



Well: Keith Stern N-16 HU (slot F)  
 Site: Keith Stern  
 Project: Marshall County, West Virginia.  
 Design: rev8  
 Rig: Nabors X08

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=747+33 @ 780.00usft (Nabors X08)

Northing	Easting	Latitude	Longitude
14444899.57	1726913.62	39.77485561	-80.69214745

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.978°



Azimuths to Grid North  
 True North: -0.20°  
 Magnetic North: -8.98°

Magnetic Field  
 Strength: 51856.8snT  
 Dip Angle: 66.72°  
 Date: 3/5/2020  
 Model: IGRF2015

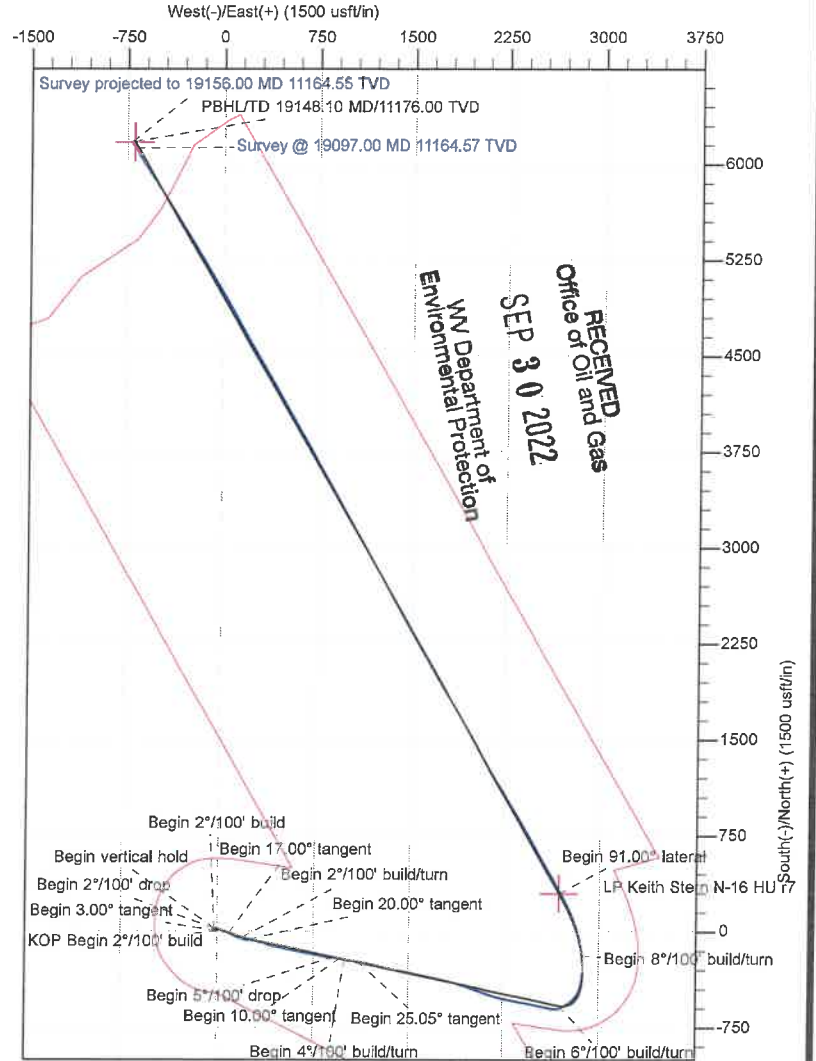
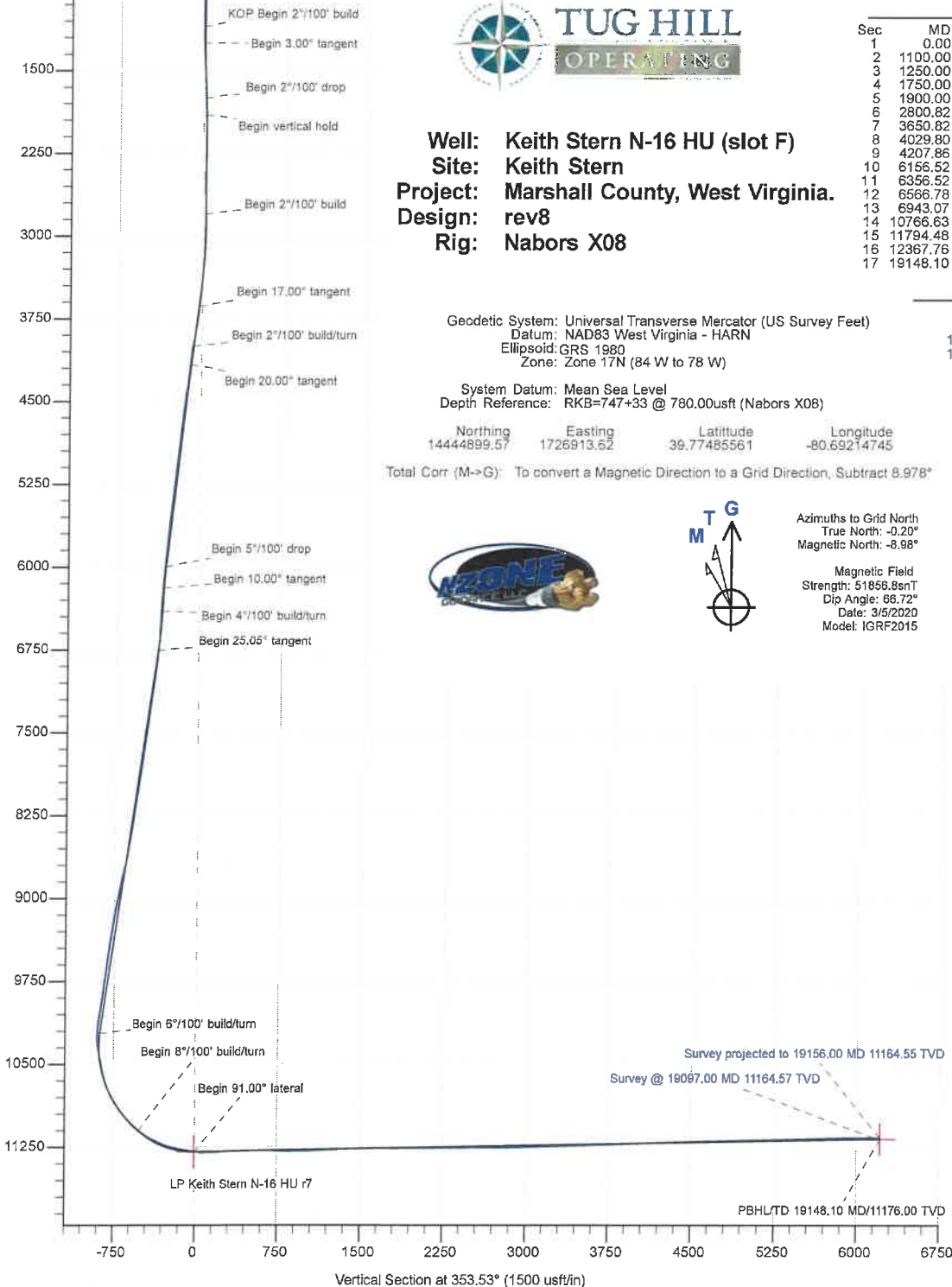
SECTION DETAILS

