





Cathedral Energy Services

Survey Report

Company: Anadarko Petroleum Corporation	Local Co-ordinate Reference: Well Vonderlage Fed 28N-W31HZ
Project: DJ Wattenberg	TVD Reference: KB=13' @ 4856.0ft (Ensign #123)
Site: Vonderlage Pad (SESW S31-T3N-R66W)	MD Reference: KB=13' @ 4856.0ft (Ensign #123)
Well: Vonderlage Fed 28N-W31HZ	North Reference: Grid
Wellbore: HZ	Survey Calculation Method: Minimum Curvature
Design: FINAL	Database: USA EDM 5000 Multi Users DB

Project DJ Wattenberg		
Map System: US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum: North American Datum 1983		
Map Zone: Colorado Northern Zone		

Site Vonderlage Pad (SESW S31-T3N-R66W)				
Site Position:	Northing:	1,307,441.84 ft	Latitude:	40.175335
From: Lat/Long	Easting:	3,189,134.79 ft	Longitude:	-104.823165
Position Uncertainty: 0.0 ft	Slot Radius:	13.200 in	Grid Convergence:	0.44 °

Well Vonderlage Fed 28N-W31HZ				
Well Position	+N/-S	0.0 ft	Northing:	1,307,442.05 ft
	+E/-W	0.0 ft	Easting:	3,189,164.97 ft
Position Uncertainty		0.0 ft	Wellhead Elevation:	ft
			Latitude:	40.175335
			Longitude:	-104.823057
			Ground Level:	4,843.0 ft

Wellbore HZ					
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	7/4/2013	8.60	66.79	52,791

Design FINAL				
Audit Notes:				
Version:	1.0	Phase:	ACTUAL	Tie On Depth: 784.0
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)
	0.0	0.0	0.0	5.86

Survey Program		Date 8/23/2013
From (ft)	To (ft)	Survey (Wellbore)
113.0	784.0	Survey #1 (Surface Gyros)
885.0	11,611.0	Survey #2 (HZ)
		Tool Name
		Gyro
		MWD
		Description
		Gyro
		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	
113.0	0.26	102.26	113.0	-0.1	0.3	0.0	0.23	0.23	
213.0	0.47	41.22	213.0	0.2	0.7	0.3	0.41	0.21	
313.0	0.65	25.02	313.0	1.0	1.3	1.2	0.24	0.18	
413.0	0.50	32.84	413.0	1.9	1.7	2.1	0.17	-0.15	
513.0	0.52	38.82	513.0	2.6	2.3	2.8	0.06	0.02	
613.0	0.65	38.81	613.0	3.4	2.9	3.7	0.13	0.13	
713.0	0.23	74.17	713.0	3.9	3.4	4.3	0.48	-0.42	
784.0	0.88	67.61	784.0	4.2	4.1	4.6	0.92	0.92	Last Surface Gyro @ 771' MD
885.0	1.00	79.20	885.0	4.6	5.7	5.2	0.22	0.12	
978.0	2.60	125.30	977.9	3.6	8.2	4.4	2.19	1.72	
1,072.0	6.20	133.20	1,071.6	-1.1	13.6	0.3	3.87	3.83	

