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

IN THE MATTER OF THE PROMULGATION) CAUSE NO. 531
AND ESTABLISHMENT OF FIELD RULES)
TO GOVERN OPERATIONS FOR THE) DOCKET NO. 161000455
NIOBRARA FORMATION, JACKSON)
COUNTY, COLORADO) TYPE: SPACING

REQUEST FOR RECOMMENDATION OF
APPROVAL OF APPLICATION WITHOUT A HEARING

SandRidge Exploration & Production, LLC, Operator No. 10598, ("SandRidge" or "Applicant"), by and through its undersigned attorneys, hereby 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 August 25, 2016, amended September 16, 2016, verified application ("Application") and the supporting exhibits without a hearing.

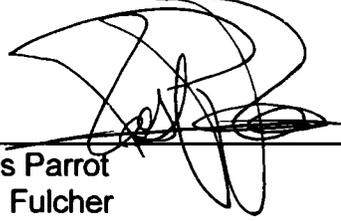
Applicant requests that the above-captioned matter be approved based upon: (i) the merits of the Application, and (ii) Applicant's sworn written testimony verifying sufficient facts along with exhibits that adequately support the relief requested in the Application. To Applicant's information and belief,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

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

DATED this 3 day of October, 2016.

Respectfully submitted,

SANDRIDGE EXPLORATION & PRODUCTION, LLC

By: 
James Parrot
Jillian Fulcher
Beatty & Wozniak, P.C.
Attorneys for Applicant
216 16th Street, Suite 1100
Denver, Colorado 80202
(303) 407-4499

**SANDRIDGE
EXPLORATION
& PRODUCTION,
LLC**

Cause No. 531
Docket No. 161000455

Land Testimony – Richard Silman
Cause No. 531; Docket No. 161000455
Spacing Application
Unnamed Field, Jackson County, Colorado

October 2016 Colorado Oil and Gas Conservation Commission Hearing

My name is Richard Silman, I am currently employed as a Senior Landman for SandRidge Exploration and Production, LLC (“SandRidge” or “Applicant”). I graduated from the University of Oklahoma in 2009 with a Bachelor in Business Administration in Energy Management. I have over 7 years of experience in petroleum land management and the oil and gas business. I am personally familiar with the lands subject to, and the matters set forth in the May 19, 2016 verified application (the “Application”) filed herein.

In support of the Application, I am submitting Six (6) exhibits. The exhibits are attached to my sworn testimony and form the basis for the Application requesting to: (1) establish an approximate 2560-acre drilling and spacing unit (“DSU”) for Sections 28, 29, 32 and 33, Township 7 North, Range 80 West, 6th P.M. (“Application Lands”) and authorize up to sixteen (16) horizontal wells in the proposed DSU for production of oil, gas, and associated hydrocarbons from the Niobrara Formation, and (2) authorize reduced setbacks for the northern and southern boundaries of the application lands. In support of its Application, Applicant states and alleges as follows:

1. Exhibit No. L-1

Exhibit No. L-1 is an overhead map containing the existing spacing under Order No. 531-1, and producing wells covering the Application Lands and adjacent sections. Please note that the existing spacing creates a window of approximately 1440 acres within the application lands that are currently left out of a producing unit.

2. Exhibit No. L-2

Exhibit No. L-2 is a leasehold map indicating no unleased tracts within the application lands or lands adjacent to the proposed DSU. Please note that Applicant currently owns 100% of the working interest within the application lands.

3. Exhibit No. L-3

Exhibit No. L-3 is a proposed development map which indicates the approximate location for the sixteen extended reach laterals and the existing 480-acre DSU for the Spicer 3-32H (API# 05-057-06469). Applicant has agreed to limit the completion interval to 300 feet from the Spicer 3-32H while the well is still producing. The 640-acre unit established by Order 531-1 will be vacated once Applicant plugs and abandons both the Buffalo Ditch 1-32H (API# 05-057-06463) and Buffalo Ditch 2-32H (API# 05-057-06464). Applicant intends to commence operations for the initial extended reach lateral by the end of 2018.

4. Exhibit No. L-4

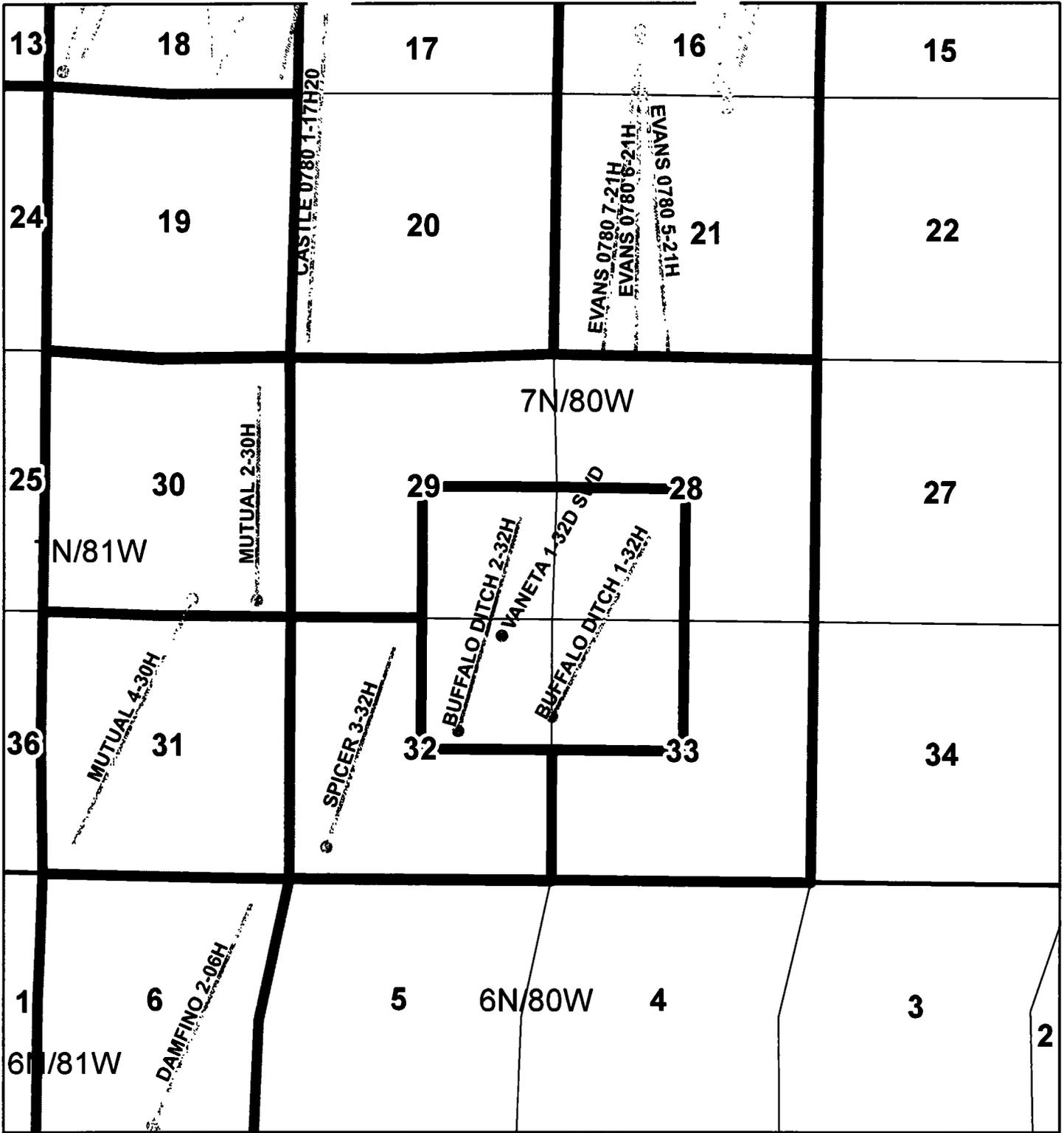
Exhibit No. L-4 is a wetlands map that provides the approximate location for lands currently subject to wetlands restrictions by the Colorado Parks and Wildlife. Applicant has agreed to limit the number of additional pad locations to a total of Four (4) pads within the entire DSU. The Map depicts the proposed pad locations in purple. Under the existing spacing created by Order 531-1, applicant would need separate production facilities for wells containing federal royalties. The creation of the proposed 2560-acre DSU will allow applicant to minimize the environmental footprint by consolidating production to one central tank facility.

5. Exhibit No. L-5

Exhibit No. L-5 is a Sixteen (16) section topographic map centered on the Application Lands.

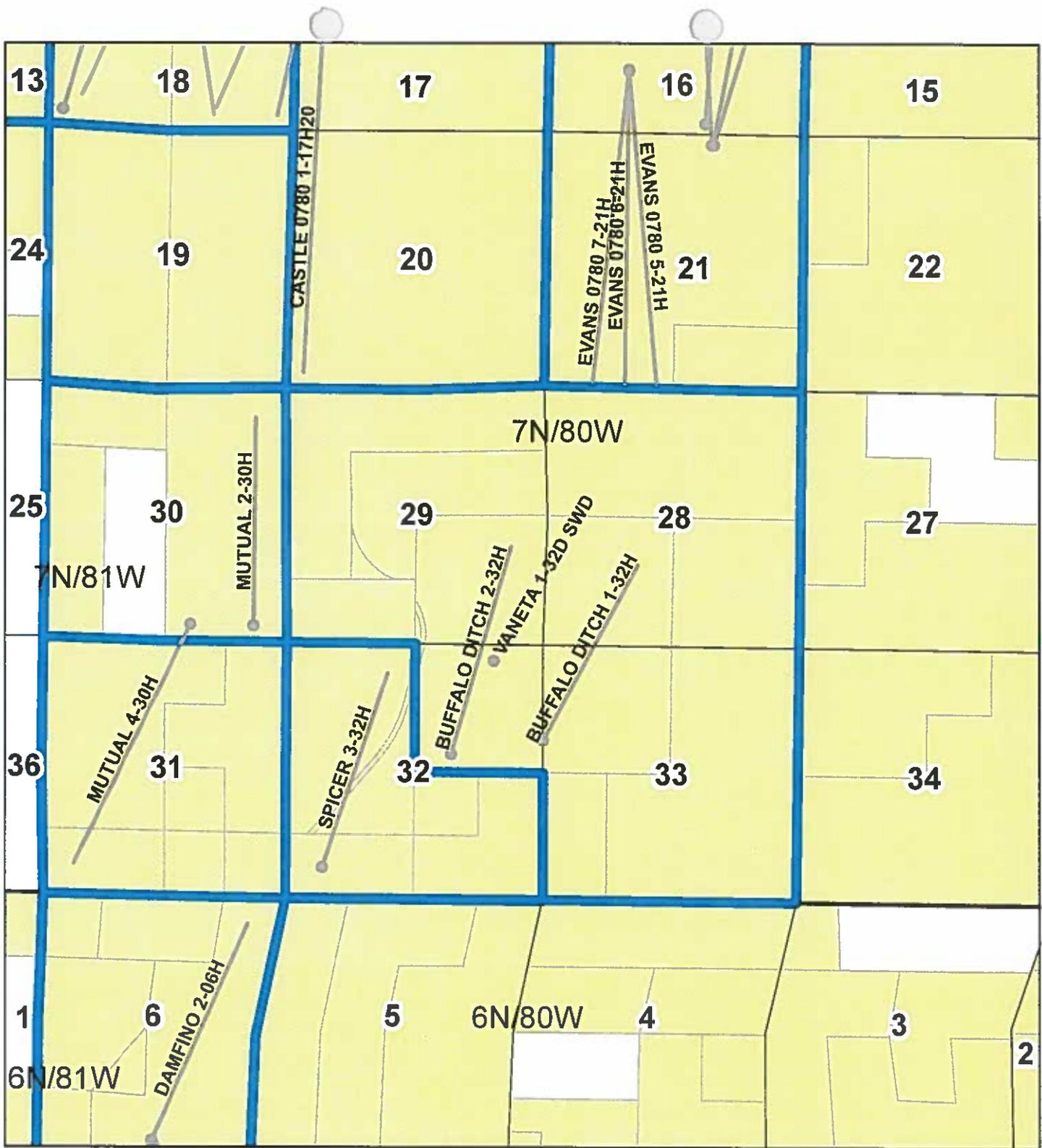
6. Exhibit No. L-6

Exhibit No. L-6 is a Sixteen (16) section aerial map centered on the Application Lands.



