



RAILROAD COMMISSION OF TEXAS

HEARINGS DIVISION

PROPOSAL FOR DECISION

OIL AND GAS DOCKET NO. 08-0295605

THE APPLICATION OF ENERGEN RESOURCES CORPORATION PURSUANT TO STATEWIDE RULE 9 FOR A PERMIT TO DISPOSE OF OIL AND GAS WASTE BY INJECTION INTO A POROUS FORMATION NOT PRODUCTIVE OF OIL OR GAS CENTRAL FACILITY, WELL NO. 1WD, SPRABERRY (TREND AREA) FIELD, GLASSCOCK COUNTY, TEXAS.

HEARD BY: Richard Eyster, P.G. – Technical Examiner
Terry Johnson – Hearings Examiner

REVIEWED BY: Ryan Lammert – Administrative Law Judge

APPEARANCES:

REPRESENTING:

APPLICANT:

Tim George
Kerry Pollard

Energen Resources Corporation

PROTESTANTS:

John Hicks
Mike Gable
Cary McGregor

Laredo Petroleum, Inc.

PROCEDURAL HISTORY

Application Filed:	November 7, 2014
Protest Received:	November 6, 2014
Notice of Hearing:	May 7, 2015
Corrected Notice of Hearing:	May 13, 2015
Date of Hearing:	May 28, 2015
Transcript Received:	June 11, 2015
Closings Received:	July 9, 2015
Proposal For Decision Issued:	September 13, 2016

STATEMENT OF THE CASE

Energen Resources Corporation (Energen) seeks authority to dispose of oil and gas waste by injection pursuant to Statewide Rule 9 (16 Tex. Admin. Code §3.9) into a porous formation not productive of oil or gas, Central Facility, Well No. 1WD, (API No.42-173-36233), Spraberry (Trend Area) Field, Glasscock County, Texas. The well is located on a 15 acre lease, approximately 14 miles southeast of the town of Garden City in Glasscock County. The proposed injection interval is from 2,800 ft. to 4,650 ft. in the San Andres Formation. Produced salt water and RCRA-exempt waste will be injected into the well.¹ Notice of the subject application was published in the *Midland Reporter Telegram*, a newspaper of general circulation in Glasscock County. Notice of the application was sent to the Glasscock County Clerk, and offset operators within one half mile on November 07, 2014. Energen is the surface owner of the injection tract.

The application is protested by Laredo Petroleum Inc., (Laredo) an operator of one producing oil well within one-quarter mile of the proposed disposal well. Laredo is concerned that there may be a lack of confinement of the injected fluids due to Laredo's nearby wells not being cemented through the proposed injection zone.

The Technical Examiner and Administrative Law Judge (collectively, "Examiners") recommend the application be granted and the disposal permit issued. Energen has met its burden of proof under Chapter 27 of the Texas Water Code and the Commission's Statewide Rule 9.

APPLICABLE LAW

The Railroad Commission may grant an application for a disposal well permit under Texas Water Code § 27.051(b)² and may issue a permit if it finds:

1. The use or installation of the injection well is in the public interest;
2. The use or installation of the injection well will not endanger or injure any oil, gas, or other mineral formation;
3. With proper safeguards, both ground and surface fresh water can be adequately protected from pollution; and
4. The applicant has made a satisfactory showing of financial responsibility as required by Section 27.073.

¹ Resource Conservation and Recovery Act: Examples of RCRA exempt oil and gas waste includes produced water, drilling fluids, hydraulic fracturing flow back fluids, rig wash and workover wastes.

² Tex. Water Code §27.051(b)(1-4).

DISCUSSION OF THE EVIDENCE

APPLICANTS EVIDENCE

At the hearing, the Applicant offered evidence and testimony from Kerry Pollard, P. E., consulting engineer. The proposed injection well, the Central Facility Well No. 1WD, (1WD Well) will serve Energen's Central Facility. The Central Facility is where Energen brings the oil production by flowlines from their various leases, collectively called the Five Stones Area, consisting of approximately 26,000 acres. There is a LACT (Lease Automatic Custody Transfer Plant) at the Central Facility where the oil is transferred for sale. Kerry Pollard, P.E., testified that most of the water is removed (knocked out) at the tank batteries on the leases before it goes into the flowlines that take the oil to the Central Facility. The remaining water is knocked out at the Central Facility and it is this remaining knockout water that Energen is requesting to dispose of by injection into the 1WD Well. Currently, the remaining knockout water is trucked off site to another disposal well.³

Energen had originally requested to inject a maximum of 10,000 barrels per day, (bbls/d) with an average of 5,000 bbls/d into the San Andres Formation. At the hearing, to mitigate concerns of the Protestants, Energen amended it's application to decrease the maximum daily injection volume to a maximum volume of 3,000 bbls/d and an average daily volume of 2,000 bbls/d. Mr. Pollard testified that on a typical day Energen may have to dispose of a couple hundred (200) bbls/d. However, if there are problems at a tank battery they may have to dispose up to 1,000 bbls/d to a maximum of 2,000 bbls/d but does not anticipate injection to be over 2,000 bbls/d and Energen expects to inject an average of a "couple of hundred (200) bbls/d."⁴ The Examiners conclude no further notice was required as this revised maximum daily injection volume was less than the volume previously noticed. The proposed injection interval is the San Andres Formation (San Andres) between 2,800 feet and 4,650 ft. The interval is suitable for disposal and is used for disposal in other area wells.

Mr. Pollard testified that the proposed injection well has been drilled, and completed and will be operated as follows:⁵

- The well was drilled to a depth of 5,555 ft. in the San Andres Formation.

³ Tr. pg 8, lns 3-16.

⁴ Tr. pg 41 lns 5-20.

⁵ Tr. pg 21-lns 13-25, pgs 22-23. Energen Exhibit No.5 well schematic & Energen Exhibit No. 6, W-2 for the proposed 1WD Well.

- Surface casing (8 5/8-inch) was set at a depth of 493 ft. with cement circulated to the surface.
- Long-string casing (5 1/2-inch) was set to a depth of 5,555 ft. with cement circulated to the surface.
- Injection tubing (2 7/8-inch) will be set with a packer at 2,790 ft.
- The injection interval will be from 2,800 ft. to 4,650 ft.
- A bridge plug will be set at 4,750 ft.
- The maximum daily injection volume will be 3,000 bbls/d with an average daily injection volume of 200 to 2,000 bbls/d.
- The maximum surface injection pressure will be 1,275 pounds per square inch gauge (psig) with an average surface injection pressure of 1,275 psig.
- The well will inject produced salt water and RCRA-exempt waste.

1/4 MILE AREA OF REVIEW (AOR)

RULE §3.9 (7) (A) Area of Review.

Except as otherwise provided in this paragraph, the applicant shall review the date 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.

According to Energen Exhibit No. 10 there are no unplugged or improperly plugged wells within the 1/4 mile area of review. There is one active oil well within the 1/4 mile AOR, Laredo's W. Jost Oil Unit, Well No. 39E, (J 39EWell), (API No. 173-34396). The well is located 1025 ft in a south east direction from the proposed injection well, the BUQW at this location is 425 ft.⁶ The well is drilled and cased as follows;

- The well was drilled to a total depth (TD) of 8,738 ft.
- Surface casing, 8-5/8-inch, is set at 530 ft., and cemented to surface.

⁶ Energen Exhibit No. 10.

- Intermediate casing, 5-1/2 inch, is set at 8,731ft. and cemented to 4,363 ft.
- Production Tubing, 2 7/8-inch, was set at 8,611.

