



RAILROAD COMMISSION OF TEXAS

HEARINGS DIVISION

AMENDED PROPOSAL FOR DECISION

OIL AND GAS DOCKET NO. 08-0291954

THE APPLICATION OF RUGER PROPERTIES, LLC, PURSUANT TO STATEWIDE RULE 9 FOR A COMMERCIAL PERMIT TO DISPOSE OF OIL AND GAS WASTE BY INJECTION INTO A POROUS FORMATION NOT PRODUCTIVE OF OIL OR GAS, PEGGY SWD LEASE WELL NO. 1, SPRABERRY (TREND AREA) FIELD, MIDLAND COUNTY, TEXAS.

HEARD BY: Paul Dubois – Technical Examiner
Terry Johnson – Hearings Examiner

HEARING DATE: October 27, 2014

APPEARANCES:

REPRESENTING:

APPLICANT

Clay Nance
Shannon Brandt
Don Hale
Larry Carlisle, P.E.

Ruger Properties, LLC

Will Lane

CrownQuest Operating

Jay H. Floyd, Jr.

Timber Floyd, Inc.

PROTESTANT

Barry Hagemann
Nguyen Ngoc, P.E.

Judkins Tull Walton

PROCEDURAL HISTORY

Application Filed:	June 5, 2014
Protest Received:	August 4, 2014
Request for Hearing:	August 25, 2014
Notice of Hearing:	September 15, 2014
Date of Hearing:	October 27, 2014
Transcript Received:	November 12, 2014
Proposal For Decision Issued:	February 18, 2015
Amended Proposal For Decision Issued:	May 5, 2015

STATEMENT OF THE CASE

Pursuant to Statewide Rule 9 (16 Tex. Admin. Code § 3.9), Ruger Properties, LLC (Ruger) seeks a commercial permit to dispose of oil and gas waste by injection into a porous formation not productive of oil or gas, Peggy SWD Lease Well No. 1, Spraberry (Trend Area) Field, Midland County, Texas. This permit would authorize Ruger to drill a new well into the San Andres Formation in the depth interval from 4,000 feet to 4,600 feet.

On May 23, 2014, notice of the application was mailed to the Midland County Clerk, to offset operators and to the surface owner of the subject tract. A supplemental notice was mailed on July 17, 2014. Notice of the application was published on May 24, 2014, in the *Midland Telegraph-Reporter*, a newspaper of general circulation in Midland County. Two operators—CrownQuest Operating and Timber Floyd, Inc.—appeared at hearing in support of the application. The application is protested by Judson Tull Walton (Walton), an adjoining surface owner.

The Railroad Commission may grant a permit under Chapter 27 of the Texas Water Code, Subchapter D¹ in whole or part and may issue a permit to dispose of fluids by underground injection 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 if required by Section 27.073.

A proposal for decision (PFD) in this matter was issued on February 18, 2015, recommending approval of the application. While reviewing the Exceptions and Replies, the Examiners discovered what appeared to be a material error in Ruger's pressure-front calculations (Ruger Exhibit No. 28). This error resulted in a significant underestimation of the effect that injection activity would have on formation pressure. By letter dated March 18, 2015, the Examiners notified the parties of the error and re-opened the record for the limited purpose of determining whether the pressure-front calculations offered at hearing were accurate. Both parties responded and both agreed the pressure front calculations were in error. Both parties subsequently presented additional calculations that were in substantive agreement.

¹

Tex. Water Code § 27.051(b)(1-4).

Ruger moved to admit additional information into the record, including revised calculations, an affidavit from its expert witness, and amended its application for a reduced daily injection volume from a maximum of 20,000 barrels per day to 10,000 barrels per day. The Examiners have admitted the filings of both parties into the record (Ruger late-filed Exhibit No. 30, Walton late-filed Exhibit No. 26).

Based on the arguments in the Exceptions and Replies, together with a reconsideration of evidence in the record, the Examiners now recommend Ruger's application be denied.

DISCUSSION OF EVIDENCE

Direct cases were given by both parties. The Applicant's evidence is discussed first, followed by the Protestant's. Evidence from both parties regarding the pressure-front calculations is discussed last and includes evidence offered at the hearing and the parties' responses to the Examiners' March 18, 2015, letter.

APPLICANT'S EVIDENCE

Don Hale, owner of Ruger, has 35 years of oil and gas industry experience. In 2011 he formed Petroplex SWD Systems, which operates four disposal wells in the San Andres Formation. He formed Ruger to also be an operator of disposal wells. Ruger has an active Form P-5 on file with the Commission. Mr. Hale stated he has not experienced any issues with overpressure in the San Andres Formation at other locations.²

Ruger proposes to drill a new well to dispose of salt water into the San Andres Formation. Ruger has an agreement with the landowner, Jay H. Floyd, Jr., to drill and operate the well and associated facilities on a five-acre tract. A drilling permit (No. 789236, API No. 42-329-39529) was issued by the Commission for the well. A wellbore schematic diagram is included as Attachment A (Ruger Exhibit No. 23). The construction and operational details of the well are as follows:

- The well will be drilled to a depth of 4,600 feet.
- Surface casing (9 5/8-inch) will be set to a depth of 375 feet with cement circulated to the surface.
- Production casing (7-inch) will be set to a depth of 4,600 feet with cement circulated to the surface.

² Tr. pg.72, lns. 2-6.

- The well will be perforated in the San Andres Formation, with the exact depths to be determined based on well log analysis after the borehole is drilled.
- Injection tubing (3 ½-inch) will be set with a packer not more than 100 feet above the uppermost perforation.
- The maximum daily injection volume will be 10,000 barrels per day (BPD).
- The maximum surface injection pressure will be 2,000 pounds per square inch gauge (psig), with an average surface injection pressure of 1,800 psig.
- The facility will receive salt water for disposal by pipeline from at least one operator and by truck from other operators.

The Commission's Groundwater Advisory Unit (GAU) determined the base of usable quality groundwater (BUQW) to be at a depth of 325 feet, and the base of underground sources of drinking water (USDW) to be at a depth of 1,200 feet. The GAU determined that, if otherwise compliant with Commission rules, the proposed well will not endanger freshwater in the area.

