# Class VI Injection Well Application

Contains proprietary business information.

## Attachment 05: Pre-operational Testing Program

**40 CFR 146.82(a)(8), 146.87**

Dragon Project
Tazewell County, Illinois

21 November 2024

# Project Information

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Dragon Injection Well 1 (DRG INJ1) Location:
Tazewell County, Illinois
Latitude: 40.45742° N
Longitude: 89.74468° W

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# List of Acronyms and Abbreviations

| | |
|---|---|
| ACZ | above confining zone |
| APT | annulus pressure test |
| bpm | barrels per minute |
| BHA | bottomhole assembly |
| $CO_2$ | carbon dioxide |
| CBL-VDL | cement bond log-variable density log |
| DRG ACZ1 | Dragon Above Confining Zone Monitoring Well 1 |
| DRG INJ1 | Dragon Injection Well 1 |
| DRG OBS1 | Dragon Deep Observation Well 1 |
| DRG MA1 | Dragon Mahomet Aquifer Monitoring Well 1 |
| DST | drill stem test |
| EPA | Environmental Protection Agency |
| FOT | fall-off test |
| Fbgl | feet below ground level |
| MIT | mechanical integrity test |
| PBI | proprietary business information |
| PISC | post-injection site care and closure |
| psi | pounds per square inch |
| RAT | radioactive tracer |
| SRT | step-rate test |
| TBD | to be determined |
| TDS | total dissolved solids |
| UIC | Underground Injection Control |
| USDW | underground source of drinking water |

# 1. Introduction

This document details the proposed Pre-operational Testing Program that will be implemented to characterize the chemical and physical features of the lithology at the Dragon Project site. The formations of note include, but are not limited to, the following:

- Mt. Simon Sandstone (injection zone),
- Eau Claire Shale (confining zone),
- Ironton-Galesville Sandstones (above confining zone [ACZ] monitoring interval),
- St. Peter Sandstone (lowermost underground source of drinking water [USDW]),
- Mahomet Aquifer System (shallowest and the only utilized USDW).

The Pre-operational Testing Program laid out in this document is designed to meet the testing requirements of Title 40 of the U.S. Code of Federal Regulations Section 146.87 (40 CFR 146.87), and the well construction requirements of 40 CFR 146.86. Attachment 01: Narrative, (2024) details the construction plan for the Dragon Injection Well 1 (DRG INJ1). This document details how the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical information of the injection zone, confining zone, and other relevant geologic formations will be determined and verified (Figure 1, Figure 2, and Figure 3). The Pre-operational Testing Program includes a combination of logging, coring, fluid sampling, and formation hydrogeologic testing that will be completed when the project wells are drilled. The wells to be drilled for the Dragon Project include:

- DRG INJ1
- Dragon Deep Observation Well 1 (DRG OBS1)
- Dragon Above Confining Zone Monitoring Well 1 (DRG ACZ1)
- Dragon Mahomet Aquifer Monitoring Well 1 (DRG MA1)

Vault Dragon CCS LP will notify the United States Environmental Protection Agency (EPA) 30 days ahead of the planned spud date for each of the project wells of the intent to drill, log, and test each well as well as a schedule of well logging and testing activities. An updated timeframe will be provided at least 48 hours in advance to serve as notice and provide the opportunity to witness the relevant tests or logs.

DRG OBS1 is expected to be the first well drilled with the timing dependent on the anticipated receipt of the Class VI injection well permit. A minimal logging suite will be run to establish depths and thicknesses of formations at the site. This initial logging suite will be used to identify zones suitable for core acquisition and well testing. A more extensive logging suite is planned for DRG INJ1 to assist with characterization of the main formations of interest. DRG OBS1 will allow the project to determine the behavior of various intervals in the Knox Group which have caused lost circulation issues for other wells in the region.

The Ironton-Galesville Sandstones will be the ACZ monitoring interval for the project; this is the same unit used in other projects in the region such as the Archer Daniels Midland Illinois Industrial CCS Project in Decatur, Illinois.

The lowermost underground source of drinking water (USDW) at the Dragon Project site is in the St. Peter Sandstone, and its base is the top of the Shakopee Formation (Attachment 01: Narrative, 2024) as displayed in Figure 1. Shallow sources of groundwater in the project area are found within 200 ft of the surface in the Mahomet Aquifer System including in the Mahomet Sand Member of the Banner Formation which comprises Mahomet Aquifer, and in less continuous sands within the overlying Glasford Formation and Mason Group (Attachment 01: Narrative, 2024). These groundwater sources will be monitored using the DRG MA1 well and selected other groundwater wells in the area. The EPA defines a USDW as an aquifer with less than 10,000 total dissolved solids (TDS), measured in milligrams per liter.

Fluid samples will be collected and used to complete the baseline aqueous geochemistry for the shallow USDW monitoring interval (DRG MA1), the lowermost USDW, and ACZ monitoring intervals (DRG ACZ1) for future comparison to monitoring data collected after injection operations begin. The ACZ interval will be regularly sampled as part of the Testing and Monitoring program, and as a contingent action during the Post-injection Site Care and Closure (PISC) phase of the project. The lowermost USDW will only be sampled once during the Pre-operational Testing Program and then as a contingent action during the injection and PISC phases of the project (Attachment 06: Testing and Monitoring, 2024; Attachment 08: Post-injection Site Care and Site Closure, 2024).

