EMERGENCY AND REMEDIAL RESPONSE PLAN
40 CFR 146.94(a)

Project Name: Tri-State CCS Redbud 1

Facility Information

Facility contact: Tri-State CCS, LLC
14302 FNB Parkway
Omaha, Nebraska 68154
402-691-9500

Well location: Fairhaven, Hancock County, West Virginia

Well Name	Latitude	Longitude
TR1-1	40.59722582	-80.5716718
TR1-2	40.55529898	-80.6001

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List of Acronyms

AoR	Area of Review
CO_2	Carbon Dioxide
EPA	Environmental Protection Agency
ERRP	Emergency and Remedial Response Plan
FRS	Facility Registry Service
OSHA	Occupational Safety and Health Administration
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
USGS	United States Geologic Survey

1. Introduction

The purpose of this Emergency and Remedial Response Plan (ERRP) is to meet the requirements of 40 CFR 146.94 and to describe the actions that Tri-State CCS, LLC shall take to address movement of the injection fluid or formation fluid in a manner that may endanger an underground source of drinking water (USDW) at Tri-State CCS Redbud 1 in Hancock County, West Virginia (the "project') during the construction, operation, or post-injection site care periods of the permitted injection wells. This plan functions as an addition to emergency management plans associated with the operation and maintenance of surface facilities and is not intended to duplicate the requirements of those plans.

If Tri-State CCS, LLC obtains evidence that the injected Carbon Dioxide (CO_2) stream and/or associated pressure front may cause an endangerment to a USDW, Tri-State CCS, LLC must perform the following actions:

1. Initiate shutdown plan for the injection well.
2. Take all steps reasonably necessary to identify and characterize any release.
3. Notify the UIC Program Director of the emergency event within 24 hours.
4. Implement applicable portions of the approved ERRP.

Where the phrase "initiate shutdown plan" is used, the following protocol will be employed: Tri-State CCS, LLC will immediately cease injection. However, in some circumstances, Tri-State CCS, LLC will, in consultation with the UIC Program Director, determine whether gradual cessation of injection (using the parameters set forth in the Summary of Requirements of the Class VI permit) is appropriate.

2. Local Resources and Infrastructure

Since the project's Area of Review (AoR) delineation is based on the 220 psi pressure threshold plus a buffer of 1 mile, "nearby" resources and infrastructure are considered those that are within the AoR (Figure 1).

Nearby resources that may be affected as a result of an emergency event include: Underground Sources of Drinking Water (USDWs) as described in subsection 2.7 of the Application Narrative, Tomlinson Run State Park, Tomlinson Run Lake, Tomlinson Run, Whiteoak Run, Mercer Run, Cunningham Run, Middle Run, Brimstone Run, Goose Run, Carpenter Run, Cherry Lake, and the Ohio River. Note that Little Blue Run Lake shown in Figure 1was recently drained and returned to agricultural use.

Land parcels within the project AoR are generally used for farming, residential, and parking structures. Other nearby infrastructure that may be affected as a result of an emergency includes: highways and county roads, cemeteries, railroad, Tomlinson Run State Park, residences, transmission lines, water supply wells, oil and gas wells and pipelines, and hospitals, schools, residences, prisons, and roads associated with the cities of New Manchester and Chester, West Virginia, and East Liverpool, Ohio. The location of the project along with along with nearby resources and infrastructure is illustrated in Figure 1, Figure 2, and Figure 3, with the project AoR, injection and monitoring wells, and the plume at end of injection (80 years) shown for reference.

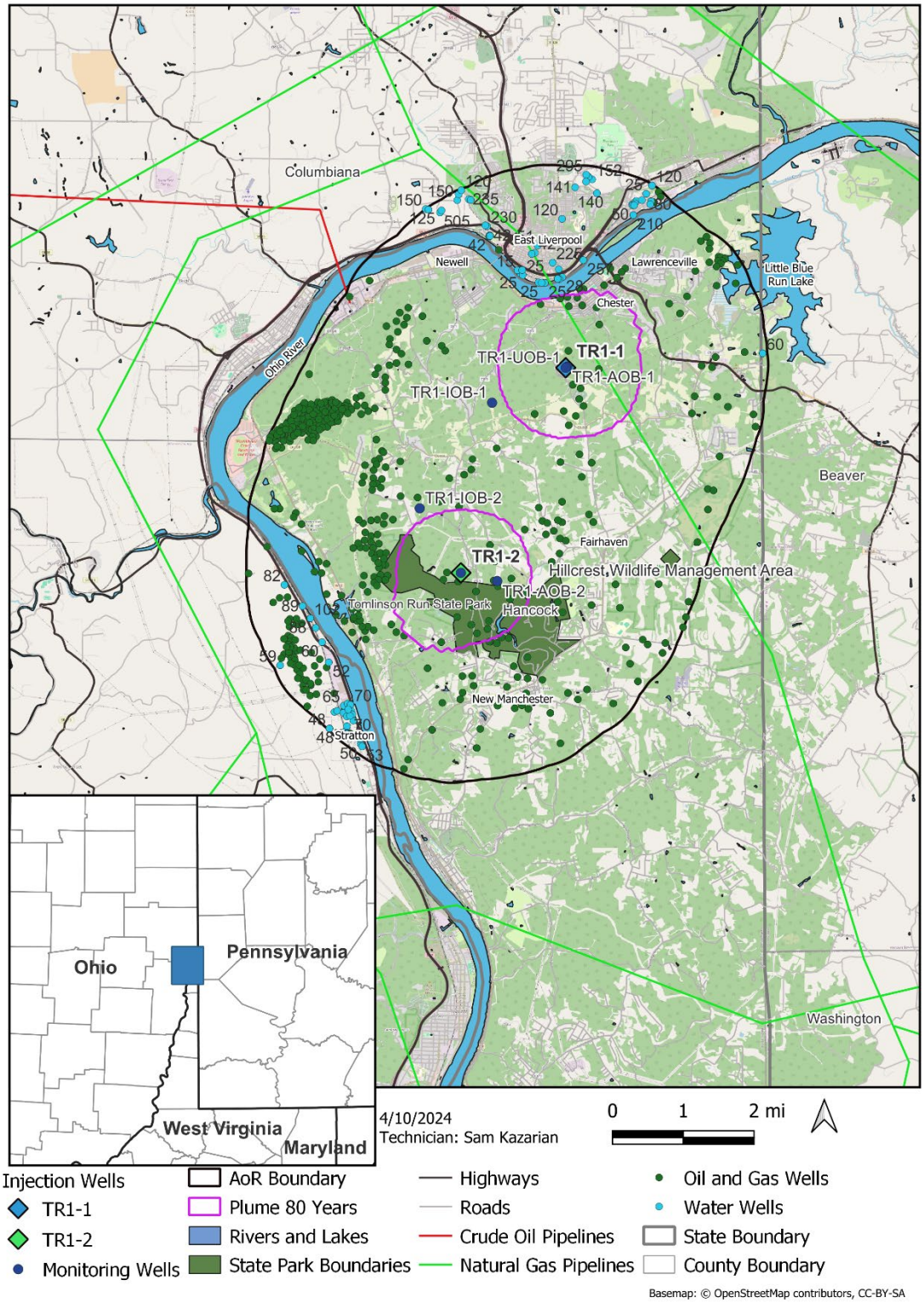

Figure 1: Map of the AoR, injection and monitoring wells, plume at 80 years, State Park boundaries, rivers and lakes, pipelines, roads, oil and gas wells, and water wells.

