INJECTION WELL PLUGGING PLAN
40 CFR §146.92(b)

Brown Pelican CO_2 Sequestration Project

1.0 Facility Information and Overview

Facility name: Brown Pelican CO_2 Sequestration Project
BRP CCS1, CCS2 and CCS3 Wells

Facility contact: [redacted]

Well location: Penwell, Texas

BRP CCS1	31.76479314	-102.7289311
BRP CCS2	31.76993805	-102.7332448
BRP CCS3	31.76031163	-102.7101566

Oxy Low Carbon Ventures, LLC (OLCV) will conduct injection well plugging and abandonment (P&A) according to the procedures contained in this document.

The injection wells will be plugged and abandoned in accordance with the requirements of Environmental Protection Agency (EPA) document 40 CFR Subpart H – Criteria and Standards Applicable to Class VI Wells. The plugging procedure and materials will be designed to prevent any unwanted fluid movement, resist the corrosive aspects of carbon dioxide (CO_2) with water mixtures, and protect any underground sources of drinking water (USDWs).

Plugging procedures for CO_2 Injection wells are presented in this document. Plugging plans for monitoring and water withdrawal wells are presented in Appendix A of this document.

2.0 CO_2 Injection Wells

2.1 Planned Tests or Measures to Determine Bottomhole Reservoir Pressure

1. After injection has ceased, the well will be flushed with a kill fluid. A minimum of three tubing volumes will be injected without exceeding the fracture pressure. All kill fluids that will be pumped will be 10 ppg NaCl brine.
2. Bottomhole pressure measurements will be taken using the installed downhole gauges. In case the gauges are not functioning properly, the operator will run a pressure gauge during the P&A process of the well.
3. A Temperature log will be run, and the well will be pressure tested to ensure integrity both inside and outside the casing before plugging. Production Logging Tool (PLT), tracers, and noise or active pulsed neutron logs could be run in substitution.
4. If a loss of mechanical integrity is discovered, the well will be repaired before proceeding further with the plugging operations.
5. All casing in this well will have been cemented to the surface at the time of construction and will not be retrievable at abandonment.
6. After injection is terminated permanently, the injection tubing and packer will be removed.
7. The balanced-plug placement method will be used to plug the well. A cement retainer will be used to isolate the perforated section and prevent flowback of formation fluids that could contaminate the plug.
8. All of the casing strings will be cut off at least 5 ft below the surface and plow line.
9. A blanking plate with the required permit information will be welded on top of the cutoff casing.

Any necessary revisions to the well plugging plan to address any new information collected during logging, testing, and completion of the well will be made after these activities have been completed. The final plugging plan will be submitted to the Underground Injection Control (UIC) Program Director.

2.2 Planned Mechanical Integrity Test(s)

OLCV will conduct a temperature log and potentially additional logs listed in Table 1 and a pressure test to verify mechanical integrity before plugging the injection well, as required by 40 CFR §146.92(a).

Table 1—Planned and Possible Mechanical Integrity Tests

Test Description	Location
Temperature log (External MIT)	Injection wells and monitoring wells
Pulsed neutron log (External MIT)	Injection wells and monitoring wells
Noise log (External MIT)	Injection wells and monitoring wells
Annular Pressure Test (Internal)	Injection wells and monitoring wells

The following tools are able to detect fluid movements behind the long string casing. Tools will be run on wireline. Quality assurance for the logs will be provided by the vendor at time of selection.

Temperature logs are used to locate gas entries, detect casing leaks, and evaluate fluid movement behind casing. They are also used to detect lost-circulation zones and cement placement. Temperature logs are used as a basic diagnostic tool and are usually paired with other tools like acoustics or multi arms calipers if more in depth analysis is required.

Temperature instruments used today are based on elements with resistances that vary with temperature. The variable resistance element is connected with bridge circuitry or constant current circuit, so that a voltage response proportional to temperature is obtained. The voltage signal from temperature device is then usually converted to a frequency signal transmitted to the surface, where it is converted back to a voltage signal and recorded. The absolute accuracy of temperature logging instruments is not high (in the order of +- 5°F), but the resolution is good (0.05°F) or better, although this accuracy can be compromised by present day digitalization of the signal on the surface. The temperature instrument usually can be included in the string with other tools, such as radioactive tracer tools or spinners flowmeters. Temperature logs are run continuously, typically at cable speeds of 20 to 30 ft/min.