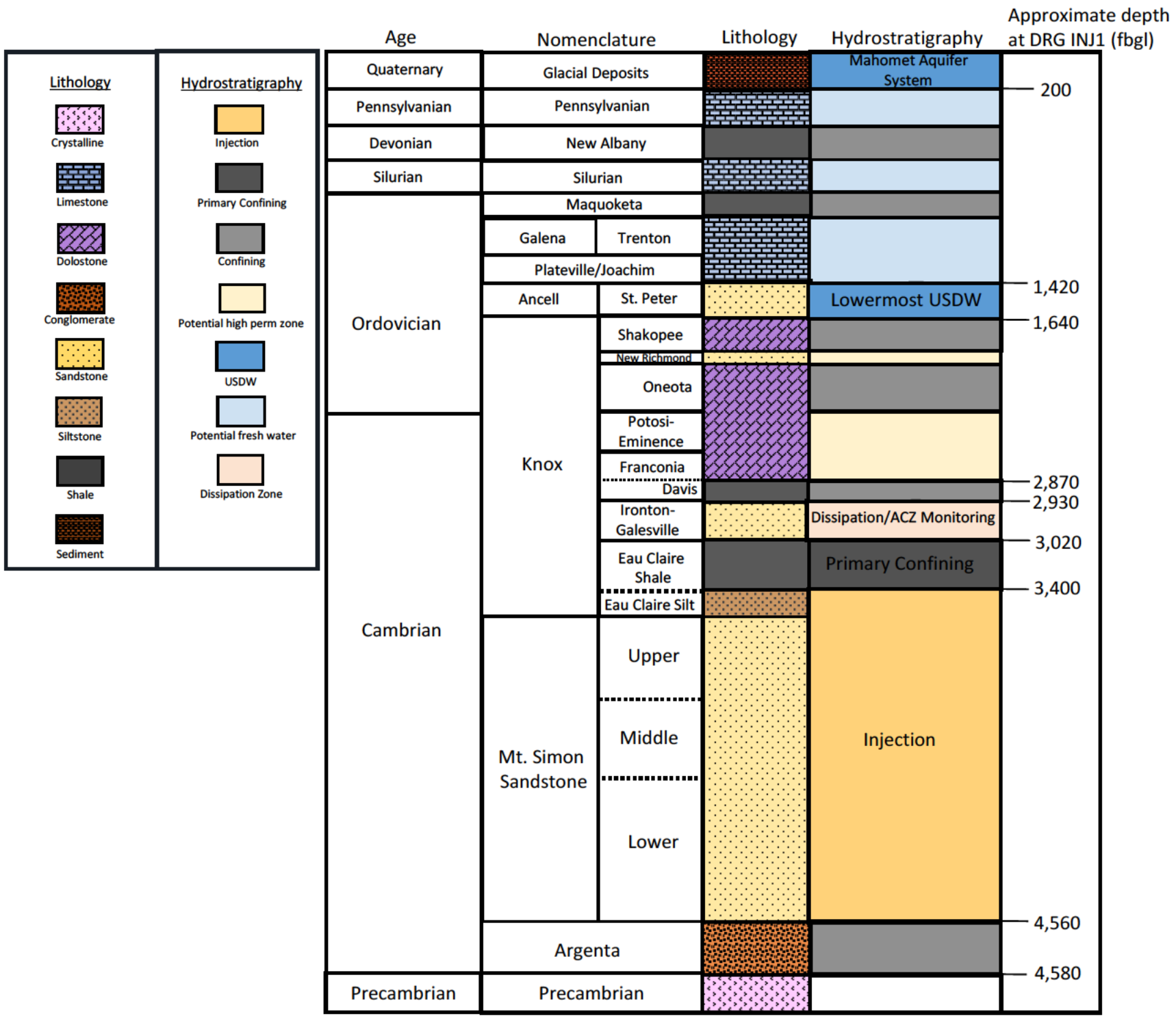
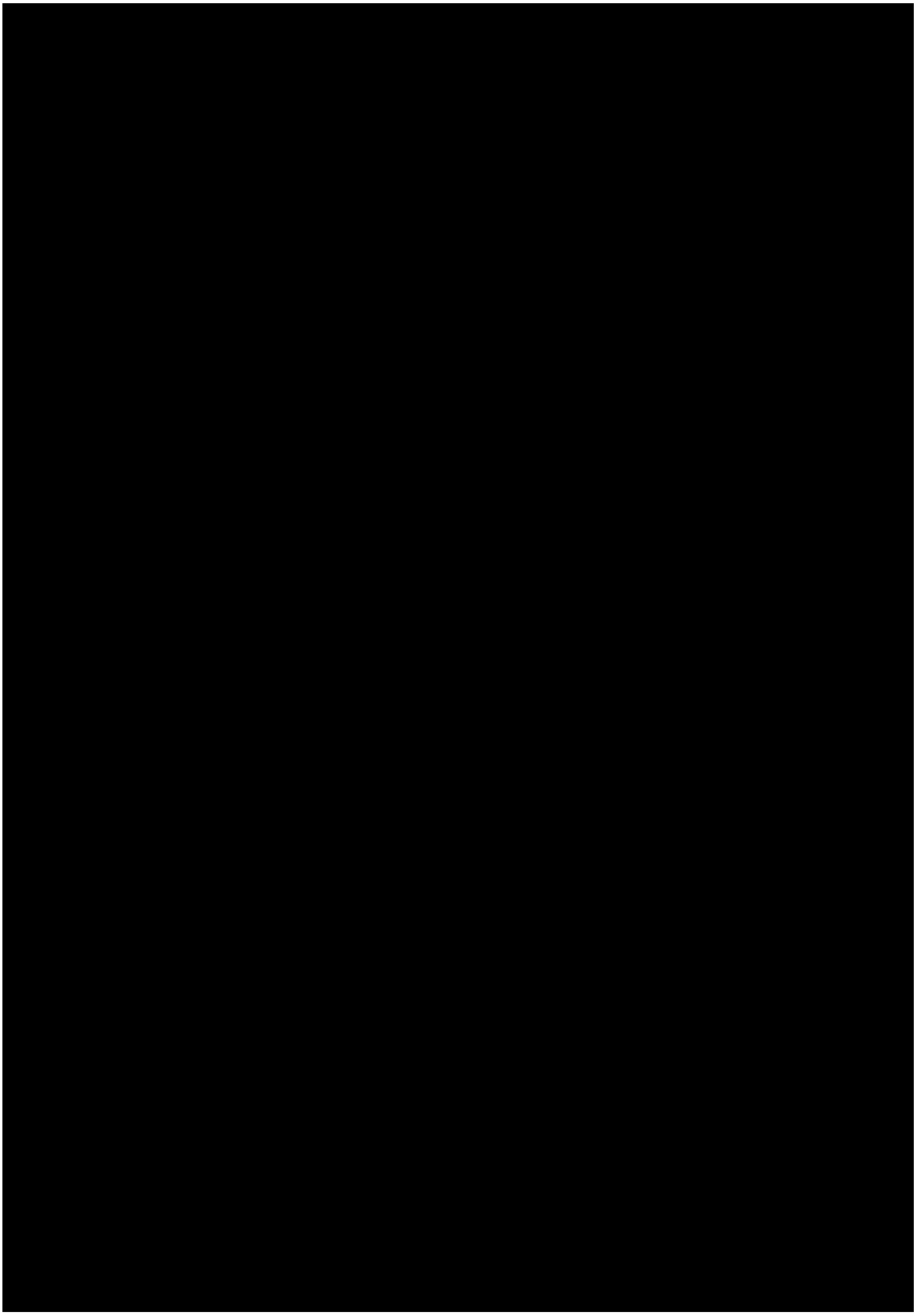



