Post-Injection Site Care (PISC) and Site Closure Plan

About this Document

This document compiles text from the FutureGen permit application for Morgan County Class VI UIC Wells 1, 2, 3, and 4 into the PISC and site closure plan template provided in the *Class VI Project Plan Development Guidance*. The intent is to identify whether sufficient information was provided in the permit application to complete the project plans; <u>this is not considered a complete or approvable project plan</u>.

Identified deficiencies and questions are presented in highlighted text.

To facilitate reference to applicant submittals, text is color-coded and sections of the original documents are noted (some text has been edited slightly):

- Red text is from the FutureGen permit application.
- Blue text is from the additional information provided in November 2013.
- Green text is from the additional information provided in December 2013.
- Purple text is from additional information provided in January 2014 (including the Testing and Monitoring spreadsheet)

Text written by EPA is black.

• Text written by the Alliance is orange.

Table and figure numbers reflect the labels in FutureGen's submissions.

Post-Injection Site Care (PISC) and Site Closure Plan

Facility Information

Facility name: FutureGen 2.0 Project: Morgan County Class VI UIC Wells 1, 2, 3, and 4

Facility contacts (names, titles, phone numbers, email addresses):

Kenneth Humphreys, Chief Executive Officer, FutureGen Industrial Alliance, Inc., Morgan County Office, 73 Central Park Plaza East, Jacksonville, IL 62650, 217-243-8215

Location (town/county/etc.): Morgan County, IL; 26–16N–9W; 39.800266°N and 90.07469°W"

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 below in Table 1 and Figure 1.

Changes in pressure relative to initial conditions were calculated from simulation results. Preinjection pressures were defined as the initial pressure measured_at the monitoring locations before injection begins. Simulations were conducted for 20 years of carbon dioxide (CO₂) injection at a rate of 1.1 MMT/yr distributed into the injection wells, followed by 80 years of post-injection. Table 1 lists predicted aqueous pressure differentials over time at the top of the injection zone_monitoring locations of the monitoring wells. For the injection well, the depth corresponds to the monitoring locations of the single-level in-reservoir (SLR) monitoring wellsand for one depth interval immediately above the primary confining zone (MW3, the ACZ early detection monitoring well). The model suggests a maximum injection pressure differential of 446-479 psi at the injection well at the time injection is stopped. Simulation results show the magnitude and area of elevated pressure gradually decreasing over time after injection stops.

The FutureGen Industrial Alliance, Inc. (Alliance) will conduct model calibration, on an annual basis for the first 5 years following the initiation of injection operations. Following the fifth year of injection, the model calibration will occur at a minimum of every 5 years. Some conditions would warrant reevaluation prior to the next scheduled reevaluation. These conditions are described in the Area of Review and Corrective Action Plan.

Model calibration may also occur when actual operational data differ significantly from initial estimated operational values that were used for model inputs, or when monitoring data and model results differ significantly as per specified in the regulation.

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 top of the injection zone at the injection "point" increase during the 20-year injection period from $\frac{1,693}{1,779}$ psi to a maximum of $\frac{2,139}{2,258}$ 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 is stopped.

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 Re	eservoir #	1	
SLR2	R2 Single Level Reservoir #2				
ACZ1	Z1 Above Confining Zone #1				
ACZ2	2 Above Confining Zone #2				
Injection Well	Injection Well Geometric centroid of four horizontal laterals				tal laterals
evel-Level					

 Table 1. Pressure differential to baseline conditions at well locations near the base of the Ironton Formation for-Well-3_Above Confining Zone Well 1 (ACZ1) and ACZ2 and at the top of-middle of the Mount Simon 11 layer in the injection zone for the rest of the wells during and after injection (Table 7.1 from FutureGen's permit application).

	Pressure Differential (psi)				
Year	MW 1	MW 2	MW 3	MW 4	Injection Well
Distance from Injection Well (ft)	7,749	3,149	1,221	6,574	0
0 (Start injection)	0	0	0	0	0
1	116	166	0	119	289
2	155	209	0	160	339
3	181	236	0	187	365
4	200	255	0	206	381
5	215	271	0	221	393
10	263	319	0	270	424
15	292	343	1	300	438
20 Stop injection at year end)	313	358	2	320	446
21	228	242	2	234	258
22 (Approximate maximum extent of CO ₂ Plume)	183	191	2	188	200
23	155	161	2	160	168
24	136	141	3	140	145
25	121	125	3	125	129
30	81	84	4	84	85
35	62	64	4	64	64
40	50	51	5	51	51
45	41	42	5	43	42
50	35	36	5	36	36
60	27	27	5	28	27
70	21	22	5	22	21
80	18	18	5	18	17
90	15	15	5	15	14
100	13	13	4	13	12
•	Well Identifier on Figure 7.1 MW 1 Stratigraphic Well (converted to Single-Level Monitoring Well) MW 2 Injection Zone Multi-Level Monitoring Well MW 3 ACZ Early-Detection Monitoring Well MW 4 Injection Zone Single-Level Monitoring Well MW 4 Geometric centroid of four horizontal laterals				
MW 1 MW 2 MW 3					
MW 4 Injection Well					

Commented [JRM1]: Table should be updated to reference well names as defined in the T&M plan. A comment in the T&M plan was to create a table that lists all the monitoring wells (RAT#1, RAT#2, SLR#1, SLR#2, ACZ#1, ACZ#2) and their locations. This can then be referred to from this plan.





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Figure 2. Aqueous Pressure differentials from baseline condition at the top of the injection zone and CO₂ plume extents at 20 years (end of injection) and 70 years (site closure) after start of injection

<u>Predicted Position of the CO₂ Plume and Associated Pressure Front Upon Cessation of</u> <u>Injection and at Site Closure</u>

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 well 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 lower part of the Lombard)and into the primary confining zone. The computational model results indicate indeed 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 (above MSL) at the FutureGen 2.0 stratigraphic well, corresponding to the top of the Lombard 5 layer of the numerical model.

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The CO_2 plume forms a cloverleaf pattern as a result of the four lateral_-injection_-well designs. 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.

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Figure 3. Cutaway view of CO₂-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 (from Figure 3.22 in FutureGen's permit application).

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Figure 4. Cutaway view of CO₂-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 (from Figure 3.23 in FutureGen's permit application).

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, and 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 cloverleaf pattern of the CO₂ plume that forms as a result of the four lateral-injection-well design. The central portion of the plume is a result of CO₂ injection into the Elmhurst in the vertical section of each well. Figures presenting the cross-sectional views show the location of the open interval relative to the plume and stratigraphic units. It can be seen in Figure 3 and Figure 4Figure 6 and Figure 7 that after 20 years of continuous CO₂ injection, the plume has spread both laterally and vertically, with some CO₂ migrating into the lower part of the Lombard. At 20 years, the plume grows larger with time primarily in the lateral direction, but also vertically. Two years after the cessation of CO_2 injection (at 22 years), the plume reaches its maximum lateral extent. However, the CO₂ within the plume continues to redistribute by migrating slowly upward due to buoyancy effects, with and some of the CO₂ dissolvinges at the CO₂-brine interface at the edge of the plume. The vertical layering represented in the model is one of the controlling factors in the plume shape at later times. In general, the CO₂ tends to accumulate below a layer with a relatively higher gas entry pressure (and often lower permeability) than that of the layer directly below it. This area of relatively higher CO₂ saturation can be seen as the green "ledge" feature in the plume, and as the flat-topped orange zone. Because the plume migrates primarily upward after injection ceases, the green feature becomes narrower with time. The vertical cross sections showing the plume at 70 years illustrate how the CO₂ distribution within the plume becomes more uniform with time. Because of the dissolution process, the CO₂ separate-phase plume area (in the horizontal plane) at 100 years is 2.2% smaller than the maximum area at 22 years.

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 lower most USDW, the St Peter Sandstone, under initial conditions prior to injection,

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Figure 5. Determination of the Top of the Injection Zone, based on Geophysical Logs and Modeling Results.



Figure 6. Cutaway view of CO₂-rich phase saturation along A-A' (Wells 1 and 3) at 20 and 70 years (from Figure 3.22 in FutureGen's December 2013 submission).





 CO_2 migration during the post-injection site care (PISC) period was modeled to predict CO_2 plume redistribution after injection ceases. 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. **Error! Reference source not found.** Figure 5. Simulated

plume area over time (the vertical dashed line denotes the time CO_2 injection ceases) (Figureshows the cumulative area of the CO_2 mass plume with time. The maximum plume extent, 6.46 mi², occurs at 22 years after the start of injection (2 years after the cessation of injection).





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 mi² 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. Simulated plume area over time (the vertical dashed line denotes the time CO_2 injection ceases) (Figure Error! Reference source not found.).





Figure 6. Simulated areal extent of the CO₂ plume at the time of site closure (70 years after CO₂ injection was initiated) (Figure 7.3 in FutureGen's permit application).

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 four monitoring wells. The Testing and Monitoring section of this permitPlan lists planned and considered monitoring. In addition, FutureGen will conduct groundwater sampling in the shallow, semi-consolidated glacial sediments that make up the surficial aquifer.

Threewo fully cased reservoir access tubes (RATs) will be installed within the boundaries of the simulated 5-year CO₂ plume. The RATs will extend to the base of the reservoir and into the Precambrian bedrock. The RATs will be non-perforated, cemented casings used to monitor CO₂ arrival and quantify saturation levels via downhole pulsed-neutron capture (PNC) geophysical logging across the reservoir and confining zone.

A discussion and location map showing the updated and revised monitoring well network are provided below.

Location of Monitoring Wells

Monitoring well locations are described in the Testing and Monitoring Plan. Their coordinates are provided in Attachment A. 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 and 2) detecting any unforeseen containment loss.

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 CO₂. The design includes a total of eightseven monitoring wells as follows:

- 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: pressure, temperature, and hydrogeochemical indicators of CO₂.
- 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 CO₂-injection laterals. Monitored parameters: pressure, temperature, and hydrogeochemical indicators of CO₂.
- Two-Three reservoir access tube (RAT) wells _- These are fully cased wells, which allow access for monitoring instrumentation in the reservoir via pulsed neutronPNC logging equipment. The wells will not be perforated so as To avoid two-phase flow near the borehole, which can distort the CO₂ saturation measurements, the wells will not be perforated. Monitoring parameters: quantification of CO₂ saturation across the reservoir and caprock.

Post-Injection Site Care and Site Closure Plan for FutureGen 2.0 Alliance Preliminary draft – do not distribute **Commented [TE3]:** Incorporate table or reference T&M Plan in the draft permit.

Commented [TE4]: Specify or reference table.

Commented [TE5]: Specify or reference table.

• One underground sources of drinking water (USDW) well – This well will be used to monitor the lowermost USDW (St. Peter Sandstone). Monitored parameters: pressure, temperature, and hydrogeochemical indicators of CO₂.

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Figure 7. Updated and revised plan for monitoring wells (submitted January 2014).

FutureGen will also conduct sampling in the shallow, semi-consolidated glacial sediments that make up the surficial aquifer, using approximately 10 local landowner wells and one well drilled for the project(Figure 8). The coordinates of these wells are provided in Attachment B.





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.

Post-Injection Site Care and Site Closure Plan for FutureGen 2.0 Alliance Preliminary draft – do not distribute Commented [TE7]: Add corresponding table with GPS coordinates for proposed groundwater monitoring wells (consistent with T&M Plan)

FutreuGen : provided in attachment

Summary of Planned Post-Injection Monitoring Activities

A suite of indirect geophysical monitoring methods were evaluated to assess their efficacy and effectiveness for monitoring the areal extent, evolution, and fate and transport of the injected CO₂ plume under site-specific conditions. Technologies that were retained for implementation in the monitoring program include PNC logging, passive seismic monitoring, integrated surface deformation monitoring, and time-lapse gravity surveys. These methodologies will be applied during both injection and post-injection phases of the project. The following table Table 2 summarizes the testing and monitoring activities planned for the post-injection phase.

Monitoring Category	Monitoring Method/Location	Frequency (Post-Injection Phase)	
	Fluid sampling in surficial aquifers: 10 local landowner wells and 1 project-drilled well	Every 5 yearsNone Planned	
Groundwater Quality and Geochemistry Monitoring	Fluid sampling in St. Peter: one lowermost USDW well	Geochemistry Every 5 years Continuous temperature and pressure monitoring	
	Fluid sampling in Ironton: two ACZ wells	Geochemistry Every 5 years Continuous temperature and pressure monitoring	
	Fluid sampling in Mount Simon: two single-level monitoring wells	Every 5 years	
Injection Zone Monitoring	Pulsed-neutron capture (PNC) logging at 3 RAT wells	Every 5 years	
	Pressure monitoring in Mount Simon: two single- level monitoring wells	Continuous	
	Integrated deformation monitoring: five surface monitoring stations	Continuous	
Indirect Geophysical Monitoring Techniques	Passive Passive seismic monitoring (microseismicity): five surface monitoring stations and downhole-deep microseismic arrays in two ACZ wells and five seismometers in shallow cased bore holes.	Continuous	Formatted: Font: 10 pt

Table 2. Summary of post-injection monitoring activities.

Groundwater Quality Monitoring

FutureGen will conduct groundwater sampling every 5 years according to the procedures described below, from Section 7.2.1 of the permit application.

Explicitly specify which specific parameters that will be analyzed. FutureGen is also lacking	Commented [TE8]: Groundwater sampling parameters.
specific details in its sampling methods, analytical techniques <mark>, laboratory information, and</mark>	Commented [TE9]: Request QASP.
guality assurance and surveillance measures. [Request from FutureGen.] 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 Quality Assurance and Surveillance Plan (QASP). See QASP Table A.2 for Monitoring Tasks, Methods, and Schedule. The information is summarized below.	
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). Surficial aquifer monitoring is not planned during the 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, and hydrogeochemical indicators of CO ₂ (Table 6) and brine composition. A comprehensive suite of geochemical and isotopic analysis will be performed on collected fluid samples and analytical results will be used.	Commented [TE10]: Specify or reference table 5.
to characterize baseline geochemistry and provide a metric for comparison during operational phases. Selection of this initial analyte list was based on relevance for detecting the presence of	
fugitive brine and CO ₂ . Results for this comprehensive set of analytes will be evaluated and a determination will be made regarding which analytes to carry forward through the operational	
phases of the project. This selection process will consider the uniqueness and signature strength of each potential analyte and whether their characteristics provide for a high-value leak-detection capability. Once baseline conditions have been established, observed differences in the	
geochemical and isotopic signature between the reservoir and overlying monitoring intervals, along with predictions of leakage-related pressure response, will be used to specify triggers values that would prompt further action, including a detailed evaluation of the observed response	
and possible modification of the monitoring approach and/or storage site operations. This evaluation will be supported by numerical modeling of theoretical leakage scenarios that will be used to evaluate leak-detection capability and interpret any observed pressure and/or	
geochemical/isotopic change in the ACZ wells.	
l arget parameters for the USDW and surficial aquifer wells include pressure, temperature, and hydrogeochemical indicators of CO_2 (Table 6) and brine composition. A comprehensive suite of	Commented [TE11]: Specify or include table for referenceor

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geochemical and isotopic analyses will be performed on collected fluid samples during the

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baseline monitoring period. Tables 7 and 8 in the FutureGen 2.0 Testing and Monitoring Plan respectively-list of the initial parameters to be sampled and analyzed, respectively. The selection of this initial analyte list was based on relevance for detecting the presence of fugitive brine and CO₂. Results for this comprehensive set of analytes will then be evaluated and a determination will be made regarding which analytes to carry forward through the operational phases of the project. This selection process will consider the uniqueness and signature strength of each potential analyte and whether their characteristics provide for a high–value leak-detection capability. Trigger values for the lowermost USDW monitoring well and the surficial aquifer monitoring wells have not been defined. 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 CO₂ transport between the Ironton and the St. Peter aquifers.

