



Orchard Storage Company LLC

Underground Injection Control – Class VI Permit Application for

Orchard No. 1 to No. 7

Section 6 – Plugging and Abandonment Plan

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May 2023



SECTION 6 – INJECTION WELL PLUGGING PLAN

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6.1 Injection Well Plugging Plan Overview

As described in *Section 4 – Engineering Design and Operating Strategy*, the Orchard Storage Company LLC (Orchard Storage) injection wells Orchard No. 1 through No. 7 will be completed as a single injection interval within the [REDACTED]. After the conclusion of the [REDACTED] injection operations, the wells will be permanently plugged. Complete plugging and abandonment prognoses are included in *Appendix G*.

The following outline describes the procedures and types of plugs that will be set to isolate the injection interval, to prevent contamination of the Underground Sources of Drinking Water (USDWs), and to properly plug and abandon Orchard No. 1 through No. 7 according to Title 16, Texas Administrative Code (16 TAC) **§5.203** and 16 TAC **§3.14** [Title 40, U.S. Code of Federal Regulations (40 CFR) **§146.92**] regulations.

6.1.1 Injection Well Pre-Plugging Activities

1. Orchard Storage will comply with all reporting and notification provisions.
 - a. The Environmental Protection Agency (EPA) Underground Injection Control (UIC) Director will be notified 60 days in advance of planned plugging efforts [40 CFR **§146.92(c)**].
 - b. The Texas Railroad Commission (TRRC) and the UIC Director will be notified at least 60 days before plugging a well. If any changes are proposed to the original well-plugging plan, a revised plan will be submitted [16 TAC **§5.201(k)(3)(A)**].
 - c. A notice of intention to plug and abandon (Form W-3A) will be filed with the appropriate TRRC district office and the UIC Director at least 5 days prior to the beginning of plugging operations.
 - d. Plugging operations will not start until the Director approves the proposed procedure.
 - e. The district office will be notified at least 4 hours before commencing plugging operations.
2. Casing inspection and cement bond logs will be run prior to plugging.
3. Bottomhole reservoir pressure will be measured using the downhole pressure gauges permanently installed behind the [REDACTED] in.) production casing string. Details for this system are provided in *Section 5 – Testing and Monitoring Plan* (16 TAC **§5.203 (h)(1)(C)** [40 CFR **§146.89(b)**]).
4. External mechanical integrity will be demonstrated through approved temperature logging methods as described in *Section 5*, per 16 TAC **§5.203 (h)(1)(D)** [40 CFR **§146.89(c)**].
5. Injection well will be flushed with a buffer fluid prior to pulling the injection tubing and packer (16 TAC **§5.203** and **§3.14** [40 CFR **§146.92(a)**]).
6. Tubing and packer seal assembly will be pulled prior to plugging and abandonment (P&A) operations.

6.1.2 Injection Well Plugging Activities

1. Pull seal assembly from the packer to just above the packer.
2. Fill the wellbore with at least 9.5 pounds per gallon (ppg) of 40 viscosity-treated drilling mud, and ensure the well is in static condition.
3. Pull tubing and seal assembly and remove from the well.
4. Isolate the gross injection interval:
 - a. Set a permanent bridge plug made of corrosion-resistant alloy (CRA) at approximately 50 feet (ft) below the upper confinement zone in the [REDACTED].
 - b. Place a 300 ft acid-resistant cement plug above the permanent bridge plug to cover the length of the upper confining zone.
 - c. Displace the cement with at least 9.5 ppg of 40 viscosity-treated drilling mud.
 - d. The plug will be qualified by tagging the top and conducting a successful pressure test.
5. Spot a ~400 ft cement plug from at least 50 ft below the surface-casing setting depth, to a minimum of 50 ft into the base of the USDW. Displace cement with at least 9.5 ppg of 40 viscosity-treated drilling mud.
6. Set a 50 ft cement plug from 50 ft to the surface.
7. Cut casing 3 ft below ground level and weld on a ½ in. steel plate.

Within 60 days after plugging, Orchard Storage will submit, pursuant to 40 CFR **§146.91(e)**, a certified well-plugging report to the Director. The report will be retained for 10 years following site closure. Also note that a complete well-plugging record (Form W-3), pursuant to 16 TAC **§5.203**, will be filed within **30 days** to the appropriate TRRC district office after plugging operations are completed.

6.1.3 Orchard No. 1 Plugging and Abandonment

Figure 6-1 shows the original wellbore schematic for Orchard No. 1, prior to beginning plugging operations.

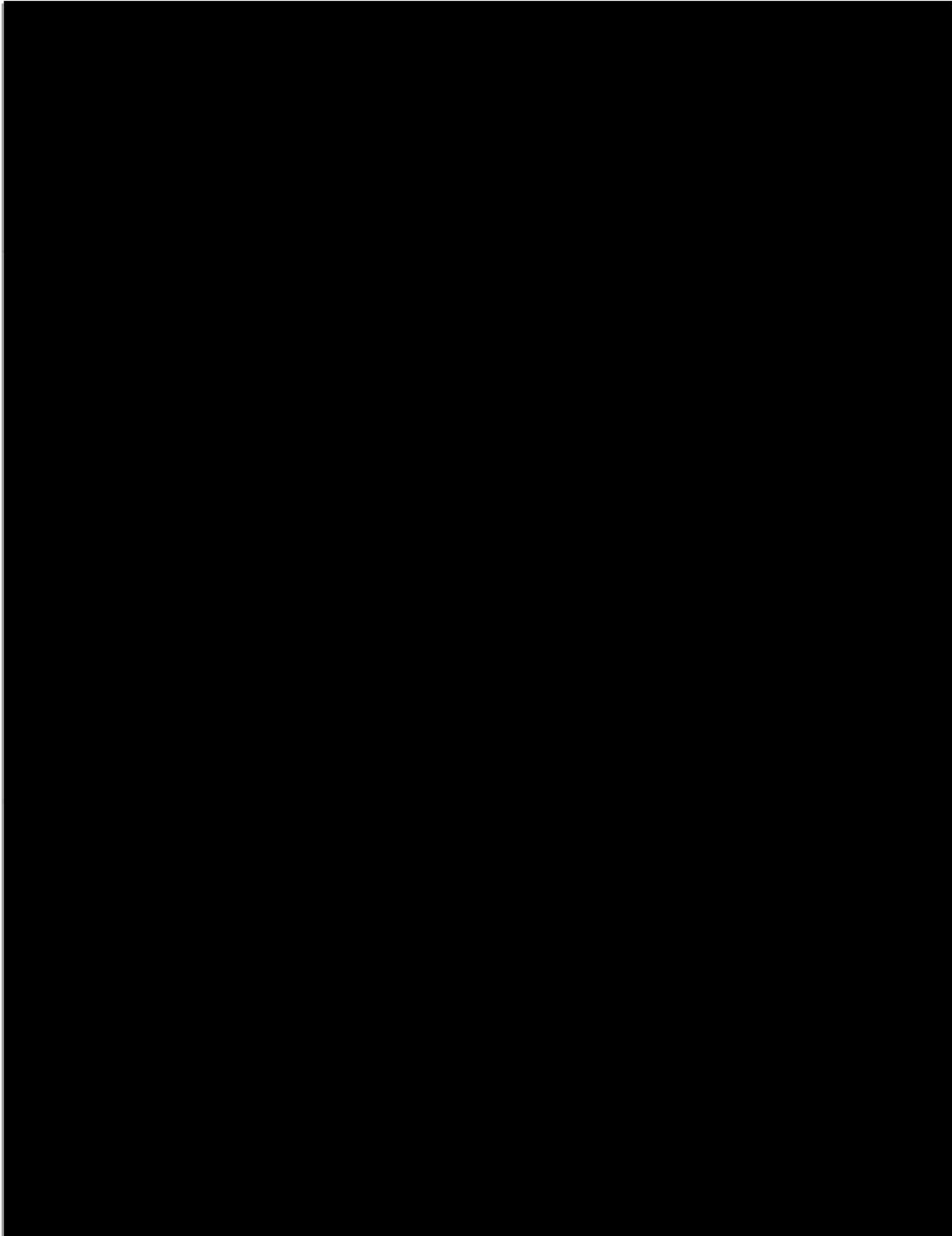


Figure 6-1 – Wellbore Schematic for Orchard No. 1 Before Plugging and Abandoning

6.1.3.1 Plug Details

Table 6-1 shows the planned plugging details for Orchard No. 1. Figure 6-2 shows a schematic of the injection well after it is plugged.

Table 6-1 – Plugging Details for Orchard No. 1

Plug Number	
Purpose	
Casing Outer Diameter (OD)	
Casing Inner Diameter (ID)	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

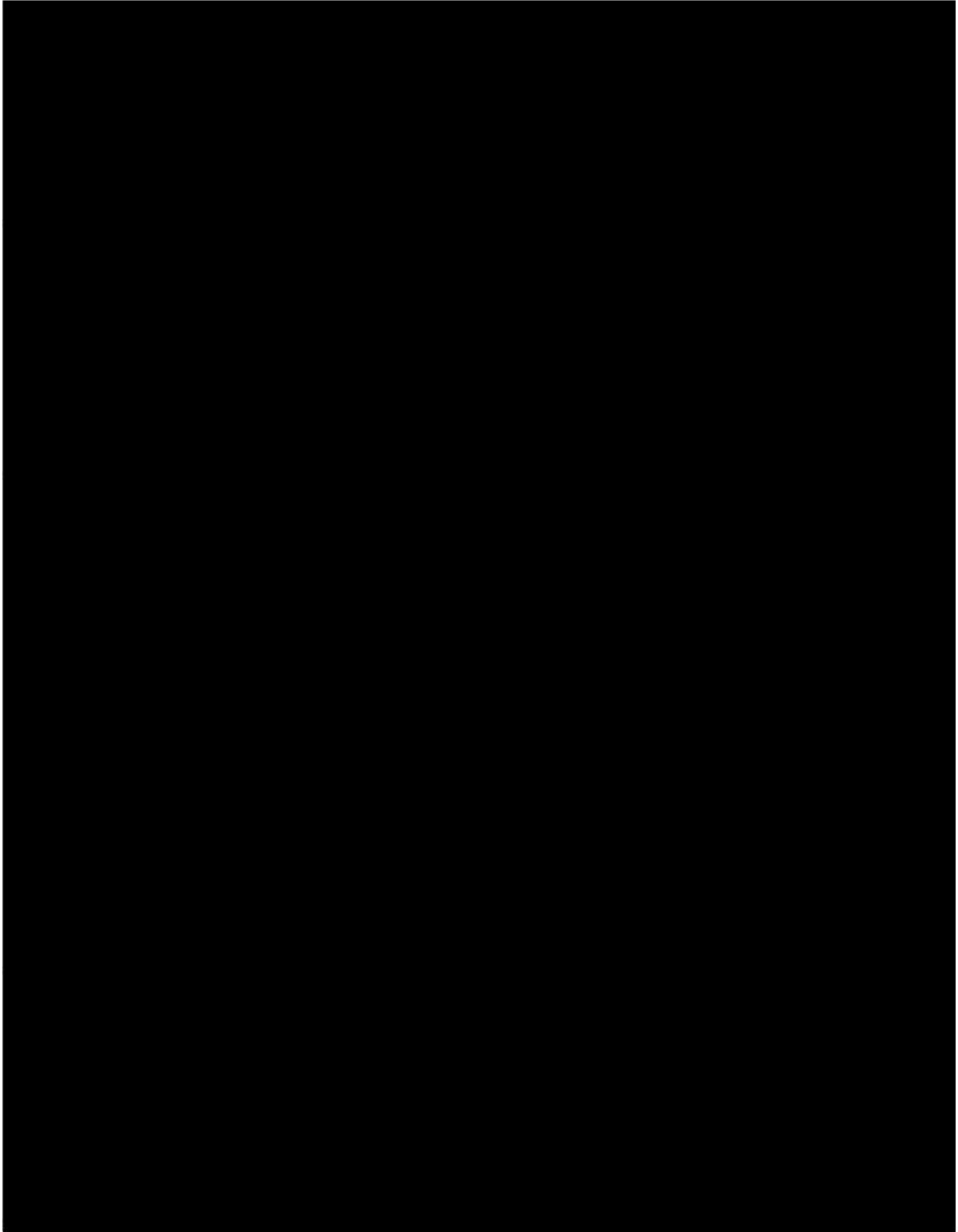


Figure 6-2 – Plugging Schematic for Orchard No. 1

6.1.4 Orchard No. 2 Plugging and Abandonment

Figure 6-3 shows the original wellbore schematic for Orchard No. 2, prior to beginning plugging operations.

