CaMI's Countess well (10-22-17-16W4): the Upper Cretaceous succession at a Unique Subsurface Laboratory and Technology Demonstration Site in Newell County, Alberta

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Containment & monitoring needs/applications

- Secure carbon storage (CCS)
- Steam chamber containment and conformance.
- Enhanced petroleum recovery.
- Shale gas and tight oil (hydraulic fracturing).
- Fugitive emissions.
- Acid gas disposal
- Produced water disposal.
- Induced seismicity risk analysis and mitigation.

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Canada's CO_2 emissions

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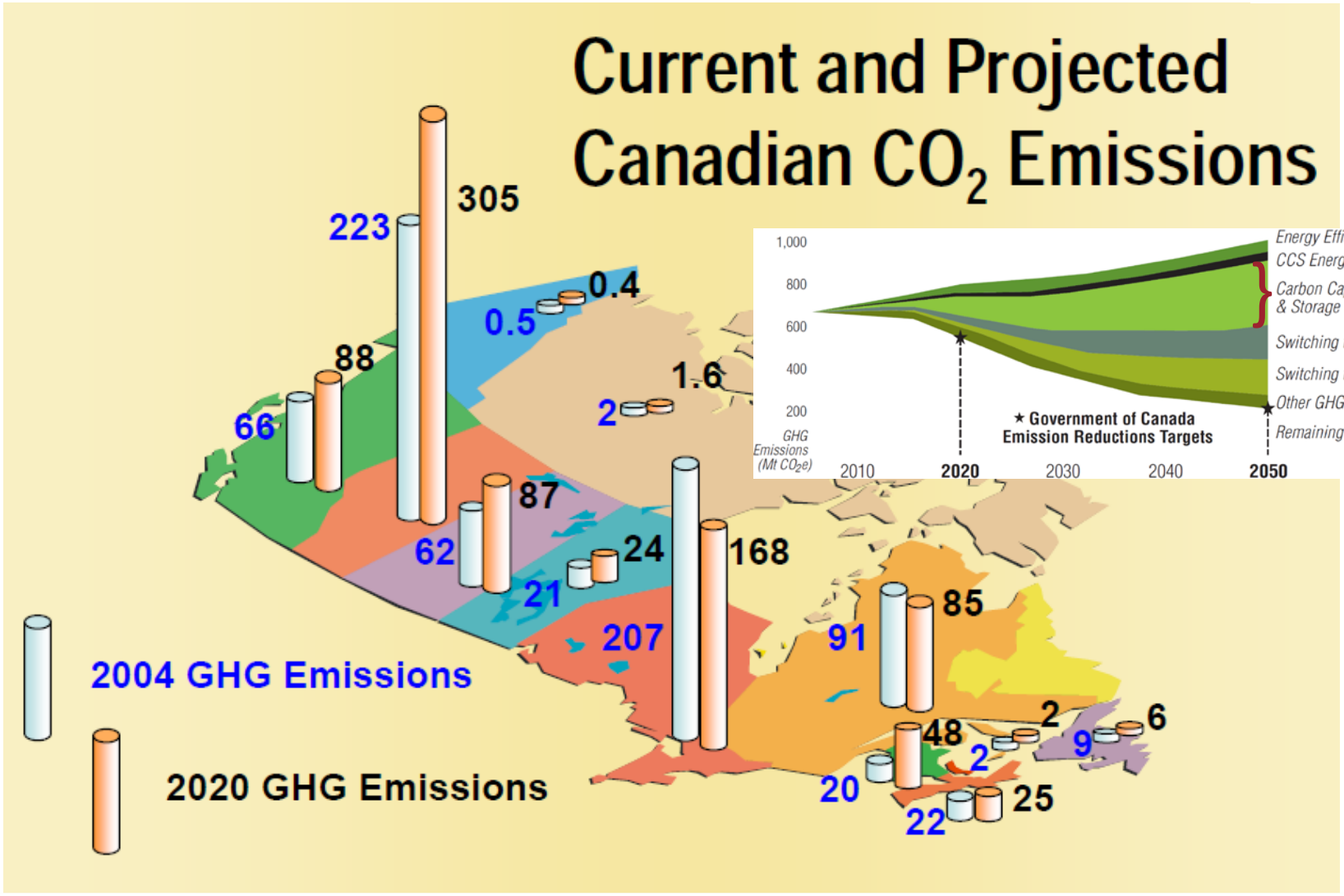
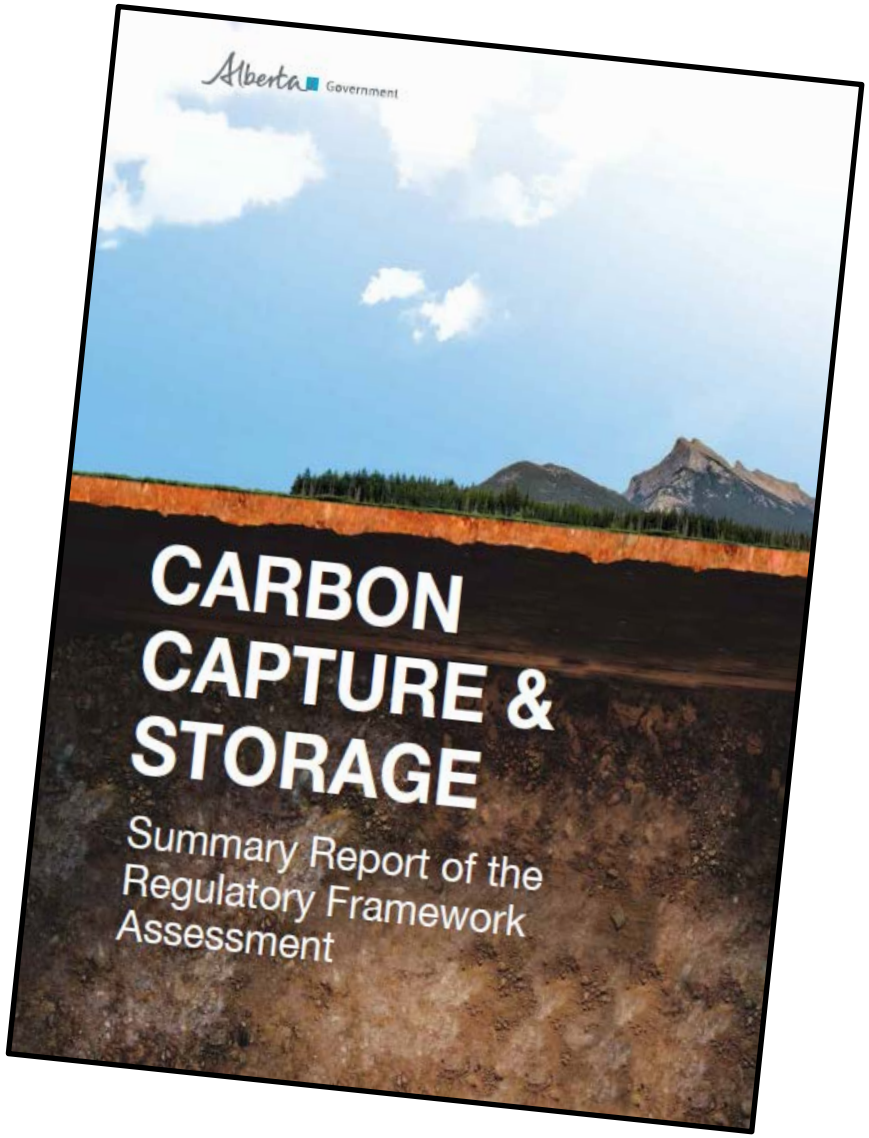


