State of Ohio
Class II UIC Program
Peer Review

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Conducted by the

Ohio Department of Natural Resources
Division of Oil & Gas

Conducted by the
Groundwater Protection Council
Contents
Introduction .................................................................................................................................................. 4
The Class II UIC Program ............................................................................................................................... 7
The Peer Review Process ............................................................................................................................... 11
Ohio Class II UIC Peer Review ...................................................................................................................... 13
Review Team .................................................................................................................................................. 13
Executive Summary ....................................................................................................................................... 13
Program Overview .......................................................................................................................................... 13
Permitting and File Review ............................................................................................................................ 14
Financial Assurance ....................................................................................................................................... 15
Public Outreach .............................................................................................................................................. 15
Well Construction .......................................................................................................................................... 16
Mechanical Integrity Testing ........................................................................................................................... 17
Inspections ..................................................................................................................................................... 17
Compliance and Enforcement ......................................................................................................................... 18
Overall Program Findings ............................................................................................................................... 19
Part I: General Administrative Overview ..................................................................................................... 20
Statutory Authorities and Regulatory Jurisdictions ......................................................................................... 20
Administration, Staffing and Funding ............................................................................................................ 21
Data Management Program ........................................................................................................................... 23
Interagency Coordination ............................................................................................................................... 25
Changes in Program Activities since Primacy .................................................................................................. 26
Identified Strengths ........................................................................................................................................ 27
Review Suggestions ........................................................................................................................................ 28
Part II: Permitting and Compliance Review .................................................................................................. 30
Permit Application Flow and Review Process .................................................................................................. 30
Technical Aspects of the Permit Review Process ............................................................................................. 32
Area of Review Considerations and Procedures ............................................................................................ 35
Induced Seismicity Considerations .................................................................................................................. 35
Administrative Aspects of Permit Application Review ................................................................................... 37
Aquifer Exemptions ......................................................................................................................................... 39
Data Management Systems Used in Permit Application Review ................................................................... 39
Periodic File Review Process .......................................................................................................................... 40
Introduction

Underground injection is the placement of fluids, including but not limited to waste by-products, into the subsurface through a wellbore. Underground injection is not a new practice. The Chinese injected freshwater for salt extraction as early as A.D. 300. The first documented use of injection to dispose oilfield produced water (brine) was in Texas during the 1930s, over eighty years ago. Beginning in the 1930s, the oil and gas industry also began to inject produced water into pressure-depleted oil reservoirs in order to enhance recovery of crude oil resources. During the 1970s and 80s, oil refineries and chemical industries began to inject liquid wastes in deep disposal wells. Today, underground injection is used to remove more than 50 percent of the liquid hazardous waste, and more than 98 percent of salt water produced by onshore oil and gas operations from the surface environment.

Some waste is an unavoidable by-product of a myriad of resource development and manufacturing processes that create thousands of products that we use in our daily lives including: steel, plastics, pharmaceuticals, fuels, and natural gas. Underground injection is an important waste management practice internationally and in the United States. Some renewable energy sources, such as geothermal, also rely on underground injection. Municipalities need underground injection to replenish aquifers (aquifer storage and recovery), combat saline water encroachment in coastal areas, to dispose of residual waste streams generated by treatment and desalination of water for public use, and to dispose treated sewage. While industries continue to develop ways to reduce waste volumes and recycle, generated wastes must be disposed in a safe manner. Various types of injection wells have unique associated benefits and risks. To dispose fluids safely, injection wells must be properly constructed, located in an appropriate geologic setting, operated, maintained and monitored in accordance with standards that are protective of our groundwater resources.

Liquid wastes can be managed in a variety of ways other than underground injection including:

- treatment and release into surface waters, such as rivers, through a National Pollutant Discharge Elimination System (NPDES) permit issued pursuant to the federal Clean Water Act;
- biological treatment;
- Incineration;
- storage in evaporation pits;
- discharge into percolation pits; and
- beneficial re-use (e.g., irrigation, livestock watering, ice or dust control)

Each of these practices has its limitations and associated environmental risks. For many waste streams, including produced water generated during oil and gas exploration practices, the
volumes are too great to rely solely on these alternative waste management practices. Furthermore, injecting highly saline fluids back into deep subsurface reservoirs that contain equally saline water is a common-sense waste management practice that poses fewer environmental or public health risks than these alternatives.

Underground injection plays a crucial role in disposing residual wastes, especially those that would pose the greatest risks to society if managed by any other method, such as discharge to surface waters. In other words, if underground injection is restricted or eliminated, the result will be more, not less risk of environmental harm.

In 1974, Congress passed the Safe Drinking Water Act (SDWA), which required the U.S. Environmental Protection Agency (USEPA) to develop minimum federal requirements for injection practices. Regulations adopted pursuant to the SDWA are now administered by U.S. EPA along with state and tribal partners that collectively constitute the UIC Program. The purpose of the UIC Program is to protect public health by preventing contamination of underground sources of drinking water (USDWs).

A USDW is defined as an “aquifer or its portion which supplies any public water system or contains a sufficient quantity of groundwater to supply a public water system, and either currently supplies a public water system, or contains less than 10,000 milligrams per liter of total dissolved solids and is not an exempted aquifer.” Most groundwater used for public drinking water today contains less than 500 milligrams per liter of Total Dissolved Solids (TDS), and most water that is treated for drinking water contains less than 3,000 milligrams per liter TDS. Therefore, the UIC Program ensures that water resources that could be treated and used as drinking water in the future are protected today.

After passage of the Safe Drinking Water Act (1974), U.S. EPA worked with a twelve-member state workgroup to develop the UIC Program rules (1976-1977). From the onset of rule development, regulatory officials sought to apply lessons learned from decades of injection experience. Prior to enactment of the federal regulations, USEPA and state officials examined best practices and problems associated with injection well operations that pre-dated passage of the SDWA.

While developing the UIC Program regulatory framework, USEPA and state officials recognized six pathways through which injected fluids could potentially migrate into USDWs. Officials sought to develop regulatory standards that mitigate and effectively address the following pathways:

- migration of fluids through a faulty injection well casing;
- migration of fluids through the annulus located between the casing and wellbore;
• migration of fluids from an injection zone through the confining strata;
• vertical migration of fluids through improperly abandoned and improperly completed wells that penetrate the injection zone;
• lateral migration of fluids from within an injection zone into a protected portion of that stratum; and
• direct injection of fluids into or above an USDW

The USEPA has defined six classes of injection wells that are permitted and regulated under the SDWA, which are summarized in the following table.

<table>
<thead>
<tr>
<th>U.S.EPA Classification</th>
<th>Injection Well Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS I</td>
<td>Wells used to inject waste beneath the lowermost USDW</td>
</tr>
<tr>
<td>CLASS II</td>
<td>Wells used to dispose of fluids associated with the production of oil and natural gas</td>
</tr>
<tr>
<td>CLASS III</td>
<td>Wells used to inject fluids for the extraction of minerals</td>
</tr>
<tr>
<td>CLASS IV</td>
<td>Wells used to dispose of hazardous or radioactive wastes into or above a USDW (NOTE: Ohio does not have any Class IV wells)</td>
</tr>
<tr>
<td>CLASS V</td>
<td>Wells not included in the other classes generally used to inject non-hazardous waste</td>
</tr>
<tr>
<td>CLASS VI</td>
<td>Wells used to geologically sequester carbon dioxide to reduce greenhouse gas emissions</td>
</tr>
</tbody>
</table>

Table 1 Injection well classification chart Source: after USEPA

The USEPA is charged with enforcement of the SDWA, and exercises that authority directly or through formal agreements with state and tribal partners, under their oversight. The USEPA has given primary enforcement authority (primacy) over underground injection wells to those state agencies or tribes that have shown they are able to implement a UIC Program that is effective in protecting groundwater resources. These requirements are in Sections 1422 and 1425 of the SDWA, and the Federal Register (40 Code of Federal Regulations Sections 144

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The states that USEPA has determined have regulations, laws, and resources in place that meet the federal requirements and are authorized to run the UIC Program, are referred to as Primacy states. Primacy states manage their programs subject to periodic audits and program reviews conducted by USEPA. In states that have not received primary responsibility for the UIC Program, USEPA remains the responsible regulatory agency. These states are referred to as Direct Implementation (or DI) states, because USEPA directly implements the federal UIC regulations in these states. Some states share responsibility with the USEPA, with authority over some well classes residing at the state level, and other well classes being regulated by USEPA.

The Class II UIC Program

Class II injection wells are used primarily to inject fluids that are associated with oil and gas exploration and production (E&P) activities including drilling, stimulation (hydraulic fracturing), and production operations. Since the inception of oil and gas exploration and development (1860), the oil and gas industry has been generating and managing produced water. Produced water is the water extracted from the subsurface during oil and gas E&P activities. Produced water occurs naturally within underground formations, and is brought to surface along with oil and gas through a cased wellbore.

Produced water is generated during several oil and gas E&P activities including:

- drilling through saline water zones that naturally occur in the subsurface and overlie the target oil and gas reservoir(s);
- stimulation of oil or gas reservoirs by hydraulic fracturing during the flow back and swabbing process; and
- workover operations, and
- during day-to-day production operations

Long before hydraulic fracturing operations started in the 1940’s, the oil and gas industry generated large volumes of produced water that was capable of harming the environment if not properly managed.

Produced water characteristics and physical properties vary considerably depending on the geographic location of the field, the geological formation with which the produced water has been in contact for thousands of years, and the type of hydrocarbon product being produced. Produced water properties and volumes can even vary throughout the lifetime of an oil and gas well or reservoir. Produced waters can be highly saline, with salt concentrations exceeding 200,000 milligrams per liter of chloride (more than ten times as salty as sea water) or may be pure enough for agricultural or irrigation purposes. In addition, produced water commonly contains many organic and inorganic compounds that can lead to toxicity. Some of these are
naturally occurring dissolved or emulsified hydrocarbons derived from associated crude oil while others are related to chemicals that have been added for well-control or reservoir stimulation purposes. These fluid wastes are specifically excluded from hazardous waste classification under the Resource Conservation and Recovery Act (RCRA).

The 1980 amendments to the RCRA required USEPA to conduct a study of the environmental and potential human health impacts associated with E&P wastes and their associated waste management practices. USEPA completed its two-year study in 1987. Based on the findings in the Report to Congress, and on oral and written comments received during public hearings in the spring of 1988, on June 30, 1988, USEPA decided not to recommend federal regulation of E&P wastes as hazardous wastes under Subtitle C of RCRA (USEPA 1988). This determination is commonly referred to as the “RCRA exemption”. Although produced water is exempt from one section of RCRA, it is subject to requirements in RCRA Subtitle D and the Safe Drinking Water Act.

Approximately 20.5 billion barrels (bbl.) of produced water are generated by federal and state onshore operations in 2012. Generally, the volume of produced water from oil wells does not remain constant over time. The water-to-oil ratio can increase over the life of a conventional oil well. For such wells, water makes up a small percentage of produced fluids when the well is new. Over time, the percentage of water increases and the percentage of crude oil declines. On average, more than seven bbl. of water are produced for each barrel of oil. For crude oil wells nearing the end of their productive lives, water can comprise as much as 98% of the fluid brought to the surface.

Shale gas wells generate most of their produced water after hydraulic fracturing operations are completed and pumping pressure is relieved from well. During the flow back process, water-based fracturing fluid mixed with natural formation (connate) water begins to flow back to surface. The majority of produced water recovered from typical shale gas operations is recovered during the first several months. Ohio’s Utica Shale formation flows back roughly 10% of injected fluids.

Produced water is separated from crude oil or natural gas at the surface facility associated with producing oil and gas wells. It is delivered to Class II injection well facilities by pipeline or truck. Once delivered to the storage facility at the injection well, any remaining crude oil is skimmed, the water may be filtered to remove solids such as sand or silt, and the water may undergo other types of treatment prior to injection.


Today there are approximately 168,000 Class II injection wells operating in 31 states. There are three types of Class II injection wells:

- Hydrocarbon storage wells;
- Enhanced oil recovery wells; and,
- Produced water disposal wells.

Hydrocarbon storage wells are used to pump crude oil and other hydrocarbons that are liquid at standard temperature and pressure underground for temporary storage, prior to recovery, processing and use. Enhanced oil recovery (EOR) wells are used to prolong the productive life of oil wells within a specific oil field. Secondary recovery is an EOR process commonly referred to as water-flooding. Salty water produced with oil is separated from the oil at surface and re-injected in the oil-producing formation to drive oil to proximal, pumping oil wells completed in the same reservoir. This saline waste-water by-product is referred to as “produced water” or “salt water” because salts (sodium, calcium, magnesium, potassium chlorides) are the predominant dissolved constituents in produced water. Produced water disposal wells are sometimes referred to as “salt water disposal wells” because they inject fluids into deep saline reservoirs for disposal purposes. Nationally, approximately 60 percent of all salt water produced with onshore oil production wells is re-injected at Class II EOR wells, while 40 percent is injected for disposal.