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Well:	Vonderlage Fed 28N-W31HZ	North Reference:	Grid
Wellbore:	HZ	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
1,165.0	5.20	154.50	1,164.2	-8.4	19.1	-6.4	2.50	-1.08	
1,259.0	7.10	146.70	1,257.6	-17.1	24.1	-14.5	2.20	2.02	
1,352.0	9.10	134.90	1,349.7	-27.1	32.5	-23.6	2.79	2.15	
1,446.0	11.00	130.40	1,442.3	-38.1	44.6	-33.4	2.19	2.02	
1,539.0	12.20	123.70	1,533.4	-49.4	59.5	-43.0	1.94	1.29	
1,633.0	13.20	125.30	1,625.1	-61.1	76.5	-52.9	1.13	1.06	
1,726.0	13.50	118.70	1,715.6	-72.4	94.7	-62.4	1.67	0.32	
1,820.0	14.60	117.70	1,806.7	-83.2	114.8	-71.0	1.20	1.17	
1,914.0	15.60	118.70	1,897.5	-94.8	136.4	-80.3	1.10	1.06	
2,004.0	16.00	121.30	1,984.1	-107.0	157.6	-90.4	0.90	0.44	
2,093.0	18.60	124.70	2,069.1	-121.5	179.8	-102.5	3.13	2.92	
2,183.0	17.30	125.30	2,154.7	-137.4	202.5	-116.0	1.46	-1.44	
2,274.0	17.10	125.20	2,241.6	-152.9	224.5	-129.2	0.22	-0.22	
2,364.0	17.60	129.00	2,327.5	-169.1	245.9	-143.1	1.38	0.56	
2,454.0	17.10	122.30	2,413.4	-184.7	267.6	-156.4	2.29	-0.56	
2,544.0	17.60	126.00	2,499.3	-199.8	289.8	-169.2	1.35	0.56	
2,634.0	18.50	122.50	2,584.9	-215.5	312.9	-182.4	1.57	1.00	
2,724.0	19.80	123.60	2,669.9	-231.6	337.6	-195.9	1.50	1.44	
2,814.0	18.60	123.30	2,754.9	-247.9	362.3	-209.6	1.34	-1.33	
2,904.0	20.10	129.30	2,839.8	-265.6	386.3	-224.8	2.77	1.67	
2,994.0	18.90	134.30	2,924.7	-285.6	408.7	-242.3	2.28	-1.33	
3,084.0	15.80	137.80	3,010.6	-304.8	427.4	-259.6	3.63	-3.44	
3,174.0	14.90	136.30	3,097.4	-322.3	443.6	-275.3	1.09	-1.00	
3,264.0	13.10	134.40	3,184.7	-337.8	458.9	-289.2	2.06	-2.00	
3,354.0	10.80	132.40	3,272.7	-350.6	472.4	-300.5	2.60	-2.56	
3,445.0	9.10	127.40	3,362.4	-360.7	484.4	-309.4	2.09	-1.87	
3,534.0	8.80	127.20	3,450.3	-369.1	495.4	-316.6	0.34	-0.34	
3,625.0	8.30	130.30	3,540.3	-377.6	506.0	-323.9	0.75	-0.55	
3,715.0	8.70	128.40	3,629.3	-386.0	516.2	-331.3	0.54	0.44	
3,805.0	8.00	130.10	3,718.3	-394.3	526.4	-338.4	0.82	-0.78	
3,895.0	6.60	128.70	3,807.6	-401.5	535.2	-344.8	1.57	-1.56	
3,985.0	5.80	119.00	3,897.1	-407.0	543.2	-349.4	1.46	-0.89	
4,075.0	6.40	131.30	3,986.6	-412.5	551.0	-354.1	1.59	0.67	
4,165.0	5.50	131.20	4,076.1	-418.6	558.0	-359.5	1.00	-1.00	
4,255.0	4.00	120.50	4,165.8	-423.1	563.9	-363.3	1.93	-1.67	
4,345.0	2.50	147.20	4,255.6	-426.3	567.7	-366.1	2.33	-1.67	
4,435.0	1.90	148.90	4,345.6	-429.2	569.5	-368.8	0.67	-0.67	
4,525.0	1.70	146.50	4,435.5	-431.6	571.0	-371.1	0.24	-0.22	
4,616.0	1.30	138.10	4,526.5	-433.5	572.5	-372.8	0.50	-0.44	
4,706.0	0.90	159.20	4,616.5	-434.9	573.4	-374.1	0.63	-0.44	
4,886.0	1.30	257.50	4,796.4	-436.7	571.9	-376.0	0.94	0.22	
5,156.0	1.50	152.00	5,066.4	-440.5	570.6	-379.9	0.83	0.07	
5,426.0	1.00	269.40	5,336.4	-443.6	569.9	-383.1	0.80	-0.19	
5,696.0	0.60	288.20	5,606.4	-443.2	566.2	-383.1	0.18	-0.15	
5,966.0	0.50	305.70	5,876.3	-442.1	563.9	-382.2	0.07	-0.04	
6,236.0	0.40	292.70	6,146.3	-441.0	562.1	-381.3	0.05	-0.04	
6,506.0	0.90	286.90	6,416.3	-440.1	559.2	-380.7	0.19	0.19	
6,596.0	1.60	282.10	6,506.3	-439.6	557.3	-380.4	0.79	0.78	
6,641.0	4.00	337.90	6,551.2	-438.0	556.0	-378.9	7.49	5.33	
6,686.0	8.40	351.60	6,596.0	-433.3	555.0	-374.4	10.25	9.78	
6,731.0	13.10	353.40	6,640.2	-425.0	553.9	-366.2	10.47	10.44	
6,776.0	17.60	352.70	6,683.6	-413.1	552.5	-354.6	10.01	10.00	
6,821.0	22.20	355.60	6,725.9	-397.9	550.9	-339.6	10.45	10.22	

