Complete Information Collected for State Case Studies

I. REGULATORY AUTHORITY

A. CALIFORNIA

1) Oil and Gas
   - Dept. of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR) – Regulates Oil, gas, EOR, EGR, and the UIC Program.
2) Water
   - The State Water Resources Control Board and Regional Water Quality Control boards are responsible for the management of water resources.[1]
3) Environment
   - California Air Resources Board/CalEPA – air pollutants (CO_2 emissions from vehicles)
4) Power Plants
   - California Energy Commission – is responsible for power plant licensing & permitting.

B. TEXAS

1) Oil and Gas
   - Texas Railroad Commission (TRRC) – oil and gas, pipelines, UIC (class II).
     - **Note**: Under specific FutureGen legislation, the TRRC (i) regulates CO_2 injection for EOR; and (ii) has liability for all injected CO_2 (both EOR and deep saline) from the facility.

   - The Texas Administrative Code provides a comprehensive regulatory scheme for the underground storage of any gas.[2] Specifically, the Code defines "gas storage well" as "a well used for the injection or withdrawal of natural gas or any other gaseous substance into or out of an underground gas storage facility."[3] To take advantage of this broad definition, an entity interested in underground CO_2 storage in Texas would need to get a permit from the TRRC. The underground storage permit process is comprehensive and requires, inter alia, public notice, protection of fresh drinking water, and multiple safety guarantees.

2) Water
   - Groundwater use is increasingly regulated by local Groundwater Conservation Districts (GCDs) as mandated by the Texas Water Code.[4] The purpose of the GCD is "to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those

[1] Cal. Water Code, §13100.
[2] 16 T.A.C. § 3.97 (2006).
[3] 16 T.A.C. § 3.97(a)(6).
[4] Tex. Water Code § 36.0015.

groundwater reservoirs or their subdivisions," and is the preferred method of groundwater regulation by the Legislature.[5]

- In addition to GCDs, groundwater is also regulated by the Texas Groundwater Protection Committee, an interagency committee designed to coordinate the regulations of groundwater by multiple state agencies.[6] State agencies delegated the responsibility of protecting groundwater are the Department of Agriculture, the Railroad Commission of Texas, and the State Soil and Water Conservation Board.[7]

3) Environment
   - Texas Council on Environmental Quality (TCEQ) – UIC (classes I, IV, V)
     Note: Under specific FutureGen legislation, the TCEQ regulates CO_2 injection into deep saline aquifers.[8]

C. WYOMING

1) Oil and Gas
   - Wyoming Oil and Gas Conservation Commission – regulates class II wells under the Underground Injection Control (UIC) Program.[9]
2) Water
   - Wyoming Department of Environmental Quality, Water Quality Division
     - Regulates class I, IV and V wells under the UIC Program.[10]
     - Regulates groundwater pollution control, operates the water and wastewater program, and maintains surface water quality standards.[11]
3) Environment
   - Wyoming Department of Environmental Quality, Land Quality Division
     - Regulates class III wells under the UIC Program.[12]
     - Administers and enforces regulations regarding land disturbances resulting from mining and reclamation.[13]
4) Power Plants
   - Wyoming Public Service Commission – regulates electric industry, including pipeline siting and construction.[14]

D. MICHIGAN

1) Oil and Gas
   - **Michigan Department of Environmental Quality, Oil & Gas** group regulates drilling activities and everything related to minerals (coal, oil and gas classified as

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[5] *Id.*
[6] Tex. Water Code §26.403(a).
[7] *Id* at §26.406(b).
[8] 30 T.A.C. § 331.11(a)(4)(d) (2006); see FutureGen Alliance, http://www.futuregenalliance.org.
[9] http://deq.state.wy.us/wqd/groundwater/uicprogram/index.asp.
[10] *Id.*
[11] http://deq.state.wy.us/wqd/index.asp
[12] http://deq.state.wy.us/wqd/groundwater/uicprogram/index.asp.
[13] http://deq.state.wy.us/lqd/index.asp.
[14] *See* http://psc.state.wy.us/default.htm.

minerals) (MDEQOG). One charge: Prevention of Waste and Conservation of Oil and Gas.[15]

- "Declaration of Policy; conservation of oil and gas.
  Sec. 61502. It has long been the declared policy of this state to foster conservation of natural resources so that our citizens may continue to enjoy the fruits and profits of those resources. Failure to adopt such a policy in the pioneer days of the state permitted the unwarranted slaughter and removal of magnificent timber abounding in the state, which resulted in an immeasurable loss and waste. In an effort to replace some of this loss, millions of dollars have been spent in reforestation, which could have been saved had the original timber been removed under proper conditions. In past years extensive deposits of oil and gas have been discovered that have added greatly to the natural wealth of the state and if properly conserved can bring added prosperity for many years in the future to our farmers and landowners, as well as to those engaged in the exploration and development of this great natural resource. The interests of the people demand that exploitation and waste of oil and gas be prevented so that the history of the loss of timber may not be repeated. It is accordingly the declared policy of the state to protect the interests of its citizens and landowners from unwarranted waste of gas and oil and to foster the development of the industry along the most favorable conditions and with a view to the ultimate recovery of the maximum production of these natural products. To that end, this part is to be construed liberally to give effect to sound policies of conservation and the prevention of waste and exploitation."[16]

- **EPA Region 5** has primacy for all classes of injection wells.
- **Overview of Regulations:**
  - Oil and Gas exploration, drilling, and operating is regulated under the Natural Resources and Environmental Protection Act, Act No. 451 of the Public Acts of 1994, as amended (last amended 9/10/2004).
  - Michigan's Oil and Gas Regulations includes the following:
    - Part 615 - Supervisor of Wells
    - Part 616 - Orphan Well Fund
    - Part 617 - Unitization

E. INDIANA

1) Oil and Gas

- Indiana Department of Natural Resources (DNR) Division of Oil and Gas regulates the drilling, completion, monitoring, plugging and abandonment of Class II wells; injection for enhanced oil recovery; and underground storage.[17]
- USEPA Region 5 administers Class 1 and V wells. There are no Class III Wells in Indiana [40 CFR 144.6.] Although the state does not have primacy, the UIC rules for the Indiana Department of Environmental management are authorized by IC 14-37-3 found at 312 IAC16-1-1 *et seq*.

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[15]

[16] Mich. Comp. Law Ann. § 324.61502 (West 2006).

[17] http://www.in.gov/dnr/dnroil/

2) Water
   - Indiana Department of Natural Resources (DNR) Division of Water is manages and regulates state surface and groundwater resources.[18] State water quality is monitored by the Indiana Department of Environmental Management, Office of Water Quality.[19]

3) Power Plants
   - The Indiana Utility Regulatory Commission (IURC) regulates power plants in their roles as utilities as well as pipelines[20].
   - The Indiana Department of Environmental Management (IDEM) regulates power plant air & water emissions.
   - The Indiana Department of Natural Resources (DNR) monitors power plants' water use and impact.

F. ILLINOIS

a. Pollution Control Board in conjunction with Illinois Environmental Protection Agency (IEPA): UIC I, IV, V
b. Department of Natural Resources, Office of Mines and Minerals, Oil and Gas Division: oil and gas, UIC II
   - The Oil and Gas Division runs the Underground Injection Control Program to monitor the construction and operation of Class II injection wells in IL.
c. Illinois Commerce Commission: pipeline siting and safety

G. KENTUCKY

- Environmental and Public Protection Cabinet**:** [21]
  - Department for Environmental Protection
    - *Division of Air Quality*[22] –
      i. Since 1967, Kentucky has operated an air-quality monitoring network. There are 143 monitoring sites in 31 different counties. The monitoring sites are located near populous areas or polluted sites with U.S. EPA guidance.
      ii. The Division of Air Quality achieves and maintains air quality through:
         - Operation of the air monitoring network;
         - Creating effective partnerships with air pollution sources and the public;
         - Maintenance of a reasonable and effective compliance assurance program.
    - *Division of Environmental Services*[23]
      i. KYDES is responsible for monitoring the environmental status of underground storage tanks, groundwater, and rivers/lakes/streams, as well as taking enforcement actions and ensuring permit compliance.

[18] http://www.in.gov/dnr/water/about/index.html
[19] http://www.in.gov/idem/programs/water/index.html
[20] http://www.in.gov/oucc/publications/MerchantPlantFS.html
[21] *See generally*, http://www.eppc.ky.gov/cabinetagencies/.
[22] http://www.air.ky.gov/.
[23] http://www.dep.ky.gov/lab/.

- *Division of Waste Management*[24] – implements waste management program to protect human health and the environment.
- *Division of Water*[25] – manages and protects water resources.

- Department for Natural Resources
  - *Division of Abandoned Mine Lands*[26] -
    i. Manages state's coal mines to protect public from health and safety problems
    ii. Operates the water supply replacement program, which extends waterlines into areas where coal mining contaminated drinking water.
  - *Division of Oil and Gas Conservation*[27] – manages exploration and extraction of all mineral resources, minimizes surface loss and damages, and encourages the maximum recovery of oil and gas from all deposits.

- EPA Underground Injection Control Program
  - Preventing contamination of groundwater supplies from underground injection or other activities.
  - Regulating Class II wells which are injection and/or disposal wells associated with the production of oil and natural gas.
  - *Division of Oil and Gas* is responsible for
    - Regulating the bonding, permitting, drilling, casing, operating and plugging of all wells.
    - Protecting the correlative rights of mineral owners.
    - Conserving and protecting the crude oil and natural gas reserves of Kentucky.
    - Insuring fresh water aquifers and mineable coal seams are protected from unreasonable damage due to production of crude oil and natural gas.
  - *Division of Water* is responsible for
    - Preserving the water resources of Kentucky.
    - Prevention, abatement and control of all water pollution.
    - Regulating water pollution from oil and gas facilities.
  - *Division of Waste Management*
    - Insuring that waste management activities within Kentucky are conducted in a manner to protect human health and the environment.

Regulating hazardous waste, solid waste, special waste, abandoned sites, underground storage tanks and remediation of chemical and petroleum releases to the environment.

II. EXPERIENCE WITH CO_2 INJECTION - EXISTING PROJECTS, INSTITUTIONAL CAPACITY/RESOURCES TO REGULATE

A. CALIFORNIA

- Historic Carbon Dioxide Injection Projects[28]

Field Name	*Project Type*	*Timeframe*	*Cumulative Net CO_2*

[24] http://www.waste.ky.gov/.
[25] *Id.*
[26] http://www.aml.ky.gov/.
[27] http://www.dogc.ky.gov/.
[28] CITE.

			Injected (Mcf)
Coyote East, Hualde Dome Unit	WAG	1982-1984	143,080
Huntington Beach, Onshore Area A-37	Cyclic	1981-1982	1893,892
Wilmington, Fault Block I	WAG	1983-1986	2,329,900
Wilmington, Fault Block III	WAG	1981-1996	3,490,301
Wilmington, Fault Block V	WAG	1982-1989	8,463,295
Venture D-6	Pilot flood	1988-1988	216,159
Coles Levee, North Stevens	Flood	1981-1984	1,706,355
Lost Hills, Etchegoin	Pilot/WAG	2000-2002	1,886,421
State Total			*18,419,403*

- About 25,000 injection wells are used for waterflood, steamflood, cyclic steam, CO2 flood and water disposal. These wells are referred to as Class II injection wells in the Underground Injection Control (UIC) program.[29]

- *Injection Well Permitting:* Operators of Class II injection wells must file for a permit with the Division. Before a permit is issued, the proposed injection project is studied by Division engineers and reviewed by the appropriate Regional Water Quality Control Board. Division engineers to evaluate the geologic and engineering information, solicit public comments, and hold a public hearing, if necessary. Injection project permits include many conditions, such as approved injection zones, allowable injection pressures, and testing requirements.[30]

B. TEXAS

- Texas has substantial capacity for CO_2 injection and State resources to regulate the same.
- Texas generally, and the Permian Basin[31] specifically, leads the United States in experience with CO_2 injections. In Texas alone, for example, there are 10,000 permitted carbon dioxide injection wells, 8,000 of which inject carbon dioxide exclusively. Those wells inject over 1 billion cubic feet of CO_2 daily. In 2005, the Permian Basin produced its billionth barrel of oil from injected carbon dioxide.[32]
- *Background*[33]
  - OOIP: 95.4 billion barrels
  - Recovered (or proved): 33.7 billion barrels
  - Remaining OIP: 61.7 billion barrels
  - Amenable to CO_2 EOR: 39.3 billion barrels
- For a full summary of this potential, including the identities of specific reservoirs, see *Basin Oriented Strategies for CO_2 Enhanced Oil Recovery (DOE, February 2006)* (attached).

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[29]. http://www.consrv.ca.gov/dog/general_information/class_injection_wells.htm.
[30] *Id*
[31] While the bulk of the Permian Basin is in Texas, it also straddles New Mexico. The vast majority, if not all, of the CO_2 injection in the Permian Basin occurs in Texas.
[32] CITE.
[33] CITE.