0 0.5 1 Miles

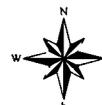
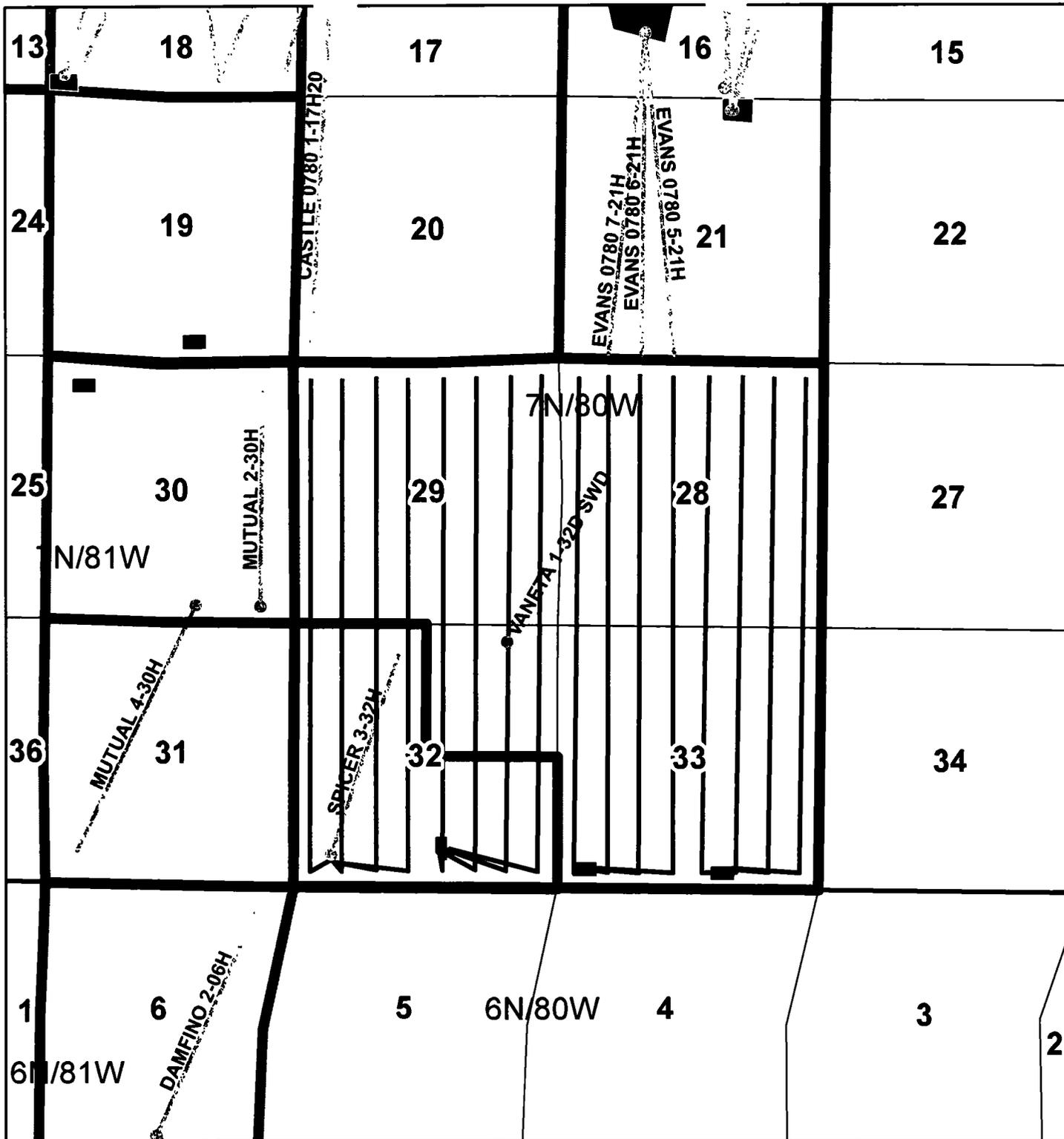
<p>Exhibit No. L-1 10/3/2016</p>	<p>7N-80W, Sec. SW/4 28, SE/4 29, NE/4 32, & NW/4 33: All 640 Acres more or less</p>
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0 0.5 1 Miles

