1 CLASS VI PERMIT APPLICATION NARRATIVE
40 CFR 146.82(a)

Facility Information

Facility (site) Name: Polk Carbon Storage Complex (PCSC)
Facility Operator: Tampa Electric Company (TEC)

Facility Contact: CLA MED AS CBI [redacted]

Project Location: Polk County, Florida

Injection Well Name and Coordinates:

Well Name	Latitude	Longitude
PSC_IW1	CLAIMED AS CBI [redacted]	[redacted]
PSC_IW2	[redacted]	[redacted]
PSC_IW3	[redacted]	[redacted]

Table of Contents

List of Tables

List of Figures

List of Acronyms/Abbreviations

2D	2-Dimensional
3D	3-Dimensional
AoR	Area of Review
bbl/d	Barrels per day
BHP	Bottom Hole Pressure
CCS	Carbon capture, and storage
CO_2	Carbon dioxide
CMG	Computer Modelling Group
D_H	Hydraulic Diameter
DRM	Dynamic Reservoir Model
EoS	Equation of State
EPA	Environmental Protection Agency
f_D	Darcy's Friction Factor
ft	feet
g	Acceleration due to Gravity
GEM	General Equation of State
KB	Kelly Bushing
$k_{r,CO2}$	CO_2 Relative Permeability
kh	Permeability-Thickness Product
k_h	Absolute Horizontal Permeability
k_v	Absolute Vertical Permeability
$k_{r,w}$	Water Relative Permeability
mg/L	milligrams per liter
MIP	Mercury Intrusion Porosimetry
MMt	Millions of Metric tons
MMtpa	Millions of Metric tons per annum
ΔP	Pressure Drop
ΔP_{TH}	Threshold Pressure
PISC	Post-Injection Site Care
PCSC	Polk Carbon Storage Complex
P_{grid}	Grid Block Pressure
pH	Potential Hydrogen
ppm	Parts per Million
psi	Pounds per square inch
psia	Pounds per square inch, absolute
ρ	Fluid Density
ρ_i	Injection Zone Fluid Density
ρ_u	Underground Source for Drinking Water Fluid Density
RCA	Routine Core Analysis
R_e	Reynolds Number
RO	Reverse Osmosis
SCA	Specialized Core Analysis
SEM	Static Earth Model

S_{grmax}	Maximum Residual Gas Saturation
SS	Subsea
S_{wconn}	Connate Water Saturation
S_{wirr}	Irreducible Water Saturation
TEC	Tampa Electric Company
T_{grid}	Grid Block Temperature
TVD	True Vertical Depth
UCPZ-1	Upper Cretaceous Permeable Zone 1
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
U.S. DOE	United States Department of Energy
U.S. EPA	United States Environmental Protection Agency
v	Fluid Velocity
z_i	Injection Zone Top Depth
z_u	Underground Source for Drinking Water Bottom Depth

1.1 Project Background and Contact Information

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)]***

1.1.1 Project Background

Tampa Electric Company (TEC) is proposing the development of an industrial-scale carbon capture and storage (CCS) complex in Polk, Hardee, Manatee and Hillsborough counties in Florida (**Figure 1-1**). The Polk Carbon Storage Complex (PCSC) is planned to be located south of the town of Bradley Junction. CLA MED AS CBI [redacted] The project is seeking to permit and drill up to three injection wells (PSC_IW1, PSC_IW2, PSC_IW3), three in-zone monitoring wells (PSC_IZ1, PSC_IZ2, and PSC_IZ3), two above-zone monitoring wells (PSC_AZ1, and PSC_AZ2), and seven shallow USDW monitoring wells (PSC_GW1, PSC_GW2, PSC_GW3, PSC_GW4, PSC_GW5, PSC_GW6, and PSC_GW7).

TEC and its subsurface consultants and partners have conducted a thorough evaluation of the regional and local geology, well infrastructure, injection site design, and overall project planning to support a UIC Class VI application. TEC currently operates two deep UIC Class I non-hazardous wastewater injection wells CLAIMED AS CBI [redacted] Additionally, privately procured seismic data, legacy oil and gas well data, and other publicly available data were also incorporated to develop computational models to determine the project's area of review and subsequently, design project plans.

1.1.2 Partners and Collaborators

Key project partners and their role for the PCSC project are listed in **Table 1-1.**

Table 1-1. Partners and Collaborators.

Partner	Role
Tampa Electric Company (TEC)	Project owner and operator

1.1.3 Project Timeframe

CLA MED AS CBI [redacted] The post-injection timeframe has been chosen after evaluating the results of the computational modeling. Additional details on the post-injection timeframe can be found in **Section 9.5 of the Post-Injection Site Care and Site Closure Plan**.

CLAIMED AS CBI

[redacted]

1.1.4 Proposed Injection Mass and CO_2 Source

CLAIMED AS CBI [redacted]

1.1.5 Injection Depth Waiver

No injection depth waiver is currently sought in this application.

1.1.6 Aquifer Exemption

No aquifer exemption is currently sought in this application.

1.1.7 Applicable Permit Information Under 40 CFR 144.31(e)(1) through (6)

Table 1-2 provides information on activities conducted by TEC for this project which require it to obtain permits under the Resource Conservation and Recovery Act (RCRA), Underground Injection Control (UIC), the National Pollution Discharge Elimination system (NPDES) program under the Clean Water Act (CWA), or the Prevention of Significant Deterioration (PSD) program under the Clean Air Act.

Table 1-2. Permit Information Required under 40 CFR144.31(e)(1).

Regulation	Jurisdiction	Activity	Relevant Permits
Resource Conservation and Recovery Act (RCRA)	State		NA
Underground Injection Control (UIC) Program	Federal – U.S. Environmental Protection Agency (U.S. EPA) – Region IV	CO_2 injection well drilling and operation	Class VI Injection Well Permits
National Pollutant Discharge Elimination System (NPDES) – Clean Water Act (CWA)	State	Discharge of once-through cooling water and non-hazardous wastewater	FL0043869 FL0000817 FL0000809
Prevention of Significant Deterioration (PSD) – Clean Air Act (CAA)	State	Operation of combustion sources for power generation	

1.1.7.1 Contact Details for TEC

Facility (site) Name: Polk Carbon Storage Complex (PCSC)
Facility Operator: Tampa Electric Company (TEC)
Facility Contact: CLA MED AS CBI [redacted]
Project Location: Polk County, Florida

Well Name	Latitude (decimal)	Longitude (decimal)
PSC_IW1	CLAIMED AS CBI [redacted]	[redacted]
PSC_IW2	[redacted]	[redacted]
PSC_IW3	[redacted]	[redacted]

1.1.7.2 Applicable SIC Codes

Per 40 CFR 144.31(e)(3), applicable SIC codes are listed below:
4911 – Electric Services

1.1.7.3 Operator Details

Name: Tampa Electric Company (TEC)
Address: 702 N. Franklin St.
Tampa, FL 33602
Telephone number: 813-228-1111
Ownership status: TEC is an indirect, wholly owned subsidiary of Emera, Inc.
Nature of the entity (Federal, State, private, public): Private

1.1.7.4 Other permit information required under 40 CFR 144.31(e)(6)

The PCSC project-related activities conducted by TEC are listed in **Table 1-3**. **Table 1-4** summarizes the applicable project-related permits.

Table 1-3. Activities conducted by TEC, and applicable permits as noted in 40 CFR 144.31(e)(6)

Permit	Jurisdiction	Activity	Relevant Permits and Agreements
Drilling Permits	State	Drilling of characterization and monitoring wells	See State UIC Program under SDWA below.

Permit	Jurisdiction	Activity	Relevant Permits and Agreements
Valid Access Agreements	County, Township/City	Construction of project wells, siting injection and monitoring infrastructure	
Encroachment Permits	County, Township/City	Construction of project wells, siting injection and monitoring infrastructure	
Restricted Lane Use Permits	State, County	Construction of project wells, siting injection and monitoring infrastructure	

Table 1-4. Applicable permits and construction approvals as noted in 40 CFR 144.31(e)(6)

Permit	Jurisdiction	Relevant Permits
Hazardous Waste Management Program under RCRA	Federal, state	NA
U.S. EPA UIC Program under SDWA	Federal	NA
State UIC Program under SDWA	State	0281232-013-014-UO-1I
NPDES under CWA	State	FL0043869
PSD Program under CAA	State	1050233-034-AC (PSD-FL-421)
Nonattainment Program under CAA	State	NA
Dredge and Fill Permits under Section 404 of the CWA	Federal	NA
Other permits	Federal, state, county, city	

1.2 <u>Site Characterization</u>

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

The proposed geologic CO_2 storage site is located in southwestern Polk County in south-central Florida. CLAIMED AS CBI [redacted] The nearest towns include Bradley Junction to the north, Fort Meade to the east, and Bowling Green to the southeast. The greater Tampa suburban area is located approximately 20 miles to the northwest, **Figure 1-1**. The topography around the Polk Power Station is relatively flat, has various shallow water bodies, and has a mean elevation of roughly 135 feet above sea level. Within the Area of Review (AoR), there are no springs, state or EPA subsurface cleanup sites, quarries, or tribal lands but there are active phosphate mines.

1.2.1.1 Regional Geologic Structures

The geologic storage site is located in south-central Florida along the west limb of Florida's peninsular arch. This arch is a large positive structural feature that is buried in the subsurface and trends northwest-to-southeast, **Figure 1-2.** Based on local well control and regional wells, the structural dip at the PCSC is CLAIMED AS CBI [redacted] the dip in the Upper Storage Complex (described later) is CLAIMED AS CBI [redacted].

1.2.1.2 Regional Sedimentary Rocks of Polk County

Around 75 million years ago, during the Upper Cretaceous period, Florida's peninsular arch was submerged under a shallow ocean. This aquatic environment provided an ideal setting for the deposition of carbonate materials, as discussed by Ozakar, 2015. [1] An idealized rendering of the depositional setting is shown in **Figure 1-3:** the facies are largely comprised of carbonate materials and textures up-dip of the shelf's foreslope. During the Late Cretaceous era, the Florida Peninsula experienced transgression – the sea advancing onto the land – along with a warming climate. These conditions led to the formation of extensive deposits of open marine carbonate across the peninsula. Evaporite rocks formed in shallow warm waters where the rate of evaporation enabled the precipitation of evaporite minerals like gypsum that later became anhydrite as surmised by Ozakar (2015)[2]. The anhydrite units serve as an overlying, impermeable confining zone, as demonstrated by the existing wastewater disposal operations at Polk Power Station. This will be referred to as the anhydrite-rich or anhydrite caprock zone for the Upper Storage Complex, **Figure 1-3.** The Upper Storage Complex is the primary target considered for CO_2 storage, with a data acquisition plan that further characterizes a deeper potential Lower Storage Complex.

In Polk County, TEC's two wastewater injection wells were drilled to a depth of 8000 feet, with lithology dominated by carbonate rocks, punctuated by some evaporite rock intervals and rare siliciclastic rocks, **Figure 1-4.** Based on a drilling report for wastewater injection well TEC_IW-2, [2] **Figure 1-4** defines the proposed geologic storage zones' depositional sequence and associated depths for the PCSC. Stratigraphic nomenclature and succession for the Atkinson and Washita are based on interpretations by Bozkurt. [3]

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[1] Ozakar, E., 2015. Lithostratigraphy, Depositional Environment and Diagenetic History of Upper Cretaceous-Paleocene Strata of TEC DIW-1 Deep Well, Polk County, Florida, Master's Thesis, Florida State University.
[2] MWH Global, 2013. Polk Power Station Class I Injection Well IW-2 and Dual Zone Monitor Well DZMW-2 Drilling and Testing Report.
[3] Bozkurt, S., 2015. Lithostratigraphy, Depositional Environment and Diagenetic History of the Lower and Upper Cretaceous Section of TEC DIW-1 Deep Well, Polk County, Florida, Master's Thesis, Florida State University.

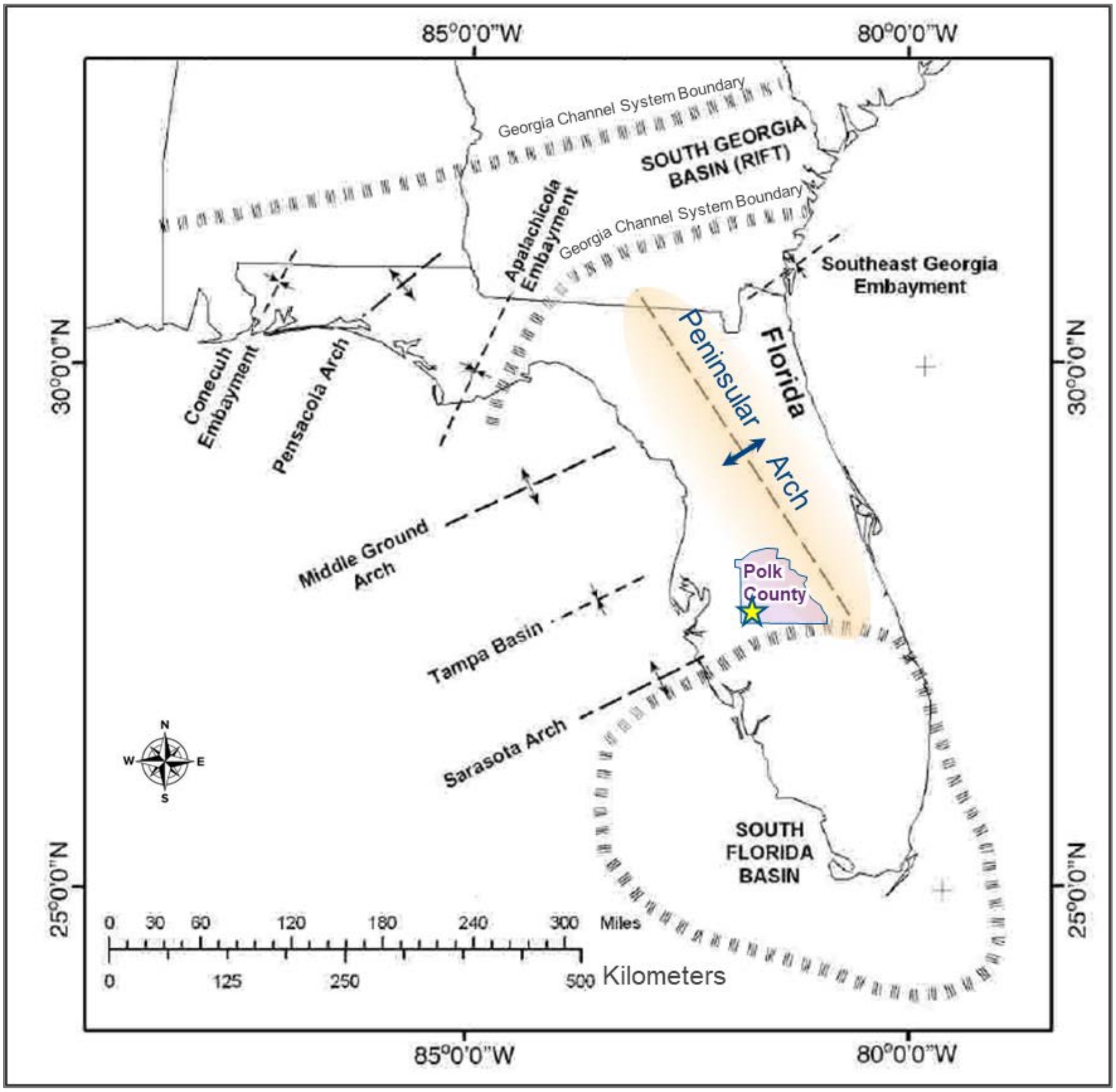

Figure 1-2. Map showing the locations of major geologic structures and basins across the state of Florida. The yellow star is the location of TEC's Polk Power Station. Map modified from Lloyd (1991). [4]

[4] Lloyd, J.M., 1991, Part I - 1988 and 1989, Florida Petroleum Production and Exploration, FGS Information Circular, No. 107.

