



Well: Lackawanna N-04 HM (slot AA)  
 Site: Lackawanna  
 Project: Wetzel County, West Virginia (UTM17 NAD83)  
 Design: rev4  
 Rig: Precision 528

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N-S	+E-W	Dleg	TFace	VSect	Annotation
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.00	
2	2018.00	0.00	0.00	2018.00	0.00	0.00	0.00	0.000	0.00	KOP Begin 3°/100' build
3	3346.43	26.57	172.93	3299.33	-300.22	37.25	2.00	172.927	-267.24	Begin 26.57° tangent
4	6146.96	26.57	172.93	5804.12	-1543.28	191.49	0.00	0.000	-1373.74	Begin 8°/100' build/turn
5	7064.54	50.00	320.54	6624.83	-1464.49	-39.04	8.00	154.650	-1176.92	Begin 10°/100' build/turn
6	7483.52	91.00	329.98	6762.00	-1144.86	-255.56	10.00	14.215	-790.91	Begin 91.00° lateral
7	17422.15	91.00	329.98	6588.47	7459.19	-5227.13	0.00	0.000	9108.37	PBHL/TD 17422.15 MD/6588.47 TVD

ANNOTATIONS SURVEYS

MD	Inc	Azi	TVD	+N-S	+E-W	VSect	Annotation
216.00	0.58	251.97	216.00	-0.34	-1.04	0.32	MWD surveys
17313.00	90.15	329.49	6625.77	7404.57	-5196.31	9045.95	Survey @ 17313.00 MD 6625.77 TVD
17369.00	90.15	329.49	6625.62	7452.81	-5224.75	9101.78	Survey projected to 17369.00 MD 6625.62 TVD

Geodetic System: Universal Transverse Mercator (US Survey Feet)  
 Datum: NAD83 West Virginia - HARN  
 Ellipsoid: GRS 1980  
 Zone: Zone 17N (84 W to 78 W)

System Datum: Mean Sea Level  
 Depth Reference: RKB=1306+18 @ 1324.00ft (Precision 528)

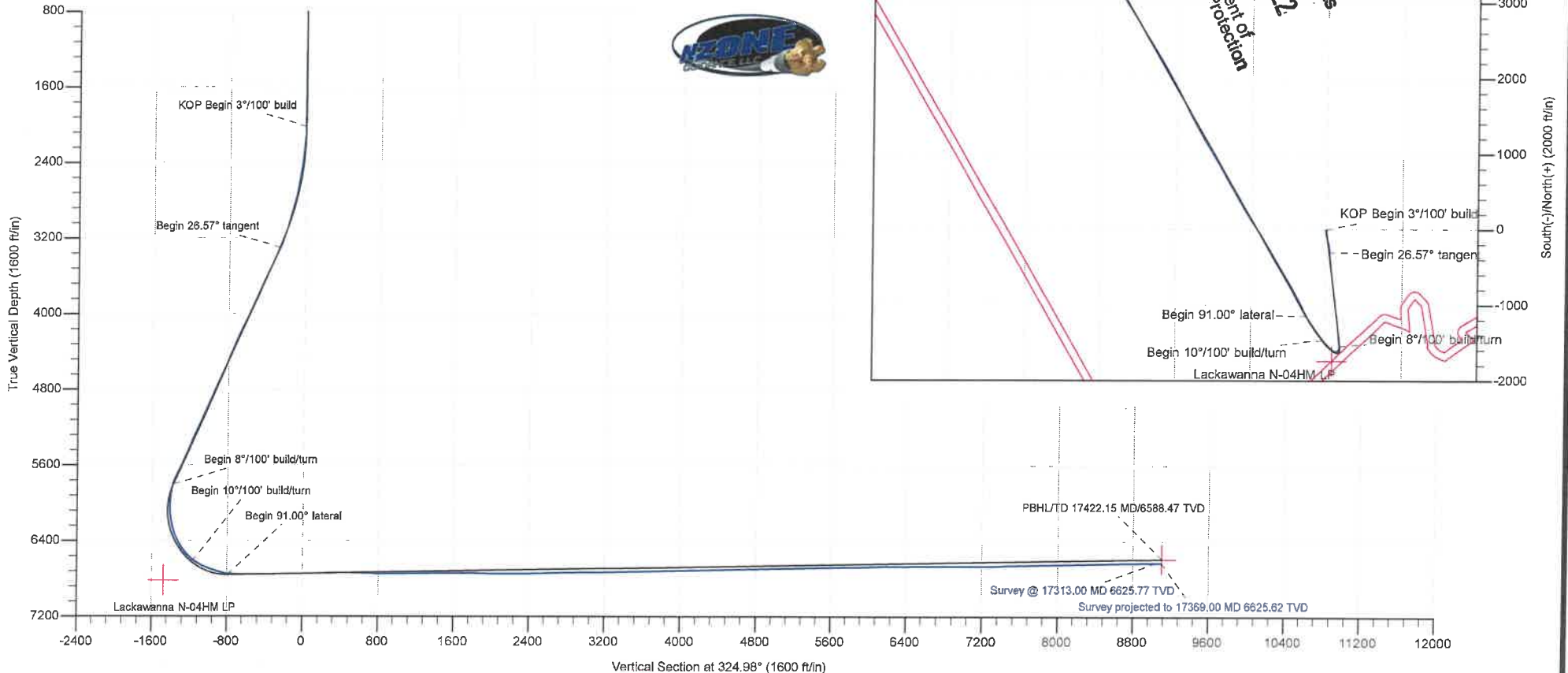
Northing: 14383323.22    Easting: 1680775.62    Latitude: 39.60606594    Longitude: -80.85670714

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.707°



Azimuths to Grid North  
 True North: -0.09°  
 Magnetic North: -8.71°

Magnetic Field  
 Strength: 51863.5snT  
 Dip Angle: 66.67°  
 Date: 6/28/2019  
 Model: IGRF2015



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<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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<b>Project</b>	Wetzel County, West Virginia (UTM17 NAD83)		
<b>Map System:</b>	Universal Transverse Mercator (US Survey Feet)	<b>System Datum:</b>	Mean Sea Level
<b>Geo Datum:</b>	NAD83 West Virginia - HARN		
<b>Map Zone:</b>	Zone 17N (84 W to 78 W)		

<b>Site</b>	Lackawanna				
<b>Site Position:</b>		<b>Northing:</b>	14,383,374.84 usft	<b>Latitude:</b>	39.60620769
<b>From:</b>	Lat/Long	<b>Easting:</b>	1,680,777.71 usft	<b>Longitude:</b>	-80.85669942
<b>Position Uncertainty:</b>	0.00 ft	<b>Slot Radius:</b>	13-3/16 "	<b>Grid Convergence:</b>	0.091 °

<b>Well</b>	Lackawanna N-04 HM (slot AA)					
<b>Well Position</b>	<b>+N/-S</b>	0.00 ft	<b>Northing:</b>	14,383,323.23 usft	<b>Latitude:</b>	39.60606594
	<b>+E/-W</b>	0.00 ft	<b>Easting:</b>	1,680,775.62 usft	<b>Longitude:</b>	-80.85670714
<b>Position Uncertainty</b>	0.00 ft	<b>Wellhead Elevation:</b>	ft	<b>Ground Level:</b>	1,306.00 ft	

<b>Wellbore</b>	Original Hole				
<b>Magnetics</b>	<b>Model Name</b>	<b>Sample Date</b>	<b>Declination (°)</b>	<b>Dip Angle (°)</b>	<b>Field Strength (nT)</b>
	IGRF2015	6/28/2019	-8.616	66.665	51,863.52940062

<b>Design</b>	Surveys Original Hole				
<b>Audit Notes:</b>					
<b>Version:</b>	1.0	<b>Phase:</b>	ACTUAL	<b>Tie On Depth:</b>	0.00
<b>Vertical Section:</b>	<b>Depth From (TVD) (ft)</b>	<b>+N/-S (ft)</b>	<b>+E/-W (ft)</b>	<b>Direction (°)</b>	
	0.00	0.00	0.00	324.98	

<b>Survey Program</b>	Date 7/14/2019			
<b>From (ft)</b>	<b>To (ft)</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>
216.00	1,236.00	MWD surf (Original Hole)	MWD	MWD - Standard
1,298.00	17,313.00	MWD (Original Hole)	MWD	MWD - Standard
17,369.00	17,369.00	Projection (Original Hole)	MWD	MWD - Standard

