1.0 Introduction

Long Draw Prospect is a stratigraphic and potential structural play two to five miles southeast of the giant Jonah Field, in sections 6, 7, 8, and 16 T28N-R107W, Sublette County, Wyoming. The prospect is situated in the northern part of the Greater Green River Basin and lies west-southwest of the Wind River Uplift, Pinedale Anticline, and the Pinedale Thrust. The Sevier Overthrust salient, Moxa Arch, and La Barge Platform lie westward of Long Draw and Jonah Field proper (Figure 1). The properties consist of two leases totaling 1899.74 gross and 1269.67 net Federal and State acres more or less. Long Draw is prospective over an interval of 12,000 to 13,000 feet, at depths of 7,000 to 21,000 feet. Prospective reservoirs include Tertiary Fort Union, an unnamed Tertiary Unit, the Lance Formation, intervals of the Mesaverde Group, the Frontier Formation, and the Upper Dakota-Muddy Sandstones. Expected EURs for the Fort Union/Lance/Upper Mesaverde intervals are in the range of 0.85 to 1 BCFG and up to 75,000 BO at normal pressures. If higher pressure (i.e., overpressured) zones are encountered in the Lance and deeper formations, EURs can be expected in the range of 2 to 4BCFG on average. Better producing wells within Jonah field have yielded 10 BCFG and 75,000 BO from well completed Lance intervals.
Figure 1. Index map of Greater Green River Basin and Long Draw Prospect, T28N R107W Sublette County, Wyoming. Line of cross section A-A’ which is Figure 4 is also shown.
Expected reservoirs are largely fluvial sandstones in the Fort Union/Lance/Mesaverde Group, deposited in meandering to braided-stream environments and interbedded with siltstones and mudstones. Producing sands in these intervals average 7.7% porosity in Jonah Field, with a maximum of 12.9% porosity, and permeabilities averaging 0.145mD. Deeper intervals of the Mesaverde Group (i.e., Rock Springs and Blair) become more marine in nature with depth, and are essentially untested in the Jonah-Long Draw area. The Frontier Formation contains several sand benches that range in depositional environment from fluvial to marine, with nearshore and uppershore face deposits being the most productive on the nearby Moxa Arch and La Barge Platforms. The Dakota/Muddy Sandstones are fluvial to restricted/marginal marine. Both the Frontier and Dakota produce economic quantities of gas in the region of the Greater Green River Basin, along with reasonable quantities of oil.

2.0 Prospect Location and Acreage

Laramie & Associate’s Long Draw Oil and Gas Prospect is situated in Township 28 North – Range 107 West, 6th P.M., Sublette County, Wyoming, west of U.S. Highway 191 some 35 miles south of the town of Pinedale and 65 miles north of the town of Rock Springs. The location is near the southern end of the Hoback Basin, a sub-basin of the Greater Green River Basin (Figure 1). Long Draw is approximately 2 miles south-southeast of the giant Jonah Gas Field, with an estimated recoverable reserve of over 15 TCFG, and 4 miles south of the Pinedale Anticline Field with an estimated 39 TCFG recoverable reserves.

The acreage is flanked on the east-northeast by the Pinedale Anticline and Thrust and the Wind River Mountains, and on the west by the La Barge Platform and Moxa Arch. Laramie’s holdings on Long Draw consist of 1259.74 gross Federal acres (629.87 net acres) in Sections 6, 7, and 8 of T28N – R107W, an uncommitted tract within the Hacienda Unit, and an additional 640 (gross and net) State acres in Section16 T28N - R107W (Figure 2). There is an existing shut-in gas well on the described Federal lease in C NE Section 8 T28N - R107W drilled in 1997 and cased to 13,404 feet. That well is further described in Section 5.5 of this report.
Figure 2. Long Draw leases (shown in yellow) in relation to Jonah Field and the Hacienda Unit, T28N R107-108W, Sublette County, Wyoming.
3.0 Prospect Access, Terrain, Climate and Environment

The Long Draw acreage lies approximately one and one-half miles west of U.S. Highway 191, between the small towns of Farson to the south and Boulder on the north. Access to the lands is afforded by BLM/County roads and ranch roads which traverse the properties as shown in Figure 3.

Mean elevation of the properties is 7000 feet above sea level. The terrain is mostly a flat to gently south-southeast dipping table land, with vegetation primarily of sage and various grasses. The main topographic feature is the shallow southeast draining Long Draw, which branches through Sections 7, 8, and 16 of the Prospect. Elevation changes between the table lands and the drainages formed by Long Draw and its branches range 60 to 80 feet maximum.

