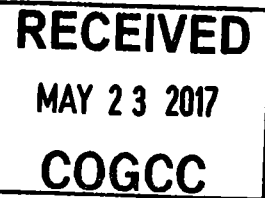




02187679

05/23/17

## **511 Documents**



BEFORE THE OIL AND GAS CONSERVATION COMMISSION  
OF THE STATE OF COLORADO

IN THE MATTER OF THE AMENDED ) Cause No. 535  
APPLICATION OF WHITING OIL AND GAS )  
CORPORATION FOR AN ORDER TO AMEND ) Docket No. 170600334  
ORDER NO. 535-268 TO INCLUDE THE )  
CARLILE, FORT HAYES, CODELL ) Type: SPACING  
FORMATIONS AND ALLOW FOR ADDITIONAL )  
WELLS IN AN EXISTING 960-ACRE DRILLING )  
AND SPACING UNIT AND ESTABLISHING )  
WELL LOCATION RULES APPLICABLE TO )  
THE DRILLING AND PRODUCING OF WELLS )  
FROM THE CARLILE, FORT HAYS, CODELL )  
AND NIOBRARA FORMATIONS COVERING )  
CERTAIN LANDS IN TOWNSHIP 11 NORTH, )  
RANGE 58 WEST, 6TH P.M., WELD COUNTY, )  
COLORADO. )

REQUEST FOR RECOMMENDATION OF  
APPROVAL OF APPLICATION WITHOUT A HEARING

Whiting Oil and Gas Corporation ("Applicant"), Operator No. 96155, by its attorneys, Welborn Sullivan Meck & Tooley, P.C., requests pursuant to Rule 511.a. of the Rules and Regulations of the Colorado Oil and Gas Conservation Commission for the Director to recommend approval of its April 13, 2017, amended May 5, 2017, verified application ("Application") and the supporting exhibits without a hearing.

Applicant requests that the above-captioned matter be approved based upon: (i) the merits of the Application, and (ii) Applicant's sworn written testimony verifying sufficient facts along with exhibits that adequately support the relief requested by the Application. To Applicant's information and belief, no protests were timely filed in this matter.


[Remainder of page intentionally left blank]

WHEREFORE, Applicant requests that its request for a recommendation for approval of its Application without a hearing be granted.

DATED this 22nd day of May, 2017

Respectfully submitted,

By: \_\_\_\_\_

  
Joseph C. Pierzchala  
Welborn, Sullivan Meck & Tooley, P.C.  
Attorneys for Applicant  
1125 17th Street, Suite 2200  
Denver, CO 80202  
(303) 830-2500  
jpierzchala@wsmtlaw.com

**BEFORE THE OIL AND GAS CONSERVATION COMMISSION  
OF THE STATE OF COLORADO**

IN THE MATTER OF THE AMENDED	) Cause No. 535
APPLICATION OF WHITING OIL AND GAS	)
CORPORATION FOR AN ORDER TO	) Docket No. 170600334
AMEND ORDER NO. 535-268 TO INCLUDE	)
THE CARLILE, FORT HAYES, CODELL	)
FORMATIONS AND ALLOW FOR	)
ADDITIONAL WELLS IN AN EXISTING 960-	)
ACRE DRILLING AND SPACING UNIT AND	)
ESTABLISHING WELL LOCATION RULES	)
APPLICABLE TO THE DRILLING AND	)
PRODUCING OF WELLS FROM THE	)
CARLILE, FORT HAYS, CODELL AND	)
NIOBRARA FORMATIONS COVERING	)
CERTAIN LANDS IN TOWNSHIP 11 NORTH,	)
RANGE 58 WEST, 6TH P.M., WELD	)
COUNTY, COLORADO.	)

**SUMMARY OF RULE 511 WRITTEN TESTIMONY**

Whiting Oil and Gas Corporation ("Applicant"), by and through its attorneys, Welborn Sullivan Meck & Tooley, P.C., submits this written testimony and the accompanying Exhibits A, B and C to the Oil and Gas Conservation Commission of the State of Colorado ("Commission") in support of its application for an order amending Order No. 535-268, only insofar as it applies to the Application Lands described below, to (1) include the Carlile, Fort Hays, and Codell Formations, (2) allow for additional wells, and (3) allow for modified well setbacks in the existing 960-acre drilling and spacing unit and establishing well location rules applicable to the drilling of wells and producing of oil, gas and associated hydrocarbons from the Carlile, Fort Hays, Codell and Niobrara Formations covering the following lands in Weld County, Colorado ("Application Lands"):

**Township 11 North, Range 58 West, 6th P.M.**  
Section 25: S½  
Section 36: All

Based upon work supervised by Mr. Scott McDaniel, Applicant listed in Exhibit A to the Application in this matter the names and addresses of the interested parties and each of those parties was notified as indicated in the Certificate of Mailing filed in this matter. Mr. Scott McDaniel prepared the written land testimony, Exhibit A hereto. Mr. Mark K. Odegard prepared the written geologic testimony, Exhibit B hereto. Mr. Donald F. Koenig prepared the written engineering testimony, Exhibit C hereto. Copies of the affiants' respective resumes are included with their testimony.

Attached to Exhibit A is a map depicting the Application Lands, which also depicts certain lands in the vicinity of the Applications Lands.

As stated in the testimony, several wells have been drilled, tested and completed in the Niobrara and Codell Formations upon lands in the immediate vicinity of the Application Lands, and the Razor #12F-0101A well was completed in the Codell Formation on 960-acre spacing in Sections 1 and 12, Township 10 North, Range 58 West under Order No. 535-507.

The geologic testimony exhibits include: a type log which indicates the Niobrara, Fort Hays, Codell, and Carlile Formations are in contact with each other; a subsea structure map which shows the structural strike is generally Northwest-Southeast across the Application Lands; an isopach of the Niobrara, Fort Hays, Codell, and Carlile Formations in the vicinity of the lands included in this application; and a log cross section of the Niobrara, Fort Hays, Codell, and Carlile Formations showing the continuity of the Formations across the Application Lands.

The engineering exhibits set forth the engineering characteristics of the Niobrara, Fort Hays, Codell, and Carlile reservoirs intended to be drilled and produced by Applicant. Based on reservoir characteristics from certain 960-acre drilling and spacing units that are producing from the Niobrara and Codell Formations, the estimated drilling and completion economics for the Applicant's proposed spacing unit and increased well density would produce favorable economics for the proposed operations. Further, the exhibits support inter-well setbacks of 100 feet based on data from six analogous wells, and, based on four analogous wells, demonstrate that eight wells in a zone will have an estimated drainage area of 49 acres per well, for a total drainage area of less than 960 acres. Finally, the engineering testimony and exhibits describe Whiting's wellbore layout, alternating between producing the "A," "B," "C," benches of the Niobrara Formation, Fort Hays, Codell and Carlile zones. The increased well density is further supported by past testimony provided by Mr. Ralph Nelms in Docket 1309-SP-1149 showing the limited hydraulic fracture pressure communication and calculated short hydraulic fracture half-lengths in the Niobrara Formation.

Based upon this geologic and engineering information, Applicant believes that amending Order No. 535-268, only insofar as it applies to the Application Lands to (1) include the Carlile, Fort Hayes, and Codell Formations, (2) allow for additional wells, and (3) allow for modified well setbacks in the existing 960-acre drilling and spacing unit will result in economic wells with a favorable return on investment that will allow for efficient drainage and recovery of hydrocarbons from the Niobrara, Fort Hays, Codell, and Carlile Formations without causing waste or injuring correlative rights.

Dated this 22nd day of May, 2017

Respectfully submitted,

WHITING OIL AND GAS CORPORATION

By:

A handwritten signature in black ink, appearing to read 'JP', is written over a horizontal line.

Joseph C. Pierzchala  
Welborn Sullivan Meck & Tooley, P.C.  
Attorneys for Applicant  
1125 17th Street, Suite 2200  
Denver, CO 80202  
(303) 830-2500  
jpierzchala@wsmtlaw.com

<b>Exhibit A</b>	<b>Docket No. 170600334</b>
<b>WHITING OIL AND GAS CORPORATION</b>	<b>Land Testimony – Rule 511</b>
<b>Scott McDaniel</b>	<b>Weld County, Colorado</b>

**Township 11 North, Range 58 West, 6<sup>th</sup> P.M.**

**Section 25: S½**

**Section 36: All**

**Weld County, Colorado**

In support of the Request for Director Approval of the Verified Amended Application of Whiting Oil and Gas Corporation in Cause 535, Docket No. 170600334, and pursuant to Rule 511.b., Scott McDaniel, Regional Land Manager of Whiting Oil and Gas Corporation deposes and states as follows:

I am employed as a Regional Land Manager for Whiting Oil and Gas Corporation ("Whiting"). I have over 28 years of experience as a Landman and have been employed with Whiting since August of 2008 working directly with properties that are the subject of today's hearing.

In support of our Application today, I have prepared one (1) exhibit. The exhibit is attached to my sworn testimony and forms the basis for Whiting's Application to obtain an order to:

- 1) Amend Order 535-268 to include the Carlile, Fort Hays and Codell Formations and modify the well location rules applicable to the drilling of wells and producing of oil, gas and associated hydrocarbons from the Niobrara, Carlile, Fort Hays and Codell Formations in an existing 960-acre drilling and spacing unit previously established for the Niobrara Formation covering the S½ of Section 25 and all of Section 36, Township 11 North, Range 58 West, 6<sup>th</sup> P.M., Weld County, Colorado (the "Application Lands"); and
- 2) Approve up to a total of 32 horizontal wells within the 960-acre drilling and spacing unit comprised of the Application Lands, for the production of oil, gas and associated hydrocarbons from the Niobrara, Carlile, Fort Hays and Codell Formations; and
- 3) Require the productive interval of the wellbore of any permitted wells to be located no closer than 100 feet from the unit boundaries, and no closer than 100 feet from the productive interval of each wellbore be no closer than 100 feet from the treated interval of any other wellbore producing from the Niobrara, Carlile, Fort Hays and Codell Formations, and no closer than 100 feet from a unit boundary unless such boundary abuts or corners lands for which the Commission has not at the time of the drilling permit

application granted the right to locate the treated interval of the wellbore no closer than 100 feet from a unit boundary. If the Commission has not at the time of the drilling permit application granted to the owners of the adjacent or cornering lands the right to locate the treated interval of the wellbore no closer than 100 feet from a unit boundary, then the treated interval of the wellbore shall be located no closer than 300 feet from the unit boundary, without exception being granted by the Director.

Attached Exhibit "A-1" Whiting Leasehold, Existing Spacing Unit Boundaries,  
Proposed Spacing Unit Boundaries


The attached Exhibit "A-1" is a plat depicting the Application Lands and lands in the vicinity of the Application Lands which have previously had drilling and spacing orders approved by the COGCC for the Niobrara Formation under Order No. 535-268 issued February 11, 2013,. The plat covers an area generally centered 19 miles North and 2 miles East of the town of New Raymer, Colorado. The plat is color coded to show the previously approved COGCC drilling and spacing units, proposed COGCC drilling and spacing units and Whiting leasehold. The lands which are the subject of this application are shown inside the red boundary and are crosshatched in red. Whiting's leasehold is shown in yellow.

Several wells have been drilled, tested and completed in the Niobrara and Codell Formations upon lands in the immediate vicinity of the Application Lands, and the Razor #12F-0101A well was completed in the Codell Formation on 960-acre spacing in Sections 1 and 12, Township 10 North, Range 58 West under Order No. 535-507. Therefore, Whiting believes amending Order 535-268 to include the Carlile, Fort Hays and Codell Formations and modify the well location rules applicable to the drilling of wells and producing of oil, gas and associated hydrocarbons from the Niobrara, Carlile, Fort Hays and Codell Formations will allow development of the Niobrara, Carlile, Fort Hays and Codell Formations to occur, will not promote waste, will not violate correlative rights and will assure the greatest ultimate recovery of oil, gas and associated hydrocarbon substances from the reservoir.

Based upon our examination of relevant records, and under my direction and control, all of the unleased mineral interest owners and mineral lessees within the Application Lands and lands which are contiguous or corner to the Application Lands have received notice of this Application.

To the best of my knowledge and belief, all of the matters set forth herein, my testimony and in the exhibits are true, correct and accurate.

Dated this 19th day of May, 2017

  
\_\_\_\_\_  
Scott McDaniel



Regional Land Manager


STATE OF COLORADO                    )  
  ) ss  
CITY AND COUNTY OF DENVER        )

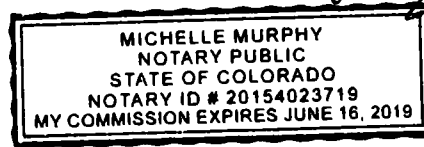
I, the undersigned Notary Public in and for said County in said State, hereby certify that Scott McDaniel, whose name as Regional Land Manager of Whiting Oil and Gas Corporation, is signed to the foregoing instrument and who is known to me, acknowledged before me on this day that, being informed of the contents of the instrument, executed the same voluntarily for and as the act of said corporation.

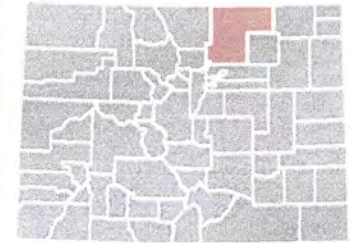
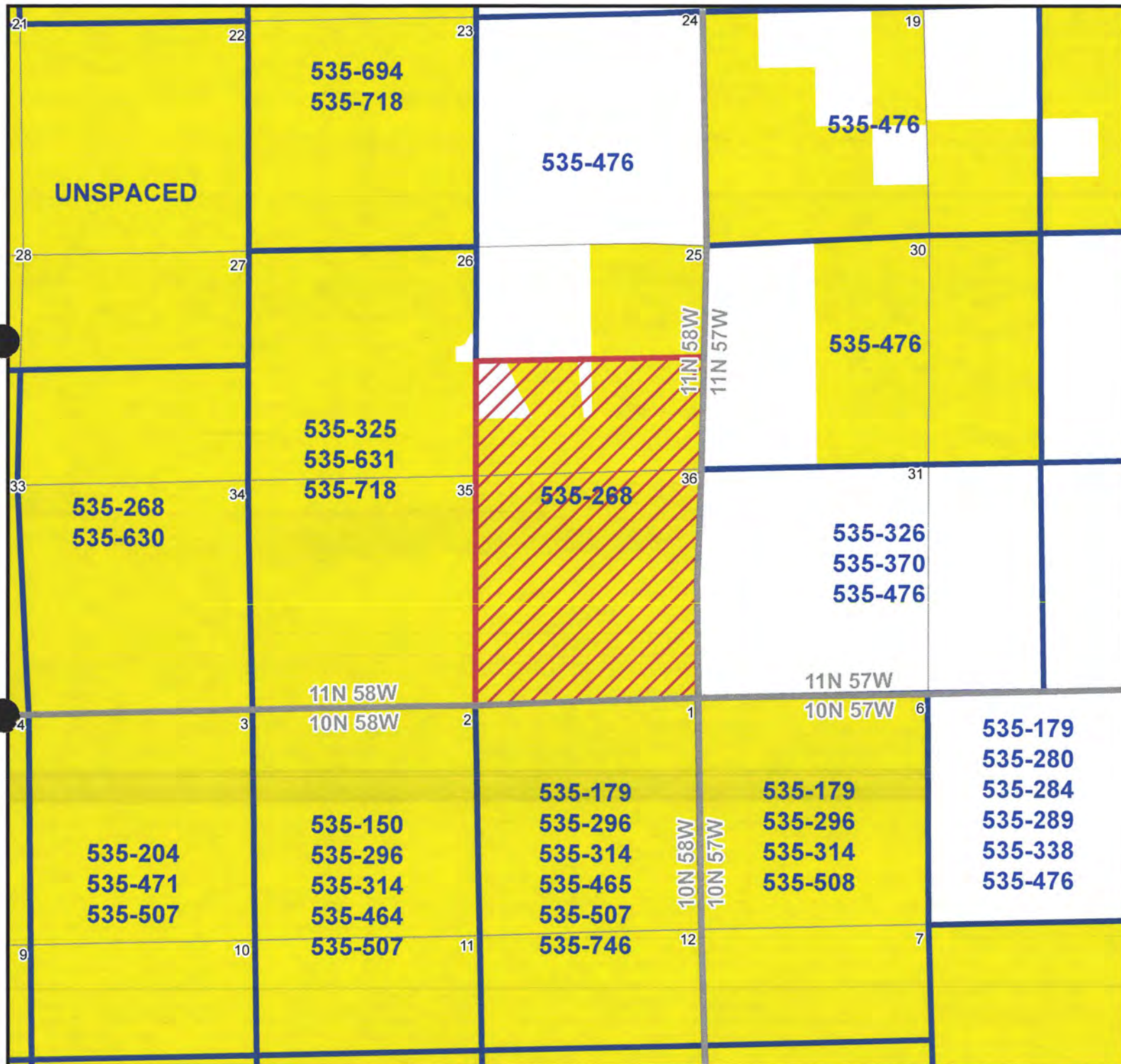
Subscribed and sworn to before me this 19<sup>th</sup> day of May, 2017.

Witness my hand and official seal

My commission expires 6/16/2019

  
Notary Public





**Exhibit "A-1"**  
Weld County, Colorado

- Application Lands
- Existing Spacing Units

---

## **EXPERIENCE**

---

### **Regional Land Manager**

August 11, 2008 to Present

Whiting Oil and Gas Corporation

Confirm land ownership and availability for lease/purchase. Negotiate agreements with land owners for drilling or production rights. Draft and administer contracts including, but not limited to, Joint Operating Agreements, Purchase and Sale Agreements, and Unit Agreements; ensure compliance with government regulations. Lead and direct the work of support staff.

### **Project Manager**

2002 to August 1, 2008

Contex Energy Company, Denver, CO

Managed numerous lease acquisition projects for a large lease brokerage firm. I was responsible for managing field personnel, reporting progress to the client, building lease and mineral purchase files, preparing assignments and other legal documents, due diligence reviews and title curative.

### **Oil and Gas Landman**

1999 to 2001

The Meramar Company, Littleton, CO

Managed small lease and right-of-way acquisition projects throughout the Rocky Mountain Region. My responsibilities included title research, lease and right-of-way acquisition, map preparation, lease file management and due diligence reviews.

### **Land Manager**

1997 to 1998

Petrogulf Corporation, Denver, CO

Managed land and lease acquisitions for a very aggressive oil and gas operator in the Rocky Mountain Region. My job description included managing field brokers, coordinating the acquisition of mineral interests and oil and gas leases within a prospect area, working with engineers and geologist on a prospect development basis, and managing lease records.

### **Oil and Gas Landman**

1996 to 1997

Tom Noonan, Gillette, WY

Contract Landman for a Lease Broker in the Powder River Basin. I performed detailed ownership searches and reports in a highly productive coalbed methane play, calculated net revenue interests and purchased oil and gas leases.

### **Oil and Gas Landman and Project Manager**

1994 to 1996

The Meramar Company, Denver, CO

Performed oil and gas lease acquisitions for a small Lease Broker in the Rocky Mountain Region. Managed several small lease acquisition projects in central Kansas and Northwestern Colorado. I performed patent to present grantee/grantor ownership checks and prepared lease status reports for the clients.

### **Commercial Title Examiner**

1991 to 1994

Title Services, Inc., Denver, CO

Prepared title reviews and commitments on commercial property for a large title insurance company. Managed the commercial title department for two years and trained support staff.

### **Oil and Gas Landman**

1983 to 1991

Frontier Land and Exploration, Lakewood, CO

Worked for a large lease brokerage firm managed and owned by my father, John T. McDaniel. Performed ownership and leasehold checks in Southeastern and Southwestern Colorado. Negotiated and purchased oil and gas leases.

## **EDUCATION**

---

### **Red Rocks Community College, 1982 to 1983**

Golden, CO

Computer Science/Geology GPA: 3.3

Worked towards an Associate of Science Degree in Computer Science with some advanced studies in Geology.

Learned programming in COBOL, FORTRAN, BASIC and RPGII languages. Ran out of money and had to enter the work force before completing my degree

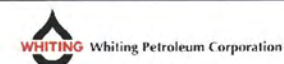
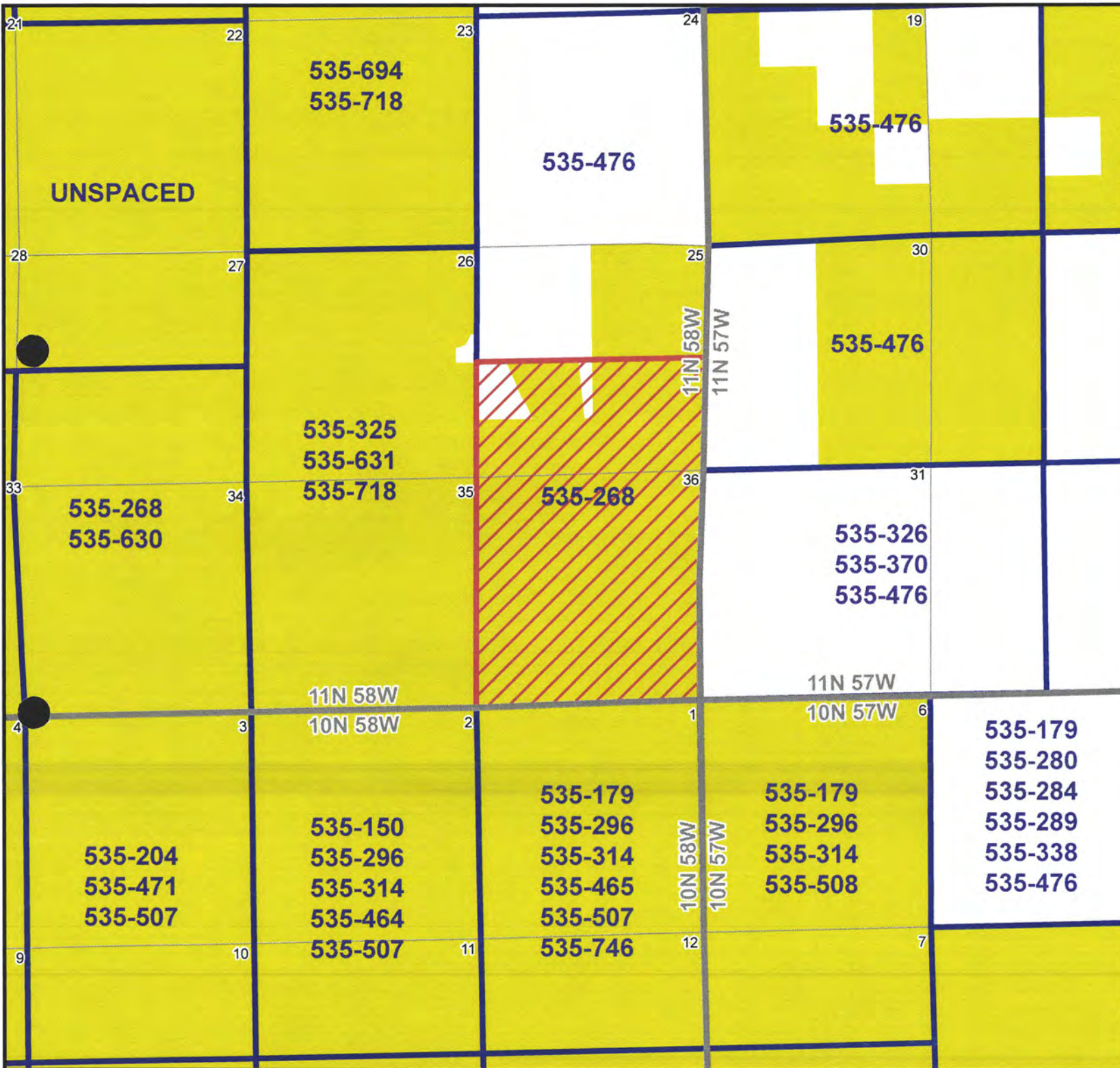
### **Arapahoe Community College and University of Colorado at Denver, 1981 to 1982**

Littleton, CO and Denver, CO

Business GPA: 3.0

Worked on my basic studies with a focus on accounting and geology. Decided to transfer to Red Rocks Community College to focus more on Computer Science.





**Exhibit "A-1"**  
Weld County, Colorado

- Application Lands
- Existing Spacing Units

<p align="center"><b>Exhibit B</b></p> <p align="center"><b>WHITING OIL AND GAS CORPORATION</b></p> <p align="center"><b>Samuel Z. Scott</b></p>	<p align="center"><b>Docket No. 170600334</b></p> <p align="center"><b>Geologic Testimony – Cause 535</b></p> <p align="center"><b>Weld County, Colorado</b></p>
--	--

My name is Samuel Z. Scott. I am currently employed as a Senior Geologist with Whiting Oil and Gas Corporation. I have over 10 years' experience in petroleum exploration and I am familiar with the geologic characteristics on the Applications Lands, and the matters set forth in the **Docket 170600334** application. A copy of my resume is contained in the exhibit booklet submitted by Whiting.

In support of Whiting's Application in the above referenced docket, I have prepared and am submitting four (4) exhibits. The exhibits are attached to my sworn testimony and form the basis for Whiting's application requesting to:

1. Amend Order No. 535-268, insofar as it applies to the Application Lands, to (1) include the Carlile, Fort Hays, and Codell Formations in the existing drilling and spacing unit in order to efficiently and economically recover oil, gas and associated hydrocarbons from the Carlile, Fort Hays, Codell and Niobrara Formations in the proposed unit and (2) allow an additional twenty-eight wells, for a total of up to 32 wells within the unit in order to efficiently and economically recover oil, gas and associated hydrocarbons from the Carlile, Fort Hays, Codell and Niobrara Formations.

