



Company: Chesapeake  
 Lease/Well: State of WV DNR A BRK/3H

Rig Name: Nomac 37  
 State/County: West Virginia/Brooke  
 Latitude: 40.32, Longitude: -80.54  
 GRID North is 0.66 Degrees West of True North  
 VS-Azi: 0.00 Degrees



**FIELD COPY ONLY (NOT DEFINITIVE)**

Depth Reference : RKB = 18'

**DRILLOG HA GYRO SURVEY CALCULATIONS**

Filename: stateofwvnrabr3h\_ed.ut  
 Minimum Curvature Method  
 Report Date/Time: 10/24/2012 / 08:29

Vaughn Energy Services  
 Morgantown, West Virginia  
 304-777-2189  
 Leon Laskowski

Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	****
100.00	0.12	293.93	100.00	0.04	-0.10	0.04	0.10	293.93	0.12
200.00	0.19	294.60	200.00	0.15	-0.34	0.15	0.37	294.22	0.07
300.00	0.05	294.00	300.00	0.24	-0.52	0.24	0.57	294.31	0.14
400.00	0.14	292.66	400.00	0.30	-0.67	0.30	0.74	294.02	0.09
500.00	0.14	290.74	500.00	0.39	-0.90	0.39	0.98	293.45	0.01
600.00	0.11	293.63	600.00	0.47	-1.09	0.47	1.19	293.19	0.03
700.00	0.31	289.74	700.00	0.60	-1.43	0.60	1.55	292.61	0.21
800.00	0.41	206.60	800.00	0.37	-1.85	0.37	1.88	281.37	0.48
900.00	1.48	229.59	899.98	-0.78	-2.99	-0.78	3.09	255.34	1.11
1000.00	3.51	247.36	999.88	-2.80	-6.80	-2.80	7.35	247.63	2.15
1100.00	4.91	250.94	1099.61	-5.37	-13.67	-5.37	14.68	248.54	1.42
1200.00	6.75	241.42	1199.09	-9.58	-22.87	-9.58	24.79	247.27	2.07
1300.00	7.84	244.81	1298.28	-15.29	-34.20	-15.29	37.46	245.91	1.18
1400.00	7.72	242.87	1397.36	-21.26	-46.35	-21.26	50.99	245.36	0.29
1500.00	5.33	231.24	1496.71	-27.23	-55.95	-27.23	62.23	244.05	2.72
1600.00	4.20	237.47	1596.36	-32.11	-62.67	-32.11	70.41	242.87	1.25
1700.00	3.09	239.82	1696.16	-35.44	-68.08	-35.44	76.75	242.50	1.12
1800.00	2.06	246.89	1796.06	-37.49	-72.06	-37.49	81.23	242.51	1.08
1900.00	1.35	245.25	1896.01	-38.69	-74.78	-38.69	84.20	242.64	0.71
2000.00	0.89	244.82	1995.99	-39.51	-76.55	-39.51	86.15	242.70	0.46
2100.00	0.74	249.94	2095.98	-40.07	-77.86	-40.07	87.57	242.77	0.17
2200.00	0.68	263.68	2195.98	-40.36	-79.06	-40.36	88.77	242.96	0.18
2300.00	0.60	281.76	2295.97	-40.31	-80.17	-40.31	89.73	243.30	0.22
2400.00	0.54	289.08	2395.96	-40.05	-81.12	-40.05	90.47	243.72	0.10
2500.00	0.56	313.66	2495.96	-39.56	-81.92	-39.56	90.97	244.22	0.23
2600.00	0.44	322.24	2595.96	-38.93	-82.51	-38.93	91.23	244.74	0.14
2700.00	0.50	332.42	2695.95	-38.24	-82.94	-38.24	91.33	245.25	0.10
2800.00	0.52	344.36	2795.95	-37.42	-83.26	-37.42	91.29	245.80	0.11
2900.00	0.56	344.38	2895.94	-36.51	-83.52	-36.51	91.15	246.39	0.04