Annual average temperature for the Long Draw area and surrounds is 36.5°F with average annual highs of 51.8°F and an annual average low of 21.2°F. Temperature ranges from mid-80s in summer to lows of -40°F in winter. Average annual rain fall is 11 to 12 inches with an average of 65 inches of snow.

Wildlife in the area includes mule deer, antelope, greater sage grouse, eagles, and other small species. While the area has been considered environmentally sensitive, several environmental impact assessments and studies have been carried out pertaining to the adjacent Jonah Field and surrounds. These studies have shown that oil and gas development can proceed when there is cooperation between industry and government agencies, and that the environment can be protected through sustainable development practices. The success of the Jonah Field in this respect indicates that there should be no difficulty in proceeding with development on Long Draw, especially with the fact that producing and/or shut-in wells already exist on the properties as well as adjacent leases.
Figure 3. Shaded relief map of terrain and topography on Long Draw Prospect with access roads and leases. Note location of Energy Equity Co. 1-8 Radio Towers well, C NE Section 8 T28N R107W.
4.0 Existing Infrastructure

Infrastructure in support of oil and gas operations is abundant in the area of Long Draw Prospect due to the proximity of Jonah and Pinedale Anticline oil and gas fields. Several gathering systems are in place including 20 inch or greater lines to processing facilities at the towns of Opal, Granger, and Black Fork, Wyoming. The Falcon Compressor Station is located in Section 36 T30N – R108W, approximately 8 miles north-northwest of Long Draw. Highway access to the area is afforded by paved U.S. highways and state and county roads, as well as all-weather County and BLM roads. Additional support and maintenance facilities are available at Pinedale and Rock Springs. The mainline of the Union Pacific RR follows Interstate 80 through Rock Springs, affording rail access and facilities at that location.

5.0 Long Draw Prospect Geology

Long Draw is a stratigraphic play with structural assist and is prospective over much of the Upper Cretaceous and parts of the Lower Cretaceous sedimentary sections. The prospective area has much in common with Jonah and Pinedale fields, including many of the unique geologic characteristics and production “reliant on a complex interplay of geologic factors, including structure, reservoir sandstone and siltstone thickness, porosity development, permeability and reservoir pressures, which are in turn related to sedimentary facies, diagenesis, water saturations, and related controls on relative permeabilities to gas” (Longman and Kneller, 2015; AAPG, 2016). Primary targets from around 8000 to 14,000 feet exist in the Upper Cretaceous Lance Formation equivalent to that producing at Jonah and Pinedale Anticline, the Upper Mesaverde, and Ericson Sandstones.

Deep opportunities exist in the Rock Springs and Blair Formations, the Frontier Sandstone, and Upper Dakota/Muddy Sandstone intervals at depths of 14,000 to 21,000 feet. Additional secondary targets may exist in intervals of the unnamed Tertiary unit (Law and Johnson, 1989) underlying the Tertiary Fort Union and overlying the Cretaceous Lance Formation, as well as the Fort Union itself. Based on information from wells in the vicinity of Long Draw, IPs for gas production from the Lance-Mesaverde could be in the range of 300 to 3,000 MCFGPD. Average recoverable reserves for the Lance based on Jonah Field production are expected to be in the range of 2 to 4 BCFG and 40,000 to 75,000 BO per well. In normally pressured zones outside of the Jonah Field, EURs for the Lance will likely range from 0.85 to 1BCF per well with 2500 to 5000 BO over the LOW.
Figure 4. Cross section A-A' (see Figure 1 for location). Orange line indicates top of overpressuring in region, based on well log interpretation.
5.1 Structure

Long Draw Prospect is situated in one of the deepest parts of the Green River Basin southwest of the Wind River Uplift and south of the Hoback sub-basin. The Jonah structure and the Pinedale Anticline are to the north and northeast respectively (Figure 1). The La Barge Platform, Moxa Arch, and the Sevier fold and thrust belt lie to the west. Regional dip at Long Draw is east-northeast at about 200 to 300 feet per mile on top of the Lance. The east-northeast dip is the result of basin-margin loading by the Wind River Uplift and asymmetric subsidence which accommodated an east-northeast thickening wedge of sediment coeval with movement on the Uplift (Figure 4).