Alberta Government Regulatory Framework Assessment (08/2013)

"Require MMV and closure plans to be based on a project-specific risk assessment, and include the use of best available technologies to monitor the atmosphere, surface, ground and surface water, and subsurface."



RFA closure MMV

Recommendations for closure requirements

a) Sequestered CO_2 and affected fluids are conforming to the objectives and regulatory requirements as described in the project application and approvals.

c) Sequestered CO_2 and affected fluids are contained in the sequestration complex.

d) Sequestered CO_2 is behaving in a predictable manner.

e) Sequestered CO_2 is expected to continue to behave in a predictable manner and is trending towards stability"

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Monitoring challenges

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Verification of conformance and containment

- Thin storage formations (saturation-thickness)
- Caprock integrity
- Thief zones, resolution from monitoring methods
- High rock matrix *K* and *μ* values
- Pressure vs CO_2 saturation
- Pressure interference with existing hydrocarbon pools
- Pressure interference between adjacent CCS projects
- Brine/CO_2 migration through old wells
- Out of zone CO_2 migration to another storage formation (pore space encroachment)

CMCRI Field Research Station

Sec. 22-17-16W4 (Courtesy Cenovus Energy)

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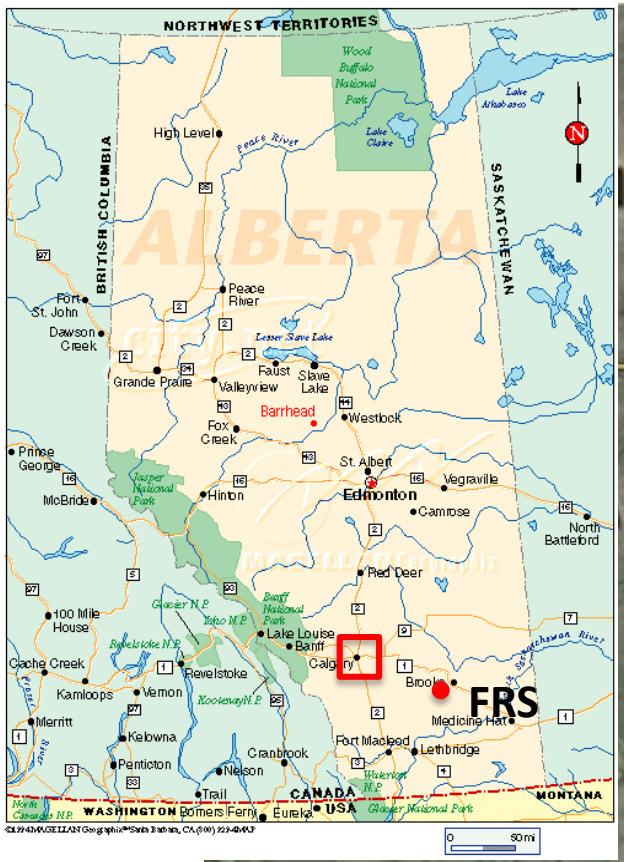