Note: FutureGen has **not yet submitted a final list of the planned parameters**; see the text above. In particular, aqueous and/or separate-phase CO₂ is not listed as a target parameter under consideration in these tables, and this should be discussed further. Depending on the final suite of parameters chosen, it may be appropriate to monitor for CO₂ indirectly, e.g., by monitoring dissolved inorganic carbon concentrations in combination with pH as recommended by researchers such as Wilkin and Digiulio (2010). However, this determination will need to be made after the final list of parameters is received. (Reference: Wilkin, R.T. and D.C. Digiulio, 2010. Geochemical Impacts to Groundwater from Geologic Carbon Sequestration: Controls on pH and Inorganic Carbon Concentrations from Reaction Path and Kinetic Modeling. Environ. Sci. Technol. 44(12): 4821-4827.)

Also, while the "ACZ - PISC" tab of the January 2014 spreadsheet indicates that FutureGen is planning to take samples from the surficial aquifers every five years, the "ACZ - Inj" tab indicates that FutureGen does not plan to take any samples from the surficial aquifers after the baseline period. This should be clarified.

Table 33. Sampling schedule for surficial aquifer monitoring wells.

Monitoring well name/location/map reference: Surficial aquifer monitoring wells 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	Every 5 yearsNone Planned			
Pressure	None Planned Every 5 years			
Temperature	None PlannedEvery 5 years			
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 PlannedEvery 5 years			

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Monitoring well name/location/map reference: One USDW monitoring well (see Figure 7) 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			

Table 44. Sampling schedule for the USDW monitoring well.

Temperature Continuous Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic Every 5 years carbon, total organic carbon, carbon and water isotopes, and radon

Table 55. Sampling schedule for ACZ monitoring wells.

Monitoring well name/location/map reference: Two ACZ monitoring wells (see Error! Reference source not found.7) 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			

Sampling methods:

SA sampling plan-procedures areis referenced discussed below, but not provided and specific details are provided in the FutureGen QASP Table A.2.

Specific field sampling protocols are in the project-specific sampling plan to be developed prior to initiation of field test operations, once the test design has been finalized. The work will comply with applicable U.S. Environmental Protection Agency (EPA) regulatory procedures and relevant American Society for Testing and Material ASTM International, IS and other procedural standards applicable for groundwater sampling and analysis. All sampling and analytical measurements will be performed in accordance with project quality assurance (QA) requirements, samples will be tracked using appropriately formatted chain-of-custody forms, and analytical results will be managed in accordance with a project-specific data management plan. Investigation-derived waste will be handled in accordance with site requirements.

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

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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 under consideration and groundwater sample collection requirements is provided in Table 6. The relative benefit of each analytical measurement will be evaluated throughout the design and initial injection testing phase of the project to identify the analytes best suited to meeting project monitoring objectives under site-specific conditions. If some analytical measurements are shown to be of limited use and/or cost prohibitive, they will be removed from the analyte list. 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). If implemented, monitoring for tracers will follow standard aqueous sampling protocols.

Sampling and analytical techniques for target parameters are given in Table 6 and Table 7, respectively.

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), HNO3 to pH ${<}2$	60 days
Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl	20-mL plastic vial	Filtered (0.45 μm), HNO3 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 μ m), 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)	250mL 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 ₂ SO ₄ to pH <2, Cool 4°C	28 days

Table 6. Aqueous sampling requirements for target parameters (adapted from Table 7 of FutureGen
Testing and Monitoring Plan permit application).

Volatile Organic Analysis (VOA)	Bottle set 1: 3-40_mL sterile clear glass vials	Zero headspace, Cool <6 °C, Clear glass vials will be UV-irradiated for additional sterilization	7 days
	Source Set 2: 3-40-mL sterile amber glass vials		
Methane	Bottle set 1: 3-40_mL sterile clear glass vials	Zero headspace, Cool <6 °C, Clear glass vials (bottle set 1) will be UV- irradiated for additional sterilization	7 days
	Bottle set 2: 3-40 <u>-</u> mL sterile amber glass vials		
Stable Carbon Isotopes $^{13/12}$ C (δ^{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 (δD) and ^{18/16} O (δ ¹⁸ O) of Water	60-mL plastic or glass	Filtered (0.45_µm), Cool 4°C	45 days
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 ₂ H ₆ , C ₃ H ₈ , iC ₄ H ₁₀ , nC ₄ H ₁₀ , iC ₅ H ₁₂ , nC ₅ H 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 polyethy	lene; PETE = polyethyler	ne terephthalate	
<u>HDPE = high_density</u> polyethylene; PETE = polyethylene terephthalate			
poryeuryrene terephthatate			

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
T race Metals: Sb, As, Ba, Cd, Cr, Cu, Pb, Hg, Sc, Tl	20-mL plastic vial	Filtered (0.45 μ m), HNO ₃ to pH <2	60 days
Anions: Cl ⁻ , Br ⁻ , F ⁻ , SO ₄ ²⁻ , NO ₃ ⁻ ,	20-mL plastic vial	Cool 4°C	4 5 days
Gravimetric Total Dissolved Solids (TDS), compare to TDS by calculation from major ions	250-mL plastic vial	Filtered (0.45 µm), no preservation Cool 4°C	-
Water Density	100 mL plastic vial	Filtered (0.45 μm), no preservation Cool 4°C	60 days
Alkalinity	100 mL HDPE	Filtered (0.45 µm) Cool 4°C	5 days
Dissolved Inorganic Carbon (DIC)	20-mL plastic vial	Cool 4°C	45 days
Total Organic Carbon (TOC)	40 mL glass	unfiltered	14 days
Carbon Isotopes (14C, 13/12C)	5-L HDPE	pH>6	14 days
Water Isotopes (214H, 18/16O)	20 mL glass vial	Cool 4°C	45 days
Radon (²²²Rn)	1.25 L PETE	Pre-concentrate into 20 mL scintillation cocktail. Maintain groundwater temperature prior to pre-concentration	1 day
Naphthalene Sulfonate or Fluorinated Benzoic Acid Tracers (aqueous phase)	500 mL HDPE	Filtered (0.45 µm), no preservation	60 days
Perfluorocarbon Tracer (PFT) (seCO ₂ -or gas phase)	500 mL glass	unfiltered, Cool 4°C	60 days
pH	Field parameter	None	< 1 h
Specific Conductance	Field parameter	None	<1-h
Temperature	Field parameter	None	< 1 h

HDPE = high_density_polyethylene; PETE = polyethylene terephthalate

 Monitoring Plan
 OASP).
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 Carbon analyzer, phosphoric acid digestion of TIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Dissolved Inorganic Carbon (DIC)	SW846 9060A or equivalent Carbon analyzer, phosphoric acid digestion of DIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Total Organic Carbon (TOC)	SW846 9060A or equivalent 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 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 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 Headspace GC/FID	10 μg/L	±20%	Blanks, LCS, spike, spike duplicates per batch of 20

		Detection	Typical	
Parameter	Analysis Method	Limit or Range	Precision/ Accuracy	QC Requirements
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%
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 ₂ O Laser	Range: - 500‰ to 200‰ vs. VSMOW	^{2/1} H: ±2.0‰ ^{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 ¹³ C: ±0.2‰	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 ₂ H ₆ , C ₃ H ₈ , iC ₄ H ₁₀ , nC ₄ H ₁₀ , iC ₅ H ₁₂ , nC ₃ H 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
рН	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

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si,	ICP OES, PNNL AGG- ICP-AES (similar to EPA Method 6010B)	0.1 to 1 mg/L (analyte dependent)	±10%	Daily calibration; blanks and duplicates and matrix spikes at 10% level per batch of 20

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
T race Metals: Sb, As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Tl	ICP MS, PNNL AGG 415 (similar to EPA Method 6020)	1 μg/L for trace elements	±10%-	Daily calibration; blanks and duplicates and matrix spikes at 10% level per batch of 20
Anions: Cl ⁻ , Br ⁻ , F ⁻ , SO4 ²⁻ , NO ₃ ⁻ , CO ₃ ²⁻	Ion Chromatography, AGG- IC-001 (based on EPA Method 300.0A)	-	±15%	Daily calibration; blanks and duplicates at 10% level per batch of 20
TDS	Gravimetric Method Standard Methods 2540C	12 mg/L	± 5%	Balance calibration, triplicate samples
Water Density	Standard Methods 227	0.0001 g/mL	±0.0%	Triplicate measurements
Alkalinity	Titration, standard methods 102	4-mg/L	±3 mg/L	Triplicate titrations
Dissolved Inorganic Carbon (DIC)	Carbon analyzer, phosphoric acid digestion of DIC	0.002%	±10%	Triplicate analyses, daily calibration
Total Organic Carbon (TOC)	Carbon analyzer; total carbon by 900°C pyrolysis minus DIC = TOC	0.002%	±10%	Triplicate analyses, daily calibration
Carbon Isotopes (^{14/12} C, ^{13/12} C)	Accelerator MS	10⁻¹⁵	- ±4‰ for ¹⁴C; ±0.2‰ for ¹³ C	Triplicate analyses
Water Isotopes (² H/ ¹ H, ^{18/16} O)	Water equilibration coupled with IRMS ; Alternatively, consider WS-CRDS	10.°	$\begin{array}{l} -IRMS:\pm1.0\% \ for \\ {}^{2}H;\pm0.15\% \ for {}^{48}O; \\ WS \ CRDS:\pm0.10\% \\ for {}^{2}H;\pm0.025\% \ for \\ {}^{48}O \end{array}$	Triplicate analyses
Radon (²²² Rn)	Liquid scintillation after pre-concentration	- 5 mBq/L	- <u>±10%</u>	Triplicate analyses
Naphthalene Sulfonate <u>or</u> Benzoic Acid Tracer (aqueous phase)	Liquid chromatography- mass spectrometry (LC-MS) or gas chromatography with electron capture detector (ECD)	$\frac{5 \text{ parts per}}{\text{trillion } (5 \times 10^{12})}$ $\underline{\text{or } 10 \text{ parts per}}{\text{quadrillion } (10 \times 10^{15})}$	Varies with conc.,±30% at detection limit	Duplicates 10% of samples, significant number of blanks for cross contamination
Perfluorocarbon Tracer (PFT) (scCO ₂ or gas phase)	Gas chromatography with electron capture detector (ECD)	10 parts per quadrillion (10 x 10 ¹⁵)	Varies with conc., ±30% at detection limit	Duplicates 10% of samples, significant number of blanks for cross-contamination
pH	pH electrode	2 to 12 pH units	±0.2 pH unit For indication only	User calibrate, follow manufacturer recommendations

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Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Specific conductance	Electrode	0 to 100 mS/cm	±1% of reading For indication only	User calibrate, follow manufacturer recommendations
Temperature	Thermocouple	5 to 50°C	±0.2°C For indication only	Factory calibration
ICP = inductively coupled plasma; IRMS = isotope ratio mass spectrometry; MS = mass spectrometry; OES = optical emission spectrometry; WS CRDS = wavelength scanned cavity ring down spectroscopy.				

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, flormation fluids, and pipeline fluid as well as environmental gas or air samples will conform to EPA guidance as discussed in Section B.1.3 of the FutureGen 2.0 QASP.

Detail in its description of laboratory and chain-of-custody procedures is limited. FutureGen should provide a more detailed Testing and Monitoring Plan containing this information. afRequest from FutureGen.

FutureGen Response: See FutureGen QASP Sections B.1.3, B.1.5 thru B.1.7.

Quality assurance and surveillance measures:

The Quality Assurance and Surveillance-QASP is incorporated as an attachment to the Testing and Monitoring Plan.

Data quality assuranceQA 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 Monitoring, Verification, and Accounting (MVA) program (e.g., pressure and aqueous concentration measurements). QA requirements for selected geophysical methods, which provide indirect measurements of CO₂ nature and extent will be performed based on best industry practices and the QA protocols recommended by the geophysical services contractors selected to perform the work.

FutureGen lacks detail in its description of quality assurance and surveillance protocols. [Request from FutureGen.]

Section B of the FutureGen QASP provides details of QA and surveillance protocols.

Plan for guaranteeing access to all monitoring locations:

The locations of the ACZ and USDW wells hasve been finalized, pending final signing of landowner agreements. For these wells, the land 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. Ten local landowners originally agreed to have their surficial aquifer wells sampled; one opted out during a recent sampling event.

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. Power for all monitoring wells will be provided by a stand-alone solar array with battery backup so that a dedicated power supply to these more distal locations is not required.

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), and 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

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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.

Once the reservoir model has been updated with detailed site_specific information from the injection site, predictive simulations of pressure response will be generated for each single level reservoir monitoringSLR well. These predicted responses will be compared to with monitoring results 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.

Direct pressure monitoring in the injection zone will take place as indicated in Table 8.

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

Well Location/Map Reference	Depth(s)/Formation(s)	Frequency (Post-Injection Phase)
Two single-level monitoring wells (SLR Wells 1 and 2, see Figure 7)	Mount Simon/4,150 ft.	Continuous

Quality assurance and surveillance measures:

Data quality assuranceQA and surveillance protocols adopted by the project will be 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 MVA program (e.g., pressure and aqueous concentration measurements) are covered in Sections 5.2.2 and 5.2.3 above. QA requirements for selected geophysical methods, which provide indirect measurements of CO₂ nature and extent and are being tested for their applicability under site conditions, are not addressed in this 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.

FutureGen is also lacking specific details in its quality assurance and surveillance measures. FutureGen should provide more detailed quality assurance and surveillance measures. [Request from FutureGen.]

FutureGen Response: See FutureGen QASP Section B.7.

Plan for guaranteeing access to all monitoring locations:

The location of these wells has been finalized, pending final signing of landowner agreements. The land will either be purchased or leased for the life of the project, so access will be secured.

Direct Geochemical Plume Monitoring

FutureGen will conduct direct CO₂ plume monitoring to meet the requirements of 40 CFR 146.93(b). Target parameters include pressure, temperature, and hydrogeochemical indicators of CO₂ and brine composition. A comprehensive suite of geochemical and isotopic analyses will be performed on collected fluid samples and analytical results will be used to characterize baseline geochemistry and provide a metric for comparison during operational phases. Selection of this initial analyte list was based on relevance for detecting the presence of CO_2 within the reservoir and fugitive brine and CO_2 above the primary confining zone. The results for this comprehensive set of analytes will be evaluated and a determination will be made regarding which analytes to carry forward through the operational phases of the project. This selection process will consider the uniqueness and signature strength of each potential analyte and whether their characteristics provide for a high-value leak--detection capability. Once baseline hydrogeochemical/isotopic conditions have been established and the reservoir model has been refined, predictive simulations of pressure and CO₂ arrival response will be generated for each SLR monitoring well. These predicted responses will be compared with monitoring results 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.

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.

Commented [TE13]: Specify or reference table.

Direct fluid sampling in the injection zone will take place as shown-indicated in Table 9.

Table 9	. Monitoring	schedule for	direct geochemical	plume monitoring.

Monitoring well name/location/map reference: Two SLR monitoring wells (see_Figure 7-) 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, general water-quality parameters (pH, alkalinity, total dissolved solids, specific gravity), and any tracers added to the CO ₂ stream	Every 5 years			

Sampling methods:

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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.

A sampling plan is referenced below, but not provided.

Periodically, fluid samples will be collected from the monitoring wells completed in the injection zone. 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). These types of pressurized sampling methods are needed to collect the two-phase fluids (i.e., aqueous and scCO₂ solutions) for measurement of the percent of water and CO₂ present at the monitoring location. Fluid samples will be analyzed for parameters that are indicators of CO₂ dissolution, including major cations and anions, selected metals, general waterquality parameters (pH, alkalinity, TDS, specific gravity), and any tracers added to the CO2 stream. Changes in major ion and trace element geochemistry are expected in the injection zone, but the arrival of proposed fluorocarbon or sulfonate tracers (co-injected with the CO₂) should provide an improved early-detection capability, because these compounds can be detected at 3 to 5 orders of magnitude lower relative concentration. 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 CO₂ 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 techniques for target parameters are given-listed in Table 10 and Table 11, respectively.