Exhibit No. L-2
10/3/2016

7N-80W, Sec. SW/4 28, SE/4 29,
NE/4 32, & NW/4 33: All
640 Acres more or less



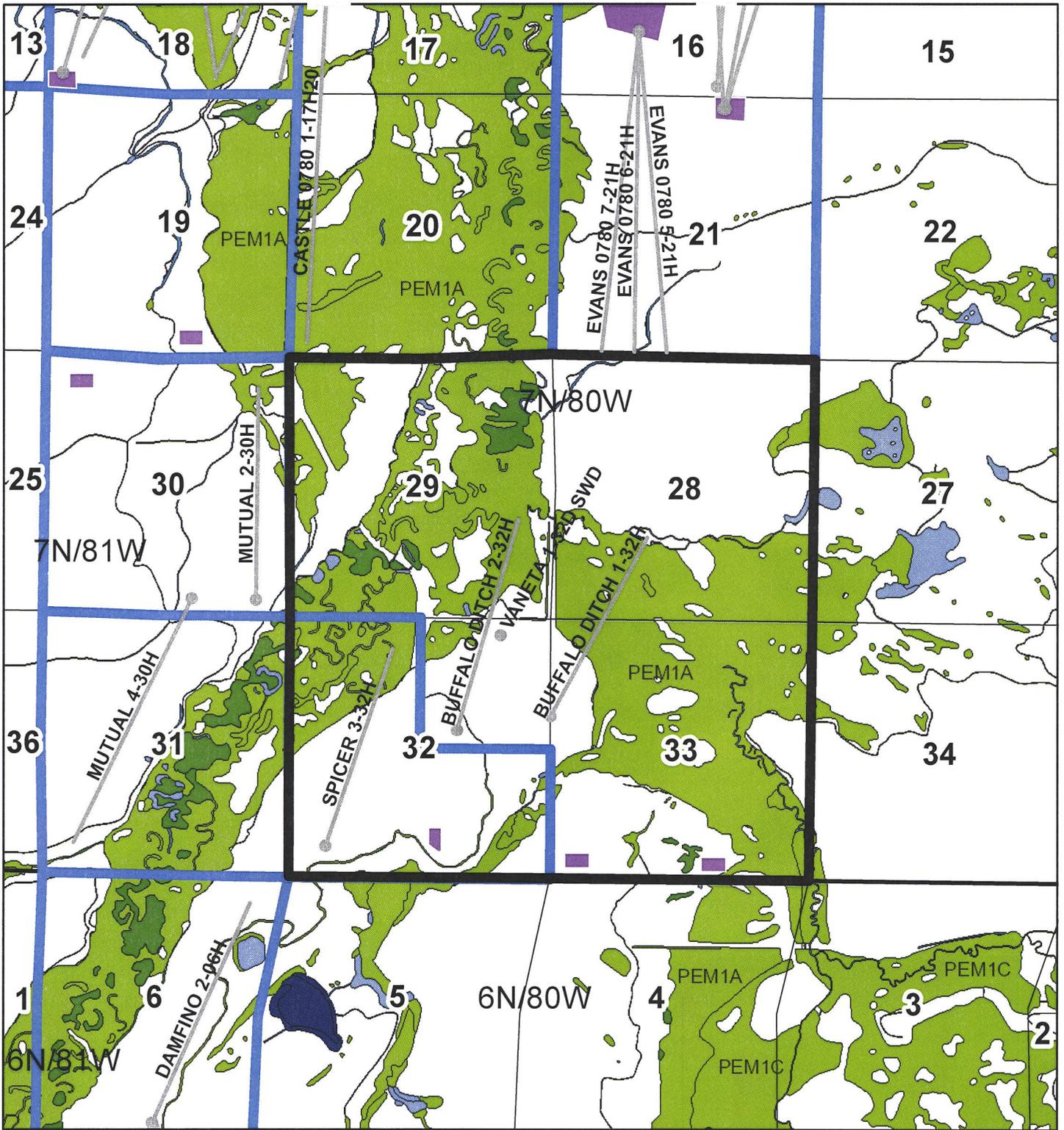
0 0.5 1 Miles

Exhibit No. L-3

10/3/2016

7N-80W, Sec. 28, 29, 32, & 33

All 2560 Acres more or less



Legend

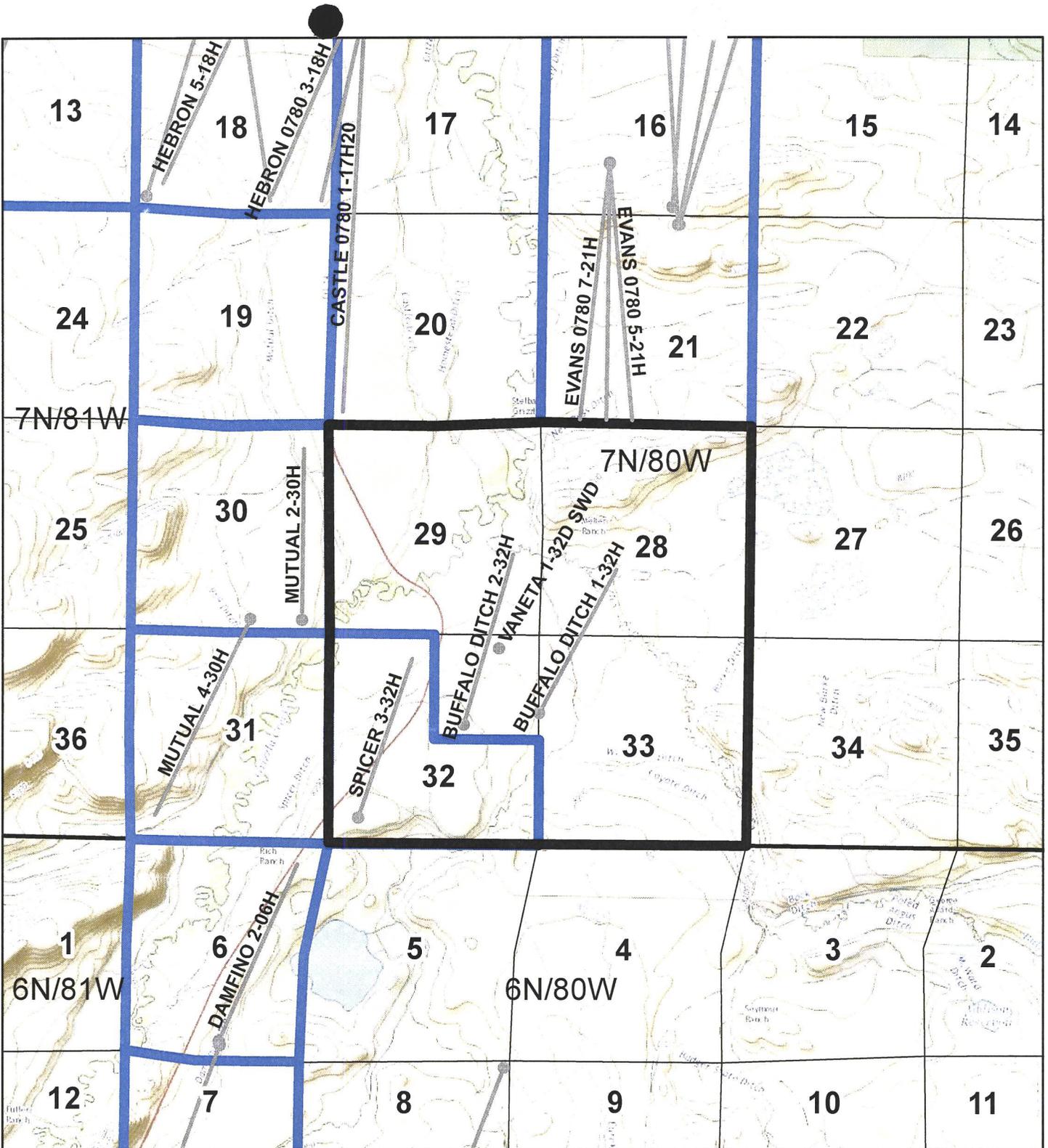
 Proposed Pad Sites



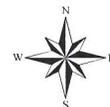
0 0.5 1 Miles

Exhibit No. L-4
10/3/2016

7N-80W, Sec. 28, 29, 32, & 33
All 2560 Acres more or less



Service Layer Credits: USGS The National Map: National Boundaries Dataset, 3D Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line



0 0.5 1 Miles

Exhibit No. L-5
10/3/2016

7N-80W, Sec. 28, 29, 32, & 33
All 2560 Acres more or less

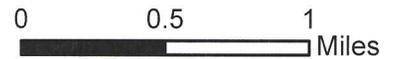


Exhibit No. L-6
10/3/2016

7N-80W, Sec. 28, 29, 32, & 33
All 2560 Acres more or less

Geology Testimony – Scott Cherry
Cause No. 531; Docket No. 161000455
Spacing Application
Unnamed Field, Jackson County, Colorado

October 2016 Colorado Oil and Gas Conservation Commission Hearing

My name is Scott Cherry, and I am currently employed as a Geologist by SandRidge Exploration and Production, LLC (“SandRidge” or “Applicant”). I graduated from Baylor University with a Bachelor of Science degree in Geology and a Master of Science degree in Geology from the University of Arkansas. I have over 5 years of experience in oil and gas exploration and development in the continental United States. I am familiar with the lands subject to, and the matters set forth in the verified application (the “Application”) filed herein.

In support of the Application, I am submitting four (4) exhibits. The exhibits are attached to my sworn testimony and form the basis for the Application for an order (1) to establish one approximate 2,560 acre drilling and spacing unit for Section 28, 29, 32, and 33, Township 7 North, Range 80 West, 6th P.M. and (2) to authorize up to sixteen horizontal wells in the proposed drilling and spacing unit for the production of oil, gas, and associated hydrocarbons from the Niobrara Formation. In support of its amended Application, Applicant states and alleges as follows:

1. Exhibit No. G-1

Exhibit No. G-1 is a type log for the Niobrara Formation for a well drilled in the vicinity of the Application Lands. Track 1 contains the gamma ray curve; Track 2 contains the deep resistivity curve, with red color-fill denoting values greater than or equal to 20 ohms; Track 3 contains density porosity and neutron porosity curves.

2. Exhibit No. G-2

Exhibit No. G-2 is a regional stratigraphic cross-section A-A', reference datum top of Niobrara. The location of cross-section A-A' is inset in Exhibit No. G-2. The cross-section shows the interval from the top of the Niobrara to the top of the underlying Carlile. Each log contains gamma ray, deep resistivity, neutron porosity, and, as available, density porosity. This exhibit demonstrates that the Niobrara Formation is laterally continuous throughout the vicinity of the Application Lands.

3. Exhibit No. G-3

Exhibit No. G-3 is a structure map constructed on the top of the Niobrara Formation. The regional dip for the Niobrara Formation underlying the Application Lands is approximately 400 feet per mile to the east.

4. Exhibit No. G-4

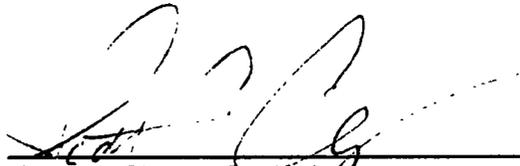
Exhibit No. G-4 is an isopach map of the total thickness of the Niobrara Formation. Total thickness of the Niobrara Formation underlying the Application Lands is approximately 440 feet.

Conclusions

The Niobrara Formation is a sequence of chinks, marls, and limestones deposited in the Cretaceous Western Interior Seaway in a deep water marine environment. This environment was laterally continuous and covered much of present-day North America. Regional cross sections demonstrate that the Niobrara Formation is laterally continuous and stratigraphically consistent throughout the vicinity of the Application Lands. The Niobrara Formation exists under the entirety of the Application Lands and is a common source of supply.

The matters described herein were devised under my direction and control. To the best of my knowledge and belief, all of the matters set forth herein, my testimony and the supporting exhibits, are true, correct, and accurate.

Dated this 3rd day of October, 2016.



Scott A. Cherry, Geologist
SandRidge Exploration and Production, LLC

VERIFICATION

STATE OF OKLAHOMA)
) ss.
COUNTY OF OKLAHOMA)

The foregoing instrument was subscribed and sworn to before me this 3rd day of October, 2016, by Scott Cherry, Geologist for SandRidge Exploration and Production, LLC.

Witness my hand and official seal.

My commission expires: 8/13/18

Emily Rains
Notary Public

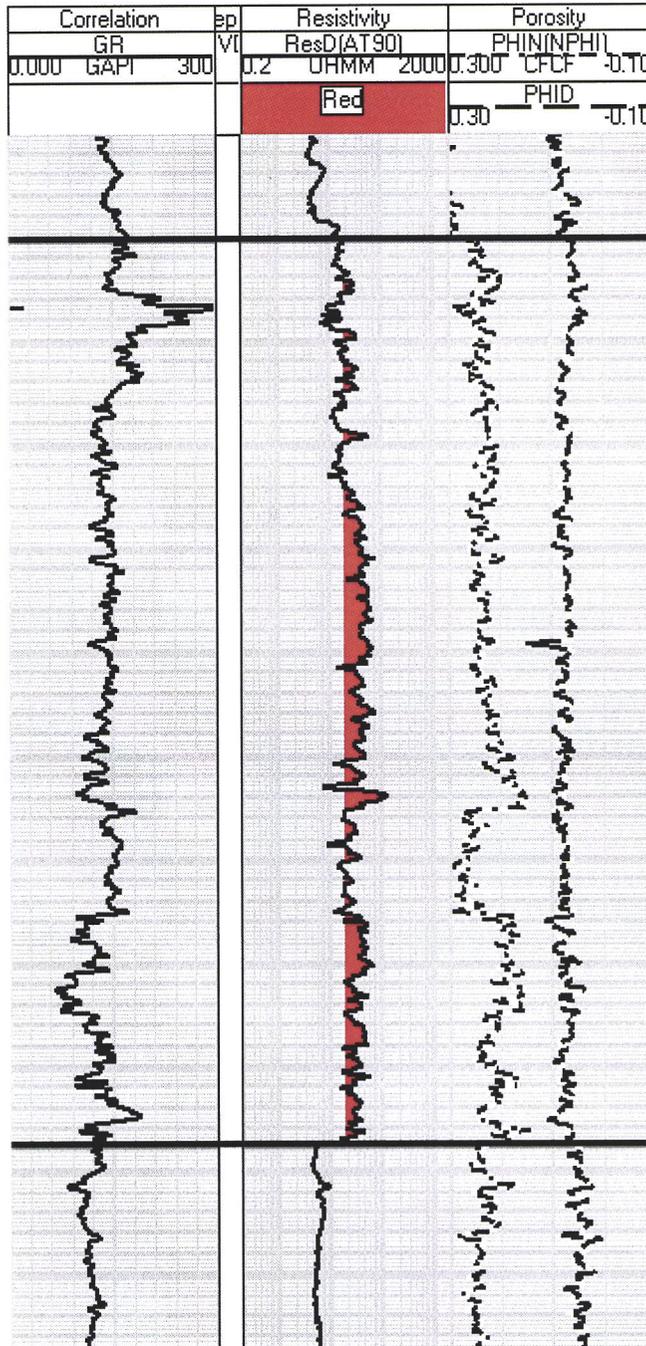


Exhibit No. G-1

Type Log



EOG RESOURCES INC
BUFFALO DITCH 2-32H
TWP: 7 N - Range: 80 W - Sec. 32
05057064640000



Niobrara

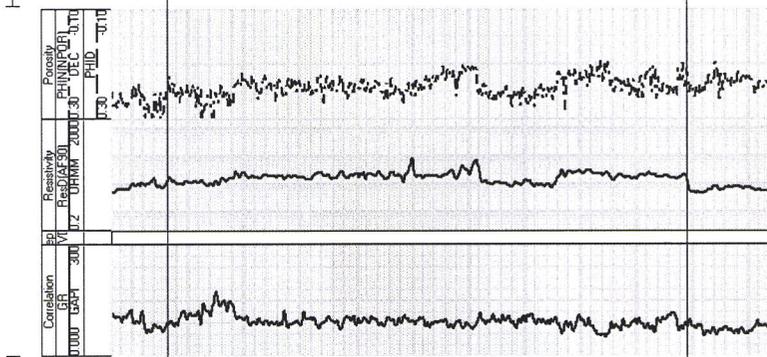
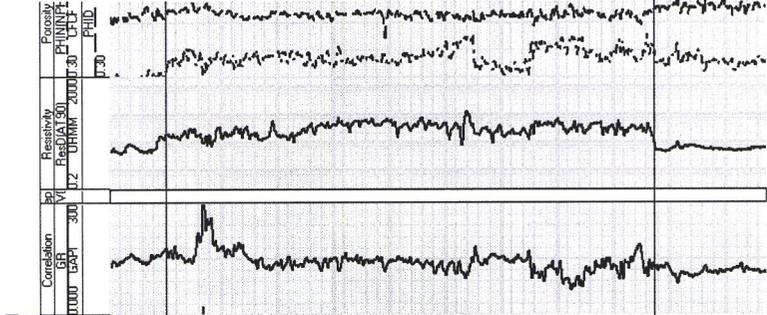
Carlile