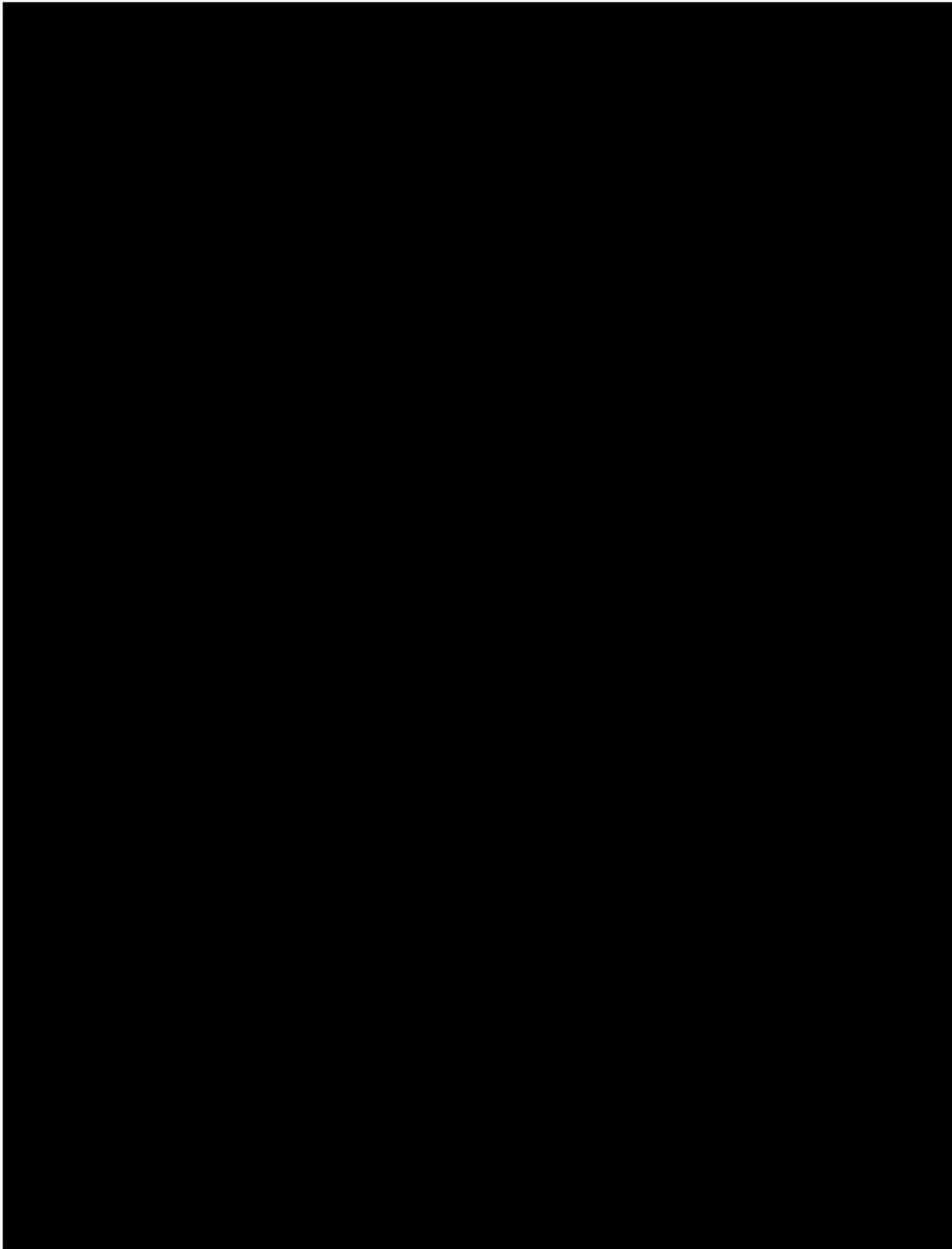


Figure 6-3 – Wellbore Schematic for Orchard No. 2 Before Plugging and Abandoning

6.1.4.1 Plug Details

Table 6-2 shows the planned plugging details for Orchard No. 2. Figure 6-4 shows a schematic of the injection well after it is plugged.

Table 6-2 – Plugging Details for Orchard No. 2

Plug Number				
Purpose				
Casing OD				
Casing ID				
Top of Plug				
Bottom of Plug				
Cement Volume (sacks)				
Slurry Volume (ft ³)				
Slurry Weight (lb/gal)				
Type of Cement or Other Material				
Placement				

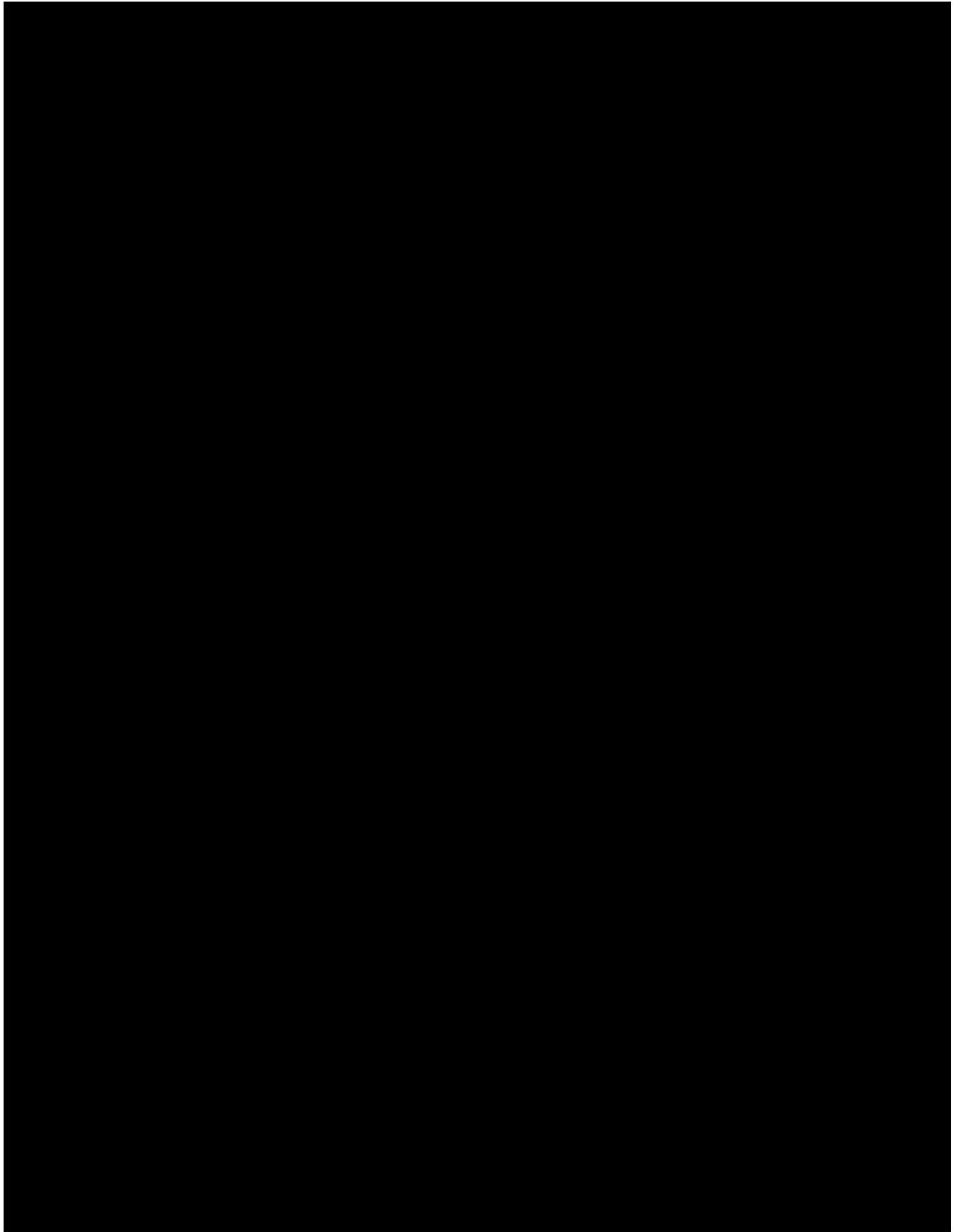


Figure 6-4 – Plugging Schematic for Orchard No. 2

6.1.5 Orchard No. 3 Plugging and Abandonment

Figure 6-5 shows the original wellbore schematic for Orchard No. 3, prior to beginning plugging operations.

