

Noble Energy

Weld County, CO (NAD 83)

Sec. 28-T9N-R59W (LC28-15-A)

Rainbow LC28-74-1HNA

05-123-38849

Plan B

Design: Actual Surveys

Sperry Drilling Services

Final Survey Report

17 September, 2014

Surface UWI : 05-123-38849

Well Coordinates: 1,506,938.07 N, 3,421,408.86 E (40° 42' 54.07" N, 103° 58' 47.21" W)

Ground Level: 4,842.00 usft

Local Coordinate Origin:

Viewing Datum:

TVDs to System:

North Reference:

Unit System:

Geodetic Scale Factor Applied

Version: 5000.1 Build: 70

Centered on Well Rainbow LC28-74-1HNA

RKB=24ft @ 4866.00usft (H&P 273)

N

Grid

API - US Survey Feet - Custom

HALLIBURTON

Project: Weld County, CO (NAD 83)
 Site: Sec. 28-T9N-R59W (LC28-15-A)
 Well: Rainbow LC28-74-1HNA
 Wellbore: Plan B
 Design: Actual Surveys

Noble Energy

HALLIBURTON
 Drilling

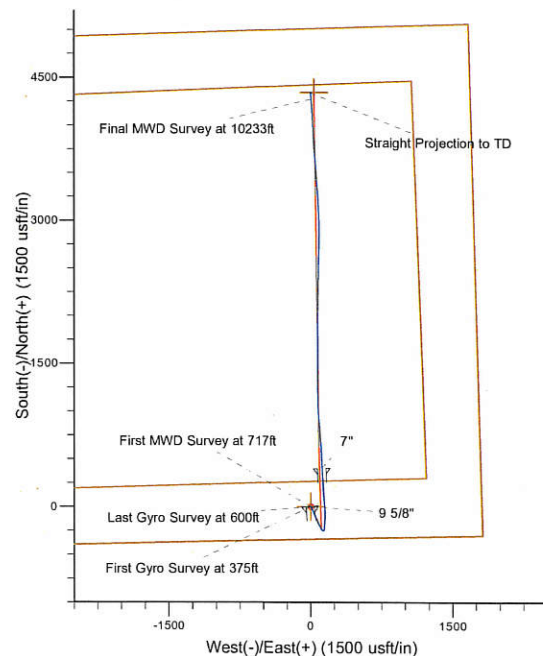
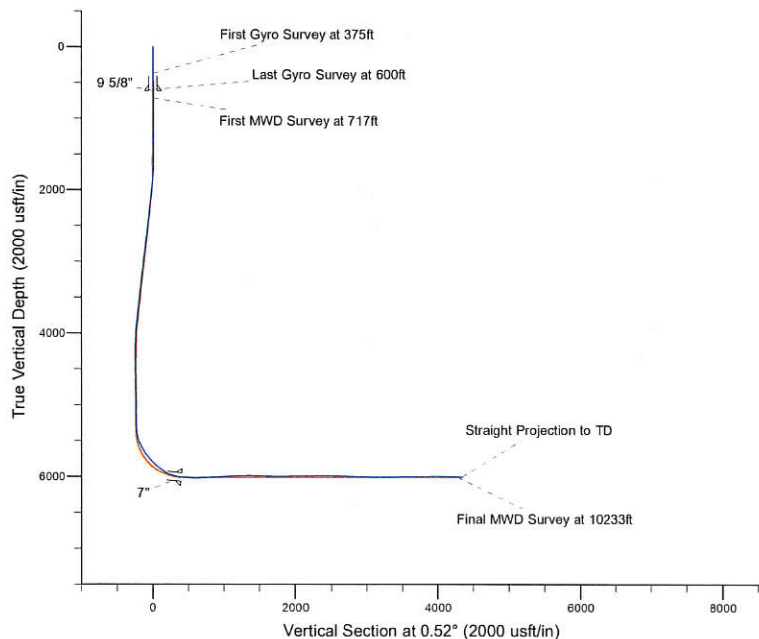
Platted SHL: 340' FSL, 1810' FEL
 Platted Lat/Long: 40.715020 N, 103.979780 W
 Location: Sec. 28-T9N-R59W

