ATTACHMENT E: POST-INJECTION SITE CARE AND SITE CLOSURE PLAN

Facility Information

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Well location:	Decatur, Macon County, IL; 39º53'09.32835", -88º53'16.68306"

This Post-Injection Site Care and Site Closure (PISC) plan describes the activities that ADM will perform to meet the requirements of 40 CFR 146.93. ADM will monitor groundwater quality and track the position of the carbon dioxide plume and pressure front for ten (10) years. This alternative post-injection site care timeframe was approved by EPA, but ADM may not cease post-injection monitoring until a demonstration of non-endangerment of USDWs has been approved by the Director pursuant to 40 CFR 146.93(b)(3). Following approval for site closure, ADM will plug all monitoring wells, restore the site to its original condition, and submit a Site Closure report and associated documentation.

Pre- and Post-Injection Pressure Differential

The formation pressure at the injection well is predicted to decline rapidly within the first 4 years following cessation of injection. Based on the modeling of the pressure front as part of the AoR delineation, pressure is expected to decrease to pre-injection levels by the end of the PISC timeframe. Additional information on the projected post-injection pressure declines and differentials is presented in the permit application and the Area of Review and Corrective Action Plan (Attachment B to this permit).

Predicted Position of the CO_2 Plume and Associated Pressure Front at Site Closure

Figure 1 shows the predicted extent of the plume and pressure front at the end of the 10 year PISC timeframe, representing the maximum extent of the plume and pressure front. This map is based on the final AoR delineation modeling results submitted in May 2016, per 40 CFR 146.84.

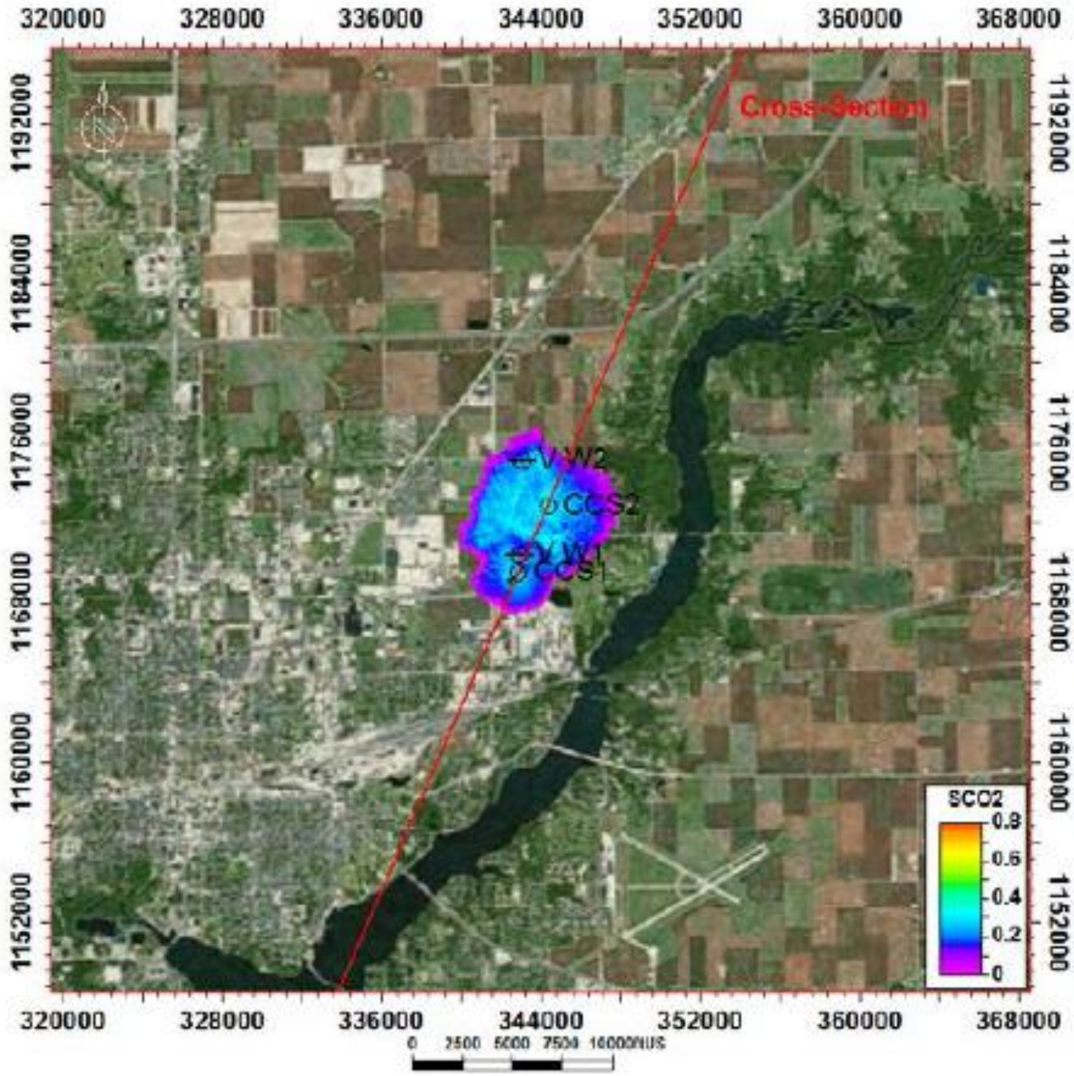


Figure 1. Predicted extent of the CO_2 plume 10 years after the cessation of injection (Est Yr 2031). Pressure front (DPif = 62.2 psi) not shown because pressure is expected to decrease below that level at site closure.

Post-Injection Monitoring Plan

Performing groundwater quality monitoring and plume and pressure front tracking as described in the following sections during the post-injection phase will meet the requirements of 40 CFR 146.93(b)(1). The results of all post-injection phase testing and monitoring will be submitted annually, within 60 days of the anniversary date of the date on which injection ceases, as described under "Schedule for Submitting Post-Injection Monitoring Results," below.

A quality assurance and surveillance plan (QASP) for all testing and monitoring activities during the injection and post injection phases is provided in the Appendix to the Testing and Monitoring Plan.

Groundwater Quality Monitoring

Table 1 and Table 2 present the planned direct and indirect monitoring methods, locations, and frequencies for groundwater quality monitoring above the confining zone in the Quaternary and/or Pennsylvanian strata, the St. Peter Formation, and the Ironton-Galesville Sandstone. All of the monitoring wells are located on ADM property. Table 3 identifies the parameters to be monitored and the analytical methods ADM will employ, and Figure 2 shows the locations of the monitoring wells.

Table 1. Post-Injection Phase Direct Groundwater Monitoring Above Confining Zone.[1,2]

Target Formation	Monitoring Activity	Monitoring Location(s)	Frequency: Year 1	Frequency: Years 2-3	Frequency: Years 4-9	Frequency: Year 10
Quaternary and/or Pennsylvanian strata	Fluid sampling	Shallow monitoring wells: MVA10LG, MVA11LG, MVA12LG, MVA13LG	Annual	Annual	Annual	Annual
	Distributed Temperature Sensing (DTS)	CCS#1	Continuous	None	None	None
		CCS#2	Continuous	None	None	None
St. Peter	Fluid sampling	GM#2	Annual	Annual	Annual	Annual
	Pressure/ temperature monitoring	GM#2	Continuous	Continuous	Annual	Annual
	DTS	CCS#1	Continuous	None	None	None
		CCS#2	Continuous	None	None	None
Ironton-Galesville	Fluid sampling	VW#2	Annual	Annual	Annual	Annual
	Pressure/ temperature monitoring	VW#2	Continuous	Continuous	Annual	Annual
	DTS	CCS#1	Continuous	None	None	None
		CCS#2	Continuous	None	None	None

Note 1: Collection and recording of continuous monitoring data will occur at the frequencies described in Table 4.

Note 2: Annual sampling and monitoring will occur up to 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director.

Table 2. Post-Injection Phase Indirect Groundwater Monitoring Above the Confining Zone [1]

Target Formation	Monitoring Activity	Monitoring Location(s)	Frequency: Year 1	Frequency: Years 2-3	Frequency: Years 4-9	Frequency: Year 10
Quaternary and/or Pennsylvanian strata	Pulse Neutron Logging/RST	VW#1	Year 1	Year 3	Year 5, Year 7	Year 10
		VW#2	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#1	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#2	Year 1	Year 3	Year 5, Year 7	Year 10

Target Formation	Monitoring Activity	Monitoring Location(s)	Frequency: Year 1	Frequency: Years 2-3	Frequency: Years 4-9	Frequency: Year 10
St. Peter	Pulse Neutron Logging/RST	VW#1	Year 1	Year 3	Year 5, Year 7	Year 10
		VW#2	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#1	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#2	Year 1	Year 3	Year 5, Year 7	Year 10
Ironton-Galesville	Pulse Neutron Logging/RST	VW#1	Year 1	Year 3	Year 5, Year 7	Year 10
		VW#2	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#1	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#2	Year 1	Year 3	Year 5, Year 7	Year 10

Note 1: Logging surveys will occur within 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director.

Table 3. Summary of Analytical and Field Parameters for Groundwater Samples.

Parameters	Analytical Methods (1)
Quaternary/Pennsylvanian	
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Total Dissolved Solids	Gravimetry; APHA 2540C
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple
St. Peter	
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry

Parameters	Analytical Methods [1]
Total Dissolved Solids	Gravimetry; APHA 2540C
Water Density (field)	Oscillating body method
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple
Ironton-Galesville	
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Isotopes: δ^{13}C of DIC	Isotope ratio mass spectrometry
Total Dissolved Solids	Gravimetry; APHA 2540C
Water Density (field)	Oscillating body method
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple

Note 1: ICP = inductively coupled plasma; MS = mass spectrometry; OES = optical emission spectrometry; GC-P = gas chromatography - pyrolysis. An equivalent method may be employed with prior approval of the Director.

