ATTACHMENT I: PRE-OPERATIONAL TESTING PLAN
CTV III

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Version History

Version	Revision Date	File Name	Description of Change
1	5/3/2022	Preoperational Formation Testing CTV III	Original submission
2	5/24/2024	Attachment I CTV III Preoperational Plan_V2	Response to February 20, 2024 EPA Comments
3	2/14/2025	Attachment I CTV III Preoperational Plan_V3	Response to October 31, 2025 EPA Comments
4	8/20/2025	Attachment I CTV III Preoperational Plan_V4	Response to May 19, 2025 EPA Comments

Facility Information

Facility Name: CTV III

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Well Location(s): Victoria Island, San Joaquin County, CA
37.89 / -121.53

1. Overview

Pre-operational formation testing for the project includes a suite of logging, coring, geohydrologic testing and reservoir testing during the drilling and completion of the injection and monitoring wells. Specifically:

1. Open-hole logging will support reservoir rock and fluid properties characterization.
2. Coring of the reservoir and confining layer will provide data on porosity, permeability, mineralogy, and lithology.
3. Fluid sampling, pressure and temperature data gathering will define project baselines.
4. Reservoir testing will assess reservoir and confining layer geomechanics.

The results of the testing activities will be documented in a report and submitted to the U.S. Environmental Protection Agency (EPA) after the well drilling and testing activities have been completed, and before carbon dioxide injection commences.

For injection and monitoring wells, see **Attachment G: Well Construction and Testing (Attachment G)** for pre-injection testing of project wells.

Preoperational testing schedule will be discussed with EPA during site review and testing will be completed prior to the injection of CO_2.

Methods for tests will be consistent with U.S. EPA (2013), and testing methods listed in the **Attachment C: Testing and Monitoring Plan (Attachment C)**. Well-specific Construction and Plugging (CP) Plans are included in **Attachment G**. This Pre-Operational Testing Plan summarizes planned pre-operational testing activities, schedule, and reporting to the U.S. Environmental Protection Agency (EPA). CTV will commence construction and testing activities following EPA approval of this Pre-Operational Testing Plan and once the necessary permit to construct the new wells has been obtained.

2. Schedule and Reporting

Results of additional future testing will be documented in a report submitted to the EPA after the new well drilling, well repurposing, and testing activities have been completed, but before carbon dioxide (CO_2) injection commences. CTV will notify the Director at least 30 days prior to conducting any testing.

3. Injection Well Testing

Wireline logging of the injection wells will consist of conventional and advanced open-hole logs of the surface, intermediate, and injection hole sections. Cement bond logs will be run on the surface, intermediate, and injection casing sections to verify cement integrity and zonal isolation. A pulsed neutron capture log will be run on the injection hole to provide a baseline water-to-gas saturation to support saturation and injection modeling over the life of the project.

All tests listed below will be performed at the injection wells.

3.1 Wireline logs prior to running casing

The following logs will be run for the surface, intermediate and long-string sections:

- Deviation checks
- Dual induction laterolog
- Gamma ray
- Caliper
- Compensated neutron
- Formation density
- Mud log

3.2 Wireline logs after running casing

The following will be conducted for surface, intermediate, and long-string sections:

- Cement Bond Log
- Casing Inspection Log

3.3 Additional Injection Well Testing

Additional injection well testing will include the following:

- Internal mechanical integrity/standard annulus pressure test (SAPT)
- External mechanical integrity (at least one of) oxygen activation log, noise log, and temperature log
- Pressure fall-off testing as described in **Attachment C**
- Injectivity tests

4. Coring Program

Several whole cores will be taken from a newly drilled wellbore in the project to evaluate fluid and rock properties to calibrate against open hole logs. The objective of the coring zones is to

determine the nature of sand reservoir containers and their transitions to shales. Cores will be taken across sealing interfaces and across the injection zones. Formations to be cored are:

- Mokelumne Formation (Injection Zone)
- Capay Shale (Confining Zone)
- Nortonville Shale (sidewall core may be obtained in place of whole core)
- Domengine (sidewall core may be obtained in place of whole core)

Tests that are planned to be performed are listed below and displayed in **Table I-1** with corresponding formations for analysis:

- Routine core analysis (porosity, permeability, saturation, grain density)
- Rock mechanics (including triaxial load testing, refer to **Appendix I-1: Unconfined and Triaxial Compressive Strength Test Procedure** for testing procedure)
- Capillary pressure (MICP) to determine pore throats and relate water saturations to permeability (K) and porosity (φ)
- Threshold entry pressure (TEP)
- X-ray diffraction (XRD) to determine clay mineralogy and validate petrophysical clay volume calculations
- Thin section and scanning electron microscopy (SEM) analyses
- CO_2-water relative permeability
- Pore volume compressibility
- Geochemical compatibility
- Core descriptions

5. Additional Pre-Operational Testing

Additional pre-operational testing will include the following.

