



Well: Lackawanna N-05 HM (slot BB)
 Site: Lackawanna
 Project: Wetzel County, West Virginia (UTM17 NAD83)
 Design: rev3
 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	0.00	0.00	
2	1818.00	0.00	0.00	1818.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 2°/100' build
3	3243.00	28.50	185.00	3184.96	-345.84	-30.26	2.00	185.000	-245.38	Begin 28.50° tangent
4	5328.80	28.50	185.00	5018.00	-1337.32	-117.00	0.00	0.000	-948.85	Begin 3°/100' build/turn
5	5581.44	35.83	188.62	5231.73	-1470.67	-133.37	3.00	16.292	-1040.45	Begin 35.83° tangent
6	6329.70	35.83	188.62	5838.37	-1903.76	-199.05	0.00	0.000	-1329.87	Begin 8°/100' build/turn
7	7235.47	50.00	307.97	6601.13	-1960.17	-562.02	8.00	135.549	-1139.64	Begin 10°/100' build/turn
8	7692.17	91.00	330.00	6752.00	-1637.55	-828.33	10.00	31.621	-721.32	Begin 91.00° lateral
9	17388.32	91.00	330.00	6582.84	6758.34	-5675.56	0.00	0.000	8825.37	PBHL/TD 17388.32 MD/6582.84 TVD

ANNOTATIONS SURVEYS

MD	Inc	Azi	TVD	+N-S	+E-W	Vsect	Annotation
216.00	1.19	87.70	215.98	0.09	2.24	-1.37	MWD surveys
17327.00	91.56	330.29	6638.81	6710.17	-5621.99	8754.03	Survey @ 17327.00 MD 6638.81 TVD
17378.00	91.56	330.29	6637.42	6754.45	-5647.26	8804.19	Survey projected to 17378.00 MD 6637.42 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)

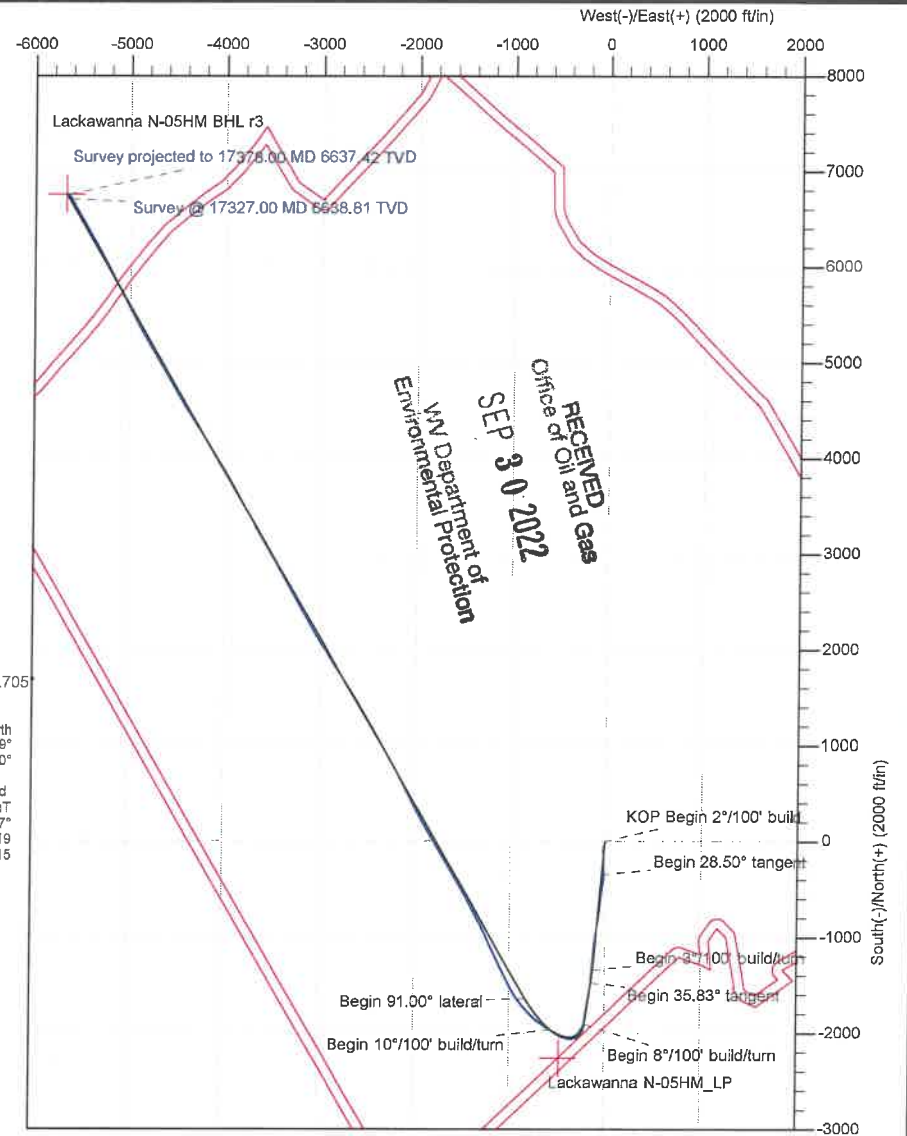
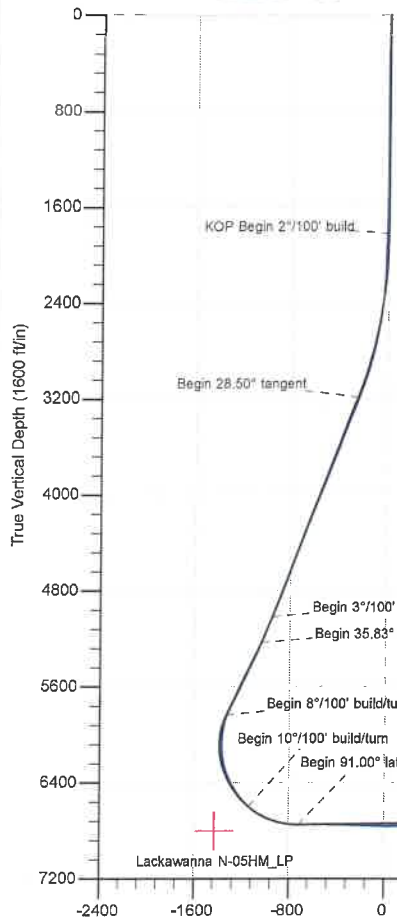
Northing	Easting	Latitude	Longitude
14383311.24	1680775.08	39.60603303	-80.85670914

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.705°



Azimuths to Grid North
 True North: -0.09°
 Magnetic North: -8.70°

Magnetic Field
 Strength: 51870.2snT
 Dip Angle: 66.67°
 Date: 6/7/2019
 Model: IGRF2015



Lackawanna N-05HM BHL r3
 Survey @ 17327.00 MD 6638.81 TVD
 Survey projected to 17378.00 MD 6637.42 TVD

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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

SEP 30 2022

WV Department of
Environmental Protection

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

Well	Lackawanna N-05 HM (slot BB)					
Well Position	+N/-S	0.00 ft	Northing:	14,383,311.24 usft	Latitude:	39.60603303
	+E/-W	0.00 ft	Easting:	1,680,775.08 usft	Longitude:	-80.85670914
Position Uncertainty		0.00 ft	Wellhead Elevation:	ft	Ground Level:	1,306.00 ft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	6/7/2019	-8.614	66.670	51,870.15612012

Design	Surveys Original Hole				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)	
	0.00	0.00	0.00		319.98

Survey Program	Date 6/26/2019			
From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
216.00	3,062.00	MWD surf (Original Hole)	MWD	MWD - Standard
3,155.00	17,327.00	MWD (Original Hole)	MWD	MWD - Standard
17,378.00	17,378.00	Projection (Original Hole)	MWD	MWD - Standard

