

Carbon Dioxide Sequestration:
Report on Identified Statutory and Regulatory Issues

**“A BLUEPRINT FOR THE REGULATION OF GEOLOGIC SEQUESTRATION OF
CARBON DIOXIDE IN NEW MEXICO”**

New Mexico Energy, Minerals, Natural Resources Department
Oil Conservation Division

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Executive Summary

The Governor's Executive Order 2006-69 requires the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) coordinate with a stakeholder group to explore and identify statutory and regulatory requirements needed to geologically sequester anthropogenic carbon dioxide.

The purpose of this report is to identify the issues and challenges associated with geologic sequestration that must be addressed by potential statutory and regulatory changes, to identify questions, concerns and recommendations of the stakeholder group, to present findings and research for policy development, and to present proposed statutory changes and identify regulatory changes that must be addressed once the statutory direction is established. No attempt was made to address or identify challenges of carbon sequestration outside the scope of transportation, injection and geologic storage.

This report is due to the Governor's Climate Change Action Implementation Team on December 1, 2007.

Geologic sequestration of carbon dioxide has been identified as a technically viable means to significantly reduce anthropogenic emissions of the greenhouse gas carbon dioxide (CO₂) over long timescales. Studies suggest that in appropriately selected and managed geologic reservoirs it is very likely that the fraction of stored CO₂ will be greater than 99 percent over 100 years, and likely that the fraction of stored CO₂ will not significantly diminish below that for the first 1,000 years.¹

Implementation of a regulatory framework for geologic sequestration of CO₂ raises numerous property rights, siting, monitoring, storage verification, and liability issues, including the following:

- *Potential Current and Future Conflicts with Subsurface and Surface Interests*

Potential conflicts with mineral estate interests, pore space and storage right owners, surface interests, and groundwater use may arise and must be anticipated.

- *Ownership of Geologic Formation/Pore Space and the Right to Sequester*

Ownership of the pore space must be identified and made clear so that the appropriate interests can be remunerated for the right to sequester, or so condemnation proceedings can properly advance and the proper parties compensated before any commercial-scale sequestration can begin.

- *Long-term Liability*

¹ IPCC Special Report on Carbon dioxide Capture and Storage (2005) p. 246.

A statutory and regulatory scheme controlling CO₂ sequestration should include an appropriate mechanism(s) to protect public and private interests against the long-term liability and inherent unknowns (e.g. economic, environmental, carbon dioxide accounting, human health and safety, etc.) of commercial-scale carbon dioxide sequestration projects in order to promote development of projects and to encourage climate mitigation.

Such a scheme should address the questions: Should the state retain long-term liability (i.e. monitoring, measurement, and mitigation responsibilities, including personal and property damages) of all sequestration projects or a limited number of initial projects to promote industry and commercial participation? Should the state take on only those projects demonstrated to be performing as predicted to encourage careful and proper site selection? What is the best means to fund the state's long-term liability should it opt to take on the long-term liability and ownership of sequestration projects? Or, should industry retain liability with liability modeled on one or more of current federal environmental liability schemes?

To address the potential conflicts and uncertainties outlined above and to ensure the viability and success of any commercial-scale carbon sequestration project, several statutory changes would be necessary to address a variety of issues.

Identified Statutory Issues:

- *Authority to Regulate Carbon Sequestration*

OCD currently is tasked with regulating the injection of CO₂ into oil and gas reservoirs for the purposes of enhancing hydrocarbon recovery, prevention of CO₂ waste, and for disposal (such as acid gas injection). OCD also has the authority to require that CO₂ be injected, even after the possibility of enhanced production has elapsed, to prevent the waste of CO₂ that would otherwise be vented. Further, OCD also regulates naturally occurring CO₂ and may require injection not limited to oil and gas reservoirs if the CO₂ is a product of or used in oil and gas operations.

However, there exists no clear authority for the state to regulate anthropogenic CO₂ injection for sequestration purposes alone, nor does it have general authority to regulate injection/sequestration of CO₂ not produced in oil and gas operations into reservoirs other than those that produce oil and gas.

Because oil and gas reservoirs are anticipated to ultimately constitute only a small fraction of the total sequestration volumes in New Mexico, clear authority to regulate the sequestration of anthropogenic CO₂ into all potential geologic reservoirs, not limited to productive oil and gas reservoirs, for purposes of long-term/permanent sequestration is essential to any regulatory framework for commercial-scale geologic sequestration.

- *Ownership of Geologic Formation/Pore Space*

Pore space evacuated by the extraction of oil and gas minerals likely belongs not to the mineral interest but to the surface owner, who would have the sole power to grant storage rights for the purpose of sequestering carbon dioxide. New Mexico case law does not address the question of storage rights directly, but does hold that the mineral interest does not include the solids of the earth.

The holdings of several other cases reinforce that New Mexico retains a preference for the majority view that the mineral estate includes only the oil and gas native to the formation, and not rights to the formation or the pore space itself, unless the conveyance or severance of the mineral estate explicitly states otherwise. Therefore, the surface owner likely retains possession of the pore space/geologic formation and the sole right to store non-native gas in the evacuated space, but perhaps only after the mineral estate has been removed or depleted.

Clear statutory language defining the extent of surface ownership of the pore space and mineral estate interests could potentially avoid unnecessary litigation on this point.

- *Unitization of Recoverable Hydrocarbons*

To account for the enhanced recovery anticipated from injecting CO₂ into depleted oil and gas pools, it will be necessary to unitize such pools by voluntary agreement among the pool operators or through an Oil Conservation Division order compelling it, to provide a process to equitably allocate costs and production among the various mineral interests.

The authority granted by the Statutory Unitization Act currently provides for voluntary or compulsory unitization of a pool or part of a pool. OCD can only compel unitization when three-quarters of the interests consent. This may prove to provide an unacceptable means of blocking planned sequestration projects, as minority interests could refuse to ratify unitization orders, making the operation of the unit as a sequestration project difficult.

Under an effective CO₂ sequestration program it is anticipated that OCD would need to unitize larger areas than is now the practice. While not definitive, the language in the Unitization Act may be flexible enough to allow OCD to properly unitize pools of adequate size.

The Act also requires OCD to find that unitization will “substantially increase the ultimate recovery of oil and gas from the pool or unitized portion thereof.” Because substantially increased recovery may not always be the result in a program designed primarily for the sequestration of CO₂, this language may pose a barrier.

The Act further requires OCD to find “that the estimated additional costs, if any, of conducting such operations will not exceed the estimated value of the additional oil and gas so recovered plus a reasonable profit.” Interpreted to mean the costs of production of additional hydrocarbons (CO₂ separation and re-injection/cycling, etc.) as opposed to the costs of the entire sequestration project, this language may not pose a barrier, but the statute may need to be clarified.

Also, statutory continuation of expiring leases may be considered to facilitate pre-project planning of CO₂ sequestration projects.

Unitization of federal minerals with non-federal minerals is provided for in the federal “Mineral Leasing Act,” and must be approved by the Secretary of the Interior for the purpose of more properly conserving the oil and gas resources.

- *Condemnation of Storage Space and Transportation Corridors by Eminent Domain*

Subsurface storage space and surface easements for pipelines and injection facilities will be necessary for a large-scale sequestration effort. There will be significant up-front costs associated with the projects, and there will have to be some certainty that an operator who makes those investments will not be prevented from completing the project by not having the authority to condemn minority interests.

No authority exists under current law to provide for the acquisition by eminent domain of subsurface pore space for the purposes of CO₂ sequestration. Authority to condemn subterranean storage space, similar to current statutory provisions authorizing the condemnation of underground storage space for natural gas, would be necessary for CO₂ sequestration operators to acquire the storage rights from property owners with whom they have not reached an agreement, however, the scale for sequestration will be significantly greater than gas storage projects.

Authority currently exists to condemn surface land for pipeline construction, including CO₂ pipelines. This provision applies only to trunk lines, or primary transportation lines, and not to gathering lines. 70-3A-1 et seq. establishes the means by which easements for smaller disposal lines and gathering lines may be acquired across private property.

- *Long-term liability*

The various forms of liability (e.g. economic and environmental) inherent in proposed sequestration projects and how they will be addressed within a given regulatory framework are perceived as being significant factors in making sequestration projects feasible and for attaining public acceptance of the technologies, processes and regulations.

Sufficient financial assurances and appropriate and reasonable liability standards together with thorough, clear and reasonable regulations can create the required

degree of certainty and predictability necessary for insurers to offer adequate coverage in this new and unexplored field and for operators to develop realistic business models.

Similarly, sufficient financial assurances and a properly scaled liability standard, combined with protective regulations, can also instill confidence in the public that the state can manage and control this largely untested field while providing adequate protections and ensuring a mechanism for compensation and environmental mitigation should accidents occur. Further, developing the right level of legal liability can create in insurers an additional layer of regulatory oversight beyond what the state itself could otherwise provide. All of this must be accomplished without placing an undue financial burden on the industry, stifling development of carbon dioxide sequestration projects, which are viewed as an important component of the state's climate change mitigation strategy.

Liability and financial assurance can be accommodated on essentially four levels: (1) the federal government; (2) state government; (3) industry; or (4) the individual corporation or owner/operator.

Short-term liabilities inherent in any drilling or injection project can likely be best addressed through the contractual arrangements between CO₂ generator and injector. But liabilities following the injection and closure phases of the projects present a unique problem given the long-term economic and environmental unknowns and the anticipated scale of sequestration projects, both in terms of time and space, required for successful CO₂ mitigation.

Much of the sequestration literature assumes that long-term liability must be transferred to the public sector to maintain economic viability and to encourage industry participation.

However, such transfer of liability raises concerns that with limited liability, operators may have a reduced incentive to ensure sequestration is successful beyond the endurance of their direct liability. Another difficulty would be determining what level of funding would be necessary for a post-closure fund that would be used to cover the costs of monitoring, verification, mitigation and liability. As no true precedent exists with which to determine adequate and reasonable funding levels for the areal extent and duration contemplated for sequestration projects, this factor will pose a significant planning and actuarial challenge.

Alternatives include having the state accept liability for a limited number of projects (e.g. the first enhanced oil recovery project, the first deep saline project, the first deep coal project, etc.) or for a limited time frame (e.g. projects permitted during the first five years of CO₂ sequestration), or for injectors and the carbon sequestration industry to retain ownership and liability with coverage provided by some combination of individual liability, insurance, or an industry-funded trust fund.

Transfer of liability and ownership of injected CO2 to the state

Transfer of liability to the state would require the authority to impose a sequestration fee on injected CO2 volumes in order to fund the state's future liabilities, monitoring, measurement and verification (MMV) obligations.

Liability for injected CO2

The injectors liability can be modeled on any one or a combination of programs such as the Price Anderson Act, CERCLA, the Safe Drinking Water Act's Underground Injection Control Program, the Low-Level Radioactive Policy Act or on traditional private insurance options.

One possible liability scheme could include some or all of the following:

- Statutorily imposed strict liability for extraordinary occurrences, e.g. for contamination of protected groundwater sources, or for catastrophic releases (above a certain volume) of CO2 to the atmosphere or to non-storage formations.
- Negligence standard for all other events and occurrences.
- Imposition of strict liability for total response costs if willful misconduct or willful negligence is proven, or if the event was due to a violation of some applicable standard or regulation or if the operator failed to provide reasonable assistance with response operations.
- Creation of an industry-funded pool with deferred premiums for accident coverage and environmental mitigation costs that exceed an individual's insurance liability.
- Demonstration of financial assurance for insurance and industry-funded deferred premiums.
- Creation of a closure and post-closure trust fund (measuring, monitoring, mitigation and accidents (property and human health)), paid on a per-volume-injected basis.
- Declaration in the permit of who the primary responsible parties will be and who will bear the liability.
- Limitation of defenses, as in CERCLA, to: 1) act of God; 2) act of war; and 3) an act or omission on the part of a third party or agent if the Defendant exercised due care to address precautions against potential consequences of third party acts or omissions that could have been reasonably foreseen to result.
- Financial assurance for plugging and abandonment of individual wells, as well as the injection project as a whole, based on an approved cost estimate (updated and maintained annually by the injector).
- Submission of a closure plan and post-closure plan for review and approval by the Division.

- *Authority to Bond Injection Projects & Facilities*

Aside from the costs associated with post-closure MMV and potential mitigation, are the costs associated with reclaiming project sites and facilities following injector abandonment or insolvency. The state would need to ensure that injectors provide adequate financial assurance to cover the cost of any necessary plugging, reclamation or mitigation required as a result of abandonment or insolvency.

- *Authority to Enter Land for Inspection Purposes*

The state will need clear authority to enter surface estates to inspect facilities and the integrity and functioning of injection wells and other bore holes that may penetrate the CO₂ sequestration zone. And in the event of the transfer of ownership/liability to the state, the Division will require authority to enter surface properties to plug abandoned wells and reclaim sequestration surface facilities.

- *Protection of Surface Owner Interests*

The Surface Owners Protection Act applies only to exploration, drilling or production of oil and gas, and would need to be amended to include activities related to the sequestration of carbon dioxide to adequately protect the interests of surface owners in the same way they are currently protected during and after oil and gas production.

Identified Regulatory Issues

Regulatory changes will be necessary to implement the statutory requirements and policy decisions, as well as EPA Underground Injection Control (UIC) program requirements that are forthcoming. The following is an outline of the general regulatory issues identified to date.

General

- Statement of Division's General Authority
- Enforcement/Penalties
- Prohibit venting of CO₂
- Definition of Permanent Sequestration
- CO₂ Registry

Siting & Permitting

- Property Rights
- Mineral Leases
- Site & Reservoir characterization and mapping (baseline data)
- Injection
- Radius of Influence/Area of Review

- Proposed public safety and emergency response plan
- Siting
- Bonding
- Notice Requirements
- Permit conditions
- Procedure and Requirements for Transfer/Sale of Sequestration Project

Drilling & Operations

- OCD Right of Entry
- Casing requirements
- CO2 purity
- Operators right of surface entry
- Monitoring during injection
- CO2 safety

Post-Injection & Closure

- 10-year demonstration of reservoir and well integrity after cessation of injection phase before evaluation for potential transfer of ownership/liability? Or proper length of time to demonstrate integrity after injection phase (when formation pressures stabilize)?
- Monitoring
- Plugging
- Reclamation/Restoration of surface
- Qualifications for transfer

Post-Closure

- Transfer of liability
- Long-term monitoring plan
- Mitigation plan

Introduction

The Governor's Executive Order 2006-69 requires EMNRD to "explore requirements needed to ... geologically sequester significant amounts of anthropogenic carbon dioxide in the state, including but not limited to geologic surveys, infrastructure, and ownership of liabilities. ... In addition, EMNRD shall coordinate with the stakeholder group to develop and propose rules regarding carbon dioxide ... storage."

The New Mexico Climate Change Advisory Group in its final report of December 2006 identified the Oil Conservation Division as the likely agency to oversee development and implementation of a regulatory framework for geologic sequestration of CO₂ due to its institutional and technical expertise in drilling, deep-well injection, current regulatory oversight of ongoing carbon dioxide injection projects, as well as the anticipated synergies with enhanced oil recovery.

Pursuant to the foregoing Executive Order, EMNRD's Oil Conservation Division (OCD) held a series of public stakeholder meetings with representatives from community and non-governmental organizations, oil and gas exploration and production companies, power generation companies, and industry groups to gather input and recommendations for a proposed statutory and regulatory framework for CO₂ sequestration.

The purpose of this report is: 1) to identify the issues and challenges that must be addressed through statutory and/or regulatory changes to fully develop a comprehensive regulatory framework for the safe and effective sequestration of carbon dioxide in furtherance of the Governor's Executive Order; 2) identify questions, concerns and recommendations presented to the Division through the stakeholder process; 3) present findings and research to date for policy development; and 4) present an outline of proposed statutes and regulations.

Background

Based on current sequestration pilot projects and decades of enhanced oil recovery efforts, evidence suggests that geologic sequestration is a technically viable means to significantly reduce anthropogenic emissions of CO₂ and permanently separate it from the atmosphere.

In its December 2006 Final Report, the New Mexico Climate Change Advisory Group (CCAG) included carbon capture and storage/re-use among its greenhouse gas emissions reductions strategies.² Governor Richardson directed the CCAG in Executive Order 2005-033 to develop proposals to reduce New Mexico's greenhouse gas emissions to 2000 levels by the year 2012, 10 percent below 2000 levels by 2020, and 75 percent below 2000 levels by 2050 as part of a climate change mitigation strategy.

In recommendation ES-11, focused primarily on the capture and re-injection/re-use of CO₂ in the processing of natural gas, the CCAG proposed a CO₂ capture and re-injection/re-use target of 7 percent of CO₂ emissions every year, based on the prior year's emissions, for a total of 25.1 million metric tons of CO₂ equivalent captured and stored/re-used by 2020.³

For context, there are currently 70 CO₂ injection projects in the United States, injecting more than 35 million tons of CO₂ annually, primarily for enhanced oil recovery.⁴ In 2000, New Mexico emitted approximately 83 million metric tons of CO₂ equivalent,⁵ of which 30 million metric tons CO₂ equivalent came from the burning of coal.⁶ As CO₂ is emitted from coal-burning facilities and natural gas processing plants, it is also being mined in Union and Harding counties at the rate of about 8.6 billion cubic feet per month (452,800 metric tons/month on average since January 2006). In 2006, these counties produced more than 104 billion cubic feet (5.5 million metric tons) of CO₂, primarily for enhanced oil recovery in southeastern New Mexico and west Texas.

A recent MIT report concluded that "CO₂ capture and sequestration is the critical enabling technology that would reduce CO₂ emissions significantly while also allowing coal to meet the world's pressing energy needs."⁷ Geologic storage of CO₂ is also considered a viable and effective means of successfully sequestering CO₂ from the atmosphere over long timescales. Based on decades of studies in analogous hydrocarbon systems, natural gas storage operations and enhanced oil recovery projects, a 2005 Special Report by Intergovernmental Panel on Climate Change reported that "[f]or large-scale operational CO₂ storage projects, assuming that sites are well selected, designed, operated and appropriately monitored ... [i]t is very likely the fraction of stored CO₂ retained is more than 99% over the first 100 years [and that] [i]t is likely the fraction of stored CO₂ retained is more than 99% over the first 1000 years."⁸

² New Mexico Climate Change Advisory Group, Final Report (December 2006)
<http://www.nmclimatechange.us/ewebeditpro/items/O117F10150.pdf>

³ Id. Appendix H-43-H-46.

⁴ David Hawkins and George Peridas, "No Time Like the Present: NRDC's Response to MIT's 'Future of Coal' Report," p. 4 (2007).

⁵ New Mexico Climate Change Advisory Group, Final Report, Appendix D-5 (December 2006).

⁶ Id., Appendix D-20.

⁷ MIT Interdisciplinary Study, "The Future of Coal: Options for a Carbon-Constrained World," p. x (2007).

⁸ *IPCC Special Report on Carbon dioxide Capture and Storage* (2005) p. 246.

While CO₂ has been injected into various geologic formations in New Mexico for decades for enhanced oil recovery and acid gas disposal, the idea of permanent CO₂ storage, or sequestration, for the purpose of mitigating global climate change is a fairly novel one with few commercial-scale prototypes upon which to draw guidance in the development of a regulatory framework. To date, there exist no comprehensive regulatory models that address the unique long-term measurement, monitoring and verification requirements, or the liability and property rights issues such a comprehensive and large-scale effort presents. There are, however, numerous useful analogs, mostly developed in the oil and gas fields and by oil and gas regulatory agencies that can serve as models. Similarly, current federal environmental regulations offer useful models for controlling and assigning liability.

Current estimates suggest that New Mexico has a CO₂ storage capacity of 6 gigatons in its oil and gas fields and roughly twice that capacity within the state's deep saline aquifers.⁹ As a consequence, oil and gas reservoirs, and more specifically enhanced oil recovery, are expected to ultimately play a relatively small role in carbon sequestration. But because the infrastructure for CO₂ injection is already largely in place in oil and gas fields, and because of the potential market interest and synergy with enhanced hydrocarbon recovery and the known geology of those fields, oil and gas fields will likely be among the first commercial-scale sequestration targets in the state.

Primary considerations in the development of CO₂ sequestration regulations are to reduce the effects of climate change by ensuring the permanent geologic sequestration of anthropogenic CO₂, to protect human health and the environment, groundwater supplies, property interests, and to avoid disturbing current CO₂ injection and enhanced oil recovery practices.

Any CO₂ sequestration program must achieve the protection of underground drinking water sources required under the U.S. Environmental Protection Agency's Underground Injection Control Program (UIC), which is managed in the state by the OCD and the New Mexico Environment Department (NMED). OCD has developed proposed regulations tailored to ensure safe and effective CO₂ sequestration while complying with EPA's UIC program requirements. OCD contemplates coordinating with appropriate regulatory agencies, both state and federal, to achieve optimal protection of human health and the environment under any CO₂ sequestration framework that is ultimately adopted.

Before advancing to statutory and regulatory issues raised by proposed CO₂ sequestration, a review of some important concepts will serve as useful background for understanding the policy implications any regulatory framework for the sequestration of carbon dioxide may have.

Potential Current and Future Interference with Subsurface Interests

Sequestration of CO₂ in the subsurface geology, while identified as a viable and important means of mitigating climate change and greenhouse gas emissions, will also invariably lead to potential conflicts with other subsurface interests, such as the mineral estate (oil, gas and coal)

⁹ David Borns, Underground Storage Technology Program Manager, Sandia National Laboratories, personal communication.

and associated interests, groundwater users and surface ownership (who are owners of the subsurface geologic formations and pore spaces). Given the areal extent and long timeframes required for sequestration of CO₂ – on the order of hundreds to thousands of years – consideration must also be given to the future discovery of subsurface minerals or the ascendant value of currently non-economic resources, such as saline waters, that might conflict with CO₂ sequestration.