There are four vertical producing wells and two plugged wells located greater than one quarter-mile but within one half-mile of the proposed disposal well. The five producing wells are operated by either Energen or Laredo and are completed in the Spraberry (Trend Area) Field, around 1,750 ft. below the base of the proposed disposal interval.⁷

The wells greater than one quarter-mile but within one half-mile of the proposed 1WD well are;

1. Laredo's W Jost oil Unit 39F (API No. 173-36630). The BUQW at this well is 400 ft. The well is drilled and cased as follows;

- The well was drilled to a total depth (TD) of 10,419 ft.
- Surface casing, 13 5/8-inch, is set at 563 ft. and cemented to surface.
- Intermediate casing, 8 5/8 inch, is set at 5,041 ft and cemented to surface.
- Long string casing, 5 1/2-inch, was set at 10,419 ft. and cemented to 3,864 ft.

2. Energen's Frio -A- #1 (API No. 173-34019), is an active oil well. The BUQW is 400 ft. The well was drilled and cased as follows;

- The well was drilled to a TD of 10,050 ft.
- Surface casing, 13 3/8-inch, is set at 440 ft. and cemented to surface.
- Intermediate casing, 8 5/8 inch, is set at 5,285 ft. and cemented to 1,680 ft.
- long string casing, 5 1/2-inch, was set at 10,050 ft. and cemented to surface.

3. Laredo's Yellow Rose 40 # 2 (API No. 173-34688). The well is an active oil well. The BUQW is 450 ft.

⁷ Energen Exhibit No. 11.

- The well was drilled to a TD of 10,352 ft. and plugged back to 10,265 ft.
- Surface casing, 13 3/8 inch, is set at 566 ft. and cemented to surface.
- Intermediate casing 8 5/8 inch, is set at 2,898 ft. and cemented to surface.
- Long String casing, 5 1/2 inch is set at 10,352 ft. and cemented to 2,900 ft.

4. Energen's Frio-B- #1 (API No. 173-34636) is an active oil well with the BUQW at 425 ft.

- The well was drilled to a TD of 10,214 ft., and plugged back to 10,155 ft.
- Surface casing, 13 3/8 inch, was set at 483 ft. cemented to surface.
- Intermediate casing, 8 5/8 inch is set at 5,222 ft., cemented to surface.
- Long string casing, 5 1/2 inch is set at 10,214 ft., cemented to surface.

5. Saxon Operating's Mary Rape # 1 (API No. 173-30212). The BUQW is at 400 ft. The well is plugged and abandoned. The well is plugged as follows:

- The well was drilled to a TD of 7,747 ft.
- Surface casing, 8 5/8 inch, is set at 460 ft and cemented to surface.
- Two cement plugs are set from 389 ft to 510 ft. and from 2,524 ft. to 2,700 ft.
- There is 4 1/2 inch casing set at 7,747 ft cemented to 5,488 ft. which was cut to 5,020 ft. at plugging.
- A cast iron bridge plug is set at 6,780 ft with 20 ft of cement on top of the bridge plug.
- Between the plugs the well was filled with 9.9 lb/gallon drilling mud.

6. Saxon Operating's J.M. Cox # 1 (API No. 173-30161). The well is inactive and plugged. The BUQW is at 400 ft. The well is plugged as follows:

- The well was drilled to a TD of 7,747 ft.
- Surface casing, 8 5/8 inch, is set at 460 ft. and cemented to surface.
- Two cement plugs are set from 411 ft. to 485 ft., and from 485 ft. to 517 ft.
- A third cement plug is set from 2,524 ft to 2,700 ft.
- There is 4 1/2 inch casing set at 7,747 ft cemented to 5,488 ft., which was cut to 5,020 ft at plugging.
- A cast iron bridge plug is set at 6,780 ft with 20 ft of cement on top of the bridge plug.
- Between the plugs the well was filled with 10.0 lb/gallon drilling mud.

One horizontal wellbore transects the one-quarter mile AOR. The horizontal well, Laredo's J.E. Cox 33-40 (Alloc-G) # 7SU (API No. 173-36073), is completed in the Spraberry (Trend Area) Field, which underlies the disposal interval. The surface location (in which the wellbore penetrate the San Andres Formation) is more than one half-mile to the north of the proposed disposal well.

7. Laredo's J.E. Cox 33-40 (Alloc-G) # 7SU is an active oil well. The BUQW is 425 ft.

The well is completed as follows:

- Drilled to a total vertical depth (TVD) of 7,825 ft. with a measured depth (MD) of 15,510 ft.
- Surface casing, 13 3/8 inch, is set at 583 ft. and cemented to surface.
- DV tool set at 4,886 ft., cemented to 3,700 ft.
- Intermediate casing, 8 5/8 inch was set at 7,594 ft., cemented to 4,886 ft.
- Additional casing, 5 1/2 inch, was set at 15,498 ft. MD, cemented to 5,640 ft.

Mr. Pollard testified that, "they (the seven wells) are drilled and cased in such a way that the usable quality of water is protected with casing and cement from below the usable quality of water back to the surface."⁸

Groundwater, Geology and Hydrocarbon Resources

The San Andres Formation is not productive of hydrocarbons in this area; in fact, it is relied upon for the underground disposal of oil and gas waste in Glasscock County. The proposed disposal interval has a gross thickness of about 1,850 ft., with 240 ft of perforations. The average porosity is about 7.5 percent, and some sand intervals have up to 9 percent porosity. The Commission's Groundwater Advisory Unit (GAU) January 9, 2014, letter to Energen stated that the interval from the ground surface to a depth 425 ft. must be protected. The base of usable quality groundwater ("BUQW") occurs at a depth of 425 ft. and must be protected. A January 31, 2014, Commission "No Harm" letter was received by Energen, in the letter the GAU concludes that, "our review of the data contained in the application and of other geologic data indicate if otherwise compliant with Commission rules and guidance, using this disposal well and injecting oil and gas waste into the subsurface stratum will not endanger freshwater strata in the area. The base of the underground source of drinking water ("USDW") is estimated to occur at 875 ft."⁹

A review of water well records by Energen identified 28 water wells within a one-mile radius of the proposed disposal wells. The depth of the water wells ranged from 315 ft. to 420 ft.¹⁰

The BUQW and the top of the disposal interval are separated by approximately 2,375 ft., including at least 500 ft. of anhydrite and shale, which is sufficiently impermeable to seal the top of the disposal interval.¹¹

Even with the industry downturn there is significant production from the Spraberry (Trend Area) Field in Glasscock County, the top of Spraberry Trend occurs at a depth of about 6,400 ft. about 1,750 ft. below the base of the proposed disposal interval. Production from the Spraberry (Trend Area) Field has historically been through the use of vertical wells. However, in recent years horizontal wells with laterals over a mile have been used to further develop this field. The horizontal wells require multi-stage hydraulic fracture stimulation treatments, which require large quantities of water and produce large volumes of waste water requiring disposal. Shale units within the Clearfork Formation, which is part of the Spraberry (Trend Area) Field but is not productive in this area, and the base of the

⁸ Tr. pg 33., lns 13-17.

⁹ Tr. pg. 25, lns 14-25. pg 26 lns 1-12. Energen Exhibit Nos. 7 & 8.

