

SECTION 6 – INJECTION WELL PLUGGING PLAN

TABLE OF CONTENTS

6.1	Introduction	2
6.2	Zonal Isolation of Injection Zone/Intermediate Plugback Plan	2
6.2.1	Pre-Plugging Activities	2
6.2.2	Zonal Isolation Activities.....	5
6.3	Final Plug and Abandonment.....	5
6.3.1	Pre-Plugging Activities	7
6.3.2	Plugging Activities.....	7
6.3.3	Plug Details	9
6.4	Monitoring Wells Plugging and Abandonment	12
6.4.1	Above-Zone Monitoring Well Plugging Activities.....	12
6.4.2	Groundwater Monitoring Well Plugging Activities.....	12

Figures

Figure 6-1 – WC IW-A No. 001 – First Plugback/Zonal Isolation Wellbore Schematic	4
Figure 6-2 – WC IW-A No. 001 Prior to Final Plug and Abandonment	6
Figure 6-3 – WC IW-A No. 001 – Plugged Wellbore Schematic.....	11
Figure 6-4 – WC AZMW-A No. 001 – Plugged Wellbore Schematic	13

Tables

Table 6-1 – Description of Casing, Tubing, and Other Well Construction Materials to Be Removed	7
Table 6-2 – Plug Details for Plugs #1–#7.....	9
Table 6-3 – Plug Details for Plugs #8–#14.....	10

6.1 Introduction

This plugging plan for the WC IW-A No. 001 was prepared to meet the requirements of Statewide Order (SWO) 29-N-6 **§3631** [Title 40, U.S. Code of Federal Regulations (40 CFR) **§146.92**]. It provides the steps that will be taken to plug and abandon the planned stages of well development including final abandonment. Any plugging activities required for the monitoring wells associated with this project are also discussed below. A complete plugging and abandonment procedure for the injection well has been included in *Appendix H-3* of this application.

As described in *Section 4 – Engineering Design and Operating Strategy*, the well will be completed with multiple injection horizons within the gross injection zone. Each injection interval will be utilized for a discrete period as identified in the carbon front model and operating plans. Once an active injection interval has been exhausted of CO₂ storage capabilities, the injection interval will be plugged to prevent crossflow conditions between new and existing injection intervals. Once the exhausted sand package has been plugged, a new injection interval uphole will be perforated and opened for injection. This process will be repeated until the entire gross injection interval has been fully developed. After approximately 20 years of injection, or when available storage capacity has been fully utilized, the well will be permanently plugged and abandoned.

The following details outline the procedures for both types of plugs to be installed in this well. In summary, the two types of plugs are:

1. Isolation of the active injection section via recompletion operations
2. Final plug and abandonment of the wellbore

6.2 Zonal Isolation of Injection Zone/Intermediate Plugback Plan

When the current zone has been exhausted of available pore space or the carbon front migration monitoring indicates storage capacity has been reached, the zone will be abandoned. The general procedure for zonal isolation is described below and illustrated by the first plugback schematic in Figure 6-1 (*Appendix H-1*).

6.2.1 Pre-Plugging Activities

1. Harvest Bend CCS LLC (Harvest Bend CCS) will comply with reporting and notification provisions.
 - a. The Underground Injection Control (UIC) Program Director (UIC Director) will be notified 60 days in advance of planned plugging efforts. [40 CFR **§146.92(c)**]
 - b. Notice of Intent to Plug will be communicated to the Louisiana Department of Natural Resources (LDNR) by submitting Form UIC-17 with detailed plans. [SWO 29-N-6 **§3631.A.4**]
 - c. Plugging operations will not start until the UIC Director approves the proposed plan.

