





Cathedral Energy Services

Survey Report

Company:	Anadarko Petroleum Corporation	Local Co-ordinate Reference:	Well Pennington 28N-2HZ
Project:	DJ Wattenberg	TVD Reference:	KB=13' @ 4873.0ft (Ensign #123)
Site:	Pennington Pad (S2-T2N-R67W)	MD Reference:	KB=13' @ 4873.0ft (Ensign #123)
Well:	Pennington 28N-2HZ	North Reference:	Grid
Wellbore:	STK	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		Pennington Pad (S2-T2N-R67W)			
Site Position:		Northing:	1,302,375.69 ft	Latitude:	40.161619
From:	Lat/Long	Easting:	3,179,796.01 ft	Longitude:	-104.856716
Position Uncertainty:	0.0 ft	Slot Radius:	13.200 in	Grid Convergence:	0.42 °

Well	Pennington 28N-2HZ					
Well Position	+N/-S	0.0 ft	Northing:	1,302,375.69 ft	Latitude:	40.161619
	+E/-W	0.0 ft	Easting:	3,179,796.01 ft	Longitude:	-104.856716
Position Uncertainty		0.0 ft	Wellhead Elevation:	ft	Ground Level:	4,860.0 ft

Wellbore	STK				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	11/12/2013	8.57	66.76	52,742

Design	FINAL				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	7,711.0
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W	Direction	
	(ft)	(ft)	(ft)	(°)	
	0.0	0.0	0.0	352.21	

Survey Program	Date	11/20/2013			
From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description	
113.0	943.0	Survey #1 (HZ)	Gyro	Gyro	
1,077.0	7,711.0	Survey #2 (HZ)	MWD	Geolink MWD	
7,854.0	11,763.0	Survey #1 (STK)	MWD	Geolink MWD	

Survey									
Measured	Inclination	Azimuth	Vertical	+N/-S	+E/-W	Vertical	Dogleg	Build	Formations /
Depth (ft)	(°)	(°)	Depth (ft)	(ft)	(ft)	Section (ft)	Rate (°/100ft)	Rate (°/100ft)	Comments
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	
113.0	0.24	137.37	113.0	-0.2	0.2	-0.2	0.21	0.21	
213.0	0.19	13.95	213.0	-0.2	0.3	-0.2	0.38	-0.05	
313.0	0.44	358.58	313.0	0.4	0.4	0.3	0.26	0.25	
413.0	0.48	0.54	413.0	1.2	0.4	1.1	0.04	0.04	
513.0	0.28	319.98	513.0	1.8	0.2	1.7	0.32	-0.20	
613.0	0.27	250.55	613.0	1.9	-0.2	1.9	0.31	-0.01	
713.0	0.14	134.01	713.0	1.7	-0.3	1.8	0.36	-0.13	
813.0	0.31	54.99	813.0	1.8	0.0	1.8	0.31	0.17	
913.0	0.23	209.49	913.0	1.8	0.1	1.7	0.53	-0.08	
943.0	0.30	198.45	943.0	1.7	0.1	1.6	0.29	0.23	

