



RAILROAD COMMISSION OF TEXAS

HEARINGS DIVISION

OIL & GAS DOCKET NO. 02-0295336, et al.

THE APPLICATIONS OF HILCORP ENERGY COMPANY PURSUANT TO 16 TEX. ADMIN. CODE §3.46 FOR PERMITS TO INJECT FLUID INTO A RESERVOIR PRODUCTIVE OF OIL OR GAS, WEST RANCH -A- LEASE, WELL NUMBERS 1129, 1144, 1133, 1139, 1089, 1136, 1131, 1104, 1149, 1126, 1115, & 1127, WEST RANCH (41-A & 98-A CONS.) FIELD, JACKSON COUNTY, TEXAS

HEARD BY: Brian Fancher, P.G. – Technical Examiner
John Dodson - Legal Examiner

APPEARANCES:

APPLICANT:

Brian Sullivan
Bill Hayenga
Jay King
Abel Salazar
Jill Fisk
Michael Schoetz

Dan Gutierrez

PROTESTANTS:

David Moraine
Todd Lanphere
Andy Trevino

Phillip Ledbetter
J. Eric Magee

REPRESENTING:

Hilcorp Energy Company

Texas General Land Office

REPRESENTING:

Phere Operating, Inc.

Texana Groundwater Conservation District

PROCEDURAL HISTORY

Application Published:
Application Filed:

October 8, 2014 & February 11, 2015
October 8, 2014

Protest Received:	November 4, 2014
Request for Hearing:	December 3, 2014
Notice of Hearing:	January 30, 2015
Hearing Held:	March 18 and 20, 2015
Transcript Received:	April 13, 2015
Record Closed:	April 13, 2015
Proposal for Decision Issued:	May 6, 2015

STATEMENT OF THE CASE

This Examiners' Proposal For Decision is made of the following oil and gas docket numbers: 02-0295336; 02-0294742; 02-0294743; 02-0294849; 02-0294850; 02-0294851; 02-0294854; 02-0294855; 02-0294856; 02-0294858; 02-0294859; and 02-0294860. At the onset of the hearing, the Examiners ruled to consolidate the above-named dockets into Oil & Gas Docket No. 02-0295336 for administrative convenience and due to the common facts and parties of the cases (Pg. 16 L. 16, Vol. I).¹

Hilcorp Energy Company ("Hilcorp" or "Applicant") seeks authority to inject produced water into its West Ranch -A- Lease (the "Subject Lease"), Well Nos. 1129, 1144, 1133, 1139, 1089, 1136, 1131, 1104, 1149, 1126, 1115, and 1127 (the "Subject Wells"), pursuant to Statewide Rule 46 [16 Tex. Admin. Code §3.46].² The Subject Lease is composed of roughly 4,700-acres. Collectively, Hilcorp proposes to inject 240,000 barrels of produced water per day (20,000 barrels of water per day per well) into five sand-members of the Frio Formation from 5,050 to 6,339 feet. Hilcorp maintains that the scope of this case is to inject produced water from the overlying Catahoula Formation into the Subject Wells' proposed injection interval to reach minimum missibility in the Subject Field. Hilcorp acknowledges, however, that this requested relief will advance Hilcorp's ultimate goal of employing a carbon-dioxide ("CO2") flood on the Subject Lease for enhanced recovery purposes in the West Ranch (41-A & 98-A Cons.) Field in Jackson County, Texas.

On January 30, 2015, Notice of Hearing was issued by the Commission for the above-named twelve individual dockets. Each docket's Notice of Hearing lists only the West Ranch (98-A) Field as the Commission-designated field pertinent to the respective application. However, at its public conference held on January 27, 2014, the Commission approved Hilcorp's application to consolidate the West Ranch (98-A) Field and West Ranch (41-A) Field into the West Ranch (41-A & 98-A Consolidated) Field in Jackson County, Texas.³

Mr. Dan Gutierrez, a representative of the Texas General Land Office ("GLO"), provided public comment in support Hilcorp's consolidated application. With regard to the Subject Lease, Mr. Gutierrez stated that the GLO has entered in a unitization agreement with Hilcorp. Mr.

¹ Citations are to the page, line and volume of the transcript made for the subject application's proceedings held on March 18 and 20, 2015.

² The subject applications were filed with the Oil & Gas Division on October 8, 2014. As a result, this case is being considered under the version of Statewide Rule 46 that was in effect from July 2, 2012, through November 16, 2014.

³ Hilcorp's Exh. I – Copy of Oil & Gas Final Order 02-0292677; Application of Hilcorp Energy Company to Consolidate the West Ranch (41-A) and West Ranch (98-A) Fields and to Adopt Field Rules for the Proposed West Ranch (41-A & 98-A Cons.) Field, Jackson County, Texas.

Gutierrez suggested that the GLO will benefit from future production resulting from Hilcorp's proposed injection operations (Pg. 32, L. 13).

Hilcorp's consolidated application is protested by Phere Operating, Inc. ("Phere") and Texana Groundwater Conservation District ("Texana"). Phere operates a leasehold of roughly 374-acres ("Phere's Acreage"), which immediately offsets the Subject Lease's northern boundaries.⁴ Phere alleges that Hilcorp's application should not be approved because: (1) injection fluids will not be confined to the proposed injection interval, (2) pollution of groundwater will result through several plugged and abandoned wells located on the Subject Lease, and (3) Phere will be unable to recover its fair share of hydrocarbons in the Subject Field as a result of Hilcorp's proposed injection operations (Pg. 19, L. 20 through Pg. 27, L. 16).

Texana is the groundwater district established in Jackson County, Texas. Texana believes that Hilcorp's consolidated application should not be because: (1) potential pollution of fresh water could result from Hilcorp's proposed injection operations, (2) Hilcorp's applications are incomplete, and should thereby be dismissed, because Hilcorp failed to specifically list in its applications that the water to be injected comes from the Catahoula Formation, and (3) Hilcorp has failed to agree or commit to a groundwater monitoring plan in relation to its applications (Pg. 27, L. 19 through Pg. 30, L. 8).

DISCUSSION OF THE EVIDENCE

Statewide Rule 46 ("SWR 46")

Generally, SWR 46 requires that a permit be approved prior to conducting fluid injection operations in a reservoir productive of oil, gas, or geothermal resources. An applicant is required to file its injection application to the Commission's Austin office, as well as supply a copy to affected persons who include: (1) the owner of record of the surface tract on which the well is located; (2) each commission-designated operator of any well located within one-half mile of the proposed injection well; (3) the county clerk of the county in which the well is located; and (4) the city clerk or other appropriate city official of any city where the well is located within the corporate city limits of the city.⁵ In addition, notice of each injection application is required to be published once by the applicant in a newspaper of general circulation for the county where the injection well will be located.

SWR 46(c)(5)(B) defines "affected persons" as:

[A] person who has suffered or will suffer actual injury or economic damage other than as a member of the general public or as a competitor, and includes surface owners of property on which the well is located and commission-designated operators of wells located within one-half mile of the proposed disposal well.

⁴ Hilcorp Exh. A.

⁵ 16 Tex. Admin. Code §3.46(c) ("Notice and opportunity for hearing").