USEPA has awarded primacy for the Class II Program to 44 states and territories, and two tribes. The following map shows the distribution of Primacy states and Direct Implementation states.

Class II injection well regulations establish standards that address the six potential pathways in the following manner:
• Prior to issuance of a permit, geologists evaluate the suitability of a proposed site for injection. As part of the permit review process, geologists determine the depth of the deepest USDW, evaluate the adequacy of the proposed injection zone, and examine the thickness and nature of confining strata on a site specific basis.

• Permit writers establish the depth of surface casing necessary to extend through and isolate all USDWs.

• In addition to cemented surface casing, Class II injection wells must be constructed with multiple layers of protection (cemented, steel casing strings) between USDWs and the injected waste stream. Most Class II injection wells have three-to-six layers of protection between the injected fluid and the protected groundwater. Therefore, injected fluids can only enter USDWs as a result of faulty casing when there are multiple, concurrent failures of cemented, steel casing strings.

• Regulators establish injection pressure limits designed to confine injected fluids in the authorized injection zone.

• The mechanical integrity of casing and injection tubing are tested prior to commencement of injection operations and monitored on a regular, scheduled basis thereafter. Mechanical integrity tests must be conducted at least every five years, and more frequent tests may be required by rule or permit condition.

• All known wellbores that penetrate the proposed injection zone are evaluated within an “Area of Review” surrounding the proposed injection well. Wellbores that pose potential avenues for fluid migration by virtue of their construction or plugging status must be mitigated before injection can be authorized.

• Injection owners must monitor their operations and submit reports regarding injection pressures and fluid volumes.

Produced water is injected into depleted oil and gas reservoirs or deep reservoirs that are naturally saline. These saline reservoirs contain water with similar in chemistry to the injected produced water. Typically, produced water is injected into porous and permeable sandstone or dolomite formations that are overlain by “confining strata”.

Confining units consist of rock types that typically have low permeability, such as shale, halite (salt), anhydrite, and some limestone formations. When confining units overlie oil and gas reservoirs, they are also referred to as “cap rocks” because the strata have effectively sealed oil, natural gas and even CO₂ in the underlying reservoir for millions of years with no, or minimal, leakage. The effectiveness of confining units has been further validated through extensive stratigraphic tests, and decades of successful experience at gas storage and injection operations.
Constructing a wellbore and maintaining mechanical integrity throughout injection operations is a key principal of injection well regulations. An injection well is said to have “mechanical integrity” if:

1) there are no significant leaks in the casing, including injection tubing (the string of steel pipe through which fluids are actually injected), and
2) there is no significant fluid movement behind casing (either behind cement or in uncemented annular spaces) into a USDW

Class II regulations require operators to construct a well in a manner that mechanical integrity can be tested and monitored

Injection well operators are required to verify that each Class II well has mechanical integrity before commencement of injection is approved; at least every five years thereafter; and every time down hole equipment, such as injection tubing or packer, is removed for servicing or repair. These standards are enforced to protect USDWs and ensure that fluids are injected into the authorized injection zone.

The Peer Review Process
The Ground Water Protection Council (GWPC) conducts the Class II UIC Peer Review process under the joint GWPC and Interstate Oil and Gas Compact Commission (IOGCC) “StatesFirst” Initiative. The purpose of this process is to assess the effectiveness of Class II UIC programs that have been delegated to states under Sections 1422 or 1425 of the Safe Drinking Water Act (SDWA).

The review team consists of the following persons:

- two volunteer state Class II UIC program persons from primacy programs of states that reside outside of the USEPA Region of the state being reviewed
- A GWPC staff member
- A facilitator hired by the GWPC
- An federal observer from the USEPA Region in which the state being reviewed resides

The review process and desired timing is as follows:

1) Initial contact with states to solicit volunteers for review (GWPC)
2) Coordination of timing for the review with the state program (GWPC)
3) Recruiting of review team members at least 60 days prior to the in-state interview (GWPC)
4) Distribution of the questionnaire to the state program to be reviewed at least 60 days prior to the in-state interview (GWPC)
5) Notification to state program of review team members at least 30 days prior to in-state review (GWPC)
6) Submission of the completed questionnaire to the GWPC at least 30 days prior to the in-state interview
7) Review of the completed questionnaire and development of follow-up questions no later than two weeks prior to the in-state interview (Review team)
8) In-state interview of up to 1 ½ days (Review team and state program staff)
9) Prepare draft report within 60 days following in-state interview (Non-observer team members, facilitator and GWPC representative)
10) Initial review of draft report by team within 30 days following draft completion
11) Submission of draft report to state program within 30 days following team review (GWPC)
12) Review and comment submission by the state to GWPC within 30 days of receipt of draft
13) Revision of draft within 30 days following receipt of state program input (Non-observer team members, facilitator and GWPC representative)
14) Approval of the final report within 15 days of revision completion (GWPC Executive Director)
15) Printing of copies of the final report per state request within 10 days following approval by GWPC Executive Director (GWPC)
16) Posting of the final report on the GWPC website within 10 days following approval by GWPC Executive Director (GWPC)
17) Distribution of 25 copies of the printed report to the state program (GWPC)

The general rules of a review include the following:
- Review team members agree to operate under rules of confidentiality and may not discuss the review findings or draft report with persons who are not members of the team until the final report is published
- Observers are entitled to submit questions to the review team as part of the in-state interview but are not permitted to participate in drafting of the report
- Observers may submit comments on the draft report at their discretion
- Preparation and approval of the draft report will be accomplished using a consensus approach
- Minority reports, other than those that may be published by the reviewed state, are not allowed
- Comments in the report will not be attributed to any individual team member
- The GWPC is solely responsible for the content of the final report
- The report is the intellectual property of the GWPC and any distribution of or quotation from the report may only be done with the express permission of the GWPC
Ohio Class II UIC Peer Review

Review Team
The following persons conducted the Ohio Peer Review:

State team members:
Stan Belieu, Deputy Director, UIC Program and Field Operations, Nebraska Oil and Gas Conservation Commission (NOGCC), Region 7
Mark Bohrer, UIC and Treating Plant Manager/Petroleum Engineer, North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division, Region 8

GWPC staff and consultants:
Joe Lee, GWPC and former PA UIC Program Manager
John Taylor, Former USEPA Region 5 UIC Program Manager and GWPC Facilitator

Observers:
Ross Micham, Geologist, USEPA Region 5
Nichole Saunders, Environmental Defense Fund

Executive Summary
The peer review of the Class II UIC program administered by the Ohio Department of Natural Resources, Division of Oil and Gas Resource Management (DOGRM) was conducted by a review team made up of UIC managers and technical staff from state Class II agencies of states outside of the EPA region in which Ohio resides (Region 5). This included an in-state interview of DOGRM staff and management at the DOGRM office in Columbus, Ohio on July 13 and 14, 2016. The in-state interview was based on responses to a comprehensive questionnaire completed by the state UIC staff and follow-up questions posed to the UIC staff during the interview. In addition, the interview team members reviewed the state’s statutes and rules governing the UIC program and other materials provided by the state. A list of acronyms used in this report is attached as Appendix A. The UIC Program has resided in three different divisions since primacy was granted due to department reorganizations. However, we will use DOGRM whenever possible when referencing UIC activities because that is the agency which currently regulates oil and gas E&P.

Program Overview
The Ohio Class II UIC program is managed by DOGRM under the authority found in Section 1509 of the Ohio Revised Code (RC). RC 1509.03 requires the Chief of DOGRM to adopt rules for the administration, implementation, and enforcement of RC Chapter 1509. RC 1509.22 requires
the Chief to adopt rules regarding the injection into wells of brine resulting from, obtained from, or produced in connection with oil or gas drilling, exploration, or production. Ohio obtained primacy for the Class II UIC program under Section 1425 of the SDWA on September 22, 1983.

The UIC program is led by a UIC Manager. Overall management of the UIC program is supervised by the Deputy Chief of DOGRM responsible for UIC activities. The Chief and Assistant Chief of DOGRM are also frequently involved in UIC issues. UIC program responsibilities are handled by the UIC Manager, the UIC Administrator, two UIC Geologists, and four UIC inspectors assigned to different Regions within Ohio. Substantial support is also provided by the Seismic Manager and Technician, Legal Counsel, the Public Information Officer, and other DOGRM staff as needed. Other DOGRM field inspectors not specifically assigned to UIC are sometimes called upon to assist when needed.

In 2015 overall funding for the UIC program was approximately $1,100,000. This consisted of funds from two sources:

1) $953,000 in state funds. These funds are generated through a per barrel brine disposal fee that generated approximately 3.2 million dollars in 2015. Brine disposal fees go into the general oil and gas fund and in addition to UIC needs also help support activities such as orphan well plugging. In addition to the brine disposal fee, the DOGRM obtains substantial fees through a severance tax on produced oil and gas, and permit fees; which are currently $1,000 per saltwater disposal well; and,

2) $147,000 in grant funds from USEPA.

The current inventory of Class II UIC wells in Ohio includes a total of 217 Class II-Disposal wells and 127 Class II- Enhanced Recovery wells. In addition, 73 annular disposal wells (AD) remain active and 1939 AD wells are in temporary abandonment status. Over 31 million barrels of fluid were injected into Class II wells in 2015. DOGRM has issued an average of approximately 20 Class II UIC permits per year in recent years. All permits issued have been for individual wells, as DOGRM does not issue area permits.

Permitting and File Review
All UIC permits are issued from the Columbus central office. The UIC application review process is well conceived and designed to provide a good technical and administrative judgment of any proposed Class II well. Although individual permit reviews are led by more than one individual, routine communication is maintained between staff responsible for permit decisions. This insures consistent application of the principles used to determine permitting outcomes. DOGRM does not distinguish between commercial and non-commercial wells for purposes of permit review, as all wells are held to stringent standards. Reviews include a thorough
technical review of well construction and operating specifications. Division staff indicated that there is not a specific frequency for file reviews, which are normally conducted only when permit modifications are requested. DOGRM uses a ½ mile radius Area of Review (AOR) during the permit review process for most wells, except for those disposing of 200 barrels per day or less of brine. For these lower capacity wells, an AOR of ¼ mile is used. DOGRM has the authority to deny permits for technical or bonding reasons, but not specifically for enforcement status, although operators with a history of non-compliance can be addressed through general public health provisions. However, DOGRM does have the authority to suspend or revoke permits for non-compliance under 1509.04 (C).

The review team believes that the permitting process implemented by DOGRM provides appropriate protection for USDWs.

**Financial Assurance**
Ohio law provides for a variety of financial assurance requirements. All operators are required to have bonds & insurance on UIC wells. Insurance is not accepted in lieu of bonds. Operators must have liability insurance for property damage in the amount of one million to 5 million dollars depending on the well location and well design. Wells in non-urban areas require 1 million dollars coverage, those in urban areas 3 million dollars coverage, and horizontal wells 5 million dollars coverage. An operator must provide a bond of five thousand dollars for one well or 15 thousand dollars for more than one well of any type. To meet bonding requirements, Ohio allows for a blanket bond in the form of a surety bond, a letter of credit, cashier's check, or a certificate of deposit.

The review team suggests that the DOGRM consider substantially increasing required blanket bond amounts to assure that bond amounts are sufficient to meet state program needs.

**Public Outreach**
Permit applicants must place a public notice for five days in a newspaper of general circulation in the county where the proposed well is to be located. A 15 day public comment period immediately follows the public notice. Additionally, the applicant must deliver this notice to all operators either producing from or injecting into the proposed disposal formation within the area of review (½ mile or ¼ mile radius). If the proposed well is in an urban area (defined as a population >5000 in any township or any Municipal corporation), the applicant must provide notice to the board of trustees of the township or the executive authority of the municipal corporation and to all owners of real property within 500 feet of the well location.

All comments and objections received by DOGRM are reviewed and catalogued before being scanned and included with the application for the proposed well and, if issued, permit file. All comments are considered as public records and as such are filed with the application.
Depending on the number of comments received, comment responses from DOGRM are either written and addressed back to the commenter or if more numerous, compiled with similar comments in the form of “frequently asked questions” and posted on DOGRM’s web site for public access. If a person calls DOGRM to ask questions or provide comments, those are addressed on the phone by UIC staff.

