





Cathedral Energy Services

Survey Report

Company:	EnCana Oil & Gas (USA) Inc	Local Co-ordinate Reference:	Well MCU 22-13C (N22W Pad)
Project:	Mamm Creek	TVD Reference:	KBE @ 7048.0ft (Nabors M15)
Site:	N22W Pad	MD Reference:	KBE @ 7048.0ft (Nabors M15)
Well:	MCU 22-13C (N22W Pad)	North Reference:	True
Wellbore:	DD	Survey Calculation Method:	Minimum Curvature
Design:	FINAL	Database:	USA EDM 5000 Multi Users DB

Project	Mamm Creek		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	Colorado Central Zone		

Site		N22W Pad			
Site Position:		Northing:	1,587,870.64 ft	Latitude:	39.425629
From:	Lat/Long	Easting:	2,361,187.41 ft	Longitude:	-107.761673
Position Uncertainty:	0.0 ft	Slot Radius:	13.200 in	Grid Convergence:	-1.43 °

Well	MCU 22-13C (N22W Pad)					
Well Position	+N/-S	0.0 ft	Northing:	1,587,973.47 ft	Latitude:	39.425903
	+E/-W	0.0 ft	Easting:	2,361,065.64 ft	Longitude:	-107.762113
Position Uncertainty		0.0 ft	Wellhead Elevation:	ft	Ground Level:	7,026.0 ft

Wellbore		DD			
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	8/5/2012	10.09	65.69	52,119

Design	FINAL			
Audit Notes:				
Version:	1.0	Phase:	ACTUAL	Tie On Depth: 0.0
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)
	0.0	0.0	0.0	267.12

Survey Program		Date	8/27/2012		
From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description	
124.0	9,333.0	Survey #1 (DD)	MWD	Geolink MWD	

Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	
124.0	0.50	182.00	124.0	-0.5	0.0	0.0	0.40	0.40	
154.0	0.50	165.50	154.0	-0.8	0.0	0.0	0.48	0.00	
185.0	0.20	195.70	185.0	-1.0	0.0	0.0	1.10	-0.97	
215.0	0.70	244.90	215.0	-1.1	-0.2	0.2	1.96	1.67	
246.0	1.10	273.00	246.0	-1.2	-0.6	0.7	1.89	1.29	
277.0	1.30	284.30	277.0	-1.1	-1.3	1.3	1.00	0.65	
307.0	2.20	285.90	307.0	-0.8	-2.1	2.2	3.00	3.00	
338.0	2.50	274.10	337.9	-0.6	-3.4	3.4	1.83	0.97	
369.0	2.50	268.20	368.9	-0.6	-4.7	4.8	0.83	0.00	
460.0	4.00	230.40	459.8	-2.7	-9.2	9.3	2.79	1.65	
494.0	4.20	232.40	493.7	-4.2	-11.1	11.3	0.72	0.59	
521.0	4.20	237.50	520.6	-5.3	-12.7	12.9	1.38	0.00	

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Wellbore:	DD	Survey Calculation Method:	Minimum Curvature
Design:	FINAL	Database:	USA EDM 5000 Multi Users DB