The surface facilities will be constructed with access to FM 1379. Water and skim oil storage tanks will be located within a containment structure made of an impermeable synthetic material. The structure will have 3-foot high sidewalls and a sufficient volume to contain the combined fluid capacity of all of the tankage and equipment within the structure. Waste haulers will connect directly to the receiving tanks. The truck unloading lanes will be paved with concrete and sloped to direct spillage for containment.

There are three existing wellbores at or within a one-quarter mile radius of the proposed well. The Parker & Parsley Development Co., Floyd H Lease, Well No. 1 (API No. 42-329-00479) is located about 150 feet to the northwest and has been plugged and abandoned. The well was drilled in 1951. Surface casing was set to 135 feet and intermediate casing was set to 3,768 feet. Upon plugging in 1992, six plugs were set in the wellbore, including a cement plug from 275 feet to 375 feet in the production casing. Ruger did not present information regarding cement behind the casing; therefore, Mr. Hale stated that Ruger would accept a permit condition requiring it to re-enter the Floyd H Well No. 1 and squeeze cement behind the production casing from 375 feet to isolate the BUQW.³

There are two wellbores that are located about one-quarter mile from the subject well. The Phillips Petroleum, Marion Lease Well No. 12 (API No. 42-329-01295), located

³ Tr. pg. 85, ln. 15 through pg. 86, ln. 8.

1,271 feet to the east, was drilled in 1951 and was plugged in 1986. This well is plugged in such a manner to isolate the proposed injection interval from the BUQW. The Endeavor Energy Resources, Floyd H Lease Well No. 2 (API No. 42-329-00468) produces from the Spraberry (Trend Area) Field at a depth of 7,042 feet. The Floyd H Well No. 2, located about 1,400 feet to the west, was drilled in 1951, and is cased and cemented to isolate the proposed injection interval from the BUQW.

Larry Carlisle, P.E., provided expert engineering testimony for Ruger. His testimony included well log analysis of the Phillips Petroleum, Marion Lease Well No. 12, located 1,271 feet east of the proposed injection well. Mr. Carlisle stated the Rustler Formation is one of several formations between the USDW and the injection interval. The Rustler Formation is about 1,300 feet thick and is composed primarily of very hard anhydrite and salt. In addition, the upper 125 feet or so of the San Andres Formation exhibits very little porosity or permeability and acts as a seal to the overlying Grayburg Formation. The base of the injection interval is delineated by an abrupt shale contact at about 4,650 feet.

Mr. Carlisle considers the San Andres Formation to have good permeability and porosity for disposal operations; the average permeability is about 17 millidarcies and the average porosity is about 19 percent in Midland County, based on Texas Water Development Board information.⁴ Mr. Carlisle used a porosity of 13 percent for his engineering calculations. He has determined the San Andres Formation to have an estimated 350 feet of gross pay and 280 feet of net effective pay for injection.

Seven wellbores are located outside of the one-quarter mile radius but within one-half mile of the proposed disposal well. Mr. Carlisle described common well completion practices in the 1950s when most of these wells were drilled. About 240 feet of surface casing was cemented to the surface, and production casing was set with about 1,000 feet of cement above the bottom of the casing string. The remainder of the production string annulus would be filled with mud, which, Mr. Carlisle stated, would retain its density properties over time and inhibit the upward movement of fluid along the annulus.

The nearest hydrocarbon production in the area is from the Spraberry Formation at a depth of about 7,050 feet below ground surface. The deepest hydrocarbon production is from the Strawn and Atoka Formations. Currently, most of the nearby production activity is in the Wolfcamp Formation, beginning at a depth of about 8,900 to 9,000 feet. Mr. Hale stated that typical fracture stimulations in this area require about 100,000 bbl water for a one-mile lateral, and about 30 to 50 percent of the water flows back and requires disposal within the first year of production. From June 12, 2014, through October 23, 2014, the Commission approved 482 drilling permits in Midland County. During this same time, 435 permits were approved for adjacent Glasscock County. From June 15, 2014, through

⁴

Ruger Exh. No. 21. Texas Water Development Board, Numbered Publication 157, September-October 1972.

October 23, 2014, the Commission approved 341 completion reports for wells in Midland County, and 370 completion reports for wells in Glasscock County. Mr. Hale believes this level of permitting and completion activity and the salt water disposal needs associated with production and fracture stimulation indicate a continued demand for quality disposal facilities such as the proposed Peggy SWD Well No. 1.

Four injection wells are located within a two-mile radius of the proposed disposal well. Two of these wells are shut in, and one has not yet become operational. Only one of the four wells is an active commercial disposal well authorized to inject up to 2,000 BPD.

Will Lane, production engineer for CrownQuest Operating (CrownQuest), testified in support of the application. CrownQuest currently operates wells within a mile and a half of the proposed disposal well. CrownQuest's development plans include more wells closer to the proposed well on the Floyd Ranch. CrownQuest plans to drill between 30 and 50 vertical wells and 4 horizontal wells in the area in 2015. CrownQuest plans to pipe salt water to the Peggy SWD Well No. 1. Currently CrownQuest trucks its salt water to disposal facilities at a cost of about \$1.65 per barrel. Moving the water by pipeline to the Peggy SWD Well No. 1 will reduce that cost to about \$0.55 per barrel. With no additional drilling, CrownQuest will maintain a need to dispose of about 700 BPD from its existing wells in the immediate area. With its planned vertical well development, its water disposal needs will grow to 9,578 BPD by February 2016. With its planned vertical and horizontal development, CrownQuest's disposal needs will increase to 11,848 BPD by January 2016. CrownQuest believes the Peggy SWD Well No. 1 will allow it to reduce disposal costs which will extend the economic life of its wells in the area.

Jay H. Floyd, Jr., is the surface owner of the proposed injection well tract and a representative of Timber Floyd, Inc., an operator of wells within the one-half mile area of review. Mr. Floyd supports Ruger's application.

PROTESTANT'S EVIDENCE

The application is protested by Mr. Judkins Tull Walton (Walton), who was represented at the hearing by consultants Barry Hagemann and Nguyen Ngoc, P.E. Walton believes the proposed disposal well may harm fresh groundwater and the currently permitted disposal capacity in Midland County is more than sufficient to meet current and near future needs. Walton notes that the total daily permitted disposal capacity in Midland County is 516,300 BPD, and the monthly permitted disposal capacity is more than 16 million barrels per month (BPM). Actual Form H-10 monthly disposal volumes for Midland County commercial disposal wells are typically about 2 million BPM, and about 5 million BPM for all injection wells.