The following tools could be run in substitution of temperature log. They follow the same principle of detection of anomalies outside the injection zone.

Pulse neutron log (PNL) provides formation evaluation and reservoir monitoring in cased holes. PNL is deployed as a wireline logging tool with an electronic pulsed neutron source and one or more detectors that typically measure neutrons or gamma rays. High-speed digital signal electronics process the gamma ray response and its time of arrival relative to the start of the neutron pulse. Spectral analysis algorithms translate the gamma ray energy and time relationship into concentrations of elements. Each logging company has its own proprietary designs and improvements on the tool.

Schlumberger's Pulsar Multifunction Spectroscopy Service (PNX) pairs multiple detectors with a high output pulsed neutron generator in a slim tool with an outer diameter (o.d.) of 1.72 in. for through-tubing access in cased hole environments. The housing is corrosion-resistant, allowing deployment in wellbore environments such as CO_2. The tool's integration of the high neutron output and fast detection of gamma rays with proprietary pulse processing electronics, allows to differentiate and quantify gas-filled porosity from liquid-filled and tight zones. The tool can accurately determine saturation in any formation water salinity across a wide range of well conditions, mineralogy, lithology, and fluid contents profile at any inclination. Detection limits for CO_2 saturation for the PNX tool vary with the logging speed as well as the formation porosity. Detailed measurement and mechanical specifications for the PNX tool are provided in the QASP document. The wireline operator will provide QA/QC procedures and tool calibration for their equipment.

Haliburton's RMT-D reservoir monitor tool: The Halliburton Reservoir Monitor Tool 3-Detector™ (RMT-3D™) pulsed-neutron tool solves for water, oil, and gas saturations within reservoirs using three independent measurements (Sigma, C/O, and SATG). This provides the ability to uniquely solve simple or complex saturation profiles in reservoirs, while eliminating phase-saturation interdependency. The RMT-#D provides gas phase analysis to identify natural gases, nitrogen, CO_2, steam, and air. The tool has 2.125 in diameter OD that allows it to be run through tubing.

Pass/Fail Criteria

Well Plugging is considered pass when it meets the objective of minimizing the chance of leak of fluid to USDW.

Temperature Survey

The temperature log is one of the approved logs for detecting fluid movement outside pipe. A final differential temperature survey will be run during plugging operations and will provide a final temperature curve.

The temperature will be logged down from the surface to total depth in the well. Recommended line speed for the logging operations is 20 to 30 ft/min. In general, the procedure for wireline operations will be as follows:

1. Attach a temperature probe and casing collar locator (CCL) to the wireline.
2. Begin the temperature survey. The tools will be lowered into well at 20 to 30 feet/minute, recording temperature in wellbore. The temperature survey will be run to the deepest attainable depth in the wellbore.
3. Following completion of the survey, the wireline tools will be retrieved from the wellbore.
4. A successful temperature log will "PASS" if there are no observed, unexplained anomalies outside of the permitted injection zone.
5. If temperature anomalies are observed outside of the permitted zone, additional logging may be conducted to determine whether a loss of mechanical integrity or containment has occurred. Depending on the nature of the suspected movement, radioactive tracer, noise, oxygen activation, or other logs approved by the UIC Program Director may be required to further define the nature of the fluid movement or to diagnose a potential leak.

Pressure Test

After setting the initial plug across the well completion interval / perforation, an annular pressure test (APT) will be conducted to verify internal mechanical integrity. The APT is a short-term pressure test (30 minutes) where the well is shut in and the fluid in the annulus is pressurized to a predetermined pressure and is monitored for leak off. BRP will use a test pressure of 500 psi for the Mechanical Integrity Test. BRP will use a 5% decrease in pressure (test pressure x .05) from the stabilized test pressure during the duration of the test to determine if test is successful. If the annulus pressure decreases by ≥5%, the well will have failed the APT. If a well fails an APT, the test will be repeated. If the APT is again failed, the downhole equipment will be removed from the well and the source of the failure will be investigated. In general, the test procedure will be as follows:

1. Connect a high-resolution pressure transducer to the annulus casing valve and increase the annulus pressure to 500 psi and hold this pressure for 30 minutes.
2. At the conclusion of the 30-minute test the annulus pressure will be bled off to 0 psi and the pressure recording equipment will be removed from the casing valve.