- Numerous companies in Texas are engaged in the CO_2 business, including: ExxonMobil, Occidental Petroleum, Anadarko Petroleum Corporation, PetroSource Energy Company, and Kinder Morgan CO_2 Company, LP.[34]

C. WYOMING

- CO_2 EOR Experience[35]

Reservoir	Timeframe	Production (b/d)	Cumulative Production to 2000 (million barrels)
Lost Soldier	1989 – 2006	3,000	44
Wertz	1986 – 2006	1,300	17
Salt Creek	2004 – 2006	25,000	
Teapot Dome	2005 – 2015		

- *Background*
  - OOIP: 15.2 billion barrels
  - Recovered: 4.8 billion barrels
  - Remaining OIP: 10.4 billion barrels
  - Amenable to CO_2 EOR: 7.6 billion barrels
- A component of the state-mandated Enhanced and Improved Oil Recovery Commission research program is on CO_2 capture for enhanced recovery.[36]
  - Injecting CO2 into well bores to move the remaining oil for recovery has proven to be very successful in numerous reservoirs. While CO2 is not the only substance relevant to EOR, there is particular interest, as well as direction from the Wyoming Legislature, to improve techniques for separating CO2 from flue gasses. EORI scientists are studying techniques to do so in a cost effective and energy efficient manner.
  - Highlights of the CO2 capture research include:
    - Development of synthetic compounds that have higher absorption than liquids
    - Development of concepts for appropriately modifying inorganic membranes
    - Development of a poly (ionic liquid) CO2 sorbent
    - Development of two polymer membranes with high CO2 selectivity and permeability[37]

D. MICHIGAN

- Michigan wells initially used recycled gas injection for both pressure management and for secondary recovery. It appears that this practice was primarily replaced with water flooding starting around 1958, although one or two recycled gas injection wells were reported through 1984. CO2 injection has just recently started and there seem to be very few wells using this approach. There are also about 55 natural gas

[34] CITE
[35] DOE, *Basin Oriented Strategies for CO2 EOR: Rocky Mountain Region* (Feb 2006).
[36] Enhanced Oil Recovery Commission, *AProgress Report to the Joint Minerals, Business, and Economic Development Committee* 2 (Nov. 1, 2005), *available at* http://eori.gg.uwyo.edu/downloads/report11105.pdf.
[37] *Id.* at 6.

storage wells. MDEQOG has a set of animated maps the present the history of well development in the state going back to the 1940's at this location.[38]

- Historically, there is some interesting information about the use of secondary recovery in Michigan based on a series of 7 short papers prepared in the 1976-1978 timeframe. One of these pamphlets cannot be found but table 1 summarizes the information contained in those that are available. In the six fields covered in the reports, secondary recovery and pressure management is thought to have increased production by 16.3 million barrels through 1978. These reports are interesting for several additional reasons including depth (or at least history) of experience with injection, use of computer-based predictions about capacity, regulatory efforts at unitization and history of permitting activity. The pamphlets are available online and are referenced in the source section at the end of this document.
  - 6 reports covering 6 fields only compiled during period 1976-1978 covering span of 1940-1974 or 1978[39]:
    - OOIP – 216.7 million barrels
    - Recoverable OOIP – 19.5 million barrels
    - Total recovered oil to date - 29.8 million barrels
    - Total recovered to date from secondary recovery or pressure mgmt – 16.3 million barrels
  - In 1984[40]:
    - Gas injection: 6,439,797 MCF – 181 injection wells
    - Water injection: 6,603,000 BBL – 502 injection wells
    - Total primary oil production in 1984 – 2,074,576 BBL
    - Total secondary oil production in 1984 – 5,314,832 BBL
  - November 2005-May 2006 – CO2 injection reporting at 4 facilities (not it is not clear if this all of the CO2 injection activity in the state) [41]:
    - Oil production: 29,201 MSCF
    - Gas production: 1,301,647 MSCF
    - CO2 injection: 2,011,089 MSCF
    - CO2 produced: 1,426,772 MSCF

[38] http://www.michigan.gov/deq/0,1607,7-135-3311_4111_4231-146189--,00.html

[39] (Michigan) Department Of Natural Resources, Geology Division, Production And Proration Unit, Secondary Recovery Reports No. 1, 2, 4, 5, 6 and 7. See resource list at end of document for full list of web locations for these reports.

[40] Obtained from MDEQOG – Table 12b. Pressure Maintenance and Secondary Recovery Operations – a discontinued Database.

[41] Obtained from MDEQOG based on information reported in monthly reports #7126A, 7126B, 7609, 7107 and Operating Report EQP form 7609.

Table 1 – Summary of Recovery Information in Secondary Recovery Reports Cited Above (Resource 5-10)

Field / Operator	Status / History	Estimated OOIP (MB= million barrels)	Estimated Recovery of OOIP	Estimated gas in solution	Estimated recovery of gas	Secondary recovery / recovery from pressure management
Beaver Creek / Pure Oil Co (Union Oil of CA)	Discovered in 1947, wells in place by 1948, started water flooding after becoming unitized in 1963. 58 injection wells and 53 producing wells	39.3 MB	7.8MB / Actual as of 1975: 10.8MB	36,000 Mcf	Est N/A (Actual as of 1975: 18,670,641 Mcf	Est 5.8MB, actually recoverd through 1975: 3MB
Enterprise Field / Sun Oil	Deemed dry in 1940, reworked in 1950. 1.4 MMcf gas injected through 1961 then switched to water (found "casing head gas" had been recycling through reservoir. 19 producing wells, 15 injection wells, 1 brine disposal well	12.7 MB	2.1 MB / Actual through 1975: 2.9MB	10,800 Mcf	7,280 Mcf (Actual through 1975: 1,300 Mcf)	1.1MB
Hamilton Field, Richfield Pool/ Sun Oil	Discovered in 1940, waterflood started in 1957. 27 producing wells, 17 injection wells. Converted to natural gas storage by 1976	13.3 MB	2.8MB / Actual by 1975: 5.9MB	12,250 Mcf	5,000 Mcf	2.8 MB
Onondaga 10 Unit/ Mobil Oil	Pressure management not secondary recovery. Started in 1973. 15 producing wells, 6 injection wells, 4 water supply wells by about 1977	18 MB	2.7 MB / Actual through June 1977: 4.5 MB	21,140 Mcf + 3,360 gas cap	11,098 Mcf (Actual by 1977: 4,040,000 Mcf)	5.6 MB
Aurelius 35 Unit / Mobil Oil	Pressure management. Started 1974; 5 producing wells, 2 injection wells	7.7 MB	0.8 MB / Actual by 1977: 1.3 MB	4,564 Mcf	2,574 Mcf (Actual by 1977: 676,511 Mcf)	1.7 MB
Columbus 3 / Sun Oil	Pressure management. Tried to start 1970, could not get permit till 1974. 10 pumping wells, 6 flowing wells, 1 brind disposal, 2 gas injection wells	11.4 MB	3.3 MB / Actual by June 1978: 4.4 MB	7055 Mcf + 3623 gas cap	NA	2.1MB
	Total	216.7 MB	19.5 MB / Actual 29.8 MB by 1974-1977			16.3 MB

- Definition of Waste – and relationship to one mission of the MDEQOG:
  - It appears that Michigan oil and gas law is heavily influenced by its early experience of presumably less than optimally planned oil and gas development. The state has authority to unitize fields and is driven by the mission of preventing waste and conserving oil and gas resources. Accordingly, the rules define "Waste" as follows:
  - "Waste" in addition to its ordinary meaning includes all of the following:

(i) "Underground waste", including all of the following:

(A) The inefficient, excessive, or improper use or dissipation of the reservoir energy, including gas energy and water drive, of any pool, and the locating, spacing, drilling, equipping, operating, or producing of a well or wells in a manner to reduce or tend to reduce the quantity of oil or gas ultimately recoverable from any pool.

(B) Unreasonable damage to underground fresh or mineral waters, natural brines, or other mineral deposits from operations for the discovery, development, and production of oil or gas.

(ii) "Surface waste", as those words are generally understood in the including all of the following:

(A) The unnecessary or excessive surface loss or destruction without beneficial use, however caused, of gas, oil, or other product, but including the loss or destruction, without beneficial use, resulting from evaporation, seepage, leakage, or fire, especially a loss or destruction incident to or resulting from the manner of spacing, equipping, operating, producing a well or wells, or incident to or resulting from inefficient storage or handling of oil.

(B) The unnecessary damage to or destruction of the surface; soils; animal, fish, or life; property; or other environmental values from or by oil and gas operations.

(C) The unnecessary endangerment of public health, gas operations.

(D) The drilling of unnecessary wells.

(iii) "Market waste", which includes the production of oil or gas in any field or pool in excess of the market demand as defined in this part.

E. INDIANA

- To date there has been no experience, but potential exists for CO2-EOR in Illinois Basin area.[42]

- Regulation would likely fall under Class II wells, per model in other states.

F. ILLINOIS

[42]http://www.fossil.energy.gov/programs/oilgas/publications/eor_co2/Illinois_%26_Michigan_Basin_Document.pdf and http://sequestration.org/publish/oil_eor_map_dec05.pdf#search=%22Indiana%20EOR%22

Historic Carbon Dioxide Injection Projects

Field Name	*Project Type*	*Timeframe*	*Cumulative Net CO2 Injected (Mcf)*
Forsythe	Single well huff and puff?	1990	One truckload
Decatur	Single well huff and puff	1997	20 tons
Mattoon	Immiscible—continuous injection and huff and puff	1993	

From: Petroleum Technology Transfer Council, Illinois Basin CO_2 Workshop, http://www.pttc.org/solutions/sol_2006/551.htm

see also: http://www.osti.gov/bridge/product.biblio.jsp?osti_id=73038 (report on Mattoon field)
DOE, Basin Oriented Strategies for CO_2 Enhanced Oil Recovery, http://www.fossil.energy.gov/programs/oilgas/publications/eor_co2/illinois_co2_eor.pdf

Potential Future Project: FutureGen

US DOE coal gasification and carbon sequestration project. Mattoon, IL and Tuscola, IL two of the four remaining potential locations.
See http://www.fossil.energy.gov/programs/powersystems/futuregen/

G. KENTUCKY

- To date, there have been no CO2-EOR projects in Kentucky. However, due to the similarity in reservoir characteristics to those in Illinois, projects in that state may serve as a guide for Kentucky EOR projects.[43]

- The oil reservoirs in Kentucky are shallow, and therefore only candidates for miscible CO_2-EOR, not "Traditional Practices" EOR.. However, when applying "State-of-the-art Technology" (involving higher volume CO_2 injection, immiscible EOR, and lower risk), 15 immiscible EOR oil reservoirs become technically feasible and 8 reservoirs are economically feasible.[44]

III. SURFACE LIABILITY - DAMAGE TO AGRICULTURAL LANDS, RESIDENTIAL, PUBLIC SAFETY

A. CALIFORNIA

1) Surface Water Rights
   - In California, there is no private ownership of ground or flowing water and groundwater is wholly owned by the State.[45]

[43] U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, *Basin Oriented Strategies for CO2 Enhanced Oil Recovery: Illinois &Michigan Basins* 6-8 (Feb. 2006).
[44] *Id.* at 6-9.
[45] State v. Superior Court of Riverside County, 78 Cal. App. 4th 1019, 1022-1023 (4th Dist. 2000).

- The State has the power to supervise and regulate the use of water,[46] and the State is to regulate so as to protect the public interest in and beneficial use of all water in the State, and particularly to maximize the public benefit from use of groundwater.[47]
- A private party can obtain the right to use of water by owning land appurtenant to the water source (overlying rights), by appropriating water (appropriative rights), by inheriting a pueblo right (pueblo rights), or by open and notorious prescription (prescriptive rights).[48]
- All uses of water, regardless of the right upon which the use is based, are subject to the Constitutional standard that the use must be reasonable and beneficial.[49]
- "Pollution" is defined in the California water act as "an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either. . . (A) The waters for beneficial uses, [or] (B) Facilities which serve these beneficial uses.[50]
    - A relevant type of pollution is "contamination," which is defined as "an impairment of the quality of the waters of the state by waste to a degree which creates a hazard to the public health through poisoning or through the spread of disease. . . [including] any equivalent effect resulting from disposal of waste, whether or not waters of the state are affected."[51]

2) Liability Associated with Oil and Gas Wells
    - Wells with known high pressure gas(es) or wells being drilled in areas where the pressure is unknown must be equipped with sufficiently strong casings and other safety devices so as to prevent blowouts, explosions, and fires.[52]
    - The Department of Conservation was to investigate and report on options for guaranteeing blowout insurance for persons drilling or redrilling wells in high pressure areas.[53]

B. TEXAS

1) Surface Water Rights
    - The state of Texas adopted and follows the traditional common law "rule of capture" to define groundwater rights.[54] The rule of capture provides that landowners have the right to the entire subsurface and can take and use any groundwater accessible from their land.[55] Additionally, a landowner can not be held liable for depriving other neighboring landowners of the water's use. The only exceptions to landowner

[46] Central and West Basin Water Replenishment District v. Southern California Water Co., 109 Cal. App. 4th 891, 904 (2d Dist. 2003).
[47] Cal. Water Code §105.
[48] Central and West Basin Water Replenishment District v. Southern California Water Co., 109 Cal. App. 4th at 906.
[49] Cal. Const., art. X, §2.
[50] Cal. Water Code, §13050(l).
[51] *Id.* at §13050(k).
[52] DOGGR Code 3219.
[53] *Id*. at 3219.5.
[54] *See* Houston & Texas Central Railway Co. v. East, 98 Tex. 146, 81 S.W. 279 (1904); Sipriano v. Great Spring Waters of America, Inc, 1 S.W.3d 75, 75 (Tex. 1999).
[55] Sipriano v. Great Spring Waters of America 1 S.W. 3d at 76.

liability under the rule of capture are negligence in causing subsidence of land, willful waste, and malice.[56]

- Water pollution (in the context of injection wells) is defined as "the alteration of the physical, chemical, or biological quality of, or the contamination of, water that makes it harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose."[57] An offense is committed when a person "discharges or allows the discharge of any waste or pollutant into any water in the state that causes or threatens to cause water pollution."[58]

2) Liability Associated with Oil and Gas Wells

- Texas law and regulations comprehensively require oil & gas operators to protect the environment – specifically including land and surface water – and makes them liable for clean-up costs and related harm in the event of a spill or other release of materials to the environment.[59]
- Any alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any surface or subsurface water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose is prohibited.[60]
- Specifically with respect surface liability, TRRC regulations exempt from clean-up liability innocent parties who agree voluntarily to clean-up contaminated property.[61] Parties who are responsible for the damage remain liable. These provisions are part of the TRRC's Voluntary Cleanup Program.

