ATTACHMENT E: POST-INJECTION SITE CARE AND SITE CLOSURE PLAN
40 CFR 146.93(a)

CTV V

1.0 Document Version History

Version	Revision Date	File Name	Description of Change
1	6/12/2023	Att E - CTV V PISC_v1	Original Submission
2	9/11/2023	Att E - CTV V PISC_v2	Edits to Section 6 to address administrative completeness

2.0 Facility Information

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This Post-Injection Site Care (PISC) and Site Closure Plan describes the activities that Carbon TerraVault Holdings, LLC (CTV) will perform to meet the requirements of 40 CFR 146.93. CTV will monitor groundwater quality and track the position of the carbon dioxide (CO_2) plume and pressure front during the post-injection period. CTV will not cease post-injection monitoring until a demonstration of non-endangerment of underground sources of drinking water (USDWs) has been approved by the UIC Program Director pursuant to 40 CFR 146.93(b)(3). Following approval for site closure, CTV will plug all monitoring wells, restore the site to its original condition, and submit a site closure report and associated documentation.

3.0 Pre- and Post-Injection Pressure Differential [40 CFR 146.93(a)(2)(i)]

Injection is planned to commence for 25 years. Based on the computational modeling, Upper and Lower Injection Zone pressure is expected to stabilize approximately 20 years after injection ceases (see **Attachment B** Figure 4.5). Injection limits will be based on the fracture pressure of the Upper and Lower Injection Zones. Additional information on the projected post-injection pressure declines and differentials is presented in the Narrative Permit Application (**Attachment A**), and the Area of Review (AoR) and Corrective Action Plan (**Attachment B**).

Using the base case scenario of 100% CO_2 injectate, **Figure 3.1** shows the modeled pressure at monitoring well locations KI-M-M1, KI-M-M2, KI-M-S1, and KI-M-S2 at top perforation point (TPP) during the injection period and 100 years post-injection. **Figure 3.2** shows the pressure increase at monitoring well locations KI-M-M1, KI-M-M2, KI-M-S1, and KI-M-S2 at TPP during the injection period and 20 years post-injection. Pressure decline trends are discussed further in Section 6.2, below.

The storage reservoir will be operated such that the bottom-hole injection pressures will not exceed the fracture pressure of the reservoir with a 10% safety factor. This operating strategy is to minimize the potential for induced seismicity and to ensure confinement of the injectate.

4.0 Predicted Position of the CO_2 Plume and Associated Pressure Front at Site Closure [40 CFR 146.93(a)(2)(ii)]

Figure 4.1 shows the predicted maximum extent of the plume (100 years post-injection) and pressure at the end of the PISC timeframe, representing the maximum extent of the plume and pressure front. This map is based on the final AoR delineation modeling results submitted pursuant to 40 CFR 146.84 (**Attachment B**).

5.0 Post-Injection Monitoring Plan [40 CFR 146.93(b)(1)]

Monitoring during the post-injection phase will include pressure monitoring and fluid composition monitoring within injection zones and above the upper confining zone. The monitoring plan described in the following sections 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 90 days of the end of each year, as described under "Schedule for Submitting Post-Injection Monitoring Results" below.

The Testing and Monitoring Plan describes the monitoring strategies within the injection zone, above the confining zone, and within any USDW. A quality assurance and surveillance plan (QASP) for all testing and monitoring activities during the injection and post-injection phases is provided in **Appendix 10**.

Pressure monitoring of the Upper Injection Zone and Lower Injection Zone storage reservoirs will monitor for pressure stabilization. This is the best method to confirm confinement of the reservoir. If pressures in the reservoir trends are inconsistent when compared to computational modeling results, CTV will assess for potential leakage. Throughout the AoR there are USDWs in formations overlying the confining zones. As such, ongoing groundwater monitoring of the USDWs will assess potential impacts. Groundwater samples will be analyzed annually for indicators of CO_2 movement into the USDWs.

CTV has obtained surface access rights for the duration of the project.

5.1 Monitoring Above the Confining Zone

Table 1 presents the monitoring methods, locations, and frequencies for monitoring above the confining zone. **Table 2** identifies the parameters to be monitored and the analytical methods CTV will employ. **Table 3** presents sampling and recording frequencies for continuous monitoring.

5.2 Carbon Dioxide Plume and Pressure Front Tracking [40 CFR 146.93(a)(2)(iii)]

CTV will employ direct and indirect methods to track the extent of the CO_2 plume and the presence or absence of elevated pressure.

Table 4 presents the direct and indirect methods that CTV will use to monitor the CO_2 plume, including the activities, locations, and frequencies CTV will employ. The parameters to be analyzed as part of fluid sampling in the Upper Injection Zone and Lower Injection Zone (and associated analytical methods) are presented in **Table 5**.

Table 6 presents the direct and indirect methods that CTV will use to monitor the pressure front, including the activities, locations, and frequencies CTV will employ. Direct monitoring will include pressure gauges to monitor the pressure of the CO_2 plume in the two Upper Injection Zone and two Lower Injection Zone monitoring wells. Additionally, seismic monitoring via installed surface and/or shallow borehole seismometers will be utilized to detect micro-seismic events.

Fluid sampling will be performed as described in Section B.1. of the QASP; sample handling and custody will be performed as described in Section B.3. of the QASP; and quality control will be ensured using the methods described in Section B.5. of the QASP.

Using the base case scenario of 100% CO_2 injectate, **Figure 5.1** shows the location of the injection wells and the predicted CO_2 plume development through time in plan view for the upper and lower storage reservoirs. **Figure 5.2** shows the location of the injection wells and the predicted CO2 plume development through time in cross-section.

5.3 Schedule for Submitting Post-Injection Monitoring Results [40 CFR 146.93(a)(2)(iv)]

All post-injection site care monitoring data and monitoring results collected using the methods described above will be submitted to EPA in annual reports submitted within 90 days following the anniversary date on which injection ceases. The reports will contain information and data generated during the reporting period (i.e., well-based monitoring data, sample analysis, and the results from updated site models).

6.0 <u>Alternative Post-Injection Site Care Timeframe</u>

An alternative PISC timeframe of 25 years (as compared to the default of 50 years) is appropriate based on the results of the detailed geologic analyses and numerical plume and pressure-front modeling presented in **Attachment A** (Narrative Permit Application Report) and **Attachment B** (AoR and Corrective Action Plan). In addition to the factors discussed below, a shorter PISC timeframe is supported because the CTV V project injection wells will inject for a maximum of 25 years in the Upper Injection Zone and 15 years in the Lower Injection Zone (see **Attachment B** Table 3.4).

