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CLASS VI PERMIT APPLICATION NARRATIVE
40 CFR 146.82(a)

Venture Global CCS Cameron, LLC CO_2 Sequestration Project

Facility Information

Facility Name: Venture Global CCS Cameron, LLC CO_2 Sequestration Project

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Venture Global CCS Cameron, LLC
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Well Location: West Cameron Block 5 CS004 Well 001, Cameron Parish, Louisiana
[redacted]

1 Project Background and Contact Information

Venture Global LNG, Inc. is a long-term, low-cost producer of North American liquefied natural gas (LNG). With facilities planned to be strategically located along the Gulf Coast in southern Louisiana, Venture Global LNG, Inc. has positioned itself to become a global leader in the export market of LNG from the United States. As a leader in this industry, Venture Global LNG, Inc. is aware of the universal demand for clean energy and the social and environmental responsibilities operators have to produce much-needed energy with a lower carbon footprint. To this end, Venture Global LNG, Inc. is taking steps to ensure that the energy it exports meets these requirements by voluntarily engaging in carbon capture and sequestration (CCS) through Venture Global CCS Cameron, LLC (Venture Global).

Venture Global LNG, Inc. is commissioning the Calcasieu Pass LNG facility (Calcasieu Pass) and is permitting the adjacent CP2 LNG facility (CP2 LNG), which are ideally positioned on the Calcasieu Ship Channel near the entrance to the Gulf of Mexico (see Figure 1-1). This area features deep-water access, proximity to plentiful natural gas supplies, and ease of transport for buyers from around the globe. Calcasieu Pass has a nameplate export capacity of 10 million tonnes per annum (Mtpa) of LNG.[1] CP2 LNG will have a nameplate export capacity of 20 Mtpa of LNG.[2]

The Venture Global CCS Cameron, LLC CO_2 Sequestration Project (Project) will capture and store carbon dioxide (CO_2) generated at the Calcasieu Pass and CP2 LNG facilities, thereby lowering the carbon intensity of the LNG produced at the two terminals.

The CO_2 will be derived from the acid gas removal units in Calcasieu Pass and CP2 LNG. CCS has already been incorporated into the design and permitting review for CP2 LNG; therefore, CO_2 will first be captured from CP2 LNG, which anticipates starting construction in the fourth quarter

[1] https://ventureglobalIng.com/project-calcasieu-pass/.
[2] https://ventureglobalIng.com/cp2-lng/.

of 2023, with a Phase 1 in-service target during the fourth quarter of 2026. The actual start of construction of CP2 LNG is dependent on the issuance of all relevant permits and authorizations. Construction and in-service of the Phase 2 CP2 LNG facilities are expected to follow Phase 1 by 12 months.[3] Subject to the issuance of all relevant permits and authorizations to engage in CCS, CO_2 captured from Calcasieu Pass is anticipated to be added to the sequestration stream approximately six months after the in-service target of the Phase 2 CP2 LNG facilities. At that time, the total injection amount of CO_2 from both LNG terminals will be approximately 1Mtpa. The CO_2 concentration in the injection stream is anticipated to be approximately [redacted] percent.

Venture Global will then geologically sequester the captured CO_2 into subsurface formations in offshore State of Louisiana waters at a location approximately [redacted] miles south of the LNG terminals.

[redacted]

The depositional environment along the Gulf of Mexico coastline of the southern United States offers an ideal geologic setting to sequester greenhouse gases. The targeted reservoir formations consist of very porous unconsolidated sands with high permeabilities that are highly coveted for underground injection operations. These sand formations are interbedded with shales, clays, and mudstones, which provide excellent barriers to the upward movement of the injected gases.

These formations are from the Middle to Lower Miocene in age. The physical properties of the Miocene sands require strategic completion and operating plans to optimize the utilization of

[3] FERC, Draft Environmental Impact Statement for Venture Global CP2 LNG, LLC and Venture Global CP Express, LLC, Docket Nos. CP22-21-000 and CP22-22-000. Available at: https://elibrary ferc.gov/eLibrary/filelist?accession_number=20230119-3072. Accessed February 2023.

available pore space within the subsurface. Consequently, Venture Global's well design was engineered to ensure safe operating conditions and long-term containment of injected gases. The CO_2 injection well was designed to meet the requirements of API Recommended Practice 1171 Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs and the regulatory requirements outlined in 40 CFR 146.86 [LAC 43:XVII.3617].

The offshore location was selected for its ideal subsurface geology for the sequestration of CO_2, proximity to the surface facilities, and available pore space, all of which minimize impacts to the surrounding communities and environment. There will be direct increases in local tax revenue, personal earnings, and local business activity during construction and operation of the Calcasieu Pass and CP2 LNG facilities. The State of Louisiana and Cameron Parish will receive significant temporary direct and indirect economic benefits due to the Calcasieu Pass and CP2 LNG facilities during their respective construction phases. By voluntarily engaging in CCS at both facilities, there will be an even greater long-term environmental and economic benefit during the operating life of the LNG and CCS facilities. The environmental benefits of this CCS project will extend beyond the state and local communities to the global community as well. The sequestration of 1 Mtpa of CO_2 is estimated to be equivalent to removing approximately 215,000 gasoline-powered passenger vehicles for one year.[4]

The Louisiana State Mineral and Energy Board and Venture Global CCS Cameron, LLC entered into an Operating Agreement to allow Venture Global CCS Cameron, LLC to lease the pore space beneath State property in Louisiana offshore blocks West Cameron Blocks 5, 6, 7, 24, 25, and 26 in Cameron Parish. The details of the Agreement for lease CS004 can be found in Resolution #22-09-010.[5]

The well and associated project infrastructure will be fully owned and operated by Venture Global.

No injection depth waiver is being sought.

Provided below is a list of state, tribe, and territory contacts, as described at 40 CFR 146.82(a)(20).

Venture Global CCS Cameron, LLC **CO_2 Sequestration Project** **Louisiana State Contacts**
Louisiana Department of Environmental Quality, Environmental Services Bryan Johnston, Air Permits Administrator Louisiana Department of Environmental Quality, Office of Environmental Services P.O. Box 4313 Baton Rouge, LA 70821-4313

[4] "Greenhouse Gas Equivalencies Calculator." EPA, Environmental Protection Agency, Mar. 2021, www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
[5] Resolution #22-09-010, Louisiana State Mineral and Energy Board (Sept. 14, 2022), http://www.dnr.louisiana.gov/assets/OMR/media/forms_pubs/CS004.pdf.

Venture Global CCS Cameron, LLC CO_2 Sequestration Project Louisiana State Contacts
Louisiana Department of Environmental Quality, Water Permits Division Scott Guilliams, Water Permits Administrator Louisiana Department of Environmental Quality, Water Permits Division P.O. Box 4313 Baton Rouge, LA 70821-4313
Louisiana Department of Natural Resources, Office of Conservation Stephen Lee, Injection and Mining Division Director Louisiana Department of Natural Resources, Office of Conservation P.O. Box 94275 Baton Rouge, LA 70804
Louisiana Department of Natural Resources, Office of Conservation Steven Giambrone, Pipeline Division Director Louisiana Department of Natural Resources, Office of Conservation P.O. Box 94275 Baton Rouge, LA 70804
Louisiana Department of Natural Resources, Office of Conservation Chris Sandoz, Engineering - Regulatory Division Director Louisiana Department of Natural Resources, Office of Conservation P.O. Box 94275 Baton Rouge, LA 70804
Louisiana Department of Natural Resources, Office of Conservation Pat Molbert, Engineering - Regulatory Division, Lafayette District Manager Louisiana Department of Natural Resources, Office of Conservation 825 Kaliste Saloom Rd Brandywine III, Suite 220 Lafayette, LA 70508
Louisiana Department of Natural Resources, Office of Coastal Management Kevin Lovell, Assistant Secretary Louisiana Department of Natural Resources, Office of Coastal Management P.O. Box 44487 Baton Rouge, LA 70804-4487

Venture Global CCS Cameron, LLC **CO_2 Sequestration Project** **Louisiana State Contacts**
Louisiana Department of Wildlife and Fisheries Nicole Lorenz, Wildlife Diversity Program Manager Louisiana Department of Wildlife and Fisheries Wildlife Diversity Program P.O. Box 98000 Baton Rouge, LA 70898
Louisiana Department of Culture, Recreation and Tourism, Division of Archaeology – State Historic Preservation Officer Kristin Sanders, State Historic Preservation Officer Louisiana Office of Cultural Development P.O. Box 44247 Baton Rouge, LA 70804-4241
Louisiana Office of State Lands Lawrence Rosso, Jr., Public Lands Utilization Manager 1201 N. Third Street Suite 7-210 Baton Rouge, LA 70802

Five files have been uploaded.

- VG_Cameron_Application_Narrative.pdf
- VG_Cameron_Application_Narrative_App1.pdf
- VG_Cameron_Application_Narrative_App2.zip
- VG_Cameron_Glossary.pdf
- VG_Cameron_Project_Information_Tracking.pdf

GSDT Submission - Project Background and Contact Information
GSDT Module: Project Information Tracking ***Tab(s):*** General Information tab; Facility Information and Owner/Operator Information tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Required project and facility details ***[40 CFR 146.82(a)(1)]***

2 Site Characterization

2.1 Overview

[redacted]

The following Site Characterization was prepared for Venture Global's proposed CS004 Well 001 to meet the requirements of 40 CFR 146.82(a)(2), (3), (5) and (6).

Geology: The regional geologic setting of the proposed site is in the Gulf of Mexico basin, an extensively studied and explored super basin considered one of the richest petroleum basins in the world. The sandstones of the Middle and Lower Miocene sections along the Gulf Coast of Louisiana have sufficient porosity, permeability, and lateral continuity and are of sufficient depth and thickness to store the proposed volume of CO_2 from the Project. The upper confining Middle Miocene *Textularia W* (Text W) shale has low enough permeability and sufficient thickness and lateral continuity of mudstone beds to serve as the primary upper confining zone. The lower confining Lower Miocene *Robulus L* (Rob L) shale has low enough permeability and sufficient thickness and lateral continuity of mudstone beds to serve as the lower confining zone. See later in this section 2 where this is discussed in more depth.

Maps and cross sections of the AoR were prepared for the proposed CS004 Well 001 to meet requirements of 40 CFR 146.82(a)(2) and 40 CFR 146.82(a)(3)(i). Structure and thickness (isopach) maps demonstrate the spatial relationship between the proposed site and geologic features at each stratigraphic level of identified zones of interest. Cross sections demonstrate lateral continuity and structural trends across the AoR. See later in this section 2 and also Module 2, Area of Review and Corrective Action Plan where this discussed in more depth.

Faults in the AoR are identified and characterized by applying 3D seismic surveys to meet the requirements of 40 CFR 146.82(a)(3)(ii). Faults in the AoR are dynamically modeled utilizing GEM software,[6] developed by Computer Modeling Group, Ltd, and do not pose a threat to containment. Probabilistic screening of fault stability during and after injection determined low risk of induced seismicity of the faults in and near the AoR through the Fault Slip Potential (FSP)[7] tool, developed by Stanford Center for Induced and Triggered Seismicity. A review of the seismic history of the proposed site according to requirements in 40 CFR 146.82(a)(3)(v) supports this determination. See Module 2, Area of Review and Corrective Action Plan where this discussed in more depth.

Geomechanical Information: In lieu of measured data, which is not yet available but will be collected upon issuance of the Class VI Permit to Construct, analogous geomechanical and petrophysical data were included in the site characterization near the proposed CS004 Well 001 to satisfy requirements of 40 CFR 146.82(a)(3)(iv). The data analyzed indicate favorable petrophysical and geomechanical properties in the injection zone, confining zones and overlying units. See section 2.6 of this document where this is discussed in more depth.

Hydrologic and Hydrogeographic Information: Hydrologic and hydrogeologic information of nearby water wells, springs and underground sources of drinking water (USDWs) was collected and analyzed according to 40 CFR 146.82(a)(3)(vi). Structural maps and cross sections indicate the location, depth and lateral limits of USDWs, water wells and springs within and around the AoR. 40 CFR 146.82(a)(5).] See section 2.8 of this document where this is discussed in more depth.

Baseline Geochemical Information: Site-specific data of the brine at the injection zone and mineralogy of injection and confining zones will be collected upon issuance of the Class VI Permit to Construct. Offset analogous data were used to determine fluid- and solid-phase geochemistry at the site according to 40 CFR 146.82(a)(6). Results of the geochemical modeling performed using PHREEQC[8] version 3 software,[9] developed by the US Geological Survey (USGS), indicate the geochemistry of the proposed site supports the injection of CO_2-rich fluid. See section 2.9 of this document where this is discussed in more depth.

2.2 Regional Geology, Hydrogeology, and Local Structural Geology [40 CFR 146.82(a)(3)(vi)]

The following site characterization of the regional geology of southwest Louisiana is a compilation and evaluation of publicly available data, including results and analyses of exploratory wells and

[6] Available at: https://www.cmgl.ca/gem. Accessed November 2022.
[7] Available at: https://scits.stanford.edu/fault-slip-potential-fsp. Accessed November 2022.
[8] PHREEQC stands for PH REdox EQuilibrium (in C language).
[9] Available at https://www.usgs.gov/software/phreeqc-version-3. Accessed November 2022.

borings for hydrocarbons, geothermal, storage and groundwater. Documents, well, and groundwater information were provided by the State of Louisiana Department of Natural Resources (LDNR). The USGS report, "Geologic Framework for the National Assessment of Carbon Dioxide Storage Resources – U.S. Gulf Coast," (Robert-Ashby et al., 2014) provides a study evaluating possible targets for geologic storage of CO_2 in and along the U.S. Gulf Coast ("USGS Storage Assessment"). The USGS Storage Assessment also includes literature from peer-reviewed journals, dissertations, and theses of southern Louisiana regional geology.

The proposed CS004 Well 001 targets the Middle and Lower Miocene age sandstone formations in the Gulf of Mexico basin, shallow offshore waters in the State of Louisiana. The Lower and Middle Miocene (proposed CO_2 injection zone) geologic units lie between regionally extensive shales that act as confining zones: the Rob L underlies the injection zone, the Amphistegina B (Amph B) sits between the Lower and Middle Miocene, and the Text W is immediately above the injection zone.

2.2.1 General Regional Geologic History

The Gulf of Mexico basin covers an area of about 148 million acres, encompassing the state-waters boundary of the United States, areas of Texas, Louisiana, Mississippi, Alabama, Arkansas, Missouri, Kentucky, Tennessee, Florida, and Illinois (Roberts-Ashby et al., 2014). The Gulf of Mexico Basin was formed by the rift of Pangaea during the Mesozoic Period, resulting in crustal extension and seabed expansion (Galloway, 2008). The earliest recorded sedimentation occurred during the Late Triassic to Early Jurassic Period and is comprised of the non-marine red beds, deltaic sandstones, conglomerates, siltstones, and shales of the Eagle Mills Formation. During the Middle Jurassic Period, a thick sequence of anhydrite and salt beds collectively called the Louann Salt covered these sediments and, where the Eagle Mills Formation is absent, pre-Cambrian igneous basement rock. From the Jurassic Period through the Holocene, sediments accumulated to depths of up to 20 kilometers in the basin depocenter located beneath southern Louisiana (Galloway, 2008).

The structural opening of the Gulf of Mexico Basin was aided by NW-SE trending transfer faults which influenced rates of subsidence and salt distribution (Galloway, 2008). Basement structures such as the Ouachita and Appalachian Mountain ranges and the Llano uplift widely shaped the Louann Salt and subsequent strata deposition. Structural flexures such as the Balcones, Luling-Mexia-Talco, State Line, and Pickins-Gilberton fault zones are regional influences on salt tectonics. The Gulf of Mexico Basin today is a landscape influenced by sediment loading and salt mobilization expressed as growth-fault related structures, allochthonous salt bodies, salt welds, salt-based detachment faults, salt diapirs, and basin-floor compressional fold belts (Galloway, 2008).