¹⁰ Energen Exhibit No. 9 Water Well Report

¹¹ Energen Exhibit No. 4, 1WD well log.

injection interval are sufficient to prevent harm to the underlying hydrocarbon resources. The base of the proposed injection well has over 500 ft. of shale separating the proposed injection interval from the productive formations within the Spraberry (Trend Area) Field.¹²

Mr. George introduced Energen Exhibit No. 17, a package of pressure data from the 1 WD Well. The investigation was performed by Precision Pressure Data, Inc. Mr. Pollard stated that since there has been some question, mentioned in the Protestants opening statement, that some areas of the San Andres has higher pressure than others and there is some concern about injection increasing the pressures. Since the well was already perforated Mr. Pollard requested that Energen run a bottom hole pressure test to see what the pressure is in this well. The pressure test date was 2/24/15 with the well shut in. Mr. Pollard testified that the "important thing to look at (on the pressure test) is at the very bottom, and you see at 4,500 ft. or right near, at the bottom of the perforations the pressure that was recorded was 2,043 pounds (lbs), roughly. You see that gradient is .457 and that's the highest gradient in the entire wellbore. A solid column of saltwater you would expect to have a gradient of .465, but again this shows that the pressure is well below saltwater gradient in this well and, in my opinion is not what some people might consider overpressured, which would be substantially above a saltwater gradient, and this is a normal (pressure), not affected by injection or anything else in this part of the San Andres, so it is not referred to as overpressured."¹³

Mr. George asked Mr. Pollard if this survey is reflective of the San Andres at this location, in this vicinity. Mr. Pollard answered, "Yes Sir". He was then asked by Mr George if, in his opinion, the San Andres at this location, is it over pressured, or not overpressured. Mr. Pollard replied "it is not overpressured."¹⁴ Mr. George then introduced Energens Exhibit No. 18, a 03/10/215 swabbing report from Energen on the 1 WD Well. Mr. Pollard testified that Energen made one swabbing run from the surface and eight different swabbing runs and the fluid level was at 1,800 ft. so the water was feeding in, and the (water) level stayed at 1,800 ft. They recovered 40 barrels of water. The tubing pressure during those last eight runs was zero or on a vacuum. That means after they would swab the water, the well goes into a vacuum. The well is not overpressured because the water would not flow up the well. Mr. George asked Mr. Pollard if this swabbing information confirm your opinion that this area of the San Andres is not overpressured. He replied "Yes, Sir" (it is not over pressured).¹⁵

¹² Tr. pg. 19. Ins 1-25. Energen Exhibit No. 4 the 1WD well log.

¹³ Tr. pgs. 50-51.

¹⁴ Energen Exhibit No.17. Tr. pg 52. Ins 5-11.

¹⁵ Tr. pg 54. Ins 1-23.

During cross examination by the Protestant's attorney Mr. Hicks, Mr. Pollard was asked if he had a number for the permeability for the proposed injection interval. Mr. Pollard stated that he did not have a measured permeability, it's not like it's a sandstone where you have darcies of permeability or even maybe a hundred millidarcies. It's a little difficult in dolomite because every well can be different.¹⁶

Mr. Hicks then asked Mr. Pollard if he had performed any pressure front calculations for this application. Mr. Pollard stated that he had performed a pressure front calculation and entered a couple of parameters but stated that he did not have good parameters. Mr. Hicks asked what the pressure front calculation showed. Mr. Pollard stated that he did a calculation injecting between 1,000 and 2,000 bbls/d after one year or so, depending on the parameters you use on porosity, pay interval and permeability the pressure increase at Laredo's W. Jost Oil Unit, Well No. 39 E, (J 39 E Well), located 1,025 ft from the proposed injection well would be between 25 and 200lbs of pressure.

Mr. Hicks then asked Mr. Pollard to look at the well bore sketch of Laredo's J 39 E Well contained in Energen Exhibit No. 10. Since there is approximately 1,500 ft. of uncemented 5.5 inch casing through the proposed injection zone in the J 39 E Well, Mr. Hicks asked Mr. Pollard "How that shows confinement of that injection fluid in that interval if you don't have cement across that? Mr. Pollard answered, "Well, a confinement exists in our particular well. That's what you have to show the Commission."¹⁷

ENDANGER OR INJURE ANY OIL, GAS, OR OTHER MINERAL FORMATION

There are no wells currently producing from the San Andres Formation within two miles of the proposed 1WD injection well. The San Andres formation is a blanket dolomite formation across Glasscock county. The current production within two miles is from the Sprayberry (Trend Area), which occurs at depths of 6,500 ft. to approximately 9,800 ft. Shale units immediately below the base of the injection interval are sufficient to prevent harm to the underlying hydrocarbon resources. There is a minimum of 500 ft of shale layers separating the proposed injection interval from the area production.¹⁸

SEISMIC EVENTS

A review of the records of the U. S. Geologic Survey identified no seismic events with a magnitude greater than 1.0 within a 9.08 kilometer radius (100 square miles) of the proposed disposal well between January 1, 1973, and January 17, 2015.

¹⁶ Tr. pgs. 62 & 63.

¹⁷ Tr. pg. 65, lns 5-13.

¹⁸ Energen Exhibit No.3.Structural Cross Section.

PUBLIC INTEREST

Energen is currently hauling water from their Central Facility LACT Plant by truck to injection wells. The use of the 1WD Well will allow Energen to reduce their disposal costs and reduce the number of trucks on local roads. Mr. Pollard introduced Energen Exhibit No. 16, a chart showing monthly well count as well as the production of oil and gas from the Five Stones Area. Mr. Pollard testified that the chart shows that until 2010 there were only ten wells in this area. From 2010 to 2015 the well count increased to over 400 wells. The oil production has gone from below one hundred barrels per month in 2009 and in five years production was up to over half a million barrels a month from this one area. Energen intends to drill more horizontal wells and for production to increase. Gas production has increased from 10 million cubic feet per month per month to over 1.5 billion cubic ft. per month.¹⁹

FINANCIAL ASSURANCE

Energen has a current approved Form P-5 (Organization Report), and \$250,000 bond for financial assurance.

PROTESTANTS EVIDENCE

The application is protested by Laredo Petroleum Inc, ("Laredo") who is primarily concerned that;

- The injected fluids will not be confined to the injection interval due to five of Laredo's nearby wells that Laredo refers to as their Potential Problem Wells, (PPWs) that are not cemented across the injection interval.
- There is not sufficient isolation between the injection interval and groundwater because the PPWs will serve as conduits.
- The San Andres in this area is corrosive, dangerous and generally overpressured.
- The proposed disposal is likely to harm Laredo's existing production and will interfere with Laredo's ability to drill new wells on its lease.

Laredo currently has six San Andres disposal wells in the area but stated that they would be shutting in their San Andres wells and utilizing deep (Ellenburger) third party injection wells for disposal of their water.

¹⁹ Tr. pg 49. Ins1-25. Energen Exhibit No. 16.

Mr. Mike Gable, P.E., Laredo's Production Engineering and Operation Support Manager, submitted Laredo Exhibit No. 4, a table, which shows the number of Laredo wells with casing leaks and their distance from San Andres injection wells. Out of 333 wells in the study 25 wells (7.5%) developed leaks. The table shows that for 27 wells located less than one half mile from a San Andres injection well there were 6 wells (22.2%) that developed casing leaks, for the 74 wells located one half mile to one mile from a San Andres injection well there were 7 wells (9.5%) that had casing leaks. For the 111 wells located 1 mile to 1.5 miles from a San Andres injection well there were 6 wells (5.4%) with casing leaks, for the 121 wells located 1.5 to 2 miles from a San Andres injection well there were 6 wells (5.0%) that developed casing leaks.