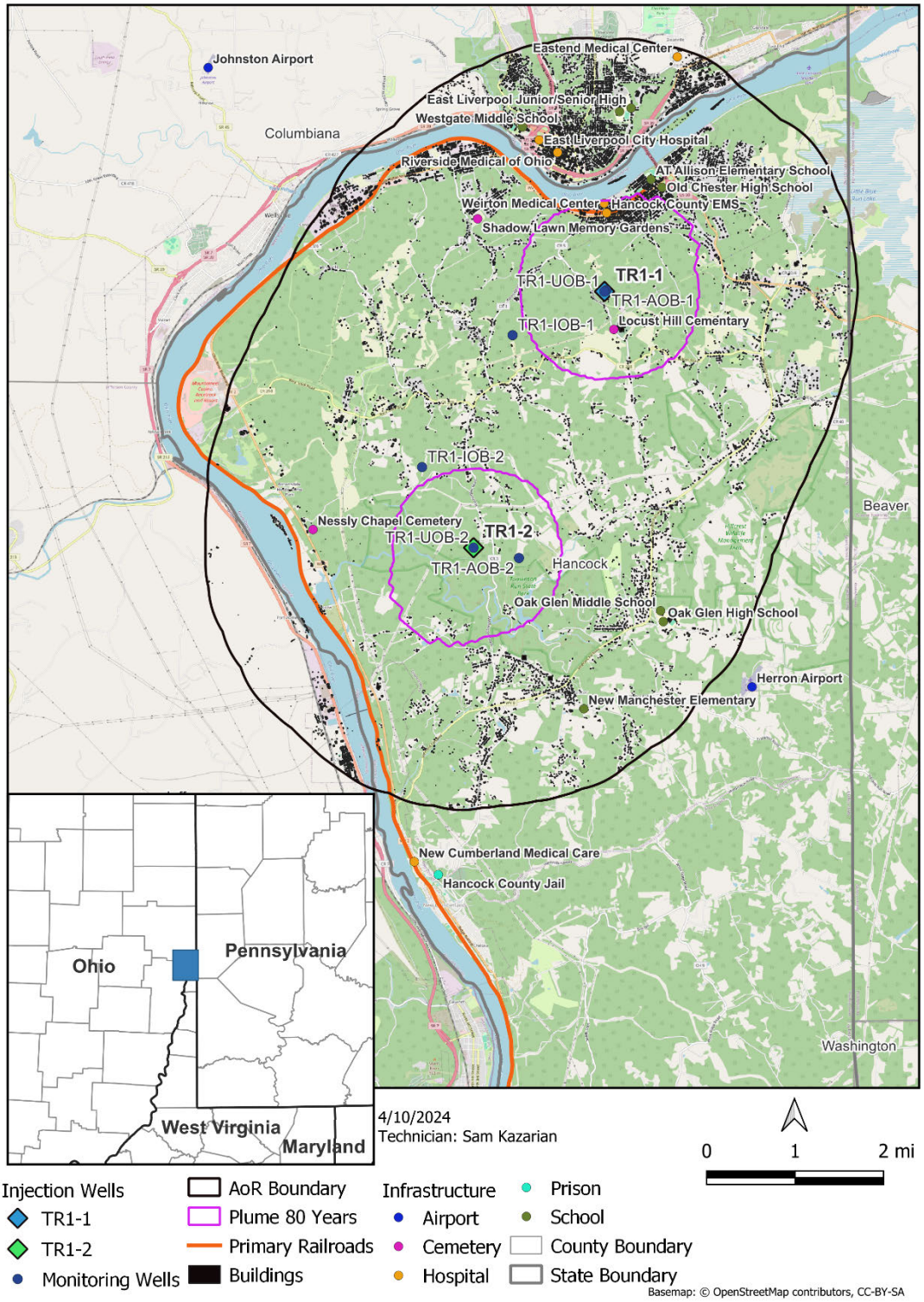

Figure 2: Map of the AoR, injection and monitoring wells, plume at 80 years, primary railroads, building footprints, and other nearby infrastructure (airports, cemeteries, hospitals, prisons, and schools).

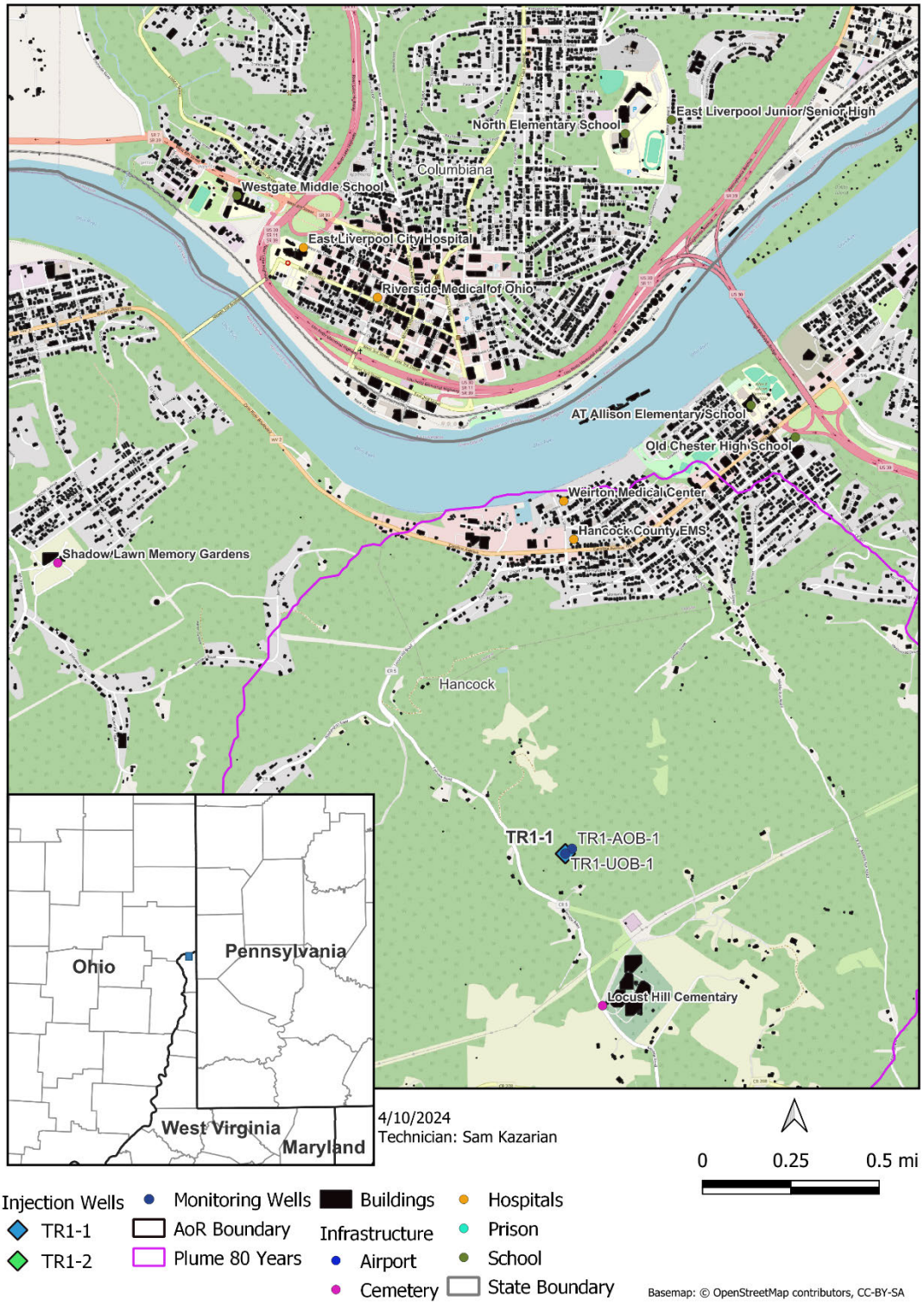

Figure 3: Zoom in map of Chester, WV and East Liverpool, OH with injection and monitoring wells, the 80-year plume, building footprints, and detail of nearby infrastructure (airports, cemeteries, hospitals, prisons, and schools).

3. Potential Risk Scenarios

The following is a list of events, related to the project, that could potentially result in an emergency response:

- Injection or monitoring (verification) well integrity failure;
- Injection well monitoring equipment failure (e.g., shut-off valve or pressure gauge, etc.);
- Fluid (e.g., brine) or CO_2 leakage to a USDW or the surface;
- A natural disaster (e.g., tornado, lightning strike, wildfire); or
- Induced or natural seismic event.

Response actions will depend on the severity of the event(s) triggering an emergency response. "Emergency events" are categorized as shown in Table 1. A summary of the severity of the outlined scenarios (Appendix A) is shown in Table 2.

Table 1: Degrees of risk for emergency events.

Emergency Condition	Definition
Major emergency	Event poses immediate substantial risk to human health, resources, or infrastructure. Emergency actions involving local authorities (evacuation or isolation of areas) should be initiated.
Serious emergency	Event poses potential serious (or significant) near term risk to human health, resources, or infrastructure if conditions worsen or no response actions taken.
Minor emergency	Event poses no immediate risk to human health, resources, or infrastructure.

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Table 2: Summary of risk scenarios and their relative timing, degree of risk, and location in Appendix A.

