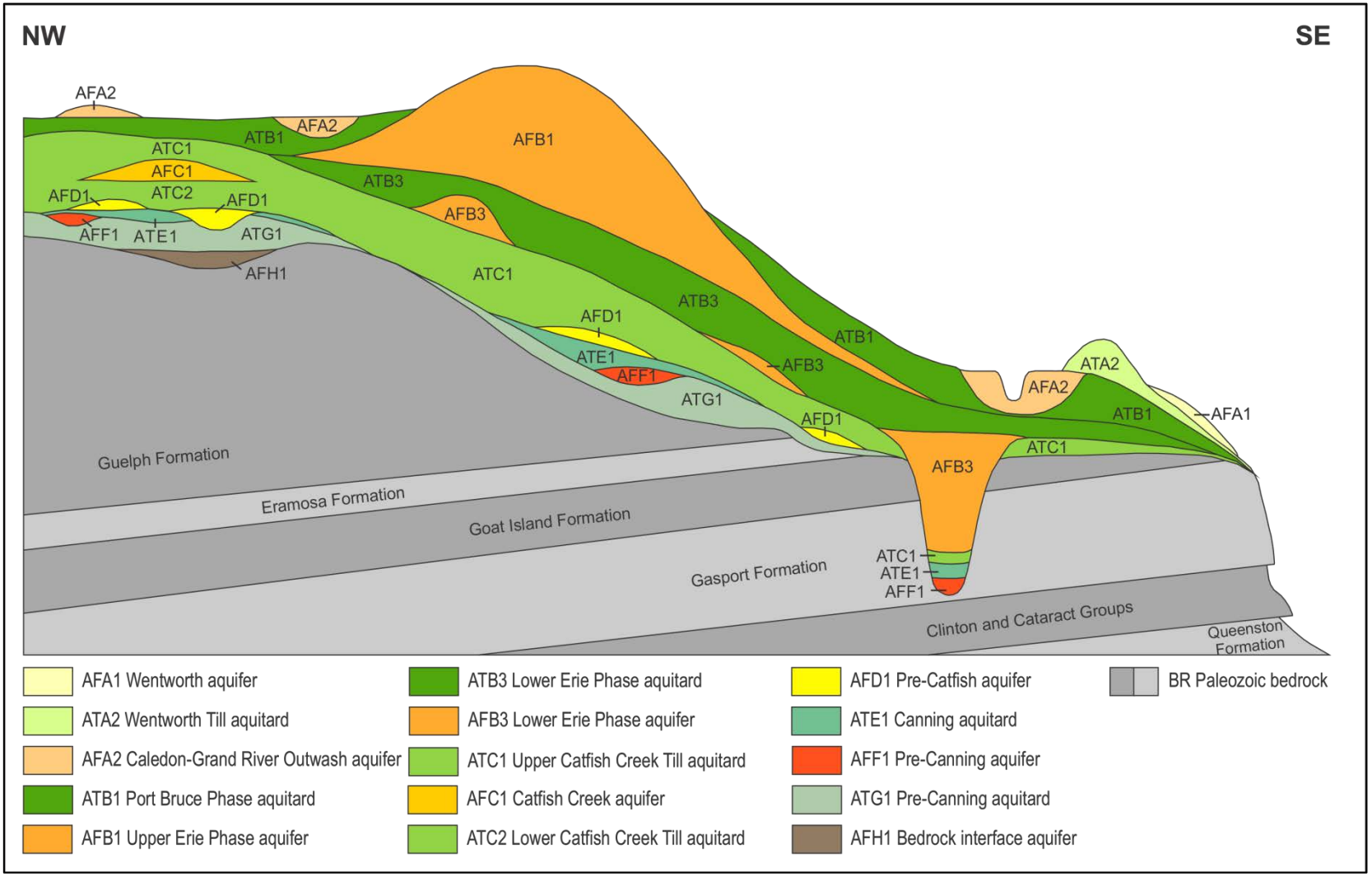
Where does the data come from?



Drilling!

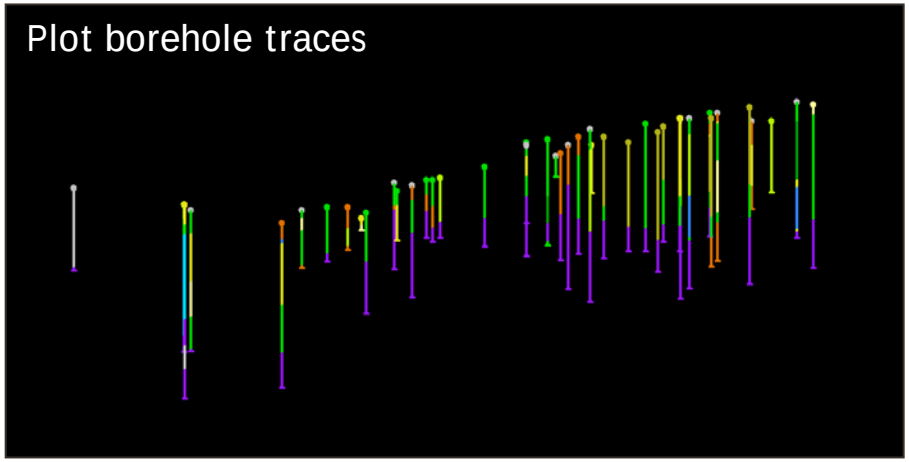


Conceptual Framework

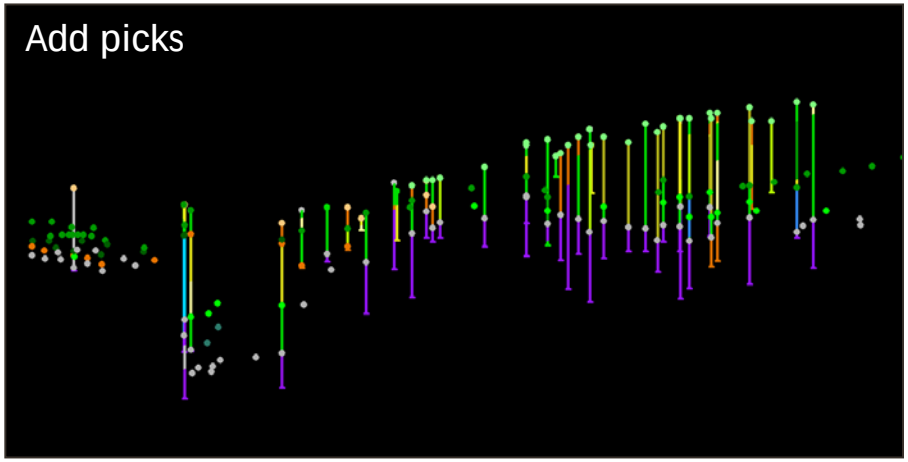


Modelling Process

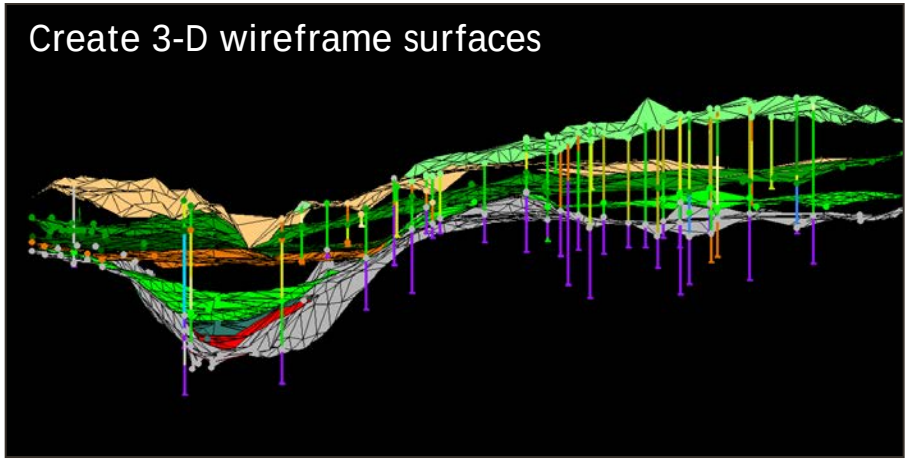
Plot borehole traces



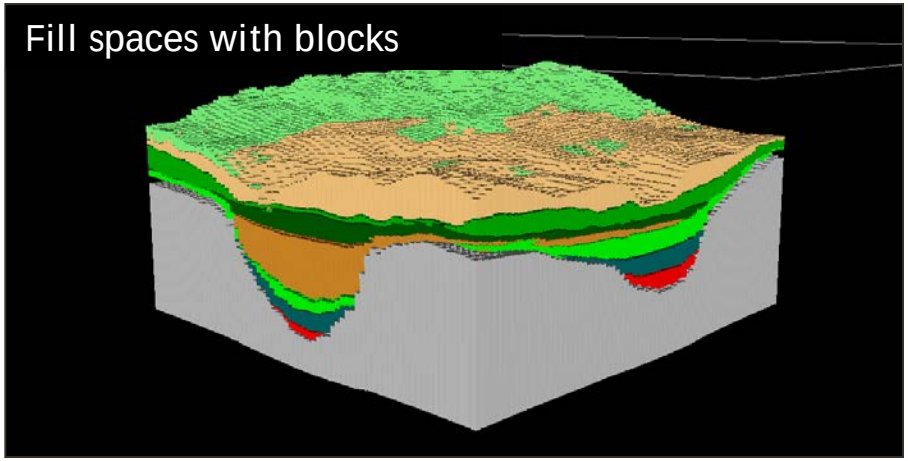
Add picks



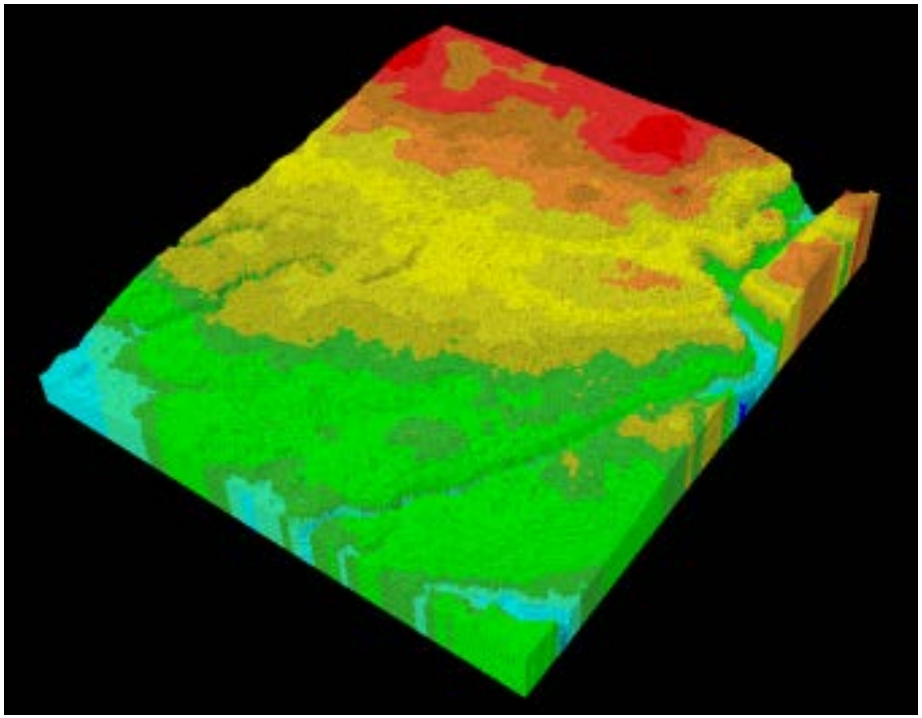
Create 3-D wireframe surfaces

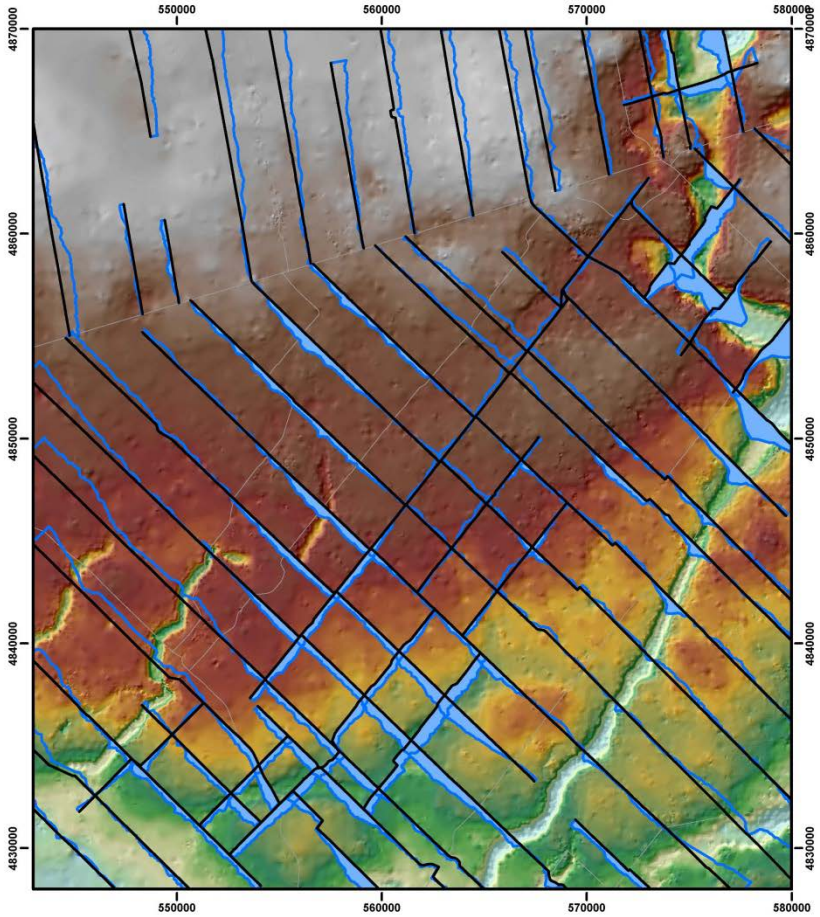


Fill spaces with blocks

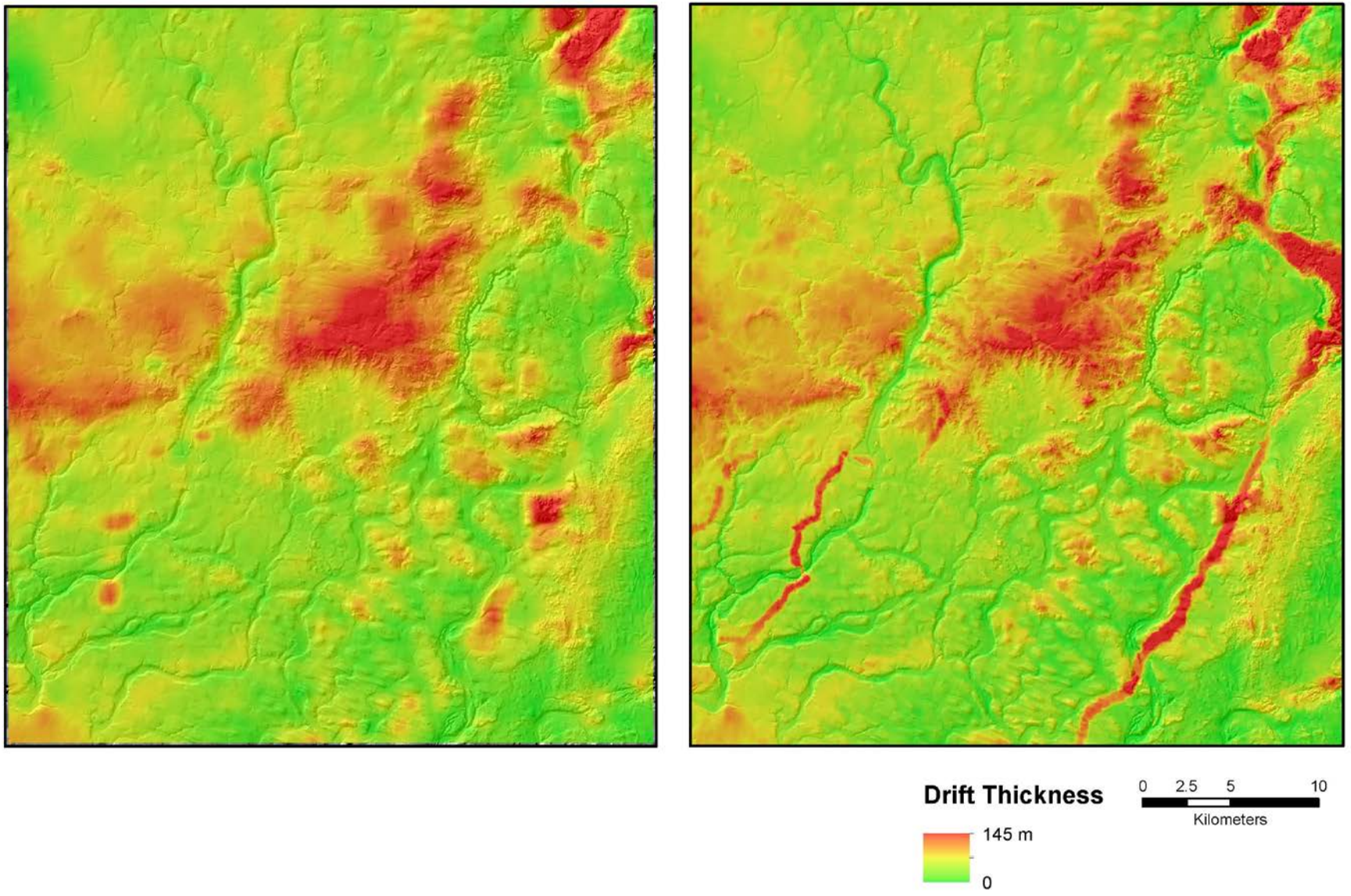


Bedrock Surface

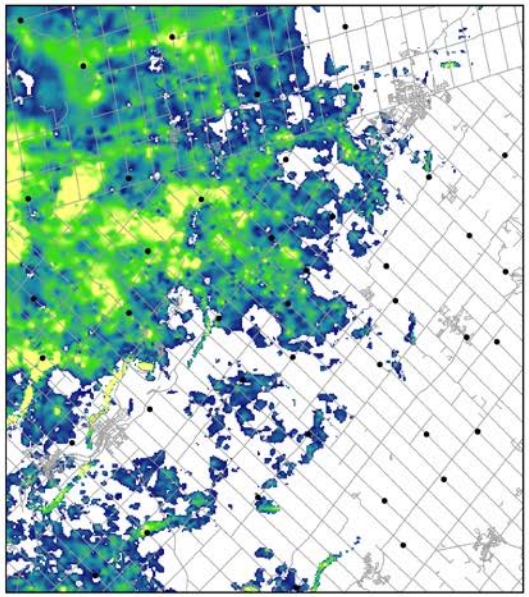


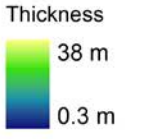


Drift Thickness



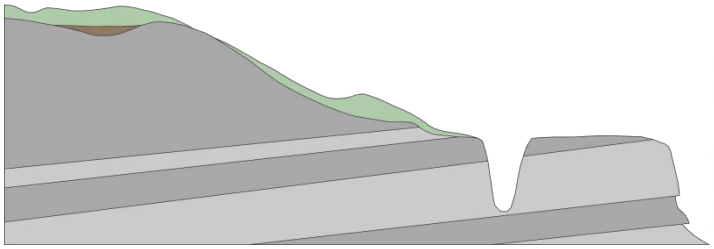
Pre-Canning Aquitard





NW

SE



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ATA2 Wentworth Till - Paris Moraine aquitard
AFA2 Caledon-Grand River Outwash aquifer
ATB1 Port Bruce Phase aquitard
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ATE1 Canning aquitard
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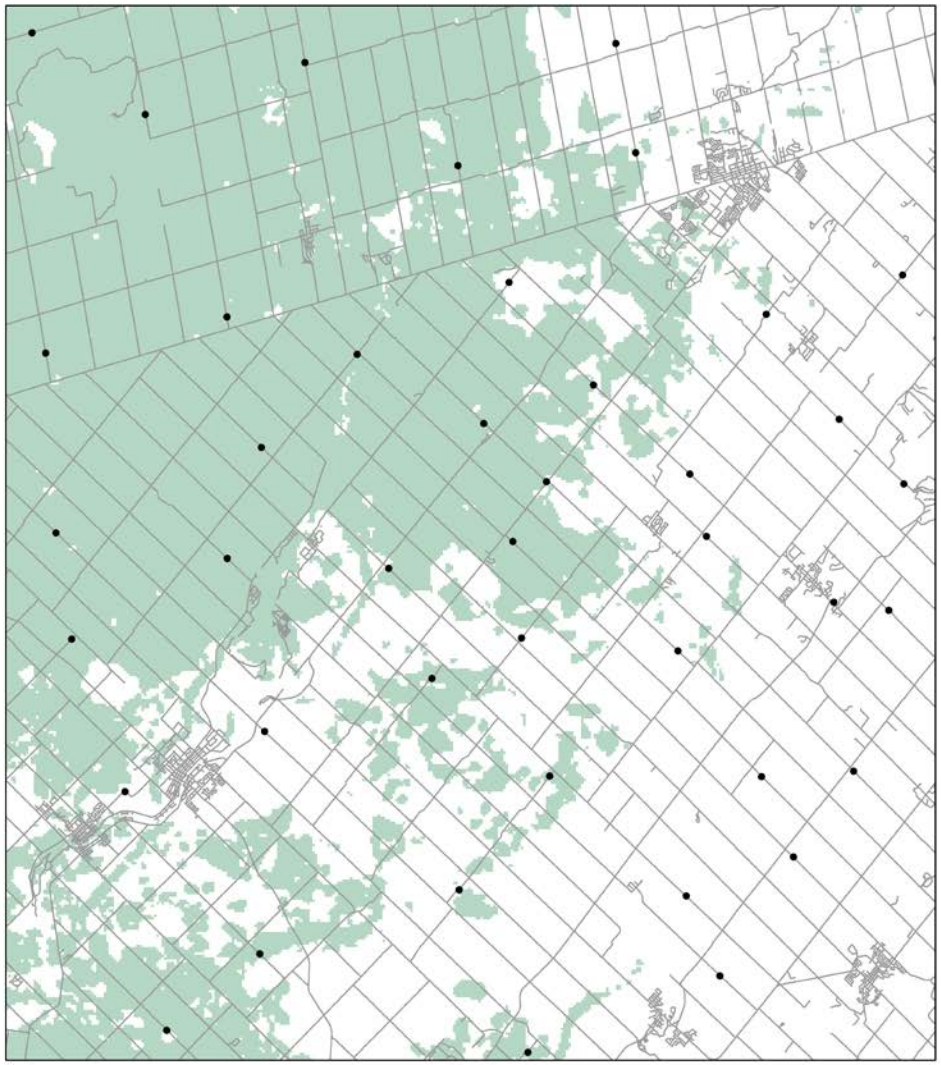
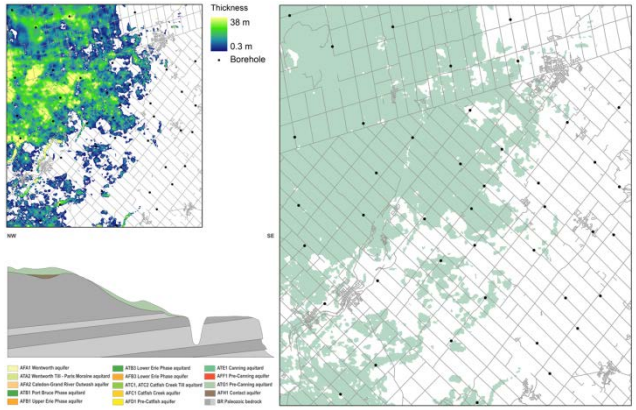
AFH1 Contact aquifer
BR Paleozoic bedrock