Survey										
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)	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
216.00	1.19	87.70	215.98	0.09	2.24	-1.37	0.55	0.55	0.00	
MWD surveys										
246.00	1.03	76.65	245.98	0.16	2.81	-1.68	0.89	-0.53	-36.83	
277.00	0.57	68.94	276.98	0.28	3.23	-1.86	1.52	-1.48	-24.87	
307.00	0.78	86.83	306.97	0.35	3.57	-2.03	0.98	0.70	59.63	
337.00	0.66	83.52	336.97	0.38	3.95	-2.25	0.42	-0.40	-11.03	
367.00	0.59	90.28	366.97	0.40	4.27	-2.44	0.34	-0.23	22.53	
397.00	0.31	60.71	396.97	0.44	4.50	-2.56	1.18	-0.93	-98.57	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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Survey										
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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)	Department of Environmental Protection	Department of Protection
428.00	0.41	92.33	427.97	0.47	4.68	-2.65	0.70	0.32		102.00
473.00	0.22	68.21	472.97	0.50	4.92	-2.78	0.51	-0.42		-53.60
518.00	0.49	117.48	517.97	0.44	5.18	-2.99	0.85	0.60		109.49
563.00	0.24	94.33	562.97	0.35	5.44	-3.23	0.63	-0.56		-51.44
609.00	0.16	104.28	608.97	0.32	5.60	-3.35	0.19	-0.17		21.63
656.00	0.15	153.37	655.97	0.25	5.69	-3.47	0.27	-0.02		104.45
700.00	0.05	174.90	699.97	0.18	5.72	-3.54	0.24	-0.23		48.93
791.00	0.03	198.82	790.97	0.12	5.71	-3.58	0.03	-0.02		26.29
886.00	0.25	272.91	885.96	0.11	5.50	-3.45	0.26	0.23		77.99
979.00	0.13	157.75	978.96	0.02	5.34	-3.42	0.35	-0.13		-123.83
1,074.00	0.14	130.42	1,073.96	-0.16	5.46	-3.63	0.07	0.01		-28.77
1,169.00	0.16	85.43	1,168.96	-0.22	5.69	-3.82	0.12	0.02		-47.36
1,215.00	0.18	99.82	1,214.96	-0.23	5.82	-3.92	0.10	0.04		31.28
1,296.00	0.34	246.15	1,295.96	-0.35	5.73	-3.95	0.62	0.20		180.65
1,359.00	0.58	268.75	1,358.96	-0.43	5.24	-3.70	0.47	0.38		35.87
1,454.00	0.52	231.57	1,453.96	-0.71	4.42	-3.38	0.37	-0.06		-39.14
1,549.00	0.79	191.77	1,548.95	-1.62	3.95	-3.78	0.54	0.28		-41.89
1,641.00	0.87	178.29	1,640.94	-2.93	3.84	-4.72	0.23	0.09		-14.65
1,737.00	0.72	176.92	1,736.93	-4.27	3.89	-5.77	0.16	-0.16		-1.43
1,831.00	2.11	199.79	1,830.90	-6.48	3.34	-7.11	1.57	1.48		24.33
1,926.00	3.09	201.26	1,925.80	-10.52	1.82	-9.22	1.03	1.03		1.55
2,021.00	4.06	202.90	2,020.62	-16.00	-0.42	-11.98	1.03	1.02		1.73
2,115.00	5.91	196.47	2,114.26	-23.71	-3.09	-16.17	2.05	1.97		-6.84
2,211.00	7.85	191.56	2,209.56	-34.87	-5.80	-22.97	2.11	2.02		-5.11
2,305.00	9.34	191.46	2,302.51	-48.64	-8.60	-31.71	1.59	1.59		-0.11
2,400.00	11.11	190.00	2,395.99	-65.21	-11.73	-42.40	1.88	1.86		-1.54
2,495.00	12.37	186.58	2,489.00	-84.33	-14.48	-55.27	1.51	1.33		-3.60
2,588.00	13.44	184.20	2,579.65	-105.01	-16.41	-69.86	1.28	1.15		-2.56
2,683.00	15.35	181.94	2,671.67	-128.59	-17.65	-87.12	2.10	2.01		-2.38
2,778.00	17.29	179.54	2,762.84	-155.27	-17.96	-107.36	2.16	2.04		-2.53
2,872.00	18.20	177.86	2,852.37	-183.91	-17.30	-129.72	1.11	0.97		-1.79
2,967.00	19.56	177.17	2,942.25	-214.62	-15.96	-154.10	1.45	1.43		-0.73
3,062.00	21.80	177.13	3,031.13	-248.13	-14.29	-180.83	2.36	2.36		-0.04
3,155.00	25.79	176.00	3,116.20	-285.57	-12.02	-210.97	4.32	4.29		-1.22
3,251.00	26.70	179.86	3,202.31	-327.97	-10.51	-244.41	2.01	0.95		4.02
3,346.00	27.67	186.12	3,286.83	-371.26	-12.81	-276.08	3.18	1.02		6.59
3,441.00	29.76	186.38	3,370.15	-416.63	-17.78	-307.63	2.20	2.20		0.27
3,535.00	30.12	186.84	3,451.60	-463.23	-23.18	-339.85	0.45	0.38		0.49
3,630.00	29.24	189.28	3,534.14	-509.80	-29.76	-371.28	1.57	-0.93		2.57
3,725.00	29.35	186.49	3,617.00	-555.83	-36.13	-402.43	1.44	0.12		-2.94
3,821.00	29.64	183.69	3,700.56	-602.90	-40.32	-435.78	1.47	0.30		-2.92
3,916.00	29.95	186.73	3,783.00	-649.89	-44.61	-469.01	1.62	0.33		3.20
4,011.00	30.47	189.22	3,865.11	-697.22	-51.25	-500.99	1.43	0.55		2.62

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Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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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)
4,106.00	31.07	187.35	3,946.73	-745.31	-58.25	-533.32	1.19	0.63	-1.97
4,200.00	29.92	186.79	4,027.73	-792.65	-64.12	-565.79	1.26	-1.22	-0.60
4,295.00	29.55	187.92	4,110.22	-839.38	-70.15	-597.70	0.71	-0.39	1.19
4,391.00	30.21	189.12	4,193.46	-886.67	-77.24	-629.36	0.93	0.69	1.25
4,485.00	29.76	187.49	4,274.88	-933.16	-84.03	-660.59	0.99	-0.48	-1.73
4,580.00	29.48	185.15	4,357.47	-979.81	-89.20	-693.00	1.25	-0.29	-2.46
4,675.00	29.38	185.16	4,440.21	-1,026.31	-93.40	-725.91	0.11	-0.11	0.01
4,770.00	28.69	186.34	4,523.27	-1,072.18	-98.01	-758.07	0.94	-0.73	1.24
4,865.00	27.54	186.55	4,607.06	-1,116.66	-103.03	-788.91	1.21	-1.21	0.22
4,960.00	27.01	186.36	4,691.50	-1,159.92	-107.93	-818.89	0.57	-0.56	-0.20
5,056.00	28.49	186.00	4,776.45	-1,204.36	-112.74	-849.83	1.55	1.54	-0.38
5,151.00	30.50	183.46	4,859.14	-1,250.96	-116.56	-883.06	2.49	2.12	-2.67
5,246.00	30.95	186.52	4,940.81	-1,299.30	-120.79	-917.36	1.71	0.47	3.22
5,339.00	31.44	187.54	5,020.36	-1,347.11	-126.69	-950.17	0.77	0.53	1.10
5,434.00	29.09	184.73	5,102.41	-1,394.69	-131.84	-983.30	2.89	-2.47	-2.96
5,529.00	30.24	183.36	5,184.96	-1,441.59	-135.15	-1,017.09	1.41	1.21	-1.44
5,625.00	32.50	185.50	5,266.93	-1,491.40	-139.04	-1,052.74	2.62	2.35	2.23
5,720.00	36.22	188.71	5,345.34	-1,544.58	-145.74	-1,089.15	4.35	3.92	3.38
5,815.00	36.94	189.12	5,421.63	-1,600.51	-154.52	-1,126.34	0.80	0.76	0.43
5,910.00	35.97	190.01	5,498.04	-1,656.17	-163.89	-1,162.94	1.16	-1.02	0.94
6,005.00	35.77	189.42	5,575.02	-1,711.03	-173.28	-1,198.91	0.42	-0.21	-0.62
6,099.00	35.99	187.85	5,651.19	-1,765.50	-181.55	-1,235.31	1.01	0.23	-1.67
6,172.00	35.91	187.65	5,710.28	-1,807.96	-187.33	-1,264.11	0.19	-0.11	-0.27
6,227.00	37.45	186.42	5,754.39	-1,840.57	-191.35	-1,286.50	3.10	2.80	-2.24
6,321.00	35.38	193.45	5,830.07	-1,895.46	-200.88	-1,322.41	4.95	-2.20	7.48
6,368.00	33.05	200.57	5,868.95	-1,920.71	-208.55	-1,336.81	9.85	-4.96	15.15
6,417.00	29.93	207.60	5,910.74	-1,944.07	-218.92	-1,348.03	9.82	-6.37	14.35
6,464.00	27.16	213.93	5,952.03	-1,963.37	-230.34	-1,355.46	8.72	-5.89	13.47
6,512.00	25.27	217.97	5,995.09	-1,980.54	-242.76	-1,360.63	5.41	-3.94	8.42
6,559.00	23.69	222.63	6,037.87	-1,995.39	-255.33	-1,363.92	5.31	-3.36	9.91
6,607.00	23.47	229.31	6,081.87	-2,008.72	-269.11	-1,365.27	5.58	-0.46	13.92
6,654.00	22.86	236.43	6,125.09	-2,019.88	-283.82	-1,364.35	6.10	-1.30	15.15
6,701.00	22.68	246.45	6,168.45	-2,028.55	-299.74	-1,360.76	8.25	-0.38	21.32
6,748.00	23.38	253.92	6,211.71	-2,034.75	-317.01	-1,354.40	6.39	1.49	15.89
6,796.00	24.88	262.09	6,255.53	-2,038.78	-336.17	-1,345.17	7.62	3.13	17.02
6,843.00	26.37	269.65	6,297.91	-2,040.21	-356.40	-1,333.24	7.64	3.17	16.09
6,891.00	28.53	275.63	6,340.51	-2,039.15	-378.48	-1,318.24	7.29	4.50	12.46
6,938.00	30.37	282.75	6,381.45	-2,035.42	-401.25	-1,300.74	8.41	3.91	15.15
6,987.00	33.14	288.99	6,423.12	-2,028.33	-426.00	-1,279.39	8.76	5.65	12.73
7,034.00	36.57	292.33	6,461.69	-2,018.82	-451.11	-1,255.96	8.35	7.30	7.11
7,082.00	39.52	294.43	6,499.49	-2,007.07	-478.25	-1,229.51	6.71	6.15	4.38
7,129.00	42.55	298.21	6,534.94	-1,993.37	-505.88	-1,201.25	8.33	6.45	8.04
7,177.00	46.15	299.88	6,569.26	-1,977.07	-535.20	-1,169.91	7.88	7.50	3.48
7,224.00	50.51	300.76	6,600.50	-1,959.34	-565.49	-1,136.86	9.38	9.28	1.87