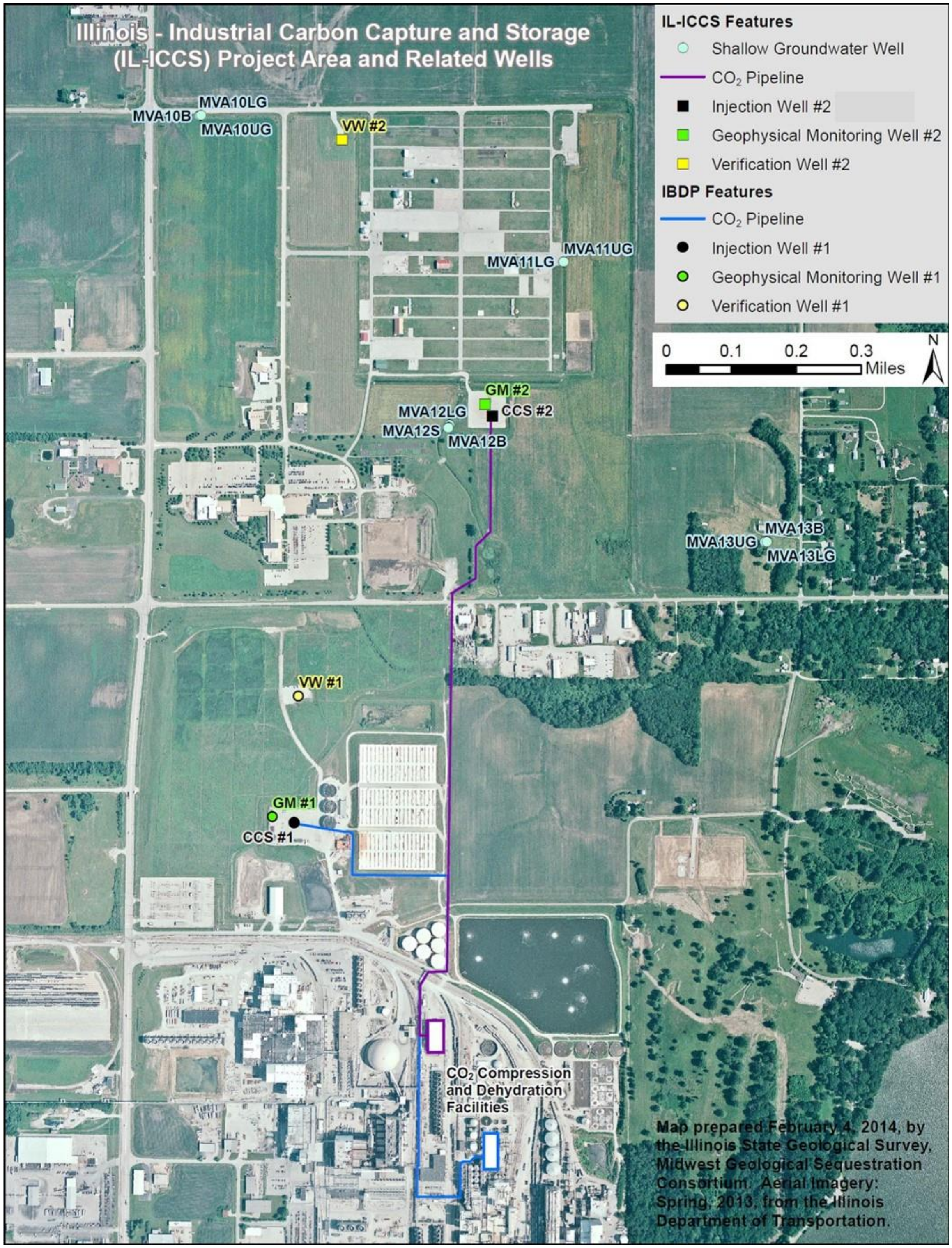


Figure 2. Location of shallow groundwater monitoring wells and deep monitoring wells.

Sampling will be performed as described in section B.2 of the QASP; this section of the QASP describes the groundwater sampling methods to be employed, including sampling SOPs (section B.2.a/b), and sample preservation (section B.2.g).

Sample handling and custody will be performed as described in section B.3 of the QASP.

Quality control will be ensured using the methods described in section B.5 of the QASP.

Collection and recording of continuous monitoring data will occur at the frequencies described in Table 4.

Table 4. Sampling and Recording Frequencies for Continuous Monitoring.

Well Condition	Minimum sampling frequency: once every[(1)(4)]	Minimum recording frequency: once every[(2)(4)]
For continuous monitoring of the injection well:	5 seconds	5 minutes [(3)]
For the well when shut-in:	4 hours	4 hours

Note 1: Sampling frequency refers to how often the monitoring device obtains data from the well for a particular parameter. For example, a recording device might sample a pressure transducer monitoring injection pressure once every two seconds and save this value in memory.

Note 2: Recording frequency refers to how often the sampled information gets recorded to digital format (such as a computer hard drive). Following the same example above, the data from the injection pressure transducer might be recorded to a hard drive once every minute.

Note 3: This can be an average of the sampled readings over the previous 5-minute recording interval, or the maximum (or minimum, as appropriate) value identified over that recording interval.

Note 4: DTS sampling frequency is once every 10 seconds and recorded on an hourly basis.

Carbon Dioxide Plume and Pressure Front Tracking

ADM will employ direct and indirect methods to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure.

Table 5 presents the direct and indirect methods that ADM will use to monitor the CO_2 plume, including the activities, locations, and frequencies ADM will employ. ADM will conduct fluid sampling and analysis to detect changes in groundwater in order to directly monitor the carbon dioxide plume. The parameters to be analyzed as part of fluid sampling in the Mt. Simon (and associated analytical methods) are presented in Table 6. Indirect plume monitoring will be employed using pulsed neutron capture/reservoir saturation tool (RST) logs to monitor CO_2 saturation and 3D surface seismic surveys. Quality assurance procedures for seismic monitoring methods are presented in Section B.9 of the QASP.

Table 5. Post-Injection Phase Plume Monitoring.[(1,2)]

Target Formation	Monitoring Activity	Monitoring Location(s)	Frequency: Year 1	Frequency: Years 2-3	Frequency: Years 4-9	Frequency: Year 10
Direct Plume Monitoring						
Mt. Simon	Fluid sampling	VW#2	Annual	Annual	Annual	Annual

Target Formation	Monitoring Activity	Monitoring Location(s)	Frequency: Year 1	Frequency: Years 2-3	Frequency: Years 4-9	Frequency: Year 10
Indirect Plume Monitoring						
Mt. Simon	Pulse Neutron Logging/RST	VW#1	Year 1	Year 3	Year 5, Year 7	Year 10
		VW#2	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#1	Year 1	Year 3	Year 5, Year 7	Year 10
		CCS#2	Year 1	Year 3	Year 5, Year 7	Year 10
	3D surface seismic survey	Northern extent of plume area (fold coverage ~ 600 acres)	Once (Year 1) (Est 2020)	None	None	Once (Year 10) (Est 2030)

Note 1: Sampling and geophysical surveys will occur within 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director.

Note 2: Seismic surveys will be performed in the 4th quarter before or the 1st quarter of the calendar year shown or alternatively scheduled with the prior approval of the Director.

Table 6. Summary of analytical and field parameters for fluid sampling in the Mt. Simon.

Parameters	Analytical Methods [(1)]
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry
Total Dissolved Solids	Gravimetry; APHA 2540C
Water Density(field)	Oscillating body method
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple

Note 1: ICP = inductively coupled plasma; MS = mass spectrometry; OES = optical emission spectrometry; GC-P = gas chromatography - pyrolysis. An equivalent method may be employed with the prior approval of the Director.

Table 7 presents the direct and indirect methods that ADM will use to monitor the pressure front, including the activities, locations, and frequencies ADM will employ. ADM will deploy pressure/temperature monitors and distributed temperature sensors to directly monitor the position of the pressure front. Passive seismic monitoring using a combination of borehole and surface seismic stations to detect local events over M 1.0 within the AoR will also be performed. Quality assurance procedures for seismic monitoring methods are presented in Section B.9 of the QASP.

Table 7. Post-Injection Phase Pressure Front Monitoring.[1,2]

Target Formation	Monitoring Activity	Monitoring Location(s)	Frequency: Year 1	Frequency: Years 2-3	Frequency: Years 4-9	Frequency: Year 10
Direct Pressure Front Monitoring						
Mt. Simon	Pressure/ temperature monitoring	VW#2	Continuous 4 Intervals	Continuous 4 Intervals	Continuous 4 Intervals	Continuous 4 Intervals
		CCS#1	Continuous	Continuous	Annual	Annual
		CCS#2	Continuous	Continuous	Annual	Annual
	Distributed Temperature Sensing (DTS)	CCS#1	Continuous	None	None	None
		CCS#2	Continuous	None	None	None
Other Monitoring						
Multiple	Passive seismic	A combination of borehole and surface seismic stations located within the AoR.	Continuous	Continuous	Continuous	Continuous

Note 1: Collection and recording of continuous monitoring data will occur at the frequencies described in Table 4.

Note 2: Annual monitoring surveys will occur up to 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director.

Monitoring locations relative to the predicted location of the CO_2 plume and pressure front at 5-year intervals throughout the post-injection phase are shown in Figure 3 through Figure 5. Predicted pressure profiles at the top of the injection interval and bottom-hole pressure at CCS#2 for 50 years after the commencement of injection are shown in Figure 6 and Figure 7. The predicted amount of CO_2 in the mobile gas, trapped gas, and dissolved (aqueous) phases for 50 years after the commencement of injection is shown in Figure 8.

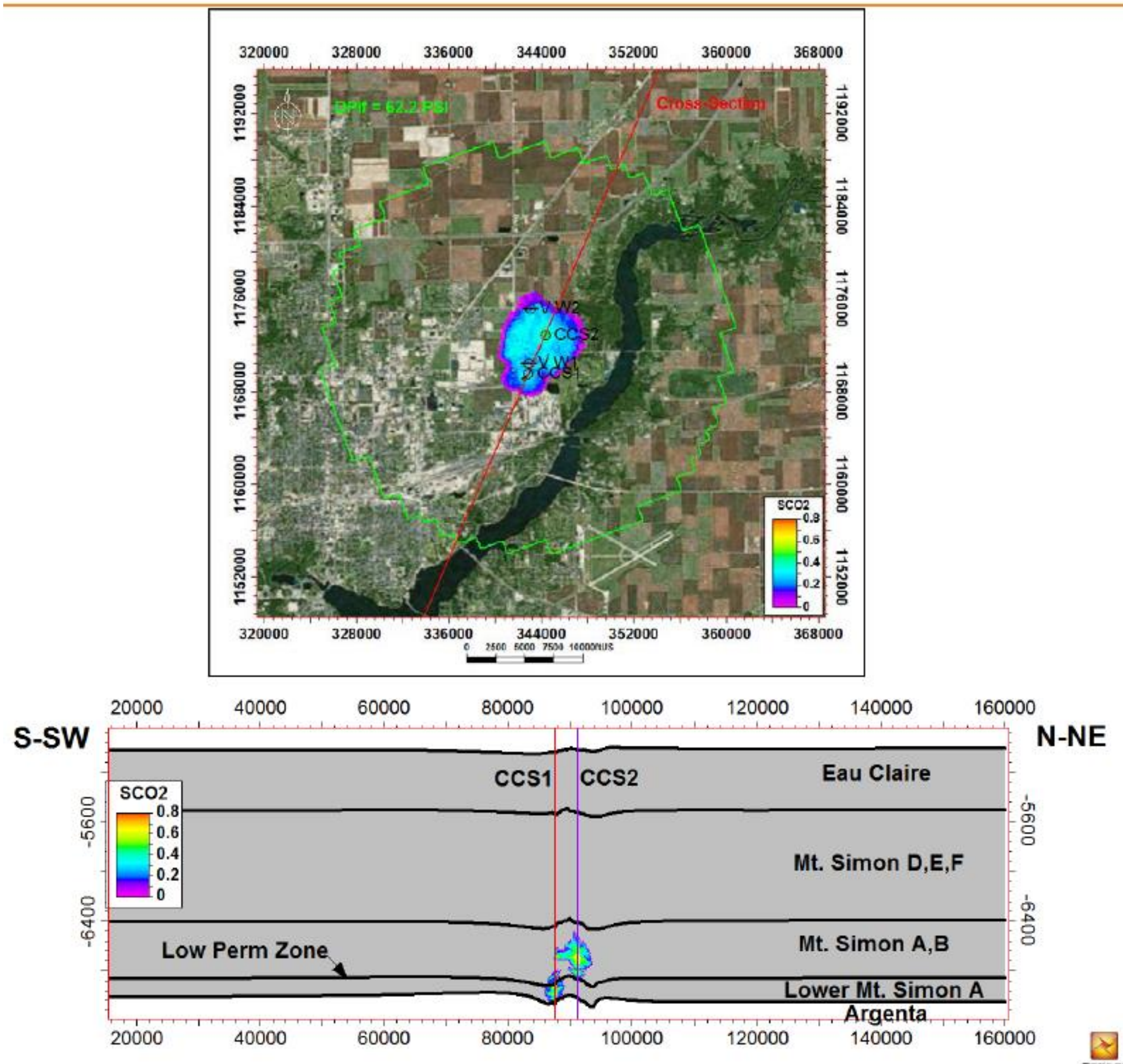
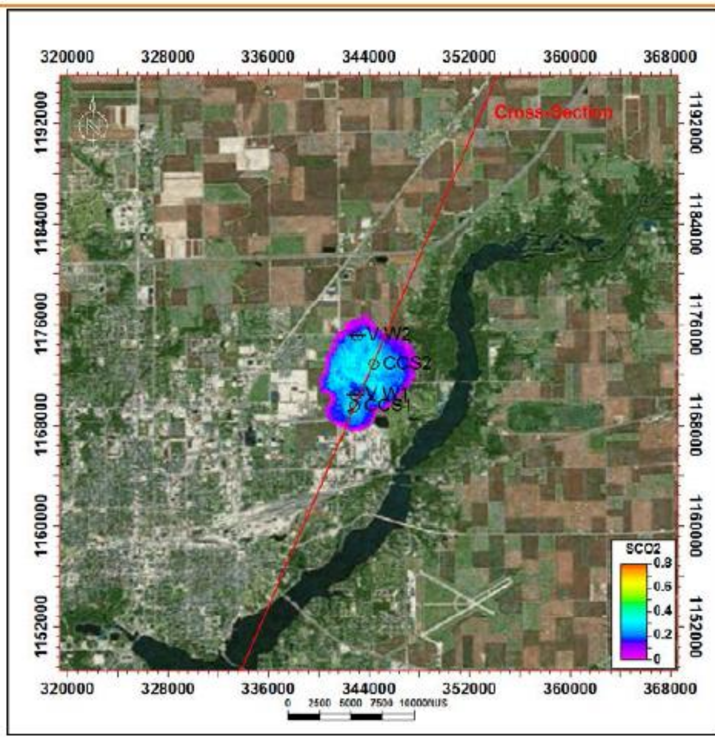


Figure 3. Predicted extent of the CO_2 plume and pressure front (DPif = 62.2 psi) relative to monitoring locations, at the beginning of the post-injection phase.