Injection well and monitoring well construction are presented in **Appendix 5**, and wells will be constructed and plugged for the case of the injection wells in order to maintain integrity and prevent fluid leakage.

6.1 Computational Modeling Results

Site-specific computational modeling was conducted to evaluate plume and pressure front migration and CO_2 trapping processes. Computational modeling was completed using Schlumberger's ECLIPSE 300 (E300) Equation of State Compositional Simulator. Two separate static geological models, one for the Upper Injection Zone and one for the Lower Injection Zone were developed based on site-specific geologic data and served as input to the two corresponding simulation models. Details on modeling methods, results, and sensitivity analyses, are presented in **Attachment B** (AoR and Corrective Action Plan). These results are used for discussion of plume and pressure front migration and site-specific trapping processes below.

6.2 Predicted Timeframe for Pressure Decline

Figure 3.1 to this plan displays simulated pressure at the location of the monitoring wells and Figure 4.5 to **Attachment B** displays average pore-volume pressure in the AoR region for the upper and lower injection zones.

In the Upper Injection Zone, average initial pressure (prior to injection) is predicted to be approximately 2,400 pounds per square inch (psi), and increase to a maximum of 2,525 psi during the injection period and drop to 2,450 psi at the end of injection. After the injection period, pressure is predicted to rapidly decline to 2,420 psi 6 years after the end of injection. At that point, pressure decreases asymptotically, approaching a pressure of 2,415 psi.

In the Lower Injection Zone, average initial pressure is predicted to be approximately 3,040 psi, and increase to a maximum of 3,140 psi during the injection period and drop to 3,120 psi at the end of injection. After the injection period, pressure is predicted to rapidly decline, to 3,095 psi 6 years after the end of injection and 3,063 psi 25 years after the end of injection. At that point, pressure decreases asymptotically, approaching a pressure of 3,053 psi.

The pressure at the monitoring well locations is plotted in **Figure 3.1** for reference. The pressure at the monitoring well location declines to below the respective critical pressures within 22 years of the end of injection, which is denoted by the "star" symbol. Predicted pressure at KI-I-M2 never exceeds its critical pressure.

6.3 Predicted Rate of Plume Migration

Figure 5.1 displays the location of the simulated upper and lower injection zone CO_2 plumes at various times. For the Upper Injection Zone, plumes are shown 1, 5, 10, 20, 25 (end of injection period), 50, and 100 years post-injection. The upper zone CO_2 plume is predicted to move slowly after the injection period, with a maximum lateral expansion of 2,920 feet from the end of injection to 100 years post-injection (29 feet per year). For the Lower Injection Zone, plume outlines are shown for 1, 5, 10, 15 (end of injection), 25, 50, and 100 years after injection ends, and maximum lateral expansion is 4,220 feet from the end of injection to 100 years post-injection (42 feet per year).

During the lifetime of the project the separate-phase CO_2 plume is predicted to intersect five existing wells that will be properly plugged and abandoned and no other sensitive receptors (**Attachment B** Figure 5.1). EPA Class VI Well Plugging, PISC and Site Closure Guidance states that when the plume is migrating at a negligible rate as compared to the location of sensitive receptors, the plume migration rate may be considered sufficiently minor as to not pose an endangerment to USDWs. The rate of movement predicted for the CTV V storage project and lack of interface with sensitive receptors that have not already been identified and addressed supports a PISC timeframe of 25 years.

6.4 Site-Specific Trapping Processes

At the CTV V site, site-specific computational modeling indicates CO_2 trapping will occur primarily by capillary trapping and CO_2 dissolution in the brine. Equilibrium geochemical modeling is presented in **Appendix 3** and indicates only minor CO_2 mineralization as compared to other trapping processes. Geochemical modeling in **Appendix 3** is based in part on the results of laboratory studies of geologic core and fluid geochemistry collected in the vicinity of the CTV V project. Equilibrium geochemical modeling of the injection of CO_2 indicates that changes in mineralogy and aqueous chemistry are likely to occur, but overall, geologic units are composed dominantly of silicate minerals such as quartz and feldspar that are not expected to be highly reactive during CO_2 sequestration. More reactive minerals like calcite and pyrite are present in relatively smaller amounts compared to the silicate minerals. Site-specific geochemical modeling does support that CO_2 will dissolve into solution (dissolution trapping).

Based on site-specific computational modeling (**Attachment B**), the majority of the CO_2 injectate is projected to remain as separate-phase CO_2 ("capillary trapping"), including 65% of total injected mass for the Upper Injection Zone and 66% for the Lower Injection Zone at the end of the simulation. The remaining portion of the CO_2 is projected to dissolve in the formation brine ("dissolution trapping"). **Figure 6.1a/b** shows the cumulative storage for each of the trapping processes. These site-specific results are consistent with scientific research studies of key CO_2 trapping processes in saline reservoirs (Krevor et al., 2015). As discussed below the fraction of CO_2 predicted to be stored via capillary trapping in pore space also remains relatively constant in the post-injection period, supporting a reduced PISC timeframe.

A total of 16.7 million metric tons (MMT) of CO_2 are planned to be emplaced during the 25-year injection period (trapping rate of 0.7 MMT/yr), 10.3 MMT in the Upper Injection Zone and 6.4 MMT in the Lower Injection Zone. In the Upper Injection Zone, at the end of the injection period, 7.7 MMT are present in the supercritical phase (75%), and 2.4 MMT are dissolved in the brine (25%). After injection ceases, the supercritical plume redistributes itself and continues to dissolve into the aqueous phase. At the end of the 25-year PISC period, 72% (7.4 MMT) of the injected CO_2 is stored in the pore space as a supercritical phase, and the remaining 28% percent (2.8 MMT) are dissolved in the aqueous phase. The percentage of CO_2 in the supercritical phase remains similar for the remainder of the model simulation. At the end of the simulation (100 years after the end of injection), 65% of the mass is supercritical (6.7 MMT) and 35% is dissolved in the brine (3.5 MMT).

For the Lower Injection Zone, at the end of the injection period, 5.1 MMT are present in the supercritical phase (80%), and 1.3 MMT are dissolved in the brine (20%). At the end of the 25-year PISC period, 75% (4.8 MMT) of the injected CO_2 is stored in the pore space as a supercritical phase, and the remaining 25% percent (1.6 MMT) are dissolved in the aqueous phase. These remain similar for the remainder of the model simulation. At the end of the simulation (100 years after the end of injection), 65% of the mass is stored in the pore space (4.2 MMT) and 35% is dissolved in the brine (2.2 MMT).

