Injection and Geologic Storage Regulation of Anthropogenic Carbon Dioxide

A Preliminary Joint Report by

The Texas General Land Office
The Railroad Commission of Texas
The Texas Commission on Environmental Quality

In Consultation with:

The Bureau of Economic Geology, Jackson School of Geosciences,
The University of Texas at Austin

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Acronyms

Agencies – The agencies responsible for this report. Unless otherwise specified, these are BEG, GLO, RRC, and TCEQ (see acronyms below).

BEG – Bureau of Economic Geology at The University of Texas at Austin

CCS – Carbon Capture and Storage

CFR – Code of Federal Regulations

CMP – Coastal Management Plan

CO_2 – Carbon dioxide, an atmospheric gas that is both naturally occurring and caused by man as a product of fossil fuel combustion. Also, for purposes of this report, unless otherwise noted, "CO_2" means "anthropogenic CO_2."

CWA - Clean Water Act

EGR – Enhanced gas recovery

EOR – Enhanced oil recovery

EPA – The US Environmental Protection Agency

ESA - Endangered Species Act

GS – Geologic Storage or Geologic Sequestration

GLO – Texas General Land Office

NEPA - National Environmental Policy Act

NRC – (Texas) Natural Resources Code

ROW – Right of Way

RRC – Railroad Commission of Texas

SDWA – Safe Drinking Water Act

SLB – School Land Board

TCEQ – Texas Commission on Environmental Quality

THC - Texas Historical Commission

UIC – Underground Injection Control, as described under the Safe Drinking Water Act

USDW – Underground Source of Drinking Water

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Executive Summary

Reporting Under Senate Bill 1387

The 81st Texas Legislature (2009) enacted Senate Bill 1387 (SB 1387), relating to implementation projects for the capture, injection, sequestration, or geologic storage (GS, also known as geologic sequestration) of carbon dioxide (CO_2). SB 1387 provides a specifically defined statutory basis for regulating geologic storage of anthropogenic CO_2 within the existing framework of the Texas Injection Well Act (Chapter 27, Texas Water Code).

Senate Bill 1387 directs the Railroad Commission of Texas (RRC), the Texas Commission on Environmental Quality (TCEQ), the General Land Office of Texas (GLO), and the Bureau of Economic Geology of the University of Texas at Austin (BEG), to coordinate, prepare, and file with the Legislature not later than December 1, 2010, two preliminary reports related to geologic storage of CO_2. The first report focuses on a preliminary framework for managing activities related to GS of CO_2 on state-owned land. The second report focuses on GS of CO_2 on privately-owned lands and commercial operations. Because of the overlap in information between these two reports, they have been combined into a single document.

Although some differences in requirements exist in the geologic settings for onshore and offshore storage of CO_2 on state lands, and in saline formations underlying all other onshore lands of Texas, most technical criteria are identical. A primary goal of this report is to clarify some of the technical and regulatory issues surrounding GS, especially as they relate to the regulatory jurisdictions of the RRC and the TCEQ.

Technical Issues for Sites

The fundamental technical goals for identifying candidate storage sites include a deep subsurface geologic formation with:

- Sufficient storage capacity to contain the target volume;
- Sufficient injectivity to receive the CO_2 at the intended rate; and
- A sealing and trapping system (stratigraphic interval) that will retain and sequester the CO_2 over the required time period.

The greatest potential for GS of CO_2 in Texas occurs in saline formations, and in operating and depleted oil and gas fields. Saline formations consist of sedimentary rocks that are saturated with brine salts, which generally is not suitable for agricultural use or human consumption. In contrast with oil and gas formations, there is less data with respect to the physical characteristics of saline formations and the potential migration pathways between saline formations and underground sources of drinking water (USDWs). Therefore, the potential movement and chemical interactions of an injected CO_2 “plume” through the brine must be clearly understood. Operating and depleted oil and gas fields are likely to have properties that are suitable for GS. Also, the historic or depleted fields may once again become economically viable with changes in market conditions or improved production techniques. GS is occurring in some oil fields currently identified as enhanced oil recovery (EOR) projects (e.g., Permian Basin).

In these fields, operators attempt to recover and reuse as much of the injected CO_2 as possible, as a certain percentage is recaptured as a bi-product of petroleum production.

Background Information and New Regulations

Underground injection is regulated under the federal Safe Drinking Water Act (SDWA), under which the U. S. Environmental Protection Agency (EPA) has established the Underground Injection Control (UIC) Program. On July 25, 2008, EPA published a proposed rule for underground injection of CO_2 for long-term GS in non-productive formations. The proposed regulations would establish the criteria and standards for issuance of a new class of wells, Class VI, to be permitted exclusively for injection of CO_2 for long-term subsurface storage in non-enhanced oil recovery (non-EOR) and non-enhanced gas recovery (non-EGR) scenarios. The regulations would be codified in 40 CFR Part 146, Subpart H.

Senate Bill 1387 amended the Texas Water Code to add §27.041, relating to jurisdiction, which specifies that the RRC has jurisdiction over injection of anthropogenic CO2 for geologic storage into a reservoir that is initially or may be productive of oil, gas, or geothermal resources, or a saline formation directly above or below that reservoir. Section 27.041, together with §27.011, implies that the TCEQ has jurisdiction over CO_2 GS in reservoirs that do not meet these criteria. This joint report contains recommendations to address regulatory issues arising from the jurisdictional framework established in SB 1387. In addition, SB 1387 requires coordination between the RRC and the TCEQ to ensure the regulation of CO_2 storage in Texas is performed in an economically and environmentally sound manner. SB 1387 also requires that the permit applicant provide to the RRC a letter from TCEQ's Executive Director stating that underground freshwater strata will not be injured by the permitted activity.

Methods of Financial Assurance

Financial assurance describes financial mechanisms to assure completion of certain activities required of an operator. Under the rules proposed by the RRC to implement SB 1387 (16 TAC Chapter 5), an applicant for a CO_2 GS facility permit must file a bond or letter of credit, and have it approved by the RRC before a permit is issued. This report highlights various types of financial assurance mechanisms that may be considered for GS activities.

Legal Issues to be Considered

Many legal and regulatory issues will influence suitability of sites for GS of CO2.

- Both surface and mineral rights will need to be acquired to clearly establish pore-space ownership;
- GS operators will need the rights to sufficient surface access (through surface ownership or lease holdings) to construct support infrastructure (injection wells, pipelines, monitoring equipment etc.);
- The regulatory framework must be clearly defined to reduce uncertainty for stakeholders; and

- The operators and the state agency must agree upon a reasonable and flexible post-injection monitoring plan before beginning of CO_2 injection to reasonably limit the time during which an operator must maintain financial assurance.

Recommendations

Senate Bill 1387 requires that the agencies provide recommendations with respect to several jurisdictional and regulatory areas. This report includes nine recommendations. Briefly, these recommendations are as follow:

- Section 5.1, regarding additional legislation, modification to the RRC-TCEQ Memorandum of Understanding (MOU), or new rules for regulating GS facilities and associated anthropogenic CO_2 injection wells. At this time, the agencies see no need to revise the MOU as recently amended, or rules related to GS of anthropogenic CO_2 under the jurisdiction of the RRC, The agencies do, however, recommend additional legislation regarding GS projects over which the TCEQ currently has jurisdiction.
- Section 5.2, regarding which agency(ies) should have jurisdiction over permitting related to anthropogenic CO_2 injection wells and GS facilities that are used for the injection and storage of anthropogenic CO_2 in saline formations not productive of oil, gas, or geothermal resources or any other permitting of GS facilities not subject to Subchapter C-1, Chapter 27, Water Code. This report recommends two options – both options recommend additional supporting legislation:
  - Option 1 would give to the RRC jurisdiction for all CO_2 injection and GS, with the TCEQ retaining responsibility for the advisory letters in compliance with §27.046, Texas Water Code. Alternatively,
  - Option 2 retains shared RRC and TCEQ jurisdiction as provided under §27.041 and §27.011, Texas Water Code.

  In addition, the agencies have identified a potential jurisdictional problem with respect to disposal of acid gas by injection. Currently, under the Class II UIC rules, the RRC administers a program to regulate injection of acid gas, including CO_2 generated at natural gas processing plants. This activity is undertaken as an alternative to flaring. Such injection is currently permitted as a disposal activity, rather than a geologic storage activity. Because the CO_2 derived from gas processing appears to be included in the definition of anthropogenic CO_2 added by SB 1387, and because the CO_2 is typically injected into formations not productive of oil, gas, or geothermal resources, or above or below such formations, the language in SB 1387 could imply that jurisdiction over such injection changed from RRC to TCEQ. This implication presents a potential conflict (which the agencies believe was not intended) regarding acid gas disposal wells permitted by the RRC. Therefore, if jurisdiction over CO_2 GS remains shared by the RRC and the TCEQ (e.g. Option 2), the Legislature may wish to clarify that injection of anthropogenic CO_2, as a component of acid gas generated in association with gas processing, into a non-productive formation falls under the jurisdiction of the RRC for the purpose of disposal as well as

geologic storage. Placing jurisdiction for all CO_2 GS under the RRC, would eliminate the issue of jurisdiction with respect to acid gas disposal.

- Section 5.3, regarding ensuring that public land management and leasing laws are adequate to accommodate GS. The GLO has adequate authority to lease public lands for geologic storage of CO_2 and a robust system for leasing properties for mineral development, including enhanced recovery operations. The agencies made no recommendations regarding this issue.
- Section 5.4, regarding appropriate rights-of-way for anthropogenic CO_2 pipelines on state-owned land The GLO already has the authority necessary to issue pipeline easements. No additional authority is needed.
- Section 5.5, regarding methods to mitigate any negative effects of federal greenhouse gas reporting requirements on owner and producers of naturally occurring CO_2: The EPA has proposed to expand the mandatory reporting rules for greenhouse gases to include reporting of injection and geologic sequestration of CO_2. However, these rules provide for reporting both natural and anthropogenic CO_2. Possible competitive advantages or disadvantages of using one form versus the other could be mitigated by legislation. Developing educational outreach efforts and materials by state and federal agencies, trade associations, and by environmental groups also may be beneficial.
- Section 5.6, regarding recommendations to address the attributes of the subsurface area of operations for GS facilities: The agencies believe that no recommendations beyond the proposed RRC rules are necessary.
- Section 5.7, regarding recommendations to address the methods of financial assurance and the allocation of long-term liability for the post-operational phases of GS projects: It is not clear whether or not the Anthropogenic Carbon Dioxide Storage Trust Fund created by SB 1387 (Trust Fund) could be used to perform long-term activities, for example, to address unanticipated migration of CO_2 after a GS site has been closed. In addition, TCEQ does not appear to have statutory access to this or any other trust fund for any activities deemed within the jurisdiction of TCEQ.
- Section 5.8, regarding criteria for identifying candidate sites in seven geologic settings (operating oil and gas fields; depleted oil and gas fields; saline formations; unmineable coal seams; coal beds used for methane recovery; geothermal systems; and igneous formations): The greatest potential for deep subsurface geologic storage of CO_2 in Texas occurs in saline formations, and operating or depleted oil and gas fields. In general, the remaining categories are not currently feasible in Texas due to economic or geologic factors.
- Section 5.9, regarding a permitting process for anthropogenic CO2 injection well and GS facilities that are used for the injection and storage of anthropogenic CO2 in saline formations not productive of oil, gas, or geothermal resources: The TCEQ will have authority under the Water Code to adopt equivalent rules for permitting and regulating CO2 injection in Class VI wells after EPA adopts the new rules should the jurisdiction remain as it is current set out in the Texas Water

Code under Option 2. The RRC also would have the necessary authority under the Water Code under Option 1.

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Chapter I: Introduction

1.1 Senate Bill 1387, The Reporting Framework

The 81st Texas Legislature (2009, Regular Session) enacted Senate Bill 1387 (SB 1387), relating to implementation of projects involving the capture, injection, sequestration, or geologic storage (GS, also known as geologic sequestration) of carbon dioxide (CO_2). SB 1387 provides a specifically defined statutory basis for regulation of geologic storage of anthropogenic CO_2 within the existing framework of the Texas Injection Well Act (Chapter 27, Texas Water Code).

Senate Bill 1387 directs specific state agencies to coordinate, prepare, and file with the Legislature not later than December 1, 2010, two preliminary reports related to geologic storage of carbon dioxide.

Section 9 of Senate Bill 1387 directs the Commissioner of the Texas General Land Office (Land Commissioner) to coordinate with the Bureau of Economic Geology of The University of Texas at Austin (BEG); the Railroad Commission of Texas (RRC); the Texas Commission on Environmental Quality (TCEQ); and the heads of other appropriate agencies to prepare and file with the Legislature a preliminary report on a recommended framework for managing activities related to geologic storage of carbon dioxide on State-owned land. The bill requires that the report include:

- Recommended criteria for identifying candidate geologic storage sites in each of several onshore and offshore geological settings;
- A proposed regulatory framework for leasing state-owned land for geologic storage, including an assessment of options to ensure that the State receives fair market value for using State-owned property for geologic storage;
- A proposed procedure for:
    - providing an opportunity for public review of, and the presentation of comments by interested persons regarding, any activities related to geologic storage of CO_2 on State-owned land; and
    - ensuring that the quality of the natural and cultural resources of State-owned land overlying the site of a geologic storage facility are protected from any geologic storage activities at the site;
- A description of the status of leasehold or mineral estate liability issues related to the geological subsurface trespass of, or caused by, anthropogenic CO_2 stored in State-owned land, including any relevant experience from enhanced oil recovery (EOR) using CO_2 on State-owned land;
- Recommendations for additional legislation that may be required to ensure that public land management and leasing laws are adequate to accommodate geologic storage;
- Identification of the legal and regulatory issues specific to geologic storage in cases in which title to the mineral estate is held by the State but title to the surface estate is not held by the State; and

- Recommendations for additional legislation that may be required to clarify the appropriate framework for issuing rights-of-way for anthropogenic carbon dioxide pipelines on State-owned land.

Section 10 of Senate Bill 1387 directs the TCEQ and the RRC, in consultation with the BEG, to prepare and file with the Legislature not later than December 1, 2010, a joint preliminary report that:

- Analyzes the requirements for the injection and geologic storage of anthropogenic carbon dioxide into saline formations that are not productive of oil, gas, or geothermal resources;
- Recommends a permitting process for anthropogenic CO_2 injection wells and geologic storage facilities that are used for the injection and storage of anthropogenic CO_2 in saline formations not productive of oil, gas, or geothermal resources;
- Recommends the agency or agencies that should have jurisdiction over permitting of anthropogenic CO_2 injection wells and geologic storage facilities that are used for the injection and storage of anthropogenic CO_2 in saline formations not productive of oil, gas, or geothermal resources, or any other permitting of geologic storage facilities not subject to Subchapter C-1, Chapter 27, Water Code;
- Assesses the status of compliance with any federal rules regulating the geologic storage and associated injection of anthropogenic carbon dioxide; and
- Includes:
    - A procedure for providing an opportunity for public review of, and the presentation of comments by interested persons regarding, any activities related to geologic storage of CO_2;
    - A procedure for ensuring that the quality of the natural and cultural resources of land overlying the site of a geologic storage facility are protected from any geologic storage activities at the site;
    - Recommended criteria for identifying candidate geologic storage sites in each of the following types of geological settings:
        - operating oil and gas fields;
        - depleted oil and gas fields;
        - unmineable coal seams;
        - saline formations;
        - geological systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity;
        - geological systems containing igneous formations; and
        - coal beds being used for methane recovery;

- Recommendations for methods to mitigate any negative effects of federal greenhouse gas reporting requirements on owners and producers of naturally occurring carbon dioxide;
- A description of the status of leasehold or mineral estate liability issues related to the geological subsurface trespass of, or caused by, anthropogenic CO_2 stored in private or state-owned land, including any relevant experience from enhanced recovery operations using CO_2;
- An analysis of and recommendations to address:
  - The attributes of the subsurface area of operations for geologic storage facilities; and
  - The methods of financial assurance and the allocation of long-term liability for the post-operational phases of geologic storage projects;
- The status of any applications for permits that have been received before the report required by Section 10 of SB 1387 is prepared;
- An update on the exchange of information between the TCEQ and the RRC as required by the memorandum of understanding described by §27.049, Water Code, as added by SB 1387, and as required by §27.046, Water Code, as added by SB 1387;
- The status of any request for primary enforcement authority for the underground injection and geologic storage of anthropogenic CO_2 under the federal Underground Injection Control (UIC) program; and
- Any recommendations for additional legislation, modifications to the memorandum of understanding, or new rules for regulating geologic storage facilities and associated anthropogenic CO_2 injection wells.

Because of the overlap in information required by Sections 9 and 10 of Senate Bill 1387, this document combines both reports.

1.2 Geologic Storage of Carbon Dioxide in Texas: Background

Carbon capture and storage (CCS) technology involves the capture and long-term storage of carbon dioxide (CO_2). Among the different methods for storing captured CO_2, geologic sequestration (GS, also known as geologic storage), has the greatest potential for large-scale CO_2 sequestration in the near term. Geologic storage consists of injecting captured CO_2 into underground geologic formations that will trap the CO_2 and prevent it from being released to the atmosphere. Large storage capacity exists in deep saline formations, oil and gas reservoirs, and unmineable coal seams throughout the U.S. in both onshore and offshore geologic settings. According to a 2005 report by the Intergovernmental Panel on Climate Change, as much as 54 percent of a worldwide greenhouse gas mitigation effort through 2100 could be achieved safely by use of CCS.[1]

Several factors combine to make Texas a prime location for future CCS projects:

[1] http://www.ipcc.ch/publications_and_data/publications_and_data_reports_carbon_dioxide.htm: IPCC, 2005 Chapter 8, p 353-354

- Texas has a leading role in the nation's production of energy;
- As a by-product of energy production from combustion of carbon-based fuels, Texas ranks first among states in production of CO_2 (Table 1A and 1B)

Table 1, CO_2 Emissions in Texas

Table 1A: CO_2 Emissions for 2007 in Texas
Given in million metric tons

	EPA[2]	EIA[3]
Commercial	**10.3**	**10.3**
Residential	**12.3**	**12.3**
Transportation	**203.5**	**203.2**
Industrial	**221.1**	**183.7**
Electric Power	**229.6**	**230.0**
Total	**676.8**	**639.5**

Table 1B: Ranking of CO_2 Emissions from Top 10 States in 2007
Given in million metric tons

	EPA[4]	EIA[5]
Texas	**676.8**	**639.5**
California	**402.8**	**402.1**
Pennsylvania	**274.3**	**278.0**
Ohio	**267.7**	**269.4**
Florida	**256.3**	**258.1**
Illinois	**242.8**	**243.3**
Indiana	**230.8**	**235.6**
New York	**201.2**	**200.3**
Louisiana	**194.9**	**185.9**
Georgia	**184.0**	**185.6**

- Texas has a huge capacity for storage of CO_2 in underground formations throughout much of the State (Figure 1)

[2] **http://www.epa.gov/climatechange/emissions/state_energyco2inv.html**
[3] http://www.eia.doe.gov/oiaf/1605/state/state_emissions.html
[4] http://www.epa.gov/climatechange/emissions/state_energyco2inv.html
[5] http://www.eia.doe.gov/oiaf/1605/state/state_emissions.html

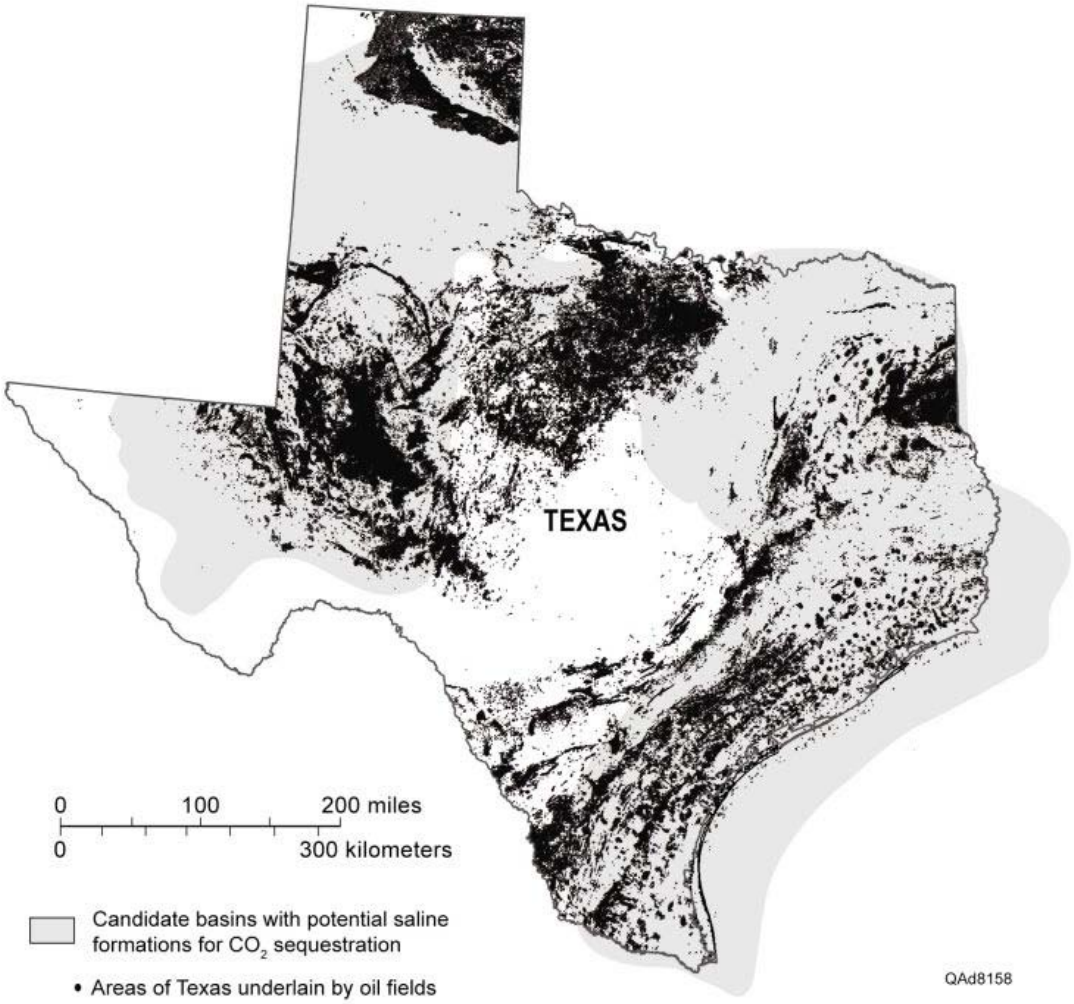

Figure 1, Oil and Gas Fields, and Saline Formations in Texas

- Texas is a center for well and pipeline technologies essential for CO_2 geologic storage projects as a result of decades of experience in petroleum exploration and production.
- Texas has numerous declining oil and gas fields across the State, which can provide the double benefit of sequestration and enhanced hydrocarbon production, making the economics of CO_2 injection more favorable.
- Texas has favorable and well understood geology. Geologists have been exploring the thick sedimentary sequence of the Texas subsurface for many decades using state-of-the art techniques to characterize the structure and rock properties. Other states may have fewer options for geologic sequestration due to thin sedimentary sections over basement rocks or lack of existing geologic information.

- Texas has a well-developed community of service companies and a mature regulatory environment. Texas is a leader in the subsurface management of oil field and industrial wastes by injection wells. Regulators at the Texas Railroad Commission and the Texas Commission on Environmental Quality are experienced in the review and permitting of injection wells.
- Texas has a highly skilled and experienced workforce. Texas is unrivaled in the number of geologists and engineers with know-how related to subsurface mapping, reservoir studies, and drilling and completion methods.

While the main focus of SB 1387 is geologic storage of anthropogenic CO_2 in settings not associated with production of oil or natural gas, the history of the RRC's regulation of the injection of CO_2 for enhanced recovery purposes under its Class II injection well regulations provides experience that is pertinent to the success of geologic storage in Texas

The U.S. oil and gas industry has been using carbon dioxide in enhanced oil recovery (EOR) for almost 40 years. CO_2 also is used in a few instances for enhanced gas recovery (EGR) operations, although this use is much less mature than EOR and is generally on the scale of pilot studies.[6] The majority of the CO_2 supply currently used in EOR is naturally occurring (rather than anthropogenic). In the late 1970s, several major discoveries were made of high quality CO_2-bearing geological formations, including the McElmo Dome (southwestern Colorado), the Bravo Dome (northeastern New Mexico), and the Sheep Mountain (southern Colorado). These findings facilitated and accelerated additional EOR activities. There are over 100 such projects in the U.S. and approximately 3,100 miles of CO_2 pipelines.

Approximately 10.8 trillion cubic feet[7] of CO_2 has been injected into EOR fields in the U.S. since the 1970s, resulting in an increase in yields of 650,000 extra barrels of oil each day--more than 10 percent of daily U.S. total production.[8] It is projected that CO_2 captured from new coal-fired power plants could reduce the amount of oil imports by 5 million barrels per day if all of the captured CO_2 is used for EOR. [9]

Texas has been a leader in developing CO_2 injection technology. As of mid-2008, there were 9,421 permitted CO_2 EOR injection wells in Texas. The first large-scale, commercial CO_2 EOR project began operations in 1972 at the Scurry Area Canyon Reef Operators Committee (SACROC) oil field near Snyder in West Texas. Over 175 million metric tons of CO_2 have been injected at SACROC from 1972 to 2010.[10] Initially, the project used CO_2 separated from the production of natural gas. CO_2 for SACROC and other EOR fields in the Permian Basin now comes primarily from naturally occurring sources mentioned above. The naturally occurring CO_2, which has been trapped in the

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[6] (Intergovernmental Panel on Climate Change, Special Report on Carbon Dioxide Capture and Storage, (Bert Metz, ed., Cambridge University Press 2005), at 33 (Table TS.5), 216-217, 262, available at http://www.ipcc.ch/ipccreports/special-reports.htm [IPCC SPECIAL REPORT].)

