# ATTACHMENT E: POST-INJECTION SITE CARE (PISC) AND SITE CLOSURE PLAN

## Facility Information

**Facility Name:** FutureGen 2.0 Morgan County $CO_2$ Storage Site
IL-137-6A-0004 (Well #4)

**Facility Contacts:** Kenneth Humphreys, Chief Executive Officer,
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**Location of Injection Well:** Morgan County, IL; 26−16N−9W; 39.80111ºN and 90.07544ºW

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

## Pre- and Post-Injection Pressure Differential

The information regarding pre- and post-injection pressure differentials, as required by 40 CFR 146.93(a)(2)(i) is presented below.

The maximum injection pressure differential is 479 psi at the injection well when injection stops. The magnitude and area of elevated pressure gradually decreases over time after injection stops; as further detailed in Table 1.

Figure 1 shows the pressure differential versus time for monitoring well locations in the Area of Review (AoR) and at the geometric centroid of the four horizontal injection wells. Simulated pressures at the injection "point" increase during the 20-year injection period from 1,779 psi to a maximum of 2,258 psi. The highest pressures are in the immediate vicinity of each injection well. As shown, pressures at the injection and monitoring well locations decline over time after injection ceases. Despite the modeled pressure of 2,258 psi, current permit limitations will require the pressure in the injection well not to exceed 2,252 psi.

Figure 2 presents aqueous pressure differentials from baseline at the top of the injection zone and the extent of the carbon dioxide plume at 20 years after the start of injection (i.e., the end of injection) and 70 years after the start of injection (i.e., at site closure).

**Table 1. Pressure differential to baseline conditions at well locations near the base of the Ironton Formation for Above Confining Zone Well 1 (ACZ1) and ACZ2 and at the middle of the Mount Simon 11 layer in the injection zone for the rest of the wells during and after.**

| | Pressure Differential (psi) | | | | |
|---|---|---|---|---|---|
| Year | SLR1 | SLR2 | ACZ1 | ACZ2 | Injection Well |
| Distance from Injection Well (ft) | 3740 | 6555 | 1010 | 3740 | 0 |
| Elevation (ft) | -3371 | -3414 | -2763 | -2751 | -3390 |
| 0 (Start injection) | 0 | 0 | 0 | 0 | 0 |
| 1 | 223 | 125 | 0 | 0 | 350 |
| 2 | 277 | 165 | 0 | 0 | 394 |
| 3 | 311 | 192 | 0 | 0 | 417 |
| 4 | 333 | 211 | 0 | 0 | 431 |
| 5 | 348 | 225 | 0 | 0 | 441 |
| 10 | 393 | 274 | 0 | 0 | 466 |
| 15 | 413 | 313 | 1 | 1 | 475 |
| 20 (Stop injection at year end) | 425 | 338 | 2 | 2 | 479 |
| 21 | 255 | 235 | 2 | 2 | 259 |
| 22 (Approximate maximum extent of $CO_2$ Plume) | 199 | 186 | 2 | 2 | 200 |
| 23 | 167 | 157 | 2 | 2 | 167 |
| 24 | 145 | 137 | 3 | 3 | 145 |
| 25 | 129 | 121 | 3 | 3 | 128 |
| 30 | 85 | 81 | 4 | 4 | 84 |
| 35 | 64 | 61 | 4 | 4 | 63 |
| 40 | 51 | 49 | 5 | 5 | 50 |
| 45 | 42 | 40 | 5 | 5 | 41 |
| 50 | 36 | 34 | 5 | 5 | 35 |
| 60 | 27 | 26 | 5 | 5 | 26 |
| 70 | 22 | 21 | 5 | 5 | 21 |
| 80 | 18 | 17 | 5 | 5 | 17 |
| 90 | 15 | 14 | 5 | 5 | 14 |
| 100 | 13 | 12 | 4 | 4 | 12 |

| | |
|---|---|
| SLR1 | Single-Level in-Reservoir #1 |
| SLR2 | Single-Level in-Reservoir #2 |
| ACZ1 | Above Confining Zone #1 |
| ACZ2 | Above Confining Zone #2 |
| Injection Well | Geometric centroid of four horizontal laterals |

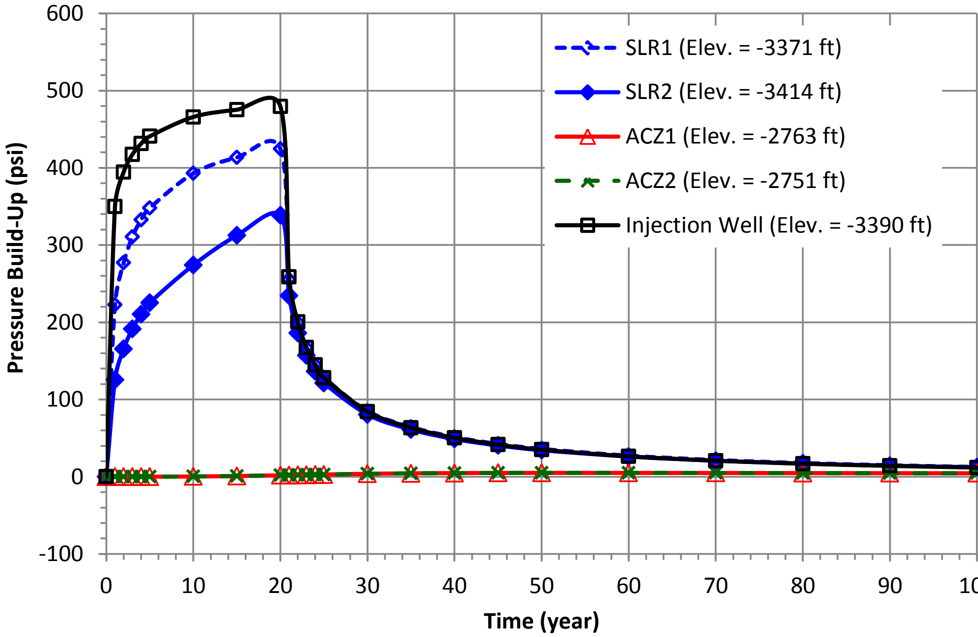



**Figure 1. Simulated aqueous pressure differential versus time at monitoring well locations near the base of the Ironton Formation for ACZ1 and ACZ2 and at the middle of the Mount Simon 11 layer in the injection zone for the rest of the wells.**

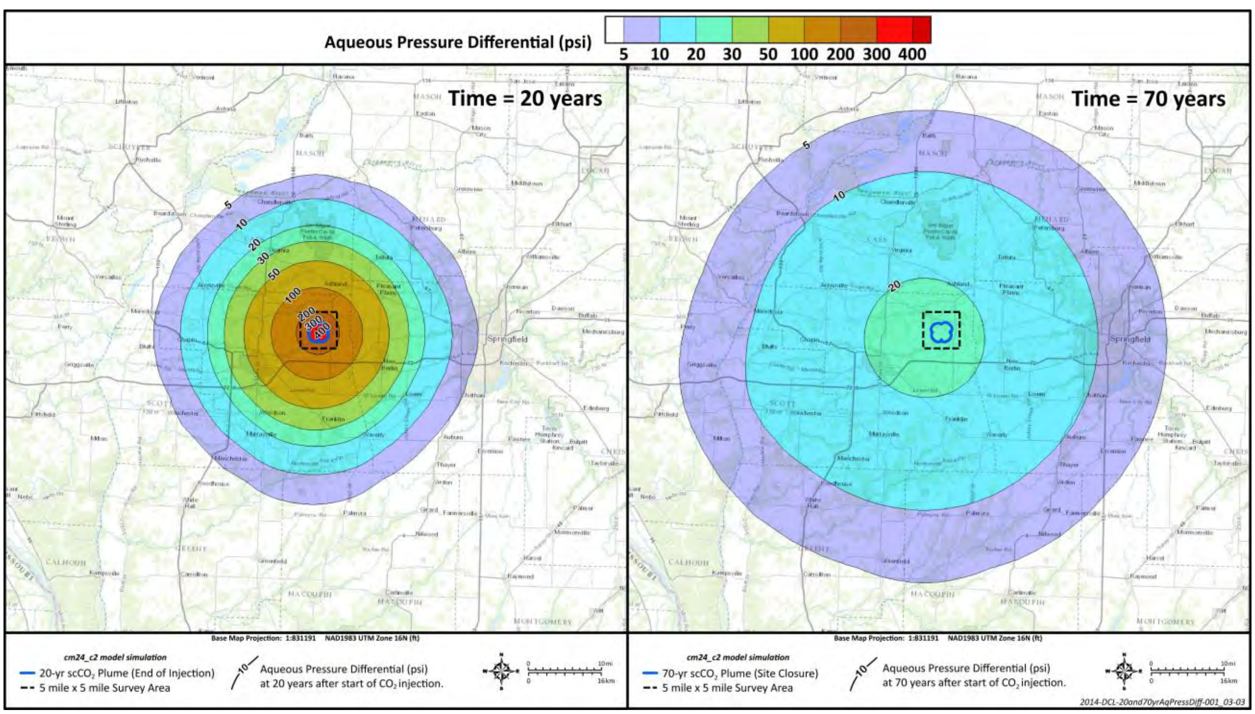



**Figure 2. Aqueous pressure differentials from baseline condition at the top of the injection zone and $CO_2$ plume extents at 20 years (end of injection) and 70 years (site closure) after start of injection.**

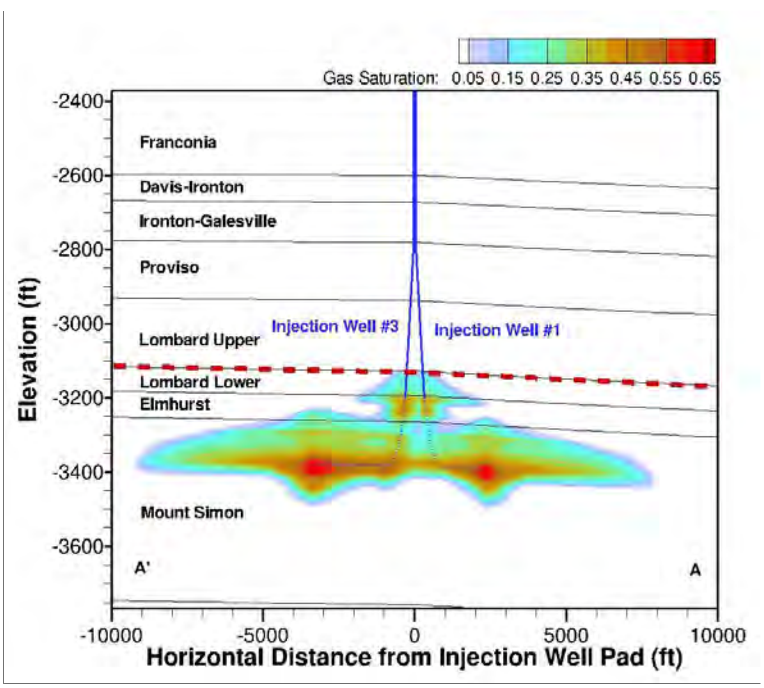
**Predicted Position of the $CO_2$ Plume and Associated Pressure Front Upon Cessation of Injection and at Site Closure**

The information regarding the predicted position of the carbon dioxide plume and associated pressure front at site closure, as required by 40 CFR 146.93(a)(2)(ii) is presented below.

The areal extent of the $CO_2$ plume increases during injection and for 2 years post-injection. As the areal extent decreases (at year 22), the plume migrates predominately upward. The computational modeling results indicate that the sequestered $CO_2$ will migrate above the Mount Simon Sandstone, into the Elmhurst as well as the lower part of the Lombard.

Figure 3 and Figure 4 show the upward migration of the $CO_2$ plume near the injection wells at 20 and 70 years. These two-dimensional images demonstrate various levels of gas saturation or upward migration into the injection zone (Mount Simon Formation, Elmhurst Sandstone, and the lower part of the Lombard). The computational model results indicate that the Model Layer "Lombard 5" is the top unit containing a fraction of injected $CO_2$ during the 100-year simulation. The top of the injection zone is set at 3,153 ft ( below MSL) at the FutureGen stratigraphic well, corresponding to the top of the Lombard 5 layer of the numerical model.

The computational model estimates that the $CO_2$ plume forms a cloverleaf pattern as a result of the four lateral-injection-well design. The plume grows both laterally and vertically as injection continues. Most of the $CO_2$ resides in the Mount Simon Sandstone. A small amount of $CO_2$ enters into the Elmhurst and the lower part of the Lombard Formation. When injection ceases at 20 years, the lateral growth becomes negligible but the plume continues to move slowly primarily upward. Once $CO_2$ reaches the low-permeability zone in the upper Mount Simon it begins to move laterally.



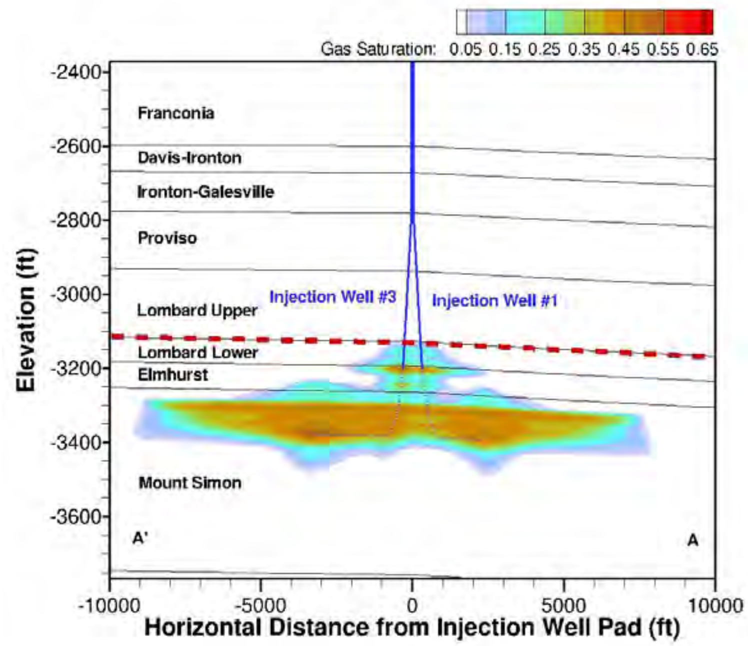
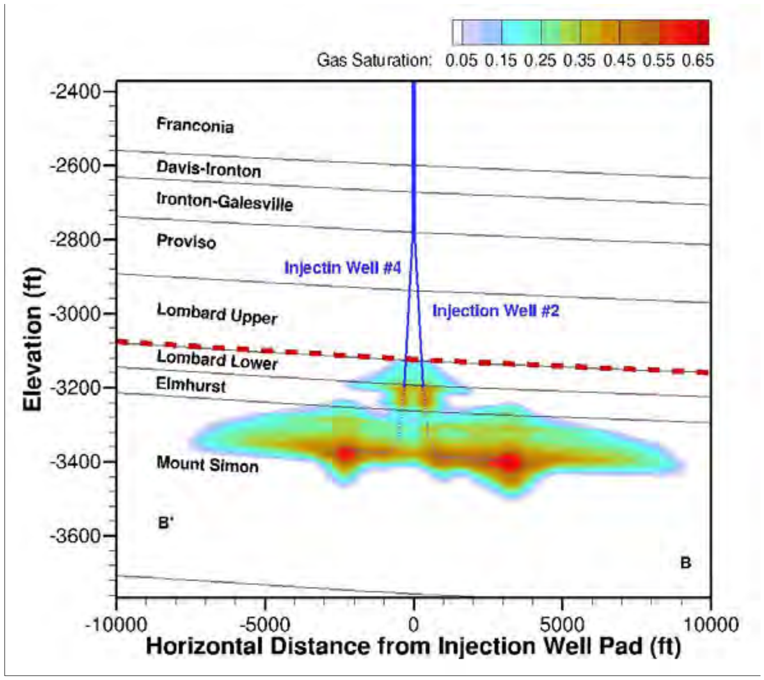



**Figure 3. Cutaway view of $CO_2$-rich phase saturation along A-A' (Injection Wells 1 and 3) at 20 and 70 years. The red dashed line indicates the top of the injection zone.**



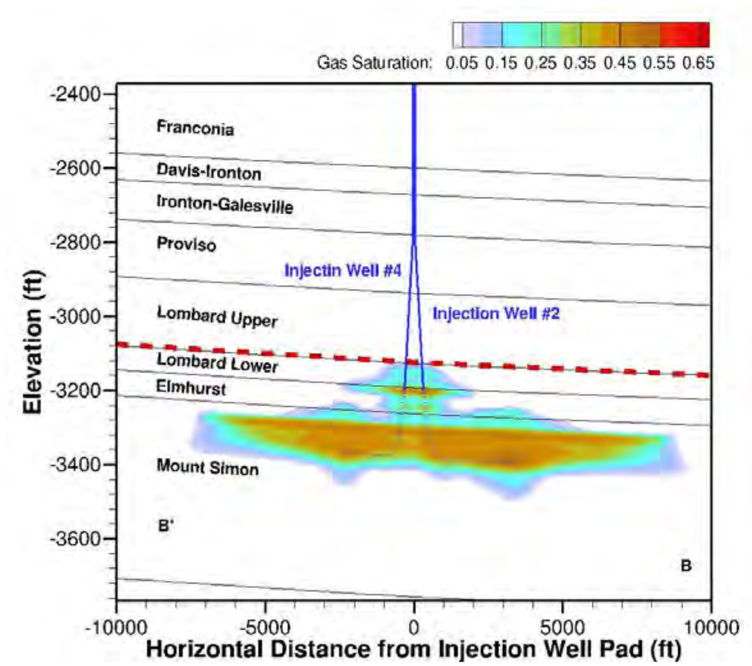




**Figure 4. Cutaway view of $CO_2$-rich phase saturation along B-B' (Injection Wells 2 and 4) at 20 and 70 years. The red dashed line indicates the top of the injection zone.**

Reservoir conditions are such that the $CO_2$ remains in the supercritical state throughout the domain and for the entire simulation period. The three-dimensional distribution of the $CO_2$-rich (or separate-) phase saturation is presented for selected times (i.e., 20 and 70 years). Additionally, to better illustrate the $CO_2$ migration through time and space, a cross-sectional view of the $CO_2$ plume is presented as slices through the center of the injection wells and along the well traces. Figure 3 and Figure 4 show the $CO_2$-rich (or separate) phase saturation for selected times for slices A-A' and B-B', respectively.