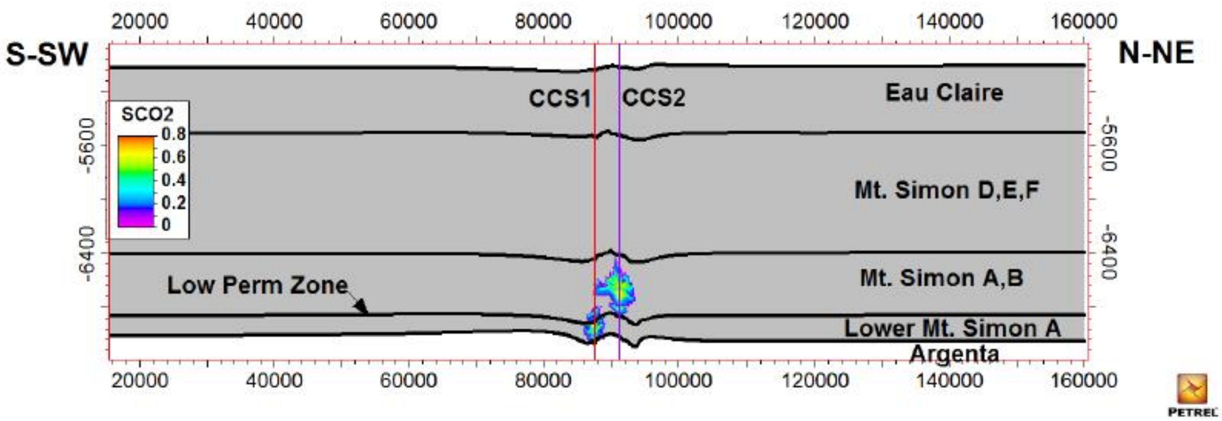


Figure 4. Predicted extent of the CO_2 plume and pressure front (DPif = 62.2 psi) relative to monitoring locations, at the end of 5 years after the cessation of injection.

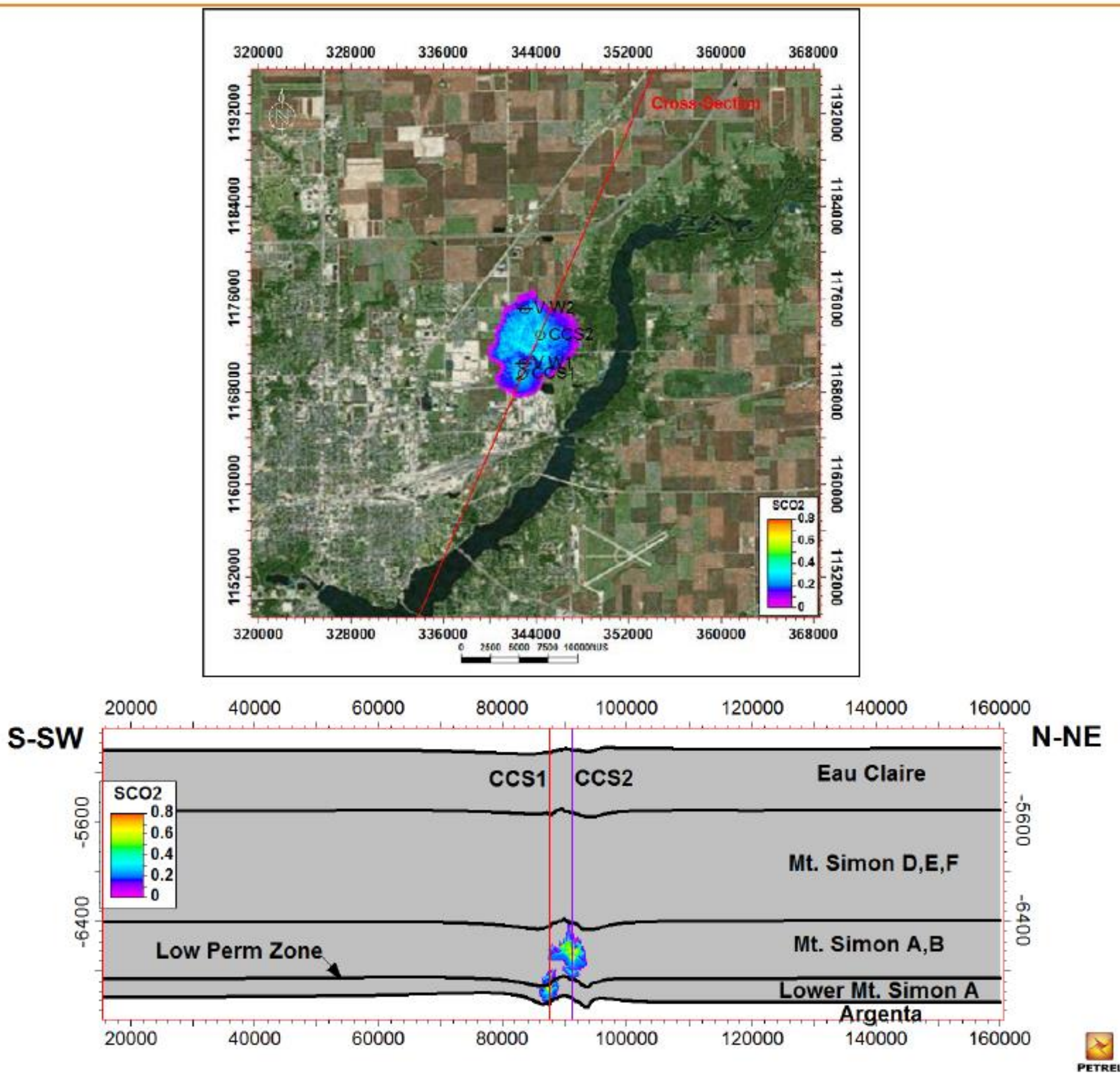


Figure 5. Predicted extent of the CO_2 plume and pressure front (DPif = 62.2 psi) relative to monitoring locations, at the end of 10 years after the cessation of injection (predicted time of site closure).

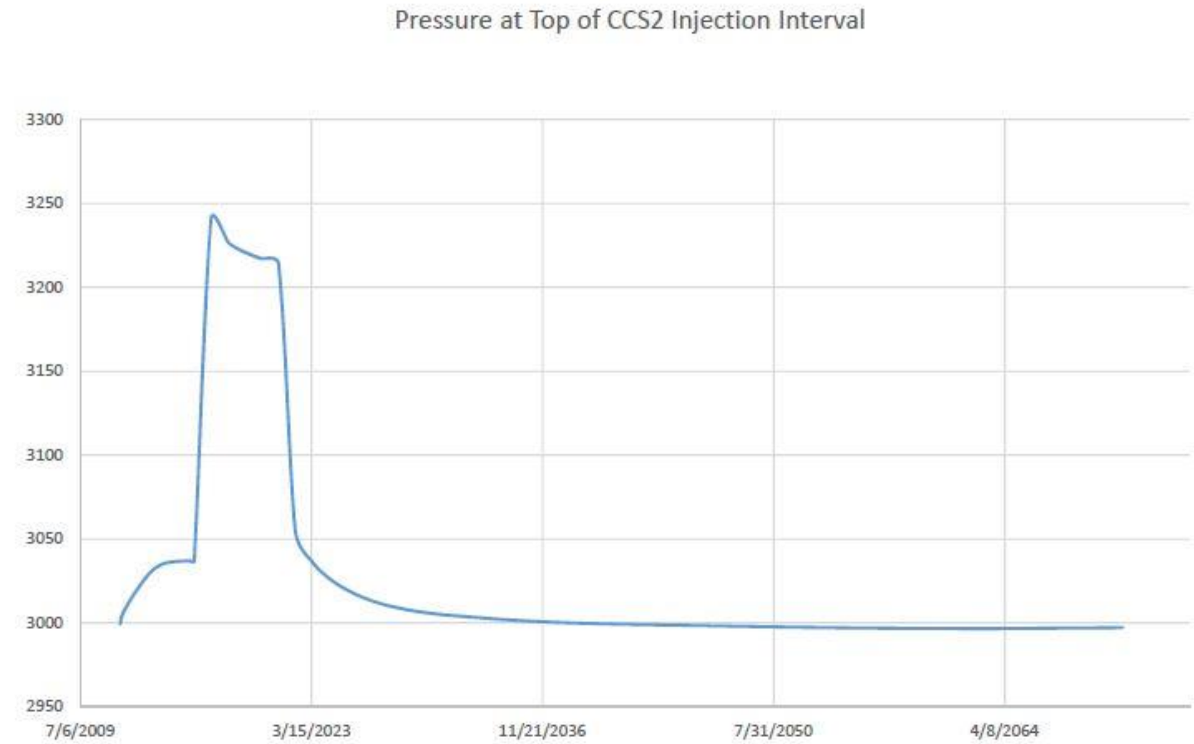


Figure 6. Predicted pressure profile at the top of the CCS#2 injection interval, simulated for 50 years after the commencement of injection.

