THE ADAPTIVE MANAGEMENT APPROACH TO CCS PROJECT PLANNING: THE FORT NELSON CCS PROJECT AS A CASE STUDY

James A. Sorensen,[1] Steven A. Smith,[1] Charles D. Gorecki,[1] David V. Nakles,[2] Nicholas A. Azzolina,[2] Scott C. Ayash,[1] Edward N. Steadman,[1] and John A. Harju[1]

[1] Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

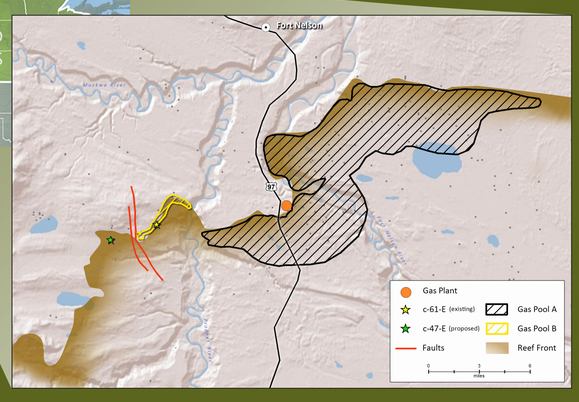
[2] The CETER Group, Inc.
4952 Oakhurst Avenue
Gibsonia, PA 15044

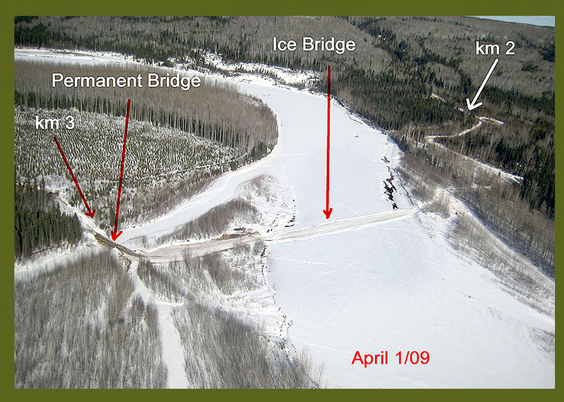
Introduction

The Plains CO_2 Reduction (PCOR) Partnership and Spectra Energy Transmission (SET) have investigated the feasibility of a carbon capture and storage (CCS) project to inject CO_2 produced by SET's Fort Nelson Gas Plant near Fort Nelson, British Columbia, Canada, into a deep saline formation. Baseline characterization data were collected on potential injection target and sealing formations and used to create geomodels and conduct dynamic simulations of injection scenarios. The characterization data and initial modeling results were then used to conduct two rounds of risk assessment of potential injection scenarios. While a final injection strategy has not yet been determined, a draft monitoring, verification, and accounting (MVA) plan has been developed using assumptions based on the characterization, modeling, and risk assessment efforts. The draft MVA plan covers the surface, near-surface, and deep subsurface environments and includes specific technologies, measurement locations, monitoring schedule, and baseline data necessary to address critical project risks and identify any deviations from expected conditions. The adaptive management approach integrates characterization, modeling, and risk assessment to ensure that MVA strategies remain fit for purpose and cost-effective. The Fort Nelson CCS feasibility study serves as a real-world example of how two iterative applications of the adaptive management approach were used to inform characterization efforts, evaluate potential injection scenarios, and develop a comprehensive MVA plan for a commercial-scale CCS project.

Fort Nelson, British Columbia, Canada

The Fort Nelson CCS project location is remote, with the site being accessible only in winter using an ice bridge and ice roads. Cold-weather gear is essential. Additionally, snowmobiles may be required to get sample equipment to the shallow groundwater wells.

