

CERTIFIED SURVEY SHEET

HALLIBURTON

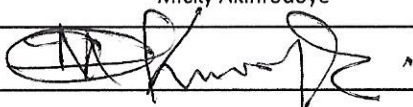
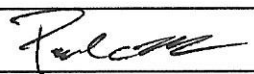
Sperry Drilling

OPERATOR:	Noble		
WELL:	Cutthroat LC28-75-1AHNB		
FIELD:	Wattenberg		
GRADED ELEVATION:	4843	ft. above MSL	
RIG FLOOR (KB) HEIGHT:	24		
TVD REFERENCE:	4867	ft. above MSL	
RIG:	H&P 273		
LEGALS:	Sec. 28	Tw. 9 N	Rng. 59 W
COUNTY	Weld		
STATE:	Colorado		
CAL. METHOD:	Minimum Curvature		
NORTH REFERENCE:	Grid	Total Correction:	7.143
VERTICAL SEC. DIR.:	351.62		

SSDS Job Number:	901399595
Start Date of Job:	7/7/2014
End Date of Job:	7/12/2014
Lead Directional Driller:	Micky Akinrodoye
Other SSDS DDs:	Marco Rolong
SSDS MWDs:	Paul Kock
	JP Centeno
	Micah Asato

Hole Section	Surface	Intermediate	Production	1st Sidetrack	2nd Sidetrack	3rd Sidetrack	4th Sidetrack
Hole Size	13 3/4	8 3/4	6 1/8				
Casing Size	9 5/6	7					
Casing Depth	649	6427					
Survey Type	Gyro	MWD	MWD				
Tie-On Depth	0	654	6383				
First Survey Depth	378	717	6460				
Last Survey Depth	654	6383	10333				
Bit Projection to TD	658	6437	10397				

The following Halliburton - Sperry Drilling personnel, do certify the above information to be accurate:

Print Name:	Micky Akinrodoye	Print Name:	Paul Kock
Sign Name:		Sign Name:	
Print Name:	Marco Rolong	Print Name:	JP Centeno
Sign Name:		Sign Name:	

Examples of Survey Types:

Tie On to Surface Casing (Assumed Vertical), Tie On to existing MWD Survey (prior drilled hole)
MWD - Halliburton-Sperry Drilling Measurement While Drilling (MWD) Surveys
Gyro Surveys - Provided by third party vendor

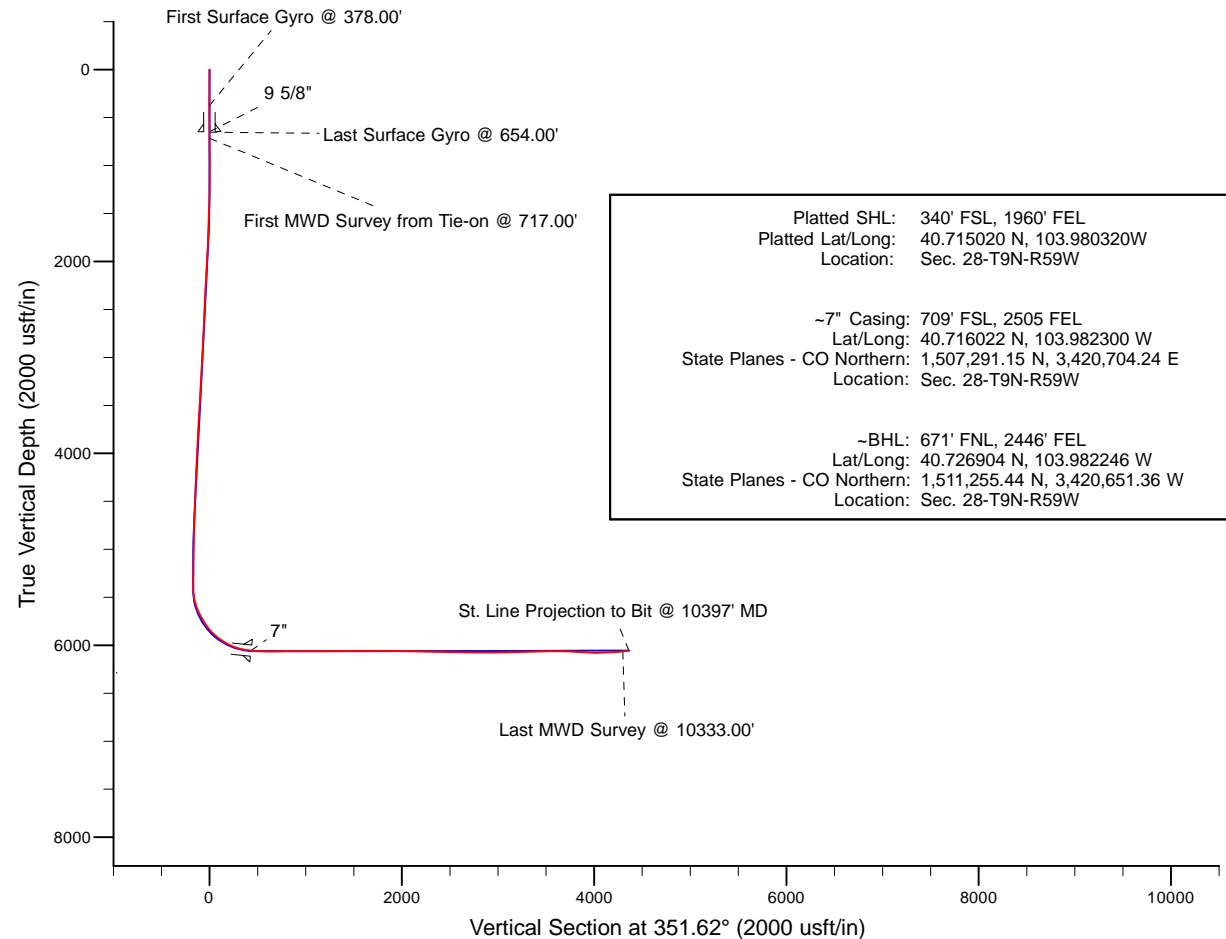
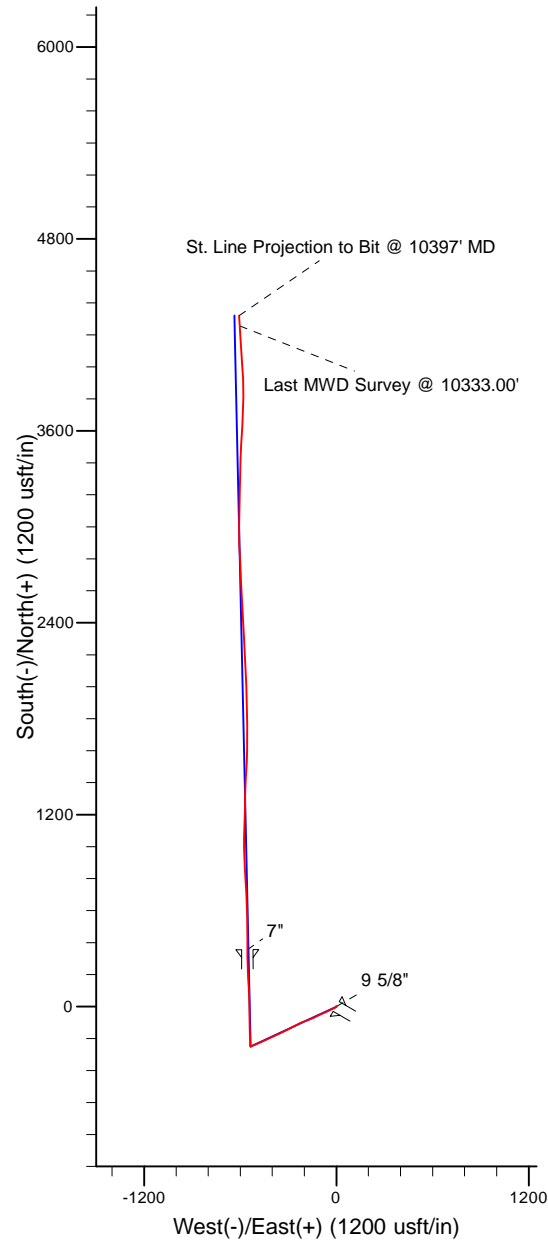
Project: Weld County, CO (NAD 83)
Site: Sec. 28-T9N-R59W (LC28-15-A)
Well: Cutthroat LC28-75-1AHNB
Wellbore: Plan B
Design: Field Surveys