Walton identified three nearby units—Endeavor's Tex-Harvey Spraberry Unit and Pioneer's Shackelford and Preston Spraberry Units—covering about 122 square miles, and stated that both of these operators maintain a significant injection capacity on these units.

Mr. Hagemann identified approximately 248 disposal wells in these units from an online search of Commission records.⁵ Mr. Hagemann stated his opinion that there exists adequate disposal capacity in Midland County to meet the present and future needs of the industry.

Mr. Ngoc reviewed available scout tickets, completion reports, and plugging reports for 10 wells within a one-half mile radius of the proposed disposal well. All but two of these wells were drilled in the 1950s. Based on the available completion information and, where applicable, plugging information, Mr. Ngoc developed wellbore schematic diagrams. In doing so, however, Mr. Ngoc had to calculate the cement tops because completion reports in the 1950s did not require this information. In performing these calculations, Mr. Ngoc used a cement loss factor of 20 to 30 percent, based on his best professional judgement. This analysis indicated all of these wells were completed with some length of uncemented annular spaces between casing or liner and the formation. According to Mr. Ngoc's analysis two nearby wells may act as a conduit for migration between the injection interval and the BUQW:

- Pioneer's Marion Lease Well No. 5 (API No. 42-329-01288) is located about 1,930 feet to the northeast and does not contain any cement in the casing annulus from 237 feet to about 6,600 feet, which includes the BUQW and the proposed injection zone. The well is currently shut in, but it also holds a permit to inject fluid into the Spraberry Formation (below the proposed injection zone).
- Pioneer's Marion Lease Well No. 11 (API No. 42-329-01294) is a plugged well located about 1,970 feet to the southeast and does not contain any cement in the casing annulus from 237 feet to about 4,830 feet, which includes the BUQW and the proposed injection zone. There are several plugs within the casing itself.

In addition, Mr. Ngoc stated his expert opinion that the Floyd H Well No. 1 (150 feet from the subject disposal well) was properly plugged in 1992.⁶ He acknowledged that other wells in the area did have adequate containment of the San Andres Formation injection interval.

Finally, Mr. Ngoc disputes Mr. Carlisle's assertion that drilling mud left in an uncemented casing annulus would retain its density properties over time and inhibit the upward movement of fluid. Mr. Ngoc recalled his experience in the Wasson (San Andres) Field in which the residual mud dried and did not provide as good of a seal as cement.⁷

⁵ Walton Exh. Nos. 6 & 7.

⁶ Tr. pg. 98, Ins. 15-20.

⁷ Tr. pg. 234, Ins. 12-20.

FORMATION PRESSURE CALCULATIONS

While reviewing the Exceptions and Replies, the Examiners discovered a material error in Ruger's pressure-front calculations. This error resulted in a significant underestimation of the effect that injection activity would have on formation pressure. The ultimate concern is that the proposed injection activities will result in an offset formation pressure sufficient to raise injected waste fluids through nearby wells and into the BUQW.

Initial Proof

Mr. Carlisle conducted several engineering calculations to assess the potential impacts of fluid injection at offset locations from the proposed disposal well. First, Mr. Carlisle conducted volumetric calculations to demonstrate the areal extent of injected fluid over time. Assuming the Peggy SWD Well No. 1 injects 20,000 BPD for 30 years, Mr. Carlisle calculates the injected fluid would occupy all of the San Andres Formation pore space out to a radius of 3,280 feet from the injection well.⁸

Second, Mr. Carlisle performed pressure-front calculations to estimate the future formation pressure at an offset well caused by injection at the subject well. Specifically, Mr. Carlisle calculated a pressure front at the Phillips Petroleum, Marion Lease Well No. 12 (API No. 42-329-01295), located 1,271 feet to the east (Attachment B, Ruger Exhibit No. 28). Mr. Carlisle assumed the current formation pressure is 930 psi at the top of the injection interval. Mr. Carlisle based the 930 psi value on the pressure necessary to cause a rise of San Andres Formation fluids to a height in the wellbore of about 2,000 feet, which he believes to be reasonable for the area. Mr. Carlisle stated he was aware of several San Andres Formation injection wells that accepted fluid on a vacuum.⁹ That is, the formation pressure was less than that predicted by a normal hydrostatic gradient of 0.465 psi per foot, and would therefore take water for disposal without additional pressure applied at the surface.¹⁰

Mr. Carlisle's initial calculations indicated the following:

- The formation pressure necessary to raise San Andres fluids to the BUQW is 1,709 psi, and the pressure necessary to raise San Andres fluids to the ground surface is 1,860 psi.

⁸ The Examiners estimate reducing the daily injection rate from 20,000 BPD to 10,000 BPD would consequently reduce the 30-year invaded radius from 3,280 feet to about 2,319 feet.

⁹ Tr. pg. 150, Ins. 14-17.

¹⁰ 16 Tex. Admin. Code §3.13.051(c)(1)(C)(iii).

- After 10 years of injection at a rate of 20,000 BPD, the formation pressure in the 1,271-foot offset well would be 1,429 psi.
- A “worst-case” analysis at the 1,271-foot offset well based on a 10 percent decrease in permeability, a 5 percent decrease in porosity, and a variable time injection horizon yields a formation pressure after 10 years of 1,470 psi and after 20 years it will be 1,655 psi.¹¹

Calculation Error

While reviewing the Exceptions and Replies, the Examiners attempted to, but could not, duplicate the results of Ruger’s pressure front calculations. Attachment C contains the Examiners’ verification calculations. On March 18, 2015, the Examiners notified the parties of the error and their belief that the correct offset formation pressure should be 2,536 psi, not 1,429 psi. The parties were also given an opportunity to respond to the Examiners’ findings.

Corrected Proof

By letter dated April 2, 2015 (Ruger Exhibit No. 30), Ruger confirmed the calculations on its Exhibit No. 28 were incorrect—a result, it stated, of the inadvertent truncation of the compressibility input parameter by the computer software.¹² Instead, Mr. Carlisle stated the 10-year calculated pressure at the 1,271-foot offset well should be corrected to be 2,536 psi, which is sufficient to raise San Andres fluids above the BUQW and the ground surface.