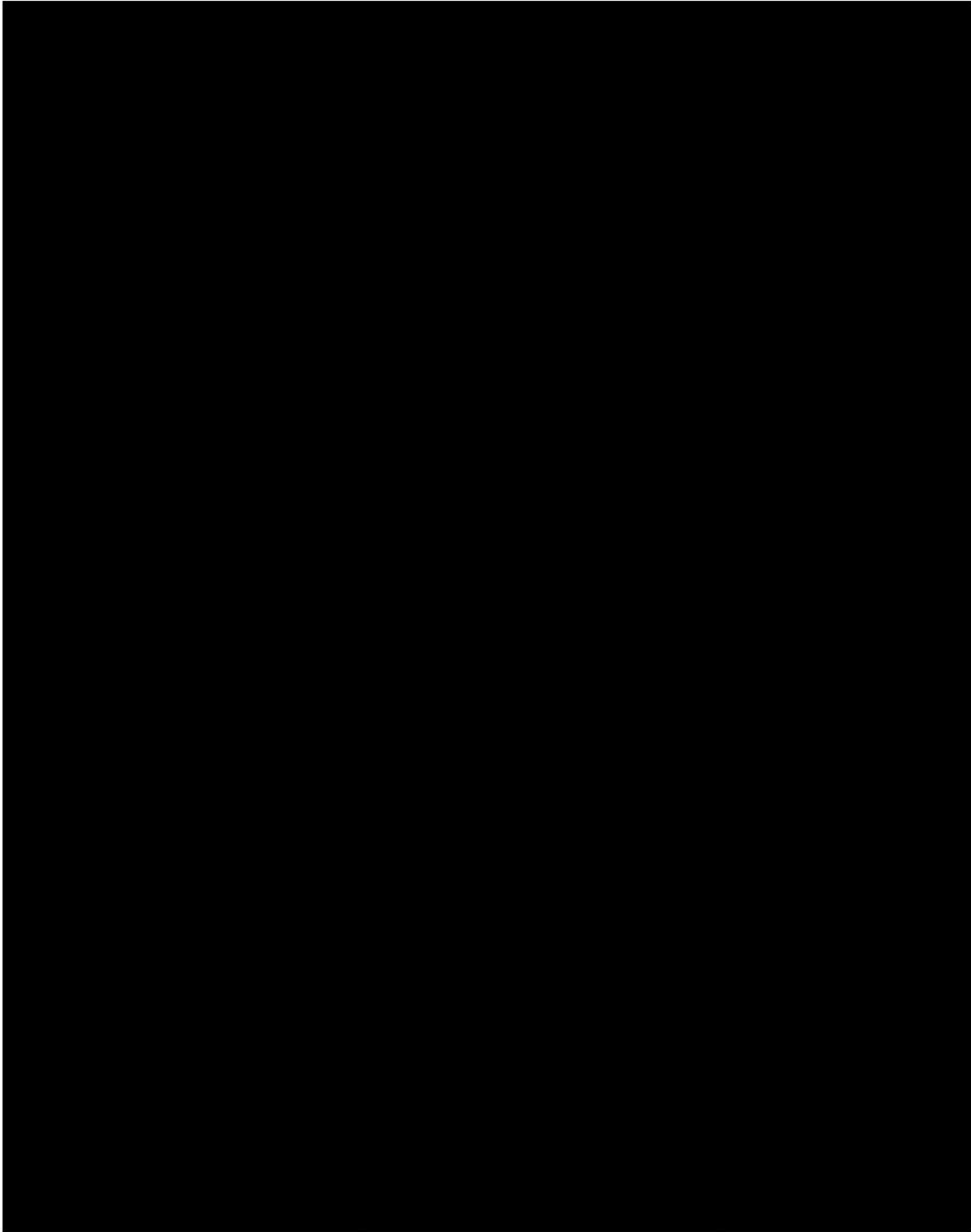


Figure 6-5 – Wellbore Schematic for Orchard No. 3 Before Plugging and Abandoning

6.1.5.1 Plug Details

Table 6-3 shows the planned plugging details for Orchard No. 3. Figure 6-6 shows a schematic of the injection well after it is plugged.

Table 6-3 – Plugging Details for Orchard No. 3

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

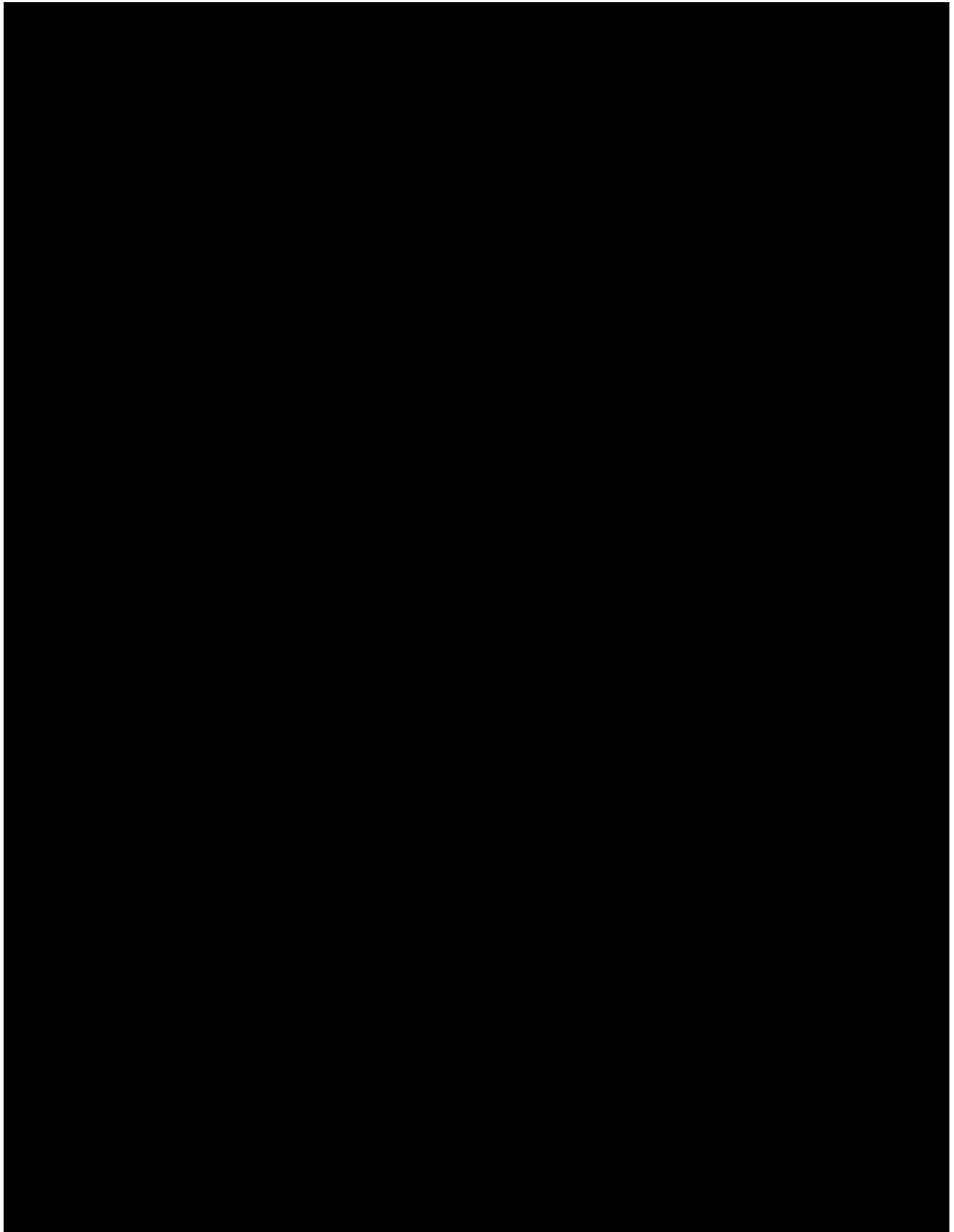


Figure 6-6 – Plugging Schematic for Orchard No. 3

6.1.6 Orchard No. 4 Plugging and Abandonment

Figure 6-7 shows the original wellbore schematic for Orchard No. 4, prior to beginning plugging operations.

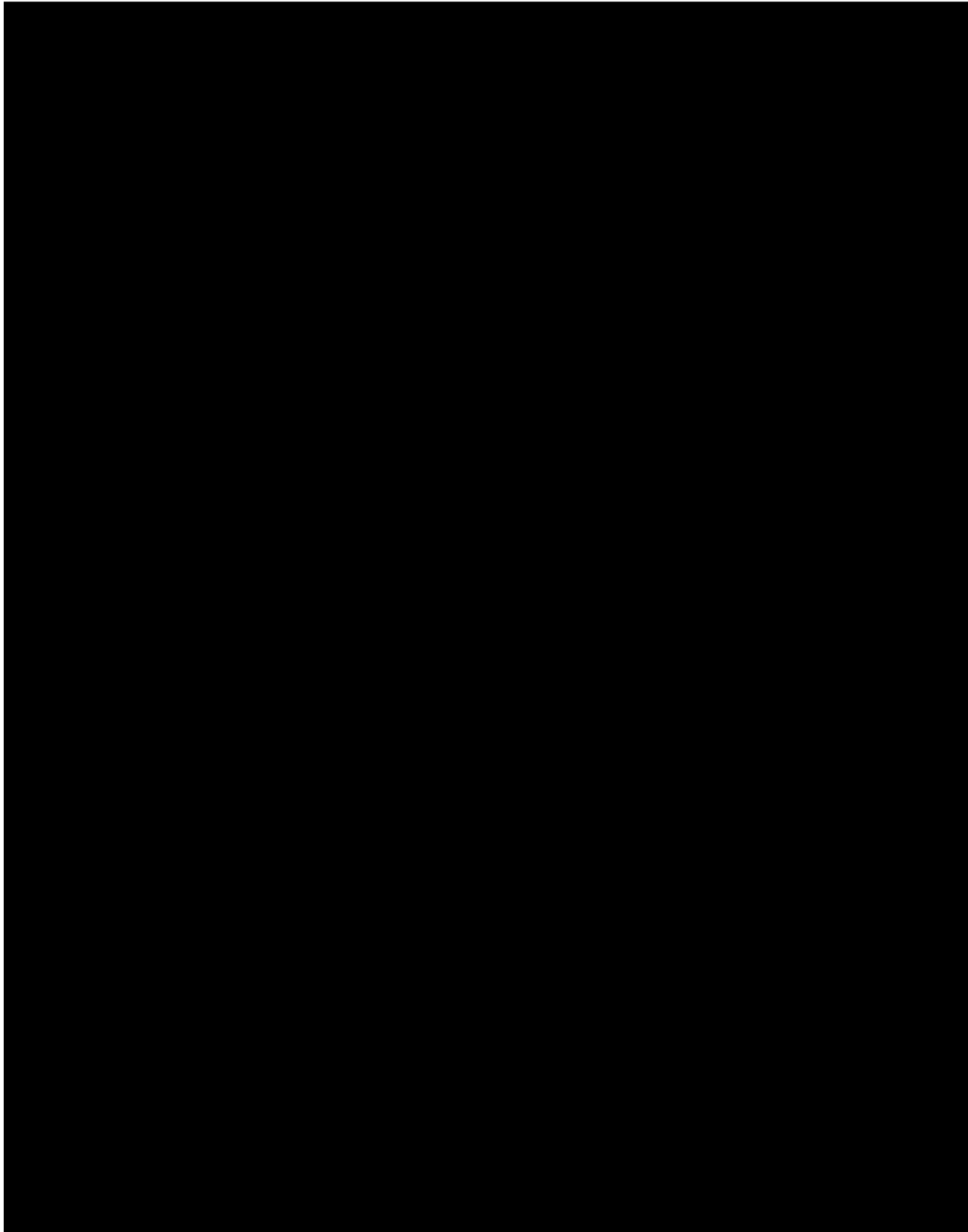


Figure 6-7 – Wellbore Schematic for Orchard No. 4 Before Plugging and Abandoning

6.1.6.1 Plug Details

Table 6-4 shows the planned plugging details for Orchard No. 4. Figure 6-8 shows a schematic of the injection well after it is plugged.