Risk Scenario	Construction Period	Injection Period	PISC Period	Degree of Risk	Appendix A #
Fluid communication between formations while drilling	x			Serious to Major	1, 2, and 3
Fluid leakage into or near USDW or ground surface through wellbore (injection, monitoring, P&A, or other), surface equipment failure, faults, fractures, or confining zone failure		x	x	Minor to Major	4-7
External impact to project wellheads or pipelines		x	x	Serious to Major	20-22
Loss of mechanical integrity (injection or monitoring well)	x	x	x	Minor to Major	4-7
Migration of CO_2 outside of defined AOR		x	x	Minor to Major	18-19
Injection or monitoring equipment failure/malfunction		x	x	Minor to Serious	23-26
Induced seismicity		x	x	Minor to Major	27-28
Natural disaster (hurricane, earthquake, tornado, lightning, flood, wildfire)		x	x	Minor to Major	29-30
Accident or unplanned event (e.g., electrical outage causing injection to stop, unauthorized activity)		x		Minor	3, 8, 31, and 34

4. Emergency Identification and Response Actions

Steps to identify and characterize the event will be dependent on the specific issue identified, and the severity of the event. The risk scenarios in Table 2, along with their corresponding response actions, are summarized in Appendix A: Emergency Remedial and Response Risk Scenarios. The order of notification for an event is shown in Appendix B.

For all emergencies, Tri-State CCS, LLC will follow these steps:

- Initiate the emergency shutdown plan for the injection well.
- Immediately notify the Project Manager during construction or Operations Manager during operations.

- Notify the 24-hour Emergency Contact (Appendix B) followed by the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).
- Determine the severity of the event, based on the information available, within 24 hours of notification.
- Implement the appropriate response, as outlined in this ERRP.

The appropriate course of action hinges upon both the emergency's nature and its severity. A comprehensive risk assessment will precede any request for operational permission, with a formal report on risk severity furnished to the UIC Program Director.

Where the phrase “initiate the emergency shutdown plan” is used, the following protocol will be employed: Tri-State CCS, LLC will endeavor to immediately cease injection; however, in some circumstances, a gradual cessation of injection may be appropriate and will be identified and determined in consultation with the UIC Program Director.

The potential risk scenarios specified in Section 3, elaborated upon in Appendix A: Emergency Remedial and Response Risk Scenarios, are conceptual in nature. Response plans may be subject to adjustment in collaboration with the UIC Program Director, considering the unique health, safety, and environmental factors of each situation. In instances necessitating external aid, the primary project contact will promptly inform the 24-Hour Emergency Contact listed in Appendix B: Emergency Contact List of this ERRP after notifying local emergency responders. Further emergency communication will be contingent upon the emergency type and the notification criteria outlined in Appendix A: Emergency Remedial and Response Risk Scenarios.

4.1 Seismic Sensing

Based on the project operating conditions, it is unlikely that injection operations would induce a seismic event outside a ten (10) mile radius from the wellhead. Therefore, this portion of the response plan is developed for any seismic event with an epicenter within a ten (10) mile radius of either injection well.

The seismicity of the region is discussed in subsection 2.6 of the Application Narrative. There have been four seismic instances within 50 miles of the injection locations over the last 40 years, the closest was 31.8 miles from the AoR and the largest was a magnitude 4.0. The AoR is considered to have the lowest risk of damaging earthquakes on the United States Geologic Survey (USGS) scale, with fewer than 2 expected within a 10,000-year period. These data indicate that the AoR and surrounding area is tectonically stable (see Section 2 of the Application Narrative for additional details).

To monitor the area for seismicity, Tri-State CCS, LLC will rely on the established USGS and State real-time seismic monitoring networks. There are 11 stations within 50 miles of the permitted injection wells shown in Figure 4. If a felt event is identified based on local reports or a significant event is located at the injection site using the regional array (M >= 2.0), Tri-State CCS, LLC will, in consultation with the UIC Program Director, develop an alternate seismicity monitoring plan using additional local geophone deployment.

Based on the periodic analysis of the monitoring data, according to the monitoring schedule or as otherwise determined by the operator, observed level of seismic activity, and local reporting of felt events, the operator will assign the site an operating state (Table 3). The operating state is determined using threshold criteria that correspond to the site's potential risk and level of seismic activity. The operating state provides operating personnel information about the potential risk of further seismic activity and guides them through a series of response actions.

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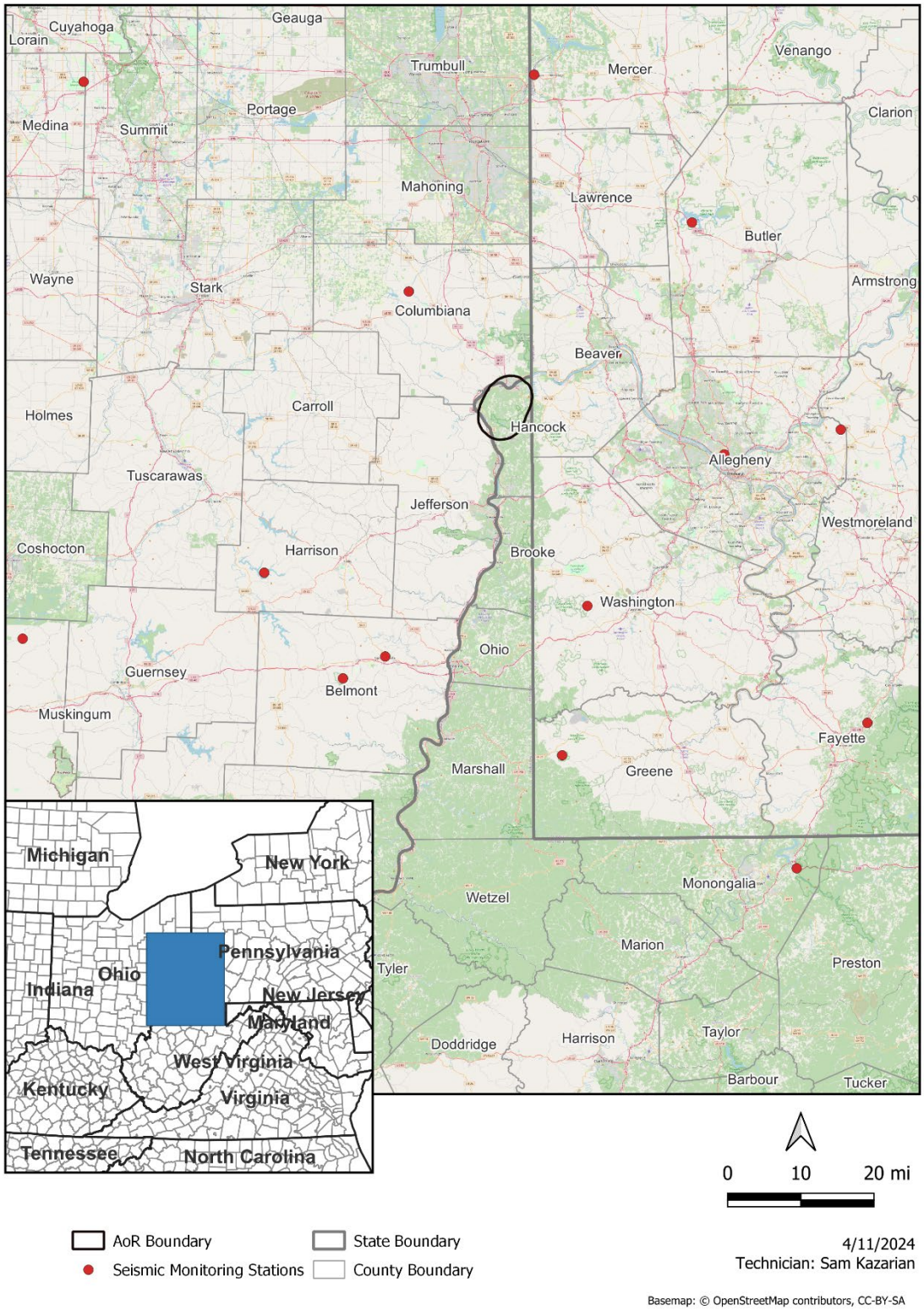

Figure 4: Map of AoR and USGS seismic stations.

Table 3: Seismic monitoring system, for seismic events with an epicenter within a ten (10) mile radius of either injection well.

Operating State	Threshold Condition[1,2]	Response Action[3]
Green	Seismic events less than M2.0	1. Continue normal operation within permitted levels.
Yellow	Five (5) or more seismic events within a 30-day period having a magnitude less than or equal to M2.0	1. Continue normal operation within permitted levels. 2. Within 24 hours of the incident, notify the UIC Program Director of the operating status of the well.
Orange	Seismic event greater than M2.0 and no felt report	1. Continue normal operation within permitted levels. 2. Within 24 hours of the incident, notify the UIC Program Director, of the operating status of the well. 3. Review seismic and operational data. 4. Report findings to the UIC Program Director and issue corrective actions.
Magenta	Seismic event greater than M2.0 and local observation or report	1. Initiate rate reduction plan. 2. Vent CO_2 from surface facilities if required. 3. Within 24 hours of the incident, notify the UIC Program Director of the operating status of the well. 4. Limit access to wellhead to authorized personnel only. 5. Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary. 6. Monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure; identify and implement appropriate remedial actions (in consultation with the UIC Program Director). 7. Determine if leaks to groundwater or surface water occurred. 8. If USDW contamination is detected: a. Notify the UIC Program Director within 24 hours of the determination. b. Initiate Shutdown Plan. c. Shut in well (close flow valve) d. Vent CO_2 from surface facilities e. Identify and implement appropriate remedial actions (in consultation with UIC Program Director) 9. Review seismic and operational data. 10. Report findings to the UIC Program Director and issue corrective actions.