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								Build Rate (°/100ft)	Turn Rate (°/100ft)
7,272.00	55.25	301.47	6,629.46	-1,939.56	-598.25	-1,100.65	9.95	9.88	1.48
7,319.00	59.21	303.31	6,654.90	-1,918.39	-631.60	-1,062.98	9.05	8.43	3.91
7,367.00	63.43	306.21	6,677.93	-1,894.37	-666.17	-1,022.36	10.26	8.79	6.04
7,414.00	67.82	308.41	6,697.33	-1,868.42	-700.20	-980.60	10.27	9.34	4.68
7,461.00	70.42	311.75	6,714.08	-1,840.14	-733.79	-937.35	8.64	5.53	7.11
7,508.00	74.11	314.65	6,728.40	-1,809.50	-766.40	-892.91	9.81	7.85	6.17
7,556.00	78.24	317.46	6,739.87	-1,775.94	-798.73	-846.42	10.31	8.60	5.85
7,651.00	88.13	319.04	6,751.13	-1,705.65	-861.45	-752.26	10.54	10.41	1.66
7,698.00	91.03	321.86	6,751.47	-1,669.42	-891.37	-705.27	8.61	6.17	6.00
7,746.00	92.04	326.69	6,750.19	-1,630.47	-919.38	-657.44	10.28	2.10	10.06
7,841.00	90.68	330.82	6,747.93	-1,549.30	-968.63	-563.60	4.58	-1.43	4.35
7,936.00	89.58	333.19	6,747.71	-1,465.42	-1,013.22	-470.69	2.75	-1.16	2.49
8,032.00	88.79	332.67	6,749.08	-1,379.95	-1,056.90	-377.14	0.99	-0.82	-0.54
8,126.00	88.79	334.25	6,751.07	-1,295.87	-1,098.89	-285.76	1.68	0.00	1.68
8,221.00	88.04	334.25	6,753.69	-1,210.34	-1,140.15	-193.72	0.79	-0.79	0.00
8,316.00	87.47	333.72	6,757.41	-1,125.03	-1,181.79	-101.62	0.82	-0.60	-0.56
8,409.00	89.71	334.42	6,759.70	-1,041.42	-1,222.44	-11.45	2.52	2.41	0.75
8,504.00	91.82	334.16	6,758.43	-955.84	-1,263.64	80.59	2.24	2.22	-0.27
8,599.00	91.43	333.90	6,755.74	-870.47	-1,305.23	172.71	0.49	-0.41	-0.27
8,693.00	88.92	331.00	6,755.45	-787.14	-1,348.70	264.47	4.08	-2.67	-3.09
8,788.00	91.34	332.32	6,755.24	-703.54	-1,393.79	357.50	2.90	2.55	1.39
8,883.00	89.93	330.65	6,754.18	-620.07	-1,439.13	450.58	2.30	-1.48	-1.76
8,976.00	91.25	331.96	6,753.23	-538.50	-1,483.78	541.76	2.00	1.42	1.41
9,072.00	92.31	332.05	6,750.25	-453.78	-1,528.82	635.61	1.11	1.10	0.09
9,167.00	91.56	330.47	6,747.04	-370.53	-1,574.48	728.71	1.84	-0.79	-1.66
9,262.00	91.96	328.62	6,744.12	-288.68	-1,622.60	822.34	1.99	0.42	-1.95
9,357.00	94.15	328.10	6,739.06	-207.92	-1,672.36	916.19	2.37	2.31	-0.55
9,453.00	92.92	328.62	6,733.14	-126.35	-1,722.63	1,010.98	1.39	-1.28	0.54
9,548.00	90.42	330.65	6,730.37	-44.43	-1,770.62	1,104.58	3.39	-2.63	2.14
9,642.00	89.89	329.77	6,730.11	37.15	-1,817.32	1,197.09	1.09	-0.56	-0.94
9,737.00	88.75	328.01	6,731.24	118.48	-1,866.40	1,290.93	2.21	-1.20	-1.85
9,831.00	89.58	331.35	6,732.61	199.60	-1,913.84	1,383.56	3.66	0.88	3.55
9,925.00	88.75	332.84	6,733.98	282.66	-1,957.83	1,475.46	1.81	-0.88	1.59
10,020.00	88.79	332.76	6,736.02	367.13	-2,001.24	1,568.07	0.09	0.04	-0.08
10,115.00	88.66	332.49	6,738.14	451.47	-2,044.91	1,660.74	0.32	-0.14	-0.28
10,210.00	89.45	331.88	6,739.70	535.49	-2,089.24	1,753.58	1.05	0.83	-0.64
10,305.00	88.97	331.88	6,741.01	619.26	-2,134.01	1,846.53	0.51	-0.51	0.00
10,398.00	90.37	330.91	6,741.55	700.91	-2,178.53	1,937.68	1.83	1.51	-1.04
10,493.00	89.98	330.73	6,741.26	783.85	-2,224.85	2,030.99	0.45	-0.41	-0.19
10,588.00	89.36	330.38	6,741.80	866.58	-2,271.55	2,124.37	0.75	-0.65	-0.37
10,684.00	91.34	329.15	6,741.22	949.51	-2,319.88	2,218.97	2.43	2.06	-1.28
10,778.00	91.30	331.26	6,739.05	1,031.06	-2,366.58	2,311.44	2.24	-0.04	2.24
10,874.00	91.82	330.91	6,736.44	1,115.06	-2,412.98	2,405.61	0.65	0.54	-0.36