Mr. Gable testified that Laredo believes that the casing leak data shown on Laredo Exhibit No. 4 indicates that there is a large jump in the number of casing leaks as you get closer to an SWD well. Mr. Gable further testified that " (333 wells) that's a fairly large sample size, so there's always going to be wells that develops leaks, so, probably the 5 to 5.4 percent we're saying is, you know a well that's going to have issues no matter what happens. We believe the data is very indicative that the wells that are closer to San Andres SWD wells develop casing leaks that put the well bore in jeopardy. Of these 25 wells represented in the study, Laredo was unable to successfully get any of the wells back online after developing a casing leak. Laredo attempted to repair 10 of the 25 wells and were unsuccessful in all 10 of the of those attempts and the cost was an average of \$214,000 per well. The remaining 15 wells were plugged abandoned or plugged and temporarily abandoned."²⁰

Mr. Hicks, Laredo's attorney, asked Mr. Gable if the wells with casing leaks were old. Mr Gable replied that the wells have been spudded since 2008. "They are all less than seven years old. On average the wells failed at about 3.5 years after injection began in the area."²¹

Mr. Gable was asked by the Examiners if he knew what the injection volumes for Laredo's San Andres wells in the area were. Mr. Gable testified that between their six San Andres injection wells they peaked out at about 17,000 bbls/d, combined or about 3,000 bbls/d. He further stated that there is a large number of third party San Andres injection wells and he did not pull everyone of those wells and plot their injection history. ²²

Mr. Gable testified that Laredo believes that based on their casing leak study the zone is overpressured in a lot of their leasehold, and there are drilling hazards that an overpressured zone presents and so Laredo is moving away from San Andres injection into

²⁰ Tr. pgs 95-97, lns, 1-25

²¹ Tr. pg. 97 lns 6-13.

²² Tr. pg., 99, lns 2-16.

deeper intervals, specifically the Ellenburger Formation. Laredo introduced their Exhibit No. 5, a map showing Laredo's two active and four San Andres disposal wells that Laredo claims are inactive, four active deep commercial disposal wells which Laredo has defined as greater than 9,500 ft. One deep well is in Glasscock county and three are in Reagan County. The map also shows two deep disposal wells that are permitted but not active. Laredo contends they are currently injecting water into all four of the deep third party commercial disposal wells. Laredo is also injecting into two of their San Andres disposal wells but plans on shutting them in as soon as deep injection is available.

Mr. Gable was asked by Mr. Hicks if he had any concerns about the fact that the Jost 39 E Well is not cemented across the proposed injection interval. Mr. Gable responded that "Yes sir, I do. We believe that it is not cemented across the injection interval and that fluid is going to enter into the uncemented production casing and migrate up. It can either cause Bradenhead pressure which we have observed on some wells in Reagan County offsetting our wells. That would be the better of the two cases. The other alternative is that at the surface casing, it (the fluid) exceeds the frac gradient of the rock at the shoe and breaches and contaminates the water table. I believe both are a possibility".²³

Mr. McGregor, P. E., Laredo's consulting petroleum engineer, introduced Laredo's Exhibit No. 6, a 12 mile radius map related to unprotected/ uncemented wells around the proposed injection well. The map shows six wells with Bradenhead pressures, as well as three injection wells in close proximity to the wells with Bradenhead issues. These wells are located approximately 9.4 to 10.8 miles south east of the proposed injection well. The map also shows two wells with flow problems about 4.5 miles to the northwest of the 1WD Well. The map also shows an injection permit that was protested by Energen and was denied by the Commission.²⁴

Mr. McGregor testified that all the wells with Bradenhead issues were uncemented through the San Andres. There are two Laredo wells in the northern portion of the map (approximately 4.5 miles to the northwest of the proposed 1WD Well) that had flow problems while drilling through the San Andres. Those are the Wilde 10-4, (API No. 173-37036), and the Wilde 10-2, (API No. 173-36576). The second set is two Laredo wells in Reagan county, about 13 miles south of the proposed injection well. The two wells are the SRH-A 1106, (API No. 383-39305), and the SRH-A 1107 (API No. 383-39306). Mr. McGregor testified that Laredo had managed to weight the drilling mud up enough to drill through the high flow zones and complete the wells.²⁵

²³ Tr. pg. 112, lns10-25., pg 113, lns 1-4.

²⁴ Laredo Exhibit No. 6.

²⁵ Tr. pgs. 117-120., lns 1-25.

The third well control problem that Laredo shows on their Exhibit No. 6 is the Draco Energy, Inc.'s Debus 2 Well (API No. 173-36353), (Debus No.2 Well) located 6.1 miles to the northeast of the proposed injection well. This well encountered high flows that despite increasing the mud weight, the operator could not control and the well had to be abandoned.²⁶

Laredo Exhibit No. 6 shows three Energen injection wells that Laredo asserts are pressure constrained. They are; Energen's Neil # 1WD (API No. 173-34676), Energen's San Saba -A- # 1WD, (API No. 173-36227) and Energen's Guadalupe -48- #1WD, (API No. 173-34677).

Laredo Exhibit No. 6 also shows two of Laredo's San Andres injection wells located six miles that Laredo used to determine a bottom hole pressure (BHP). The two wells are the Sugg A 171 SWD #2, (API No. 383-37089) and the Sugg A 171 SWD No.1. Mr. McGregor testified that the two San Andres wells had been shut in "awhile" so those are calculated San Andres bottom hole pressures from shut-in tubing pressure. The calculated bottom hole pressure reported are 2,264 psi at 3,652 ft. with a gradient of 0.62 psi/ft for the the Sugg A 171 SWD No.2, and a calculated bottom hole pressure of 1,893 psi with a pressure gradient of 0.60 psi/ft. But, Mr. McGregor said, those are elevated over pressured wells.

On Laredo Exhibit No.6 there are three disposal wells in Reagan county that received letters from the Commission requiring bottom hole pressure tests, they are: Williams Oil Company's Holt 132 No. 2 (API No. 383-31489) located 9.4 miles south of the proposed injection well. Texas Water Disposal Services's Holt 132 No. 1D (API No. 383-31488), located 9.9 miles from the proposed injection well, and Pride Energy's Holt 112 No.1. Mr. McGregor stated that the Holt 132 No. 1D had a shut in bottom hole pressure of 2,483 psi at 3,200 ft with a pressure gradient of 0.77psi., "they are definitely overpressured".²⁷

Laredo's Exhibit No. 7 is a map showing what Laredo contends are five Potential Problem Wells (PPWs). Mr. McGregor testified "there is one well the Jost 39E Well (39E Well) within one quarter-mile. There are no wells within one half-mile that are uncemented or unprotected, but we have two that are just outside the half mile radius, the Jost 39 K Well (39K Well) and the A Cope OU 39 B Well (39B Well). There is one well the Sherrod OU 39M Well (39M Well) approximately three quarters mile and another well the Fuchs 39 O Well right at one mile."²⁸

²⁶ Laredo Exhibit No.17.

²⁷ Tr. pgs 122-123. Laredo Exhibit No. 6.

²⁸ Tr. pg 127, Ins 1-22, Laredo Exhibit No. 7.

Mr. Hicks introduced Laredo Exhibit No. 8, wellbore diagrams of the five PPWs shown on Laredo Exhibit No. 7 that do not have the San Andres disposal interval completely isolated. These five wells are producing oil wells. Mr. McGregor testified the closest Laredo PPW is the J 39 E Well, which is the only PPW located within one quarter-mile from the proposed 1WD Well. The J 39 E Well has 8 5/8-inch surface casing set at 530 ft., which is 105 ft below the 425 ft. BUQW. The J 39 E Well has 5 1/2 inch casing set at 8,731 ft. cemented to 4,405 ft. He stated that there is a significant portion of the injection interval (2,800 ft to 4,405 ft.) that is not cemented and so will not confine fluids and the first priority of an injection permit is the fluids will be confined to that zone.²⁹ The other four PPWs are located further than one half-mile from the proposed 1WD Well.