Table 6-4 – Plugging Details for Orchard No. 4

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

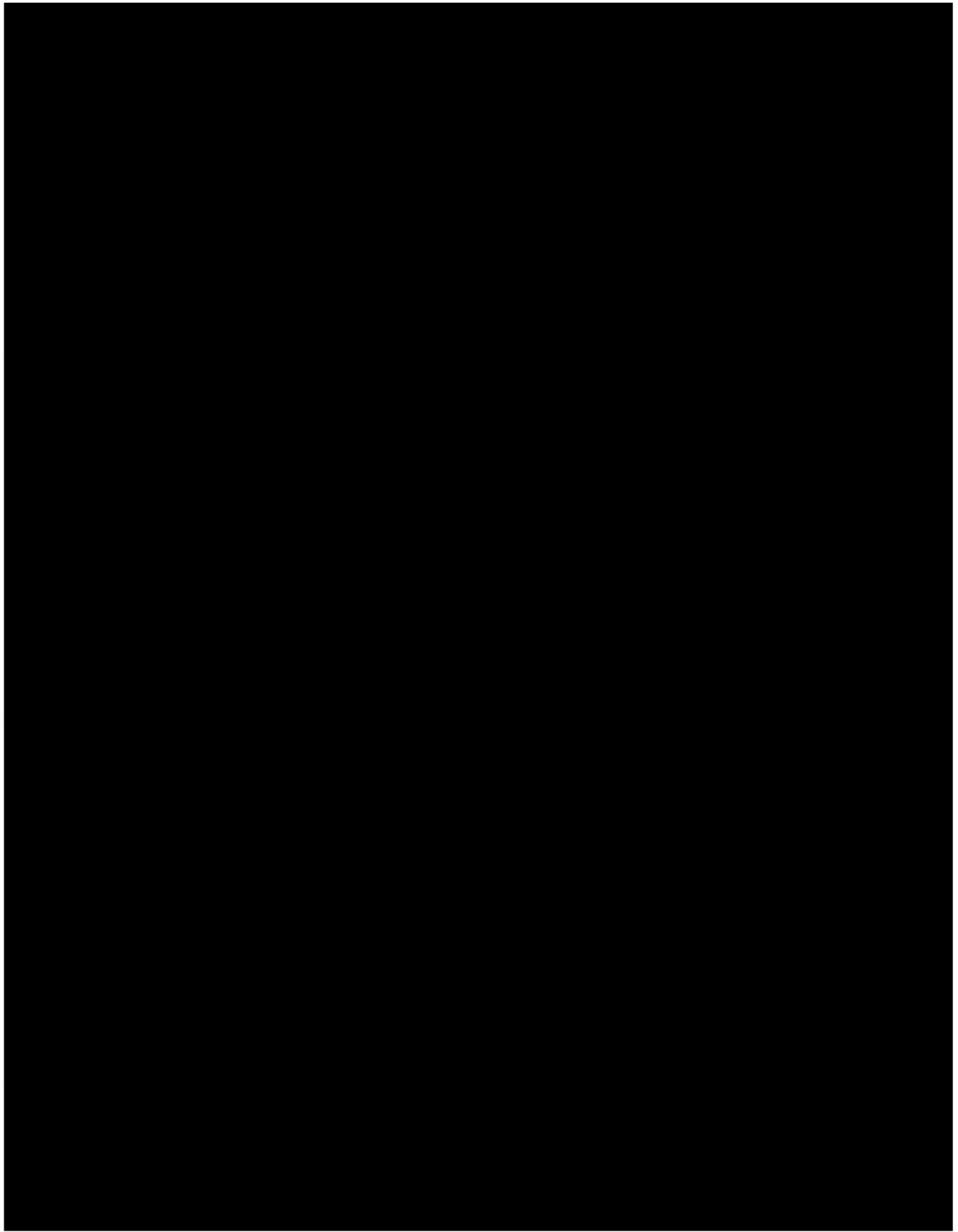


Figure 6-8 – Plugging Schematic for Orchard No. 4

6.1.7 Orchard No. 5 Plugging and Abandonment

Figure 6-9 shows the original wellbore schematic for Orchard No. 5, prior to beginning plugging operations.

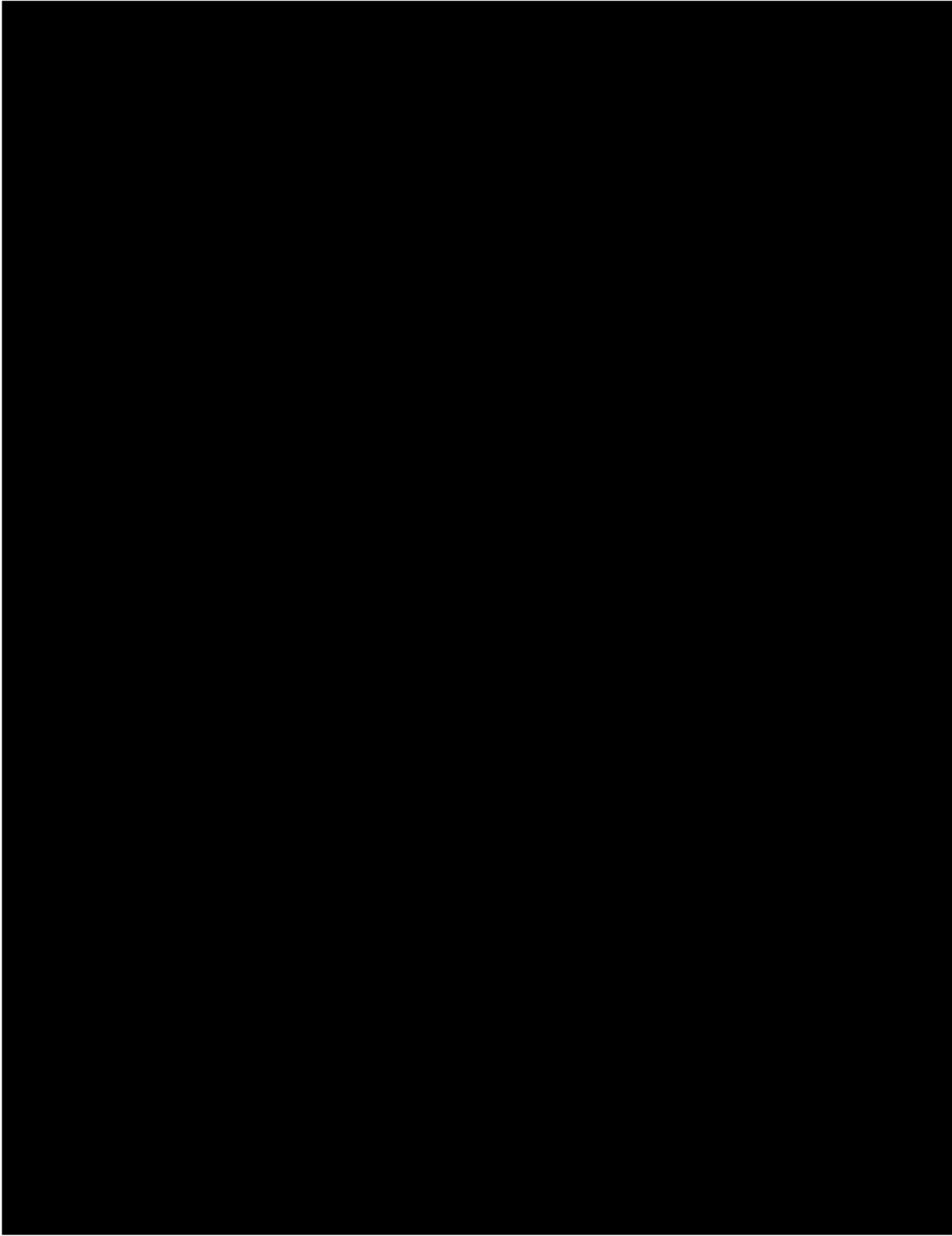


Figure 6-9 – Wellbore Schematic for Orchard No. 5 Before Plugging and Abandoning

6.1.7.1 Plug Details

Table 6-5 shows the planned plugging details for Orchard No. 5. Figure 6-10 shows a schematic of the injection well after it is plugged.

Table 6-5 – Plugging Details for Orchard No. 5

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

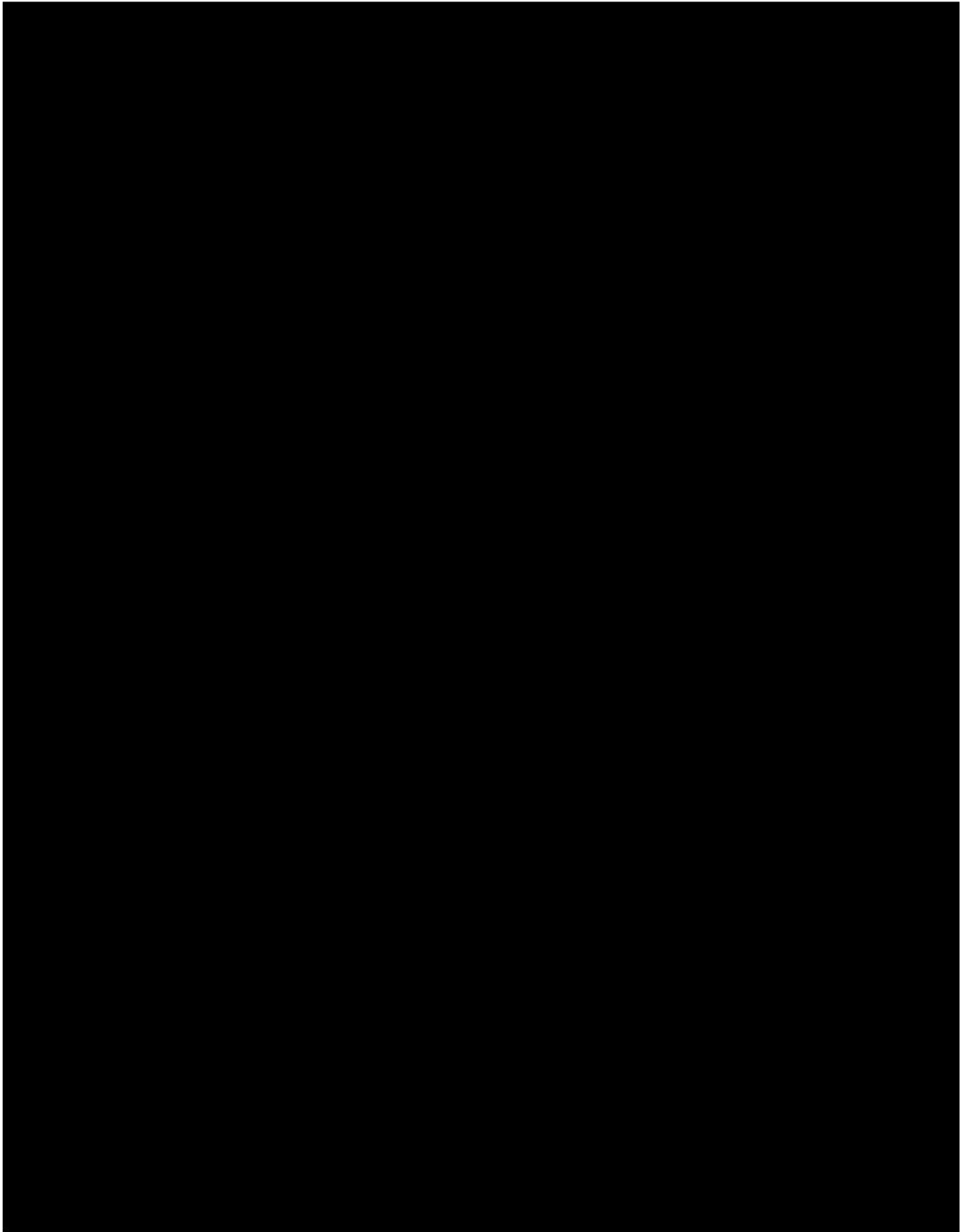


Figure 6-10 – Plugging Schematic for Orchard No. 5

6.1.8 Orchard No. 6 Plugging and Abandonment

Figure 6-11 shows the original wellbore schematic for Orchard No. 6, prior to beginning plugging operations.

