8.0 Class VI Emergency and Remedial Response Plan

This chapter describes the emergency and remedial response actions the Alliance would undertake at the Morgan County CO_2 storage site in the unlikely event of an emergency that could endanger an USDW within the AoR described in Chapter 3.0, Area of Review and Corrective Action Plan. This chapter is intended to demonstrate the Alliance's compliance with 40 CFR 146.94 and takes into account the EPA's March 2011 *Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators*, including the "Sample Template of an Emergency and Remedial Response Plan" in Appendix E (EPA 2011). Prior to beginning operations, the Alliance will also prepare a comprehensive Emergency and Remedial Response Plan to address protection for all environmental resources and infrastructure that could be affected by an adverse event and will describe the actions the Alliance would undertake to protect such resources and infrastructure as needed.

Section 8.1 describes the development of the Alliance's Emergency and Remedial Response Plan, including the components of the plan developed for the protection of USDWs. Section 8.2 describes the emergency or remedial response actions the Alliance will undertake to protect USDWs if an adverse event were to occur. Section 8.3 describes the steps the Alliance will take to amend its Class VI Emergency and Remedial Response Plan as needed. Section 8.4 describes staff training and exercise procedures. Section 8.5 provides emergency contacts (to the extent known at the present time) and Section 8.6 describes communications with adjacent landowners and emergency response personnel. Section 8.7 describes the components of the communications plan and emergency procedures that will be developed for the Alliance's comprehensive Emergency and Remedial Response Plan. References for sources cited in this chapter are provided in Section 8.8.

8.1 Development of a Comprehensive Emergency and Remedial Response Plan

The Alliance will develop a comprehensive Emergency and Remedial Response Plan for its Morgan County CO_2 storage site. Following the EPA's recommendations in its draft guidance and in keeping with good business practices, the Alliance will identify what actions will be necessary in the unlikely event of an emergency at the site. The plan will ensure that site operators know which entities and individuals are to be notified and what actions need to be taken to expeditiously mitigate any emergency situation and protect human health and safety and the environment, including USDWs.

The Alliance will develop its comprehensive plan as follows:

1. Identify potential emergency scenarios that could occur during construction, operation, or post-injection site care. All potential emergency situations, regardless of likelihood, will be identified.
2. Identify the resources or infrastructure that could be adversely affected if the emergency events were to occur.
3. Describe the response actions that must be taken to address the emergency.
4. Prepare a list of facility emergency 24-hour contacts and a list of people to contact in an emergency.

5. Prepare a communications plan and emergency notification procedures describing the potential audiences and communication methods.

6. Prepare a Safety and Health Plan.

This comprehensive plan will be available to the EPA when it is completed.

To demonstrate compliance with the EPA's UIC Class VI regulations, the remainder of this chapter provides the part of the Alliance's Emergency and Remedial Response Plan that describes the actions the Alliance will take to address movement of the injection or formation fluids that could endanger a USDW during construction, operation, or post-injection site care periods.

8.1.1 Identification of Adverse Events

Despite the extensive efforts to site, engineer, construct, and operate the injection wells (as described throughout this supporting documentation), there are circumstances that, while unlikely, could lead to migration or a release of CO_2 requiring emergency and remedial response actions. Specifically, the movement of the CO_2 plume or pressure front could differ from the predicted AoR and, as a result, intercept transmissive faults and fractures or encounter previously unidentified fractures or abandoned wells. In addition, faults and fractures could be generated and become conduits for CO_2 or brine movement from the injection zone. Equipment malfunctions could also occur.

Risk Levels

Although the risk level (as expressed in terms of the likelihood of occurrence and the severity of the consequences) varies among these events, the Alliance has not attempted to assign risk levels to them as suggested in the EPA's draft guidance. Rather, the Alliance has developed emergency and remedial response actions for all possible events regardless of their probability of occurrence.

This section identifies adverse events that could occur during the construction, operation, and post-injection site care periods. For each event, the Alliance developed a thorough description of potential response actions that will be applied to stop, control, and remedy an unplanned release of CO_2 or brine from the injection zone in order to protect USDWs.

A set of adverse events has been identified that could indicate the potential for or result in the unintended release of CO_2 or movement of brine from the Mount Simon Sandstone. The possible scenarios consist of both slow and sudden releases of CO_2 or brine. Such releases will result in the implementation of emergency or remedial actions as described in Section 8.2.

Table 8.1 lists the potential adverse events that could occur during the construction, injection, and post-injection site care periods that will trigger response actions to protect USDWs.