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Wellbore:	HZ	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
6,866.0	25.00	1.10	6,767.1	-379.9	550.5	-321.7	7.91	6.22	
6,911.0	27.60	5.70	6,807.4	-360.0	551.7	-301.8	7.34	5.78	
6,956.0	30.20	6.40	6,846.8	-338.4	554.0	-280.1	5.83	5.78	
7,001.0	34.40	3.60	6,884.9	-314.5	556.0	-256.1	9.91	9.33	
7,046.0	40.10	3.90	6,920.7	-287.3	557.8	-228.8	12.67	12.67	
7,091.0	47.00	2.30	6,953.3	-256.4	559.5	-197.9	15.53	15.33	
7,136.0	52.70	1.60	6,982.3	-222.0	560.6	-163.6	12.72	12.67	
7,181.0	58.70	0.00	7,007.6	-184.8	561.1	-126.6	13.65	13.33	
7,226.0	63.50	358.00	7,029.4	-145.5	560.4	-87.5	11.35	10.67	
7,271.0	66.20	357.80	7,048.5	-104.8	558.9	-47.2	6.01	6.00	
7,316.0	69.10	357.70	7,065.6	-63.2	557.3	-6.0	6.45	6.44	
7,361.0	71.50	358.00	7,080.8	-20.9	555.7	36.0	5.37	5.33	
7,406.0	73.80	358.00	7,094.2	22.1	554.2	78.5	5.11	5.11	
7,451.0	76.80	358.70	7,105.6	65.6	553.0	121.7	6.83	6.67	
7,496.0	80.30	359.90	7,114.5	109.7	552.4	165.5	8.21	7.78	
7,541.0	83.90	359.40	7,120.7	154.2	552.2	209.8	8.08	8.00	
7,581.0	87.70	359.50	7,123.6	194.1	551.8	249.4	9.50	9.50	
7,679.0	90.66	352.21	7,125.0	291.8	544.7	345.8	8.03	3.02	
7,769.0	90.75	351.58	7,123.9	380.9	532.0	433.2	0.71	0.10	
7,859.0	91.10	350.84	7,122.5	469.8	518.3	520.2	0.91	0.39	
7,949.0	92.07	351.08	7,120.0	558.6	504.1	607.2	1.11	1.08	
8,038.0	87.58	353.32	7,120.3	646.8	492.1	693.6	5.64	-5.04	
8,128.0	87.41	354.79	7,124.2	736.2	482.7	781.6	1.64	-0.19	
8,218.0	88.29	0.17	7,127.6	826.0	478.8	870.6	6.05	0.98	
8,308.0	90.04	2.77	7,128.9	916.0	481.1	960.3	3.48	1.94	
8,398.0	91.45	2.94	7,127.7	1,005.9	485.6	1,050.2	1.58	1.57	
8,488.0	90.75	3.80	7,126.0	1,095.7	490.9	1,140.1	1.23	-0.78	
8,576.0	90.40	5.07	7,125.1	1,183.4	497.7	1,228.0	1.50	-0.40	
8,666.0	91.01	3.74	7,124.0	1,273.1	504.6	1,318.0	1.63	0.68	
8,756.0	90.40	359.40	7,122.9	1,363.1	507.0	1,407.7	4.87	-0.68	
8,847.0	92.59	356.50	7,120.5	1,454.0	503.8	1,497.8	3.99	2.41	
8,937.0	95.14	355.92	7,114.4	1,543.6	497.9	1,586.3	2.91	2.83	
9,027.0	93.30	354.57	7,107.8	1,633.0	490.4	1,674.5	2.53	-2.04	
9,117.0	90.04	356.25	7,105.2	1,722.7	483.2	1,763.0	4.07	-3.62	
9,207.0	90.48	355.64	7,104.8	1,812.4	476.9	1,851.6	0.84	0.49	
9,297.0	90.13	356.35	7,104.3	1,902.2	470.6	1,940.3	0.88	-0.39	
9,387.0	89.78	358.91	7,104.4	1,992.1	466.9	2,029.4	2.87	-0.39	
9,477.0	89.60	4.49	7,104.9	2,082.0	469.5	2,119.1	6.20	-0.20	
9,567.0	90.04	4.30	7,105.2	2,171.8	476.4	2,209.1	0.53	0.49	
9,657.0	91.01	3.81	7,104.3	2,261.6	482.8	2,299.0	1.21	1.08	
9,747.0	90.57	3.72	7,103.1	2,351.3	488.7	2,389.0	0.50	-0.49	
9,837.0	90.04	2.18	7,102.6	2,441.2	493.3	2,478.8	1.81	-0.59	
9,927.0	88.90	359.93	7,103.4	2,531.2	495.0	2,568.5	2.80	-1.27	
10,017.0	89.69	358.31	7,104.6	2,621.2	493.6	2,657.9	2.00	0.88	
10,107.0	91.89	357.66	7,103.3	2,711.1	490.4	2,747.0	2.55	2.44	
10,197.0	91.80	356.76	7,100.4	2,801.0	486.1	2,835.9	1.00	-0.10	
10,287.0	89.16	357.99	7,099.7	2,890.8	481.9	2,924.9	3.24	-2.93	
10,377.0	88.55	358.16	7,101.5	2,980.8	478.9	3,014.1	0.70	-0.68	
10,467.0	88.46	357.26	7,103.8	3,070.7	475.3	3,103.2	1.00	-0.10	
10,557.0	87.41	355.57	7,107.0	3,160.4	469.7	3,191.9	2.21	-1.17	
10,647.0	87.05	356.82	7,111.4	3,250.1	463.7	3,280.5	1.44	-0.40	
10,737.0	89.16	356.70	7,114.4	3,339.9	458.6	3,369.3	2.35	2.34	
10,827.0	90.75	356.93	7,114.4	3,429.8	453.6	3,458.2	1.79	1.77	