A basin-scale dip-oriented cross-section over the general area of the proposed CO_2 storage site portrays present day Gulf of Mexico basin structure in **Error! Reference source not found.**. **Error! Reference source not found.**(A) illustrates the path of the cross-section from a general north to south direction; the proposed CO_2 sequestration location is approximated by the red star. **Error! Reference source not found.**(B), modified from Galloway (2008), is a north-south illustrated cross-section with generalized structure, stratigraphy, crustal and salt features with the proposed facility location projected in the approximate location relative to shoreline.

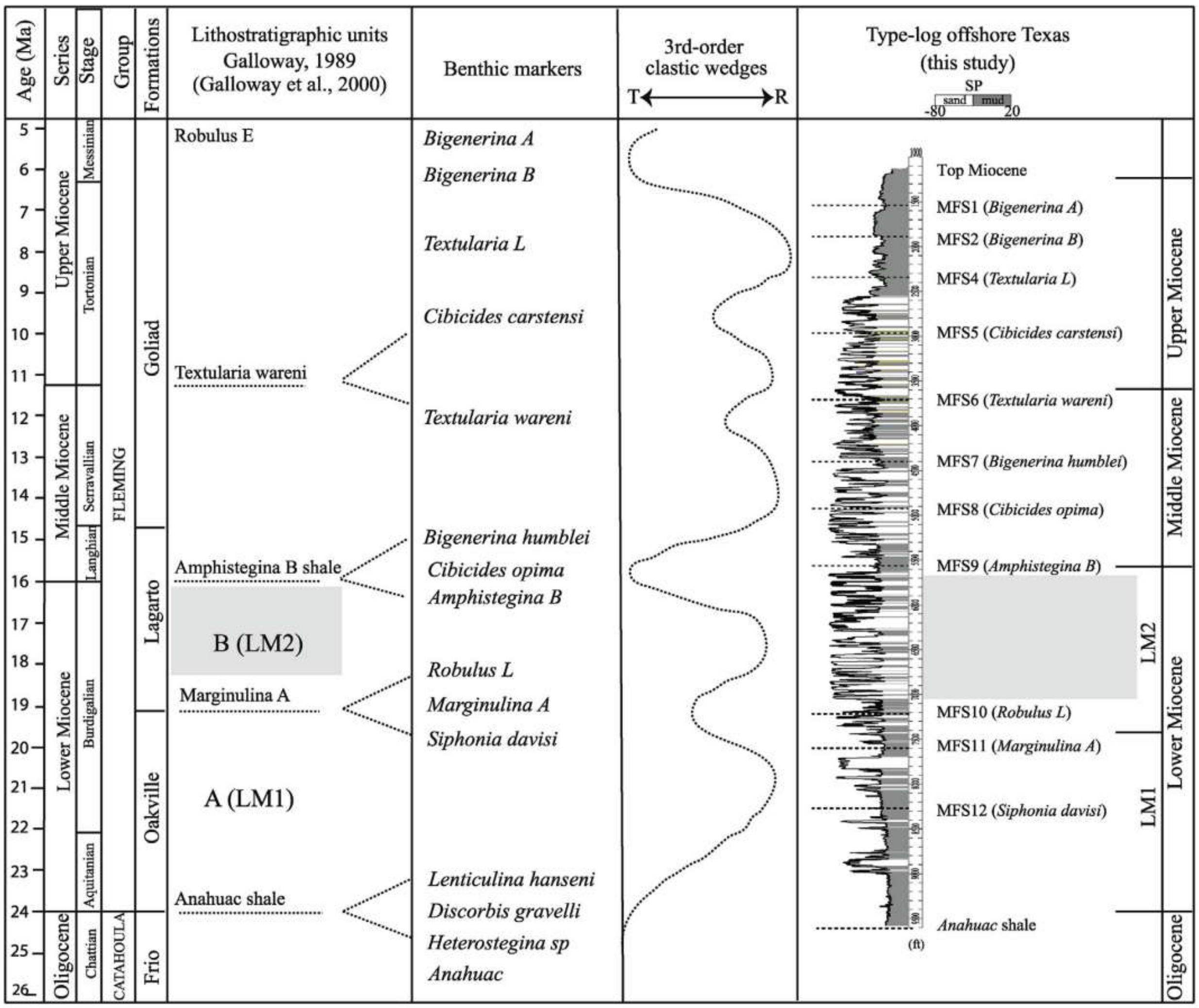
[redacted]

2.2.2 *Regional Characteristics of the Injection and Confining Zones*

The following discussion includes the regional characteristics of the Lower and Middle Miocene (proposed CO_2 injection zone), the *Rob L* that underlies the injection zone, the *Amph B*, a regional shale bed that sits between the Lower and Middle Miocene, and the *Text W*, which is the confining zone that is immediately above the injection zone.

2.2.2.1 Miocene

Miocene depositional episodes are characteristically fluvio-deltaic systems separated by regionally extensive fine-grained sealing units. The Miocene increases in age into the offshore province. Miocene strata are divided into three stratigraphic units: Lower, Middle, and Upper Miocene, corresponding to the Fleming Group. This study focuses on the Middle and Lower Miocene. Figure 2-3 illustrates the general stratigraphic column of South Louisiana and the relationship of lithostratigraphic and biostratigraphic Miocene divisions.



Source: (Olariu et al., 2019)

The Miocene is divided into biostratigraphic units. The column on the right lists the more widely used marker Foraminifera and assemblages.

Figure 2-3: Stratigraphic Section of South Louisiana

Figure 2-4 illustrates the regional stratigraphic column generated from a composite of two wells in close proximity to the proposed CO_2 injection well, [redacted]

[redacted]

[redacted]

[redacted]

The Lower Miocene is a high sediment supply rate depositional episode following the end of the Oligocene-age Anahuac transgression (Galloway, 2008). The Lower Miocene is further subdivided into the Lower Miocene I and Lower Miocene II. The Lower Miocene I is the basal unit, from the Oligocene-age Anahuac Shale to the *Marginulina A* (Marg A) benthic marker. The lower boundary of the Lower Miocene I unit is indicated the *Rob L* benthic marker, while the *Amph B* shale marker serves as the upper boundary (Galloway et al., 2000). The Lower Miocene II SAU, defined by the *Amph B* top-seal limit and State-water boundary, covers an area of 9,924,000 acres (Roberts-Ashby et al., 2014). The shale-rich *Rob L* and *Amph B* should act as robust regional seals (typically for oil and gas migration and entrapment, but also for CO_2 sequestration) and both the Lower Miocene I and Lower Miocene II reservoirs are noted in the USGS storage assessment as "self-sealed" (Roberts-Ashby et al., 2014).

The Middle Miocene is a short-lived genetic sequence (3 million years) of deltaic sediments prograding into the continental shelf deposited conformably upon the *Amph B* shale. The Middle Miocene ends in a transgression in sea level and deposition of a regional marine shale containing either the *Textularia stapperi* or Text W biostratigraphic marker (Trevino and Meckel, 2017). The *Amph B* and *Text W* benthic faunal tops are major flooding surfaces corresponding to global rises in sea level (Combellas-Bigott and Galloway, 2006). Galloway et al. (2000) describes in detail the Middle Miocene under the western fringe of the Mississippi Delta system and the eastern edge of the Texas/Louisiana shore-zone system. The USGS Storage Assessment describes the Middle Miocene Storage Assessment Unit (SAU) as "self-sealed" as the fine-grained regional shales that mark the top of the Middle Miocene should act as robust regional seals (Robert-Ashby et al., 2014).

Structurally, the proposed CO_2 storage site lies on the northern margin of the Gulf of Mexico. During the Middle Jurassic, a thick Louann Salt precipitated in the Gulf of Mexico basin. Rapid sediment loading associated with late Cenozoic deposition-initiated salt flow, producing salt structures, and induced faulting roughly paralleling the present-day coastline. These faults are often listric – a convex shape which produces fault cuts at a steeper angle in the shallower-affected sediments and fault throws which generally increase with depth. Smaller faults were produced during the down-to-the-coast faults to accommodate movement of these large blocks of sediment. The proposed site is situated away from the regional faults as shown in Figure 2-5; however, there as some local faults in the vicinity of the proposed site (discussed in Section 2.4 "Faults and Fractures").

Hydrocarbon production in the Gulf Coast region from Middle and Lower Miocene sands beneath the *Text W* and *Amph B* stratigraphic units, respectively, demonstrates the capability of these clay-rich shales as vertical and laterally sealing units to contain hydrocarbons and prevent vertical migration of buoyant fluids (see Figure 2-). [redacted].

[10] Production data from Enverus's Drillinginfo database as of December 2022.
[11] Production data from Enverus's Drillinginfo database as of October 2007.

[redacted]

The following is a regional geological overview of the injection and confining zones captured in Figure 2-4.

2.2.2.2 Lower Confining Zone: Robulus L

The *Rob L* is a regionally-extensive transgressive shale deposited conformably on top of the *Marginulina A* sandstones and shales. Miocene shales associated with maximum flooding surfaces, such as the *Rob L*, are fine-grained sedimentary rocks formed from mud deposited in a marine environment. The mud is composed of clay minerals and silt-sized particles. The regional lithology for this unit is anticipated as clay-rich (>50%) marine shale with interbedded silt and sand beds (Olariu et al., 2019). Illite and mixed layer illite and smectite are common in the Robulus interval (Pasley et al., 1988). Marine shales are considered effective top seals because they have low permeabilities and are regionally deposited.

2.2.2.3 Injection Zone: Middle and Lower Miocene Sandstones

Middle Miocene sandstones along the Texas and Louisiana shore-zone system are fluvial-dominated deltaic deposits which prograde the continental margin as much as 70 km (Galloway, 2008). Gross sandstone thickness averages 3,200 ± 900 ft, with an average net-sandstone thickness of 480 ± 140 ft (Robert-Ashby et al., 2014). According to Nehring Associates, Inc. (2010), the regional reservoir porosity was estimated to be 28 percent ± 4 percent (same as the Lower Miocene). Reginal permeability ranges from 20 millidarcies (mD) to 8,000 mD, with an average of 500 mD (Robert-Ashby et al., 2014).

Lower Miocene sandstones in southwest Louisiana are fluvial-dominated deltaic deposits which prograded the continental margin 65-80 km basinward (Galloway, 2008). Gross sandstone thickness averages 3,100 ± 800 ft, with an average net sandstone thickness of 1,150 ± 500 ft (Robert-Ashby et al., 2014). Regional reservoir porosity gathered from a production database of 432 petroleum-reservoir-averaged porosity measurements by Nehring Associates, Inc. (2010) was analyzed by the Texas Bureau of Economic Geology and found to be 28% (± 4%) (Roberts-Ashby et al., 2014). Regional permeability measurements in the production database averaged 500 mD (Nehring Associates, Inc., 2010).

2.2.3 Regional Shale Bed: Amphistegina B

The Lower Miocene depositional episode terminates with the maximum flooding surface within the widespread *Amph B* calcareous marine shale (Galloway, 2008). This regional, transgressive shale can reach thicknesses of 820 ft and is identified as a sealing interval in the Offshore CO_2 Storage Resource Assessment by the U.S. Department of Energy National Energy Technology Laboratory (Trevino and Meckel, 2019). [redacted]

2.2.4 Upper Confining Zone: Textularia W

The Middle Miocene depositional episode terminates by regional marine transgressive shale *Text W* (Galloway, 2008). Due to its regionally extensive deposition, this transgressive shale is used as the lithostratigraphic marker for the boundary between the Upper and Middle Miocene along the northern Gulf of Mexico (Trevino and Meckel, 2019) and it is considered by the USGS Storage Assessment to be a suitable sealing interval.

[redacted]

[redacted]

[redacted]

Stratigraphic column displaying the east-west distribution of the Tertiary rocks within the U.S. Gulf Coast study area. Storage assessment units consist of a reservoir (red) and regional seal (blue). Wavy lines indicate unconformable contacts. Adapted from Dubiel and others (2007a), Warwick and others (2007), and Mancini and others (2008b). **Modified from Roberts-Ashby et al USGS 2012 (Open-File Report 2012–1024–H)**

Figure 2-9: Generalized stratigraphic column for the Texas / Louisiana Gulf Coast area showing the target injection interval. The red arrow at the top shows the approximate location of the target site in the central Gulf Coast. The regional seals which are also the confining zones in the target CO_2 injection site have been highlighted.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2.4 Faults and Fractures [40 CFR 146.82(a)(3)(ii)]

[redacted]

[redacted].

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[13] https://scits.stanford.edu/fault-slip-potential-fsp.

Site Geology

2.5 Injection and Confining Zone Details [40 CFR 146.82(a)(3)(iii)]

2.5.1 Overview

The injection formations are the Middle Miocene and Lower Miocene 2, while the confining zones are the [redacted] The depth and areal extent of the injection and confining zones were determined from combination of available well logs from wells in the vicinity of the injection site and also the 3D seismic horizon interpretation.

[redacted]

Table 2-1: Injection and Confining Zones as Encountered [redacted]

System	Group / Formation Name	Injection / Confining Zone	Formation Top – Formation Bottom (ft TVD[16])	Thickness (ft)
Miocene	[redacted]	[redacted]	[redacted]	[redacted]
Miocene	[redacted]	[redacted]	[redacted]	[redacted]
Miocene	[redacted]	[redacted]	[redacted]	[redacted]
Miocene	[redacted]	[redacted]	[redacted]	[redacted]
Miocene	[redacted]	[redacted]	[redacted]	[redacted]

The injection and confining zones were also correlated to other wells surrounding the injection site as shown in Figure 2-26.

[redacted]

[16] True vertical depth

[redacted]

Key seismic horizons (Text W, CIB OP, Amph B, and Rob L) interpreted from seismic volume and tied to depth picks from offset well tops from well logs were used to generate the lateral extent of the injection and confining zones in areas away from well control (Figures 2-23 and 2-24).

General mineralogy and reservoir characteristics of the AoR are described in the following sections, first regionally from pooled studies. Where available, offset core and cuttings data from published research are included. Finally, analyses of offset wellbores were compiled to represent the proposed well site characteristics. Wireline logs, petrophysical analyses and production data from wellbores adjacent to the proposed sequestration well were also studied to calculate anticipated conditions at the proposed well site.

Upon issuance of the Class VI Permit to Construct, data will be gathered during drilling of the proposed CO_2 injection well, CS004 Well 001, to update the data obtained via the above research with site specific information. Table 2-2 lists open hole wireline logs planned during the drilling of the proposed well with top and base depths designed to provide specific data pertinent to the site characterization. If necessary, the proposed top and base of each investigative procedure will be subject to minor depth changes during drilling to analyze the objective formations. During the drilling of the proposed well, coring operations are planned to obtain mineralogic, petrophysical, mechanical, and geochemical data to further refine this site characterization (see Table 2-3).