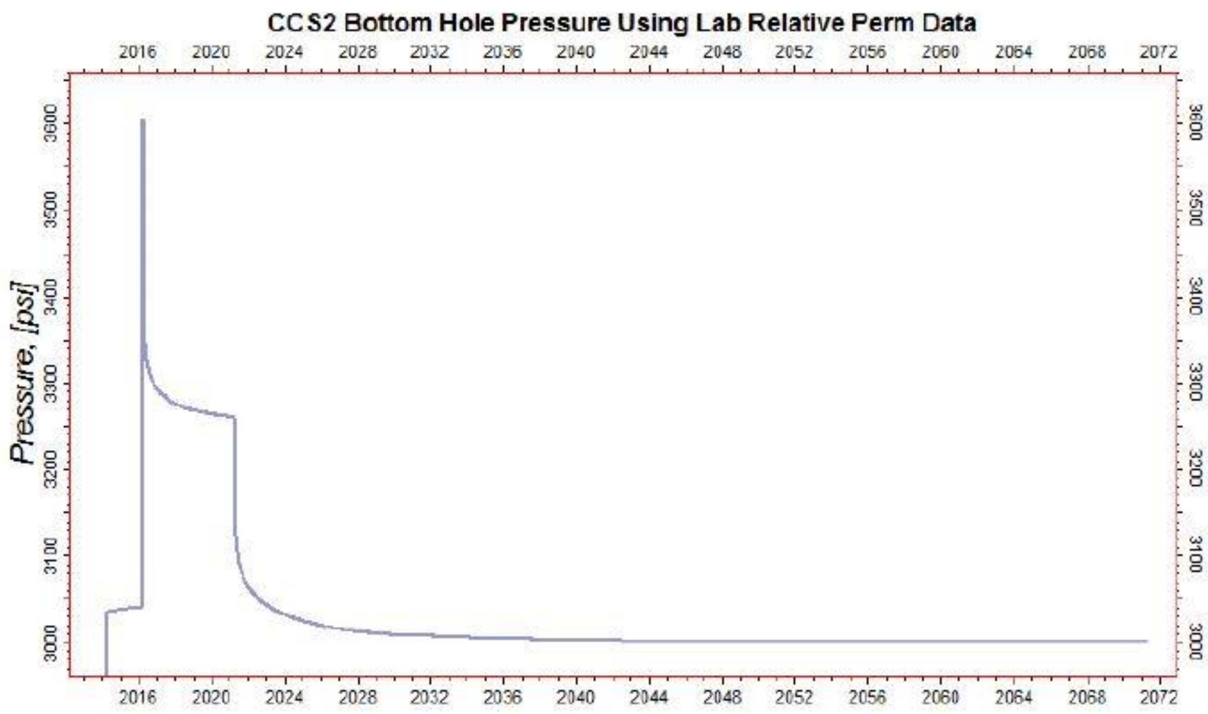


Figure 7. Predicted CCS#2 bottom-hole pressure profile, simulated for 50 years after the commencement of injection.

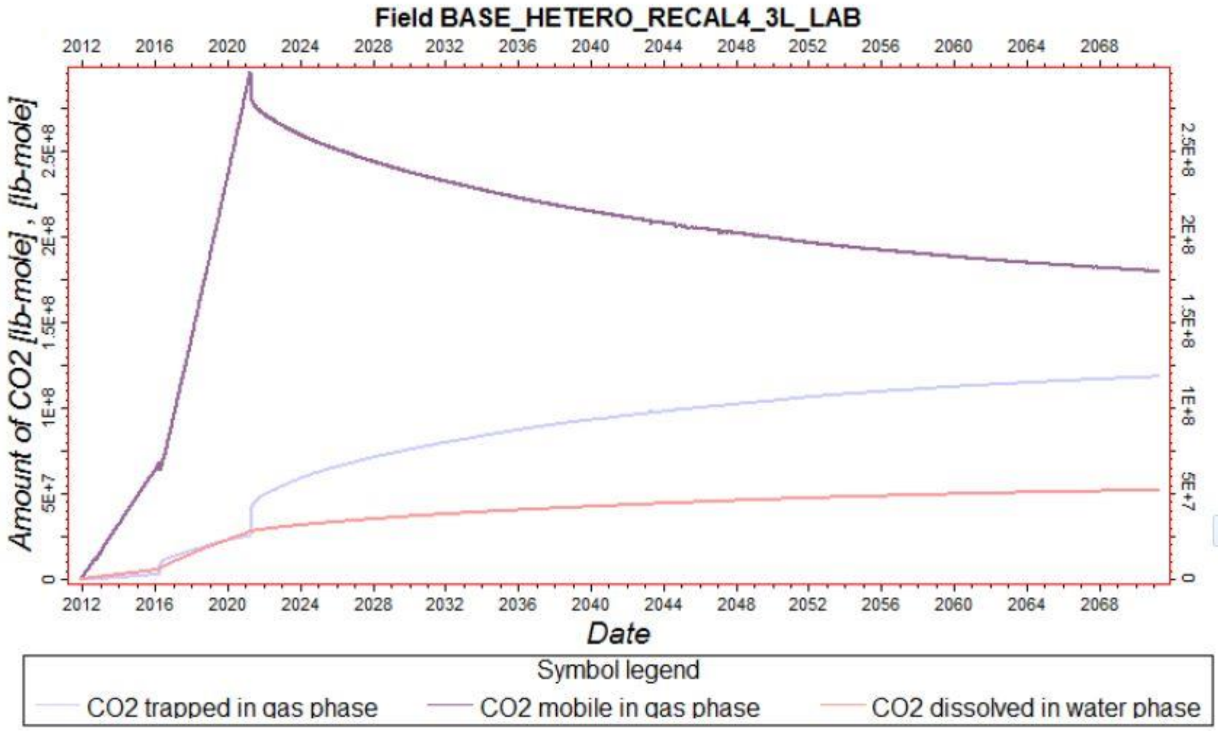


Figure 8. Predicted CO_2 phase distribution, simulated for 50 years after the commencement of injection.

Schedule for Submitting Post-Injection Monitoring Results

All post-injection site care monitoring data and monitoring results (i.e., resulting from the groundwater monitoring and plume and pressure front tracking described above) will be submitted to the Director in annual reports. These reports will be submitted each year, within 60 days following the anniversary date of the date on which injection ceases or alternatively with the prior approval of the Director.

The annual reports will contain information and data generated during the reporting period; i.e. seismic data acquisition, well-based monitoring data, sample analysis, and the results from updated site models.

Alternative Post-Injection Site Care Timeframe

ADM will conduct post-injection monitoring for ten years following the cessation of injection operations. ADM demonstrated that an alternative PISC timeframe is appropriate, pursuant to 40 CFR 146.93(c)(1). This demonstration is based on the computational modeling to delineate the AoR; predictions of plume migration, pressure decline, and carbon dioxide trapping; site-specific geology; well construction; and the distance between the injection zone and the nearest USDWs.

ADM will conduct all of the monitoring described under “Groundwater Quality Monitoring” and “Carbon Dioxide Plume and Pressure Front Tracking” above and report the results as described under the “Schedule for Submitting Post-Injection Monitoring Results.” This will continue until ADM demonstrates, based on monitoring and other site-specific data, that no additional monitoring is needed to ensure that the project does not pose an endangerment to any USDWs, per the requirements at 40 CFR 146.93(b)(2) or (3).

If any of the information on which the demonstration was based changes or the actual behavior of the site varies significantly from modeled predictions, e.g., as a result of an AoR reevaluation, ADM may update this PISC and Site Closure Plan pursuant to 40 CFR 146.93(a)(4). ADM will update the PISC and Site Closure Plan, within six months of ceasing injection or demonstrate that no update is needed and as necessary during the duration of the PISC timeframe.

Non-Endangerment Demonstration Criteria

Prior to authorization of site closure, ADM will submit a demonstration of non-endangerment of USDWs to the Director, per 40 CFR 146.93(b)(2) or (3).

To make the non-endangerment demonstration, ADM will issue a report to the Director. This report will make a demonstration of USDW non-endangerment based on the evaluation of the site monitoring data used in conjunction with the project's computational model. The report will detail how the non-endangerment demonstration uses site-specific conditions to confirm and demonstrate non-endangerment. The report will include (or appropriately reference): all relevant monitoring data and interpretations upon which the non-endangerment demonstration is based, model documentation and all supporting data, and any other information necessary for the Director to review the analysis. The report will include the following components:

Summary of Existing Monitoring Data

A summary of all previous monitoring data collected at the site, pursuant to the Testing and Monitoring Plan (Attachment C of this permit) and this PISC and Site Closure Plan, including data collected during the injection and PISC phases of the project, will be submitted to help demonstrate non-endangerment. Data submittals will be in a format acceptable to the Director [40 CFR 146.91(e)], and will include a narrative explanation of monitoring activities, including the dates of all monitoring events, changes to the monitoring program over time, and an explanation of all monitoring infrastructure that has existed at the site. Data will be compared with baseline data collected during site characterization [40 CFR 146.82(a)(6) and 146.87(d)(3)].

Comparison of Monitoring Data and Model Predictions and Model Documentation

The results of computational modeling used for AoR delineation and for demonstration of an alternative PISC timeframe will be compared to monitoring data collected during the operational and the PISC period. The data will include the results of time-lapse temperature and pressure monitoring, groundwater quality analysis, passive seismic monitoring, and geophysical surveys (i.e. logging, operating-phase VSP, and 3D surface seismic surveys) used to update the computational model and to monitor the site. Data generated during the PISC period will be used to help show that the computational model accurately represents the storage site and can be used as a proxy to determine the plume's properties and size. The operator will demonstrate this degree of accuracy by comparing the monitoring data obtained during the PISC period against the model's predicted properties (i.e. plume location, rate of movement, and pressure decay). Statistical methods will be employed to correlate the data and confirm the model's ability to accurately represent the storage site. The validation of the computational model with the large volume of available data will be a significant element to support the non-endangerment demonstration. Further, the validation of the complete model over the areas, and at the points, where direct data collection has taken place will help to ensure confidence in the model for those areas where surface infrastructure preclude geophysical data collection and where direct observation wells cannot be placed.

Evaluation of Carbon Dioxide Plume

The operator will use a combination of time-lapse RST logs, time-lapse VSP surveys, and other seismic methods (2D or 3D surveys) to locate and track the extent of the CO_2 plume. Figure 9, Figure 10, and Figure 11 present examples of how the data may be correlated against the model prediction. In Figure 9, a series of RST logs are compared against the model's predicted plume vertical extent at a specific point location at a specified time interval. A good correlation between the two data sets will help provide strong evidence in validating the model's ability to represent the storage system. Similarly, Figure 10 illustrates a comparison of the time-lapse VSPs against the predicted spatial extent of the plume at a specified time interval. Also, limited 2D and 3D seismic surveys will be employed to determine the plume location at specific times. The data produced by these activities will be compared against the model using statistical methods to validate the model's ability to accurately represent the storage site. Figure 11 presents an example of how the data from time-lapse 3D seismic surveys may be correlated against the model prediction.

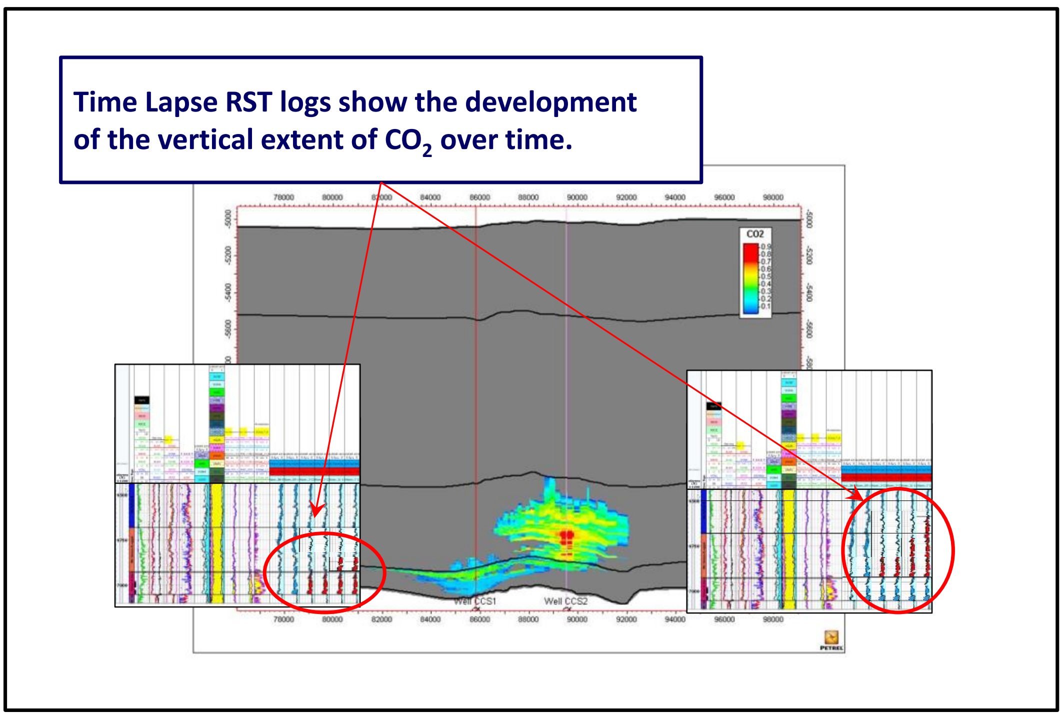


Figure 9. Comparison of the time-lapse RST logs against the predicted vertical extent of the plume at a specific time interval during the operational and PISC period can provide validation of the model's accuracy.