Of the Subject Wells, Well No. 1136 is located nearest to Phere's Acreage.⁶ However, Phere does not have a well that falls within a half-mile radius of Well No. 1136. In other words, by letter of the rule (*i.e.*, SWR 46(c)(1)) Hilcorp was not required to provide Phere a copy of the injection applications for Well No. 1136 or any other well because Phere does not operate a well located within a half-mile from any of the Subject Wells. Nonetheless, Hilcorp did not formally contest Phere's standing to participate in this proceeding (Pg. 20 L. 25, Vol. I).

Applicant's Evidence (Hilcorp)

King's Supporting Testimony

Mr. Jay King, a Staff Geologist employed at Hilcorp, testified as an expert geologic witness on behalf of Hilcorp.

The Subject Field was formed on January 27, 2015, through a consolidation of the West Ranch (41-A) and West Ranch (98-A) Fields ("41-A Field and 98-A Field").⁷ Historically, the 41-A and 98-A Fields were two of six major reservoirs that comprised the West Ranch Field, which was discovered in 1938. The Commission's March 2015 Oil Proration Schedule indicates that the 41-A Field has produced a cumulative 84,232,036 barrels of oil, and the 98-A Field has produced a total of 44,948,843 barrels of oil. Furthermore, each proration schedule indicates that Hilcorp and Etaba Operating Company are the only operators with wells in the Subject Field.⁸

Hilcorp is in the process of unitizing portions of the Frio Formation for enhanced recovery purposes. From an aerial perspective, Hilcorp's proposed unit includes roughly 4,700-acres. The purpose of Hilcorp's proposed unit is to employ enhanced recovery operations in the Frio Formation to rescue residual hydrocarbons which were not recovered by previous operators in the Subject Field. Mr. King testified that approval of Hilcorp's consolidated application is integral for Hilcorp to successfully exercise its proposed secondary recovery operations on the Subject Lease.

Geology

Hilcorp's proposed injection interval is from 5,050 feet to 6,339 feet. This application is aimed at injecting produced water that originates from the Catahoula Formation ("Catahoula") into the Frio Formation ("Frio"). Stratigraphically, the Catahoula, Anahuac Shale, and Frio occur sequentially when uninterrupted by depositional or structural irregularities. Mr. King testified that the Catahoula is the historically preferred zone of choice for disposal by operators in the area, and that the Catahoula has become slightly overcharged. As a result, Hilcorp proposes to take produced water from the Catahoula and inject it into the Frio to obtain minimum miscibility in the proposed injection interval.

⁶ Hilcorp Exh. A – By estimation using the scale on the exhibit (1" = 3,000 ft.), the Examiners approximate the southwest tip of Phere's Acreage is situated about 2,400 feet northwest of Well No. 1136.

⁷ Hilcorp Exh. I.

⁸ Hilcorp Exhs. G and H – March 2015 Oil Proration Schedules for the 41-A and 98-A Fields. Etaba Operating Company is listed as a delinquent operator.

Beneath the Subject Lease, the Frio is composed of the following sand-members: (1) Greta (historically named the West Sand); (2) Glasscock; (3) Ward; (4) 41-A; and (5) 98-A (historically named the Four Way Ranch Sand).⁹ These five sand members make up the historic productive zones of the West Ranch Field. Mr. King testified that the top of each member occurs below the surface at roughly 5,100 feet, 5,500 feet, 5,670 feet, 5,760 feet, and 6,100 feet, respectively (Pg. 42 L. 18, Vol. I).¹⁰ The average permeability of each member is between 25 to 30 millidarcies, with exception to the Greta which offers about one Darcy of permeability (Pg. 62, L. 11).

The Anahuac Shale ("Anahuac"), also known as the marine wedge,¹¹ essentially is an impermeable shale approximately 500 feet thick. Mr. King testified that the Anahuac is regionally contiguous and occurs from roughly 4,450 feet to 5,000 feet below the surface (Pg. 43, L. 6).¹² Furthermore, the Anahuac is a soft, dispersive sedimentary formation that contains high smectite clay mineralogy. Mr. King stated that because the Anahuac includes a high percentage of smectite clay, it has a natural propensity to swell around wellbore casings which penetrate it once it comes into contact with water (Pg. 43, L. 19).¹³ In other words, according to Mr. King, the Anahuac not only acts as a cap to the proposed injection interval, it also acts as a seal around wellbore casings once it comes into contact with water (Pg. 49, L. 15).

Hilcorp submitted structure maps for the 41-A and 98-A members based on the measured tops of each zone.¹⁴ The 41-A and 98-A members extend longitudinally from northeast to southwest with the center of the Subject Lease being the highest structural position. Mr. King testified that the Subject Field's (*i.e.*, the 41-A and 98-A members) dominant structural feature is its four-way dip closure. Furthermore, Mr. King testified that the same four-way closure is found in the proposed injection intervals overlying members (*i.e.*, the Greta, Glasscock, and Ward).

In summary, Mr. King's expert testimony is that the proposed injection interval is continuous and contiguous, and that the Anahuac is a sufficient seal for injection of produced water throughout the Subject Lease (Pg. 57, L. 16).¹⁵

Salazar's Supporting Testimony

Mr. Abel Salazar, a Staff Reservoir Engineer at Hilcorp, testified as an expert reservoir engineer on behalf of Hilcorp (Pg. 68, L. 18). Mr. Salazar testified that he has spent 30 years working with secondary and tertiary recovery operations for various operators. Mr. Salazar testified that he was the operations manager and reservoir engineer for tertiary recovery projects for the Oyster Bayou and Hastings Fields, which he states are analogous fields to the subject application (Pg. 66, L. 12).

⁹ Hilcorp Exh. C – Chronostratigraphic column of geologic members that make up the Frio Formation in Jackson County.

¹⁰ Hilcorp Exh. 5 – Bauernchmidt, A.J., Jr.; *West Ranch Oil Field, Jackson County, Texas*; Bulletin of the American Association of Petroleum Geologists, Vol. 28, No. 2 (February 1944); Figures 7 and 8.

¹¹ *Id.* - Pg. 203, at ¶ 1.

¹² *Id.*

¹³ Hilcorp Exh. No. 6, pgs. 129 and 137 – Wilson, M.J. and L. Wilson; *Clay Mineralogy and Shale Instability: An Alternative Conceptual Analysis*; The Mineralogical Society 2014.

¹⁴ Hilcorp Exh. Nos. 8 and 7, respectively.

¹⁵ Hilcorp Exh. Nos. 10 and 11 – Crosssections A-A' and B-B'.

Injection Interval

Hilcorp seeks to permit the subsurface interval from 5,050 to 6,339 feet in each of the twelve Subject Wells. As previously mentioned, Hilcorp's proposed injection interval includes five (5) Frio-aged sand members (*i.e.*, the Greta, Glasscock, Ward, 41-A, and 98-A, successively). Initially, Hilcorp intends to inject only in the Glasscock and Ward members to raise the reservoir pressure to minimum miscibility - essentially the original reservoir pressure seen before its depletion.