Table 2-2: Planned Geophysical Wireline Logged Intervals

Geophysical Log Suite	Log Interval Top (ft MD[17])	Log Interval Bottom (ft MD)	Use
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]	[redacted]		[redacted]
[redacted]			[redacted]
[redacted]			[redacted]
[redacted]			[redacted]

[17] Measured depth

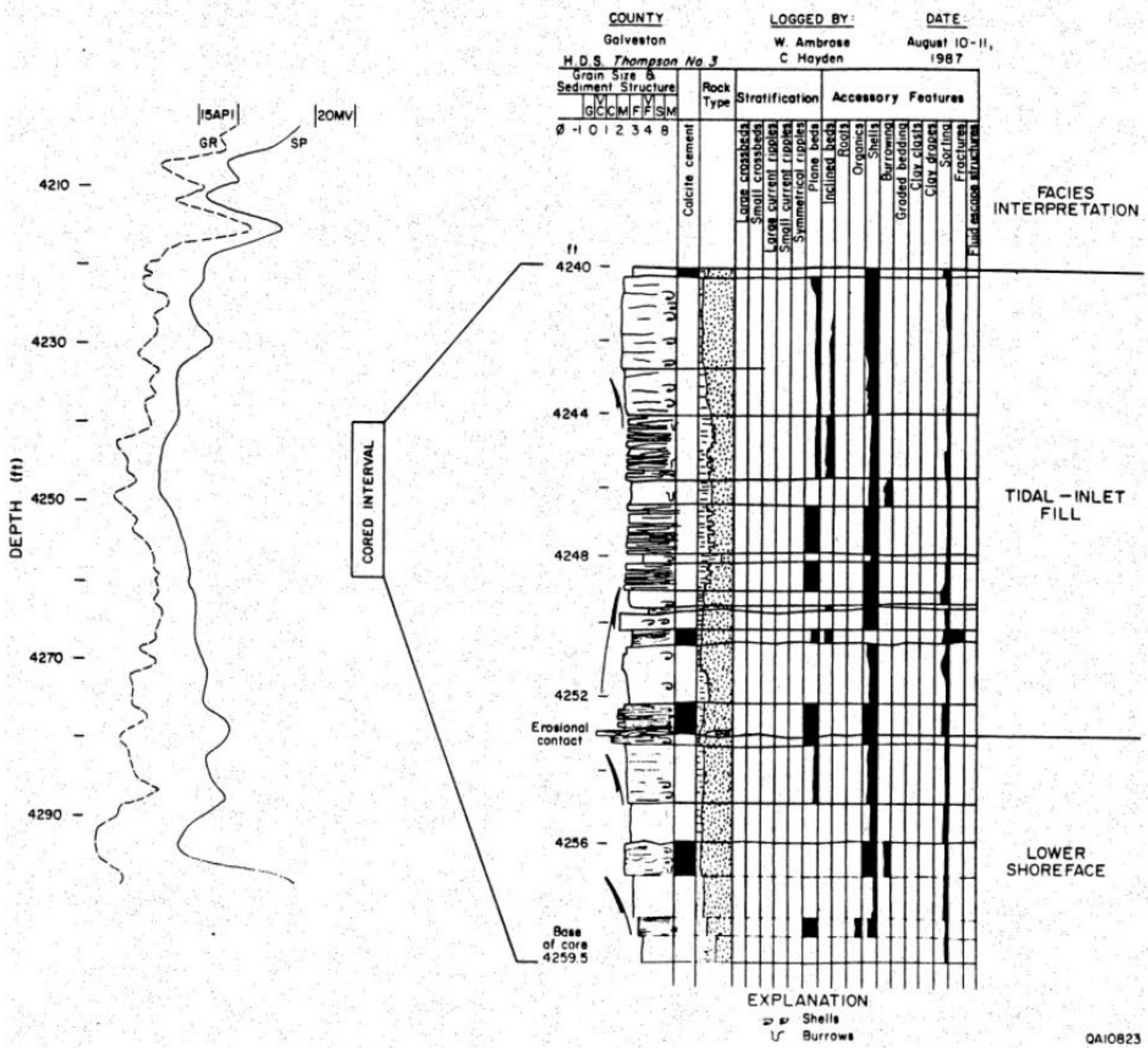
Table 2-3: Whole Cored Intervals Planned within Anticipated Formation Measured Depths

Core #	Interval Top (ft)	Interval Bottom (ft)	Stratigraphic Unit	Zone
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

2.5.2 *Injection Zone Geology*

The injection interval is made up of the sandstones of the Middle and Lower Miocene, [redacted] Both the Middle and Lower Miocene sandstones are lithologically similar and anticipated to behave similarly under the injection conditions. In this section they are broken out by age, as the data are sourced from different publications.

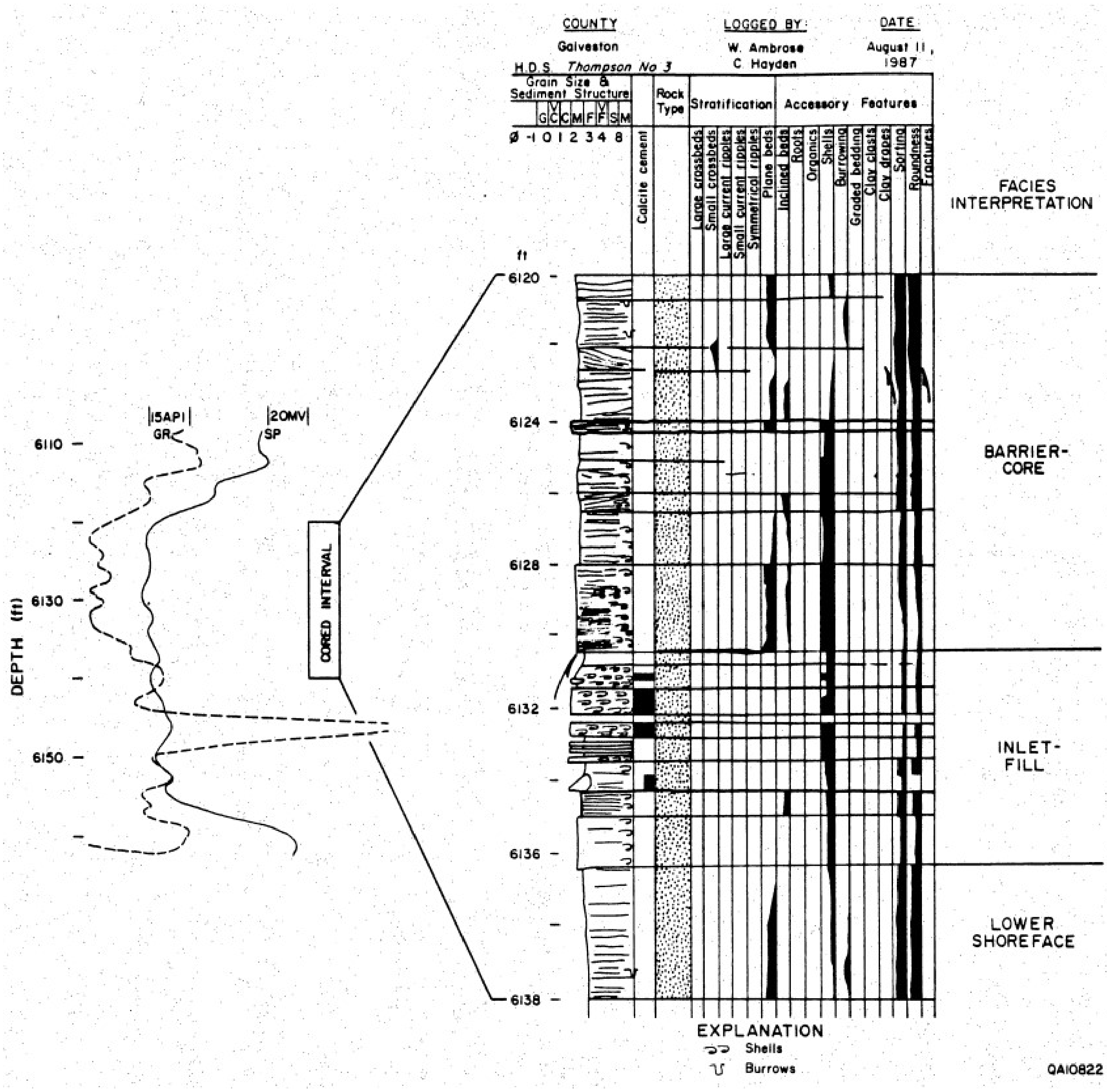
The Middle Miocene depositional environment is prograding deltaic sequences interbedded with marine shales and massive sandstones interrupted by thin, regionally extensive marine transgressive shales. Within the Middle Miocene, the sand intervals are the target reservoir for CO_2 storage. Figure 2-27 is a core description of a Middle Miocene sandstone interval at depths approximately [redacted] feet shallower than anticipated in the target reservoir. Sand in the core ranged from very fine grained to very coarse, with most of the sands' grain size identified as fine or medium. Shells were noted throughout the core and calcite cement was occasionally present.



Source: from Northeast Hitchcock Field, Galveston Co., Texas (Ambrose, 1988)

Figure 2-27: Core Description of Middle Miocene Sandstone from Depths of 4,240 to 4,259.5 Feet

The Lower Miocene section sands, as described from samples, are loosely consolidated with calcite cement, if cemented. Grain size and sorting is dependent upon depositional facies and ranges from laminated sand and silt to massive, well-sorted sandstones with greater than 70% quartz content (Ambrose, 1988). Figure 2-28 is a core description of a Lower Miocene sandstone interval [redacted]. Sands within this core range from fine to coarse-grained. Beds in this core are primarily planar, though some crossbedding is noted. Shells are described throughout the length of the core and the beds highest in shell content contain calcite cement.



Source: from Northeast Hitchcock Field, Galveston Co., Texas (Ambrose, 1988)

Figure 2-28: Core description of Lower Miocene Sandstone from Depths of 6,120 to 6,138 Feet

An example mineralogy of Middle and Lower Miocene sands, organized by facies, is displayed in Table 2-4 (Ambrose, 1988). Feldspar is a common constituent mineral and is dependent upon fluvial processes for deposition. Calcite grains, pyrite and siderite are accessory minerals that may be present in Middle and Lower Miocene sandstone reservoirs, each comprising less than 10% of the mineralogic composition. Pore occluding minerals include calcite cement, quartz overgrowths and detrital or authigenic clay minerals. Feldspar alteration into kaolinite or chlorite and diagenesis of smectite into illite are recorded in the Miocene section across onshore and offshore Texas and Louisiana.

Table 2-4: Mineralogy and Reservoir Characteristics of Injection Interval Sand from Ambrose, 1988

	Facies		
	Barrier Core	Tidal Inlet	Lower Shoreface
Sand Body and Interval (ft)	5,460 (5435-5452.5) 6,150 (6120-6130)	4,240 (4240-4253) 6,150 (6130-6136)	4,240 (4253-4259.5) 6,150 (6136-6140)
Mineralogy (percent)			
Quartz	75	74	59
Feldspar	19	10	25
Calcite	0	3	3
Clay	5	12	12
Other	1: Fe-Dolomite	1: Pyrite	1: Pyrite or Fe-Dolomite
Median Grain Size (phi)	2.73	2.92	3.19
Standard Deviation in Grain Size (phi)	0.97	1.05	1.04
Permeability to Frio Water (md)	2,570	None Reported	1,890
Porosity (percent)	32	None Reported	35
Texture Index	29	48	None Reported

In Figure 2-30, a composite log of well [redacted] displays from left to right: subsea depth calculated from the kelly bushing noted on the raster log, shale volume or Vshale (VSHL), measured depth, calculated permeability (K15), and deep induction resistivity (INILD01) in the right track. [redacted], are associated with maximum flooding surfaces used for correlation within the Upper, Middle and Lower Miocene intervals. [redacted]. Net sand is derived from facies interpretation of seismic properties during the construction of the geocellular model. Permeabilities of the injection sands range up to [redacted].

[redacted]

2.5.3 Upper Confining Zone Geology

The primary upper confining unit for the Middle and Lower Miocene injection interval [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2.5.4 Lower Confining Zone

The primary lower confining unit for the Middle and Lower Miocene injection interval is the shale associated with the *Rob L* maximum flooding surface. No publicly available core data from the Rob L shale were identified. The stratigraphy of the Lower Miocene west of the AoR was studied in the "Preliminary Stratigraphy and Depositional Framework of Miocene in Offshore Texas and Louisiana for CO_2-EOR Resource Assessment" (Olariu et al., 2017) and "The Stratigraphy and Petroleum Potential of the Lower Miocene, Offshore Galveston and Jefferson Counties, Texas" (Kiatta, 1971). Both studies refer to the Rob L shale as a regional fine-grained transgressive deposit. The Rob L in Vermilion offshore area is described as a massive shale section with an inferred deep-water environment. The Rob L's consistency and occurrence from the southern tip of Texas to the eastern boundary of Louisiana brands it a useful marker bed in regional correlations.

[redacted]

[redacted]

The calculated shale volume log of the individual shale beds that have been mapped over the AoR indicates these beds are composed of greater than 50% clay minerals. Silt comprised of quartz, feldspar and calcite grains will form the bulk of non-clay mineralogy. Thus, the anticipated mineral composition of the Rob L shales is favorable to act as a seal to downward migration of injected CO_2.

2.5.5 Porosity and Permeability

The porosity and permeability of the target geologic formations and confining intervals were estimated from a combination of petrophysical evaluations of available logs in nearby wellbores and also from public domain literature.

2.5.5.1 Porosity

[redacted] Total porosity was calculated from the density logs and then used to generate a porosity depth trend, excluding erroneous data from washout zones. Then effective porosity (PHIEST, Φeff) was derived using the porosity depth trend (PHIMEAN, Φmean) and shale volume (Vshale) as follows:

$$\emptyset_{eff} = \emptyset_{mean} * (1 - Vshale)$$

Vshale is computed from either the gamma ray or spontaneous potential (SP) logs, depending on log availability through the target depths as follows:

$$Vshale = \frac{(GR - GRsand)}{(GRshale - GRsand)} \quad or \quad Vshale = \frac{(SP - SPsand)}{(SPshale - SPsand)}$$

A quality check of the PHIEST curve was performed by overlaying the computed PHIEST (using the porosity depth trend) with the PHIE curve calculated from measured density porosity logs and found to be comparable (Figure 2-36).

[redacted]

A relationship between PHIEST curve and SP or gamma ray was derived for the [redacted] and applied to other surrounding wells in the area (which had no porosity log) to produce estimates of effective porosities over the Middle and Lower Miocene intervals. The effective porosity logs from multiple wells were used in the static geological model as input to model porosity across the area away from well control. In the model, effective porosity is distributed using a sequential Gaussian simulation algorithm.

2.5.5.2 Horizontal Permeability

In the absence of actual permeability data in the study area, horizontal permeability was estimated using the industry-standard equation below:

$$K(mD) = \left[70 * \emptyset_{eff}^{\ 2} * \left(1 - S_{W\ irr}\right)/S_{W\ irr}\right]^2$$

Where K is permeability, Φeff is effective porosity and S_{Wirr} is irreducible water saturation.

In the absence of measured S_{Wirr} derived from core analysis, several S_{Wirr} values were estimated to produce permeabilities of the cleanest (Vshale <15%) sand beds ranging from 1,000 to 2,500 mD, in divisions of 500 mD (Figure 2-37). This permeability range was chosen from publicly available regional permeability values of Miocene sandstone.

[redacted]

For the dynamic modeling of the CO_2 sequestration, a Swirr of [redacted] was assumed to generate horizontal permeabilities that compare well with analog data for Miocene reservoirs in the region. It is also worth noting that the empirical permeability equation was derived for sandstones and thus not applicable to the confining and intra reservoir shales. Log-derived permeabilities in shales in the confining zones were much higher than analog information. For CO_2 sequestration modeling, a permeability of [redacted] mD was assumed for the confining and intra-reservoir shales.

Upon issuance of the Class VI Permit to Construct, data will be collected during coring and logging operations that will provide site-specific and formation-specific porosity and permeability values to further refine the reservoir and seal characteristics examined in the section below.