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Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
3000.00	0.63	349.92	2995.94	-35.49	-83.75	-35.49	90.96	247.03	0.09
3100.00	0.58	359.11	3095.93	-34.44	-83.85	-34.44	90.65	247.67	0.11
3200.00	0.57	10.62	3195.93	-33.45	-83.77	-33.45	90.20	248.23	0.12
3300.00	0.52	20.26	3295.92	-32.53	-83.52	-32.53	89.63	248.72	0.10
3400.00	0.51	15.93	3395.92	-31.68	-83.24	-31.68	89.06	249.16	0.04
3500.00	0.50	10.84	3495.92	-30.83	-83.04	-30.83	88.57	249.63	0.05
3600.00	0.49	8.60	3595.91	-29.98	-82.89	-29.98	88.14	250.12	0.02
3700.00	0.35	6.86	3695.91	-29.25	-82.79	-29.25	87.81	250.54	0.14
3800.00	0.49	9.38	3795.91	-28.53	-82.68	-28.53	87.47	250.97	0.15
3900.00	0.53	9.68	3895.90	-27.64	-82.54	-27.64	87.04	251.48	0.04
4000.00	0.49	14.12	3995.90	-26.77	-82.35	-26.77	86.60	251.99	0.06
4100.00	0.42	21.86	4095.90	-26.02	-82.11	-26.02	86.14	252.42	0.09
4200.00	0.33	23.28	4195.89	-25.41	-81.86	-25.41	85.71	252.76	0.09
4300.00	0.39	16.18	4295.89	-24.81	-81.65	-24.81	85.34	253.10	0.07
4400.00	0.49	357.09	4395.89	-24.05	-81.58	-24.05	85.05	253.57	0.17
4500.00	0.45	353.95	4495.89	-23.24	-81.64	-23.24	84.88	254.11	0.05
4600.00	0.51	354.08	4595.88	-22.40	-81.73	-22.40	84.74	254.67	0.07
4700.00	0.51	355.39	4695.88	-21.51	-81.81	-21.51	84.59	255.27	0.01
4800.00	0.42	353.03	4795.87	-20.69	-81.89	-20.69	84.46	255.82	0.09
4900.00	0.23	350.04	4895.87	-20.12	-81.97	-20.12	84.41	256.21	0.19
4975.00	0.15	351.23	4970.87	-19.88	-82.01	-19.88	84.39	256.38	0.11