C. WYOMING

1) Surface Water Rights

- Water is the property of the state, with use rights attaching to the land for irrigation, or to a legally recognized beneficial application.[62]
- Beneficial use shall be the basis, the measure and limit of the right to use water at all times, not exceeding the statutory limit.

2) Liability Associated with Oil and Gas Wells

- The operator must pay the surface owner

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[56] Fain v Great Spring Waters of America, Inc., 973 S.W.2d 327 (Tex.App. 1998).
[57] Tex. Water Code §27.002(4).
[58] *Id.* at §7.147(a).
[59] *See, e.g.*, 16 T.A.C. § 3.91 (cleanup of soil contaminated by a crude oil spill).
[60] *Id.* at 3.8(a)(28). The standard is "no pollution." *Id.* at § 3.8(b).
[61] *Id.* at § 4.445.
[62] WYO STAT. ANN. § 41-3-101 (2005).

- compensation equal to the amount of damages sustained by the surface owner for loss of production and income, loss of land value and loss of value of improvements caused by oil and gas operations.[63]
- Unless both parties provide otherwise by written agreement, within sixty (60) days after the oil and gas operator receives notice of damages pursuant to subsection (a) of this section, the oil and gas operator shall make a written offer of settlement to the surface owner as compensation for damages. The surface owner seeking compensation for damages under this section may accept or reject any offer made by the oil and gas operator.[64]
- The surface owner can bring an action for damages if the surface owner who submits a notice as required under subsection (a) of this section receives no reply to his notice, receives a written rejection or counter offer or rejects an offer or counter offer from the oil and gas operator.[65]
- The surface owner must bring the action within two years after the damage was discovered, or should have been discovered through due diligence.[66]

D. MICHIGAN

1) Liability Associated with Oil and Gas Wells

- The Michigan rule prohibits a permittee from causing damage to the surface and subsurface. This is spelled out in several places including:
  - Section 615 Part 5 – well completion and operation - R 324.504 / Rule 504. … ”An oil and gas operation shall not be commenced or continued at a location where it is likely that a substance may escape in a quantity sufficient to pollute the air, soil, surface waters, or groundwaters, or to cause unnecessary endangerment of public health, safety, or welfare until the permittee has complied with the methods and means to prevent pollution or eliminate the unnecessary endangerment of public health, safety, or welfare as specified by the supervisor. “
  - Section 615 Part 7 – Disposal of oil and gas field waste or both -
    - R324.701 / Rule 701: “The storage, transportation, or disposal of brine, crude oil, or oil or gas field waste that results in, or that the supervisor determines may result in, pollution is prohibited…”
    - R 324.703 / Rule 703. A permittee of a well shall inject oil or gas field fluid wastes, or both, into an approved underground formation in a manner that prevents waste. The disposal formation shall be isolated from fresh water strata by an impervious confining formation.
    - R 324.705 / Rule 705: “A permittee of a well is responsible for the proper disposal of all brines produced in association with oil or gas production, or both, or brines accumulated in drilling mud pits or tanks and shall ensure that waste, as defined in section 61501(p) of the act, will not occur.”

[63] *Id.* at § 30-5-405.
[64] *Id.* at § 30-5-406(b).
[65] *Id.* at § 30-5-406(c).
[66] *Id.* at § 30-5-409.

- Interesting to note that 324.61505a / Sec. 61505a prohibits drilling or exploration under the Great Lakes or connected bays and harbors unless there is a grandfathered lease.

E. INDIANA

1) Surface Water Rights

- Surface waters in Indiana must be put to beneficial uses to the fullest extent, and non-beneficial uses must be prevented.[67]

- Water is considered a natural resource, and the owner of the land on which non-public water falls, pools, or flows has the right to use the water.[68] The owner of land contiguous to public water is entitled to use the amount of water necessary for domestic purposes, which have priority over all other uses (i.e. a Riparian Rights structure).[69]

- Surface property owners may agree to integrate their land interests in order to develop drilling as a unit, or the commission may order such integration of interests for drilling as a unit if it would prevent waste or the drilling of unnecessary wells.[70]

2) Property

- The Indiana Responsible Property Transfer Law.[71]
    - Discusses liability in the context of property transfers, including mention of environmental damage.

3) LIABILITY ASSOCIATED WITH OIL AND GAS WELLS

- A person who plugs, replugs, or repairs a well does *not* assume liability for:
    1. future remedial action on the well, and
    2. conditions subsequently arising with respect to the well,

  nor does that person admit liability for:
    1. the condition, or
    2. the damages resulting therefrom[72]

- The permit for an oil and gas well may be revoked for polluting the water or land of Indiana or failure to address an issued notice of a violation, among other things.[73]

- The commission may order an owner to plug, replug, or repair any well that is found to be causing environmental harm or waste,[74] or the commission may itself plug, replug, or

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[67] IN CODE ANN. 14-25-1-1 (West 2006).
[68] *Id.* at § 14-25-1-2.
[69] *Id.* at § 14-25-1-3. *See also*, City of Elkhart v. Christiana Hydraulics, , 59 N.E.2d 353 (Ind. 1945) (holding that an upper riparian owner cannot use water in such a way that will make it unavailable for a lower riparian owner).
[70] IN CODE ANN. § 14-37-9-1 (West 2006).
[71] *Id.* at § 13-25-3, *available at* http://www.ai.org/legislative/ic/code/title13/ar25/ch3.html
[72] IN CODE ANN. § 14-37-8-14 (West 2006).
[73] *Id.* at § 14-37-13-1.
[74] *Id.* at § 14-37-8-12 9.

repair the well.[75] The revocation of a permit does not absolve the owner of its plugging and abandonment obligations, and the cost of plugging or repair will be paid for by either the owner of the well or taken out of the well bond.[76]

- In addition to revocation of the permit for and/or plugging of the well, the commission may asses a civil penalty not to exceed $10,000 for each day the violation occurs.[77]

F. ILLINOIS

225 ILCS 725/19.1: **Abandoned well; order to cease operation; hearing**

If, after notice and an opportunity for a hearing, the Department finds that a well drilled for the exploration, development, storage or production of oil or gas, or as injection, salt water disposal, salt water source, observation, and geological or structure test has been abandoned or is leaking salt water, oil, gas or other deleterious substances into any fresh water formation or onto the surface of the land in the vicinity of the well, the Department shall issue an order that the well be properly plugged, replugged or repaired to remedy such situation. If the permittee fails to do so within 30 days from the date of the order, then any person duly authorized by the Department may enter upon the land on which the well is located and plug, replug, or repair the well as may be reasonably required to remedy the condition. The costs and expenses incurred by the Department under this Act shall be a debt due by the permittee to the Department together with interest at the rate set forth in Section 2-1303 of the Code of Civil Procedure. The permittee's failure to comply with the Department's order is a violation of this Act.

If the Department determines that any condition or practice exists, or that any person or permittee is in violation of any requirement of this Act or the rules adopted hereunder or any permit condition, which condition, practice or violation creates an imminent danger to the health or safety of the public, or an imminent danger of significant environmental harm or significant damage to property, any authorized employee or agent of the Department may order the immediate cessation of operation. If a responsible party cannot be readily located in the judgment of the employee or agent issuing the order, the employee or agent may take any action he deems necessary to cause a cessation of operations and abatement of any condition.

62 Ill. Adm. Code 240.1630: **Emergency Well Plugging, Emergency Repair Work, Emergency Projects**

c) The cost of all emergency well plugging, emergency repair work and emergency remediation projects completed under this Section shall be paid from the Annual Well Fee portion of the Plugging and Restoration Fund. Permittees or responsible parties for which funds were expended under this Section shall be required to reimburse the Plugging and Restoration Fund for all the expenditures.

225 ILCS 725/8a: **Notice of violation; investigation; hearing**

When an inspector or other authorized employee or agent of the Department determines that any permittee, or any person engaged in conduct or activities required to be permitted under this Act, is in violation of any requirement of this Act or the rules adopted hereunder or any permit condition, or has falsified or otherwise misstated any information on or relative to the

[75] *Id.* at § 14-37-13-2.
[76] *Id.*
[77] *Id.*

permit application, a notice of violation shall be completed and delivered to the Director or his designee.

In determining whether to take actions in addition to remedial action necessary to abate a violation, the Director shall consider the person's or permittee's history of previous violations including violations at other locations and under other permits, the seriousness of the violation including any irreparable harm to the environment or damage to property, the degree of culpability of the person or permittee and the existence of any additional conditions or factors in aggravation or mitigation including information provided by the person or permittee.

The Director shall serve the person or permittee with his decision at the conclusion of the investigation. Modification of the notice of violation may include:

1. any different or additional remedial action required to abate the violation and the time within which the violation must be abated;
2. the assessment of civil penalties not to exceed $ 1,000 a day for each and every act of violation;
3. probationary or permanent modification or conditions on the permit which may include special monitoring or reporting requirements; and
4. revocation of the permit.

62 Ill. Adm. Code 240.155: **Civil Complaint**

b) In accordance with Section 11 of the Act, the Department through the Attorney General shall bring an action in the name of the People of the State of Illinois against such person in the circuit court of the county wherein any part of the land or any activity which is the subject matter of such action is located, or a final administrative order was entered, to restrain such person from continuing such violation or from carrying out the threat of violation. In such action the Department, in the name of the People of the State of Illinois, may obtain such injunctions, prohibitory and mandatory, including temporary restraining orders and preliminary injunctions, or other enforcement orders as the facts may warrant, including but not limited to:

1) an assessment of a $ 1,000 civil penalty per documented event in the previous 2 years; and/or
2) submission of a bond in accordance with Subpart O; and/or
3) denial of new drilling and/or operating permits.

c) The provisions of this Section apply to the following:

1) violations of any requirement of the Act that the Department determines creates a substantial and imminent danger to the health or safety of the public; or
2) violations of the Act that pose an imminent danger of substantial environmental harm or cause environmental damage to property or contamination of surface or ground waters of the State as a result of improper disposal, release, or discharge of produced fluid; or
3) if the permittee has shown a pattern of documented events involving improper disposal, release, or discharge of produced fluids within the previous 2 years from the date of the most recent event.

62 Ill. Adm. Code 240.875: **Leaking Previously Plugged Well**

Where any fluids are potentially leaking into the freshwater zones or to the surface as determined by geologic and field investigation, through a well plugged under the supervision of the Department, the well shall be replugged by the last permittee of record for the lease on which the leaking well was located when the well was last plugged. If the permittee is no longer in existence or cannot be located, the well shall be plugged or replugged by the current permittee of

the lease where the well is located. Pending plugging of the well all injection wells within a 1/4 mile radius of the leaking well shall be shut-in until the leaking well is plugged. The leaking or previously leaking well shall be plugged regardless of well status at the time of plugging.

62 Ill. Adm. Code 240.1640: **Repayment of Funds**
a) The permittee must reimburse the Plugging and Restoration Fund for all funds obligated from the Plugging and Restoration Fund, excepting OPA reimbursed monies, for repair, plugging, restoration or remediation work on the permittee's wells or sites, together with all interest accrued, as provided under Section 19.9 of the Act.

IV. SUBSURFACE LIABILITY (GEOPHYSICAL TRESPASS, HYDROCARBON DAMAGE, GROUNDWATER CONTAMINATION)

A. CALIFORNIA

- To further the elimination of waste by increasing the recovery of underground hydrocarbons. . . the grant in an oil and gas lease or contract to a lessee or operator of the right or power, in substance, to explore for and remove all hydrocarbons from any lands in the state, in the absence of an express provision to the contrary contained in the lease or contract, is deemed to allow the lessee or contractor, or the lessee's or contractor's successors or assigns, to do what a prudent operator using reasonable diligence would do, having in mind the best interests of the lessor, lessee, and the state in producing and removing hydrocarbons, including, but not limited to, the injection of air, gas, water, or other fluids into the productive strata, the application of pressure heat or other means for the reduction of viscosity of the hydrocarbons, the supplying of additional motive force, or the creating of enlarged or new channels for the underground movement of hydrocarbons into production wells, when these methods or processes employed have been approved by the supervisor, except that nothing contained in this section imposes a legal duty upon the lessee or contractor, or the lessee's or contractor's successors or assigns, to conduct these operations.[78]
- (c) The supervisor may require an operator to implement a monitoring program, designed to detect releases to the soil and water, including both groundwater and surface water, for aboveground oil production tanks and facilities.

