



RAILROAD COMMISSION OF TEXAS

HEARINGS DIVISION

PROPOSAL FOR DECISION

OIL & GAS DOCKET NO. 09-0300841

THE APPLICATION OF TXON PARTNERS, LLC PURSUANT TO STATEWIDE RULE 46 TO INJECT FLUID INTO A RESERVOIR PRODUCTIVE OF OIL OR GAS FOR THE MANGOLD KMA WATERFLOOD UNIT, WELL NO. 202, K-M-A FIELD, WICHITA COUNTY, TEXAS

OIL & GAS DOCKET NO. 09-0301018

THE APPLICATION OF TXON PARTNERS, LLC PURSUANT TO STATEWIDE RULE 46 TO INJECT FLUID INTO A RESERVOIR PRODUCTIVE OF OIL OR GAS FOR THE MANGOLD KMA WATERFLOOD UNIT, WELL NO. 1017, K-M-A FIELD, WICHITA COUNTY, TEXAS

HEARD BY: Paul Dubois – Technical Examiner
Jennifer Cook – Administrative Law Judge

APPEARANCES:

APPLICANT:
Norman Giese
Michael Labbe
Gilles Labbe
Wade Tidmore

REPRESENTING:
TXON Partners, LLC

PROTESTANT:
Clayton M. Henry
Robert H. Henry

REPRESENTING:
Robert H. Henry, et al

PROCEDURAL HISTORY

	Docket No. 09-0300841	Docket No. 09-0301018
	Well No. 202	Well No. 1017
Application Published:	May 12, 2016	January 14, 2016
Application Filed:	May 20, 2016	January 25, 2016
Protest Received:	May 31, 2016	February 1, 2016
Revised Application Filed:	n/a	June 7, 2016
Request for Hearing:	June 6, 2016	July 6, 2016
Notice of Hearing:	June 17, 2016	July 7, 2016
Hearing Held:		July 25, 2016
Transcript Received:		August 15, 2016
Record Closed:		January 23, 2017
Proposal for Decision Issued:		January 26, 2017

STATEMENT OF THE CASE

Pursuant to Statewide Rule 46, TXON Partners, LLC (“TXON”), seeks authority to inject fluid into a reservoir productive of oil or gas for the Mangold KMA Waterflood Unit, Well Nos. 202 and 1017, K-M-A Field, Wichita County, Texas.¹ TXON, the current operator of the Mangold KMA Waterflood Unit (Lease No. 09007) (“Unit”), plans to convert two existing wellbores to injection service for continued waterflood development. The KMA Field is a mature field that was initially developed in the late 1930s. After two years of heavy production a cooperative gas injection pressure maintenance project was employed, and by the 1950s secondary recovery by water injection was initiated. The plugging records for some wells in the field on and near the Unit are incomplete or the plugging status is unknown. TXON’s pressure measurements and calculations, however, indicate that the waterflood activities will not cause injected fluids to be lifted to the shallow freshwater strata. A consolidated hearing was held for the two docketed applications on TXON’s request.

The applications are protested by the surface owners of the disposal tracts: Robert H. Henry, Clayton M. Henry, Helen Henry Wright, Margaret Drew Henry, individually and as Trustee of the Margaret Drew Henry Trust (“the Henrys”). The Henrys participated in the hearing by offering direct evidence and cross-examination. Generally, the Henrys were dissatisfied with TXON’s management of a number of issues on the lease, including the remediation of hydrocarbon and saltwater spills. Specifically with regard to saltwater injection activities, the Henrys were concerned about the potential for harm to the underlying Seymour Aquifer upon which their ranch depends. The Henrys testified to several instances of suspected surface salt water breakouts on their property. The Commission’s District 09 staff have inspected the property and followed up on the complaints.

The Technical Examiner and Administrative Law Judge (“Examiners”) conclude that TXON has failed to meet its burden of proof to demonstrate that the proposed disposal activities

¹ In Commission records, the subject field is formally identified as the “K-M-A Field” (ID No. 47902 001), a name derived from the initials of three local landowners in the 1930s. The field is referenced in other sources as “K. M. A.” and “KMA”. For simplicity, the Examiners will use “KMA” throughout the body of the PFD.

will not cause the pollution of freshwater strata unproductive of oil, gas or geothermal resources, and that the proposed injection wells will prevent the waste of hydrocarbons in the KMA Field. The Examiners recommend the applications be denied at this time. There is conflicting evidence about reservoir pressure on the lease and in the reservoir. Notably, the reservoir pressure in the two wells was measured to be very low (122 psi, or less), but there is also evidence of saltwater seeping to the surface.

APPLICABLE LAW

16 Tex. Admin. Code §3.46, Fluid Injection into Productive Reservoirs, states:

(a) Permit required... Permits may be issued when the injection will not endanger oil, gas, or geothermal resources or cause the pollution of freshwater strata unproductive of oil, gas, or geothermal resources.

It is TXON's burden to demonstrate that the proposed injection wells will not endanger oil, gas, or geothermal resources or cause the pollution of freshwater strata unproductive of oil, gas, or geothermal resources.

MATTERS OFFICIALLY NOTICED

At the hearing on July 25, 2016, the Examiners took official notice of the contents of the docketed case file for this matter. Specifically, the Examiners referenced communications between Commission Staff and the parties regarding pressure front calculations. Neither party objected to official notice being taken of the contents of the docketed case file.²

By letter dated November 29, 2016, the Examiners notified the parties of their intention to take official notice, pursuant to TEX. GOV'T CODE § 2001.090, of the following:

1. TXON's Exhibit Nos. 1 and 2 each included five pages from a 1952 Bureau of Mines study on the K. M. A. oil field. The Examiners notified the parties of their intent to take official notice of the entire publication:

Dobyns, R. P., et al, "Petroleum-Engineering Study of K. M. A. Reservoir, Southwestern Part K. M. A. Oil Field, Wichita and Archer Counties, Tex." *Report of Investigations*, No. 4892, U.S. Department of the Interior, Bureau of Mines, June 1952, 188 pages.
<http://digital.library.unt.edu/ark:/67531/metadc38582/>, accessed on November 22, 2016.

2. Railroad Commission mainframe records accessed on November 22, 2016, that identify all of the injection and producing wells, both currently active and historical, on the Mangold KMA Waterflood Unit:

Underground Injection Control (UIC) Inquiry Menu records for Project No. F-02438 (7 records).

² Tr. 60: 11 - 22.