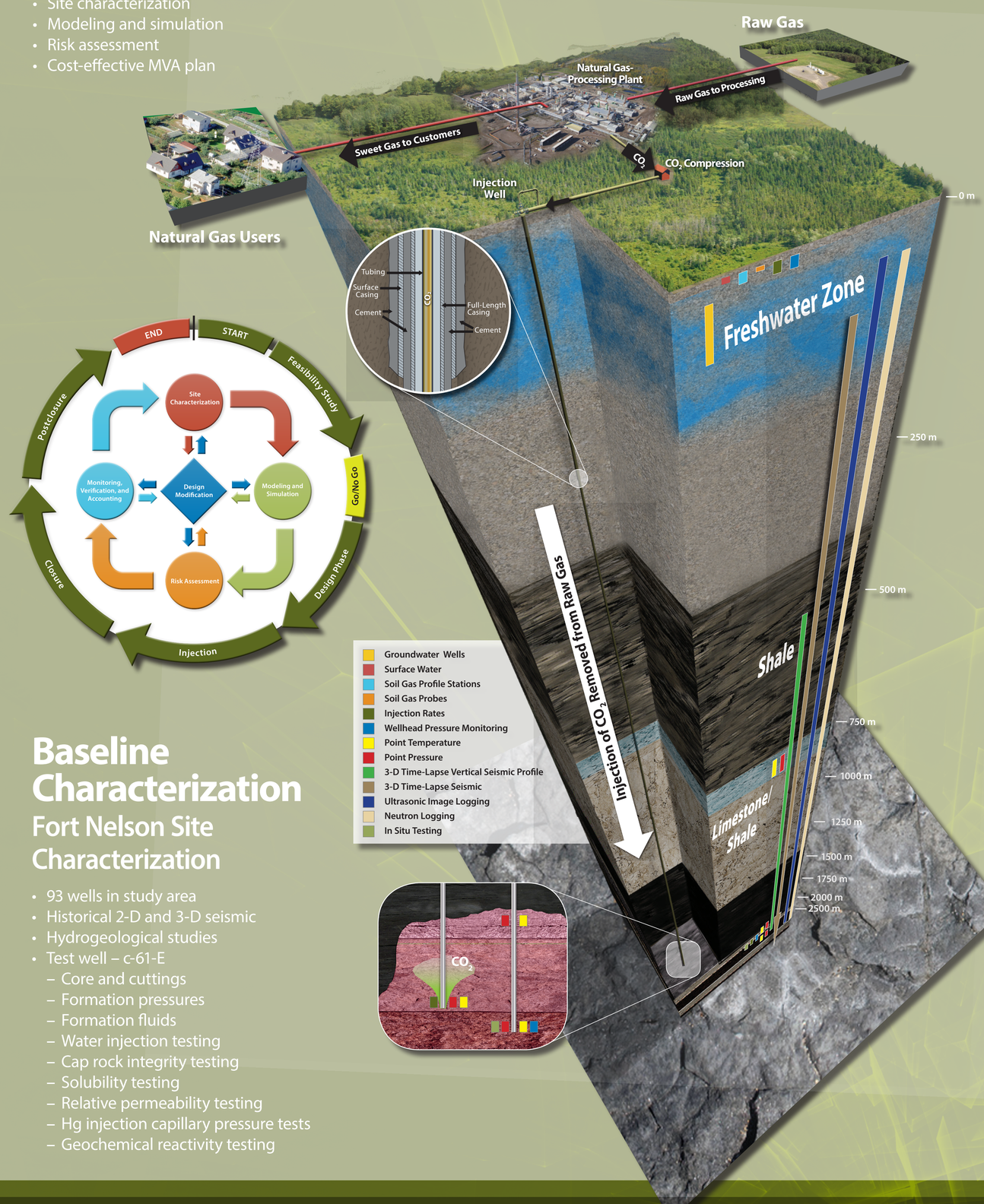




MVA

Approach

- Risk-based approach to define MVA strategy
- Site characterization
- Modeling and simulation
- Risk assessment
- Cost-effective MVA plan



Baseline Characterization

Fort Nelson Site Characterization

- 93 wells in study area
- Historical 2-D and 3-D seismic
- Hydrogeological studies
- Test well – c-61-E
  - Core and cuttings
  - Formation pressures
  - Formation fluids
  - Water injection testing
  - Cap rock integrity testing
  - Solubility testing
  - Relative permeability testing
  - Hg injection capillary pressure tests
  - Geochemical reactivity testing

Risk Assessment

The second-round risk assessment expanded the first-round risk assessment by addressing the relative project risks associated with two injection locations: a new proposed drilling location (west) and the original test well location (east). As suggested by the results of the first-round risk assessment, the injection west location was chosen to reduce the likelihood that injection would impact gas pools before the end of their productive life. The draft MVA plan was developed based on the injection west scenario.