2. Applicant requests the surface location for each proposed horizontal well be located at a legal location in the above-described drilling and spacing units or on adjacent lands. Applicant further requests that the 150 foot distance between treated intervals of each wellbore established in Order No. 535-268 be amended and that the new setback be no closer than 100 feet from the treated interval of any other wellbore producing from the Carlile, Fort Hays, Codell and/or Niobrara Formations, and no closer than 100 feet from a unit boundary unless such boundary abuts or corners lands for which the Commission has not at the time of the drilling permit application granted the right to locate the treated interval of the wellbore no closer than 100 feet from a unit boundary. If the Commission has not at the time of the drilling permit application granted to owners of adjacent or cornering lands the right to locate the treated interval of the wellbore no closer than 100 feet from a unit boundary, then the treated interval of the wellbore shall be located no closer than 300 feet, or the distance permitted in the adjacent or cornering lands, whichever is less, without exception being granted by the Director.

3. Applicant further requests that the wells are drilled from no more than four (4) well pads within the unit.

4. Applicant requests authority to drill only those wells necessary to determine the well density which allows the most efficient drainage of the Carlile, Fort Hays, Codell and Niobrara Formations, prevents waste, does not adversely affect correlative rights, and assures the greatest ultimate recovery of oil, gas and associated hydrocarbon substances from the Carlile, Fort Hays, Codell and Niobrara Formations. The proposed drilling and spacing unit is not smaller than the maximum area that can be economically and efficiently drained by the authorized wells in such drilling and spacing unit. Applicant further maintains that a well drilled in the above-proposed drilling and spacing units will have no adverse effect on correlative rights of adjacent owners.

**Exhibit B-1: TYPE LOG** The Niobrara Formation is a late Turonian (89 Ma) to early Campanian (82 Ma) age formation that was deposited during a marine transgression of the Western Interior Cretaceous seaway. It is comprised of three distinct members, the Fort Hays, which is often referred to as the "D"

or Lower Chalk, the Smoky Hill, which is comprised of the Niobrara "B" and "C" Chalks and the Beecher Island, which is more commonly known as the "A" Chalk. These members consist of chalk interbedded with silty marlstone laminations. The Niobrara overlies the Codell Formation, which is a fine-grained marine sandstone deposited during a relative low-stand in the Cretaceous seaway. Below the Codell formation the Carlile which consists of a similar lithology to the Codell but with a lower amount of net sand relative to silt and detrital clay. The Carlile formation appears to be hydraulically coupled with the Codell and therefore may contribute minor production to wells completed in the Codell.

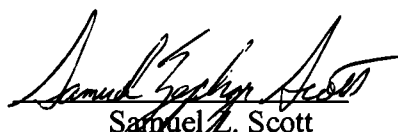
**Exhibit B-2: SUBSEA STRUCTURE MAP-** The asymmetric shape of the Denver Basin is evident in the true vertical structure map on top of the Niobrara. The structural strike is locally oriented NW-SE across the application lands, with an average elevation at the top of the Niobrara of -700 feet below sea level.

**Exhibit B-3: GROSS ISOPACH MAP** This exhibit represents the gross isopach thickness from the top of the Niobrara formation through the base of the Codell. Across the application lands, the average thickness is 360 feet.

**Exhibit B-4: CROSS SECTION-** This cross section represents the vertical distribution of chalk benches within the Niobrara, commonly referred to as the A, B & C chalks as well as the Fort Hays member of the Niobrara and the Codell/Carlile. The datum for the cross section is the top of the Niobrara. The Niobrara and Codell/Carlile formations are ubiquitous across the application lands and share a common source of supply. The log curves represented on the cross section include spontaneous potential (SP), gamma ray (GR) and deep resistivity (ILD).

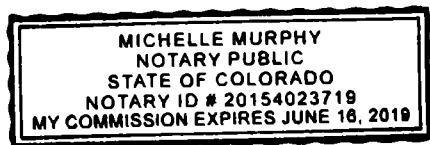
Based upon geologic information available the proposed drilling and spacing units will allow efficient drainage of the Niobrara and Codell/Carlile Formations, will prevent waste, will not adversely affect correlative rights and will assure the greatest ultimate recovery of gas and associated hydrocarbons.

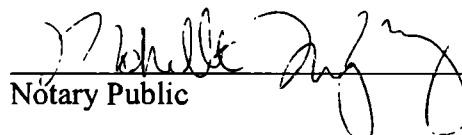
Geology Exhibits B-1, B-2, B-3, and B-4 were prepared by me and to the best of my knowledge; all of the matters set forth are true, correct, and accurate.

  
Samuel Z. Scott  
Senior Geologist

BEFORE ME, the undersigned, on this day personally appeared Mr. Samuel Z. Scott in his capacity as a Senior Geologist for Whiting Petroleum Corporation and its wholly owned subsidiary Whiting Oil and Gas Corporation.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this 19<sup>th</sup> day of May 2017.



  
Notary Public

My Commission Expires 6/18/2019

Sam.Scott@whiting.com

(817) 304-4516  
2629 W 35<sup>th</sup> Ave ,Denver, CO 80211

## **WORK EXPERIENCE**

- Senior Geologist** **03/2017-Present**  
**Whiting Petroleum Corp.-Central Rockies Team** **Denver, CO**  
\*Lead geologist for development of Whiting's Redtail Assets.  
\*Generator of new exploration opportunities in the greater DJ Basin
- Senior Geologist** **01/2014-03/2017**  
**Whiting Petroleum Corp.-Northern Rockies Team** **Denver, CO**  
\*Lead geologist for Whiting's Sanish Bakken/Three Forks Asset.  
\*Developed Section-Based Mapping method for evaluation of irregular geometries associated with horizontal wells.  
\*Delineated Exploration Prospects in the Madison Misson Canyon Fm.
- Senior Geologist** **2/2012-01/2014**  
**Whiting Petroleum Corp.-Gulf Coast Team** **Denver, CO**  
\*Lead geologist working on emerging exploration play in the Brown Dense of Northern Louisiana. Worked closely with team members on all aspects of well selection, data gathering, analysis, permitting, and execution.  
\*Responsible for steering exploration horizontal well in zone using real time data.  
\*Presented to outside companies once a decision was made to exit the play and sell.
- Senior Geologist** **12/2011-02/2012**  
**Occidental Petroleum, Inc.-CA Growth Team** **Bakersfield, CA**  
\* Lead geologist on specialized team focused on unlocking the Monterey Shale oil resource play. Worked closely with completions engineers, reservoir engineers, and petrophysicists to develop completion strategy for nanodarcy permeability rock.  
\*Construct basin scale Petrel models for mapping of TOC, maturity, and overpressure.  
\*Plan, supervise, and execute drilling of deep wells targeting generating shales.  
\*Develop workflows to better constrain mechanical stratigraphy and stress state.
- Senior Geologist** **07/2010-12/2011**  
**Occidental of Elk Hills-Shale Asset Team** **Bakersfield, CA**  
\*Lead Geologist for OXY's 29R Structure. AFE'd and supervised drilling of 25 new shale wells. Designed and supervised drilling and stimulation of 1st horizontal shale completion in OXY's Kern County discovery area.  
\*Updated STOOIP Petrel models for 29R and 14Z areas. Mentored junior geologists.  
\*Part of multidisciplinary team supervising outsourced dual perm simulation.
- Senior Geologist** **01/2010-07/2010**  
**Occidental of Elk Hills-Gunslinger RMT** **Bakersfield, CA**



- \*Built Petrel model for OXY's Kern County discovery. Worked closely with reservoir simulators for STOOIP estimation and forecasting.
- \*Generate AFEs and new drilling locations.

**Staff Geologist** **04/2007-12/2009**  
**Occidental Permian- South RMT** **Houston, TX**

- \*Construct STOOIP Petrel Models for OXY Permian in San Andres, Grayburg and Wolfcamp assets (CRCU, Rhodes Cowden, NCU, South Cowden).
- \* Mentor junior geologists.
- \*Initiate and supervised core description and building of sequence stratigraphic framework for OXY's North Cowden Grayburg field.

**Geoscience Intern** **05/2006-08/2006**  
**OXY Permian-Integrated Reservoir Management** **Houston, TX**

- \*Constructed full-field porosity model for the Fullerton San Andres Unit using PETREL. Calculated permeability from transforms, oil saturations, and STOOIP.

**Research Assistant** **01/2005-04/2006**  
**Bureau of Economic Geology-RCRL** **Austin, TX**

- \*Measured section and mapped throughout study area in Last Chance Canyon, NM.
- \*Acquired ground based LIDAR, transferred field mapping, and modeled clinoforms.

**TA (teaching assistant)** **08/2004-12/2004**  
**University of Texas at Austin** **Austin, TX**

- \*Instructed introductory level paleontology labs. Grade exams and coursework.

**Geotech** **02/2004-06/2004**  
**Approach Resources, Inc.** **Fort Worth, TX**

- \*Imported digital logs, reservoir pressure tests and calibrated and straightened raster logs. Performed basic log quality control in the field, and prepared cross sections.

**Open-Hole Wireline Logging Engineer** **06/2001-02/2003**  
**Halliburton Energy Services** **Bakersfield, CA**

- \*Gained operational and theoretical knowledge of wireline tools. Performed log quality control for a major client.

## **EDUCATION**

***The University of Texas Jackson School of Geosciences*** ***Austin, TX***  
***M.S. Geological Sciences*** ***2004-2007***  
***Advisor: Dr. Charles Kerans*** ***G.P.A.-3.78***

***The Colorado College*** ***Colorado Springs, CO***  
***B.A Geology*** ***1997-2001***  
***Advisor: Dr. Paul Myrow*** ***G.P.A.-3.14***

**Halliburton Fort Worth Learning Center**  
**Basic L & P Field Engineer I**

**Fort Worth, TX**  
**08/2001-11/2001**

**THESIS TOPIC** - Along-Strike Variability of Clinothems in a Mixed Carbonate Siliciclastic Ramp Setting: Last Chance Canyon, NM

**SKILLS AND PROFICIENCIES**

- \*Software: Petra, Geographix, Powerlog, Interactive Petrophysics, Openworks, Petrel, GOCAD, basic UNIX proficiency, Lowis, DSS, OFM and Microsoft Office suite.
- \*Specialized: Petrel expert, Carbonate Petrographic Techniques, Outcrop field work
- \*Operations: Wireline log interpretation and environmental tool response.
- \*Language: Conversational Spanish language skill.
- \*Interpersonal/Communication: Effective speaker and writer.

**PROFESSIONAL AFFILIATIONS**

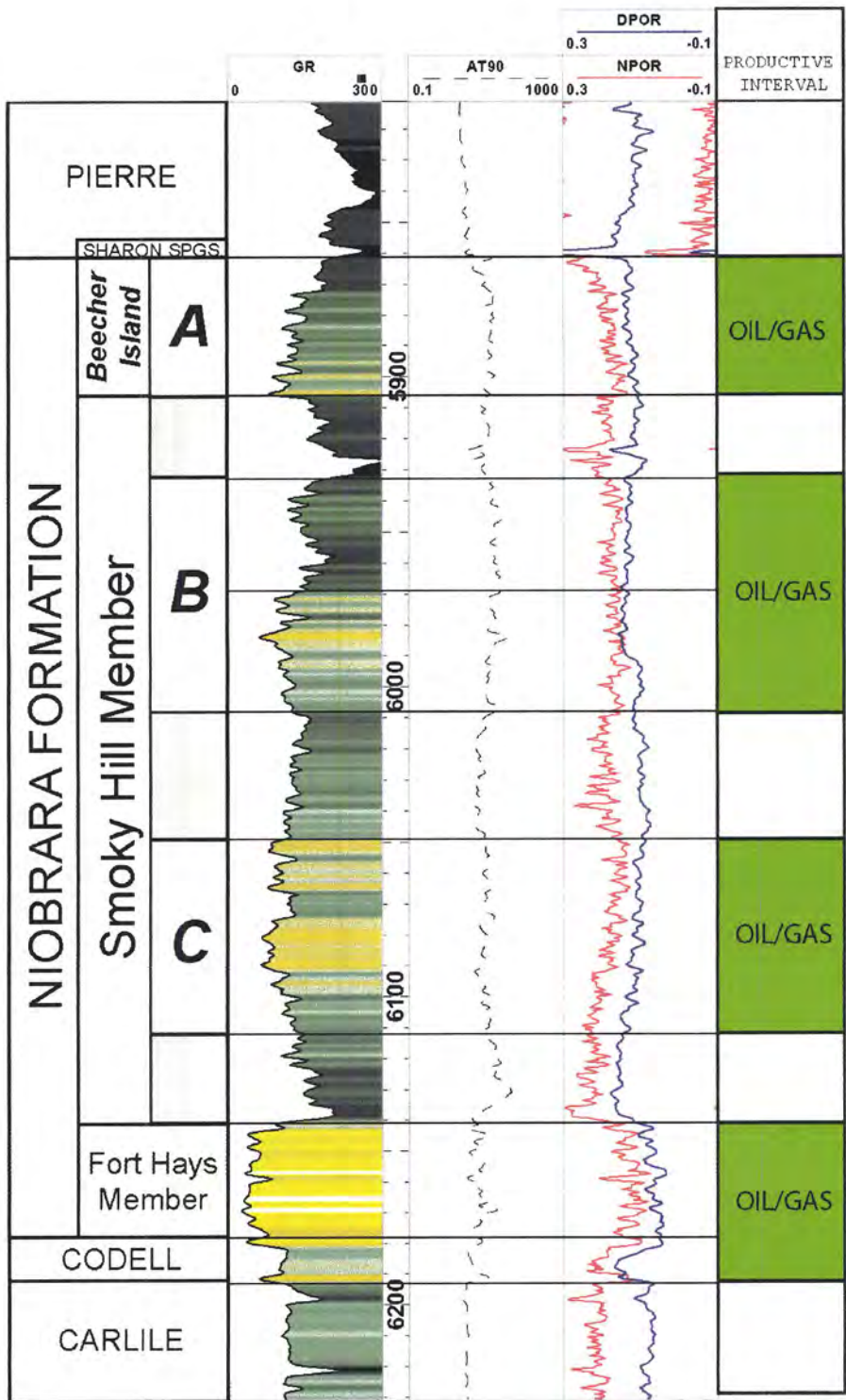
- \*AAPG, SEPM, GSA, RMAG

**PUBLICATIONS AND PRESENTATIONS**

- \*RMAG Hot Plays Forum 2015- 20 minute oral presentation
- \*RMAG Hot Plays Core Workshop – ½ day workshop
- \*OXY CA Shale Forum 2012—30 minute oral presentation
- \*WTGS annual meeting 2009—30 minute oral presentation
- \*OXY West Texas Carbonate Field Trip 2007, 2008, and 2009-Co-Leader
- \*RCRL annual meeting 2007—30 minute oral
- \*RCRL annual meeting 2005—30 minute oral
- \*RCRL field trip 2005—Led day of field trip in thesis area
- \*AAPG annual meeting 2005—Morning Poster Session
- \*Occidental Intern Presentation 2006—3 presentations to diverse audiences
- \*WTGS annual meeting 2006—30 minute oral presentation

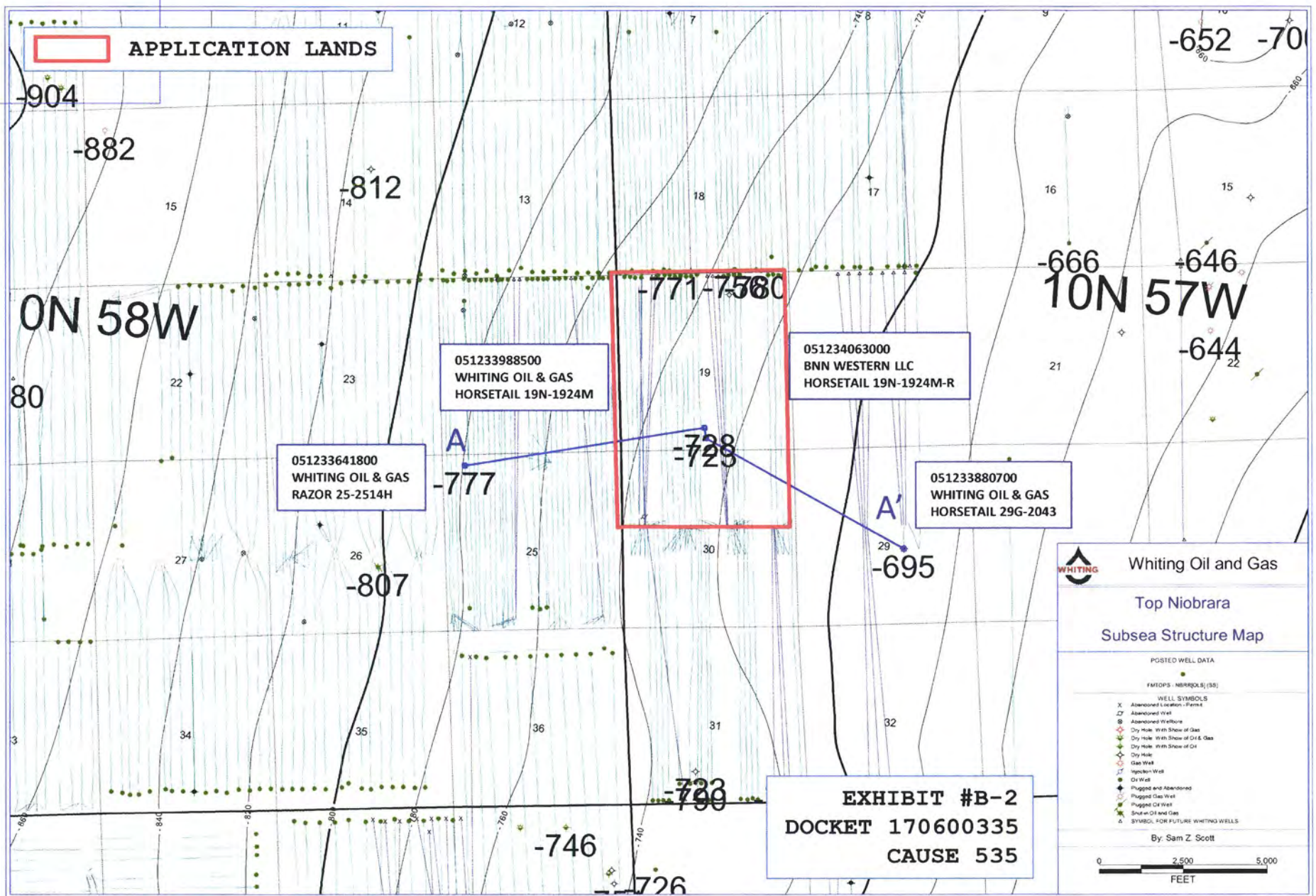
051233249100  
 WHITING OIL & GAS CORP.  
**TERRACE 36-32M**  
 T10N R59W S36

KB : 4,905  
 TD : 6,928

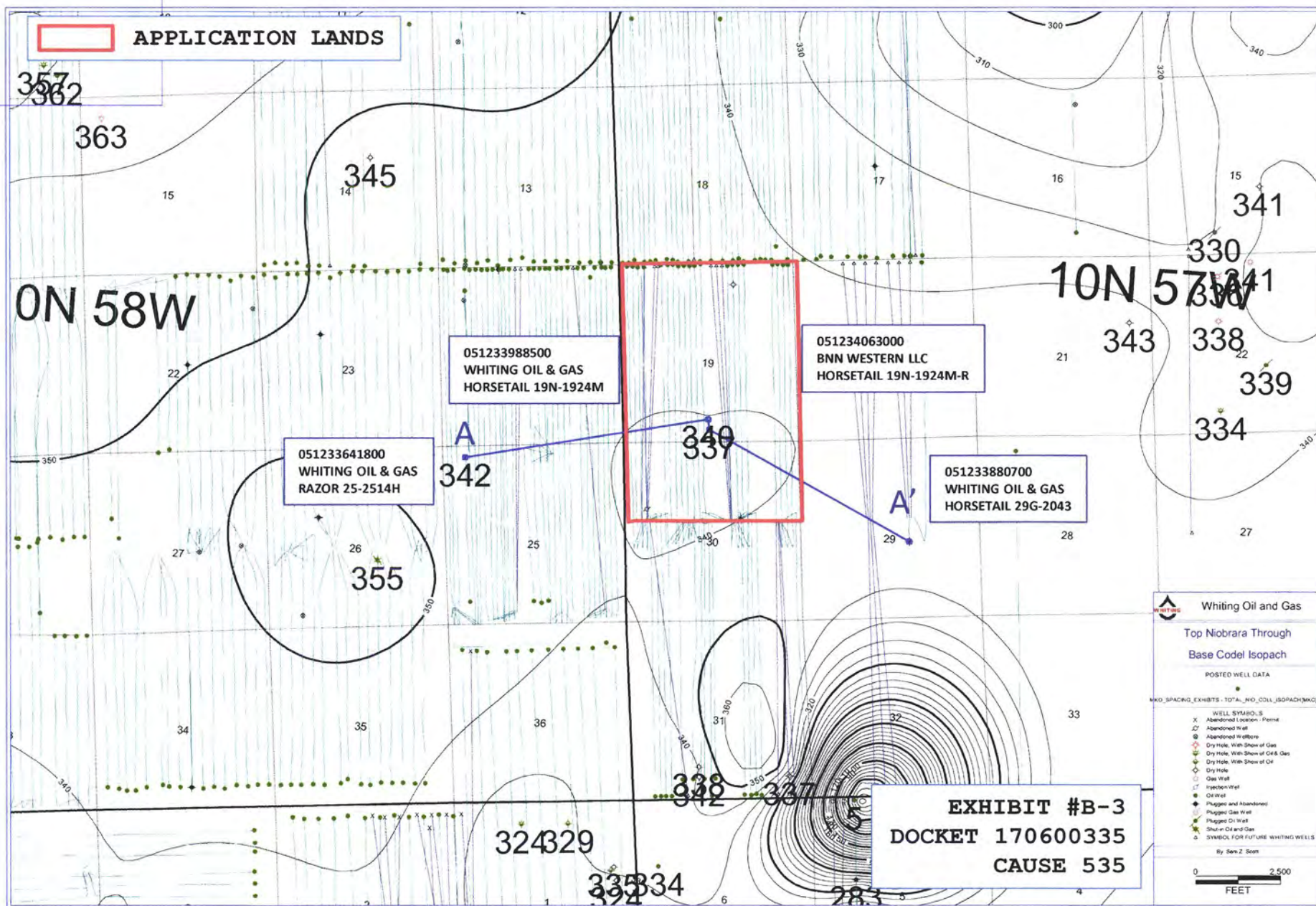


170600335

EXHIBIT #B-1  
 DOCKET 170600335  
 CAUSE 535



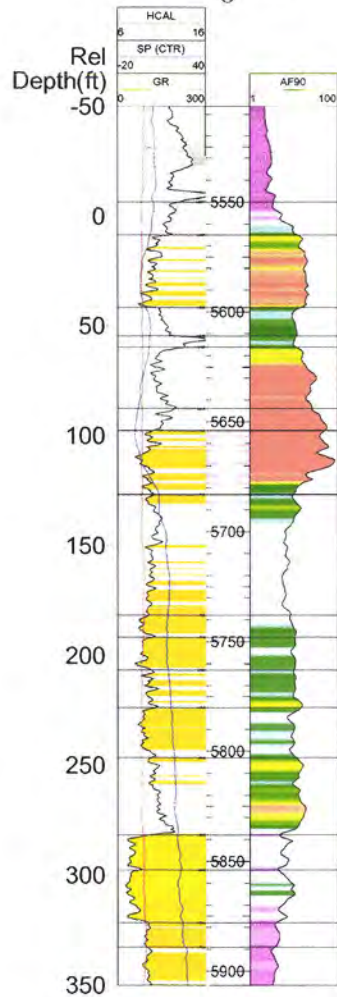




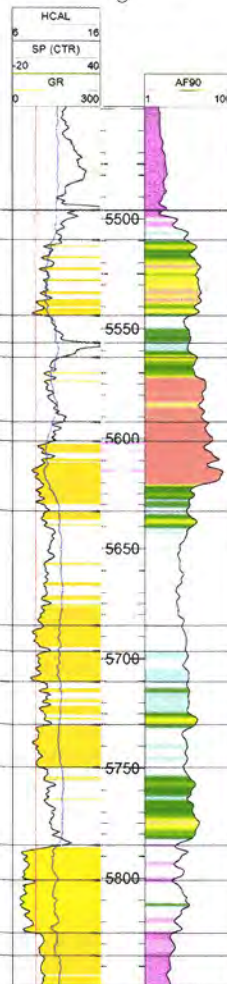


A

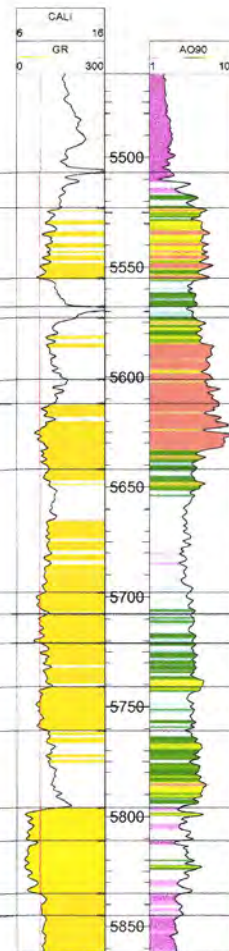
051233641800  
WHITING OIL & GAS  
RAZOR 25-2514H  
T10N R58W S25



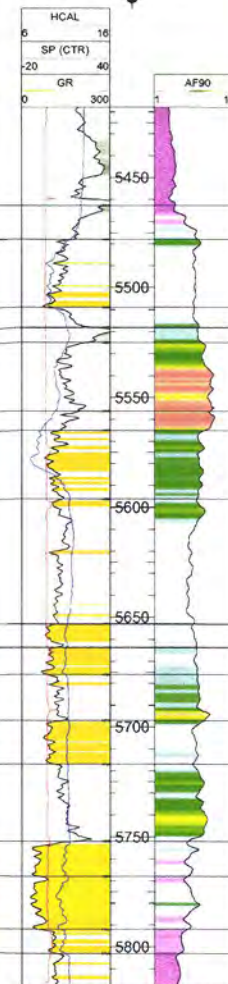
051233988500  
WOGC  
HORSETAIL 19N-1924M  
T10N R57W S19



051234063000  
BNN WESTERN LLC  
HORSETAIL 19N-1924M-R  
T10N R57W S19

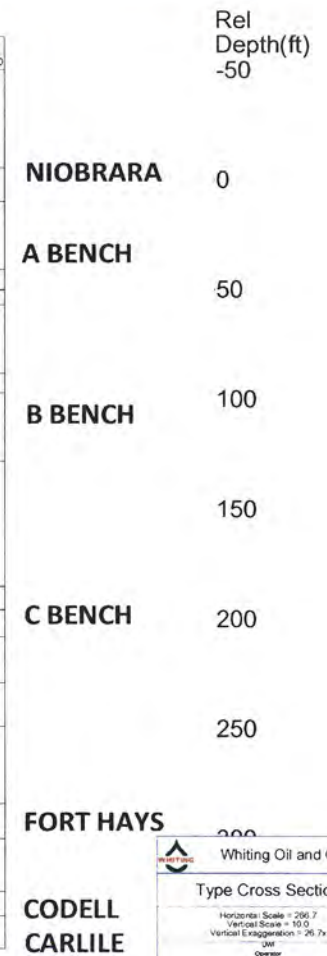


051233880700  
WOGC  
HORSETAIL 29G-2043  
T10N R57W S29



A'

**EXHIBIT #B-4**  
**DOCKET 170600335**  
**CAUSE 535**



Sam.Scott@whiting.com

(817) 304-4516  
2629 W 35<sup>th</sup> Ave ,Denver, CO 80211

## **WORK EXPERIENCE**

**Senior Geologist** **03/2017-Present**  
**Whiting Petroleum Corp.-Central Rockies Team** **Denver, CO**

- \*Lead geologist for development of Whiting's Redtail Assets.
- \*Generator of new exploration opportunities in the greater DJ Basin

**Senior Geologist** **01/2014-03/2017**  
**Whiting Petroleum Corp.-Northern Rockies Team** **Denver, CO**

- \*Lead geologist for Whiting's Sanish Bakken/Three Forks Asset.
- \*Developed Section-Based Mapping method for evaluation of irregular geometries associated with horizontal wells.
- \*Delineated Exploration Prospects in the Madison Mission Canyon Fm.