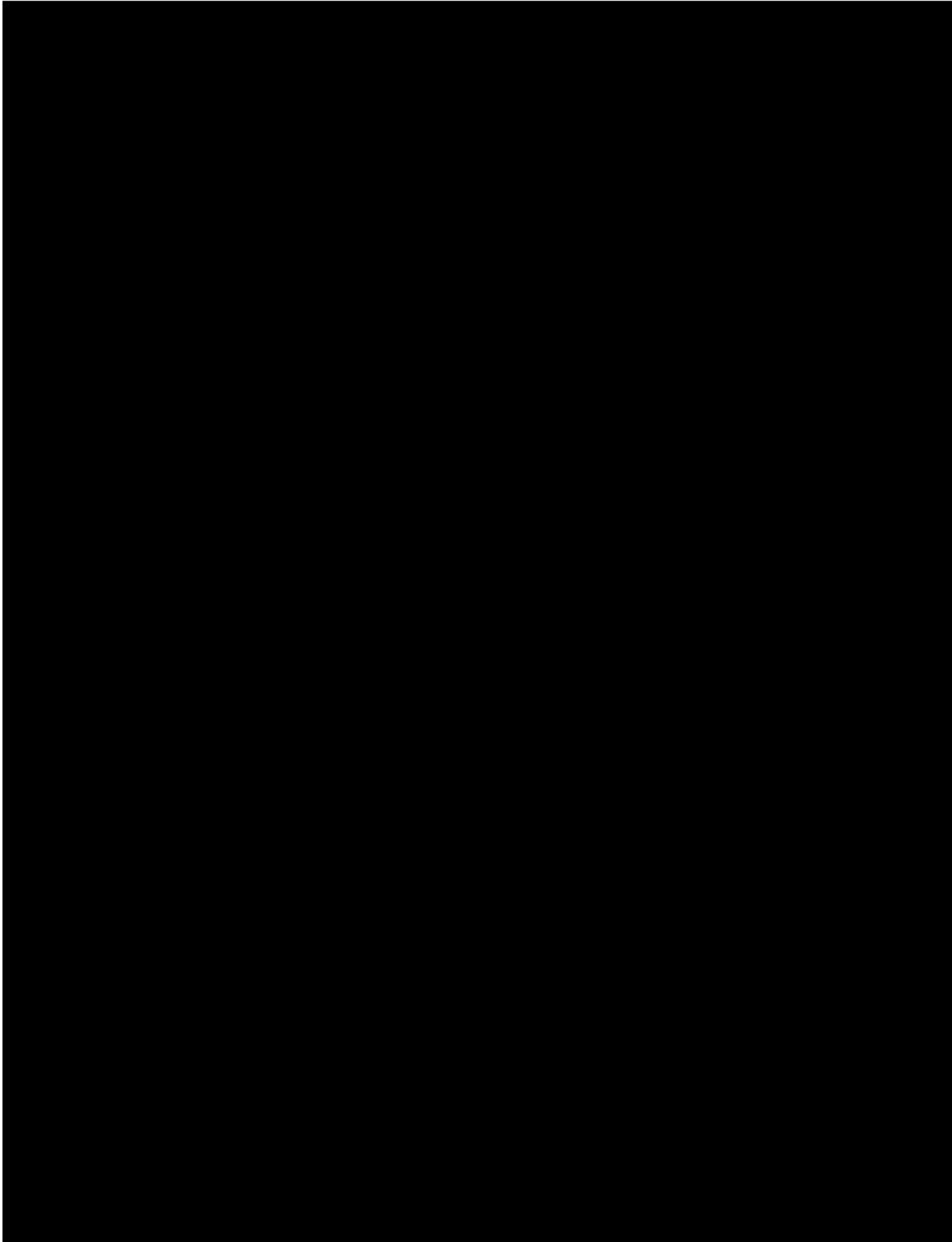


Figure 6-11 – Wellbore Schematic for Orchard No. 6 Before Plugging and Abandoning

6.1.8.1 Plug Details

Table 6-6 shows the planned plugging details for Orchard No. 6. Figure 6-12 shows a schematic of the injection well after it is plugged.

Table 6-6 – Plugging Details for Orchard No. 6

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

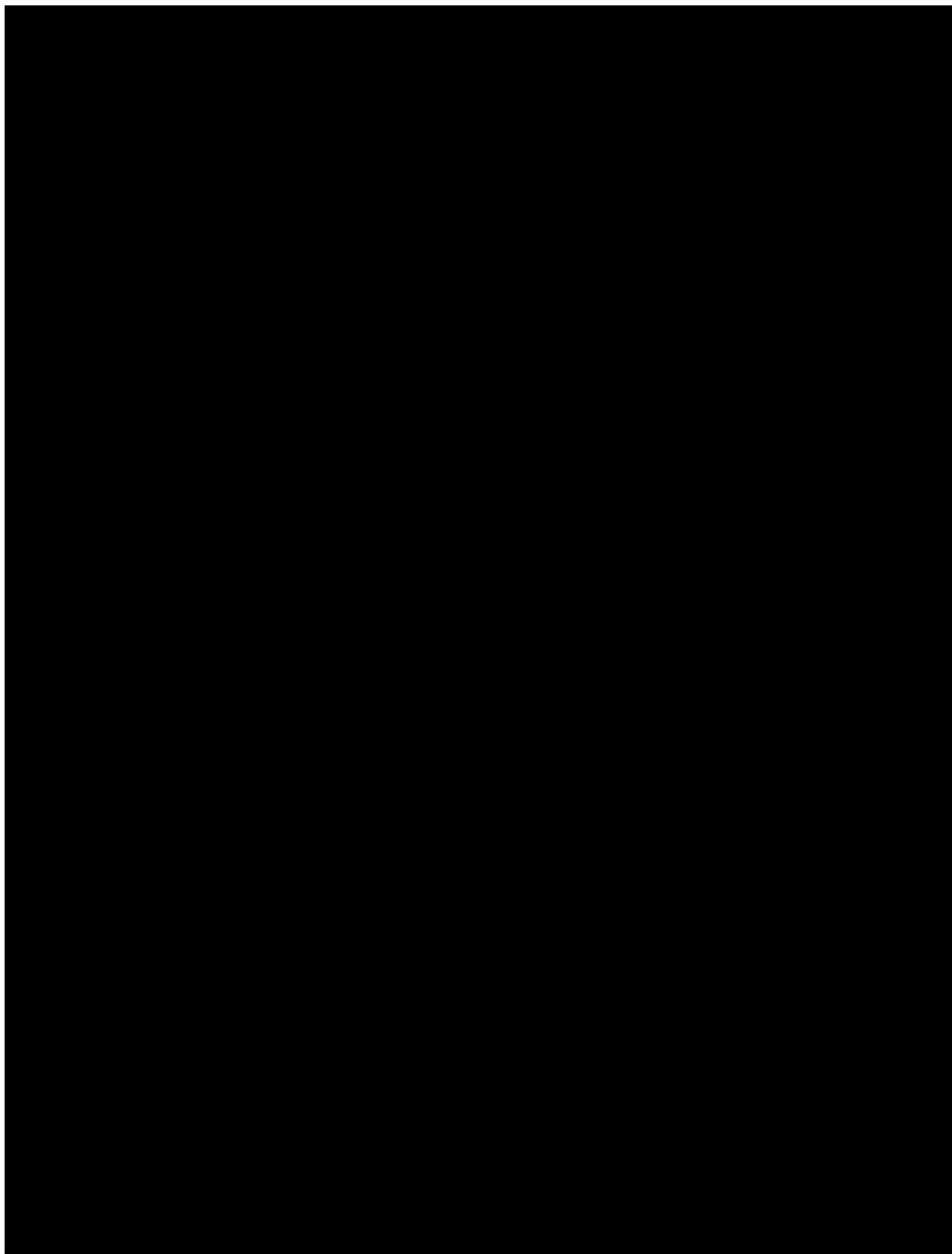


Figure 6-12 – Plugging Schematic for Orchard No. 6

6.1.9 Orchard No. 7 Plugging and Abandonment

Figure 6-13 shows the original wellbore schematic for Orchard No. 7, prior to beginning plugging operations.

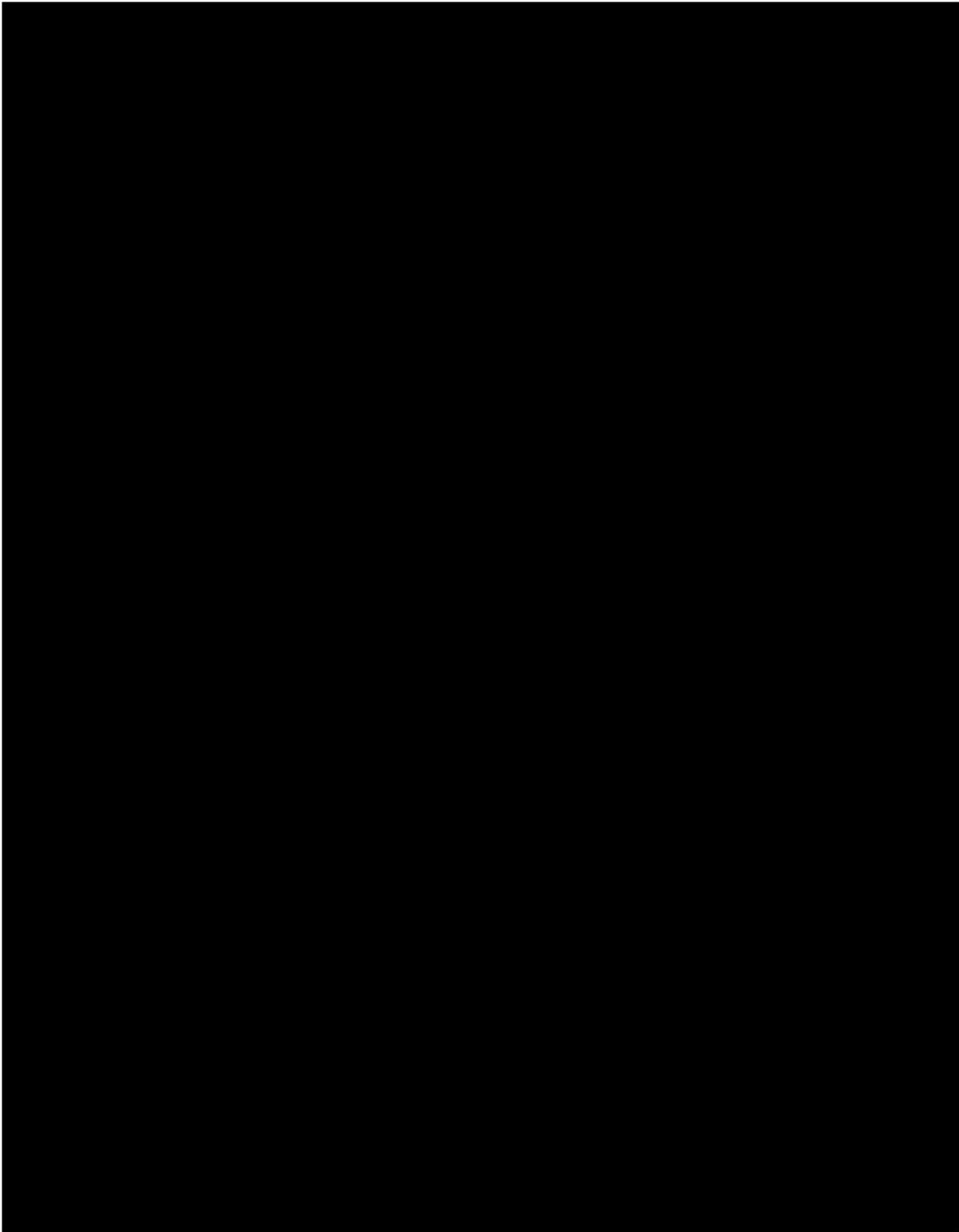


Figure 6-13 – Wellbore Schematic for Orchard No. 7 Before Plugging and Abandoning

6.1.9.1 Plug Details

Table 6-7 shows the planned plugging details for Orchard No. 2. Figure 6-14 shows a schematic of the injection well after it is plugged.