2. Tubing pressure will be measured using the downhole gauge [REDACTED]. This measurement will provide information to calculate the well kill-weight fluid density. [SWO 29-N-6 §3631.A.3.a; 40 CFR §146.92(b)(1)]
3. External mechanical integrity will be demonstrated through approved logging methods, such as a temperature log [REDACTED], described in *Section 5*. [SWO 29-N-6 §3631.A.2; 40 CFR §146.92(a)]
4. Harvest Bend CCS will conduct a mechanical integrity test (MIT) to at least 500 pounds per square inch (psi) on the casing-tubing annulus.

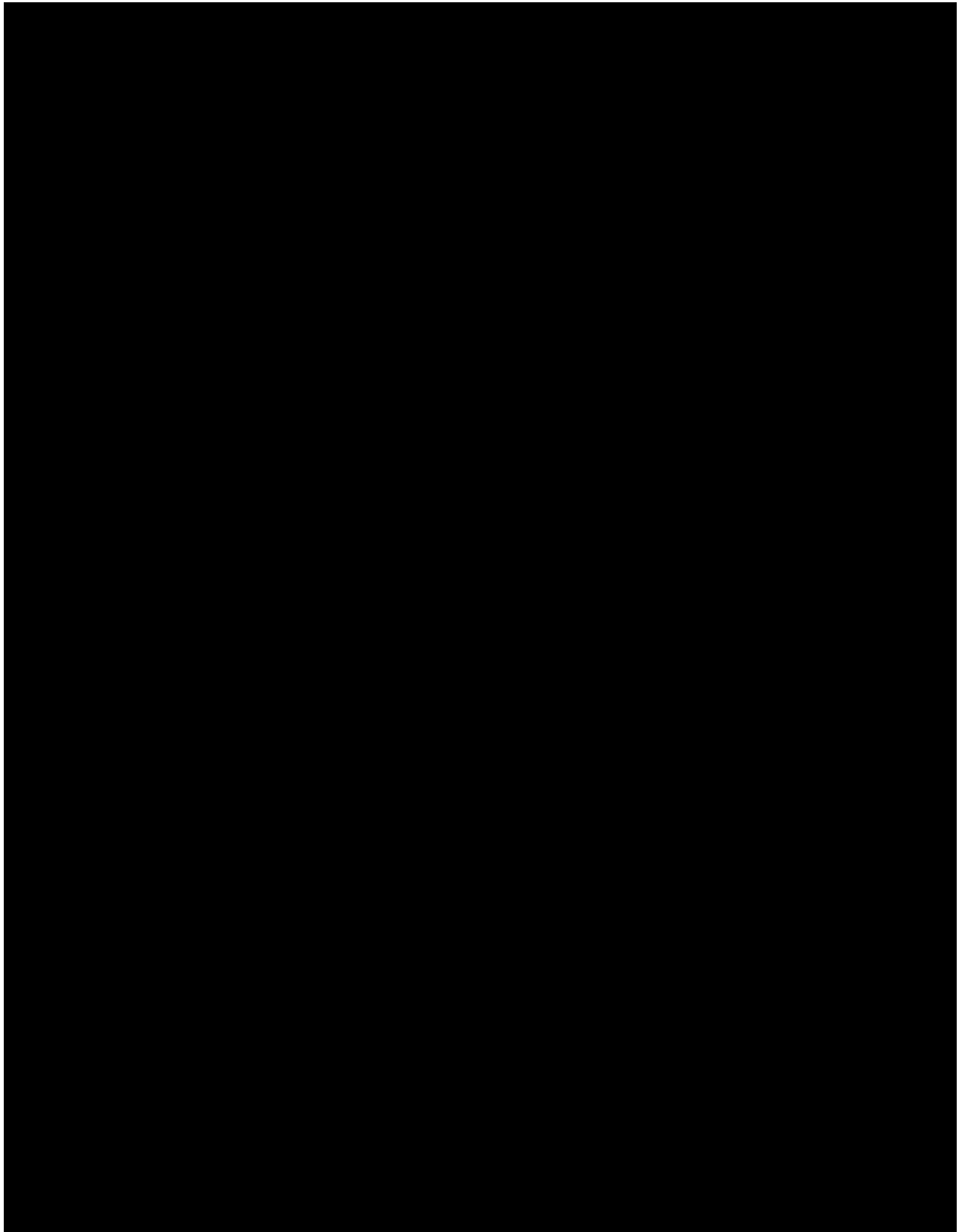


Figure 6-1 – WC IW-A No. 001 – First Plugback/Zonal Isolation Wellbore Schematic

6.2.2 Zonal Isolation Activities

1. After pressure testing the annulus, a CO₂ compatible thru tubing plug and cement will be set above the injection zone to be isolated.
2. The plug will be qualified by conducting a successful pressure test.

6.3 Final Plug and Abandonment

At the conclusion of the injection and post-injection pressure and temperature monitoring operations discussed in *Section 7 – Post-Injection Site Care and Site Closure Plan*, the injection well will be prepared for final plug and abandonment (P&A). Figure 6-2 shows the status of the wellbore following injection and post-injection monitoring operations and prior to final plug and abandonment.

