Attachment E.I.5. Sampling Standard Operating Procedures

Note: This attachment contains procedures PCC intends to utilize. PCC reserves the right to substitute functionally equivalent procedures to those presented herein.

CO_2 GRAB SAMPLING STANDARD OPERATING PROCEDURE

AN-0501 SAMPLING STATION

1.1 COLLECTING GRAB SAMPLE FOR BULK CONSTITUENT CHEMICAL ANALYSIS CONSTITUENT ANALYSES (CO_2, N_2, O_2)

Grab samples of the injectate will be collected from the lab sample quick-connect port of AN-0501 (located at end of pipeline, proximate to CSS #1 wellhead) in a clean-certified and evacuated 500cc stainless steel gas canister (or equivalent depending on laboratory). The gas cylinder with isolation valves at the inlet and outlet of the cylinder will be supplied by the laboratory and will be either batch-certified or individually-certified clean. Additional clean fitting and sampling equipment is provided as needed by the field samplers. Field personnel will wear nitrile or latex gloves while collecting the gas sample as an additional measure.

This procedure is based on the Purging - Fill and Empty method described in Section 9.1 of GPA 2166[1] and assumes the pressure let-down regulator in AN-0501 is set at 15 psig (or higher) for the gas supplied at the lab sample quick-connect. Steps for collecting a grab sample are as follows:

1. Connect inlet of gas cylinder to the sample port quick-connect with a short piece of clean flexible tubing.
2. Open cylinder inlet valve, let cylinder fill until its pressure equilibrates with the supply pressure
3. Close cylinder inlet valve, open cylinder outlet valve and purge gas from cylinder to safe location
4. Close cylinder outlet valve
5. Repeat steps 2 through 4 until a total of thirteen (13) fill-and-purge cycles are completed.
6. For the 14th fill, open cylinder inlet valve, let cylinder fill until its pressure equilibrates with the supply pressure.
7. Close cylinder inlet valve and disconnect sample cylinder from the sample port quick-connect.
8. Prepare cylinder for shipping to the analytical laboratory.
9. Complete Field Form and Chain of Custody Form (provided by analytical laboratory).

The sample cylinder and Chain of Custody Form are shipped to an analytical laboratory for analysis by at least one of the approved methods given in Section of the Quality Assurance and Surveillance Plan (e.g., ASTM D1946, ASTM

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[1] Obtaining Natural Gas Sample for Analysis by Gas Chromatography, GPA Midstream Standard 2166-22, GPA Midstream Association, Tulsa, OC, 2022. Available at: https://www.gpamidstream.org/resources/publications

D1945, GPA 2261, GPA 2177, ASTM E1747, EPA Method 3/3C, ISBT 2.0). Sample hold time is 30 days from time of collection.

1.2 COLLECTING SAMPLE FOR ISOTOPES ANALYSIS

Grab samples of the injectate will be collected from the lab sample quick-connect port of AN-0501 (located at end of pipeline, proximate to CSS #1 wellhead) in a Single-Use IsoTube. Install a quick-connect to ¼" NPT female adapter to the lab sample port of AN-0501, follow the procedure of the attached ISOTECH sheet titled "Collecting Wellhead Samples in Single-Use IsoTubes", and complete the Field Form.

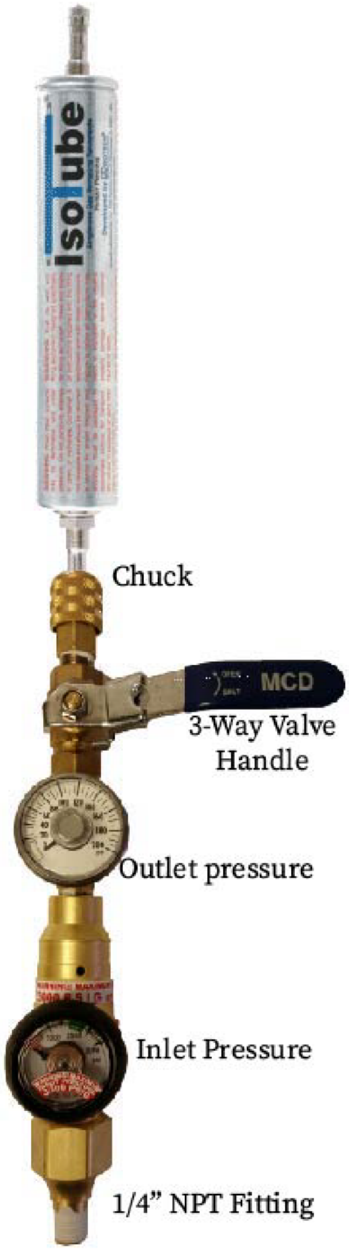
ISOTECH
a Stratum Reservoir brand
www.isotechlabs.com

Collecting Wellhead Samples in Single-Use IsoTubes®

CAUTION: The IsoTube® wellhead sampling device includes a pressure regulator that is rated for use up to a maximum of 3000 p.s.i.g. (200 bars). If pressures higher than this could be encountered, additional pressure control will be required.

NOTE: IsoTubes® are NOT suitable for gases containing hydrogen sulfide (H_2S, sour gas).

