CLASS VI PRE-OPERATION NARRATIVE
40 CFR 146.82(c)

Rose Carbon Capture and Storage Project
Jefferson County, Texas
ExxonMobil Low Carbon Solutions Onshore Storage LLC
October 2024

Project Background Information

On March 7, 2024, ExxonMobil Low Carbon Solutions Onshore Storage LLC (ExxonMobil) submitted an Underground Injection Control (UIC) Class VI Permit Application (Application) to the U.S. Environmental Protection Agency (EPA) for the Rose Carbon Capture and Storage (CCS) Project (Project) in Jefferson County, Texas. The Project location is in the Houston Embayment of the Gulf Coast Basin, with well-documented formations for injection and containment of carbon dioxide (CO2). The CO2 is derived from relatively pure industrial sources, [redacted].

The Application was made in accordance with the requirements of the UIC Program for Carbon Dioxide Geologic Sequestration Wells promulgated in the Code of Federal Regulations, Title 40, Sections 146.81 through 146.95 [40 CFR 146.81–146.95]. Subsequent to initial application, ExxonMobil incorporated data from a stratigraphic well ([redacted]) designed to address certain data gaps and uncertainties in the Application. An Amended Application was submitted to the EPA on August 29, 2024, and presents a more refined level of understanding about the suitability of the Project site for sequestration of CO2 and how underground sources of drinking water (USDW) will be protected throughout the lifecycle of the Project.

The data acquisition program for the stratigraphic well produced a significant amount of new site-specific information. Field observations were made of the core samples, geological logging data were collected through the injection and confining zones, injectivity testing yielded measurements of injection zone permeability, and numerous laboratory tests were performed on core and fluid samples for refining the site characterization and geochemical model. As a result, a new Area of Review (AoR) model was developed and changes to the injection strategy and well design were made to align with the site characterization data. Sufficient geologic characterization data were available to model the AoR, optimize the operating parameters, and identify the risks and uncertainties of the Project.

The three proposed injection well locations specified in the Class VI Permit Application, listed in Table 1, were drilled with additional data acquisition as specified in 40 CFR 146.87. Data from these proposed injection wells are provided in this pre-operation narrative and confirms the results of the previously drilled stratigraphic well and the site characterization which forms the basis of the modeling submitted in the Amended Permit Application on August 29, 2024. As such, no changes are proposed to the planned facilities or operating strategy for the project.

[redacted]				
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]				

GSDT Submission - Project Background and Contact Information

GSDT Module: Project Information Tracking
Tab(s): General Information tab; Facility Information and Owner/Operator Information tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☐ Required project and facility details ***[40 CFR 146.82(a)(1)]***
☒ NO UPDATES NECESSARY

Pre-Operational Logging and Testing [40 CFR 146.82(c)(4),(7) and 146.87]

The section below provides information on the pre-operational logging and testing program conducted at each of the three propose injectors specified above. This includes a comprehensive well logging suite, fluid sampling, pressure and temperature measurements, core analysis, fracture pressure calculation and hydrogeologic testing. Figure 1 shows the stratigraphic section of the appraisal well and proposed injector wells. All these proposed injector wells is within 1 mile of the [redacted] appraisal well location.

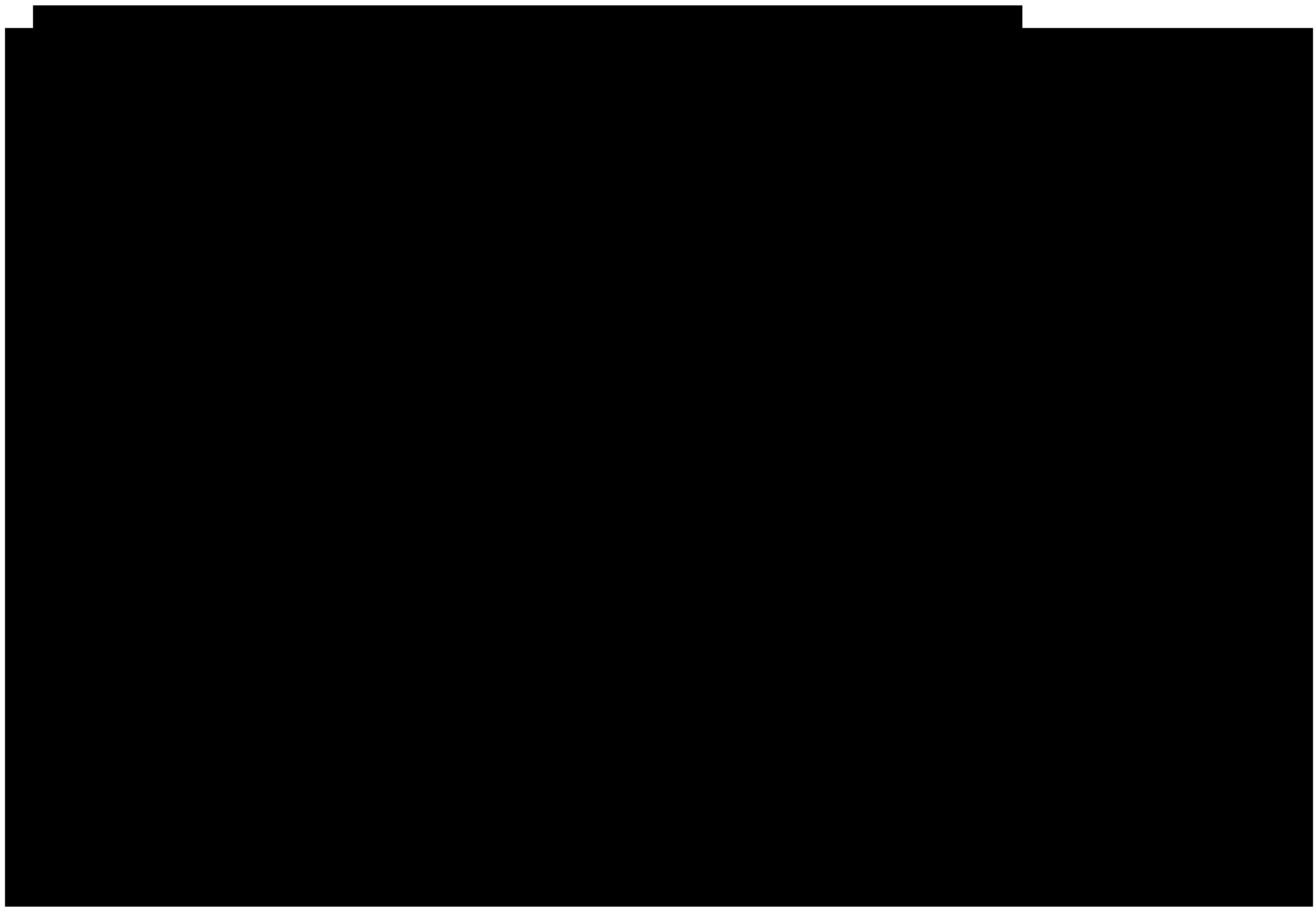
Well Logging [40 CFR 146.87(a)(2) and (3)]

A comprehensive set of petrophysical logs were acquired in each proposed injector well to characterize both injection zone and confining zone properties (Table 2). Following the guidelines set forth in regulation CFR 146.87, these data were also used to validate the initial site characterization based on data acquired directly from the [redacted] appraisal well. In addition to standard open-hole logs, advanced nuclear magnetic resonance (NMR) logs were also run in each well to estimate formation permeability and irreducible water saturation across the zones of interest. Table 3 summarizes the petrophysical properties based on log analysis for each well and further demonstrates that formation properties (porosity, permeability, irreducible water saturation) are consistent with the appraisal well across each injection zone. Appendix I provides petrophysical log interpretation plots for each well and Appendix II provides the raw and interpreted curves in digital LAS format.

Wireline formation pressures and fluid samples were also collected from both target injection zones and the above confining zone in each well. Figure 2 shows the formation pressures vs depth and Figure 3 shows the formation pressure gradient for each zone. Based on these plots it is clear the sands above the Upper Composite Confining Zone are offset from the Fleming injection zone, which is further offset from the Frio injection zone across the Anahuac Seal in each well. These data therefore support the separation of the Fleming and Frio injection zones and further confirms the suitability of the Upper Composite Confining Zone and Anahuac Seal as confining zone units. The small amount of offset in the formation pressure gradients between wells is believed to result

from measurement uncertainty (depth and pressure) when surveys are combined between wells. Table 4 summarizes the water analysis results for each well and Appendix III provides the comprehensive water analysis reports provided by Core Laboratories. These lab analysis results confirm the general trend of increasing formation water salinity with depth, which is also readily apparent as a change in formation pressure gradient across the Fleming.

Figure 4 shows fluid sample temperatures vs depth, along with cased-hole temperature logs acquired in two of the three injector wells, against the reference temperature gradient used in simulation modeling. Based on these data, no change to the temperature gradient used in the simulation model is required.