As a result, Ruger reduced its requested daily injection rate to 10,000 BPD, and offered another set of calculations that showed the following (Attachment D):¹³

- After 10 years of injection at a rate of 10,000 BPD, the formation pressure in the 1,271-foot offset well would be 1,733 psi.
- The impact of the 10,000 BPD injection rate at Pioneer’s Marion Lease Well No. 5 located about 1,930 feet to the northeast, would be 1,632 psi after 10 years of injection.

¹¹ Ruger Exh. No. 28.

¹² Ruger Exh. No. 30. Note: The Examiners find the error to have been caused by input of the porosity parameter as a whole number percentage (13), but the equation was formatted for a decimal value (0.13).

¹³ Ruger Exh. No. 30, page A-4.

- A "worst-case" analysis at Pioneer's Marion Lease Well No. 5 located about 1,930 feet to the northeast, based on a 10 percent decrease in permeability, a 5 percent decrease in porosity, and a variable time injection horizon yields an formation pressure after 10 years of 1,703 psi and after 20 years it will be 1,796 psi.

At the hearing, Mr. Ngoc testified that Ruger's pressure-front calculations unreasonably underestimate the current formation pressure of the San Andres Formation. Mr. Carlisle estimated the formation pressure to be 930 psi, while Mr. Ngoc stated the formation was likely at a normal or virgin pressure of 2,000 psi, as the top of the injection interval was at a depth of 4,000 feet. Mr. Ngoc did not provide pressure front calculations at the hearing; he stated there was no need to do so because he of his opinion that the current formation pressure is 2,000 psi. By letter dated April 2, 2015, Walton's representatives agreed that Ruger's original pressure front calculations were in error.

EXAMINERS' OPINION

The Railroad Commission may grant a permit for a commercial disposal well if it meets the requirements of the Texas Water Code § 27.051(b)(1- 4). The Examiners conclude Ruger has not demonstrated that groundwater can be adequately protected from pollution and recommend the denial of the permit. A discussion of the required elements in the Texas Water Code §27.051(b)(1-4) follows, beginning with the groundwater protection element within §27.051(b)(3).

Protecting Ground and Surface Fresh Water from Pollution

The record evidence demonstrates there are two nearby wells that are not adequately cased, cemented or plugged in such a way to ensure isolation of the BUQW from waste fluids injected into the disposal interval. Specifically, Pioneer's Marion Well No. 5, located 1,930 feet to the northeast, contains uncemented casing from a depth of 237 feet to a depth of about 6,600 feet, and is thus uncemented through the BUQW and the disposal interval. The fundamental question is this: Will the proposed injection activities result in an offset formation pressure sufficient to raise injected waste fluids to the BUQW in the Marion Well No. 5 located 1,930 feet to the northeast? Ruger's burden is to prove the answer to this question is "no." However, Ruger has failed prove its proposed disposal activities will not cause pollution to fresh water.

The future formation pressure at an offset well is the sum of: (1) the initial formation pressure; and (2) the increased pressure caused by the injection of fluids into the formation. The actual initial formation pressure can only be determined once a well has been drilled and a bottom-hole pressure test is conducted. Without a well to test, an estimate may be deduced from other known variables and conditions. Starting from scratch, one would calculate a normal pressure gradient at a depth of 4,000 feet to be

1,860 psi.¹⁴ Then, the formation pressure could be adjusted based on available evidence of over- or under-pressurization. Hydrocarbon production from a zone would lower the formation pressure; waste injection into a zone would increase the formation pressure. Mr. Carlisle stated he was aware of many San Andres wells that take disposal fluids on a vacuum. Thus, one could conclude that the San Andres in those areas has a formation pressure less than the normally expected pressure. But, the presence of such a vacuum in a well does not establish the magnitude of under-pressurization. What is more, in this case, there has been no documented production from the San Andres Formation within a two-mile radius of the proposed disposal well. Thus, there is no actual evidence to support the formation being under-pressured. Therefore, the record does not contain evidence supporting a finding that the formation pressure is 930 psi—half of what would be normally expected.

The Examiners acknowledge that, in the original PFD, it was concluded that a current formation pressure of 930 psi is a "reasonable estimate" in this case. In this amended PFD, that conclusion is withdrawn. In the original PFD, the context that informed "reasonableness" for the Examiners was Ruger's pressure-front calculations that are now known to be erroneous. The initial calculations indicated a pressure in the 1,271-foot offset well to be 1,429 psi. Consequently, the pressure in the more distant 1,930-foot offset well would be even lower. Thus, the Examiners believed, an initial formation pressure of 930 psi was, relatively speaking, less critical to the calculated outcome than it otherwise proved to be.

Ruger's pressure-front calculation error, and the subsequently corrected values, have altered the context that informs the reasonableness of an estimate of initial formation pressure. The initial erroneous calculation of a 10-year pressure of 1,429 psi at the 1,271-foot offset well underestimated the correct pressure by 1,107 psi. The correct fluid pressure of 2,536 psi at a depth of 4,000 feet exceeds the pressure necessary to raise salt water to the BUQW (1,709 psi) and the ground surface (1,860 psi). Further, the Examiners calculate Ruger's proposed injection parameters would result in a pressure of 2,335 psi in the 1,930-foot offset well (see Examiners' Calculations in Attachment C).

With its corrected pressure calculations and reduced injection rate, Ruger asserts the following (Attachment D):

- In 10 years, the formation pressure Pioneer's Marion Lease Well No. 5 located about 1,930 feet to the northeast, would be 1,632 psi.

The Examiners agree with the calculated pressure value. However, the corrected calculations—with the reduced disposal rate—now indicate that an accurate estimate of initial

¹⁴ 4,000 feet x 0.465 psi/foot = 1,860 psi. The normal pressure gradient of 0.465 psi/foot is specified in 16 Tex. Admin. Code §3.13.051(c)(1)(C)(iii).

formation pressure is critical to ensuring protectiveness. Ruger's calculated pressure outcomes are on the cusp of causing harm. In the absence of substantiating evidence (beyond conclusory testimony that the San Andres at a depth of 4,000 feet will support a 2,000-foot column of water), an initial formation pressure of 930 psi can no longer be considered a reasonable estimate. It may be possible, but it is not, on its own, reasonable, given the sensitivity of the calculated pressure outcomes on this parameter. Specifically, a slightly higher San Andres Formation initial pressure of 1,007 psi—an increase of just 77 psi—would be sufficient to raise salt water to the BUQW in the nearby Marion Lease Well No. 5 after 10 years. It is now apparent and the Examiners conclude, Ruger must carry this burden with more substantial evidence.