1. Locate a suitable, vertical port for collecting a sample. A 'suitable port' will supply a dry, liquid free gas sample and should consist of both a ¼" female NPT port, and a control valve that can be used to turn the gas on and off.
2. Make sure that the threads on the Wellhead Sampler are clean and wrap 2 or 3 layers of Teflon® tape, clockwise onto the male threads of the filter.
3. Screw the Wellhead Sampler into the sampling port and then tighten by using a wrench on the body of the filter.
4. With the Wellhead Sampler valve in the "shut" position, slowly open the *control valve on the sampling port*. Line pressure will be indicated on the **inlet** pressure gauge.
5. Insert the bottom IsoTube® valve into the Wellhead Sampler by simply pushing it firmly into the chuck (there are cogs in the chuck which grip the threads on the IsoTube® valve and hold it in place). To further tighten the IsoTube® in place, lightly rotate it with your fingers, screwing it into the chuck.
6. Turn the handle on the 3-way valve to the "open" position (vertical). The IsoTube® will fill with gas. Note the pressure on the outlet gauge. The pressure should be less than 80 p.s.i.g.
7. With the 3-way valve still in "open" position, the Wellhead Sampler and the IsoTube® can be purged by depressing the spring valve in the tip of the top IsoTube® valve (like letting the air out of a tire). Hold the spring valve open for a few seconds. This shortcut should be minimized if you are sampling very wet gases or under very cold conditions as it can result in condensing liquids in the IsoTube®.
8. Final purging and filling of the IsoTube® is accomplished by rotating the handle on the 3-way valve "open" and "shut" to alternately pressurize and vent the IsoTube®.
9. The IsoTube® should be filled to the output pressure of the regulator and then vented to atmospheric pressure by watching the outlet pressure gauge and listening to the flow of gas out the vent. The more times this process is repeated, the less the chance of atmospheric contamination of the sample. A minimum of 10 cycles is recommended.
10. After the IsoTube® is filled for the last time, leave the 3-way valve in the "open" position.
11. The IsoTube® may now be removed from the chuck by sliding the knurled sleeve on the outside of the chuck down, away from the IsoTube®. This process should be done quickly so as to minimize the amount of gas lost. If the IsoTube® is held very lightly, it will generally pop up out of the chuck from the spring action of the valve and the gas pressure. Be ready to catch it.
12. Replace the end caps on the IsoTube® valves and fill out one of the adhesive-backed labels with the sample identification information using the ball point pen provided (press hard as three copies are made). Attach the label to the IsoTube® in the location marked and return the IsoTube® to the shipping carton. When an entire sheet of sample tags has been used, one of the copies should be placed in the box with the IsoTubes® and the other can be retained for your records.
13. Seal the box, attach the appropriate hazardous material labels, and ship the samples as described on the enclosed shipping instructions.**



****(Hazardous materials can only be shipped by someone properly certified to do so; shipping instructions are included with each box of IsoTubes® merely to simplify the shipping process.)**

ISOTECH
a Stratum Reservoir brand

STRESS
ENGINEERING
SERVICES INC.

an employee-owned company

Corrosion Coupon Handling and Analysis

Standard Operating Procedure

Prepared for:
PureField Carbon Capture, LLC
Russell, Kansas

12 December 2024

SES Document No.: 2024_2133-PR-01_Rev1

Rev	Date	Description	Originator	Checker	Reviewer
0	09-Sept-2024	Issued for Use	Adam Rowe	-	Bruce Craig Suresh Divi
1	12-Dec-2024	Revised and Added References	Adam Rowe	-	N/A

Corrosion Coupon Handling and Analysis

Standard Operating Procedure

SES Document No.: 2024_2133-PR-01_Rev1

12 December 2024

Prepared for:

PureField Carbon Capture, LLC

Russell, Kansas

Contact: Tim Eggeman

Prepared by: ______________________
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Reviewed by: ______________________
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List of Tables

1. Purpose

The Russell CO_2 Capture and Sequestration project plans to utilize corrosion coupons as part of the corrosion monitoring strategy for well integrity. Metal specimens are to be installed in the CO_2 stream and removed after three month exposure periods in order to assess whether the stream is corrosive to various materials of construction. This document details the standard operating procedure (SOP) for corrosion coupon handling and analysis.

2. Definitions

Table 1 defines terms and abbreviations used in this SOP.