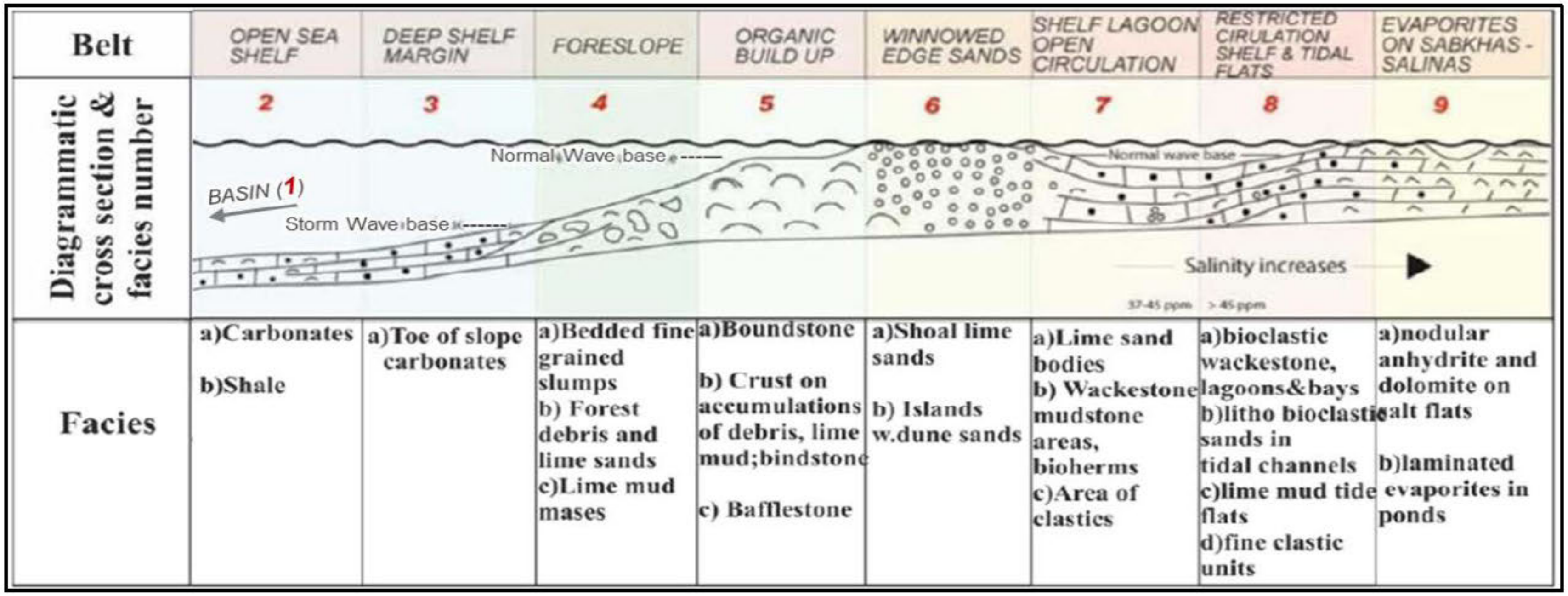

Figure 1-3. Shallow marine shelf with standard facies model of Wilson (1975) [5] (modified after Alnaji, 2002 [6]). In Florida, Cretaceous age sediments rarely have a siliciclastic influx. Thus, sandstone facies, as depicted here, are rare. The depositional settings for the reservoir zones are comprised of carbonate materials and textures up-dip of the shelf's foreslope.

[5] Wilson, J.L., 1975, Carbonate facies in geological history, Springer, New York, pp. 471.

[6] Alnaji, N. S. 2002, The geology of the Upper Permian - Permian Basin, Department of Geological Sciences, Columbia, University of South Carolina, MSc.

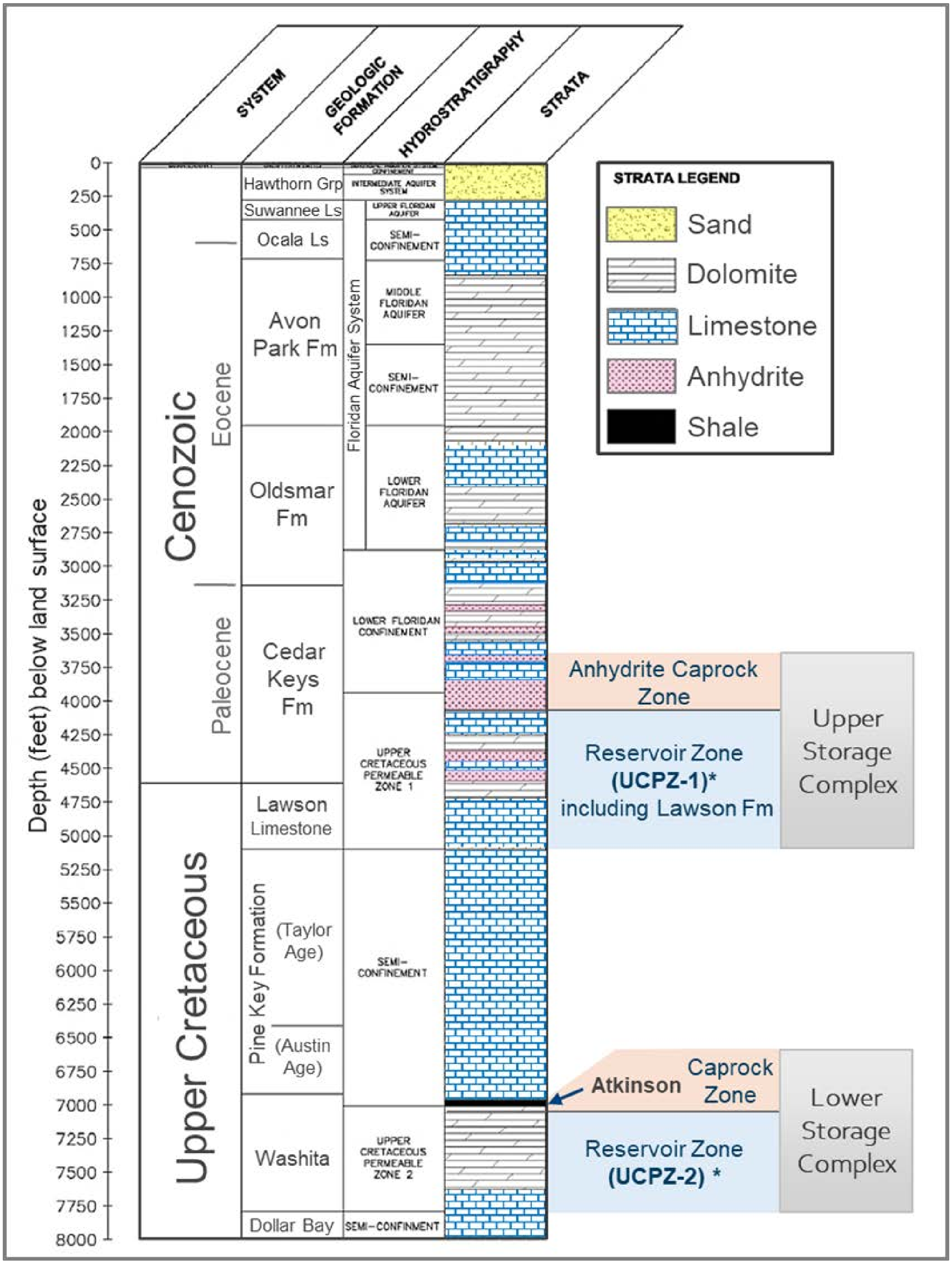

Figure 1-4. Stratigraphic chart indicating the composition of formations and proposed storage complexes. Image modified from MWH Global, 2013.[2]

1.2.1.3 The Sedimentary Succession

Sediments encountered during the drilling and construction of the TEC_IW-1 range in age from Holocene to Upper Cretaceous. Lithologic descriptions are based on formation samples collected from the TEC_IW-1 [7] and TEC_IW-2 wells, plus existing literature. In descending order, a general description of the lithostratigraphy and its relationship to the hydrostratigraphy of the site is provided below and illustrated in the stratigraphic column shown in **Figure 1-4.**

Pliocene-Pleistocene Series (Upper Cenozoic)
At the Polk Power Station, undifferentiated clastic (surface) deposits of Plio-Pleistocene age extend to a depth of approximately 40 feet bls (below land surface). The undifferentiated surficial deposits, which include the Cypresshead Formation, consist primarily of sands, clayey sands, and clays. [8] The Cypresshead Formation, which was first used by Huddleston (1988) [9] and extended into Florida by Scott [10], is typically a mottled fine- to coarse-grained, often gravelly, variably clayey quartz sand by Scott. [11]

Hawthorn Group
Dall and Harris [12] first used the term “Hawthorn beds” for phosphatic sediments being quarried for fertilizer near the town of Hawthorne in Alachua County, Florida. Florida geologists have extensively studied, mapped, and discussed the unit since the early 1900’s because of its economic importance. The Hawthorn Group is comprised of the Peace River Formation and the Arcadia Formation. The Peace River Formation occurs from approximately 40 feet bls to 230 feet bls and consists of light gray sandy phosphatic clays, interbedded limestone, and brownish gray chert. The intermediate aquifer is located in the Arcadia Formation, which occurs from approximately 230 feet to 280 feet bls and consists of light gray limestone interbedded with phosphatic clays. The lithology from 280 feet to 300 feet bls represents a transitional zone of grey-blue-green phosphatic clay to yellowish-gray micritic limestone. A moderate amplification of the gamma ray signature accompanies this section.

Suwannee Limestone
Cooke and Mansfield [13] introduced the term Suwannee Limestone to describe an interval of yellowish limestones exposed on the banks of the Suwannee River in northern Florida. In this type of area, the Suwannee Limestone is normally a very pale orange, moderately indurated, porous

[7] Tampa Electric Company – Polk Power Station Class I Injection Well DIW-1/Dual Zone Monitoring Well DZMW-1 Drilling and Testing Report.
[8] Spechler, R.M. and Kroening, S.E., 2007. Hydrology of Polk County, Florida: U.S. Geological Survey Scientific Investigations Report 2006-5320, 114p.
[9] Huddleston, P.F., 1988. A revision of the lithostratigraphic units of the Coastal Plain of Georgia: the Miocene through Holocene: Georgia Geological Survey Bulletin 104, 162 p.
[10] Scott, T.M., 1988. The Lithostratigraphy of the Hawthorn Group (Miocene) of Florida: Florida Geological Survey, Bulletin 59, 148 p.
[11] Scott, T.M., 1992. A geological overview of Florida. Florida Geological Survey, Open-File Report 50, 78 p.
[12] Dall, W.H., and Harris, G.D., 1892, Correlation papers - Neocene: United States Geological Survey Bulletin 84, 349 p.
[13] Cooke, C.W., and Mansfield, W., 1936. Suwannee Limestone of Florida (abstract). Geological Society of America Proceedings, 1935.

calcarenite that contains numerous fossil foraminifera, mollusks, and echinoids, Ceryak.[14] According to Wedderburn[15], the upper boundary of the Suwannee Limestone occurs at the contact between the slightly sandy carbonates of the Suwannee Limestone and the phosphatic and sandy sediments of the Hawthorn Group. The contact between the Hawthorn group and the Oligocene age Suwannee Limestone may be an unconformity, but it is only marked by a gradational color change in lithology and the absence of phosphate in the Suwannee. The contact is best seen by the abrupt increase in gamma ray activity in the lower section of the phosphatic Hawthorn Group. Numerous studies in central Florida have used gamma ray attenuation to determine this contact. The Oligocene unit within the TEC_IW-2 location is approximately 120 feet thick and exists between the depths of 300 feet to 420 feet bls. It is composed primarily of well-consolidated limestones. The limestone is generally yellowish-gray micrite to biomicrite, with a well-rounded, medium-grained calcarenite texture. The Suwannee Limestone is composed of moderately to well-sorted foraminifera (*Dictyoconus cookei, Rotalia sp., and Amphistegina sp.)*, pelloids, abraded echinoderm, and mollusk fragments.

Ocala Limestone

Dall and Harris[16] first used the term "Ocala Limestone" for limestone that was being mined near the town of Ocala in Marion County, Florida. Applin and Applin[17] recognized two distinct units within the Ocala Limestone: an upper coquinoid (unsorted and often unbroken shelly materials) member and a lower, more fine-grained micritic member - a terminology that the USGS still uses. The Late Eocene age Ocala Limestone is approximately 295 feet thick and occurs from about 420 feet to 715 feet bls. It is composed primarily of yellowish-gray micrites to biomicrites containing the larger characteristic benthonic foraminifera. These include *Amusium sp.*, *Lepidocyclina sp. Operculinoides sp.*, and *Heterostegina sp.* The gamma ray logs show less radioactivity in the Ocala Limestone than the overlying Suwannee Limestone, except in the sporadic occurrences of dolostone. Textures range from poorly consolidated chalk to coquina-like grainstones, which further discerns the contact between the Suwannee and Ocala limestones.

Avon Park Formation

The term "Avon Park Formation" was originally used by Applin and Applin (1944) to describe rocks of the late Middle Eocene age in northern and peninsular Florida. Miller[18] defined the Avon Park Formation as "the sequence of predominantly brown limestones and dolomites of various textures that lies between the gray, largely micritic limestones of the Lake City Limestone and the white foraminiferal coquina of the Ocala Limestone."

The Middle Eocene age Avon Park Formation is distinguished from the Ocala Limestone by a greater degree of lithification. The Avon Park Formation extends from approximately 715 feet to

[14] Ceryak, R., Knapp, M. S., and Burnson, T., 1983. The geology and water resources of the upper Suwannee River Basin, Florida, Florida Dept. of Natural Resources, Bureau of Geology, Report of Investigation No. 87.
[15] Wedderburn, L.A., Knapp, M.S., Waltz, D.P., and Burns, W.S., 1982. Hydrogeologic reconnaissance of Lee County, Florida: South Florida Water Management District Technical Publication 86-1, 193 p.
[16] Dall, W.H., and Harris, G.D., 1892. Correlation papers - Neocene: United States Geological Survey Bulletin 84, 349 p.
[17] Applin, P. L., and Applin, E. R., 1944. Regional subsurface stratigraphy and structure of Florida and southern Georgia: American Association of Petroleum Geologists Bulletin, Vol. 28, p. 1673-1753.
[18] Miller, J.A., 1986. Hydrogeological framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama and South Carolina. U.S. Geological Survey Professional Paper 1403-B, 91 p.

a depth of 1,950 feet bls and is about 1,235 feet thick. Biostratigraphic designation for identifying the top of the Avon Park Formation occurred at a depth of 715 feet bls with the presence of an olive gray dolostone, a slight increase in gamma ray log and a decrease in resistivity logs. The first occurrence of the diagnostic foraminifera *Dictyconus Americanus* was identified at 730 feet bls. Strata consists primarily of yellowish gray limestone until transitioning to dark yellowish brown dolostone at 810 feet bls. The dolostone ranges from dark to pale yellowish brown and is moderately to well-indurated. Induration increases towards the base of the formation. Moderate yellowish brown, microcrystalline to crystalline dolomitic limestone is more common near the formation base from 1,260 feet to 1,590 feet bls. The dolomitic limestones are well-indurated with abundant vugular dissolution, sucrosic crystallization, and thin anhydrite beds. The lithology from approximately 1,590 feet to the base of the formation at 1,950 feet bls is composed of dolomitic limestone (grainstone to packstone) and grayish-brown dolostone.

Oldsmar Formation

Miller [19] defined the Oldsmar Formation as “the sequence of white to gray limestone and interbedded tan to light-brown dolomite that lies between the pelletal, predominantly brown limestone and brown dolomite of the Middle Eocene and the gray, coarsely crystalline dolomite of the Cedar Keys Formation.” Duncan, et al. (1994) recognized a stratigraphic marker bed (glauconite marker bed) at the top of the Oldsmar Formation. The Oldsmar Formation also commonly contains the guide fossil *Heliocostegina gyralis*. In the IW-2 borehole, the top of the Early Eocene age Oldsmar Formation extends from approximately 1,950 feet to a depth of 3,140 feet bls and consists of very pale orange limestone and dolomitic limestone with yellowish brown and light olive gray dolostone interbedded with anhydrite. The lithology changes to an olive-gray and yellowish-gray dolostone interbedded with anhydrite from 2,620 feet to the base of the formation at 3,140 feet bls. The top of the Oldsmar Formation can be hard to identify because of the lack of diagnostic microfossils. This unit is identified on geophysical logs by increased borehole diameters on the caliper log, due to a slight increase in permeability and a sharp decrease in resistivity.

Cedar Keys Formation

The Cedar Keys Formation is a succession of gray to off-white, coarsely crystalline dolomite that is moderately porous in the upper portion, and the lower two-thirds consists of tan to gray, finely crystalline to microcrystalline dolomite interbedded with white to clear anhydrite (Miller, 1986). The thick anhydrite beds of the Cedar Keys Formation form the lower confining unit of the Floridan Aquifer System (FAS), which exhibited low to very low permeability (Miller, 1986). The Cedar Keys Formation also commonly contains the guide fossil *Borelis gunteri* (Chen, 1965).

At the TEC_IW-2 site, the Paleocene age Cedar Keys Formation extends from approximately 3,140 feet to 4,610 feet bls. This unit is identified on geophysical logs by a slight increase in gamma ray activity and a decrease in resistivity characteristic of hard crystalline dolomite and dolostone. The Cedar Keys Formation can be separated into two parts (Miller, 1986). The upper unit is composed primarily of light olive gray dolostone and dolomitic limestone with thinly interbedded anhydrite. The lower unit is composed primarily of light bluish-gray massive anhydrite with thin beds of dolostone, dolomitic limestone and limestone. The upper Cedar Keys

[19] Miller, J.A., 1986. Hydrogeological framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama and South Carolina. U.S. Geological Survey Professional Paper 1403-B, 91 p.

Formation is present from 3,140 feet to 3,330 feet bls and is primarily moderately indurated light olive gray moderately indurated dolostone and limestone interbedded with anhydrite. The top of the Cedar Keys Formation is marked by a distinct lithology of light olive gray dolostone, with traces of anhydrite and the absence of fossils Chen. [20] This unit is identified on geophysical logs by increased gamma activity characteristic of hard crystalline dolomite and dolostone.