Details of structure at Long Draw are shown in Figure 5, as mapped on the Lance. This map is reproduced and modified after DuBois, et al (2004). It does not show the Pinedale Thrust, which is projected to traverse from north to south through the center of T28N-R107W between the previously mentioned Energy Equity 1-8 Radio Towers and Samson Resources Bull Draw 3-11 wells. The Bull Draw 3-11 well is some 650 feet high to the 1-8 Radio Towers despite the regional east-northeast dip, and is likely on the extension of the Pinedale Anticline and separated from the 1-8 Radio Towers by the Pinedale Thrust. East-northeast regional dip is shown in the vicinity of Long Draw and terminates to the east in the Farson Syncline (a.k.a. Sand Draw Syncline). The giant Jonah gas field lies two to three miles north and northwest of Long Draw and is separated from Long Draw by the near vertical, southern bounding shear/transverse fault of the Jonah structure. The Jonah Field itself is a pie-shaped wedge reaching an apex about 8 to 10 miles west of Long Draw. The field is bounded on the south by a left-lateral wrench fault with a significant vertical component of movement. The west bounding fault is more nearly vertical with possibly no wrench movement. Hanson, et al (2004), suggest that the south fault had a protracted, episodic, and complex displacement history beginning with paleostructural development in the Late Cretaceous. The field is further traversed by several more minor north trending somewhat arcuate faults. The structure terminates in the Farson Syncline.

No seismic was immediately available to the author to further interpret the structure in and around Long Draw. The regional east-northeast dip on the Upper Cretaceous Lance Formation is interpreted from available well control. Older vintage low-fold 2D seismic is available. At least three ca. 1980s lines cross the Long Draw leases. The Section 6 T28N-R107W leases are partially covered by modern 3D seismic which is again available through local seismic brokerage houses. 3D seismic has been successfully used in this area to identify and delineate Lance channels and fault systems. These applications are more fully discussed in Hanson, et al (2004). 3D seismic imaging is strongly recommended prior to prospecting for deeper horizons such as the Frontier and Muddy Sandstones. Previous “constructed” maps on the Frontier Sandstone at Long Draw suggest development of a local structural high at this point, which should be further investigated by modern 3D seismic.
5.2 Stratigraphy of Prospective Section

A generalized stratigraphic column of producing or potentially producible Tertiary and Upper Cretaceous reservoirs is presented in Figure 6, and are further described here.

5.2.1 Known Producing Zones – Long Draw, Jonah, and Pinedale Anticline Area:

5.2.1.1 Tertiary Fort Unit

The Tertiary (Paleocene) Fort Union Formation is unconformably overlain by the Eocene Wasatch Formation and underlain by the Upper Cretaceous Lance Formation. In the vicinity of Jonah and Long Draw, the Fort Union is composed of arkosic sandstones interbedded with mudstones and several laterally persistent coal beds (DuBois, et al, 2004). The base of the lowest coal is considered the boundary between the Fort Union and the so-called “Unnamed Tertiary Unit” (see Section 5.2.1.2). The Fort Union is known to produce gas in the Hacienda Unit, south of the southernmost bounding fault of Jonah Field (Figure 5).

5.2.1.2 Unnamed Tertiary Unit

An unnamed Tertiary unit defined by Law and Johnson (1989) at Pinedale Anticline is present in the Jonah area and ranges from 600 to 1000 feet thick. This unit occasionally produces at Jonah and south of the southern bounding fault of Jonah Field, and may actually be part of the Lance Formation. It is composed of isolated fluvial sand bodies interbedded with non-marine mudstones (DuBois, et al, 2004). The unit is primarily a gas producer, but has yielded some oil as well.
Figure 6. Stratigraphic column for Lower Tertiary (Paleocene) and Upper Cretaceous intervals Jonah-Long Draw area (modified after Hanson, et al, 2004).
5.2.1.3 Upper Cretaceous Lance Formation

The Upper Cretaceous Lance Formation is considered the primary target reservoir sequence on the Long Draw Prospect. Prolific production has been established from the Lance at Jonah and Pinedale Anticline, as well as several wells south of the southernmost bounding wrench fault of Jonah Field. This includes the Stephens Poblano Federal 1-28 in Section 28 T28N-R107W south of the Long Draw leases, and the shut-in Energy Equity Co. 1-8 Radio Towers well on the Long Draw leases in Section 8 T28N-R107W. A third Lance producer, now shut-in, the Samson Resources Bull Draw 3-11, is situated two miles east of the Long Draw Prospect. This well is thought to be east of the Pinedale Thrust Fault and more structurally influenced than other Lance production in T28N R107W. These wells are discussed in more detail elsewhere in this report.