Stratigraphic Cross-Section, Datum = Niobrara

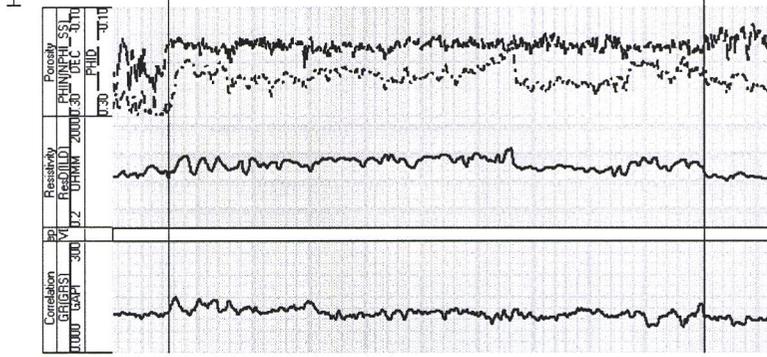
A'



FOG RESOURCES INC
 BUFFALO DITCH 1-3-2H
 TWP. 7 N. Range: 80 W. Sec. 32
 05057064640000



FOUNDATION ENERGY MANAGEMENT LLC
 FEDERAL COALMONT 23-12R
 TWP. 7 N. Range: 81 W. Sec. 23
 05057064920000



A



TREND EXPL LTD
 FEDERAL 1-2-41
 TWP. 8 N. Range: 80 W. Sec. 24
 05057060710000

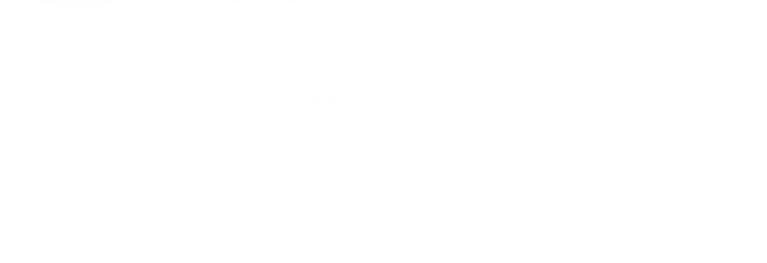


Exhibit No. G-3

Structural Map of Top of Niobrara

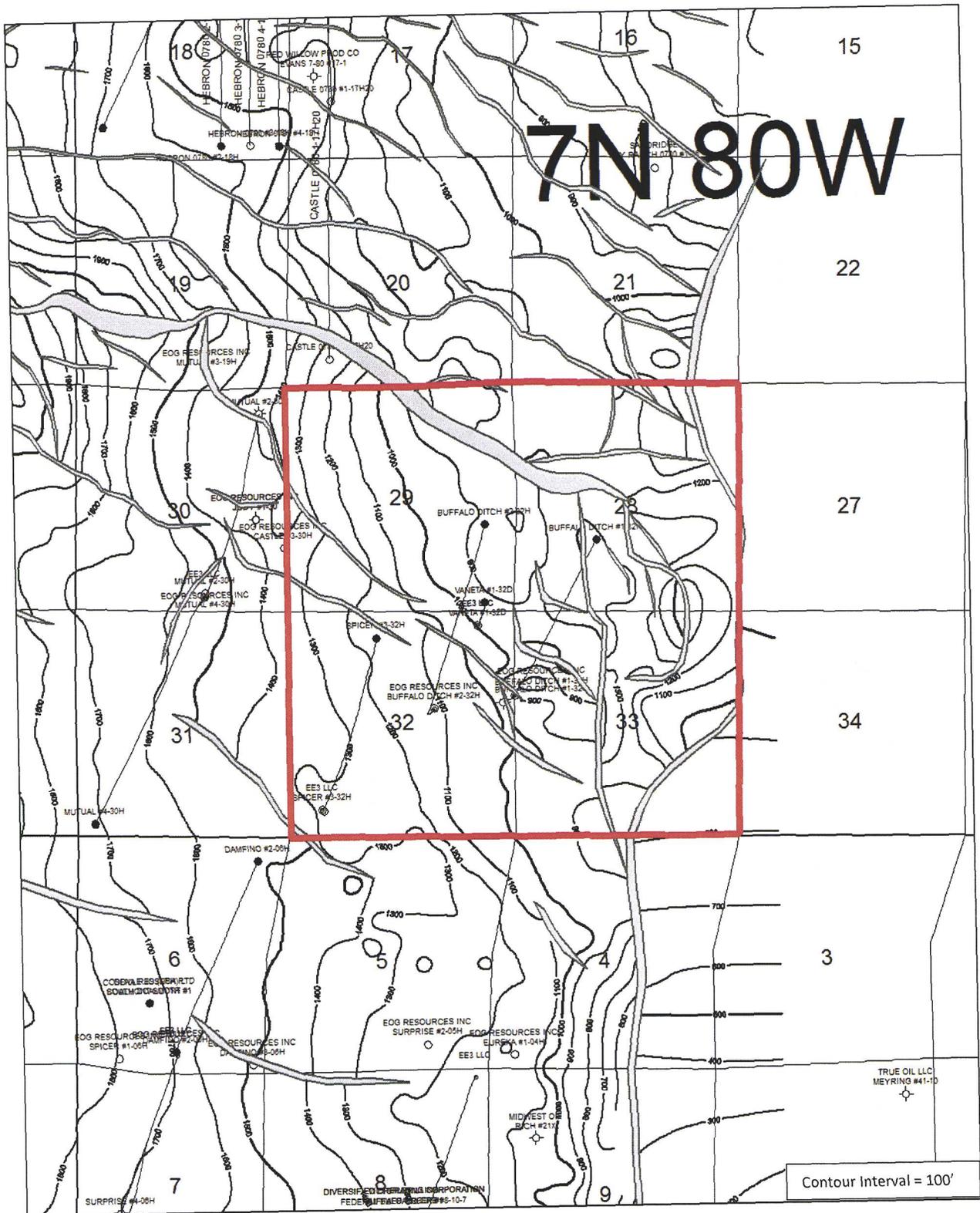
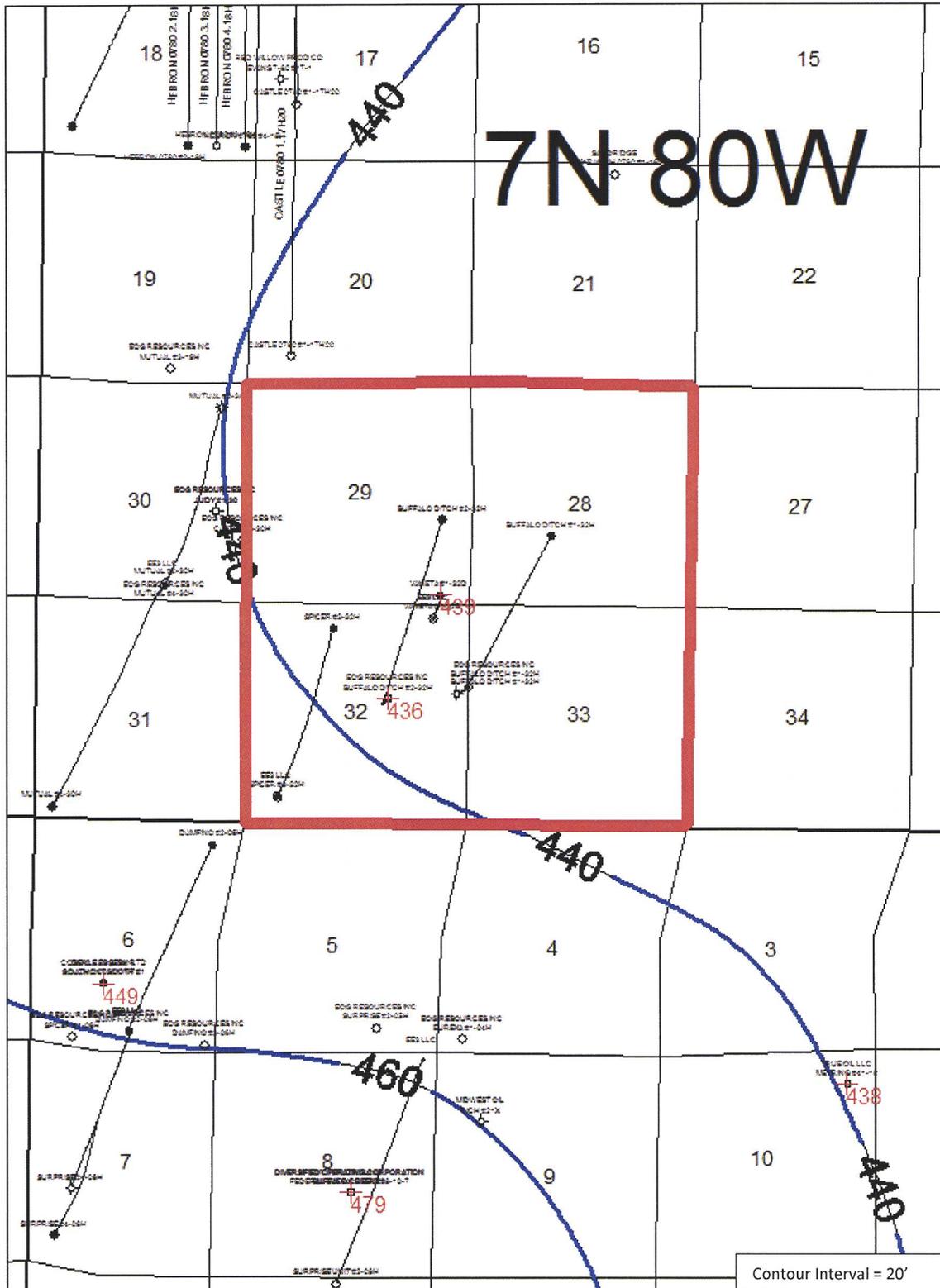


Exhibit No. G-4

Isopach of Niobrara Formation



SandRidge Exploration & Production LLC

Wesley K McAlister – Engineering Testimony

Cause No. 531, Docket No. 161000455

Request to establish one approximate 2,560-acre drilling and spacing unit for Sections 28, 29, 32 and 33, Township 7 North, Range 80 West, 6th P.M., Jackson County, Colorado, authorize the drilling for up to sixteen (16) horizontal wells within the proposed unit and authorize the reduction of setbacks from the northern and southern boundaries within the proposed unit from 300 ft. to 100 ft., for production of oil, gas and associated hydrocarbon from the Niobrara formation

My name is Wesley McAlister, and I am currently employed as a Reservoir Engineer in the Rockies Division for SandRidge Exploration & Production LLC (SD). I graduated from the University of Oklahoma in 2007 with a Bachelor of Science degree in Petroleum Engineering. I have over eight years of experience in reservoir engineering, completions, production operations, and related matters. I am familiar with the lands subject to, and the matters set forth in the application (the "Application") filed herein. My resume/c.v. is attached to this submission. See [Appendix](#).