The maximum pressure differential corresponds to the end of the injection period (year 20). After that time, the pressure slowly dissipates, resulting in the maximum pressure differential being below 30 psi at 70 years, and below 20 psi at 100 years. The pressure differential distribution has been presented instead of a defined pressure front because the calculated pressure head in the Mt. Simon is greater than the calculated pressure head in the lowermost underground source of drinking water (USDW), the St. Peter Sandstone, under initial conditions prior to injection. Figure 2 presents aqueous pressure differentials from baseline at the top of the injection zone and the extent of the carbon dioxide plume at 20 years after the start of injection (i.e., the end of injection) and 70 years after the start of injection (i.e., at site closure).

The model predicts that the areal extent of the $CO_2$ plume (defined as 99.0 percent of the separate-phase $CO_2$ mass) increases during injection and for 2 years post-injection and then begins to decrease as buoyancy forces dominate and plume migration is predominately upward. Figure 5 shows the cumulative area of the $CO_2$ mass plume with time. The maximum plume extent, 6.46 $mi^2$, occurs at 22 years after the start of injection (2 years after the cessation of injection).

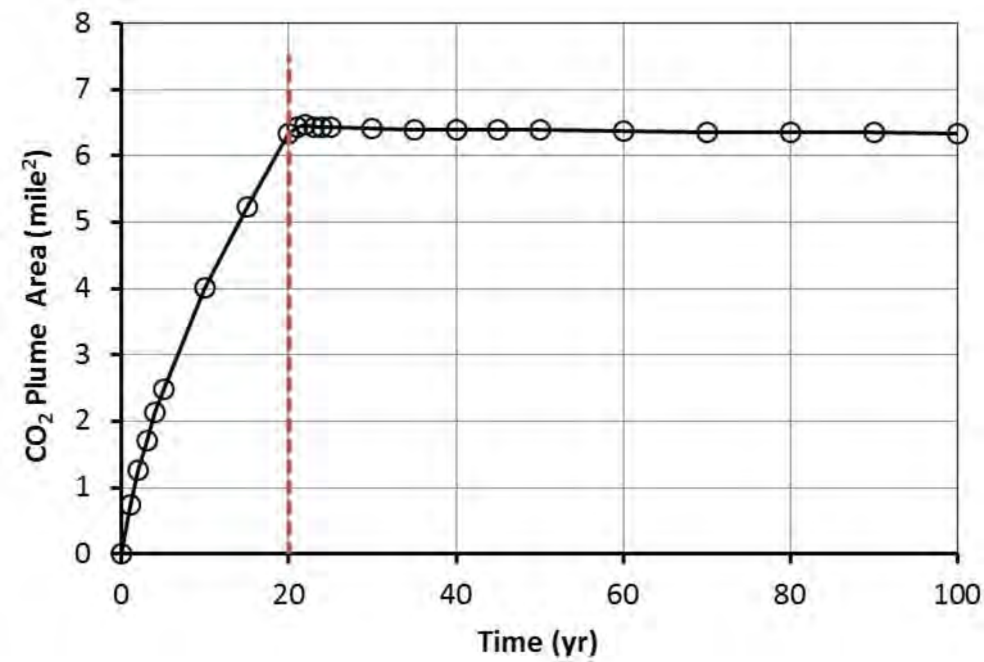
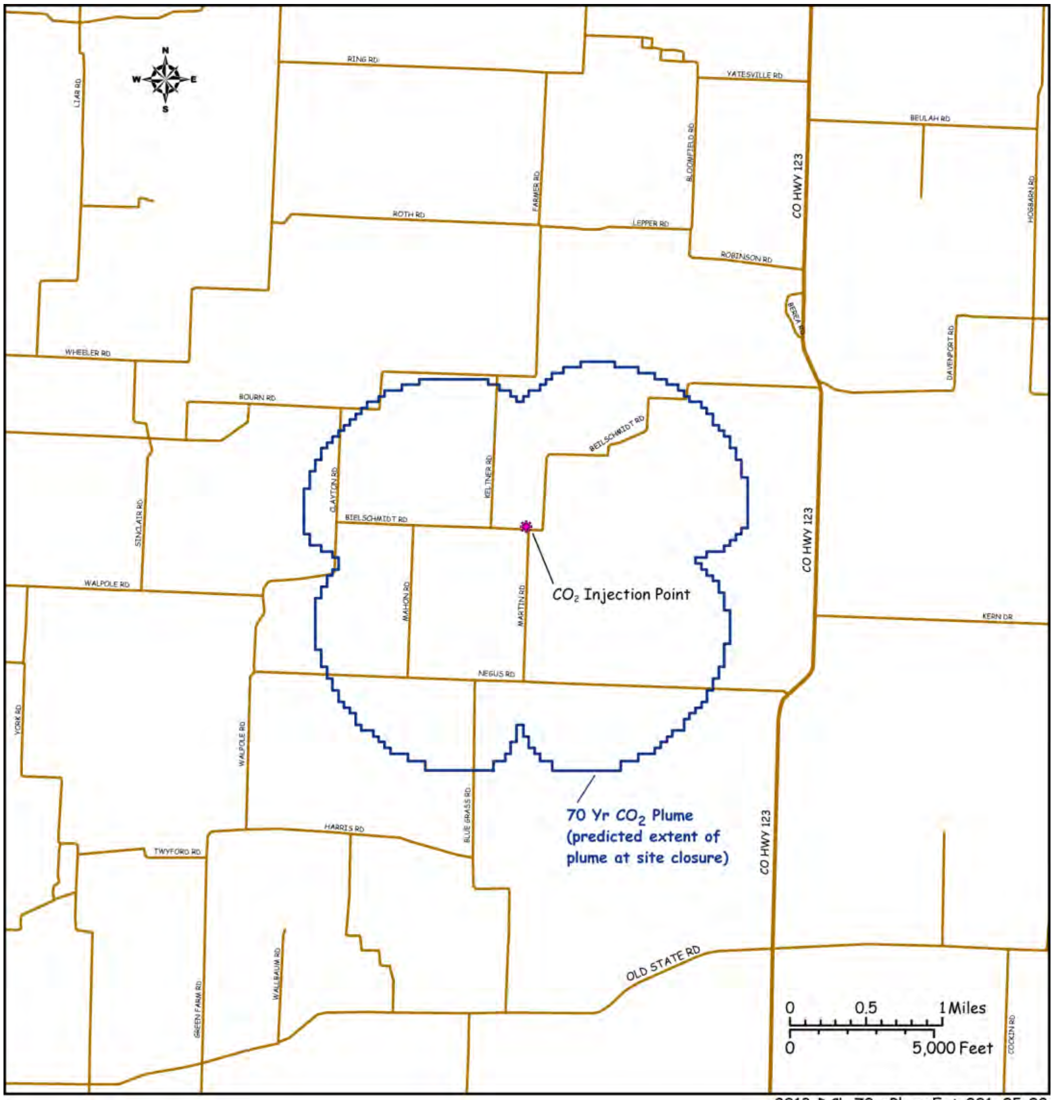



**Figure 5. Simulated plume area over time (the vertical dashed line denotes the time $CO_2$ injection ceases).**

The predicted extent of the $CO_2$ plume at the time of site closure, 50 years after the cessation of $CO_2$ injection, was determined from the computational model results.

Figure 6 shows the predicted areal extent of the $CO_2$ plume (defined as 99.0 percent of the separate-phase $CO_2$ mass) at the time of site closure. The simulation predictions show that 99.0 percent of the separate-phase $CO_2$ mass would be contained within an area of 6.35 $mi^2$ at the time of site closure. This plume is only 1.7% smaller than the maximum plume area, which occurs at 22 years after the start of injection (Figure 5).




2013-DCL-70yrPlumeExt-001_05-08

**Figure 6. Simulated areal extent of the $CO_2$ plume at the time of site closure (70 years after $CO_2$ injection was initiated).**

**Post-Injection Monitoring Plan**

FutureGen will perform post-injection monitoring, as required by 40 CFR 146.93(b), as described below.

Pressure monitoring of the injection zone will occur in three monitoring wells. The Testing and Monitoring Plan (Attachment C of this permit) describes the planned monitoring activities.

Quality assurance and surveillance measures:

Data quality assurance and surveillance protocols adopted by the project are designed to facilitate compliance with the requirements specified in 40 CFR 146.90(k). Quality Assurance (QA) requirements for direct measurements within the injection zone, above the confining zone, and within the shallow USDW aquifer that are critical to the post-injection monitoring, program (e.g., pressure and aqueous concentration measurements) are described in the Quality Assurance and Surveillance Plan (QASP) that is presented in Appendix G of the Testing and Monitoring Plan. These measurements will be performed based on best industry practices and the QA protocols recommended by the geophysical services contractors selected to perform the work.

***Location of Monitoring Wells***

Monitoring well locations are described in the Testing and Monitoring Plan (Attachment C of this permit). Their coordinates are provided in Appendix A of this plan. The objective of the monitoring program is to select and implement a suite of monitoring technologies that are both technically robust and provide an effective means of 1) evaluating $CO_2$ mass balance, 2) detecting any unforeseen containment loss, and 3) evaluating pressure changes in the reservoir to ensure that monitored values corroborate modeled expectations.

As part of the project's design optimization, the monitoring well network has been configured (Figure 7) to effectively monitor and account for the injected $CO_2$ and pressure changes. The design includes a total of nine monitoring wells:

- **Two Above Confining Zone (ACZ) wells.** These wells will be used to monitor immediately above the Eau Claire caprock in the Ironton Sandstone. Monitored parameters include: pressure, temperature, and hydrogeochemical indicators of $CO_2$ (Table 6).
- **Two Single-Level in-Reservoir (SLR) wells** (one of which is a reconfiguration of the previously drilled stratigraphic well). These wells will be used to monitor within the injection zone beyond the east and west ends of the horizontal $CO_2$-injection laterals. Monitored parameters include: pressure, temperature, and hydrogeochemical indicators of $CO_2$ (Table 6). One additional SLR well (a tenth monitoring well) will be installed outside of the expected $CO_2$ plume to monitor pressure effects in the injection zone.
- **Three Reservoir Access Tubes (RAT) wells.** These are fully cased wells, which allow access for monitoring instrumentation in the reservoir via pulsed neutron capture (PNC) logging equipment. To avoid two-phase flow near the borehole, which can distort the

$CO_2$ saturation measurements, the wells will not be perforated. Monitoring parameters include: quantification of $CO_2$ saturation across the reservoir and caprock.

- **One USDW well.** This well will be used to monitor the lowermost USDW (the St. Peter Sandstone). Monitored parameters include: pressure, temperature, and hydrogeochemical indicators of $CO_2$ (Table 6).

Although monitoring of the shallow surficial aquifer is not required or anticipated during the post-injection period, the network remains available for monitoring activities should the need arise.