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
552.0	4.50	253.00	551.5	-6.3	-14.8	15.1	3.90	0.97	
583.0	5.70	261.50	582.4	-6.9	-17.5	17.8	4.56	3.87	
613.0	6.50	268.30	612.2	-7.1	-20.7	21.0	3.59	2.67	
644.0	7.80	274.10	643.0	-7.0	-24.5	24.8	4.79	4.19	
674.0	8.90	279.00	672.7	-6.5	-28.8	29.1	4.36	3.67	
705.0	10.00	280.20	703.3	-5.7	-33.9	34.1	3.60	3.55	
736.0	11.00	280.60	733.7	-4.7	-39.4	39.6	3.23	3.23	
767.0	12.30	282.40	764.1	-3.4	-45.5	45.7	4.35	4.19	
798.0	13.00	279.30	794.3	-2.1	-52.2	52.3	3.14	2.26	
859.0	14.50	272.10	853.6	-0.8	-66.6	66.6	3.73	2.46	
949.0	15.40	271.00	940.6	-0.1	-89.8	89.7	1.05	1.00	
1,041.0	16.00	266.50	1,029.1	-0.7	-114.7	114.6	1.48	0.65	
1,132.0	15.30	263.70	1,116.7	-2.8	-139.1	139.1	1.13	-0.77	
1,223.0	13.20	261.20	1,204.9	-5.7	-161.3	161.4	2.40	-2.31	
1,316.0	12.20	263.70	1,295.7	-8.4	-181.6	181.8	1.23	-1.08	
1,411.0	11.30	269.40	1,388.7	-9.6	-200.9	201.1	1.55	-0.95	
1,430.0	11.20	268.60	1,407.3	-9.6	-204.6	204.8	0.98	-0.53	
1,555.0	11.10	268.60	1,530.0	-10.2	-228.8	229.0	0.08	-0.08	
1,650.0	12.40	270.20	1,623.0	-10.4	-248.1	248.3	1.41	1.37	
1,746.0	12.70	264.70	1,716.7	-11.4	-268.9	269.2	1.28	0.31	
1,841.0	12.30	263.00	1,809.4	-13.6	-289.4	289.7	0.57	-0.42	
1,937.0	13.50	266.40	1,903.0	-15.5	-310.7	311.1	1.48	1.25	
2,032.0	13.60	266.20	1,995.4	-17.0	-332.9	333.3	0.12	0.11	
2,128.0	13.40	266.60	2,088.7	-18.4	-355.3	355.8	0.23	-0.21	
2,223.0	13.10	265.30	2,181.2	-19.9	-377.0	377.5	0.45	-0.32	
2,319.0	13.10	266.30	2,274.7	-21.5	-398.7	399.3	0.24	0.00	
2,414.0	13.60	265.20	2,367.1	-23.1	-420.6	421.2	0.59	0.53	
2,509.0	13.80	265.40	2,459.4	-25.0	-443.0	443.7	0.22	0.21	
2,604.0	12.60	268.00	2,551.9	-26.2	-464.6	465.4	1.41	-1.26	
2,700.0	12.80	269.40	2,645.6	-26.7	-485.7	486.5	0.38	0.21	
2,795.0	12.60	267.60	2,738.2	-27.3	-506.6	507.3	0.47	-0.21	
2,890.0	12.20	265.40	2,831.0	-28.5	-527.0	527.7	0.65	-0.42	
2,985.0	12.50	264.50	2,923.8	-30.3	-547.2	548.0	0.38	0.32	
3,081.0	12.40	265.60	3,017.6	-32.1	-567.8	568.7	0.27	-0.10	
3,176.0	12.50	266.80	3,110.3	-33.4	-588.3	589.2	0.29	0.11	
3,271.0	12.30	264.40	3,203.1	-35.0	-608.6	609.6	0.58	-0.21	
3,366.0	12.10	266.50	3,296.0	-36.6	-628.6	629.7	0.51	-0.21	
3,461.0	11.70	269.10	3,388.9	-37.3	-648.2	649.2	0.70	-0.42	
3,557.0	11.60	267.50	3,482.9	-37.9	-667.6	668.6	0.35	-0.10	
3,652.0	12.90	268.80	3,575.8	-38.6	-687.7	688.8	1.40	1.37	
3,747.0	12.70	267.60	3,668.4	-39.2	-708.7	709.8	0.35	-0.21	
3,841.0	12.40	267.90	3,760.2	-40.0	-729.2	730.2	0.33	-0.32	
3,937.0	12.10	266.10	3,854.0	-41.1	-749.5	750.6	0.51	-0.31	
4,033.0	12.00	266.20	3,947.9	-42.4	-769.5	770.6	0.11	-0.10	
4,128.0	11.90	265.60	4,040.8	-43.8	-789.1	790.3	0.17	-0.11	
4,223.0	12.80	271.20	4,133.6	-44.4	-809.4	810.6	1.58	0.95	
4,318.0	12.70	269.10	4,226.3	-44.3	-830.4	831.5	0.50	-0.11	
4,414.0	12.60	268.90	4,319.9	-44.7	-851.4	852.5	0.11	-0.10	
4,509.0	12.70	269.70	4,412.6	-44.9	-872.2	873.3	0.21	0.11	
4,605.0	12.80	269.50	4,506.3	-45.1	-893.4	894.5	0.11	0.10	
4,700.0	12.30	263.70	4,599.0	-46.3	-913.9	915.1	1.43	-0.53	
4,795.0	12.10	265.00	4,691.9	-48.3	-933.9	935.2	0.36	-0.21	
4,890.0	12.20	264.40	4,784.7	-50.1	-953.8	955.1	0.17	0.11	