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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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)
10,969.00	91.78	330.65	6,733.46	1,197.93	-2,459.33	2,498.88	0.28	-0.04	-0.27
11,064.00	91.21	330.65	6,730.98	1,280.71	-2,505.88	2,592.21	0.60	-0.60	0.00
11,158.00	90.46	329.77	6,729.61	1,362.28	-2,552.57	2,684.70	1.23	-0.80	-0.94
11,253.00	90.07	329.68	6,729.17	1,444.32	-2,600.47	2,778.33	0.42	-0.41	-0.09
11,347.00	89.89	330.03	6,729.20	1,525.61	-2,647.67	2,870.94	0.42	-0.19	0.37
11,442.00	91.52	328.98	6,728.03	1,607.45	-2,695.87	2,964.62	2.04	1.72	-1.11
11,537.00	92.35	327.75	6,724.82	1,688.29	-2,745.67	3,058.54	1.56	0.87	-1.29
11,632.00	92.18	327.75	6,721.07	1,768.57	-2,796.33	3,152.60	0.18	-0.18	0.00
11,726.00	91.78	327.66	6,717.82	1,847.98	-2,846.52	3,245.69	0.44	-0.43	-0.10
11,821.00	91.38	327.92	6,715.20	1,928.33	-2,897.14	3,339.77	0.50	-0.42	0.27
11,916.00	90.86	327.04	6,713.34	2,008.42	-2,948.20	3,433.94	1.08	-0.55	-0.93
12,011.00	91.82	328.89	6,711.12	2,088.93	-2,998.57	3,527.99	2.19	1.01	1.95
12,106.00	92.09	331.09	6,707.88	2,171.14	-3,046.06	3,621.48	2.33	0.28	2.32
12,200.00	91.69	330.73	6,704.78	2,253.23	-3,091.73	3,713.73	0.57	-0.43	-0.38
12,295.00	91.65	329.77	6,702.01	2,335.68	-3,138.85	3,807.16	1.01	-0.04	-1.01
12,390.00	90.81	331.00	6,699.97	2,418.25	-3,185.79	3,900.58	1.57	-0.88	1.29
12,484.00	90.90	331.61	6,698.57	2,500.69	-3,230.91	3,992.74	0.66	0.10	0.65
12,577.00	90.37	331.79	6,697.54	2,582.57	-3,275.00	4,083.79	0.60	-0.57	0.19
12,672.00	90.07	331.44	6,697.18	2,666.15	-3,320.16	4,176.84	0.49	-0.32	-0.37
12,767.00	89.76	331.09	6,697.32	2,749.45	-3,365.84	4,270.00	0.49	-0.33	-0.37
12,861.00	91.56	330.82	6,696.23	2,831.62	-3,411.47	4,362.27	1.94	1.91	-0.29
12,956.00	90.73	329.50	6,694.34	2,914.00	-3,458.73	4,455.75	1.64	-0.87	-1.39
13,050.00	90.20	329.42	6,693.57	2,994.96	-3,506.49	4,548.47	0.57	-0.56	-0.09
13,146.00	89.71	329.77	6,693.65	3,077.76	-3,555.08	4,643.12	0.63	-0.51	0.36
13,241.00	91.08	330.38	6,692.99	3,160.09	-3,602.47	4,736.64	1.58	1.44	0.64
13,335.00	90.81	331.17	6,691.44	3,242.11	-3,648.35	4,828.97	0.89	-0.29	0.84
13,430.00	90.46	331.96	6,690.39	3,325.64	-3,693.59	4,922.02	0.91	-0.37	0.83
13,524.00	89.85	331.09	6,690.14	3,408.27	-3,738.40	5,014.12	1.13	-0.65	-0.93
13,619.00	91.21	331.35	6,689.26	3,491.53	-3,784.14	5,107.29	1.46	1.43	0.27
13,714.00	91.08	331.44	6,687.36	3,574.92	-3,829.61	5,200.39	0.17	-0.14	0.09
13,809.00	90.51	330.82	6,686.04	3,658.10	-3,875.47	5,293.59	0.89	-0.60	-0.65
13,903.00	89.98	329.94	6,685.64	3,739.82	-3,921.93	5,386.05	1.09	-0.56	-0.94
13,998.00	91.74	329.50	6,684.21	3,821.84	-3,969.83	5,479.66	1.91	1.85	-0.46
14,093.00	91.34	329.98	6,681.66	3,903.87	-4,017.68	5,573.25	0.66	-0.42	0.51
14,188.00	90.51	327.39	6,680.13	3,985.01	-4,067.05	5,667.14	2.86	-0.87	-2.73
14,282.00	91.30	328.98	6,678.64	4,064.88	-4,116.59	5,760.16	1.89	0.84	1.69
14,377.00	90.64	328.54	6,677.03	4,146.09	-4,165.86	5,854.03	0.83	-0.69	-0.46
14,471.00	90.20	328.10	6,676.34	4,226.08	-4,215.22	5,947.03	0.66	-0.47	-0.47
14,567.00	89.85	328.36	6,676.30	4,307.70	-4,265.76	6,042.04	0.45	-0.36	0.27
14,662.00	91.52	328.45	6,675.17	4,388.61	-4,315.53	6,136.01	1.76	1.76	0.09
14,757.00	91.16	328.27	6,672.94	4,469.46	-4,365.35	6,229.97	0.42	-0.38	-0.19
14,851.00	90.95	328.62	6,671.21	4,549.55	-4,414.54	6,322.93	0.43	-0.22	0.37
14,946.00	91.91	330.38	6,668.84	4,631.37	-4,462.73	6,416.58	2.11	1.01	1.85

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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WV Department of Environmental Protection									
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)
15,041.00	91.56	330.73	6,665.97	4,714.07	-4,509.41	6,509.93	0.52	-0.37	0.37
15,136.00	91.21	330.65	6,663.67	4,796.88	-4,555.91	6,603.24	0.38	-0.37	-0.08
15,231.00	90.77	329.42	6,662.03	4,879.17	-4,603.35	6,696.77	1.37	-0.46	-1.29
15,325.00	90.20	329.68	6,661.23	4,960.20	-4,650.98	6,789.46	0.67	-0.61	0.28
15,418.00	89.63	328.80	6,661.37	5,040.11	-4,698.55	6,881.24	1.13	-0.61	-0.95
15,514.00	89.36	328.71	6,662.22	5,122.19	-4,748.34	6,976.12	0.30	-0.28	-0.09
15,608.00	90.24	330.12	6,662.55	5,203.10	-4,796.17	7,068.84	1.77	0.94	1.50
15,702.00	90.20	330.38	6,662.18	5,284.71	-4,842.81	7,161.33	0.28	-0.04	0.28
15,797.00	89.89	331.44	6,662.11	5,367.73	-4,889.00	7,254.61	1.16	-0.33	1.12
15,891.00	89.63	331.35	6,662.50	5,450.26	-4,934.00	7,346.75	0.29	-0.28	-0.10
15,987.00	91.30	332.05	6,661.72	5,534.78	-4,979.51	7,440.74	1.89	1.74	0.73
16,081.00	90.95	332.10	6,659.88	5,617.81	-5,023.52	7,532.64	0.38	-0.37	0.05
16,175.00	90.59	332.40	6,658.62	5,700.99	-5,067.29	7,624.48	0.50	-0.38	0.32
16,269.00	91.47	332.49	6,656.93	5,784.32	-5,110.76	7,716.25	0.94	0.94	0.10
16,364.00	91.16	332.32	6,654.75	5,868.49	-5,154.76	7,809.00	0.37	-0.33	-0.18
16,459.00	90.90	332.93	6,653.04	5,952.84	-5,198.43	7,901.68	0.70	-0.27	0.64
16,554.00	90.81	332.67	6,651.62	6,037.32	-5,241.85	7,994.30	0.29	-0.09	-0.27
16,649.00	91.16	331.09	6,649.99	6,121.09	-5,286.62	8,087.24	1.70	0.37	-1.66
16,743.00	90.64	330.73	6,648.51	6,203.22	-5,332.32	8,179.53	0.67	-0.55	-0.38
16,838.00	90.33	331.00	6,647.71	6,286.20	-5,378.57	8,272.81	0.43	-0.33	0.28
16,932.00	89.67	330.21	6,647.71	6,368.10	-5,424.70	8,365.20	1.10	-0.70	-0.84
17,028.00	91.78	329.94	6,646.49	6,451.29	-5,472.59	8,459.70	2.22	2.20	-0.28
17,123.00	91.34	330.03	6,643.91	6,533.52	-5,520.09	8,553.22	0.47	-0.46	0.09
17,218.00	91.34	329.94	6,641.68	6,615.76	-5,567.60	8,646.75	0.09	0.00	-0.09
17,312.00	91.65	330.12	6,639.23	6,697.16	-5,614.54	8,739.28	0.38	0.33	0.19
17,327.00	91.56	330.29	6,638.81	6,710.17	-5,621.99	8,754.03	1.28	-0.60	1.13
Survey @ 17327.00 MD 6638.81 TVD									
17,378.00	91.56	330.29	6,637.42	6,754.45	-5,647.26	8,804.19	0.00	0.00	0.00
Survey projected to 17378.00 MD 6637.42 TVD									