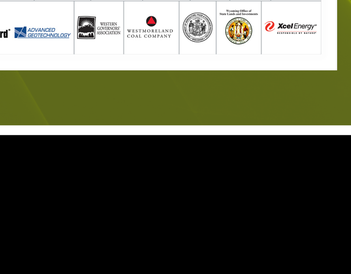
50-year Injection Scenario

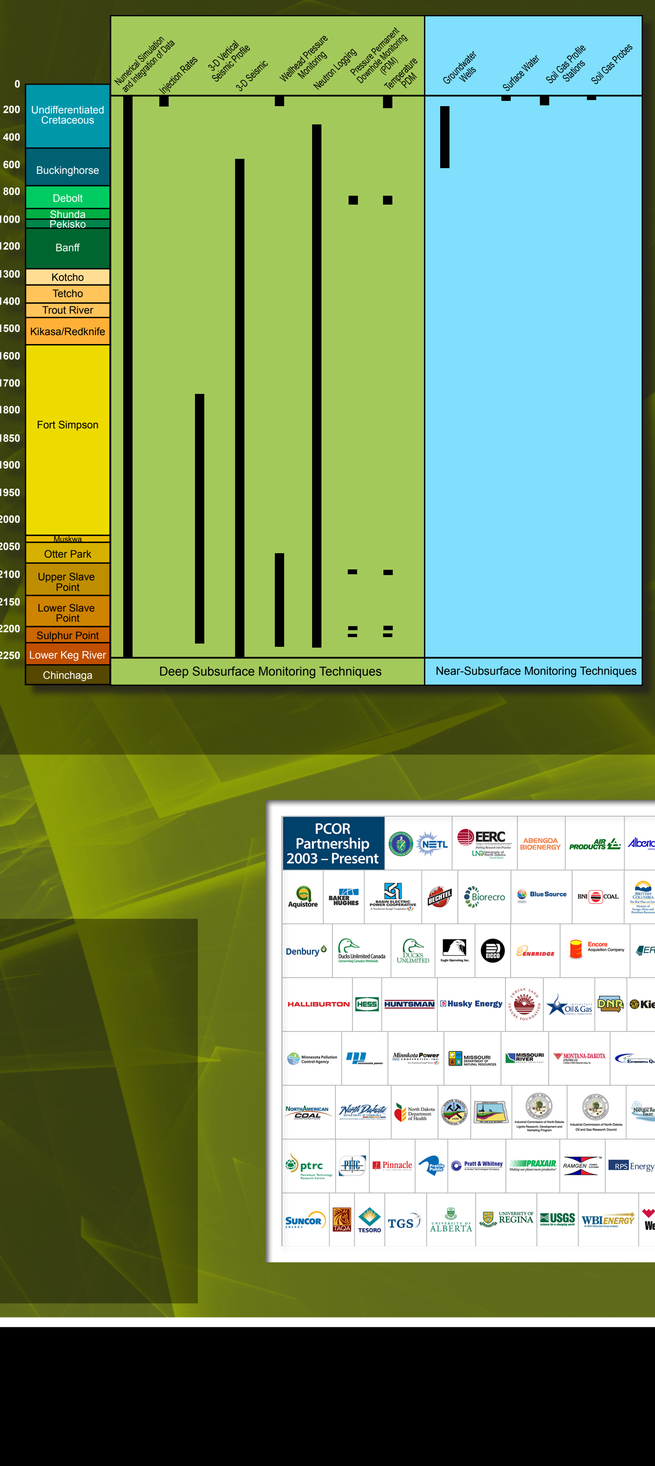
Injection

- Three injection wells
  - Sulphur Point Formation
- 120-MMscf/d injection rate
  - 2.5 million tons/year

Monitoring Elements

- Three deep monitoring wells
  - Debolt Formation
  - Sulphur Point Formation
- Shallow groundwater-monitoring wells in vicinity of deep monitoring wells and injection wells
- Surface water sampling
  - Lakes
  - Rivers
- Soil gas monitoring in vicinity of deep monitoring wells and injection wells





General Conclusions

Climate, terrain, and remoteness will present significant challenges:

- Limited access means fewer sampling locations and events.
- Short work season means MVA technology installation will be expensive and require longer lead times for planning and elevated levels of coordination.
- Some MVA technologies will be severely hampered.
- These limitations may preclude Fort Nelson CCS operations from fully implementing many recommended protocols/technologies but should not prevent the application of required protocols/technologies.

Acknowledgment

This material is based on work supported by the U.S. Department of Energy (DOE) National Energy Technology Laboratory under Award No. DE-FC26-05NT42592.