<b>Survey</b>										
<b>Measured Depth (ft)</b>	<b>Inclination (°)</b>	<b>Azimuth (°)</b>	<b>Vertical Depth (ft)</b>	<b>+N/-S (ft)</b>	<b>+E/-W (ft)</b>	<b>Vertical Section (ft)</b>	<b>Dogleg Rate (°/100ft)</b>	<b>Build Rate (°/100ft)</b>	<b>Turn Rate (°/100ft)</b>	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
216.00	0.58	251.97	216.00	-0.34	-1.04	0.32	0.27	0.27	0.00	
<b>MWD surveys</b>										
246.00	0.31	267.75	246.00	-0.39	-1.27	0.41	0.98	-0.90	52.60	
277.00	0.46	260.82	276.99	-0.41	-1.47	0.51	0.51	0.48	-22.35	
338.00	0.41	264.84	337.99	-0.47	-1.93	0.72	0.10	-0.08	6.59	
383.00	0.31	268.50	382.99	-0.49	-2.21	0.87	0.23	-0.22	8.13	
429.00	0.40	267.29	428.99	-0.50	-2.50	1.02	0.20	0.20	-2.63	
474.00	0.25	285.05	473.99	-0.48	-2.75	1.18	0.40	-0.33	39.47	

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<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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## Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	WV Department of Environmental Protection	
								Build Rate (°/100ft)	Turn Rate (°/100ft)
520.00	0.32	259.03	519.99	-0.48	-2.97	1.31	0.32	0.15	-56.57
610.00	0.06	148.59	609.99	-0.57	-3.19	1.37	0.38	-0.29	-122.71
701.00	0.07	319.06	700.99	-0.57	-3.21	1.38	0.14	0.01	187.33
791.00	0.19	83.80	790.99	-0.51	-3.09	1.36	0.26	0.13	138.60
886.00	0.31	302.89	885.99	-0.35	-3.15	1.52	0.50	0.13	-148.33
981.00	0.08	119.02	980.99	-0.24	-3.31	1.70	0.41	-0.24	185.40
1,076.00	0.22	165.09	1,075.99	-0.45	-3.21	1.47	0.18	0.15	48.49
1,171.00	0.17	151.91	1,170.99	-0.75	-3.09	1.16	0.07	-0.05	-13.87
1,236.00	0.04	79.87	1,235.99	-0.83	-3.02	1.05	0.25	-0.20	-110.83
1,298.00	0.15	222.98	1,297.99	-0.89	-3.06	1.03	0.30	0.18	230.82
1,361.00	0.07	25.68	1,360.99	-0.92	-3.10	1.03	0.35	-0.13	258.25
1,456.00	0.09	4.89	1,455.99	-0.79	-3.07	1.11	0.04	0.02	-21.88
1,551.00	0.17	257.65	1,550.99	-0.74	-3.20	1.23	0.23	0.08	-112.88
1,646.00	0.38	174.86	1,645.99	-1.09	-3.31	1.01	0.42	0.22	-87.15
1,741.00	0.47	165.45	1,740.98	-1.78	-3.18	0.37	0.12	0.09	-9.91
1,836.00	0.30	189.31	1,835.98	-2.40	-3.12	-0.17	0.24	-0.18	25.12
1,930.00	0.51	222.67	1,929.98	-2.95	-3.45	-0.44	0.33	0.22	35.49
2,025.00	1.58	184.28	2,024.96	-4.57	-3.83	-1.54	1.29	1.13	-40.41
2,120.00	3.55	183.62	2,119.86	-8.81	-4.12	-4.85	2.07	2.07	-0.69
2,214.00	5.76	178.10	2,213.55	-16.43	-4.14	-11.08	2.40	2.35	-5.87
2,309.00	7.42	175.29	2,307.92	-27.31	-3.48	-20.37	1.78	1.75	-2.96
2,404.00	8.20	172.27	2,402.04	-40.14	-2.07	-31.68	0.93	0.82	-3.18
2,499.00	9.69	171.31	2,495.88	-54.75	0.05	-44.87	1.58	1.57	-1.01
2,594.00	10.36	170.05	2,589.43	-71.07	2.74	-59.77	0.74	0.71	-1.33
2,688.00	11.71	167.08	2,681.69	-88.70	6.33	-76.27	1.56	1.44	-3.16
2,783.00	14.83	164.63	2,774.14	-109.82	11.71	-96.66	3.34	3.28	-2.58
2,877.00	16.01	164.54	2,864.75	-133.91	18.35	-120.20	1.26	1.26	-0.10
2,969.00	16.57	166.67	2,953.06	-158.91	24.76	-144.35	0.89	0.61	2.32
3,059.00	18.58	170.46	3,038.86	-185.54	30.10	-169.22	2.57	2.23	4.21
3,158.00	20.66	169.35	3,132.11	-218.26	35.94	-199.37	2.13	2.10	-1.12
3,253.00	22.06	171.00	3,220.58	-252.35	41.83	-230.67	1.60	1.47	1.74
3,346.00	27.55	176.12	3,304.98	-291.09	46.02	-264.80	6.33	5.90	5.51
3,441.00	29.87	177.54	3,388.29	-336.66	48.52	-303.55	2.55	2.44	1.49
3,536.00	28.27	173.92	3,471.33	-382.67	51.92	-343.18	2.50	-1.68	-3.81
3,632.00	28.29	174.66	3,555.87	-427.92	56.45	-382.84	0.37	0.02	0.77
3,723.00	26.21	172.18	3,636.77	-469.31	61.19	-419.45	2.60	-2.29	-2.73
3,816.00	26.77	173.96	3,720.01	-510.48	66.19	-456.04	1.04	0.60	1.91
3,911.00	27.61	174.74	3,804.51	-553.68	70.45	-493.86	0.96	0.88	0.82
4,005.00	25.83	171.47	3,888.47	-595.63	75.49	-531.11	2.46	-1.89	-3.48
4,099.00	26.19	172.73	3,972.95	-636.46	81.15	-567.79	0.70	0.38	1.34
4,195.00	27.60	174.22	4,058.57	-679.60	86.07	-605.95	1.63	1.47	1.55
4,290.00	28.35	173.35	4,142.47	-723.90	90.90	-645.00	0.90	0.79	-0.92
4,384.00	25.68	168.97	4,226.21	-766.07	97.38	-683.25	3.54	-2.84	-4.66