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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), HNO3 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 ₂ SO ₄ to pH <2, Cool 4°C	28 days
Total Organic Carbon (TOC)	250-mL amber glass	Unfiltered, H ₂ SO ₄ to pH <2, Cool 4°C	28 days
Dissolved Organic Carbon (DOC)	125-mL plastic vial	Filtered (0.45 μm), H ₂ SO ₄ to pH <2, Cool 4°C	28 days
Volatile Organic Analysis (VOA)	Bottle set 1: 3-40-mL sterile clear glass vials 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 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 (δ^{13} C) of DIC in Water	60-mL plastic or glass	Filtered (0.45-µm), Cool 4°C	14 days

Table 10. Aqueous sampling requirements for target parameters (adapted from Table 5.4 of FutureGen's permit application).

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} Η (δD) and ^{18/16} O (δ ¹⁸ O) of Water	60-mL plastic or glass	Filtered (0.45-µm), Cool 4°C	45 days
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, CH4, 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 polyethy	lene; PETE = polyethyler	e terephthalate	

Table 11. Analytical requirements (adapted from Table 5.5 of FutureGen's permit application).

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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 Carbon analyzer, phosphoric acid digestion of TIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Dissolved Inorganic Carbon (DIC)	SW846 9060A or equivalent Carbon analyzer, phosphoric acid digestion of DIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Total Organic Carbon (TOC)	SW846 9060A or equivalent 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 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 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 Headspace GC/FID	10 µg/L	±20%	Blanks, LCS, spike, spike duplicates per batch of 20

		Detection	Typical	
Parameter	Analysis Method	Limit or Range	Precision/ Accuracy	QC Requirements
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%
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 ₂ O Laser	Range: - 500‰ to 200‰ vs. VSMOW	^{2/1} H: ±2.0‰ ^{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 ¹³ C: ±0.2‰ ^{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 ₂ H ₆ , C ₃ H ₈ , iC ₄ H ₁₀ , nC ₄ H ₁₀ , iC ₅ H ₁₂ , nC ₃ H 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
рН	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

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si,	ICP OES, PNNL-AGG- ICP AES (similar to EPA Method 6010B)	0.1 to 1 mg/L (analyte dependent)	±10%	Daily calibration; blanks and duplicates and matrix spikes at 10% level per batch of 20

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
T race Metals: Sb, As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Tl	ICP MS, PNNL AGG 415 (similar to EPA Method 6020)	1 μg/L for trace elements	±10%-	Daily calibration; blanks and duplicates and matrix spikes at 10% level per batch of 20
Anions: Cl ⁻ , Br ⁻ , F ⁻ , SO4 ²⁻ , NO ₃ ⁻ , CO ₃ ²⁻	$\begin{array}{c} \begin{array}{c} \text{ons: Cl}^{-}, \text{Br}^{-}, \text{F}^{-}, \\ \hline 12^{+}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \end{array} \begin{array}{c} \begin{array}{c} \text{Ion-Chromatography, AGG-} \\ \hline 12^{-}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \begin{array}{c} \begin{array}{c} \text{Ion-Chromatography, AGG-} \\ \hline 12^{-}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \end{array} \begin{array}{c} \begin{array}{c} \text{Ion-Chromatography, AGG-} \\ \hline 12^{-}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \begin{array}{c} \begin{array}{c} \text{Ion-Chromatography, AGG-} \\ \hline 12^{-}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \end{array} \begin{array}{c} \begin{array}{c} \text{Ion-Chromatography, AGG-} \\ \hline 12^{-}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \end{array} \begin{array}{c} \begin{array}{c} \text{Ion-Chromatography, AGG-} \\ \hline 12^{-}, \text{NO}_3^{-}, \text{CO}_3^{-2} \end{array} \end{array} \end{array}$		Daily calibration; blanks and duplicates at 10% level per batch of 20	
TDS	Gravimetric Method Standard Methods 2540C	12 mg/L	± 5%	Balance calibration, triplicate samples
Water Density	Standard Methods 227	0.0001-g/mL	±0.0%	Triplicate measurements
Alkalinity	Titration, standard methods 102	4-mg/L	±3 mg/L	Triplicate titrations
Dissolved Inorganic Carbon (DIC)	Carbon analyzer, phosphoric acid digestion of DIC	0.002%	±10%	Triplicate analyses, daily calibration
Total Organic Carbon (TOC)	Carbon analyzer; total carbon by 900°C pyrolysis minus DIC = TOC	0.002%	±10%	Triplicate analyses, daily calibration
Carbon Isotopes (^{14/12} C, ^{13/12} C)	Accelerator MS	$\frac{10^{-15}}{\pm 0.2\% \text{ for}^{-14}\text{C};}$		Triplicate analyses
Water Isotopes (² H/ ⁴ H, ^{18/16} O)	Water equilibration coupled with IRMS ; Alternatively, consider WS-CRDS	10. 9	-IRMS: ±1.0% for ² H; ±0.15% for ¹⁸ O; WS-CRDS: ±0.10% for ² H; ±0.025% for ¹⁸ O	Triplicate analyses
Radon (²²² Rn)	Liquid scintillation after pre-concentration	-5 mBq/L	- <u>±10%</u> -	Triplicate analyses
Naphthalene Sulfonate <u>or</u> Benzoic Acid Tracer (aqueous phase)	Liquid chromatography- mass spectrometry (LC-MS) or gas chromatography with electron capture detector (ECD)	$\frac{5 \text{ parts per}}{\text{trillion } (5 \times 10^{12})}$ $\frac{\text{or } 10 \text{ parts per}}{\text{quadrillion } (10 \times 10^{15})}$	Varies with conc.,±30% at detection limit	Duplicates 10% of samples, significant number of blanks for cross-contamination
Perfluorocarbon Tracer (PFT) (scCO2 or gas phase)	Gas chromatography with electron capture detector (ECD)	10 parts per quadrillion (10 x 10 ¹⁵)	Varies with conc., ±30% at detection limit	Duplicates 10% of samples, significant number of blanks for cross-contamination
рН	pH electrode	2 to 12 pH units	±0.2 pH unit For indication only	User calibrate, follow manufacturer recommendations

Parameter	Analysis Method	Detection Limit or Range Typical Precision/ Accuracy		QC Requirements	
Specific conductance	Electrode	0 to 100 mS/cm	±1% of reading For indication only	User calibrate, follow manufacturer recommendations	
Temperature	Thermocouple	5 to 50°C	±0.2°€ For indication only	Factory calibration	
ICP = inductively coupled plasma; IRMS = isotope ratio mass spectrometry; MS = mass spectrometry;					

ICP = inductively coupled plasma; IRMS = isotope ratio mass spectrometry; MS = mass spectrometry; OES = optical emission spectrometry; WS-CRDS = wavelength scanned eavity ring-down spectroscopy

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

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

[Not specified.]

Quality assurance and surveillance measures:

Quality QA and surveillance protocols to be followed during the post-injection period are specified in the FutureGen QASP.

Data quality assuranceQA and surveillance protocols adopted by the project **will be 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 MVA program (e.g., pressure and aqueous concentration measurements) are covered in Sections 5.2.2 and 5.2.3 above. QA requirements for selected geophysical methods, which provide indirect measurements of CO₂ nature and extent will be performed based on best industry practices and the QA protocols recommended by the geophysical services contractors selected to perform the work.

Plan for guaranteeing access to all monitoring locations:

The location of these wells has been finalized, pending final signing of landowner agreements. The land will either be purchased or leased for the life of the project, so access will be secured.

Indirect Carbon Dioxide Plume and Pressure-Front Tracking

FutureGen will track the carbon dioxideCO₂ plume and pressure front to meet the requirements of 40 CFR 146.93(b).

The frequency of indirect plume and pressure-front monitoring activities during the postinjection phase, based on the information submitted in January 2014, is given in Table 12.

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

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

The coordinates of the monitoring wells/stations are provided in Attachment C.

Integrated deformation monitoring

Integrated deformation monitoring integrates ground data from permanent Global Positioning System (GPS) stations, 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 **Error! Reference** source not found.



Figure <u>10</u>12. Collocated Microseismic and Integrated Surface Deformation Monitoring Stations.

Passive seismic monitoring (microseismicity)

Note: Some of this information may need to be included in the Emergency and Remedial Response Plan instead of or in addition to the Testing and Monitoring Plan.

The objective of the microseismic monitoring network (Figure 7; downhole arrays will also be installed at the two ACZ wells) is to accurately determine the locations, magnitudes, and focal mechanisms of 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 seismic events, and 3) identifying features that may indicate areas of caprock failure and possible containment loss. Once a seismic event has been identified, a decision must be made regarding the level of impact a given event could have on storage site operations and what the response will be. This decision and response framework will consist of an automated event location and magnitude determination, followed by an alert for a technical review in order to reduce the likelihood of false positives. Identification of events with sufficient magnitude or that are located in a sensitive area (caprock) will be used as input for decisions that guide the adaptive strategy. Seismic events that affect the operations of CO_2 injection can be divided into two groups/tiers:- 1) events that create felt seismicity at the surface and may lead to public concern or structural damage, and 2) events not included in group one, but that might indicate failure or impending failure of the caprock. The operational protocol for responding to events in group one (Tier I) will follow a "traffic light" approach (modified after Zoback 2012; National Research Council 2012) that uses three operational states:

- 1. Green: Continue normal operations unless injection-related seismicity is observed with magnitudes greater than M_=_2.
- 2. Yellow: Injection-related seismic events are observed with magnitude 2 < M < 4. The injection rate will be slowed and the relationship between rate and seismicity will be studied to guide mitigation procedures, including reduced operational flow rates.
- 3. Red: Magnitude 4 or greater seismic events. Injection operations will stop and an evaluation will be performed to determine the source and cause of the ground motion.

Tier II operational responses to an event or collection of events that indicate possible failure of the primary confining zone may include initiation of supplemental adaptive monitoring activities, injection rate reduction in one or more injection laterals, or pressure reduction using brine extraction wells.

Proposed Schedule for Submitting Post-Injection Monitoring Results

FutureGen will submit monitoring reports annually.

During the PISCpost injection site care period, monitoring reports will be prepared and submitted to the EPA Region 5 UIC office annually. PISCost injection site care monitoring reports will be submitted within 90 days of completion of field work associated with the monitoring event. 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. Monitoring reports will include appropriate sampling records, laboratory analysis, and field data.

From Draft UIC Program Guidance on Class VI Well Plugging, Post-Injection Site Care, and Site Closure:

The EPA requests that the following information be submitted with all reports:

- a list of all monitoring events that have taken place during the reporting period and all monitoring dates
- identification of any data gaps
- identification of any changes to the monitoring program during the reporting period (e.g., drilling of new monitoring wells, closure of monitoring wells)
- presentation, synthesis, and interpretation of the entire historical data set of monitoring results, with respect to any change in risk of endangerment to USDWs
- any necessary changes to the project PISC and Site Closure Plan to continue protection of USDWs
- for groundwater geochemistry monitoring using wells: the most recent and up-to-date historical database of all groundwater monitoring results and Quality Assurance/Quality Control (QA/QC) monitoring results
- interpretation of any changing trends and evaluation of fluid leakage and migration, including uncertainty analysis (if appropriate). This may include graphs of relevant trends and interpretive diagrams (e.g., Piper and Stiff diagrams)
- a map showing all monitoring wells and indicating wells that are believed to be in the location of the separate-phase carbon dioxide plume
- an evaluation of data quality for each sampling event
- copies of all laboratory analytical reports
- records of calibration of all field instrumentation
- a description of all sampling equipment and sampling methods used
- sample chain-of-custody records
- the name and contact information for the EPA-certified laboratory conducting the analysis
- documentation of the monitoring well construction specifications (or reference to previously submitted documentation), sampling procedure, laboratory analytical procedure, and QA/QC standards
- for groundwater pressure monitoring: measured depth to fluid, or pressure transducer readings in all wells, fluid density, and fluid temperature
- if using pressure transducers, records of the most recent calibration or verification of the measurement instruments

- records of the surveying of wellhead and measurement point elevations (or reference to previously submitted documentation)
- measured pressure in all wells
- time-series graphs and pressure or head maps used in interpretation of pressure data
- for geophysical surveys: a description and technical justification of all survey techniques and methodologies used (or reference to previously submitted documentation)
- a map showing the location of all survey equipment positions during the test
- maps showing the interpreted location of separate-phase CO₂ in the injection zone and its location in any additional zones in which it was detected using geophysical surveys.

The PISCpost injection site care monitoring plan will be reviewed prior to cessation of injection operations. Monitoring and operational results will be reviewed for adequacy in relation to objectives of the PISCpost injection site care monitoring. The monitoring locations, methods, and schedule will be analyzed in relation to the size of the CO₂ storage zone, pressure front, and protection of USDWs. If the PISCpost injection site care plan changes, a modified plan will be submitted to the EPA Region 5 UIC Branch Office_for approval within 30 days of implementing the changes in the field.

The PISC plan will be reviewed every 5 years during the PISC period. 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 CO₂ storage zone, pressure front, and protection of USDWs. In case of change to the PISC plan, a modified plan will be submitted to the EPA Region 5 UIC Branch Office for approval within 30 days of making of the changes.

Table 13. 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

Alternative Post-Injection Site Care Time Frame

FutureGen is not requesting an alternative PISC time frame.

Non-Endangerment Demonstration Criteria

During the PISC, the owner or operator may submit a demonstration of non-endangerment of USDWs to reduce the initial permitted PISC monitoring time_frame. EPA suggestions for non-endangerment demonstrations begin on page 41 of the guidance and include the following:

-3.3.1 Summary of Existing Monitoring Data

3.3.2 Comparison of Monitoring Data and Model Predictions and Model Documentation

3.3.3 Evaluation of Carbon Dioxide Plume

3.3.4 Evaluation of Mobilized Fluids

3.3.5 Evaluation of Reservoir Pressure

3.3.6 Evaluation of Potential Conduits for Fluid Movement.

Site Closure Plan

1

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 PISCpost-injection site care 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 (http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx). 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.

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
- records reflecting the nature, composition, and volume of the CO₂ 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 is used for CO₂ storage
- the name of the Illinois and local agencies and the EPA Region 5 Branch_Office to which the survey plat was submitted
- the volume of fluid injected, the injection zone, and the period over which injection occurred.

PISCost injection site care 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.

Planned Remedial/Site Restoration Activities

1

At the end of the PISCpost injection site care phase, FutureGen will ensure the site is reclaimed and returned to predevelopment development 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 PISCpost injection site care phase. The surface facilities at the storage site will include the Site Control Building and the WAPMMS (Well Annular Pressure Maintenance and Monitoring 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 WAPMMS 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 WAPMMS Building and the Site Control Building will be converted to an exterior wall. The injection wells will be plugged and capped below grade (see Chapter 6.0). The gravel pad will be removed. The WAPMMS 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.

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All surface facilities will be removed at the end of the PISCpost injection site care phase. These facilities will include the WAPMMS 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 to predevelopment-development condition.

Plugging the Monitoring Wells

FutureGen will plug the monitoring wells to meet the requirements of 40 CFR 146.93(e). There are two types of well completion designs being considered: one with a perforated-cased horizontal lateral, the other with an open, uncased horizontal lateral. The FutureGen monitoring well design includes five deep monitoring wells and three deep RAT wells, as listed in Table 14. Monitoring well construction and plugging schematics showing the depth to tubing stub, exposed formation intervals, casing diameters, casing depths, depths to USDWs, and the placement of all plugs are presented for each well type in Attachment D.

Table 14. --Planned monitoring wells within the FutureGen site network.

	Single-Level In- Reservoir (SLR)	Above Confining Zone (ACZ)	USDW	Reservoir Access Tube (RAT)
# of Wells	2	2	1	3
Total Depth (ft)	4,150	3,470	2,000	4,465
Monitored Zone	Mount Simon SS	Ironton SS	St. Peter SS	Mount Simon SS
Monitoring Instrumentation	Fiber-optic P/T (tubing conveyed) ^b ; P/T/SpC probe in monitored interval ^(a)	Fiber-optic (microseismic) cable cemented in annulus; P/T/SpC probe in monitored interval ^(a)	P/T/SpC probe in monitored interval ^(a)	Pulsed-neutron logging equipment

(a) The P/T/SpC (pressure, temperature, specific conductance) probe is an electronic downhole multiparameter probe incorporating sensors for measuring fluid P/T/SpC within the monitored interval. This probe may also be configured with sensors to measure pH and Eh. The probe is installed inside tubing string, which is perforated (slotted) over the monitoring interval. Sensor signals are multiplexed to a surface data logger through a single conductor wireline cable.