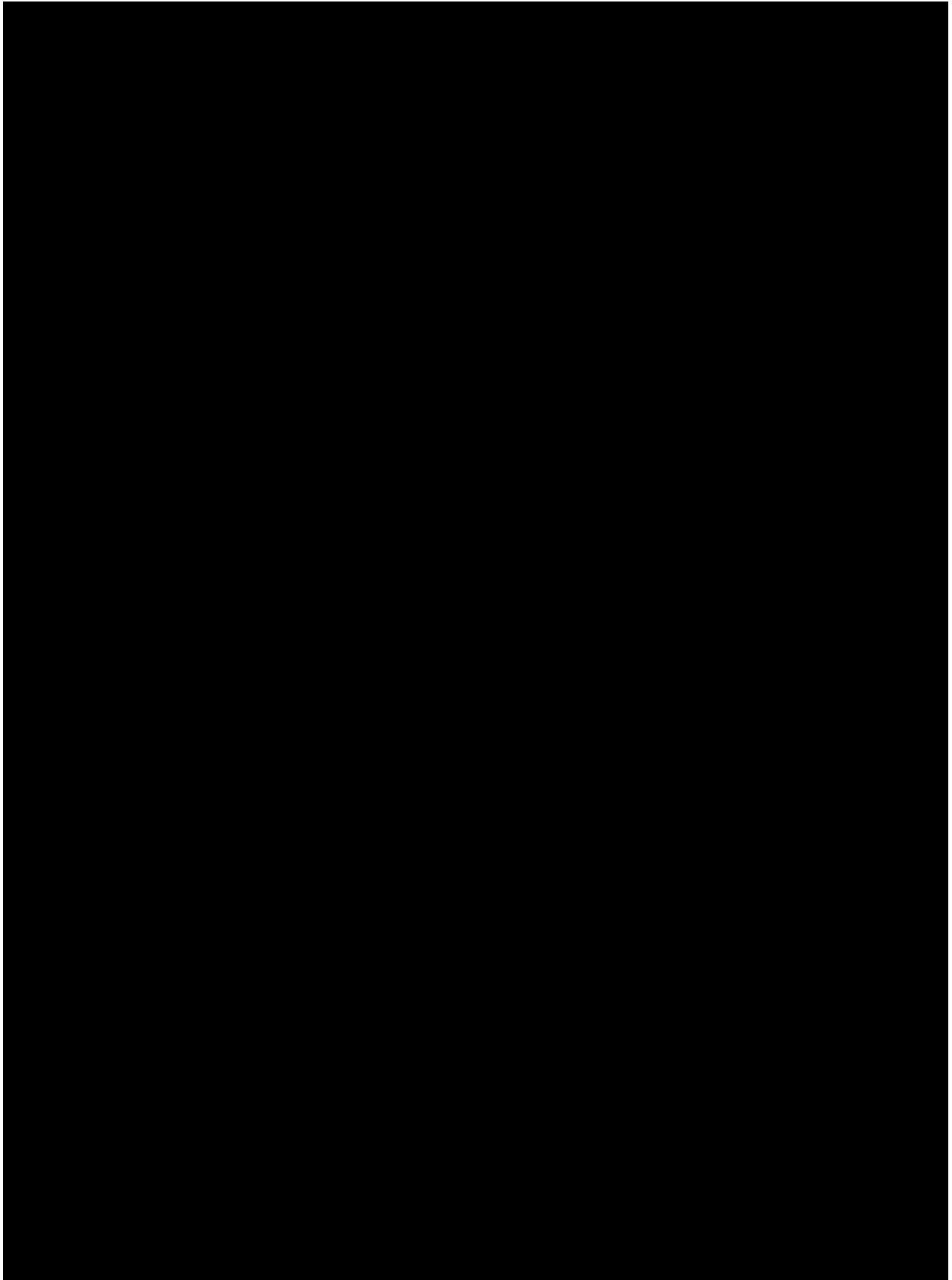


Figure 6-2 – WC IW-A No. 001 Prior to Final Plug and Abandonment

The general final plug and abandonment procedures are described below, and Figure 6-3 (*Appendix H-2*) shows the final plugged injection-well schematic.

6.3.1 Pre-Plugging Activities

1. Harvest Bend CCS will comply with all reporting and notification provisions.
 - a. The UIC Director will be notified 60 days in advance of planned plugging efforts. [40 CFR §146.92(c)]
 - b. Notice of Intent to Plug will be communicated to the LDNR by submitting Form UIC-17 with detailed plans. [SWO 29-N-6 §3631.A.4]
 - c. Plugging operations will not start until the UIC Director approves the proposed plan.
2. Casing inspection and cement bond logs will be performed prior to plugging.
3. Tubing pressure will be measured using the downhole gauge installed [REDACTED]. This measurement will provide information to calculate the well kill-fluid density. [SWO 29-N-6 §3631.A.3.a; 40 CFR §146.92(b)(1)]
4. External mechanical integrity will be demonstrated through approved logging methods, such as a temperature log [REDACTED], described in *Section 5*. [SWO 29-N-6 §3631.A.2; 40 CFR §146.92(a)]
5. All uncemented, non-permanent components of the well will be removed, if possible.

Table 6-1 – Description of Casing, Tubing, and Other Well Construction Materials to Be Removed

Well Component	Size	Amount	Notes/Comments
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	

6.3.2 Plugging Activities

The summary procedure is as follows. A full plugging procedure is included in *Appendix H-3*.


































































1. Flush the well with buffer/kill-weight fluid [SWO 29-N-6 §3631.A.2; 40 CFR §146.92(a)] and pressure test the annulus. Remove tubing and packer.
2. The gross injection interval will be fully isolated.

- a. A balanced, CO₂-resistant cement plug will be set across the final perforated injection interval extending ~150' above the base of the upper confining interval (UCI).
 - b. The plug will be qualified by tagging the top and conducting a successful pressure test.
 - c. A CO₂-resistant (CR) cast-iron bridge plug (CIBP) will be set at [REDACTED] and a balanced, CO₂-resistant cement plug pumped from [REDACTED].
 - d. The plug will be qualified by tagging the top.
3. [REDACTED]
 4. [REDACTED]
 5. [REDACTED]
 6. Casing will be cut 5' below plow level and a ½" steel plate, bearing the well serial number, welded on.

Final plugging reports, certified by the operator and the person who performed the plugging operation, will be submitted to the UIC Director within 30 days after plugging. Harvest Bend CCS will retain the final plugging report at least 10 years following site closure.