[redacted]

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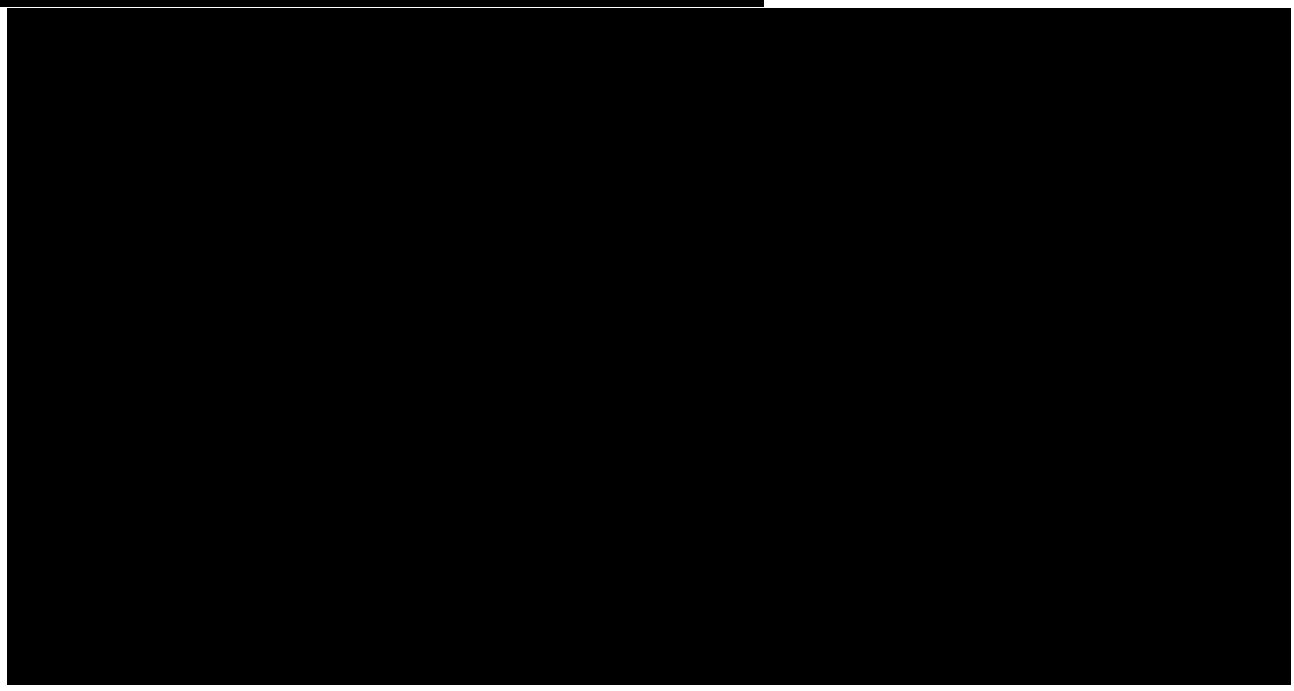
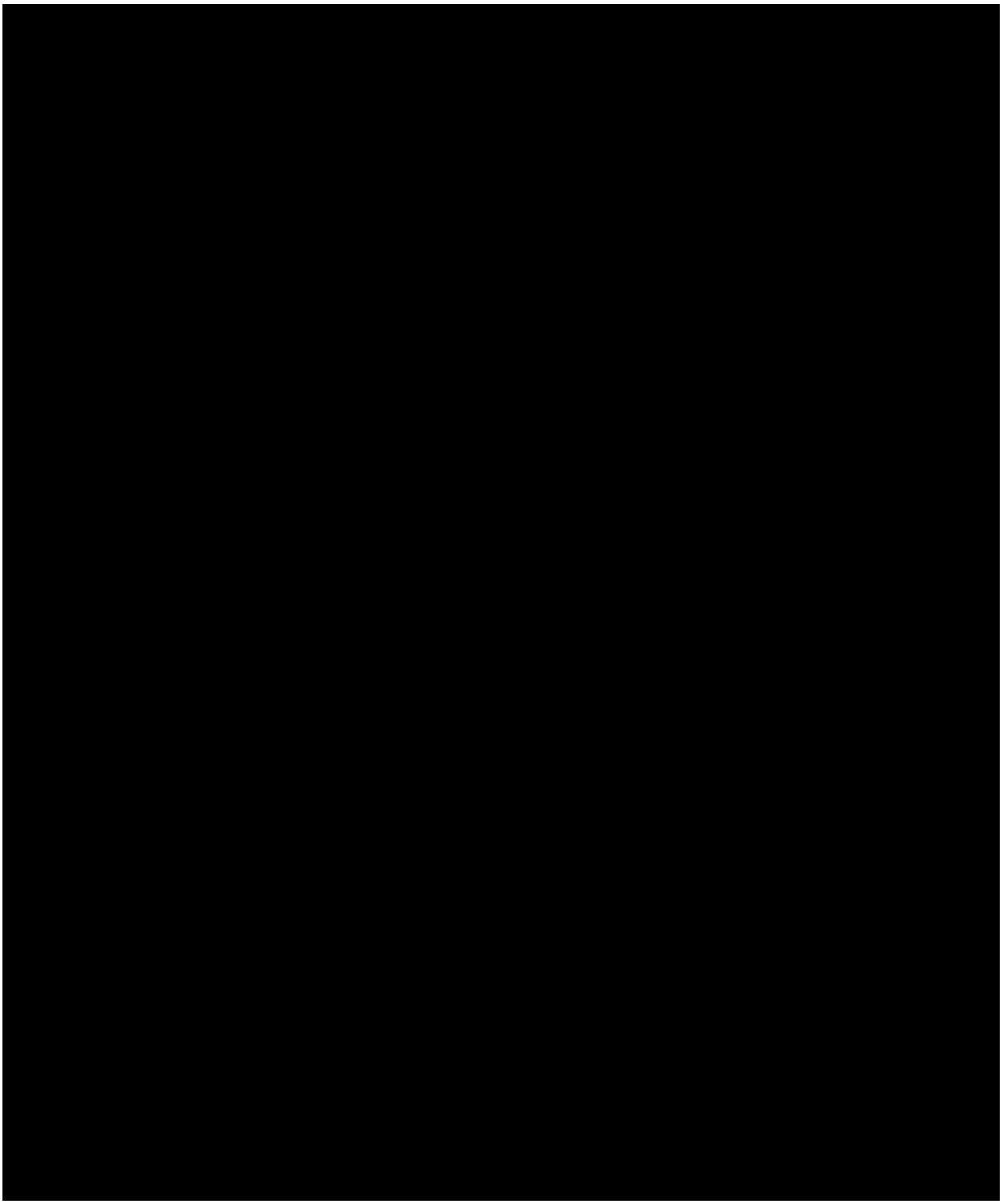




Core Analyses [40 CFR 146.87(b)]

Table 5 lists the conventional cores and rotary sidewall cores (RSWC) acquired from the appraisal well and the proposed injector wells. Figure 1 shows the approximate location for the conventional cores acquired in each well. A comprehensive set of core analyses were performed on the appraisal well to characterize both the confining zones and injection zones properties. These analyses included routine core analysis (RCAL), special core analysis (SCAL), geomechanics and reservoir & seal quality analyses. Supplemental core analysis was recently performed on cores collected from the proposed injector wells. Table 6 summarizes the average porosity and permeability for each zone and demonstrates that zonal properties are consistent with those determined at the appraisal well location. It is worth noting that shale porosity was measured using the Gas Research Institute's (GRI) crushed rock method and shale permeability was estimated based on high pressure mercury injection using Swanson's method. [redacted] This demonstrates that the confining zone shales are competent seals with very low effective properties, which is further supported by the high capillary entry pressures measured by mercury injection. Figure 5 shows all core porosity and permeability data colored by log-derived shale volume. [redacted] Therefore, it may be concluded based on these data that the formation properties for both the confining zones and injection zones are adequate.

[redacted]

[redacted]

Fracture Pressure of the Injection and Confining Zones [40 CFR 146.87(d)(1)]

Minimum horizontal stress gradients at the injectors are calculated using the log data acquired from these wells and the equation below, which was calibrated using offset data and step rate tests performed in the [redacted] appraisal well. The results are shown in Figure 6. Overall, the profiles are remarkably similar between the four wells. It is then concluded that the fracture gradients calculated in Sections 2.6.3 and 2.6.4 of the Amended Permit Application are valid for the injectors.

$$S_{hmin} = \frac{v}{1-v}\left(S_V - P_p\right) + P_p + C$$

where P_p *is the pore pressure,* S_V *is the overburden stress and* v is Poison's ratio which is calculated from dipole sonic logs as follows:

$$v = \frac{0.5\left(\frac{t_s}{t_p}\right)^2 - 1}{\left(\frac{t_s}{t_p}\right)^2 - 1}$$

Hydrogeologic Testing [40 CFR 146.87(e)(1)-(3)]

Below outlines the analysis of the Injection Fall-off tests (IFT) conducted for the proposed injection wells to verify hydrogeologic characteristics of the injection zone. Prior to the test, each well was perforated in the targeted reservoir per the completion procedure. The technical objective of each IFT was to determine the permeability thickness, skin and injectivity for the reservoir. The injection volumes for each test were determined based on reservoir quality and the ability to obtain a strong response for formation analysis. The duration of the shut-in periods was also based on the observed pressure response. Below are the details for each well and the analysis performed on the fall-off tests.

[redacted]

[redacted]

[redacted]

[redacted].

Key results are summarized below:

- [redacted]
- [redacted]
- [redacted]
- [redacted].