Survey Report



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<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
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<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	WV Department of Environmental Protection Rate (°/100ft)
4,477.00	24.65	172.39	4,310.39	-805.08	103.81	-718.88	1.92	-1.11	3.68
4,572.00	26.67	175.51	4,396.02	-845.97	108.10	-754.84	2.56	2.13	3.28
4,666.00	27.68	174.56	4,479.64	-888.74	111.82	-792.00	1.17	1.07	-1.01
4,761.00	26.77	172.91	4,564.12	-931.94	116.56	-830.09	1.24	-0.96	-1.74
4,856.00	27.29	172.94	4,648.74	-974.78	121.87	-868.23	0.55	0.55	0.03
4,951.00	27.24	172.20	4,733.19	-1,017.94	127.50	-906.80	0.36	-0.05	-0.78
5,046.00	25.50	167.70	4,818.31	-1,059.47	134.81	-945.00	2.79	-1.83	-4.74
5,141.00	26.02	172.68	4,903.87	-1,100.12	141.82	-982.32	2.34	0.55	5.24
5,235.00	28.44	176.53	4,987.46	-1,142.92	145.80	-1,019.65	3.18	2.57	4.10
5,330.00	27.69	172.54	5,071.29	-1,187.39	150.04	-1,058.50	2.13	-0.79	-4.20
5,424.00	26.54	173.61	5,154.96	-1,229.92	155.21	-1,096.30	1.33	-1.22	1.14
5,518.00	25.79	175.41	5,239.33	-1,271.17	159.19	-1,132.36	1.16	-0.80	1.91
5,613.00	26.69	175.83	5,324.54	-1,313.05	162.39	-1,168.50	0.97	0.95	0.44
5,708.00	26.13	171.95	5,409.63	-1,355.05	166.87	-1,205.46	1.91	-0.59	-4.08
5,803.00	25.14	174.38	5,495.28	-1,395.84	171.78	-1,241.69	1.52	-1.04	2.56
5,898.00	26.95	174.50	5,580.63	-1,437.36	175.82	-1,278.01	1.91	1.91	0.13
5,975.00	28.09	173.24	5,648.92	-1,472.73	179.62	-1,309.16	1.66	1.48	-1.64
6,038.00	28.18	171.55	5,704.47	-1,502.17	183.56	-1,335.53	1.27	0.14	-2.68
6,085.00	27.69	171.47	5,746.00	-1,523.95	186.81	-1,355.23	1.05	-1.04	-0.17
6,133.00	23.38	181.05	5,789.32	-1,544.52	188.29	-1,372.92	12.41	-8.98	19.96
6,180.00	19.30	195.02	5,833.11	-1,561.36	186.10	-1,385.46	13.81	-8.68	29.72
6,228.00	15.47	204.42	5,878.92	-1,574.86	181.40	-1,393.82	9.87	-7.98	19.58
6,275.00	13.45	209.43	5,924.43	-1,585.33	176.12	-1,399.36	5.05	-4.30	10.66
6,322.00	13.05	210.66	5,970.18	-1,594.66	170.73	-1,403.90	1.04	-0.85	2.62
6,369.00	12.62	224.02	6,016.02	-1,602.92	164.45	-1,407.07	6.37	-0.91	28.43
6,417.00	11.91	245.82	6,062.95	-1,608.72	156.29	-1,407.13	9.70	-1.48	45.42
6,464.00	11.12	262.52	6,109.01	-1,611.30	147.36	-1,404.12	7.26	-1.68	35.53
6,513.00	12.09	277.29	6,157.02	-1,611.26	137.59	-1,398.48	6.36	1.98	30.14
6,560.00	13.05	291.26	6,202.90	-1,608.71	127.76	-1,390.75	6.76	2.04	29.72
6,607.00	16.22	298.73	6,248.38	-1,603.63	117.05	-1,380.45	7.84	6.74	15.89
6,654.00	18.95	302.51	6,293.18	-1,596.37	104.86	-1,367.51	6.29	5.81	8.04
6,702.00	21.67	304.44	6,338.19	-1,587.17	90.97	-1,352.00	5.84	5.67	4.02
6,749.00	26.81	307.61	6,381.03	-1,575.78	75.41	-1,333.75	11.28	10.94	6.74
6,797.00	30.73	311.12	6,423.10	-1,561.11	57.59	-1,311.50	8.89	8.17	7.31
6,844.00	33.80	315.87	6,462.85	-1,543.82	39.43	-1,286.92	8.47	6.53	10.11
6,892.00	37.27	320.70	6,501.91	-1,522.98	20.92	-1,259.23	9.29	7.23	10.06
6,939.00	41.36	322.02	6,538.27	-1,499.72	2.34	-1,229.52	8.88	8.70	2.81
6,987.00	45.98	321.58	6,572.98	-1,473.68	-18.15	-1,196.44	9.65	9.63	-0.92
7,082.00	57.67	320.26	6,631.59	-1,415.85	-65.20	-1,122.08	12.35	12.31	-1.39
7,129.00	64.13	323.34	6,654.44	-1,383.58	-90.55	-1,081.10	14.89	13.74	6.55
7,178.00	67.38	324.57	6,674.56	-1,347.46	-116.83	-1,036.44	7.02	6.63	2.51
7,225.00	70.33	325.80	6,691.52	-1,311.47	-141.85	-992.61	6.73	6.28	2.62
7,273.00	71.78	325.45	6,707.10	-1,274.00	-167.49	-947.21	3.10	3.02	-0.73
7,320.00	71.16	326.24	6,722.04	-1,237.13	-192.51	-902.65	2.07	-1.32	1.68

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<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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WV Department of Environmental Protection									
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7,368.00	76.66	328.97	6,735.34	-1,198.19	-217.19	-856.61	12.69	11.46	5.69
7,415.00	81.76	330.90	6,744.13	-1,158.25	-240.31	-810.63	11.58	10.85	4.11
7,461.00	84.31	331.43	6,749.71	-1,118.25	-262.32	-765.24	5.66	5.54	1.15
7,512.00	89.67	332.22	6,752.39	-1,073.37	-286.36	-714.69	10.62	10.51	1.55
7,556.00	90.20	332.22	6,752.44	-1,034.45	-306.87	-671.04	1.20	1.20	0.00
7,651.00	89.63	331.78	6,752.58	-950.57	-351.47	-576.75	0.76	-0.60	-0.46
7,747.00	90.46	330.11	6,752.50	-866.65	-398.09	-481.28	1.94	0.86	-1.74
7,842.00	90.07	329.84	6,752.06	-784.40	-445.62	-386.64	0.50	-0.41	-0.28
7,937.00	89.49	329.41	6,752.43	-702.44	-493.66	-291.95	0.76	-0.61	-0.45
8,032.00	91.43	329.58	6,751.67	-620.60	-541.88	-197.26	2.05	2.04	0.18
8,127.00	91.16	329.14	6,749.52	-538.88	-590.28	-102.56	0.54	-0.28	-0.46
8,222.00	90.81	329.23	6,747.89	-457.31	-638.94	-7.83	0.38	-0.37	0.09
8,317.00	90.59	329.67	6,746.72	-375.50	-687.23	86.88	0.52	-0.23	0.46
8,410.00	92.13	329.05	6,744.52	-295.51	-734.61	179.57	1.78	1.66	-0.67
8,505.00	91.52	329.05	6,741.49	-214.08	-783.44	274.29	0.64	-0.64	0.00
8,599.00	90.07	328.35	6,740.19	-133.77	-832.27	368.08	1.71	-1.54	-0.74
8,694.00	90.02	327.82	6,740.11	-53.13	-882.49	462.94	0.56	-0.05	-0.56
8,788.00	88.44	327.56	6,741.38	26.31	-932.73	556.82	1.70	-1.68	-0.28
8,883.00	88.31	326.68	6,744.07	106.05	-984.28	651.71	0.94	-0.14	-0.93
8,977.00	88.88	329.41	6,746.38	185.78	-1,034.01	745.54	2.97	0.61	2.90
9,072.00	90.95	329.49	6,746.52	267.59	-1,082.30	840.25	2.18	2.18	0.08
9,168.00	90.90	330.20	6,744.97	350.58	-1,130.51	935.89	0.74	-0.05	0.74
9,263.00	90.59	330.46	6,743.73	433.12	-1,177.53	1,030.47	0.43	-0.33	0.27
9,358.00	90.15	330.64	6,743.12	515.84	-1,224.24	1,125.01	0.50	-0.46	0.19
9,453.00	89.89	330.28	6,743.08	598.49	-1,271.08	1,219.58	0.47	-0.27	-0.38
9,548.00	89.49	329.58	6,743.60	680.71	-1,318.68	1,314.22	0.85	-0.42	-0.74
9,643.00	91.60	329.41	6,742.70	762.55	-1,366.90	1,408.92	2.23	2.22	-0.18
9,738.00	91.03	329.14	6,740.52	844.19	-1,415.42	1,503.63	0.66	-0.60	-0.28
9,832.00	90.29	330.02	6,739.43	925.25	-1,463.01	1,597.32	1.22	-0.79	0.94
9,926.00	90.77	329.32	6,738.56	1,006.38	-1,510.48	1,691.00	0.90	0.51	-0.74
10,021.00	88.35	328.53	6,739.29	1,087.73	-1,559.51	1,785.76	2.68	-2.55	-0.83
10,115.00	88.70	330.55	6,741.71	1,168.73	-1,607.14	1,879.43	2.18	0.37	2.15
10,211.00	88.53	329.76	6,744.03	1,251.97	-1,654.90	1,975.01	0.84	-0.18	-0.82
10,306.00	88.62	331.43	6,746.40	1,334.70	-1,701.53	2,069.52	1.76	0.09	1.76
10,399.00	90.64	331.78	6,747.00	1,416.51	-1,745.75	2,161.89	2.20	2.17	0.38
10,494.00	90.29	331.69	6,746.22	1,500.18	-1,790.74	2,256.23	0.38	-0.37	-0.09
10,589.00	90.07	331.34	6,745.93	1,583.68	-1,836.05	2,350.61	0.44	-0.23	-0.37
10,684.00	90.73	333.10	6,745.26	1,667.72	-1,880.32	2,444.84	1.98	0.69	1.85
10,779.00	92.75	334.06	6,742.38	1,752.76	-1,922.57	2,538.73	2.35	2.13	1.01
10,874.00	91.65	331.08	6,738.73	1,837.00	-1,966.29	2,632.81	3.34	-1.16	-3.14
10,969.00	91.47	331.16	6,736.14	1,920.16	-2,012.16	2,727.23	0.21	-0.19	0.08
11,064.00	90.64	332.22	6,734.40	2,003.78	-2,057.20	2,821.56	1.42	-0.87	1.12
11,159.00	90.51	329.23	6,733.44	2,086.63	-2,103.65	2,916.07	3.15	-0.14	-3.15