A public hearing on an application can be called by the Chief of DOGRM. A hearing will only be called to address a comment or objection which is determined to have raised a valid issue. There is no restriction on who may raise a valid comment or objection. A valid issue may be something that cannot be addressed by permit condition or operating requirement. Hearings allow formal comment presentations, which may be recorded by a stenographer and which become part of the public record. If the Chief determines that a comment or objection is not valid and thus a public hearing is not required, DOGRM either provides notification to the individual registering comment/objection or places the determination on the DOGRM website. In situations where there is substantial public interest, but a valid issue requiring a public hearing has not been established, DOGRM has conducted public information meetings. These meetings may utilize information stations manned by DOGRM staff and/or may provide an opportunity to ask questions along with short presentations by DOGRM staff.

The team believes the public notice and hearings requirements implemented by the DOGRM are sufficient to provide adequate public notice and input concerning the issuance of Class II permits. However, given the high level of interest by Ohio citizens in many permit applications, the review team suggests the DOGRM consider increasing the transparency of the process through various measures including expanding public notification procedures and comment periods.

Well Construction

All injection wells must have surface casing cemented to surface and set to a depth at least 50 feet below the base of all known USDWs. An intermediate casing must be run and cemented to surface if a USDW is encountered after setting and cementing the surface casing. The agency does not provide for an alternative construction method for new wells besides setting surface casing through the deepest USDW. DOGRM further requires injection casing to be cemented a minimum of 300 feet above the top of the permitted injection zone. The DOGRM inspection staff uses the Inspection Priorities Standard Operating Procedures (SOP) that establishes the witnessing of the placement and cementing of any casing string that is considered to be protective of USDWs as the highest priority. This SOP document is available to the public upon request.

In some areas of the state where injection occurs, groundwater resources are limited to fractures in shallow shale, coal, siltstone, or sandstone lenses. The lenticular, braided,
The intertwining nature of these deposits prohibits reliably naming and mapping a lowest USDW across any appreciable portions of this area. In these areas, surface casing depth is prescribed by rule (1501:9-1-08 (M) (4) (f)). The rule requires that surface casing shall be set to the deepest of several potential depths, which are designed to provide a substantial margin of safety.

The review team believes the well construction requirements are adequate to protect USDWs from contamination from injected fluids.

**Mechanical Integrity Testing**

Since the promulgation of new rules in 2012, all newly permitted UIC wells are required to continuously monitor the pressure of the annulus between the tubing and the casing in the injection well as a demonstration of Part I well component integrity. This is known as annulus pressure monitoring (APM) and requires that a positive pressure must be kept on the annulus and monitored by the operator monthly. However, before a well is placed on APM it must first pass an initial standard annulus pressure test (SAPT). For UIC wells permitted before 2012, operators may continue to run either a SAPT or a monthly “mini-test”, which is a SAPT, run at a lower pressure. For the approximately 165 UIC wells permitted before 2012, their operators may also choose to utilize APM instead of a pressure test, and about 50% have chosen this option. Inspectors check the annulus pressure during routine inspections and often witness the mini-tests. Since the inception of the UIC program, Ohio has witnessed all SAPTs.

To demonstrate Part II cement integrity, DOGRM usually requires a Cement Bond Log (CBL). No other geophysical logs have been accepted. However, cementing records may be accepted for old converted wells. DOGRM evaluates the quality and effectiveness of casing cement jobs by submitted CBLs or, in the case of a converted production well, cement tickets with calculations for cement volumes to fill up backside of the casing. In addition, inspectors are on-site for cement jobs to witness mixing and pumping of cement. DOGRM assesses existing completions with no CBL by verifying cement tops and requires the original cement ticket and cement calculations. However, DOGRM still requires a CBL of the injection casing, and can require a new CBL to be run for any other casing string if there is concern for the adequacy of the cement job. DOGRM has historically witnessed a very high percentage of all casing cement jobs, and currently witnesses 100% of them.

The review team believes the DOGRM program adequately addresses both parts of the mechanical integrity requirement.

**Inspections**

DOGRM maintains a very strong field presence which plays an integral part in the effectiveness of Ohio’s Class II UIC program. This includes quarterly inspections of all salt water disposal and
enhanced recovery UIC wells. With the increase in resources in recent years, DOGRM now utilizes four senior inspectors who are assigned almost entirely to UIC duties. These inspectors rarely perform other types of inspections. These inspectors each have assigned areas and if they are not available to cover a priority activity, such as witnessing a mechanical integrity test or the setting of well casing, they are able to call upon other DOGRM oil and gas inspectors, who cover all types of oil and gas activities, to cover it for them.

The dedicated UIC inspectors are quite experienced, with an average of 15 years’ service inspecting UIC and oil and gas wells. In addition three of the four dedicated UIC inspectors had previous experience in the oilfield/ environmental field before beginning work with DOGRM. The inspectors prioritize and manage their own duties and responsibilities, which include quarterly inspections and compliance, follow up in accordance with established priorities. However, when emergency conditions or urgent inspection needs arise, they are coordinated by central office staff. In addition to routine inspections, DOGRM has placed priority on witnessing most well construction activities. As such, they witness 100% of surface casing being set and in recent years have also witnessed all long string casing being set as well. In addition to the high level of experience of inspectors, Ohio has established Region 5 accepted SOPs and implements periodic training.

DOGRMs Inspection Priorities Standard Operating Procedure (SOP) specifies that the agency must respond to all public complaints as soon as feasible and must respond to emergency situations and public complaints where there is a potential threat to health or safety within 24 hours. Inspectors have access to RBDMS in the field, this database allows for access to the wells’ entire data history including scanned images and previous inspections and permitting history. During field inspections, inspectors collect data and enter it into the RBDMS system via laptop computers. They also use Smartphones for email and to locate wells via the internet.

The review team believes the field inspection program of the DOGRM program provides an adequate level of protection to USDWs

Compliance and Enforcement

The compliance and enforcement program of the DOGRM relies on a strong field presence and inspection program. Since DOGRM inspectors visit all saltwater disposal and enhanced recovery wells at least once a quarter, violations are usually noted rather quickly. In addition, violations are sometimes self-reported by the well operator. DOGRM’s enforcement response varies depending upon the type of violation and the relative risk of endangering USDWs. For administrative violations, a compliance notice documenting the violation is issued by either the inspector or the central office in Columbus depending on nature of the violation.
Certain more serious types of violation go straight to an Administrative Order (AO). If the violation is viewed as “Material and substantial”, the operator can be ordered to immediately cease operations at the well in violation. This occurs via a phone call from the UIC Inspector to the operator followed by a formal written AO. For cases where the AO does not resolve the violation, a referral is made to the Ohio Attorney General’s (AG) Office requesting that legal action be initiated.

DOGRM has achieved a high rate of returning wells in violation to compliance, in large part due to the high level of follow-up inspections by field inspectors and central office staff. However, it is recognized that the number of violations might be reduced if the DOGRM were to be granted the ability to assess civil penalties, as is the case in a number of other oil and gas producing states. The review team recognizes that the Ohio legislature would first need to grant the ODNR statutory authority before the DOGRM could consider rule making. In the absence of this authority, DOGRM has successfully negotiated consent agreements in a number of cases, whereby the operator agreed to pay a fine, or take some other environmentally related action.

The review team believes the compliance/ enforcement program implemented by the DOGRM is sufficient to ensure substantial compliance and has sufficient authority to compel a return to compliance in those cases where non-compliance does occur.

Overall Program Findings
The review team performed an in-depth review of the Ohio UIC Class II program via a review of Ohio laws and regulations, responses to a questionnaire, and a two day state interview of UIC and DOGRM management staff. Information provided by the Ohio DNR prior to the peer review was of great assistance; however, much of the understanding of the program was achieved during the actual in-state interview. The DOGRM has devoted substantial resources toward the UIC program in recent years which has led to the development of a very knowledgeable staff with expertise in many areas. The managers and staff show great flexibility in covering a wide range of duties. The review team was impressed with the quality of staff and the manner in which the program was being implemented. The effective utilization of the RBDMS data management system, which DOGRM was instrumental in helping develop, has also aided the implementation of all aspects of DOGRM’s UIC program. The USEPA representative was also very helpful in providing a perspective on USEPA Region 5’s oversight of the Ohio program.

The suggestions and review team comments provided in this report represent opportunities to further strengthen the Ohio Class II UIC Program. In all subject areas investigated as a part of this peer review, the DOGRM managed program has been found to provide the necessary elements, from both a regulatory and activity standpoint to protect USDWs.
Part I: General Administrative Overview

Statutory Authorities and Regulatory Jurisdictions

Overall responsibility for Ohio’s Oil and Gas program, including the injection of produced fluids for disposal or enhanced recovery (UIC Class II wells), has been delegated by the state legislature to the Ohio Department of Natural Resources (DOGRM).

The DOGRM has authority to adopt rules and make orders as necessary to administer operations for and relating to the production of oil and gas, including UIC Class II wells. All proposed rules must be approved by the Ohio legislature prior to adoption. The authority to administer the Class II UIC program is found in Section 1509 of the Ohio Revised Code (RC). RC 1509.03 requires the Chief of the Division of Oil and Gas Resources Management (DOGRM) to adopt rules for the administration, implementation, and enforcement of RC Chapter 1509. RC 1509.22 requires the Chief to adopt rules regarding the injection into wells of brine resulting from, obtained from, or produced in connection with oil or gas drilling, exploration, or production.

The Division of Oil and Gas was originally created in 1965 within the ODNR with responsibility for regulating Ohio’s oil and natural gas industry. In 2000, the Divisions of Oil & Gas and Reclamation were merged to create the Division of Mineral Resources Management. The merger weakened regulation of all oil and gas related activities by spreading managerial and inspection responsibilities over many mineral extraction industries throughout the state.

Over the past 50 years, many rule changes have occurred which have strengthened Ohio’s oil and UIC programs. Of note were the elimination of pits for “temporary storage” which in reality was often a disposal method in 1986 and the substantial increase in requirements for annular disposal wells in 1989. New statute which became effective on September 16, 2004, (House Bill 278) granted the DOGRM sole and exclusive authority to regulate oil and gas operations.

In September 2011, DOGRM was created pursuant to House Bill 153. This action was due in part to the growing importance of the horizontal shale gas industry in Ohio along with a need to assure proper regulation of it.

Since 2010, substantial changes have been made to Ohio law and rules which have provided the UIC program with increased tools that can be applied as needed. Senate Bill 165, which was effective in June 2010, modernized well construction language, established performance objectives, established and increased regulatory fees, required inspector notifications, expanded reporting requirements, and dedicated funding to the orphan well program.
New well construction rules took effect on August 1, 2012. DOGRM’s standards now provide increased emphasis on state-specific geology, hydrology, surface conditions, and drilling practices. In addition, new operating, monitoring, and reporting rules for injection wells were implemented on Oct. 1, 2012. These new rules were created to further strengthen the state’s UIC monitoring program by allowing the chief to require additional geologic evaluation, injection well monitoring, and testing. These standards and a new seismic monitoring program allow DOGRM to better monitor and research seismicity throughout Ohio. Additional authorities dealing with chemical disclosure, brine hauling, water sampling, and water use disclosure also were added through Senate Bill 315 which took effect on September 11, 2012. As a result of all the new and previously existing authorities, the Chief of DOGRM now has broad authority to issue Chief’s Orders requiring additional information or testing, or shutting down wells when necessary in order to protect groundwater resources.

While DOGRM has authority over oil and gas activities, the Ohio Oil and Gas Commission is an independent body appointed by the governor with authority to hear appeals of Chief’s Orders issued by DOGRM. The decisions of the commission are binding, but may be appealed to the local county court by either party.

The USEPA granted DOGRM primacy authority for permitting and regulating UIC Class II injection under Section 1425 of the Safe Drinking Water Act (SDWA) on September 22, 1983. This authority covers all lands of the state except those that are designated as Indian lands where the authority remains with USEPA Region 5, however, at this time there are no federally recognized tribes in Ohio. At the time of this peer review, the DOGRM regulated a total of 217 Class II-Disposal wells and 127 Class II- Enhanced Recovery wells. In addition, 73 annular disposal wells (AD) remain active and 1939 AD wells are in temporary abandonment status.