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Wellbore: HZ	Survey Calculation Method: Minimum Curvature
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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
10,919.0	91.45	355.14	7,112.7	3,521.5	447.3	3,548.8	2.09	0.76	
11,009.0	92.51	357.28	7,109.6	3,611.3	441.3	3,637.5	2.65	1.18	
11,099.0	93.21	358.15	7,105.1	3,701.1	437.8	3,726.5	1.24	0.78	
11,189.0	93.30	359.44	7,100.0	3,790.9	435.9	3,815.6	1.43	0.10	
11,279.0	92.33	358.94	7,095.5	3,880.8	434.6	3,904.9	1.21	-1.08	
11,369.0	92.33	358.17	7,091.9	3,970.7	432.3	3,994.1	0.85	0.00	
11,459.0	88.02	356.25	7,091.6	4,060.6	427.9	4,083.1	5.24	-4.79	
11,526.0	88.46	355.16	7,093.7	4,127.4	422.9	4,149.0	1.75	0.66	Last Cathedral Survey @ 11,526' MD
11,611.0	88.46	355.16	7,096.0	4,212.0	415.8	4,232.5	0.00	0.00	Projection to Bit @ 11,611'

Targets									
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (ft)	Easting (ft)	Latitude	Longitude
VF 28N - VP (2) - hit/miss target - Shape	0.00	0.00	4,270.0	-440.3	563.1	1,307,001.75	3,189,728.07	40.174114	-104.821054
- actual wellpath misses target center by 14.3ft at 4359.7ft MD (4270.3 TVD, -426.8 N, 568.0 E)									
- Point									
VF 28N - VP - hit/miss target - Shape	0.00	0.00	3,812.8	-440.3	409.1	1,307,001.75	3,189,574.07	40.174118	-104.821605
- actual wellpath misses target center by 132.0ft at 3890.9ft MD (3803.5 TVD, -401.2 N, 534.8 E)									
- Point									
Vonderlage Fed 28N-W: - hit/miss target - Shape	0.00	0.00	7,126.0	4,212.6	432.1	1,311,654.65	3,189,597.07	40.186890	-104.821395
- actual wellpath misses target center by 34.2ft at 11611.0ft MD (7096.0 TVD, 4212.0 N, 415.8 E)									
- Point									

Design Annotations					
Measured Depth (ft)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Comment	
784.0	784.0	4.2	4.1	Last Surface Gyro @ 771' MD	
11,526.0	7,093.7	4,127.4	422.9	Last Cathedral Survey @ 11,526' MD	
11,611.0	7,096.0	4,212.0	415.8	Projection to Bit @ 11,611'	

Checked By: _____	Approved By: _____	Date: _____
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