The surface location for the Subject Wells is located on the peripheral of the Subject Field near the original oil-water contact (Pg. 51, L. 22). From an aerial view, the Subject Wells' surface locations form an upright horse-shoe shape in the southern-half of the Subject Lease.¹⁶

Development Plan

Although Hilcorp's applications only consider injection of produced water, Mr. Salazar testified that Hilcorp has future plans to apply for Commission approval to inject CO₂ through the Subject Wells in the 41-A and 98-A members in the year 2016. Then, prospectively, after roughly seven (7) years of CO₂-injection into the 41-A and 98-A members, Hilcorp will have "processed" or completed its tertiary recovery from the Subject Field (Pg. 71, L. 6). Mr. Salazar stated that in order to inject CO₂ into the Glasscock and Ward members, Hilcorp will need to raise the reservoir pressure in the Glasscock and Ward members to minimum miscibility, which will occur after seven to eight years of water injection. In other words, Hilcorp will need to inject produced water for seven to eight consecutive years into the Glasscock and Ward members to effectively implement a tertiary recovery operation with CO₂-injection into the Glasscock and Ward Members (Pg. 71, L. 15). Mr. Salazar stated that the minimum miscibility pressure is approximately 2,700 pounds per square inch. Mr. Salazar testified that an estimated 60 million barrels of oil will ultimately be recovered as a result of Hilcorp's planned tertiary recovery project in the proposed injection interval (Pg. 74, L. 1).

Lastly, Mr. Salazar testified that if Hilcorp is unable to control Phere's offsetting 374-acre leasehold, then Hilcorp will drill a line of "water curtain" wells along the lease line between the property/leasehold lines of Hilcorp and Phere (Pg. 75, L. 17).

Fisk's Supporting Testimony

Ms. Jill Fisk, the Asset Team Leader for Hilcorp's Central Texas Assets, testified as an expert petroleum engineer on behalf of Hilcorp. Ms. Fisk previously was a Reservoir Engineer at Hilcorp prior to her current position. Ms. Fisk is responsible for the design, drilling, completion and permitting of the Subject Wells.

Ms. Fisk testified that Hilcorp's proposed unitization agreement for the Subject Lease only includes the 41-A and 98-A Members (Pg. 92, L. 11).

¹⁶ See Hilcorp Exh. A.

The Wells (Casing, Cementing and Completion)

The Subject Wells are either newly drilled wells or are planned to be drilled in the near future (Pg. 127, L. 11). Ms. Fisk testified that the Subject Wells are drilled, cased and cemented or are proposed to be done so as described below:

Well 1089

Well No. 1089 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 2,304 feet and cemented to surface with 600 sacks of cement (cement returns to surface). The well has 3 ½" 9.3# Class A tubing with an Arrow Set Packer at 5,507 feet inside 7" 26# casing with top of cement at or above 1,400 feet (confirmed by Cement Bond Log or CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.¹⁷

Well 1104

Well No. 1104 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 2,304 feet and cemented to surface with 600 sacks of cement (cement returns to surface). The well has 3 ½" 9.3# Class A tubing with an Arrow Packer set at 5,658 feet inside 7" 26# casing with top of cement at 3,210 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.¹⁸

Well 1115

Well No. 1115 is a proposed new drill. The proposed well design has 10 ¾" 40.5# surface casing set at a depth of 1,574 feet and cemented to surface with ~1,474 sacks of cement. The well will have 7" 26# production casing set at 6,447 feet and cemented with ~1,800 sacks of cement. The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.¹⁹

Well 1126

Well No. 1126 is a proposed new drill. The proposed well design has 10 ¾" 40.5# surface casing set at a depth of 1,574 feet and cemented to surface with ~1,474 sacks of cement. The well will have 7" 26# production casing set at 6,447 feet and cemented with ~1,800 sacks of cement. The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²⁰

¹⁷ Hilcorp Exh. No. 14a-g.

¹⁸ Hilcorp Exh. No. 15a-g.

¹⁹ Hilcorp Exh. No. 16a-g.

²⁰ Hilcorp Exh. No. 17a-g.

Well 1127

Well No. 1127 is a proposed new drill. The proposed well design has 10 ¾" 40.5# surface casing set at a depth of 1,574 feet and cemented to surface with ~1,474 sacks of cement. The well will have 7" 26# production casing set at 6,447 feet and cemented with ~1,800 sacks of cement. The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²¹

Well 1129

Well No. 1129 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 1,576 feet and cemented to surface with 2,010 sacks of cement (multiple cement jobs, 93 barrels of cement in returns to surface). The well has 3 ½" 9.3# tubing with an Arrow Set Packer at 5,485 feet inside 7" 26# casing with the top of cement at or above 1,400 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²²

Well 1131

Well No. 1131 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 2,300 feet and cemented to surface with 611 sacks of cement (cement returns to surface). The well has 7-5/8" 33.7# casing set at 6,650 feet with the top of cement at 4,070 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 3,250 psig. This higher pressure is only for a short test of a new completion procedure. This test is a joint program with British Petroleum ("BP") and Hilcorp. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²³

Well 1133

Well No. 1133 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 1,573 feet and cemented to surface with 888 sacks of cement (cement returns to surface). The well has 3 ½" 9.3# tubing with an Arrow Set Packer at 5,486 feet inside 7" 26# casing with the top of cement at or above 1,470 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²⁴

Well 1136

Well No. 1136 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 1,575 feet and cemented to surface with 1673 sacks of cement (cement returns to surface).

²¹ Hilcorp Exh. No. 18a-g.

²² Hilcorp Exh. No. 19a-g.

²³ Hilcorp Exh. No. 20a-g.

²⁴ Hilcorp Exh. No. 21a-g.

The well has 3 ½" 9.3# tubing with an Arrow Set Packer at 5,668 feet inside 7" 26# casing with top of cement at or above 1,400 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²⁵

Well 1139

Well No. 1139 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 1,573 feet and cemented to surface with 888 sacks of cement (cement returns to surface). The well has 3 ½" 9.3# tubing with an Arrow Set Packer at 5,472 feet inside 7" 26# casing with top of cement at 1,385 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²⁶

Well 1144

Well No. 1144 is a new drill. The well has 10 ¾" 40.5# surface casing set at a depth of 2,346 feet and cemented to surface with 1,053 sacks of cement (cement returns to surface). The well has 3 ½" 9.3# tubing with an Arrow Set Packer at 5,637 feet inside 7" 26# casing with top of cement at 1,565 feet (confirmed by CBL). The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²⁷

Well 1149

Well No. 1149 is a proposed new drill. The proposed well design has 10 ¾" 40.5# surface casing set at a depth of 1,574 feet and cemented to surface with ~1,474 sacks of cement. The well will have 7" 26# casing set at 6,447 feet and cemented with ~1,800 sacks of cement. The proposed injection will be at a maximum rate of 20,000 barrels a day with a surface injection pressure of 2,525 psig. The design of this well is to protect freshwater resources and keep fluids in the injection interval.²⁸

Areas of Review (AOR)

Hilcorp performed a review of each Commission-regulated well (e.g. production wells) located within the ½-mile radius of each subject well's surface location. Ms. Fisk testified that although SWR 46 only requires injection well applicants to perform a study of wells within ¼-mile of a proposed injection well, Hilcorp chose to perform a review of all wells located within a ½-mile radius on its own initiative (Pg. 98, L. 3).

Ms. Fisk testified that since Hilcorp has taken over the Subject Field, it has compiled an inventory of each active or inactive well ever drilled in the field (Pg. 126, L. 1). Ms. King testified that there are about 700 wellbores in the West Ranch -A- Field (i.e. wells completed

²⁵ Hilcorp Exh. No. 22a-g.

