

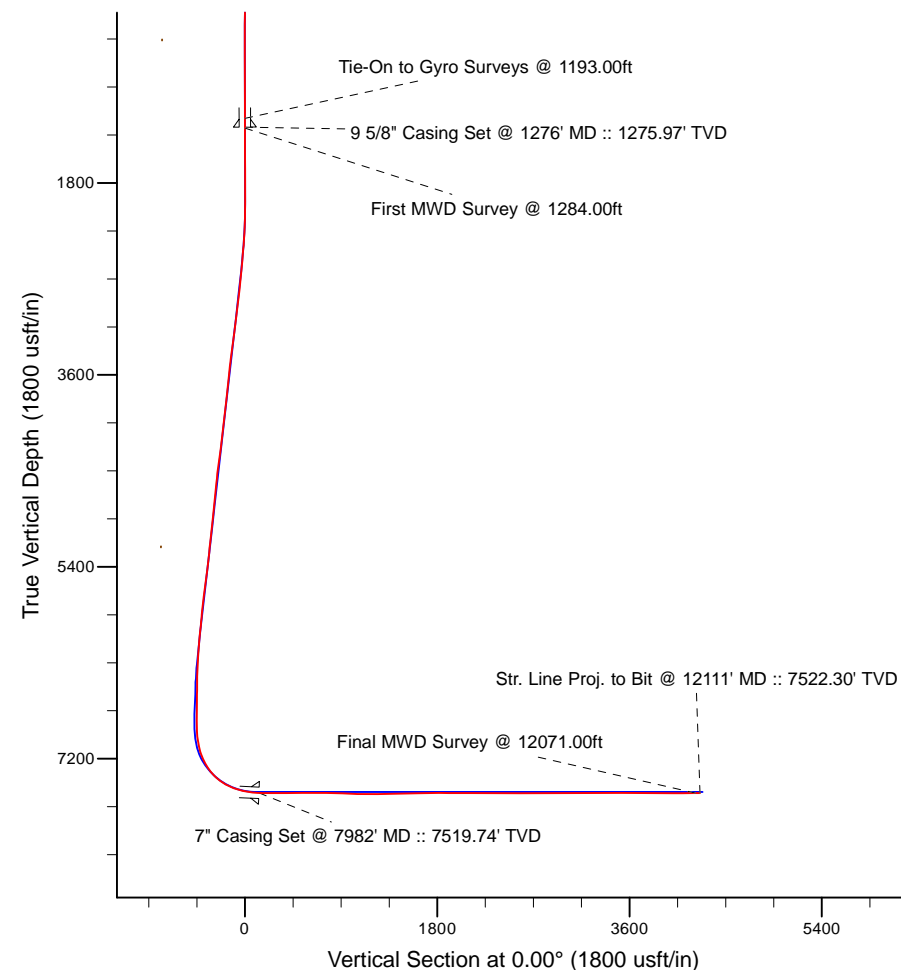
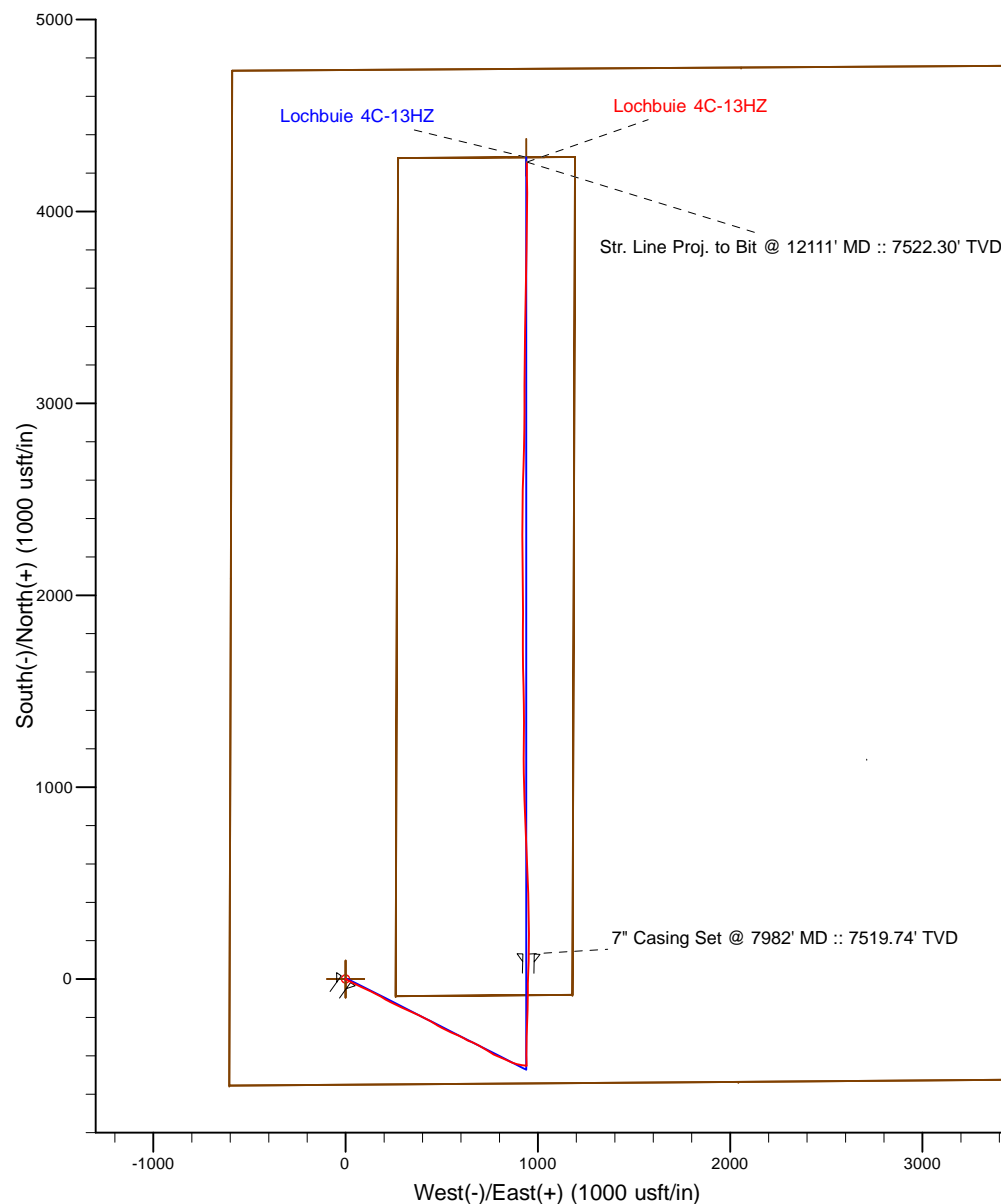
Project: Weld County, CO (NAD 83)
 Site: Sec. 13-T1N-R66W
 Well: Lochbuie 4C-13HZ
 Wellbore: Plan A
 Design: Actual Surveys