Overlain by an unnamed Tertiary unit and underlain by the Upper Mesaverde, the Lance is divided in descending order into the Upper Lance, Middle Lance, Jonah, Yellow Point, and Wardell intervals (Figure 7). In the vicinity of Long Draw and Jonah, the Lance consists of a thick (2500 to 3500 feet), entirely non-marine sequence of fine grained, amalgamated single and multistory (stacked) braided-stream to meandering channel-fill sandstones intercalated with siltstone and mudstone overbank and flood plain deposits, resulting in strongly compartmentalized reservoirs.

The principal direction of sediment transport was from north-northwest to south-southeast, parallel to the paleoaxis of the basin, nearly parallel to present day structural strike in the area of the Long Draw Prospect. This configuration of deposition and structure, along with compartmentalization of the reservoir intervals both vertically and laterally suggests strong possibilities for stratigraphic traps across the Long Draw leases.
Figure 7. Zoning and naming conventions for Upper Cretaceous Lance Formation, Jonah Field, Sublette County, Wyoming (after Eberhard and Mullen, 2004).
5.2.1.4 Upper Mesaverde Formation

The Mesaverde Formation in this region consists of the Upper Mesaverde, the Ericson Sandstone, the Rock Springs Formation, and the basal Blair Formation. Both the Upper Mesaverde and the Ericson produce at Jonah Field immediately north of Long Draw Prospect and are considered target reservoir intervals on Long Draw.

The Upper Mesaverde at Long Draw was dominantly deposited by fluvial, non-marine processes. It is considered to be a lateral equivalent of the Almond Sandstone of the eastern Green River Basin. The Upper Mesaverde produces at Jonah Field and in wells south of the southern bounding fault of Jonah Field. It also produces in fields on the Moxa Arch where it is called the Almond.

5.2.1.5 Ericson Sandstone

The Ericson Sandstone is about 250 to 300 feet thick in this area and underlies the Upper Mesaverde/Almond units. The Ericson is sandstone with interbeds of siltstone and shale deposited in meandering and braided-stream systems. The upper part of the Ericson is a conglomeratic sandstone with less siltstone and shale than the lower part and considered to be a braided-stream system.

5.2.2 Potential & Prospective Zones:

5.2.2.1 Rock Springs Formation

The Rock Springs Formation is overlain by the Upper Mesaverde and Ericson, and is a middle member of the Mesaverde Group. It has yielded significant gas shows in wells in Jonah Field and is considered a prospective zone for gas production. Like the other members of the upper and middle units of the Mesaverde Group in this area, the Rock Springs was deposited in dominantly fluvial environments and consists of channel-fill sandstones and interbedded siltstones and shales or mudstones. The Rock Springs in the area of Long Draw is projected to be 1900 to 2000 feet in thickness.
5.2.2.2 Blair Formation

The Blair Formation is the deepest formation penetrated by wells at Jonah Field. In this region the Blair is a fine-grained marine sandstone underlying the Hilliard Shale, and is the lower most member of the Upper Cretaceous Mesaverde Formation. At Long Draw the Blair ranges to 400 feet thick and is a well-sorted, fine-grained marine sandstone overlying the marine Hilliard Shale. The lowermost sandstones of the Blair produce in fields on the flank of the Rock Springs Uplift southeast of Long Draw. At that location the lower Blair is interpreted as a series of submarine fans (Roehler, 1993).

5.2.2.3 Frontier Formation

The Frontier Formation is projected at approximately 19,500 to 20,300 feet at Long Draw. This formation is a proven producer at La Barge field (discovered in 1974) west of Long Draw, with a projected recoverable of 1.8 TCFG from that field, as well as from several other fields along the Moxa Arch trend. At least four benches of the Frontier occur in the area of La Barge, transitioning from a fluvio-deltaic system in the west to fluvial-estuarine eastward. Most Frontier reservoirs in this region occur in marine upper shoreface and fluvial channel-fill sandstone facies.

Reservoir quality is, in most cases, directly related to original environment of deposition. Natural fracturing of the formation gives rise to potential high-permeability “sweet spots” within the reservoir intervals. In general, Frontier fluvial channel-fill sandstones form southeast-trending belts which are a few miles wide, several tens of feet thick, and separated by interchannel shale and sandy shale. Marine shoreface sediments form a continuous northeast-thinning sheet of sandstone of 40 to 120 feet thick with the cleanest sandstones developed near the top of the shoreface deposits (Dutton, et al, 1992).
5.2.2.4 Lower Cretaceous Dakota/Muddy Sandstones

The Dakota/Muddy Sandstone constitutes the deepest potential producing horizon examined in the Long Draw area. Few wells have penetrated to the expected depths of the Muddy at Long Draw. However, the Muddy is known to have been deposited in a variety of fluvial, restricted and marginal marine environments. The Muddy produces both oil and gas in fields along the Moxa Arch west and southwest of Long Draw (see Figure 1). The Lucky-Ditch Field on that structure has produced a cumulative 107 MMBO and 74 BCFG from the Muddy Sandstones. Swan-Blue Forest has yielded 1.1 MMBO and 47 BCFG, while the Dakota/Muddy at Church Buttes Field has produced a total of 1.879 MMBO and 680 BCFG over its lifetime.