Table 8.1. Potential Adverse Events

Injection Period
• Loss of mechanical integrity (injection or monitoring wells)
• Migration of CO_2 from injection zone through faults and fractures
• Migration of CO_2 from injection zone through undocumented wells
• Migration of CO_2 from injection zone through failure of the confining zone (loss of containment)
• Monitoring equipment failure or malfunction
• Movement of brine from injection zone
• Earthquake
Post-Injection Site Care Period
• Loss of mechanical integrity (monitoring wells)
• Migration of CO_2 from injection zone through faults and fractures
• Migration of CO_2 from injection zone through undocumented wells
• Migration of CO_2 from injection zone through failure of the confining zone (loss of containment)
• Monitoring equipment failure or malfunction
• Movement of brine from injection zone
• Earthquake

8.1.2 Resources or Infrastructure Potentially Affected

As described in Chapter 3.0, the delineated AoR (based on modeling results) is an area of approximately 5,000 ac. The Alliance also identified a 25-mi^2 survey area around the injection wells for assessment of any other possible conduits from the injection zone.

The land surface above the AoR and the survey area is used primarily for agriculture. Residences and farm-related buildings are scattered across the land surface, particularly along roads. Surface-water features such as creeks, streams, and impoundments formed by small earthen dams also are found in the area. Limited stretches of woodland parallel stretches of the streams. Most of the land surface is farmland. Shallow groundwater-supply wells are associated with residences.

Using Morgan County property records, the Alliance conducted an inventory of all buildings within the survey area. Then, using the Beacon™ web-based database, photographs of the structures on each parcel were viewed and building types on each parcel were categorized and tabulated. Approximately 65 residences were identified within the survey area, with 10 residences within the AoR. In the unlikely event that CO_2 or formation fluids (brine) from the injection zone move through release pathways (e.g., unknown faults or abandoned wells), brine may diffuse toward the over-pressurized, lowermost USDW (St. Peter Sandstone). It should be noted that no shallow groundwater-supply wells currently extend into this highly brackish USDW. It is extremely unlikely that CO_2 migration from the injection zone could reach and adversely affect shallow groundwater-supply wells or reach surface-water bodies.

Figure 8.1 shows the location of residences, known water wells, and surface-water bodies within the AoR and the survey area, relative to the Morgan County CO_2 storage site.