Noble Energy

HALLIBURTON
Sperry Drilling

LEGEND

- ✕ Cutthroat LC28-75-1AHNB, Plan B, RevB0 - PROPOSAL V0
- ▣ Field Surveys



Platted SHL: 340' FSL, 1960' FEL
Platted Lat/Long: 40.715020 N, 103.980320 W
Location: Sec. 28-T9N-R59W

~7" Casing: 709' FSL, 2505 FEL
Lat/Long: 40.716022 N, 103.982300 W
State Planes - CO Northern: 1,507,291.15 N, 3,420,704.24 E
Location: Sec. 28-T9N-R59W

~BHL: 671' FNL, 2446' FEL
Lat/Long: 40.726904 N, 103.982246 W
State Planes - CO Northern: 1,511,255.44 N, 3,420,651.36 W
Location: Sec. 28-T9N-R59W

WELL DETAILS: Cutthroat LC28-75-1AHNB

Ground Level: 4843.00
RKB=24ft @ 4867.00usft (H&P 273)

Created By: Pari Amanlou
Created On: 7-12-14

Noble Energy

Weld County, CO (NAD 83)

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

Cutthroat LC28-75-1AHNB

Plan B

Design: Field Surveys

Sperry Drilling Services

Final Survey Report

15 July, 2014

Well Coordinates: 1,506,935.50 N, 3,421,259.19 E (40° 42' 54.07" N, 103° 58' 49.15" W)

Ground Level: 4,843.00 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 Cutthroat LC28-75-1AHNB

RKB=24ft @ 4867.00usft (H&P 273)