6.3.3 Plug Details

Table 6-2 – Plug Details for Plugs #1–#7






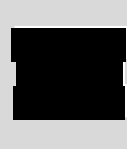
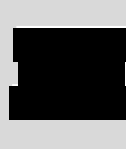




























































Plug Description							
Plug Number	1	2	3	4	5	6	7
Diameter of Bore in Which Plug Will Be Placed (in)							
Depth to Bottom of Workstring (MD)							
Sacks of Cement to Be Used (sks)							
Slurry Volume to Be Pumped (ft ³)							
Slurry Weight (lb/gal)							
Calculated Top of Plug (MD)							
Bottom of Plug (MD)							
Depth of Thru Tubing Plug (MD)							
Type of Cement or Other Material							
Method of Emplacement							

* 

MD = Measured Depth

sks = Sacks

Table 6-3 – Plug Details for Plugs #8–#14

Plug Description							
Plug Number	8	9	10	11	12	13	14
Diameter of Bore in Which Plug Will Be Placed (in)							
Depth to Bottom of Workstring (MD)							
Sacks of Cement to Be Used (each plug) (sks)							
Slurry Volume to Be Pumped (ft³)							
Slurry Weight (lb/gal)							
Top of Plug (MD)							
Bottom of Plug (MD)							
Depth of Thru Tubing Plug (MD)							
Type of Cement or Other Material							
Method of Emplacement							