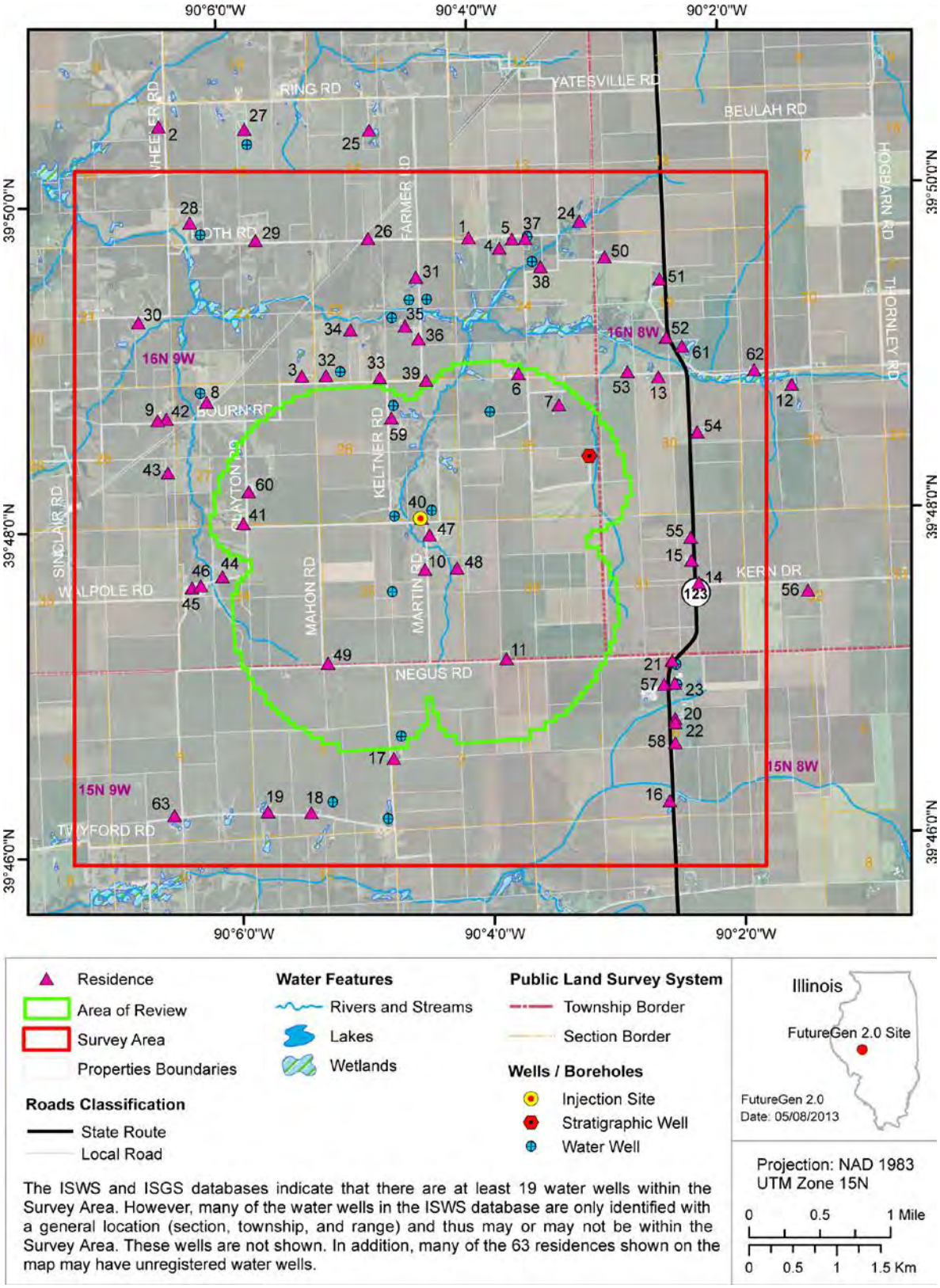

Figure 8.1. Map of Residences, Water Wells, and Surface-Water Features Within the Delineated AoR and Survey Area

8.2 Emergency and Remedial Response Actions to Protect USDWs

As described in other chapters of this supporting documentation, the Alliance has undertaken extensive efforts to characterize the proposed storage site, including identifying any possible geologic or other conduits between the injection zone and USDWs (see Chapter 2.0, Geology and Hydrology). The Alliance will also construct and operate the injection wells in compliance with UIC regulatory requirements (see Chapter 4.0, Construction and Operations Plan) and will implement a comprehensive testing and monitoring effort to verify that the Morgan County CO_2 storage site is operating as permitted and is not endangering USDWs (see Chapter 5.0, Testing and Monitoring). After injection ceases, the injection wells will be plugged in accordance with regulatory requirements (see Chapter 6.0, Injection Well Plugging Plan) and the site will continue to be monitored for as long as is required to demonstrate that USDWs will not be endangered (see Chapter 7.0, Post-Injection Site Care and Site Closure Plan). In sum, the Alliance has undertaken or has committed to undertaking all necessary actions to site, engineer, construct, and operate the injection wells in compliance with the applicable UIC regulations and to protect USDWs.

Despite these actions and commitments to prevent adverse events from occurring or to reduce the likelihood that adverse events will affect the permanent storage of CO_2 at the Morgan County site, if an adverse event did occur, the Alliance will deploy a variety of emergency or remedial responses depending on the circumstances (e.g., the location, type, and volume of a release) to protect USDWs. Table 8.2 summarizes the types of adverse events that could occur and the likely sequence of responses that will be undertaken to protect USDWs. Whether the adverse event occurred during construction, operation, or post-injection site care will affect the response. Emergency and remedial responses will be considered in a sequence of progressively more extensive actions. The list for each adverse event is ordered accordingly. This arrangement of responses is conceptual: the reality of an adverse event will determine the actual response(s) deployed. If any adverse event occurred, the Alliance will notify the EPA Director within 24 hours. Following actions taken to address the emergency, the Alliance will demonstrate the efficacy of the remedial response actions to the satisfaction of the Director before resuming injection operations. The Director will be informed when injection operations are scheduled to resume.