N

Grid

Dec-Deg - API - US Survey Feet - Custom

HALLIBURTON

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	Toolface Azimuth (°)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cutthroat LC28-75-1AHNB_SHL - Cutthroat LC28-75-1AHNB_SL - Cutthroat LC28-75-1AHNB_600										
378.00	0.10	194.54	378.00	-0.32	-0.08	-0.30	0.03	0.03	0.00	194.54
First Surface Gyro @ 378.00'										
649.00	0.39	300.09	649.00	-0.08	-0.94	0.06	0.16	0.11	38.95	118.49
9 5/8"										
654.00	0.40	300.34	654.00	-0.07	-0.97	0.08	0.16	0.15	5.09	12.95
Last Surface Gyro @ 654.00'										
717.00	0.28	317.55	717.00	0.16	-1.27	0.34	0.25	-0.19	27.32	147.99
First MWD Survey from Tie-on @ 717.00'										
810.00	0.28	325.21	810.00	0.51	-1.55	0.73	0.04	0.00	8.24	93.83
996.00	0.07	55.22	995.99	0.95	-1.72	1.19	0.16	-0.11	48.39	165.96
1,274.00	0.59	103.97	1,273.99	0.70	-0.19	0.72	0.20	0.19	17.54	54.28
1,367.00	2.15	236.06	1,366.97	-0.39	-1.17	-0.21	2.78	1.68	142.03	141.84
1,460.00	3.87	231.90	1,459.84	-3.30	-5.09	-2.52	1.86	1.85	-4.47	-9.32
1,553.00	5.64	234.93	1,552.51	-7.86	-11.30	-6.13	1.92	1.90	3.26	9.59
1,646.00	8.00	245.72	1,644.85	-13.15	-20.94	-9.96	2.88	2.54	11.60	33.93
1,738.00	9.43	245.05	1,735.79	-18.96	-33.61	-13.86	1.56	1.55	-0.73	-4.39
1,833.00	9.10	246.50	1,829.55	-25.24	-47.56	-18.04	0.43	-0.35	1.53	145.44
1,928.00	10.10	245.72	1,923.22	-31.66	-62.04	-22.28	1.06	1.05	-0.82	-7.80
2,022.00	9.68	244.55	2,015.82	-38.45	-76.69	-26.85	0.50	-0.45	-1.24	-155.01
2,117.00	10.87	244.22	2,109.30	-45.77	-91.97	-31.88	1.25	1.25	-0.35	-2.99
2,212.00	10.87	244.71	2,202.59	-53.50	-108.13	-37.16	0.10	0.00	0.52	90.24
2,307.00	10.69	243.51	2,295.92	-61.25	-124.12	-42.50	0.30	-0.19	-1.26	-129.32
2,402.00	10.43	243.82	2,389.31	-68.98	-139.72	-47.87	0.28	-0.27	0.33	167.83
2,497.00	10.16	249.97	2,482.78	-75.64	-155.31	-52.19	1.19	-0.28	6.47	106.81
2,686.00	10.10	251.45	2,668.83	-86.62	-186.68	-58.48	0.14	-0.03	0.78	103.71
2,781.00	10.50	244.99	2,762.31	-92.93	-202.42	-62.43	1.29	0.42	-6.80	-74.10
2,876.00	10.43	244.63	2,855.73	-100.28	-218.04	-67.42	0.10	-0.07	-0.38	-137.13
2,971.00	10.15	244.05	2,949.20	-107.62	-233.34	-72.46	0.31	-0.29	-0.61	-159.98
3,066.00	9.69	243.26	3,042.78	-114.88	-248.00	-77.50	0.50	-0.48	-0.83	-163.91
3,161.00	9.07	244.52	3,136.51	-121.70	-261.90	-82.22	0.69	-0.65	1.33	162.29
3,256.00	9.96	242.64	3,230.20	-128.70	-275.96	-87.10	0.99	0.94	-1.98	-20.18
3,350.00	9.78	241.78	3,322.81	-136.21	-290.21	-92.45	0.25	-0.19	-0.91	-141.11
3,445.00	10.00	240.68	3,416.40	-144.07	-304.51	-98.13	0.31	0.23	-1.16	-41.20
3,541.00	10.38	241.09	3,510.88	-152.33	-319.35	-104.15	0.40	0.40	0.43	11.01
3,636.00	10.12	247.51	3,604.37	-159.66	-334.56	-109.18	1.23	-0.27	6.76	105.97
3,730.00	10.40	248.15	3,696.86	-165.97	-350.06	-113.17	0.32	0.30	0.68	22.47
3,825.00	9.43	245.33	3,790.45	-172.41	-365.09	-117.35	1.14	-1.02	-2.97	-154.79
3,920.00	9.85	243.21	3,884.10	-179.33	-379.42	-122.10	0.58	0.44	-2.23	-41.25
4,015.00	9.19	243.30	3,977.79	-186.40	-393.45	-127.05	0.69	-0.69	0.09	178.75
4,110.00	8.39	242.39	4,071.68	-193.02	-406.37	-131.72	0.85	-0.84	-0.96	-170.59
4,205.00	8.96	245.18	4,165.59	-199.34	-419.22	-136.09	0.75	0.60	2.94	37.82
4,299.00	9.45	245.92	4,258.38	-205.56	-432.91	-140.25	0.54	0.52	0.79	13.95
4,394.00	8.96	246.52	4,352.16	-211.69	-446.82	-144.29	0.53	-0.52	0.63	169.21
4,489.00	8.34	246.78	4,446.08	-217.35	-459.94	-147.98	0.65	-0.65	0.27	176.52
4,584.00	7.85	246.28	4,540.13	-222.68	-472.21	-151.46	0.52	-0.52	-0.53	-172.07
4,679.00	7.21	246.16	4,634.31	-227.70	-483.60	-154.76	0.67	-0.67	-0.13	-178.65
4,773.00	6.48	247.41	4,727.64	-232.12	-493.89	-157.64	0.79	-0.78	1.33	169.09
4,868.00	6.10	249.64	4,822.07	-235.93	-503.58	-160.00	0.48	-0.40	2.35	148.37
4,963.00	5.58	246.23	4,916.57	-239.55	-512.53	-162.27	0.66	-0.55	-3.59	-147.98
5,058.00	5.29	248.61	5,011.15	-243.01	-520.84	-164.49	0.39	-0.31	2.51	143.32
5,153.00	3.79	244.98	5,105.85	-245.93	-527.76	-166.37	1.61	-1.58	-3.82	-170.96
5,248.00	2.53	252.77	5,200.70	-247.88	-532.61	-167.59	1.40	-1.33	8.20	165.04
5,342.00	0.95	233.39	5,294.65	-248.96	-535.22	-168.28	1.77	-1.68	-20.62	-169.08
5,432.00	0.73	231.46	5,384.65	-249.77	-536.26	-168.92	0.25	-0.24	-2.14	-173.64
5,472.35	1.39	350.25	5,424.99	-249.44	-536.55	-168.56	4.61	1.65	294.40	138.91
Cutthroat LC28-75-1AHNB_KOP										