2) Groundwater Rights

- The same regulatory structure applies to groundwater as it does to surface waters, except that groundwater is wholly owned by the State.[79]

B. TEXAS

1) Mineral Rights
   - Absolute Ownership of Subsurface Minerals:

[78] DOGGR Code 3106(c).

[79] *See, infra* note45.

- Under Texas mineral[80] rights law, generally speaking, the owner of land owns the minerals, oil, and gas beneath it, unless those estates have been severed. The landowner also owns the reservoir storage land beneath the land. Oil and gas interests are also subject to the rule of capture, entitling the owner of land on which a well sits to all of the oil and gas that may be obtained through the well, regardless of the land on which the oil and gas "sits," subject to due care and reasonableness considerations intended to protect other landowners.

- Texas law is clear that once oil or gas has been "captured," it becomes the personal property of the party who captured it. If the oil or gas is then injected into the ground for storage to be used at a later date, it remains the property of the capturer, regardless of the ownership of the surface overriding the storage area (and thus the ownership of the storage area).[81] Under this analysis, all injected CO_2 would remain the property of the injector, which would also seemingly retain whatever corresponding liabilities that might exist. However, if injected CO_2 is not intended for future use, such a rationale might not apply. Texas law also makes clear that captured substances lose their status as personal property if abandoned. It seems possible that injected CO_2 intended for essentially permanent storage could be considered abandoned when injected.

- Check on Absolute Ownership: The Negative Rule of Capture and Limitations on Recovery for Trespass:
  - Despite Texas' firm adherence to the rule that a landowner owns everything beneath the surface of his land, Texas courts have recognized limits on the ability of landowners to recover damages for subsurface intrusions. Texas recognizes the "negative rule of capture," under which there is no trespass when injected secondary recovery forces move across property lines.[82] The rationale is policy-based: the trespass effectuates greater recovery of useful substances.

  - In the case of CO_2 injected for effectively permanent storage, and not for secondary recovery, such policy reasons are absent. Thus, such protection against liability for trespass may not exist. At least one other state has declined to apply the negative rule of capture where a "greater good" rationale is absent.[83]

  - However, as in Chance, one unreported Texas Court of Appeals decision suggests that the state still may not recognize a cause of action for subsurface intrusion absent a showing of actual harm, regardless of the reason for the intrusion or the benefits of the intrusion to the intruding party. In FPL Farming, Ltd. v. Texas Natural Resource Conservation Commission, the court held that no "taking" results when a party is permitted to inject nonhazardous wastewater into

[80] In Texas, a "mineral" has traditionally been defined as any inorganic species with a definite chemical composition. In practice, essentially any substance on or beneath the surface may be considered a mineral if the circumstances so allow (e.g., interested parties so intend, the commercial world considers it as such).
[81] *See* Lone Star Gas Co. v. Murchison, 353 S.W.2d 870 (Tex. Civ. App. 1962).
[82] *See, e.g.*, Railroad Commission of Texas v. Manziel, 361 S.W.2d 560 (Tex. 1962).
[83] See Chance v. BP Chemicals, Inc., 670 N.E.2d 985 (Ohio 1996) (holding that absolute ownership of subsurface could not exist, and declined to allow recovery where neither physical damage nor interference with use was shown).

a deep subsurface saltwater formation lying beneath another party's land, and rejected a challenge to the grant of an injection permit where no "impairment" existed. The plaintiff had challenged the Commission's approval of a wastewater injection permit under which the wastewater would reach the plaintiff's subsurface within ten years. The court held that migration of the wastewater alone did not constitute impairment and that "some measure of harm must accompany the migration" for impairment to exist, which was not present in this case. The defendant satisfied its initial burden of demonstrating that there would be no impairment, and the plaintiff was unable to defeat that showing; it did not identify specific intended future uses of the subsurface, and there was no evidence that the permit would hamper any speculative future uses. On the takings question, the court held that the plaintiff had failed to show any permanent loss of the rights to possess, use, and dispose of the subsurface property. In closing, however, the court did note that the plaintiff would be entitled to damages if it could later show that migration had in fact occurred and that it suffered harm as a result.[84]

- In summary, despite the general rule that a landowner owns outright the entire subsurface beneath his land, the landowner has no claim if substances injected by a third party merely migrate within the subsurface. Claims may exist where actual harm or impairment of use can be shown. The burden of proof, however, lies with the plaintiff to demonstrate that such impairment exists, and Texas courts appear hesitant to find such harm or impairment.

2) Groundwater Rights
   - Groundwater and Absolute Ownership:
     - Under Texas law, the owner of the surface also owns all groundwater[85] beneath his land, and has the right to use it for any purpose.[86] No liability attaches if the landowner's use of groundwater causes harm to an adjacent landowner.[87] It is unclear what, if any, limits on recovery for "invasion" into groundwater. Texas courts might impose, although it follows that if no actual harm or impairment of use is caused by such an "invasion," courts may reject trespass claims for the same reason such claims are rejected for "invasion" into the subsurface generally.
3) CO_2 as a Waste
   - If carbon dioxide is deemed a "waste," a wide variety of regulatory liabilities could be imposed. For example, "oil and gas wastes" are extensively regulated (whether on the surface or subsurface).[88] The disposal of "oil and gas wastes" can only be in geologic formations that are separated from "freshwater formations by impervious

[84] 2003 WL 247183 (Tex. Civ. App. 2003).
[85] The term "groundwater" is used in a general sense and refers to all water beneath the surface other than defined subterranean streams.
[86] *See, e.g.*, Bartley v. Sone, 527 S.W.2d 754 (Tex. Civ. App. 1975); Glasscock Underground Water Conservation District v. Pruit, 915 S.W.2d 577 (Tex. Civ. App. 1996).
[87] *See* generally Behrens, Eric and Matthew G. Dore, Rights of Landowners to Percolating Groundwater in Texas, 32 S. TEX. L. REV. 185 (1991).
[88] 16 T.A.C. § 3.8.

beds which will give adequate protection to such freshwater formations." [89] Application must be made to the TRRC to engage in such conduct, and the application must be supported by a letter from the TCEQ "stating that the use of such formation will not endanger the freshwater strata in that area and that the formations to be used for disposal are not freshwater-bearing ."[90]

4) Regulatory Environment
   - The subsurface injection of fluids into reservoirs productive of oil, gas, geothermal resources is extensively regulated. A permit from the TRRC is required.[91] The permit application is subject to notice and public comment.[92] The area of review includes existing wells (whether operating or not) with a quarter mile of the proposed injection well.[93]

C. WYOMING

1) Mineral Rights
   - The Commission has the authority to require and regulate:
     - (B) The noncommercial underground disposal into Class two [2] injection wells as defined under the federal Safe Drinking Water Act of salt water, nonpotable water and oil field wastes related to oil and gas production in such a manner as to prevent contamination of the waters of the state.[94]

2) Groundwater Rights
   - All waters, including groundwaters are the property of the State and are subject to State control of their beneficial use.
   - Rights to underground water
     - Rights to underground water shall be subject to the same preferences as provided by law for surface waters, and rights not preferred may be condemned and changed to a preferred use in the manner provided by law for surface waters. Nothing herein contained shall be construed to impair the rights of municipal corporations to acquire any underground water or underground water rights for a necessary public purpose by eminent domain or condemnation proceedings.[95]
   - Prohibited Acts
     - No person . . . shall: (i) Cause, threaten or allow the discharge of any pollution or wastes into the waters of the state; (ii) Alter the physical, chemical, radiological, biological or bacteriological properties of any waters of the state; (iii) Construct, install, modify or operate any sewerage system, treatment works, disposal system or other facility, excluding uranium mill tailing facilities, capable of causing or contributing to pollution. . . . [96]

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[89] *Id*. at. § 3.9(2).
[90] *Id*.
[91] *Id.* at § 3.46(a).
[92] *Id.* at. § 3.46(c).
[93] *Id.* at. § 3.46(e).
[94] WOGCC 30-5-104

[95] Wy. Stat. Ann. § 41-3-906.
[96] Wy. Stat. Ann. § 35-11-301 (a).

- Release of Hazardous Substances
  - "Hazardous Substance" is defined as any substance or waste which, after release, constitutes a threat to public health or welfare, or other aquatic life or wildlife because of its quantity, concentration, chemical, corrosive, flammable,reactive, toxic, infectious, or radioactive characteristics. The term shall also include all substances so designated by the U. S. Environmental Protection Agency. The term shall not include oil.[97] A hazardous substance release in any amount which enters, or threatens to enter, waters of the state shall be reported, contained, removed, and disposed of in accordance with these regulations.
  - Any person owning or having control over oil or a hazardous substance which, after release, enters, or threatens to enter, waters of the state shall:
    - (i) immediately take appropriate action to stop and contain the release. . . .
    - (iii) Immediately proceed to correct the cause of the release.

D. MICHIGAN

0) Mineral Rights

- Public Act 42 of 1963, the Dormant Minerals Act, terminated dormant mineral rights not held by the surface owner and vested those rights with the surface owner. In general, mineral rights belong to the surface owner.
- Under ownership in place theory the nature of the interest of the landowner in oil and gas contained in his land is the same as his interest in solid minerals; solid minerals are part of the land in or beneath which they are located, and as a consequence the owner of land is also the owner of the oil and gas in or beneath it. *Wronski v. Sun Oil Co.*, 89 Mich.App. 11, 21, 279 N.W.2d 564, 569 (1979).
- Under rule of capture, owner of tract of land acquires title to the oil and gas which he produces from wells drilled thereon, even if it may be proved that part of such oil or gas migrated from adjoining lands; under such rule, in absence of state regulation of drilling practices, landowner is not liable to adjacent landowners whose land is drained as result of such operations. *Wronski v. Sun Oil Co.*, 89 Mich.App. 11, 21, 279 N.W.2d 564, 569 (1979).
- Fair share rule providing that each operator should have opportunity equal to that afforded other operators to recover equivalent of amount of recoverable oil and gas underlying his property does not do away with rule of capture, but rather acts to place limits on its proper application. *Wronski v. Sun Oil Co.*, 89 Mich.App. 11, 21, 279 N.W.2d 564, 569 (1979).
- The damages and required remediation / remuneration for damage to the subsurface do not seem to be addressed explicitly in the regulations. That said, the following section within Section 615 Part 8 – Injection Wells stipulates: R 324.802: (3) A permittee of a well shall ensure that an injection well is constructed and operated so that the injection of fluids is confined to strata approved by the supervisor or authorized representative of the supervisor.
- Further, the requirements for constructing and gaining approval for constructed wells are quite detailed. They require integrity testing and testing for leaks at each step in

[97] Water Quality Rules and Regulations, Chapter IV, §3(a).

Section 615 Parts 4 and 5. The plugging provisions are equally detailed and contained in Section 615 Part 9

E. INDIANA

1) Mineral Rights
   - Minerals are not owned by the surface estate. This was upheld in Ohio Oil Co. v. Indiana in which the U.S. Supreme Court agreed with the Indiana Supreme Court that an Indiana oil and gas regulation did not amount to taking of private property because the surface owners did not own the subsurface oil and gas under Indiana law.[98]
   - Indiana has a compulsory unitization statue; limits liability to adjacent landowners for migrating minerals (applicable to CO_2 injection).

2) Groundwater Rights
   - Groundwater is a public natural resource, to be conserved and put only to the most beneficial use.[99] Waste of groundwater includes permitting or causing the pollution of a fresh water strata by causing salt water, highly mineralized water, or otherwise contaminated water to enter the strata.[100]
   - An operator of a well using secondary recovery techniques is liable to adjoining landowners for pollution or contamination of the subsurface, particularly groundwater of any adjacent landowners, and the landowner is entitled to damages for the injury.[101]

F. ILLINOIS

62 Ill. Adm. Code 240.350: **Groundwater and Potable Water Supply Information**

a) The applicant shall submit a statement certifying there are no potable water wells located within two hundred (200) feet of the proposed Class II UIC well, and no municipal water supply wells located within two thousand five hundred (2500) feet of the proposed Class II UIC well.

b) Fresh Water Analyses
1) The applicant shall submit a standard laboratory analysis of fresh water from two (2) or more fresh water wells located within one (1) mile of the proposed injection well and showing the location and depth of the well, and dates the samples were obtained. The samples shall be analyzed for at least the following parameters: pH, Chloride, Total Dissolved Solids, and Specific Gravity. The samples shall be obtained and analyzed no earlier than one (1) year prior to the date of filing of the application. The locations of the well from which the fresh water samples were obtained shall also be shown on the map required in Section 240.320.

G. KENTUCKY

[98] 177 U.S. 190 (1900).
[99] IN CODE ANN. § 14-25-3-3 (West 2006).
[100] *Id.* at § 14-25-3-2.
[101] *Mowrer v. Ashland Oil & Refining Co*, 518 F.2d 659 (Ind. 1975).