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Wellbore:	DD	Survey Calculation Method:	Minimum Curvature
Design:	FINAL	Database:	USA EDM 5000 Multi Users DB

Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
4,985.0	12.50	265.10	4,877.5	-52.0	-974.1	975.4	0.35	0.32	
5,081.0	11.90	262.40	4,971.4	-54.2	-994.2	995.7	0.86	-0.62	
5,177.0	12.00	268.40	5,065.3	-55.7	-1,014.0	1,015.5	1.30	0.10	
5,272.0	12.20	268.80	5,158.2	-56.2	-1,033.9	1,035.4	0.23	0.21	
5,367.0	12.20	271.10	5,251.0	-56.2	-1,054.0	1,055.5	0.51	0.00	
5,463.0	11.60	269.80	5,345.0	-56.1	-1,073.8	1,075.3	0.68	-0.62	
5,559.0	11.20	270.20	5,439.1	-56.1	-1,092.8	1,094.2	0.42	-0.42	
5,654.0	12.00	269.70	5,532.1	-56.1	-1,111.9	1,113.3	0.85	0.84	
5,749.0	12.10	273.20	5,625.0	-55.6	-1,131.7	1,133.0	0.78	0.11	
5,844.0	12.10	269.50	5,717.9	-55.1	-1,151.6	1,152.9	0.82	0.00	
5,940.0	11.90	265.20	5,811.8	-56.0	-1,171.5	1,172.8	0.95	-0.21	
6,035.0	11.50	263.00	5,904.9	-58.0	-1,190.7	1,192.1	0.63	-0.42	
6,130.0	11.30	266.40	5,998.0	-59.8	-1,209.4	1,210.8	0.74	-0.21	
6,226.0	10.90	264.80	6,092.2	-61.2	-1,227.8	1,229.3	0.53	-0.42	
6,321.0	9.10	265.90	6,185.7	-62.5	-1,244.2	1,245.8	1.91	-1.89	
6,416.0	7.70	265.10	6,279.7	-63.6	-1,258.1	1,259.7	1.48	-1.47	
6,511.0	5.90	265.60	6,374.0	-64.5	-1,269.3	1,270.9	1.90	-1.89	
6,606.0	5.90	264.10	6,468.5	-65.4	-1,279.0	1,280.7	0.16	0.00	
6,702.0	5.00	264.00	6,564.1	-66.3	-1,288.1	1,289.8	0.94	-0.94	
6,797.0	3.50	266.80	6,658.8	-66.9	-1,295.1	1,296.8	1.59	-1.58	
6,893.0	3.10	270.20	6,754.7	-67.1	-1,300.6	1,302.3	0.46	-0.42	
6,988.0	3.90	270.20	6,849.5	-67.1	-1,306.4	1,308.1	0.84	0.84	
7,084.0	4.20	257.10	6,945.3	-67.8	-1,313.1	1,314.8	1.01	0.31	
7,180.0	3.70	255.10	7,041.0	-69.4	-1,319.5	1,321.3	0.54	-0.52	
7,217.7	2.91	255.08	7,078.7	-70.0	-1,321.6	1,323.5	2.11	-2.11	MCU22-13C TGT
7,275.0	1.70	255.00	7,135.9	-70.6	-1,323.8	1,325.7	2.11	-2.11	
7,370.0	1.80	240.70	7,230.9	-71.7	-1,326.5	1,328.4	0.47	0.11	
7,466.0	1.80	246.50	7,326.8	-73.0	-1,329.2	1,331.2	0.19	0.00	
7,550.0	0.60	318.10	7,410.8	-73.2	-1,330.7	1,332.7	2.03	-1.43	
7,645.0	0.70	323.60	7,505.8	-72.4	-1,331.4	1,333.3	0.12	0.11	
7,741.0	0.90	341.60	7,601.8	-71.2	-1,332.0	1,333.9	0.33	0.21	
7,836.0	1.00	323.60	7,696.8	-69.8	-1,332.7	1,334.5	0.33	0.11	
7,932.0	0.80	293.50	7,792.8	-68.9	-1,333.8	1,335.6	0.53	-0.21	
8,028.0	1.50	283.90	7,888.8	-68.3	-1,335.6	1,337.4	0.75	0.73	
8,123.0	0.70	280.10	7,983.7	-67.9	-1,337.4	1,339.1	0.85	-0.84	
8,218.0	0.70	260.00	8,078.7	-67.9	-1,338.6	1,340.3	0.26	0.00	
8,314.0	1.30	257.60	8,174.7	-68.2	-1,340.2	1,341.9	0.63	0.62	
8,409.0	0.70	251.30	8,269.7	-68.7	-1,341.8	1,343.5	0.64	-0.63	
8,504.0	0.30	255.70	8,364.7	-68.9	-1,342.6	1,344.4	0.42	-0.42	
8,599.0	0.30	216.30	8,459.7	-69.2	-1,343.0	1,344.8	0.21	0.00	
8,694.0	0.30	197.00	8,554.7	-69.6	-1,343.2	1,345.0	0.11	0.00	
8,789.0	0.60	174.80	8,649.7	-70.3	-1,343.2	1,345.1	0.36	0.32	
8,885.0	0.40	192.00	8,745.7	-71.2	-1,343.2	1,345.1	0.26	-0.21	
8,980.0	0.30	190.90	8,840.7	-71.7	-1,343.4	1,345.3	0.11	-0.11	
9,076.0	0.60	243.90	8,936.7	-72.2	-1,343.9	1,345.8	0.50	0.31	
9,171.0	0.40	223.50	9,031.7	-72.7	-1,344.5	1,346.5	0.28	-0.21	
9,283.0	0.20	147.62	9,143.7	-73.1	-1,344.7	1,346.7	0.36	-0.18	Last Cathedral Survey @ 9,283' MD
9,323.3	0.20	147.62	9,184.0	-73.2	-1,344.6	1,346.6	0.00	0.00	MCU22-13C BHL
9,333.0	0.20	147.60	9,193.7	-73.3	-1,344.6	1,346.6	0.00	0.00	Projection to Bit @ 9,333' MD