HORIZONTAL DISPLACEMENT IS  
84.39 FEET AT 256.38 DEGREES

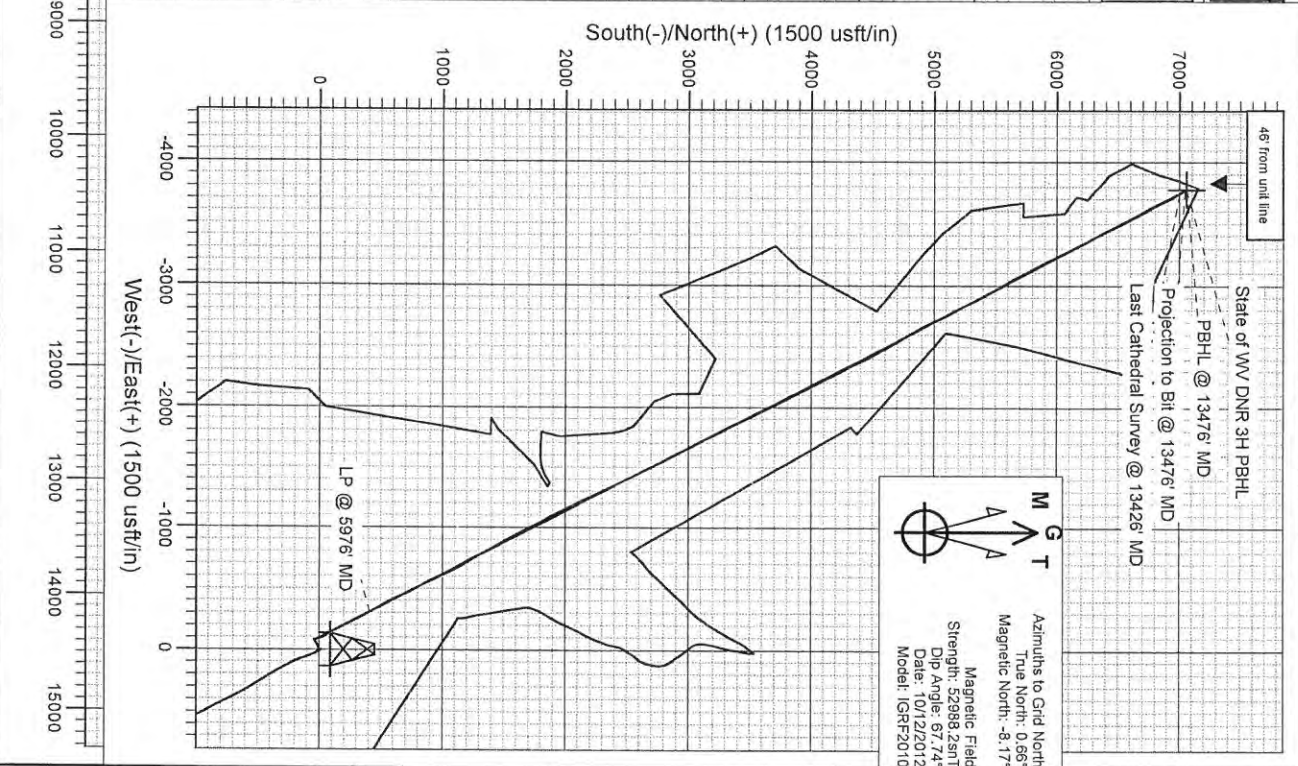
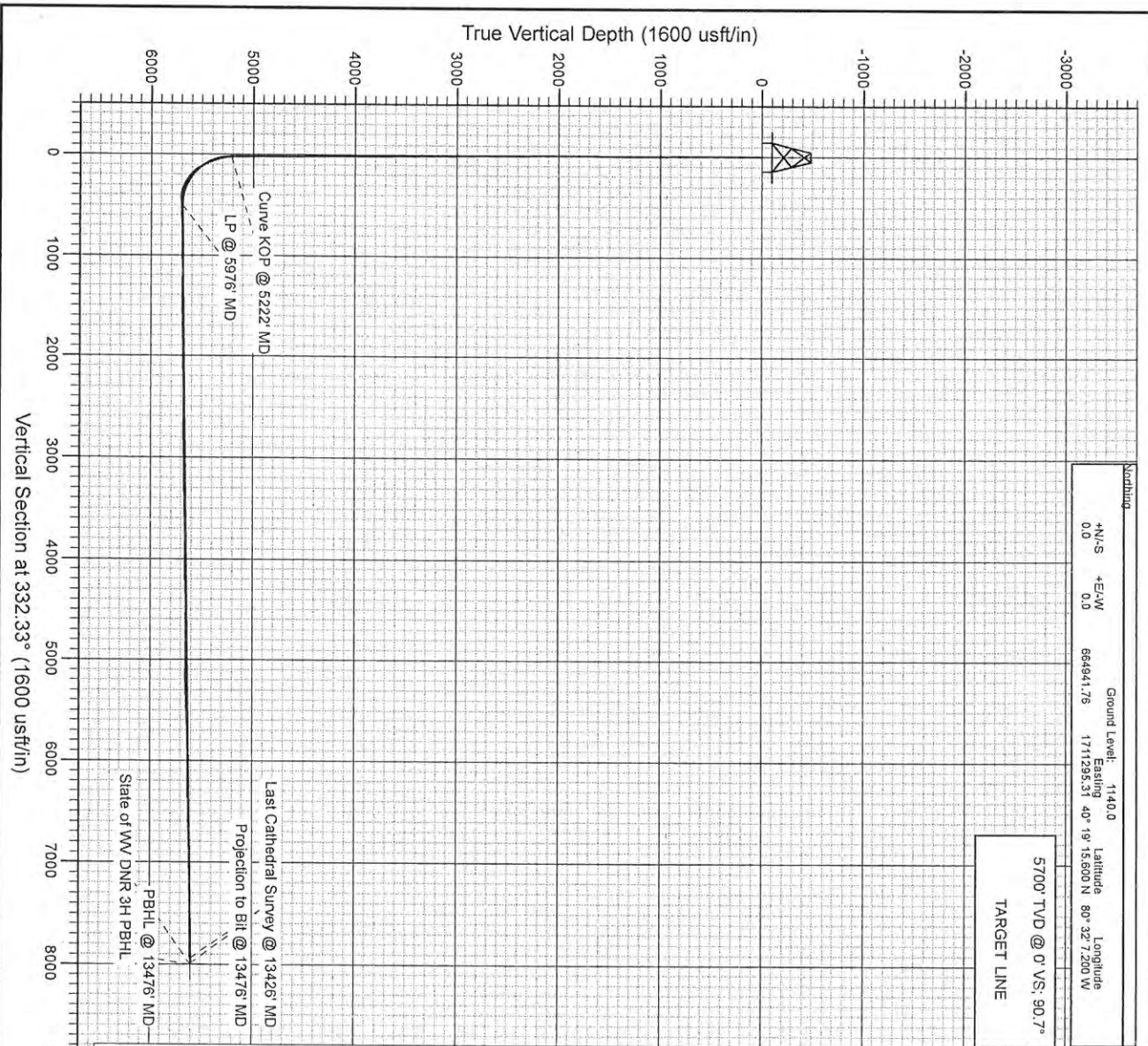
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Project: Brooke County, WV  
 Site: State of WV DNR  
 Well: State of WV DNR A BRK 3H  
 Wellbore: HZ  
 Design: HZ



