SECTION 5 – TESTING AND MONITORING PLAN

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5.1 Introduction

The operating plans for the proposed Orchard Storage Company LLC (Orchard Storage) Orchard [redacted] injection well include robust testing and monitoring programs, which are designed to satisfy the requirements of 16 Texas Administrative Code (TAC) ***§*5.203 (j)** [Title 40, U.S. Code of Federal Regulations (40 CFR) **§146.90**]. This section discusses the key details of this program.

5.2 Reporting Requirements

In compliance with 16 TAC **§5.207** [40 CFR **§146.91**] requirements, Orchard Storage will provide the following routine reports to the Underground Injection Control (UIC) Director.

Per-Occurrence Reporting:

- Any noncompliance with a permit condition or malfunction of the injection system, which may cause fluid migration into or between Underground Sources of Drinking Water (USDWs)
    - Verbal Notification – Reported within 24 hours of the event
- Any evidence that the injected CO_2 stream or associated pressure front may cause an endangerment to a USDW
    - Verbal Notification – Reported within 24 hours of the event
    - Written Notification – Reported within five working days of the event
- Any failure to maintain mechanical integrity
    - Verbal Notification – Reported within 24 hours of the event
- Any significant data that indicate the presence of leaks in the well or lack of confinement to the storage reservoir
    - Verbal Notification – Reported within 24 hours of the event
    - Written Notification – Reported within five working days of the event
- Any changes to the physical, chemical, and other relevant characteristics of the CO_2 stream from what has been described in the proposed operating data
    - Written Notification – Reported within 72 hours of composition change
- Description of any event that exceeds operating parameters for annulus pressure or injection pressure as specified in the permit
    - Verbal Notification – Reported within 24 hours of the event
    - Written Notification – Reported within 72 hours of the event
- Description of any event that triggers a shut-off device either downhole or at the surface and the response taken
    - Verbal Notification – Reported within 24 hours of the event
    - Written Notification – Reported within 72 hours of the event
- Any release of CO_2 into the atmosphere or biosphere
    - Verbal Notification – Reported within 24 hours of the event

Semi-Annual Reports:

- Summary of wellhead pressure monitoring
- Any changes to the source of the CO_2 stream
- Any changes to the physical, chemical, and other relevant characteristics of the CO_2 stream from what has been described in the proposed operating data
- Monthly average, maximum and minimum values of injection pressure, flow rate, temperature, volume, and annular pressure
- Description of any event that exceeds operating parameters for annulus pressure or injection pressure as specified in the permit
- Monthly volume and/or mass of the CO_2 stream injected over the reporting period, and the volume injected cumulatively over the life of the project
- Monthly annulus fluid volume added
- Results of any monitoring as described in this section

Annual Reports:

- Any corrective action performed
- Recalculated area of review (AOR) or statement confirming monitoring and operational data supports current delineation of AOR on file with the Commission
- Proof of good faith claim to sufficient property rights for storage facility operation
- Tons of CO_2 injected

Reports to be submitted within 30 days after the following events:

- Any well workover
- Any test of the injection well conducted if required by the Director
- Any periodic mechanical integrity tests

Notification to the UIC authority (16 TAC **§5.206(c)**), in writing, 30 days in advance of:

- Any planned workover
- Any planned stimulation activities
- Any other planned test of the injection well

Orchard Storage will submit all reports, submittals, and notifications to the Environmental Protection Agency (EPA) and Texas Railroad Commission (TRRC) and ensure that all records are retained throughout the project's life. Per 16 TAC **§5.207(e)** [40 CFR **§146.91(f)**], these records will be maintained for 10 years after site closure. The records will be delivered to the Director upon request after the retention period. Monitoring data will be retained for 10 years post-collection, while well-plugging reports, post-injection site care data, and the site closure report will be retained for 10 years after site closure.

5.3 Testing Plan Review and Updates

Per 16 TAC **§5.207(a)(3)** [40 CFR **§146.90(j)**], the Testing and Monitoring Plan will be reviewed and revised as necessary at least every five years to incorporate collected monitoring data. Plan amendments will also be submitted within one year of an AOR reevaluation following significant facility changes, such as the development of offset monitoring wells or newly permitted injection wells within the AOR, or as required by the Director.