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	WV Department of Environmental Protection Rate (°/100ft)	Rate (°/100ft)
11,253.00	90.37	329.32	6,732.72	2,167.43	-2,151.68	3,009.80	0.18	-0.15	0.10
11,348.00	89.85	328.70	6,732.54	2,248.87	-2,200.59	3,104.57	0.85	-0.55	-0.65
11,443.00	92.09	329.23	6,730.93	2,330.26	-2,249.56	3,199.32	2.42	2.36	0.56
11,538.00	91.47	328.88	6,727.98	2,411.69	-2,298.39	3,294.03	0.75	-0.65	-0.37
11,633.00	91.21	328.26	6,725.76	2,492.73	-2,347.91	3,388.82	0.71	-0.27	-0.65
11,727.00	90.99	328.00	6,723.95	2,572.55	-2,397.53	3,482.66	0.36	-0.23	-0.28
11,822.00	91.21	328.79	6,722.13	2,653.44	-2,447.31	3,577.47	0.86	0.23	0.83
11,917.00	91.78	329.14	6,719.65	2,734.81	-2,496.27	3,672.21	0.70	0.60	0.37
12,012.00	91.60	328.61	6,716.85	2,816.10	-2,545.35	3,766.95	0.59	-0.19	-0.56
12,106.00	91.65	328.09	6,714.18	2,896.09	-2,594.66	3,860.75	0.56	0.05	-0.55
12,201.00	91.16	328.09	6,711.85	2,976.71	-2,644.86	3,955.58	0.52	-0.52	0.00
12,296.00	90.90	330.28	6,710.15	3,058.28	-2,693.51	4,050.30	2.32	-0.27	2.31
12,390.00	91.47	329.67	6,708.20	3,139.65	-2,740.54	4,143.92	0.89	0.61	-0.65
12,485.00	90.99	329.76	6,706.16	3,221.66	-2,788.44	4,238.58	0.51	-0.51	0.09
12,578.00	90.46	329.23	6,704.99	3,301.78	-2,835.64	4,331.28	0.81	-0.57	-0.57
12,673.00	90.95	330.55	6,703.82	3,383.96	-2,883.29	4,425.92	1.48	0.52	1.39
12,767.00	90.59	331.16	6,702.55	3,466.05	-2,929.07	4,519.42	0.75	-0.38	0.65
12,861.00	92.04	330.99	6,700.40	3,548.30	-2,974.52	4,612.86	1.55	1.54	-0.18
12,956.00	91.30	330.28	6,697.63	3,631.05	-3,021.08	4,707.35	1.08	-0.78	-0.75
13,051.00	90.24	330.11	6,696.35	3,713.48	-3,068.30	4,801.95	1.13	-1.12	-0.18
13,146.00	91.03	330.02	6,695.30	3,795.80	-3,115.70	4,896.57	0.84	0.83	-0.09
13,241.00	90.46	329.05	6,694.06	3,877.68	-3,163.86	4,991.26	1.18	-0.60	-1.02
13,336.00	92.26	329.49	6,691.81	3,959.31	-3,212.39	5,085.96	1.95	1.89	0.46
13,430.00	91.78	329.58	6,688.49	4,040.28	-3,260.02	5,179.61	0.52	-0.51	0.10
13,525.00	91.34	329.05	6,685.91	4,121.95	-3,308.48	5,274.30	0.72	-0.46	-0.56
13,620.00	90.29	330.64	6,684.56	4,204.08	-3,356.20	5,368.94	2.01	-1.11	1.67
13,714.00	92.18	330.99	6,682.53	4,286.12	-3,402.02	5,462.43	2.04	2.01	0.37
13,809.00	91.47	331.43	6,679.51	4,369.34	-3,447.75	5,556.82	0.88	-0.75	0.46
13,903.00	90.90	331.16	6,677.56	4,451.77	-3,492.89	5,650.23	0.67	-0.61	-0.29
13,999.00	90.42	331.25	6,676.46	4,535.89	-3,539.13	5,745.66	0.51	-0.50	0.09
14,093.00	89.98	331.43	6,676.13	4,618.37	-3,584.21	5,839.08	0.51	-0.47	0.19
14,188.00	91.74	331.43	6,674.70	4,701.79	-3,629.64	5,933.46	1.85	1.85	0.00
14,282.00	91.65	331.34	6,671.92	4,784.28	-3,674.64	6,026.83	0.14	-0.10	-0.10
14,377.00	91.78	331.16	6,669.08	4,867.53	-3,720.31	6,121.22	0.23	0.14	-0.19
14,472.00	90.86	330.99	6,666.89	4,950.65	-3,766.24	6,215.66	0.98	-0.97	-0.18
14,567.00	89.98	331.16	6,666.19	5,033.80	-3,812.19	6,310.12	0.94	-0.93	0.18
14,662.00	90.42	331.69	6,665.86	5,117.23	-3,857.63	6,404.52	0.73	0.46	0.56
14,757.00	90.37	329.84	6,665.21	5,200.12	-3,904.02	6,499.03	1.95	-0.05	-1.95
14,852.00	90.15	330.20	6,664.78	5,282.41	-3,951.49	6,593.66	0.44	-0.23	0.38
14,947.00	90.46	328.44	6,664.27	5,364.11	-3,999.97	6,688.38	1.88	0.33	-1.85
15,041.00	90.29	328.88	6,663.66	5,444.39	-4,048.85	6,782.18	0.50	-0.18	0.47
15,137.00	89.93	328.79	6,663.47	5,526.54	-4,098.54	6,877.97	0.39	-0.38	-0.09
15,231.00	89.54	329.41	6,663.91	5,607.19	-4,146.81	6,971.72	0.78	-0.41	0.66

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
15,325.00	88.79	329.67	6,665.28	5,688.21	-4,194.45	7,065.41	0.84	-0.80	0.28
15,419.00	90.68	329.32	6,665.71	5,769.19	-4,242.17	7,159.11	2.04	2.01	-0.37
15,514.00	90.33	329.49	6,664.87	5,850.96	-4,290.52	7,253.83	0.41	-0.37	0.18
15,608.00	92.35	328.97	6,662.67	5,931.71	-4,338.59	7,347.54	2.22	2.15	-0.55
15,703.00	91.96	328.61	6,659.10	6,012.90	-4,387.78	7,442.26	0.56	-0.41	-0.38
15,797.00	91.12	328.79	6,656.58	6,093.19	-4,436.60	7,536.03	0.91	-0.89	0.19
15,892.00	90.59	329.67	6,655.16	6,174.81	-4,485.19	7,630.75	1.08	-0.56	0.93
15,987.00	92.18	330.02	6,652.86	6,256.92	-4,532.90	7,725.38	1.71	1.67	0.37
16,081.00	91.74	330.46	6,649.65	6,338.48	-4,579.53	7,818.93	0.66	-0.47	0.47
16,175.00	91.08	330.37	6,647.33	6,420.20	-4,625.93	7,912.48	0.71	-0.70	-0.10
16,269.00	90.55	330.11	6,646.00	6,501.79	-4,672.58	8,006.07	0.63	-0.56	-0.28
16,364.00	90.11	330.02	6,645.45	6,584.11	-4,719.99	8,100.70	0.47	-0.46	-0.09
16,460.00	91.38	330.55	6,644.20	6,667.48	-4,767.57	8,196.27	1.43	1.32	0.55
16,554.00	90.59	330.28	6,642.59	6,749.21	-4,813.97	8,289.84	0.89	-0.84	-0.29
16,649.00	92.84	329.67	6,639.74	6,831.42	-4,861.48	8,384.43	2.45	2.37	-0.64
16,745.00	92.22	330.20	6,635.51	6,914.42	-4,909.53	8,479.97	0.85	-0.65	0.55
16,839.00	91.38	330.20	6,632.55	6,995.95	-4,956.22	8,573.54	0.89	-0.89	0.00
16,933.00	90.86	329.93	6,630.72	7,077.40	-5,003.12	8,667.15	0.62	-0.55	-0.29
17,028.00	90.02	329.76	6,629.99	7,159.54	-5,050.84	8,761.80	0.90	-0.88	-0.18
17,123.00	91.56	329.23	6,628.68	7,241.38	-5,099.05	8,856.50	1.71	1.62	-0.56
17,218.00	90.90	329.05	6,626.64	7,322.91	-5,147.77	8,951.22	0.72	-0.69	-0.19
17,313.00	90.15	329.49	6,625.77	7,404.57	-5,196.31	9,045.95	0.92	-0.79	0.46
<b>Survey @ 17313.00 MD 6625.77 TVD</b>									
17,369.00	90.15	329.49	6,625.62	7,452.81	-5,224.75	9,101.78	0.00	0.00	0.00
<b>Survey projected to 17369.00 MD 6625.62 TVD</b>									

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment
		+N/-S (ft)	+E/-W (ft)	
216.00	216.00	-0.34	-1.04	MWD surveys
17,313.00	6,625.77	7,404.57	-5,196.31	Survey @ 17313.00 MD 6625.77 TVD

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<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