**Figure 1: Site-specific stratigraphic column for project site with age, nomenclature, generalized lithology, and zone of use.**

After the data acquired in DRG MA1, DRG OBS1, DRG ACZ1, and DRG INJ1 have been analyzed, a Pre-operational Narrative will be submitted to the EPA that will provide the new data and the updated static and computational models that will incorporate the data from the Pre-Operational Testing Program.



# 2. Pre-injection Testing Plan – Injection Well (146.87 (a))

The following tests and logs will be conducted when DRG INJ1 is drilled, the casing is installed and cemented, and the hydrogeologic properties are tested in accordance with 40 CFR 146.87(a), (b), (c), and (d). The tests and procedures are described in the section below.

DRG INJ1 will be the carbon dioxide ($CO_2$) injection well, and the primary well used to collect pre-operational data that will include but not be limited to:

- Wireline logs, core, fluid samples, and well test data,
- Well integrity data that will ensure that the project wells will not serve as a conduit for $CO_2$ or injection zone fluid migration to the overlying USDWs.

## *2.1. Deviation Checks (146.87 (a)(1))*

Deviation surveys will be obtained as the wells are drilled to determine the wellbore path from the surface to the total depth of the well. A wireline survey tool will be used to measure the inclination. The tool has an electronic timer that is set at the surface to allow enough time to run the tool in the drill pipe to the desired depth. Following the set time, the tool will be removed from the well, and the results will be reviewed prior to the resumption of drilling activity.

An alternative way to measure these deviation surveys is to place a measurement while drilling tool on the bottomhole assembly (BHA) just above the drill bit. This tool records the inclination (deviation) and azimuth (direction) of the tool, and then transmits this information to surface in real-time.

The planned maximum allowable deviation in the well is five degrees, so the hole deviation will be maintained at less than five degrees. If necessary, the wellbore will be steered back to an acceptable deviation with directional tools such as a downhole motor or rotary steerable system added to the BHA. Surveys will be taken at the frequency shown in Table 1. In general, a survey will be performed every 500 feet while drilling unless deviation of the borehole becomes apparent.

Should the deviation increase, more frequent surveys will be performed, and remedial actions will occur as necessary to bring the well within specification. More frequent surveys will also be performed while drilling through zones that are likely to cause the bit to "walk" creating a greater risk for deviation. Surveys will be repeated at the intervals specified in Table 1 until the wellbore has less than 1 degree of inclination.