6.5 Confining Zone Characterization

The Narrative Permit Application Report (**Attachment A**) includes a detailed evaluation of the Capay Shale formation, a regionally continuous sealing facies present throughout the Sacramento Basin that acts as the upper confining zone for the storage project. The Capay Shale ranges from 72 to 4,154 feet thick throughout the AoR (**Attachment A** Table 2.4-5). The geometric average permeability of the upper confining zone is 2.4 mD (**Attachment A** Section 2.4.2.1). Geochemical modeling indicates that the Capay Shale will not be significantly reactive with CO_2 (**Appendix 3**). There are no transmissive faults through the Capay Shale at the site. These attributes indicate that the confining zone will restrict upwards fluid movement and support a reduced PISC timeframe.

6.6 Assessment of Fluid Movement Potential

The AoR and Corrective Action Plan (**Attachment B**) presents information on abandoned wells within the AoR. **Appendix 6** contains a wellbore list with corrective action assessment. There are 76 wells within the AoR that penetrate either the upper or lower injection zones. Four wells located within the CO_2 plumes and have been identified for corrective action. If isolation of this formation is determined to be deficient in such a way that USDW may be impacted, corrective action plans will be communicated and implemented prior to injection to ensure non-endangerment of USDW. Before the date of site closure, all wells in the AoR will have been evaluated and if necessary appropriately plugged and will not be a potential conduit for fluid movement.

6.7 Location of USDWs

Delineation of the depth to the top of the injection zone and the depth of the lowermost USDW are discussed in the Narrative Permit Application Report (**Attachment A**). **Attachment A** Figure 2.2-4 presents a cross-section showing the USDW depth and key geologic formations. Distance between the upper injection zone and the lowermost USDW ranges between approximately 700 to 1,200 feet along this cross-section. There is significant thickness that exists between the injection zone and lowermost USDW, which as described in **Attachment A**, consists of several fine-grained geologic units. Along with the other analyses previously described, the significant thickness between the injection zone and lowermost USDW is another assurance of the limited risk to USDW and supports a shorter PISC timeframe.

7.0 <u>Non-Endangerment Demonstration Criteria</u>

Prior to authorization of site closure, CTV will submit a demonstration of non-endangerment of USDWs to the Director as per 40 CFR 143.93(b)(2) or (3).

CTV will provide a report to the Director that demonstrates USDW non-endangerment based on the evaluation of site monitoring data. The report will detail how the non-endangerment determination is based on site-specific conditions, supported with the computational model. All relevant monitoring data and interpretations will be provided.

7.1 Summary of Monitoring Data

A summary of the site monitoring data, pursuant to the Testing and Monitoring Plan and this PISC and Site Closure Plan, including data collected during the injection and PISC phases of the project will be presented. Data submission will be in a format acceptable to the Director and will include:

1. A narrative that explains the monitoring activities,
2. Dates of all monitoring events,
3. A description of changes to the monitoring program over time,
4. An explanation of all monitoring information that has existed at the site,
5. An explanation of how the monitoring data from injection and PISC has varied from the baseline data during site characterization, and
6. A summary of any emergencies that occurred during the injection and post-injection phases of the project. Included will be a description of how any issues have been resolved and that there is no endangerment to the USDW.

7.2 Evaluation of the CO_2 Plume and the AoR

Computational modeling results calibrated with monitoring data (e.g., pressure) will be used to support that the plume has stabilized and that the pressure change is negligible (less than 10 psi per year) and poses no risk for potential vertical migration. Computational modeling results calibrated with monitoring data from storage reservoir, USDW, and above-zone will be used to demonstrate:

1. The lack of CO_2 leakage over the project timeframe,
2. The accuracy of the model to predict and represent the storage reservoir, and
3. The computational model's adequate definition of the AoR.

7.3 Evaluation of Reservoir Pressure

Monitoring data will be reviewed to ensure that the CO_2 plume has stabilized post-injection and that the reservoir pressure change is negligible (less than 10 psi per year). This demonstration will be supported by the computational model that has been calibrated with the most recent monitoring data. The plume is trapped by pinch-out of the reservoir sands. Plume migration is minimal, as such pressure stabilization will be used for non-endangerment assessment.

7.4 Evaluation of Potential Conduits for Fluid Movement

Wells that require corrective action will be reviewed and assessed prior to PISC and Site Closure. This includes monitoring wells, injection wells, and other wells that penetrate within the AoR and the confining layer. Final demonstration will be made that natural and artificial conduits will not allow fluid migration from the storage reservoir.

7.5 Evaluation of Seismicity Monitoring

Demonstration will be made that the plume has stabilized and the pressure change is negligible (less than 10 psi per year), minimizing the risk for induced seismicity after site closure. Final review will be made with the seismicity monitoring to demonstrate seal integrity and that there is no further endangerment of the USDW.

8.0 Site Closure Plan

CTV will conduct site closure activities to meet the requirements of 40 CFR 146.93(e), with notification to the permitting agencies at least 120 days prior to its intent to close the site. Upon approval of the permitting agencies, CTV will plug the injection and monitoring wells, restore the site, and submit a site closure plan to the EPA.

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

1. Verification of injector and monitoring well plugging,
2. Notifications to state and local authorities per 40 CFR 146.93 (f)(2),
3. Composition and volume of the injected CO_2, and
4. Post-injection monitoring records.

CTV will record a notation to the property deed that will indicate:

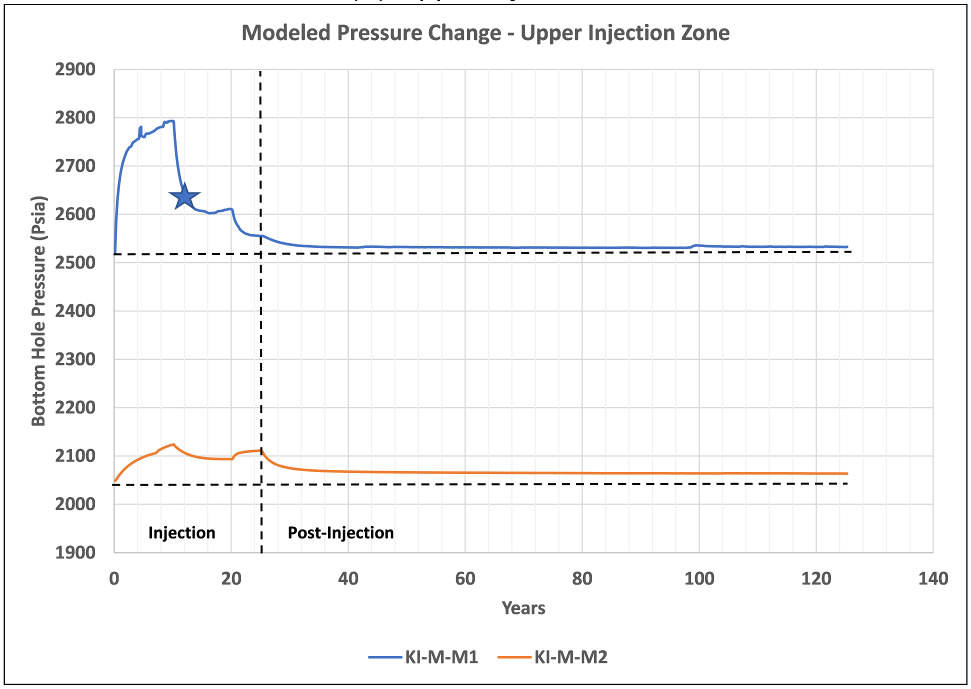
1. The property was used for CO_2 sequestration, the period of injection, and the volume of CO_2 injected,
2. The formation into which the fluid was injected, and
3. The name of the local agency to which a plat of survey with injection well locations was submitted.