Table 8.2. Adverse Events Potentially Affecting USDWs

Event/Description	Time of Event	Avoidance Measures	Potential Response Actions	Response Personnel	Equipment
Loss of mechanical integrity (injection or monitoring wells): As a well is drilled, multiple concentric strings of casing are installed and cemented. If the cement seal with the outer annulus or inner annuli failed, there will be a pathway for cross contamination of formations, including USDWs. During injection, CO_2 could travel through geologic formations above the injection and confining zones into a USDW. Post-injection, CO_2 could travel through a compromised monitoring well into a USDW.	Construction/ drilling; operations/ injection; post-injection site care	Care in well construction particularly with respect to cement placement	Specific response will be dependent on the type of well (injection or monitoring). In general, the following will be undertaken: – Stop injection. – Check the monitoring record in an attempt to identify cause. – Log hole; check casing and borehole condition. – Repair annulus seal or replace casing. – Create a hydraulic barrier by reservoir pressure downstream of leak. – Grout or install chemical sealant barrier in an adjoining well to block leak. – Abandon well by completely closing it (seal with cement). – Drill new well if necessary. – Conduct groundwater remediation as required.	Drilling crew, supervising professionals, geotechnical subcontractors	Existing or newly mobilized drill rig, logging equipment, cement or casing as required
Migration of CO_2 from injection zone through faults and fractures: This could occur as a result of existing unknown faults or fractures or new, seismically induced faults or fractures.	Operations/ injection; post-injection site care	Extensive geophysical characterization has not identified faults or fractures	– Stop injection. – Assess cause by reviewing monitoring data. – Conduct geophysical survey in an attempt to locate leaks. – If warranted, resume injection, but reduce injection pressure by reducing flow rate or inject through additional injection wells. – Intensify monitoring to determine whether migration continues with continued injection.		

Table 8.2. (contd)

Event/Description	Time of Event	Avoidance Measures	Potential Response Actions	Response Personnel	Equipment
			– Lower reservoir pressure by removing liquids (water, brine, etc.) from the storage reservoir. – Intersect the migration with extraction wells in the vicinity of the leak, withdraw and re-inject. – Lower the reservoir pressure by promoting new pathways to access new volumes or strata in the storage reservoir. – Create a hydraulic barrier by increasing reservoir pressure upstream of the leak. – Inject grout or chemical sealant to block the leak. – Stop injection to stabilize the reservoir system. – Stop injection, extract CO2 from the reservoir, and re-inject in a more suitable location. – Conduct groundwater remediation as required.	Onsite operating staff, supervising professionals, geophysical consultants	Newly mobilized drill rig, geophysics monitoring trucks
Migration of CO_2 from injection zone through undocumented wells	Operations/ injection; post-injection site care	Drilling records and site walkthroughs were conducted. Only three wells were identified and none penetrate the confining zone.	– Stop injection. – Assess the cause by reviewing monitoring data. – Conduct a geophysical survey in an attempt to locate migration. – Repair leaking wells by re-plugging with cement. – Repair leaking injection wells with well-recompletion techniques such as replacing casing and packers or re-cementing annular spaces. – Plug and abandon wells that cannot be repaired.	Drilling crew, supervising professionals, geotechnical subcontractors	Newly mobilized drill rig, logging equipment, cement or casing as required

Table 8.2. (contd)

Event/Description	Time of Event	Avoidance Measures	Potential Response Actions	Response Personnel	Equipment
			– Create a hydraulic barrier by increasing reservoir pressure upstream of the leak. – Install chemical sealant or grout barriers to block leaks. – Conduct groundwater remediation as required.		
Migration of CO_2 from injection zone through failure of the confining zone (loss of containment)	Operations/ injection; post-injection site care	Careful monitoring and control of injection flow and pressure with periodic monitoring well sampling	– Stop injection. – Verify integrity of well bore. – Proceed to response for migration of CO2 through well bore, through faults or fractures, or through undocumented abandoned wells according to location of migration. – Conduct groundwater remediation as required.	Onsite operating staff, supervising professionals, geophysical consultants	Newly mobilized drill rig, geophysics monitoring trucks
Monitoring well equipment malfunction: Failure or malfunction of well instrumentation that monitors wellhead pressure, temperature, or annulus pressure could result in false readings. In this event, the reservoir could become over-pressurized, possibly resulting in hydraulic fractures in the confining zone.	Operations/ injection	Preventive maintenance of equipment	– Stop injection. – Review monitoring records. – Perform reservoir injection tests to determine extent of fracturing. – Completely close the well (seal with cement). – Drill new well if necessary. – Conduct groundwater remediation as required.	Drilling crew, supervising professionals, geotechnical and instrument subcontractors	Newly mobilized drill rig and/or instrument repair truck
Movement of brine from injection zone: This could occur as a result of existing unknown faults or fractures, seismically induced faults or fractures, or failure of the confining zone (loss of containment).	Operations/ injection; post-injection site care	Careful monitoring and control of injection flow and pressure with periodic monitoring well sampling.	– Stop injection. – Assess cause by reviewing monitoring data. – Proceed to response for migration of CO2 from injection zone through faults or fractures according to location of migration. – Conduct groundwater remediation as required.	Onsite operating staff, supervising professionals, geophysical consultants	Newly mobilized drill rig, geophysics monitoring trucks