HALLIBURTON
 Sperry Drilling

LEGEND

- Lochbuie 4C-13HZ, Plan A, Rev A1 V0
- Actual Surveys



7" Casing: ~673.41' FSL, ~1555.05' FWL
 Lat/Long: 40.045869 N, -104.729399 E
 State Planes - CO Northern: 1,260,493.29' N, 3,215,738.66' E
 Location: Sec. 13-T1N-R66W

BHL: ~485.00' FNL, ~1533.37' FWL
 Lat/Long: 40.057200 N, -104.729432 E
 State Planes - CO Northern: 1,264,620.55' N, 3,215,693.55' E
 Location: Sec. 13-T1N-R66W

WELL DETAILS: Lochbuie 4C-13HZ	
Ground Level: 5078.00	
RKB = 13 @ 5091.00usft (Ensign 132)	
Design: Actual Surveys (Lochbuie 4C-13HZ/Plan A)	
Created By: Clint Eshelman	Date: 3/3/2014
Reviewed: _____	Date: _____

Anadarko Petroleum Corp.

Weld County, CO (NAD 83)

Sec. 13-T1N-R66W

Lochbuie 4C-13HZ

Plan A

Design: Actual Surveys

Sperry Drilling Services

Standard Report

03 March, 2014

Well Coordinates: 1,260,354.85 N, 3,214,787.44 E (40° 02' 43.84" N, 104° 43' 58.08" W)

Ground Level: 5,078.00 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 Lochbuie 4C-13HZ

RKB = 13 @ 5091.00usft (Ensign 132)

