Installation of a purpose-built groundwater monitoring well network to characterize groundwater methane in the Peace Region, BC

Maximilian Goetz
Energy & Environment Research Initiative (EERI)
University of British Columbia

AGENDA

- Monitoring Well Installation Project (MWIP)
- Focused sub-studies
  - Occurrence and origin of methane in Hudson's Hope aquifer
  - Sunset Paleovalley Groundwater Flow Modeling
- Q & A

Max Goetz, UBC

Andrew Allen, SFU

Roger Beckie

UBC

Aaron Cahill

HERIOT WATT UNIVERSITY

Dirk Kirste

SFU SIMON FRASER UNIVERSITY

Geoscience BC

Key-contributors: Bethany Ladd, Laurie Welch, Chelton VanGeloven, Bernhard Mayer

STUDY AREA

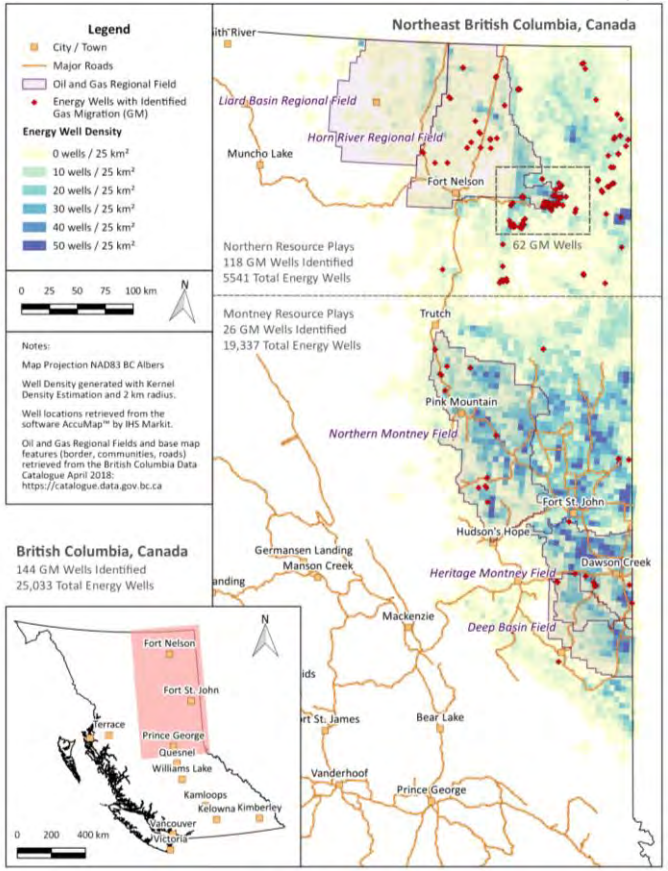

British Columbia
Edmonton
Calgary
Vancouver


Fort St John
Hudson's Hope
Dawson Creek
Chetwynd

MOTIVATION

- Establishing baseline groundwater chemistry is important in areas where hydrocarbon extraction is occurring

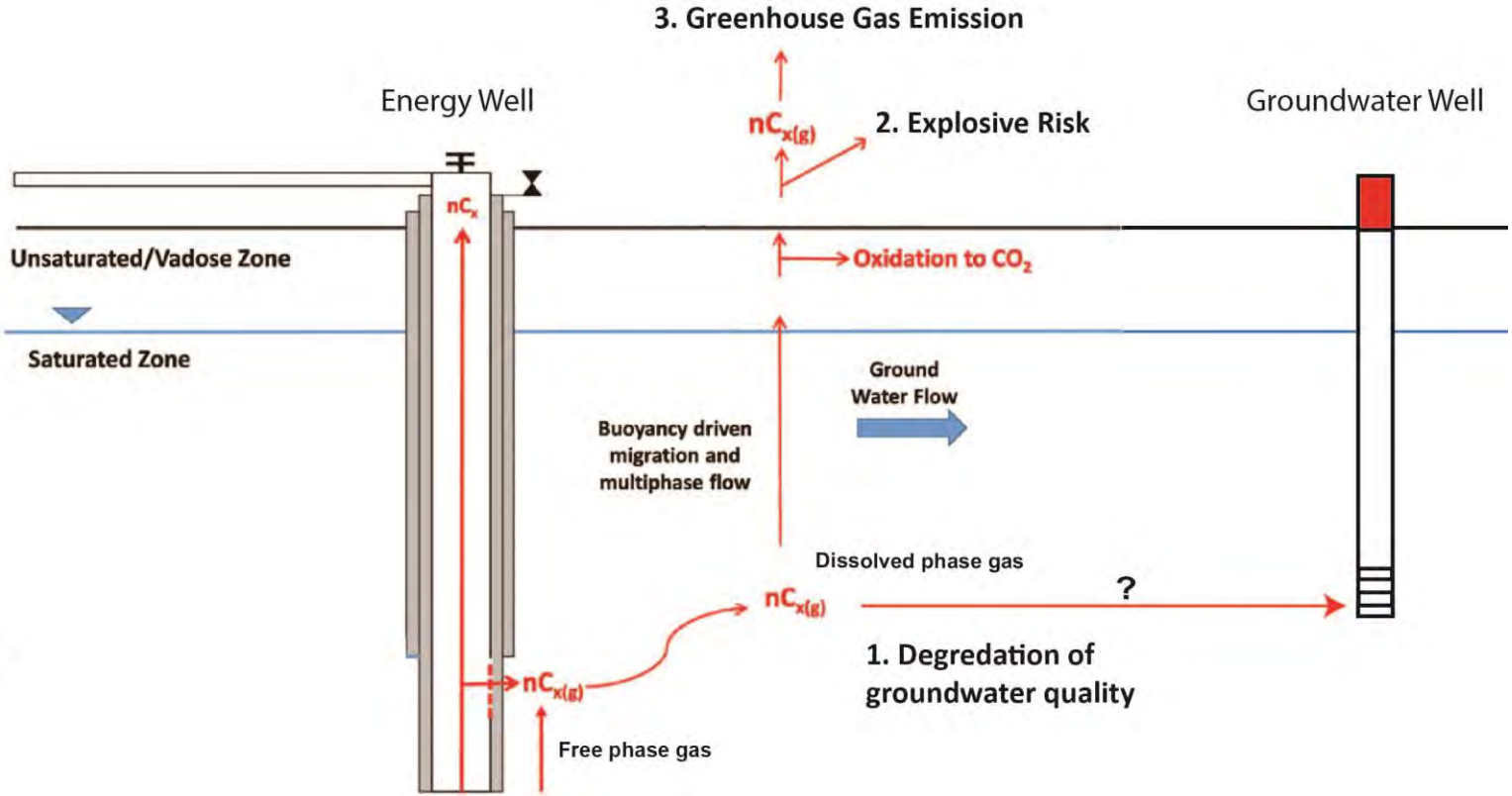
- Incidents of identified and reported gas migration are relatively low in NEBC