(b) Fiber-optic cable attached to the outside of the tubing string, in the annular space between the tubing and casing.

SS = sandstone.

Since FutureGen did not propose performing regular MIT tests of the monitoring wells, we should verify whether they will perform one on the monitoring wells before plugging.

Upon site-conclusion of the post-operations monitoring 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 Attachment E). All deep monitoring wells at the site will

be plugged to prevent any upward migration of the CO_2 or formation fluids to USDWs. Each of the deep monitoring wells will be plugged and abandoned using best practices to prevent-and communication of fluids between the injection zone and the USDWs. The deep monitoring wells in the injection interval have a direct connection between the injection formation and ground surface. The well-plugging program will be 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 CO₂-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_seismie-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 have be inscribed with the well identification number and the date of plug and abandonment_inscribed on it.

Soil will be backfilled around the well to bring the area around the well back to pre-wellinstallation grade. Any remaining surface faciliites 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.

Each injection well casing will be plugged with cement and 6 percent water gel spacers to ensure that the well does not provide a conduit from the injection zone to the USDW zone or ground surface. As mentioned above, two types of well completion designs are being considered: one with a perforated cased horizontal lateral, the other with an open, uncased horizontal lateral. The procedures for plugging and abandoning both types of horizontal CO₂ injection wells are very similar, whether they are a cased and perforated completion or an open hole completion. However, cement volumes will differ depending upon the total depth and horizontal length of the well. Table 6.1 summarizes the plugging plans for each type of well completion and describes intervals that will be plugged and the materials and methods that will be used to plug the intervals.

For both well completion designs, the portion of the well corresponding to the injection zone will be plugged using CO₂-resistant cement with a retainer method. Class A well cements are formulated in accordance with API Specification 10A (API 2010) standards and are similar to

ASTM Type I Portland cements (ASTM C465, ASTM 2010). CO₂-resistant cement is formulated with the addition of pozzalan or other materials that reduce production of calcium hydroxide and calcium silicate hydrate, that weaken cements in the presence of CO₂. The cement retainer will be set at a depth of 3,900 ft, at the contact between the Eau Claire Formation and the Mount Simon Sandstone, and will be constructed of corrosion resistant materials. Depending upon the horizontal length and well construction, approximately 450 to 1,475 sacks of CO₂-resistant cement will be used to plug the injection interval (this includes a 10 percent excess volume to be squeezed through the perforations into the Mount Simon Sandstone).

The pressure used to squeeze the cement will be determined from the bottom hole pressure data measured before beginning the plugging and abandonment process. However, the injection pressure of the cement will not exceed the fracture pressure of the Mount Simon Sandstone. If it appears that the injection pressure will exceed the fracture pressure and the total amount of eement has not been pumped into the injection zone, cement pumping will cease and the tubing will be removed from the cement retainer to allow the pressure to return to static conditions. After allowing the pressure to reduce, the tubing will be re-strung through the cement retainer and cement pumping will be attempted again. A rapid increase in pressure on the tubing would indicate that the perforations have been sealed with cement, and no additional cement will be added to the zone or plug.

After the remainder of the casing has been filled with cement, the casing sections will be cut off approximately 5 ft bgs, and a steel cap will be welded to the top of the deep casing string. The eap will have the well identification number, the UIC Class VI permit number, and the date of plug and abandonment inscribed on it. Soil will be backfilled around the well to bring the area around the well back to pre-well-installation grade. This area will then be planted with natural vegetation.

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 well.

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

Plugging the Verification Well

Information on Plugs:							
	Plug	Plug	Plug	Plug	Plug	Plug	Plug
-	#1	#2	#3	#4	#5	#6	#7
Diameter of Boring in Which Plug							
Will be Placed	-	-	-	-	-	-	-

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Depth to Bottom of Tubing or							
Drill Pipe	-	-	-	-	-	-	-
Sacks of Cement to be Used (each							
plug)	-	-	-	-	-	-	-
Slurry Volume to be Pumped	-	-	-	-	-	-	-
Slurry Weight	-	-	-	-	-	-	-
Top of Plug	-	-	-	-	-	-	-
Bottom of Plug	-	-	-	-	-	-	-
Type of Cement or Other Material	-	-	-	-	-	-	-
Method of Emplacement (e.g.,							
balance method, retainer method,							
or two-plug method)	-	-	-	-	-	-	-

Attachments:

Injection well construction plan/schematics showing depth to tubing stub, exposed formation intervals, casing diameters, depths, etc.

Information on formations, depths to USDWs, etc.

Schematic/drawings of the placement of all plugs.

Tests or Measures to Determine Bottom-Hole Pressure

Bottom hole pressure measurements will be used to determine the pressure required to squeeze the cement from the well casing into the injection reservoir. In addition, these data will be used to determine the need for well control equipment. The weight of brine required to prevent the well from flowing will be calculated using this information. The pressure measurements will also be used to determine the formulation of cement to be used to plug the well (i.e., cement setting retardants may need to be added to the cement to prevent premature setting and curing of the cement).

Bottom hole pressure measurements will be performed and recorded throughout the duration of the project. Pressure gauges will be placed in the injection tubing or within the deep casing string within the injection zone, and these pressure measurement devices will allow for continuous, real-time, surface readout of the pressure data. The bottom hole reservoir pressure will be obtained using the final measurements from the pressure gauges in the injection zone after the injection of CO₂. After the bottom hole pressure is determined, a buffered fluid (brine) will be used to flush and fill each well to maintain pressure control of the well. The bottom hole pressure will be used to stabilize each well.

Injection Well Testing to Ensure Mechanical Integrity

The mechanical integrity of each well must be demonstrated after CO₂ injection and prior to the plugging of the well to ensure conduits between the injection zone and the USDWs or ground surface have not developed. External mechanical integrity will be evaluated by performing temperature logging on the injection well..

The temperature log will be run over the entire depth of each injection well. Data from the logging run will be evaluated for anomalies in the temperature curve, which would be indicative of fluid migration outside of the injection zone. These data will also be compared to data from the logs performed prior to injection of CO₂ into the well. Deviations between the temperature logs performed before and after the injection of CO₂ may indicate issues related to the integrity of the well casing or cement.

Plugging Plan

Each injection well casing will be plugged with cement and 6 percent water gel spacers to ensure that the well does not provide a conduit from the injection zone to the USDW zone or ground surface. Two types of well completion designs are being considered: one with a perforated cased horizontal lateral, the other with an open, uncased horizontal lateral. The procedures for plugging and abandoning both types of horizontal CO₂ injection wells are very similar, whether they are a cased and perforated completion or an open hole completion. However, cement volumes will differ depending upon the total depth and horizontal length of the well.

For both well completion designs, the portion of the well corresponding to the injection zone will be plugged using CO₂-resistant cement with a retainer method. Class A well cements are formulated in accordance with API Specification 10A (API 2010) standards and are similar to ASTM Type I Portland cements (ASTM C465, ASTM 2010). CO₂-resistant cement is formulated with the addition of pozzalan or other materials that reduce production of calcium hydroxide and calcium silicate hydrate, that weaken cements in the presence of CO₂. The cement retainer will be set at a depth of 3,900 ft, at the contact between the Eau Claire Formation and the Mount Simon Sandstone, and will be constructed of corrosion resistant materials. Depending upon the horizontal length and well construction, approximately 450 to 1,475 sacks of CO₂-resistant cement will be used to plug the injection interval (this includes a 10 percent excess volume to be squeezed through the perforations into the Mount Simon Sandstone).

The pressure used to squeeze the cement will be determined from the bottom hole pressure data measured before beginning the plugging and abandonment process. However, the injection pressure of the cement will not exceed the fracture pressure of the Mount Simon Sandstone. If it appears that the injection pressure will exceed the fracture pressure and the total amount of cement has not been pumped into the injection zone, cement pumping will cease and the tubing will be removed from the cement retainer to allow the pressure to return to static conditions. After allowing the pressure to reduce, the tubing will be re-strung through the cement retainer and cement pumping will be attempted again. A rapid increase in pressure on the tubing would indicate that the perforations have been sealed with cement, and no additional cement will be added to the zone or plug.

After the remainder of the casing has been filled with cement, the casing sections will be cut off approximately 5 ft bgs, and a steel cap will be welded to the top of the deep casing string. The eap will have the well identification number, the UIC Class VI permit number, and the date of plug and abandonment inscribed on it. Soil will be backfilled around the well to bring the area around the well back to pre-well-installation grade. This area will then be planted with natural vegetation.

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 well.

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

Plugging the Geophysical Wells:

See P&A Plans.

Tests or Measures to Determine Bottom-Hole Pressure

Bottom hole pressure measurements will be used to determine the pressure required to squeeze the cement from the well casing into the injection reservoir. In addition, these data will be used to determine the need for well control equipment. The weight of brine required to prevent the well from flowing will be calculated using this information. The pressure measurements will also be used to determine the formulation of cement to be used to plug the well (i.e., cement-setting retardants may need to be added to the cement to prevent premature setting and curing of the cement).

Bottom hole pressure measurements will be performed and recorded throughout the duration of the project. Pressure gauges will be placed in the injection tubing or within the deep casing string within the injection zone, and these pressure measurement devices will allow for continuous, real-time, surface readout of the pressure data. The bottom hole reservoir pressure will be obtained using the final measurements from the pressure gauges in the injection zone after the injection of CO₂. After the bottom hole pressure is determined, a buffered fluid (brine) will be used to flush and fill each well to maintain pressure control of the well. The bottom hole pressure will be used to stabilize each well.

Injection Well Testing to Ensure Mechanical Integrity

Post-Injection Site Care and Site Closure Plan for FutureGen 2.0 Alliance Preliminary draft – do not distribute **Commented [TE15]:** Cite location or include P&A Plans...and plug to surface.

The mechanical integrity of each well must be demonstrated after CO₂ injection and prior to the plugging of the well to ensure conduits between the injection zone and the USDWs or ground surface have not developed. External mechanical integrity will be evaluated by performing temperature logging on the injection well, as described in Section 5.3.2.

The temperature log will be run over the entire depth of each injection well. Data from the logging run will be evaluated for anomalies in the temperature curve, which would be indicative of fluid migration outside of the injection zone. These data will also be compared to data from the logs performed prior to injection of CO₂ into the well. Deviations between the temperature logs performed before and after the injection of CO₂ may indicate issues related to the integrity of the well casing or cement.

Plugging Plan

The FutureGen microseismic<u>seismie</u> 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 Error! Reference source not found..



Figure 8. . Diagram of Microseismic and Tiltmeter Wells After Plugging and Abandonment

Upon conclusion of the post-operations monitoring period, all geophysical wells will be plugged and capped below grade in accordance with the approved monitoring well Plugging and Abandonment Plans (see Attachment E). All downhole instrumentation will be removed and

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each injection-microseismic_well casing and tiltmeter well casing will be plugged with cement and 6 percent water gel spacers-to ensure that the well does not provide a conduit from-to the injection zone-shallow to the-USDW zone or ground surface. As discussed in Chapter 4.0, two types of well completion designs are being considered: one with a perforated-cased horizontal lateral, the other with an open, uncased horizontal lateral_. The procedures for plugging and abandoning both types of horizontal CO₂-injection-wells are very similar, whether they are a eased and perforated completion or an open-hole completion. However, cement volumes will differ depending upon the total depth and horizontal length-of the well.

For both well-completion designs, the portion of the well corresponding to the injection zone will be plugged using CO₂-resistant cement with a retainer method. cClass A well cement_will be s are formulated in accordance with API Specification 10A (API 2010) standards and are similar to ASTM Type I Portland cements (ASTM C465, ASTM 2010). CO₂-resistant cement is formulated with the addition of pozzalan or other materials that reduce production of calcium hydroxide and calcium silicate hydrate, that weaken cements in the presence of CO₂. The cement retainer will be set at a depth of 3,900 ft, at the contact between the Eau Claire Formation and the Mount Simon Sandstone, and will be constructed of corrosion resistant materials. Depending upon the horizontal length and well construction, approximately 450 to 1,475 sacks of CO₂-resistant cement will be used to plug the injection interval (this includes a 10 percent excess volume to be squeezed through the perforations into the Mount Simon Sandstone), 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 pressure used to squeeze the cement will be determined from the bottom hole pressure data measured before beginning the plugging and abandonment process. However, the injection pressure of the cement will not exceed the fracture pressure of the Mount Simon Sandstone. If it appears that the injection pressure will exceed the fracture pressure and the total amount of cement has not been pumped into the injection zone, cement pumping will cease and the tubing will be removed from the cement retainer to allow the pressure to return to static conditions. After allowing the pressure to reduce, the tubing will be re-strung through the cement retainer and cement pumping will be attempted again. A rapid increase in pressure on the tubing would indicate that the perforations have been sealed with cement, and no additional cement will be added to the zone or plug.

After the remainder of the casing has been filled with cement, the casing sections will be cut off approximately 5 ft bgs, and a steel cap will be welded to the top of the deep casing string. The cap will have be inscribed with the well identification number, the UIC Class VI permit number, and the date of plug and abandonment-inscribed on it.

Soil will be backfilled around the well to bring the area around the well back to pre-wellinstallation grade. This area will then be planted with natural vegetation. Any remaining surface facilities associated with the geophysical monitoring station will be reclaimed and the area will be returned to predevelopment condition. All gravel pads, cement surface pads, instrumentation

vaults, GPS monuments, access roads, and surface facilities will be removed, and the land will be reclaimed for agricultural or other beneficial pre-construction uses.

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 well.

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

Attachment A

Locations of the Deep Monitoring Wells

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

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Attachment B

Location of Surficial Aquifer Monitoring Wells

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

Attachment C

Locations of Microseismic Monitoring Stations and Integrated Deformation Stations

Well ID/Station ID	Well/Station Type	Latitude (WGS84)	Longitude (WGS84)
MS1	 Microseismic monitoring Station 1(shallow borehole) Integrated deformation monitoring station 	39.8110768	-90.09797015
MS2	 Microseismic monitoring Station 2 (shallow borehole) Integrated deformation monitoring station 	39.78547402	-90.05028403
MS3	 Microseismic monitoring Station 3 (shallow borehole) Integrated deformation monitoring station 	39.81193502	-90.06016279
MS4	 Microseismic monitoring Station 4 (shallow borehole) Integrated deformation monitoring station 	39.78558513	-90.09557015
MS5	 Microseismic monitoring Station 5 (shallow borehole) 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

Attachment D

1

Planned Construction Design and Plugging and Abandonment Plan Diagrams for Deep Monitoring Wells and Reservoir Access Tube Wells



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


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

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Constructed Well

monitoring wells.



