Southern Utah Wilderness Alliance
Petition for Review
UIC Permit UT22291-10328

Exhibit Six

BEFORE THE ENVIRONMENTAL APPEALS BOARD
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

In re:	)
UIC Permit Number: UT22291-10328 Enhanced Oil Recovery Well RBU 1-10D River Bend Unit, Uintah County, Utah API No. 43-047-34312	)

DECLARATION OF BRIANA E. MORDICK (filed in support of)
PETITION FOR REVIEW

1. My name is Briana E. Mordick and I am a staff scientist for the Natural Resources Defense Council. I make the following statements from personal knowledge. This Declaration is filed in support of Southern Utah Wilderness Alliance's Petition for Review in the above-captioned matter.

2. I am a petroleum geologist with more than nine years of experience in this field. From January 2005-September 2010 I worked for Anadarko Petroleum Corporation, first as a geologist and then senior geologist and team lead. More recently I have worked for the Natural Resources Defense Council, first as a science fellow and now as a staff scientist. My professional experience includes: enhanced oil recovery underground injection operations, drilling more than 150 new wells and selecting hundreds of new drilling locations; describing and analyzing core data; and, analyzing well logs, core and production data and recommending zones to be completed for production. I have presented at numerous forums including ones held by EPA and the American Chemical Society. My resume is attached hereto as Exhibit A.

3. I have thoroughly reviewed and am familiar with the following documents: *Gasco Energy's (revised) June 2014 Underground Injection Control (UIC) Permit Application, River Bend Unit (RBU) 1-10D*, NENE Sec. 10, T10S, R18E, Uintah County, Utah, API # 43-047-34312 ("Gasco UIC Permit Application"); *EPA's July 2014 Draft UIC Permit 22291-10328, Well RBU 1-10D*, NENE Sec. 10, T10S, R18E, Uintah County, Utah, API # 43-047-34312 and certain accompanying materials ("Draft EPA UIC Permit"); and *EPA's November 17, 2014 Final UIC Permit UIC Permit UT22291-10238,* NENE Sec. 10, T10S, R18E, Uintah County, Utah, API # 43-047-34312 and certain accompanying materials, including EPA's Response to Public Comments ("Final EPA UIC Permit").

4. At the request of the Southern Utah Wilderness Alliance (SUWA) I prepared comments on the Draft EPA UIC Permit. These comments were submitted to EPA with a cover letter on or about August 26, 2014. A copy of those comments is attached hereto as Exhibit B.

5. At my request, SUWA sought to obtain copies of Attachment G2 to Gasco's UIC Permit Application which purported to contain a water analysis report for the produced water collected from the DSS Evap Sample. *See* Gasco UIC Permit Application at 7. EPA did not provide SUWA with a copy of Attachment G2 until December 17, 2014, well after we filed our comments on the Draft EPA UIC Permit.

6. A section of my comments on the Draft EPA UIC Permit discussed concerns about the maximum allowable injection pressure ("MAIP"). I explained that the MAIP calculated in the Draft EPA UIC Permit did not meet Federal Class II regulations, 40 C.F.R. § 146.23(a)(1). In particular, I stated that EPA had underestimated the specific gravity of the injectate and highlighted that Gasco's UIC Permit Application, Table G-1, Summary of TDS Concentrations – Representative Injection Fluid, indicated that the TDS concentration of a representative sample of the injection fluid was 158,679 mg/L. Given this TDS value, I calculated that this fluid should have a specific gravity of approximately 1.125. Although EPA did not explicitly state the value of specific gravity used in its MAIP calculation, by back-calculating from the proposed injection pressure it appeared that EPA was using of value of specific gravity of approximately 1.025. This value is inconsistent with the TDS value of the injection fluid listed in Gasco's UIC Permit Application. As a result of this miscalculation, the proposed MAIP was too high and may endanger underground sources of drinking water ("USDWs") by allowing injected fluids to fracture the confining zone, which may create pathways through which injected fluids can migrate into USDWs. On December 17, 2014, EPA