Table 8.2. (contd)

Event/Description	Time of Event	Avoidance Measures	Potential Response Actions	Response Personnel	Equipment
Earthquake: If a seismic event were to occur, induced faults or fractures or well leakage could occur.	Operations/ injection; post-injection site care	The site is located in a seismically stable region.	– Stop injection. – Evaluate integrity of storage volume by gas pressure response and monitoring instrumentation. – If a leak is detected, conduct a geophysical survey to locate new fracture zone. – If warranted, resume injection but reduce injection pressure by reducing flow rate or inject through additional injection wells. – Intensify monitoring to determine whether migration is continuing with continued injection. – Lower reservoir pressure by removing liquids (water, brine, etc.) from the storage reservoir. – Intersect the migration with extraction wells in the vicinity of the leak, withdraw, and re-inject. – Lower the reservoir pressure by promoting new pathways to access new volumes or strata in the storage reservoir. – Create a hydraulic barrier by increasing reservoir pressure upstream of the leak. – Inject grout or chemical sealant to block leak. – Stop injection to stabilize reservoir system. – Stop injection, extract CO2 from reservoir, and re-inject in more suitable location. – Conduct groundwater remediation as required.	Onsite operations staff, drilling crew, supervising professionals, geotechnical contractors, mechanical contractors, as required	Newly mobilized drill rig, logging equipment, cement or casing, as required

Table 8.2. (contd)

Event/Description	Time of Event	Avoidance Measures	Potential Response Actions	Response Personnel	Equipment
Groundwater/USDW contamination: If there were a failure of the confining zone or injection or monitoring well, CO_2 or brine could reach groundwater, requiring remediation.	Operations/ injection; post-injection site care	The entire CO_2 injection project is focused on preventing escape of CO_2 while sequestering the CO_2. The FutureGen oxy-combustion process incorporates gas-cleaning processes to remove at least 97% of contaminants, including mercury, prior to injection. Trace contaminants that might be entrained in CO_2 leaking into USDWs will pose inconsequential risk to the water quality.	– Stop injection. – Assess cause by reviewing monitoring data. – Conduct a geophysical survey in an attempt to locate migration. – If the leak cannot be located or while pursuing corrective measures for the leak, the following remedies may be considered: ✓ Drill wells to intersect accumulations in groundwater, preferably near CO_2 aquifer entrance zones. Extract groundwater contaminated with gaseous or dissolved CO_2 water and treat ex situ. ✓ Dissolve mineralized CO_2 (carbonates) in water and extract as a dissolved phase through an extraction well for ex situ air stripping. ✓ Extract groundwater with metals mobilized by CO_2 and treat ex situ to remove metals and residual CO_2. ✓ Use hydraulic barriers to immobilize and contain contaminants by deploying injection and extraction wells. ✓ Deploy in situ chemical or biological treatment technologies to enhance biochemical degradation or stabilization of CO_2-related contaminants. ✓ Create a hydraulic barrier by	Drilling crew, supervising professionals, geotechnical subcontractors, environmental or water-treatment contractors	Water-treatment equipment, new wellhead plumbing to and from water-treatment equipment, reagents for optional in situ treatment, newly mobilized drill rig, logging equipment, cement or casing, as required

Table 8.2. (contd)

Event/Description	Time of Event	Avoidance Measures	Potential Response Actions	Response Personnel	Equipment
			increasing reservoir pressure upstream of a leak. ✓ Place grouts or chemical sealant barriers to block leaks. ✓ Discontinue injection. ✓ Provide individual water-treatment systems for each water-supply well user. The configuration for each ex situ treatment system will be determined by water chemistry. Applicable treatment technologies include but are not limited to aeration, pH adjustment, ion exchange, oxidizing filter (manganese greensand), membrane filtration, etc.)		

8.3 Amending the Emergency and Remedial Response Plan

The Alliance will review and, as necessary, revise its Emergency and Remedial Response Plan at least once every 5 years. In addition, the Alliance will review and, as necessary, revise its Emergency and Remedial Response Plan within 1 year of an AoR reevaluation or within 1 year after any significant changes to the facility such as the addition of injection or monitoring wells. Any revised plan will be submitted to the EPA UIC Program Director for approval. If, after a review, the Alliance determines that no revisions are necessary, the Alliance will submit its determination and the basis for it to the EPA UIC Program Director.