The second Laredo PPW, the A Cope OU # 39B (API No. 173-34708), is located just outside one half-mile radius and the top of the cement is 4,050 ft. 8 5/8 inch surface casing, is set at 662 ft. and the BUQW is 425 ft. Mr. McGregor testified that in this well a very significant portion of this wellbore, there's no confinement, it's a conduit to the surface. The third well, the E Jost Oil Unit #39K, (API No. 173-35538), that's just outside one half-mile, none of the San Andres interval is cemented, the top of cement is 6,020 ft. The well has 8 5/8 inch surface casing set at 548 ft. the BUQW is 425 ft. The fourth PPW is located about three quarters of a mile from the 1WD Well is the Sherrod OU 39M Well, (API No. 173-34909), again in this well only a portion of the San Andres has cement across the zone. The 39M Well has 8 5/8 surface casing set at 613 ft and the BUQW is 425 ft. The very last PPW, the Fuchs # 39O, (API No. 173-33967), located just inside one mile, has 8 5/8 inch surface casing set at 613 ft. and the BUQW is 425 ft. This well also has a portion of the San Andres that is uncemented.³⁰

Mr. Hicks introduced Laredo Exhibits 9, 10, and 11, pressure front equations. Mr. McGregor stated that the pressure front equations are for the Jost 39E well located 1,025 ft. from the proposed 1WD injection well.

For Exhibits No. 9, Mr. McGregor testified that the current reservoir pressure he used was 1,708 psi and the way that was derived "was the shut in that were done yesterday by Laredo on its two injection wells in Reagan County, the Suggs A 171 Well No. 1, and the Suggs A 171 Well No. 2 shown on Laredo Exhibit No. 6, so, from those two, we determined recently the .61 psi per foot to 2,800 ft. We end up with 1,708 lbs. The injection rate they (Energen) are applying for is 10,000 bbls/d. The permeability used in this calculation was 25 millidarcies, the formation thickness, 940 ft. The porosity that was used was 15%.³¹ The calculations are run out to 25 years. The results of this which you already knew what the answer was going to be because if you start with .66 psi/ft in an

²⁹ Tr. pg. 135 Ins 1-20.

³⁰ pg 135 Ins 21-25. pg. 136, Ins 1-16. Laredo Exhibit No. 8.

³¹ Tr. pg 136 Ins 1-18.

overpressured zone your fluid can already go to surface and then begin flowing. This calculation just supports what you know. If you start with an over pressured gradient that was based on those two wells, then this should be the result."³²

Mr. Hicks asked Mr. McGregor if the pressure front equations in Laredo Exhibit No. 10 and 11 are based on the Applicant's testimony. Mr. McGregor replied they were. "If you look at Exhibit 10, the current reservoir pressure I used was 1,280 pounds on this analysis because we have a bottom hole pressure from Energen that shows .457 psi/ft that Mr. Pollard used, and the injection rate of 10,000 bbls/d. There was testimony of 5 millidarcies (permeability), and a formation thickness of 1,000 ft. with a porosity of 7.5%. Using those parameters at the end of year one we're able to lift fluid to the surface because at the end of year one, based on the calculations, the gradient will be .674, and essentially, if you get heavier than the weight of the fluid that needs to be lifted you will be able to move that fluid to the surface, so if the fluid is freshwater flow back water for example, that's .433 psi/ft. Here the calculated gradient at the end of year one, is .674. That's much greater, so that will push a column of fluid that only weighs .465 to the surface and it will be flowing at some rate."³³ It shows that the change in pressure due to injecting 10,000 bbls/d for a year is 608 lbs, and after 25 years the change in pressure is 1,017lbs."³⁴

Laredo Exhibit No. 11, is another sensitivity run on the pressure front equations. Mr. McGregor testified that for this equation he changed the injection volume to 2,000 bbls/d, and all the other parameters are the same ones used in Laredo Exhibit No. 10. He testified that "as you can see where it says zero at the end of the first year we have pushed fluid to the surface. Even at 2,000 bbls/d of water injection, at the end of one year the pressure change was 122 psi, and at the end of 25 years it's 200 lbs."³⁵

Mr. Hicks then introduced Laredo Exhibit No. 12, a Proposal for Decision (PFD), and Final Order for Oil and Gas docket No. 08-0279365, a High Roller Wells LLC application for a SWR 9 injection well application that was protested by Energen and Endeavor Energy Resources, LP (Endeavor). Mr. Hicks asked Mr. McGregor what the key findings from the High Roller that he wanted to point out. Mr. McGregor replied "The PFD, the Examiners recommended approval. The Commissioners overruled it. The PFD for example, on page 4, the two operators (Protestants) are primarily concerned that the

³² Tr. pg 140, lns 1-17.

³³ Tr. pg 140, lns 18-25., pg 141, lns 1-14.

³⁴ Tr. pg., 141, lns 23-25. pg 142, ln 1.

³⁵ Tr. pg., 142, lns 1-25.

injected fluids will adversely affect the existing producing wells and the development of their offset acreage." ³⁶

Mr. Hicks introduced Laredo Exhibit No. 15, a chart indicating the projected oil and the cumulative oil for the remaining oil reserves as of 1/1/2015 for Laredo's five uncemented San Andres wells, the chart extends to year 2043. Mr. McGregor testified "that the line that's drawn between 2018 and 2019, that is basically four years from 1/20/2015, four full years. Mr. Gable's testimony was around three and one half-years on average, (before a casing leak develops). There's some less, some more, so the point of the exhibit is to give the Examiners an idea of the potential reserves lost." ³⁷

Mr. Hicks asked Mr. McGregor to look at their Exhibit No. 6, which Mr. McGregor said starts to represent some of the flow problems Laredo experienced while drilling through the San Andres. Mr. McGregor stated that there are four Laredo wells that experienced flow problems on their Exhibit No. 6 map. The Wilde 10 # 2, (API No. 173-36578), and the Wilde 10 # 4, API No. 173-37036), are located approximately 5.5 to 6.0 miles north-north west from the proposed 1WD Well. The other two wells, the SRH-A 1106 SM Well, (API No. 383-39305), and the SRH-A 1107 SM Well, (API No. 383-39306) are located in Reagan County, approximately 13 miles south of the proposed 1 WD Well.

Laredo Exhibit No. 16 is a chart which shows the flow problems with the Wilde and SRH Wells shown on Laredo Exhibit No. 6. Mr. McGregor testified that three wells encountered flow problems while drilling through the San Andres, and the fourth well, the Wilde 10 #2 Well encountered flows at the intermediate casing point, after they had drilled through the San Andres. ³⁸ However, Laredo was able to control the flows and the wells are currently producing wells. ³⁹

Mr. Hicks introduced Laredo Exhibit No. 17 a cross section and daily drilling reports for the Debus No. 2 Well. Mr. McGregor testified that during drilling the well started taking heavy water flows with H₂S at 3,300 in the San Andres. Despite increasing the mud weight, the operator could not control and the well had to be plugged and abandoned. He also stated that the well is located 2,100 ft. away from an injection well, "so, ...this flow, it's over pressured." ⁴⁰

³⁶ Tr. pg. 144, lns 3-16.

³⁷ Tr. pg. 149 lns 1-14.

³⁸ Tr. pgs. 151-152.. Laredo Exhibit No. 16.

³⁹ Tr. pgs 153, lns 1-4.

⁴⁰ Tr. pg 155, lns 6-25. pg 156, lns 1-25.