Cahill et al. 2019

Geoscience BC

FUGITIVE GAS



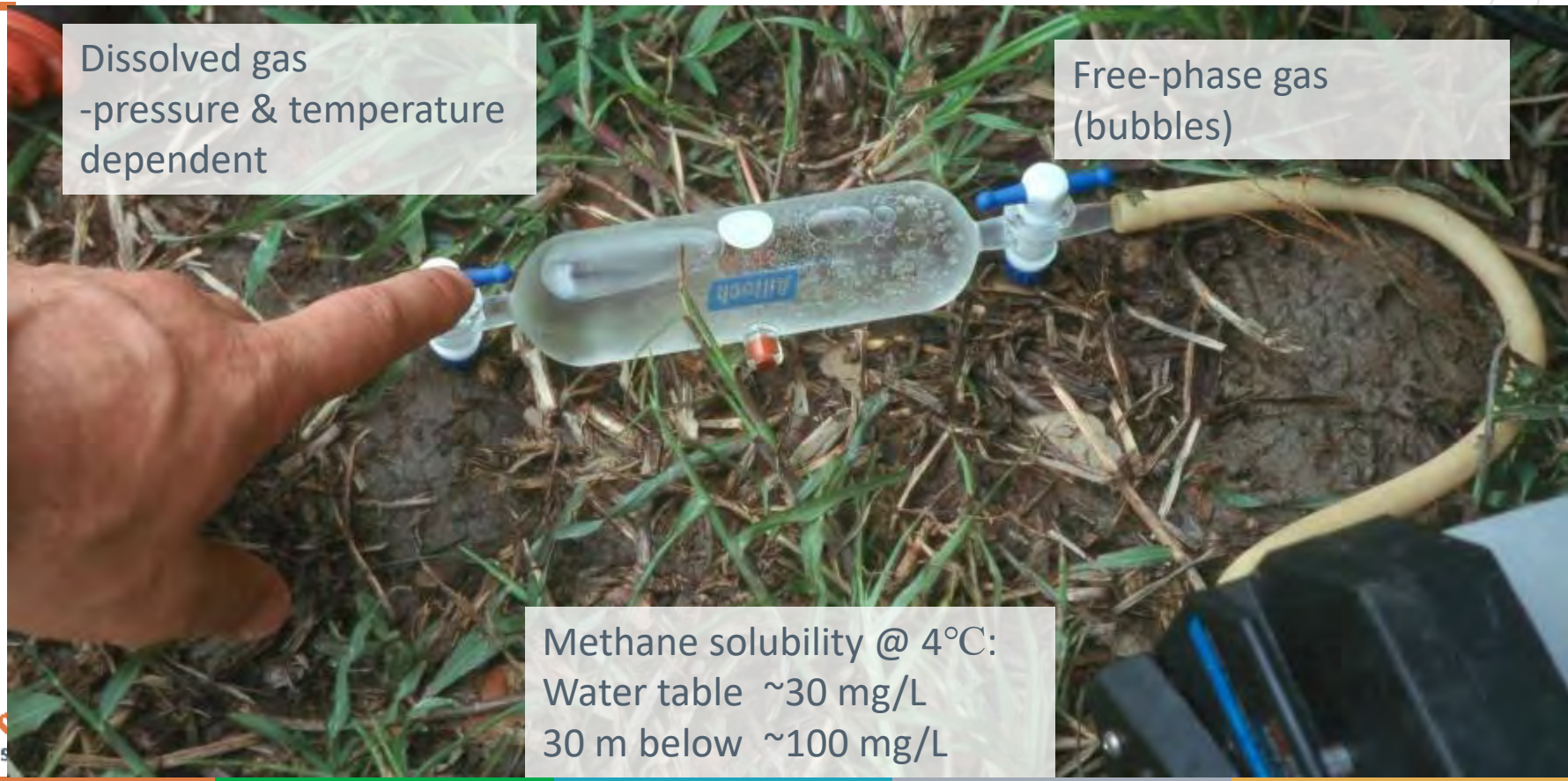
Modified from Cahill et al. 2019

NATURAL GAS

	Formation process	Typical composition	Environment
Thermogenic	Heat + pressure	85% Methane 9% ethane 3% propane Trace gases	Shale Coal
Biogenic	Microbial activity under anoxic conditions	methane + carbon dioxide	Compost piles Landfills Sewer systems Swamps Aquifers

Geoscience BC

NATURAL GAS


Dissolved gas
-pressure & temperature dependent
Free-phase gas (bubbles)
Methane solubility @ 4°C:
Water table ~30 mg/L
30 m below ~100 mg/L

PROJECT OBJECTIVES

1. Determine groundwater quality on a regional scale
   - Emphasis on determining distribution, concentration and origin of dissolved methane in shallow groundwater
   - Assess potential impacts from oil & gas development (fugitive gas)

2. Provide groundwater monitoring infrastructure to the region as a legacy, and a platform for future research activities

BASELINE AND PROXIMAL WELLS

- 29 Monitoring stations installed in Peace Region
- “Baseline” monitoring wells
  - > 1km from nearest energy well
- “Proximal” monitoring wells
  - < 500m from nearest energy well
- Project technical advisory committee
  - Well locations, project strategy and oversight

Geoscience BC

GEOLOGY

- Glaciogenic Quaternary overlying Cretaceous bedrock
- Quaternary geology very heterogeneous and complex
- Many mapped paleovalleys “buried valleys”