provided SUWA with attachments E1 and G2, EPA's calculation of bottom hole pressure and an analysis of the chemical composition of the proposed injectate, respectively. The chemical analysis shows a calculated density of 1.1 mg/l, which corresponds to a specific gravity of 1.1. However, in attachment E1, EPA states that "the specific gravity of the injected water is anticipated to be no more than 1.03," in direct conflict with the density of the injection water sample. EPA offers no justification for this discrepancy. Using a specific gravity of 1.1, the calculated bottom hole pressure would be approximately 2320 psi, or approximately 150 psi higher than EPA's calculated pressure of 2171 psi. Given EPA's calculated fracture pressure of 4180 psi listed in attachment E1, this would result in an absolute maximum allowable surface injection pressure of 1860 psi. EPA's proposed maximum allowable injection pressure of 1945 psi exceeds this, which could result in fracturing of the injection and confining zones, endangering USDWs. Using the maximum allowable injection pressure calculation listed in our comment letter and a specific gravity of 1.1, the maximum allowable injection pressure, incorporating a safety factor, should be no more than approximately 1690 psi.

7. The Final EPA UIC Permit and Response to Comments does not address or even mention my comment regarding the underestimation of the specific gravity of the injectate and the resulting inaccurate MAIP. Instead, EPA contends that it correctly calculated MAIP through an alternate equation that is sufficiently conservative and complies with 40 C.F.R. § 146.23. This misses the point. Because EPA continues to rely on an inaccurate specific gravity for the injectate its MAIP calculation is too high.

8. I note that Attachment B to the Final EPA UIC Permit is Gasco's undated Evaluation of the Zone of Endangering Influence for the RBU 1-10D Injector. This document contains a statement that "[t]he average injection water will have a TDS of 27,000 mg/L,

corresponding to a specific gravity of 1.02." At no point does EPA attempt to reconcile this statement with the 158,679 mg/L figure in Gasco's UIC Permit Application, which we now know to have a corresponding specific gravity of 1.1. Gasco's undated Evaluation of the Zone of Endangering Influence for the RBU 1-10D Injector was not made available prior to the release of the Final EPA UIC Permit.

9. Determining the proper MAIP is a significant issue. It is important in order to protect USDWs and comply with Federal Class II regulations which require that "[i]njection pressure at the wellhead shall not exceed a maximum which shall be calculated so as to assure the pressure during injection does not initiate new factures or propagate existing fractures in the confining zone adjacent to the USDWs." 40 C.F.R. § 146.23(a)(1).

I declare under the penalty of perjury that the foregoing is true and correct.

Executed on December 17, 2014 in San Francisco, California.

Briana E. Mordick

Declaration of Briana E. Mordick – Exhibit A

SUWA Petition for Review

UIC Permit: UT22291-10328

BRIANA E. MORDICK

PROFESSIONAL EXPERIENCE

NATURAL RESOURCES DEFENSE COUNCIL
September 2010 – Present

STAFF SCIENTIST (September 2012 – Present)
SCIENCE FELLOW (September 2010 – September 2012)

Technical advisor on issues related to oil and natural gas extraction and geologic sequestration of carbon dioxide. Provides scientific expertise and analysis in support of advocacy efforts. Identifies regulatory solutions and industry best practices to address the environmental impacts of oil and natural gas extraction Engages with and serves as a liaison to the scientific community.

ANADARKO PETROLEUM CORPORATION
January 2005 – September 2010

Greater Natural Buttes Natural Gas Field, Uinta Basin, UT (June 2009 – September 2010)
Senior Geologist & Team Lead

- Geologist responsible for drilling 50+ wells and selecting 500+ new drilling locations
- Worked to develop new criteria and methods for selecting optimal well locations
- Lead a team of four co-workers who were responsible for two drilling rigs and hundreds of wells; organized and lead meetings; provided weekly updates to management; served as point of contact for extended team members

Salt Creek Field CO_2 Enhanced Oil Recovery Project, Natrona County, WY (Nov 2006 – June 2009)
Geologist II