[7] 210-230 billion metric tons using conversion factors of 19.5-21.25 cubic ft per 1,000 metric tons

[8] EOR Performance and Modeling, Bai, Baojun, JPT, January 2010, p. 38 – 47

[5] ARI March 2010 white paper entitled: U.S. Oil Production Potential from Accelerated Deployment of Carbon Capture and Storage.

[6] BEG from personal communication with Kinder Morgan CO_2 Co.

deep subsurface for millions of years, is pumped to the surface, compressed to a near-liquid (supercritical) state, and transported via pipeline to the Permian Basin. These natural sources of CO_2 have facilitated and accelerated EOR activities in the Permian Basin. Another major source of CO_2 used for EOR is the Jackson Dome in Mississippi. Jackson Dome CO_2 currently is used for EOR in Mississippi and soon will be transported to the Texas Gulf Coast along a newly constructed pipeline. There are plans to augment this supply with anthropogenic CO_2 from industrial sources in Louisiana and Texas.[11]

Although EOR operations recycle and reuse as much as possible of the CO_2 injected for EOR purposes, 50 percent or more of the initially injected CO_2 cannot be recovered for reuse and remains incidentally stored or sequestered in the geologic formation. This percentage gradually increases over the life of the EOR operation as the injected CO_2 is recaptured and recycled and, consequently, accumulates in the reservoir. Storage of CO_2 incidental to the production of oil during EOR operations is indistinguishable from the geologic storage of CO_2 that would occur if the depleted oil formation were to be later used for storing anthropogenic CO_2. The CO_2 would be injected through the same wellbore into the same formation and typically at pressures (and depths) that ensure that it remains in the supercritical state.

During the past decade, a number of research projects conducted by the University of Texas Bureau of Economic Geology (BEG), including the Frio Brine Pilot Project for experimental injection of CO_2 regulated by the Texas Commission on Environmental Quality (TCEQ), have made important contributions to the State's experience with geologic storage technology.[12]

Although the nation has experience in the geologic storage of CO_2, especially storage associated with EOR, it lacked a regulatory framework for implementing geologic storage on a large commercial scale in a non-EOR scenario. On July 25, 2008, the United States Environmental Protection Agency (US EPA) published proposed regulations under the Safe Drinking Water Act for injection of CO_2 for geologic sequestration in a non-enhanced recovery scenario.[13] In 2009, the 81st Texas Legislature addressed significant jurisdictional and technical issues through the passage of Senate Bill 1387 (SB 1387). SB 1387 provides a statutory basis for regulation of geologic storage of anthropogenic CO_2 within the existing framework of the Texas Injection Well Act (Chapter 27, Texas Water Code).

SB 1387's amendments of Chapter 27 assign to the RRC jurisdiction over geologic sequestration of anthropogenic CO_2 (CO_2 GS) in a broad range of conditions and geologic settings, and assign to the TCEQ review and advisory responsibility for protection of fresh water concerning each permit application to RRC for geologic storage of anthropogenic CO_2. Also, both agencies are required to develop a memorandum of understanding (MOU), or amend the existing one, concerning interagency coordination to address regulation of geologic storage of anthropogenic

[11] DOE Techline June 2010
[12] http://www.beg.utexas.edu/gccc/research.php
[13] These regulations EPA proposed on July 25, 2008 have not been finalized as of the publication of this report

carbon dioxide. The existing MOU between the two agencies was updated, effective October 21, 2010.

The TCEQ, the RRC, and the GLO, in consultation with the BEG, developed this joint report to provide a unified state agency response to the requirements of Sections 9 and 10 of SB 1387. A summary of recommendations from this report can be found in Chapter 5. A copy of SB 1387 can be found in Appendix I of this report.

1.3 Regulatory Chronology

- On April 2, 2007, in *Massachusetts v. EPA*, 549 U.S. 497 (2007), the Supreme Court found that greenhouse gases are air pollutants covered by the Clean Air Act.
- July 25, 2008, the United States Environmental Protection Agency (EPA) issued proposed rules for underground injection of carbon dioxide (CO_2) for capture and long-term geologic storage (geologic sequestration, or GS). EPA issued the rule within the regulatory framework of the Underground Injection Control (UIC) well permitting program, which is authorized under the federal Safe Drinking Water Act (SDWA), 33 U.S.C. § 300.h-3.
- On October 30, 2009, EPA promulgated regulations to require reporting of greenhouse gas emissions from 31 sectors of the economy.
- In the regular Legislative Session in early 2009, the Texas Legislature passed, and the governor signed into law, four bills with bearing on carbon sequestration and its implications. These included SB 1387, which among other things required the Texas Railroad Commission to implement rules to regulate the injection of CO_2 into non-productive formations above or below oil and gas producing formations for the purpose of geologic storage. The bill also requires a report from the General Land Office, and a second from The Texas Railroad Commission and the Texas Commission on Environmental Quality for recommendations on facilitating geologic sequestration in a manner consistent with corresponding EPA draft rule issued on July 25, 2008. The University of Texas Bureau of Economic Geology was directed to assist on these reports.

The 81st Legislature also enacted Senate Bill 184, relating to “no regrets” greenhouse gas emissions reduction strategies, which requires the Comptroller of Public Accounts (comptroller) to prepare and deliver to the Legislature a report that includes a list of strategies for reducing greenhouse gas emissions in Texas that: (1) result on net savings for consumers or businesses in this state; (2) can be achieved without financial cost to consumers or businesses in this state; or (3) help businesses in the state maintain global competitiveness.

House Bill 469, enacted by the 81st Legislature (Regular Session, 2009), provided incentives for the implementation of certain projects to capture and sequester carbon dioxide that would otherwise be emitted into the atmosphere.

House Bill 1796, enacted by the 81st Legislature (Regular Session, 2009), established a framework for offshore geologic storage repository for carbon dioxide. HB 1796 requires that the TCEQ adopt standards for the location, construction, maintenance,

monitoring, and operation of an offshore CO2 repository, consistent with the EPA regulations. BEG must perform the measurement, monitoring and verification (MMV) and serve as a scientific advisor for the MMV of the repository. HB 1796 also requires that the GLO contract with BEG to conduct a study of state-owned offshore submerged land to identify potential locations for a repository and to recommend to the School Land Board suitable sites for CO2 storage based on the findings of the study. Once the School Land Board selects a location, it may issue requests for proposals for the lease of state submerged land for the construction of any necessary infrastructure for the transportation and storage of CO2 to be stored in the CO2 repository and may contract for construction or operational services for the repository. Once the repository is established, the School Land Board may accept CO2 for storage and may establish a storage fee.

- On December 7, 2009, the Administrator of the EPA formally declared carbon dioxide and five other greenhouse gases to be air pollutants and found that the current and projected concentrations of these greenhouse gases, including CO_2, in the atmosphere "threaten the public health and welfare of current and future generations."
- On March 22, 2010, EPA proposed to expand the mandatory reporting rules for greenhouse gases (expanding requirements promulgated on October 30, 2009) to include carbon dioxide injection and geologic sequestration activities, as well as for petroleum and natural gas systems.
- On March 26, 2010, the Railroad Commission of Texas published for comment in the *Texas Register*, draft rules to implement requirements for the geologic storage of anthropogenic CO_2 as required by SB 1387. These rules provide the process for submittal and review of permit applications, technical criteria consistent with EPA Class VI draft rule and state established protective measures, a state trust fund, public notice, monitoring and reporting, financial assurance, emergency response, and criteria for site closure.
- On August 6, 2010, the EPA sent two final carbon capture and sequestration (CCS) rule packages to the Office of Management and Budget's Office of Information and Regulatory Affairs for review. The first rule package would establish the major regulatory framework for the Class VI injection wells, as proposed on July 25, 2008. The second rule package would finalize the greenhouse gas mandatory reporting rules (MRR) for CO_2 injection for enhanced recovery and geologic storage proposed by the EPA on April 12, 2010.
- On October 21, 2010, amendments to the Memorandum of Understanding between the TCEQ and the RRC to reflect updates and changes required by Section 2 of SB 1387 became effective.
- In December, 2010, the RRC is expected to finalize rules to regulate geologic storage of CO_2 in, and the injection of CO_2 into, a reservoir that is initially or may be productive of oil, gas, or geothermal resources or a saline formation directly above or below that reservoir.

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Chapter II: Technical and Regulatory Considerations

2.1 Recommended criteria for identifying candidate sites[14]

Senate Bill 1387 requires that this report include recommended criteria for identifying candidate geologic storage sites in the following seven settings:

- Saline formations;
- Operating oil and gas fields;
- Depleted oil and gas fields;
- Coal beds being used for methane recovery
- Unmineable coal seams;
- Geologic systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity; and
- Geologic systems containing igneous formations.

In Texas, there is a huge potential for geologic storage of CO_2 in saline formations, and in operating and depleted oil and gas fields, the preferred settings for geological storage. Data on estimated storage capacity for CO_2 in saline formations, oil and gas reservoirs, and unmineable coal seams in Texas are summarized in the 2008 U.S. Department of Energy's National Energy Technology Laboratory (DOE NETL) Carbon Sequestration Atlas[15] as follows:

- Saline formations in Texas have an estimated storage capacity of between 533,600 and 2,133,300 million metric tons (MMT). This is almost twice the storage capacity available in Louisiana, which is the state with the second largest storage capacity.
- Oil and gas reservoirs in Texas have an estimated storage capacity of approximately 47,761 MMT. Texas has the most storage capacity available in this geologic setting, with the possible exception of Alaska, which has not yet been assessed.
- Unmineable coal seams in Texas have an estimated storage capacity of 18,538 to 26,469 MMT, which is the third largest capacity available in the U.S. after Alaska and Wyoming.

These storage capacity estimates were based solely on the suitability of geologic formations to store CO_2 on a regional scale and did not take into account economic, local scale, legal, and regulatory issues that will need to be balanced with geologic suitability.

At least in the near future, economics most likely will be the driving force for CO_2 geologic storage activity. This is especially true for Texas given the large potential for

[14] SB 1387, Section 9(b)(1) and 10(c)(1)
[15] DOE NETL, 2008 http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlas/

enhanced recovery of oil and gas (i.e. EOR and EGR) using CO_2. Therefore, although saline formations have the greatest potential capacity for geologic storage in Texas, industry likely will first store anthropogenic carbon dioxide in association with enhanced recovery in oil and/or gas fields. It could be many years before Texas sees any applications for geologic storage of anthropogenic CO_2 in saline formations.[16]

2.1.1 Technical Criteria for Siting

Most of the technical criteria for identifying a suitable geologic storage site are identical for both onshore and offshore settings. The fundamental technical criteria for identifying candidate storage sites include subsurface geologic formations with:

- Sufficient storage capacity to contain the target volume;
- Sufficient injectivity to receive the CO_2 at the intended rate; and
- A sealing and trapping system (stratigraphic interval) that will contain the injected CO_2 over the required time period, effectively sequestering CO_2.

In developing State criteria for the siting of geologic storage facilities, the best approach is to apply the same siting criteria to the full range of geologic and natural resource settings specified in Senate Bill 1387. Such an approach is consistent with that proposed by EPA for Class VI wells injecting CO_2 for geologic storage.

All types of CO_2 geologic storage sites must include integrity and continuity of the overlying confining zone(s) and sufficient storage capacity to prevent displacement of saline water into underground sources of drinking water. In addition, although not required by the proposed federal regulations or SB 1387, injection is likely to take place at a depth sufficient to maintain the CO_2 at a high density, which corresponds to depths greater than 800 meters (2600+ feet) below the surface. Although proposed to be required by the federal regulations, but not by SB 1387, in Texas, injection of CO_2 for geologic storage will most likely take place below the lowermost underground source of drinking water, generally because deep saline formations, oil and gas reservoirs and unmineable coal seams are the target formations with the greatest geologic storage capacity. Also, the greater depth is more likely to provide an effective trapping mechanism and, therefore, provide greater protection for USDWs.

The amount of dissolved mineral constituents in subsurface pore-space fluids increases with depth, generally as a result of longer time periods during which fluids have been in contact with, and, therefore have partially dissolved, deep subsurface rocks. The greater the amount of dissolved solids in a fluid, the higher its salinity. Saline formations, or geologic units that contain brines, are ubiquitous in the deep subsurface, however the depths at which the transition occurs from fresh water to slightly saline water to brine vary with geographic location and geology. Geologic units from which oil and gas is produced contain brine and are bounded above and below by saline formations.

Not all saline formations contain oil and/or hydrocarbon gas (gas) accumulations, or at least, not in economically viable quantities. In order for oil or gas to accumulate in a

[16] http://www.jsg.utexas.edu/news/rels/062810.html

reservoir there must have been a source of organic material, sufficient pressure and temperature to allow the organic material to be converted to a hydrocarbon and a trapping mechanism to keep the hydrocarbons from migrating to the shallow subsurface.

Areas where hydrocarbons have been, or have the potential to be, produced, have the benefit of more data with which to evaluate suitability for a geologic storage site. There also is an economic advantage to using geologic sites with potential for hydrocarbon production. A disadvantage of using hydrocarbon reservoirs for geologic storage is that many wells may have been drilled through the overlying confining layers, and may provide potential vertical pathways for leakage of CO_2 through annuli of existing wells, especially old wells that may have corroded casing or compromised annular cement. Another potential issue with using hydrocarbon reservoirs for geologic storage of CO_2 is that, while they may be able to maintain wellbore integrity under production regimes, problems may arise when fields are converted to pure geologic storage and pressure perturbations become more evident.

Saline formations and oil and gas reservoirs traditionally have been treated as separate types of geologic settings from a regulatory standpoint, but many of the criteria for physical evaluation from a geological perspective are the same or at least exist in a continuum. Criteria for evaluating potential geologic storage sites can be broadly separated into two categories: (1) legal and regulatory and (2) physical properties. Even if a site is suitable for geologic storage because of its physical characteristics, it will not be suitable for geologic storage if there are unresolved legal or regulatory issues. Legal and regulatory issues are discussed later in this report. The reader is referred to Section 2.1.2 for discussion of regulatory issues, and to Chapter 3 for legal issues.

Physical Criteria for Evaluating Potential GS Sites

Senate Bill 1387 directs the agencies to make recommendations with respect to attributes of the subsurface area of operations for geologic storage facilities.[17] The agencies have no legislative or rule recommendations on this issue. However, the agencies have identified technical considerations for physical criteria necessary for successful geologic storage of carbon dioxide. Physical criteria that must be considered to evaluate suitability of GS sites fall into two categories: near surface and subsurface.

Near-surface criteria include:

- Surface geology and topography. Surface expressions of fluid discharge (springs) either from deep, regional fluid circulation patterns, or seepage along faults or fracture systems may be present.
- Current and historical land use. Industrial sites may have chemical contamination issues that will need to be quantified to distinguish between ambient surface conditions and CO_2 injection-related conditions. Old oil fields may have wells that need to be properly plugged and abandoned.

[17] SB 1387, Section 10(c)(5)

- Cultural features such as archaeological sites, wildlife preserves, and State or National parks. These sites need to be evaluated in accordance with laws in addition to UIC. These are described in Section 2.4.2 and Appendix II.
- Potential to determine surface deformation. In some areas, satellite methods such as InSAR (interferometric synthetic aperture radar) or airborne lidar light (laser) detection and ranging remote sensing methods can be used to detect geomechanical deformation. GS activities may cause slight changes in elevation.
- Depth to the water table. Thickness of the unsaturated zone (i.e. vertical distance between land surface and top of water table) will influence choice of near surface and surface monitoring techniques.

Subsurface characteristics suitable for GS sites include:

- The formation(s) into which CO_2 will be injected must have good reservoir properties including:
    - Sufficient porosity and permeability in one or more sub-units (often sand layers) of the formation to allow for sufficient fluid injection rates;
    - Sufficient thickness and lateral extent of individual injection zone layers; and
    - Sufficient pressure and temperature (i.e. depth below surface) to allow injectate CO_2 to remain in supercritical phase (i.e. more like a liquid than a gas).
- The injection and confining zones should have properties that would prevent adverse effects from pressure increase or chemical change as a result of CO_2 injection. Examples of adverse effects include stress on faults allowing fault slippage, increase in fracture transmissivity, mobility of naturally occurring chemical species above health based standards, and displacement of formation fluids into USDWs. Accordingly, injection zone formation characteristics should include the following considerations to prevent adverse effects from pressure or chemical changes:
    - Internal reservoir architecture and geometry that allows for lateral and vertical migration of CO_2 away from the injection well(s);
    - Salinity low enough to allow for some dissolution of CO_2 into brine;
        - Pore pressure well below injection threshold (i.e. below fracture pressure of injection or confining zones, and below pressures that could cause changes in fault characteristics); and
        - Mineralogy and fluid chemistry that is not conducive to geochemical reactions with the injected CO_2 stream that may compromise retention of the stored CO_2, or protection of underground sources of drinking water (USDWs).
- The geologic setting must have mechanism(s) for preventing injected CO_2 from buoyantly rising to the shallow subsurface or surface. Accordingly, geologic setting should include the following considerations:

- In structurally simple geologic settings (i.e. absence of major faulting or excessive inclination (dip) of layers) alternating layers of high and low porosity-permeability rocks, or great thicknesses of low porosity-permeability rocks, will serve as confining zones;
- Sites at which the proposed injection zone outcrops nearby could result in the escape of CO_2 or native brine through lateral flow. The proposed site must include a suitable physical trap for the CO_2 as a result of the geologic structural and stratigraphic conditions in the injection and confining zone(s).
- In structurally complex geologic settings (i.e. areas with major faults or salt domes) juxtaposition of higher porosity-permeability zones against lower porosity-permeability zones can create structural traps that prevent significant out-of-zone fluid migration;
- In either simple or complex structural settings, the presence of transmissive faults (i.e. faults along which fluids can freely migrate) through a confining zone will cause a site to be unsuitable for geologic storage of CO_2;
- A confining zone may have mineralogic characteristics that help trap any CO_2 that may invade lower portions of the zone;
- Confining zones must have high enough fracture pressure to withstand pressure perturbations in the underlying injection zone;
- Each field will have different histories and practices with regard to maintenance of well casings. For example, there is an effective cathodic-protection system to help prevent well casing deterioration in the SACROC oil field.[18]

- Existing wellbores within the geologic storage facility's area of influence must be evaluated for integrity.
- Knowledge of underground sources of drinking water (USDWs) is necessary. Accordingly, hydrologic evaluation should include the following considerations:
  - Age, environment of deposition, and post depositional processes of geological units result in differing depths, permeabilities, and flow patterns of USDWs. In Texas, depth to the base of a USDW can range from several hundred feet (e.g. minor Permian-age aquifers in west Texas) up to more than four thousand feet (e.g. Carrizo-Wilcox and Gulf Coast aquifers).
  - Lateral variations in water-bearing zones must be considered when evaluating potential sites for geologic storage. For example, the Wilcox Group of formations occurs at the surface along a zone that parallels the Texas Gulf Coast. This same group of rocks dip and are buried by successively thicker accumulations of younger rocks and sediments toward the Gulf of Mexico. Groundwater in shallower portions of this group of formations is potable (e.g. Carrizo-Wilcox aquifer), but in deeper zones the

[18] Personal communication with Kinder Morgan

groundwater becomes saline. Limitations on volumes and rates of CO_2 injection into saline formation zones of the Wilcox Group to prevent lateral or up-dip displacement of brine into the Carrizo-Wilcox aquifer zone is of concern.

- Chemical composition of aquifer rocks and fresh groundwater will influence the type of monitoring techniques used to demonstrate that injected CO_2 remains in the deep subsurface.

- The more appropriate data that are available, the more accurate will be the estimations of volumes of CO_2 that can be held in a particular GS facility.
  - The types of subsurface data that may be available for many areas in Texas include: surface seismic and borehole (wireline logs) geophysical data, cores and core analyses, and past oil field production data,
  - Availability of data for use in static and predictive-fluid-flow numerical models to predict transport of CO_2 is critical in determining the Area of Review (AOR) in the permitting process, and in developing an effective monitoring program.

Offshore Considerations

The primary advantage of an offshore geologic storage site is that underground sources of drinking water are not a concern. In addition, ownership of pore space is not a concern because the State of Texas owns the rights to submerged lands out to 3 leagues (10.3 miles) from the Gulf shoreline. The Federal government owns leasing rights to Gulf of Mexico offshore continental shelf (OCS) waters, which are between 10.3 and 200 miles from the Gulf shoreline. Seafloor geohazards are a potential problem in offshore settings, but are usually restricted to water deeper than about 1,000 feet. Water depths in State of Texas submerged lands are typically much shallower.

Recommendations for Evaluating Potential Geologic Storage Sites

As noted, the greatest potential for deep subsurface storage of CO_2 in Texas occurs in saline formations, and oil and gas fields (Figures 2 and 3). The remaining categories in Texas are not equally suitable at this time, primarily due to economics, but also due to technology and experience. In light of this and the siting criteria for CO_2 GS sites presented above, the agencies make the following observations for the various geologic settings listed in SB 1387.