[redacted]

[redacted]

- [redacted] [redacted]

[redacted].

[redacted]

Key results are summarized below:

- [redacted]

[redacted]

[redacted]

- [redacted]

[redacted]

Key results are summarized below:

- [redacted]

Based on the results in the injection fall-off tests, injection rates specified in Section 3 of the Amended Permit Application are expected to be achievable within the constraints specified.

Pre-Operational Logging and Testing GSDT Submissions
GSDT Module: Pre-Operational Testing ***Tab(s):*** All tabs Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Logging and testing results ***[40 CFR 146.82(c)(7) and 146.87]***

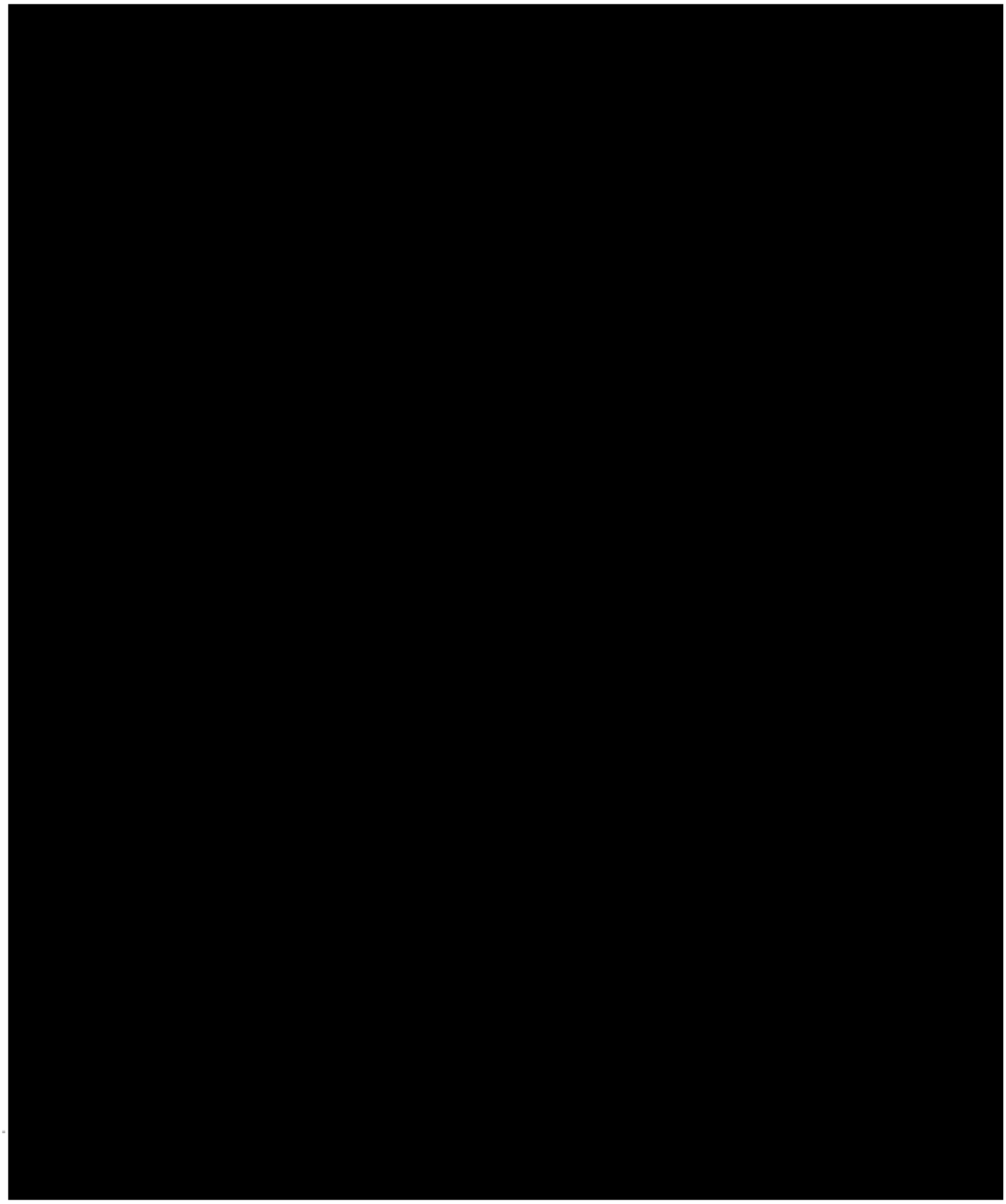
Final Injection Well Construction Procedures [40 CFR 146.82(c)(5)]

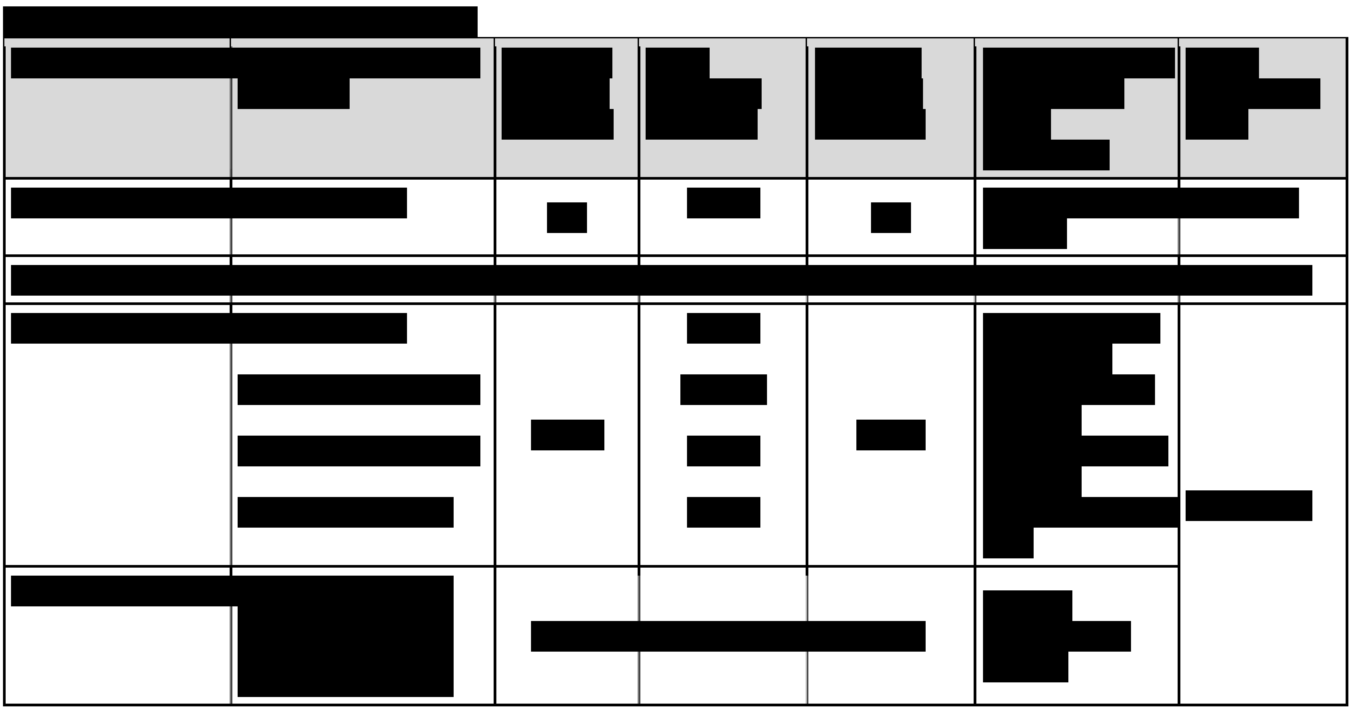
The three proposed injection well locations specified in the Class VI Permit Application, listed in Table 1 above, were drilled adhering to the procedures included in the Class VI Permit Application and meet the requirements of 40 CFR 146.82(c)(5). Actual "as-drilled" schematics are included and have been updated with each wells specific depths, lengths, and other applicable information to meet the requirements of 40 CFR 146.82(a)(11).