Ownership of Geologic Formation/Pore Space & the Right to Sequester

Related to the concept of CO₂ ownership is the property rights issue of the ownership of the target pore space and the right to sequester CO₂. In New Mexico, the common law on this issue is somewhat unsettled as no case directly tests theories of pore space ownership. However, several cases from the New Mexico Supreme Court indicate preference for the majority view among states that the pore space and subsurface geologic formation belongs to the surface owner, not the mineral estate.

There are essentially two competing theories that ultimately define the liability of CO₂ injectors in relation to pore space owners.

One legal theory, not widely adopted, is the “reverse” or “negative rule of capture,” which holds that just as an owner may capture such oil or gas that migrates from adjoining property to a well on his own land under the “rule of capture,” so may he inject into a formation substances which might migrate to the property of others. Under this rule, liability for the migration of injected substances is essentially limited in preference for policies encouraging enhanced hydrocarbon recovery, or, as in this case, possibly in preference for policies encouraging the mitigation of climate change through sequestration of CO₂.

This approach may be justified by positing that sequestration of CO₂, and the consequent reduction of greenhouse gas emissions, is a public benefit, or a mitigation of a public nuisance. A likely impediment to this approach is the 5th Amendment of the U.S. Constitution, which provides that no property shall be taken for public use without just compensation. Assuming that the pore space containing the mineral estate is the property of the surface owner and not the mineral estate, this property right presents problems for the application of the negative rule of capture because the non-consensual occupation of privately held space is considered a taking.

The alternative, and more widely adopted theory, is that an injector is liable to the surface owner for any provable subsurface trespass or nuisance he may commit. As the majority of states hold that the subsurface geologic structures – including the pore space as distinct from the mineral estate – belongs to the surface property owner, an injector of CO₂ must acquire the right to access and sequester CO₂ from the appropriate surface owner(s) or face liability for trespass, nuisance, or numerous other possible tortious or equitable claims.

Rights to sequester can be acquired either through negotiation, or ultimately by means of condemnation proceedings pursuant to the state’s powers of eminent domain. This concept addresses the important distinction between the rights of the pore space owner and the mineral

estate, which are two separate interests, even though they may share the same geologic strata. Generally, the mineral interest, being fugacious, is limited to the minerals themselves, whereas the pore space interest includes the sand, and gravel, etc., which comprise the geologic formation, but do not extend to the hydrocarbons occupying the interstices.

A minority view is that a severance of the mineral estate should be construed as granting exclusive rights to the subterranean strata for all purposes relating to minerals, whether “native” or “injected,” absent explicit language to the contrary in the severance of the mineral estate. This view would eliminate the problem of having to secure storage rights from the surface owner, but it is a minority view, and may not withstand a constitutional takings challenge.

Long-term Liability

Drawing from current oil and gas practices, the short-term liabilities inherent in any drilling or injection project – whether environmental or economic – can likely be best addressed through the contractual arrangements between generator and injector, as they are now. But liabilities following the injection and closure phases of projects present a unique problem given the anticipated scale, both in terms of time (hundreds to thousands of years) and space, required for successful CO₂ sequestration and accurate CO₂ inventories. For example, literature and studies to date on the topic suggest that wells and boreholes will present the most common risk of leakage.

Because of the breadth and depth of the unknowns over the long time scales anticipated necessary for successful CO₂ sequestration, transfer of liability to the public sector has been conceived of as one way to encourage the development of sequestration projects by limiting potential liabilities. But this liability model also raises many issues, such as how to control the burden on the public and how to fund monitoring and verification efforts, as well as any potential long-term mitigation that may be required.

The alternative would be to require the injector to retain liability in combination with a fund or some other financial assurance mechanism to ensure the storage field is adequately covered for long-term monitoring and verification purposes, as well personal and property liability. Several pre-existing models culled from federal environmental statutes and regulations present workable examples of how this might be accomplished.

In considering implementation of a liability system in which the injector would retain liability, public confidence and safety, as well as environmental protection should be foremost considerations given the scale of the anticipated injections and the potential the unknowns of such a new technology.

Identified Statutory Issues

To address the potential conflicts and uncertainties outlined above, several statutory and regulatory changes are anticipated.

Authority to Regulate Carbon Sequestration

Issue:

OCD would need to have clear authority to regulate the sequestration of anthropogenic CO₂ into all potential geologic reservoirs, not limited to oil and gas, for purposes of long-term/permanent sequestration. In the case of oil and gas reservoirs, the OCD may require the authority to dissolve or modify previously established field(s) or producing unit(s) contained within the boundaries of the proposed carbon storage field.

Analysis:

OCD currently has authority under NMSA 70-2-6 and 70-2-11 to regulate the injection/sequestration of CO₂ into oil and gas reservoirs for the purposes of enhancing hydrocarbon recovery, prevention of CO₂ waste, and for disposal. OCD also has the authority under NMSA 70-2-12.B(21) to require that CO₂ be injected, even after the possibility of enhanced production has elapsed, to prevent the waste of CO₂ that would otherwise be vented. Further, OCD also has the authority to regulate naturally occurring CO₂ and require sequestration/injection not limited to oil and gas reservoirs if the CO₂ is a product of or used in oil and gas operations. However, there exists no clear authority for the Division to regulate anthropogenic CO₂ injection for sequestration purposes alone, nor does it have general authority to regulate injection/sequestration of CO₂ not produced in oil and gas operations into reservoirs other than those of oil and gas.

Because oil and gas reservoirs are anticipated to ultimately constitute only a small fraction of the total sequestration volumes in New Mexico, clear authority to regulate the sequestration of anthropogenic CO₂ into all potential geologic reservoirs, not limited to productive oil and gas reservoirs, for purposes of long-term/permanent sequestration is essential to any regulatory framework for commercial-scale geologic sequestration.

OCD is believed to be the proper entity for such authority given its institutional and technical expertise in drilling, deep-well injection, and its current regulatory oversight of ongoing carbon dioxide injection projects. Further, it is believed that the earliest carbon sequestration projects will probably take place in depleted oil and gas reservoirs given existing infrastructure, knowledge of the target reservoirs and a proven ability to contain gases over geologic timescales, as well as the industry's expertise in injection and CO₂.

Ownership of Pore Space/Geologic Formation

Issue:

No statutory language currently exists defining the extent of surface owner property rights with respect to the geologic formation or the pore space within it. New Mexico common law in this area remains largely undeveloped because the question of ownership of the formation or pore space has not been directly tested in the courts. However, several cases from the New Mexico Supreme Court indicate preference for the majority view among states that the pore space and subsurface geologic formation belongs to the surface owner. A majority of jurisdictions, including a preponderance of oil and gas producing states, follow this common-law American rule. A consequence is that any large-scale CO₂ sequestration effort will likely require the acquisition of underground storage rights from surface owners by negotiation or condemnation.

Issues Raised During the Workgroup:

- Is it possible for the state to claim ownership of the pore space as part of the public domain for a beneficial use (e.g. similar to common law rules guiding aquifer recharge)?
- Any proposed regulatory framework should protect the future interests of mineral interest holders – injection of CO₂ may impede or prevent future technologies from extracting currently non-economic hydrocarbons, so these future interests must be protected.
- Currently, injection of CO₂ for enhanced oil recovery is considered part of the mineral lease operations and does not require the consent of the pore space owner – at what point does CO₂ injection become storage and require acquisition of storage space rights?
- Any sequestration regulatory framework must include but not be limited to hydrocarbon reservoirs and contain provisions for injection into other formations, such as saline aquifers.

Analysis:

Pore space for CO₂ sequestration has been identified in three major reservoir types, each with similar ownership interests:

- Depleted Oil & Gas Reservoirs

Pore space evacuated by the extraction of oil and gas minerals likely belongs not to the mineral interest, but to the surface owner, who would have the sole power to grant storage rights for the purpose of sequestering carbon dioxide. New Mexico case law does not address the question of storage rights directly, but does hold that the mineral interest does not include the solids of the earth. The holdings of several other cases reinforce that New Mexico retains a preference for the majority view that the mineral estate includes only the oil and gas native to the formation, and not rights to the formation or the pore space itself, unless the conveyance or severance of the mineral estate explicitly states otherwise. Therefore, the surface owner likely retains possession of the pore space/geologic formation and the sole right to store non-native gas in the evacuated space, but perhaps only after the mineral estate has been removed or depleted.

In general, case law holds that the mineral interest retains the right to access by reasonable means subsurface minerals as long as there are recoverable minerals remaining to be extracted and as long as there has been no abandonment, but that the right to the pore space/geologic formation reverts to the surface owner once the minerals have been depleted. *Westerman v. Pennsylvania Salt Mfg. Co.*, 260 Pa. 140, 146 (1918). In *Westerman*, the Supreme Court of Pennsylvania held that the coal mining interest had “no perpetual right of way” through the land and that “its right will cease when the coal therein is exhausted or abandoned.” *Westerman*, 260

Pa. at 146. Years later, the West Virginia Supreme Court of Appeals ruled in accordance, holding that the evacuated space following mineral extraction remains the property of the surface owner. *Tate v. United Fuel Gas Co.*, 137 W.Va. 272, 282, 71 S.E.2d 65, 72 (1952) (“as long as there remain recoverable minerals which are mined in good faith, the space may be used by the owner of the minerals”).

While there had been division among jurisdictions as to the extent of the surface owners rights vis-à-vis the mineral estate owners (*compare Tate, supra*, (holding that when there are no recoverable minerals remaining, the mineral interest has no “right to use the space” in the geologic formation which is property of the surface owner) *with Central Kentucky Natural Gas Co. v. Smallwood*, 252 S.W.2d 866 (1952) (holding that the mineral interest owner, not the surface owner, has authority to grant a gas storage lease)), a majority position seems to have taken hold following the ruling in *Emeny v. United States*, 188 Ct.Cl. 1024, 412 F.2d 1319 (1969), which held that the surface owner retains ownership of the evacuated pore space. In *Emeny* the court found that “[t]he surface of the leased lands and everything in such lands, except the oil and gas deposits covered by the leases, were still the property of the respective landowners according to the language of the mineral conveyance. Property retained by the landowner included the “geological structures beneath the surface, including any such structure that might be suitable for the underground storage of ‘foreign’ or ‘extraneous’ gas produced elsewhere.” *Emeny*, 412 F.2d at 1323. See *Ellis v. Arkansas Louisiana Gas Co.*, 450 F.Supp. 412 (E.D. Okla. 1978) *aff’d* 609 F.2d 436 (10th Cir. 1979) (holding that it is the surface owner’s power to grant storage rights and that it is “the American view is that the cavern is owned by surface owners”); *Southern Natural Gas Co. v. Sutton*, 406 So.2d 669 (La. App. 2nd Cir. 1981) (“Surface ownership, however, includes the right to use the reservoir underlying ... for storage purposes”); *Department of Transportation v. Goike*, 560 N.W.2d 365, 365-366 (Mich. Ct. App. 1997) (holding that subterranean storage space, once it has been evacuated of the minerals and gas, belongs to the surface owner and that a mineral right is a right to the minerals themselves, not to the land surrounding the minerals); *Pomposini v. T.W. Phillips Gas & Oil Co.*, 580 A.2d 776 (1990) *aff’d sub nom. Keppel v. Fairman Drilling Co.*, 615 A.2d 1298 (1992) (“the right to extract gas did not include the right to use the cavernous spaces owned by the lessor for the storage of gas in the absence of an express agreement therefore”); M.J. Harvey, Jr., 109 IBLA 31 at 33, GFS (O&G) 1989-75 (May 25, 1989) (to the extent that no valuable minerals underlay the tract in question, the owner of the surface estate rather than the owner of the mineral estate owned the non-mineral strata); and Phillips Petroleum Co., 105 IBLA 345, GFS (O&G) 1989-9 (Nov. 17, 1988) (operator who had consent of surface owner but not of mineral owner was entitled to use a dry hole as a salt water injection well). It is possible to read the holding of *Emeny* narrowly, as turning on the language of the lease, and not a general proclamation that the pore space is absolutely retained by the surface owner. Since *Emeny*, this paradigm of subsurface interest has become well established for cases where the intent of the original conveyance did not clearly include the subsurface geologic formation/pore space.

However, the rights of the surface owner to the geologic formation appear to be qualified by any persistent rights of the mineral estate, which survive as long as there remain minerals to extract and the interest has not been abandoned. In the New York case of *International Salt Co. v. Geostow* the court found that the surface owners were precluded from executing a waste storage

contract with a third party to use the excavated space created by the salt mining activities, as there still remained minerals in place and International Salt Co. required use of the previously mined sections as a means of access to the un-mined portions of their mineral property. *International Salt Co.*, 878 F.2d 570, 575 (2nd Cir. 1989) (“[A] grantee of subsurface minerals, until exhaustion of the mine, has the exclusive right to use the excavated chamber in connection with its mining activities”). The court relied on an earlier case to hold that the mineral owner’s interest in the location of the minerals “reverts to the surface landowner by operation of law at some time subsequent to removal of the [minerals].” *Id.* (quoting *United States Steel Corp. v. Hoge*, 503 Pa. 140, 148, 468 A.2d 1380, 1384 (1983)) (internal quotations omitted). Citing *Westerman and Tate*, *supra*, the *International Salt Co.* court indicated preference for a definition of exhaustion “when no ‘mineable’ or ‘recoverable’ minerals remain.” *Id.* In the recent case of *Goike*, *supra*, the Michigan Court of Appeals appears to have clarified this issue somewhat in holding that while “[a] surface owner possesses the right to the storage space created after the evacuation of underground minerals or gas ... [the] mineral estate holder may ‘store’ any fluid minerals or gas native to the chamber that has not yet been extracted, [but] they cannot introduce any foreign or extraneous minerals or gas into the chamber. Only the surface owner possesses the right to use the cavern for storage of foreign minerals or gas, and then only after defendants have extracted the native gas from the cavern.” *Goike*, 560 N.W.2d at 366.

A survey of case law through 1986 revealed the trend among jurisdictions toward recognizing in the surface owner the exclusive rights to the subsurface formation and pore space had, by that point, already been well established among most jurisdictions. Fred McGaha, *Underground Gas Storage: Opposing Rights and Interests*, 46 La. L. Rev. 871, 873 (1986). McGaha attributed this paradigm in both case law and legal thinking to an increase in the scientific understanding of the nature of minerals and of geology. Early understanding suggested that minerals had the potential to migrate freely beneath the surface, so that once extracted “the depleted reservoir may one day be refilled by one of these migrating fluids.” 46 La. L. Rev. at 876; see *Hammonds v. Central Kentucky Natural Gas*, 75 sw2d 204, 204 (ky ct app 1934); *Central Kentucky Natural Gas Co. v. Smallwood*, 252 sw2d 866 (Ky. Ct. App. 1952) (“the geological formations or strata common to this class of minerals may be exhausted a thousand times and the mineral owner still retain the exclusive rights to take all the minerals which find their way into the formation, whether through injection or in any other way”). But as McGaha explained:

For this reason, in the past it was recommended that storage companies acquire the interests of mineral owners as to any remaining oil or gas and also as to any future migrating minerals. ... We now realize that minerals are locked in non-permeable container-like formations and do not freely flow through underground rivers, making it unnecessary to protect a mineral owner’s interest in a depleted reservoir. It is not going to refill absent a geological event connecting two underground reservoirs. Since the surface owner owns the land ‘from core to crust’ it only makes sense that he, rather than the mineral owner, owns depleted reservoirs. The ‘container’ in which minerals are locked should not be considered a part of the mineral estate.

Id. (citations omitted).

The opposing minority view is most clearly articulated in *Smallwood, supra*, and endorsed by the authors of Williams & Meyers, *Oil and Gas Law*. In *Smallwood*, which was overruled by *Texas American Energy Corp. v. Citizens Fidelity Bank & Trust Co.*, 736 S.W.2d 25 (Kentucky S. Ct. 1987), on a different issue, the court held that it is the mineral interest that has the right to assign or convey storage rights to the pore space or geologic formation, not the surface owner. *Smallwood*, 252 S.W.2d at 868 (“We conclude that the mineral rather than the surface owner is entitled to the rental or royalty accruing under a gas storage lease”). While acknowledging the counterargument based on the ancient legal principle of “Cuius est solum, eius est usque ad coelum et ad inferos” (*for whomsoever owns the soil, it is theirs up to the sky and down to the depths*), especially in situations where strata have been depleted of oil and gas or never contained recoverable minerals, Williams & Meyers urges adoption of the view that severance of minerals from the surface estate “should be construed as granting exclusive rights to the subterranean strata for all purposes relating to minerals, whether “native” or “injected,” absent contrary language in the instrument severing such minerals.” W&M 1:222, p.334-335.

Somewhat in support of this minority view, the Ohio court and more recently the Colorado court, for example, have for different reasons placed limits on the rights of the surface owner to the subsurface pore space below with the qualification by the deciding courts that the particular facts in each case were not appropriate for the application of oil and gas law. In *Chance v. BP Chemicals*, 670 N.E.2d 985 (Ohio 1996) the defendants/appellees were injecting waste byproducts from the production of industrial chemicals, unrelated to oil and gas production, which plaintiffs/appellants alleged damaged the substrata, making it unusable for other purposes. *Chance*, 670 N.E.2d at 989. As such, the court declined to apply various rules developed from oil and gas cases (e.g. the negative rule of capture and the determination of compensation based on appropriation of underground gas storage), “around which a special body of law has arisen on special circumstances not present here.” *Id.* at 991. But most significantly, the court limited the rights of the surface owner to the pore space below, holding that “subsurface ownership rights are limited ... [c]onsequently, we do not accept appellants’ assertion of absolute ownership of everything below the surface of their properties.” *Id.* at 992. In limiting surface ownership rights, the court looked to *Willoughby Hills v. Corrigan*, 29 Ohio St.2d 39, 49, 58 O.O.2d 100, 105, 278 N.E.2d 658, 664 (1972), which cited *United States v. Causby*, 328 U.S. 256, 66 S.Ct. 1062, 90 L.Ed. 1206 (1946), to state that the doctrine of “Cuius est solum” “has no place in the modern world.” *Id.* at 991. The Ohio court also extended the reasoning of *Hinman v. Pacific Air Transp.*, 84 F.2d 755, 758 (C.A. 9, 1936) (“We own so much of the space above the ground as we can occupy or make use of, in connection with the enjoyment of our land”) to apply equally to below-ground interests. *Id.* at 991-992. The Ohio court in *Chance*, however, recognized that appellants did have a limited property interest in the rock into which the injectate was placed, so that injectors could be liable in situations where there is demonstrable interference with the surface owner’s “reasonable and foreseeable use of their properties.” *Id.* at 992 (emphasis added). Thus, the court held, “appellants [had] the burden of establishing that the injectate interfered with the reasonable and foreseeable use of their properties.” *Id.* at 993.

Colorado recently similarly extended the reasoning of *Willoughby Hills* “to apply as well to ownership of subsurface rights” in a case where appellants alleged trespass following the injection of water for aquifer recharge. *Bd. of County Comm'rs v. Park County Sportsmen's*

Ranch, 45 P.3d 693, 701 (Colo. 2002). The Colorado supreme court held that “[w]ater is not a mineral” and, as in *Chance*, that “[t]he law of minerals and property ownership ... is inapplicable” to the particular situation. *Id.* at 710. Relying on distinctions between water law and oil and gas law derived from the Colorado constitution, water law statutes and legislative intent, as well as from state common law, the Colorado court distinguished the application of water law from that of oil and gas law. Specifically, the court found that the legislature, “in authorizing the use of aquifers for storage of artificially recharged waters ... has ... supplanted the Landowners’ common-law property ownership theory.” *Id.* at 703. The court then found that based on the state’s constitution, statutes and case law “neither surface water, nor ground water, nor the use rights thereto, nor the water-bearing capacity of natural formations belong to a landowner as a stick in the property rights bundle,” but do belong to the legitimate holders of water use rights. *Id.* 707, 710. Further, the project in *Sportsmen’s* included “constructed wells, dams, recharge reservoirs, and other water works,” but the project did not include “the location of any *artificial* features on or in the Landowners’ properties,” which, the court held, meant that no consent was required, that an easement or just compensation was unnecessary, and that no trespass occurred “simply as the result of water moving into an aquifer and being contained or migrating in the course of the aquifer’s functioning underneath the lands of another.” *Id.* at 713-714 (emphasis added). The court reasoned that “[t]his construction of the Colorado constitution and statutes implements Colorado’s policy that water is a public resource available for public agency and private use in a system of maximum utilization for beneficial use under decreed rights,” because:

Allowing property owners to control who may store water in natural formations, or charging water right use holders for easements to occupy the natural water bearing surface or underground formations with their appropriated water, would revert to common-law ownership principles that are antithetical to Colorado water law and the public's interest in a secure, reliable, and flexible water supply made available through the exercise of decreed water use rights. It would disharmonize Colorado's historical balance between water use rights and land ownership rights. It would inflate and protract litigation by adding condemnation actions to procedures for obtaining water use decrees. It would counter the state's goals of optimum use, efficient water management, and priority administration.

Id. at 714.

Thus, the Ohio and Colorado courts stand for the fairly unique propositions that subsurface rights can be limited by the extent to which the surface owner has a reasonable and foreseeable use that would be or has been demonstrably impeded by the injector, and that there is no action for trespass in the case of injected water when there is no artificial structure on the property of the landowner and the injected water has been decreed to be a beneficial resource to the public domain.