- Injector well
- Monitor well
- Groundwater well
- Geodetic monument
- Instruments

CaMI Field Research Station (FRS)

- Undertake controlled CO_2 release at 300 m & 500 m depth; ~1000 t/yr.
- Determine CO_2 detection thresholds
- Develop improved monitoring technologies.
- Monitor fugitive gas emissions.
- University & industry field training & research, integrating engineering and geoscience
- Provide quantitative monitoring protocols to regulators and industry.
- Accelerate public outreach & education.
- Provide on-site fuel cell for CO_2 source and natural gas utilization; energy storage; energy efficiency

Public engagement

March 13 & May 8, 2014: County of Newell

- Manager – Planning and Development
- Director of Information Technology
- Manager of Fire and Emergency Services
- Chief Administrative Officer
- Director of Corporate Services
- Director of Agricultural Services

The latest in greenhouse gas containment technology: Don Lawton, PhD, PGeoph is proposing a carbon capture containment and monitoring research station near Scandia that will attract international attention when up and running in early 2015. Lawton, centre, made a pitch for County of Newell support last week with part of his team, Ruth Klinkhammer, right, and Kirk Osadetz, left. Mickey Dumont | Chronicle photo

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FRS#1 well (Feb-March 2015)

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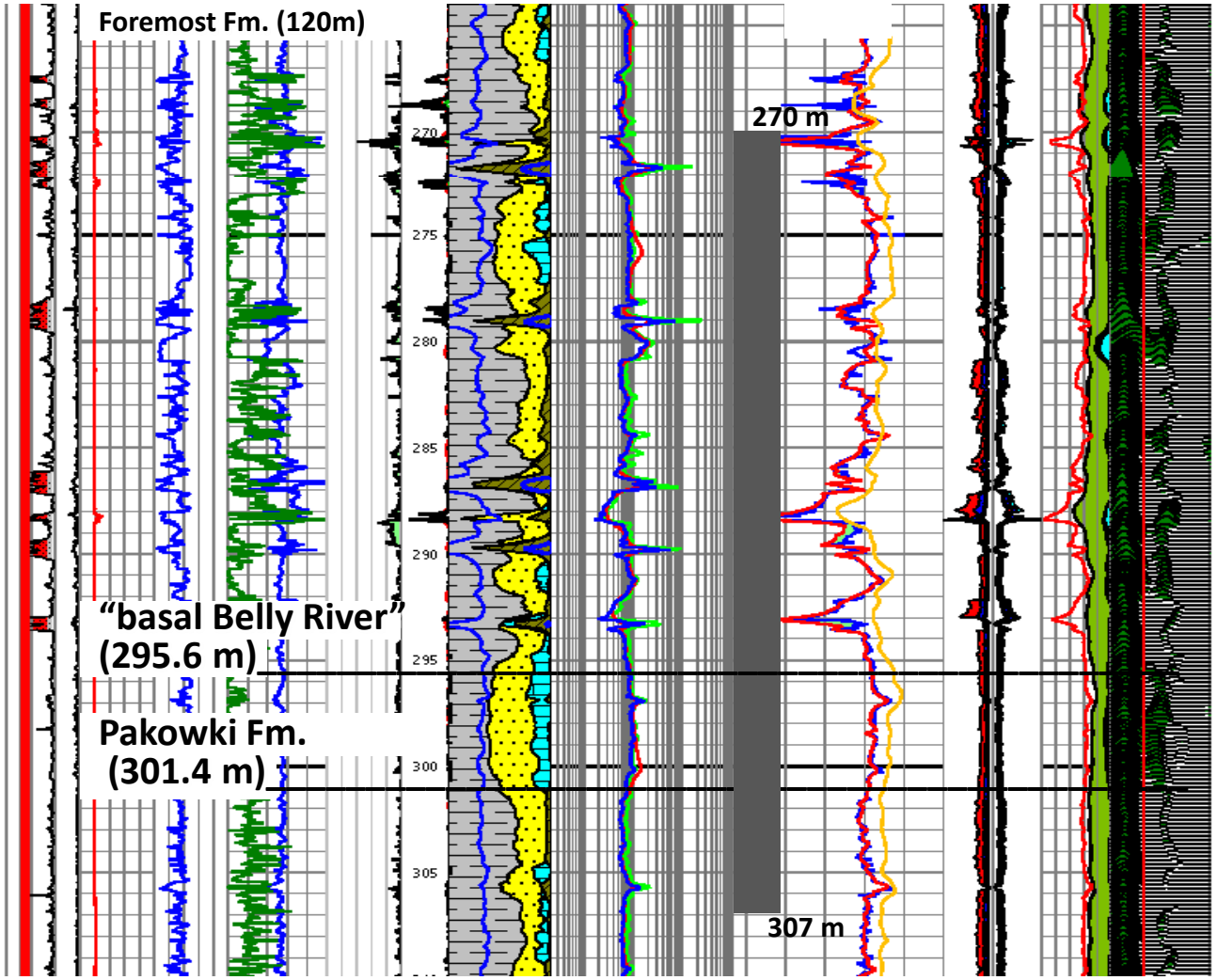
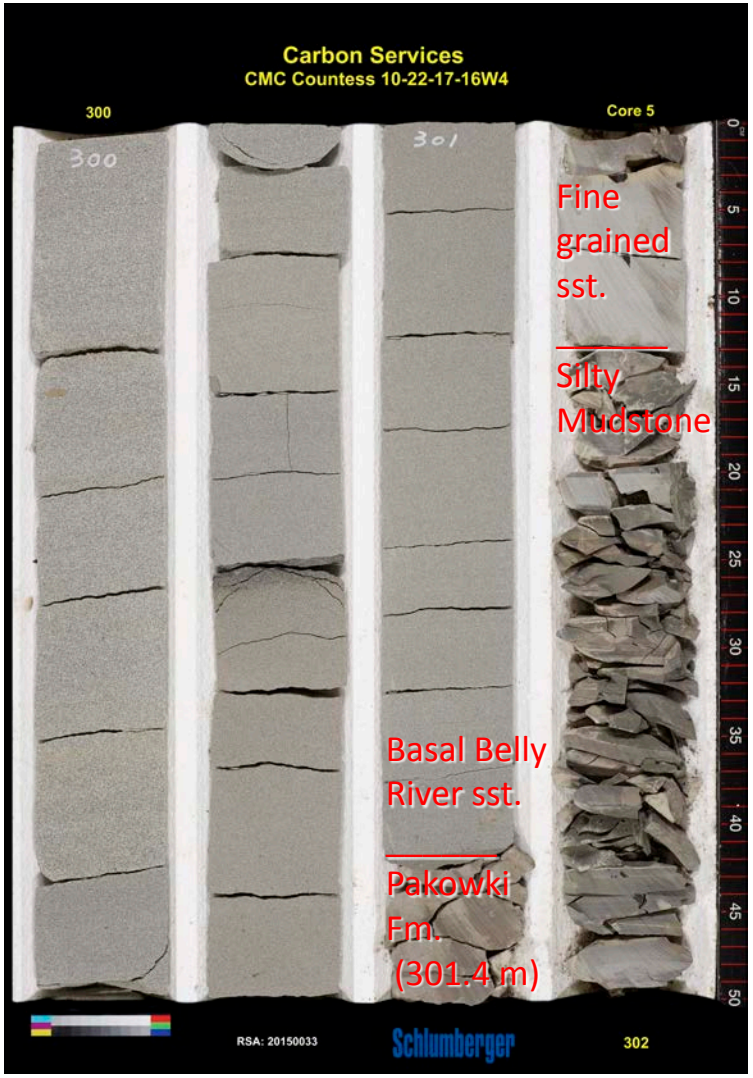
Foremost and Pakowki Formations (270-307 m displayed)