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	1100.00	0.00	0.00	1100.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 2°/100' build
3	1250.00	3.00	320.00	1249.93	3.01	-2.52	2.00	320.000	3.27	Begin 3.00° tangent
4	1750.00	3.00	320.00	1749.25	23.05	-19.34	0.00	0.000	25.09	Begin 2°/100' drop
5	1900.00	0.00	320.00	1899.18	26.06	-21.87	2.00	180.000	28.36	Begin vertical hold
6	2800.82	0.00	320.00	2800.00	26.06	-21.87	0.00	320.000	28.36	Begin 2°/100' build
7	3650.82	17.00	108.00	3637.58	-12.62	97.18	2.00	108.000	-23.49	Begin 17.00° tangent
8	4029.80	17.00	108.00	4000.00	-46.86	202.56	0.00	0.000	-69.38	Begin 2°/100' build/turn
9	4207.86	20.00	101.93	4168.86	-61.20	257.13	2.00	-35.608	-89.78	Begin 20.00° tangent
10	6156.52	20.00	101.93	6000.00	-198.98	909.21	0.00	0.000	-300.13	Begin 5°/100' drop
11	6356.52	10.00	101.93	6192.94	-209.66	959.80	5.00	180.000	-316.45	Begin 10.00° tangent
12	6566.78	10.00	101.93	6400.00	-217.21	995.52	0.00	0.000	-327.97	Begin 4°/100' build/turn
13	6943.07	25.05	101.94	6757.80	-240.58	1106.07	4.00	0.012	-363.64	Begin 25.05° tangent
14	10766.63	25.05	101.94	10221.66	-575.46	2690.09	0.00	0.000	-874.83	Begin 6°/100' build/turn
15	11794.48	50.00	352.53	11104.51	-192.41	2869.48	6.00	-124.833	-514.43	Begin 8°/100' build/turn
16	12367.76	91.00	330.02	11294.00	300.14	2687.92	8.00	-32.235	-4.56	Begin 91.00° lateral
17	19148.10	91.00	330.02	11176.00	6172.33	-699.76	0.00	0.000	6211.87	PBHLTD 19148.10 MD/11176.00 TVD

ANNOTATIONS SURVEYS

MD	Inc	Azi	TVD	+N-S	+E-W	VSect	Annotation
170.00	0.75	330.63	170.00	0.97	-0.55	1.02	MWD surveys
19097.00	90.02	327.12	11164.57	6119.72	-888.33	6158.30	Survey @ 19097.00 MD 11164.57 TVD
19156.00	90.02	327.12	11164.55	6169.27	-720.36	6211.15	Survey projected to 19156.00 MD 11164.55 TVD

True Vertical Depth (1500 usft/in)



<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stern N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

<b>Project</b>	Marshall County, West Virginia.		
<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)		

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<b>Site</b>	Keith Stern				
<b>Site Position:</b>		<b>Northing:</b>	14,444,890.33 usft	<b>Latitude:</b>	39.77483004
<b>From:</b>	Lat/Long	<b>Easting:</b>	1,726,932.47 usft	<b>Longitude:</b>	-80.69208048
<b>Position Uncertainty:</b>	0.00 usft	<b>Slot Radius:</b>	13-3/16 "	<b>Grid Convergence:</b>	0.197 °