UIC Permit Records for Project No. F-02438 (7 records).
UIC Inquiry Menu records for District 09 Lease No. 09007 (26 records).
Well Bore Oil Lease Inquiry for District 09 Lease No. 09007 (67 records).

3. Railroad Commission Online System records accessed on November 28, 2016, that identify all of the injection and producing wells, both currently active and historical, on the Mangold KMA Waterflood Unit:

Wellbore Query Results for District 09 Lease No. 09007 (67 records).
Injection/Disposal Permit Query Results for District 09 Lease No. 09007 (25 records).

4. Railroad Commission District 09 Inspection Reports of the Mangold KMA Waterflood Unit (Lease No. 09-09007) dated July 15, July 27, August 8, August 17, October 26, October 27, and November 2, 2016.

By letter dated November 29, 2016, the Examiners notified the parties of their intent to take official notice of these materials, and provided hard copies of the materials to the parties. The parties were given 15 days to object or respond to the Examiners' intent to take official notice, but neither party did.

The Henrys filed a timely reply on December 9, 2016, through which they requested the Examiners also take official notice of certain other inspection-related materials, including photographs and analytical results of samples collected during various inspections.

On January 3, 2017, the Examiners received an email from District 09 staff containing a photograph and an August 4, 2016 inspection report of the Henry property. By letter dated January 11, 2017, the Examiners notified the parties of their intent to take official notice of these materials (the email and two attachments), and provided hard copies of these materials to the parties. The parties were given 10 days to object or respond to the Examiners' intent to take official notice. On January 23, 2017, the Examiners notified the parties that the noticed materials were admitted into the record, and the record was subsequently closed. The Examiners did not take official notice of materials dated prior to July 8, 2016, or to matters that were not demonstrated to be associated with injection well permitting concerns (i.e., we did not take official notice of matters related to general lease operating practices and conditions, as those matters were not included in the call of the hearing.)

DISCUSSION OF THE EVIDENCE

Attachment A to this PFD is a map prepared by the Examiners identifying the locations of various features described in the evidence.

APPLICANT'S EVIDENCE

Project Description

The Unit (Lease No. 09007) consists of approximately 676 acres of land on the south side of the Wichita River and on the west side of State Highway 25 in Wichita County, Texas. Farm-

to-Market Road ("FM") 1180 crosses the southern part of the Unit³ (see Attachment A). TXON has operated the Unit since November 2015, and the Henrys are the surface owners of the injection tracts and most of the land that comprises the Unit. TXON holds an active Form P-5 (Operator No. 875374).

TXON seeks to redevelop the existing historical waterflood on the Unit. TXON determined that the original peripheral waterflood resulted in an accumulation of oil saturation in the center of the lease, which is the target for the redeveloped waterflood. This application is for two wells (Nos. 202 and 1017). TXON has recently published notice for three more injection well permits to convert existing wellbores (Nos. 6, 15E and 404) to injection. The project also includes one new well to be drilled and two existing permitted injection wells (see Attachment A). Four producing wells will also be a part of the project. TXON estimates that this project will result in an incremental recovery of about 180,000 barrels of oil and about \$370,000 in severance tax revenue for the State of Texas.⁴

There are at least two other waterflood operations underway in the KMA Field on adjoining units, including one to the north operated by Texas Energy and one to the west operated by Stephens & Johnson.⁵ TXON also operates other wells in the area, including on the Anna Mangold Lease, which is immediately south of the KMA Mangold Waterflood Unit.⁶

Groundwater and Geology

The base of usable quality drinking water (BUQW) and the base of underground sources of drinking water (USDW) are estimated to occur at a depth of 60 feet. The Commission's Groundwater Advisory Unit (GAU) requires the groundwater to be protected to a depth of 60 feet for all wells drilled on this lease. Norman Giese, TXON's Vice President of engineering, stated his knowledge of shallow groundwater in the area at about 30 to 40 feet below ground surface.⁷

Well log-based geologic cross sections indicate that the proposed KMA Formation injection interval is overlain by at least 400 feet of shale based on seven gamma ray logs of nearby wells.⁸ Mr. Tidmore stated that he had permitted numerous wells in Wichita County and he was not aware of any groundwater contamination in Wichita County that was caused by failed surface casing.⁹

The initial KMA Field waterflood operations in the 1940s included the injection of freshwater. Later, saltwater was injected. The mixture of diverse fluids in the formation may

³ TXON Exh. Nos. 1 and 2.

⁴ Tr. 23: 2 through 25: 4.

⁵ Tr. 36: 4 – 22.

⁶ Tr. 94: 7 – 16. Note: Commission records indicate that TXON's Mangold, Anna Lease ID No. is 33132.

⁷ Tr. 38: 6 – 10.

⁸ TXON Exh. Nos. 2, 7 and 8; Tr. 27: 6-9.

⁹ Tr. 41: 16 – 20.

have caused corrosive agents, including hydrogen sulfide and carbon dioxide, to form in the reservoir.¹⁰

Well No. 202

TXON's Exhibit No. 1 is a copy of the injection well application for Well No. 202, including Forms H-1, H-1A, and supporting attachments. Well No. 202 is located in the northwest corner of the Unit, 330 feet from the west unit line and about 1,200 feet south of the north unit line (the Wichita River). Well No. 202 was completed on May 6, 2010, in the KMA Field at a depth of 3,940 feet. The base of usable quality water ("BUQW") and the base of underground sources of drinking water ("USDW") were estimated by the Commission's Groundwater Advisory Unit ("GAU") to occur at a depth of 60 feet. Surface casing was set to a depth of 84 feet and cemented to the surface. The top of the KMA Formation was encountered at a depth of 3,658 feet. Production casing was set to a depth of 3,926 feet, and the well was plugged back to 3,913 feet. The production casing annulus was cemented to a depth of 2,600 feet, as determined by a cement bond log. The well was perforated and fracture stimulated from 3,712 feet to 3,772 feet.¹¹ The well is carried on the current proration schedule as a producing oil well.¹²

For injection service, TXON proposes to set tubing to a depth of 3,675 feet, and the injection interval will be 3,700 feet to 3,850 feet. TXON requests authority to inject up to 3,000 barrels per day ("bpd") of saltwater, and the average daily injected volume is estimated to be about 2,500 bpd. The maximum injection pressure will be limited to 1,850 pounds per square inch ("psi").