8.4 Staff Training and Exercise Procedures

All operations employees will receive training related to health and safety, operational procedures, and emergency response according to the roles and the responsibilities of their work assignments. Initial training will be conducted by, or under the supervision of, a project operations manager or a designated representative. Trainers will be thoroughly familiar with the operations plan and Emergency and Remedial Response Plan.

Facility personnel will participate in annual training that teaches them to perform their duties in ways that prevent the discharge of CO_2. The training will include familiarization with operating procedures, and equipment configurations appropriate to the job assignment, as well as emergency response procedures, equipment, and instrumentation. New personnel will be instructed before beginning their work.

Refresher training will be conducted at least annually for all operations personnel. Monthly briefings will be provided to operations personnel according to their respective responsibilities and will highlight recent operating incidents, actual experience in operating equipment, and recent storage reservoir monitoring information.

Only personnel who have been properly trained will participate in drilling, construction, operations, and equipment repair at the storage site. A record including the person's name, date of training, and the instructor's signature will be maintained.

8.5 Emergency Contacts

If a CO_2 release were detected, the Emergency Coordinator and Operations Manager on duty will be notified immediately. The Emergency Coordinator will be responsible for notifying offsite emergency agencies and resources. If the Emergency Coordinator was not available, the Operations Manager will contact outside emergency response organizations appropriate for the situation. These organizations are listed in Table 8.3. The EPA UIC Program Director will also be notified within 24 hours.

Agency emergency response services will also be provided by the ISGS, IDNR, and USGS Water Resources for Illinois.

Table 8.3. Outside Emergency Response

Agency	Location	Phone
Fire	Alexander, IL	911 217-478-3341
Ambulance	Jacksonville, IL	911 217-245-7540
Passavant Area Hospital	Jacksonville, IL	217-245-9541
State Police		217-786-7101
Illinois Emergency Management Agency	Springfield, IL	217-782-7860
Illinois Emergency Management Agency/Region Six	Springfield, IL	217-782-0922
Jacksonville/Morgan County Emergency Services & Disaster Agency	Jacksonville, IL	217-479-4616
Sheriff	Jacksonville, IL	217-245-4143

In addition to the emergency contact lists, a list of contacts for state agencies within the AoR is presented in Table 8.4. There are no federally recognized Native American Tribes located within the AoR.

Table 8.4. Agency Emergency Response

Agency	Person	Position	Address and Phone
Illinois State Geological Survey	Randall A. Locke, II	Environmental Geochemist and Head Geochemistry Section	Room 387, Natural Resources Building 15 E. Peabody University of Illinois Champaign, IL 61820 217-333-3866
Illinois Department of Natural Resources	-	Office of Law Enforcement	One Natural Resources Way Springfield, IL 62702 217-785-8407
USGS Water Resources for Illinois	-	Illinois Water Science Center	1201 W. University Avenue, Suite 100 Urbana, IL 61801 (217) 328-8747

8.6 Communications with Adjacent Landowners and Emergency Response Personnel

Prior to the start of CO_2 injection operations, the Alliance will formally communicate with landowners living adjacent to the storage site to provide information on the nature of the operations, potential risks, and appropriate response approaches under various emergency scenarios.

8.7 Communications Plan and Emergency Notification Procedures

The Alliance's comprehensive Emergency and Remedial Response Plan will include a communications plan and describe emergency notification procedures. Among other things, this will include the following information:

- emergency response contact(s) and role(s)
- communication methods (e.g., Internet, newspapers, public service announcements via broadcast radio or TV)
- other contacts: e.g., local water systems, CO_2 source(s) and pipeline operators, potentially affected landowners, regional response teams, etc.
- the location of the injection and monitoring wells (coordinates and directions to the storage site)
- a map of the area including the location of the wells, nearby population centers, and sensitive environments
- schematics and diagrams of the facility and the well, including the location of monitoring equipment and emergency shutoffs.

8.8 References

40 CFR 146.94. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 146, "Underground Injection Control Program: Criteria and Standards," Section 94, "Emergency and remedial response."

EPA (U.S. Environmental Protection Agency). 2011. *Draft Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance for Owners and Operators*. EPA 816-D-10-012, Office of Water (4606M), Washington, D.C.