²⁶ Hilcorp Exh. No. 23a-g.

²⁷ Hilcorp Exh. No. 24a-g.

²⁸ Hilcorp Exh. No. 25a-g.

within or through the proposed injection interval). Hilcorp's wellbore-evaluation of the Subject Field included a mechanical review of each well to determine whether: (1) the well will be used as a producing well in the planned tertiary recovery project; (2) the well will be converted to a reservoir monitoring well; or, (3) the well will be plugged and abandoned (Pg 126, L. 24).

Ms. Fisk testified that Hilcorp plans to convert 400 of the existing 700 wells in the West Ranch -A- Field into reservoir monitoring wells. The planned reservoir monitoring wells will be converted by installing tubing and pressure gauges on each monitoring wells' casing string. Furthermore, the pressure gauges will be connected to a Supervisory Control and Data Acquisition ("SCADA") system, which provide realtime monitoring pressure changes in any string of casing in each monitoring well (Pg. 128, L. 1). Each monitoring well will be classified as shut-in.

Ms. Fisk sponsored well tabulations for the Subject Wells that provides various data for each well located within ½-mile radius of the Subject Wells. For example, Hilcorp Exh. No. 22c (Well No. 1136) indicates that there are 33 wells within ½-mile of Well No. 1136. Of these 33 wells, 15 are classified as plugged and abandoned, nine (9) are planned monitoring wells, four (4) are planned to be producing wells, two (2) are planned water source wells completed in the Catahoula, two (2) are injection wells in Hilcorp's consolidated application, and one (1) is planned to be plugged and abandoned.

In summary, Ms. Fisk testified that Hilcorp plans to address any issues that may arise immediately to prevent the migration of fluids outside of the proposed injection interval. According to Ms. Fisk, no wells located within ½-mile of the Subject Wells will be a conduit for the migration of injected fluids, and that approval of Hilcorp's consolidated application is necessary to recover hydrocarbons in the Subject Field that would otherwise go unrecovered (Pg. 133, L. 10).

Usuable Quality Water

Ms. Fisk testified that the current base of usable quality water ("BUQW") occurs at 1,450 feet below the surface location of the Subject Wells, and that the BUQW was determined by the Commission's Underground Water Advisory Unit.

Protestant's Argument (Phere)

As previously mentioned, Phere's Acreage is made of roughly 374-acres that immediately offsets the Subject Lease's northern boundaries. Phere has wells completed in the West Ranch (Glasscock) and West Ranch (Ward) Fields.²⁹ Phere alleges that Hilcorp's applications should not be approved because: (1) injection fluids will not be confined to the proposed injection interval, (2) pollution of groundwater will result through 31 problem wells located on the Subject Lease, and (3) Phere will be unable to recover its fair share of hydrocarbons in the Subject Field as a result of Hilcorp's proposed injection operations (Pg. 19, L. 20 through Pg. 27, L. 16).

²⁹ Hilcorp Exhs. E and F – Proration schedules for the West Ranch (Glasscock) and West Ranch (Ward) Fields, respectively.

Trevino's Supporting Testimony

Mr. Andres Trevino, Consulting Engineer, testified on behalf of Phere as an expert witness [petroleum engineering].³⁰ Mr. Trevino is a former employee of the Commission and is registered as a Professional Engineer with the Texas Board of Professional Engineers.

Phere performed a review of (1) the Commission-documented orphaned wells in the Subject Field, and (2) the area wells in a similar fashion to Hilcorp's AORs that were mentioned above in Hilcorp's direct case. Mr. Trevino asserted that an orphaned well is considered to be a well that does not belong to an active operator (Pg. 215, L. 20).³¹

First, Mr. Trevino testified that Phere identified 31 orphaned wells in the Subject Field through the Commission's GIS system. Of the 31 orphaned wells, Mr. Trevino concluded the following: (1) 21 wells are plugged and abandoned; (2) six (6) of the 31 wells are approved by the Oil & Gas Division to be plugged with state-funds; (3) two (2) of the 31 are under contract to be plugged with state-funds; and (4) three (3) of the 31 wells remain idle as untouched orphaned wells.³²

Mr. Trevino testified that 18 of the 21 plugged and abandoned orphaned wells were found to have fluid levels that range from 880 feet to zero (0) feet below ground surface. The recorded fluid levels signify the top of a column of fluid inside the wellbore. The implication of these 18 wells having such high fluid levels is an indication that each well's respective reservoir contains sufficient pressure to raise a column of reservoir-fluid from the subsurface reservoir above the current BUQW at 1,450 (Pg. 217, L. 21). Mr. Trevino asserted that because wells in the Subject Field have not been active producers for a considerable length of time, the reservoir pressures have increased thereby resulting in the recorded high fluid levels measured in the 21 plugged orphan wells (Pg. 218, L. 5).

Mr. Trevino stated that four (4) of the 21 plugged and abandoned orphaned wells were verified to be plugged and abandoned in a way where the deepest plug was set above Hilcorp's proposed injection interval (Pg. 218, L. 23). The plugging reports ("W-3") for the Drummond, J.H Lease - Well No. 1C (API No. 42-239-02349), Well No. 4 (API No. 42-239-02338), Well No. 4B (API No. 42-239-02348), and Well No. 6 (API No. 42-239-02320) record that each well's deepest plug was set from 4,454 feet to 4,611 feet; 2,369 feet to 2,512 feet; 1,850 feet to 2,046 feet; and 1,450 feet to 1,240 feet, respectively.³³ Mr. Trevino testified that the cause for setting the deepest plugs at the reported depths is likely due to either bad casing, junk in the wellbore or tubing left in the wellbore which deter the placement of cement at deeper depths (Pg. 219, L. 15).

³⁰ The Examiners presume that Mr. Trevino testified on behalf of Phere as an expert in petroleum engineering because counsel on behalf of Hilcorp voluntarily waived qualification of Mr. Trevino as an expert witness (Pg. 214, L. 7).

³¹ Phere Exh. No. 2 - Multi-page exhibit titled "Orphaned Wells in the West Ranch Field." The exhibit's first page is a table of 31 wells with individual well data, followed by two aerial maps and several Form W-3s.

³² *Id.* The three (3) unplugged orphan wells mentioned include Well Nos. 7, 1, and 5 (API Nos. 42-239-02341; 42-239-02335; and 42-239-02947, respectively).

³³ Compare transcript at Pg. 218, L. 24, Vol. 1 with Phere Exhibit No. 2.

Phere submitted two excerpts of the Commission's manual titled, "Well Completion and Plugging Procedures Reference Manual," which explains how a producing or injection well is required to be plugged.³⁴ Each excerpt used from the manual exemplifies how a wellbore is required to be plugged when cement is not present on the outside of the intermediate or production casing string. In other words, each excerpt shows where cement is required to be placed during the plugging of a well when cement is not present on the back-side of the intermediate or production casing-strings (*i.e.*, the block-squeeze methodology). Mr. Trevino testified that a properly plugged wellbore contains cement plugs along the following: (1) a plug within 100' immediately above the well's producing zone; (2) a plug that extends 50' above and 50' below the BUQW; (3) a plug that extends 50' above and 50' below the surface casing shoe (*i.e.*, the base of the surface casing); and (4) a plug within 10' of the ground surface (*i.e.*, a top plug).