TXON identified 21 well locations within a one-quarter mile area of review around Well No. 202. TXON did not provide available plugging records for any of these wells, but it did provide a tabulation of well information including the spud dates, total depths, and current well status. That tabulation indicated the following:

- Five (5) of the 21 wells are indicated with an "unknown" or "historic" status and no plugging details were reported.
- Three (3) are indicated as plugged and unknown.
- Five (5) are known to have been plugged, and the plugging dates are known.
- Two (2) are producing.
- One (1) is shut-in.
- One (1) was a dry hole.

¹⁰ Tr. 196: 15 through 197: 18.

¹¹ TXON Exh. No. 1.

¹² TXON Exh. No.2.

- Four (4) are permitted locations that have not been drilled.

Thus, there are eight (8) wellbores within one-quarter mile of Well No. 202 for which plugging evidence is insufficient to demonstrate that the BUQW is isolated from the injection interval (see Attachment A). Therefore, TXON conducted a pressure front calculation to assess whether salt water injection at Well No. 202 would cause sufficient pressure to raise formation fluids from the injection zone to the BUQW in the nearest offset well with an unknown plugging status (Well No. 9A [API No. 42-485-05797], located 631 feet to the north-northeast. TXON's calculations were based on the following parameters:

- The current reservoir pressure is 61 psi at a depth of 3,712 feet based on recent a fluid level survey of this well.
- Reservoir porosity is 16 percent, permeability is 41 millidarcies, and the average reservoir thickness is 63 feet.

TXON calculates that injecting 3,000 bpd for 20 years will increase the reservoir pressure in the offset well by 687 psi (to a total reservoir pressure of 748 psi), which is not sufficient to raise injected fluids to the BUQW in the offset Well No. 9A. Assuming a detrimental case analysis of 10 percent reduction in permeability and 5 percent decrease in porosity, the 20-year reservoir pressure would be 919 psi (a reservoir pressure of about 1,699 psi is necessary to raise formation fluids to the BUQW). Therefore, TXON concludes that injection activities at Well No. 202 will not harm freshwater resources.

Well No. 1017

TXON's Exhibit No. 2 is a copy of the injection well application for Well No. 1017, including Forms H-1, H-1A, and supporting attachments. Well No. 1017 is located in the northeast corner of the Unit, 1,395 feet from the east unit line and about 500 feet south of the north unit line (the Wichita River). Well No. 1017 was completed on May 22, 2009, in the KMA Field at a depth of 4,059 feet. The BUQW and based of USDW were estimated by the GAU to occur at a depth of 60 feet. Surface casing was set to a depth of 84 feet and cemented to the surface. The top of the KMA Formation was encountered at a depth of 3,694 feet. Production casing was set to a depth of 4,058 feet, and the well was plugged back to 4,040 feet. The production casing annulus was cemented to a depth of 2,290 feet, as determined by a cement bond log. The well was perforated and fracture stimulated from 3,710 feet to 3,995 feet. The well is carried on the current proration schedule as a producing oil well.¹³

For injection service, TXON proposes to set tubing to a depth of 3,685 feet, and the injection interval will be 3,710 feet to 3,995 feet. TXON originally requested authority to inject up to 3,000 barrels per day ("bpd") of saltwater, but that request was revised downward to 1,300 bpd based on pressure front calculations (discussed below). The maximum injection pressure will be limited to 1,855 pounds per square inch ("psi").

TXON identified 10 well locations within a one-quarter mile area of review around Well No. 1017. TXON did not provide available plugging records for any of these wells, but it did

¹³ TXON Exh. No.2.

provide a tabulation of well information including the spud dates, total depths, and current well status. That tabulation indicated the following:

- One (1) of the 10 wells is indicated with an “unknown” status and no plugging details were reported.
- One (1) was a dry hole, but the date, drilling and plugging details are unknown.
- Two (2) were known to have been plugged, and the plugging dates are known.
- Two (2) are producing wells.
- Four (4) are permitted locations that have not been drilled.

Thus, there are two (2) wellbores within one-quarter mile of Well No. 1017 for which plugging evidence is insufficient to demonstrate that the BUQW is isolated from the injection interval (see Attachment A). Therefore, TXON’s original application included a pressure front calculation to assess whether salt water injection at Well No. 1017 would cause sufficient pressure to raise formation fluids from the injection zone to the BUQW in the nearest offset well with an unknown plugging status (the dry hole, identified as “1E” but no API number), located 690 feet to the north-northwest. TXON’s calculations were based on the following parameters:

- The current reservoir pressure is 122 psi at a depth of 3,710 feet based on recent a fluid level survey of this well.
- Reservoir porosity is 16 percent, permeability is 41 millidarcies, and the average reservoir thickness is 87 feet.
- Saltwater is injected at a rate of 3,000 bpd for 20 years from Well No. 1017.
- TXON also included the 2,750 permitted injection volume for its nearby Well No. 1019, in the pressure front calculation.

TXON calculated that injecting 5,750 bpd for 20 years will increase the reservoir pressure in the offset well by 933 psi (to a total reservoir pressure of 1,055 psi), which is not sufficient to raise injected fluids to the BUQW in the offset dry hole 1E (a reservoir pressure of about 1,697 psi is necessary to raise formation fluids to the BUQW). Assuming a detrimental case analysis of 10 percent reduction in permeability and 5 percent-point decrease in porosity, the 20-year reservoir pressure would be 1,206 psi.

However, TXON testified that Commission staff found the initial pressure front calculation to be deficient because the suspect offset dry hole 1E was also susceptible to pressure influences from another operator’s injection well—the Texas Energy Operations, LC Bradley Lease Well No. 21T (API No. 42-485-45080) located about 1,000 feet to the northwest of dry hole 1E. TXON revised the pressure front calculations to include the potential influence from the Bradley 21T well. Wade Tidmore, P.E., stated that TXON reduced the requested volume in Well No. 1017 from 3,000 bpd to 1,300 bpd based on the revised pressure front calculations to

prevent a critical reservoir pressure situation at the location of the suspect dry hole No. 1E.¹⁴ The revised pressure front calculation was not offered into evidence by TXON, but it is in the record as the Examiners have taken official notice of the docketed case file. The revised pressure front calculation was based on a 5,000 bpd injection volume from the Bradley Well No. 21T, and a 2,000 bpd injection volume from TXON's nearby Well No. 1019. TXON calculated that injecting 8,300 bpd (total combined for the three wells) for 20 years will increase the reservoir pressure in the offset well by 1,346 (to a total reservoir pressure of 1,468 psi), which is not sufficient to raise injected fluids to the BUQW in the offset dry hole 1E.¹⁵ Assuming a detrimental case analysis of 10 percent reduction in permeability and 5 percent-point decrease in porosity, the 20-year reservoir pressure would be 1,686 psi (a reservoir pressure of about 1,697 psi is necessary to raise formation fluids to the BUQW). In this calculation, all of the injected fluid (8,300 bpd) was injected at the location of Well No. 1017, the closest injection well to dry hole 1E.