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WV GEOLOGICAL SURVEY  
 MORGANTOWN, WV

# Cathedral Energy Services

## Survey Report

<b>Company:</b> Chesapeake Energy Corp	<b>Local Co-ordinate Reference:</b> Well State of WV DNR A BRK 3H
<b>Project:</b> Brooke County, WV	<b>TVD Reference:</b> WELL @ 1158.0usft (Original Well Elev)
<b>Site:</b> State of WV DNR	<b>MD Reference:</b> WELL @ 1158.0usft (Original Well Elev)
<b>Well:</b> State of WV DNR A BRK 3H	<b>North Reference:</b> Grid
<b>Wellbore:</b> HZ	<b>Survey Calculation Method:</b> Minimum Curvature
<b>Design:</b> HZ	<b>Database:</b> USA EDM 5000 Multi Users DB

<b>Project</b> Brooke County, WV		
<b>Map System:</b> US State Plane 1927 (Exact solution)	<b>System Datum:</b>	Mean Sea Level
<b>Geo Datum:</b> NAD 1927 (NADCON CONUS)		
<b>Map Zone:</b> West Virginia North 4701		Using geodetic scale factor

<b>Site</b> State of WV DNR		
<b>Site Position:</b>	<b>Northing:</b> 664,929.27 usft	<b>Latitude:</b> 40° 19' 15.478 N
<b>From:</b> Lat/Long	<b>Easting:</b> 1,711,305.58 usft	<b>Longitude:</b> 80° 32' 7.066 W
<b>Position Uncertainty:</b> 0.0 usft	<b>Slot Radius:</b> 13-3/16"	<b>Grid Convergence:</b> -0.66 °

<b>Well</b> State of WV DNR A BRK 3H			
<b>Well Position</b>	<b>+N/-S</b> 0.0 usft	<b>Northing:</b> 664,941.76 usft	<b>Latitude:</b> 40° 19' 15.600 N
	<b>+E/-W</b> 0.0 usft	<b>Easting:</b> 1,711,295.31 usft	<b>Longitude:</b> 80° 32' 7.200 W
<b>Position Uncertainty</b>	0.0 usft	<b>Wellhead Elevation:</b> usft	<b>Ground Level:</b> 1,140.0 usft

<b>Wellbore</b> HZ					
<b>Magnetics</b>	<b>Model Name</b>	<b>Sample Date</b>	<b>Declination (°)</b>	<b>Dip Angle (°)</b>	<b>Field Strength (nT)</b>
	IGRF2010	10/12/2012	-8.83	67.74	52,988

<b>Design</b> HZ				
<b>Audit Notes:</b>				
<b>Version:</b> 1.0	<b>Phase:</b> ACTUAL	<b>Tie On Depth:</b> 0.0		
<b>Vertical Section:</b>	<b>Depth From (TVD) (usft)</b>	<b>+N/-S (usft)</b>	<b>+E/-W (usft)</b>	<b>Direction (°)</b>
	0.0	0.0	0.0	332.33