5.4 Testing Strategies

5.4.1 Open Hole Logging

Orchard Storage plans to run an advanced suite of open hole logs to obtain data for parameters used in static and dynamic subsurface modeling. The following Baker Technology log descriptions are provided as an example of the types of logs to be run. The specific logging vendor will be selected just prior to drilling the well. Commercial and supply chain issues may affect the final vendor selection.

A list of planned open hole logs is provided in Table 4-10 of *Section 4 – Engineering Design and Operating Strategy*.

Baker Hughes Rockview™ Formation Lithology eXplorer (FLeX)
Mineralogical characterization tool equipped with a pulsed neutron spectrometer. Allows for a resolution of uncertainties compared to traditional petrophysical evaluation methods. Enhanced porosity determination, clay type/volume determination, and lithofacies identification.

Baker Hughes MR eXplorer (MReX)
Nuclear magnetic resonance-based instrument. By alternating static and pulsed radio frequency magnetic fields, the pore space fluid hydrogen protons are aligned and spun when interacting with the two magnetic fields. These “spin-echoes” can be recorded and analyzed based on amplitude and echo decay rates. This gives information on the porosity, pore size, and type of present fluid. Reliable data acquisition is available in almost every borehole environment.

Baker Hughes UltrasonicXplorer (UXPL)
Borehole acoustic imaging service using a rotating acoustic transducer. Provides high-resolution feedback during drilling, completion, and production operations. Documents stratigraphic features, unconformities, dip/strike, and borehole shape. The design allows for use in any mud type, large diameter boreholes, and full 360° coverage.

Baker Hughes STAR-XR
High-resolution formation resistivity imaging in conductive mud systems. Carries 144 sensors downhole to measure geologic features coupled with enhanced petrophysical reservoir evaluation. Identifies structural dips, depositional environments, borehole stability, and net pay in thinly bedded sequences. Applicable in the well-to-well correlation of sedimentary and stratigraphic

information.

Baker Hughes XMAC F1 (XMAC-F1)

Acoustic services using monopole and dipole measurements provide quality compressional and shear-wave measurements in low-velocity and unconsolidated formations, enhanced value and understanding of petrophysics, reservoir characterization, and rock mechanical properties. The XMAC-F1 service builds on the previous XMAC ELITE, can log at twice the speed, and can measure shear slowness up to 1,200 microseconds per foot (µs/ft).

5.4.2 Initial Step-Rate Injectivity Test

Before beginning CO_2 injection, Orchard Storage will conduct a step-rate injectivity test to measure the fracture gradient of [redacted] in compliance with 16 TAC **§5.203(f)(2)(A)** [40 CFR **§146.87(d)(1)**] and 16 TAC **§5.203(f)(2)(C)** [40 CFR **§146.87(e)(3)**]. Bottom hole, surface readout pressure and temperature gauges will be run to the total depth of the wellbore. Initial bottom hole pressure and temperature readings will be measured before injection. All gauges will be calibrated before testing.

5.4.2.1 Testing Method

Specific wellbore and injection zone properties will define the final test parameters. The following test method outlines the expected test injection rates and times. The injection of brine will begin at 1.5 barrels per minute (bpm) and be held for a minimum of 30 minutes. The injection rates will be stepped up in 2.0-3.0 bpm increments until at least three measurements have been taken both below and above the estimated formation fracture initiation pressure. Each stage will require a hold duration of at least 30 minutes or until pressure has stabilized.

A plot of stabilized injection pressure versus injection rate at each step should graphically represent a linearly sloped line until the fracture initiation pressure has been exceeded. Table 5-1 shows a step-rate test example, and Figure 5-1 is the corresponding graphical representation.