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





Attachment 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 attachment:

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

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IC* IC* <thic*< th=""> <thic*< th=""> <thic*< th=""></thic*<></thic*<></thic*<>	24" 140	0-150		150			30)"	<u></u> тh	e Dump Baile	er Method		
10-3.100 13.100 14.75" Other 5-1/2" 10 0.3.470 3.470 9.5" 5.5"	16" 84	0-600		600			20)"	Th	e Two-Plug N	lethod		
CEMENTING TO FLUG AND ABANDON DATA: PLUG # PL	10-3/4 51	0-3,100		3.100			14	£"	Oth	ner			
Lementine for Los Barabarabarabarabarabarabarabarabarabara	05-1/2 1/	TO BLUG AND		13,470		DI 110	<u>у</u> ,	J	DI 110 #2	DI 110 #4	DI 110 #E	DI 110 #0	BLUG #7
Action of tubing or profile Pipe (ft) 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,200 3,350 3,200 3,200 4 5 4 5	Size of Hole or Bine in y	which Blue Mil	I Be Placed (inche		PL0G /	1	5 5"	FLUG #3	PLUG #4	PLUG #8	PLUG #6	PLOG #7
Saks 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.) 33,350 3,200 0 Messured Top of Plug (ft.) 33,350 3,200 0 Slurry WL (Lb./Gal.) 15,82 15,82 15,6 Type Cement or Other Material (Class III) EverCreft EverCreft Class A LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS WHERE CASING WILL BE VARIED (if any) From To From To 3,470' 13,350' (perforated) Image: Casing A and a	Depth to Bottom of Tub	ing or Drill Pit	pe íft			3.470'	-	3 350	3.200				
Slurry Volume To Be Pumped (cu, ft.) 68 2.5 52.8 Image: Constraint of the provided in theprovided in the provided in theprovided in	Sacks of Cement To Be	Used (each plu	lg)			61		22	447				
Calculated Top of Plug (ft.) 3,350 3,200 0 Image: Calculated Top of Plug (ft.) Measured Top of Plug (ft.) 3,350 3,200 0 Image: Calculated Top of Plug (ft.) Measured Top of Plug (ft.) 3,350 3,200 0 Image: Calculated Top Plug (ft.) Measured Top of Plug (ft.) 15,82 15,82 15,82 Image: Calculated Top Plug (ft.) Type Cament or Other Material (Class III) EverCret EverCret Class A Image: Calculated Top Plug (ft.) LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (ff any) To Image: Calculated Top Plug (ft.) <	Slurry Volume To Be Pu	mped (cu. ft.)				68		25	528				
Measured Top of Plug (if tagged ft.) 3.350 3.200 0 0 Slurry WL (Lb/Gal.) 15.62 15.62 15.6 0 Type Cement or Other Material (Class III) EverCret EverCret Class A 0 LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any) To 70 70 3.470' 3.350' (spretrated) 0 0 0 0 3.400' 13.420' (screened) 0 0 0 0 Estimated Cost to Plug Wells Statchmets and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is tub, accurate, and complete. Jum avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (Please type or print) Signature Date Signed Name and Official Title (Please type or print) Signature Mate Signed 03/03/2014 03/03/2014	Calculated Top of Plug (ft.)				3,350		3,200	0				
Slurry Wt. (Lb./Gal.) 15.82 15.82 15.6 Type Cement of Other Material (Class III) EverCreft Class A Image: Class A LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any) Image: Class A Image: Class A Image: Class A IST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any) To Image: Class A Image: Class A IST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any) To Image: Class A Image: Class	Measured Top of Plug (if	f tagged ft.)				3,350		3,200	0				
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 3.470' 3.350' (perforated)	Slurry Wt. (Lb./Gal.)					15.82		15.82	15.6				
LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any) From To 3,470' 3,330' (perforated)	Type Cement or Other M	laterial (Class	III)			EverCr	ret	EverCret	Class A				
From To From To 3,470' (3,350' (perforated)	LIS	T ALL OPEN H	OLE AND/OR	PERFORAT	ED INTE	RVALS A	AND I	NTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	ny)	
3.470' 3.350' (perforated) 3.400' 3.420' (screened) 3.400' 3.420' (screened) Estimated Cost to Plug Wells Std29,480 Certification I certify under the penalty of law that I have personally examined and an 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 an avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (<i>Please type or prim</i>) Signature Date Signed Kenneth K. Humphreys, Chief Executive Officer Kautt H. Humpthraya Date Signed	From			Τo					From			То	
3.400' 3.420' (screened) Estimated Cost o Plug Wells S429,480 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. Jam aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (Please type or prim) Signature Kenneth K. Humphreys, Chief Executive Officer Kauth H. Humpfung Date Signed	3.470'		3,350' (per	forated)									
Estimated Cost to Plug Wells S429,480 Certification I certify under the penalty of law that I have personally examined and an 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 avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (<i>Please type or primp</i> Kenneth K. Humphreys, Chief Executive Officer	3,400'		3,420' (scr	eened)									
Estimated Cost to Plug Wells S429,480 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 avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (<i>Please type or primg</i> Kenneth K. Humphreys, Chief Executive Officer Signature Kenneth K. Humphreys, Chief Executive Officer						_	-						
S429,480 Certification I certify under the penalty of law that I have personally examined and an 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 an avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (<i>Please type or print</i>) Kenneth K. Humphreys, Chief Executive Officer Date Signed 03/03/2014	Estimated Cost to Plug	Malls											
Certification I certify under the penalty of law that I have personally examined and an 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 an avare that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR 144.32) Name and Official Title (<i>Please type or print</i>) Signature Date Signed 03/03/2014	\$429,480												
Name and Official Title (Please type or print) Signature Kenneth K. Humphreys, Chief Executive Officer Signature	l certify under the attachments and t information is tru- possibility of fine	penalty of law that, based on e, accurate, ar and imprison	v that I have p I my inquiry o nd complete. ment. (Ref. 4	ersonally e f those indi I am aware 0 CFR 144∂	(examine i viduals e that the 32)	Certific d and am immedia ere are si	catio fam ately ignifi	DN iliar with th responsible cant penalt	e informatio e for obtainin ies for subm	n submitted ng the inform itting false i	in this docur nation, I belic nformation, i	nent and all eve that the ncluding the	•
Kenneth K. Humphreys, Chief Executive Officer Kuell H. Hunghreys 03/03/2014	Name and Official Title	(Please type o	or print)		Sign	ature				·		Date Signed	
	Kenneth K. Humphre	Kenneth K. Humphreys, Chief Executive Officer							H. H.	undre	Y s	03/03/2014	

					OM	/IB No. 2040-	0042 Ap	oroval Expire	s 11/30/2014		
\$€PA	United States Environmental Protection Agency Washington, DC 20460 PLUGGING AND ABANDONMENT PLAN me and Address of Facility Iname and Address of Owner/Operator										
	PLUGG	ING AN	D AB	ANDO	оимі	ENT PL	AN				
Name and Address of Facility				Name ar	nd Addr	ess of Owne	/Operator				
RAT1 Well, FutureGen 2.0, Morg	an County, IL			Future 73 Ce	Gen Al ntral Pa	liance irk Plaza Ea	st, Jackson	ille, IL 626	50		
Locate Well and Outline Unit on Section Plat - 640 Acres		State Illinois			M	ounty Lorgan		Permiti	lumber		
N		Surface	Location I	Descript	ior						
		se 1/4	of SW 1/	4 of SW	1/4 of	SW 1/4 of	Section 26	Township	l6n Range	9w	
▋ ┝╶┽╼┝╸┽╼┣╶┽╼╿		Locate w	ell in two	directio	ns from	nearest line	s of quarter	section and	drilling unit		
		Surface									
	-	Location	ft. fi	rm (N/S)	Lir	ne of quarter	section				
│ ┝╶┽╼┝╴┽ ╼┠╶ ┽╼╏	-+-	and	ft. from (E/W)	Line o	of quarter se	ction.				
			TYPE OF	AUTHO	RIZATIO	N		WELL A	CTIVITY		
		✓ Ind	ividual Pe	erm it			CLAS	IS I			
▌▕⊢┽╼┝╴┽╼┠╶┽╼╏		Are	a Permit				CLAS	65 II			
┃ ┝╶╅╼┝╴┽╼┣╶╅╼┢		Rul	e					rine Disposa	u		
	i I	Numbe	r of Wells	1			님택	nhanced Re	covery		
			Hydrocarbon Storage								
								55 111			
5		Lease Na	ume				Well Num	per			
CASING AND TUE	CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF CEMENT PLUGS										
SIZE WT (LB/FT) TO BE PUT I	N WELL (FT) TO	BE LEFT IN W	ELL (FT)	HOLE	E SIZE	The The	e Balance Me	thod			
20" 94 0-150	150)		26"		Птр	Dump Baile	r Method			
13-3/8 61 0-600	600)		17.5"	'	The The	• Two-Plug N	lethod			
9-5/8" 36 0-3,450	3.4	50		12.25	577	🗌 otł	ier -				
4-1/2" 10.5 0-4,465	4,4	65	7.875"								
CEMENTING TO PLUG AND	ABANDON DATA:		PLUG #	¥1 PL	UG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7	
Size of Hole or Pipe in which Plug Wi	II Be Placed (inche	9	4.5"	4.5	"						
Depth to Bottom of Tubing or Drill Pip	pe (ft		4,440'	3,4	50'						
Sacks of Cement To Be Used (each plu	ng)		79	262	2						
Slurry Volume To Be Pumped (cu. ft.)			89	309	9						
Calculated Top of Plug (ft.)			3,450'	0'							
Reasured Top of Plug (if tagged ft.)			3,450'	0'	/						
Type Cement or Other Material (Class	IID		EverCi	at C1s	o acc A						
	OLE AND/OR PERI		ERVALSA		RVALS	WHERE CAS		VARIED (if a	nw)		
From		To			ITTALU	From		TAIGED (II a	To		
Estimated Cost to Plug Wells										_	
\$308,830											
I certify under the penalty of lav attachments and that, based on information is true, accurate, ar possibility of fine and imprison	v that I have perso I my inquiry of tho nd complete. I am ment. (Ref. 40 CF	nally examine se individual: aware that th R 144.32)	Certific ed and am s immedia here are si	cation familiar ately resp ignifican	r with th ponsible it penalt	e informatio e for obtaini ies for subm	n submitted ng the inform itting false i	in this docur ation, I belie nformation, i	nent and all we that the ncluding the	à	
Name and Official Title (Please type of	or print)	Sia	nature						Date Signed	1	
Kenneth K. Humphreys, Chief Exe	ecutive Officer		Knett H. Hunghays 03/03/2014				1				

				10	/IB No. 2040-	0042 Ap	oroval Expire	s 11/30/2014			
\$€PA	United States Environmental Protection Agency Washington, Dc 20460 PLUGGING AND ABANDONMENT PLAN me and Address of Facility Name and Address of Owner/Operator										
	PLUGGIN	g ane	D ABA	ANDONM	ENT PL	AN					
Name and Address of Facility				Name and Addr	ess of Owne	r/Operator					
RAT2 Well, FutureGen 2.0, Morg	an County, IL			FutureGen Al 73 Central Pa	liance irk Plaza Ea	ist, Jacksonv	ville, IL 626	50			
Locate Well and Outline Unit on Section Plat - 640 Acres	5	State Illinois		C c	ounty Lorgan		Permit	Number			
N	5	Surface Lo	cation D	escriptior							
		nw 1/4 of	SW 1/4	of SW 1/4 of	SW 1/4 of	Section 36	Township	16n Range	9w		
▋ ┝─┽─┝─┽─┣╶┽─┆	- <u>+</u> - [ocate we	ll in two	directions from	nearest line	es of quarter	section and	drilling unit			
▋└┶┶┶┻┷╛	!	Surface									
	- u	ocation	ft. fr	m (N/S) Lii	ne of quarter	section					
▋ ┝╴┽╼┝╴┽╼┣╴┽╼╏		and fi	t. from (E	E/W) Line (of quarter se	ction.					
	 ∎ Г	1	TYPE OF	AUTHORIZATIO	N	_	WELL A	CTIVITY			
	i_[Indivi	idual Per	rm it		CLAS	6S I				
	<u> </u>	Area	Permit				SS II				
┃ ┝┽╾┝┽╾┣╺╅╾╽	-+-	Rule					irine Dispos:	al			
▌┢╋╅╼┝╴┽╼┣╴┽╼┆		Number	of Wells	1		L He	lydrocarbon	Storage			
						CLAS	, 55 III	J.			
S		oaco Nam				Woll Num	hor				
				wen Num							
CASING AND TO	SING RECORD AFTER P	LUGGING		I			ACEMENTO	FCEMENTPI	LUGS		
SIZE WT (LB/FT) TO BE PUT I	NWELL (FT) TO BE LI	EFT IN WE	LL (FT)	HOLE SIZE	Th 🗹	e Balance Me	thod				
20" 94 0-150	150			17.5"		e Dump Baile	er Method				
0.5/8" 36 0.3.450	2 450		12.25" Other								
4-1/2" 10.5 0-4.465	4.465			7 875"	L Of	ner					
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 Wi	Il Be Placed (inche		4.5"	4.5"							
Depth to Bottom of Tubing or Drill Pi	pe (ft		4,440'	3,450'							
Sacks of Cement To Be Used (each pl	nd)		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	111)		EverCr	et [Class A							
LIST ALL OPEN H	OLE AND/OR PERFORA	TED INTER	RVALS A	ND INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	iny) T-			
From	To.		-		From			10			
			—H								
Estimated Cost to Plug Wells											
\$308,830											
l certify under the penalty of la attachments and that, based or information is true, accurate, a possibility of fine and imprison	v that I have personally I my inquiry of those in Id complete. I am awar ment. (Ref. 40 CFR 144	examined dividuals i rethatthe 1.32)	ertific and am immediat rearesi	ation familiar with th tely responsible gnificant penalt	e informatio e for obtaini ies for subm	n submitted ng the infom itting false i	in this docur nation, I belie nformation, i	nent and all eve that the including the	9		
Name and Official Title (Please type of	or print)	Signa	ature	/	/			Date Signed			
Kenneth K. Humphreys, Chief Ex-	ecutive Officer	Knell H. Hundreys 03/03/2014				1					

						ON	/IB No. 2040-	0042 Ap	oroval Expire	s 11/30/2014	
€EDΩ		United S	itates En Was	ivironm hingtor	ental Protec 1, DC 20460	tion /	Agency				
	PLU	GGING	AND	D AB	ANDO	١MI	ENT PL	AN			
Name and Address of Facility					Name and	Addr	ess of Owne	r/Operator			
RAT3 Well, FutureGen 2.0, Morg	an County, II	L			FutureGe 73 Centr	n Al al Pa	liance irk Plaza Ea	ist, Jackson	ville, IL 626	50	
Locate Well and Outline Unit on		St	ate			Co	ounty		Permit	Number	
Section Plat - 640 Acres		n	linois			M	lorgan				
N		Su	irface Lo	ocation	Descriptior		_				-
		se	1/4 01	f ne 1/	4 of <u>ne</u> 1/	4 of	se 1/4 of	Section 34	Township	16n Range	9₩
╎─┾╶┨╾┾╶┥╾┾╶┥	-+-	Lo	cate we	ll in two	directions	from	nearest line	es of quarter	section and	drilling unit	
· ┝-╅-┝-┽-┣-╅-┟		Su	Irface	_	_	_					
	i I	Lo	cation	ft. f	rm (N/S)	_Lir	ne of quarter	section			
		an	id f	t. from (E/W)l	ine c	of quarter se	ction.			
w tit tit tit tit tit tit tit til tit tit			7	TYPE OI	FAUTHORIZ	ATIO	N		WELL /	ACTIVITY	
· ┝-ᆧ─┝-┽─┣-╃─┞	_⊥ (+)			Permit	ermit				55 I 29 II		
	! Y	l l ř	Rule	i cinic					rine Dispos	al	
	-+-		- Iture		1				nhanced Re	covery	
· ┝-┽-┝-┽-┣-┽-┞		1	Number	of Wells	;			L D.	lydrocarbon	Storage	
				_				CLA	65 III		
S		Le	ase Nam	ne				Well Num	ber		
CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF CEMENT PLUGS											
SIZE WT (LB/FT) TO BE PUT IN WELL (FT) TO BE LEFT IN WELL (FT) HOLE SIZE											
20" 94 0-150		150			26"		🗌 🔲 ты	e Dump Baile	er Method		
13-3/8 61 0-600		600			17.5"		Th	e Two-Plug N	lethod		
9-5/8" 36 0-3,450		3,450			12.25"		🗌 🗌 Otł	ner			
4-1/2" 10.5 0-4,465		4,465			7.875"						
CEMENTING TO PLUG AND	ABANDON DA	TA:		PLUG	#1 PLUG	#2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of Hole or Pipe in which Plug Wi	II Be Placed (i	inche		4.5"	4.5"	_					
Depth to Bottom of Tubing or Drill Pip	pe (π			4,440'	3,450						
Slurry Volume To Be Pumped (cu. ft.)	18)			79	300	_					
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)			EverC	ret Class	А					
LIST ALL OPEN H	OLE AND/OR	PERFORATE	ED INTE	RVALS	AND INTERV	ALS	WHERE CAS	ING WILL BE	VARIED (if a	uny)	•
From		Τo					From			То	
						_					
\$308,830											
I certify under the penalty of lav attachments and that, based on information is true, accurate, ar possibility of fine and imprison	v that I have p my inquiry of nd complete. ment. (Ref. 4)	ersonally e f those indi I am aware 0 CFR 144.3	C x amined viduals that the 32)	ertific and an immedia ere are s	cation familiar wi ately respon ignificant p	ith th nsible enalt	e informatio e for obtainin ies for subm	n submitted ng the infom itting false i	in this docu ation, I beli nformation,	nent and all eve that the including the	ð
Name and Official Title (Rieses type of	r arinti		Sign	ature						Date Signed	1
Kenneth K. Humphreys, Chief Exe	cutive Office	er		K	utt	Ħ.	Hun	ducy	4	03/03/2014	1
EPA Form 7520-14 (Poul 12-11)			-								