In support of the Application, I am submitting eleven (11) exhibits. The exhibits are attached to my sworn testimony and form the basis for the Application requesting an Order to establish an approximate 2,560-acre drilling and spacing unit for Sections 28, 29, 32 and 33, Township 7 North, Range 80 West, authorize the drilling of up to sixteen (16) wells within the proposed unit and authorize the reduction of setbacks for the boundaries closest to the heel and toe of a horizontal well drilled within the proposed unit from 300 ft. to 100 ft., for production of oil, gas and associated hydrocarbon from the Niobrara formation.

1. Exhibit No. E-1.1

Exhibit No. E-1.1 is a table showing reservoir engineering calculations for vertical wells that penetrated the Niobrara Formation in the North Park Basin in the area T6N-9N and R79W-81W. This table shows the calculated original oil-in-place ("OOIP") for a 640-acre drainage area surrounding each vertical well. The total thickness ("h") of the Niobrara, average water saturation ("SW") in the Niobrara and the average porosity ("por") in the Niobrara were estimated from publically released openhole logs run in each vertical well. The total thickness of the Niobrara formation consists of the sum of the individual chalk and marl benches/members within the Niobrara. The oil Formation Volume Factor ("Bo") was determined from PVT analyses on produced oil and gas samples collected on the Buffalo Ditch 1-32H. It should be noted that not all ten (10) vertical wells penetrated the entire Niobrara formation. The entire Niobrara interval is not present in the Fischer 15 (API 0505706260000), State 6-81-24-4 (API 05057065100000) and the Judy 1-30 (API 05057064660000) due to faulting and/or the total depth of the subject wells. This accounts for the lower OOIP per section for the Niobrara in these wells. Therefore from this exhibit it may be concluded that the average OOIP per section in the Niobrara, not including the Fischer 15, State 6-81-24-4 and the Judy 1-30, is approximately 51.5 MMBO.

2. Exhibit No. E-2.1

Exhibit No. E-2.1 is a table showing reservoir engineering calculations for horizontal wells that are completed in the Niobrara Formation in the North Park Basin in the area T6N-8N and R80W-81W. This table shows the estimated ultimate recovery ("EUR"), OOIP and the calculated drainage area for each well. The EURs in the table were determined using production decline curve analysis. A net Niobrara thickness of 169 feet was used for all wells based on the effective stimulated height determined from the analyses of the microseismic monitoring programs conducted on the Buffalo Ditch 2-32H and the Mutual 2-30H. To approximate the porosity over the 169' Niobrara interval, log-derived porosities from the ten vertical wells in Exhibit No. E-1.1, along with the available core data from the Buffalo Ditch 1-32H and Buffalo Ditch 2-32H were used. These analyses resulted in an average porosity of 8% over the subject 169 foot Niobrara interval. For the water saturation ("SW"), an analysis of log calculations from the ten referenced vertical wells and available core data indicated an average SW over the 169 foot Niobrara interval of 48.5%. Numerical reservoir simulation was used to determine an approximate oil recovery factor ("RF") using a range of reservoir permeabilities calculated from available core data and horizontal well rate-time analysis. This work resulted in an oil recovery factor of 13.9% being used in the drainage area calculations, and compares very well with recoveries currently being used for horizontal wells completed in the Niobrara in the DJ Basin.

3. Exhibit No. E-3.1

Exhibit No. E-3.1 is a table showing the average OOIP in each of the Niobrara benches in the North Park Basin. This table is based on the calculations for the vertical wells shown in Exhibit No. E-1.1. Information from this table is used in the Rate Transient Analysis (RTA) modeling study discussed below.

4. Exhibit No. E-4.1

Exhibit No. E-4.1 summarizes the major wellbore, completion and production data used in the RTA modeling study performed on the Surprise 02-08H. The subject well is a horizontal Niobrara well drilled by EE³, the operator at the time, in 2014. The lateral portion of the well landed in the D-Chalk bench of the Niobrara.

5. Exhibit No. E-5.1

Exhibit No. E-5.1 shows the gross oil, gas and water production from the Surprise 02-08H horizontal Niobrara well. The subject well flowed naturally up casing and tubing for approximately seven months. During this time the oil production rate was relatively constant at approximately 450 BOPD. Falling surface flowing pressures indicated that the subject well was starting to load up therefore a bottomhole pump, rods and beam unit were installed in February 2016 and placed back on production.

6. Exhibit No. E-6.1

Exhibit No. E-6.1 summarizes the calculated hydraulic fracture properties and Niobrara reservoir properties used in the RTA Model Study. The fracture properties were determined using type curve analysis and hydraulic fracture treatment pressure analysis techniques. The determined hydraulic fracture geometry, i.e. effective fracture half-length and effective fracture height, compares very well

with the interpretation of the hydraulic fracture treatment microseismic monitoring programs performed on the Mutual 2-30H and Buffalo Ditch 02-32H. The average matrix porosity, oil saturation and water saturation shown in Exhibit No. E-5.1, are based on the calculated effective fracture height of 170 ft. and the average Niobrara reservoir properties previously shown in Exhibit No. E-2.1. The oil Formation Volume Factor (Bo) was determined from PVT analyses on produced oil and gas samples collected on the Buffalo Ditch 01-32H. The effective reservoir permeability and calculated drainage area were determined from the history match performed as part of the RTA model study.

7. Exhibit No. E-7.1

The top diagram in Exhibit No. E-7.1 shows the aerial view of the single horizontal well model used to history match the well performance of the Surprise 02-08H. A model area of 320 acres (5280' x 2640') was selected so as to observe any pressure depletion that the model would predict outside of the stimulated reservoir volume (SRV). The SRV, represented by the white rectangle, was determined from the type curve matching of the rate and pressure data. Also observed in the top diagram are the fracture half-length of 170 ft. previously discussed and the 30 completion intervals. In the model each completion interval is represented as a single dual-wing fracture (yellow diamonds).

The lower diagram in Exhibit No. E-7.1 shows the history match generated during the RTA study. The actual gross oil, gas and water production rates are indicated by the green, red and blue symbols. The model predicted rates are shown as the solid green, red and blue lines. The history match was performed on the recorded surface flowing pressures converted to flowing bottomhole pressures. The model was given the actual surface flowing oil rates and based on these predicted the resulting bottomhole flowing pressures. As with the producing rates the actual pressures are shown as the brown symbols and the model predicted pressures as the solid brown line.

8. Exhibit No. E-8.1

Exhibit No. E-8.1. shows the RTA model 50 year production forecast based on the completion and reservoir parameters determined in the production history match illustrated in Exhibit No. E-7.1. The forecast assumed a bottomhole flowing pressure ramp of 1800 psia to 200 psia over the 50 year period. An abandonment rate of 30 BO/month was also used. The model prediction indicates an oil EUR at the end of fifty years of approximately 468 MBO. This compares very well with the 474 MBO EUR estimated from type curve analysis. This EUR results in a calculated recovery factor for the 39 acre drainage area of approximately 30%. This may appear at first review to be high for an unconventional / shale type reservoir however the model is predicting very little drainage outside of the SRV area. The forecast oil EUR for the Surprise 02-08H is only 1.85% of the estimated OOIP for a 640 acre area or section assuming effective fracture height of 170 ft.

9. Exhibit No. E-9.1

Exhibit No. E-9.1. shows the predicted reservoir pressure distribution in the model area (320 acres) at various time points during the model simulation. As may be observed predicted depletion does not occur to any significant extent outside of the SRV even after 50 years of production.

10. Exhibit No. E-10.1 and Exhibit No. E-11.1

Exhibit No. E-10.1. shows the model predicted reservoir pressure distribution profiles across the entire producing lateral in the x-direction. Also shown are zoomed in views of the reservoir pressure distribution profile from the end of the lateral to the boundary of the model area in the x-direction. Snapshots of both these profiles are shown at 10 year, 20 year and 50 year points in the well's predicted producing life. As may be observed in these pressure distribution profiles the RTA model predicts very little pressure depletion in the reservoir from the boundary to the end of the lateral, even after 50 years. It may also be noted that there is only a very small amount of pressure drop at 100' beyond the end of the lateral. Most of this is due to how the model handles the completion efficiency of the toe stimulation. Microseismic monitoring during the hydraulic fracture treatment on the Mutual 2-30H showed very few microseismic events occurring around the toe of the lateral and no microseismic events occurring beyond the toe of the lateral. This would indicate very poor stimulation efficiency at the toe of the lateral which would result in poor to no flow from the reservoir into the well at the toe of the lateral. The microseismic mapping interpretation from the Mutual 2-30H is shown in Exhibit No. E-11.1. With no flow from the reservoir into the toe of the lateral no reservoir depletion is occurring beyond the toe of the lateral, ever at 100 ft. away for the toe. This would indicate that there is no flow of hydrocarbons across the section lease line, even with a setback of 100 ft., and that wells drilled using the current 300 ft. from boundary of section setbacks would have a high probability of leaving unproduced hydrocarbons in these areas. The calculations for the estimated amount of oil reserves that would be left in the Niobrara are shown below. The calculation is based on the assumption that the setbacks at the heel and toe for all horizontal Niobrara wells drilled in the section are 100 ft. Therefore the "undrained" area at the heel and toe ends of the section would be approximately 200 ft. wide by 5,280' long. It is also assumed that this "undrained" area includes the entire average thickness (446 ft.) of the Niobrara section.

$$\text{Undrained Area} = 400' \times 5,280' / 43,560 = 48.5 \text{ acres per section}$$

$$\text{OOIP in Undrained Area} = 51,800 \text{ MBO per section} \times 48.5 / 640 = 3,925 \text{ MBO}$$

$$\text{Reserves in Undrained Area} = 3,925 \text{ MBO} \times 30\% = 1,177 \text{ MBO per section}$$

Testimony and Conclusions

SandRidge Exploration and Production LLC (SD) believes that drilling and completing horizontal wells in the Niobrara Formation underlying the Application Lands in the North Park Basin is the most efficient and economic method to develop the resource potential of this formation. SD is monitoring the performance of all horizontal wells in all parts of the North Park and DJ Basins.

