

State of New Mexico  
Energy, Minerals and Natural Resources Department

---

Susana Martinez  
Governor

Ken McQueen  
Cabinet Secretary

Matthias Sayer  
Deputy Cabinet Secretary

David R. Catanach, Division Director  
Oil Conservation Division



March 15, 2017

TO: David Catanach, Director, OCD *Dlc*  
Daniel Sanchez, UIC Program Manager, OCD *DS*

FROM: Phillip Goetze, Engineering Bureau, OCD *PG*

**RE: FINAL REPORT AND RECOMMENDATIONS REGARDING INJECTION  
SURVEY RESULTS FOR THE MARALO SHOLES B WELL NO. 2 (API 30-025-  
09806; SWD-1127); OWL SWD OPERATING LLC**

This document is a summary of recent activities related to the testing for the Maralo Sholes B Well No. 2 (the "subject well") performed by the operator, OWL SWD Operating LLC (OWL or the "Operator"). The subject is located 660 feet from the South line and 660 feet from the East line (Unit letter P) of Section 25, Township 25 South, Range 36 East, NMPM. The well is approximately one mile west of the City of Jal in southeastern New Mexico (see Figure 1). The well is located on federal mineral estate under the regulatory authority of the Bureau of Land Management.

The authority to inject was approved by administrative order SWD-1127 dated June 1, 2008. The order approved an injection interval from 2938 feet to approximately 3055 feet below surface in the lower Yates and upper Seven Rivers Formations. The injection interval is open hole and the maximum surface injection pressure is limited to 588 pounds per square inch (psi).

The origins for the investigation of the subject well was due to the following initiatives:

1. The Oil Conservation Division (the "Division") received a formal correspondence from the City of Jal dated April 28, 2016;
2. The review of three applications (Administrative applications No. pMAM1530041540 [Abyss SWD No. 1]; No. pMAM1530040908 [Mojo SWD No. 1]; and No. pMAM1530039137 [Nomad SWD No. 1]) by OWL for additional commercial disposal wells in the same vicinity of the subject well with similar proposed disposal intervals; and
3. The Division's review to a formal request by the United States Environmental Protection Agency (EPA) correspondence dated August 31, 2016, to review current oil and gas injection activities within New Mexico that may potentially impact Underground Sources of Drinking Water (USDWs).

The Division submitted a request as a Notice to Operator dated July 28, 2016, to initiate an injection survey for the subject well. The deadline to complete requested survey was modified on several occasions due to equipment limitations, due to well conditions, and due to

scheduling/availability issues. Two different injection surveys were completed; the second survey being conducted after the open-hole portion of the well was cleared of debris following the initial injection survey.

The three cited applications for new disposal wells in this area as the subject well were reviewed by the Division during the fourth quarter of 2015. All three applications were denied in November 2015 as not being qualified for approval through an administrative review process and would require an examiner hearing for the review.

#### **SUBJECT WELL CONSTRUCTION AND HISTORY:**

The subject well was spudded on May 25, 1947, and was completed as an oil producer in the Yates Formation on June 30, 1947. The production was from an open-hole interval beginning at the shoe of the 7-inch production casing set at 2935 feet below ground surface (BGS) to a total depth of 2950 feet BGS. Figure 3 provides a current well completion diagram.

Following a period of oil production, the well was recompleted in 1961 with bottom plugged back and shallow perforations added from 2871 feet BGS to 2910 feet BGS to produce from a gas sand zone in the Yates.

The well files showed three sizes of casing being used for the construction of the well. One exclusive feature of the well is the 8 $\frac{5}{8}$ -inch intermediate casing which has no cement in the annulus between the casing and borehole and was reported as having the shoe of the casing sealed only with drilling mud. This portion of the borehole was reported to penetrate the Santa Rosa Formation, a 10-foot water show in the Rustler Formation, and a single stringer of salt above the major salt interval at 1250 feet BGS (see Figure 3).

The well was proposed for plugging on October 26, 1993, but the Notice of Intent was subsequently withdrawn. The remaining period between 1993 and 2003, when Southwest Royalties, Inc. became the new operator, are not documented in the Division's well file. In 2003, Southwest Royalties, Inc. initiated plans to convert the producing well to a disposal well, but did not complete the application process and the well was placed into a temporary abandonment status.

Notice for the conversion of the well to a disposal well was initiated on May 19, 2008, after Division received an application from the Fulfer Oil and Cattle Company, LLC (Fulfer).

#### **INJECTION HISTORY OF SUBJECT WELL:**

In 2008, a revised application was submitted to the Division to convert the well by performing remedial action to squeeze cement the perforations used in the recovery from the gas sand and deepening the open hole interval to 3055 feet BGS.

In the C-108 application provided to the Division, the applicant included the following information:

1. [Response to C-108 Section VII, Item 1] the proposed daily injection rate and sources as being "5000 bpd of produced water from Fulfer's own operation and surrounding production of the same waters."

2. [Response to C-108 Section VII, Item 4] the sources are described as “only produced water from formation in this area.”

The C-108 application also included an extensive discussion by the Division, including the Hobbs District Geologist, to determine the potential of the Capitan Reef complex being part of the proposed interval. The District Geologist provided his opinion in an e-mail dated May 16, 2008, that “the reef is not present in the area of the proposed disposal” and further states that the “Reef is probably at least a mile or more to the west.”

The Division reviewer also noted that an area of review (AOR) well, the Sholes B 25 Well No. 1 (API No. 30-025-09812; Unit letter H of Section 25, Township 25 South, Range 36 East, NMPM), should be plugged or temporarily abandoned (see Figure 2). Both this AOR well and the subject well produced from the Jalmat; Tansill-Yates-Seven Rivers (Oil) pool (pool code: 33820; referred to as the “Jalmat pool”). The application also lists another AOR well, the Humphreys Well No. 1 (API No. 30-025-09815), as being “inactive”.

With this information, the administrative order was issued and injection in the well commenced on January 6, 2009, with a reported average daily injection rate of 3,000 barrels. Injection continued until the end of November 2014 with the same operator and averaged an injection rate of 3,843 barrels of water per day (BWPD) with a peak injection rate for a single month being 6,088 BWPD (August 2010) (see Graph 1). Change of ownership of the subject well occurred in late 2015 and OWL commenced injection in 2016 averaging 18,427 BWPD with a peak injection for a single month being August 2016 with 34,580 BWPD.

#### **INJECTION SURVEYS:**

Prior to the commencing the first injection survey, the Division requested that the Operator install a bradenhead valve for the 8 $\frac{5}{8}$ -inch intermediate casing. This was to be monitored for any changes in pressure in this annular space during the injection surveys.

The well was initially tested in September 2016 without any modifications or maintenance of the injection interval. Results of this first survey activity were inconclusive in presenting the distribution of injection fluids for the entire permitted interval due to debris in the borehole. However, the pre-survey testing for the first survey effort did not demonstrate upward migration of fluids between the production casing and the intermediate casing or any issues with the existing tubing and packer system. A copy of the survey results is found in Attachment 3.

The Division and representatives from OWL participated in a meeting in Santa Fe on October 24, 2016. The result of the meeting was to have a new survey with an injection profile over the entire open-hole interval along with an additional effort to be conducted by OWL to demonstrate that the injection interval is not hydrologically connected with the Capitan Reef aquifer system.

Prior to the second testing of the injection interval, the Operator replaced and replumbed the valve recently installed in the 8 $\frac{5}{8}$ -inch casing for monitoring of annular pressure for this casing.

Consultant for OWL provided a Sundry NOI to the District Supervisor for the second injection survey on November 15, 2016, following discussions on possible deepening of the exiting open-

hole interval to provide additional borehole depth to accommodate survey logging tools. This proposal was withdrawn by the consultant and the final proposed plan included only a cleaning of the borehole to the original depth of 3055 feet BGS.

OWL activities for the second test at the well were initiated on November 28, 2016, and completed on December 9, 2016. Copies of the survey results are found in Attachments 5 and 6.

Mr. Chad Kronkosky, P.E., CEK Engineering LLC (CEK) of Lubbock, TX, conducted a review of the injection survey results and compiled a summary report on behalf of OWL. The report was forwarded through the Operator to the Division on January 20, 2017. This report included the efforts to address the items found in the Division's Notice to Operator. A copy of the report is included as Attachment 7.

#### **ADDITIONAL INFORMATION SOURCES:**

As part of this effort, the Division compiled and reviewed other sources of data and information available through public sources or personal communications. One of these documents was the Hydrologic Investigation Report prepared by Souder, Miller and Associates (2015) on behalf of the City of Jal. The report presented a thorough evaluation of the hydrology and ground water sources in this area including the Westfield Facility, the current municipal well field for the city. The report identified both the Santa Rosa Formation of the Dockum Group and the Capitan Reef aquifer as potential sources for assessment and possible future development to provide sustainable water sources for the city.

Another source for investigation of the hydrology for this area of Lea County was a presentation by Dr. Lewis Land of the National Cave and Karst Research Institute/New Mexico Bureau of Geology and Mineral Resources (NMBGMR) with regards to water levels in this area of the Capitan Reef aquifer. Dr. Land and the Bureau of Land Management (BLM) have attempted to assess and quantify the impacts of multiple sources (such as drought cycles, diversions of the Pecos River, agriculture uses, oil and gas industry uses, municipal area uses, etc.) on the Capitan Reef aquifer by continuing the effort to monitor the existing groundwater network in Eddy and Lea Counties.

#### **CONCLUSIONS:**

The Division reviewed all the submittals by OWL, the information provided to the Division and Division's records and offers the following conclusions:

1. The injection surveys completed by the Operator have demonstrated that injection fluids are entering the approved interval described in Administrative order SWD-1127 for the rate of injection used in the surveys. The injection survey results also indicate no vertical migration of disposal fluids to shallower formations.
2. Though the injection surveys did not demonstrate migration to shallower formations, the technical review and subsequent administrative order SWD-1127 did not contain a condition for remedial action to be completed on the open annulus of the 8 $\frac{3}{4}$ -inch intermediate casing where two USDWs are exposed to the Salado formation with its salt intervals. The current well construction is in violation of Rule 19.15.16.10(A) NMAC and,



with continued disposal operation, increased risk for impacts to USDWs if this situation is not addressed.

3. The calculations for assessing the radius of influence (Perturbed/Displaced reservoir Volume Due to Injection (Kronkosky, 2017)) estimated an effected area of 223 acres based on the current total of injection volume. Though these calculations are viable, the model used for these calculations assumes a radial, uniform growth of the injection plume under homogeneous and isotropic conditions.

Division contends that location of the well in the backreef transition into the Capitan Reef lithosome (and inclusive aquifer) is not lithologically homogenous and is modified by structural features, such as the South Jal submarine canyon (Hiss, 1975), which impacts flow direction and transmissivity (see Figure 4C). These features result in a model with a geometry that is non-radial and very susceptible to a preferred flow direction. This model is further augmented by the higher specific gravity of the disposal fluids and its preference to migrate in the down-dip direction towards the west, in general, and possibly north due to the effects of the South Jal submarine canyon. This model would favor a migration of disposal fluids towards the lithostratigraphic boundary of the Seven Rivers Formation and the Capitan Reef, as presented in cross sections by Kronkosky (2017) and Hiss (1976), with the opportunity to impact the Capitan Reef aquifer (see Figure 4D).

4. Additionally, there is indication of impacts to correlative rights and the existing production from wells still active in the Jalmat pool. The AOR well identified in the C-108 application review, the Sholes B 25 Well No. 1 (API No. 30-025-09812), showed a significant increase in water cut from production in the same interval being used for disposal. This producing well is north of the subject well and has a continuous record of monthly production starting prior to 1993 (see Figure 2).

The well is completed with an open hole interval from 2906 feet to 2950 feet. Prior production information showed a period that well was shut-in in 1979 due to high water production. The average production at this time was reported as 10 barrels of oil per day (BOPD), six thousand cubic feet of gas (MCFPD), and 1000 BWPD. A 24-hour test conducted in 1982 showed production results of 27 barrels of oil (BO), 35 thousand cubic feet of gas (MCF), and 936 BW.

Graph 2 shows a summary of production (gas and water) for the Sholes B 25 Well No. 1 for a period beginning in 2007. Prior to the period of the graph, no significant water production was reported during a period from 2004 to 2007. However, with the increased injection rates utilized by OWL, the graphed data showed a significant increase in the water cut for this well.

For November 2016, this well reported 182 MCF produced with 50,400 BW during 19 days of operation and in the following month reported 204 MCF of gas produced along with 71,067 BW during 31 days of operation. The reported totals for the four previous months in 2016 starting with July were as follows: 5 BO, 361 MCF, 599 BW, 31 days of

operation; 296 MCF, 564 BW, 25 days of operation; 322 Mcf, 0 BW, 30 days of operation; and 355 MCF, 78 BW, 31 days of operation.

There are no other producing wells adjacent to the subject well that have continuous monthly reporting for this same period. The only active injection well, the Sholes B 25 Well No. 2 (API No. 30-025-09808), in the vicinity of the subject well shows significant lower injection volumes for the same period of review and is interpreted as having little influence on the production of the Sholes B 25 Well No. 1.

5. The operation of the subject well is not consistent with the information provided in the Form C-108 application submitted for administrative review by the Division. Sources proposed for disposal in the subject well were identified as being from the area and, primarily, for the produced water from the original applicant with primary production from the Jalmat pool. Based on volumes, the subject well is now a commercial operation and the current operator has not provided any supplemental information as to the additional sources of the produced water or its water quality.
6. The Capitan Reef aquifer in this southern area of Lea County continues to have an increase in water levels as represented by measurements from deep monitoring wells located in the Reef. Figure 6 shows a significant decrease in the depth-to-water for the aquifer with the Southwest Jal monitoring well demonstrating a rise of over 400 feet in the water level for a 35-year period. As proposed by Land (2016), the only source with potential for such impacts would have to be associated with the disposal activities of UIC Class II wells.

If the City of Jal is going to have the opportunity for the future assessment of this portion of the Capitan Reef aquifer for municipal use, the Division should make every effort to minimize all potential sources that may impact the aquifer. This should include commercial disposal operations in shallower zones above the Capitan Reef aquifer in the vicinity.

Finally, the Operator's report provides the following statement regarding water quality:

*"The WELL's equivalent (injection interval) in the Capitan Reef (Late/Upper Seven Rivers) Margin is located 3.5+ miles to the west and approximately 200-300' down dip structurally. Additionally, in our opinion, there is sufficient evidence (HISS 1975, NMOCD Case No. 8405 testimony/Water Sample Analysis, IC Potash Corp Feasibility Study) that the interstitial waters of the Capitan Reef and back reef Artesia Group members near the WELL are mineralized above 10,000 mg/L (TDS), digital copies provided on FTP site."*

Division counters that the Capitan Reef is shown to have occurrences of both water quality below and above the 10,000 milligrams per liter (mg/L) total dissolved solids (TDS) threshold as defined in Rule 19.15.2.7(U)(1) NMAC. In response to the examples offered in the report:

1. Hiss (1975) provided a figure compiling water quality that showed historical dissolved chloride concentrations for this area of the Capitan Reef aquifer (CPAQ) ranging from 1,200 to 3,300 mg/L (see Figure 4B). Samples obtained from intervals in the Seven Rivers Formation (SVRV) range from 1,900 to 18,000 mg/L while the samples from the shallower Yates Formation (YTES) range from 1,500 to 69,000 mg/L.

2. The referenced sample for Case No. 8405 (offered as Exhibit 1) for Division Order R-7935 demonstrated a TDS of 12,856 mg/L for the Capitan Reef from a well located 4.2 miles to the northwest [West Jal Disposal No. 1; API 30-025-26676; last injecting at an average of 3,576 BWPd into 10 feet of perforations].
3. The IC Potash report (Crowl et al, 2011) provided an extensive discussion of the Jal Water System, a former municipal water source currently being operated by Chevron for oil and gas operations. This report included an assessment for water quality for its proposed production field ranging from 8,000 parts per million (ppm) to 13,000 ppm based on data from the Jal Water System wells.

The approach to characterize the Capitan Reef aquifer based on limited water quality information is not acceptable to support the statement that this aquifer is not protectable as a USDW, and additionally, does not satisfy the requirements for determination of an Exempted Aquifer as accepted under New Mexico State Demonstration for Class II Wells as detailed in 40 CFR 146.4.

#### **RECOMMENDATIONS:**

Based upon the findings of the testing and the reports, the Division recommends the following actions for the Director to consider:

1. **For the Operator:** Amend Administrative order SWD-1127 to include a maximum daily injection rate of 6550 BWPd. This rate was based on the maximum injection rate used for the second survey that showed disposal fluids confined to the approved interval. This maximum injection rate was also consistent with the daily rates of injection by the prior operator for the operation of the well during 2010 and 2011 report periods.
2. **For the Operator:** Include in the amended order a requirement for the operator to install a monitoring system at the wellhead to verify and document this disposal rate for inspection of the well site and that can be compiled for later review.
3. **For the Operator:** Require the operator to submit a remedial plan that shall seal the shoe and the length of the 8 $\frac{3}{4}$ -inch intermediate casing as to isolate the following lithologies in the annulus of the borehole: the salt section, the identified occurrence of groundwater in the Rustler formation and the exposed section of the Santa Rosa Formation. This remedial plan should be submitted in a C-103 Sundry Notice of Intent to the District Supervisor for review and approval.
4. **For the Operator:** Require the operator to provide a list of produced water sources representative of current fluids being disposed in the subject well. This submittal would also provide laboratory analyses representative of the major volumes or from the tank battery/pipeline for the subject well.
5. **For the Division:** Continued compilation and verification of hydrologic information including current efforts by the New Mexico Office of the State Engineer, the USGS, the BLM and the NMBGMR for this area of the Capitan Reef aquifer system.

The effort to assess and manage injection of the area of Jal is necessary to provide a minimum potential to impact the Capitan Reef aquifer in this area. This allows the maintenance of the current aquifer system without additional contributions from shallow disposal at high rates of injection and the opportunity for assessment of the USDWs in this area by the City of Jal. If the investigation of the aquifer determines that there are portions which can be excluded based on criteria in 40 CFR

146.4, then a hearing can be conducted to establish an Exempted Aquifer based on applications for future disposal in this interval.

**REFERENCES:**

- Crowl, W. J., Hulse, D. E., and Tucker, G., 2011, Prefeasibility study for the Ochoa Project, Lea County, NM; NI 43-101 Technical Report, prepared by Gustavson Associates for IC Potash Corporation;
- Harris, P. M., and Saller, A. H., 1999, Subsurface expression of the Capitan depositional system and implications for hydrocarbon reservoirs, northeastern Delaware Basin: *in* Geologic Framework of the Capitan Reef: Society for Sedimentary Geology (SEPM), Special publication No. 65, p. 37-49.
- Hiss, W. L., 1973, Capitan aquifer observation-well network, Carlsbad to Jal New Mexico: New Mexico State Engineer Technical Report 38, 76 p.
- Hiss, W. L., 1975, Stratigraphy and ground-water hydrology of the Capitan aquifer, southeastern New Mexico and western Texas: University of Colorado Department of Geological Sciences, Ph.D. Dissertation, 396 p.
- Hiss W. L., 1976, Structure of the Permian Guadalupian Capitan aquifer, southeastern New Mexico and western Texas: U. S. Geological Survey Open-File Report 76-0053, 338 p.
- Hiss W. L., 1976a, Structure of the Permian Guadalupian Capitan aquifer, southeast New Mexico and western Texas: New Mexico Bureau of Geology and Mineral Resources Resource Map 6; one page.
- Hiss, W. L., 1980, Movement of ground water in the Permian Guadalupian aquifer systems, southeastern New Mexico and western Texas: *in* New Mexico Geological Society Guidebook, 31<sup>st</sup> Field Conference, Trans-Pecos Region, p. 289-294.
- Land, Lewis, 2016, Using brackish water from karstic aquifers to augment freshwater resources in the semi-arid southwest, Paper No. 31-4; Geological Society of America Annual Meeting, Denver Colorado.
- Souder, Miller and Associates, 2015, Hydrologic Investigation Report, City of Jal Water Rights Appropriation Project, Jal, Lea County, New Mexico; prepared for the City of Jal, p. 110.
- Records of the New Mexico Oil Conservation Division: Publicly available information (well files, hearing orders, case files, production information) offered through E-permitting, Imaging and GIS databases.

**FIGURES:**

FIGURE 1: General Location Map of City of Jal and Related Geologic Features

FIGURE 2: Aerial Photograph Map Showing Major Features and Wells Near the Maralo Sholes B Well No. 2 Location

FIGURE 3: Maralo Sholes B No. 2 Well Diagram

FIGURE 4: Relevant Excerpts from Referenced Reports on the Capitan Reef Aquifer

FIGURE 5: Hydrographs of Capitan Reef Aquifer Monitoring Wells Near Jal, New Mexico

**GRAPHS:**

GRAPH 1: Daily Injection Rate vs. Time: Maralo Sholes B Well No. 2 (30-025-09806; SWD-1127)

GRAPH 2: Recent Production vs. Time: Sholes B 25 Well No. 1 (30-025-09812)

**ATTACHMENTS:**

Attachment 1: New Mexico Oil Conservation Division: Notice to Operator dated July 28, 2016

Attachment 2: City of Jal Correspondence dated April 28, 2016

Attachment 3: OWL SWD Operating LLC: Results of Indepth Injection Profile dated September 2, 2016

Attachment 4: OWL SWD Operating LLC: Daily Summaries for Second Injection Surveys

Attachment 5: OWL SWD Operating LLC: Results of Indepth Injection Profile dated December 2, 2016

Attachment 6: OWL SWD Operating LLC: Results of Pump-In Tracer dated December 2, 2016

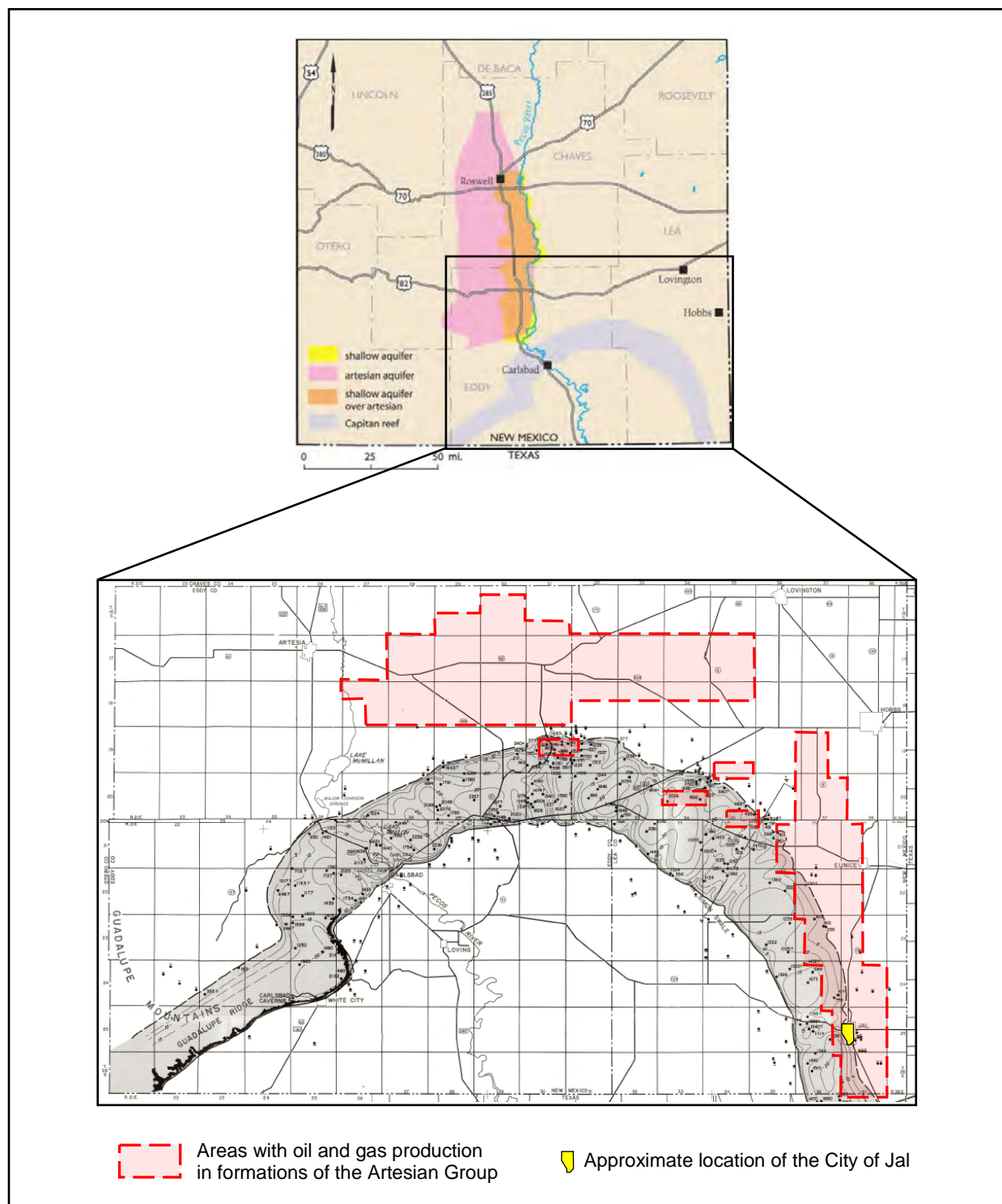
Attachment 7: CEK Engineering LLC: Final UIC Geological Assessment dated January 12, 2017

Cc: UIC Class II Program Imaging File  
Administrative Order SWD-1127  
Well File API 30-025-09806  
Oil Conservation Division – Hobbs District Office  
Ben Stone, SOS Consulting, LLC  
Robert Gallagher, Mayor, City of Jal and City Council members  
Nevin Bannister, OWL SWD Operating, LLC



Oil Conservation Division  
Energy, Minerals and Natural Resources Department  
State of New Mexico

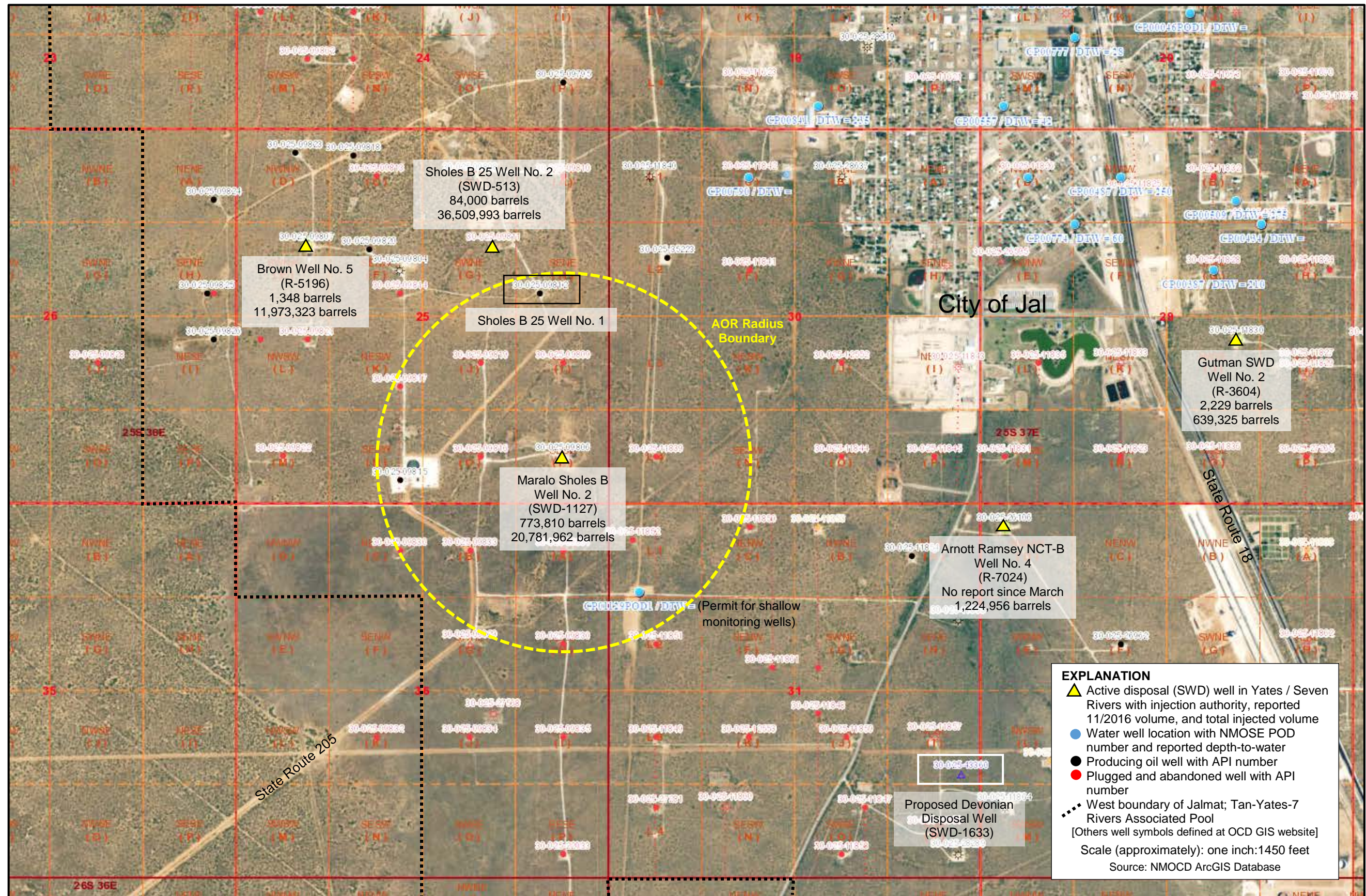
**FIGURE 1: General Location Map of City of Jal and Related Geologic Features**







**FIGURE 2: Aerial Photograph Map Showing Major Features and Wells Near the Maralo Sholes B Well No. 2 Location**





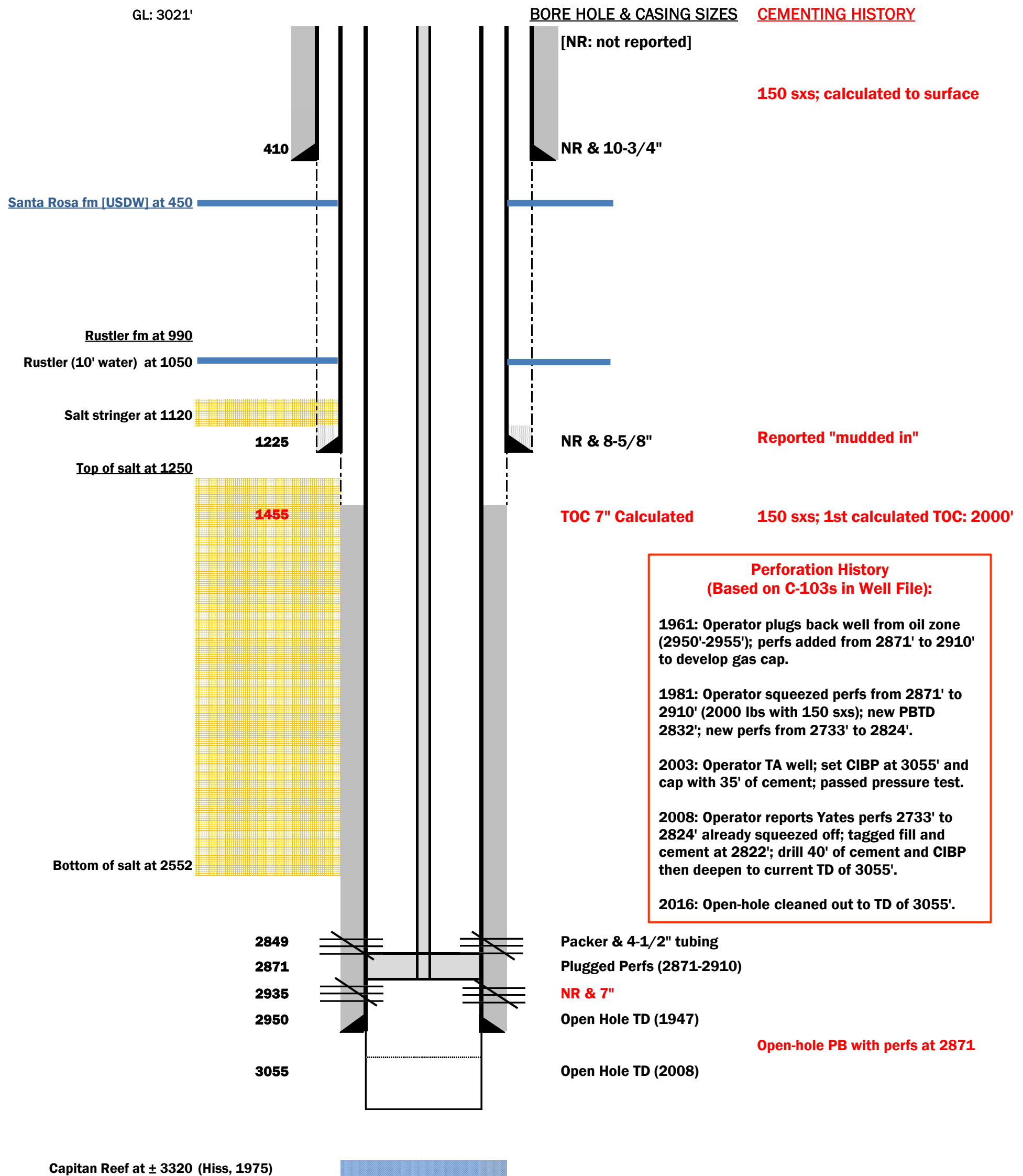


**Maralo Sholes B Well No. 2 (SWD-1127)**

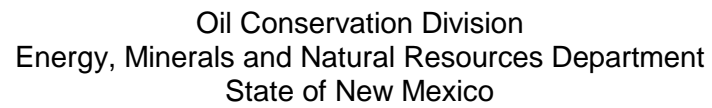
**OWL SWD Operating, LLC**

**UL P, Sec 25, T25S, R36E, NMPM; Lea County**

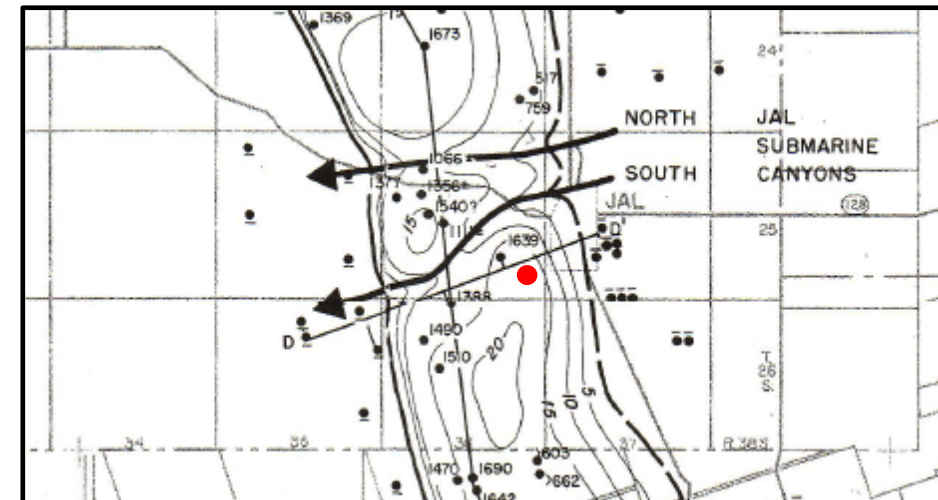
Author: PRG; 1/2017





[illegible]

EXPLANATION	
●	Approximate location of Maralo Shoals B Well No. 2

[illegible]

This geological cross-section illustrates the Delaware Basin from West to East. The wells shown are Gulf Wilson Federal Comm. #1, Gulf Lea State "GB" #1, Enron Hefner "11" Comm. #1, Union Luzon Federal #1, and Exxon Davidson Federal #1. The stratigraphic units from top to bottom are Tansill, Yates, Seven Rivers, Capitan (Shattuck Sh.), Goat Seep, Bell Canyon, and Cherry Canyon. Three reef/fore reef areas are highlighted in the center. Geophysical data tracks include Gamma Ray (GR), Acoustic (us/ft), Neutron Porosity, and Density (g/cc). A 100 m scale bar is provided.