<b>Survey Program</b> Date 10/31/2012				
<b>From (usft)</b>	<b>To (usft)</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>
100.0	4,975.0	Gyro 2 (HZ)	MWD	Geolink MWD
4,975.0	13,476.0	Survey #1 (HZ)	MWD	Geolink MWD

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100u)	Formations / Comments
4,975.0	0.15	351.23	4,970.9	-19.9	-82.1	20.5	0.00	0.00	
5,091.0	0.20	238.30	5,086.9	-19.9	-82.2	20.6	0.25	0.04	
5,122.0	0.20	47.70	5,117.9	-19.9	-82.3	20.6	1.28	0.00	
5,154.0	1.40	347.80	5,149.9	-19.4	-82.3	21.0	4.10	3.75	
5,186.0	3.30	333.50	5,181.8	-18.2	-82.8	22.3	6.17	5.94	
5,217.0	4.70	338.90	5,212.8	-16.3	-83.6	24.5	4.67	4.52	
5,248.0	6.60	340.40	5,243.6	-13.4	-84.7	27.5	6.15	6.13	
5,279.0	9.70	342.50	5,274.3	-9.2	-86.1	31.8	10.04	10.00	
5,311.0	12.60	342.50	5,305.7	-3.3	-87.9	37.9	9.06	9.06	
5,342.0	15.40	341.00	5,335.8	3.8	-90.3	45.3	9.11	9.03	
5,374.0	16.50	339.40	5,366.5	12.1	-93.3	54.0	3.70	3.44	
5,406.0	20.00	333.10	5,396.9	21.2	-97.4	64.0	12.54	10.94	

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WV GEOLOGICAL SURVEY  
MORGANTOWN, WV

# Cathedral Energy Services

## Survey Report

<b>Company:</b>	Chesapeake Energy Corp	<b>Local Co-ordinate Reference:</b>	Well State of WV DNR A BRK 3H
<b>Project:</b>	Brooke County, WV	<b>TVD Reference:</b>	WELL @ 1158.0usft (Original Well Elev)
<b>Site:</b>	State of WV DNR	<b>MD Reference:</b>	WELL @ 1158.0usft (Original Well Elev)
<b>Well:</b>	State of WV DNR A BRK 3H	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	HZ	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	HZ	<b>Database:</b>	USA EDM 5000 Multi Users DB