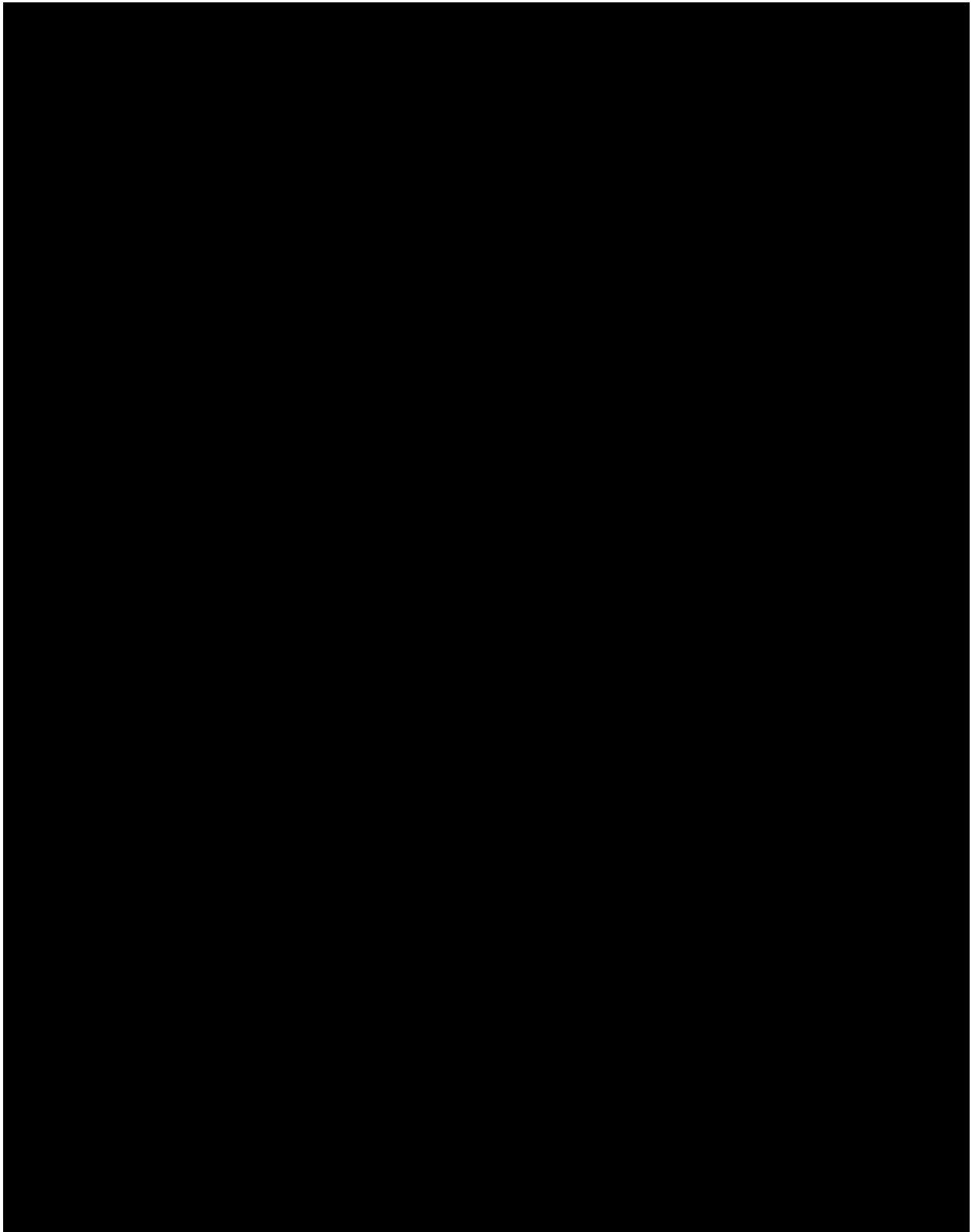


Figure 6-3 – WC IW-A No. 001 – Plugged Wellbore Schematic

6.4 Monitoring Wells Plugging and Abandonment

When the storage space has been fully utilized and the post-injection site care period, as discussed in *Section 7 – Post-Injection Site Care and Site Closure Plan*, has ended, monitoring the carbon front and ground water will no longer be needed. At this time, all monitoring wells will be prepared for P&A and plugged in a manner which will not allow movement of injection or formation fluids that endangers a USDW.

Both types of monitoring wells will be drilled to depths that are too shallow to intersect injection layers, confinement layers, or the corrosive injectate fluids. As such, there is no need for a plugging procedure designed for containment of, or resistance to, acidic fluids.

General plugging plans for the monitoring wells are provided below. The proposed plugging schematic for the above-zone monitoring well (WC AZMW-A No. 001) [REDACTED] is shown in Figure 6-4 (*Appendix H-4*).

6.4.1 Above-Zone Monitoring Well Plugging Activities

1. After pressure testing the annulus, the well will be flushed with kill-weight fluid.
2. Squeeze perforations with cement. Wait on cement (WOC), tag top of plug, then conduct a successful pressure test.
3. Remove tubing and packer.
4. Perform casing-inspection log and cement bond log.
5. A CIBP will be set at [REDACTED] with [REDACTED] of class H cement pumped on top of it to plug across the [REDACTED] surface casing shoe and base of the USDW.
6. A [REDACTED] cement plug will be spotted from [REDACTED].
7. Casing will be cut 5' below plow level and a ½" steel plate, bearing the well serial number, welded on.

Final plugging reports, certified by the operator and the person who performed the plugging operation, will be submitted to the UIC Director within 60 days after plugging.

6.4.2 Groundwater Monitoring Well Plugging Activities

1. The perforated monitoring interval will be squeezed with cement to seal off exposure to the USDW.
2. The plug will be qualified by tagging the top and conducting a successful pressure test.
3. The wellbore will be filled with grout to [REDACTED].
4. A [REDACTED] cement plug will be spotted at surface and the casing cut off to 5' below ground level.
5. A ½" steel plate will then be welded across the top of the casing.