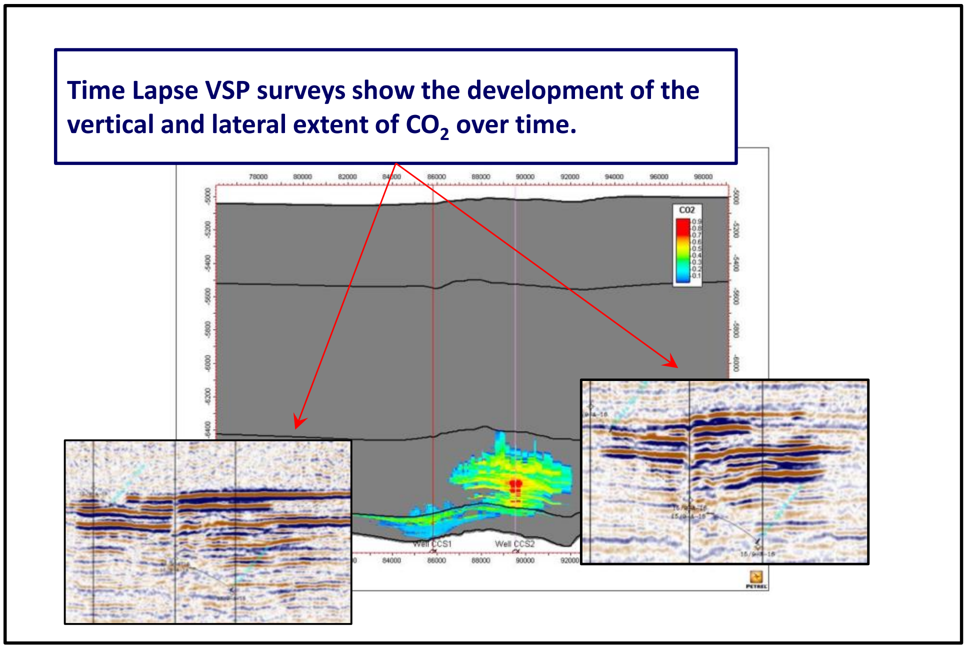


Figure 10. Comparison of the time-lapse VSPs against the predicted spatial extent of the plume at specific time intervals during the operational and PISC period can provide validation of the model's accuracy.

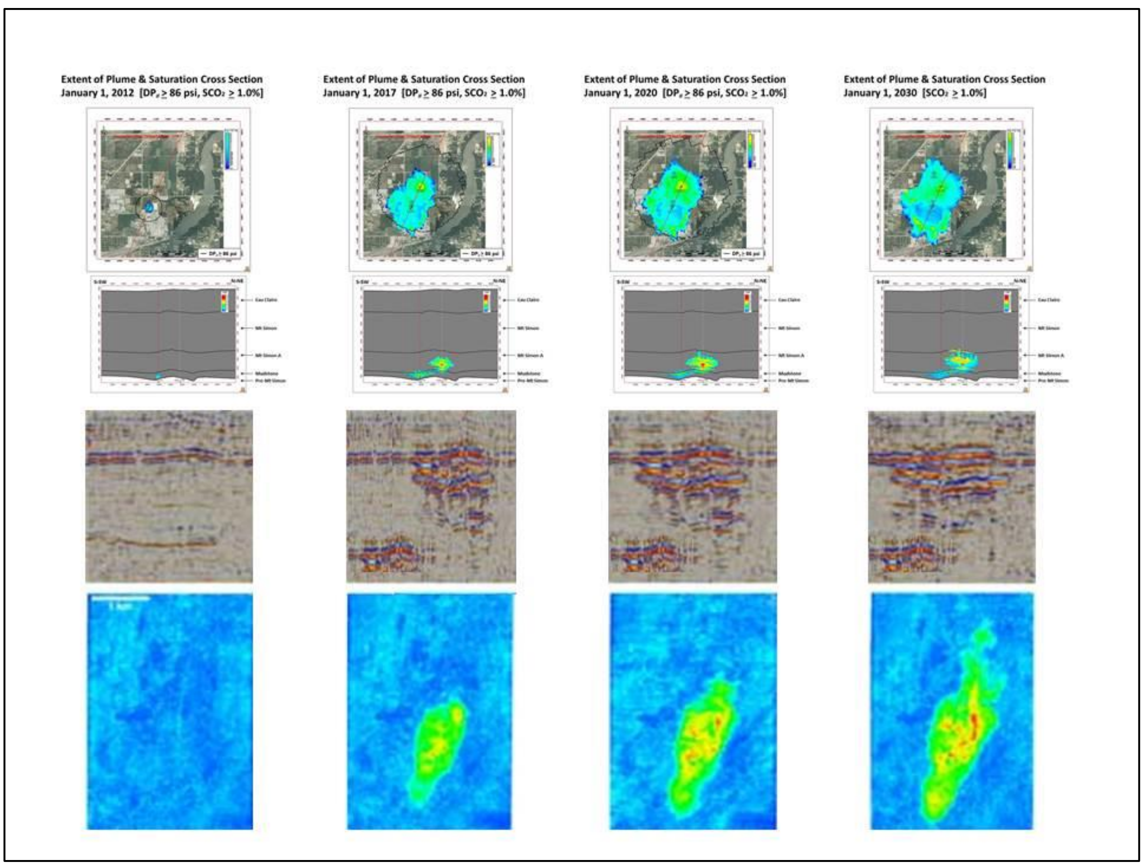


Figure 11. Comparison of the time-lapse surface 3D against the predicted spatial extent of the plume at specific time intervals during the operational and PISC period can provide validation of the model's accuracy.

Regarding the separate-phase carbon dioxide plume, the PISC monitoring data will be used to support a demonstration of the stabilization of the CO_2 plume as the reservoir pressure returns toward its pre-injection state. The storage interval (Mt. Simon) is considered to be an open reservoir system with a regional dip oriented NW (up-dip) to SE (down-dip) and having excellent porosity (20%) and permeability (120 mD). Locally, the storage interval has thin stratigraphic bands of low permeability siltstone to mudstone. These bands act as baffles that restrict the plume's vertical movement. Modeling performed to delineate the plume and pressure front predicts that, during the PISC period, the CO_2 will gradually rise through the reservoir until it encounters a baffle at which time it pools and spreads laterally. Based on the results of a 50 year post injection simulation, the top of the CO_2 plume is about 900 vertical feet below the primary seal formation (Eau Claire Shale). Additionally, the model predicts that over half the CO_2 will have become immobilized within the formation. This, in conjunction with the reservoir pressure returning to its pre-injection state, will be used to indicate there is essentially no driving force to cause significant plume movement. Indeed, the middle Mt. Simon contains intervals of eolian sandstone which are very tightly cemented by quartz overgrowths with some facies having permeabilities <0.01 mD. These intervals will act as more than a baffle and will significantly impede any vertical plume migration due to buoyancy forces.

The stabilization of the site conditions combined with the site's characteristic of not having any local penetrations of the seal formation will be the central focus of the operator's demonstration of non-endangerment. Equalization of plume to the site's pre-injection conditions will be one element in demonstrating non-endangerment. To demonstrate this, a case was examined to determine how long it would take a slowly expanding plume to reach the nearest penetration of the seal formation. Shown in Figure 15, the closest penetration of the seal formation is approximately 17 miles from the injection well. Assuming the plume continues to grow at 1% per year, it would take over 600 years for the plume to reach this plugged and abandoned well. Because this well is down dip from the injection well, it is likely the plume will never reach this location.

Evaluation of Mobilized Fluids

In addition to carbon dioxide, mobilized fluids may pose a risk to USDWs. These include native fluids that are high in TDS and therefore may impair a USDW, and fluids containing mobilized drinking water contaminants (e.g., arsenic, mercury, hydrogen sulfide). The geochemical data collected from monitoring wells will be used to demonstrate that no mobilized fluids have moved above the seal formation and therefore after the PISC period would not pose a risk to USDWs. In order to demonstrate non-endangerment, the operator will compare the operational and PISC period samples from layers above the injection zone, including the lowermost USDW, against the pre-injection baseline samples. This comparison will support a demonstration that no significant changes in the fluid properties of the overlying formations have occurred and that no mobilized formation fluids have moved through the seal formation. This validation of seal integrity will help demonstrate that the injectate and or mobilized fluids would not represent an endangerment to any USDWs.

Additionally, RST logs will be used to monitor the salinity of the reservoir fluids in the observation zone above the Eau Claire Shale seal. Figure 12 shows the relationship between salinity and sigma for two different temperatures while Table 8 shows the compositions of the groundwater at various intervals. This table shows the difference between the salinity level of the Mt Simon and the Ironton-Galesville (the interval directly above the confining zone). By comparing the time lapse RST logs against the pre-injection baseline logs, the operator will be able to monitor any changes in reservoir fluid salinity. RST logs indicating steady salinity levels within each zone would indicate no movement of fluids out of the storage unit, confirming the integrity of the well and seal formation.

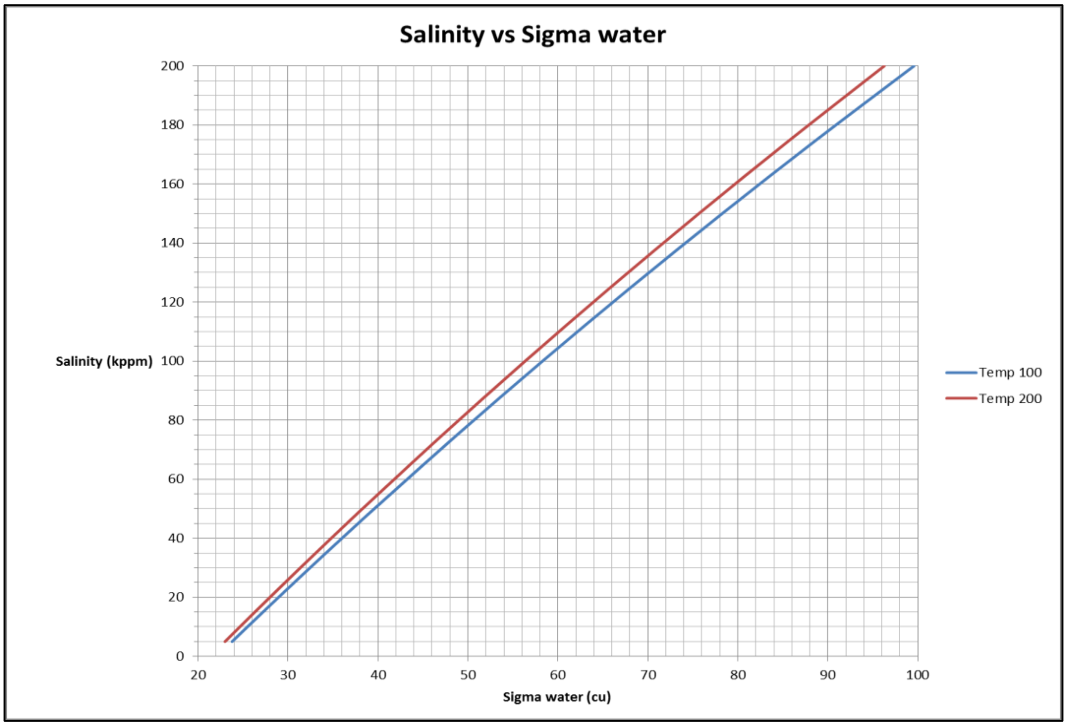


Figure 12. The red and blue lines show the relationship between salinity and sigma for at 100°F and 200°F.