[1] Specified magnitudes refer to magnitudes determined by USGS seismic monitoring stations or reported by the USGS National Earthquake Information Center using the national seismic network. *USGS open file report 2008-1262*.

[2] "Felt report" and "local observation and report" refer to events confirmed by local reports of felt ground motion or reported on the USGS "Did You Feel It?" reporting system.

[3] Reporting findings to the UIC Program Director and issuing corrective action will occur within 25 business days (five weeks) of change in operating state.

Operating State	Threshold Condition[1,2]	Response Action[3]
Red	Seismic event greater than M2.0, and local observation or report, and local report and confirmation of damage[4] Seismic event >M3.5	1. Initiate shutdown plan. 2. Vent CO_2 from surface facilities if required. 3. Within 24 hours of the incident, notify the UIC Program Director of the operating status of the well. 4. Limit access to wellhead to authorized personnel only. 5. Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary. 6. Monitor well pressure, temperature, and annulus pressure to verify well status and determine the cause and extent of any failure; identify and implement appropriate remedial actions (in consultation with the UIC Program Director). 7. Determine if leaks to ground water or surface water occurred. 8. If USDW contamination is detected: a. Notify the UIC Program Director within 24 hours of the determination. b. Identify and implement appropriate remedial actions (in consultation with the UIC Program Director). 9. Review seismic and operational data. 10. Report findings to the UIC Program Director and issue corrective actions.

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[4] Onset of damage is defined as cosmetic damage to structures, such as bricks dislodged from chimneys and parapet walls, broken windows, and fallen objects from walls, shelves, and cabinets.

5. Response Personnel and Equipment

The Project Manager during construction or the Operations Manager during operation and post-injection site care is responsible for implementing this ERRP. Project personnel and local authorities will also be relied upon to implement this ERRP.

The Project Manager during construction or the Operations Manager during operation and post-injection site care is the 24-Hour Emergency Contact for the project. A site-specific emergency contact list (Appendix B) will be maintained during the life of the project and will be updated at least annually as described in Section 6 below.

Equipment needed in the event of an emergency and remedial response will vary, depending on the triggering emergency event. Response actions (cessation of injection, well shut-in, and evacuation) will generally not require specialized equipment to implement. Where specialized equipment (such as a drilling rig or logging equipment) is required, Tri-State CCS, LLC will be responsible for procurement of any necessary additional specialized equipment (e.g., drilling rigs or logging equipment).

6. Emergency Communications Plan

In the event of an emergency requiring outside assistance, project personnel will notify the 24-Hour Emergency Contact identified in Appendix B of this ERRP as soon as possible after requesting outside assistance from local emergency responders. Tri-State CCS, LLC will maintain site-specific maps of well locations and access roads that will be readily available for local emergency responders.

In accordance with West Virginia Code §15-5C, for any "incident" at the well, as defined by the code, the Project and/or Operations manager will report the incident to, within 15 minutes of ascertaining the occurrence, the Division of Homeland Security and Emergency Management at the Mine and Industrial Accident Call Center at 1-866-987-2338 and/or 911. An "incident" is defined as the following:

- An injury to an individual at a well, well pad or pipeline facility that results in death or serious bodily injury or that has a reasonable potential to cause death;
- An unintended confinement of an individual in an enclosed space at a well, well pad or pipeline facility from which a person will not be released for a period exceeding fifteen minutes;
- The unintended ignition or explosion of oil, natural gas or other substance at a well, well pad or pipeline facility;
- An unintended fire in or about a well, well pad not extinguished within fifteen minutes of discovery of the unintended fire; and
- Any unintended release of poisonous or combustible substances that have a reasonable potential to cause death.

"Well" means any shaft or hole sunk, drilled, bored or dug into the earth or into underground strata for the extraction or injection or placement of any liquid, oil or natural gas, or any shaft or hole sunk or used in conjunction with such extraction or injection or placement. The term "well" does not include any shaft or hole sunk, drilled, bored or dug into the earth for the sole purpose of core drilling or pumping or extracting therefrom potable, fresh or usable water for household, domestic, industrial, agricultural or public use.

"Well pad" means any area constructed and maintained for use to create a well.

"Well operator" means any person or persons, firm, partnership, independent contractor, company or corporation that drills or engages in hydraulic fracturing for any liquid, oil or natural gas, or that completes or operates wells to produce any liquid, oil or natural gas.

The Project/Operations Manager will report:

- The name, title, and business affiliation of the individual making the report;
- The identification and location of the well, well pad; and
- Notification that an incident has occurred.

In addition, if any of the following information is known, it will also be reported:

- Then-available information concerning the nature and extent of the incident, including any information that concerns the existence or nonexistence of potential threats to the public health;
- In the event of an unplanned fire that cannot be contained within fifteen minutes, explosion or release, preliminary information regarding the type of substance involved and, if a release, the estimated amount released, if known; and
- The name, title, business affiliation, and contact information of the individual designated to serve as a contact person on behalf of the well operator. In the case of an emergency that requires an evacuation, Tri-State CCS, LLC will communicate and work with the Hancock County Office of Emergency Management and local officials to issue a mandatory evacuation order for the public, if necessary, activate the County's emergency notification system, and evacuate the public from the affected areas. Tri-State CCS, LLC will provide shelters and homes for the public affected by the emergency.

Tri-State CCS, LLC will communicate to the public about any event that requires an emergency response to ensure the public understands what happened and whether there are any environmental, health, or safety implications. This may include working closely with the Hancock County Office of Emergency Management to activate the County's emergency notification system and/or local broadcasting and news agencies in Hancock County and the region. Tri-State CCS, LLC will describe what happened, any actual or potential impacts to the environment or other local resources, how the event was investigated, what responses were taken, and the status of the response. The amount of information, timing, and communication method(s) will be tailored to the event; its severity; impacts on drinking water, other environmental resources, or the surrounding community; and the public's awareness of the event. For emergency responses that require

ongoing action, Tri-State CCS, LLC will provide periodic updates on progress to local broadcasting and new agencies to be communicated to the public.

Tri-State CCS, LLC will communicate with entities who may need to be informed about or act in response to the event, including local water system(s), CO_2 source(s), pipeline operator(s), landowners, Regional Response Teams (as part of the National Response Team), and local authorities.

7. Plan Review

This ERRP shall be periodically reviewed as follows:

- At least once every five (5) years following its approval by the permitting agency;
- Within one (1) year of an AoR reevaluation;
- Following any significant changes to the injection process or the injection facility, or an emergency event; or
- As required by the UIC Program Director; and
- At least annually for the Emergency Contact List in Appendix B of this ERRP.

An amended ERRP should be submitted to the UIC Program Director within one (1) year of an AoR reevaluation, following any significant changes to the facility, or when required by the UIC Program Director. Amendments must be approved by the UIC Program Director and incorporated into the permit and are subject to permit modification requirements. If the review indicates that no amendments to the ERRP are necessary, Tri-State CCS, LLC will provide the UIC Program Director with the documentation supporting the "no amendment necessary" determination. Updating the Emergency Contact List and clarifications or corrections are not considered an amendment to the ERRP and do not require permit modification (40 CFR 144.41).

8. Staff Training and Exercise Procedures

Tri-State CCS, LLC will integrate the ERRP into its existing operating procedures and training protocols. Tri-State CCS, LLC will determine the required training programs for each employee commensurate with their job function, safety requirements, and regulatory requirements. All employees at Tri-State CCS Redbud 1 will be trained—this training will be documented prior to commencing injection. Tri-State CCS, LLC will hold safety meetings with each contractor prior to commencement of any new contract work on the project with emergency measures specific to the contractor's work explained. Tri-State CCS, LLC will provide information about employee training status, schedules, and coursework to regulatory authorities upon request and prior to commencing injection.

Tri-State CCS, LLC intends to provide training courses for field personnel that may include, but are not limited to:

- Emergency action planning
- Hazard communication (HAZCOM)
- Basic fire extinguishers
- Major emergency response

- OSHA 10-hour and 30-hour general industry
- Risk management for oil and gas field operations

Periodic training will be provided, not less than annually, to construction personnel, well operators, project safety personnel, environmental personnel, the operations manager, and corporate communications. The training plan will record that the necessary personnel have been trained and possess the required skills to perform their relevant emergency response activities described in the ERRP.