Administration, Staffing and Funding
DOGRM funds the UIC program using both USEPA and state funds. The USEPA UIC grant of approximately $147,000 also requires the state to match at least 25% of the grant amount. Without significant additional monetary commitment by DOGRM, the annual USEPA grant and required state match would have averaged about $196,000 in recent years. The program expenses have averaged $1,100,000 in recent years. Since the funding levels available to USEPA for the UIC program have been essentially unchanged for the past 25 years, states have had to assume increasingly greater amounts of the total cost of running the UIC program. This is certainly the case in Ohio, where $196,000 per year would essentially support one inspector and possibly two office staff. Everything beyond an annual inspection, records management, and minimal enforcement would not be possible with only those funding sources.
The UIC operating funds are generated through a per barrel brine disposal fee that generated approximately 3.2 million dollars in 2015. Over 31 million barrels of fluid were injected into Class II wells in 2015. This fee is five cents per barrel for in-district brine and 20 cents per barrel for out-of-district brine, with a fee cap of $100,000 per well. Operators are allowed to keep 3% of the fee to cover administrative costs of collecting the fee. In addition to the brine disposal fee, the DOGRM obtains substantial fees through a severance tax on produced oil and gas, and permit fees, which are currently $1,000 for a saltwater disposal well. The general oil and gas fund, which all these revenue sources contribute to, is more than adequate to cover all oil and gas needs, such as plugging idle and orphaned wells.

The increase in UIC revenue which has occurred since 2010 has allowed the DOGRM to substantially increase staffing levels for the UIC program. In 2015, over 12 work years were devoted to UIC activities by DOGMR staff at a personnel cost of approximately $1,100,000. Additional funds were spent on equipment, vehicles, travel and other incidentals in support of these efforts. Eight staff members devoted 100% of their time to UIC activities; this included the UIC Manager, the UIC Administrator, two UIC Geologists, and four senior inspectors assigned to different Regions within Ohio. In addition, the Assistant Chief and the Deputy Chief responsible for UIC activities devoted nearly a full work year between them to UIC activities, and the Chief of DOGRM was frequently involved in UIC issues.

Substantial support staff was made available for UIC activities during fiscal year 2015. This includes 1.6 work years from the Seismic Manager and Technician, five work years from Legal Counsel, and nearly half time from the Public Information Officer. Other DOGRM field inspectors are sometimes called upon to assist when full time inspectors are not available, and other DOGRM staff from various disciplines is called upon when needed. In general, office staff is responsible for permitting, file reviews, coordinating enforcement, reporting, and records management. Field staff is responsible for inspections, testing, well construction and ensuring compliance with enforcement actions. DOGRM has benefited from the vast experience of the field staff and management, and has been able to hire well qualified office staff in order to build the program for the future. A challenge now will be to develop and keep current a succession plan to ensure that current levels of expertise are maintained.

With the expansion of staff resources related to UIC, it becomes very important to assure that procedures are clearly defined and understood by all involved. DOGRM has been very proactive in developing a set of 14 Standard Operating Procedures (SOPs) which cover a broad range of activities. These include:

- preliminary area of review;
- permit review;
• well construction;
• surface facility construction;
• routine inspections;
• standard annular pressure tests;
• positive displacement test;
• fresh-water brine interface test;
• plugging;
• restoration;
• land treatment of saline solid wastes;
• in-situ treatment of saline soils;
• bioremediation of crude oil contaminated soil; and
• enforcement

While these documents serve as an excellent guide to help train new employees and maintain consistency in operations, most of the SOPs are more than 10 years old and the DOGRM plans to update them. An excellent example of a very recent SOP which provides clear direction is the one covering inspection priorities.

Another series of documents which could be very helpful in the on-going development of DOGRM’s UIC program are the series of UIC Program Guidance’s which have been issued by USEPA from the inception of the program until now. Program guidance’s cover almost all aspects of the program ranging from administrative to technical, and have been developed in response to the many issues that have arisen in the UIC program. A number of the technical guidance’s reflect recommendations from the UIC National Technical Workgroup, which includes both USEPA and state members, including at times a representative from DOGRM. DOGRM is aware of the different USEPA guidance’s and has implemented the recommendations from several. However, they acknowledged that further evaluation and review of guidance documents, like the one dealing with commercial wells, might be useful.

Data Management Program

DOGRM maintains a comprehensive electronic data system to track information on wells and operators in Ohio, along with other related information in their Risk Based Data Management System (RBDMS). Through RBDMS, UIC data is fully integrated with oil and gas data. Data stored includes owner registration, applications, financial assurance, insurance, permitting, inspections, well construction, testing, logs, enforcement and compliance.

Over the past 20 years, DOGRM has been a national leader in developing and implementing RBDMS. They are now working toward the next generation of the system, which will be cloud-based. As such, DOGRM is coordinating with other states involved in similar efforts, such as Colorado and California. Among the objectives of this coordination are allowing for electronic
permitting, electronic reporting to USEPA, and assisting with public records requests in a manner that provides for transparency of records while reducing the amount of time that DOGRM staff need to spend on such requests. In addition, DOGRM has a goal of providing an interface which will allow inspectors to be able to prioritize pre-permit site inspections, application tracking, well construction data management, quarterly and follow-up inspections, and enforcement actions.

Development of this new system will be a lengthy and complex effort. A Detailed Requirements Document (DRD) is being developed. So far it includes 450 pages with over 1500 pages of appendices, and the work is not yet complete. This amount of detail was needed as the new system will be designed to walk the user through any situation they might encounter, much like tax preparation software. It is hoped that the DRD can be completed and contracts awarded within a year to begin the development process. At present, a decision has not yet been made as to whether to put the proposal out for bids or to attempt sole source procurement. It is expected that it will take several years to develop and implement the new system.

Although the DOGRM has been working on uploading data to USEPA’s new national database, there are still a wide range of problems with that system which need to be resolved before full electronic reporting can occur. DOGRM has provided data on mechanical integrity tests, inspections, well inventory and permitting whenever the national system has been operational. In the interim, DOGRM continues to provide basic information to the UIC national database twice a year via EPA 7520 reporting forms. These forms are currently filled out by hand from data printouts and then submitted to USEPA electronically.

The DOGRM maintains physical and electronic copies of records, forms, reports and other items which are required by the permit. These electronic and physical copies are kept at the DOGRM main office in Columbus, Ohio. These documents are kept on site and will not be discarded for at least 50 years, per DOGRM records retention policies.

The current Ohio RBDMS uses an Access database capable of auto-generating periodic reports, letters, notices and various forms. All DOGRM staff has access rights to enter new or updated information into RBDMS, and information is typically added on a daily basis. Information entered in the field by the inspectors is reviewed and approved by the UIC Manager, who then approves its incorporation into the system. Forms submitted by operators to the Columbus central office are reviewed and accepted by staff before being entered into RBDMS. Additionally, RBDMS has the ability for inputting some directional information related to injection wells. DOGRM also can provide specific information contained in RBDMS to the public.
Interagency Coordination

The DOGRM has active Memorandums of Understanding (MOUs) with the Ohio Environmental Protection Agency (OEPA), the Ohio Department of Health (ODH), and the Ohio Department of Commerce (ODC). In addition, the Ohio Division of Geological Survey (ODGS) provides input during application reviews on regional structure, deep faulting and seismicity.

Coordination with the OEPA includes review by DOGRM of renewal applications for Class I wells, and upon request for selected Class V wells. In return, DOGRM occasionally requests OEPA's assistance on specific issues. A recent example was a request by an operator to use fiberglass tubing in a Class II well. DOGRM has requested specific services from the ODC and ODH, which has included electrical inspections from the ODC and assistance with radiation related issues from ODH. As a result of the increased need for assistance on radiation issues, DOGRM has now hired a Radiation Specialist from the ODH to develop radiation protection plans and assist with Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) and other special issues. USEPA defines TENORM as “Naturally occurring radioactive materials that have been concentrated or exposed to the accessible environment as a result of human activities such as manufacturing, mineral extraction, or water processing."

ODGS provides input to DOGRM on all Class II permit applications. DOGRM provides a copy of the application and plat map to ODGS, who then conduct a regional review. ODGS uses available data to construct structure maps and also reviews seismic event data. ODGS has an archive of wire log data and cores, which are made available to DOGRM. In addition, ODGS has an archive of about 450 water samples covering all important formations and reservoirs in Ohio. These samples have been analyzed for specific gravity, which could assist DOGRM in setting allowable pressures during the permitting process.

DOGRM has always enjoyed an excellent relationship with the USEPA. DOGRM staff has served on USEPA's UIC National Technical Workgroup and have assisted with other national USEPA UIC efforts that involve Class II. DOGRM has also been an active participant in Regional Class II meetings involving USEPA Region 5 and Class II state agencies from Region 5 states. In previous years, DOGRM referred a few complex enforcement cases to USEPA Region 5 in order to utilize USEPA's administrative penalty authority and bring about a more expeditious settlement.

DOGRM has also been a very active member of national organizations involved with groundwater protection and the oil and gas industry. These include GWPC and the Interstate Oil and Gas Compact Commission (IOGCC). DOGRM officials have been involved with many committees and held leadership roles in both organizations, including the Assistant Chief of
DOGIRM who served two terms as President of GWPC. Through these organizations, DOGRM has interacted with state agencies from across the country, USEPA Headquarters and Regional offices, environmental organizations and industry groups. This has led to a very productive exchange of experiences and approaches, which has been very helpful to DOGRM in building and refining their UIC program.

Changes in Program Activities since Primacy
The DOGRM UIC program has continued to operate effectively since primacy was approved, however, a number of major changes have occurred through the years which have served to strengthen an already strong UIC program. Staffing levels were originally robust during the early years of the program, but were seriously reduced prior to 2000 due to budget cuts caused by economic conditions. With the advent of horizontal drilling, substantial new resources have been made available to the oil and gas program since around 2010, including UIC, with the result that now over 12 work years are devoted by DOGRM to the UIC effort. The UIC regulatory program was also greatly enhanced by the adoption of the RBDMS data management system, which has allowed effective tracking of all well related activities. The planned upgrade of this system is expected to further strengthen the program.

One of the major challenges originally faced by the DOGRM UIC program was the threat to groundwater resources posed by annular disposal (AD) wells; which had only one layer of protection (surface casing) and often used prepared clay rather than cement as a means of setting the casing. However, the great majority of brine disposal in Ohio is accomplished through conventional injection wells. The 1986 Reauthorization of the Safe Drinking Water Act required Ohio to submit a report to the USEPA demonstrating that Ohio was implementing a regulatory program that was protective of groundwater resources. This demonstration, unique to Ohio, was the result of Ohio’s allowance of the practice of annular disposal. To satisfy this requirement, DOGRM took a number of steps including implementing new regulations in 1989 which provided a number of new safeguards including requiring cement behind the casing, and new mechanical integrity tests to assure that these wells did not pose a threat to USDWs. When primacy was granted, approximately 10,000 wells in Ohio were authorized for AD. DOGRM has effectively implemented these new requirements, resulting in a reduction in the number of active AD wells to 73, with 1939 AD wells in temporary abandoned status. It is likely that few if any of these temporarily abandoned wells will ever return to active status, and DOGRM has indicated that they would like to eliminate all provisions allowing new AD wells when rules are next revised.

As mentioned previously, since 2010, there have been several rounds of new authorities granted to the DOGRM which have significantly strengthened the UIC program. At this point, DOGRM is embarking on a state required five year review of the entire program. This will be a
very labor intensive process through which the cost of all rules must be justified versus the benefits. The review will include the entire oil and gas program, and thus many comments will need to be addressed. The entire process will ultimately lead to legislative review and actions. There are a number of objectives that DOGRM would like to achieve through this process including standardization of the public notification requirements and extension of the public comment period. They would also like to remove pre-1983 provisions in the rules in order to eliminate points of confusion which currently exist in the rules, and eliminate the practice of annular disposal. Additional points that DOGRM would like to address include improving setback and spacing requirements, requiring reporting on generated waste, increasing reporting frequency, standardizing notifications for inspection, and better definitions of surface facility requirements.

One development which has had a major impact on the DOGRM UIC program during the past five years is the substantial increase in brine from out-of-state due to regulatory changes in other states being disposed of in Ohio saltwater disposal wells. Increased in-state and out-of-state oil and gas development resulted in the transport of brine into Ohio which increased Ohio’s brine volumes from 8.1 million barrels in 2010 to 12.6 million barrels in 2012 and 14 million barrels in 2013; with approximately 60% of this total originating from out-of-state. This increased the burden on virtually all aspects of the UIC Program (~160 active Class II injection wells in 2009 to 215 active Class II injection wells in 2015 – a 34% increase).