In New Mexico, where storage of natural gas in the subsurface is not a common practice and the

law on this point is less than fully developed, the early case of *Jones-Noland Drilling Co. v. Bixby*, 282 P. 383 (1929) seems to have established in New Mexico the holding that the mineral estate is limited and does not include rights to the geologic formation. Specifically, the Supreme Court of New Mexico held that the oil and gas lease conveys the right to ingress and egress to explore for, discover, develop and remove oil and gas only. And while the mineral interest is a real estate interest, “it does not convey a greater interest in the soil, except the oil and gas, than to enable the owner of the lease to use the soil in carrying out and availing the leases of the above-named rights.” *Id.* at 383. Therefore, “[t]he lessee is not the owner of the solids of the earth ... and merely has the right to use the solid portion so far as necessary to bore for, discover, and bring to the surface oil and gas.” *Id.*

While no New Mexico case law is directly on point, several cases do comport with *Bixby* and imply a strong preference for the majority position that subsurface pore space is strictly a surface interest by acknowledging that an action for subsurface trespass is available to surface owners. In *Snyder Ranches, Inc. v. Oil Conservation Comm’n of New Mexico*, 110 NM 637, 798 P.2d 587 (NM 1990), for example, Mobil had acquired authority from the New Mexico Oil Conservation Division to inject salt water through a disposal well into an underground formation on land adjoining the plaintiff. *Snyder Ranches, Inc.*, 798 P.2d at 588. Expert testimony established that a “sealing fault line” would block the further migration of the salt water and that the fault line and plaintiff’s boundary line merge at some point. *Id.* at 590. Plaintiffs alleged that this merger indicates Mobil’s injected salt water would encroach upon their subsurface property, thereby constituting trespass, but “[t]he fact that the fault line and the boundary line merge at a particular point does not mean that the fault line encompasses land beyond the boundary line.” *Id.* at 589. Because of this evidentiary problem the plaintiffs were unable to prove trespass, nonetheless, the *Snyder Ranches* court went on to state in dicta that Mobil could be held liable for actual subsurface trespass on account of its injected salt water if trespass could ever be proven, even though such injection was authorized and licensed by the Oil Conservation Division. *Id.* at 590.

Subsequently, in *Hartman v. Texaco Inc.*, 1997-NMCA-032, 123 N.M. 220, 937 P.2d 979 (NM Ct. App. 1997), plaintiff alleged common law trespass and statutory trespass when injected water caused a blowout in his well. The lower court ruled in the plaintiff’s favor on the common law trespass claim, but ruled against the plaintiff on the statutory trespass claim; the New Mexico Court of Appeals affirmed both holdings. *Id.* at 982-983. The court made clear that New Mexico recognizes that “an action for common law trespass does provide relief for trespass beneath the surface of the land ... [so] we do not disturb [that decision] on appeal.” *Id.* at 983 (citing *Schwartzman Inc. v. Atchison, Topeka & S.F. Ry.*, 857 F.Supp. 838, 844 (D.N.M.1994) (trespass for pollution of groundwater); *Lincoln-Lucky & Lee Mining Co. v. Hendry*, 9 N.M. 149, 155, 50 P. 330, 332 (1897) (subsurface trespass by mining shaft); Restatement (Second) of Torts § 159 (1965)); see also *McNeill v. Rice Engineering*, 139 N.M. 48, 128 P.3d 476, 2006 -NMCA- 015 (2005). The statutory trespass claim was held inapposite because “[n]othing in the statute indicates that the legislature envisioned applying [the statute] to a subsurface trespass by injected water...” *Id.* at 984.

While no case law appears to extend the reasoning of *Chance* and *Sportsmen’s* to oil and gas

law, it seems that the reasoning employed could be applied to carbon dioxide sequestration, because most surface owners make no use of their subsurface pore space and demonstrating damage, harm or interference with the surface owner's reasonable and foreseeable use and enjoyment could prove challenging. Adopting this argument to carbon dioxide sequestration would probably require the legislature to include careful language in the authorizing statutes establishing the public benefit of carbon dioxide sequestration. A declaration of public benefit, coupled with a putative lack of demonstrable harm and possibly an argument that anthropogenic carbon dioxide injected into the subsurface becomes part of a subsurface stream of native gases, could be employed as a means to avoid having to condemn pore space and pay just compensation to surface owners for the right to use the pore space. The benefit of this approach would be to avoid the expense, time, and challenge of acquiring all the necessary pore space storage rights from respective surface owners. As the areal extent of carbon dioxide sequestration units is expected to be quite large, the number of landowner interests may make the process cumbersome and slow. As in *Sportsmen's*, common-law ownership principles applied to the pore space could be seen as "antithetical" to the public's interest in a secure, reliable and efficient process for the injection and sequestration of carbon dioxide.

On the other hand, storage space costs should be nominal, especially early in the development of carbon sequestration, and any legislative action that does not provide for compensation or legal condemnation of what is arguably a valid property interest poses a significant constitutional takings challenge. Ultimately, the volume of case law establishing a surface owner's property interest in subsurface pore space and the 5th Amendment of the U.S. Constitution's "takings" clause recommend the less controversial option of pursuing legitimate condemnation of the pore space interests through just compensation. Also, a powerful policy argument stands against a wholesale abrogation of landowner subsurface rights because of their inherent and historic value, as discussed by Steven D. McGrew, *Selected Issues in Federal Condemnations for Underground Natural Gas Storage Rights: Valuation Methods, Inverse Condemnation, and Trespass*, 51 Case W. Res. L. Rev. 131, 147 (Fall 2000). This argument is discussed in more detail in the section on subsurface trespass below.

- Saline Aquifers

Comprising the largest potential storage volume in New Mexico, saline aquifers will present significantly greater costs, technological problems and geologic unknowns than sequestration in depleted oil and gas reservoirs. For these reasons, it is believed that sequestration in deep saline aquifers will evolve after sequestration in depleted hydrocarbon reservoirs. However, any statutory and regulatory system must address the complexities of storage in saline aquifers.

All ground waters of the state of New Mexico are statutorily declared to be public waters, belonging to the state and as such are subject to appropriation for beneficial use. However, the Office of the State Engineer does not have authority to regulate the appropriation of waters found at depths greater than 2,500 feet and in concentrations in excess of 1,000 parts per million (ppm) dissolved solids. While the waters themselves may be appropriable and within the public domain, the aquifer storage space is not in the public domain, but is the property interest of the surface estate.

NMSA 72-12-1 and 72-12-18 both declare for different purposes that ground waters belong to the public and are subject to appropriation for beneficial use. The predecessors of these statutes were held constitutional in *Yeo v. Tweedy*, 34 N.M. 611, 286 P. 970 (1929) and in *State ex rel. Bliss v. Dority*, 55 N.M. 12, 225 P.2d 1007 (1950). In *Dority*, the New Mexico Supreme Court established that appropriation of public waters was not limited to waters “upon the public lands” because “water of underground rivers with defined banks have always been subject to appropriation” and so the state statute clearly meant to sever water ownership to the public domain ownership of the land. *Dority*, 225 P.2d 1007, at 1017 (emphasis added).

However, while all ground waters of the state are within the public domain, not all ground waters fall within the jurisdiction of the state engineer. In *Tweedy*, the court determined that before the state engineer can assume jurisdiction over underground water bodies “he must find that they have boundaries reasonably ascertained by scientific investigations, or by surface indications.” *Tweedy*, 286 P. 970, 976. Nonetheless, the current statute makes clear that “[n]o past or future order of the state engineer declaring an underground water basin having reasonably ascertainable boundaries shall include water in an aquifer, the top of which aquifer is at a depth of twenty-five hundred feet or more below the ground surface at any location at which a well is drilled and which aquifer contains non-potable water.” NMSA 72-12-25. “Non-potable water,” for the purpose of this act, means water containing not less than 1,000 ppm of dissolved solids. NMSA 72-12-25.

While the water itself is in the public domain, the aquifer which holds it is not. “Absent proof of some possessory ownership interest in land ... the State has no legally cognizable interest in the aquifer ...” *New Mexico v. General Elec. Co.*, 335 F.Supp.2d. 1185, 1205 (D.N.M. 2004) aff’d *New Mexico v. General Elec. Co.*, 467 F.3d 1223 (10th Cir. 2006). In *General Electric*, New Mexico brought suit to recover alleged damages to an aquifer from subsurface contamination, alleging contamination damaged both groundwater and the aquifer itself. *Id.* at 1211. But the court found that “[i]n contrast to the state’s water resources ... the New Mexico Constitution and statutes do not speak of permanent State ownership or trusteeship of *all* of the soils, clay, sand, gravel, rocks and minerals within the state—the geological constituents of which any aquifer is comprised.” *Id.* at 1203. That question – “[w]hether the State has retained an ownership or trust interest in the minerals, including sand and gravel, underlying parcels of state land that have been sold and conveyed to others is a fact-specific determination under New Mexico law, and is not determined by a blanket state property law rule.” *Id.*

Instead, the courts look to the ownership of the surface and its soils, but in *General Electric* found that the state cited neither statutory nor case authority to support their assertion that the state owned the aquifer as a natural resource in the same sense that it owned in trust the public’s water. *Id.* at 1203-1204. The court held that “unless the State claims some proprietary interest in the land or the aquifer’s subsurface geologic materials as a landowner or title holder, then it would seem that the chemical contamination of those geologic materials impacts the State’s interests in groundwater only when it results in further groundwater contamination.” *Id.* 1204. Absent such proof of ownership, the court held the state had no property interest in the aquifer storage space or the geologic formation itself. *Id.* at 1205. This holding was subsequently

affirmed by the 10th Circuit, which found that “the State as guardian of the public trust has no possessory interest in the sand, gravel, and other minerals that make up the aquifer – a necessary requisite to maintaining a trespass action.” *Id.* 1248.

Lacking ownership of the surface or some express property interest in the geologic formation itself, the state, therefore, has no property interest in the storage space contained within New Mexico aquifers, the ownership of which appears to abide by the same property rules discussed above in the analysis of oil and gas reservoirs. Consequently, barring the alternative approach discussed above, acquisition of storage rights, by negotiation or condemnation, would also seem to be required for sequestration of carbon dioxide in deep saline formations. Also, the Office of the State Engineer appears to have no authority over saline aquifers deeper than 2,500 feet and which contain total dissolved solids in excess of 1,000 ppm.

- Deep Coal Seams

The third likely reservoir type identified for sequestration of CO₂ are unminable coal seams. Like depleted oil reservoirs, CO₂ storage in coal seams will, under some conditions, provide enhanced hydrocarbon recovery. There are, however, additional technical challenges that must be addressed before any large scale sequestration project in coal seams is advanced. It is expected that the legal issues with regard to pore space will be highly analogous to those identified for other subsurface reservoirs, discussed above.

- Subsurface Trespass

As a consequence of the expected subsurface ownership theory, subsurface trespass becomes a significant issue that must be considered for subsurface injection plans.

New Mexico recognizes the action of subsurface trespass but requires that there be demonstrable proof of physical infringement by a person or thing that results in damage. Consequently, the negative rule of capture – the theory derived from oil and gas law that just as a landowner may capture what minerals may migrate from adjoining lands to a well bottomed on his own land, so may he inject into a formation substances that may migrate through the subsurface to the land of others – is disfavored in New Mexico, as it has been similarly viewed with disfavor in other jurisdictions. Therefore, in the operation of carbon dioxide sequestration, landowners who successfully demonstrate a physical subsurface infringement into their property resulting in damage will likely be successful in bringing a trespass action against injectors, unless available remedies are statutorily limited to, for example, inverse condemnation. Such a legislative limitation of the available remedies could have a significant economic impact on carbon dioxide sequestration by limiting the liability of carbon dioxide injectors, because punitive damages are generally not available in inverse condemnation actions, only compensatory damages. The law of subsurface trespass has not developed much beyond basic first-order questions in New Mexico, so the law of other jurisdictions must serve as a guide for more complex subsurface trespass issues.

Other possible causes of action available to surface owners in response to the intrusion of carbon dioxide into their subsurface space include negligence, private nuisance for non-physical infringement that affects the use and enjoyment of property (currently recognized as a cause of action in New Mexico only when no other theories of recovery are available, but the New Mexico Supreme Court is currently scheduled to review this holding, so the law may change), conversion (money paid to injectors, a portion of which should have been paid to the landowner for rental of the pore space for storage), and unjust enrichment (gaining the value of the storage space without having to pay for it). Surface owners may also opt to waive the tort of trespass and sue under *assumpsit*, on the theory that by injecting into the subsurface the injector assumes an implied contractual duty to pay rental for the right to inject into the subsurface. This latter option, similar to unjust enrichment, may be employed in situations where trespass damages are more difficult to establish. The following analysis, however, deals only with the claim of subsurface trespass.

New Mexico courts have held that trespass is a direct physical infringement of another's right of possession, *Schwartzman, Inc. v. Atchison, Topeka & Santa Fe Ry. Co.*, 857 F.Supp. 838, 844 (D.N.M. 1994) (citations and internal quotations omitted), and that a trespass may be committed on or beneath the surface of the earth. *Id.* (citing Restatement (Second) of Torts § 159 (1977)); see *Hartman v. Texaco Inc.*, 1997-NMCA-032, 123 N.M. 220, 937 P.2d 979 (NM Ct. App. 1997) (“[I]n New Mexico an action for common law trespass does provide relief for trespass beneath the surface of the land”); *Snyder Ranches, Inc. v. Oil Conservation Comm’n of New Mexico*, 110 NM 637, 798 P.2d 587, 590 (NM 1990) (stating in dicta that nothing would prevent plaintiff seeking redress for actual trespass resulting from injection operations).

Subsurface trespass claims are limited to common-law actions, the courts having determined that statutory trespass is limited by legislative intent to surface trespass. *Hartman*, 937 P.2d at 984. Owing to the requirement for direct physical infringement, the New Mexico courts appear to require a showing of damage for subsurface trespass claims as evidence of infringement, *Schwartzman*, 857 F. Supp. at 844 (“the groundwater contamination must have reached Plaintiff’s property and damaged it”), which is contrary to the guidance provided by the Restatement (Second) of Torts (“One is subject to liability to another for trespass, irrespective of whether he thereby causes harm to any legally protected interest of the other, if he intentionally enters land in the possession of the other, or causes a thing or third person to do so”). § 158 (1965). In explaining the general rule, the Restatement (Second) of Torts suggests that for indirect trespass, as when an actor causes a thing to infringe upon another’s property, that “[i]t is enough that an act is done with knowledge that it will to a substantial certainty result in the entry of the foreign matter.” § 158 cmt. h. Whether this divergence from the general rule expressed in *Schwartzman* is actually the court’s holding or whether the court merely equated proof of damage to groundwater to proof of direct physical infringement of the subsurface is unclear. Whichever the case, New Mexico courts do require direct evidence, beyond affidavits or testimony of experts, to demonstrate physical infringement. *Schwartzman*, 857 F. Supp. at 845 (“the only evidence of physical contamination...is based on the opinions of Plaintiff’s experts,” but plaintiff “must identify *specific facts*, which show physical invasion of contaminants”) (citations omitted, emphasis in original).

A direct physical infringement of subsurface property occurs when physical evidence supports the claim. *Schwartzman*, 857 F. Supp. at 845; *Snyder Ranches, Inc.*, 798 P.2d at 590; *Hartman*, 937 P.2d at 981, 983. In *Schwartzman*, the plaintiffs had done no soil or groundwater testing to demonstrate contamination due to the activities of defendant railway company, and instead relied on evidence based solely on the opinions of experts, which the court held was insufficient to establish actual trespass. *Schwartzman*, 857 F. Supp. at 845. Likewise in *Snyder Ranches*, the plaintiff's reliance on the fact that survey maps showed his property boundary merging with a "sealing fault" that would block the flow of injected salt water as "proof positive that the fault line must include part of their land," was insufficient to establish that salt water injected by defendants on the adjoining property must have infringed on their property. *Snyder Ranches, Inc.*, 798 P.2d at 589, 590. Conversely, in *Hartman*, plaintiff's contention that defendant's injection of salt water at high pressures created vertical fractures allowing the escape of salt water into plaintiff's well was supported by evidence "that a substantial volume of the injected water was never recovered, indicating that it had escaped the formation." *Hartman*, 937 P.2d at 981. While common law subsurface trespass was not challenged by defendant on appeal, the court of appeals went out of its way to make clear it would not disturb the trial court's ruling, *Id.* at 983, effectively emphasizing the legitimacy of the subsurface trespass claim.

New Mexico further appears to hold that there is no claim for subsurface trespass for the injection of salt water produced on site in the production of oil and gas due to an implied authorization for disposal by injection because such practice is a necessary part of the purpose of the lease; though the same is not true for the injection of salt water produced off site, unless, perhaps, an instrument or contract specifies otherwise. *McNeill v. Rice Engineering and Operating, Inc.*, 133 N.M. 804, 70 P.3d 794, 798, 801 (NM Ct. App. 2003). In *McNeill*, the New Mexico Court of Appeals reviewed case law from other jurisdictions (Kansas, Louisiana and Illinois), which suggested that "there may be an implied authorization to dispose of salt water in order for the production of oil and gas on that person's land to be accomplished," but that that rationale "does not apply to the disposal of salt water produced on other property," to determine the trial court erred in granting a broad right to dispose of off-site salt water when the instrument in question did not explicitly allow it. *Id.* 801-802 (citations omitted). The right to inject salt water produced on-site from oil and gas wells stems from the theory that such production "is a necessary and unavoidable" result of the production of oil and gas that has been explicitly authorized by the original mineral conveyance. See *Colburn v. Parker and Parsley Development Co.*, 17 Kan.App.2d 638, 842 P.2d 321, 326 (Ct. App. Kansas 1992) ("We hold the granting clause in an oil and gas lease includes an implied covenant to dispose of the salt water produced during operations by utilizing a saltwater disposal well drilled on the leased premises without additional compensation to the lessor. We hold that such a right is required in order for the production of oil and gas to be accomplished"); *Leger v. Petroleum Engineers, Inc.*, 499 So.2d 953 (La. Ct. App. 3rd cir. 1986) ("[W]e conclude that, under the facts present, the ...[salt water disposal], of which plaintiffs complain, is impliedly granted because such use causes no damage to the surface or sub-surface and is reasonably, if not absolutely, necessary for accomplishment of the overall purpose for which the lease was granted, i.e., production of oil from the leased property"); but see *Gill v. McCullom*, 311 N.E.2d 741 (App. Ct. 5th dist. Ill 1974) ("The injection must have some relation to the primary purpose of obtaining production"); *Farragut v. Massey*, 612 So.2d 325 (S. Ct. Miss. 1992) ("The right of the mineral owner to use and occupy the land is restricted to operations for exploring for and extracting minerals from that land. Thus, the land

cannot be used ... to dispose of salt water from other land”) (quoting 1 E. Kuntz, *A Treatise on the Law of Oil and Gas*, § 3.2 at 87-88 (1987)).

The method employed in New Mexico to calculate damage to subsurface property from trespass depends on whether the damage is permanent or temporary. *McNeill v. Burlington Resources Oil & Gas Co.*, 141 NM 212, 153 P.3d 46, 54 (N.M. Ct. App. 2007). *McNeill* applied trespass damage calculations developed in *Amoco v. Carter Farms*, 103 NM 117, 703 P.2d 894 (NMSC 1985), to subsurface trespass. For permanent subsurface injuries the measure for damages is the diminution in the fair market value of the entire property; for temporary injuries, “the measure of damages is the cost of repair or remediation, so long as this cost is less than the diminution in fair market value.” *Id.* at 54-55 (citations omitted). When the actions of the owner of the mineral estate have rendered the surface totally unusable for a period of time, then the damages are determined by the land’s rental value for that period. *Id.* For these purposes, “[t]emporary damages are generally defined as damages that can be remedied, removed, or abated within a reasonable period and at a reasonable expense,” and “permanent damages are defined as those damages caused by an injury that is fixed and where the property will always remain subject to that injury” so that they are “damages for the entire injury done – past, present, and prospective” and are “practically irremediable.” *Id.* (citing *Morsey v. Chevron, USA, Inc.*, 94 F.3d 1470, 1476 (10th Cir.1996)).

While the issue of subsurface trespass has been reviewed in only a handful of cases in New Mexico, discussed above, the issue has been more fully considered in other jurisdictions, offering guidance for conflicts that have not yet been addressed in this state.

The law of subsurface trespass has, by and large, paralleled the development of oil and gas law in that, in many ways, whether an action lies in the former has been dependent on the reasoning of the latter. One of the earlier subsurface trespass claims exemplifies this dependent relationship addressing the question of ownership of injected gas to determine whether a trespass claim was valid. In *Hammonds v. Central Kentucky Natural Gas*, 75 S.W.2d 204 (Ky. Ct. App. 1934) (overruled by *Texas American Energy Corp. v. Citizens Fidelity Bank & Trust Co.*, 736 S.W.2d 25, 28 (Kentucky S. Ct. 1987)), the plaintiff/appellant brought an action for trespass given that her 54 acres of property were included within the boundary of defendant’s/appellee’s 15,000-acre natural gas storage field without her knowledge or consent. *Hammonds*, 75 S.W.2d at 204. The court analogized natural gas to wild animals and thereby applied the ancient rule of *ferae naturae* to the natural gas, even that which had been previously reduced to possession and controlled on the surface. *Id.* at 205; see *Bezzi v. Hocker*, 370 F.2d 533 (10th Cir.1966) (stating that ownership was lost when gas was re-injected into the common source of supply and commingled with virgin gas). Following this analogy, the court found that “if in fact the gas turned loose in the earth wandered into the plaintiff’s land, the defendant is not liable to her for the value of the use of her property, for the company ceased to be the exclusive owner of the whole of the gas – it again became the mineral *ferae naturae*.” *Id.* at 207.