Table 8. Fluid parameters for the Pennsylvanian, Ironton-Galesville, and Mt Simon.

Constituent	Pennsylvanian	Ironton-Galesville	Mt. Simon
Conductivity (mS/cm)	1.5	80	170
TDS (mg/L)	1,000	65,600	190,000
Cl^- (mg/L)	170	36,900	120,000
Br^- (mg/L)	1	180	680
Alkalinity (mg/L)	380	130	80
Na^+ (mg/L)	140	17,200	50,000
Ca^{2+} (mg/L)	100	5,200	19,000
K^+ (mg/L)	1	520	1,700
Mg^{2+} (mg/L)	50	950	1,800
pH (units)	7.2	6.9	5.9

Evaluation of Reservoir Pressure

The operator will also support a demonstration of non-endangerment to USDWs by showing that, during the PISC period, the pressure within the Mt. Simon rapidly decreases toward its pre-injection static reservoir pressure. Because the increased pressure during injection is the primary driving force for fluid movement that may endanger a USDW, the decay in the pressure differentials will provide strong justification that the injectate does not pose a risk to any USDWs.

The operator will monitor the downhole reservoir pressure at various locations and intervals using a combination of surface and downhole pressure gauges. The measured pressure at a specific depth interval will be compared against the pressure predicted by the computational model. Agreement between the actual and the predicted values will help validate the accuracy of the model and further demonstrate non-endangerment. Figure 13 provides an illustrative example of how the operator will demonstrate agreement between the computational model prediction and the actual measured parameters at the various monitoring wells and respective measurement depths. This figure shows that during the 10 years of the PISC period, the actual reservoir pressure (red line) falls to pre-injection levels and has a decay rate similar to the rate predicted by the model. Based on risk-based criteria listed in the PISC and Site Closure Plan, pressure decline toward pre-injection levels is one factor indicative of USDW non-endangerment. The close alignment between the predicted and actual pressures will further validate the model's accuracy in representing the reservoir system.

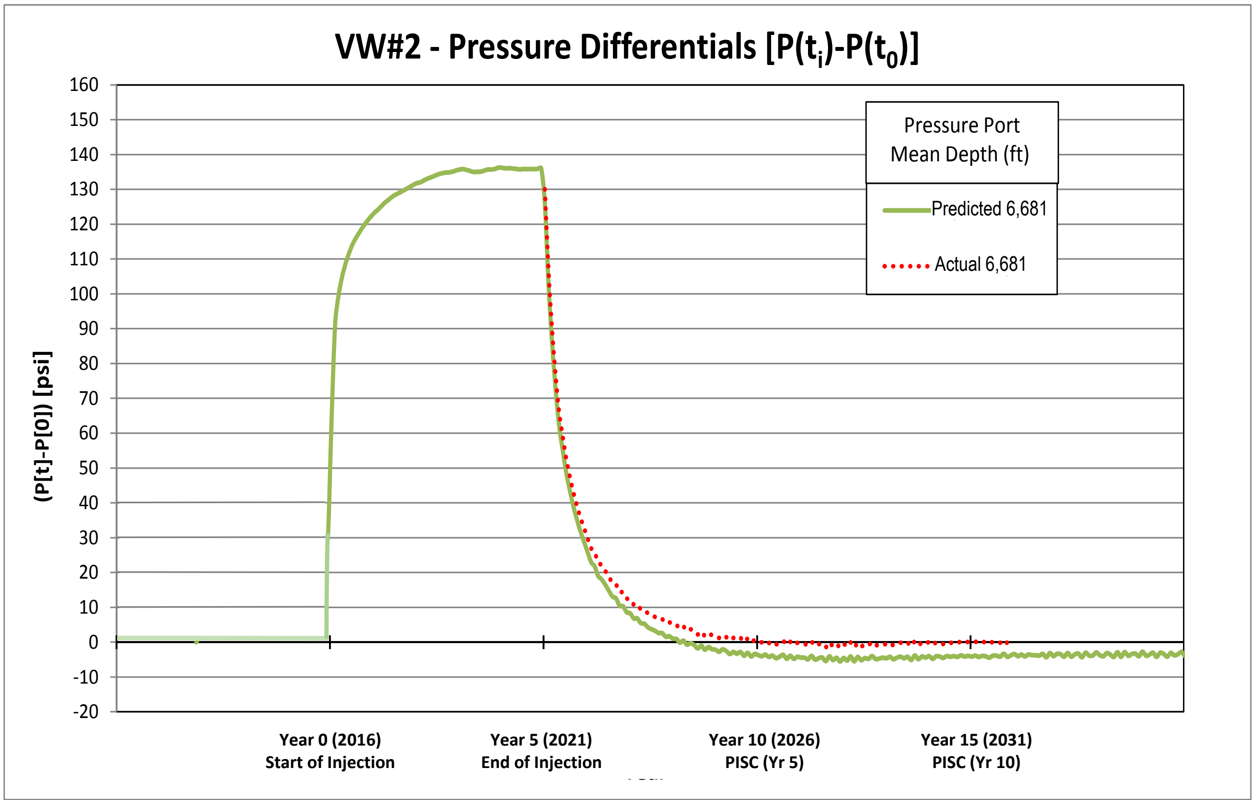


Figure 13. Illustration of Verification Well #2 comparison of actual dP versus the predicted monitoring interval dP during PISC period through year 2031.

One of the key comparisons that may be made is between the observed injection reservoir pressure and the model predicted pressure. Figure 14 shows an illustrative example of differential reservoir pressure predicted for three years after injection ceases, relative to original static reservoir pressure. The contour southwest of the CCS#2 well is the 10 psi contour as predicted by the computational model. Direct observations will be utilized during the PISC period to verify that pressure observations at CCS#2 have declined in conformance with the model. Pressure decline to this level within this time frame is an indication of the excellent lateral continuity within the regionally extensive, open Mt. Simon reservoir. Observed reduction of reservoir pressure to this extent would help validate the model and indicate substantial reduction in the potential of injection-pressure induced brine or CO_2 migration.

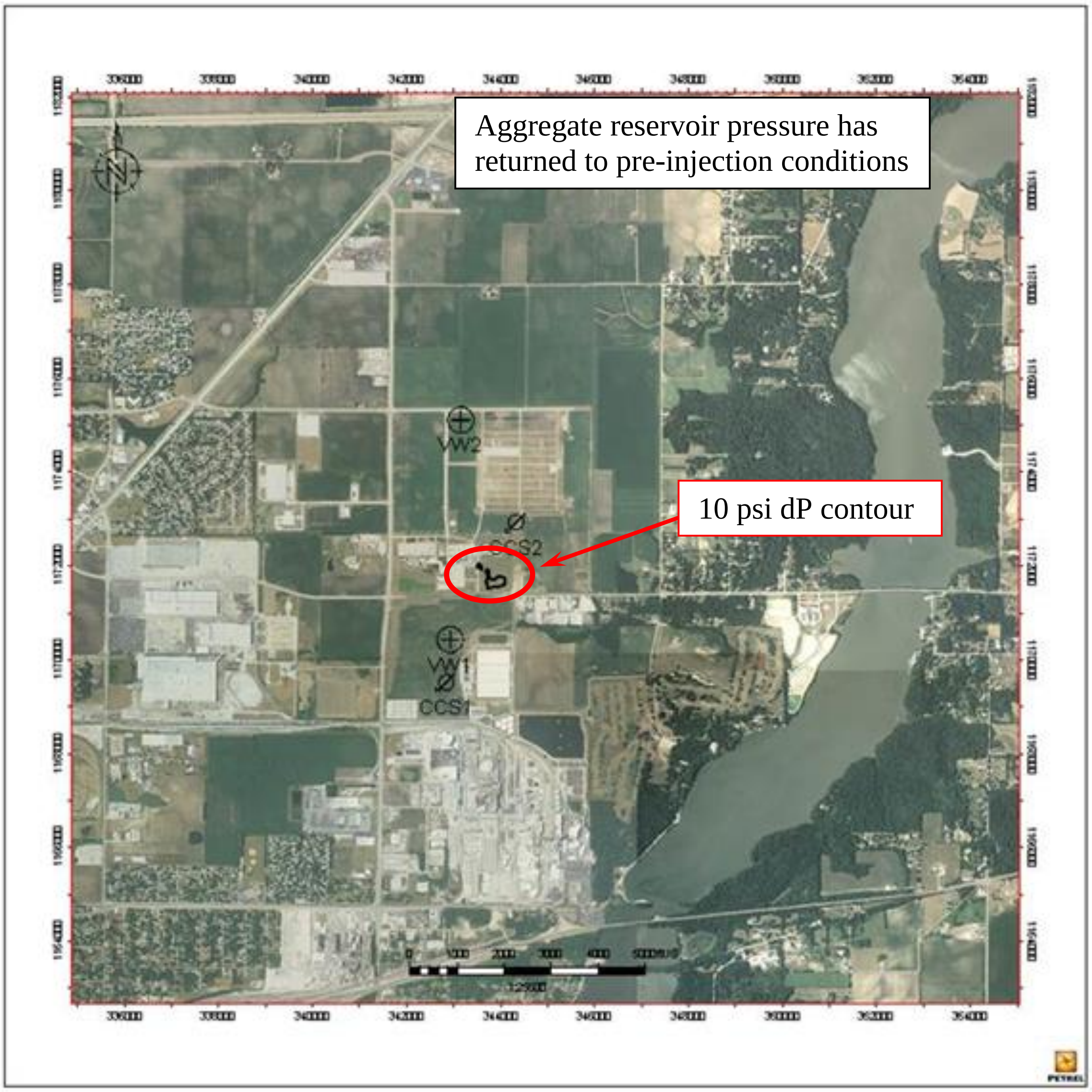


Figure 14. Example of how direct pressure measurements at CCS#1, CCS#2, & VW#2 will support the 10 psi differential pressure contour as predicted by the flow model (inside red circle), shown at April 1, 2024.

Evaluation of Potential Conduits for Fluid Movement

Other than the project wells, there are no identified potential conduits for fluid movement or leakage pathways within the AoR. As shown in Figure 15, the closest penetration of the confining zone is approximately 17 miles from the injection well. Based on the computational model, if the plume were to continue to grow at 1% per year it would take over 600 years for the plume to reach this well. Because this well is down dip from the injection well, it is likely the plume will never reach this location. Based on this information, the potential for fluid movement through artificial penetrations of the seal formation does not present a risk of endangerment to any USDWs.