This substantial increase in injection activity played a major role in the development of new funding sources, such as the brine disposal fee and the resultant large increase in staff to properly handle the expanded workload. It also was a major factor, along with horizontal drilling, leading to revised statutes and regulations which have been implemented since 2010. Because this has led to tighter regulation of all wells, no specific additional requirements have been added for commercial wells. DOGRM has, however, initiated random sampling of trucks hauling out-of-state brine. The brine is checked for chemical analyses, specific gravity, and sources. One test recently identified a fluid that was not authorized in Ohio. An average of 50 samples a year are being collected and analyzed, with a total of more than 200 collected and analyzed so far.

**Identified Strengths**

1) The Ohio UIC program has been effectively administered by DOGRM since the granting of primacy in 1983.

2) The new authorities granted to DOGRM since 2010 have significantly strengthened the program. The ability of the Chief of DOGRM to issue Chief’s Orders to alter requirements and address imminent harm situations by requiring additional
testing/monitoring, well shut-ins or other special conditions is critical to the program’s success.

3) ODNR has placed emphasis on the regulation of technologically enhanced naturally occurring radioactive materials (TENORM). This has included devoting substantial resources to this effort including the use of staff with specific expertise in this area.

4) The DOGRM UIC program is fortunate to be able to utilize the many years of relevant experience provided by the Chief, the Assistant Chief and the Deputy Chief responsible for UIC activities, and many of the field inspectors and other staff. These individuals provide an abundance of technical knowledge and expertise and a wealth of institutional knowledge. They and the more recently hired staff have shown great technical competence and understanding of the UIC program.

5) Use of the RBDMS data management system allows the agency to store and utilize regulatory aspects of UIC data that are critical to management of the Class II program. Over the past 20 years, DOGRM has been a national leader in the development and implementation of RBDMS and the upcoming modifications will only serve to make the system more effective, especially by helping field inspectors more effectively manage their assigned wells.

6) DOGRM has a long history of effective coordination with other Ohio agencies, the USEPA, and other state and federal agencies and organizations across the country. This collaborative expertise has been very beneficial in helping DOGRM address emerging issues like induced seismicity and TENORM.

7) DOGRM has made major strides in eliminating the potential problems caused by annular disposal. The number of active annular disposal wells has been reduced to only 73, and these wells must now meet enhanced well construction requirements and conduct a mechanical integrity test every five years. While nearly 2000 annular disposal wells remain in temporarily abandoned status (oil production mode only), it is unlikely that any of these wells will return to active injection status.

8) The 14 sets of Standard Operating Procedures (SOPs) that DOGRM has developed have been a great help in defining roles and procedures. Recent work on the Enforcement and Inspection Priorities documents has been very impressive.

9) The five year review process that DOGRM is now beginning will allow for continuous improvement in program effectiveness.

Review Suggestions

1) The review team recognizes the amount of time and effort that the 5 year rule review process will take. However, it presents an opportunity to eliminate confusion at various points in the Ohio Administrative Code where more recent rules are not consistent with rules carried over from before UIC primacy was granted in 1983. With regard to
administrative penalty authority, the review team recognizes that the Ohio legislature would first need to grant the ODNR statutory authority before the DOGRM could consider rule making in this area. DOGRM could however, utilize the review process to explore what types of rules could be developed if legislative approval were given.

2) The review team suggests updating those Standard Operating Procedures (SOPs) which are more than 10 years old and developing new ones in areas that may not have been previously covered. While this would require time and effort in the short run, complete and up-to-date SOPs will bring substantial benefits in the long term by serving as a key element of the training program for new staff. Updates to the SOP’s should help maintain an efficient and consistent program.

3) The review team suggests that DOGRM review the USEPA UIC Program Guidance’s. These Guidance’s cover various administrative and technical aspects of the UIC program and many have been developed with input from the UIC National Technical Workgroup. Many of the suggestions contained in these documents might prove useful to DOGRM in addressing emerging areas of interest, such as commercial wells, and other areas where the experience of USEPA and other states might prove useful.
Part II: Permitting and Compliance Review

Permit Application Flow and Review Process
Ohio UIC applications are administered by the DOGRM Chief through the UIC Program Administrator. To obtain a permit for a UIC Class II well, an operator submits a completed DOGRM Permit Application. DOGRM received 18 UIC applications (includes permit applications and modification applications) in 2015, and anticipated a similar number in 2016.

In practice, an operator will usually request a preliminary Area of Review (AOR) of their proposed well location and disposal formation. DOGRM conducts a preliminary AOR at no cost and replies with findings of the AOR and whether or not the location and formation is subject to any obvious issues such as problem wells or proximity to sensitive areas. If a company chooses to go forward with a formal application, an application packet is sent to them. However, some permit applications are submitted with no request for a preliminary AOR.

After the application is date stamped by the receptionist, it is forwarded to the permit & bonding group for initial entry of basic application data into Ohio’s RBDMS. This group also processes fee payments, verifies the financial responsibility and registration of the operator, and assigns the unique application number if no outstanding issues are identified. All basic data entry into RBDMS occurs at this time. Application reviews and status are tracked on a UIC tracking sheet, and on a checklist for each application. The process is the same for applications to amend existing permits.

A UIC geologist examines each application and reviews it for completeness. The review is performed by going through a checklist of required items for a complete application, and initialing each item.

A complete application includes:

- Form 1 (application): Includes: the name and address of the applicant, application type, well type, urban area declaration, landowner royalty listing, drilling tools to be used, source of water to be used for drilling/completion, location data, emergency contact phone numbers, identification of roads for egress and ingress, well name, proposed total depth, proposed geologic formation, permit API (if an existing well), and proposed casing program.
- Form 210 (supplement to application), Includes: the proposed injection zone name, the depth interval, the geologic description, the fluid type to be injected, the casing program description, the proposed testing method for casing pressure tests, surface facility plans, the proposed injection volumes and pressures, planned method of measurement of
volumes and pressures, the proposed corrective action if one or more problem wells exist in AOR, and a well construction schematic.

- Map showing AOR, the royalty owner of parcel and subject tract, and all owners of wells injecting or producing from proposed injection formation.
- Form 4 (restoration plan), plat map, surface facility plans, and proof of public notice.

Upon a determination that a permit application is complete, a UIC geologist and manager review the application together prior to allowing public notice to be run by the applicant.

Permit applications also include a Surface Facility Plan. Under the plan, all salt water storage facilities are to be constructed to prevent contamination of surface and/or groundwater. The operator must notify DOGRM prior to construction, so that inspectors can arrange to be on-site. The plan includes dike dimensions for containment, and the number and capacity of tanks. The storage volume is equal to the diked open volume plus six inches of freeboard. In addition, the containment area requires an impervious material liner. The plan must show how piping is connected, and other information as necessary. There are also retention requirements for offloading pads. Further, a new rule may require plans that have been stamped by a Professional Engineer (PE). DOGRM does not normally authorize emergency or temporary pits in the case of an overflow, spill or leak, although they may be authorized as part of an emergency response.

After the application is received and deemed complete, the UIC geologist requests a site review of the proposed location by the UIC inspector. A site review includes:

- the Geographic Positioning System (GPS) location of the well stake;
- comments on site preparation/construction;
- need for a blowout preventer;
- orientation of the rig;
- specifications for reserve/drilling pits; and
- identification of any mines, water wells, structures, streams, flood plain, wetlands or other notable features

Depending on the concerns related to the drilling of the UIC well or construction of the facility, the inspector may be accompanied by a DOGRM engineer with knowledge of construction.

If an application is found to be incomplete, a UIC geologist will contact the applicant and identify the missing items or information in order to complete the application. Ohio Rule 1501:9-1-02 (B)(2) allows an applicant 30 days to submit the items or information that is missing from an application. If an applicant fails to respond, the applicant is notified again of an incomplete application. After a second 30 day period of non-response, the application is
returned to the applicant with a letter stating it is incomplete and has been denied. Just as in
the case of a denied permit, the application is returned to the applicant. DOGRM keeps the
completed AOR documentation, and files it by county for future use.

The agency does not differentiate between major and minor application amendments.
However, if a change of the injection interval is proposed, a new application must be
submitted, and new public notices given. Although allowed by US EPA, DOGRM does not
distinguish between commercial and non-commercial UIC wells. The agency does not allow a
well to be used for the disposal of both Class I and Class II fluids.

Upon final disposition, permits are stored as paper files at the DOGRM UIC central office in
Columbus. In addition, all permits are scanned and stored electronically in RBDMS. All well
files can be accessed through RBDMS.

Technical Aspects of the Permit Review Process
DOGRM determines the deepest USDW using a structure contour map stored as a shapefile in a
Geographic Information System (GIS). The UIC geologist reviews the proposed well location
(Lat/Long), and surface elevation (from plat map and confirmed by 7.5’ quadrangle topographic
maps.

DOGRM collects and maintains records and data, and prepares maps regarding the depth and
quality of groundwater in aquifers that are designated as USDWs. ODNR, Division of Water
Resources is responsible for identifying and determining the basal elevation of USDWs. The
mapping for the state is done by Ohio Division of Geological Survey (ODGS) which is part of the
ODNR. All USDW records, data and maps are available to the regulated industry and public
upon request.

The proposed casing and cementing program is reviewed, approved and, as necessary,
corrected as part of the permitting process and must comply with all well construction rules.
Form 1 and Form 210 require an applicant to describe the proposed casing program. Approved
casing programs are then printed on the issued permit. USDW maps are used in conjunction
with location and elevation data to identify the depth to the base of the deepest known USDW.
Additionally, field inspectors have authority to alter casing programs in the field if conditions
require it. Surface casing must be cemented to surface prior to drilling through any oil/gas
bearing zone or flow zones. An intermediate casing must be run and cemented to surface if a
not previously identified USDW is encountered after setting and cementing the surface casing.
Well construction rules require that casing be set at least 50 feet below the deepest USDW and
cemented to surface. The agency does not allow for an alternative construction method for
new wells besides setting surface casing through the deepest USDW.
Injection takes place in some areas of the state where groundwater resources are limited to fractures in shallow shale, coal, siltstone, or sandstone lenses. These areas are in SE and SW Ohio where the freshwater aquifers (USDWs) are braided and intertwined in a manner that makes them spatially discrete and discontinuous, which prohibits reliably naming and mapping a lowest USDW across any appreciable portions of this area. In these areas, surface casing depth is prescribed by rule (1501:9-1-08 (M)(4)(f)). The rule requires that surface casing shall be set to the deepest of several potential depths. These include: (1) a minimum of 300 feet deep, and at least 100 feet below deepest local perennial stream base; (2) at least 50 feet below the base of the lowest spring or deepest water well within 500 feet of the UIC well; or (3) in cases where aquifers are developed in valley-fill, surface casing must extend to 100 feet below the base of the valley-fill aquifer for any well within 1000 feet of the 100-year floodplain. The surface casing rule requires intermediate casing to be set if any freshwater zone (<10,000 mg/L TDS) is encountered below the base of the set, and cemented surface casing (1501:9-1-08 (M)(6)(b)(i)). In all cases, the depth of surface casing is substantially greater than maximum depth of USDWs as determined by ODNR Division Water Resources.

To ensure that new wells are constructed in a manner that is protective of USDWs, well construction rules at 1501:9-1-08 require surface casing to be free of apparent defects and set at least 50 feet below the deepest underground source of water containing less than 10,000 mg/L TDS, and sealed by circulating cement to the surface and witnessed by a representative of DOGRM. The DOGRM inspection staff uses a priority matrix that establishes the witnessing of the placement and cementing of any casing string that is considered to be protective of the USDW as the highest priority. Pursuant to RC 1509.12, for wells with defective casing that cannot be remedied, the owner is required to plug the well.

Ohio didn’t grandfather EOR wells in the 1983 rules. If the existing EOR wells didn’t meet the new constructions standards, they were shut down and plugged.

Since the new rules in 2012, all new UIC wells are required to have an automatic shut-off device installed and set to terminate injection operations if the permitted maximum allowable surface injection pressure on the injection pump is exceeded. If mechanical failures or downhole problems cause contamination of the land or waters the UIC well operator is required to cease injection.

As mentioned, field inspectors have authority to alter casing programs in the field, including surface casing, due to site conditions encountered during drilling or development. USDWs deposited in fluvial environments can vary significantly in thickness and depth in the field. In addition, abandoned mines may be encountered and, through which, casing must be set. If another USDW is identified below the set surface casing in a well, an intermediate casing string
is required and must be cemented to surface. If changes to the casing plan are significant, the operator must then submit changes in writing to the agency for review. Compliance with the rule is based on the as-built well.