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<b>Well</b>	Keith Stern N-16 HU (slot F)					
<b>Well Position</b>	+N/-S	0.00 usft	<b>Northing:</b>	14,444,899.57 usft	<b>Latitude:</b>	39.77485561
	+E/-W	0.00 usft	<b>Easting:</b>	1,726,913.62 usft	<b>Longitude:</b>	-80.69214745
<b>Position Uncertainty</b>	0.00 usft		<b>Wellhead Elevation:</b>	usft	<b>Ground Level:</b>	747.00 usft

<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	3/5/2020	-8.781	66.717	51,856.76028537

<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) (usft)</b>	<b>+N/-S (usft)</b>	<b>+E/-W (usft)</b>	<b>Direction (°)</b>	
	0.00	0.00	0.00	353.53	

<b>Survey Program</b>	<b>Date</b>	4/21/2020			
<b>From (usft)</b>	<b>To (usft)</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>	
170.00	698.00	MWD surf (Original Hole)	NS-GYRO-MS	North sensing gyrocompassing m/s	
792.00	2,177.00	MWD int (Original Hole)	MWD	MWD - Standard	
2,269.00	19,097.00	MWD (Original Hole)	MWD	MWD - Standard	
19,156.00	19,156.00	Projection (Original Hole)	MWD	MWD - Standard	

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
170.00	0.75	330.63	170.00	0.97	-0.55	1.02	0.44	0.44	0.00	
<b>MWD surveys</b>										
202.00	0.70	313.93	201.99	1.29	-0.79	1.37	0.68	-0.16	-52.19	
233.00	0.66	314.81	232.99	1.54	-1.05	1.65	0.13	-0.13	2.84	
265.00	0.79	327.73	264.99	1.86	-1.30	2.00	0.65	0.41	40.38	
288.00	0.75	330.37	287.99	2.13	-1.46	2.28	0.23	-0.17	11.48	
320.00	0.62	326.32	319.98	2.45	-1.66	2.62	0.43	-0.41	-12.66	

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stem N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stem	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stem N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
352.00	0.70	311.64	351.98	2.73	-1.90	2.92	0.58	0.25	-45.88
383.00	0.66	334.67	382.98	3.01	-2.12	3.23	0.88	-0.13	74.29
415.00	0.83	312.88	414.98	3.34	-2.37	3.58	1.02	0.53	-68.09
446.00	1.27	330.36	445.97	3.79	-2.70	4.07	1.74	1.42	56.39
474.00	1.27	327.29	473.96	4.32	-3.02	4.63	0.24	0.00	-10.96
540.00	1.23	345.57	539.95	5.62	-3.60	5.99	0.60	-0.06	27.70
603.00	1.45	339.59	602.93	7.02	-4.04	7.43	0.41	0.35	-9.49
666.00	0.92	312.08	665.92	8.11	-4.70	8.59	1.21	-0.84	-43.67
698.00	0.88	319.64	697.91	8.47	-5.05	8.98	0.39	-0.13	23.63
792.00	0.66	282.99	791.91	9.14	-6.04	9.76	0.56	-0.23	-38.99
887.00	1.14	255.57	886.90	9.03	-7.49	9.81	0.67	0.51	-28.86
982.00	1.05	249.86	981.88	8.49	-9.22	9.48	0.15	-0.09	-6.01
1,076.00	0.66	240.63	1,075.87	7.93	-10.50	9.06	0.44	-0.41	-9.82
1,171.00	0.70	245.90	1,170.86	7.43	-11.51	8.67	0.08	0.04	5.55
1,266.00	1.10	275.17	1,265.85	7.27	-12.95	8.68	0.63	0.42	30.81
1,360.00	1.85	308.13	1,359.82	8.29	-15.04	9.93	1.17	0.80	35.06
1,455.00	2.42	313.84	1,454.75	10.62	-17.69	12.55	0.64	0.60	6.01
1,550.00	3.03	315.86	1,549.64	13.82	-20.89	16.08	0.65	0.64	2.13
1,644.00	2.81	326.50	1,643.52	17.52	-23.89	20.10	0.62	-0.23	11.32
1,739.00	2.68	327.82	1,738.41	21.34	-26.36	24.18	0.15	-0.14	1.39
1,832.00	2.11	341.97	1,831.33	24.81	-28.04	27.81	0.88	-0.61	15.22
1,927.00	0.44	332.56	1,926.31	26.80	-28.75	29.87	1.77	-1.76	-9.91
2,022.00	0.40	212.94	2,021.31	26.84	-29.10	29.95	0.76	-0.04	-125.92
2,116.00	0.48	180.95	2,115.30	26.17	-29.29	29.31	0.27	0.09	-34.03
2,177.00	0.65	81.02	2,176.30	25.97	-28.95	29.07	1.43	0.28	-163.82
2,269.00	1.19	202.75	2,268.29	25.17	-28.80	28.26	1.77	0.59	132.32
2,316.00	1.41	208.64	2,315.28	24.21	-29.27	27.36	0.55	0.47	12.53
2,363.00	1.36	206.88	2,362.27	23.21	-29.80	26.42	0.14	-0.11	-3.74
2,408.00	1.14	206.18	2,407.26	22.33	-30.24	25.60	0.49	-0.49	-1.56
2,455.00	0.79	196.68	2,454.25	21.60	-30.54	24.91	0.82	-0.74	-20.21
2,502.00	0.62	128.83	2,501.25	21.13	-30.43	24.43	1.70	-0.36	-144.36
2,549.00	0.75	87.26	2,548.25	20.99	-29.93	24.23	1.07	0.28	-88.45
2,597.00	1.36	61.86	2,596.24	21.27	-29.11	24.42	1.57	1.27	-52.92
2,644.00	2.07	54.65	2,643.22	22.03	-27.93	25.03	1.58	1.51	-15.34
2,691.00	2.72	54.56	2,690.17	23.16	-26.33	25.98	1.38	1.38	-0.19
2,738.00	3.38	57.99	2,737.11	24.54	-24.24	27.12	1.46	1.40	7.30
2,786.00	3.69	62.39	2,785.02	26.01	-21.67	28.29	0.86	0.65	9.17
2,833.00	3.36	71.52	2,831.93	27.15	-19.03	29.12	1.38	-0.70	19.43
2,880.00	3.47	84.71	2,878.84	27.71	-16.30	29.38	1.68	0.23	28.06
2,927.00	3.91	96.58	2,925.75	27.66	-13.30	28.98	1.87	0.94	25.26
2,974.00	4.57	101.67	2,972.62	27.10	-9.87	28.04	1.62	1.40	10.83
3,021.00	5.67	102.28	3,019.43	26.23	-5.77	26.71	2.34	2.34	1.30
3,069.00	6.37	104.49	3,067.17	25.06	-0.87	25.00	1.54	1.46	4.60