Table 6-7 – Plugging Details for Orchard No. 7

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

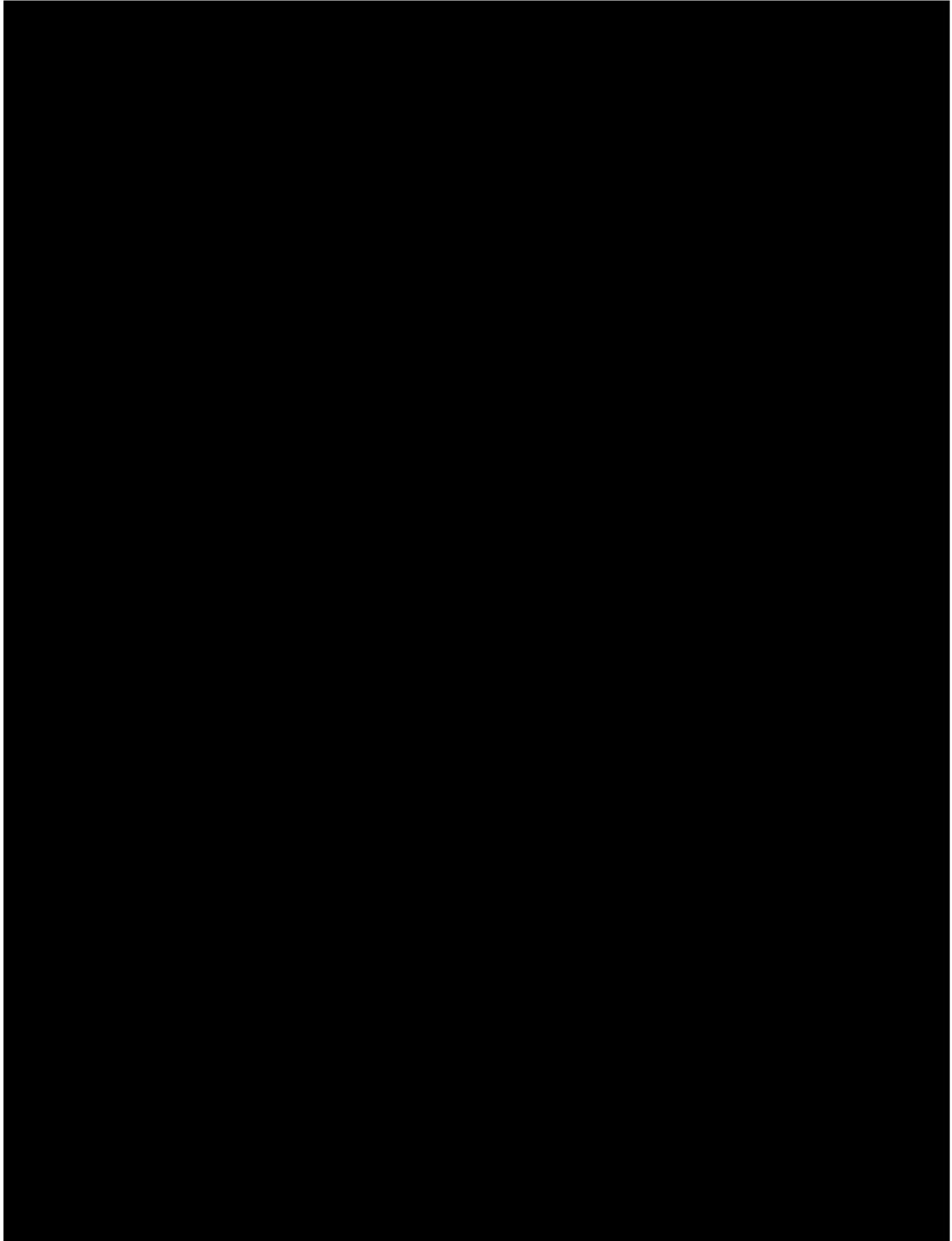


Figure 6-14 – Plugging Schematic for Orchard No. 7

6.2 Monitoring Well Plugging Plan and Regulatory Requirements

As described in *Section 4 – Engineering Design and Operating Strategy*, Orchard MW No. 1 and MW No. 3 will be completed as a single perforated interval just above the upper confinement layer. The Orchard MW No. 2 will be recompleted as an in-zone monitoring well. At the conclusion of the post-injection site care period, the well will be permanently plugged. Complete plugging and abandonment prognoses are in *Appendix G*.

The following outline describes the procedures and types of plugs that will be set to isolate the perforated interval and to prevent contamination of the USDWs. Orchard MW No. 1 will be properly plugged and abandoned according to 16 TAC **§5.203** and **§3.14** [40 CFR **§146.92**] regulations.

6.2.1 Monitoring Well Pre-Plugging Activities

1. Orchard Storage 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. The TRRC and the UIC Director will be notified at least 60 days before plugging a well. If any changes are proposed to the original well-plugging plan, a revised plan will be submitted [16 TAC **§5.201(k)(3)(A)**].
 - c. A notice of intention to plug and abandon (Form W-3A) will be filed with the appropriate TRRC district office and the UIC Director at least 5 days prior to the beginning of plugging operations.
 - d. Plugging operations will not start until the proposed procedure has been approved by the UIC Director.
 - e. The district office will be notified at least 4 hours before commencing plugging operations.
2. Casing inspection and cement bond logs will be run prior to plugging.
3. External mechanical integrity will be demonstrated through approved temperature logging methods as described in *Section 5 – Testing and Monitoring Plan*, per 16 TAC **§5.203 (h)(1)(D)** [40 CFR **§146.89(c)**].
4. The monitoring well will be flushed with a buffer fluid prior to pulling the injection tubing and packer seal assembly (16 TAC **§5.203** and **§3.14** [40 CFR **§146.92(a)**]).
5. Tubing and packer seal assembly will be pulled prior to P&A operations.

6.2.2 Monitoring Well Plugging Activities

1. Pull seal assembly from the packer to just above the packer.
2. Fill the wellbore with at least 9.5 ppg, 40 viscosity-treated drilling mud, and ensure the well is in static condition.
3. Pull tubing and seal assembly and remove from the well.
4. Isolate the gross injection interval:
 - a. Set a permanent cast-iron bridge plug ~50 ft above the packer and ~300 ft above the upper confinement layer in the [REDACTED] in. casing.
 - b. Place a 300 ft cement plug above the bridge plug.
 - c. Displace cement with minimum 9.5 ppg, 40 viscosity-treated drilling mud.

- d. The plug will be qualified by tagging the top of the cement and conducting a successful pressure test.
5. Spot a 400 ft cement plug from at least 50 ft below the surface-casing setting depth, to a minimum of 50 ft into the base of the USDW. Displace cement with minimum 9.5 ppg, 40 viscosity-treated drilling mud.
6. Set a 50 ft cement plug from 50 ft to the surface.
7. Cut casing 3 ft below ground level and weld on a ½ in. steel plate.

Within **60 days** after plugging, Orchard Storage will submit, pursuant to [40 CFR **§146.91(e)**], a certified plugging report to the UIC Director. The well-plugging report will be retained for 10 years following site closure. Also note that a complete well-plugging record (Form W-3), pursuant to 16 TAC **§5.203**, will be filed within **30 days** to the appropriate TRRC district office after plugging operations are completed.

6.2.3 Plugging Plan, Orchard MW No. 1

6.2.3.1 Monitoring Wellbore Profile Prior to Plugging and Abandonment, Orchard MW No. 1

The original wellbore schematic for Orchard MW No. 1, prior to beginning plugging operations, is provided in Figure 6-15.

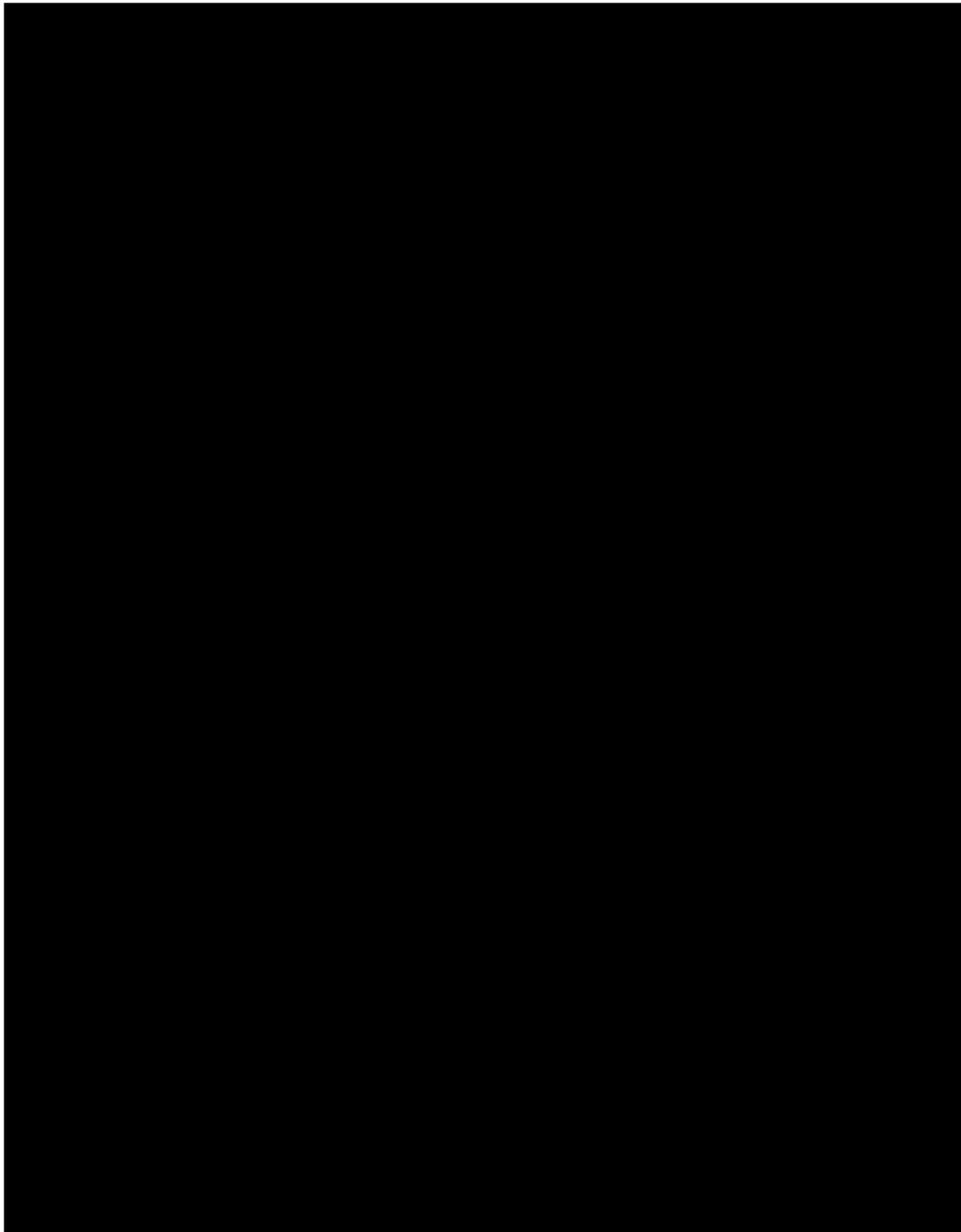


Figure 6-15 – Wellbore Schematic for Orchard MW No. 1 Before Plugging and Abandoning