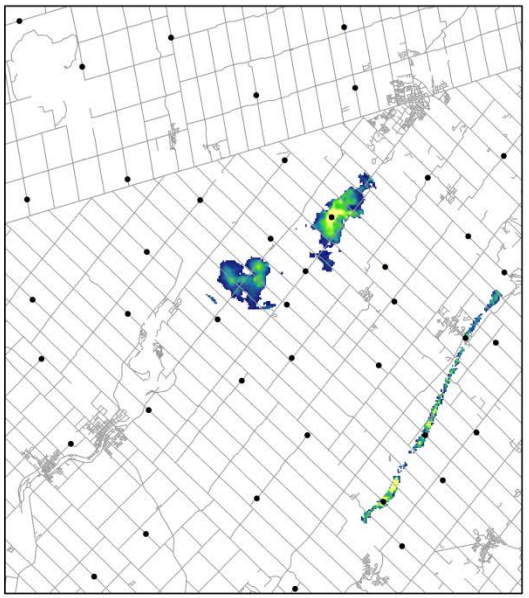


Pre-Canning Aquitard

- 1 or 2 older tills
- Overlies bedrock or a contact aquifer
- Oxidized
- Deep weathering profile

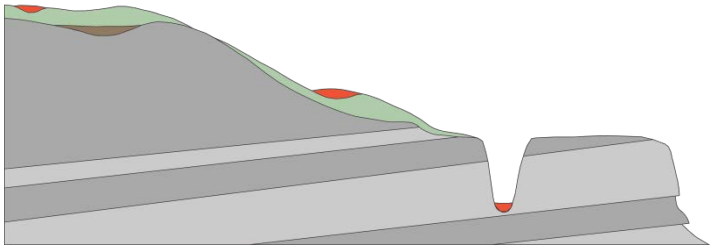


Pre-Canning Aquifer



Thickness
20 m
0.3 m
Borehole

NW SE



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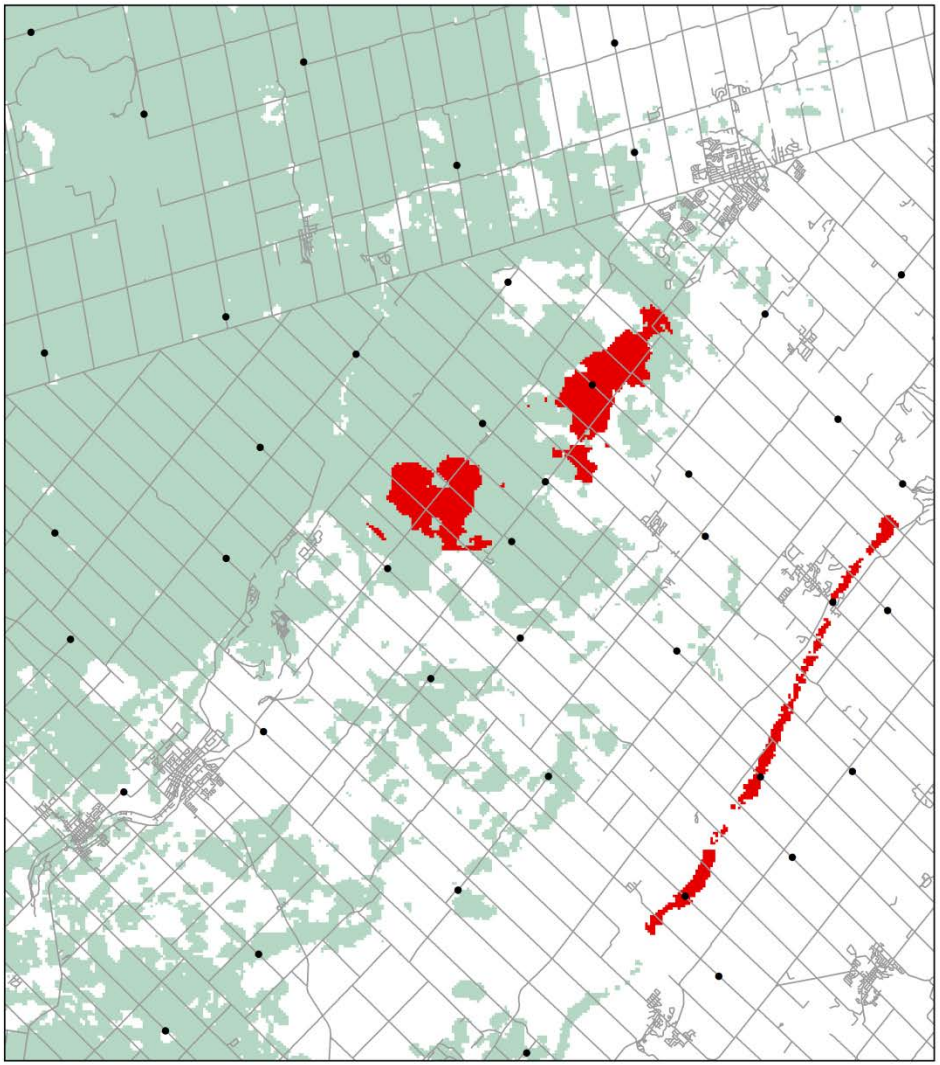
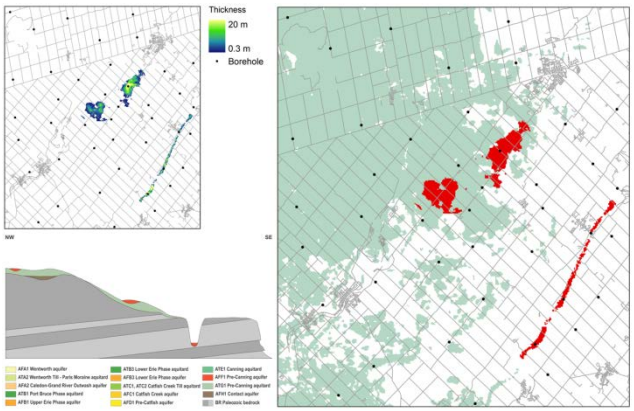
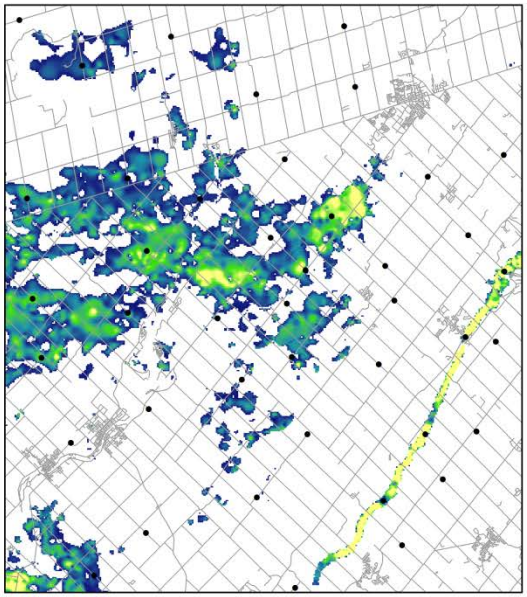


Pre-Canning Aquifer

- Localized stratified sediments
- Subaquatic fan
- Rockwood bedrock valley fill

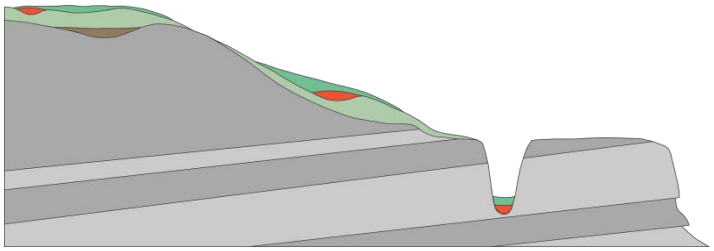


Canning Aquitard

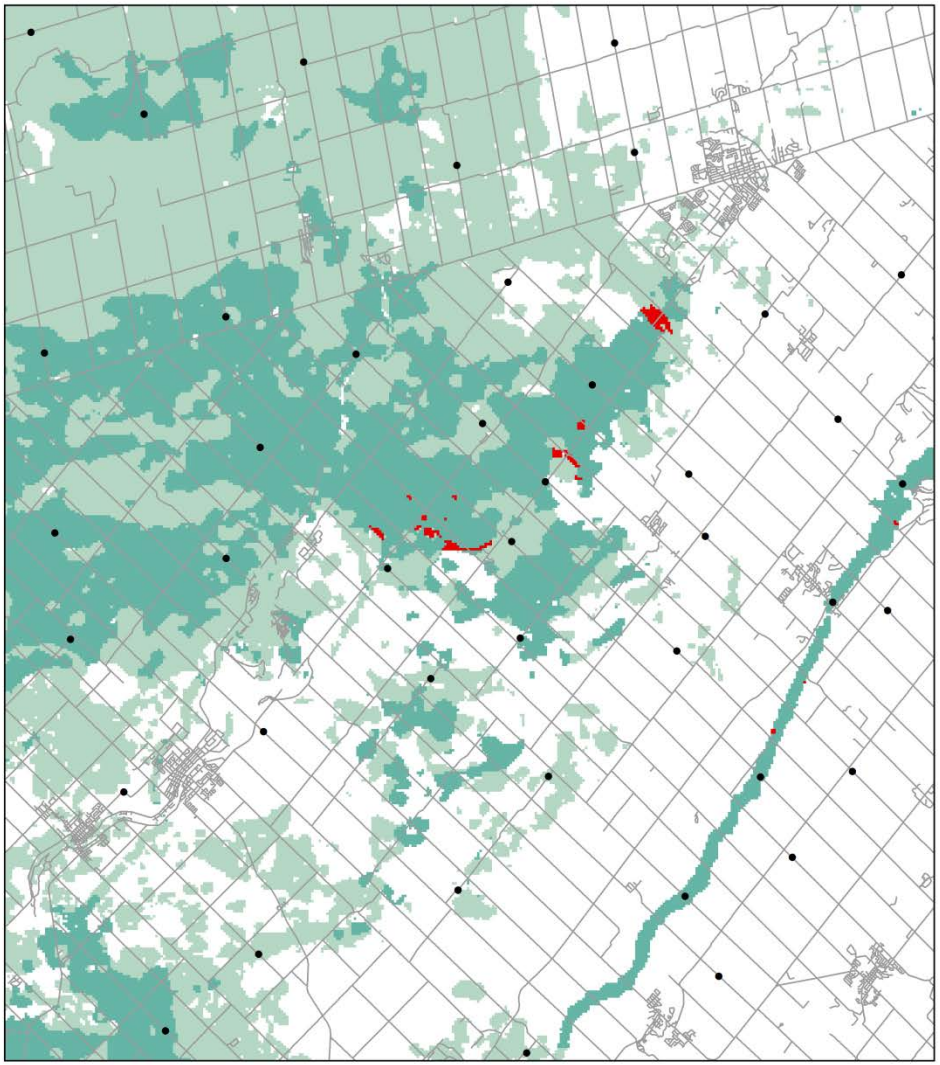


Thickness
19 m
0.3 m
Borehole

NW



SE



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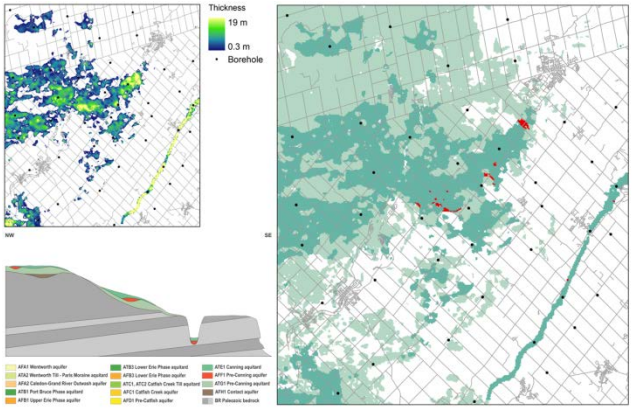
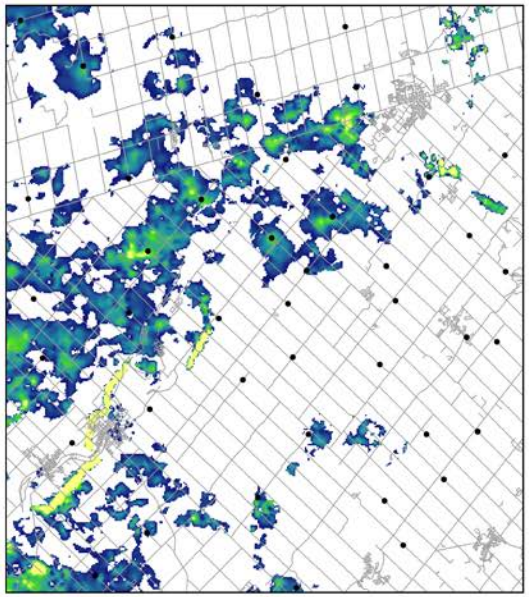
Canning Aquitard

- Till and associated glaciolacustrine sediment
- Confines older aquifer sediment in the Rockwood buried valley
- Reddish colour in western boreholes

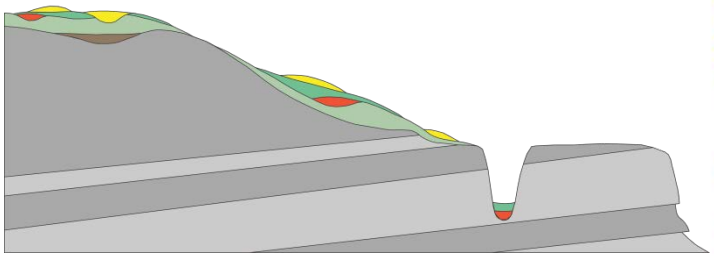


Pre-Catfish Aquifer



Thickness
60 m
0.3 m
Borehole

NW SE



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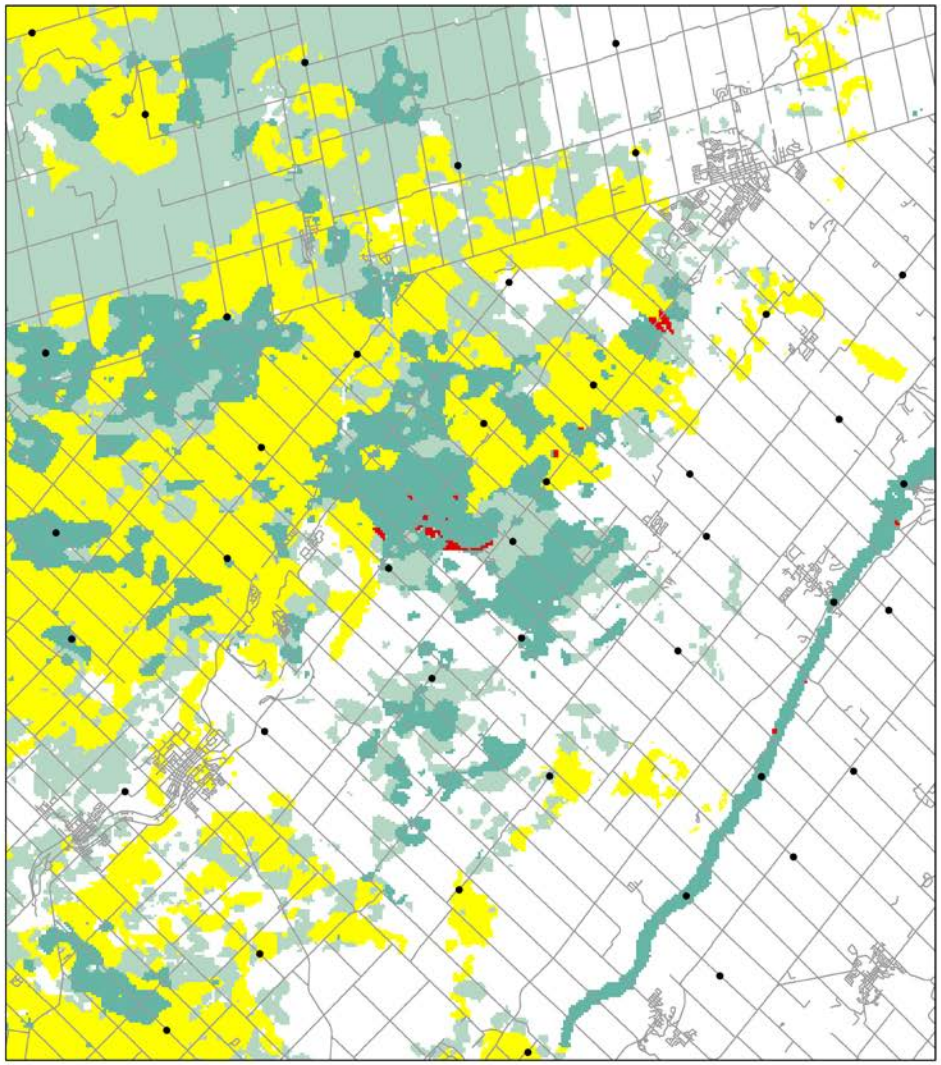
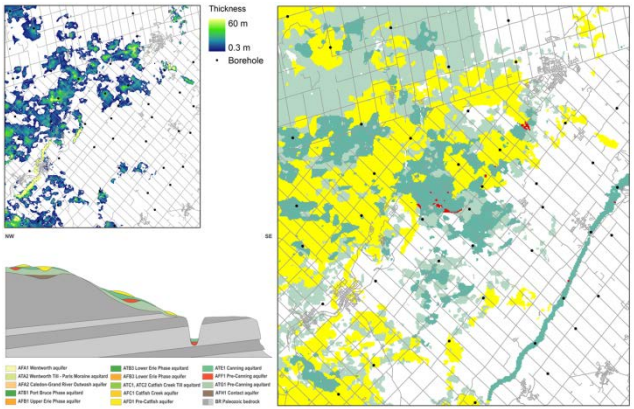


Pre-Catfish Aquifer

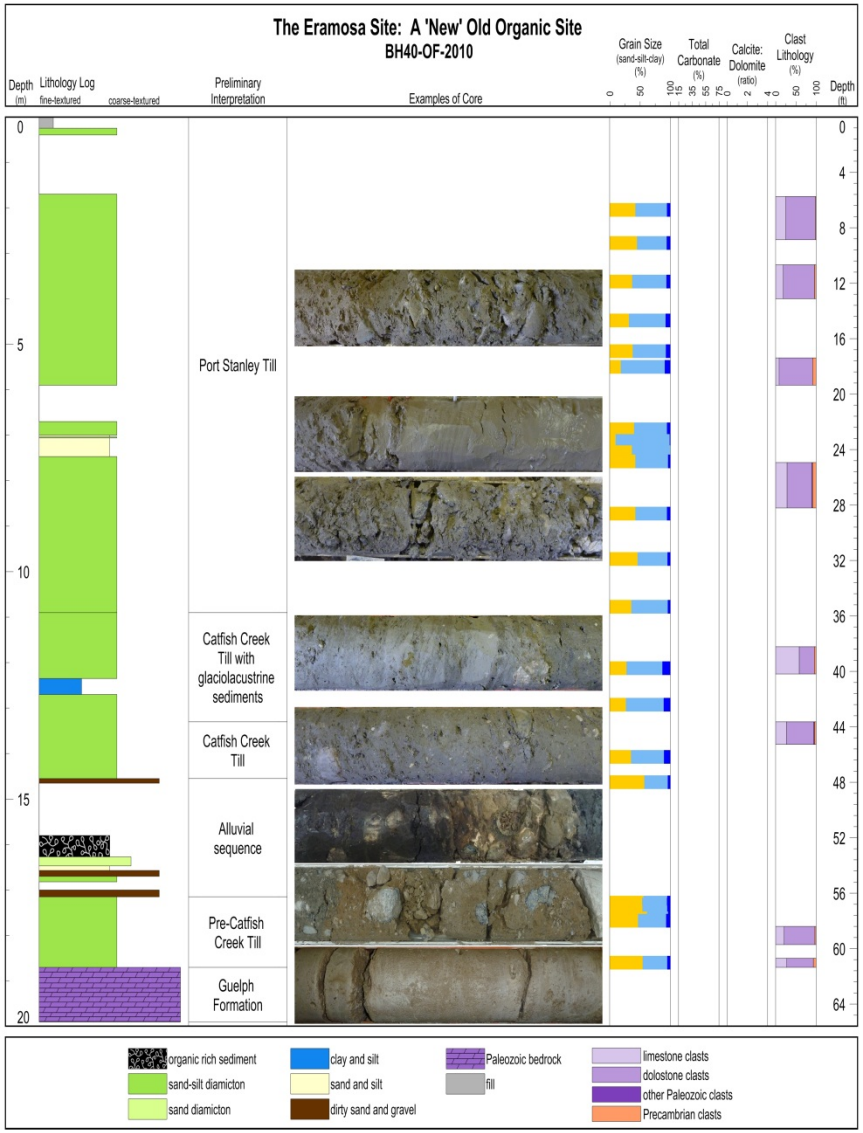
- Glaciolacustrine/subaquatic fan sediments
- Outwash and ice marginal deposits
- Alluvium



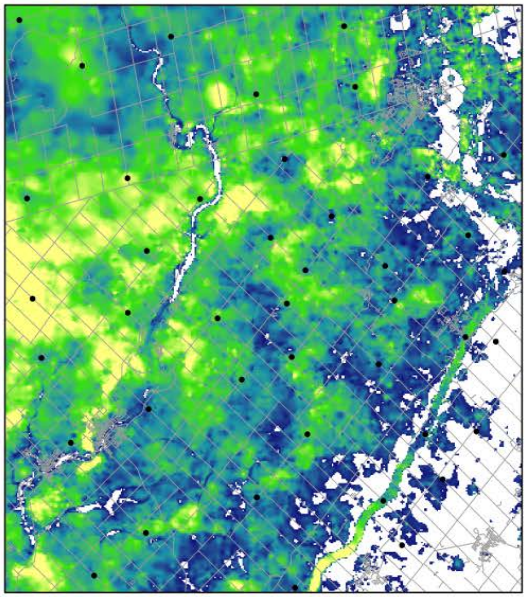
The magic of sub-till organics!