**Figure 4D: Type Geophysical Log Response with Correlations**  
Cross section through Capitan aquifer complex showing relationship with backreef Artesian Group units; cross section is located approximately 10.5 miles northwest of Jal. Source: Harris and Saller (1999)

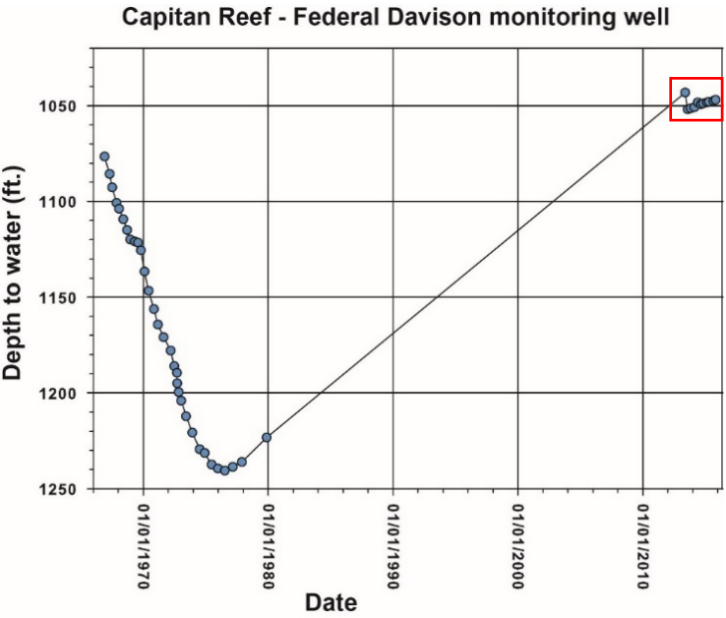
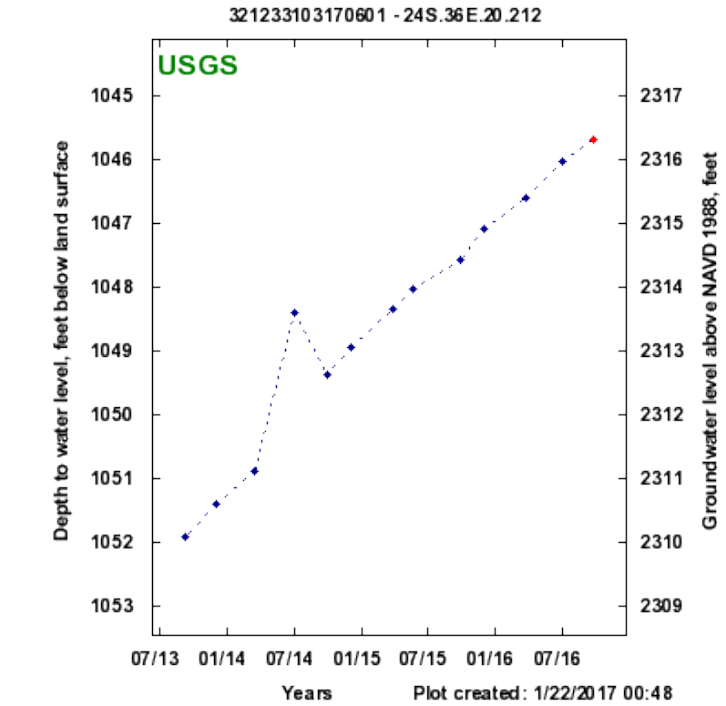




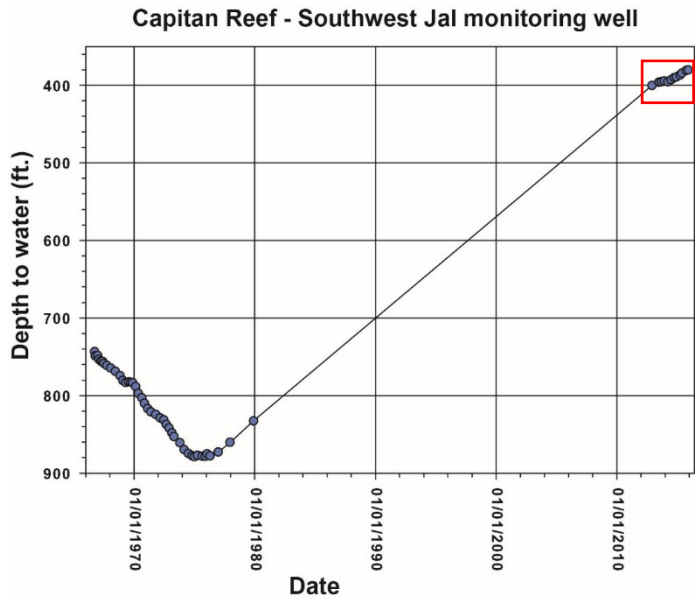
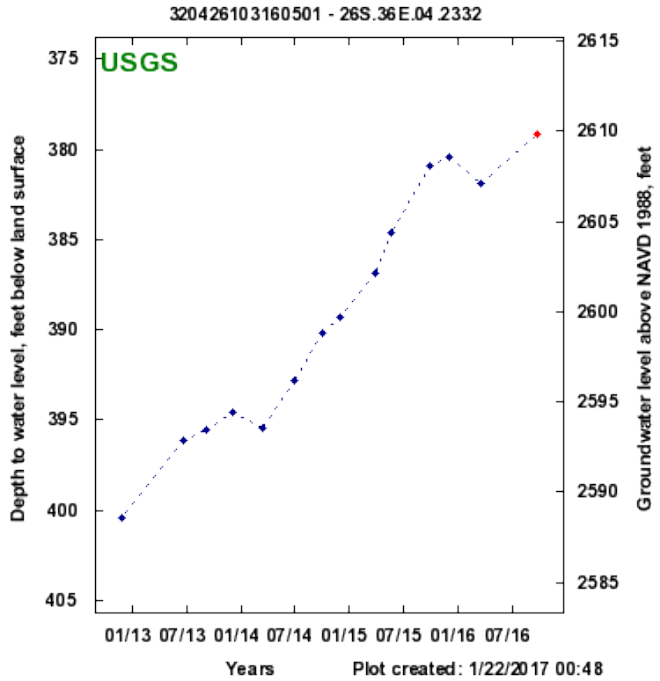
FIGURE 5: Hydrographs of Capitan Reef Aquifer Monitoring Wells Near Jal, New Mexico

**MONITORING WELL DESCRIPTION**  
**USGS Well Identification: 321233103170601**  
Location: 660 ft FNL / 1980 ft FEL; Sec 20, T24S, R36E, NMPM  
Lat: 32° 12' 33.3" Long: 103° 17' 5.9" NAD83  
Original completion information:  
Davison Federal No. 1 (30-025-21725)  
Spud: 07/22/1965 P&A: 09/30/1966  
TD: 17,691 feet PBTD: 5,713 feet  
Relinquished to the USGS WRD for monitoring use on 12/08/1967.

Index map showing locations of USGS monitoring wells relative to Jal, New Mexico

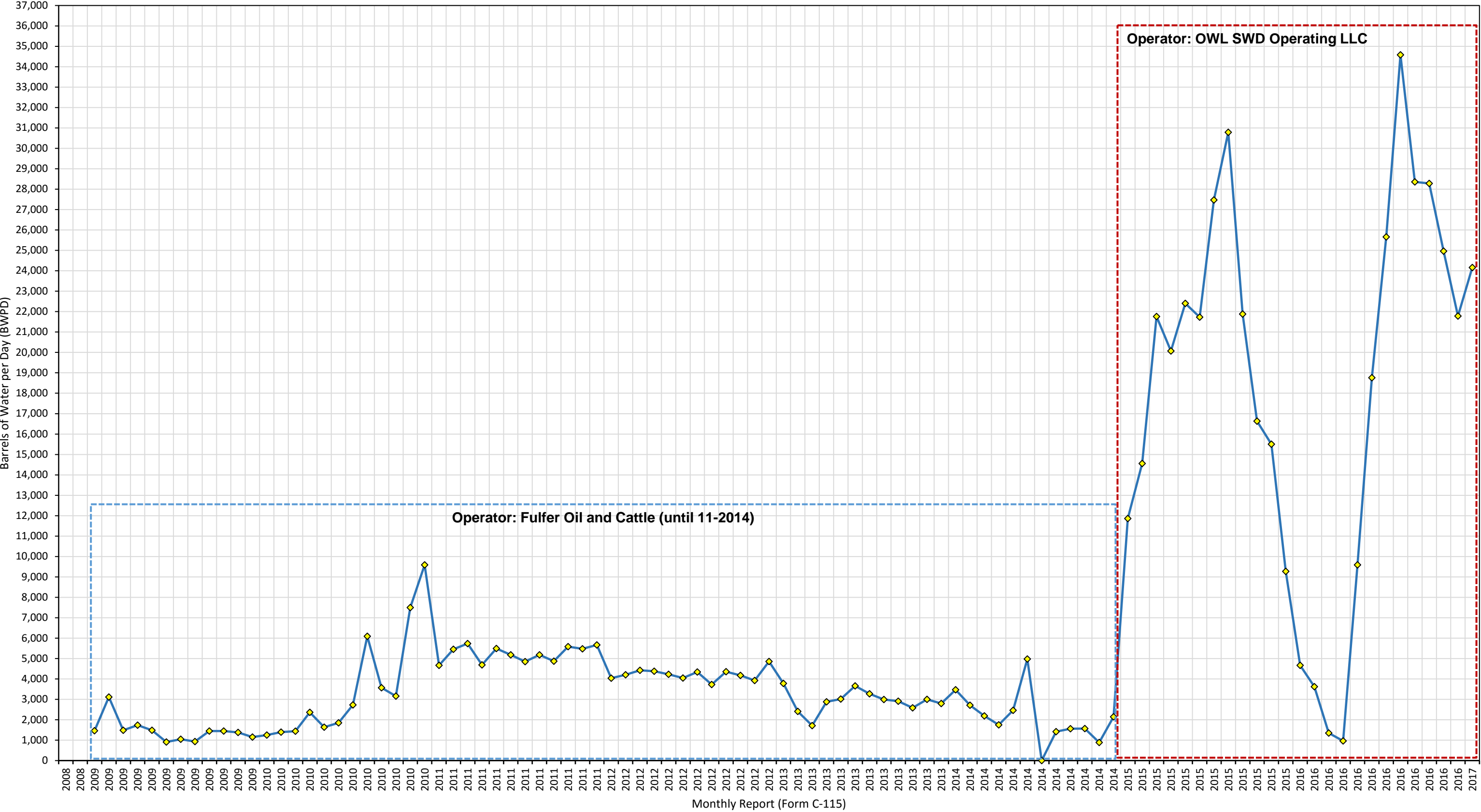


Graph Data Sources: USGS Groundwater Watch database and Land (2016)

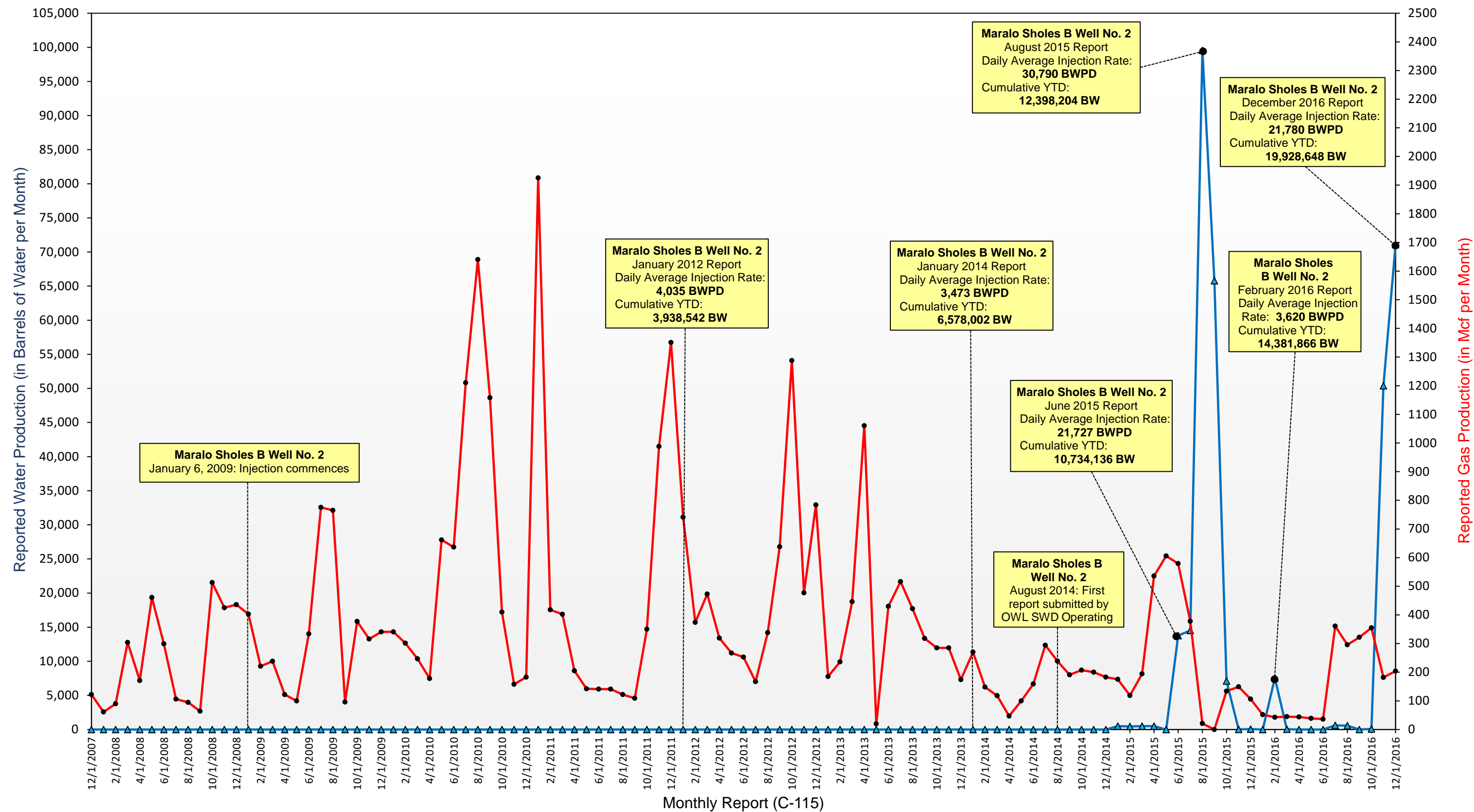


**MONITORING WELL DESCRIPTION**  
**USGS Well Identification: 320426103160501**  
Location: 1980 ft FNL / 1980 ft FEL; Sec 4, T26S, R36E, NMPM  
Lat: 32° 4' 25.8" Long: 103° 16' 4.7" NAD83  
Original completion information:  
Southwest Jal Unit No. 1 (30-025-20843)  
Spud: 04/21/1964 P&A: 03/05/1966  
TD: 13,505 feet PBTD: 5,300 feet  
Relinquished to the USGS WRD for monitoring use on 03/15/1966.

**GRAPH 1: Daily Injection Rate vs. Time: Maralo Sholes B Well No. 2 (30-025-09806; SWD-1127)**



GRAPH 2: Recent Production vs. Time: Sholes B 25 Well No. 1 (30-025-09812)



State of New Mexico  
Energy, Minerals and Natural Resources Department

---

Susana Martinez  
Governor

Tony Delfin  
Deputy Cabinet Secretary

David R. Catanach, Division Director  
Oil Conservation Division



**\*Response Required – Deadline Enclosed\***  
*Underground Injection Control Program*

July 28, 2016

Mr. Nevin Bannister  
Chief Operating Officer  
OWL SWD Operating, LLC  
8214 Westchester Drive, Suite 850  
Dallas, TX 75225

**RE: NOTICE TO OPERATOR: REQUIREMENT TO CONDUCT INJECTION SURVEY**

Maralo Sholes B Well No. 2 (API 30-025-09806)  
660' FSL, 660' FEL; Unit P, Sec 25, T25S, R36E, NMPM, Lea County, New Mexico  
Injection Authority: Administrative Order SWD-1127  
Order Date: June 1, 2008  
Permitted Interval: Yates and Seven Rivers formations; 2938 feet to 3055 feet

Mr. Bannister:

The Division is in receipt of a formal correspondence by the City of Jal regarding the potential impacts of the operation of the injection well referenced above (the "subject well"). This correspondence presents concerns for the protection of underground source of drinking water in the vicinity of the subject well. In response to this correspondence, the Engineering Bureau is conducting a technical review of the well file and operation with respect to the conditions contained in the administrative order.

OWL SWD Operating, LLC (the "operator" or "OWL") has responded to recent requests for inspection and upgrade of the wellhead in order to monitor an intermediate casing string that is only sealed in place with drilling mud and not cement. This situation is being assessed for potential vertical migration of fluids behind casing and may require additional testing based on the results of the Bradenhead monitoring.

During the review of the well file, the Division found that the reported volumes of injection fluids increased significantly during the calendar year 2015 (see attachment). The average daily injection rate for 2015 was approximately 19,500 barrels of water per day (BWPD) while the highest single-month rate happened in August with approximately 30,790 BWPD. All of the reported volumes were

injected with a surface pressure of zero (0) pounds per square inch (PSI). Conversely, the injection volumes for the period from 2009 to 2014 showed an average of 3300 BWPD with all volumes injected with a surface pressure of 0 PSI.


The Division is required "*to ensure that the injected water enters only the proposed injection interval*" as a condition of the administrative order. Based on the recent injection information and lack of any quantitative testing, the Division cannot confidently determine that the injection fluids are staying within the permitted interval. Therefore, the Division is stipulating that the operator conduct an injection survey for the subject well with the results to be submitted within the next twenty-one (21) days of this correspondence date.

The type of injection survey may be either a temperature survey or a radioactive tracer survey. At a minimum, the injection survey will be conducted to established industry protocols with results that provide a clear interpretation. A description of activities to conduct the proposed injection survey must be submitted in a Notice of Intent Sundry for approval by the Hobbs District Supervisor. Scheduling of the injection survey must provide the opportunity for Division personnel to be present to witness the activities. All test results, logs and reports prepared as a result of the injection survey are to be submitted to the attention of the Division Director in Santa Fe.

In the event that a satisfactory response is not received to this letter of direction within the prescribed period, enforcement will occur. Such enforcement may include immediate shut-in and an application for appearance by OWL before a Division Examiner to terminate the injection authority granted in the administrative order.

Please contact Mr. Daniel Sanchez, Fields Operations Manager (505.476.3493), with any questions regarding this correspondence.

Sincerely,



DAVID R. CATANACH  
Director

DRC/prg

Attachment: GRAPH 1: INJECTION RATE VS. TIME: Maralo Sholes B No. 2 (30-025-09806; SWD-1127)

cc: Oil Conservation Division – Hobbs District Office  
Well File API 30-025-09806  
Administrative Order SWD-1127  
Bureau of Land Management – Carlsbad Field Office  
Mr. Bob Gallagher, City Manager, City of Jal





## CITY OF JAL

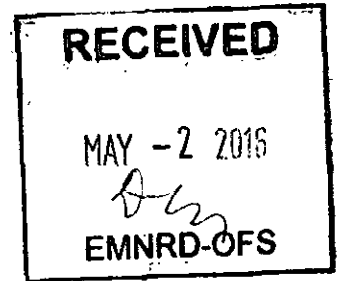
JAL, NEW MEXICO 88252

PO DRAWER 340  
PHONE 395-3340

April 28, 2016

Mr. Matthew Earthman  
Souder, Miller & Assocs.  
3451 Candelaria Rd NE  
Albuquerque, NM 87112

Mr. Earthman,



I want to take this opportunity to communicate with you about a concern that was brought to the city by several individuals and companies. The concern is in reference to our pending application for 900 acre feet of water and nine well locations.

There are several disposal wells in the same section that we are considering to place our wells, Section 25, T 25S, R 36E, that would be utilized for drinking water. In particular, there is a disposal well, Owl Maralo Sholes B #2, that has continued to inject large volumes of disposal water, 13 million barrels in 2015. In addition to the ongoing volumes of water, a company is now constructing a 16 inch line that will travel west out of the Jal area. The purpose for this line, as we understand it, would be to transport produced water for disposal in the above-mentioned disposal well.

Before the city undertakes the expenditure to drill water supply wells in the area close to this well, we would like to ensure this salt water disposal well is injecting into the permitted Seven Rivers Zone and will not cause problems with shallow fresh water aquifers.

Our specific request is for you to involve the Oil Conservation Division and the State Engineer Office in requiring the following information.

1. Provide documentation to demonstrate wellbore integrity;
2. To run a spinner survey to demonstrate injection is within the permitted interval

We strongly believe that these tests and any others that the regulatory agencies believe are warranted should be conducted immediately and then on a regular basis thereafter to ensure that the drinking water to the residents of our community has not been negatively impacted or contaminated in any manner.

Please do not hesitate to contact me should you have any questions or require additional information.

Respectfully,

Bob Gallagher, City Manager

XC: David Martin, Sec. EMNRD  
David Catanach, Director, OCD  
Tom Blaine, State Engineer

**Final Report for Maralo Sholes B Well No. 2  
Attachment 2**



## TEMP SURVEY W/ TRACER AND CHANNEL CHECKS

Company	OWL SWD OPERATING, LLC	Location:	API # : 30-025-09866	Other Services			
Well	MARLO SHOLES B WELL #2		660' FSL & 660' FEL UNIT P, NM/PM				
Field	N/A						
County	LEA	State	NEW MEXICO				
Permanent Datum GL Elevation 3021'							
Lcg Measured From 2' Elevation 3023'							
Drilling Measured From DF GL 3021'							
Date	9-2-2016	1.375" TOOLS					
Run Number	ONE						
Depth Driller	3085'						
Depth Logger	3085'						
Bottom Logged Interval	3005'						
Top Log Interval	SURFACE						
Open Hole Size	N/A						
Type Fluid	WATER						
Density / Viscosity	N/A						
Max Recorded Temp.	98.5 DEG.						
Estimated Cement Top	N/A						
Time Well Ready	ROA						
Time Logger on Bottom	1:05 PM						
Equipment Number	HU #08						
Location	SNYDER TEXAS						
Recorded By	HAGINS, T.						
Witnessed By	MR JIM WARD						
Borehole Record							
Run Number	Bit	From	To	Size	Weight	From	To
				4.5"	IPC	0	2892'
Casing Record							
Size	Weight	Top	Bottom				
10.75"	35#	0	410'				
Surface String	22#	0	1223'				
Pot. String	7"	20#	0	2935'			
Production String							
Liner							

<<< Fold Here >>>


All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

### Comments

LOG CORRECTED TO DEPTH OF 7" CASING SHOE AT 2935'.



PERFORATIONS									
SQUEEZED: 2733-2824', 2871-2910. OPEN HOLE: 2935-3055'									
<b>INJECTION WELL:</b> SHUT-IN DATE   N/A                      HOUR   N/A                      TOTAL S.I. TIME   N/A                      S.I. PRESS   N/A METERED INJ. RATE 6300 BPD                      PRESSURE VACUUM   TEMP                      N/A                      FLUID TYPE   WATER TOTAL VOLUME TO DATE   N/A                      FLUID LEVEL TUBING   N/A									
<b>PRODUCER:</b> FLOWING                      PUMPING                      CHOKE SETTING                      HOURS PROD. FLUID LEVEL CSG.                      TBG.                      RATE                      B/W                      B/O FLUID TYPE									
<b>FRAC OR ACID WELLS:</b> TIME FINISHED FRAC OR ACID                      ACID                      FLUID - CALS                      SAND # RATE - BPM                      PRESSURE									
CONCLUSIONS									
THIS SURVEY WAS RAN TO DETERMINE THE ZONES OF INJECTION AND TO DETECTED ANY CHANNEL OR PACKER LEAKS.  NO CHANNELS OR PACKER LEAKS WERE DETECTED AT TIME OF SURVEY. THE CHANNEL AND PACKER CHECKS HAVE BEEN PRESENTED ON THIS LOG.  NOTE: INJECTION TRACER INTENSITY LOSS CALCULATIONS INDICATED THAT 20% WAS EXITING THE WELL BORE AT 2935-2955'. THE REMAINING 80% WAS EXITING THE WELL BORE FROM 2955' TO BELOW THE DEPTH GAMMA OF 3002'.  THE TEMPERATURE AND TRACER INDICATED THAT FLUID IS MOVING BELOW DEPTH LOGGER AT 3005'.									