Table 1. Definitions

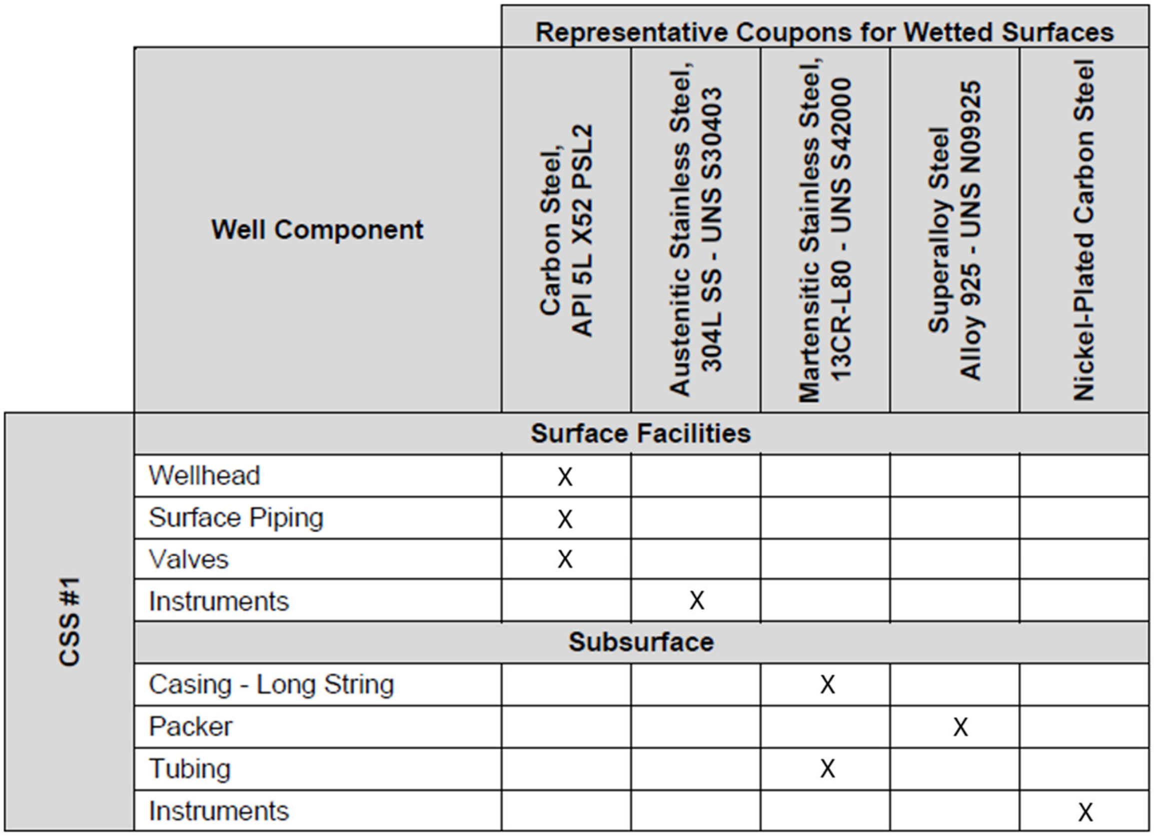
Term	Definition
AISI	American Iron and Steel Institute
ASTM	ASTM International (formerly American Society for Testing and Materials)
CARB	California Air Resources Board
CCS	Carbon capture and sequestration
EDS	Energy dispersive x-ray spectroscopy
EPA	United States Environmental Protection Agency
MTR	Mill test report
NACE	National Association of Corrosion Engineers
PCC	PureField Carbon Capture, LLC
SOP	Standard operating procedure
VCI	Vapor phase corrosion inhibitor
XRD	X-ray diffraction

3. General

This SOP is intended to satisfy EPA 816-R-13-001 [1] and CARB CCS Protocol Subsection C.4.3.1.4 [2]. Corrosion coupons shall be prepared, handled, and analyzed in accordance with NACE SP0775 [3] and the requirements of this procedure. All material procurement, corrosion coupon handling, and field procedures shall be in accordance with PCC requirements.

The metallurgies that need to be represented by corrosion coupons are presented in Table 2. Each unique metallurgy shall be represented by duplicate corrosion coupons for each three-month (quarterly) time interval being monitored.

Table 2. Metallurgies for Corrosion Coupons



		Representative Coupons for Wetted Surfaces				
	Well Component	**Carbon Steel, API 5L X52 PSL2**	**Austenitic Stainless Steel, 304L SS - UNS S30403**	**Martensitic Stainless Steel, 13CR-L80 - UNS S42000**	**Superalloy Steel Alloy 925 - UNS N09925**	**Nickel-Plated Carbon Steel**
CSS #1	**Surface Facilities**					
	Wellhead	X				
	Surface Piping	X				
	Valves	X				
	Instruments		X			
	Subsurface					
	Casing - Long String			X		
	Packer				X	
	Tubing			X		
	Instruments					X

4. Processing of Corrosion Coupons

Coupons shall be procured from PCC-approved suppliers. Coupon sizes shall be in accordance with manufacturer requirements for the coupon holders installed in the flowline. The flowline diameter shall be considered, and subsize coupons may be used if necessary.

All coupons shall to the extent practicable be of equivalent metallurgy to the equipment that they represent. Acceptable materials are presented below:

- Carbon steel: API 5L Grade X52, AISI 1018 (UNS G10180)
- Austenitic stainless steel: UNS S30400 or UNS S30403
- Martensitic stainless steel: 13Cr-L80, UNS S41000, UNS S42000
- Alloy 925: UNS N09925 only
- Nickel-plated carbon steel: Same or similar nickel plating procedure as represented part

Coupons may be stamped or saw-cut to size, but final surface preparation shall be by grinding to remove any cold-worked material. Grinding shall be controlled such that excessive heat is not generated on the coupon. All surfaces, including edges, shall be finished by grinding with 120 grit paper. Abrasive medium shall be non-metallic such as aluminum oxide or silicon carbide.

The carbon steel coupon intended for nickel plating shall be finished in accordance with the nickel plating procedure to be used on the represented parts to ensure equivalent plating integrity. Nickel plating should be done on the coupon in accordance with the production plating procedure such that the final coupon dimensions are suitable for the coupon holder.

Coupons shall be individually stamped with a unique coupon identification number that is traceable to the heat number and MTR for the alloy. Low stress stamps shall be used. For the nickel-plated coupon, the supplier shall ensure that marking does not disrupt the plating. It may be necessary to stamp the nickel-plated coupon prior to plating such that the identification is still visible after plating.

The number of coupons procured shall be sufficient for quarterly replacement of duplicate coupons over the planned injection period. Additional coupons are recommended for laboratory use and in case of damage. For example, in the case of a 12-year injection period a minimum of 96 coupons of each alloy are needed plus a number of extra coupons to be determined by PCC or a designated representative.

Prior to packaging for field installation, each coupon shall be cleaned and weighed with an analytical balance in accordance with ASTM G1 [4] to within ±0.5 mg. The initial mass of each specimen shall be recorded, traceable to the unique coupon identification. The final machined dimensions shall be measured and recorded, and the calculated surface area for each coupon shall be recorded (including the edges).