Second, Mr. Trevino testified that numerous area wells within the Subject Wells' ¼-mile AORs were plugged insufficiently (Pg. 221, L. 18). Although Hilcorp's application's were determined to be administratively complete, 31 of the mentioned area wells potentially form a conduit for pollution from the proposed injection interval to the BUQW (Pg. 222, L. 1). Phere submitted a table titled "Problem Plugged Wells in the West Ranch Field: Only Wells Within ¼-Mile Area of Review." Mr. Trevino defined that "problem wells" in this proceeding as wells plugged in the Subject Wells' ¼-mile AOR, where the deepest plug was placed above Hilcorp's proposed injection interval (5,050 feet to 6,339 feet) ("31 Problem Wells").³⁵

In summary, Mr. Trevino stated that 31 Problem Wells exist within the Subject Wells' ¼-mile AORs. Mr. Trevino testified that although the 31 Problem Wells were considered to be properly plugged by the Commission (*i.e.*, each of the 31 wells' plugging reports were approved by the Commission), they provide a conduit for pollution as a result Hilcorp's proposed operations contemplated by its applications. In other words, the produced water injected through Hilcorp's proposed operations could potentially flow upwards through unplugged perforations, or casing leaks, in the 31 Problem Wells and into the BUQW provided that sufficient reservoir pressure is present (Pg. 223, L. 12).

Utilizing data found in the physical files for the Subject Wells, Phere performed calculations to estimate the reservoir pressure for the 41-A and 98-A members (Pg. 240, L. 7), as well as pressure-front calculations for the Greta, Glasscock, Ward, 41-A, and 98-A members. Mr. Trevino testified that pressure-front calculations are commonly used by the Commission's UIC to determine the anticipated increase in pressure at a particular distance in a specified timeframe (Pg. 240, L. 19).

Mr. Trevino testified that after two years of injection the calculated bottom-hole pressure will increase from 2,393 pounds per square inch ("psi") to 2,636 psi (Pg. 241, L. 8). The amount of pressure necessary to raise a column of brine water to (1) the ground surface and (2) the BUQW is 2,850 psi and 2,176 psi, respectively. Mr. Trevino testified that the pressure required to raise a column of 9.5 lb/gallon drilling mud to the BUQW is 2,310 psi.³⁶ The pressure

³⁴ Phere Exh. No. 3.

³⁵ Phere Exh. No. 4.

³⁶ 9.5 pound per gallon (lb/gal) drilling mud is commonly used in the practice of plug and abandonment operations.

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required to raise 10.5 lb/gallon drilling mud to the BUQW is 2,553 psi. In summary, Mr. Trevino testified that the above calculations indicate that without any of Hilcorp's proposed injection operations there is enough reservoir pressure to raise 9.5 lb/gallon mud to the BUQW. Furthermore, once Hilcorp's proposed injection operations commence there will be sufficient reservoir pressure to raise 10.5 lb/gallon mud to the BUQW (Pg. 242, L. 1). Mr. Trevino testified that his estimated pressure-front calculations were performed for each member, and that the predominant result indicates that sufficient reservoir pressure exists to raise reservoir fluids to the BUQW.

In conclusion, Mr. Trevino testified that the Problem Wells, combined with the estimated reservoir pressures and pressure-front calculations, could result in contamination of usable quality water at the BUQW (Pg. 242, L. 10). Specifically, when asked if "that injection" is likely to threaten usable groundwater, Mr. Trevino responded, "It's highly possible. It's highly likely. All you need is a leak, and these 70 to 80-year old steel casings having pressurized salt water from the Catahoula on one side and drilling mud and possibly salt water from the Frio [on the other]. And we haven't even talked about CO₂ entering those wellbores." (Pg. 246, L. 14)

Lamphere's Supporting Testimony

Mr. Todd Lamphere, Phere's owner, testified as a fact witness on behalf of Phere. Mr. Lamphere testified that Phere produces roughly 25 barrels of oil per day and 1,000 barrels of water per day from Phere's Acreage. Mr. Lamphere testified that he is concerned that Hilcorp's injection fluids will cross the mutual lease line boundaries between Hilcorp and Phere and enter Phere's Acreage (Pg. 269, L. 19). Mr. Lamphere testified that Phere is likely to incur economic damages as a result of the transposed injection fluids originating from Hilcorp's Subject Lease because he is unable to dispose of an increased amount of produced water on Phere's Acreage. As a result, Mr. Lamphere opposes Hilcorp's applications and request that they be denied.

Protestant's Evidence (Texana)

Texana claims that Hilcorp has not been forth coming in providing Texana details of a proposed voluntary monitoring system. Texana feels Hilcorp is moving too fast in acquiring permits before the monitoring system is in place or can be evaluated in order to meet Hilcorp's self-imposed deadlines. Texana expressed concern over the hundreds of old plugged wells that exist within the proposed injection interval and the eventual CO₂ sequestration project.

Texana further argued that the applications should be denied as the applications failed to identify the Catahoula as a source of water for the injection project.

EXAMINERS' RECOMMENDATION

This application centers on one issue – whether Hilcorp should be granted authority to inject produced water through the Subject Wells into the proposed injection interval at a cumulative rate of 240,000 barrels of produced water per day (*i.e.*, 20,000 bbl/day x 12 wells). Considerations taken into account include whether fluids will be confined to the proposed injection interval and whether pollution of surface and/or groundwater may potentially occur as a

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result of the proposed injection operations.³⁷ For context, Phere raised concerns with 62 wells that were drilled through Hilcorp's proposed injection interval. The 62 wells include: (1) 31 orphaned wells; and (2) 31 Problem Wells located within the Subject Wells' ¼-mile AOR.

Based on the evidence in the record, the Examiners recommend that Hilcorp's applications be approved, but with special conditions.³⁸ Given the large scope of this project and the ages of many of the wells on the Subject Lease, the Examiners are persuaded that the 31 Problem Wells identified by Phere potentially could result in injected fluids escaping the proposed injection interval due to the placement of each well's respective bottom plug (*i.e.*, the deepest plug) being above the top of the proposed injection interval.³⁹ Furthermore, two (2) of the 31 Problem Wells' deepest plug is located above the existing BUQW, thereby offering the potential for pollution of fresh groundwater. As a result, the Examiners recommend that prior to commencing the injection operations requested in this proceeding, Hilcorp reenter and replug the 31 Problem Wells pursuant to Statewide Rule 14, and also place a cement plug immediately above the proposed injection interval. Alternatively, the Examiners believe that Hilcorp should incorporate the 31 Problem Wells into its planned monitoring well program by converting the 31 Problem Wells into monitoring wells.