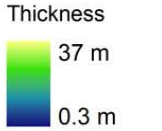
- Radiocarbon dating
- Pollen / macrofossils

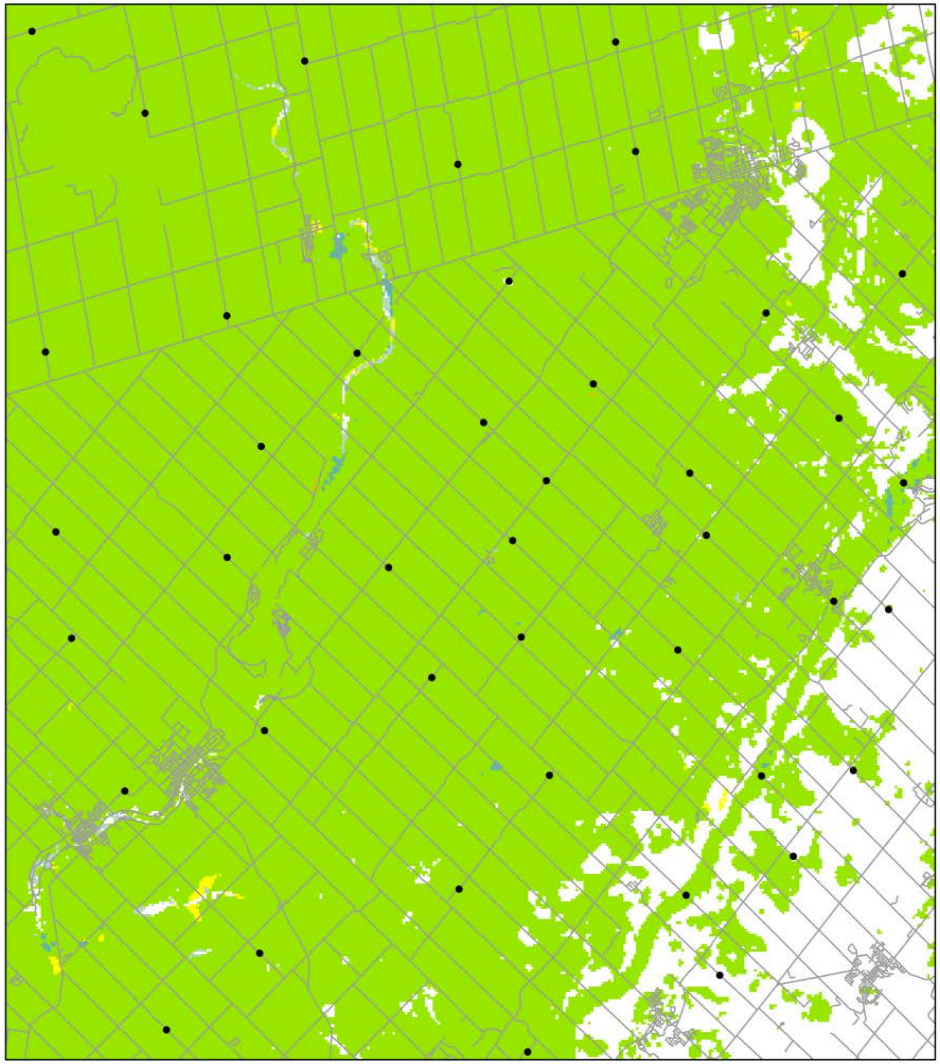
>52 200
54 500 ±2 900



Catfish Creek Till Aquitard







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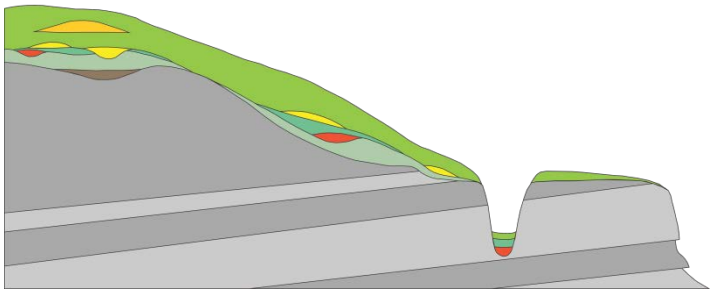

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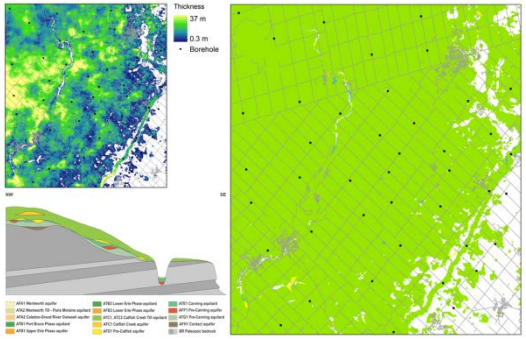
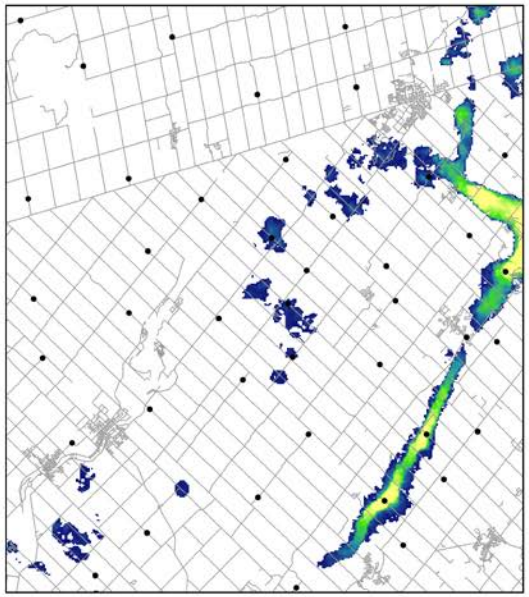
BR Paleozoic bedrock

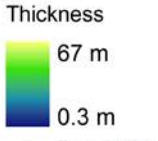
Catfish Creek Till Aquifer and Aquitard

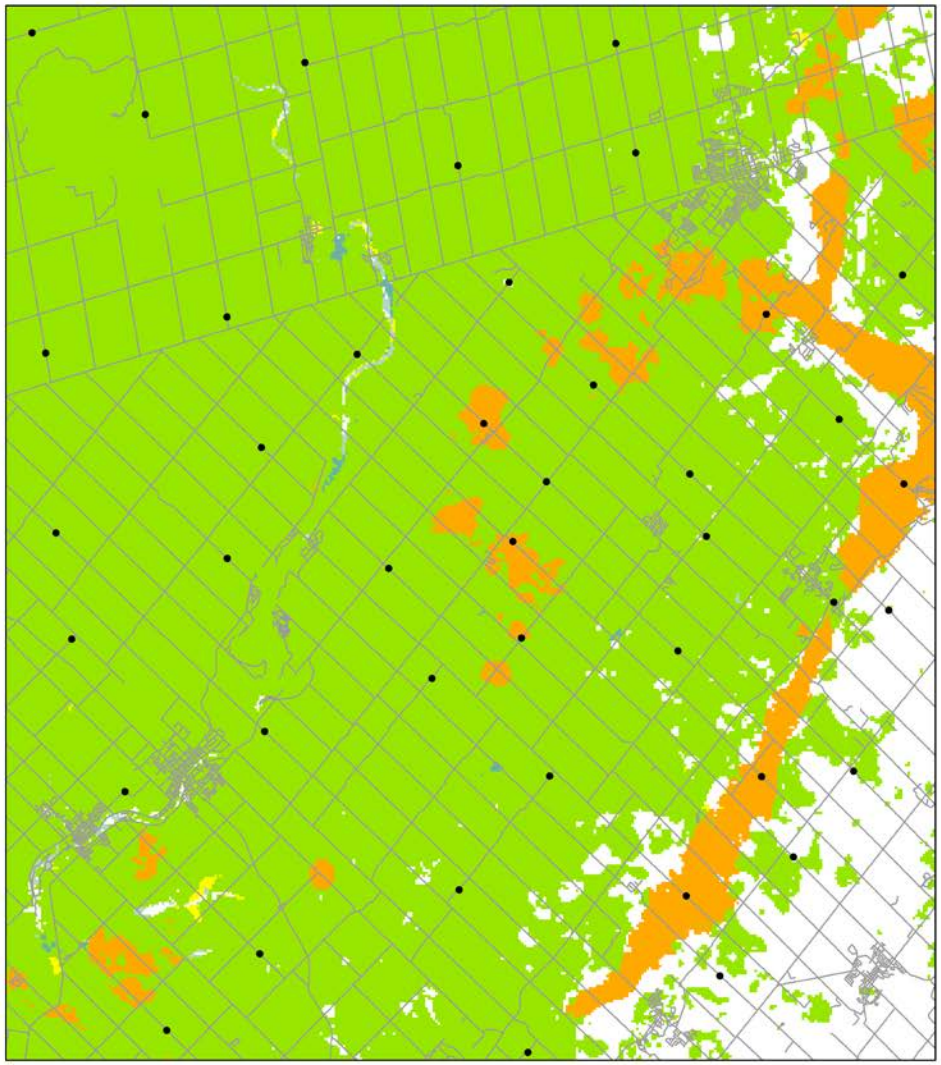
- Till, glaciolacustrine sediments
- Early lobate then regional ice flow
- Localized aquifers



Lower Erie Phase Aquifer







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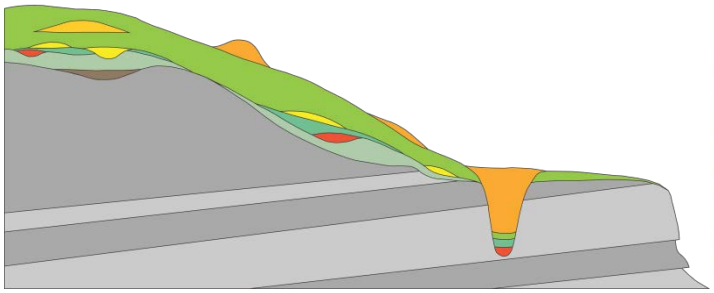

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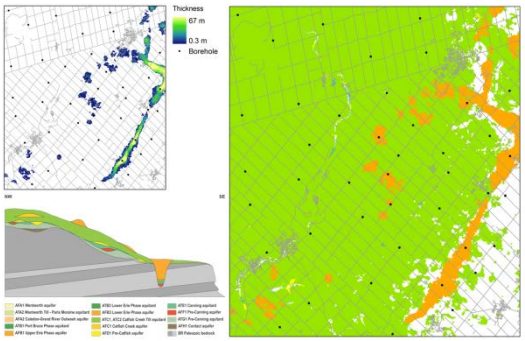
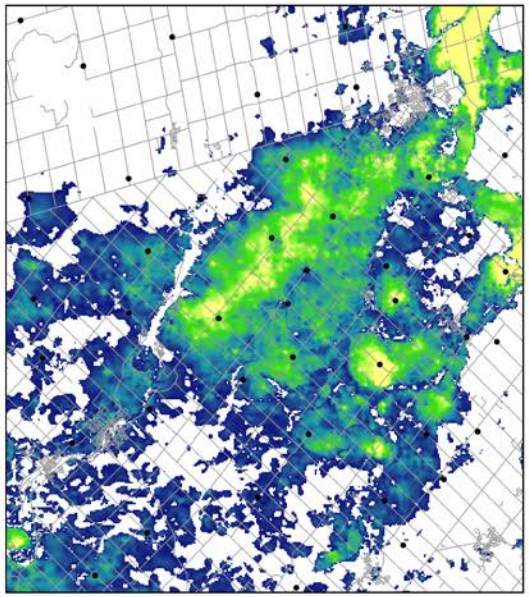
AFH1 Contact aquifer
BR Paleozoic bedrock

Lower Erie Phase Aquifer

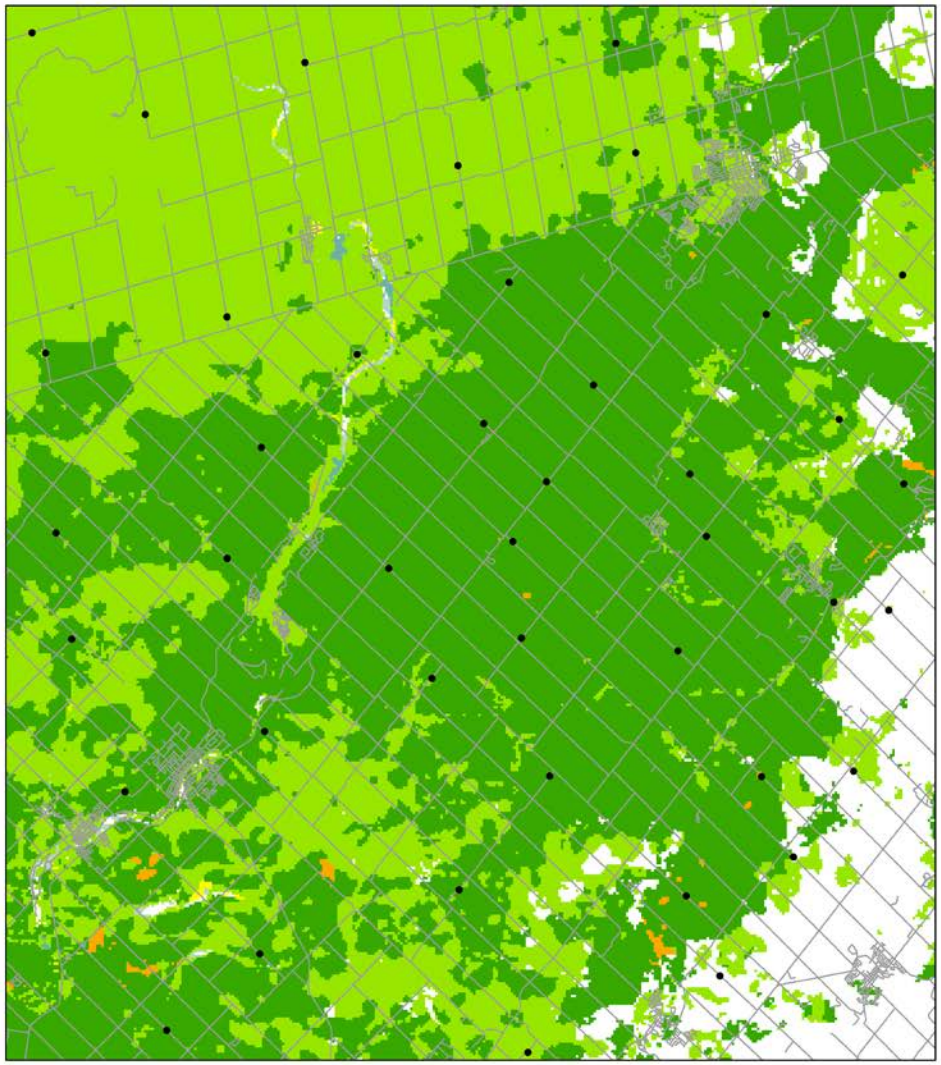
- Bedrock valley fill
- Northern sediment source
- Recharge or receive water from the bedrock aquifer



Lower Erie Phase Aquitard



Thickness
68 m
0.3 m
Borehole



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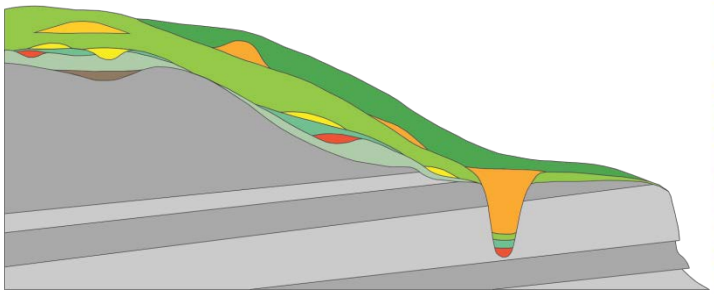

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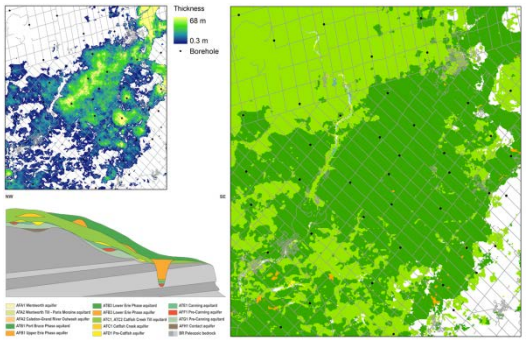
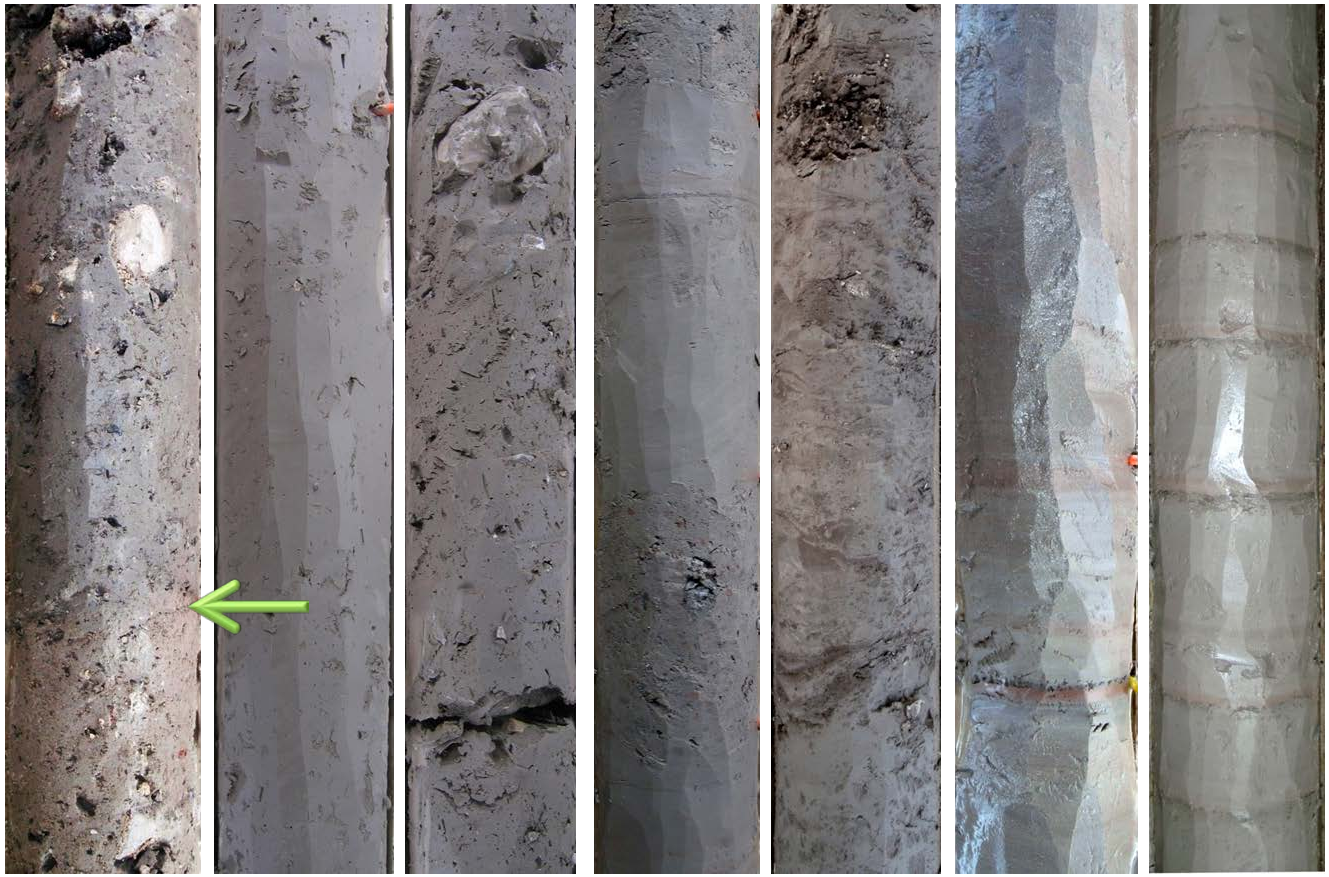
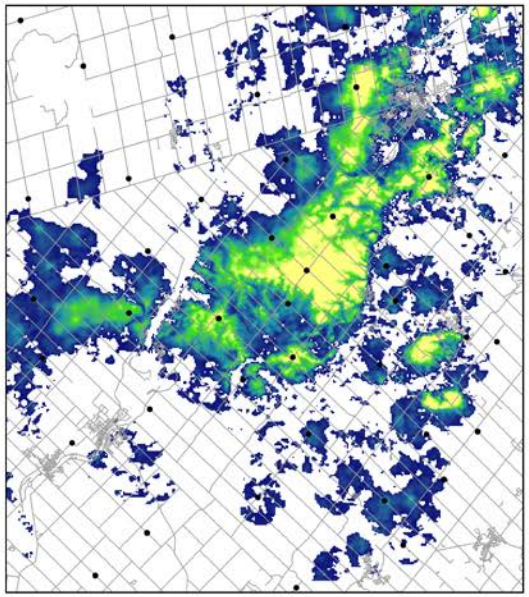
Lower Erie Phase Aquitard