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	Toolface Azimuth (°)
5,480.00	1.73	354.27	5,432.64	-249.23	-536.58	-168.35	4.61	4.38	52.57	20.13
5,526.00	7.43	355.16	5,478.47	-245.58	-536.90	-164.69	12.39	12.39	1.93	1.16
5,574.00	12.55	353.92	5,525.73	-237.29	-537.71	-156.37	10.68	10.67	-2.58	-3.02
5,621.00	17.11	355.60	5,571.15	-225.32	-538.78	-144.37	9.74	9.70	3.57	6.20
5,669.00	21.34	357.92	5,616.47	-209.54	-539.64	-128.63	8.95	8.81	4.83	11.34
5,716.00	25.45	358.81	5,659.59	-190.89	-540.16	-110.11	8.78	8.74	1.89	5.32
5,764.00	28.00	359.01	5,702.46	-169.31	-540.57	-88.70	5.32	5.31	0.42	2.11
5,811.00	30.64	358.50	5,743.44	-146.30	-541.08	-65.86	5.64	5.62	-1.09	-5.63
5,859.00	34.28	358.95	5,783.93	-120.55	-541.64	-40.30	7.60	7.58	0.94	3.99
5,906.00	38.24	359.68	5,821.82	-92.76	-541.97	-12.76	8.48	8.43	1.55	6.52
5,954.00	43.13	0.29	5,858.21	-61.48	-541.97	18.19	10.22	10.19	1.27	4.88
6,001.00	47.87	359.67	5,891.14	-27.97	-541.99	51.34	10.13	10.09	-1.32	-5.55
6,049.00	52.78	359.01	5,921.78	8.96	-542.42	87.94	10.28	10.23	-1.37	-6.12
6,096.00	56.13	357.31	5,949.10	47.18	-543.66	125.93	7.71	7.13	-3.62	-22.93
Cutthroat LC28-75-1AHNB_Lateral										
6,144.00	58.99	356.27	5,974.84	87.62	-545.93	166.27	6.23	5.96	-2.17	-17.34
6,190.00	63.64	356.79	5,996.92	127.89	-548.37	206.46	10.16	10.11	1.13	5.73
6,238.00	68.56	357.10	6,016.36	171.70	-550.71	250.14	10.27	10.25	0.65	3.36
6,285.00	73.50	357.95	6,031.63	216.09	-552.62	294.34	10.65	10.51	1.81	9.38
6,333.00	78.55	358.67	6,043.22	262.63	-553.99	340.59	10.62	10.52	1.50	7.97
6,383.00	82.58	359.57	6,051.42	311.94	-554.75	389.48	8.25	8.06	1.80	12.50
6,427.00	84.27	359.89	6,056.46	355.65	-554.95	432.75	3.90	3.83	0.73	10.72
7"										
6,460.00	85.53	0.13	6,059.39	388.52	-554.95	465.27	3.90	3.83	0.73	10.69
6,555.00	87.78	359.51	6,064.93	483.35	-555.24	559.13	2.46	2.37	-0.65	-15.40
6,650.00	90.18	357.83	6,066.62	578.30	-557.45	653.38	3.08	2.53	-1.77	-35.01
6,745.00	91.48	357.26	6,065.25	673.20	-561.52	747.86	1.49	1.37	-0.60	-23.67
6,840.00	90.22	357.50	6,063.84	768.09	-565.86	842.37	1.35	-1.33	0.25	169.21
6,934.00	90.77	356.57	6,063.03	861.95	-570.72	935.95	1.15	0.59	-0.99	-59.40
7,029.00	89.75	357.87	6,062.60	956.84	-575.33	1,030.49	1.74	-1.07	1.37	128.11
7,124.00	89.66	1.05	6,063.09	1,051.82	-576.22	1,124.59	3.35	-0.09	3.35	91.63
7,219.00	90.93	2.42	6,062.60	1,146.77	-573.35	1,218.10	1.97	1.34	1.44	47.17
7,314.00	90.06	0.82	6,061.78	1,241.73	-570.66	1,311.65	1.92	-0.92	-1.68	-118.53
7,409.00	91.11	0.92	6,060.81	1,336.71	-569.22	1,405.41	1.11	1.11	0.11	5.44
7,503.00	90.80	3.53	6,059.24	1,430.62	-565.57	1,497.78	2.80	-0.33	2.78	96.75
7,598.00	90.22	3.52	6,058.39	1,525.43	-559.73	1,590.73	0.61	-0.61	-0.01	-179.01
7,693.00	88.98	1.73	6,059.06	1,620.33	-555.38	1,683.98	2.29	-1.31	-1.88	-124.72
7,788.00	89.78	359.25	6,060.08	1,715.31	-554.57	1,777.83	2.74	0.84	-2.61	-72.14
7,883.00	91.11	358.58	6,059.35	1,810.29	-556.37	1,872.05	1.57	1.40	-0.71	-26.73
7,978.00	89.45	357.77	6,058.88	1,905.23	-559.39	1,966.43	1.94	-1.75	-0.85	-153.99
8,073.00	87.69	357.60	6,061.25	2,000.12	-563.23	2,060.86	1.86	-1.85	-0.18	-174.49
8,168.00	87.72	357.56	6,065.06	2,094.96	-567.24	2,155.27	0.05	0.03	-0.04	-53.11
8,263.00	88.52	357.26	6,068.17	2,189.81	-571.53	2,249.73	0.90	0.84	-0.32	-20.55
8,358.00	88.77	357.07	6,070.42	2,284.67	-576.22	2,344.26	0.33	0.26	-0.20	-37.23
8,453.00	91.26	357.79	6,070.40	2,379.56	-580.48	2,438.77	2.73	2.62	0.76	16.13
8,547.00	88.03	356.59	6,070.98	2,473.44	-585.09	2,532.31	3.67	-3.44	-1.28	-159.62
8,642.00	87.78	356.82	6,074.45	2,568.22	-590.55	2,626.87	0.36	-0.26	0.24	137.41
8,737.00	89.11	356.86	6,077.03	2,663.03	-595.78	2,721.44	1.40	1.40	0.04	1.72
8,832.00	89.94	358.06	6,077.82	2,757.93	-599.99	2,815.94	1.54	0.87	1.26	55.33
8,927.00	90.09	356.47	6,077.79	2,852.82	-604.53	2,910.47	1.68	0.16	-1.67	-84.61
9,021.00	91.79	0.19	6,076.25	2,946.75	-607.26	3,003.80	4.35	1.81	3.96	65.42
9,116.00	90.52	1.01	6,074.33	3,041.72	-606.27	3,097.61	1.59	-1.34	0.86	147.15
9,211.00	91.88	0.83	6,072.34	3,136.69	-604.74	3,191.34	1.44	1.43	-0.19	-7.54
9,306.00	90.80	1.18	6,070.12	3,231.65	-603.08	3,285.04	1.20	-1.14	0.37	162.04
9,401.00	92.56	1.16	6,067.34	3,326.58	-601.14	3,378.68	1.85	1.85	-0.02	-0.65
9,496.00	91.54	2.11	6,063.94	3,421.48	-598.43	3,472.17	1.47	-1.07	1.00	137.04
9,590.00	90.52	3.16	6,062.25	3,515.36	-594.11	3,564.42	1.56	-1.09	1.12	134.16
9,685.00	88.80	3.77	6,062.81	3,610.18	-588.37	3,657.39	1.92	-1.81	0.64	160.47
9,780.00	86.95	1.35	6,066.34	3,705.01	-584.13	3,750.59	3.20	-1.95	-2.55	-127.46
9,875.00	86.61	1.37	6,071.67	3,799.84	-581.88	3,844.07	0.36	-0.36	0.02	176.64

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	Toolface Azimuth (°)
9,967.00	87.72	358.84	6,076.22	3,891.71	-581.71	3,934.94	3.00	1.21	-2.75	-66.35
10,062.00	89.72	356.29	6,078.35	3,986.59	-585.74	4,029.39	3.41	2.11	-2.68	-51.92
10,156.00	91.76	356.21	6,077.13	4,080.38	-591.89	4,123.07	2.17	2.17	-0.09	-2.25
10,251.00	94.08	356.34	6,072.29	4,175.05	-598.06	4,217.63	2.45	2.44	0.14	3.20
10,333.00	96.34	356.06	6,064.85	4,256.52	-603.47	4,299.02	2.78	2.76	-0.34	-7.02
Last MWD Survey @ 10333.00'										
10,397.00	96.34	356.06	6,057.78	4,319.98	-607.84	4,362.44	0.00	0.00	0.00	0.00
St. Line Projection to Bit @ 10397' MD - Cutthroat LC28-75-1AHNB_BHL										