5.3 Lance/Upper Mesaverde Reservoir Characteristics & Gas Quality

The Upper Cretaceous Lance Formation accounts for most of the production in the vicinity of Long Draw. Here, as previously stated, the Lance is comprised of amalgamated channel-fill sandstones deposited in braided to meandering stream environments intercalated with overbank or floodplain siltstones and mudstones. Due to original depositional environment as well as other factors, Lance reservoirs are highly heterogeneous and strongly compartmentalized. Within Jonah and Pinedale fields, the reservoirs are overpressured, helping to increase storage, preserve porosity and permeability, and increase relative permeability.

5.3.1 Reservoir Parameters (cutoffs):

Pay interval definition (well log), single and multistory stacked channels (Jennings and Ault, 2004):

*Gamma Ray (GR)*: \( \leq 65 \text{ API Units} \)

*Density Porosity at 2.65 gm/cm\(^3\)*: \( \geq 8\% \)

*Resistivity (R)*: \( \geq 40 \text{ ohms} \)
Water Saturation: \( \leq 50\% \)

Spacing (original): Jonah Field 80ac units, two wells per unit, 40 acres per well; spacing has since been modified to allow for close-spaced infill development.

Gross Interval: 2500 feet or more

Net Sand: 28 to 53\% of gross interval

Net Pay, \( @ \leq 50 \ S_w \): 100 to 500 feet

Average Porosity (core; Cluff and Cluff, 2004): 7.7\%

Maximum Porosity (core): 12.9\%

Porosity Percent (core): \( >9\% = 30\% \)

Average Permeability (core): 0.145 mD; permeability to gas = 1 to 20\( \mu \)D (i.e., 0.001-0.02 mD) (Eberhard and Mullen, 2004, 2000)

5.3.2 Gas & Liquids Analysis

5.3.2.1 Jonah Field (Section 7 T28N – R108W) Gas

\[
\begin{align*}
&\text{Carbon Dioxide} = 0.806\% \\
&\text{Nitrogen} = 0.604\% \\
&\text{Methane} = 85.63\% \\
&\text{Ethane} = 7.703\% \\
&\text{Propane} = 3.45\% \\
&\text{Iso-butane} = 0.791\% \\
&\text{Iso-pentane} = 0.193\% \\
&\text{N-pentane} = 0.134 \\
&\text{Btu's} = 1152 \\
&\text{Specific gravity} = 0.664 \\
&\text{Z-factor} = 0.9972
\end{align*}
\]
5.3.2.2 Jonah Field (SW SE Section 28 T29N-R108W) Liquids

\[ GOR = 86.2 \text{MMCF (separator) per 1 bbl separator oil (11.6 BO/MMCFG)} \]

\[ Btus = 1112 \]

\[ Specific Gravity = 0.6612 \]

5.3.3 Reservoir Pressures & Mud Weights

*Static Bottom Hole (Jonah):* variable due to compartmentalization; 
\~6200 psi @ \~10,500 feet

*Pressure Gradients (Jonah, overpressure):* 0.58-0.65 psi/ft (measured at 800-9300 feet); 
wells drilled outside the faults defining Jonah Field have encountered normally pressured sandstones.

*Mud weights:* 11.5 to 12.2 ppg (Jonah Field); non-overpressured areas (outside of 
bounding faults of Jonah Field) = 9.6 to 10.3ppg