<b>Project</b>	Wetzel County, West Virginia (UTM17 NAD83)		<b>RECEIVED</b> Office of Oil and Gas
<b>Map System:</b>	Universal Transverse Mercator (US Survey Feet)	<b>System Datum:</b>	Mean Sea Level
<b>Geo Datum:</b>	NAD83 West Virginia - HARN		<b>SEP 30 2022</b>
<b>Map Zone:</b>	Zone 17N (84 W to 78 W)		WV Department of Environmental Protection

<b>Site</b>	Lackawanna				
<b>Site Position:</b>	<b>Northing:</b>	14,383,374.84 usft	<b>Latitude:</b>	39.60620769	
<b>From:</b>	Lat/Long	<b>Easting:</b>	1,680,777.71 usft	<b>Longitude:</b>	-80.85669942
<b>Position Uncertainty:</b>	0.00 ft	<b>Slot Radius:</b>	13-3/16 "	<b>Grid Convergence:</b>	0.091 °

<b>Well</b>	Lackawanna N-04 HM (slot AA)					
<b>Well Position</b>	<b>+N-S</b>	0.00 ft	<b>Northing:</b>	14,383,323.23 usft	<b>Latitude:</b>	39.60606594
	<b>+E-W</b>	0.00 ft	<b>Easting:</b>	1,680,775.62 usft	<b>Longitude:</b>	-80.85670714
<b>Position Uncertainty</b>	0.00 ft	<b>Wellhead Elevation:</b>	ft	<b>Ground Level:</b>	1,306.00 ft	

<b>Wellbore</b>	Original Hole				
<b>Magnetics</b>	<b>Model Name</b>	<b>Sample Date</b>	<b>Declination</b>	<b>Dip Angle</b>	<b>Field Strength</b>
	IGRF2015	6/28/2019	(°)	(°)	(nT)
			-8.616	66.665	51,863.52940062

<b>Design</b>	Surveys Original Hole				
<b>Audit Notes:</b>					
<b>Version:</b>	1.0	<b>Phase:</b>	ACTUAL	<b>Tie On Depth:</b>	0.00
<b>Vertical Section:</b>	<b>Depth From (TVD)</b>	<b>+N-S</b>	<b>+E-W</b>	<b>Direction</b>	
	(ft)	(ft)	(ft)	(°)	
	0.00	0.00	0.00	324.98	

<b>Survey Program</b>	<b>Date</b>	7/14/2019			
<b>From (ft)</b>	<b>To (ft)</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>	
216.00	1,236.00	MWD surf (Original Hole)	MWD	MWD - Standard	
1,298.00	17,313.00	MWD (Original Hole)	MWD	MWD - Standard	
17,369.00	17,369.00	Projection (Original Hole)	MWD	MWD - Standard	

<b>Survey</b>										
<b>Measured Depth (ft)</b>	<b>Inclination (°)</b>	<b>Azimuth (°)</b>	<b>Vertical Depth (ft)</b>	<b>+N-S (ft)</b>	<b>+E-W (ft)</b>	<b>Map Northing (usft)</b>	<b>Map Easting (usft)</b>	<b>Latitude</b>	<b>Longitude</b>	
0.00	0.00	0.00	0.00	0.00	0.00	14,383,323.23	1,680,775.62	39.60606594	-80.85670714	
216.00	0.58	251.97	216.00	-0.34	-1.04	14,383,322.89	1,680,774.58	39.60606502	-80.85671083	
<b>MWD surveys</b>										
246.00	0.31	267.75	246.00	-0.39	-1.27	14,383,322.84	1,680,774.36	39.60606488	-80.85671164	
277.00	0.46	260.82	276.99	-0.41	-1.47	14,383,322.81	1,680,774.15	39.60606482	-80.85671237	
338.00	0.41	264.84	337.99	-0.47	-1.93	14,383,322.76	1,680,773.69	39.60606466	-80.85671400	
383.00	0.31	268.50	382.99	-0.49	-2.21	14,383,322.74	1,680,773.41	39.60606461	-80.85671500	
429.00	0.40	267.29	428.99	-0.50	-2.50	14,383,322.73	1,680,773.12	39.60606458	-80.85671601	
474.00	0.25	285.05	473.99	-0.48	-2.75	14,383,322.74	1,680,772.87	39.60606463	-80.85671691	
520.00	0.32	259.03	519.99	-0.48	-2.97	14,383,322.75	1,680,772.65	39.60606464	-80.85671770	



<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	WV Department of Environmental Protection
610.00	0.06	148.59	609.99	-0.57	-3.19	14,383,322.66	1,680,772.43	39.60606440	-80.85671849
701.00	0.07	319.06	700.99	-0.57	-3.21	14,383,322.66	1,680,772.41	39.60606440	-80.85671853
791.00	0.19	83.80	790.99	-0.51	-3.09	14,383,322.72	1,680,772.53	39.60606456	-80.85671813
886.00	0.31	302.89	885.99	-0.35	-3.15	14,383,322.87	1,680,772.47	39.60606499	-80.85671834
981.00	0.08	119.02	980.99	-0.24	-3.31	14,383,322.98	1,680,772.31	39.60606528	-80.85671890
1,076.00	0.22	165.09	1,075.99	-0.45	-3.21	14,383,322.77	1,680,772.41	39.60606471	-80.85671853
1,171.00	0.17	151.91	1,170.99	-0.75	-3.09	14,383,322.47	1,680,772.53	39.60606389	-80.85671813
1,236.00	0.04	79.87	1,235.99	-0.83	-3.02	14,383,322.39	1,680,772.60	39.60606366	-80.85671789
1,298.00	0.15	222.98	1,297.99	-0.89	-3.06	14,383,322.34	1,680,772.56	39.60606351	-80.85671801
1,361.00	0.07	25.68	1,360.99	-0.92	-3.10	14,383,322.31	1,680,772.52	39.60606344	-80.85671815
1,456.00	0.09	4.89	1,455.99	-0.79	-3.07	14,383,322.44	1,680,772.55	39.60606379	-80.85671803
1,551.00	0.17	257.65	1,550.99	-0.74	-3.20	14,383,322.48	1,680,772.42	39.60606391	-80.85671850
1,646.00	0.38	174.86	1,645.99	-1.09	-3.31	14,383,322.14	1,680,772.31	39.60606297	-80.85671889
1,741.00	0.47	165.45	1,740.98	-1.78	-3.18	14,383,321.45	1,680,772.44	39.60606107	-80.85671845
1,836.00	0.30	189.31	1,835.98	-2.40	-3.12	14,383,320.82	1,680,772.50	39.60605936	-80.85671825
1,930.00	0.51	222.67	1,929.98	-2.95	-3.45	14,383,320.27	1,680,772.17	39.60605785	-80.85671940
2,025.00	1.58	184.28	2,024.96	-4.57	-3.83	14,383,318.66	1,680,771.79	39.60605341	-80.85672077
2,120.00	3.55	183.62	2,119.86	-8.81	-4.12	14,383,314.41	1,680,771.51	39.60604176	-80.85672180
2,214.00	5.76	178.10	2,213.55	-16.43	-4.14	14,383,306.79	1,680,771.48	39.60602083	-80.85672194
2,309.00	7.42	175.29	2,307.92	-27.31	-3.48	14,383,295.92	1,680,772.14	39.60599095	-80.85671965
2,404.00	8.20	172.27	2,402.04	-40.14	-2.07	14,383,283.09	1,680,773.55	39.60595572	-80.85671470
2,499.00	9.69	171.31	2,495.88	-54.75	0.05	14,383,268.47	1,680,775.67	39.60591556	-80.85670726
2,594.00	10.36	170.05	2,589.43	-71.07	2.74	14,383,252.15	1,680,778.36	39.60587074	-80.85669782
2,688.00	11.71	167.08	2,681.69	-88.70	6.33	14,383,234.53	1,680,781.95	39.60582232	-80.85668517
2,783.00	14.83	164.63	2,774.14	-109.82	11.71	14,383,213.41	1,680,787.33	39.60576428	-80.85666619
2,877.00	16.01	164.54	2,864.75	-133.91	18.35	14,383,189.31	1,680,793.97	39.60569808	-80.85664273
2,969.00	16.57	166.67	2,953.06	-158.91	24.76	14,383,164.32	1,680,800.38	39.60562941	-80.85662013
3,059.00	18.58	170.46	3,038.86	-185.54	30.10	14,383,137.69	1,680,805.72	39.60555625	-80.85660133
3,158.00	20.66	169.35	3,132.11	-218.26	35.94	14,383,104.97	1,680,811.56	39.60546636	-80.85658078
3,253.00	22.06	171.00	3,220.58	-252.35	41.83	14,383,070.87	1,680,817.45	39.60537270	-80.85656006
3,346.00	27.55	176.12	3,304.98	-291.09	46.02	14,383,032.13	1,680,821.64	39.60526629	-80.85654540
3,441.00	29.87	177.54	3,388.29	-336.66	48.52	14,382,986.57	1,680,824.14	39.60514115	-80.85653678
3,536.00	28.27	173.92	3,471.33	-382.67	51.92	14,382,940.56	1,680,827.54	39.60501477	-80.85652497
3,632.00	28.29	174.66	3,555.87	-427.92	56.45	14,382,895.30	1,680,832.07	39.60489046	-80.85650916
3,723.00	26.21	172.18	3,636.77	-469.31	61.19	14,382,853.92	1,680,836.81	39.60477678	-80.85649256
3,816.00	26.77	173.96	3,720.01	-510.48	66.19	14,382,812.74	1,680,841.81	39.60466367	-80.85647505
3,911.00	27.61	174.74	3,804.51	-553.68	70.45	14,382,769.54	1,680,846.07	39.60454502	-80.85646014
4,005.00	25.83	171.47	3,888.47	-595.63	75.49	14,382,727.60	1,680,851.11	39.60442979	-80.85644250
4,099.00	26.19	172.73	3,972.95	-636.46	81.15	14,382,686.77	1,680,856.77	39.60431764	-80.85642263
4,195.00	27.60	174.22	4,058.57	-679.60	86.07	14,382,643.63	1,680,861.69	39.60419913	-80.85640540
4,290.00	28.35	173.35	4,142.47	-723.90	90.90	14,382,599.33	1,680,866.52	39.60407745	-80.85638851
4,384.00	25.68	168.97	4,226.21	-766.07	97.38	14,382,557.16	1,680,873.00	39.60396160	-80.85636573
4,477.00	24.65	172.39	4,310.39	-805.08	103.81	14,382,518.15	1,680,879.43	39.60385445	-80.85634314
4,572.00	26.67	175.51	4,396.02	-845.97	108.10	14,382,477.25	1,680,883.72	39.60374211	-80.85632813
4,666.00	27.68	174.56	4,479.64	-888.74	111.82	14,382,434.49	1,680,887.44	39.60362464	-80.85631516
4,761.00	26.77	172.91	4,564.12	-931.94	116.56	14,382,391.29	1,680,892.18	39.60350598	-80.85629861
4,856.00	27.29	172.94	4,648.74	-974.78	121.87	14,382,348.44	1,680,897.49	39.60338829	-80.85627997
4,951.00	27.24	172.20	4,733.19	-1,017.94	127.50	14,382,305.29	1,680,903.12	39.60326975	-80.85626024
5,046.00	25.50	167.70	4,818.31	-1,059.47	134.81	14,382,263.76	1,680,910.43	39.60315567	-80.85623453
5,141.00	26.02	172.68	4,903.87	-1,100.12	141.82	14,382,223.11	1,680,917.44	39.60304399	-80.85620986
5,235.00	28.44	176.53	4,987.46	-1,142.92	145.80	14,382,180.31	1,680,921.42	39.60292642	-80.85619597
5,330.00	27.69	172.54	5,071.29	-1,187.39	150.04	14,382,135.84	1,680,925.66	39.60280427	-80.85618118
5,424.00	26.54	173.61	5,154.96	-1,229.92	155.21	14,382,093.31	1,680,930.83	39.60268746	-80.85616306
5,518.00	25.79	175.41	5,239.33	-1,271.17	159.19	14,382,052.06	1,680,934.81	39.60257414	-80.85614918
5,613.00	26.69	175.83	5,324.54	-1,313.05	162.39	14,382,010.18	1,680,938.01	39.60245911	-80.85613804