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment
		+N/-S (ft)	+E/-W (ft)	
216.00	215.98	0.09	2.24	MWD surveys
17,327.00	6,638.81	6,710.17	-5,621.99	Survey @ 17327.00 MD 6638.81 TVD

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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

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WV Department of
Environmental Protection

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

Well	Lackawanna N-05 HM (slot BB)					
Well Position	+N/-S	0.00 ft	Northing:	14,383,311.24 usft	Latitude:	39.60603303
	+E/-W	0.00 ft	Easting:	1,680,775.08 usft	Longitude:	-80.85670914
Position Uncertainty		0.00 ft	Wellhead Elevation:	ft	Ground Level:	1,306.00 ft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	6/7/2019	-8.614	66.670	51,870.15612012

Design	Surveys Original Hole				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)	
	0.00	0.00	0.00	319.98	

Survey Program	Date	6/26/2019			
From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description	
216.00	3,062.00	MWD surf (Original Hole)	MWD	MWD - Standard	
3,155.00	17,327.00	MWD (Original Hole)	MWD	MWD - Standard	
17,378.00	17,378.00	Projection (Original Hole)	MWD	MWD - Standard	

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
0.00	0.00	0.00	0.00	0.00	0.00	14,383,311.24	1,680,775.08	39.60603303	-80.85670914
216.00	1.19	87.70	215.98	0.09	2.24	14,383,311.33	1,680,777.32	39.60603327	-80.85670118
MWD surveys									
246.00	1.03	76.65	245.98	0.16	2.81	14,383,311.41	1,680,777.89	39.60603347	-80.85669915
277.00	0.57	68.94	276.98	0.28	3.23	14,383,311.53	1,680,778.31	39.60603380	-80.85669767
307.00	0.78	86.83	306.97	0.35	3.57	14,383,311.59	1,680,778.65	39.60603397	-80.85669645
337.00	0.66	83.52	336.97	0.38	3.95	14,383,311.62	1,680,779.02	39.60603406	-80.85669512
367.00	0.59	90.28	366.97	0.40	4.27	14,383,311.64	1,680,779.35	39.60603411	-80.85669396
397.00	0.31	60.71	396.97	0.44	4.50	14,383,311.68	1,680,779.58	39.60603421	-80.85669316
428.00	0.41	92.33	427.97	0.47	4.68	14,383,311.72	1,680,779.76	39.60603431	-80.85669251

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	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	Longitude
WV Department of Environmental Protection									
473.00	0.22	68.21	472.97	0.50	4.92	14,383,311.74	1,680,780.00	39.60603438	-80.85669165
518.00	0.49	117.48	517.97	0.44	5.18	14,383,311.68	1,680,780.25	39.60603423	-80.85669076
563.00	0.24	94.33	562.97	0.35	5.44	14,383,311.59	1,680,780.52	39.60603396	-80.85668982
609.00	0.16	104.28	608.97	0.32	5.60	14,383,311.57	1,680,780.67	39.60603390	-80.85668926
656.00	0.15	153.37	655.97	0.25	5.69	14,383,311.49	1,680,780.77	39.60603370	-80.85668894
700.00	0.05	174.90	699.97	0.18	5.72	14,383,311.42	1,680,780.79	39.60603351	-80.85668884
791.00	0.03	198.82	790.97	0.12	5.71	14,383,311.36	1,680,780.79	39.60603334	-80.85668886
886.00	0.25	272.91	885.96	0.11	5.50	14,383,311.35	1,680,780.57	39.60603330	-80.85668962
979.00	0.13	157.75	978.96	0.02	5.34	14,383,311.26	1,680,780.41	39.60603306	-80.85669020
1,074.00	0.14	130.42	1,073.96	-0.16	5.46	14,383,311.09	1,680,780.54	39.60603258	-80.85668974
1,169.00	0.16	85.43	1,168.96	-0.22	5.69	14,383,311.02	1,680,780.76	39.60603240	-80.85668896
1,215.00	0.18	99.82	1,214.96	-0.23	5.82	14,383,311.01	1,680,780.90	39.60603238	-80.85668848
1,296.00	0.34	246.15	1,295.96	-0.35	5.73	14,383,310.90	1,680,780.80	39.60603206	-80.85668881
1,359.00	0.58	268.75	1,358.96	-0.43	5.24	14,383,310.81	1,680,780.31	39.60603183	-80.85669055
1,454.00	0.52	231.57	1,453.96	-0.71	4.42	14,383,310.53	1,680,779.49	39.60603107	-80.85669346
1,549.00	0.79	191.77	1,548.95	-1.62	3.95	14,383,309.63	1,680,779.02	39.60602858	-80.85669514
1,641.00	0.87	178.29	1,640.94	-2.93	3.84	14,383,308.31	1,680,778.91	39.60602495	-80.85669553
1,737.00	0.72	176.92	1,736.93	-4.27	3.89	14,383,306.98	1,680,778.97	39.60602130	-80.85669535
1,831.00	2.11	199.79	1,830.90	-6.48	3.34	14,383,304.76	1,680,778.41	39.60601521	-80.85669733
1,926.00	3.09	201.26	1,925.80	-10.52	1.82	14,383,300.73	1,680,776.89	39.60600414	-80.85670275
2,021.00	4.06	202.90	2,020.62	-16.00	-0.42	14,383,295.24	1,680,774.66	39.60598909	-80.85671072
2,115.00	5.91	196.47	2,114.26	-23.71	-3.09	14,383,287.53	1,680,771.99	39.60596794	-80.85672023
2,211.00	7.85	191.56	2,209.56	-34.87	-5.80	14,383,276.37	1,680,769.27	39.60593729	-80.85672994
2,305.00	9.34	191.46	2,302.51	-48.64	-8.60	14,383,262.61	1,680,766.47	39.60589950	-80.85673996
2,400.00	11.11	190.00	2,395.99	-65.21	-11.73	14,383,246.04	1,680,763.35	39.60585400	-80.85675114
2,495.00	12.37	186.58	2,489.00	-84.33	-14.48	14,383,226.91	1,680,760.60	39.60580149	-80.85676103
2,588.00	13.44	184.20	2,579.65	-105.01	-16.41	14,383,206.24	1,680,758.66	39.60574472	-80.85676801
2,683.00	15.35	181.94	2,671.67	-128.59	-17.65	14,383,182.66	1,680,757.43	39.60567997	-80.85677253
2,778.00	17.29	179.54	2,762.84	-155.27	-17.96	14,383,155.97	1,680,757.12	39.60560668	-80.85677379
2,872.00	18.20	177.86	2,852.37	-183.91	-17.30	14,383,127.33	1,680,757.78	39.60552802	-80.85677161
2,967.00	19.56	177.17	2,942.25	-214.62	-15.96	14,383,096.62	1,680,759.12	39.60544367	-80.85676702
3,062.00	21.80	177.13	3,031.13	-248.13	-14.29	14,383,063.12	1,680,760.78	39.60535165	-80.85676129
3,155.00	25.79	176.00	3,116.20	-285.57	-12.02	14,383,025.67	1,680,763.06	39.60524880	-80.85675342
3,251.00	26.70	179.86	3,202.31	-327.97	-10.51	14,382,983.27	1,680,764.57	39.60513234	-80.85674830
3,346.00	27.67	186.12	3,286.83	-371.26	-12.81	14,382,939.98	1,680,762.27	39.60501347	-80.85675671
3,441.00	29.76	186.38	3,370.15	-416.63	-17.78	14,382,894.61	1,680,757.30	39.60488890	-80.85677462
3,535.00	30.12	186.84	3,451.60	-463.23	-23.18	14,382,848.01	1,680,751.90	39.60476093	-80.85679406
3,630.00	29.24	189.28	3,534.14	-509.80	-29.76	14,382,801.45	1,680,745.32	39.60463307	-80.85681769
3,725.00	29.35	186.49	3,617.00	-555.83	-36.13	14,382,755.41	1,680,738.94	39.60450667	-80.85684058
3,821.00	29.64	183.69	3,700.56	-602.90	-40.32	14,382,708.34	1,680,734.76	39.60437743	-80.85685571
3,916.00	29.95	186.73	3,783.00	-649.89	-44.61	14,382,661.35	1,680,730.46	39.60424838	-80.85687121
4,011.00	30.47	189.22	3,865.11	-697.22	-51.25	14,382,614.02	1,680,723.83	39.60411842	-80.85688905
4,106.00	31.07	187.35	3,946.73	-745.31	-58.25	14,382,565.93	1,680,716.83	39.60398638	-80.85692015
4,200.00	29.92	186.79	4,027.73	-792.65	-64.12	14,382,518.59	1,680,710.95	39.60385640	-80.85694128
4,295.00	29.55	187.92	4,110.22	-839.38	-70.15	14,382,471.86	1,680,704.93	39.60372809	-80.85696295
4,391.00	30.21	189.12	4,193.46	-886.67	-77.24	14,382,424.57	1,680,697.84	39.60359824	-80.85698839
4,485.00	29.76	187.49	4,274.88	-933.16	-84.03	14,382,378.09	1,680,691.05	39.60347061	-80.85701276
4,580.00	29.48	185.15	4,357.47	-979.81	-89.20	14,382,331.43	1,680,685.87	39.60334249	-80.85703138
4,675.00	29.38	185.16	4,440.21	-1,026.31	-93.40	14,382,284.94	1,680,681.68	39.60321483	-80.85704654
4,770.00	28.69	186.34	4,523.27	-1,072.18	-98.01	14,382,239.06	1,680,677.07	39.60308886	-80.85706318
4,865.00	27.54	186.55	4,607.06	-1,116.66	-103.03	14,382,194.58	1,680,672.04	39.60296671	-80.85708126
4,960.00	27.01	186.36	4,691.50	-1,159.92	-107.93	14,382,151.32	1,680,667.15	39.60284793	-80.85709888
5,056.00	28.49	186.00	4,776.45	-1,204.36	-112.74	14,382,106.88	1,680,662.34	39.60272591	-80.85711621
5,151.00	30.50	183.46	4,859.14	-1,250.96	-116.56	14,382,060.28	1,680,658.52	39.60259793	-80.85713005
5,246.00	30.95	186.52	4,940.81	-1,299.30	-120.79	14,382,011.94	1,680,654.29	39.60246520	-80.85714533