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<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
3,116.00	7.03	107.39	3,113.85	23.54	4.40	22.90	1.58	1.40	6.17
3,164.00	7.56	109.67	3,161.46	21.60	10.17	20.32	1.26	1.10	4.75
3,213.00	8.09	111.61	3,210.00	19.25	16.41	17.28	1.21	1.08	3.96
3,261.00	8.70	112.31	3,257.49	16.63	22.91	13.94	1.29	1.27	1.46
3,308.00	9.10	111.52	3,303.92	13.91	29.66	10.48	0.89	0.85	-1.68
3,356.00	9.58	110.64	3,351.28	11.11	36.93	6.88	1.04	1.00	-1.83
3,451.00	10.72	109.94	3,444.79	5.31	52.63	-0.65	1.21	1.20	-0.74
3,545.00	11.82	110.73	3,536.98	-1.08	69.85	-8.94	1.18	1.17	0.84
3,640.00	13.27	112.92	3,629.71	-8.77	89.00	-18.74	1.61	1.53	2.31
3,734.00	14.99	115.74	3,720.86	-18.25	109.89	-30.51	1.97	1.83	3.00
3,829.00	16.52	116.53	3,812.29	-29.62	133.04	-44.42	1.63	1.61	0.83
3,924.00	17.62	113.45	3,903.11	-41.37	158.32	-58.95	1.50	1.16	-3.24
4,019.00	18.76	108.71	3,993.36	-52.00	185.98	-72.62	1.97	1.20	-4.99
4,113.00	22.54	101.85	4,081.32	-60.55	217.94	-84.72	4.77	4.02	-7.30
4,208.00	24.48	95.61	4,168.45	-66.21	255.36	-94.57	3.32	2.04	-6.57
4,302.00	22.15	100.36	4,254.77	-71.30	292.18	-103.77	3.18	-2.48	5.05
4,397.00	21.09	105.37	4,343.09	-79.06	326.29	-115.32	2.24	-1.12	5.27
4,492.00	20.43	106.07	4,431.93	-88.18	358.70	-128.03	0.74	-0.69	0.74
4,587.00	19.12	105.45	4,521.32	-96.91	389.63	-140.20	1.40	-1.38	-0.65
4,682.00	18.33	105.45	4,611.29	-105.04	419.03	-151.58	0.83	-0.83	0.00
4,777.00	18.46	105.89	4,701.44	-113.13	447.89	-162.88	0.20	0.14	0.46
4,872.00	18.98	103.70	4,791.41	-120.91	477.37	-173.93	0.92	0.55	-2.31
4,967.00	19.64	101.94	4,881.07	-127.87	507.99	-184.30	0.93	0.69	-1.85
5,062.00	20.74	101.94	4,970.23	-134.66	540.07	-194.65	1.16	1.16	0.00
5,156.00	21.09	101.06	5,058.04	-141.34	572.95	-205.01	0.50	0.37	-0.94
5,251.00	20.48	100.62	5,146.85	-147.68	606.06	-215.04	0.66	-0.64	-0.46
5,346.00	19.91	99.92	5,236.01	-153.53	638.33	-224.49	0.65	-0.60	-0.74
5,440.00	20.04	100.80	5,324.36	-159.31	669.92	-233.78	0.35	0.14	0.94
5,535.00	19.78	101.23	5,413.68	-165.49	701.68	-243.50	0.31	-0.27	0.45
5,630.00	19.95	102.11	5,503.03	-172.02	733.29	-253.55	0.36	0.18	0.93
5,724.00	19.86	101.85	5,591.41	-178.66	764.60	-263.68	0.13	-0.10	-0.28
5,820.00	20.13	101.15	5,681.63	-185.21	796.76	-273.81	0.38	0.28	-0.73
5,914.00	20.43	100.44	5,769.80	-191.31	828.77	-283.48	0.41	0.32	-0.76
6,009.00	20.35	98.77	5,858.85	-196.83	861.40	-292.64	0.62	-0.08	-1.76
6,041.00	20.57	98.25	5,888.83	-198.49	872.46	-295.53	0.89	0.69	-1.63
6,135.00	20.17	97.89	5,976.95	-203.08	904.86	-303.75	0.45	-0.43	-0.38
6,230.00	17.23	98.95	6,066.93	-207.52	934.98	-311.55	3.12	-3.09	1.12
6,323.00	14.06	99.83	6,156.47	-211.59	959.73	-318.39	3.42	-3.41	0.95
6,354.00	13.80	100.62	6,186.56	-212.91	967.07	-320.53	1.04	-0.84	2.55
6,449.00	11.73	100.88	6,279.20	-216.83	987.69	-326.74	2.18	-2.18	0.27
6,481.00	11.60	100.88	6,310.54	-218.05	994.05	-328.67	0.41	-0.41	0.00
6,578.00	12.44	100.71	6,405.42	-221.83	1,013.89	-334.67	0.87	0.87	-0.18
6,673.00	14.41	99.39	6,497.82	-225.66	1,035.61	-340.92	2.10	2.07	-1.39
6,768.00	15.69	98.95	6,589.55	-229.59	1,059.96	-347.56	1.35	1.35	-0.46