Ruger offered the argument that drilling mud filling the annulus of 50-year old wells would further impede vertical migration of fluids to shallow fresh water zones. Walton disputes this assertion. The Examiners observe that the Commission's rules require certain amounts of cement to be placed to isolate fresh water, corrosive, or productive fluid-bearing formations. The presence, quality, or condition of drilling mud is immaterial to this analysis.

The Use or Installation of the Injection Well Is in the Public Interest

The Applicant has demonstrated that the use or installation of the proposed Peggy SWD Well No. 1 is in the public interest. Two of the four operators of wells within a one-half mile area of review were present at the hearing in support of Ruger. CrownQuest, specifically, provided a tabulation of projected water production and disposal needs of its current and planned development, including an statement that the Peggy SWD Well No. 1 will cause it significant cost savings over other existing disposal options. Ruger testified that the other two operators, Pioneer and Endeavor, were also in support of the application and have indicated they, too, would utilize the Peggy SWD Well No. 1.

Protestant Walton provided a summary of permitted disposal capacity in Midland County and a list of about 248 disposal permits in three large unitized areas near the proposed disposal well.¹⁵ On examination, the evidence does not support the Protestant's position. First, the Examiners acknowledge the impracticality of correlating permitted to actual disposal volumes. While a well may be permitted with a maximum daily volume, there are many reasons why the permitted volume is not routinely achievable that have nothing to do with the need for disposal services. In and of itself, this comparison is not useful.

Second, the list of about 248 disposal wells purportedly in the three unitized areas, on its own, carries no weight as evidence. The list—compiled from queries of the Commission's online information system—actually represents all injection permits (disposal, secondary recovery, etc.) associated with several leases. The Protestant claims these

¹⁵

Walton Exh. No. 7.

leases to be associated with the three units identified on Walton's Exhibit No. 6. The Examiners note these three units appear to cover at least 122 square miles as indicated on Walton Exhibit No. 6. So, more or less, there are about two injection permits per square mile section. In an area with extensive production dating back to the early 1950s with secondary recovery, this is not unreasonable. In fact, this is consistent with Ruger's demonstration that there are four injection wells within a two-mile radius.¹⁶ What's more, the Examiners took judicial notice of the locations of the first five wells listed on Walton's Exhibit No. 7 on the Commissions online geographic information system, which indicated four of the five wells are plugged and abandoned.¹⁷ Again, this is consistent with the well status of nearby injection wells reported by Ruger. Apart from identifying the wells on the exhibit, the Protestant provided no additional information to support an analysis of its relevance or importance.

Protecting Oil, Gas, or Other Mineral Formations

The evidence of record supports the conclusion that the Peggy SWD Well No. 1 will not endanger or injure any oil, gas, or other mineral formation. The San Andres Formation is not productive in the area, and there is no historical production in the overlying strata. The nearest producing stratum is the Spraberry Formation at a depth of about 7,050 feet, which is located 2,450 feet below the base of the proposed disposal interval.

Financial Responsibility

Ruger has an active Form P-5 and a letter of credit for the amount of \$25,000 for financial assurance. Ruger has made a satisfactory showing of financial responsibility as required by the Texas Water Code §27.073.

FINDINGS OF FACT

1. On May 23, 2014, notice of the application was mailed to the Midland County Clerk, offset operators, and the surface owner of the subject tract.
 - a. Notice of the application was published on May 24, 2014, in the *Midland Telegraph-Reporter*, a newspaper of general circulation in Midland County.
 - b. On July 17, 2014, notice of the application was mailed to adjoining surface owners not included in the May 23, 2014 notice.

¹⁶ Ruger Exh. No. 29.

¹⁷ See <http://www.gisp.rrc.state.tx.us/GISViewer2/>

2. The application is protested by Judkins Tull Walton, an adjoining property owner to the south.
3. Ruger Properties, LLC proposes to permit a newly-drilled commercial disposal well in the San Andres Formation and assigned to the Spraberry (Trend Area) Field. Ruger Properties, LLC proposes to construct and operate the well as follows:
 - a. The well will be drilled to a depth of 4,600 feet.
 - b. Surface casing (9 5/8-inch) will be set to a depth of 375 feet with cement circulated to the surface.
 - c. Production casing (7-inch) will be set to a depth of 4,600 feet with cement circulated to the surface.
 - d. The well will be perforated in the San Andres Formation, with the exact depths to be determined based on well log analysis after the borehole is drilled.
 - e. Injection tubing (3 1/2-inch) will be set with a packer not more than 100 feet above the uppermost perforation.
 - f. The maximum daily injection volume will be 10,000 barrels per day (BPD).
 - g. The maximum surface injection pressure will be 2,000 pounds per square inch gauge (psig), with an average surface injection pressure of 1,800 psig.
 - h. The facility will receive salt water for disposal by pipeline from at least one operator and by truck from other operators.
4. In the location of the subject disposal well, the San Andres Formation exhibits the following characteristics:
 - a. The average permeability is about 17 millidarcies in Midland County.
 - b. The average porosity is about 19 percent in Midland County; a porosity of 13 percent was used for the pressure calculations.
 - c. 280 feet of net effective pay for injection.
 - d. The formation may contain hydrogen sulfide and corrosive fluids.