Appendix A: Emergency Remedial and Response Risk Scenarios

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
1	Construction Period	Fluid Leakage - Drilling operations: Hydrostatic column controlling the well decreases below the formation pressure, resulting in a sudden influx of fluid, causing a well control event with loss of containment.	• Flow sensor • Pressure sensor • Tank level indicator • Tripping displacement practices • Mud weight control	• Blowout prevention (BOP) equipment • Kill fluid • Well control training • BOP drills • BOP testing protocol • Kick drill • Lubricators for wireline operations	**Drilling:** • Stop operation • Close BOP • Clear floor and secure area • Execute well control procedure • Evaluate drilling parameters to identify root cause • Notify 24-Hour Emergency Contact and UIC Program Director and propose an action plan based on the finding • Continue operations **Completion:** • Stop operations • Close BOP • Clear floor and secure area • Execute well control procedure • Notify 24-Hour Emergency Contact and UIC Program Director and propose remediation plans. • Continue operations • In case of influx, control the well, without compromising the shoe integrity • In the case of the shoe leaking, squeeze to regain integrity • In the case of the surface casing leaking, squeeze or install a casing patch. • Notify 24-Hour Emergency Contact and UIC Program Director and propose remediation plans. • Report any incidents to local Sheriff's office	• Project manager • Rig crew • Rig manager • Field superintendent

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
2	Construction Period	Fluid Leakage - Drilling operations:Failure of surface casing completion to protect USDW while drilling resulting in cross flow of brine between formations resulting in fluid losses into the underground source of drinking water (USDW).	• Pressure sensors • Cement bond log (CBL)	• Pressure sensors • USDW will be covered with the surface casing • Casing test after cementing surface casing to check integrity • CBL to check cement bonding	• In case of influx, control the well, without compromising the shoe integrity • In the case of the shoe leaking, squeeze to regain integrity • In the case of the surface casing leaking, squeeze or install a casing patch. • Notify 24-Hour Emergency Contact and UIC Program Director and propose remediation plans. • Notify Emergency Services within 15 min (WVC 15-5C)	• Project manager • Rig crew • Rig manager • Field superintendent
3	Construction Period	Unauthorized access/activity: Unauthorized activity on filed site	• Field personnel logs	• Fencing around well sites • Security in place	• Report any incidents to local Sheriff's office	• Field superintendent • Company man
4	Construction Period	Fluid Leakage - Drilling through USDW: Improper well control during the drilling of one or more monitoring or injection wells, the drilling fluid weight exceeds the aquifer reservoir pressure, and the drilling fluid migrates into the pores and contaminates a USDW.	• Flow sensor • Pressure sensor • Mud weight control	• Well control training • Overbalance mud program	Drilling: • Stop operation • Close BOP • Clear floor and secure area • Execute well control procedure • Evaluate drilling parameters to identify root cause • Notify 24-Hour Emergency Contact and UIC Program Director and propose remediation plans. • Implement corrective actions • Continue operations	• Project manager • Rig crew • Rig manager • Field superintendent
5	Injection Period	Fluid Leakage – UIC Wellbores:A loss of mechanical integrity in the injection well causing a tubing/packer to leak due to corrosion damage, damage to the tubulars during installation, fatigue,higher load profiles, and other issues, that could cause communication of formation fluids with the annularcasing tubing as well as sustained casing pressure. There is no loss of containment (LOC) in this scenario.	• Pressure and temperature gauges on surface and downhole real time• Pulsed-neutron logs • Annular pressure testCO_2 leak sensors on the wellhead	• Tubing at 13CR or coated • Inhibited packer fluid in annulus • Corrosion monitoring plan • Dry CO2 injected • 13CR packers • CR tubing tailpipes below packers • New tubing or inspection of tubing before reinstalling	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Follow protocol to stop operation, vent, or deviate CO2 • Notify 24-Hour Emergency Contact • Troubleshoot the well • If tubing leak is detected, notify UIC Program Director and propose an action plan based on the finding • Schedule well service to repair tubing	• Operations manager • Field superintendent • Project manager

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
6	Injection/ Post Injection Site Care Period	Fluid Leakage – MW Wellbores A loss of mechanical integrity in the monitoring well causing a tubing/packer to leak due to corrosion damage, damage to the tubulars during installation, fatigue, higher load profiles, and others and could cause a communication of the formation fluids with the annular casing tubing as well as sustained casing pressure. There is no LOC in this scenario.	• Pressure and temperature gauges on surface and downhole real time • Pulsed-neutron logs • Annular pressure test. CO2 leak sensors on the wellhead	• Tubing at 13CR or coated • Inhibited packer fluid in annulus • Corrosion monitoring plan • 13CR packers • CR tubing below/between packers • CR or Inconel carrier for the sensors • New tubing or inspection of tubing before reinstalling • Cased hole logging program • Observation wells are designed to be outside of the projected plume for most of the project which reduces the risk of contact with CO2	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Notify 24-Hour Emergency Contact • Troubleshoot the well • Notify UIC Program Director and propose an action plan for well service •Schedule well service to repair tubing, isolate CO2 zone, or abandon the well	• Operations manager • Field superintendent • Project manager •Rig crew and DH contractors
7	Injection Period	Fluid Leakage – UIC Wellbores: A loss of mechanical integrity in the injection wells causing a casing leak due to corrosion, damage in the tubulars during installation, fatigue, higher load profiles, or others. This event could cause migration of CO2 and brines through the casing, the cement sheet, and into different formations of the injection target or into USDW.	• Pressure and temperature gauges on surface and downhole real time • CO2 leak sensors on the wellhead • DTS fiber real time alongside the casing • Flow rate monitoring • Pulsed-neutron logs • CBL/Ultra-sonic logging • USDW water monitoring	• CO2-resistant cement and metallurgic across injection zone • Injection through tubing and packer • Inhibited packer fluid in the annular • Cement to surface • Corrosion monitoring plan • Cased hole logging program • New casing and tubing installed	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Follow protocol to stop operation, vent, or deviate CO2 • Notify 24-Hour Emergency Contact • Troubleshoot the well. • Evaluate if there is a movement of CO2 or brines to USDW. In the remote event that USDW gets affected, discuss remediation options with the UIC Program Director • Notify UIC Program Director and propose an action plan based on the finding and location of the leak • Schedule well service to repair the casing	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation contractors
8	Injection period	Unauthorized access/activity: Unauthorized activity on filed site	• Field personnel logs	• Fencing around well sites • Security in place	• Report any incidents to local Sheriff's office	• Field superintendent • Company man