**Table 1: DRG INJ1 deviation survey frequencies to be taken.**

| Range of Deviation | Frequency of Survey |
|---|---|
| <1 degree | 1 survey per every 500 feet of hole |
| >1 degree, but < 2 degrees | 1 survey per every 250 feet of hole |
| >2 degrees | 1 survey per every 100 feet of hole |

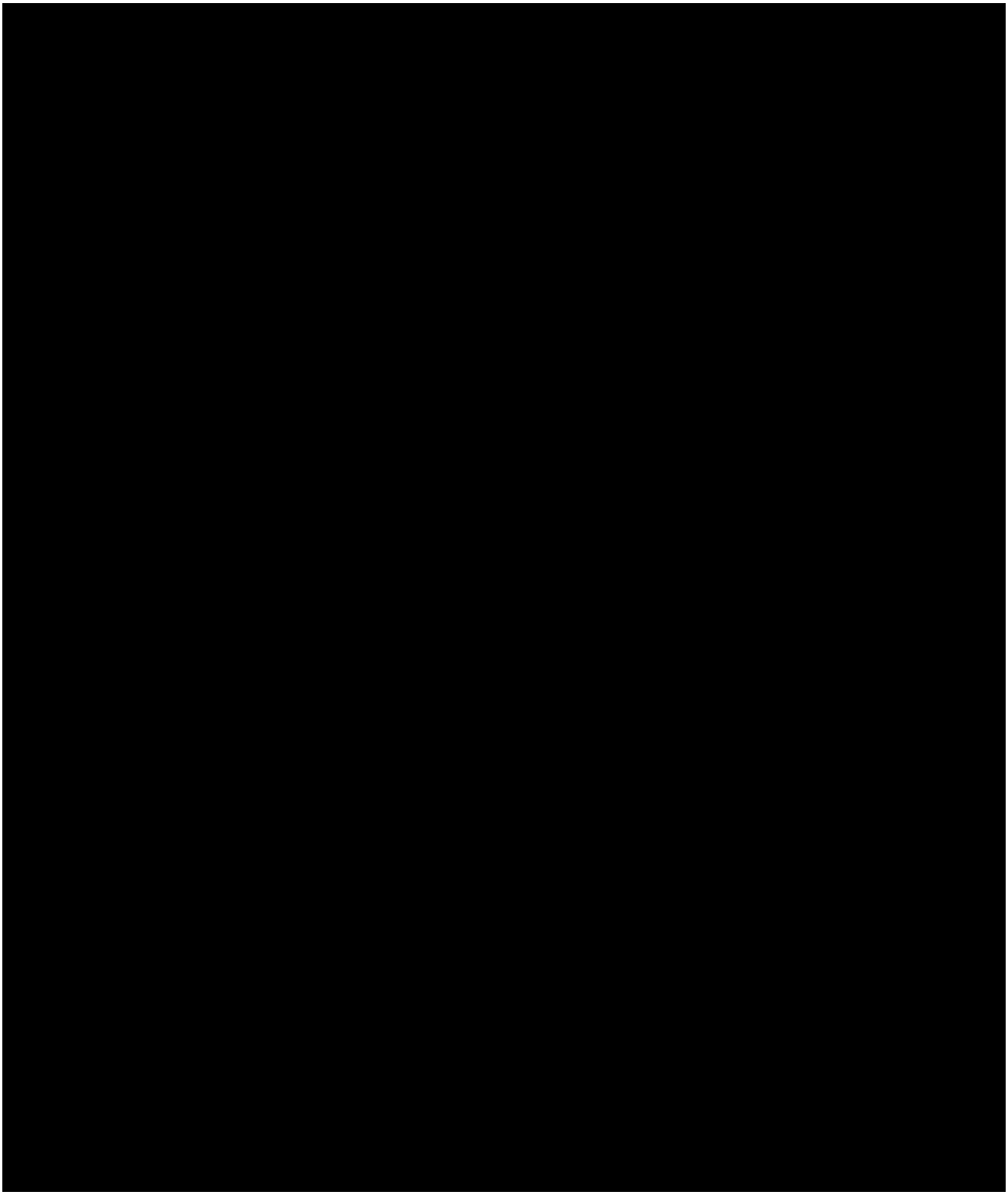
## 2.2. Tests and Logs

### 2.2.1. Tests and Logs Performed During Drilling

#### 2.2.1.1. Well Logging

Table 2 and Figure 4 summarize the type and purpose of each well log that the Dragon Project proposes to acquire in the surface, intermediate (contingent), and long string casing segments of the well.

In addition to the well logs listed in Table 2, the project may run other specialty well logs over the injection zone and confining interval to further characterize these formations. Specialty logs may include, but are not limited to, elemental capture spectroscopy, dipole sonic in multiple modes, or zero offset vertical seismic profiles.



### *2.2.1.2. DRG INJ1 Well Core Program (146.87 (b)(d))*

After DRG OBS1 has been drilled, the well logs will be analyzed and used to pick the optimal intervals to obtain core from the confining zone and the injection zone in DRG INJ1. Up to 60 feet of core will be acquired in both the Eau Claire Shale and the Mt. Simon Sandstone. Table 3 summarizes the plans for whole core acquisition from DRG INJ1.