Sensor	Offset (ft)	Schematic	Description	Len (ft)	OD (in)	Wt (lb)
			1.375-7 1.375" WEIGHT BAR	7.00	1.38	50.00
			1.375-3	5.00	1.38	100.00

				TREJCT-137_57 (137_57_1) 1.375" EJECTOR	3.08	1.38	10.00		
CCL	4.04			CCL-137_19 (137_19_01) CCL	2.50	1.38	3.00		
				GR-1.375 (0001) GAMMA	3.54	1.38	5.00		
GR	0.00								
Dataset: msb#2.db: field/well/GAMMA/pass1 Total Length: 21.12 ft Total Weight: 168.00 lb O.D.: 1.38 in									

Company:  
 Well:  
 File: C:\Warrior\Data\msb#2.db  
 Dataset: field/well/TRACER/\_tracer/\_\_shottabl\_1  
 Reference Rate: 7222.7 b/d

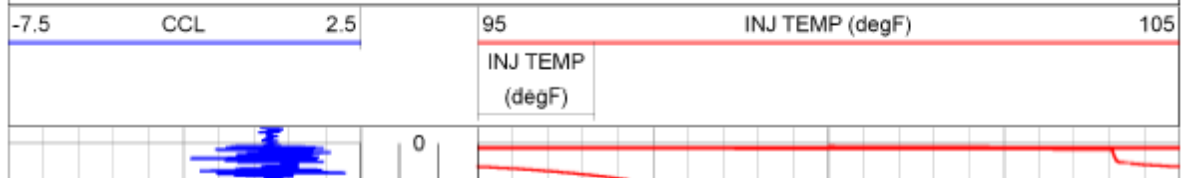
#### TRACER RESULTS

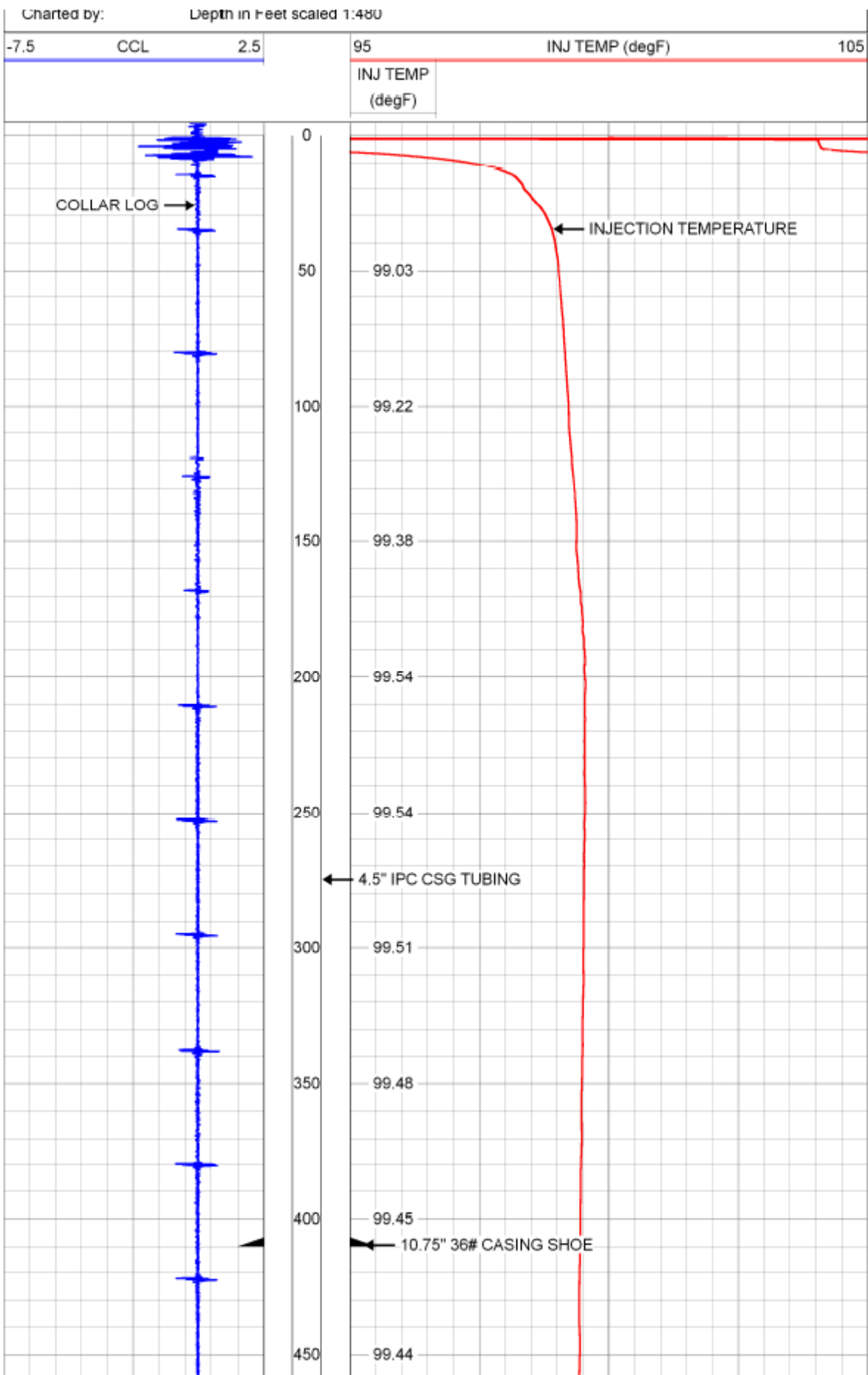
#	Depth (ft)	Time	Integration	Flow (%)	Delta (%)	Comment
1	2874.50	13:28:24	349943.00	99.99		
2	2924.22	13:28:49	349979.00	100.00	-0.01	
3	2955.57	13:29:15	282989.00	80.86	19.14	
4	2999.88	13:29:46	149440.00	42.70	38.16	

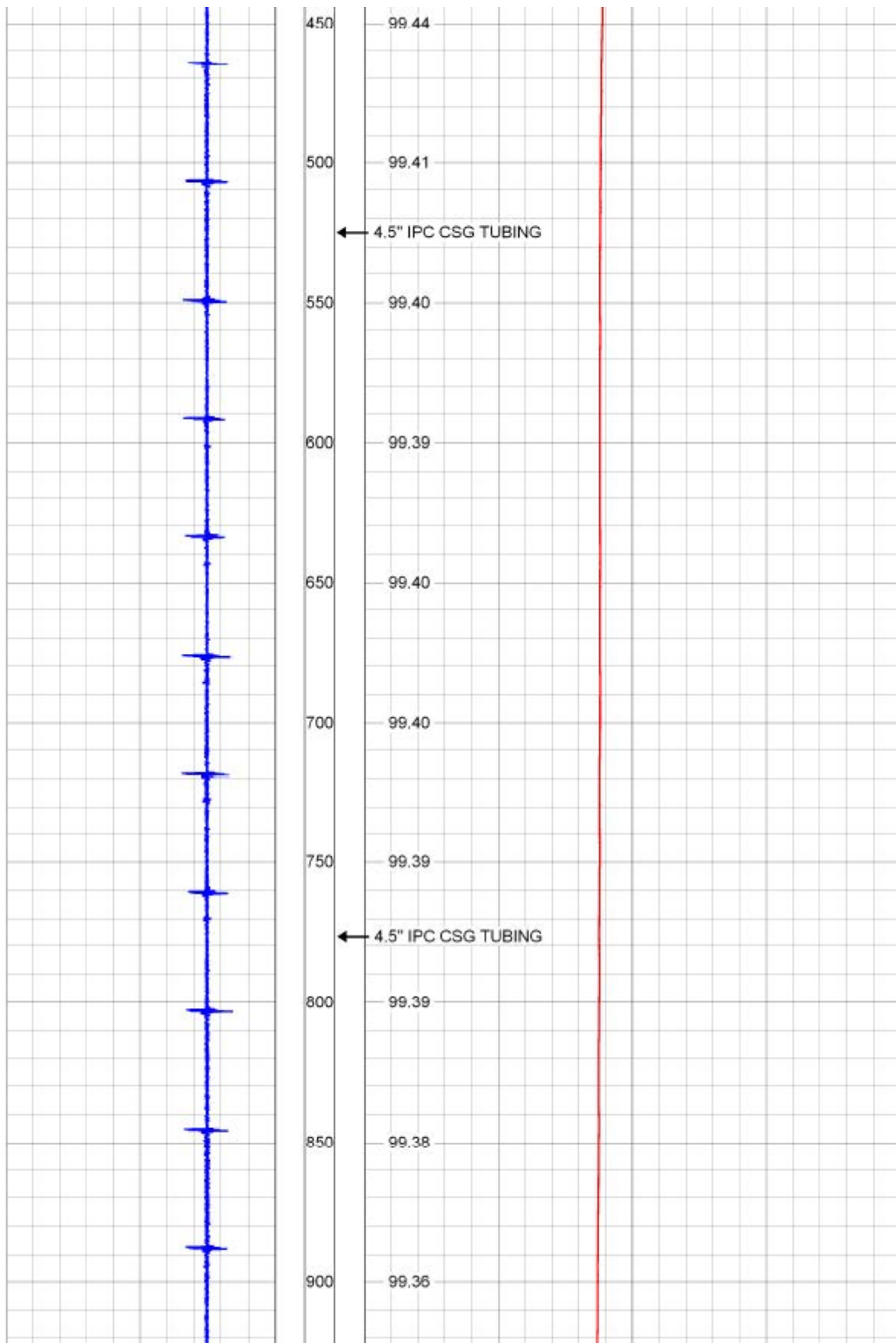


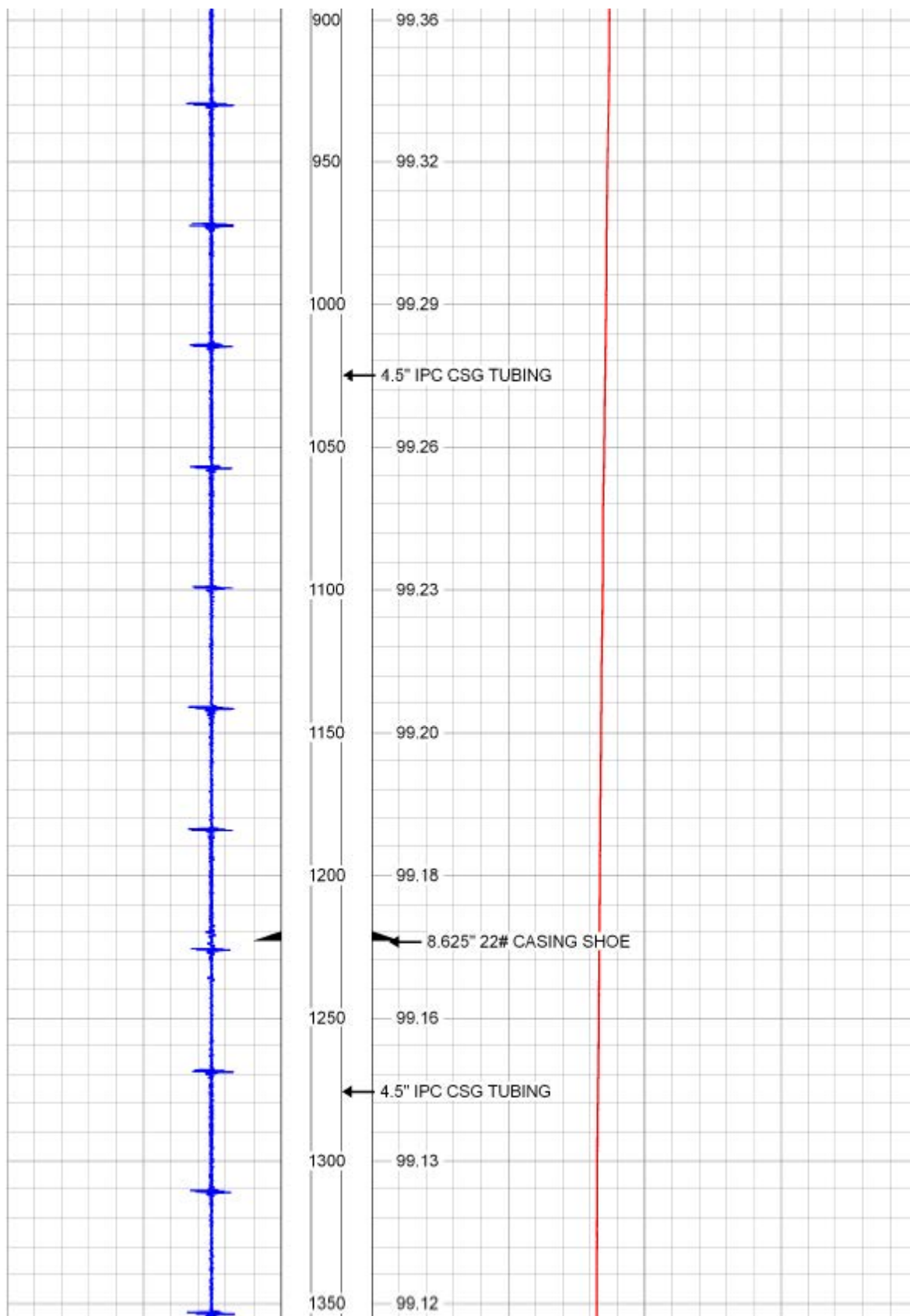
#### INJECTION TEMPERATURE SURFACE TO DEPTH LOGGER

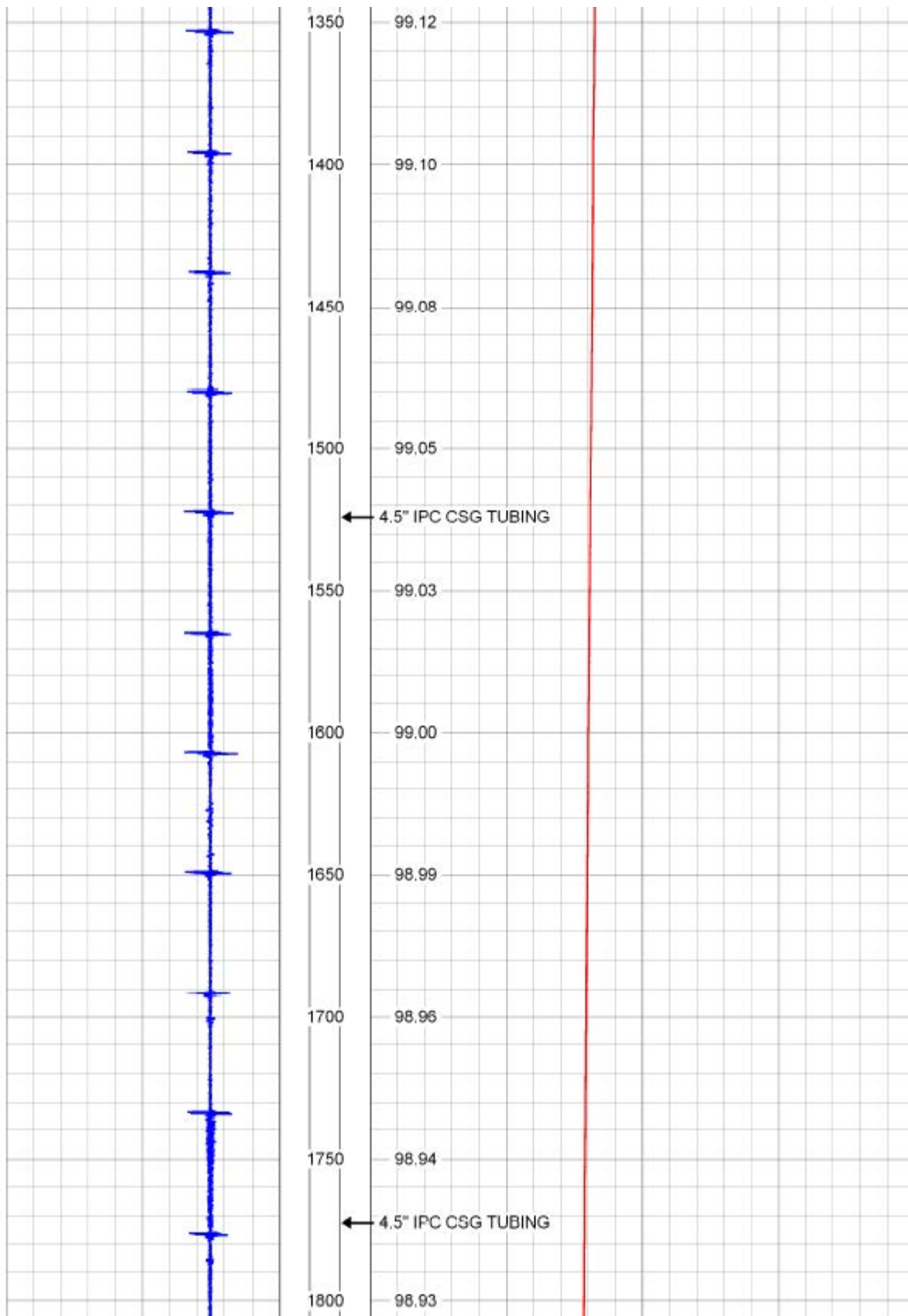
Database File: msb#2.db  
 Dataset Pathname: TEMP  
 Presentation Format: trccompb  
 Dataset Creation: Fri Sep 02 18:31:31 2016  
 Charted by: Depth in Feet scaled 1:480