PROTESTANTS' EVIDENCE

The Henrys are protesting the two applications because they are concerned that fresh groundwater and surface water may become contaminated by the injection activities, and they are concerned that TXON is not being a responsible operator. The Henrys provided photographic evidence of spills and several possible surface breakouts of salt water. Clayton Henry stated that, for this reason, they believe a comprehensive assessment should be conducted before the injection permits are granted.

Groundwater Protection

Robert Henry testified ground and surface water on the property is used for agricultural purposes—raising cattle and growing wheat.¹⁶ The Wichita River forms the northern border of the Unit, and intermittent Camp Creek runs north across the Unit and into the Wichita River. He also testified that most of the Unit overlies the Seymour Aquifer, including the locations of Well Nos. 202 and 1017.¹⁷

Mr. Henry stated that he did not think the GAU's 60-foot groundwater protection depth was sufficient. According to Mr. Henry, the GAU requires 100 feet of surface casing on parts of his ranch where there is no shallow groundwater, but only 60 feet of surface casing in areas where there is shallow groundwater in the Seymour Aquifer. Further, Mr. Henry cited Well No. 607, which was completed on the Unit on June 15, 1938, with 122 feet of surface casing, as an acknowledgement that long ago the Commission and operators recognized the need for deeper surface casing.

Commission Staff indicated that the 60-foot groundwater protection depth was originally based on information from the W.T. Waggoner Ranch, also in North Texas, but that statement was derived from land in a different survey; at its closest, the Waggoner Ranch is about 5 miles

¹⁴ Tr. Pg. 53-54.

¹⁵ Pressure front calculation dated June 7, 2016, signed and sealed by Wade Tidmore, P.E.

¹⁶ Tr. 99:18 through 100:3.

¹⁷ Henrys Exh. No. 1.

away. The Henrys engaged in correspondence with Commission staff regarding this matter, but Commission staff sustained its position that 60 feet of surface casing was adequate in this area.¹⁸ The Henrys argue that injection wells on the Unit that have less than 100 feet of surface casing should be subject to mechanical integrity testing every year.¹⁹

In addition, the Henrys note that Well No. 202 is at an elevation of 1,026 feet, and well No. 1017 is lower, along the Wichita River flood plain at an elevation of about 1,000 feet—a 26-foot elevation differential, which is nearly half of the 60-foot groundwater protection depth. The Henrys believe that the 26-foot difference is significant and leaves little room for local variance or error.²⁰

Suspected Saltwater Breakouts

The Henrys identified three locations (see Attachment A) at which they believe saltwater is escaping to the ground surface, which, they assert, never happened prior to TXON becoming the lease operator:²¹

- **Area No. 1** is an area of dead vegetation, salt crystals and water ponding in a wheat field on the southeast part of the Unit, south of FM 1180. Mr. Henry stated water was observed bubbling out of the ground. A sample of the liquid collected on July 8, 2016, was analyzed by the Red River Authority of Texas Environmental Laboratory and shown to have 69,000 milligrams per liter (“mg/L”, which is equivalent to parts per million [“ppm”]) of total dissolved solids (TDS).²²
- **Area No. 2** is an area where Mr. Henry observed water flowing out of a hill in the vicinity of Well No. 307, on the east-central part of the Unit. A sample of the liquid collected on July 8, 2016, was analyzed by the Red River Authority of Texas Environmental Laboratory and shown to have 28,400 mg/L TDS.²³ A photograph of the area indicates some dead vegetation, but also algal growth in and along the wet ground. A sample collected by a District 09 field inspector on July 6, 2016 was determined to not be oil-field related based on an analysis of chlorides by titration.²⁴
- **Area No. 3** is located north of Well No. 202. Originally observed as a small area of pooled water, the location had dried and was not flowing, so no sample could be collected.²⁵

¹⁸ See various correspondence in the docketed case file.

¹⁹ Tr. 124: 1 through 125: 4.

²⁰ Tr 118: 8 through 119: 15.

²¹ The “Area No.” descriptors were created by the Examiners to facilitate identification and communication of these concerns.

²² Henrys Exh. Nos. 10, 11. Tr. 128: 21 through 129: 8.

²³ Henrys Exh. Nos. 10, 12a & 12b.

²⁴ Henrys Exh. No. 15.

²⁵ Henry Exh. No. 13.

The Henrys also described several other instances of soil contamination adjacent to several wells, and a saltwater spill caused by a broken flow line. The Henrys have notified the Commission's District 09 office, who has inspected the Unit on several occasions in the past year.

Well Records

The Henrys provided Commission records regarding the well completion and plugging details of several wells on the Unit, including the following:

- A letter dated March 17, 1983, from District 09 to the Oil & Gas Division recommending that three wells (Nos. 106, 107 and 109) be removed from the proration schedule, as the wells were plugged according to a statement from the operator. Forms W-3, Plugging Record, were submitted for each well, but these records contained no cementing evidence.²⁶ This letter was evidence of the lack of plugging data for one other well (No. 107) on the Unit that was not within a one-quarter mile area-of-review of the two application wells.
- Form W-3 Plugging Reports for Well Nos. 102W, 2-1, 9, 6012, 602 and 616, which were drilled after 1937 and plugged after 2008. All of these wells include at least one cement plug between the proposed injection interval and the BUQW. In several of the wells, however, the original plugging plan had to be altered due to technical problems encountered during the plugging operations. One of these wells (No. 9, also identified in records as No. 9A) was within the one-half mile area-of-review of the application well No. 202; the other five wells were not. The Henrys argue that deviation from the original plugging plans indicate a potential concern for groundwater contamination.

In conclusion, Mr. Robert Henry stated his beliefs that (1) the cause and source of the suspected breakout areas need to be determined; (2) a review of the reservoir and its pressure needs to be undertaken; and (3) the review should include assessment of the plugged wells and possibly unplugged wells in the area.²⁷

MATERIALS OFFICIALLY NOTICED

The Examiners took official notice of certain materials to provide a more complete picture of oil and gas activities that have occurred and continue to occur in the KMA Field and on the Unit.