The middle and lower Cedar Keys Formation is present from 3,330 feet to approximately 4,290 feet bls and consists primarily of hard crystalline anhydrite interbedded with well-indurated limestone (packstone), dolostone, and dolomitic limestone. The lithology from 3,400 feet to 4,200 feet bls is light gray anhydrite interbedded with medium light gray to light olive gray limestone and dolomitic limestone. The lithology changes with light gray anhydrite interbedded with thin beds of yellowish gray to light olive gray dolomitic limestone and dolostone from 3,990 feet to approximately 4,250 feet bls.

Lawson Limestone

The contact between the overlying Cedar Keys Formation and underlying Upper Cretaceous age Lawson Limestone is a transition into a very light brown, fine-grained crystalline dolostone and/or chalky dolomitic limestone (Chen, 1965). The Lawson Limestone is separated into upper and lower members by Vernon [21] and Applin. [22] The upper member comprised primarily of cream-colored, fine-grained dolomitic limestone and light brown dolostone with gypsum lenses and the presence of *Rotalid sp.* and *Orbitoides sp.* (Applin and Applin, 1944, Vernon, 1951). The lower member is similar to the upper member with cream-colored dolomitic limestone is devoid of gypsum and is less fossiliferous, with the presence of *Lepidorbitoides sp.* and *Sulcoperculina lawsoni (*Applin and Applin, 1944).

The upper member of the Lawson limestone is present from 4,390 feet to 4,690 feet bls and is pale yellowish brown dolostone and dolomitic limestone with weakly sucrosic and vuggy secondary porosity. This unit was identified by an abrupt transition in lithology from medium to very fine-grained dolomitic limestone and color from yellowish gray to yellowish brown. This unit is identified on geophysical logs by increased gamma activity.

The lower member of the Lawson Limestone is present from 4,700 feet to 5,050 feet bls and is primarily very pale orange dolomitic limestone. The transition between the upper and lower Lawson Limestone was identified with decreased dolostone, increased limestone and dolomitic limestone, and the presence of *Sulcoperculina lawsone* (Applin and Applin, 1944). A decrease in gamma activity from the upper Lawson Limestone member identifies this unit on geophysical logs.

[20] Chen, C.S., 1965. The Regional Lithostratigraphic Analysis of Paleocene and Eocene Rocks of Florida: *Florida Geological Survey*, Bulletin 45.
[21] Vernon, R.O., 1951. Geology of Citrus and Levy Counties, Florida: Florida Geological Survey, Bulletin 33.
[22] Applin, P.L. and Applin, E.R., 1967. The Gulf Series in the Subsurface in Northern Florida and Southern Georgia: United States Geological Survey Professional Paper 524-G, 37 p.

Beds of Taylor Age (Upper Pine Key Formation)

The lower member of the Lawson Limestone and Beds of Taylor age have very similar lithology, comprised of low permeability, very pale orange “chalky” dolomitic limestone with anhydrite inclusions. This is supported by Applin and Applin, 1967, which stated the Beds of Taylor Age located in the Florida Peninsula are carbonate facies composed mainly of chalk, in which lenses of dolomite and dolomitic chalk are irregularly interbedded. The top of the Taylor Age deposits are represented by the first occurrence of abundant *Inoceramus sp.* (Vernon, 1951). The top of Taylor age deposits have also been identified by a series of strong, evenly spaced variations in resistivity observed on the resistivity geophysical log, generally referred to as “Taylor kicks” (Vernon, 1951).

Beds of Taylor age are present from 5,067 feet to 6,420 feet bls and are primarily low permeability chalky limestone with sparse lignitic shale and anhydrite inclusions. The contact between the overlying Lawson Limestone and Beds of Taylor age is observed by abrupt variations in the resistivity log and increased gamma ray attenuation. Thin shale beds are associated with abrupt gamma ray “spikes” near the bottom of the sequence (Vernon, 1951), which correspond to depths of 5,610 feet and 5,980 feet bls in TEC_IW-2.

Beds of Austin Age (Lower Pine Key Formation)

The Beds of Austin age are known to be composed mainly of moderately hard limestone, sands, and shale (Vernon, 1951). Pyrite is also commonly present either as large crystals or crystal clusters or as aggregates of very small particles replacing shell structures (Applin and Applin, 1967). The Beds of Austin age are overlain by lower permeability chalky limestone composed in the Beds of Taylor age. The contact between the Taylor and Austin Groups can’t be precisely determined due to the similarity of lithology and the rare occurrence of species in the units. Thus, the contact between two units has been distinguished on the basis of color differences and correlations with adjacent wells in terms of the thickness of the unit. It is observed that there is a sharp color change from light gray to white at a depth of around 6420 feet (Bozkurt, 2015). Beds of Austin age are present from 6,420 feet to 6,940 feet bls at TEC_IW-2.

Atkinson Formation and Washita-age Formations

The name Atkinson Formation was introduced with three unnamed members; upper, middle, and lower; for the dominantly marine pre-Austin age rocks of the Gulf Series in the subsurface in southern Alabama, southern Georgia, Florida, and as far south as the Florida Keys (Applin and Applin, 1967). The upper member of the Atkinson Formation is composed of light brownish to medium gray, sandy, dense, hard, shaly limestone with thin beds of sandstone and inclusions of lignite (Vernon, 1951). Locally, the Atkinson Formation’s upper member is of shallow water marine origin and is composed of shale, sandstone, siltstone, and a few lenses of limestone. The Atkinson has low permeability marked by approximately 90 feet of low permeability clay and lignitic shale unit from 6,935 feet to 7,010 feet bls. This is supported by a significant increase in natural gamma ray log response, increases in dual induction (resistivity), and a decrease in sonic velocity (increased sonic travel time). From 7,010 to 7,120 feet bls, the sonic velocity increases due to the dense, low permeability limestones near the base of this confining unit.

Washita-age Formations

As described by Bozkurt (2015), this group of Washita-age formations are comprised of the undifferentiated Panther Camp, Rookery Bay and Corkscrew Swamp Formations grouped here as one unit. According to a study by Maher and Applin (1968) the unit is composed chiefly of very fine-grained calcitic dolomite that contains frequent interbedded lenses of anhydrite and chalky limestone. The unit has been observed as a unit that consists of crystalline tan to gray dolomite and light to dark gray limestone, including brownish spotty dolomite based on drill cuttings samples from TEC_IW-1. A few fragments of dark gray shale and some anhydrites were also seen in the unit. Dolomite is tan to medium gray, aphanitic, and medium to coarse crystalline. Some are porous and contain small amounts of pelloids and fossil fragments. Vuggy porosity was observed in thin sections (Bozkurt, 2015). Limestone that contains abundant fragments of pelloids is tan to light brown, somewhat fossiliferous, and very porous. Some samples contain spotty dolomite. In general, the unit consists mostly of dolomite interbedded with limestone and anhydrite lenses. Altogether, this porous Washita-age reservoir is found in TEC_IW-2 well at a depth of 7,120 feet and an approximate thickness of 660 feet. Underlying the reservoir is the Dollar Bay Formation at 7,780 ft, believed to be a shaley formation based on the notable increase in gamma ray log response.

Dollar Bay Formation

At approximately 7,780 ft bsl, the Dollar Bay Formation is described by Bozkurt (2015) as mostly cream-chalky limestone interbedded with dolomite and anhydrite. The Dollar Bay Formation is comprised of intraclastic foraminiferal packstone, foraminiferal wackestone, fossiliferous grainstone, and packstone of various carbonate textures. Diagenetic processes have occluded much of the porosity, so this formation is considered an underlying confining interval for the Washita-age Formations above.

1.2.2 Maps and Cross Sections of the AoR [40 CFR 146.82(a)(2), 146.82(a)(3)(i)]

Characterization of the subsurface is based on well logs and the correlation of interpreted well tops (formation picks). This data has been used to prepare a series of maps and geologic cross-sections for the proposed storage complex and study area. The subsurface characterization includes logs from wells shown in **Figure 1-5**; this base map also features the orientations of cross-sections and well-sections shown in the figures that follow. Most of the wells shown in **Figure 1-5** are logged from the Eocene’s Oldsmar Fm down through the Upper Cretaceous into the Dollar Bay Formation. Based on well log interpretations, the Dollar Bay Formation represents the deepest confining interval for this storage area and marks the base of the Static Earth Modeling that was performed for the PCSC.

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[redacted]

Among the cross-sections found in **Figure 1-5**, the TEC_IW-2 well provides a representative type log for the storage site's stratigraphy, **Figure 1-6**. The TEC_IW-2 well is located approximately 2.4 miles north of the proposed PSC_IW3 injection well. The gamma ray log (GRNORM) in **Figure 1-6** offers insight into the interbedded nature of the carbonate and anhydrite beds representing the confining zone. For this project, the Lawson Formation is considered the primary reservoir zone which is capped by thick evaporite units (anhydrites) found in the Cedar Keys Formation. Technically, this primary reservoir zone includes Upper and Lower portions of the

Lawson Formation and a portion of the Lower Cedar Keys, **Figure 1-3** and **Figure 1-6**. Within the Cedar Keys and Lawson Formations, the alternating deflections seen in the sonic log correspond with alternating carbonate and anhydrite lithologies associated with fluctuations in sea level over the peninsula. Carbonates are more dominant here and are punctuated by some significant anhydrite units.

A deeper, second potential storage reservoir includes carbonates of Washita age (UCPZ-2), and a confining unit comprised of the Atkinson Formation comprised of Shale and dense dolomite, **Figure 1-6**.

The lateral continuity of the stratigraphic succession under the proposed storage site is revealed in the following well-sections that are flattened on mean sea level (msl) and include intervals at supercritical depth and deeper. The gamma ray logs in well section A-A' show the relative abundance and continuity of carbonates and anhydrites, **Figure 1-7**. Similarly, **Figure 1-8** presents the well section B-B' that trends towards the southeast. These well sections reveal the laterally continuous reservoir units and their confining zones. Furthermore, the well-sections show the persistence of the primary caprock, the anhydrites of the Cedar Keys Formation.

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[redacted]

Subsurface interpretations were made by preparing a 3D static earth model (SEM). The interpreted well tops form the basis for contouring key stratigraphic zones used in preparing the SEM. The SEM's CLAIMED AS CBI [redacted] footprint is shown in **Figure 1-5**. Cross-sections through this model are shown in **Figure 1-9**. The north-south model cross-section runs through the Polk Power Station; the west-east cross-section runs through the proposed storage field, **Figure 1-10**.

CLA MED AS CBI

[redacted]

[redacted]

Derived from the 3D SEM, gross thickness maps for some of the key stratigraphic zones are presented below. The gross thickness of the primary storage reservoir, the UCPZ-1, is provided in **Figure 1-11**; the Pine Key (Taylor) represents the zone's base. Near the proposed injection wells, inside the modeled CO_2 plume area, the zone is estimated to [redacted]. The gross thickness of the primary confining interval, the anhydrite-rich interval of the Cedar Keys, is provided in **Figure 1-12**. The gross thickness of this anhydrite-rich confining interval over the CO_2 Plume area [redacted]. Further down this section, below the chalky Pine Keys Formation, another carbonate-rich zone, the Washita Reservoir (UCPZ-2), represents a potential secondary reservoir zone, [redacted], **Figure 1-13**. The Atkinson overlies the UCPZ-2 and is considered its confining zone; its [redacted] **Figure 1-14.**

CLAIMED AS CBI

[redacted]

CLA MED AS CBI

[redacted]

CLAIMED AS CBI [redacted]

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

Lloyd (1991) presented a regional synthesis of the present-day structural patterns that exist across the state of Florida. The analysis shows gentle arches and synclines forming along Florida's peninsular arch as shown earlier in **Figure 1-2**.

Several existing 2D seismic lines were licensed for review. These lines were studied to determine whether any significant features, like faults, penetrated the storage complex. The closest of these 2D lines ran along Fort Green Road, flanking the east side of the proposed storage area, **Figure 1-15**. This 2D line was acquired in 1972, is 13.6 miles in length, has a seismic fold of 12, and a geophone interval of 330 ft, **Figure 1-16**. CLAIMED AS CBI [redacted] Structurally, this area is considered uninteresting as there is no local orogenesis or rifting. However, smaller structural features can exist, and these would be associated with the strata reacting to sediment loading.

A 3D seismic data acquisition will be gathered as described in **Section 7.1 of the Testing and Monitoring Plan**. The borehole imaging listed in **Section 5.2.2.1 of the Pre-Operational Testing Plan** can provide evidence for any fracturing or faulting that may be present and is part of the site's characterization plan.

CLAIMED AS CBI

[redacted]

CLAIMED AS CBI

[redacted]

1.2.2.2 Subsidence Features

There are no mapped elements such as faults, arches, or other structural features that would impact the integrity of the confining system. This determination is based on interactive maps from Florida's Department of Environmental Protection. Furthermore, there are no incidents or reports of subsidence in or near the PCSC that would affect the integrity of the confining system, **Figure 1-17**. In terms of shallow geohazards, the PCSC site is located in Florida's "Area IV region," which consists of cohesive sediments interlayered with discontinuous carbonate beds. There are very few sinkholes in this area. There are two sinkholes (Subsidence Incidence Report) in the AoR, **Figure 1-17.** Neither will affect any drilling-related activities.

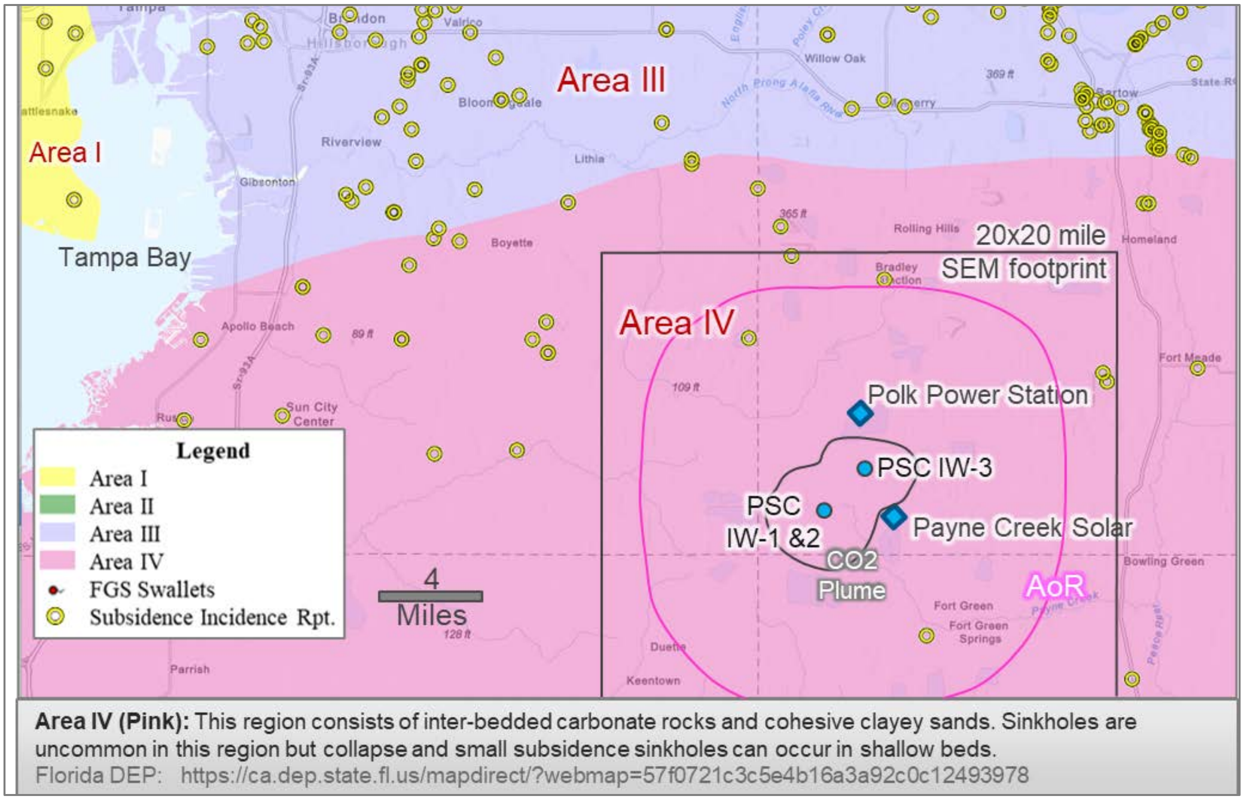

Figure 1-17. Risk classification and subsidence report map in Polk County and adjacent area.