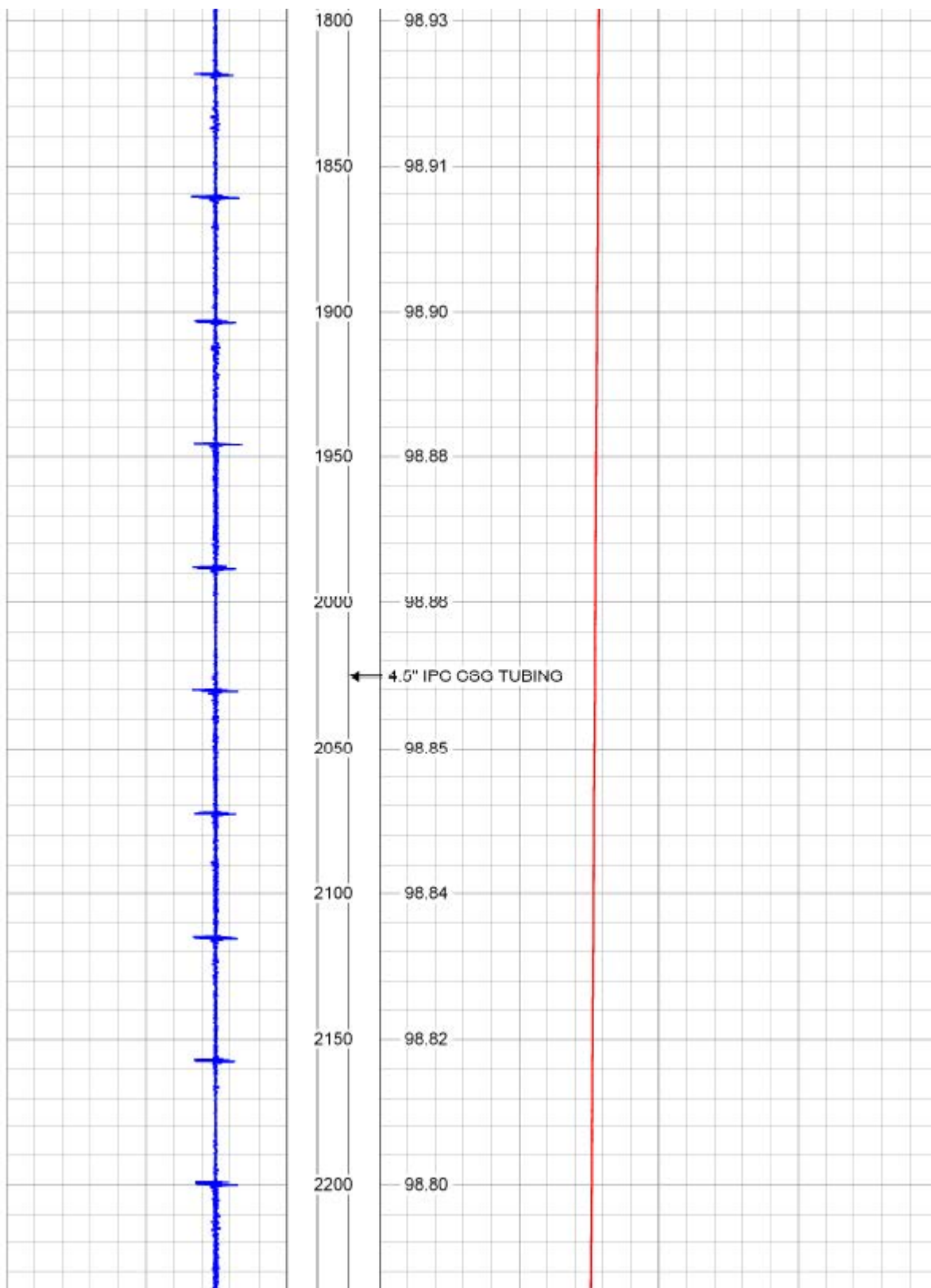


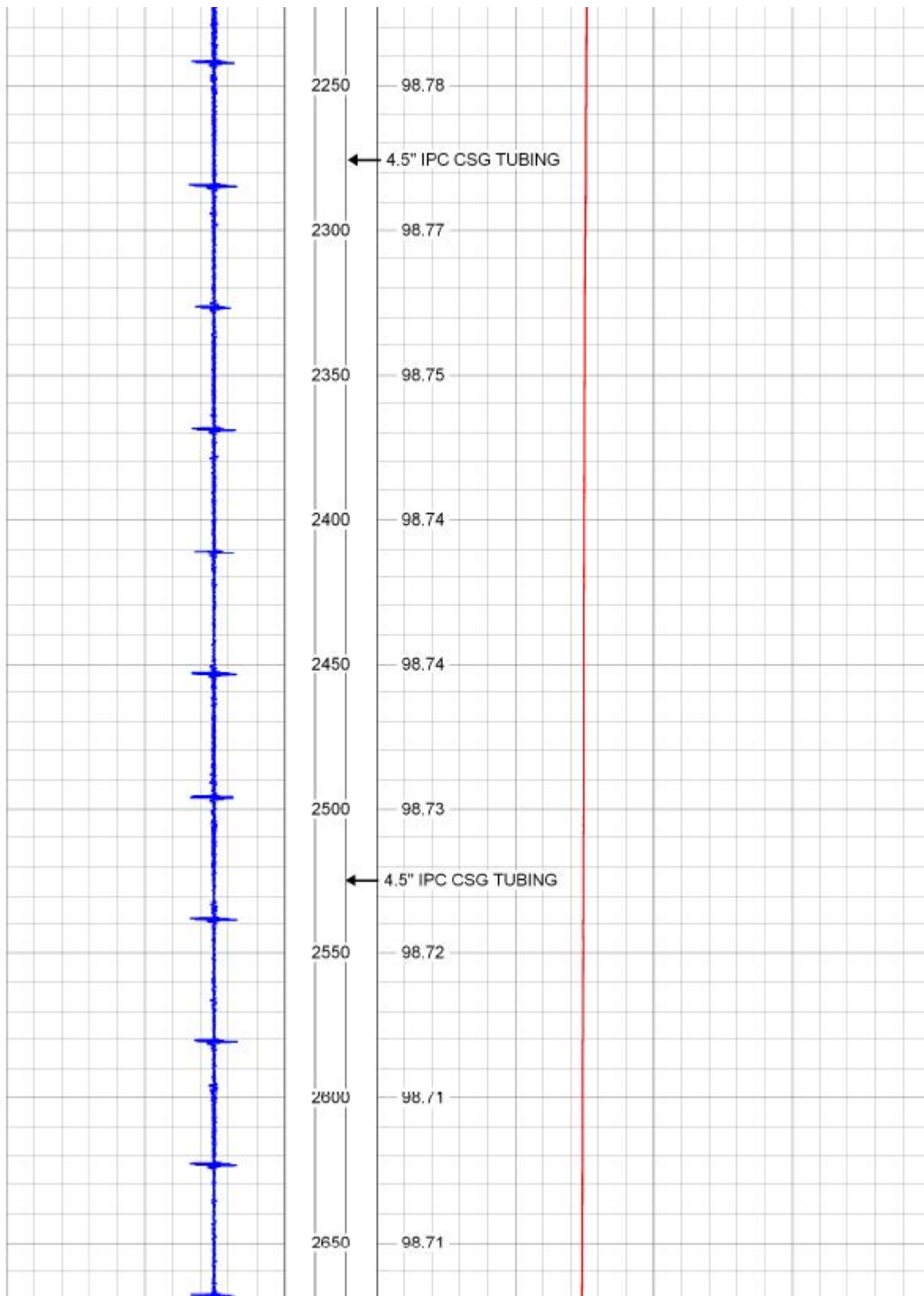




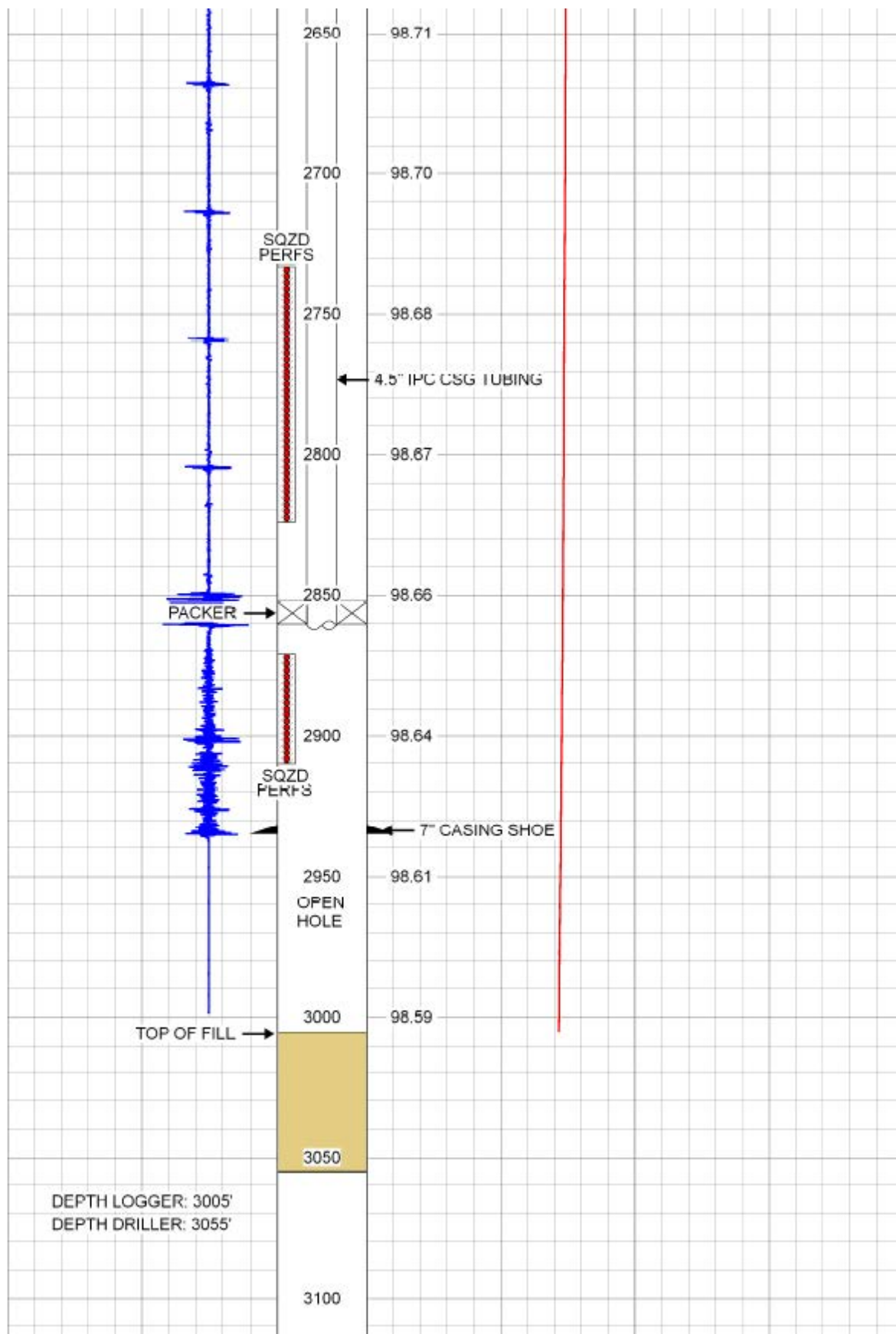


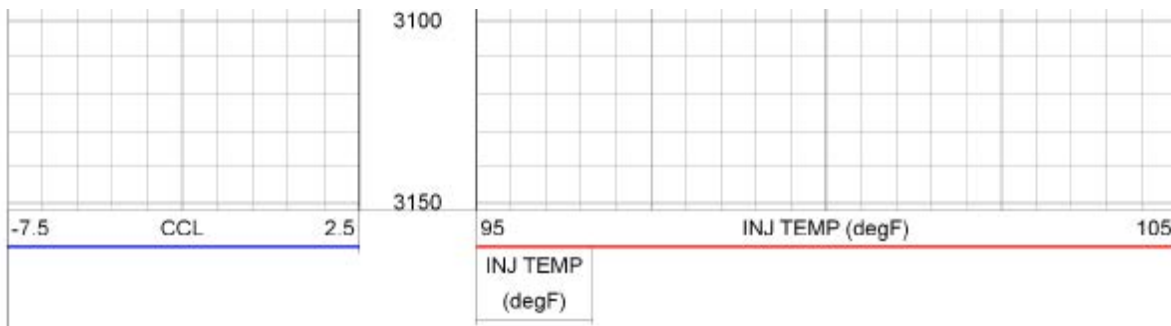






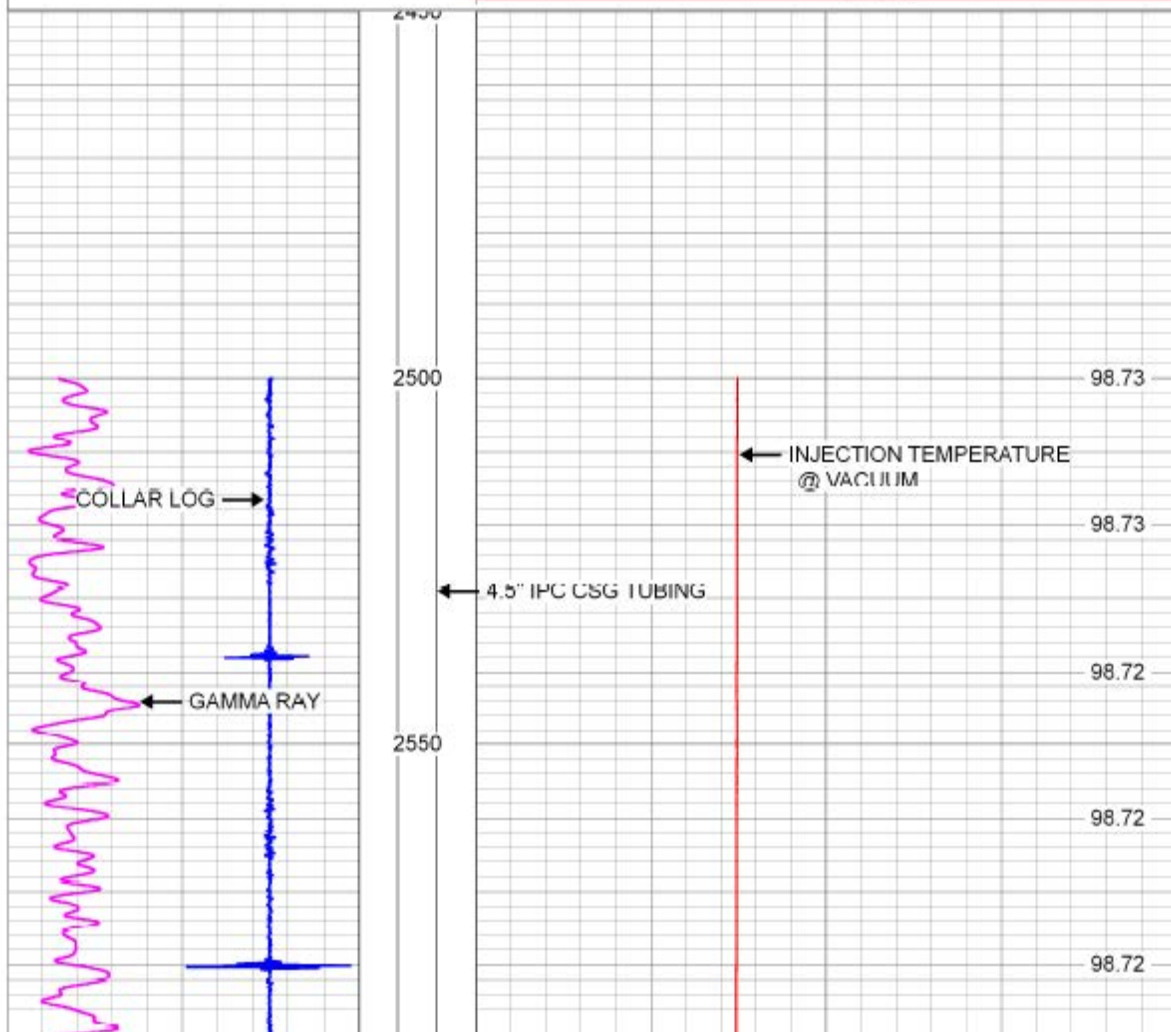


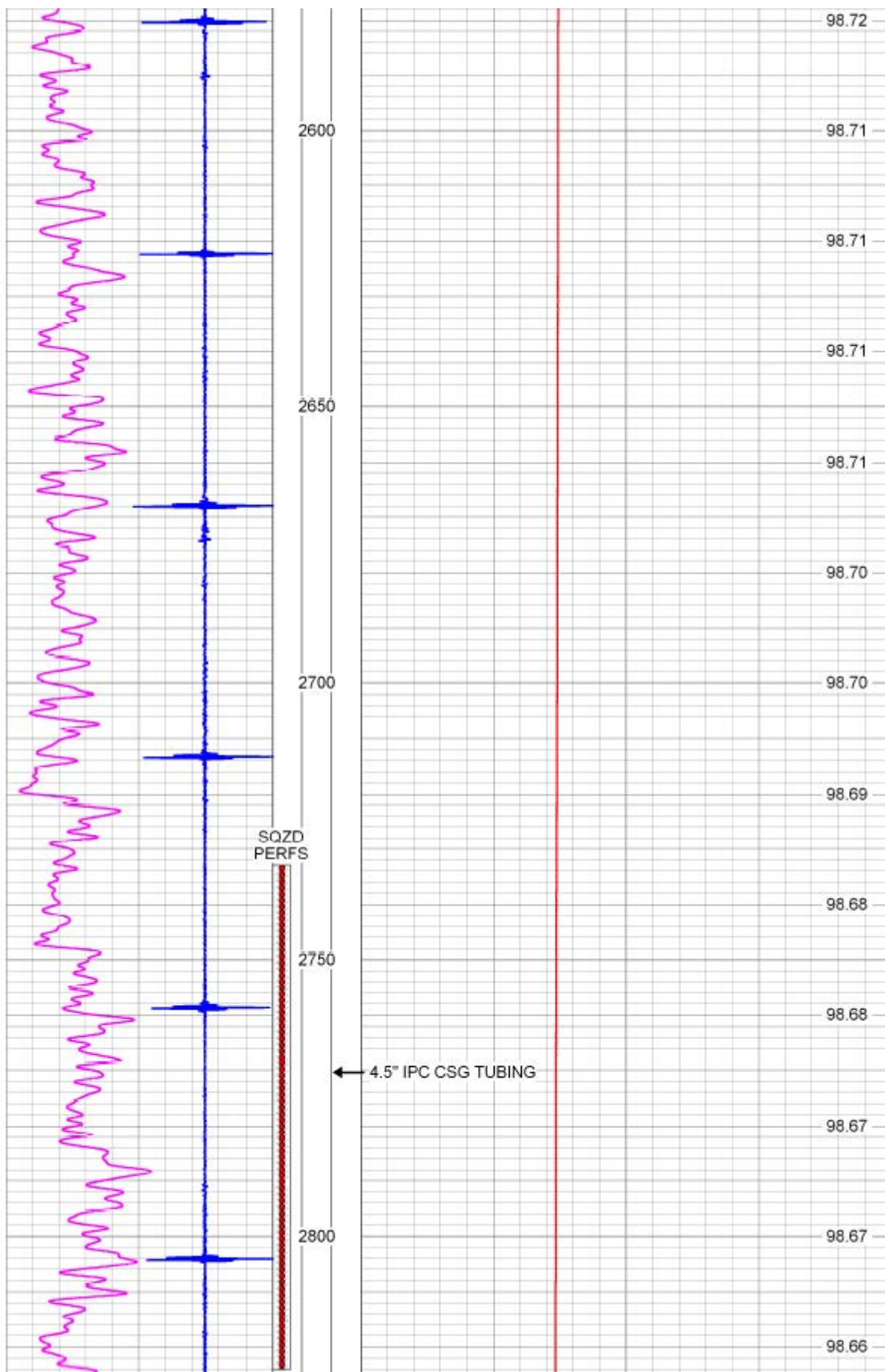


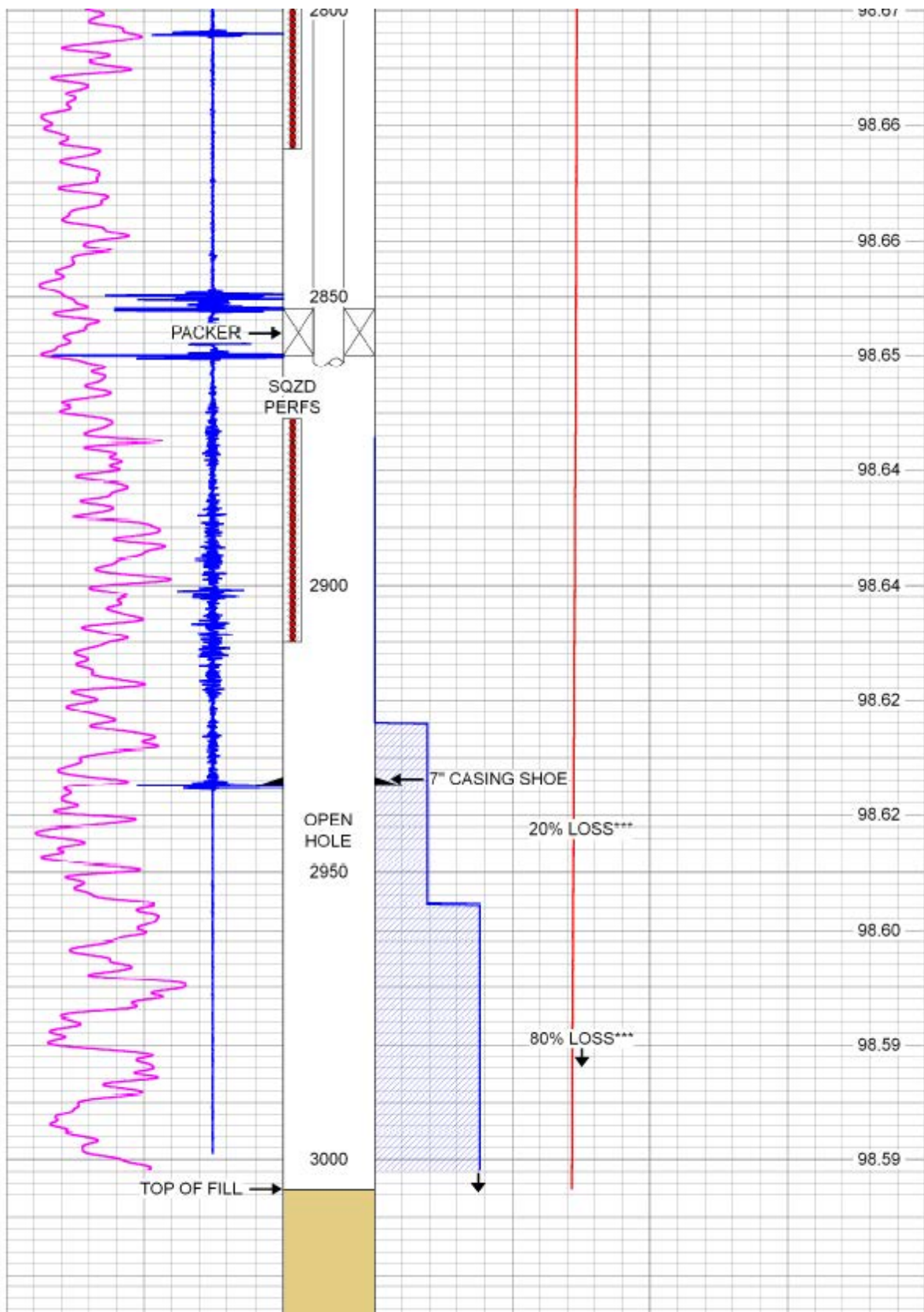


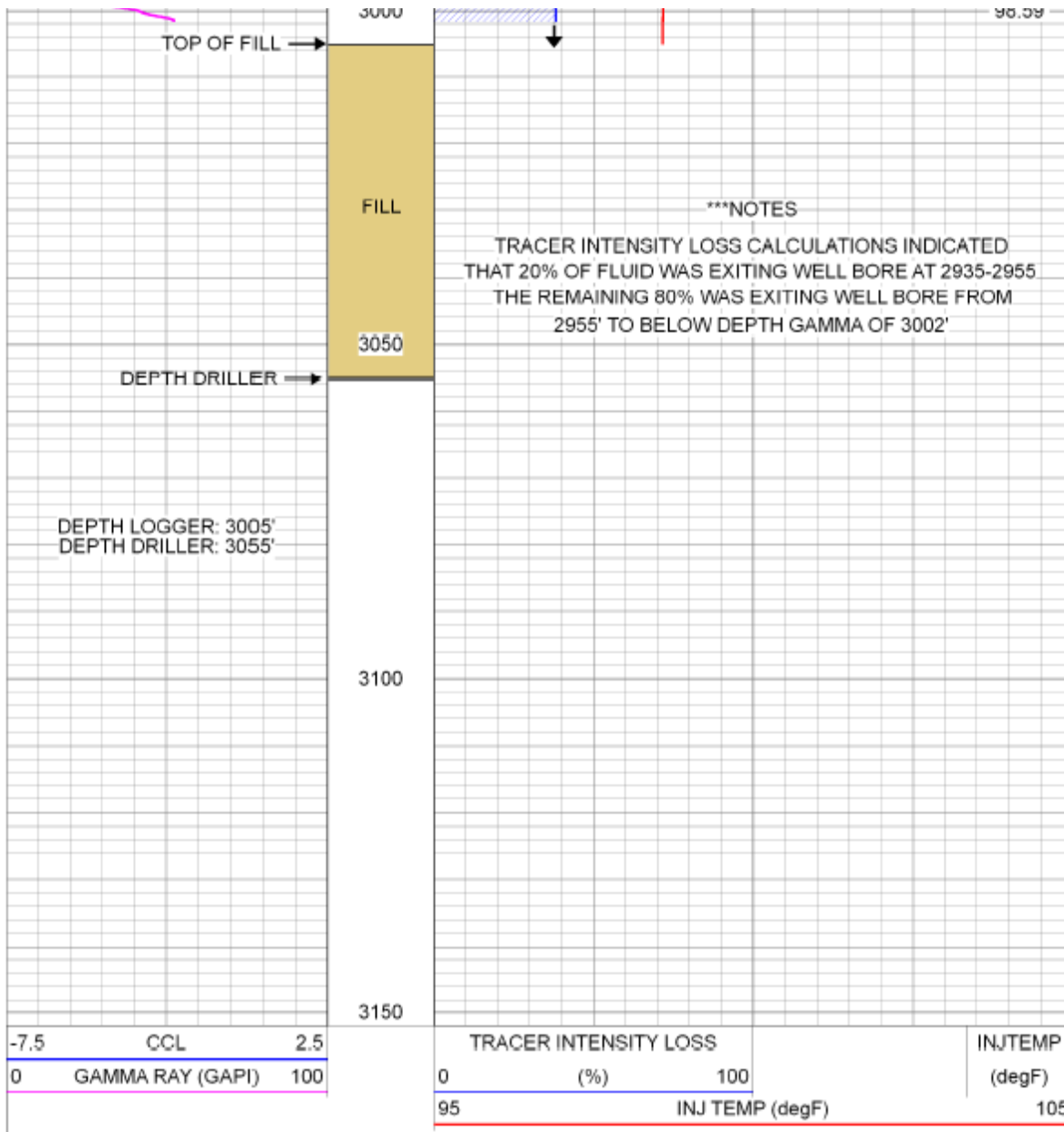
# COMPOSITE

Database File: msb#2.db  
 Dataset Pathname: COMPOSITE  
 Presentation Format: trccompb  
 Dataset Creation: Fri Sep 02 18:53:19 2016  
 Charted by: Depth in Feet scaled 1:240





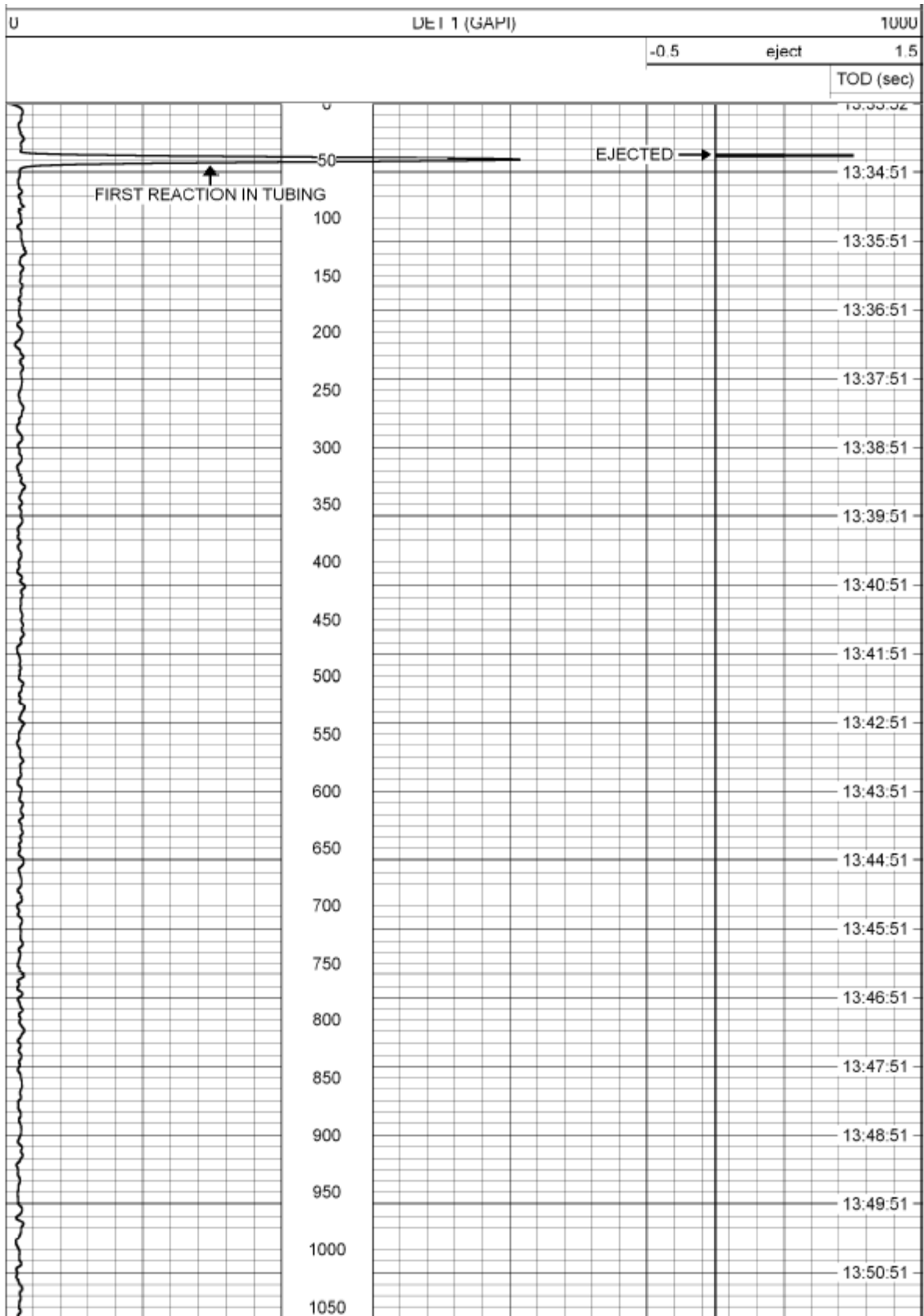




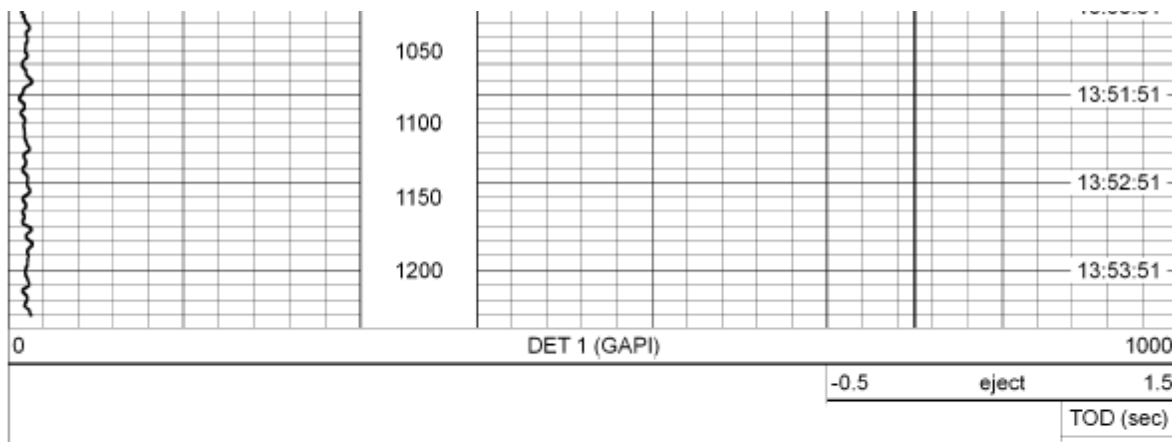
1200 SEC UPWARD CHANNEL CHECK AT 2925'  
NO CHANNEL DETECTED WITH R/A

Database File: msb#2.db  
Dataset Pathname: VEL/pass1  
Presentation Format: tracer  
Dataset Creation: Fri Sep 02 13:33:52 2016 by Log PIP Casedhole Loggi  
Charted by: Time scaled 36"/hour

0	DET 1 (GAPI)	1000
	-0.5	eject 1.5
		TOD (sec)
		13.33.52

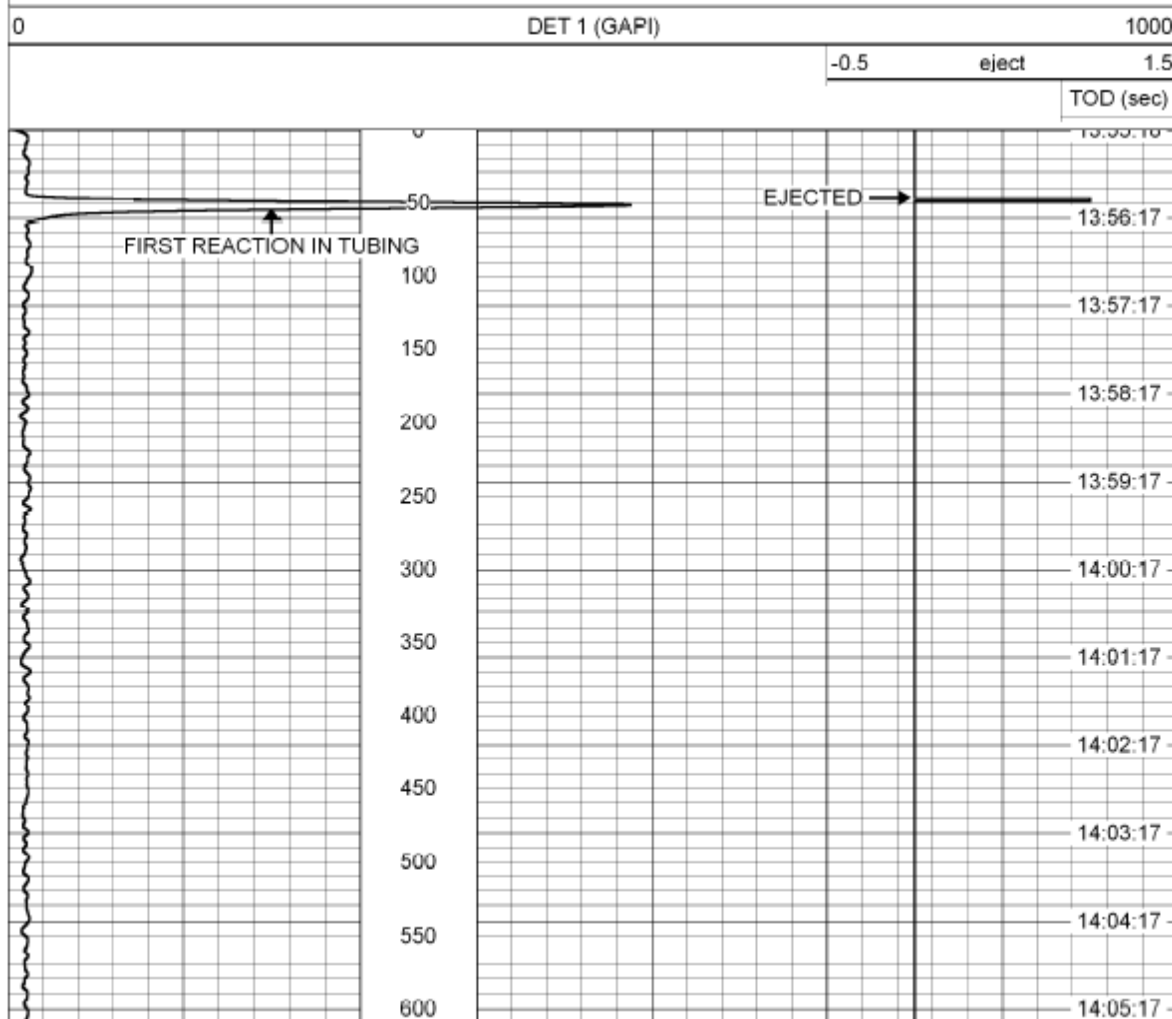


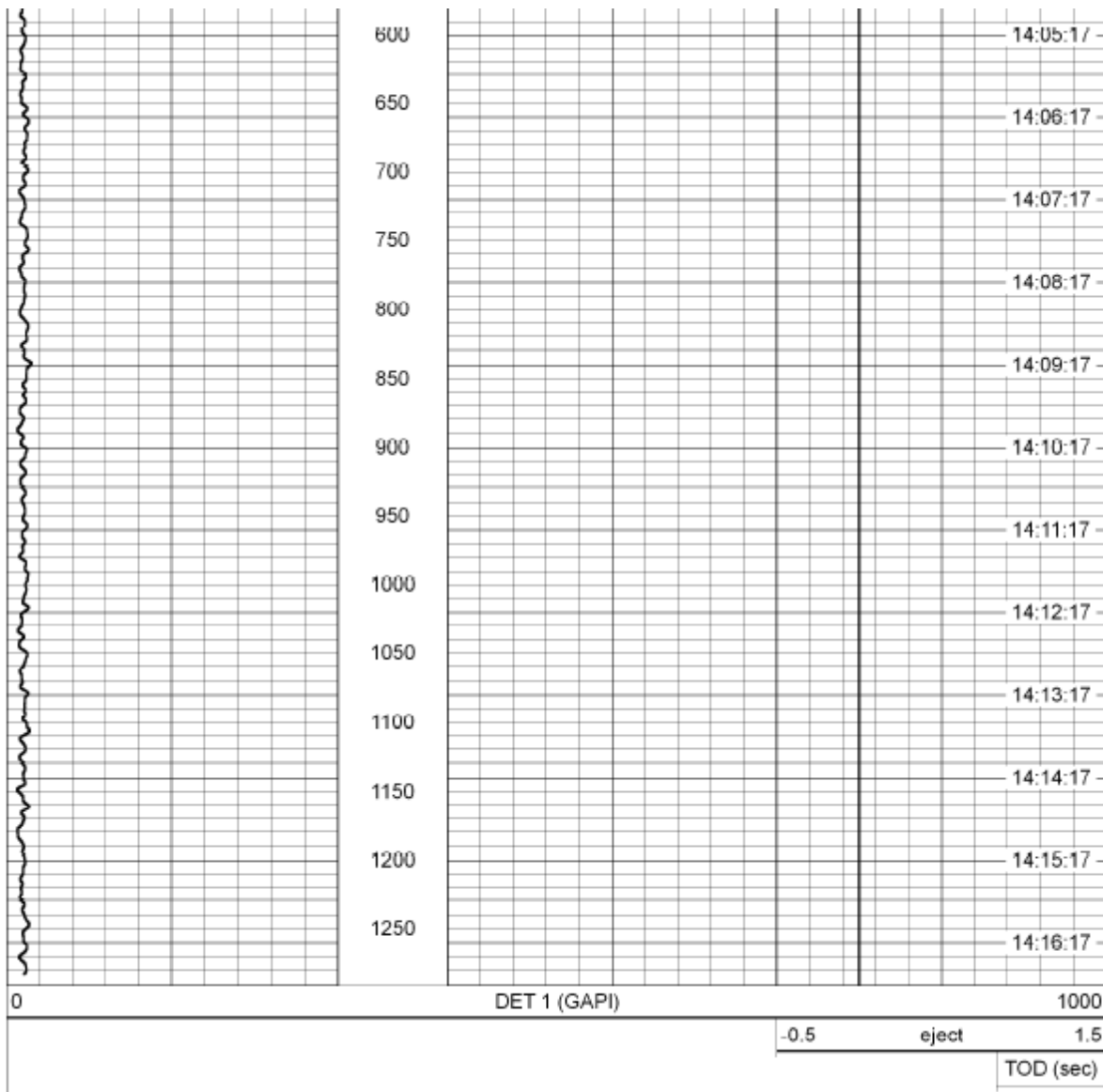




1200 SEC UPWARD CHANNEL CHECK AT 2865'  
NO CHANNEL DETECTED WITH R/A

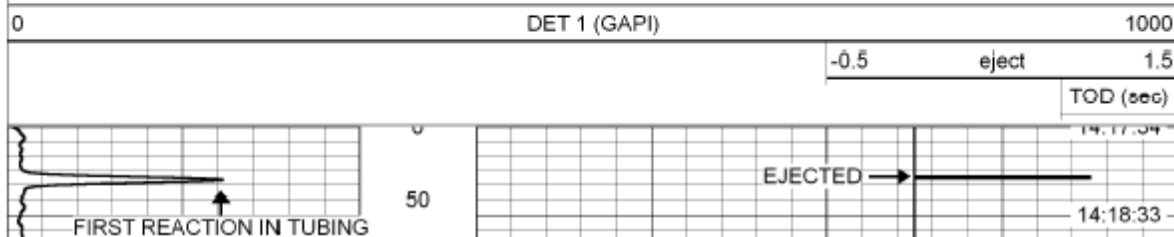
Database File: msb#2.db  
Dataset Pathname: VEL/pass2  
Presentation Format: tracer  
Dataset Creation: Fri Sep 02 13:55:18 2016 by Log PIP Casedhole Loggi  
Charted by: Time scaled 36"/hour



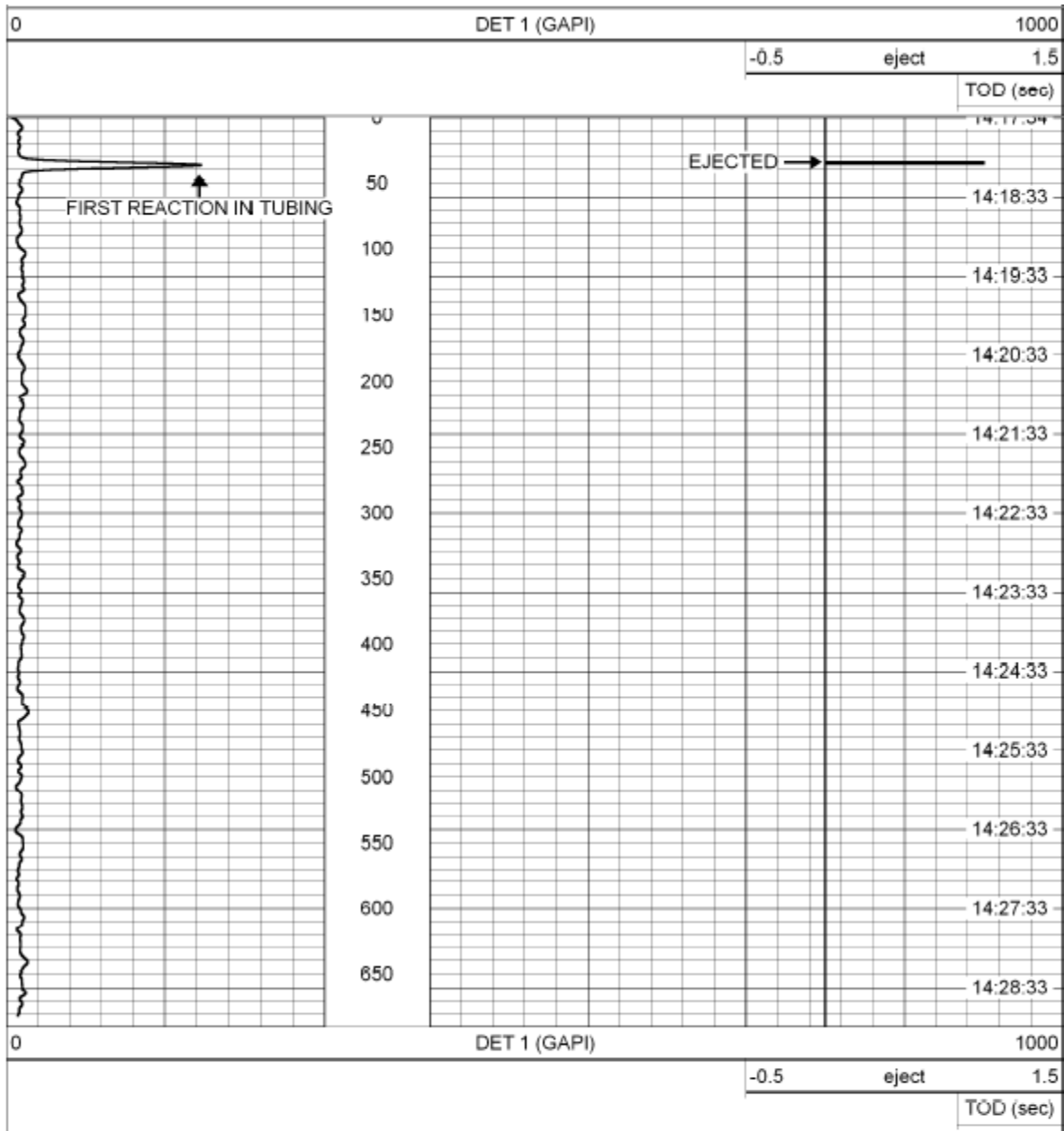


600 SECOND PACKER CHECK AT 2830'  
NO LEAK DETECTED WITH R/A

Database File: msb#2.db  
 Dataset Pathname: VEL/pass3  
 Presentation Format: tracer  
 Dataset Creation: Fri Sep 02 14:17:34 2016 by Log PIP Casedhole Loggi  
 Charted by: Time scaled 36"/hour







Company	OWL SWD OPERATING , LLC
Well	MARLO SHOLES B WELL #2
Field	N/A
County	LEA
State	NEW MEXICO

# **OWL SWD Operating**

## **Maralo Sholes B #2**

**11/28/16**

**08:15** arrived location Baker Hughes Coil tubing (Alex Prado, Corey Denzy, Jace Huddle, Rogelio Sosa) rigging up Reservoir Services (Richard Valencia, Abraham Rodriguez) for water transfer, Thru-Tubing Solutions (Darel) thru tubing motor and bit WTX (Robert Pringle) OWL (Tyler Richardson)

**09:00** Shut down rig up due to high winds

**10:15** Resume rig up

**11:00** Renegade wireline (Munny Flores, Zack Ortis) Jim Smith (spinner and temp tools) arrives

**11:15** Safety meeting with Baker Hughes and personnel on location

**11:30** pressure test wellhead

**11:45** RIH with coil and wash out nozzle

**13:00** Tagged at 3008' by coil tubing measurements using Nitrogen to lift returns back to surface Reservoir Services monitoring flow back tank for returns Getting back returns equal to amount pumped well not taking fluids

**14:30** Leave location coil not making any new hole as of yet

**11/29/16**

**08:30** Arrived location Baker Hughes has been released made no progress on drilling out Will rig up pulling unit this evening to drill out WTX (Robert Pringle) OWL (Tyler Richardson) ESC (Energy Service Company) pulling unit crew (Francisco Silva, Michael Sanchez, Juan Terrazas, Jesse Hernandez)

**10:30** Leave location

**11/30/16**

**0830** Arrive location ESC unit laying down 4.5 csg and pkr

**09:30** Out of the hole with 4.5 csg and pkr changing tongs and BOP rams from 4.5 to 3.5 for workover string waiting for work string to arrive

**10:15** Work string arrives Well-Foam equipment arrives

**12:15 RIH with tubing and scraper**

**12:45 Tongs broke waiting on new set**

**14:00 Leave location**

**12/1/16**

**10:00 Arrive location crew TOO H with tubing and scraper WFR (Wellbore Fishing and Rental tools)(Drew) Ran scraper to 2930'**

**10:30 RIH with tubing and 6.25 bit (WFR)**

**11:00 Renegade Wireline arrives**

**11:30 Rig up Well-Foam continue RIH with tubing and 6.25 bit**

**12:45 Pickup next joint of tubing and RIH**

**13:30 Start clean out**

**14:00 FTH vacuum truck arrives to empty half tank**

**14:30 Leave location**

**12/2/16**

**09:30 Arrive location Renegade Wireline RIH with Temp tool and Spinner wireline td 3072' correlated to casing bottom. Tubing tally td 3057' not using KB on either measurement.**

**12:00 Leave location**

**Initial readings on the spinner log show fluids going into the formation at 3005-3010' computed logs should be sent to Santa Fe by @ 12/6/16.**

**They will run tracer scan after Spinner runs are complete no data on that log yet.**

**12/3/16**

**Robert Pringles called said finished running RA Tracerscan (Renegade Wireline Mike Salas) on 12/2/16, 12/3/16 RIH with 3.5 work string to lay down then RIH with 4.5" casing and packer Made it most of the way in will wait til morning to nipple down BOP and circulate packer fluid. Said Tracer showed fluid going into permitted zone. Computed logs will be sent to Santa Fe around 12/6/16 POOH w/4.5" casing and packer lay down 4.5" casing, pick up and RIH w/3.5" work string**

**12/4/16**

Received call from Robert Pringles, said that they had nipped down the BOP and was circulating packer fluid. Tried to test and got communication between 7" and 8 5/8" casings, will trip out of hole and pick 3.5" work string up to find leak

**12/5/16**

12:40 Arrived location to check on progress, POOH with 3.5" work string, Using plugs and packer to isolate where communication between the 7" and 8 5/8" is coming in at, 13:30 RIH w/work string and packer RIH 8 stands and pressure tested below packer held 500# POOH w/4 stands and pressure check below packer.

**12/6/16**

09:30 POOH W/3.5 work string and RPB found leak at 30' laying work string down Will dig out cellar to top of 8 5/8 @ 20' below surface and check on where leak is.

11:30 out of the hole laid down work string and pkr

12:15 start rigging pulling unit

13:30 finish rigging down unit

14:00 start digging out cellar

**12/7/16**

12:00 arrive location, Backhoe is back filling hole so rig can back in and rig back up. A culvert has been put inside the cellar. Will put fence around after finish with the well.