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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
6,862.00	16.88	98.77	6,679.78	-233.65	1,086.01	-354.53	1.27	1.27	-0.19
6,957.00	19.49	99.39	6,770.03	-238.34	1,115.28	-362.49	2.75	2.75	0.65
7,051.00	22.10	100.62	6,857.90	-244.15	1,148.13	-371.97	2.82	2.78	1.31
7,146.00	22.72	102.73	6,945.73	-251.49	1,183.59	-383.26	1.07	0.65	2.22
7,240.00	23.29	104.40	7,032.25	-260.11	1,219.30	-395.85	0.92	0.61	1.78
7,335.00	21.84	103.70	7,119.98	-268.97	1,254.66	-408.63	1.55	-1.53	-0.74
7,428.00	21.01	103.17	7,206.55	-276.86	1,287.70	-420.20	0.92	-0.89	-0.57
7,559.00	22.32	102.99	7,328.29	-287.81	1,334.81	-436.38	1.00	1.00	-0.14
7,618.00	22.32	103.52	7,382.87	-292.94	1,356.62	-443.95	0.34	0.00	0.90
7,712.00	23.99	102.03	7,469.30	-301.10	1,392.67	-456.11	1.88	1.78	-1.59
7,805.00	26.10	99.65	7,553.55	-308.47	1,431.33	-467.79	2.51	2.27	-2.56
7,900.00	27.55	99.83	7,638.32	-315.72	1,473.58	-479.76	1.53	1.53	0.19
7,994.00	26.41	99.92	7,722.09	-323.04	1,515.59	-491.76	1.21	-1.21	0.10
8,101.00	25.75	103.34	7,818.20	-332.50	1,561.65	-506.35	1.53	-0.62	3.20
8,182.00	27.69	100.97	7,890.55	-340.14	1,597.25	-517.96	2.73	2.40	-2.93
8,277.00	27.11	100.62	7,974.89	-348.33	1,640.20	-530.94	0.63	-0.61	-0.37
8,371.00	27.42	102.64	8,058.45	-357.02	1,682.37	-544.32	1.04	0.33	2.15
8,465.00	26.67	101.59	8,142.17	-365.99	1,724.16	-557.94	0.95	-0.80	-1.12
8,558.00	24.13	102.90	8,226.18	-374.43	1,763.14	-570.72	2.80	-2.73	1.41
8,652.00	23.20	103.61	8,312.27	-383.08	1,799.86	-583.45	1.03	-0.99	0.76
8,746.00	23.95	105.28	8,398.43	-392.46	1,836.27	-596.88	1.07	0.80	1.78
8,841.00	23.99	105.89	8,485.23	-402.83	1,873.44	-611.37	0.26	0.04	0.64
8,936.00	25.44	105.36	8,571.53	-413.52	1,911.69	-626.30	1.54	1.53	-0.56
9,031.00	25.80	107.21	8,657.19	-425.04	1,951.12	-642.20	0.92	0.38	1.95
9,125.00	26.89	108.71	8,741.43	-437.92	1,990.79	-659.46	1.36	1.16	1.60
9,219.00	26.63	110.81	8,825.36	-452.22	2,030.62	-678.16	1.04	-0.28	2.23
9,313.00	25.53	110.29	8,909.79	-466.73	2,069.31	-696.93	1.20	-1.17	-0.55
9,408.00	25.22	108.53	8,995.62	-480.26	2,107.70	-714.70	0.86	-0.33	-1.85
9,503.00	25.00	107.12	9,081.65	-492.60	2,146.08	-731.29	0.67	-0.23	-1.48
9,597.00	24.43	106.68	9,167.04	-504.03	2,183.68	-746.88	0.64	-0.61	-0.47
9,692.00	24.35	103.43	9,253.56	-514.22	2,221.55	-761.27	1.42	-0.08	-3.42
9,787.00	25.18	102.20	9,339.83	-523.04	2,260.36	-774.41	1.03	0.87	-1.29
9,881.00	25.58	100.97	9,424.75	-531.12	2,299.82	-786.89	0.70	0.43	-1.31
9,975.00	24.74	101.76	9,509.83	-538.99	2,339.00	-799.13	0.96	-0.89	0.84
10,069.00	24.74	101.59	9,595.21	-546.96	2,377.53	-811.38	0.08	0.00	-0.18
10,164.00	24.92	100.80	9,681.43	-554.70	2,416.66	-823.48	0.40	0.19	-0.83
10,259.00	25.44	101.15	9,767.40	-562.40	2,456.34	-835.60	0.57	0.55	0.37
10,353.00	25.27	100.18	9,852.34	-569.85	2,495.90	-847.46	0.48	-0.18	-1.03
10,447.00	24.92	101.67	9,937.47	-577.40	2,535.04	-859.38	0.77	-0.37	1.59
10,530.00	25.05	101.67	10,012.70	-584.49	2,569.37	-870.29	0.16	0.16	0.00
10,624.00	25.54	103.78	10,097.69	-593.34	2,608.54	-883.50	1.09	0.52	2.24
10,655.00	25.76	100.18	10,125.64	-596.12	2,621.67	-887.74	5.08	0.71	-11.61
10,702.00	25.80	99.13	10,167.96	-599.55	2,641.82	-893.42	0.98	0.09	-2.23