After cleaning, coupons shall only be handled by individuals wearing clean plastic or rubber gloves. Coupons shall be handled carefully in order to avoid contamination or damage that may affect corrosion monitoring. Coupons shall be wrapped in VCI paper and individually packaged in closed containers with indicating silica gel. Each package shall be clearly marked with the unique coupon identification number and material class. Once ready, coupons shall be shipped in accordance with the instructions provided by PCC or their designated representative.

5. Installation of Corrosion Coupons

Corrosion coupons shall be mounted in holders located downstream of the surface equipment and upstream of the injection wellhead as detailed in the Testing and Monitoring Plan for Russell CO_2 Storage Complex. PCC (or its subcontractors) is responsible for the design, construction, and operation of the corrosion coupon monitoring station, including selection and installation of the corrosion coupon holders. Corrosion coupon holders shall be designed to suspend strip-type flat corrosion coupons in duplicate pairs and shall be sized such that coupons are fully immersed in the CO_2 stream. Each coupon holder shall have a unique identification number.

Only new coupons may be installed in the system. Exposed coupons shall not be re-used.

Prior to coupon installation, the following information shall be recorded for each holder:

- System name and location
- Installation date
- Coupon holder identification number
- Coupon identification numbers (two coupons)
- Orientation of the coupons and holder

Coupons shall only be handled by individuals wearing clean plastic or rubber gloves in order to prevent contamination that may affect corrosion monitoring results. Care should be taken not to damage coupons during handling and installation. Contaminated coupons must be thoroughly cleaned of contaminants before installation. Damaged coupons shall not be installed. If a coupon becomes damaged during handling, it shall be recorded, set aside, and a new coupon of the same material shall be selected for installation.

Corrosion coupons shall be installed in accordance with manufacturer instructions for the coupon holder being used, which should address these basic steps:

1. Attach duplicate coupons to the coupon holder.
2. Engage the plug with the retriever and set retriever to the retracted position.
3. Attach the retriever to the service valve.
4. Pressurize the retriever.
5. Open the service valve.
6. Inject the coupon holder into the stream.
7. Screw in the plug.
8. Depressurize the retriever and disengage the plug.
9. Remove the retriever from the service valve.
10. Remove the service valve from the access fitting.

Once all coupons have been installed, a field installation report shall be prepared and submitted to PCC.

6. Removal of Corrosion Coupons

Corrosion coupons shall be retrieved and replaced following three-month exposure durations for the monitoring station. Corrosion coupons shall be retrieved in pairs in accordance with manufacturer instructions for the coupon holder being used, which should address these basic steps:

1. Attach the service valve in the open position to the access fitting.
2. Attach the retriever to the service valve.
3. Engage the plug with the retriever.
4. Pressurize the retriever.
5. Unscrew the plug.
6. Retract the retriever, extracting the coupon holder from the flowline.

7. Close the service valve to isolate the process.
8. Depressurize the retriever and remove the plug.
9. Remove both coupons from the coupon holder.

Once the coupons are removed, they should be photographed immediately in order to capture their conditions. Both sides of each coupon should be photographed and included in the report. The following information shall be recorded for each coupon removed:

- System name and location (include sketch if available)
- Removal date
- Coupon holder identification number
- Coupon identification number
- Visual observations such as damage, discoloration, deposit types, condensation, etc.
- If known, any significant excursions, extended shutdowns, or other pertinent operational abnormalities that occurred during the coupon exposure duration.

The coupon and holder numbers should be referenced against the installation report to ensure that they match.

If deposits are present on the coupons, they should be collected as soon as possible in the field in sealed plastic containers, labeled with the unique coupon identification number, and promptly delivered to the third party analysis laboratory for testing. Field operations shall take care to prevent any deposits or substances on the coupons from contaminating surrounding areas after removal. The field operator shall be responsible for removing and disposing of materials used for containment during coupon retrieval activities.

Coupons shall only be handled by individuals wearing clean plastic or rubber gloves in order to prevent contamination that may affect test results. Care shall be taken not to damage coupons during handling, and coupons should be processed and packaged quickly in order to minimize oxidation following removal and exposure to air. Coupons shall be dried before packaging, which can be done with dry air or gentle blotting with lint-free cloth or tissue. No grease or other substances shall be applied to the coupons.

Coupons shall be wrapped in VCI paper and individually packaged in closed containers with fresh desiccant. Each package shall be clearly marked with the unique coupon identification number. Once ready, coupons shall be shipped immediately to the third-party analysis laboratory in accordance with the instructions provided by PCC or their designated representative. All field reports and photographs shall be submitted via email or other agreed upon electronic file transfer method to the third-party analysis laboratory and PCC. The third-party analyst laboratory shall be approved by PCC and shall have significant experience with corrosion coupon analysis.

One unexposed coupon of each material shall be also submitted to the laboratory with the first batch of coupons removed from the field as a control.

7. Laboratory Analysis of Corrosion Coupons

Upon receipt of retrieved coupons from the field, a licensed professional metallurgical engineer shall oversee the corrosion coupon laboratory analysis and shall review and sign the analysis reports.