As illustrated in the aforementioned exhibits the calculated drainage areas for the existing horizontal Niobrara wells range from 5.2 acres to 96.52 acres, with the average drainage area of only 40.26 acres. These same wells also have laterals with lengths ranging from 2,800 feet to 5,100 feet with an average completed lateral length of 4,000 feet. Therefore, it may be concluded based on the calculated drainage areas in Exhibit No. E-2.1, that at least sixteen (16) horizontal wells for the Niobrara in the proposed 2,560-acre drilling and spacing unit will be required to efficiently develop the Niobrara

and avoid waste of the hydrocarbon resource. Also, the aforementioned exhibits show the current 300 ft. from section boundary setback limit at the heel and toe of the lateral portion of each horizontal well drilled in the Niobrara has a high probability of leaving unrecovered reserves in the ground. These exhibits also show minimal pressure depletion in the reservoir much beyond the heel and toe of the horizontal lateral indicating no flow of hydrocarbons across the section boundary.

Based on my engineering analysis, it is my recommendation that the Commission authorize the drilling of up to sixteen (16) horizontal wells in the proposed approximately 2,560-acre drilling and spacing unit for Sections 28, 29, 32 and 33, Township 7 North, Range 80 West, 6th P.M. for the production of oil, gas and associated hydrocarbons from the Niobrara Formation and authorize the reduction of setbacks for the boundaries closest to the heel and toe of a horizontal well drilled within the proposed 2,560-acre unit from 300 ft. to 100 ft.; and that by doing so, the development of the said application lands will promote efficient drainage, protect correlative rights and avoid waste of the resource.

The Spicer 3-32H (SD working interest is 100%) is a horizontal well currently producing in economic quantities and is located in Section 32 of the proposed 2,560-acre drilling and spacing unit. SandRidge Exploration and Production LLC will not complete or perforate any part of a well that is within 300 ft. of this (Spicer 3-32H) producing well.

The matters described herein were devised under my direction and control. To the best of my knowledge and belief, all matters set forth herein, my testimony and the supporting exhibits are true, correct and accurate.

Dated this 3rd day of October, 2016.



Wesley McAlister, Reservoir Engineer
SandRidge Exploration and Production, LLC

VERIFICATION

STATE OF OKLAHOMA)
) ss.
COUNTY OF OKLAHOMA)

The foregoing instrument was subscribed and sworn to before me this 3rd day of October, 2016, by Wesley McAlister, Reservoir Engineer for SandRidge Exploration and Production, LLC.

Witness my hand and official seal.

My commission expires: 8/13/18

Emily Rains

Notary Public



Exhibit No. E-1.1

Niobrara OOIP Calculations from Vertical Wells in North Park Basin
 T6N-T9N / R79W-R81W
 Jackson County, Colorado

By Well	API	Current Operator	Field	Sec	TWN	RNG	Top of Niobrara (feet)	Bottom of Niobrara (feet)	Average h (feet)	Average Porosity (%)	Average Sw (%)	SoPhiH	Niobrara Chalk OOIP per Section (Bbls Oil)	Niobrara Marl OOIP per Section (Bbls Oil)	Total Niobrara OOIP per Section (Bbls Oil)
State 1-36	05057060650000	Markus Production Inc	Coalmont	36	T7N	R81W	6,230	6,699	469	7.1%	59.4%	14.104	25,190,968	25,555,473	50,746,441
Federal 1-24	05057060710000	Trend Exploration LTD	Wildcat	24	T8N	R80W	10,624	11,100	476	4.4%	62.3%	10.307	15,244,250	21,840,951	37,085,201
SCM 1	05057062440000	Joseph P Doyle	Grizzly Creek	6	T6N	R80W	6,516	6,553	450	6.6%	48.0%	16.729	28,560,126	31,630,261	60,190,387
Fischer 15	05057062600000	Conoco Phillips Co	McCallium	15	T9N	R79W	7,234	7,602	368	4.9%	62.9%	8.576	10,293,773	20,560,994	30,854,767
Buffalo Ditch 2-32H	05057064640000	Sandridge Energy	Eclipse	32	T7N	R80W	7,093	7,536	443	5.7%	54.7%	12.132	17,148,733	26,502,551	43,651,284
Judy 1-30	05057064660000	Sandridge Energy	Unnamed	30	T7N	R80W	6,822	7,104	282	5.1%	41.1%	8.630	19,440,640	11,609,494	31,050,134
Vaneta 1-32D	05057064670000	Sandridge Energy	Eclipse	32	T7N	R80W	7,304	7,753	497	5.3%	39.2%	16.675	28,456,650	31,539,270	59,995,920
Federal Coalmont 23-12R	05057064920000	Foundation Energy MG	Coalmont	23	T7N	R81W	5,736	6,194	458	8.0%	57.7%	16.444	29,031,704	30,133,457	59,165,161
Arapaho State 6-18-36-3	05057065070000	Dakota Exploration LLC	Grizzly Creek SE	36	T6N	R81W	5,828	6,259	431	8.6%	63.8%	13.813	26,332,586	23,365,063	49,697,649
State 6-81-24-4	05057065100000	Dakota Exploration LLC	Unnamed	24	T6N	R81W	5,921	6,299	378	10.3%	61.2%	14.774	22,830,953	30,325,118	53,156,071

Where:

OOIP = Original oil in place (bbls)
 Area = drainage area
 Bo = formation volume factor (rbv/STB)
 por = porosity (fraction)
 SW = water saturation (fraction)

Input Assumptions:

Bo = 1.38 Oil FVF in res bbls/STB calculated from PVT analysis
 Area = 640 acres in a single section

Notes:

Not all wells penetrated the entire Niobrara section

Equation Used:

$$OOIP = (7758 * Area * h * por * (1 - SW)) / Bo$$

Exhibit No. E-2.1

Niobrara EUR and Drainage Area Calculations from Horizontal Wells in North Park Basin
T6H-T8N / R80W-R81W
Jackson County, Colorado

Lease	API	Sec	TWN	RNG	Date of 1st Production	30-Day (BOPD)	60-Day (BOPD)	90-Day (BOPD)	EUR (MBO)	OOIP (Mbbbls)	H (ft)	Porosity (Fraction)	Water Saturation (Fraction)	Calculated Drainage Area (acres)
Buffalo Ditch 01-32H	05057064630000	32	T7N	R80W	1/1/2008	217	253	225	60	429	169	0.08	0.485	10.97
Buffalo Ditch 02-32H	05057064640100	32	T7N	R80W	7/25/2008	68	54	58	55	392	169	0.08	0.485	10.03
Mutual 02-30H	05057064650000	30	T7N	R80W	7/25/2008	523	412	370	161	1,159	169	0.08	0.485	29.61
Mutual 07-17H	05057064720000	17	T7N	R80W	12/21/2008	394	326	290	251	1,803	169	0.08	0.485	46.05
Surprise 04-06H	05057064800000	6	T6N	R80W	10/5/2010	325	239	220	124	892	169	0.08	0.485	22.78
Hebron 05-18H	05057065020000	18	T7N	R80W	12/23/2010	335	303	269	218	1,572	169	0.08	0.485	40.15
Hebron 01-18H	05057065010000	18	T7N	R80W	12/20/2010	106	81	60	28	203	169	0.08	0.485	5.20
Coalmont 03-13H	05057065080000	13	T7N	R81W	8/1/2013	157	155	140	279	2,005	169	0.08	0.485	51.21
Herbon 03-12H	05057064980000	12	T7N	R81W	8/19/2013	385	420	375	269	1,939	169	0.08	0.485	49.53
Hebron 02-07H	05057064990000	7	T7N	R80W	10/9/2013	238	230	177	113	810	169	0.08	0.485	20.69
Damfino 02-06H	05057064820000	6	T6N	R80W	11/6/2013	507	550	527	232	1,666	169	0.08	0.485	42.57
Peterson Ridge 01-20H	05057065150000	20	T8N	R80W	1/17/2014	300	292	241	203	1,457	169	0.08	0.485	37.23
Spicer 03-32H	05057064690000	32	T7N	R80W	8/19/2014	453	226	447	251	1,809	169	0.08	0.485	46.22
Grizzly 03-32H	05057065230000	32	T8N	R80W	9/8/2014	544	241	478	340	2,445	169	0.08	0.485	62.46
Mutual 04-30H	05057064690000	30	T7N	R80W	12/22/2014	467	545	540	525	3,778	169	0.08	0.485	96.52
Surprise Unit 02-08H	05057065260000	8	T6N	R80W	7/13/2015	366	451	463	397	2,857	169	0.08	0.485	72.99

Where:

OOIP = Original oil in place (bbls)
EUR = estimated ultimate recovery (bbls)
RF = recovery factor (fraction)
Area = drainage area
Bo = formation volume factor (rvb/STB)
por = porosity (fraction)
SW = water saturation (fraction)

Input Assumptions:

Bo = 1.38 Oil FVF in res bbls/STB calculated from PVT analysis
SW = 0.485 Average water saturation (fraction) determined from log analysis
RF = 0.139 Recovery factor (fraction) determined from reservoir simulation
h = 169 Average height of propped frac in feet determined from microseismic data

Equation Used:

OOIP = EUR/RF
Area = (OOIP*Bo)/(7758/1000*h*por*(1-SW))

Average Drainage Area: 40.26

Exhibit No. E-3.1

Average Reservoir Properties per Niobrara Bench in North Park Basin

North Park Average (10 well)	Top (feet)	Bottom (feet)	Thick (feet)	Porosity	Sw	SoPhiH	OOIP Chalk per section (barrels)	OOIP Marl per section (barrels)	Total OOIP per section (barrels)
Bench A			36	6.3%	77.4%	0.518	1,865,415		1,865,415
Bench A (Inter)			37	5.4%	82.5%	0.352		1,266,891	1,266,891
Bench B			63	5.7%	51.9%	1.718	6,182,339		6,182,339
Bench B (Inter)			79	6.0%	40.0%	2.848		10,247,170	10,247,170
Bench C			62	4.9%	52.0%	1.452	5,224,586		5,224,586
Bench C (Inter)			59	12.3%	45.4%	3.942		14,182,021	14,182,021
Bench D			47	6.3%	44.3%	1.626	5,851,878		5,851,878
Bench D (Inter)			21	7.2%	49.1%	0.782		2,815,089	2,815,089
Bench E			43	6.0%	55.0%	1.169	4,205,978		4,205,978
Niobrara			446			14.409	23,330,196	28,511,170	51,841,366

Exhibit No. E-4.1

Summary of Wellbore, Completion and Production Data for the Surprise 02-08H

Wellbore

- 9-5/8" 36# K-55 @ 1,447'
- 5-1/2" 23# P-110 @ 12,604' (TVD 7,386')

Completion

- Completed lateral length: 4,580'
- Number completion intervals: 30
- Number of Perf Clusters: 2 per interval
- Amt. Fluid: 143,687 bbls 35# X-L gel
- Amt. Proppant: 6.2 MM lbs 20/40 sand