**Senior Geologist** **2/2012-01/2014**  
**Whiting Petroleum Corp.-Gulf Coast Team** **Denver, CO**

- \*Lead geologist working on emerging exploration play in the Brown Dense of Northern Louisiana. Worked closely with team members on all aspects of well selection, data gathering, analysis, permitting, and execution.
- \*Responsible for steering exploration horizontal well in zone using real time data.
- \*Presented to outside companies once a decision was made to exit the play and sell.

**Senior Geologist** **12/2011-02/2012**  
**Occidental Petroleum, Inc.-CA Growth Team** **Bakersfield, CA**

- \* Lead geologist on specialized team focused on unlocking the Monterey Shale oil resource play. Worked closely with completions engineers, reservoir engineers, and petrophysicists to develop completion strategy for nanodarcy permeability rock.
- \*Construct basin scale Petrel models for mapping of TOC, maturity, and overpressure.
- \*Plan, supervise, and execute drilling of deep wells targeting generating shales.
- \*Develop workflows to better constrain mechanical stratigraphy and stress state.

**Senior Geologist** **07/2010-12/2011**  
**Occidental of Elk Hills-Shale Asset Team** **Bakersfield, CA**

- \*Lead Geologist for OXY's 29R Structure. AFE'd and supervised drilling of 25 new shale wells. Designed and supervised drilling and stimulation of 1st horizontal shale completion in OXY's Kern County discovery area.
- \*Updated STOOIP Petrel models for 29R and 14Z areas. Mentored junior geologists.
- \*Part of multidisciplinary team supervising outsourced dual perm simulation.

**Senior Geologist** **01/2010-07/2010**  
**Occidental of Elk Hills-Gunslinger RMT** **Bakersfield, CA**

- \*Built Petrel model for OXY's Kern County discovery. Worked closely with reservoir simulators for STOOIP estimation and forecasting.
- \*Generate AFEs and new drilling locations.

**Staff Geologist** **04/2007-12/2009**  
**Occidental Permian- South RMT** **Houston, TX**

- \*Construct STOOIP Petrel Models for OXY Permian in San Andres, Grayburg and Wolfcamp assets (CRCU, Rhodes Cowden, NCU, South Cowden).
- \* Mentor junior geologists.
- \*Initiate and supervised core description and building of sequence stratigraphic framework for OXY's North Cowden Grayburg field.

**Geoscience Intern** **05/2006-08/2006**  
**OXY Permian-Integrated Reservoir Management** **Houston, TX**

- \*Constructed full-field porosity model for the Fullerton San Andres Unit using PETREL. Calculated permeability from transforms, oil saturations, and STOOIP.

**Research Assistant** **01/2005-04/2006**  
**Bureau of Economic Geology-RCRL** **Austin, TX**

- \*Measured section and mapped throughout study area in Last Chance Canyon, NM.
- \*Acquired ground based LIDAR, transferred field mapping, and modeled clinoforms.

**TA (teaching assistant)** **08/2004-12/2004**  
**University of Texas at Austin** **Austin, TX**

- \*Instructed introductory level paleontology labs. Grade exams and coursework.

**Geotech** **02/2004-06/2004**  
**Approach Resources, Inc.** **Fort Worth, TX**

- \*Imported digital logs, reservoir pressure tests and calibrated and straightened raster logs. Performed basic log quality control in the field, and prepared cross sections.

**Open-Hole Wireline Logging Engineer** **06/2001-02/2003**  
**Halliburton Energy Services** **Bakersfield, CA**

- \*Gained operational and theoretical knowledge of wireline tools. Performed log quality control for a major client.

## **EDUCATION**

***The University of Texas Jackson School of Geosciences*** ***Austin, TX***  
***M.S. Geological Sciences*** ***2004-2007***  
***Advisor: Dr. Charles Kerans*** ***G.P.A.-3.78***

***The Colorado College*** ***Colorado Springs, CO***  
***B.A. Geology*** ***1997-2001***  
***Advisor: Dr. Paul Myrow*** ***G.P.A.-3.14***



**Halliburton Fort Worth Learning Center**  
**Basic L & P Field Engineer I**

**Fort Worth, TX**  
**08/2001-11/2001**

**THESIS TOPIC** - Along-Strike Variability of Clinothemms in a Mixed Carbonate Siliciclastic Ramp Setting: Last Chance Canyon, NM

**SKILLS AND PROFICIENCIES**

- \*Software: Petra, Geographix, Powerlog, Interactive Petrophysics, Openworks, Petrel, GOCAD, basic UNIX proficiency, Lowis, DSS, OFM and Microsoft Office suite.
- \*Specialized: Petrel expert, Carbonate Petrographic Techniques, Outcrop field work
- \*Operations: Wireline log interpretation and environmental tool response.
- \*Language: Conversational Spanish language skill.
- \*Interpersonal/Communication: Effective speaker and writer.

**PROFESSIONAL AFFILIATIONS**

- \*AAPG, SEPM, GSA, RMAG

**PUBLICATIONS AND PRESENTATIONS**

- \*RMAG Hot Plays Forum 2015- 20 minute oral presentation
- \*RMAG Hot Plays Core Workshop – ½ day workshop
- \*OXY CA Shale Forum 2012—30 minute oral presentation
- \*WTGS annual meeting 2009—30 minute oral presentation
- \*OXY West Texas Carbonate Field Trip 2007, 2008, and 2009-Co-Leader
- \*RCRL annual meeting 2007—30 minute oral
- \*RCRL annual meeting 2005—30 minute oral
- \*RCRL field trip 2005—Led day of field trip in thesis area
- \*AAPG annual meeting 2005—Morning Poster Session
- \*Occidental Intern Presentation 2006—3 presentations to diverse audiences
- \*WTGS annual meeting 2006—30 minute oral presentation

<p align="center"><b>Exhibit C</b></p> <p align="center"><b>WHITING OIL AND GAS CORPORATION</b></p> <p align="center"><b>Donald F. Koenig</b></p>	<p align="center"><b>Docket No. 170600334</b></p> <p align="center"><b>Engineering Testimony – Rule 511</b></p> <p align="center"><b>Weld County, Colorado</b></p>
---	--

## ENGINEERING TESTIMONY

Township 11 North, Range 58 West, 6th P.M.

Section 25: S½

Section 36: All

My name is Donald F. Koenig. I am currently employed as a Reservoir Engineering Manager with Whiting Oil and Gas Corporation ("Whiting"). I have over 19 years of experience in reservoir engineering and am familiar with the reservoir engineering characteristics on the lands addressed in this testimony, and the matters set forth in Docket 170600334. A copy of my resume is attached to this testimony.

In support of Whiting's application (the "Application") in the above referenced docket, I have prepared and am submitting E-1 through E-8. The exhibits are attached to my sworn testimony and form the basis for Whiting's Application to gain approval to drill and complete on increased well density up to 32 wells in the requested 960-acre drilling and spacing unit for the Niobrara and Codell Formations covering the following lands ("Application Lands"):

Township 11 North, Range 58 West, 6th P.M.

Section 25: S½

Section 36: All

Exhibit E-1a presents the Niobrara/Codell/Fort Hayes formation reservoir characteristics and a volumetric calculation showing the estimated oil recovery from increased density wells drilled on 960-acre spacing on the Application Lands. I have broken out the Niobrara "A", "B", "C" and Fort Hays/Codell zone characteristics. There is an estimated 74 MMBO in this 960 acre spacing unit, of which Whiting hopes to recover up to 12% of the oil in place.

Exhibit E-2a presents the calculated drainage areas and estimates the drainage width for three analogous Niobrara wells located in Township 10 North- Range 58 West and one analogous wells in Township 10 North- Range 59 West. The average drainage for these four wells of various lateral lengths is 49 acres with a corresponding drainage width of 216 ft. The wells produce from the Niobrara "A" and Niobrara "B". Production is similar from Codell/Fort Hayes and Niobrara "C" wells located just to the East of these wells.

Exhibit E-2b demonstrates the economics for the same four analogous Niobrara wells. With a Rate of Return ("ROR") around 5%, Return on Investment ("ROI") of 0.89

and average payout of 8.42 years, the area has been barely economic. The economics were run at a 50 \$/BBL oil price when the average price was higher through the initial production of these wells.

Exhibit E-3 analyzes the economics for an average well in a 960-acre spacing unit with up to 32 wells. Again the economics are good for a 50 \$/BBL price with a ROR of 35% and ROI of 1.97. The Estimated Ultimate Recovery ("EUR") for this case was derived from the EUR calculated on Exhibit E-1 using an average 12% recovery factor on the four zones in the Niobrara and Fort Hays/Codell.

Exhibits E-4 contains the decline curves for four analogous Niobrara wells in Exhibit E-2a and b.

Exhibit E-5 contains the results from RTA analysis for six horizontal Niobrara wells. Rate Transient Analysis demonstrates an estimated frac half-length of 84 feet and only 19 microdarcies of permeability. The hydraulic fracture half-length calculated from rate transient analyses, together with downhole pressure data from offset wells indicates that less than a 100 foot setback is sufficient. According to our findings, some waste is inevitable with 100 foot setbacks, but it is less than that created by the state-wide 600 foot setback.

Exhibit E-6 represents a half spacing unit depiction of the wellbore layout for these spacing units with Whiting alternating between producing the "A," "B," "C," and Fort Hays Codell zones. Whiting believes that each of the four zones will act as separate reservoirs. Due to Bentonites and other low permeability areas located between the zones in the Niobrara, the fracs do not grow into other zones. Both daily downhole pressure monitoring and post-frac tracer data has shown that there is not communication between zones.

Exhibit E-7 details oil, gas and water analysis for wells located on trend with the four analogous wells.

Exhibit E-8 shows data from a frac tracer survey that we took when we frac'd a vertical Niobrara "B" well, the Razor 26J-2633L. The well-log shows that the frac is contained in the Niobrara "B" while that the Niobrara "A" and "C" are separate zones.

Findings from the engineering analyses presented in Exhibits E-1, E-2a and b, E-3, E-4, E-5, E-6, E-7 and E-8 are summarized below:

- (1) Offset wells have cumulatively produced between 29 and 81 MBO per well with an average EUR of 141 MBO from a single well drilled into a spacing unit. An average EUR of 267 MBO is expected for 960 acre spacing unit well with up to eight wells per zone. The total amount of oil in place in the Niobrara is 74 MMBO per 960 acre spacing unit.

- (2) The four analogous wells presented in Exhibit 2a and b had an average EUR of 141 MBO and an estimated drainage area of 49 acres per well. The EURs presented in Exhibits 1 and the economics in Exhibit 3 take into account better fracture technology. It also shows that when multiplied by eight wells per zone, the wells should drain less than 960 acres. Exhibit 8 gives an example of the frac not growing into the other zones; it stays contained in the Niobrara "B".
- (3) The 960 spacing unit case presented in the Economics Exhibits (E3) provided acceptable economics and will efficiently drain the Niobrara.
- (4) Past testimony provide by Mr. Ralph Nelms and updated here has shown very limited hydraulic fracture pressure communication, and calculated short hydraulic fracture half-lengths in the Niobrara formation.

The proposed increased density drilling program on 960-acre on the Application Lands is designed to protect correlative rights and prevent waste by utilizing Reservoir Engineering evaluation tools including but not limited to RTA analysis, geo-mechanical and numerical simulation modeling.

Engineering Exhibits E-1, E-2a and b, E-3, E-4, E-5, E-6, E-7 and E-8 were prepared by me and to the best of my knowledge, all of the matters set forth are true, correct, and accurate.

**Dated this 15th day of May, 2017.**

Donald F. Koenig  
Donald F. Koenig

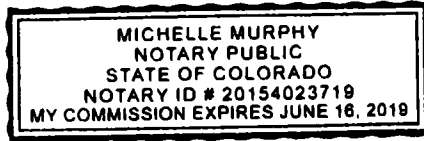
STATE OF COLORADO )  
 ) ss.  
CITY AND COUNTY OF DENVER )


I, the undersigned Notary Public in and for said County in said State, hereby certify that Donald F. Koenig, whose name as Reservoir Engineering Manager of Whiting Oil and Gas Corporation, is signed to the foregoing instrument and who is known to me, acknowledged before me on this day that, being informed of the contents of the instrument, executed the same voluntarily for and as the act of said corporation.

Subscribed and sworn before me this 15<sup>th</sup> day of May, 2017.

Witness my hand and official seal

My commission expires 6/16/2019.



  
Notary Public

## DONALD F. KOENIG

788 Mueller Drive  
Highlands Ranch, CO 80129

---

### PROFESSIONAL EXPERIENCE

WHITING PETROLEUM CORPORATION, Denver, Colorado <i>Senior Reservoir Engineer.</i>	2013 to present
EOG RESOURCES INC, Denver, CO <i>Reservoir Engineering Advisor</i>	2005-2013
MARATHON OIL COMPANY, Houston, TX <i>Advanced Reservoir Engineer</i>	2003-2005
MARATHON OIL COMPANY, Oklahoma City, OK <i>Reservoir Engineer II</i>	2000-2003
MARATHON OIL COMPANY, Tyler, TX <i>Reservoir Engineer I</i>	1997-2000

### EDUCATION:

Montana Tech	B.S.	Petroleum Engineering	1997
--------------	------	-----------------------	------

VOLUMETRICS INCREASED DENSITY- 960 acre Spacing Unit						
Niobrara Formation Reservoir Parameter Description	A-Zone	B-Zone	C-Zone	Fort Hays/Codell/Carlile	Average/Total	Units
Depth ( True Vertical Depth Below Ground Level)	5,570	5,620	5,740	5,810		feet
Porosity	0.13	0.13	0.11	0.13	0.12	fraction
Swi ( Initial Water Saturation Percent of Pore Space)	0.35	0.35	0.35	0.35	0.35	fraction
Net Pay Thickness	32	55	58	19	164	feet
Initial Reservoir Pressure	2,700	2,750	2,800	2,835	2,800	psi
Initial Reservoir Temperature	230	230	230	230	230	deg F
Gas Oil Ratio (Initial)	460	460	460	460	460	cubic feet/stock tank barrel
Oil Gravity	34.9	34.9	34.9	34.9	34.9	deg API
Gas Gravity	0.921	0.921	0.921	0.921	0.921	Air = 1.0
Initial Formation Volume Factor						
Calculated from Standing's Correlation	1.32	1.32	1.32	1.32	1.32	reservoir bbls/stock tank barrel
Number Of Wells	8	8	8	8		
Recovery Factor						
Used for Whiting 120-acre calculations	12%	12%	10%	14%	12%	% of volumetric oil in place
Drainage Area For Spacing Unit	960	960	960	960		acres
OOIP = 7758 x 960 x H x 0.12 x (1-0.35) / 1.32 (960 acres) (estimated)	15,256,460	26,222,040	23,398,128	8,710,118	73,586,746	stock tank barrels
EUR = OOIP x RF (960 acres estimated)	1,830,775	3,146,645	2,339,813	1,219,417	8,536,649	stock tank barrels
EUR for horizontal wells/zone in 960 acre spacing unit (estimated)	228,847	393,331	292,477	152,427	266,770	stock tank barrels per well
Drainage area for each of 8 horizontal wells/zone drilling on 960-acre spacing					160	acres per well
EUR (stock tank barrels per acre ft) (estimated)	59.6	59.6	42.0	66.9		stock tank barrels/acre-ft
EQUATIONS USED:						
OOIP = 7758 X AREA X HEIGHT X POROSITY X (1-Swi)/Boi ( stock tank barrels)						
EUR = OOIP X RF (stock tank barrels)						
OOIP = Original Oil In place (stock tank barrels)						
EUR = Estimated Ultimate Oil Recovery (stock tank barrels)						
AREA = (acres)    HEIGHT = NET PAY (feet)						
POROSITY = Fraction of Total Rock Volume (fraction)						
Swi = Initial Water Saturation (fraction)						
RF = Recovery Factor of OOIP (fraction)						
Boi = Initial Oil Formation Volume Factor (reservoir barrels / stock tank barrels)						

Exhibit E-1

Docket 170600334

Cause No. 535

## Redtail Runway Drainage Calculations

	Units	Razor Federal 30K-1907	Razor Federal 30K-1908	Razor 08E-1704	Wolf 12L-0103
Niobrara Zone		<b>A</b>	<b>B</b>	<b>B</b>	<b>A</b>
Porosity	fraction	0.13	0.13	0.13	0.13
Initial Water Saturation	fraction	0.35	0.35	0.35	0.35
Net Pay Thickness	feet	32	55	55	32
Initial Reservoir Pressure	psi	2,700	2,750	2,750	2,750
Initial Reservoir Temperature	deg F	230	230	225	225
Gas Oil Ratio (Initial)	scf/bbl	460	460	460	460
Oil Gravity	deg API	34.9	34.9	34.9	34.9
Gas Gravity	Air = 1.0	0.921	0.921	0.921	0.921
Initial Formation Volume Factor					
Standing's Correlation	res. bbls/stock tank bbls	1.32	1.32	1.32	1.32
OOIP/acre	stock tank barrels	15,892	27,315	27,315	15,892
Recovery Factor	%	14%	14%	12%	12%
Estimated EUR	stock tank barrels	183,733	225,948	123,329	31,706
Estimated Drainage Area	acres	<b>83</b>	<b>59</b>	<b>38</b>	<b>17</b>
Spacing Unit Length	ft	7,920	7,920	7,920	7,920
Calculated Drainage Width	ft	<b>454</b>	<b>325</b>	<b>207</b>	<b>91</b>

<b>Average EUR</b>	<b>141,179</b>	<b>BO</b>
<b>Average Drainage Area</b>	<b>49</b>	<b>acres</b>
<b>Average Drainage Width</b>	<b>216</b>	<b>FT</b>



## Redtail Runway Economics

### Exhibit E-2b

#### Niobrara Formation Drilling and Completion Economics

Drilling and Completion Costs:	\$4.00	MM
Oil Price:	\$50	/bbl
Gas Price:	\$3.00	/Mcf
Operating Expenses Monthly:	\$10,000	/month
Operating Expenses \$/MCF:	\$0.50	/Mcf
Working Interest:	100%	
Net Revenue Interest:	80%	
State Severance Oil:	5%	
State Severance Gas:	5%	
County Ad Valorem:	4.95%	
Gas Shrink	0.9	

	Units	Razor Federal 30K-1907	Razor Federal 30K-1908	Razor 08E-1704	Wolf 12L-0103
IP:	BOPD	400	466	363	193
Gross EUR Oil	MBO	184	226	123	32
Gross EUR Gas	MMCF	270	193	478	85
Net EUR Oil	MBO	147	181	99	25
Net EUR Gas	MMCF	216	154	383	68
NPV 10%	M\$	-581	254	-1,738	-3,286
DCFROR	%	6%	12%	0%	0%
ROI		1 18	1 53	0 65	0.19
Projected Life or Payout	Years	8.65	5 01	16.08	3.92

Average EUR	141	MBO
Average DCFROR	5%	
Undiscounted ROI	0.89	
Payout	8.42	Years

### Exhibit E-3

#### Niobrara Formation 960-acre Spacing Drilling and Completion Economics

Drilling and Completion Costs:	\$4.00	MM
Oil Price:	\$50	/bbl
Gas Price:	\$3.00	/Mcf
Operating Expenses Monthly:	\$12,000	/month
Operating Expenses \$/MCF:	\$0.50	/Mcf
Working Interest:	100%	
Net Revenue Interest:	80%	
State Severance Oil:	5%	
State Severance Gas:	5%	
County Ad Valorem:	4.95%	
Gas Shrink	0.9	
Initial Gas Oil Ratio:	550	scf/stb
Final Gas Oil Ratio:	2500	scf/stb
Initial Oil Rate:	11,552	barrels of oil per month
IP:	380	BOPD
Gross EUR Oil	267	MBO
Gross EUR Gas	606	MMCF
Net EUR Oil	213	MBO
Net EUR Gas	485	MMCF

#### Un-risked Economics:

Economics shown below are for each individual well assuming 32 horizontal wells are drilled in a 960-acre spacing unit:

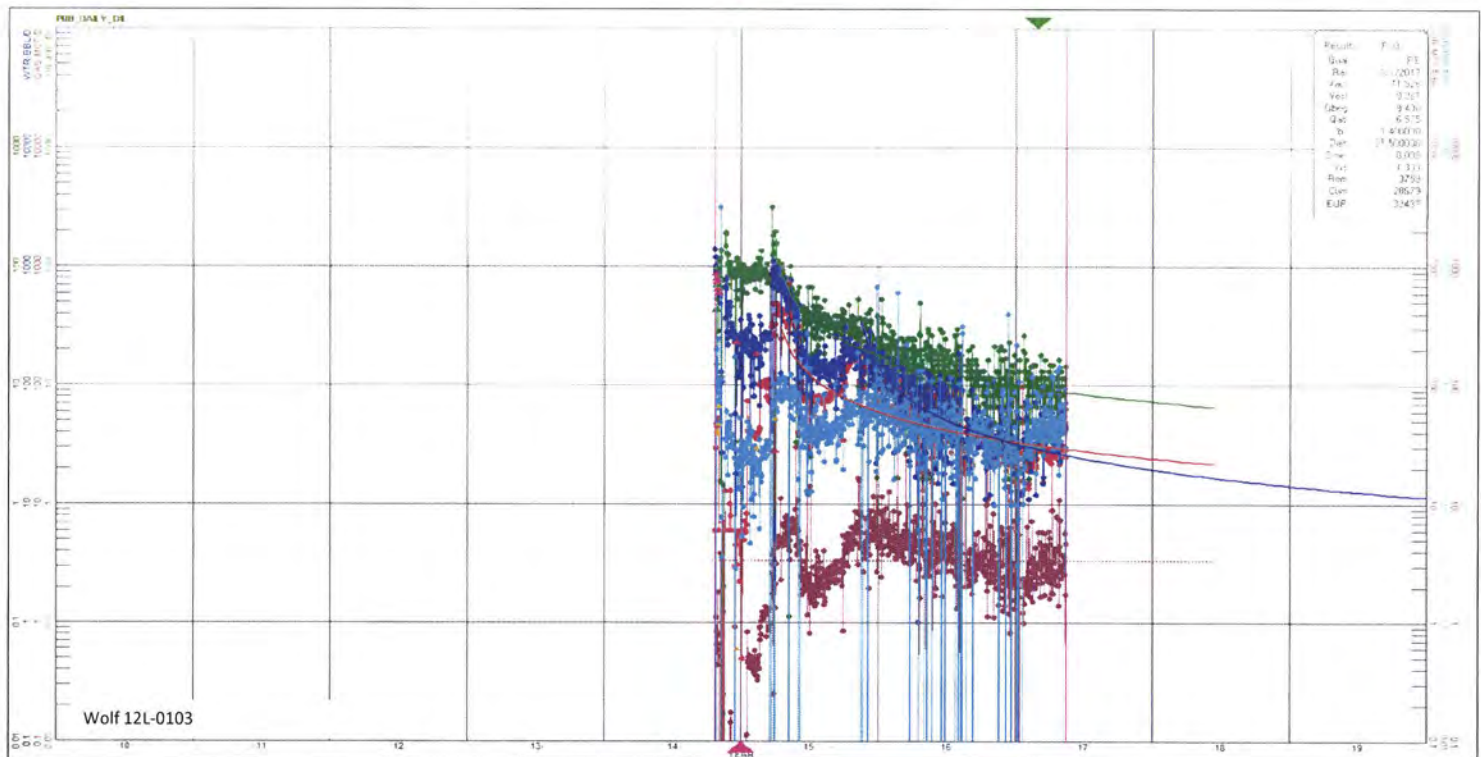
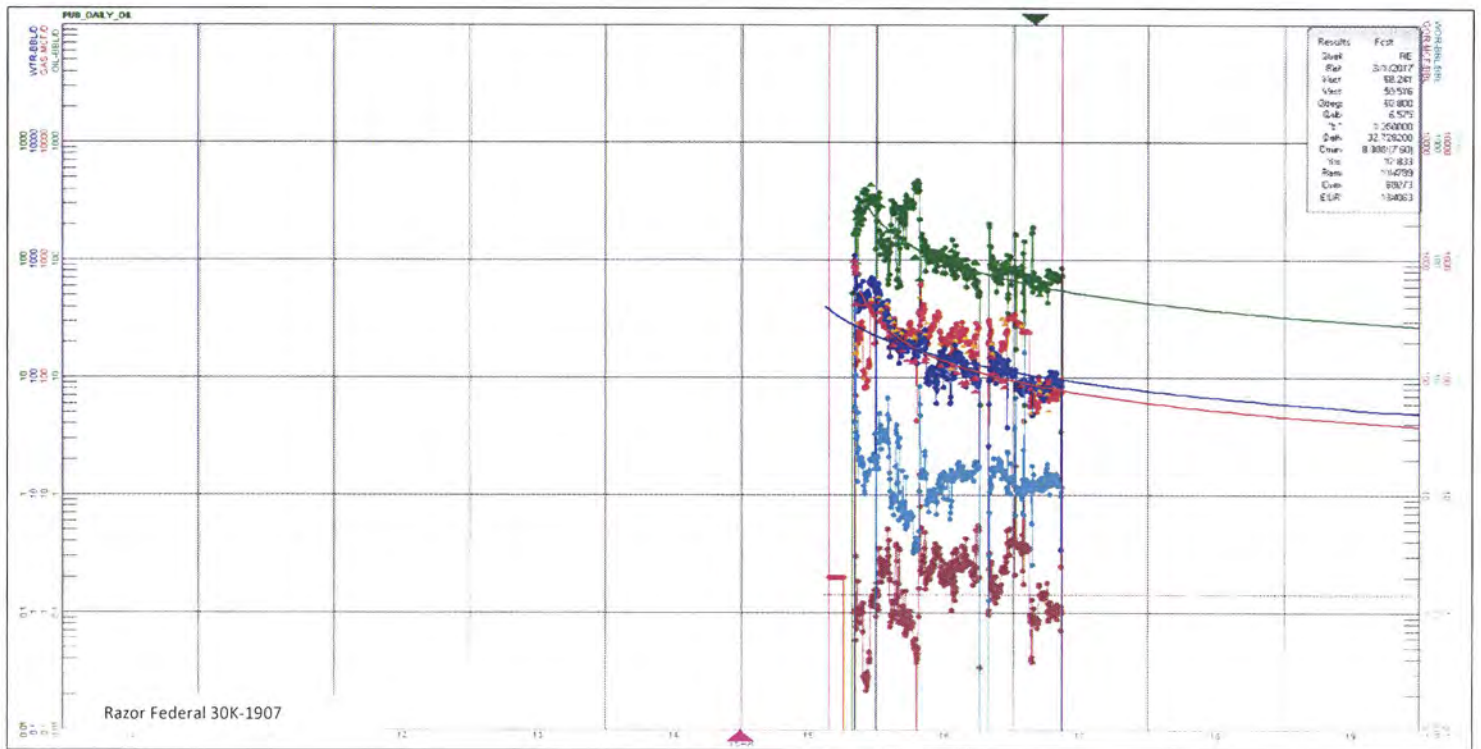
Un-risked Gross EUR Oil:	267	MBO
Un-risked Gross EUR Gas:	606	MMCF
NPV 10	1972.94	M\$
DCFROR	35%	
ROI	1.97	
Payout	1.79	Years

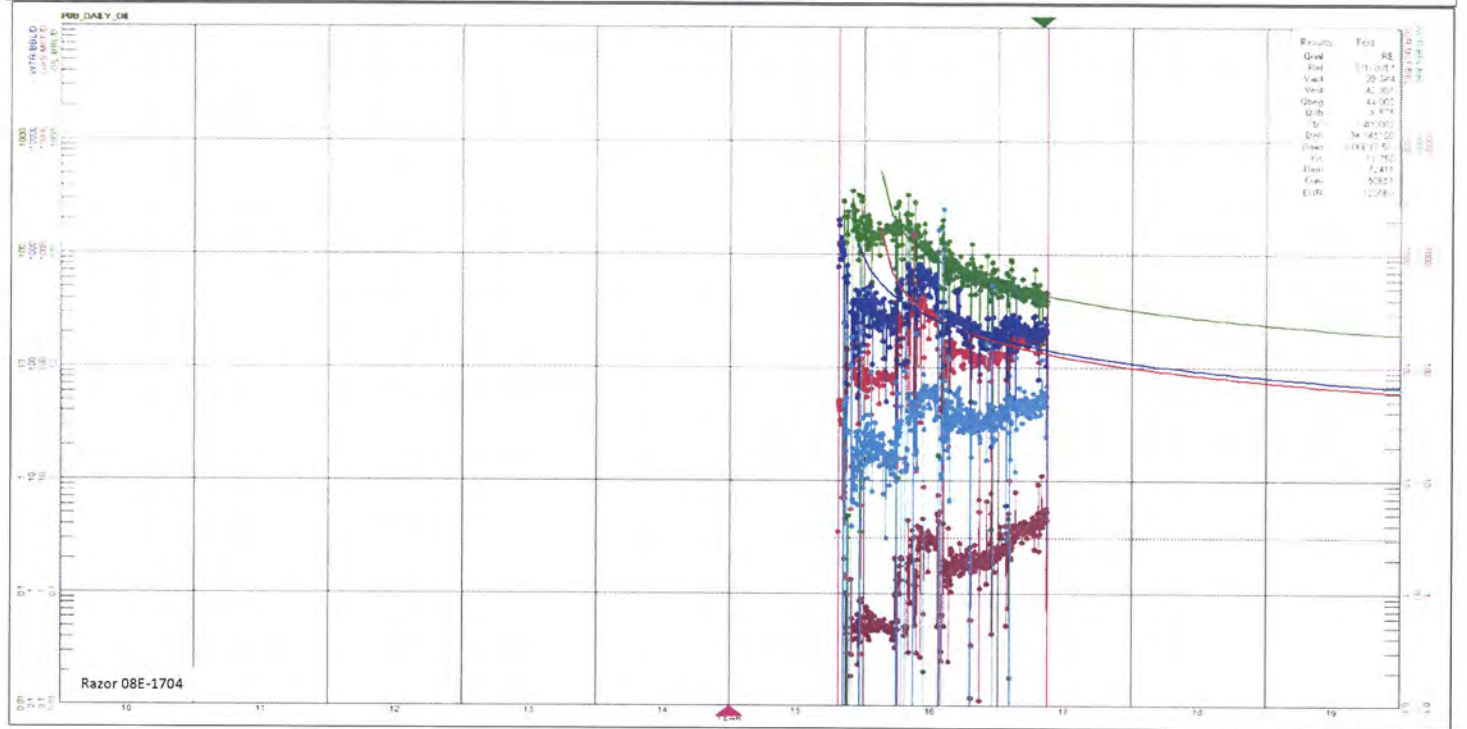
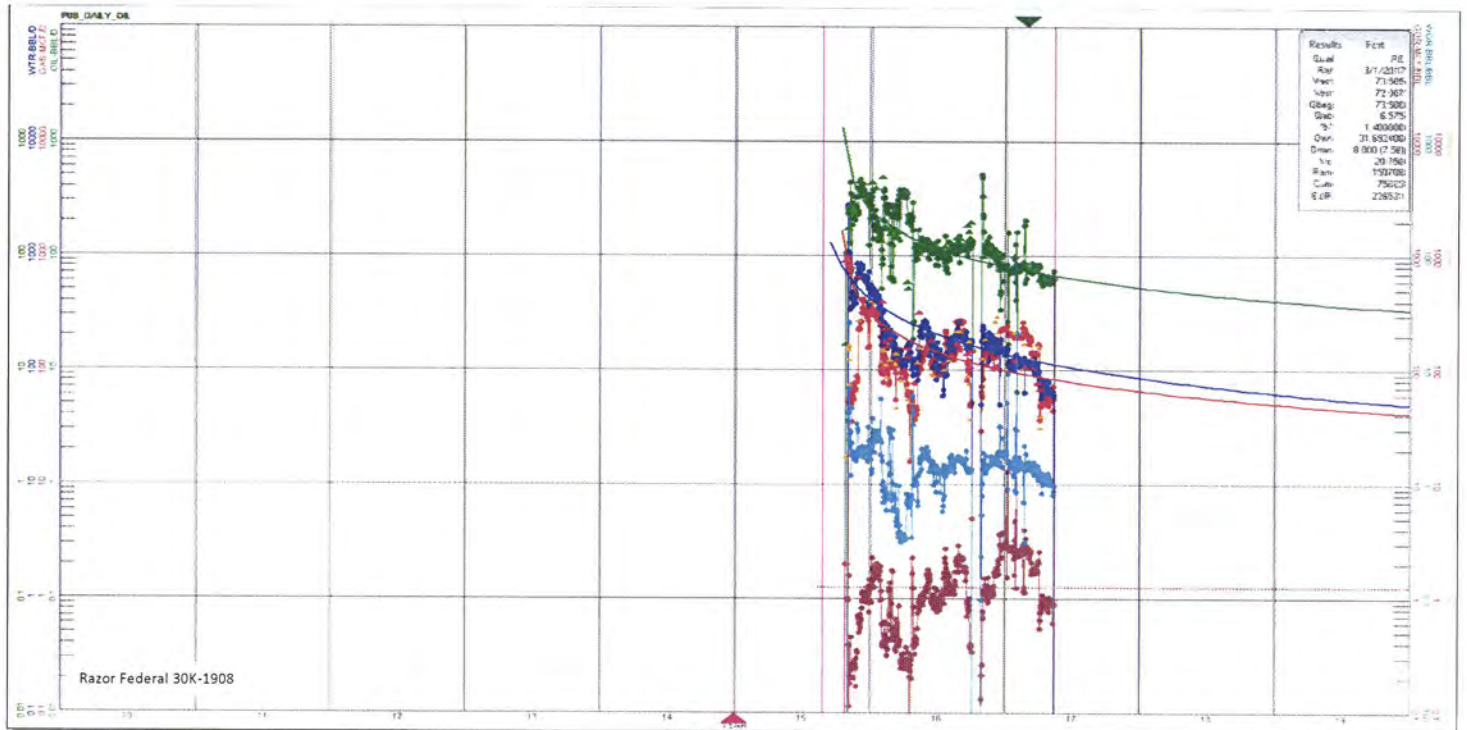
#### **Conclusion: Project Economics are Favorable**

Exhibit E-3

Docket 170600334

Cause No. 535

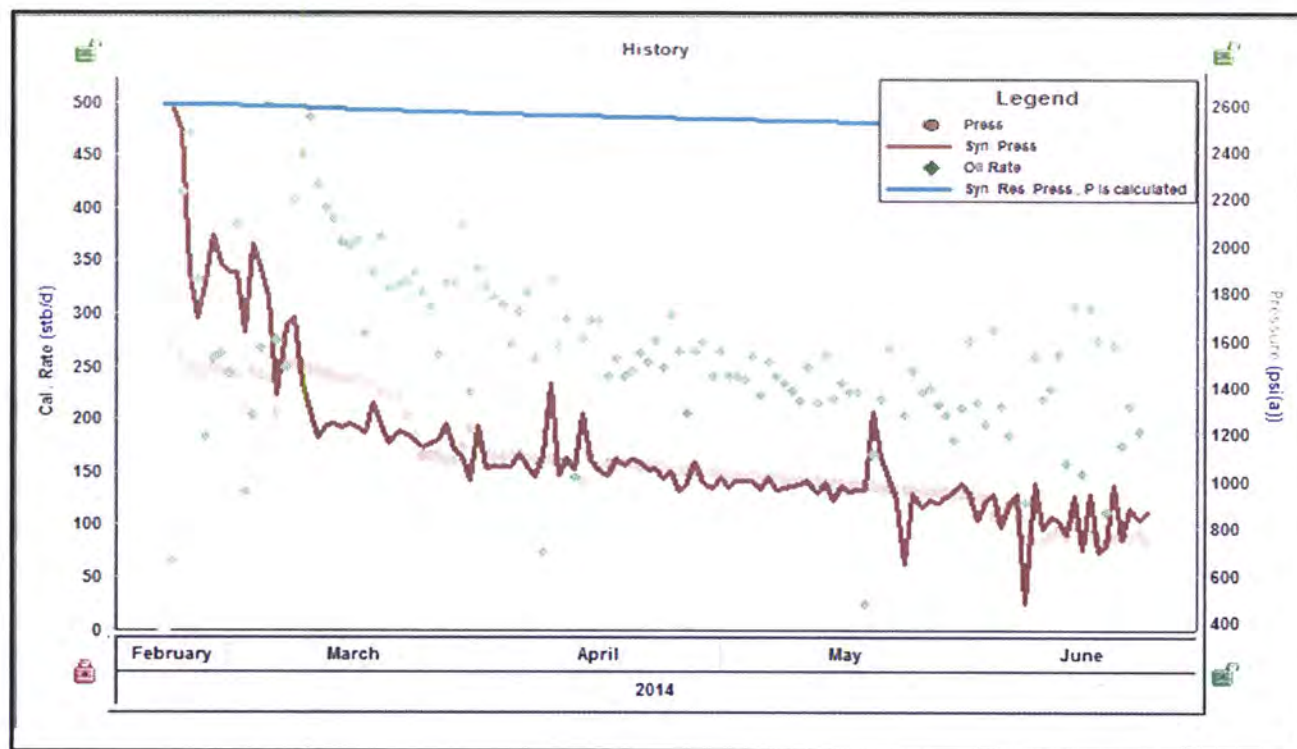
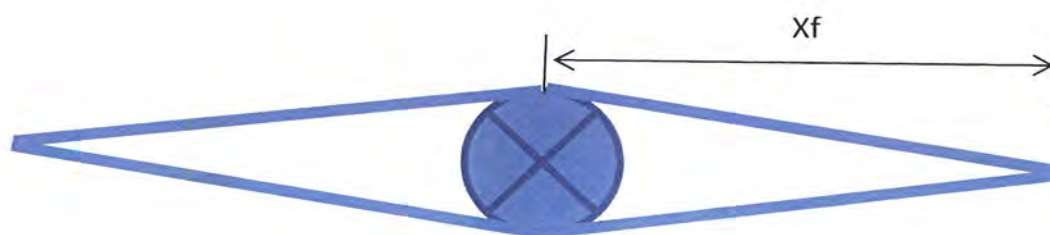




## Whiting Niobara B RTA Results

RTA Indicates that Frac Half Lengths average 85 ft and the permeability to Oil is only 19 MicroDarcies

Well Name	Drilling Unit	Well Location	Oil Permeability MicroDarcies	Xf ft
Wildhorse 16-13H	640	SEC 16 T9N R59W	17	50
Two Mile 22-13H	640	SEC 22 T11N R57W	17	85
Horsetail 18-0733H	960	SEC 18 T10N R57W	12	105
Wolf 35-2623H	960	SEC 35 T10N R59W	3	100
Horsetail 16-1610BH	640	SEC 16 T10N R57W	24	70
Horsetail 07-611H	960	SEC 18 T10N R57W	40	95
			19	84



1280 Acre Well Layout

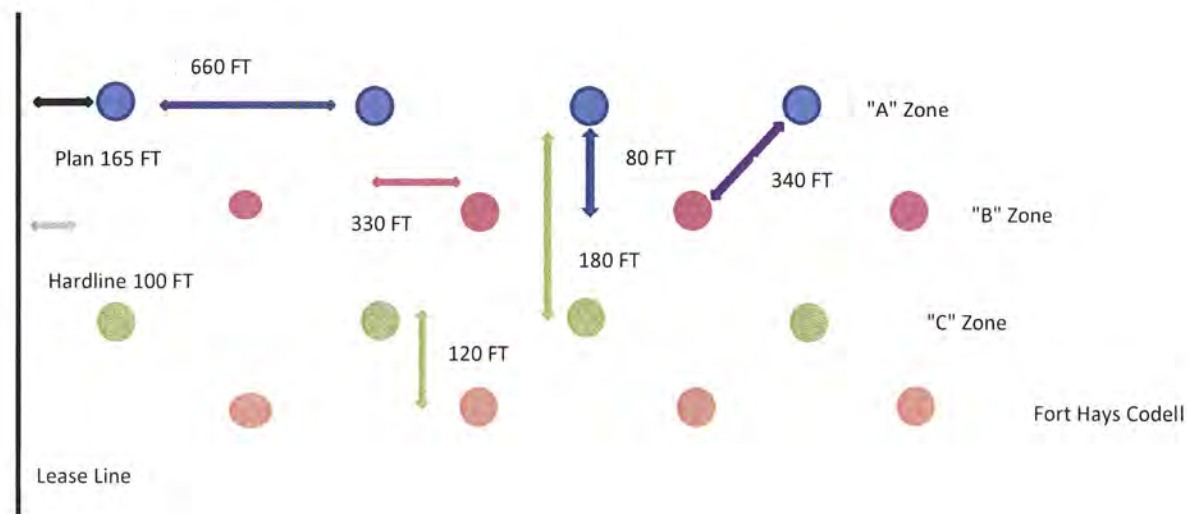


Exhibit E-6  
Docket 170600334  
Cause No. 535





# TECHNOLOGY LABORATORY, INC.

1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414

## Extended Hydrocarbon Liquid Analysis (OHA) E & P Tank Information

Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80202-2300

Contact: Tom Gibbons

Sample ID: Oil from separator  
Well #: Horizontal 07-0611H  
Lab ID: A3547-01-01  
Sampled By: Bill Emery  
Analyzed By: Bill Emery

Sampled: 12/15/13  
Received: 12/15/13  
Analyzed: 12/20/13

Field: Pawnee Buttes  
Cylinder: 150 cc SS  
Sample Temperature °F: 132  
Sample Pressure (psig): 8  
Sampling Method: Water Displacement

COMPONENT	Mole %	Weight %	LV %
Carbon Dioxide	0.000	0.000	0.300
Nitrogen (Air)	0.000	0.000	0.000
Methane	0.000	0.000	0.000
Ethane	0.100	0.000	0.074
Propane	1.196	1.417	0.617
Isobutane	2.384	2.196	0.230
n-Butane	2.188	1.098	1.462
Isopentane	0.967	0.628	0.797
n-Pentane	1.495	1.231	1.476
Cyclopentane	0.336	0.202	0.701
n-Hexane	0.388	0.583	1.190
Cyclohexane	0.619	0.454	0.434
Other Hexanes	1.314	0.688	1.049
Other Heptanes	4.107	3.568	3.842
Methylcyclohexane	0.928	0.762	0.774
2,2,4-Trimethylpentane	0.000	0.000	0.000
Benzene	0.265	0.177	0.181
Toluene	0.000	0.000	0.000
Ethylbenzene	0.141	0.111	0.114
Xylenes	0.791	0.733	0.885
C8	0.188	0.343	1.402
C9	0.024	0.330	0.291
C10+	79.252	81.083	76.711
Total	100.000	100.000	100.000

API Gravity (from tank sample) °API 60/60  
Real Vapor Pressure (from tank sample) psig

36.0  
9.8

C10+ Average Molecular Weight:  
C10+ specific gravity:

287.9  
0.871  
ASTM D1945 ASTM D1570 (OHA)

Analytical Methods:

Page 2 of 2



# TECHNOLOGY LABORATORY, INC.

Centre Professional Office Park  
1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414

## CERTIFICATE OF ANALYSIS

Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80202-2300

Sampled: 12/10/2013  
Received: 12/10/2013  
Analyzed: 12/10/2013

Sample ID: Horizontal 07-0611H  
Sample Point: Separator  
Field: Pawnee  
Laboratory ID: A9506-01

Cylinder: SS-150  
Sample Pressure (psig): 12  
Sample Temperature °F: 132

COMPONENT	Mole %	GPM @ 14.696
Oxygen/Nitrogen	0.734	-
CO <sub>2</sub>	2.210	-
Methane	57.390	-
Ethane	15.407	4.1206
Propane	13.494	3.7183
n-Butane	1.678	0.5488
i-Butane	5.729	1.8602
n-Pentane	1.089	0.3965
i-Pentane	1.311	0.4747
Hexanes Plus	0.951	0.4116
Totals:	100.000	11.4798

Gross Wet Real BTU/scf at 60°F & 14.696 psia  
Gross Dry Real BTU/scf at 60°F & 14.696 psia  
Relative Density (AIR=1)

1547.29  
1574.69  
0.9608

*Lee Bellus*  
TECHNOLOGY LABORATORY, INC.

Page 1 of 1



# TECHNOLOGY LABORATORY, INC.

1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414

## Extended Hydrocarbon Liquid Analysis (OHA) E & P Tank Information

Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80202-2300

Contact: Tom Gibbons

Sample ID: Oil from separator  
Well #: Razor 12-C1411H  
Lab ID: A7457-07-01  
Sampled By: Bill Emery  
Analyzed By: Bill Emery

Sampled: 1/20/14  
Received: 12/06/13  
Analyzed: 12/11/13

Field: Pawnee Buttes  
Cylinder: 150 cc SS  
Sample Temperature °F: 120  
Sample Pressure (psig): 1  
Sampling Method: Water Displacement

COMPONENT	Mole %	Weight %	LV %
Carbon Dioxide	0.000	0.000	0.000
Nitrogen (Air)	0.000	0.000	0.000
Methane	0.000	0.013	0.074
Ethane	0.164	0.041	0.092
Propane	2.875	1.066	1.809
Isobutane	0.214	0.104	0.161
n-Butane	0.802	0.192	0.011
Isopentane	0.391	0.237	0.290
n-Pentane	0.729	0.442	0.533
Cyclopentane	0.181	0.107	0.104
n-Hexane	0.699	0.507	0.580
Cyclohexane	0.533	0.387	0.380
Other Hexanes	0.957	0.660	0.734
Other Heptanes	2.251	1.951	2.050
Methylcyclohexane	0.569	0.403	0.406
2,2,4-Trimethylpentane	0.000	0.000	0.000
Benzene	0.177	0.117	0.100
Toluene	0.657	0.509	0.444
Ethylbenzene	0.385	0.344	0.300
Xylenes	0.891	0.885	0.769
C8	3.624	3.450	3.536
C9	3.719	3.947	3.955
C10+	79.589	84.421	83.412
Total	100.000	100.000	100.000

API Gravity (from tank sample) °API 60/60  
Real Vapor Pressure (from tank sample) psig

30.7  
3.9

Volume of gas per volume of liquid:  
C10+ Average Molecular Weight:  
C10+ specific gravity:

SCF/Gal: 0.1471 SCF/Bar: 6.1770  
257.7  
0.860  
ASTM D1945 ASTM D1570 (OHA)

Analytical Methods:

Page 62 of 68



# TECHNOLOGY LABORATORY, INC.

Centre Professional Office Park  
1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414

## CERTIFICATE OF ANALYSIS

Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80202-2300

Sampled: 3/25/2014  
Received: 3/25/2014  
Analyzed: 3/27/2014

Sample ID: Razor 214  
Sample Point: Meter  
Field: Pawnee  
Laboratory ID: B1122-01

Cylinder: SS-150  
Sample Pressure (psig): 7.7  
Sample Temperature °F: 60

COMPONENT	Mole %	GPM @ 14.696
Oxygen/Nitrogen	1.151	-
CO <sub>2</sub>	2.661	-
Methane	58.610	-
Ethane	14.860	3.9207
Propane	12.744	3.5117
n-Butane	1.586	0.5187
i-Butane	5.277	1.6636
n-Pentane	1.011	0.3701
i-Pentane	1.199	0.4343
Hexanes Plus	1.101	0.4767
Totals:	100.000	10.8959

Gross Wet Real BTU/scf at 60°F & 14.696 psia  
Gross Dry Real BTU/scf at 60°F & 14.696 psia  
Relative Density (AIR=1)

1509.94  
1536.87  
0.9461

*Lee Bellus*  
TECHNOLOGY LABORATORY, INC.