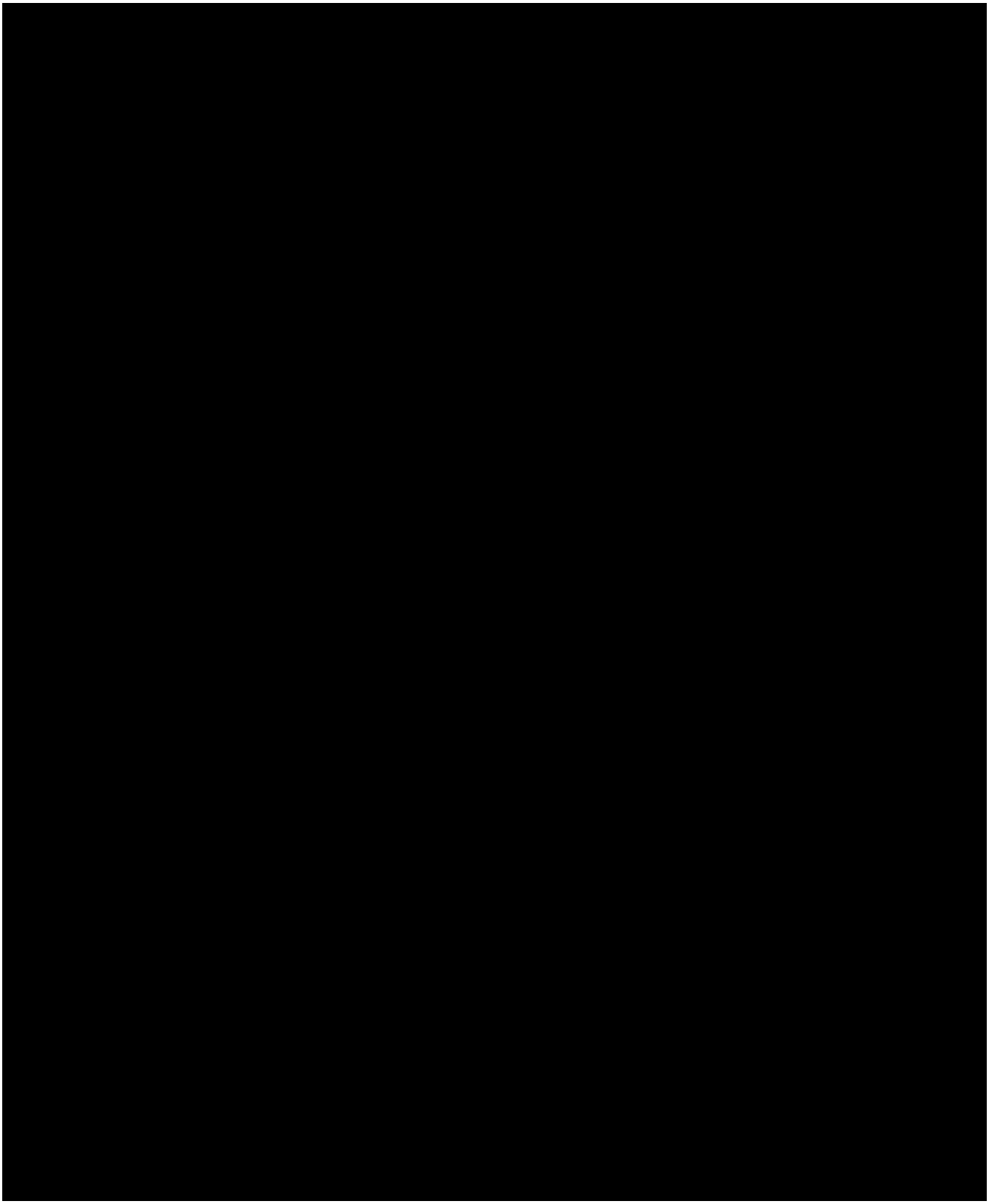
Casing and Cementing

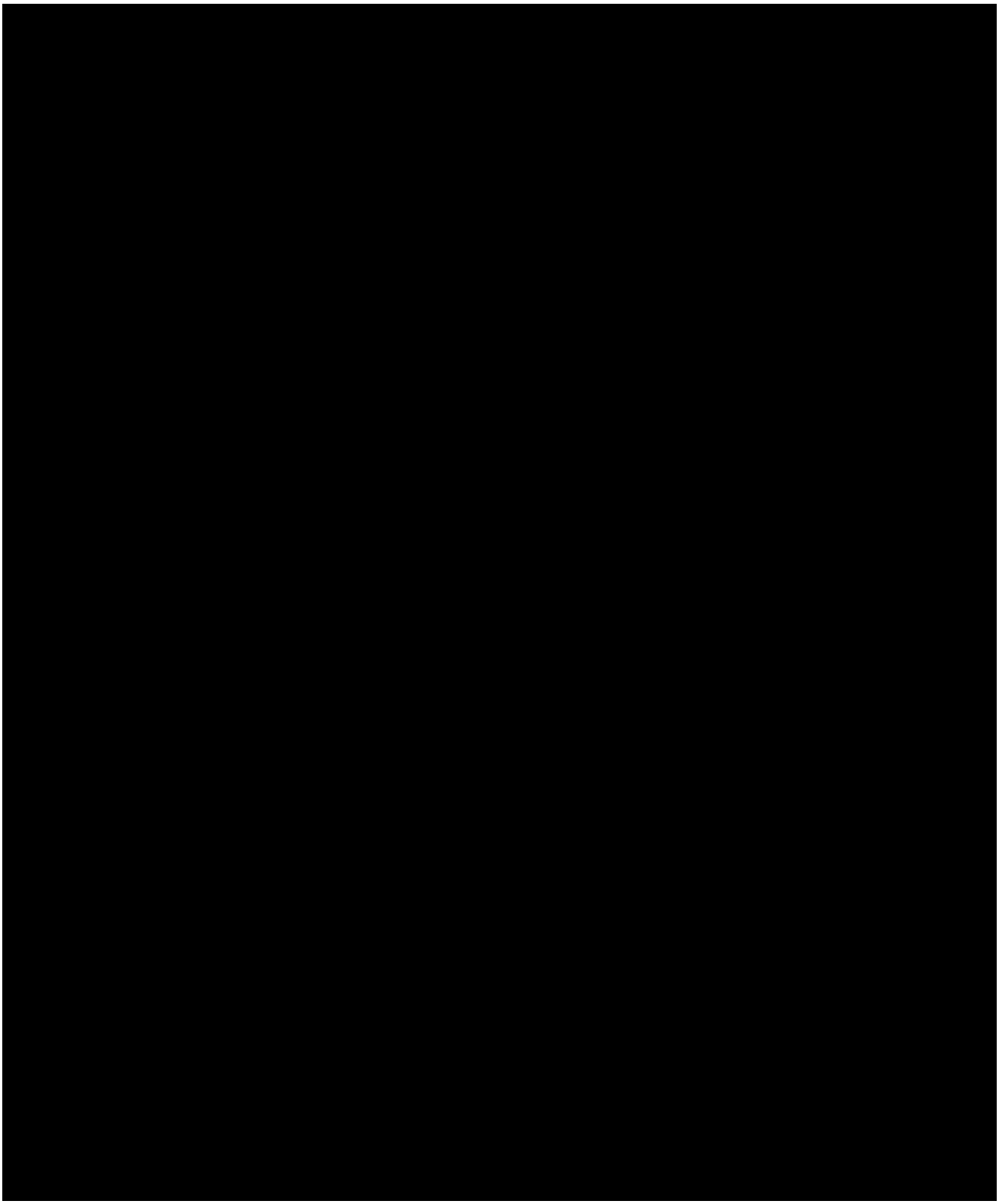
The details for the proposed injectors are provided in Tables 7, 8 and 9. Casing Details provide an update to the information submitted in the Class VI Permit Application. The data provided are the "as-drilled" data and adhere to the procedures included in the Class VI Permit Application and required by 40 CFR 146.8(c)(5).

[redacted]