~7" Casing: 729' FSL, 1663.5' FEL
 Lat/Long: 40° 31' 6.490" N, 104° 27' 10.855" W
 State Planes - CO Northern: 1,433,437.43N, 3,291,079.78E
 Location: Sec. 4-T6N-R63W

Platted BHL: 675' FNL, 1650' FEL
 Lat/Long: 40.726940 N, 103.979370 W
 State Planes - CO Northern: 1511282.19 N, 3421448.03 E
 Location: Sec. 28-T9N-R59W

LEGEND

- Rainbow LC28-74-1HNA, Plan B, Rev B0 - PROPOSAL V0
- Actual Surveys



WELL DETAILS: Rainbow LC28-74-1HNA

Ground Level: 4842.00
 RKB=24ft @ 4866.00usft (H&P 273)

Created By: Gordy Roth
 Created On: 08/27/2014

Design Report for Rainbow LC28-74-1HNA - Actual Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
375.00	0.80	300.23	374.99	1.32	-2.26	1.30	0.21
First Gyro Survey at 375ft							
600.00	0.20	349.73	599.98	2.50	-3.69	2.46	0.31
Last Gyro Survey at 600ft - Tie On to Gyro Survey at 600ft							
717.00	0.29	16.99	716.98	2.98	-3.64	2.95	0.12
First MWD Survey at 717ft							
902.00	0.10	105.34	901.98	3.38	-3.35	3.35	0.16
1,181.00	0.25	45.02	1,180.98	3.75	-2.68	3.73	0.08
1,460.00	0.31	349.48	1,459.97	4.92	-2.39	4.90	0.10
1,553.00	0.29	346.53	1,552.97	5.40	-2.49	5.38	0.03
1,645.00	0.37	3.94	1,644.97	5.92	-2.52	5.90	0.14
1,737.00	3.04	158.94	1,736.93	3.94	-1.63	3.93	3.67
1,832.00	5.27	155.79	1,831.68	-2.39	1.07	-2.38	2.36
1,927.00	4.89	155.02	1,926.30	-10.04	4.57	-10.00	0.41
2,022.00	7.17	155.78	2,020.77	-19.12	8.71	-19.04	2.40
2,117.00	6.24	151.85	2,115.12	-29.08	13.58	-28.95	1.09
2,212.00	7.37	162.56	2,209.45	-39.44	17.84	-39.28	1.78
2,307.00	7.06	158.06	2,303.70	-50.67	21.85	-50.47	0.68
2,401.00	6.74	156.56	2,397.02	-61.09	26.20	-60.85	0.39
2,496.00	7.95	155.22	2,491.24	-72.17	31.17	-71.89	1.29
2,591.00	8.09	154.79	2,585.31	-84.18	36.77	-83.85	0.16
2,781.00	7.93	155.88	2,773.46	-108.24	47.82	-107.81	0.12
2,876.00	7.92	156.47	2,867.55	-120.22	53.11	-119.74	0.09
2,970.00	7.48	154.98	2,960.70	-131.71	58.29	-131.17	0.51
3,065.00	6.86	158.87	3,054.96	-142.60	62.95	-142.03	0.83
3,160.00	6.14	157.92	3,149.35	-152.60	66.90	-151.99	0.77
3,255.00	5.32	158.08	3,243.87	-161.39	70.46	-160.75	0.86
3,350.00	7.06	149.93	3,338.32	-170.53	75.03	-169.85	2.05
3,445.00	7.09	149.29	3,432.59	-180.63	80.95	-179.89	0.09
3,540.00	7.25	150.23	3,526.85	-190.87	86.92	-190.08	0.21
3,635.00	7.49	152.50	3,621.07	-201.57	92.75	-200.72	0.40
3,730.00	7.92	149.51	3,715.21	-212.70	98.93	-211.80	0.62
3,825.00	7.57	148.82	3,809.34	-223.69	105.49	-222.73	0.38
3,920.00	7.29	150.78	3,903.54	-234.31	111.68	-233.29	0.40
4,015.00	4.28	142.75	3,998.05	-242.39	116.76	-241.33	3.27
4,109.00	2.40	131.35	4,091.89	-246.48	120.37	-245.39	2.11
4,204.00	2.01	124.54	4,186.82	-248.74	123.23	-247.62	0.49
4,299.00	1.53	114.01	4,281.77	-250.20	125.76	-249.06	0.61
4,394.00	1.57	109.87	4,376.74	-251.16	128.14	-250.00	0.13
4,489.00	1.30	84.27	4,471.71	-251.50	130.44	-250.31	0.72
4,584.00	1.32	67.17	4,566.68	-250.96	132.52	-249.76	0.41
4,773.00	2.11	39.85	4,755.60	-247.45	136.76	-246.20	0.59
4,868.00	2.02	46.13	4,850.54	-244.94	139.09	-243.68	0.26
4,963.00	1.73	26.57	4,945.49	-242.50	140.93	-241.22	0.73
5,058.00	1.38	10.03	5,040.45	-240.09	141.77	-238.80	0.60
5,247.00	1.08	9.49	5,229.41	-236.09	142.46	-234.80	0.16
5,337.00	1.09	4.41	5,319.39	-234.40	142.67	-233.11	0.11
5,385.00	4.94	352.01	5,367.32	-231.90	142.42	-230.61	8.09
5,432.00	11.27	357.74	5,413.83	-225.30	141.95	-224.01	13.56