This holding was met with contemporaneous disapproval in numerous other jurisdictions, Fred McGaha, *Underground Gas Storage: Opposing Rights and Interests*, 46 La. L. Rev. 871, 873

(1986), but was not explicitly overruled in Kentucky until 1987. See *Texas American Energy Corp.*, *supra*, (“[I]n those instances when previously extracted oil or gas is subsequently stored in underground reservoirs capable of being defined with certainty and the integrity of said reservoirs is capable of being maintained, title to such oil or gas is not lost”). During the intervening time many jurisdictions followed the contradictory reasoning of *White v. New York State Natural Gas Corp.*, 190 F. Supp. 342 (W.D.Pa. 1960), which held that gas in storage “has not escaped from its owners,” but “is yet very much in the possession of the storage companies, being within a well-defined storage field ... and being subject to the control of the storage companies...” *Id.* at 348. See also *Lone Star Gas Company v. Murchison*, 353 S.W.2d 870 (Ct. Civ. App. Texas 1962) (“the owner of gas does not lose title thereof by storing the same in a well-defined underground reservoir”); but see *Anderson v. Beech Aircraft Corp.*, 237 Kan. 336, 699 P.2d 1023 (Kansas S. Ct. 1985) (injector not a natural gas public utility lost ownership to gas stored when no certificate authorizing storage was obtained and the use of subsurface storage space was without authorization or consent of landowner).

In holding that ownership of injected gas previously reduced to possession is retained by the injector, the courts have had to distinguish between native gas and non-native gas. See *White v. New York State Natural Gas Corporation*, 190 F.Supp. 342, 347-348, 349 (W.D.Pa.1960) (distinguishing between chemical and physical properties of depleted native gas and injected stored gas); *Humble Oil & Refining v. West*, 508 S.W.2d 812, 817 (Tex. 1974) (distinguishing between native gas and “extraneous gas” for purposes of determining royalty payments); *Reese Exploration v. Williams Natural Gas* 983 F.2d 1514 (10th Cir. 1993) (distinguishing between non-native and native gas); *Ellis v. Arkansas Louisiana Gas Co.*, 450 F.Supp. 412, 419 (E.D. Okla. 1978) (holding there is no commingling of economically recoverable native gas and storage gas).

Having established ownership of stored gas and distinguishing between native and non-native gas, courts then began holding storage companies liable for damage arising from their injections of extraneous gas, including actions for subsurface trespass. 46 La. L. Rev. 871, 879 (1986). In New Mexico, the state legislature has statutorily declared that gas storage companies are the owners of injected gas. NMSA 70-6-8 (1995).

The issue of subsurface trespass quickly becomes complex and how it has been analyzed depends greatly upon whether the materials involved in the alleged trespass are part of normal hydrocarbon recovery (enhanced recovery), a function of natural gas storage, or whether they are part of a disposal process, as each appears to be governed by a semi-distinct set of policy-based trespass rules.

In the case of enhanced hydrocarbon recovery, a theory favoring the senior mineral estate developed in oil and gas law known as the “negative rule of capture,” which has been applied to the injection of fluids generally involved in the secondary or tertiary recovery of hydrocarbons, and which is now viewed with disfavor by most jurisdictions and legal scholars, Fred McGaha, *Underground Gas Storage: Opposing Rights and Interests*, 46 La. L. Rev. 871, 884 (1986), but is nonetheless worthy of note. In upholding the rule, the Texas Supreme Court explained in

Railroad Comm'n of Texas v. Manziel, 361 S.W.2d 560 (Texas 1962), that the negative rule of capture suggests that “[j]ust as under the rule of capture a land owner may capture such oil or gas as will migrate from adjoining premises to a well bottomed on his own land, so also may he inject into a formation substances which may migrate through the structure to the land of others, even if it thus results in the displacement under such land of more valuable with less valuable substances.” *Manziel*, 361 S.W.2d at 568 (quoting Williams & Meyers: Oil and Gas Law, § 204.5). Adopting this theory, the court laid out that the policy reasons for doing so were to encourage the maximal recovery of hydrocarbon resources, the extraction of which by secondary or tertiary recovery methods could otherwise be blocked by any adjoining property interest on the basis of subsurface trespass claims. *Id.* The court held that the rules and principles of surface trespass are not applicable to subsurface invasions resulting from secondary recovery of natural resources when authorized by the state commission. *Id.* This position, while not tested directly in New Mexico, has been preemptively and explicitly rejected by the state’s Supreme Court in dicta. *Snyder Ranches, Inc.*, 798 P.2d at 590 (“The issuance of a license by the State does not authorize trespass or other tortious conduct by the licensee, nor does such license immunize the licensee from liability for negligence or nuisance which flows from the licensed activity”).

Rather than employing the negative rule of capture, most jurisdictions hold that mineral interests may make valid claims of subsurface trespass against injectors causing impairment to or displacement of their valid mineral interest. The New Mexico court has expressed its willingness to recognize trespasses upon the mineral estate as in *Snyder Ranches*, *supra*, and in *Hartman v. Texaco Inc.*, 1997-NMCA-032, 123 N.M. 220, 937 P.2d 979 (NM Ct. App. 1997). In *Hartman*, the court recognized, but declined to review, the lower court’s holding that Texaco’s injected water had trespassed upon Hartman’s lease. *Hartman*, 937 P.2d at 983. For more complex cases of mineral trespass, rulings from other jurisdictions must serve as guide.

In *Humble Oil & Refining v. West*, 508 S.W.2d 812 (Texas 1974), the action was not strictly one of trespass, but plaintiffs (West) sought to enjoin Humble Oil from using a gas field as a storage facility until all native gas, which had been reserved from the conveyance of the storage rights and mineral and surface estates, had been depleted. Humble Oil owned the mineral interests and the surface estate, subject to West’s royalty interest, and had produced 89 percent of the recoverable gas reserves, averring that production of the remaining recoverable gas would have resulted in destruction of the reservoir’s gas storage capacity due to “watering out” of the pore space. *West*, 508 S.W.2d at 814, 816. Humble Oil had injected extraneous gas into the formation for storage. The Supreme Court of Texas refused to require Humble Oil to produce the remaining native gas to depletion for that would destroy their property right to the storage space. *Id.* at 816. Instead, the court attempted to balance the competing interests and ruled that the burden is on the party commingling gases to properly identify the “aliquot share” of each owner and to pay a royalty on that amount, but if that share is not possible to establish with “reasonable certainty,” the injector is then responsible for paying royalties on all gas subsequently produced from the field, extraneous stored gas and native gas alike. *Id.* at 817-819.

In the case of natural gas storage, the federal Natural Gas Act, 15 U.S.C. § 717 *et seq.*, provides for the right of eminent domain for the construction of pipelines over private land, which has

been interpreted to include the right to condemn subsurface storage space (“the necessary land or other property, in addition to right-of-way, for the location of *compressor stations, pressure apparatus, or other stations or equipment* necessary to the proper operation of such pipe line”). 15 U.S.C. § 717f(h) (emphasis added); see *Columbia Gas Transmission Corp. v. Exclusive Gas Storage Easement*, 776 F.2d 125, 128 (“we read the words ... [compressor stations, pressure apparatus or other stations or equipment] as sufficiently broad to encompass the underground gas storage facility”). At the state level, subsurface storage of natural gas and the condemnation of subsurface storage space is provided for in NMSA 70-6-1 *et seq.*

By enacting the Natural Gas Act, Congress, it is argued, has effectively preempted common-law trespass claims, leaving only the action of inverse condemnation available to property holders. Steven D. McGrew, *Selected Issues in Federal Condemnations for Underground Natural Gas Storage Rights: Valuation Methods, Inverse Condemnation, and Trespass*, 51 Case W. Res. L. Rev. 131, 147 (Fall 2000). The resolution of this question has significant financial implications as punitive damages are available for trespass claims, but only compensatory damages are available for inverse condemnation claims. *Id.* at 150, 163-164. This concern, however, may not apply to the sequestration of carbon dioxide because there has been no federal preemption of this regulatory field, as there has arguably been for storage of natural gas in the enactment of the Natural Gas Act. See *Columbia Gas Transmission Corp. v. An Exclusive Natural Gas Storage Easement in the Clinton Subterranean Geological Formation Beneath 80 Acres, Worthington Twp., Richland County, Ohio*, 747 F.Supp. 401, 403 (N.D. Ohio, E. Division 1990). Without pursuing this issue further, it is presumed that common law trespass remains a viable action for carbon dioxide sequestration and has not been federally preempted. However, it is possible landowner actions could be constrained statutorily by the state legislature to inverse condemnation, which would have the desirous effect of limiting an injector’s liability, and thereby encourage sequestration by eliminating the possibility of punitive damage awards.

In the case of hazardous waste disposal, the courts have been careful to distinguish injections related to the extraction of oil and gas from injections unrelated to hydrocarbon production. In *Chance v. BP Chemicals*, 670 N.E.2d 985 (Ohio 1996), the Ohio Supreme Court found that “a special body of law has arisen [around oil and gas cases] based on special circumstances,” *Id.* at 991, not present with the injection of other materials. However, this distinction seems to have been made for the primary purpose of avoiding the application of the negative rule of capture. *Id.* (“Since appellee’s injection well operation has nothing to do with the extraction or storage of oil or gas, we find the negative rule of capture inapplicable to our consideration of this case”).

Perhaps the most interesting holding in *Chance* is the limitation of the surface owner’s subterranean interests, discussed above. The Ohio court looked to *Willoughby Hills v. Corrigan*, 29 Ohio St.2d 39, 49, 58 O.O.2d 100, 105, 278 N.E.2d 658, 664 (1972), which cited *United States v. Causby*, 328 U.S. 256, 66 S.Ct. 1062, 90 L.Ed. 1206 (1946), to state that the doctrine of “Cuius est solum” “has no place in the modern world.” *Id.* at 991. The Ohio court also extended the reasoning of *Hinman v. Pacific Air Transp.*, 84 F.2d 755, 758 (C.A. 9, 1936) (“We own so much of the space above the ground as we can occupy or make use of, in connection with the enjoyment of our land”) to apply equally to below-ground interests. *Id.* at 991-992. While ultimately limiting the surface owners’ subterranean interests, the court did not go so far as to preclude subsurface trespass, but required that any injection must be shown to interfere with a landowner’s “reasonable and foreseeable use” of the property. *Id.* at 992.

A powerful policy argument, however, has been made to limit the application of the holding in *Chance*. Steven D. McGrew has posited that “subsurface rights should be treated differently than air rights because the historical use of subsurface property has been much more extensive and profitable for property owners than the historical use of air rights.” 51 Case W. Res. L. Rev. 131, 178. Landowners have had the right to profit off the valuable subsurface resources, including caves and mineral resources, such as natural gas. *Id.* Because the landowner has an unquestionable right to profit from and alienate these subsurface interests:

...storage operators cannot plausibly argue that property owners have no protectable property interest in the same geological formation in which they did have a protectable and alienable interest when the formation contained native natural gas. Such a reversal should require strong justification. While it is true that underground natural gas storage serves an important public interest, that alone would not provide sufficient justification, for the Constitution forbids the taking of property for the public interest without the payment of just compensation.... Given these considerations, it is not difficult to come to the conclusion that a storage operator that knowingly uses property – even subsurface property – without paying for the right to do so should be liable for trespass.

Id. at 178-179.

The 10th Circuit has employed a slightly lower standard of proof for subsurface trespass claims than the standard, discussed above, that New Mexico courts appear to apply. In the 10th Circuit, subsurface trespass claims have been successful when circumstantial evidence was sufficient to demonstrate that the injectors expected the injected material to enter the landowner’s subsurface. *Beck v. Northern Natural Gas Co.*, 170 F.3d 1018 (10th Cir. 1999). In *Beck*, the court did not require each landowner to “directly prove” that storage gas was actually located under each property because the circumstantial evidence presented was sufficient to demonstrate that the target formation was highly permeable, continuous and interconnected beneath the plaintiffs’ properties. *Id.* at 1022 Also, and most importantly, the defendant itself had earlier sought to prove the entire acreage was suitable for gas storage, had demonstrated that a significant portion of the field’s storage capacity was in the formation below each plaintiff, and testimony from defendant’s senior engineer stated that defendant “had actually been storing gas in the...formation under all of the landowners for the prior seventeen years.” *Id.*

Subsurface infringement can, by the common law process of adverse possession, establish a prescriptive easement to the subsurface pore space. *Ellis v. Arkansas Louisiana Gas Co.*, 450 F.Supp. 412 (E.D. Okla. 1978) *aff’d* 609 F.2d 436 (10th Cir 1979). In *Ellis*, the court held that, as required by Oklahoma law, a prescriptive right may be acquired by establishing each of the elements of adverse possession (actual, adverse, open, notorious, peaceable, exclusive and hostile possession) for a period of fifteen years. *Ellis*, 450 F.Supp. at 423-424. In *Ellis* the court

held that the plaintiffs, seeking damages for unauthorized storage of gas beneath their property, and their predecessors in title knew that a geologic formation under their land was part of the region's gas storage facility, that it had been used as such continuously for nearly 30 years, and that the injection facilities were obviously visible and that plaintiffs knew their purpose, thereby establishing the prescriptive easement and the right to store gas. *Id.* at 424.

Injection of carbon dioxide (CO₂) into the subsurface would qualify in New Mexico and elsewhere as a direct physical infringement adequate to establish the action of trespass. CO₂ is no different than the various injected materials contemplated for subsurface infringement in *Schwartzman* (chemical contaminants), *Snyder* (salt water) *Hartman* (salt water), and *Beck* (natural gas). The Texas Supreme Court, for example, has held that fracking can be a subterranean trespass. *Mission Resources, Inc., v. Garza Energy Trust*, 166 S.W.3d 301, 310-311, 160 Oil & Gas Rep. 1144 (Tx. Ct. App. 2005) (“fracing can create a subsurface trespass if the invasion alleged is direct and the action taken intentional”).

The difficulty in establishing a valid action for subsurface trespass will be in demonstrating actual physical infringement, especially as New Mexico appears to apply a more stringent standard of proof than, for example, the 10th Circuit. Proof of infringement in New Mexico appears to require more than mere affidavits or expert testimony, but some demonstration of actual, physical infringement, such as sampling evidence from groundwater monitoring wells, soil samples, air monitoring or geophysical surveys. Landowners seeking to establish a trespass claim against CO₂ injectors would also likely have to demonstrate that any CO₂ detected is injected gas, as opposed to native gas. As explained in *Schwartzman*, such burden is on the landowner to establish, which means the landowner would have to pay for the monitoring and analysis. This burden makes establishing non-obvious, minimally intrusive CO₂ trespass actions difficult. However, if the New Mexico courts were to adopt a standard more akin to that expressed by the 10th Circuit in *Beck*, subsurface trespass could be easier to establish if the property in question is within the contemplated storage field or its designated buffer zone. This would likely be so because, as part of the permitting process, the state will likely require a description of the formation and its areal extent targeted for CO₂ injection; such information that the court found to be adequate circumstantial evidence to establish subsurface trespass in *Beck*. By the same token, such claims should be eliminated by a requirement that any CO₂ injection project acquire the storage rights for the proposed project area, either through negotiation or condemnation proceedings. Trespass claims are more likely to arise in cases where the storage project has exceeded its proposed area of influence, and injected CO₂ has migrated beyond the intended project boundaries, in which cases such circumstantial evidence is not likely to be as readily available or may be non-existent for landowners to rely upon to establish the validity of their claims.

The implied authorization for injection that applies to secondary recovery of hydrocarbons likely won't be applicable to the vast majority of CO₂ injection projects as CO₂ floods and enhanced oil and gas recovery are anticipated to make up only a small fraction of the total sequestration volume in New Mexico.

If carbon dioxide emissions become federally regulated, its storage/injection would likely be considered permanent, as subsequent release back to the atmosphere will face a number of significant policy, regulatory and practical barriers. For this reason calculation of damage awards for subsurface trespass claims in New Mexico may be figured based on the diminution of value of the entire property, as outlined in *McNeill*. However, compensating the landowner at a rate equivalent to the loss of rental value, since the storage space is no longer available to the surface owner for other rental/storage purposes, seems to make better policy sense, while also perhaps more effectively protecting the interests of the landowner, because it avoids the difficulties inherent in calculating the diminution of value to the entire property. Where the market rental value for the storage space will be conceivably more ascertainable than an uncertain and nebulous determination of the diminution of value, the more certain, comparable and measurable method should probably be employed. This measure, however, may be something that is addressed by the courts unless the legislature develops a subsurface trespass statute that spells out damages. Alternatively, surface owners may opt to claim unjust enrichment or sue under assumpsit for breach of implied contract, as discussed above, to avoid the difficulty of ascertaining damages under trespass.

Further Issues Raised During Analysis:

1. At what point does CO₂ injection become storage and require acquisition of storage space rights? (Because there are limited CO₂ sequestration/storage projects, this question has not been tested yet in the courts).
2. At what point is a mineral interest considered depleted/non-economic?
3. Can non-depleted mineral interests claim trespass against injector of carbon dioxide?
4. Would the injection of carbon dioxide constitute temporary or permanent trespass?
5. Does the state have authority to condemn federal pore space? How will condemnation/storage be handled within federally owned pore space?
6. What is the proper process upon termination of a mineral lease to transition to CO₂ sequestration from EOR?
7. What uses of aquifer storage require compensation? Compensation to whom?
8. How will condemnation of pore space for CO₂ sequestration affect current acid gas and saline water injection practices?

Unitization of Recoverable Hydrocarbons

Issue:

In order to account for the enhanced recovery anticipated from injecting CO₂ into depleted oil and gas pools it will be necessary to unitize such pools. That is, by either voluntary agreement among the pool operators or through a Division order compelling it, depleted oil and gas fields subject to CO₂ sequestration/injection will need to be operated as a unit in order to equitably allocate costs and production among the various interests. Distinguishing between the pore space interests and the mineral interests, such unitization will apply only to the mineral interests.

In anticipation of the scale of commercial CO₂ sequestration, it is expected that most, if not all, depleted oil and gas fields in the state will be evaluated for sequestration and may therefore require unitization on a large scale.

Analysis:

The authority granted by the Statutory Unitization Act (NMSA 70-7-1 et seq.), provides for voluntary or compulsory unitization of a pool or part of a pool. The Act requires that the plan of unitization, whether voluntary or compulsory, be ratified by three-quarters of the working interest, royalty interest and overriding royalty interest owners. The consequence is that OCD can only compel unitization against the minority interest. This may prove an unacceptable means of blocking planned sequestration projects, as minority interests could refuse to ratify unitization orders, making operation of the unit as a sequestration field difficult. Non-unitized interests may have available to them legal remedies such as nuisance and trespass actions for any provable interference with their mineral production. It may, however, be desirable for injectors to have acquired some level of voluntary agreement for unitization among mineral interests before enabling compulsory unitization by Division order.

Under an effective CO₂ sequestration program it is anticipated that OCD would need to unitize larger areas than is now normally the practice. However, there is a precedent in the nearly 1 million acre Bravo Dome Unit that produces CO₂ in northwest New Mexico..

The Act also requires OCD to find that unitization will “substantially increase the ultimate recovery of oil and gas from the pool or unitized portion thereof.” NMSA 70-7-5. Because increased recovery may not always result in a program designed primarily for the sequestration of CO₂, this language may pose a barrier.

The Act further requires OCD to find “that the estimated additional costs, if any, of conducting such operations will not exceed the estimated value of the additional oil and gas so recovered plus a reasonable profit.” NMSA 70-7-6.A(3). Interpreted to mean the costs of production of additional hydrocarbons (CO₂ separation and re-injection/cycling, etc.) as opposed to the costs of the entire sequestration project, this language should not pose a barrier.

Statutory continuation of expiring leases may be considered to facilitate planning and implementation of CO₂ sequestration projects.

Unitization of federal minerals with non-federal minerals is provided for in the federal “Mineral Leasing Act,” 30 USC Code, Chapter 3A, Subchapter 1 § 184a: “...any State owning lands or interests therein acquired by it from the United States may consent to the operation or development of such lands or interests, or any part thereof, under agreements approved by the Secretary of the Interior made jointly or severally with lessees or permittees of lands or mineral deposits of the United States or others, for the purpose of more properly conserving the oil and gas resources within such State. Such agreements may provide for the cooperative or unit operation or development of part or all of any oil or gas pool, field, or area; for the allocation of production and the sharing of proceeds from the whole or any specified part thereof regardless of the particular tract from which production is obtained or proceeds are derived; and, with the consent of the State, for the modification of the terms and provisions of State leases for lands

operated land developed thereunder, including the term of years for which said leases were originally granted, to conform said leases to the terms and provisions of such agreements...”

Further Issues Raised During Analysis:

1. Does the unitization of federal minerals conflict with the purpose of CO₂ sequestration? How to handle sequestration units that include strata with federal minerals?
2. What is the effect of Indian ownership on unitization for carbon sequestration?

Condemnation of Storage Space and Transportation Corridors by Eminent Domain

Issue:

Subsurface sequestration space and surface easements for pipelines and injection facilities will be necessary for a large-scale sequestration program.

OCD does not have the power under existing law to provide for the acquisition by eminent domain of subsurface pore space for the purposes of CO₂ sequestration. Authority to condemn subterranean storage space, similar to provisions in NMSA 70-6-1 through 70-6-8 authorizing the condemnation of underground storage space for natural gas, would be necessary for CO₂ sequestration operators to acquire the storage rights from property owners who have not reached an agreement.

Compensable parties may not be limited to the target pore space owners, however, as there may be room for mineral interests to argue that since oil and gas reservoirs may never be fully depleted, CO₂ sequestration constitutes interference with their estate and requires just compensation if interference or harm is provable. Currently, New Mexico law prohibits the condemnation of storage space for gas storage in strata capable of producing oil in paying quantities through any known recovery method. Likewise, no strata capable of producing gas in paying quantities can be condemned unless the recoverable volumes of native gas are substantially depleted and unless the formation has greater value or utility as a storage reservoir.