A new type of well design whose usage began in 2011 are those wells with substantial open hole completions, where the open hole portion may stretch for as much as 1000 feet. These are primarily high volume wells, often where the operator has requested use of multiple formations, with larger diameter tubing and production casing. While there are only about 20 of these wells permitted to date, they dispose of a large volume of fluids and their use is increasing. To date, DOGRM has required tracer and spinner surveys to determine if there are concerns, and DOGRM could require casing and perforating at the receiving zones. None of these wells have been plugged, and plugging may present a challenge regarding the isolation of lower zones.

DOGRM allows for dual well completions (a well producing and disposing through two different strings of tubing) on a case-by-case basis. All but one dual completion well in Ohio are annular disposal wells where waste disposal is between the surface and production casing. The one non-annular disposal well uses a special downhole tool that allows simultaneous production and disposal from different formations. DOGRM intends to phase out both dual completions and new annular disposal wells with the next round of rulemaking.

UIC wells in Ohio operate on a maximum injection pressure that is calculated by a formula established in rule; and, the maximum injection rate is dependent on what the injection formation may accept at that permitted maximum injection pressure and which will not cause problems within the area of review. If the UIC well is injecting at 200 barrels or less per day, the area of review is reduced from a ½ mile radius to a ¼ mile radius.

An operator can request a modification of the approved maximum allowable injection pressure from DOGRM. The formula used to calculate maximum allowable injection pressure incorporates specific gravity into the equation. The standard calculation incorporates a conservative value for specific gravity to determine an initial injection pressure. But, when approved by DOGRM, the pressure can be modified after recalculation using a different specific gravity of the fluid to be injected. Such a modification requires daily testing confirmation and quarterly submittal of laboratory testing of this parameter. The UIC field staff has hydrometers to do specific gravity spot checks of injection fluid at wells with specific gravity-based pressure variances.

DOGRM has not determined that any problems exist with the compatibility between the injectate and the cement or between the injectate and the formation fluid.
DOGRM has an extensive catalogue of analysis of Ohio’s brines and the delivered oil and gas waste fluids for disposal. In addition, Ohio has a program where inspectors periodically sample from trucks and storage tanks. This is especially important when dealing with fluids transported from neighboring states. The fluids are analyzed for a standard suite of inorganic and organic constituents. If unapproved fluids are found in this process, the DOGRM initiates appropriate enforcement action against the company and hauler of the brine and works to educate the involved parties on allowable fluids.

Area of Review Considerations and Procedures
In Ohio, the area of review (AOR) for Class II SWD and EOR injection wells is determined based on volume. If the well is being permitted for 200 barrels/day or less, the AOR is a radius of ¼ mile. If the well is permitted for volumes greater than 200 barrels/day, then the AOR is a radius of ½ mile. Operators must undertake corrective actions for any oil and gas wells of concern in this area. If a well or wells are identified for corrective action in the AOR, the approved corrective action becomes part of the permit conditions. Until the corrective action has been completed, the well operator would not receive their authorization to begin operations. If the operator cannot locate the well and perform corrective action, the authorization is denied.

DOGRM does not issue area permits in Ohio’s Class II UIC program. Thus, in enhanced oil recovery (EOR) operations, each well has to be individually permitted. There are 127 EOR wells (73 are in the Berea Quaker State Field). Two other areas are both old, shallow oil fields. Ohio has had some efforts in shallow unconventional oil well development but no permit applications have been approved to date.

Ohio has an SOP for determining the adequacy of a plug job for wells that penetrate the injection zone within the AOR. The procedures require that penetrating wells must have cement across the proposed injection interval and a minimum of 100’ of cement atop the proposed disposal zone. Well construction records and plugging reports are used during the AOR review. For example, the top of cement is determined by a CBL, if one is available. If close, the operator must document using a volume calculation for cement.

Induced Seismicity Considerations
The agency has concluded, based upon credible scientific evidence, that two Class II disposal well operations have been linked to induced seismicity in Ohio. One seismic event occurred in Trumbull County and the other in Mahoning County, both in northeast Ohio. The Mahoning County event was the higher of the two with a recorded magnitude of 4.0 Mm on the Richter scale. There were no personal injuries or documented property damage associated with either of the induced seismic events. The DOGRM has documented their findings and conclusions in a published report for the Northstar #1 well in Mahoning County, which is available to the public.
Operation of both of these wells was voluntarily suspended by their operators. These suspensions were then followed up with cease injection orders issued by DOGRM.

Rules were adopted in 2012 to require more extensive monitoring at existing injection wells and require additional testing and permitting requirements for applications and new permits. These rules authorize the Chief of DOGRM to prescribe tests from a toolbox that includes pressure falloff tests, spinner tests, tracer tests, step rate tests, and any other test the Chief deems necessary. They also authorize the Chief to preclude injection based on the results of these tests. Auto-shut down switches must be installed on new disposal wells in addition to monitoring and recording devices on the injection tubing and tubing/casing annulus (authorized by RC 1509.22 D).

All wells (including UIC wells) completed within a three mile buffer area around ODGS-identified known faults or recent earthquake epicenters are required to be monitored for seismic activity during completion activities. This 3 mile requirement also applies to wells completed near sites where seismic events have been recorded since ODGS’s network deployment in 1999.

In areas where recent induced events have been recorded, the injection well operations have been suspended and additional applications in these areas have not been submitted. Additionally, most deep injection wells in Ohio must be monitored for seismic activity and operators must perform downhole testing in advance of regular operations to determine flow conditions and the location of fluid injection within the formation. The DOGRM has deployed more than 30 seismic instruments throughout the eastern part of the state in order to monitor the potential for induced seismic activity. The data from the seismic stations is sent in real time to the Columbus office for regular evaluation and study. In addition, DOGRM can require additional types of testing or logging (e.g., fall-off tests, spinner surveys, step-rate tests, radioactive tracer tests, dipole sonic logs, resistivity logs, etc) at sites that may pose greater seismic risk. DOGRM does not require more detailed assessments of the reservoir properties.

Ohio’s induced seismicity has occurred in wells that are injecting into or in close proximity to the geologic basement formations. No other conclusive links to induced seismicity such as rate, pressure, or known structures has been identified or published. In Ohio, 41 (19%) of the 215 Class II disposal wells either penetrate the surface of the Pre-Cambrian basement or inject fluids into a reservoir directly overlying basement rocks. There is currently seismic monitoring around 11 of these wells. DOGRM only began permitting with seismic monitoring requirements in 2012, when new rules became effective. DOGRM can also require additional seismic monitoring under 1501:9-3-06 (C)(2). Under this rule DOGRM can, by order, require pre-2012 wells to comply with new rules as necessary. If required, the operator bears the cost of the required installations. The two wells linked to seismic events were both in compliance with
applicable state rules.

Unfortunately, very little detailed data exists about basement formation features in Ohio regarding either location or orientation. The DOGRM provides well applications and locations for ODGS to produce structure maps used in application evaluation. Upon request, the OGDS provides both conventional and geophysical maps that are used in application reviews.

DOGRM now prevents use of the Mount Simon (basal sand near the basement) in eastern Ohio. Any basal sand area disposal well applications are limited to penetrating only formations above the basal sand thereby mandating a vertical separation from the crystalline basement. DOGRM can also require increased seismic monitoring for these wells. However, in the central Ohio, the Mount Simon is stable and has been the injection zone of choice for decades without an indication of injection induced seismicity.

DOGRM is prepared to deal with Class II injection well applications in areas of the state that have a history of seismic activity. Those areas of oil and gas development that have “a history of seismic activity” are limited to western Ohio (this is possibly part of New Madrid Seismic Zone), and extreme northern Ashtabula County. There is little or no recent oil and gas activity in western Ohio and any applications for injection activity in northern Ashtabula County would be heavily cautioned against. If a permit was still pursued, rigorous monitoring conditions would be applied if the permit was issued.

If significant seismicity is recorded near or around oil/gas operations, and it seems reasonable the two may be related, the DOGRM’s seismic group works with the ODGS and seismic consultants, if necessary, to review both the recorded seismic data and injection data to determine if the Class II activity is related to induced seismicity event.

**Administrative Aspects of Permit Application Review**

When a UIC well application is received at DOGRM, it goes through administrative review to determine if the requirements for the operator are met (i.e. registered owner, insured, bonded, fee, etc). After these administrative requirements have been confirmed, UIC technical staff reviews the submittal for technical completeness (i.e. all permitting forms and documents are included and filled out correctly). Once it is determined the application is complete, a public notice is drafted, and sent to the applicant for posting in the newspaper.

Permit applicants for class II disposal wells must run public notice for five days in any newspaper of general circulation in the county where the proposed well is to be located. A 15 day public comment period immediately follows the public notice. Additionally, the applicant must deliver this notice to all operators either producing from or injecting into the proposed disposal formation within the area of review (½ mile or ¼ mile radius). If the proposed well is in
an urban area (defined as an unincorporated population of >5000 in any township or any municipal corporation), the applicant must provide notice to the board of trustees or the executive authority of the municipal corporation and to all owners of real property within 500 feet of the well location.

All comments and objections are reviewed and catalogued before being scanned and included with the application for the proposed well and, if issued, permit file. DOGRM staff meets to discuss the comments received and determine their relevance and validity. All comments are considered as public records and, as such, are filed with the application. Depending on the number of comments received, comment responses from DOGRM are either written and addressed back to the commenter or, if more numerous, compiled with similar comments in the form of “frequently asked questions” and posted on DOGRM’s web site for public access. If a person calls DOGRM to ask questions or provide comments, those are addressed on the phone by UIC staff.

A public hearing on an application can be called by the Chief of DOGRM. The Chief has the obligation to rule on validity of objections on the basis of health and safety, and the conservation of natural resources. A hearing will only be called to address an objection which is determined to have raised a valid issue. A valid issue may be something that cannot be addressed by permit condition or operating requirement. There is no restriction on who may raise a valid objection. Hearings allow formal comment presentations, which may be recorded by a stenographer or may be submitted in writing and which become part of the public record. The location of the hearing is at the discretion of the Chief. The hearing could be located near the proposed well or at DOGRM’S central office in Columbus. If the Chief determines a public hearing is not required, DOGRM either provides notification to the individual registering comment/objection or places the determination on the DOGRM website. There is currently no appeal process if the request for a hearing is denied. In situations where there is substantial public interest, but a valid issue requiring a public hearing has not been established, DOGRM has conducted public information meetings. These meetings may utilize information stations manned by DOGRM staff and/or may provide an opportunity to ask questions along with short presentations by DOGRM staff.

The UIC permit application is reviewed by DOGRM with participation from other agencies. The ODGS provides technical assistance for applications by providing maps and data on known faults, and providing available geophysical data. In addition, DOGRM will periodically consult with OEPA on types of UIC well construction.

Ohio law provides for a variety of financial assurance requirements. All operators are required to have bonds & insurance on UIC wells. Operators of wells must have liability insurance for
property damage in the amount of 1 million to 5 million dollars depending on the well location and well design. An operator must provide a bond of five thousand dollars for one well or 15 thousand dollars for more than one well of any type. To meet bonding requirements, Ohio allows for a blanket bond in the form of a surety bond, a letter of credit, cashier’s check, or a certificate of deposit. Transporters are not allowed to use a letter of credit to satisfy requirements, but they can utilize a cashier’s check for $15,000. Haulers must carry $15,000 blanket bond on trucks, and $600,000 liability insurance. Insurance is not accepted in lieu of bonds.

Ohio law requires allocation (by contract) of 14% of previous revenue to the abandoned well fund per year be expended for orphan well plugging. Last year there was $3.5 million dollars was available for well plugging. Traditionally that amount has been about 1 million dollars per year. In Ohio, UIC wells are viewed as a great asset, and are thus rarely abandoned and the bonds forfeited. DOGRM is aware of about 600 orphaned or abandoned wells currently in their program, and which are prioritized for plugging. There are, however, potentially thousands more orphaned or abandoned wells that have not yet been identified. To date, no UIC wells have fallen into this category.

Aquifer Exemptions
Ohio has no exempt aquifers, and there is no provision proposed to allow aquifer exemptions. No interest has been expressed by operators and the DOGRM has discouraged the practice in order to maximize protection of ground water resources. It is viewed that there are very few areas in Ohio where an aquifer exemption would even be practical. The only likely areas would be EOR operations in the old, shallow oil plays which are not active. The only other possibility would be in the Berea Mecca pool, which dates from 1859, and where development consisted of 80 foot oil wells with a sandstone aquifer below. However, there has been no proposal to inject within the Berea Mecca Pool.