2.5.6 Upper Confining Zone

2.5.6.1 Porosity

Porosity is low in clay-rich Miocene shale layers like the upper confining zone [redacted]. Primary pores are filled with illite, chlorite, kaolinite, and pyrite minerals. Burial and compaction further reduce intrinsic porosity as pressure aligns the clay platelets and interstitial water is squeezed from the clay particles. As observed in thin section analyses [redacted], secondary porosity formed by mineral dissolution and alteration is the majority of present-day pore space in the mudstones. These secondary pores are filled with authigenic clays and anatase. Intraparticle pores within clay platelets are small and may not contribute to effective porosity within the shales. Table 2-6 records measured porosity and permeability derived from MICP tests of Middle Miocene mudstones from the [redacted] The measured porosity ranges between [redacted]

The Vshale and PHIEST attributes of the [redacted] to the proposed storage site were analyzed to examine sealing capability. Figure 2-38 is a histogram of the Vshale (or percentage clay) values present within the confining beds. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2.5.6.2 Permeability

Permeability in the Middle Miocene mudstones is very low. Table 2-6 shows measured porosity and permeability derived from MICP tests of Middle Miocene mudstones from the ARCO Well No. A-3 OCS-G-3496. The calculated permeability ranges between [redacted] mD, as shown in Figure 2-41.

[redacted]

The permeability (K15) attributes of the [redacted] to the proposed storage site were analyzed to examine sealing capability. Figure 2-42 is a histogram of the K15 log-based values present within the confining beds. [redacted]

[redacted]

The [redacted] marine shales are extensive and of sufficient thickness to act as regional seals against upward migration of injected CO_2. Upon receipt of a Class VI Permit to Construct, data will be collected, analyzed, and compared with findings in the regional and local study to confirm adequate sealing properties of the [redacted]

2.5.7 *Injection Zone*

Middle Miocene reservoirs across onshore southern Louisiana, similar to the proposed injection formation, provide a range of potential porosity and permeability values. Over depths of 6,500 to 18,000 feet, porosities of Middle Miocene sand range from 20-35% with permeability values of

300 to 1,100 mD (Goddard, 2001). The Lower Miocene reservoir conditions range from 22 to 30% porosity and 100 to 2,500 mD permeability at depths from 10,000 to 17,500 feet.

2.5.7.1 Porosity

Figure 2-43 is a compilation of porosity values of Miocene and Oligocene sandstones in Cameron Parish plotted by depth. A trendline is provided and used to extrapolate potential average porosities within the proposed injection interval. [redacted]

[redacted]

[redacted]

[redacted]

2.5.7.2 Permeability

Figure 2-45 is a compilation of permeability values of Miocene and Oligocene sandstones in Cameron Parish plotted by depth. [redacted]

[redacted]

2.5.8 Lower Confining Zone

2.5.8.1 Porosity

Miocene age marine shale beds, like the Rob L lower confining zone, have low porosity. The Vshale and PHIEST attributes of the two Rob L shale beds in wellbores proximal to the proposed storage site were analyzed to examine sealing capability. Figure 2-46 is a histogram of the Vshale (or percentage clay) values present within the confining beds. [redacted]

[redacted]

[redacted]

[redacted]

2.5.8.2 Permeability

Permeability in the Rob L shale is expected to reflect similar values to the Middle Miocene mudstones examined in the upper confining zone. However, average permeabilities as calculated in [redacted] The log-based estimates are higher than the range of measured permeability (see Table 2-6) values across the Miocene mudstones, as the permeability equation is more applicable to sandstone units. Therefore, similar to the upper confining zone, a permeability value of [redacted] was assumed for the lower confining shale and other intra-reservoir shales.

[redacted]

Based on regional studies and local petrophysical analysis, the marine shale beds mapped within the Rob L are widespread, of sufficient thickness, and composed of favorable mineralogy and associated petrophysical properties (shale volume, effective porosity and permeability) to act as regional seals against the migration of injected fluid.

Upon receipt of a Class VI Permit to Construct, data will be collected, analyzed, and compared with findings in the regional and local study to confirm adequate sealing properties of the Rob L.

2.5.9 Geophysical Survey

2.5.9.1 Reflection Seismic Profiles

Fifteen square miles of three-dimensional (3D) surface seismic data were licensed by Venture Global and included in this interpretation. The boundary of the seismic data license is outlined in blue on Figure 2-50.

[redacted]

[redacted]

2.5.9.2 Velocity control and synthetic seismogram

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Extracts of publicly available gravity data surrounding the proposed injection site from industry papers were reviewed to validate lateral extent of the target intervals interpreted from well correlation and 3D seismic data. Figure 2-54 and Figure 2-56 are regional overview maps referenced from Steven Dutch, Professor Emeritus, Natural and Applied Sciences, University of Wisconsin – Green Bay.

[redacted]

[redacted]

[redacted]

A data set of gravity station measurements from USGS,[19] across the states of Louisiana and Arkansas which covers the proposed CO_2 storage site was also utilized (see Figure 2-55). Although the USGS datapoints encompass a relatively wide-spaced grid (approximately one data point every 9 miles), the captioned grids in Figure 2-56 and Figure 2-57 confirm the regional geologic setting of large quantities of sediment on top of less dense salt structures.

[redacted]

As stated on the USGS Arkansas and Louisiana Isostatic Gravity Anomaly Map webpage:[20]

> The isostatic residual gravity map reflects variations in the Earth's gravity field caused by density variations in the rocks composing the upper part of the Earth's

[19] US Geological Survey, "Arkansas and Louisiana Aeromagnetic and Gravity Maps and Data—A Website for Distribution of Data," Version 1.0, August 2008. Available at https://pubs.usgs.gov/ds/352/. Accessed November 20022.

[20] US Geological Survey, "Arkansas and Louisiana Isostatic Gravity Anomaly Map," Version 1.0, August 2008. Available at https://pubs.usgs.gov/ds/352/arkla_iso.html. Accessed November 2022.

> crust. The Isostatic residual gravity grid was derived from the Bouguer gravity anomaly data by removing the gravitational effect of the compensating mass that supports topographic loads. The thickness of this compensating mass was calculated using averaged digital topography by assuming a crustal thickness for sea level topography of 30 kilometers (18 miles), a crustal density of 2.67 g/cc, and a density contrast between the crust and upper mantle of 0.40 g/cc.

Positive value trends delineate rocks denser than the Bouguer reduction density of 2.67 g/cc, whereas a negative closure such as the -25.6 milligals (mGal) contour in Figure 2-54 result from rocks of lower density (such as salt structures). Although there is a relatively sparse distribution of data points at this offshore location, the contours reflect the proposed CO_2 storage site is in an area absent proximal salt structures, consistent with interpretation of aforementioned well control and 3D seismic reflection data. Therefore, subsequent geological modeling was based on 3D seismic data and available well logs.

2.5.10 *Static Geological Model*

A 3D geological model was created using available 3D seismic data and well logs and this model captured the depth, areal extent and thickness of the target injection zones and confining zones.

The seismic volumes were analyzed to obtain insight into the structural model and for facies interpretation away from well locations. Several methods such as spectral decomposition and color blending, amplitude-based attribute maps and curvature were helpful in identifying fluvial and near shore facies such as channels and oxbow lakes. In addition, the synthetic seismograms generated during the interpretation phase as well as a calculated relative acoustic impedance volume were used to verify that the sands are mostly negative impedance.

The structural framework (Figure 2-58) for the model is from the key horizons interpreted from the 3D seismic [redacted] also interpreted from the 3D seismic as discussed under the Sections "Faults & Fractures." Additional well markers and fine scale conformable layering were then used to further refine the vertical layering of the models resulting in cells with a vertical thickness of [redacted] feet. The horizontal dimensions used to define the cells of the model were [redacted] feet by [redacted] feet.

[redacted]

[redacted]

Furthermore, the seismic volumes were analyzed to obtain insight into facies interpretation away from well locations. The synthetic seismograms generated during the interpretation phase as well as a calculated relative acoustic impedance volume were used to verify that the sands are mostly negative impedance. Thereafter, several seismic attribute analyses were undertaken to model the presence and variation of sands away from existing wells' locations. Examples of amplitude maps generated from the available seismic data are shown in Figure 2-59.

[redacted]

Then lithofacies were interpreted for all wells in the model's area containing a spontaneous potential (SP) or gamma ray (GR) curve. The interpreted facies logs (sands interpreted yellow and shale gray) (see Figure 2-60 "Track labelled Lithofacies" for select wells) were then upscaled for use in the facies property model along with the facies interpretation obtained from the seismic volumes and incorporated into the Geo cellular model.

Facies proportions from well data were honored for each zone in the model. The resulting facies model was then used to condition the property distribution from the previously reviewed estimated porosity logs (see Figure 2-60 "Track labelled PHIEST" for select wells) obtained from the petrophysical analysis.

[redacted]

The property model was generated using the sequential Gaussian simulation algorithm and was loaded to the GEM software for dynamic simulation. [redacted]

[redacted]

2.5.11 Storage Capacity Assessment

Storage capacity within the modeled section of the leased pore space area (see Figure 2-63 - limited to the leased boundary to the North and East, and faults to the South and West) was estimated using the following equation.

CO_2 Storage Mass (Mt[22]) = Net Pore Volume × $\rho CO_2 \times E$

where:

[redacted]

E is the storage efficiency factor [redacted]

The estimated storage capacity of the model site area is about [redacted]

[22] Units: t = metric tonne = 1,000 kg; Mt – Mega tonne = 1 million t.

[23] SRMS Guidelines (Guidelines for Applications of the CO_2 Storage Resources Management System) which was sponsored by the Society of Petroleum Engineers, the World Petroleum Council, the American Association of Petroleum Geologists, the Society of Petroleum Evaluation Engineers, the Society of Exploration Geophysicists, the Society of Petrophysicists and Well Log Analysts, and the European Association of Geoscientists and Engineers, published June 2022.

[redacted]

2.6 Geomechanical and Petrophysical Information [40 CFR 146.82(a)(3)(iv)]

Apart from a density log from [redacted] well, relevant well logs and core measurement data for geomechanical analysis are yet to be acquired. Thus, geomechanical analysis was performed using analog information and established industry assumptions and equations, as discussed in the following sections.

2.6.1 Determination of Vertical Stress (S_v) from Density Measurements

The vertical stress, also known as overburden stress, can be characterized by the pressure exerted on a formation at a given depth due to the total weight of the rocks and fluids above that depth[24]. Vertical stress is calculated with the density data logged [redacted] Table 2-7 shows the overburden gradient, vertical stress, and average densities of the top confining, injection, and lower confining zones from the [redacted] The average bulk density of confining zones was assumed to be [redacted] grams per cubic centimeter (g/cm^3) based on nearby Miocene mudstone samples.

Table 2-7: Calculated Vertical Stresses from [redacted]

Formation	Depth (ft)	Avg Density (g/cm^3)	Avg Density (lb/ft^3)	Vertical Stress (psi)	Gradient (psi/ft)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

2.6.2 Elastic Moduli and Fracture Gradient

Elastic moduli and fracture gradients are determined from laboratory analysis of core samples. Tests are performed on two-inch diameter vertical plugs from each core. Core samples are not available at this time but will be recovered during the drilling of the CO_2 injection well. The core samples will undergo triaxial compressive strength testing to provide the geophysical properties listed in the table below. The Poisson's ratios for the upper and lower confining zones and injection zone have been estimated based on literature and will be updated when laboratory results are available.

Table 2-8: Triaxial Compressive Strength Test Results

Sample Number	Depth (ft)	Zone	Member	Confining Pressure (psi)	Compressive Strength (psi)	Young's Modulus (10^6 psi)	Poisson's Ratio
N/A[(a)]	N/A[(a)]	[redacted]	[redacted]	N/A[(a)]	N/A[(a)]	N/A[(a)]	[redacted]
N/A[(a)]	N/A[(a)]	[redacted]	[redacted]	N/A[(a)]	N/A[(a)]	N/A[(a)]	[redacted]
N/A[(a)]	N/A[(a)]	[redacted]	[redacted]	N/A[(a)]	N/A[(a)]	N/A[(a)]	[redacted]

[24] Society of Exploration Geophysicists (SEG) Wiki: https://wiki.seg.org/wiki/Dictionary:Overburden_pressure

(a) Results are pending the retrieval and lab testing of cores which will occur when the injection well is drilled.
(b) Values have been estimated from literature and may be updated upon the availability of laboratory results.

2.6.3 *Injection Zone Fracture Gradient*

The fracture pressure gradient was estimated using Eaton's equation. This method was created for Gulf Coast sands to determine the fracture pressure of the rock. Eaton's equation is commonly accepted as the standard practice for the determination of fracture gradients. The calculation requires Poisson's ratio ("v"), overburden gradient ("OBG"), and pore gradient ("PG") to determine the required pressure to fracture the injection zone. These variables can be changed to match the site-specific injection zone.

In the absence of site-specific data available, gradients of [redacted] psi/ft[25] and [redacted] psi/ft[26] were assumed for both the overburden and pore gradients, respectively. Sandstones have a wide range of possible Poisson ratios (0.1 – 0.4). Therefore, the literature focused primarily on sandstones that more closely represent the unconsolidated nature of the Miocene sands. Soft sandstones typically have a range of 0.2 – 0.35 (Molina et al., 2016). In 2014, a case study was done to model fracture initiation in poorly consolidated sandstone. The Poisson's ratio for this rock was determined to be [redacted] ([redacted] as representative of the Miocene sands. [redacted]

$$FG = \frac{n}{1 - n}(OBG - PG) + PG$$

[redacted]

Table 2-9: Fracture Gradient Calculation Inputs and Results

Depth (ft)	Zone	Member	Overburden Stress (psi/ft)	Pore Pressure (psi/ft)	Poisson's Ratio	Fracture Gradient (psi/ft)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Per 40 CFR 146.88(a), the maximum allowable pressure is based on the step-rate test results. This test will be conducted upon completion of the CO_2 injection well. If the step-rate test cannot

[25] Jon Jincai Zhang, Applied Petroleum Geomechanics, 2019.
[redacted]

identify a fracture gradient, core analysis will be performed in conjunction with Eaton's method to determine the fracture pressure.

2.6.4 Confining Zone Fracture Gradient

Eaton's equation was also used to estimate the fracture gradient of the confining zones. Pore and overburden gradients were assumed to be [redacted] psi/ft and [redacted] psi/ft, respectively. The confining zones consist of clay rich shales overlying and underlying the injection zone. These shales have a typical range for Poisson's ratio of 0.28 – 0.43 (Molina et al., 2016). As seen in Figure 2-64, an increase in clay content tends to increase Poisson's ratio of the rock (Zhang and Bentley 2005).