Design Report for Rainbow LC28-74-1HNA - Actual Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
5,480.00	15.74	1.25	5,460.49	-214.10	141.91	-212.81	9.46
5,527.00	20.05	6.17	5,505.21	-199.71	142.92	-198.41	9.71
5,575.00	24.31	4.28	5,549.65	-181.67	144.54	-180.36	9.00
5,622.00	28.07	4.05	5,591.81	-160.98	146.04	-159.66	8.00
5,670.00	31.23	4.39	5,633.52	-137.30	147.79	-135.97	6.59
5,716.00	33.97	2.90	5,672.27	-112.57	149.36	-111.22	6.21
5,764.00	37.36	359.88	5,711.27	-84.61	150.01	-83.25	7.96
5,811.00	40.35	356.43	5,747.87	-55.15	149.03	-53.81	7.85
5,859.00	43.89	356.33	5,783.47	-23.03	146.99	-21.70	7.38
5,906.00	45.90	355.79	5,816.76	10.06	144.71	11.37	4.35
5,954.00	48.55	355.51	5,849.35	45.19	142.04	46.47	5.54
6,001.00	52.36	357.05	5,879.27	81.35	139.70	82.61	8.49
6,049.00	56.10	355.87	5,907.33	120.21	137.29	121.45	8.04
6,096.00	58.55	354.51	5,932.70	159.63	133.96	160.83	5.75
6,144.00	62.91	355.09	5,956.16	201.32	130.17	202.49	9.14
6,191.00	69.50	355.57	5,975.11	244.16	126.68	245.29	14.05
6,239.00	74.54	357.56	5,989.93	289.72	123.96	290.82	11.22
6,285.00	78.90	358.30	6,000.49	334.45	122.34	335.54	9.61
6,307.00	80.80	358.29	6,004.37	356.09	121.70	357.17	8.64
6,369.00	85.43	357.71	6,011.80	417.59	119.55	418.65	7.53
6,461.00	86.55	357.56	6,018.23	509.29	115.76	510.31	1.23
6,556.00	88.49	356.00	6,022.34	604.04	110.43	605.01	2.62
6,650.00	92.65	355.86	6,021.41	697.78	103.76	698.68	4.43
6,745.00	94.54	355.38	6,015.45	792.31	96.52	793.15	2.05
6,840.00	94.32	354.81	6,008.11	886.68	88.42	887.44	0.64
6,934.00	91.32	355.52	6,003.49	980.22	80.51	980.90	3.28
7,029.00	93.53	358.58	5,999.47	1,074.99	75.62	1,075.63	3.97
7,124.00	93.17	358.53	5,993.92	1,169.80	73.23	1,170.41	0.38
7,219.00	91.36	0.06	5,990.16	1,264.71	72.07	1,265.31	2.49
7,314.00	89.07	0.65	5,989.81	1,359.70	72.65	1,360.30	2.49
7,409.00	87.41	1.11	5,992.73	1,454.64	74.11	1,455.25	1.81
7,503.00	87.93	0.06	5,996.55	1,548.56	75.07	1,549.17	1.25
7,598.00	89.72	359.73	5,998.49	1,643.53	74.90	1,644.14	1.92
7,693.00	90.49	359.67	5,998.32	1,738.53	74.40	1,739.13	0.81
7,788.00	89.23	359.25	5,998.55	1,833.52	73.50	1,834.11	1.40
7,883.00	90.92	0.40	5,998.43	1,928.52	73.21	1,929.10	2.15
7,978.00	91.57	1.98	5,996.36	2,023.47	75.19	2,024.07	1.80
8,073.00	91.14	0.79	5,994.12	2,118.41	77.48	2,119.03	1.33
8,168.00	90.99	1.59	5,992.35	2,213.38	79.45	2,214.00	0.86
8,263.00	90.65	1.40	5,990.99	2,308.33	81.93	2,308.98	0.41
8,357.00	89.01	0.64	5,991.27	2,402.32	83.61	2,402.97	1.92
8,452.00	88.52	0.69	5,993.32	2,497.29	84.71	2,497.95	0.52
8,546.00	89.04	1.05	5,995.32	2,591.25	86.13	2,591.93	0.67
8,641.00	88.40	0.68	5,997.44	2,686.22	87.57	2,686.90	0.78
8,736.00	88.15	0.85	6,000.30	2,781.17	88.84	2,781.86	0.32
8,831.00	86.14	0.41	6,005.03	2,876.04	89.88	2,876.73	2.17
8,926.00	89.20	359.54	6,008.90	2,970.95	89.84	2,971.64	3.35
9,020.00	90.96	357.45	6,008.76	3,064.91	87.37	3,065.57	2.91
9,115.00	91.14	357.61	6,007.02	3,159.80	83.28	3,160.42	0.25
9,210.00	89.41	355.80	6,006.57	3,254.64	77.82	3,255.21	2.64
9,305.00	89.07	355.70	6,007.83	3,349.37	70.78	3,349.87	0.37