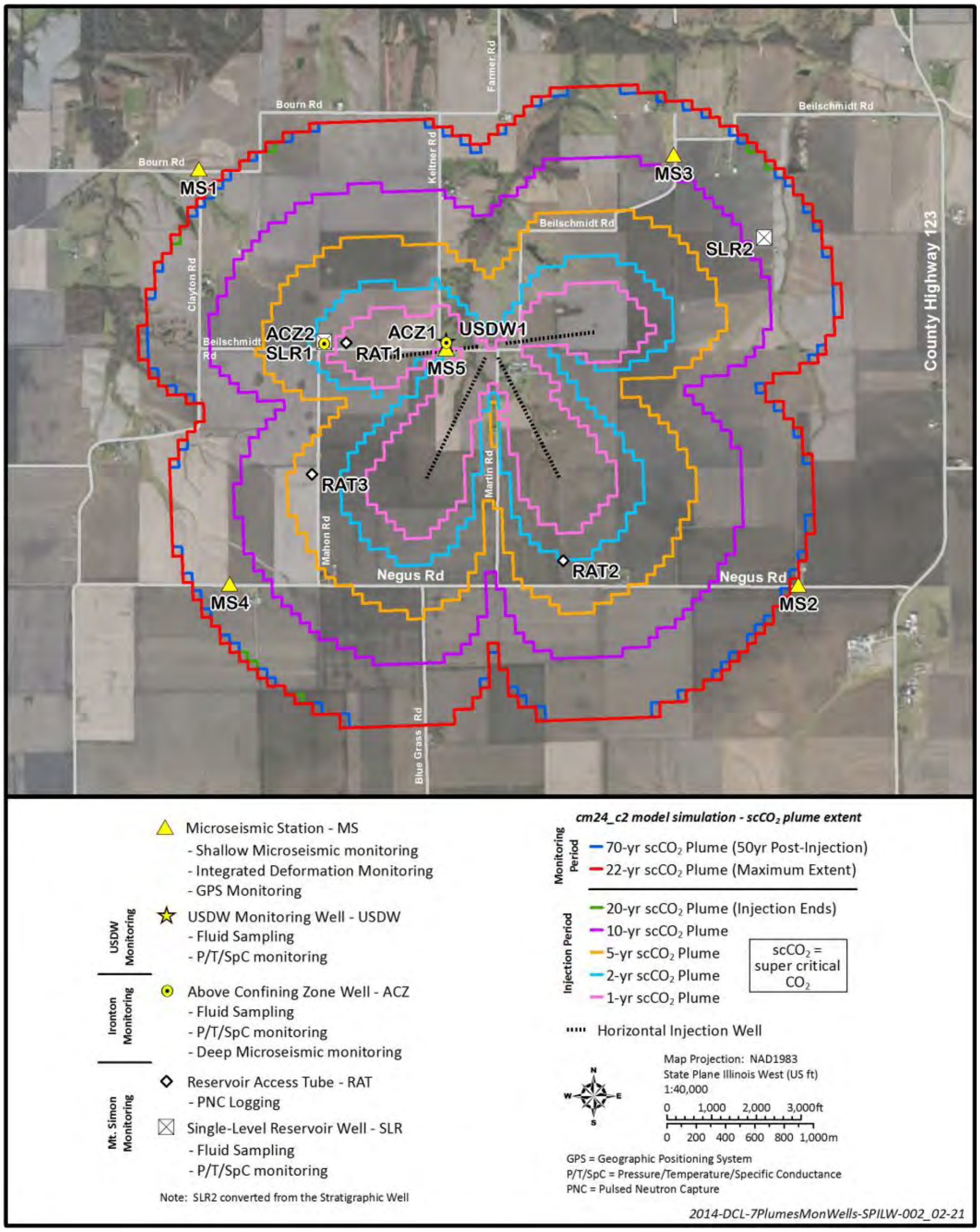



**Figure 7. Map of monitoring well locations.**

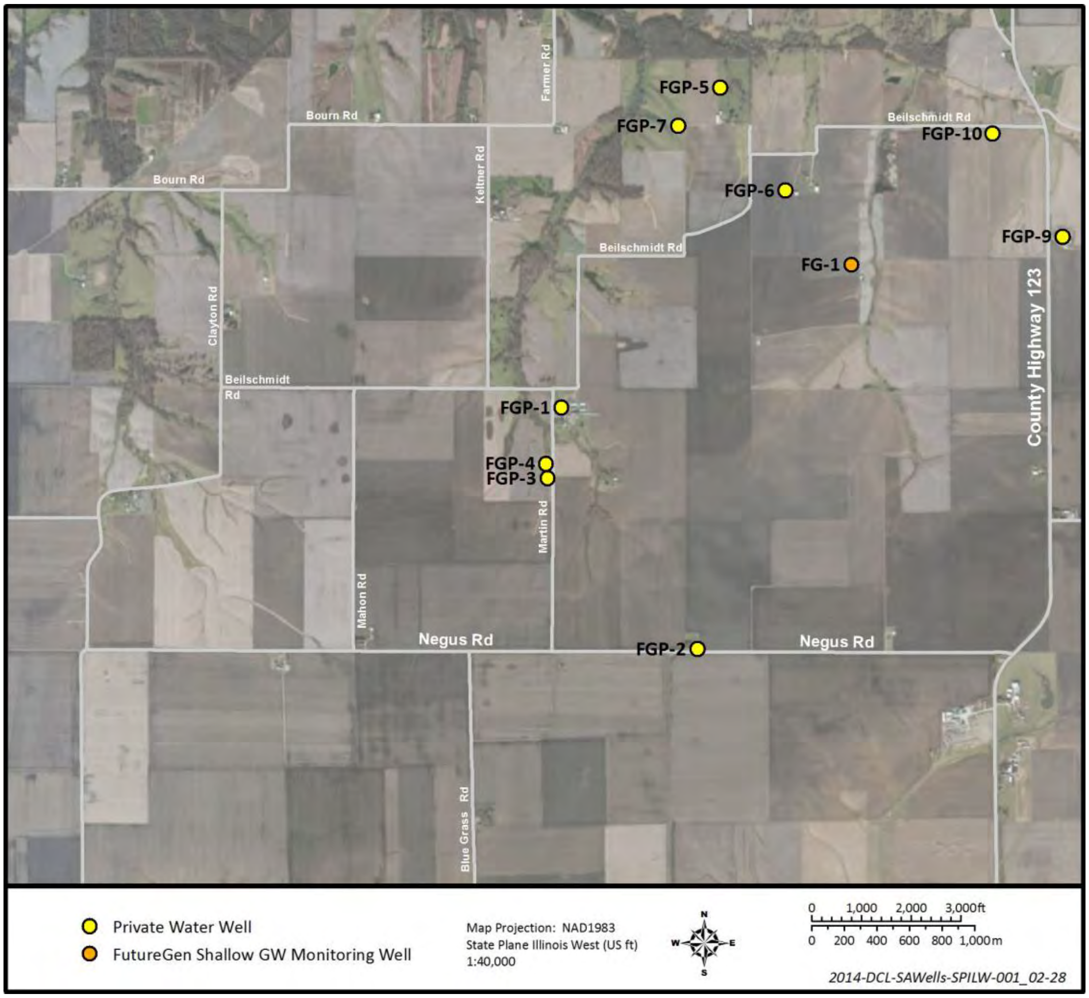



**Figure 8. Surficial aquifer monitoring locations. Well FG-1 is a dedicated well drilled for the purposes of the FutureGen project, while wells FGP-1 through FGP-10 wells are local landowner wells.**

### *Summary of Planned Post-Injection Monitoring Activities*

The suite of indirect geophysical monitoring methods that will be used to monitor the areal extent, evolution, and fate and transport of the injected $CO_2$ plume during PISC include: PNC logging, passive seismic monitoring, integrated surface deformation monitoring, and time-lapse gravity surveys. Table 2 summarizes the testing and monitoring activities planned for the post-injection phase; collection and recording of continuous monitoring data will occur at the frequencies described in Table 13.

**Table 2. Summary of post-injection monitoring activities.**

| Monitoring Category | Monitoring Method/Location | Frequency (Post-Injection Phase) |
|---|---|---|
| Groundwater Quality and Geochemistry Monitoring | Fluid sampling in surficial aquifers: 9 local landowner wells and 1 project-drilled well | None Planned |
| | Fluid sampling in St. Peter: one lowermost USDW well | Geochemistry Every 5 years<br><br>Continuous temperature and pressure monitoring |
| | Fluid sampling in Ironton: two ACZ wells | Geochemistry Every 5 years<br><br>Continuous temperature and pressure monitoring |
| Injection Zone Monitoring | Fluid sampling in Mount Simon: SLR monitoring wells | Every 5 years |
| | Pulsed-neutron capture (PNC) logging at 3 RAT wells | Every 5 years |
| | Pressure monitoring in Mount Simon: two SLR monitoring wells | Continuous |
| Indirect Geophysical Monitoring Techniques | Integrated deformation monitoring: five surface monitoring stations | Continuous |
| | Passive deep microseismic arrays in two ACZ wells and five seismometers in shallow cased bore holes. | Continuous |
| Note: For details and information on continuous monitoring, see Table 13. | | |

### *Groundwater Quality Monitoring*

FutureGen will conduct groundwater sampling every 5 years according to the procedures described below.

Specific information concerning the sampling methods, analytical techniques, laboratories and quality assurance for sampling for the post-injection monitoring program are presented in the FutureGen QASP; see Table A.2 for Monitoring Tasks, Methods, and Schedule.

Sampling will take place at the frequencies specified in Table 3 (for the surficial aquifers), Table 4 (for the St. Peter), and Table 5 (for the Ironton). Because near-surface environmental impacts are not expected, surficial aquifer (<100 ft bgs) monitoring will only be conducted for a sufficient duration to establish baseline conditions (minimum of three sampling events) prior to start of the injection phase of the project.

- Surficial aquifer monitoring is not planned during the post-injection phase; however, the need for additional surficial aquifer monitoring will be continually evaluated throughout the operational phases of the project, and may be reinstituted if conditions warrant or if requested by the EPA UIC Program Director.
- Target parameters for the ACZ wells include pressure, temperature, hydrogeochemical indicators of $CO_2$, and brine composition (Table 6).
- Target parameters for the USDW and surficial aquifer wells include pressure, temperature, hydrogeochemical indicators of $CO_2$, and brine composition (Table 6).

If a leakage response is observed in the ACZ early-detection monitoring wells (Ironton) then the decision not to institute USDW aquifer triggers will be reevaluated based on the magnitude of the observed leakage response and predictive simulations of $CO_2$ transport between the Ironton and the St. Peter Formations.

**Table 3. Sampling schedule for surficial aquifer monitoring wells.**

| **Monitoring well name/location/map reference:** Surficial aquifer monitoring wells<br>**Well depth/formation(s) sampled:** Shallow glacial sediments (approx. 17 ft – 49 ft) | |
|---|---|
| **Parameter/Analyte** | **Frequency (Post-Injection Phase)** |
| Dissolved or separate-phase $CO_2$ | None Planned |
| Pressure | None Planned |
| Temperature | None Planned |
| Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic carbon, total organic carbon, carbon and water isotopes, and radon | None Planned |

**Table 4. Sampling schedule for the USDW monitoring well.**

| **Monitoring well name/location/map reference:** One USDW monitoring well (see Figure 7)<br>**Well depth/formation(s) sampled:** St. Peter Sandstone (2,000 ft) | |
|---|---|
| **Parameter/Analyte** | **Frequency (Post-Injection Phase)** |
| Dissolved or separate-phase $CO_2$ | Every 5 years |
| Pressure | Continuous |
| Temperature | Continuous |
| Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic carbon, total organic carbon, carbon and water isotopes, and radon | Every 5 years |
| Note: For details and information on continuous monitoring, see Table 13. | |

**Table 5. Sampling schedule for ACZ monitoring wells.**

| **Monitoring well name/location/map reference:** Two ACZ monitoring wells (see Figure 7)<br>**Well depth/formation(s) sampled:** Ironton Sandstone (3,470 ft) | |
|---|---|
| **Parameter/Analyte** | **Frequency (Post-Injection Phase)** |
| Dissolved or separate-phase $CO_2$ | Every 5 years |
| Pressure | Continuous |
| Temperature | Continuous |
| Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic carbon, total organic carbon, carbon and water isotopes, and radon | Every 5 years |
| Note: For details and information on continuous monitoring, see Table 13. | |

Note: collection and recording of continuous monitoring data will occur at the frequencies described in Table 13.

<u>Sampling methods:</u>

Sampling procedures are discussed below, and specific details are provided in the FutureGen QASP Table A.2.

During all groundwater sampling, field parameters (pH, specific conductance, and temperature) will be monitored for stability and used as an indicator of adequate well purging (i.e., parameter stabilization provides indication that a representative sample has been obtained). Calibration of field probes will follow the manufacturer's instructions using standard calibration solutions. A comprehensive list of target analytes and groundwater sample collection requirements is provided in Table 6. All analyses will be performed in accordance with the analytical requirements listed in Table 7. Additional analytes may be included for the shallow USDW based on landowner requests (e.g., coliform bacteria).

**Table 6. Aqueous sampling requirements for target parameters.**

| Parameter | Volume/Container | Preservation | Holding Time |
|---|---|---|---|
| Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si, | 20-mL plastic vial | Filtered (0.45 µm), $HNO_3$ to pH <2 | 60 days |
| Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl | 20-mL plastic vial | Filtered (0.45 µm), $HNO_3$ to pH <2 | 60 days |
| Cyanide (CN-) | 250-mL plastic vial | NaOH to pH > 12, 0.6g ascorbic acid Cool 4°C, | 14 days |
| Mercury | 250-mL plastic vial | Filtered (0.45 µm), $HNO_3$ to pH <2 | 28 days |
| Anions: $Cl^-$, $Br^-$, $F^-$, $SO_4^{2-}$, $NO_3^-$ | 125-mL plastic vial | Filtered (0.45 µm), Cool 4°C | 45 days |
| Total and Bicarbonate Alkalinity (as $CaCO_3^{2-}$) | 100-mL HDPE | Filtered (0.45 µm), Cool 4°C | 14 days |
| Gravimetric Total Dissolved Solids (TDS) | 250-mL plastic vial | Filtered (0.45 µm), no preservation, Cool 4°C | 7 days |
| Water Density | 100-mL plastic vial | No preservation, Cool 4°C | |
| Total Inorganic Carbon (TIC) | 250-mL plastic vial | $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Dissolved Inorganic Carbon (DIC) | 250-mL plastic vial | Filtered (0.45 µm), $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Total Organic Carbon (TOC) | 250-mL amber glass | Unfiltered, $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Dissolved Organic Carbon (DOC) | 125-mL plastic vial | Filtered (0.45 µm), $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Volatile Organic Analysis (VOA) | Bottle set 1: 3-40-mL sterile clear glass vials<br>Bottle set 2: 3-40-mL sterile amber glass vials | Zero headspace, Cool <6 °C, Clear glass vials will be UV-irradiated for additional sterilization | 7 days |
| Methane | Bottle set 1: 3-40-mL sterile clear glass vials<br>Bottle set 2: 3-40-mL sterile amber glass vials | Zero headspace, Cool <6 °C, Clear glass vials (bottle set 1) will be UV-irradiated for additional sterilization | 7 days |
| Stable Carbon Isotopes $^{13/12}C$ ($\delta^{13}C$) of DIC in Water | 60-mL plastic or glass | Filtered (0.45-µm), Cool 4°C | 14 days |
| Radiocarbon $^{14}C$ of DIC in Water | 60-mL plastic or glass | Filtered (0.45-µm), Cool 4°C | 14 days |
| Hydrogen and Oxygen Isotopes $^{2/1}H$ ($\delta D$) and $^{18/16}O$ ($\delta^{18}O$) of Water | 60-mL plastic or glass | Filtered (0.45-µm), Cool 4°C | 45 days |

| Parameter | Volume/Container | Preservation | Holding Time |
|---|---|---|---|
| Carbon and Hydrogen Isotopes ($^{14}C$, $^{13/12}C$, $^{2/1}H$) of Dissolved Methane in Water | 1-L dissolved gas bottle or flask | Benzalkonium chloride capsule, Cool 4°C | 90 days |
| Compositional Analysis of Dissolved Gas in Water (including $N_2$, $CO_2$, $O_2$, Ar, $H_2$, He, $CH_4$, $C_2H_6$, $C_3H_8$, $iC_4H_{10}$, $nC_4H_{10}$, $iC_5H_{12}$, $nC_5H_{12}$, and $C_6$+) | 1-L dissolved gas bottle or flask | Benzalkonium chloride capsule, Cool 4°C | 90 days |
| Radon ($^{222}Rn$) | 1.25-L PETE | Pre-concentrate into 20-mL scintillation cocktail. Maintain groundwater temperature prior to pre-concentration | 1 day |
| pH | Field parameter | None | <1 h |
| Specific Conductance | Field parameter | None | <1 h |
| HDPE = high-density polyethylene; PETE = polyethylene terephthalate | | | |

**Table 7. Analytical requirements.**

| Parameter | Analysis Method | Detection Limit or Range | Typical Precision/ Accuracy | QC Requirements |
|---|---|---|---|---|
| Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si, | ICP-AES, EPA Method 6010B or similar | 1 to 80 µg/L (analyte dependent) | ±10% | Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20 |
| Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl | ICP-MS, EPA Method 6020 or similar | 0.1 to 2 µg/L (analyte dependent) | ±10% | Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20 |
| Cyanide (CN-) | SW846 9012A/B | 5 µg/L | ±10% | Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20 |
| Mercury | CVAA SW846 7470A | 0.2 µg/L | ±20% | Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20 |
| Anions: $Cl^-$, $Br^-$, $F^-$, $SO_4^{2-}$, $NO_3^-$ | Ion Chromatography, EPA Method 300.0A or similar | 33 to 133 µg/L (analyte dependent) | ±10% | Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20 |
| Total and Bicarbonate Alkalinity (as $CaCO_3^{2-}$) | Titration, Standard Methods 2320B | 1 mg/L | ±10% | Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20 |
| Gravimetric Total Dissolved Solids (TDS | Gravimetric Method Standard Methods 2540C | 10 mg/L | ±10% | Balance calibration, duplicate samples |
| Water Density | ASTM D5057 | 0.01 g/mL | ±10% | Balance calibration, duplicate samples |
| Total Inorganic Carbon (TIC) | SW846 9060A or equivalent<br>Carbon analyzer, phosphoric acid digestion of TIC | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Dissolved Inorganic Carbon (DIC) | SW846 9060A or equivalent<br>Carbon analyzer, phosphoric acid digestion of DIC | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Total Organic Carbon (TOC) | SW846 9060A or equivalent<br>Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector. | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Dissolved Organic Carbon (DOC) | SW846 9060A or equivalent<br>Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector. | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Volatile Organic Analysis (VOA) | SW846 8260B or equivalent<br>Purge and Trap GC/MS | 0.3 to 15 µg/L | ±20% | Blanks, LCS, spike, spike duplicates per batch of 20 |
| Methane | RSK 175 Mod<br>Headspace GC/FID | 10 µg/L | ±20% | Blanks, LCS, spike, spike duplicates per batch of 20 |
| Stable Carbon Isotopes $^{13/12}C$ ($1^{13}C$) of DIC in Water | Gas Bench for $^{13/12}C$ | 50 ppm of DIC | ±0.2p | Duplicates and working standards at 10% |

| Parameter | Analysis Method | Detection Limit or Range | Typical Precision/ Accuracy | QC Requirements |
|---|---|---|---|---|
| Radiocarbon $^{14}C$ of DIC in Water | AMS for $^{14}C$ | Range: 0 i 200 pMC | ±0.5 pMC | Duplicates and working standards at 10% |
| Hydrogen and Oxygen Isotopes $^{2/1}H$ (δ ) and $^{18/16}O$ (1$^{18}$O) of Water | CRDS $H_2O$ Laser | Range: -500‰ to 200‰ vs. VSMOW | $^{2/1}H$: ±2.0‰<br><br>$^{18/16}O$: ±0.3‰ | Duplicates and working standards at 10% |
| Carbon and Hydrogen Isotopes ($^{14}C$, $^{13/12}C$, $^{2/1}H$) of Dissolved Methane in Water | Offline Prep & Dual Inlet IRMS for $^{13}C$; AMS for $^{14}C$ | $^{14}C$ Range: 0 & DupMC | $^{14}C$: ±0.5pMC<br><br>$^{13}C$: ±0.2‰<br><br>$^{2/1}H$: ±4.0‰ | Duplicates and working standards at 10% |
| Compositional Analysis of Dissolved Gas in Water (including $N_2$, $CO_2$, $O_2$, Ar, $H_2$, He, $CH_4$, $C_2H_6$, $C_3H_8$, $iC_4H_{10}$, $nC_4H_{10}$, $iC_5H_{12}$, $nC_5H_{12}$, and $C_6$+) | Modified ASTM 1945D | 1 to 100 ppm (analyte dependent) | Varies by compon-ent | Duplicates and working standards at 10% |
| Radon ($^{222}Rn$) | Liquid scintillation after pre-concentration | 5 mBq/L | ±10% | Triplicate analyses |
| pH | pH electrode | 2 to 12 pH units | ±0.2 pH unit For indication only | User calibrate, follow manufacturer recommendations |
| Specific Conductance | Electrode | 0 to 100 mS/cm | ±1% of reading For indication only | User calibrate, follow manufacturer recommendations |

ICP-AES = inductively coupled plasma atomic emission spectrometry; ICP-MS = inductively coupled plasma mass spectrometry; LCS = laboratory control sample; GC/MS = gas chromatography–mass spectrometry; GC/FID = gas chromatography with flame ionization detector; AMS = accelerator mass spectrometry; CRDS = cavity ring down spectrometry; IRMS = isotope ratio mass spectrometry; LC-MS = liquid chromatography-mass spectrometry; ECD = electron capture detector

Laboratory to be used/chain-of-custody procedures:

Samples will be tracked using appropriately formatted chain-of-custody forms. The sample handling and chain of custody of water, formation fluids, and environmental gas or air samples will conform to EPA guidance, and be conducted as discussed in Sections B.1.3 and B.1.5 thru B.1.7 of the FutureGen QASP (Appendix G of the Testing and Monitoring Plan).