Contact Foremost and Pakowki Fm.'s

Pakowki Fm.: Pakowki Fm. is composed of thin to medium beds of fine grained sandstone interbedded with a light grey mudrock arranged in coarsening upward parasequences with cored tops at 301.43, 303.70, 305.30 and 305.63 m.

"Basal Belly River Sandstone": The basal Foremost Fm., informally termed "basal Belly River", occurs as a massive bed of medium grained sandstone, 295.65-301.43 m. Average 13% porosity.

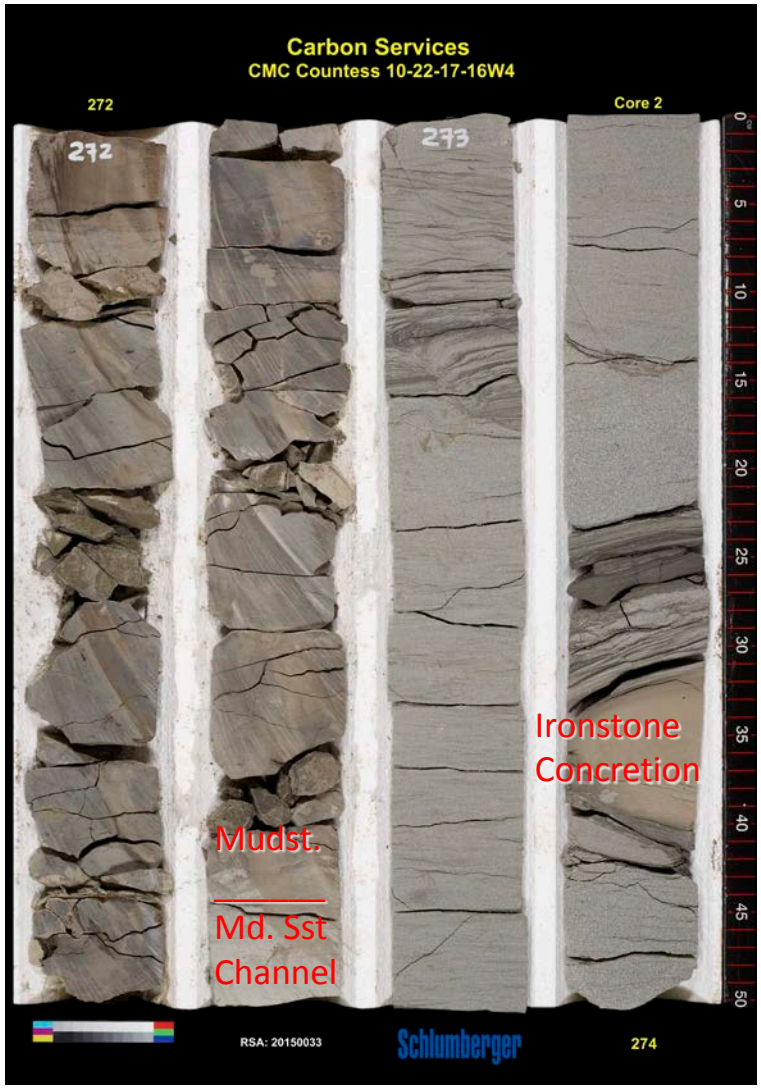


Foremost Fm. MacKay Coal Zone

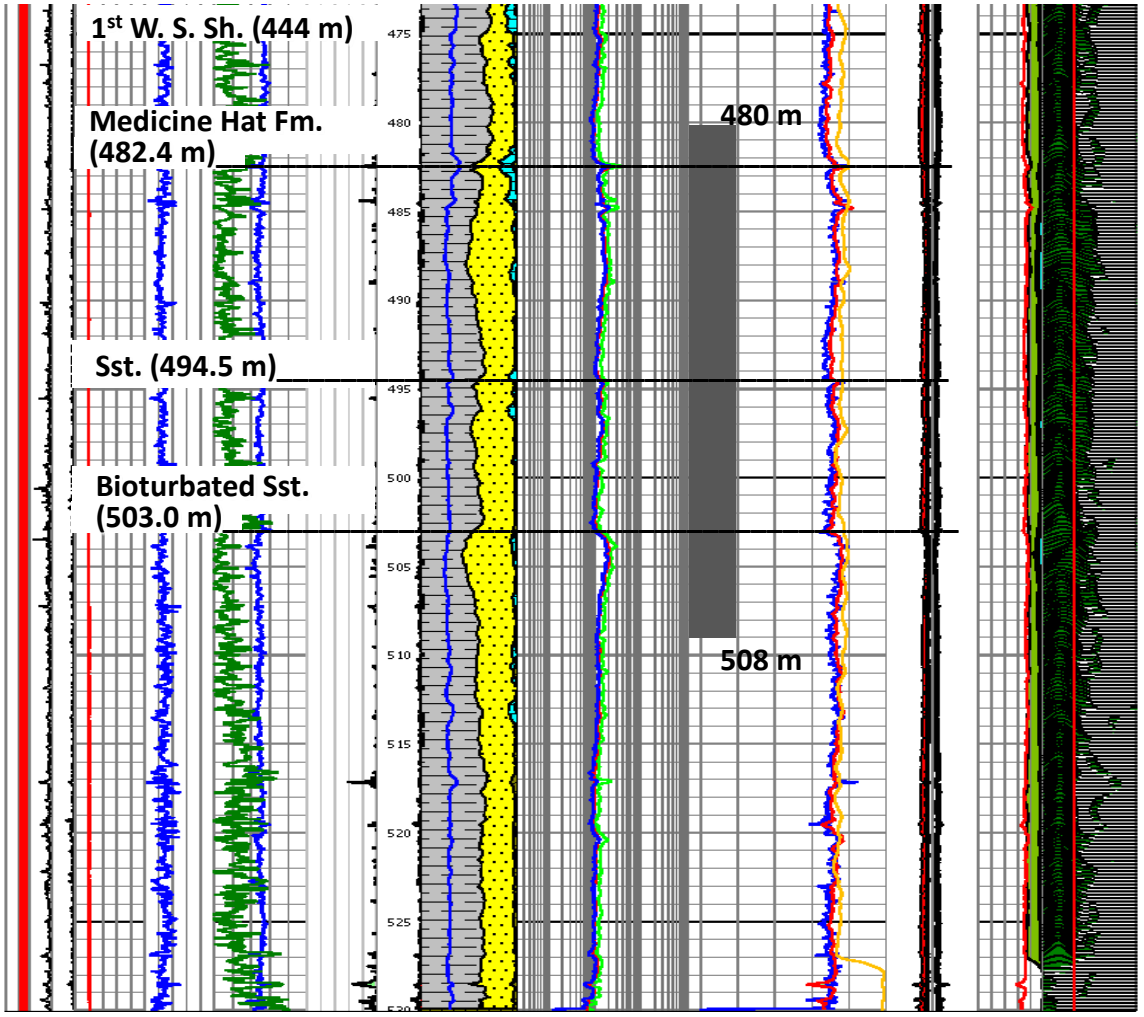
Foremost Fm., MacKay coal zone (part): Above a thin bedded fine grained sandstone, 295.08-296.65 m, the succession passes upwards into thin to medium beds of both fining and coarsening upward successions, ~ 2 m thick, comprising interbedded fine grained sandstone, brownish grey mudstone and uncleated coal or coaly mudrock. Coals are generally thin, < 0.5 m thick, with tops at, 264.16, 269.80, 271.22, 277.96, 278.74, 284.51, 286.43, 289.41, 293.15 m.

Foremost Fm. MacKay Coal Zone Channel

Foremost Fm., MacKay coal zone (part): A scour-based, fining upward cross-bedded medium grained sandstone with mud clasts and granules, probably a filled channel scour, occurs between 272.90-276.86 m. Iron carbonate nodules are common and bioclastic fragments occur in some of the cross-bedded fine sandstone beds.