WV Department of  
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<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stern N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

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**Survey**

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Buird Rate (°/100usft)	Turn Rate (°/100usft)
10,750.00	24.40	90.16	10,211.44	-601.24	2,662.05	-897.38	8.44	-2.92	-18.69
10,797.00	23.78	80.40	10,254.37	-599.68	2,681.11	-897.98	8.57	-1.32	-20.77
10,844.00	23.74	71.79	10,297.40	-595.15	2,699.45	-895.54	7.38	-0.09	-18.32
10,891.00	22.42	63.79	10,340.64	-588.23	2,716.48	-890.58	7.23	-2.81	-17.02
10,939.00	21.89	63.79	10,385.10	-580.23	2,732.72	-884.47	1.10	-1.10	0.00
10,986.00	21.85	57.29	10,428.72	-571.64	2,747.94	-877.64	5.15	-0.09	-13.83
11,034.00	21.32	55.97	10,473.36	-561.93	2,762.69	-869.66	1.50	-1.10	-2.75
11,081.00	22.59	54.92	10,516.95	-551.96	2,777.16	-861.38	2.83	2.70	-2.23
11,128.00	22.33	48.24	10,560.39	-540.82	2,791.21	-851.90	5.46	-0.55	-14.21
11,175.00	22.68	43.49	10,603.82	-528.30	2,804.11	-840.91	3.94	0.74	-10.11
11,223.00	24.70	41.21	10,647.77	-514.04	2,817.08	-828.20	4.62	4.21	-4.75
11,270.00	25.58	36.81	10,690.32	-498.53	2,829.63	-814.20	4.39	1.87	-9.36
11,317.00	26.86	28.64	10,732.50	-481.08	2,840.81	-798.12	8.14	2.72	-17.38
11,364.00	28.70	20.11	10,774.10	-461.15	2,849.78	-779.34	9.31	3.91	-18.15
11,412.00	31.60	16.16	10,815.60	-438.24	2,857.25	-757.41	7.32	6.04	-8.23
11,459.00	33.89	13.43	10,855.13	-413.67	2,863.72	-733.72	5.80	4.87	-5.81
11,507.00	36.44	10.53	10,894.37	-386.63	2,869.43	-707.50	6.35	5.31	-6.04
11,554.00	38.55	5.96	10,931.67	-358.33	2,873.50	-679.84	7.43	4.49	-9.72
11,601.00	40.31	1.39	10,967.98	-328.56	2,875.39	-650.47	7.22	3.74	-9.72
11,648.00	42.42	358.75	11,003.25	-297.50	2,875.42	-619.62	5.82	4.49	-5.62
11,696.00	45.32	356.73	11,037.85	-264.27	2,874.09	-586.45	6.71	6.04	-4.21
11,743.00	49.41	357.35	11,069.68	-229.75	2,872.31	-551.95	8.76	8.70	1.32
11,790.00	51.43	356.38	11,099.63	-193.58	2,870.33	-515.78	4.58	4.30	-2.06
11,837.00	53.19	354.36	11,128.36	-156.52	2,867.32	-478.62	5.06	3.74	-4.30
11,884.00	57.36	350.49	11,155.14	-118.25	2,862.19	-440.02	11.16	8.87	-8.23
11,931.00	62.11	347.33	11,178.82	-78.44	2,854.36	-399.57	11.65	10.11	-6.72
11,979.00	65.36	342.49	11,200.07	-36.91	2,843.14	-357.04	11.29	6.77	-10.08
12,026.00	68.57	341.44	11,218.46	4.21	2,829.75	-314.68	7.13	6.83	-2.23
12,074.00	70.24	342.41	11,235.34	46.93	2,815.81	-270.66	3.96	3.48	2.02
12,121.00	73.41	341.00	11,250.00	89.32	2,801.79	-226.97	7.32	6.74	-3.00
12,169.00	78.07	338.63	11,261.82	132.96	2,785.73	-181.79	10.82	9.71	-4.94
12,216.00	79.91	335.20	11,270.80	175.39	2,767.64	-137.59	8.16	3.91	-7.30
12,263.00	81.27	332.04	11,278.49	216.92	2,747.04	-94.00	7.24	2.89	-6.72
12,286.00	82.33	331.42	11,281.77	236.97	2,736.26	-72.87	5.33	4.61	-2.70
12,318.00	83.03	331.24	11,285.85	264.82	2,721.03	-43.48	2.26	2.19	-0.56
12,343.00	83.03	331.24	11,288.88	286.58	2,709.09	-20.52	0.00	0.00	0.00
12,381.00	83.08	330.45	11,293.47	319.52	2,690.72	14.28	2.07	0.13	-2.08
12,412.00	84.66	330.54	11,296.78	346.34	2,675.54	42.65	5.10	5.10	0.29
12,444.00	88.35	330.72	11,298.73	374.17	2,659.87	72.07	11.54	11.53	0.56
12,475.00	90.95	331.42	11,298.92	401.30	2,644.88	100.71	8.69	8.39	2.26
12,570.00	93.67	329.93	11,295.10	484.05	2,598.40	188.17	3.26	2.86	-1.57
12,664.00	92.92	329.84	11,289.69	565.23	2,551.31	274.14	0.80	-0.80	-0.10
12,759.00	91.52	330.19	11,286.01	647.45	2,503.87	361.18	1.52	-1.47	0.37