9.0 References

Krevor, S., M.J. Blunt, S.M. Benson, C.H. Pentland, C. Reynolds, A. Al-Menhali, and B. Niu. 2015. Capillary trapping for geologic carbon dioxide storage – From pore scale physics to field scale implications. *International Journal of Greenhouse Gas Control* 40: 221-237. <https://doi.org/10.1016/j.ijggc.2015.04.006>.

FIGURES

(A) Upper Injection Zone



(B) Lower Injection Zone

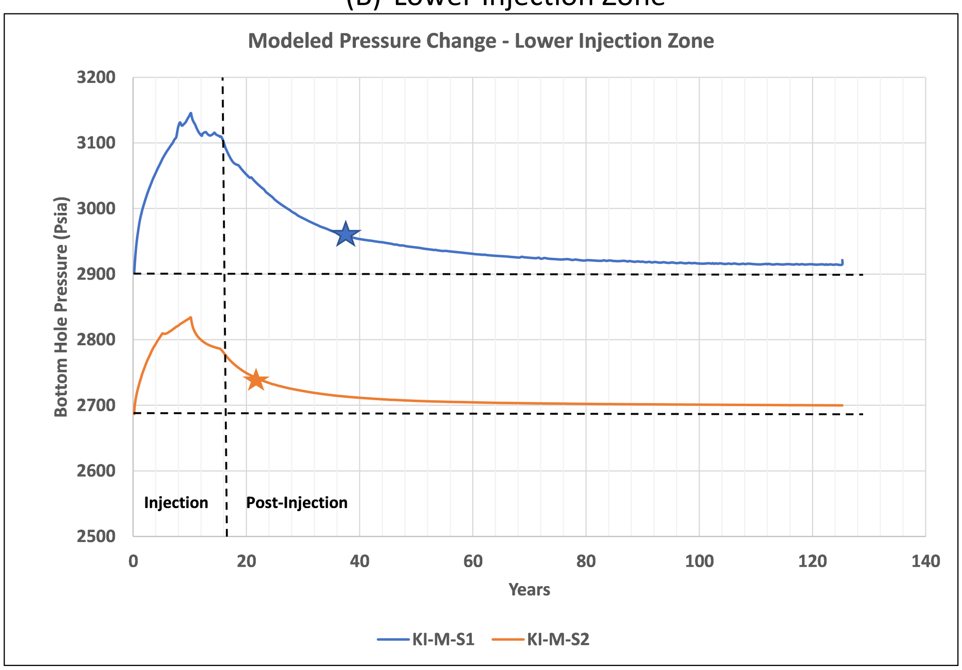
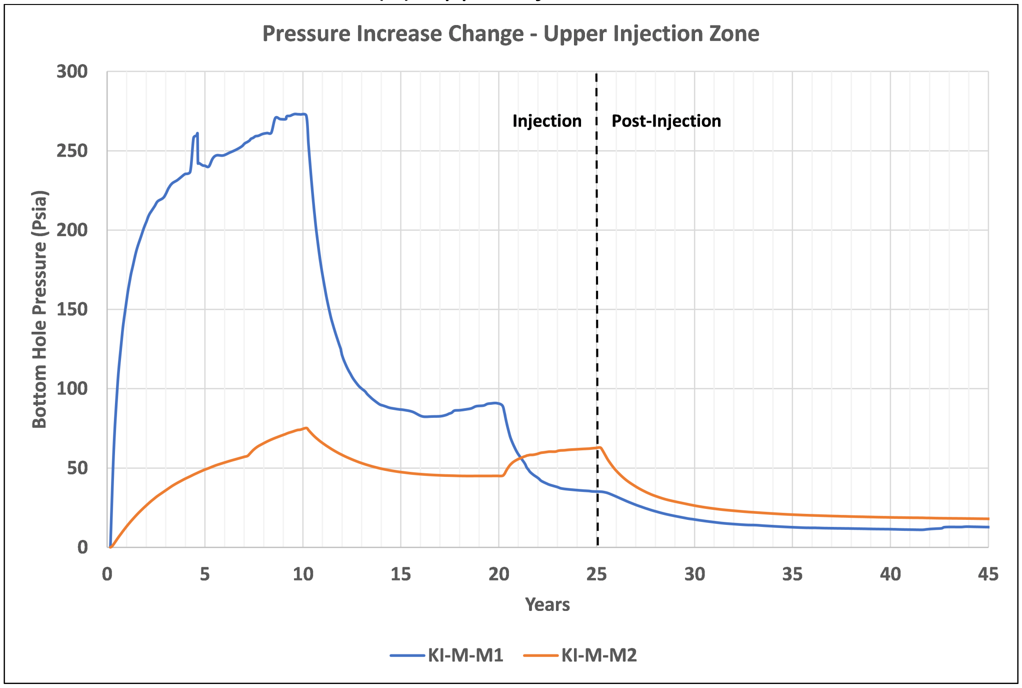


Figure 3.1: Modeled pressure at monitoring well locations KI-M-M1, KI-M-M2 (Upper Injection Zone), KI-M-S1 and KI-M-S2 (Lower Injection Zone) at top of perforation (TPP) during the injection period and 100 years post injection. Horizontal dashed line indicates initial pressure. The star symbol denotes the critical pressure required at the specific monitoring well locations and as can be seen the pressures drop below critical pressure within 22 years of the end of injection.