KMA Field and Unit Background

The Unit produces from the K.M.A. Formation, which is a member of the Pennsylvanian-aged Strawn Group. The producing interval has been designated as the KMA Field (No. 47902 001). The field was discovered in 1931 at a depth of 3,719 feet. Development of the field was very slow until 1937. Rapid development over the following 2 years resulted in 700 wells drilled across a 12,500 acre area. The KMA Field is a complex anticline structure with strata "...that

²⁶ Henrys Exh. No. 16.

²⁷ Tr. 166: 11 – 16.

grades from oolite lime through sandstone and sandy limes into sandstone and shales, far from the ideal picture of a reservoir adaptable to secondary recovery."²⁸ Two distinct members of the KMA Formation, Zone 1 and Zone 2, are productive of oil. These zones exhibit average porosity of about 16 percent and permeability ranging from about 40 to 200 md. The initial reservoir pressure was about 1,750 psi. The reservoir was originally produced by a solution-gas mechanism, with no evidence of a water drive.²⁹

However, the two years of rapid development from 1937 to 1939 significantly depleted the reservoir pressure. In late 1939 the K.M.A. Pressure Maintenance Association was organized to coordinate injecting dry gas back into the reservoir for pressure maintenance support. The field was subsequently developed cooperatively by multiple operators.³⁰

In 1949, the North Texas Oil and Gas Association requested the U.S Bureau of Mines study the KMA Field to evaluate the effectiveness of the pressure maintenance program and to investigate the potential for waterflooding the field. The study was published in 1952. The gas injection pressure maintenance project did not maintain the reservoir pressure in the field, but it did contribute to a 12.2 percent incremental increase in oil production (about 5 million barrels of incremental recovery and 46 million barrels of total recovery through 1949). The U.S. Bureau of Mines estimated at the time that waterflooding the field may produce an additional 46 million barrels of oil.³¹

Well Records

The Commission's on-line system indicates 2,167 wells are identified within the KMA Field, and the Commission's mainframe system indicates 67 wells have been drilled on the 676-acre Unit (Lease No. 09007). Out of these 67 wells, 24 are active wells carried on the Commission's proration schedule.

The Commission's records also indicate at least 25 injection wells have existed on the Unit (Lease No. 09007) over time. Seven injection wells are associated in Commission records with with secondary recovery project no. F-02438, five of which were active as of December 20, 2016 as indicated below:³²

Well No.	UIC No.	Injection Authorization Date	Permitted Daily Injection Volume	Permitted Maximum Injection Pressure
1010W	000032912	11/14/1956	900 bpd	1,300 psi
607	000097485	05/07/2007	3,000 bpd	1,850 psi
608	000099068	06/25/2008	3,000 bpd	1,815 psi
1015	000100050	02/10/2009	2,750 bpd	1,845 psi
1019	000105765	10/02/2012	2,750 bpd	1,880 psi

²⁸ Dobyns, R. P., et al, 1952.

²⁹ *Id.*

³⁰ *Id.*

³¹ *Id.*

³² Commission records indicated that on November 22, 2016, an active permit existed for Well No. 405. That permit was cancelled on December 9, 2016, by a written request from TXON.

District 09 Inspection Records

On July 15, 2016, Robert Henry showed District 09 Staff a suspected surface seep location (Area No. 2, GPS coordinates 33.85565° N, 98.84132° W) near Well Nos. 3-10 and 307 (see Attachment A). District 09 Staff observed algae and moss growth in the water and green vegetation in the area. A water sample was collected and returned to the District 09 office for analysis. The liquid sample was analyzed for chlorides by titration, and a value of 6,000 ppm was measured. District 09 Staff reports this value to be a little higher than normal for this area, although Wichita County is known to have high-chloride shallow water. The chloride content of produced saltwater in the area is 50,000 to 100,000 ppm.³³

On August 4, 2016, District 09 staff observed fluid bubbling to the surface on the Henry property at GPS coordinates 33.84831° N, 98.83994° W. The seep photograph taken by District 09 Staff indicates this is the same location as Area No. 1 (Henry Exh. No. 11, see also Attachment A). The inspection report (No. 128087) indicates non-compliance with Statewide Rule 13(1)(6)(A), surface control of well, with a description of “HRWT for SFP” (“High-Risk Well Test for State-Funded Plugging”). District 09 Staff indicate a contract has been awarded to re-enter and plug the well, which is expected to occur in January or February of 2017. This surface location is about 150 feet south of a well location identified as “No. 1” (no API No.) on the Commission’s GIS system, but no other information is available. The surface location is also about 250 feet north-northeast of the plugged Anna Mangold Lease Well No. 11 (API No. 42-485-87034). This location, Area No. 1, appears to be south of the Unit on TXON’s Anna Mangold Lease.³⁴ Area No. 1 is about 5,900 feet southeast of Well No. 202 and 7,000 feet south of Well No. 1017.

Inspection Report No. 129873, dated August 8, 2016, contains a hand-written annotation, “Possible breakout. Checked all injection wells within ¾ mile (and) didn’t find any violations.” The report does not identify the location of the possible breakout, but does note that Well Nos. 608 (an injection well) and 15E (a pumping well) were inspected and no violations were observed. Well Nos. 608 and 15E are within a three-quarter mile radius of Area No. 1, the suspected breakout.

Other inspection reports in the record did not indicate matters relevant to these injection well permit applications.

EXAMINERS’ ANALYSIS

The Examiners recommend TXON’s applications be denied as presented because TXON failed to demonstrate the proposed injection activities will not cause the pollution of freshwater strata not productive of oil, gas, or geothermal resources. The Examiners desire to be clear, however: We do not conclude that secondary recovery and waterflooding activities cannot be safely implemented on the Unit; we do conclude that the existing evidence suggests a degree of risk that warrants closer scrutiny and a more comprehensive evaluation of existing and potential future reservoir conditions associated with water injection on the Unit to ensure that freshwater

³³ Email from Logan Baker, RRC District 09, to Shiela Weigand, RRC Hearings Division Investigator, dated December 20, 2016, with attachments.

³⁴ District 09 Inspection Report No. 128087, dated August 4, 2016; and TXON Exh. Nos. 1 & 2.

resources will not be harmed via numerous historical wellbores for which plugging information is insufficient or not documented. Further, the evidence indicates the permitting of additional injection wells is underway by TXON, and these same issues should be addressed in those cases as well.