- Described and analyzed core data to develop full field depositional model
- Analyzed well logs, core, and production data to determine flow pathways of oil and CO_2
- Assisted in construction of digital 3D geologic reservoir model used for oil and CO_2 flow simulation modeling

Ozona Natural Gas Field, Crockett County, Texas (Jan 2005 – Nov 2006)
Geologist I

- Geologist responsible for drilling 100+ natural gas wells, analyzing logs, and recommending zones to be completed for production
- Remapped subsurface geology, resulting in greater predictability of productive zones in wells
- Successfully presented underdeveloped natural gas prospect at the North American Prospect Expo (NAPE) and engaged a partner to develop these prospects

ANADARKO PETROLEUM CORPORATION
The Woodlands, Texas

GEOSCIENCE INTERN
September 2004 - November 2004

Evaluated the Baxter shale in active Wyoming oil and gas fields for shale-gas production potential.

EDUCATION

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Chapel Hill, North Carolina

MASTER OF SCIENCE, GEOLOGICAL SCIENCES
September 2002 – May 2005

Thesis: Pyroxene thermobarometry of basalts from the Coso and Big Pine volcanic fields, California

BOSTON UNIVERSITY
Boston, Massachusetts

BACHELOR OF ARTS, EARTH SCIENCE
September 1998 – May 2002

Senior Thesis: Provenance of discrete ash layers from the Izu-Bonin Arc system using Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry

BRIANA E. MORDICK

CONTINUING EDUCATION

Subsurface Mapping • Well-Site Operations • Core and Depositional Systems Analysis • Sequence Stratigraphy • Petrophysics • Introduction to Seismic • Risk Analysis • Sedimentology and Stratigraphy of Coastal Successions • Modern Terrigenous Clastic Depositional Environments

PUBLICATIONS

Mordick, B.E., Glazner, A.F., 2006, Clinopyroxene thermobarometry of basalts from the Coso and Big Pine volcanic fields, California: Contributions to Mineralogy and Petrology, v. 152, no. 1, p. 111-124.

SELECTED PRESENTATIONS

- October 19, 2010:
  - Forum: National Research Council of the National Academies, Board on Earth Sciences and Resources, Committee on Earth Resources
    - Meeting Title: "Meeting Our Nation's Natural Resource Needs: Balancing Risks and Rewards"
    - Presentation Title: "Environmental Impacts of Oil and Gas Production"
- March 11, 2011:
  - Forum: EPA Hydraulic Fracturing Study Technical Workshop
    - Meeting Title: Well Construction and Operations
    - Presentation & Abstract Title: "Risks to Drinking Water from Oil and Gas Wellbore Construction and Integrity: Case Studies and Lessons Learned"
- April 30, 2012
  - Forum: Eurasia Group Workshop
    - Meeting Title: US Unconventional Oil and Gas Resources: National Security Implications
    - Panel: Obstacles to US unconventional oil and gas development
    - Presentation Title: Environmental Impacts of Oil and Natural Gas Production
- March 15, 2013
  - Forum: Woodrow Wilson Center
    - Meeting Title: Shale Gas Revolution in China: Game Changer for Coal?
    - Presentation Title: Shale Gas Revolution in China: Game Changer for Coal?
- October 4, 2013
  - Forum: American Chemical Society, Western Regional Meeting
    - Meeting Title: Hydraulic Fracturing in California: Environmental Issues with the Largest Shale Oil Formation in the U.S.
    - Panel Discussion
- May 21, 2014
  - Forum: Institute for Advanced Sustainability Studies
    - Meeting Title: Shale Gas in Europe – A Transdisciplinary Approach
    - Presentation Title: Water Use and Waste Water Management in US Shale Gas and Tight Oil Production
- August 13, 2014
  - Forum: American Chemical Society 248th National Meeting
    - Meeting Title: Evolving Science and Environmental Impacts of Hydraulic Fracturing
    - Presentation Title: Filling the data gap: What we know (and don't know) about fracking and acidizing in California