Mr. McGregor was asked by Mr. Hicks to explain Laredo Exhibit No.18, a detailed map of Laredo's planned development, centered on the proposed injection well with a quarter mile, one half-mile, and a one mile radius circles drawn around the proposed well. Laredo has 20 vertical producing wells within the one mile radius, and they are planning on drilling 25 vertical wells within the one mile radius and eight horizontal wells within the half mile radius of the proposed injection well. Mr. McGregor testified that Laredo is very concerned about trying to develop their leasehold through an overpressured San Andres and there are 25 vertical wells that are at risk of additional rig time. Laredo plans on drilling two vertical wells within a quarter mile of the proposed injection well, three vertical wells within a half mile and three vertical wells at the half mile ring.

Laredo Exhibit No. 19 is a map showing Energen's production, Energen's San Andres injection wells, with three Energen San Andres injection wells that Laredo contends are pressure constrained wells. The three wells are the Neal No. 1WD (API No. 173-34676), San Saba -A- No.1WD (API No 173- 36227), and the Guadalupe -48- No. 1WD, (API No. 173-34677).⁴¹

The Neal No. 1WD is operating at 92% of its permitted pressure of 1,400 psi. The San Saba -A- No.1WD is operating at 95% of its permitted pressure of 1,400 psi and the Guadalupe -48- No. 1WD is operating at 91% of its permitted pressure of 1,400 psi.⁴²

Mr. McGregor stated that these wells are injecting between 2,000 and 4,000 bbls/d and injection into these wells is pressure constrained to their permit. "The wells are operating at 95% or so and so ... when you are looking at over pressure, we see over pressure, those three wells that are pressure constrained are the ones closest to the proposed injection well."⁴³

Mr. Hicks introduced Laredo Exhibits Nos. 22, 23, and 24, Commission letters requiring the operators to shut in their injection wells and perform bottom hole pressure fall off tests. Laredo Exhibit No. 22 is a Commission letter to Pride Energy Company Holt 112, Lease, No. 1 Well. Laredo Exhibit No. 23 is the Williams Oil company's Holt 132 Lease Well No. 2, and Laredo Exhibit No. 24 is the Texas Water Disposal Services, LLC, Holt 132 Lease, Well No. 1D. Mr. Hicks asked Mr. McGregor if "these wells are related to the wells previously discussed on Laredo Exhibit No. 6, that were prompted by the high Bradenhead

⁴¹ Laredo Exhibit No. 19.

⁴² Laredo Exhibit No. 20.

⁴³ Tr. pg 16, lns 11-25. pg 162, lns 1-20.

pressures on the wells located in Reagan County approximately ten miles south of the proposed injection well?" Mr. McGregor replied they were.⁴⁴

Mr. McGregor was asked by the Examiners if these three injection wells were still being allowed to inject. Mr. McGregor replied that he believed the wells were still allowed to inject.⁴⁵ The Examiners also asked Mr. McGregor if the Bradenhead pressures returned to normal and if they were still producing, Mr McGregor stated, "I think they still may show Bradenhead pressure and he thought the wells were still producing."⁴⁶

Mr. Hicks asked, "Mr. McGregor to wrap up, if, in your opinion does this--with the 39E Well within a quarter mile, would the applied for injection application confine fluids to the disposal interval." Mr. McGregor replied "No it would not. There is no confinement because there is no cement across the zone, and it will be over pressured. He was also asked if in his opinion will the exposure of the five wells that are not cemented, their exposure to nearby injection, would that decrease their useful life? He replied "yes it would". Mr. Hicks then asked Mr. McGregor if the decreased life span of the wells would lead to a loss of reserves, Mr. McGregor replied "Yes it would."⁴⁷

EXAMINERS' ANALYSIS OF THE EVIDENCE

The evidence in the record demonstrates Energen has met its burden of proof and that the proposed Central Facility 1WD disposal well application meets the requirements of Chapter 27 of the Texas Water Code and Statewide Rule 9. The Examiners conclude the proposed Central Facility 1WD Well will not endanger or injure any oil, gas, or other mineral formation, both fresh ground and surface water will be adequately protected from pollution, the well is in the public interest, and Energen has adequate financial assurance. As a result, the Examiners recommend the subject disposal well application be approved and the permit issued. The required elements of the Texas Water Code § 27.051(b) will be taken in turn.

Public Interest

The 1WD Well will be used to dispose of Energen's residual knockout water from their 26,000 acre Five Stones Area by injection into the 1WD Well. Currently, the residual knockout water coming into the Central Facility is trucked off site. The oil production has increased to over half a million barrels a month from this one area. And Energen intends

⁴⁴ Tr. pg 164, lns. 8-13.

⁴⁵ Tr. pg 125, lns. 1-16.

⁴⁶ Tr. pg 126, lns 9-16.

⁴⁷ Tr. pg 168, lns 8-22

to drill more horizontal wells and for production to increase. The use of the well will reduce operating and disposal costs for Energen and reduce truck traffic on local roads.

With Proper Safeguards, Both Ground and Surface Fresh Water Can Be Adequately Protected from Pollution

A January 31, 2014, Commission "No Harm" letter was received by Energen, in the letter the GAU concludes that, "Our review of the data contained in the application and of other geologic data indicate if otherwise compliant with Commission rules and guidance, using this disposal well and injecting oil and gas waste into the subsurface stratum will not endanger freshwater strata in the area.". The upward migration of fluids into fresh water or the surface is one of the Protestants concerns. The top of the disposal interval is overlain by more than 350 ft. of interbedded anhydrite, and shale which will prevent the upward migration of the injected fluids out of the proposed injection zone.

Area of Review

Effective November 17, 2014, the Commission most recently amended Statewide Rule 9, but left unchanged the Area of Review requirements.⁴⁸ A permit application for a disposal well pursuant to Statewide Rule 9 requires a review of wellbores within a one-quarter mile area of review identifying any unplugged or improperly plugged wells that penetrate the disposal zone. §3.9 (7)(A) states " the applicant shall review the date of public record for wells that penetrate the proposed disposal zone within a one-quarter 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."⁴⁹ There are no unplugged or improperly plugged wells within the one-quarter mile area of review that penetrate the disposal zone.

Statewide Rule 9 does not require operators to perform a one-quarter mile area of review analysis to identify producing wells with uncemented casing through the injection interval.

There is one producing well within the one-quarter mile area of review that penetrates the proposed disposal zone. The well is Laredo's W. Jost Oil Unit, Well No. 39E, located 1,025 ft in a south east direction from the proposed injection well. The BUQW at this location is 425 ft. The well has 8-5/8-inch surface casing set at 530 ft., 105 ft. below the BUQW, and cemented to surface.⁵⁰

⁴⁸ See 16 Tex. Admin. Code § 3.9 (7).

⁴⁹ See 16 Tex. Admin. Code § 3.9 (7) (A).

⁵⁰ Energen Exhibit No. 10, Laredo Exhibit No. 8.

There are no wells within one half-mile of the proposed injection well that are uncemented through the proposed injection zone. There are two of Laredo's Potential Problem Wells that are just outside the half mile radius, the Jost 39 K Well (39K Well) and the A Cope OU 39 B Well (39B Well). There is one well the Sherrod OU 39M Well (39M Well) approximately three quarters mile and another well the Fuchs 39 O Well approximately one mile from the proposed injection well. Laredo's Exhibit No. 8, well completion schematics of Laredo's five PPWs, shows that the five wells have surface casing set below the BUQW and cemented to surface, as required in Commission rules.

The Examiners are unaware of any Commission precedent denying an application based upon the presence of a producing well with uncemented casing through the injection interval. To the contrary, in Oil and Gas Docket No. 08-0297983, a Final Order was issued granting an application wherein the protestant voiced concerns over the same issue.