N

True

API - US Survey Feet - Custom

HALLIBURTON



Design Report for Lochbuie 4C-13HZ - 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
13.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00
113.00	0.45	216.45	113.00	-0.32	-0.23	-0.32	0.45
213.00	0.51	171.70	213.00	-1.07	-0.40	-1.07	0.37
313.00	0.46	192.95	312.99	-1.90	-0.43	-1.90	0.19
413.00	0.43	162.84	412.99	-2.65	-0.41	-2.65	0.23
513.00	0.39	84.42	512.99	-2.98	0.04	-2.98	0.52
613.00	0.42	41.07	612.99	-2.67	0.62	-2.67	0.30
713.00	0.46	31.72	712.98	-2.05	1.07	-2.05	0.08
813.00	0.45	4.72	812.98	-1.32	1.32	-1.32	0.21
913.00	0.41	3.04	912.98	-0.57	1.37	-0.57	0.04
1,013.00	0.25	202.38	1,012.98	-0.41	1.30	-0.41	0.65
1,113.00	0.44	111.62	1,112.97	-0.76	1.58	-0.76	0.51
1,193.00	0.42	68.21	1,192.97	-0.76	2.14	-0.76	0.40
Tie-On to Gyro Surveys @ 1193.00ft							
1,276.00	0.21	35.31	1,275.97	-0.52	2.51	-0.52	0.32
9 5/8" Casing Set @ 1276' MD :: 1275.97' TVD							
1,284.00	0.20	29.00	1,283.97	-0.50	2.52	-0.50	0.32
First MWD Survey @ 1284.00ft							
1,474.00	0.45	354.44	1,473.97	0.53	2.61	0.53	0.16
1,665.00	0.03	69.19	1,664.97	1.30	2.59	1.30	0.23
1,853.00	0.39	326.19	1,852.96	1.85	2.27	1.85	0.21
1,948.00	0.23	343.95	1,947.96	2.30	2.04	2.30	0.19
2,042.00	1.65	122.68	2,041.95	1.75	3.13	1.75	1.95
2,136.00	2.80	133.63	2,135.88	-0.57	5.93	-0.57	1.30
2,230.00	4.56	123.05	2,229.68	-4.19	10.72	-4.19	2.00
2,325.00	6.69	121.19	2,324.22	-9.11	18.62	-9.11	2.25
2,419.00	8.97	120.23	2,417.34	-15.64	29.64	-15.64	2.43
2,513.00	12.16	115.07	2,509.73	-23.53	44.95	-23.53	3.54
2,607.00	12.99	112.69	2,601.48	-31.80	63.66	-31.80	1.04
2,701.00	15.02	114.91	2,692.68	-41.00	84.46	-41.00	2.23
2,795.00	13.54	115.39	2,783.77	-50.85	105.45	-50.85	1.58
2,889.00	13.82	117.23	2,875.11	-60.71	125.37	-60.71	0.55
3,077.00	13.98	117.29	3,057.60	-81.39	165.52	-81.39	0.09
3,172.00	15.61	120.88	3,149.45	-93.22	186.69	-93.22	1.97
3,266.00	16.44	118.68	3,239.80	-106.09	209.21	-106.09	1.09
3,360.00	14.97	117.54	3,330.29	-118.09	231.65	-118.09	1.60
3,455.00	16.07	116.75	3,421.82	-129.68	254.27	-129.68	1.18
3,550.00	13.79	115.24	3,513.61	-140.43	276.25	-140.43	2.43
3,645.00	15.14	113.09	3,605.60	-150.12	297.91	-150.12	1.53
3,740.00	14.06	114.35	3,697.53	-159.75	319.83	-159.75	1.18
3,835.00	14.38	115.33	3,789.62	-169.55	341.01	-169.55	0.42
3,930.00	16.02	115.71	3,881.29	-180.29	363.49	-180.29	1.73
4,025.00	12.60	114.02	3,973.33	-190.19	384.77	-190.19	3.63
4,120.00	14.10	114.40	4,065.76	-199.19	404.77	-199.19	1.58
4,216.00	14.50	119.97	4,158.79	-210.03	425.83	-210.03	1.49
4,311.00	15.69	121.10	4,250.51	-222.60	447.14	-222.60	1.29
4,406.00	14.26	121.49	4,342.28	-235.35	468.11	-235.35	1.51
4,501.00	15.56	118.33	4,434.08	-247.51	489.31	-247.51	1.61
4,691.00	12.23	116.48	4,618.50	-268.58	529.76	-268.58	1.77