Production Model

- 7-11-2015: 1st Production - flowing up casing
- 9-1-2015: Installed tubing & packer – flowing up tubing
- 2-1-2016: Installed Downhole pump – pumping / flowing up tubing

Exhibit No. E-5.1

Production Plot for the Surprise 02-08H

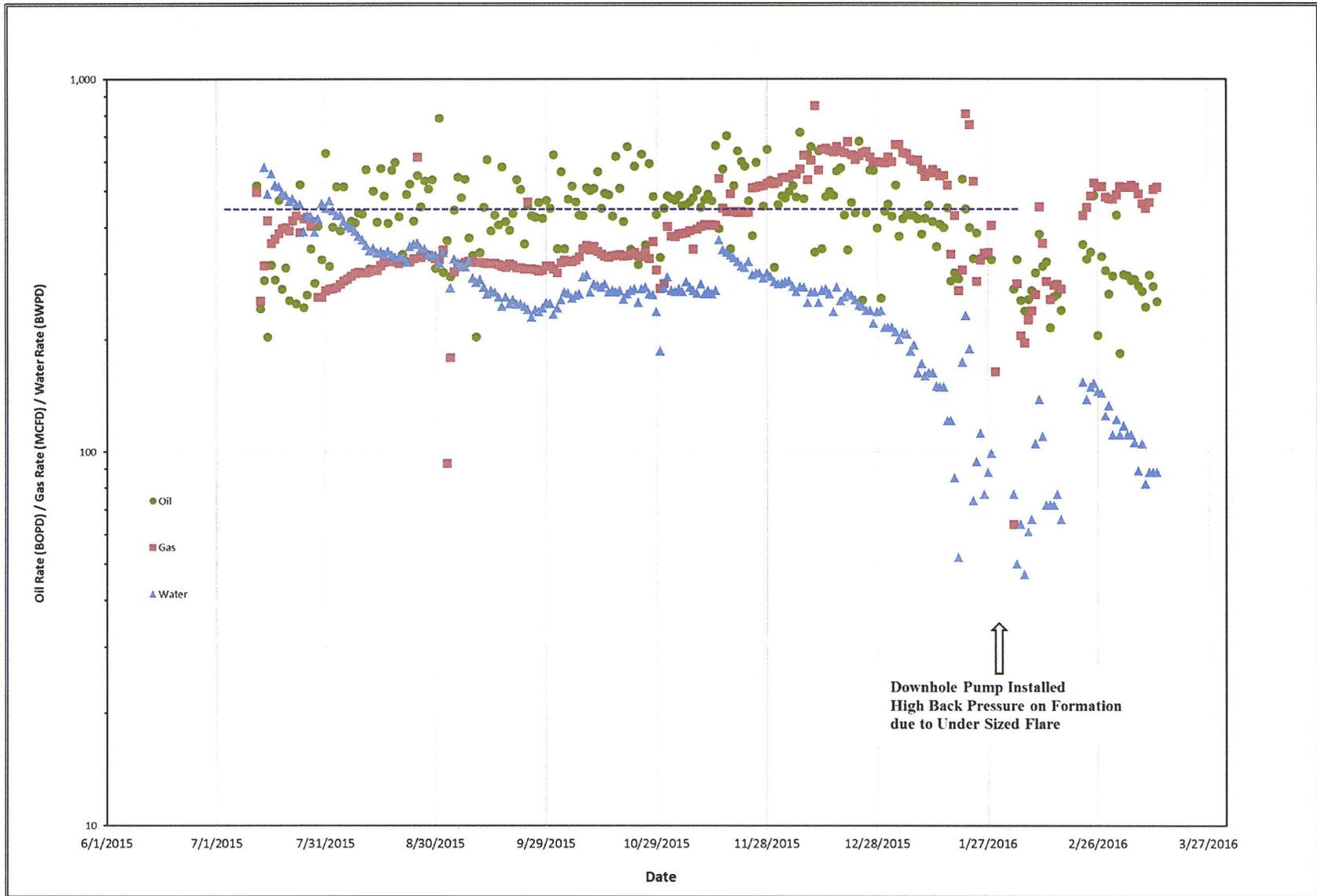


Exhibit No. E-6.1

Summary of Hydraulic Fracture and Reservoir Properties for the Surprise 02-08H

Fracture Properties

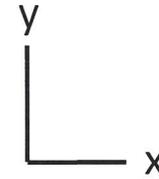
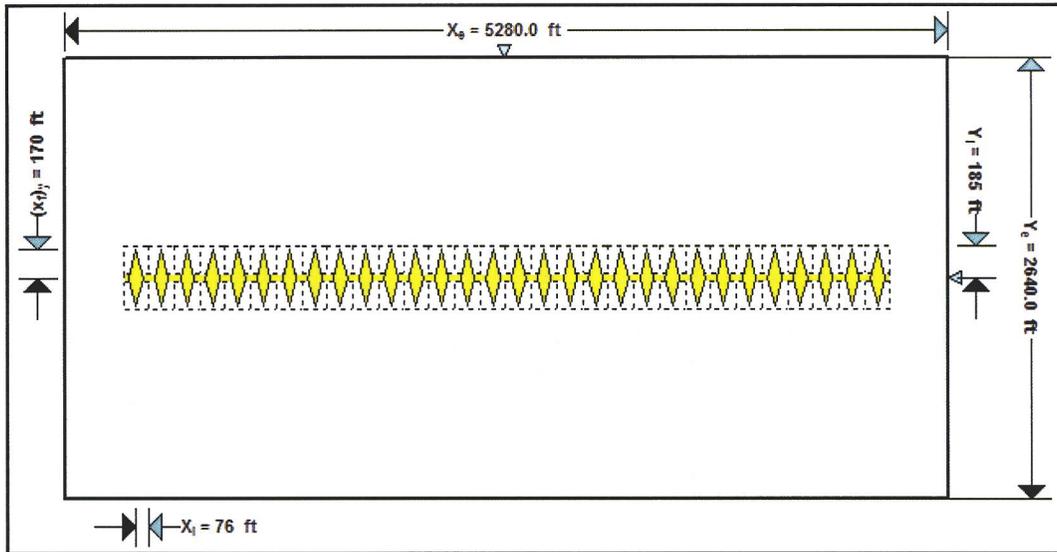
- Stimulated Lateral Length: 4,580'
- Effective Fracture half-length: 170'
- Fracture Conductivity F_{CD} : 1,000
- Effective Fracture Height: 170'
- Fracture skin: 1.0

Reservoir Properties

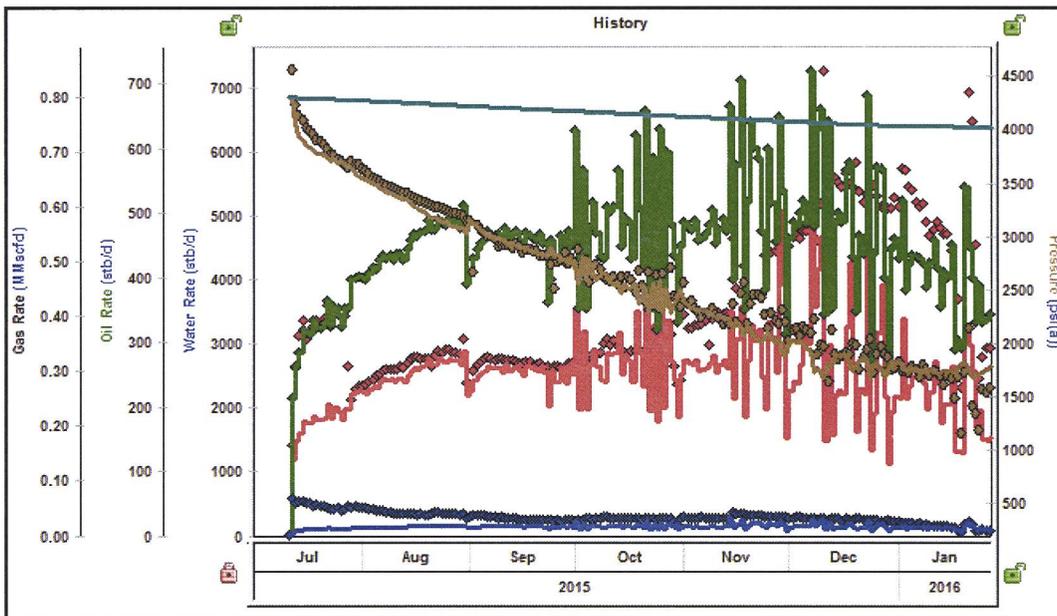
- Avg. Matrix Porosity: 7.8%
- Effective Reservoir Perm: 0.043 md (matrix & natural fractures)
- Avg. Oil Sat.: 52.8%
- Avg. Water Sat.: 47.2%
- Oil FVF: 1.38 res bbls/STB
- Original Reservoir Pressure: 4300 psia
- Effective Reservoir Thickness: 170'
- Calculates Drainage Area: 39 acres

Exhibit No. E-7.1

RTA Model and History Match for the Surprise 02-08H



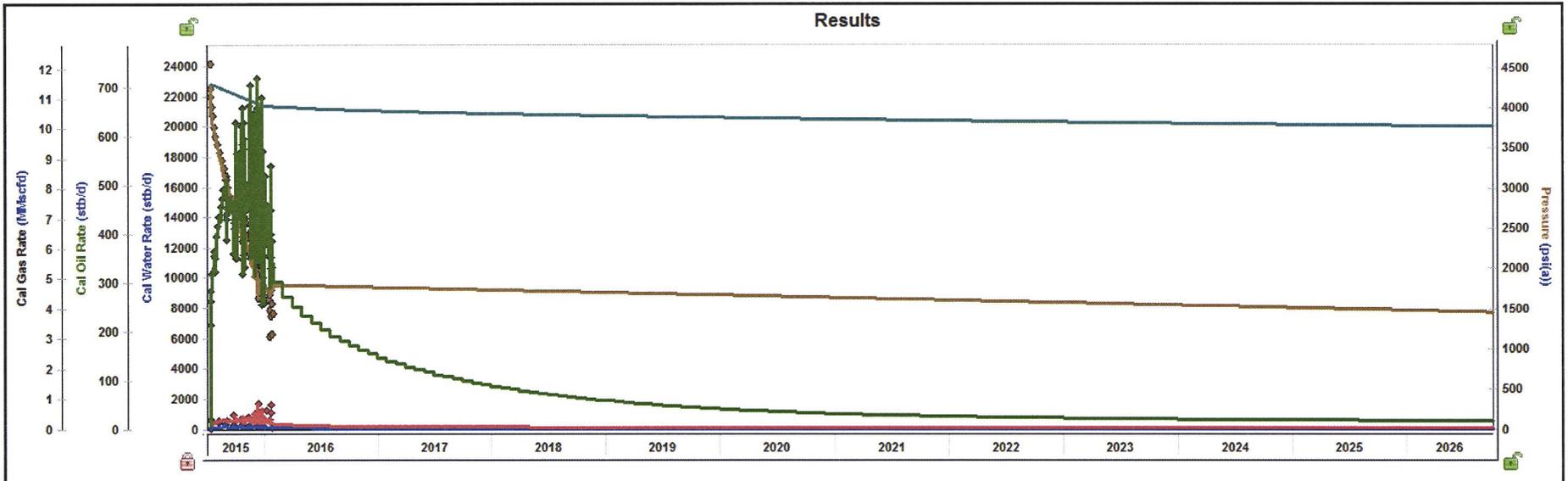
Arial view of single well in 320 acre plot