Design Report for Rainbow LC28-74-1HNA - Actual Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
9,399.00	89.82	355.15	6,008.74	3,443.06	63.28	3,443.49	0.99
9,494.00	91.39	355.36	6,007.73	3,537.73	55.42	3,538.08	1.67
9,589.00	90.55	355.72	6,006.13	3,632.43	48.03	3,632.71	0.96
9,683.00	91.20	354.87	6,004.69	3,726.10	40.33	3,726.31	1.14
9,778.00	91.73	357.01	6,002.26	3,820.82	33.60	3,820.97	2.32
9,873.00	89.41	355.87	6,001.32	3,915.63	27.70	3,915.72	2.72
9,968.00	90.99	359.05	6,000.99	4,010.52	23.49	4,010.57	3.74
10,062.00	88.89	356.48	6,001.08	4,104.43	19.83	4,104.44	3.53
10,157.00	88.43	355.70	6,003.31	4,199.18	13.35	4,199.13	0.95
10,233.00	87.35	355.25	6,006.10	4,274.89	7.36	4,274.79	1.54
Final MWD Survey at 10233ft							
10,300.00	87.35	355.25	6,009.20	4,341.59	1.82	4,341.43	0.00
Straight Projection to TD							

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
375.00	374.99	1.32	-2.26	First Gyro Survey at 375ft
600.00	599.98	2.50	-3.69	Last Gyro Survey at 600ft
600.00	599.98	2.50	-3.69	Tie On to Gyro Survey at 600ft
717.00	716.98	2.98	-3.64	First MWD Survey at 717ft
10,233.00	6,006.10	4,274.89	7.36	Final MWD Survey at 10233ft
10,300.00	6,009.20	4,341.59	1.82	Straight Projection to TD

Vertical Section Information

Angle Type	Target	Azimuth (°)	Origin Type	Origin +N/-S (usft)	Origin +E/-W (usft)	Start TVD (usft)
Target	Rainbow LC28-74-1HNA_BHL	0.52	Slot	0.00	0.00	0.00