Design Report for Lochbuie 4C-13HZ - Actual Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
4,786.00	13.45	112.74	4,711.12	-277.34	548.96	-277.34	1.55
4,881.00	13.56	111.76	4,803.50	-285.74	569.49	-285.74	0.27
4,976.00	14.42	117.98	4,895.68	-295.42	590.28	-295.42	1.82
5,071.00	14.18	116.49	4,987.74	-306.16	611.15	-306.16	0.46
5,165.00	12.96	117.19	5,079.11	-316.11	630.83	-316.11	1.31
5,260.00	14.37	114.98	5,171.42	-325.96	650.99	-325.96	1.58
5,355.00	13.07	114.86	5,263.71	-335.45	671.42	-335.45	1.37
5,450.00	13.58	116.65	5,356.15	-344.97	691.14	-344.97	0.69
5,545.00	14.63	121.86	5,448.29	-356.31	711.30	-356.31	1.73
5,640.00	14.21	122.24	5,540.30	-368.86	731.35	-368.86	0.45
5,735.00	13.02	120.91	5,632.63	-380.58	750.39	-380.58	1.30
5,830.00	13.86	116.01	5,725.03	-391.07	769.80	-391.07	1.49
5,925.00	14.95	116.06	5,817.04	-401.44	791.04	-401.44	1.15
6,021.00	12.43	110.54	5,910.31	-410.51	811.84	-410.51	2.95
6,116.00	13.63	115.97	6,002.86	-419.00	831.48	-419.00	1.80
6,211.00	13.44	113.38	6,095.23	-428.28	851.68	-428.28	0.67
6,306.00	11.57	107.07	6,187.97	-435.46	870.92	-435.46	2.44
6,401.00	11.34	108.94	6,281.08	-441.28	888.86	-441.28	0.46
6,496.00	8.95	101.92	6,374.59	-445.84	904.93	-445.84	2.83
6,591.00	7.48	95.45	6,468.62	-447.96	918.32	-447.96	1.83
6,686.00	5.58	97.77	6,563.00	-449.17	929.05	-449.17	2.02
6,782.00	3.57	104.64	6,658.69	-450.56	936.57	-450.56	2.17
6,877.00	1.47	107.14	6,753.59	-451.66	940.59	-451.66	2.21
6,972.00	0.26	38.74	6,848.58	-451.85	941.89	-451.85	1.47
7,067.00	2.17	0.42	6,943.55	-449.89	942.04	-449.89	2.08
7,115.00	6.20	358.85	6,991.41	-446.39	942.00	-446.39	8.40
7,162.00	9.24	355.29	7,037.98	-440.09	941.63	-440.09	6.54
7,210.00	12.70	356.20	7,085.10	-430.98	940.97	-430.98	7.22
7,257.00	16.64	358.60	7,130.56	-419.09	940.46	-419.09	8.48
7,305.00	20.95	0.35	7,175.99	-403.63	940.35	-403.63	9.05
7,352.00	25.83	1.42	7,219.11	-384.98	940.65	-384.98	10.42
7,400.00	31.04	0.47	7,261.31	-362.14	941.01	-362.14	10.89
7,447.00	36.17	359.70	7,300.44	-336.13	941.04	-336.13	10.95
7,495.00	41.30	0.85	7,337.87	-306.11	941.20	-306.11	10.79
7,543.00	46.00	2.05	7,372.59	-273.00	942.05	-273.00	9.94
7,591.00	52.28	2.92	7,403.98	-236.75	943.64	-236.75	13.15
7,638.00	58.57	2.35	7,430.64	-198.11	945.41	-198.11	13.42
7,686.00	63.69	2.10	7,453.81	-156.12	947.04	-156.12	10.68
7,733.00	68.87	0.30	7,472.71	-113.12	947.93	-113.12	11.56
7,781.00	74.06	0.29	7,487.96	-67.63	948.16	-67.63	10.81
7,828.00	76.32	0.92	7,499.97	-22.19	948.64	-22.19	4.98
7,876.00	80.77	1.48	7,509.50	24.83	949.63	24.83	9.34
7,923.00	83.67	1.51	7,515.87	71.38	950.84	71.38	6.17
7,945.00	86.36	1.63	7,517.78	93.28	951.44	93.28	12.24
7,982.00	87.57	1.39	7,519.74	130.22	952.42	130.22	3.33
7" Casing Set @ 7982' MD :: 7519.74' TVD							
8,047.00	89.69	0.98	7,521.29	195.18	953.76	195.18	3.33
8,143.00	89.26	358.86	7,522.17	291.17	953.63	291.17	2.25
8,238.00	91.30	358.89	7,521.71	386.15	951.76	386.15	2.15
8,333.00	91.36	357.92	7,519.50	481.08	949.12	481.08	1.02
8,428.00	89.07	357.90	7,519.15	576.01	945.66	576.01	2.41