- Hydrologic and Hydrogeologic Information:
  - Groundwater sample collection and analysis during well construction to establish the depth of the lowermost underground source of drinking water (USDW) within the Area of Review (AoR) (analytes and testing methods in **Attachment C**).
  - Determine static fluid levels
  - Baseline pressure and temperature data will be collected at all monitoring wells using methods described in **Attachment C**.
- Geochemistry/Geochemical Data

  - Characterize the baseline geochemistry of the Injection Zone, and Domengine and the Markley Formations for all parameters (and methods) described in **Attachment C** to (1) confirm the inputs to the geochemical modeling and (2) establish a baseline for monitoring. Baseline geochemistry samples will be collected at all monitoring wells (**Attachment C**).
  - Characterize mineralogy of the Confining Zone and Injection Zone to confirm inputs to the geochemical modeling.
  - Geochemical modeling (PHREEQC) will be revised with newly collected data during the pre-operational phase.

- Geomechanics
  - Clarify formation ductility, principal stresses, pore pressure, fracture gradient, and other petrophysical parameters to confirm geomechanical assumptions based on data collected during logging, testing, and coring described above.
  - Geomechanical modeling will be revised as needed based on newly collected data.
- Seismic History and Seismic Risk
  - Establish pressure in the Injection Zone (anticipated testing methods: pressure gauge measurement).
  - Continue to establish baseline seismicity using methods listed in **Attachment A: Narrative Application Report** and **Attachment C**.
  - CTV will monitor seismicity with surface and/or shallow borehole seismometers. The seismometers will be able to detect events with a magnitude down to 0 to 0.5 and will be installed one year prior to injection to provide baseline seismicity. In addition, CTV will monitor the Northern California Earthquake Data Center (NCEDC) network for seismic events. Historical seismicity within the area will be accounted for in the baseline assessment.
- Facies Changes in the Injection or Confining Zones/Site Geomodel
  - Confirm the thickness of the Injection Zone sands at the location of the injection wells to provide additional information on their suitability for injection, including facies changes that could facilitate preferential flow (anticipated testing methods: cores and well logging data, see Sections 3 and 4 above).
  - Confirm thickness of the Confining Zone.
  - Update site geomodel and dynamic model as needed to reflect any heterogeneities identified during the pre-operational phase based on data collected during logging, testing, and coring described above.

- CO_2 Stream Compatibility with Subsurface Fluids and Minerals
  - Confirm the composition of the CO_2 injectate as part of baseline sampling and provide verification that it will not react with the formation matrix (anticipated testing methods: injectate analysis and core testing, geochemical modeling).
  - Confirm that the properties of the CO_2 stream are consistent with the AoR delineation model inputs (anticipated testing methods: various geochemical analyses).
  - Confirm that the analytes for the injectate and ground water quality monitoring are appropriate based on the results of the geochemical modeling evaluation (anticipated testing methods: various geochemical analyses).
  - Following the pre-construction measurement of the composition, properties, and corrosiveness of the injectate, review the well construction materials and cement in the context of the results of these tests (anticipated testing methods: various geochemical analyses).
- Injection and Confining Zone Integrity
  - Confirm the fracture pressure of the injection zone via a site-specific step rate test in the project area on newly drilled injection wells.
  - Determine the fracture pressure of the confining zone via a site-specific mini-frac in the project area.
- Injection Well Construction
  - Following pre-construction measurement of the composition, properties, and corrosiveness of the injectate, review well construction materials and cement in the context of the results of these tests (anticipated testing methods: various geochemical analyses).
- Storage Capacity
  - Reevaluate CO_2 storage capacity based on site-specific injection zone characteristics.
- Financial Responsibility
  - Updated cost estimates based on third party assessment and confirmation of insurance and credit line.
- Alternative PISC Timing Determination
  - Acquisition of data gathered as part of preoperational testing will aid in refining plume stability in support of alternative PISC timing.

6. References

U.S. Environmental Protection Agency (U.S. EPA), 2013. Underground Injection Control (UIC) Program Class Six Well Testing and Monitoring Guidance. Office of Water (4606M) EPA 816-R-13-001, March 2013.

Tables

Table I-1: Testing Method by Formation.

Test	Nortonville Shale[1]	Domengine[1]	Capay Shale	Mokelumne River
Routine Core Analysis	x	x	x	x
Rock Mechanics			x	x
Capillary Pressure	x		x	x
Threshold Entry Pressure	x		x	
X-Ray Diffraction (XRD)	x	x	x	x
Thin Section & Scanning Electron Microscopy (SEM)			x	x
CO2-Water Relative Permeability				x
Pore Volume Compressibility				x
Geochemical Compatibility				x
Core Descriptions	x	x	x	x

[1] Sidewall core may be obtained in place of whole core.