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# Abstract


**Objectives**

Injection rate history and future performance prediction are presented for multiple planned $CO_2$ injection wells in the LaBarge Field. Of primary interest is the long-term $CO_2$ plume size and pressure interference between wells with different well spacing and conceptual facies descriptions in the Madison and Bighorn tight carbonate geologic formations. Uncertainty analysis is used to predict the likelihood of achieving target injection rates over time, given considerable uncertainty in permeability thickness, relative permeability, and skin due to limited data in the aquifer region.

**Method**

LaBarge produces methane, helium, $CO_2$ and $H_2S$ from the Madison Formation. Since 2005, two Acid Gas Injector (AGI) disposal wells have successfully reinjected $H_2S$ and $CO_2$ into the Madison aquifer (43 miles South of the producing field), demonstrating suitable injectivity and storage capacity. In 2025, plans are to dispose of up to an additional 2.4 million metric tons per year of $CO_2$ by drilling a third and fourth disposal well (both $CO_2$ injection only) near the AGI aquifer region (Figure 1). A dynamic model, calibrated through history-matching of the AGI wells performance, was used to evaluate the impact of key parameters affecting $CO_2$ injectivity, and to predict $CO_2$ plumes and aquifer pressure as a result of injection through time.

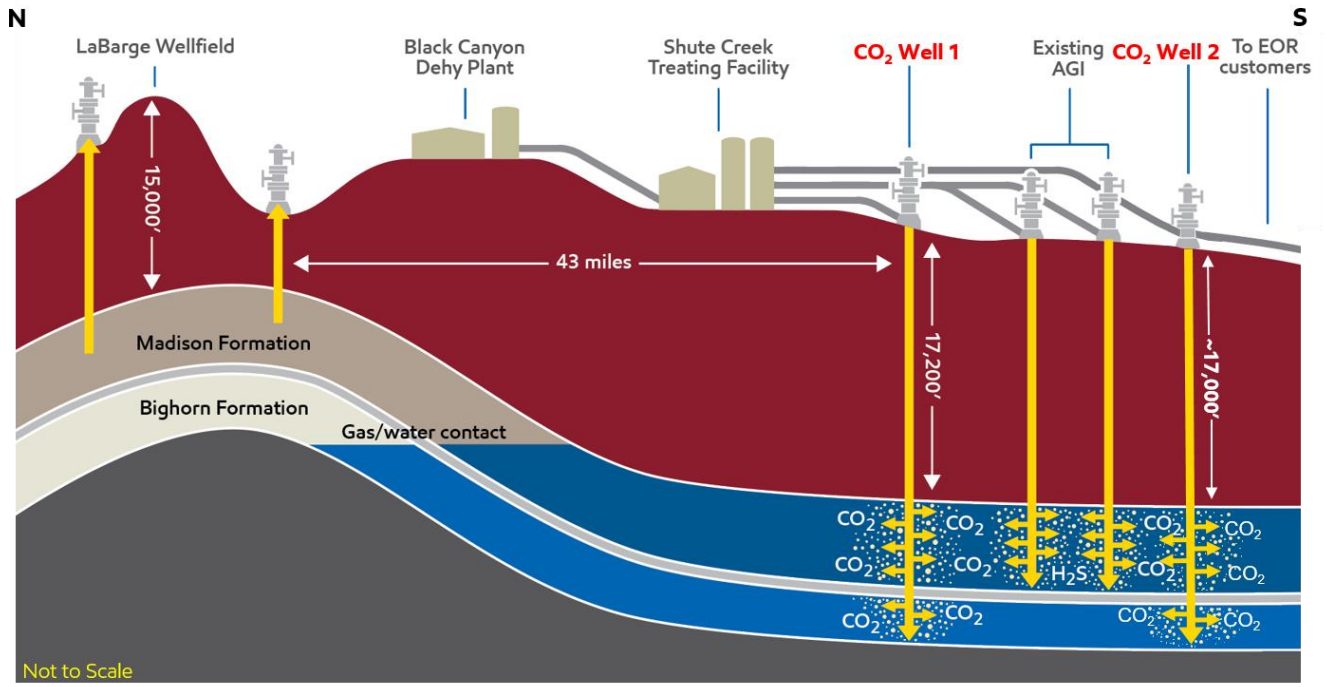


*Figure 1:Schematic illustration of existing LaBarge producing well field, existing AGI disposal wells and future expansion of carbon capture project using two new $CO_2$ disposal wells.*

**Results**

Mississippian-age Madison and Ordovician-age Bighorn facies distributions were derived from conceptual ideas based on limited logs, outcrop observation and ExxonMobil's knowledge of shallow marine open carbonate ramps and diagenetic processes. Several facies scenarios were used to guide stochastic population of properties spatially and vertically. Multiple simulation realizations describing variability in reservoir properties were used to investigate plume size, pressure interference as a function of well spacing, and the impact of permeability thickness, relative permeability and skin to maintaining an average target rate of 60 – 70 MMCFD (~1.7 MMSM3/day) in each new disposal well. The model was run to 80 years to increase confidence in maintaining target injection rates for an extended period.

In a comingled, Madison-Bighorn injection reservoir simulation base case, after 80 years the $CO_2$ plume diameters at the third and fourth new disposal wells are expected to grow up to approximately 32,000' and 28,500' respectively in the Madison and 26,400' and 20,000' respectively in the Bighorn. Probabilistic modeling predicts a 70% likelihood of achieving desired target rates per well. Additionally, dynamic simulation analysis was conducted to understand $CO_2$ plume sizes and potential for pressure interference between the two new $CO_2$ disposal wells and the AGI wells over time. Results show considerable spacing is required to prevent significant AGI injectivity decline.

**Novel Information**

ExxonMobil continues to evaluate additional $CO_2$ injectors in the LaBarge aquifer region. Understanding of the range of injectivity, plume migration and pressure response that results from variability in the subsurface parameters will be used for optimal business decisions regarding well count, location, injection rates forecasts and to demonstrate extremely high confidence in permanent $CO_2$ storage.