Note: If a failure in the long string casing is identified, the operator will prepare a plan to repair the well before plugging and abandonment

2.3 Information on Plugs

OLCV will use the materials and methods noted in Table 2, Table 3, and Table 4 to plug the Injection wells. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction.

The cement(s) formulated for plugging will be compatible with CO_2. Discussion about CO_2 resistant cement selection and additive is located in the Construction Plan – Appendix B. The cement formulation and required certification documents will be submitted to the agency along with the well plugging plan. OLCV will report the wet density and will retain duplicate samples of the cement used for each plug. In plugging procedures in Section 3.0, curing time for CO_2 resistant cement is assumed to be 4 hours. The curing time for the CO_2 resistant plugs will be determined at time of operation via laboratory testing in compliance with API 10B2 (Testing of Oilwell Cements). OLCV utilizes industry recognized thresholds of 50 psi compressive strength to pressure test and 500 psi compressive strength for physically tagging. 500 psi (or greater) compressive strength will be achieved for abandonment slurries and will be reached in < 48 hours after placement. All plug mud will be 9.5-10 ppg NaCl brine with lime added at 1.0 ppb (pound per barrel) to raise the PH to >10.5 to combat corrosion, H_2S and CO_2 contamination. Xanthan gel will be added to the mud so that the viscosity is > 50 sec/qt.

Table 2—Information on Cement Plugs for BRP CCS1

Plug No.	Placement Method	Type Slurry	ID (in.)	MD Depths (ft)	Density (ppg)	Sacks	bbl
1	Squeeze plug	CO_2-resistant cement	4.892	4,624 to 5,667	14.8	246	58
2	Balance plug	CO_2-resistant cement	4.892	4,524 to 4,624	14.8	12	3
3	Balance plug	CO_2-resistant cement	4.892	4,000 to 4,200	14.8	24	6
4	Balance plug	CO_2-resistant cement	4.892	3,750 to 3,950	14.8	24	6
5	Balance plug	CO_2-resistant cement	4.892	2,700 to 2,800	14.8	12	3
6	Balance plug	CO_2-resistant cement	4.892	1,750 to 1,850	14.8	12	3
7	Balance plug	CO_2-resistant cement	4.892	791 to 891	14.8	12	3
8	Balance plug	CO_2-resistant cement	4.892	0 to 475	14.8	56	13

Notes:

- All plug depths will be adjusted after the well is drilled and completed.
- The plugging procedure will be updated as required by EPA and Texas regulators.
- Formation tops will be adjusted after running openhole electric logs.

Table 3—Information on Cement Plugs for BRP CCS2

Plug No.	Placement Method	Type Slurry	ID (in.)	MD Depths (ft)	Density (ppg)	Sacks	bbl
1	Squeeze plug	CO_2-resistant cement	4.892	4,450 to 5,768	14.8	326	77
2	Balance plug	CO_2-resistant cement	4.892	4,350 to 4,450	14.8	12	3
3	Balance plug	CO_2-resistant cement	4.892	4,000 to 4,200	14.8	24	6
4	Balance plug	CO_2-resistant cement	4.892	3,750 to 3,950	14.8	24	6
5	Balance plug	CO_2-resistant cement	4.892	2,700 to 2,800	14.8	12	3
6	Balance plug	CO_2-resistant cement	4.892	1,750 to 1,850	14.8	12	3
7	Balance plug	CO_2-resistant cement	4.892	792 to 892	14.8	12	3
8	Balance plug	CO_2-resistant cement	4.892	0 to 475	14.8	56	13

Notes:

- All plug depths will be adjusted after the well is drilled and completed.
- The plugging procedure will be updated as required by EPA and Texas regulators.
- Formation tops will be adjusted after running open hole electric logs.