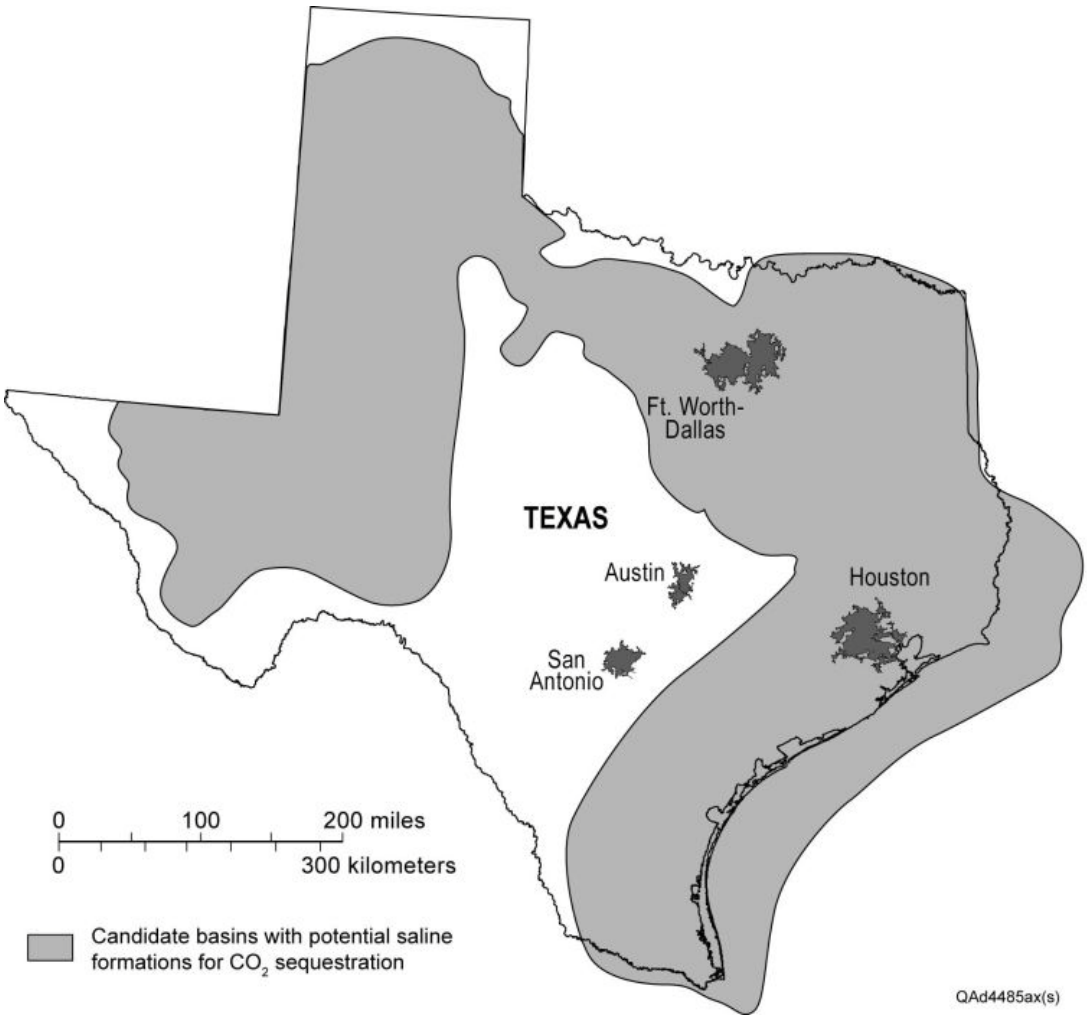

Figure 2, Saline Formations in Texas

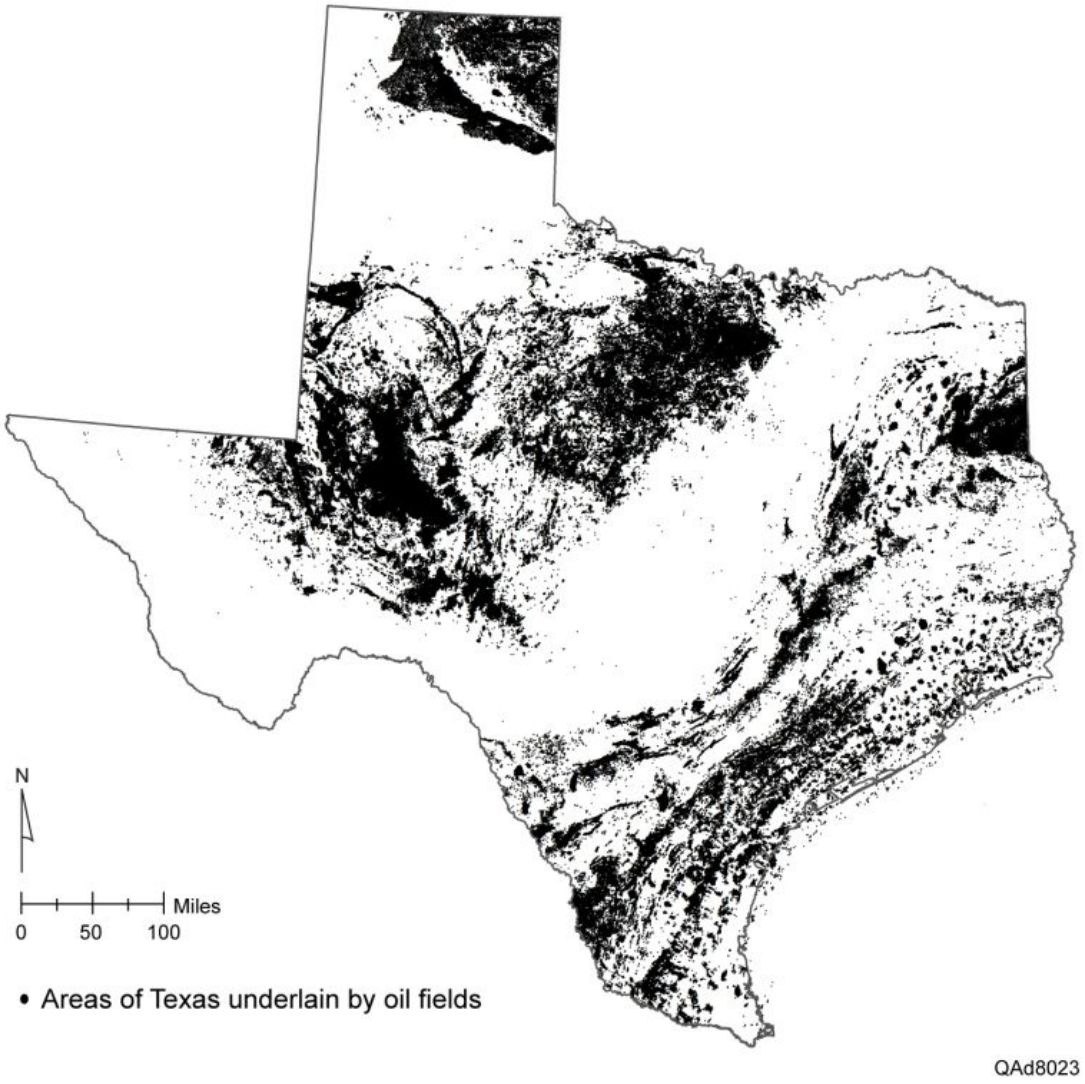

Figure 3, Oil and Gas Fields in Texas

Saline Formations

Saline formations are sedimentary rocks that are saturated with brine, which generally is not suitable for agricultural use or human consumption. Therefore, these aquifers are not usually underground sources of drinking water (USDWs). These formations are plentiful and distributed more widely than are oil and gas reservoirs. Saline formations are estimated to contain the largest storage capacity of the various geologic settings for permanently storing CO_2 in Texas and elsewhere. This is mainly a result of the immense volume of the subsurface that these types of formations occupy relative to hydrocarbon reservoirs. However, in contrast to oil and gas formations, there are less data with respect to the physical characteristics of saline formations and the potential migration pathways between saline formations and underground sources of drinking water (USDWs). Therefore, the potential movement of an injected CO_2 "plume" through the brine must be clearly understood, including the displacement of the formation fluids

and the potential for chemical interactions between CO_2 and existing minerals in the formation.

Operating and Depleted Oil and Gas Fields

Oil and gas fields are separated into two categories, operating and depleted, in SB 1387. However, active operating fields, whether or not enhanced recovery techniques (EOR or EGR) are used, are likely to have geologic similarities to fields that are historic or depleted, insofar as each would have a porous and permeable formation potentially suitable for GS, as well as an effective trapping mechanism. Also, the historic or depleted fields may once again become economically viable with changes in market conditions or improved production techniques. For these reasons, both are good candidates for GS, and are combined herein for technical discussion purposes only.

Geologic storage is occurring in many active oilfields in Texas that is currently documented as enhanced oil recovery (EOR). Geologic storage incidental to enhanced recovery is common in the Permian Basin (Figure 4) in places, such as the Scurry Area Canyon Reef Operators Committee (SACROC) field in Scurry County, Texas. The CO_2 that is currently being used for EOR in the Permian Basin is a purchased commodity. For this reason, EOR operators in the Permian Basin attempt to recover and reuse as much of the injected CO_2 as possible, as a certain percentage is re-captured as a bi-product of petroleum production. Although EOR operations recycle and reuse as much as possible of the injected CO_2 that is re-captured as a bi-product of petroleum production, approximately 50 percent of the initially injected CO_2 is not recoverable because it remains stored in the producing formation. This stored percentage gradually increases over the life of the EOR project as the injected CO_2 is recaptured from production and recycled, and consequently, accumulates in the reservoir. Also, additional oilfields in Texas, both in the Permian Basin and along the Gulf Coast, have potential for future development of CO_2 EOR (Figures 4 and 5).

Oil and gas formations are expected to play a critical role in the initial phases of implementing GS, especially in Texas. Reasons for this include:

- The potential to recover some of the costs of GS through EOR or EGR;
- Existing oil and gas fields are often located near to existing CO_2 transport and injection facilities;
- These reservoirs are attractive candidates for geologic storage of CO_2 because they are generally the best understood of the potential storage formations; and
- Depleted formation pressure may increase storage capacity.

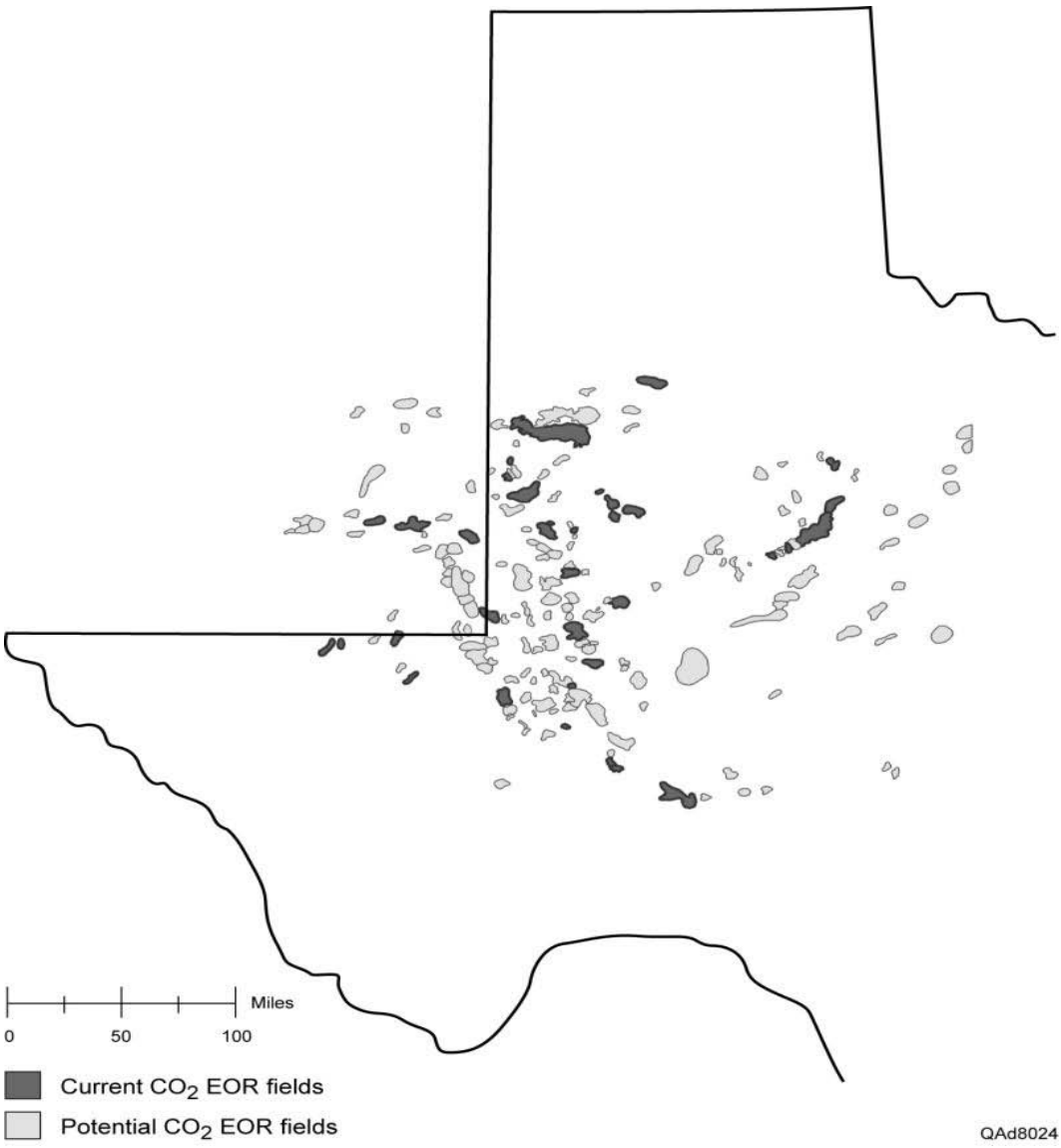

Figure 4, Oil and Gas Fields, Permian Basin with EOR or Potential EOR Usage

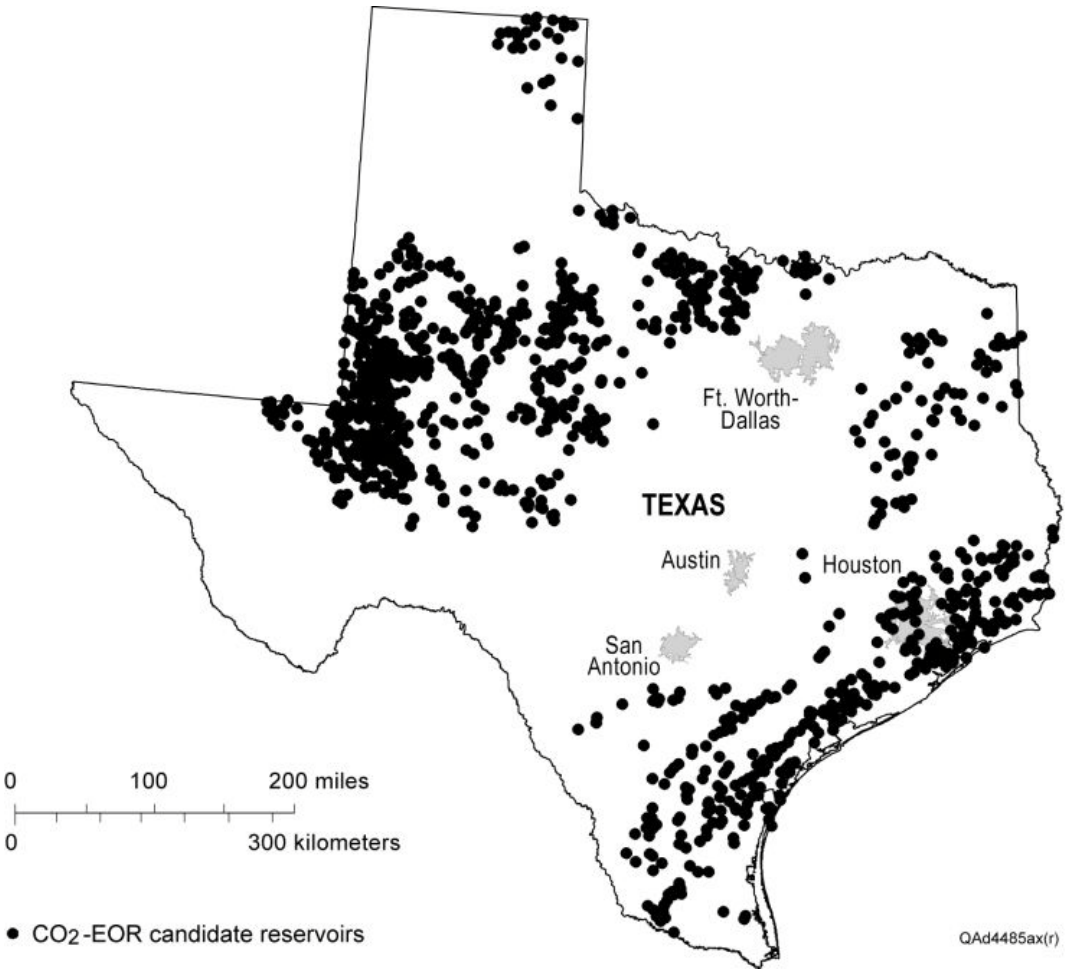

Figure 5, Oil and Gas Fields in Texas with potential EOR usage

Storage of CO_2 incidental to the production of oil during EOR operations is indistinguishable from the storage of CO_2 that would occur if the depleted oil formation were to be later used for GS. The CO_2 would be injected through the same wellbore into the same formation.

In oil and gas operations, the role of economic considerations is inherent. Thus, while storage can take place adjacent to an operating field, the most obvious criteria for identifying storage opportunities in active and historic oil and gas fields will be heavily based on the economic potential of enhanced recovery using CO_2.

Unmineable coal seams & enhanced coalbed methane (ECBM)

Unmineable coal seams are those coal seams that have been determined to be unsuitable for mining, generally because they contain brine, methane, and other gases. One potential attraction of unmineable coal seams is the possibility that injection of carbon dioxide will enhance the production of methane, a process known as enhanced coal bed methane production (ECBM), which could potentially offset storage costs. In some areas outside of Texas, the potential storage capacity of these formations is believed to be considerably larger than the storage capacity of oil and gas fields, but less than the storage capacity of deep saline formations.

Portions of Texas are underlain by coal seams, but most of them are low quality (lignite) and occur at relatively shallow depths (less than 2,400 ft). ECBM production does not currently take place in Texas. However, some studies show that there is potential for future ECBM using low-quality coals of Texas.[19] Other states, such as Colorado, Montana, and Wyoming, where ECBM is practiced, are studying the feasibility of commercial storage of anthropogenic CO_2 in these formations.

The occurrence of unmineable coal and coalbed methane fields in Texas is fairly restricted and does not constitute a large proportion of the stratigraphic intervals suited for CO_2 storage. For these reasons the capacity of coal formations is deemed insignificant compared to the saline formations and EOR opportunities available for storage of CO_2 in Texas.

Geothermal systems

The use of CO_2 for improving the performance of geothermal systems is a topic of ongoing research. Preliminary research indicates that the need for isolation and containment (closed system) in a sequestration reservoir is not fully compatible with the need for dynamic development and fluid circulation (open system) of a geothermal reservoir. Although there may be several synergistic positive impacts of integrating CO_2 reservoirs above geothermal reservoirs, the possibilities have yet to be fully explored. There are sites where this may be feasible.[20]

Igneous Formations

In Texas, igneous rocks are present in the Trans-Pecos and Llano Uplift regions. In both of these regions, the igneous rocks are present at the surface and hence fail to meet several of the minimum suitability criteria for geologic storage sites, such as a sufficient confining mechanism. In Texas, the opportunities for long-term geologic storage of CO_2 in igneous formations are negligible.

Other places in the United States where more suitable igneous formations are being considered for CO_2 geologic storage are primarily located in the large basalt provinces such as the Columbia River Plateau of the Pacific Northwest (Idaho, Oregon, and Washington). There also is an area with some potential for CO_2 sequestration in igneous rocks along the southeastern U.S. Atlantic coast (Georgia and South Carolina).

2.1.2 Regulatory Discussion

Background Information and New Regulations

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[19] McVay, D.A., R.O. Bello, W.B. Ayers Jr., G.A. Hernandez, J.A. Rushing, S.K. Ruhl, M.F. Hoffman, and R.I. Ramazanova, 2009, Evaluation of the technical and economic feasibility of CO2 sequestration and enhanced coal-bed methane recovery in Texas low-rank coals in M. Grobe, J.C. Pashin, and R.L. Dodge, eds., AAPG Studies in Geology 59: Carbon Dioxide Sequestration in Geological Media – State of the Science, p.665-688.

[20] http://trib.com/news/opinion/mailbag/article_0d1e58ab-6c30-5418-a28c-d11cf84ba03c.html, CO2 sequestration is essential to Wyo, by Ronald Surdam - Perspective | Posted: Tuesday, February 23, 2010

Underground injection is regulated under the federal Safe Drinking Water Act (SDWA), under which the U. S. Environmental Protection Agency (EPA) established the Underground Injection Control (UIC) Program. In the UIC program, EPA established five classes of injection wells:

- Class I wells are wells into which hazardous wastes and nonhazardous industrial or municipal wastes are injected beneath the lowermost USDW.
- Class II wells include enhanced recovery injection wells and injection wells for the disposal of oil and gas wastes.
- Class III wells are associated with solution mining.
- Class IV wells are wells used for the shallow injection of hazardous wastes and have been banned except when used as part of authorized groundwater remediation projects.
- Class V wells include shallow injection of non-hazardous fluids not covered by Class I wells, and, in some cases, experimental wells.

States may apply for primacy of the UIC program or allow the EPA to directly administer the program in their state. In Texas, the EPA-approved UIC program is split between the TCEQ and the RRC. The TCEQ has jurisdiction over Class I wells, certain Class III wells (uranium mining and sulfur mining wells), Class IV wells, and certain Class V wells (those wells not associated with oil and gas activity). The RRC has jurisdiction over Class II wells and the remaining Class III wells. The RRC also has jurisdiction over underground storage of liquid or liquefied hydrocarbons in salt formations, underground storage of gas in productive or depleted reservoirs, and underground storage of gas in salt formations.

On July 25, 2008, the EPA published a proposed rule for underground injection of CO_2 for long-term geologic storage in a non-productive formation. The proposed regulations would establish a new class of wells, Class VI. The regulations establishing the criteria and standards for issuance of Class VI well permits would be codified in 40 CFR Part 146, Subpart H.[21] Class VI wells would be permitted exclusively for injection of CO_2 for long-term geologic storage in non-enhanced recovery scenarios.

Technical requirements discussed in the EPA's proposed Class VI regulations include:

- Geologic site characterization;
- Proper construction of injection wells, including demonstration that the materials to be used are compatible with carbon dioxide;
- Determination of the "area of review" around the injection wells, including periodic re-evaluation of the area of review using monitoring and operational data to confirm movement of CO_2 within the subsurface as predicted;
- Mechanical integrity testing of the injection wells;
- Groundwater monitoring;

[21] 33 U.S.C. § 300.h-3.

- Tracking the location of injected CO_2 and resulting pressure front;
- Extended post-monitoring site care in accordance to an approved post-injection care and closure plan, and plugging of all wells; and
- Financial responsibility and assurance requirements to ensure that funds would be available for well plugging, monitoring, site care, closure, and emergency and remedial response.

Other key principles and features of the proposed federal rules include the following:

- The proposed rules do not cover capture and transportation of CO_2, determination of property rights, transfer of liability among parties, atmospheric releases of CO_2, and certification of greenhouse gas reductions.
- The proposed rules do not cover CO_2 streams that meet the definition of a hazardous waste. Such streams are subject to the more stringent requirements of UIC Class I wells and the Resource Conservation and Recovery Act (RCRA).
- The proposed rules do not address the injection of CO_2 that already is taking place pursuant to Class II well permits issued under other existing UIC regulations, such as enhanced oil recovery operations.
- A Class VI well permit would be issued for the duration of the CO_2 storage project.
- States could apply for primacy to regulate Class VI wells; however, the EPA has not determined whether states may obtain primacy *only* for Class VI wells. Presently, states may obtain primacy to regulate all five UIC well classes, to regulate Class I, III, IV and V wells, or to regulate only Class II wells.
- The proposed rules require continuous monitoring at the wellhead and down-hole.
- The EPA proposes setting the CO_2 injection depth at below the lowermost formation containing underground sources of water (USDWs), defined as aquifers that supply public water systems. However, the EPA has not determined whether to allow a variance from this restriction at the discretion of EPA or the primacy State based on site-specific conditions.

EPA has indicated that it intends to finalize the Class VI UIC regulations in November of 2010, at the earliest. The RRC, the TCEQ, and the BEG all commented on this proposed rule as a matter of record. In March of 2010, the RRC published proposed rules[22] intended to meet EPA's Class VI requirements and the requirements of SB 1387. These rules were in the final stages of development at the time this report was finalized. SB 1387 contemplates that the RRC will seek primacy for this program upon adoption of the RRC rules and the EPA regulations related to Class VI injection wells, the RRC will seek primacy for this program as required by SB 1387.

Section 1425 of the federal SDWA allows states seeking primacy for Class II wells to demonstrate that their existing standards are effective in preventing endangerment of

[22] 16 TAC Chapter 5

USDWs. These programs must include requirements for permitting, enforcement, inspection, monitoring, record keeping, and reporting that demonstrate the effectiveness of their requirements. Texas' Class II UIC program was approved by the EPA under Section 1425. However, under §1422 of the federal SDWA, states applying to EPA for primary enforcement responsibility to administer the UIC program (primacy) must show that the state programs meet EPA's minimum federal requirements for UIC programs, including construction, operating, monitoring and testing, reporting, and closure requirements for well owners or operators. Absent some action from Congress or the courts, states will be required to apply for primacy for the UIC program for GS of CO_2 (Class VI) under §1422 of the SDWA. Therefore, the state's program must be at least as stringent as the EPA's program. Where states do not seek this responsibility or fail to demonstrate that they meet the EPA's minimum requirements, the EPA is required to implement a UIC program for the state (Direct Implementation).

For the UIC considerations at the state level, the RRC has rules under development intended to be consistent with the final EPA rule relating to Class VI facilities. These were published for comment in the *Texas Register*, on March 26, 2010, to implement Section 2 of Senate Bill 1387.

SB 1387 delegated jurisdiction to the RRC for injection of anthropogenic carbon dioxide for the purpose of geological storage. Under the rules proposed by the RRC, a person may apply for a permit to inject anthropogenic CO_2 into productive formations and into saline formations directly above and below the productive formations, for the purpose of geological storage. The bill also authorizes the RRC to impose fees for permitting and regulation of CO_2 GS, and establishes an Anthropogenic Carbon Dioxide Storage Trust Fund for specified uses by the RRC for regulation of such geologic storage.

SB 1387 requires that the agencies determine the need for, and make recommendations to the Legislature for, any additional legislation, modification of the Memorandum of Understanding (MOU) between the RRC and the TCEQ, or new rules for geologic storage and associated wells.[23] At this time, the agencies have no recommendations related to the MOU, which was amended effective October 21, 2010, to address coordination of work related to geologic storage of anthropogenic carbon dioxide, among other issues. In addition, the agencies see no need to revise the proposed regulations related to geologic storage of anthropogenic carbon dioxide at this time. The agencies do, however, have recommendations for additional legislation regarding sites where the TCEQ has jurisdiction over GS of anthropogenic CO_2. Suggested language for this additional legislation is included in Section 5.1.

SB 1387 requires coordination between the RRC and the TCEQ to ensure the regulation of carbon dioxide storage in Texas is performed in an economically and environmentally sound manner. SB 1387 also requires that the permit applicant obtain and submit to the RRC a letter from the Executive Director of the TCEQ stating that freshwater strata will not be injured by the permitted activity.

The RRC has been active in the regulation of underground injection activities for more than seventy years. Texas has had an established program regulating CO_2 injection for

[23] SB 1387, Section 10(c)(9) of Senate Bill 1387

the purpose of EOR in operating oil and gas fields under permits issued by the RRC. The RRC issued the first permit to inject water into a productive reservoir in 1936, and the commercial use of CO_2 in the production of oil began in 1972 in the SACROC unit in the Permian Basin of West Texas. Formations with a production history that are currently non-productive (e.g., depleted fields) and into which operators wish to commence CO_2 injection may require a Class II or Class VI permit, depending on the amount of CO_2 injected, and the production economics.

In the federal Class VI injection well rules proposed on July 25, 2008, the EPA defined Class VI injection wells as "[W]ells used for geologic sequestration of carbon dioxide beneath the lowermost formation containing an underground source of drinking water (USDW).[24]" State law does not prohibit geologic storage of CO_2 in a formation above a USDW. Such a prohibition would prevent CO_2 sequestration in large parts of the U.S. where suitable sediments for CO_2 injection are either absent, or only exist at shallow depths. However, in Texas, from a practical standpoint, it is unlikely that an applicant would be able to demonstrate that such a formation would meet technical criteria for geologic storage.