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stern N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N-S (usft)	+E-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
12,853.00	91.56	329.14	11,283.49	728.55	2,456.41	447.11	1.12	0.04	-1.12
12,948.00	90.77	330.89	11,281.55	810.81	2,408.95	534.20	2.02	-0.83	1.84
13,042.00	89.63	328.61	11,281.23	892.00	2,361.60	620.21	2.71	-1.21	-2.43
13,137.00	89.58	328.78	11,281.88	973.17	2,312.24	706.42	0.19	-0.05	0.18
13,231.00	88.84	328.78	11,283.18	1,053.55	2,263.52	791.78	0.79	-0.79	0.00
13,326.00	89.45	328.61	11,284.59	1,134.71	2,214.16	877.99	0.67	0.64	-0.18
13,421.00	90.55	329.31	11,284.59	1,216.11	2,165.18	964.38	1.37	1.16	0.74
13,515.00	92.75	329.66	11,281.89	1,297.05	2,117.47	1,050.18	2.37	2.34	0.37
13,610.00	92.35	330.01	11,277.66	1,379.10	2,069.78	1,137.09	0.56	-0.42	0.37
13,705.00	92.26	330.37	11,273.84	1,461.46	2,022.59	1,224.24	0.39	-0.09	0.38
13,799.00	91.78	329.31	11,270.53	1,542.69	1,975.40	1,310.27	1.24	-0.51	-1.13
13,894.00	92.13	329.75	11,267.29	1,624.52	1,927.25	1,397.00	0.59	0.37	0.46
13,988.00	91.69	329.14	11,264.15	1,705.42	1,879.49	1,482.77	0.80	-0.47	-0.65
14,082.00	90.42	328.78	11,262.42	1,785.95	1,831.03	1,568.24	1.40	-1.35	-0.38
14,177.00	90.37	328.70	11,261.77	1,867.15	1,781.73	1,654.49	0.10	-0.05	-0.08
14,271.00	91.03	329.14	11,260.62	1,947.65	1,733.21	1,739.94	0.84	0.70	0.47
14,366.00	89.98	329.75	11,259.78	2,029.45	1,684.92	1,826.67	1.28	-1.11	0.64
14,461.00	89.80	329.75	11,259.96	2,111.52	1,637.06	1,913.60	0.19	-0.19	0.00
14,555.00	89.89	330.19	11,260.22	2,192.90	1,590.02	1,999.77	0.48	0.10	0.47
14,650.00	89.93	331.07	11,260.37	2,275.69	1,543.43	2,087.28	0.93	0.04	0.93
14,744.00	90.68	329.31	11,259.87	2,357.25	1,496.70	2,173.58	2.04	0.80	-1.87
14,838.00	91.03	330.63	11,258.46	2,438.62	1,449.66	2,259.73	1.45	0.37	1.40
14,933.00	90.90	330.63	11,256.86	2,521.39	1,403.08	2,347.23	0.14	-0.14	0.00
15,028.00	90.73	330.81	11,255.51	2,604.25	1,356.62	2,434.79	0.26	-0.18	0.19
15,122.00	90.51	330.63	11,254.50	2,686.23	1,310.65	2,521.44	0.30	-0.23	-0.19
15,216.00	90.51	330.72	11,253.66	2,768.19	1,264.61	2,608.05	0.10	0.00	0.10
15,311.00	90.07	330.28	11,253.18	2,850.87	1,217.83	2,695.48	0.65	-0.46	-0.46
15,406.00	91.25	330.72	11,252.08	2,933.54	1,171.06	2,782.90	1.33	1.24	0.46
15,500.00	90.73	330.10	11,250.46	3,015.27	1,124.65	2,869.34	0.86	-0.55	-0.66
15,594.00	90.33	330.37	11,249.59	3,096.87	1,077.99	2,955.67	0.51	-0.43	0.29
15,689.00	92.18	330.54	11,247.51	3,179.49	1,031.15	3,043.05	1.96	1.95	0.18
15,784.00	91.78	330.63	11,244.23	3,262.19	984.52	3,130.48	0.43	-0.42	0.09
15,879.00	91.69	330.63	11,241.35	3,344.95	937.95	3,217.95	0.09	-0.09	0.00
15,973.00	91.34	330.90	11,238.87	3,426.94	892.06	3,304.60	0.47	-0.37	0.29
16,068.00	90.90	331.33	11,237.01	3,510.11	846.18	3,392.40	0.65	-0.46	0.45
16,163.00	91.47	330.90	11,235.05	3,593.27	800.30	3,480.21	0.75	0.60	-0.45
16,257.00	91.56	330.28	11,232.56	3,675.13	754.16	3,566.74	0.67	0.10	-0.66
16,352.00	91.34	330.28	11,230.16	3,757.61	707.07	3,654.00	0.23	-0.23	0.00
16,447.00	92.18	330.46	11,227.24	3,840.14	660.13	3,741.30	0.90	0.88	0.19
16,541.00	91.78	330.02	11,223.99	3,921.70	613.50	3,827.59	0.63	-0.43	-0.47
16,636.00	91.65	330.02	11,221.15	4,003.95	566.05	3,914.66	0.14	-0.14	0.00
16,731.00	91.78	330.90	11,218.30	4,086.56	519.23	4,002.03	0.94	0.14	0.93
16,825.00	91.08	331.07	11,215.96	4,168.74	473.65	4,088.81	0.77	-0.74	0.18
16,920.00	92.35	331.69	11,213.12	4,252.09	428.17	4,176.76	1.49	1.34	0.65