Survey tool program

From (usft)	To (usft)	Survey/Plan	Survey Tool
375.00	600.00	Surface Surveys	Flexi-Shot
717.00	6,307.00	MWD Surveys - Intermediate	MWD+SC
6,369.00	10,300.00	MWD Surveys - Production	MWD+SC

Casing Details

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
617.40	617.38	9 5/8"	9-5/8	13-3/4
6,352.00	6,010.26	7"	7	8-3/4

Design Report for Rainbow LC28-74-1HNA - Actual Surveys

Wellbore Targets

Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude
Rainbow LC28-74-1HN - actual wellpath hits target center - Point	0.00	0.00	0.00	0.00	0.00	1,506,938.08	3,421,408.86	40° 42' 54.072 N	103° 58' 47.208 W
Rainbow LC28-74-1HN - actual wellpath hits target center - Polygon	0.00	0.00	0.00	0.00	0.00	1,506,938.08	3,421,408.86	40° 42' 54.072 N	103° 58' 47.208 W
Point 1				0.00	4,297.70	-3,007.22	1,511,235.73	3,418,401.67	
Point 2				0.00	183.34	-2,889.14	1,507,121.42	3,418,519.75	
Point 3				0.00	299.66	1,218.45	1,507,237.74	3,422,627.30	
Point 4				0.00	4,468.12	1,067.79	1,511,406.15	3,422,476.64	
Point 5				0.00	4,297.70	-3,007.22	1,511,235.73	3,418,401.67	
Rainbow LC28-74-1HN - actual wellpath hits target center - Polygon	0.00	0.00	0.00	0.00	0.00	1,506,938.08	3,421,408.86	40° 42' 54.072 N	103° 58' 47.208 W
Point 1				0.00	4,897.70	-3,607.23	1,511,835.73	3,417,801.67	
Point 2				0.00	-416.66	-3,489.15	1,506,521.42	3,417,919.75	
Point 3				0.00	-300.34	1,818.46	1,506,637.74	3,423,227.30	
Point 4				0.00	5,068.12	1,667.80	1,512,006.15	3,423,076.64	
Point 5				0.00	4,897.70	-3,607.23	1,511,835.73	3,417,801.67	
Rainbow LC28-74-1HN - actual wellpath misses target center by 37.55usft at 10299.59usft MD (6009.18 TVD, 4341.19 N, 1.85 E) - Point	0.00	0.00	6,012.00	4,344.16	39.17	1,511,282.19	3,421,448.03	40° 43' 36.984 N	103° 58' 45.732 W

Directional Difficulty Index

Average Dogleg over Survey:	1.84 °/100usft	Maximum Dogleg over Survey:	14.05 °/100usft at 6,191.00 usft
Net Tortousity applicable to Plans:	0.81 °/100usft	Directional Difficulty Index:	6.201

Audit Info

North Reference Sheet for Sec. 28-T9N-R59W (LC28-15-A) - Rainbow LC28-74-1HNA - Plan B

All data is in US Feet unless otherwise stated. Directions and Coordinates are relative to Grid North Reference.

Vertical Depths are relative to RKB=24ft @ 4866.00usft (H&P 273). Northing and Easting are relative to Rainbow LC28-74-1HNA

Coordinate System is US State Plane 1983, Colorado Northern Zone using datum North American Datum 1983, ellipsoid GRS 1980

Projection method is Lambert Conformal Conic (2 parallel)

Central Meridian is 105° 30' 0.000 W°, Longitude Origin:0° 0' 0.000 E°, Latitude Origin:40° 47' 0.000 N°

False Easting: 3,000,000.00usft, False Northing: 1,000,000.00usft, Scale Reduction: 0.99998963

Grid Coordinates of Well: 1,506,938.07 usft N, 3,421,408.86 usft E

Geographical Coordinates of Well: 40° 42' 54.07" N, 103° 58' 47.21" W

Grid Convergence at Surface is: 0.98°

Based upon Minimum Curvature type calculations, at a Measured Depth of 10,300.00usft
the Bottom Hole Displacement is 4,341.59usft in the Direction of 0.02° (Grid).

Magnetic Convergence at surface is: -7.10° (23 July 2014, BGGM2013)