Texas also defines "water to be protected" differently than the federal laws define "underground sources of drinking water (USDWs)." The federal definition of USDW includes any portions of the subsurface containing ground water of less than 10,000 mg/L in total dissolved solids, which has not been designated by the State and EPA as an exempt aquifer.[25] In the TCEQ rules[26] and the RRC rules,[27] groundwater containing total dissolved solids of less than 10,000 mg/L is within the scope of the term "fresh water" as defined in the Texas Water Code.[28] Notably, just as protection of USDWs is mandated by the federal Safe Drinking Water Act, protection of fresh water during injection well operation is required by the Texas Water Code.

EOR and Geologic Storage

As mentioned above, the RRC has in place an EPA-delegated UIC program under the federal SDWA. Under that program, EOR wells are classified as Class II wells. The Class II UIC program includes effective technical requirements, including well logs to identify potential geologic storage formations and their sealing or confining formations, well construction requirements, mechanical integrity testing requirements, identification of potential release points via abandoned wells with a requirement for related corrective action, permit conditions that set allowable well pressures, volumes, and depths, reporting requirements to document activities, and facilitate effective regulatory oversight.

Section 11 of SB 1387 requires the RRC to adopt rules under §27.047 of the Water Code, relating to the geologic storage of CO_2 in, and the injection of CO_2 into, a reservoir that is initially or may be productive of oil, gas, or geothermal resources or a saline formation directly above or below that reservoir. The RRC also will be adopting

[24] Title 40, CFR, proposed §144.6(f) and 146.5(f)
[25] 40 CFR § 144.3
[26] 30 TAC § 331.2
[27] Draft Rule 16 TAC § 5.102
[28] TWC § 27.003

rules that include measurement, monitoring, and verification provisions to account for CO_2 that is geologically sequestered in association with enhanced recovery.

Jurisdiction of Acid Gas Disposal and Geologic Storage

SB 1387 amends Texas Water Code to add new §27.041, relating to jurisdiction, which assigns to the RRC jurisdiction over the "geologic storage of CO2 in, and the injection of CO2 into, a reservoir that is initially or may be productive of oil, gas, or geothermal resources or a saline formation directly above or below that reservoir."

SB 1387 also defines "anthropogenic carbon dioxide" as follows:

"Anthropogenic carbon dioxide":

(A) means:

(i) carbon dioxide that would otherwise have been released into the atmosphere that has been:

(a) stripped, segregated, or divided from any other fluid stream; or

(b) captured from an emissions source, including:

(1) an advanced clean energy project as defined by §382.003, Health and Safety Code, or another type of electric generation facility; or

(2) an industrial source of emissions;

(ii) any incidental associated substance derived from the source material for, or from the process of capturing, carbon dioxide described by Subparagraph (i); and

(iii) any substance added to carbon dioxide described by Subparagraph (i) to enable or improve the process of injecting the carbon dioxide; and

(B) does not include naturally occurring carbon dioxide that is recaptured, recycled, and reinjected as part of enhanced recovery operations.

Acid gas separated from methane and other hydrocarbons during natural gas processing often includes both CO_2 and hydrogen sulfide (H_2S). The underground injection of this acid gas for disposal purposes is currently a permitted activity regulated by the RRC under its Class II UIC Program. This injection typically occurs at or near the natural gas processing facility into non-productive formations or into formations that are not above or below productive formations. Such injection is currently permitted as a disposal activity, rather than a geologic storage activity. Prior to applicable provisions of the Clean Air Act, these gases were flared to prevent accumulations of hydrogen sulfide, which is explosive and flammable, as well as poisonous.

Because the CO_2 derived from natural gas processing appears to be included in the definition of anthropogenic carbon dioxide in SB 1387, and because it is typically injected into formations not productive of oil, gas, or geothermal resources, or above or below such formations, the language in SB 1387 could imply that jurisdiction over such injection changed from the RRC to the TCEQ. This implication presents a potential conflict (which the agencies believe was not intended) regarding acid gas waste disposal wells permitted by the RRC.

Therefore, legislation may be necessary to clarify that injection of anthropogenic CO_2, as a component of acid gas generated in association with natural gas processing, into a non-productive formation for the purpose of geologic storage, is under the jurisdiction of the RRC for the purpose of disposal as well as geologic storage.

Beyond EOR: Jurisdiction of Saline Formations and Geologic Storage in Non-Productive Settings

Texas has great potential for enhanced recovery as a means for geologic storage of CO_2 and effective regulatory procedures already are in place (Class II rules). However, the volume of anthropogenic CO_2 available may ultimately exceed that needed for enhanced recovery. As a result, it will be necessary to use other geologic settings for geologic storage of anthropogenic CO_2. Existence of CO_2 pipelines, surface separation equipment, and other necessary facilities will likely make saline formations stacked above and below oil and gas reservoirs the next most attractive option for geologic storage of anthropogenic CO_2. Jurisdiction for this setting will be with the RRC as established by SB 1387. However, after the capacity associated with oil and gas resources are exhausted, or currently in locations distant from oil and gas regions, industry in Texas may need to rely on saline formations not stacked or associated with oil and gas reservoirs for geologic storage of anthropogenic CO_2. Under SB 1387, TCEQ has jurisdiction for this type of geologic storage.

The new RRC rules proposed in response to SB 1387 are adequate for saline formations vertically accessible to and/or stacked with oil and gas fields. The TCEQ would need to adopt rules for geologic storage in other settings. These are discussed in Sections 2.2.1 and 5.1 of this report. Both RRC and TCEQ rules will need to be consistent with EPA's Class VI rules for geologic sequestration.

2.2 Analysis of the requirements for the injection and geologic storage of anthropogenic carbon dioxide into saline formations that are not productive of oil, gas, and geothermal resources.[29]

2.2.1 Analysis of Agency Jurisdiction and Permits Required

The following analysis of agency jurisdiction and permit requirements is based on the statutory framework of the Texas Water Code and the federal Safe Drinking Water Act.[30] The analysis also assumes commercial-scale (non-experimental) geologic storage according to Class VI well technical requirements proposed by EPA in July 2008.[31] The analysis of agency jurisdiction and permits required for geologic storage of CO_2 is shown in Table 2 below. The table contrasts permitting requirements before the State obtains Class VI well primacy from EPA, with those permitting requirements after primacy is obtained.

Considering geologic storage of CO_2 into saline formations *not* productive of oil, gas, or geothermal resources, the table identifies two categories denoted from left to right: "Geologic Storage in Saline Formations Directly Above or Below Initially or Potentially

[29] SB 1387, Section 10 (b) (1)
[30] TWC Chapter 27 and 42 USCA, §300h-1
[31] Federal Register, Vol. 73, No. 144, pp 43492 – 43541

Productive Reservoirs for Oil, Gas, or Geothermal Resources"; and "Geologic Storage *Not* in Saline Formations Directly Above or Below Initially or Potentially Productive Reservoirs for Oil, Gas, or Geothermal Resources." The table further categorizes from top to bottom, the types of permits required for injection and geologic storage of CO_2: the top two categories depending on whether EPA asserts any direct role in permitting of CO_2 geologic storage projects before the State receives Class VI primacy/authorization from EPA, and the third category covering permit requirements after the State receives Class VI primacy from EPA.

Table 2: Analysis of Requirements for Injection and Geologic Storage of Anthropogenic CO_2 in Saline Formations Not Productive of Oil, Gas, or Geothermal Resources.[32]

	Geologic storage in saline formations directly above or below initially or potentially productive reservoirs for oil, gas, or geothermal resources	Geologic storage in saline formations not directly above or below initially or potentially productive reservoirs for oil, gas, or geothermal resources
Before State Primacy for Class VI Injection Wells, using existing State UIC Primacy under 40 CFR Part 147, Subpart SS-Texas	Requires RRC §27.043 permit (with inclusion of Class VI requirements)*	Requires TCEQ §27.011 permit (with inclusion of Class VI requirements)*
Before State Primacy for Class VI Injection Wells, under EPA Direct Implementation of Class VI Program	Requires RRC §27.043 permit and either EPA approval of the permit under its direct implementation authority as meeting Class VI requirements, or a separate Class VI permit issued by EPA	Requires TCEQ §27.011 permit and either EPA approval of the permit under its direct implementation authority as meeting Class VI requirements, or a separate Class VI permit issued by EPA
After State Primacy for Class VI Injection Wells	Requires RRC §27.043 UIC Class VI Permit	Requires TCEQ §27.011 UIC Class VI Permit

Analytical conclusions concerning agency jurisdictions and permits required for CO_2 GS in non-productive saline formations are as follows:

[32] Statutory Basis of Table 2: Ch. 27, Texas Water Code, §27.011, §27.041, and §27.043, and SDWA Analysis is based on EPA proposal of Class VI injection well rules for CO_2 geologic storage anticipated to be adopted in late 2010 or early 2011. ALSO: *Whitehurst, Lee, EPA Office of Ground Water & Drinking Water, 2/27/2010: Presentation at Ground Water Protection Council Conference, Austin, Texas.

1. Of the two categories of geologic storage into saline formations not productive of oil, gas, or geothermal resources, the first, geologic storage in saline formations directly above or below initially or potentially productive reservoirs, is under RRC jurisdiction.[33] In the second category, geologic storage in non-productive saline formations not directly above or below initially or potentially productive reservoirs, by interpretation of the Texas Water Code (TWC),[34] defaults to TCEQ jurisdiction. Therefore, TCEQ will need to permit and regulate geologic storage projects in this second category.
2. The jurisdictional specification of the Texas Water Code[35] in regard to CO_2 geologic storage in "a saline formation directly above or below" an initially or potentially productive reservoir is interpreted to include geologic storage of CO_2 in all saline formations overlying or underlying the subject reservoir, to the lateral extent of the reservoir. Accordingly, wells permitted by the RRC for oil, gas, or geothermal resource production would remain under RRC jurisdiction if converted for injection and geologic storage of CO_2 in portions of any saline formations overlying or underlying the produced reservoir. Under such interpretation, wells for geologic storage of CO_2 would, nonetheless, be subject to the constraints of Class VI well siting criteria as proposed by EPA, i.e., for injection to be in suitable formations and separated from USDWs by suitable confining formations or strata.
3. A state will have 270 days from the effective date of EPA's Class VI UIC rules to submit to EPA a program revision application to obtain Class VI primacy.[36] SB 1387 contemplates that RRC under § 27.048, Water Code, is to seek primacy to administer and enforce the Class VI UIC program. Upon completion of RRC rulemaking establishing consistency with the federal Class VI well requirements, the RRC will submit a program revision application to EPA.
4. If a state does not meet the 270-day time requirement in applying for Class VI UIC authority, EPA may proceed to directly implement a Class VI program for the state until the state receives primacy to administer the Class VI program. During any period of direct implementation of the Class VI program by the EPA region, injection well permits necessary under Chapter 27, Texas Water Code, would not be sufficient to authorize CO_2 geologic storage under the federal SDWA, i.e., permit approval by the EPA regional office would also be needed. EPA has indicated that in a Class VI direct implementation situation, the EPA region would attempt to work closely with the state geologic storage permitting programs, including coordination of technical reviews for resource efficiency.[37] After technical review and opportunity for public participation meeting federal Class VI well requirements, EPA would either add its approval to the state-issued permit or issue a separate Class VI permit.

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[33] Texas Water Code (TWC) §27.041
[34] TWC §27.041 with §27.011
[35] TWC §27.041(a) and §27.041(c)
[36] 40 CFR §145.32
[37] Whitehurst, L., EPA Office of "Ground Water and Drinking Water": personal communication, 3/16/10

5. EPA staff coordinating the Class VI rule development advise that in the interim between EPA's Class VI rule adoption and the addition of Class VI authority to a state's existing UIC program primacy, or initiation of direct implementation of a Class VI program within the state by EPA, Texas may permit CO_2 GS projects under existing program primacy,[38] by issuance of a Class I or a Class V UIC permit with recommended inclusion of Class VI-type application and permit requirements. Inclusion of Class VI requirements should ensure appropriate project siting and design (including construction, operation, monitoring, etc.) to enable eventual reclassification of the wells and reissuance of the permits as Class VI at an appropriate time. During such interim period, permitting of CO_2 GS wells and projects under the RRC's rules developed in response to Senate Bill 1387 should result in a close match of requirements proposed by EPA for Class VI wells. With respect to such interim period permitting by TCEQ, permits could be based on Class I application and permit requirements, with supplementation to meet Class VI requirements as proposed or adopted by EPA.
6. Both the RRC and TCEQ presumably will need to adopt and implement Class VI-equivalent rules and obtain Class VI primacy in response to §27.048, together with the jurisdictional specifications of §27.011 and §27.041, to avoid a permit process that includes EPA technical review and approval of a state issued permit, or an outright dual-permitting burden necessitating a Chapter 27 permit from the RRC or TCEQ, plus a direct-implementation Class VI UIC permit from EPA.
7. Additional permits or authorizations for construction and operation of CO_2 geologic storage projects may include TCEQ air permits for compressors and pumps associated with pipeline operation in transport of CO_2 to injection wells. If the facility is located within the Texas Coastal Zone Boundary, the permitting agency must perform a review to ensure that the proposed geologic storage facility is consistent with the applicable Texas Coastal Management Program goals and policies. Other considerations may include storm water permits and spill contingency plans under the federal Clean Water Act, National Environmental Policy Act (NEPA) studies where federal funds are involved, surveys for the federal Endangered Species Act, and studies conducted in accordance with the State of Texas Antiquities Code. These additional considerations are discussed in Section 2.4.2 of this report and in Appendix II of this report.

2.2.2 General Regulatory Performance Standards for CO_2 Geologic Storage

Performance standards applicable to injection of CO_2 for geologic storage are provided in State statute and agency proposed rules.

Section 27.003 of the Texas Water Code, relating to policy and purpose, states that it is the policy of this state and the purpose of this chapter to maintain the quality of fresh water in the state to the extent consistent with the public health and welfare and the operation of existing industries, taking into consideration the economic development of

[38] 40 CFR Part 147, Subpart SS – Texas

the state, to prevent underground injection that may pollute fresh water, and to require the use of all reasonable methods to implement this policy.

Section §27.051(b-1)[39] of the Texas Water Code states that the Railroad Commission may issue a permit (for geologic storage of CO_2) under Subchapter C-1[40] if it finds that:

(1) the injection and geologic storage of anthropogenic carbon dioxide will not endanger or injure any oil, gas, or other mineral formation;

(2) with proper safeguards, both ground and surface fresh water can be adequately protected from carbon dioxide migration or displaced formation fluids;

(3) the injection of anthropogenic carbon dioxide will not endanger or injure human health and safety;

(4) the reservoir into which the anthropogenic carbon dioxide is injected is suitable for or capable of being made suitable for protecting against the escape or migration of anthropogenic carbon dioxide from the reservoir; and

(5) the applicant for the permit meets all of the other statutory and regulatory requirements for the issuance of the permit.

Section §27.046[41] of the Texas Water Code requires a letter from the Executive Director of the TCEQ.

§27.046. LETTER FROM EXECUTIVE DIRECTOR.

(a) The railroad commission may not issue a permit (for CO_2 GS) under rules adopted under this subchapter until the applicant for the permit provides to the railroad commission a letter from the executive director (of the TCEQ) stating that drilling and operating the anthropogenic carbon dioxide injection well for geologic storage or operating the geologic storage facility will not injure any freshwater strata in that area and that the formation or stratum to be used for the geologic storage facility is not freshwater sand.

(b) To make the determination required by Subsection (a), the executive director shall review:

(1) the area of review and corrective action plans;

(2) any subsurface monitoring plans required during injection or post injection;

(3) any post-injection site care plans; and

(4) any other elements of the application reasonably required in order for the executive director to make the determination required by Subsection (a).

(c) The commission (TCEQ) shall adopt rules to implement and administer this section.

[39] As amended by SB 1387 Section 3
[40] TWC §27.041 – §27.049 as amended by SB 1387, Section 2
[41] As amended by SB 1387 Section 2

40 CFR §144.12(a) states that no owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 142 or may otherwise adversely affect the health of persons. The applicant for a permit shall have the burden of showing that the requirements of this paragraph are met.

2.2.3 Technical Requirements for Class VI Carbon Dioxide Geologic Storage Wells

Section 27.047 of the Texas Water Code requires that the RRC adopt rules and procedures reasonably required for the performance of its powers, duties, and functions under Subchapter C-1 of Chapter 27,[42] including rules for:

(1) the geologic storage and associated injection of anthropogenic carbon dioxide, including:

(A) geologic site characterization;

(B) area of review and corrective action;

(C) well construction;

(D) operation;

(E) mechanical integrity testing;

(F) monitoring;

(G) well plugging;

(H) post injection site care;

(I) site closure; and

(J) long-term stewardship;

(2) the enforcement of this subchapter and rules adopted by the railroad commission under Subchapter C-1; and

(3) the collection and administration of:

(A) fees imposed under Section 27.045; and

(B) penalties imposed for a violation of Subchapter C-1 or rules adopted by the railroad commission under this subchapter.

Pursuant to §27.047, the RRC proposed rules on March 26, 2010 (Title 16, Texas Administrative Code, Chapter 5). The federal Class VI UIC rules as proposed by EPA include elements (1) (A) through (J) above. EPA approval of state primacy for Class VI wells would require the state to meet the federal Class VI requirements by providing equivalent or greater protection on a rule-for-rule basis (Safe Drinking Water Act).[43]

[42] TWC §27.041 – §27.049 as amended by SB 1387, Section 2
[43] §1422 [Title 42 USCA §300h-1])

Consequently, a follow-up rulemaking by RRC may be necessary in the future as part of a primacy process.

The need for the TCEQ to also develop and adopt Class VI-equivalent geologic storage rules, though not expressly required in SB 1387, is implied by TWC §27.048(b)(2)[44] in order for the State to gain primacy to administer and enforce the program for geologic storage of CO_2 in saline formations under TCEQ jurisdiction as derived from §27.011 and §27.041.

2.3 Recommendations for a permitting process for anthropogenic CO_2 injection wells and geologic storage facilities that are used for the injection and storage of anthropogenic CO_2 in saline formations not productive of oil, gas, or geothermal resources.[45]

Under §27.011 of the Texas Water Code, the TCEQ regulates all injection wells that are not under the jurisdiction of the RRC. SB 1387 specified formation characteristics to define RRC jurisdiction over carbon dioxide injection. Injection of carbon dioxide for geologic storage into formations that are not specified in statute falls under the jurisdiction of the TCEQ. Section 27.041 of the Texas Water Code establishes the RRC jurisdiction over the geologic storage of carbon dioxide and the injection of carbon dioxide into, a reservoir that is initially or may be productive of oil, gas or geothermal resources, or a saline formation directly above or below that reservoir. Consequently, the TCEQ has jurisdiction over the injection of carbon dioxide into a formation that is not productive of oil, gas or geothermal resources and is not a saline formation directly above or below such a reservoir. Prior to adoption of any new regulations by the EPA, injection of carbon dioxide for purposes of sequestration into formations other than those described in Texas Water Code §27.041 (e.g. under RRC jurisdiction) may be authorized by the TCEQ under existing rule requirements for Class I or Class V injection wells (depending on the characteristics of the proposed injection formation and the location of nearby underground sources of drinking water). When the EPA adopts the Class VI well rules, the TCEQ will have authority under the Water Code for adoption of equivalent rules for permitting and regulation of CO_2 injection in this new class of wells (Class VI).

The current underground injection control programs of the TCEQ and the RRC comply with State requirements for injection wells under the Texas Injection Well Act[46] and are authorized injection programs approved by the EPA under the federal Safe Drinking Water Act.

2.3.1 Class I Injection Wells Relative to Class VI Rules

A Class I well is a well into which hazardous wastes and nonhazardous industrial or municipal wastes (as opposed to CO_2 deemed as non-hazardous) are injected beneath the lowermost USDW. Class I injection wells are authorized by individual permits, and associated pre-injection equipment can be authorized under the same permit or under a

[44] SB 1387 Section 2
[45] SB 1387 Section 10(b)(2)
[46] TWC Chapter 27

separate pre-injection unit registration. An applicant submits an application for a permit to the executive director. An application is subjected to administrative and technical review by the executive director's staff. Applications for Class I injection well permits are subject to requirements for public notice by newspaper publication in the local area and mailed notice to neighboring property owners. The public is provided opportunity to comment on the application and to request a contested case hearing. A contested case hearing is provided if requested by the applicant, the executive director, or by an affected person who satisfies the requirements for requesting a hearing. Contested case hearings are conducted by the State Office of Administrative Hearings with final decisions made by the TCEQ commissioners. If the application is approved by the TCEQ, a permit is issued establishing the requirements for the construction, operation, and closure of the injection well. The TCEQ may include any provisions in the permit necessary for the protection of fresh water. The permits are typically issued for a term of ten years and may be renewed by the permittee.

2.3.2 Class II Injection Wells Relative to Geologic Storage

A Class II injection well, with respect to geologic storage of carbon dioxide, is an injection well used to enhance recovery of oil and gas.[47] The RRC does not authorize these wells by rule, but issues a permit for the wells or groups of wells associated with the enhanced recovery project. An applicant for a permit must submit a completed application to the RRC, where it undergoes administrative and technical review by Oil and Gas Division staff. Applications for Class II enhanced recovery injection well permit applications are subject to requirements for public notice by newspaper publication in the local area and mailed notice to the surface owner and to nearby operators. Affected persons are provided opportunity to comment on the application. If the RRC receives a protest from an affected person to an application, the application cannot be processed administratively. Upon request from the applicant, the RRC will schedule a hearing on a protested application. The RRC also may determine that a hearing is in the public interest. After the hearing, the Railroad Commission makes a final determination on the application.

2.3.3 Class V Injection Wells Relative to Class VI Rules

The Class V designation is for wells that do not fall under the Class I – IV or Class VI categories. Class V wells are typically shallow wells that inject fluids into or above an underground source of drinking water. Class V wells also may be used to test experimental technologies. Class V wells are typically authorized by rule, but the TCEQ may require a particular Class V injection well to be authorized by an individual permit. TCEQ rules establish the requirements for the construction, operation, and closure of Class V wells. These rules are established to protect groundwater, and the TCEQ can add specific terms and conditions to an authorization to protect fresh water from pollution. Class V injection wells authorized by rule are not subject to requirements for public notice, opportunities for public comment or a contested case hearing.

[47] §91.101, Natural Resources Code

2.3.4 EPA Class VI Injection Wells and TCEQ Rules

As previously noted, EPA's rules published on July 25, 2008, to regulate the injection of carbon dioxide for purposes of sequestration proposed a new designation for a Class VI injection well. Once EPA's Class VI regulations are adopted (or EPA establishes additional requirements for carbon dioxide injection wells under a different category), the TCEQ could propose new rules equivalent to the EPA regulations to implement carbon dioxide injection requirements for those projects that are not subject to the RRC's jurisdiction under Texas Water Code, §27.041. After the TCEQ has adopted such rules, it could apply to the EPA for approval of a revision of the state's authorized underground injection control program under the Safe Drinking Water Act to include regulation of carbon dioxide injection under TCEQ's jurisdiction. Because of the delineation of agency jurisdiction under Texas Water Code, §27.011 and §27.041(c), both the TCEQ and the RRC are required to apply to EPA for approval of the State's UIC program to authorize carbon dioxide injection and geologic storage under the Class VI program.

2.3.5 RRC proposed rules for geologic storage of anthropogenic carbon dioxide

On March 26, 2010, the RRC published for comment, draft rules to implement requirements for the geologic storage of anthropogenic CO_2 to implement by SB 1387. These rules are intended to provide the means of submittal and review of project applications, technical criteria consistent with EPA Class VI draft rule and state established protective measures, a state trust fund, public notice and contact of stakeholders, monitoring and reporting, financial assurance, emergency response, and criteria for site closure. Once adopted, these requirements would provide the framework for an effective permitting process in accordance with SB 1387.

2.4 Procedures for Public Review and Comment and for Ensuring the Quality of Cultural and Natural Resources[48]

2.4.1 Public review and comment on State and Private Lands

2.4.1.1 Notice

Land not owned by the State

Under the proposed RRC rules,[49] an applicant for a geologic storage facility is required to provide a copy of the application for public review in two ways. First, a copy must be filed with the county clerk of the county or counties that include the subject site. The city clerk, or appropriate city official must be similarly informed if any part the proposed geologic storage facility is within their city limits. The applicant also is required to post a copy on an Internet website. Subsequent revisions to the application must be filed with the county clerk(s) and city clerk, if applicable, and must be updated online when the revisions are submitted to the RRC.

[48] SB 1387, Section 10(c)(2) and Section 9(b)(3)
[49] 16 TAC §5.204

Under the RRC's proposed rules, the applicant also must contact surface owners, mineral rights lease holders, and surface lease holders abutting the outermost boundary of the Area of Review as defined in the application.

State-owned land

There are multiple opportunities for public review and comment on activities related to geologic storage on state owned land through the process used by the School Land Board (SLB). The SLB usually meets twice a month and notice of any meeting will be published in the Texas Register, including a posting regarding any action under consideration. All SLB meetings are webcast on the GLO web site. There is time for public comment on each action and at the end of every meeting.

The first step is to make the decision of which tracts may be suitable for CO_2 sequestration. GLO staff will make an initial determination, and recommend School SLB approval of such determination. The public will have the opportunity to speak on the matter at the meeting where SLB approval is sought, or any subsequent meetings, if the SLB postpones taking action on the matter at the initial meeting.

Following the determination of the SLB on which tracts are suitable, the public or staff may nominate any or all of the tracts for inclusion in an upcoming lease sale. Notice of the lease sale will be published, with the public having an opportunity to speak out concerning the proposed lease, at any of the SLB's meetings up to and including the day bids are opened. The public may at anytime during the life of the lease request to be placed on the SLB agenda to discuss on-going operations and to request SLB action on their concerns.