Declaration of Briana E. Mordick – Exhibit B

SUWA Petition for Review

UIC Permit: UT22291-10328

Comments submitted via e-mail (Aalto.Tom@epa.gov, Suchomel.Bruce@epa.gov)
Attachments sent via UPS First Class Mail Only

August 26, 2014

U.S. Environmental Protection Agency
Region 8
ATTN: Tom Aalto
8OC-EISC
1595 Wynkoop Street
Denver, CO 80202-1129

Re: Comments - Draft Permit, EPA UIC Permit UT22291-10328, River Bend Unit 1-10D Well

Greetings:

The Southern Utah Wilderness Alliance (SUWA) respectfully submits timely comments on the United States Environmental Protection Agency's (EPA) draft permit for the proposed River Bend Unit 1-10D Undergound Injection Control well (EPA permit number UT22291-10328). On July 24, 2014, EPA granted SUWA's request for a ten-day comment period extension through August 26, 2014.

The following comments were prepared at the request of SUWA by Briana Mordick, Staff Scientist for the Natural Resources Defense Council. Ms. Mordick is a geologist with extensive knowledge and expertise on issues related to oil and natural gas extraction, including enhanced recovery methods. Ms. Mordick's *curriculum vitae* is attached as well. All other referenced documents and exhibits will be sent via UPS First Class Mail.

August 25, 2014

To: Landon Newell, Staff Attorney, Southern Utah Wilderness Alliance
Steve Bloch, Attorney, Southern Utah Wilderness Alliance

From: Briana Mordick, Staff Scientist, Natural Resources Defense Council

Subject: Comments on Draft Underground Injection Control Permit UT22291-10328, Class II Enhanced Oil Recovery Well, RBU 1-10D, API No.: 43-047-34312, Uintah County, UT

This report responds to the request of the Southern Utah Wilderness Alliance ("SUWA") for a technical review of the Draft Underground Injection Control Permit UT22291-10328, Class II Enhanced Oil Recovery Well, RBU 1-10D, API No.: 43-047-34312, Uintah County, UT. I have reviewed the draft permit and supporting documents and detailed my comments below. My CV detailing my qualifications to provide this technical review is attached.

The permit applicant, Gasco, and the Environmental Protection Agency ("EPA") have not sufficiently demonstrated that the proposed injection well will not endanger Underground Sources of Drinking Water ("USDWs").[1] Specifically, as discussed in greater detail in the comments that follow:

- The proposed injection well and offset wells are not properly designed and constructed and may currently be endangering USDWs
- The proposed maximum allowable injection pressure ("MAIP") in the draft permit may result in fracturing of the injection or confining zone, potentially creating pathways that may allow injected fluids to reach USDWs
- The Area of Review ("AoR") evaluation is not sufficient and neither the applicant nor EPA has demonstrated that the proposed ¼-mile fixed radius is appropriate to protect USDWs.

Consequently, the draft permit should not be approved unless and until these deficiencies are addressed.

Well Construction

The design and construction of the proposed injection well, the RBU 1-10D, and nearby offset wells are not sufficient to protect USDWs.

[1] As noted in the draft permit, the Base of Moderately Saline Water (BWSW) corresponds with the base of the USDWs in the area. However, no analyses of water from this interval were provided in the permit application.

In the permit application, the base of the deepest USDW in the proposed injection well is estimated at 2523 feet. However, the surface casing, which is intended to isolate and protect usable groundwater, is set at 2414 feet. Furthermore, the top of cement behind the production casing is estimated to be at 2980 feet. In other words, the surface casing does not extend below the base of the USDW and the production casing cement does not extend above the base of either the USDW or the surface casing. This means that a portion of the annular space adjacent to the USDW is uncemented. Leaving this annular space uncemented puts both the USDW and well integrity at risk.