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
9	Injection Period/ Post Injection Site Care Period	Fluid Leakage – MW Wellbores:A loss of mechanical integrity in the monitoring well causing a casing leak due to corrosion, damage in the tubulars during installation, fatigue, higher load profiles, and others. This event could cause a migration of CO2 and brines through the casing, the cement sheet, and into different formations of the injection target or into USDW.	• Pressure and temperature gauges on surface and downhole real time • CO2 leak sensors on the wellhead • Pulsed-neutron logs • CBL/Ultra-sonic logging • USDW water monitoring	• CO2-resistant cement across injection zone • 13CR packers • Inhibited packer fluid in the annular • Cement to surface • Corrosion monitoring plan • Cased hole logging program • New casing • New or inspected tubing before reinstallation • Observation wells are designed to be outside of the projected plume for most of the project's life cycle which minimizes the risk of contact with CO2	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Notify 24-Hour Emergency Contact • Troubleshoot the well • Evaluate if there is a movement of CO2 or brines to USDW. In the remote event that USDW gets affected, discuss remediation options with the UIC Program Director • Notify UIC Program Director and propose an action plan based on the findings and the location of the leak. • Schedule well service to repair the casing	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation contractors
10	Injection Period / Post Injection Site Care Period	Fluid Leakage – Legacy Wellbores: Brines and CO2 could migrate through poor cement bonding, cement degradation, or cracking in the cement of plugged and abandoned (P&A) wells.	• USDW water sampling • Pulsed-neutron logs	• Legacy wells are properly abandoned for brine movement because of pressurization of injection zone • Injectors will be abandoned as soon as CO2 injection ends, except if they are left as observation wells	• Notify 24-Hour Emergency Contact • Evaluate if it's a positive CO2 release because of a leak in the legacy/P&A well • Notify regulator and propose plan to repair the well, delineate the area, and identify potential resources affected	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
11	Injection	Fluid Leakage – Faults and Fractures: During injection, the pressurization of the injection zone exceeds the sealing capacity of the confining zone above or if there are features such as fault or fractures that are reactivated. Creating a leakage pathway for CO2 and brine to migrate to a shallower formation, including a USDW.	• USDW water sampling • Pulsed-neutron log in injector and observation wells	• Injection is limited to 90% of frac gradient • Extensive characterization of the rocks shows good sealing capacity • If the confining zone above the Paluxy fails, the Selma Group will act as a buffer formation before CO2 or brines are able to reach the USDW	• Notify 24-Hour Emergency Contact • Assess root cause by reviewing monitoring data • Notify UIC Program Director • If necessary, follow protocol to stop injection. • If necessary, conduct geophysical survey to delineate potential leak path • Evaluate if there is a movement of CO2 or brines to USDW. If USDW gets affected, discuss with UIC Program Director remediation options, action plan, and monitoring program. • Actions to restore injection will depend on the nature of the leak path and the extent. Operator needs to reevaluate model and discuss action plan with UIC Program Director	• Operations manager • Field superintendent • Geologist • Reservoir engineer • Project manager • Remediation contractors
12	Injection Period	Fluid Leakage - Geomechanical Seal Failure Elevated well bottomhole pressure (BHP) either exceeds the permitted maximum injection pressure or the estimated maximum injection pressure is inaccurate (i.e., the true fracture pressure is lower than the estimated maximum pressure) in the injection zone, resulting in the failure of the confining system and leading to vertical migration of CO2 or brine to a USDW, the surface or atmosphere (CO2 only).	• Pressure gauges on surface and downhole real time • USDW water sampling • Pulsed-neutron log in injector and observation wells	• Injection is limited to less than 90% of the fracture gradient • Core and geomechanical testing and geochemical modeling of the upper confining zone show good sealing capacity and fluid compatibility, respectively • If the confining zone above the Paluxy fails, the Selma Group will act as a buffer formation before CO2 or brines are able to reach the USDW • Microfracture test prior to receiving authorization to operate, confirm formation breakdown pressure.	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Follow protocol to stop injection • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Notify 24-Hour Emergency Contact • Assess root cause by reviewing monitoring data • If required, conduct geophysical survey to delineate potential leakage pathway • Evaluate if there is a movement of CO2 or brines to USDW. • Notify UIC Program Director and propose remediation options, action plan, and monitoring program • Actions to restore injection will depend on the nature of the leak path and the extent. Operator needs to reevaluate model and discuss action plan with UIC Program Director • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Monitoring staff • Geologist • Reservoir engineer • Project manager • Remediation contractors

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
13	Injection Period	Fluid Leakage - Surface Infrastructure: Vehicle strikes other surface equipment (e.g., tank battery pumps/compressors, etc.), causing the release of CO_2 at the surface.	• Use of protective equipment, such as bollards, fences, locking gates • Use of appropriate fencing and signage	• Temperature-controlled building and/or containment, as required by regulation or law, will be proposed to protect the surface equipment and other instrumentation (i.e., interrogator, gauges, meters, etc.).	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Follow protocol to shut down CO_2 delivery • If there is injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact • Clear location and secure the perimeter. If possible, install containment devices around the location. • Evaluate environmental impact (soil, water, fauna, vegetation), • Assess mechanical integrity of the system • Notify UIC Program Director and propose repair actions • Repair or replace equipment • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Project manager • Plant manager • Remediation contractors
14	Injection Period	Fluid Leakage - Surface Infrastructure: Failure of a valve results in leakage of CO_2 with potential impacts to health, safety, and the environment, particularly if the leak is not detected and corrected.	• Routine field inspections • Routine inspection of emergency alert systems, monitoring systems and controls.	• Equipment upstream or downstream of the failed valve can be used to isolate the problem as necessary • Preventative maintenance • Periodic inspections	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • If there are injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact • Clear location and secure the perimeter. I • Evaluate environmental impact • Assess mechanical integrity of the system • Notify UIC Program Director and propose repair actions • Repair or replace equipment • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Plant manager • Remediation contractors • Emergency teams

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
15	Injection Period	Fluid Leakage – Surface Infrastructure: The CO2 stream is blocked between valves on the surface, heated (e.g., by the sun), and expands to rupture the line or flowline on the site is plugged and the pressure sensor fails to detect the change, resulting in a CO2 leak.	• Pressure, temperature, and flowmeter sensors in real time • Field inspections	• Relief valves (e.g., Pressure Safety Valves) in areas where this is a risk as part of the design process • Equipment upstream or downstream of the failed valve can be used to isolate the problem as necessary • Cleaning protocols: - Wiping the lines- Testing with water - Performing cleaning runs to remove any debris. • Witches hat (cone strainer) filters can be used to filter out large pieces of debris on startup	• Trigger Emergency isolation valves • SCADA alarms notification to operations staff • Follow protocol to shut down CO2 delivery • If there are injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact to activate emergency plan, reverse 9-1-1 protocol for residents or occupants in proximity to occurrence. • Clear location and secure the perimeter. If possible, install containment devices around the location • Evaluate environmental impact (soil, water, fauna, vegetation), • Assess mechanical integrity of the system • Notify UIC Program Director and propose repair actions • Repair or replace equipment • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Plant manager • Remediation contractors
16	Injection Period	Fluid Leakage – Natural Disaster: A natural disaster event - e.g., hurricane, lightning, tornadoes, floods, landslides – impacts the pipelines or flowlines at the storage location, forcing the release of CO2 at the surface.	• Pressure and flowmeter sensors in real time • Field inspections	• HAZOP review • ESD valve installed near the wellhead so it will cease injection whenever any leak occurs downstream or upstream of the ESD • Weather monitoring	• Trigger Emergency isolation valves • SCADA alarms notification to operations staff • Follow protocol to shut down CO2 delivery if the automatic shutoff device is not functional • If there are injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact • Clear the location and secure the perimeter. If possible, install containment devices around the location. • Assess mechanical integrity of the pipelines or flowlines • Notify UIC Program Director and propose action plan • Evaluate environmental impact (soil, water, fauna, vegetation), and present remediation plan to the UIC Program Director for approval • Execute remediation, and install additional monitoring system as needed	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
					• Notify Emergency Services within 15 min (WVC 15-5C)	
17	Injection Period	Fluid Leakage – Surface Infrastructure: Failure of CO2 transport flowlines from the CO2 capture system to Tri-State CCS Hub CO2 Injection wellhead.	• Surface P/T gauges and flowmeters at inlet and delivery point.	• Preventive maintenance • Periodic inspections • Monitoring devices at both ends of the transmission pipeline and flowline	• Trigger emergency isolation valves • SCADA alarms notification to operations staff • Follow protocol to shut down CO2 delivery • Detect CO2 stream release and its location • Initiate evacuation plan • Notify 24-Hour Emergency Contact • Transmission line and/or flowline failure will be inspected to determine the root cause of the failure • Notify UIC Program Director and propose action plan • Repair/replace the damaged transmission line or flowline, and if warranted, put in place the measures necessary to eliminate such events in the future • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Remediation contractors • Emergency teams • Plant manager/ • contact

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
18	Injection Period	Loss of Containment - Vertical Migration via injection well: During the life of the injector wells, there are induced stresses and chemical reactions on thetubulars and cement exposed to the CO2 pressure and plume.Changes in temperature and injection pressure create stresses in the tubulars trying to expand or contract, and it can lead to microannulus effects, resulting in fugitive movement of brines/CO2.	• CO2 leak sensors on the wellhead • DTS fiber real time alongside the casing • USDW water monitoring • Pulsed-neutron logs (PNL) to be run for external integrity • CBL/Ultra-sonic logging • Pressure gauges at surface • Flow rate monitoring	• CO2-resistant cement and metallurgic across injection zone • Injection through tubing and packer, 13CR or better tubing and 13CR packers. • Cement to surface • Cased hole logging program • USDW covered as second barrier with surface casing and surface cement sheet • New casing installed, 13CR or better.	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Follow protocol to stop operation, vent, or deviate CO2 • Notify 24-Hour Emergency Contact • Troubleshoot the well • Evaluate if there is a movement of CO2 or brines to USDW. • Notify UIC Program Director and discuss action plan to repair the well or P&A based on the findings of the assessment	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation contractors
19	Injection Period/ Post Injection Site Care Period	Loss of Containment - Vertical Migration via monitoring well: During the life of the injector wells, there are induced stresses and chemical reactions on the tubulars and cement exposed to the CO2 pressure and plume. Changes in temperature and injection pressure create stresses in the tubulars trying to expand or contract, and it can lead to microannulus effects, resulting in fugitive movement of brines/CO2	• CO2 leak sensors on the wellhead • USDW water monitoring • Pulsed-neutron logs to be run for external integrity • CBL/Ultra-sonic logging • Pressure gauges at surface	• CO2-resistant cement across injection zone • Cement to surface • Case hole logging program • USDW covered as second barrier with surface casing and surface cement sheet • New casing installed, 13CR or better. • Observation wells are designed to be outside of the plume for most of the injection period	• Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Notify 24-Hour Emergency Contact • Troubleshoot the well. • Evaluate if there is a movement of CO2 or brines to USDW. • Notify UIC Program Director and discuss action plan to repair the well or P&A based on the findings of the assessment	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation contractors