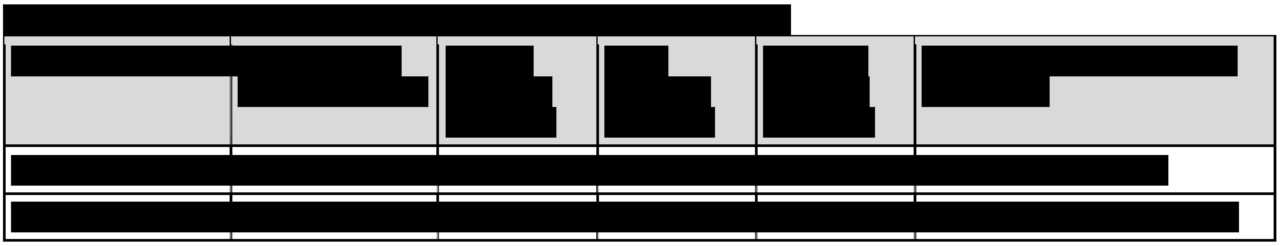


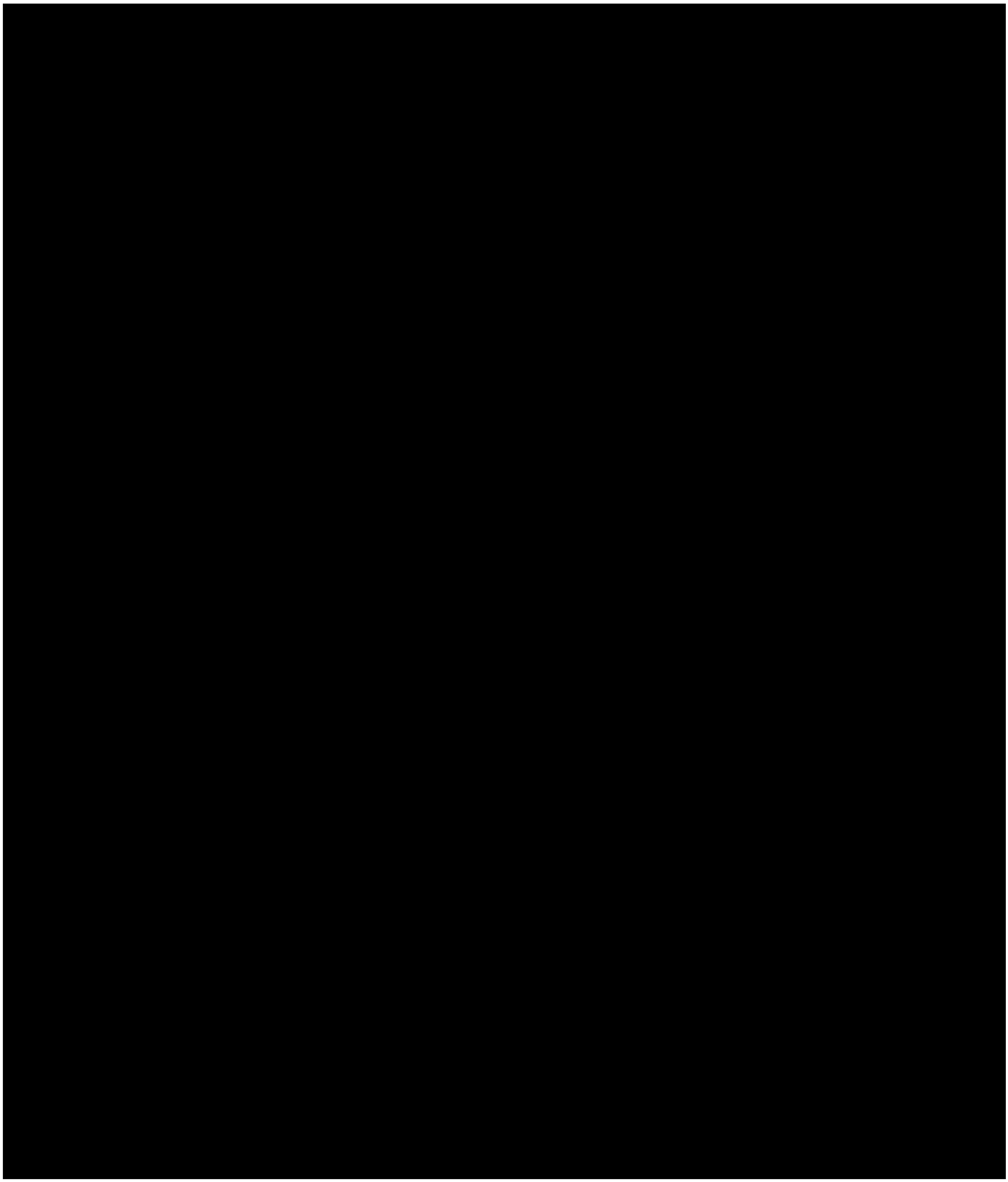




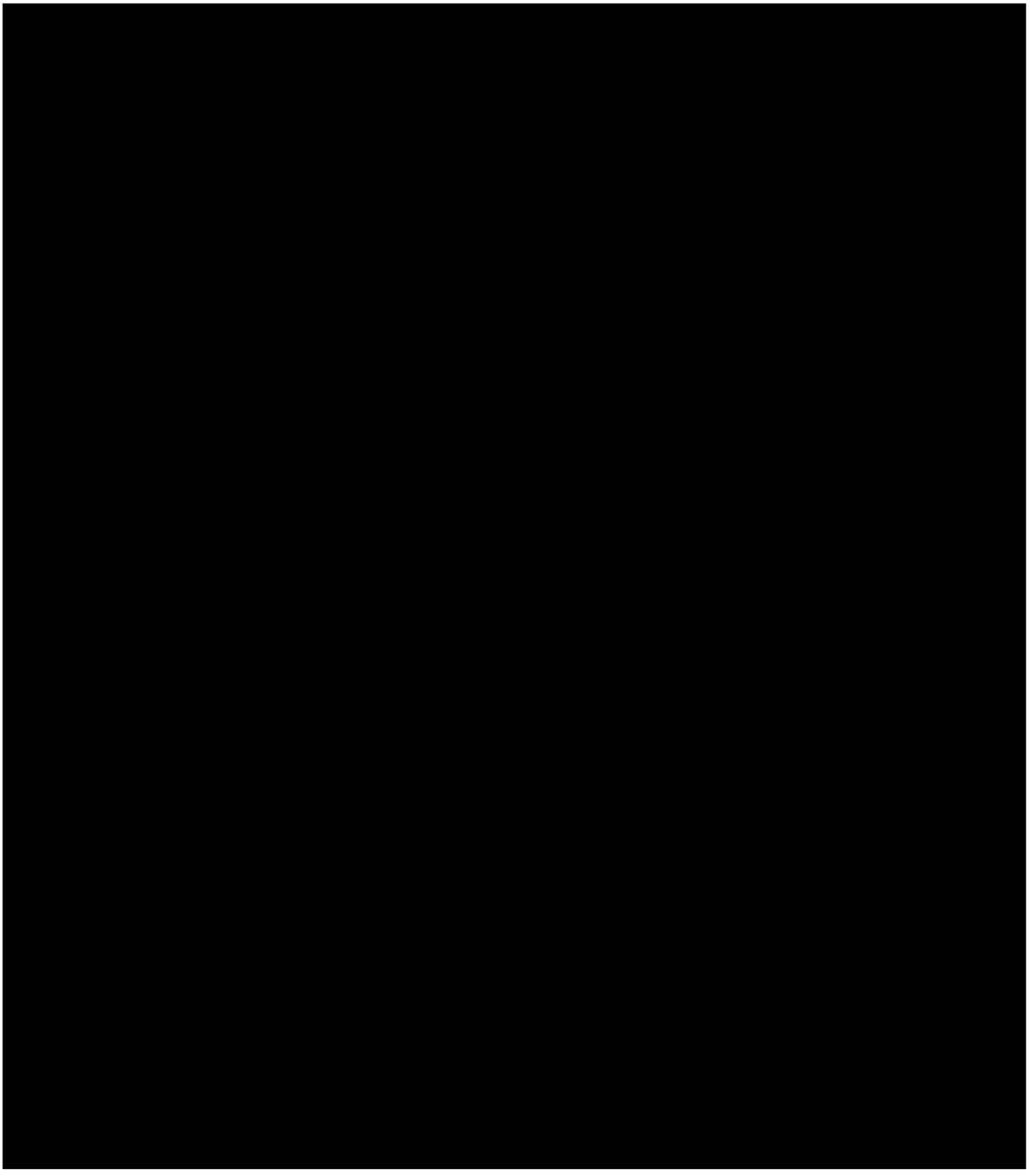
Tubing and Packer

The details for the three proposed injectors are provided in Table 10, 11 and 12. Tubing and Packer details provide an update to the information submitted in the Class VI Permit Application. The data provided are the "as-completed" data and adhere to the procedures included in the Class VI Permit Application and required by 40 CFR 146.82(c)(5).

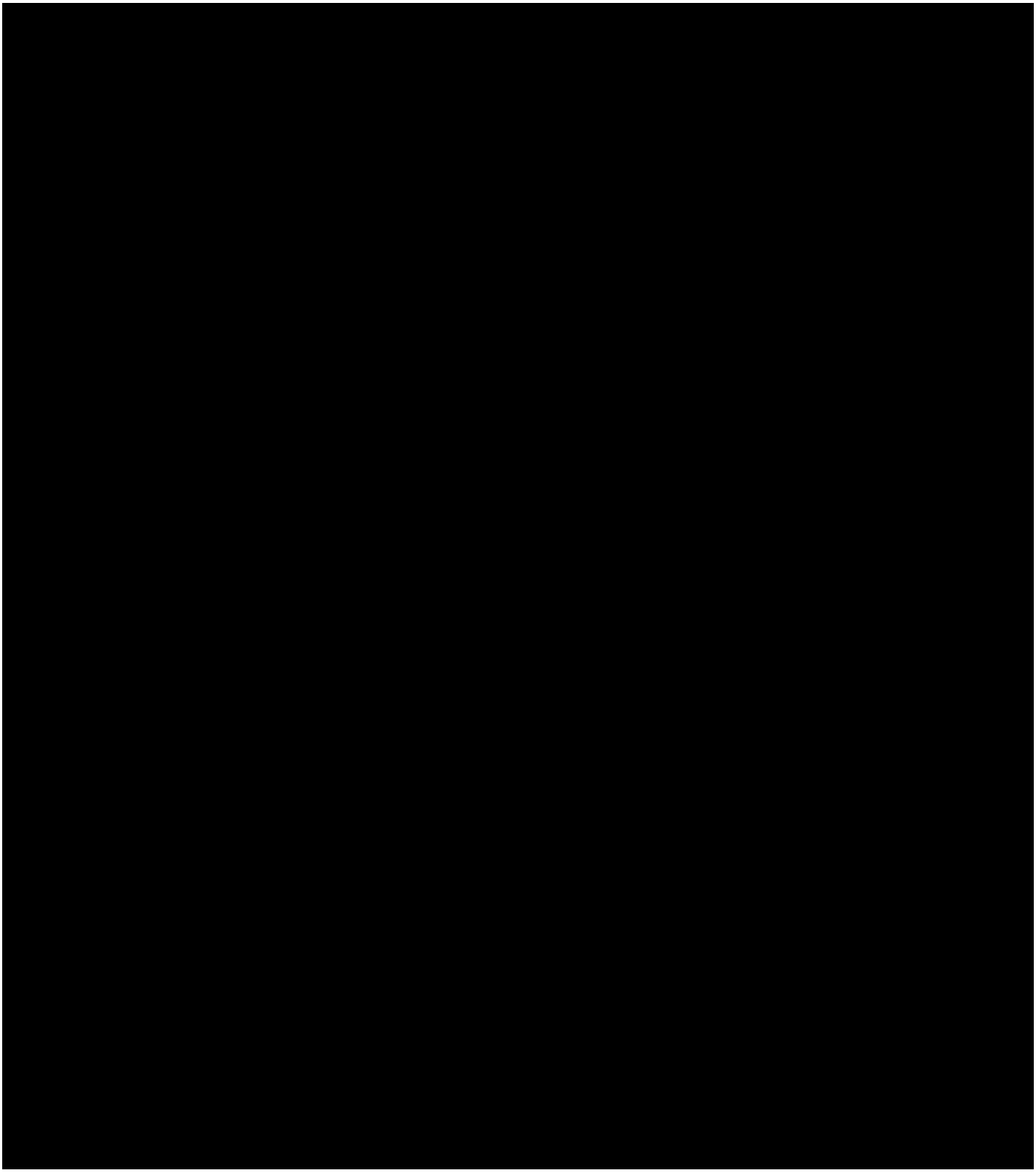




[redacted]