Over Pressurization

It is well known that in some areas the San Andres Formation has pressure issues. There are four Laredo wells that Laredo contends experienced flow problems while drilling through the San Andres due to pressure in the San Andres Formation. The Wilde 10 No 2 Well, and the Wilde 10 No. 4 Well, both located approximately 5.5 to 6.0 miles north of the proposed 1WD Well. The other two wells, the SRH-A 1106 SM Well, and the SRH-A 1107 SM Well, are located in Reagan County, approximately 13 miles south of the proposed 1 WD Well. Mr. McGregor testified that Laredo had managed to weight the drilling mud up enough to drill on through the high flow zones and the wells were successfully completed and are currently producing.⁵¹ There is also a well the Debus No. 2 Well located 6.1 miles north east of the proposed 1WD Well that encountered high flows while drilling that the operator could not control and the well had to be temporarily plugged and abandoned.

The Examiners give little weight to the pressure front calculations in Laredo Exhibit Nos. 9, 10 and 11. The equations do not accurately represent reservoir conditions or injection volumes at the site of the proposed injection well. The equations made the following assumption; first, the equation assumed the annular space in the well is filled with water instead of drilling mud. Laredo did not dispute that their PPWs have drilling mud in the annular spaces instead of water. Second, Mr. McGregor was asked by Mr. Hicks if he had tried to "get the bottom hole pressures in this area, (around the proposed 1WD Well, Mr. McGregor testified that "I didn't, just in Reagan County." But, Mr. McGregor said, those (the Reagan County wells) are elevated over pressured wells.⁵²

⁵¹ Tr. pgs. 117-120., lns 1-25.

⁵² Tr. pgs. 122-123.

Laredo Exhibit No. 9 uses a bottom hole pressure (1789 psi) calculated from two of Laredo's San Andres injection wells in Reagan County, approximately 6 miles south of the proposed injection well. Mr. McGregor further testified that the wells had been shut in "for a while" and the bottom hole pressures were calculated from shut in tubing pressures. Laredo did not provide information on how long the wells had been shut in prior to calculating the bottom hole pressures or the equations used to calculate the BHP.⁵³ The pressure front equation also used a volume of 10,000 bbls/d instead of the 200 to 2,000 bbls/d that Energen plans to inject. The pressure front equation shown in Laredo Exhibit No. 10 also uses 10,000 bbls/d and water in the annular space, so is not representative of the proposed injection operations. Laredo's Exhibit No. 11, is another a pressure front equation that uses 2,000 bbls/d as the injection volume. The pressure front equation shows after 10 years of injecting 2,000 bbls/d there is an increase in reservoir pressure of 180 psi and an increase of 203 psi after 25 years of injection. Even if the annular spaces in Laredo's PPWs were in fact filled with water instead of drilling mud neither pressure is sufficient to displace a column of 9.5 lb drilling mud up the Jost 39 E Well bore with enough pressure to fracture the formation forcing the injectate past the cemented surface casing into the BUQW as Laredo contends could happen.

Laredo contends three of Energens' injection wells are pressure constrained. The Neal No. 1WD is operating at 92% of its permitted pressure of 1,400 psi. The San Saba -A- No.1WD is operating at 95% of its permitted pressure of 1,400 psi and the Guadalupe -48- No. 1WD is operating at 91% of its permitted pressure of 1,400 psi.⁵⁴ The three wells are permitted to inject 10,000 bbls/d and Mr. Gable stated that these wells are injecting between 2,000 and 4,000 bbls/d into these wells.⁵⁵

Mr. Gable was then asked by the Examiners if was familiar with injection pressures and volumes for Laredo's six San Andres wells. Mr. Gable testified that Laredo's six San Andres injection wells peaked out at about 3,000 bbls/d for each well, which is the average for the three Energen wells that Laredo maintains are pressure constrained. Laredo did not present any of their six San Andres wells as pressure constrained.

The Examiners conclude that Laredo's argument that an injection well is pressure constrained simply due to the well operating at close to its maximum pressure and not taking the maximum permitted volume is not convincing. A disposal permit issued by the Commission stating the maximum volume the well is permitted to inject is a regulatory limit and not the volume that could actually be injected. This is true for several reasons. First, the facility may not be physically able to inject the permitted volume. This could be due the way the well is constructed, for example the tubing size may not be able to handle the

⁵³ Tr. pg. 122.

⁵⁴ Laredo Exhibit No. 20.

⁵⁵ Tr. pg 162, lns 1-13.

permitted volume, the disposal pumps may not be able to inject the permitted volumes, or the formation may not be able to accept the permitted volume of fluid, or a combination of all the above.

High Flows

Although there are high flow issues 5.5 - 6 miles to the north and 13 miles to the south of the proposed 1WD Well, Energen provided evidence in the form of a bottom hole pressure test in the proposed 1WD Well that showed that at the site of the proposed 1WD Well, the San Andres is not over pressurized. The 1WD Well's pressure at 4,500 ft was approximately 2,043 psi, with a pressure gradient .457psi/ft. After each swabbing run the fluid level in the well recovered to 1,800 ft., and the well was also pulling a vacuum when shut in.⁵⁶

The Examiners asked Mr. McGregor if Laredo was having any fluid coming into the wells and into drinking water in any of their wells such as the J 39E Well that are not cemented through the San Andres. Mr. McGregor answered "not from the existing injection near that well, the nearest injection to that well is approximately 2.25 to 2.5 miles away, but if we put one 1,000 ft. away I believe it is going to be a problem quickly."⁵⁷

The Examiners then asked "but that area right now is not pressured to the point where it's causing water to come up into the wells?" Mr. McGregor responded "That's correct, there is nothing showing on the Bradenhead."⁵⁸

The Examiners find it noteworthy that Laredo did not provide any evidence that the Jost 39 E Well, which is one of Laredo's Potential Problem Wells, located 1,025 ft. from the proposed injection well in the area that Laredo claims is over pressured, had experienced any pressure or high flow issues while being drilled or completed. Laredo also did not provide any evidence that any of their four other Potential Problem Wells within a mile of the proposed injection well had any pressure or high flow issues during drilling.

The Examiners conclude that the evidence in the record indicates the San Andres is **not** over pressurized at this site, and that Energen's proposed well construction for the proposed 1WD Well meets the requirements of Statewide Rule 9. The well is cased, cemented, and completed in a manner consistent with Commission rule requirements and will be protective of both ground and surface water. The injection interval is capped by impervious boundaries immediately above and below the proposed interval.

⁵⁶ Tr. pg 54, lns 1-23.

⁵⁷ Tr. pg. 153, lns 21-25

⁵⁸ Tr. pg 154, lns 5-9.

The Examiners also determined the five Laredo Potential Problem Wells are cased, cemented, and completed in a manner consistent with Commission rule requirements and will be protective of both fresh ground and surface water.

Endanger or Injure Any Oil, Gas, or Other Mineral Formation.

A two-mile area of review for current or historical production from the same or correlative interval is the current standard for review regarding determining whether a disposal well should be permitted under Statewide Rule 9. Energen has demonstrated that there is no San Andres or Clear Fork Formations production within a two-mile radius of the proposed SWD. Shale units within the Clearfork Formation, which is part of the Spraberry (Trend Area) Field but is not productive in this area, and the base of the injection interval are sufficient to prevent harm to the underlying hydrocarbon resources. The base of the proposed injection well has over 500 ft. of shale separating the proposed injection interval from the productive formations within the Spraberry (Trend Area) Field.