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
20	Injection Period/ Post Injection Site Care Period	Loss of Containment-Lateral Migration of CO2 Outside Defined AOR:The CO2 plume moves faster or in an unexpected pattern and expands beyond the secured pore space for the project and the AOR.	• Pulsed-neutron logs in observation wells • Pressure and temperature gauges real time in observation wells	• Detailed geologic model with stratigraphic wells as calibration • Seismic survey integrated in the model • Extensive characterization of the rocks and formation • Periodic review of CO2 and pressure plume within AOR every 5 years • Monitor the plume over PISC	**Injection period:** • Trigger Emergency Shutdown system • SCADA alarms notification to operations staff • Notify 24-Hour Emergency Contact • Review monitoring data and trends and compare with the simulation. • Notify UIC Program Director, propose action plan and request to keep injection process while AOR is reviewed, if the data show that CO2 will stay in the secured pore space .• Perform logging in observation wells. • Conduct geophysical survey as required to evaluate AOR. • Recalibrate model and simulate new AOR • Assess if additional corrective actions are needed and if it's required to secure additional pore space • Assess if any remediation is needed, and discuss action plan with UIC Program Director • Present AOR review to UIC Program Director for approval and adjust monitoring plan **Post Injection Site Care Period:** • SCADA alarms notification to monitoring personnel • Notify 24-Hour Emergency Contact • Review monitoring data and trends, compare with the simulation • Notify UIC Program Director and propose action plan • Conduct geophysical survey as required to evaluate AOR • Recalibrate model, and simulate new AOR • Assess if additional corrective actions are needed and if it's required to secure additional pore space •Assess if any remediation is needed, and discuss action plan with UIC Program Director	• Operations manager • Field superintendent • Geologist • Reservoir engineers • Project manager

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
21	Injection Period/Post Injection Site Care Period	Containment - Pressure Propagation:A "pressure front" that exceeds the minimum pressure necessary to cause fluid flow from the injection zone into a USDW through a hypothetical conduit (i.e., an artificial penetration that is perforated in both intervals).	• Pulsed-neutron logs • Pressure gauges on surface and downhole real time • USDW water monitoring • Flow rate monitoring • Incremental leakage modeling to validate a lack of potential for fluid movement into the USDW.	• Detailed geologic model with stratigraphic wells as calibration • Seismic survey integrated in the model • Extensive characterization of the rocks and formation • Periodic review of CO2 and pressure plume within AOR every 5 years • Monitor the plume until stabilization (min 10 years) • USDW covered as second barrier with surface casing and surface cement sheet • Cased hole logging program	**Injection period:** • Identification by monitoring staff • Notify 24-Hour Emergency Contact • Review monitoring data and trends and compare with the simulation • If endangerment to USDW is suspected follow shut down procedure. • Notify UIC Program Director and propose action plan and request to keep injection process while AOR is reviewed, if the data shows that the CO2 will stay in the secured pore space • Perform logging in observation wells • Conduct geophysical survey as required to evaluate AOR • Recalibrate model and simulate new AOR • Assess if additional corrective actions are needed and if it's required to secure additional pore space • Assess if any remediation is needed, and discuss action plan with UIC Program Director • Present AOR review to UIC Program Director for approval and adjust monitoring plan **Post Injection Site Care Period**: • Identification by monitoring staff • Notify 24-Hour Emergency Contact • Review monitoring data and trends and compare with simulations • Notify UIC Program Director and propose action plan • Conduct geophysical survey as required to evaluate AOR • Recalibrate model, and simulate new AOR • Assess if additional corrective actions are needed and if it's required to secure additional pore space • Evaluate if there is a movement of CO2 or brines to USDW. In the remote event that USDW gets affected, discuss remediation options with the UIC Program Director	• Operations manager • Field superintendent • Monitoring staff • Geologist • Reservoir engineers • Project manager • Remediation contractors

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
22	Injection Period	External impact – UIC Well:During injection, the wellhead is hit by a massive object that causes major damage to the equipment. The well gets disconnected from the pipeline and from the shutoff system and leads to a loss of containment of CO2 and brine.	• Pressure, temperature, and flow sensors in real time • Field inspections	• Fence location and block direct access to the wellhead • Bollards and/or concrete barriers installed to protect installation • No populated area	• Trigger emergency isolation valves • SCADA notification to monitoring or operations staff • Follow protocol to shut down CO2 delivery if the automatic shutoff device is not functional • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • If there are injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact • Clear the location and secure the perimeter. If possible, install containment devices around the location. • Contact well control special team to execute blowout emergency plan that may include but is not limited to capping the well, secure location, drill relief well to kill injector, properly repair or abandon injection well. This plan would be discussed with UIC Program Director • Evaluate environmental impact (soil, water, fauna, vegetation)• Notify UIC Program Director and propose action plan • Execute remediation, and install monitoring system as needed • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation contractors • Well control specialist

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
23	Injection Period/ Post Injection Site Care Period	External impact – MW: The wellhead of the deep monitoring well is hit by a massive object that causes major damage leading to a LOC. Since the well is open to the formation pressure at the injection zone, formation fluids have the potential to flow and spill on the location.	• Pressure, temperature, and flow sensors in real time • Field inspections • Incremental leakage modeling to validate a lack of potential for fluid movement into the USDW.	• Fence location and block direct access to the wellhead • Bollards and/or concrete barriers installed to protect installation • No populated area • Lined pads • Reduced pressure in the monitoring well compared with the injector well on bottom	• SCADA alarms notification to operations staff • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • If there are injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact • Clear the location and secure the perimeter. If possible, install containment devices around the location. • Contact well control special team to execute blowout emergency plan that may include, but is not limited to, capping the well, securing the location, drilling relief well to kill the injector, properly repairing, or abandoning the injection well. • Evaluate environmental impact (soil, water, fauna, vegetation) • Notify UIC Program Director and propose action plan • Execute remediation, and install monitoring system as needed • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Project manager • Rig crew and DH contractors • Remediation contractors • Well control specialist

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
24	Injection Period	External impact – Pipeline:During injection, the CO2 pipeline is hit causing major damage and LOC of the CO2.	• Pressure, temperature, and flowmeter sensors in real time • Field inspections • Bollards and/or concrete barriers installed to protect aboveground piping at valve stations • Appropriate warning signage/painting • Appropriate fencing	• Buried pipe • Bollards and/or concrete barriers installed to protect aboveground piping at valve stations • Painting for visibility in varied weather conditions • Signage along right of way as needed • Pipeline is part of One Call system	• Trigger emergency isolation valves • SCADA alarms notification to operations staff • If there are injured personnel, call emergency team, and execute evacuation protocol • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Verify CO2 flow was shut off by the system or start protocol to stop flow • Notify 24-Hour Emergency Contact • Clear the location and secure the perimeter. If possible, install containment devices around the location • Evaluate environmental impact (soil, water, fauna, vegetation) • Notify UIC Program Director and propose action plan • Execute remediation, and install monitoring system as needed • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Remediation contractors • Emergency teams • Plant manager/contact
25	Injection Period	Monitoring Equipment Failure or Malfunction: Failure of the monitoring system/ alarm devices that lead to over pressurization of the system or reservoir beyond the design limits, causing fracturing of the reservoir, leaks or failure on equipment and tubulars, and damage of the facilities.	• Real-time pressure monitoring system and redundancy • Field inspections	• Preventive maintenance • Periodic inspections	• SCADA alarms notification to operations staff • If there are injured personnel, call emergency team, and execute evacuation protocol • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Notify 24-Hour Emergency Contact • Assess mechanical integrity of the system, and propose repair actions if needed • Assess any potential environmental impact • Notify UIC Program Director and propose action plan • Repair or replace instrumentation. Calibrate equipment. • Review monitoring records, and if needed, perform an injectivity test or falloff test to evaluate reservoir	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams • Geologist • Reservoir engineers • Monitoring staff