Undocumented Wellbores

The Commission requires an applicant for an injection well to identify potential conduits for the migration of injected fluids into freshwater strata within an “area of review” around the proposed injection well. Statewide Rule 46(e) states:

The applicant shall review the data of public record for wells that penetrate the proposed disposal zone within a 1/4 mile radius of the proposed disposal well to determine if all abandoned wells have been plugged in a manner that will prevent the movement of fluids from the disposal zone into freshwater strata. The applicant shall identify in the application any wells which appear from such review of public records to be unplugged or improperly plugged and any other unplugged or improperly plugged wells of which the applicant has actual knowledge.

There are multiple wellbores in the area for which plugging and abandonment details are unknown, and any of these may act as conduits for injected fluid migration into the shallow Seymour Aquifer. The wells on the following tables (and are also shown on Attachment A) are those identified by TXON that did not have adequate plugging documentation:³⁵

**One-Quarter Mile Area of Review
 Undocumented Wellbores**

Well No. 202

TXON Exh. No. 1 Map ID	Well No.	API No.	Spud Date	Total Depth (ft)	Approximate Distance to Well No. 202 (ft)
2	150W	Unknown	Unknown	Unknown	1,150
3	109	42-485-87512	April 1938	3,830	850
4	157W	Unknown	Unknown	Unknown	1,120
6	9A	42-485-05797	Unknown	4,315	630
7	107	42-485-87511	April 1938	3,835	940
10	187	Unknown	Unknown	Unknown	710
19	347W	42-485-88048	Unknown	Unknown	1,280
20	206W	Unknown	Unknown	Unknown	1,180

³⁵ TXON Exh. Nos. 1 and 2.

Well No. 1017

TXON Exh. No. 2 Map ID	Well No.	API No.	Spud Date	Total Depth (ft)	Approximate Distance to Well No. 1017 (ft)
3	1E	Unknown	Unknown	Unknown	670
9	1A	Unknown	Unknown	Unknown	1,301

In addition, the Henrys and District 09 Staff identified a potential breakout from a historical well (Area No. 1). According to District 09 Staff, a contract to plug the historical well at this location has been issued for the State Funded Plugging Program. The potential breakout at this location (Area No. 1) is about 5,900 feet southeast of Well No. 202 and 7,000 feet south of Well No. 1017.

Reservoir Pressure Measurements, Calculations and Observations

When potential conduits for migration are identified, an applicant typically must demonstrate that injected fluids will not migrate and harm freshwater resources. In doing so, the applicant may undertake one of several approaches, such as re-entering and adequately plugging the problematic wellbore(s), or performing engineering analysis to establish that the physical conditions for migration will not occur as a result of the requested injection authority. In the present cases, TXON conducted pressure front calculations in an attempt to demonstrate that injection activities will not harm freshwater strata. The Examiners are not persuaded by TXON's argument, specifically because of two streams of contrary and irreconcilable evidence: (1) TXON measured the reservoir pressure in the proposed injection wells to be very low—from 61 to 122 psi; but (2) bubbling surface liquid with 69,000 ppm TDS was documented at a nearby location (Area No. 1), which indicates reservoir pressure of about 1,700 psi or more, the pressure necessary to lift reservoir fluid from the KMA Field to the ground surface. The Examiners find that reconciliation of these conflicting pieces of evidences is needed.

The Commission is charged by Statute and Rule to protect groundwater resources. In doing so, the Commission requires applicants to identify wellbores within a one-quarter mile area of review for which plugging information does not affirmatively demonstrate that the freshwater resources are adequately protected. The central question thus becomes: Will sufficient reservoir pressure be created at the location of a potential conduit for migration (i.e., a wellbore lacking credible plugging documentation or not adequately plugged) sufficient to lift injected fluids into freshwater strata? The point of concern, or regulatory interest, with regard to the protection of freshwater, is not the injection well location, but the location of the "problematic" wellbore. Once a potential conduit is identified, the Commission's concern is to prevent groundwater contamination, and to do so requires an assessment of all fluid and pressure sources that may affect the problematic wellbore, including injection sources and withdrawal points (producing wells). TXON's analysis did not include potential pressure impacts from (1) the four or five other injection wells that are currently active on the Unit; (2) the four additional injection wells that TXON is seeking to permit through other applications; or (3) potential impacts from other injection wells on adjoining units or leases.

In fact, other evidence in the record suggests that injection wells may influence reservoir pressure and flow further than one one-quarter mile from the injection location. TXON's Exhibit No. 5 includes a graphic entitled "Mangold Waterflood Plan," identifying some of the injection and producing wells on the Unit. Notably, this graphic indicates that injection at Well No. 1017 will have an impact on the reservoir pressure and flow regime at the producing wells, which are about 4,000 feet to the southwest, and also indicates reservoir pressure communication between distant wells. Based on this information, a one-quarter mile area of review may not be sufficient to assess risks to freshwater resources. In addition, that graphic does not appear to identify all of the existing injection wells on the Unit—notably, Well No. 1019 is omitted. From this diagram, which does not appear to be a final engineering design diagram, it would appear that injection into the KMA Field may exhibit an area of influence far greater than one-quarter mile. The evidence in the record does not lead the Examiners to find, based on a preponderance of the evidence, that freshwater strata will not be harmed.

The Henrys documented, and District 09 Staff corroborated, a potential saltwater breakout at what the Examiners have identified as Area No. 1. A fluid sample collected by the Henrys exhibited a TDS level of 69,000 ppm, which is representative of produced saltwater. The District 09 Staff Inspection Report identified a potential historical wellbore on the Commission's GIS system about 150 feet from the suspected breakout location. In addition, District 09 Staff identified one injection well (No. 608) about 3,000 feet northwest of the suspected breakout location. This information at this point in time suggests that injection activity could impact reservoir pressure more than one-quarter mile from the injection location.

The Examiners conclude that significant variability and uncertainty exists in the existing reservoir pressures throughout the reservoir as evidenced by low pressure measurements and potential surface breakouts, and the evidence is currently not sufficient to conclude that freshwater resources will be protected. Further, in such a mature field, the reservoir pressure front calculations should include all sources—not just the sources being permitted, but those that have already been permitted, and those that are currently in the planning or permitting process. In addition, fluid withdrawal and the impact on pressure should also be considered.