[redacted]



Corrective Action Status [40 CFR 146.82(c)(6)]

Corrective Action is planned prior to injection start-up for two artificial penetrations within the AoR as described in Section 3 – Area of Review and Corrective Action Plan of the Amended Permit Application. A summary of these wells is provided in Table 13 below.

T[redacted]

[redacted]									

Corrective Action GSDT Submissions

GSDT Module: AoR and Corrective Action module
Tab(s): Corrective Action tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☐ Corrective action documentation ***[40 CFR 146.82(c)(6)]***
☒ NO UPDATES NECESSARY

Demonstration of Mechanical Integrity [40 CFR 146.82(c)(8) and 146.89]

Mechanical integrity tests were performed on the [redacted] wells. The test(s) followed the procedure in the Class VI Permit Application. Prior to running the completion, CBL and VDL logs were run on each well to demonstrate there is no significant fluid movement into a USDW through channels adjacent to the wellbore as per 40 CFR 146.89(a)(2). [redacted]fter the production packer and tubing were run and set, [redacted]

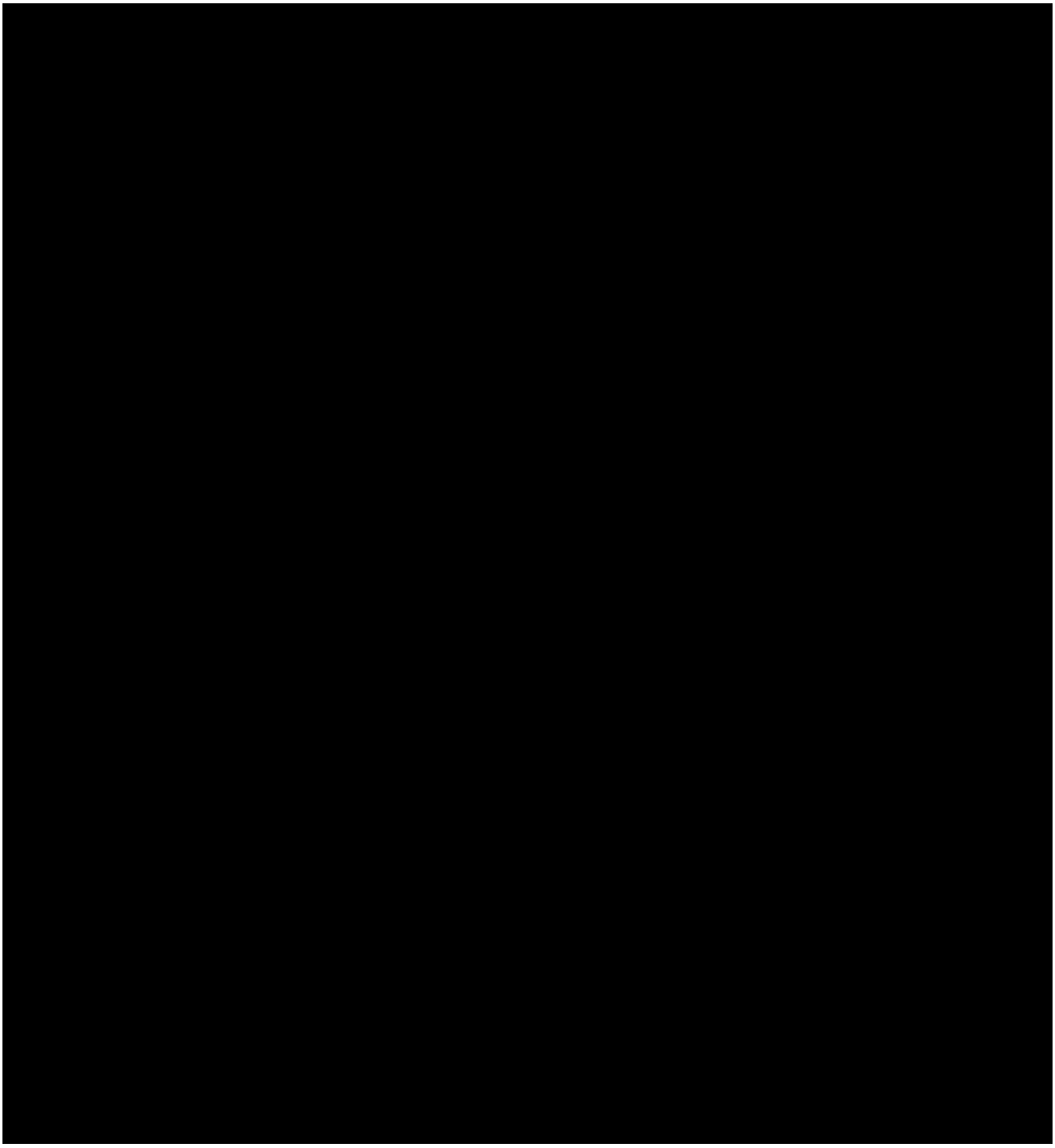
[1] Readily available well identification numbers provided from public data sources up to August 1, 2024.

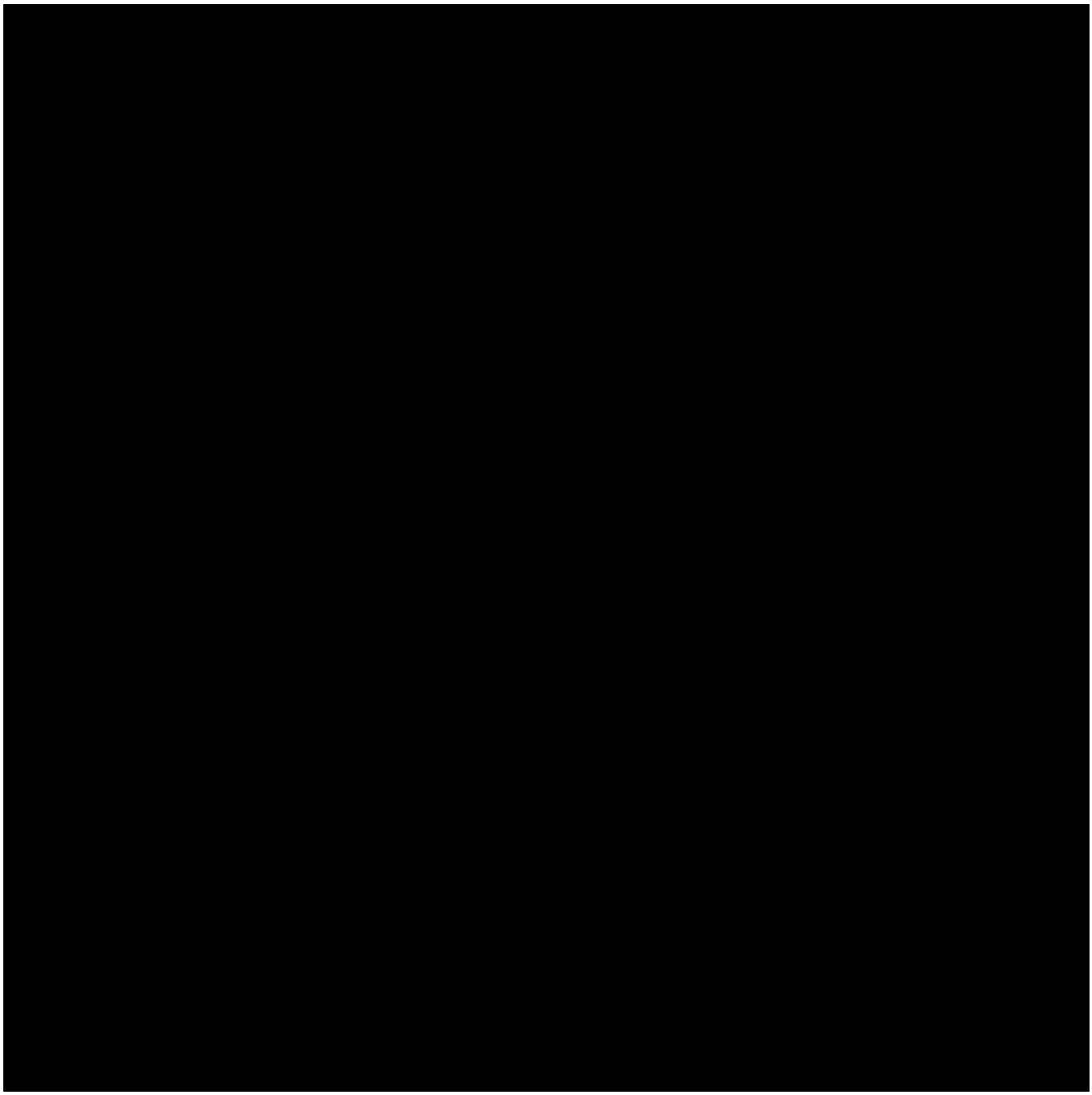
[2] API:42245E070100 and an associated dry hole (API: 245) were determined to be associated with Broussard JE Jr-1 and not separate wellbores.