Page 1 of 1

Exhibit E-7a

Docket 170600334

Cause No. 535



TECHNOLOGY LABORATORY, INC.  
CENTRE PROFESSIONAL PARK  
1612 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414

CERTIFICATE OF ANALYSIS

Whiting Petroleum Corp.  
1700 Broadway  
Denver, CO 80290-2300

Sample ID: Horseshoe 07-0611H  
Laboratory ID: A9543-01

Sampled: 12/18/13  
Received: 12/18/13

Project No.:  
Matrix: Water

CAS Number	Parameter	Result	Units	MDL	Method	Date Analyzed
N/A	Specific Gravity	1.0038			ASTM D1298	12/23/13
N/A	Resistivity	0.2793	Ohm Meters @ 68 °F		EPA-120.1	12/23/13
N/A	pH	7.1	Units		EPA-150.1	12/23/13
N/A	Total Dissolved Solids (TDS)	352.70	mg/L	5	EPA-160.1	12/23/13
16387-00-6	Chloride	14243	mg/L	1	EPA-300.1	12/23/13
18785-72-3	Sulfate	20.0	mg/L	0.05	EPA-300.1	12/23/13
71-52-3	Bicarbonate	927	mg/L	1	EPA-310.2	12/23/13
97328-76-2	Carbonate (CO <sub>3</sub> )	< 1.0	mg/L	1	EPA-310.2	12/23/13
7440-39-3	Dissolved Barium	20.5	mg/L	0.01	EPA-6010B	12/23/13
7440-42-8	Dissolved Boron	20.2	mg/L	0.006	EPA-6010B	12/23/13
7440-70-2	Dissolved Calcium	190	mg/L	0.1	EPA-6010B	12/23/13
7439-89-6	Dissolved Iron	14.2	mg/L	0.007	EPA-6010B	12/23/13
7439-95-4	Dissolved Magnesium	35.5	mg/L	0.02	EPA-6010B	12/23/13
7440-09-7	Dissolved Potassium	19.2	mg/L	0.1	EPA-6010B	12/23/13
7440-23-5	Dissolved Sodium	89.99	mg/L	0.01	EPA-6010B	12/23/13
7704-94-6	Dissolved Zirconium	0.077	mg/L	0.01	EPA-6010B	12/23/13

*Lu. Little*  
TECHNOLOGY LABORATORY, INC.

The results contained in this report  
relate only to those items tested.

Page 1 of 1



TECHNOLOGY LABORATORY, INC.  
CENTRE PROFESSIONAL PARK  
1612 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414

CERTIFICATE OF ANALYSIS

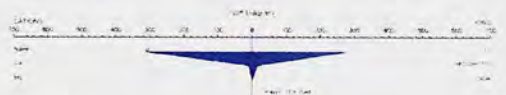
Whiting Petroleum Corp.  
1700 Broadway  
Denver, CO 80290-2300

Sample ID: Racco 21 K Pl  
Laboratory ID: A0790-01

Sampled: 01-28-14  
Received: 01-28-14

Project No.:  
Matrix: Water

CAS Number	Parameter	Result	Units	MDL	Method	Date Analyzed
N/A	Specific Gravity	1.01			ASTM D1298	02/04/14
N/A	Resistivity	0.320	Ohm Meters @ 68 °F		EPA-120.1	02/04/14
N/A	pH	6.9	Units		EPA-150.1	02/04/14
N/A	Total Dissolved Solids (TDS)	4774.0	mg/L	5	EPA-160.1	02/04/14
16387-00-6	Chloride	9183	mg/L	1	EPA-300.1	02/04/14
18785-72-3	Sulfate	2.005	mg/L	0.05	EPA-300.1	02/04/14
71-52-3	Bicarbonate	670	mg/L	1	EPA-310.2	02/04/14
97328-76-2	Carbonate (CO <sub>3</sub> )	< 1.0	mg/L	1	EPA-310.2	02/04/14
7440-39-3	Dissolved Barium	21.6	mg/L	0.01	EPA-6010B	02/04/14
7440-42-8	Dissolved Boron	18.3	mg/L	0.006	EPA-6010B	02/04/14
7440-70-2	Dissolved Calcium	190	mg/L	0.1	EPA-6010B	02/04/14
7439-89-6	Dissolved Iron	12.23	mg/L	0.007	EPA-6010B	02/04/14
7439-95-4	Dissolved Magnesium	35.5	mg/L	0.02	EPA-6010B	02/04/14
7440-09-7	Dissolved Potassium	19.9	mg/L	0.1	EPA-6010B	02/04/14
7440-23-5	Dissolved Sodium	23.01	mg/L	0.01	EPA-6010B	02/04/14
7704-94-6	Dissolved Zirconium	0.077	mg/L	0.01	EPA-6010B	02/04/14



*Lu. Little*  
TECHNOLOGY LABORATORY, INC.



Estimation of Frac Height Growth using Tracer Data

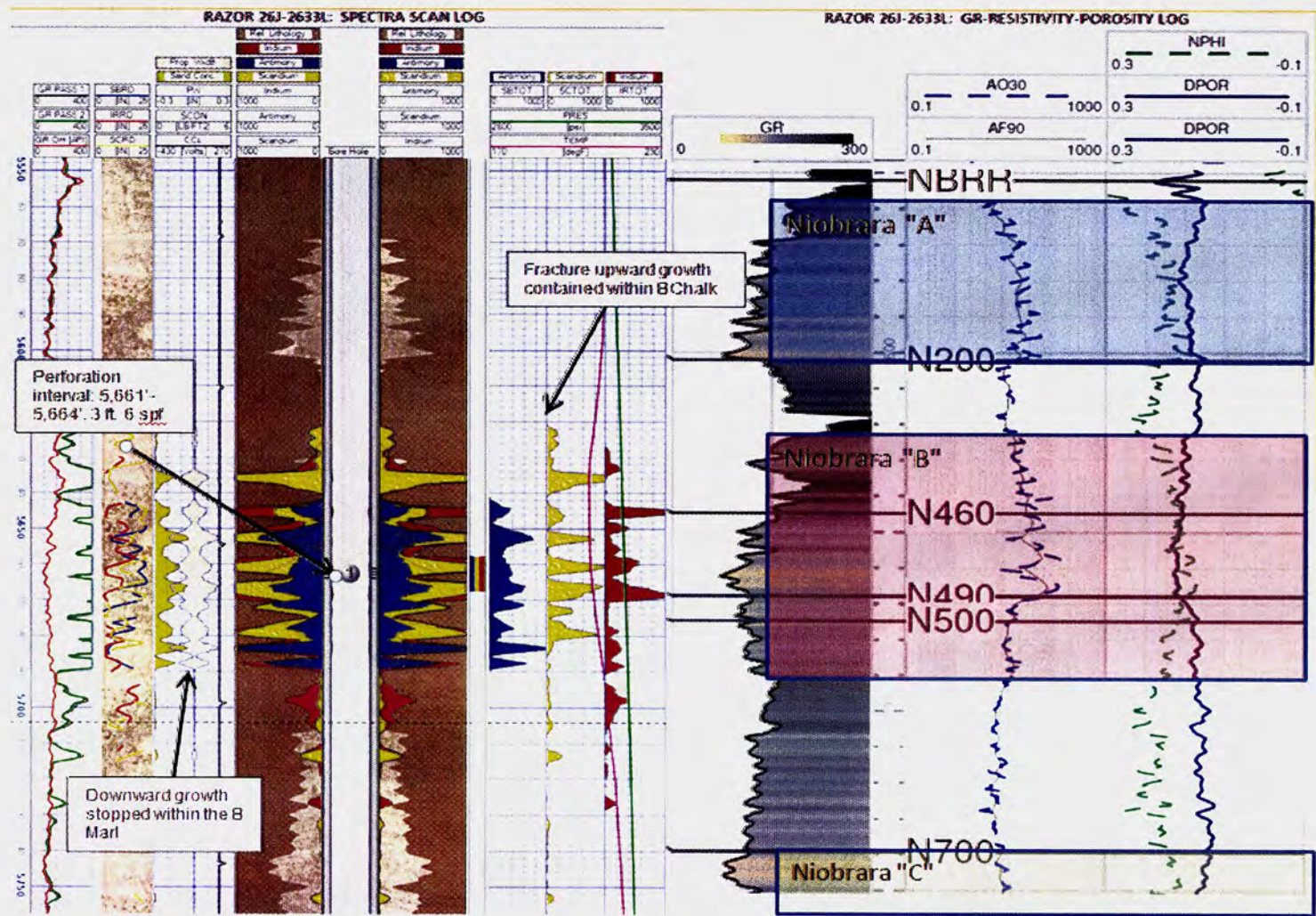


Exhibit E-8  
Docket 170600334  
Cause No. 535

ORIGINAL

BEFORE THE OIL AND GAS CONSERVATION COMMISSION  
OF THE STATE OF COLORADO

RECEIVED

JUL 05 2017

COGCC

IN THE MATTER OF THE AMENDED )  
APPLICATION OF WHITING OIL AND GAS )  
CORPORATION FOR AN ORDER TO )  
AMEND ORDER NO. 535-268 TO INCLUDE )  
THE CARLILE, FORT HAYES, CODELL )  
FORMATIONS AND ALLOW FOR )  
ADDITIONAL WELLS IN AN EXISTING 960- )  
ACRE DRILLING AND SPACING UNIT AND )  
ESTABLISHING WELL LOCATION RULES )  
APPLICABLE TO THE DRILLING AND )  
PRODUCING OF WELLS FROM THE )  
CARLILE, FORT HAYS, CODELL AND )  
NIOBRARA FORMATIONS COVERING )  
CERTAIN LANDS IN TOWNSHIP 11 NORTH, )  
RANGE 58 WEST, 6TH P.M., WELD )  
COUNTY, COLORADO. )

Cause No. 535

Docket No. 170600334

Type: SPACING AND  
INCREASED DENSITY

SUBMISSION OF SUPPLEMENTAL RULE 511 MATERIALS


Whiting Oil and Gas Corporation ("Applicant"), Operator No. 96155, by its attorneys, Welborn Sullivan Meck & Tooley, P.C., in support of the captioned Application, submits the following supplemental Engineering Testimony supporting efficient and economic development of the Niobrara, Fort Hays, Codell, and Carlile Formations for production of oil, gas, and associated hydrocarbons within the Application Lands.

Dated: June 30, 2017

Respectfully submitted,

WHITING OIL AND GAS CORPORATION

By:

  
\_\_\_\_\_  
Joseph C. Pierzchala  
Geoffrey W. Storm  
Welborn Sullivan Meck & Tooley, P.C.  
Attorneys for Applicant  
1125 17th Street, Suite 2200  
Denver, CO 80202  
(303) 830-2500  
jpierzchala@wsmtlaw.com  
gstorm@wsmtlaw.com

<p align="center"><b>Exhibit C</b></p> <p align="center"><b>WHITING OIL AND GAS CORPORATION</b></p> <p align="center"><b>Donald F. Koenig</b></p>	<p align="center"><b>Docket No. 170600334</b></p> <p align="center"><b>Engineering Testimony – Rule 511</b></p> <p align="center"><b>Weld County, Colorado</b></p>
---	--

### **ENGINEERING TESTIMONY**

Township 11 North, Range 58 West, 6th P.M.

Section 25: S½

Section 36: All

My name is Donald F. Koenig. I am currently employed as a Reservoir Engineering Manager with Whiting Oil and Gas Corporation ("Whiting"). I have over 19 years of experience in reservoir engineering and am familiar with the reservoir engineering characteristics on the lands addressed in this testimony, and the matters set forth in Docket No. 170600334. A copy of my resume is attached to this testimony.

In support of Whiting's application (the "Application") in the above referenced docket, I have prepared and am submitting E-1 through E-8. The exhibits are attached to my sworn testimony and form the basis for Whiting's Application to gain approval to drill and complete on increased well density up to 32 wells in the requested 960-acre drilling and spacing unit for the Niobrara, Fort Hays, Codell, and Carlile Formations covering the following lands ("Application Lands"):

Township 11 North, Range 58 West, 6th P.M.

Section 25: S½

Section 36: All

Exhibit E-1 presents the Niobrara and Fort Hays/Codell/Carlile Formation reservoir characteristics and a volumetric calculation showing the estimated oil recovery from increased density wells drilled on 1280-acre spacing on the Application Lands. I have broken out the Niobrara "A", "B", "C" and Fort Hays/Codell/Carlile zone characteristics. There is an estimated 98 MMBO in this 1280-acre spacing unit, of which Whiting hopes to recover up to 12% of the oil in place.

Exhibit E-2aA presents the calculated drainage areas and estimates the drainage width for eight analogous Niobrara wells located in Township 10 North, Range 58 West and Township 10 North, Range 59 West. The average drainage for these eight wells of various lateral lengths is 64 acres with a corresponding drainage width of 354 ft. The wells produce from the Niobrara "A" and Niobrara "B".

Exhibit E-2aB presents the calculated drainage areas and estimates the drainage width for eight analogous Codell wells located in Township 10 North, Range 58 West. The average drainage for these eight wells of various lateral lengths is 108 acres with a corresponding drainage width of 592 ft.

Exhibit E-2bA demonstrates the economics for the same eight analogous Niobrara wells. With a Rate of Return ("ROR") around 14%, Return on Investment ("ROI") of 1.11 and average payout of 8 years, the area has been barely economic. The economics were run at a 50 \$/BBL oil price when the average price was higher through the initial production of these wells.

Exhibit E-2bB demonstrates the economics for the same eight analogous Codell wells. With a Rate of Return ("ROR") around 10%, Return on Investment ("ROI") of 0.88 and average payout of 8 years, the area has been barely economic. The economics were run at a 50 \$/BBL oil price when the average price was higher through the initial production of these wells.

Exhibit E-3 analyzes the economics for an average well in a 1280-acre spacing unit with up to 32 wells. Again the economics are good for a 50 \$/BBL price with a ROR of 47% and ROI of 2.28. The Estimated Ultimate Recovery ("EUR") for this case was derived from the EUR calculated on Exhibit E-1 using an average 12% recovery factor on the four zones in the Niobrara and Fort Hays/Codell.

Exhibits E-4a-h contains the decline curves for the eight analogous Niobrara wells in Exhibits E-2aA and E-2bA and the decline curves for the eight analogous Codell wells in Exhibits E-2aB and E-2bB.

Exhibit E-5 contains the results from RTA analysis for six horizontal Niobrara wells. Rate Transient Analysis demonstrates an estimated frac half-length of 84 feet and only 19 microdarcies of permeability. The hydraulic fracture half-length calculated from rate transient analyses, together with downhole pressure data from offset wells indicates that less than a 100 foot setback is sufficient. According to our findings, some waste is inevitable with 100 foot setbacks, but it is less than that created by the state-wide 600 foot setback.

Exhibit E-6 represents a half spacing unit depiction of the wellbore layout for these spacing units with Whiting alternating between producing the "A," "B," "C," and Fort Hays/Codell zones. Whiting believes that each of the four zones will act as separate reservoirs. Due to Bentonites and other low permeability areas located between the zones in the Niobrara, the fracs do not grow into other zones. Both daily downhole pressure monitoring and post-frac tracer data has shown that there is not communication between zones.

Exhibits E-7a and E-7b details oil, gas and water analysis for wells located on trend with four analogous wells.

Exhibit E-8 shows data from a frac tracer survey that we took when we frac'd a vertical Niobrara "B" well, the Razor 26J-2633L. The well-log shows that the frac is contained in the Niobrara "B" while that the Niobrara "A" and "C" are separate zones.

Findings from the engineering analyses presented in the above-referenced Exhibits are summarized below:

- (1) Offset Niobrara Formation wells have cumulatively produced between 32 and 336 MBO per well with an average EUR of 174 MBO from a single Niobrara well. Offset Codell Formation wells have cumulatively produced between 81 and 279 MBO per well with an average and EUR of 146 MBO from a single Codell well drilled into a spacing unit. An average EUR of 356 MBO is expected for 1280-acre spacing unit well with up to eight wells per zone. The total amount of oil in place in the Niobrara A, B, C zones and Fort Hays/Codell/Carlile Formations is 98 MMBO per 1280-acre spacing unit.
- (2) The eight analogous Niobrara wells presented in Exhibits E-2aA and E-2bA had an average EUR of 174 MBO and an estimated drainage area of 64 acres per well. The eight analogous Codell wells presented in Exhibit E-2aB and E-2bB had an average EUR of 146 MBO and an estimated drainage area of 108 acres per well. The EURs presented in Exhibits 1 and the economics in Exhibit 3 take into account better fracture technology. It also shows that when multiplied by eight wells per zone, the wells should drain less than 1280 acres. Exhibit 8 gives an example of the frac not growing into the other zones; it stays contained in the Niobrara "B".
- (3) The 1280-acre spacing unit case presented in the Economics Exhibits (E3) provided acceptable economics and will efficiently drain the Niobrara Formation.
- (4) Past testimony provide by Mr. Ralph Nelms and updated here has shown very limited hydraulic fracture pressure communication, and calculated short hydraulic fracture half-lengths in the Niobrara formation.

The proposed increased density drilling program on 960-acre on the Application Lands is designed to protect correlative rights and prevent waste by utilizing Reservoir Engineering evaluation tools including but not limited to RTA analysis, geo-mechanical and numerical simulation modeling.

Engineering Exhibits E-1, E-2a and b, E-3, E-4, E-5, E-6, E-7 and E-8 were prepared by me and to the best of my knowledge, all of the matters set forth are true, correct, and accurate.

Dated this 27<sup>th</sup> day of June, 2017.

  
Donald F. Koenig





VOLUMETRICS INCREASED DENSITY- 960 acre Spacing Unit						
Niobrara Formation Reservoir Parameter Description	A-Zone	B-Zone	C-Zone	Fort Hays/Codell/Carlile	Average/Total	Units
Depth ( True Vertical Depth Below Ground Level)	5,570	5,620	5,740	5,810		feet
Porosity	0.13	0.13	0.11	0.13	0.12	fraction
Swi ( Initial Water Saturation Percent of Pore Space)	0.35	0.35	0.35	0.35	0.35	fraction
Net Pay Thickness	32	55	58	19	164	feet
Initial Reservoir Pressure	2,700	2,750	2,800	2,835	2,800	psi
Initial Reservoir Temperature	230	230	230	230	230	deg F
Gas Oil Ratio (Initial)	460	460	460	460	460	cubic feet/stock tank barrel
Oil Gravity	34.9	34.9	34.9	34.9	34.9	deg API
Gas Gravity	0.921	0.921	0.921	0.921	0.921	Air = 1.0
Initial Formation Volume Factor						
Calculated from Standing's Correlation	1.32	1.32	1.32	1.32	1.32	reservoir bbls/stock tank barrel
Number Of Wells	8	8	8	8		
Recovery Factor						
Used for Whiting 120-acre calculations	12%	12%	10%	14%	12%	% of volumetric oil In place
Drainage Area For Spacing Unit	960	960	960	960		acres
OOIP = 7758 x 960 x H x 0.10 x (1-0.35) / 1.32 (960 acres) (estimated)	15,256,460	26,222,040	23,398,128	8,710,118	73,586,746	stock tank barrels
EUR = OOIP x RF (960 acres estimated)	1,830,775	3,146,645	2,339,813	1,219,417	8,536,649	stock tank barrels
EUR for horizontal wells/zone in 1280 acre spacing unit (estimated)	228,847	393,331	292,477	152,427	266,770	stock tank barrels per well
Drainage area for each of 8 horizontal wells/zone drilling on 960-acre spacing					160	acres per well
EUR (stock tank barrels per acre ft) (estimated)	59.6	59.6	42.0	66.9		stock tank barrels/acre-ft
EQUATIONS USED:						
OOIP = 7758 X AREA X HEIGHT X POROSITY X (1-Swi)/Boi ( stock tank barrels)						
EUR = OOIP X RF (stock tank barrels)						
OOIP = Original Oil In place (stock tank barrels)						
EUR = Estimated Ultimate Oil Recovery (stock tank barrels)						
AREA = (acres)    HEIGHT = NET PAY (feet)						
POROSITY = Fraction of Total Rock Volume (fraction)						
Swi = Initial Water Saturation (fraction)						
RF = Recovery Factor of OOIP (fraction)						
Boi = Initial Oil Formation Volume Factor (reservoir barrels / stock tank barrels)						

Exhibit E-1  
Docket 170600334  
Cause No. 535

## Redtail Runway Drainage Calculations

	Units	Razor Federal 30K- 1907	Razor Federal 30K- 1908	Razor 08E- 1704	Wolf 12L- 0103	Razor 10E- 0302	Razor FED 30K-3105	Razor FED 30K-3107	Wolf 35- 2613
Zone		A	B	B	A	B	B	A	B
Porosity	fraction	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Initial Water Saturation	fraction	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Net Pay Thickness	feet	32	55	55	32	55	55	32	55
Initial Reservoir Pressure	psi	2,700	2,750	2,750	2,750	2,750	2,750	2,700	2,750
Initial Reservoir Temperature	deg F	230	230	225	225	230	230	225	230
Gas Oil Ratio (Initial)	scf/bbl	460	460	460	460	460	460	460	460
Oil Gravity	deg API	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Gas Gravity	Air = 1.0	0.921	0.921	0.921	0.921	0.921	0.921	0.921	0.921
Initial Formation Volume Factor									
Standing's Correlation	res. bbls/stock tank bbls	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
OOIP/acre	stock tank barrels	15,892	27,315	27,315	15,892	27,315	27,315	15,892	27,315
Recovery Factor	%	12%	12%	12%	12%	12%	12%	12%	12%
Estimated EUR	stock tank barrels	183,733	225,948	123,329	31,706	132,141	336,613	196,517	159329
Estimated Drainage Area	acres	96	69	38	17	40	103	103	49
Spacing Unit Length	ft	7,920	7,920	7,920	7,920	7,920	7,920	7,920	7,920
Calculated Drainage Width	ft	530	379	207	91	222	565	567	267

**Average EUR** 173,665 **BO**  
**Average Drainage Area** 64 **acres**  
**Average Drainage Width** 354 **FT**



## Redtail Runway Drainage Calculations

	Units	RAZOR 11F-0206B	RAZOR 11G-0210B	RAZOR 12F-0106B	RAZOR FED 30K-3108	RAZOR FEDERAL 12F-1304B	RAZOR FEDERAL 12F-1301A	RAZOR 12F-0101A	RAZOR 25B-2551
Zone		Codell	Codell	Codell	Codell	Codell	Codell	Codell	Codell
Porosity	fraction	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Initial Water Saturation	fraction	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Net Pay Thickness	feet	19	19	19	19	19	19	19	19
Initial Reservoir Pressure	psi	2,700	2,750	2,750	2,700	2,750	2,750	2,700	2,750
Initial Reservoir Temperature	deg F	240	240	240	240	240	240	240	240
Gas Oil Ratio (Initial)	scf/bbl	460	460	460	460	460	460	460	460
Oil Gravity	deg API	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9
Gas Gravity	Air = 1.0	0.921	0.921	0.921	0.921	0.921	0.921	0.921	0.921
Initial Formation Volume Factor									
Standing's Correlation	res. bbls/stock tank bbls	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
OOIP/acre	stock tank barrels	9,073	9,073	9,073	9,073	9,073	9,073	9,073	9,073
Recovery Factor	%	15%	15%	15%	15%	15%	15%	15%	15%
Estimated EUR	stock tank barrels	114,125	138,039	111,020	278,933	95,450	105,013	80,624	248,529
Estimated Drainage Area	acres	84	101	82	205	70	77	59	183
Spacing Unit Length	ft	7,920	7,920	7,920	7,920	7,920	7,920	7,920	7,920
Calculated Drainage Width	ft	461	558	449	1,127	386	424	326	1,004

**Average EUR 146,467 BO**  
**Average Drainage Area 108 acres**  
**Average Drainage Width 592 FT**

## Redtail Runway Economics

### Exhibit E-2bA

#### Niobrara Formation Drilling and Completion Economics

Drilling and Completion Costs:	\$4.00	MM
Oil Price:	\$50	/bbl
Gas Price:	\$3.00	/Mcf
Operating Expenses Monthly:	\$10,000	/month
Operating Expenses \$/MCF:	\$0.50	/Mcf
Working Interest:	100%	
Net Revenue Interest:	80%	
State Severance Oil:	5%	
State Severance Gas:	5%	
County Ad Valorem:	4.95%	
Gas Shrink	0.9	

	Units	Razor Federal 30K- 1907	Razor Federal 30K- 1908	Razor 08E- 1704	Wolf 12L- 0103	Razor 10E- 0302	Razor FED 30K-3105	Razor FED 30K-3107	Wolf 35- 2613
IP:	BOPD	400	466	363	193	435	519	562	448
Gross EUR Oil	MBO	184	226	123	32	132	197	336	159
Gross EUR Gas	MMCF	270	193	478	85	230	733	448	294
Net EUR Oil	MBO	147	181	99	25	106	158	269	127
Net EUR Gas	MMCF	216	154	383	68	184	586	358	235
NPV 10%	M\$	-581	254	-1,738	-3,286	-1,350	35	3,206	-806
DCFROR	%	6%	12%	0%	0%	0%	11%	86%	0%
ROI		1.18	1.53	0.65	0.19	0.77	1.23	2.36	0.94
Projected Life or Payout	Years	8.65	5.01	16.08	3.92	11.92	4.62	1.14	14

**Average EUR 174 MBO**  
**Average DCFROR 14%**  
**Undiscounted ROI 1.11**  
**Payout 8 Years**

Exhibit E-2bA

Docket

170600334

Cause No. 535

## Redtail Runway Economics

### Exhibit E-2bB

#### Niobrara Formation Drilling and Completion Economics

Drilling and Completion Costs:	\$4.00	MM
Oil Price:	\$50	/bbl
Gas Price:	\$3.00	/Mcf
Operating Expenses Monthly:	\$10,000	/month
Operating Expenses \$/MCF:	\$0.50	/Mcf
Working Interest:	100%	
Net Revenue Interest:	80%	
State Severance Oil:	5%	
State Severance Gas:	5%	
County Ad Valorem:	4.95%	
Gas Shrink	0.9	