Table 5-1 – Step-Rate Injectivity Test Example

Step	Rate (bbl/min)	Time (min)	Pressure (psi)
0	0	0	0
1	0.2	30	100
2	0.4	30	200
3	0.8	30	400
4	1.6	30	802
5	2.4	30	1,201
6	3.2	30	1,400
7	4.0	30	1,600

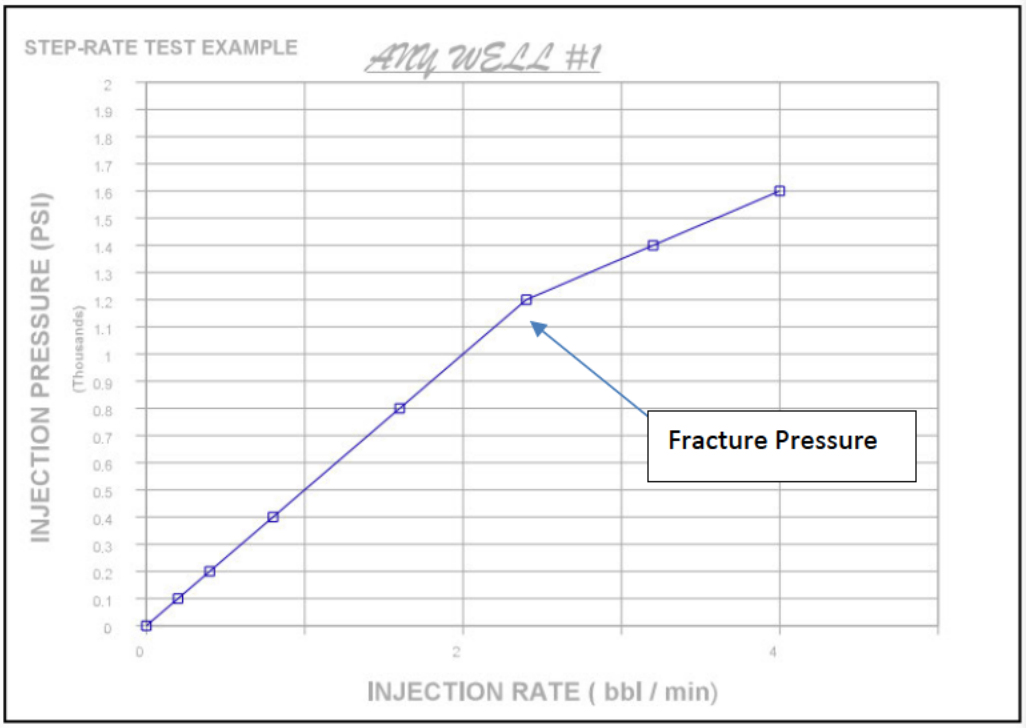

Figure 5-1 – Example Step-Rate Injectivity Test[1]

Upon reaching a stabilized pressure after completing the final step, pressures will be recorded at the highest frequency of the gauge for a period indicated by the step-up phase of testing, to calculate the rate of pressure bleed-off.

[1] https://www.epa.gov/sites/default/files/documents/INFO-StepRateTest.pdf

5.4.3 Chemical Composition Confirmation Testing

In compliance with 16 TAC **§5.203(j)(2)(A)** [40 CFR **§146.90(a)**] requirements, Orchard Storage will sample the CO_2 injection stream and evaluate any potential interactions of carbon dioxide and other injectate components. CO_2 injection stream samples will be taken quarterly for chemical analysis of the parameters listed in Table 5-2 plus continuous pressure and temperature analysis.

5.4.3.1 Sampling Methods

[redacted] Sampling cylinders will be purged with the injectate gas to expel laboratory-added gas.

Table 5-2 – Injectivity Test Parameters and Analytes Measured and Measurement Frequency

Parameter/Analyte	Frequency
Pressure	Continuous
Temperature	Continuous
CO_2 (%)	Quarterly
Water (lb/MMscf)	Quarterly
Oxygen (%)	Quarterly
Sulfur (ppm)	Quarterly
Methane (%)	Quarterly
Ethane (%)	Quarterly
Other Hydrocarbons (%)	Quarterly
Hydrogen Sulfide (ppm)	Quarterly
Benzene (%)	Quarterly

5.4.4 Mechanical Integrity Testing – Annulus Pressure Test

In accordance with 16 TAC **§5.203 (h)(1)(C)** [40 CFR **§146.89(b)**], Orchard Storage will demonstrate mechanical integrity by performing annular pressure tests when the well is completed, before the start of injection, and after any workover operation involving the removal and replacement of the tubing and packer.