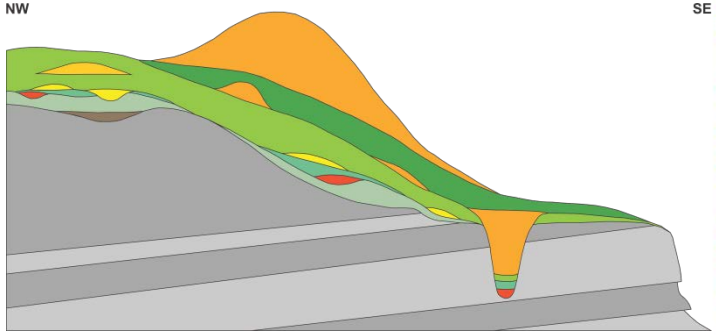
- Fine-textured diamicton and glaciolacustrine sediments
- Deformation!
- Interlobate zone

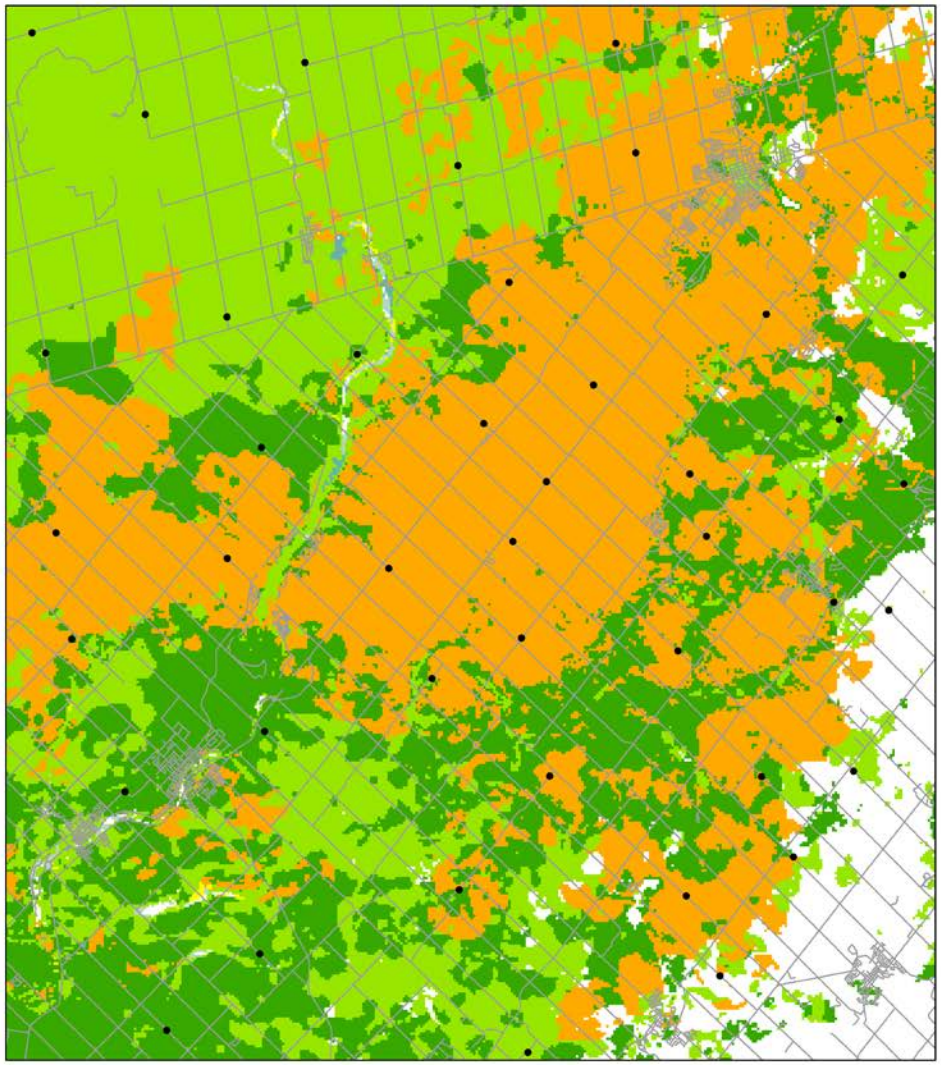




Upper Erie Phase Aquifer

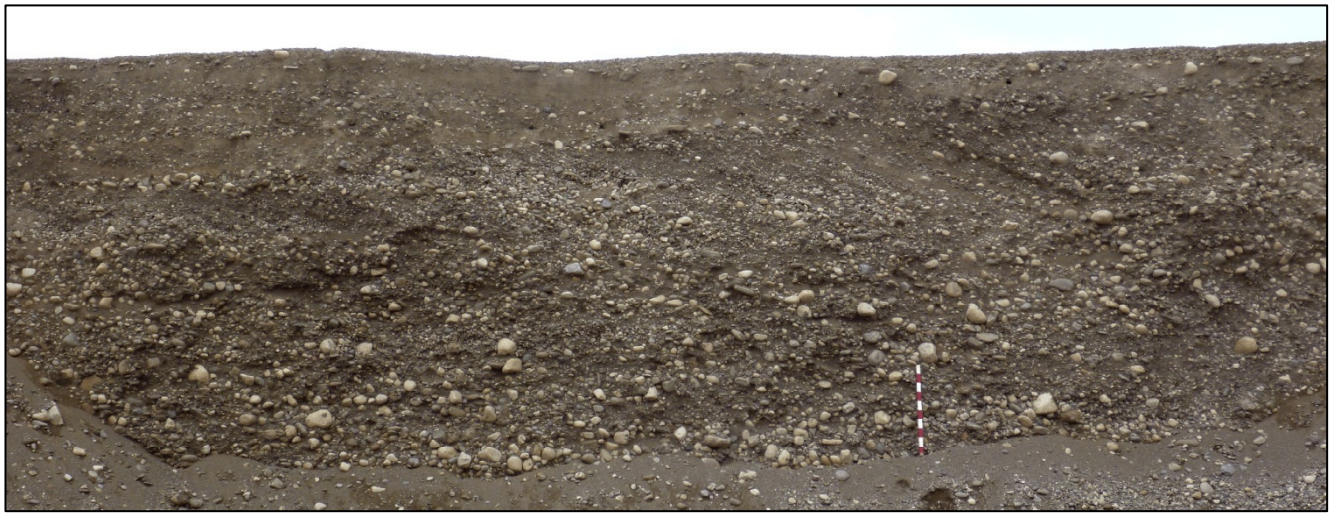






AFA1 Wentworth aquifer
ATA2 Wentworth Till - Paris Moraine aquitard
AFA2 Caledon-Grand River Outwash aquifer
ATB1 Port Bruce Phase aquitard
AFB1 Upper Erie Phase aquifer
ATB3 Lower Erie Phase aquitard
AFB3 Lower Erie Phase aquifer
ATC1, ATC2 Catfish Creek Till aquitard
AFC1 Catfish Creek aquifer
AFD1 Pre-Catfish aquifer
ATE1 Canning aquitard
AFF1 Pre-Canning aquifer
ATG1 Pre-Canning aquitard
AFH1 Contact aquifer
BR Paleozoic bedrock

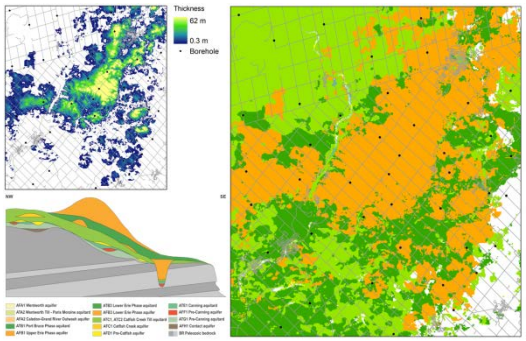
Upper Erie Phase Aquifer – Orangeville Moraine



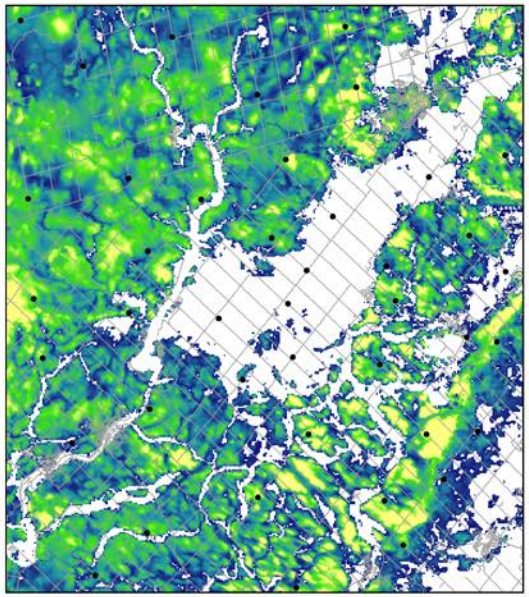
Upper Erie Phase Aquifer – Orangeville Moraine

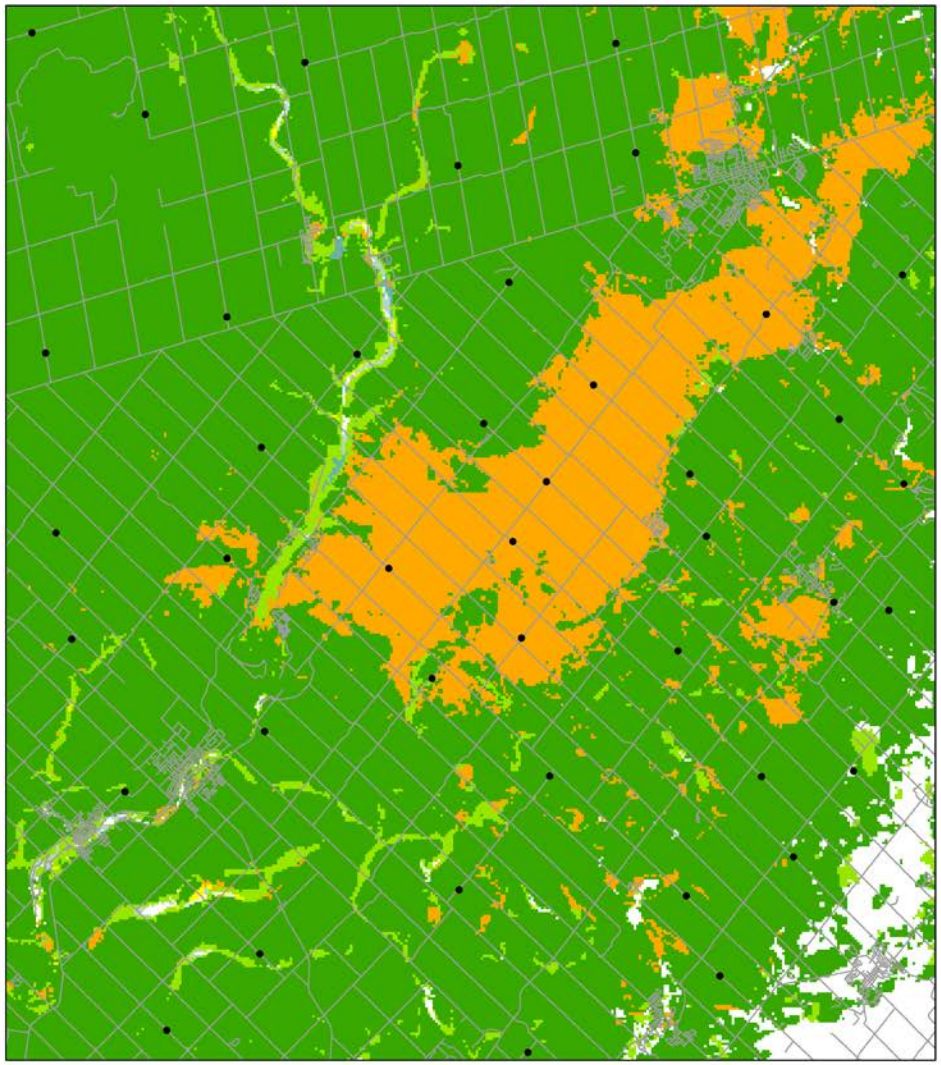
Upper Erie Phase Aquifer – Orangeville Moraine

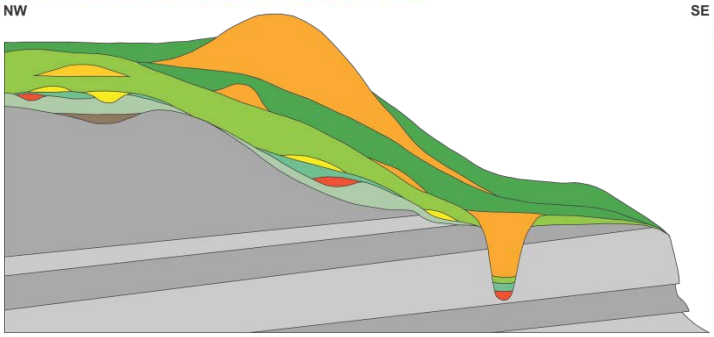
- Dominated by subaquatic fans
- Eskers
- SW to WSW paleoflow directions



Port Bruce Phase Aquitard







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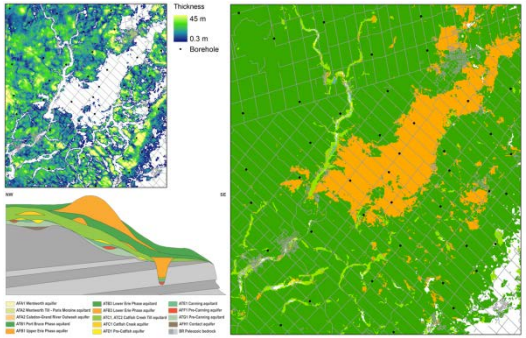
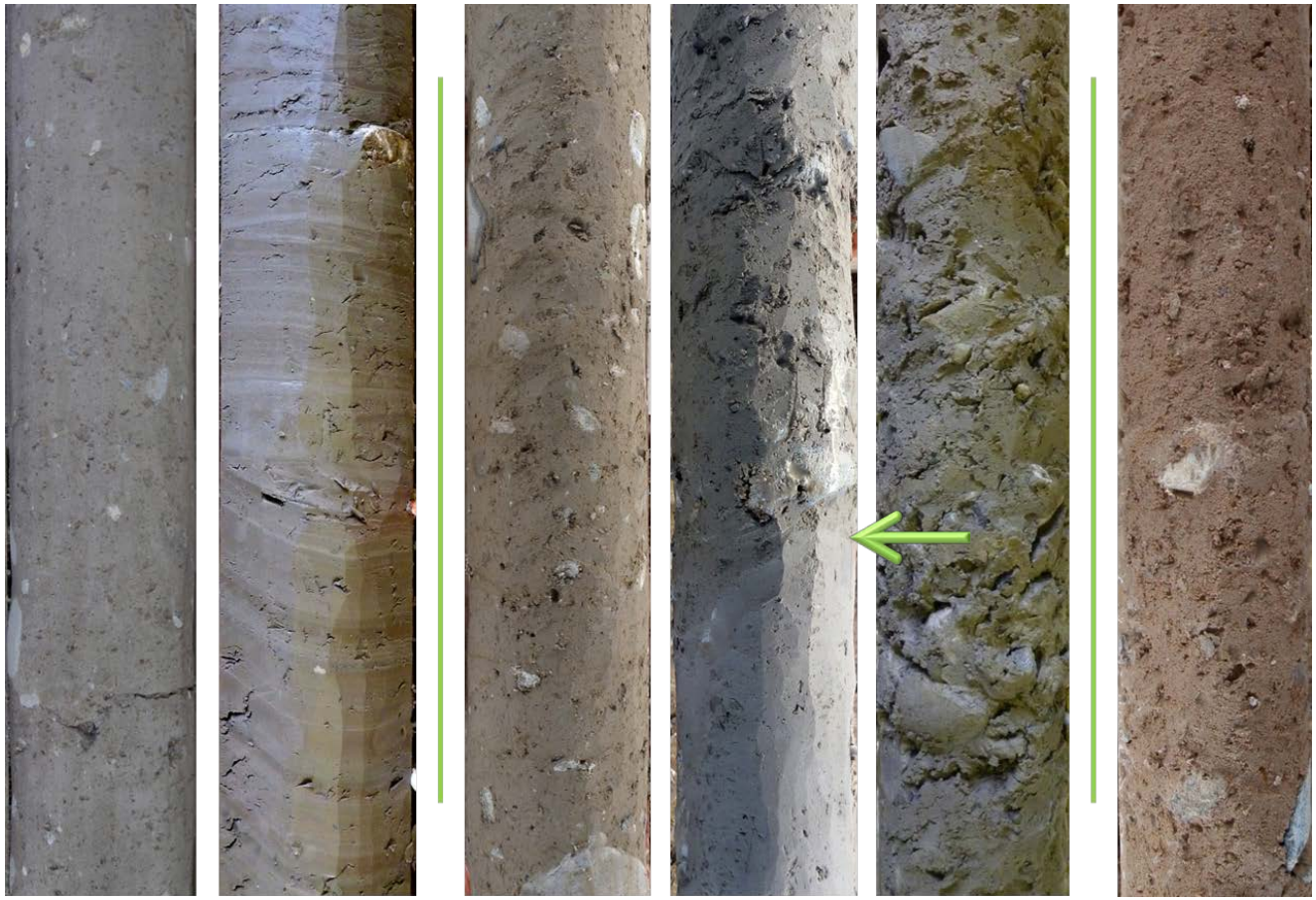
ATG1 Pre-Canning aquitard
AFH1 Contact aquifer
BR Paleozoic bedrock

Port Bruce Phase Aquitard

- Port Bruce Phase ice advance
- Tavistock Till, Port Stanley Till, upper sandy till, glaciolacustrine sediments
- Upper aquitard, partially confines the Orangeville Moraine aquifer