12:30 spotting unit to rig up

13:00 rigging up unit

**12/8/16**

12:30 arrive location 4.5" csg already in the hole, BOP still on well circulating packer fluid. Will run MIT on 12/9/16 at 09:00

**12/9/16**

09:00 MIT/BHT-OK Ran with 540# ended with 525# 32 minute test  
Energy Services Company (Cleve) Ser#6973 Cal date 12/8/16 1000# spring

**Left chart with Robert (OWL) Energy Services Company Pulling unit crew will back fill cellar and connect lines back up after rigging down unit.**

**11:00 leave location Crew rigging down pump truck from well to connect and pump out plug in packer**

**13:00 Robert called said unit is rigged down and well is hooked back up.**



# INTERVAL SUMMARY TABLE

ZONES (FT)				WATER		
				STB/D		
INT.	Top	Bot		QWZT	QWZI	%QWI
1	2900	3005		-6874	0	0%
2	3005	3010		-6874	-3307	48%
3	3010	3025		-3566	-453	7%
4	3025	3040		-3113	-995	14%
5	3040	3050		-2118	-263	4%
6	3050	3055		-1856	-1343	20%
7	3055	3060		-513	-161	2%
8	3060	3062		-352	-352	5%
9	3062	3065		0	0	0%
TOTALS					-6874	100%

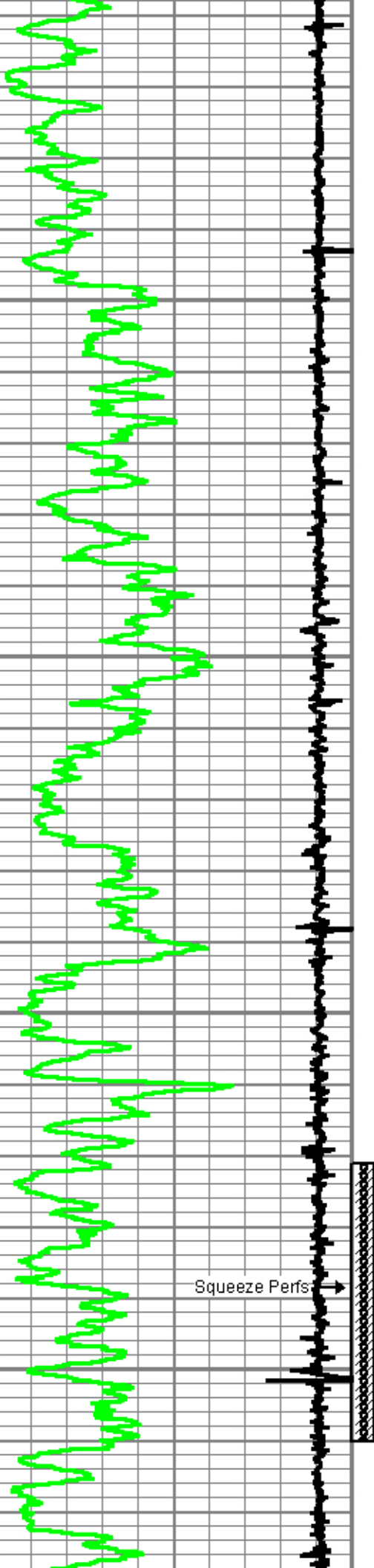


## Merged Spinner Passes

Database File: marales sholes b002.db  
Dataset Pathname: merge1  
Presentation Format: sparall2  
Dataset Creation: Fri Dec 02 21:50:29 2016  
Charted by: Depth in Feet scaled 1:240

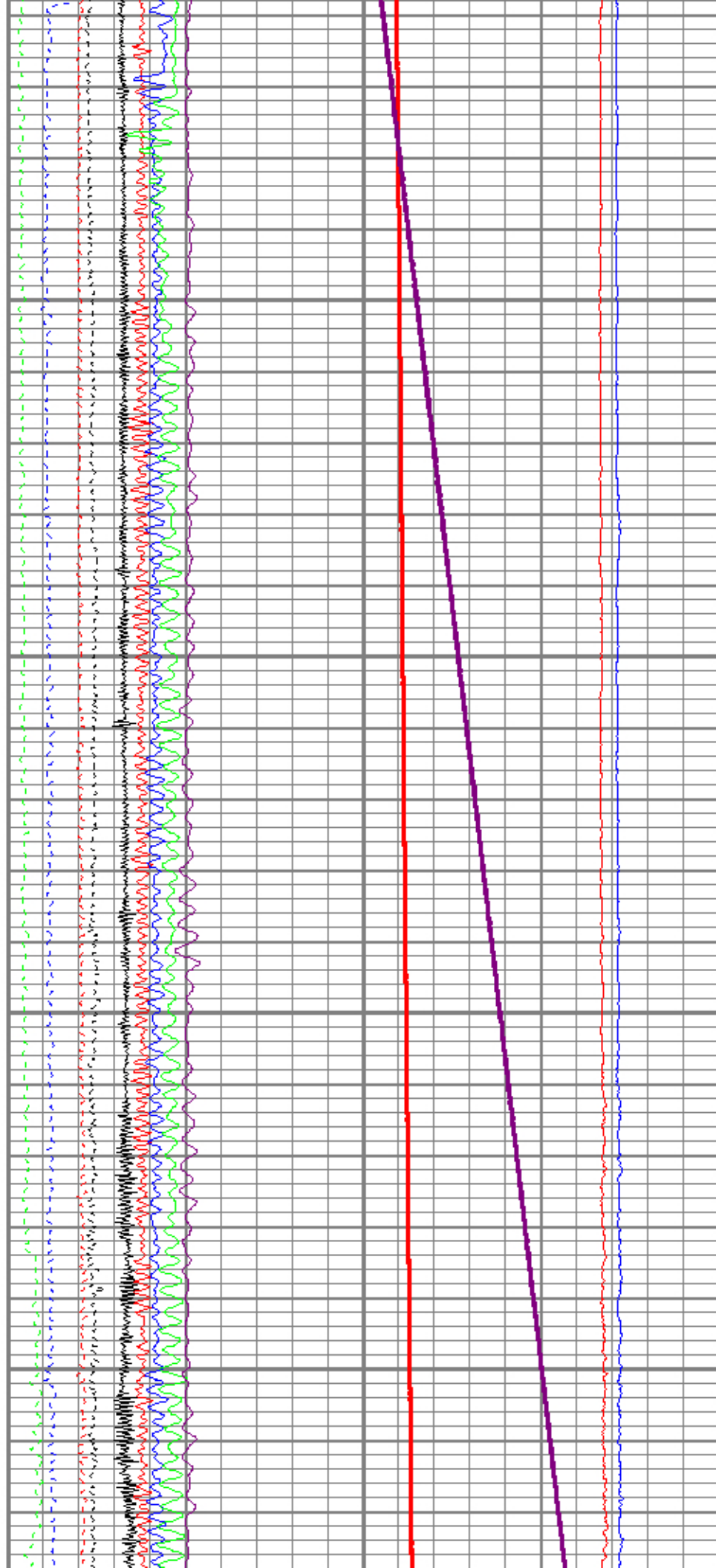
-10	CCL (mV)	1	-16	Spinner Dn 30 FPM (rps)	16	62	Temp Injecting (degF)	75
0	Gamma Ray (GAPI)	50	-16	Spinner Dn 60 FPM (rps)	16	1150	Pressure (psi)	1350
			-16	Spinner Dn 90 FPM (rps)	16	0	Caliper X Arm (in)	10
			-16	Spinner Dn 120 FPM (rps)	16	0	Caliper Y Arm (in)	10
			-16	Spinner Dn 150 FPM (rps)	16			
			-16	Spinner Up 30 FPM (rps)	16			
			-16	Spinner Up 60 FPM (rps)	16			
			-16	Spinner Up 90 FPM (rps)	16			
			-16	Spinner Up 120 FPM (rps)	16			



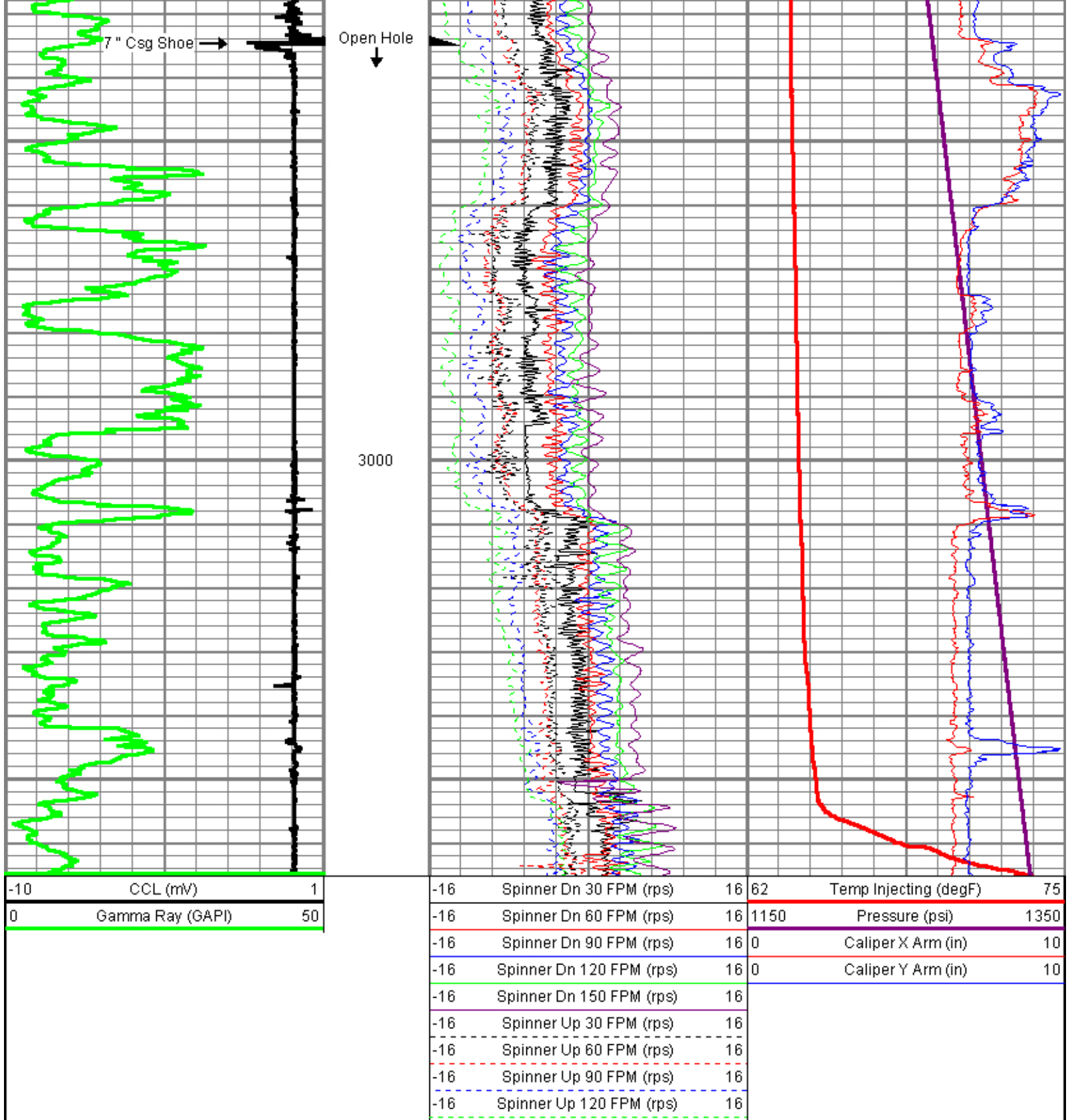


2800

2900





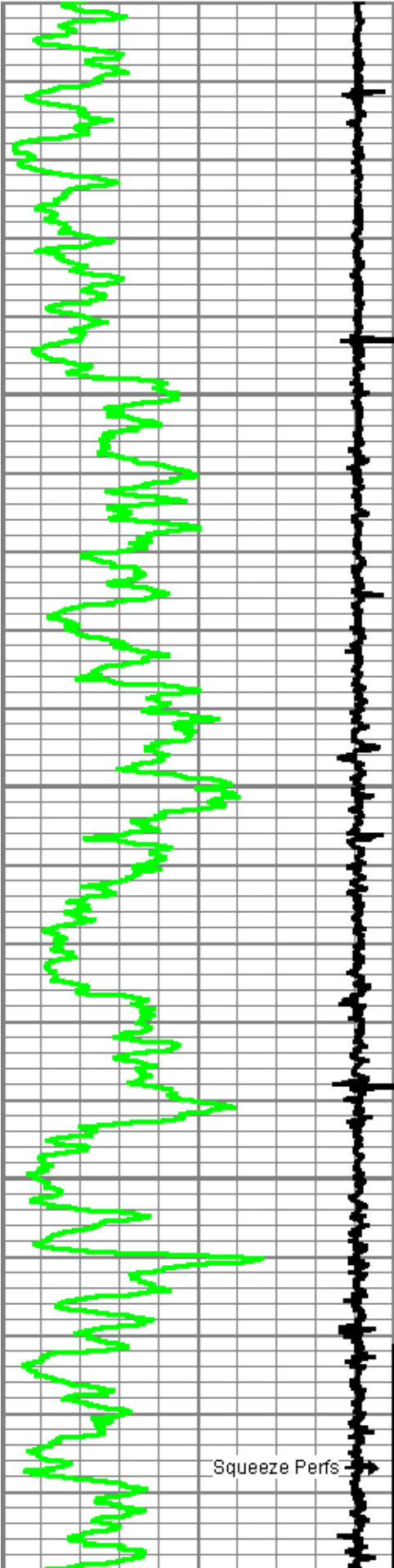


## Flowing Vs. Shut-in Temperatures

Database File: marales sholes b002.db  
 Dataset Pathname: merge2  
 Presentation Format: pl\_fvst  
 Dataset Creation: Fri Dec 02 21:50:36 2016  
 Charted by: Depth in Feet scaled 1:240

-10	CCL (mV)	1
0	GR (GAPI)	50

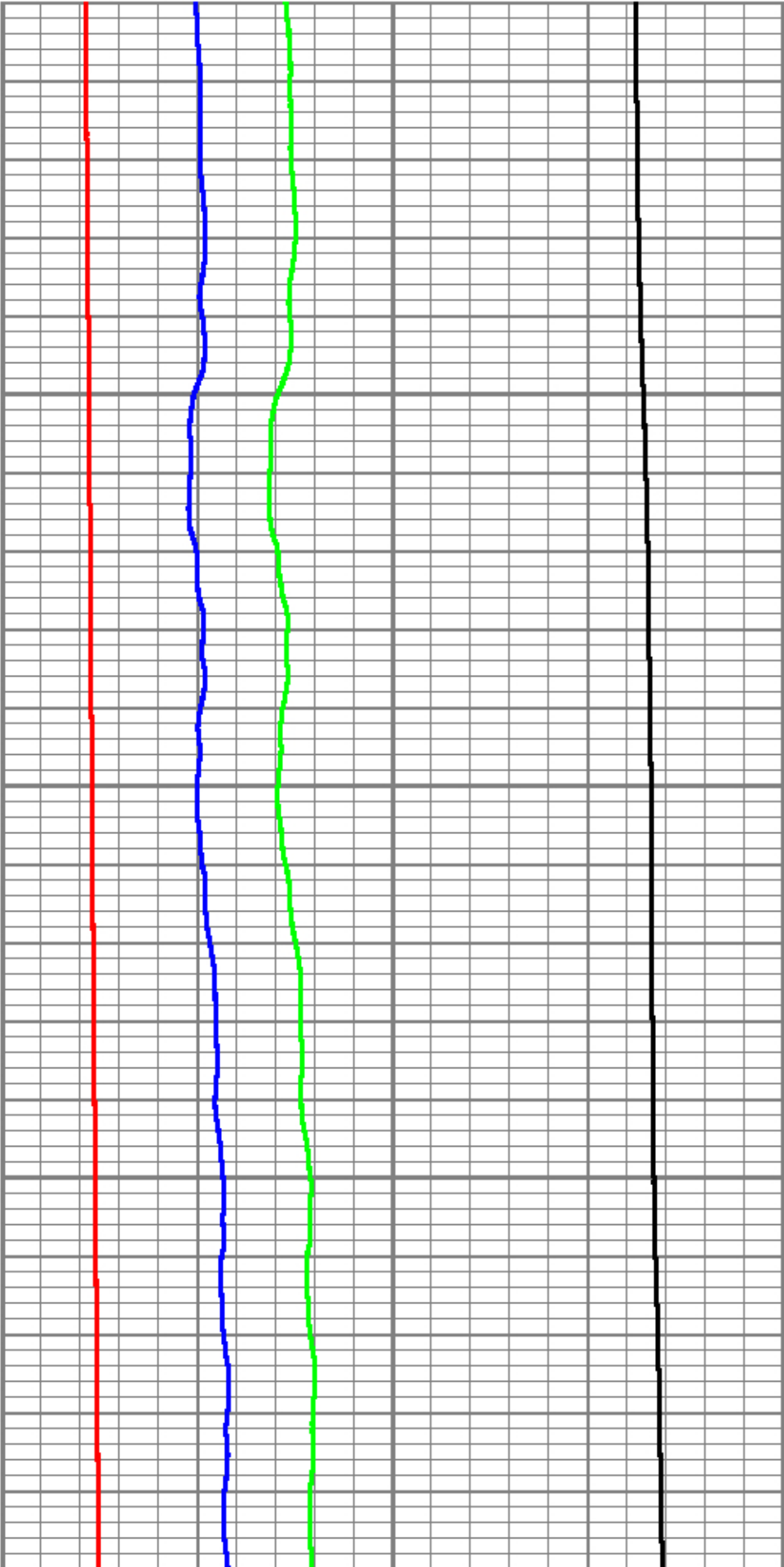
60	Temperature Injecting (degF)	90
60	1/2 Hr. Shut-in Temperature (degF)	90
60	1 Hr. Shut-in Temperature (degF)	90
60	12+ Hr. Shut-in Temperature (degF)	90

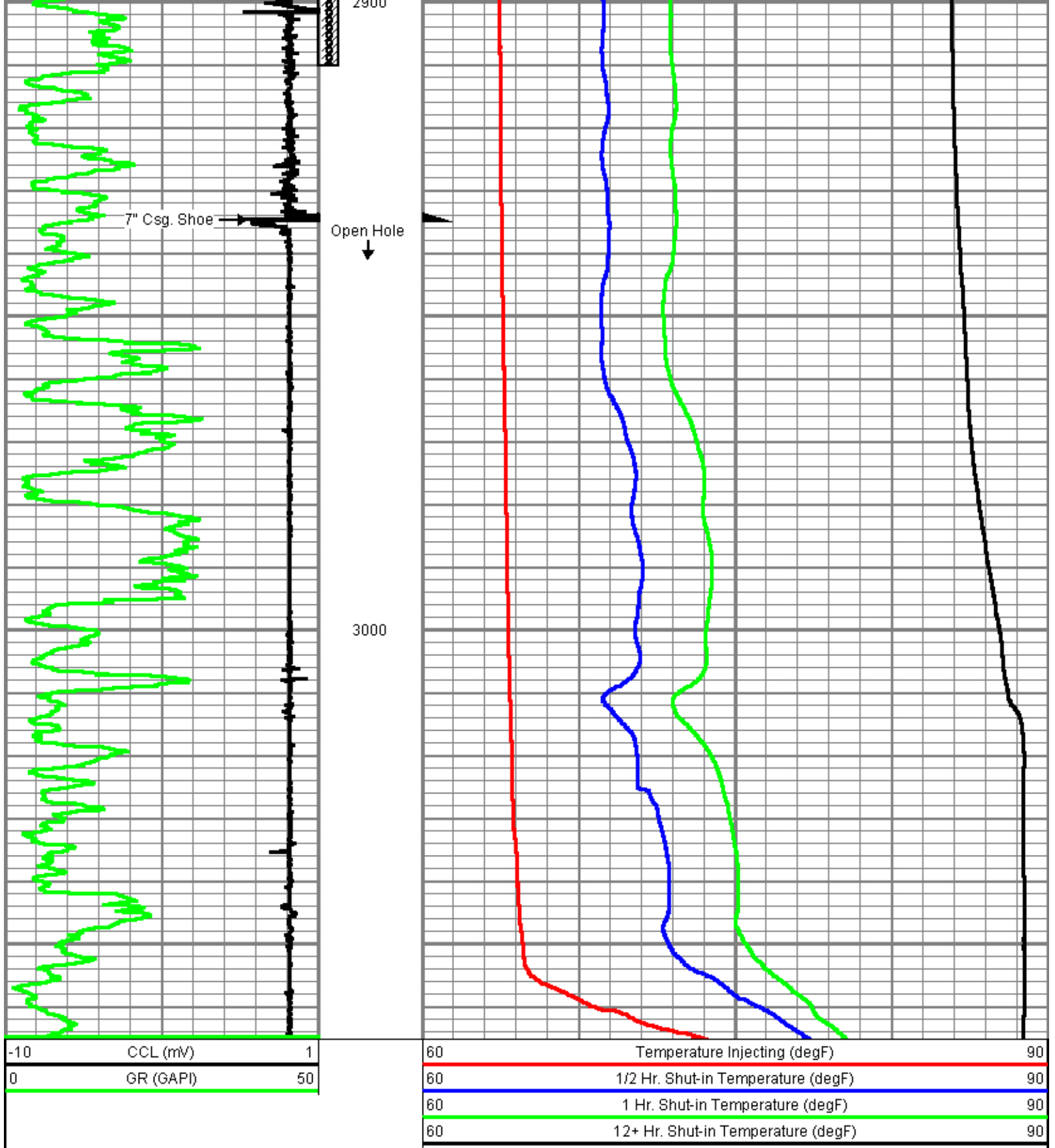


2700

2800

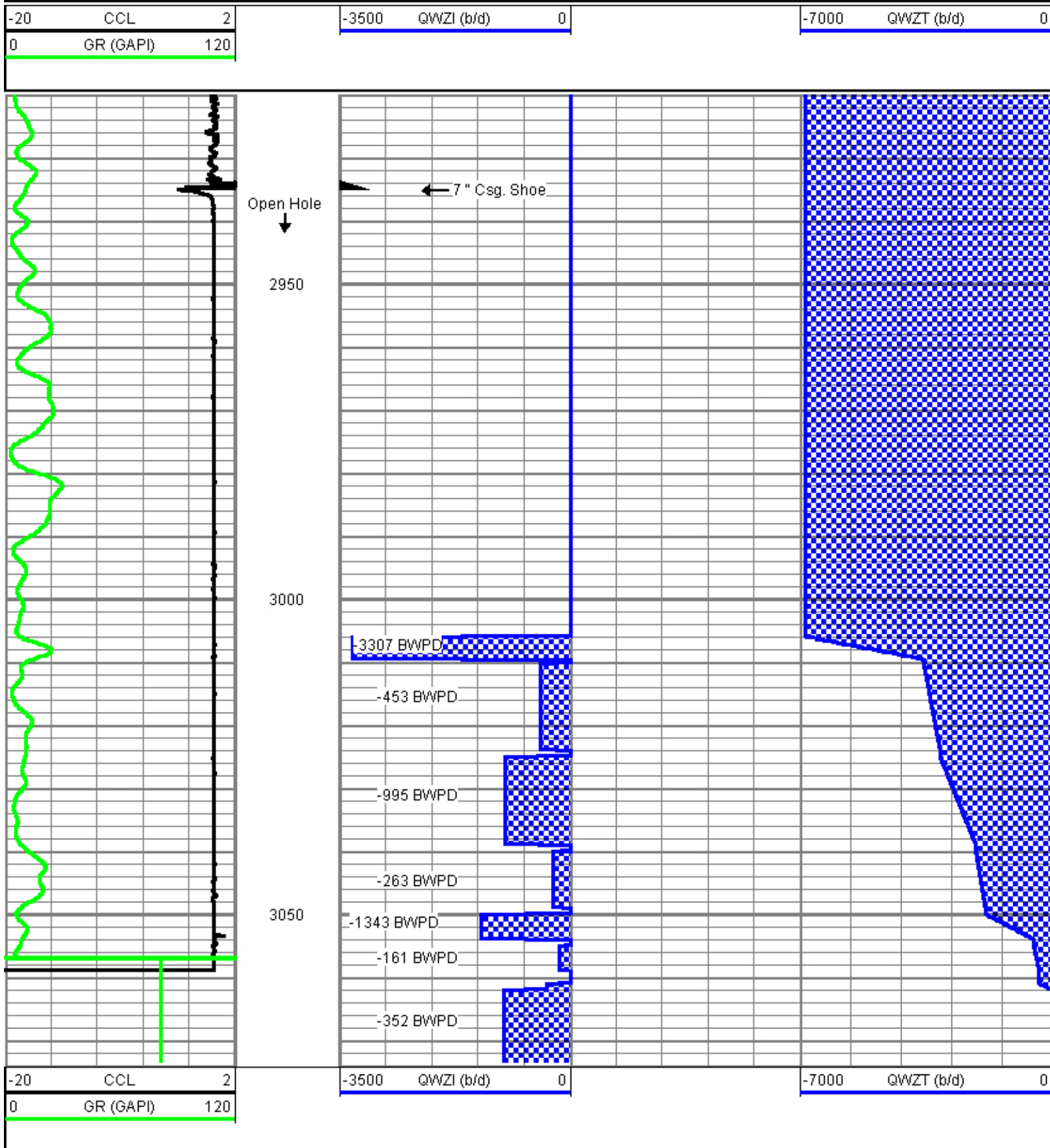
2900





## Q Interval & Q Total

Database File: marales sholes b002.db  
 Dataset Pathname: f1  
 Presentation Format: pl\_qint



Company OWL  
 Well Maralo Sholes B #2  
 Field Yates & Seven Rivers  
 County Lea





**PUMP-IN  
TRACER**

Company	Owl SWD Operating	Company	Owl SWD Operating
Well	Maralo Sholes B #002	Well	Maralo Sholes B #002
Field	Maralo Sholes	Field	Maralo Sholes
County	Lea	County	Lea
State	New Mexico	State	New Mexico
Location:		API#:	
SEC N/A TWP N/A RGE N/A		660 FSL & 660' FEL	
Permanent Datum	Ground Level	Elevation	2749'
Log Measured From	K.B. 13" Above Perm. Datum		
Drilling Measured From	Kelly Busting		
Other Services		Elevation	
3-Arm		K.B. 2762'	
Caliper		D.F. 2761'	
		G.L. 2749'	
Date	December 2, 2016		
Run Number	ONE		1,375' Tools
Depth Driller	2935		
Depth Logger	3072		
Bottom Logged Interval	3072		
Top Log Interval	2600'		
Open Hole Size	N/A		
Type Fluid	Water		
Density / Viscosity	N/A		
Max. Recorded Temp.	122.1 F		
Estimated Cement Top	N/A		
Time Well Ready	R.O.A		
Time Logger on Bottom	9:00 AM		
Equipment Number	Truck #48		
Location	Leveland		
Recorded By	M.Salas		
Witnessed By			
Borehole Record			
Run Number	Bit	From	To
		Size	Weight
		3.5"	M/A
			From
			Surface
			To
			2817'
Tubing Record			
Casing Record	Size	Wgt/Ft	Top
Surface String			
Prot. String			
Production String	7"	20#	Surface
Liner			
EXP. LINER			2935'

==== Fold Here =====


All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

**Final Report for Maralo Sholes B Well No. 2  
Attachment 6**

LOG WAS SET TO 7" CASING-SHOE SET @ 2935'

PERFORATIONS						
OPEN HOLE: 2935' - 3072'						
INJECTION WELL:						
SHUT-IN DATE	12-02-2016	HOUR	3:30 P.M.	TOTAL S.I. TIME	1 HOUR	S.I. PRESS 0-PSI
METERED INJ. RATE	6542 B/D	PRESSURE	0-PSI	TEMP	122 DB	FLUID TYPE WATER
TOTAL VOLUME TO DATE		FLUID LEVEL TUBING FULL				
PRODUCER:						
FLOWING	PUMPING	CHOKE SETTING			HOURS PROD.	
FLUID LEVEL CSG.	TBG.	RATE	B/W		B/O	
FLUID TYPE WATER						
FRAC OR ACID WELLS:						
TIME FINISHED FRAC OR ACID	ACID %		FLUID - GALS		SAND #	
RATE - BPM	PRESSURE					
CONCLUSIONS						
THIS SURVEY WAS RUN TO DETERMINE THE ZONES OF INJECTION,THERE WAS NO INDICATION OF A CHANNEL-UP FROM CASING SHOE						
NOTE: A TOTAL OF 507 BARRLES WERE PUMPED DURING SURVEY						
100% CASING RATE -6542 - B/D						
100% TUBING RATE -6542- B/D						

Sensor	Offset (ft)	Schematic	Description	Len (ft)	OID (in)	Wt (lb)
CCL	8.94		1.36CHD 1.36 Cable Head	1.00	1.38	2.00
			SBAR-1.375" (000) 7' 1.375" Tungsten Sinkar Bar	7.00	1.38	61.00
			SBAR-169x5 (0001) Striker Bar 1 3/8 by 5 foot	5.00	1.38	30.00
			DUMJECT-PROBE (DUMPROBE)	2.17	1.38	10.00
			CCL-Probe (Probe_1) 1 3/8" Probe Logging CCL	1.89	1.38	5.00
			DUMDET-KC (KCPOS) KC SCINT GR	3.46	1.38	10.00
			DUMCAL-PROBE (PROBE01) PROBE XY CALIPER	3.43	1.38	20.00
TEMP	0.00		TEMP.Probe (P01) Probe 1 3/8" Temp	1.55	1.38	4.00
Dataset: maralo-#2.db: MARALO2/in/temp/pass1						
Total Length: 25.49 ft						
Total Weight: 142.00 lb						
O.D. 1.38 in						



### TRACER RESULTS

#	Depth (ft)	Time	Integration	Flow (%)	Delta (%)	Comment
2	2626.00	18:05:20	156472.00	100.00		
3	2852.00	18:05:55	156472.00	100.00	0.00	
4	2906.00	18:06:24	156472.00	100.00	0.00	
5	2956.00	18:06:56	156472.00	100.00	0.00	
6	3015.00	18:07:40	129882.00	83.01	16.99	
7	3044.00	18:08:16	53749.30	34.35	48.66	
8	3053.00	18:08:56	20823.60	13.31	21.04	
9	3056.00	18:09:49	7049.81	4.51	8.80	
10	3060.00	18:11:13	5049.81	3.23	1.28	

### VELOCITY FROM TRACER

#	Depth (ft)	Time	D Space (ft)	D Time (sec)	Flow (b/d)	Flow (%)	Delta (b/d)	Delta (%)
11	2363	18:05:20	0.00	0.00				
12	2852	18:05:55	225.00	33.31	6537.78	100.00		
13	2906	18:06:24	54.00	29.00	6536.99	100.00	0.79	0.00
14	2956	18:06:56	50.00	29.07	6542.69	100.00	-5.70	0.00
15	3015	18:07:40	59.00	37.60	5400.26	82.61	1142.43	17.39
16	3044	18:08:16	29.00	42.94	2206.73	33.76	3193.53	48.85
17	3053	18:08:56	9.00	36.06	815.47	12.47	1391.25	21.28
18	3056	18:09:49	3.90	53.72	230.27	3.52	585.20	8.95
19	3060	18:11:13	4.00	69.32	180.42	2.76	49.85	0.76

Company:  
Well:  
File: F:\maralo-#2.db  
Dataset: MARALO/2/VEL/\_tracer/\_shottbl\_1  
Reference Rate: 6548.2 b/d

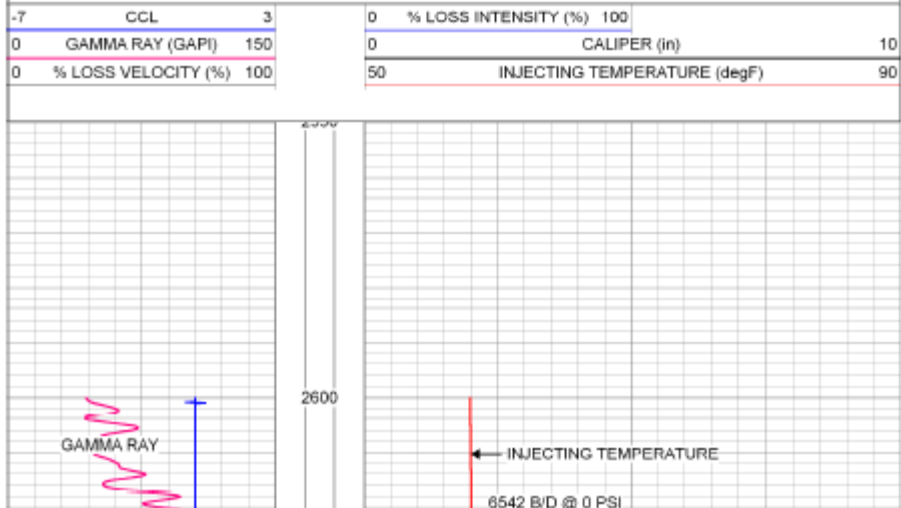
### VELOCITY RESULTS

#	Depth (ft)	Time	D Space (ft)	D Time (sec)	Csg ID (in)	Flow (b/d)	Flow (%)	Delta (%)	Comment
1	2920.00	18:31:15	5.28	5.00	8.35				
9	3000.00	18:37:11	5.28	2.26	6.81	6548.22	100.00		
8	3010.00	18:38:37	5.28	2.60	6.80	5869.71	89.58	13.42	
7	3020.00	18:35:21	5.28	6.40	6.39	2697.26	41.19	45.39	
6	3030.00	18:34:49	5.28	5.00	6.29	2502.73	38.22	2.97	
5	3040.00	18:33:42	5.28	5.80	6.39	2230.05	34.06	4.16	
4	3050.00	18:32:52	5.28	12.00	6.30	1047.91	16.00	18.05	
3	3060.00	18:32:02	5.28	69.00	6.28	179.50	2.74	13.26	
2	3066.00	18:31:52	0.00	300.00	6.28	0.01	0.00	2.74	NO FLOW