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Wellbore:	STK	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
1,077.0	0.30	201.70	1,077.0	1.0	-0.2	1.0	0.01	0.00	
1,171.0	2.70	184.60	1,170.9	-1.4	-0.4	-1.4	2.57	2.55	
1,264.0	3.70	174.40	1,263.8	-6.6	-0.3	-6.5	1.23	1.08	
1,358.0	6.60	186.90	1,357.4	-15.0	-0.7	-14.8	3.29	3.09	
1,451.0	8.10	186.20	1,449.7	-26.8	-2.0	-26.3	1.62	1.61	
1,545.0	9.10	183.30	1,542.6	-40.8	-3.2	-40.0	1.16	1.06	
1,638.0	10.10	178.50	1,634.3	-56.3	-3.4	-55.3	1.38	1.08	
1,732.0	11.00	174.90	1,726.7	-73.5	-2.4	-72.5	1.19	0.96	
1,825.0	12.00	177.30	1,817.8	-92.0	-1.1	-91.0	1.19	1.08	
1,915.0	12.90	176.80	1,905.7	-111.4	-0.1	-110.3	1.01	1.00	
2,005.0	14.30	182.50	1,993.2	-132.5	0.0	-131.3	2.15	1.56	
2,095.0	15.60	182.80	2,080.1	-155.7	-1.1	-154.1	1.45	1.44	
2,185.0	17.90	181.90	2,166.3	-181.6	-2.2	-179.6	2.57	2.56	
2,275.0	16.30	179.90	2,252.3	-208.1	-2.6	-205.8	1.89	-1.78	
2,365.0	15.10	185.50	2,339.0	-232.4	-3.7	-229.7	2.15	-1.33	
2,455.0	14.40	189.30	2,426.0	-255.1	-6.6	-251.8	1.33	-0.78	
2,546.0	15.40	184.90	2,514.0	-278.3	-9.5	-274.4	1.66	1.10	
2,636.0	15.60	186.10	2,600.7	-302.2	-11.8	-297.8	0.42	0.22	
2,726.0	14.70	185.90	2,687.6	-325.6	-14.3	-320.7	1.00	-1.00	
2,816.0	16.60	186.10	2,774.2	-349.8	-16.8	-344.3	2.11	2.11	
2,906.0	15.50	184.80	2,860.7	-374.5	-19.2	-368.5	1.29	-1.22	
2,996.0	14.00	183.70	2,947.7	-397.4	-20.9	-390.9	1.70	-1.67	
3,086.0	13.90	185.50	3,035.1	-419.0	-22.6	-412.1	0.49	-0.11	
3,176.0	12.80	184.70	3,122.7	-439.7	-24.5	-432.3	1.24	-1.22	
3,266.0	13.50	183.40	3,210.3	-460.1	-25.9	-452.4	0.84	0.78	
3,356.0	12.40	187.30	3,298.0	-480.2	-27.8	-472.0	1.56	-1.22	
3,446.0	10.40	184.60	3,386.2	-497.9	-29.6	-489.3	2.30	-2.22	
3,536.0	10.70	190.90	3,474.7	-514.2	-31.9	-505.1	1.32	0.33	
3,626.0	8.20	188.20	3,563.5	-528.7	-34.4	-519.2	2.82	-2.78	
3,716.0	9.20	195.10	3,652.4	-542.0	-37.2	-532.0	1.60	1.11	
3,806.0	9.30	192.60	3,741.3	-556.1	-40.6	-545.4	0.46	0.11	
3,896.0	7.60	186.30	3,830.3	-569.1	-42.9	-558.0	2.15	-1.89	
3,986.0	6.90	185.60	3,919.6	-580.4	-44.0	-569.1	0.78	-0.78	
4,076.0	6.20	184.90	4,009.0	-590.6	-45.0	-579.1	0.78	-0.78	
4,166.0	5.80	182.70	4,098.5	-600.0	-45.6	-588.3	0.51	-0.44	
4,256.0	4.70	177.10	4,188.1	-608.2	-45.6	-596.4	1.35	-1.22	
4,437.0	3.00	169.60	4,368.7	-620.3	-44.4	-608.5	0.98	-0.94	
4,617.0	1.70	162.60	4,548.6	-627.5	-42.8	-615.9	0.74	-0.72	
4,797.0	1.10	161.00	4,728.5	-631.6	-41.4	-620.2	0.33	-0.33	
4,977.0	1.30	182.90	4,908.5	-635.3	-40.9	-623.9	0.28	0.11	
5,157.0	1.10	191.40	5,088.4	-639.0	-41.4	-627.6	0.15	-0.11	
5,337.0	1.10	175.00	5,268.4	-642.5	-41.6	-630.9	0.17	0.00	
5,517.0	0.60	298.00	5,448.4	-643.7	-42.3	-632.1	0.84	-0.28	
5,697.0	0.70	7.60	5,628.4	-642.2	-42.9	-630.5	0.41	0.06	
5,877.0	0.50	322.20	5,808.4	-640.5	-43.3	-628.7	0.28	-0.11	
6,057.0	0.70	333.50	5,988.3	-638.9	-44.3	-627.0	0.13	0.11	
6,238.0	0.10	259.50	6,169.3	-637.9	-44.9	-626.0	0.38	-0.33	
6,418.0	0.40	225.10	6,349.3	-638.4	-45.5	-626.4	0.18	0.17	
6,598.0	0.40	232.60	6,529.3	-639.2	-46.4	-627.0	0.03	0.00	
6,643.0	0.50	298.80	6,574.3	-639.2	-46.7	-627.0	1.11	0.22	
6,688.0	4.50	4.00	6,619.3	-637.4	-46.8	-625.2	9.59	8.89	
6,733.0	8.30	3.00	6,664.0	-632.4	-46.5	-620.2	8.45	8.44	
6,778.0	13.40	3.20	6,708.2	-623.9	-46.0	-611.9	11.33	11.33	