Hilcorp is the only active operator in the Subject Field (*i.e.*, the 41-A and 98-A members). Hilcorp is also in the process of unitizing depths 5,708 feet to 6,265 feet for secondary and/or tertiary recovery purposes. Because Hilcorp estimates that it will recover approximately 60 million additional barrels of oil from the Frio, in part as a result of the proposed injection operations in this proceeding, the Examiners believe that replugging or modifying the 31 Problem Wells into monitoring wells is a reasonable and environmentally-prudent condition that outweighs the cost to Hilcorp in doing so.⁴⁰ No evidence was offered at the hearing to indicate the associated cost for reentering and replugging the 31 Problem Wells. Hilcorp argues that because the 31 Problem Wells were previously plugged in a fashion that was historically approved by the Commission, it does not intend to reenter them for replugging (Pg. 182, L. 4). Throughout the course of the hearing, no where did Hilcorp explicitly state that it was opposed to reentering area wells for their replugging. Instead, representatives of Hilcorp simply stated that if a problem were to arise, then it would be handled accordingly. Noteworthy, the record indicates that if Phere does not agree to join Hilcorp's proposed unit, Hilcorp intends to go through the additional expense of drilling numerous curtain injection wells followed by a row of production wells.

In part, SWR 46's purpose is to protect usable quality water from harm as a result of injection of oil and gas waste. Furthermore, Statewide Rule 46 requires that injection fluids remain confined to the permitted injection interval.⁴¹ At the hearing, Hilcorp indicated that if not for the protests, the subject applications would have been approved administratively (Pg. 95, L. 3 & Pg. 259, L. 6, Vol. I). However, the Examiners believe that it is inappropriate to overlook

³⁷ 16 Tex. Admin. Code §3.46(a)

³⁸ The Examiners' recommended special conditions only pertain to the 31 Problem Wells located within ¼-mile of the Subject Wells. The special conditions do not pertain to the 31 orphaned wells identified by Phere in its Exh. No. 2.

³⁹ See Phere Exh. No. 4 for the table of 31 Problem Wells.

⁴⁰ For context, Hilcorp potentially stands a net-revenue of roughly \$3.6 billion (\$60/bbl x 60,000,000 barrels of oil) as a result of its proposed operations, which includes a conceptual CO2-flood once it has completed its proposed waterflood in the subject application.

⁴¹ See 16 Tex. Admin. Code §3.46(d)(1)(E).

AOR-wells (*i.e.* the 31 Problem Wells) which do not contain sufficient plugs below the base of usable quality water, or immediately above the top of the proposed injection interval.

Comparitively, Hilcorp's requested relief in this proceeding is somewhat uncommon because it involves twelve injection wells utilized to inject up to 240,000 barrels of produced water per day only to purposefully raise reservoir pressures for tertiary operations in the future. Typically, SWR 46 applications are aimed at the inclusion of just one or two injection/disposal wells with the purpose of ridding oil and gas waste. To consider whether nearly 700 wellbores are properly completed, or plugged and abandoned, so that potential migration of injected fluids will not cause harm to fresh water or recoverable hydrocarbons is not a common task.

The Examiners opine that a disharmony of time is a factor in this proceeding (Pg. 259, L. 14, Vol. I). Specifically, Hilcorp's applications were considered against the version of SWR 46 that was in effect from July 2, 2012, through November 16, 2014. Although the historic area wells were considered to be sufficiently plugged by past Commission-regulations, a discord appears when comparing the plugging requirements of today's regulations to the 31 Problem Wells. The Examiners believe that the most practical solution to satisfy the modern rules in effect is to reenter the 31 Problem Wells for replugging, or conversion into monitoring wells, to prevent potential pollution of groundwater or escape of injected fluids from the proposed injection interval.

Potential Pollution of Fresh Groundwater

On behalf of Hilcorp, Ms. Fisk alleged that all wells located within ½-mile of the Subject Wells will not be a conduit for the migration of injected fluids, and that approval of Hilcorp's applications is necessary to recover hydrocarbons in the Subject Field that would otherwise go unrecovered (Pg. 133, L. 10). The Examiners agree that Hilcorp stands to potentially recover an additional 60 million barrels of oil as a result, at least in part, of its requested relief in this proceeding. However, in order to recover the estimated 60 million barrels of oil, Hilcorp needs to increase the reservoir pressure within the Frio to the point of minimum miscibility. In other words, Hilcorp acknowledges that it will purposefully raise the reservoir pressure in the Frio (*i.e.*, the proposed injection interval) beneath the Subject Lease to at least 2,700 psig to initiate CO₂-injection operations.

Phere's argument with respect to calculated reservoir pressures and pressure-front calcuations went undisputed. While Hilcorp maintains that the 31 Problem Wells were plugged in a manner that was previously approved by the Commission over the span of several decades, Hilcorp did not contest whether Phere's calculations were inaccurate. With regard to Hilcorp's proposed injection Well Nos. 1136 and 1144, Phere identified that Problem Well Nos. 86 and 256 are plugged and abandoned in a fashion where the deepest plug was placed above the existing BUQW. Furthermore, the base of the deepest plug in Problem Well No. 275 is reportedly located 16 feet below the BUQW.⁴² Ms. Fisk alleges that the BUQW has deepened overtime, and as a result Problem Well Nos. 86 and 256 were considered to be compliant by Commission staff (Pg. 186, L. 22). What's more, Ms. Fisk testified that it is her opinion that it's

⁴² 16 Tex. Admin. Code §3.14(d)(2) states that cement plugs shall be set to isolate usable quality water strata. Commission practice to ensure isolation of usable quality water strata requires that a cement plug be placed 50' below the base of usable quality water and 50' above the top of usable quality water.

not necessary to have a cement plug at or below the existing BUQW to prevent pollution because at the time Well Nos. 86, 256, and 275 were plugged, they were done so based on prior Commission regulations. Ms. Fisk testified that Hilcorp has determined that the 31 Problem Wells do not pose a threat for injection fluids to escape the proposed injection interval (Pg. 182, L. 1). The Examiners fundamentally disagree with Ms. Fisk's opinion that the 31 Problem Wells are plugged in manner to prevent the escape of injection fluids from the proposed injection interval because the 31 Problem Wells do not contain cement plugs immediately above the top of the proposed injection interval. The Examiners believe that it is improper to conclude that pollution of groundwater will not occur in two (2) of the 31 Problem Wells which are not plugged below the existing BUQW, simply because its plugging report was approved.

Ms. Fisk testified that Hilcorp intends to implement a "monitoring program" with its proposed injection operations by converting 400 of 700 existing wells into "monitoring wells," which were previously drilled and completed in various members that comprise the Frio beneath the Subject Lease. Ms. Fisk testified that a monitoring well is essentially a shut-in, idle well that will include tubing and pressure gauges on each casing string, and that each gauge will be connected to a real-time SCADA monitoring system. However, Ms. Fisk also testified that the monitoring program will only be an active part of the planned CO₂-flood in the future, not the proposed waterflood in this proceeding. The Examiners find nothing in the record to indicate how Hilcorp would determine whether a problem could be detected in the subsurface with regard to the proposed injection of produced water in general because the purpose of the monitoring program is to monitor CO₂-injection. Ms. Fisk testified that if a problem occurs, then Hilcorp will fix it accordingly. The Examiners believe that this suggests Hilcorp expects problems to occur as a result of its proposed injection operations. Phere identified that nine (9) of the 31 Problem Wells are located inside 900 feet to their closest subject injection well. No where did Hilcorp identify the location of its proposed monitoring wells, nor whether the monitoring wells would be able to detect injection fluids escaping the proposed injection interval in the 31 Problem Wells because the monitoring system's purpose is for monitoring CO₂-injection. Without replugging the 31 Problem Wells to place a cement plug immediately above the top of the proposed injection interval, the Examiners believe that Hilcorp's proposed monitoring system, by itself, is insufficient to determine whether injection fluids remain confined to the injection interval within the 31 Problem Wells. As a result, the Examiners recommend that the 31 Problem Wells be reentered and replugged to place a cement plug immediately above the proposed injection interval, in addition to the requirements of Statewide Rule 14. Alternatively, the Examiners recommend that Hilcorp convert the 31 Problem Wells into monitoring wells associated with its planned monitoring program prior to injection of produced water. By converting the 31 Problem Wells into monitoring wells, Hilcorp would satisfy the issue of whether or not the 31 Problem Wells provide a potential conduit for the escape of injection fluids from the proposed injection interval because Hilcorp would be required to perform pressure tests on each casing-string in order to continuously include the Problem Well as a monitoring well.