The annular pressure tests should demonstrate the mechanical integrity of the casing, tubing, and packer. These tests are conducted by pressuring the annulus to a minimum of 500 pounds per square inch (psi) fluid pressure, then using a block valve to isolate the test pressure source from the test pressure gauge upon test initiation, with all ports into the casing annulus closed except the one monitored by the test pressure gauge. The test pressure will be monitored and recorded for a minimum duration of 30 minutes using a pressure gauge, with sensitivities that can indicate a loss

of 5%. Any loss of test pressure exceeding 5% during the minimum 30 minutes will indicate a lack of mechanical integrity.

All annulus pressure test results will be submitted to the TRRC on Form H-5 within 30 days of log run completion.

5.4.5 External Mechanical Integrity Testing – Temperature Log

In adherence to the requirements of 16 TAC **§5.203 (h)(1)(D)** [40 CFR **§146.89(c)**], Orchard Storage will perform an annual external mechanical integrity test (MIT) by deploying a temperature log, through the tubing. Temperature logs will be run before initiating injection operations, to establish a baseline against which future logs can be compared. The well will be shut in for approximately 36 hours before running the temperature logs to allow temperatures to stabilize. Satisfactory mechanical integrity is demonstrated by the proper correlation between the baseline and subsequent logs.

All temperature logs recorded during the MIT will be submitted to the TRRC within 30 days of completing the log run.

5.4.6 Pressure Fall-Off Testing

Orchard Storage will perform a required pressure fall-off test every five years per 16 TAC **§5.203 (j)(2)(F)** [40 CFR **§146.90(f)**]. The tests will measure near-wellbore formation properties and monitor for near-wellbore environmental changes that may impact injectivity and result in pressure increases.

5.4.6.1 <u>Testing Method</u>

Injection rates and pressures will be held as constant as is practical prior to the test. Pressure and rate data will be recorded continuously before and during the fall-off period. Pressure gauges to supplement the permanent gauges will be run into the well, if needed, several days prior to initiation of the fall-off test to allow for a period of stable injection prior to shut-in. The length of time for stabilization prior to shut-in will be determined in advance using pressure-transient well-test design methods that incorporate anticipated rates and formation properties.

Ideally, the fall-off test will be run sufficiently long to allow identification and analysis of the Infinite Acting Flow Regime (IARF). Given the heterogeneous nature of the injection interval, it may not be possible to identify this IARF flow regime through simple, semi-log straight line plots. [redacted]

5.4.6.2 Analytical Methods

Mechanical integrity will be determined through standard diagnostic plotting. This determination is accomplished via analysis of observed pressure changes and pressure derivatives on standard diagnostic log-log and semi-log plots, using specialized pressure-transient analysis software. The analysis will integrate additional data beyond the injection well's rate and pressure data. The additional data may include operational history, offset wells' injection and operational history, and distributed temperature sensing (DTS) sensor data from the injection well being tested. Depending on the complexity of the pressure response, it may be necessary to incorporate numerical modeling into the interpretation workflow.

Comparing pressure fall-off tests can expose significant changes in the well or reservoir conditions before initial injection with later tests. The effects of the fluid flow as well as the injected fluid's compressibility will be considered and incorporated into the analysis. The well parameters resulting from fall-off testing will be compared against those used in AOR determination and computational site modeling. Notable changes in reservoir properties may dictate that an AOR reevaluation is necessary.

5.4.6.3 Quality Assurance/Control

All field equipment will undergo inspection and testing before operation. Manufacturer calibration recommendations will be adhered to during the pressure gauge use in the fall-off test. Documentation certifying proper calibration will also be enclosed with the test results. Further validation of the test results will be recorded using a second bottom hole pressure gauge.

5.4.7 Injection Conformance Monitoring

[redacted] If the rate changes at a specific set of perforations, this data can be used, along with other pressure and rate information, to gain valuable insight into injection conformance. The use of this data will allow changes to operating or completion parameters as necessary for storage zone management purposes.