The state currently has authority under 70-3-5 to condemn surface land for pipeline construction, including CO₂ pipelines. This provision applies only to trunk lines, or primary transportation lines, and not to gathering lines or presumably to CO₂ injection lines. NMSA 70-3A-1 et seq. establishes the means by which easements for smaller disposal lines and gathering lines may be acquired across private property.

All condemnation proceedings must be done in accord with and pursuant to NMSA 42-1-1 to 42A-1-33.

Issues Raised During Workgroup Meeting:

- Will the size and scale of the units/formations make condemnation difficult or cost prohibitive?
- If the goal is to condemn only the target storage space/interval/strata, what's the effect on the other intervals? Can hydrocarbon exploration/production continue in other intervals?

- What's the method of valuation for condemnation?
- Compensation to the pore space owner should be offset by the value of any liability assumed by the state that would otherwise reside with the pore space/surface owner

Analysis:

NMSA 70-6-1 et seq. can either be amended to include condemnation for CO2 sequestration or condemnation provisions may be included in a separate statute, but because the target pore space and geologic formations are the property interests of the surface owner, a process for the condemnation of the pore space for CO2 storage must be established to accommodate situations where surface owners and injectors are unable to agree on sequestration terms.

Several methods of valuation have been analyzed by the courts for determining the fair market value of pore space for storage of natural gas that may be applicable to valuation of sequestration space for CO2:

- Comparable agreements/rentals/sales
- Capitalization of rental income: multiply acreage rental by comparable storage rights to arrive at present worth of the future income stream, using filing date of condemnation as start date and termination of storage field as end date. Fair market value is equated to a capital sum which, when invested as of the date of the filing, would earn income equal to comparable storage rentals for the future
- Depreciation in the fair market value of condemned tract as a whole by reason of the taking of the storage easement: based on the difference in the fair market value of the entire condemned tract before and after the taking.
- Viewpoint of value: just compensation should be measured from the point of view of the landowner (what the landowner has lost, not what the petitioner (injector) has gained), e.g., if there are still quantities of native oil or gas in the storage easement not in paying quantities (having no effect on the tract's market value), then these volumes would not be taken into account in the valuation.

On the issue of whether compensation is necessary for the mineral estate interests, CO2 sequestration might be sufficiently distinguishable from the storage of natural gas in that it does not preclude later or even concurrent production of hydrocarbons, and may be anticipated to generate, facilitate or increase such production. Unlike the situation for storage of natural gas which essentially precludes concurrent hydrocarbon recovery, there may be no ostensibly negative impact or interference with the production of the mineral estate beyond the cost of segregating the CO2 from production volumes (which production is expected to be enhanced by the CO2) and re-injecting/cycling it back into the formation.

Further Issues Raised During Analysis:

1. Valuation of otherwise non-recoverable/non-economic minerals

Authority to Transfer Liability/Ownership to State

Issue:

The various forms of liability (e.g. economic and environmental) inherent in proposed sequestration projects and how they will be addressed within a given regulatory framework are perceived as being significant factors in making sequestration projects feasible on the industry side, but also as being crucial for advancing public acceptance of the technologies, processes and regulations.

Short-term liabilities inherent in any drilling or injection project – whether environmental or economic – can likely be best addressed through the contractual arrangements between CO₂ generator and injector, as such liabilities are currently handled. But liabilities following the injection and closure phases of the projects present a unique problem given the long-term economic and environmental unknowns and the anticipated scale of sequestration projects, both in terms of time and space, required for successful CO₂ mitigation.

Nearly all of the sequestration literature assumes that long-term liability must be transferred to the public sector to maintain economic viability and to encourage industry participation. Because the lifespan of sequestration projects after closure, which would include continuous monitoring, measurement and verification (MMV) of the reservoir integrity, is contemplated to endure for possibly hundreds to thousands of years, the public sector (because of the longevity of public institutions and the ease of transferability of institutional knowledge) is seen as the most viable entity capable of maintaining these projects over the long term. Alternatives include having the state accept liability for a limited number of projects (e.g. the first enhanced oil recovery project, the first deep saline project, the first deep coal project, etc.) or for a limited time frame (e.g. first 5 years of CO₂ sequestration), or for injectors and the carbon sequestration industry to retain ownership and liability with coverage provided by a combination of individual liability, insurance, and an industry-funded trust fund.

Policy Considerations:

- Is transfer of liability and ownership of CO₂ to the public sector the proper model?
- Should there be a limit to the liability that is transferred? Should the state be indemnified against claims or mitigation costs above a certain amount?
- Should the state accept liability for only a certain number of projects (e.g. the first enhanced oil recovery project, the first several deep saline projects, the first deep coal projects, etc.) or should the state accept liability for those projects initiated within a limited time frame (e.g. first 5 years of CO₂ sequestration)?
- If liability is transferred to the public sector, how shall the costs be funded – a fee program based on volume of CO₂ injected?
- Should the generator or injector retain any liability – environmental, economic or for CO₂ accounting purposes?
- Should CO₂ generators/injectors have the choice to transfer liability to the public sector and pay a long-term liability fee or maintain liability with bonding to cover insolvency or abandonment?
- Who owns the sequestered CO₂ should it become a viable product in the future?

Issues Raised During Workgroup Meetings:

- Will the state be liable for mitigation/damages after transfer? Should state liability beyond the amount covered by the fee pool be protected as a sovereign immunity?
- Texas proposes to accept liability only for FutureGen sites.
- If there is a fee, it should be used only for mitigation, long-term monitoring, and verification of sequestration projects (i.e. protected against other legislative appropriations).
- State should only take on ownership/liability of projects where monitoring following cessation of injection/operations indicates the project is performing as predicted.
- State should only take on ownership/liability of projects with a demonstrated leakage rate of less than 1 percent?
- How will parties/individuals injured be able to recover? Through industry fund?
- An alternative to a sequestration fee is to fund the long-term monitoring, measurement, verification and mitigation through a portion of the severance taxes collected on the enhanced recovery made possible by the CO₂ injections.
- Having the state take on the long-term liability makes the project more appealing – the sooner the state takes on liability the more appealing the project
- If there is a transfer of liability, the state must have the right to enter private land and plug/re-plug problem wells within the sequestration unit to ensure field/storage integrity.
- Is/will CO₂ be considered a “hazardous substance” under federal CERCLA/RCRA laws and how might that impact liability for generators, transporters and disposers/injectors?

Analysis:

Because the issues of financial assurance and liability are, in many ways, so tightly interrelated, the review and analysis of these issues have been addressed jointly.

The literature reviewing carbon dioxide sequestration liability and financial assurance issues looks to several pre-existing regulatory models for possible guidance. Those regulatory schemes are reviewed and discussed below. Finally, drawing from these models and the workgroup comments, a proposed regulatory and liability scheme is presented for discussion, however, OCD makes no recommendation as to the proper liability scheme at this time.

Price-Anderson Nuclear Industries Indemnity Act: 42 U.S.C. s. 2210

The Price-Anderson Nuclear Industries Indemnity Act (Act), passed into law in 1957 and revised and extended on several occasions since, serves to partially indemnify the nuclear industry against liability claims arising from nuclear incidents while making available a large pool of funds to cover public compensation for claims of personal injury and property damage. The Act holds nuclear reactor operators/owners strictly liable for “extraordinary nuclear occurrences,” as defined by the Act and within the financial limits imposed by the Act. Claimants must establish negligence or that there was a violation of some standard or regulation to demonstrate liability for other “nuclear incidents.”

The Act was originally deemed necessary to jump start a private nuclear power industry, which otherwise viewed the then-unquantified liability risks associated with nuclear power production as a complete deterrent. (American Nuclear Society, Background for Position Statement 54). Licensees under the Act must obtain the maximum amount of liability insurance available on the market, which is currently set at \$300 million per reactor. Any valid monetary claims that fall within this amount are paid for by the insurers. Beyond that, the Price Anderson fund, financed by the licensees themselves as provided for by the Act, makes up the difference. Each licensee is responsible for a maximum contribution to the fund of \$95.8 million in the event of an accident. The total fund would currently cover about \$10 billion in public liability claims (based on the number of operational reactors at present), but no licensee must pay more than \$15 million for any given incident in a single year. In this scheme, any costs exceeding the coverage provided by first the insurance and then the fund would be covered by the federal government.

The Act requires as a condition of the operating license issued by the Nuclear Regulatory Commission that the licensee “have and maintain financial protection of such type and in such amounts as the [Commission] in the exercise of its licensing and regulatory authority and responsibility shall require ... to cover public liability claims.” 42 U.S.C. § 2210(a). The Act further provides that the Commission may, also as a condition of the license, “maintain an indemnification agreement,” but also “that an applicant waive any immunity from public liability conferred by Federal or State law.” *Id.* According to 42 U.S.C. § 2210 (c), the NRC shall “with respect to licenses issued between August 30, 1954, and December 31, 2025,” for which financial protection of less than \$560,000,000 is required, “agree to indemnify and hold harmless the licensee and other persons indemnified, as their interest may appear, from public liability arising from nuclear incidents which is in excess of the level of financial protection required of the licensee.” Further, “[t]he aggregate indemnity for all persons indemnified in connection with each nuclear incident shall not exceed \$500,000,000 excluding costs of investigating and settling claims and defending suits for damage, provided, however, “that this amount of indemnity shall be reduced by the amount that the financial protection required shall exceed \$60,000,000. 42 U.S.C. § 2210(c). Such indemnification contracts “shall cover public liability arising out of or in connection with the licensed activity.” *Id.*

The Act goes on to provide that the NRC or the Energy Secretary may incorporate provisions in indemnity agreements or insurance policies or contracts as proof of financial protection that waive “any issue or defense as to conduct of the claimant or fault of persons indemnified” for “any extraordinary nuclear occurrence” to which an insurance policy or contract furnished as proof of financial protection or an indemnity agreement applies. 42 U.S.C. § 2210(n). This section of the Act essentially establishes that nuclear facilities “stand strictly liable” for an “extraordinary nuclear occurrence,” so that nuclear incidents that are not deemed “extraordinary” do not trigger strict liability and a claimant must prove negligence or establish a regulatory violation. 14 Am. Jur. Proof of Facts 3d 85 § 16. According to the Act, an “extraordinary occurrence” is defined as “any nuclear event causing a discharge or dispersal of course, special or nuclear, or by-product material from its intended place of confinement in amounts off site, or causing radiation levels off site, which the Nuclear Regulatory Commission or Secretary of Energy, as appropriate, determines to be substantial, and which , determines has resulted or will probably result in substantial damages to persons off site or property off site.” *Id.* (citing 42

U.S.C. § 2214 (j)).

The Act requires that the primary financial protection required for large nuclear reactors (larger than 100 mega-Watts) “shall be the maximum amount available at reasonable cost and on reasonable terms from private sources.” 42 U.S.C. § 2210(a)(1). The Act provides that “primary financial protection may include private insurance, private contractual indemnities, self-insurance, other proof of financial responsibility, or a combination of such measures, and shall be subject to such terms and conditions as the Commission may, by rule, regulation, or order, prescribe.” *Id.* But the Act allows a licensee to defer premiums under an industry “retrospective rating plan” that defers in whole or in major part the premium charges “until public liability from a nuclear incident exceeds or appears likely to exceed the level of the primary financial protection [i.e. the insurance] required of the licensee involved in the nuclear incident.” *Id.* The Act also limits the maximum amount of the deferred premium that may be charged against a licensee following any nuclear incident to no more than \$95.8 million, subject to adjustment for inflation, and not more than \$15 million in any single year, also subject to adjustment for inflation. *Id.* The Act further limits a licensee’s liability by limiting the amount that may be charged following a nuclear incident to the licensee’s pro rata share of the aggregate public liability claims and costs. *Id.*

According to the Act, the aggregate public liability for a single nuclear incident of persons indemnified, including legal costs authorized within the Act, is limited to the maximum amount of financial protection required of large nuclear reactors (100 mega-Watts or more). 42 U.S.C.A. § 2210 (e)(1)(A). But in the event that a nuclear incident involves damages in excess of the amount of the aggregate public liability, “Congress will thoroughly review the particular incident ... and take whatever action is determined to be necessary (including approval of appropriate compensation plans and appropriation of funds) to provide full and prompt compensation to the public for all public liability claims resulting from a disaster of such magnitude.” 42 U.S.C.A. § 2210 (e)(2).

In such cases, the Act provides that the Energy Secretary or the Nuclear Regulatory Commission (NRC) shall “make a survey of the causes and extent of damage” and “expeditiously” submit a report to Congress, the Representatives of the affected districts, the Senators of the affected states and to the public, the parties involved, and to the courts. 42 U.S.C.A. § 2210 (i)(1)(A)-(B). Within three months of the incident the President must submit to Congress an estimate of the dollar value of personal injuries and property damage in excess of the aggregate public liability and recommendations for additional sources of funds to pay claims. 42 U.S.C.A. § 2210 (i)(2)(A)-(B).

The NRC codifies the conditions for indemnity agreements, liability limits, and fees for the different classes of licenses in 10 CFR pt. 140. Generally, reactors rated below 100 mega-Watts have lower primary insurance requirements than larger reactors. 10 CFR § 140.11 (a)(1)-(4). Coverage for non-profit educational reactors is a function of their maximum power and the size of the neighboring population ($x = B(P)$, where x is the amount of financial protection; B is the base amount of financial protection (\$185 times the maximum power level); and P is the

population factor (on a scale from 1 to 2; and area considered is within a radius in miles equal to the square root of the maximum reactor power level)). 10 CFR § 140.12. Large commercial reactors are required to obtain financial protection “[i]n an amount equal to the sum of \$300,000,000 and the amount available as secondary financial protection (in the form of private liability insurance available under an industry retrospective rating plan providing for deferred premium charges equal to the pro rata share of the aggregate public liability claims and costs ...).” 10 CFR § 140.11 (a)(4). As discussed above, such deferred premium charges are limited to \$95.8 million with respect to any nuclear incident and \$15 million per incident within a single year. *Id.*; 42 U.S.C. § 2210(a)(1). In cases where a licensee is authorized to operate two or more nuclear reactors at the same location, the total primary financial protection required is the highest amount that would otherwise be required for any one of those reactors. 10 CFR § 140.11 (b).

The NRC’s regulations further require that each licensee at the issuance of the license, and annually, demonstrate to the Commission that it maintains one of several types of guarantee of payment of deferred premium (surety bond, letter of credit, revolving credit/term loan arrangement, maintenance of escrow deposits of government securities, annual certified financial statement showing that cash can be generated and made available, or other type of guarantee “as may be approved by the Commission”) in an amount of \$15 million for each reactor licensed for operations. 10 CFR § 140.21.

Resource Conservation and Recovery Act (RCRA); 42 U.S.C. § 6901, et seq.

Enacted in 1976, the Resource Conservation and Recovery Act (RCRA) was passed to encourage the recycling of materials, establish a means to regulate the cleanup and proper storage and handling of hazardous wastes that pose a threat to human health and the environment, and to reduce dependence on foreign energy. 42 U.S.C. § 6901. Unlike the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, discussed below), however, RCRA regulates actively managed and operational sites, facilities and processes. Similar to the philosophy employed subsequently in the writing of CERCLA and in the formulation of the Underground Injection Control program (UIC), *infra*, RCRA directs the Administrator of the U.S. Environmental Protection Agency to promulgate regulations that, among other things, provide for the financial responsibility (including financial responsibility for corrective actions) of the responsible parties.

According to the regulations, “[a]n owner or operator of each facility must establish financial assurance for closure of the facility” in accord with one of several options provided in the regulations. 40 C.F.R. § 264.143. One option is to establish a “closure trust fund.” § 264.143 (a)(1). Payments into the trust fund must be made annually by the owner or operator over the term of the facility’s RCRA permit, or over the term of its remaining operating life, whichever is shorter. § 264.143 (a)(3). Annual payments are based on a formula where the payment is equal to the current closure cost estimate, subtracted by the current value of the trust fund, then divided by the years remaining in the pay-in period. § 264.143 (a)(3)(i).

A second option is a surety bond, guaranteeing payment into a closure trust fund. § 264.143 (b). RCRA mandates that the wording of the surety bond be identical to that specified in § 264.151 (b). When a surety bond is employed, the owner or operator must also establish a standby trust fund, so that under the terms of the bond, all payments made to the bond get deposited by the surety into the standby trust fund. § 264.143 (b).

Another option is a surety bond guaranteeing performance of closure. § 264.143 (c). Such bonds must be effective before the initial receipt of hazardous waste for treatment, storage or disposal. § 264.143 (c)(1). The surety company issuing the bond must, at a minimum, be among those listed as acceptable sureties on Federal Bonds in Circular 570 of the U.S. Department of the Treasury. *Id.* The wording of the bond must be identical to § 264.151 (c). As above, the owner or operator using a surety bond must also establish a standby trust fund. § 264.143 (c)(3).

Also available as an option for financial assurance is a closure letter of credit, § 264.143 (d), which is established when an owner/operator obtains an irrevocable standby letter of credit from an issuing institution which has the authority to issue letters of credit and whose letter-of-credit operations are regulated and examined by a Federal or State agency. § 264.143 (d)(1). The wording of the letter of credit must be identical to the wording specified in § 264.151 (d). As above, an owner/operator who uses a letter of credit to satisfy the financial assurance requirements must also establish a standby trust fund. § 264.143 (d)(3). The letter of credit must be irrevocable, issued in an amount at least equal to the current closure cost estimate, and issued for a period of at least 1 year, providing that the expiration date will be automatically extended for a period of at least 1 year. § 264.143 (d)(5)-(6).

Owner/operators can also meet their financial assurance requirements by obtaining closure insurance. § 264.143 (e). The closure insurance policy must be issued for an amount at least equal to the current closure cost estimate and must guarantee that funds will be available to close the facility whenever final closure occurs. § 264.143 (e)(3)-(4). The policy must provide that the insurer may not cancel, terminate, or fail to renew the policy except for failure to pay the premium, and the automatic renewal of the policy must provide, at a minimum, the insured with the option of renewal at the face value of the expiring policy. § 264.143 (e)(8). And, the policy must contain a provision allowing assignment of the policy to a successor owner or operator, though such assignment may be conditioned upon the consent and approval of the insurer, provided it is not unreasonably refused. § 264.143 (e)(7). Once final closure begins, an owner/operator may request reimbursements for closure expenditures by submitting itemized bills to EPA's regional administrator, who will, if the expenses are in accordance with the approved closure plan or are otherwise justified, instruct the insurer to make reimbursements in the proper amounts if the cost of closure do not exceed the current insurance policy. § 264.143 (e)(5).

RCRA financial assurance can also be established through a financial test and corporate guarantee for closure, whereby an owner/operator demonstrates the ratio of its total liabilities to net worth is less than 2; a ratio of the sum of net income, plus depreciation, depletion, and amortization to total liabilities greater than 0.1; and a ratio of current assets to current liabilities

of greater than 1.5; and a net working capital and net worth at least six times the sum of the current closure and post-closure cost estimates, and the current plugging and abandonment cost estimates; and tangible net worth of at least \$10 million. § 264.143 (f)(1). To demonstrate that an owner/operator meets this test, it must submit a letter signed by the entity's chief financial officer worded as specified in § 264.151 (f), and a copy of an independent, certified public accountant's report. § 264.143 (f)(3). The owner/operator must submit updated information within 90 days after the close of each succeeding fiscal year; if it no longer meets the requirements above, the owner/operator must send notice of intent to establish alternate financial assurance, which must be obtained within 120 days after the end of such fiscal year. § 264.143 (f)(6). This financial test alternative can also be met by obtaining a written guarantee from a guarantor that is the direct or higher-tier parent corporation of the owner/operator, or a firm with a "substantial business relationship" with the owner or operator. § 264.143 (f)(10).

Finally, an owner/operator may choose to use multiple financial mechanisms to achieve its financial assurance requirements. § 264.143 (g). Available mechanisms, however, "are limited to trust funds, surety bonds guaranteeing payment into a trust fund, letters of credit, and insurance. *Id.* Likewise, a single financial mechanism may be used to cover multiple facilities. § 264.143 (h). For all mechanisms, whenever the current closure cost estimate increases to an amount greater than the amount of credit or financial assurance, the owner/operator must within 60 days after the increase, increase the financial assurance accordingly; whenever the current closure cost decreases, the amount of assurance required may be reduced accordingly with written approval by the EPA regional administrator. § 264.143 (a)(7), (b)(7), (c)(7), (d)(7), (e)(9), (f)(6).

Similar mechanisms are available for funding post-closure financial assurance. § 264.145 et. seq. And, an owner/operator may satisfy the requirements for financial assurance for both closure and post-closure care for one or more facilities by using a trust fund, surety bond, letter of credit, insurance, financial test, or corporate guarantee that meets the specifications of §§ 264.143 and 264.145. § 264.146.

Beyond closure and post-closure financial assurance mandates, RCRA requires that owners/operators demonstrate financial responsibility "for bodily injury and property damage to third parties caused by sudden accidental occurrences arising from operations of the facility or group of facilities." § 264.147(a). As such, RCRA requires liability coverage "in the amount of at least \$1 million per occurrence with an annual aggregate of at least \$2 million, exclusive of legal defense costs." *Id.* Coverage may be achieved by acquiring a liability insurance policy, through a financial test or corporate guarantee, a letter of credit, a surety bond, by obtaining a trust fund, or a combination of such mechanisms. § 264.147 (a)(1)-(6).