[redacted]

Figures 13-15 show the circle charts collected during the pressure tests for the surface casing, production casing, and tubing annulus after the packer was set. Based on the test results, there are no evidence of leaks or fluid movement within the wellbore. No changes need to be made to the mechanical integrity evaluations specified in the testing and monitoring plan [40 CFR 146.82(c)(2)].

[redacted]





In addition to the pressure integrity testing, baseline measurements including electromagnetic thru-tubing casing inspection and pulsed neutron (sigma) logs were also acquired. These logs are listed under Table 2. No meaningful analysis can be performed using the reference baseline logs until after project start-up.

Plan Updates [40 CFR 146.82(c)(9)]

Prior to submission of the Amended Permit Application to the EPA on August 29, 2024, ExxonMobil drilled a stratigraphic well ( ) designed to address data gaps and uncertainties. This appraisal well was placed in a

central location relative to all three proposed injection wells at the Project site, maximizing the applicability of data collection and analysis to support planned operations.

The data acquisition program for the stratigraphic well produced a significant amount of new site-specific information, which was integrated into our characterization of the site and development of the operating strategy. The data acquired during the drilling of the three proposed injection wells at the Project site confirms this characterization and project plan. As such, no changes are required to:

- Site Characterization Updates [40 CFR 146.82(c)(2)]
- Final AoR Model and Delineation [40 CFR 146.82(c)(1)]
- Compatibility of the CO2 Stream [40 CFR 146.82(c)(3)]

All required information is included in the Amended Permit Application and GSDT uploads.

AoR Model and Corrective Action Delineation GSDT Submissions
GSDT Module: AoR and Corrective Action ***Tab(s):*** All applicable tabs Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Final computational modeling details ***[40 CFR 146.82(c)(1) and 146.84(c)]*** ☒ Tabulation of all wells within final AoR that penetrate confining zone ***[40 CFR 146.82(a)(4)]*** *Note: No change from the original submission.*

AoR and Corrective Action

No updates are required to the Area of Review and Corrective Action. Please refer to Section 3 – Area of Review and Corrective Action Plan in the Amended Permit Application.

AoR and Corrective Action GSDT Submissions
GSDT Module: AoR and Corrective Action ***Tab(s):*** All applicable tabs Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☐ Updated AoR and Corrective Action Plan ***[40 CFR 146.82(c)(9) and 146.84(b)]*** ☒ NO UPDATES NECESSARY

Testing and Monitoring

No updates are required to the testing and monitoring plan. Please refer to Section 5 – Testing and Monitoring Plan in the Amended Permit Application.

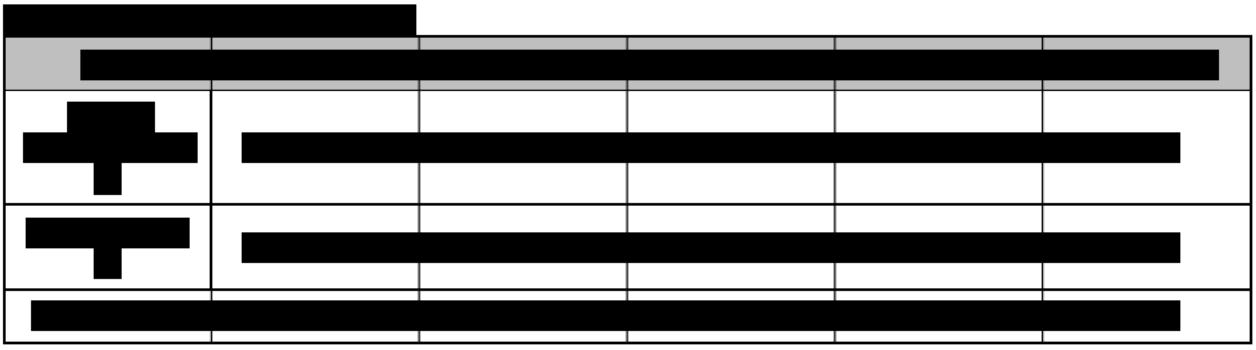
Testing and Monitoring GSDT Submissions

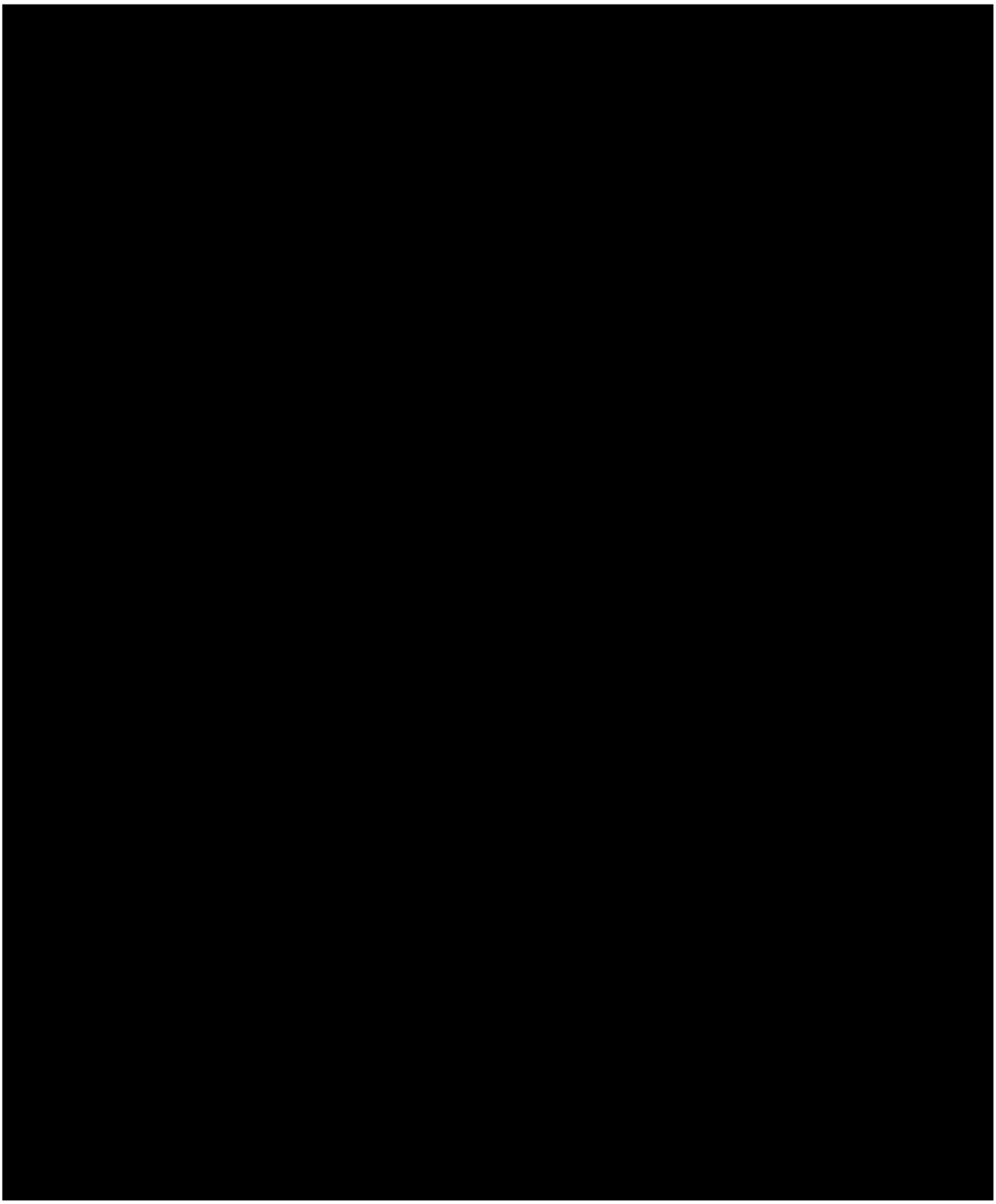
GSDT Module: Project Plan Submissions
Tab(s): Testing and Monitoring tab