Per 16 TAC **§5.206 (d)(2)(F)(i)** [40 CFR **§146.88(e)(2)]**, automatic shut-off systems and alarms will be installed to alert the operator and shut-in the well when operating parameters such as annulus pressure, injection rate, etc. diverge from permitted ranges or gradients.

5.4.8 Cement Evaluation and Casing Inspection Logs

Per 16 TAC **§5.203 (h)(2)** [40 CFR **§146.89(d)**], a comprehensive cased hole logging suite will be run on the production casing string at the time of initial well completion. This suite of logs will include

a radial cement investigation, a multi-arm caliper, and a digital log to establish the condition of the casing metal. This survey will characterize the original state of the wellbore materials. Following the tubing and packer installation, an initial through-tubing inspection log will be run on the well. This survey will serve as the baseline for future casing inspection efforts.

Casing inspection logs will be performed every five years using a combination of conventional casing inspection logs and through-tubing surveys. The tools that will be run at that time include:

- Five-year casing inspection
    - Casing section below the packer:
        - Multiple-armed calipers to measure the inner diameter of the casing as the tool is raised or lowered into the well
        - Ultrasonic tools to measure wall thickness and provide information about the outer surface of the casing or tubing as well as cement bonding
        - Electromagnetic tools that measure the magnetic flux of the tubular and can provide mapped circumferential images to indicate potential pitting
    - Casing section from packer to surface:
        - Through-tubing casing inspection log
- If tubing must be removed, conventional casing inspection logs only will be run, consisting of:
    - Multiple-armed calipers to measure the inner diameter of the casing as the tool is raised or lowered into the well
    - Ultrasonic tools to measure wall thickness and provide information about the outer surface of the casing or tubing as well as cement bonding
    - Electromagnetic tools that measure the magnetic flux of the tubular and can provide mapped circumferential images to indicate potential pitting

Orchard Storage will provide a schedule of all logging plans to the Director at least 30 days prior to conducting the first test. Notice will be provided at least 48 hours in advance of such activity.

5.4.8.1 Casing Log Equipment Overview

Through-tubing logging technology provides the ability to evaluate casing deformation and eccentricity measurements, in conjunction with other well-integrity tools such as multi-finger calipers and multiple pipe-thickness logging tools. This technology provides quality measurements without requiring the removal of the tubing and packer (Yang et al., 2021).

The following descriptions of the through-tubing logging tools that will be run are provided for information purposes. The final vendor will be selected prior to operations based on availability and commercial considerations.

The GOWell instruments listed in Table 5-3 utilize Pulsed Eddy Current (PEC) decay technology to measure the thicknesses of multiple concentric tubulars. Basic PEC decay technology theory is included in the supplemental information at the end of this document. These tools can be run stand-alone or combined with other well integrity and correlation instruments—such as multi-finger

imaging caliper, temperature, noise, pressure, fluid density, capacitance, flowmeter, gamma ray, and casing collar locator.

GOWell PEC decay measurements are not affected by wellbore fluid type, chemical precipitates, or other foreign material deposits. They are also not affected by the type or distribution of annular materials such as cement, mud, liquid, or gas.

Table 5-3 – PEC Tool List

Pulsed Eddy Current Decay Thickness Instruments					
Tool	Tool O.D.	Max # concentric pipes	Max O.D.	Max Combined Wall Thicknesses	Ratings (degF/K psi)
MTD-B/C	1-11/16"	2	10-3/4"	1.75"	350/15
MTD-G	1-11/16"	3	16"	2.5"	350/15
ePDT-II	2" / 1-11/16"	3-5	30" / 18-5/8"	3.5"	350/20

Technical specification documents are included in *Appendix E*. Logging speeds depend on the size and number of tubulars to be logged. In general, multiple tubulars and larger sizes will necessitate slower data acquisition speeds, which range from 30 feet per minute to 5 feet per minute, based on the complexity of the wellbore configuration.

GOWell PEC decay instruments measure the increase or decrease of metal thickness for each concentric tubular. PEC decay data combined with inspection of the tubular's inner diameter (ID) using an imaging caliper or other methods can reliably predict the inside versus outside location of corrosion or flaws on the innermost tubular. Internal wear based on drilling or other known causes of internal damage is readily assessed with the assumption that the measured metal loss in such cases is "internal."