Plan for guaranteeing access to all monitoring locations:

The land on which the ACZ and USDW wells are located will either be purchased or leased for the life of the project, so access will be secured.

Access to the surficial aquifer wells will not be required over the lifetime of the project. Access to wells for baseline sampling has been on a voluntary basis by the well owner. Nine local landowners agreed to have their surficial aquifer wells sampled although sampling is not anticipated in surficial wells during the PISC period.

### *Carbon Dioxide Plume and Pressure-Front Tracking*

Direct Pressure Monitoring:

FutureGen will conduct direct pressure-front monitoring to meet the requirements of 40 CFR 146.93(b). Continuous monitoring of injection zone pressure and temperature (P/T) will be performed with sensors installed in wells that are completed in the injection zone. P/T monitoring in the monitoring wells will be performed using a real-time monitoring system with surface readout capabilities so that pressure gauges do not have to be removed from the well to retrieve data.

The following measures will be taken to ensure that the pressure gauges are providing accurate information on an ongoing basis:

- High-quality (high-accuracy, high-resolution) gauges with low drift characteristics will be used.
- Gauge components (gauge, cable head, cable) will be manufactured of materials designed to provide a long life expectancy for the anticipated downhole conditions.
- Upon acquisition, a calibration certificate will be obtained for every pressure gauge. The calibration certificate will provide the manufacturer's specifications for range, accuracy (% full scale), resolution (% full scale), drift (< psi per year), and calibration results for each parameter. The calibration certificate will also provide the date that the gauge was calibrated and the methods and standards used.
- Gauges will be installed above any packers so they can be removed if necessary for recalibration by removing the tubing string. Redundant gauges may be run on the same cable to provide confirmation of downhole pressure and temperature. Pressure gauges will be calibrated on an annual basis with current annual calibration certificates provided with test results to the EPA. In lieu of removing the injection tubing, the calibration of downhole pressure gauges will demonstrate accuracy by using a second pressure gauge, with current certified calibration, that will be lowered into the well to the same depth as the permanent downhole gauge. Calibration curves, based on annual calibration checks (using the second calibrated pressure gauge) developed for the downhole gauge, can be used for the purpose of the fall-off test. If used, these calibration curves (showing all historic pressure deviations) will accompany the fall-off test data submitted to the EPA.

- Upon installation, all gauges will be tested to verify they are functioning (reading/transmitting) correctly.
- Gauges will be pulled and recalibrated whenever a workover occurs that involves removal of tubing. A new calibration certificate will be obtained whenever a gauge is recalibrated.

Direct pressure monitoring in the injection zone will take place as indicated in Table 8. Collection and recording of continuous monitoring data will occur at the frequencies described in Table 13.

**Table 8. Monitoring schedule for direct pressure-front tracking.**

| Well Location/Map Reference | Depth(s)/Formation(s) | Frequency (Post-Injection Phase) |
|---|---|---|
| Two SLR monitoring wells (SLR Wells 1 and 2, see Figure 7) | Mount Simon/4,150 ft. | Continuous |
| Note: For details and information on continuous monitoring, see Table 13. | | |

Direct Geochemical Plume Monitoring:

FutureGen will conduct direct $CO_2$ plume monitoring to meet the requirements of 40 CFR 146.93(b). Target parameters include pressure, temperature, and hydrogeochemical indicators of $CO_2$ (Table 6) and brine composition.

In addition to direct plume sampling and characterization, indirect montoring of the $CO_2$ plume will be conducted by continuing the periodic PNC logging across the injection zone and primary confining zone. PNC logging is a proven method for quantifying $CO_2$ saturation around a borehole. The PNC logging will be conducted using the three RAT wells. The RAT wells will be logged every 5 years during the post-injection period. Information collected will be compared with prior logs to determine trends.

Direct fluid sampling in the injection zone will take place as indicated in

Table 9 (collection and recording of continuous monitoring data will occur at the frequencies described in Table 13).

**Table 9. Monitoring schedule for direct geochemical plume monitoring.**

| **Monitoring well name/location/map reference:** Two SLR monitoring wells (see Figure 7)<br>**Well depth/formation(s) sampled:** Mount Simon Sandstone (4,150 ft) | |
|---|---|
| **Parameter/Analyte** | **Frequency (Post-Injection Phase)** |
| Dissolved or separate-phase $CO_2$ | Every 5 years |
| Pressure | Continuous |
| Temperature | Continuous |
| Other parameters, including major cations and anions, selected metals, and general water-quality parameters (pH, alkalinity, total dissolved solids, specific gravity) | Every 5 years |
| Note: For details and information on continuous monitoring, see Table 13. | |

<u>Sampling methods:</u>

The FutureGen QASP and Testing and Monitoring Plan provide supplemental details about the sampling and analysis protocols for the direct fluid sampling that are outlined below.

Fluid samples will be collected from the monitoring wells completed in the injection zone as detailed in Table 9 above. Fluid samples will be collected using an appropriate method to preserve the fluid sample at injection zone temperature and pressure conditions. Examples of appropriate methods include using a bomb-type sampler (e.g., Kuster sampler) after pumped or swabbed purging of the sampling interval, using a Westbay sampler, or using a pressurized U-tube sampler (Freifeld et al. 2005).

Fluid samples will be analyzed for parameters that are indicators of $CO_2$ dissolution, including major cations and anions, selected metals, and general water-quality parameters (pH, alkalinity, TDS, specific gravity). Analysis of carbon and oxygen isotopes in injection zone fluids and the injection stream ($^{13/12}C$, $^{18/16}O$) provides another potential supplemental measure of $CO_2$ migration. Where stable isotopes are included as an analyte, data quality and detectability will be reviewed throughout the active injection phase, and upon the UIC Program Director's approval, will be discontinued if these analyses provide limited benefit. Sampling and analytical requirements for target parameters are listed in Table 10 and Table 11, respectively.

<u>Laboratory to be used/chain-of-custody procedures</u>:

See FutureGen QASP Sections B.4.3 thru B.4.7.

**Table 10. Aqueous sampling requirements for target parameters.**

| Parameter | Volume/Container | Preservation | Holding Time |
|---|---|---|---|
| Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si, | 20-mL plastic vial | Filtered (0.45 µm), $HNO_3$ to pH <2 | 60 days |
| Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl | 20-mL plastic vial | Filtered (0.45 µm), $HNO_3$ to pH <2 | 60 days |
| Cyanide (CN-) | 250-mL plastic vial | NaOH to pH > 12, 0.6g ascorbic acid Cool 4°C, | 14 days |
| Mercury | 250-mL plastic vial | Filtered (0.45 µm), $HNO_3$ to pH <2 | 28 days |
| Anions: $Cl^-$, $Br^-$, $F^-$, $SO_4^{2-}$, $NO_3^-$ | 125-mL plastic vial | Filtered (0.45 µm), Cool 4°C | 45 days |
| Total and Bicarbonate Alkalinity (as $CaCO_3^{2-}$) | 100-mL HDPE | Filtered (0.45 µm), Cool 4°C | 14 days |
| Gravimetric Total Dissolved Solids (TDS) | 250-mL plastic vial | Filtered (0.45 µm), no preservation, Cool 4°C | 7 days |
| Water Density | 100-mL plastic vial | No preservation, Cool 4°C | |
| Total Inorganic Carbon (TIC) | 250-mL plastic vial | $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Dissolved Inorganic Carbon (DIC) | 250-mL plastic vial | Filtered (0.45 µm), $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Total Organic Carbon (TOC) | 250-mL amber glass | Unfiltered, $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Dissolved Organic Carbon (DOC) | 125-mL plastic vial | Filtered (0.45 µm), $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| Volatile Organic Analysis (VOA) | Bottle set 1: 3-40-mL sterile clear glass vials<br>Bottle set 2: 3-40-mL sterile amber glass vials | Zero headspace, Cool <6 °C, Clear glass vials will be UV-irradiated for additional sterilization | 7 days |
| Methane | Bottle set 1: 3-40-mL sterile clear glass vials<br>Bottle set 2: 3-40-mL sterile amber glass vials | Zero headspace, Cool <6 °C, Clear glass vials (bottle set 1) will be UV-irradiated for additional sterilization | 7 days |
| Stable Carbon Isotopes $^{13/12}C$ ($\delta^{13}C$) of DIC in Water | 60-mL plastic or glass | Filtered (0.45-µm), Cool 4°C | 14 days |
| Radiocarbon $^{14}C$ of DIC in Water | 60-mL plastic or glass | Filtered (0.45-µm), Cool 4°C | 14 days |
| Hydrogen and Oxygen Isotopes $^{2/1}H$ ($\delta D$) and | 60-mL plastic or glass | Filtered (0.45-µm), Cool 4°C | 45 days |

| Parameter | Volume/Container | Preservation | Holding Time |
| --- | --- | --- | --- |
| $^{18/16}O$ ($\delta^{18}O$) of Water | | | |
| Carbon and Hydrogen Isotopes ($^{14}C$, $^{13/12}C$, $^{2/1}H$) of Dissolved Methane in Water | 1-L dissolved gas bottle or flask | Benzalkonium chloride capsule, Cool 4°C | 90 days |
| Compositional Analysis of Dissolved Gas in Water (including $N_2$, $CO_2$, $O_2$, Ar, $H_2$, He, $CH_4$, $C_2H_6$, $C_3H_8$, $iC_4H_{10}$, $nC_4H_{10}$, $iC_5H_{12}$, $nC_5H_{12}$, and $C_6$+) | 1-L dissolved gas bottle or flask | Benzalkonium chloride capsule, Cool 4°C | 90 days |
| Radon ($^{222}Rn$) | 1.25-L PETE | Pre-concentrate into 20-mL scintillation cocktail. Maintain groundwater temperature prior to pre-concentration | 1 day |
| pH | Field parameter | None | <1 h |
| Specific Conductance | Field parameter | None | <1 h |
| HDPE = high-density polyethylene; PETE = polyethylene terephthalate | | | |

**Table 11. Analytical requirements.**

| Parameter | Analysis Method | Detection Limit or Range | Typical Precision/ Accuracy | QC Requirements |
|---|---|---|---|---|
| Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si, | ICP-AES, EPA Method 6010B or similar | 1 to 80 µg/L (analyte dependent) | ±10% | Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20 |
| Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl | ICP-MS, EPA Method 6020 or similar | 0.1 to 2 µg/L (analyte dependent) | ±10% | Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20 |
| Cyanide (CN-) | SW846 9012A/B | 5 µg/L | ±10% | Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20 |
| Mercury | CVAA SW846 7470A | 0.2 µg/L | ±20% | Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20 |
| Anions: $Cl^-$, $Br^-$, $F^-$, $SO_4^{2-}$, $NO_3^-$ | Ion Chromatography, EPA Method 300.0A or similar | 33 to 133 µg/L (analyte dependent) | ±10% | Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20 |
| Total and Bicarbonate Alkalinity (as $CaCO_3^{2-}$) | Titration, Standard Methods 2320B | 1 mg/L | ±10% | Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20 |
| Gravimetric Total Dissolved Solids (TDS | Gravimetric Method Standard Methods 2540C | 10 mg/L | ±10% | Balance calibration, duplicate samples |
| Water Density | ASTM D5057 | 0.01 g/mL | ±10% | Balance calibration, duplicate samples |
| Total Inorganic Carbon (TIC) | SW846 9060A or equivalent<br>Carbon analyzer, phosphoric acid digestion of TIC | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Dissolved Inorganic Carbon (DIC) | SW846 9060A or equivalent<br>Carbon analyzer, phosphoric acid digestion of DIC | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Total Organic Carbon (TOC) | SW846 9060A or equivalent<br>Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector. | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Dissolved Organic Carbon (DOC) | SW846 9060A or equivalent<br>Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector. | 0.2 mg/L | ±20% | Quadruplicate analyses, daily calibration |
| Volatile Organic Analysis (VOA) | SW846 8260B or equivalent<br>Purge and Trap GC/MS | 0.3 to 15 µg/L | ±20% | Blanks, LCS, spike, spike duplicates per batch of 20 |
| Methane | RSK 175 Mod<br>Headspace GC/FID | 10 µg/L | ±20% | Blanks, LCS, spike, spike duplicates per batch of 20 |
| Stable Carbon Isotopes $^{13/12}C$ ($1^{13}C$) of DIC in Water | Gas Bench for $^{13/12}C$ | 50 ppm of DIC | ±0.2p | Duplicates and working standards at 10% |

| Parameter | Analysis Method | Detection Limit or Range | Typical Precision/ Accuracy | QC Requirements |
|---|---|---|---|---|
| Radiocarbon $^{14}C$ of DIC in Water | AMS for $^{14}C$ | Range: 0 i 200 pMC | ±0.5 pMC | Duplicates and working standards at 10% |
| Hydrogen and Oxygen Isotopes $^{2/1}H$ (δ ) and $^{18/16}O$ (1$^{18}$O) of Water | CRDS $H_2O$ Laser | Range: -500‰ to 200‰ vs. VSMOW | $^{2/1}H$: ±2.0‰<br><br>$^{18/16}O$: ±0.3‰ | Duplicates and working standards at 10% |
| Carbon and Hydrogen Isotopes ($^{14}C$, $^{13/12}C$, $^{2/1}H$) of Dissolved Methane in Water | Offline Prep & Dual Inlet IRMS for $^{13}C$; AMS for $^{14}C$ | $^{14}C$ Range: 0 & DupMC | $^{14}C$: ±0.5pMC<br><br>$^{13}C$: ±0.2‰<br><br>$^{2/1}H$: ±4.0‰ | Duplicates and working standards at 10% |
| Compositional Analysis of Dissolved Gas in Water (including $N_2$, $CO_2$, $O_2$, Ar, $H_2$, He, $CH_4$, $C_2H_6$, $C_3H_8$, $iC_4H_{10}$, $nC_4H_{10}$, $iC_5H_{12}$, $nC_5H_{12}$, and $C_6$+) | Modified ASTM 1945D | 1 to 100 ppm (analyte dependent) | Varies by compon-ent | Duplicates and working standards at 10% |
| Radon ($^{222}Rn$) | Liquid scintillation after pre-concentration | 5 mBq/L | ±10% | Triplicate analyses |
| pH | pH electrode | 2 to 12 pH units | ±0.2 pH unit For indication only | User calibrate, follow manufacturer recommendations |
| Specific Conductance | Electrode | 0 to 100 mS/cm | ±1% of reading For indication only | User calibrate, follow manufacturer recommendations |

ICP-AES = inductively coupled plasma atomic emission spectrometry; ICP-MS = inductively coupled plasma mass spectrometry; LCS = laboratory control sample; GC/MS = gas chromatography–mass spectrometry; GC/FID = gas chromatography with flame ionization detector; AMS = accelerator mass spectrometry; CRDS = cavity ring down spectrometry; IRMS = isotope ratio mass spectrometry; LC-MS = liquid chromatography-mass spectrometry; ECD = electron capture detector

## Indirect Carbon Dioxide Plume and Pressure-Front Tracking

FutureGen will track the $CO_2$ plume and pressure front to meet the requirements of 40 CFR 146.93(b) using integrated deformation monitoring and passive seismic monitoring.

The frequency of indirect plume and pressure-front monitoring activities during the post-injection phase, is given in Table 12 (collection and recording of continuous monitoring data will occur at the frequencies described in Table 13). The coordinates of the monitoring wells/stations are provided in Appendix C of this Plan.

**Table 12. Monitoring schedule for indirect plume and pressure-front monitoring.**

| Monitoring Technique | Location | Frequency (Post-Injection Phase) |
|---|---|---|
| Integrated deformation monitoring | 5 locations (see Figure 7) | Continuous |
| Passive seismic monitoring (microseismicity) | Surface measurements (see Figure 7) plus downhole sensor arrays at ACZ Wells 1 and 2 | Continuous |

*Integrated deformation monitoring*

Integrated deformation monitoring integrates ground data from permanent Global Positioning System (GPS) stations, and tiltmeters, supplemented with annual Differential GPS (DGPS) surveys, and larger-scale Differential Interferometric Synthetic Aperture Radar (DInSAR) surveys to detect and map temporal ground-surface deformation. These data reflect the dynamic geomechanical behavior of the subsurface in response to $CO_2$ injection. These measurements will provide useful information about the evolution and symmetry of the pressure front. These results will be compared with model predictions throughout the operational phase of the project and significant deviation in observed response would result in further action, including a detailed evaluation of the observed response, calibration/refinement of the numerical model, and possible modification to the monitoring approach and/or storage site operations. Integrated deformation monitoring will take place at the locations shown in Figure 7.