						01	MB No. 2040-	0042 Ap	proval Expire	s 11/30/2014	
United States Environmental Protection Agency Washington, DC 20460 PLUGGING AND ABANDONMENT PLAN											
⇒EPA	PLU	IGGING	3 AN	D AB	A١	DONM	ENT PL	AN			
Name and Address of Facility					Nai	me and Addr	ess of Owne	r/Operator			
Well SLR1, FutureGen 2.0, Morga	in County, I	L			Ft 7:	atureGen Al 3 Central Pa	liance ark Plaza Ea	ıst, Jackson	ville, IL 626	50	
Locate Well and Outline Unit on		S	tate			C	ounty		Permit	Number	
Section Plat - 640 Acres		1	llinois			N	lorgan				
N		S	urface L	ocation	Des	criptior					0
		s	W 1/4 c	of SW 1	4 of	SW 1/4 of	SW 1/4 of	Section 26	Township	16n Range	9w
╏ ┝╌┽ ─┝╴┽ ─┣╶┽━┞		L	ocate w	ell in two	dir	ections from	nearest line	es of quarter	section and	drilling unit	
│		s	urface								
	i I	L	ocation	ft. 1	'rm ([N/S) Li	ne of quarter	section			
╽╴┝╴┽╼┝╴┽╼ ┠ ╶┽╼┟	-+-	a	nd	ft. from	E/W	() Line	of quarter se	ction.			
				TYPE O	FAU	THORIZATIO	N	_	WELL A	CTIVITY	
			🖌 Indi	vidual P	erm i	it		CLA	SS I		
		i	Area	Permit					55 II Nime Biener		
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╽╴┝╶┽╼┝╴┽╼┣╴┽╼┞	_ <u>↓</u> _		Number	of Wells	<u>1</u>			1 83	innanceu Re	Storage	
	!							CLA	55 III	otorage	
s			ease Nai	me				Well Num	ber		
CASING AND TUE	ING RECORD	AFTER PL	UGGING	;			METH	OD OF EMPL	ACEMENT O	F C EMENT PI	LUGS
SIZE WT (LB/FT) TO BE PUT IN WELL (FT) TO BE LEFT IN WELL (FT) HOLE SIZE											
20" 94 0-150		150			12	26"		e Dump Baile	er Method		
13-3/8 61 0-600		600			1	.7.5"	The Two-Plug Method				
9-5/8" 36 0-3.450		3,450	12.25"			Other					
5-1/2" 17 0-4,150		4,150			8	3''					
CEMENTING TO PLUG AND	ABANDON DA	ATA:		PLUG	#1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of Hole or Pipe in which Plug Wil	I Be Placed (inche		5-1/2"		5-1/2"					
Depth to Bottom of Tubing or Drill Pip	e (ft			4,150'	_	3,500'					
Sacks of Cement To Be Used (each plu	ig)			78	_	388					
Siurry volume to Be Pumped (cu. ft.)				8/	_	458					
Measured Top of Plug (if tagged ft)				3,500'	-	0					
Slurny Wt. (Lb/Gal.)				15.82	-	15.6					1
Type Cement or Other Material (Class I	11)			EverC	ret	Class A					
LIST ALL OPEN H	OLE AND/OR	PERFORAT	ED INTE	RVALS	AND	INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	inv)	
From		To					From	T		To	
4000'	4100' (per	forated and	l fractur	ed)							
Estimated Cost to Plug Wells					_						
\$536,600											
I certify under the penalty of law attachments and that, based on information is true, accurate, ar possibility of fine and imprisoni	/ that I have p my inquiry o id complete. nent. (Ref. 4	oersonally of those ind I am aware IO CFR 144.	ex amine i viduals e that th 32)	d and an immedi ere are s	cat n far ately igni	İON niliar with th y responsibl ficant penalt	e informatio e for obtainin ties for subm	n submitted ng the inforn itting false i	in this docur nation, I belio nformation, i	nent and all eve that the including the	•
Name and Official Title (Pipese type o	r arinfl		Sign	nature						Date Signed	
Kenneth K. Humphreys, Chief Exe	Kenneth K. Humphreys, Chief Executive Officer Knett th. Humphreys 03/03/2014										
EBA Form 7520-14 (Poul 12-11)	A Form 7520-14 (Rev. 12-11)										

					10	/IB No. 2040⊣	0042 App	oroval Expire	s 11/30/2014		
United States Environmental Protection Agency Washington, DC 20460 PLUGGING AND ABANDONMENT PLAN											
- EPA	PLUG	GING A		AN	DONM	ENT PL	AN				
Name and Address of Facility				Nam	ne and Addr	ess of Owner	/Operator				
Well SLR2, FutureGen 2.0, Morga	in County, IL			Fu 73	tureGen Al Central Pa	liance irk Plaza Ea	st, Jackson	ville, IL 626	50		
Locate Well and Outline Unit on		State			Co	ounty		Permit	Number		
Section Plat - 640 Acres		Illin	01 S		N	lorgan					
N		Surfa	ce Location	Desc	riptior	_				0	
		IIW -	1/4 of ne 1	/4 of	ne_1/4 of	se 1/4 of	Section 25	Township	16fi Range	9₩	
┝┽╌┝┽╼┣╶┽╾╎		Locat	e well in two	o dire	ctions from	nearest line	s of quarter	section and	drilling unit		
○ ┝-╅ ─┝ -┽─┣-╅─┟		Surfa	ce								
	i	Locat	ion ft. f	frm (f	1/S) Lii	ne of quarter	section				
		and	ft. from	(E/W)		of quarter se	ction.	MELL (OTIVITY		
w	±		I TFE O	erm it	INORIZATIO	N		WELL /	CONTRACT OF T		
╷┝┽╌┝┽╼┣┽╌┆	<u>- Y</u>	- 1日2	Area Permit	ernin			CLAS	55 II			
			Rule					rine Dispos:	al		
				1	_			nhanced Re	covery		
│		Num	iber of wells	5			H	lydrocarbon	Storage		
							CLAS	55 III			
S		Lease	Name				Well Num	ber			
CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF CEMENT PLUGS											
SIZE WT (LB/FT) TO BE PUT IN WELL (FT) TO BE LEFT IN WELL (FT) HOLE SIZE											
24" 140 0-132	1	132		3	0"	🗌 🗌 The	e Dump Baile	er Method			
16" 84 0-556	2	556		20)''	The	e Two-Plug №	lethod			
10-3/4 51 0-3.934		3.934		1.	4.75"	Oth Oth	ier				
7	2	4,150		9	.5"						
CEMENTING TO PLUG AND	ABANDON DAT	A:	PLUG	#1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7	
Depth to Bottom of Tubing or Drill Pir	i Be Placed (in	cne	4.150'	-	3.500!						
Sacks of Cement To Be Used (each plu	(n)		124		619						
Slurry Volume To Be Pumped (cu. ft.)	- 37		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)		EverC	ret	Class A						
LIST ALL OPEN H	OLE AND/OR PE	ERFORATED I	INTERVALS	AND	INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	uny)		
From		То				From			То		
4000'	4100' (perfor	ated and fra	ctured)								
				-							
Estimated Cost to Plug Wells											
\$571,600											
l certify under the penalty of law attachments and that, based on information is true, accurate, ar possibility of fine and imprison	/ that I have per my inquiry of 1 id complete. I nent. (Ref. 40	rsonally exam those individu am aware tha CFR 144.32)	Certifi nined and an uals immedi at there are s	cati n fam ately signif	ON Illar with th responsible icant penalt	e information e for obtainir ies for subm	n submitted ng the inform itting false i	in this docur nation, I beli nformation, i	nent and all ave that the including the	9	
Name and Official Title (Riesee free o	r arinfi		Signature					T	Date Signed	1	
Kenneth K. Humphreys, Chief Exe	cutive Officer	·]	riginature K	m	tt 7	l. Hu	ndue	r.s	03/03/2014	1	
A Form 7520-14 (Rev. 12-11)											

					01	MB No. 2040-	0042 Ap	proval Expire	es 11/30/2014		
.≎.EPA		United Stat	tes Environm Washingto	n, D	al Protection C 20460	Agency					
WEFA	PLU	GGING A	AND AE	A	NDONM	ENT PL	AN				
Name and Address of Facility				Na	me and Addr	ess of Owne	r/Operator				
Well USDW1, FutureGen 2.0, Mo	rgan County,	IL		Fi 7	utureGen Al '3 Central Pa	liance ark Plaza Ea	ist, Jackson	ville, IL 626	50		
Locate Well and Outline Unit on		State			C	ounty		Permit	Number		
Section Plat - 640 Acres		Illin	lois		N	forgan					
N		Surfa	ace Location	Des	scriptior	_					
		SW	1/4 of SW 1	/4 01	f <u>SW</u> 1/4 of	se 1/4 of	Section 26	Township	16n Range	9w	
│ ┝─┽ ─ ┝─┽ ─ ┣╶┽─╏		Loca	te well in tw	o dir	rections from	nearest line	es of quarter	section and	drilling unit		
│		Surfa	ice								
	i I	Loca	tion ft.	frm	(N/S)Li	ne of quarter	section				
│ ┝╶┽─┝─┽─┣╶┽─¦	-+-	and	ft. from	(E/V	V) Line	of quarter se	ction.				
			TYPE C	OF AU	UTHORIZATIO	N		WELL /	ACTIVITY		
│			Individual P	erm	it			SS I			
			Area Permit					55 II Irina Dienae	al		
▎▕⊢┽╼┝╴┽╼ ┠ ╶┽╼╽	-+-		. are	4			首に	nhanced Re	coverv		
│ ┝┽╌┝┽╌┣┽╌╿		Nu	mber of Well	s 1			L Hig	lvdrocarbon	Storage		
			_				CLA	, 55 III			
s		Leas	e Nam e				Well Num	ber			
CASING AND TUE	ING RECORD	AFTER PLUG	GING			METH	OD OF EMPL	ACEMENT O	F CEMENT PI	LUGS	
SIZE WT (LB/FT) TO BE PUT IN WELL (FT) TO BE LEFT IN WELL (FT) HOLE SIZE											
16" 55 0-150		150			20"	Птр	e Dump Baile	er Method			
10-3/4 40.5 0-600		600		1	14.75"	Птр	e Two-Plug N	lethod			
5-1/2" 17 0-2,000		2.000			9.5"	Otł	ner				
CEMENTING TO PLUG AND	ABANDON DA	TA:	PLUG	#1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7	
Size of Hole or Pipe in which Plug Wi	ll Be Placed (ii	nche	9.5"		5.5"						
Depth to Bottom of Tubing or Drill Pip	pe (ft		2,000	,	1,880'						
Sacks of Cement To Be Used (each plu	1g)		56		209						
Slurry Volume To Be Pumped (cu. ft.)			63		246						
Calculated Top of Plug (ft.)			1,880	,	0						
Slume M(t (b (Gal))			1,000	_	15.6						
Type Cement or Other Material (Class	00		Class	Δ	Class A						
	OLE AND/OP	PERFORATED	INTERVALS	AND		WHERE CAS		VARIED (if a	unv)		
From		To		T		From	1		To		
2.000'	1,880' (perf	orated)									
1,930'	1,950' (scre	ened)									
Estimated Cost to Plug Wells											
\$319,000											
l certify under the penalty of law attachments and that, based on information is true, accurate, ar possibility of fine and imprison	v that I have po my inquiry of nd complete. I ment. (Ref. 40	ersonally exa those individ am aware th CFR 144.32)	Certifi mined and a luals immed at there are	icat m fai iatel sign	tion miliar with th y responsibl ificant penal	e informatio e for obtainin ties for subm	n submitted ng the inforn itting false i	in this docu nation, I beli nformation,	nent and all eve that the including the	9	
Name and Official Title (Please type of	r arinfl		Signature						Date Signed	1	
Kenneth K. Humphreys, Chief Exe	cutive Office	ar	K	'an	itt n	. Hur	udury	A	03/03/2014	1	
EPA Form 7520-14 (Rev. 12-11)	Enm 75/0.14 (Bau 12.11)										

							ON	/IB No. 2040-	0042 Ap	oroval Expire	s 11/30/2014	
			United St	tates Er Wa	nvironme shington	ental F I, DC :	rotection / 20460	Agency				
SELLA		PLU	IGGING	ANI	D AB	ANI	ооли	ENT PL	AN			
Name and Address of Fac	sility					Name	and Addr	ess of Owne	r/Operator			
Well MS1, FutureGen	2.0, Morgan	n County, IL				Futa 73	ireGen Al Central Pa	liance rk Plaza Ea	ist, Jackson	ville, IL 626	50	
Locate Well and Ou	itline Unit on		Sta T11	nte linois			Co	unty		Permit	Number	
Section Plat - 640 Ac	res		50	rface L	ocation	Descr	intior	.orgun				
	N		se	1/4 0	f se 1/	4 of 1	ne 1/4 of	nw 1/4 of	Section 27	Township	16n Range	9w
▌┝∔₋⊢∔₋	.L∔_i	_ <u>i_</u>	Lo	cate we	ell in two	dired	tions from	nearest line	s of quarter	section and	drilling unit	
	<u>ሐ !</u> !	!	Su	rface								
	Ţ + - !	-+-	Lo	cation	ft, f	rm (N		ne of quarter	section			
▋┣╀╼┝╌┽╼	╺┠╴┽╼┞	-+-	an	d	ft. from (E/W)	Line	f quarter se	ction.			
					TYPE OF	AUTI	HORIZATIO	N	1	WELL A	CTIVITY	
W		E I	,	Indiv	/idual Pe	erm it			CLA	6S I		
┃ ┝┽╾┝┽╸	╺┠╴┽╼┝	-+-		Area	Permit				CLA	65 II		
▋┝╅╼┝┽╸	┉╷┙			Rule	•					rine Dispos	al	
				lumber	of Wollo	1	-		- E	nhanced Re	covery	
▋╞┽╼┝┽╸	╺┠╴┽╼┟	-+-	"	umber	or weirs				_□•	lydrocarbon	Storage	
Liii										65 III		
	S		Le	ase Nar	ne				Well Num	ber		
CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF CEMENT PLUGS												
SIZE WT (LB/FT)	TO BE PUT IN	WELL (FT)	TO BE LEF	T IN WE	ELL (FT)	н	DLE SIZE	🗹 Th	e Balance Me	thod		
13-3/8 54	0-130		130			17	.5"	The	e Dump Baile	er Method		
7-5/8 26.4	0-350		350			11	.5"	The	e Two-Plug N	lethod		
								Other Other	ner			
CEMENTING	TO PLUG AND	ABANDON DA	ATA:		PLUG #	¥1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of Hole or Pipe in w	hich Plug Wil	ll Be Placed (inche		7-5/8''							
Depth to Bottom of Tubir	ng or Drill Pip	e (ft			330							
Sacks of Cement To Be U	Ised (each plu	1g)			74	-						
Slurry Volume to Be Pun Colouisted Ten of Blue (f	nped (cu. π.)				87	-						
Calculated Top of Plug (F	t.)				0	-						
Slurp()Mt (Lb /Gal.)					15.6	-						
Type Cement or Other Ma	terial (Class	un			Clase /							
LIST	ALL OPEN H	OLE AND/OR	PERFORATE	D INTE	RVALS A		TERVALS	WHERE CAS	ING WILL BE	VARIED (if a	uny)	
From			To					From	T	(To	
Estimated Cost to Plug V	Vells											
\$25,000												
				(Certific	atio	n					
I certify under the	penalty of law	v that I have r	ersonaliv e	aminea	d and am	ı fami	liar with th	e informatio	n submitted	in this docur	nent and all	
attachments and th	nat, based on	my inquiry o	f those indiv	viduals	immedia	ately r	esponsible	for obtainin	ng the inform	ation, I beli	eve that the	
information is true possibliity of fine a	, accurate, ar and imprison	nd complete. ment. (Ref 4	l am aware 0 CFR 144 3	that the 2)	ere are si	ignifi	ant penalt	ies for subm	itting false i	nformation, i	including the	•
possionly of file of				-,						,	B-4- C'	
Name and Official Title (ame and Official Title (Please type or print) Signature Date Signed											
Kenneth K. Humphrey	s, Chief Exe	ecutive Offic	er		K	un	H K	Hur	gluey	~	03/03/2014	1
				-				/	-			