**Table 3: Whole core collection plan.**

| Core Type | Target Interval MD (feet) | Formation | Core Size |
|---|---|---|---|
| Whole Core | Up to 60 feet | Eau Claire Shale | 4-inch |
| Whole Core | Up to 60 feet | Mt. Simon Sandstone | 4-inch |
| Sidewall Core | Contingency | As Needed | 1.5-inch |
| Note: Whole core plugs will be taken from the whole core at regular intervals. Sidewall core collection will be contingent on the results of the well logging and the success of the whole core acquisition. | | | |

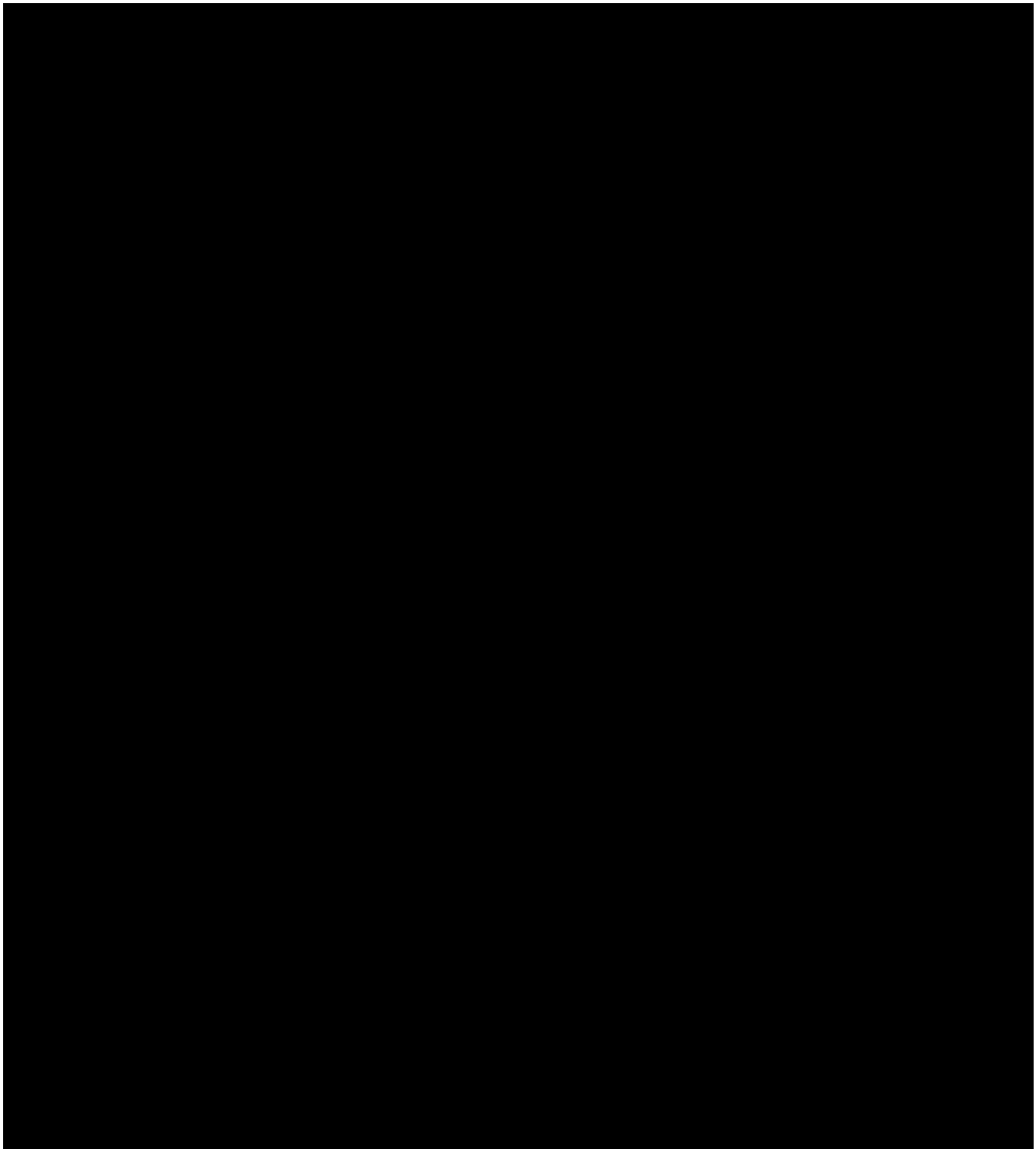
Sidewall core will be used as contingency to acquire additional data where the project was not able to obtain the desired whole core intervals. Sidewall cores will be analyzed for routine rock property data (as outlined in Table 4) to calibrate geophysical wireline logs and to supplement formation property data.

Additional core will be collected if:

- Interpretated well data indicates that additional data are needed to meet Class VI permit requirements.
- As required by the UIC Program Director.

Core samples from DRG INJ1 will provide site specific information regarding local geologic properties. The laboratory-derived core measurements will be integrated with wireline logs and used for petrophysical calibration. The integrated dataset will then be correlated with wireline logs from offset wells to support the correlation and confirmation of stratigraphy and rock properties.

Core acquisition and analysis plans will be provided once finalized with a coring contractor prior to well installation (Table 4).