Once the winning bidder is determined, the lease will be negotiated and executed by the Commissioner. However, the basic lease framework will have been approved by the SLB in an open meeting.

2.4.1.2 Opportunity for Hearing

Land not owned by the State

If the RRC receives a protest of an application from a person who is notified pursuant to the proposed rule requirements, or another affected person, within 30 days of receipt of the application by the RRC, receipt of individual notice, or the last publication notice, then the RRC must inform the applicant that their application cannot be administratively approved. Subsequently, the applicant may request a hearing before the RRC. Also, the commission would schedule a hearing if the director determines that a hearing is in the public interest.

Under the proposed rules, if and when a hearing is scheduled, the RRC must provide notice to affected persons, local governments, and other persons, who express in writing an interest in the application. After the hearing, the examiner will recommend a final action by the RRC.

Under the proposed rules, if no protests are received by the RRC from a person or entity notified in accordance with rule, the director may administratively approve the application.

State-owned land

There are multiple opportunities for public review and comment on activities related to geologic storage on state owned land through the process used by the School Land Board (SLB). The SLB usually meets twice a month and notice of any meeting will be published in the Texas Register, including a posting regarding any action under consideration. All SLB meetings are webcast on the GLO web site. Time is allowed for public comment on each action and at the end of each board meeting.

2.4.1.3 Public Meeting

Land not owned by the State

If the RRC receives a protest of an application from a person who is notified pursuant to the proposed rule requirements, or another affected person, within 30 days of receipt of the application by the RRC, receipt of individual notice, or the last publication notice, then the RRC must inform the applicant that their application cannot be administratively approved. Subsequently, the applicant may request a hearing before the RRC. Also, the commission would schedule a hearing if the director determines that a hearing is in the public interest.

Under the proposed rules, if and when a hearing is scheduled, the RRC must provide notice to affected persons, local governments, and other persons, who express in writing an interest in the application. After the hearing, the examiner will recommend a final action by the RRC.

Under the proposed rules, if no protests are received by the RRC from a person or entity notified in accordance with rule, the director may administratively approve the application.

State-owned land

There are multiple opportunities for public meetings on activities related to geologic storage on state owned land through the process used by the SLB.

Notice of the lease sales for candidate sites will be published in accordance with applicable rules, with the public having an opportunity to speak out concerning the proposed lease, at any of the SLB's meetings, up to and including the day bids are opened. Additionally, a member of the public may, at anytime during the life of the lease request to be placed on the SLB agenda to discuss on-going operations and to request SLB action on their concerns.

2.4.2 Procedures for Ensuring Protection of the Quality of the Natural and Cultural Resources of Land Overlying a Geologic Storage Facility[50]

Land not owned by the State

Numerous state and federal laws are in place to ensure preservation of cultural and natural resources of land overlying the geologic storage facility. These laws are described in more detail in Appendix II and include:

[50] SB 1387, Sections 9(b)(3) and 10(c)(2)

- The federal Safe Drinking Water Act and state regulations adopted under the Texas Injection Well Act, Chapter 27, Texas Water Code to implement the delegated Underground Injection Control program. The Texas UIC program is intended to protect underground sources of drinking water. (Also see Sections 2.1.2, 2.2.3, and 2.3 of this document for more discussion of UIC rules.)
- National Environmental Protection Act (NEPA). NEPA would apply to facilities that receive federal funding. Under NEPA, the site is screened for impact to parks and wildlife preserves, endangered species habitat, wetlands, floodplains, and sites of historic importance. Sociological impact to the community is also evaluated.
- The Clean Water Act (CWA), which may require discharge permits under the National Pollutant Discharge Elimination System (NPDES), and/or spill plans for a geologic storage facility, depending on a range of criteria including location, equipment, and history.
- The federal Endangered Species Act (ESA) and regulations enacted by the Texas Parks and Wildlife Department for the protection of threatened and endangered species, including their habitat, in Texas. An applicant for a geologic storage facility permit may need to determine if there is potential impact to Endangered Species
- Regulations enacted by the Texas Historical Commission under the Texas Antiquities Code, under which a permit applicant for a geologic storage facility would be required to determine whether or not there are any cultural resources in the area that are required to be protected.

State-owned land

There are several different protections in place that would maintain the quality of the natural and cultural resources of the surface property. Any lease would include reporting, siting and inspection requirements, as well as specific language to ensure environmental, historical and geologic structural integrity protection. The Railroad Commission also has drafted financial assurance requirements that cover corrective action, emergency and remedial response, monitoring, and closure. Additionally, any GS lease issued on state owned submerged lands requires a Coastal Management Plan (CMP) consistency determination. The General Land Office will review and determine that the GS lease is in compliance with the goals and policies of the CMP before the GS lease could be issued.

Also, as discussed above, other environmental programs such as NEPA, CWA, ESA, TCMP, and the State of Texas Antiquities Code are expected to come into play on state owned lands. The reader is referred to the previous section of this report for additional information on UIC/SDWA. For other regulatory considerations, please refer to Appendix II of this report.

2.5 Analysis of, and recommendations to address:[51]

- the attributes of the subsurface area of operations for geologic storage facilities; and
- the methods of financial assurance and the allocation of long-term liability for the post-operational phases of geologic storage projects

2.5.1 Attributes of the subsurface area of operations for geologic storage facilities

The attributes of the subsurface area of operations for Class VI wells are more fully described in previous parts of this report. For more detail, the reader is referred to Section 2.1.1 of this report in the section titled "Technical Criteria for Siting". Briefly, these are as follow:

- Sufficient storage capacity to contain the target volume;
- Sufficient injectivity to receive the CO_2 at the intended rate; and
- A sealing and trapping system (stratigraphic interval) that will retain the CO_2 over the required time period, effectively sequestering CO_2.

For purposes of financial assurance and allocation of long-term liability for the post-operational phases of geologic storage projects, the impacted subsurface area of operations must be thoroughly identified through the accumulation of comprehensive testing and monitoring, to demonstrate the nature and extent of the CO_2 plume and pressure front. Regulations should require adequate data to allow regulators to predict the activity of the CO_2 plume when the project enters into the post-operational phase.

The state rules, pending their adoption and presumably subsequent primacy approval by EPA, appear to be adequate for their intended purpose, and hence no additional recommendations in that regard, are offered at this time.

2.5.2 Methods of Financial Assurance

SB 1387 requires a showing of both Financial Responsibility and Financial Assurance. Both are used to assure completion of certain activities required of an operator. Financial assurance is a term used to describe financial mechanisms to assure completion of certain activities required of an operator. This section discusses the various options for financial assurance.

RRC rules proposed in response to SB 1387 (16 TAC Chapter 5) would require an operator to post a bond or letter of credit for the operational (injection) and monitoring (post-injection) phases of an anthropogenic carbon dioxide GS facility. EPA's proposed rules also would require that operators maintain financial assurance for activities related to operating, maintaining, monitoring, and closing geologic storage facilities. The rule proposed by EPA on July 25, 2008, did not designate any specific financial assurance mechanism. Instead, it specified a general duty to obtain financial assurance acceptable to the Director. EPA proposes to provide guidance that describes

[51] SB 1387, Section 10(c)(5)

recommended types of financial mechanisms that operators can use to meet this requirement at a later date.

RRC proposed rules would require an applicant for an anthropogenic carbon dioxide GS facility permit to demonstrate that it has met certain financial requirements for corrective action, injection well plugging, post-injection storage facility care and storage facility closure, and emergency and remedial response until the RRC approves closure of the facility.

In determining whether the applicant is financially responsible, the RRC must rely on the person's most recent audited annual report filed with the U.S. Securities and Exchange Commission under Section 13 or 15(d), Securities and Exchange Act of 1934 (15 U.S.C. Section 78m or 78o(d)). Moreover, the RRC must rely on the person's most recent quarterly report filed with the U. S. Securities and Exchange Commission under Section 13 or 15(d), Securities Exchange Act of 1934 (15 U.S.C. Section 78m or 78o(d)) or, if the person is not required to file such a report, the person's most recent audited financial statement.

Risks to be covered by Financial Assurance

The EPA set out four activities specific to GS sites that should be covered:

- Plugging and Abandonment
- Corrective Action
- Post Injection Site Care and Site Closure
- Emergency and Remedial Response

The EPA's proposed rules for geologic sequestration of CO_2 did not address financial assurance for long-term care. It is not clear how financial exposure for any unanticipated migration will be handled since the operator will no longer be required to provide financial assurance after site closure is approved.

Financial Mechanism Options for EPA Regulated Activities

The EPA has designed several financial assurance mechanisms for other regulated activities that could be considered for GS sites. Each mechanism and its relative risk applicable to geologic storage activities, is described below.

Financial assurance mechanisms fall into two categories: (1) third party instruments that transfer risk to third party issuers, such as fully funded and pay-in-trust arrangements, irrevocable standby letters of credit, surety bonds and insurance; or (2) self-insurance instruments such as financial tests and corporate guarantees.

2.5.2.1 Fully Funded Trusts

Fully funded trusts are considered one of the more secure forms of financial assurance because a regulated third party trustee receives full funding of the cost estimates in the form of cash. Investments in the trust are primarily conservative in nature for the benefit of the regulatory agency. The primary negative factor is that such mechanism could place a cash flow burden on the operator because it requires full initial funding.

Risk: Low for all geologic storage activities

2.5.2.2 Pay-In Trusts

A pay-in-trust is similar to a fully funded trust except that the applicable cost estimate is funded over a defined period of time instead of at the inception of the regulated activity. EPA's approach allows pay-in-trusts, provided the pay-in period does not exceed three years.[52] This pay-in period is shorter than the ten-year option currently available to Class I well operators. A pay-in-trust has similar advantages and disadvantages as the fully funded trust except that the regulatory agency would be assuming more risk of financial shortfall if the operator became unable or unwilling to fully fund the instrument.

Risk: Medium for all geologic storage activities provided that the funding period does not exceed three years

2.5.2.3 Irrevocable Standby Letters of Credit

An irrevocable standby letter of credit is issued through a financial institution such as a bank and provides timely funding in the event a demand is made on the mechanism. One benefit for the operator could be the absence of an initial cash outlay compared to that of a funded or pay-in-trust arrangement; however, fees occur and usually range between 1-3% per year.

Risk: Low for all geologic storage activities

2.5.2.4 Surety Bonds

A surety bond is issued by a surety company. There are two basic types of surety bonds currently allowed under EPA rules: payment and performance bonds.

Payment Bond – A payment bond is similar to the irrevocable standby letter of credit in that the surety company provides cash funding upon demand.

Risk: Low for all geologic storage activities

Performance bond – A performance bond allows the surety company the option of either paying the full amount of the bond or hiring a contractor to perform the required activity. Performance by a surety company over a long period of time could shift significant risk to the State should the surety's financial condition deteriorate over time. This is especially important in light of post injection site care that could span decades.[53] Moreover, the longer the regulatory agency relies upon a surety company to perform, the risk of litigation increases should the surety's contractor not perform on a timely basis or in accordance with the applicable permit action requirements.

Risk: Medium for short-term geologic storage activities such as plugging and abandonment,

[52] Page 43521 of EPA's proposed rules
[53] Page 43540 of EPA's proposed rules

Risk: Medium to high for long-term geologic storage activities such as post injection site care. For these activities, financial risk increases with time.

2.5.2.5 Insurance

An insurance mechanism can result in significant collection risks due to the complex nature of the terms and conditions of each policy. While it is possible to negotiate favorable policy terms and conditions, insurance requires considerable expertise and resources. In addition, subsequent modification of policy terms could occur without the State's knowledge or consent. Like a performance bond, the State assumes more risk of the insurer going out of business before the activities are completed if such mechanism was used for long term actions, such as post injection site care.

Insurance is different from the other financial assurance mechanisms in two major ways: it is a cost *reimbursement* mechanism, and the insurer retains the right to challenge its obligation to reimburse. Unlike a letter of credit, where the State can present the letter to the bank for cash payment, under an insurance policy, the State would have to provide the initial funding to secure an outside contractor before it could seek reimbursement from the insurance company. Insurance is an option for oil and gas well plugging financial assurance in Texas, however, to date no operators have used the insurance option at RRC. Some participants in EPA's rulemaking process expressed concerns that mutual insurance companies may be reluctant to provide the high levels of coverage that may be necessary for GS projects and that some insurers may only cover the injection phase of such projects.[54] For these reasons, insurance may not be a viable, and is not a preferred, mechanism for GS activities.

Risk**:** High for all geologic storage activities, particularly for long term activities

2.5.2.6 Financial Test and Corporate Guarantee

Financial Test: Financial tests, under existing EPA rules for other programs, requires the operator of the facility to provide annual evidence of its capacity to absorb certain environmental cost obligations by meeting specific financial ratios and/or bond ratings. While favored by operators due to the cost savings, this mechanism places substantial risk on the State because there is no third party financial institution providing funding should the operator be unable or unwilling to perform the required activity. For example, in the event of bankruptcy, the State would most likely become a general unsecured claimant. The risk of financial deterioration of the operator before completion of a long term project such as post injection site care represents an even greater risk.

One option to ensure a higher degree of protection to the State would be to eliminate the ratio test alternative and require all companies to meet a minimum, unsecured bond rating threshold as gauged by well established and recognized rating agencies such as Standard and Poor's (S&P) or Moody's Corporation (Moody's). Raising the bond rating threshold from its current minimum requirement of BBB to A as issued by S&P would mirror a conservative approach taken by the Nuclear Regulatory Commission in their regulatory program.[55] Moreover, a higher threshold also would allow a company to

[54] Summary of EPA Webinars on Financial Responsibility of GS Wells, pages 5 and 8
[55] 10 CFR §30.35 Appendix C to Part 30

secure an alternate mechanism at a reasonable price and in a timely manner should its rating fall below the minimum requirement.

EPA is assessing whether a financial rating threshold similar to those used by other Federal agencies is appropriate[56] in light of recommendations from EPA's Office of the Inspector General and the U.S Government Accountability Office.

Risk: Medium for short-term geologic storage activities

Risk: High for long-term geologic storage activities

Corporate Guarantee: Corporate guarantees could be used if the facility operator does not meet the requirements of the financial test, but a higher tiered parent company does. It has similar advantages and disadvantages as the financial test noted above.

Risk: Medium for short-term geologic storage activities

Risk: High for long-term geologic storage activities

2.5.2.7 State-Controlled Trust Fund

Another option would be a pool of monies either provided initially by the operator or built up over time through fees. SB 1387 contemplates such a mechanism for purposes including long-term monitoring, and even plugging abandoned GS wells, but whether such fund can be used for all EPA anticipated activities is unclear. EPA also identified what is termed a State-administered compensation (or trust) fund along with other financial assurance models in a docket accompanying their proposed rules titled "Approaches to Geologic Sequestration Site Stewardship After Site Closure."

In light of the fact that the operator's financial assurance mechanism will be released after post-injection site care is approved, this form of financial assurance may be an avenue to explore to support any unanticipated migration after the site is permanently closed.

2.5.2.8 Summary on Financial Issues

EPA rules set out several types of financial assurance mechanisms that serve several purposes. Some of these may involve an acceptable level of financial risk to the state, while others may expose the State to more risk than the regulating agencies deem prudent. Fully funded trusts, pay-in-trusts with less than three years pay in duration, letters of credit and payment bonds pose the least amount of risk to the State related to an operator's short and long term obligations. Performance bonds pose somewhat more, but acceptable, risk for an operator's short term obligations such as well plugging and site closure, but more risk for long term obligations such as post injection monitoring. It has been the regulating agencies' experience that insurance poses the most risk to the State because of collection risk due to the complex nature of the terms and conditions of each policy and because it is a cost reimbursement mechanism where the insurer retains the right to challenge its obligation to reimburse.

[56] Page 43522 of EPA's proposed rules

Under EPA's proposal for Class VI injection wells, post-injection site care financial demonstration would be secured within 180 days of notifying the Director that the well will be plugged and abandoned. Such action could leave the State with significant financial risk. At a minimum, financial assurance should be provided over the period of time that revenue is received prior to plugging and abandonment. This pre-funding concept also would be consistent with SB 1387 relating to the Anthropogenic Carbon Dioxide Storage Trust Fund whereby fees are collected up-front.[57]

2.5.3 Allocation of Long-Term Liability for the Post-Operational Phases of Geologic Storage Projects

Texas Natural Resources Code, §120.002, relating to Ownership of Anthropogenic Carbon Dioxide, as added by SB 1387, considers CO_2 as property that could be deeded or sold to another party other than the storage operator.

Because long-term geologic storage of CO_2 on a commercial basis is a relatively new concept, it may be difficult to estimate the appropriate amount of funds needed for an individual site or collectively at all sites. While the availability of adequate funds is necessary, it also is important to avoid collecting excessive funds.

In addition, the State must be able to readily access funds as necessary. SB 1387 established an Anthropogenic Carbon Dioxide Trust Fund[58] as a special fund in the State Treasury. The fees collected by the Railroad Commission under Subchapter C-1, Chapter 27, Water Code, and penalties imposed for violations of that subchapter or rules drafted under that subchapter are to be deposited to the credit of the fund. The fund can be used by the RRC for certain activities, including:

(1) inspecting, monitoring, investigating, recording, and reporting on geologic storage facilities and associated anthropogenic carbon dioxide injection wells;

(2) long-term monitoring of geologic storage facilities and associated anthropogenic carbon dioxide injection wells;

(3) remediation of mechanical problems associated with geologic storage facilities and associated anthropogenic carbon dioxide injection wells;

(4) repairing mechanical leaks at geologic storage facilities;

(5) plugging abandoned anthropogenic carbon dioxide injection wells used for geologic storage;

(6) training and technology transfer related to anthropogenic carbon dioxide injection and geologic storage; and

(7) compliance and enforcement activities related to geologic storage and associated anthropogenic carbon dioxide injection wells.

There are three distinct phases in the life of a CO_2 GS facility: Operational (active injection), monitoring (post-injection), and post-closure (after the state has approved site closure). The operator will be required to maintain financial assurance for the first two

[57] Subtitle D, Title 3, Natural Resources Code, Section120.003 (c) and (d), as amended by SB 1387.
[58] Texas Natural Resources Code, §120.003

phases, but is released from the requirement to maintain financial assurance after the State approves closure of the facility (the third phase).

SB 1387 added new language[59] relating to ownership of anthropogenic carbon dioxide, which provides that, unless otherwise expressly provided by a contract, bill of sale, deed, mortgage, deed of trust, or other legally binding document or by other law, anthropogenic CO_2 stored in a geologic storage facility is considered to be the property of the storage operator or the storage operator's heirs, successors, or assigns. Therefore, the responsibility for the CO_2 in a geologic storage facility permitted by the RRC is that of the operator. However, the risk of the injected carbon dioxide or displaced formation fluids endangering a USDW decreases over time, there is no guarantee that the operator will still exist should this occur at some point in the future.

SB 1387 established the Anthropogenic Carbon Dioxide Storage Trust Fund, which may be used by the RRC for, among other things, long-term monitoring of geologic storage facilities and associated injection wells, remediation of mechanical problems, and repairing mechanical leaks at geologic storage facilities. The RRC's proposed rules provide for the funding of the Trust Fund, which could be used by the RRC for these activities during the post-closure phase of geologic storage if necessary. However, it is not clear whether or not the Trust Fund could be used by the RRC to perform more comprehensive remedial activity, if necessary, during the post-closure phase.

Therefore, the agencies recommend that the Legislature consider clarifying that the Trust Fund may be used to address any unanticipated migration after site closure if the operator or other responsible entity, as set out by §120.002 of the Natural Resources Code, cannot be found, no longer exists, has no funds, or is unable to address the issue after GS facility closure.

In addition, no such mechanism (e.g., a Trust Fund) was established for those geologic storage facilities that would be under the jurisdiction of the TCEQ. Financial mechanisms for such long-term activities, for example, to address unanticipated migration of carbon dioxide after a site under the jurisdiction of the TCEQ has been closed, may need to be explored.

For GS facilities on State-owned land, House Bill 1796 (HB 1796) requires the School Land Board (SLB) to collect fees for the storage of carbon dioxide in the carbon dioxide offshore repository.[60] In addition, HB 1796 requires the SLB to acquire title to carbon dioxide stored in the repository on a determination by the SLB that permanent storage has been verified and that the storage location has met all applicable state and federal requirements for the closure of CO_2 storage sites.[61] Also, HB 1796 added §382.508, which states that on the date the permanent school fund (PSF) acquires the right, title, and interest in CO_2 in the repository, the producer of the CO_2 is relieved of liability for any act or omission regarding the CO_2 in the repository, except that the producer of CO_2 is not relieved of liability for any act or omission regarding the generation of stored CO_2 performed before it was stored, nor is a person who contracts with the SLB for construction or operation of the repository relieved of liability for any act or omission

[59] §120.002 to the Natural Resources Code
[60] Section 382.505, Texas Health and Safety Code
[61] Section 382.507, Texas Health and Safety Code

regarding the construction or operation of the repository. Although HB 1796 does not establish a specific trust fund for the repository, it is assumed that the SLB could use funds from those collected through fees for the construction, operation, monitoring, closure, remediation (if necessary), and post-closure care of the repository.

Approaches for addressing post-closure stewardship should take into consideration first, that risks associated with GS sites after site closure will likely decline over time and second, the odds of an adverse occurrence will likely increase as the number of sites grows.

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CHAPTER III: LEGAL CONSIDERATIONS UNDER SB 1387

Legal and regulatory issues that will influence suitability of sites for GS include:

- Pore space ownership: Current thoughts are that both surface rights and mineral rights will need to be acquired to clearly establish pore-space ownership
- Surface ownership or lease holdings: In order to meet regulatory requirements, GS operators will need to have sufficient surface access to construct CO_2 pipelines to injection well locations, to construct surface handling facilities, and to install subsurface and surface monitoring equipment
- Regulatory framework must be clearly defined to reduce uncertainty for industrial operators
- A reasonable and flexible monitoring plan must be agreed upon prior to beginning of CO_2 injection to limit operators' financial liability

3.1 Proposed regulatory framework for State-owned lands in order to ensure that the state receives fair market value for geologic storage.[62]

The GLO currently has a very robust system for leasing properties for mineral development, including enhanced recovery operations. The public or staff nominate tracts for inclusion in an upcoming lease sale. The notice contains a brief description of the tract, lease terms, bid closing date, and other such information deemed necessary for a third party to make an informed bid. On the day of the sale, all bids are read publicly with the high bidder winning. A proposed lease is drafted and sent to the winning bidder for execution. Once executed, the lease is returned to the GLO for execution by the Land Commissioner. These policies and procedures will serve as the basic framework for the leasing of tracts for CO_2 sequestration, and can be adapted as necessary to address any technical issues or regulations established by other agencies.

3.2 Status of leasehold or mineral liability Issues related to subsurface trespass [63]

3.2.1 State-owned Lands

The GLO should not enter into any sequestration lease that does not include the mineral and surface owner, if they are different. For offshore tracts, the State will be both parties. Where the surrounding tracts also are state tracts, trespass should not be an issue. Trespass may become an issue when others own the adjacent tracts. The more immediate question may involve inadvertent releases of CO_2.

The extent of any liability is unknown at this time. Commercial geologic sequestration of anthropogenic carbon dioxide is a new area that would involve cases of first impression. There are cases involving CO_2 injection for enhanced recovery operations, however, they are fact specific, and generally turn on who owns the pore space (generally the

[62] SB 1387, Section 9(b)(2)
[63] SB 1387, Section 9(b)(4) and Section 10(c)(4)

surface owner), and whether or not RRC rules have been followed. The location of the facility would also have a significant impact on liability questions. The GLO can control activities on property that belongs to the Permanent School Fund and structure transactions in such a manner as to limit the liability of the State.

3.2.2 Lands not owned by the State[64]

Several legally recognized interests might exist in property where underground pore space in a particular interval or intervals is to be used for geologic storage. Surface owners, mineral owners, lessees of solid minerals, such as coal, oil and gas lessees, and owners of non-operating interests in production all might have legal rights that could be affected by GS.[65] Because the law recognizes an ownership interest in subsurface pore space, a regulatory program that manages storage (as opposed to one that manages solely for water protection) may benefit from clear rules about how these rights will be recognized and protected, as well as a process for assuring that the storer secures the legal property right to store carbon dioxide.

Texas law is clear that injection of carbon dioxide into underground formations for enhanced recovery operations is a reasonable use of the surface estate for extracting oil and gas. Texas law also is relatively clear with respect to storage of natural gas in geologic reservoirs. Legal paradigms associated with storage of natural gas in geologic reservoirs are most closely related to geologic storage of carbon dioxide. Even though natural gas is stored for relatively short periods of time and carbon dioxide likely will be stored for very long periods of time, the storage time should not impact the determination of who has legal interests in the structure used for storage.

Case Law Survey

Texas statutory law does not address which estate, surface or mineral, possesses ownership of the pore space for storage purposes unless the contract severing the surface and mineral estates expressly specifies. Natural gas storage activities most closely resemble GS activities, but natural gas storage case law in Texas gives conflicting results. In one case, *Mapco v. Carter*, the mineral owner was determined to possess the storage space,[66] while in another case, *Emeny v. U.S.*, the court held that the surface owner had rights to the pore space.[67] The Texas Supreme Court in *Humble Oil v. West* cited, but did not rely on, *Emeny*.[68]

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[64] Portions of this section come from Analysis of Property Rights Issues Related to Underground Space Used for Geologic Storage of Carbon Dioxide, David Cooney, IOGCC Task Force on Carbon Capture and Geologic Storage, Subgroup of State Oil and Gas Attorneys, Marvin Rogers, David Cooney, and Cammy Taylor.)