The designated third-party analysis laboratory shall document all samples and coupons received from the field. Any deposits that were collected from coupons in the field after extraction shall be promptly analyzed. The scope of deposit analysis shall be agreed upon by PCC or their designated representative and may include:

- Energy dispersive x-ray spectroscopy (EDS)
- X-ray diffraction (XRD)
- Sulfide and carbonate detection

The third-party laboratory shall conduct the following tasks on corrosion coupons received from the field:

1. Receive, photograph, and document all coupons received from the field. The unique coupon identification shall be recorded, and traceability shall be maintained throughout the coupon analysis.
2. Visually examine the coupons before cleaning and record observations.
3. Collect and analyze significant deposits in accordance with the agreed upon deposit analysis protocol.
4. Clean each coupon in accordance with ASTM G1 and dispose of all used cleaning supplies. Cleaning should be sufficient to remove any oils and deposits without causing metal loss. Acids should only be used when necessary to remove adherent deposits, and only inhibited acid solutions are acceptable. Bead blasting may only be used to remove tightly adhered deposits with approval from PCC. Rinse with alcohol or acetone and dry completely in air. A heat gun may be used to dry coupons prior to weighing.
5. Weigh each coupon using an analytical balance in accordance with ASTM G1 to within ±0.5 mg and record mass. Calculate mass loss from the initial mass (provided by coupon supplier) measured prior to installation.
6. One unexposed coupon shall be cleaned and weighed as well using the same process to ensure that the cleaning method does not have a significant effect on the initial coupon mass. This step is only required for the first batch of coupons unless the cleaning method is changed.
7. Calculate the average general corrosion rate using the mass loss and initial surface area (provided by coupon supplier) for each coupon in accordance with NACE SP0775.
8. Photograph each coupon in the cleaned condition, capturing both sides of the coupon.

9. Examine each coupon at a magnification of 20x for evidence of pitting and localized corrosion. Any corrosion observed shall be recorded and indicated on the respective photograph in the report. For plated coupons, note the condition of the plating and any damage.
10. Where localized corrosion is observed, the maximum depth of pitting shall be determined by preparing a metallographic cross-section through the largest pit in the coupon. The maximum pitting rate shall then be calculated in accordance with NACE SP0775. When multiple pits are present, pit density (pits per unit area) shall be measured and recorded.

Each corrosion coupon examined shall be individually reported, and each report shall include the following information:

1. Coupon details including the unique identification number, material type, and dates of installation and removal.
2. Information from the coupon supplier, which can be either transcribed into the laboratory report or appended to report.
3. Information from field reports, which can be either transcribed into the laboratory report or appended to report.
4. If available, operational information provided by the operator during coupon exposure, including:
    a. Temperature and pressure profiles
    b. Flow rates
    c. Gas analysis
    d. Fluid analysis (if fluids were found)
5. Laboratory test results
    a. Mass loss
    b. Calculated average corrosion rate
    c. Deepest measured pit (if pitting is present)
    d. Calculated maximum pitting rate
    e. Photographs and observations
    f. Deposit analysis results (if deposits were present and analyzed)

The reports for multiple coupons may be combined into a documentation package for a batch of coupons. All reports shall be submitted to PCC or a designated representative. At the request of PCC, the laboratory shall maintain a spreadsheet of corrosion coupon results in order to follow any long term corrosion activity trends.

The calibration and frequency of calibration for instruments are the responsibility of the laboratory conducting the analysis and shall be performed in accordance with their standard operating procedures, which are based upon the requirements of the specific analytical test methods being implemented and equipment manufacturer recommendations. The third-party analyst is responsible for disposal of the coupons when the monitoring program is complete.

8. References

1. U.S. Environmental Protection Agency (EPA), "Geologic Sequestration of Carbon Dioxide: Underground Injection Control (UIC) Program Class VI Well Testing and Monitoring Guidance," EPA 816-R-13-001, March 2013.

2. California Air Resources Board (CARB), “Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard,” Section C: Permanence Requirements for Geologic Sequestration, Subsection C.4.3.1.4, pp. 88-89, August 13, 2018.

3. Association for Materials Protection and Performance (AMPP), “Preparation, Installation, Analysis, and Interpretation of Corrosion Coupons in Oilfield Operations,” NACE SP0775-2023, AMPP, 2023.

4. ASTM G1, “Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens,” ASTM International, 2003 (Reapproved 2017).

Memorandum

Prepared For:	Purefield Carbon Capture, LLC
From:	Trihydro Corporation
Date:	February 4, 2025
Re:	Standard Operating Procedure – Low-Flow (Micro-Purge or Low Stress) Well Sampling

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1.0 PURPOSE, SCOPE, AND RESPONSIBILITIES

This standard operating procedure (SOP) is intended to provide methods for low-flow sampling of groundwater from monitoring wells at MS-1 through MS-6, and MS-11 at the Purefield Carbon Capture. LLC (PCC) Russell CO_2 Storage Complex. Low-flow (micro-purge or low stress) sampling is a method of collecting samples from a well; the method may not require the removal of large volumes of water and therefore does not overly agitate the water and suspended particles.

Low-flow sampling includes collecting water directly from the screened interval of a well (screened interval) without disturbing stagnant water above the screen. This is accomplished by pumping the well at low enough flow rates to maintain minimal drawdown of the water column, followed by in-line sample collection. Typical flow rates for low-flow sampling range from 0.1 to 0.5 liters per minute (L/min).

PCC or its subcontractors performing tasks within this SOP are responsible for meeting SOP requirements. For projects where activities within this SOP are necessary, the project manager (or designee) is responsible for ensuring that those activities are conducted in accordance with this and other SOPs. Project team members are responsible for documenting procedural information in sufficient detail (i.e., calculations, field notes, reports, etc.) and reporting changes. Such documentation will be included as a component of project records.