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100u)	Formations / Comments
5,438.0	22.50	332.90	5,426.7	31.5	-102.6	75.6	7.82	7.82	
5,469.0	24.70	331.20	5,455.1	42.5	-108.4	88.0	7.43	7.10	
5,501.0	28.50	330.20	5,483.7	55.0	-115.5	102.3	11.96	11.88	
5,533.0	32.40	330.90	5,511.3	69.1	-123.4	118.5	12.24	12.19	
5,564.0	34.80	331.40	5,537.1	84.1	-131.7	135.7	7.79	7.74	
5,596.0	39.80	332.10	5,562.6	101.2	-140.9	155.1	15.68	15.63	
5,628.0	44.60	332.20	5,586.3	120.2	-150.9	176.5	15.00	15.00	
5,659.0	47.60	332.50	5,607.8	140.0	-161.3	198.9	9.70	9.68	
5,691.0	51.10	330.50	5,628.6	161.3	-172.9	223.2	11.92	10.94	
5,722.0	56.30	331.90	5,647.0	183.2	-184.9	248.1	17.16	16.77	
5,754.0	62.00	332.30	5,663.4	207.5	-197.7	275.6	17.84	17.81	
5,785.0	66.50	333.60	5,676.8	232.4	-210.4	303.5	15.00	14.52	
5,817.0	72.20	333.70	5,688.1	259.2	-223.7	333.4	17.81	17.81	
5,848.0	75.50	334.20	5,696.8	285.9	-236.8	363.2	10.76	10.65	
5,880.0	82.20	333.10	5,702.9	314.0	-250.7	394.6	21.21	20.94	
5,911.0	88.60	332.10	5,705.4	341.5	-264.9	425.4	20.89	20.65	
5,943.0	90.70	331.40	5,705.6	369.6	-280.1	457.4	6.92	6.56	
6,067.0	94.30	330.50	5,700.2	477.9	-340.2	581.3	2.99	2.90	
6,193.0	93.40	331.90	5,691.7	588.1	-400.8	706.9	1.32	-0.71	
6,319.0	90.00	332.50	5,688.0	699.5	-459.5	832.9	2.74	-2.70	
6,443.0	90.70	334.30	5,687.3	810.3	-515.0	956.8	1.56	0.56	
6,569.0	90.00	334.20	5,686.5	923.8	-569.8	1,082.8	0.56	-0.56	
6,696.0	89.20	334.30	5,687.4	1,038.2	-624.9	1,209.7	0.63	-0.63	
6,822.0	88.50	332.90	5,689.9	1,151.0	-681.0	1,335.6	1.24	-0.56	
6,948.0	91.70	327.50	5,689.7	1,260.3	-743.5	1,461.5	4.98	2.54	
7,073.0	90.50	329.70	5,687.3	1,367.0	-808.6	1,586.2	2.00	-0.96	
7,196.0	89.70	330.40	5,687.1	1,473.6	-870.1	1,709.1	0.86	-0.65	
7,322.0	90.70	331.40	5,686.6	1,583.7	-931.3	1,835.0	1.12	0.79	
7,448.0	90.20	332.40	5,685.6	1,694.8	-990.7	1,961.0	0.89	-0.40	
7,573.0	90.90	331.50	5,684.4	1,805.1	-1,049.5	2,086.0	0.91	0.56	
7,697.0	91.90	333.00	5,681.4	1,914.8	-1,107.2	2,210.0	1.45	0.81	
7,822.0	91.70	332.20	5,677.5	2,025.7	-1,164.7	2,334.9	0.66	-0.16	
7,945.0	89.60	333.90	5,676.1	2,135.4	-1,220.4	2,457.9	2.20	-1.71	
8,070.0	88.70	334.40	5,677.9	2,247.8	-1,274.9	2,582.8	0.82	-0.72	
8,196.0	90.20	335.30	5,679.1	2,361.9	-1,328.4	2,708.7	1.39	1.19	
8,322.0	91.20	332.30	5,677.6	2,474.9	-1,384.1	2,834.6	2.51	0.79	
8,448.0	92.20	333.10	5,673.9	2,586.8	-1,441.8	2,960.5	1.02	0.79	
8,575.0	90.70	332.70	5,670.7	2,699.9	-1,499.7	3,087.5	1.22	-1.18	
8,703.0	89.20	332.80	5,670.8	2,813.6	-1,558.3	3,215.5	1.17	-1.17	
8,828.0	90.50	332.10	5,671.1	2,924.4	-1,616.1	3,340.5	1.18	1.04	
8,952.0	91.90	332.50	5,668.5	3,034.2	-1,673.7	3,464.4	1.17	1.13	
9,078.0	92.00	332.80	5,664.2	3,146.1	-1,731.5	3,590.4	0.25	0.08	
9,204.0	92.20	332.90	5,659.6	3,258.1	-1,789.0	3,716.3	0.18	0.16	
9,328.0	88.50	333.60	5,658.8	3,368.8	-1,844.8	3,840.2	3.04	-2.98	
9,453.0	89.70	332.90	5,660.8	3,480.4	-1,901.1	3,965.2	1.11	0.96	
9,580.0	90.80	333.00	5,660.2	3,593.5	-1,958.8	4,092.2	0.87	0.87	
9,706.0	90.70	332.50	5,658.6	3,705.5	-2,016.5	4,218.2	0.40	-0.08	
9,831.0	91.50	332.90	5,656.2	3,816.6	-2,073.8	4,343.1	0.72	0.64	
9,955.0	90.00	332.00	5,654.6	3,926.5	-2,131.2	4,467.1	1.41	-1.21	
10,082.0	91.00	331.80	5,653.5	4,038.5	-2,191.0	4,594.1	0.80	0.79	
10,209.0	90.20	332.50	5,652.1	4,150.8	-2,250.3	4,721.1	0.84	-0.63	
10,335.0	90.50	334.40	5,651.4	4,263.5	-2,306.6	4,847.1	1.53	0.24	
10,462.0	88.80	332.80	5,652.1	4,377.3	-2,363.1	4,974.0	1.84	-1.34	