5. Two nearby wells may act as a conduit for migration between the injection interval and the BUQW:
 - a. Pioneer's Marion Lease Well No. 5 (API No. 42-329-01288) is a shut-in well located about 1,930 feet to the northeast and does not contain any cement in the casing annulus from 237 feet to about 6,600 feet, which includes the BUQW and the proposed injection zone.
 - b. Pioneer's Marion Lease Well No. 11 (API No. 42-329-01294) is a plugged well located about 1,970 feet to the southeast and does not contain any cement in the casing annulus from 237 feet to about 4,830 feet, which includes the BUQW and the proposed injection zone.
6. The evidence in the record does not demonstrate that both ground and surface fresh water will be adequately protected from pollution.
 - a. The base of usable quality groundwater (BUQW) is at a depth of 325 feet, and the base of underground sources of drinking water (USDW) is at a depth of 1,200 feet.
 - b. The formation pressure necessary to raise salt water from the top of the injection interval (4,000 feet) to the BUQW is 1,709 psi. The formation pressure necessary to raise salt water from the top of the injection interval and the ground surface is 1,860 psi.
 - c. Ruger's estimated initial pressure in the San Andres Formation of 930 psi is not supported by evidence in the record. Under a normal pressure gradient, a formation pressure of 1,860 psi at 4,000 feet is expected.
 - d. The actual initial formation pressure at 4,000 feet is not known.
 - e. Under a normal pressure gradient and a reduced injection rate of 10,000 BPD for 10 years, the calculated pressure at Pioneer's Marion Lease Well No. 5 located about 1,930 feet to the northeast is 2,562 psi, which is sufficient to raise injected fluids to the BUQW and the ground surface.
7. The proposed disposal well is in the public interest.
 - a. The four operators of wells within a one-half mile area of review are in support of the application, demonstrating a need for additional

disposal capacity. CrownQuest Operating and Timber Floyd participated in the hearing.

- b. CrownQuest anticipates a need to dispose of an additional 11,000 BPD by 2016.
 - c. Use of the Peggy SWD Well No. 1 will significantly lower waste disposal costs for CrownQuest Operating.
 - d. Pipelines to the proposed disposal well will reduce disposal costs and vehicular traffic on nearby roadways.
 - e. Four injection wells are located within a two-mile radius of the proposed well. One of these is shut-in, and two others are private wells. The fourth has a daily capacity of only 2,000 BPD
8. The Applicant has demonstrated that injected fluids will not endanger or injure oil or gas formations.
- a. The San Andres Formation is not productive of oil or gas in the area.
 - b. The Spraberry Formation is productive at a depth of 2,450 feet below the proposed disposal interval.
 - c. The proposed disposal well will not penetrate the Spraberry (Trend Area) Field.
9. Ruger Properties, LLC has a current approved Form P-5 (Organization Report) and has posted a \$25,000 financial assurance letter of credit.

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 § 3.9
- 3. Ruger Properties, LLC has failed to demonstrate that, with proper safeguards, both ground and surface fresh water can be adequately protected from pollution. Texas Water Code § 27.051(b)(3)
- 4. Ruger Properties, 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 9.

RECOMMENDATION

Based on the above findings of fact and conclusions of law, the Examiners recommend the Commission enter an order denying the pending application.

Respectfully submitted,



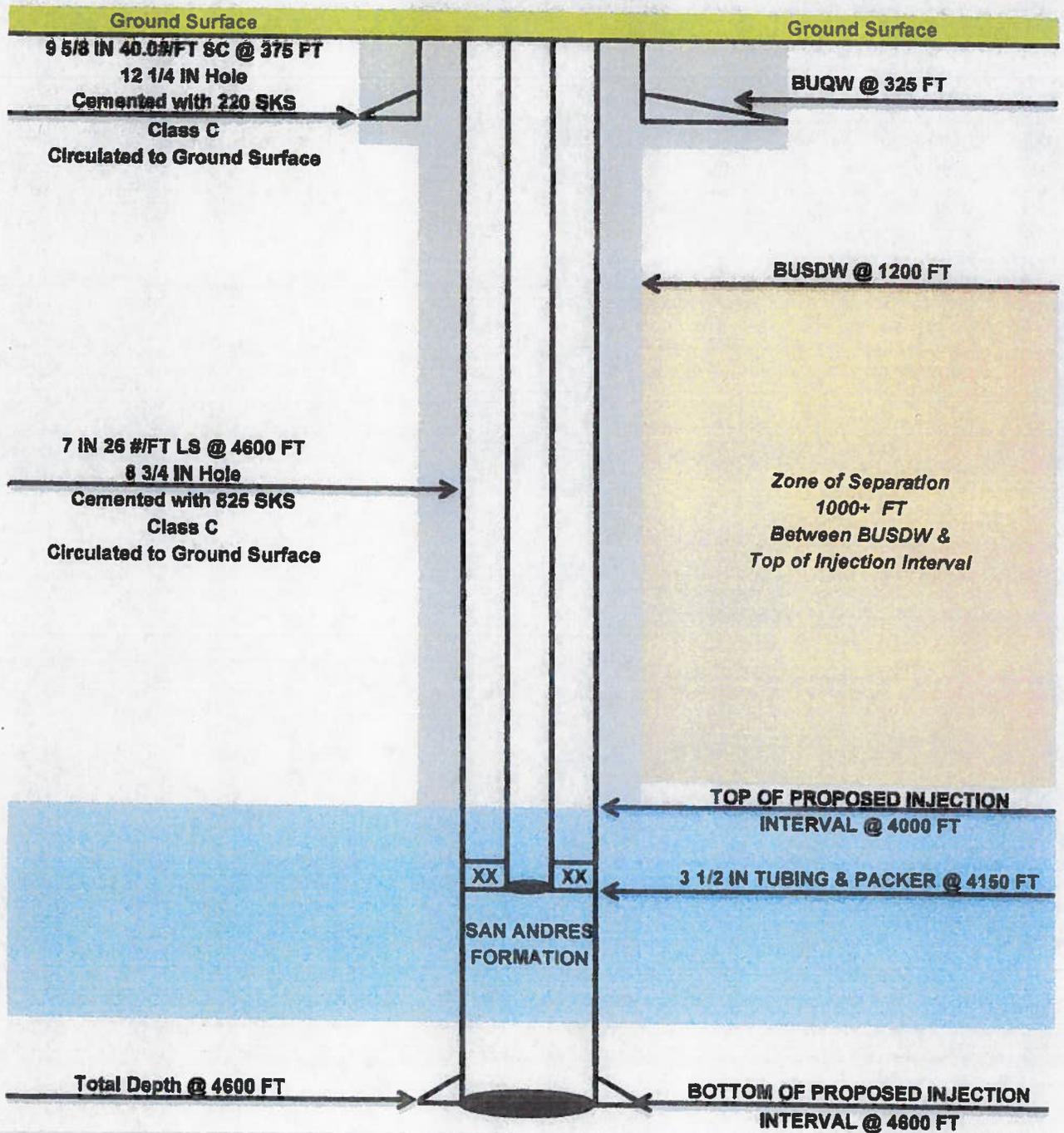
Paul Dubois
Technical Examiner



Terry Johnson
Hearings Examiner

Ruger Properties, LLC
Peggy SWD, Well No. 1
Sprayberry (Trend Area) Field
Commercial Disposal Facility
Proposed Wellbore Configuration