The surface casings for the wells identified in the permit application as being within or near the ¼-mile AoR are set significantly shallower than the surface casing in the proposed injection well. The permit application does not specify the depths to the base of the USDW for these wells. However, a review of the map of the Base of Moderately Saline Ground Water ("BMSW")[2], which, as stated in the draft permit, "corresponds to the base of the USDWs in the area," indicates that the BMSW in these offset wells is likely to be at similar depths as the BMSW in the RBU 1-10D, or approximately 2500 feet. The surface casing in all five listed offset wells does not extend below the base of the USDW.

As with the RBU 1-10D, in three of the five offset wells, the top of the production casing cement does not extend above the base of the surface casing. In one such well, the RBU 5-11D, the top of the production cement also does not extend above the base of the USDW. In this well, the base of the surface casing is at 500', the base of the USDW is at approximately 2500', and the top of the production casing cement is at 4160', meaning that almost 1650 feet of wellbore behind the production casing is uncemented.

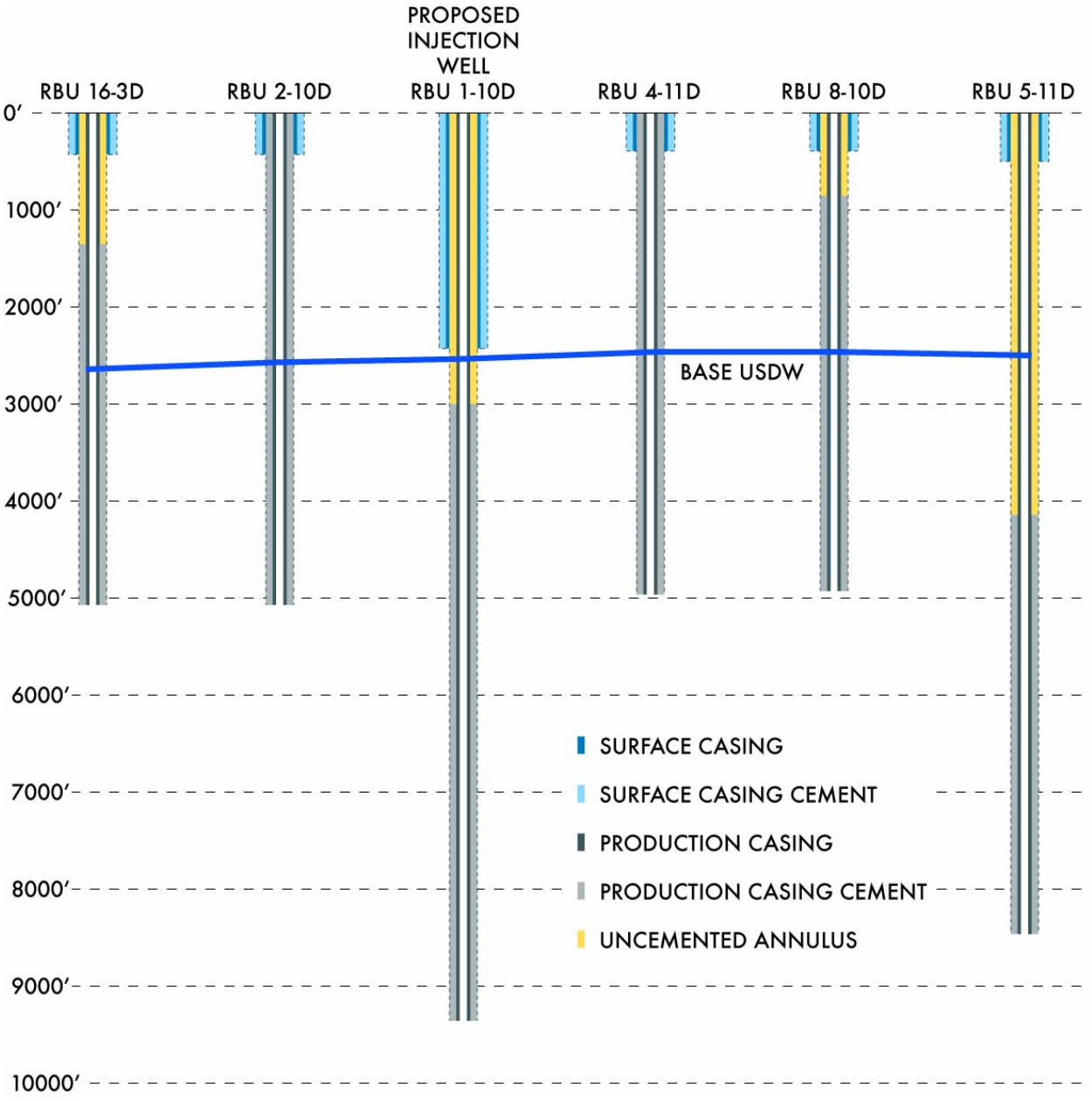
Failing to extend surface casing in any well to below the base of the lowest USDW puts those USDWs below the base of the surface casing at significant risk of contamination. Cross flow may occur between the USDW and other formations, potentially leading to contamination of the USDW. Leaving a potential flow zone uncemented can also result in overpressurization of the annulus and/or result in casing corrosion, both of which may lead to a well integrity failure, further putting drinking water at risk. Properly constructed wells typically have at least two barriers between USDWs and fluids contained in the well: 1) the surface casing and 2) the