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt_v14

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Survey									WV Department of Environmental Protection	
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
5,339.00	31.44	187.54	5,020.36	-1,347.11	-126.69	14,381,964.14	1,680,648.39	39.60233393	-80.85716654	
5,434.00	29.09	184.73	5,102.41	-1,394.69	-131.84	14,381,916.55	1,680,643.23	39.60220326	-80.85718512	
5,529.00	30.24	183.36	5,184.96	-1,441.59	-135.15	14,381,869.65	1,680,639.92	39.60207448	-80.85719712	
5,625.00	32.50	185.50	5,266.93	-1,491.40	-139.04	14,381,819.84	1,680,636.04	39.60193769	-80.85721121	
5,720.00	36.22	188.71	5,345.34	-1,544.58	-145.74	14,381,766.67	1,680,629.34	39.60179170	-80.85723529	
5,815.00	36.94	189.12	5,421.63	-1,600.51	-154.52	14,381,710.74	1,680,620.56	39.60163813	-80.85726676	
5,910.00	35.97	190.01	5,498.04	-1,656.17	-163.89	14,381,655.08	1,680,611.19	39.60148530	-80.85730036	
6,005.00	35.77	189.42	5,575.02	-1,711.03	-173.28	14,381,600.21	1,680,601.79	39.60133466	-80.85733402	
6,099.00	35.99	187.85	5,651.19	-1,765.50	-181.55	14,381,545.75	1,680,593.52	39.60118512	-80.85736368	
6,172.00	35.91	187.65	5,710.28	-1,807.96	-187.33	14,381,503.28	1,680,587.74	39.60106852	-80.85738444	
6,227.00	37.45	186.42	5,754.39	-1,840.57	-191.35	14,381,470.68	1,680,583.73	39.60097899	-80.85739888	
6,321.00	35.38	193.45	5,830.07	-1,895.46	-200.88	14,381,415.78	1,680,574.20	39.60082826	-80.85743303	
6,368.00	33.05	200.57	5,868.95	-1,920.71	-208.55	14,381,390.53	1,680,566.52	39.60075896	-80.85746041	
6,417.00	29.93	207.60	5,910.74	-1,944.07	-218.92	14,381,367.18	1,680,556.16	39.60069486	-80.85749733	
6,464.00	27.16	213.93	5,952.03	-1,963.37	-230.34	14,381,347.88	1,680,544.74	39.60064191	-80.85753800	
6,512.00	25.27	217.97	5,995.09	-1,980.54	-242.76	14,381,330.71	1,680,532.32	39.60059481	-80.85758219	
6,559.00	23.69	222.63	6,037.87	-1,995.39	-255.33	14,381,315.85	1,680,519.75	39.60055406	-80.85762690	
6,607.00	23.47	229.31	6,081.87	-2,008.72	-269.11	14,381,302.52	1,680,505.97	39.60051751	-80.85767590	
6,654.00	22.86	236.43	6,125.09	-2,019.88	-283.82	14,381,291.37	1,680,491.26	39.60048695	-80.85772817	
6,701.00	22.68	246.45	6,168.45	-2,028.55	-299.74	14,381,282.70	1,680,475.34	39.60046320	-80.85778473	
6,748.00	23.38	253.92	6,211.71	-2,034.75	-317.01	14,381,276.49	1,680,458.07	39.60044624	-80.85784608	
6,796.00	24.88	262.09	6,255.53	-2,038.78	-336.17	14,381,272.46	1,680,438.91	39.60043525	-80.85791412	
6,843.00	26.37	269.65	6,297.91	-2,040.21	-356.40	14,381,271.04	1,680,418.67	39.60043143	-80.85798598	
6,891.00	28.53	275.63	6,340.51	-2,039.15	-378.48	14,381,272.10	1,680,396.60	39.60043444	-80.85806434	
6,938.00	30.37	282.75	6,381.45	-2,035.42	-401.25	14,381,275.82	1,680,373.83	39.60044476	-80.85814514	
6,987.00	33.14	288.99	6,423.12	-2,028.33	-426.00	14,381,282.92	1,680,349.07	39.60046436	-80.85823300	
7,034.00	36.57	292.33	6,461.69	-2,018.82	-451.11	14,381,292.42	1,680,323.96	39.60049057	-80.85832209	
7,082.00	39.52	294.43	6,499.49	-2,007.07	-478.25	14,381,304.18	1,680,296.83	39.60052296	-80.85841837	
7,129.00	42.55	298.21	6,534.94	-1,993.37	-505.88	14,381,317.88	1,680,269.20	39.60056071	-80.85851638	
7,177.00	46.15	299.88	6,569.26	-1,977.07	-535.20	14,381,334.18	1,680,239.88	39.60060560	-80.85862038	
7,224.00	50.51	300.76	6,600.50	-1,959.34	-565.49	14,381,351.91	1,680,209.58	39.60065442	-80.85872783	
7,272.00	55.25	301.47	6,629.46	-1,939.56	-598.25	14,381,371.68	1,680,176.83	39.60070888	-80.85884400	
7,319.00	59.21	303.31	6,654.90	-1,918.39	-631.60	14,381,392.86	1,680,143.47	39.60076718	-80.85896230	
7,367.00	63.43	306.21	6,677.93	-1,894.37	-666.17	14,381,416.88	1,680,108.90	39.60083329	-80.85908490	
7,414.00	67.82	308.41	6,697.33	-1,868.42	-700.20	14,381,442.83	1,680,074.87	39.60090471	-80.85920557	
7,461.00	70.42	311.75	6,714.08	-1,840.14	-733.79	14,381,471.10	1,680,041.29	39.60098251	-80.85932464	
7,508.00	74.11	314.65	6,728.40	-1,809.50	-766.40	14,381,501.75	1,680,008.67	39.60106681	-80.85944026	
7,556.00	78.24	317.46	6,739.87	-1,775.94	-798.73	14,381,535.30	1,679,976.35	39.60115910	-80.85955484	
7,651.00	88.13	319.04	6,751.13	-1,705.65	-861.45	14,381,605.60	1,679,913.62	39.60135243	-80.85977713	
7,698.00	91.03	321.86	6,751.47	-1,669.42	-891.37	14,381,641.83	1,679,883.70	39.60145206	-80.85988315	
7,746.00	92.04	326.69	6,750.19	-1,630.47	-919.38	14,381,680.77	1,679,855.70	39.60155913	-80.85998237	
7,841.00	90.68	330.82	6,747.93	-1,549.30	-968.63	14,381,761.95	1,679,806.45	39.60178229	-80.86015677	
7,936.00	89.58	333.19	6,747.71	-1,465.42	-1,013.22	14,381,845.83	1,679,761.86	39.60201283	-80.86031461	
8,032.00	88.79	332.67	6,749.08	-1,379.95	-1,056.90	14,381,931.30	1,679,718.17	39.60224776	-80.86046922	
8,126.00	88.79	334.25	6,751.07	-1,295.87	-1,098.89	14,382,015.37	1,679,676.18	39.60247884	-80.86061783	
8,221.00	88.04	334.25	6,753.69	-1,210.34	-1,140.15	14,382,100.91	1,679,634.93	39.60271392	-80.86076383	
8,316.00	87.47	333.72	6,757.41	-1,125.03	-1,181.79	14,382,186.21	1,679,593.29	39.60294838	-80.86091118	
8,409.00	89.71	334.42	6,759.70	-1,041.42	-1,224.44	14,382,269.82	1,679,552.64	39.60317817	-80.86105505	
8,504.00	91.82	334.16	6,758.43	-955.84	-1,263.64	14,382,355.40	1,679,511.44	39.60341338	-80.86120087	
8,599.00	91.43	333.90	6,755.74	-870.47	-1,305.23	14,382,440.77	1,679,469.85	39.60364803	-80.86134804	
8,693.00	88.92	331.00	6,755.45	-787.14	-1,348.70	14,382,524.10	1,679,426.38	39.60387705	-80.86150191	
8,788.00	91.34	332.32	6,755.24	-703.54	-1,393.79	14,382,607.70	1,679,381.29	39.60410685	-80.86166155	
8,883.00	89.93	330.65	6,754.18	-620.07	-1,439.13	14,382,691.17	1,679,335.94	39.60433627	-80.86182209	
8,976.00	91.25	331.96	6,753.23	-538.50	-1,483.78	14,382,772.74	1,679,291.30	39.60456048	-80.86198016	
9,072.00	92.31	332.05	6,750.25	-453.78	-1,528.82	14,382,857.47	1,679,246.26	39.60479336	-80.86213961	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Lackawanna N-05 HM (slot BB)
Project:	Wetzel County, West Virginia (UTM17 NAD83)	TVD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Site:	Lackawanna	MD Reference:	RKB=1306+18 @ 1324.00ft (Precision 528)
Well:	Lackawanna N-05 HM (slot BB)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Jul2216dt v14