*Passive seismic monitoring (microseismicity)*

The objective of the microseismic monitoring network (Figure 7; five stations and downhole arrays in the two ACZ wells) is to accurately determine the locations, magnitudes, and focal mechanisms of any potential injection-induced seismic events with the primary goals of 1) addressing public and stakeholder concerns related to induced seismicity, 2) estimating the spatial extent of the pressure front from the distribution of any potential seismic events, and 3) identifying features that may indicate areas of caprock failure and possible containment loss. The Emergency and Remedial Response Plan (Attachment F to this permit) provides additional information about seismic monitoring).

**Table 13. Sampling and Recording Frequencies for Continuous Monitoring.**

| Well Condition | Minimum sampling frequency: once every | Minimum recording frequency: once every |
|---|---|---|
| For operating injection wells that are required to monitor continuously: | 5 seconds | 5 minutes [1] |
| For injection wells that are shut-in: | 4 hours | 4 hours |
| For monitoring wells (USDW, ACZ, SLR): | 30 minutes | 2 hours |

[1] This can be an average of the sampled readings over the previous 5-minute recording interval, or the maximum (or minimum, as appropriate) value identified over that recording interval

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

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

## Proposed Schedule for Submitting Post-Injection Monitoring Results

During the PISC period, monitoring reports will be prepared and submitted to the EPA Region 5 UIC office annually. The reports will summarize methods and results of the groundwater-quality monitoring, $CO_2$ storage zone pressure tracking, and indirect geophysical monitoring for $CO_2$ plume tracking. See Table 14.

**Table 14. Post-injection phase reporting schedule.**

| Planned Testing/Monitoring | Reporting Schedule |
|---|---|
| Groundwater Quality Monitoring Data | Annual |
| Carbon Dioxide Plume and Pressure-Front Tracking Data | Annual |
| Direct Pressure Monitoring Data | Annual |
| Indirect Carbon Dioxide Plume and Pressure-Front Tracking Data | Annual |

The PISC and Site Closure Plan will be reviewed every 5 years during the PISC period (e.g., concurrent with or as a result of 5-year reevaluations of the AoR). Results of the plan review will be included in the PISC monitoring reports. Monitoring and operational results will be reviewed for adequacy in relation to the objectives of PISC monitoring. The monitoring locations, methods, and schedule will be analyzed in relation to the size of the $CO_2$ storage zone, pressure front, and protection of USDWs. In case of changes to the PISC plan, a modified plan will be submitted to the EPA Region 5 UIC Branch Office for not less than 30 days prior to the planned intiation of the changes.

## Alternative Post-Injection Site Care Time Frame

FutureGen is not requesting an alternative PISC time frame. As indicated in Section O(6)(b)(v) of this permit, the permittee shall continue to conduct post-injection site monitoring for at least 50 years or for the duration of any alternative timeframe approved pursuant to 40 CFR 146.93(c).

## Non-Endangerment Demonstration Criteria

Prior to approval of the end of the PISC period, FutureGen will submit a demonstration of non-endangerment of USDWs to the UIC Program Director (40 CFR 146.93(b)(3)).

FutureGen will issue a report to the UIC Program Director. This report will make a demonstration of USDW non-endangerment based on the evaluation of the site monitoring data used in conjunction with the project's computational model. The report will include information detailing how the non-endangerment demonstration evaluation uses site-specific conditions to confirm and demonstrate non-endangerment. The report will include all relevant monitoring data and interpretations upon which the non-endangerment demonstration is based and any other information necessary for the UIC Program Director to replicate the analysis. The report will include the sections discussed below.

### Summary of Existing Monitoring Data

A summary of all previous monitoring data at the site, including data collected during the injection and PISC phases of the project, will be submitted to help demonstrate non-endangerment. Data submittals will be in a format acceptable to the UIC Program Director (40 CFR 146.91(e)), and will include a narrative explanation of monitoring activities, including the dates of all monitoring events, changes to the monitoring program over time, and an explanation of all monitoring infrastructure that has existed at the site.

### Comparison of Monitoring Data and Model Predictions and Model Documentation

The results of computational modeling used for AoR delineation will be compared to monitoring data collected during the operational and the PISC period. Monitoring data will also be compared with baseline data collected during site characterization, per 40 CFR 146.82(a)(6) and 146.87(d)(3). The data used to update the computational model and to monitor the site will include both direct (e.g., temporal measurements of pressure, temperature, groundwater quality, and injection zone fluid composition) and indirect geophysical methods (e.g., passive seismic and integrated deformation monitoring, PNC logging). Data generated during the PISC period will be used to show that the computational model accurately represents the storage site and can be used as a proxy to determine the plume's properties and size. FutureGen will demonstrate this degree of accuracy by comparing the monitoring data obtained during the PISC period against the model's predicted properties (i.e., plume location, rate of movement, and pressure decay). Statistical methods will be employed to correlate the data and confirm the model's ability to accurately represent the storage site. The validation of the computational model with the large volume of available data will be a significant element to support the non-endangerment demonstration. Further, the validation of the complete model over the areas, and at the points, where direct data collection has taken place will ensure confidence in the model for those areas where surface infrastructure preclude geophysical data collection and where there are no direct observation wells.

**Evaluation of Carbon Dioxide Plume**

FutureGen will use a combination of monitoring data, logs, geophysical surveys, and seismic methods to locate and track the movement of the $CO_2$ plume. The data produced by these activities will be compared against the modeled predictions (see Figure 6) using statistical methods to validate the model's ability to accurately represent the storage site. Regarding the separate-phase carbon dioxide plume, the PISC monitoring data will show the stabilization of the $CO_2$ plume as the reservoir pressure returns to its near pre-injection state. For the separate-phase carbon dioxide plume, the risk to USDWs will decrease when the extent of pure-phase carbon dioxide ceases to grow either laterally or vertically. The stabilization of the plume combined with the lack of local penetrations of the confining formation will be significant factors in FutureGen's demonstration of non-endangerment. Furthermore, FutureGen's monitoring wells screened above the confining layer may be used to determine aqueous-phase concentrations of carbon dioxide and mobilized constituents in order to assess USDW endangerment. If a demonstration can be made, in conjunction with monitoring data, that a vast majority of the carbon dioxide has been immobilized via trapping mechanisms, this is strong evidence that the risk to USDWs posed by the carbon dioxide plume has decreased. Modeling may also be used to estimate future plume migration. Modeling results, including sensitivity analyses, may be used to demonstrate that plume migration rates are negligible based on available site characterization, monitoring, and operational data.

**Evaluation of Mobilized Fluids**

In addition to carbon dioxide, mobilized fluids may pose an ongoing risk to USDWs. These include native fluids that are high in TDS and therefore may impair a USDW, and fluids containing mobilized drinking water contaminants (e.g., arsenic, mercury, hydrogen sulfide). The geochemical data collected from monitoring wells will be used to demonstrate that no mobilized fluids have moved above the confining formation and, therefore after the PISC period, would not pose a risk to USDWs. Of particular importance are any monitoring wells that are screened above the primary confining zone, within any USDWs, and in the vicinity of any known leakage pathways. Monitoring data indicating steady or decreasing trends of potential drinking water contaminants below actionable levels (e.g., secondary and maximum contaminant levels) will be used for this demonstration. In order to demonstrate non-endangerment, FutureGen will compare the operational and PISC period samples of the lowermost USDW against the pre-injection baseline samples. This comparison will show that no significant changes have occurred in the fluid properties of the overlying formations. This will demonstrate that no mobilized formation fluids have moved through the confining formation. This validation of confining zone integrity will demonstrate that the injectate and/or mobilized fluids would not represent an endangerment to any USDWs.

**Evaluation of Reservoir Pressure**

FutureGen will also demonstrate non-endangerment to USDWs by showing that during the PISC period, the pressure within the Mount Simon rapidly decreases to its near pre-injection static reservoir pressure. Because the increased pressure is the primary driving force for fluid movement that may endanger a USDW, the decay in the pressure differentials will provide strong justification that the injectate no longer poses a risk to any USDWs.

FutureGen will monitor the downhole reservoir pressure at various locations and intervals using a combination of surface and downhole pressure gauges. The measured pressure at a specific depth interval will be compared against the pressure predicted by the computational model (see Figures 1 and 2). Agreement between the actual and the predicted values will validate the accuracy of the model and further demonstrate non-endangerment.

**Evaluation of Potential Conduits for Fluid Movement**

Other than the project and monitoring wells, other distant potential conduits for fluid movement, or leakage pathways within the AoR are adequately constructed and/or plugged. Based on this information, the potential for fluid movement through artificial penetrations of the confining formation does not present a risk of endangerment to any USDWs.

**Evaluation of Passive Seismic Data**

Seismic monitoring will be used to further demonstrate confining formation integrity. FutureGen will provide seismic monitoring data showing that no seismic events have occurred that would indicate fracturing or fault activation near or through the confining formation. This validation of confining zone integrity will provide further support to demonstrate that the $CO_2$ plume is no longer an endangerment to any USDWs, by indicating that the response to the imposed fluid pressures due to injection are confined to the vicinity of the injection zone and below.

## Site Closure Plan

FutureGen will conduct site closure activities to meet the requirements of 40 CFR 146.93(e). Site closure will occur at the end of the PISC period. Site closure activities will include decommissioning surface equipment, plugging monitoring wells, restoring the site, and preparing and submitting site closure reports.

The EPA Region 5 UIC Branch Office will be notified at least 120 days before site closure. In addition, state and local agencies including the Illinois State Geological Survey and Illinois

Department of Natural Resources, as well as City of Jacksonville and Morgan County agencies will be notified prior to the scheduled site closure. At this time, there are no federally recognized Native American Tribes located within the AoR or the State of Illinois. If a federally recognized Native American Tribe exists in the AoR or the State of Illinois at the time of site closure, it will be notified of site closure at that time.

A revised site closure plan will be submitted to the EPA Region 5 UIC Branch Office and state and local (and tribal) governmental agencies, if any changes have been made to the original site closure plan. After site closure is authorized, site closure field activities will be completed.

**Planned Remedial/Site Restoration Activities**

At the end of the PISC phase, FutureGen will ensure the site is reclaimed and returned to predevelopment condition to meet the requirements of 40 CFR 146.93(e).

Surface equipment decommissioning will occur in two phases: the first phase will occur after the active injection phase, and the second phase will occur at the end of PISC phase. The surface facilities at the storage site will include the Site Control Building and the APS (Annulus Pressurization System) Building.

At the end of the active injection period, plume monitoring will continue, but there will be no further need for the pumping and control equipment. The Site Control Building will be demolished. All features will be removed except the APS Building, a 12-ft-wide access road with five parking spaces, a concrete sidewalk from the parking lot to the building, underground electrical and telephone services, and a chain-link fence surrounding the building. The common wall between the APS Building and the Site Control Building will be converted to an exterior wall. The injection wells will be plugged and capped below grade (see the Injection Well Plugging Plan in Attachment D of this permit). The gravel pad will be removed. The APS Building at the storage site will be repurposed to act as the collection node for data from the plume monitoring equipment. The building will contain equipment to receive real-time data from the monitoring wells and other monitoring stations and send the data via an internet connection to be analyzed offsite during the 50-year post-injection monitoring period.

All surface facilities will be removed at the end of the PISC phase. These facilities will include the APS Building, the access road with parking spaces, all sidewalks, underground electrical and telephone services, and fencing at the injection well sites. The site will be reclaimed and returned to predevelopment condition.

Soil will be backfilled around the monitoring and geophysical wells to bring the area around the wells back to pre-well-installation grade. Any remaining surface facilities associated with the monitoring well will be reclaimed and the area will be returned to predevelopment condition. All gravel pads, access roads, and surface facilities will be removed, and the land will be reclaimed for agricultural or other beneficial pre-construction uses.

**Plugging the Monitoring Wells**

Upon conclusion of the post-injection site care period (~50 years), all monitoring wells will be plugged and capped below grade in accordance with the approved monitoring well Plugging and Abandonment Plans (see Appendix E of this Plan). All deep monitoring wells at the site will be plugged to prevent any upward migration of the $CO_2$ or formation fluids into USDWs. Each of the deep monitoring wells will be plugged and abandoned using best practices to prevent communication of fluids between the injection zone and USDWs. The deep monitoring wells in the injection interval have a direct connection between the injection formation and ground surface. The well-plugging program is designed to prevent communication between the injection zone and the USDWs.

Before the wells are plugged, the internal and external integrity of the wells will be confirmed by conducting cement-bond, temperature, and noise logs on each of the wells. In addition, a pressure fall-off test will be performed above the perforated intervals (where present) to confirm well integrity. The results of the logging and testing will be reviewed and approved by appropriate regulatory agencies prior to plugging the wells.

The wells with perforations (the SLR monitoring wells, the ACZ monitoring wells, and lowermost USDW monitoring well) will be plugged using a $CO_2$-resistant cement retainer method to cement the perforated intervals and a balanced plug method to cement the well above the perforated zones and the cement retainer. The RAT monitoring wells will not have perforations; therefore, only the balanced plug method will be used to plug these wells. Once the interior of the casing has been properly plugged with cement, the casing will be cut off below ground and capped. Regulations at the time of the plugging and abandonment will dictate the specifications regarding the depth at which the casing is cut and the method used to cap the well. The cap will be inscribed with the well identification number and the date of plug and abandonment.

**Plugging the Geophysical Wells**

The FutureGen microseismic and deformation monitoring designs include five geophysical monitoring stations. Two types of well completions will be constructed at each of the five geophysical monitoring stations: both well types will be completed as sealed access tubes designed to support downhole installation of either microseismic or tiltmeter instrumention in a subsurface moisture free environment. Well construction and plugging schematics showing the exposed formation intervals, casing diameters, casing depths, depths to USDWs, and the placement of all plugs are presented for each well type in Figure 9.

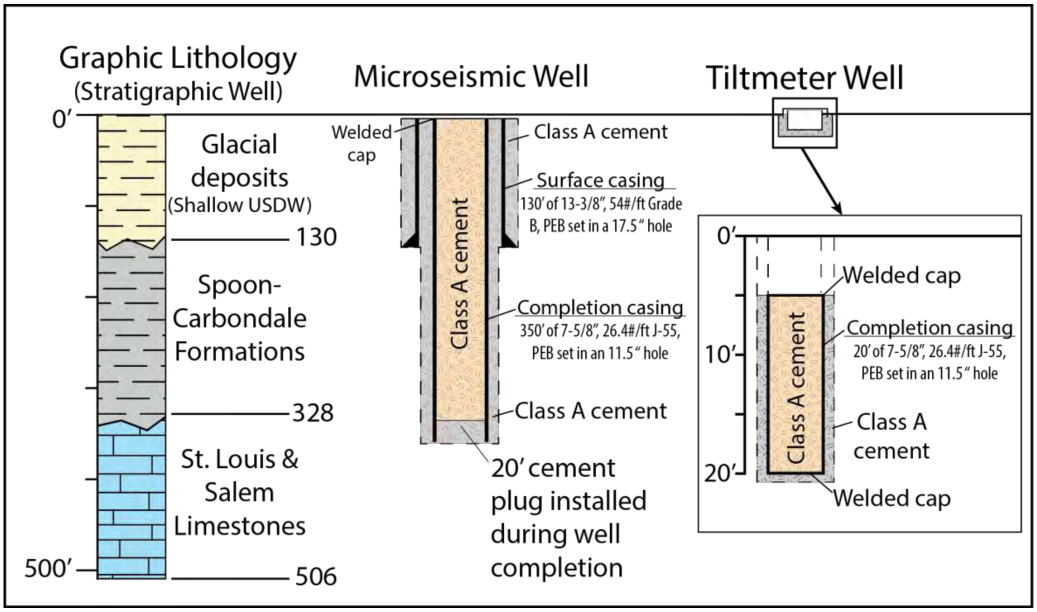



**Figure 9. Diagram of Microseismic and Tiltmeter Wells After Plugging and Abandonment.**

Upon conclusion of the post-injection site care period, all geophysical wells will be plugged and capped below grade in accordance with the approved monitoring well Plugging and Abandonment Plans (see Appendix E of this plan). All downhole instrumentation will be removed and each microseismic well casing and tiltmeter well casing will be plugged with cement to ensure that the well does not provide a conduit to the shallow USDW zone or ground surface. The procedures for plugging and abandoning both types of wells are very similar. However, cement volumes will differ depending upon the total depth of the well.