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
378.00	378.00	-0.32	-0.08	First Surface Gyro @ 378.00'
654.00	654.00	-0.07	-0.97	Last Surface Gyro @ 654.00'
717.00	717.00	0.16	-1.27	First MWD Survey from Tie-on @ 717.00'
10,333.00	6,064.85	4,256.52	-603.47	Last MWD Survey @ 10333.00'
10,397.00	6,057.78	4,319.98	-607.84	St. Line Projection to Bit @ 10397' MD

Vertical Section Information

Angle Type	Target	Azimuth (°)	Origin Type	Origin		Start TVD (usft)
				+N/_S (usft)	+E/-W (usft)	
Target	Cutthroat LC28-75-1AHNB_BHL	351.62	Slot	0.00	0.00	0.00

Survey tool program

From (usft)	To (usft)	Survey/Plan	Survey Tool
378.00	654.00	Surface Gyro Surveys	Flexi-Shot
717.00	6,383.00	MWD Surveys-Intermediate	MWD+SC
6,460.00	10,333.00	MWD Surveys- Production	MWD+SC

Casing Details

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
649.00	649.00	9 5/8"	9-5/8	13-3/4
6,427.00	6,056.46	7"	7	8-3/4

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Targets associated with this wellbore

Target Name	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Shape
Cutthroat LC28-75-1AHNB_SHL	0.00	0.01	0.00	Point
Cutthroat LC28-75-1AHNB_600	0.00	0.01	0.00	Polygon
Cutthroat LC28-75-1AHNB_SL	0.00	0.01	0.00	Polygon
Cutthroat LC28-75-1AHNB_KOP	5,425.00	-249.65	-535.27	Circle
Cutthroat LC28-75-1AHNB_BHL	6,057.38	4,321.65	-636.81	Point
Cutthroat LC28-75-1AHNB_Lateral	6,063.85	0.00	0.00	Polygon

Directional Difficulty Index

Average Dogleg over Survey:	1.90 °/100usft	Maximum Dogleg over Survey:	12.39 °/100usft at 5,526.00 usft
Net Tortousity applicable to Plans:	0.83 °/100usft	Directional Difficulty Index:	6.243

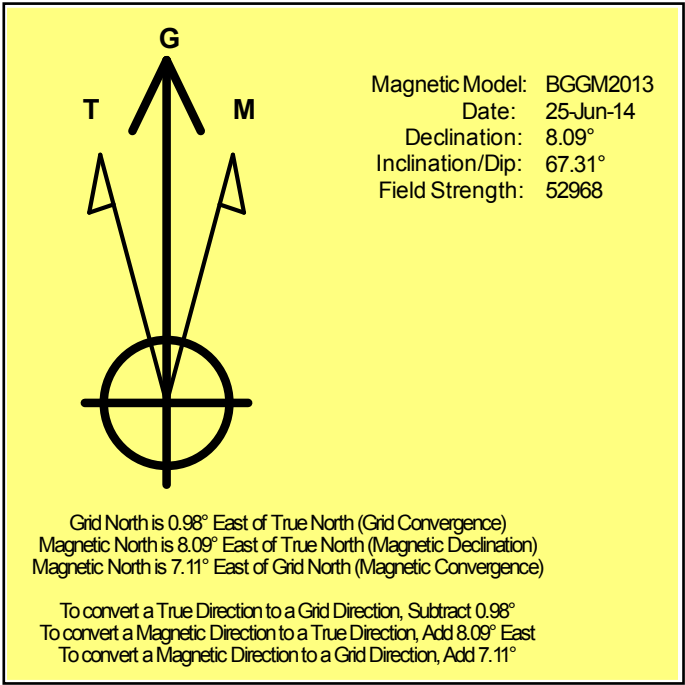
Audit Info

**North Reference Sheet for Sec. 28-T9N-R59W (LC28-15-A) - Cutthroat
LC28-75-1AHNB - 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 @ 4867.00usft (H&P 273). Northing and Easting are relative to Cutthroat LC28-75-1AHNB
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 -105.50°, Longitude Origin:0.000000°, Latitude Origin:40.783333°
False Easting: 3,000,000.00usft, False Northing: 1,000,000.00usft, Scale Reduction: 0.99998963

Grid Coordinates of Well: 1,506,935.50 usft N, 3,421,259.19 usft E
Geographical Coordinates of Well: 40° 42' 54.07" N, 103° 58' 49.15" W
Grid Convergence at Surface is: 0.98°

Based upon Minimum Curvature type calculations, at a Measured Depth of 10,397.00usft
the Bottom Hole Displacement is 4,362.53usft in the Direction of 351.99° (Grid).
Magnetic Convergence at surface is: -7.11° (25 June 2014, , BGGM2013)



Noble Energy

Weld County, CO (NAD 83)

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

Cutthroat LC28-75-1AHNB

Plan B

Design: Field Surveys

Sperry Drilling Services

Geodetic Report

15 July, 2014

Well Coordinates: 1,506,935.50 N, 3,421,259.19 E (40° 42' 54.07" N, 103° 58' 49.15" W)

Ground Level: 4,843.00 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 Cutthroat LC28-75-1AHNB

RKB=24ft @ 4867.00usft (H&P 273)