Hilcorp's geologic witness testified about the salient geologic aspects pertinent to Hilcorp's applications. Mr. King testified that beneath the Subject Lease, the Frio is couched as a four-way closure structure, meaning that on the four-sides of the Subject Field the Frio dips away from the center of the Subject Lease. In other words, if one were to stand on the top of each member which makes up the Frio in the subsurface and walk across the Subject Lease in a

straight line, he or she would more or less walk uphill on one side of the lease then downhill on the other. The importance of this structure is significant with regard to the placement of each Subject Well, which collectively form an under arching horse-shoe on the south-half of the Subject Lease. The Commission's Groundwater Advisory Unit (GAU) issued letters of determination for each subject well's proposed location, which states that the BUQW exists at 1,450 feet. In other words, at each subject well's existing or proposed surface location the GAU specified that fresh water exists from the ground surface to a depth of 1,450 feet. Moreover, the GAU determined that the Goliad Aquifer occurs from 900 feet to 1,450 feet, and contains "superior-quality water." The record indicates that the base of the Goliad Aquifer (*i.e.*, the BUQW) doesn't necessarily exist as simple cake-layers of one flat-surface atop another. Instead, the Goliad Aquifer's depositional form likely occurs in a juxtaposed fashion similar to the wavy surface of desert sand dunes. The Examiners believe that the potential for pollution is made possible due to the deepest plugs in Problem Wells 86, 256, and 275 being placed above or very near the BUQW when coupled with Phere's calculated increase in reservoir pressure taken from Hilcorp's proposed injection operations. The Examiners believe that in order to minimize potential pollution of fresh water in Problem Well Nos. 86, 256, and 275, Hilcorp should replug these Problem Wells as previously recommended.

Mr. King also testified as to the natural aspects of the proposed injection interval's cap, the Anahuac. Mr. King's arguments with regard to the Anahuac were predominately unrefuted. Mr. King testified that the Anahuac is mineralogically composed of smectite, which naturally swells once it is introduced to water. As a result, Hilcorp indicated that the wells on the Subject Lease which were drilled through the Anahuac are now sufficiently sealed off from upwards migration behind the casing by the Anahuac (Pg. 207, L. 6). However, the record does not include explicit examples of the Anahuac's effectiveness in this regard. Instead, Hilcorp's position with regard to the Anahuac's swelling nature is based on an alternative conceptual study, which describes the Anahuac in a general sense. Hilcorp assumes that the Anahuac will be of the same quality throughout its proposed injection operation. Hilcorp proposes to raise reservoir pressures in the Frio to what it believes was the original reservoir pressure by injecting up to 240,000 barrels of water per day for seven years until minimum missibility is reached (*i.e.*, a reservoir pressure of 2,700 psi). If Hilcorp's proposed operation commences and goes uninterrupted, it will inject up to 598,080,000 barrels (*i.e.*, 25,119,360,000 gallons) of water in seven years. No where did Hilcorp indicate that there is more or less a breaking point of the swelling capability of the Anahuac. In fact, Mr. King testified that he does not have any evidence to support the effects of CO₂ interaction to the swelling capability of the Anahuac (Pg. 63, L. 8, Vol. I). As a result, the Examiners believe that three (3) of the 31 Problem Wells (Well Nos. 86, 256, and 275) are not plugged in conformity with today's plugging requirements and offer the potential for injection fluids to pollute fresh groundwater. Moreover, the Examiners believe that the remaining 28 Problem Wells are insufficiently plugged to contain injection fluids to the depths of the proposed injection interval.

With regard to the 31 Problem Wells, Phere identified the following: (a) one (1) was drilled in the 1930's; 14 were drilled in the 1940's; three (3) were drilled in the 1950's; three (3) were drilled in the 1960's; two (2) were drilled in the 1970's; and five (5) were drilled in the 1980's. Furthermore, the 31 Problem Wells were drilled to total depths that span from 5,590 feet

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to 8,360 feet.⁴³ Hilcorp claims that each of the 31 Problem Wells were plugged in a manner which satisfied prior Commission plugging rules; however, no clear evidence was submitted at the hearing to indicate whether the appropriate placement of cement behind pipe exists in each Problem Well. It is Hilcorp's position that each of the 31 Problem Wells sufficiently contains cement inside and outside each casing string to prevent the upward migration of fluids in the Problem Wells, yet no clear evidence was submitted to indicate the tops of cement behind pipe in each of the 31 Problem Wells. The Examiners acknowledge Hilcorp's position that the Problem Wells were plugged in a manner which presumably complied with the Commission's historic plugging requirements. However, given the magnitude of Hilcorp's proposed project, the Examiners believe that Hilcorp must ensure that each Problem Well is plugged in a manner that minimizes as much as reasonably possible the potential for pollution of fresh groundwater via escape of injection fluids from the injection interval.

Potential Harm of Mineral Formations

Phere's counsel indicated that Hilcorp's proposed unitization agreement seeks to unitize depths ranging from 5,708 to 6,265 feet. Furthermore, Hilcorp's proposed unit potentially includes Phere's Acreage once Phere executes a unitization agreement. Ms. Fisk testified that the primary purpose of the Subject Wells is to inject into the Ward and Glasscock members, which are not part of Hilcorp's proposed unit (Pg. 140, L. 2). Phere is listed as an operator in the West Ranch (Glasscock) and West Ranch (Ward) Fields, not the Subject Field. Yet, Hilcorp's proposed injection interval in these applications includes the Greta, Glasscock, Ward, 41-A, and 98-A Members. While Phere alleges that it will be harmed as a result of Hilcorp's planned injection operations, neither Phere nor Texana provided evidence of specific, known damages likely to occur as a result of Hilcorp's proposed injection operations.

FINDINGS OF FACT

1. Hilcorp Energy Company ("Hilcorp") requests injection authority pursuant to Statewide Rule 46 for the West Ranch -A- Lease, Well Nos. 1129, 1144, 1133, 1139, 1089, 1136, 1131, 1104, 1149, 1126, 1115, 1127 ("Subject Wells"), West Ranch (41-A & 98-A Cons.) Field ("Subject Field"), Jackson County, Texas ("Subject Application").
2. Notices of Hilcorp's Subject Application and hearing were issued to all persons entitled to notice. Phere Operating, Inc. ("Phere") and Texana Groundwater Conservation District ("Texana") protest the Subject Application.
3. Notices of the Subject Application were published October 8, 2014, and February 11, 2015, in the *Jackson County Herald Tribune*, a newspaper of general circulation in Jackson County, Texas. The Notice of Hearing was published January 30, 2015. Well No. 1129 had notice published in the *Jackson County Herald Tribune* on September 3, 2014, and February 11, 2015. Well No. 1136 had notice published in the *Jackson County Herald Tribune* September 17, 2014, and February 11, 2015.
4. Hilcorp is the only active operator in the Subject Field.