A. The Division of Water requires that parties performing certain activities with the potential to pollute groundwater must create and implement a Groundwater Protection Plan in order to establish site-specific practices that will prevent groundwater pollution.[102]

Activities that Require a Groundwater Protection Plan[103]

Land Treatment or land disposal of a pollutant

Storage, treatment, disposal, or handling of a waste

Commercial or industrial storing or related handling in bulk quantities of raw materials, intermediate substances or products, finished products, substances held for recycling, or other pollutants held in tanks, drums, or other containers or piles

Transmission in pipelines of raw materials, finished products, or other pollutants

Mining and associated activities

Installation, construction, operation, or abandonment of wells, boreholes, or core holes

Commercial or industrial transfer, including loading and unloading, in bulk quantities of raw materials, intermediate substances or products, finished products, substances held for recycling, or other pollutants.

The Groundwater branch is responsible for permit issuance and Groundwater Protection Plan review. The Groundwater branch also is responsible for monitoring groundwater conditions throughout the state and creates various reports on groundwater quality.[104]

A Groundwater Protection Plan is not required if the party can demonstrate that the activity has no reasonable potential of altering the properties of the groundwater in a manner that will be detrimental to public health, animal or aquatic life, or the use of groundwater.[105]

V. EXISTING EOR/EGR

A. CALIFORNIA

Enhanced Oil Recovery (Barrels)	2000	2001	2002	2003	2004
Total # Projects	61	57	57	57	52
Water Flooding	43,752,000	43,286,000	46,660,000	42,683,000	42,658,900
Thermal	135,738,000	135,814,000	108,436,000	87,850,700	104,539,600
Gas Injection	1,992,000	2,975,000	4,264,000	4,814,000	6,652,000
Total Incremental Production	181,482,000	182,075,000	159,360,000	135,357,700	153,850,500

[102] 401 KAR 5:037. Groundwater protection plans.
[103] *Id.* at §2(2).
[104] http://www.water.ky.gov/.
[105] 401 KAR 5:037 §2(3).

DOGGR Code 3106(c) To further the elimination of waste by increasing the recovery of underground hydrocarbons, it is hereby declared as a policy of this state that the grant in an oil and gas lease or contract to a lessee or operator of the right or power, in substance, to explore for and remove all hydrocarbons from any lands in the state, in the absence of an express provision to the contrary contained in the lease or contract, is deemed to allow the lessee or contractor, or the lessee's or contractor's successors or assigns, to do what a prudent operator using reasonable diligence would do, having in mind the best interests of the lessor, lessee, and the state in producing and removing hydrocarbons, including, but not limited to, the injection of air, gas, water, or other fluids into the productive strata, the application of pressure heat or other means for the reduction of viscosity of the hydrocarbons, the supplying of additional motive force, or the creating of enlarged or new channels for the underground movement of hydrocarbons into production wells, when these methods or processes employed have been approved by the supervisor, except that nothing contained in this section imposes a legal duty upon the lessee or contractor, or the lessee's or contractor's successors or assigns, to conduct these operations.

B. TEXAS

- "Texas oil producers are familiar with using technology for improving oil recovery. For example, operators can draw upon the experiences of a number of CO_2-EOR floods in the Permian basin as well as the secondary (waterfloding) efforts in Texas. In addition, a large N_2-Immiscible flood has been conducted in the Hawkins field since 1987 that has allowed an additional 40 MMBbls of oil to be recovered."[106]

C. WYOMING

- Rocky Mountain region oil producers are familiar with using technology for improving oil recovery. CO_2-EOR projects in Colorado's Rangely Field and Wyoming's Lost Soldier and Wertz fields have been underway since the 1980's. In addition, several new projects have been initiated in the past two years.
- "Several CO_2-EOR projects are currently underway in Wyoming. Two CO_2-EOR projects, in the Lost Soldier and Wertz fields, have been underway since the 1980's. Two additional projects, at Salt Creek and Patrick Draw fields, have been started by Anadarko in the past few years. Lost Soldier and Wertz Fields. The CO_2 floods in the Lost Soldier and Wertz (1986) fields are reported as being successful. The Lost Soldier flood began in 1989 in the Tensleep formation and has since been expanded to the Darwin-Madison and Cambrian formations. The three floods combined produce at a rate of over 3,000 barrels per day. The Wertz flood began in 1986 in the Tensleep formation and has since been expanded to the Darwin-Madison formation. The two floods currently produce at a rate of 1,300 barrels per day. The Lost Soldier flood has recovered over 44 million barrels of oil (through year 2000) which is 11% OOIP and the Wertz field has recovered over 17 million barrels of oil (through year 2000) which is 8% OOIP. Salt Creek Field. The Salt Creek oil field (Wall Creek reservoir) of northeasternWyoming was discovered in 1917 and is operated by Anadarko Petroleum. Full scale waterflooding in the field began in 1961. Following a successful CO_2-EOR pilot, a full scale CO_2-EOR project was started in 2004.

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[106] U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, *Basin Oriented Strategies for CO2 Enhanced Oil Recovery: East and Central Texas* 3-3 (Feb. 2006).

Injection of CO_2 into the Salt Creek oil field began in January of 2004. It is expected to raise field production to 25,000 - 30,000 BPD, compared to 6,000 BPD in 2004. This CO_2-EOR project could reverse the state's oil production decline. Approximately 130 MMcf/d of CO_2 is being injected into the formation. Early results are meeting expectations and are promising."[107]

- Enhanced Oil Recovery Research

30-8-101. Enhanced and improved oil recovery commission created; duties.

(a) The Wyoming enhanced and improved oil recovery commission is created.

(b) The commission . . . shall develop:

(i) A research program at the institute for energy research and enhanced oil recovery at the University of Wyoming. The program shall focus on oil and gas recovery technological issues, including carbon dioxide separation, reservoir sweep performance and reservoir displacement efficiency;

(ii) An expanded program at the institute focusing on technology transfer, to help industry with access to and application of existing enhanced oil recovery and improved oil recovery technology. The program shall be designed to promote research and technology transfer efforts, including polymer and surfactant flooding, horizontal drilling, zone specific fracturing and three dimensional seismic infill drilling;

(iii) A research program to identify and evaluate all potential sources of carbon dioxide for the purpose of reducing emissions in the state, increasing potential source points for use of industrial carbon dioxide and decreasing the cost of carbon dioxide to industrial users;

(iv) A research program for chemical engineering research on carbon dioxide separation from power plant flue gas, including experiments, theoretical models, laboratory and prototype testing.

(c) In developing programs under subsection (b) of this section, the commission shall direct development to economically viable solutions.

. . .

(e) The commission shall provide preliminary progress reports to the joint minerals, business and economic development interim committee by November 1, 2004 and November 1, 2005.

According to the Wyoming Geological Survey (WGS), approximately 8 billion barrels of oil remain in Wyoming fields and between 5% and 15% of this oil can be recovered with EOR technologies. Therefore, a broad application of EOR could increase the state's ultimate oil production by anywhere from 400 million to 1.2 billion barrels. Using a conservative estimate that 5% of 8 billion barrels can be recovered using EOR techniques, and assuming that those

[107] U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, *Basin Oriented Strategies for CO2 Enhanced Oil Recovery: Rocky Mountain Basin* 6-11 - 6-12 (Feb. 2006).

returns are spread across 20 years, and based on a conservative price of $45 per barrel, the revenues to Wyoming government from royalties and property and production taxes would amount to $150 million annually, or $3 billion across the 20-year period.[108]

D. MICHIGAN

- Two small miscible CO_2-EOR floods have been ongoing in Michigan for the past 10 years using CO_2 from an Antrim shale gas processing plant. In 1996, Core Energy, LLC, began CO_2 miscible flood projects on two Niagran pinnacle reef field reservoirs at 5200 feet depth, Dover 33 and Dover 36,with OOIP's of 4.1 and 3.7 MMBbls, respectively. Dover 36 is expected to ultimately produce an estimated 31% of its OOIP through primary production. Injection of 5.4 Bcfof CO_2 has increased production by an additional 5% of the field OOIP. Dover 33 is expected to perform better, with primary production netting 33% of the OOIP. CO_2 EOR is expected to produce an additional 18% OOIP after 21 Bcf of CO_2 injection. The field operator attributes the low recovery efficiency at Dover 36 to the highly heterogeneous nature of the reservoir. The more optimized well patterns for CO_2 injection in Dover 33account for the higher expected recovery efficiency. A third CO_2 EOR project is being conducted by a joint venture between Michigan Technical University, Western Michigan University and Jordan Development Company,LLC on the Dover 35 field. This Niagran pinnacle reef field is similar in size and reservoir characteristics to the Dover 33 and 36 fields. CO_2 injection began in 2004 and the operators expect to produce an additional 10-25% of the field's 2.2 MMBbls of OOIP in addition to an expected ultimate primary recovery of 44% OOIP.

E. INDIANA

- There is no existing EOR, however, Indiana has 2 large fields currently undergoing water injection (this is secondary recovery, tertiary recovery with traditional practices will not be possible, However, potential exists for state-of the-art storage in 15 immiscible reservoirs[109].

F. ILLINOIS

Illinois oil fields have had only brief experiences with CO2 injection. A small pilot was initiated in the Forsyth field, utilizing CO2 from the Archer-Daniels-Midland Ethanol Processing Facility in Decatur, IL. Few results from this project have been published. In the early 1990s, a single-well huff-and-puff CO2 pilot project began in the Mattoon field. Drilled to a depth of 1,800' in the Cypress Reservoir, this project also utilized CO2 trucked from ADM's ethanol plant in Decatur, IL. After several months of operation, the pilot was shutdown due to high CO2 costs compared to oil recovery. Currently, there is considerable work underway at locating and characterizing reservoirs suitable for CO2-EOR. (DOE 2005)

225 ILCS 725/23.1: **Enhanced recovery methods permitted**

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[108] Enhanced Oil Recovery Commission, *AProgress Report to the Joint Minerals, Business, and Economic Development Committee* 2 (Nov. 1, 2005), *available at* http://eori.gg.uwyo.edu/downloads/report11105.pdf.

[109] http://www.fossil.energy.gov/programs/oilgas/publications/eor_co2/Illinois_%26_Michigan_Basin_Document.pdf

The owner or owners of any tract of land which is productive or capable of being productive of oil or gas or any owner or operator of an oil and gas leasehold on which productive wells are situated, under a lease authorizing the lessee or his assigns to explore for and remove oil and gas, from any sand, strata, or formation, shall be permitted, in the interest of oil and gas conservation, to use any enhanced recovery method for the purpose of recovering the oil and gas contained therein; provided, that the owner or operator of a well to be used for any enhanced recovery method shall make a written application to the Department for authority so to do, and provided that written approval has been granted him by the Department; and provided further that the operation shall be done under the rules and regulations of the Department; and further provided, that use of any enhanced recovery method shall not be deemed to be an unlawful act.

See **Carter Oil Co. v. Dees**, 340 Ill. App. 449, 92 N.E.2d 519 (4th Dist. 1950) (holding that the lessor was entitled to convert an offset well into and injection well in order to maintain pressure and increase production in other wells because doing so is in accordance with what a "prudent operator, using reasonable diligence would do.").

G. KENTUCKY

- Kentucky has the same projection as Indiana

VI. EXISTING WELL ABANDONMENT REGULATIONS

A. CALIFORNIA

- **DOGGR Code 3208**. Well abandonment: operator must show all proper steps have been taken to isolate all oil-bearing or gas-bearing strata in well, and to protect underground or surface water from any detrimental substance and to prevent subsequent damage to life, health, property, and other resources.

- **3208.1.** (a) To prevent, as far as possible, damage to life, health, and property, the supervisor or district deputy may order the reabandonment of any previously abandoned well if the supervisor or the district deputy has reason to question the integrity of the previous abandonment. The operator responsible for plugging and abandoning deserted wells under Section 3237 shall be responsible for the reabandonment.

B. TEXAS

- Well plugging is extensively regulated, with advance notice and technical performance criteria applying to the operations. The TRRC applies the following criteria before approaching an application to plug a well (*16 T.A.C. § 3.14*):
  - ◊ "(i) the surface owner shall assume responsibility for plugging the well and obligate himself, his heirs, successors, and assignees to complete the plugging operations;
  - ◊ "(ii) the operator responsible for plugging the well shall place all cement plugs required by this rule up to the base of the usable quality water strata; and
  - ◊ "(iii) the surface owner shall submit:
    - "(I) a signed statement attesting to the fact that:

i. "(-a-) there is no groundwater conservation district for the area in which the well is located; or
ii. "(-b-) there is a groundwater conservation district for the area where the well is located, but the groundwater conservation district does not require that the well be permitted or registered; or
iii. "(-c-) the surface owner has registered the well with the groundwater conservation district for the area where the well is located; or

- "(II) a copy of the permit from the groundwater conservation district for the area where the well is located."

C. WYOMING

- WOGCC, Chapter 3, Section 14, Reporting; Section 15, Plugging of Wells, Stratigraphic Tests, Core, or Other Exploratory Holes

- WOGCC Regulations, Chapter 4, Environmental Rules, Including Underground Injection Control Program Rules for Enhanced Recovery and Disposal Projects, Section 8. Casing and Cementing of Injection Wells.