(A) Upper Injection Zone



(B) Lower Injection Zone

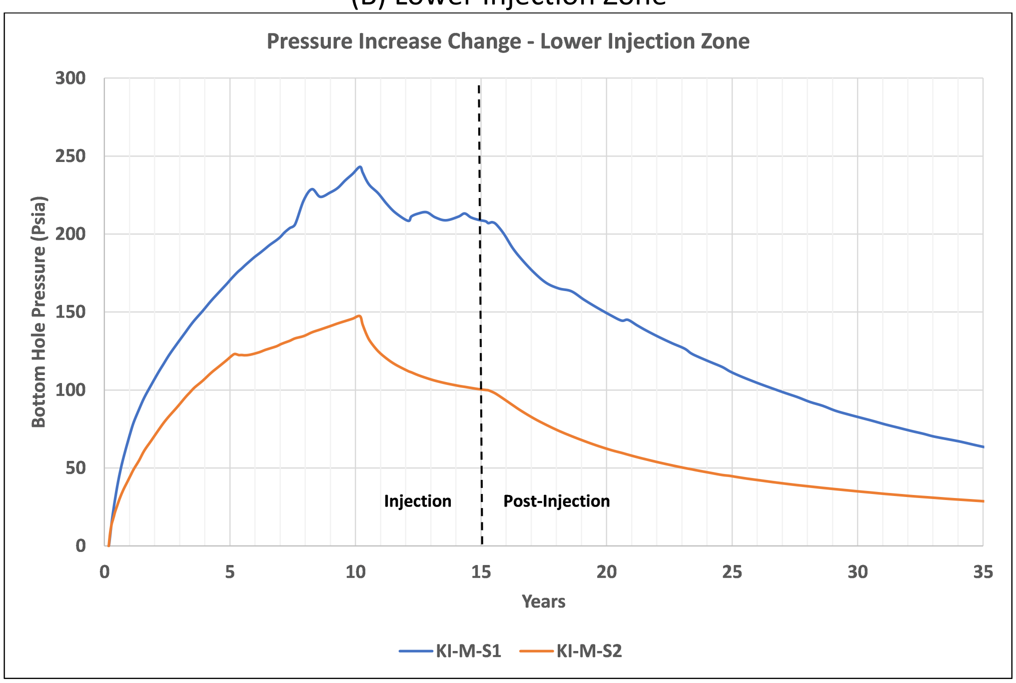


Figure 3.2: Pressure increase at monitoring well locations KI-M-M1, KI-M-M2 (Upper Injection Zone), KI-M-S1 and KI-M-S2 (Lower Injection Zone) at top of perforation (TTP) during the injection period and 20 years post injection for the storage site.

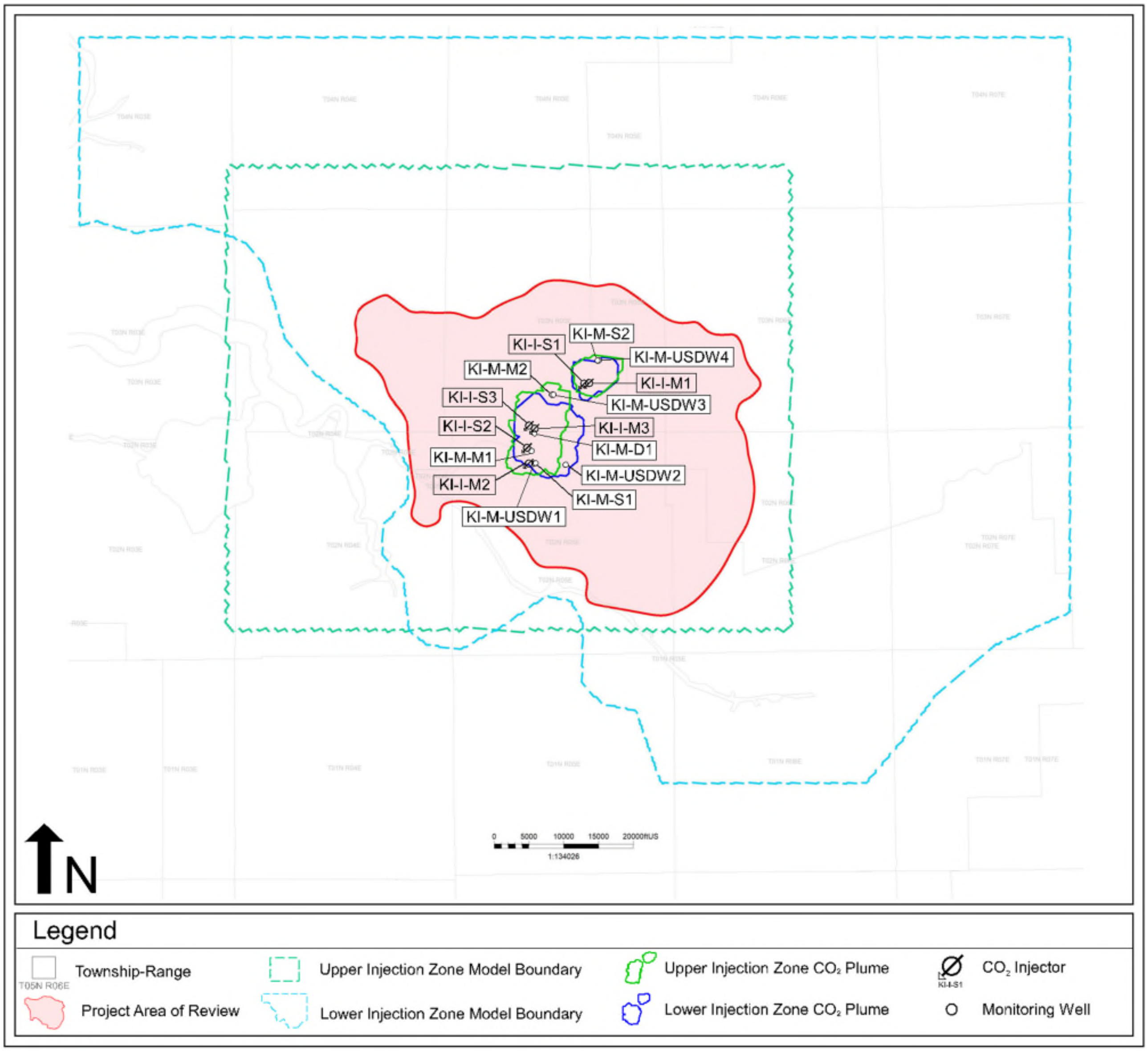


Figure 4.1: Map of the predicted extent of the CO_2 plume at site closure.