[65] *See* Williams and Meyers, Oil and Gas Law Vol. 1, §222 (Matthew Bender, 2006), for identification of property interests related to storage of natural gas in geologic reservoirs.

[66] *Mapco, Inc. v. Carter*, 808 S.W.2d 262 (Tex. App.—Beaumont 1991), *rev'd in part*, 817 S.W.2d 686 (Tex. 1991).

[67] *Emeny v. United States*, 412 F.2d 1319 (Ct. Cl. 1969).

[68] *Humble Oil & Refining Co. v. West*, 508 S.W.2d 812 (Tex. 1974).

In *Mapco*, the court held that the subsurface storage area was owned by the mineral owner, who was entitled to compensation for the use of the storage area.[69] The mineral owner had created a cavern within a salt dome for the purpose of storing natural gas.[70] The cavern walls were constructed of salt, a mineral in Texas (and specifically reserved to the mineral owner in lease documents); therefore, the mineral owner in this case had the exclusive right to the storage.[71] This decision was overruled in part by the Texas Supreme Court, but not on the matter of ownership of the storage space.[72]

In *Emeny*, the Federal Court of Claims, applying Texas law, held that the surface owners retained all property rights, except the mineral rights for oil and gas operations, and the geological subsurface pore space belonged to the surface owners for storage purposes.[73] Natural gas produced elsewhere was transported through the mineral owner's pipeline into the pore space and stored there until the gas was needed.[74] The contracted rights of the mineral owners contained in the oil and gas lease were "for the sole and only purpose of mining and operating for oil and gas and of laying pipe lines . . . to produce, save, and take care of said products."[75] The court reasoned that this language allowed the mineral owner to store gas produced only from the leased premises, not extraneous gas produced elsewhere.[76]

West cited *Emeny,* stating the surface owner retained the pore space for storage purposes of natural gas.[77] However, ownership of the pore space was conceded to the surface estate, and *West* turned on the issue of whether the pore space could be used for storage purposes prior to all gas being produced from the pore space.[78]

In this analysis, it is fair to conclude that in Texas, *Mapco* applies only when the storage space is created and comprised of a mineral. Arguably, *Mapco* does not apply to geologic storage because the space will be a geological non-mineral pore space. Surface owners in Texas have a solid interest because the *Mapco* court did emphasize that the storage space was comprised of salt and not a geological pore space.[79]

Texas case law on storage ownership seems to indicate that surface owners have a stronger argument for the right to authorize the pore space for storage. Currently, the case law is uncertain.

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[69] *Mapco*, 808 S.W.2d at 274.

[70] *Id.* at 264.

[71] *Id.* at 274.

[72] *Mapco, Inc. v. Carter*, 817 S.W.2d 686, 688 (Tex. 1991).

[73] *Emeny*, 412 F.2d at 1323.

[74] *Id.* at 1322.

[75] *Id.* at 1323.

[76] *Id.*

[77] *Humble Oil*, 508 S.W.2d at 815.

[78] *Id.*

[79] *Mapco*, 808 S.W.2d at 274.

Mineral owners have valid arguments that a potential purchaser of the pore space for GS of CO_2 should be required to obtain their consent as well, particularly if the geologic storage project could adversely affect mineral exploration or production.

There are many perspectives on whether the surface or mineral owner should have title to the pore space for gas storage purposes. Two commenters have noted that, while surface owners in most states prevail in pore space ownership of stored natural gas situations, mineral owners have valid interest as well and it would be prudent for a potential purchaser to secure the rights from both estates.[80] While this suggestion may be unsatisfactory to potential purchasers who prefer not to obtain consent from both the mineral owner and the surface owner, as well as pay just compensation to both estates, this approach may be beneficial in that a potential purchaser will know clearly who to contact and pay to secure the storage space rights without the fear of litigation.

Other commenters suggest four potential conclusions regarding subsurface storage of gas.[81]

First, the mineral owner should be granted the exclusive right to the storage space "for all purposes relating to minerals, whether 'native' or 'injected', absent contrary language in the instrument severing such minerals."[82] Under this view, the surface owner should not have any rights or be owed any compensation concerning the pore space unless some use of the surface is needed for the storage,[83] which might be a reasonable approach when the subject is natural gas from the mineral estate, but might not be so reasonable for geologic storage of CO_2 where, during the application process, regulatory determination should be made on whether or not GS will impact oil and gas or other mineral development that are in the vicinity of these activities.

Second, the owners of non-operating interests in the production of minerals should not be compensated and their consent should not be needed if the pore space no longer contains minerals; i.e., if the pore space is empty and using the space for storage as the next logical step, then those mineral interest owners have no interest in the space.[84]

Third, the operating rights owner should not be compensated and consent should not be needed for the right to store natural gas unless the operating rights owner will be negatively impacted by the injection of natural gas.[85]

Finally, the consent of the mineral owner should be required regardless of whether the pore space still contains oil and gas.[86]

Through their conclusions, it appears that Williams & Meyers strongly believe that the dominant interest in the storage space belongs to the mineral owner, not the surface owner. Extrapolating their view, the mineral owner's rights must be secured in every

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[80] Elizabeth J. Wilson & Mark A. de Figueirdo, Geologic Carbon Dioxide Sequestration: An Analysis of Subsurface Property Law, 36 ELR 10114, 21 (2006).
[81] Williams & Meyers, 1 Oil & Gas Law § 222 at 334.
[82] *Id.* at 335.
[83] *Id.* at 334.
[84] *Id.* at 336-337.
[85] *Id.* at 337.
[86] *Id.* at 338.

situation where a potential purchaser seeks to acquire the storage space, whereas the surface owner's rights need not be secured unless the use of the surface is required.

Subsurface Trespass

Subsurface trespass cases offer an indication of how the law treats private ownership interests in underground pore space. Based on case law, subsurface trespass is probably a cause of action, and adjacent property owners may be able to prevail if they can demonstrate reasonable and foreseeable damages caused by unauthorized use of their pore space. An analysis comparing secondary oil and gas recovery and hazardous waste case law to the geologic storage of carbon dioxide helps in formulating reasonable policy for property rights affected by geologic storage.

Trespass by EOR

In Texas, a cause of action for damages probably exists for subsurface trespass attributable to secondary recovery operations; however, the issue of subsurface trespass is far from certain because the case law is on both sides of the trespass debate. In *RRC of Texas v. Manziel*, the Texas Supreme Court held that a permit from the RRC for oil and gas recovery precludes a trespass cause of action seeking injunctive relief.[87] The issue in *Manziel* was whether the water from the secondary recovery projects would constitute trespassing when it crossed ownership lines.[88] The court announced the "negative rule of capture" whereby "[j]ust as under the rule of capture a land owner may capture such oil and gas as will migrate from adjoining premises . . . so also may [a landowner] inject into a formation substances which may migrate through the structure to the land of others . . . ."[89] In conclusion, the court found that trespass was not a cause of action when the state regulatory body permitted the injection project. The court was without power to issue an injunction sought by the adjacent property owner.[90]

In *Mission Resources v. Garza Energy Trust,*[91] the Texas Supreme Court held that the rule of capture bars recovery of damages when the only alleged basis for damages is trespass due to subsurface hydraulic fracturing of a natural gas well extending into another's property.[92] The court did not rule out trespass as a potential cause of action under other circumstances.

The implication of these cases for carbon dioxide storage is debatable. Whether a court would find the geologic storage of carbon dioxide to be a public necessity where adjacent property owners' rights are trumped by the importance of sequestration is uncertain. On one hand, the geologic storage of carbon dioxide may lower the levels of greenhouse gas, but on the other hand, it is questionable whether the potential benefit of lowered levels of greenhouse gas is more important than the property rights of the

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[87] *R.R. Comm'n of Tex. v. Manziel*, 361 S.W.2d 560, 568 (Tex. 1962).
[88] *Id.* at 567.
[89] *Id.* at 568.

[90] *Id.*

[91] *268 S.W. 3d 1 (Tex. 2008)*
[92] *Mission Res., Inc. v. Garza Energy Trust*, 166 S.W.3d 301, 310 (Tex. App.—Corpus Christi 2005, review granted).

adjacent property owners. Secondary recovery methods are producing fungible resources in the form of oil and/or gas whereas the geologic storage of carbon dioxide might not yield fungible resources. Both *Manziel* and *Garza Energy Trust* seem to turn on the importance of secondary recovery of oil and/or gas, and the arguments why a trespass cause of action should not be actionable is based on fungible resources being produced. A regulatory program for geologic storage of CO_2 should include a declaration that the activity is of high public importance.

Trespass by Hazardous Waste Injection

Hazardous waste case law seems to permit a cause of action for subsurface trespass. The Ohio Supreme Court in *Chance v. BP Chemicals* held that regardless of the fact that the defendant was operating under a valid permit, trespass as a cause of action is not precluded.[93] Even though ultimately the adjacent property owners lost the suit because they did not meet their burden of proof in proving that trespass had indeed occurred, the court allowed the cause of action.[94]

In *Mongrue v. Monsanto Co.* the Fifth Court of Appeals found that subsurface trespass was a valid cause of action, and stated that a valid permit "does not necessarily bar claims of trespass when authorizing the disposal of waste through injection wells."[95] Subsurface trespass as a cause of action was not a primary issue for the court due to the trespassing claim being dropped,[96] but the court briefly addressed the issue anyway,[97] which might illustrate that the justices wanted to clarify whether there was a cause of action for subsurface trespass. Even though in both cases the party bringing the trespass action did not ultimately prevail for various reasons, subsurface trespass was allowed as a cause of action, which further highlights the law's recognition of property rights in subsurface pore space.

These cases also raise a couple of principles applicable to geologic storage of CO_2: Plaintiffs in both cases were surface owners, and it was difficult for the plaintiffs to prove they had suffered damages because they could not show that they actually used the subsurface and that the use had been compromised. The inability to show damages played a larger role in the outcome of these subsurface trespass situations cases than whether a cause of action existed in the first place. The law recognized the ownership right in the subsurface, but the plaintiff was not able to show an intended use was compromised or damaged. Geologic storage of carbon dioxide will be a new legitimate use of the subsurface.

The law recognizes an ownership interest in subsurface pore space. Therefore, a regulatory program that manages storage (as opposed to water protection) should include clear law about how these rights will be recognized and protected as well as a process for assuring that the legal property right to store carbon dioxide is secured.

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[93] *Chance v. BP Chemicals, Inc.*, 670 N.E.2d 985 (Ohio 1996).

[94] *Id.* at 991.

[95] *Mongrue v. Monsanto Co.*, 249 F.3d 422, 433 n. 17 (5th Cir. 2001).

[96] *Id.* at 425.

[97] *Id.* at 433 n. 17.

3.3 Recommendations for new legislation that may be needed to ensure that public land management and leasing laws are adequate for Geologic Storage.[98]

The GLO has adequate authority to lease public lands for CO_2 sequestration, and no additional authority is needed. The GLO also has a process in place for leasing properties for mineral development, including enhanced recovery operations, which can serve as a basic framework for the leasing of tracts for CO_2 sequestration. These policies and procedures can serve as the basic framework for the leasing of state tracts for the geologic storage of anthropogenic carbon dioxide. The GLO may need to include technical items in its rules and/or lease forms; however such changes will depend in large measure on the study conducted by the BEG and regulations promulgated by the TCEQ and the RRC.

3.4 Identify legal and regulatory issues specific to geologic storage where mineral estate title is held by the state, but subsurface estate title is not.[99]

This question is being answered with the understanding that "subsurface estate title" means title to pore space used for storage, which a majority of legal opinion tends to associate with the surface and not the mineral estate. Where different persons own the mineral and surface estate, the purpose of the geologic storage is a major factor in determining the relevant legal issues. If the "storage" also serves the purpose of enhanced oil and gas recovery, then for so long as the oil and gas is being recovered, the mineral owner may invoke the common law "accommodation doctrine," which allows the mineral estate to make reasonable use of the surface estate to develop the minerals. Legal issues include:

- whether or not the right of the mineral estate owner injecting CO_2 for enhanced recovery should be the same as they are today when there is no geologic storage associated with the enhanced recovery;
- whether or not the owner of the surface has the right to be compensated for storage space that is filled with CO_2 after the enhanced recovery/storage project becomes solely a storage project.

Where the surface owner does not own the minerals, but wants to lease pore space for "purely storage" of CO_2, the mineral estate owner generally would not be required as a party to any such lease. However, because the mineral estate in Texas is the dominant estate and large scale CO_2 sequestration projects might have the potential to adversely affect mineral exploration and production, it would not be advisable to enter into any such lease without both surface and mineral estate owners being a party to the lease. Adverse affects may include, but are not limited to, causing the migration of oil and gas onto adjoining property, for which there may be a conversion claim, or a total devaluation of the mineral estate, if no one will explore and/or produce the minerals for fear of causing an inadvertent release of the stored CO_2. For these reasons, the GLO recommends that any lease on state owned property include both the subsurface and surface. Requiring the storage operator to obtain a letter from the RRC in accordance

[98] SB 1387, Section 9(b)(5)
[99] SB 1387, Section 9(b)(6)

with TWC § 27.015, regarding non-endangerment of oil and gas and mineral resources, as part of its geologic sequestration application process would help assure protection of mineral interests.

3.5 Recommendations for additional legislation that may be needed regarding Rights Of Ways (ROWs) for anthropogenic CO_2 pipelines on state owned lands.[100]

The Land Commissioner currently has the necessary authority to issue rights-of-way easements for pipelines.[101] The GLO manages approximately 2,700 easements for pipelines and other rights-of-way projects, including carbon dioxide lines. No other legislation or authority is required to authorize CO_2 pipelines on state owned land.

The current procedure for authorizing proposed easements for pipeline rights-of-way is described below:

Application for miscellaneous easement is received with survey information.

- Application for miscellaneous easement is received with survey information.
- The proposed pipeline route and installation method is evaluated to determine if there are impacts to the natural resources.
- The location and amount of state owned land to be encumbered is verified by the GLO Surveying Division.
- The appropriate fees based upon the GLO published rate schedule are applied and a pipeline easement is generated.
- Pipeline right-of-way easements are typically issued for 10 or 20 years.

3.6 Update on exchange of information between the TCEQ and RRC as required by the MOU under SB 1387. [102]

Implementation of TWC § 27.049 was concluded effective October 21, 2010 by completion of concurrent rulemaking by both the TCEQ and RRC. The specific MOU provisions are currently in RRC rules found in 16 TAC §3.30, Oil and Gas Division, with the corresponding TCEQ rules found in 30 TAC §7.117, Memorandum of Understanding, which incorporate by reference RRC rules in 16 TAC Chapter 3.

Concurrent with rulemaking to update the TCEQ-RRC MOU, the TCEQ proposed rulemaking to implement TWC § 27.046, Letter from Executive Director. Senate Bill 1387 assigns jurisdiction for most forms of underground injection of anthropogenic carbon dioxide for geologic storage to the RRC and assigns TCEQ an advisory role for freshwater protection in the RRC's permitting activities for CO_2 GS. TWC § 27.046 requires that, before the RRC may issue a permit under new TWC § 27.043, Permit From Railroad Commission, the applicant for the permit must provide to the RRC a letter from the TCEQ executive director stating that underground freshwater strata will not be injured by the permitted activity. Consistent with the schedule for the MOU

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[100] SB 1387, Section 9(b)(7)
[101] Section 51.291, *et seq,* TEX. NAT. RES. CODE ANN. and Title 31 Texas Administrative Code 13.11, *et seq*
[102] SB 1387, Section 10(c)(7)

outlined above, TCEQ published proposed rules in the *Texas Register* on April 16, 2010.[103] On May 12, 2010 the TCEQ held a public hearing in Austin on the proposed rules. Comments were received from three entities, and three changes to the proposed rules were made in response to the comments. Rulemaking documents were prepared for adoption, but adoption of the TCEQ rule package was delayed to ensure that definitions are used consistently between the RRC's Class VI rules and TCEQ's SB 1387 rules. A rulemaking by TCEQ is planned to commence after the RRC adopts its "Class VI" rules.

To date the TCEQ has not received any requests for a letter as required by TWC §27.046, and the RRC has not received any applications for permits to be issued under new TWC § 27.023.

[103] 35 Texas Register, p 3005

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CHAPTER IV: COMPLIANCE WITH FEDERAL REQUIREMENTS

4.1 Assessment of the status of compliance with any federal rules.[104]

EPA Published proposed rules relating to geologic sequestration of carbon dioxide in the July 25, 2008 edition of the Federal Register.[105]

On August 6, 2010, EPA sent two final CCS rule packages to the Office of Management and Budget's Office of Information and Regulatory Affairs for review.

The first rule package would establish the major CCS regulatory framework and covers the UIC rules for permitting injection wells used for GS. This is the set of regulations for which EPA published its proposal on July 25, 2008 and a notice of data availability on August 31, 2009.

The second rule package will finalize the greenhouse gas mandatory reporting rules (MRR) for CO_2 injection for enhanced recovery and geologic storage that EPA proposed on April 12, 2010.[106]

The Unified Regulatory Agenda also lists a proposal being considered under RCRA that would be published for comment.[107] The listing indicates that "EPA received numerous comments asking for clarification on how the RCRA hazardous waste requirements apply to CO_2 streams. EPA is now considering a proposed rule under RCRA to explore options such as a conditional exemption from the RCRA requirements for hazardous CO_2 streams in order to facilitate implementation of GS while protecting human health and the environment."

It has been the agencies' understanding that EPA wants to publish the final CCS UIC rule, the final CO_2 injection MRR, and the RCRA proposal simultaneously in the same Federal Register to highlight the coordination of these requirements. The target date for publication had been September. With these two final rule packages at OMB for review, September is not out of the question, but October seems more likely.

4.2 Status of any request for primary enforcement authority for Class VI rules [108]

The state cannot apply for primacy until the EPA finally adopts these UIC regulations.

4.3 Recommendations for methods to mitigate any negative effects of federal greenhouse gas reporting requirements on owners and producers of naturally occurring CO_2[109]

On April 2, 2007, in *Massachusetts v. EPA*, 549 U.S. 497 (2007), the Supreme Court found that greenhouse gases are air pollutants covered by the Clean Air Act. The Court held that the Administrator of the U.S Environmental Protection Agency (EPA) must determine whether or not emissions of greenhouse gases from new motor vehicles

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[104] SB 1387, Sec 10(b)(4)
[105] 73 Federal Register p43492
[106] (http://www.epa.gov/climatechange/emissions/subpart/rr.html)
[107] http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201004&RIN=2050-AG60.
[108] SB 1387, Section 10(c)(8) of SB 1387
[109] SB 1387, Section 10(c)(3) of SB 1387

cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, or whether the science is too uncertain to make a reasoned decision. In 2009, the Administrator formally declared carbon dioxide and five other greenhouse gases to be pollutants and found that the current and projected concentrations of these greenhouse gases, including CO_2, in the atmosphere threaten the public health and welfare of current and future generations.

On October 30, 2009, EPA promulgated regulations to require reporting of greenhouse gas emissions from 31 sectors of the economy.[110] One of the 31 sectors was suppliers of carbon dioxide (Subpart PP, Part 98). These regulations do not require control of GHGs, but require that sources emitting such gases above certain threshold levels monitor and report emissions. The regulations require reporting of annual emissions of CO_2 and other specified GHGs in metric tons. The rule also includes provisions to ensure the accuracy of emissions data through monitoring, recordkeeping and verification (MRV) requirements. Starting in 2010, reporters must submit MRV plans and annual greenhouse gas reports to EPA. Among those required to provide such reports, all are producers of CO_2, and importers and exporters of CO_2 with annual bulk imports or exports of nitrous oxide (N_2O), fluorinated GHGs, and CO_2 that in combination are equivalent to 25,000 metric tons CO_2 or more per year.

At the time EPA proposed development of GHG reporting requirements, producers and pipeline transporters of naturally-occurring CO_2 expressed opposition to taking on the burden of monitoring, reporting, and verification of CO_2 production possibly years before limits on carbon emission are required or credits for carbon management by capture and storage/sequestration may be available. Negative effects of federal greenhouse gas reporting requirements on owners and producers of naturally-occurring carbon dioxide could include the cost of monitoring, reporting, and verification of CO_2 production, with possible economic disincentives to use naturally-occurring CO_2 for enhanced recovery, and possible public misperception of the intended use and downstream accounting through monitoring, reporting, and verification of CO_2 management by pipeline transport and injection in Class II wells for enhanced recovery. Considering that EPA already has instituted the subject reporting requirements through the October 2009 rule adoption, mitigation of negative effects of these requirements is being pursued in litigation by producers of naturally occurring CO_2. Legislative action and public outreach may also help. Both are discussed below.

SB 184, enacted by the 81st Texas Legislature (Regular Session, 2009) calls on the TCEQ to identify cost-effective ways to reduce greenhouse gas emissions. Commonly known as the "no regrets" approach, SB 184 required the Comptroller of Public Accounts (Comptroller) to prepare a report including a list of strategies for reducing emissions of greenhouse gases (GHGs) in Texas that will result in net savings for Texas consumers or businesses, can be achieved without financial cost to Texas consumers or businesses, or help Texas businesses maintain global competitiveness. The bill required the Comptroller to appoint one or more advisory committees to assist the comptroller in identifying and evaluating greenhouse gas emission reduction

[110] Mandatory Reporting of Greenhouse Gases; Final Rule, 74 FR 56260, October 30, 2009, http:www.epa.gov/climate change/emissions/emissions/downloads09/GHG-MRR-finalrule.pdf

strategies. The advisory committee includes representatives from the RRC, the TCEQ, the Department of Agriculture, the GLO, and the University of Texas Bureau of Economic Geology, and representatives of industry and the public. SB 184 requires that the Comptroller deliver this report to each member of the Legislature no later than December 31, 2010. The recommendations in the report should assist owners and producers of naturally occurring carbon dioxide in mitigating some of the negative effects of federal greenhouse gas reporting requirements.

In addition, the agencies have been actively watching and analyzing federal legislation proposed by Congress, as well as federal regulation proposed by the U.S. Environmental Protection Agency (EPA), regarding greenhouse gas emissions.

On March 22, 2010, EPA proposed to expand the mandatory reporting rules to include reporting for carbon dioxide injection and geologic sequestration, as well as for petroleum and natural gas systems.

As mentioned above, mitigation of negative effects is being pursued by producers of naturally occurring carbon dioxide through litigation. Because owners, operators, suppliers, or storers of either naturally-occurring or anthropogenic carbon dioxide will be subject to the GHG reporting requirements, any possible competitive advantage or disadvantage in use of one versus of the other form of CO_2 could be mitigated by legislation to establish equal incentives in franchise and severance tax rate reductions for production and geologic storage of both types of CO_2. With respect to increasing public understanding of the careful management of CO_2 in CCS, development of educational outreach efforts and materials by state and federal agencies, trade associations, and by environmental groups may be beneficial.

4.4 Status of any applications for permits that have been received before the report is prepared.[111]

As of the date of this report, no permit applications for geologic storage of anthropogenic CO_2 have been received.

[111] SB 1387 Section 10(c)(6) of SB 1387

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CHAPTER V: Recommendations

Senate Bill 1387 requires legislative recommendations from the agencies writing this report. These recommendations are discussed below, and each subchapter also cross-references parts of the first four chapters that provide more supporting discussion. The bill requests eight recommendations. One of the eight recommendations actually includes two separate issues (Ref: SB 1387, Section 10 (c) (5)). In this report, these two were separated for the sake of clarity (Sections 5.6 and 5.7). Thus, nine recommendations are discussed.

5.1 Recommendations for additional legislation, modification to the MOU, or new rules for geologic storage facilities and associated wells.[112]

At this time, the agencies have no recommendations related to the memorandum of understanding (MOU). Effective October 21, 2010, the RRC and the TCEQ revised the existing MOU to address coordination of work related to geologic storage of anthropogenic carbon dioxide. In addition, pending completion of rulemaking by both RRC and TCEQ, the agencies see no need to revise their rules related to geologic storage of anthropogenic carbon dioxide at this time. The agencies do, however, have recommendations for additional legislation.

One such recommendation involves adding three subsections, (a-1), (b-1) and (c-1) to §27.015, Tex. Water Code, as follows:

> §27.015. LETTER FROM RAILROAD COMMISSION.
>
> (a) A person making application to the commission for a disposal well permit under this chapter shall submit with the application a letter from the railroad commission concluding that drilling or using the disposal well and injecting industrial and municipal waste into the subsurface stratum will not endanger or injure any known oil or gas reservoir.
>
> (a-1) A person making application to the commission for a carbon dioxide geologic storage well permit under this subchapter shall submit with the application a letter from the railroad commission concluding that injection and geologic storage of carbon dioxide will not endanger or injure any oil, gas, or other mineral formation.
>
> (b) In a hearing on an application for a disposal well permit under this chapter, the commission may not proceed to hearing on any issues other than preliminary matters such as notice until the letter required from the railroad commission under Subsection (a) of this section is provided to the commission.
>
> (b-1) In a hearing on an application for a carbon dioxide geologic storage well permit under this subchapter, the commission may not proceed to hearing on any issues other than preliminary matters such as notice until

[112] SB 1387 Section 10(c)(9) of Senate Bill 1387

the letter required from the railroad commission under Subsection (a-1) of this section is provided to the commission.