5.4 Existing Production & Prospective Resources

While prolific production has been established from the Lance, Upper Mesaverde, and other 
zones at Jonah Field, great potential exists in these same zones south of the bounding faults of Jonah. 
Producing wells (*Figure 8*) in the Hacienda Unit (shown by green cross-hatching on the previous *Figure 2*), 
have established the potential outside Jonah field limits. A list of selected producing Hacienda unit 
wells and selected wells further to the east in T28N-R107W appears in *Table 1*. This list includes wells 
producing from the Lance, as well as from Mesaverde, Ericson, and the Tertiary Fort Union. Comparison 
of well logs from these wells with those of producing wells in Jonah show a striking similarity in reservoir 
characteristics of the Lance and Mesaverde. Thus, similar geologic controls on production, short of 
overpressuring, should be expected on Long Draw.
Figure 8. Annotated land base for Long Draw Prospect with key wells in vicinity, Hacienda Unit. See also Table 1 for more details.
<table>
<thead>
<tr>
<th>OPERATOR</th>
<th>WELL NAME</th>
<th>SPOT</th>
<th>YEAR COMPLETED</th>
<th>TOTAL DEPTH</th>
<th>PRODUCTION INTERVAL</th>
<th>INITIAL PRODUCTION</th>
<th>CUMULATIVE PRODUCTION</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jonah Energy LLC</td>
<td>Yellow Point 15-13</td>
<td>SW SE 13-T28N-R109W</td>
<td>2000</td>
<td>9860</td>
<td>Lance</td>
<td>5BO + 323MCFG + 10BW</td>
<td>2114BO + 317610MCFG + 7414BW</td>
<td>PG</td>
</tr>
<tr>
<td>Jonah Energy LLC</td>
<td>Wardell No. 1</td>
<td>SE SE 9-T28N-R108W</td>
<td>1975</td>
<td>11324</td>
<td>Fort Union</td>
<td>2BO + 303MCFG + 0BW</td>
<td>3388BO + 180350MCFG + 8383BW</td>
<td>SI</td>
</tr>
<tr>
<td>Jonah Energy LLC</td>
<td>Hacienda 6-17A</td>
<td>SE NW 17-T28N-R108W</td>
<td>2007</td>
<td>9558</td>
<td>Lance - Yellow Point</td>
<td>6BO + 1089MCFG + 6BW</td>
<td>2445BO + 458817MCFG + 25869BW</td>
<td>PG</td>
</tr>
<tr>
<td>Jonah Energy LLC</td>
<td>Hacienda 5-20</td>
<td>SW NW 20-T28N-R108W</td>
<td>2009</td>
<td>9578</td>
<td>Lance - Yellow Point</td>
<td>0BO + 1609MCFG + 288BW</td>
<td>2861BO + 536457MCFG +22268BW</td>
<td>PG</td>
</tr>
<tr>
<td>Jonah Energy LLC</td>
<td>Hacienda 12-21</td>
<td>SW SW 21-T28N-R108W</td>
<td>2009</td>
<td>9407</td>
<td>Lance - Jonah - Wardell</td>
<td>0BO + 877MCFG + 179BW</td>
<td>2164BO + 236920MCFG + 26854BW</td>
<td>PG</td>
</tr>
<tr>
<td>Jonah Energy LLC</td>
<td>Hacienda 5-29</td>
<td>SW NW 29-T28N-R108W</td>
<td>2001</td>
<td>10670</td>
<td>Lance - Mesaverde</td>
<td>6BO + 994MCFG +488BW</td>
<td>2755BO + 295867MCFG + 12989BW</td>
<td>PG</td>
</tr>
<tr>
<td>Samson Resources</td>
<td>Bull Draw 3-11</td>
<td>NE NW 11-T28N-R107W</td>
<td>1994</td>
<td>12780</td>
<td>Lance - Wardell</td>
<td>0BO + 300MCFG + 0BW</td>
<td>271BO + 39838MCFG + 7271BW</td>
<td>SI/NI</td>
</tr>
<tr>
<td>Stephens Production</td>
<td>Poblanco Federal 1-28</td>
<td>NE SE 28-T28N-R107W</td>
<td>2000</td>
<td>12888</td>
<td>Mesaverde/Ericson</td>
<td>226BO + 2334MCFG + 432BW</td>
<td>308BO + 678MCFG + 87BW</td>
<td>SI/PA</td>
</tr>
</tbody>
</table>

Table 1. Comparison of representative producing wells
Overpressuring in Jonah assists in increasing storage capacity and relative permeabilities, and thus larger well yields, however normally pressured wells drilled in T28N-R107-108W can still be expected to produce economic quantities of oil and gas. Decline curves for selected wells in the Hacienda Unit, such as that shown in Figure 9, indicate minimum EURs in the range of 0.85 to 1.0 BCFG over an LOW of 20 to 25 years. IPs ranging 5 to 225 BOPD and 300 to 3,000 MCFGPD can be expected. This assumes a Lance and/or Mesaverde completion only. Work by DuBois et al (2004) has shown (Figure 10) that in general liquid hydrocarbon yield increases with depth, at least for the Lance Formation, and is the result of vertical fractionation of liquids-rich hydrocarbons. Burial history modeling suggests that the Hilliard and Mowry Shales present in this region were the active source rocks.