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Survey								WV Department of Environmental Protection	
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
9,167.00	91.56	330.47	6,747.04	-370.53	-1,574.48	14,382,940.71	1,679,200.60	39.60502218	-80.86230124
9,262.00	91.96	328.62	6,744.12	-288.68	-1,622.60	14,383,022.56	1,679,152.48	39.60524717	-80.86247166
9,357.00	94.15	328.10	6,739.06	-207.92	-1,672.36	14,383,103.32	1,679,102.72	39.60546917	-80.86264790
9,453.00	92.92	328.62	6,733.14	-126.35	-1,722.63	14,383,184.89	1,679,052.45	39.60569341	-80.86282591
9,548.00	90.42	330.65	6,730.37	-44.43	-1,770.62	14,383,266.82	1,679,004.46	39.60591861	-80.86299587
9,642.00	89.89	329.77	6,730.11	37.15	-1,817.32	14,383,348.39	1,678,957.76	39.60614284	-80.86316123
9,737.00	88.75	328.01	6,731.24	118.48	-1,866.40	14,383,429.72	1,678,908.68	39.60636640	-80.86333504
9,831.00	89.58	331.35	6,732.61	199.60	-1,913.84	14,383,510.84	1,678,861.24	39.60658939	-80.86350305
9,925.00	88.75	332.84	6,733.98	282.66	-1,957.83	14,383,593.90	1,678,817.25	39.60681768	-80.86365877
10,020.00	88.79	332.76	6,736.02	367.13	-2,001.24	14,383,678.37	1,678,773.84	39.60704986	-80.86381246
10,115.00	88.66	332.49	6,738.14	451.47	-2,044.91	14,383,762.71	1,678,730.17	39.60728167	-80.86396706
10,210.00	89.45	331.88	6,739.70	535.49	-2,089.24	14,383,846.73	1,678,685.84	39.60751258	-80.86412398
10,305.00	88.97	331.88	6,741.01	619.26	-2,134.01	14,383,930.50	1,678,641.07	39.60774285	-80.86428249
10,398.00	90.37	330.91	6,741.55	700.91	-2,178.53	14,384,012.15	1,678,596.55	39.60796726	-80.86444013
10,493.00	89.98	330.73	6,741.26	783.85	-2,224.85	14,384,095.09	1,678,550.23	39.60819525	-80.86460414
10,588.00	89.36	330.38	6,741.80	866.58	-2,271.55	14,384,177.82	1,678,503.53	39.60842264	-80.86476951
10,684.00	91.34	329.15	6,741.22	949.51	-2,319.88	14,384,260.75	1,678,455.20	39.60865060	-80.86494068
10,778.00	91.30	331.26	6,739.05	1,031.06	-2,366.58	14,384,342.30	1,678,408.50	39.60887475	-80.86510604
10,874.00	91.82	330.91	6,736.44	1,115.06	-2,412.98	14,384,426.30	1,678,362.10	39.60910564	-80.86527034
10,969.00	91.78	330.65	6,733.46	1,197.93	-2,459.33	14,384,509.17	1,678,315.75	39.60933343	-80.86543448
11,064.00	91.21	330.65	6,730.98	1,280.71	-2,505.88	14,384,591.95	1,678,269.20	39.60956095	-80.86559931
11,158.00	90.46	329.77	6,729.61	1,362.28	-2,552.57	14,384,673.51	1,678,222.51	39.60978516	-80.86576468
11,253.00	90.07	329.68	6,729.17	1,444.32	-2,600.47	14,384,755.56	1,678,174.62	39.61001068	-80.86593429
11,347.00	89.89	330.03	6,729.20	1,525.61	-2,647.67	14,384,836.84	1,678,127.41	39.61023411	-80.86610147
11,442.00	91.52	328.98	6,728.03	1,607.45	-2,695.87	14,384,918.69	1,678,079.21	39.61045910	-80.86627219
11,537.00	92.35	327.75	6,724.82	1,688.29	-2,745.67	14,384,999.53	1,678,029.41	39.61068131	-80.86644858
11,632.00	92.18	327.75	6,721.07	1,768.57	-2,796.33	14,385,079.81	1,677,978.76	39.61090199	-80.86662802
11,726.00	91.78	327.66	6,717.82	1,847.98	-2,846.52	14,385,159.22	1,677,928.56	39.61112029	-80.86680581
11,821.00	91.38	327.92	6,715.20	1,928.33	-2,897.14	14,385,239.57	1,677,877.95	39.61134116	-80.86698512
11,916.00	90.86	327.04	6,713.34	2,008.42	-2,948.20	14,385,319.66	1,677,826.88	39.61156132	-80.86716600
12,011.00	91.82	328.89	6,711.12	2,088.93	-2,998.57	14,385,400.16	1,677,776.51	39.61178263	-80.86734445
12,106.00	92.09	331.09	6,707.88	2,171.14	-3,046.06	14,385,482.37	1,677,729.03	39.61200860	-80.86751262
12,200.00	91.69	330.73	6,704.78	2,253.23	-3,091.73	14,385,564.47	1,677,683.35	39.61223426	-80.86767438
12,295.00	91.65	329.77	6,702.01	2,335.68	-3,138.85	14,385,646.91	1,677,636.23	39.61246087	-80.86784126
12,390.00	90.81	331.00	6,699.97	2,418.25	-3,185.79	14,385,729.48	1,677,589.30	39.61268782	-80.86800748
12,484.00	90.90	331.61	6,698.57	2,500.69	-3,230.91	14,385,811.93	1,677,544.17	39.61291443	-80.86816729
12,577.00	90.37	331.79	6,697.54	2,582.57	-3,275.00	14,385,893.81	1,677,500.08	39.61313947	-80.86832341
12,672.00	90.07	331.44	6,697.18	2,666.15	-3,320.16	14,385,977.39	1,677,454.92	39.61336919	-80.86848334
12,767.00	89.76	331.09	6,697.32	2,749.45	-3,365.84	14,386,060.69	1,677,409.25	39.61359815	-80.86864508
12,861.00	91.56	330.82	6,696.23	2,831.62	-3,411.47	14,386,142.86	1,677,363.62	39.61382400	-80.86880668
12,956.00	90.73	329.50	6,694.34	2,914.00	-3,458.73	14,386,225.24	1,677,316.36	39.61405045	-80.86897407
13,050.00	90.20	329.42	6,693.57	2,994.96	-3,506.49	14,386,306.20	1,677,268.59	39.61427298	-80.86914325
13,146.00	89.71	329.77	6,693.65	3,077.76	-3,555.08	14,386,388.99	1,677,220.01	39.61450056	-80.86931534
13,241.00	91.08	330.38	6,692.99	3,160.09	-3,602.47	14,386,471.32	1,677,172.62	39.61472686	-80.86948320
13,335.00	90.81	331.17	6,691.44	3,242.11	-3,648.35	14,386,553.35	1,677,126.73	39.61495231	-80.86964572
13,430.00	90.46	331.96	6,690.39	3,325.64	-3,693.59	14,386,636.88	1,677,081.50	39.61518190	-80.86980590
13,524.00	89.85	331.09	6,690.14	3,408.27	-3,738.40	14,386,719.51	1,677,036.68	39.61540900	-80.86996461
13,619.00	91.21	331.35	6,689.26	3,491.53	-3,784.14	14,386,802.77	1,676,990.95	39.61563784	-80.87012659
13,714.00	91.08	331.44	6,687.36	3,574.92	-3,829.61	14,386,886.15	1,676,945.47	39.61586704	-80.87028763
13,809.00	90.51	330.82	6,686.04	3,658.10	-3,875.47	14,386,969.34	1,676,899.61	39.61609567	-80.87045007
13,903.00	89.98	329.94	6,685.64	3,739.82	-3,921.93	14,387,051.05	1,676,853.15	39.61632027	-80.87061462
13,998.00	91.74	329.50	6,684.21	3,821.84	-3,969.83	14,387,133.08	1,676,805.26	39.61654574	-80.87078427
14,093.00	91.34	329.98	6,681.66	3,903.87	-4,017.68	14,387,215.10	1,676,757.40	39.61677120	-80.87095379
14,188.00	90.51	327.39	6,680.13	3,985.01	-4,067.05	14,387,296.25	1,676,708.04	39.61699424	-80.87112867
14,282.00	91.30	328.98	6,678.64	4,064.88	-4,116.59	14,387,376.11	1,676,658.49	39.61721377	-80.87130420