2.0 PLANNING AND PROCEDURES

As stated above, low-flow sampling involves removing water directly from the screened interval without disturbing stagnant water above the screen and without significantly lowering the water table. Since this method is not based upon the removal of well volumes, it requires in-line monitoring of water-quality parameters (i.e., pH, specific conductance, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP), turbidity, dissolved CO_2) to evaluate when the groundwater to be sampled has stabilized. The sample is then collected without disturbance to flow rate, using the same pump, directly from the discharge tubing. For wells with low extraction rates, sample timing may be based on available water volume.

2.1 EQUIPMENT

The following equipment is recommended for well purging:

Required personal protective equipment (PPE), listed in site-specific health and safety plans (generally nitrile gloves and safety glasses for low-flow sampling)

☐ Bladder pump and discharge hose (both dedicated in each well) capable of <1.0 L/min draw rates

☐ Water-level meter or oil/water interface probe

☐ Compressed nitrogen

☐ Flow-through water-quality meter (for pH, specific conductance, temperature, DO, ORP, and turbidity) calibrated daily

☐ Flow-through dissolved CO_2 meter

☐ Decontamination solutions: deionized (DI) water and detergent (e.g., Alconox, Liqui-Nox, Simple Green, depending on the application).

☐ Sample containers and preservatives

☐ Sample labels

☐ Chain-of-custody forms

☐ Paper towels

☐ Ice chest or cooler

☐ Ice and resealable plastic bags

☐ Field logbook

☐ Calculator

☐ Wrist watch (with digital display)

2.2 PRE-SAMPLING

A well sampling order should be predetermined where possible. The procedure for pre-sampling is as follows:

1. Don a pair of clean nitrile gloves, safety glasses, and other required PPE.
2. Calibrate flow-through cell daily and document on field calibration form.
3. Prepare the area surrounding the well. A table (or equivalent) can be used while sampling. Prevent equipment or sample containers from touching the ground.
4. Open the well casing and remove the well cap.
5. Measure the depth to the static water level using the water-level meter.

2.3 WELL PURGING

The procedure for well purging is as follows:

1. Review and understand the proper operating and maintenance instructions for the bladder pump prior to sampling of the well.
2. Don a pair of clean nitrile gloves, safety glasses, and other required PPE.
3. Review the well-construction data to verify the proper placement of the pump intake. Inspect the location where the discharge line and pump support cable exit the well to confirm that they are in the proper position (markings should be present at the well head to show this).
4. Ensure the pump discharge line is long enough so that the pump intake can be located within the well-screen area and the discharge end can reach the purge-water container.
5. Connect the pump discharge to the flow-through water-quality meter (in accordance with the manufacturer's procedure).
6. Start the pump and begin monitoring discharge rates and the collected water volume. Adjust flows if necessary to remain in a range of 0.1 to 0.5 L/min without exceeding the maximum allowable drawdown. For bladder pumps that cycle discharge, a best practice is to adjust the discharge volume so that one pulse will fill a 40 mL or equivalent vial.
7. Monitor and record the pH, specific conductance, temperature, DO, ORP, turbidity, dissolved CO_2, depth-to-water, and volume purged at set intervals (3 to 5 minutes). These intervals should allow for turnover of at least one flow-through cell volume.
8. The industry standard maximum drawdown target in a well during low-flow sampling is 0.3 feet. In some cases, it will be necessary for the well to drawdown a considerable distance (10 ft or more in extreme cases) to maintain a minimal usable pumping rate for sampling. The additional volume of water resulting from the excess drawdown should be purged prior to initiation of stabilization readings.
9. When water-quality parameters are stable (pH, temperature, specific conductance, DO, ORP, turbidity, dissolved CO_2, and, as indicated by three consecutive readings within project-required stabilization criteria, begin sample collection. For some wells (especially deep monitoring wells or wells with limited recharge), stabilization may not occur. In this case, begin sample collection after an appropriate amount of water has been removed, usually five screen interval volumes.
    a. Stabilization is considered to be achieved when three consecutive readings are within the following limits:

Field Parameter	Stabilization Criteria
pH	±0.1 pH units
Temperature	±3 °C
Specific conductance	±3%
Dissolved oxygen	±3%
Turbidity	±10% or < 10 NTUs
Oxidation Reduction Potential	±10 millivolts
Dissolved CO_2	Considered stabilized when above parameters are stable

2.4 SAMPLE COLLECTION

The procedure for sample collection is as follows:

1. Don a pair of clean nitrile gloves, safety glasses, and other required PPE.
2. Prepare sample bottles and preservatives for sampling (label bottles with appropriate information).
3. Immediately after purging, disconnect the tubing from the flow-through cell and collect the sample directly from the pump discharge line.
4. In general samples should be collected in order of most important to least important analysis. The following analyses/samples should be collected:
    - Alkalinity, TDS, and carbonate: 500 mL unpreserved polyethylene bottle.
    - Metals: 250 mL polyethylene bottle with nitric acid (HN03) preservative. Take care when opening and filling.
    - Nitrate, bromide, fluoride, chloride, and sulfate: 250 mL unpreserved polyethylene bottle.
    - δ13C in DIC: 100 mL bottles sent by Isotech and should be field filtered.
5. Add preservatives to the samples as needed (if sample containers are not pre-preserved by laboratory), and place the sample bottles on ice. Note that most sample bottles come with preservatives already added. If such is the case, do not overfill the bottles. If a sample bottle containing preservatives is overfilled, discard the overfilled bottle and collect again, as above.
6. When purging and sampling are complete, flush the freeze kit to remove water from the tubing near ground surface.
7. Replace the well cap, secure and lock the well to prevent tampering.
8. Record the sampling information. Ensure sample labels match Chain-of-Custody fields. Place samples in zip lock bags (to keep sample bottle labels dry) and place sample bags in a cooler with ample ice and packaging material. IMPORTANT: Nitrate samples are to be analyzed within 48 hours

of collection. Samples will be shipped by courier Monday through Friday. Samples will be collected by courier around 2 pm each day.