Design Report for Lochbuie 4C-13HZ - Actual Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
8,523.00	90.00	357.42	7,519.92	670.93	941.78	670.93	1.10
8,619.00	89.57	357.04	7,520.28	766.82	937.14	766.82	0.60
8,714.00	87.96	358.09	7,522.32	861.70	933.10	861.70	2.02
8,809.00	87.22	357.41	7,526.32	956.54	929.38	956.54	1.06
8,904.00	88.70	359.36	7,529.70	1,051.44	926.70	1,051.44	2.58
8,999.00	89.63	0.50	7,531.09	1,146.43	926.59	1,146.43	1.55
9,095.00	90.68	0.86	7,530.83	1,242.42	927.73	1,242.42	1.16
9,190.00	90.80	359.93	7,529.60	1,337.41	928.38	1,337.41	0.99
9,286.00	91.30	359.13	7,527.84	1,433.39	927.59	1,433.39	0.98
9,381.00	91.73	358.63	7,525.33	1,528.33	925.74	1,528.33	0.69
9,476.00	91.24	358.65	7,522.87	1,623.28	923.48	1,623.28	0.52
9,571.00	90.80	0.04	7,521.18	1,718.25	922.40	1,718.25	1.53
9,666.00	90.12	0.26	7,520.41	1,813.25	922.65	1,813.25	0.75
9,761.00	89.32	0.35	7,520.88	1,908.24	923.15	1,908.24	0.85
9,856.00	89.63	359.45	7,521.75	2,003.24	922.99	2,003.24	1.00
9,952.00	90.06	359.33	7,522.01	2,099.23	921.96	2,099.23	0.47
10,047.00	90.19	358.52	7,521.80	2,194.22	920.18	2,194.22	0.86
10,142.00	89.75	0.23	7,521.85	2,289.21	919.15	2,289.21	1.86
10,237.00	89.94	359.95	7,522.11	2,384.21	919.30	2,384.21	0.36
10,332.00	89.57	1.50	7,522.51	2,479.19	920.50	2,479.19	1.68
10,523.00	90.37	1.74	7,522.61	2,670.12	925.90	2,670.12	0.44
10,618.00	90.00	1.08	7,522.31	2,765.09	928.23	2,765.09	0.80
10,713.00	90.00	0.66	7,522.31	2,860.07	929.68	2,860.07	0.44
10,808.00	89.94	0.19	7,522.36	2,955.07	930.38	2,955.07	0.50
10,903.00	89.69	359.74	7,522.66	3,050.07	930.32	3,050.07	0.54
10,999.00	90.19	1.25	7,522.76	3,146.06	931.15	3,146.06	1.66
11,094.00	90.31	0.67	7,522.35	3,241.05	932.74	3,241.05	0.62
11,189.00	90.37	359.74	7,521.78	3,336.05	933.08	3,336.05	0.98
11,284.00	90.80	1.38	7,520.81	3,431.03	934.01	3,431.03	1.78
11,379.00	90.87	1.31	7,519.43	3,526.00	936.24	3,526.00	0.10
11,475.00	90.25	0.92	7,518.49	3,621.97	938.11	3,621.97	0.76
11,570.00	88.52	0.80	7,519.51	3,716.95	939.54	3,716.95	1.83
11,665.00	88.33	0.92	7,522.12	3,811.91	940.96	3,811.91	0.24
11,760.00	90.12	1.18	7,523.41	3,906.88	942.70	3,906.88	1.90
11,855.00	90.25	0.51	7,523.10	4,001.87	944.10	4,001.87	0.72
11,950.00	90.37	359.79	7,522.59	4,096.86	944.35	4,096.86	0.77
12,045.00	89.88	359.42	7,522.38	4,191.86	943.70	4,191.86	0.65
12,071.00	90.12	359.41	7,522.38	4,217.86	943.43	4,217.86	0.92
Final MWD Survey @ 12071.00ft							
12,111.00	90.12	359.41	7,522.30	4,257.86	943.02	4,257.86	0.00
Str. Line Proj. to Bit @ 12111' MD :: 7522.30' TVD							

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
1,193.00	1,192.97	-0.76	2.14	Tie-On to Gyro Surveys @ 1193.00ft
1,284.00	1,283.97	-0.50	2.52	First MWD Survey @ 1284.00ft
12,071.00	7,522.38	4,217.86	943.43	Final MWD Survey @ 12071.00ft
12,111.00	7,522.30	4,257.86	943.02	Str. Line Proj. to Bit @ 12111' MD :: 7522.30' TVD