Geoscience BC

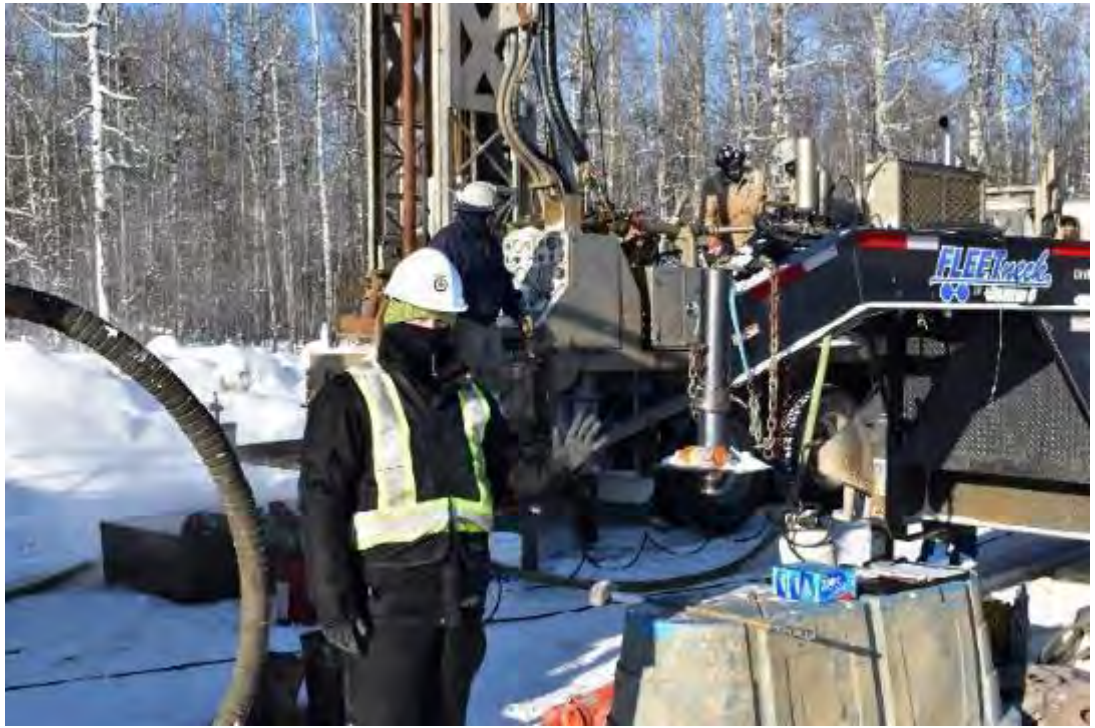
WELL INSTALLATION

Drilling campaign	Dates	EERI wells completed	Drilling Methods
1	August 2018	1 to 4	Sonic
2	February 2019	5 to 6	Air Rotary
3	June/July 2019	7 to 14	Sonic, Air Rotary, Diamond HQ
4	August 2019	15 to 23	Sonic, Air Rotary, Diamond HQ
5	September 2019	24 to 29	Sonic, Air Rotary

EERI-1 (AUG 2018)

Geoscience BC

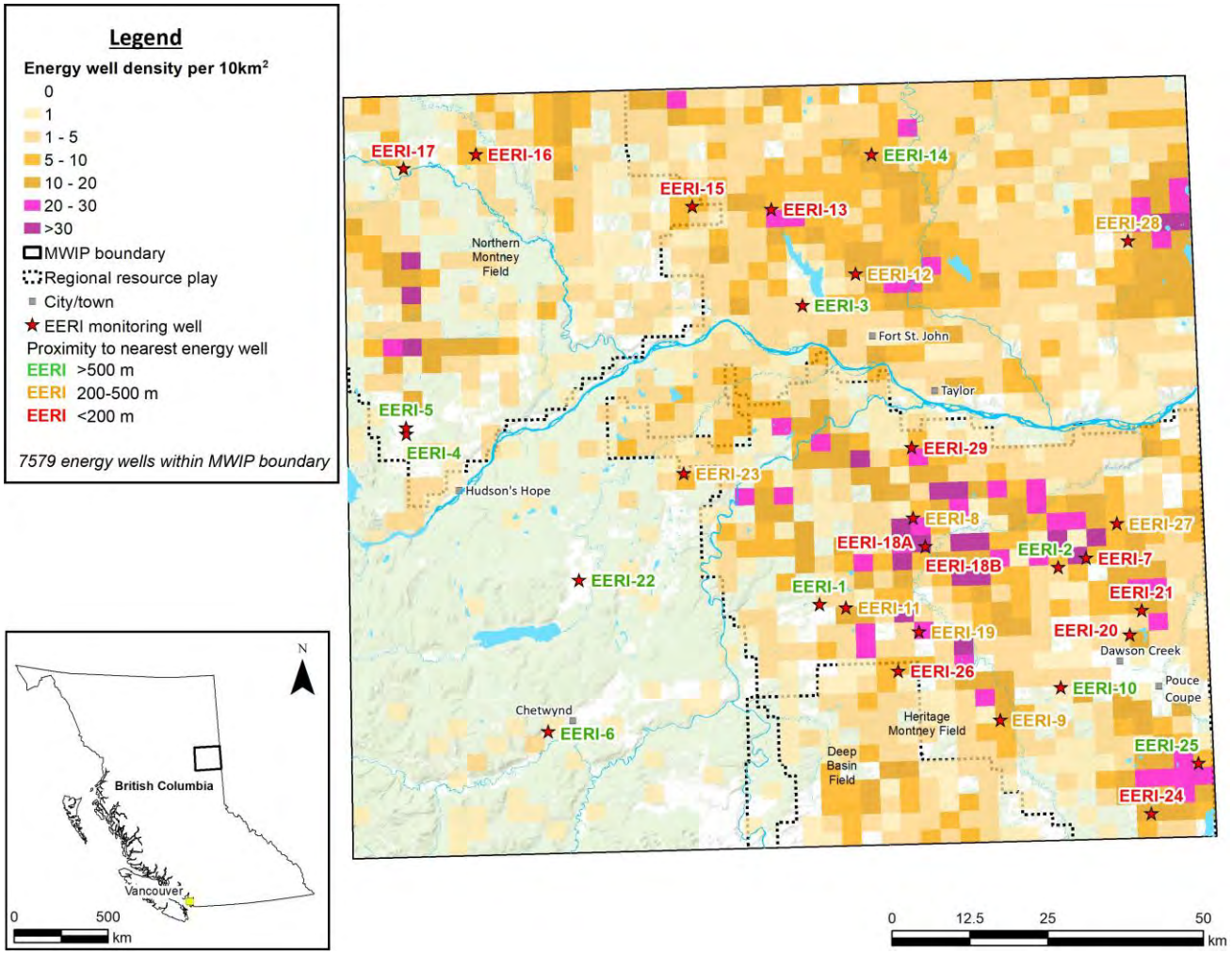
EERI-5 (FEB 2019)