N

Grid

Dec-Deg - API - US Survey Feet - Custom

HALLIBURTON

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Measured			Vertical	Local Coordinates		Geographic Coordinates		UTM Coordinates	
Depth	Inclination	Azimuth	Depth	+N/-S	+E/-W	Latitude	Longitude	Northing	Easting
(usft)	(°)	(°)	(usft)	(usft)	(usft)	(usft)	(usft)	(usft)	(usft)
0.00	0.00	0.00	0.00	0.00	0.00	40.715020	-103.980320	1,506,935.50	3,421,259.19
378.00	0.10	194.54	378.00	-0.32	-0.08	40.715019	-103.980321	1,506,935.19	3,421,259.10
649.00	0.39	300.09	649.00	-0.08	-0.94	40.715020	-103.980324	1,506,935.42	3,421,258.24
654.00	0.40	300.34	654.00	-0.07	-0.97	40.715020	-103.980324	1,506,935.44	3,421,258.21
717.00	0.28	317.55	717.00	0.16	-1.27	40.715021	-103.980325	1,506,935.66	3,421,257.92
810.00	0.28	325.21	810.00	0.51	-1.55	40.715022	-103.980326	1,506,936.02	3,421,257.64
996.00	0.07	55.22	995.99	0.95	-1.72	40.715023	-103.980326	1,506,936.46	3,421,257.47
1,274.00	0.59	103.97	1,273.99	0.70	-0.19	40.715022	-103.980321	1,506,936.21	3,421,259.00
1,367.00	2.15	236.06	1,366.97	-0.39	-1.17	40.715019	-103.980325	1,506,935.12	3,421,258.02
1,460.00	3.87	231.90	1,459.84	-3.30	-5.09	40.715011	-103.980339	1,506,932.21	3,421,254.10
1,553.00	5.64	234.93	1,552.51	-7.86	-11.30	40.714999	-103.980362	1,506,927.64	3,421,247.89
1,646.00	8.00	245.72	1,644.85	-13.15	-20.94	40.714985	-103.980397	1,506,922.36	3,421,238.25
1,738.00	9.43	245.05	1,735.79	-18.96	-33.61	40.714970	-103.980443	1,506,916.54	3,421,225.58
1,833.00	9.10	246.50	1,829.55	-25.24	-47.56	40.714953	-103.980493	1,506,910.27	3,421,211.63
1,928.00	10.10	245.72	1,923.22	-31.66	-62.04	40.714936	-103.980546	1,506,903.85	3,421,197.15
2,022.00	9.68	244.55	2,015.82	-38.45	-76.69	40.714918	-103.980599	1,506,897.06	3,421,182.50
2,117.00	10.87	244.22	2,109.30	-45.77	-91.97	40.714899	-103.980655	1,506,889.73	3,421,167.22
2,212.00	10.87	244.71	2,202.59	-53.50	-108.13	40.714878	-103.980714	1,506,882.01	3,421,151.06
2,307.00	10.69	243.51	2,295.92	-61.25	-124.12	40.714858	-103.980772	1,506,874.25	3,421,135.07
2,402.00	10.43	243.82	2,389.31	-68.98	-139.72	40.714837	-103.980828	1,506,866.53	3,421,119.47
2,497.00	10.16	249.97	2,482.78	-75.64	-155.31	40.714820	-103.980885	1,506,859.87	3,421,103.88
2,686.00	10.10	251.45	2,668.83	-86.62	-186.68	40.714791	-103.980999	1,506,848.88	3,421,072.51
2,781.00	10.50	244.99	2,762.31	-92.93	-202.42	40.714775	-103.981056	1,506,842.57	3,421,056.76
2,876.00	10.43	244.63	2,855.73	-100.28	-218.04	40.714755	-103.981113	1,506,835.23	3,421,041.15
2,971.00	10.15	244.05	2,949.20	-107.62	-233.34	40.714736	-103.981168	1,506,827.88	3,421,025.85
3,066.00	9.69	243.26	3,042.78	-114.88	-248.00	40.714716	-103.981222	1,506,820.62	3,421,011.19
3,161.00	9.07	244.52	3,136.51	-121.70	-261.90	40.714698	-103.981272	1,506,813.80	3,420,997.29
3,256.00	9.96	242.64	3,230.20	-128.70	-275.96	40.714680	-103.981324	1,506,806.81	3,420,983.23
3,350.00	9.78	241.78	3,322.81	-136.21	-290.21	40.714660	-103.981375	1,506,799.30	3,420,968.98
3,445.00	10.00	240.68	3,416.40	-144.07	-304.51	40.714639	-103.981427	1,506,791.44	3,420,954.68
3,541.00	10.38	241.09	3,510.88	-152.33	-319.35	40.714617	-103.981481	1,506,783.18	3,420,939.84
3,636.00	10.12	247.51	3,604.37	-159.66	-334.56	40.714598	-103.981537	1,506,775.85	3,420,924.63
3,730.00	10.40	248.15	3,696.86	-165.97	-350.06	40.714581	-103.981593	1,506,769.53	3,420,909.13
3,825.00	9.43	245.33	3,790.45	-172.41	-365.09	40.714564	-103.981648	1,506,763.09	3,420,894.10
3,920.00	9.85	243.21	3,884.10	-179.33	-379.42	40.714546	-103.981700	1,506,756.18	3,420,879.77
4,015.00	9.19	243.30	3,977.79	-186.40	-393.45	40.714527	-103.981751	1,506,749.11	3,420,865.74
4,110.00	8.39	242.39	4,071.68	-193.02	-406.37	40.714509	-103.981798	1,506,742.49	3,420,852.82
4,205.00	8.96	245.18	4,165.59	-199.34	-419.22	40.714493	-103.981845	1,506,736.17	3,420,839.97
4,299.00	9.45	245.92	4,258.38	-205.56	-432.91	40.714476	-103.981894	1,506,729.95	3,420,826.28
4,394.00	8.96	246.52	4,352.16	-211.69	-446.82	40.714460	-103.981945	1,506,723.82	3,420,812.37
4,489.00	8.34	246.78	4,446.08	-217.35	-459.94	40.714445	-103.981993	1,506,718.16	3,420,799.25
4,584.00	7.85	246.28	4,540.13	-222.68	-472.21	40.714431	-103.982037	1,506,712.83	3,420,786.98