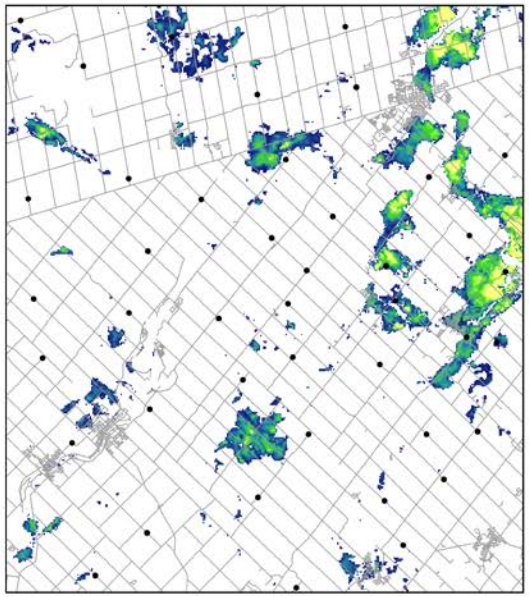


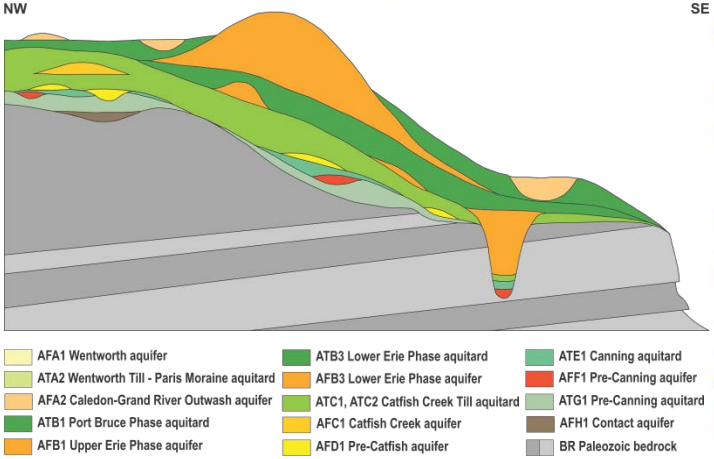
Tavistock Till

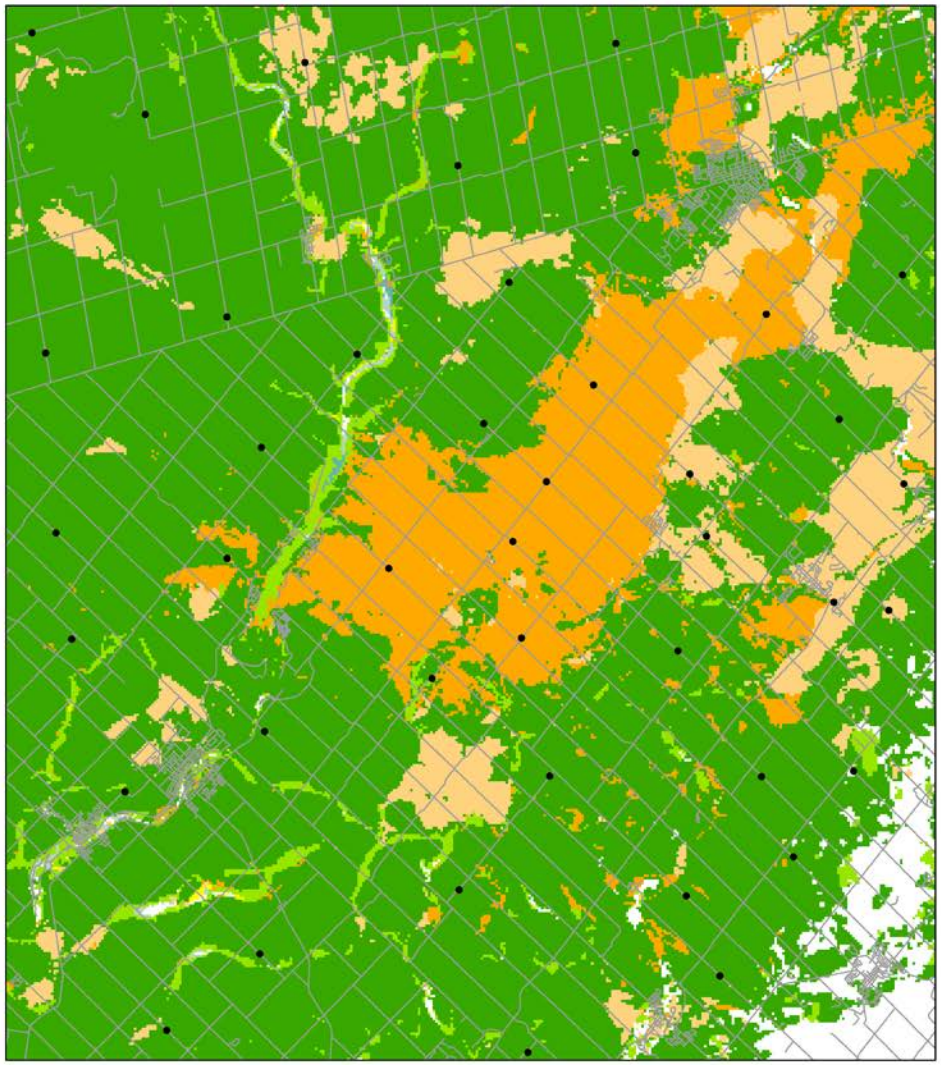
Port Stanley Till

Upper Sandy Till

Caledon – Grand River Outwash Aquifer







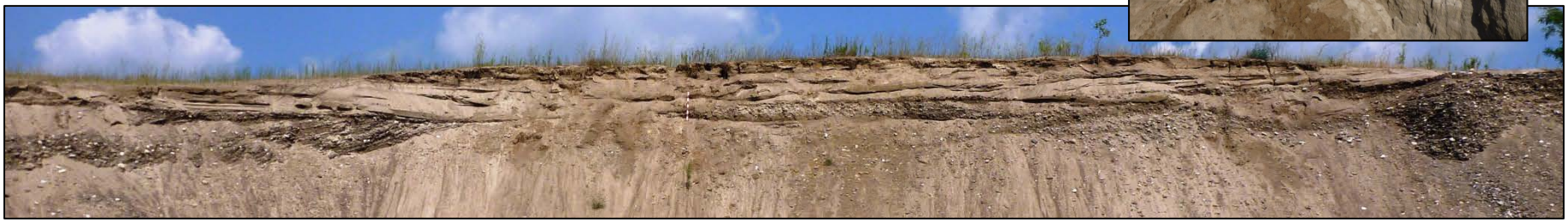
Caledon – Grand River Outwash Aquifer

Bar Front

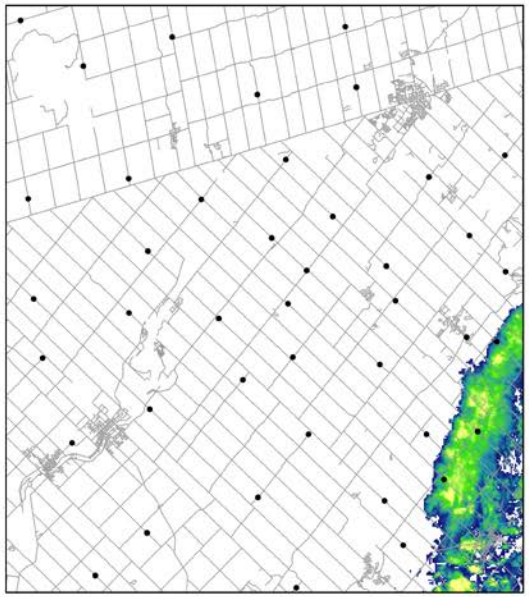
Bar core

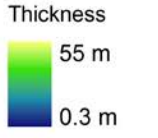
- Dominated by glaciofluvial outwash
- Cobble gravel, some sand
- On-going surface contamination
- Important source of aggregate

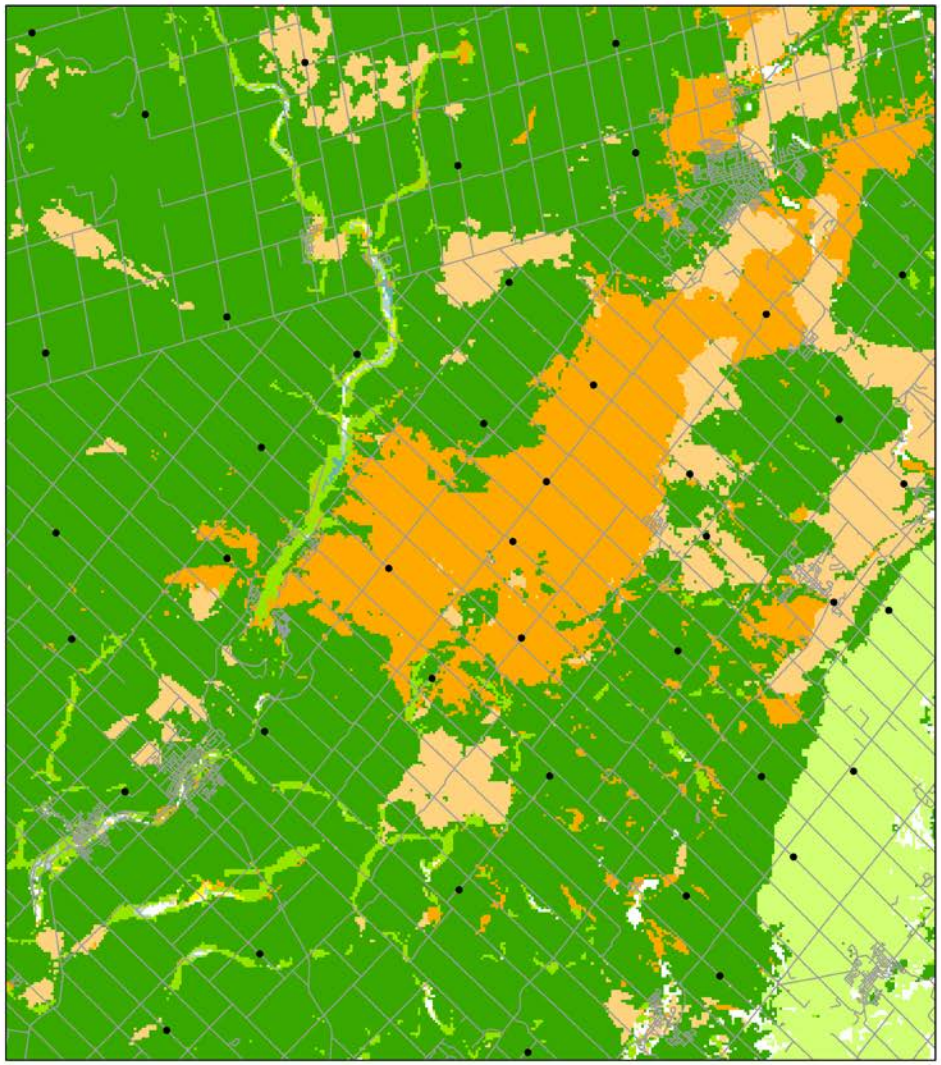
Waning Flow

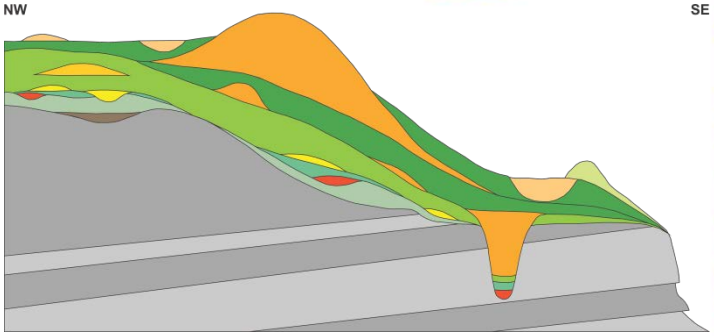


Wentworth Till – Paris Moraine Aquitard









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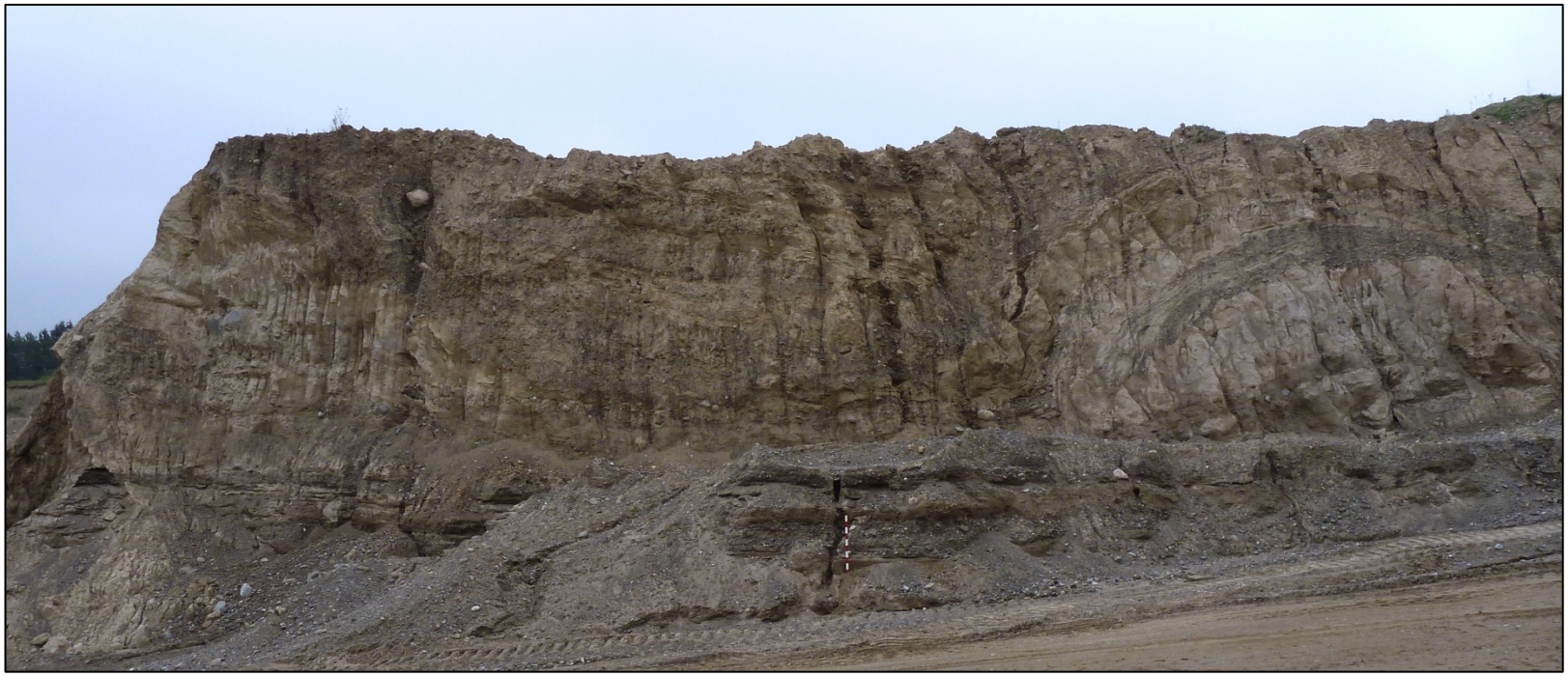
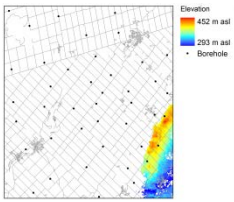
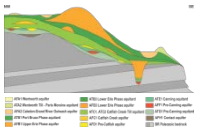
Wentworth Till – Paris Moraine Aquitard

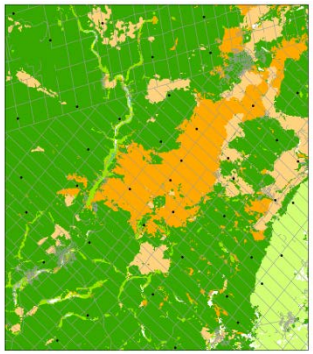


Wentworth Till – Paris Moraine Aquitard

- Diamicton (till and debris flows), dirty sand and gravel
- Course-textured stratified sediment and closed depressions provide enhanced recharge potential







Audience Participation

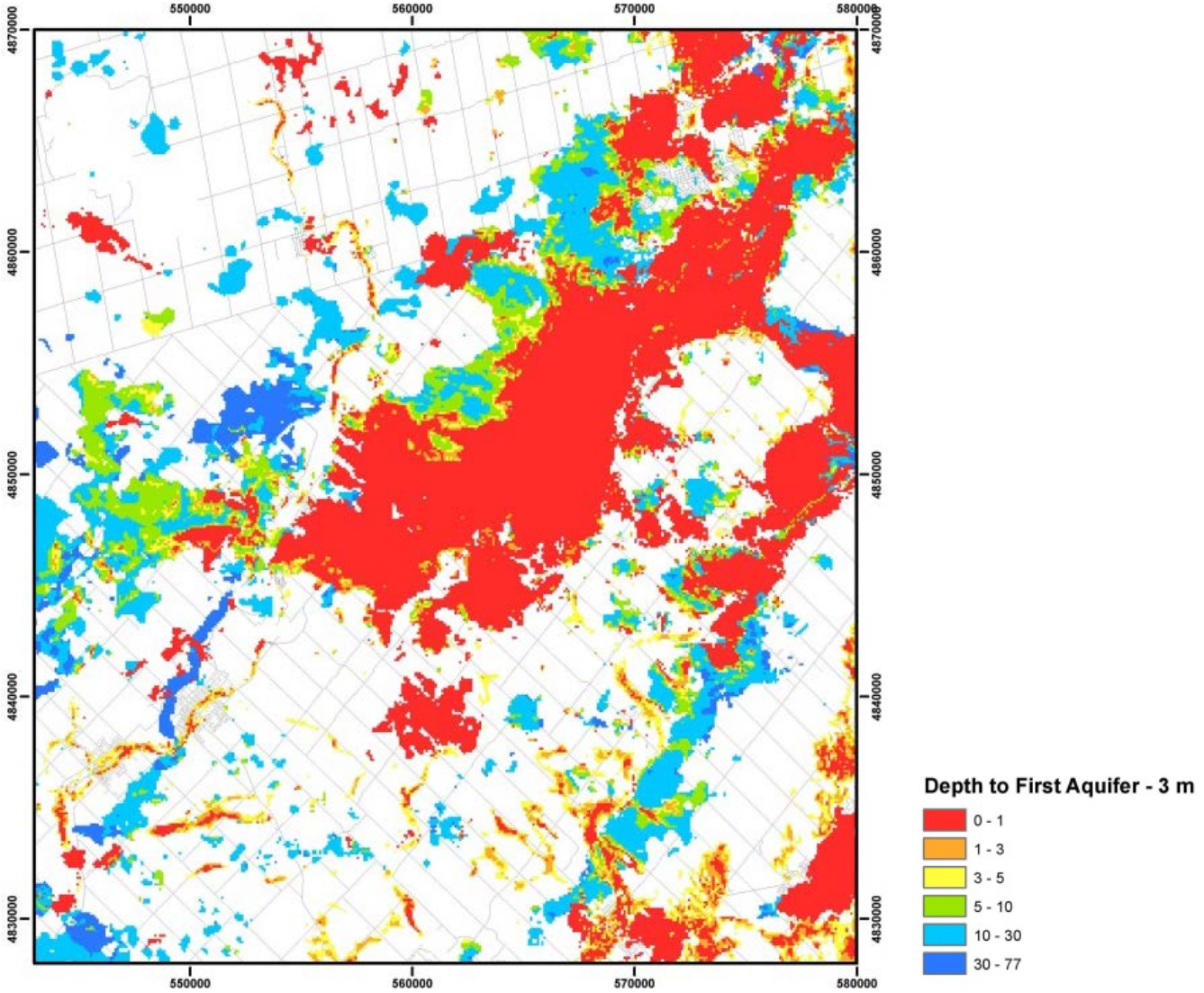
Vulnerability Maps

or

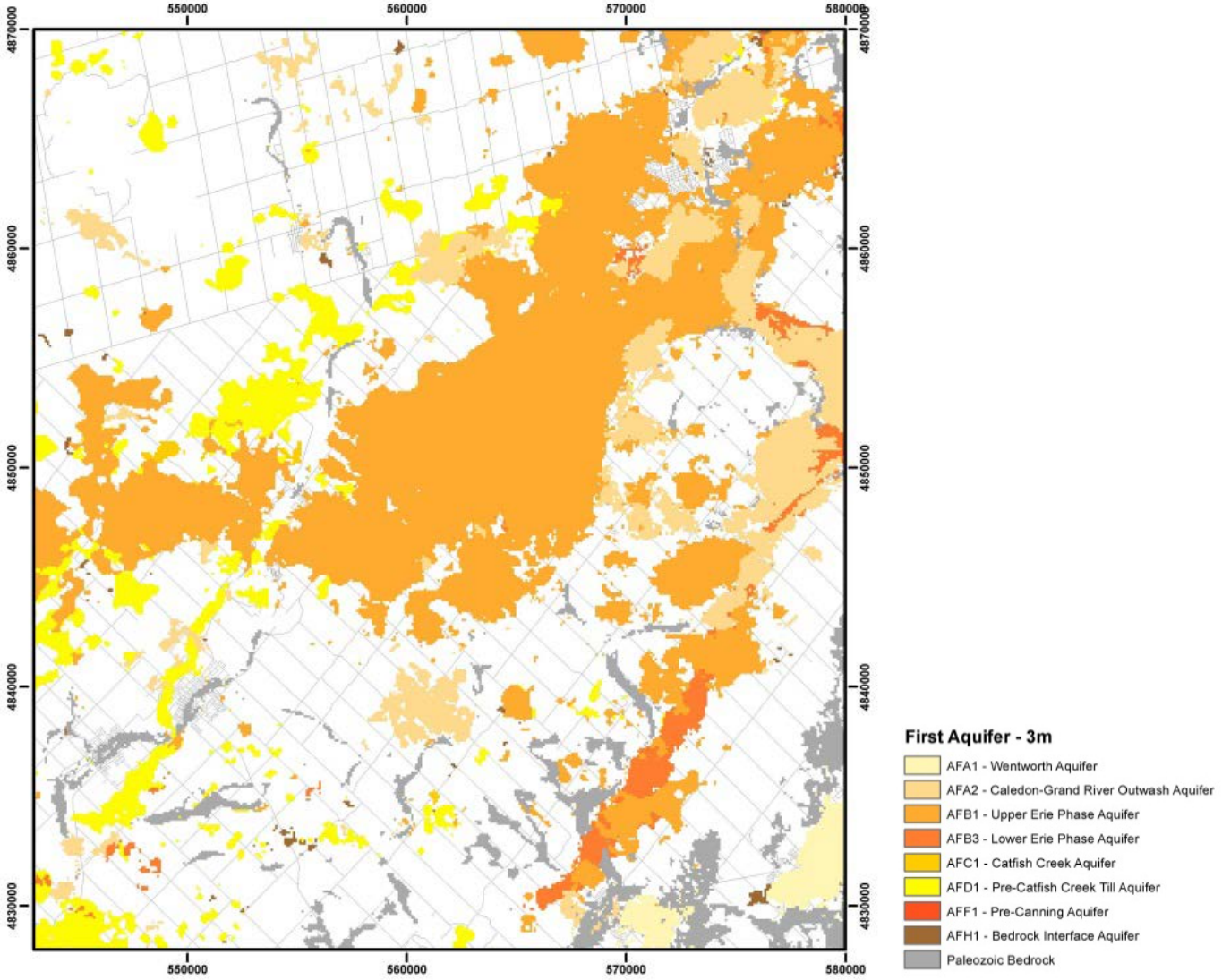
Regional Context

(How do the modeled units compare with the Waterloo and Brantford-Woodstock map areas?)