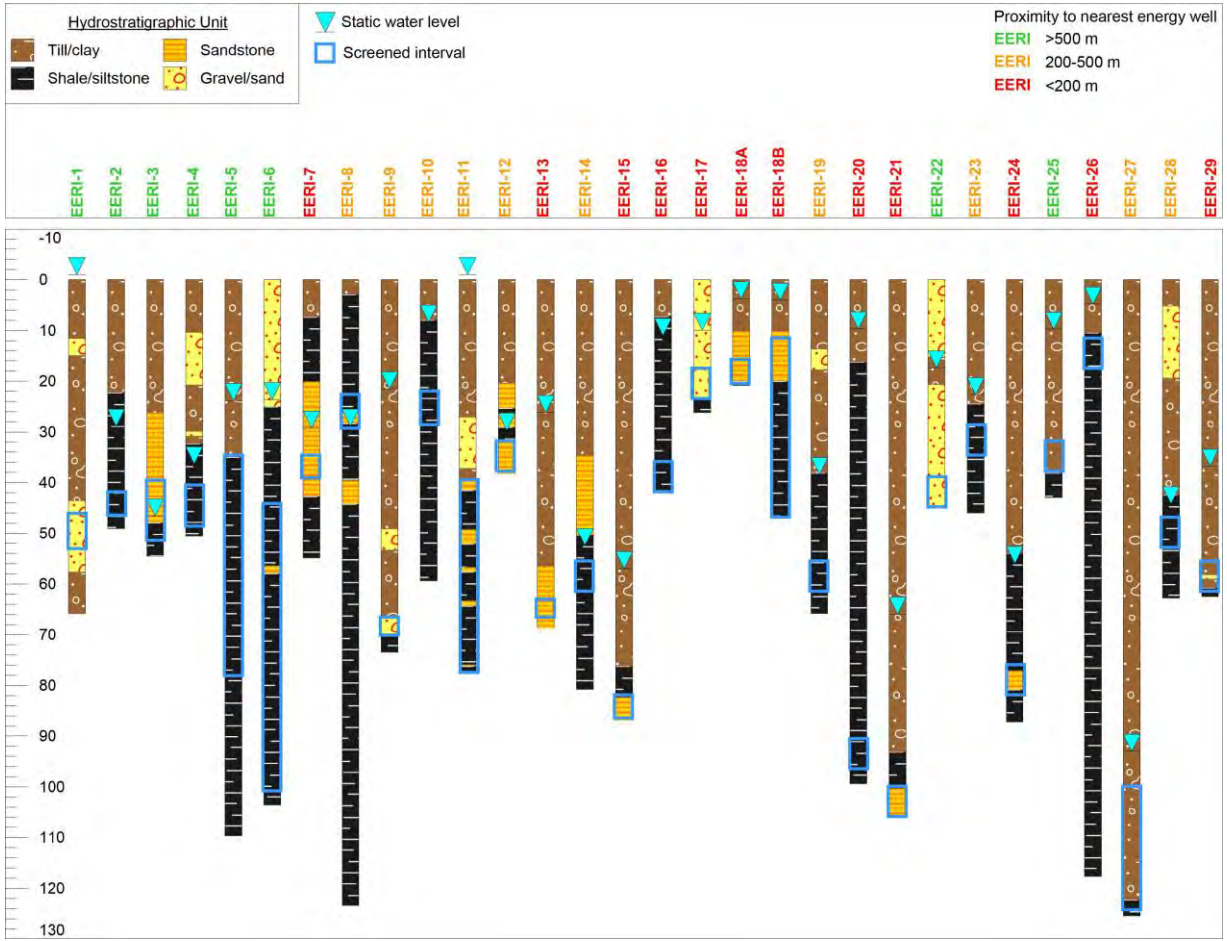
Geoscience BC

EERI-10 & 18 (SUMMER 2019)

Geoscience BC



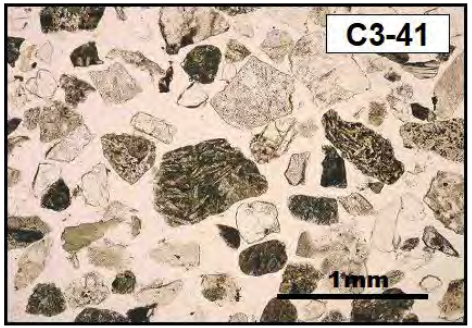
Geoscience BC



Geoscience BC

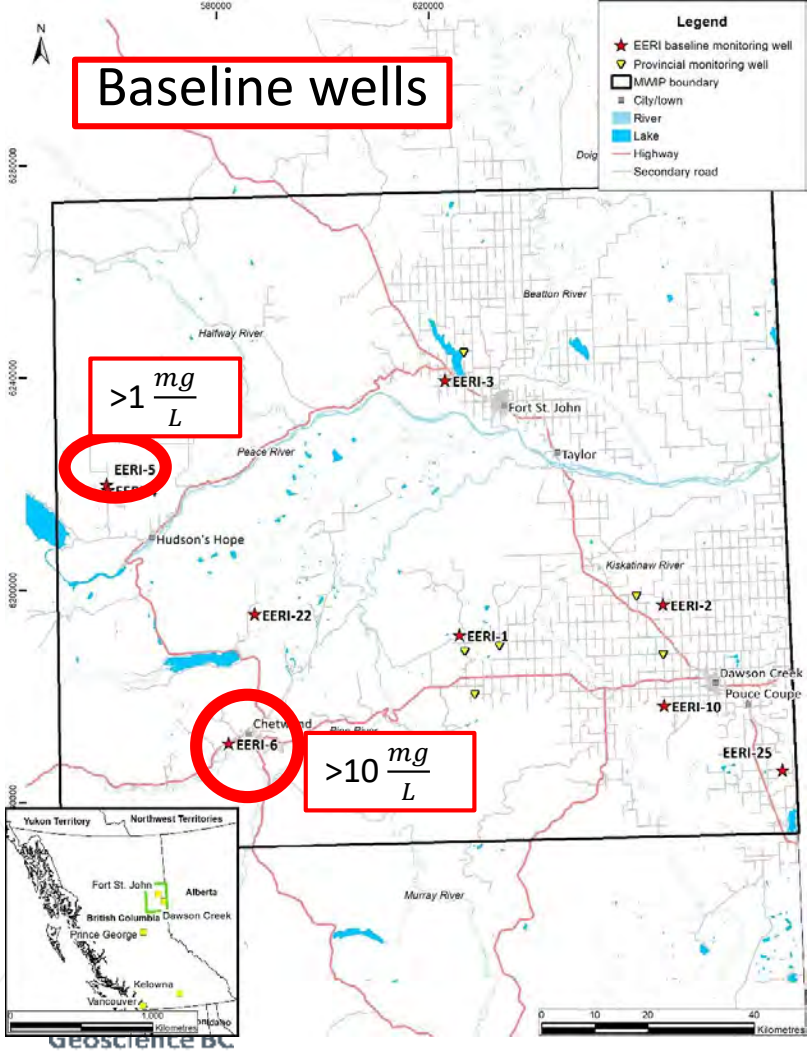
ANALYSES

- Sediment properties:
  - Mineralogy
  - Reactivity (seq. extractions)
  - Grain size dist.
  - Permeability (where possible)
- Water:
  - Dissolved gases
  - Dissolved metals, anions
  - Water isotopes (age)
  - Hydrocarbon isotopes (provenance)