	Units	RAZOR 11F- 0206B	RAZOR 11G- 0210B	RAZOR 12F- 0106B	RAZOR FED 30K-310B	RAZOR FEDERAL 12F-1304B	RAZOR FEDERAL 12F-1301A	RAZOR 12F- 0101A	RAZOR 25B- 2551
IP:	BOPD	289	447	289	549	252	237	280	676
Gross EUR Oil	MBO	114	138	111	279	95	105	81	249
Gross EUR Gas	MMCF	230	197	196	202	116	113	126	285
Net EUR Oil	MBO	91	110	89	223	76	84	64	199
Net EUR Gas	MMCF	184	158	156	161	93	90	100	228
NPV 10%	M\$	-1,786	-1,268	-1,851	1,896	-2,182	-1,971	-2,473	1,203
DCFROR	%	0%	0%	0%	47%	0%	0%	0%	32%
ROI		0.63	0.79	0.61	1.88	0.51	0.57	0.42	1.64
Projected Life or Payout	Years	10.00	12.25	9.67	1.61	8.25	9.17	6.92	2.21

**Average EUR 146 MBO**  
**Average DCFROR 10%**  
**Undiscounted ROI 0.88**  
**Payout 7.51 Years**

Exhibit E-2bB

Docket

170600334

Cause No. 535

### Exhibit E-3

#### Niobrara Formation 960-acre Spacing Drilling and Completion Economics

Drilling and Completion Costs:	\$4.00	MM
Oil Price:	\$50	/bbl
Gas Price:	\$3.00	/Mcf
Operating Expenses Monthly:	\$12,000	/month
Operating Expenses \$/MCF:	\$0.50	/Mcf
Working Interest:	100%	
Net Revenue Interest:	80%	
State Severance Oil:	5%	
State Severance Gas:	5%	
County Ad Valorem:	4.95%	
Gas Shrink	0.9	
Initial Gas Oil Ratio:	550	scf/stb
Final Gas Oil Ratio:	2500	scf/stb
Initial Oil Rate:	11,552	barrels of oil per month
IP:	380	BOPD
Gross EUR Oil	267	MBO
Gross EUR Gas	606	MMCF
Net EUR Oil	213	MBO
Net EUR Gas	485	MMCF

#### Un-risked Economics:

Economics shown below are for each individual well assuming 32 horizontal wells are drilled in a 960-acre spacing unit:

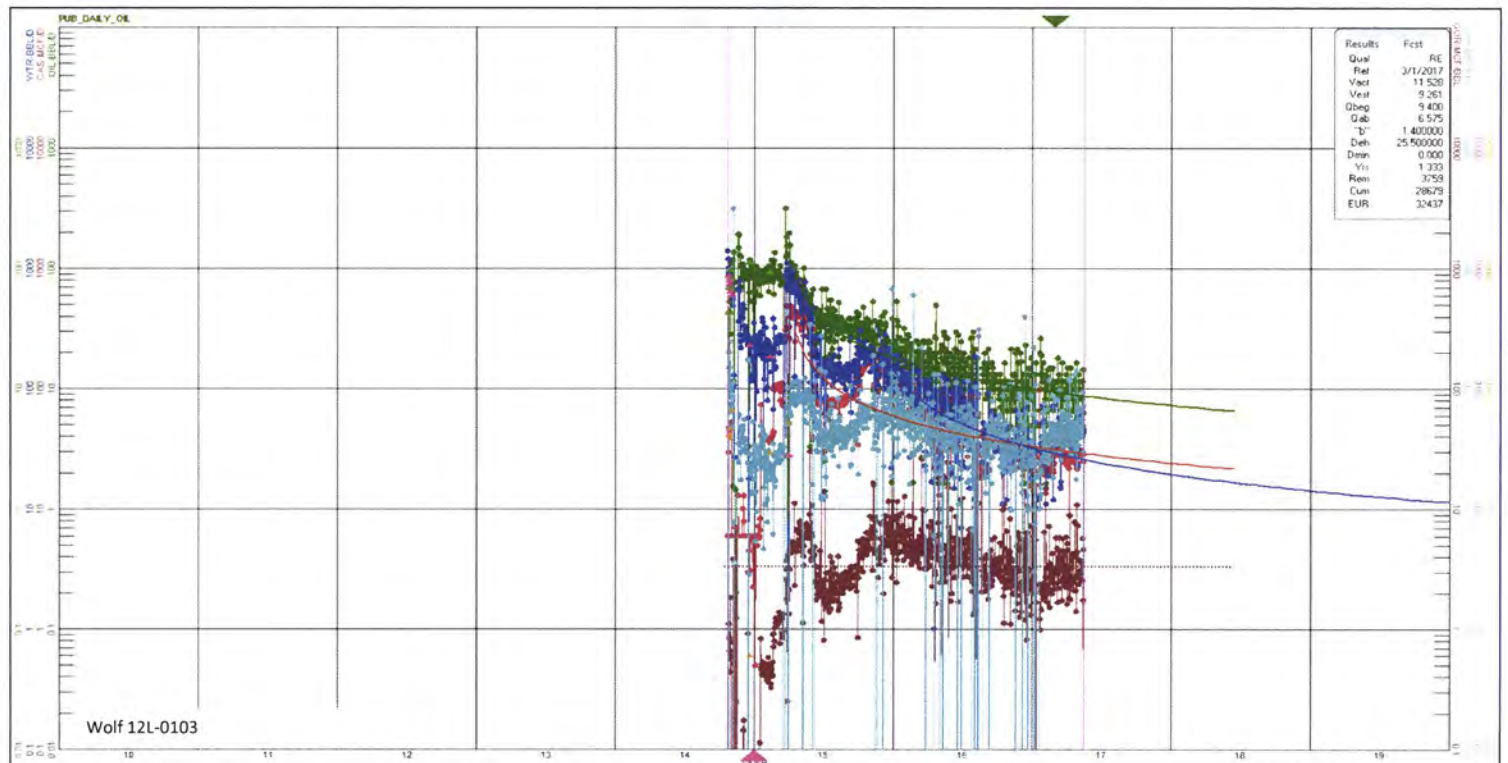
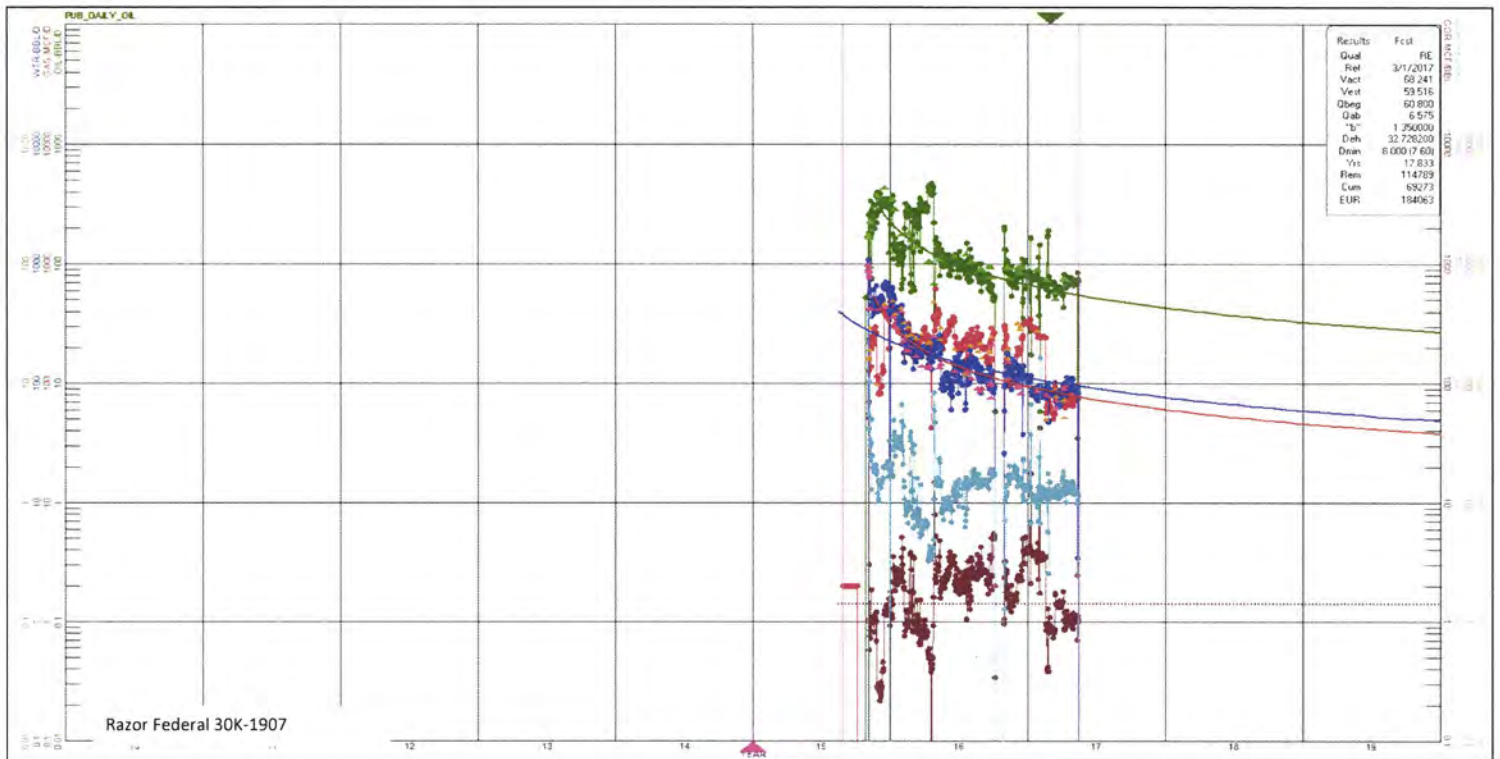
Un-risked Gross EUR Oil:	267	MBO
Un-risked Gross EUR Gas:	606	MMCF
NPV 10	1972.94	M\$
DCFROR	35%	
ROI	1.97	
Payout	1.79	Years

#### **Conclusion: Project Economics are Favorable**

Exhibit E-3

Docket 170600334

Cause No. 535



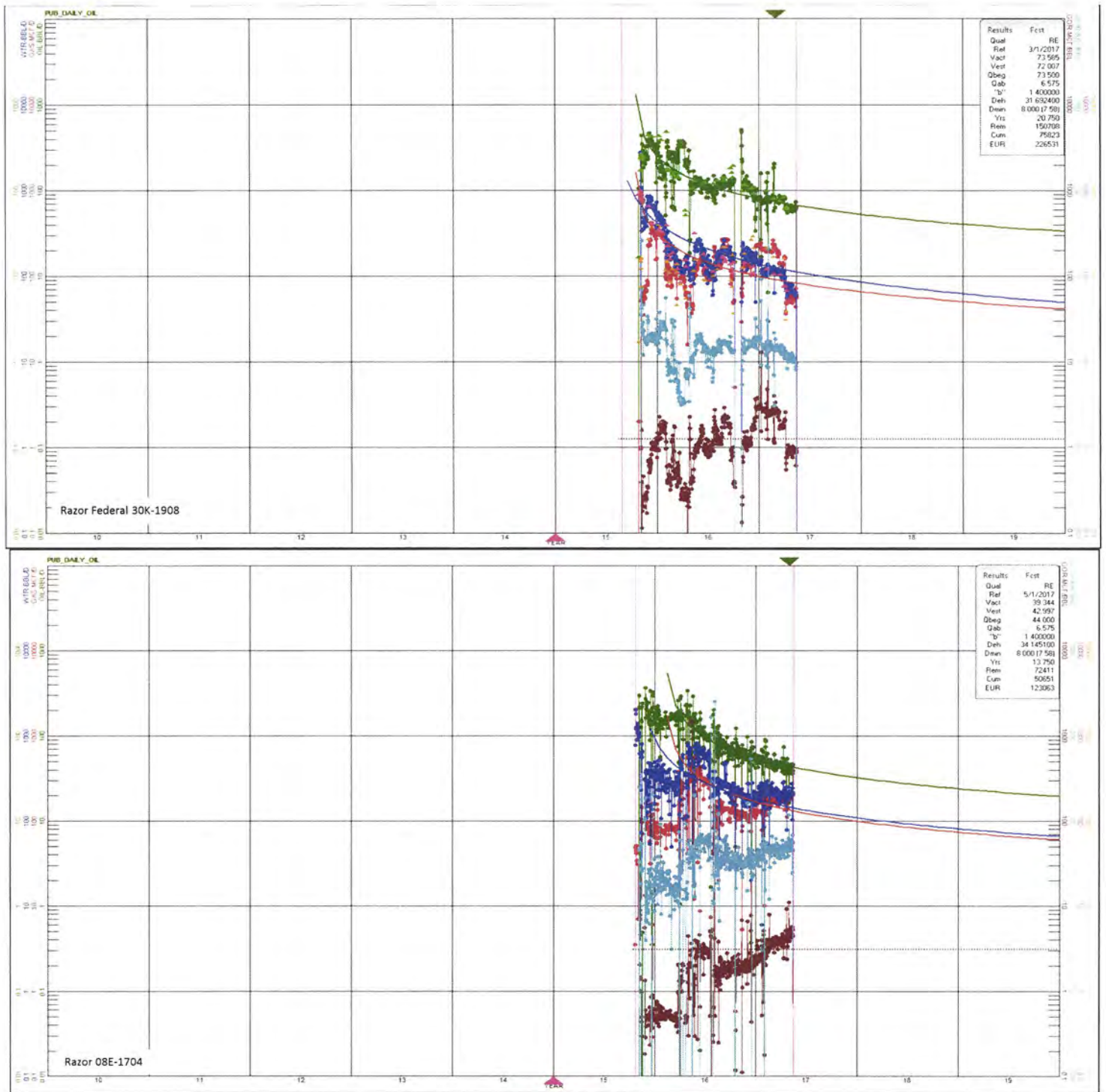
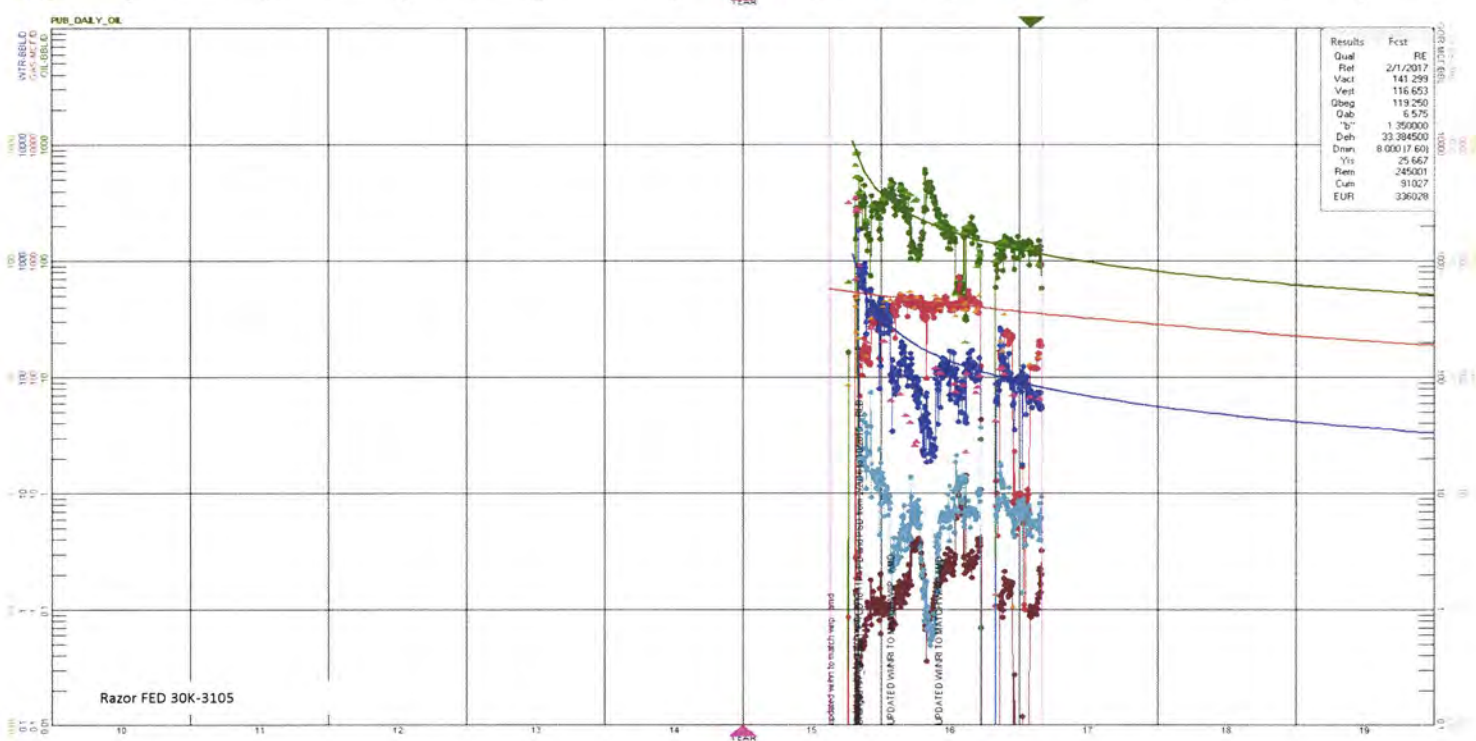
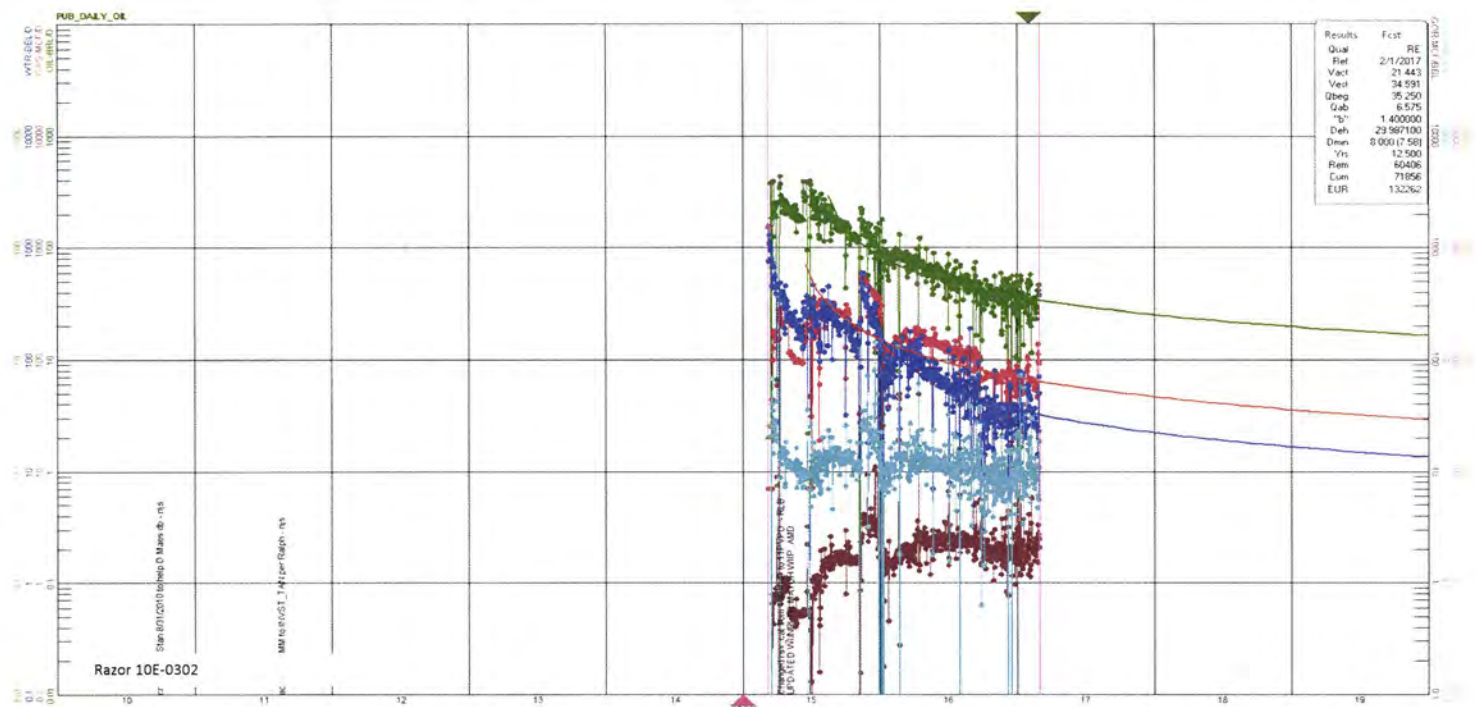
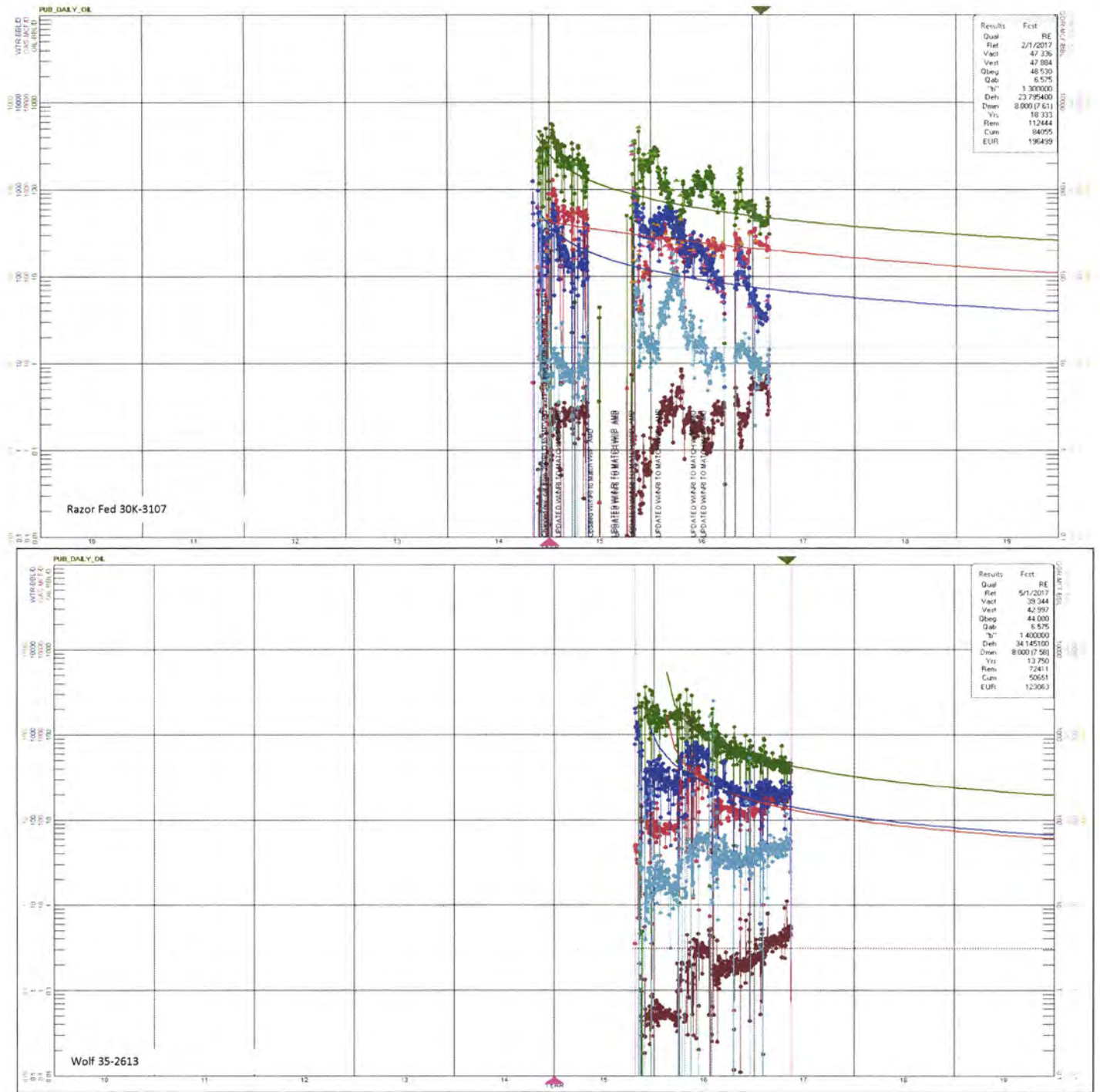
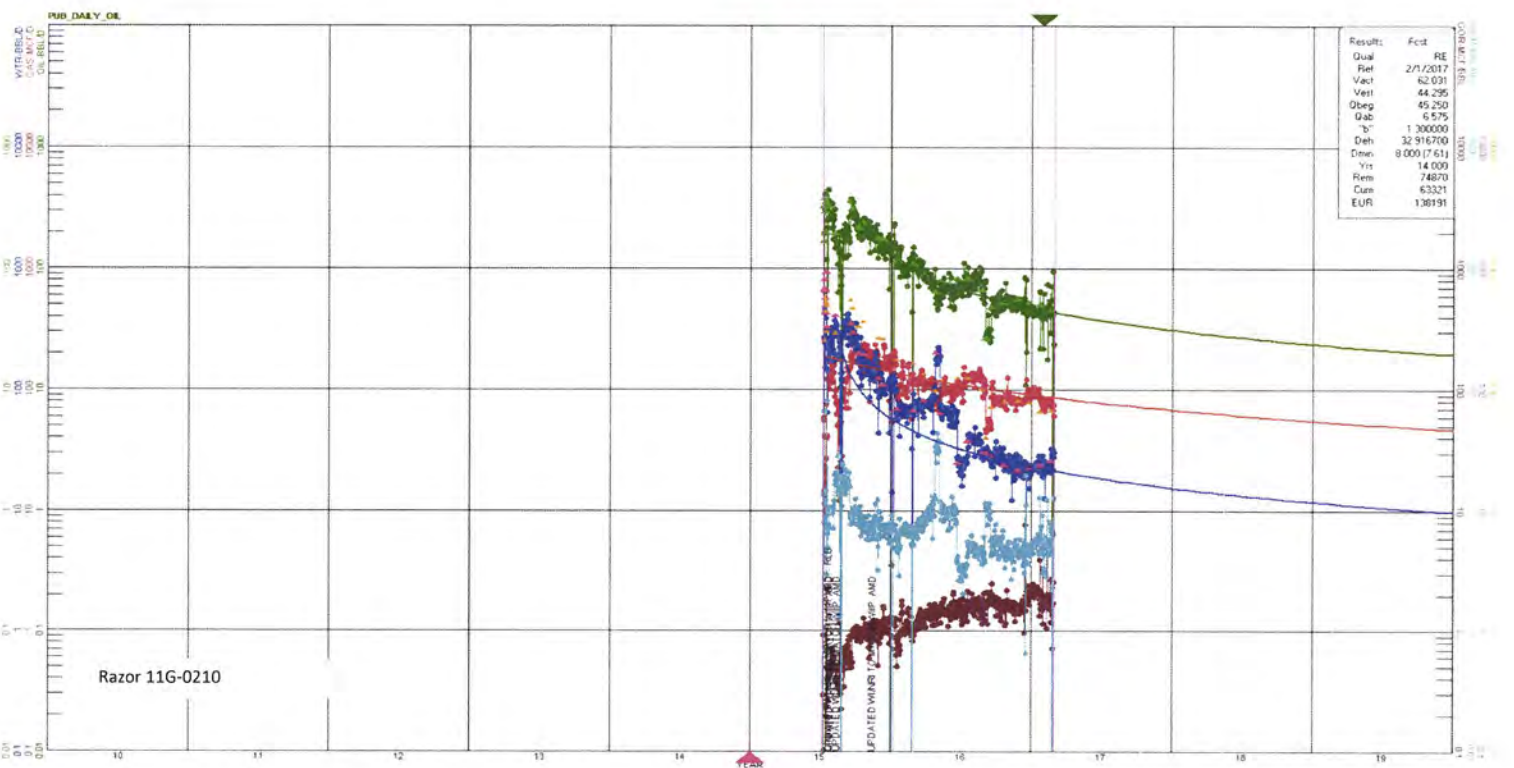
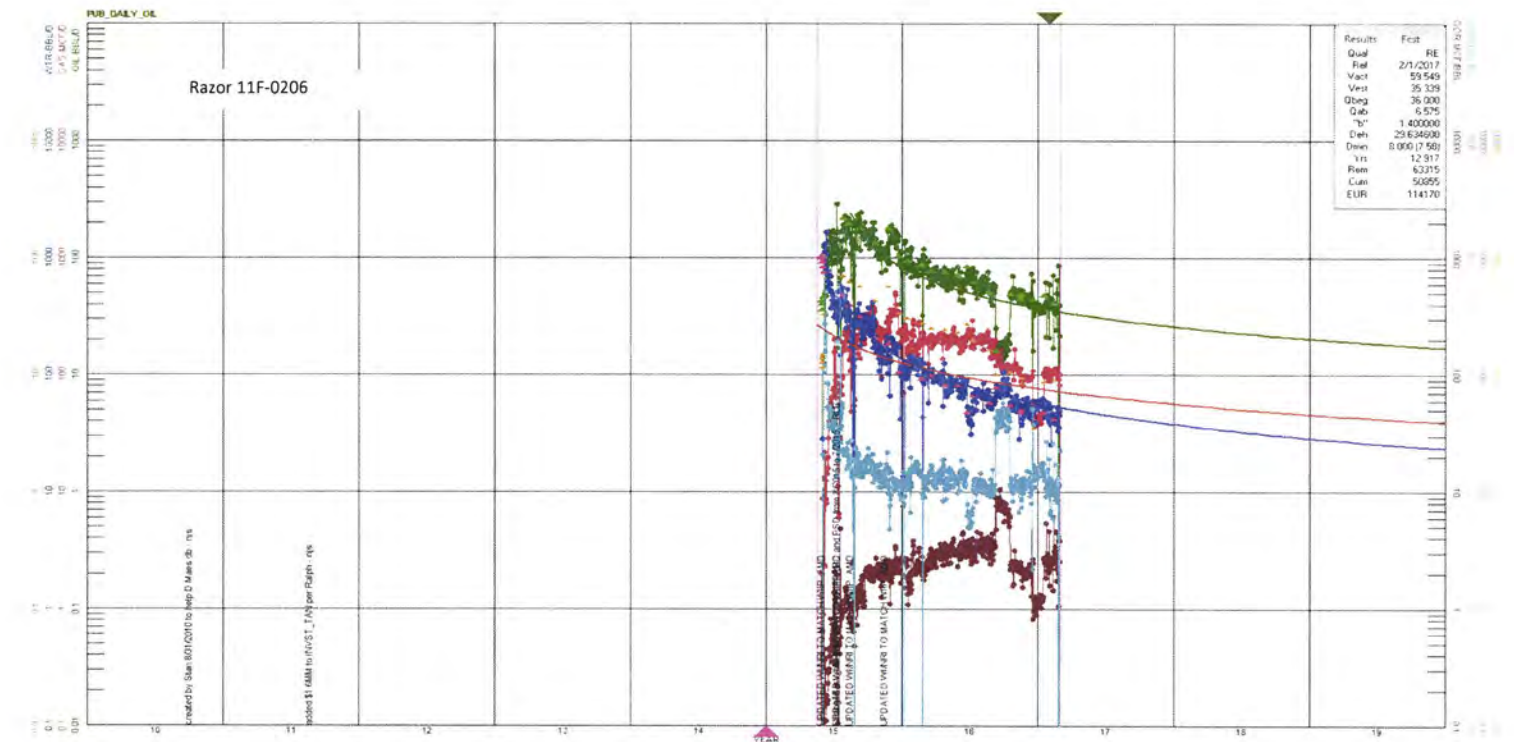