9. Secure the area by removing equipment and materials; place the dedicated bladder pump and tubing back into the well.
10. Decontaminate the water level meter.

2.5 INVESTIGATION DERIVED FLUIDS

In accordance with the U.S. Environmental Protection Agency SOP (LSASDPROC-202-R5), purge water will be placed on the ground downgradient from the well bores onsite because the investigation derived fluids do not endanger human health or the environment. Purge water will not be returned to the well. Water with decontamination solution (i..e. soap or detergent) will be containerized in 5-gallon drums and disposed in the sanitary sewer at the PureField Ingredients facility, which feeds to the City of Russell municipal waste water treatment plant for final processing.

2.6 PROCEDURAL CHANGES

When procedures change, PCC or its subcontractors will update and reapprove this SOP. Modifications may address a small component of the SOP or the entire SOP. Review of the SOP will occur 5 years after the previous revision date. The revision date will be added to the schedule (below), the title page, and the naming convention that appears in the corner of each page.

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Original	New SOP	January 23, 2025	Thomas Johns	Maggie Parish

3.0 GLOSSARY: ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

L/min – liter per minute: unit used to measure pump rates

Low-flow – refers to the velocity used during well pumping; draws water to the surface slowly

Micro-purge – another term for low-flow sampling, referred to as such because pre-sampling groundwater removal (purging) is performed at flow rates 2 to 3 orders of magnitude less than typical bailer or pump methods

PPE – personal protective equipment: minimum-required site-safety equipment; a full list is included in the site-specific HASP

Pump – an electric, compressed air, or inert gas-driven device that raises liquids by means of pressure or suction. The types of pumps used for well purging should be chosen based on the well size and depth, contaminant type, and specific factors affecting the overall performance of the sampling effort. Low-flow and micro-purge sampling is performed using specially constructed pumps, usually of centrifugal, peristaltic, or submersible design, with low draw rates (<1.0 L/min).

Purging – the action of removing groundwater from well using mechanical means from a monitoring well prior to collecting groundwater samples. Purging removes stagnant groundwater from the column, allowing groundwater surrounding the well screen to enter the collection area.

SOP – standard operating procedure: procedure to be followed when performing a routine task

Memorandum

Prepared For: Purefield Carbon Capture, LLC
From: Trihydro Corporation
Date: February 4, 2025
Re: Standard Operating Procedure – Soil Gas Sampling

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish specific procedures, methods and considerations to be used and observed when collecting soil gas samples at MS-1 through MS-6 at the Purefield Carbon Capture, LLC (PCC) Russell CO_2 Storage Complex. Additional instructions are provided for the inspection, maintenance, and calibration of field equipment and field screening using a landfill gas meter, LANDTEC GEM 2000™[1] or similar model LANDTEC GEM meter. Sampling vapor points were installed in the upper vadose zone (SVP-1S through SVP-6S) and lower vadose zone (SVP-1D through SVP-6D). Soil grab samples are collected from these sampling points in the upper and lower vadose zones.

Personnel using field equipment will properly calibrate equipment with sufficient frequency to yield valid, reproducible field data. Personnel shall identify equipment malfunctions and implement corrective action if equipment malfunctions occur. Equipment that cannot be repaired will be removed from service and replaced with operable field equipment.

PCC (and its subcontractors) are responsible for meeting SOP requirements. For projects where activities within this SOP are necessary, the Project Manager (or designee) is responsible for ensuring that those activities are conducted in accordance with this and other SOPs. Project team members are responsible for documenting procedural information in sufficient detail (i.e., calculations, field notes, reports, etc.) and reporting changes. Such documentation will be included as a component of project records.

2.0 PLANNING AND PROCEDURES

As stated above, soil gas sampling involves removing soil gas from the upper or lower vadose zone. This method requires purging and monitoring of soil gas quality parameters (i.e. oxygen [O_2], methane [CH_4], and carbon dioxide [CO_2]) to evaluate when the groundwater to be sampled has stabilized. The sample is then collected via the tygon/silicone tubing and Tedlar sample collection bags

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[1] LANDTEC and GEM are US trademarks owned by LANDTEC North America – A QED Company.

2.1 EQUIPMENT

The following equipment is recommended for soil gas purging and sampling:

- Required personal protective equipment (PPE), listed in site-specific health and safety plans (generally nitrile gloves and safety glasses for soil gas sampling)
- LANDTEC GEM 2000 (or similar) and tygon/silicone tubing (installed in each well)
- Sample containers and preservatives (Tedlar or IsoBag® gas bags)
- Sampling syringe
- Sample labels
- Chain-of-custody (COC) forms
- Paper towels
- Ice chest or cooler
- Ice and resealable plastic bags
- Field logbook
- Calculator
- Wrist watch or phone (with digital display)

2.2 ASSOCIATED FORMS

The following documents, manuals, and field forms should be used in tandem with this SOP:

- Site HASP
- Field Meter Calibration Form
- Vapor Sampling Field Forms
- LANDTEC GEM 2000 Operation Manual

2.3 PRE-SAMPLING

A well sampling order should be pre-determined where possible. The procedure for pre-sampling is as follows:

1. Don a pair of clean nitrile gloves, safety glasses, and other required PPE.
2. Calibrate LANDTEC GEM 2000 (or similar) and document on field calibration form (see below).
3. Prepare the area surrounding the well. A table (or equivalent) can be used while sampling. Prevent equipment or sample containers from touching the ground.
4. Open the well casing and remove the well cap. Pull out the tubing from the well that will be used for purging and sampling.