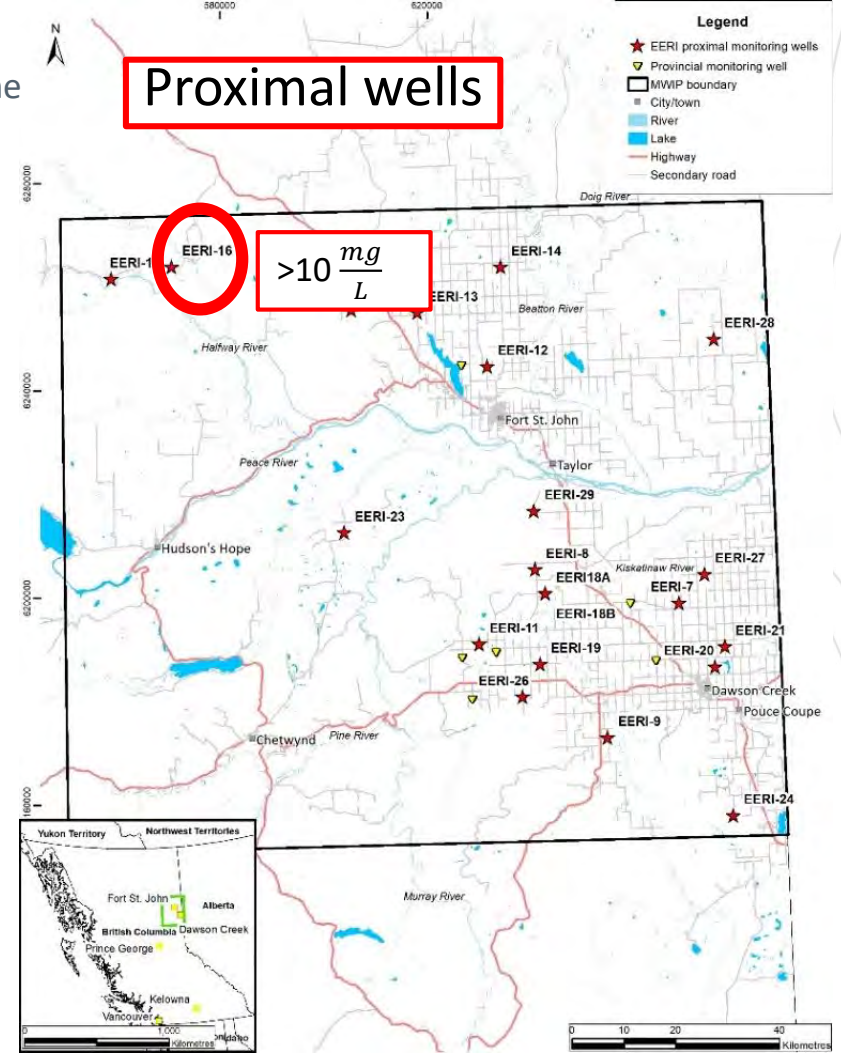
Geoscience BC

Baseline wells



2019 methane samples

Proximal wells



Occurrence and origin of groundwater methane in The District of Hudson's Hope buried valley aquifer, British Columbia, Canada

- Newly installed domestic supply wells show high dissolved gas concentrations

- Concerns over both coal-bed methane and fugitive gas
  - abundance of coal formations daylight to the west
  - unconventional natural gas activity to the north (Altares Field in the Montney Fm.).