Exhibit E-4b  
Docket 170600334  
Cause No. 535



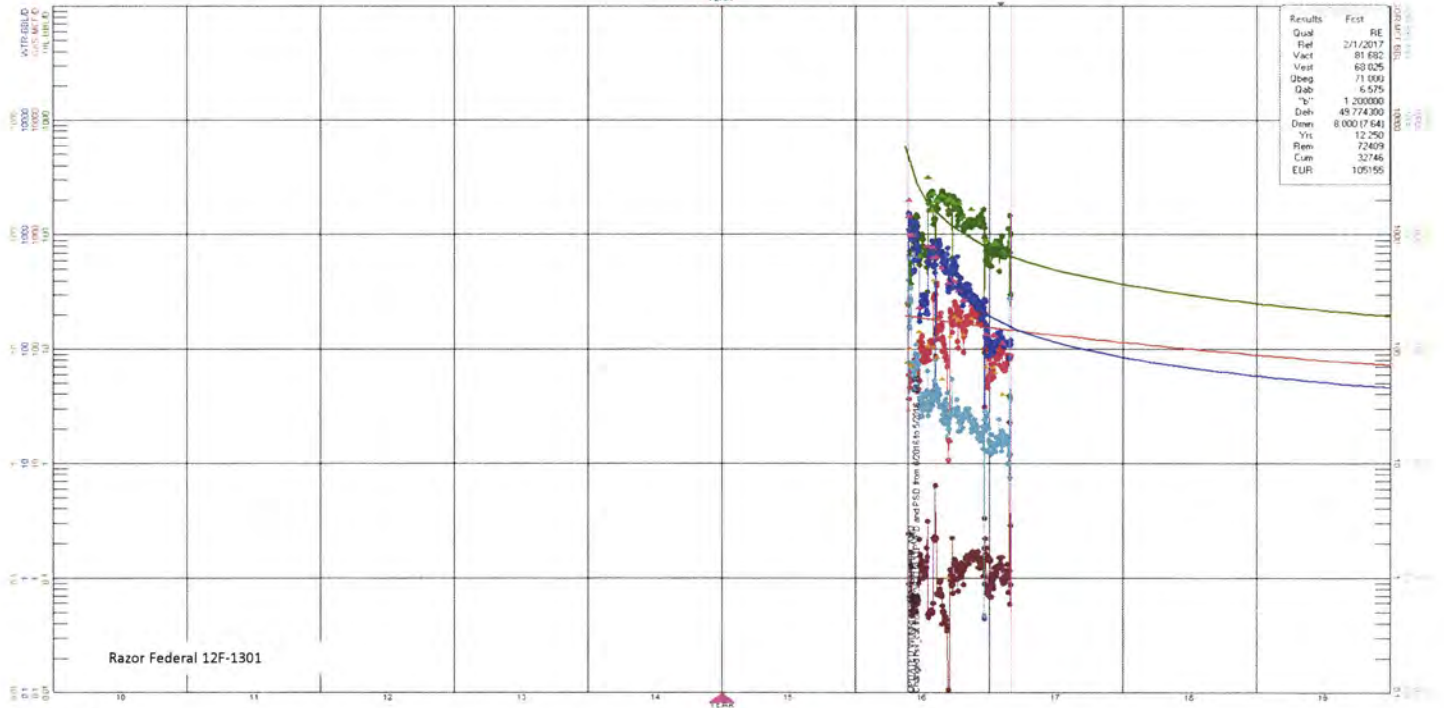
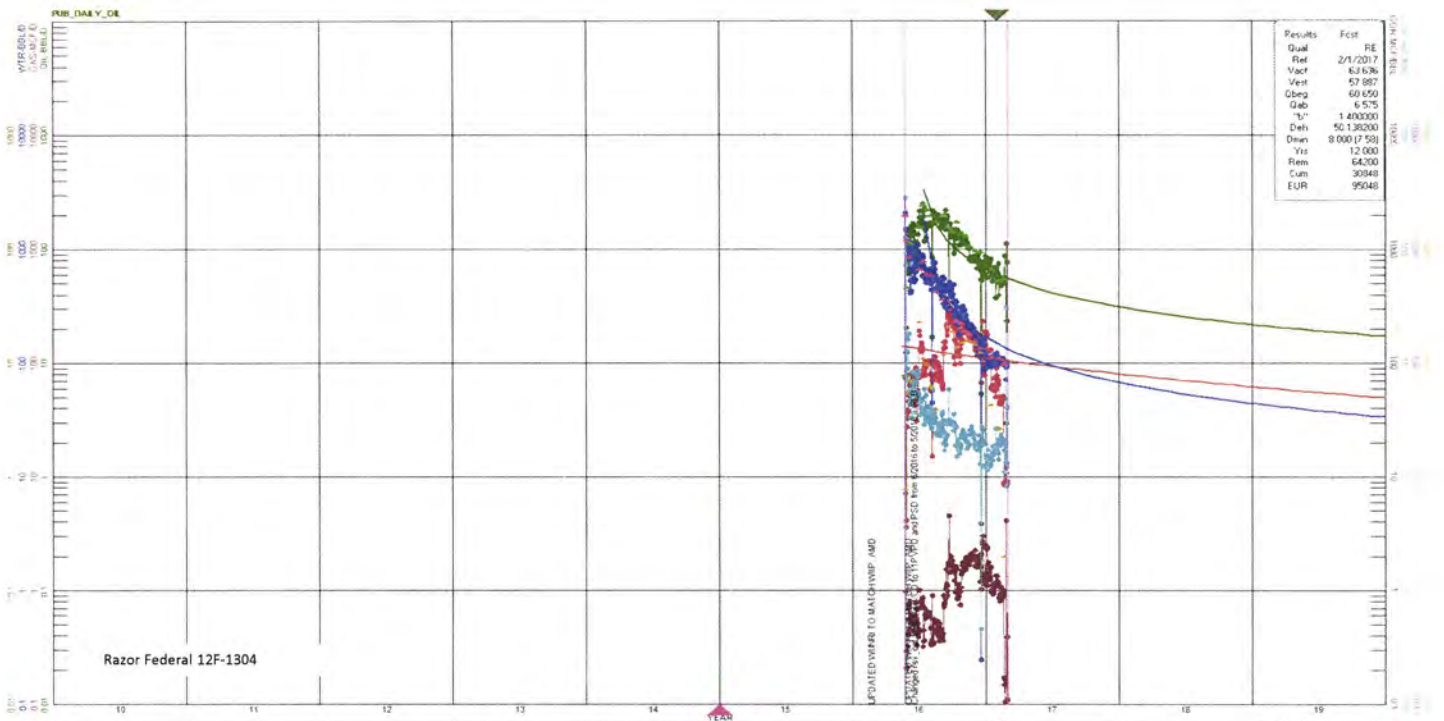


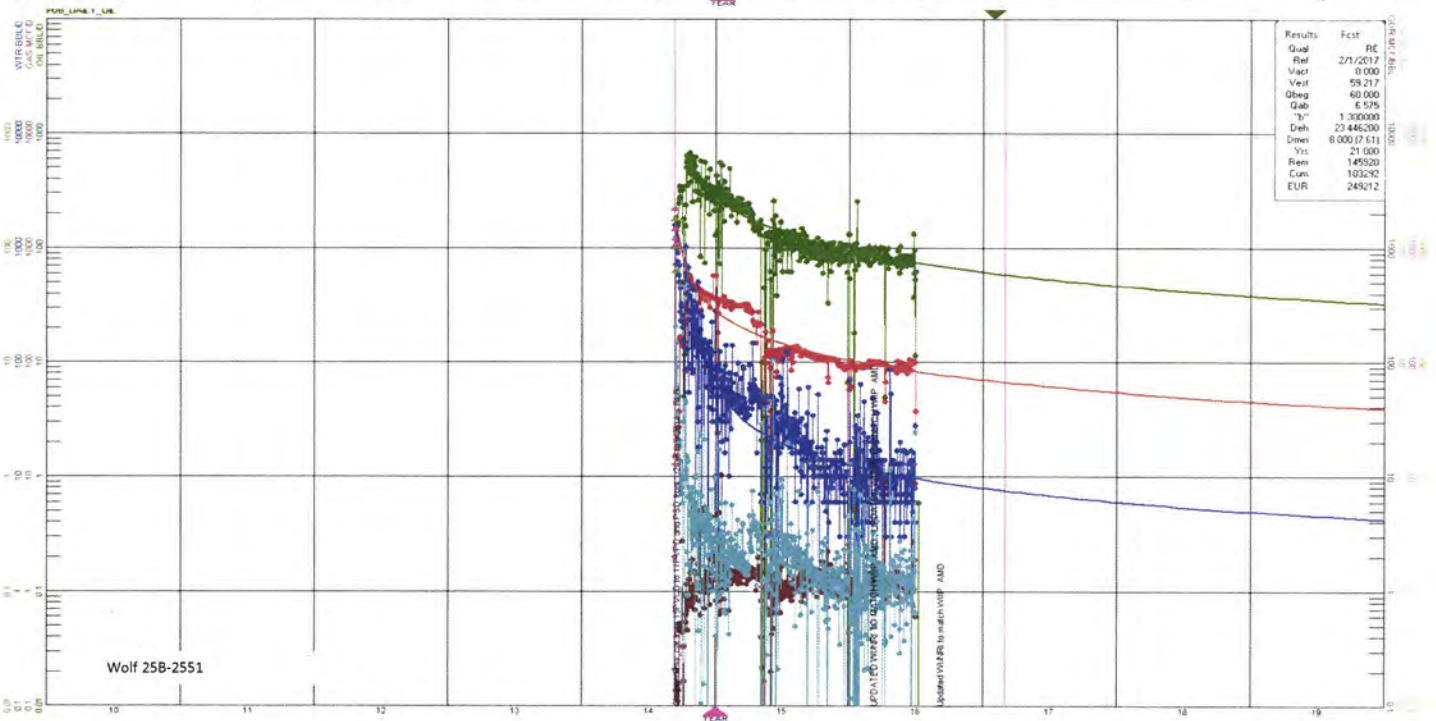
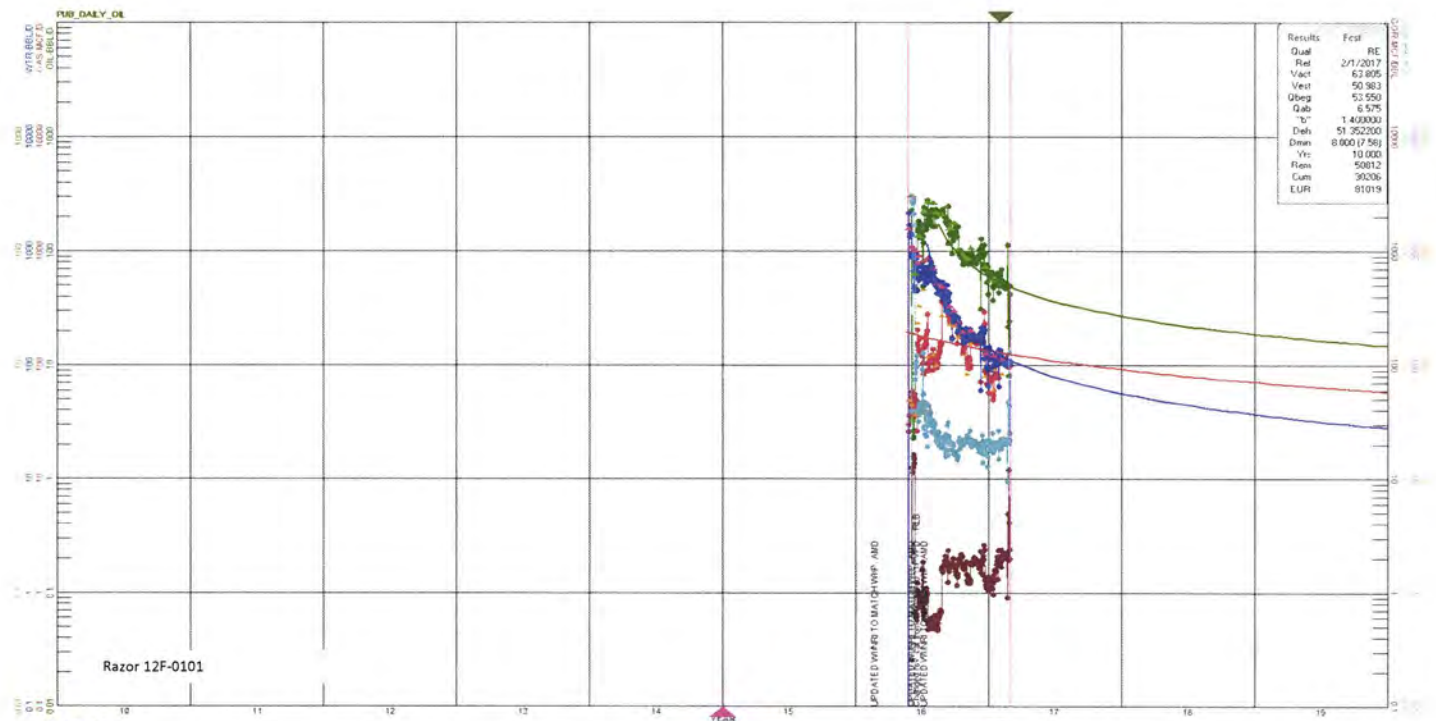










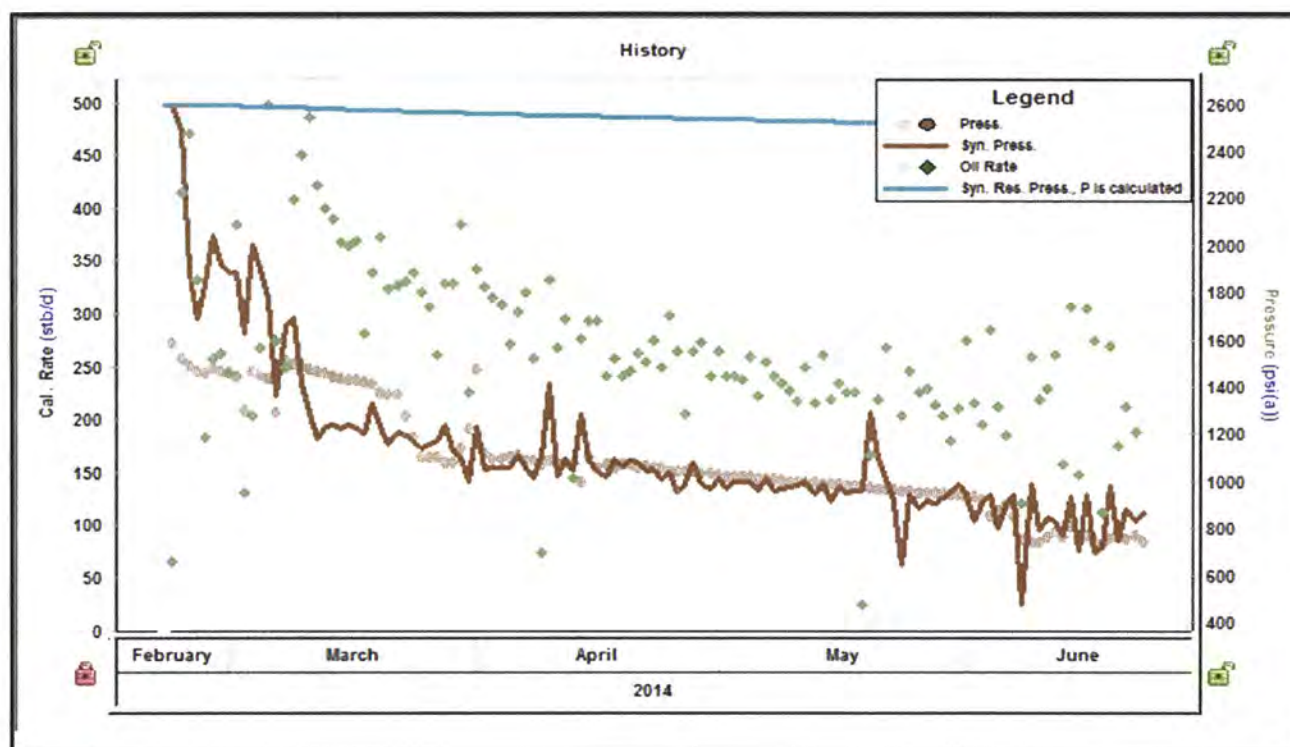
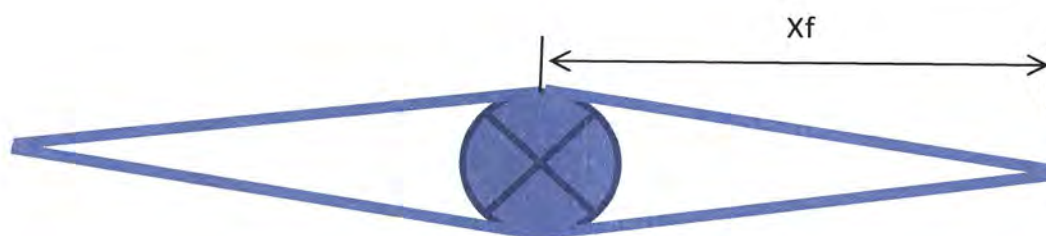




## Whiting Niobara B RTA Results

RTA Indicates that Frac Half Lengths average 85 ft and the permeability to Oil is only 19 MicroDarcies

Well Name	Drilling Unit	Well Location	Oil Permeability MicroDarcies	Xf ft
Wildhorse 16-13H	640	SEC 16 T9N R59W	17	50
Two Mile 22-13H	640	SEC 22 T11N R57W	17	85
Horsetail 18-0733H	960	SEC 18 T10N R57W	12	105
Wolf 35-2623H	960	SEC 35 T10N R59W	3	100
Horsetail 16-1610BH	640	SEC 16 T10N R57W	24	70
Horsetail 07-611H	960	SEC 18 T10N R57W	40	95
			19	84



## 1280 Acre Well Layout

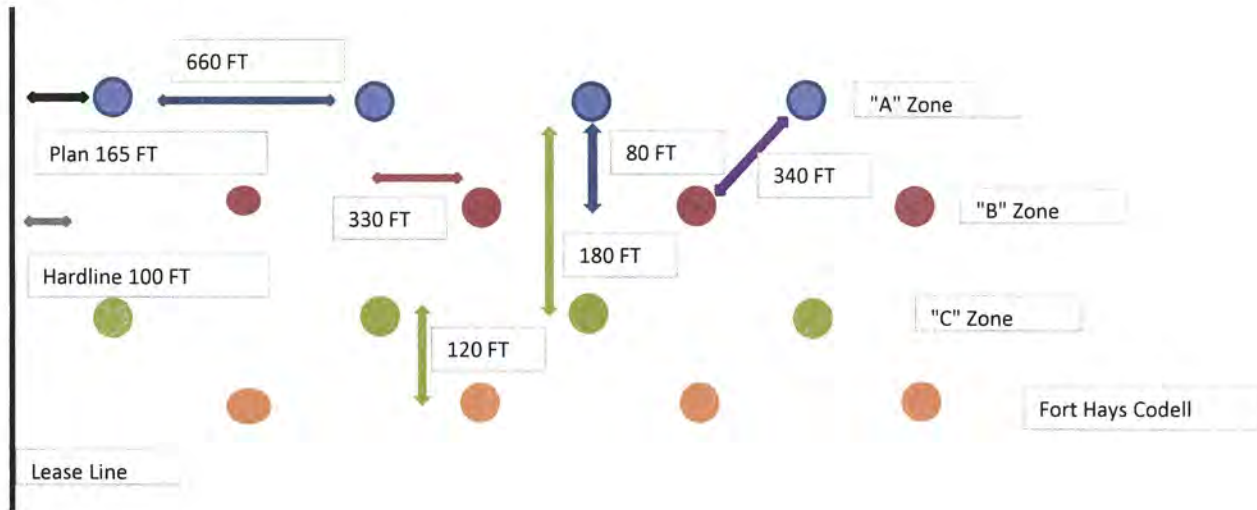


Exhibit E-6  
Docket 170600334  
Cause No. 535

**TECHNOLOGY LABORATORY, INC.**1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414**Extended Hydrocarbon Liquid Analysis (DHA)  
E & P Tank Information**Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80290-2300