(c) The commission shall find that there will be no impairment of oil or gas mineral rights if the railroad commission has issued a letter under Subsection (a) that concludes that drilling and using the disposal well will not endanger or injure any known oil or gas reservoir.

(c-1) The commission shall find that the injection and geologic storage of carbon dioxide will not endanger or injure any oil, gas, or other mineral formation, if the railroad commission has issued a letter under Subsection (a-1) that provides such conclusion.

Adoption of new §27.026, Tex. Water Code to parallel §27.045 as follows is recommended:

§27.026. FEES IN COMMISSION REGULATION OF INJECTION AND GEOLOGIC STORAGE OF CARBON DIOXIDE.

(a) The commission may impose fees to cover the cost of:

(1) permitting, monitoring, and inspecting carbon dioxide injection wells for geologic storage and geologic storage facilities; and

(2) enforcing and implementing applicable provisions of this chapter and rules adopted by the commission for injection and geologic storage of carbon dioxide.

(b) Revenue collected under this section shall be deposited to the Waste Management Account No. 549.

Adoption of new §27.051 (a-1), Tex. Water Code to parallel §27.051 (b-1) as follows is recommended:

(a-1) The commission may issue a permit for injection and geologic storage of carbon dioxide under Subchapter B if it finds:

(1) that the injection and geologic storage of carbon dioxide will not endanger or injure any oil, gas, or other mineral formation;

(2) that, with proper safeguards, both ground and surface fresh water can be adequately protected from carbon dioxide migration or displaced formation fluids;

(3) that the injection of carbon dioxide will not endanger or injure human health and safety;

(4) that the formation or stratum into which carbon dioxide is injected is suitable for or capable of being made suitable for protecting against the escape or migration of carbon dioxide from the formation or stratum; and

(5) that the applicant for the permit meets all of the other statutory and regulatory requirements for the issuance of the permit.

Revision of §27.073, Tex. Water Code as follows is recommended:

§27.073. FINANCIAL RESPONSIBILITY.

(a) A person to whom an injection well permit is issued may be required by the commission or railroad commission to maintain a performance bond or other form of financial security to ensure that:

(1) an abandoned injection well is properly plugged; or

(2) funds are available for plugging, post-injection site care, and closure of an anthropogenic carbon dioxide injection well subject to Subchapter B or Subchapter C-1.

(a-1) Notwithstanding Subsection (a), a person to whom an in situ uranium mining injection well, monitoring well, or production well permit is issued shall be required by the commission to maintain a performance bond or other form of financial security to ensure that an abandoned well is properly plugged.

(b) Each state agency is authorized to receive funds as the beneficiary of a financial responsibility mechanism established under this section for the proper plugging of an injection well. Each state agency is authorized to expend such funds from a financial responsibility mechanism for the plugging of wells covered by that mechanism.

(b-1) The railroad commission is authorized to receive funds as the beneficiary of a financial responsibility mechanism established under this chapter for the proper management of an anthropogenic carbon dioxide injection well or geologic storage facility.

(b-2) The commission is authorized to receive funds as the beneficiary of a financial responsibility mechanism established under this chapter for the proper management of an anthropogenic carbon dioxide injection well or geologic storage facility.

5.2 Recommendations regarding the agency or agencies that should have jurisdiction over permitting related to anthropogenic carbon dioxide injection in certain geologic settings.[113]

This report recommends two options pertaining to which agency(ies) should have jurisdiction over permitting of CO_2 GS. Option 1 would specify the RRC to have jurisdiction for all CO_2 injection and GS with the TCEQ retaining responsibility for the advisory letters in compliance with §27.046, Texas Water Code. Option 2 retains shared RRC and TCEQ jurisdiction as provided under §27.041 and §27.011, Texas Water Code. Both options recommend additional supporting legislation, as discussed below.

Option 1: Assign the RRC jurisdiction for all CO_2 injection and GS. Currently §27.041, Texas Water Code, relating to jurisdiction, specifies that the RRC has jurisdiction over the geologic storage of CO_2 in, and the injection of CO_2 into, a reservoir that is initially or may be productive of oil, gas, or geothermal resources or a saline formation directly

[113] SB 1387, Section 10(b)(3)

above or below that reservoir. This statute, together with existing §27.011, Texas Water Code, implies that the TCEQ has jurisdiction over CO_2 GS in reservoirs that do not meet these criteria. Assigning the jurisdiction to the RRC has jurisdiction for all CO_2 injection and GS would require amendment of §27.041, Tex. Water Code.

Under Option 1, the agencies recommend that TCEQ retain responsibility for the advisory letters as required under §27.046, Tex. Water Code. Before the RRC may issue a permit for CO2 GS, the applicant must provide to the RRC a letter from the TCEQ executive director stating that underground freshwater supplies will not be injured. In support of this function, the agencies recommend legislation for proposed new §27.026, Tex. Water Code (as described in Section 5.1) authorizing TCEQ to impose fees to cover the cost of performing the reviews provided in §27.046 and producing the advisory letters.

Option 2. Retain shared RRC and TCEQ jurisdiction as provided in §27.041 and §27.011, Tex. Water Code. If Option 2 is chosen, the agencies recommend:

- For TCEQ applications for TCEQ CO_2 GS permits, require a letter from the RRC stating that injection and CO_2 GS will not endanger or injure any oil, gas or other mineral formations. Language for three new subsections, (a-1), (b-1) and (c-1) to Sec 27.015, Tex. Water Code is included in Section 5.1 of this report.
- Similar to the RRC's Trust Fund, authorize the TCEQ to impose fees to cover the cost of its CO_2 GS program, and the authority to deposit these fees into Waste Management Account No. 549. This could be accomplished by adoption of new §27.026, Tex. Water Code to parallel §27.045 as suggested in Section 5.1.
- Repeat the protectiveness criteria for TCEQ that SB 1387 specified for CO_2 GS permits issued by the RRC (non-injury of oil, gas or mineral formations, fresh water, human health and safety; no escape or migration of CO_2 from the reservoir; and the applicant's compliance with statutory and regulatory requirements). This could be accomplished by adoption of new §27.051 (a-1), Tex. Water Code to parallel §27.051 (b-1) as described under Section 5.1.
- Specify financial responsibility requirements for CO_2 GS under TCEQ jurisdiction similar to the financial assurance provisions for CO_2 GS under RRC jurisdiction. This could be addressed by revision of §27.073, Tex. Water Code as detailed under Section 5.1
- Provide a mechanism for funds and the authority for both the TCEQ and the RRC to use those funds to address CO_2 migration events after facility closure if the owner, operator or responsible entity is no longer willing or able to do so. This could be addressed by revision of statutory specifications as discussed under Section 5.7.

In support of this recommendation (Option 1), the agencies also suggest that the Legislature consider clarifying that the Trust Fund established under §120.003, Texas Natural Resources Code, may be used to address any unanticipated migration after site closure if the operator or other responsible entity as set out by §120.002 of the Natural Resources Code, cannot be found, no longer exists, has no funds, or is unable to address the issue after GS facility closure.

Acid Gas Disposal Jurisdiction: An example of how jurisdiction over GS as assigned by SB 1387 creates an apparent discrepancy is acid gas disposal. Currently, under UIC Class II rules, the RRC administers a program permitting injection of acid gas, including CO_2, derived from gas processing plants. This activity is undertaken as an alternative to venting / flaring. Such injection is currently permitted as a disposal activity, rather than a GS activity.

Because the CO_2, a component of acid gas, derived from gas processing, appears to be included in the definition of anthropogenic carbon dioxide in SB 1387, and because it is typically injected into formations not productive of oil, gas, or geothermal resources, or above or below such formations, the language in SB 1387 could imply that jurisdiction over such injection changed from RRC to TCEQ. This implication presents a potential conflict (which the agencies believe was not intended) regarding acid gas waste disposal wells permitted by the RRC.

Therefore, if the jurisdiction over CO2 GS remains shared by the RRC and the TCEQ (i.e., Option 2), the Legislature may wish to clarify that injection of anthropogenic CO_2, as a component of acid gas generated in association with gas processing, into a non-productive formation, falls under the jurisdiction of the RRC for the purpose of disposal as well as geologic storage. Under Option 1, placing jurisdiction for all CO2 GS under the RRC, the noted concern over acid gas disposal would be eliminated.

For a more detailed discussion of these issues, the reader is referred to Section 2.1.2 (Regulatory Discussion) in the section titled “Acid Gas Disposal and Geologic Storage.”

5.3 Recommendations for additional legislation that may be required to ensure that public land management and leasing laws are adequate to accommodate geologic storage.[114]

The GLO has adequate authority to lease public lands for geologic storage of carbon dioxide and has a robust system for leasing properties for mineral development, including enhanced recovery operations. These programs include leasing procedures, valuation methodology, and lease operations. These policies and procedures can serve as the basic framework for the leasing of state tracts for the geologic storage of anthropogenic carbon dioxide. The GLO may need to include technical items in its rules and/or lease forms; however such changes will depend in large measure on the study conducted by the BEG and regulations promulgated by the TCEQ and the RRC.

This issue is discussed in similar detail in Section 3.3 of this report.

5.4 Recommendations for additional legislation that may be needed regarding ROW’s for anthropogenic carbon dioxide pipelines on State-owned lands.[115]

The GLO already has the authority necessary to issue pipeline easements. No additional authority is needed. This issue is discussed in more detail in Section 3.5 of this report.

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[114] SB 1387, Section 9(b)(5)
[115] SB 1387, Section 9(b)(7)

5.5 Recommendations for methods to mitigate any negative effects of federal greenhouse gas reporting requirements on owners and producers of naturally occurring carbon dioxide.[116]

On October 30, 2009, EPA promulgated a regulation to require reporting of greenhouse gas emissions from 31 sectors of the economy.[117] One of the 31 sectors was suppliers of carbon dioxide (Subpart PP, Part 98). On March 22, 2010, EPA proposed to expand the mandatory reporting rules to include reporting for carbon dioxide injection and geologic sequestration, as well as for petroleum and natural gas systems.

Mitigation of negative effects of GHG reporting requirements is being pursued by producers of naturally occurring CO_2 through litigation. Because owners, operators, suppliers, or storers of either naturally-occurring or anthropogenic CO_2 will be subject to the GHG reporting requirements, any possible competitive advantage or disadvantage in use of one versus the other form of CO_2 could be mitigated by legislation to establish equal incentives in franchise and severance tax rate reductions for production and geologic storage of both types of CO_2. With respect to increasing public understanding of the careful management of CO_2 in carbon capture and storage (CCS) technology, development of educational outreach efforts and materials by state and federal agencies, trade associations, and by environmental groups may be beneficial.

For a more detailed discussion of these issues, the reader is referred to Section 4.3.

5.6 Recommendations to address the attributes of the subsurface area of operations for geologic storage facilities.[118]

Senate Bill 1387 directs the agencies to advise of any recommendations to address the attributes of the subsurface area of operations for geologic storage facilities.[119] The agencies have no legislative or rule recommendations on this issue. However, there are technical considerations for physical criteria necessary for successful geologic storage of carbon dioxide.

These technical considerations are discussed in Sections 2.1.1, 2.2.3, and 2.3 of this report.

5.7 Recommendations to address the methods of financial assurance and the allocation of long-term liability for the post-operational phases of geologic storage projects.[120]

There are three distinct phases in the life of a CO_2 GS facility: Operational (active injection), monitoring (post-injection), and post-closure (after the State has approved closure). The operator will maintain financial assurance for the first two phases, but is released from the requirement to maintain financial assurance after the State approves closure of the facility (the third phase).

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[116] SB 1387, Section 10(c)(3)
[117] Mandatory Reporting of Greenhouse Gases; Final Rule, 74 FR 56260, October 30, 2009
[118] SB 1387, Section 10(c)(5)
[119] SB 1387, Section 10(c)(5)
[120] SB 1387, Section 10(c)(5)

SB 1387 added new language,[121] relating to ownership of anthropogenic carbon dioxide, which provides that, unless otherwise expressly provided by a contract, bill of sale, deed, mortgage, deed of trust, or other legally binding document or by other law, anthropogenic CO_2 stored in a geologic storage facility is considered to be the property of the storage operator or the storage operator's heirs, successors, or assigns. Therefore, the responsibility for the CO_2 in a geologic storage facility permitted by the RRC is that of the operator. Although the risk of the injected carbon dioxide or displaced formation fluids endangering a USDW decreases over time, there is no guarantee that the operator will still exist should this occur at some point in the future.

SB 1387 established the Anthropogenic Carbon Dioxide Storage Trust Fund (§120.003, Texas Natural Resources Code), which may be used by the RRC for, among other things, long-term monitoring of geologic storage facilities and associated injection wells, remediation of mechanical problems, and repairing mechanical leaks at geologic storage facilities. The RRC's proposed rules provide for the funding of the Trust Fund, which could be used by the RRC for these activities during the post-closure phase of geologic storage if necessary. However, it is not clear whether or not the Trust Fund could be used by the RRC to perform more comprehensive remedial activity, if necessary, during the post-closure phase.

Therefore, the agencies recommend that the Legislature consider clarifying that the Trust Fund may be used to address any unanticipated migration after site closure if the operator or other responsible entity as set out by §120.002 of the Natural Resources Code, cannot be found, no longer exists, has no funds, or is unable to address the issue after GS facility closure.

In addition, no such mechanism (e.g., a Trust Fund) was established for those geologic storage facilities that would be under the jurisdiction of the TCEQ. Financial mechanisms for such long-term activities, for example, to address unanticipated migration of carbon dioxide after a site under the jurisdiction of the TCEQ has been closed, may need to be explored.

For a more detailed discussion of these issues, the reader is referred to Sections 2.5.2 and 2.5.3 of this report.

5.8 Recommended criteria for identifying candidate sites.[122]

The candidate types of geologic storage sites listed in Sections 9(b)(1) and 10(c)(1) of SB 1387 include:

- Operating oil and gas fields
- Depleted oil and gas fields
- Saline formations
- Unmineable coal seams
- Coal beds used for methane recovery

[121] §120.002 to the Natural Resources Code
[122] SB 1387, Section 9(b)(1) and 10(c)(1)

- Geothermal systems
- Igneous formations

The greatest potential for deep subsurface storage of CO_2 in Texas occurs in saline formations and oil and gas fields (Figures 2 and 3 in Section 2.1.1). The remaining categories in Texas are not equally suitable at this time, primarily due to economics. Discussion for each of the three preferred geologic settings follow and all seven settings are discussed in Section 2.1.1 of this report.

Saline Formations

This is the type of geological storage site with the most potential for storing large volumes of CO_2 in the subsurface in Texas. This is mainly a result of the immense volume of the subsurface that these types of formations occupy relative to hydrocarbon reservoirs.

Operating and Depleted Oil and Gas Fields

Oil and gas fields are separated into two categories in SB 1387, but the agencies think this distinction is unnecessary from a technical perspective. Many of the depleted oil fields in Texas are candidates for CO_2 enhanced oil recovery (EOR) or were depleted before they became active EOR fields. In oil and gas operations, the role of economic considerations is inherent.

Oil and gas formations are expected to play a critical role in the initial phases of implementing GS, especially in Texas. Reasons for this include:

- the potential to recover some of the costs of GS through EOR or EGR;
- existing oil and gas fields are often located near to existing CO_2 transport and injection facilities;
- these reservoirs are attractive candidates for geologic storage of CO_2 because they are generally the best understood of the potential storage formations; and
- depleted formation pressure may increase storage capacity.

Storage of CO_2 incidental to the production of oil or gas during EOR or EGR operations is indistinguishable from the incremental storage of CO_2 that would occur if the depleted oil or gas formation were to be later used for storing anthropogenic CO_2. The CO_2 would be injected through the same well bore into the same formation.

Thus, while storage can take place adjacent to an operating field, the most obvious criteria for identifying storage opportunities in active and historic oil and gas fields will be heavily based on the economic potential of EOR or EGR using CO_2.

The reader is referred to Section 2.1.1 of this report for more discussion of the seven geologic settings listed in SB 1387. This includes additional discussion of the 3 preferred settings more briefly discussed in this chapter, which are saline formations, and depleted and operating oil and gas fields.

5.9 Recommendations for a permitting process for anthropogenic CO_2 injection wells and geologic storage facilities that are used for the injection and storage of

anthropogenic CO_2 in saline formations not productive of oil, gas, or geothermal resources.[123]

Currently the TCEQ has authority for permitting CO_2 GS injection wells under its existing Class I and Class V well programs. When the EPA adopts the Class VI well rules, TCEQ will have authority under the Water Code for adoption of equivalent rules for permitting and regulation of CO_2 injection in this new class of wells (Class VI). The reader is referred to Sections 2.2.1 and 2.3 of this report for additional details.

[123] SB 1387, Section 10(b)(2)

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Appendix I: Senate Bill 1387

By: Seliger

AN ACT relating to the implementation of projects involving the capture, injection, sequestration, or geologic storage of carbon dioxide.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Section 27.002, Water Code, is amended by adding Subdivisions (19), (20), (21), (22), (23), (24), and (25) to read as follows:

(19) "Anthropogenic carbon dioxide":

(A) means:

(i) carbon dioxide that would otherwise have been released into the atmosphere that has been:

(a) stripped, segregated, or divided from any other fluid stream; or

(b) captured from an emissions source, including:

(1) an advanced clean energy project as defined by Section 382.003, Health and Safety Code, or another type of electric generation facility; or

(2) an industrial source of emissions;

(ii) any incidental associated substance derived from the source material for, or from the process of capturing, carbon dioxide described by Subparagraph (i); and

(iii) any substance added to carbon dioxide described by Subparagraph (i) to enable or improve the process of injecting the carbon dioxide; and

(B) does not include naturally occurring carbon dioxide that is recaptured, recycled, and reinjected as part of enhanced recovery operations.

(20) "Anthropogenic carbon dioxide injection well" means an injection well used to inject or transmit anthropogenic carbon dioxide into a reservoir.

(21) "Enhanced recovery operation" means the use of any process for the displacement of hydrocarbons from a reservoir other than primary recovery and includes the use of any physical, chemical, thermal, or biological process and any co-production project.

(22) "Geologic storage" means the underground storage of anthropogenic carbon dioxide in a reservoir.

(23) "Geologic storage facility" means the underground reservoir, underground equipment, injection wells, and surface buildings and equipment used or to be used for the geologic storage of anthropogenic carbon dioxide and all surface and subsurface rights and appurtenances necessary to the operation of a facility for the geologic storage of anthropogenic carbon dioxide. The term includes any reasonable

and necessary areal buffer and subsurface monitoring zones, pressure fronts, and other areas as may be necessary for this state to receive delegation of any federal underground injection control program relating to the storage of carbon dioxide. The term does not include a pipeline used to transport carbon dioxide from the facility at which the carbon dioxide is captured to the geologic storage facility. The storage of carbon dioxide incidental to or as part of enhanced recovery operations does not in itself automatically render a facility a geologic storage facility.

(24) "Oil or gas" means oil, natural gas, or gas condensate.

(25) "Reservoir" means a natural or artificially created subsurface sedimentary stratum, formation, aquifer, cavity, void, or coal seam.

SECTION 2. Chapter 27, Water Code, is amended by adding Subchapter C-1 to read as follows:

SUBCHAPTER C-1. GEOLOGIC STORAGE AND ASSOCIATED INJECTION OF ANTHROPOGENIC CARBON DIOXIDE

Sec. 27.041. JURISDICTION. (a) Except as provided by Subsection (b), the railroad commission has jurisdiction over the geologic storage of carbon dioxide in, and the injection of carbon dioxide into, a reservoir that is initially or may be productive of oil, gas, or geothermal resources or a saline formation directly above or below that reservoir.

(b) The jurisdiction of the railroad commission over the geologic storage of carbon dioxide in, and the injection of carbon dioxide into, a saline formation described by Subsection (a) is subject to the review of the legislature based on the recommendations made in the preliminary report described by Section 10, S.B. No. 1387, Acts of the 81st Legislature, Regular Session, 2009.

(c) Except as provided by Subsection (b), the railroad commission has jurisdiction over a well used for the purpose provided by Subsection (a) regardless of whether the well was initially completed for that purpose or was initially completed for another purpose and is converted to the purpose provided by Subsection (a).

Sec. 27.042. APPLICABILITY. This subchapter does not apply to the injection of fluid through the use of a Class II injection well as defined by 40 C.F.R. Section 144.6(b) for the primary purpose of enhanced recovery operations.

Sec. 27.043. PERMIT FROM RAILROAD COMMISSION. A person may not begin drilling or operating an anthropogenic carbon dioxide injection well for geologic storage or constructing or operating a geologic storage facility regulated under this subchapter without first obtaining the necessary permits from the railroad commission.

Sec. 27.044. INFORMATION REQUIRED OF APPLICANT. The railroad commission shall require an applicant to provide any information the railroad commission considers necessary to discharge its duties under this subchapter.

Sec. 27.045. FEES. (a) The railroad commission may impose fees to cover the cost of:

(1) permitting, monitoring, and inspecting anthropogenic carbon dioxide injection wells for geologic storage and geologic storage facilities; and

(2) enforcing and implementing this subchapter and rules adopted by the railroad commission under this subchapter.

(b) Fees collected by the railroad commission under this section shall be deposited to the credit of the anthropogenic carbon dioxide storage trust fund established under Section 120.003, Natural Resources Code.

Sec. 27.046. LETTER FROM EXECUTIVE DIRECTOR. (a) The railroad commission may not issue a permit under rules adopted under this subchapter until the applicant for the permit provides to the railroad commission a letter from the executive director stating that drilling and operating the anthropogenic carbon dioxide injection well for geologic storage or operating the geologic storage facility will not injure any freshwater strata in that area and that the formation or stratum to be used for the geologic storage facility is not freshwater sand.

(b) To make the determination required by Subsection (a), the executive director shall review:

(1) the area of review and corrective action plans;

(2) any subsurface monitoring plans required during injection or post injection;

(3) any postinjection site care plans; and

(4) any other elements of the application reasonably required in order for the executive director to make the determination required by Subsection (a).

(c) The commission shall adopt rules to implement and administer this section.

Sec. 27.047. RULES. The railroad commission shall adopt rules and procedures reasonably required for the performance of its powers, duties, and functions under this subchapter, including rules for:

(1) the geologic storage and associated injection of anthropogenic carbon dioxide, including:

(A) geologic site characterization;

(B) area of review and corrective action;

(C) well construction;

(D) operation;

(E) mechanical integrity testing;

(F) monitoring;

(G) well plugging;

(H) postinjection site care;

(I) site closure; and

(J) long-term stewardship;

(2) the enforcement of this subchapter and rules adopted by the railroad commission under this subchapter; and

(3) the collection and administration of:

(A) fees imposed under Section 27.045; and

(B) penalties imposed for a violation of this subchapter or rules adopted by the railroad commission under this subchapter.

Sec. 27.048. CONSISTENCY WITH AND IMPLEMENTATION OF FEDERAL REQUIREMENTS. (a) Rules adopted by the railroad commission under this subchapter must be consistent with applicable rules or regulations adopted by the United States Environmental Protection Agency or another federal agency governing the injection and geologic storage of anthropogenic carbon dioxide.

(b) If rules or regulations adopted to govern the geologic storage and associated injection of anthropogenic carbon dioxide under the federal Safe Drinking Water Act (42 U.S.C. Section 300f et seq.) or another federal statute allow this state to seek primary enforcement authority under the underground injection control program:

(1) the railroad commission shall seek primacy to administer and enforce the program subject to the jurisdiction granted under this subchapter; and

(2) this state shall seek primacy to administer and enforce the program for the geologic storage of carbon dioxide in, and the injection of carbon dioxide into, a saline formation.

Sec. 27.049. MEMORANDUM OF UNDERSTANDING. The commission and the railroad commission, as necessary to comply with this subchapter, by rule shall:

(1) amend the memorandum of understanding recorded in 16 T.A.C. Section 3.30; or

(2) enter into a new memorandum of understanding.

Sec. 27.050. FINANCIAL RESPONSIBILITY. (a) A person to whom a permit is issued under this subchapter must provide to the railroad commission annually evidence of financial responsibility that is satisfactory to the railroad commission.

(b) In determining whether the person is financially responsible, the railroad commission shall rely on:

(1) the person's most recent quarterly report filed with the United States Securities and Exchange Commission under Section 13 or 15(d), Securities Exchange Act of 1934 (15 U.S.C. Section 78m or 78o(d)); or

(2) if the person is not required to file with the United States Securities and Exchange Commission a report described by Subdivision (1), the person's most recent audited financial statement.

SECTION 3. Section 27.051, Water Code, is amended by amending Subsection (b) and adding Subsection (b-1) to read as follows:

(b) The railroad commission may grant an application for a permit under Subchapter C in whole or part and may issue the permit if it finds:

(1) that the use or installation of the injection well is in the public interest;

(2) that the use or installation of the injection well will not endanger or injure any oil, gas, or other mineral formation;

(3) that, with proper safeguards, both ground and surface fresh water can be adequately protected from pollution; and

(4) that the applicant has made a satisfactory showing of financial responsibility if required by Section 27.073 [~~of this code~~].

(b-1) The railroad commission may issue a permit under Subchapter C-1 if it finds:

(1) that the injection and geologic storage of anthropogenic carbon dioxide will not endanger or injure any oil, gas, or other mineral formation;

(2) that, with proper safeguards, both ground and surface fresh water can be adequately protected from carbon dioxide migration or displaced formation fluids;

(3) that the injection of anthropogenic carbon dioxide will not endanger or injure human health and safety;

(4) that the reservoir into which the anthropogenic carbon dioxide is injected is suitable for or capable of being made suitable for protecting against the escape or migration of anthropogenic carbon dioxide from the reservoir; and

(5) that the applicant for the permit meets all of the other statutory and regulatory requirements for the issuance of the permit.