ATTACHMENT A
WELLBORE SCHEMATIC



NOT TO SCALE - FOR VISUAL ONLY

EXHIBIT
23

Jerry E. Carlisle
REGISTERED PROFESSIONAL ENGINEER

PRESSURE FRONT CALCULATIONS

for

RAILROAD COMMISSION OF TEXAS

FOR:
 RUGER PROPERTIES, LLC
 PEGGY SWD, WELL NO. 1
 SPRABERRY (TREND AREA) FIELD
 MIDLAND COUNTY, TX

BY:
 LARRY E. CARLISLE, P.E.
 PETROLEUM CONSULTANT
 1108 PAGEDALE DRIVE
 CEDAR PARK, TX 78613-5810

EQUATION FOR INFINITE UNBOUNDED RESERVOIR (FROM MATTHEWS & RUSSELL, 1967)

$$P(R,T) = P_i + \frac{162.6 * Q * U * B}{K * H} * \text{LOG} \frac{K * T}{70.4 * P * U * C * R * R}$$

INPUT PARAMETERS

- 17 MD = PERMEABILITY (K)
- 20000 BBLS/D = MAX. INJECTION VOLUME (Q) = BBLS/D Equivalent
- 280 FT = NET THICKNESS (H)
- 13.0 % = POROSITY (P)
- 930 PSI = CURRENT BHP (PSI)
- 4000 FT = TOP OF INJECTION INTERVAL (FT)
- 1271 FT = DISTANCE
- 325 FT = BASE OF USABLE QUALITY GROUNDWATER
- 1 RB/STB = FORMATION VOLUME FACTOR (B)
- 0.810 CP = VISCOSITY (CP)
- 0.0000065 1/PSI = FORMATION COMPRESSIBILITY @ = (Cr + Cw)
- 10 YRS = TIME (T)

ATTACHMENT B

Original Pressure-Front Calculations

CALCULATED FORMATION PRESSURE USING NOMINAL RESERVOIR VALUES:

- 1429 PSI WILL BE THE FORMATION PRESSURE IN THE WELL 1271 FT AWAY.
- 1 FT IS THE RADIUS OF ENDANGERMENT FOR THE STATED CONDITIONS
- 1860 PSI FORMATION PRESSURE WILL RAISE OILFIELD BRINE UP TO SURFACE
- 1709 PSI FORMATION PRESSURE WILL RAISE OILFIELD BRINE UP TO BUQW
- 1974 PSI FORMATION PRESSURE WILL OVERCOME A COLUMN OF 9.5 #/GAL MUD
- 1872 PSI FORMATION PRESSURE WILL OVERCOME A COLUMN OF 9.0 #/GAL MUD

CHECK EFFECT OF RESERVOIR VARIATION

- 1456 PSI FORMATION PRESSURE WILL RESULT FROM A 10% DECREASE IN PERMEABILITY
- 15 MD IS A 10% DECREASE IN THE PERMEABILITY

- 1441 PSI FORMATION PRESSURE WILL RESULT FROM A 5% DECREASE IN POROSITY
- 12 % IS A 5% DECREASE IN THE POROSITY

PERMEABILITY & POROSITY VARIATIONS COMBINED FOR "WORST" CASE ANALYSIS

- 1655 PSI FORMATION PRESSURE WILL RESULT AFTER 20 YEARS
- 1470 PSI FORMATION PRESSURE WILL RESULT AFTER 10 YEARS
- 1285 PSI FORMATION PRESSURE WILL RESULT AFTER 5 YEARS

EXHIBIT

28

Larry E. Carlisle

Larry E. Carlisle, P.E.
 Firm No. 9708



**ATTACHMENT C
EXAMINER'S CALCULATIONS**

Paul Dubois, Technical Examiner
May 1, 2015

This attachment summarizes the Examiner's efforts to evaluate Ruger's pressure front calculations and the potential for the proposed well to result in waste fluids being raised to the BUQW in nearby wells. The source equation and input parameters are defined on the second page.

First, the Examiners attempted to verify Ruger's calculated pressure of 1,429 psi at the 1,271-foot offset well by applying the input parameters on Ruger's Exhibit No. 28 to the Matthews & Russell equation:

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 930 + \left[\frac{162.6 * 20,000 * 0.81 * 1}{17 * 280} \right] * \log \left[\frac{17 * 3,650}{70.4 * 0.13 * 0.81 * 0.0000065 * 1,271^2} \right]$$

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 2,536 \text{ psi} \quad (\text{sufficient to raise water to the ground surface})$$

Second, the Examiners determined that Ruger erred by using a whole number (percent) for porosity ($\varphi = 13$) instead of the correct decimal form ($\varphi = 0.13$). Using the incorrect whole number form we calculated a pressure matching Ruger's incorrect calculated value:

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 930 + \left[\frac{162.6 * 20,000 * 0.81 * 1}{17 * 280} \right] * \log \left[\frac{17 * 3,650}{70.4 * 13 * 0.81 * 0.0000065 * 1,271^2} \right]$$

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 1,429 \text{ psi}$$

Third, the Examiners calculated the pressure-front at Pioneer's Marion Well No. 5, located 1,930 feet from the proposed well using Ruger's initial input parameters:

$$P_{(1930 \text{ ft}, 10 \text{ years})} = 930 + \left[\frac{162.6 * 20,000 * 0.81 * 1}{17 * 280} \right] * \log \left[\frac{17 * 3,650}{70.4 * 0.13 * 0.81 * 0.0000065 * 1,930^2} \right]$$

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 2,335 \text{ psi} \quad (\text{sufficient to raise water to the ground surface})$$

Fourth, the Examiners calculated the pressure-front at Pioneer's Marion Well No. 5, located 1,930 feet from the proposed well, using Ruger's reduced daily injection rate of 10,000 BPD:

$$P_{(1930 \text{ ft}, 10 \text{ years})} = 930 + \left[\frac{162.6 * 10,000 * 0.81 * 1}{17 * 280} \right] * \log \left[\frac{17 * 3,650}{70.4 * 0.13 * 0.81 * 0.0000065 * 1,930^2} \right]$$