Contact: Tom Gibbons

Sample ID: Oil from separator  
Well #: Horsetail 07-0611H  
Lab ID: A9547-01-Oil  
Sampled By: Bill Emery  
Analyzed By: Bill EmerySampled: 12/18/13  
Received: 12/18/13  
Analyzed: 12/20/13Field: Pawnee Buttes  
Cylinder: 150 cc SS  
Sample Temperature °F: 132  
Sample Pressure (psig): 8  
Sampling Method: Water Displacement

COMPONENT	Mole %	Weight %	LV %
Carbon Dioxide	0.000	0.000	0.000
Nitrogen (Air)	0.000	0.000	0.000
Methane	0.000	0.000	0.000
Ethane	0.135	0.038	0.079
Propane	1.135	0.427	0.857
Isobutane	0.388	0.186	0.250
n-Butane	2.180	1.108	1.440
Isopentane	0.661	0.624	0.757
n-Pentane	1.950	1.231	1.478
Cyclopentane	0.030	0.202	0.209
n-Hexane	1.388	1.043	1.190
Cyclohexane	0.614	0.484	0.439
Other Hexanes	1.314	0.495	1.096
Other Heptanes	4.107	3.588	3.942
Methylcyclohexane	0.625	0.732	0.774
2,2,4-Trimethylpent	0.000	0.000	0.000
Benzene	0.050	0.177	0.161
Toluene	0.692	0.856	0.483
Ethylbenzene	0.141	0.131	0.114
Xylenes	0.751	0.739	0.698
C8	3.385	3.343	3.452
C9	0.004	0.330	3.293
C10*	76.212	81.684	75.717
Total:	100.000	100.000	100.000

API Gravity (from tank sample): API 55.80  
Resid Vapor Pressure (from tank sample): psig35.0  
5.8

C10 + Average Molecular Weight

287.0

C10 + specific gravity

0.871

Analytical Methods

ASTM D1945 ASTM D6730 (DHA)

Page 2 of 11

**TECHNOLOGY LABORATORY, INC.****Centre Professional Office Park**1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414**CERTIFICATE OF ANALYSIS**Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80290-2300Sample ID: Horsetail 07-0611H  
Sample Point: Separator  
Field: Pawnee  
Laboratory ID: A9506-01Sampled: 12/10/2013  
Received: 12/10/2013  
Analyzed: 12/10/2013Cylinder: SS-150  
Sample Pressure (psig): 12  
Sample Temperature °F: 132

COMPONENT	Mole %	GPM @ 14.696
Oxygen/Nitrogen	0.734	*
CO <sub>2</sub>	2.210	*
Methane	57.395	*
Ethane	15.407	4.1206
Propane	13.494	3.7183
i-Butane	1.678	0.5480
n-Butane	5.729	1.8062
i-Pentane	1.089	0.3965
n-Pentane	1.311	0.4747
Hexanes Plus	0.951	0.4116
Totals:	100.000	11.4788

Gross Wet Real BTU/scf at 60°F & 14.696 psia  
Gross Dry Real BTU/scf at 60°F & 14.696 psia  
Relative Density (AIR=1)1547.29  
1574.69  
0.9608*Bill Emery*  
TECHNOLOGY LABORATORY, INC.

Page 1 of 1

**TECHNOLOGY LABORATORY, INC.**1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414**Extended Hydrocarbon Liquid Analysis (DHA)  
E & P Tank Information**Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80290-2300

Contact: Tom Gibbons

Sample ID: Oil from separator  
Well #: Razor 12-0141H  
Lab ID: A7457-07 Oil  
Sampled By: Bill Emery  
Analyzed By: Bill EmerySampled: 12/09/12  
Received: 12/09/12  
Analyzed: 12/11/12Field: Pawnee Buttes  
Cylinder: 150 cc SS  
Sample Temperature °F: 128  
Sample Pressure (psig): 3  
Sampling Method: Water Displacement

COMPONENT	Mole %	Weight %	LV %
Carbon Dioxide	0.000	0.000	0.000
Nitrogen (Air)	0.000	0.000	0.000
Methane	0.095	0.013	0.037
Ethane	0.164	0.041	0.092
Propane	2.873	1.065	1.609
Isobutane	0.214	0.104	0.142
n-Butane	0.802	0.362	0.511
Isopentane	0.391	0.237	0.290
n-Pentane	0.729	0.442	0.533
Cyclopentane	0.181	0.107	0.108
n-Hexane	0.699	0.507	0.580
Cyclohexane	0.533	0.397	0.380
Other Hexanes	0.657	0.666	0.734
Other Heptanes	2.251	1.951	2.054
Methylcyclohexane	0.569	0.403	0.406
2,2,4-Trimethylpent	0.000	0.000	0.000
Benzene	0.177	0.117	0.100
Toluene	0.657	0.826	0.444
Ethylbenzene	0.365	0.344	0.300
Xylenes	0.961	0.885	0.769
C8	3.624	3.450	3.538
C9	3.719	3.947	3.955
C10*	79.968	84.421	83.413
Total:	100.000	100.000	100.000

API Gravity (from tank sample): API 60.60  
Resid Vapor Pressure (from tank sample): psig20.7  
3.9

Volume of gas per volume of liquid

SCF/Gal: 0.1471

SCF/Gal: 6.1770

C10 + Average Molecular Weight

257.7

C10 + specific gravity

0.880

Analytical Methods

ASTM D1945 ASTM D6730 (DHA)

Page 02 of 08

**TECHNOLOGY LABORATORY, INC.****Centre Professional Office Park**1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 490-1414**CERTIFICATE OF ANALYSIS**Whiting Oil & Gas Corp.  
1700 Broadway  
Denver, CO 80290-2300Sample ID: Razor 21A  
Sample Point: Meter  
Field: Pawnee  
Laboratory ID: B1122-01Sampled: 3/25/2014  
Received: 3/25/2014  
Analyzed: 3/27/2014Cylinder: SS-150  
Sample Pressure (psig): 7.7  
Sample Temperature °F: 60

COMPONENT	Mole %	GPM @ 14.696
Oxygen/Nitrogen	1.151	*
CO <sub>2</sub>	2.661	*
Methane	58.610	*
Ethane	14.660	3.9207
Propane	12.744	3.5117
i-Butane	1.586	0.5187
n-Butane	5.277	1.6636
i-Pentane	1.011	0.3701
n-Pentane	1.199	0.4343
Hexanes Plus	1.101	0.4767
Totals:	100.000	10.8958

Gross Wet Real BTU/scf at 60°F & 14.696 psia  
Gross Dry Real BTU/scf at 60°F & 14.696 psia  
Relative Density (AIR=1)1509.94  
1536.67  
0.9401*Bill Emery*  
TECHNOLOGY LABORATORY, INC.

Page 1 of 1



TECHNOLOGY LABORATORY, INC.  
CENTRE PROFESSIONAL PARK  
1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 480-1414

CERTIFICATE OF ANALYSIS

Whiting Petroleum Corp.  
1700 Broadway  
Denver, CO 80290-2300

Sample ID Horsetail 07-0611H  
Laboratory ID A9549-01

Sampled 12/18/13  
Received 12/18/13

Project No Redtail Field  
Matrix Water

CAS Number	Parameter	Result	Units	MDL	Method	Date Analyzed
N/A	Specific Gravity	1.0038			ASTM D1298	12/23/13
N/A	Resistivity	0.2793	Ohm Meters @ 68 °F		EPA-120.1	12/23/13
N/A	pH	7.1	Units		EPA-150.1	12/23/13
N/A	Total Dissolved Solids (TDS)	35270	mg/L	5	EPA-160.1	12/23/13
15867-00-6	Chloride	14243	mg/L	1	EPA-300.1	12/23/13
18785-72-3	Sulfate	20.0	mg/L	0.05	EPA-300.1	12/23/13
71-52-3	Bicarbonate	927	mg/L	1	EPA-310.2	12/23/13
97328-76-2	Carbonate (CO <sub>3</sub> )	< 1.0	mg/L	1	EPA-310.2	12/23/13
7440-39-3	Dissolved Barium	20.5	mg/L	0.01	EPA-6010B	12/23/13
7440-42-8	Dissolved Boron	20.2	mg/L	0.006	EPA-6010B	12/23/13
7440-70-2	Dissolved Calcium	190	mg/L	0.1	EPA-6010B	12/23/13
7439-89-6	Dissolved Iron	14.2	mg/L	0.007	EPA-6010B	12/23/13
7439-95-4	Dissolved Magnesium	35.5	mg/L	0.02	EPA-6010B	12/23/13
7440-09-7	Dissolved Potassium	19.2	mg/L	0.1	EPA-6010B	12/23/13
7440-23-5	Dissolved Sodium	8899	mg/L	0.01	EPA-6010B	12/23/13
7704-99-6	Dissolved Zirconium	0.077	mg/L	0.01	EPA-6010B	12/23/13

*Luella*  
TECHNOLOGY LABORATORY, INC.

Page 1 of 3

\*The results contained in this report relate only to those items tested.



TECHNOLOGY LABORATORY, INC.  
CENTRE PROFESSIONAL PARK  
1012 Centre Avenue  
Fort Collins, Colorado 80526  
(970) 480-1414

CERTIFICATE OF ANALYSIS

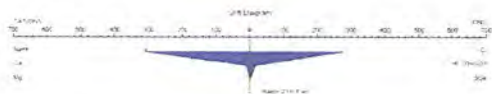
Whiting Petroleum Corp.  
1700 Broadway  
Denver, CO 80290-2300

Sample ID Redtail KRP-1  
Laboratory ID A9750-01

Sampled 12/18/13  
Received 12/18/13

Project No Redtail  
Matrix Water

CAS Number	Parameter	Result	Units	MDL	Method	Date Analyzed
N/A	Specific Gravity	1.0038			ASTM D1298	12/23/13
N/A	Resistivity	0.2793	Ohm Meters @ 68 °F		EPA-120.1	12/23/13
N/A	pH	7.1	Units		EPA-150.1	12/23/13
N/A	Total Dissolved Solids (TDS)	41340	mg/L	5	EPA-160.1	12/23/13
15867-00-6	Chloride	4565	mg/L	1	EPA-300.1	12/23/13
18785-72-3	Sulfate	4.026	mg/L	0.05	EPA-300.1	12/23/13
71-52-3	Bicarbonate	975	mg/L	1	EPA-310.2	12/23/13
97328-76-2	Carbonate (CO <sub>3</sub> )	4.1	mg/L	1	EPA-310.2	12/23/13
7440-39-3	Dissolved Barium	60.4	mg/L	0.01	EPA-6010B	12/23/13
7440-42-8	Dissolved Boron	16.6	mg/L	0.006	EPA-6010B	12/23/13
7440-70-2	Dissolved Calcium	169	mg/L	0.1	EPA-6010B	12/23/13
7439-89-6	Dissolved Iron	3.227	mg/L	0.007	EPA-6010B	12/23/13
7439-95-4	Dissolved Magnesium	32.8	mg/L	0.02	EPA-6010B	12/23/13
7440-09-7	Dissolved Potassium	31.5	mg/L	0.1	EPA-6010B	12/23/13
7440-23-5	Dissolved Sodium	1084	mg/L	0.01	EPA-6010B	12/23/13
7704-99-6	Dissolved Zirconium	0.057	mg/L	0.01	EPA-6010B	12/23/13



*Luella*  
TECHNOLOGY LABORATORY, INC.

Page 1 of 1

\*The results contained in this report relate only to those items tested.



# Estimation of Frac Height Growth using Tracer Data

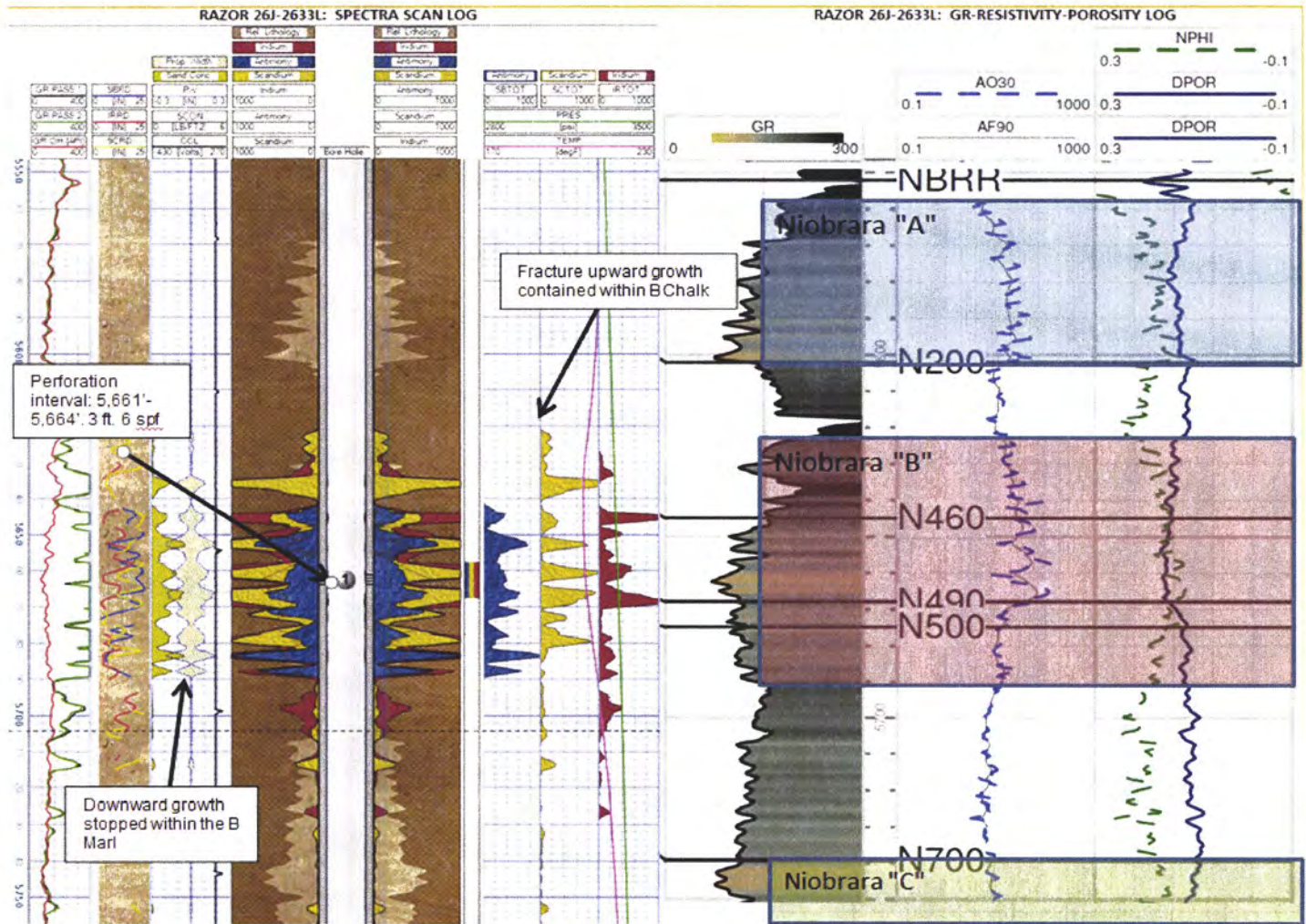
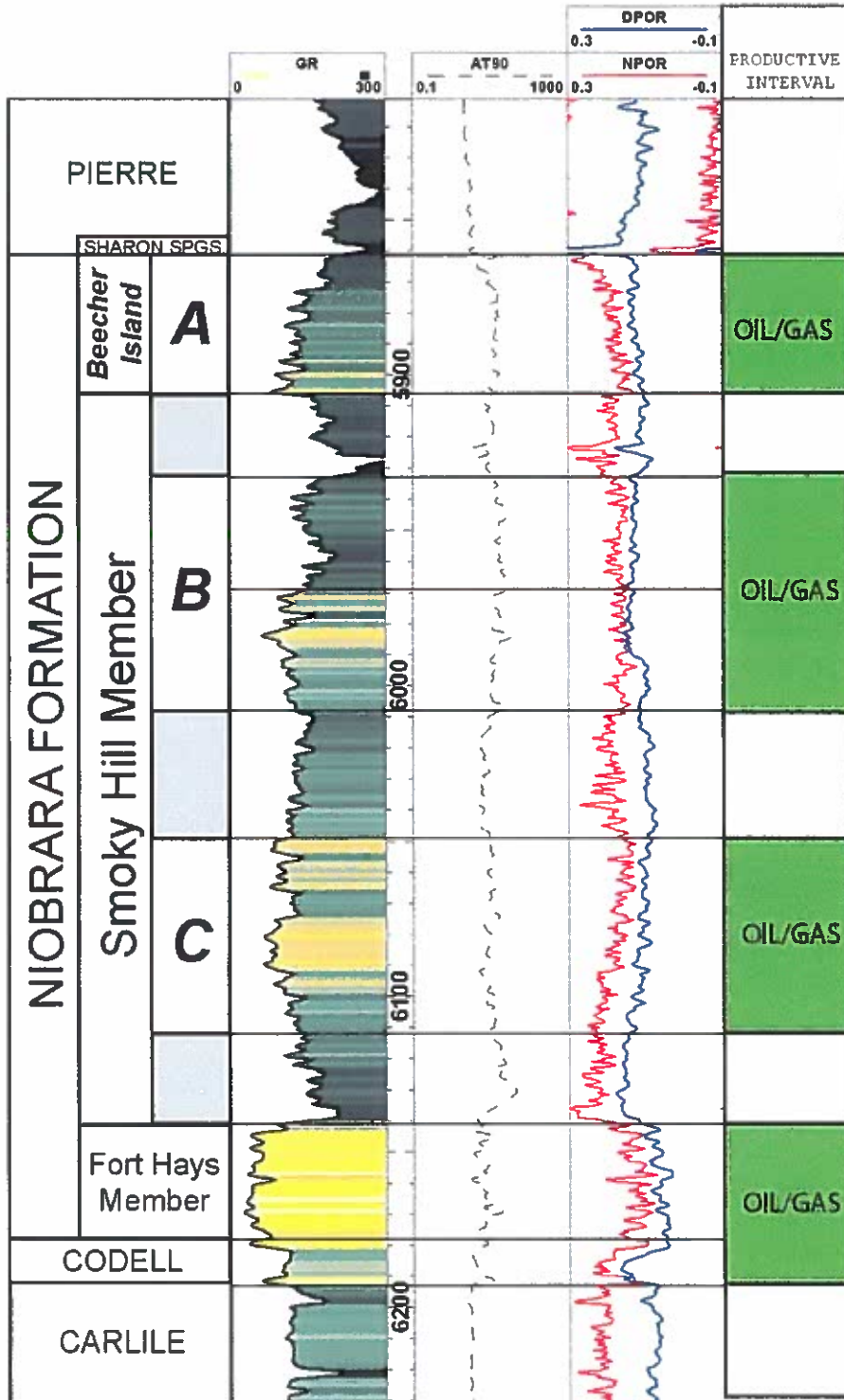


Exhibit E-8  
Docket 170600334  
Cause No. 535

051233249100  
 WHITING OIL & GAS CORP.  
**TERRACE 36-32M**  
 T10N R59W S36

KB : 4,905  
 TD : 6,928



170600334

EXHIBIT #B-1  
 DOCKET 170600334  
 CAUSE 535



APPLICATION LANDS

11N 58W

051230711600  
DUNWICK COMPANY  
HALEY 1

051230582800  
BALDERSON DRUG CO  
ROBERTS 1

051230857200  
GILBERT B D & M P  
LEBSACK-STATE 36-23

051230578900  
DAVIS OIL CO  
BEFFIE 1

EXHIBIT #B-2  
DOCKET 170600334  
CAUSE 535

Whiting Oil and Gas

Top Niobrara

Subsea Structure Map

POSTED WELL DATA

EXPLOR - NEPTUNE P (ST)

WELL 3 1000000

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)

NEPTUNE P (ST)



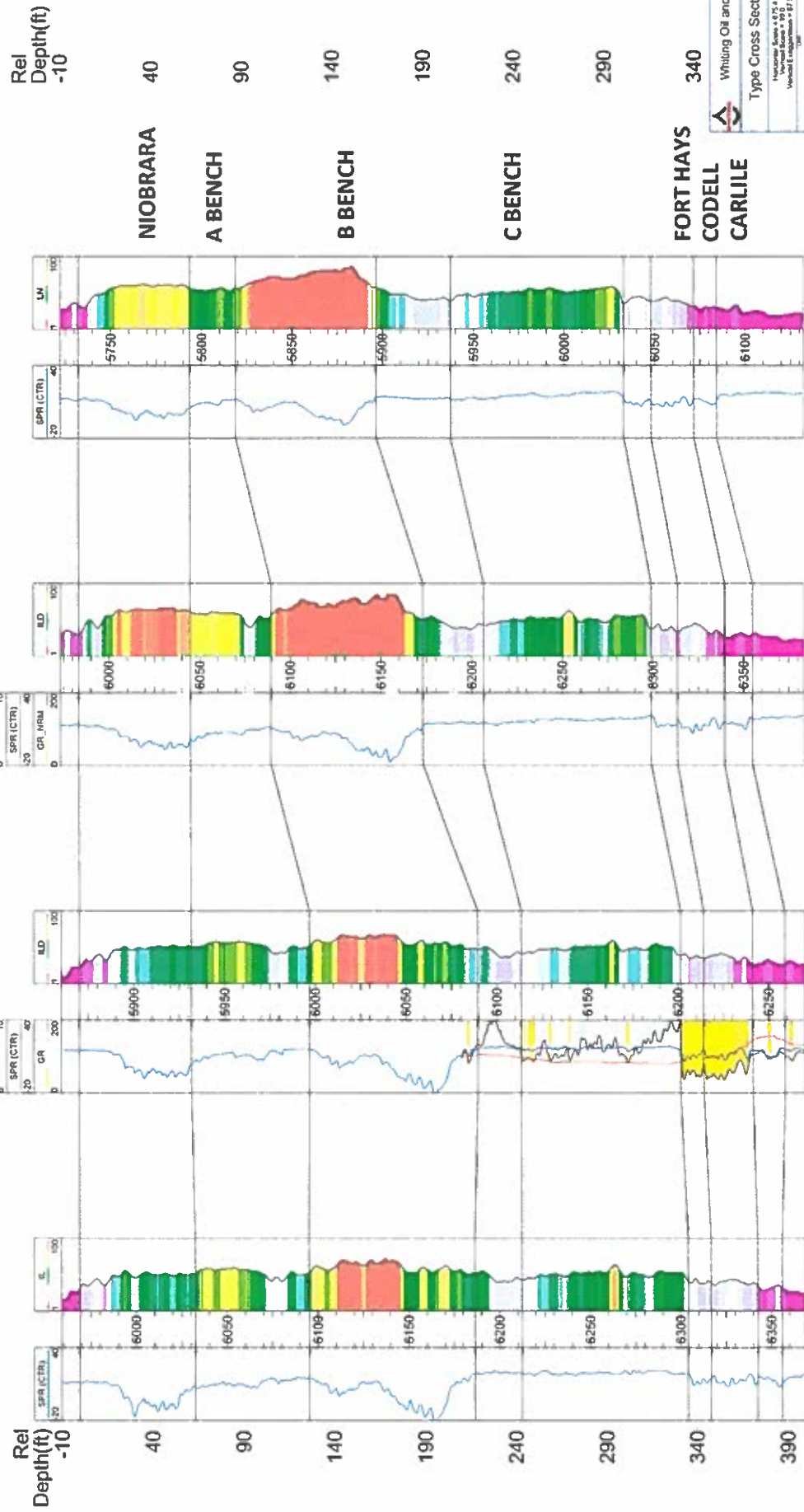
**EXHIBIT #B-4**  
**DOCKET 170600334**  
**CAUSE 535**

051230578900  
 DAVIS OIL CO  
 BEFFIE 1  
 T11N R57W S6

051230857200  
 GILBERT B D & M P  
 LEBACK-STATE 36-23  
 T11N R58W S36

051230711600  
 DUNWICK COMPANY  
 HALSEY 1  
 T11N R57W S19

051230582800  
 BALDERSON DR LG CO  
 ROBERTS 1  
 T11N R58W S24



Whiting Oil and Gas
Type Cross Section
Horizontal Axis = 0.05 x
Vertical Axis = 0.05 x
Vertical Scale = 0.05 x
Horizontal Scale = 0.05 x
Vertical Scale = 0.05 x
Horizontal Scale = 0.05 x