Table 4—Information on Cement Plugs for BRP CCS3

Plug No.	Placement Method	Type Slurry	ID (in.)	MD Depths (ft)	Density (ppg)	Sacks	bbl
1	Squeeze plug	CO_2-resistant cement	4.892	5,200 to 6,284	14.8	268	63
2	Balance plug	CO_2-resistant cement	4.892	5,100 to 5,200	14.8	12	3
3	Balance plug	CO_2-resistant cement	4.892	4,402 to 4,602	14.8	24	6
4	Balance plug	CO_2-resistant cement	4.892	3,700 to 3,900	14.8	24	6
5	Balance plug	CO_2-resistant cement	4.892	2,700 to 2,800	14.8	12	3
6	Balance plug	CO_2-resistant cement	4.892	1,750 to 1,850	14.8	12	3
7	Balance plug	CO_2-resistant cement	4.892	767 to 867	14.8	12	3
8	Balance plug	CO_2-resistant cement	4.892	0 to 475	14.8	56	13

Notes:

- All plug depths will be adjusted after the well is drilled and completed.
- The plugging procedure will be updated as required by EPA and Texas regulators.
- Formation tops will be adjusted after running open hole electric logs.

2.4 Plugging Schematics

The proposed plugging schematic for BRP CCS1 is shown in Figure 1, the proposed plugging schematic for BRP CCS2 is shown in Figure 2 and the plugging schematic for BRP CCS3 is shown in Figure 3. A sample EPA Plugging and Abandonment Plan form is found in Figure 4.