Liability coverage must also account for non-sudden accidental occurrences, as well, in the amount of at least \$3 million per occurrence with an annual aggregate of at least \$6 million, exclusive of legal defense costs. § 264.147 (b). Coverage for sudden and non-sudden accidents can be combined into a single coverage, which must be at least \$4 million per occurrence and \$8 million annual aggregate. *Id.* Coverage, as above, may be achieved by acquiring a liability insurance policy, through a financial test or corporate guarantee, a letter of credit, a surety bond,

by obtaining a trust fund, or a combination of such mechanisms. § 264.147 (b)(1)-(6).

According to RCRA, evidence that the “past or present” handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste “may present an imminent and substantial endangerment to human health or the environment” is basis for suit by the EPA administrator. 42 U.S.C. § 6973 (a).

In applying RCRA liability standards, established in 42 U.S.C. § 6973 (a), *supra*, federal courts have held that “from the legislative history ... it is clear that Congress intended RCRA ... to impose liability without fault or negligence and to apply to the present conditions resulting from past activities.” *United States v. Northeastern Pharmaceutical & Chemical Co., Inc.*, 810 F.2d 726, 741 (8th Cir. 1987). The Eighth Circuit held that RCRA “imposes strict liability upon any person who is contributing or who has contributed to the disposal of hazardous substances that may present an imminent and substantial endangerment to human health or the environment.” *Northeastern Pharmaceutical & Chemical Co., Inc.*, 810 F.2d at 745. According to American Jurisprudence Proof of Facts 3d, RCRA is a public welfare statute, “designed to protect the public and the environment from the dangers posed by improper handling of wastes,” so “compliance with the statute is a matter of strict liability, and a defendant’s lack of negligence, intention to comply, or good-faith attempt to do so, are irrelevant to the question of a defendant’s civil liability for violating a RCRA permit provision, standard, regulation, condition, requirement, prohibition, or order, and to civil liability for the defendant’s past or present contribution to the creation of an imminent and substantial endangerment.” 40 Am. Jur. Proof of Facts 3d 457 § 46.

Comprehensive Environmental Response, Compensation and Liability Act, CERCLA (Superfund)
42 U.S.C. §§ 9601-9675.

Passed by Congress in 1980, CERCLA was designed to address abandoned hazardous waste sites, as opposed to active sites managed under RCRA, *supra*. The CERCLA Superfund, or the Hazardous Substances Response Trust, is maintained by assessing a tax on petroleum and chemical industries and also by general fund appropriations for the cleanup and management of sites for which no responsible party can be identified or held accountable, most commonly because of dissolution or bankruptcy. Under CERCLA, four classes of parties, known as “potential responsible parties,” may be liable for contamination at a Superfund site: the current owner or operator of the site; the owner or operator of a site at the time that disposal of a hazardous substance, pollutant or contaminant occurred; a person who arranged for the disposal of a hazardous substance, pollutant or contaminant at a site; or a person who selected a site for disposal and transported a hazardous substance, pollutant or contaminant to that site. Liability is also limited by recognizing in the statute certain defenses and by limiting the financial responsibility. Generally, courts have imposed strict and joint and several liability under CERCLA. *Northeastern Pharmaceutical & Chemical Co., Inc.*, 810 F.2d at 732, n. 3. See (<http://www.epa.gov/Compliance/cleanup/superfund/liability.html>), Last updated on Thursday,

March 23rd, 2006).

According to CERCLA, “the owner and operator,” “any person who at the time of disposal owned or operated any facility at which such hazardous wastes were disposed of,” “any person who by contract, agreement, or otherwise arranged for disposal of hazardous substances,” and “any person who accepts or accepted any hazardous substances for transport to disposal or treatment facilities ... or sites selected by such person, from which there is a release, or a threatened release which causes the incurrence of a response costs, of a hazardous substance” shall be liable. 42 U.S.C.A. § 9607 (a)(1)-(4). Liability includes “all costs of removal or remedial action incurred by the United States Government, or a State or an Indian tribe,” “any other necessary costs of response incurred by any other person consistent with the national contingency plan,” “damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss,” and “the costs of any health assessment or health effects study carried out” pursuant to CERCLA. 42 U.S.C.A. § 9607 (a)(A)-(D).

The liability imposed by CERCLA is joint and several, strict and retroactive. 80 Am. Jur. Proof of Facts 3d 281 § 4; see *Violet v. Picillo*, 648 F.Supp. 1283, 1290 (D.R.I. 1986) (“Courts have universally acknowledged that in enacting section 107 Congress created a strict liability scheme”). The joint and several liability imposed by CERCLA “means that any single defendant can be held responsible for the entire cost of a cleanup or other response costs.” 80 Am. Jur. Proof of Facts 3d 281 § 4. Strict liability means that a complainant need not establish negligence or breach of duty. *Violet*, 648 F.Supp at 1292 (“CERCLA section 107 requires only a minimal causal nexus between the defendant's hazardous waste and the harm caused by the release at a particular disposal site. CERCLA only requires that the plaintiff prove by a preponderance of the evidence that the defendant deposited his hazardous waste at the site and that the hazardous substances contained in the defendant's waste are also found at the site”). To establish a prima facie case of liability under CERCLA, the claimant must demonstrate that the contaminated site in question is a facility as defined in § 101(9) of CERCLA; that the defendant is among one of the four categories of potentially responsible parties listed in § 107 (a); a release or threat of release of a hazardous substance has occurred at the facility; and the release or threatened release has caused the government or private party to incur “necessary” response costs consistent with the National Contingency Plan. *Violet*, 648 F.Supp. at 1289. (“Courts have generally held that liability under section 107(a)(3) requires proof of four basic elements: 1) that the generator disposed of hazardous substances; 2) at a facility which contains at the time of discovery hazardous substances of the kind the generator disposed; 3) there is a release or a threatened release of that or any hazardous substance; 4) which triggers the incurrence of response costs”); see also 80 Am. Jur. Proof of Facts 3d 281 § 2.

Liability, however, is expressly limited by statutorily defined defenses, including “(1) an act of God; (2) an act of war; (3) an act or omission of a third party other than an employee or agent of the defendant, or than one whose act or omission occurs in connection with a contractual relationship ... with the defendant ... if the defendant establishes by a preponderance of the evidence that (a) he exercised due care ... and (b) he took precautions against foreseeable acts or

omissions of any such third party and the consequences that could foreseeably result from such acts or omissions; or (4) any combination of the foregoing paragraphs [(1) through (3)].” 42 U.S.C.A. § 9607 (b)(1)-(4).

CERCLA holds that “the liability of an owner or operator or other responsible person ... shall be the full and total costs of response and damages, if (A)(i) the release or threat of release of a hazardous substance was the result of willful misconduct or willful negligence within the privity or knowledge of such person, or (ii) the primary cause of the release was a violation ... of applicable safety, construction, or operating standards or regulations; or (B) such person fails or refuses to provide all reasonable cooperation and assistance requested by a responsible public official” in connection with cleanup response activities. 42 U.S.C.A. § 9607 (c)(2). Liability shall not exceed \$300 per gross ton or \$5 million, whichever is greater, for vessels carrying hazardous substances, or \$50 million or a lesser amount as may be established by the President in regulation, but not less than \$5 million, for motor vehicles, aircraft, hazardous liquid pipeline facilities or rolling stock. 42 U.S.C.A. § 9607 (c)(1)(A)-(C). For other facilities or vessels not covered in the subsequent sections, liability is limited to “the total of all costs of response plus \$50,000,000 for any damages ...” 42 U.S.C.A. § 9607 (c)(1)(D).

Despite limiting liability for non-willful releases and those abiding by applicable operating standards and regulations, CERCLA does provide for punitive damages “in an amount at least equal to, and not more than three times, the amount of any costs incurred by the Fund as a result of such failure to take proper action.” 42 U.S.C.A. § 9607 (c)(3). This subparagraph authorizes civil action against any such person to recover the punitive damages, which will be in addition to any costs recovered from such person...” *Id.*

The original version of CERCLA included a provision establishing a “Post-Closure Liability Fund”, 42 U.S.C.A. § 9607, designed to accept the transfer of liability for the costs of monitoring, care and maintenance of a hazardous waste disposal facility incurred by other parties after the period of monitoring required by the Solid Waste Disposal Act (42 U.S.C. § 6921), but this section was repealed by Pub. L. 99-499, Title V, § 514(b), Oct. 17, 1986, 100 Stat. 1767.

In addition to the Post-Closure Fund, which applied to hazardous waste disposal sites, CERCLA directed the comptroller general to conduct a study of options for post-closure management of the liabilities associated with hazardous waste treatment, storage and disposal sites that assures the protection of human health and the environment. 42 U.S.C.A. § 9607 (k)(6)(A). The study was to look at options for developing a post-closure program that (1) assured incentives for the safe management and disposal of hazardous wastes for the protection of human health and the environment; (2) so that members of the public will have reasonable confidence that hazardous wastes will be disposed of safely and that resources will be available to address any problems that may arise, and to cover costs of long-term monitoring, care and maintenance of such sites; and (3) so that people who seek to become owners and operators of hazardous waste disposal facilities will be able to manage their potential future liabilities and attract the investment capital necessary to build, operate, and close such facilities in a manner which assures protection of human health and the environment. § 9607 (k)(6)(B).

The study was to focus on ways to ensure hazardous waste facilities will be adequately financed and that the costs “to the greatest extent possible” are borne by the owners and operators. § 9607 (k)(6)(E). Among the options the comptroller general was explicitly directed to consider were (1) voluntary risk pooling by owners and operators; (2) legislation to require risk pooling by owners and operators; (3) limiting the transfer of liability to the Post-Closure Trust Fund only in cases of insolvency of owners and operators; (4) private insurance; (5) insurance provided by the federal government; (6) co-insurance, re-insurance, or pooled-risk insurance, whether provided by the private sector or provided by or partially subsidized by the federal government; and (7) the creation of a new program to be administered by a new or existing federal agency or by a federally chartered corporation. *Id.*

To protect against the possibility of un-reimbursed expenses related to the management, care or cleanup of sites being borne by the government, CERCLA provided for liens against all real property and rights to such property belonging to parties subject to CERCLA authority. § 9607 (l).

CERCLA provides that financial responsibility, as established and determined by § 9607, discussed above, “may be established by any one, or any combination, of the following: insurance, guarantee, surety bond, or qualification as a self-insurer.” § 9608 (a)(1). Lacking certification of such financial responsibility, CERCLA provides for various penalties, such as withholding or revoking clearances for vessels and blocking entry into ports, for example. § 9608 (a)(2), (3).

CERCLA provides in § 9611 for the expenditure of the Superfund for payment of governmental response costs, compensable claims that have not been satisfied, and claims from a release or threat of release of a hazardous substance for injury to or destruction or loss of natural resources, including costs for damage assessment. § 9611 (b)(1). The Act provides that natural resources claims can only be paid from the Superfund if the President determines the claimant has exhausted all administrative and judicial remedies to recover the sum from liable parties. § 9611 (b)(2)(A).

Safe Drinking Water Act, Underground Injection Control Program (SDWA UIC): 42 U.S.C. § 300f et seq.

The Safe Drinking Water Act’s (SDWA) Underground Injection Control (UIC) program regulates the underground injection of wastes to prevent the contamination of current and potential future drinking water sources. Enacted in 1974, the SDWA directed the EPA to set and maintain health-based standards for contaminants in drinking water. In the early 1980s the Act was amended to include the UIC program, which consists of regulations promulgated under Part C of the SDWA, for which primacy has been delegated to 34 states, including New Mexico,

operating under the authority of EPA to enforce the program.
(<http://www.epa.gov/safewater/uic/primacy.html> Last updated on Tuesday, February 28th, 2006).

The UIC lumps the injection of wastes into five classes, each class includes wells with similar functions, construction and operating features so that technical requirements can be applied consistently. Class I wells include the emplacement of hazardous and non-hazardous fluids (industrial and municipal wastes) into isolated formations beneath the lowermost underground source of drinking water (USDW). *Id.* Because they may inject hazardous wastes, Class I wells are the most strictly regulated and are further regulated under RCRA. *Id.* Operators of Class I wells “must demonstrate that their hazardous injectate will not migrate from the injection zone for as long as it remains hazardous. Stephanie M. Haggerty, *Legal Requirements for Widespread Implementation of CO2 Sequestration in Depleted Oil Reservoirs*, 21 Pace Env'tl. L. Rev. 197, 206 (2003) (citations omitted). Class I well operators must continuously monitor the injection well, the fluid within the well, and any possible migration out of the target injection zone. *Id.* (citations omitted).

Class II wells include those that inject brines and other fluids associated with oil and gas production, including injections for enhanced oil recovery, such as carbon dioxide. *Id.* (citations omitted). Operators of Class II wells in New Mexico must also ensure the injectate does not migrate beyond the target injection zone, and must identify other wells in the vicinity that could serve as pathways for migration. *Id.* at 206-207 (citations omitted). Class III wells cover the injection of fluids associated with solution mining of minerals. Class IV wells cover the injection of hazardous or radioactive wastes into or above a USDW and are banned unless authorized under other statutes for groundwater remediation. Class V wells cover all underground injection not included in Classes I-IV and cover the injection of non-hazardous fluids into or above a USDW. Class V wells are typically shallow, on-site disposal systems, such as floor and sink drains which discharge directly or indirectly into groundwater, dry wells, leach fields, and similar types of drainage wells, but also include experimental wells, such as those used to conduct carbon dioxide sequestration. Groundwater recharge wells, for aquifer storage or prevention of saltwater intrusion, are included within the Class V designation, as well.

According to the statutory authority granted by the SDWA, 42 U.S.C. § 300f et seq., regulations for state underground injection programs promulgated under the SDWA “shall contain minimum requirements for effective programs to prevent underground injection which endangers drinking water sources,” § 300h (b)(1), and that those regulations “may not prescribe requirements which interfere with or impede (A) the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production or natural gas storage operations, or (B) any underground injection for the secondary or tertiary recovery of oil or natural gas, unless such requirements are *essential* to assure that underground sources of drinking water will not be endangered by such injection.” § 300h (b)(2) (emphasis added).

Underground injection of carbon dioxide for purposes of climate mitigation would be/is regulated under the SWDA UIC program. (See

http://www.epa.gov/safewater/uic/wells_sequestration.html). Currently, the U.S. EPA is urging state directors and regional administrators to consider permitting proposed carbon dioxide sequestration projects, as distinct from enhanced oil recovery (EOR) projects, under UIC's Class V category as an experimental technology. (Using the Class V Experimental Technology Well Classification for Pilot Geologic Sequestration Projects – UIC Program Guidance (UICPG #83), March 1, 2007). In its guidance document, EPA recognizes that carbon dioxide sequestration could fit within the classification of Class I wells, as well. *Id.* at 5. EPA is clear in its guidance document, however, that no carbon dioxide sequestration project should be permitted as a Class II well, but that in the case where an EOR project using CO₂ injection intends to transition to a sequestration project, that project should seek re-permitting as a Class V well before transitioning. *Id.* at 6. No specific liability and financial assurance requirements exist for Class V wells beyond that which is standard for UIC injection wells. 40 C.F.R. §§ 144.51 and 144.52 (a)(7)(i) (“The permittee, including the transferor of a permit, is required to demonstrate and maintain financial responsibility and resources to close, plug, and abandon the underground injection operation in a manner prescribed by the Director”). However, Class I wells, because they may be permitted to inject hazardous wastes, do have separate financial assurance requirements, discussed below.

The current federal UIC program provides minimum rules for siting, testing, installing, operating, monitoring, reporting, and abandonment of underground injection wells, but “provisions that would provide for widespread application of carbon sequestration are absent from the current statutes.” 21 Pace Env'tl. L. Rev. at 208 (citations omitted). This is because the UIC program “was not developed with carbon dioxide storage in mind and the regulatory framework that governs carbon dioxide storage will probably deviate from the current system.” Mark de Figueriedo, David Reiner, Howard Herzog, Kenneth Oye, *The Liability of Carbon Dioxide Storage*, (unpublished). That said, it is anticipated “EPA’s regulatory framework for underground injection will shape the regulatory environment for geologic carbon storage and may inform assessments of the risks.” M.A. De Figueiredo, D.M. Reiner, H.J. Herzog, *Framing the Long-Term In-Situ Liability Issue for Geologic Carbon Storage in the United States*, Mitigation and Adaptation Strategies for Global Change, (2005) 10:647-657, 653 (citations omitted) (henceforth *Framing the Liability Issue*). This is especially likely given the final guidance released by EPA in March 2007.

Like RCRA and CERCLA, liability created under the UIC is borne by the owner/operator of the facility or process who must provide financial assurance and demonstrate financial responsibility in case of accidents. Unlike either RCRA or CERCLA, however, the SDWA includes no statutory provisions for financial assurance, which are instead found wholly within federal regulations promulgated pursuant to Part C of the SDWA. The general permit conditions themselves require financial responsibility for the adequate plugging and abandonment of all injection wells. 40 C.F.R. §§ 144.51 and 144.52 (a)(7)(i) (“The permittee, including the transferor of a permit, is required to demonstrate and maintain financial responsibility and resources to close, plug, and abandon the underground injection operation in a manner prescribed by the Director”). The UIC regulations do, however, have specific liability and financial assurance requirements that apply only to Class I wells. § 144.60 (stating that §§ 144.61 through 144.70 apply only to Class I wells). These financial assurance requirements are modeled on those

established by RCRA. *Framing the Liability Issue* at 654. As such, the wording is nearly identical to the financial assurance requirements in the RCRA regulations.

Before selecting a method of financial assurance, Class I well operators/owners must first establish a cost estimate for plugging and abandonment. § 144.62. The written cost estimate must be in accordance with the plugging and abandonment plan, as specified in §§ 144.28 and 144.51, and “must equal the cost of plugging and abandonment at the point in the facility’s operating life when the extent and manner of its operation would make plugging and abandonment the most expensive, as indicated by its plugging and abandonment plan.” § 144.62 (a). This cost estimate must be adjusted annually for inflation, according to § 144.62 (b), and whenever a change increases the estimated cost. § 144.62 (c).

As is the case for RCRA, owners/operators of Class I wells can meet the financial assurance requirements by selecting one of several mechanisms: a plugging and abandonment trust fund, a surety bond guaranteeing payment into a plugging and abandonment trust fund, a surety bond guaranteeing performance of plugging and abandonment, an irrevocable letter of credit, private plugging and abandonment insurance, financial test and corporate guarantee, or a combination of these financial mechanisms. § 144.63 (g). And, as in the case for RCRA and CERCLA, any of the above financial assurance mechanisms can be used to cover multiple injection wells. § 144.63 (h).

In addition to plugging and abandonment requirements, the UIC regulations also require the owner/operator of Class I wells to “prepare, maintain, and comply with” a closure plan, which “survives the termination of a permit or the cessation of injection activities.” § 146.71 (a). The closure plan must be submitted as part of the permit application and, with approval, becomes a condition of the permit issued. § 146.71 (a)(1) (§§ 146.61 through 146.73 are the criteria and standards applicable to Class I wells). As discussed above, the permit conditions themselves require financial responsibility for the adequate plugging and abandonment of all injection wells, not just Class I wells. § 144.52 (a)(7). According to the criteria and standards for Class I wells, the closure plan must include assurance for financial responsibility to “close, plug and abandon the underground injection in a manner prescribed by the Director,” as required in § 144.52(a)(7). § 146.71.

Beyond the requirement for maintaining a closure plan and financial assurance for proper plugging and abandonment, owners/operators of Class I wells must also prepare and maintain a post-closure plan, which survives the termination of a permit or the cessation of injection. § 146.72. Among the plan’s mandated elements is an estimate for the cost of post-closure care. § 146.72 (a)(4)(vi). Section 146.73 requires that an owner/operator “shall demonstrate and maintain financial responsibility for post-closure care by creating a trust fund, surety bond, letter of credit, financial test, insurance, or corporate guarantee that meets the specifications for the mechanisms and instruments revised as appropriate to cover closure and post-closure care in 40 CFR Part 144, Subpart F” and “shall be no less” than the amount identified in by the estimate in § 146.72 (a)(4)(vi). The obligation to maintain financial responsibility for post-closure care survives the termination of a permit or the cessation of injection and is enforceable regardless of

whether the requirement is a condition of the permit. § 146.73.

Unlike RCRA, UIC does not extend its regulatory language to include coverage responsibility for accidents, nor does it provide coverage for damage to personal property. 67 Am. Jur. Proof of Facts 3d 95 § 33. And unlike CERCLA, which has a focus on the protection of human health and environment, the UIC regulatory language is somewhat more narrowly confined to the protection of USDW against contamination which may result in a drinking water system not complying with any national primary drinking water regulations or may otherwise adversely affect the health of people. 42 U.S.C. § 300h (d)(2).

New Mexico has been delegated primacy for the oversight and enforcement of its underground injection program (except for Indian lands) pursuant to 40 C.F.R. § 147.1600, Part 147, Subpart GG of the federal regulations. According to the delegation the Oil Conservation Division administers the UIC program for Class II wells, except for those on Indian Lands, which are administered by EPA. This authority incorporates by reference the New Mexico Oil and Gas Act (§§ 70-2-1 through -36), the Oil Conservation Division Rules and Regulations rules 701 through 708, the New Mexico Water Quality Control Commission Regulations (rules 5000 through 5299), as well as the New Mexico Water Quality Act, the Geothermal Resources Conservation Act, the Surface Mining Act, the Memorandum of Agreement between the EPA Region VI and the New Mexico Water Quality Control Commission, the Environmental Improvement Division, and the Oil Conservation Division (1983), and other documents listed in § 147.1601. None of these regulations impose additional liability or financial assurance requirements beyond what is required by the federal regulations.

The liability standard applied to the UIC program and the Safe Drinking Water Act in general, appears to be one of strict liability, 42 U.S.C. § 300h-2, but no case law nor secondary sources have been found to offer any guidance on that point.