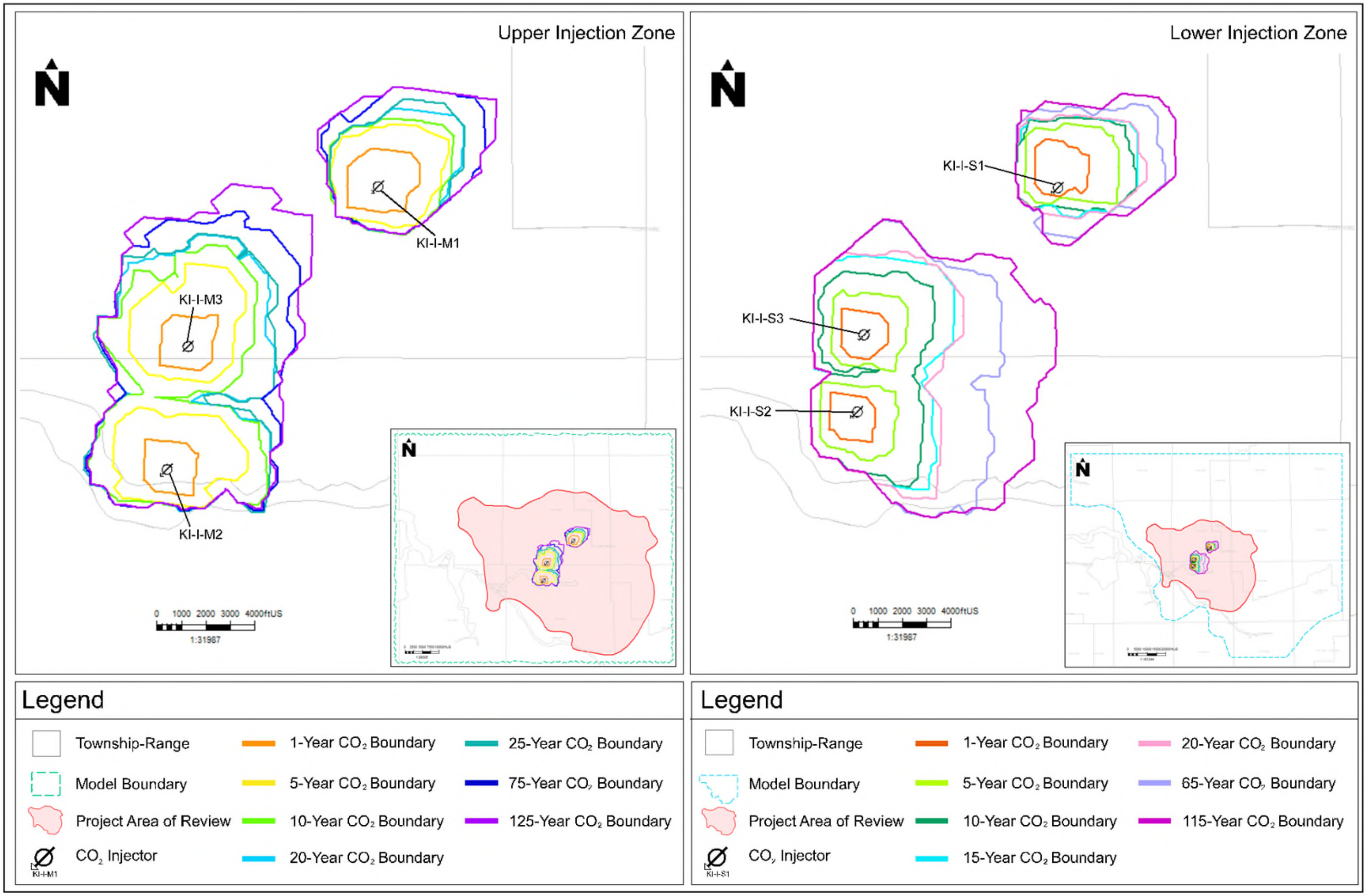


Figure 5.1: Upper Injection Zone plume development through time: 1-year, 5-year, 10-year, 15-year, 20-year, 25-year (end of injection), and 50-year and 100-year post injection (Left). Lower Injection Zone plume development through time: 1-year, 5-year, 10--year, 15-year (end of injection), and 5-year, 50-year, and 100-year post injection (Right).