[2] Anderson, P. B., Vanden Berg, M. B., Carney, S., Morgan, C., & Heuscher, S. (2012). *Moderately Saline Groundwater in the Uinta Basin, Utah, Special Study 144.* Utah Geological Survey.

production casing.[3] These redundant barriers are necessary to ensure that if one barrier fails USDWs are still protected. The proposed injection well and offset wells lack redundant barriers, putting USDWs at serious risk in the case of a well integrity failure.

The American Petroleum Institute recommends that "surface casing be set at least 100 feet below the deepest USDW encountered while drilling the well."[4] Both UIC Class I and Class VI well rules require surface casing to extend below the base of the lowest USDW, indicating that EPA clearly recognizes this as an important standard to protect groundwater.[5]

[3] Smith, J. B., & Browning, L. A. (1993, January). Proposed Changes to EPA Class II Well Construction Standards and Area of Review Procedures. In SPE/EPA Exploration and Production Environmental Conference. Society of Petroleum Engineers.
[4] American Petroleum Institute. 2009. Hydraulic Fracturing Operations – Well Construction and Integrity Guidelines. API Guidance Document HF1. First Edition, October 2009.
[5] 40 CFR 146.86(b)(2) and 40 CFR 146.65(c)(2)


PROPOSED INJECTION WELL
RBU 16-3D
RBU 2-10D
RBU 1-10D
RBU 4-11D
RBU 8-10D
RBU 5-11D
0′
1000′
2000′
3000′
4000′
5000′
6000′
7000′
8000′
9000′
10000′
BASE USDW
SURFACE CASING
SURFACE CASING CEMENT
PRODUCTION CASING
PRODUCTION CASING CEMENT
UNCEMENTED ANNULUS

While Class II rules do not explicitly require surface casing to extend below the base of the lowest USDW,[6] they do require that, "all Class II wells shall be cased and cemented to prevent movement of fluids into or between underground sources of drinking water,"[7] and that the depth to the bottom of all USDWs be considered in determining and specifying casing and cementing requirements.[8]

The permit application and draft permit state that corrective action is not anticipated to be necessary for either the proposed injection well or wells within or near the AoR. However, a review of the construction details indicates that, due to inadequate casing and cementing practices, both the proposed injection well and nearby offset wells may *currently* be endangering USDWs, not even taking into account the additional risks associated with converting the RBU 1-10D into an injection well. In sum, the current construction of the proposed injection well and nearby offset wells is insufficient to protect USDWs and the permit should not be granted unless and until these deficiencies are corrected.

The applicant and EPA must demonstrate that contamination is not currently occurring in the proposed injection well and offset wells, including but not limited to water sampling and analyses from the USDW interval in these wells. This information must also be provided to the public for additional review before the permit is granted.