⁴³ Phere Exh. No. 4.

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5. The Subject Wells will be used to inject produced water from Hilcorp's production wells completed in the Frio Formation and from water-source wells in the over-pressured Catahoula Formation.
6. The proposed Subject Wells will inject a maximum volume of 20,000 barrels per day per well and a maximum surface injection pressure of 2,525 psig per well, except for Well No. 1131 which includes a maximum surface injection pressure of 3,250 psig.
7. The proposed injection Subject Wells will be cased and cemented to confine the injected fluid to the proposed injection zone.
 - a. The requested injection interval is between 5,050 feet and 6,339 feet.
 - b. The Frio Formation is a porous and permeable formation that has produced hydrocarbons since 1938.
 - c. Stratigraphically above the Frio Formation is the Anahuac Shale that occurs from 4,450 feet to 5,000 feet. The Anahuac Shale is a roughly 500 foot thick impermeable layer that seals the Frio to prevent migration of injected fluids outside the injection interval.
 - d. The Base of Usable Quality Water ("BUQW") occurs below the Subject Wells from the ground surface to a depth of 1,450 feet. The Goliad Aquifer contains superior-quality water and occurs beneath the Subject Wells from 900 feet to 1,450 feet.
8. The produced water to be injected in Hilcorp's Subject Wells originates from Hilcorp production on the Subject Lease or from water-source wells on the Subject Lease that are completed in the Catahoula Formation.
9. There identified 31 orphaned wells in the Subject Field through the Commission's Geographic Information System ("GIS"). Of the 31 orphan wells:
 - a. 21 wells were Plugged & Abandoned ("P&A") by the Railroad Commission of Texas;
 - b. Six (6) of the 31 orphaned wells are currently approved by the Commission's Oil & Gas Division to be plugged using state-funds;
 - c. Two (2) of the 31 are under contract to be plugged with state-funds; and
 - d. Three (3) of the 31 wells remain idle as untouched orphaned wells.
10. There identified 31 P&A wells within the Subject Wells' ¼-mile Area of Review (the "Problem Wells").

11. Phere performed pressure calculations to determine the bottom-hole pressure, or reservoir pressure, for the 31 Problem Wells as a result of Hilcorp's proposed injection operations in the Subject Application.
 - a. After two years of injection the calculated bottom-hole pressure will increase from 2,393 pounds per square inch ("psi") to roughly 2,767 psi in the 31 Problem Wells.
 - b. The amount of pressure necessary to raise a column of brine water to the ground surface and the BUQW in the 31 Problem Wells is 2,850 psi and 2,176 psi, respectively.
12. The use or installation of the Subject Wells in the applied-for permits could endanger or injure oil, gas, or other mineral formations:
 - a. Each of the 31 Problem Wells could provide a conduit for migration of the injected fluids to escape the proposed injection interval due to the placement of each Problem Well's bottom plug being above the top of the proposed injection interval.
 - b. Without re-plugging each of the 31 Problem Wells so that a plug is located immediately above the proposed injection interval, injected fluids into the Subject Wells could migrate and endanger or injure oil, gas, or other mineral formations through the 31 Problem Wells.
13. With permit conditions, the use or installation of the Subject Wells will not endanger or injure oil, gas, or other mineral formations:
 - a. By reentering and replugging the 31 Problem Wells to place a cement plug immediately above 5,050 feet, or alternatively, converting the 31 Problem Wells into additional monitoring wells, injection fluids resulting from Hilcorp's applications will remain confined to the proposed injection interval.
 - b. Confining injection fluids to the proposed injection interval, as described immediately above, will not endanger or injure any oil, gas, or other mineral formations.
14. The use or installation of the Subject Wells in the applied-for permit could cause the pollution of ground and surface fresh water:
 - a. Each of the 31 Problem Wells could provide a conduit for migration of the injected fluids to escape the proposed injection interval due to the placement of each Problem Well's bottom plug being above the top of the proposed injection interval.
 - b. Without re-plugging each of the 31 Problem Wells so that the plug is located immediately above the proposed injection interval, injected fluids into the Subject

Wells could migrate and cause the pollution of ground and surface fresh water through the 31 Problem Wells.

15. With permit conditions, the use or installation of the Subject Wells will provide adequate protection from pollution of ground and surface fresh water:
 - a. By reentering and replugging the 31 Problem Wells to place a cement plug immediately above 5,050 feet, or alternatively, converting the 31 Problem Wells into additional monitoring wells, injection fluids resulting from Hilcorp's applications will remain confined to the proposed injection interval.
 - b. Confining injection fluids to the proposed injection interval, as described immediately above, will provide adequate protection from pollution of ground and surface fresh water.
16. Hilcorp will recover approximately 60 million additional barrels of oil from the Frio Formation, in part as a result of the relief requested by Hilcorp in this proceeding.
17. Approval of Hilcorp's applications will prevent waste and protect correlative rights.
18. Roughly 700 wells drilled into the Frio Formation exist on the Subject Lease.
19. Hilcorp will convert 400 of the existing 700 wells drilled into the Frio Formation on the Subject Lease into monitoring wells.
20. Hilcorp's monitoring wells are only to monitor the injection of CO₂.

CONCLUSIONS OF LAW

1. Proper notice was issued as applicable in all statutes and regulatory codes.
2. All things have occurred and been accomplished to give the Commission jurisdiction in this matter.
3. With permit conditions, Hilcorp's applications pursuant to SWR 46 for permits to inject produced water into a reservoir productive of oil or gas West Ranch -A- Lease, Well Nos. 1129, 1144, 1133, 1139, 1089, 1136, 1131, 1104, 1149, 1126, 1115, 1127, Jackson County, Texas, comply with the applicable provisions of SWR 46.
4. Approval of Hilcorp's subject applications prevents waste and protects correlative rights.
5. With proper safeguards, as provided by terms and conditions in the attached Final Order, which are incorporated herein by reference, any oil, gas, or other mineral formations will not be endangered or injured.
6. With proper safeguards, as provided by terms and conditions in the attached Final Order, which are incorporated herein by reference, ground and surface fresh water will be adequately protected from pollution or harm.

7. Hilcorp has met its burden of proof and satisfied the requirements of SWR 46.

EXAMINERS' RECOMMENDATION

Based on the record evidence, the Examiners recommend that the Commission approve Hilcorp's twelve applications, consolidated into Docket No. 02-0295336, with special conditions that Hilcorp reenter and replug the 31 Problem Wells to place a cement plug immediately above the top of the proposed injection interval, in addition to the current requirements of SWR 14; or alternatively, convert the 31 Problem Wells into monitoring wells associated with Hilcorp's monitoring program.

Respectfully,



Brian Fancher, P.G.
Technical Examiner



John Dodson
Legal Examiner