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v1

SEP 30 2022

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N-S (ft)	+E-W (ft)	Map Northing (usft)	Map Easting (usft)	WV Department of Environmental Protection	
								Latitude	Longitude
5,708.00	26.13	171.95	5,409.63	-1,355.05	166.87	14,381,968.18	1,680,942.49	39.60234375	-80.85612237
5,803.00	25.14	174.38	5,495.28	-1,395.84	171.78	14,381,927.38	1,680,947.40	39.60223168	-80.85610519
5,898.00	26.95	174.50	5,580.63	-1,437.36	175.82	14,381,885.87	1,680,951.44	39.60211765	-80.85609108
5,975.00	28.09	173.24	5,648.92	-1,472.73	179.62	14,381,850.50	1,680,955.24	39.60202049	-80.85607777
6,038.00	28.18	171.55	5,704.47	-1,502.17	183.56	14,381,821.05	1,680,959.18	39.60193961	-80.85606397
6,085.00	27.69	171.47	5,746.00	-1,523.95	186.81	14,381,799.28	1,680,962.43	39.60187979	-80.85605256
6,133.00	23.38	181.05	5,789.32	-1,544.52	188.29	14,381,778.71	1,680,963.91	39.60182329	-80.85604742
6,180.00	19.30	195.02	5,833.11	-1,561.36	186.10	14,381,761.86	1,680,961.72	39.60177704	-80.85605527
6,228.00	15.47	204.42	5,878.92	-1,574.86	181.40	14,381,748.37	1,680,957.02	39.60173999	-80.85607205
6,275.00	13.45	209.43	5,924.43	-1,585.33	176.12	14,381,737.90	1,680,951.74	39.60171126	-80.85609085
6,322.00	13.05	210.66	5,970.18	-1,594.66	170.73	14,381,728.57	1,680,946.35	39.60168568	-80.85611005
6,369.00	12.62	224.02	6,016.02	-1,602.92	164.45	14,381,720.31	1,680,940.07	39.60166302	-80.85613237
6,417.00	11.91	245.82	6,062.95	-1,608.72	156.29	14,381,714.51	1,680,931.91	39.60164712	-80.85616140
6,464.00	11.12	262.52	6,109.01	-1,611.30	147.36	14,381,711.93	1,680,922.98	39.60164008	-80.85619308
6,513.00	12.09	277.29	6,157.02	-1,611.26	137.59	14,381,711.97	1,680,913.21	39.60164022	-80.85622780
6,560.00	13.05	291.26	6,202.90	-1,608.71	127.76	14,381,714.52	1,680,903.38	39.60164727	-80.85626268
6,607.00	16.22	298.73	6,248.38	-1,603.63	117.05	14,381,719.60	1,680,892.67	39.60166127	-80.85630066
6,654.00	18.95	302.51	6,293.18	-1,596.37	104.86	14,381,726.86	1,680,880.48	39.60168126	-80.85634391
6,702.00	21.67	304.44	6,338.19	-1,587.17	90.97	14,381,736.06	1,680,866.59	39.60170659	-80.85639315
6,749.00	26.81	307.61	6,381.03	-1,575.78	75.41	14,381,747.44	1,680,851.03	39.60173793	-80.85644834
6,797.00	30.73	311.12	6,423.10	-1,561.11	57.59	14,381,762.12	1,680,833.21	39.60177832	-80.85651153
6,844.00	33.80	315.87	6,462.85	-1,543.82	39.43	14,381,779.41	1,680,815.05	39.60182587	-80.85657589
6,892.00	37.27	320.70	6,501.91	-1,522.98	20.92	14,381,800.25	1,680,796.54	39.60186319	-80.85664149
6,939.00	41.36	322.02	6,538.27	-1,499.72	2.34	14,381,823.51	1,680,777.96	39.60194716	-80.85670731
6,987.00	45.98	321.58	6,572.98	-1,473.68	-18.15	14,381,849.55	1,680,757.47	39.60201875	-80.85677993
7,082.00	57.67	320.26	6,631.59	-1,415.85	-65.20	14,381,907.38	1,680,710.42	39.60217777	-80.85694664
7,129.00	64.13	323.34	6,654.44	-1,383.58	-90.55	14,381,939.65	1,680,685.07	39.60226651	-80.85703646
7,178.00	67.38	324.57	6,674.56	-1,347.46	-116.83	14,381,975.77	1,680,658.79	39.60236583	-80.85712956
7,225.00	70.33	325.80	6,691.52	-1,311.47	-141.85	14,382,011.76	1,680,633.77	39.60246478	-80.85721818
7,273.00	71.78	325.45	6,707.10	-1,274.00	-167.49	14,382,049.23	1,680,608.13	39.60256779	-80.85730898
7,320.00	71.16	326.24	6,722.04	-1,237.13	-192.51	14,382,086.10	1,680,583.11	39.60266918	-80.85739759
7,368.00	76.66	328.97	6,735.34	-1,198.19	-217.19	14,382,125.03	1,680,558.43	39.60277621	-80.85748501
7,415.00	81.76	330.90	6,744.13	-1,158.25	-240.31	14,382,164.98	1,680,535.32	39.60288601	-80.85756685
7,461.00	84.31	331.43	6,749.71	-1,118.25	-262.32	14,382,204.97	1,680,513.30	39.60299595	-80.85764480
7,512.00	89.67	332.22	6,752.39	-1,073.37	-286.36	14,382,249.85	1,680,489.26	39.60311931	-80.85772989
7,556.00	90.20	332.22	6,752.44	-1,034.45	-306.87	14,382,288.78	1,680,468.75	39.60322631	-80.85780247
7,651.00	89.63	331.78	6,752.58	-950.57	-351.47	14,382,372.66	1,680,424.15	39.60345687	-80.85796035
7,747.00	90.46	330.11	6,752.50	-866.65	-398.09	14,382,456.58	1,680,377.53	39.60368753	-80.85812539
7,842.00	90.07	329.84	6,752.06	-784.40	-445.62	14,382,538.83	1,680,330.00	39.60391363	-80.85829370
7,937.00	89.49	329.41	6,752.43	-702.44	-493.66	14,382,620.78	1,680,281.96	39.60413892	-80.85846378
8,032.00	91.43	329.58	6,751.67	-620.60	-541.88	14,382,702.63	1,680,233.74	39.60436391	-80.85863452
8,127.00	91.16	329.14	6,749.52	-538.88	-590.28	14,382,784.34	1,680,185.34	39.60458854	-80.85880592
8,222.00	90.81	329.23	6,747.89	-457.31	-638.94	14,382,865.92	1,680,136.68	39.60481278	-80.85897822
8,317.00	90.59	329.67	6,746.72	-375.50	-687.23	14,382,947.73	1,680,088.40	39.60503766	-80.85914919
8,410.00	92.13	329.05	6,744.52	-295.51	-734.61	14,383,027.72	1,680,041.01	39.60525755	-80.85931697
8,505.00	91.52	329.05	6,741.49	-214.08	-783.44	14,383,109.15	1,679,992.18	39.60548140	-80.85948989
8,599.00	90.07	328.35	6,740.19	-133.77	-832.27	14,383,189.46	1,679,943.35	39.60570217	-80.85966281
8,694.00	90.02	327.82	6,740.11	-53.13	-882.49	14,383,270.10	1,679,893.13	39.60592385	-80.85984067
8,788.00	88.44	327.56	6,741.38	26.31	-932.73	14,383,349.53	1,679,842.89	39.60614222	-80.86001859
8,883.00	88.31	326.68	6,744.07	106.05	-984.28	14,383,429.28	1,679,791.34	39.60636146	-80.86020119
8,977.00	88.88	329.41	6,746.38	185.78	-1,034.01	14,383,509.00	1,679,741.61	39.60658063	-80.86037731
9,072.00	90.95	329.49	6,746.52	267.59	-1,082.30	14,383,590.81	1,679,693.33	39.60680551	-80.86054829
9,168.00	90.90	330.20	6,744.97	350.58	-1,130.51	14,383,673.81	1,679,645.11	39.60703365	-80.86071904
9,263.00	90.59	330.46	6,743.73	433.12	-1,177.53	14,383,756.35	1,679,598.09	39.60726053	-80.86088553
9,358.00	90.15	330.64	6,743.12	515.84	-1,224.24	14,383,839.07	1,679,551.38	39.60748792	-80.86105091