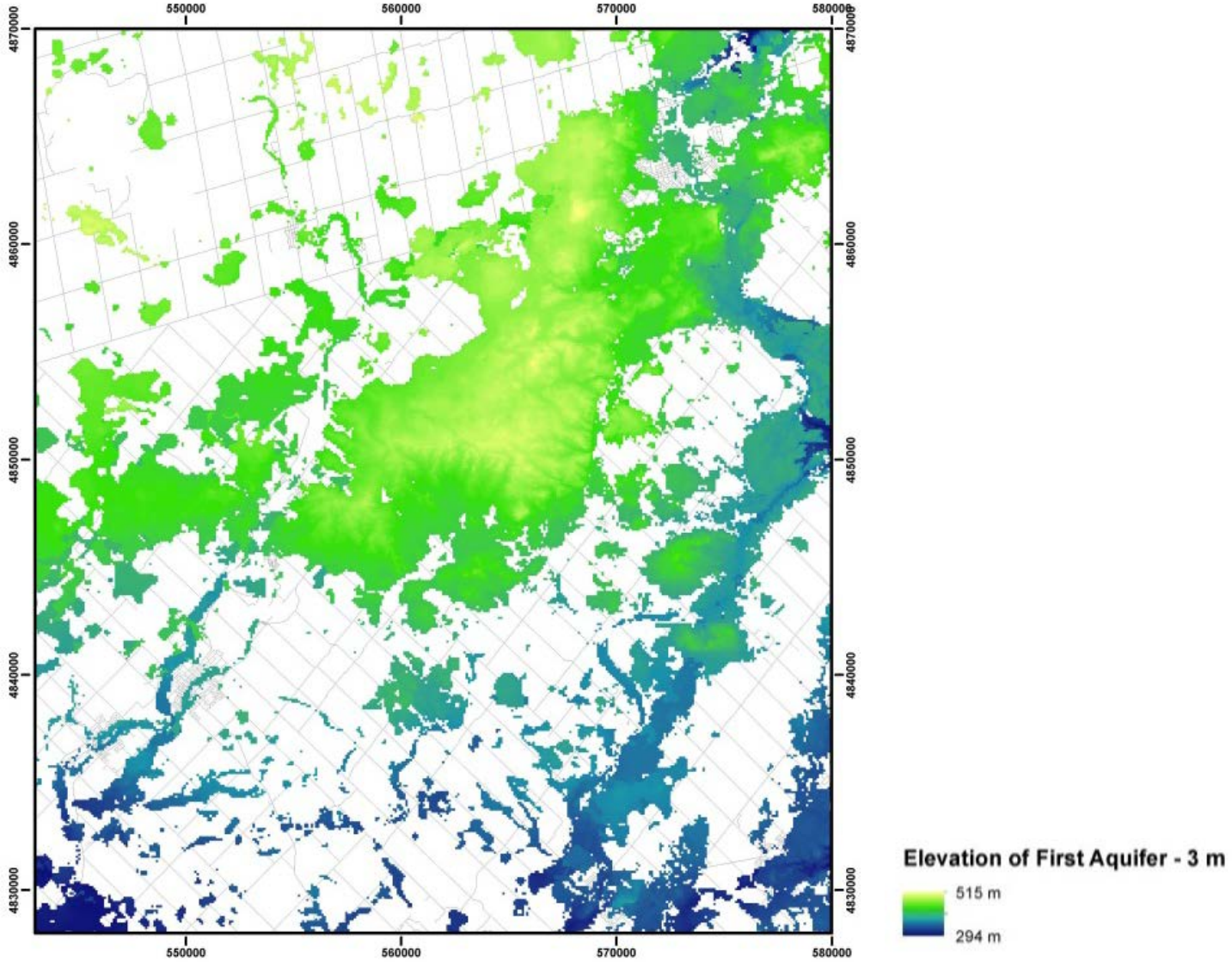
Depth to first aquifer



First aquifer ID

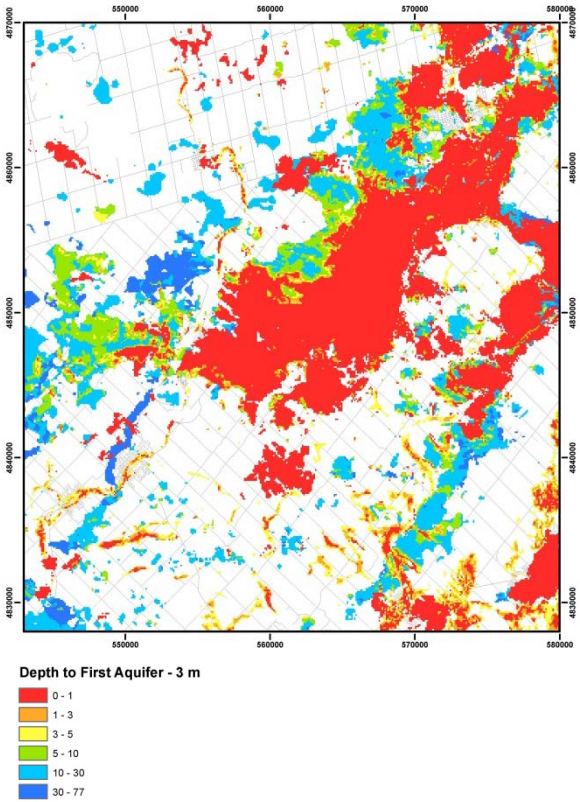


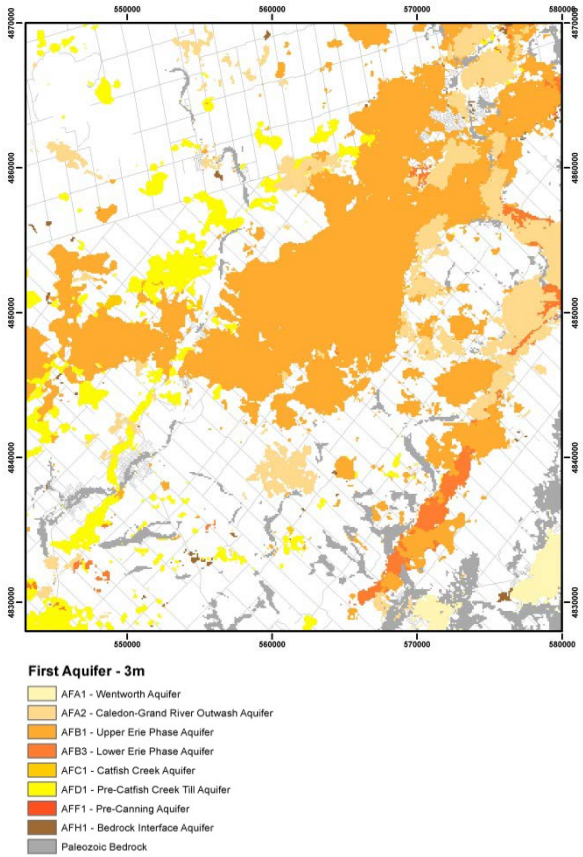
Elevation of first aquifer

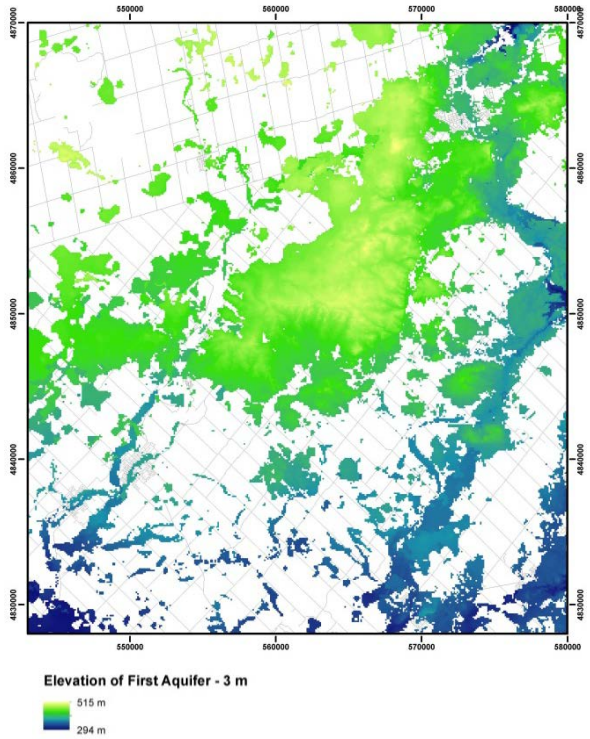


Aquifer vulnerability and recharge potential

- Depth to first aquifer
- Aquifer ID
- Elevation



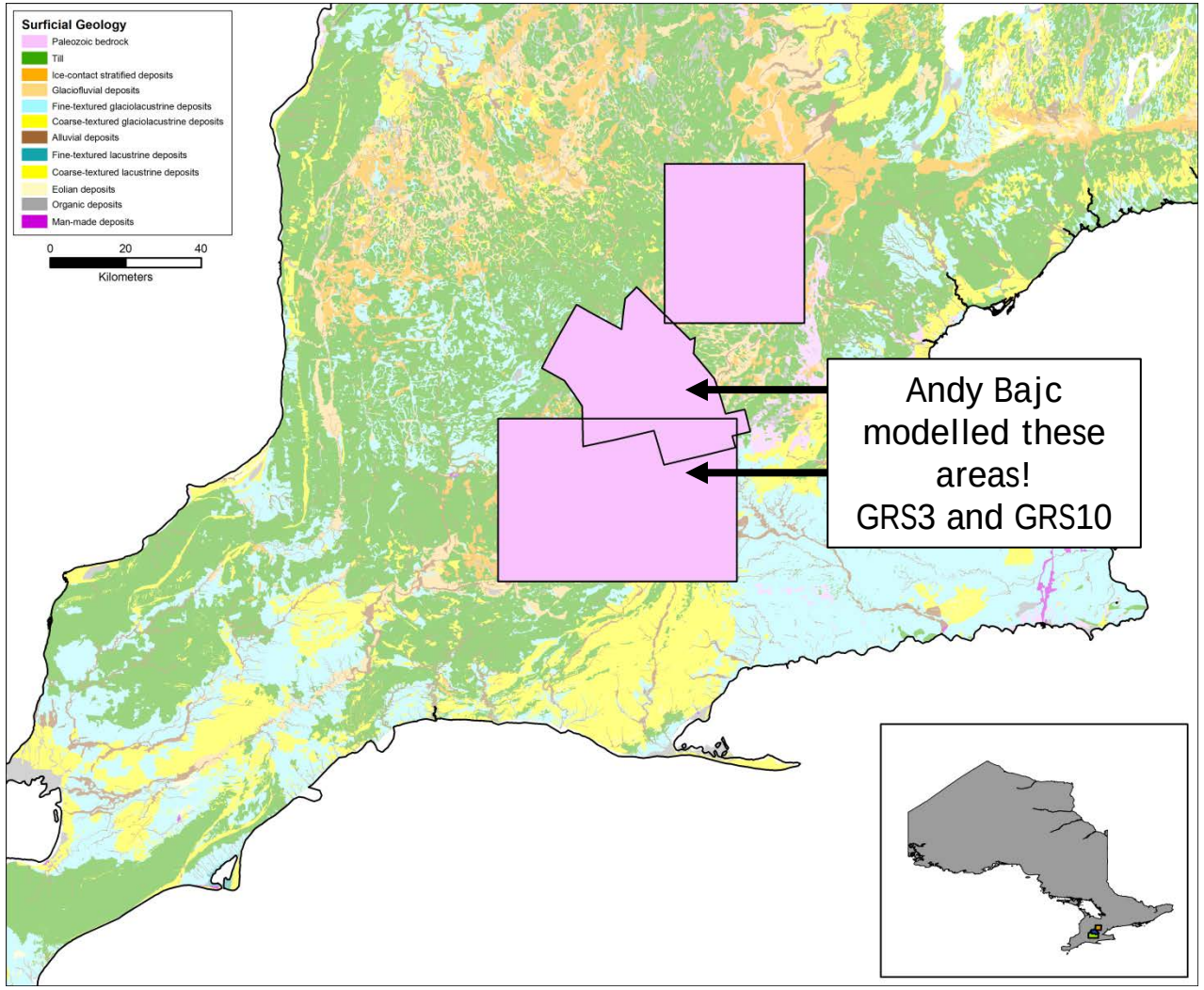


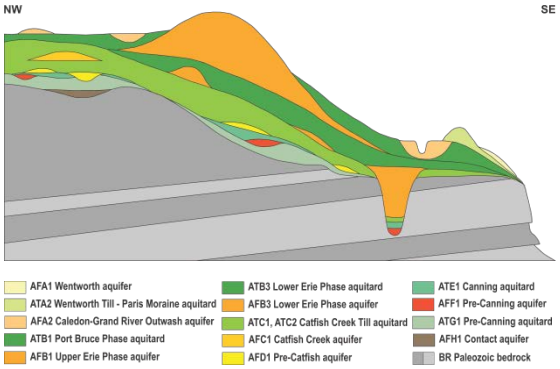


http://www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth
or
Google OGS Earth

Regional Context

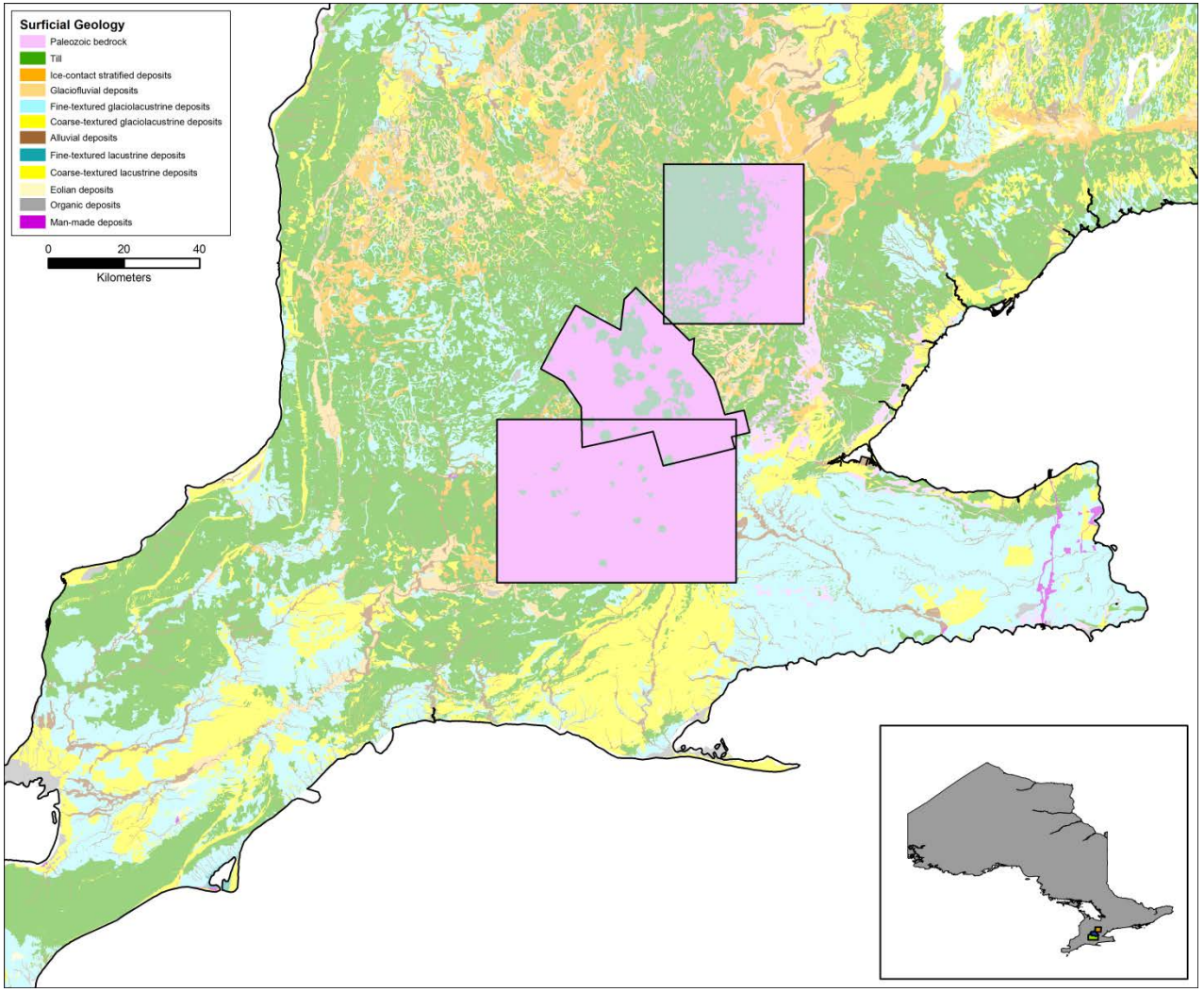
- The beginning – Ordovician, Silurian and Devonian bedrock