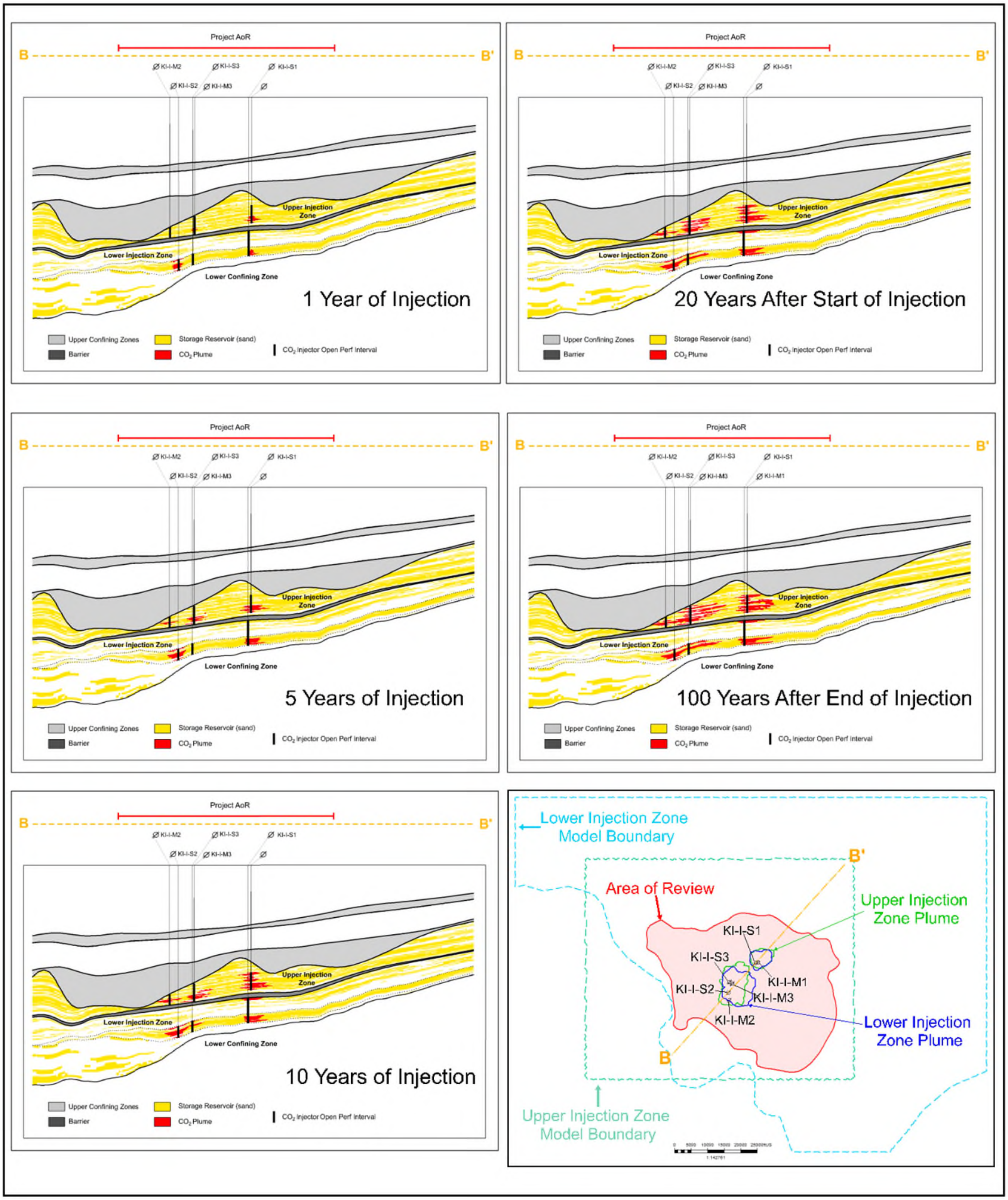
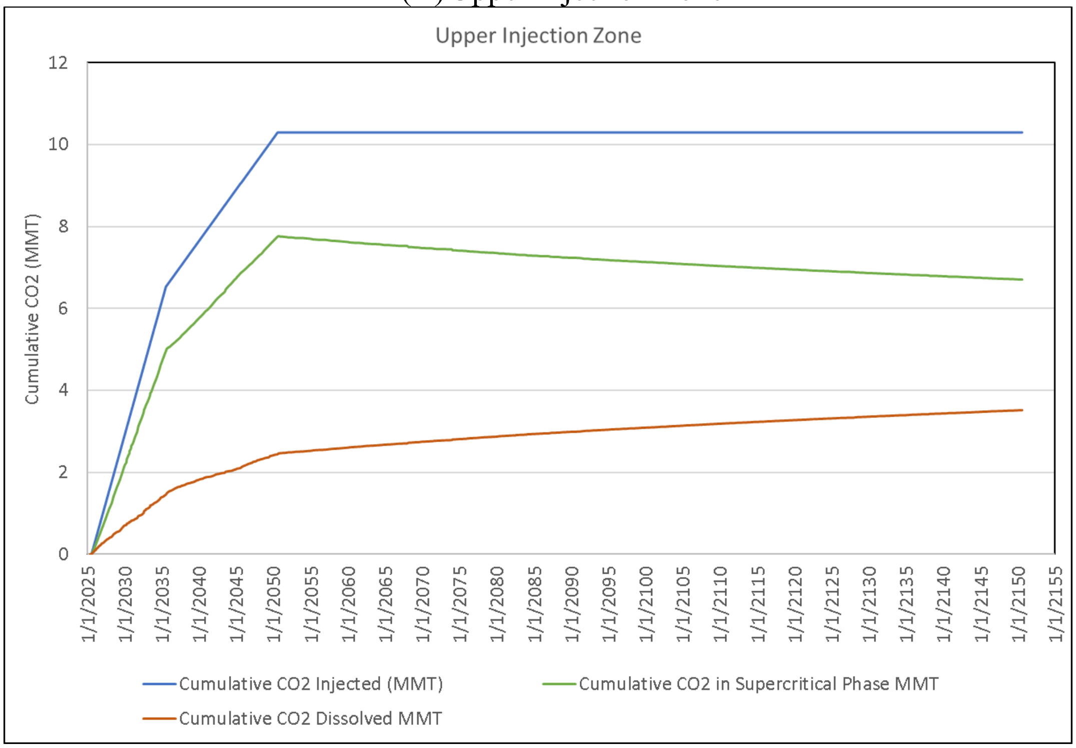


Figure 5.2. Cross sections showing plume development at varying time steps through the project area.

(A) Upper Injection Zone



(B) Lower Injection Zone

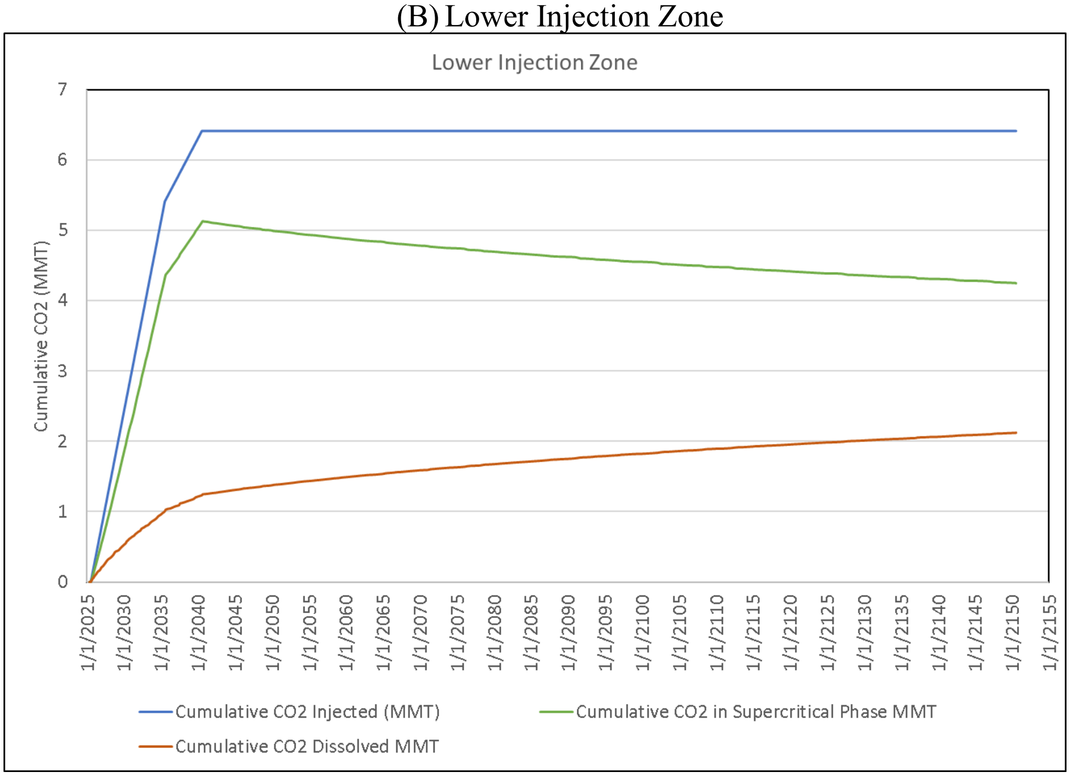


Figure 6.1 CO_2 trapping processes based on site-specific computational modeling.