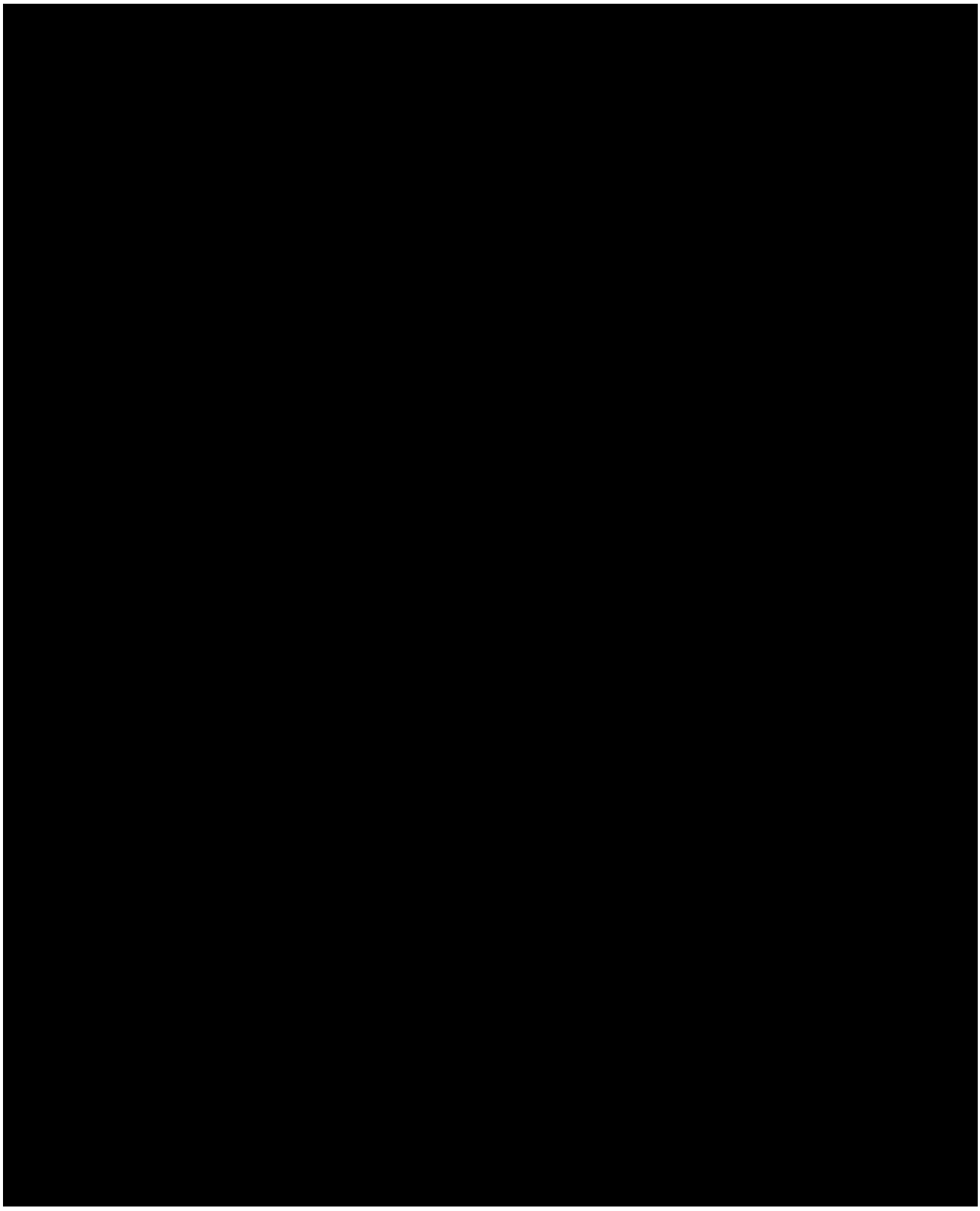
Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☐ Updated Testing and Monitoring Plan ***[40 CFR 146.82(c)(9) and 146.90]***
☒ NO UPDATES NECESSARY

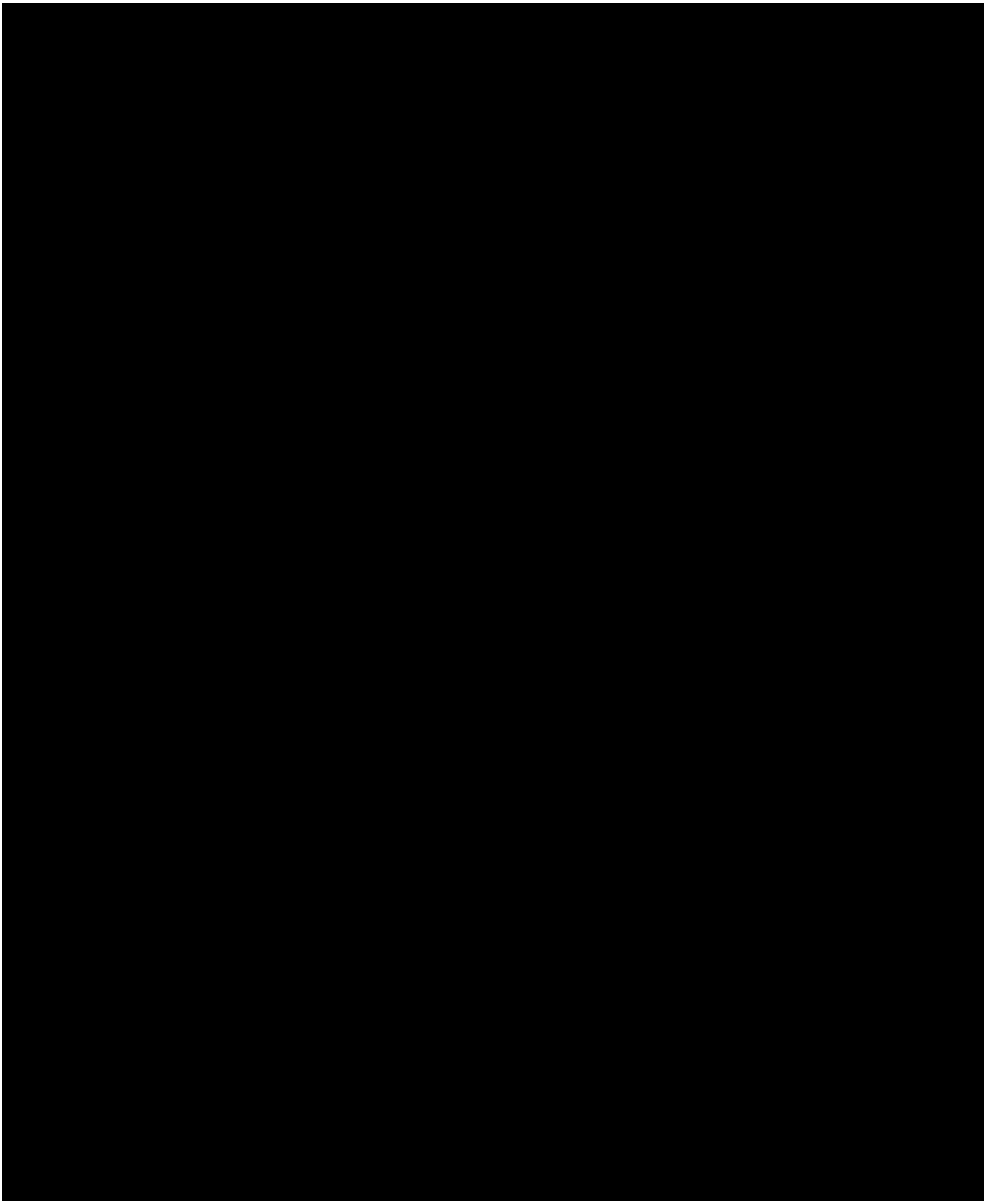
Injection Well Plugging

Updates to the injection well plugging plan are based on as-drilled depths for both casing and formation tops. Updated plug intervals and schematics are shown below. Please refer to Section 6 – Injection Well Plugging Plan in the Amended Permit Application for operational considerations.









Injection Well Plugging GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** Injection Well Plugging tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Updated Injection Well Plugging Plan ***[40 CFR 146.82(c)(9) and 146.90]*** ☐ NO UPDATES NECESSARY

Post-Injection Site Care (PISC) and Site Closure

No updates are required to Post-Injection Site Care and Site Closure. Please refer to Section 7 – Post-injection Site Care and Site Closure Plan in the Amended Permit Application.

PISC and Site Closure GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** PISC and Site Closure tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☐ Updated PISC and Site Closure Plan ***[40 CFR 146.82(c)(9) and 146.90]*** ☒ NO UPDATES NECESSARY
GSDT Module: Alternative PISC Timeframe Demonstration ***Tab(s):*** All tabs (only if an alternative PISC timeframe is requested) Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☐ Updated alternative PISC timeframe demonstration ***[40 CFR 146.82(c)(9) and 146.90]*** ☒ NO UPDATES NECESSARY

Emergency and Remedial Response

No updates are required to Emergency and Remedial Response. Please refer to Section 8 – Emergency and Remedial Response Plan in the Amended Permit Application.

Emergency and Remedial Response GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** Emergency and Remedial Response tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☐ Updated Emergency and Remedial Response Plan ***[40 CFR 146.82(c)(9) and 146.90]*** ☒ NO UPDATES NECESSARY

Well Operation [40 CFR 146.88]

No updates are required to the injection well operating procedures. Please refer to Section 4.5 – Injection Well Operating Strategy in the Amended Permit Application.