Injection Well Construction and Groundwater Protection

Well Nos. 202 and 1017 are completed with 84 feet of surface casing that is cemented to the surface. The Commission's GAU established the BUQW at a depth of 60 feet. This recommendation was initially made based on evidence submitted for the W.T. Waggoner Ranch, the nearest part of which is about 5 miles from the Unit. This determination was subsequently validated by Commission staff from well log analysis, and the Henrys introduced other information that also warrants consideration. Most of the Unit overlies the Seymour Aquifer, which consists of Quaternary-age alluvial sediments unconformably overlying Permian-age rocks. Historical wells in the area were completed with surface casing set at depths from 84 to 120 feet. The Wichita River forms the northern boundary of the Unit, and surface elevations along the river are up to 26 feet lower than the upland areas. Commission staff routinely requires annual casing-tubing annulus pressure testing for wells that have "short" surface casing (i.e., surface casing that does not completely transect the freshwater interval). Given these conditions and practices, the Examiners recommend that, if the Commission were to grant the injection permits, that a special permit condition be adopted requiring annual mechanical integrity testing for injection wells on the Unit with less than 100 feet of surface casing. TXON agreed that it

would voluntarily undertake such testing.³⁶ The Examiners conclude a permit condition requiring annual testing is warranted given what is known and uncertain about the shallow hydrogeology underlying the Unit.

Well Nos. 202 and 1017 are completed with production casing that is cemented more than 1,000 feet above the injection interval based on cement bond logs. The injection interval is directly overlain by at least 400 feet of shale based on well log analysis. Well Nos. 202 and 1017 are completed with adequate confinement to prevent the migration of injected fluids at these well locations.

FINDINGS OF FACT

1. Notice of the application for Well No. 202 was published in the *Iowa Park Leader*, newspaper of general circulation in Wichita County, Texas, on May 12, 2016. On May 19, 2016, TXON notified the owner of the surface tract, the Wichita County Clerk, and operators of wells within one-half mile of the proposed disposal well application.
2. Notice of the application for Well No. 1017 was published in the *Iowa Park Leader*, newspaper of general circulation in Wichita County, Texas, on January 14, 2016. On January 21, 2016, TXON notified the owner of the surface tract, the Wichita County Clerk, and operators of wells within one-half mile of the proposed disposal well application.
3. The applications are protested by the surface owners of the disposal tracts: Robert H. Henry, Clayton M. Henry, Helen Henry Wright, and Margaret Drew Henry, individually and as Trustee of the Margaret Drew Henry Trust (“the Henrys”).
4. The KMA Mangold Waterflood Unit (Lease No. 09007) consists of approximately 676 acres of land on the south side of the Wichita River and on the west side of State Highway 25 in Wichita County, Texas. TXON has operated the Unit since November 2015, and holds an active Form P-5 (Operator No. 875374).
5. The KMA Mangold Waterflood Unit overlies the Seymour Aquifer, a major aquifer in the State of Texas.
 - a. The Commission’s Groundwater Advisory Board identifies the base of usable quality water and the base of underground sources of drinking water to be at a depth of 60 feet.
 - b. Wells in the area have been historically completed with up to about 120 feet of surface casing.
 - c. The 60-foot BUQW/USDW was originally based on information from a survey five miles from the Unit.
6. The KMA Field (No. 47902 001) was discovered in 1931 at a depth of 3,719 feet.

³⁶ Tr. 202: 14-17.

- a. The initial reservoir pressure was about 1,750 pounds per square inch (“psi”).
 - b. The reservoir was originally produced by a solution-gas mechanism, with no evidence of a water drive.
 - c. The two years of rapid development from 1937 to 1939 significantly depleted the reservoir pressure.
 - d. In late 1939 the K.M.A. Pressure Maintenance Association was organized to coordinate injecting dry gas back into the reservoir for pressure maintenance support.
 - e. Following a 1952 study by the U.S. Bureau of Mines, extensive waterflooding was undertaken across the field.
7. The KMA Mangold Waterflood Unit has been extensively developed.
- a. 67 wells have been drilled on the 676-acre Unit and 24 wells are currently active.
 - b. 25 injection wells have existed on the Unit over time, and five injection permits were active as of December 20, 2016.
 - c. TXON’s current development plan includes at least 8 injection wells and 4 producing wells.
 - d. TXON proposes to convert Well Nos. 202 and 1017 to injection service.
 - i. As proposed, Well No. 202 will inject a maximum of 3,000 barrels of saltwater per day.
 - ii. TXON originally sought a maximum injection rate of 3,000 barrels per day for Well No. 1017, but reduced that request to 1,300 barrels of saltwater per day based on pressure front calculations.
 - e. TXON is in the process of applying for three additional injection well permits on the Unit.
8. Two surface water samples collected by the Henrys indicate elevated levels of total dissolved solids that is consistent with produced saltwater.
- a. 69,000 ppm TDS was measured in a sample collected in an area identified by the Henrys as a suspected saltwater breakout. District 09 Staff confirmed the possibility of a problem unplugged well in the area and have initiated a State Funded Plugging action on the suspect well.
 - b. A reservoir pressure of about 1,700 psi or greater is necessary to lift liquid from the KMA reservoir to the base of usable quality groundwater.

9. Within a one-quarter mile area of review around Well No. 202 there are 8 wellbores for which plugging data is not available or insufficient to determine that freshwater strata will be protected.
 - a. TXON estimates Well No. 202 will not cause sufficient pressure in an offset well to raise reservoir fluids to the BUQW through the closest undocumented wellbore (Well No. 9A), about 630 feet away.
 - b. TXON's pressure front calculation was based on a bottom hole pressure of 61 psi at Well No. 202 measured by a fluid level survey.
 - c. TXON's pressure front calculations did not include reservoir pressure influences from other existing injection wells in the area.
 - d. TXON's pressure front calculations did not include reservoir pressure influences from other proposed injection wells on the Unit.
 - e. TXON's pressure front calculations did not include reservoir pressure influences due to oil or water production from the reservoir.