Data Management Systems Used in Permit Application Review
DOGRM was actively involved in the development of RBDMS and was one of the original adopters of the system. The present data management system utilized by DOGRM went into operation in 2001. RBDMS is used to manage the application process, permit issuance, and operational life of the well. RBDMS is also used to store all bonding, insurance, and compliance information. The data management system and data are locally stored at DOGRM.

At present, applicants can submit application via electronic forms but these do not link with the electronic database. Therefore, at this time staff must manually enter the data into the database. There is no electronic application tracking or workflow management system. Permit application status is not searchable or available on the web.
Periodic File Review Process

DOGRM has not established a regular process for initiating file reviews, and only conducts them as needed. At present, file reviews are conducted when operators request permit modifications. Other factors, such as compliance history, are not currently used in initiating a file review. Over a year period, DOGRM conducts file reviews on less than 5% of the total UIC well permits.

As part of a file review, DOGRM reviews well construction, the area of review, and the operator’s compliance history for the well. If a deficiency is detected during the file review, DOGRM works with the operator to achieve corrective action and compliance.

Identified Strengths

1) The UIC application review process is well conceived and designed to provide a good technical and administrative judgment of any proposed Class II well. Reviews include a thorough technical review of well construction and operating specifications.

2) The review team commends DOGRM for the extensive effort undertaken to assure that permitted injection wells do not induce seismic events in the State of Ohio. Ohio has been a national leader in this effort through such measures as establishing an extensive seismic monitoring network, placing stringent requirements on new permits, and not allowing injection into deep formations in areas of seismic concern.

3) The review team commends DOGRM on the development and implementation of an innovative brine sampling program to assure that all fluids disposed of through Ohio Class II injection wells meet permit requirements and do not cause endangerment to USDWs. While DOGRM maintains an extensive catalog of information on the various brines present in Ohio, similar information has not been available for brines brought in from neighboring states. The brine sampling program is addressing this issue to help assure that these fluids also meet all program requirements.

4) DOGRM in cooperation with the Ohio Geologic Survey has developed detailed maps of geologic formations and oil and gas resources. This information has been critical in supporting the DOGRM’s permitting and monitoring programs. Converted wells are held to the same standards as new wells.

Review Suggestions

1) The review team suggests that the DOGRM consider substantially increasing required blanket bond amounts to assure that bond amounts are sufficient to meet state program needs.

2) The State of Oklahoma has developed extensive procedures for notifying the public of all seismic events which occur in that state. DOGRM may wish to review the Oklahoma procedures to assess whether it might be beneficial to adopt some of them in Ohio.

3) DOGRM has placed major emphasis on increasing the public transparency of the
Agency’s UIC regulatory processes. In view of the significant public interest which has been expressed regarding many of the permit applications which DOGRM has received, the review team suggests that DOGRM continue to place priority on continuing to improve the level of transparency in all UIC operations.

4) The review team suggests that DOGRM continue to explore ways of increasing public involvement during the regulatory process. One approach would be to provide more educational opportunities to the public regarding the nature of injection wells and the UIC program.

5) DOGRM may wish to consider mechanisms to increase the length of the public comment period for permit applications. A number of these applications have raised significant public interest and a longer comment period would provide more opportunity for full public involvement.

6) The review team suggests extending the expanded public notification procedures which currently apply in urban areas to all portions of the state.

7) DOGRM may wish to consider placing public notices on-line. This approach has been utilized in a number of other oil and gas producing states and has been found to be an effective method of communication with the public.

8) Currently DOGRM only conducts file reviews when an operator requests a permit modification. The review team suggests establishing additional criteria based on specific events, such as compliance or MIT issues, which would cause a file review to be conducted.

9) While at this time it appears unlikely that aquifer exemptions will be requested or granted in Ohio, the review team suggests establishing default procedures that would be followed in the event that such a request is received. If such a request is received, the DOGRM should work with the Region 5 office of the Environmental Protection Agency (EPA) to determine what specific regulatory language would need to be added to meet current requirements.
Part III: Well Construction

Casing, Cementing, Tubing, and Packer Requirements

The DOGRM has enforced requirements for well construction and cementing of Class II injection wells since 1982. DOGRM requires construction and cementing to ensure protection of public health, safety, and the environment. A DOGRM representative (Inspector) is typically present during installation and cementing of the surface casing. The requirements specified by the Division for well construction, cementing, tubing and packer requirements are contained in the conditions attached to the Class II UIC well permit. Figure 1 is an Ohio example of typical UIC well construction.

Figure 1 Ohio example of typical UIC well construction


The surface casing is the primary barrier to protect USDWs from contamination. DOGRM
requires operators to set surface casing for a UIC well at a minimum depth of 50 feet below the lowermost USDW and the casing must be cemented to the surface. DOGRM further requires all long string casing to be cemented a minimum of 300 feet above the top of the permitted injection zone.

Without exception, packers are required for all newly completed and converted injection wells. There are no requirements on the type of packer that an operator may use. Except for annular disposal wells, all injection is done through tubing and packer set no more than 100 feet above the injection zone.

Annular disposal (AD) wells (see figure 2) are gravity feed systems connected by pipeline to wells on the same lease. These wells are limited to disposing not more than an average of 10 barrels a day of fluids and must meet new rules promulgated in 1989. These rules now require verification of adequate cement behind the casing, and an approved alternative MIT must be run every five years. After adoption of the 1989 rules, DOGRM conducted file reviews of all approved AD wells; this review was largely responsible for reducing the AD inventory to its current level of 73 active wells, with 1939 AD wells in temporary abandoned status. The approved alternative MIT is a positive displacement test using nitrogen to suppress a full column of fluid below surface casing base. It is then necessary to sustain this pressure for one hour with no more than a 1% loss of pressure. While specific ground water contamination related to AD wells has not been established since the full implementation of the 1989 rules, the practice only provides one layer of protection to USDWs and thus poses a much greater risk to ground water resources. As such, DOGRM has indicated a desire to eliminate the practice through the next round of rule making.
At the time of Ohio’s primacy for the UIC class II program, existing UIC wells were allowed to be “grandfathered” into the Class II Program if they met a list of conditions that were mailed to well owners/operators in December of 1982. Operators were required to comply with the new requirements by January of 1983. Ohio’s grandfathered UIC wells meet the current well construction standards.

DOGRM evaluates the quality and effectiveness of casing cement jobs by submitted cement bond logs or, in the case of a converted production wells, cement tickets with calculations for cement volumes to fill up backside of the casing. In addition, inspectors are on-site for cement jobs to witness mixing and pumping of cement. Inspectors assess existing completions with no CBL by verifying cement tops and require the original cement ticket and cement calculations. However, DOGRM still requires a CBL of the production casing, and can require a new CBL to be run for any other casing string if there is concern for the adequacy of the cement job. DOGRM
has historically witnessed a very high percentage of all surface casing cement jobs. If such evaluations indicate that the well does not meet current construction standards, the permit may be denied. Alternatively, DOGRM could allow the applicant to bring the well up to current standards through remedial action such as a squeeze job to increase height of the cement. If the well cannot comply with well construction standards, DOGRM may require the well to be plugged.

Well construction inspection
DOGRM conducts well construction inspections on a regular basis. Operators must notify the assigned inspector forty-eight hours prior to a wide range of UIC well field activities including spudding, casing installation, cementing, tubing and packer installation, and any testing (such as casing pressure tests, MITs, permit condition tests, flowline tests, surface facility construction, blow out preventer tests, etc in order that the inspector can be present to witness the activity.

Data Management for Well Construction Operations
UIC well operators are required to submit the Well Construction Report (form 8), MIT results, cement tickets, cement evaluation logs, surface hole drilling fluid additives report (form 8A), well stimulation additives report (form 8B), and all geophysical logs run. This includes a gamma ray, density neutron and resistivity logs. The logs are all stored in paper and electronic form.

All UIC well operators are required to monitor injection pressure and injection volumes for each well on a daily operational basis with average and maximum pressures and volumes compiled monthly. The operators must file this information annually on forms supplied by the DOGRM.

At present, RBDMS does not generate wellbore schematics electronically based upon submitted construction information but this enhancement is expected to be included with the proposed RBDMs upgrade.

MIT Procedures and Exceptions
Since the promulgation of new rules in 2012, all newly permitted UIC wells are required to continuously monitor the pressure of the annulus between the tubing and the packer in the injection well. This is known as annulus pressure monitoring (APM) and requires that a positive pressure must be kept on the annulus and monitored by the operator monthly. For UIC wells permitted before 2012, operators may continue to run either a Standard Annulus Pressure Test (SAPT) or a monthly “mini-test”. For the SAPT, the required test pressure (the maximum injection pressure or 300 psi, whichever is greater) is held for 15 minutes with an allowable pressure change of (+/-) five percent. The other option is to conduct a “mini-test” where the operator can conduct a monthly SAPT pressure test at 200 psi or greater for 15 minutes with an allowable (+/-) five percent change in pressure. Wells permitted before 2012 may also choose
to utilize APM instead of a pressure test, and many have chosen this option. Inspectors check the annulus pressure during routine inspections and often witness the mini-tests.

Ohio rules allow an operator to request the use of an alternate test rather than a SAPT or APM to show mechanical integrity once every five years. Possible tests include tracer surveys, noise logs, temperature surveys, or other logs or tests approved by the Chief. Ohio rules currently allow these external logs to be used for part 1 of MIT if approved by the Chief. Since they do not address internal well integrity, little interest has ever been shown in requesting their usage, and none have ever been approved for this purpose.

Identified Strengths

1) The review team commends the DOGRM on their excellent casing and construction requirements program. This includes requiring surface casing be set below the lowermost USDW with cement circulation to surface, and a very complete and active field presence to assure that all requirements are met.

2) The review team commends DOGRM’S extensive field presence during most well construction operations including casing installation, cementing, and tubing and packer installation.

3) The DOGRM has shown a commitment to maintaining the mechanical integrity of UIC wells through frequent visits to these well to witness mini-tests and spot-check annulus pressure.
Part IV: Inspections

Witnessing of Mechanical Integrity Testing
Prior to 2012, Ohio rules required mechanical integrity to be demonstrated by a pressure test. An initial pressure test at the maximum allowable injection pressure or a minimum of 300 psi (whichever is greater) for 15 minutes with a failure at over 5% loss was required. DOGRM has witnessed 100% of all initial SAPTs since the inception of the UIC Program in 1983. After that time, a similar full test could be run every five years, or a monthly mini-test could be run at run at 200 psi. For wells permitted after rule changes in 2012, the initial pressure test was still required, but it was then to be followed by continuous annulus monitoring. For the wells permitted before the 2012 rule change, the operators are given the option of continuing with pressure tests or switching to continuous annulus monitoring. Of the approximately 165 wells with this option, about half have switched to continuous annulus monitoring. DOGRM inspectors witness all five year tests, and since all standard Class II wells are visited every three months, inspectors will try to witness monthly mini-tests in connection with their visits.

For wells using continuous monitoring, some operators have used a particular system of hardware and software for continuous monitoring that can be checked by phone and inspectors have been given access to it at any time. While operators must provide an annual report of monthly maximum and minimum pressures, the DOGRM central office can ask for continuous monitoring data at any time. Since the inspectors are equipped with state-issued gauges they can check at any time to see if pressure is being maintained.

Annular disposal wells must pass a special USEPA approved test, conducted at five year intervals to remain active. This is a positive displacement test using nitrogen where the pressure must be held for one hour with less than a 1% loss. All of these tests are witnessed by DOGRM inspectors.

Conduct and Management of Field Operations by the Agency
A key component in the success of the DOGRM’s UIC program is a strong field presence. With the increase in resources in recent years, DOGRM now utilizes four senior inspectors who are assigned almost entirely to UIC duties and rarely perform other types of inspections. These inspectors each have assigned areas and if they are not available to cover a priority activity, such as witnessing a mechanical integrity test or the setting of well casing, they are able to call upon other DOGRM oil and gas inspectors, who cover all types of oil and gas activities, to fill in for them. Many of these other inspectors, who are responsible for respective counties, also have significant prior experience with UIC wells, and if called upon to fill in, they coordinate with the UIC dedicated inspector, who assures that necessary information is made available, prior to their site visit.
Since the dedicated UIC inspectors are quite experienced, they prioritize and manage their own duties and responsibilities, which include quarterly inspections and compliance follow ups, in accordance with established priorities. However, when emergency conditions or urgent inspection needs arise, inspections are coordinated by central office staff. The increase in field inspection staff has come at a critical time, since the UIC related workload has significantly increased with the adoption of rules promulgated since 2012. There are now many more tests which can be required, and witnessing some of these tests may take a full day. This is especially true for new wells being drilled.