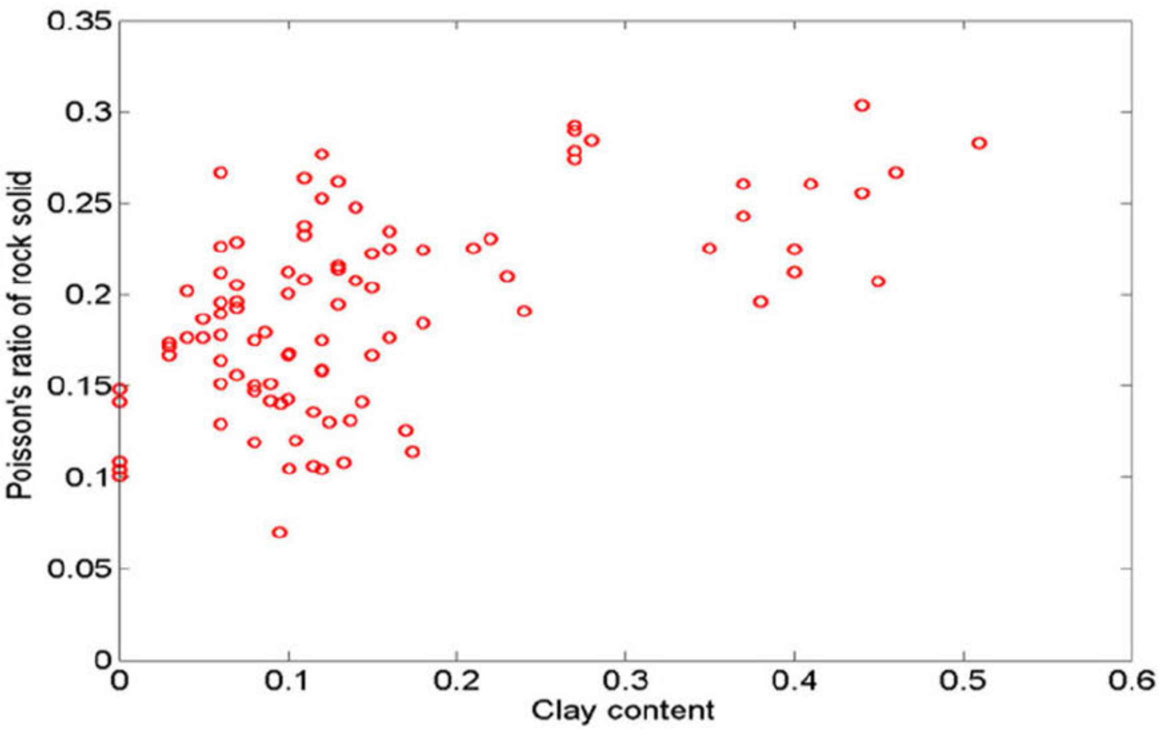


Figure 2-63: Clay Content vs Poisson's Ratio of Solid Rock (Zhang and Bentley 2005)

Based on this research, a value for Poisson's ratio of [redacted] was chosen as a conservative estimate to ensure that the confining rock does not fracture during injection. Although these shales are considered "clay rich", a lower Poisson's ratio was chosen to be more conservative. Using these values in the equation below, a fracture gradient of [redacted] psi/ft was calculated. Applying a [redacted]% safety factor provides a maximum allowable pressure of [redacted] psi/ft.

Table 2-10: Upper Confining Zone Fracture Gradient Calculated using Triaxial Test Results and Eaton's Equation

Depth (ft)	Zone	Member	Overburden Stress (psi/ft)	Pore Pressure (psi/ft)	Poisson's Ratio	Fracture Gradient (psi/ft)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

2.7 *Seismic History [40 CFR 146.82(a)(3)(v)]*

An important consideration in the design and development of all new injection well projects is the determination of the potential of injection activities to induce a seismic event. This effort includes:

1. Identification of historical seismic events within proximity to the project
2. Determination of operational influences on nearby faults

2.7.1 *Identification of Historical Seismic Events*

The target area for CO_2 sequestration lies in an area of low seismic risk according to available USGS data – see Figure 2-65 – map extract[27] from USGS Earthquake database. According to USGS hazard rating, the area is in a zone with rating of 2 to 4 compared to other regions with rating as high as 80 (red colored contour area in the US map insert in Figure 2-65).

[27] Map was extracted from the USGS Earthquake database (https://earthquake.usgs.gov/earthquakes/maps on February 17, 2023.

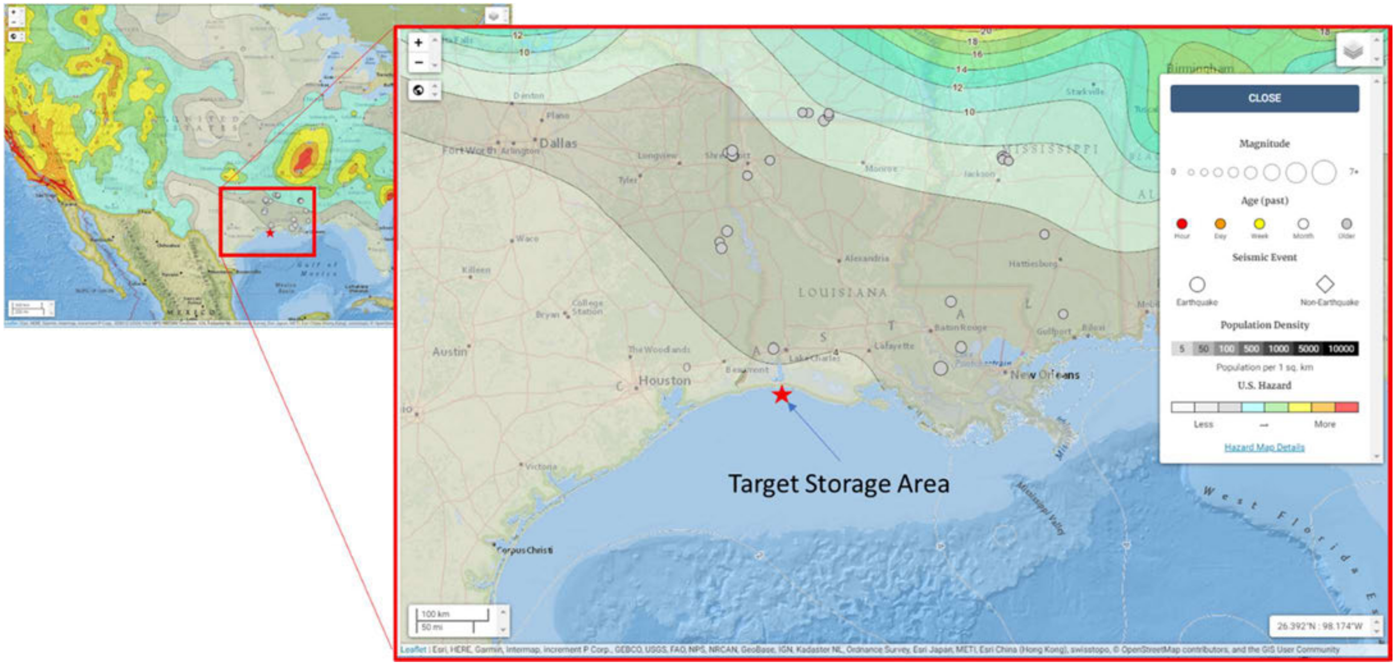


Figure 2-64: USGS Earthquake Hazard Map (extracted February 2023) (https://earthquake.usgs.gov/earthquakes/maps. Also includes an overlay of earthquake occurrence in the State of Louisiana.

The hazard map, according to USGS captures "the probability of a large earthquake within 50 kilometers (~31 miles) of a specific location in United states over a certain period. The calculation is based on the latest available information from seismic hazards."[28]

According to the same USGS database,[29] no seismic events greater than a 2.0 magnitude have been recorded within [redacted] miles of the proposal well site since 1900 (see Figure 2-66 and Figure 2-67).

[28] https://www.usgs.gov/faqs/.
[29] https://earthquake.usgs.gov/earthquakes/search/.

[redacted]

[30] Available at: https://earthquake.usgs.gov/earthquakes/search/. Accessed November 2022.

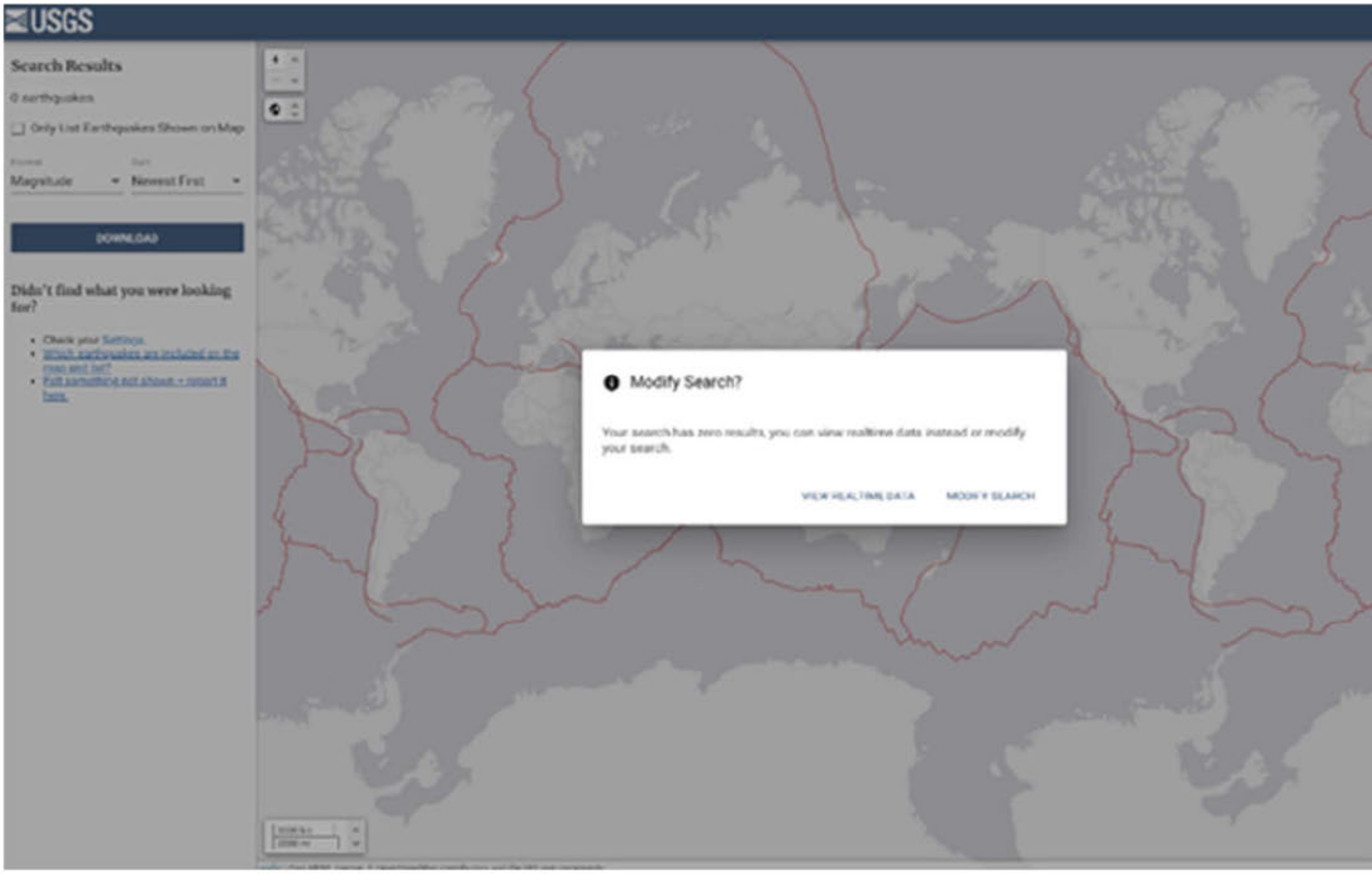


Figure 2-66: Earthquake Search Results from the USGS Earthquake Catalog[31] [Search box indicates zero results from Search parameters shown in Figure 2-66] Based on USGS's historical record compiled by the Louisiana Geological Survey (Stevenson and McCulloh, 2001), two earthquakes have been recorded [redacted] Both earthquakes had a magnitude of 3.8.

[31] Available at: https://earthquake.usgs.gov/earthquakes/search/. Accessed November 2022.

[redacted]

Overall, Stevenson and McCulloh noted that earthquakes in the State of Louisiana tend to be of low magnitude and low frequency.

2.7.2 Influence of Nearby Faults

EPA regulations require that a complete understanding of the extent and location of the resultant injection plume be determined and identified. [redacted] Low frequency and magnitude of historical seismic events, and low risk of earthquake hazards, based on available information to date suggest potential seismicity, if any, in the area will not interfere with containment of CO_2.

2.8 Hydrologic and Hydrogeologic Information [40 CFR 146.82(a)(3)(vi), 146.82(a)(5)]

The proposed CS004 Well 001 is approximately [redacted] miles off the coast of Cameron Parish. These public domain information sources and well logs from legacy wells in the vicinity of the proposed injection well have been used to assess the base depth of USDW in the AoR. The legacy wells were drilled previously to explore for oil and gas, but penetrated water bearing shallow intervals.

The proposed CO_2 sequestration well is close to the Chicot Aquifer system that serves as the source for water for the Cameron Parish (Figure 2-69). The Chicot Aquifer is composed of unconsolidated silt, sand, and gravel interbedded with layers of clay. The depositional environment of these layers is likely to have been estuarine, tidal marsh, or stream-based, with deposits dipping and thickening toward the Gulf of Mexico. Recharge to the aquifer system occurs via precipitation at locations where the system outcrops to the north; discharge is primarily by water withdrawals from wells. Due to withdrawals for public supply, industry, and irrigation to the north of the AoR, groundwater flow direction has been to the north and northeast.