10. Within a one-quarter mile area of review around Well No. 1017 there are 2 wellbores for which plugging data is not available or insufficient to determine that freshwater strata will be protected.
 - a. TXON estimates Well No. 1017 will not cause sufficient pressure in an offset well to raise reservoir fluids to the BUQW through the closest undocumented wellbore (Dry Hole No. 1E), about 690 feet away.
 - b. TXON's pressure front calculation was based on a bottom hole pressure of 122 psi at Well No. 1017, measured by a fluid level survey.
 - c. TXON's pressure front calculations did include reservoir pressure influences from two other existing injection wells less than one-quarter mile from Dry Hole No. 1E, including TXON's Well No. 1019 at 2,000 barrels per day and Texas Energy Operations' Bradley Lease Well No. 21T at 5,000 barrels per day.
 - i. Well No. 1019's permitted maximum injection rate is 2,750 barrels per day, and the reservoir pressure at Well No. 1019 is not known.
 - ii. To prevent the accumulation of reservoir pressure at Dry Hole No. 1E sufficient to lift injected fluids to the BUQW, TXON reduced its requested injection rate at Well No. 1017 to 1,300 barrels per day based, in part, on a 2,000 bpd injection rate at Well No. 1019;
 - iii. The pressure impact of pressure front modeling using Well No. 1019's current permitted injection rate of 2,750 barrels per day has not been considered.

11. There is not sufficient reservoir pressure information to reconcile (1) very low bottom hole pressure readings at Well Nos. 202 and 1017, with (2) evidence of a saltwater breakout elsewhere on or adjacent to the Unit.


CONCLUSIONS OF LAW

1. Resolution of the subject application is a matter committed to the jurisdiction of the Railroad Commission of Texas. Tex. Nat. Res. Code § 81.051.
2. All notice requirements have been satisfied. 16 Tex. Admin. Code § 3.46.
3. TXON Partners LLC has failed to demonstrate that the proposed injection activities will not harm freshwater strata. 16 Tex. Admin. Code § 3.46.
4. TXON Partners LLC has not met its burden of proof and its application does not satisfy the requirements of Chapter 27 of the Texas Water Code and the Railroad Commission's Statewide Rule 46.

EXAMINERS' RECOMMENDATION

Based on the above findings of fact and conclusions of law, the Examiners recommend the Commission enter an order denying the application of TXON Partners LLC for authority to inject produced saltwater into the Mangold KMA Waterflood Unit, Well Nos. 202 and 1017, KMA Field, Wichita County, Texas.

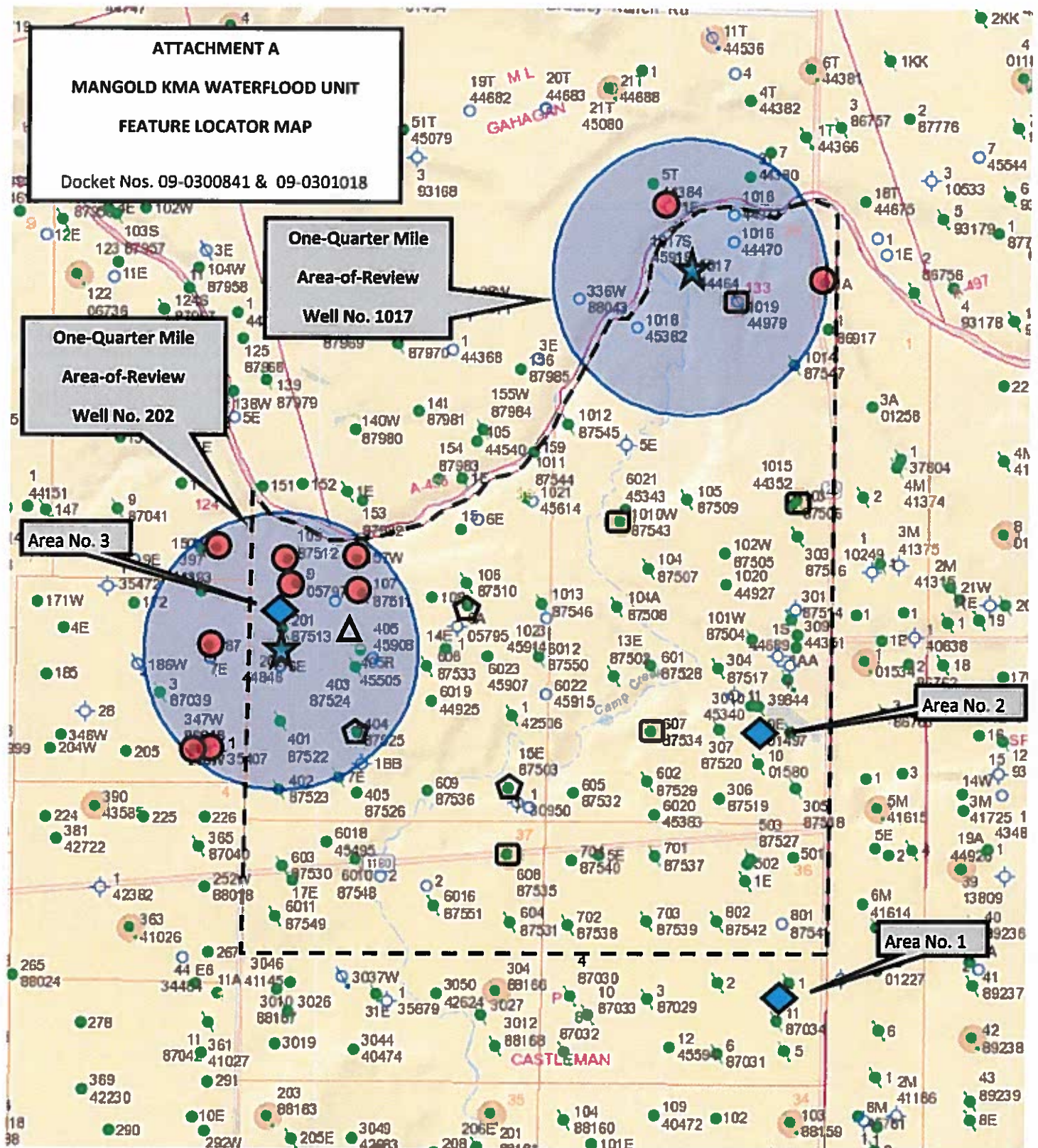
Respectfully,


Paul Dubois
Technical Examiner


Jennifer Cook
Administrative Law Judge

ATTACHMENT A
MANGOLD KMA WATERFLOOD UNIT
FEATURE LOCATOR MAP

Docket Nos. 09-0300841 & 09-0301018



LEGEND

- Mangold KMA Waterflood Unit Boundary
- Subject Injection Wells (This Application)
- Location of "Problem" Wells
- Approximate Location of Possible Saltwater Breakout Identified by Protestants.
- Location of Existing Injection Wells on the Unit
- Other Proposed Disposal Wells (Not This Application)
- Other Proposed New Disposal Well (Not This Application)