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Wellbore:	STK	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
6,823.0	17.10	7.40	6,751.6	-612.1	-44.9	-600.4	8.58	8.22	
6,868.0	20.20	8.70	6,794.2	-597.9	-42.9	-586.6	6.95	6.89	
6,913.0	23.80	0.10	6,835.9	-581.1	-41.7	-570.1	10.72	8.00	
6,958.0	28.00	353.40	6,876.4	-561.5	-42.9	-550.6	11.36	9.33	
7,003.0	33.30	358.50	6,915.1	-538.7	-44.4	-527.7	13.11	11.78	
7,048.0	37.30	0.30	6,951.9	-512.7	-44.7	-501.9	9.18	8.89	
7,093.0	42.50	359.40	6,986.4	-483.8	-44.8	-473.3	11.63	11.56	
7,138.0	48.00	359.00	7,018.0	-451.9	-45.2	-441.6	12.24	12.22	
7,183.0	54.60	359.10	7,046.2	-416.8	-45.8	-406.8	14.67	14.67	
7,228.0	61.00	359.40	7,070.1	-378.7	-46.3	-369.0	14.23	14.22	
7,273.0	64.90	359.50	7,090.6	-338.7	-46.7	-329.2	8.67	8.67	
7,318.0	66.90	358.90	7,109.0	-297.6	-47.2	-288.5	4.61	4.44	
7,363.0	69.70	358.60	7,125.6	-255.8	-48.2	-246.9	6.25	6.22	
7,409.0	71.60	358.90	7,140.8	-212.4	-49.1	-203.8	4.18	4.13	
7,454.0	73.80	359.90	7,154.2	-169.5	-49.5	-161.2	5.33	4.89	
7,499.0	76.60	1.50	7,165.7	-126.0	-49.0	-118.2	7.11	6.22	
7,544.0	80.10	2.10	7,174.8	-81.9	-47.6	-74.7	7.89	7.78	
7,589.0	84.80	2.80	7,180.7	-37.4	-45.7	-30.8	10.56	10.44	
7,605.0	87.50	2.90	7,181.8	-21.4	-44.9	-15.1	16.89	16.87	
7,711.0	90.60	3.60	7,183.5	84.4	-38.9	88.9	3.00	2.92	
7,854.0	87.60	2.70	7,185.8	227.1	-31.1	229.2	2.19	-2.10	
7,944.0	87.50	1.40	7,189.6	317.0	-27.8	317.8	1.45	-0.11	
7,980.0	89.00	0.00	7,190.7	353.0	-27.4	353.4	5.69	4.17	
8,069.0	88.90	359.60	7,192.4	442.0	-27.7	441.6	0.47	-0.11	
8,159.0	89.50	358.40	7,193.6	531.9	-29.3	531.0	1.49	0.67	
8,249.0	89.80	358.20	7,194.2	621.9	-31.9	620.5	0.40	0.33	
8,339.0	91.30	358.00	7,193.3	711.8	-34.9	710.0	1.68	1.67	
8,429.0	90.40	357.10	7,192.0	801.7	-38.8	799.6	1.41	-1.00	
8,519.0	92.80	357.90	7,189.5	891.6	-42.7	889.2	2.81	2.67	
8,609.0	93.10	357.20	7,184.8	981.4	-46.5	978.7	0.85	0.33	
8,699.0	92.70	357.20	7,180.3	1,071.2	-50.9	1,068.2	0.44	-0.44	
8,790.0	92.10	357.70	7,176.5	1,162.0	-55.0	1,158.8	0.86	-0.66	
8,880.0	92.90	357.30	7,172.5	1,251.8	-58.9	1,248.3	0.99	0.89	
8,970.0	91.60	357.40	7,169.0	1,341.7	-63.1	1,337.9	1.45	-1.44	
9,060.0	90.20	357.60	7,167.6	1,431.6	-67.0	1,427.5	1.57	-1.56	
9,150.0	88.50	359.70	7,168.6	1,521.5	-69.1	1,516.9	3.00	-1.89	
9,240.0	89.30	359.80	7,170.3	1,611.5	-69.5	1,606.1	0.90	0.89	
9,330.0	89.30	1.10	7,171.4	1,701.5	-68.8	1,695.1	1.44	0.00	
9,420.0	88.70	0.50	7,173.0	1,791.5	-67.5	1,784.1	0.94	-0.67	
9,510.0	88.60	0.50	7,175.1	1,881.5	-66.7	1,873.2	0.11	-0.11	
9,600.0	88.60	0.40	7,177.3	1,971.4	-66.0	1,962.2	0.11	0.00	
9,690.0	89.00	2.30	7,179.2	2,061.4	-63.9	2,051.0	2.16	0.44	
9,780.0	91.50	3.60	7,178.8	2,151.2	-59.3	2,139.4	3.13	2.78	
9,870.0	91.30	2.90	7,176.6	2,241.1	-54.2	2,227.8	0.81	-0.22	
9,961.0	90.20	2.30	7,175.4	2,332.0	-50.1	2,317.3	1.38	-1.21	
10,051.0	89.50	2.20	7,175.7	2,421.9	-46.5	2,405.9	0.79	-0.78	
10,141.0	90.50	2.90	7,175.7	2,511.8	-42.5	2,494.4	1.36	1.11	
10,231.0	91.60	3.40	7,174.0	2,601.7	-37.6	2,582.8	1.34	1.22	
10,321.0	91.30	2.50	7,171.7	2,691.5	-33.0	2,671.2	1.05	-0.33	
10,411.0	91.30	3.40	7,169.7	2,781.4	-28.3	2,759.6	1.00	0.00	
10,501.0	92.20	3.90	7,166.9	2,871.1	-22.6	2,847.7	1.14	1.00	
10,591.0	92.50	2.90	7,163.3	2,960.9	-17.3	2,935.9	1.16	0.33	
10,681.0	90.60	2.10	7,160.8	3,050.8	-13.3	3,024.5	2.29	-2.11	