For both well-completion designs, class A cement will be used to plug the well casing. The geophysical wells will not have perforations; therefore, the balanced plug method will be used to plug these wells. Once the interior of the casing has been properly plugged with cement, the casing will be cut off below ground and capped. Regulations at the time of the plugging and abandonment will dictate the specifications regarding the depth at which the casing is cut and the method used to cap the well. The cap will be inscribed with the well identification number and the date of plug and abandonment.

The methods and materials described in this plan are based upon current understanding of the geology at the site and current well designs. If necessary, the plans will be updated to reflect the latest well designs. These new designs, materials, and methods will be described in the Notice of Intent to Plug submitted at least 60 days prior to the plugging of the wells.

After the completion of the plugging activities, a plugging report will be submitted to the UIC Program Director describing the methods used and tests performed on the well during plugging. This report will be submitted to the UIC Program Director within 60 days of completing the plugging activities.

**Site Closure Reporting**

A site closure report will be submitted to the EPA Region 5 UIC Branch Office and the previously notified state and local regulatory agencies within 90 days of site closure. The site closure report will include the following information:

- Documentation of appropriate well plugging, including a survey plat of the injection well location;
- Documentation of the well-plugging report to Illinois and local agencies that have authority over drilling activities at the facility site; and
- Records reflecting the nature, composition, and volume of the $CO_2$ injected in UIC wells.

In association with site closure, a record of notation on the facility property deed will be added to provide any potential purchaser of the property with the following information:

- Notification that the subsurface was used for $CO_2$ storage;
- The name of the Illinois and local agencies and the EPA Region 5 Branch Office to which the survey plat was submitted; and
- The volume of fluid injected, the injection zone, and the period over which injection occurred.

PISC and site closure records will be retained for 10 years after site closure. At the conclusion of the 10-year period, these records will be delivered to the EPA Region 5 UIC Branch Office for further storage.

## APPENDIX A: Deep Monitoring Well Locations

| Well ID | Well Type | Latitude (WGS84) | Longitude (WGS84) |
|---|---|---|---|
| **ACZ1** | Above Confining Zone 1 | 39.80034315 | -90.07829648 |
| **ACZ2** | Above Confining Zone 2 | 39.80029543 | -90.08801028 |
| **USDW1** | Underground Source of Drinking Water | 39.80048042 | -90.0782963 |
| **SLR1** | Single-Level in-Reservoir 1 | 39.8004327 | -90.08801013 |
| **SLR2** | Single-Level in-Reservoir 2 | 39.80680878 | -90.05298062 |
| **RAT1** | Reservoir Access Tube 1 | 39.80035565 | -90.08627478 |
| **RAT2** | Reservoir Access Tube 2 | 39.78696855 | -90.06902677 |
| **RAT3** | Reservoir Access Tube 3 | 39.79229199 | -90.08901656 |

# APPENDIX B: Surficial Aquifer Monitoring Well Locations

| Well ID | Well Type | Latitude | Longitude |
|---|---|---|---|
| **FG-1** | FutureGen Shallow Monitoring Well | 39.80675 | -90.05283 |
| **FGP-1** | Private Well | 39.79888 | -90.0736 |
| **FGP-2** | Private Well | 39.78554 | -90.0639 |
| **FGP-3** | Private Well | 39.79497 | -90.0746 |
| **FGP-4** | Private Well | 39.79579 | -90.0747 |
| **FGP-5** | Private Well | 39.81655 | -90.0622 |
| **FGP-6** | Private Well | 39.81086 | -90.057560 |
| **FGP-7** | Private Well | 39.81444 | -90.065241 |
| **FGP-9** | Private Well | 39.80829 | -90.0377 |
| **FGP-10** | Private Well | 39.81398 | -90.0427 |

## APPENDIX C: Microseismic Monitoring and Integrated Deformation Station Locations

| Well ID/Station ID | Well/Station Type | Latitude (WGS84) | Longitude (WGS84) |
|---|---|---|---|
| **MS1** | • Microseismic monitoring Station 1(shallow borehole)<br>• Integrated deformation monitoring station | 39.8110768 | -90.09797015 |
| **MS2** | • Microseismic monitoring Station 2 (shallow borehole)<br>• Integrated deformation monitoring station | 39.78547402 | -90.05028403 |
| **MS3** | • Microseismic monitoring Station 3 (shallow borehole)<br>• Integrated deformation monitoring station | 39.81193502 | -90.06016279 |
| **MS4** | • Microseismic monitoring Station 4 (shallow borehole)<br>• Integrated deformation monitoring station | 39.78558513 | -90.09557015 |
| **MS5** | • Microseismic monitoring Station 5 (shallow borehole)<br>• Integrated deformation monitoring station | 39.80000524 | -90.07830287 |
| **ACZ1** | • Deep microseismic station (deep borehole) | 39.80034315 | -90.07829648 |
| **ACZ2** | • Deep microseismic station (deep borehole) | 39.80029543 | -90.08801028 |

# APPENDIX D: Planned Construction Design and Plugging and Abandonment Plan Diagrams for Deep Monitoring Wells and Reservoir Access Tube Wells

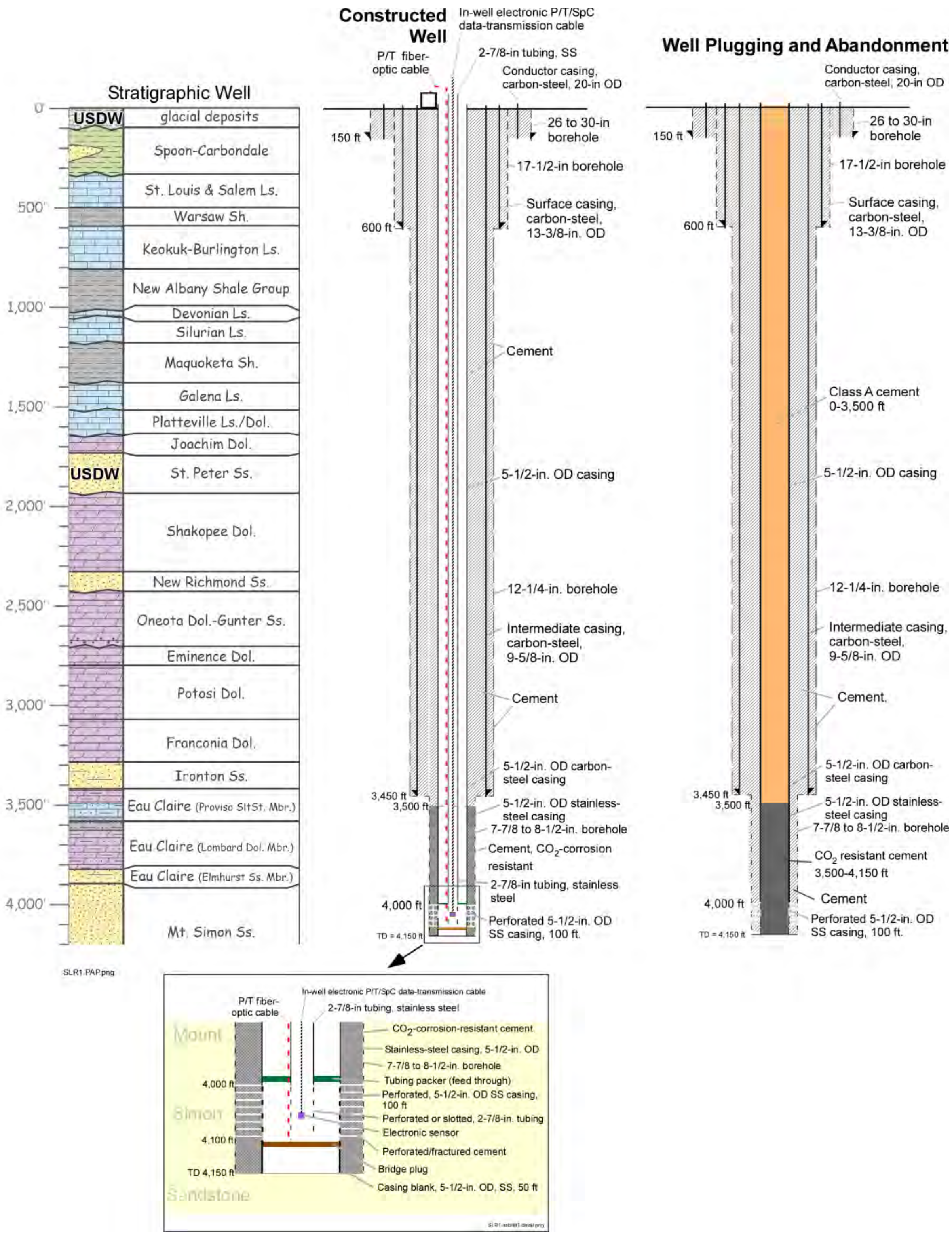



**Figure D-1. Construction design and plugging and abandonment plan for new 5.5-in.-diameter single-level in-reservoir monitoring well.**

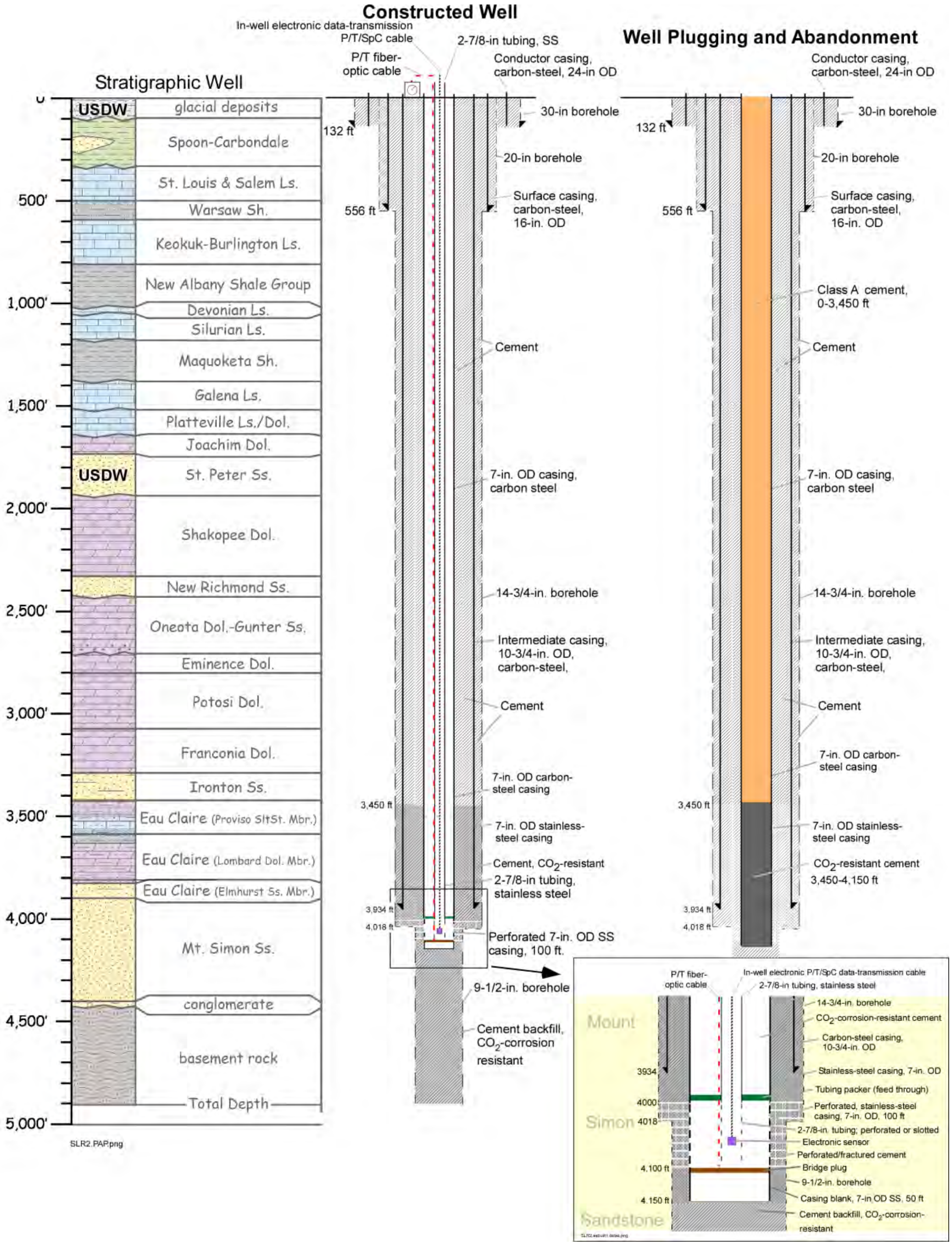



**Figure D-2. Construction design and plugging and abandonment plan for 7-in.-diameter single-level in-reservoir monitoring well to be reconfigured from the stratigraphic well.**