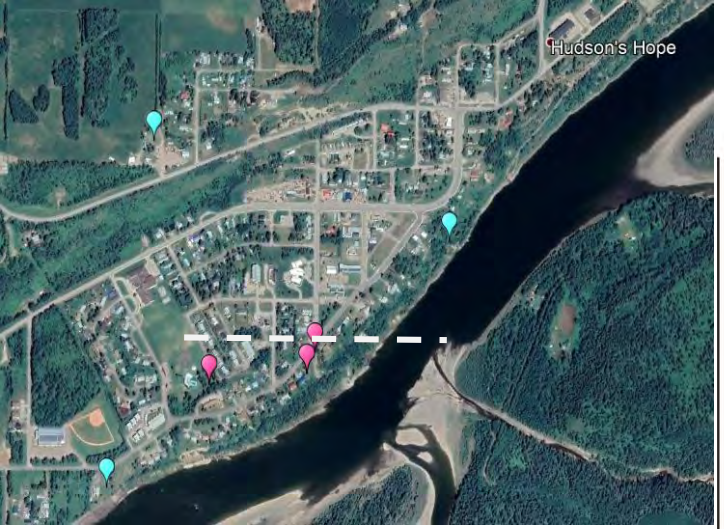
Geoscience BC

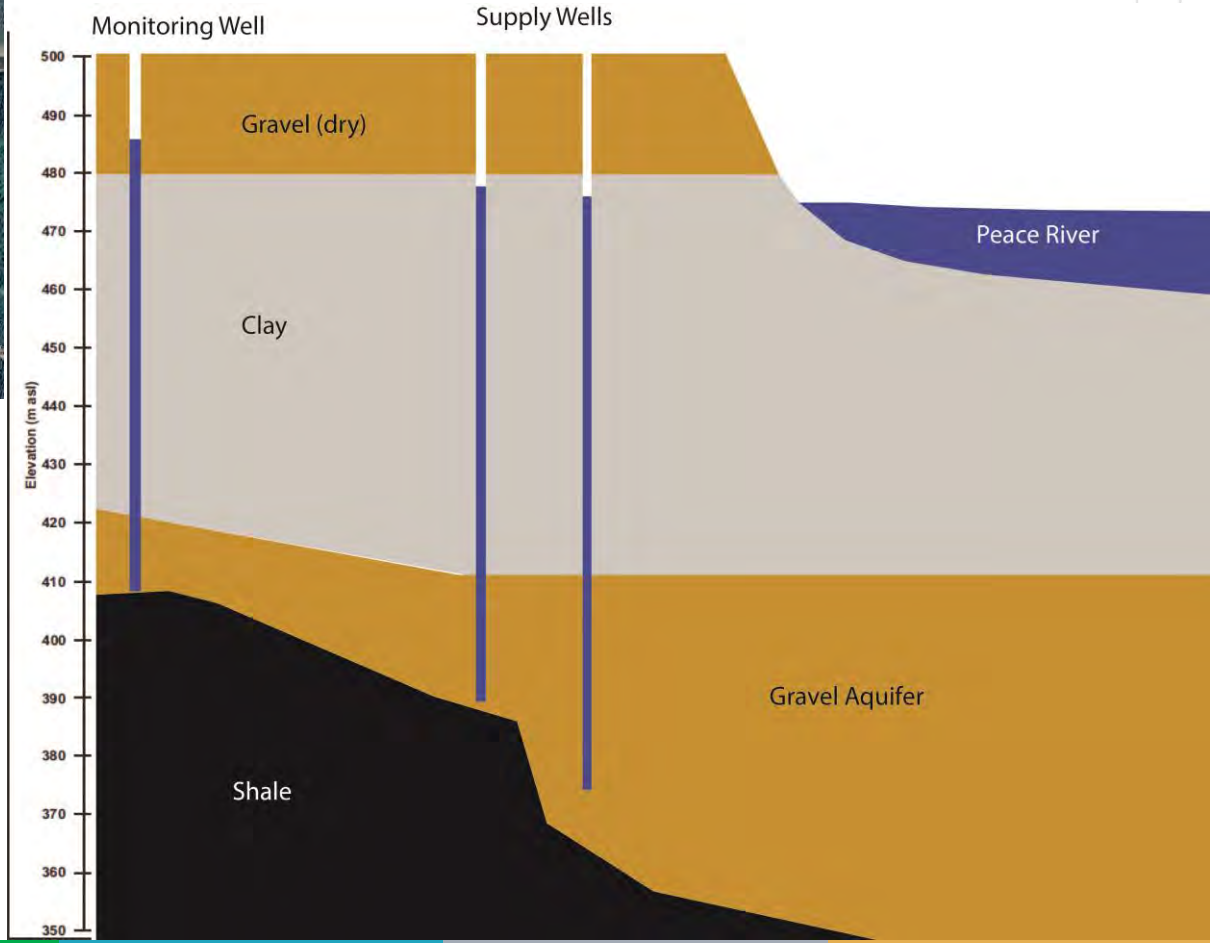
Hudson's Hope

>25 mg/L
CH4

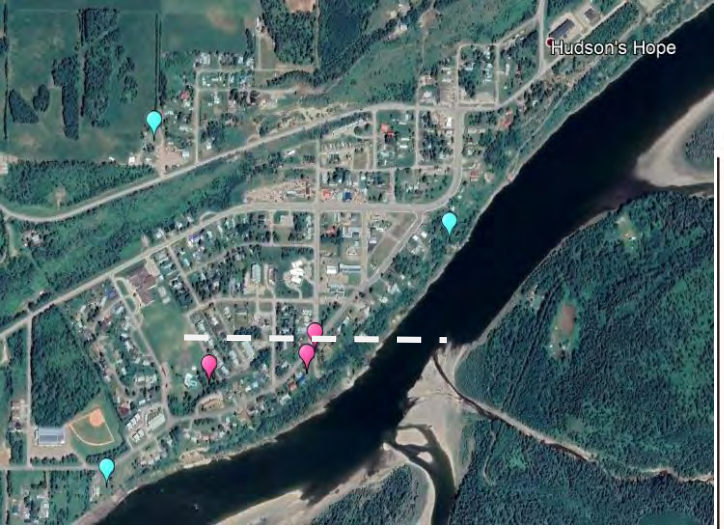
Peace River

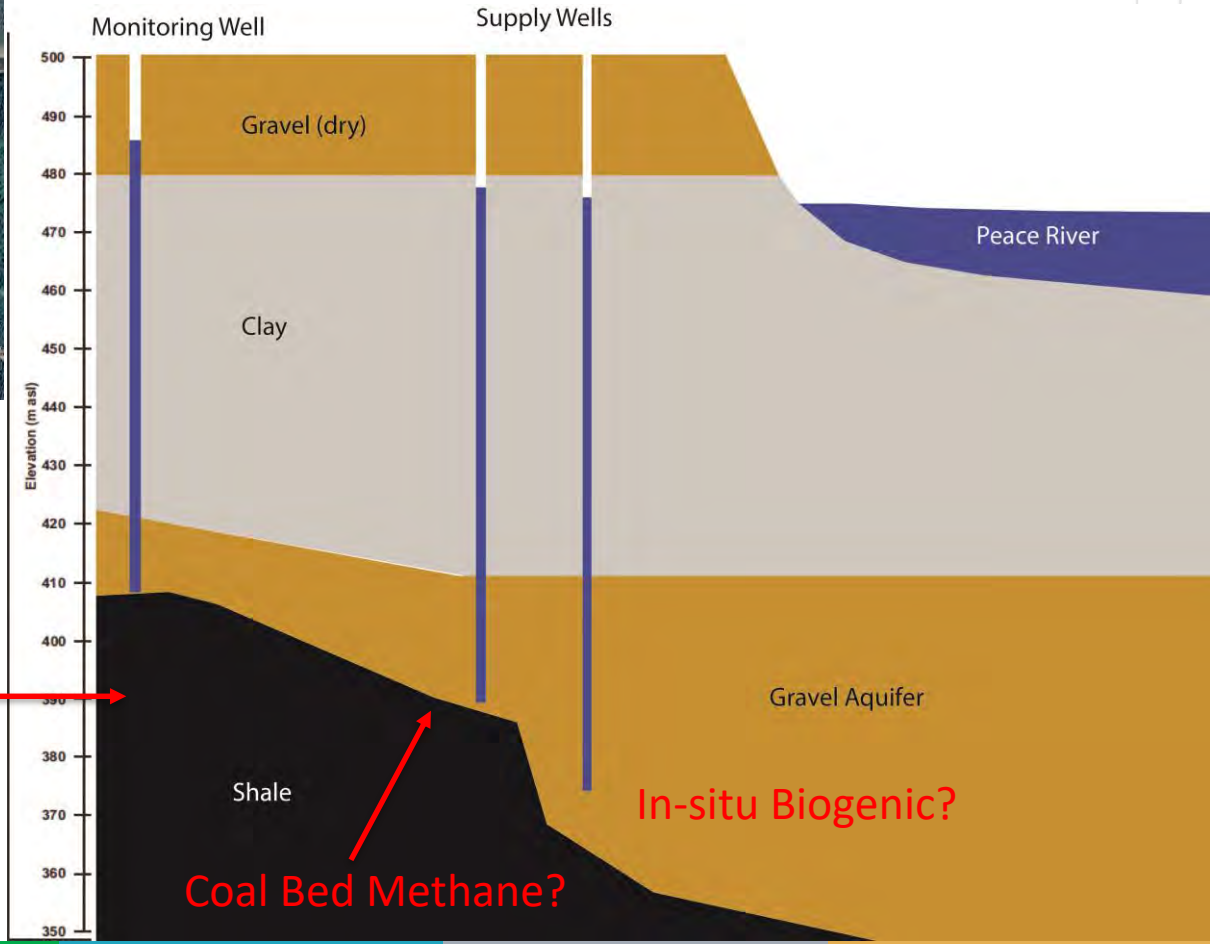