6.2.3.2 Plug Details

Table 6-8 – Plugging Details for Orchard MW No. 1

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

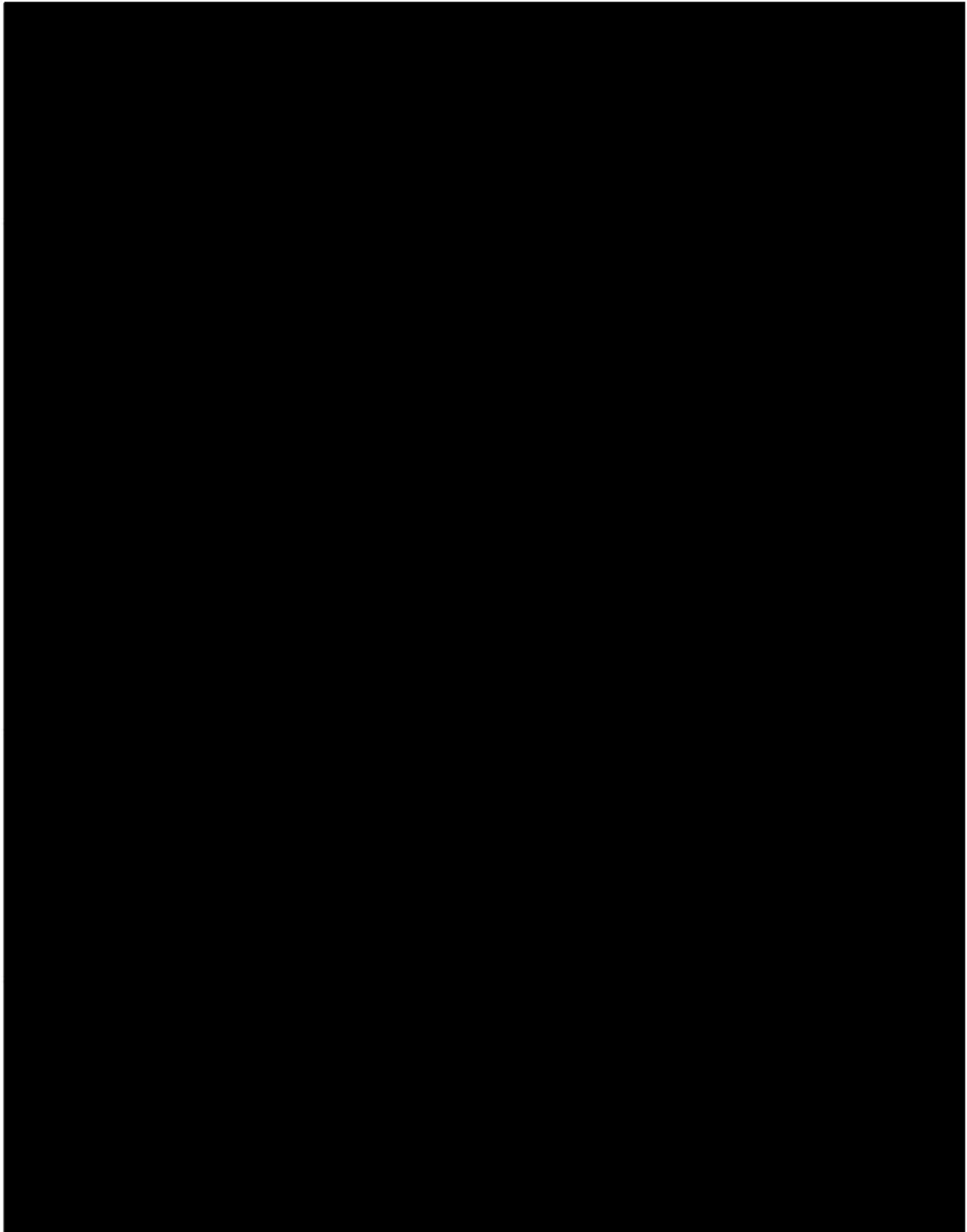


Figure 6-16 – Plugging Schematic for Orchard MW No. 1

6.2.4 Plugging Plan, Orchard MW No. 2

6.2.4.1 Monitoring Wellbore Profile Prior to Plugging and Abandonment, Orchard MW No. 2

The original wellbore schematic for Orchard MW No. 2, prior to beginning plugging operations, is provided in Figure 6-17.

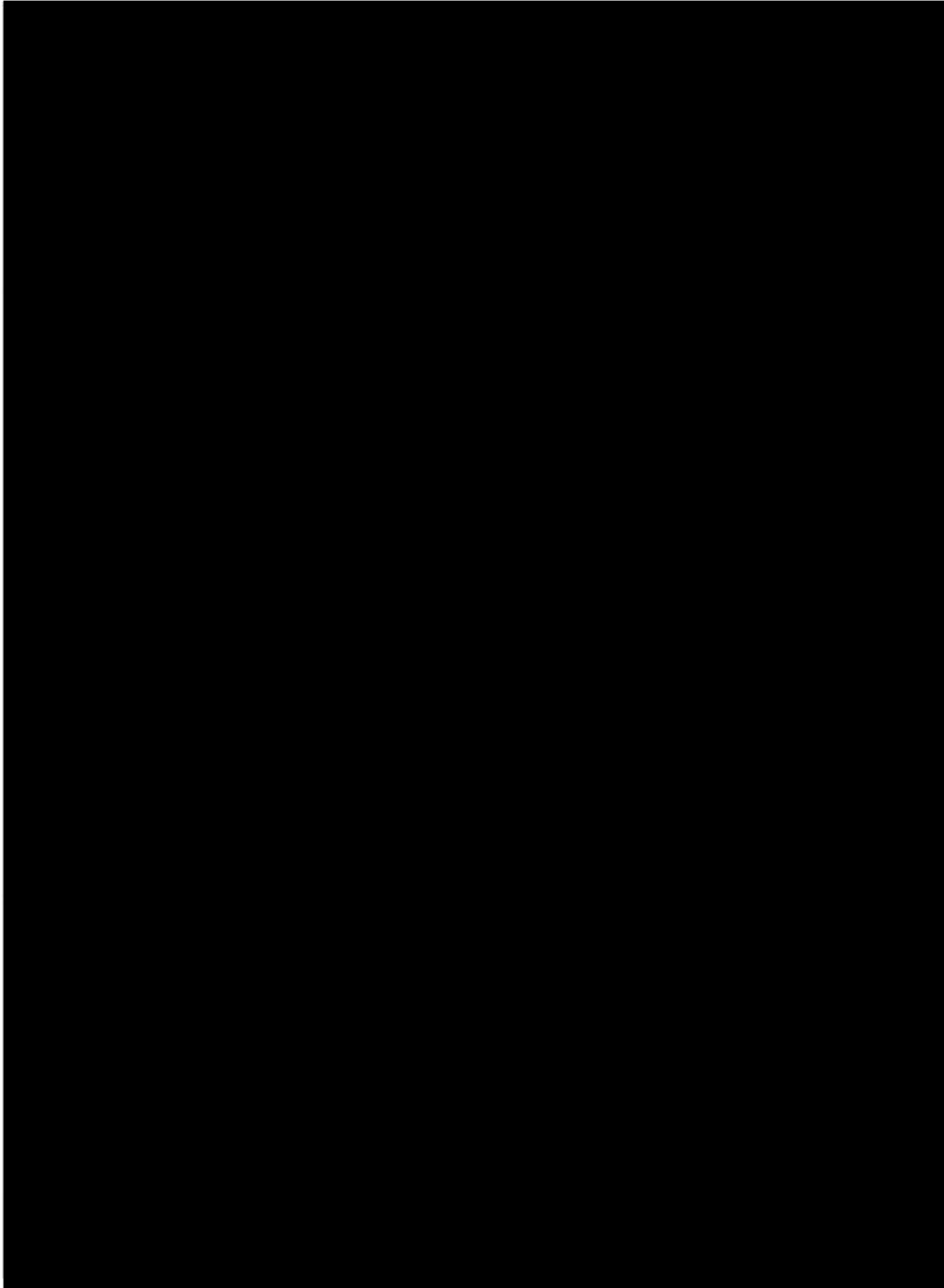


Figure 6-17 – Wellbore Schematic for Orchard MW No. 2 Before Plugging and Abandoning