### *2.2.2. Tests and Logs Performed During and After Casing Installation (146.87 (a)(2), (3))*

#### *2.2.2.1. Well Logging*

Table 5 summarizes the cased hole well logs that will be acquired after casing is set and cemented for each well section. The bottom of the surface casing will be set at approximately [redacted] feet below ground level (fbgl) as per Attachment 01: Narrative, (2024). Intermediate casing will be installed in the injection well if lost circulation zones are encountered in the Knox Supergroup such that drilling can not be continued to planned total depth. As such, logging runs in the intermediate casing string have been labeled as contingency. Long string casing will be set at approximately [redacted] fbgl, which is approximately 20 below the top of the Precambrian Basement (Attachment 01: Narrative, 2024). A 10-foot rathole is planned for all sections of the well, so the bottom of the casing will be approximately 10 feet shallower than the bottom of the hole section.

[redacted]

### 2.2.2.2. *Fluid Sampling and Analysis (146.87 (b – d))*

The characterization of injection zone fluids will be based on analysis of fluid samples acquired from DRG INJ1. These samples will be collected through swabbing, drill stem tests (DSTs), or downhole pumps and will provide information on the baseline aqueous geochemistry of the injection zone fluids. The fluid samples will be analyzed for TDS and major analytes (Table 6). The static fluid level of the injection zone will also be established in DRG INJ1.

**Table 6: Summary of analytical and field parameters for groundwater samples**

| Parameters | Analytical Methods [1] |
|---|---|
| Cations: Ca, Fe, K, Mg, Na, Si | EPA 6010B |
| Cations: Al, Sb, As, Ba, Cd, Cr, Cu, Pb, Mn, Hg, Se, Tl | EPA 200.8, EPA 245.1 |
| Anions: Br, Cl, F, $NO_3$, and $SO_4$ | EPA 300.0 |
| Alkalinity | SM 2320B |
| TDS | SM 2540C |
| Total Organic Carbon | SM 5310C |
| Dissolved Inorganic Carbon | SM 5310C |
| Total and Dissolved $CO_2$ | ASTM D513-06B |
| Stable Isotopes of δ13C | Isotope Ratio Mass Spectrometry [2] |
| pH | Field with multi-probe system |
| Conductivity/Resistivity | Field with multi-probe system |
| Temperature | Field with multi-probe system |

[1] An equivalent method may be employed with the prior approval of the Underground Injection Control (UIC) Program Director.
[2] Gas evolution technique by Atekwana and Krishnamurthy (1998) with modifications made by Hackley et al. (2007)

### 2.2.2.3. *Step-Rate Testing (146.87 (d)(1))*

A step-rate test (SRT) will be performed on the injection zone interval through the analysis of the pressure response to increases in injection rates. This is done to determine:

- Fracture opening pressure (to determine the fracture gradient),
- Fracture propagation pressure,
- Fracture closure pressure.

Injection at each of the rates will be performed on DRG INJ1 for the same period as detailed in the high-level procedure below. A formal procedure will be provided to the EPA prior to the running of the SRT.

1. Record downhole static pressure and temperature for a minimum of one hour.
2. Rig-up pump truck, ensure sufficient volume of fluid is present at location to begin testing.
3. Pressure test lines above maximum anticipated operating pressure, but below equipment rating.
4. Begin SRT.

a. Pump first step of test at first desired rate (e.g., 0.5 barrels per minute [bpm]) for a defined time (e.g., 0.5 hours)
b. After the first step is completed, increase rate to next step (e.g., 1.0 bpm) for the same defined step time (0.5 hours).
c. Repeat until the end of the test.

5. Shut-in well at the wing valve(s). Record the time of shut-in, the rate prior to shut-in and the instantaneous shut-in pressure.
6. Rig-down pump truck.
7. Monitor pressure falloff for minimum of 24-hours.

The data from this test will be analyzed using appropriate analysis software, and the results will be included in the post installation reporting. Gauge calibration records will also be provided at this time.

The results from the SRT will be combined with the results from the core analyses and log data to determine the direction and magnitude of the three principal components of the stress field as well as the fracture gradient. Additional data may include, but are not limited to, triaxial compressive strength tests of core samples as well as dipole sonic and image logs.

### *2.2.3. Demonstration of Mechanical Integrity (146.87 (a)(4))*

Table 7 summarizes the mechanical integrity tests (MITs) that will be used to demonstrate the integrity of the injection well.

**Table 7: Pre-operational mechanical integrity testing schedule for the injection well.**

| Class VI Rule Citation | Rule Description | Test Description | Program Period |
|---|---|---|---|
| 40 CFR 146.89(a)(1) | MIT - Internal | Annulus pressure test (APT) | Following initial completion |
| 40 CFR 146.87(a)(4) | MIT - External | Temperature log | Following initial completion |
| 40 CFR 146.87(a)(4) | MIT - External | Radioactive tracer (RAT) log | Following initial completion (if needed) |
| 40 CFR 146.87(a)(4) | MIT - External | CBL-VDL | During initial completion |
| 40 CFR 146.87(a)(4) | MIT - External | Ultrasonic Cement Evaluation | During initial completion |

Vault Dragon CCS LP will notify EPA at least 30 days prior to conducting the test and provide a detailed description of the testing procedure. Notice and the opportunity to witness these tests/logs shall be provided to EPA at least 48 hours in advance of a given test/log.

#### *2.2.3.1. Internal Mechanical Integrity Testing (146.87 (a)(4)(i))*

Internal mechanical integrity refers to the integrity of the seal between the long string casing, injection tubing, wellhead, and packer as well as the integrity of the individual components. In this subsection, the annulus refers to the casing-tubing annulus. The effectiveness of this seal can be confirmed with an annulus pressure test (APT) and annular pressure monitoring.