Actual production & model forecast production

Exhibit No. E-8.1

RTA Model Production Forecast for the Surprise 02-08H



Forecast Options

Forecast Time Method: Duration
 Start Date: 01/29/2016 MM/DD/YYYY

	Time		Control		Sandface Pressure		
	Step Type	Duration	# of Steps	Interpolation	Control Type	Initial	Final
		month				psi(a)	psi(a)
1	Arithmetic	600.0	600	Ramp	Pressure	1800.00	200.00
2	Arithmetic			Ramp	Pressure		

Forecast Constraints

P_{min} : psi(a)
 $(Q_g)_{max}$: MMscfd $(Q_g)_{ab}$: MMscfd
 $(Q_o)_{max}$: stb/d $(Q_o)_{ab}$: 1.0 stb/d
 $(Q_w)_{max}$: stb/d $(Q_w)_{ab}$: stb/d

Forecast Results

EUR_g: 1128 MMscf RR_g: 1045 MMscf
 EUR_o: 468.544 Mstb RR_o: 378.149 Mstb
 EUR_w: 276.831 Mstb RR_w: 219.011 Mstb

Exhibit No. E-9.1

RTA Model Forecast Reservoir Pressure Distribution Maps for the Surprise 02-08H

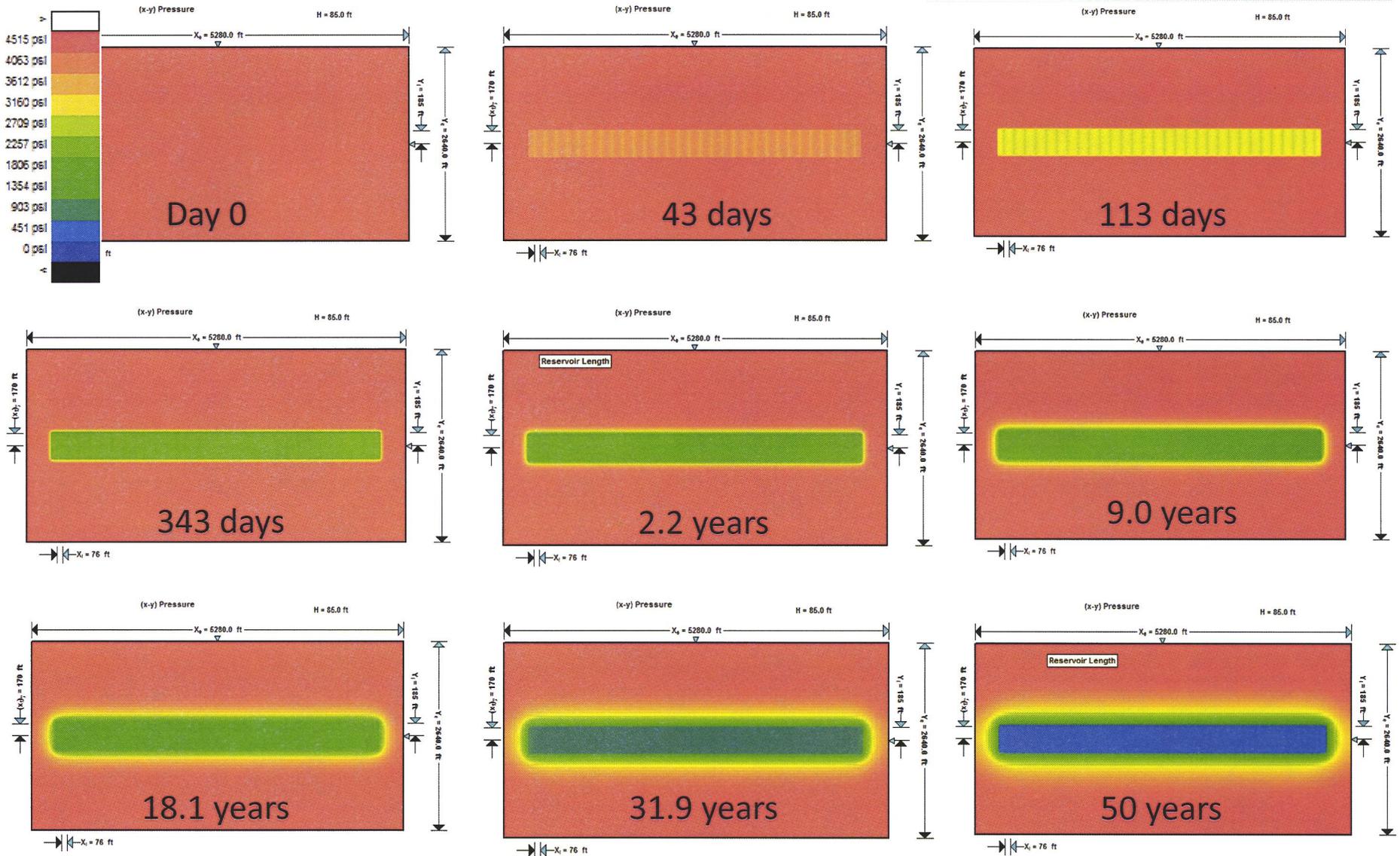
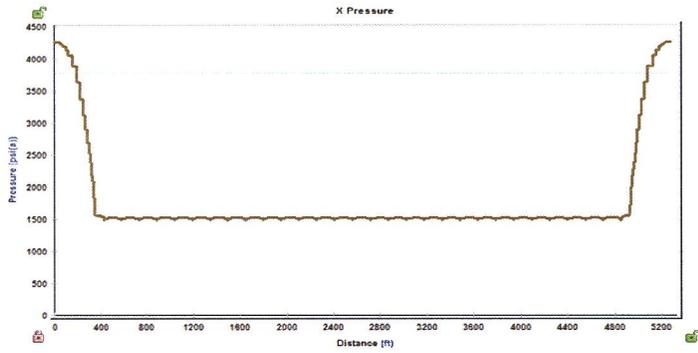


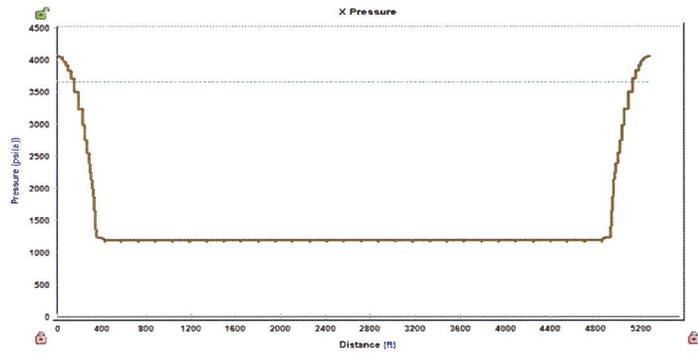
Exhibit No. E-10.1

RTA Model Forecast Cross Section Reservoir Pressure Distribution Maps for the Surprise 02-08H

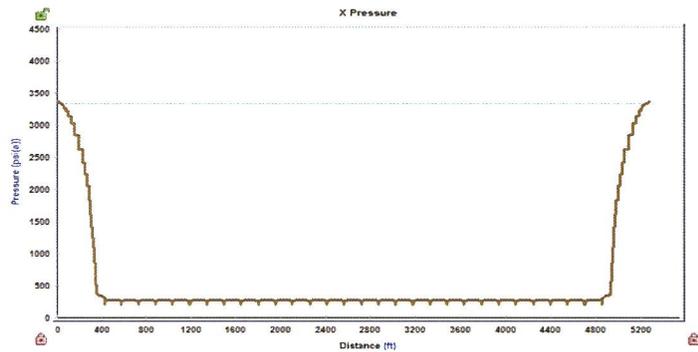
Across entire lateral in x - direction



After 10 yrs



After 20 yrs



After 50 yrs

Zoomed in on one end

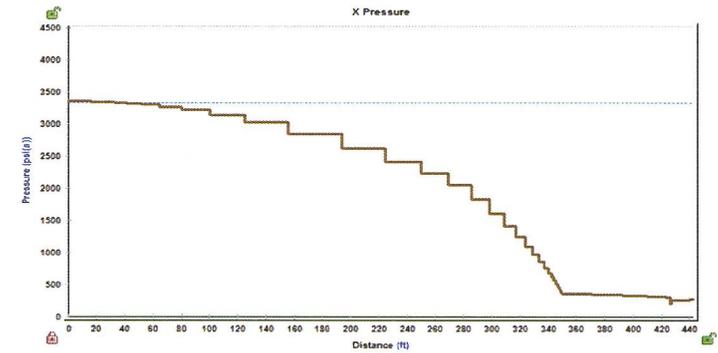
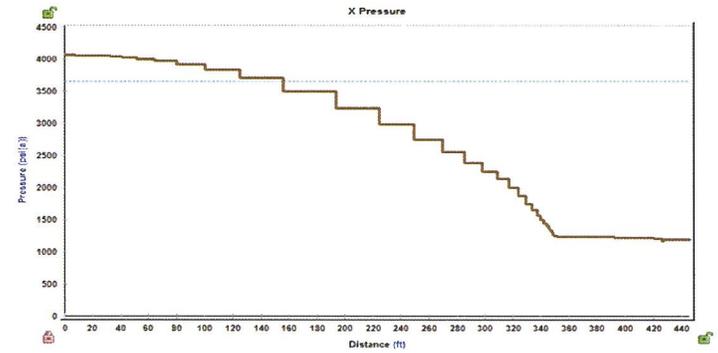
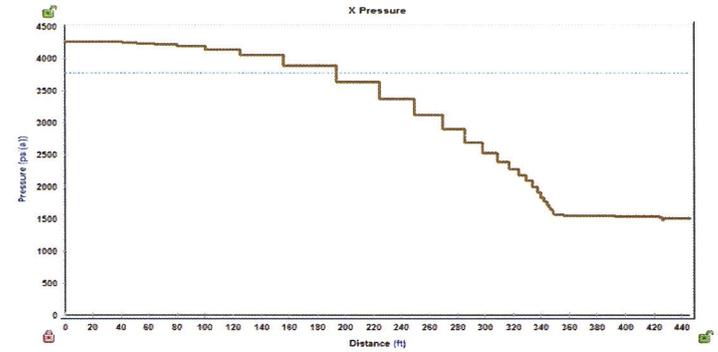


Exhibit No. E-11.1

Mutual 2-30H Microseismic Mapping Results