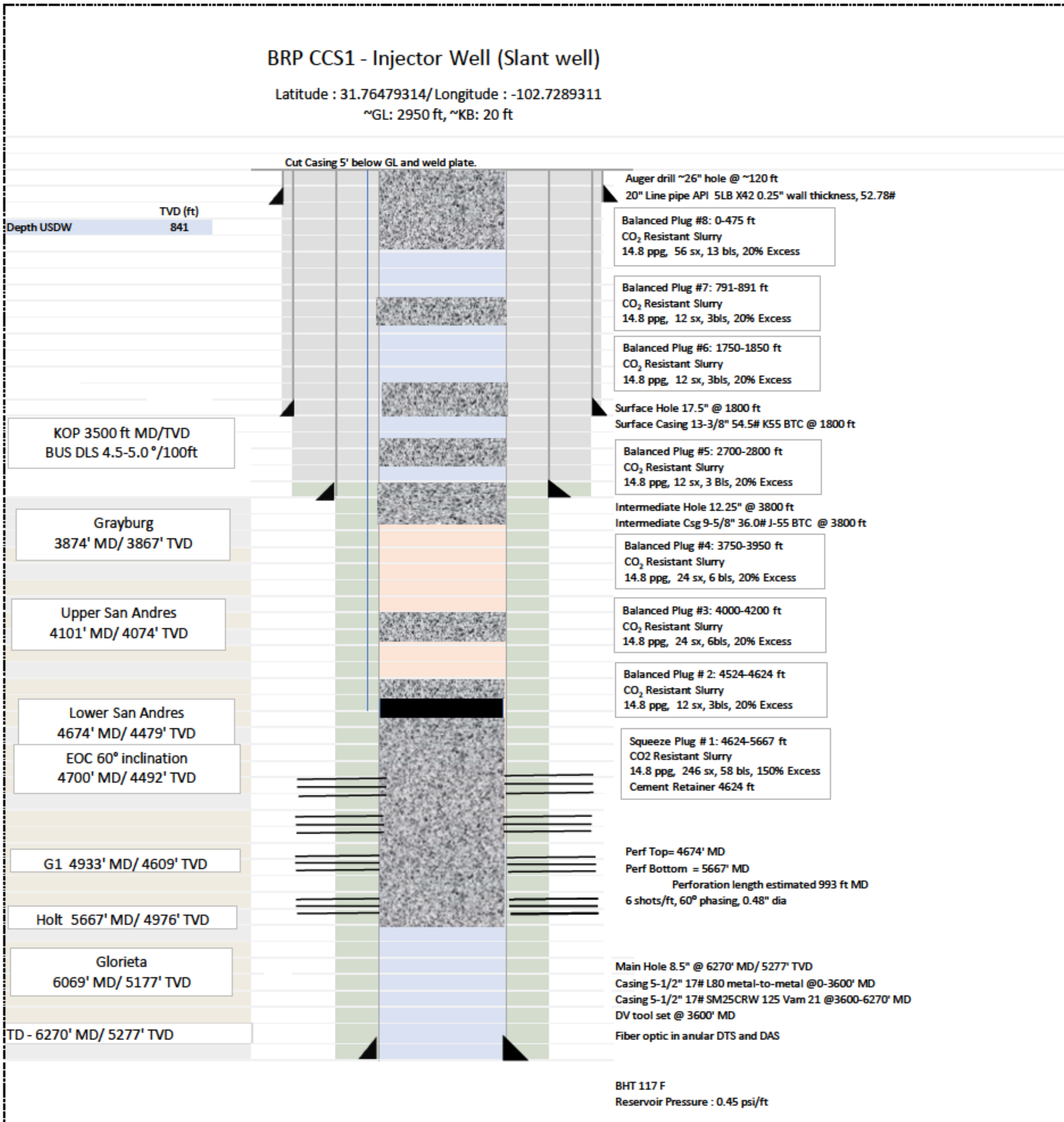


Figure 1—BRP CCS1 injection well plugging schematic

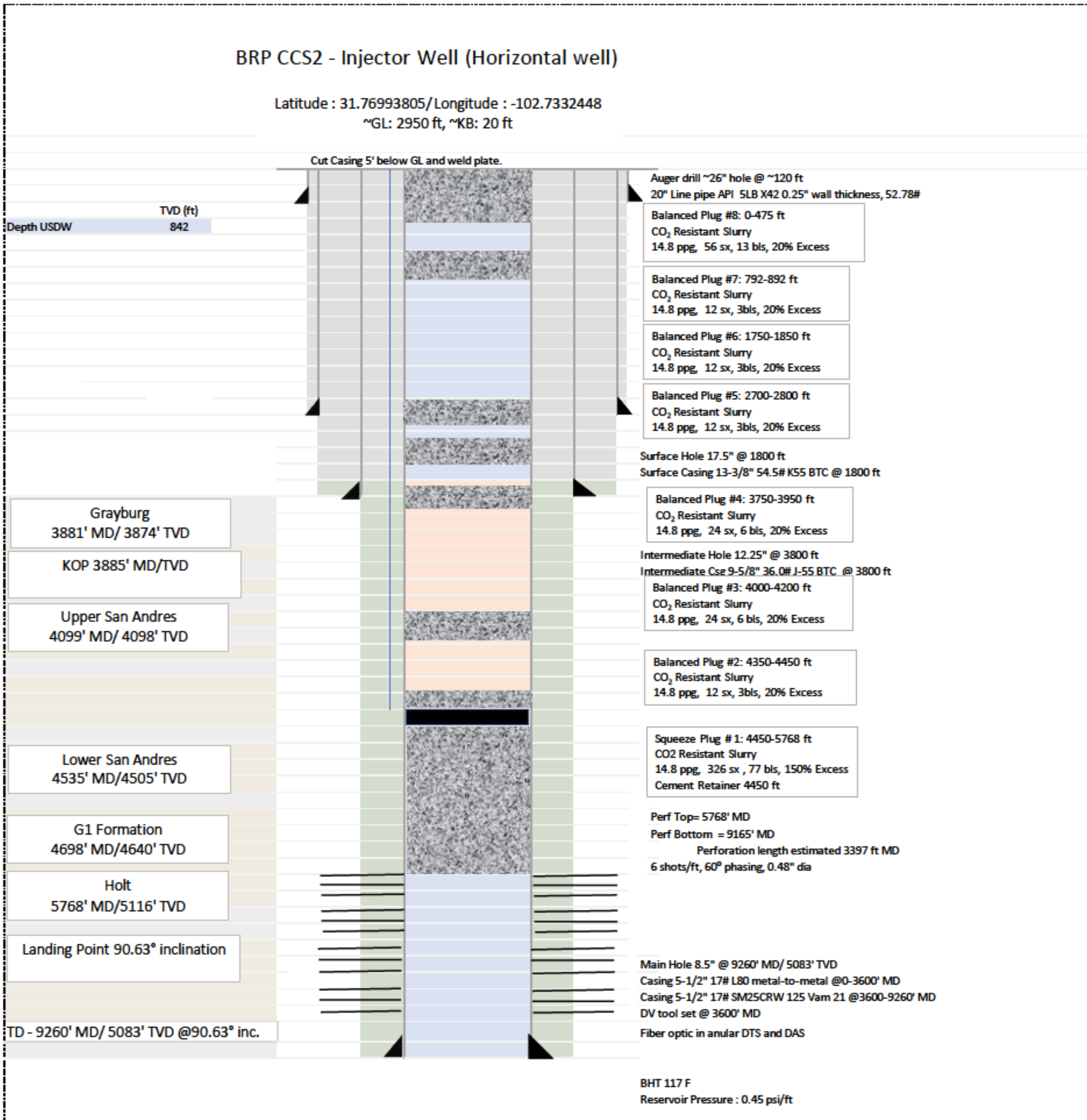


Figure 2—BRP CCS2 injection well plugging schematic

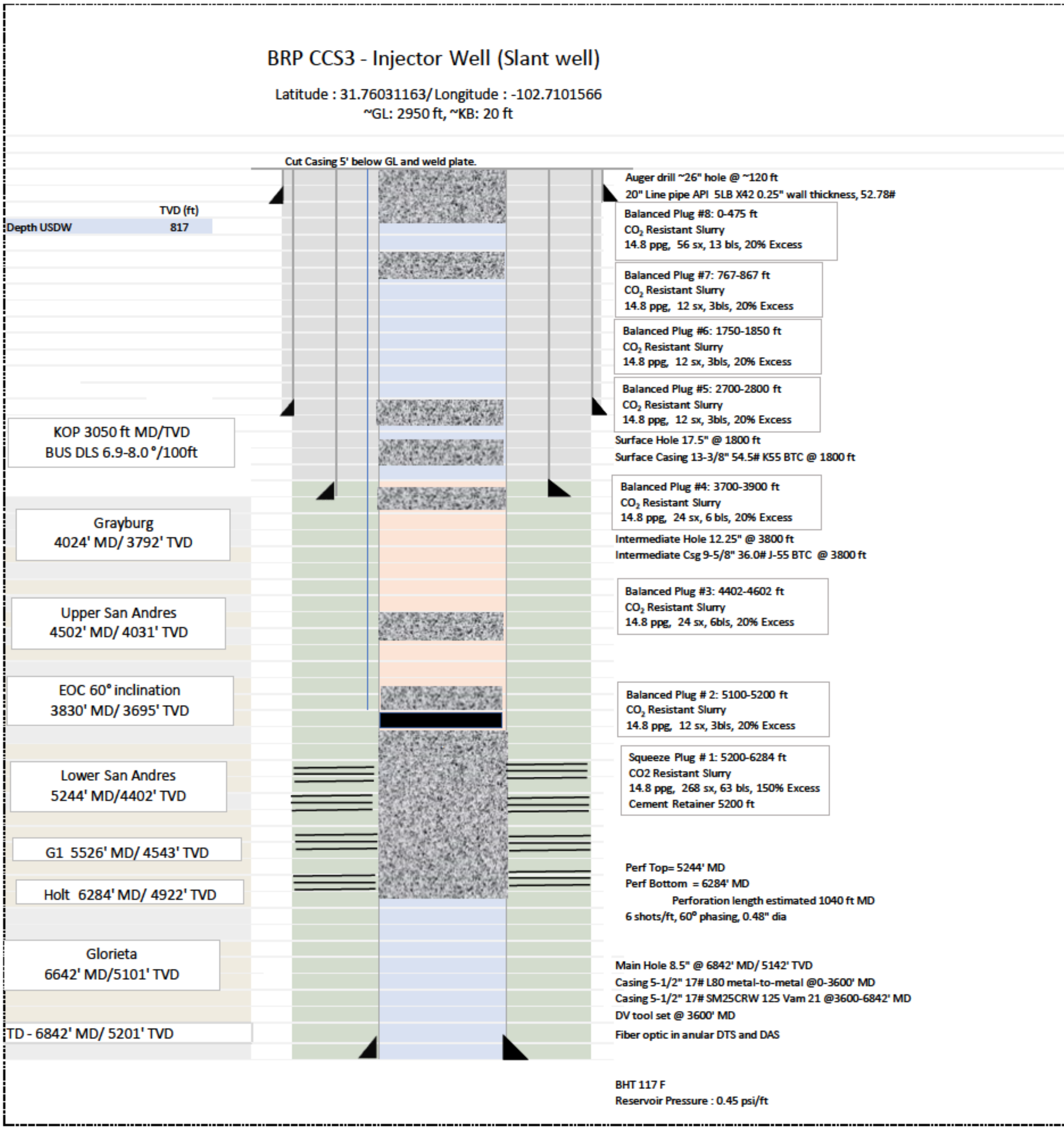


Figure 3—BRP CCS3 injection well plugging schematic

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

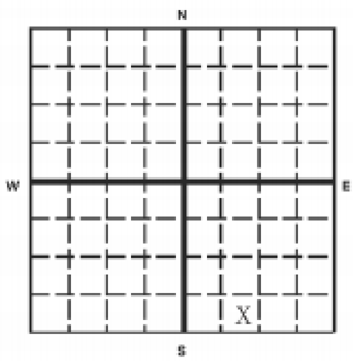
EPA

United States Environmental Protection Agency
Washington, DC 20460

PLUGGING AND ABANDONMENT PLAN

Name and Address of Facility	Name and Address of Owner/Operator
Morgan County Class VI UIC Well #1 (cased well completion, 1,500 ft lateral) [address not yet available]	FutureGen Alliance, Inc. 73 Central Park Plaza East, Jacksonville, IL 62650

Locate Well and Outline Unit on Section Plat - 640 Acres



State	County	Permit Number
Illinois	Morgan	not yet issued

Surface Location Description
SE 1/4 of SE 1/4 of SW 1/4 of SE 1/4 of Section 26 Township 16N Range 9W

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

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

TYPE OF AUTHORIZATION

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

Number of Wells 1

Lease Name

WELL ACTIVITY

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

Well Number

CASING AND TUBING RECORD AFTER PLUGGING