Injection pressure

Federal Class II regulations require that,

"Injection pressure at the wellhead shall not exceed a maximum which shall be calculated so as to assure that the pressure during injection does not initiate new fractures or propagate existing fractures in the confining zone adjacent to the USDWs."[9]

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[6] A report by the General Accounting Office, an internal EPA Mid-Course Evaluation of the UIC program, and a federally chartered advisory committee found that Class II well construction rules were insufficient to protect drinking water and recommended that the rules be changed to require surface casing to extend below the base of protected water. EPA proposed to make these changes in the early 1990s, but they were never finalized. Nevertheless, these improvements are still needed in order to adequately protect USDWs and should be implemented in permitting decisions. *See* Smith, J. B., & Browning, L. A. (1993, January). Proposed Changes to EPA Class II Well Construction Standards and Area of Review Procedures. In *SPE/EPA Exploration and Production Environmental Conference*. Society of Petroleum Engineers.

[7] 40 CFR 146.22(b)(1)

[8] 40 CFR 146.22(b)(1)(ii)

[9] 40 CFR 146.23(a)(1)

The MAIP calculated in the draft permit does not meet this requirement. The proposed MAIP is too high and may endanger USDWs by allowing injected fluids to fracture the confining zone, which may create pathways through which injected fluids can migrate into the USDW.

The proposed MAIP in the draft permit is equal to EPA's estimated fracture pressure at the base of the confining zone/top of the injection zone. The MAIP should not be equal to, but rather should be less than, the fracture pressure of the confining zone and incorporate an appropriate safety factor. Class VI rules require that the maximum injection pressure be no greater than 90% of the fracture pressure of the injection zone.[10] For Class II wells, EPA Region 5 recommends adding a safety factor of 0.05 to the specific gravity of the injectate.[11]

In the draft permit, EPA states that the MAIP calculation was performed using injection fluid density and injection zone data submitted by the applicant. Despite repeated requests, EPA declined to make this information available.[12] It is therefore very difficult to evaluate the adequacy of EPA's MAIP calculation in the draft permit because EPA does not include all the inputs used to derive the MAIP, notably the specific gravity ("SG") of the injectate. By back calculating from the available information, it appears that EPA is using a SG of approximately 1.025. This is the value of SG commonly assumed for seawater due to the average density of seawater being equal to 1.025 g/ml. Seawater is commonly assumed to have an average total dissolved solids ("TDS") concentration of 35,000 mg/L. The permit application submitted by Gasco indicates that the TDS concentration of a representative sample of injection fluid is 158,679 mg/L, or approximately 4.5 times the average TDS concentration of seawater. As such, the density and therefore specific gravity of the injection fluid will be significantly higher. Assuming a standard ambient pressure and temperature of 25° C and 100 kPA, the density of water with a TDS concentration of 158,679 mg/L would be approximately 1.125 g/ml, or a SG of 1.125. Using this value of SG and the following equation to determine MAIP, which includes a safety factor:

$$MAIP_{surface} = \{[FG - 0.433 * (SG + 0.05)] * D\} - 14.7$$

where:
FG = fracture gradient (assume value used in draft permit, 0.860 psi/ft)
0.433 = density of water in psi/ft
SG = specific gravity
0.05 = safety factor
D = depth

[10] 40 CFR 146.88(a)
[11] "Requirements for Commercial Underground Injection Control Class II Wells." *EPA Region 5 Water*. Environmental Protection Agency, n.d. Web. 20 Aug. 2014.
[12] *See* e-mail correspondence between Landon Newell, SUWA, and Tom Aalto, EPA.

14.7 = conversion factor from absolute pressure to gauge pressure

the MAIP for the RBU 1-10D would be 1637 psig, or approximately 16% lower than the EPA's proposed MAIP.

Additionally, the fracture gradient of the injection and confining zones must be confirmed with field data from the proposed well, and the MAIP must be adjusted to reflect any difference between the actual and estimated FG.