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

Lithological Descriptions and Depositional Environments of Potential Storage Zones

PCSC is considering two storage reservoirs for CO_2 storage – the Upper Cretaceous Permeable Zone 1 (UCPZ-1) and the Upper Cretaceous Permeable Zone 2 (UCPZ-2), as summarized in **Table 1-5.** The extensive logging and coring of the two Class I wells at Polk Power Station serve as the basis for identifying upper and lower CO_2 storage reservoirs. Type logs from the TEC_IW-2 are shown in **Figure 1-6,** which outline the two proposed CO_2 storage zones. Both storage zones were deposited on a shallow, partially restricted marine shelf with little to rare terrigenous sources. The permeabilities given in **Table 1-5** are based on core testing, an in-situ pressure tests that includes packer testing, recirculation testing, and spinner log tests.

The upper storage complex, UPCZ-1, has a reservoir zone at a depth of 4,200 ft MD and is sufficiently deep for supercritical CO_2 storage. The UCPZ-1 (Lawson, paired with the lower Cedar Keys) has a CLAIMED AS CBI [redacted] in the proposed storage area, **Figure 1-11**. The upper reservoir is comprised of carbonate and evaporite units of the lower Cedar Keys Formation and carbonate rocks in the Lawson Formation. The upper member of the Lawson Formation is pale yellowish brown dolostone and dolomitic limestone with weakly sucrosic and vuggy secondary porosity. The lower member of the Lawson Limestone is primarily very pale orange limestone and marked by the abrupt lack of dolostone. Petrophysical analysis conducted on available core samples paired with well logs obtained from TEC_IW-1 and TEC_IW-2 provided reservoir properties for these members. Photos of example cores are shown in **Figure 1-18**. The Lower Cedar Keys had an [redacted], and the Upper Lawson had an [redacted] The Lower Lawson has an [redacted] Wastewater injection data from TEC_IW-1 and TEC_IW-2 were used to estimate average injection zone permeabilities for the Upper and Lower Lawson. [redacted] these results are described further in **Section 2A.1 of the Computational Modeling Details** section. For the proposed injection wells, the depth prognosis for this storage complex and the UCPZ-2 is given in **Table 1-7**.

The lower, deeper storage complex, UPCZ-2, is comprised of shale, evaporites, and carbonate units of the Atkinson Formation and undifferentiated carbonate strata of Washita age. The Atkinson Formation's upper member is of shallow water marine origin and is composed of shale, sandstone, siltstone, and a few lenses of limestone; its lower portion is comprised of dense dolomite. The Atkinson has low permeability marked by approximately 90 feet of low permeability clay and lignitic shale, and the lower portion consists of dense limestone and dolomitic limestones. [redacted]

Site-specific data describing the injection and confining zones will be gathered during the drilling of wells and is described in **Section 5.2 of the Pre-Operational Testing Program**. Currently, estimations of porosity and permeability are based on well logs and core test results from wells in Polk County. The petrophysical data values are summarized in **Table 1-5** and are representative of the modeling work conducted for TEC.

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[redacted]

Table 1-5. Estimated reservoir quality parameters for the storage complex. Average MD, average gross thickness and average porosity are based on the modeled CO_2 plume area.

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CO_2 Storage Complex	Caprock & Reservoir	Avg MD (ft)	Avg Gross Thickness (ft)	Avg Porosity (%)	Permeability (md)	Depositional Setting
Upper	Confining zone: Cedar Keys Anhydrite Zone	[redacted]	[redacted]	[redacted]	[redacted]	Shallow subtidal to supratidal environment with intermittent carbonate deposition
	Reservoir: UCPZ-1 (Carbonates) Cedar Key & Lawson Fm.	[redacted]	[redacted]	[redacted]	[redacted]	Shallow subtidal to intertidal depositional environment
Lower	Caprock: Atkinson (Shale)	[redacted]	[redacted]	[redacted]	[redacted]	Shallow marine
	Reservoir: UCPZ-2 (Carbonates) Washita, Undifferentiated	[redacted]	[redacted]	[redacted]	[redacted]	Shelf lagoon to restricted shelf lagoon environments.

Notes. a) Values from laboratory measurements; b) Values from downhole packer testing conducted during well construction; c) Values estimated recently from wastewater injection. d) Value determined from Spinner Test in TEC_IW-1 well (see *Computational Modeling Details* section for more information).

Lithological Descriptions and Depositional Environments of Confining Systems.

The upper storage complex, UCPZ-1, has a confining zone comprised of thick anhydrite and dolostones of the Cedar Keys Formation. These units are interpreted to be deposited on an extensive tidal flat environment with some periods of marine deposition. CLAIMED AS CBI [redacted] At the PCSC site, this formation is CLAIMED AS CBI [redacted] An 800 ft thick anhydrite dominant section from the Cedar Keys has been identified and modeled as the caprock zone for the upper reservoir (UCPZ-1). The net thickness of these anhydrites totals CLA MED AS CBI [redacted] Petrophysical analysis conducted on well logs and core samples obtained from TEC_IW-1 and TEC_IW-2 provided reservoir properties for the anhydrites of the Cedar Keys Formation, which has an CLAIMED AS CBI [redacted] The low porosity and permeability values of this formation's anhydrites make it a very favorable confining zone. CLAIMED AS CBI [redacted]

Table 1-6. Permeability and threshold entry pressure of anhydrite confining zone.

Well	Formation	Sample Depth	Displacing Fluid	Test Temp	Confining Stress	Pore Pressure	Permeability to Brine	Threshold Entry Pressure
		(ft)	Gas	°F	psi	psi	mD	psi
TEC_IW-2	Anhydrite	CLAIMED AS CBI [redacted]						

Table 1-7. Prognosis of formation top depths for the three proposed injection wells. These top estimates are where the regionally contoured surfaces intersect the well trajectories. (Measured depth) MD from well Kelly Bushing. The Oldsmar Formation and shallower are interpolated from the TEC_IW-2 well.

System	Stratigraphic Unit	Hydrogeologic/ Storage System	Top Depth [MD] (ft)		
			PSC_IW1	PSC_IW2	PSC_IW3
Cenozoic	**Hawthorn Grp**	USDW	CLAIMED AS CBI [redacted]		
	Suwannee Ls.	USDW			
	Ocala Ls	Semi Confining			
	Avon Park Fm	USDW			
	Oldsmar Fm	USDW			
	Cedar Keys (top)	Observation/Monitoring Zone			
	Anhydrite Top	Anhydrite Caprock Zone			
	UCPZ*- 1 (top)	Saline Reservoir			
Upper Cretaceous	**Upper Lawson**	Saline Reservoir			
	Lower Lawson	Saline Reservoir			
	Pine Key (Taylor)	Tight zone			
	Pine Key (Austin)	Tight zone			
	Atkinson	Confining Zone			
	Washita (UCPZ-2)**	Saline Reservoir			
	Dollar Bay	Semi Confining			

* UCPZ: Upper Cretaceous Permeable Zone
** Undifferentiated Panther Camp, Rookery Bay, and Corkscrew Swamp Formations

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

TEC, through a third-party testing lab, conducted bench-scale rock mechanics tests to assess the compressive strength, tensile strength, compressibility, and fracture pressure among other geomechanical properties of the Cedar Keys anhydrite and the Lower Lawson reservoir zones. Samples for these tests were acquired during the drilling of TEC's Class I wastewater injection wells, TEC_IW-1 and TEC_IW-2. One sample from the Cedar Keys anhydrite caprock and two samples from the Lower Lawson reservoir were used for geomechanical analyses. The depths and relevant properties of these samples are listed in **Table 1-8**. None of the samples showed any indication of natural fractures.

Table 1-8. Samples used for geomechanical testing at PCSC.

Well Name	Formation	Core Depth (ft)	Sample Orientation	Diameter (in)	Length (in)	L:D Ratio	Mass (g)	Bulk Density (g/cc)
TEC_IW-2	Anhydrite	3873.05	Vertical	CLAIMED AS CBI [redacted]				
TEC_IW-2	Lower Lawson	4731.00	Vertical					
TEC_IW-2	Lower Lawson	4737.35	Vertical					

Three types of tests were conducted on these samples:

- Triaxial compressive strength – Sample is subjected to loading in three principal stress directions to assess stress-strain relationships, ductility, and elasticity of a rock sample.
- Indirect tensile strength (Brazilian test) – Sample is subjected to loading from opposite directions along a single axis to determine the tensile strength of a rock.
- Pore volume compressibility – Sample is saturated with brine and subjected to uniaxial loading while being measured for pore volume.

Testing was conducted in compliance with the ASTM- D7012-14e1 standard. [23]

Prior to testing, samples were conditioned by saturating with synthetic brine that is compatible with carbonate rocks. Cylindrical core plug test samples were acquired from whole core using a wire saw and cut to a 1.5 in. diameter rough cylinder. The ends were trimmed with the same wire saw to create the proper length for each designated test. A lathe with a polycrystalline diamond contacts (PDC) tipped bit was used to create a perfect right cylinder for RMA testing.

Geomechanical test results for the three samples are summarized in **Table 1-9**.

Table 1-9. Summary of triaxial test and Brazilian tensile strength tests testing results at PCSC.

Formation	Core Depth (ft)	Confining Stress (psi)	Young's Modulus (psi)	Tensile Strength (psi)	Poisson's Ratio
Anhydrite	CLAIMED AS CBI [redacted]				
Lower Lawson					
Lower Lawson					

As a primary observation from the values presented in **Table 1-9**, CLAIMED AS CBI [redacted]

[23] ASTM International, 2023. Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures. ASTM D7012-14e1, updated July 06, 2023.

CLA MED AS CBI [redacted]

TEC used the data in **Table 1-9** to estimate fracture pressure gradients in the confining layer and the reservoir zones. For this, TEC used three methods that relate Poisson's ratio or tensile strength, overburden pressure, pore pressure, and fracture pressure:

- Method 1 proposed by Eaton (1969) [24] which estimates the minimum horizontal stress to propagate a fracture (S_{Hmin}),
- Method 2 proposed by Blanton and Olson (1999) [25] which also estimates the minimum horizontal stress to propagate a fracture (S_{Hmin}),
- Method 3 proposed by Fjær *et al.* (2008) [26] which estimates the maximum pressure to initiate a fracture ($P_{f,max}$)

Note that S_{Hmin} is equivalent to the pressure at which a fracture that has already been initiated closes, meaning injection pressure at or above this value will propagate an already existing fracture. Whereas Pf, max is equivalent to a pressure at which a fracture is generated in an unfractured reservoir rock, meaning injection pressure at or above this value will generate a fracture in an unfractured reservoir. The true value of fracture pressure for the reservoir is likely between these two values.

In all the calculations, TEC assumed an overburden pressure gradient CLAIMED AS CBI [redacted] Resulting calculated fracture pressure for the Cedar keys anhydrite and the Lower Lawson reservoir zone are listed in **Table 1-10**.

Table 1-10. Samples used for geomechanical testing at PCSC. Values in parentheses indicate gradients calculated based on pressure values and depth of the zone of interest.

Formation	Core Depth (ft)	S_{Hmin} (Method 1, psia)	S_{Hmin} (Method 2, psia)	$P_{f,max}$ (Method 3, psia)	Average fracture pressure (psia)
Anhydrite	CLAIMED AS CBI [redacted]				
Lower Lawson					
Lower Lawson					

Notably, the fracture pressure values suggested by Method 1 and Method 2 are smaller than those predicted by Method 3. The difference between these values is that S_{Hmin} is the pressure required to continue to propagate an existing fracture in an ideal condition (tensile strength of the rock is zero) whereas $P_{f,max}$ is the maximum injection pressure that the reservoir could sustain prior to inducing a fracture wherein no previous fractures are present. The actual pressure at which a fracture is initiated is expected to lie between these two values, which is why an average is presented. CLAIMED AS CBI [redacted]

[24] Eaton, B.A., 1969. Fracture Gradient Prediction and Its Application in Oilfield Operations. *J. Pet. Technol.* 21 (10): pp. 1353–1360.
[25] Blanton, T.L., & Olson, J.E., 1999. Stress Magnitudes from Logs: Effects of Tectonic Strains and Temperature. Software - Practice and Experience, 47-53.
[26] Fjær, Erling & Holt, R. & Horsrud, Per & Raaen, Arne & Risnes, Rasmus, 2008. Petroleum Related Rock Mechanics. 2nd edition..

CLAIMED AS CBI [redacted]

For pore volume compressibility, a reservoir sample from TEC_IW-2 at CLAIMED AS CBI [redacted] was used. The sample was saturated with brine comparable to reservoir brine and was subjected to an overburden CLAIMED AS CBI [redacted]. A radial stress was maintained to ensure there was no strain in the radial direction to simulate a uniaxial strain test per ASTM guidelines. Axial strain was then applied, and deformation was measured in conjunction with changes in pore fluid volumes. Sample dimensions and measured fluid volumes as well as applied stress measurements were used to compute results shown in **Table 1-11**.

Table 1-11. Samples used for geomechanical testing at PCSC.

Formation	Core Depth (ft)	Porosity	Bulk Compressibility (psi^{-1})	Grain Compressibility (psi^{-1})	Pore Volume Compressibility (psi^{-1})
Lower Lawson	CLAIMED AS CBI [redacted]				

The pore volume compressibility value of CLAIMED AS CBI [redacted] was used as input to the dynamic reservoir simulation model as noted in **Section 2.3.4 of the AoR and Corrective Action Plan** attachment.

CLAIMED AS CBI [redacted]

Details on core acquisition and testing at PCSC are addressed in **Section 5.2.2.3 of the Pre-Operational Testing Program** attachment. For each injection well, TEC also intends to acquire a dipole sonic log to analyze the existence of fractures as well as provide indications of pressure-wave (P-wave) and shear-wave (S-wave) velocities that could later be used to connect with P-wave and S-wave velocities on core samples and obtain a more complete geomechanical description of the wellbore. Triaxial strength tests will be conducted on reservoir and caprock samples to determine site-specific Young's Modulus, Poisson's ratio, and compressive strength. Combined ultrasonic and triaxial testing with Mohr-Coulomb analyses will help determine borehole stability and breakout potential. Additionally, sonic logs collected from the wells will be used to replicate the calculations discussed in this section to compute fracture gradients to supplement such determinations from triaxial and/or Brazilian tensile strength tests that will be conducted on core plugs or sidewall core samples. Additionally, fracture or parting pressure of the sequestration zone and primary confining layer and the corresponding fracture gradients will be determined via step-rate or leak-off tests as indicated in **Section 5.2.2.6 of the Pre-Operational Testing Program** attachment.

While site-specific stress orientations and values are not available, **Figure 1-19** provides regional trends for the maximum horizontal stress for eastern North America. It is postulated that these data are rarely collected in Florida since the area is structurally "benign" or gentle because the region does not have any known orogenesis or rifting. While significant structural (tectonic) features are not expected in the AoR, 2D and 3D seismic surveys will be conducted to further characterize the storage complexes.