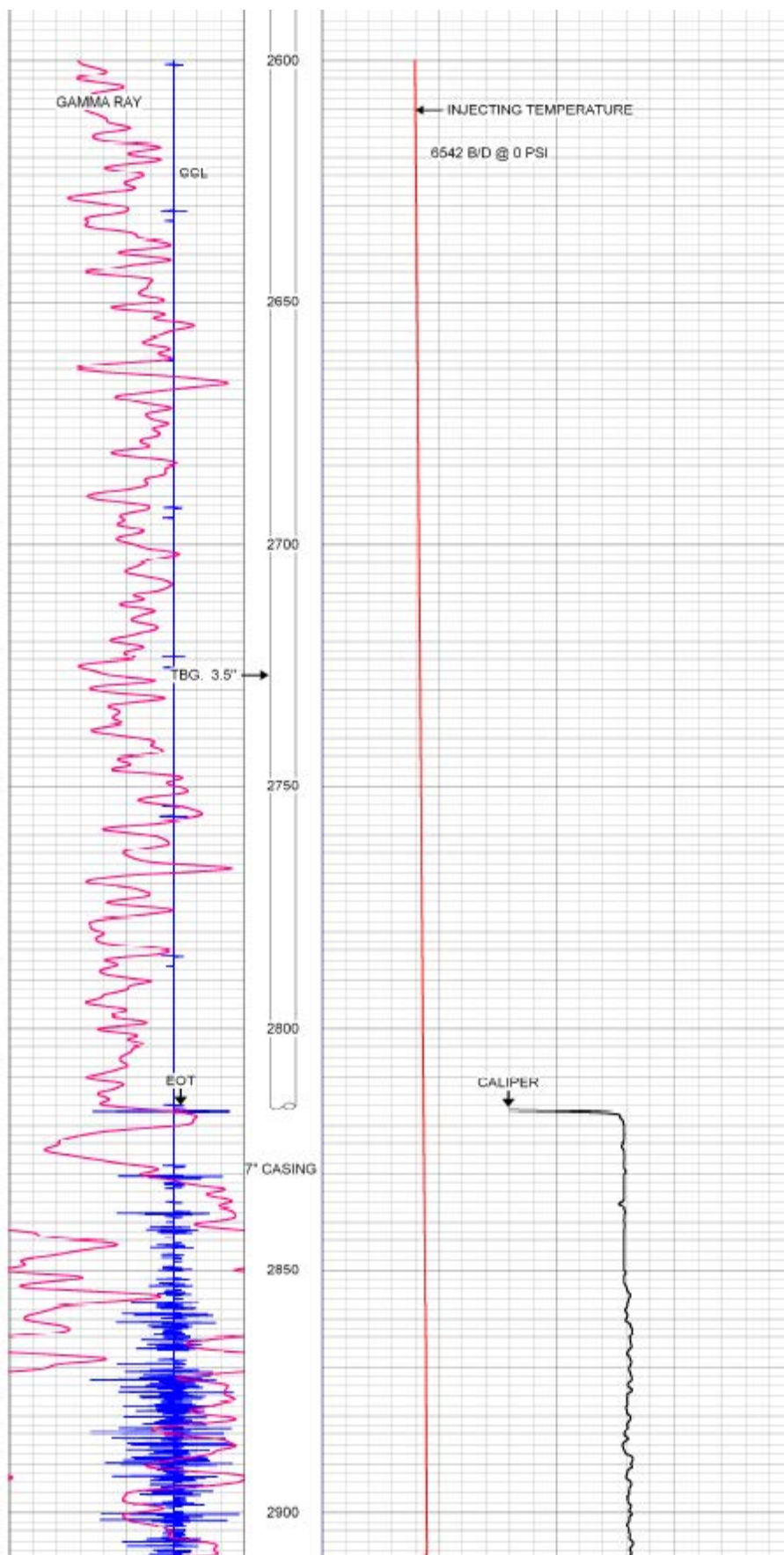


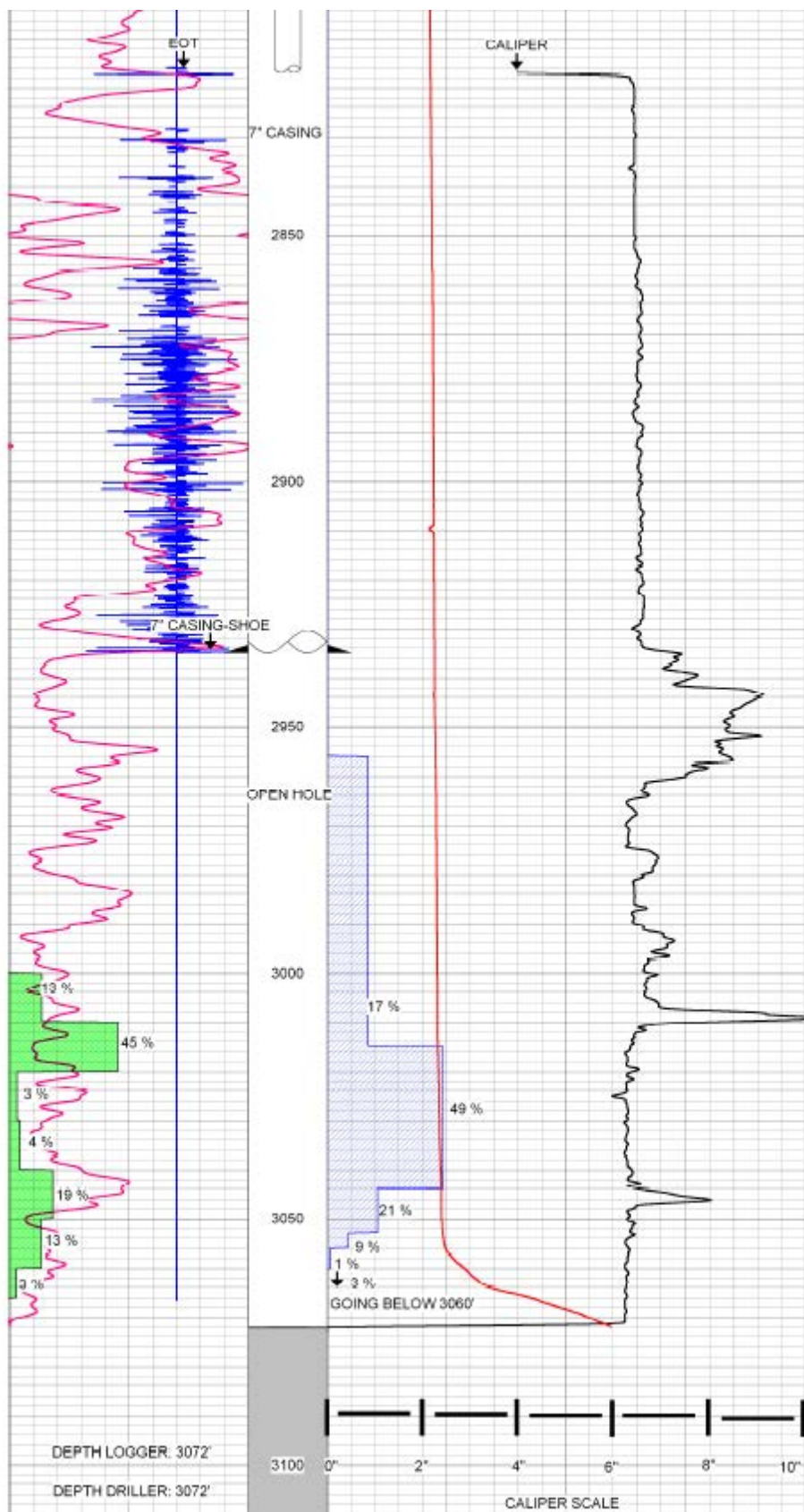
## H2O Injection Composite

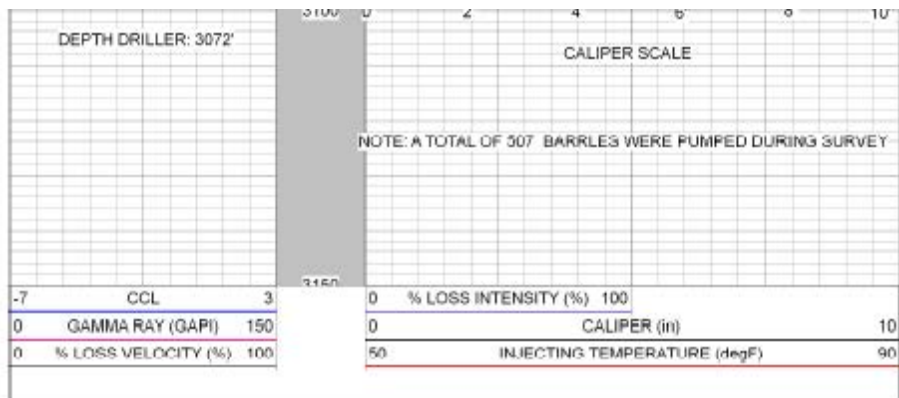
Database File: f:\maralo-#2.db  
Dataset Pathname: MARALO/2/VEL/\_composFIN  
Presentation Format: trccomp  
Dataset Creation: Fri Dec 02 20:21:38 2016  
Charted by: Depth in Feet scaled 1:240





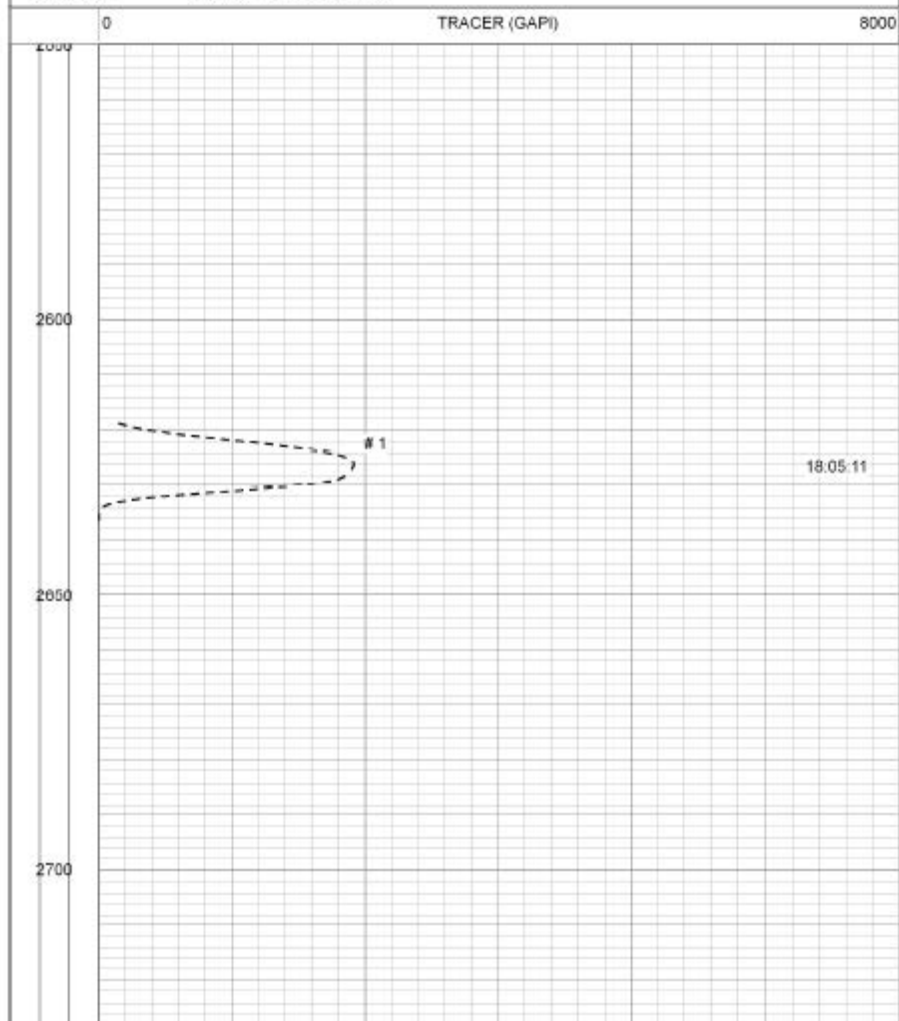


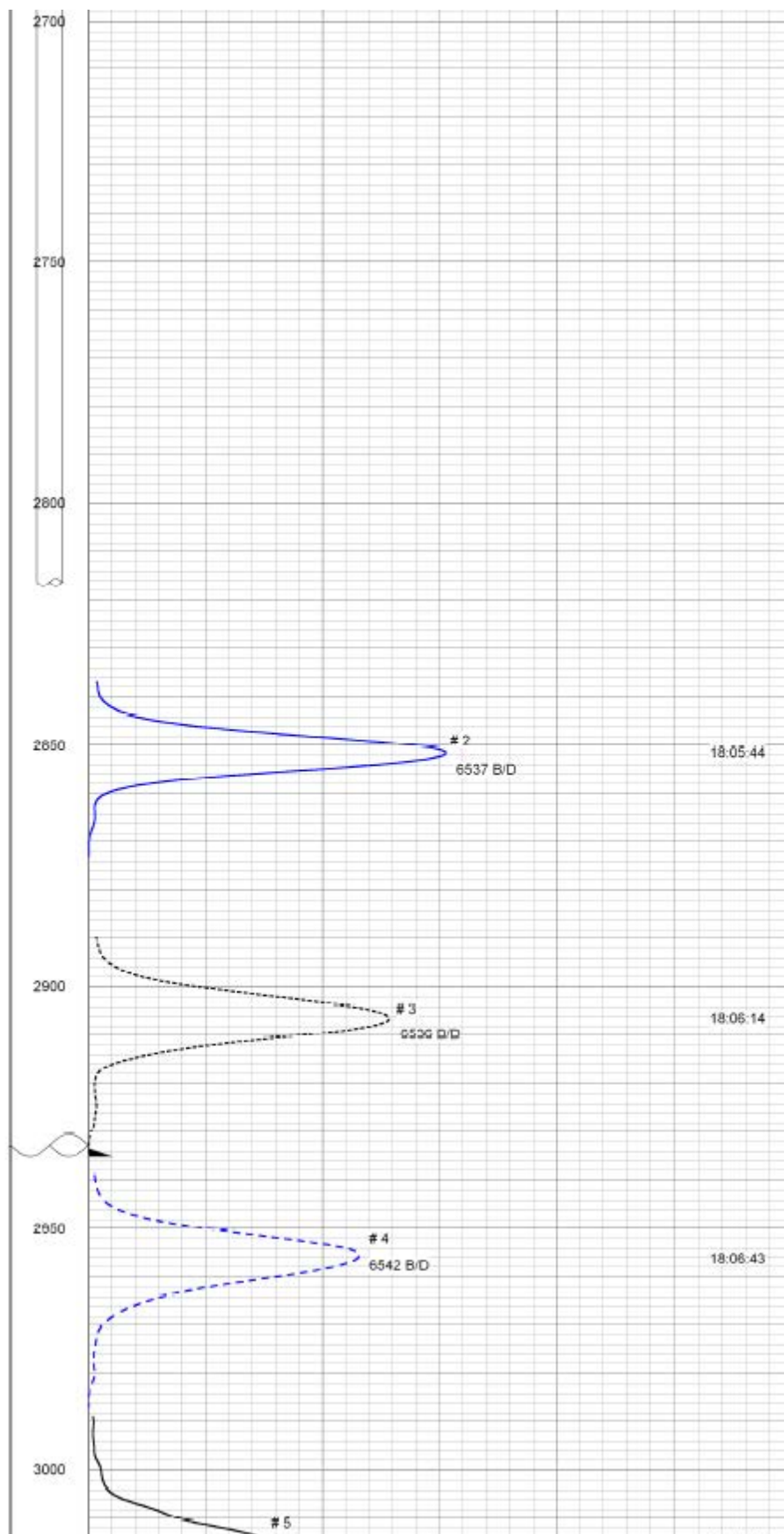


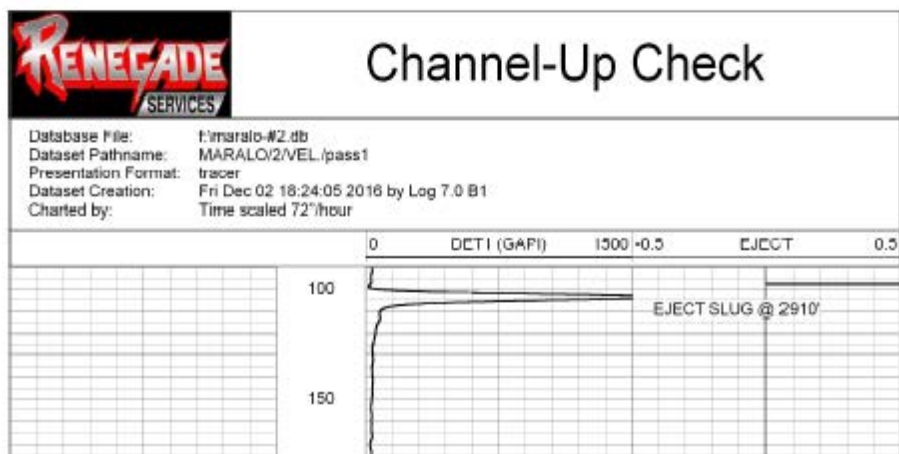
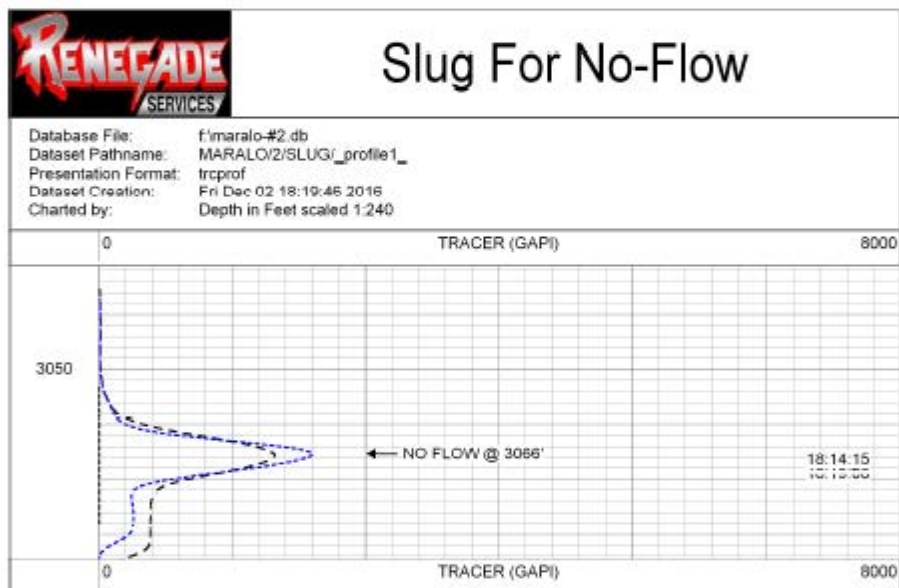
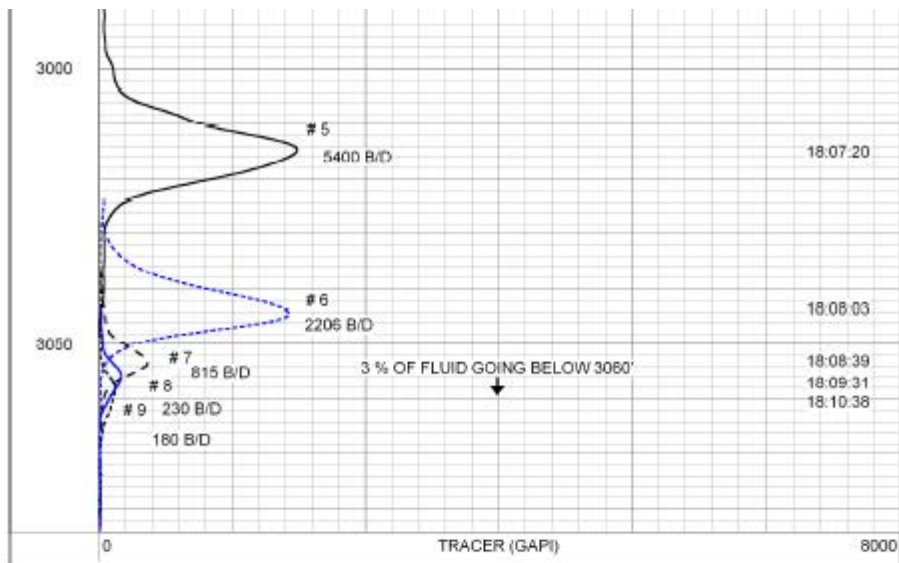


## H2O Tracer Profile

Database File: f:\maralo-#2.db  
 Dataset Pathname: MARALO2/TRACER/\_profiles2\_  
 Presentation Format: trcprof  
 Dataset Creation: Fri Dec 02 18:11:53 2016  
 Charted by: Depth in Feet scaled 1.240





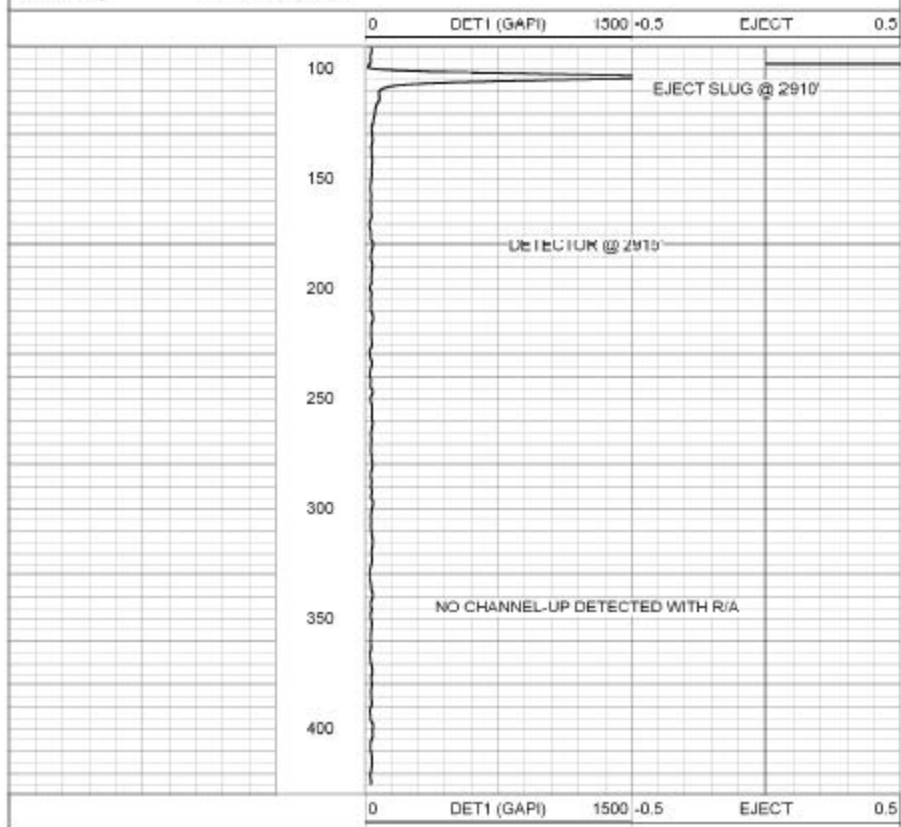






## Channel-Up Check

Database File: f:\maralo-#2.db  
Dataset Pathname: MARALO/2/VEL/pass1  
Presentation Format: tracer  
Dataset Creation: Fri Dec 02 18:24:05 2016 by Log 7.0 B1  
Charted by: Time scaled 72"/hour



Company Owl SWD Operating  
Well Maralo Sholes B #002  
Field Maralo Sholes  
County Lea  
State New Mexico

January 12, 2017

Mr. Nevin Bannister  
Chief Operating Officer  
OWL SWD Operating, LLC  
8214 Westchester Drive, Suite 850  
Dallas, TX 75225

**RE: Final UIC Geological Assessment Concerning:**

NOTICE TO OPERATOR: Requirement to Conduct Injection Survey, Dated July 28, 2016 (EMNRD)

Maralo Sholes B Well No. 2 (API 30-25-09806)

660' FSL & 660' FEL, Sec. 25 T25S R36E

Lea County, New Mexico

Injection Authority: Administrative Order SWD-1127

Order Date: June 1, 2008

Permitted Interval: Yates and Seven Rivers (2938'-3055')

Mr. Bannister:

Per your request, CEK Engineering LLC has performed an Underground Injection Control (UIC) Geological Assessment for the Maralo Sholes B Well No. #2 (API 30-25-09806), herein WELL. The following is our final assessment, completed on or about January 12, 2017, we have incorporated the following:

- i.) Discussions from our October 24, 2016 meeting with David Catanach, Phillip Goetze and Michael McMillan (EMNRD) in Santa Fe, New Mexico.
- ii.) Results from the cleanout and injection survey re-run, performed December 2, 2016.

We specifically note, to the best of our understanding, the above "NOTICE TO OPERATOR" was sent in response to that certain letter dated April 28, 2016 from the City of Jal, New Mexico to Mr. Matthew Earthman (Souder, Miller & Assoc.) XC: David Martin, Sec. EMNRD; David Catanach, Director OCD; and Tom Blaine, State Engineer, enclosed herein (LETTER).

The LETTER was prepared due to concerns raised by several individuals and companies to the City of Jal, as well as, the City of Jal's pending application of 900 ac-ft of water per annum and nine well locations proposed in the same section (Sec. 25 T25S R36E) as the WELL. The City of Jal's specific concerns were related to the WELL's wellbore integrity, and potential contamination of shallow (< 600' MD) fresh water aquifer in the immediate area.

Additionally, Renegade Services performed an Injection Survey (Temperature, Tracer) on the WELL, September 2, 2016 (SURVEY1); the results of the SURVEY1 were inconclusive, tool set down 50' (3005' MD) above base of injection interval. Because the SURVEY1 results were inconclusive, Maxey G. Brown (OCD District 1 Supervisor) sent Ben Stone (SOS Consulting – OWL Regulatory Consultant) that certain email dated September 6, 2016, enclosed herein (EMAIL).

The EMAIL was prepared, after consultation with David Catanach, to serve as formal notice for OWL to proceed with the cleanout of the 50' of fill and to re-run the injection survey.

The following UIC Geological Assessment was prepared to specifically address concerns mention in the LETTER and EMAIL, in addition to informal discussions (email, phone conversations) raised by OWL's Staff/Consultants regarding potential out of zone injection into the Capitan Reef. Additionally, as an attachment to this report, we specifically address comments posed by Mr. Goetze, during our October 24, 2016 meeting, concerning the spatial location of the injected fluids with respect to the Capitan Reef (Seven Rivers Shelf Margin).

### **UIC Geological Assessment**

The WELL is injecting into the very top of the Seven Rivers Formation and basal Yates Formation. The WELL is situated (completed) in the back reef lagoonal environment (comprised of shelf carbonates, siliciclastics and evaporites) of the Guadalupian Artesia Group. Neutron/Gamma Ray Well Log signatures identify several highly porous and permeable, regionally extensive, eolian sand/dolomitic grainstone reservoirs. These reservoirs are the, updip, productive members of the Jalmat, Rhodes, and Scharbrough oil and gas fields (combined production to date is ~ 100 MMBO & 1.9 TCF).

The WELL's equivalent (injection interval) in the Capitan Reef (Late/Upper Seven Rivers) Margin is located 3.5+ miles to the west and approximately 200-300' down dip structurally. *Additionally, in our opinion, there is sufficient evidence (HISS 1975, NMOCD Case No. 8405 testimony/Water Sample Analysis, IC Potash Corp Feasibility Study) that the interstitial waters of the Capitan Reef and back reef Artesia Group members near the WELL are mineralized above 10,000 mg/L (TDS), digital copies provided on FTP site.*

Several injection wells (examples in the cross-section) have injected into the same reservoirs at high rates since the late 1960's and possibly earlier. Additionally we have identified 460+ injection wells in the immediate area injecting into the same/similar reservoirs as the WELL. These wellbores have been utilized for secondary recovery operations and salt water disposal since the early 1960's.

Additionally, we observed in the literature core analysis reports indicating that Seven Rivers (in the back reef lagoonal environment) eolian siliciclastics reservoirs have permeability's in excess of 350 millidarcies. These core analysis reports support our Pressure Transient Analysis stochastic modeling.

### **Current (12-02-2016) Injection Profile Survey Assessment**

Based on our review of that certain Injection Profile Survey performed by Renegade Services on December 2, 2016 (SURVEY2); we observe that ALL fluid is being injected into the approved permitted interval (Lower Yates / Upper Seven Rivers, 2938'-3055'). We specifically call your attention to the comparison exhibit of SURVEY1 and SURVEY2, enclosed herein; and note that the spinner, temperature, and tracers logs all indicated a no-flow vertical boundary at ~ 3055' (MD). Additionally, both SURVEY 1 and SURVEY 2 indicated a no-flow (no channeling of fluids behind the 7" production casing) vertical boundary at ~ 2935' (top of open-hole section).

### **Summary / Professional Opinion**

Based on SURVEY1 and SURVEY2 results for the WELL, and our regional geological/injection well study; it is our professional opinion that the injected fluids into the WELL are remaining within the permitted interval (Lower Yates / Upper Seven Rivers, 2938'-3055'). This opinion is based on regional/local scale geological interpretation, wellbore configuration and surface operations (injection pressures between Vacuum and 575 psi).

Additionally, the WELL **is not** injecting into the Capitan Reef (limestone); the WELL is injecting into the Upper Seven Rivers Sands (minor amounts into dolomitized shelf carbonate grainstones). These same reservoirs are hydrocarbon productive in the updip members in the Jalmat, Rhodes, and Scharbrough oil and gas fields located in the immediate area.

Based on the results of SURVEY1 and SURVEY2, at this time our opinion is, the WELL does not pose a threat to public health or safety (this opinion does not encompass an environment site assessment, which we have not performed nor reviewed). *We reserve the right to revise this statement, based on additional data collected subsequent to the date of this report.*

If you have additional questions, please do not hesitate to contact me at you convenience.

Respectfully,



Chad E. Kronkosky, P.E.  
President

**Enclosures (4):**

Letter dated April 28, 2016 from the City of Jal, New Mexico to Mr. Matthew Earthman (Souder, Miller & Assoc.)  
XC: David Martin, Sec. EMNRD; David Catanach, Director OCD; and Tom Blaine, State Engineer

Email dated September 6, 2016 from Maxey G. Brown (OCD District 1 Supervisor) to Ben Stone (SOS Consulting – OWL Regulatory Consultant).