(a) Wells used for injection of gas, air, water, or other extraneous fluid into the producing formation shall be cased with safe and adequate casing or tubing so as to prevent leakage, and shall be so set or cemented that damage will not be caused to oil, gas, or fresh water sources.

(b) The provisions of Chapter 3, Section 22, shall apply to all injection wells.

(c) Before a new well drilled for injection or disposal is operated, the casing outside the tubing shall be tested at the greater of a minimum pressure of 300 psi or a pressure equivalent to the maximum injection pressure, but no higher than 1,000 psi. For the purpose of pressure testing, packers must be set within one hundred feet (100') of perforations. The same rules apply to testing existing wells newly converted to injection or disposal. Operators must provide the Commission staff the opportunity to witness all integrity tests. In the event a representative of the Commission is unable to witness the test, the operator is required to provide documentation of the test to the Commission. A retrievable bridge plug will be utilized in casing to test tubingless completions.

Water Quality Rules and Regulations
Chapter XI
DESIGN AND CONSTRUCTION STANDARDS FOR SEWERAGE SYSTEMS, TREATMENT WORKS, DISPOSAL SYSTEMS OR OTHER FACILITIES CAPABLE OF CAUSING OR CONTRIBUTING TO POLLUTION AND MOBILE HOME PARK AND CAMPGROUND SEWERAGE AND
PUBLIC WATER SUPPLY DISTRIBUTION SYSTEMS

Part G Well Construction Standards
Section 70. Plugging and Abandonment.
(a) All wells that are no longer useful (including test wells) must be plugged

in order to assure that groundwater supply is protected and preserved for further use and to eliminate the potential physical hazard. A well is considered "abandoned" when it has not been used for a period of one year, unless the owner demonstrates his intention to use the well again by properly maintaining the well in such a way that. . . .

(b) Preliminary work. Before a well is plugged and abandoned, it shall be investigated by the permittee (owner/ operator) to determine its condition, details of construction and whether there are obstructions that will interfere with the process of filling and sealing (requirements to be observed when plugging laid out).

. . .

(g) Reports. Within 15 days after a well has been plugged and abandoned, the owner shall file a plugging record with the Water Quality Division.

D. MICHIGAN

- Michigan has detailed well-plugging requirements that are contained in Section 615 Part 9. These rules include provisions for:
  - ◊ R324.61519 / Sec. 61519 requires the Supervisor of Wells to enter a property and properly (repair or) plug a well within 30 days if it is determined that the well operator is in violation of Section 615 (and the well is essentially closed) requirements. The costs for this action would be born by the surety or the owner/operator.
  - ◊ R 324.61520 / Sec. 61520 Abandoning well without properly plugging – this section finds the owner/operator who abandons a well without properly plugging the well as guilty of a misdemeanor, punishable by imprisonment for not more than 90 days, or a fine of not more than $1,000.00 and costs of prosecution, or both.
  - ◊ R 324.902 – Section 902 Plugging instructions; methods and materials – this section describes the need for plugging instructions to be issued by the Supervisor after a well operator has filed a notice to close the well. These instructions specify:

    (a) The type and amount of plugging material to be used.

    (b) The depths at which bridges are to be set.

    (c) The depths and lengths of cement plugs.

    (d) The amount of casing to be pulled.

    (e) Other requirements the supervisor determines are necessary for the proper plugging of the well.

- In addition, there are provisions governing the confinement of oil, gas, brine, and fresh water; the use of cement plugs, and other provisions.

E. INDIANA

- The current Oil and Gas Act contains provisions addressing inactive wells and temporary abandonment status. Plugging and abandonment is required when the well

(1) is completed as a nonproductive well; (2) ceases to produce oil or natural gas; or (3) is no longer operated for the purpose for which the well is permitted; unless authorized to delay.[110]

- Memo cites concern over misclassification of "inactive" wells as "active. "In the past, Oil and Gas Inspectors have been directed to view wells that are "hooked to flow" as "active" even though the pumping unit may have been disconnected from the rods or even removed completely and the well is not otherwise tended on a regular basis. We estimate that more than 3,000 wells that have been previously classified as "active" may in fact be "inactive".[111]
- Indiana has an Oil and Gas Environmental Fund for the purposes of supplementing the cost of well abandonment (for wells for which the permit was revoked), covering the costs of remedial plugging and/or repairing of wells after abandonment, and to cover the costs of environmental damage mitigation or public health and safety protection. Annual fees from oil and gas wells and civil penalties collected are deposited into the fund, and the fund is maintained at a balance between $500,000 – 1,500,000.[112]
- The Orphaned and Abandoned Well Program is responsible for the plugging of improperly abandoned oil and gas wells. As of July, 2006, there were 1,323 wells in the program.

F. ILLINOIS

62 Ill. Adm. Code 240.1115: **Plugging Responsibility**

The current permittee or person required to be the permittee is responsible for plugging wells as defined in Sections 240.200, 240.300, 240.1800 and 240.1900 of this Part. In the case of leaking wells, plugging responsibility is in accordance with Sections 240.870 and 240.875 of this Part.

62 Ill. Adm. Code 240.1130: **Plugging and Temporary Abandonment of Inactive Production Wells**

a) Any idle production well on an active lease or unit that has not been in operation for 24 consecutive months shall be deemed abandoned, in accordance with Section 240.1600(c) of this Part, and plugged in accordance with Section 240.1140 of this Part unless the well has been approved for Future Use status in accordance with subsection (c).

Plugging and Restoration Fund Program

The PRF Program is a program created by law that authorizes the Division of Oil & Gas to plug abandoned and leaking wells. In order for a well to qualify for plugging through the PRF Program, the Division of Oil & Gas must make a finding that the well constitutes an emergency, or make a finding that the well meets the definition for an "orphan" or "abandoned" well. There are over 4,500 wells in Illinois covered by the PRF Program. The Division has funds to plug approximately 500 wells annually. http://www.dnr.state.il.us/mines/dog/program_prf.htm

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[110] IN CODE ANN. § 14-37-8-1(a) (West 2006).

[111] http://www.in.gov/dnr/dnroil/pdf/inactivewells.pdf#search=%22number%20of%20EOR%20wells%20in%20Indiana%22

[112] IN CODE ANN. § 14-37-10.

G. KENTUCKY

Permit application requires a well abandonment plan

The most acceptable plan from EPA's standpoint is setting a continuous cement plug from top to bottom. If separate plugs are desired to be set, the plan may be more complicated to coordinate with Division of Oil & Gas inspector. Also, each plug will have to set up and be tagged before the next plug is set. After the well is plugged, EPA inspector will provide documentation to the Atlanta office, and the EPA bond will then be released back to the operator.

Default Permit Application Abandonment Plan: Plugging and Abandonment Procedure

Move in and rig up workover rig. Kill well as necessary with lease water.

Nipple up blowout preventer and test pipe rams to 1000 psi.

Pull out of hole with 2-3/8" tubing and packer.

Run in hole with cement retainer on 2-3/8" tubing. Set cement retainer +50' above top perforation in Dundee. Establish injection rate into perforations with fresh water and squeeze perforations with 40 sacks Class "A" cement (wt 15.7 ppg; yield 1.18 cf/sk) through retainer.

Stab out of retainer and leave 10 sx cement on top of retainer (+86 linear feet).

Pull up to 750' (100' below surface casing shoe depth). Spot 25 sacks of same cement from 750-535'.

Pull up to 50'. Spot 10 sacks cement to surface. Pull out of hole with tubing. C-14

Cut off 8-5/8" & 5-1/2" casing 4' below ground level. Weld 1/2" steel plateon 5-1/2" casing stub.

Backfill and clean up location.

Plugging and Abandonment Costs

	$
Workover Rig (including rig move) ($120/hr)	$3600
Cementing & Service	$2200
Rentals (BOP & FW tank)	$ 650
Water Transportation	$ 350
Welder	$ 250
Supervision	$ 900
Cement Retainer	$1250
Surface Restoration	$ 500
TOTAL P&A COSTS	$9700

*** see bonding requirements below ***

VII. BONDS/FEES

A. CALIFORNIA

An individual oil and gas well indemnity or cash bond or Class II commercial waste water disposal well indemnity or cash bond must be filed by the operator and executed by a surety company authorized to do business in this State (licensed by the California Department of Insurance). The bond shall secure the State against all losses, charges, and expenses incurred by the State to obtain compliance. An indemnity or cash bond can be terminated when the well is

completed or plugged and abandoned properly, another valid bond substituted for it, all required records are filed, and all operations are in compliance.

Bond Amounts

Individual Oil and Gas Wells (onshore surface location)

- $15,000 - less than 5,000 feet deep
- $20,000 - at least 5,000 but less than 10,000 feet deep
- $30,000 - 10,000 or more feet deep

Onshore Wells Covered by a Blanket Bond

- $100,000 (covers 50 or fewer total onshore wells owned by an operator)
- $250,000 (covers more than 50 total onshore wells owned by an operator)
- $1,000,000 (covers all wells owned by an operator, including idle wells)

Individual Class II Commercial Waste-Water Disposal Wells - $50,000

A Class II well may be covered by either an individual Class II commercial waste-water disposal well indemnity or cash bond or a blanket indemnity or cash bond. However, only **one** Class II commercial well may be covered by a $250,000 or a $1,000,000 blanket bond. Additional Class II commercial wells must be covered by individual bonds.

Individual Five-Year Idle Wells - $5,000

Operators may file a $5,000 individual indemnity or cash bond to cover their idle wells under Section 3206 of the PRC.

DOGGR Code 3205.2. (a) any person who engages in the operation of a class II commercial wastewater disposal well, as defined in subdivision (d), shall file an indemnity bond with the supervisor for fifty thousand dollars ($50,000) for each well so used. The bond shall cover all operations of drilling, redrilling, deepening, altering casing, maintaining, or abandoning the well and attendant facilities. The bond shall be executed by the person as the principal, and by an authorized surety company as the surety, and, except for differences in the amount, shall be in substantially the same language and upon the same conditions as provided in Section 3204.
(b) A blanket bond submitted under subdivision (a) or (c) of Section 3205 may be used in lieu of the bond required in subdivision (a), except that the termination and cancellation shall be in accordance with subdivision (c) of this section.
(c) Notwithstanding Section 3207, any bond issued in compliance with this section may be terminated and canceled and the surety relieved of all obligations thereunder when the well is properly abandoned or another valid bond has been substituted therefor.

3208. For the purposes of Section 3207, a well is properly completed when it has been shown, to the satisfaction of the supervisor, that the manner of producing oil or gas or injecting fluids into the well is satisfactory and that the well has maintained production of oil or gas or injection for a continuous six-month period. A well is properly abandoned
when it has been shown, to the satisfaction of the supervisor, that all proper steps have been taken to isolate all oil-bearing or gas-bearing strata encountered in the well, and to protect underground or surface water suitable for irrigation or farm or domestic purposes from the infiltration or addition of any detrimental substance and to prevent subsequent damage to life, health, property, and other resources.

B. TEXAS

Operators must meet financial security and insurance requirements. Specifically, operators shall submit well-specific plugging insurance policies, bonds and letters of credit on forms prescribed by the TRRC. *16 T.A.C. § 3.78(e).*

- Texas operates an abandoned/orphaned well program: http://www.rrc.state.tx.us/divisions/og/site_rem/StatefundedCleanupProgram.html. Funding for the program comes from regulatory fees, permit fees and bond fees paid by the oil & gas industry.

C. WYOMING

30-5-404 Surety bond or guaranty; approval; objections; release of surety bond or guaranty

(b) The surety bond or other guaranty shall be in an amount of not less than two thousand dollars ($2,000.00) per well site on the land. At the request of the oil and gas operator, after attempted consultation with the surface owner the commission may establish a blanket bond or other guaranty in an amount covering oil and gas operations on the surface owner's land as identified by an oil and gas operator in the written notice required under W.S. 30-5-402(e). Neither the minimum amount of the per well site bond or other guaranty specified in this subsection nor a blanket bond or other guaranty established by the commission is intended to establish any amount for reasonable and foreseeable damages.

WOGCC 30-5-104 The Commission has the authority to require and regulate:
vii) To use funds collected under W.S. 30-5-116(b) to plug wells and seismic holes and reclaim the surrounding area affected by them, if the commission is unable to enforce its regulations and laws requiring the owner, seismic contractor or hole plugger to plug and reclaim and if the owner, seismic contractor or hole plugger does not have an adequate surety bond or other guaranty to cover the cost of plugging and reclamation. *Nothing in this paragraph shall be construed to create any liability by the state for failure to adequately plug or reclaim wells or holes.*

Section 4. Bonding Requirements (Forms 8, 8A, 8E, and 8F).
(a) [T]he Commission shall require from the owner/operator a good and sufficient bond running to the State of Wyoming conditioned that each well shall be operated and maintained in such a manner as not to cause waste or damage the environment and upon permanent abandonment each well shall be plugged in accordance with the rules and regulations of the Commission. The minimum amount of bond or bonds required to be furnished shall be as follows:
(i) for wells of less than 2,000 feet in depth an individual bond in the amount of $10,000.00 for each such well;
(ii) for wells of 2,000 feet or more in depth an individual bond in the amount of $20,000.00 for each such well;
(iii) or in the alternative, a blanket bond in the amount of $75,000.00 covering all wells including wells less than 2,000 feet in depth. If the Commission has an acceptable blanket bond in the amount of $25,000.00 from an owner/operator prior to July 1, 2000, such owner/operator is not required to post the additional coverage under this subsection (iii).