Corrosive Formation Fluids

Corrosive San Andres Formation fluid is a well known concern for drillers and operators in Glasscock County. When Laredo's Jost 39 E Well was drilled, Commission rules did not require full cement behind intermediate or production casing through the San Andres Formation. The Commission has since modified its rules to protect well integrity, freshwater and hydrocarbon resources from corrosion risks. Effective January 1, 2014, the Commission amended Statewide Rule 13, requiring operators to cement production casing through corrosive formations such as the San Andres in Glasscock County.⁵⁹ This rule applies to new wells. The Commission did not require operators of existing wells to perform remedial work bringing older wells into compliance with the new standard.

Laredo contends the injected fluids will contribute to the corrosion of uncemented production casing in its nearby wells, which will harm the production of hydrocarbons from those wells. In this case, Laredo contends that corrosion on an uncemented wellbore could result in premature well abandonment. Laredo attributes the 25 casing leaks out of 333 wells with unprotected casing as shown on Laredo's Exhibit No. 4, to corrosion from San Andres Formation fluids. Mr. Gable testified that "there's always going to be wells that develop casing leaks, probably 5 to 5.4 percent that going to have issues no matter what happens. We believe the data is very indicative that the wells that are closer to San Andres SWD wells develop casing leaks that put the well bore in jeopardy."⁶⁰

However, Laredo did not document the wells affected. Laredo did not provide the wells names, locations, the cause, or depth of the casing leaks. Casing failure can occur

⁵⁹ See 16 Tex. Admin. Code §§ 3.13 (b)(3)(B) and 3.13 (b)(2)(A)(i).

⁶⁰ Tr. pg. 96 Ins 1-25.

for many reasons not just from corrosion caused by formation fluids. Neither did Laredo detail the injection intervals, volumes or pressures of the injection wells that Laredo contends caused the 25 casing leaks. Nor did Laredo provide evidence or testimony on the steps taken to attempt to repair the 10 wells with casing leaks that Laredo tried to repair. Even if the casing study was accurate and a wells' odds of develop a casing leak increases as the distance to an injection well decreases, the evidence in the record shows that for the 27 wells with an injection well less than one half mile, only 6 of the 27 wells (22.2%) developed a casing leak. Wells uncemented across the injection interval at .5 to 1 mile have only a 9.5% or about a 1 in 10 chance of developing a casing leak. Of the 121 wells located one mile to two miles from an injection well there were only 6 wells (5.0%) that developed a casing leak.

The Examiners find little evidence in the record supporting Laredo's concern that approval of the Subject Application would result in stranding recoverable reserves. Casing leaks are common in the San Andres and are routinely repaired. According to Laredo's expert witness, Mr. McGregor, a well completed without cement across the San Andres has around a 5 % or 1 in 20 chance of a casing leak. If casing repairs are not successful another well can be drilled. If the Commission denied saltwater disposal well applications simply based on the presence of wells with uncemented production casing, it would be very difficult to permit a disposal well in Glasscock County. To the Examiners' knowledge it has not done so, and a convincing argument for its application in this case has not been presented. To the contrary, in Oil and Gas Docket No. 08-0297983, a Final Order was issued granting an application wherein the protestant voiced concerns over the same issue.

The Examiners conclude Energen has met its burden of proof with this element of the Texas Water Code. The evidence in the record demonstrates the proposed disposal well will be completed (i.e., drilled, cased, cemented,) and operated in a manner protective of oil, gas, or other mineral formations pursuant to Texas Water Code § 27.051(b)(2).

Financial Assurance

Energen has an active P-5 and financial assurance in the form of a \$250,000 bond.

FINDINGS OF FACT

1. Notice of this hearing was given to all parties entitled to notice at least ten days prior to the date of hearing.
2. Notice of the subject application was published in the *Midland Reporter Telegram*, a newspaper of general circulation in Glasscock County, on November 04, 2014. Notice of the application was sent to the Glasscock County Clerk, offset operators within ½ mile on November 07, 2014. Energen is the surface owner of the injection tract.

3. At the hearing Energen reduced the requested maximum daily injection volume to 3,000 bbls/d. Additional notice was not required as this revised maximum daily injection volume was less than the volume previously noticed.
4. The proposed disposal well has been drilled, completed, and operated as follows:
 - a. Surface casing (8 5/8-inch) was set at a depth of 493 ft. with cement circulated to the surface.
 - b. Long-string casing (5 1/2-inch) was set to a depth of 5,555 ft. with cement circulated to the surface.
 - c. Injection tubing (2 7/8-inch) will be set with a packer at 2,790 ft.
 - d. The injection interval will be from 2,800 ft. to 4,650 ft.
 - e. A bridge plug will be set at 4,750 ft.
 - f. The maximum daily injection volume will be 3,000 bbls/d with an average daily injection volume of 200 to 2,000 BPD.
 - g. The maximum surface injection pressure will be 1,275 pounds per square inch gauge (psig).
 - h. The well will inject produced salt water and RCRA-exempt waste.
5. Formation fluids in the San Andres Formation are corrosive.
 - Casing leaks routinely occur in the San Andres Formation
 - Casing leaks have occurred in the absence of nearby injection activity.
 - Casing leaks are routinely repaired by operators of wells in the field.
6. The use or installation of the injection well is in the public interest.
 - Horizontal wells are being permitted and drilled in the area.
 - The 1WD Well will be used to dispose of Energen's residual knockout water from their 26,000 acre Five Stones Area.
 - The use of the well will reduce operating and disposal costs.

7. The use or installation of the injection well will not endanger or injure any oil, gas, or other mineral formation.
- The San Andres Formation is not productive in this area.
 - The nearest production is in the Spraberry (Trend Area) Field, and the injection interval is separated from the Spraberry (Trend Area) Field by a minimum of 500 ft. of shale.
 - The proposed disposal well is completed (i.e., drilled, cased, cemented,) and will be operated in a manner protective of oil, gas, or other mineral formations pursuant to Texas Water Code § 27.051(b)(2).
8. With proper safeguards, both ground and surface fresh water can be adequately protected from pollution.
- The base of usable quality groundwater ("BUQW") occurs at a depth of 425 ft. and the base of the underground sources of drinking water ("USDW") is 875 ft.
 - The well is completed with 493 ft. of surface casing cemented to the surface.
 - There one producing well within a one-quarter mile Area of Review, which is completed with cemented surface casing that will protect the BUQW.
 - A minimum of 500 ft. of impermeable anhydrite and shale directly overlay the injection interval.
 - The applicant has made a satisfactory showing of financial responsibility as required by Section 27.073.
 - Energen has an active Organization Report (Form P-5, Operator No. (252002), and has filed a \$250,000 bond for financial assurance.

CONCLUSIONS OF LAW

1. All notice requirements have been satisfied. 16 Tex. Admin. Code § 3.9.
2. The evidence in the record is sufficient to establish that the use or installation of the injection well is in the public interest. Tex. Water Code § 27.051(b)(1).

3. The evidence in the record is sufficient to establish that the use or installation of the injection well will not endanger or injure any oil, gas, or other mineral formation. Tex. Water Code § 27.051(b)(2).
4. The evidence in the record is sufficient to establish that, with proper safeguards, both ground and surface fresh water can be adequately protected from pollution. Tex. Water Code § 27.051(b)(3).
5. The applicant has made a satisfactory showing of financial responsibility as required by Section 27.073 of the Texas Water Code. Tex. Water Code § 27.051(b)(4).

RECOMMENDATION

Based on the above findings of fact and conclusions of law, the Examiners recommend the Commission enter an order approving the application as amended of Energen Resources Corporation, Pursuant to Statewide Rule 9 for a permit to inject fluid into a reservoir not productive of oil or gas, Central Facility Well No. 1WD, Spraberry (Trend Area) Field, Glasscock County, Texas.

Respectfully submitted,



Richard Eyster, P.G.
Technical Examiner



Ryan Lammert
Administrative Law Judge