SECTION 4. Sections 27.071 and 27.072, Water Code, are amended to read as follows:

Sec. 27.071. POWER TO ENTER PROPERTY. Members of the commission and the railroad commission and employees of the commission and the railroad commission may enter public or private property to inspect and investigate conditions relating to injection well, monitoring well, disposal well, [~~or~~] production well, or geologic storage activities within their respective jurisdictions or to monitor compliance with a rule, permit, or other order of the commission or railroad commission. Members or employees acting under the authority of this section who enter an establishment on public or private property shall observe the establishment's safety, internal security, and fire protection rules.

Sec. 27.072. POWER TO EXAMINE RECORDS. Members of the commission and the railroad commission and employees of the commission and railroad commission may examine and copy those records or memoranda of a business they are investigating as provided by Section 27.071 [~~of this code~~] that relate to the operation of an injection well, monitoring well, disposal well, [~~or~~] production well, or geologic storage facility, or any other records required to be maintained by law.

SECTION 5. Section 27.073, Water Code, is amended by amending Subsection (a) and adding Subsection (b-1) to read as follows:

(a) A person to whom an injection well permit is issued may be required by the commission or railroad commission to maintain a performance bond or other form of financial security to ensure that:

(1) an abandoned injection well is properly plugged; or

(2) funds are available for plugging, postinjection site care, and closure of an anthropogenic carbon dioxide injection well subject to Subchapter C-1.

(b-1) The railroad commission is authorized to receive funds as the beneficiary of a financial responsibility mechanism established under this chapter for the proper management of an anthropogenic carbon dioxide injection well or geologic storage facility.

SECTION 6. Chapter 91, Natural Resources Code, is amended by adding Subchapter R to read as follows:

SUBCHAPTER R. AUTHORIZATION FOR MULTIPLE OR ALTERNATIVE USES OF WELLS

Sec. 91.801. RULES AUTHORIZING MULTIPLE OR ALTERNATIVE USES OF WELLS. The commission shall adopt rules allowing:

(1) a person to obtain a permit for a well from the commission that authorizes the well to be used for multiple purposes; and

(2) an operator of a well authorized by a permit issued by the commission to convert the well from its authorized purpose to a new or additional purpose.

Sec. 91.802. LAW APPLICABLE TO GEOLOGIC STORAGE FACILITIES AND ASSOCIATED INJECTION WELLS. (a) In this section, "anthropogenic carbon dioxide injection well" has the meaning assigned by Section 27.002, Water Code.

(b) If a well is authorized as or converted to an anthropogenic carbon dioxide injection well for geologic storage, Subchapter C-1, Chapter 27, Water Code, applies to the well.

(c) A conversion of an anthropogenic carbon dioxide injection well from use for enhanced recovery operations to use for geologic storage is not considered to be a change in the purpose of the well.

SECTION 7. Subtitle D, Title 3, Natural Resources Code, is amended by adding Chapter 120 to read as follows:

CHAPTER 120. OWNERSHIP AND STEWARDSHIP OF ANTHROPOGENIC CARBON DIOXIDE

Sec. 120.001. DEFINITIONS. In this chapter:

(1) "Anthropogenic carbon dioxide," "anthropogenic carbon dioxide injection well," and "geologic storage facility" have the meanings assigned by Section 27.002, Water Code.

(2) "Commission" means the Railroad Commission of Texas.

(3) "Storage operator" means a person authorized by the commission to operate a geologic storage facility.

Sec. 120.002. OWNERSHIP OF ANTHROPOGENIC CARBON DIOXIDE. (a) This section does not apply to anthropogenic carbon dioxide injected for the primary purpose of enhanced recovery operations.

(b) Unless otherwise expressly provided by a contract, bill of sale, deed, mortgage, deed of trust, or other legally binding document or by other law, anthropogenic carbon dioxide stored in a geologic storage facility is considered to be the property of the storage operator or the storage operator's heirs, successors, or assigns.

(c) Absent a final judgment of wilful abandonment rendered by a court or a regulatory determination of closure or abandonment, anthropogenic carbon dioxide stored in a geologic storage facility is not considered to be the property of the owner of the surface or mineral estate in the land in which the anthropogenic carbon dioxide is stored or of a person claiming under the owner of the surface or mineral estate.

(d) The owner, as designated by Subsection (b) or (c), of the anthropogenic carbon dioxide stored in a geologic storage facility, or the owner's heirs, successors, or assigns, may produce, take, extract, or otherwise possess anthropogenic carbon dioxide stored in the facility.

Sec. 120.003. ANTHROPOGENIC CARBON DIOXIDE STORAGE TRUST FUND. (a) The anthropogenic carbon dioxide storage trust fund is created as a special fund in the state treasury.

(b) The anthropogenic carbon dioxide storage trust fund is an interest-bearing fund. Interest earned on money in the fund shall be deposited to the credit of the fund.

(c) Fees collected by the commission under Subchapter C-1, Chapter 27, Water Code, and penalties imposed for violations of that subchapter or rules adopted under that subchapter shall be deposited to the credit of the anthropogenic carbon dioxide storage trust fund.

(d) The anthropogenic carbon dioxide storage trust fund may be used by the commission only for:

(1) inspecting, monitoring, investigating, recording, and reporting on geologic storage facilities and associated anthropogenic carbon dioxide injection wells;

(2) long-term monitoring of geologic storage facilities and associated anthropogenic carbon dioxide injection wells;

(3) remediation of mechanical problems associated with geologic storage facilities and associated anthropogenic carbon dioxide injection wells;

(4) repairing mechanical leaks at geologic storage facilities;

(5) plugging abandoned anthropogenic carbon dioxide injection wells used for geologic storage;

(6) training and technology transfer related to anthropogenic carbon dioxide injection and geologic storage; and

(7) compliance and enforcement activities related to geologic storage and associated anthropogenic carbon dioxide injection wells.

Sec. 120.004. EXTRACTION OF STORED ANTHROPOGENIC CARBON DIOXIDE. (a) The commission shall adopt rules allowing anthropogenic carbon dioxide stored in a geologic storage facility to be extracted for a commercial or industrial use.

(b) The commission has jurisdiction over the extraction of anthropogenic carbon dioxide stored in a geologic storage facility.

SECTION 8. Section 27.038, Water Code, is repealed.

SECTION 9. (a) In this section:

(1) "Anthropogenic carbon dioxide," "geologic storage," and "geologic storage facility" have the meanings assigned by Section 27.002, Water Code, as amended by this Act.

(2) "State-owned land" includes state-owned submerged land.

(b) Not later than December 1, 2010, the Commissioner of the General Land Office shall prepare and file with the legislature a preliminary report on a recommended framework for managing activities related to geologic storage on state-owned land. The report shall include:

(1) recommended criteria for identifying candidate geologic storage sites in each of the following types of onshore and offshore geological settings:

(A) operating oil and gas fields;

(B) depleted oil and gas fields;

(C) unmineable coal seams;

(D) saline formations;

(E) geological systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity;

(F) geological systems containing igneous formations; and

(G) coalbeds being used for methane recovery;

(2) a proposed regulatory framework for leasing state-owned land for geologic storage, including an assessment of options to ensure that the state receives fair market value for using state-owned property for geologic storage;

(3) a proposed procedure for:

(A) providing an opportunity for public review of, and the presentation of comments by interested persons regarding, any activities related to geologic storage on state-owned land; and

(B) ensuring that the quality of the natural and cultural resources of state-owned land overlying the site of a geologic storage facility are protected from any geologic storage activities at the site;

(4) a description of the status of leasehold or mineral estate liability issues related to the geological subsurface trespass of, or caused by, anthropogenic carbon dioxide stored in state-owned land, including any relevant experience from enhanced oil recovery using carbon dioxide on state-owned land;

(5) recommendations for additional legislation that may be required to ensure that public land management and leasing laws are adequate to accommodate geologic storage;

(6) an identification of the legal and regulatory issues specific to geologic storage in cases in which title to the mineral estate is held by the state but title to the surface estate is not held by the state; and

(7) recommendations for additional legislation that may be required to clarify the appropriate framework for issuing rights-of-way for anthropogenic carbon dioxide pipelines on state-owned land.

(c) In preparing the preliminary report under Subsection (b) of this section, the Commissioner of the General Land Office shall coordinate with:

(1) the Bureau of Economic Geology of The University of Texas at Austin;

(2) the Railroad Commission of Texas;

(3) the Texas Commission on Environmental Quality; and

(4) the heads of other appropriate agencies.

(d) This section expires December 31, 2010.

SECTION 10. (a) In this section, "anthropogenic carbon dioxide," "geologic storage," and "geologic storage facility" have the meanings assigned by Section 27.002, Water Code, as amended by this Act.

(b) Not later than December 1, 2010, the Texas Commission on Environmental Quality and the Railroad Commission of Texas, in consultation with the Bureau of Economic Geology of The University of Texas at Austin, shall prepare and file with the legislature a joint preliminary report that:

(1) analyzes the requirements for the injection and geologic storage of anthropogenic carbon dioxide into saline formations that are not productive of oil, gas, or geothermal resources;

(2) recommends a permitting process for anthropogenic carbon dioxide injection wells and geologic storage facilities that are used for the injection and storage of anthropogenic carbon dioxide in saline formations not productive of oil, gas, or geothermal resources;

(3) recommends the agency or agencies that should have jurisdiction over permitting described by Subdivision (2) of this subsection or any other permitting of geologic storage facilities not subject to Subchapter C-1, Chapter 27, Water Code; and

(4) assesses the status of compliance with any federal rules regulating the geologic storage and associated injection of anthropogenic carbon dioxide.

(c) The preliminary report shall include:

(1) recommended criteria for identifying candidate geologic storage sites in each of the following types of geological settings:

(A) operating oil and gas fields;

(B) depleted oil and gas fields;

(C) unmineable coal seams;

(D) saline formations;

(E) geological systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity;

(F) geological systems containing igneous formations; and

(G) coalbeds being used for methane recovery;

(2) a proposed procedure for:

(A) providing an opportunity for public review of, and the presentation of comments by interested persons regarding, any activities related to geologic storage; and

(B) ensuring that the quality of the natural and cultural resources of land overlying the site of a geologic storage facility are protected from any geologic storage activities at the site;

(3) recommendations for methods to mitigate any negative effects of federal greenhouse gas reporting requirements on owners and producers of naturally occurring carbon dioxide;

(4) a description of the status of leasehold or mineral estate liability issues related to the geological subsurface trespass of, or caused by, anthropogenic carbon dioxide stored in private or state-owned land, including any relevant experience from enhanced recovery operations using carbon dioxide;

(5) an analysis of and recommendations to address:

(A) the attributes of the subsurface area of operations for geologic storage facilities; and

(B) the methods of financial assurance and the allocation of long-term liability for the post-operational phases of geologic storage projects;

(6) the status of any applications for permits that have been received before the report is prepared;

(7) an update on the exchange of information between the Texas Commission on Environmental Quality and the Railroad Commission of Texas as required by the memorandum of understanding described by Section 27.049, Water

Code, as added by this Act, and as required by Section 27.046, Water Code, as added by this Act;

(8) the status of any request for primary enforcement authority for the underground injection and geologic storage of anthropogenic carbon dioxide under the underground injection control program; and

(9) any recommendations for additional legislation, modifications to the memorandum of understanding, or new rules for regulating geologic storage facilities and associated anthropogenic carbon dioxide injection wells.

(d) This section expires December 31, 2010.

SECTION 11. (a) The Texas Commission on Environmental Quality shall adopt rules under Section 27.046, Water Code, as added by this Act, as soon as practicable after the effective date of this Act.

(b) Not later than March 1, 2010, the Railroad Commission of Texas shall adopt rules under Section 27.047, Water Code, as added by this Act, for the geologic storage and associated injection of carbon dioxide in connection with enhanced recovery operations, excluding enhanced recovery operations for which:

(1) there is a reasonable expectation of more than insignificant future production volumes or rates as a result of the injection of anthropogenic carbon dioxide; and

(2) operating pressures are not higher than reasonably necessary to produce the production volumes or rates described by Subdivision (1) of this subsection.

(c) Not later than September 1, 2010, the Railroad Commission of Texas shall adopt rules under Section 27.047, Water Code, as added by this Act, for the geologic storage of carbon dioxide in, and the injection of carbon dioxide into, a reservoir that is initially or may be productive of oil, gas, or geothermal resources.

(d) The Texas Commission on Environmental Quality and the Railroad Commission of Texas shall adopt rules under Section 27.049, Water Code, as added by this Act, as soon as practicable after the effective date of this Act.

(e) The Railroad Commission of Texas shall adopt rules under Sections 91.801 and 120.004, Natural Resources Code, as added by this Act, as soon as practicable after the effective date of this Act.

SECTION 12. This Act does not make an appropriation. A provision in this Act that creates a new governmental program, creates a new entitlement, or imposes a new duty on a governmental entity is not mandatory during a fiscal period for which the legislature has not made a specific appropriation to implement the provision.

SECTION 13. This Act takes effect September 1, 2009.

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Appendix II: Federal and State Regulations

To ensure preservation of cultural and natural resources of land overlying the geologic storage facility under SB 1387, discussion may be broadly divided into three categories. These include projects with federal funding / jurisdiction, projects under federal law with state delegation, and state laws that would apply to a proposed facility.

Federal Funding: National Environmental Policy Act

Projects involving federal funds would be required to include a study in accordance with the National Environmental Policy Act (NEPA). The National Environmental Policy Act (NEPA) [42 U.S.C. 4321 et seq.] was signed into law on January 1, 1970. The Act establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment, and provides a process for implementing these goals within federal agencies. The Act also established the Council on Environmental Quality (CEQ).

NEPA requires the federal government to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony. Federal agencies must prepare detailed statements assessing the environmental impact of, and alternatives to, major federal actions significantly affecting the environment. These statements are commonly referred to as environmental impact statements (EIS's).

Implementation

In 1978, CEQ promulgated regulations [40 CFR Parts 1500-15081] implementing NEPA which are binding on all federal agencies. The regulations address the procedural provisions of NEPA and the administration of the NEPA process, including preparation of EIS's.

Most federal agencies have promulgated their own NEPA regulations and guidance, which generally follow the CEQ procedures but are tailored for the specific mission and activities of the agency. The agency with jurisdiction typically reviews the project and provides comment in accordance with their NEPA requirements.

Federal and State Agency Roles

The role of a federal agency in the NEPA process depends on that agency's expertise and relationship to the proposed undertaking. The agency carrying out the federal action is responsible for complying with the requirements of NEPA. In some cases, there may be more than one federal agency involved in an undertaking. In this situation, a lead agency is designated to supervise preparation of the environmental analysis. Federal agencies, together with state, tribal or local agencies, may act as joint lead or cooperating agencies. For specific environmental or cultural issues, state agencies are consulted and their approval is required. Delegated states, where appropriate, provide the necessary review and comment in various program areas, in most cases without formal federal involvement.

Federal Laws with State Delegation

Unlike NEPA, there are federal laws applicable to facilities under SB 1387 where the states are fully delegated and the day to day involvement of the federal government is very limited or non-existent.

Safe Drinking Water Act – Underground Injection Control Program

On July 25, 2008, the United States Environmental Protection Agency (EPA) issued proposed rules for underground injection of carbon dioxide (CO_2) for capture and long-term geologic storage (geologic sequestration, or GS). EPA issued the rule within the regulatory framework of the Underground Injection Control (UIC) well permitting program, which is authorized under the federal Safe Drinking Water Act (SDWA), 33 U.S.C. § 300.h-3.

The proposed regulatory amendments would establish a new class of wells, Class VI. The regulations establishing the criteria and standards for issuance of Class VI wells would be codified in 40 CFR Part 146, Subpart H. This geologic sequestration is typically considered to be one of the key options under climate change legislation.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, more commonly known as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. EPA is the federal agency responsible for creating and enforcing national water quality regulations under the CWA. Each state and Indian tribe may develop its own program for enforcing CWA requirements.

Section 402 of the CWA establishes the permitting program under the National Pollution Discharge Elimination System (NPDES). Permitting authority is divided according to point sources and non-point sources. The point source discharges were initially regulated under the original version of the Act in 1972. Non-point sources were later regulated in amendments to the Act in 1987 under Section 319. It also includes requirements to protect navigable waters from catastrophic spills of oil and refined products under Section 311. This requirement is implemented by way of a spill plan, which is kept onsite, rather than by way of a permit process.

The Clean Water Act provides for state primacy of the NPDES program for discharges into navigable waters. The State of Texas (TCEQ) has primacy for this act under the TPDES program. The RRC does not have a delegated NPDES program for discharges under its jurisdiction, and, therefore, both a state discharge permit and a federal NPDES permit may be required.

NPDES (or TPDES by delegation) establishes pollutant limits on the discharge of produced water that generally include a volume (quantity) and concentration (quality) (U.S. EPA, 2004). There are two types of permits under the NPDES program that allow for the discharge of pollutants from point sources. These are individual permits, which are specific to an individual facility, and general permits, which cover multiple facilities within a specific permit category.

Operating facilities with no discharge are not required to obtain a discharge permit.

The Environmental Protection Agency's Oil Pollution Prevention Rule became effective January 10, 1974. It was published under the authority of Section 311(j)(1)(C) of the Clean Water Act. The regulation may be found at Title 40, Code of Federal Regulations, Part 112 (40 CFR 112). The prevention rule was revised on July 17, 2002. Facilities subject to the rule must prepare and implement a plan to prevent any discharge of oil into or upon navigable waters of the United States or adjoining shorelines. The plan is called a Spill Prevention, Control, and Countermeasure (SPCC) Plan.

Section 311 of the CWA regulates storage of oil and " applies to any owner or operator of a non-transportation related onshore or offshore facility engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing, using, or consuming oil and oil products, which due to its location, could reasonably be expected to discharge oil in quantities that may be harmful……into or upon the navigable waters of the United States or adjoining shorelines……."

Unlike oil spill contingency plans that address cleanup measures after a spill, SPCC Plans are preventive measures to assure that a spill from an Aboveground Storage Tank (AST) is contained and countermeasures are established to prevent oil spills that could reach navigable waters. These regulations would apply to many facilities permitted for geologic sequestration. Owners and operators of Aboveground Storage Tanks (AST's) which store more than 1,320 gallons of oil must have and implement an SPCC Plan.

These regulations are implemented by means of plans kept onsite (as opposed to a permit process) and subject to review when the facility is inspected by local, state or federal authorities.

With a few caveats, exploration and production activities of the oil and gas industry are exempt from regulation of the permitting authority under this law. Some of the aspects of geologic storage may not qualify for the exemption, but some parts will. Most aspects of NPDES permitting are delegated to the State of Texas under the TPDES program. For surface spills, geologic storage faciities would be required under federal regulations to keep a spill plan if they store oil or motor fuels above the threshold of 1320 gallons. These plans are often reviewed in the event of site inspections by local, state or federal authorities. The overwhelming majority of site inspections have been performed by local and state authorities, and the future is expected to follow that pattern. The nature of the activities associated with geologic storage, with proper regulation under the CWA, are not expected to adversely affect the natural and cultural resources of land that overlies the geologic storage facility.

Endangered Species Act

The Endangered Species Act (ESA) is a federal law intended to protect endangered species and their habitat. In 1973, ESA provided for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend. The Act:

- authorizes the determination and listing of species as endangered and threatened;

- prohibits unauthorized taking, possession, sale, and transport of endangered species;
- provides authority to acquire land for the conservation of listed species, using land and water conservation funds;
- authorizes establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife and plants;
- authorizes the assessment of civil and criminal penalties for violating the Act or regulations; and
- authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction for any violation of the Act or any regulation issued thereunder.

The United States Fish and Wildflife Service, and Texas Parks and Wildlife share jurisdiction regarding Threatened and Endangered Species issues in Texas. Under projects with NEPA (federal) jurisdiction (see NEPA subsection above), a finding of no impact on endangered species or their habitat is a typical requirement from each of these agencies. Otherwise, approval of a habitat mitigation plan may be needed. Measures may range from site-specific project changes intended to protect habitat, or payment of fees that would allow for the usage or taking of habitat. The fees collected are then used for purchase of critical habitat elsewhere. This purchased habitat would then be owned by a government entity or designated agency whose purpose is conservatorship.

For projects not under NEPA, an owner/operator may still need to gain a finding of no impact, implement a mitigation plan, or pay applicable fees, as the ESA applies to both public and private lands. The owner/operator would need to make a determination of the need for reporting and review by these agencies on a case-by-case basis according to whether or not the project site included endangered species habitat.

Texas Antiquities Code

An oil and gas operator, or facility owner operator for a GS facility will need to comply with the Texas Antiquities Code as administered by the Texas Historical Commission (THC). This commission is intended to “protect, and preserve all sites, objects, buildings, pre-twentieth century shipwrecks, and locations of historical, archeological, educational, or scientific interest, including but not limited to prehistoric and historical American Indian or aboriginal campsites, dwellings, and habitation sites, archeological sites of every character, treasure imbedded in the earth, sunken or abandoned ships and wrecks of the sea or any part of their contents, maps, records, documents, books, artifacts, and implements of culture in any way related to the inhabitants, pre-history, history, natural history, government, or culture in, on, or under any of the land in the State of Texas, including the tidelands, submerged land, and the bed of the sea within the jurisdiction of the State of Texas.”

Categorical exclusions listed in §195.0525(e) of the Texas Antiquities Code, which include:

(14) oil, gas, or other mineral exploration, production, processing, marketing, refining, or transportation facility or pipeline project in an area where the project will cross state or local public roads, rivers, and streams, unless they contain a recorded archeological site or a designated state land tract in Texas' submerged lands;

(15) maintenance, operation, replacement, or minor modification of an existing oil, gas, or other mineral exploration, production, processing, marketing, refining, or transportation facility or pipeline;

Apparently, many oil and gas activities such as exploration, processing, and maintenance for wells and pipelines, would qualify for this exemption. However, it would also appear that geologic storage may not be part of these exemptions. The facility owner/operator would need to make this determination with the THC.

TRANSMITTAL LETTER FOR SENATE BILL 1387

In accordance with the requirements of Senate Bill 1387, Sections 9 and 10, the Railroad Commission of Texas, the Texas Commission on Environmental Quality, the Texas General Land Office, and the Texas Bureau of Economic Geology, hereby submit this report to the Texas Legislature.

Railroad Commission of Texas

John Tintera, Executive Director

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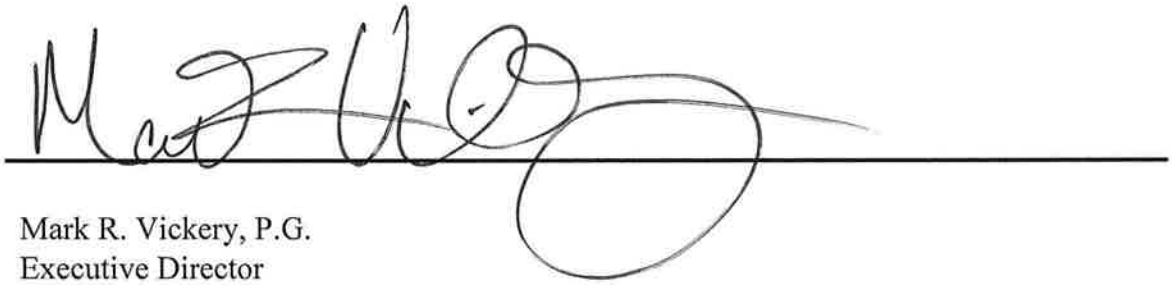
Texas Commission on Environmental Quality



Mark R. Vickery, P.G.
Executive Director

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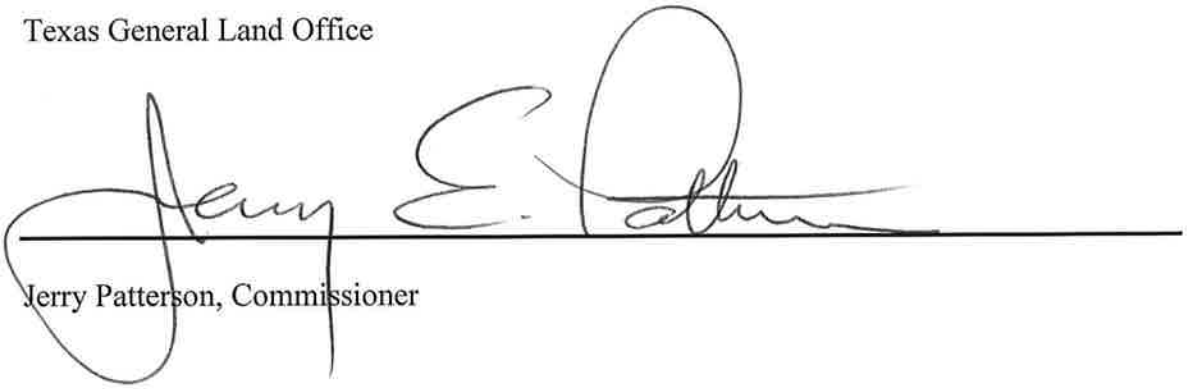
Texas General Land Office



Jerry Patterson, Commissioner

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Texas Bureau of Economic Geology

Scott W. Tinker, Director