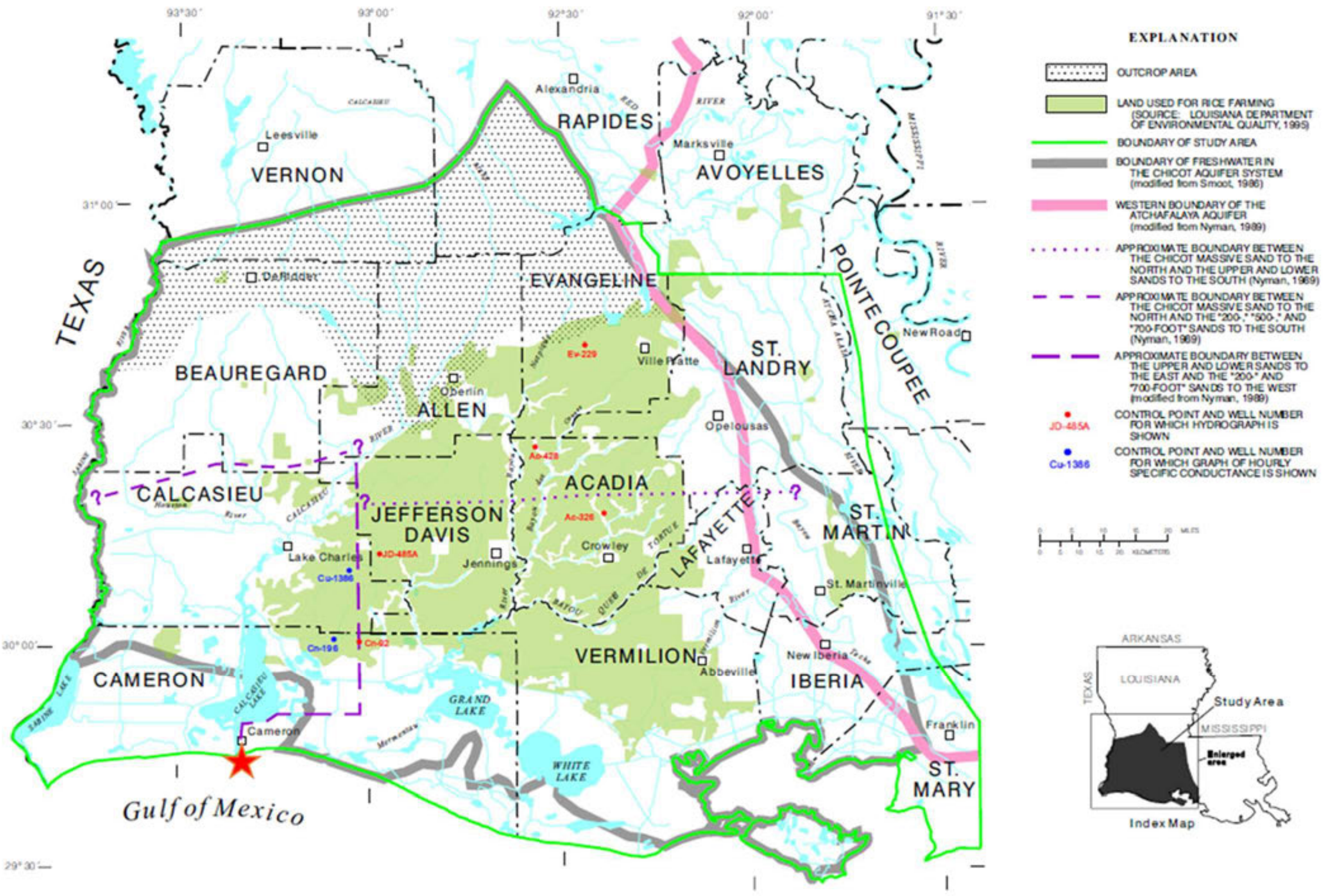
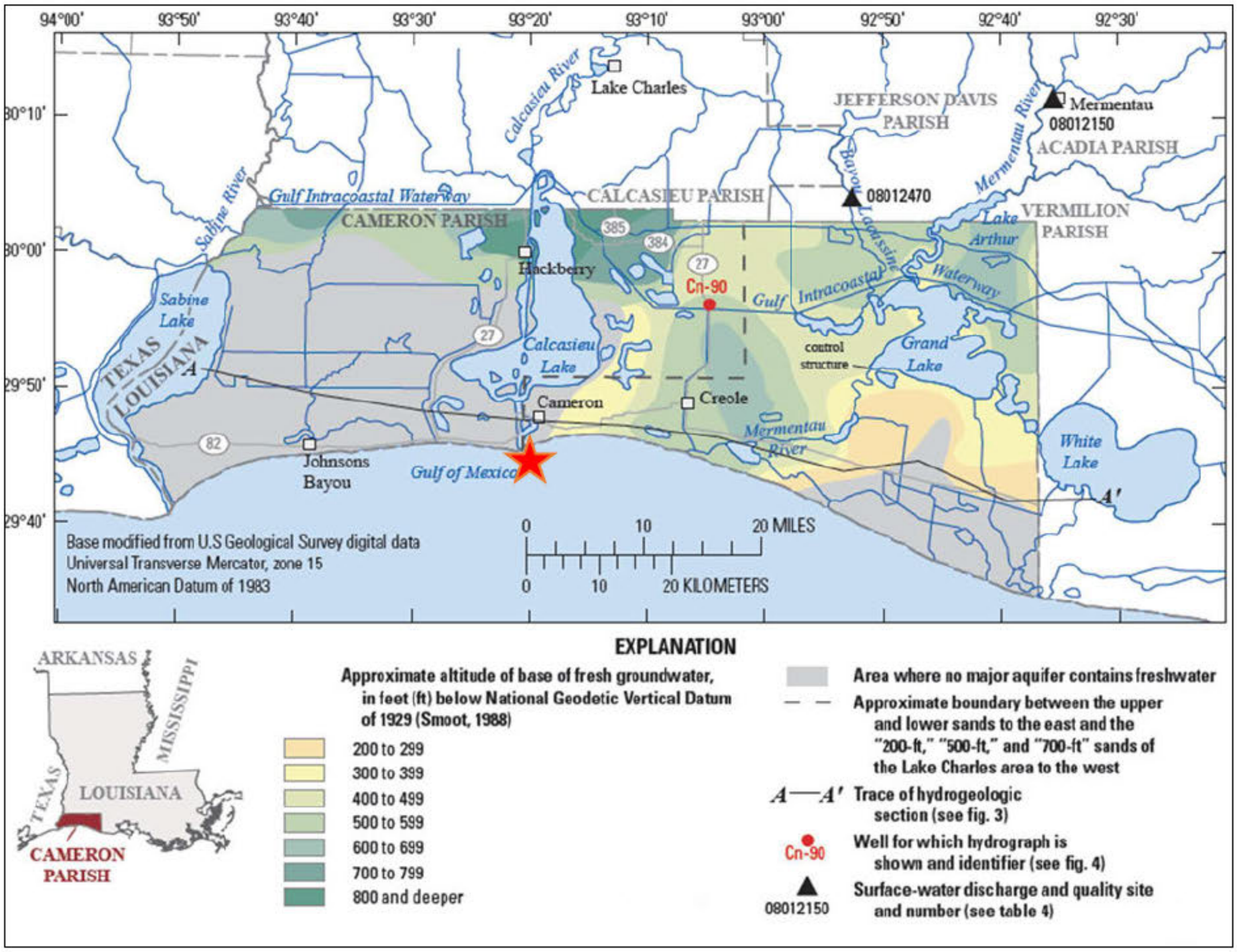


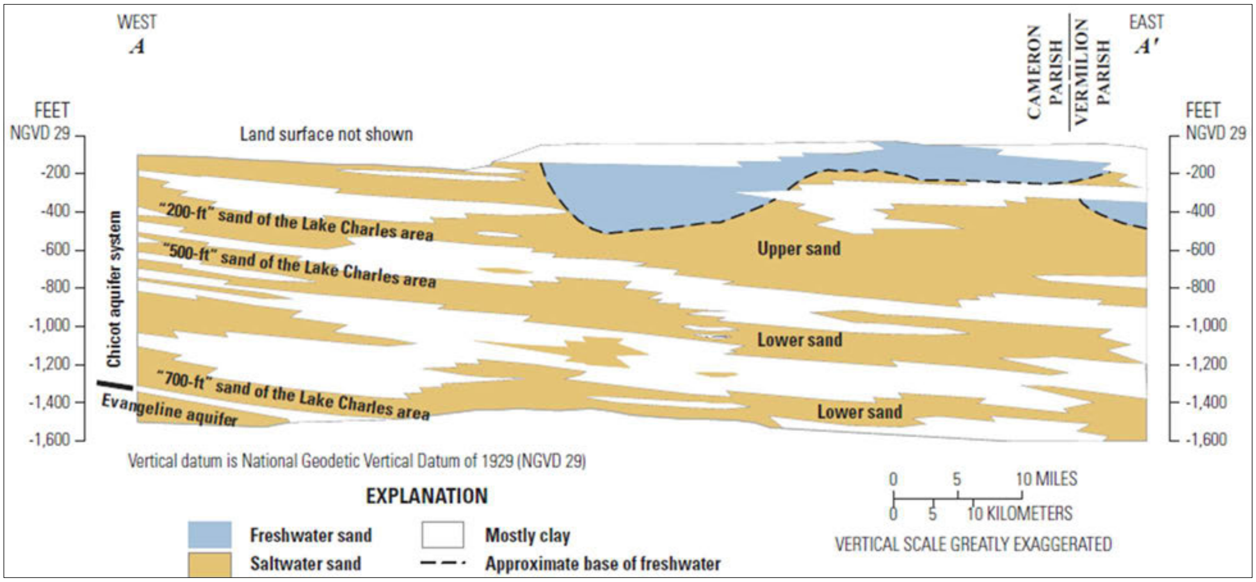
Figure 2-68: Location of the CO_2 Sequestration well (red star) relative to the Chicot Aquifer System (Green boundary) (from USGS, Lovelace et al., 2004 "Withdrawals, Water Levels, and Specific Conductance in the Chicot Aquifer System in Southwestern Louisiana, 2000-03")

The aquifer is made up of six sand units: shallow sand, upper sand, lower sand, "200-Foot Sand," "500-Foot Sand," and "700-Foot Sand," according to the USGS Water Resources of Cameron

Parish, Louisiana.[32] However, due to underlying features, these sand units exist at varied depths across Louisiana. The terms "200-Foot Sand," "500-Foot Sand," and "700-Foot Sand" refer to analogous sand bodies rather than the actual depths and are used here for consistency. The Upper Sand, "200-Foot Sand," and "500-Foot Sand" are the primary sources of fresh groundwater in southwest Louisiana, including Cameron Parish. However, no major aquifer contains fresh groundwater in the southwestern part of the parish, to the west of the project's AoR, shown by the red star in Figure 2-70.



[32] US Geological Survey, "Water resources of Cameron Parish, Louisiana," Fact Sheet 2013–3076, March 2014. Available at: https://pubs.usgs.gov/fs/2013/3076/pdf/fs2013-3076.pdf. Accessed November 2022.



Generalized west-to-east hydrogeologic section through southern Cameron Parish, Louisiana.

Figure 2-69: Water Resources Map (from USGS, Water Resources of Cameron Parish, Louisiana)

2.8.1 Upper Sand

The upper sand is present in the eastern part of the parish. The upper sand contains freshwater underlain by saltwater in Cameron Parish except along the southeastern coast where no freshwater is present. In Cameron Parish, the upper sand is stratigraphically equivalent to, and continuous with, the "200-ft" sand and generally contains freshwater underlain by saltwater in the northern and eastern areas of the parish.

2.8.2 "200-Foot Sand"

The "200-Foot Sand" generally consists of fine to medium sand with coarse grained sand and sometimes gravel at its base where the zone is thickest. This layer generally dips southward at approximately 10 feet per mile. The "200-Foot Sand" occurs from approximately 180 to 380 feet below the surface according to water wells drilled in the vicinity of the AoR. Regionally, it supplies water for irrigation, industrial, public supply, and domestic purposes. Rural users also obtain groundwater from the Cameron Parish Water Works Districts 1 or 6.

The "200-Foot Sand" generally contains freshwater (salinity of 250 mg/l chloride concentration or ~832 mg/l NaCl concentration) underlain by saltwater in the northern and eastern areas of the parish. West of Calcasieu Lake, this unit contains only saltwater. Based on median values of chemical constituents, freshwater from the aquifer is moderately hard, but does not exceed the EPA's Secondary Maximum Contaminant Levels for drinking water.[33]

[33] US Geological Survey, "Water Resources of Cameron Parish, Louisiana," Fact Sheet 2013–3076, March 2014. Available at: https://pubs.usgs.gov/fs/2013/3076/pdf/fs2013-3076.pdf. Accessed November 2022.

2.8.3 "500-Foot Sand"

The "500-Foot Sand" is a heavily used unit in Cameron Parish, particularly to the north and east of Calcasieu Lake. It is composed of fine to coarse grain sand fining upward and grades to deltaic deposits. The "500-Foot Sand" is hydraulically separated from the "200-Foot Sand" by approximately 200 feet of predominantly clay material, which serves as a barrier to groundwater flow migration between the two sand units. At the proposed CS004 Well 001, the "500-Foot Sand" occurs at an approximate depth of [redacted] feet to [redacted] feet below surface. Similar to the "200-Foot Sand," the "500-Foot Sand" contains freshwater underlain by saltwater in the northern and central areas of the parish, but solely saltwater throughout the majority of the rest of the parish.

However, approximately [redacted] miles from the proposed injection well, only one water well (Well No. [redacted] drilled to a depth of [redacted] feet) identifies the Chicot aquifer's "500-Foot Sand" as its primary water source target. The well's specified use is [redacted], and it is located adjacent to the [redacted]

According to the USGS study of 2014 (Lovelace et al.), the maximum sampled salinity from the Chicot aquifer in the Cameron Parish was 7,744 ppm NaCl (equivalent to 12,100 uS/cm specific conductance).

According to the LDNR Water Wells by Parish Database,[34] numerous wells have been drilled along the coastal plain in southwest Louisiana (Figure 2-71). These wells supply water for a variety of functions, including domestic, public supply, irrigation, and industrial uses. Depths of most of the wells vary from shallow (10 feet to 20 feet) monitor wells to much deeper (200 feet to 300 feet) supply wells. All but a few of these deeper wells target the "200-Foot Sand" or the upper sand. The closest well to the proposed CO_2 sequestration well is about [redacted] miles to the [redacted], drilled only to [redacted] and currently plugged and abandoned. This well location is [redacted] miles ([redacted]) from the AoR. The closest active USDW well (Haymark Estate SL 5366Z No, 023) for domestic or irrigation with a total depth of [redacted] ft is approximately [redacted] miles to the [redacted] and is [redacted] ft from the AoR. The approximate location of this well in shown on the map in Figure 2-71 and in a surveyor's plat in Appendix 1.

[34] Louisiana Department of Natural Resources, SONRIS Data Portal, "Water Wells by Parish" Database. Available at: https://sonlite.dnr.state.la.us/pls/apex/f?p=108:2086:1488431081405::NO:2086. Accessed November 2022.

[redacted]

2.8.4 Base of a Potential USDW Offshore from Well Logs

Well resistivity logs for two nearby offshore wells have identified the base of a potential USDW in the vicinity of the target CO_2 sequestration well (Figure 2-72). [redacted]

[redacted]

There is no water sample measurement of the potential USDW interval in the vicinity of the proposed CO_2 sequestration well; however, it is assumed to be less than 10,000 mg/l NaCl, similar to the Chicot aquifer. The top of the proposed upper injection interval is approximately [redacted] ft below the base of estimated USDW.

2.8.5 *Injection Zone Water Chemistry / Properties*

There is no measured water sample analysis in the offshore well in the vicinity of the CO_2 sequestration well. Review of measured data from the USGS National Produced Waters Database,[35] filtered to include only Miocene series reservoir water samples in Texas and Louisiana Gulf Coast Basin only Texas and Louisiana, suggest salinity range from 50,000 to 150,000 mg/l over the target interval of injection as shown in Figure 2-73.

[35] https://www.sciencebase.gov/catalog/item/59d25d63e4b05fe04cc235f9.

[redacted]

In addition, the U.S. Geological Survey National Produced Waters Geochemical Database[36] was used to identify nearby fluid samples from Miocene series sands. Figure 2-74 identifies the location relative to the proposed storage site location. Samples from [redacted]. Sample data are provided in Table 2-11.

[redacted]

The identified samples are about [redacted] miles from the proposed site and were sampled at depths below the proposed injection interval. Hence, data from Land, Macpherson and Mack, 1988 obtained

[36] Available at https://eerscmap.usgs.gov/pwapp/. Accessed November 2022.

from Miocene reservoirs in South Marsh Island and Eugene Island, Jefferson Parish, offshore Louisiana, were also reviewed (Table 2-12).

[redacted]

The data were filtered to include only samples [redacted] (and total dissolved solids calculated form the data), resulting in [redacted], as shown in Table 2-13. Total dissolved solids (TDS) in Table 2-13 were estimated from the reported the individual ions concentrations.

[redacted]

Overall, TDS from the Land, Macpherson and Mack data range ~47,000 to 162,000 mg/l, which is comparable to the range from USGS National Produced Waters analyses database for the Miocene reservoirs. A comparison of the two datasets indicates density, chlorides, calcium, and silica are similar, though sulfate, bicarbonate and iron are higher in the USGS sample data set. Furthermore, salinity manually estimated from resistivities and SP well logs (raster images) from legacy wells in the vicinity of the CO_2 sequestration well range ~60,000 to 130,000 mg/l.

Therefore, an average salinity of [redacted] mg/l was assumed (based on the range from analog data from public domain databases and well logs) in the GEM modeling for the target injection intervals. This is well above the maximum salinity for the definition of USDW of 10,000 mg/l total dissolved solids per 40 CFR 144.3.

2.9 Geochemistry [40 CFR 146.82(a)(6)]

The CO_2-rich gas is planned to be injected at temperatures and pressures above critical values, which will result in a supercritical phase, lighter than formation brine. The supercritical CO_2 will mix with in-situ reservoir brine and buoyantly rise within the aquifer to accumulate beneath the seal rock (Lindeberg and Wessel-Berg, 1997). The CO_2-brine will react with seal rock brine and diffuse into the seal rock. CO_2 that diffuses upward will react with seal rock minerals (Hildenbrand et al., 2002). To simulate the slow diffusion, geochemical interactions at the seal rock-fluid-CO_2 interface were modeled.