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	Local Coordinates		Geographic Coordinates		UTM Coordinates	
				+N/-S (usft)	+E/-W (usft)	Latitude (usft)	Longitude (usft)	Northing (usft)	Easting (usft)
4,679.00	7.21	246.16	4,634.31	-227.70	-483.60	40.714418	-103.982079	1,506,707.81	3,420,775.59
4,773.00	6.48	247.41	4,727.64	-232.12	-493.89	40.714406	-103.982116	1,506,703.39	3,420,765.30
4,868.00	6.10	249.64	4,822.07	-235.93	-503.58	40.714396	-103.982151	1,506,699.57	3,420,755.62
4,963.00	5.58	246.23	4,916.57	-239.55	-512.53	40.714387	-103.982184	1,506,695.96	3,420,746.66
5,058.00	5.29	248.61	5,011.15	-243.01	-520.84	40.714378	-103.982214	1,506,692.50	3,420,738.35
5,153.00	3.79	244.98	5,105.85	-245.93	-527.76	40.714370	-103.982239	1,506,689.57	3,420,731.43
5,248.00	2.53	252.77	5,200.70	-247.88	-532.61	40.714365	-103.982257	1,506,687.62	3,420,726.58
5,342.00	0.95	233.39	5,294.65	-248.96	-535.22	40.714362	-103.982266	1,506,686.54	3,420,723.97
5,432.00	0.73	231.46	5,384.65	-249.77	-536.26	40.714360	-103.982270	1,506,685.74	3,420,722.93
5,472.35	1.39	350.25	5,424.99	-249.44	-536.55	40.714361	-103.982271	1,506,686.07	3,420,722.64
5,480.00	1.73	354.27	5,432.64	-249.23	-536.58	40.714361	-103.982271	1,506,686.27	3,420,722.62
5,526.00	7.43	355.16	5,478.47	-245.58	-536.90	40.714371	-103.982272	1,506,689.93	3,420,722.30
5,574.00	12.55	353.92	5,525.73	-237.29	-537.71	40.714394	-103.982274	1,506,698.21	3,420,721.48
5,621.00	17.11	355.60	5,571.15	-225.32	-538.78	40.714427	-103.982277	1,506,710.19	3,420,720.41
5,669.00	21.34	357.92	5,616.47	-209.54	-539.64	40.714470	-103.982280	1,506,725.97	3,420,719.55
5,716.00	25.45	358.81	5,659.59	-190.89	-540.16	40.714522	-103.982280	1,506,744.62	3,420,719.03
5,764.00	28.00	359.01	5,702.46	-169.31	-540.57	40.714581	-103.982280	1,506,766.20	3,420,718.62
5,811.00	30.64	358.50	5,743.44	-146.30	-541.08	40.714644	-103.982281	1,506,789.20	3,420,718.12
5,859.00	34.28	358.95	5,783.93	-120.55	-541.64	40.714715	-103.982281	1,506,814.96	3,420,717.55
5,906.00	38.24	359.68	5,821.82	-92.76	-541.97	40.714791	-103.982281	1,506,842.75	3,420,717.22
5,954.00	43.13	0.29	5,858.21	-61.48	-541.97	40.714877	-103.982279	1,506,874.03	3,420,717.22
6,001.00	47.87	359.67	5,891.14	-27.97	-541.99	40.714969	-103.982277	1,506,907.54	3,420,717.21
6,049.00	52.78	359.01	5,921.78	8.96	-542.42	40.715070	-103.982276	1,506,944.47	3,420,716.77
6,096.00	56.13	357.31	5,949.10	47.18	-543.66	40.715175	-103.982278	1,506,982.68	3,420,715.53
6,144.00	58.99	356.27	5,974.84	87.62	-545.93	40.715286	-103.982284	1,507,023.12	3,420,713.26
6,190.00	63.64	356.79	5,996.92	127.89	-548.37	40.715397	-103.982290	1,507,063.39	3,420,710.82
6,238.00	68.56	357.10	6,016.36	171.70	-550.71	40.715517	-103.982296	1,507,107.20	3,420,708.49
6,285.00	73.50	357.95	6,031.63	216.09	-552.62	40.715639	-103.982300	1,507,151.59	3,420,706.57
6,333.00	78.55	358.67	6,043.22	262.63	-553.99	40.715767	-103.982302	1,507,198.13	3,420,705.20
6,383.00	82.58	359.57	6,051.42	311.94	-554.75	40.715902	-103.982302	1,507,247.44	3,420,704.45
6,427.00	84.27	359.89	6,056.46	355.65	-554.95	40.716022	-103.982300	1,507,291.15	3,420,704.24
6,460.00	85.53	0.13	6,059.39	388.52	-554.95	40.716112	-103.982298	1,507,324.02	3,420,704.25
6,555.00	87.78	359.51	6,064.93	483.35	-555.24	40.716373	-103.982293	1,507,418.85	3,420,703.95
6,650.00	90.18	357.83	6,066.62	578.30	-557.45	40.716633	-103.982295	1,507,513.80	3,420,701.74
6,745.00	91.48	357.26	6,065.25	673.20	-561.52	40.716894	-103.982304	1,507,608.69	3,420,697.68
6,840.00	90.22	357.50	6,063.84	768.09	-565.86	40.717155	-103.982314	1,507,703.58	3,420,693.33
6,934.00	90.77	356.57	6,063.03	861.95	-570.72	40.717412	-103.982325	1,507,797.45	3,420,688.47
7,029.00	89.75	357.87	6,062.60	956.84	-575.33	40.717673	-103.982336	1,507,892.33	3,420,683.86
7,124.00	89.66	1.05	6,063.09	1,051.82	-576.22	40.717934	-103.982334	1,507,987.31	3,420,682.97
7,219.00	90.93	2.42	6,062.60	1,146.77	-573.35	40.718194	-103.982317	1,508,082.26	3,420,685.84
7,314.00	90.06	0.82	6,061.78	1,241.73	-570.66	40.718455	-103.982302	1,508,177.22	3,420,688.53
7,409.00	91.11	0.92	6,060.81	1,336.71	-569.22	40.718715	-103.982291	1,508,272.20	3,420,689.97