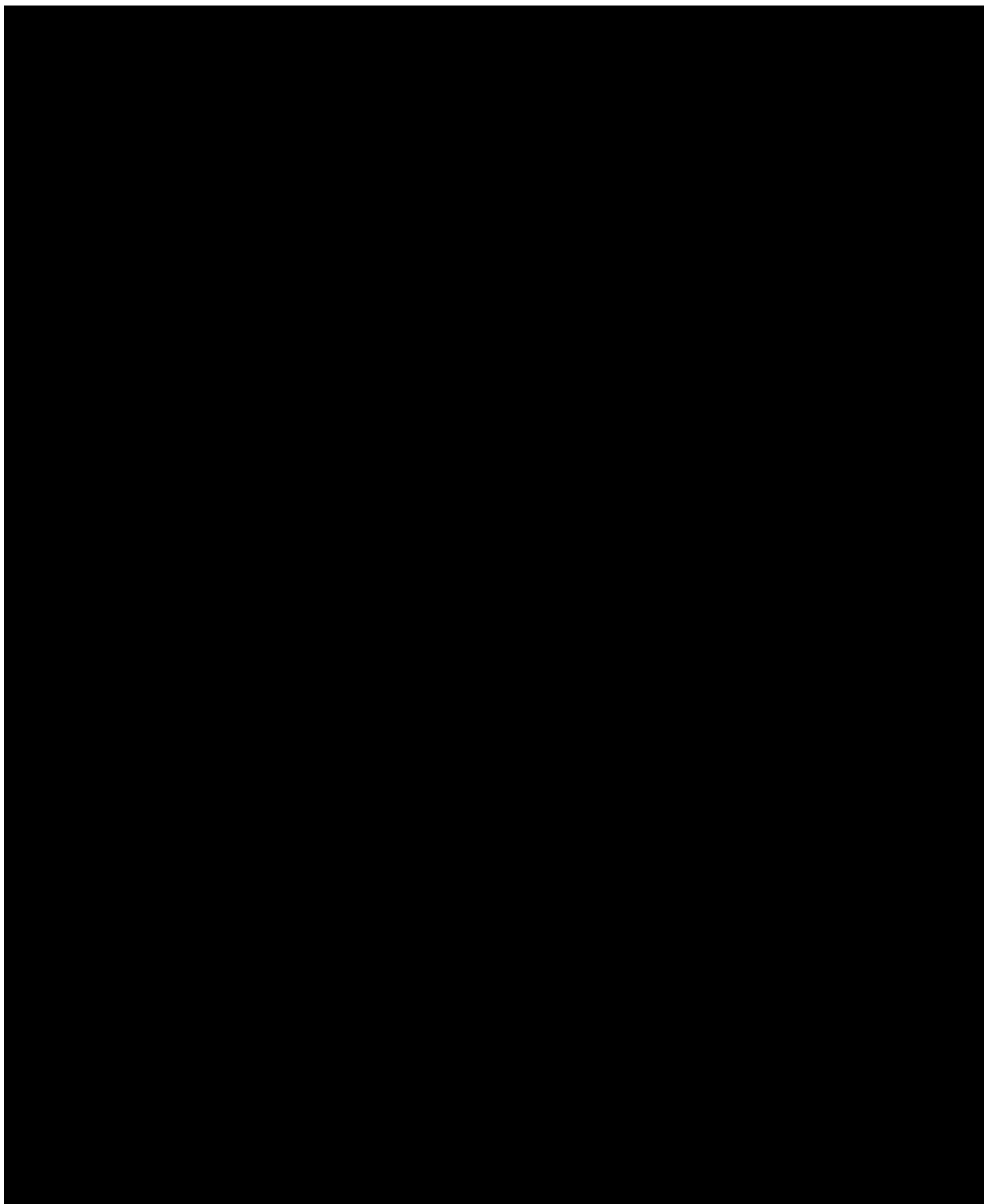


Figure 6-4 – WC AZMW-A No. 001 – Plugged Wellbore Schematic

Detailed schematics and procedures are provided in *Appendix H*, as follows:

- Appendix H-1 WC IW-A No. 001 – First Plugback/Zonal Isolation Wellbore Schematic
- Appendix H-2 WC IW-A No. 001 – Plugged Wellbore Schematic
- Appendix H-3 WC IW-A No. 001 – Detailed Plugging Procedure
- Appendix H-4 WC AZMW-A No. 001 – Plugged Wellbore Schematic