The degree of penetration is reported in percent wall loss from the nominal and absolutes value of metal thickness, expressed in inches or millimeters. Due to well-understood and long-established PEC decay physics principles, reported metal gain or loss is assumed to be distributed evenly around the pipe's circumference.

The GOWell PEC decay instruments measure the increase or decrease of metal thickness, which includes both internal and external corrosion effects. This overall metal thickness/degree of penetration is valid in identifying areas of well integrity concern. Additionally, integrity assessment of the production tubulars (i.e., tubing(s) and first casing) is only part of whether a wellbore and its associated tubulars are in such a condition as to be protective of public health, safety, and the environment. The newer generation GOWell PEC decay instruments provide an opportunity to assess the state of the protection tubulars (i.e., second casing, surface casing, etc.). Protection string(s) data is acquired simultaneously with the tubing and production string data.

5.4.9 Logging and Testing Reporting

A report that includes log and test results obtained during the drilling and construction of Orchard #1, and interpretated by a knowledgeable log analyst, will be submitted to the Director as per 16 TAC **5.203 (h)(2)** [40 CFR **§146.87(a)**]

5.5 Monitoring Programs

5.5.1 Continuous Injection Stream Monitoring

Orchard Storage will continuously monitor the injection pressures, rates and volumes, and annulus pressures to meet the 16 TAC ***§*5.203 (j)(2)(B)** [40 CFR **§146.90(b)**] requirements. [redacted] Per 16 TAC ***§*5.206 (d)(2)(B**), the total volume of CO_2 injected into the Project Orchard facility will be metered through a master meter or a series of master meters. The volume or mass of CO_2 injected into [redacted] will be metered through an individual well meter.

[redacted]

[redacted]

5.5.1.1 Analytical Methods

Orchard Storage will review and interpret continuously monitored parameters to validate that they are within permitted limits. The data review will also review trends to help determine any need for equipment maintenance or calibration. These data reports will be submitted semiannually.

5.5.2 Corrosion Coupon Monitoring

Orchard Storage will monitor for corrosion of the well tubing and casing materials per the 16 TAC ***§*5.203 (j)(2)(C)** [40 CFR ***§*146.90(c)**] requirements. A corrosion coupon monitoring system will be employed for this evaluation. Additionally, the casing inspection logs run every five years will provide information regarding corrosion of the tubulars.

5.5.2.1 Sampling Methods

Corrosion coupons, comprised of the same material as the injection flowline, tubing, and production casing, will be placed in the CO_2 injection flowline. These coupons will be removed quarterly and examined for corrosion per American Society for Testing and Materials (ASTM) standards for corrosion testing evaluation. After removal, the coupons will be visually inspected for signs of corrosion, including pitting, and measured for weight and size. The corrosion rate will be estimated by applying a weight loss calculation method that divides the weight loss recorded during the exposure period by the duration.

5.5.3 Soil Gas Monitoring

Soil gas monitoring will be used to check chemical compositions of the near surface environment and soil vadose zone. These environments are subjected to strong seasonal effects and influenced by a wide range of natural process and human activities. As with any of these types of monitoring, establishing a baseline condition is very important. Orchard Storage intends to install the soil gas monitoring stations at least a year prior to injection to better understand baseline conditions through multiple seasons. [redacted] Quality assurance and traceability methods will be used to ensure proper handling of samples and lab techniques.

5.5.4 Ground Water Quality Monitoring

To meet 16 TAC **§5.203 (j)(2)(C)** [40 CFR **§146.90(d)**] requirements, ground-water quality and geomechanical monitoring will be conducted above the confining zone to detect potential changes that could result from fluid leakage from the injection zone. [redacted]

[redacted]

The parameters to be measured are provided in Table 5-4.