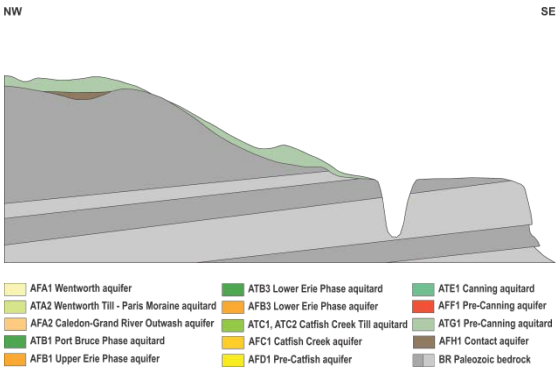




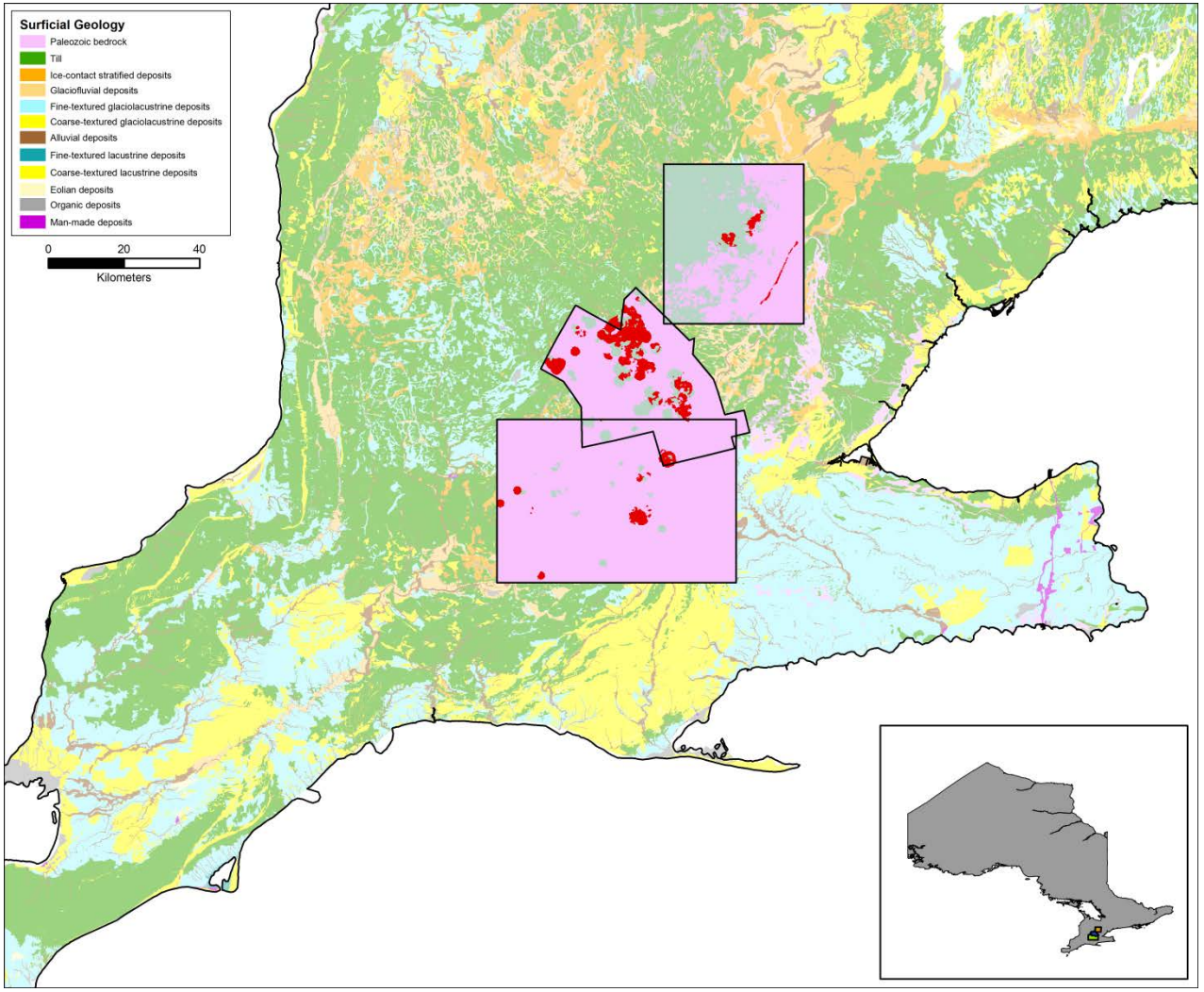
Regional Context: Pre-Canning Aquitard

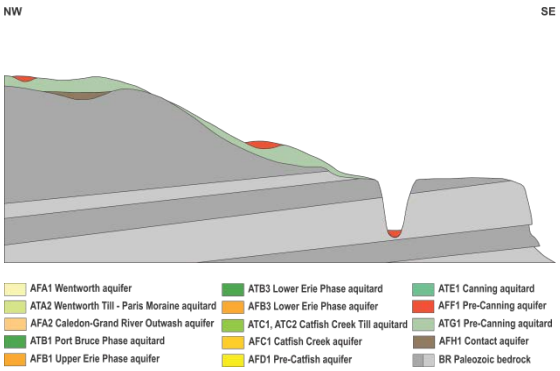
- 1 or 2 older ice advances



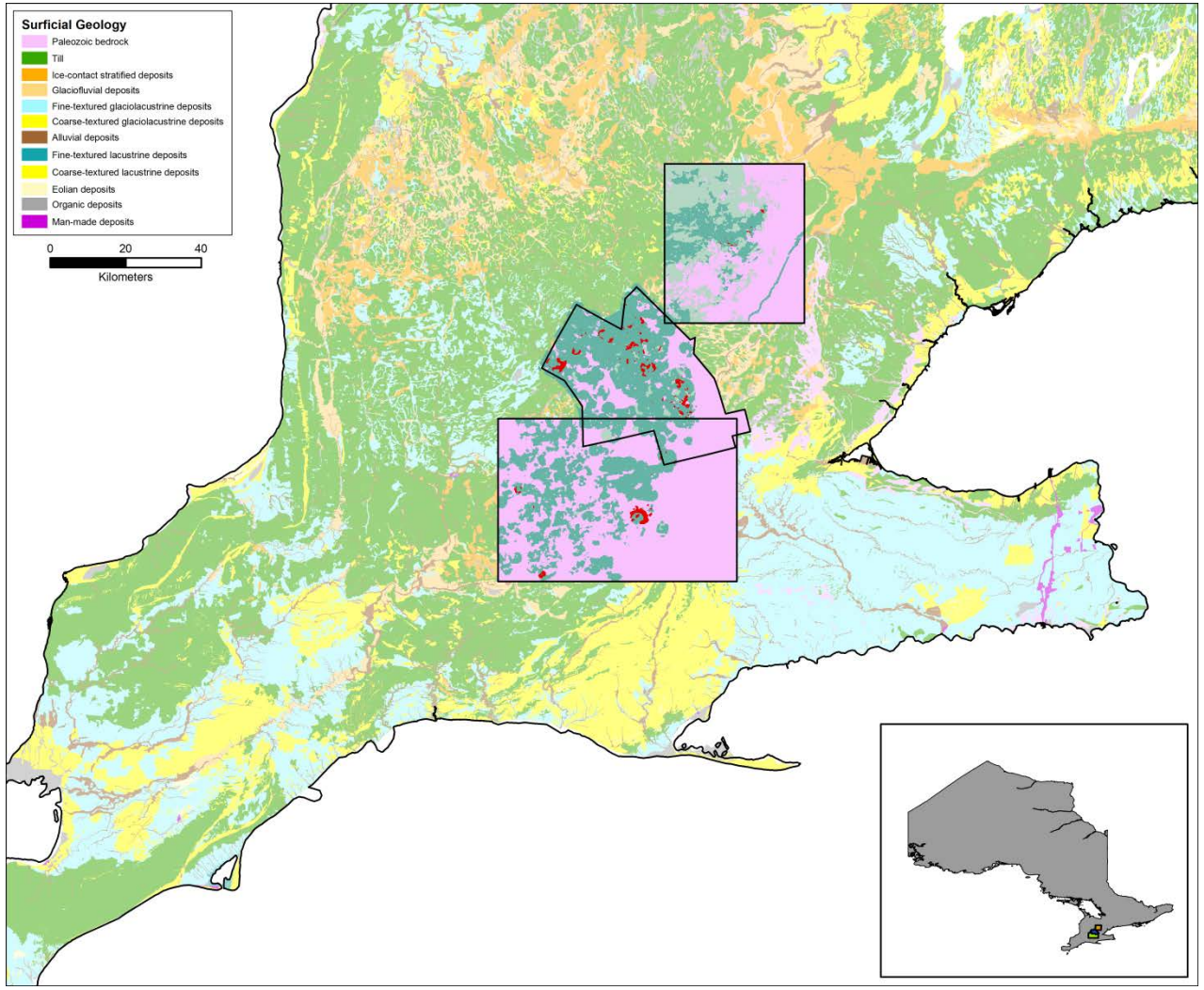


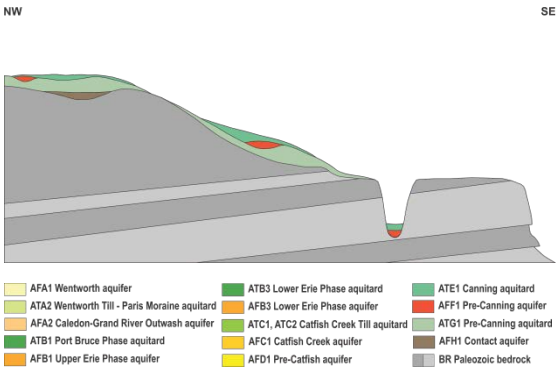
Regional Context: Pre-Canning Aquifer



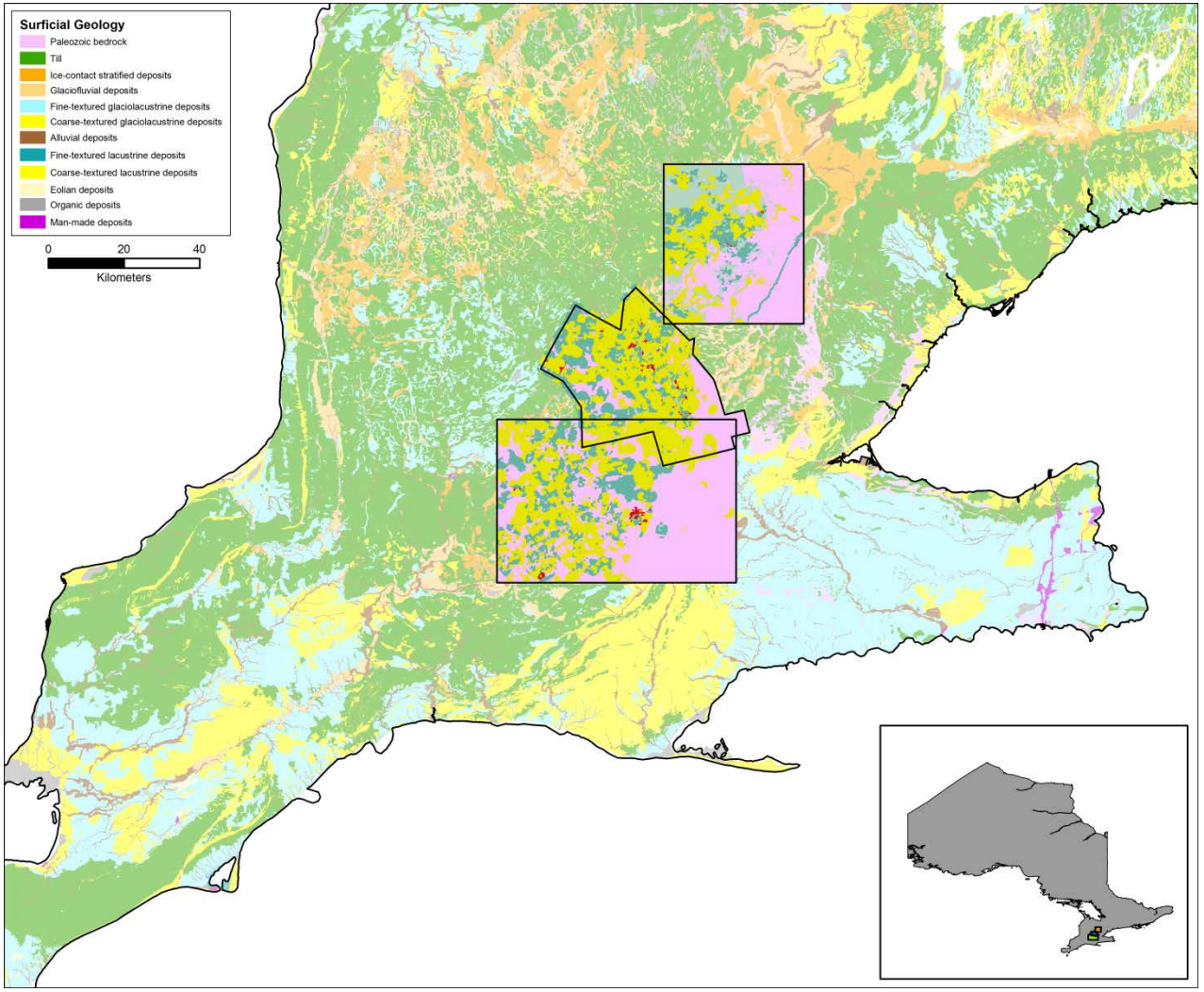


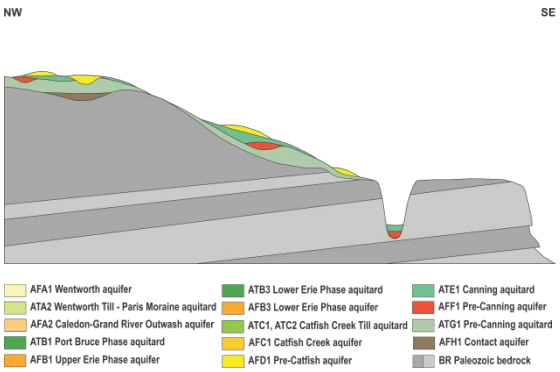
Regional Context: Canning Aquitard





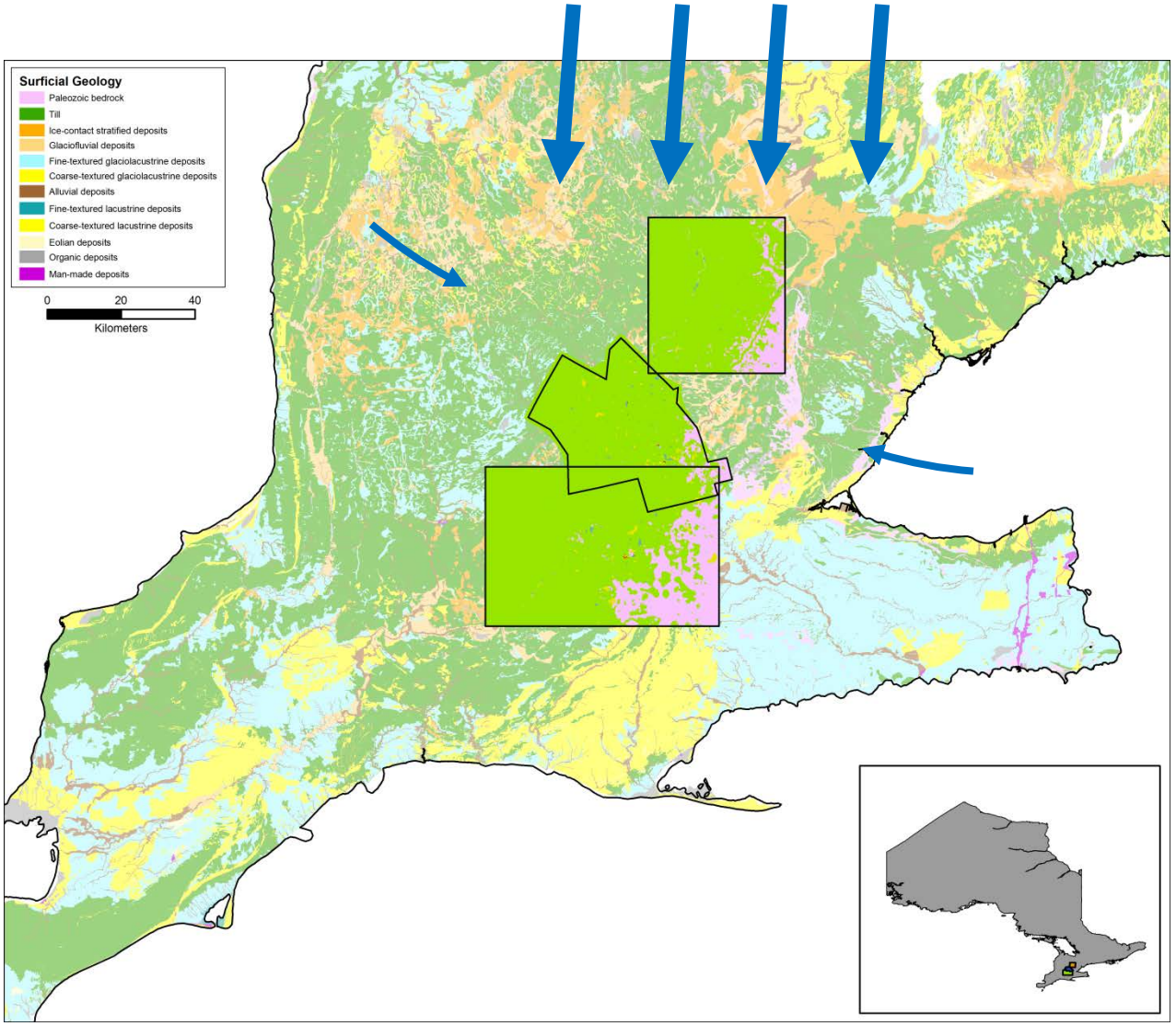
Regional Context: Pre-Catfish Aquifer

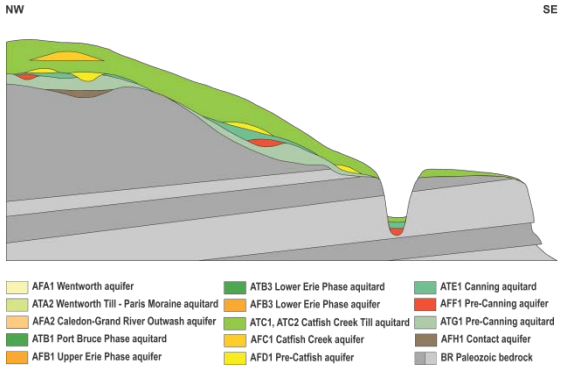




Regional Context: Catfish Creek Till Aquitard

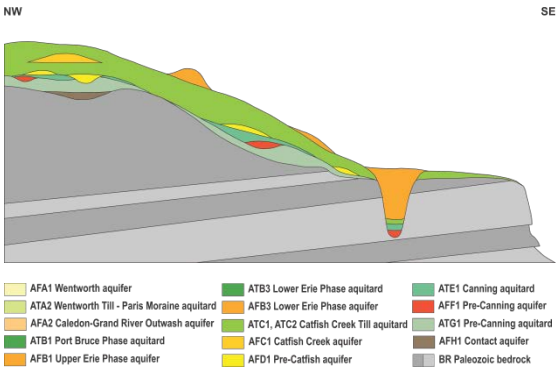
- Late Wisconsin (Nissouri Phase) ice advance
- Early lobate flow
- Later regional flow

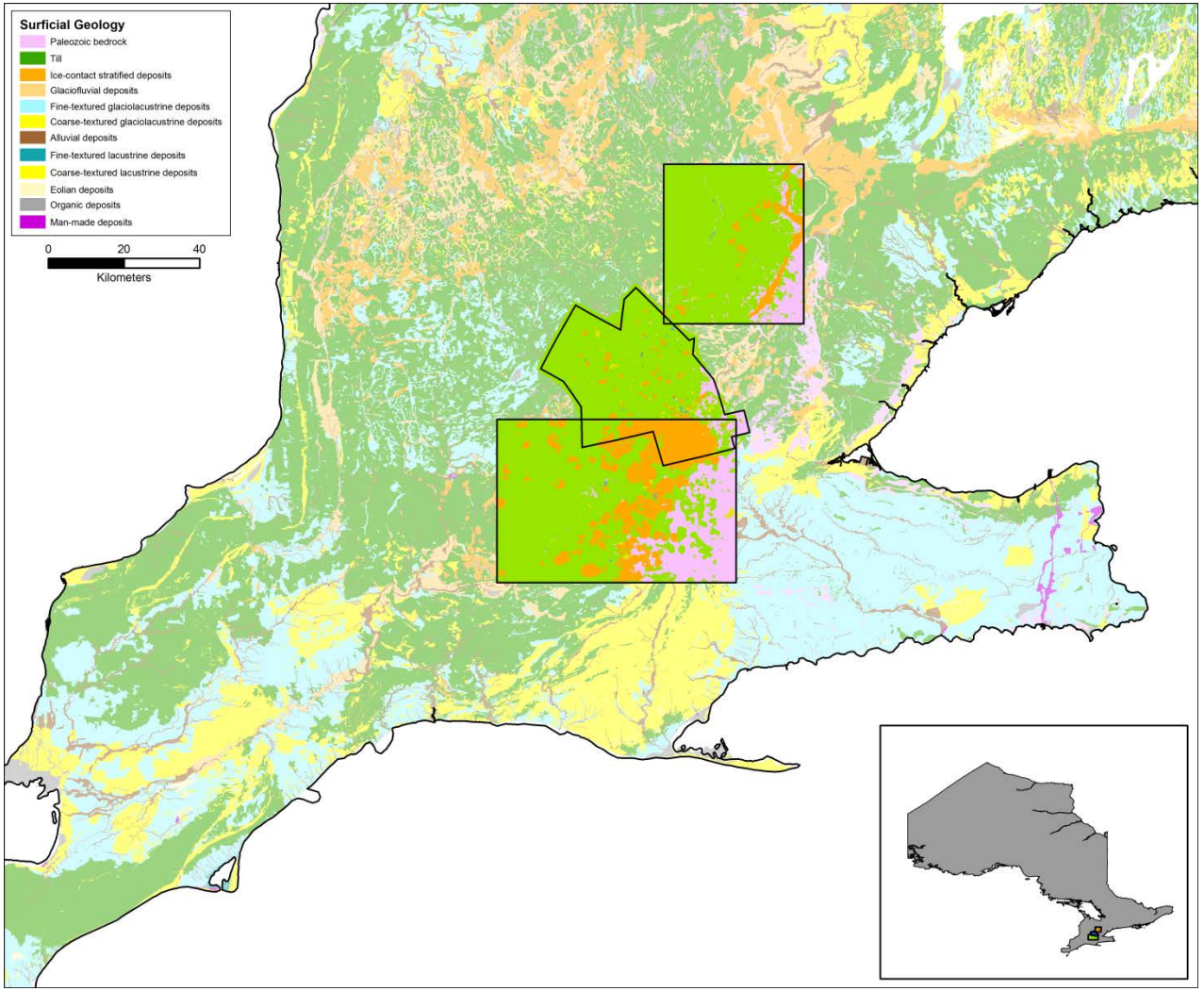




Regional Context: Lower Erie Phase Aquifer

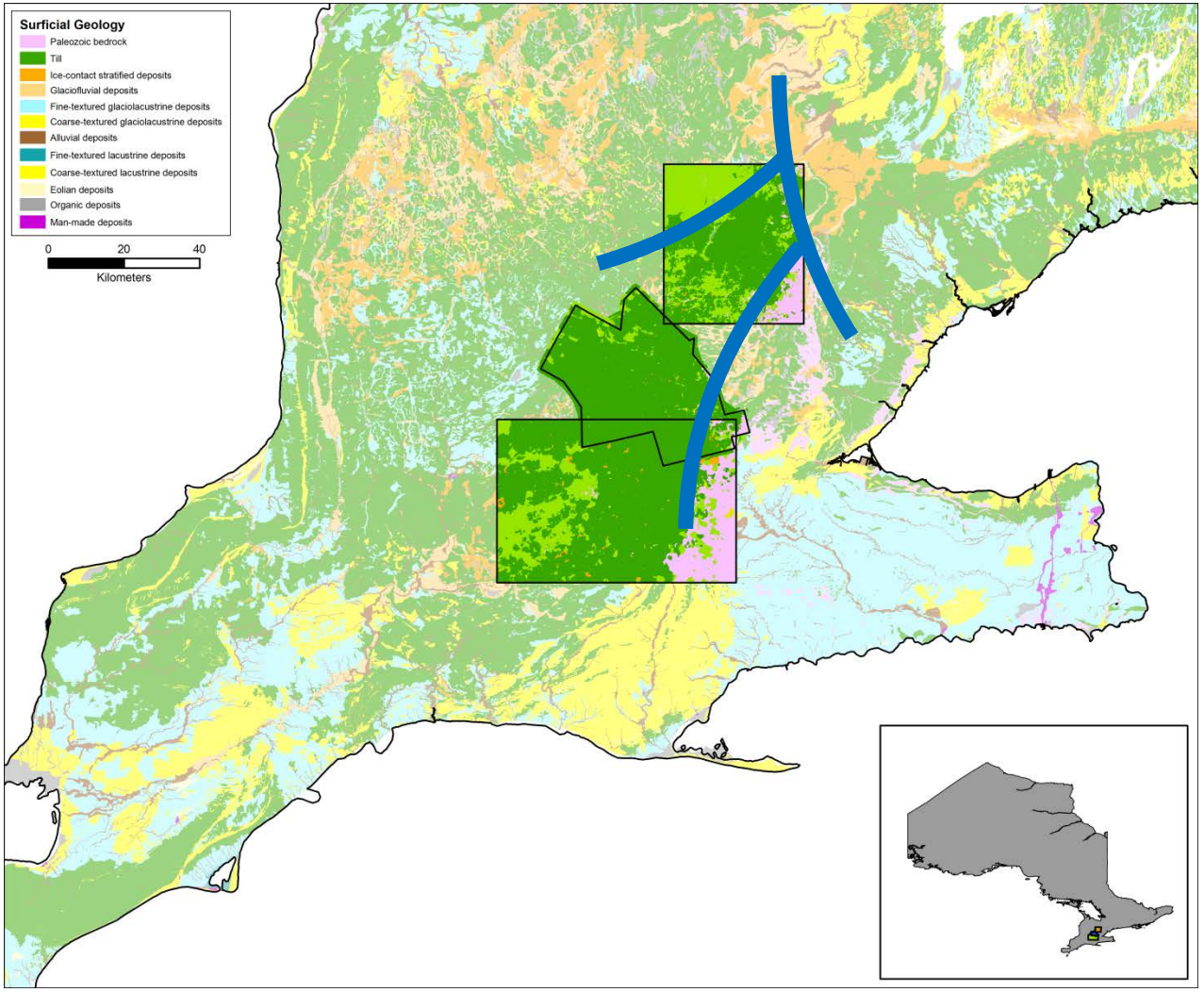
- Thinning and breakup of Catfish ice

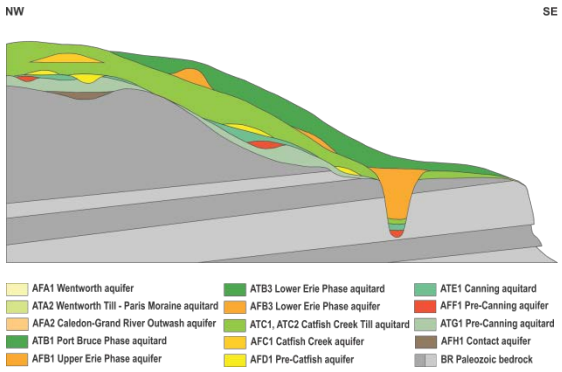




Regional Context: Lower Erie Phases Aquitard

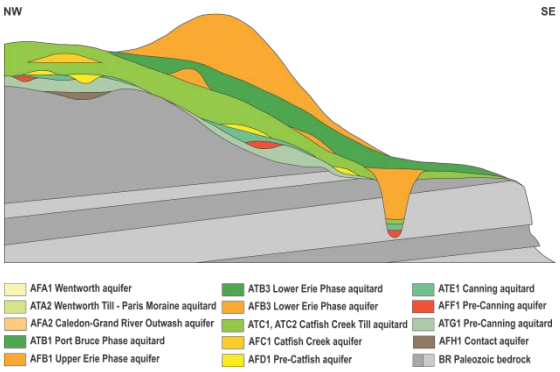
- Glaciolacustine sediments and diamicton
- Lobate ice forms the wall of the lake