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

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Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N-S (ft)	+E-W (ft)	Map Northing (usft)	Map Easting (usft)	WV Department of Environmental Protection	
								Latitude	Longitude
9,453.00	89.89	330.28	6,743.08	598.49	-1,271.08	14,383,921.72	1,679,504.54	39.60771510	-80.86121675
9,548.00	89.49	329.58	6,743.60	680.71	-1,318.68	14,384,003.93	1,679,456.94	39.60794109	-80.86138531
9,643.00	91.60	329.41	6,742.70	762.55	-1,366.90	14,384,085.77	1,679,408.73	39.60816606	-80.86155606
9,738.00	91.03	329.14	6,740.52	844.19	-1,415.42	14,384,167.42	1,679,360.20	39.60839049	-80.86172790
9,832.00	90.29	330.02	6,739.43	925.25	-1,463.01	14,384,248.47	1,679,312.61	39.60861329	-80.86189644
9,926.00	90.77	329.32	6,738.56	1,006.38	-1,510.48	14,384,329.60	1,679,265.14	39.60883631	-80.86206452
10,021.00	88.35	328.53	6,739.29	1,087.73	-1,559.51	14,384,410.96	1,679,216.12	39.60905995	-80.86223817
10,115.00	88.70	330.55	6,741.71	1,168.73	-1,607.14	14,384,491.95	1,679,168.48	39.60928259	-80.86240685
10,211.00	88.53	329.76	6,744.03	1,251.97	-1,654.90	14,384,575.19	1,679,120.72	39.60951141	-80.86257598
10,306.00	88.62	331.43	6,746.40	1,334.70	-1,701.53	14,384,657.93	1,679,074.09	39.60973882	-80.86274109
10,399.00	90.64	331.78	6,747.00	1,416.51	-1,745.75	14,384,739.73	1,679,029.87	39.60996367	-80.86289766
10,494.00	90.29	331.69	6,746.22	1,500.18	-1,790.74	14,384,823.40	1,678,984.89	39.61019365	-80.86305694
10,589.00	90.07	331.34	6,745.93	1,583.68	-1,836.05	14,384,906.90	1,678,939.58	39.61042316	-80.86321736
10,684.00	90.73	333.10	6,745.26	1,667.72	-1,880.32	14,384,990.95	1,678,895.30	39.61065416	-80.86337411
10,779.00	92.75	334.06	6,742.38	1,752.76	-1,922.57	14,385,075.98	1,678,853.06	39.61088787	-80.86352366
10,874.00	91.65	331.08	6,738.73	1,837.00	-1,966.29	14,385,160.22	1,678,809.33	39.61113479	-80.86367846
10,969.00	91.47	331.16	6,736.14	1,920.16	-2,012.16	14,385,243.38	1,678,763.46	39.61134798	-80.86384087
11,064.00	90.64	332.22	6,734.40	2,003.78	-2,057.20	14,385,327.00	1,678,718.42	39.61157783	-80.86400036
11,159.00	90.51	329.23	6,733.44	2,086.63	-2,103.65	14,385,409.85	1,678,671.97	39.61180556	-80.86416484
11,253.00	90.37	329.32	6,732.72	2,167.43	-2,151.68	14,385,490.66	1,678,623.95	39.61202768	-80.86433493
11,348.00	89.85	328.70	6,732.54	2,248.87	-2,200.59	14,385,572.09	1,678,575.03	39.61225154	-80.86450817
11,443.00	92.09	329.23	6,730.93	2,330.26	-2,249.56	14,385,653.48	1,678,526.07	39.61247525	-80.86468161
11,538.00	91.47	328.88	6,727.98	2,411.69	-2,298.39	14,385,734.92	1,678,477.24	39.61269911	-80.86485455
11,633.00	91.21	328.26	6,725.76	2,492.73	-2,347.91	14,385,815.95	1,678,427.72	39.61292188	-80.86502997
11,727.00	90.99	328.00	6,723.95	2,572.55	-2,397.53	14,385,895.77	1,678,378.09	39.61314128	-80.86520574
11,822.00	91.21	328.79	6,722.13	2,653.44	-2,447.31	14,385,976.66	1,678,328.32	39.61336365	-80.86538206
11,917.00	91.78	329.14	6,719.65	2,734.81	-2,496.27	14,386,058.03	1,678,279.36	39.61358733	-80.86555548
12,012.00	91.60	328.61	6,716.85	2,816.10	-2,545.35	14,386,139.32	1,678,230.27	39.61381078	-80.86572934
12,106.00	91.65	328.09	6,714.18	2,896.09	-2,594.66	14,386,219.31	1,678,180.97	39.61403066	-80.86590399
12,201.00	91.16	328.09	6,711.85	2,976.71	-2,644.86	14,386,299.93	1,678,130.77	39.61425227	-80.86608181
12,296.00	90.90	330.28	6,710.15	3,058.28	-2,693.51	14,386,381.50	1,678,082.11	39.61447649	-80.86625415
12,390.00	91.47	329.67	6,708.20	3,139.65	-2,740.54	14,386,462.87	1,678,035.09	39.61470015	-80.86642070
12,485.00	90.99	329.76	6,706.16	3,221.66	-2,788.44	14,386,544.88	1,677,987.19	39.61492559	-80.86659035
12,578.00	90.46	329.23	6,704.99	3,301.78	-2,835.64	14,386,625.00	1,677,939.99	39.61514582	-80.86675754
12,673.00	90.95	330.55	6,703.82	3,383.96	-2,883.29	14,386,707.17	1,677,892.33	39.61537169	-80.86692632
12,767.00	90.59	331.16	6,702.55	3,466.05	-2,929.07	14,386,789.27	1,677,846.56	39.61559733	-80.86709843
12,861.00	92.04	330.99	6,700.40	3,548.30	-2,974.52	14,386,871.52	1,677,801.11	39.61582340	-80.86724940
12,956.00	91.30	330.28	6,697.63	3,631.05	-3,021.08	14,386,954.27	1,677,754.54	39.61605087	-80.86741431
13,051.00	90.24	330.11	6,696.35	3,713.48	-3,068.30	14,387,036.70	1,677,707.33	39.61627743	-80.86758154
13,146.00	91.03	330.02	6,695.30	3,795.80	-3,115.70	14,387,119.02	1,677,659.92	39.61650371	-80.86774944
13,241.00	90.46	329.05	6,694.06	3,877.68	-3,163.86	14,387,200.89	1,677,611.76	39.61672876	-80.86792003
13,336.00	92.26	329.49	6,691.81	3,959.31	-3,212.39	14,387,282.53	1,677,563.23	39.61695316	-80.86809193
13,430.00	91.78	329.58	6,688.49	4,040.28	-3,260.02	14,387,363.50	1,677,515.60	39.61717572	-80.86826064
13,525.00	91.34	329.05	6,685.91	4,121.95	-3,308.48	14,387,445.17	1,677,467.14	39.61740021	-80.86843230
13,620.00	90.29	330.64	6,684.56	4,204.08	-3,356.20	14,387,527.30	1,677,419.43	39.61762596	-80.86860131
13,714.00	92.18	330.99	6,682.53	4,286.12	-3,402.02	14,387,609.34	1,677,373.60	39.61785147	-80.86876361
13,809.00	91.47	331.43	6,679.51	4,369.34	-3,447.75	14,387,692.56	1,677,327.87	39.61808019	-80.86892557
13,903.00	90.90	331.16	6,677.56	4,451.77	-3,492.89	14,387,774.98	1,677,282.74	39.61830675	-80.86908543
13,999.00	90.42	331.25	6,676.46	4,535.89	-3,539.13	14,387,859.11	1,677,236.50	39.61853797	-80.86924919
14,093.00	89.98	331.43	6,676.13	4,618.37	-3,584.21	14,387,941.59	1,677,191.42	39.61876468	-80.86940885
14,188.00	91.74	331.43	6,674.70	4,701.79	-3,629.64	14,388,025.01	1,677,145.99	39.61899396	-80.86956973
14,282.00	91.65	331.34	6,671.92	4,784.28	-3,674.64	14,388,107.49	1,677,100.99	39.61922067	-80.86972910
14,377.00	91.78	331.16	6,669.08	4,867.53	-3,720.31	14,388,190.74	1,677,055.32	39.61944949	-80.86989087
14,472.00	90.86	330.99	6,666.89	4,950.65	-3,766.24	14,388,273.87	1,677,009.38	39.61967796	-80.87005356
14,567.00	89.98	331.16	6,666.19	5,033.80	-3,812.19	14,388,357.02	1,676,963.44	39.61990649	-80.87021630