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 1,632 \text{ psi}$$

Fifth, the Examiners calculated the pressure-front at Pioneer's Marion Well No. 5, located 1,930 feet from the proposed well, using Ruger's reduced daily injection rate of 10,000 BPD, and a normal hydrostatic gradient bottom hole pressure of 1,860 psi:

$$P_{(1930 \text{ ft}, 10 \text{ years})} = 1,860 + \left[\frac{162.6 * 10,000 * 0.81 * 1}{17 * 280} \right] * \log \left[\frac{17 * 3,650}{70.4 * 0.13 * 0.81 * 0.0000065 * 1,930^2} \right]$$

$$P_{(1271 \text{ ft}, 10 \text{ years})} = 2,562 \text{ psi} \quad (\text{sufficient to raise water to the ground surface})$$

From Matthews & Russell, 1967:

$P_{(r,t)}$ = Formation pressure at an offset distance (r) and time (t) in an infinite, unbounded reservoir

$$P_{(r,t)} = P_i + \left[\frac{162.6 * Q * \mu * B}{k * h} \right] * \log \left[\frac{k * t}{70.4 * \varphi * \mu * C * r^2} \right]$$

Matthews, C. S., and Russell, D. G. Pressure Buildup and Flow Tests in Wells. Henry L. Doherty Memorial Fund of AIME and the Society of Petroleum Engineers of AIME. New York. 1967.

Ruger's Input Parameters:

Parameter	Symbol	Applicant's Input Value	Units
Permeability	k	17	millidarcies
Injection Volume	Q	20,000	bbl/day
Net Thickness	h	280	feet
Porosity	φ	13 0.13	percent decimal form
Current bottom-hole pressure	P_i	930	psi
Top of injection interval	--	4,000	feet
Distance to offset well	r	1,271	feet
Base of Usable Quality Water	--	325	feet
Formation volume factor	B	1	bbl _{res} /bbl _{st}
Viscosity	μ	0.81	centipoise
Compressibility	C	0.0000065	psi ⁻¹
Time	t	10 3,650	years days

Hydrostatic Gradients and Pressures

A normal hydraulic gradient for saltwater is 0.465 psi/foot [16 Tex. Admin. Code §3.13.051(c)(1)(C)(iii)]. The Base of Usable Quality Water (BUQW) is at a depth of 325 feet, and the top of the injection interval is at 4,000 feet.

Pressure required to raise a column of salt water from the top of the injection interval to the BUQW:

$$P_{(h)} = (4,000 \text{ ft} - 325 \text{ ft}) * \left(0.465 \frac{\text{psi}}{\text{ft}} \right) = 1,709 \text{ psi}$$

Pressure required to raise a column of salt water from the top of the injection interval to the ground surface:

$$P_{(h)} = (4,000 \text{ ft}) * \left(0.465 \frac{\text{psi}}{\text{ft}} \right) = 1,860 \text{ psi}$$

PRESSURE FRONT CALCULATIONS

for
RAILROAD COMMISSION OF TEXAS

FOR:

RUGER PROPERTIES, LLC
PEGGY SWD, WELL NO. 1
SPRABERRY (TREND AREA) FIELD
MIDLAND COUNTY, TX

BY:

LARRY E. CARLISLE, P.E.
PETROLEUM CONSULTANT
1108 PAGEDALE DRIVE
CEDAR PARK, TX 78613-5810

EQUATION FOR INFINITE UNBOUNDED RESERVOIR (FROM MATTHEWS & RUSSELL, 1967)

$$P(R,T) = P_i + \frac{162.6 \cdot Q \cdot U \cdot B}{K \cdot H} \cdot \text{LOG} \frac{K \cdot T}{70.4 \cdot P \cdot U \cdot C \cdot R \cdot R}$$

INPUT PARAMETERS

- 17 MD = PERMEABILITY (K)
- 10000 BBL/D = MAX. INJECTION VOLUME (Q) = BBL/D Equivalent
- 280 FT = NET THICKNESS (H)
- 13.0 % = POROSITY (P)
- 930 PSI = CURRENT BHP (PSI)
- 4000 FT = TOP OF INJECTION INTERVAL (FT)
- 1930 FT = DISTANCE
- 326 FT = BASE OF USABLE QUALITY GROUNDWATER
- 1 RB/STB = FORMATION VOLUME FACTOR (B)
- 0.810 CP = VISCOSITY (CP)
- 0.0000065 1/PSI = FORMATION COMPRESSIBILITY © = (Cr + Cw)
- 10 YRS = TIME (T)

ATTACHMENT D
Corrected Pressure-Front
Calculations

CALCULATED FORMATION PRESSURE USING NOMINAL RESERVOIR VALUES:

- 1632 PSI WILL BE THE FORMATION PRESSURE IN THE WELL 1930 FT AWAY
- 1 FT IS THE RADIUS OF ENDANGERMENT FOR THE STATED CONDITIONS
- 1860 PSI FORMATION PRESSURE WILL RAISE OILFIELD BRINE UP TO SURFACE
- 1709 PSI FORMATION PRESSURE WILL RAISE OILFIELD BRINE UP TO BUQW
- 1974 PSI FORMATION PRESSURE WILL OVERCOME A COLUMN OF 9.5 #/GAL MUD
- 1872 PSI FORMATION PRESSURE WILL OVERCOME A COLUMN OF 9.0 #/GAL MUD

CHECK EFFECT OF RESERVOIR VARIATION

- 1698 PSI FORMATION PRESSURE WILL RESULT FROM A 10% DECREASE IN PERMEABILITY
- 15 MD IS A 10% DECREASE IN THE PERMEABILITY

- 1639 PSI FORMATION PRESSURE WILL RESULT FROM A 5% DECREASE IN POROSITY
- 12 % IS A 5% DECREASE IN THE POROSITY

PERMEABILITY & POROSITY VARIATIONS COMBINED FOR "WORST" CASE ANALYSIS

- 1798 PSI FORMATION PRESSURE WILL RESULT AFTER 20 YEARS
- 1703 PSI FORMATION PRESSURE WILL RESULT AFTER 10 YEARS
- 1611 PSI FORMATION PRESSURE WILL RESULT AFTER 5 YEARS

Exhibit A-4

Larry E. Carlisle
Larry E. Carlisle, P.E.
Firm No. 9708