It is of interest to note that comparison of cumulatives from the earliest wells in the Hacienda Unit with those from wells drilled after 2002 show a considerable difference in yield from similar and equivalent Lance intervals in the older wells. While this may well be explained by differences in geology and possibly reservoir compartmentalization, it also is suggested here that best completion practices were not in use in the earlier wells. Much has been learned since the discovery of Jonah Field ca. 1992, and the most effective completion practices across the Lance and Mesaverde were not developed in Jonah until ca. 2001-2004.

Eberhard, et al (2000) discussed several possible causes of low completion efficiency, but two in particular. The two main causes were believed to be 1) reintroduction of fluid into previously fracked zones to kill gas flow in preparation for the next stage of fracturing; and 2) shutting-in earlier producing zones for extended periods during completion of additional zones. Several more efficient completion methods have been developed in the intervening years (Eberhard and Mullen, 2004), including induced stress inversion (Hewett and Spence, 1998), which has been used with much success in the Jonah Field.

It is also relevant that much of the Cretaceous stratigraphic column has yet to be tested in the normally pressured area south of Jonah, including that beneath Long Draw Prospect. Given that almost every Cretaceous interval in the area produces at least gas, this yields potential for considerable recoverable reserves from zones other than the Lance/Mesaverde alone.
Figure 9. Decline curve for Jonah Energy LLC 5-20 Hacienda Section 20 T28N R108W, Hacienda Unit, U. Cret. Lance Formation production (from WO&GCC files).
5.5 Wells on Long Draw Prospect

5.5.1 Energy Equity Co. 1-8 Radio Towers (Sec. 8 T28N-R107W)

The Energy Equity Co. 1-8 Radio Towers well, C NE Section 8 T28N-R107W, occurs on the Laramie & Associates WYW-181410 lease, within the Hacienda Unit. Originally drilled by Ultra Petroleum, the 1-8 well reached a total depth of 13,405 feet in September 1998, and penetrated almost the full section of the Upper Mesaverde and possibly the Ericson Sandstones. A full suite of logs was run from bottom of surface casing to TD by Western Atlas, including High Definition Induction/GR, Compensated Neutron-Density, and Multipole Array Acoustic/GR logs. Two strings of P-110 four and a half-inch production casing were run in 7.875 inch hole and landed at 13,404 feet with a PBTD of 13,354 feet. The well was subsequently perforated over a gross interval of 12,167 to 13,210 feet, 4SPF. No treatment records are available from the Wyoming Oil and Gas Conservation Commission (WOGCC). The well is currently reported as a shut-in gas well as of September 2002. No IP or cumulatives are reported in the WOGCC files. Very little crossover effect is noted between the density and neutron logs, however lack of crossover may be due to flushing at the well bore face and a masking effect on the density log.

Quick look log analysis methods (Crain, 1978-2016) using the cut-offs listed in Section 5.3.1 of this report, indicate a total of 463 feet of net sand present over the interval 9040 to 13,320 feet. More detailed analysis of the Jonah Zone of this well below Middle Lance indicates a gross stratigraphic interval of 280 feet with 150 feet of net sand (53.5% of gross) using the cut-offs, for the Jonah interval alone. Sixty-eight feet of the 150 net sand feet (i.e., 45% of net) meet criteria for potential production.

This well should be re-evaluated with modern log analysis techniques and considered for possible re-entry to complete potential reserves behind pipe and/or twinning.
References