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# Cathedral Energy Services

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<b>Well:</b>	State of WV DNR A BRK 3H	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	HZ	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	HZ	<b>Database:</b>	USA EDM 5000 Multi Users DB

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100u)	Formations / Comments
10,589.0	89.30	332.20	5,654.2	4,489.9	-2,421.7	5,101.0	0.61	0.39	
10,716.0	90.10	330.30	5,654.9	4,601.2	-2,482.8	5,228.0	1.62	0.63	
10,844.0	92.30	329.00	5,652.2	4,711.7	-2,547.5	5,355.8	2.00	1.72	
10,971.0	93.00	329.00	5,646.4	4,820.4	-2,612.8	5,482.5	0.55	0.55	
11,096.0	92.20	333.50	5,640.7	4,929.9	-2,672.8	5,607.3	3.65	-0.64	
11,223.0	92.60	332.90	5,635.4	5,043.1	-2,730.1	5,734.1	0.57	0.31	
11,350.0	90.00	334.30	5,632.5	5,156.8	-2,786.5	5,861.1	2.32	-2.05	
11,478.0	89.50	333.50	5,633.0	5,271.8	-2,842.8	5,989.0	0.74	-0.39	
11,604.0	91.90	332.10	5,631.5	5,383.8	-2,900.4	6,115.0	2.21	1.90	
11,730.0	90.10	330.00	5,629.3	5,494.0	-2,961.4	6,240.9	2.19	-1.43	
11,857.0	91.00	330.10	5,628.1	5,604.1	-3,024.8	6,367.8	0.71	0.71	
11,983.0	90.00	332.70	5,627.0	5,714.7	-3,085.1	6,493.8	2.21	-0.79	
12,107.0	90.80	333.10	5,626.1	5,825.1	-3,141.6	6,617.8	0.72	0.65	
12,233.0	93.70	332.80	5,621.2	5,937.2	-3,198.8	6,743.7	2.31	2.30	
12,358.0	92.00	332.90	5,615.0	6,048.3	-3,255.8	6,868.5	1.36	-1.36	
12,483.0	90.20	334.80	5,612.6	6,160.4	-3,310.9	6,993.4	2.09	-1.44	
12,609.0	90.60	333.70	5,611.7	6,273.9	-3,365.6	7,119.3	0.93	0.32	
12,734.0	90.80	332.80	5,610.2	6,385.5	-3,421.8	7,244.3	0.74	0.16	
12,859.0	90.40	332.40	5,608.8	6,496.5	-3,479.4	7,369.3	0.45	-0.32	
12,984.0	92.50	333.20	5,605.7	6,607.6	-3,536.5	7,494.2	1.80	1.68	
13,109.0	90.90	332.20	5,602.0	6,718.7	-3,593.8	7,619.2	1.51	-1.28	
13,237.0	90.80	333.30	5,600.1	6,832.4	-3,652.4	7,747.2	0.86	-0.08	
13,364.0	90.20	331.90	5,599.0	6,945.2	-3,710.8	7,874.1	1.20	-0.47	
13,426.0	90.90	330.80	5,598.4	6,999.6	-3,740.6	7,936.1	2.10	1.13	
13,476.0	90.90	330.80	5,597.6	7,043.2	-3,764.9	7,986.1	0.00	0.00	

Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude
State of WV DNR 3H PE - hit/miss target - Shape - Point	0.00	360.00	5,602.2	7,057.1	-3,775.3	671,998.95	1,707,519.93	40° 20' 24.900 N	80° 32' 57.000 W
- survey misses target center by 17.9usft at 13476.0usft MD (5597.6 TVD, 7043.2 N, -3764.9 E)									

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
13,426.0	5,598.4	6,999.6	-3,740.6	Last Cathedral Survey @ 13426' MD
13,476.0	5,597.6	7,043.2	-3,764.9	Projection to Bit @ 13476' MD

Checked By: \_\_\_\_\_ Approved By: \_\_\_\_\_ Date: \_\_\_\_\_

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FEB 27 2015

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MORGANTOWN, WV