Low-Level Radioactive Waste Policy Act (LLWPA): 42 U.S.C. § 2021b et seq.

Unlike any of the liability models discussed, the Low-Level Radioactive Waste Policy Act (LLRWPA) provides that each state may be responsible for handling the disposal of low-level radioactive waste generated within the state, except essentially that which was created by the federal government. 42 U.S.C. § 2021b et seq. The Act also encourages states to work cooperatively to form compact regions as a means to handle commercially produced low-level waste.

According to the Act, each state or compact region in which low-level radioactive waste is generated “upon the request of the generator or owner of the waste, shall take title to the waste, shall be obligated to take possession of the waste, and shall be liable for all damages directly or indirectly incurred by such generator or owner as a consequence of the failure of the State to take

possession of the waste as soon after January 1, 1993, as the generator or owner notifies the State that the waste is available for shipment.” § 2021e (d)(2)(C). If the state or compact region “elects not to take title to, take possession of, and assume liability for such waste,” it must repay with interest any amount collected as a surcharge” over a certain period. *Id.* However, this provision of the Act, which was intended to provide states with an incentive to manage its low-level waste, was deemed by the Supreme Court to be unconstitutional and violative of the 10th Amendment. *New York v. United States*, 505 U.S. 144, 175, 112 S.Ct. 2408, 2428, 120 L.Ed.2d 120 (1992) (“Because an instruction to state governments to take title to waste, standing alone, would be beyond the authority of Congress, and because a direct order to regulate, standing alone, would also be beyond the authority of Congress, it follows that Congress lacks the power to offer the States a choice between the two”).

Written according to the proposals of the National Governor’s Association with the purpose of giving states more control over the siting of low-level waste dumps, the Act has been widely perceived as less than successful, for despite the formation of several compact regions no new low-level radioactive waste dumps have been established “largely because no state regulatory agency will approve a disposal facility within its borders.” *Framing the Liability, supra*, at 653. In effect, the incentives built into the Act are generally perceived to be too weak to prompt siting of new dump sites by host states which generally do not want dump sites located in their state. Deborah M. Mosteghel, *The Low-Level Radioactive Waste Policy Amendments Act: An Overview*, 43 DePaul L. Rev. 379 (Winter 1994). According to at least one interpretation, “[t]he example of low-level radioactive waste shows that liability regimes may discourage storage,” and “also raises questions of the efficacy of turning over liability to the states.” *Framing the Liability, supra*, at 653.

Liability Analysis

Literature evaluating the impediments to and feasibility of large-scale, commercial carbon dioxide sequestration has explored possible mechanisms to address the liability and financial assurance levels that might be required. This aspect of the regulatory framework can have a significant impact on the success and viability of any carbon sequestration program, as noted in the comments received from environmental groups and industry representatives on the draft interim report. Sufficient financial assurances and an appropriate and reasonable liability standard together with thorough, clear and reasonable regulations can create the required degree of certainty and predictability necessary for insurers to offer adequate coverage in this new and unexplored field and for operators to develop realistic business models. Similarly, sufficient financial assurance and a properly scaled liability standard, combined with protective regulations, can also instill confidence in the public that the state can manage and control this largely untested field while providing adequate protections and ensuring a mechanism for compensation and environmental mitigation should accidents occur. Further, as the literature discussed below explores, developing the right level of legal liability can create in insurers an additional layer of regulatory oversight beyond what the state itself could otherwise provide. All of this must be accomplished without placing an undue financial burden on the industry, or

otherwise stifling development of carbon dioxide sequestration projects, which are viewed as an important component of the state's climate change mitigation strategy.

According to the literature reviewed to date, liability and financial assurance can be accommodated on essentially four levels: (1) the federal government; (2) state government; (3) industry; or (4) the individual corporation or owner/operator. *Framing the Liability, supra*, at 653. Some combination of these will likely need to be employed to achieve the best balance of liabilities and to ensure adequate incentive exists to undertake sequestration projects, but selecting the right combination or balance will require careful consideration of the various interests and inherent risks.

Drawing on current oil and gas practices, the short-term liabilities inherent in any drilling or injection project – whether environmental or economic – can likely be best addressed through the contractual arrangements between generator and injector and the private market, as they are now. This may not be true, however, for the largest sequestration projects. Likewise, liabilities following the injection and closure phases of projects present a unique problem given the anticipated scale, both in terms of time (hundreds to thousands of years) and space, required for successful CO₂ sequestration and accurate CO₂ inventories. Liabilities facing this new field include potential trespass actions involving both surface and subsurface interests (e.g. hard-rock minerals, hydrocarbon minerals, and pore space), and harm to human health, private property, and/or to the environment due to sudden events or as a result of a leakage over longer time scales. Literature and studies to date on the topic suggest that wells and boreholes will present the most common risk of leakage to the surface and other non-target formations, but unknown or unanticipated sources of leakage or other unanticipated problems may represent the greatest risks in terms of actual costs and liability.¹⁰

Because of the breadth and depth of the unknowns over the requisite time scales involved in successful sequestration, transfer of liability to the public sector has been conceived of as one way to encourage the development of sequestration projects by limiting potential liabilities that must be born by the individual injector or the industry. But this liability model also raises many issues, such as how to limit the burden on the public and how to fund continued, long-term monitoring and verification efforts, as well as any potential long-term environmental mitigation or property compensation that may be required.

Alternatively, drawing from current environmental regulatory frameworks, the long-term liability could be maintained by the injectors themselves and managed according to the models established by one of several pre-existing environmental regulations, discussed above. An example of some combination of these models is presented below:

A liability scheme may:

- Impose strict liability for extraordinary occurrences, e.g. for contamination of protected groundwater sources, or for catastrophic releases (above a certain volume) of CO₂ to the atmosphere or to non-storage formations.

¹⁰ David Borins, personal communication.

- Impose a negligence standard for all other events and occurrences
- Impose strict liability for total response costs if willful misconduct or willful negligence is proven, or if the event was due to a violation of some applicable standard or regulation or if the operator failed to provide reasonable assistance with response operations
- Create an industry-funded pool with deferred premiums for accident coverage and environmental mitigation costs that exceed an individual's insurance liability
- Require demonstration of financial assurance for insurance and industry-funded deferred premiums
- Create a closure and post-closure trust fund (measuring, monitoring, mitigation and accidents (property and human health)), paid on a per-volume-injected basis
- Declare in the permit who the primary responsible parties will be who will bear the liability
- Limit defenses, as in CERCLA, to: 1) act of God; 2) act of war; and 3) an act or omission on the part of a third party or agent if the Defendant exercised due care to address precautions against potential consequences of third party acts or omissions that could have been reasonably foreseen to result
- Require financial assurance for plugging and abandonment of individual wells, as well as the injection project as a whole, based on an approved cost estimate (updated and maintained annually by the injector)
- Require submission of a closure plan and post-closure plan for review and approval by the Division

Transfer of Liability to Public Sector

Transfer of liability to the public sector is not without precedent, as a similar scheme was contemplated and employed briefly by CERCLA, which had in its original form created a "Post-Closure Liability Fund," 42 U.S.C. § 9607, that was designed to accept the transfer of liability for the costs of monitoring, care and maintenance of a hazardous waste disposal facility incurred by other parties after a period of required monitoring by the owner/operator (a maximum five-year period before eligibility for transfer with a \$200 million fund cap). The fund was obligated to pay all costs arising out of liability imposed by CERCLA with respect to a hazardous waste disposal facility after its closure, provided that the facility received a permit under Subtitle C of the Solid Waste Disposal Act, and complied with other regulatory requirements designed to protect against future releases of hazardous substances. *Superfund Amendments and Reauthorization Act of 1986: Hearing on S. 2892 Before the S. Comm. On Finance*, 98th Cong. 64 (Sept. 19, 1984) (statement of Mikel M. Rollyson, acting tax legislative counsel, Dept. of the Treasury). Thus, if these prerequisites were satisfied, future liabilities arising from the operation of the facility were shifted from the responsible parties to the Federal Government. *Id.* Because payment of the tax shifted liability for post-closure damages to the Federal Government, the tax payments could be equated with premium payments for post-closure Government liability insurance paid by such owners and operators. *Id.* Conversely, in the absence of such insurance,

owners and operators of disposal facilities would be liable for post-closure claims in perpetuity. *Id.*

Solid waste operators sought to retain the Post-Closure Liability Fund and the policy of shifting liability to the federal government. *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans.*, 98th Cong. 62 (May 15, 1984) (statement of Richard L. Hanneman, Dir. of Gov. Affairs, Nat. Solid Wastes Mgmt. Assoc.). According to testimony from the National Solid Waste Management Association, the Post-Closure Liability Fund was a prepaid, pooled-risk fund generated by payments from operators during the active life of a facility. *Id.* Those sites that operated with a Solid Waste Disposal Act permit, remained trouble free, and did not pose a threat to public health qualified for the fund, but the operator of the site remained responsible for monitoring and maintenance for 30 years after closure of the facility. *Id.* Arguments in favor of eliminating the fund included the concern that with limited liability, operators had no incentive to design facilities to last any longer than their liability endured. *Id.* The Association, however, argued that the performance of facilities would not be affected, as performance criteria were dictated by regulations guiding the issuance of operating permits, and that without such a fund, the public and government were gambling that the CERCLA Superfund or the responsible parties would still be around to pay for future cleanups, mitigation and compensation. *Id.* The Association argued that the fund “internalized” into the cost of disposal the cost of long-term protection and monitoring, so that generators of waste pay that cost upfront, thereby avoiding public subsidy of disposal. *Id.* at 67. As a compromise to those voicing concerns over the fund, the Association indicated its willingness to extend the waiting period for the transfer of liability and to increase or eliminate altogether the \$200 million cap on the fund, which was seen by some to be inadequate. *Id.*

At the time of these debates, the Hazardous Waste Council argued against the retention of the Post-Closure Liability Fund because “[t]he more rapid the transfer of liability to a federally-backed fund, the less incentive there is to pursue permanent and protective methods of management.” *Id.* at 129 (statement of Richard C. Fortuna, Exec. Dir., Hazardous Waste Treatment Council). Further, “[t]his attractive liability transfer also exacerbates the cost differential between treatment and disposal by allowing the long-term cost of facility liability, monitoring and maintenance to be assumed by the Federal government, rather than having these post-closure expenses internalized in the price of individual and land disposal transactions.” *Before the Subcommittee on Commerce, Transportation and Tourism, H. Comm. on Energy and Commerce*, 98th Cong. 197-198 (Feb. 28, 1984) (statement of Dr. Nelson Mossholder, Technical Dir., Stablex Corp., on behalf of the Hazardous Waste Treatment Council)

Criticism came from environmental groups, as well, which saw the Post-Closure Liability Fund as creating “an incentive to do the most modest, minimal cleanup, adopt the most minimal approach, that would get you by that first 5 years and not assume responsibility for the subsequent acceptability of the disposal practice.” *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans.*, 98th Cong. 474 (June 13, 1984) (statement of Kenneth Kamlet, Dir. Pollution and

Toxic Substances Div. Nat. Wildlife Fed.). According to the National Wildlife Federation's testimony, the fund "put() the incentive in the wrong place, in short, and we think that the environment and the public would be better protected without it, putting the liability on the shoulders of those that pursue these alternatives rather than on the shoulders of a less accountable trust fund of this sort." *Id.*

Another factor to be considered in the creation of such a post-closure fund is the level of funding that should be required. The CERCLA fund was criticized as being arbitrarily set at \$200 million, when the actual costs of any future mitigation that might be necessary were completely unknown and perhaps totally unpredictable. A similar difficulty will be faced when trying to determine the appropriate level of funding for a carbon dioxide sequestration post-closure fund, as no true precedent exists with which to determine adequate and reasonable funding levels for the areal extent and duration contemplated for sequestration projects.

The OCD makes no recommendation regarding management of post-closure liability for sequestration projects. Numerous policy issues and concerns must be addressed that could weigh heavily on any nascent sequestration industry and could have far-reaching consequences for the state's populace. Instead, an outline of issues is presented below for the contemplation of policy makers with the intention to pursue more in depth research following initial policy guidance.

The concept of a post-closure liability fund presents features that make it both attractive and problematic. Such a fund could establish a long-term money source for environmental mitigation and personal property and injury compensation far into the future that could potentially outlive the viability of any injector/operator or its insurance plan. Difficulties inherent in establishing such a fund include the challenge of determining proper payment levels and the concern that injectors/operators will engineer their operations to a minimum level necessary only to achieve transfer to the public sector, rather than to that which is most protective. Funding levels can be fluid and adapted on an interim basis as more data and experience accrues, but the risk remains that any funding level will be considered arbitrary to some extent; if it is set too high, the funding requirements will pose a disincentive to the industry; if it is too low, the fund won't be adequate to achieve the necessary protection and public confidence. Coupled with adequate and reasonable regulatory standards and oversight, concerns about minimally engineered systems can be addressed, but given the range of unknowns in this new field, these may never be fully eliminated.

Ultimately, a liability system similar to that established by the Price-Anderson Act might offer the greatest level of assurance and flexibility through, essentially, a triple layer of accountability. Initial liability could be addressed through a private insurance requirement, then for claims and mitigation that exceed an individual operator's insurance capacity, liability would be covered through an industry-funded deferred compensation program. For events that exceed the capacity of both, the state could step in to offer compensation and mitigation, either directly or through a re-insurance program of part or all of the industry's liability. This would have the benefit of creating an immediately available funding pool for liability claims through the insurance program, while extending liability to the entire industry for larger claims.

The primary drawback to such a system is the concept of indemnity, for which the Price-Anderson Act has received significant criticism. In a new field, such as carbon sequestration, the idea of indemnifying operators against liability for the most catastrophic events could be politically unpalatable and a non-starter. However, unlike the nuclear power industry, carbon dioxide sequestration likely poses a far-reduced threat compared to nuclear energy production and likely won't be considered an abnormally dangerous activity, similar to natural gas transportation and storage. For this reason, indemnifying the sequestration industry against catastrophic events should be considered less of a risk and less of an industry give away than it is perceived for the nuclear power industry.

Tagging the industry with a double layer of liability – private insurance and an industry-wide fund, in addition to well-bonding and project bonding requirements – could add up to a financial burden that is too unwieldy to spur industry development. Price-Anderson's approach to this problem, allowing the industry fund to be a deferred payment (until an event appears likely to exceed the insurance capacity), could be adapted to lessen the immediate and overall financial impact on any one operator and the industry as a whole. In addition, the deferred payment could be limited to a set amount/fraction of a larger total, as it is in the Price-Anderson scheme, for which each operator/injector would be liable in a given year or per occurrence.

The benefit of this approach is that owners/operators remain directly accountable through private insurance up to, perhaps, a maximum bearable level, before the burden shifts first to the industry itself, then to the public sector. To keep premiums to a minimum, operators would be encouraged to maintain demonstrably safe operations and the insurance industry, to limit their exposure, would serve as an added layer of oversight, in addition to the state's regulatory and statutory framework.

Transfer of liability and ownership of the injected gas to the public sector may pose too great a financial burden, especially for a state with a populace of limited means and other significant resource-demanding needs (e.g. education, health care). However, philosophically, everyone – not just industry – is responsible in part for climate change and should bear some burden for its mitigation. Transferring liability for sequestration projects accords with this philosophy.

An alternative to an outright transfer of liability to the public sector could be a program where the state acts as a re-insurer. More research needs to be done to determine how such a system might work.

Strict, Joint and Several Liability, Alternative Liability & Insurability

What level of liability, if any, ought to be imposed and whether that liability should be dictated by statute or left to the common-law system of the courts are additional determinations requiring initial policy guidance. Several factors speak to the benefit of statutorily defining the level of liability for different parties (e.g. injectors, generators, transporters) and for different events (e.g. catastrophic leaks, trespass, nuisance, contamination of drinking water sources), perhaps chief among them the predictability and public confidence gained that could eliminate to some extent

uncertainty that would otherwise serve as an impediment to development. At the same time, much can be said for limiting the initial regulatory and statutory framework overseeing a new field for which little practical data exists, allowing for greater flexibility in permitting until data can dictate appropriate and reasonable standards. Likewise, as more knowledge, data and practical experiences accrue, especially specific to New Mexico geology, proper and reasonable liability standards (e.g. strict liability, negligence, joint and several, alternative liability) may become apparent and applied in due course through the courts or by statutory amendments. The experience of national environmental laws provides some insight into this issue.

The nation's two chief environmental laws, RCRA and CERCLA, impose – through judicial interpretation in the case of RCRA and by express congressional intent in the case of CERCLA – strict liability against potentially responsible parties, and in the case of CERCLA, impose the additional burden of joint and several liability. In the early years of these laws insurers and industry representatives objected to the expansive nature of this liability scheme, urging Congress to eliminate language that allowed the courts to impose that level of liability, especially with regard to CERCLA. See *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans.*, 98th Cong. 518-527 (May 15, 1984). Around that time in the mid-1980s, law reviews noted that “[i]nsurers no longer offer pollution policies because of unpredictable judicial determinations of the scope and extent of insurer liability. The future availability of pollution insurance is doubtful.” Judith M. Nixon, *The Problem with RCRA – Do the Financial Responsibility Provisions Really Work?*, 36 Am. U. L. Rev. 133 (Fall 1986).

In the case of strict liability, however, it has been suggested that such a standard “probably makes claims more predictable than they would be under a negligence standard,” Jeffrey Kehne, *Encouraging Safety Through Insurance-Based Incentives: Financial Responsibility For Hazardous Wastes*, 96 Yale L. J. 403 (1986), because it is easier to predict when and under what conditions the insured will be held accountable. Generally, at common law, strict liability is reserved for those activities deemed to be abnormally dangerous or ultra-hazardous, which, at best, is an unanswered question in the case of carbon dioxide sequestration, but which will most likely be found not to be abnormally dangerous, similar to natural gas storage and transportation.

Strict liability

The hazardous waste industry argued that strict liability is a “harsh standard” applied under CERCLA and RCRA because many defendants could be liable even if they followed the standard of reasonable care and violated no regulations for releases “over which they had no actual control.” *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans.*, 98th Cong. 520 (May 15, 1984) (statement of John J. Fitzpatrick, Jr., Washington counsel to Gulf Oil Corporation). The American Insurance Association argued before Congress that strict liability applied under CERCLA verged on a standard of absolute liability, improperly lacking any evaluation of the conduct or nature of the activities of the defendant, and that such a standard

“necessarily depreciates incentives otherwise available to encourage defendants to act carefully and responsibly” because they were being held liable whether or not they spent time and resources acting responsibly. *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans.*, 98th Cong. 628 (June 13, 1984) (statement of The American Insurance Association).

It has been argued, however, that in the case of hazardous substances and waste managed by both CERCLA and RCRA, two public policy goals designed to protect human health and the environment are served by the imposition of strict liability: cleanup of hazardous waste contamination and deterrence of future contamination. Edmund B. Frost, *Strict Liability as an Incentive for Cleanup of Contaminated Property*, 25 Hous. L. Rev. 951 (1988). By imposing strict liability, federal regulators are assured of determining a responsible party, which in turn is a powerful motivator for operators to properly handle hazardous wastes. Applied to CERCLA, owner-operator liability “is both broader and narrower than the owner’s liability under the common law” strict liability standard. *Id.* “It is broader because it can attach whenever a facility is contaminated with any hazardous substances warranting response costs,” and “narrow[er] because it applies only to response costs (costs of investigation and cleanup), natural resources damages, and the cost of health assessments,” but not “to any liability for personal injury or any third party economic damages which may be attributed to the condition.” *Id.* As such, the statutory construction of CERCLA both assures the accountability of owners/operators for specified, targeted claims, while essentially limiting liability for personal injury and economic damages by requiring a higher standard of proof (negligence) for those claims.

In the larger scheme, a regulatory framework that includes detailed and protective criteria for the site selection, drilling, operations, closure and post-closure management and monitoring of sequestration wells and project areas together with express statutory language creating strict liability for certain events and/or parties could go a long way toward eliminating, or at least reducing, the unknown risks inherent in a developing technology so that insurers would be willing to provide at least some coverage. Further, such a scheme could offer significant benefits in terms of public acceptance of an unknown and potentially risky mitigation technology by providing for a lower standard of proof for some important claims and associated damages (e.g. apply a strict liability standard to any impairment of drinking water resources, vegetation die-off from leakage of CO₂, and subsurface trespass). This approach could provide for a more conservative (protective) handling of some high-profile concerns (drinking water sources), while allowing a higher standard of proof (negligence) to be applied to property damage and personal injury claims as a means of statutorily limiting injector liability. Without clear statutory language to dictate liability standards, injectors, insurers and the public must await the uncertain process of litigation for the courts to determine applicable liability standards, a process cited in the early years of CERCLA as a significant deterrent to insurers. Any imposition of a strict liability scheme, however, should be implemented with care and flexibility to ensure the standard is not onerous and properly serves the goals of protection and deterrence and does not cause project avoidance by being overly prescriptive, as opposed to being performance based.

Joint and Several Liability

Unlike strict liability, which has been argued increases the predictability of liability, joint and several liability potentially expands liability well beyond what an individual operator may have contributed to an accident or situation to the point that it may prevent insurers or injectors from participating, as in the early days of CERCLA. A consideration favoring a closer evaluation of the utility of joint and several liability in the field of carbon sequestration is that it ensures direct accountability regardless of the number and variety of parties involved in a given project, and may hasten settlement among potentially responsible parties, avoiding the cost of dilatory litigation proceedings.