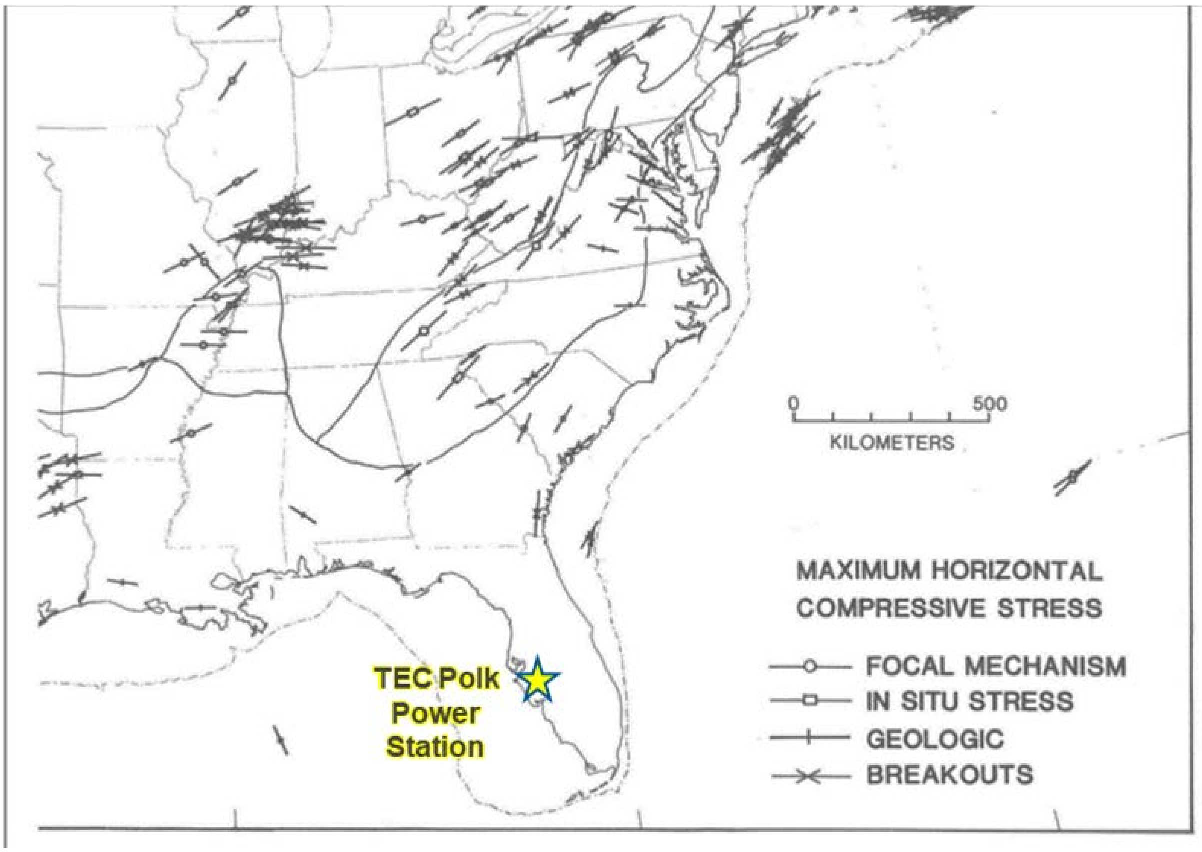

Figure 1-19. Map of maximum horizontal compressive stress orientations. Solid, continuous curves delineate different physiographic province boundaries. [27]

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

Polk County, Florida, has not historically experienced significant seismic activity compared to regions along tectonic plate boundaries or fault lines. No known seismic events have occurred within the region of the project site or near Polk County. The area is considered relatively stable in terms of seismicity, with few recorded seismic events. Sources of data characterizing the seismic

[27] Zoback, M. L., and Zoback, M. D., 1989. Tectonic stress field of the continental United States, in Pakiser, L. C., and Mooney, W. D., Geophysical framework of the continental United States: Boulder, Colorado, Geological Society of America Memoir 172.

history of Polk County and its vicinity are predominantly documented by seismic monitoring networks operated by the United States Geological Survey (USGS), local seismograph stations, and historical records. These sources compile seismic data from both natural and induced seismic events over time. The USGS Earthquake Hazards Program and the National Earthquake Information Center (NEIC) are primary sources of seismic data, providing information on earthquakes of various magnitudes and their geographical distribution. The USGS has prepared a national seismic hazard map and estimations of peak ground acceleration; clearly, Florida is at low risk for experiencing seismicity, **Figure 1-20.**

The most recent earthquake felt in Florida occurred on January 28, 2020, near the town of Century in the Florida Panhandle. This 3.8 magnitude earthquake was felt by some residents and is associated with the Bahamas Fracture Zone in Alabama. However, it's important to note that earthquakes of this magnitude are relatively rare in Florida, and larger seismic events are even less common. The region around Polk County, Florida, is not associated with active tectonic plate boundaries or major fault lines that typically generate frequent seismic activity. Earthquakes in Florida are relatively infrequent and usually linked to natural processes such as subsidence or stress release in response to human activities like mining or groundwater extraction. Florida does not have the same level of seismic activity as areas along plate boundaries or fault zones.

Given the limited history of seismic activity in Polk County, the risk to subsurface containment intervals for carbon sequestration is considered very low. Geomechanical studies and fault stability analyses can provide crucial data to demonstrate that seismic activity poses minimal risk to storage complexes. These analyses may include examining subsurface rock formations, stress distribution, fault conditions, and the mechanical properties of the geological materials. Results indicating stable geology, absence of active faults, and low-stress levels can support the conclusion that seismic activity is unlikely to pose a significant risk to subsurface containment.

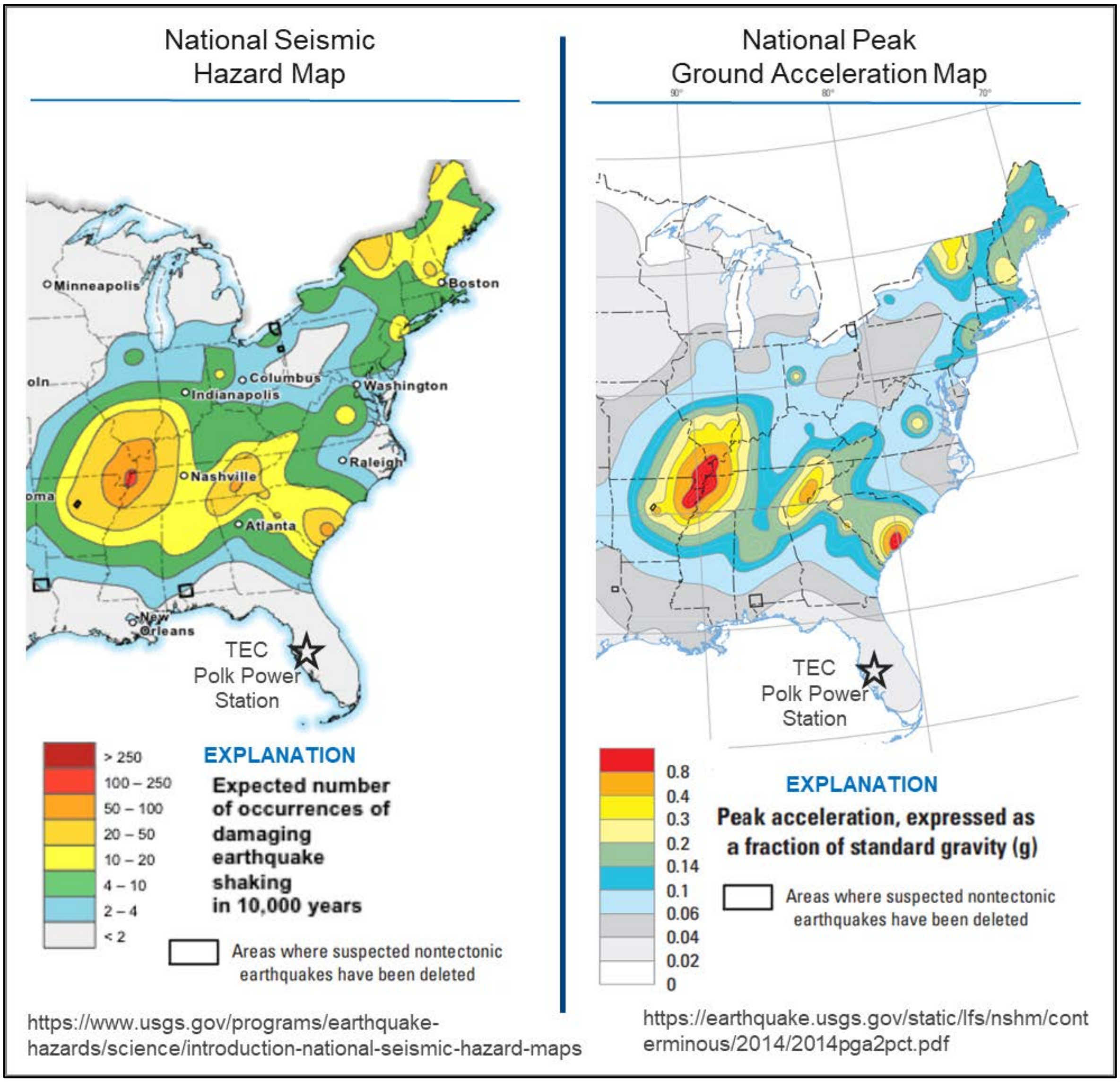

Figure 1-20. National Seismic Hazard and Peak Grounds Acceleration Maps for the Eastern U.S. These maps indicate that Florida is at very low risk for seismic hazards. Image modified from the USGS.

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

The underground sources of drinking water in South Florida generally consist of three hydrological units. [28]

- Surficial aquifer system
- Intermediate aquifer system
- Floridan aquifer system

[28] Spechler, R.M., and Kroening, S.E., 2007. Hydrology of Polk County, Florida: U.S. Geological Survey Scientific Investigations Report 2006-5320, 114 p.

The uppermost hydrological unit in the area is referred to as the surficial aquifer system, **Figure 1-21.** It consists mostly of sand, and locally contains gravel and sandy limestone of Pliocene to Holocene age. The thicker permeable sediments of the surficial aquifer system have been assigned to local aquifers. The general water flow direction is normally from northeast to southwest, as noted in **Figure 1-21,** but this can be locally altered due to water extraction.

The thickness of the surficial aquifer system varies widely throughout southeastern Florida, but generally ranges from 100 to 200 ft in inland areas (Spechler and Kroening, 2007). In some areas, it is the primary source of drinking water and serves as a recharge zone for deeper aquifers.

The intermediate aquifer system, sometimes referred to as the upper confining unit, overlies and confines the Floridan aquifer system. It includes all low-permeability late and middle Miocene beds. [29] Local aquifers are present in the upper confining unit where thick, permeable sand beds or sandy limestone beds are present, including the intermediate aquifer system of southwestern Florida. The intermediate aquifer system is an important source of water in several counties in southwestern Florida, where the underlying Floridan aquifer system is brackish or saline. The permeable beds within the Hawthorn Group form this aquifer in that area. This aquifer system is a complex assembly of carbonate and siliciclastic sediments with abrupt contacts between facies, resulting in permeable zones that are only locally hydraulically connected (Spechler and Kroening, 2007).[31] Near the Tampa, Florida area, the intermediate aquifer system upper confining unit has been breached by sinkholes, and groundwater withdrawals from the Upper Floridan aquifer have resulted in lowered water levels in some lakes and wetlands near major pumping centers.

The Floridan aquifer is a thick sequence of permeable limestone and dolostone of mostly Tertiary age. It consists of Upper Floridan and Lower Floridan units, which are separated by a confining zone. The top and bottom of the Floridan aquifer system are confined by lower permeability rock. A vertical continuous sequence of permeable carbonate rocks is usually used to define the top of the Floridan aquifer. Due to its broad area, no single formation or stratigraphic unit marks the top of the Floridan aquifer system; therefore, local or regional variations in permeability and connectivity are used to define which carbonate units are included or excluded from the Floridan aquifer system (Spechler and Kroening, 2007).[31]

[29] Miller, J.A., 1986. Hydrogeologic framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama, and South Carolina: U.S. Geological Survey Professional. Paper 1403–B, 91 p.

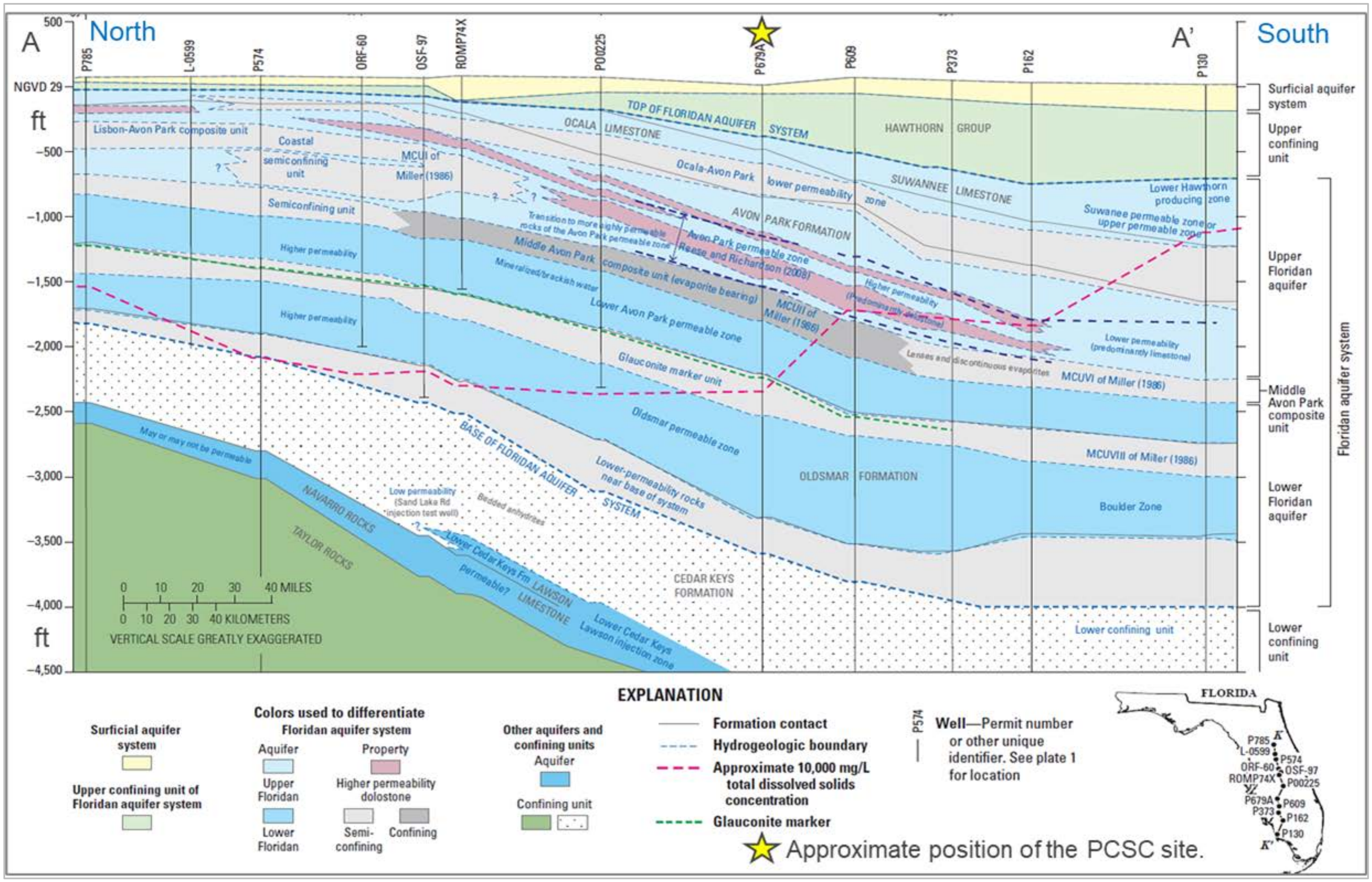

Figure 1-21. Cross section depicting the hydrological units in Florida (image taken from William et al., 2015). [30]

[30] Williams, Lester J., and Eve L. Kuniansky, 2015. Revised Hydrogeologic Framework of the Floridan Aquifer System in Florida and Parts of Georgia, Alabama, and South Carolina. 1807. U.S. Geological Survey.

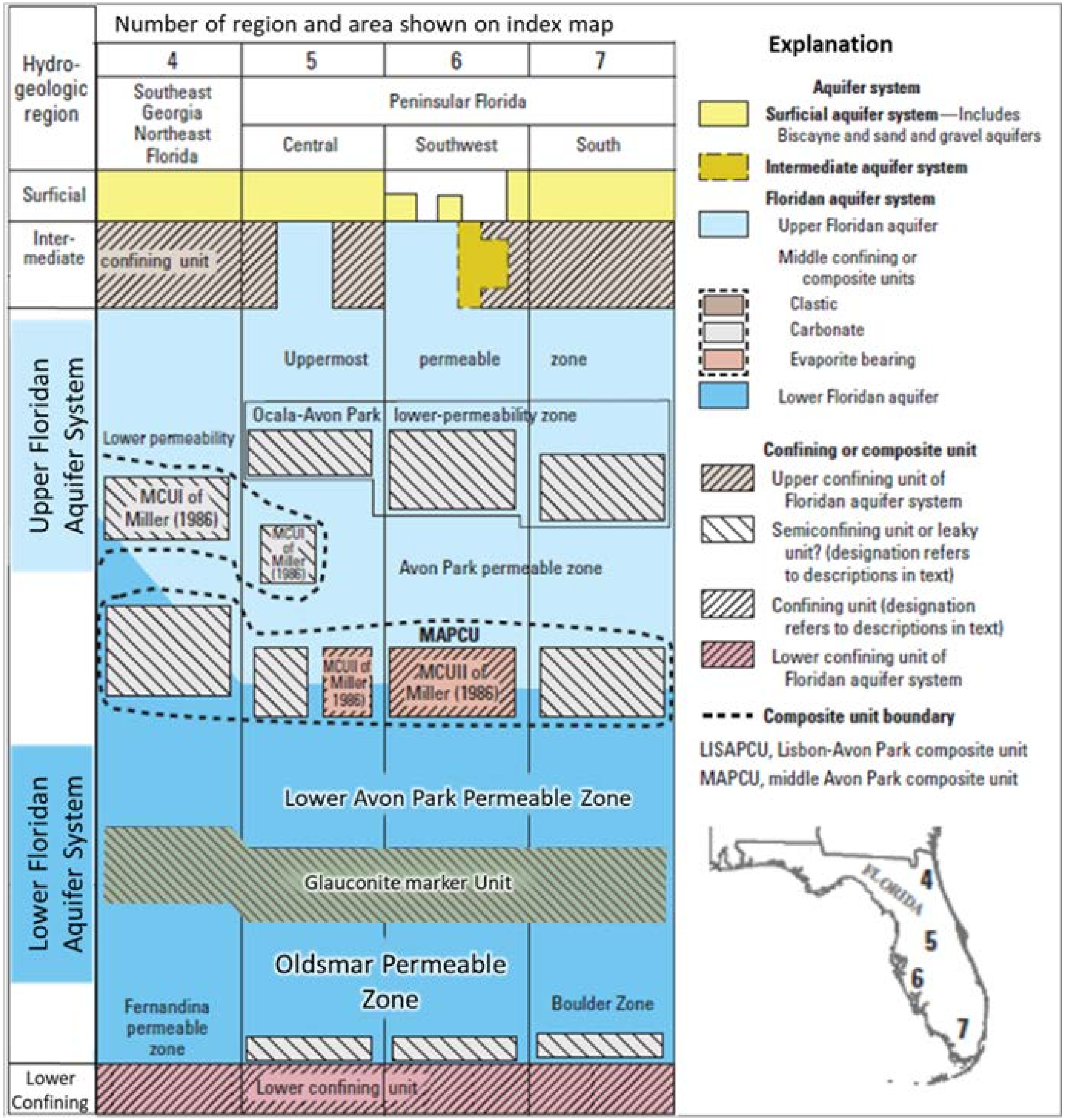

Figure 1-22. Aquifers and Composite and Confining Units of the Floridan Aquifer System, Southeastern United States. (Polk and adjacent counties are encompassed in the Southwest Peninsular Florida description). [31]

The base of the Floridan aquifer system is marked by the lower confining unit, consisting of predominantly low permeability late Paleocene to middle Eocene rocks. In north-central, central, and southern Florida, the base of the Floridan aquifer system is marked at the top of a distinctive massively bedded anhydrite sequence within the middle two-thirds of the Cedar Keys Formation.