(b) The bond or bonds required by these rules shall remain in full force and effect until:

(i) the permanent plugging and abandonment of the well or wells has been approved by the Supervisor;
(ii) the well has been properly converted to a water well in a manner approved by the Supervisor, in conjunction with the State Engineer;
(iii) the successive owner/operator or purchaser of the well or wells and/or the site(s) has provided a bond or other surety in an amount and form acceptable to the Commission; or
(iv) the bond has been released by the Commission.

(c) In the event an owner/operator has a blanket bond covering wells on fee or patented lands, the Commission will normally not ask for additional coverage if the wells are producing, monitoring, injecting, or disposing. Wells which are not producing, injecting, or disposing are deemed to be idle. The Supervisor may require an increased bonding level up to $3.00 per foot for each idle well as soon as the operator's total footage of idle wells exceeds 8,300 feet or 25,000 feet depending upon which level of blanket bond is in place. As wells are removed from idle status up to $3.00 per foot bonding requirements will be reduced accordingly.
(d) For wells on which the additional bonding is required, the Supervisor may allow the operator to post at least 5.55% of the new bond each month for eighteen (18) months or until the total amount of the bond has been posted.
(e) In lieu of additional bonding, the Supervisor may accept a detailed plan of operation which includes a time schedule to permanently plug and abandon idle wells or take such action as may be necessary to remove the well from idle status. This plan and time schedule is subject to approval by the Supervisor, and shall not exceed one (1) year from the date of filing. Plans filed by the first owner/operator go with the property in the event of a sale. The next owner/operator is responsible for completing the plans of the previous owner/operator unless the Supervisor accepts an alternate plan.
. . .
(i) . . . An operator may post a cashier's check, certificate of deposit or letter of credit if it complies with Chapter 3, Sections 5 and 6 as applicable.
. . .
(k) In determining the amount of bond to be posted, whether a single well site bond or blanket bond, the Supervisor shall consider the proposed plan of work and operations submitted by the operator in its notice to the surface owner and may consider any other factors which would materially impact the bond amount needed to secure payment of damages, including, but not limited to the following:
(i) loss of production and income;
(ii) loss of land value;
(iii) and loss of value of improvements caused by oil and gas operations.

Section 7. Forfeiture, Release, or Return of Surety Bond or Other Guaranty.
(a) The purpose of a surety bond or other guaranty posted as security pursuant to the Commission's rules is to insure that the principal or person posting same complies with the Oil and Gas Conservation Law, the Commission's rules, and the orders of the Commission, the State Oil and Gas Supervisor, or their agents, including, but not limited to, proper plugging of wells and seismic holes and reclamation of the area affected by same. Site reclamation must be initiated within one (1) year of permanent abandonment of a well or last use of a pit and shall be completed in as timely a manner as climatic conditions allow.

(c) If the Commission determines the principal on the bond delivered pursuant to Sections 4(a) through (e) of this chapter has complied with the Oil and Gas Conservation Law, the Rules of the Commission, and the orders of the Commission, the State Oil and Gas Supervisor, or their agents including, but not limited to, production facility removal, produced water pit closure, proper plugging of wells and seismic holes and reclamation of the surrounding affected area, with respect to all operations secured thereby, then the Commission shall release the obligation of the bond.

D. MICHIGAN

Rules governing bonds/ fees and insurance are contained in the general provisions for the Supervisor of Wells and in the administrative rules. Operators must demonstrate financial security as follows:

- 324.61525 Permit to drill well…an operator cannot commence drilling until they have obtained a permit, secured a bond as described below and paid a fee ($300).
- R 324.212 Conformance bond amounts - Rule 212. A person who drills or operates a well shall file a conformance bond with the supervisor for the following amounts, as applicable:

  (a) Single well conformance bonds… -

  (i) $10,000.00 for wells up to and including 2,000 feet deep, true vertical depth.

  (ii) $20,000.00 for wells deeper than 2,000 feet, but not deeper than 4,000 feet, true vertical depth.

  iii) $25,000.00 for wells deeper than 4,000 feet, but not deeper than 7,500 feet, true vertical depth.

  (iv) $30,000.00 for wells deeper than 7,500 feet, true vertical depth.

  (b) …

  (c) Blanket conformance bonds… A maximum of 100 wells may be covered by a blanket conformance bond.

  (i) $100,000.00 for wells up to and including 2,000 feet deep, true vertical depth.
  (ii) $200,000.00 for wells deeper than 2,000 feet but not deeper than 4,000 feet, true vertical depth.

  (iii) $250,000.00 for wells deeper than 4,000 feet, true vertical depth.

  (d) A person shall not be required to file a blanket conformance bond or bonds in an aggregate amount of more than $250,000.00 when the aggregate amount of the conformance bonds is $250,000.00, the permittee may file 1 blanket conformance bond of $250,000.00 to cover all of his or her wells.
- Other provisions in Section 615 Part 2 require an annual demonstration of the financial security of the operator, modifications of the above provisions for specific exceptions, and indications of cases where the bond requirements may be increased or expanded if problems arise.

In addition, Michigan runs an orphan well program that is funded from fees and fines collected through the program. The most recent (2006) report of the program[113] shows a total of 158 orphaned wells broken into the following categories:

- CATEGORY IB WELLS: (leaking oil resulting in contamination of soils, surface water resources, or the groundwater where water wells used for public consumption are not yet contaminated) – 2 wells
- CATEGORY II WELLS: (not known to be leaking) – 131 wells

CATEGORY III WELLS: (Plugged using Orphan Well Funds; sites still require remedial work) – 25 wells

E. INDIANA

- **Fees required for oil and gas well permits**

A one time fee of $250 is required as a part of the permit application. For expedited review, there is a $750 permit fee.

An annual of fee is assessed based on the number of permits:

one permit - $150
two to five permits - $300
six to twenty-five permits - $750
twenty-six to 100 permits - $1000
for each additional permit over 100 - $15

- **Bonds required for oil and gas well applicants.**[114]

Bonds are required for parties that have never been granted an oil and gas well permit, a party that has a demonstrated history of violating well permits within past 2 years, a party that failed to pay civil penalties or a party that failed to pay the annual fee for its well.

A bond in the amounting to at least $2,500 for each well, or a blanket bond of $45,000 for any number of wells is required.

- **Alternatives to Bonds:**

Instead of a bond, the owner can submit cash or a certificate of deposit. For noncommercial natural gas wells, the commission may require proof of financial ability to abandon the well.

- **Bond Duration**

The bond is effective until the owner or operator appropriately plugs or abandons each well covered under the bond (including blanket bonds), or a substitute bond is accepted for each well.

F. ILLINOIS

225 ILCS 725/6: **Hearings and adoption of rules**

(2) The drilling, deepening or conversion of any well is hereby prohibited until such application is made and the applicant is issued a permit therefore as provided by this Act.

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[113] State of Michigan: 2006 Orphan Well List; found online at: http://www.deq.state.mi.us/documents/deq-ogs-land-oilandgas-2006-orphan-list.pdf

[114] *Id.* at § 1437-6.

Additionally, each applicant who has not been issued a permit that is of record on the effective date of this amendatory Act of 1991, or who has not thereafter made payments of assessments under Section 19.7 of this Act for at least 2 consecutive years preceding the application, shall execute, as principal, and file with the Department a bond, executed by a surety authorized to transact business in this State, in an amount estimated to cover the cost of plugging the well and restoring the well site, but not to exceed $ 5000, as determined by the Department for each well, or a blanket bond in an amount not to exceed $ 100,000 for all wells, before drilling, deepening, converting, or operating any well for which a permit is required that has not previously been plugged and abandoned in accordance with the Act. The Department shall release the bond if the well, or all wells in the case of a blanket bond, is not completed but is plugged and the well site restored in accordance with the Department's rules or is completed in accordance with the Department's rules and the permittee pays assessments to the Department in accordance with Section 19.7 of this Act for 2 consecutive years.

In lieu of a surety bond, the applicant may provide cash, certificates of deposit, or irrevocable letters of credit under such terms and conditions as the Department may provide by rule.

The sureties on all bonds in effect on the effective date of this amendatory Act of 1991 shall remain liable as sureties in accordance with their undertakings until released by the Department from further liability under the Act. The principal on each bond in effect on the effective date of this amendatory Act of 1991 shall be released from the obligation of maintaining the bond if either the well covered by a surety bond has been plugged and the well site restored in accordance with the Department's rules or the principal of the surety has paid the initial assessment in accordance with Section 19.7 and no well or well site covered by the surety bond is in violation of the Act.

No permit shall be issued to an individual, partnership, or other unincorporated entity that is not a resident of Illinois until that individual, partnership, or other unincorporated entity has irrevocably consented to be sued in Illinois.

(3) To require the person assigning, transferring, or selling any well for which a permit is required under this Act to notify the Department of the change of ownership. The notification shall be on a form prescribed by the Department, shall be executed by the current permittee and by the new permittee, or their authorized representatives, and shall be filed with the Department within 30 days after the effective date of the assignment, transfer or sale. Within the 30 day notification period and prior to operating the well, the new permittee shall pay the required well transfer fee and, where applicable, file with the Department the bond required under subsection (2) of this Section.

62 Ill. Adm. Code 240.1500: **When Required, Amount and When Released**

a) To Drill, Deepen, Convert or Operate an Oil or Gas Well

1) A bond, in the amount as herein provided, shall be submitted along with an application to drill, deepen, convert, operate or transfer a production or Class II well if:

A) such applicant was not an owner on September 26, 1991 of the right to drill and produce the well or wells in the transfer request; or

B) such applicant was not a permittee of record on September 26, 1991; or

C) such applicant has had a bond forfeited or is the subject of an unappealed, unabated Department final administrative decision requiring wells to be plugged; or

D) such applicant was not assessed an annual well fee as of July 1 preceding the application date, unless applicant was a permittee of record of an unplugged well in the previous fiscal year and not the subject of an unappealed, unabated Department final administrative decision; or
E) such applicant has had funds expended and/or wells plugged on its behalf by the Department using funds from the Plugging and Restoration Fund; or
F) such applicant is not an appointed trustee or receiver in accordance with Section 240.1410(a)(4) of this Part.

2) When a bond is required to be filed with the Department to drill, deepen, convert or operate an oil or gas well, the amount of the bond shall be:
A) $ 1,500 for a well less than 2000 feet deep;
B) $ 3,000 for a well 2,000 or more feet deep;
C) $ 25,000 for up to 25 wells of a permittee;
D) $ 50,000 for up to 50 wells of a permittee; or
E) $ 100,000 for all wells of a permittee.

3) Failure to provide the required bond will result in the issuance of a cessation of operations order in accordance with Section 240.185(b) of this Part.

4) A bond submitted pursuant to Section 240.1500(a) shall be released when:
A) all wells covered by the bond are plugged and restored in accordance with Subpart N of these rules; or
B) all wells covered by the bond are transferred in accordance with Subpart N of these rules; or
C) the permittee has paid assessments to the Department in accordance with Section 19.7 for 2 consecutive years and such permittee is not in violation of the Act.

62 Ill. Adm. Code 240.1530: **Forfeiture of Bonds**

a) A permittee's failure to comply with the Department's order to plug, replug or repair a well, or to restore a well site, within thirty (30) days of the issuance of such order constitutes grounds for bond forfeiture, pursuant to Sections 6 and 19.1 of the Act.
c) The Department may allow a surety to undertake necessary plugging, replugging, repair or site restoration work if the surety can demonstrate an ability to complete such work in accordance with the requirements of the Act. No surety liability shall be released until the successful completion of all plugging, replugging, repair or site restoration ordered by the Department.

G. KENTUCKY

- In order to obtain a permit, an operator must have enough money set aside to plug an injection well. The cost of plugging can be determined by acquiring bids (minimum of three) or by using the cost estimate above.
- The requirement for plugging costs can be accomplished using a number of different mechanisms:
  - ◊ **Option 1.** Obtain an Irrevocable Letter of Credit from your bank with a Stand By Trust Agreement. This is the most common financial arrangement used by operators.
  - ◊ **Option 2.** Set up a fully funded trust with your bank.
  - ◊ **Option 3.** Obtain a Surety Performance Bond by an insurance company and execute a Stand By Trust Agreement.

- ◊ **Option 4.** Prepare a Financial Statement and Chief Financial Officer's Letter. Include an Independent Auditor's Verification Statement. This option is typically reserved for Fortune 500 companies.

- Blanket Bond Tiered Bonding Structure:
  - ◊ 1 – 25 wells require a $10,000 bond
  - ◊ 25 -100 wells require a $25,000 bond
  - ◊ 101-500 wells require a $50,000 bond
  - ◊ 501 wells or more require a $100,000 bond.