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	Local Coordinates		Geographic Coordinates		UTM Coordinates	
				+N/-S (usft)	+E/-W (usft)	Latitude (usft)	Longitude (usft)	Northing (usft)	Easting (usft)
7,503.00	90.80	3.53	6,059.24	1,430.62	-565.57	40.718973	-103.982272	1,508,366.11	3,420,693.62
7,598.00	90.22	3.52	6,058.39	1,525.43	-559.73	40.719233	-103.982245	1,508,460.92	3,420,699.46
7,693.00	88.98	1.73	6,059.06	1,620.33	-555.38	40.719493	-103.982223	1,508,555.81	3,420,703.81
7,788.00	89.78	359.25	6,060.08	1,715.31	-554.57	40.719754	-103.982215	1,508,650.80	3,420,704.62
7,883.00	91.11	358.58	6,059.35	1,810.29	-556.37	40.720014	-103.982215	1,508,745.77	3,420,702.83
7,978.00	89.45	357.77	6,058.88	1,905.23	-559.39	40.720275	-103.982220	1,508,840.72	3,420,699.80
8,073.00	87.69	357.60	6,061.25	2,000.12	-563.23	40.720536	-103.982228	1,508,935.61	3,420,695.96
8,168.00	87.72	357.56	6,065.06	2,094.96	-567.24	40.720796	-103.982237	1,509,030.44	3,420,691.96
8,263.00	88.52	357.26	6,068.17	2,189.81	-571.53	40.721057	-103.982246	1,509,125.29	3,420,687.67
8,358.00	88.77	357.07	6,070.42	2,284.67	-576.22	40.721317	-103.982257	1,509,220.15	3,420,682.97
8,453.00	91.26	357.79	6,070.40	2,379.56	-580.48	40.721578	-103.982267	1,509,315.05	3,420,678.71
8,547.00	88.03	356.59	6,070.98	2,473.44	-585.09	40.721836	-103.982278	1,509,408.92	3,420,674.10
8,642.00	87.78	356.82	6,074.45	2,568.22	-590.55	40.722096	-103.982292	1,509,503.69	3,420,668.65
8,737.00	89.11	356.86	6,077.03	2,663.03	-595.78	40.722356	-103.982305	1,509,598.51	3,420,663.41
8,832.00	89.94	358.06	6,077.82	2,757.93	-599.99	40.722617	-103.982314	1,509,693.41	3,420,659.20
8,927.00	90.09	356.47	6,077.79	2,852.82	-604.53	40.722878	-103.982324	1,509,788.30	3,420,654.67
9,021.00	91.79	0.19	6,076.25	2,946.75	-607.26	40.723136	-103.982329	1,509,882.23	3,420,651.93
9,116.00	90.52	1.01	6,074.33	3,041.72	-606.27	40.723396	-103.982319	1,509,977.20	3,420,652.92
9,211.00	91.88	0.83	6,072.34	3,136.69	-604.74	40.723657	-103.982308	1,510,072.16	3,420,654.45
9,306.00	90.80	1.18	6,070.12	3,231.65	-603.08	40.723917	-103.982296	1,510,167.12	3,420,656.11
9,401.00	92.56	1.16	6,067.34	3,326.58	-601.14	40.724178	-103.982283	1,510,262.05	3,420,658.05
9,496.00	91.54	2.11	6,063.94	3,421.48	-598.43	40.724438	-103.982267	1,510,356.95	3,420,660.76
9,590.00	90.52	3.16	6,062.25	3,515.36	-594.11	40.724695	-103.982246	1,510,450.83	3,420,665.08
9,685.00	88.80	3.77	6,062.81	3,610.18	-588.37	40.724955	-103.982219	1,510,545.65	3,420,670.82
9,780.00	86.95	1.35	6,066.34	3,705.01	-584.13	40.725215	-103.982198	1,510,640.48	3,420,675.07
9,875.00	86.61	1.37	6,071.67	3,799.84	-581.88	40.725475	-103.982184	1,510,735.30	3,420,677.32
9,967.00	87.72	358.84	6,076.22	3,891.71	-581.71	40.725728	-103.982178	1,510,827.18	3,420,677.48
10,062.00	89.72	356.29	6,078.35	3,986.59	-585.74	40.725988	-103.982187	1,510,922.05	3,420,673.45
10,156.00	91.76	356.21	6,077.13	4,080.38	-591.89	40.726246	-103.982203	1,511,015.84	3,420,667.30
10,251.00	94.08	356.34	6,072.29	4,175.05	-598.06	40.726506	-103.982220	1,511,110.51	3,420,661.14
10,333.00	96.34	356.06	6,064.85	4,256.52	-603.47	40.726730	-103.982234	1,511,191.98	3,420,655.73
10,397.00	96.34	356.06	6,057.78	4,319.98	-607.84	40.726904	-103.982246	1,511,255.44	3,420,651.36

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
378.00	378.00	-0.32	-0.08	First Surface Gyro @ 378.00'
654.00	654.00	-0.07	-0.97	Last Surface Gyro @ 654.00'
717.00	717.00	0.16	-1.27	First MWD Survey from Tie-on @ 717.00'
10,333.00	6,064.85	4,256.52	-603.47	Last MWD Survey @ 10333.00'
10,397.00	6,057.78	4,319.98	-607.84	St. Line Projection to Bit @ 10397' MD

Vertical Section Information

Angle Type	Target	Azimuth (°)	Origin Type	Origin		Start TVD (usft)
				+N/_S (usft)	+E/-W (usft)	
Target	Cutthroat LC28-75-1AHNB_BHL	351.62	Slot	0.00	0.00	0.00

Survey tool program

From (usft)	To (usft)	Survey/Plan	Survey Tool
378.00	654.00	Surface Gyro Surveys	Flexi-Shot
717.00	6,383.00	MWD Surveys-Intermediate	MWD+SC
6,460.00	10,333.00	MWD Surveys- Production	MWD+SC

Casing Details

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
649.00	649.00	9 5/8"	9-5/8	13-3/4
6,427.00	6,056.46	7"	7	8-3/4

Design Report for Cutthroat LC28-75-1AHNB - Field Surveys

Design Targets

Shape	Target Name	TVD ()	Northing ()	Easting ()	+N/-S	+E/-W	Created	Updated
-------	-------------	------------	-----------------	----------------	-------	-------	---------	---------

Directional Difficulty Index

Average Dogleg over Survey:	1.90 °/100usft	Maximum Dogleg over Survey:	12.39 °/100usft at 5,526.00 usft
Net Tortousity applicable to Plans:	0.83 °/100usft	Directional Difficulty Index:	6.243

Audit Info

North Reference Sheet for Sec. 28-T9N-R59W (LC28-15-A) - Cutthroat LC28-75-1AHNB - 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 @ 4867.00usft (H&P 273). Northing and Easting are relative to Cutthroat LC28-75-1AHNB

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 -105.500000°, Longitude Origin:0.000000°, Latitude Origin:40.783333°

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

Grid Coordinates of Well: 1,506,935.50 usft N, 3,421,259.19 usft E

Geographical Coordinates of Well: 40° 42' 54.07" N, 103° 58' 49.15" W

Grid Convergence at Surface is: 0.98°

Based upon Minimum Curvature type calculations, at a Measured Depth of 10,397.00usft

the Bottom Hole Displacement is 4,362.53usft in the Direction of 351.99° (Grid).

Magnetic Convergence at surface is: -7.11° (25 June 2014, , BGGM2013)