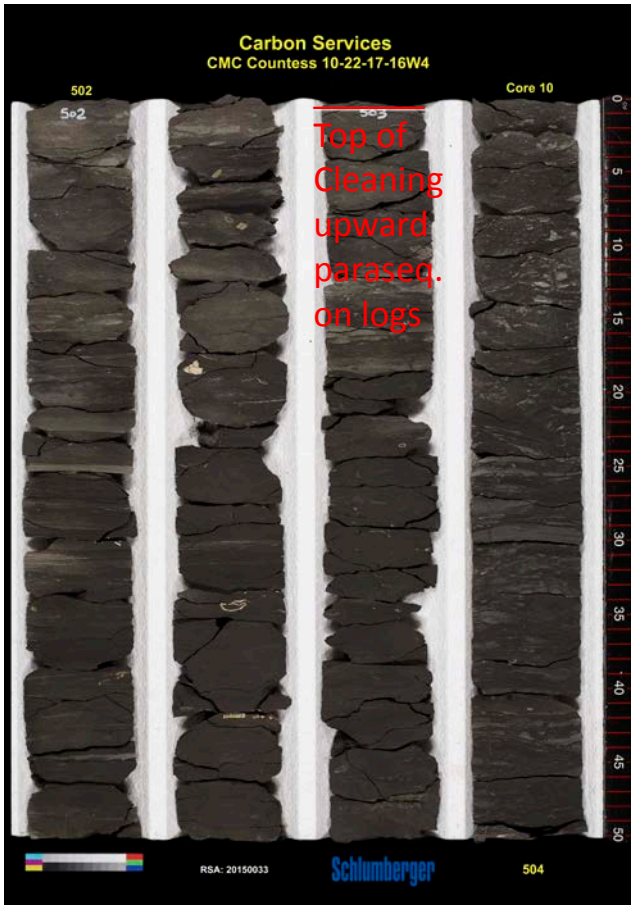


1st White Speckled Shale and Medicine Hat Fm. (480-508 m)