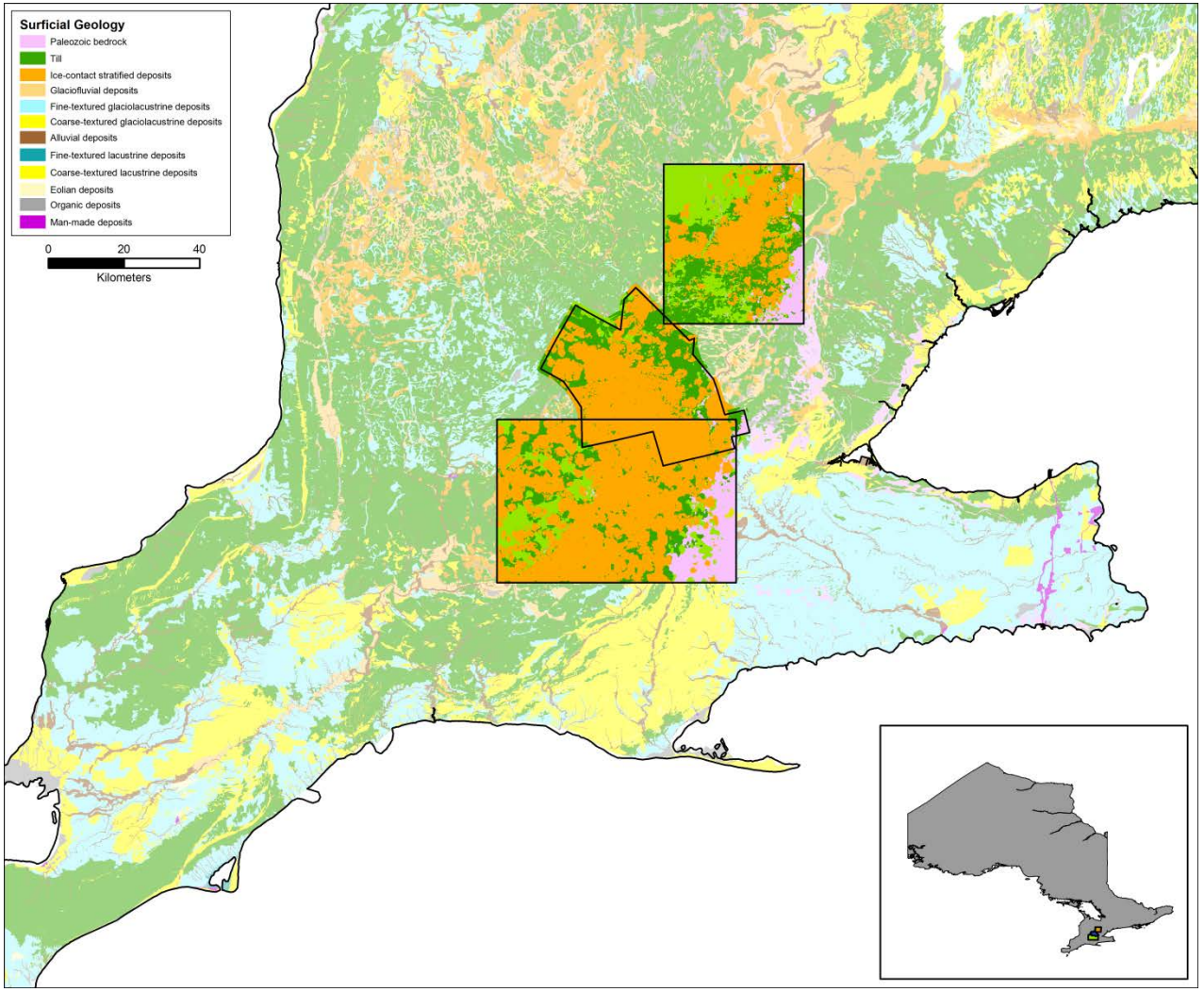




Regional Context: Upper Erie Phase Aquifer

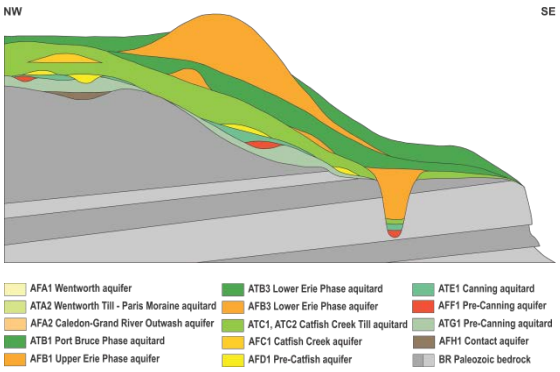
- Orangeville and Waterloo moraine sediments are deposited in the interlobate zone

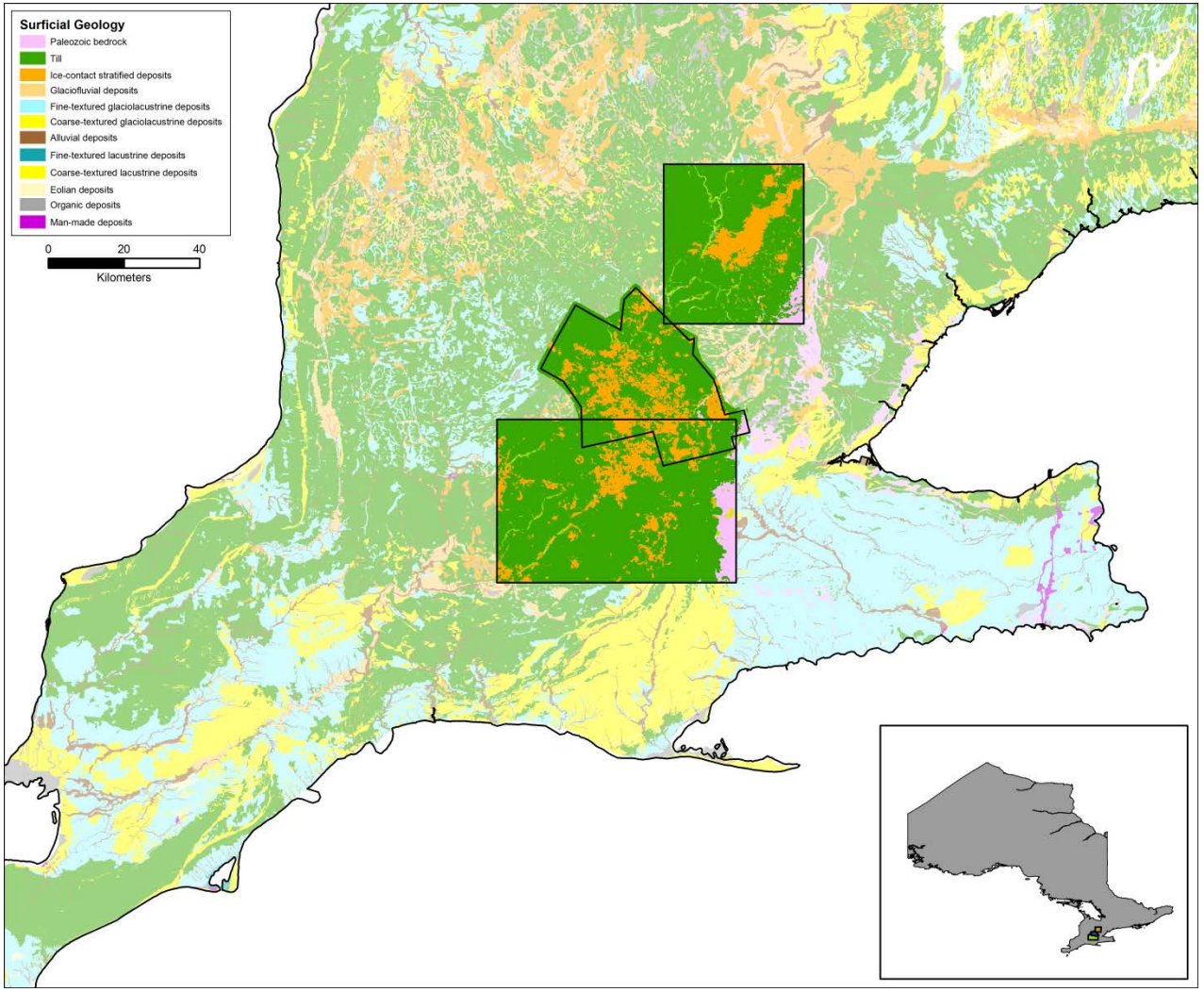




Regional Context: Port Bruce Phase Aquitard

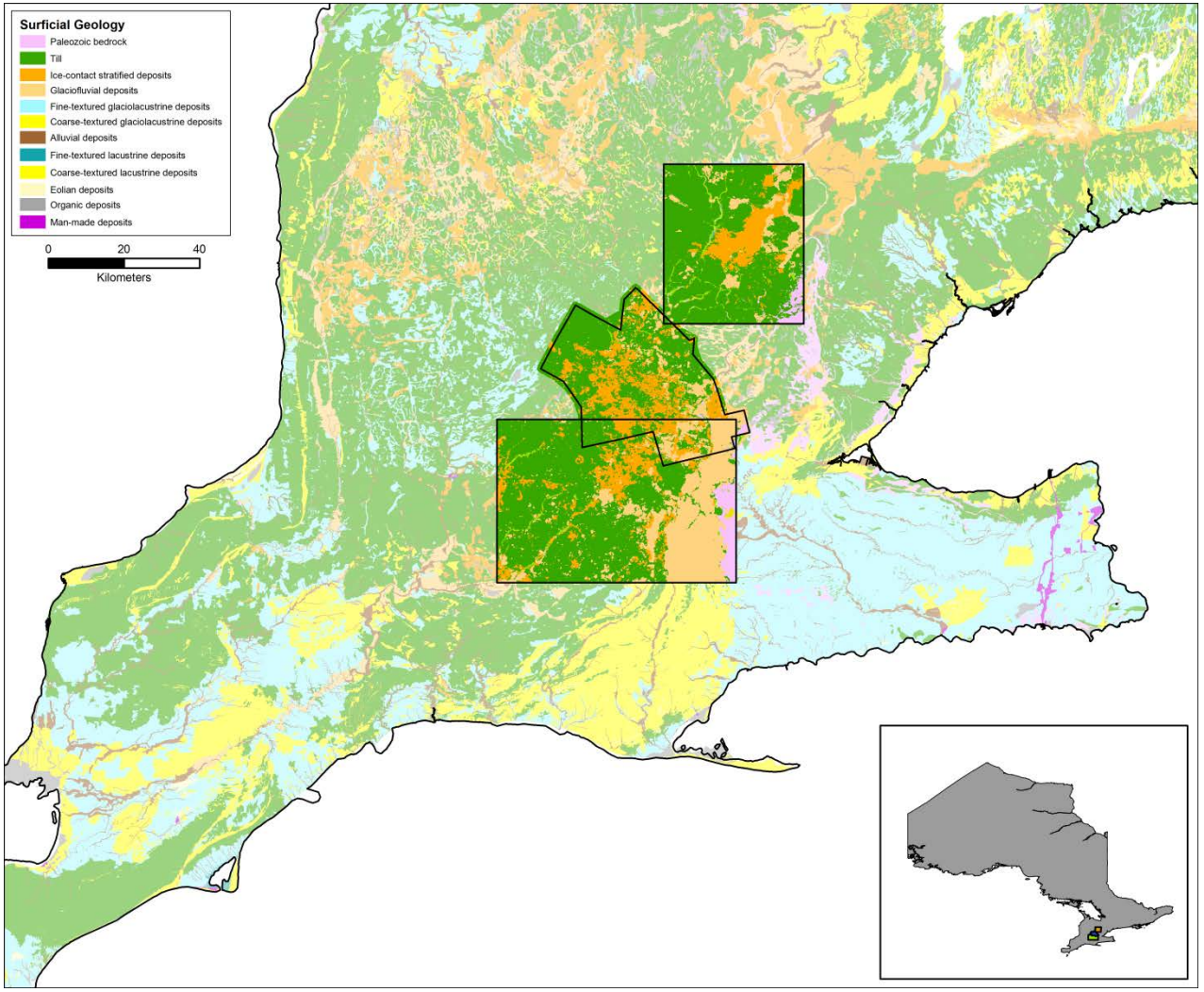
- Ice advances partially burying the moraine sediments
- PROTECTION!

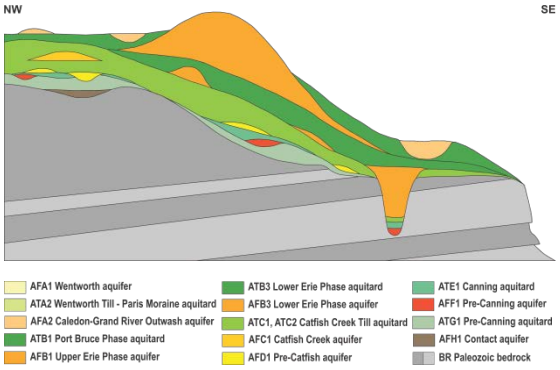




Regional Context: Caledon–Grand River Outwash Aquifer

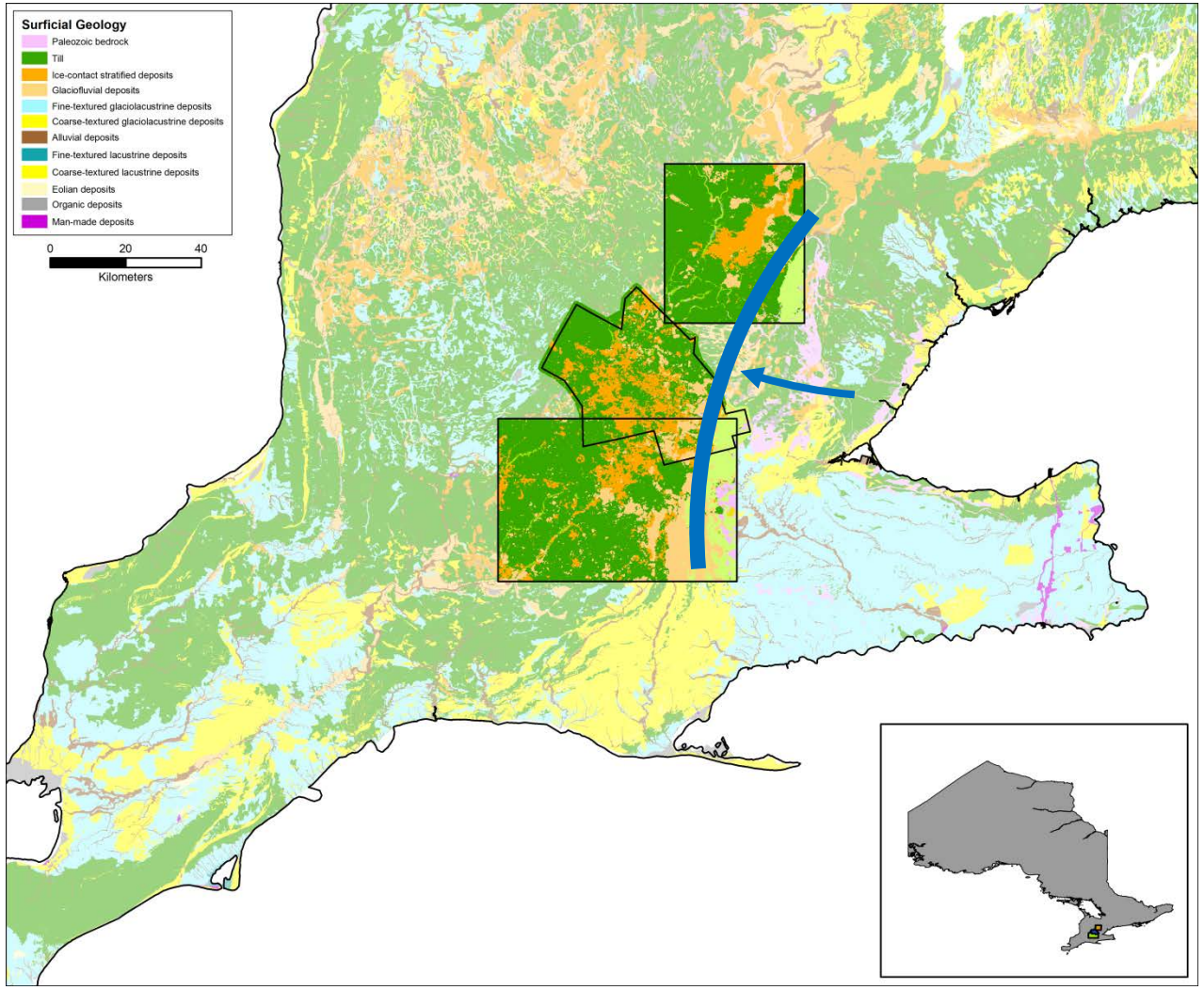
- Ice recedes and glaciofluvial outwash is deposited

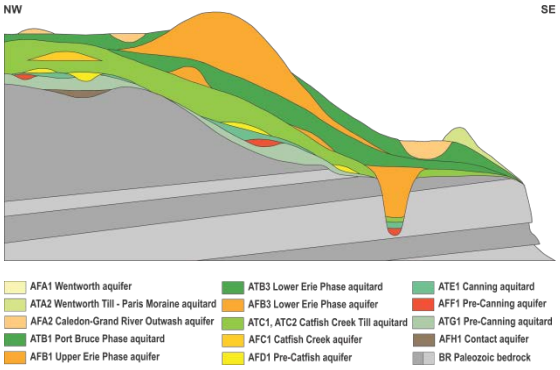




Regional Context: Wentworth Till Aquitard

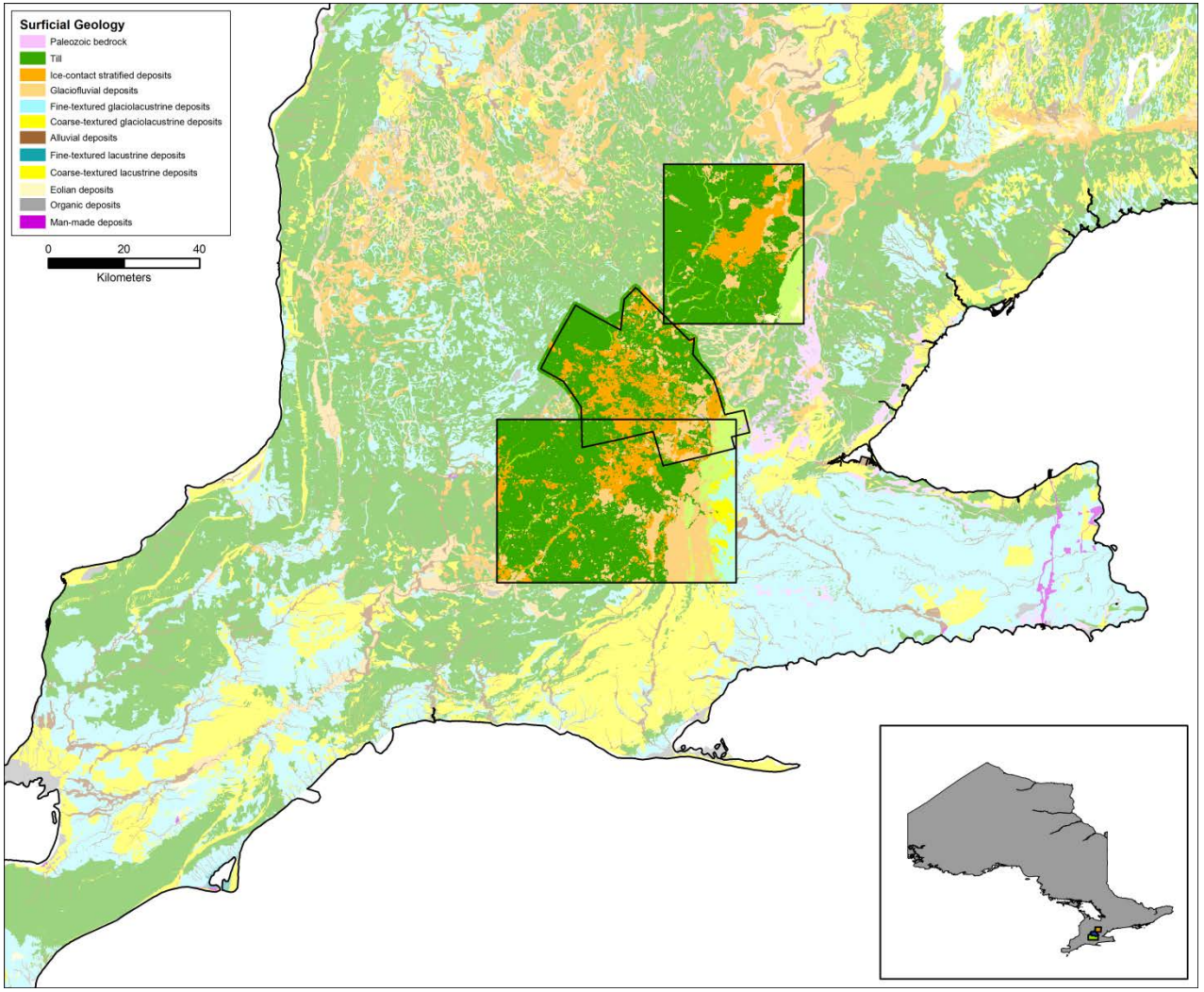
- Ice advances partially over-riding the outwash

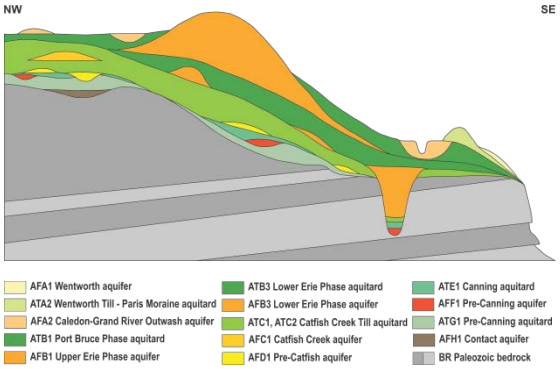




Regional Context: Late Glacial Aquifers and Aquitards

- Ice recedes and glaciolacustrine sediments are deposited





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