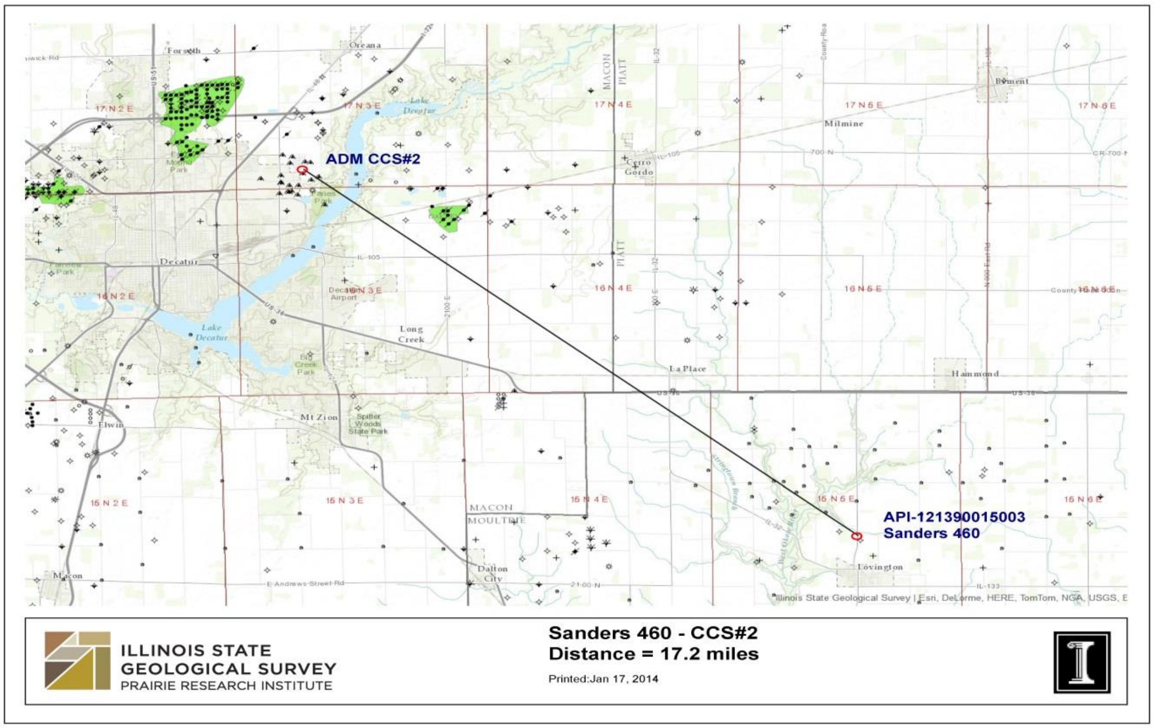


Figure 15. The closest penetration the seal formation (Eau Claire) is 17.2 miles from CCS#2. Based on a plume growth of 1.0% per year, it would take over 600 years for the project's CO_2 plume to reach this well.

Evaluation of Passive Seismic Data

Finally, passive seismic monitoring will be used to help further demonstrate seal formation integrity. The operator will provide seismic monitoring data showing that no seismic events have occurred that would indicate fracturing or fault activation near or through the seal formation. This validation of seal integrity will provide further support for a demonstration that the CO_2 plume is no longer an endangerment to any USDWs. Figure 16 illustrates how these data could be presented. This figure shows a subset of locatable microseismic events occurring during part of the IBDP project's operational period. From this figure one can see that a majority of the microseismic events occur in the lower Mt Simon and the Precambrian basement. No events are observed near the Eau Claire seal formation indicating that no fracturing or fault activation is occurring within this formation. This provides additional verification of the Eau Claire formation's seal integrity and indicates that to date the response to the imposed fluid pressures due to injection are confined to the vicinity of the injection zone and below.

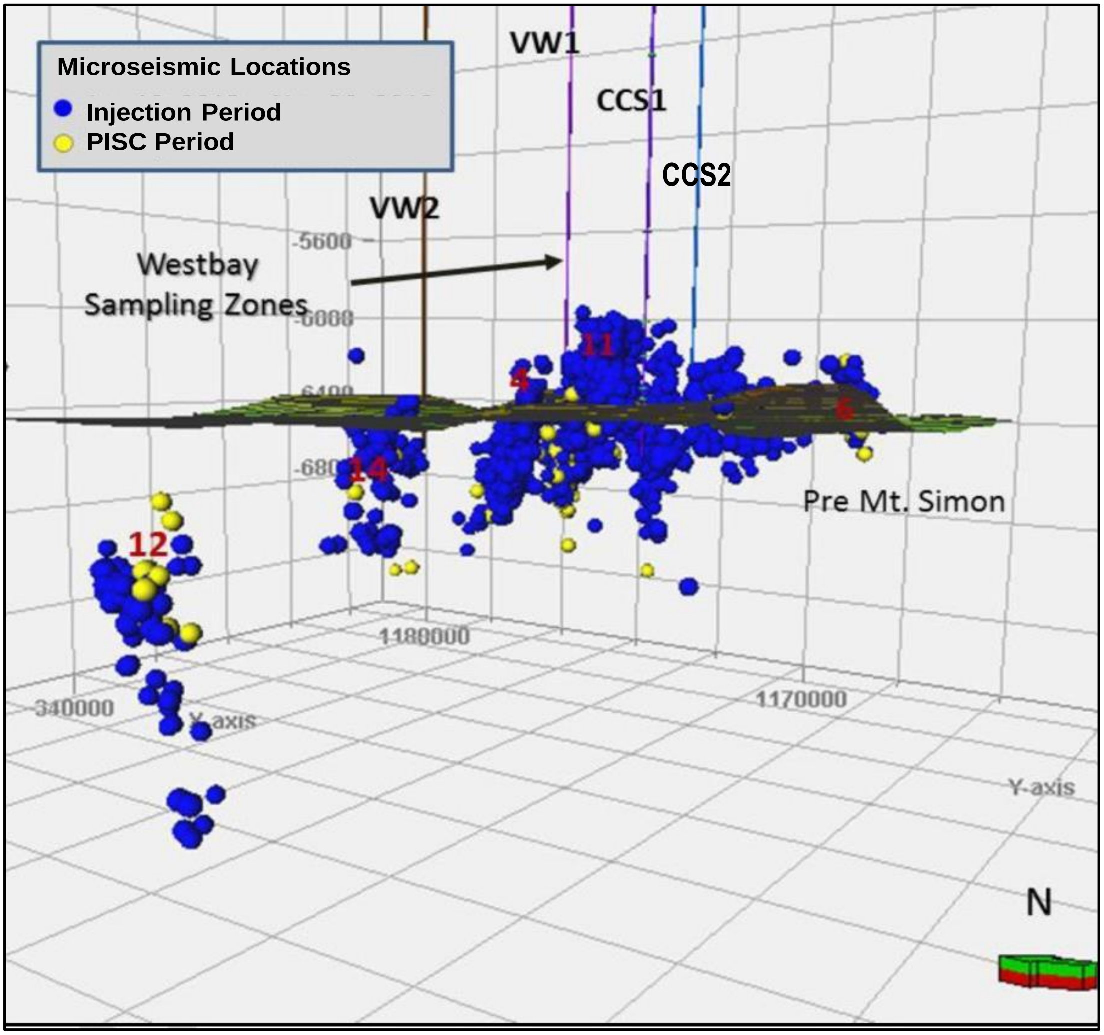


Figure 16. Visual representation showing the microseismic activity occurring during the injection and post injection periods. (Figure provided by IBDP project)

Site Closure Plan

ADM will conduct site closure activities to meet the requirements of 40 CFR 146.93(e) as described below. ADM will submit a final Site Closure Plan and notify the permitting agency at least 120 days prior of its intent to close the site. Once the permitting agency has approved closure of the site, ADM will plug the verification well(s) and geophysical well(s); restore the site and move out all equipment; and submit a site closure report to the Director. The activities, as described below, represent the planned activities based on information provided to EPA in November 2013. The actual site closure plan may employ different methods and procedures. A final Site Closure Plan will be submitted to the Director for approval with the notification of the intent to close the site.

Plugging the Verification Well(s)

The well will be flushed with a kill weight brine fluid. A minimum of three tubing volumes will be injected without exceeding fracture pressure. A final external MIT will be conducted to ensure mechanical integrity. Detailed plugging procedures are provided below. All casing in this well will be cemented to surface and will not be retrievable at abandonment. After injection ceases and after the appropriate post-injection monitoring period is finished, the completion equipment will be removed from the well.

Type and Quantity of Plugging Materials, Depth Intervals

Well cementing software (e.g., Schlumberger's CemCade) will be used to model the plugging and aid in the plug design. The cements used for plugging will be tested in the lab prior to plug placement and both wet and dry samples will be collected during plugging for each plug to ensure quality of the plug.

All of the casing strings will be cut off at least 3 feet below the surface, below the plow line. A blanking plate with the required permit information will be welded to the top of the cutoff casing.

Volume Calculations

Volumes will be calculated for the specific abandonment wellbore environment based on desired plug diameter and length required. The methodology employed will be to:

1) Choose the following:
    - a. Length of the cement plug desired.
    - b. Desired setting depth of base of plug.
    - c. Amount of spacer to be pumped ahead of the slurry.
2) Determine the following:
    - a. Number of sacks of cement required.
    - b. Volume of spacer to be pumped behind the slurry to balance the plug.
    - c. Plug length before the pipe is withdrawn.
    - d. Length of mud freefall in drill pipe.
    - e. Displacement volume required to spot the plug.

Plugging and Abandonment Procedure

At the end of the serviceable life of the verification well, the well will be plugged and abandoned. In summary, the plugging procedure will consist of removing all components of the completion system and then placing cement plugs along the entire length of the well. Prior to placing the cement plugs, casing inspection and temperature logs will be run confirming external mechanical integrity. If a loss of integrity is discovered then a plan to repair using the cement squeeze method will be prepared and submitted to the agency for review and approval. At the surface, the well head will be removed; and the casing will be cut off 3 feet below surface. A detailed procedure follows:

1. Move in workover unit with pump and tank.
2. Record bottom hole pressure using down hole instrumentation and calculate kill fluid density. Pressure test annulus as per annual MIT requirements.
3. Fill both tubings with kill weight brine as calculated from Bottom hole pressure measurement (expected approximately 9.5 ppg).
4. Nipple down well head and nipple up BOPs.
5. Remove all completion equipment from well.
6. Keep hole full with workover brine of sufficient density to maintain well control.
7. Log well with CBL, temperature, mechanical inspection log to confirm external mechanical integrity.
8. Pick up work string (either 2 7/8'' or 3 ½'') and trip in hole to PBTD.
9. Circulate hole two wellbore volumes to ensure that uniform density fluid is in the well.
10. The lower section of the well will be plugged using CO_2 resistant cement from TD around 7150ft to around 800ft above the top of the Eau Claire formation (to approximately 4200 ft). This will be accomplished by placing plugs in 500 foot increments. Using a density of 15.9 ppg slurry with a yield of 1.11 cf/sk, approximately 360 sacks of cement will be required (to incorporate a safety factor, 423 sacks are assumed: 3000 ft X .1305 cu ft/ft x 1.2 excess / 1.11 cf/sk = 423 sacks). Actual cement volume will depend upon actual weight of the casing within the plugged zone. This will require at least six plugs of 500 feet in length. No more than two plugs will be set before cement is allowed to set and plugs verified by setting work string weight down onto the plug.
11. Pull ten stands of tubing (600 ft) out and shut down overnight to wait on cement curing.
12. After appropriate waiting period, TIH ten stands and tag the plug. Resume plugging procedure as before and continue placing plugs until the last plug reaches the surface.
13. Nipple down BOPs.
14. Remove all well head components and cut off all casings below the plow line.
15. Finish filling well with cement from the surface if needed. Total of approximately 464 sacks total cement used in all remaining plugs above 4200 feet (4200 ft X .1305 cu ft/ft / 1.18 cu ft/sk = 464 sks). Cement calculations based on using Class A cement from 4000 ft back to surface with a density of 15.6 ppg and a yield of 1.18 cu ft /sk. Lay down all work string, etc. Clean cellar to where a plate can be welded with well name onto lowest casing string at 3 feet, or as per permitting agency directive.
16. If required, install permanent marker back to surface on which all pertinent well information is inscribed.
17. Fill cellar with topsoil.

18. Rig down workover unit and move out all equipment. Haul off all workover fluids for proper disposal.
19. Reclaim surface to normal grade and reseed location.
20. Complete plugging forms and send in with charts and all lab information to the regulatory agency. Plugging report shall be certified as accurate by ADM and shall be submitted within 60 days after plugging is completed.