Internal mechanical integrity will be demonstrated by way of an APT as is standard for Underground Injection Control (UIC) wells. A baseline APT will be performed to 1,500 pounds per square inch (psi) after the tubing, packer, downhole equipment, and the wellhead have been installed as outlined in Attachment 01: Narrative, (2024). 1,500 psi has been designated as the maximum operating pressure for the annulus. The APT procedures for the injection well are given in Section 5 – *APT Procedures for Injection Well*.

In addition to the APT, the tubing will be inspected as it is being installed to monitor the tubing for corrosion. Once injection commences, injection pressure, annular pressure, and annular fluid volumes will be monitored continuously to ensure internal well integrity and proper annular pressure is maintained (Attachment 06: Testing and Monitoring, 2024).

#### *2.2.3.2. External Mechanical Integrity Testing (146.87 (a)(4)(ii – iv))*

External mechanical integrity refers to the absence of fluid movement through channels in the cement between the long string casing and the borehole. The external integrity of DRG INJ1 and DRG OBS1 will be monitored through the life of the project wells. The external mechanical integrity will be monitored on the schedule provided in Attachment 06: Testing and Monitoring, (2024).Generally accepted methods for evaluating external mechanical integrity include:

- Temperature or noise log,
- Oxygen-activation logging or radioactive tracer (RAT) logging (during operation),
- Or other logs the operator deems appropriate.

After completion, a baseline temperature log will be run from surface to the bottom of the long string casing to establish baseline temperature conditions along the well. Temperature logging will be performed at regular intervals during the injection phase of the project based on the schedule provided in the Testing and Monitoring Plan (Attachment 06: Testing and Monitoring, 2024). The results of these logs will be compared to the baseline data for indications of anomalous upward fluid migration. If the temperature logging data suggest that an issue with external well integrity exists, a RAT log will be performed to further evaluate external well integrity.

In addition to the baseline temperature log, a cement bond log-variable density log (CBL-VDL), an advanced ultrasonic cement evaluation log, will be run across the intermediate and long string casing after completion of the injection well to confirm the integrity of the cement between the casing and the formation (Table 5). CBL-VDLs are recorded with sonic tools that detect the bond of the casing and formation to the cement and identify potential damage or channels in the cement.

# 3. Pre-injection Testing Plan – DRG OBS1 (146.87 (a))

DRG OBS1 is expected to be the first well drilled for the project. The well will be logged to establish depths to formation tops, fluid sampling zones, and potential coring intervals in the injection well. The deep observation well will also be used to confirm that the Ironton-Galesville Sandstones will provide a suitable ACZ monitoring interval. Intermediate casing will be installed in the well in the event that lost circulation zones are encountered in the Knox Supergroup when the well is drilled, as such, logging runs in the intermediate casing string have been labeled as contingency.

## *3.1. Deviation Checks (146.87 (a)(1))*

Deviation surveys will be obtained as the observation well is drilled, following the procedure outlined in Section 2.1 *Deviation Checks*.

## *3.2. Tests and Logs*

### *3.2.1. Tests and Logs Performed During Drilling*

Table 8 summarizes the open hole logs that will be acquired before casing has been set for the surface, intermediate, and long string casing, as well as the purpose of each well log. The long string casing will terminate in the top of the Mt. Simon Sandstone.

### *3.2.2. Tests and Logs Performed During and After Casing Installation*

Table 9 summarizes the cased hole logs that will be run after casing has been set for the surface, intermediate, and long string casing, as well as the purpose of each well log.

### 3.2.3. *Demonstration of Mechanical Integrity (146.87 (a)(4))*

Table 10 summarizes the MITs to be performed on the deep observation well after installation and prior to commencing $CO_2$ injection operations:

**Table 10: Pre-operational mechanical integrity testing schedule for the deep observation well**

| Test Name | Test Description | Program Period |
|---|---|---|
| MIT - Internal | APT | Following initial completion |
| MIT - External | Temperature log | Following initial completion |
| MIT - External | CBL-VDL | During initial completion |
| MIT - External | Ultrasonic Cement Evaluation | During initial completion |

Notice and the opportunity to witness the test/log shall be provided to EPA at least 48 hours in advance of a given test/log. Note that the APT will be run to 500 psi.

# 4. Pre-injection Testing Plan – ACZ Monitoring Well DRG ACZ1 (146.87 (a))

## *4.1. Deviation Checks (146.87 (a)(1))*

Deviation surveys will be obtained as the ACZ well is drilled and will follow the procedure outlined in Section 2.1 *Deviation Checks*.

## *4.2. Tests and Logs*

### *4.2.1. Tests and Logs Performed During Drilling*

Open hole gamma ray and caliper logs will be run in the DRG ACZ1 long string casing section before casing is set (Table 11).

In DRG MA1 and DRG ACZ1, cuttings will be collected to identify shallow USDW formation tops where cores and logging are not feasible or planned.

### *4.2.2. Tests and Logs Performed During and After Casing Installation*

DRG ACZ1 will be drilled after DRG OBS1. Cased hole logs will be acquired in DRG ACZ1 to assess cement integrity and obtain baseline pulsed neutron logs for future reference (Table 11).