Design Report for Lochbuie 4C-13HZ - Actual Surveys

Vertical Section Information

Angle Type	Target	Azimuth (°)	Origin Type	Origin +N/_S (usft)	Origin +E/-W (usft)	Start TVD (usft)
User	No Target (Freehand)	0.00	Slot	0.00	0.00	0.00

Survey tool program

From (usft)	To (usft)	Survey/Plan	Survey Tool
13.00	1,193.00	MS Energy Gyro Surveys	NS-GYRO-MS
1,284.00	7,945.00	MWD Vertical/Build Surveys	MWD+IFR1+SC
8,047.00	12,071.00	MWD Lateral Surveys	MWD+IFR1+SC

Casing Details

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
1,276.00	1,275.97	9 5/8" Casing Set @ 1276' MD :: 1275.97' TVD	9-5/8	13-1/2
7,982.00	7,519.74	7" Casing Set @ 7982' MD :: 7519.74' TVD	7	8-3/4

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
Lochbuie 4C-13HZ_SE	0.00	0.00	0.00	0.00	0.00	1,260,354.85	3,214,787.44	40° 2' 43.843 N	104° 43' 58.084 W
- actual wellpath hits target center									
- Polygon									
Point 1				0.00	4,733.06	-589.01	1,265,082.46	3,214,157.52	
Point 2				0.00	4,750.03	2,057.79	1,265,122.33	3,216,803.98	
Point 3				0.00	4,766.61	4,704.75	1,265,161.81	3,219,450.60	
Point 4				0.00	2,125.81	4,698.62	1,262,521.15	3,219,467.32	
Point 5				0.00	-515.89	4,691.54	1,259,879.58	3,219,483.09	
Point 6				0.00	-535.03	2,043.33	1,259,837.53	3,216,835.25	
Point 7				0.00	-554.96	-604.76	1,259,794.70	3,214,187.52	
Point 8				0.00	2,089.47	-596.81	1,262,439.00	3,214,172.60	
Lochbuie 4C-13HZ_LC	0.00	0.00	0.00	0.00	0.00	1,260,354.85	3,214,787.44	40° 2' 43.843 N	104° 43' 58.084 W
- actual wellpath hits target center									
- Polygon									
Point 1				0.00	4,278.57	273.07	1,264,635.46	3,215,023.47	
Point 2				0.00	4,284.47	1,193.12	1,264,649.32	3,215,943.40	
Point 3				0.00	-81.54	1,180.63	1,260,283.53	3,215,968.69	
Point 4				0.00	-88.46	260.58	1,260,268.65	3,215,048.76	
Lochbuie 4C-13HZ_SL	0.00	0.00	0.00	0.00	0.00	1,260,354.85	3,214,787.44	40° 2' 43.843 N	104° 43' 58.084 W
- actual wellpath hits target center									
- Point									
Lochbuie 4C-13HZ_BH	0.00	0.00	7,511.00	4,282.98	939.72	1,264,645.64	3,215,690.03	40° 3' 26.168 N	104° 43' 45.998 W
- actual wellpath misses target center by 27.74usft at 12111.00usft MD (7522.30 TVD, 4257.86 N, 943.02 E)									
- Point									

Directional Difficulty Index

Average Dogleg over Survey:	1.80 °/100usft	Maximum Dogleg over Survey:	13.42 °/100usft at 7,638.00 usft
Net Tortousity applicable to Plans:	0.35 °/100usft	Directional Difficulty Index:	6.306

Design Report for Lochbuie 4C-13HZ - Actual Surveys

Audit Info

North Reference Sheet for Sec. 13-T1N-R66W - Lochbuie 4C-13HZ - Plan A

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

Vertical Depths are relative to RKB = 13 @ 5091.00usft (Ensign 132). Northing and Easting are relative to Lochbuie 4C-13HZ

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: 0.99996323

Grid Coordinates of Well: 1,260,354.85 usft N, 3,214,787.44 usft E

Geographical Coordinates of Well: 40° 02' 43.84" N, 104° 43' 58.08" W

Grid Convergence at Surface is: 0.50°

Based upon Minimum Curvature type calculations, at a Measured Depth of 12,111.00usft the Bottom Hole Displacement is 4,361.04usft in the Direction of 12.49° (True).

Magnetic Convergence at surface is: -8.01° (22 January 2014, , BGGM2013)