Company: Tug Hill Operating LLC
Project: Wetzel County, West Virginia (UTM17 NAD83)
Site: Lackawanna
Well: Lackawanna N-05 HM (slot BB)
Wellbore: Original Hole
Design: Surveys Original Hole

Local Co-ordinate Reference:
TVD Reference:
MD Reference:
North Reference:
Survey Calculation Method:
Database:

Well Lackawanna N-05 HM (slot BB)
 RKB=1306+18 @ 1324.00ft (Precision 528)
 RKB=1306+18 @ 1324.00ft (Precision 528)
 Grid
 RECEIVED
 Office of Oil and Gas
 Minimum Curvature
 DB_Jul2216dt_v14

SEP 30 2022

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
14,377.00	90.64	328.54	6,677.03	4,148.09	-4,165.86	14,387,457.32	1,676,609.23	39.61743700	-80.87147872
14,471.00	90.20	328.10	6,676.34	4,226.08	-4,215.22	14,387,537.31	1,676,559.86	39.61765688	-80.87165361
14,567.00	89.85	328.36	6,676.30	4,307.70	-4,265.76	14,387,618.93	1,676,509.32	39.61788123	-80.87183268
14,662.00	91.52	328.45	6,675.17	4,388.61	-4,315.53	14,387,699.84	1,676,459.55	39.61810363	-80.87200899
14,757.00	91.16	328.27	6,672.94	4,469.46	-4,365.35	14,387,780.70	1,676,409.73	39.61832589	-80.87218550
14,851.00	90.95	328.62	6,671.21	4,549.55	-4,414.54	14,387,860.78	1,676,360.55	39.61854603	-80.87235975
14,946.00	91.91	330.38	6,668.84	4,631.37	-4,462.73	14,387,942.61	1,676,312.35	39.61877094	-80.87253050
15,041.00	91.56	330.73	6,665.97	4,714.07	-4,509.41	14,388,025.30	1,676,265.67	39.61899822	-80.87269585
15,136.00	91.21	330.65	6,663.67	4,796.88	-4,555.91	14,388,108.11	1,676,219.18	39.61922583	-80.87286053
15,231.00	90.77	329.42	6,662.03	4,879.17	-4,603.35	14,388,190.40	1,676,171.74	39.61945201	-80.87302859
15,325.00	90.20	329.68	6,661.23	4,960.20	-4,650.98	14,388,271.43	1,676,124.10	39.61967474	-80.87319734
15,418.00	89.63	328.80	6,661.37	5,040.11	-4,698.55	14,388,351.34	1,676,076.54	39.61989440	-80.87336585
15,514.00	89.36	328.71	6,662.22	5,122.19	-4,748.34	14,388,433.42	1,676,026.75	39.62011999	-80.87354226
15,608.00	90.24	330.12	6,662.55	5,203.10	-4,796.17	14,388,514.34	1,675,978.92	39.62034241	-80.87371170
15,702.00	90.20	330.38	6,662.18	5,284.71	-4,842.81	14,388,595.95	1,675,932.27	39.62056672	-80.87387693
15,797.00	89.89	331.44	6,662.11	5,367.73	-4,889.00	14,388,678.96	1,675,886.09	39.62079489	-80.87404053
15,891.00	89.63	331.35	6,662.50	5,450.26	-4,934.00	14,388,761.49	1,675,841.08	39.62102170	-80.87419994
15,987.00	91.30	332.05	6,661.72	5,534.78	-4,979.51	14,388,846.01	1,675,795.58	39.62125400	-80.87436113
16,081.00	90.95	332.10	6,659.88	5,617.81	-5,023.52	14,388,929.04	1,675,751.56	39.62148222	-80.87451702
16,175.00	90.59	332.40	6,658.62	5,700.99	-5,067.29	14,389,012.23	1,675,707.80	39.62171084	-80.87467202
16,269.00	91.47	332.49	6,656.93	5,784.32	-5,110.76	14,389,095.55	1,675,664.32	39.62193984	-80.87482601
16,364.00	91.16	332.32	6,654.75	5,868.49	-5,154.76	14,389,179.72	1,675,620.33	39.62217117	-80.87498183
16,459.00	90.90	332.93	6,653.04	5,952.84	-5,198.43	14,389,264.07	1,675,576.65	39.62240298	-80.87513651
16,554.00	90.81	332.67	6,651.62	6,037.32	-5,241.85	14,389,348.55	1,675,533.23	39.62263518	-80.87529029
16,649.00	91.16	331.09	6,649.99	6,121.09	-5,286.62	14,389,432.32	1,675,488.47	39.62286541	-80.87544886
16,743.00	90.64	330.73	6,648.51	6,203.22	-5,332.32	14,389,514.45	1,675,442.77	39.62309115	-80.87561073
16,838.00	90.33	331.00	6,647.71	6,286.20	-5,378.57	14,389,597.43	1,675,396.52	39.62331921	-80.87577458
16,932.00	89.67	330.21	6,647.71	6,368.10	-5,424.70	14,389,679.33	1,675,350.38	39.62354431	-80.87593802
17,028.00	91.78	329.94	6,646.49	6,451.29	-5,472.59	14,389,762.52	1,675,302.50	39.62377296	-80.87610767
17,123.00	91.34	330.03	6,643.91	6,533.52	-5,520.09	14,389,844.75	1,675,255.00	39.62399897	-80.87627597
17,218.00	91.34	329.94	6,641.68	6,615.76	-5,567.60	14,389,926.98	1,675,207.49	39.62422500	-80.87644429
17,312.00	91.65	330.12	6,639.23	6,697.16	-5,614.54	14,390,008.39	1,675,160.55	39.62444874	-80.87661060
17,327.00	91.56	330.29	6,638.81	6,710.17	-5,621.99	14,390,021.40	1,675,153.10	39.62448450	-80.87663700
Survey @ 17327.00 MD 6638.81 TVD									
17,378.00	91.56	330.29	6,637.42	6,754.45	-5,647.26	14,390,065.68	1,675,127.83	39.62460621	-80.87672651
Survey projected to 17378.00 MD 6637.42 TVD									

Design Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment
		+N/-S (ft)	+E/-W (ft)	
216.00	215.98	0.09	2.24	MWD surveys
17,327.00	6,638.81	6,710.17	-5,621.99	Survey @ 17327.00 MD 6638.81 TVD
17,378.00	6,637.42	6,754.45	-5,647.26	Survey projected to 17378.00 MD 6637.42 TVD