Table 5-4 – Ground Water Quality Parameters Measured and Measurement Frequency

Parameter/Analyte	Frequency
Aqueous and pure-phase carbon dioxide	Every five years
Total dissolved solids	Every five years

pH	Every five years
Specific conductivity (SC)	Every five years
Temperature	Every five years
Density	Every five years
Other parameters including major anions and cations, trace metals, hydrocarbons, and volatile organic compounds	Every five years

5.5.4.1 Sampling Methods

Fluid samples will be acquired from the groundwater monitoring wells at monitored formation temperatures and maintained at formation pressures within a pressurized container. This step is taken to ensure that dissolved gas losses do not occur. [redacted]

5.5.4.2 Analytical Methods

Orchard Storage will test water samples and maintain results for the parameters listed in Table 5-4. If the CO_2 injectate contains unique impurities, then groundwater samples will also be tested to flag any concentrations of these impurities exceeding the baseline. Testing results will be stored in an electronic database.

Potential signs that fluid may be leaking from the injection interval(s) may be detected upon observation of the following trends:

- Change in total dissolved solids
- Changing signature of major cations and anions
- Increasing carbon dioxide concentration
- Decreasing pH
- Increasing concentration of injectate impurities
- Increased concentration of leached constituents
- Increased reservoir pressure and/or static water levels

5.5.4.3 Laboratory to Be Used/Chain of Custody Procedures

[redacted]

Orchard Storage will observe standard chain-of-custody procedures and maintain records, to allow full reconstruction of the sampling procedure, storage, and transportation, including problems encountered.

5.5.4.4 Quality Assurance and Surveillance Measures

Orchard Storage will collect duplicate samples and trip blanks for quality assurance/quality control (QA/QC) purposes. These duplicate samples will validate test results and ensure that samples have

not been contaminated.

[redacted]

5.5.5 Upper Confining Interval Monitoring

An above-zone monitoring well, Orchard MW#1, will be drilled and completed on the Orchard Storage property, as shown in Figure 5-3. [redacted] Any deviations from baseline pressures or temperature will initiate additional investigations in the area. If necessary, fluid samples can be obtained from this well.

5.5.6 Seismic Monitoring

[redacted] If an event greater than 2.5 is detected, Orchard Storage will compare it with injection history and publicly available data from nearby oil and gas activity to determine if a correlation to injection activity can be determined.

[redacted]

[redacted]

[redacted]

5.5.7 Injection Plume Monitoring

Orchard Storage will use both direct and indirect methods to track the CO_2 plume and the pressure front tracking, in accordance with 16 TAC **§5.203 (j)(2)(E)** [40 CFR **§146.90(g)**]. The direct monitoring method uses the continuously recorded pressures and temperatures to calculate the plume extent. [redacted]

Orchard Storage will use these methods to verify reservoir conditions during injection, track plume migration, and validate the plume model. Continuous pressure and temperature monitoring of the injection reservoir will allow for monitoring of reservoir conditions and inform calculations, while VSP surveys will determine the actual plume migration. [redacted]

5.5.7.1 <u>Direct Monitoring: Rate Transient Analysis</u>

Rate transient analysis, in conjunction with reservoir simulations using known reservoir characteristics, will allow for calculating more complex parameters within the injection interval. Direct monitoring will be based on continuous pressure, temperature, and injection rate data to calculate the properties of the reservoir and verify the plume model results.

The reservoir model built during the site evaluation phase will be used to monitor the reservoir conditions during injection operations predictively. Through flow simulation and transient flow

analyses, the reservoir model will be updated with injection activity regularly to evaluate the injection stream's effect on reservoir conditions. This analysis can be performed to monitor the magnitude and extent of temperature and pressure changes within the injection zone. Continual monitoring of bottom hole pressures and temperatures combined with known reservoir parameters will predict reservoir conditions throughout the injection intervals.

Additionally, any shut-in periods can be observed and treated as a pressure fall-off test. To do this, the shut-in wellhead pressure, bottom hole pressure, and temperature readings will be recorded and used for pressure transient analysis of the reservoir. The analysis results will include the radius and magnitude of pressure buildup and reservoir performance characteristics such as permeability and transmissibility. Analysis results will then confirm, and adjust as necessary, the previous model realizations.