Hazardous waste handlers argued against the imposition of joint and several liability because it “allows parties that contribute only small quantities of hazardous substances to release sites to be held liable for the full amount of cleanup costs and resource damages.” *Id.* This argument that joint and several liability presented a gross inequity constituted the repeated refrain from industry and insurance groups during the CERCLA amendment hearings in the mid-1980s. “By imposing joint and several liability, potentially responsible parties have no incentive to come forward, absent an enforcement action, to initiate a voluntary cleanup ... [this] not only discourages responsible corporate behavior, but it also guarantees cleanups will have to be initiated under adversarial conditions.” *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans., 98th Cong. 518-519 (May 15, 1984) (statement of John J. Fitzpatrick, Jr., Washington counsel to Gulf Oil Corporation).*

On the other hand, joint and several liability was seen as an ideal means to maintain responsibility and achieve a speedy, extra-judicial settlement among the parties, who have the best and most accurate knowledge of their own contributions, without the cost and dilatory effect of typically prolonged lawsuits. See *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans., 98th Cong. 87-95 (April 3, 1985).* The policy motivation driving the application of joint and several liability is that it “appropriately reverses or transfers the burden of proof to those who do have the knowledge or should have the knowledge of what materials went to those sites and that it is in their best interest to negotiate among themselves and come forward with a settlement.” *Reauthorization of and Possible Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980: Hearing on H.R. 5640 Before the H. Subcomm. on Water Res. of the Comm. On Public Works and Trans., 98th Cong. 29 (April 3, 1985) (statement of Thomas C. Jorling, Prof. of Env. Studies and Dir., Center for Env. Studies, Williams College).*

Though joint and several liability may make sense for hazardous waste, where numerous parties may have had access to various waste sites with varying degrees of responsibility (transporters, generators, etc.) over a long period of time, fewer parties are likely to be involved in any given carbon sequestration project. While there will be transporters, injectors, generators and landowners involved in carbon dioxide sequestration, because of the nature of the project relative to the handling of hazardous waste, joint and several liability seems to be an unnecessary standard to impose. Hazardous waste sites may contain a wide variety of wastes of varying dangers deposited by numerous responsible parties, whereas carbon dioxide waste would involve

disposal of a single, consistent waste from far fewer potential sources. All of these factors seem to suggest that the utility of imposing joint and several liability on carbon dioxide sequestration is less valuable than perhaps has been for the field of hazardous waste management. However, management of a single sequestration field would be unitized, so that if there were multiple injectors into a single field, there would be multiple potentially responsible parties, therefore parsing responsibility for a leak or other event might be difficult. In such cases, assigning joint and several liability might speed the resolution of any disputes over responsibility and encourage settlement among the parties while ensuring someone, ultimately, is held accountable. Courts have generally applied joint and several liability where two or more persons cause a single and indivisible harm. Thus, the assignment of joint and several liability might be best left to the courts as the facts of a given situation that might require its application cannot be completely anticipated and to impose it statutorily precludes the flexibility inherent in the courts.

Alternative Liability

Somewhat related to joint and several liability is the theory of alternative liability, which essentially shifts the burden of proving causation from the plaintiff to the defendants after the plaintiffs meet a threshold level of proof (that a harm occurred and that one of the defendants is the cause of the harm). Melinda H. Van der Reis, *An Amendment for the Environment: Alternative Liability and the Resource Conservation and Recovery Act*, 34 Santa Clara L. Rev. 1269, 1270 (1994). Before the successful advancement of alternative liability theory, plaintiffs were unable to recover if they could not apportion responsibility or establish which among several tortfeasors were responsible for the harm. Where alternative liability has been established and accepted, plaintiffs The theory of alternative liability is codified in section 433(B) of the Second Restatement of Torts, subsection (3), which states: “Where the conduct of two or more actors is tortious, and it is proved that harm has been caused to the plaintiff by only one of them, but there is uncertainty as to which one has caused it, the burden is upon each such actor to prove that he has not caused the harm.” 34 Santa Clara L. Rev. 1269 (citing Restatement (Second) of Torts § 433(B)(3)). In the comments on subsection (3), the Second Restatement of Torts explains that the rule “applies only where it is proved that each of two or more actors has acted tortiously, and that the harm has resulted from the conduct of some one of them,” which still remains the plaintiff’s burden of proof. Restatement (Second) of Torts § 433(B) cmt. (g). Further, the Restatement notes that “[t]he cases thus far decided ... have all been cases in which all of the actors involved have been joined as defendants. All of these cases have involved conduct simultaneous in time, or substantially so, and all of them have involved conduct of substantially the same character, creating substantially the same risk of harm, on the part of each actor.” Restatement (Second) of Torts § 433(B)(3) cmt. (h).

As comment (d) explains, “[t]he reason for the exceptional rule placing the burden of proof as to apportionment upon the defendant or defendants is the injustice of allowing a proved wrongdoer who has in fact caused harm to the plaintiff to escape liability merely because the harm which he has inflicted has combined with similar harm inflicted by other wrongdoers...” Restatement (Second) of Torts § 433(B)(3) cmt. d. The Restatement suggests that “in such a case the defendant may justly be required to assume the burden of producing that evidence, or if he is not able to do so, of bearing the full responsibility. *Id.*

In California, alternative liability theory has been extended to environmental cases where proving causation among numerous potential defendants has proved impossible. 34 Santa Clara L. Rev. at 1287 (citing *Zands v. Nelson*, 779 F. Supp. 1254 (S.D. Cal. 1991)). According to Van der Reis, “[a]pplication of modified burden-of-proof requirements [alternative liability] permits and encourages enforcement of environmental protection statutes, and should be applied more broadly to environmental regulations, leading to greater compliance and more careful handling by operators. 34 Santa Clara L. Rev. at 1270, 1287. She suggests that vague statutes, problems with burden of proof, and lapse of time between an event and injury, pose substantial difficulties for legislators trying to craft workable environmental statutes. 34 Santa Clara L. Rev. at 1287. She argues that for environmental statutes to be workable “[t]he potential liability of the actors involved in a hazardous waste generation, transportation, and treatment regime requires clear and unambiguous legislation” so that parties are aware of their potential liability at the outset of an undertaking. *Id.* Stating a clear and unambiguous liability standard has the additional benefit of allowing court to look at the legislation and understand the intent of the legislators, allowing them to rule accordingly, which they cannot do under RCRA, for example. *Id.*

In her recommendations for amending RCRA to establish an alternative liability standard, Van der Reis suggests that language should make clear that alternative liability applies in situations where multiple tortfeasors caused harm and where causation is difficult for a plaintiff to prove. 34 Santa Clara L. Rev. at 1296. Further, language should require plaintiffs to meet a slightly higher initial threshold of proof before the burden is shifted to the defendants to maintain equity, and language “should delineate the defendant’s burden if alternative liability is implicated.” *Id.* Where the liability standard is clear and does not favor environmental defendants, there will be less confusion and debate over what level of liability is imposed, and there will be greater consistency in enforcement and compliance. *Id.* However, the author does acknowledge that broader application of the alternative liability theory may also “significantly” widen the scope of environmental litigation, encouraging plaintiffs to redress their injuries in court. 34 Santa Clara L. Rev. at 1270.

Statutorily instituting alternative liability may induce the benefits ascribed to it by Van der Reis; certainly the literature tends to support the concept that predictability and certainty rooted in clear statutory language can aid the development and growth of an un-tested industry. At the same time, shifting the burden of proof to the defendants early in the life of a regulatory scheme might prevent a liability standard from naturally settling out of its own accord in a way that meets the needs of the disparate parties, and such an imposition could simply add to the burden of a nascent and unproven industry. However, similar to the argument for strict liability, imposing alternative liability could serve as an effective means of reassuring the public that operators and injectors of carbon dioxide will be held liable when at fault for harm, even if causation is difficult to prove, as it may very well be given the size and duration of anticipated projects.

Un-insurability

Also discussed in the CERCLA reauthorization debates of 1984-85 was the issue of the un-insurability of hazardous waste facilities and waste disposal sites given the retroactivity of the Act, a perceived certainty that seepage would occur at some point, and the unknown and

seemingly expansive liabilities an insurance company would be taking on. *Superfund Amendments and Reauthorization Act of 1986: Before the S. Comm. On Environment and Public Works* 87-95 (April 3, 1985). See also L. De-Wayne Layfield, *CERCLA, Successor Liability, and the Federal Common Law: Responding to an Uncertain Legal Standard*, 68 Tex. L. Rev. 1237 (May 1990). At the time several prominent leaders in the insurance industry testified to the un-insurability of hazardous waste sites; they were critical of provisions that allowed for the un-contracted for extension of liability of a responsible party through joint and several liability – potentially making one party financially liable for all the costs associated with a hazardous waste site even though their privately negotiated insurance contract specified a lower-level of liability. *Id.* at 26-37. The difficulties identified and associated with insuring hazardous waste sites are that numerous parties may be responsible over decades for delivering waste to a given site, so identifying responsible parties and allocating their culpability is a challenge and may be done somewhat arbitrarily through joint and several liability. Also, insurers suggested that “because of the near certainty that leakage will occur and the open-ended nature of the resulting liability” it was impossible for the private sector to provide insurance. *Superfund Amendments and Reauthorization Act of 1986: Before the S. Comm. On Environment and Public Works* 35 (April 3, 1985) (statement of William O. Bailey, president of Aetna Life & Casualty and the immediate past chairman of the American Insurance Association). Further, insurance companies asserted that the provision for strict liability was a significant impediment to insurability given that even if a party acted with reasonable care and violated no regulations they could still be held liable for harm done. *Id.* at 140-141.

In these debates, insurers tended to want to shift the burden for what they perceived as an un-insurable practice, due in large part to the certainty of seepage, to the public sector, similar to the way flood insurance has been handled jointly between the public and private sectors. *Superfund Amendments and Reauthorization Act of 1986: Before the S. Comm. On Environment and Public Works* 38 (April 3, 1985) (statement of Jones, T. Lawrence, President American Insurance Association). At that time, insurers felt that responsible parties were attempting to unfairly transfer liability, beyond what the premiums were intended to cover, to the insurers. *Id.* at 97-102.

Authority to Impose Sequestration Fee on Injected CO2 Volumes & Tax Exemptions

Issue:

If it is decided that a transfer of liability and ownership of sequestered CO2 to the public sector is proper, it is contemplated that there should be some fund available to cover the monitoring, measurement, verification (MMV) and mitigation costs associated with long-term management of sequestration projects following operational and post-closure phases.

Such a fund could be managed by the state and based on a fee assessed per volume sequestered.

Issues Raised During Workgroup Meetings:

- Will the fee apply only to CO2 injected for sequestration purposes and not to EOR projects?

- How will the state handle out-of-state CO₂ generators sequestering in state? Will out-of-state generators be assessed a fee at the state line? Or at the point of injection?
- EOR associated with sequestration should be subject to an increased severance tax, reflecting the benefit conferred to interest owners by the recovery of otherwise non-economic resources, reserving the proceeds in a Superfund-type account to address potential future environmental remediation.
- The possibility of exemptions/financial incentives was not discussed to any great extent.

Analysis:

CO₂ sequestration literature has proposed a per-volume injection fee as a means to cover the unknown costs of long-term monitoring, measurement, verification and mitigation:

- Injection Fee
 - Mandatory contributions by injection operators to a fund managed by the state, to be used exclusively for the long-term monitoring, measurement, verification and mitigation of CO₂ storage once liability transfers to the state.

Texas has proposed a tax-exemption provision for anthropogenic CO₂ sequestration (H.B. 3431). The major provisions of the exemption are as follows:

- Producer of oil or gas recovered through an enhanced recovery project is entitled to a reduction in severance tax rate if recovery of oil uses carbon dioxide that is from an anthropogenic source, would otherwise be released to the atmosphere, and is ultimately sequestered (per OCD definition) in one or more geological formations
- Qualification for tax reduction is granted following certification by regulatory agency
- Certification requires demonstration based on substantial evidence that there is a reasonable expectation that sequestration will result in at least 99 percent of CO₂ remaining sequestered for at least 1,000 years
- Monitoring and verification for a period sufficient to demonstrate whether the sequestration is performing as expected
- Tax reduction does not apply if measuring and verification determine a different amount is being stored

Authority to Bond Injection Projects & Facilities

Issue:

Aside from the costs associated with post-closure MMV and potential mitigation, are the costs associated with reclaiming project sites and facilities following injector abandonment or insolvency. The state would need to ensure that injectors provide adequate financial assurance to cover the cost of any necessary plugging, reclamation or mitigation required as a result of abandonment or insolvency.

Issues Raised During Workgroup Meetings:

- Should bonds be required for a project and surface facilities, as well as for individual wells.
- Excessive bonding will discourage operators from undertaking sequestration projects and make them cost prohibitive given the range of cost unknowns already contemplated.

Authority to Enter Land for Inspection

Issue:

The state will need clear authority to enter surface estates to inspect facilities and the integrity and functioning of injection wells and other bore holes that may penetrate the CO2 sequestration zone. And in the event of the transfer of ownership/liability to the state, the Division will require authority to enter surface properties to plug abandoned wells and reclaim sequestration surface facilities.

Protection of Surface Owner Interests

Issue:

The Surface Owners Protection Act applies only to exploration, drilling or production of oil and gas, and would need to be amended to include activities related to the sequestration of carbon dioxide to adequately protect the interests of surface owners in the same way they are currently protected for oil and gas production.

CONCLUSION OF STATUTORY ISSUES

IDENTIFIED REGULATORY ISSUES

The above issues will need to be considered or addressed in any statutory scheme to facilitate the geologic sequestration of Carbon Dioxide. Once the policy decisions are made and the regulatory direction is determined, the rules to support those decisions will need to be implemented. An outline of the regulatory issues that must be addressed is as follows:

General

- Statement of Division's General Authority
- Enforcement/Penalties
 - Adopt OCD rules and penalties for noncompliance (70-2-31)
 - Maximum of \$1,000/day/violation
 - Some provision for criminal penalties
 - Prevent operator from selling product (if CO₂ used to enhance hydrocarbon recovery)
 - OCD can seize and sell product (if CO₂ used to enhance hydrocarbon recovery)
 - OCD can revoke permits
 - OCD can shut in injection wells
 - Prohibit the degradation of groundwater (UIC)
- Prohibit venting of CO₂
 - Provide for emergency venting provisions.
 - Allowance for equipment failure.
- Definition of Permanent Sequestration
 - Establish maximum acceptable leakage rate (1% over 1000 years?).
- CO₂ Registry
 - Mesh CO₂ sequestration accounting requirements with state registry program?
 - Ensure proper accounting of net anthropogenic CO₂ sequestration in cycled enhanced hydrocarbon projects.

Siting & Permitting

- Property Rights
 - Injector must demonstrate sufficient/adequate property rights
 - Pore space
 - Agreement/rentals with surface owners
 - Condemnation via eminent domain
 - Threshold interest to establish right to condemn
 - Mineral interests
 - Unitization (voluntary or compelled)

- Guidelines for compelling unitization of CO2 sequestration zone
 - Parties to unitization
 - Provide for contractual relationship
 - Procedure for federal/Indian minerals
 - Notice to surface owners and mineral interests within unit and extending to a defined distance beyond (1 mile?)
 - Opportunity to contest/protest unitization through hearing process
 - Provision to allocate costs when not covered by contract (compelled unitization)
 - What costs included?
 - Cycling/re-injecting CO2?
 - Costs of original CO2 injection?
 - Capital costs
 - Operating costs
 - Transportation of CO2 to site?
 - Allocation of production
- Mineral Leases
 - Existing
 - Establish which party must ensure the integrity of existing wells penetrating the storage zone.
 - New Operations
 - Can drill through storage zone if successfully demonstrate that drilling won't impact storage reservoir integrity
 - Require new wells to analyze strata above and below storage unit for CO2 and report findings
 - Site & Reservoir characterization and mapping (baseline data)
 - Reservoir
 - Type
 - Depleted oil
 - Water drive
 - Depletion drive
 - Depleted gas
 - Unminable coal seam
 - Saline aquifer
 - Original reservoir pressure
 - Injection pressures should not exceed fracture pressure and reservoir pressure should not exceed the original reservoir pressure unless the injector can demonstrate otherwise through a formal hearing process
 - Determine Reservoir size and areal extent (final storage volume)
 - Depth (average depth) and volume of proposed storage reservoir
 - Groundwater/drinking water sources (depth/height to source)

- Include deepest groundwater source
- Map faults
- Seismic/tectonic history and activity
- Regional pressure gradients
- Baseline measurements
 - Groundwater chemistry
 - Surface soils
 - Connate fluids
- Wells (determine location and status of all wells within unit and buffer zone)
 - Fracturing history of existing wells.
- Trapping mechanism (geochemical, stratigraphic, etc.)
 - Stratigraphic position and thickness of all confining strata
 - Determination of confinement mechanism to prevent CO₂ mobility
 - Stratigraphic discontinuities/spill points and likely potential leakage points
- Injection
 - Proposed Injection pressures below reservoir fracture pressure
 - Proposed volumes and rates of injection
 - Demonstrate Frac gradient (frac pressure limits)
 - Proposed monitoring and modeling methods for injected CO₂ plume
- Radius of Influence/Area of Review
 - Locate all wells (water, oil and gas, plug & abandoned)
 - Determine if properly cased/plugged to prevent leakage/seepage of CO₂ into other formations or to surface
 - Areal extent of monitoring defined
- Proposed public safety and emergency response plan
 - Worker safety and training plan
 - Corrosion monitoring and prevention plan
 - Leak detection and monitoring plan for all wells and surface facilities within the areal extent of unit
- Siting
 - OCD/Commission to approve proposed injection well site and containment/reservoir modeling
- Bonding
 - Establish independent bonding requirements (separate from oil and gas production bonding) to cover abandoned CO₂ injection projects and surface facilities
 - Bonding for individual wells
 - Effect on CO₂ generator? Need some bail out if contractual injector fails to meet contractual agreement?
- Notice Requirements

- Surface owners within x distance (1 mile ?) beyond unit area
- Mineral interests within unit area
- Interests within a buffer zone beyond areal extent of unit (1 mile?)
- Include legal description of permit area, date, time and place of hearing for permit
- Permit conditions
 - Fully revocable by OCD
 - Monthly reporting
 - Injected volumes
 - Reservoir pressures
 - Groundwater monitoring
 - 5-year major permit review
 - Injector demonstrates full permit compliance and containment
- Procedure and Requirements for Transfer/Sale of Sequestration Project
 - Require permit review at time of transfer if prior to post-closure period (?)
 - Allow for modification of permit at time of transfer(?)
 - Allowing full permit review at transfer may impose too many uncertainties
 - Continuation of bonding

Drilling & Operations

- OCD Right of Entry
 - Monitoring
 - Inspection
 - Plug/re-plug problem/abandoned wells
- Casing requirements
 - Ensure protection against acid degradation with proper casing
 - Demonstrate well is cemented to adequately confine injectate
 - To protect fresh water
- CO2 purity
 - 90-95 percent (?) (90 percent recommendation by Southwest Regional Partnership; 95 percent in Sen. Bingaman's bill)
 - Re-circulation of CO2
 - Account for volumes circulated (mass balance, how much CO2 is circulated in EOR projects; avoid double sequestration credit)
- Operators right of surface entry
 - Injection operator has right to enter and properly plug abandoned or problem wells within project area to ensure integrity of sequestration project
- Monitoring during injection
 - Injection well integrity

- Corrosion monitoring
 - Integrity of wells producing in or drilled thru injection zone
 - casings
 - groundwater
 - surface soils
 - formation pressure
 - Distributed observation wells
 - CO2 plume
 - OCD to approve monitoring/modeling proposal
 - CO2 leakage (out of formation/target zone) and seepage (to the surface)
 - Measure/trap CO2 emissions from surface facilities (plants/compressors)
 - CO2 purity
- CO2 safety
 - Public and worker safety and emergency response plans
 - Demonstrate adequate worker training
 - Posted contact info at all surface facilities and wells within unit area?
 - Contingency plans
 - Individual wells and project
 - Venting prevention
 - Allowable leak rate
 - From injection well?
 - From formation?
 - Mechanical Emergencies

Post-Injection & Closure

- 10-year demonstration of reservoir and well integrity after cessation of injection phase before evaluation for potential transfer of ownership/liability? Or proper length of time to demonstrate integrity after injection phase (when formation pressures stabilize)?
 - Demonstrate site/formation stability (Gorgon/Australia)
 - Alternative: set up a closure/transfer window – transfer/closure shall occur no sooner than a given length of time after injection ceases and no later than a certain time after injection ceases
 - Demonstrate integrity of wells (both injection and those perforating unit)
 - Can petition Commission to shorten demonstration period
 - Allowable leak rate/percentage?
 - Disallow blowdown of formation in CO2 sequestration projects (without re-injection of CO2)
 - Transfer liability of only those projects that meet expectations/minimum leak rates?
- Monitoring
 - Well Pressures
 - Inject N2 at end of injection phase for monitoring/safety (Dr. Lee)

- Soil
- Groundwater
 - Groundwater monitoring wells
 - 1 up-gradient, 3 down-gradient (gradient may change over long time spans)? Adequate for areal extent?
- Status/behavior of CO2 plume over time?
 - Proposed monitoring/modeling to be approved by OCD
- Plugging
 - Within a certain time of termination of injection phase, all injection wells must be plugged
 - State inspector on site at time of well closure/plugging
- Reclamation/Restoration of surface
 - All surface facilities to be removed and surface reclaimed
- Qualifications for transfer
 - Closure report
 - Final assessment of operations
 - Volumes injected/extracted
 - CO2 purity
 - Chemical analyses of injectate/groundwater
 - Summary of monitoring
 - Current position and characteristics of areal extent of CO2 plume
 - Model and predicted behavior of plume

Post-Closure

- Transfer of liability
 - Option for injector/operator to retain ownership/liability
 - Notification of transfer
- Long-term monitoring plan
- Mitigation plan