The characterization of ACZ monitoring zone fluids will be based on analysis of fluid samples acquired from DRG ACZ1. These samples will be collected through swabbing, DSTs, or downhole pumps and will provide information on the baseline aqueous geochemistry of the ACZ monitoring zone fluids for comparison to future monitoring data. The fluid samples will be analyzed for TDS and major analytes (Table 6). The static fluid level of the ACZ monitoring zone will also be established in DRG ACZ1.

In addition to sampling the ACZ monitoring zone fluids, DRG ACZ1 will be used to take a baseline sample of the St. Peter Sandstone, which is the lowermost USDW (Attachment 01: Narrative, 2024). The St. Peter Sandstone will only be sampled as a contingency in the Testing and Monitoring Program (Attachment 06: Testing and Monitoring, 2024). The sample from the St. Peter Sandstone will be collected using the same methods outline for the sample from the ACZ monitoring interval.

### *4.2.3. Demonstration of Mechanical Integrity (146.87 (a)(4))*

Table 12 summarizes the MITs to be performed on the ACZ monitoring well after installation and prior to commencing $CO_2$ injection operations:

**Table 12: Pre-operational mechanical integrity testing schedule for the ACZ monitoring well**

| Test Name | Test Description | Program Period |
|---|---|---|
| MIT - Internal | Casing pressure test | Following initial completion, prior to perforating ACZ interval |
| MIT - External | Temperature log | Following initial completion |
| MIT - External | CBL-VDL | During initial completion |

Notice and the opportunity to witness the test/log shall be provided to EPA at least 48 hours in advance of a given test/log.

## 5. APT Procedures for Injection Well

An APT will be performed after the initial well completion for DRG INJ1 and DRG OBS1. The annulus will be filled with a non-corrosive fluid and additives.

The APT will be performed to demonstrate internal mechanical integrity following the initial completion of the well. The test will be performed consistent with approved and accepted guidance and regulations (CFR 146.89 (b)).

Prior to beginning the APT, a calibrated digital gauge will be installed on the annulus. The APT will begin by pressuring up the annulus to 1,500 psi (or 500 psi for DRG OBS1) after the well has reached thermal equilibrium. The pressure will be monitored for a period of no less than 60 minutes.

The following procedure will be followed for all APTs that will be run:

1. Install a calibrated digital gauge on the casing-tubing annulus. Note initial pressures on the tubing and annulus.
2. Ensure the well is in thermal equilibrium. Thermal equilibrium will be assumed under the following circumstances:
    a. Injection has not occurred for approximately 24 hours, or sufficient data indicates the wellbore temperature is static. The scenario constitutes a static APT.
    b. Injection is occurring at a constant rate (±5%), often referred to as a dynamic APT.
3. Increase annulus pressure to 1,500 psi (or 500 psi for DRG OBS1).
    a. Ensure to note the fluid level in the system prior to increasing the annulus pressure.
4. Disconnect the annulus system and ensure the annulus is isolated.
5. Monitor the annulus and tubing pressure for a period of one-hour, taking readings every 10-minutes.
6. Once the test has concluded, reconnect the annulus system.
7. Blow the pressure down to the normal operating pressure.
8. Note the fluid level in the system.

## 6. Internal Mechanical Integrity Testing for Deep Observation Well DRG OBS1

Following the completion and installation of tubing in the DRG OBS1 well, an APT will be performed after initial well completion following the procedure provided in Section 5 *APT Procedures for Injection Well*.

## 7. Internal Mechanical Integrity Testing for Monitoring Well DRG ACZ1

A casing pressure test will be performed on the ACZ monitoring well after initial well completion and prior to the perforation of the well. This test will provide an indication of the integrity of the casing-wellhead seal and casing integrity. The procedure outlined below will be followed to perform the test:

1. Install calibrated digital gauge on the wellhead. Note initial pressures.
2. Increase pressure to 1,500 psi.
3. Monitor the pressure for a period of one-hour, taking readings every 10-minutes.
4. Once the test has concluded, blow the pressure down to the pre-test pressure.

## 8. Pressure Fall-Off Test Procedures (146.87 (e))

A pressure fall-off test (FOT) will be run on DRG INJ1. The purpose of this test is to further characterize the hydrogeologic characteristics of the injection zone. During this test, fluid will be injected at a constant rate for a predetermined length of time, after which the well will be shut in, and the pressure monitored for an equal period of time.

The data from this test will be evaluated using rate superposition analysis to determine injection zone information such as: permeability, skin factor (damage), and flow regimes present. This analysis will act as a baseline measurement to determine the change in overall effectiveness and injectivity of the injection zone over time. Results from this analysis will be provided as part of the post-installation reporting.

A high-level procedure has been provided below. Note that a formal procedure will be provided to the EPA prior to running the FOT.

1. Record static bottomhole pressure and temperature for a minimum of one hour.
2. Rig-up pump truck, ensure sufficient volume of fluid is present at location to begin testing.
3. Begin injection. Inject at constant rate for predetermined duration.
4. At the end of the injection period, shut the well in at the wing-valve(s). Record the time of shut-in, rate prior to shut-in, and the shut-in pressure.
5. Secure the well.
6. Rig-down pump truck.
7. After the pressure has been allowed to decline for approximately the same duration as the injection the test can conclude.

# 9. References

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