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.≎,EPA	Vinited States Environmental Protection Agency Washington, Dc 20460 PLUGGING AND ABANDONMENT PLAN										
	PLUGG	ING AN	D AB/	ANDONM	ENT PL	AN					
Name and Address of Facility				Name and Add	ress of Owne	r/Operator					
Well MS2, FutureGen 2.0, Morga	in County, IL			FutureGen A 73 Central P	lliance ark Plaza Ea	ast, Jackson	ville, IL 626	50			
Locate Well and Outline Unit or	ı	State		C	ounty		Permit	Number			
Section Plat - 640 Acres		Surface	l ocation [Description	rongun						
N		SW 1/4	of SW 1/4	4 of SW 1/4 of	SW 1/4 of	Section 31	Township	16n Range	9w		
┨┝┽╌┝┽╌┠┽╌	È-∔-	Locate w	vell in two	directions from	n nearest line	es of quarter	section and	drilling unit			
▌┝╅╍┝╅╼┣╅╸	i⊢ -i l	Surface									
	; ; [Location	ft. fi	rm (N/S)Li	ne of quarter	section					
▋▕⊢┽╼┝╴┽╼┣╴┽╼	<u> -+- </u>	and	ft. from (E/W) Line	of quarter se	ction.					
			TYPE OF	AUTHORIZATIC	iN		WELL /	CTIVITY			
		🗹 Indi	ividual Pe	erm it		CLA	5S I				
▋▕⊢┽╾┝╌┽╼┣╴┽╼╵	<u>├-┽- </u>	Are	a Permit			CLA	65 II				
▌▕└╶┵─┝─┽─┣╺┽─╵	╘┷╼╿	🗌 Rul	e			E	Brine Dispos	al			
		Number		1		- E	nhanced Re	covery			
▋ ┝╴┽╼┝╴┽╼┣╴┽╼		Numbe	r or wells	<u> </u>		F	lydrocarbon	Storage			
			_			CLA	55 III				
S S		Lease Na	Lease Name			Well Number					
CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF C											
SIZE WT (LB/FT) TO BE PUT I	IN WELL (FT) TO	BE LEFT IN W	ELL (FT)	HOLE SIZE	Гл	e Balance Me	thod				
13-3/8 54 0-130	130)		17.5"	1 8	o Dumn Raik	or Mothed				
7-5/8 26.4 0-350	350)	11.5"			The Two-Plug Method					
					Other						
						ler					
CEMENTING TO PLUG AND	ABANDON DATA		PLUG #	1 PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7		
Rize of Hole or Rize in which Blug W	ill Bo Blacod (inche		7 2/01	1 1 200 #2	1 200 #0	1 200 #4	1200 #0	1200 #0	1200 #1		
Depth to Bottom of Tubing or Drill Bi	ine (ff		330	_							
Sacks of Cement To Be Used (each pl	lua)		74								
Slurry Volume To Be Pumped (cu. ft.)	a)		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	: 111)		Class 4								
LIST ALL OPEN H	HOLE AND/OR PERF	ORATED INT	ERVALS A	ND INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	iny)			
From	1	То	T		From	T	(··· ·	To			
Estimated Cost to Plug Wells											
\$25,000											
l certify under the penalty of la attachments and that, based of information is true, accurate, a possibility of fine and imprisor	w that I have perso n my inquiry of the ind complete. I am iment. (Ref. 40 CF	nally examine se individuals aware that th R 144.32)	Certific ed and am s immedia here are si	cation familiar with th ttely responsibl gnificant penal	ne informatio e for obtainin ties for subm	n submitted ng the infom nitting false i	in this docu nation, I beli nformation,	nent and all ave that the including the	3		
Name and Official Title (Please type	or print)	Sig	nature					Date Signed			
Kenneth K. Humphreys, Chief Ex	ecutive Officer		Knett H. Hungburgs 03/03/2014					1			

				(MB No. 2040-	0042 App	oroval Expire	s 11/30/2014		
United States Environmental Protection Agency Washington, Dc 20460 PLUGGING AND ABANDONMENT PLAN										
	PLUGGI	NG AN	D AB	ANDONN	IENT PL	AN				
Name and Address of Facility				Name and Add	ress of Owne	r/Operator				
Well MS3, FutureGen 2.0, Morgan	n County, IL			FutureGen A 73 Central I	lliance Park Plaza Ea	ist, Jackson	ville, IL 626	50		
Locate Well and Outline Unit on		State			ounty		Permit	Number		
Section Plat - 640 Acres		Illinois			Morgan					
N		Surface L	ocation	Descriptior	_				_	
		ne 1/4 c	of se 1	4 of <u>ne</u> 1/4 of	1/4 of	Section 25	Township	16n Range	9w	
┝┽╾┾┲╗┽╾╎	-+-	Locate w	ell in two	directions fro	n nearest line	es of quarter	section and	drilling unit		
· ⊢∔₋⊢∔¥¥∔₋⊦		Surface	_	_						
	i I	Location	ft. 1	'rm (N/S)l	ine of quarter	section				
		and	ft. from	(E/W) Line	of quarter se	ction.				
w 	E E	IZ	TYPE O	F AUTHORIZATI	DN		WELL /	ACTIVITY		
· ┝-┽-┝-┽-┣-┽-┞		I ∩ Indi	Permit	ermit			55 I 29 II			
	!		a -				rine Dispos	al		
			-	1		ΙΠe	nhanced Re	covery		
┦ー┾╶┨ー┾╶┤ー┾╶┤		Number	of Wells	5 1		L De	lydrocarbon	Storage		
			_			CLAS	68 III			
S		Lease Na	me			Well Num	ber			
CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF CEMENT PLUGS										
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"	П Птв	e Dump Baile	er Method			
7-5/8 26.4 0-350	350			11.5"	🗌 🗆 Тһ	e Two-Plug N	lethod			
					🗌 🗌 Oti	ner				
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 Wil	II Be Placed (inche		7-5/8"							
Depth to Bottom of Tubing or Drill Pip	pe(π		330	_						
Slurp Volume To Be Pumped (cu. ft.)	18)		74	_						
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 H	OLE AND/OR PERFO	RATED INTE	RVALS	AND INTERVAL	WHERE CAS	ING WILL BE	VARIED (if a	uny)	-	
From	To	1			From			То		
\$25,000										
l certify under the penalty of law attachments and that, based on information is true, accurate, ar possibility of fine and imprison	v that I have persona my inquiry of those d complete. I am av ment. (Ref. 40 CFR 1	lly examine indi viduals vare that th (44.32)	Certifi d and an immedi ere are s	cation n familiar with ately responsit ignificant pena	he informatio le for obtainii lties for subm	n submitted ng the inform itting false i	in this docu iation, I beli nformation,	nent and all eve that the including the	•	
Name and Official Title (Please type o	r print)	Siar	nature					Date Signed	1	
Kenneth K. Humphreys, Chief Exe	Cenneth K. Humphreys, Chief Executive Officer Kuell H. Hungdrays 03/03/2014									
A Form 7520-14 (Rev. 12-11)										

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.≎,FPΔ			United Si	tates Er Was	nvironmei shington,	ntal Protection DC 20460	Agency				
		PLU	IGGING	AND	D ABA	NDONM	ENT PL	AN			
Name and Address of Fa	acility					Name and Addr	ess of Owne	r/Operator			
Well MS4, FutureGe	n 2.0, Morga	n County, IL				FutureGen Al 73 Central Pa	liance ark Plaza Ea	ıst, Jackson	ville, IL 626	50	
Locate Well and O Section Plat - 640 A	utline Unit on Acres		Sta Ill	ate linois		N	ounty forgan		Permit	Number	
	N		Su	rface Le	ocation D	escriptior	_				
			SW	7 1/4 or	f se 1/4	of \underline{SW} 1/4 of	se 1/4 of	Section 34	Township	16n Range	9w
▋┣┽╼┝╌┽╴	╺┠╴┽╺╴┆		Lo	cate we	ill in two	directions from	nearest line	es of quarter	section and	drilling unit	
▌┝╅╼┝┽	╶┠╴┽╶╴┆		Su	rface							
	I i i	i I	Lo	cation	ft. fr	m (N/S)Li	ne of quarter	section			
	╶┠╴┽╶╴╎		an	d 1	ft. from (E	5/W) Line	of quarter se	ction.			
w			r	7	TYPE OF	AUTHORIZATIO	N		WELL A	CTIVITY	
▌┝┹╼┕┹╴	_┣_┹_╙				Rommit	mit			55 I 20 II		
			– Lin	Rule	renne				rine Dispos:	al	
	╶┠╴┽╶╎	-+-	-			1			nhanced Re	covery	
▋╞╌┽╼┝╴┽╴	╺┠╴┽ᅳ┞		N	lumber	of Wells	1		□•	lydrocarbon	Storage	
S Lease Name Well Number											
CASING AND TUBING RECORD AFTER PLUGGING METHOD OF EMPLACEMENT OF CEMENT PLUGS											
SIZE WT (LB/ET)		NMELL (FT)		TINME	ELL (ET)						
13-3/8 54	0-130	(11222 (11)	130			17.5"		e Balance Me	thod		
7-5/8 26.4	0-350		350			11.5"		e Dump Baik a Two-Plug N	er ivietriod lethod		
								ier	ice i va		
CEMENTING	TO PLUG AND	ABANDON DA	ATA:		PLUG #	1 PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of Hole or Pipe in N	which Plug Wi	ll Be Placed (inche		7-5/8"						
Depth to Bottom of Tub	ing or Drill Pi	pe (ft			330						
Sacks of Cement To Be	Used (each pil	ng)			74						
Calculated Top of Plug	(ft.)				0						
Measured Top of Plug (i	if tagged ft.)				0						
Slurry Wt. (Lb./Gal.)					15.6						
Type Cement or Other N	Aaterial (Class	III)			Class A						
LIS	T ALL OPEN H	OLE AND/OR	PERFORATE	D INTE	RVALS A	ND INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	uny)	
From			То				From			То	
Estimated Cost to Plug	Wells										
\$25,000											
l certify under the attachments and information is tru possibility of fine	e penalty of law that, based on le, accurate, ar and imprison	v that I have p i my inquiry o nd complete. ment. (Ref. 4	ersonally ex fthose indiv lam aware 0 CFR 144.3	C camined viduals that the 2)	Certific a and am immediat are are sig	ation familiar with th ely responsibl gnificant penalt	e informatio e for obtaini ties for subm	n submitted ng the infom itting false i	in this docur nation, I belie nformation, i	nent and all eve that the including the	9
Name and Official Title	(Piease type o	or print)		Sign	ature		-			Date Signed	1
Kenneth K. Humphre	ys, Chief Exe	Kuelt H. Hungburgs 03/03/2014					1				

					10	/IB No. 2040⊣	0042 App	oroval Expire	s 11/30/2014					
	Unite	ed States E Wa	nvironm ashingto	ental Protec 1, DC 20460	tion	Agency								
VEFA	PLUGGI	NG AN	D AB	ANDO	M	ENT PL	AN							
Name and Address of Facility			_	Name and	Addr	ess of Owner	/Operator							
Well MS5, FutureGen 2.0, Morgan	n County, IL		FutureGen Alliance 73 Central Park Plaza East, Jacksonville, IL 62650											
Locate Well and Outline Unit on		State			C	unty		Permit	Number					
Section Plat - 640 Acres		Illinois			M	lorgan								
N		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												
╏╴┝╴┽ ᅳ┝╴┽ ╼┠╴┽╼┞	-+-	Locate well in two directions from nearest lines of quarter section and drilling unit												
│		Surface	Surface											
		Location	.ocation ft. frm (N/S) Line of quarter section											
│ ┝┽─┝┽─┣┽─¦		and	and ft. from (E/W) Line of quarter section.											
			TYPE O	FAUTHORIZ	ATIO	N	_	WELL A	CTIVITY					
▏▕▁⊥▁└▁┴▁▐▁⊥▁└		Indi Indi	vidual P	erm it				SS I						
								s's II Irine Diense						
▎ ┝·┽─┝·┽─┣·┽─ŀ	-+-	i ku	-					nhanced Re	coven					
╽╴┝╶┽╼┝╴┽╼┣╶┽╼┞		Number of Wells 1					L He	lvdrocarbon	Storage					
							CLAS	, 55 III	J.					
s		Lease Name Well Number												
CASING AND TUE	ING RECORD AFTER	PLUGGING			METHOD OF EMPLACEMENT OF CEMENT PLUGS									
SIZE WT (LB/FT) TO BEPUT IN	WELL (FT) TO BE	LEFT IN W	ELL (FT)	HOLE S	IZE	The Balance Method								
13-3/8 54 0-130	130		17.5"			The Dump Bailer Method								
7-5/8 26.4 0-350	350		11.5"			The Two-Plug Method								
			Other											
				1										
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 Wil	I Be Placed (inche		7-5/8"											
Depth to Bottom of Tubing or Drill Pip	e (ft		330											
Sacks of Cement To Be Used (each plu	ig)		74		_									
Siurry Volume to Be Pumped (cu. π.)			87		_									
Measured Top of Plug (if tagged ft)			0		_					1				
Slurny Wt. (Lb/Gal.)			15.6		_					1				
Type Cement or Other Material (Class	IIII		Class	Δ	_									
LIST ALL OPEN H	OLE AND/OR PERFOR		ERVALS	AND INTERV	ALS	WHERE CAS	ING WILL BE	VARIED (if a	unv)					
From	To					From	T		To					
Estimated Cost to Plug Wells														
\$25,000														
I certify under the penalty of law attachments and that, based on information is true, accurate, ar possibility of fine and imprisoni	/ that I have personal my inquiry of those Id complete. I am aw nent. (Ref. 40 CFR 1	ly examine individuals rare that th 44.32)	Certifi ed and ar s immedi here are s	cation n familiar w ately respo ignificant p	ith th nsible enalt	e information for obtainir ies for subm	n submitted ng the inform itting false i	in this docur nation, I belio nformation, i	nent and all eve that the including the	•				
Name and Official Title (Pipese type o	r arinti	Sid	nature						Date Signed					
Kenneth K. Humphreys, Chief Exe	cutive Officer		7	mitt	2	1. Hu	ndue	r.s	03/03/2014	ł				
EPA Form 7520-14 (Rev 12-11)														