Geoscience BC





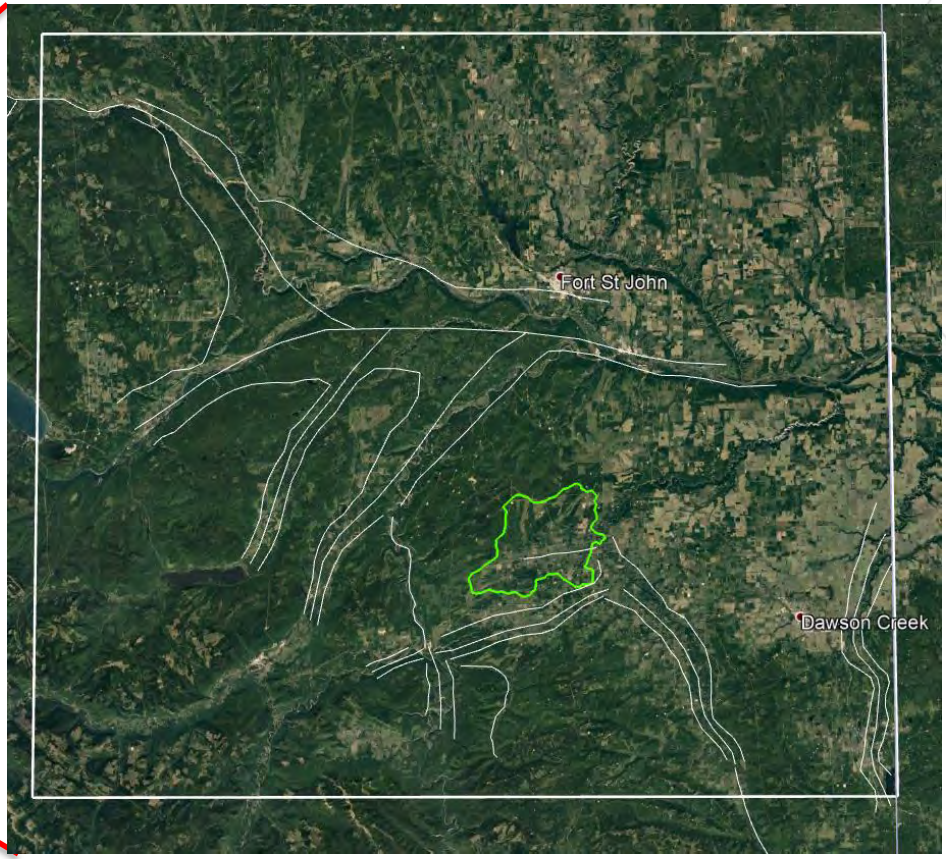
Geoscience BC





Geoscience BC

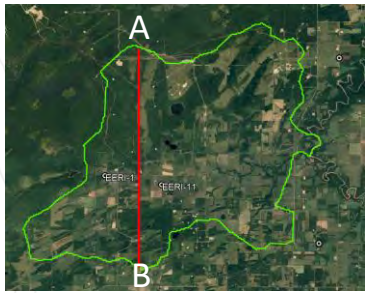
Groundwater recharge in a confined paleovalley setting, Northeast British Columbia, Canada