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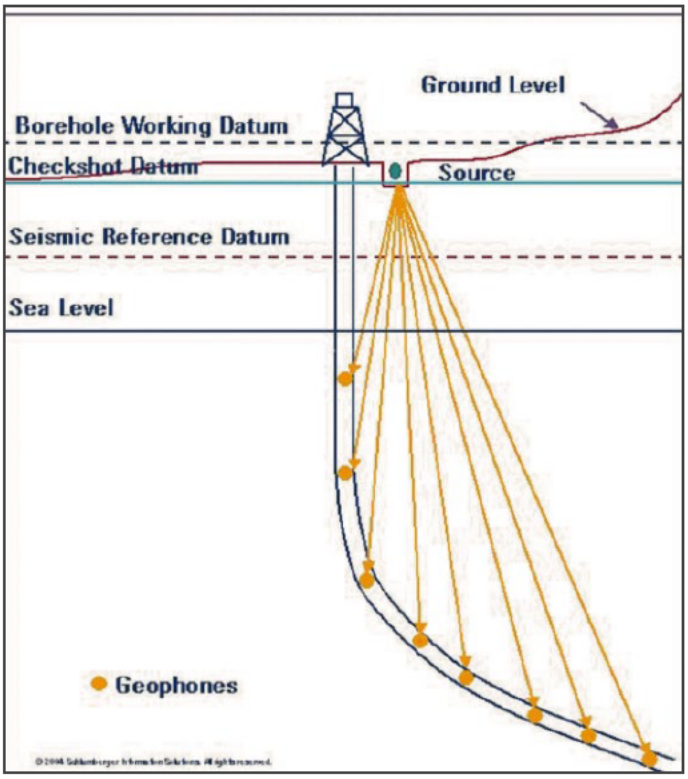

Figure 5-10 – Illustration of a Checkshot Survey

[redacted]

[redacted]

[redacted]

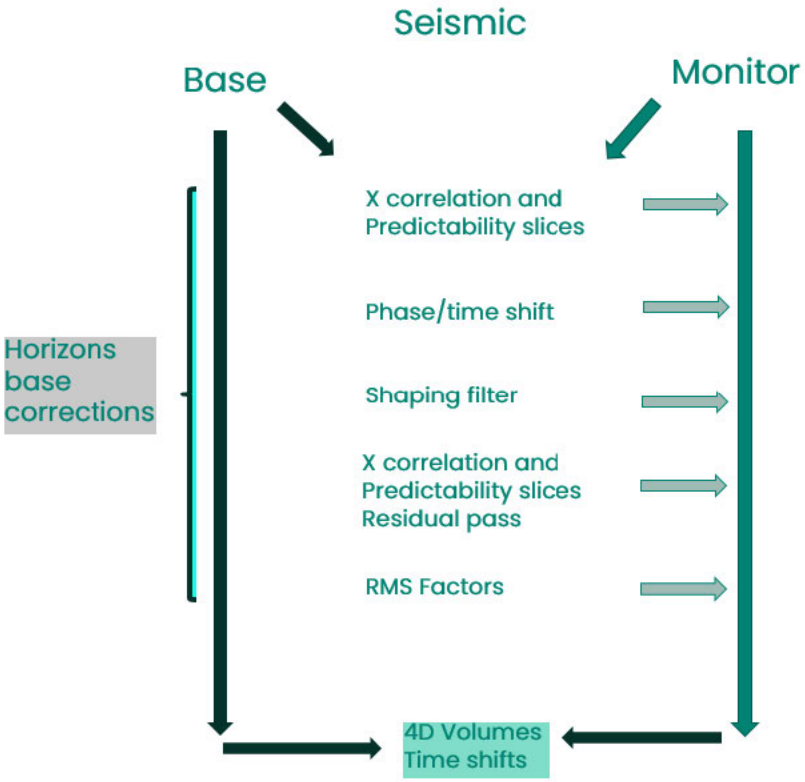

Figure 5-11 – 4D Processing Workflow Diagram

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5.6 Conclusion

The testing and monitoring plans developed for Orchard [redacted] are designed to acquire essential data to support static and dynamic reservoir modeling, track the growth of the CO_2 plume, and ensure that CO_2 does not reach USDWs or pose a risk to health, safety, or the environment.

A larger scale map of the monitoring wells, plus specification sheets for the planned technologies are provided in *Appendix E*.

[redacted]

[redacted]

[redacted]

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