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
26	Injection Period/ Post Injection Site Care Period	Injection or Monitoring Equipment Failure: Failure of surface injection or monitoring equipment including injection pumps, valves, gauges, meters, sensors, electrical, or other equipment results in potentially unsafe operating conditions and requires an emergency response at the site.	• Real-time monitoring system and redundancy • Field inspections • Routine inspection/testing of emergency alert systems, monitoring systems and controls systems	• Preventive maintenance • Periodic inspections	• SCADA alarms notification to operations staff • If there are injured personnel, call emergency team, and execute evacuation protocol • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Notify 24-Hour Emergency Contact • Assess mechanical integrity of the system, and propose repair actions if needed • Assess any potential environmental impact • Notify UIC Program Director and propose action plan • Perform Lockout/Tagout (LOTO) for defective equipment until it is properly replaced • Repair or replace instrumentation. Calibrate equipment. • If the assessment allows resuming injection safely, discuss plan with the UIC Program Director and get approval • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams • Geologist • Reservoir engineers • Monitoring staff
27	Injection Period/ Post Injection Site Care Period	Injection or Monitoring Equipment Failure:Malfunction of subsurface injection/monitoring well subsurface equipment including gauges, fiber, cables, or capillary string, requiring an emergency response at the site.	• Real-time monitoring system and redundancy • Field inspections • Routine inspection/testing of emergency alert systems, monitoring systems and controls systems.	• Preventive maintenance • Periodic inspections	• SCADA alarms notification to operations staff • If there are injured personnel, call emergency team, and execute evacuation protocol • Notify 24-Hour Emergency Contact • Assess mechanical integrity of the system, and propose repair actions if needed • Assess any potential environmental impact • Notify UIC Program Director and propose action plan • If the assessment allows resuming injection safely, discuss plan with the UIC Program Director and get approval • Repair or replace instrumentation. Calibrate equipment. • Review monitoring records, and if needed, perform an injectivity test or falloff test to evaluate reservoir	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams • Geologist • Reservoir engineers • Monitoring staff

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
28	Injection Period	Injection or Monitoring Equipment Failure: A large pressure drop in the CO2 stream results in low temperatures that could cause harm to personnel or damage/brittleness in materials (e.g., carbon steel and elastomers).	• Real time monitoring system of the CO2 injection stream	• Use of materials that are rated for low temperatures • Controlled CO2 stream composition	• SCADA alarms notification to operations staff • If there are injured personnel, call emergency team, and execute evacuation protocol • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Notify 24-Hour Emergency Contact • Assess mechanical integrity of the system, and propose repair actions if needed • Assess any potential environmental impact, and propose remedial action with the UIC Program Director, if needed • If the assessment allows resuming injection safely, discuss plan with the UIC Program Director and obtain approval • Repair or replace any damaged equipment and recalibrate • Review monitoring records and, if needed, adjust CO2 accordingly • Notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Plant manager • Emergency teams
29	Injection Period	Induced Seismicity: Pressurization of the reservoir, during injection of CO2, activates preexisting fault planes and creates a displacement that causes a seismic event. If it's a major event (>2.7 Richter), it could compromise the integrity of the wells, facilities, or pipeline.	• USGS and State real-time seismic monitoring networks • Pulsed-neutron logs • CBL/Ultra-sonic logging	• A detailed geomechanical model was created to evaluate the storage complex • The region is seismically stable • Cased hole logging program	• SCADA alarms notification to operations staff • If there is injured personnel or property damages, call emergency team, and execute evacuation protocol and secure location • Notify 24-Hour Emergency Contact • Assess any potential environmental impact • Notify UIC Program Director and propose action plan, if needed • Define new injection parameters and get approval from the UIC Program Director • If the assessment allows resuming injection safely, increase surveillance to validate effectiveness of the actions	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams • Geologist • Reservoir engineers • Monitoring staff

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
30	Injection Period/Post Injection Site Care Period	Induced Seismicity: Other subsurface injection (e.g., saltwater disposal) causes pressure changes and induced seismicity at the Project Site or induced seismicity occurs at a nearby site that impacts the Project site.	• USGS and State real-time seismic monitoring networks • Pressure gauges at surface • Pulsed-neutron logs • CBL/Ultra-sonic logging	• Detailed geomechanical model was created to evaluate the storage complex • Cased hole logging program	• SCADA alarms notification to operations staff • If there is injured personnel or property damage, call emergency team, and execute evacuation protocol and secure location • Follow protocol to stop injection (injection period) • Notify 24-Hour Emergency Contact • Assess any potential environmental impact • Notify UIC Program Director and propose action plan, if needed • Review regional information as well as monitoring records to determine the origin of the event (natural or induced) • If the assessment allows resuming injection safely, increase surveillance to validate effectiveness of the actions (injection period)	• Operations manager • Field superintendent • Project manager • Geologist • Monitoring staff • Remediation contractors
31	Injection Period/ Post Injection Site Care Period	Major seismic event: Natural seismicity causes LOC by opening transmissive features in the confining zone, resulting in release of CO2 to a USDW, surface, or atmosphere.	• USGS and State real-time seismic monitoring networks • Pulsed-neutron logs • CBL/Ultra-sonic logging	• The region is seismically stable • Cased hole logging program	• SCADA alarms notification to operations staff • If there is injured personnel or property damage, call emergency team, and execute evacuation protocol and secure location • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Notify 24-Hour Emergency Contact • Assess any potential environmental impact • Notify UIC Program Director and propose action plan, if needed • If the assessment allows resuming injection safely, increase surveillance to validate effectiveness of the actions (injection period)	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams • Geologist • Reservoir engineers • Monitoring staff

Number	Project Phase	Risk Scenario	Monitoring Equipment	Control In Place	Response Action	Response Personnel
32	Injection Period/ Post Injection Site Care Period	Other Major Natural Disaster: Natural disaster that limits or endangers the normal operation of the Hub.	• Weather monitoring	• Project safety program • Condition/atmospheric monitoring. • Emergency shutdown valves	• SCADA alarms notification to operations staff • If there is injured personnel or property damage, call emergency team, and execute evacuation protocol and secure location • Follow protocol to stop injection • Notify 24-Hour Emergency Contact • Assess mechanical integrity of the system • Assess any potential environmental impact • Notify UIC Program Director and propose repair actions based on findings • If the assessment allows resuming injection safely, increase surveillance to validate effectiveness of the actions • If necessary, notify Emergency Services within 15 min (WVC 15-5C)	• Operations manager • Field superintendent • Project manager • Remediation contractors • Emergency teams • Geologist • Reservoir engineers • Monitoring staff
33	Injection Period	Accidents or Unplanned Event:Loss of electricity causing injection to cease.	• Field inspections	• PLC with Uninterrupted Power Supply (UPS) • "Fail-Closed" shutdown valves • Consider backfeed to redundant generation sources or generation sources • Install industry standard weather mitigation on distribution lines • Solar Back-up if required	• SCADA alarms notification to operations staff • PLC/UPS programmed to initiate a closure of shutdown valves in fail safe position (Fail-Closed) • PLC/UPS will continue to monitor the shutdown and report back to the SCADA system for personnel • Designate an exclusion zone, and provide appropriate PPE for protection of onsite personnel • Verify CO2 flow was shut off by the system or start manual protocol to stop flow, visual inspection, and manually close valves. • Notify 24-Hour Emergency Contac t• Notify UIC Program Director within 24-hours of shut-in • Notify UIC Program Director of start-up procedure.	• Operations manager • Field superintendent • Project manager
34	Post-injection period	Unauthorized access/activity: Unauthorized activity on filed site	• Field personnel logs	• Fencing around well sites • Security in place	• Report any incidents to local Sheriff's office	• Field superintendent • Company man

Appendix B: Emergency Contact List

Tri-State CCS Redbud 1, Hancock County, West Virginia
Updated 4/19/24

Facility Contacts	Phone Number
24-Hour Emergency Contact During Construction: Project Manager – Claimed as PBI	Claimed as PBI
24-Hour Emergency Contact During Operation and Post-Injection: Operations Manager	TBD
Environmental Services Contractor	TBD
Local Agencies	
Hancock County Office of Emergency Management	304-564-4040
Hancock County Sheriff	304-564-3911
New Manchester Volunteer Fire Department	304-564-4497
Chester Volunteer Fire Department	304-387-1690
State Agencies	
West Virginia Emergency Management Division (24-Hour)	304-558-5380
West Virginia Emergency Management Division - Watch Center and West Virginia Department of Environmental Protection – Spill Hotline (24-Hour)	800-642-3074
West Virginia State Geological Survey	304-594-2331
Federal Agencies	
U.S. EPA Region 3 UIC Program Director (WV, PA) – Kevin Rowsey	215-814-5463
U.S. EPA Region 5 UIC Program Director (OH) – Kayla Schmalle	312-353-3944
National Response Center (24 hours)	800-424-8802