[31] Spechler, R.M., and Kroening, S.E., 2007. Hydrology of Polk County, Florida: U.S. Geological Survey Scientific Investigations Report 2006-5320, 114 p.

The lowermost USDW level, defined by 10,000 mg/L occurs in the lower part of the Floridan aquifer and is depicted in **Figure 1-23.** The regional trend indicates that at the PCSC, the corresponding depth occurs between [redacted]. As a conservative approach, the lowermost USDW depth at PCSC is assumed to be [redacted]

The surface bodies of water in the PCSC project area are mapped and displayed in **Figure 1-23**. The water well data for PCSC is detailed in **Section 2.4.1 of the Area of Review and Corrective Action Plan**.

[redacted]

Amongst the 13,410 permitted water wells in four counties that encompass the portions of AoR, the aquifer has been classified for approximately 92% of them (Spechler and Kroening, 2007)[31],

Table 1-12. According to this classification, no well targets the Lower Floridan Aquifer, which forms the lowermost USDW in the project area.

Table 1-12. Aquifer classification for permitted water wells in four counties that encompass AoR.

Aquifer	Percentage of permitted classified wells			
	County			
	Hardee	Hillsborough	Polk	Manatee
Surficial	6	4	8	1
UCU, upper confining unit IAS, intermediate aquifer system or intermediate confining unit	16	4	1	16
Upper Floridan aquifer; UPZ, upper permeable zone	18	64	54	43
Upper Floridan aquifer and Avon Park permeable zone	61	29	36	40
Lower Floridan aquifer	0	0	0	0
Combined Upper and Lower Floridan aquifers	0	0	0.2	0
Others	0	0	0	0

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

TEC collected site-specific fluid samples and core data from wastewater injection wells TEC_IW-1 and TEC_IW-2 to determine the formation's fluid and rock geochemical composition. Core analysis was conducted to estimate the porosity, permeability, and grain density. Grain density estimations combined with x-ray diffraction (XRD) evaluation were used to determine the mineralogical composition of the caprock zone (Cedar Keys) and the UPCZ-1 injection zone (Lower Lawson). **Table 1-13** shows the mineralogical composition of the storage zone formations. Site-specific fluid samples at different depths were obtained from TEC_IW-1 prior to the wastewater injection. The in-situ fluid geochemistry of the storage zone is shown in **Table 1-14.**

CLA MED AS CBI [redacted] The chemical reactions between dissolved CO_2 and reservoir minerals are controlled by their chemical compatibility.

Raza *et. al* (2019) studied the impact of geochemical reactions on CO_2 trapping in limestone and sandstone aquifers. The study included a numerical simulation of injecting CO2 into a limestone aquifer that has a mineral composition of 98% calcite, CLA MED AS CBI [redacted] The study found that geochemical reactions in limestone aquifers lead to an increase in porosity up to 16% 500 years post injection. The dissolution of calcite occurs 200 years post injection as the dissolved CO_2 in brine increases. Overall, CO_2 mineral trapping is very low compared to other tapping mechanisms. At 500 years post injection, mineralized CO_2 is less than 1% of total injected CO_2 [32]. Therefore, the potential for geochemical alteration of reservoir fluid chemistry and reservoir mineralogy is minimal during the lifetime of the proposed project. In addition, a study conducted by Mark (2010) on one of the PCSC storage formations concluded that the injection of CO_2 into carbonate rock will not drastically alter the formation porosity. [33]

CLA MED AS CBI [redacted]

TEC conducted the dynamic testing using core plug test. The test was conducted through the co-injection of CO_2 and brine at reservoir temperature and pressure on core samples from the Lower Lawson. Routine Core Analysis (RCA) was conducted at each core before and after the core plug test to observe the changes in grain density, porosity and permeability. As shown in **Table 1-15**,

CLA MED AS CBI [redacted]

Reactive transport modeling was performed to investigate the impact of geochemical reactions on reservoir rock properties due to CO_2 injection in PCSC storage formations. The long-term impact on the storage formations due to CO_2 injection was the focus of the simulation. In total 900 years of injection and post-injection period were modeled. The study includes investigating the possibility of CO_2 mineral trapping (mineralization), change in in-situ fluid pH, salinity changes and porosity and permeability alterations. Model inputs of the initial in-situ fluid chemistry and reservoir rock mineralogy were obtained from the analysis conducted by TEC on the collected site-specific fluid samples and core data from wastewater injection wells TEC IW-1 and TEC IW-2. CLA MED AS CBI [redacted]

[32] Raza, A., Gholami, R., Rabiei, M., Rasouli, V., Rezaee, R., & Fakhari, N. (2019). Impact of geochemical and geomechanical changes on CO2 sequestration potential in sandstone and limestone aquifers. *Greenhouse Gases: Science and Technology*, *9*(5), 905-923.

[33] Thomas, Mark. 2010. "Geochemical Modeling of CO_2 Sequestration in Dolomitic Limestone Aquifers." USF Tampa Graduate Theses and Dissertations.

[34] French Creek, Water Treatment Modeling Software, https://www frenchcreeksoftware.com/.

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[redacted] For more details on the reactive transport modeling set up and results analysis, please refer to **01_AppendixA**.

To address any spatial variations in geochemical interactions due to typical heterogeneity in carbonate rocks, TEC will acquire new core samples from the caprock and storage zone to determine the petrophysical and mineralogical properties of the PCSC caprock and storage reservoir (see **Section 5.2.2.3 of the Pre-Operational Testing Program**). Mineralogical analysis will be used to determine whether there is a presence of additional reactive minerals within the PCSC caprock and reservoir at the injection locations. TEC will also collect fluid samples from the injection zone and shallower zones to establish a baseline geochemical composition of reservoir fluids and rocks. Collected fluid samples will be used to develop synthetic brine compositions to run core flooding studies to assess possible interactions between injected CO_2, reservoir matrix, and in-situ brine. Fluid samples will be analyzed to determine possible changes in brine chemistry before and after CO_2 injection. Reservoir samples subjected to geochemical testing will be imaged pre- and post-testing to assess changes in the rock matrix. If TEC determines geochemical changes to reservoir rock or fluids are prominent as concluded from these tests, a reactive transport model will be built in GEM and coupled with the current reservoir model to assess long term fate of injected CO_2 as it is related to mineralogical changes in the reservoir.

Table 1-13. Mineralogical composition of the injection zone and caprock. Data is based on existing core samples from TEC's existing wastewater injection wells.

		Framework Silicate			Clay	Carbonate					Other					
Well Name	**Formation Name and depth (ft)**	**Qtz %**	**Plag %**	**Kfsp %**	**Clay %**	**Cal %**	**Mg-Cal %**	**Dol %**	**Fe-Dol %**	**Sid %**	**Apt %**	**Ana %**	**Hal %**	**Pyr %**	**Anh %**	**Gyp %**
TEC_IW-1	CLAIMED AS CBI [redacted]															
TEC_IW-2	[redacted]															
TEC_IW-2	[redacted]															
CLAIMED AS CBI [redacted]																

Table 1-14. Site-specific in-situ brine geochemistry obtained from TEC DIW-1.

Water Quality Parameter	Sample Depth Interval (feet bls)												
	1,200	2,700	2,990	3,200	3,400	3,690	3,840	4,800	5,980	6,500	7,100	7,900	7,980
Alkalinity (CaCO3 mg/L)	CLAIMED AS CBI [redacted]												
Calcium (mg/L)													
Chloride (mg/L)													
Iron (mg/L)													
Magnesium (mg/L)													
pH (std. units)													
Specific Conductivity (µS/cm)													
Sulfate (mg/L)													
Total Hardness (mg/L $CaCO_3$)													
Non-Carbonate Hardness (mg/L CaCO3)													
Total Dissolved Solids (mg/L)													

Table 1-15. Summary of dynamic testing of Lower Lawson core results.

Formation Name	Depth (ft)	Brine: CO_2 ratio	Brine Rate (ml/min)	CO_2 Rate (ml/min)	Total Fluid Thruput pore vol.	Sample Status	Grain Density (g/cc)	Porosity (%)	Perm to Air (mD)	Perm to Brine (mD)
Lower Lawson	CLAIMED AS CBI [redacted]									
Lower Lawson	[redacted]									

CLA MED AS CBI

[redacted]

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

TEC does not plan to collect any surface air and/or soil gas data at the proposed storage site.

1.3 Site Suitability [40 CFR 146.83]

The proposed storage site on the west limb of Florida's peninsular arch is comprised of thousands of feet of gently dipping carbonate beds comprised of various carbonate textures. Other intervals, like that of the Cedar Keys Formation, contain several hundred feet of anhydrite, offering a very promising seal to the primary storage zone of interest, the UCPZ-1. Although the carbonates intervals have significant heterogeneity that is typical for carbonate rocks, some intervals, as targeted here, are particularly more porous and permeable than others.

As discussed in **Section 1.2.7**, adverse reactions between the carbon dioxide stream and the target reservoir, the carbonate rocks are not anticipated. The injection zone's mineralogy is anticipated to be like that encountered in the wastewater injection wells at Polk Power Station, which have not seen any changes in injectivity resulting from the injection of mildly acidic wastewater. This can be attributed to the fact that calcite is the dominant lithology [redacted] in the Lower Lawson injection zone which, despite its tendency to react with carbonic acid, maintains a chemical equilibrium with fluid in the pore space due to buffering effects. [redacted] Therefore, the storage system appears to be geochemically compatible with CO_2 injection. From a metallurgy standpoint, TEC will select corrosion-resistant alloys (CRAs) for well tubular sections that could potentially be in contact with CO_2 to mitigate the corrosive effects of the CO_2 stream and formation fluids. All well construction materials, such as pipe and cement, will be chosen to be compatible with CO_2 in compliance with API 6A standards.

[redacted]

[redacted]

[redacted] The determination of this static storage resource estimate is summarized in **Table 1-16**. The computed mass follows equations from Peck et al. (2014) [35] and is based on reservoir volumetrics, CO_2 density storage efficiency factors. CO_2 density at reservoir conditions was estimated using a pressure-temperature lookup table from NETLCO2-SCREEN (Goodman et al., 2016). [36] This storage capacity paired with proven injectivity is more than adequate for the target injection objectives of the PCSC. Thick, impermeable anhydrite beds found in Cedar Keys Formation offer very favorable confinement for this project. It is doubtful that further confining zones above the Cedar Keys would be necessary to ensure the protection of the shallower USDW.

Table 1-16. Static storage resource estimates based on net reservoir thicknesses over one square mile. P10 represents the most conservative estimate with the greatest confidence. The P90 represents the most optimistic estimate with less confidence. The P50 represents the middle ground estimate of potential storage capacity. The mass CO_2 estimates (MMt) are for one square mile.

Formation	Area [A] (mi^2)	Gross Thickness [h_g] (ft)	Net Thickness [h_n] (ft)	Total Porosity [Φt] (dec.)	pCO_2 (lb/ft^3)	Efficiency Factors (dec.)			Mass CO_2 (MMt)		
						P10	P50	P90	P10	P50	P90
Lower Cedar *	CLAIMED AS CBI [redacted]										
Upper Lawson **											
Lower Lawson **											

$M_{CO2} = A \times h_n \times \Phi_t \times \rho_{CO2} \times E_{saline}$

where:

M_{CO2} = estimated mass of CO_2 storage resource
A = total area
h_n = gross formation thickness
Φ_t = total porosity
ρ_{CO2} = CO_2 density at in-situ pressure and temperature

$E_{saline} = E_\Phi * (E_v * E_d)$

where:

E_Φ = the fraction of total porosity that is effective, i.e., interconnected efficiency factor
E_v = the volumetric displacement efficiency factor
E_d = the microscopic displacement efficiency factor

Storage efficiency factors (E_{saline}) are based on depositional environments:

* Dolomite, unspecified

** Limestone, Shallow Shelf

E_{saline} is the fraction of the total saline reservoir pore volume that is filled by CO_2. E_{saline} is a scalar value less than one and represents the fraction of the pore space that is accessible, in effect, accounting for permeability. E_{saline} is an efficiency factor for saline reservoirs and varies based on lithology and the displacement of brine fluids. As applied here, E_h for reservoir thickness and E_A for reservoir area have been dropped because the net thickness for the reservoir and area is believed to be fully accessible and defined.

[35] Peck, W.D., Glazewski, K.A., Klenner, R.C.L., Gorecki, C.D., Steadman, E.N., and Harju, J.A., 2014, A workflow to determine CO2 storage potential in deep saline formations: Energy Procedia, v. 63, p. 5231–5238.
[36] Goodman, A., Sanguinito, S., Levine, J., 2016. Prospective CO2 resource estimation methodology: Refinement of existing US-DOE-NETL methods based on data availability, International Journal of Greenhouse Gas Control, v. 54, p. 952–965.

Injection and confining zone details, including maps and cross-sections, have been described in earlier sections and relevant parameters are summarized in **Table 1-17**.

Table 1-17. Summary of injection and confining zone parameters.

Parameter	UCPZ-1 (Proposed injection zone) Estimated value or comment	UCPZ-2 (Potential storage zone, not considered for current proposed injection) Estimated value or comment
Depth, areal extent, and thickness of the injection zones. (Computed values are over modeled CO_2 saturation area.)	CLA MED AS CBI [redacted]	[redacted]
Depth, areal extent, and thickness of confining zones. (Computed values are over modeled CO_2 saturation area.)	[redacted]	[redacted]
Thickness variability of the injection and confining zones within the CO_2 saturation area.	[redacted]	[redacted]
Injection and confining zone samples for characterizing mineralogy, porosity, and permeability.	[redacted]	[redacted]
Mineralogy and petrology of the injection and confining zones.	[redacted]	[redacted]

CLAIMED AS CBI

Parameter	UCPZ-1 (Proposed injection zone) Estimated value or comment	UCPZ-2 (Potential storage zone, not considered for current proposed injection) Estimated value or comment
	[redacted]	[redacted]
Mineralogy and geochemical reactions affecting carbon dioxide storage and containment.	[redacted]	[redacted]
Compatibility of the mineralogy of the injection and confining zones with the proposed carbon dioxide stream.	[redacted]	[redacted]
Spatial distribution of porosity and permeability values within the injection and confining zones.	[redacted]	[redacted]
Data used to determine permeability and porosity.	[redacted]	[redacted]
Estimated storage capacity and injectivity of the injection zone? What is the integrity of the confining zone?	[redacted]	[redacted]
Capillary pressure of the confining zone.	[redacted]	[redacted]

1.4 AoR and Corrective Action [40 CFR 146.84]

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)]***

The information and files submitted in the **AoR and Corrective Action Plan** satisfy the requirements of 40 CFR 146.84(b). This plan addresses the details of computational modeling to delineate the AoR, corrective action in the AoR, and triggers for AoR re-evaluation. The AoR is created to encompass the entire region surrounding PCSC where USDWs may be endangered by injection activity. The AoR is delineated by the lateral and vertical migration extent of the CO_2 plume, formation fluids and pressure front in the subsurface. A computational model was built to model the subsurface injection of CO_2 into the storage in PCSC. The GEM simulator was used to assess the development of the CO_2 plume, the pressure front, and the long-term fate of the injection. This plan details the computational modelling, assumptions that are made, and site characterization data that the model is based on to satisfy the requirements of 40 CFR 146.84(c). TEC also notes that there are currently two wells penetrating the storage system. TEC will periodically monitor the AoR for wellbores that could interfere with the storage project and develop corrective actions as necessary. **Figure 1-25** shows the AoR, project infrastructure, and relevant surface and subsurface features near PCSC. Within the AoR, there are no springs, state or EPA subsurface cleanup sites, quarries, or tribal lands but there are active phosphate mines.