Jal, New Mexico (Middle Seven Rivers) Lithology Map

Jal, New Mexico (Artesia Group) Injection Wells Map

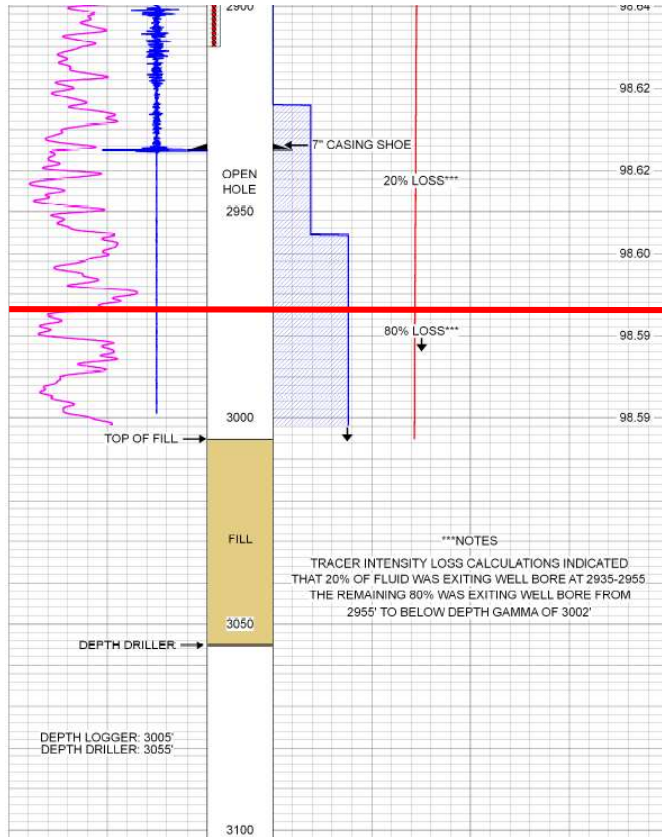
**FTP Website (contact CEK Engineering for instructions to website):**

Hiss, William, "Stratigraphy and Ground-Water Hydrology of the Capitan Aquifer, Southeastern New Mexico and Western Texas", University of Colorado, PhD Dissertation, 1975

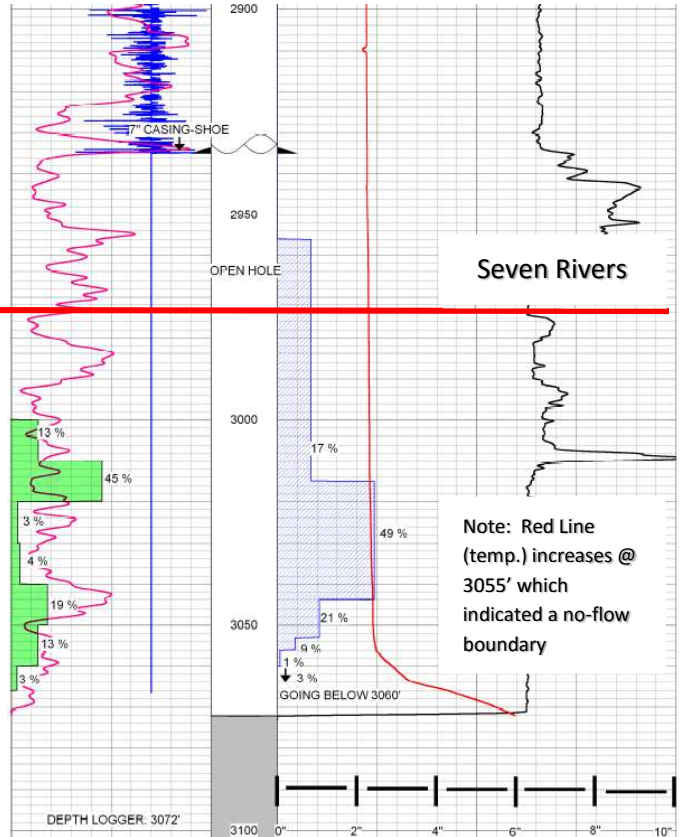
National Instrument 43-101 Technical Report "Ochoa Project Feasibility Study Lea County, New Mexico USA" IC Potash Corp.

NMOCD Case No. 8405, West Jal Disposal #1, Currently Operated by Mesquite SWD.

## Injection Profile Comparison



Initial Injection Profile (09-02-2016)



Current Injection Profile (12-02-2016)



# Maralo Sholes B No. 2 (30-025-09806; SWD 1127)

## Pressure Transient Analysis Uncertainty Modeling

*Chad E. Kronkosky, P.E.*

*January 10, 2017*

### Introduction

The following document and technical calculations were prepared in accordance of generally accepted hydrogeological principles. The following calculations utilize stochastic (monte carlo) simulation methods coupled with the line source solution to the single phase radial flow diffusivity equation, presented as follows:

For an infinite-acting reservoir, Mathews and Russell (1967) propose the following solution to the diffusivity equation.

$$p(r, t) = p_i + \left[ \frac{70.6Q_w\mu}{kh} \right] Ei \left[ \frac{-948\phi\mu c_t r^2}{kt} \right]$$

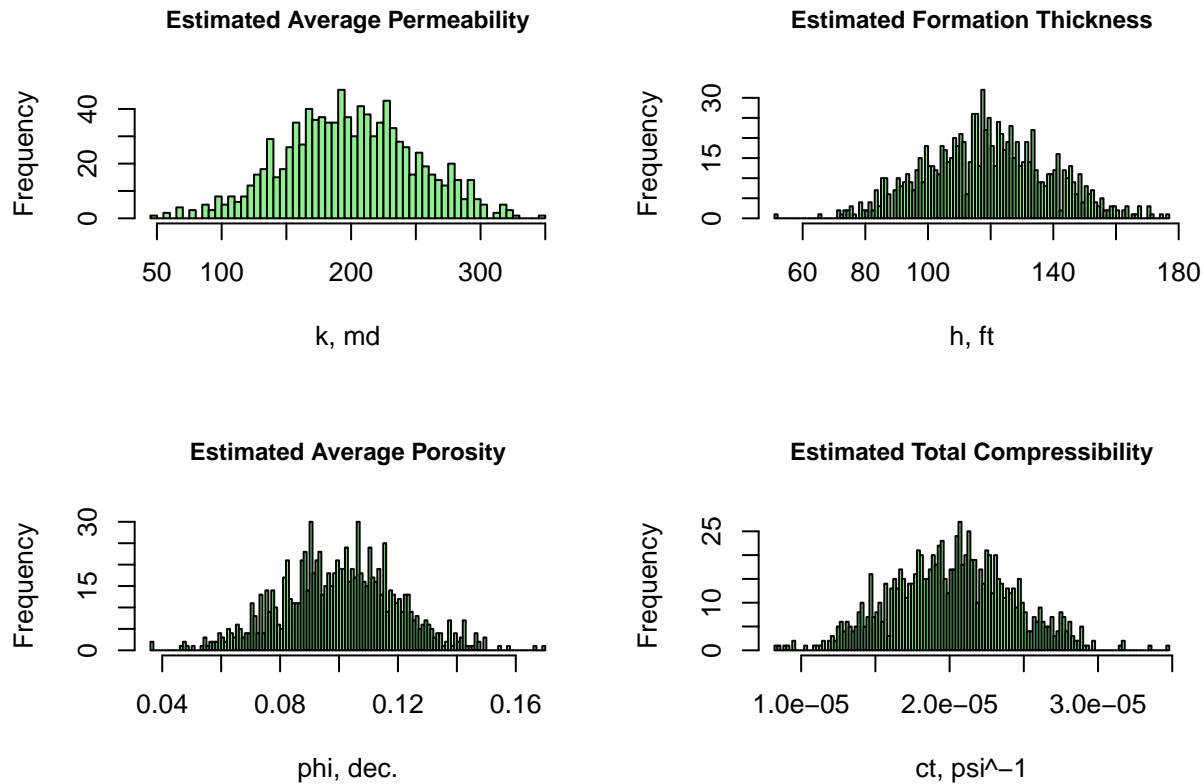
The following Pressure Transient Analysis (with uncertainty) was performed in the “R” programming environment (most off-the-shelf commercial PTA software do not handle uncertainty models well).

### Uncertainty Analysis

Parameter estimates (e.g. k, h, phi, ct) always exhibit varying degrees of uncertainty. Based on a detailed review of literature/offset publicly available information and sound professional judgement; we estimates the following parameters with normal distributions (1000 samples) with means and standard deviations as follows:

```
library(pracma)

n <- 1000
k <- rnorm(n = n, mean = 200, sd = 50)           # md
h <- rnorm(n = n, mean = 120, sd = 20)           # ft
phi <- rnorm(n = n, mean = .10, sd = 0.02)       # dec.
ct <- rnorm(n = n, mean = 2*10-5, sd = 4*10-6)    # psi-1
```



## Near Wellbore Reservoir Pressure Estimates

An estimate of the near wellbore (static) reservoir pressure (top of openhole section) as of 12-02-2016; was made utilizing the injection survey results obtained from that certain wellog prepared by Renegade Services on 12-02-2016 “Indepth Injection Profile” pressure log.

```
Pwf <- 1285 # psi (from Renegade Service 12-02-2016 Indepth Injection Profile)
q <- 7200 # bwpd ~ 5 BPM (from Renegade Service 12-02-2016 Indepth Injection Profile)
B <- 1 # bbl/bbl
u <- 1 # cp
r <- 0.33 # ft
t <- 1 # hr (from Renegade Service 12-02-2016 Indepth Injection Profile)

Pi <- Pwf - ((70.6*q*B*u)/(k*h))*expint((948*phi*u*ct*r^2)/(k*t))
```

We estimate that the near wellbore static reservoir pressure is **995 psi** which means the reservoir is **0.115 psi/ft** underpressured. This explains why most if not all injection wells (within the vacuum/artesia trend) inject on vacuum pressure (i.e. hydrostatic head in the injection tubing is greater than static reservoir head).

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	307.4	927.1	995.1	971.9	1047.0	1154.0

## Reservoir Pressure Increase Due To Injection as of (12-2016)

We estimate the reservoir pressure increase due to injection as of (12-2016) using multi-rate (avg. Fulfer and avg. Owl injection rates) superposition principles as follows:

```
t <- 24*365*((60+23)/12) # hr (total time of inj 01/2009 to 11/2016 )
t1 <- 24*365*(60/12)      # hr (total time of Fulfer inj 01/2009 to 12/2014)
q1 <- 7250125/(t1/24)      # bwpd (avg rate of Fulfer inj - total inj / total time)
q2 <- 12856680/((t-t1)/24) # bwpd (avg rate of OWL inj - total inj / total time)
r <- c(5280/2, 5280, 2*5280, 4*5280) # ft

Pr <- vector(mode = "list", length = 12)
for(i in 1:4){
  Pr[[i]] <- ((70.6*q1*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*t)) +
             ((70.6*(q2-q1)*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t1)))
}
```

The estimated reservoir pressure increase 1/2 mile from the wellbore (i.e. AOR boundary) due to injection is **295 psi**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	136.2	246.2	294.8	313.4	359.5	847.6

The estimated reservoir pressure increase 1 mile from the wellbore due to injection is **218 psi**.

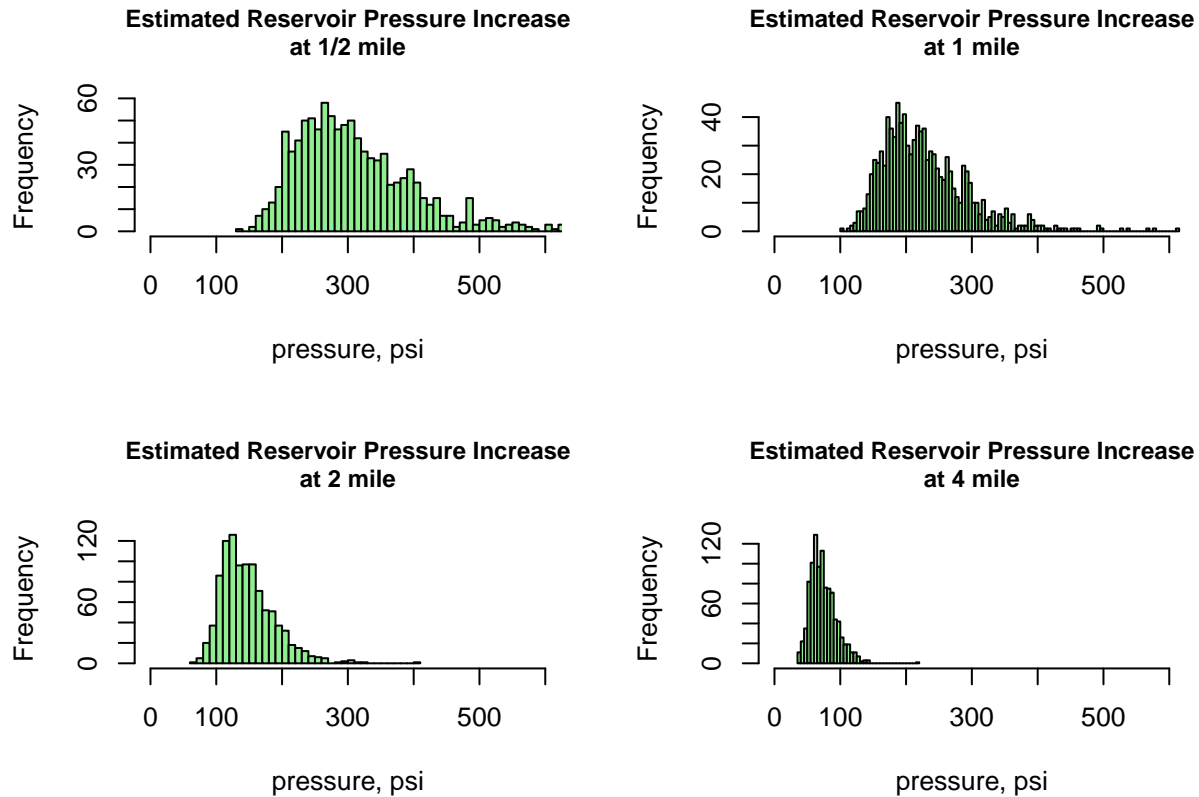
##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	102.0	182.2	217.8	229.5	263.8	610.7

The estimated reservoir pressure increase 2 mile from the wellbore (i.e. Lease/Well identification boundary) due to injection is **141 psi**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	68.34	118.60	141.00	147.90	168.80	407.70

The estimated reservoir pressure increase 4 miles from the wellbore due to injection is **71 psi**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	35.38	59.95	71.17	73.98	85.36	218.20



## Perturbed/Displaced Reservoir Volume Due To Injection as of (12-2016)

We estimated the perturbed/displaced volume due to injection as of (12-2016) using radial flow volumetrics as follows:

```
A1 <- (q1*(t1/24))/((7758*phi*h)/B)
A2 <- (q2*((t-t1)/24))/((7758*phi*h)/B)
A <- A1 + A2
```

The estimated perturbed/displaced reservoir fluid due to Fulfer Oil & Cattle LLC injection (01/2009 to 12/2014, 7.25 MMbw at 4000 bwpd) is **80 acres**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	39.35	67.69	80.25	84.18	97.13	224.90

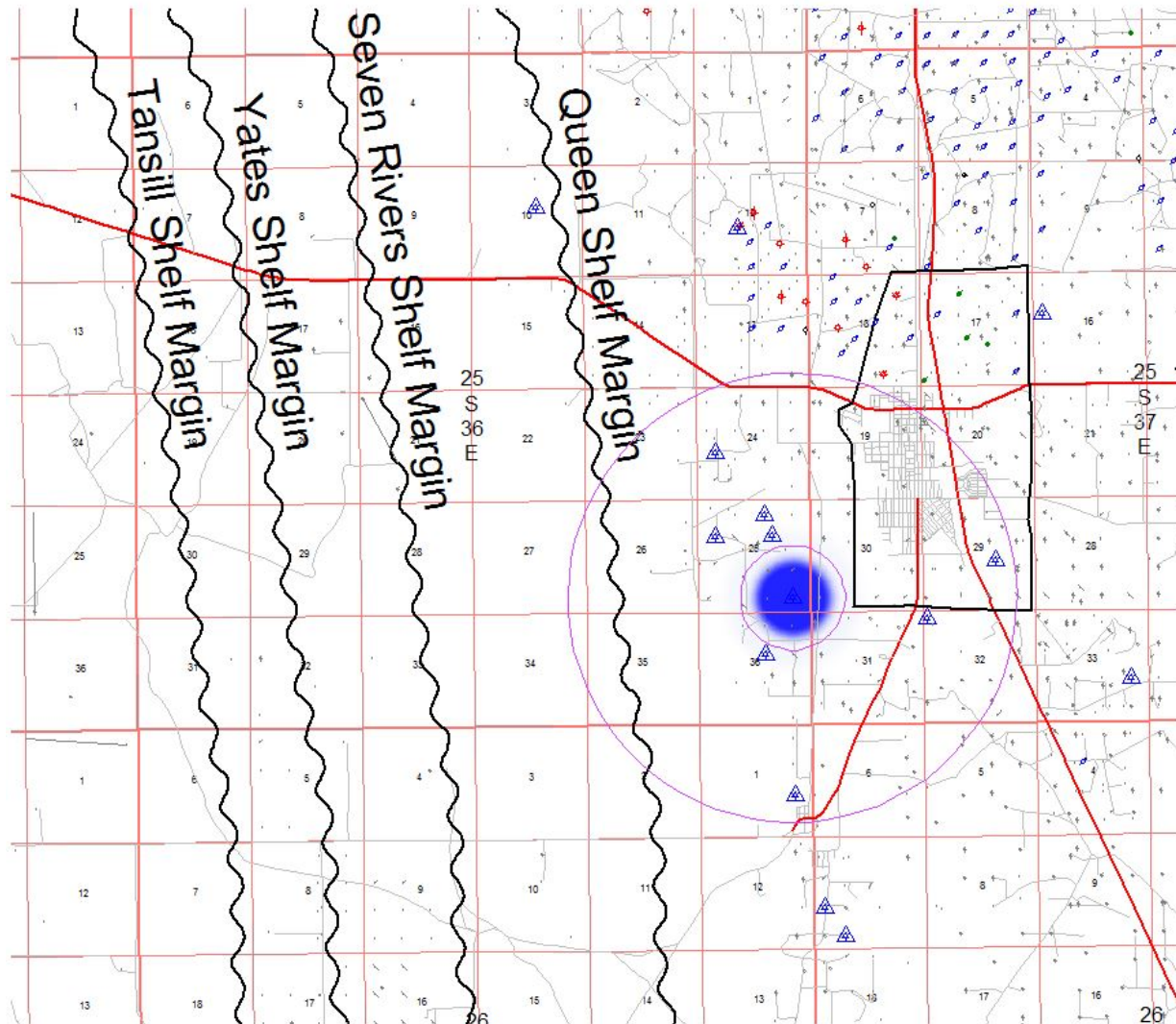
The estimated perturbed/displaced reservoir fluid due to Owl SWD Operating, LLC injection (01/2014 to 11/2016, 12.86 MMbw at 18400 bwpd) is **142 acres**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	69.77	120.00	142.30	149.30	172.20	398.80

The estimated perturbed/displaced reservoir fluid due to all injection (01/2009 to 11/2016, 20.11 MMbw) is **223 acres**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	109.1	187.7	222.5	233.5	269.4	623.7

The solid blue circle is our best estimate (based on statistics above) of the present situation (spatially) of the injected fluid. Based on our professional judgement, numerical simulation (e.g. ModFlow) is unwarranted at this time.



Note: Outer purple circle 2 Mile Lease/Well Identification Boundary; inner purple circle 1/2 Mile AOR.

## Reservoir Pressure Increase Due To Future Injection (5-year Estimate)

We estimate the reservoir pressure increase due to injection as of (12-2016 + 5-Years) using multi-rate (avg. Fulfer and avg. Owl injection rates - assuming Owl rates remain constant) superposition principles as follows:

```
t <- 24*365*((60+23+60)/12) # hr (total time of inj 01/2009 to 11/2016 + 5 years)
t1 <- 24*365*((60)/12)      # hr (total time of fulfer inj 01/2009 to 12/2014)
t2 <- 24*365*((60+23)/12)  # hr (total time of fulfer inj 01/2009 to 11/2016)
q1 <- 7250125/(t1/24)       # bwpd (avg rate of fulfer inj - total inj / total time)
q2 <- 12856680/((t2-t1)/24) # bwpd (avg rate of OWL inj - total inj / total time)
```



```

q3 <- q2                                     # bwpd (avg rate of OWL inj stays constant)
r <- c(5280/2, 5280, 2*5280, 4*5280)      # ft

for(i in 1:4){
  Pr[[i + 4]] <- ((70.6*q1*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*t)) +
    ((70.6*(q2-q1)*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t1))) +
    ((70.6*(q3-q2)*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t2)))
}

```

The estimated future reservoir pressure increase 1/2 mile from the wellbore (i.e. AOR boundary) due to 5-years of additional injection (at 18400 bwpd) is **63 psi** (from 295 psi to 357 psi).

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	27.86	51.10	63.25	68.37	78.32	231.10

The estimated future reservoir pressure increase 1 mile from the wellbore due to 5-years of additional injection (at 18400 bwpd) is **63 psi** (from 218 psi to 280 psi).

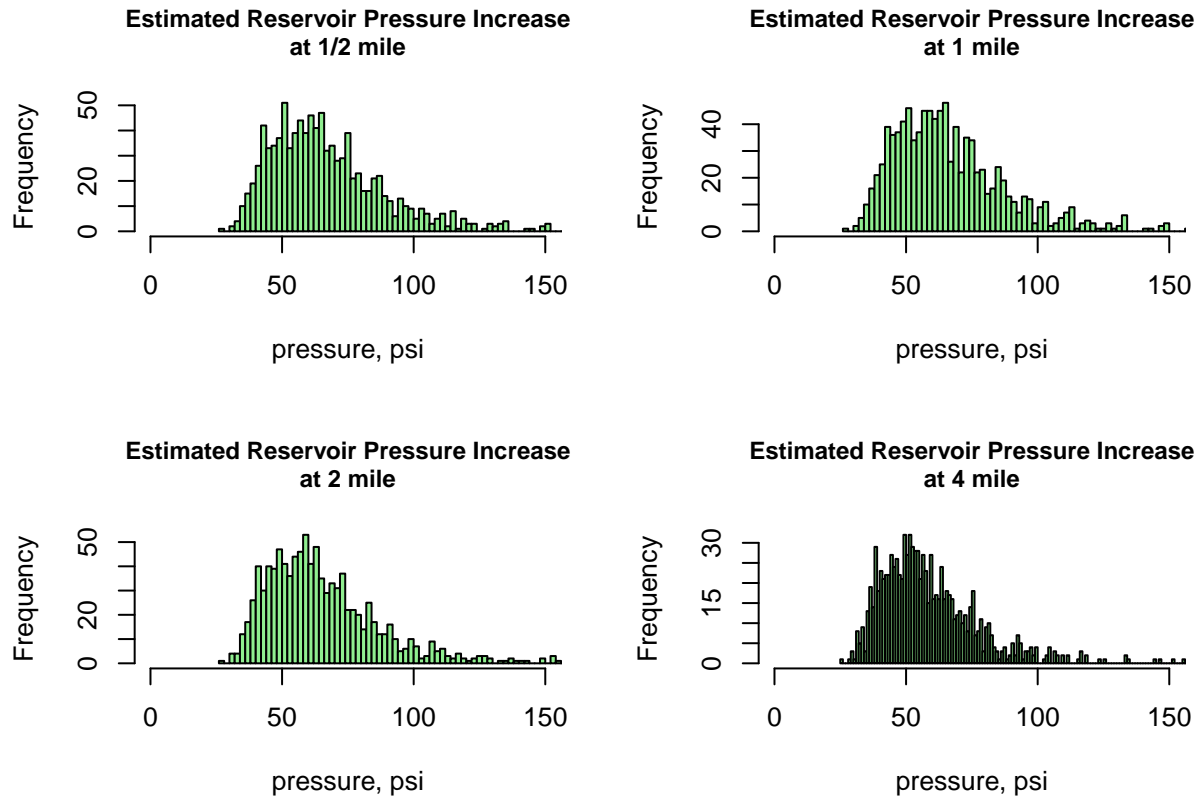
##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	27.72	50.85	62.79	67.85	77.69	226.60

The estimated future reservoir pressure increase 2 mile from the wellbore (i.e. Lease/Well identification boundary) due to 5-years of additional injection is **61 psi** (from 141 psi to 203 psi).

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	27.19	49.69	61.06	65.84	75.59	209.60

The estimated future reservoir pressure increase 4 miles from the wellbore due to 5-years of additional injection is **55 psi** (from 71 psi to 127 psi).

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	25.18	45.55	54.63	58.60	67.31	158.30



## Purturbed/Displaced Reservoir Volume Due To Due To Future Injection (5-year Estimate)

We estimated the perturbed/displaced volume due to injection as of (12-2016 + 5-Years) using radial flow volumetrics as follows:

```
A1 <- (q1*(t1/24))/((7758*phi*h)/B)
A2 <- (q2*((t-t1)/24))/((7758*phi*h)/B)
A3 <- (q3*((t-t2)/24))/((7758*phi*h)/B)
A <- A1 + A2 + A3
```

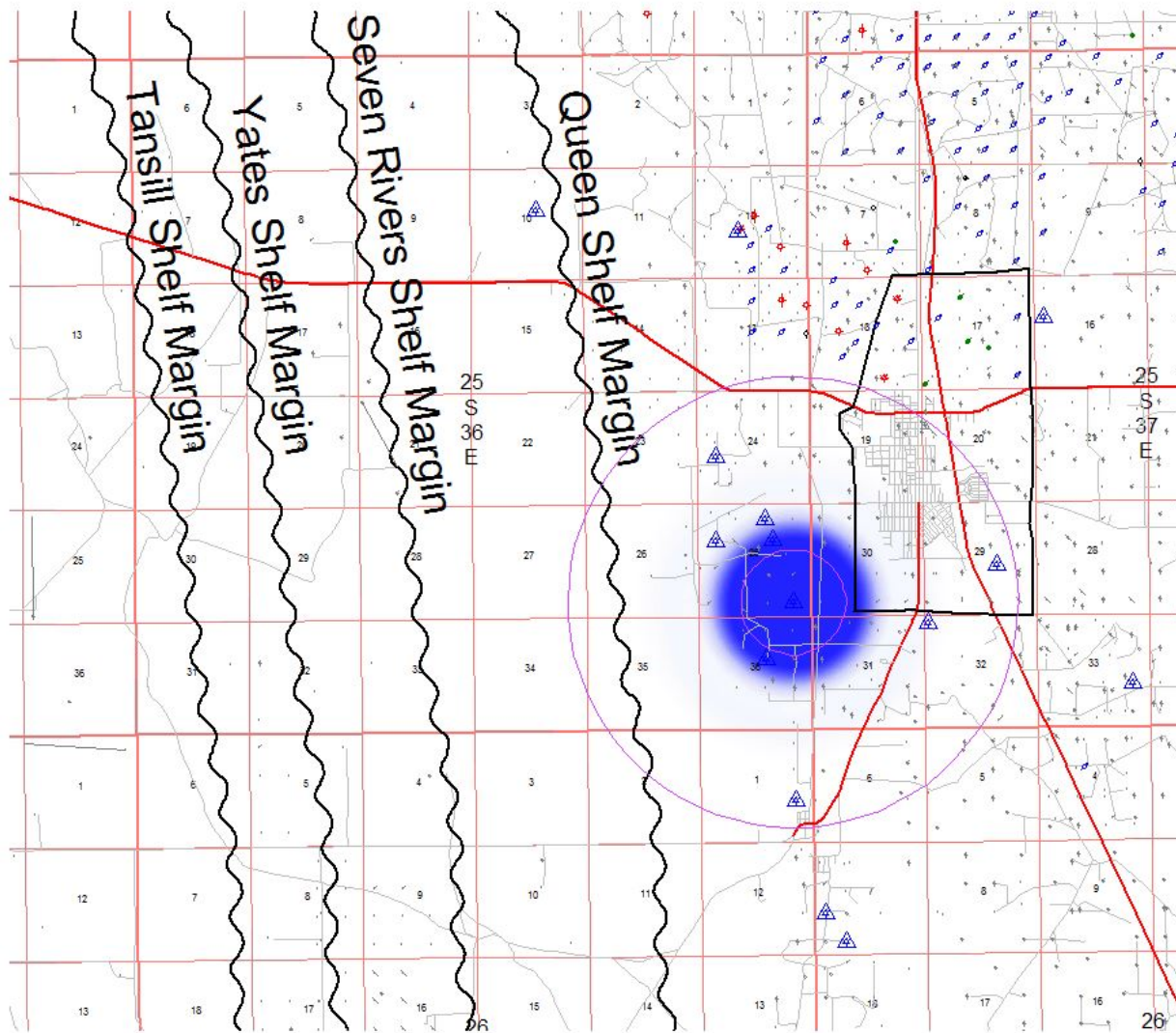
The estimated perturbed/displaced reservoir fluid due to Owl SWD Operating, LLC injection (12/2016 to 12/2021, 33.55 MMbw at 18400 bwpd) is **514 acres**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	182.0	313.1	371.2	389.4	449.3	1040.0

The estimated perturbed/displaced reservoir fluid due to all injection (01/2009 to 12/2021, 53.69 MMbw) is **965 acres**.

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	473.1	814.0	965.0	1012.0	1168.0	2705.0

The solid blue circle is our best estimate (based on statistics above) of the future situation (spatially) of the injected fluid. Based on our professional judgement, numerical simulation (e.g. ModFlow) is unwarranted at this time.



Note: Outer purple circle 2 Mile Lease/Well Identification Boundary; inner purple circle 1/2 Mile AOR.

## Reservoir Pressure Decrease (5-year Estimate) If Shut-in 12/2016.

We estimate the reservoir pressure decrease due to secession of injection as of (12-2016 + 5-Years) using multi-rate (avg. Fulfer and avg. Owl injection rates - and shut-in 12-2016 for 5-Years) superposition principles as follows:

```
t <- 24*365*((60+23+60)/12) # hr (total time of inj 01/2009 to 11/2016 + 5 years)
t1 <- 24*365*((60)/12)      # hr (total time of fulfer inj 01/2009 to 12/2014)
t2 <- 24*365*((60+23)/12)  # hr (total time of fulfer inj 01/2009 to 11/2016)
q1 <- 7250125/(t1/24)       # bwpd (avg rate of fulfer inj - total inj / total time)
q2 <- 12856680/((t2-t1)/24) # bwpd (avg rate of OWL inj - total inj / total time)
q3 <- 0                     # bwpd (avg rate of OWL inj stays constant)
r <- c(5280/2, 5280, 2*5280, 4*5280) # ft
```

```

for(i in 1:4){
  Pr[[i + 8]] <- ((70.6*q1*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*t)) +
    ((70.6*(q2-q1)*B*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t1))) +
    ((70.6*(q3-q2)*u)/(k*h))*expint((948*phi*u*ct*r[i]^2)/(k*(t-t2)))
}

```

The estimated future reservoir pressure decrease 1/2 mile from the wellbore (i.e. AOR boundary) after 5-years from secession of injection is **-270 psi** (from 295 psi to 25 psi).

```

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -756.4  -329.3  -270.4  -286.4  -226.0  -125.3

```

The estimated future reservoir pressure decrease 1 mile from the wellbore after 5-years from secession of injection is **-192 psi** (from 218 psi to 25 psi).

```

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -544.70 -232.90 -192.10 -202.70 -160.60  -91.07

```

The estimated future reservoir pressure decrease 2 mile from the wellbore (i.e. Lease/Well identification boundary) after 5-years from secession of injection is **-117 psi** (from 141 psi to 24 psi).

```

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -342.50 -139.00 -116.80 -121.50  -98.57  -57.52

```

The estimated future reservoir pressure decrease 4 miles from the wellbore after 5-years from secession of injection is **-48 psi** (from 71 psi to 23 psi).

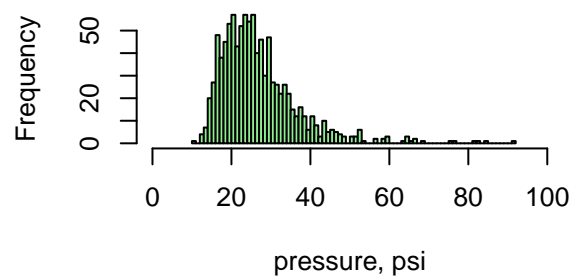
```

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -155.8000 -58.3100 -47.8100 -49.3400 -38.2600  0.5565

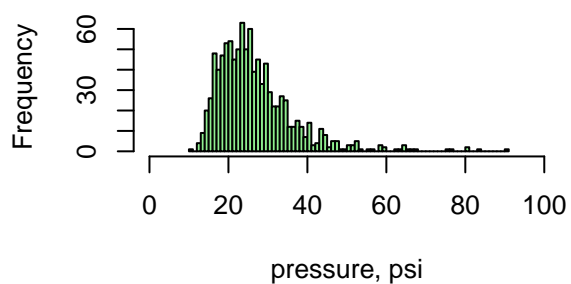
```

**We Specifcly Note That (5-Years) After The Secession of Injection The Reservoir Pressure Will Have Only Increased 25 psi From Initial (prior to injection) Conditions**

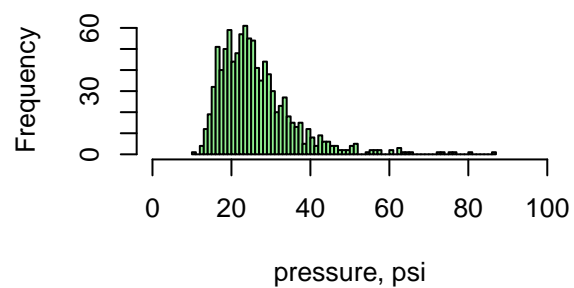
**Estimated Reservoir Pressure Increase  
at 1/2 mile**



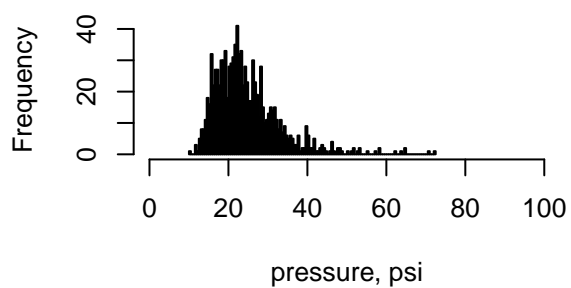
**Estimated Reservoir Pressure Increase  
at 1 mile**



**Estimated Reservoir Pressure Increase  
at 2 mile**



**Estimated Reservoir Pressure Increase  
at 4 mile**





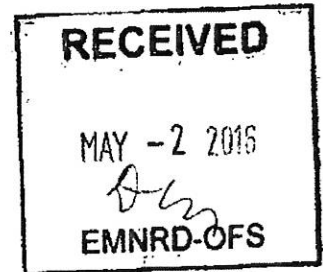
## CITY OF JAL

JAL, NEW MEXICO 88252

PO DRAWER 340  
PHONE 395-3340

April 28, 2016

Mr. Matthew Earthman  
Souder, Miller & Assocs.  
3451 Candelaria Rd NE  
Albuquerque, NM 87112



Mr. Earthman,

I want to take this opportunity to communicate with you about a concern that was brought to the city by several individuals and companies. The concern is in reference to our pending application for 900 acre feet of water and nine well locations.