TABLES

Table 1. Monitoring of ground water quality and geochemical changes above the confining zone

Target Formation	Monitoring Activity	Device	Data Collection Location(s)	Spatial Coverage or Depth	Frequency (Post-Injection Phase)
Nortonville: Ground Water Monitoring Above Confining Zone	Fluid Sampling	Pump	KI-M-USDW1 KI-M-USDW2 KI-M-USDW3 KI-M-USDW4	2,510' - 2,530' MD/VD 2,490' - 2,510' MD/VD 2,150' - 2,170' MD/VD 1,970' - 1,990' MD/VD	Annual
	Pressure	Pressure Gauge	KI-M-USDW1 KI-M-USDW2 KI-M-USDW3 KI-M-USDW4	2,470' MD/VD 2,450' MD/VD 2,110' MD/VD 1,930' MD/VD	Continuous
	Temperature	Temperature Sensor	KI-M-USDW1 KI-M-USDW2 KI-M-USDW3 KI-M-USDW4	2,470' MD/VD 2,450' MD/VD 2,110' MD/VD 1,930' MD/VD	Continuous
	Temperature	Fiberoptic cable (DTS)	KI-M-D1 KI-M-M1 KI-M-M2 KI-M-S1 KI-M-S2	2,399' MD/VD 2,486' MD/VD 2,174' MD/VD 2,534' MD/VD 1,975' MD/VD	Continuous
Domengine: Direct Monitoring Above Confining Zone	Fluid Sampling	Sampling Device	KI-M-D1	4,153' - 4,353' MD/VD	Annual
	Pressure	Pressure Gauge	KI-M-D1	4,120' MD/VD	Continuous
	Temperature	Temperature Sensor	KI-M-D1	4,120' MD/VD	Continuous
	Temperature	Fiberoptic cable (DTS)	KI-M-D1 KI-M-M1 KI-M-M2 KI-M-S1 KI-M-S2	4,153' MD 4,240' MD 3,925' MD 4,304' MD 3,749' MD	Continuous

Table 2. Summary of analytical and field parameters for ground water samples

Parameters	Analytical Methods
USDW and Domengine Formation	
Cations (Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Se, Zn, Tl)	ICP-MS EPA Method 6020
Cations (Ca, Fe, K, Mg, Na, Si)	ICP-OES EPA Method 6010B
Anions (Br, Cl, F, NO3, SO4)	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration ASTM D513-11
δ13C	Isotope ratio mass spectrometry
Hydrogen Sulfide	ISBT 14.0 (GC/SCD)
Oxygen, Argon, and Hydrogen	ISBT 4.0 (GC/DID) GC/TCD
Total Dissolved Solids	Gravimetry; Method 2540 C
Alkalinity	Method 2320B
pH (field)	EPA 150.1
Specific Conductance (field)	SM 2510 B
Temperature (field)	Thermocouple

Table 3. Sampling and recording frequencies for continuous monitoring

Parameter	Device(s)	Location	Min. Sampling Frequency	Min. Recording Frequency
During active injection	Pressure gauge	USDW Monitoring Well	5 hours	5 hours
Post injection	Pressure gauge	USDW Monitoring Well	12 hours	12 hours

Notes:

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

Table 4. Post-injection phase plume monitoring

Monitoring Category and Class VI Rule Citation	Target Formation	Monitoring Activity	Data Collection Location(s)	Spatial Coverage or Depth	Frequency (Post Injection Phase)
Plume Monitoring [40 CFR 146.90(g)] **DIRECT MONITORING**	Upper Injection Zone	Fluid Sampling	KI-M-M1	6,137' - 6,237' MD	Annual
		Pressure		6,096' MD	Continuous
		Temperature		6,096' MD	Continuous
	Upper Injection Zone	Fluid Sampling	KI-M-M2	5,038' - 5,138' MD	Annual
		Pressure		4,997' MD	Continuous
		Temperature		4,997' MD	Continuous
	Lower Injection Zone	Fluid Sampling	KI-M-S1	6,686' - 6,786' MD	Annual
		Pressure		6,645' MD	Continuous
		Temperature		6,645' MD	Continuous
	Lower Injection Zone	Fluid Sampling	KI-M-S2	6,259' - 6,359' MD	Annual
		Pressure		6,218' MD	Continuous
		Temperature		6,218' MD	Continuous
Plume Monitoring [40 CFR 146.90(g)] **INDIRECT MONITORING**	Upper Injection Zone	Pulsed Neutron Log	KI-M-M1	6,137' - 6,542' MD	Every 5 years
			KI-M-M2	5,038' - 6,265' MD	
	Lower Injection Zone	Pulsed Neutron Log	KI-M-S1	6,686' - 8,030' MD	Every 5 years
			KI-M-S2	6,259' - 7,349' MD	

Table 5. Summary of analytical and field parameters for fluid sampling in the injection zone

Parameters	**Analytical Methods**
Upper and Lower Injection Zones	
Cations (Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Se, Zn, Tl)	ICP-MS EPA Method 6020
Cations (Ca, Fe, K, Mg, Na, Si)	ICP-OES EPA Method 6010B
Anions (Br, Cl, F, NO3, SO4)	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration ASTM D513-11
δ13C	Isotope ratio mass spectrometry
Hydrogen Sulfide	ISBT 14.0 (GC/SCD)
Oxygen, Argon, and Hydrogen	ISBT 4.0 (GC/DID) GC/TCD
Total Dissolved Solids	Gravimetry; Method 2540 C
Alkalinity	Method 2320B
pH (field)	EPA 150.1
Specific Conductance (field)	SM 2510 B
Temperature (field)	Thermocouple

Table 6. Post-injection phase pressure-front monitoring

Monitoring Category and Class VI Rule Citation	Target Formation	Monitoring Activity	Data Collection Location(s)	Spatial Coverage or Depth	Frequency (Post Injection)
Pressure-Front Monitoring [40 CFR 146.90(g)] **DIRECT MONITORING**	Lower Injection Zone	Pressure	KI-M-S1	6,686' - 8,030' MD	Continuous
		Temperature			Continuous
	Lower Injection Zone	Pressure	KI-M-S2	6,259' - 7,349' MD	Continuous
		Temperature			Continuous
	Upper Injection Zone	Pressure	KI-M-M1	6,137' - 6,542' MD	Continuous
		Temperature			Continuous
	Upper Injection Zone	Pressure	KI-M-M2	5,038' - 6,265' MD	Continuous
		Temperature			Continuous
Pressure-Front Monitoring [40 CFR 146.90(g)] **INDIRECT MONITORING**	All Formations	Seismicity	Seismic Monitoring Network	Full AoR	Continuous