						DMB No. 2040-	0042 Ap	oroval Expire	es 11/30/2014						
0.594		United St	ates En	vironme	ntal Protection	n Agency									
₩EPA	PLU	IGGING	AND) ABA		IENT PL	AN								
Name and Address of Facility					Name and Ad	dress of Owne	r/Operator								
Well TM1, FutureGen 2.0, Morga	n County, IL				FutureGen 2 73 Central	Alliance Park Plaza E:	ast, Jackson	ville, IL 626	50						
Locate Well and Outline Unit on		Sta	te			County		Permit	Number						
Section Plat - 640 Acres		111	inois			Morgan									
N		Su	rface Lo	cation D	escriptior	_				0					
		1/4 of SC 1/4 of ILC 1/4 of ILW 1/4 of Section 2/ Township 1011 Range 9W													
│ ┝┽╼┝┽╼ <u>┣</u> ┽╼╏	-+-	Loc	Locate well in two directions from nearest lines of quarter section and drilling unit												
│		Sur	Surface												
i i i ¥ i i	i I	Loc	_ocation ft. frm (N/S) Line of quarter section												
	- <u>-</u>	and	1 ft	ft. from (E/W) Line of quarter section.											
w to to t		L.	ر سنهمر آ	TYPE OF	AUTHORIZATI	ON		WELL /	ACTIVITY						
╽╴┝╌┽╼┝╴┽╼┣╶┽╼╿			A rea F	Permit	min			55 II 55 II							
		Ē	Rule					rine Dispos	al						
					1	Enhanced Recovery									
│		N	umber o	ofWells	1			lydrocarbon	Storage						
				_			CLA	65 III							
S		Lea	ase Nam	e			Well Num	ber							
CASING AND TUE	BING RECORD	AFTER PLU	GGING			METH	IOD OF EMPL	ACEMENT O	F CEMENT PI	LUGS					
SIZE WT (LB/FT) TO BE PUT I	NWELL (FT)	TO BE LEF	T IN WE	LL (FT)	HOLE SIZE	Птн	e Balance Me	thod							
7-5/8 26.4 0-20		20	11.5"			🗌 🔲 тн	The Dump Bailer Method								
						🖌 🗸 Ot	her								
CEMENTING TO PLUG AND	ABANDON DA	ATA:		PLUG #	1 PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7					
Size of Hole or Pipe in which Plug Wi	II Be Placed (inche	-	7-5/8"	_										
Depth to Bottom of Tubing or Drill Pi	pe (π			20	_										
Slurry Volume To Be Pumped (cu. ff.)	4 <u>9</u>)			4	_										
Calculated Top of Plug (ft.)			5	0											
Measured Top of Plug (if tagged ft.)				0											
Slurry Wt. (Lb./Gal.)			Ē	15.6											
Type Cement or Other Material (Class	III)		ľ	Class A											
LIST ALL OPEN H	OLE AND/OR	PERFORATE	DINTER	RVALS A	ND INTERVAL	S WHERE CAS	SING WILL BE	VARIED (if a	uny)						
From		То				From			To						
Estimated Cast to Blue Well-															
\$2,000															
l certify under the penalty of lav attachments and that, based or information is true, accurate, au possibility of fine and imprison	w that I have p I my inquiry o nd complete. ment. (Ref. 4	ersonally ex f those indiv I am aware t 0 CFR 144.33	C amined riduals in that ther 2)	ertific and am mmedia rearesi	ation familiar with tely responsil gnificant pena	the informatio ble for obtaini alties for subn	n submitted ng the infom nitting false i	in this docu nation, I beli nformation,	nent and all eve that the including the	•					
Name and Official Title (Please type of	ur arinfl		Signa	iture					Date Signed	1					
Kenneth K. Humphreys, Chief Ex	ecutive Offic	er	aigna	Ka	itt 4	Hung	ducys		03/03/2014	1					
EPA Form 7520-14 (Rev 12-11)															

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€EDΩ	ι	Jnited States V	Environm Vashingto	ental Protectio n, DC 20460	n Agency									
	PLUG	GING AN	ND AB	ANDONI	MENT PL	AN.								
Name and Address of Facility				Name and Ac	dress of Owne	er/Operator								
Well TM2, FutureGen 2.0, Morgar	n County, IL			FutureGen 73 Central	Alliance Park Plaza E	ast, Jackson	ville, IL 626	50						
Locate Well and Outline Unit on		State			County		Permit	Number						
Section Plat - 640 Acres		Illinoi	s		Morgan									
N		Surface	Location	Descriptior					0					
		SW 1/4	4 of SW 1	/4 of <u>SW</u> 1/4 of	f SW 1/4 of	Section 31	Township	16fi Range	9₩					
┝┽╾┝┽╼┠╶┽╾╏	-+-1	Locate	Locate well in two directions from nearest lines of quarter section and drilling unit											
│		Surface	Surface											
	il	Locatio	ocation ft. frm (N/S) Line of quarter section											
		and	1 ft. from (E/W) Line of quarter section.											
w		V In	dividual P	erm it			WELL /	40119111						
╷┝┽╌┝┽╌┣┽╌┆			rea Permit	ernin		CLAS	55 II							
└─└╌╌─└╌╌		Rule Brine Disposal												
		Normali		1	Enhanced Recovery									
╘╴┽╼┝╌┽╼┣╶┽╼┞		Numb	er of Well	5		Hydrocarbon Storage								
						CLA	65 III							
s		Lease N	lame			Well Num	ber							
CASING AND TUB	ING RECORD AF	TER PLUGGI	NG		METH	OD OF EMPL	ACEMENT O	F CEMENT PI	LUGS					
SIZE WT (LB/FT) TO BE PUT IN	WELL (FT) TO	BE LEFT IN	LEFT IN WELL (FT) HOLE SIZE			The Balance Method The Dump Bailer Method The Two-Plug Method								
7-5/8 26.4 0-20	20	1	11.5"											
					_ V Ot	her								
					_	1								
CEMENTING TO PLUG AND	ABANDON DATA:		PLUG	#1 PLUG #	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7					
Depth to Bottom of Tubing or Drill Pin	i Be Placed (inch	le	20	_	_									
Sacks of Cement To Be Used (each plu	(n)		4	_										
Slurry Volume To Be Pumped (cu. ft.)	- 37		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 I	11)		Class	A										
LIST ALL OPEN H	OLE AND/OR PER	FORATED IN	TERVALS	AND INTERVAI	S WHERE CA	SING WILL BE	VARIED (if a	any)						
From		То			From			To						
Estimated Cost to Plug Wells														
\$2,000														
l certify under the penalty of law attachments and that, based on information is true, accurate, an possibility of fine and imprison	/ that I have perso my inquiry of the Id complete. I an nent. (Ref. 40 Cl	onally examin ose individua n aware that FR 144.32)	Certifi ned and ar als immedi there are s	cation n familiar with ately responsi significant pen	the informatic ble for obtaini alties for subr	n submitted ng the infom nitting false i	in this docu nation, I beli nformation,	nent and all eve that the including the	•					
Name and Official Title Please free o	r print)	61	anature					Date Signed	1					
Kenneth K. Humphreys, Chief Exe	cutive Officer		Ka	utt 2	. Hung	ducys	:	03/03/2014	1					

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		United States W	Environm /ashingto	ental Protec 1, DC 20460	tion	Agency											
wera	PLUG	GING AN		ANDO	NМ	ENT PL	AN										
Name and Address of Facility				Name and	Addr	ess of Owne	r/Operator										
Well TM3, FutureGen 2.0, Morga	n County, IL			FutureG 73 Cent	en Al al Pa	liance ark Plaza Ea	ıst, Jackson	ville, IL 626	50								
Locate Well and Outline Unit on		State	s			ounty forgan		Permit	Number								
Section Plat - 640 Acres		Surface	Surface Location Description														
N N		ne 1/4	ne 1/4 of Se 1/4 of ne 1/4 of nw 1/4 of Section 25 Township 16n Range 9w														
		Locate	Locate well in two directions from nearest lines of quarter section and drilling unit														
		Surface	Surface														
							Location ft. frm (N/S) Line of guarter section										
┨╴┝╌┽╼┝╴┽╼┠╴┽╼╎		and	and ft. from (E/W) Line of quarter section.														
			TYPE O	F AUTHORIZ	ATIO	N	_	WELL A	CTIVITY								
	1 ⁻	🗹 In	dividual P	erm it			CLA	6S I									
▋▕⊢┽─┝┽─┢┽─╎		Ar	ea Permit				CLA	68 II									
▌ ┝┽─┝┽─┣┽─ŀ	-+-		le				1 85	rine Dispos	al								
▌▕⊢ᆚ▃└▃┴▃┣▁┹▃╵	Number of Wells 1																
								SS III	Storage								
s																	
		Lease N	ame			I	Well Num	oer									
	SING RECORD A	PIER PLUGGI	NG	Luoira				ACEMENTO	FCEMENTPI	LUGS							
SIZE WI (LB/FT) TO BE POT II	VVELL (FT)		WELL (FI)	HULE :	IZE	∐™	e Balance Me	thod									
7-3/8 20.4 0-20	4	:0	11.5			The Dump Bailer Method The Two-Plug Method Other											
				1	-		ler										
CEMENTING TO PLUG AND	ABANDON DATA	A:	PLUG	#1 PLUG	#2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7							
Size of Hole or Pipe in which Plug Wi	II Be Placed (ind	he	7-5/8"														
Depth to Bottom of Tubing or Drill Pi	e (ft		20														
Sacks of Cement To Be Used (each plu	1 g)		4														
Slurry Volume To Be Pumped (cu. ft.)			5														
Calculated Top of Plug (ft.)			0		_												
Neasured Top of Plug (if tagged ft.)			0		_												
Type Cement or Other Material (Class	IID		Class	A	_												
LIST ALL OPEN H	OLE AND/OR PE	RFORATED IN	TERVALS	AND INTER	ALS/	WHERE CAS	ING WILL BE	VARIED (if a	uny)								
From		To				From			To								
					_												
Estimated Cost to Blue Walls																	
\$2,000																	
I certify under the penalty of Iav attachments and that, based or information is true, accurate, ar possibility of fine and imprison	v that I have per my inquiry of t nd complete. I a ment. (Ref. 40	sonally examin hose individua am aware that f CFR 144.32)	Certifi ned and ar Is immedi there are s	cation n familiar w ately respo ignificant p	ith th nsibl enali	e informatio e for obtainii ties for subm	n submitted ng the infom itting false i	in this docur nation, I belic nformation, i	nent and all eve that the including the	3							
Name and Official Title <i>(Please type o</i>	r print)	SI	gnature						Date Signed								
Kenneth K. Humphreys, Chief Ex	ecutive Officer		K	utt	H.	Her	ducy	6	03/03/2014								
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⇒EPA	PLU	GGING	AND A	\BA	NDONM	IENT PL	AN							
Name and Address of Facility				N	lame and Add	ress of Owne	r/Operator							
Well MS4, FutureGen 2.0, Morga	n County, IL				FutureGen A 73 Central F	lliance 'ark Plaza Ea	ist, Jackson	ville, IL 626	50					
Locate Well and Outline Unit on		Sta	te		c	ounty		Permit	Number					
Section Plat - 640 Acres		111	inois		1	vlorgan								
N		Sur	Surrace Location Description											
		SW	1/4 of S6	1/4	of SW 1/4 of	se 1/4 of	Section 34	Township	16n Range	9w				
│ ┝╶┽╼┝╴┽ ╼┣╶┽ ╼╏		Loc	Locate well in two directions from nearest lines of quarter section and drilling unit											
╷ ┝ <u>╅</u> ─┝┽─┣┽─┆		Sur	urface											
	i I	Loc	Location ft. frm (N/S) Line of quarter section											
· ⊢╡─⊢╡─┠╡─¦		and	Idft. from (E/W)Line of quarter section.											
w 		E D	TYP 	EOF		DN		WELL	ACTIVITY					
╷ ┝ _╄ ┥┝┿┙┣┽┙			A rea Per	ai Peri mit	mit			55 I 56 II						
		LĒ		inc				so II Brine Dispos	al					
		_		L.		Enhanced Recovery								
┝┼╌╎╌┼╌┨		N	umber of V	/ells	1	Hydrocarbon Storage								
							CLA	65 III						
s 🖸		Lea	ise Name				Well Num	ber						
CASING AND TU	BING RECORD	AFTER PLU	GGING			METH	OD OF EMPL	ACEMENT O	F CEMENT PI	LUGS				
SIZE WT (LB/FT) TO BE PUT I	N WELL (FT)	TO BE LEF	T IN WELL	(FT)	HOLE SIZE	1 🗆 ть	e Balance Me	ethod						
7-5/8 26.4 0-20		20	11.5"			The Dump Bailer Method The Two-Plug Method								
						🗸 🗸 Otl	ner							
CEMENTING TO PLUG AND	ABANDON DA	TA:	PL	UG #1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7				
Size of Hole or Pipe in which Plug Wi	II Be Placed (i	nche	7-:	5/8"	_									
Depth to Bottom of Tubing or Drill Pi	pe (π		20											
Slurry Volume To Be Pumped (cu. ft.)	ugj		4											
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	111)		Cl	ass A										
LIST ALL OPEN H	IOLE AND/OR	PERFORATE	D INTERVA	LS AN	D INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	uny)					
From		Τo				From			To					
Estimated Cast to Blue Wall-														
\$2,000														
l certify under the penalty of lav attachments and that, based or information is true, accurate, a possibility of fine and imprison	w that I have p 1 my inquiry of nd complete. ment. (Ref. 44	ersonally ex f those indiv I am aware t 0 CFR 144.32	Cer amined an iduals imm that there a 2)	tifica d am f lediate resig	ation familiar with ti ely responsib gnificant penal	he informatio le for obtainii lties for subm	n submitted ng the infom nitting false i	in this docu nation, I beli nformation,	nent and all eve that the including the	•				
Name and Official Title (Please type)	ar arinti		Signatu	e.					Date Signed	1				
Kenneth K. Humphreys, Chief Ex	ecutive Office	er	- Th	lue	the H.	Hury	ducys	:	03/03/2014					
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			United	d States Er Wa	nvironm shingto	ental F n, DC :	rotection . 20460	Agency							
VERA		PLU	GGIN	IG ANI	DAB	ANI	DONM	ENT PL	AN						
Name and Address o	Facility					Name	e and Addr	ess of Owne	r/Operator						
Well MS5, Future	Gen 2.0, Morga	n County, IL				Futa 73	ireGen Al Central Pa	liance ark Plaza Ea	ist, Jackson	wille, IL 620	550				
Locate Well an	l Outline Unit on			State			00	ounty		Permit	Number				
Section Plat - 64	0 Acres			mmors		_		lorgan							
	N			Surface L	ocation	Descr	iptior				16-	0			
			-	Leasts well in the directions from powert lines of guides section and definition with											
F4-F-	┼─ ┟ ─┤─╎	-+-		Locate well in two directions from nearest lines of quarter section and drilling unit											
	┝─┠─╅─┢			Surface	inface										
	└──┖──└			Location	ation ft. frm (N/S) Line of quarter section										
				and1	ft. from	(E/W)	Line o	of quarter se	ction.						
w		IZ man	TYPE O	FAUT	HORIZATIO	N		WELL	ACTIVITY						
			Romit	ermit											
										Rrine Disnos	al				
	┝╼┣╴┽╼┝	-+-					_		coven						
	┞─┠╌┽─┞	-+-		Number	of Well	s <u>I</u>			Hydrocarbon Storage						
	s			Lease Nan	ne				Well Nur	ıber					
	CASING AND TUE	ING RECORD	AFTER F	LUGGING				METH	OD OF EMP	LACEMENT	F CEMENT PI	LUGS			
SIZE WT (LB/FT		WELL (FT)	TO BE I	LEFT IN WE	ELL (FT)	н	DLE SIZE		a Balance N	lethod					
7-5/8 26.4	0-20		20		11.5"				The Dump Bailer Method						
									The Two-Plug Method						
						1			e rwo-riug ier						
									rei						
CEMENTI	NG TO PLUG AND	ABANDON DA	TA:		PLUG	#1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #			
Size of Hole or Pipe	n which Plug Wi	II Be Placed (inche		7-5/8"										
Depth to Bottom of T	ubing or Drill Pi	e (ft			20										
Sacks of Cement To	Be Used (each plu	1g)			4										
Slurry Volume To Be	Pumped (cu. ft.)				5										
Calculated Top of Plu	ıg (ft.)				0										
Measured Top of Plu	g (if tagged ft.)				0										
Slurry Wt. (Lb./Gal.)					15.6										
Type Cement or Othe	r Material (Class	11)			Class	A									
	LIST ALL OPEN H	OLE AND/OR	PERFOR/	ATED INTE	RVALS	AND IN	NTERVALS	WHERE CAS	ING WILL E	E VARIED (if	any)				
From			To					From			То				
						_									
Estimated Cost to PI	ug Wells														
Estimated Cost to PI	ug Wells														
Estimated Cost to PI \$2,000	ug Wells														
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