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Wellbore:	STK	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
10,771.0	89.10	1.60	7,161.1	3,140.7	-10.4	3,113.2	1.76	-1.67	
10,861.0	88.80	359.70	7,162.7	3,230.7	-9.4	3,202.2	2.14	-0.33	
10,951.0	89.10	357.50	7,164.4	3,320.7	-11.6	3,291.6	2.47	0.33	
11,041.0	89.10	357.70	7,165.8	3,410.6	-15.4	3,381.2	0.22	0.00	
11,131.0	87.80	355.70	7,168.2	3,500.4	-20.6	3,470.9	2.65	-1.44	
11,221.0	86.90	355.40	7,172.4	3,590.0	-27.5	3,560.6	1.05	-1.00	
11,311.0	86.90	355.50	7,177.2	3,679.6	-34.7	3,650.4	0.11	0.00	
11,401.0	86.90	355.50	7,182.1	3,769.2	-41.7	3,740.1	0.00	0.00	
11,492.0	88.70	356.40	7,185.6	3,859.9	-48.1	3,830.8	2.21	1.98	
11,582.0	89.30	357.20	7,187.2	3,949.7	-53.2	3,920.5	1.11	0.67	
11,672.0	91.40	356.10	7,186.6	4,039.6	-58.4	4,010.2	2.63	2.33	
11,705.0	92.00	356.50	7,185.6	4,072.5	-60.5	4,043.1	2.18	1.82	Last Cathedral Survey @ 11,705' MD Projection to Bit @ 11,763'
11,763.0	92.00	356.50	7,183.6	4,130.3	-64.1	4,101.0	0.00	0.00	

Targets									
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (ft)	Easting (ft)	Latitude	Longitude
- hit/miss target									
- Shape									
Pennington 28N-2HZ PE	0.00	0.00	7,178.0	4,131.4	-60.0	1,306,507.09	3,179,736.01	40.172961	-104.856823
- actual wellpath misses target center by 7.0ft at 11763.0ft MD (7183.6 TVD, 4130.3 N, -64.1 E)									
- Point									

7,645.2	7,183.1	7"
7,645.2	7,183.1	7"
7,645.2	7,183.1	7"
7,645.2	7,183.1	7"

Design Annotations				
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment
		+N/-S (ft)	+E/-W (ft)	
11,705.0	7,185.6	4,072.5	-60.5	Last Cathedral Survey @ 11,705' MD
11,763.0	7,183.6	4,130.3	-64.1	Projection to Bit @ 11,763'

Checked By: _____ Approved By: _____ Date: _____