APPENDIX A

Well Plan for 21,000 FT Test to Cretaceous Dakota/Muddy Sandstones

LONG DRAW PROSPECT
Sections 6, 7, 8, and 16 T28N R107W
Sublette County, Wyoming

1. Estimated Formation Depths and Thicknesses

Est. GL = ~7000 feet above mean sea level; all depths estimated TVD from surface

<table>
<thead>
<tr>
<th>Formation</th>
<th>Expected Depth</th>
<th>Expected Thickness</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eocene Wasatch Fm.</td>
<td>Surface</td>
<td>3,740</td>
<td>ark ss., mstone, coals</td>
</tr>
<tr>
<td>Paleocene Fort Union Fm.</td>
<td>3740</td>
<td>4,660</td>
<td>Sh/mstone, sparse ss</td>
</tr>
<tr>
<td>Unnamed Tertiary Unit</td>
<td>8400</td>
<td>640</td>
<td>f.g. ss, inbd siltsten,sh</td>
</tr>
<tr>
<td>U. Cret. Lance Formation</td>
<td>9040</td>
<td>1,500</td>
<td>f.g. ss, inbd siltsten,sh</td>
</tr>
<tr>
<td>Middle Lance Formation</td>
<td>10540</td>
<td>627</td>
<td>f.g. ss, inbd siltsten,sh</td>
</tr>
<tr>
<td>Jonah</td>
<td>11,167</td>
<td>282</td>
<td>f.g. ss, inbd siltsten,sh</td>
</tr>
<tr>
<td>Yellow Point</td>
<td>11,458</td>
<td>170</td>
<td>f.g. ss, inbd siltsten,sh</td>
</tr>
<tr>
<td>Wardell</td>
<td>11,628</td>
<td>264</td>
<td>f.g. ss, inbd siltsten,sh</td>
</tr>
<tr>
<td>Upper Mesaverde</td>
<td>12,207</td>
<td>1,200</td>
<td>inbddd ss, siltsten, sh</td>
</tr>
<tr>
<td>Ericson Sandstone</td>
<td>13,407</td>
<td>300</td>
<td>clg ss., siltsten, mstn</td>
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<tr>
<td>Upper Rock Springs Fm.</td>
<td>13,707</td>
<td>980</td>
<td>ss, inbd siltsten, sh</td>
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<tr>
<td>Middle Rock Springs</td>
<td>14,687</td>
<td>580</td>
<td>sh, inbd siltsten</td>
</tr>
<tr>
<td>Lower Rock Springs</td>
<td>15,267</td>
<td>200</td>
<td>ss, inbd siltsten,sh</td>
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<tr>
<td>Blair Formation</td>
<td>15,467</td>
<td>400</td>
<td>f.g marine ss</td>
</tr>
<tr>
<td>Hilliard Shale</td>
<td>15,867</td>
<td>3,700</td>
<td>marine shales, siltsten</td>
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<td>Frontier Formation</td>
<td>19,567</td>
<td>850</td>
<td>fl to mar ss, siltsten,sh</td>
</tr>
<tr>
<td>Mowry Shale</td>
<td>20,417</td>
<td>350</td>
<td>marine sh</td>
</tr>
<tr>
<td>Upper Dakota/Muddy Ss.</td>
<td>20,767</td>
<td>250</td>
<td>fl to marine ss, siltsten</td>
</tr>
<tr>
<td>Est. Total Depth (TD)</td>
<td>21,000</td>
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<td>--</td>
</tr>
</tbody>
</table>
2. Mud Logger: 3,500 to TD

3. Well-site Geologist: 3500 to TD

4. Cores: no cores planned; optional sidewall cores selected intervals Blair Ss., Frontier, and Dakota

5. Sample program: 10ft min. sample catch base surface casing to TD, 5 foot samples across all drill breaks and significant gas/oil shows; circulate bottoms-up before all TOH. Otherwise, sampling at geologist’s discretion.

6. Drill Stem Tests: no DSTs planned

7. Well log program:

   log suiteTBD in consultation with well logging contractor

   Minimum log program:
   - Gamma Ray (GR): base conductor to TD
   - Sonic: base surface csg. to TD
   - Compensated Neutron-Density suite, base surface csg to TD
   - GR/SP – Induction Resistivity

8. Mud program:
   TBD in consultation with drilling fluids contractor; best practices for Jonah area
   
   Overpressuring is not expected in this area. Nearby wells have been completed to 12800 with 9.6 to 10.3 lb. mud, however, driller should anticipate possibility of and be prepared for overpressures and necessity to flare produced gas during drilling, from top of Lance Fm. to TD.
   
   Sandstones in potentially productive zones are sensitive to formation damage, and flushing. Excessive sloughing has been noted in the sections to be drilled.

9. Casing Program: (final program TBD in consultation with PE)

   Minimum program:
   - Conductor pipe: 16 in. surface to 150 feet
   - Surface Casing: Surface to 3,500 feet
   - Production casing: minimum 5-1/2 to TD or PBTD for producing zones
   - Tubing: TBD depending on depth and pressures
10. **Completion Program:**

   TDB based on well log analysis, petrophysical, core, and engineering analyses and in accordance with proven best practices for Jonah area, with attention to avoidance or minimization of formation damage.

   Contractor should anticipate multi-stage fracture program, induced stress diversion as a completion technique or recommended best practices for modern Jonah-type wells.

11. **Other:**

   Anticipate, at operator’s option, check shot survey on completion of drilling and prior to running production string(s).