Note: 7,000 ft 5 ½" 17 #/ft (7000 ft X .1305 cu ft/ft = 914 cu ft) casing requires an estimated 914 cubic feet of cement to fill 14 plugs. An excess factor of 20% is being suggested on the lower 3000ft to accommodate cement that might be lost to the formation so total material used would be 423 sacks of EverCRETE CO_2 resistant cement and 442 sack Class A/H cement.

Approximately five days are required from move in to move out, depending on the operations at hand and the physical constraints of the well, weather, and other conditions.

See Figure 17 below for a plugging schematic.

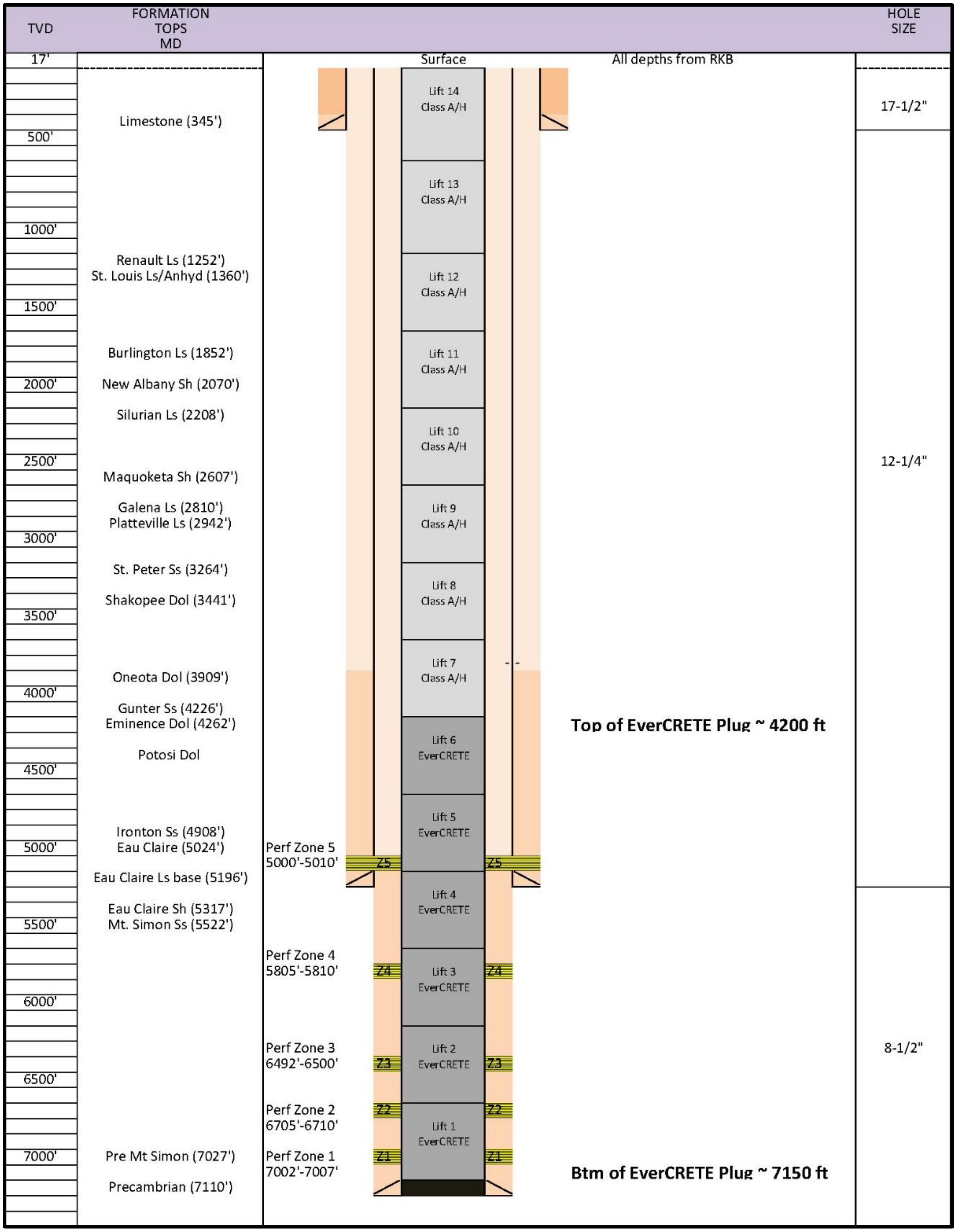


Figure 17. Representative Plugging Schematic - Verification Well.

Plugging the Geophysical Well(s)

At the end of the serviceable life of the well, the well will be plugged and abandoned utilizing the following procedure:

1. Notify the permitting agency of abandonment at least 60 days prior to plugging the well.
2. Remove any monitoring equipment from well bore. Well will contain fresh water or a mixture of fresh water and native St. Peter formation water.
3. Nipple down well head and connect cement pump truck to 4 ½ inch casing. Establish injection rate with fresh water. Mix and pump 247 sacks Class A cement (15.9 ppg). Slow injection rate to ½ bbl/min as cement starts to enter St. Peter perforations. Continue squeezing cement into formation until a squeeze pressure of 500 psi is obtained. Monitor static cement level in casing for 12 hours and fill with cement if needed to top out. Plan to have 50 sacks additional cement above calculated volume on location to top out if needed. (To incorporate a safety factor, 255 sacks are assumed: 3450 ft X .0873 cu ft/ft / 1.18 cu ft/sk = 255 sacks.)
4. After cement cures, cut off all well head components and cut off all casings below the plow line.
5. Install permanent marker at surface, or as required by the permitting agency.
6. Reclaim surface to normal grade and reseed location.

See Figure 18 below for a plugging schematic.

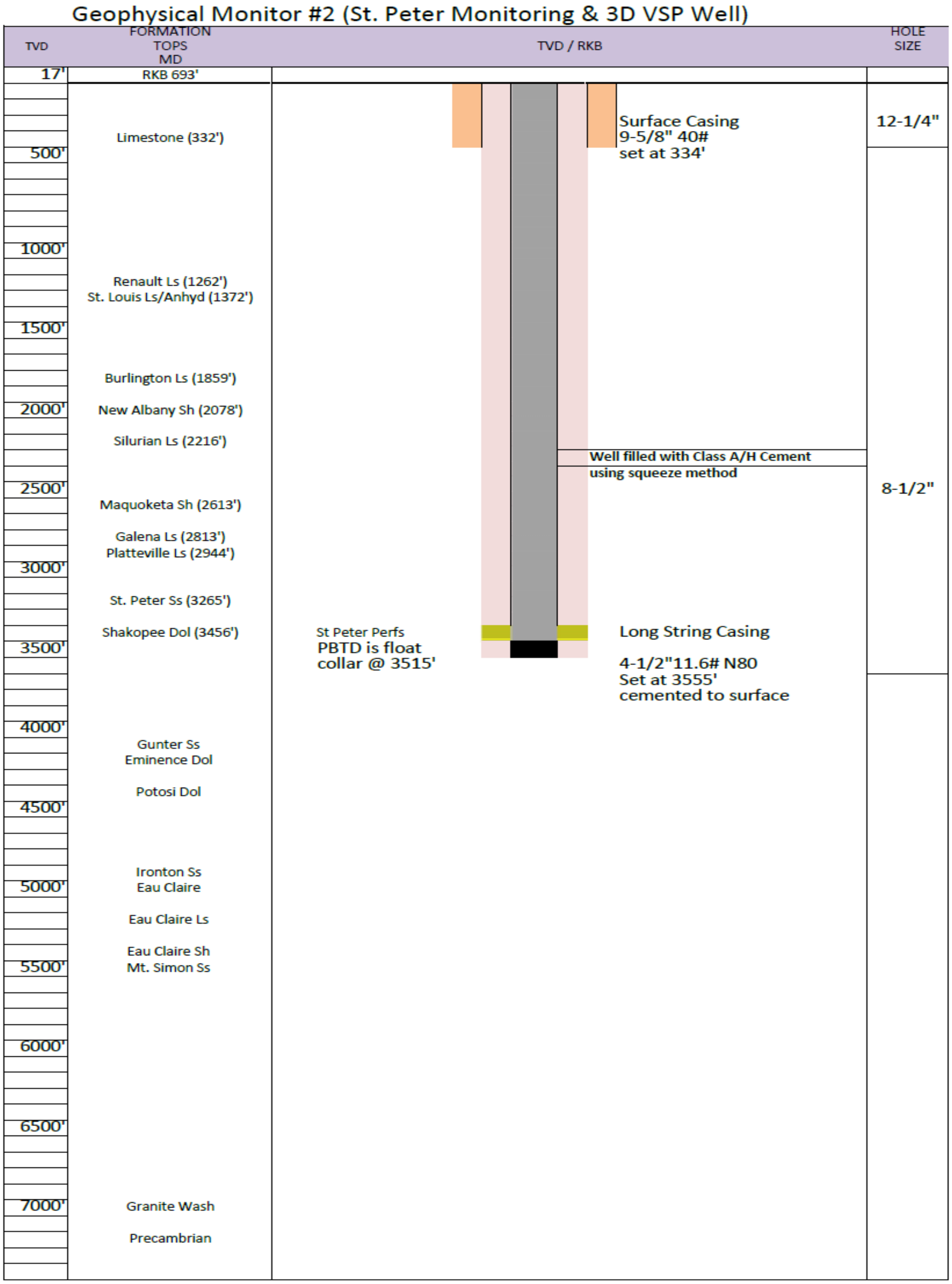


Figure 18. Representative Plugging schematic - geophysical well.

Planned Remedial/Site Restoration Activities

To restore the site to its pre-injection condition following site closure, ADM will be guided by the state rules for plugging and abandonment of wells located on leased property under The Illinois Oil and Gas Act: Title 62: Mining Chapter I: Department of Natural Resources - Part 240, Section 240.1170 - Plugging Fluid Waste Disposal and Well Site Restoration.

The following steps will be taken:

1. The free liquid fraction of the plugging fluid waste, which may consist of produced water and/or crude oil, shall be removed from the pit and disposed of in accordance with state and federal regulations (e.g., injection or in above ground tanks or containers pending disposal) prior to restoration. The remaining plugging fluid wastes shall be disposed of by on-site burial.
2. All plugging pits shall be filled and leveled in a manner that allows the site to be returned to original use with no subsidence or leakage of fluids, and where applicable, with sufficient compaction to support farm machinery.
3. All drilling and production equipment, machinery, and equipment debris shall be removed from the site.
4. Casing shall be cut off at least four (4) feet below the surface of the ground, and a steel plate welded on the casing or a mushroomed cap of cement approximately one (1) foot in thickness shall be placed over the casing so that the top of the cap is at least three (3) feet below ground level.
5. Any drilling rat holes shall be filled with cement to no lower than four (4) feet and no higher than three (3) feet below ground level.
6. The well site and all excavations, holes and pits shall be filled and the surface leveled.

Site Closure Report

A site closure report will be prepared and submitted within 90 days following site closure, documenting the following:

- Plugging of the verification and geophysical wells (and the injection well if it has not previously been plugged),
- Location of sealed injection well on a plat of survey that has been submitted to the local zoning authority,
- Notifications to state and local authorities as required at 40 CFR 146.93(f)(2),
- Records regarding the nature, composition, and volume of the injected CO_2, and
- Post-injection monitoring records.

ADM will record a notation to the property's deed on which the injection well was located that will indicate the following:

- That the property was used for carbon dioxide sequestration,

- The name of the local agency to which a plat of survey with injection well location was submitted,
- The volume of fluid injected,
- The formation into which the fluid was injected, and
- The period over which the injection occurred.

The site closure report will be submitted to the permitting agency and maintained by the operator for a period of 10 years following site closure. Additionally, the operator will maintain the records collected during the PISC period for a period of 10 years after which these records will be delivered to the Director.

Quality Assurance and Surveillance Plan (QASP)

The Quality Assurance and Surveillance Plan is presented in the Appendix of the Testing and Monitoring Plan.