All disposal and enhanced recovery wells receive quarterly inspections. These are considered baseline inspection frequencies. Inspections occur more frequently for wells that are undergoing anything other than normal activity, such as well construction activities, various types of testing, etc. For annular disposal wells, inspectors witness the five year mechanical integrity tests for active wells, and also visit temporarily abandoned wells every five years to assure that these wells have not been illegally connected for disposal. Typical inspections require the inspector to evaluate all UIC related items and some items outside of UIC authority in order address the entire well site. Items inspected include proper well identification, injection pressure and well head condition, injection lines, spill control dike, tanks in containment, injection pump, unloading pad, under drain system, and any other associated pipelines. During the visit, inspectors also check general housekeeping, condition of the site/access road, and waste management/handling facilities. Access to sites has not been a problem as Ohio Revised Code 1509.03 provides DOGRM with the authority to enter premises for the inspection of oil and gas operations. With the exception of scheduled testing and well construction, all inspections conducted are unannounced.

In addition to routine inspections, DOGRM has placed priority on witnessing most well construction activities. As such, they witness 100% of surface casing being set and cemented; and in recent years have also witnessed all long string casing being set and cemented as well. This is consistent with the May 2014 SOP #1 – Inspection Priorities. This document sets out in detail how inspectors are to prioritize oil and gas inspection activities, including UIC, and includes a matrix covering most common field activities. Except for routine inspections as mentioned above, most UIC activities are identified as requiring either a 100% response rate, or a highest possible percentage response. In practice, this latter category has been close to a 100% response rate.

Most of the DOGRM field staff, including the four dedicated UIC inspectors, is quite experienced and thus do not require extensive ongoing training. When a new inspector is hired, they are usually trained by existing experienced inspectors and managers through an in-
house training program. The extensive series of 14 SOPs is very helpful, especially the Inspection Priorities SOP, and the Well Inspection Procedures SOP. When deemed necessary, training is provided to the whole inspection staff by outside experts in areas such as cementing or control of wild wells. In some states, inspectors are given a small financial incentive for obtaining certification via taking an exam. This idea has been discussed at DOGRM. However, to date, no decisions have been reached.

The field inspection program at DOGRM has relied on RBDMS for many years. Since inspectors have access to RBDMS in the field, this database allows for access to the wells’ entire data history including scanned images and previous inspections and permitting history. The same database is used for oil and gas programs, and the UIC program. All compliance, ownership, well construction, well completion, maximum allowable injection pressure, operational and reporting history information is stored in RBDMS.

During field inspections, data is collected via laptop computers, and Smartphones are used for e-mail and well locations through the internet. In addition to well specific data, the GPS location for the well and various surface features are obtained and input into the database. The data collected is later uploaded and transmitted to the database. Once received, the inspections are then reviewed and approved in the central office and after approval are included in the well file. Compliance issues documented in the inspection reports are tracked by central office and followed up with by the field inspectors. Records are retained by DOGRM for 50 years in accordance with DOGRM policy.

While RBDMS has significantly aided DOGRM’s field activities, planned upgrades to the system will provide much more flexibility. The new system will operate on a GIS platform and will allow the inspector to rely on the database to keep their daily activities in sync with the field compliance needs. This is not available now, but the future system will automate much of this. The new system is being designed by each type of inspection, with a detailed list of questions that will walk the user through everything they need to consider, observe, document, or measure while at the site to ensure that the well is fully compliant with all aspects of the permit and the rules. DOGRM would like to tie the update effort in with national RBDMS update efforts.

**Compliance and Enforcement**

The compliance and enforcement program of the DOGRM relies on a strong field presence and inspection program. This is reflected in the SOPs for Inspection Priorities and Enforcement, which have updated within the past two years. Since DOGRM inspectors visit all saltwater disposal and enhanced recovery wells at least once a quarter, violations are usually noted
rather quickly. In addition, violations are sometimes self-reported by the well operator. DOGRM’s enforcement response varies depending upon the type of violation and the relative risk of endangering USDWs. For administrative violations, a compliance notice documenting the violation is then issued by either the inspector or the central office in Columbus depending on nature of the violation. Usually this type of compliance notice allows two weeks to resolve the violation. If it is not resolved by then, DOGRM may issue an Administrative Order (AO). The inspector has discretion to give more or less time to correct the violation, and it is a high priority for the inspector to visit the site on the date given in the notice to determine if the well has been returned to compliance.

Certain more serious types of violation, such as loss of mechanical integrity, go straight to an AO. If the violation is viewed as “Material and Substantial”, the operator can be ordered to immediately cease operations at the well in violation. This will occur through a phone call with the formal written AO to follow. For cases where the AO does not resolve the violation, referral can be made to the Ohio Attorney General’s (AG) Office requesting that legal action be initiated. This can be done for both civil and criminal cases. Because most cases are resolved at the AO level, only a small number of cases are actually referred. Those which are referred involve a major commitment of resources by both DOGRM and the AG.

DOGRM has achieved a high rate of returning wells in violation to compliance, in large part due to the high level of repeated follow-up to violations by field inspectors and central office staff. This even includes the creative step of sending out notices on orange paper to ensure that they attract attention. However, it is recognized that the number of violations might be reduced if the DOGRM were to be granted the ability to assess civil penalties, as is the case in a number of other oil and gas producing states. Such an action would, however, require legislative approval. In the absence of this authority, DOGRM has successfully negotiated consent agreements in a number of cases, whereby the operator agreed to pay a fine, or take some other environmentally related action. In previous years, DOGRM has also referred a few complex enforcement cases to USEPA Region 5 in order to utilize USEPA’s administrative penalty authority and bring about a more expeditious settlement.

Enforcement actions are currently tracked on an excel spreadsheet, which is reviewed almost daily. The current RBDMS system can generate information related to violations; however, it is necessary to run a query to obtain this information. The planned upgrade to the RBDMS system would provide daily summaries, which could be accessed by both field inspectors and central office staff.

**Emergency and Citizen Complaint Response Procedures and Processes**

Citizen complaints and emergency situations are considered a high priority by DOGRM.
DOGRMs Inspection Priorities Standard Operating Procedure (SOP) specifies that the agency must respond to all public complaints as soon as feasible and must respond to emergency situations and public complaints where these is a potential threat to health or safety within 24 hours. A field inspector will normally respond with a site visit unless it is an emergency situation, in which case DOGRM’s emergency response group handles the initial response. Even in these cases, UIC inspectors will assist and follow up through closure of the case.

The person who receives a citizen complaint is responsible for ensuring that the correct person is notified of the complaint. If a potential spill situation is identified, the case is referred to the emergency response group to address the situation. The UIC program reviews complaints raised by the public in a group involving both managers and staff, in order to determine the best course of action, and the final decision is made by the Chief of DOGRM. Citizen complaints regarding failure to restore a site are required to be investigated in accordance with Ohio Revised Code 1509.32 and a written report of investigation findings must be made available.

Citizen complaints are documented through an Access-based complaint database maintained by DOGRM. This database is tracked, and details such as conversations with the citizen who filed the complaint are documented. At present, queries must be run to track complaints; the new RBDMS upgrade will make this information and all other information related to citizen comments more readily available. There is also an incident database that includes information on spills, fires, explosions, etc. Citizen comments or objections which are received during the permitting process for UIC wells are kept in paper files.

**Identified Strengths**

1) **DOGRM maintains a very strong field presence which plays an integral part in the effectiveness of Ohio’s Class II UIC program.**

2) **DOGRM has witnessed and continues to witness 100% of initial and follow-up SAPTs throughout the life of every injection well since inception of the UIC Program in 1983.**

3) **The assignment of four highly experienced field inspectors as dedicated UIC inspectors has provided a significant level of expertise and continuity to all aspects of DOGRM’s UIC program.**

4) **The practice of inspecting all salt water disposal and enhanced recovery UIC wells on a quarterly basis increases the effectiveness of DOGRM’s UIC program by allowing staff to keep up to date on any issues before they can become a major problem, and helps assure compliance with permits and rules.**

5) **The DOGRM practice of conducting a pre-site evaluation and inspection during the Application for Permit to Drill process is commendable and tends to result in the mitigation of potential problems prior to their occurrence. This allows DOGRM to pre-mitigate potential issues and to establish appropriate permit conditions.**
6) The use of the Standard Operating Procedures (SOPs) developed for Well Inspection Procedures, Inspection Priorities, and Enforcement assures a consistent approach to field activities in line with DOGRM priorities. The recent Inspection Priorities document is especially important as it sets out via a matrix required timeframes and expectations regarding the coverage of specific activities.

7) DOGRM has been effective in returning wells in violation back into compliance in large part due to the role of the field inspectors. The frequent visits and contacts that the inspectors make to resolve a violation helps expedite the process.

8) The use of RBDMS to manage all aspects of the UIC program has allowed inspectors to access information they need in the field, and electronically transmitting their reports back to the central office in Columbus.

9) The witnessing of most well construction activities is a major achievement which helps assure the integrity of injection wells. This includes witnessing 100% of setting and cementing surface casing and usually most if not all setting and cementing of long string casing.

10) The priority placed on investigating citizen complaints through field visits is an important part of public outreach and is reflected in the priorities set in the in the Inspection Priorities SOP.

11) The practice of the UIC manager reviewing all inspection reports for completeness and accuracy prior to incorporation in the well file helps provide quality assurance.

12) DOGRM provides, maintains and calibrates state-issued gauges for inspectors to use during mechanical integrity tests and routine pressure monitoring at injection wells. This ensures that the inspector is able to check the integrity of injection wells without reliance on equipment supplied by the well owner.

13) The creative use of consent agreements to obtain not just financial settlements but also environmental improvements has proven an effective alternative to long drawn out and resource intensive legal proceedings.

Review Suggestions

1) The planned updates to RBDMS will provide the field inspectors with an improved ability to manage their workload and prioritize activities in the field. It will also provide greater transparency for the overall UIC effort. While the review team recognizes the investment of time and resources need to complete this upgrade, DOGRM should continue to make this a priority, as the long term results will be well worth the effort.

2) The review team recommends that as part of the five year review effort, DOGRM seriously consider whether some type of administrative penalty authority would be beneficial to the program, especially in terms of reducing the number of repeat violations, and explore what types of rules could be developed. The review team
recognizes that the Ohio legislature would first need to grant the ODNR statutory authority before the DOGRM could consider rule making, but DOGRM could at least prepare a cost/benefit analysis if such a change appears beneficial.

3) The review team recommends that DOGRM consider some sort of incentive program to encourage field inspectors to take training courses and obtain certification. Some other states have found this approach helpful in motivating field inspectors to continue their professional development.

Overall Program Findings

Overall the review team finds that the Ohio Class II UIC program managed by the DOGRM is well run and managed. The review team finds that the program provides appropriate protection for USDWs in accordance with the provisions of federally delegated UIC program requirements. The staff of the DOGRM has the professional and technical knowledge and experience needed to implement the program in a manner that is efficient and meets the requirements for an effective Class II UIC program under Section 1425 of the SDWA. The program is well organized and makes excellent use of professional staff and the latest data management processes to assure that USDWs are adequately protected.

Suggestions made in this report are intended to provide the state with considerations the team believes would make the program even better than it is currently. They are not intended to convey shortfalls in the program.
APPENDIX A

LIST OF ACRONYMS

AD - annular disposal
AG - Ohio Attorney General
AO - administrative order
AOR – area of review
API – a unique UIC well identifier number (from American Petroleum Institute)
CBL – cement bond log
DOGRM - Division of Oil & Gas Resources Management
MIT – Mechanical Integrity Test
MOU – Memorandum of Understanding
ODC – Ohio Department of Commerce
ODH – Ohio Department of Health
DOGRM - Ohio Department of Natural Resources
OEPA – Ohio Environmental Protection Agency
ODGS – Ohio Division of Geologic Survey
RC - Ohio Revised Code “RC 1509.03”
RBDMS - Risk Based Data Management System
SAPT – Standard Annulus Pressure Test
SDWA - Safe Drinking Water Act
SOP - standard operating procedure
TENORM - technologically enhanced naturally occurring radioactive materials
[USEPA = “Naturally occurring radioactive materials that have been concentrated or exposed to the accessible environment as a result of human activities such as manufacturing, mineral extraction, or water processing.”]

UIC – Underground Injection Control

UIC Class II wells - wells used for the injection of oil and gas produced fluids for disposal or enhanced recovery

USDW – underground sources of drinking water

USEPA – United States Environmental Protection Agency