- Estimated Cost to Depth Guidelines

	Cement Top Behind Casing**	
Well Depth*	At Surface	Below Surface
< 500'	$2300	$3000
501'-1000'	$3000	$3900
1001'-1500'	$3700	$5000
1500'-2000'	$4800	$6500 *Refers to Plug Back Depth
>2000'	$5800	$7400 **Production Casing String

VIII. ACCOUNTING LINKAGES (EXISTING CO_2 REGULATIONS THAT MAY ADDRESS LIABILITY DIRECTLY OR INDIRECTLY)

A. CALIFORNIA

- *CPUC Carbon Adder:* In December 2004 the California PUC approved a requirement that a "carbon adder" be included in resource plans for three of California's utilities, Pacific Gas and Electric Company, Southern California Edison, and San Diego Gas and Electric Company. A carbon adder is a means of accounting for possible future costs of mitigating GHG emissions. It is an expected future price for CO2e that is assumed when comparing investment options. Carbon adders are used to compare the cost of fossil fuel and renewable generation, as well as demand-side management investments. The carbon adder is used for utility planning purposes only, and is not assessed to consumers. Taking the cost of carbon into account means that an investment is considered more cost-effective if it avoids a ton of CO2 emissions at an incremental cost equal to the value of the carbon adder. The CPUC based the range of costs on a number of studies and in April 2005 assessed a carbon adder of $8.00 per ton of CO2.

B. TEXAS

- For purposes of the FutureGen project, Texas has enacted legislation that gives the State title to injected CO_2 (specifically, to the TRRC).

C. WYOMING

- NONE

D. MICHIGAN

- NONE

E. INDIANA

- Indiana conducts a GHG inventory but not a registry, however; Mayors representing 5 cities in Indiana (Bloomington, Columbus, Fort Wayne, Gary, and Michigan City) signed the U.S. Mayors Climate Change Protection Agreement, which commits them to meet or beat the Kyoto target of 7 percent reduction from 1990 levels by 2012.

F. ILLINOIS

- NONE

G. KENTUCKY

- NONE

IX. EXISTING MONITORING REGULATIONS

A. CALIFORNIA

DOGGR Code 3106(c) The supervisor may require an operator to implement a monitoring program, designed to detect releases to the soil and water, including both groundwater and surface water, for aboveground oil production tanks and facilities.

- *Testing Idle wells*: Idle wells are those that have not produced oil and/or gas or have not been used for fluid injection for six consecutive months during the last five years. The Division program encourages operators to reactivate or plug and abandon idle wells. Operators of idle wells are required to test them periodically to ensure that no damage is occurring to oil and gas reservoirs or groundwater. An idle-well test may be as simple as a fluid-level survey or may be a more complicated well-casing mechanical integrity test.

B. TEXAS

- The operator of a well shall file with the commission the appropriate completion report within 30 days after completion of the "well" or within 90 days after the date on which the drilling operation is completed, whichever is earlier. *16 T.A.C. § 3.16(b).* "Well" is defined as "A well drilled for any purpose related to exploration for or production or storage of oil or gas or geothermal resources, including a well drilled for injection of fluids to enhance hydrocarbon recovery, disposal of produced fluids, disposal of waste from exploration or production activity, or brine mining." *16 T.A.C. § 3.16(a)(4).*
- Not later than the 90th day after the date a drilling operation is completed, the operator shall file with the commission a legible and unaltered copy of a basic electric log, except that where a well is deepened, a legible and unaltered copy of a basic electric log shall be filed if such log is run over a deeper interval than the interval covered by a basic electric log for the well already on file with the TRRC. *16 T.A.C. § 3.16(c).*
- Operators of disposal/injection wells must monitor the injection pressure and volume at least monthly and report the results annually to the TRRC on Form H-10.

- Operators of hydrocarbon storage wells in salt formations must monitor the injection pressure and net volume injected or withdrawn at least monthly and report the results annually to the TRRC on Form H-10H.

C. WYOMING

- WOGCC Regulations, Chapter 4, Environmental Rules, Including Underground Injection Control Program Rules for Enhanced Recovery and Disposal Projects, Section 7 Waterflooding and Other Recovery Operations

. . .

- (d) Injection Well Integrity Demonstration. For the purpose of this rule, a mechanical integrity test of an injection well is a test designed to determine: if there is a significant leak in the casing, tubing, or packer of the well, and if there is significant fluid movement into an underground source of drinking water through vertical channels adjacent to the wellbore.

. . .

- (e) Mechanical integrity must be established by the owner or operator no less than once every five (5) years.

D. MICHIGAN

R 324.612 Secondary oil recovery projects; hearings; records. Rule 612. (1) A person desiring to inject water, gas, or other fluid into a producing formation or use other technology for the purpose of increasing the ultimate recovery of hydrocarbons from a reservoir shall file a petition for hearing pursuant to part 12 of these rules. (2) The operator of a secondary recovery project shall keep accurate records of all oil, gas and brine produced, volumes of fluids injected, and injection pressures. The operator shall file reports of the data and other data as may be required with the supervisor at regular intervals, as specified.

R 324.806 Monitoring and filing records and reports.

Rule 806. (1) A permittee of a brine disposal injection well shall, on a weekly basis, monitor and record the injection pressure, injection rate, and cumulative volume of the fluid injected. A permittee of a secondary recovery injection well shall, on a monthly basis, monitor and record the injection pressure, injection rate, and cumulative volume of the fluid injected. A permittee of a secondary recovery injection well may conduct the monitoring and recording, required by this rule, on a field or project basis by manifold monitoring, rather than on an individual well basis, if more than 1 secondary recovery injection well operates with a single manifold, and if the permittee demonstrates that manifold monitoring is comparable to individual well monitoring. A permittee of a brine disposal injection well shall report the data monthly to the supervisor, unless the supervisor requires a lesser frequency, on forms prescribed by the supervisor. A permittee of a secondary recovery injection well shall report the data annually to the supervisor, on forms prescribed by the supervisor. Injection wells utilized for gas storage are exempt from this rule.

(2) A permittee of an injection well shall file an annual monitoring report, on a form provided by the supervisor, summarizing the data of the monitoring required in subrule (1) of this rule. A permittee shall not operate an injection well unless the annual monitoring report is filed by March 1 of each year for the previous calendar year. If the report is not filed by March 1, then a

permittee may not continue injection until the required report is submitted and written approval is received from the supervisor or authorized representative of the supervisor.

(3) All records pertaining to an injection well shall be retained for a period of 3 years.

E. INDIANA

- The drilling, casing, operating, plugging and abandoning of wells is regulated by the commission to prevent (1) Waste, (2) Fresh water pollution, (3) Blowouts, (4) Cavings, (5) Seepages, (6) Fires, and (7) Unreasonably detrimental effects upon fish, wildlife, and botanical resources.[115]

- In determining the potential threat to public health and safety and/or the environment, and thus whether to plug a well, the commission takes into consideration whether the well is currently (or suspected to be) leaking oil, salt water, or natural gas into the environment; it's proximity to residential or commercial buildings or water supply wells; any immediate threats the well poses to the health or safety of the public, or to that of wildlife or livestock; the fluid levels in the well; whether the well is in an area subject to frequent flooding or close to streams or other environmentally sensitive areas; or whether the well currently poses a significant impediment to existing or proposed commercial or residential development, or to mineral extraction, agricultural, or industrial operations.

- State level, existing site characterization checklist for underground storage tanks, provides specific guidance for geologic characterization and number of monitoring wells.[116]

F. ILLINOIS

62 Ill. Adm. Code 240.780
The permittee of each Class II UIC well shall file an Annual Well Status Report, and shall include1) the name and location of the well, 2) the names of all injection intervals, 3) the setting depth of the packer, and 4) the average and maximum monthly injection rates and pressures. The operator of an enhanced oil recovery project shall complete an annual project report.

Section 240.760 Establishment of Internal Mechanical Integrity for Class II UIC Wells
An internal mechanical integrity test, consisting of a pressure test, is required prior to injection into a newly permitted well, prior to resuming injection after temporary abandonment, and at least once every 5 years from the date of the last successful test.

62 Ill. Adm. Code 240.1132: **Plugging and Temporary Abandonment of Inactive Class II UIC Wells**

e) The permittee shall apply for Future Use status by making written application on forms provided by the Department. The Department shall place the well on Future Use status and issue

[115] *Id*. at § 14-37-3-5.
[116] http://www.in.gov/idem/programs/land/lust/lustinitialsitecharact.html

a Future Use permit if the well meets the following conditions (which shall be continuing requirements):

5) If the fluid level, as tested, is higher than 100 feet below the base of the freshwater, the permittee, under supervision of the Department shall:

A) set a cast iron plug within 200 feet above the perforated or open hole interval in the cemented portion of the production casing, but no less than 100 feet below the base of the freshwater, remove any fluid to a level at least 100 feet below the base of the freshwater zone, and monitor the fluid level annually; or

B) set a cast iron plug within 200 feet above the perforated or open hole interval in the cemented portion of the production casing, but no less than 100 feet below the base of the freshwater, and pressure test the casing by maintaining a pressure of 300 PSIG (which may vary no more than 5%) for a period of 30 minutes.

G. KENTUCKY

- EPA requires operators of Class II injection wells to an "Annual Disposal/Injection Well Monitoring Report including:

1) the amount of fluid injected and the pressure at which the fluid is injected on a regular basis.
2) For enhanced recovery wells, the average and maximum injection pressure, the total volume of fluid in barrels or MCF (thousand cubic feet), and the minimum and maximum casing pressure, should be measured and recorded on a monthly basis.
3) For disposal wells, these measurements need to be taken and recorded on a weekly basis.
4) The measurements can be taken at a common manifold for injection wells in the same field. An injection fluid analysis should be taken within 12 months from the date the permit was issued, and every 12 months thereafter, or if significant changes in fluid composition occur.
5) The analysis must measure pH, total dissolved solids, and specific gravity. The analysis must also include the names and chemical composition of all chemicals used for well stimulation, and any additives or inhibitors used to prevent scaling, corrosion, and bacterial growth.
6) The annular space between the casing and tubing should be monitored for each injection well. If the pressure rises or lowers by 15 psig, the operator shall provide an explanation to the EPA and take steps to correct the problem.

- Mechanical Integrity Tests (MITs) are required:

1) Before any new well or newly converted well is placed into service
7) After any workover that resets the packer
8) For any well where the packer becomes unseated
9) Every 5 years for active standard injection wells (injection through tubing and packer)
10) Every 2 years for non-standard wells (old rule authorized wells that inject through production casing)
11) Every 2 years for idle or temporary abandoned wells. These wells have remained fully equipped and could be started back up with the flip of a switch but have been shut-in for 2 years
12) Every 2 years for abandoned wells with tubing and packer removed. A plug may be set and the casing is pressured up to 300 pounds.

Prior to a conversion from injection to production, a well must pass an MIT.

X. NATURAL GAS STORAGE

A. CALIFORNIA

- CA had 11 total underground natural gas storage sites with a working gas capacity of 266 billion cubic feet (Bcf) as of 2005.[117]

Year	*Total Storage (Mcf)*
2000	365,502,883
2001	443,999,925
2002	415,578,273
2003	425,189,309
2004	442,057,808

- **DOGGR Code 3403.5.** State required to maintain surveillance over natural gas storage facilities to insure that no damage occurs to the environment by reason of injection and withdrawal of gas, funded by per well fee.

B. TEXAS

- TX had 34 total underground natural gas storage sites with a working gas capacity of 440 Bcf as of 2005.[118]
- Title 3 of the Texas Natural Resources Code regulates oil and gas generally. The code contains a section controlling underground natural gas storage and conservation, and the TRRC oversees its application. The code grants storers of natural gas the right of eminent domain for the acquisition of underground storage facilities where certain conditions are met, including a finding by the Commission that the storage is necessary for adequate service to the public and is in the public interest. *V.T.C.A., Natural Resources Code § 91.174.* Storers may thus obtain ownership of underground storage space. Presumably, once such ownership is obtained, owners of the surface interests above the obtained storage areas (who would otherwise own the storage space) would no longer have trespass claims arising out of such storage, to the extent such claims would otherwise exist. It is unclear whether this right would be considered for CO_2 storage.

C. WYOMING

- WY had 8 total underground natural as storage sites with a working gas capacity of 46 Bcf as of 2005.[119]

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[117] Energy Information Administration, Office of Oil and Gas, *U.S. Underground Natural Gas Storage Developments:1988-2005* 3 Tbl.1 (October 2006), *available at* http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngstorage/ngstorage.pdf.
[118] *Id.*
[119] *Id.*

D. MICHIGAN

- MI had 45 total underground natural gas storage sites with a working gas capacity of 633 Bcf as of 2005.[120]

E. INDIANA

- Indiana has 22 underground natural gas storage sites with a working gas capacity of 30 billion cubic feet.[121]
- 12 of the underground storage sites are in aquifers.[122]

F. ILLINOIS

- In northern Illinois, the Cambrian Mt. Simon Sandstone is used for natural gas storage by utilities. There are a few specific sites utilized for natural gas storage: 1) Mt. Simon in the Manlove Gas Storage Field, Champaign County, Illinois, and 2) the Herscher Gas Storage Field in Kankakee County, Illinois.

G. KENTUCKY

- KY has 23 underground natural gas storage sites with a total working gas capacity of 87 Bcf.[123]

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[120] *Id.*
[121] Energy Information Administration, Office of Oil and Gas, *U.S. Underground Natural Gas Storage Developments:1988-2005* 3 Tbl.1 (October 2006), *available at* http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngstorage/ngstorage.pdf.
[122] *Id.*
[123] *Id.*