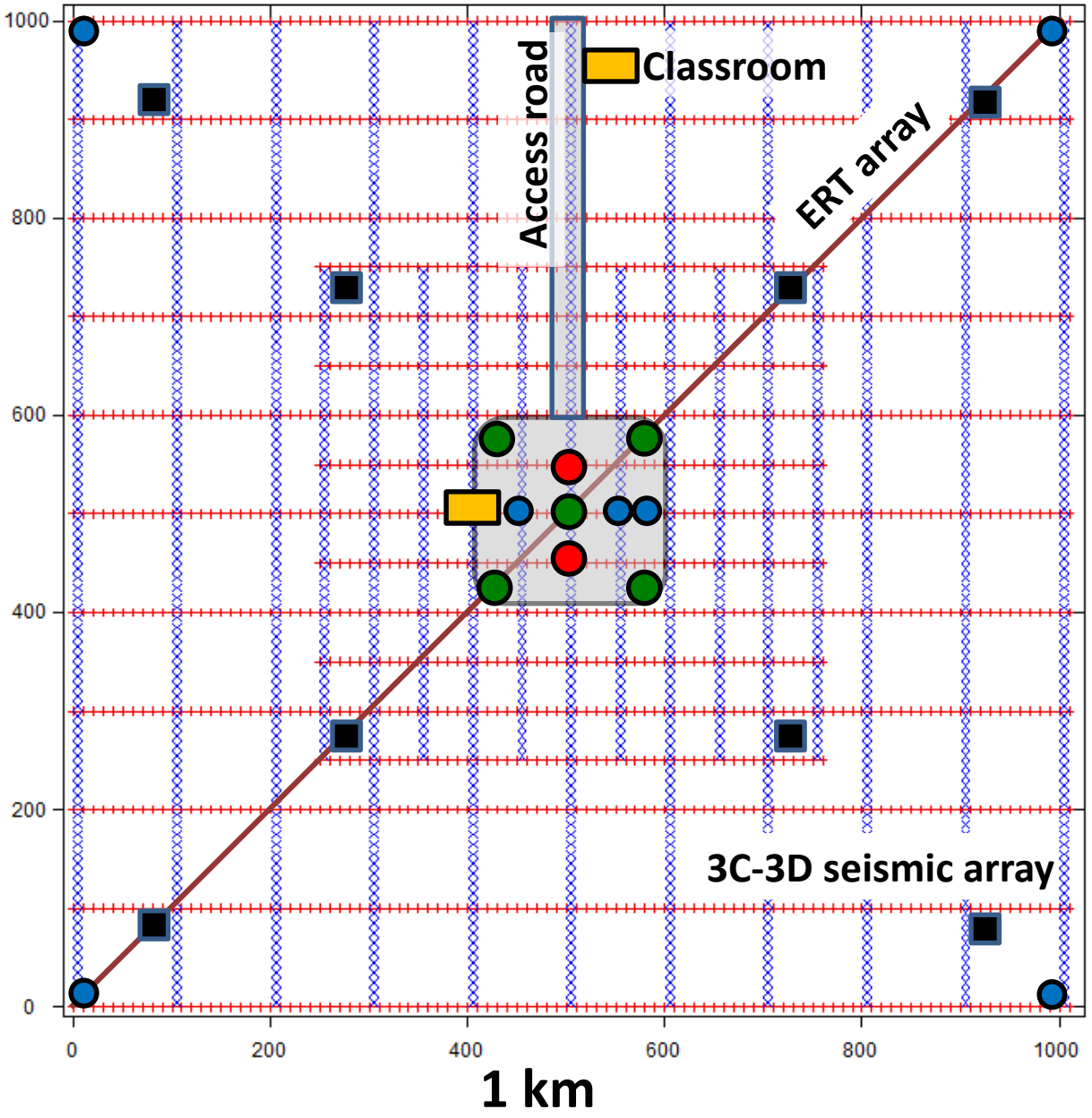


1st White Speckled Shale and Medicine Hat Fm. (480-508 m)

Medicine Hat Fm.: Thin beds of cross-bedded, cross-laminated and bioturbated fine grained sandstone to mudstone. Many thin sandstone beds have scoured or distinct bases and gradational tops, although numerous thin mudstone beds distinctly overlie sandstones. In contrast to the general tendency of beds to fine upward, well logs suggest three parasequences with tops at 503.0, 494.5 and 482.4 m that become sandier and cleaner upward. Bioturbation is common, particularly in the lower parts of the cores.



FRS monitoring plan layout



Purchased:

- **500 Inova 3C Hawk nodes**
- **MPT ERT system**

Water wells, Newell County

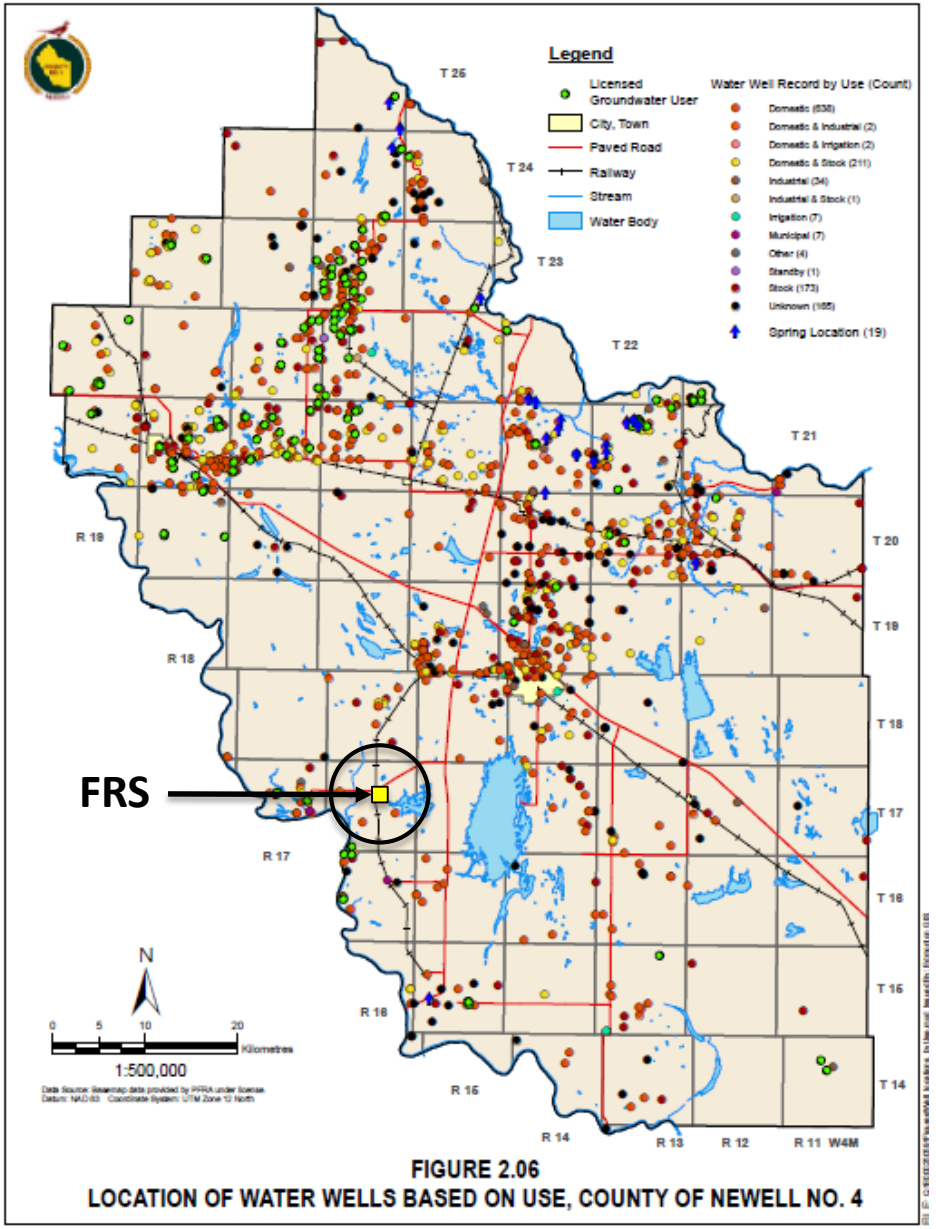
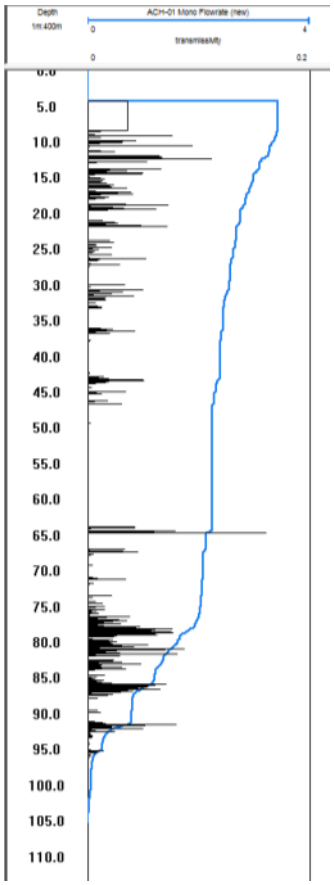
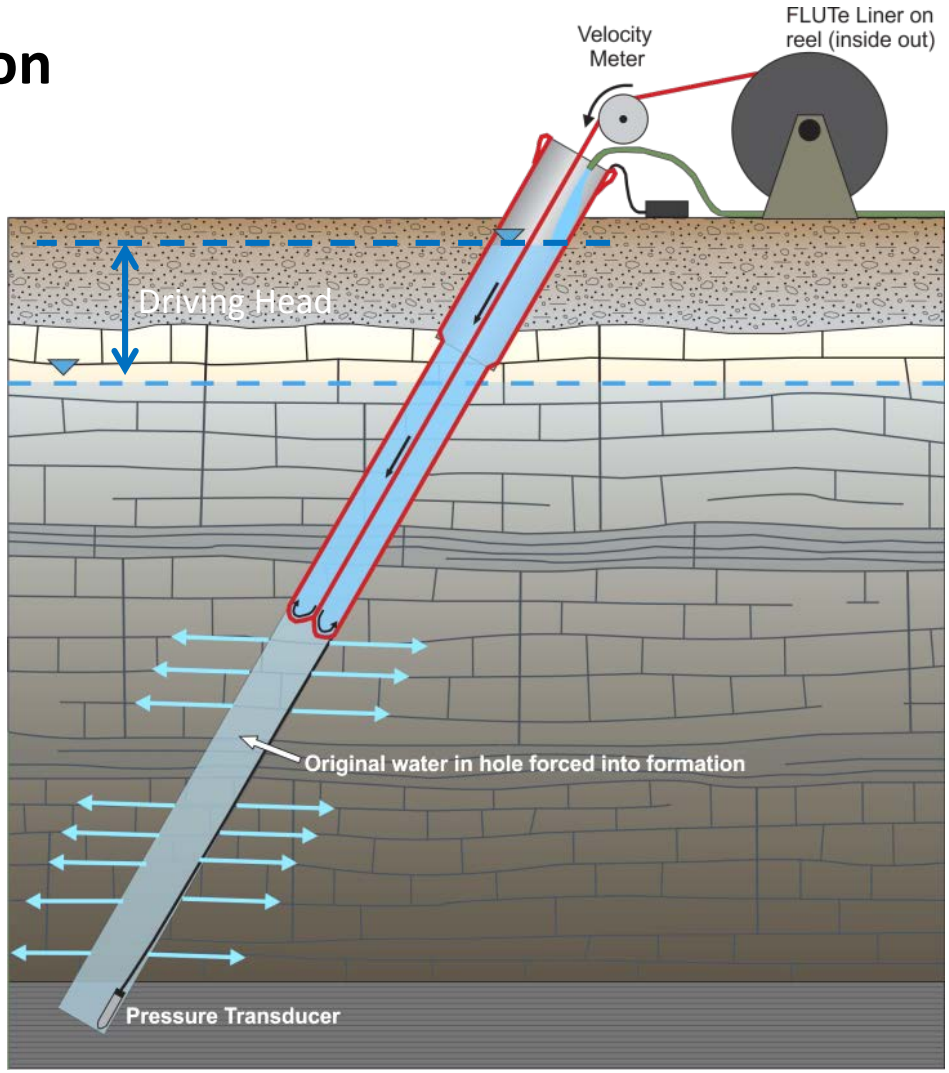


FIGURE 2.06
LOCATION OF WATER WELLS BASED ON USE, COUNTY OF NEWELL NO. 4

FLUTe hydrology profiling

Provides depth-discrete transmissivity distribution





Environmental monitoring

- Sondes for field measurements (pH, EC, T, DO, Eh)
- Soil gas flux chambers and soil gas collection probes
- Gas chromatographs for hydrocarbon and soil gas analyses
- Ion chromatograph (Dionex) for anion and cation concentration analyses on water samples
- Titrators for alkalinity and H_2S in water samples
- Portable H_2S gas analyzer
- Carbon isotope laser analyzer for methane
- Carbon and oxygen isotope laser

Mobile geochemistry laboratory

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2015 Schedule

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	April	May	June	July	Aug	Sept	Oct	Nov	Dec
PS processing									
Seismic interp.									
Log analysis									
Core logging									
Core analysis									
Reservoir model									
Simulation									
Injection appl.									
FRS 1 injector									
Monitor 1 well									
Water wells (4)									
Baseline work									
Monitor 2 well									
FRS #2									

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