CLAIMED AS CBI

[redacted]

1.5 Financial Responsibility

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]***

The **Financial Responsibility** document demonstrates the financial responsibility for injection well plugging/conversion, post-injection site care (PISC) and site closure, and emergency and remedial response according to 40 CFR 146.85. Injection well plugging and costs are estimated according to the **Injection Well Plugging Plan** and PISC and site closure costs are presented to reflect a [redacted] For more details, refer directly to the **Financial Responsibility** document where the financial instrument(s) are outlined, and costs are presented in more detail.

1.6 Injection Well Construction

TEC seeks to drill and construct three new Class VI CO_2 injection wells to support CO_2 storage operations and has designed this well construction plan in accordance with 40 CFR §146.86, pursuant to 40 CFR §146.82. TEC has implemented well design strategies and materials focused on (1) preventing movement of fluids into or between USDWs or into any authorized zones; (2) permitting the use of appropriate testing devices and workover tools and; (3) permit continuous monitoring of the annulus space between the tubing and long string casing. Any necessary changes to this well plan due to logistical or geological conditions encountered within the field will be communicated to the Director prior to well construction.

[redacted]

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

[redacted] Prior to the

stimulation, TEC will provide further details of the stimulation program and will not proceed with the well stimulation operations until approval is received. No other stimulation is proposed.

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

TEC designed all three injection wells to accommodate the maximum instantaneous mass rate that is expected from the capture facility while considering critical characteristics of the CO_2 storage reservoir. CLA MED AS CBI [redacted] Please see the additional **Well Construction Plan** included with this application for further details on the design and construction of these injection wells.

Well design principles and construction materials that are further described in subsequent sections were selected through a vetting process to ensure that they provide sufficient structural strength and sustained mechanical integrity throughout the life of the project. The design is intended to accommodate the use of the appropriate testing devices, workover tools, and continuous monitoring devices that are further described in this application. All materials were selected to be compatible with the fluids that they are expected to encounter throughout the life of the project and to meet any applicable API, ASTM, and International Standards. The portions of the wellbore and wellhead that will be in contact with CO_2 or CO_2 saturated brine, such as the injection tubing, will be a minimum of 15% chrome materials (15Cr). This summary and the additional construction plan illustrates the comprehensive analysis performed to meet the requirements of 40 CFR §146.86 and other related sections.

Injection well drilling is expected to encounter drilling hazards including shallow severe lost circulation in cavernous formations based on previous injection wells constructed by TEC. The injection well designs take into account the experiences and implemented strategies to minimize possible drilling and cementing issues. These measures include known and common practice methods of reverse circulation air drilling and multiple stage cement jobs using packer type diverter tools. The

CLA MED AS CBI [redacted]

CLA MED AS CBI [redacted]

The targeted injection formation will be tested prior to final completion using step-rate testing and pressure fall-off testing. These tests will confirm that the proposed injection zone will be able to receive the required volume of CO_2 while injection pressures will stay below 90 percent of the fracturing pressure. The injection tubing will be a minimum of 15Cr and will be sized to accommodate the expected injection rate. The size of the wellbore will allow monitoring equipment to be placed in the wellbore so that injection and annular pressure can be monitored. The tubing will also be sized such that surveillance logging can be accommodated. More details of the well construction methods and materials will be found in the following sections.

Casing and Cementing

The PCSC injection wells will be constructed with casing and cement that will be compatible with the injected CO_2. A 15Cr alloy or greater casing will be used across the injection zone and caprock. Cement across these sections will be CO_2 resistant. CLA MED AS CBI [redacted] Please see the **Section 4.1 and 4.2** of the **Well Construction Plan** for the details on the nodal analysis results. The design implemented concentric casing sizes required to isolate the injection reservoir from USDWs and prevent fluid flow into any unauthorized zones. In accordance with 40 CFR §146.87, prior to running each casing string, all open-hole logging and testing operations (deviation surveys, open hole logging, and formation testing) will be completed. Please see **Section 5.2 of the Pre-Operational Testing Program** of the permit for a detailed breakdown of which specific methods and tools will be utilized for these wells.

The surface casing string will extend through the shallow USDWs to prevent unintended fluid migration and protect shallow drinking water. The intermediate section will extend through the severe lost circulation zone and the lowermost USDW and be cemented with two stages and a packer type diverter tool. The longstring casing will extend from the surface through the injection interval with a sufficient number of centralizers. Corrosion concerns are from the presence of carbonic acid, resulting from the mixture of carbon dioxide and water, which is mildly acidic and can cause increased corrosion to metal components which it comes into contact with. The quantities of water in the injectate stream will be reduced as much as possible, however, as the CO_2 stream enters the reservoir, it encounters brine and therefore creates an acidic environment. Even though formation fluid is not expected to enter the wellbore, the metallurgy for each casing string was selected to be compatible with the fluids and stresses encountered within the well and meet any applicable API and ASTM standards. CLAIMED AS CBI [redacted] Casing loadings and stress were modeled using SLB's Tubing Design and Analysis (TDAS) software to ensure sufficient structural strength and mechanical integrity throughout the life of the PCSC project. Stresses were analyzed and calculated according to the worst-case scenarios and tubular specifications were selected accordingly. Further information on the analysis of the selected casing is available in **Section 4.5 of the Well Construction Plan**. **Table 1-18** describes the specifications of the selected casing for PSC_IW3. The same specifications will apply to PSC_IW2 and PSC_IW1 but will have different setting depths. Please see the Well Construction Plan for more details of the differences between the injection wells.

Table 1-18. Casing details of PSC_IW3.

Casing String	Casing Depth Interval (ft.)	Borehole Diameter (inch)	Wall Thickness (inch)	External Diameter (inch)	Casing Material (e.g., weight/grade/ connection)
Conductor	CLAIMED AS CBI [redacted]				
Surface					
Intermediate					
Long String					

Tubing and Packer

The tubing connects the injection zone to the wellhead, providing a pathway for safely injecting and storing CO_2. In accordance with 40 CFR § 146.86 (c), the tubing and packer material used for the construction of TEC's injection wells will be compatible with the fluids with which the material may be expected to come into contact with. The packer and tubing were selected to be a minimum of 13% chrome or similar material. The packer will be set to a depth opposite a cemented interval. Any change to the tubing and packer specifics detailed below will be communicated to the Director.

CLA MED AS CBI [redacted] Both the packer and locator seal assembly will feature premium couplings matched to the tubing and will be comprised of 15Cr80 or greater alloy.

Table 1-19. Tubing and Packer details of PSC_IW3

Material	Setting Depth Interval (ft.)	Tensile Strength (Kpsi)	Burst Strength (psi)	Collapse Strength (psi)	Material (e.g., weight/grade/ connection)
Tubing	CLAIMED AS CBI [redacted]				
Packer (Baker Hughes Model F Permanent Packer)					

CLAIMED AS CBI

[redacted]

CLAIMED AS CBI

[redacted]

CLA MED AS CBI

[redacted]

1.7 Pre-Operational Logging and Testing

The **Pre-Operational Testing Plan** was designed to obtain the necessary chemical and physical characteristics of the PCSC injection and confining zones, required to meet the testing requirements of 40 CFR § 146.87 and the well construction requirements of 40 CFR § 146.86. This testing plan includes a combination of well logging, geologic coring, fluid sampling, and hydrogeologic testing which will generate datasets to determine and/or verify the depth, thickness, porosity, permeability, mineralogy, and geochemical profiles of the primary confining zone of the storage complex (Cedar Keys Anhydrite zone) and injection interval (UCPZ-1). The **Pre-Operational Testing Plan** describes the comprehensive collection of data from the first drilled well, the PSC_IW2, which is located on Pad 1 shared by PSC_IW1 180 ft away. Similarly, the details of this plan also apply to PSC_IW3 located approximately 2.25 miles to the northeast. Baseline data will also be collected from formations within and above the PCSC to obtain a baseline description of geology and fluid chemistry which will be later compared against data obtained during the injection phase. Due to the proximity of the three PCSC injection wells, TEC will optimize data collection from injection wells by collecting a comprehensive suite of logs, cores, and other relevant datasets to support Class VI project design and operations. TEC will ensure all regulatory data collection requirements are met for each injection well in compliance with UIC Class VI standards and any applicable state level requirements.

Open-hole and cased-hole well logging data will be collected from PCSC injection wells to obtain *in-situ* physical, chemical, geologic, and geomechanical information from the above-zone and in-zone intervals within the storage complex. Logging, fluid sampling, and core or cuttings analysis will be conducted in the in-zone monitoring wells to fill in data gaps in the site model and aid in understanding the distribution of site parameters. Open-hole logs include gamma ray, spontaneous potential, neutron porosity, formation bulk density, photoelectric factor, resistivity, monopole and dipole sonic logs, resistivity logs, borehole image logs, caliper, nuclear magnetic resonance, and elemental spectroscopy logs. A mud log will be collected during drilling. Cased-hole logs to be collected include cement bond and ultrasonic image logs and distributed temperature sensing fiber optic measurements.

Pursuant to the requirements of 40 CFR § 146.87(b), rock cores will be collected in the form of whole core or sidewall cores to support core analysis studies. TEC will collect core sidewall and whole core) from the confining and reservoir zones, preserve samples on site, and ship them to a commercial core testing facility for analysis. Approximately two 60-foot core runs will be collected from the anhydrite caprock and UCPZ-1 zones. Analysis conducted on select core samples will include routine core analysis (porosity, permeability, grain density, lithology, fluid saturation), geologic/mineralogic analysis (core/thin section descriptions and X-ray diffraction), and special core analysis (geomechanics, geochemical compatibility testing, mercury intrusion capillary pressure (MICP), relative permeability, and threshold entry pressure). Core data (whole core and/or sidewall core) will be collected from subsequent PCSC injection wells and the confining and injection zones to meet the minimum Class VI testing requirements.

Pursuant to 40 CFR § 146.87(c), fluid samples will be collected from the first PCSC injection well to provide baseline profile data for the UCPZ-1 reservoir. Fluid samples will be collected in open-hole conditions using wireline-based formation testing tools. If representative samples cannot be obtained from open-hole conditions, fluid samples will be collected after the well is completed via techniques such as swabbing or pumping through tubing. Fluid sampling methods will sample reservoir pressure and static fluid levels. Fluid samples will be collected, stored, and transported using protocols discussed in **Sections 7A.1 and 7A.2 of the Quality Assurance and Surveillance Plan** (**Attachment A** of the **Testing and Monitoring Plan**). Any fluids introduced into the wellbore environment during drilling, conditioning, cementing, stimulation, or testing will be removed prior to fluid sampling to ensure samples are representative of the subsurface system. For details on baseline sampling in the shallow groundwater wells, please see section **7.1 Overall Strategy, Approach, and Conceptual Design for Testing and Monitoring** of the **Testing and Monitoring Plan.**

Pursuant to 40 CFR § 146.87(a)(4), TEC will conduct tests and run logs as needed to demonstrate the internal and external mechanical integrity of all injection wells prior to initiating CO_2 injection. Internal mechanical integrity testing involves identifying any potential leaks within the tubing, packer, and casing above the packer. External mechanical integrity testing will identify any potential fluid movement/leakage pathways through channels adjacent to the injection wellbore which could result in fluid migration into an USDW. Internal mechanical integrity within each PCSC injection well will be demonstrated by conducting a casing pressure test immediately after running casing into each wellbore segment (surface, intermediate, long string), prior to drilling out the plug on each casing string. Additionally, after each injection well is completed, a standard annular pressure test (SAPT) will be conducted to verify internal mechanical integrity prior to injection. Procedures for annular pressure testing are discussed in **Section 7.6 of the Testing and Monitoring Plan**. External MIT will be verified within PCSC injection wells using cement bond, ultrasonic, and temperature logs and/or distributed temperature sensing (DTS) fiber-optic technology. DTS will be run along the outside of the long-string casing to continuously measure temperature from surface to TD, satisfying 40 CFR § 146.87(a)(4). TEC will notify EPA at least 30 days prior to conducting the test and provide a detailed description of the testing procedure. Notice and the opportunity to witness these tests/logs shall be provided to EPA at least 48 hours in advance of a given test/log.

Pursuant to 40 CFR § 146.87(d) and (e), PCSC injection wells will undergo hydrogeologic testing to determine: (1) fracture pressure; (2) chemical characteristics; (3) formation pressure; (4) feasibility of large-scale injectivity and identification of nearby hydrogeologic boundaries. TEC will utilize a wireline formation testing tool to determine fracture pressure within the confining and reservoir zones via micro-frac tests on select intervals. Micro-frac testing conducted via wireline formation testing tools provide an opportunity to measure fracture-pressure *in-situ* by locally pressuring up a small interval along the wellbore that has been isolated using two micro-packers, thus limiting damage to the formation. Micro-frac measurements will be used to verify, calibrate, and supplement well-log-based estimates of fracture pressure obtained via dipole sonic log analysis. Wireline-formation testing tools will also be used to obtain *in-situ* measurements of formation pressure and collect fluid samples from the reservoir and confining zones (see subsection **5.2.2.4 Fluid Sampling of the Pre-Operational Testing Plan** for the fluid analysis plan). After completion, TEC will perform step rate testing and pressure fall-off testing within PCSC injection wells to verify large-scale injectivity and identify the presence of flow boundaries. Best practices will be followed during hydrogeologic testing. For further information regarding testing procedures, please reference the **Testing and Monitoring Plan**.

1.8 Well Operation

Pursuant to 40 CFR §146.82, TEC prepared the **Injection Well Operations Plan** to describe the planned operation of CO_2 injection wells for the PCSC. The PCSC injection wells will be constructed as indicated in the **Injection Well Construction Plan**.

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

The CO_2 delivered at the PSC_IW1, PSC_IW2, and PSC_IW3 wellheads will meet the specifications presented in Section 7.2 of the **Testing and Monitoring Plan**. The CO_2 will enter a header and be piped to the injection well. The injection well is currently designed to operate continuously. The CO_2 will be in the supercritical phase as it enters the wellhead and will remain in a supercritical phase within the wellbore. The injection well will not be fitted with pumps. CLAIMED AS CBI [redacted]

The PSC_IW1, PSC_IW2, and PSC_IW3 injection wells will all be monitored to ensure safe operations. Safety monitoring includes monitoring the injection pressure at the wellhead and bottomhole, monitoring the pressurized annulus, continuous fiberoptic temperature monitoring along the well, and corrosion coupon monitoring to identify corrosion. Each system is fully described in the **Testing and Monitoring Plan**. The PSC_IW1, PSC_IW2, and PSC_IW3 injection wells will have a wellhead pressure gauges and data loggers, both tied into the injection control system and set to trigger an alarm at the project control room and shut down injection in the well if the MASP is reached. Injection parameters including pressure, rate, volume and/or mass, and temperature of the CO_2 stream will be continuously measured and recorded. The pressure and fluid volume of the annulus between the tubing and long-string casing will also be continuously measured. All automatic shutdowns will be investigated prior to bringing injection back online in the well to ensure that no integrity issues were the cause of the shutdown. If an unremedied shutdown is triggered or a loss of mechanical integrity is discovered, TEC will immediately investigate and identify as expeditiously as possible the cause of the shutdown. If, upon such investigation, the well appears to be lacking mechanical integrity, or if monitoring indicates that the well may be lacking mechanical integrity, TEC will:

(1) Immediately cease injection in the affected well and in any other wells that may exacerbate the leakage risk of the affected well;

(2) Take all steps reasonably necessary to determine whether there may have been a release of the injected CO_2 stream or formation fluids into any unauthorized zone;

(3) Notify the Director in writing within 24 hours;

(4) Restore and demonstrate mechanical integrity prior to resuming injection; and

(5) Notify the Director when injection can be expected to resume.

The annular space between the tubing and long string casing of each injection well will be pressurized with a non-corrosive fluid. The annulus will be monitored continuously to ensure integrity of the well. The annulus will be filled with a 10.6 ppg sodium chloride brine with a corrosion inhibitor and oxygen scavenger additives. The minimum pressure held on the annulus at the wellhead will be between 250 psia and 500 psia, including times of shut-in.

The fiberoptic line cemented into the annulus on the outside of the long-string casing will be used to continuously monitor temperature along the length of the casing. Rapid temperature changes or other excursions from a normal operating temperature profile will be investigated to ensure that there has been no breach of wellbore integrity.

TEC will monitor and maintain mechanical integrity of the PSC_IW1, PSC_IW2, and PSC_IW3 injection wells at all times. Well maintenance and workovers will be treated as normal operations to keep the PSC_IW1, PSC_IW2, and PSC_IW3 injection wells in a safe operating condition. Procedures for well maintenance will vary depending on the nature of the procedure. All maintenance and workover operations will be monitored to ensure there is no loss of mechanical integrity. Barriers will be kept in place to ensure leakage risk is minimized. The PSC_IW1, PSC_IW2, and PSC_IW3 injection wells are designed to allow the installation of a temporary plug in the below the injection tubing to allow the tubing to be removed and replaced as needed while keeping a barrier in place. The bottomhole temperature and pressure gauge is set above the packer to allow for replacement, if needed, without removing the packer from the well.