3.0 CALIBRATION PROCEDURES

Field personnel will inspect and calibrate the LANDTEC GEM 2000 at the start of each field day. Instrument calibration may be checked anytime during the field day if unexpected or unexplained readings are obtained. The instrument will be re-calibrated, if necessary. For instruments and equipment that are calibrated on an operational basis, calibration generally consists of measuring instrumental response to standards of known composition and concentration and may include preparing a standard response curve for the compound or parameter at different concentrations. Calibration records will be maintained on calibration logs and the calibration date and time should be noted in a field logbook following instrument calibration. Calibration procedures are listed below and are documented in the LANTEC GEM 2000™ Operations Manual.

Step 1: Inspect the equipment to ensure that all contents are clean and accounted for (hydrophobic filters, charcoal hydrocarbon filter, field screen tubing, and operation manual). Inspect the calibration-gas cylinder(s) and safety valve for adequate gas supply and serviceability. If something is missing or defective, notify the project manager. Test the equipment by turning it on and exposing the probe to a source and check for a response prior to initiating the calibration process.

Step 2: Allow the instrument to reach ambient temperature, pressure, and air concentration prior to use.

Step 3: Calibrate the instrument according to the manufacturer's specifications. Calibration includes a two-point process using "fresh air" and the standard reference gas. Use a 15.0% CH_4, 15.0% CO_2, and 0.0% O_2 gas concentration calibration standard. Ensure that the span calibration concentration entered under the LANDTEC GEM 2000 calibration menu, match the concentration of the calibration standard.

Step 4: Record the manufacturer's serial number or use other means to uniquely identify calibrated equipment on the calibration log and/or in the field logbook. Also document the calibration standards, lot number, expiration date, and the calibration results (final reading).

Step 5: Document that calibration was conducted, including the time and the instrument involved, in the field notebook or on a calibration log.

Step 6: If a suspicious or unexpected reading is collected, verify calibration by testing the equipment using the calibration standard.

Step 7: If the equipment fails calibration or becomes inoperable during use, perform the following troubleshooting steps:

- Charge LANDTEC GEM 2000 built in battery pack
- Ensure that the "Fresh Air" calibration was performed in atmospheric air
- Replace span-gas calibration gas cartridge
- Ensure that calibration gas regulator is operating properly, and meter is receiving adequate volume of calibration gas

Step 8: If the equipment cannot be restored to operable use and cannot be recalibrated, remove it from service and segregate to prevent inadvertent use. Note the problem in the field notebook or equipment-calibration sheet and order replacement equipment.

4.0 SOIL GAS PURGING AND SCREENING PROCEDURES

The primary fixed gases measured using the LANDTEC GEM 2000 are O_2, CH_4, and CO_2. Concentrations of these gases are accurate up to:

- ± 1% for O_2, ± 0.3% for CH_4, and ± 0.3% for CO_2 at concentrations between 0 and 5% by volume,
- ± 1% for O_2, CH_4, and CO_2 at concentrations between 5 and 15% by volume, and
- ± 1% for O_2, ± 3% for CH_4, and ± 3% for CO_2 at concentrations above 15% by volume (Operation Manual [OM] Section 9.4).

Soil gas screening procedures are listed below:

Step 1: Attach 2 inches of tygon/silicon tubing to the nylon soil vapor well tubing and use the 300mL syringe to purge 3 times.

Step 2: Repeat a fourth time with the syringe and push the volume into the Tedlar bag. Attach the Tedlar bag to the LANDTEC GEM 2000 (or similar) and record the field parameters (CO_2, O_2 and CH_4). Repeat this process until stabilization is reached.

Step 3: Purging is considered complete, and sampling may begin when the three indicator field parameters have stabilized. Stabilization is achieved when three consecutive readings of CO_2, O_2 and CH_4 are within ± 10% of each other.

Step 4: Compare field gas meter readings against CO_2 probe well readings for confirmation that field readings are representative of site conditions.

5.0 SOIL GAS SAMPLING PROCEDURES

After fixed gases have stabilized, conduct sampling of the sol vapor point. Soil gas sampling procedures are listed below:

The procedure for sample collection is as follows:

1. Don a pair of clean nitrile gloves, safety glasses, and other required PPE.
2. Prepare sample containers for sampling (label Tedlar/IsoBag® with appropriate information).
3. Immediately after purging, disconnect the tubing from the LANDTEC GEM 2000 and attach the tubing to the 300 mL syringe.

4. Collected the sample by pushing the soil vapor into an IsoBag® (or equivalent) gas bag. Make sure you have the small plastic male “luer” fitting that will open the valve on the IsoBag®. Be careful not to overfill the IsoBag®, do not fill the IsoBag® with all 300 mL.
5. After collecting each sample, label the sample bag and check that name, time and date match the COC. Each sample will consist of one laboratory-provided sample bag and will be submitted for analysis of δ13C of DIC and GC. Secure the sample in the laboratory-provided packaging.
6. Replace the well cap, if required, and secure the well to prevent tampering.
7. Record the sampling information. Check that sample labels match COC fields. Place samples in a cardboard box with packaging material. Ensure that the COC form is included in the box with the samples. Samples will be shipped to Isotech in Champaign, IL.
8. Secure the area by removing equipment and materials; place the dedicated tubing back into the well.

6.0 PROCEDURAL CHANGES

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