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Site:	N22W Pad	MD Reference:	KBE @ 7048.0ft (Nabors M15)
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Targets									
Target Name	Dip Angle	Dip Dir.	TVD	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude
- hit/miss target	(°)	(°)	(ft)	(ft)	(ft)	(ft)	(ft)		
- Shape									
MCU22-13C TGT	0.00	0.00	7,078.0	-67.3	-1,337.8	1,587,939.49	2,359,726.54	39.425718	-107.766849
- survey misses target center by 16.5ft at 7217.7ft MD (7078.7 TVD, -70.0 N, -1321.6 E)									
- Point									
MCU22-13C BHL	0.00	0.00	9,184.0	-67.3	-1,337.8	1,587,939.49	2,359,726.54	39.425718	-107.766849
- survey misses target center by 9.0ft at 9323.3ft MD (9184.0 TVD, -73.2 N, -1344.6 E)									
- Circle (radius 25.0)									

Survey Annotations					
Measured Depth	Vertical Depth	Local Coordinates			
(ft)	(ft)	+N/-S (ft)	+E/-W (ft)	Comment	
9,283.0	9,143.7	-73.1	-1,344.7	Last Cathedral Survey @ 9,283' MD	
9,333.0	9,193.7	-73.3	-1,344.6	Projection to Bit @ 9,333' MD	

Checked By: _____ Approved By: _____ Date: _____