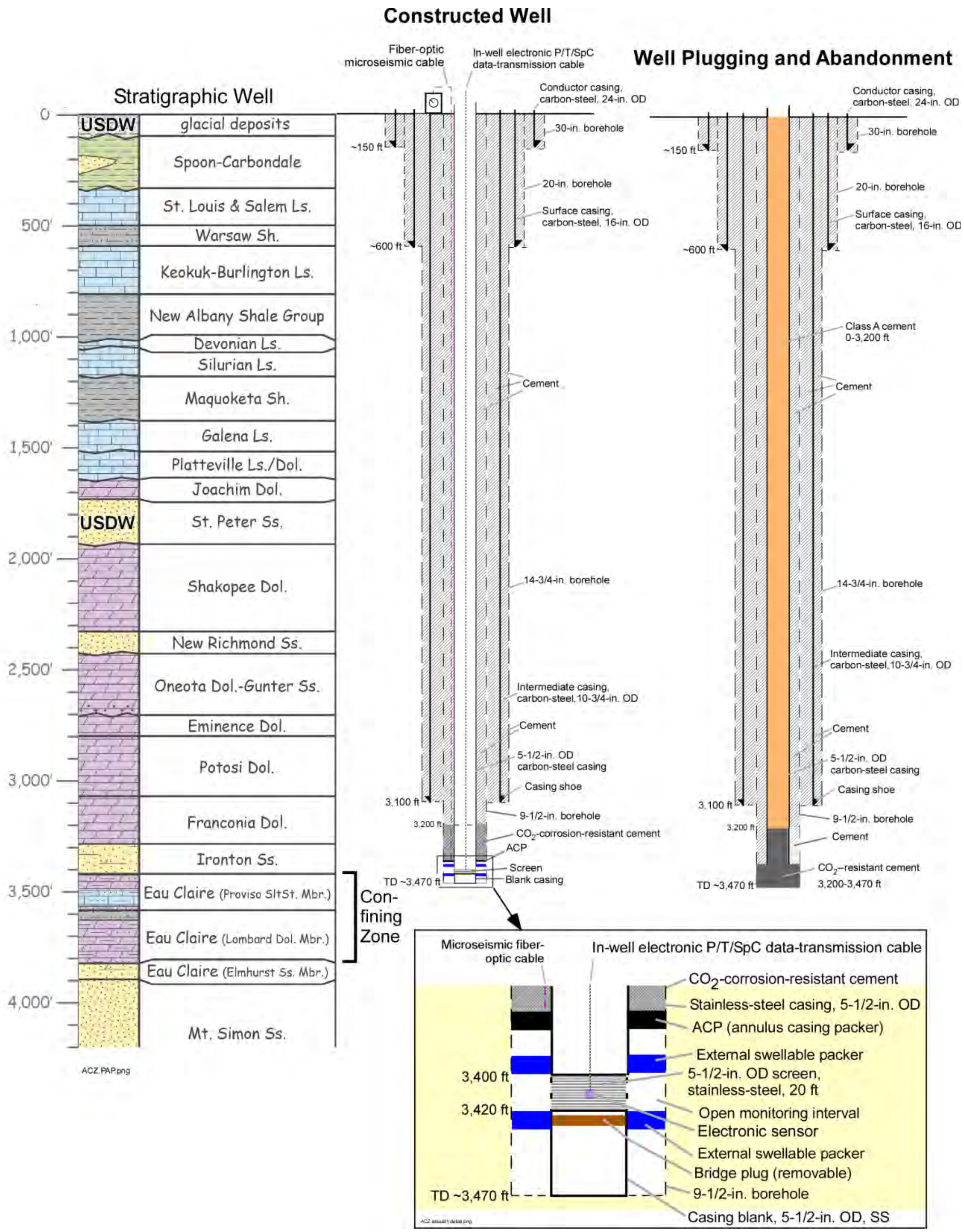



**Figure D-3. Construction design and plugging and abandonment plan for the Above Confining Zone monitoring wells.**

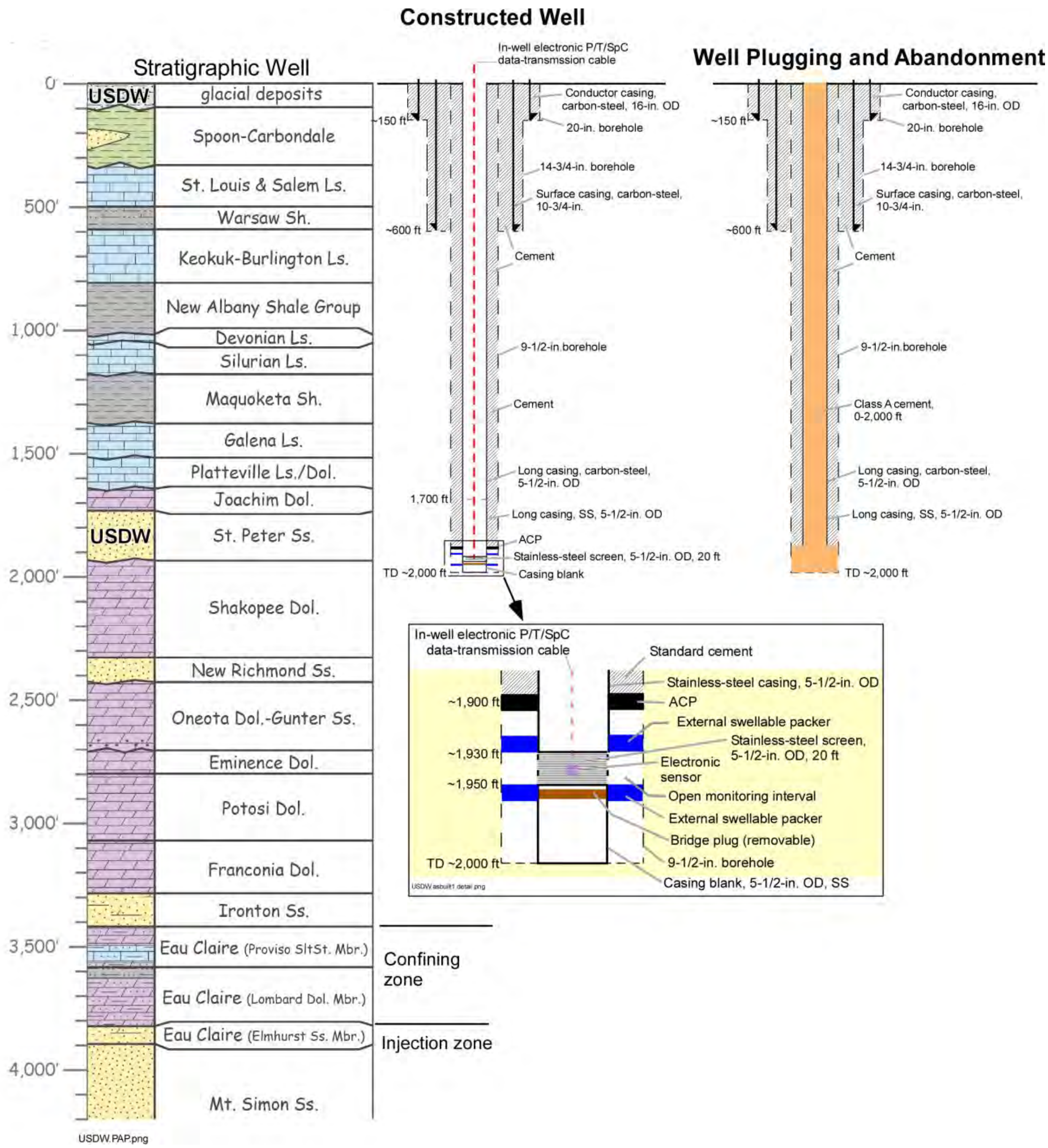



**Figure D-4. Construction design and plugging and abandonment plan for the USDW monitoring well.**

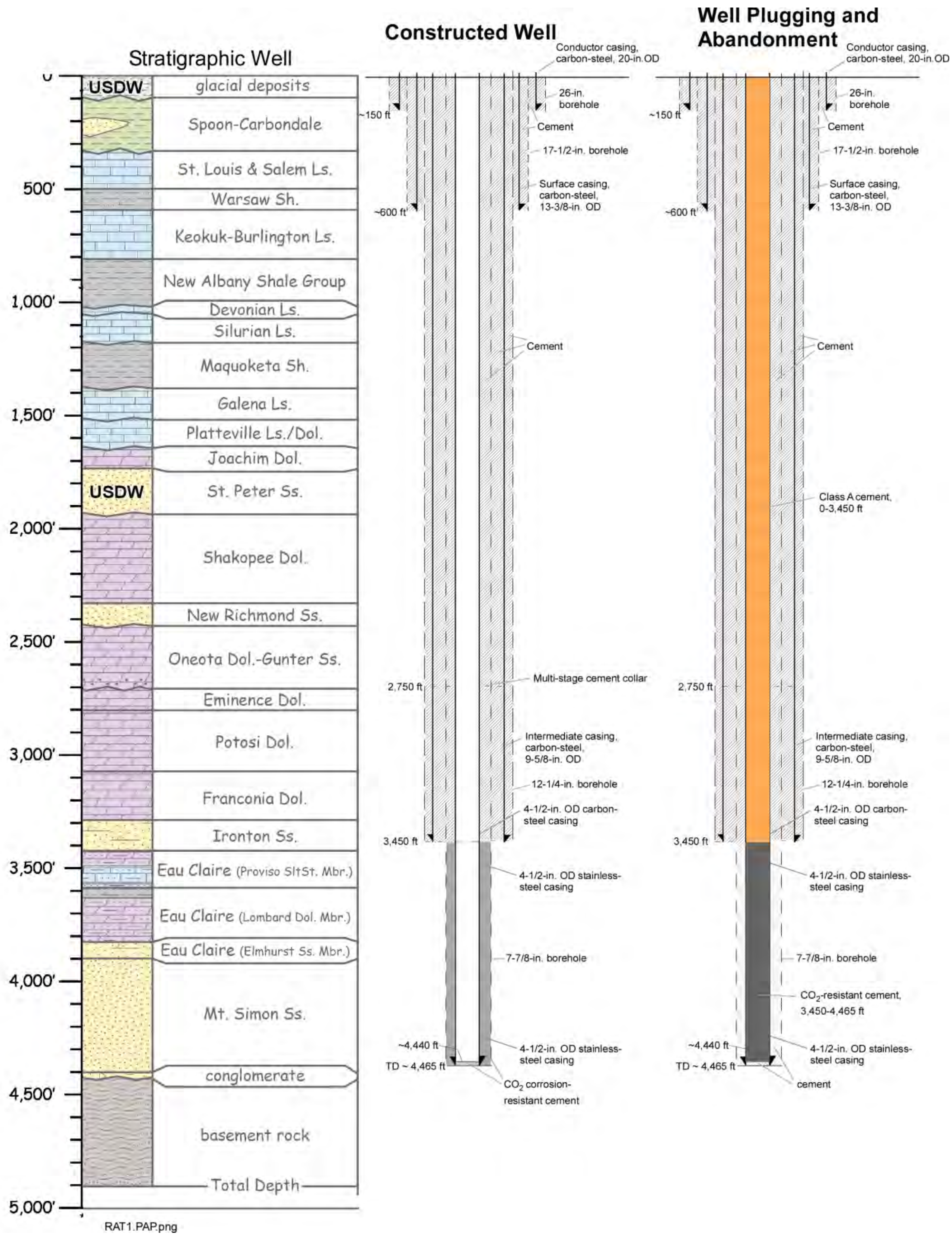



**Figure D-5. Construction design and plugging and abandonment plan for the reservoir access tube wells.**

# APPENDIX E:Plugging and Abandonment Plans for Deep Monitoring Wells, Reservoir Access Tube Wells, and Geophysical Wells

Plugging and abandonment plans for the following monitoring wells are provided in this appendix:

**Monitoring wells**

- ACZ1
- ACZ2
- RAT1
- RAT2
- RAT3
- SLR1-5.5"
- SLR2-7"
- USDW1

**Geophysical Wells**

- MS1
- MS2
- MS3
- MS4
- MS5
- TM1
- TM2
- TM3
- TM4
- TM5

OMB No. 2040-0042 Approval Expires 11/30/2014

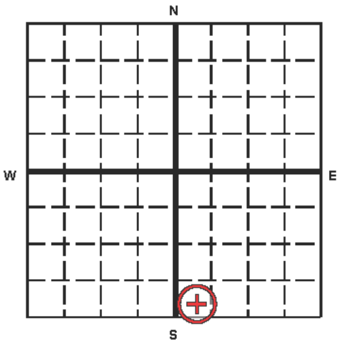
United States Environmental Protection Agency
Washington, DC 20460

EPA

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well ACZ1, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Descriptior

sw 1/4 of sw 1/4 of sw 1/4 of se 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 24" | 140 | 0-150 | 150 | 30" |
| 16" | 84 | 0-600 | 600 | 20" |
| 10-3/4 | 51 | 0-3,100 | 3,100 | 14.75" |
| 5-1/2" | 17 | 0-3,470 | 3,470 | 9.5" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 9.5" | 5.5" | 5.5" | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 3,470' | 3,350 | 3,200 | | | | |
| Sacks of Cement To Be Used (each plug) | 61 | 17 | 354 | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 68 | 20 | 418 | | | | |
| Calculated Top of Plug (ft.) | 3,350 | 3,200 | 418 | | | | |
| Measured Top of Plug (if tagged ft.) | 3,350 | 3,200 | 0 | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.82 | 15.6 | | | | |
| Type Cement or Other Material (Class III) | EverCret | EverCret | Class A | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| 3,470' | 3,350' (perforated) | | |
| 3,400' | 3,420' (screened) | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$429,480

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

EPA Form 7520-14 (Rev. 12-11)

OMB No. 2040-0042 Approval Expires 11/30/2014

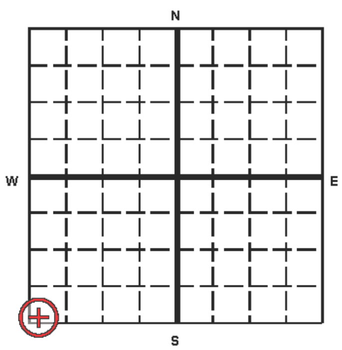
United States Environmental Protection Agency
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility:** Well ACZ2, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator:** FutureGen Alliance
73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




**State:** Illinois **County:** Morgan **Permit Number:**

**Surface Location Descriptor:** sw 1/4 of sw 1/4 of sw 1/4 of sw 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 24" | 140 | 0-150 | 150 | 30" |
| 16" | 84 | 0-600 | 600 | 20" |
| 10-3/4 | 51 | 0-3,100 | 3,100 | 14.75" |
| 5-1/2" | 17 | 0-3,470 | 3,470 | 9.5" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 9.5" | 5.5" | 5.5" | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 3,470' | 3,350 | 3,200 | | | | |
| Sacks of Cement To Be Used (each plug) | 61 | 22 | 447 | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 68 | 25 | 528 | | | | |
| Calculated Top of Plug (ft.) | 3,350 | 3,200 | 0 | | | | |
| Measured Top of Plug (if tagged ft.) | 3,350 | 3,200 | 0 | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.82 | 15.6 | | | | |
| Type Cement or Other Material (Class III) | EverCret | EverCret | Class A | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| 3,470' | 3,350' (perforated) | | |
| 3,400' | 3,420' (screened) | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells:** $429,480

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | *[signature]* | 03/03/2014 |

EPA Form 7520-14 (Rev. 12-11)

OMB No. 2040-0042 Approval Expires 11/30/2014

United States Environmental Protection Agency
Washington, DC 20460

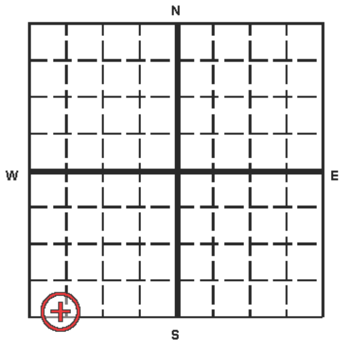
EPA

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility**
RAT1 Well, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator**
FutureGen Alliance
73 Central Park Plaza East, Jacksonville, IL 62650

**Locate Well and Outline Unit on Section Plat - 640 Acres**




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

**Surface Location Descriptior**
se 1/4 of sw 1/4 of sw 1/4 of sw 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ____ ft. frm (N/S) ____ Line of quarter section
and ____ ft. from (E/W) ____ Line of quarter section.

**TYPE OF AUTHORIZATION**
- ☑ Individual Permit
- ☐ Area Permit
- ☐ Rule

Number of Wells 1

**WELL ACTIVITY**
- ☐ CLASS I
- ☐ CLASS II
  - ☐ Brine Disposal
  - ☐ Enhanced Recovery
  - ☐ Hydrocarbon Storage
- ☐ CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 20" | 94 | 0-150 | 150 | 26" |
| 13-3/8 | 61 | 0-600 | 600 | 17.5" |
| 9-5/8" | 36 | 0-3,450 | 3,450 | 12.25" |
| 4-1/2" | 10.5 | 0-4,465 | 4,465 | 7.875" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**
- ☑ The Balance Method
- ☐ The Dump Bailer Method
- ☐ The Two-Plug Method
- ☐ Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 4.5" | 4.5" | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 4,440' | 3,450' | | | | | |
| Sacks of Cement To Be Used (each plug) | 79 | 262 | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 89 | 309 | | | | | |
| Calculated Top of Plug (ft.) | 3,450' | 0' | | | | | |
| Measured Top of Plug (if tagged ft.) | 3,450' | 0' | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.6 | | | | | |
| Type Cement or Other Material (Class III) | EverCret | Class A | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells**
$308,830

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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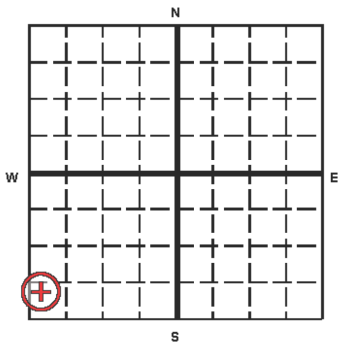
United States Environmental Protection Agency
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| RAT2 Well, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Descriptior

nw 1/4 of sw 1/4 of sw 1/4 of sw 1/4 of Section 36 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 20" | 94 | 0-150 | 150 | 26" |
| 13-3/8 | 61 | 0-600 | 600 | 17.5" |
| 9-5/8" | 36 | 0-3,450 | 3,450 | 12.25" |
| 4-1/2" | 10.5 | 0-4,465 | 4,465 | 7.875" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 4.5" | 4.5" | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 4,440' | 3,450' | | | | | |
| Sacks of Cement To Be Used (each plug) | 79 | 262 | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 89 | 309 | | | | | |
| Calculated Top of Plug (ft.) | 3,450' | 0' | | | | | |
| Measured Top of Plug (if tagged ft.) | 3,450' | 0' | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.6 | | | | | |
| Type Cement or Other Material (Class III) | EverCret | Class A | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$308,830

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

EPA Form 7520-14 (Rev. 12-11)

OMB No. 2040-0042 Approval Expires 11/30/2014

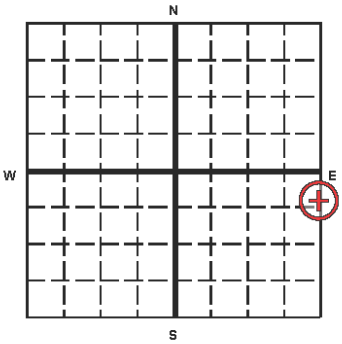
United States Environmental Protection Agency
Washington, DC 20460

EPA

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| RAT3 Well, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Description

se 1/4 of ne 1/4 of ne 1/4 of se 1/4 of Section 34 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name ___ Well Number ___

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 20" | 94 | 0-150 | 150 | 26" |
| 13-3/8 | 61 | 0-600 | 600 | 17.5" |
| 9-5/8" | 36 | 0-3,450 | 3,450 | 12.25" |
| 4-1/2" | 10.5 | 0-4,465 | 4,465 | 7.875" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 4.5" | 4.5" | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 4,440' | 3,450' | | | | | |
| Sacks of Cement To Be Used (each plug) | 79 | 262 | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 89 | 309 | | | | | |
| Calculated Top of Plug (ft.) | 3,450 | 0 | | | | | |
| Measured Top of Plug (if tagged ft.) | 3,450 | 0 | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.6 | | | | | |
| Type Cement or Other Material (Class III) | EverCret | Class A | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$308,830

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | | 03/03/2014 |

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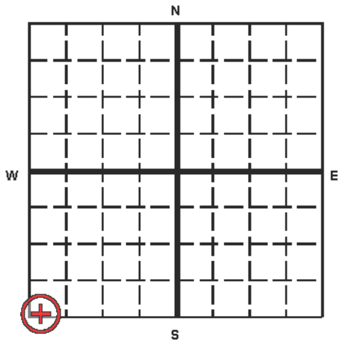
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility:** Well SLR1, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator:** FutureGen Alliance, 73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