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Lackawanna N-04 HM (slot AA)
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>TVD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Site:</b>	Lackawanna	<b>MD Reference:</b>	RKB=1306+18 @ 1324.00ft (Precision 528)
<b>Well:</b>	Lackawanna N-04 HM (slot AA)	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	Original Hole	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys Original Hole	<b>Database:</b>	DB_Jul2216dt_v14

Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
14,662.00	90.42	331.69	6,665.86	5,117.23	-3,857.63	14,388,440.44	1,676,918.00	39.62013580	-80.87037723	
14,757.00	90.37	329.84	6,665.21	5,200.12	-3,904.02	14,388,523.34	1,676,871.60	39.62036364	-80.87054156	
14,852.00	90.15	330.20	6,664.78	5,282.41	-3,951.49	14,388,605.62	1,676,824.13	39.62058982	-80.87070972	
14,947.00	90.46	328.44	6,664.27	5,364.11	-3,999.97	14,388,687.32	1,676,775.66	39.62081438	-80.87088143	
15,041.00	90.29	328.88	6,663.66	5,444.39	-4,048.85	14,388,767.61	1,676,726.77	39.62103506	-80.87105464	
15,137.00	89.93	328.79	6,663.47	5,526.54	-4,098.54	14,388,849.75	1,676,677.09	39.62126086	-80.87123064	
15,231.00	89.54	329.41	6,663.91	5,607.19	-4,146.81	14,388,930.41	1,676,628.82	39.62148256	-80.87140166	
15,325.00	88.79	329.67	6,665.28	5,688.21	-4,194.45	14,389,011.42	1,676,581.17	39.62170525	-80.87157045	
15,419.00	90.68	329.32	6,665.71	5,769.19	-4,242.17	14,389,092.41	1,676,533.46	39.62192785	-80.87173948	
15,514.00	90.33	329.49	6,664.87	5,850.96	-4,290.52	14,389,174.18	1,676,485.11	39.62215261	-80.87191077	
15,608.00	92.35	328.97	6,662.67	5,931.71	-4,338.59	14,389,254.92	1,676,437.04	39.62237454	-80.87208108	
15,703.00	91.96	328.61	6,659.10	6,012.90	-4,387.78	14,389,336.11	1,676,387.85	39.62259772	-80.87225537	
15,797.00	91.12	328.79	6,656.58	6,093.19	-4,436.60	14,389,416.40	1,676,339.03	39.62281841	-80.87242832	
15,892.00	90.59	329.67	6,655.16	6,174.81	-4,485.19	14,389,498.02	1,676,290.44	39.62304275	-80.87260049	
15,987.00	92.18	330.02	6,652.86	6,256.92	-4,532.90	14,389,580.14	1,676,242.73	39.62326846	-80.87276950	
16,081.00	91.74	330.46	6,649.65	6,338.48	-4,579.53	14,389,661.69	1,676,196.10	39.62349262	-80.87293469	
16,175.00	91.08	330.37	6,647.33	6,420.20	-4,625.93	14,389,743.41	1,676,149.70	39.62371723	-80.87309904	
16,269.00	90.55	330.11	6,646.00	6,501.79	-4,672.58	14,389,825.00	1,676,103.05	39.62394150	-80.87326432	
16,364.00	90.11	330.02	6,645.45	6,584.11	-4,719.99	14,389,907.33	1,676,055.64	39.62416777	-80.87343226	
16,460.00	91.38	330.55	6,644.20	6,667.48	-4,767.57	14,389,990.69	1,676,008.06	39.62439691	-80.87360082	
16,554.00	90.59	330.28	6,642.59	6,749.21	-4,813.97	14,390,072.43	1,675,961.66	39.62462156	-80.87376521	
16,649.00	92.84	329.67	6,639.74	6,831.42	-4,861.48	14,390,154.63	1,675,914.15	39.62484752	-80.87393353	
16,745.00	92.22	330.20	6,635.51	6,914.42	-4,909.53	14,390,237.64	1,675,866.10	39.62507566	-80.87410375	
16,839.00	91.38	330.20	6,632.55	6,995.95	-4,956.22	14,390,319.17	1,675,819.41	39.62529974	-80.87426916	
16,933.00	90.86	329.93	6,630.72	7,077.40	-5,003.12	14,390,400.61	1,675,772.51	39.62552360	-80.87443532	
17,028.00	90.02	329.76	6,629.99	7,159.54	-5,050.84	14,390,482.75	1,675,724.79	39.62574937	-80.87460439	
17,123.00	91.56	329.23	6,628.68	7,241.38	-5,099.05	14,390,564.59	1,675,676.58	39.62597431	-80.87477522	
17,218.00	90.90	329.05	6,626.64	7,322.91	-5,147.77	14,390,646.12	1,675,627.86	39.62619841	-80.87494784	
17,313.00	90.15	329.49	6,625.77	7,404.57	-5,196.31	14,390,727.78	1,675,579.32	39.62642286	-80.87511983	
<b>Survey @ 17313.00 MD 6625.77 TVD</b>										
17,369.00	90.15	329.49	6,625.62	7,452.81	-5,224.75	14,390,776.02	1,675,550.89	39.62655547	-80.87522056	
<b>Survey projected to 17369.00 MD 6625.62 TVD</b>										

Design Annotations					
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment	
		+N/-S (ft)	+E/-W (ft)		
216.00	216.00	-0.34	-1.04	MWD surveys	
17,313.00	6,625.77	7,404.57	-5,196.31	Survey @ 17313.00 MD 6625.77 TVD	
17,369.00	6,625.62	7,452.81	-5,224.75	Survey projected to 17369.00 MD 6625.62 TVD	

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