In sum, the proposed MAIP in the draft permit may be too high[13] and injecting at this pressure may endanger USDWs. The operator and EPA must:

- Resolve the apparent discrepancy between the reported salinity and density of the injectate;
- Accurately determine the density and specific gravity of the injectate;
- Use an accurate value for the specific gravity of the injectate and incorporate a safety factor in the MAIP calculation, and;
- Provide all inputs to the MAIP calculation, including the salinity and density/specific gravity of the injectate, to the public for additional review before the permit is granted.

Reservoir Stimulation

The permit application states that no additional stimulation is anticipated for the proposed well. However, Exhibit L-1 submitted by the applicant states that, "Plan call for perforating and fracking the shown intervals…" [sic]. This discrepancy must be resolved and any plan to hydraulically fracture or use other reservoir stimulation techniques must be disclosed for public review and comment and approved by EPA.

Area of Review

Under federal UIC Class II rules, the AoR may be determined using one of two methods: either a fixed radius of not less than ¼ mile or by calculating the zone of endangering influence ("ZEI"). Neither the permit application nor the draft permit consider the use of the ZEI or include a discussion of the merits of the different methods.

In 2004 the UIC National Technical Workgroup ("NTW") prepared a report entitled, "Does a Fixed Radius Area of Review meet the statutory mandate and regulatory

[13] We again note that this is difficult to evaluate due to EPA's refusal to provide the necessary data.

requirements of being protective of USDWs under 40 CFR §144.12?"[14] The purpose of the report was to summarize available information on the use of a ¼-mile fixed radius as opposed a ZEI to designate the AoR around Class II injection wells. The researchers summarized the process that led to the development of the two different AoR approaches, stating, "The final AoR regulation at 40 CFR §146.6 was adopted even though much existing evidence showed that the actual pressure influence of any authorized underground injection operation is not limited to any pre-determined radius around any proposed or existing injection well, but is a function of specific physical parameters (including initial pore pressures in both the injection zone and in the lowermost USDW and actual injection rate)."

The researchers noted incidents where injected fluids contacted improperly abandoned wells beyond a ¼-mile radius, including one case on the Texas/Louisiana border where injected fluids flowed out of orphan wells located more than a mile from the injection well, impacting a local public water supply.

Accordingly, the researchers recommended that EPA develop and adopt technical guidance regarding the AoR determination, and that every UIC program reevaluate the area of review of all authorized injection activities, stating, "The majority of EPA UIC National Technical Workgroup members understands the magnitude of the suggested action and consider this proposal as a long-term solution to *a long-standing inadequate permitting practice*." (emphasis added) The researchers went further to state, "A majority of the UIC National Technical Workgroup members believe that enough evidence exists to challenge the assumption that a fixed radius AOR is sufficient to assure adequate protection of USDWs from upward fluid migration through artificial penetrations within the pressure influence of authorized injection operations."

The isopachs provided as Exhibits J and K indicate that the injection interval does not have a uniform thickness in the vicinity of the proposed injection well, meaning that injected fluids may flow preferentially in one or more directions rather than flowing radially as the ¼-mile AoR implies. This may allow injected fluids to contact wells beyond the ¼-mile AoR. Gasco's exhibits show that many existing wells fall just outside the ¼-mile AoR. As noted above, the construction practices used in the identified offset wells are insufficient to protect groundwater. EPA lists "vertical movement of fluids through improperly abandoned and improperly completed

[14] Frazier, M., Platt, S., & Osborne, P. (2004) Does a Fixed Radius Area of Review meet the statutory mandate and regulatory requirements of being protective of USDWs under 40 CFR §144.12?. *Final Work Product from the National UIC Technical Workgroup.*

wells," as one of six key pathways of contamination through which injected fluids may reach USDWs.[15]

The fixed ¼-mile AoR is not sufficient to protect USDWs. EPA must require the applicant to more accurately determine where injected fluids will flow, in order to more thoroughly identify pathways through which injected fluids may reach groundwater.

Conclusion

The proposed injection project presents significant risks to USDWs. The draft permit should not be approved unless and until the deficiencies discussed are addressed.

[15] U.S. Environmental Protection Agency, Office of Drinking Water. (1980, May). *Statement of Basis and Purpose, Underground Injection Control Regulations.*