**State:** Illinois **County:** Morgan **Permit Number:**

**Surface Location Descriptior:** SW 1/4 of SW 1/4 of SW 1/4 of SW 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 20" | 94 | 0-150 | 150 | 26" |
| 13-3/8 | 61 | 0-600 | 600 | 17.5" |
| 9-5/8" | 36 | 0-3,450 | 3,450 | 12.25" |
| 5-1/2" | 17 | 0-4,150 | 4,150 | 8" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 5-1/2" | 5-1/2" | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 4,150' | 3,500' | | | | | |
| Sacks of Cement To Be Used (each plug) | 78 | 388 | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 87 | 458 | | | | | |
| Calculated Top of Plug (ft.) | 3,500' | 0' | | | | | |
| Measured Top of Plug (if tagged ft.) | 3,500' | 0' | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.6 | | | | | |
| Type Cement or Other Material (Class III) | EverCret | Class A | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| 4000' | 4100' (perforated and fractured) | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells:** $536,600

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
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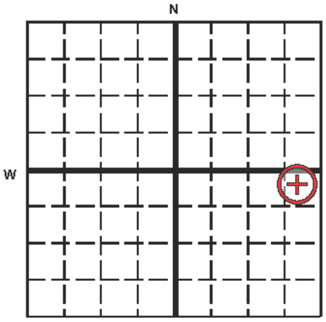
United States Environmental Protection Agency
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well SLR2, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Descriptior

nw 1/4 of ne 1/4 of ne 1/4 of se 1/4 of Section 25 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ____ ft. frm (N/S) ____ Line of quarter section
and ____ ft. from (E/W) ____ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name ____ Well Number ____

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 24" | 140 | 0-132 | 132 | 30" |
| 16" | 84 | 0-556 | 556 | 20" |
| 10-3/4 | 51 | 0-3,934 | 3,934 | 14.75" |
| 7" | 29 | 4,150 | 4,150 | 9.5" |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7" | 7" | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 4,150' | 3,500' | | | | | |
| Sacks of Cement To Be Used (each plug) | 124 | 619 | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 139 | 730 | | | | | |
| Calculated Top of Plug (ft.) | 3,500' | 0' | | | | | |
| Measured Top of Plug (if tagged ft.) | 3,500' | 0' | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.82 | 15.6 | | | | | |
| Type Cement or Other Material (Class III) | EverCret | Class A | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| 4000' | 4100' (perforated and fractured) | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$571,600

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

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|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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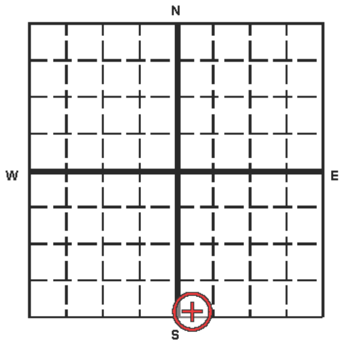
Washington, DC 20460

EPA

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well USDW1, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Descriptior

sw 1/4 of sw 1/4 of sw 1/4 of se 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

| TYPE OF AUTHORIZATION | WELL ACTIVITY |
|---|---|
| ☑ Individual Permit | ☐ CLASS I |
| ☐ Area Permit | ☐ CLASS II |
| ☐ Rule | ☐ Brine Disposal |
| Number of Wells 1 | ☐ Enhanced Recovery |
| | ☐ Hydrocarbon Storage |
| | ☐ CLASS III |

Lease Name ___ Well Number ___

CASING AND TUBING RECORD AFTER PLUGGING

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 16" | 55 | 0-150 | 150 | 20" |
| 10-3/4 | 40.5 | 0-600 | 600 | 14.75" |
| 5-1/2" | 17 | 0-2,000 | 2,000 | 9.5" |
| | | | | |

METHOD OF EMPLACEMENT OF CEMENT PLUGS

- ☑ The Balance Method
- ☐ The Dump Bailer Method
- ☐ The Two-Plug Method
- ☐ Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 9.5" | 5.5" | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 2,000' | 1,880' | | | | | |
| Sacks of Cement To Be Used (each plug) | 56 | 209 | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 63 | 246 | | | | | |
| Calculated Top of Plug (ft.) | 1,880' | 0 | | | | | |
| Measured Top of Plug (if tagged ft.) | 1,880' | 0 | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | 15.6 | | | | | |
| Type Cement or Other Material (Class III) | Class A | Class A | | | | | |

LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)

| From | To | From | To |
|---|---|---|---|
| 2,000' | 1,880' (perforated) | | |
| 1,930' | 1,950' (screened) | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$319,000

## Certification

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| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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Washington, DC 20460

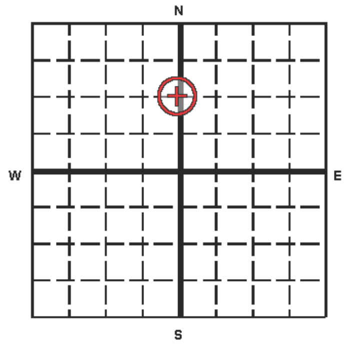
EPA

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility**
Well MS1, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator**
FutureGen Alliance
73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

**Surface Location Descriptior**
se 1/4 of se 1/4 of ne 1/4 of nw 1/4 of Section 27 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**
- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**
- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name
Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 13-3/8 | 54 | 0-130 | 130 | 17.5" |
| 7-5/8 | 26.4 | 0-350 | 350 | 11.5" |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**
- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 330 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 74 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 87 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells**
$25,000

## Certification

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| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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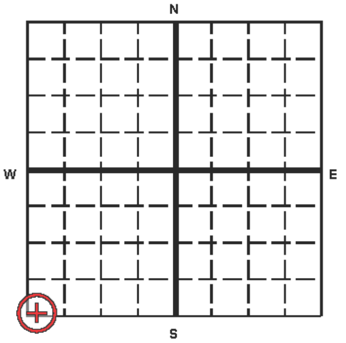
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility**
Well MS2, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator**
FutureGen Alliance
73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

**Surface Location Descriptior**
SW 1/4 of SW 1/4 of SW 1/4 of SW 1/4 of Section 31 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface
Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

Lease Name

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 13-3/8 | 54 | 0-130 | 130 | 17.5" |
| 7-5/8 | 26.4 | 0-350 | 350 | 11.5" |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 330 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 74 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 87 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells**
$25,000

## Certification

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| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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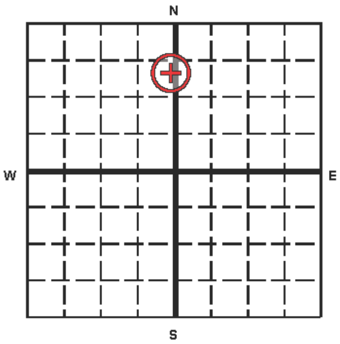
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility:** Well MS3, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator:** FutureGen Alliance, 73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

**Surface Location Descriptior**

ne 1/4 of se 1/4 of ne 1/4 of nw 1/4 of Section 25 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ____ ft. frm (N/S) ____ Line of quarter section
and ____ ft. from (E/W) ____ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

Lease Name

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 13-3/8 | 54 | 0-130 | 130 | 17.5" |
| 7-5/8 | 26.4 | 0-350 | 350 | 11.5" |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 330 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 74 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 87 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells**

$25,000

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

EPA Form 7520-14 (Rev. 12-11)

OMB No. 2040-0042 Approval Expires 11/30/2014

United States Environmental Protection Agency
Washington, DC 20460

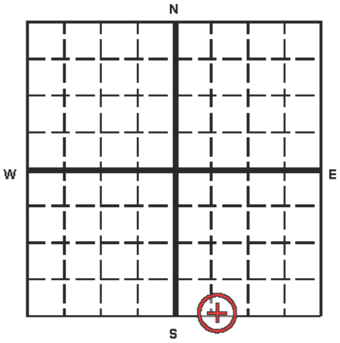
EPA

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility**
Well MS4, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator**
FutureGen Alliance
73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

**Surface Location Descriptior**
sw 1/4 of se 1/4 of sw 1/4 of se 1/4 of Section 34 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface
Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**
- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**
- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 13-3/8 | 54 | 0-130 | 130 | 17.5" |
| 7-5/8 | 26.4 | 0-350 | 350 | 11.5" |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**
- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 330 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 74 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 87 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells**
$25,000

## Certification

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| Name and Official Title *(Please type or print)* | Signature | Date Signed |
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| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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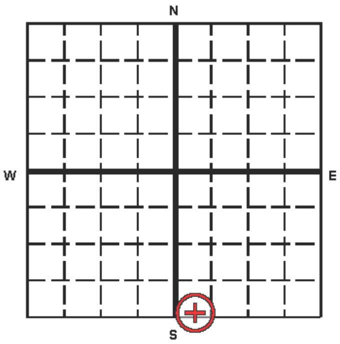
United States Environmental Protection Agency
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well MS5, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Description

sw 1/4 of sw 1/4 of sw 1/4 of se 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

Lease Name

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 13-3/8 | 54 | 0-130 | 130 | 17.5" |
| 7-5/8 | 26.4 | 0-350 | 350 | 11.5" |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [x] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [ ] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 330 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 74 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 87 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$25,000

## Certification

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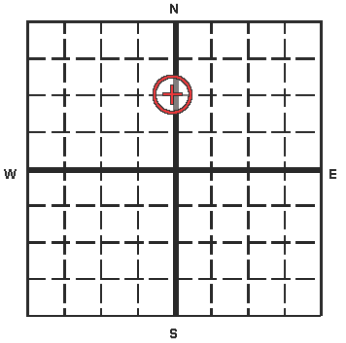
Washington, DC 20460

EPA

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well TM1, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Descriptior

se 1/4 of se 1/4 of ne 1/4 of nw 1/4 of Section 27 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

Lease Name

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 7-5/8 | 26.4 | 0-20 | 20 | 11.5" |
| | | | | |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [ ] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [x] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 20 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 4 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 5 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$2,000

## Certification

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EPA

# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well TM2, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres

N / W / E / S

| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Descriptior

sw 1/4 of sw 1/4 of sw 1/4 of sw 1/4 of Section 31 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

| TYPE OF AUTHORIZATION | WELL ACTIVITY |
|---|---|
| ☑ Individual Permit | ☐ CLASS I |
| ☐ Area Permit | ☐ CLASS II |
| ☐ Rule | ☐ Brine Disposal |
| | ☐ Enhanced Recovery |
| Number of Wells 1 | ☐ Hydrocarbon Storage |
| | ☐ CLASS III |
| Lease Name | Well Number |

CASING AND TUBING RECORD AFTER PLUGGING

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 7-5/8 | 26.4 | 0-20 | 20 | 11.5" |
| | | | | |
| | | | | |
| | | | | |

METHOD OF EMPLACEMENT OF CEMENT PLUGS

- ☐ The Balance Method
- ☐ The Dump Bailer Method
- ☐ The Two-Plug Method
- ☑ Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 20 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 4 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 5 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$2,000

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
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| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

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EPA

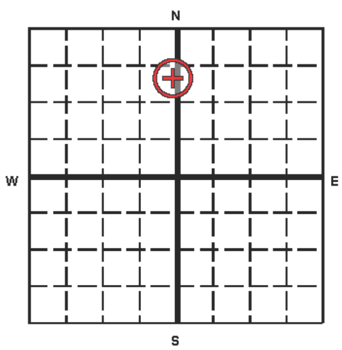
United States Environmental Protection Agency
Washington, DC 20460

# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility:** Well TM3, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator:** FutureGen Alliance, 73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

**Surface Location Description:** ne 1/4 of se 1/4 of ne 1/4 of nw 1/4 of Section 25 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 7-5/8 | 26.4 | 0-20 | 20 | 11.5" |
| | | | | |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [ ] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [x] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 20 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 4 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 5 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Estimated Cost to Plug Wells:** $2,000

## Certification

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| Name and Official Title *(Please type or print)* | Signature | Date Signed |
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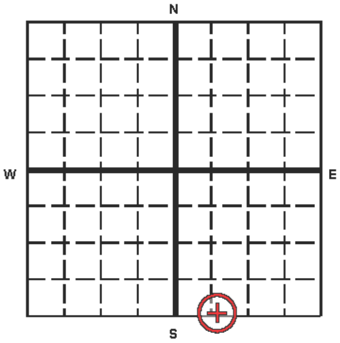
# PLUGGING AND ABANDONMENT PLAN

**Name and Address of Facility**
Well MS4, FutureGen 2.0, Morgan County, IL

**Name and Address of Owner/Operator**
FutureGen Alliance
73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres




**State** Illinois | **County** Morgan | **Permit Number**

**Surface Location Description**
sw 1/4 of se 1/4 of sw 1/4 of se 1/4 of Section 34 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface
Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**
- ☑ Individual Permit
- ☐ Area Permit
- ☐ Rule

Number of Wells 1

**WELL ACTIVITY**
- ☐ CLASS I
- ☐ CLASS II
  - ☐ Brine Disposal
  - ☐ Enhanced Recovery
  - ☐ Hydrocarbon Storage
- ☐ CLASS III

Lease Name

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 7-5/8 | 26.4 | 0-20 | 20 | 11.5" |
| | | | | |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**
- ☐ The Balance Method
- ☐ The Dump Bailer Method
- ☐ The Two-Plug Method
- ☑ Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 20 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 4 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 5 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
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**Estimated Cost to Plug Wells**
$2,000

## Certification

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**Name and Official Title** *(Please type or print)*
Kenneth K. Humphreys, Chief Executive Officer

**Signature**
Kenneth K. Humphreys

**Date Signed**
03/03/2014

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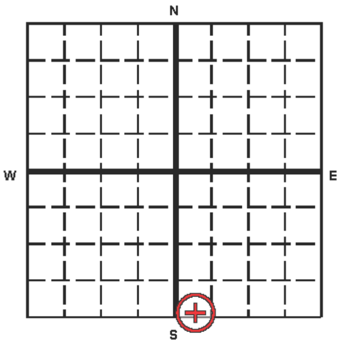
# PLUGGING AND ABANDONMENT PLAN

| Name and Address of Facility | Name and Address of Owner/Operator |
|---|---|
| Well MS5, FutureGen 2.0, Morgan County, IL | FutureGen Alliance<br>73 Central Park Plaza East, Jacksonville, IL 62650 |

Locate Well and Outline Unit on Section Plat - 640 Acres




| State | County | Permit Number |
|---|---|---|
| Illinois | Morgan | |

Surface Location Description

sw 1/4 of sw 1/4 of sw 1/4 of se 1/4 of Section 26 Township 16n Range 9w

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location ___ ft. frm (N/S) ___ Line of quarter section
and ___ ft. from (E/W) ___ Line of quarter section.

**TYPE OF AUTHORIZATION**

- [x] Individual Permit
- [ ] Area Permit
- [ ] Rule

Number of Wells 1

Lease Name

**WELL ACTIVITY**

- [ ] CLASS I
- [ ] CLASS II
  - [ ] Brine Disposal
  - [ ] Enhanced Recovery
  - [ ] Hydrocarbon Storage
- [ ] CLASS III

Well Number

**CASING AND TUBING RECORD AFTER PLUGGING**

| SIZE | WT (LB/FT) | TO BE PUT IN WELL (FT) | TO BE LEFT IN WELL (FT) | HOLE SIZE |
|---|---|---|---|---|
| 7-5/8 | 26.4 | 0-20 | 20 | 11.5" |
| | | | | |
| | | | | |
| | | | | |

**METHOD OF EMPLACEMENT OF CEMENT PLUGS**

- [ ] The Balance Method
- [ ] The Dump Bailer Method
- [ ] The Two-Plug Method
- [x] Other

| CEMENTING TO PLUG AND ABANDON DATA: | PLUG #1 | PLUG #2 | PLUG #3 | PLUG #4 | PLUG #5 | PLUG #6 | PLUG #7 |
|---|---|---|---|---|---|---|---|
| Size of Hole or Pipe in which Plug Will Be Placed (inche | 7-5/8" | | | | | | |
| Depth to Bottom of Tubing or Drill Pipe (ft | 20 | | | | | | |
| Sacks of Cement To Be Used (each plug) | 4 | | | | | | |
| Slurry Volume To Be Pumped (cu. ft.) | 5 | | | | | | |
| Calculated Top of Plug (ft.) | 0 | | | | | | |
| Measured Top of Plug (if tagged ft.) | 0 | | | | | | |
| Slurry Wt. (Lb./Gal.) | 15.6 | | | | | | |
| Type Cement or Other Material (Class III) | Class A | | | | | | |

**LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any)**

| From | To | From | To |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

Estimated Cost to Plug Wells

$2,000

## Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possiblity of fine and imprisonment. (Ref. 40 CFR 144.32)

| Name and Official Title *(Please type or print)* | Signature | Date Signed |
|---|---|---|
| Kenneth K. Humphreys, Chief Executive Officer | Kenneth K. Humphreys | 03/03/2014 |

EPA Form 7520-14 (Rev. 12-11)