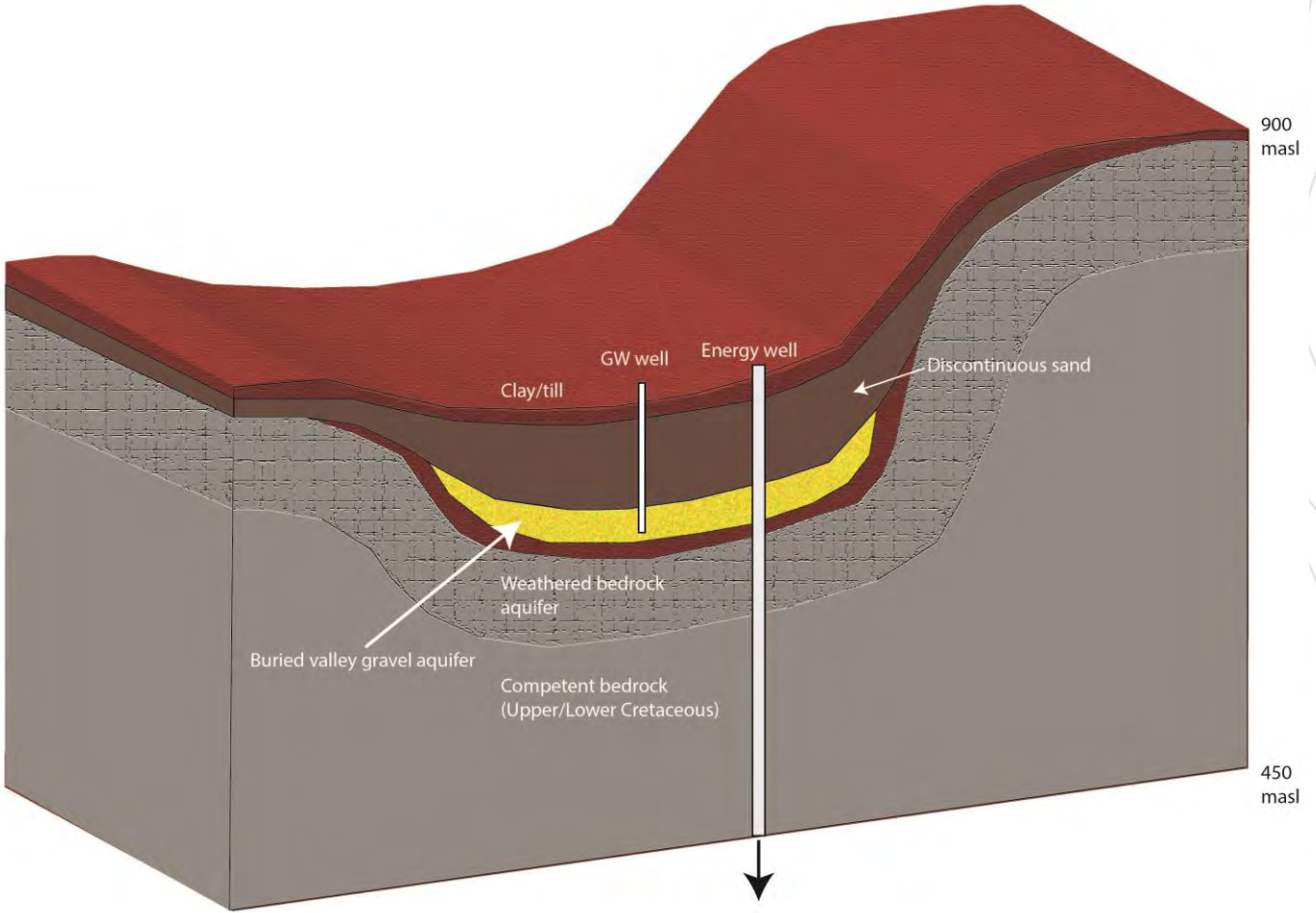


STUDY OBJECTIVES

- Determine spatial distribution of recharge
- Residence times of aquifers
- Quantify steady-state water balance

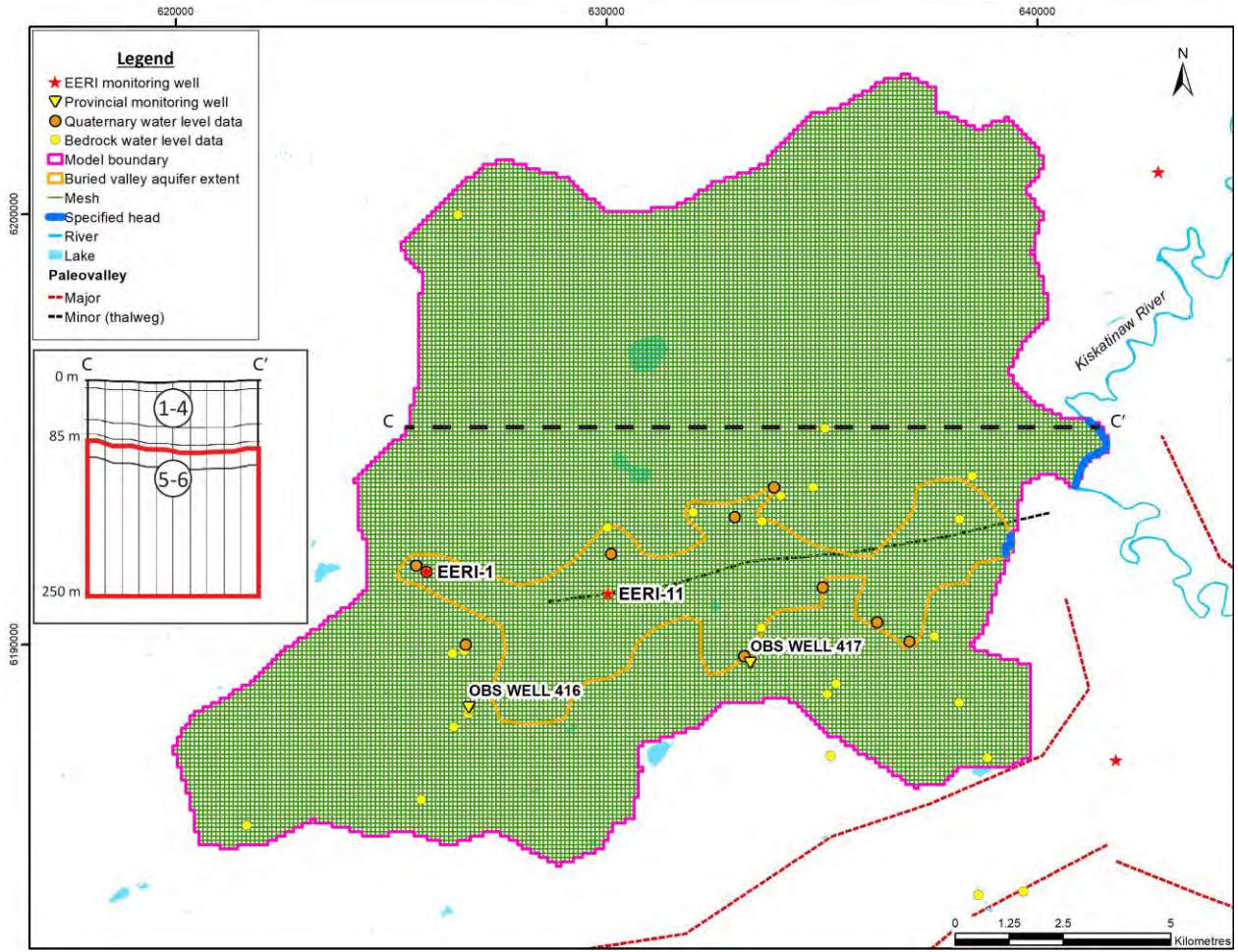
CONCEPTUAL MODEL

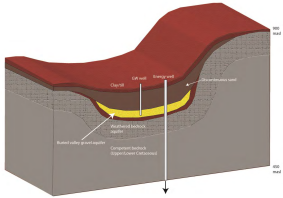




Geoscience BC

MODEL GRID





Geoscience BC

THANK YOU

Geoscience BC

This project was funded by Geoscience BC, the British Columbia Oil and Gas Commission, MITACS, and BC Ministry of Energy, Mines, and Petroleum Resources.