SIZE	WT (LB/FT)	TO BE PUT IN WELL (FT)	TO BE LEFT IN WELL (FT)	HOLE SIZE
24"	140.0	140'	140'	30"
16"	84.0	570'	570'	20"
10 3/4"	51.0	3,150'	3150'	14 3/4"
7"	29.0	6,004'	6,004'	9 1/2"

METHOD OF EMPLACEMENT OF CEMENT PLUGS

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

CEMENTING TO PLUG AND ABANDON DATA:	PLUG #1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of Hole or Pipe in which Plug Will Be Placed (inche	7"	7"	7"	7"	7"	7"	
Depth to Bottom of Tubing or Drill Pipe (ft	6,004	3,900	3,100	1,800	1,500	700	
Sacks of Cement To Be Used (each plug)	451	149	0	53	0	124	
Slurry Volume To Be Pumped (cu. ft.)	505	167	271	63	167	146	
Calculated Top of Plug (ft.)	3,900	3,100	1,800	1,500	700	0 (GL)	
Measured Top of Plug (if tagged ft.)	3,900	3,100	1,800	1,500	700	0 (GL)	
Slurry Wt. (Lb./Gal.)	15.82	15.82	8.6	15.6	8.6	15.6	
Type Cement or Other Material (Class III)	EverCrete	EverCrete	6% Gel	Class A	6% Gel	Class A	

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

From	To	From	To
(7" perforated casing) 3,950 ft MD	6,004 ft MD		

Estimated Cost to Plug Wells

Plug #1 Set through a cement retainer set at 3,900 ft MD
$600,000.00

Certification

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

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

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

Figure 4—Sample EPA Plugging and Abandonment Plan form

3.0 Narrative Description of Plugging Procedures

3.1 Notifications, Permits, and Inspections

In compliance with 40 CFR §146.92(c), OLCV will notify the regulatory agency at least 60 days before plugging the well and provide an updated Injection Well Plugging Plan, if applicable.

3.2 Plugging Procedures for BRP CCS1

[redacted]

[redacted]

The procedures described above are subject to modification during execution as necessary to ensure a successful plugging operation. Any significant modifications due to unforeseen circumstances will be described in the plugging report.

3.3 Plugging Procedures for BRP CCS2

[redacted]

[redacted]

The procedures described above are subject to modification during execution as necessary to ensure a successful plugging operation. Any significant modifications due to unforeseen circumstances will be described in the plugging report.

3.4 Plugging Procedures for BRP CCS3

[redacted]

[redacted]

[redacted]

[redacted]

The procedures described above are subject to modification during execution as necessary to ensure a successful plugging operation. Any significant modifications due to unforeseen circumstances will be described in the plugging report.