There are several disposal wells in the same section that we are considering to place our wells, Section 25, T 25S, R 36E, that would be utilized for drinking water. In particular, there is a disposal well, Owl Maralo Sholes B #2, that has continued to inject large volumes of disposal water, 13 million barrels in 2015. In addition to the ongoing volumes of water, a company is now constructing a 16 inch line that will travel west out of the Jal area. The purpose for this line, as we understand it, would be to transport produced water for disposal in the above-mentioned disposal well.

Before the city undertakes the expenditure to drill water supply wells in the area close to this well, we would like to ensure this salt water disposal well is injecting into the permitted Seven Rivers Zone and will not cause problems with shallow fresh water aquifers.

Our specific request is for you to involve the Oil Conservation Division and the State Engineer Office in requiring the following information.

1. Provide documentation to demonstrate wellbore integrity;
2. To run a spinner survey to demonstrate injection is within the permitted interval

We strongly believe that these tests and any others that the regulatory agencies believe are warranted should be conducted immediately and then on a regular basis thereafter to ensure that the drinking water to the residents of our community has not been negatively impacted or contaminated in any manner.

Please do not hesitate to contact me should you have any questions or require additional information.

Respectfully,

Bob Gallagher, City Manager

XC: David Martin, Sec. EMNRD  
David Catanach, Director, OCD  
Tom Blaine, State Engineer



State of New Mexico  
Energy, Minerals and Natural Resources Department

---

Susana Martinez  
Governor

Tony Delfin  
Deputy Cabinet Secretary

David R. Catanach, Division Director  
Oil Conservation Division



**\*Response Required – Deadline Enclosed\***  
*Underground Injection Control Program*

July 28, 2016

Mr. Nevin Bannister  
Chief Operating Officer  
OWL SWD Operating, LLC  
8214 Westchester Drive, Suite 850  
Dallas, TX 75225

**RE: NOTICE TO OPERATOR: REQUIREMENT TO CONDUCT INJECTION SURVEY**

Maralo Sholes B Well No. 2 (API 30-025-09806)

660' FSL, 660' FEL; Unit P, Sec 25, T25S, R36E, NMPM, Lea County, New Mexico

Injection Authority: Administrative Order SWD-1127

Order Date: June 1, 2008

Permitted Interval: Yates and Seven Rivers formations; 2938 feet to 3055 feet

Mr. Bannister:

The Division is in receipt of a formal correspondence by the City of Jal regarding the potential impacts of the operation of the injection well referenced above (the "subject well"). This correspondence presents concerns for the protection of underground source of drinking water in the vicinity of the subject well. In response to this correspondence, the Engineering Bureau is conducting a technical review of the well file and operation with respect to the conditions contained in the administrative order.

OWL SWD Operating, LLC (the "operator" or "OWL") has responded to recent requests for inspection and upgrade of the wellhead in order to monitor an intermediate casing string that is only sealed in place with drilling mud and not cement. This situation is being assessed for potential vertical migration of fluids behind casing and may require additional testing based on the results of the Bradenhead monitoring.

During the review of the well file, the Division found that the reported volumes of injection fluids increased significantly during the calendar year 2015 (see attachment). The average daily injection rate for 2015 was approximately 19,500 barrels of water per day (BWPD) while the highest single-month rate happened in August with approximately 30,790 BWPD. All of the reported volumes were

injected with a surface pressure of zero (0) pounds per square inch (PSI). Conversely, the injection volumes for the period from 2009 to 2014 showed an average of 3300 BWPD with all volumes injected with a surface pressure of 0 PSI.

The Division is required *"to ensure that the injected water enters only the proposed injection interval"* as a condition of the administrative order. Based on the recent injection information and lack of any quantitative testing, the Division cannot confidently determine that the injection fluids are staying within the permitted interval. Therefore, the Division is stipulating that the operator conduct an injection survey for the subject well with the results to be submitted within the next twenty-one (21) days of this correspondence date.

The type of injection survey may be either a temperature survey or a radioactive tracer survey. At a minimum, the injection survey will be conducted to established industry protocols with results that provide a clear interpretation. A description of activities to conduct the proposed injection survey must be submitted in a Notice of Intent Sundry for approval by the Hobbs District Supervisor. Scheduling of the injection survey must provide the opportunity for Division personnel to be present to witness the activities. All test results, logs and reports prepared as a result of the injection survey are to be submitted to the attention of the Division Director in Santa Fe.

In the event that a satisfactory response is not received to this letter of direction within the prescribed period, enforcement will occur. Such enforcement may include immediate shut-in and an application for appearance by OWL before a Division Examiner to terminate the injection authority granted in the administrative order.

Please contact Mr. Daniel Sanchez, Fields Operations Manager (505.476.3493), with any questions regarding this correspondence.

Sincerely,



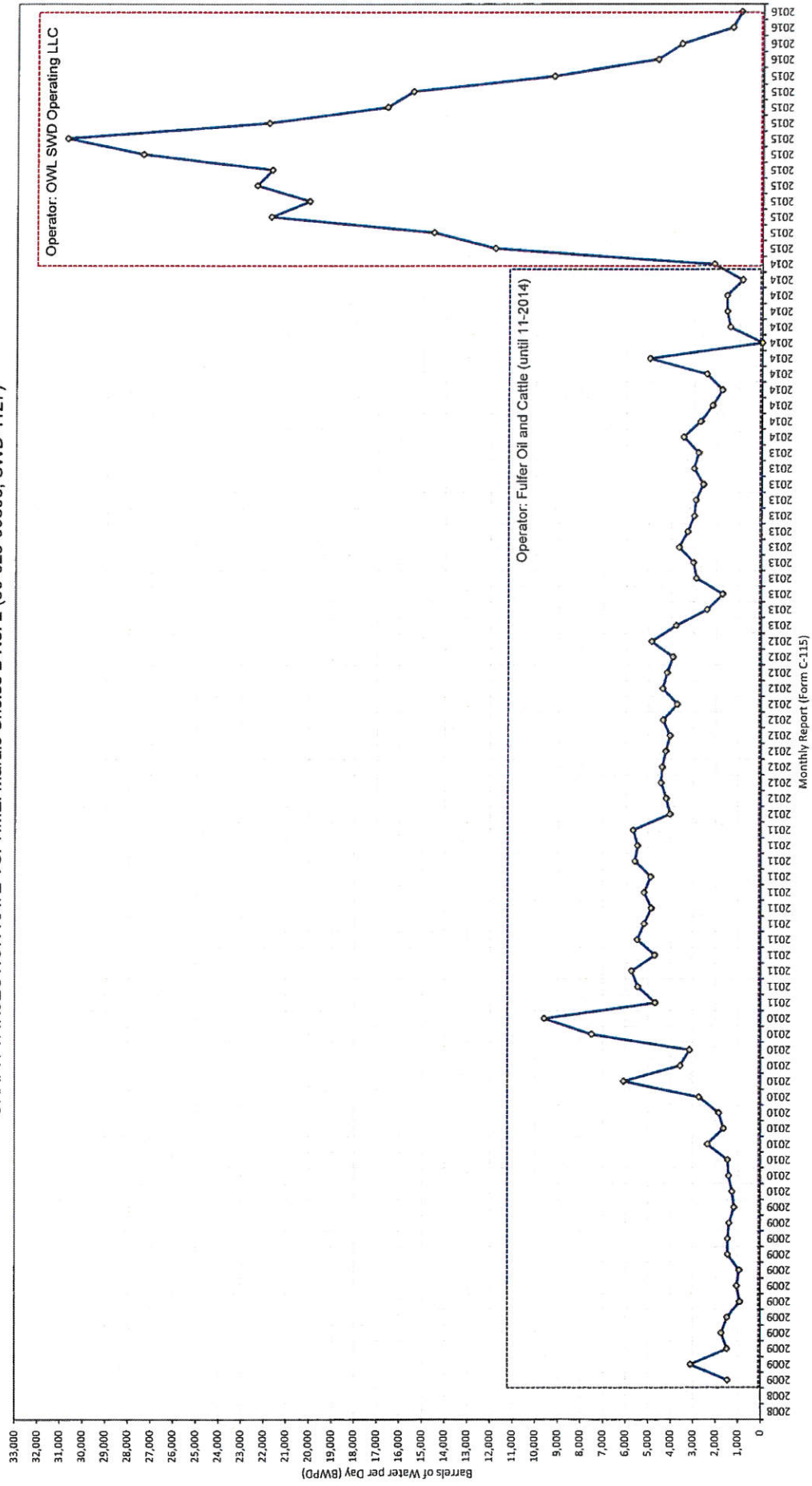
DAVID R. CATANACH  
Director

DRC/prg

Attachment: GRAPH 1: INJECTION RATE VS. TIME: Maralo Sholes B No. 2 (30-025-09806; SWD-1127)

cc: Oil Conservation Division – Hobbs District Office  
Well File API 30-025-09806  
Administrative Order SWD-1127  
Bureau of Land Management – Carlsbad Field Office  
Mr. Bob Gallagher, City Manager, City of Jal

GRAPH 1: INJECTION RATE VS. TIME: Maralo Sholes B No. 2 (30-025-09806; SWD-1127)



Mr. Bob Gallagher, City Manager  
City of Jal  
P. O. Drawer 340  
Jal, NM 88252

**Brown, Maxey G, EMNRD**

---

**From:** Brown, Maxey G, EMNRD  
**Sent:** Tuesday, September 06, 2016 3:13 PM  
**To:** Ben Stone (ben@sosconsulting.us)  
**Cc:** Catanach, David, EMNRD; Goetze, Phillip, EMNRD  
**Subject:** OWL Maralo Sholes B #2

30-025-09806

**HOBBS OCD**

SEP 6, 2016

**RECEIVED**

Ben,

I am approving the C103 I received from you today. After discussing the recent profile with Director Catanach, please move forward with the cleanout of the 50' of fill and re-run the injection profile. The condition of approval is that the profile be completed and copies to the Santa Fe office by October 7, 2016. At this time OWL will not receive a formal letter stating these requirements. This email will be used as notice. Please pass this information to your contacts at OWL.

Thanks.

Maxey G. Brown  
OCD District 1 Supervisor  
575-393-6161 ext. 102



# Jal, New Mexico (Middle Seven Rivers) Lithology Map

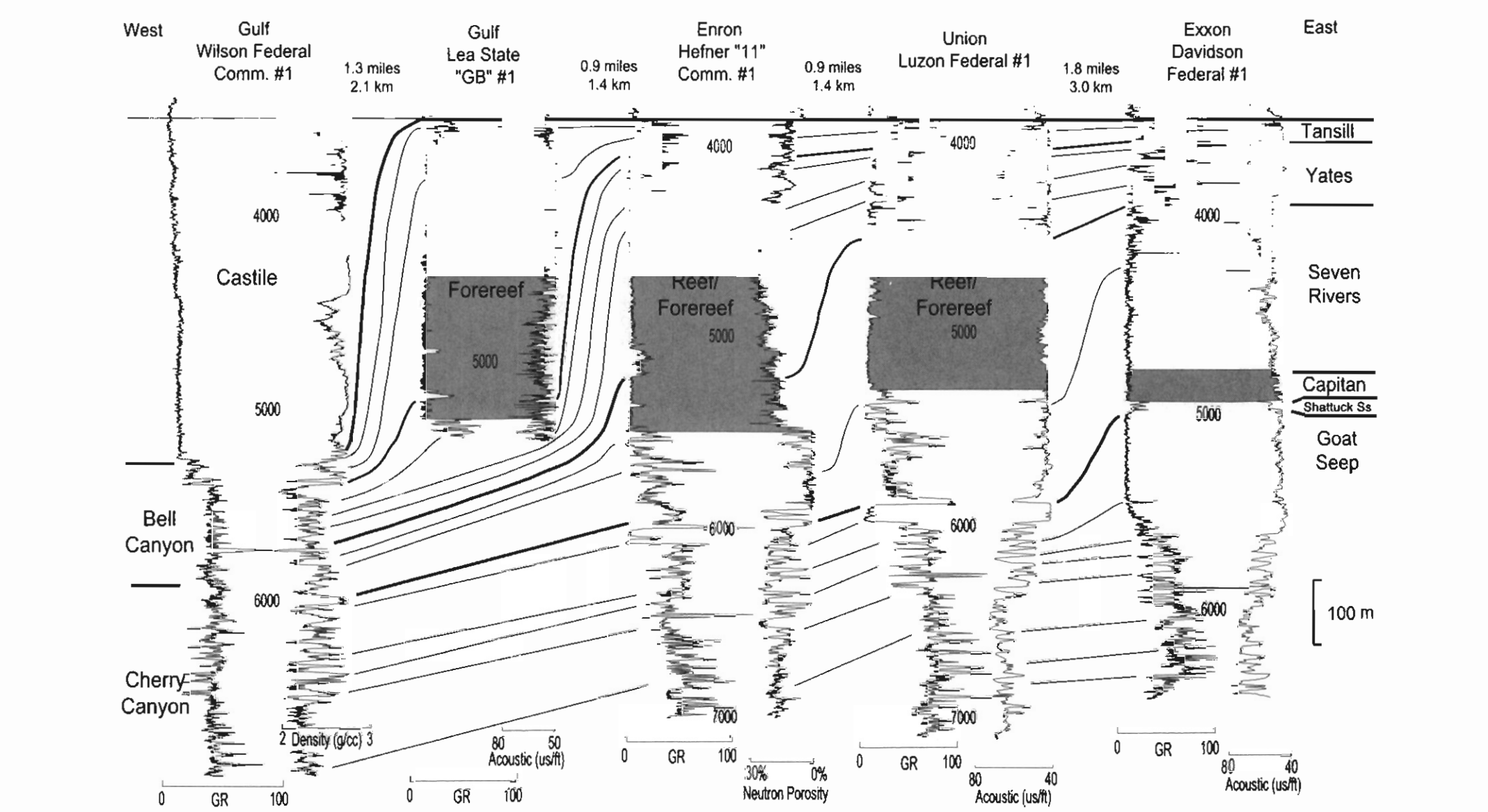


FIG. 6.—Wireline log cross-section using wells located near the seismic line shown in Figs. 3 and 4. Stratigraphy and shelf-to-basin correlations for the Capitan depositional system are shown. Section is approximately dip-oriented. Correlations follow seismic geometries as well as log patterns. Section is stratigraphic; datum is top Tansill Formation except for basin well where top Castile is used. Well locations are shown in Fig. 1.

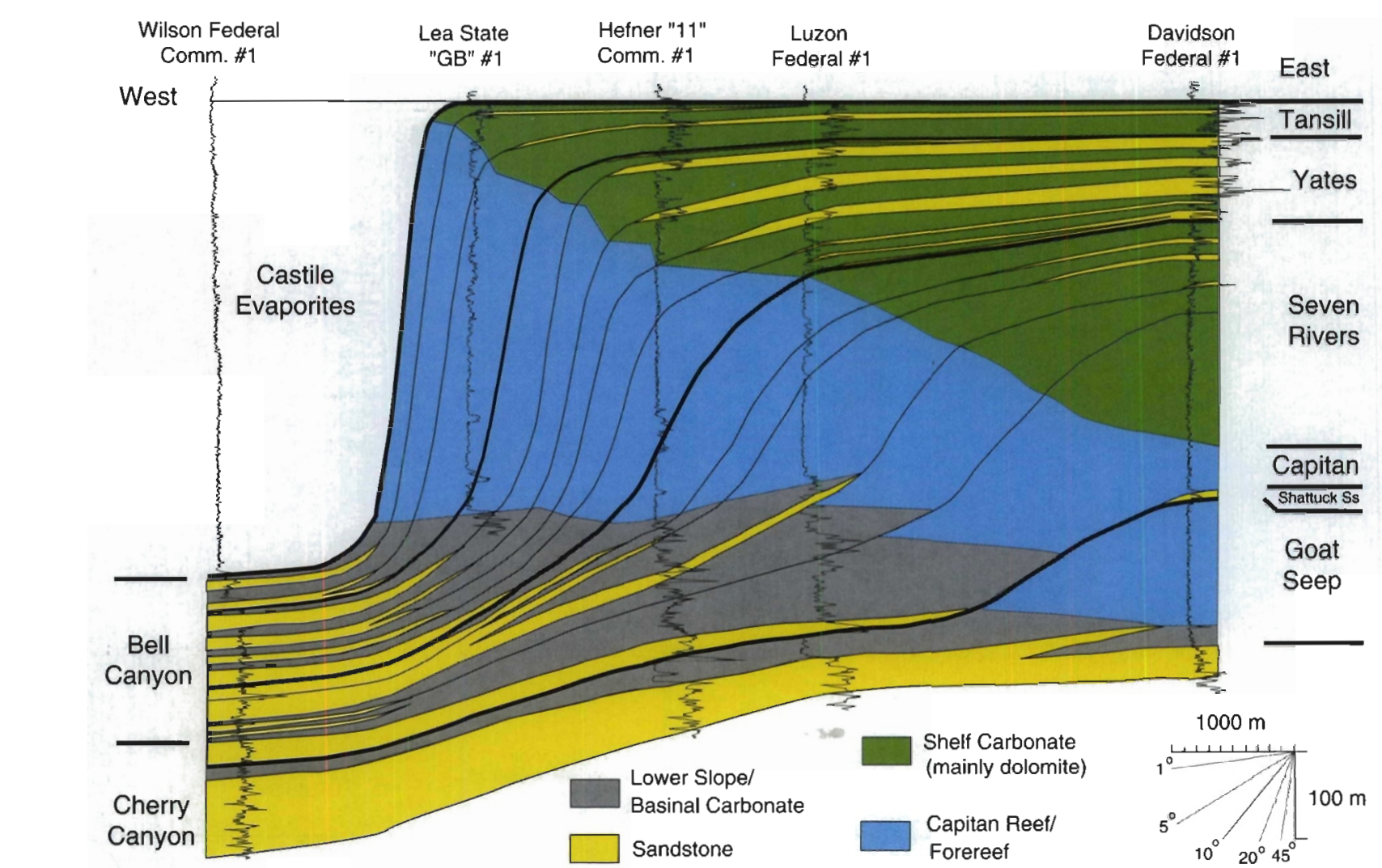
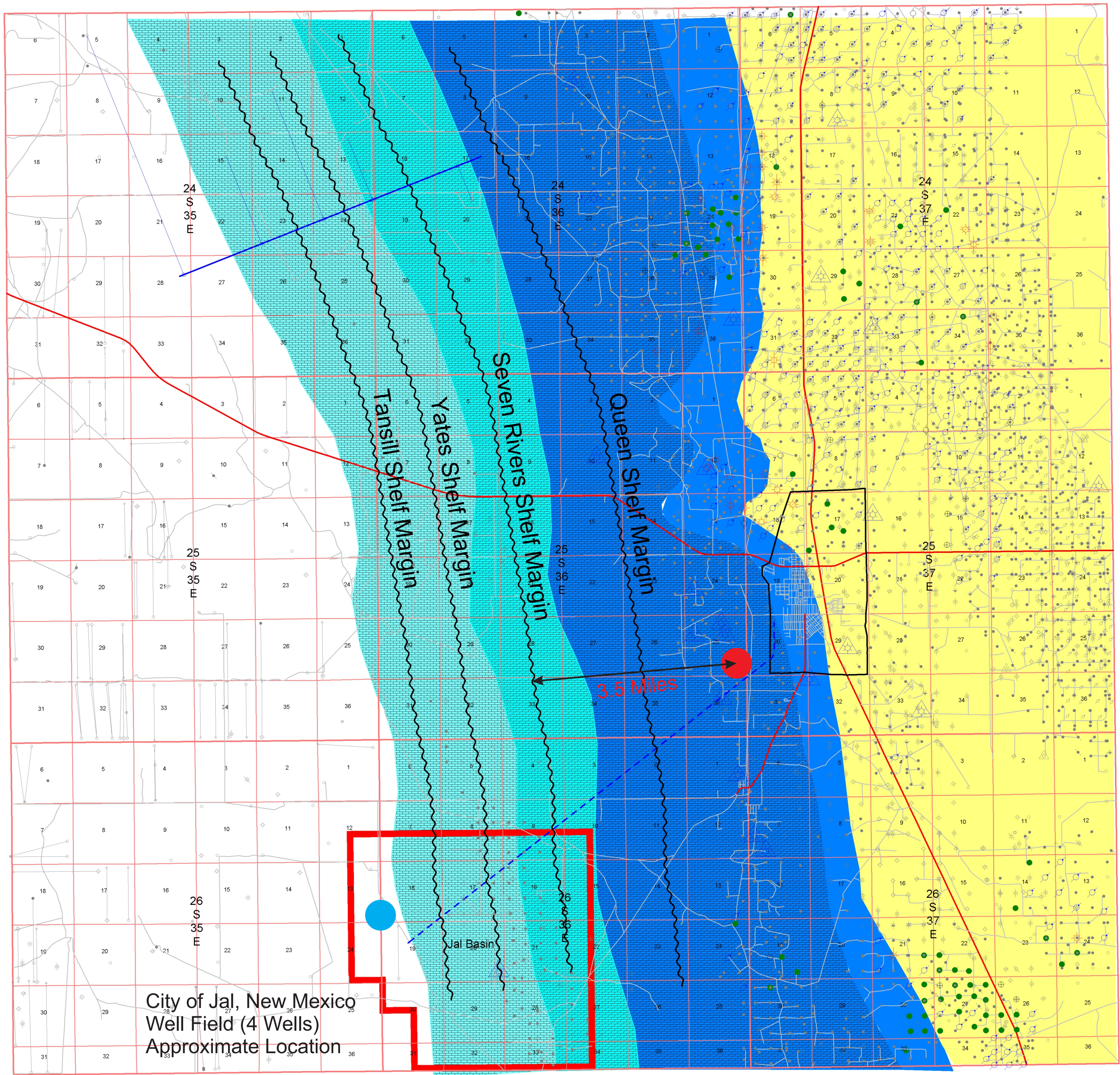


FIG. 7.—Stratigraphic cross-section of the Capitan depositional system showing gamma-ray logs, subsurface stratigraphy, lithologies and depositional environments interpreted for wells in Fig. 6.

Harris, P. M and Saller, A. H., "Subsurface Expression of the Capitan Depositional System and Implications for Hydrocarbon Reservoirs, Northeastern Delaware Basin", Geologic Framework of the Capitan Reef, Society of Sedimentary Geology (SEPM), 1999



OWL SWD Operating, LLC  
Maralo Sholes B #2  
30-025-09806  
SWD-1127 (June 1, 2008)

Lower Yates / Upper Seven Rivers  
Open Hole 2938-3055

## CEK ENGINEERING LLC

OWL SWD Operating, LLC

Jal, New Mexico SWD Project  
Guadalupe (Artesia Grp / Capitan Reef)  
Lithology (Middle Seven Rivers)

0 5,280 10,560  
FEET

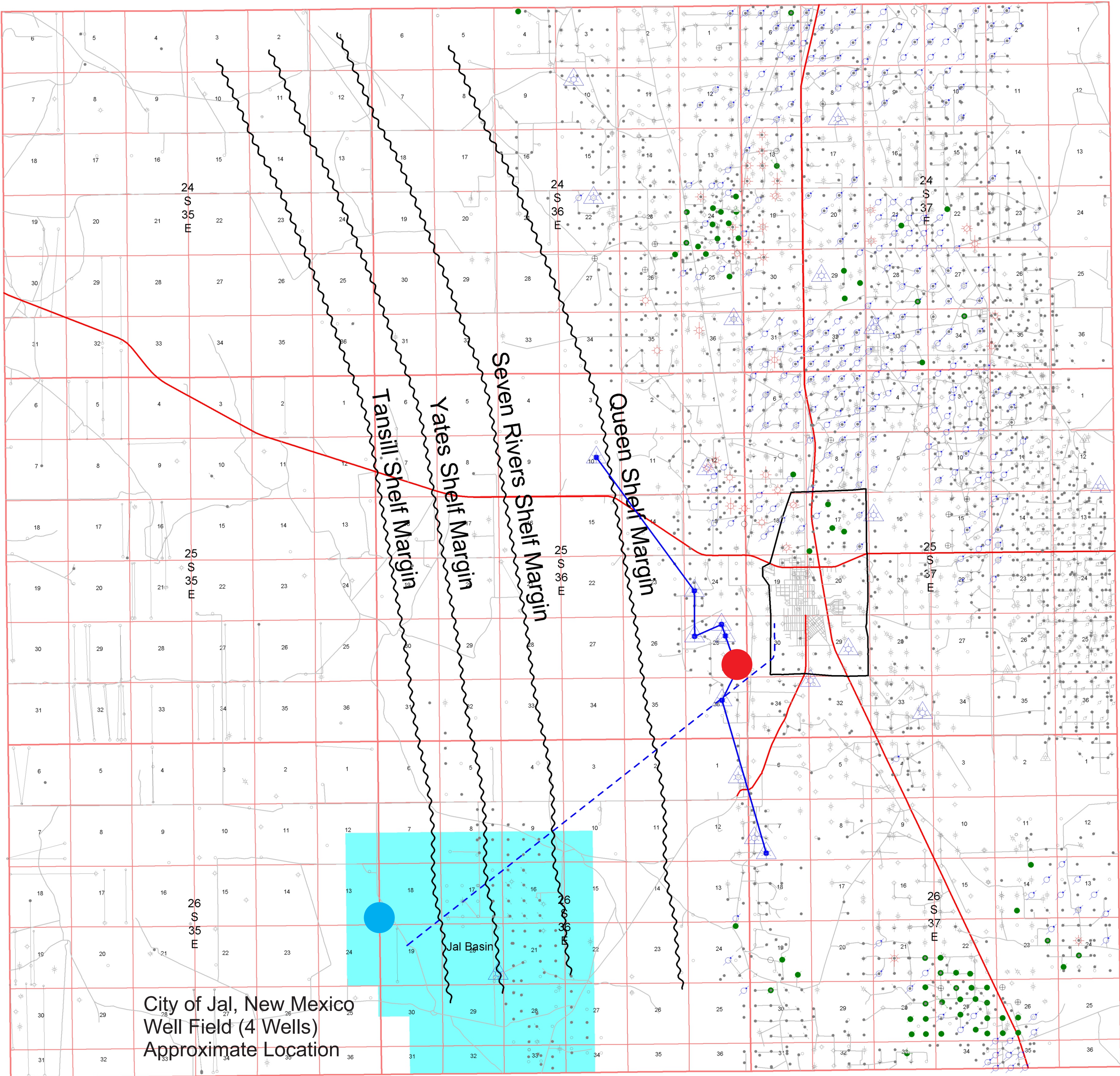
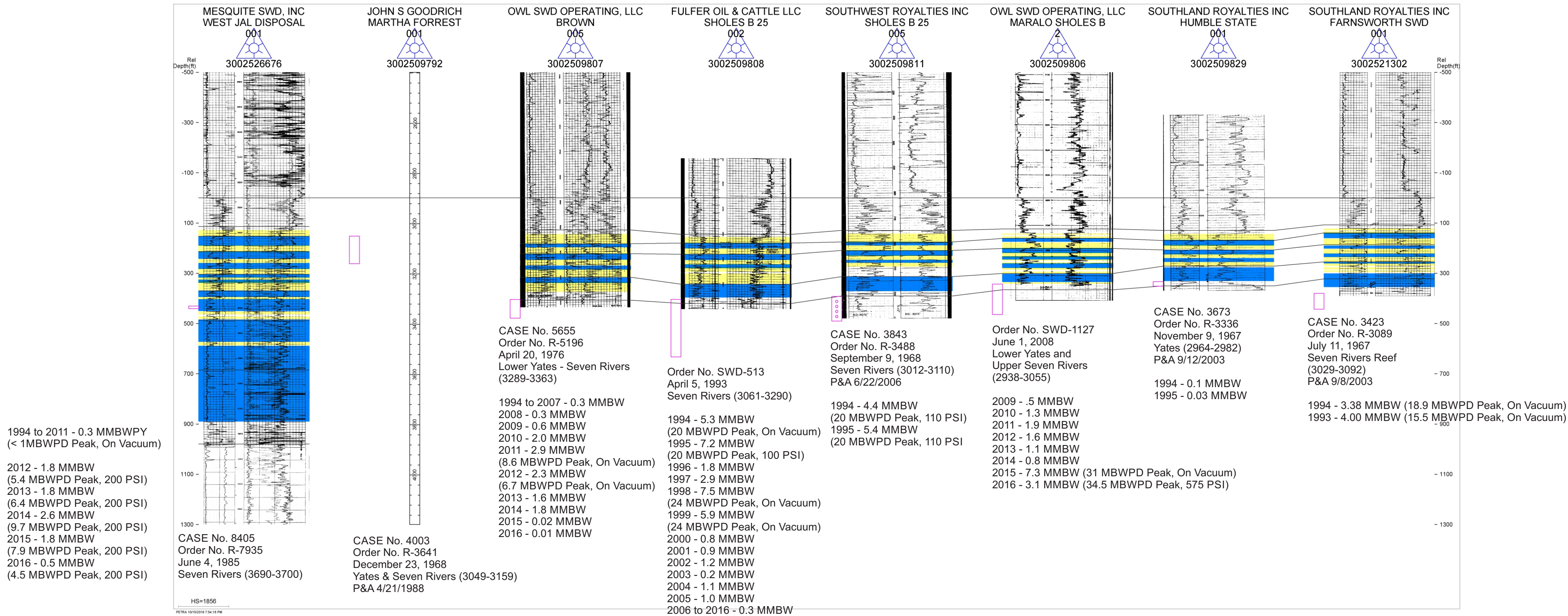
- Oil Well
- Gas Well
- Injection Well
- Permit Canceled Normal Line
- Plugged & Abandoned Oil Well
- Plugged & Abandoned Gas Well
- Temporarily Abandoned
- Dry Hole, With Show of Oil
- Dry Hole, With Show of Gas
- Suspended Gas Well
- Abandoned GAS Well
- Coal Bed Methane & Salt Water Disposal
- Abandoned Coal Bed Methane
- Shut-in Oil Well
- Shut-in Gas Well
- Other (Observation, Service, Disposal)
- Injection Well

CEK Engineering LLC  
5301 69th Street  
Lubbock, TX 79424  
(808) 702-8954  
chad.kronosky@cekengineering.com

### REMARKS

By: Chad E. Kronosky, P.E.  
October 16, 2016





OWL SWD Operating, LLC  
Maralo Shoals B #2  
30-025-09806  
SWD-1127 (June 1, 2008)

Lower Yates / Upper Seven Rivers  
Open Hole 2938-3055

CEK ENGINEERING LLC

OWL SWD Operating, LLC

Jal, New Mexico SWD Project

Guadalupe (Artesia Grp / Capitan Reef)

Artesia Grp Injection Wells (DI 10/2016)

0

5,280

10,560

FEET

WELL SYMBOLS

Oil Well

Gas Well

Injection Well

Permit Canceled Normal Line

Plugged & Abandoned Oil Well

Plugged & Abandoned Gas Well

Temporarily Abandoned

Dry Hole, With Show of Oil

Dry Hole, With Show of Gas

Suspended Gas Well

Abandoned GAS Well

Coal Bed Methane & Salt Water Disposal

Abandoned Coal Bed Methane

Shut-in Oil Well

Shut-in Gas Well

Other (Observation, Service, Disposal)

Injection Well

CEK Engineering LLC

5301 69th Street

Lubbock, TX 79424

(808) 702-8954

chad.kronosky@cekengineering.com

REMARKS

By: Chad E. Kronosky, P.E.

October 16, 2016

Jal, New Mexico (Artesia Group) Injection Wells Map