6.2.4.2 Plug Details

Table 6-9 – Plugging Details for Orchard MW No. 2

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

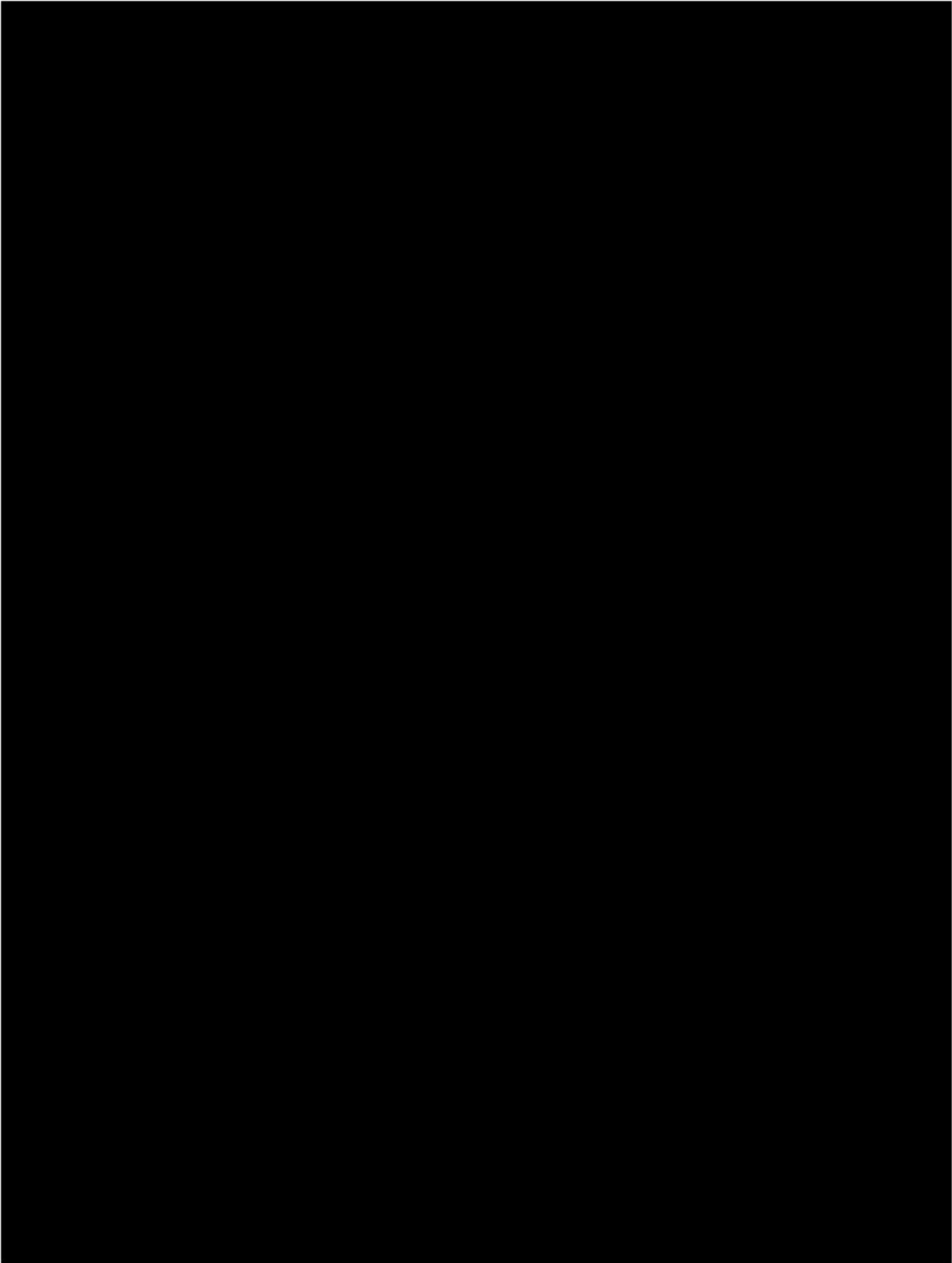


Figure 6-18 – Plugging Schematic for Orchard MW No. 2

6.2.5 Plugging Plan, Orchard MW No. 3

6.2.5.1 Monitoring Wellbore Profile Prior to Plugging and Abandonment, Orchard MW No. 3

The original wellbore schematic for Orchard MW No. 3, prior to beginning plugging operations, is provided in Figure 6-19.

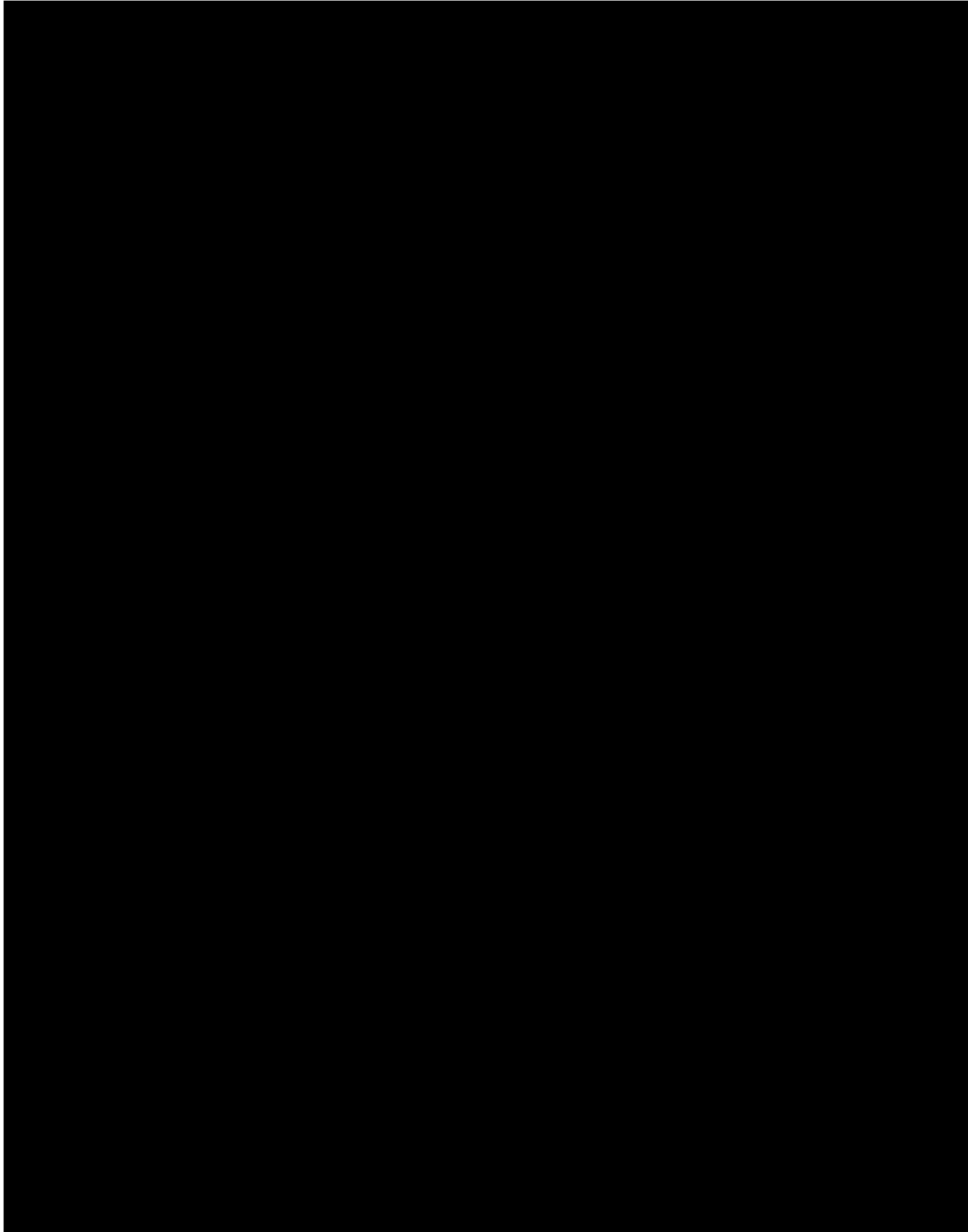


Figure 6-19 – Wellbore Schematic for Orchard MW No. 3 Before Plugging and Abandoning

6.2.5.2 Plug Details

Table 6-10 – Plugging Details for Orchard MW No. 3

Plug Number	
Purpose	
Casing OD	
Casing ID	
Top of Plug	
Bottom of Plug	
Cement Volume (sacks)	
Slurry Volume (ft ³)	
Slurry Weight (lb/gal)	
Type of Cement or Other Material	
Placement	

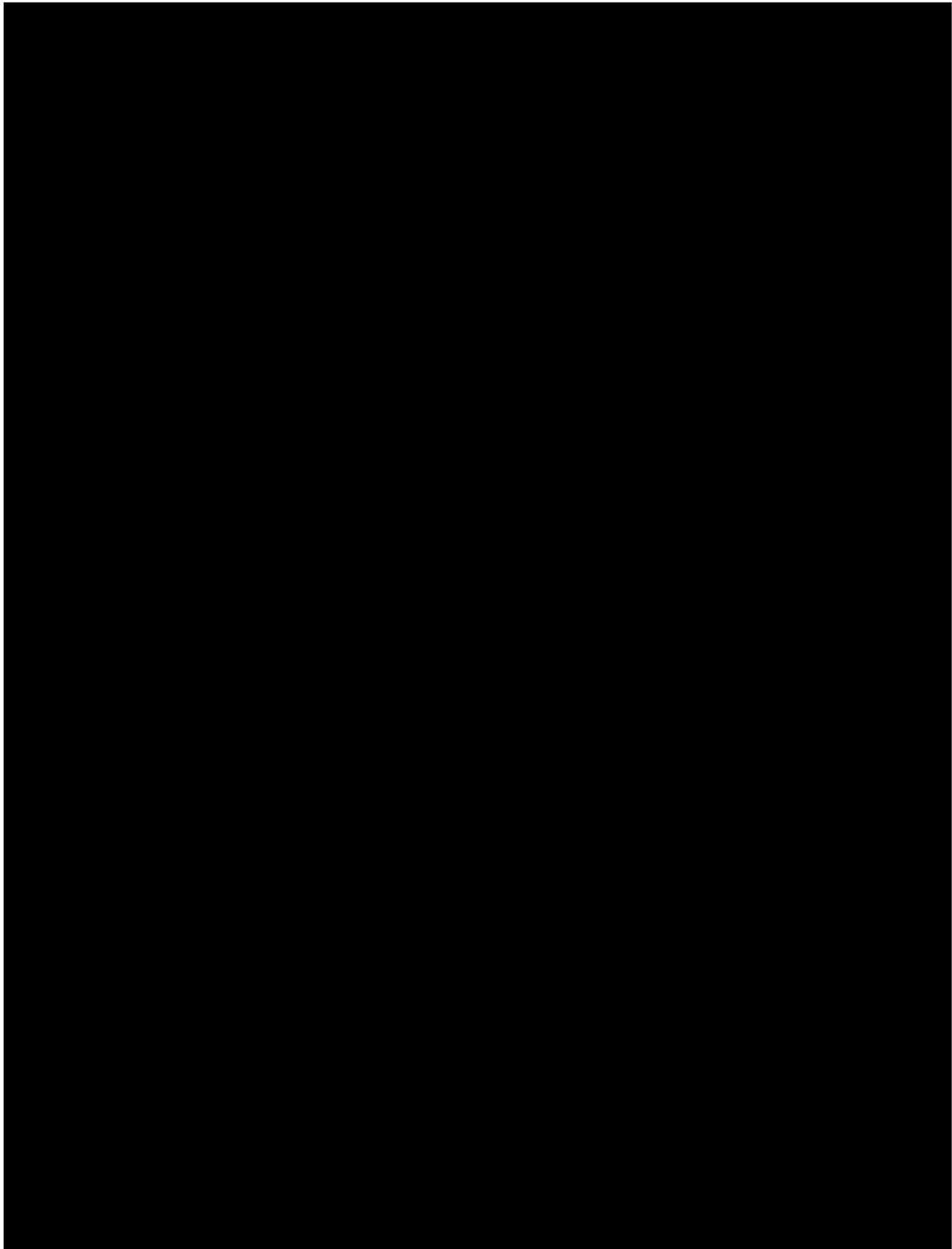


Figure 6-20 – Plugging Schematic for Orchard MW No. 3

Detailed schematics and procedures are located in *Appendix G*.

- Appendix G-1 Injection Well – Plugging Procedures
- Appendix G-2 Injection Well – Plugged Wellbore Schematics
- Appendix G-3 Monitoring Wells Plugging Procedures
- Appendix G-4 Monitoring Wells Plugged Wellbore Schematic