There is currently no measured geochemical data in the proposed area of the CO_2 injection well. Therefore, geochemical properties have been modelled using the USGS PHREEQC[37] software

[37] https://www.usgs.gov/software/phreeqc-version-3.

using water properties from public domain as discussed in the following section. Water samples are planned to be taken for water analyses when the proposed well is drilled to update the geochemical model.

2.9.1 Baseline Geochemistry

As described in the Injection Zone Water Chemistry section, reservoir fluid characteristics of Middle Miocene sandstones were estimated from two sources of Miocene reservoir fluid analyses (Land et al., 1988 and the USGS National Produced Waters Geochemical Database v2.3). The estimated reservoir brine composition is featured in the second column of Table 2-16. This table will be updated with measured data when fluid analyses are available from the injection interval. The upper confining and lower confining shale fluid chemistries are geochemically modelled by equilibrating reservoir fluid chemistry with the seal rock mineralogy, a conventional technique to approximate pore-water chemistry of argillaceous rocks (Gaus et al., 2005).

The USGS PHREEQC Interactive software is a geochemical simulator of single-phase one-dimensional reactive transport, batch-reaction equilibrium or kinetic queries. The estimated reservoir fluid chemistry is input as elemental concentrations (milligrams/Liter) at temperatures expected at the respective depths of the reservoir-seal interfaces. Total water mass in a one (1) cubic meter (m^3) rock-brine system is calculated from reservoir fluid density and porosity Table 2-15 displays parameters of the two seal equilibrium simulation inputs Table 2-16.

[redacted]

2.9.2 Simulated Reservoir-Brine-Gas Interaction

The interaction between the gas injectate, reservoir rock, and reservoir brine is modeled through PHREEQC batch reaction. The reservoir brine sample is assumed to be in equilibrium with the reservoir rock. Feed stream gas molecules defined in the Lawrence Livermore National Laboratory (LLNL) thermodynamic database[38] are included in the model at the temperature and pressure expected near the top of the injection interval [redacted]

[38] https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/DE91017525.xhtml.

Table 2-14: PHREEQC Upper and Lower Confining Zone Input Parameters

Parameter	Upper Confining Zone [redacted]	Lower Confining Zone [redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	

[redacted]

[redacted]

2.9.3 *Simulated Seal-Brine-Gas Interaction*

The seal-brine-gas interactions were modeled in PHREEQC batch reactions. The model assumes a 1 m^3 seal rock-simulated seal brine sample flushed with 1,000 moles of injected gas. The results from the [redacted] shale simulations are displayed in Table 2-17.

The pH of both confining units' brine solutions decreases due to the injection of CO_2 gas. The mass of both units' brine solution decreases, due to mineralization. [redacted]

[redacted]

2.10 Other Information (Including Surface Air and/or Soil Gas Data, if Applicable)

2.10.1 Site Evaluation of Mineral Resources

Baseline surface air and soil gas information do not exist yet in the target sequestration area. Other subsurface geochemical considerations include the potential for mineral or hydrocarbon resources beneath the proposed CO_2 storage site (see Figure 2-69). [redacted]

[redacted]

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

[redacted]

[redacted]

2.11 Site Suitability [40 CFR 146.83]

Overall, the proposed CO_2 injection site meets the suitability requirements set forth at 40 CFR 146.83 as follows:

The proposed CO_2 injection well CS004 Well 001 targets injection into the Middle and Lower Miocene age sandstones, which based on available 3D seismic data, well logs from legacy wells in the vicinity of the injection site and also regional geological reports are fluvio-deltaic sandstones at depth range of approximately [redacted] Based on review of the available information, data from legacy wells, regional analogs, and public geological reports, the target Middle and Lower Miocene sandstones have sufficient porosity (approximately [redacted]%), permeability ([redacted] lateral continuity and are of sufficient depth and thickness to store the proposed amount of CO_2. These reasonably porous and permeable sandstones allow for

CO_2 plume migration, but, based on modeling the plume and pressure front (AoR), are contained with the site designated area.

The confining zones at this designated site comprised of Text W (upper confining zone), Amph B (confining zone between the lower and upper injection intervals) and Rob L (bottom confining zone) are regionally continuous shales based on geological reports. In addition, well logs from legacy wells in the vicinity of the site and analog data confirmed these shales or mudstone beds are laterally continuous across the AoR, greater than [redacted] ft in thickness and have low permeability (approximately [redacted] mD assumed for modeling, analog data suggest much lower permeability) to serve as confining zones.

Potential CO_2 migration pathways in the Middle and Lower Miocene injection zones within the AoR are identified, located, characterized, modeled, and determined to be of low risk. [redacted]

Wellbores within the AoR are identified, located, and reviewed for potential migration pathways and are determined to be of low risk.

The proposed injection site and AoR are in an area with low frequency and magnitude of historical seismic events, and low risk of earthquake hazards based on available information to date suggest potential seismicity, if any, in the area will not interfere with containment of CO_2.

Furthermore, there is low risk of CO_2 migration or fluid displacement to the USDWs. The top of the proposed upper injection interval is about [redacted] ft below the base of estimated USDW, and there are several regionally continuous shales between the top confining zone (Text W) and base of estimated USDW. The closest well to the proposed CO_2 sequestration well is about [redacted], drilled only to [redacted] ft and is currently plugged and abandoned. This well location is approximately [redacted] miles from the AoR. The closest active USDW well is approximately [redacted] miles to the [redacted] of the proposed injection well, has a total depth of [redacted] ft and is [redacted] miles from the AoR.

The estimated storage capacity of the model site area (limited to the leased boundary [redacted]) is about [redacted] Mt, determined from the geological model and CO_2 properties from the simulation model. The storage capacity is sufficient to receive target total storage of approximately 30 Mt in the CS004 Well 001.

Upon issuance of the Class VI Permit to Construct, additional data will be collected and assessed to ensure the site remains low risk for CO_2 injection and storage.

3 AoR and Corrective Action

Module 2 Area of Review and Corrective Action Plan of this Application has been uploaded to the GSDT provides a comprehensive description of the computer modeling approach and its results. The modeling delineated the AoR. Legacy wells in the area that need corrective action have been identified. This work satisfies the requirements of 40 CFR 146.82(a) and 40 CFR 146.84(a), (b) and (c) [LAC 43:XVII.3607 and LAC 43:XVII.3615.B, respectively].

Based on the geological model described above in the “Site Characterization” section, a dynamic model of approximately the eastern half of the leased pore space was prepared using Computer Modelling Group’s (CMG’s) GEM 2022.30 simulator (GEM). GEM utilizes compositional methods with equations specific to CO_2 to effectively model and simulate plume behavior within the injection intervals. All types of trapping mechanisms were addressed in the model, except very long-term geochemical trapping.

The specifics of the injection quantities and injection intervals were used to define the extent of both the CO_2 plume and the pressure front where fluid pressures are sufficient to force fluids into a USDW. The modeling shows that both the plume and pressure front would remain within the leased pore space and there is no impact on USDWs. The AoR and Corrective Action Plan module is fully illustrated with maps, cross-sections, tables and charts. The map below shows the AoR.

[redacted]

[redacted]

Information is also provided in the AoR and Corrective Action Plan module for [redacted] wells that require or may require corrective action, including details of the proposed corrective action. [redacted]

Details regarding the criteria that will trigger a re-evaluation of the AoR are included with the relevant schedule.

Six files have been uploaded.

- VG_Cameron_2_AoR_and_CA_Plan.pdf
- VG_Cameron_2_AoR_and_CA_App1.zip
- VG_Cameron_2_AoR_and_CA_App2.dat
- VG_Cameron_2_AoR_and_CA_App3.dat
- VG_Cameron_2_AoR_and_CA_App4.pdf
- VG_Cameron_2_AoR_and_CA_App5.pdf

AoR and Corrective Action GSDT Submissions

GSDT Module: AoR and Corrective Action
Tab(s): All applicable tabs

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☒ Tabulation of all wells within AoR that penetrate confining zone ***[40 CFR 146.82(a)(4)]***
☒ AoR and Corrective Action Plan ***[40 CFR 146.82(a)(13) and 146.84(b)]***
☒ Computational modeling details ***[40 CFR 146.84(c)]***

4 Financial Responsibility

Module 12 Financial Responsibility has been completed in compliance with the requirements of 40 CFR 146.85. Venture Global is providing financial responsibility using appropriate financial instrument(s) (40 CFR 146.85(a)(1)(v)) to cover the costs of: corrective action, emergency and remedial response, injection well plugging, post injection site care and site closure. The module provides the estimated costs for each of the activities mentioned. The cost estimates will be re-evaluated every year on the anniversary of the establishment of the appropriate financial instrument(s) and the amount of the appropriate financial instrument(s) will be adjusted, upwards or downwards, if necessary.

The Financial Responsibility module also provides the assurance required by 40 CFR 146.82(a)(14) [LAC 43:XVII.3607.C.2.m].

One file has been uploaded.

- VG_Cameron_12_Financial_Responsibility.pdf

Financial Responsibility GSDT Submissions
GSDT Module: Financial Responsibility Demonstration ***Tab(s):*** Cost Estimate tab and all applicable financial instrument tabs Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Demonstration of financial responsibility ***[40 CFR 146.82(a)(14) and 146.85]***

5 Injection Well Construction

The schematic for CS004 Well 001 is shown in Figure 5-1, indicating well construction data such as hole sizes, casing setting depths, casing sizes, planned mud weights, as well as completion details such as tubing size, packer and packer fluid.

[redacted]

5.1.1 Proposed Stimulation Program [40 CFR 146.82(a)(9)]

As of the date of this Application, no formation stimulation is expected to be needed. If the need for formation stimulation is identified in the future (e.g., based on core samples or testing in the proposed injection well), Venture Global will comply with the information and approval requirements set out in 40 CFR 146.91(d)(2) and 40 CFR 146.82(a)(9) [LAC 43:XVII.3629.A.2 and LAC 43:XVII.3607.C.2.h], including that any such stimulation will not interfere with containment.

One file has been uploaded.

- VG_Cameron_9_Stimulation_Program.pdf

5.1.2 Construction Procedures [40 CFR 146.82(a)(12)]

The following is a well construction procedure for the new CO_2 injection well, CS004 Well 001, shown in Figure 5-1 and provides details on well construction materials, downhole stress management and maintenance of mechanical integrity of the well.

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

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

[redacted]	[redacted]

5.2 *Prevention of fluid movement*

The current plan to prevent the movement of fluids into and out of the potential USDWs, with a prognosed bottom at [redacted] TVD, is to isolate it behind a [redacted] surface casing that would be fully cemented up to surface. A [redacted] open hole is currently planned to be drilled to [redacted] TVD + rathole; this section depth is [redacted] below the prognosed bottom of the potential USDWs. A cement bond log will be run inside the [redacted] surface casing after its installation to verify cement bond integrity.

5.3 *Testing and monitoring devices*

Casing ported downhole gauges, fiber optic cable and tubing encapsulated conductor will be secured to the long string using clamps and cemented in place.

5.4 Contingency Plans

Real-time surveying using measurement-while-drilling (MWD) tools help control unintended wellbore inclination build-up and to perform course correction, if necessary, in real time.

A contingency fishing kit is planned to be readily available on the rig to recover parted drillstring sections, should such events occur during well construction.

Contingency plans for mud and cement loss prevention, and mitigation will be implemented, should losses occur.

- Mud Loss Contingency: Lost circulation material (LCM hereafter) would be added to the borehole as a loss curing agent. Background LCM in drilling mud is also planned as a contingency measure, to impart loss curing properties to drilling mud.
- Cement Loss Contingency: Remedial cementing in the form of contingency shoe squeezes will be performed rectify a wet shoe, when needed. A contingency "top job" using a tremie pipe/macaroni pipe is a means to remedy shallow cement losses due to which cement behind a casing does not reach the surface.

5.5 Protection of Potential USDW

Water-based mud in the [redacted] to [redacted] ppg range is currently planned for drilling the [redacted] open hole section, to maintain hydrostatic balance with the potential USDW. The potential USDW at the current well location is planned to be fully isolated behind a [redacted] casing, cemented up to surface.

5.6 Formal Standards

Major applicable standards are listed below:

1. For conductor/drivepipe: API Specification 5L, Line Pipe.
2. For seamless medium carbon casing: API Specification 5CT, Casing and Tubing, and ISO 11960, Steel Pipes for Use as Casing or Tubing for Wells.
3. For seamless chrome alloy casing, tubing, and packer materials: API Specification 5CRA, Specification for Corrosion-resistant Alloy Seamless Tubes for Use as Casing, Tubing, and Coupling Stock, and ISO 13680, Corrosion-resistant Alloy Seamless Tubular Products for Use as Casing, Tubing, Coupling Stock and Accessory Material — Technical Delivery Conditions.
4. For cements placed in wells: API Specification 10A Cements and Materials for Well Cementing.
5. For casing centralizers: API Specification 10D Casing Bow-Spring Centralizers and API Technical Report 10TR-5 Methods for Testing of Solid and Rigid Centralizers.

5.7 Well Materials Compatibility

Water-based mud chemistry and non-damaging polymer mud chemistry that are currently planned for this well are compatible with formations fluids at the chosen well location.

The annulus between tubing and casing above the packer will be filled with sodium-chloride ([redacted] lb/gal) with corrosion inhibitor. The annular fluid has a specific gravity of [redacted] and a hydrostatic head of [redacted] psi/ft.

5.8 Casing and Cementing

When successive casings strings are run into a well at every casing point, they experience thermal expansion, commonly known as "casing stretch." This casing stretch increases required fluid and cement volumes (when compared with theoretical volumetrics at ambient temperature) and necessitates a casing tally adjustment followed by a volumetrics update.

Cement curing duration is reduced at elevated geostatic temperatures at successive casing settings. Hence, cement recipe chemical adjustments are made to provide sufficient time to be able to safely pump cement into place behind casing, by delaying the onset of curing at every casing point.

The strength of chosen casings – diameter, weight, grade and connection – are sufficient for the life of the injection project. Casing corrosion can lead to loss of wall thickness over time, which in turn decreases casing strength.

Cementing details are tabulated below.

Hole Section	Cement Type	Depth (ft)	Density (ppg)	Sacks	Excess %	Vol (bbl)	Yield (cf/sack)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Notes:

[redacted]

5.9 Mechanical Integrity Verification

Casing strings will be pressure-tested as per 40 CFR 146.89 [LAC 43:XVII.3627] to validate their mechanical integrity. Cement integrity of every cemented casing will be documented by a cement-bond-log (CBL). A good cement bond log of the [redacted] surface casing through the potential USDW is sufficient validation that the potential USDW has been successfully isolated from the wellbore.

Table 5-1. Casing details.

Casing String	Casing Depth Interval and Units	Borehole Diameter	Wall Thickness	External Diameter	Casing Material (e.g., weight/ grade/ connection)	String Weight [redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Note: 1) 1 kip = 1000 lb.

5.10 Tubing and Packer

Table 5-2. Tubing and packer details.

Material	Setting Depth Interval and Units	Tensile Strength (ksi)	Burst Strength (psi)	Collapse Strength (psi)	Material Description (e.g., weight/grade/connection)
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

6 Pre-Operational Logging and Testing

The pre-operational logging and testing planned for CS004 Well No. 01 are set out in detail in the Module 8 Pre-Operational Logging and Testing uploaded to the GSDT. Cores will be taken in the [redacted] Middle and Lower Miocene injection intervals. Once the well has been drilled to total depth in the base seal, a comprehensive suite of open hole logs will be run to provide information about the petrophysical properties of the formation. After the long-string casing has been set, several cased hole logs will be run to assess the quality of the cement bond, the "roundness" of the casing, and to identify the location of the fiber optic cable.