CLA MED AS CBI [redacted]

The maximum allowable surface pressure (MASP) was estimated by using a Pipesim wellbore model to calculate the wellhead pressure assuming the maximum allowed bottomhole pressure was attained. The bottomhole pressure was set to 90% of the estimated hydraulic fracture pressure at the top perf depth for PSC_IW1, PSC_IW2, and PSC_IW3, CLAIMED AS CBI [redacted] Except during Director-approved well stimulation events (if required), TEC will ensure that the downhole pressures will not exceed 90% of the fracture pressure to maintain the integrity of the PCSC complex.

Operational parameters are expected to remain constant throughout the duration of the injection period. The only possible changes to operational parameters may stem from variations in volume of the CO_2 source, which may lead to lower injection volumes during limited periods of time.

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

CLA MED AS CBI [redacted]. **Table 1-23** below displays the chemical composition of the anticipated CO_2 stream. The CO_2 will be in the supercritical phase as it enters the wellhead and will remain in a supercritical phase within the wellbore. CLAIMED AS CBI [redacted]. Upon injection into the UCPZ-1, the CO_2 will remain in supercritical phase which will allow for minimal interaction with the formation.

Table 1-20. Proposed PSC_IW1 Injection Well Operational Parameters

Parameters/Conditions	Limit or Permitted Value	Unit
Maximum Injection Pressure		
Surface	CLA MED AS CBI [redacted]	
Downhole		
Average Injection Pressure		
Surface	CLAIMED AS CBI [redacted]	
Downhole		
Maximum Injection Rate		
Average Injection Rate		
Maximum Injection Volume and/or Mass (31-year peri od)		
Average Injection Volume and/or Mass (31-year period)		
Annular Pressure		
Maximum Annulus Pressure	CLAIMED AS CBI [redacted]	
Annulus Pressure/Tubing Differential		
Maximum Annulus Pressure at the Wellhead		

Table 1-21. Proposed PSC_IW2 Injection Well Operational Parameters

Parameters/Conditions	Limit or Permitted Value	Unit
Maximum Injection Pressure		
Surface	CLAIMED AS CBI [redacted]	
Downhole		
Average Injection Pressure		
Surface	CLAIMED AS CBI [redacted]	
Downhole		
Maximum Injection Rate		
Average Injection Rate		
Maximum Injection Volume and/or Mass (31-year period)		
Average Injection Volume and/or Mass (31-year period)		

Parameters/Conditions	Limit or Permitted Value	Unit
Annular Pressure		
Maximum Annulus Pressure	CLAIMED AS CBI [redacted]	
Annulus Pressure/Tubing Differential		
Maximum Annulus Pressure at the Wellhead		

Table 1-22. Proposed PSC_IW3 Injection Well Operational Parameters

Parameters/Conditions	Limit or Permitted Value	Unit
Maximum Injection Pressure		
Surface	CLA MED AS CBI [redacted]	
Downhole		
Average Injection Pressure		
Surface	CLAIMED AS CBI [redacted]	
Downhole		
Maximum Injection Rate		
Average Injection Rate		
Maximum Injection Volume and/or Mass (30-year period)		
Average Injection Volume and/or Mass (30-year period)		
Annular Pressure		
Maximum Annulus Pressure	CLAIMED AS CBI [redacted]	
Annulus Pressure/Tubing Differential		
Maximum Annulus Pressure at the Wellhead		

Table 1-23. Specifications of the Anticipated CO_2 Stream Composition

Component	Specification	Unit
Minimum CO_2	CLAIMED AS CBI [redacted]	
Water Content		
Impurities (Dry Basis)		
Total Hydrocarbons	CLA MED AS CBI [redacted]	
Inert Gases (N_2, Ar,)		
Hydrogen Sulfide		
Total Sulfur		
Oxygen		
Carbon Monoxide		
Glycol		

1.9 Testing and Monitoring Plan

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]***

The **Testing and Monitoring Plan** describes how TEC will monitor injection operations at PCSC, pursuant to 40 CFR § 146.90, for the duration of the injection phase of this project CLAIMED AS CBI [redacted]. The **Testing and Monitoring Plan** has been designed to ensure that injection wells are operating as planned, to track the CO_2 plume and pressure front across PCSC to ensure they are moving as predicted, and to ensure the injected CO_2 and/or reservoir fluids do not become a contamination risk to USDWs.

TEC plans to use 15 project wells strategically placed to inject and monitor injection operations and groundwater resources. These wells include three injection and three in-zone monitoring wells completed in the UCPZ-1 storage reservoir, two above-zone monitoring wells completed in the first permeable zone of the Upper Cedar Keys limestone/dolomite, and seven shallow groundwater monitoring wells completed in the Middle Floridan Aquifer.

The **Testing and Monitoring Plan** includes monitoring CO_2 chemical and physical characteristics, injection well mechanical integrity, corrosion, groundwater quality and geochemistry, direct pressure front movement, CO_2 plume migration, and reservoir hydrogeologic properties across PCSC. The chemical and physical characteristics of the CO_2, along with operational parameters (i.e., composition, injection rate, volume, pressure), will be monitored with various surface and downhole equipment, including mass flow meters, a gas chromatograph or equivalent, and pressure/temperature gauges. Internal injection well mechanical integrity will be monitored continuously with an annulus pressure monitoring system, whereas external mechanical integrity will be monitored with temperature measurements using the DTS fiber-optics run from surface to TD. Corrosion monitoring will also be implemented using corrosion coupons of materials that are to be in contact with CO_2. Groundwater quality and geochemistry monitoring will be conducted regularly in the above-zone wells (PSC_AZ 1 and 2) using downhole pressure measurements coupled with fluid sampling analysis. Fluid sampling and analysis in shallow groundwater wells (PSC_GW 1 through 7) may also be used, on an as-needed basis, during the injection phase. For details on baseline sampling in the shallow groundwater wells, please see section **7.1 Overall Strategy, Approach, and Conceptual Design for Testing and Monitoring** of the **Testing and Monitoring Plan**.

Groundwater data from all above-confining zone monitoring wells can be used to detect any measurable CO_2 or brine migration out of the injection zone before it can result in any impacts on USDW aquifer water quality. The CO_2 plume and associated pressure front will be imaged and tracked across PCSC using repeat geophysical surveys and downhole pressure measurements, respectively. Reservoir hydrogeological properties (i.e., injectivity) will be measured with periodic pressure fall-off testing.

Subsurface characterization will also include a 3D seismic survey with a full-fold imaging footprint of approximately 40 square miles. To ensure adequate coverage, the survey design assumes a one-mile perimeter (buffer) around the existing modeled CO_2 plume saturation area. Furthermore, the 3D survey is supplemented with approximately 82 miles of 2D lines radiating out from the 3D survey's footprint. Together, these surveys will be used to characterize the stratigraphic thickness and continuity of the target reservoirs and confining zones and to determine whether any stratigraphic or structural features are present. Furthermore, the 3D seismic survey may serve as the baseline survey for all subsequent seismic surveys at the site. **Table 1-24** summarizes the testing and monitoring methods to be implemented at PCSC. For further detail on the testing and monitoring methods, frequencies, and locations, please refer to the **Testing and Monitoring Plan and Quality Assurance and Surveillance Plan**.

The **Testing and Monitoring Plan** will be reviewed at a minimum of once every five years. The plan will be adjusted accordingly to meet any changes to the facility or site conditions over time. All amended plans will be sent to the Region IV UIC Program Director for approval as outlined in the permit modification requirements in sections 40 CFR § 144.39; § 144.41.

Table 1-24. PCSC testing and monitoring methods and frequencies for all project phases.

Monitoring Category	Monitoring Parameter		Method	Purpose (40 CFR Section Reference)
Monitoring Plan Update	Review Every Five Years		Update as Required	146.90(j)
CO_2 Stream Analysis	Chemical Composition		Gas Chromatograph or Analyzer and/or Physical Sampling	146.90(a) 146.91(a)(2) 146.91(a)(7)
Continuous Recording of Operational Parameters	Injection Pressure		Wellhead Pressure Gauge: Tubing	146.88(e)(1) 146.90(b) 146.91(a)(2)
	Injection Rate and Mass/Volume		Coriolis Mass Flow Meter	146.88(e)(1) 146.90(b) 146.91(a)(2)
	Annular Pressure Monitoring		Wellhead Pressure Gauge: Annulus	146.88(e)(1) 146.90(b) 146.91(a)(2)
	Annulus Fluid Volume		Annulus Monitoring System	146.91(a)(6)
Corrosion Monitoring	Corrosion		Corrosion Coupon	146.89(d) 146.90(c) 146.91(a)(7)
Groundwater Quality and Fluid	Above-Zone	Shallow Groundwater	Direct Fluid Sampling: Low Flow Purge	146.90(d)

Monitoring Category	Monitoring Parameter		Method	Purpose (40 CFR Section Reference)
Sampling & Analysis		1st Permeable Zone	Direct Fluid Sampling: U-Tube Technology Downhole Pressure: Downhole Pressure Gauge	146.90(d) 146.90(g)(1) 146.91(a)(7)
	In-Zone		Downhole Pressure: Downhole Pressure Gauge	146.90(g)(1)
Mechanical Integrity Testing (MITs)	Internal		Continuous Pressure Monitoring of Annulus and Injection Tubing: Wellhead Pressure Gauge	146.87(a)(4) 146.89(a)(1) 146.89(b)
	External		DTS Fiber-Optics	146.87(a)(4) 146.89(a)(2) 146.89(c) 146.92(a)
Hydrogeologic Testing	Pressure Fall-Off Testing		Pressure Fall-Off Testing	146.90(f) 146.91(a)(7)
Direct Pressure Front Monitoring	In-Zone Pressure Tracking		1) Wellhead Pressure Gauge 2) Downhole Pressure Gauge	146.90(g)(1)
Indirect CO_2 Plume Monitoring	Indirect CO_2 Plume Imaging		3D Seismic or Equivalent	146.90(g)(2)

Note: For testing frequencies, please refer to **Table 7-2** of the **Testing and Monitoring Plan**.

1.10 <u>Injection Well Plugging</u>

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)]***

Prior to plugging the injection wells, TEC will demonstrate mechanical integrity to ensure no pathway has been established between the injection zone and the underground sources of drinking water (USDWs) or ground surface according to 40 CFR § 146.82(a)(16) and 40 CFR § 146.92(b). [redacted], the injection wells will be plugged or converted to monitoring wells to ensure containment of the CO_2 in the injection zone. Upon completion of operations, the final bottomhole pressure of the injection wells will be measured, and a buffered fluid (brine) will be used to flush and fill the wells to maintain pressure control. The injection tubing strings, packers, and gauges will be removed from the wells. The mechanical integrity of the wells will be determined to ensure no communication has been established between the injection zone and the USDWs or ground surface (per 40 CFR § 146.92). Finally, the wellbore will be plugged. CO_2 resistant cement will be squeezed into the perforations to seal and fill the wellbore up to the UCPZ-1 and additional plugs will be placed along the wellbore. The casing will then be cut at least five feet below ground level and sealed with a welded steel plate. For more specific information on well plugging procedures, please refer to the **Injection Well Plugging Plan**.

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

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)]***

The **Post-Injection Site Care and Site Closure (PISC)** plan describes the activities TEC will perform to meet the requirements of 40 CFR 146.93. The PISC period will begin after all CO_2 injection operations conclude and will end with site closure. [redacted]

Section 9.5 of the Post-Injection Site Care and Site Closure Plan includes computational modeling that was completed to determine the pressure differential, position of the CO_2 plume, and prediction of CO_2 migration throughout PCSC. CMG-GEM, a compositional reservoir simulator, which is used to delineate AoR, was also used to model fluid movement during the post-injection period; it solves an equation of state (EoS) to accurately predict density changes of the injected fluid as well as mass transfer and transport in diffusive and advective conditions. [redacted]

Following the cessation of injection, all injection wells will be used as monitoring wells and will continue to contribute data that will be utilized in the post-injection monitoring program. Post-injection monitoring will include mechanical integrity testing, groundwater quality and geochemistry monitoring, direct pressure front monitoring, and indirect CO_2 plume monitoring. Every five years during the post-injection phase of the project, monitoring data will be incorporated into computational models and the monitoring plan will be reviewed and updated, if necessary, based on modeling results. For further information on the testing and monitoring methods, frequencies, and locations during the PISC period, please refer to **Section 9.4** of the **Post-Injection Site Care and Site Closure Plan**.

Once TEC demonstrates plume and pressure stabilization along with USDW non-endangerment, TEC will provide the UIC Program Director with a Notice of Intent for site closure. Once site closure is approved, TEC will plug and abandon all injection and monitoring wells pursuant to 40 CFR § 146.92; § 146.93(e), restore the site and all areas disturbed to a condition agreed upon with the Program Director (as close to pre-injection conditions as possible), and submit a site closure report and any other associated documentation. Please refer to the **Post-Injection Site Care and Site Closure Plan** for additional information regarding the post-injection modeling, monitoring, and closure of PCSC.

1.12 Emergency and Remedial Response

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)]***

The **Emergency and Remedial Response Plan (ERRP)** details actions that PCSC shall take to address movement of CO_2 or formation fluid in a manner that may endanger a USDW during the construction, operation, or post-injection site care periods, pursuant to 40 CFR § 146.82(a)(19) and § 146.94(a).

Examples of potential risks include: (1) injection or monitoring well integrity failure, (2) injection well monitoring equipment failure, (3) natural disaster, (4) fluid leakage into a USDW, (5) CO_2 leakage to USDW or land surface, or (6) an induced seismic event. In the case of one of the listed risks, site personnel, project personnel, and local authorities will be relied upon to implement this **ERRP**.

PCSC will communicate to the public about any event that requires an emergency response to ensure that the public understands what happened and whether there are any environmental or safety implications. This will include a detailed description of the event, any impacts to the environment or other local resources, how the event was investigated, what actions were taken, and the status of the remediation. The **ERRP** will be reviewed at least once every five years following it approval, within one year of an AoR reevaluation, within the timeframe indicated by the Region IV UIC Program Director following any significant changes to the injection process or the injection facility, or an emergency event, or as required by the permitting agency. Periodic training will be provided to well operators, plant safety and environmental personnel, the plant manager, plant superintendent, and corporate communications to ensure that the responsible personnel have been trained and possess the required skills to perform their relevant emergency response activities described in the **ERRP**.

1.13 Injection Depth Waiver and Aquifer Exemption Expansion

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)]***

Not Applicable for PCSC.

1.14 Other Information

Not Applicable for PCSC.

1.15 Environmental Justice

PCSC is primarily located in the southwest portion of unincorporated Polk County, Florida, with sections of the AoR extending into Hillsborough, Manatee and Hardee counties. It is about 40 miles southeast of Tampa and about 60 miles southwest of Orlando. A social characterization assessment will cover an area including nearby communities of Bradley Junction, the City of Fort Meade, and the City of Mulberry.

For social characterization, disadvantaged communities (DACs) have been identified using the Energy Justice and EJSCREEN tools (**Figure 1-29**). [37] Communities in southwestern Polk County have been identified as the pre-defined community outreach area for TEC and with whom TEC has traditionally engaged. For communities outside southwestern Polk County, such as Lakeland, Auburndale and Winter Haven, the PCSC will have little effect. If project variables change, the area of impact will also change and the CLEP will be updated accordingly.

[37] https://energyjustice.egs.anl.gov/

CLAIMED AS CBI

[redacted]

As of the 2020 census, Polk County had a population of 725,046 people, 78% of whom identify as white, as presented in **Table 1-25.** [38] Every student in the Polk County Public School System has access to free lunch through the Free and Reduced-Price School Meal Program. The community dynamics within Polk County are distinct from nearby Orlando and Tampa. Historically, Bradley Junction has been an underserved community, as is shown in **Table 1-25.** However, within the last 25 years, both Polk County and TEC have worked hard to integrate Bradley Junction into the larger community. TEC sponsors the community gala, which is called the Night of Champions, centering education in Bradley Junction, as is shown in **Figure 1-29.**

In conjunction with other community actors, TEC helped to bring mobile hotspots to the students of the Polk County public school system. This program turned school buses into mobile wi-fi hotspots, enabling parents to drive into the same parking lot as the school bus and have their child connect to the wi-fi to complete schoolwork. Lack of access to broadband occurs in high poverty rate communities.

There are two major local papers which are focused on Polk County and the surrounding areas, including the Lakeland Ledger and the Polk Democrat, which is published semi-weekly from Bartow, a community within Polk County. There is little mention of energy, environmental justice, or climate change topics within those publications as it relates to the PCSC.

The proposed project prioritizes engagement with and for the benefit of communities and to mitigate potential harm. Integrating economic and social data will help both the project team and local stakeholders understand potential benefits and disbenefits/burdens associated with the PCSC.

[38] https://www.census.gov/quickfacts/polkcountyflorida

Table 1-25. Demographic Information for Polk County.

Race and Hispanic Origin	Percent
White, alone	78.00%
Black or African American, alone	16.80%
American Indian and Alaska Native, alone	0.70%
Asian, alone	1.90%
Native Hawaiian and Other Pacific Islander, alone	0.10%
Two or More Races	2.50%
Hispanic or Latino	27.40%
White alone, not Hispanic or Latino	53.90%