Prior to the commencement of CO_2 injection, Venture Global will conduct a step-rate injectivity test to measure the fracture gradient of CS004 Well No. 01 in compliance with 40 CFR 146.87(d)(1) [LAC 43:XVII.3617.B.4.a] and 40 CFR 146.87(e)(3) [LAC 43:XVII.3617.B.5.c]. A bottomhole pressure gauge and bottomhole temperature gauge will be run to the total depth of the wellbore, and a continuous readout gauge will also be installed. Initial bottomhole pressure and bottomhole temperature readings will be measured prior to injection.

The Pre-Operational Logging and Testing module also describes the mechanical integrity tests (MITs) that will be carried out prior to injection.

One file has been uploaded.

- VG_Cameron_8_Pre-Operational_Testing.pdf

Pre-Operational Logging and Testing GSDT Submissions
GSDT Module: Pre-Operational Testing ***Tab(s):*** Welcome tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ Proposed pre-operational testing program ***[40 CFR 146.82(a)(8) and 146.87]***

7 Well Operation

Venture Global plans to inject 1 Mtpa of CO_2 into CS004 Well No. 01. The source of the CO_2 stream will be the Calcasieu Pass and CP2 LNG facilities.

The CO_2 will be injected, and remain, in a super-critical state through the life of the project. The reservoir properties of the Miocene sands (high porosity and high permeability) allow for a pseudo-infinite acting reservoir with the ability to absorb the injected CO_2 and relieve pressure quickly. A periodic recompletion strategy will be used to maximize utilization of pore space for CO_2 sequestration. Starting from the bottom of the well, in the deepest injection interval, CO_2 will be injected for a discreet period. No other portion of the gross injection interval will be opened during these injection periods. After a certain amount of time, the injection into that interval will cease, a plug will be set to isolate that zone, and additional perforations will be added to the subsequent shallower injection interval as defined by reservoir modeling results. This sequence is anticipated to be repeated [redacted] times over the life of the project (for a total of [redacted] injection stages) until the upper confining horizon has been reached. Direct and indirect monitoring of surface and downhole parameters are included in the Module 3 Testing and Monitoring Plan.

Except during stimulation, surface injection pressures will be limited such that bottom hole pressure does not exceed 90% of the fracture pressure of the injection reservoir. In no case, however, shall injection pressure initiate fractures or propagate existing fractures in the confining zone or cause the movement of injection or formation fluids into a USDW. Table 7-1 details pressures anticipated for each injection interval. Note that a 90% safety factor has been used to determine Maximum Wellhead Injection Pressure for each interval. PROSPER and TUBEMOVE software packages were used to calculate wellhead and annular pressures.

Table 7-1: Pressure summary for each injection interval

Parameters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Injection Interval, ft (TVDSS)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Net Injection Interval, ft	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Max Injection Pressure (surface) - psi	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Max Injection Pressure (downhole) - psi	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avg Injection Pressure (surface) - psi	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avg Injection Pressure (downhole) - psi	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Max Injection Rate - Mtpa	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avg Injection Rate - Mtpa	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Annulus Pressure - psi @ Surface (start of CO_2 injection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Annulus Pressure - psi @ Packer (start of CO_2 injection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Annulus Pressure - psi @ Surface (during CO_2 injection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Annulus Pressure - psi @ Packer (during CO_2 injection)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Annulus/Tubing Pressure differential - psi	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Operational Procedures [40 CFR 146.82(a)(10)]

Key proposed operational procedures include those discussed below. Note that potential triggers that may require an AoR re-evaluation are included in Module 2 Area of Review and Corrective Action Plan.

Stimulation Program – All stimulation activities must be approved by the Director prior to conducting the stimulation as per 40 CFR 146.82. Based on an initial assessment of the geologic formation properties (prior to obtaining cores and tests in the well that is the subject of this Application), it is not foreseen that any stimulation will be required. However, initial stimulation to enhance the injectivity potential of the injection zone associated with near wellbore mud cake removal will be proposed to the Director if required. Later, it may be necessary to propose treatments to remove carbonate material or saline precipitations resulting from extended periods of injection.

Additional Injection Limitation – No injectate other than the identified CO_2 fluid stream shall be injected except fluids used for stimulation, rework, and well tests as approved by the Director. There shall also be no injection of fluids between the outermost casing protected USDW's and the wellbore.

Annulus Fluid – The permittee must fill the annulus between the tubing and the long string casing with a non-corrosive fluid approved by the Director. Specifications of this fluid are in Module 7 Construction Details.

Annulus/Tubing Pressure Differential – Except during workovers or times of annulus maintenance, and unless the Director determines that such requirement might harm the integrity of the well or endanger USDWs, Venture Global shall maintain on the annulus a pressure that exceeds the operating injection pressure. Anticipated annular pressures for each injection interval a listed in Table 7-1.

Automatic Alarms and Automatic Shut-off System – Venture Global will install, continuously operate, and maintain an automatic alarm and an automatic shutdown system. Such systems will integrate into those maintained in the main control room at the LNG facilities. Downhole shutoff systems, or other mechanical devices that provide equivalent protection may also be provided by Venture Global or if required by the Director. Venture Global shall demonstrate the functionality of the alarm, shutdown, and shut-off systems prior to the Director authorizing injection, and at a minimum of once every 12 months after the last approved demonstration.

Precautions to Prevent Well Blowouts – Except at specific times as approved by the Director, Venture Global shall maintain a pressure on the well which will prevent the return of the injection fluid to the surface. The wellbore must be filled with a high specific gravity fluid during workovers to maintain a positive (downward) gradient and/or a plug shall be installed which can resist the pressure differential. A blowout preventer must be installed and kept in proper operational condition whenever the wellhead is removed to work on the well. A wireline retrievable subsurface safety valve shall be installed about 300 feet below the mudline to help secure the well in the event of catastrophic damage to the wellhead. Well blowout emergency response measures are outlined in Module 6 Emergency Remediation and Response Plan.

Proposed Carbon Dioxide Stream [40 CFR 146.82(a)(7)(iii) and (iv)]

CO_2 will be captured and conditioned to a high purity at the Calcasieu Pass and CP2 LNG facilities and exported approximately [redacted] miles offshore at supercritical conditions via an [redacted] pipeline for injection into CS004 Well 001. The compositional makeup and calculated parameters modelled for the exported fluid are as follows.

[redacted]

Primarily due to the presence of water, the CO_2 injection stream has been determined to be corrosive. Corrosion rates were calculated for different temperatures and pressures. As a result, 25Cr / 22Cr and Duplex stainless-steel metallurgy was recommended and selected for tubulars that would be exposed to the CO_2 fluid stream and corrosion-resistant cement will be used to cement casing strings that penetrate the injection interval.

8 Testing and Monitoring

The Testing and Monitoring Plan describes how Venture Global will monitor the Project site pursuant to 40 CFR 146.90. In addition to demonstrating that the well is operating as planned, the CO_2 plume and pressure front are moving as predicted, and that there is no endangerment to USDWs. The monitoring data will be used to validate and adjust the geological models used to predict the distribution of the CO_2 within the storage zone to support AoR reevaluations and a non-endangerment demonstration.

The Testing and Monitoring Plan fulfills the following EPA requirements:

- 40 CFR 146.90(g): Direct monitoring of subsurface pressure and temperature to define and monitor reservoir conditions.
- 40 CFR 146.90(g): Indirect monitoring to track the extent of the carbon dioxide plume and the pressure front.
- 40 CFR 146.90(j): Review and revision of the Testing and Monitoring Plan as needed but no less than every 5 years.
- 40 CFR 146.84(e): Plan amendments or demonstration of continued applicability of the existing plan submitted within one year of an AoR reevaluation.
- 40 CFR 146.87(d, e), 40 CFR 146.8740, CFR 146.89(d) & 146.90(a): Comparison of baseline values from rigorous cased hole tests and logging measurements with identical tests and logging measurements made at scheduled intervals and at recompletion during the injection phase.
- 40 CFR 146.91(a, b, c, d, f), 40 CFR 146.69, 40 CFR 146.82: Reporting the results of all testing and monitoring activities to the EPA in compliance with scheduled requirements and retention of records for the project lifecycle.
- 40 CFR 146.90(a): Carbon dioxide injectate stream analysis.
- 40 CFR 146.88(e)(1), CFR 146.89(b) and CFR 146.90(b): Continuous recording of operational parameters.
- 40 CFR 146.90(d): Above confining zone monitoring of groundwater quality.
- 40 CFR 146.89(c): External mechanical integrity testing of the injection well.
- 40 CFR 146.90(f): Pressure fall-off testing of the injection zones.

Two files have been uploaded.

- VG_Cameron_3_Testing_and_Monitoring_Plan.pdf
- VG_Cameron_3_T&M_App1.zip

Testing and Monitoring GSDT Submissions

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

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☒ Testing and Monitoring Plan ***[40 CFR 146.82(a)(15) and 146.90]***

9 Injection Well Plugging

In this section, detailed plugging schematics are presented in Figure 9-1 and Figure 9-2. A detailed description of the isolation procedure for each of the [redacted] injection stages at the end of their respective injection durations is discussed, as well as permanent abandonment.

[redacted]

[redacted]

CS004 Well 001 Injection Well Plugging Program: Injection Stages [redacted]

[redacted]

[redacted]

[redacted] Figure 9-2.

[redacted]

[redacted]

CS004 Well 001 Injection Well Plugging Program: Permanent Abandonment

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Plan revision number: 0
Plan revision date: June 29, 2023

[redacted]

[redacted]

[redacted]

[redacted]

One file has been uploaded.

- VG_Cameron_4_Injection_Well_Plugging_Plan.pdf

Injection Well Plugging GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** Injection Well Plugging tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☒ Injection Well Plugging Plan ***[40 CFR 146.82(a)(16) and 146.92(b)]***

10 Post-Injection Site Care (PISC) and Site Closure

The Post-Injection Site Care and Closure Plan is designed to integrate the continuous flow of new information and data about the project and its performance with ongoing monitoring. The Post-Injection Site Care and Closure Plan is an essential part of the risk management approach where the monitoring results will be used by Venture Global to verify, test, and iterate the risk assessment on an ongoing basis.

The information submitted and the associated rule requirement in the Post-Injection Site Care and Closure Plan are as follows:

- Post-Injection Monitoring Plan [40 CFR 146.93(b)(1)]
- Non-Endangerment Demonstration Criteria per [40 CFR 146.93(b)(2) and (3)]
- Site Closure Plan [40 CFR 146.93]

There is no alternative PISC timeframe proposed at this time.

One file has been uploaded.

- VG_Cameron_5_PISC_and_Site_Closure_ Plan.pdf

PISC and Site Closure GSDT Submissions
GSDT Module: Project Plan Submissions ***Tab(s):*** PISC and Site Closure tab Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☒ PISC and Site Closure Plan ***[40 CFR 146.82(a)(17) and 146.93(a)]***
GSDT Module: Alternative PISC Timeframe Demonstration ***Tab(s):*** All tabs (only if an alternative PISC timeframe is requested) Please use the checkbox(es) to verify the following information was submitted to the GSDT: ☐ Alternative PISC timeframe demonstration ***[40 CFR 146.82(a)(18) and 146.93(c)]***

11 Emergency and Remedial Response

The Emergency and Remedial Response Plan (ERRP) describes actions that Venture Global shall take to address movement of the injection fluid or formation fluid in a manner that may endanger a USDW and nearby infrastructure during the construction, operation, and post-injection site care periods.

The ERRP includes Emergency Identification and Response Actions to potential risk scenarios associated with CS004 Well 001 for the following events:

- Well blowout
- Injection well or monitoring well integrity failure
- Injection well monitoring equipment failure
- Migration beyond the leased pore space
- Fluid (e.g., brine) or CO_2 leakage to a USDW
- Release of CO_2 to the surface
- A natural disaster; hurricane
- Accidents or unplanned events
- Subsidence or uplift resulting in property or infrastructure damage
- Induced or natural seismic event.

Offsite emergency organization, (e.g., United States Coast Guard, Cameron Parish Sheriff's Department) and government notification agency, (e.g., EPA Region 6, LDNR) contact details are listed in the ERRP, as well as an internal Venture Global emergency communication plan.

The ERRP meets the requirements for the Class VI Permit Application as referenced in 40 CFR 146.94.

Much of the ERRP will be integrated into the Venture Global LNG Calcasieu Pass LNG Plant Emergency Response Plan (ERP) and future Venture Global LNG CP2 LNG Plant ERP. Injection well operations and any emergency response will normally be controlled, monitored and managed from within the plant sites and Emergency Operations Center. The Calcasieu Pass LNG Plant ERP was most recently revised and updated in August 2022 and has been fully vetted and is in accordance with requirements of the United States Coast Guard, Federal Energy Regulatory Commission (FERC), Cameron Parish Sheriff's Office, Louisiana State Police, and other state and local agencies.

References used in preparation of the ERP include: 29 CFR 1910.38, 29 CFR 1910.120, 29 CFR 1910.165, 40 CFR 355, NFPA 1561, NFPA1600, NFPA 1616 and NFPA 1620.

One file has been uploaded.

- VG_Cameron_6_ERRP.pdf

Emergency and Remedial Response GSDT Submissions

GSDT Module: Project Plan Submissions
Tab(s): Emergency and Remedial Response tab

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☒ Emergency and Remedial Response Plan ***[40 CFR 146.82(a)(19) and 146.94(a)]***

12 Injection Depth Waiver and Aquifer Exemption Expansion

Venture Global is not seeking an injection depth waiver or aquifer exemption expansion.

No file has been uploaded to the GSDT.

Injection Depth Waiver and Aquifer Exemption Expansion GSDT Submissions

GSDT Module: Injection Depth Waivers and Aquifer Exemption Expansions
Tab(s): All applicable tabs

Please use the checkbox(es) to verify the following information was submitted to the GSDT:
☐ Injection Depth Waiver supplemental report ***[40 CFR 146.82(d) and 146.95(a)]***
☐ Aquifer exemption expansion request and data ***[40 CFR 146.4(d) and 144.7(d)]***

13 Optional Additional Project Information [40 CFR 144.4]

Venture Global will ensure all necessary permits, clearances, and licenses for project construction are obtained prior to the initiation of work, as required. Specifically, it is anticipated that the Project will likely require National Historic Preservation Act of 1966 (54 USC 300101 et seq.), Endangered Species Act (16 USC 1531 et seq.), Marine Mammal Protection Act (16 USC 1361 et seq.), and Coastal Zone Management Act (16 USC 1451 et seq.) compliance. Venture Global will acquire the necessary permits and clearances.

14 Other Information

In addition to the application files noted in previous sections of this Application Narrative, Venture Global has uploaded the following additional files:

- VG_Cameron_1_Summary_of_Requirements.pdf (narrative)
- VG_Cameron_7_Construction_Details.pdf (narrative)
- VG_Cameron_7_Construction_Details_App1.pdf (plat showing artificial penetrations in and around the AoR)
- VG_Cameron_10_Environmental_Justice.pdf (narrative)
- VG_Cameron_10_EJ_App1.pdf (references)
- VG_Cameron_11_QASP.pdf (narrative)
- VG_Cameron_11_QASP_App1.pdf (SureVIEW DTS)
- VG_Cameron_11_QASP_App2.pdf (log manual)
- VG_Cameron_11_QASP_App3.pdf (references)
- VG_Cameron_Requirements_Matrix.pdf

At this point, no additional information has been requested by the UIC Program Director pursuant to 40 CFR 146.82(a)(21).

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A table of references and pdf files for those available in the public domain are provided in Appendix 2.

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