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stem N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia Office of Oil and Gas	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stem	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stem N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
17,015.00	91.91	329.84	11,209.58	4,334.93	381.81	4,264.30	2.00	-0.46	-1.95	
17,109.00	91.21	329.66	11,207.02	4,416.10	334.47	4,350.28	0.77	-0.74	-0.19	
17,204.00	90.64	329.93	11,205.49	4,498.19	286.68	4,437.24	0.66	-0.60	0.28	
17,298.00	92.13	329.93	11,203.22	4,579.51	239.60	4,523.35	1.59	1.59	0.00	
17,393.00	91.78	330.10	11,199.98	4,661.75	192.15	4,610.41	0.41	-0.37	0.18	
17,488.00	91.38	330.02	11,197.36	4,744.04	144.75	4,697.51	0.43	-0.42	-0.08	
17,582.00	91.03	330.37	11,195.38	4,825.59	98.04	4,783.81	0.53	-0.37	0.37	
17,676.00	90.86	330.54	11,193.83	4,907.35	51.69	4,870.27	0.26	-0.18	0.18	
17,770.00	91.25	330.90	11,192.10	4,989.33	5.73	4,956.91	0.56	0.41	0.38	
17,865.00	90.86	329.49	11,190.35	5,071.75	-41.48	5,044.12	1.54	-0.41	-1.48	
17,960.00	90.81	330.10	11,188.97	5,153.84	-89.27	5,131.07	0.64	-0.05	0.64	
18,055.00	91.82	329.23	11,186.79	5,235.81	-137.24	5,217.93	1.40	1.06	-0.92	
18,149.00	91.78	328.70	11,183.83	5,316.31	-185.68	5,303.38	0.57	-0.04	-0.56	
18,244.00	91.91	328.61	11,180.78	5,397.41	-235.07	5,389.52	0.17	0.14	-0.09	
18,338.00	91.69	328.96	11,177.82	5,477.76	-283.76	5,474.85	0.44	-0.23	0.37	
18,433.00	91.47	329.23	11,175.20	5,559.24	-332.54	5,561.30	0.37	-0.23	0.28	
18,528.00	91.34	328.17	11,172.87	5,640.39	-381.87	5,647.49	1.12	-0.14	-1.12	
18,623.00	90.95	326.76	11,170.98	5,720.46	-432.96	5,732.81	1.54	-0.41	-1.48	
18,717.00	91.12	327.73	11,169.28	5,799.50	-483.80	5,817.08	1.05	0.18	1.03	
18,812.00	91.03	327.73	11,167.50	5,879.81	-534.52	5,902.59	0.09	-0.09	0.00	
18,907.00	90.95	327.29	11,165.85	5,959.93	-585.54	5,987.95	0.47	-0.08	-0.46	
19,002.00	90.29	327.29	11,164.83	6,039.86	-636.87	6,073.16	0.69	-0.69	0.00	
19,097.00	90.02	327.12	11,164.57	6,119.72	-688.33	6,158.30	0.34	-0.28	-0.18	
<b>Survey @ 19097.00 MD 11164.57 TVD</b>										
19,156.00	90.02	327.12	11,164.55	6,169.27	-720.36	6,211.15	0.00	0.00	0.00	
<b>Survey projected to 19156.00 MD 11164.55 TVD</b>										

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
170.00	170.00	0.97	-0.55	MWD surveys
19,097.00	11,164.57	6,119.72	-688.33	Survey @ 19097.00 MD 11164.57 TVD

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<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stern N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

<b>Project</b>	Marshall County, West Virginia.		
<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)		

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<b>Site</b>	Keith Stern				
<b>Site Position:</b>		<b>Northing:</b>	14,444,890.33 usft	<b>Latitude:</b>	39.77483004
<b>From:</b>	Lat/Long	<b>Easting:</b>	1,726,932.47 usft	<b>Longitude:</b>	-80.69208048
<b>Position Uncertainty:</b>	0.00 usft	<b>Slot Radius:</b>	13-3/16 "	<b>Grid Convergence:</b>	0.197 °

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<b>Well</b>	Keith Stern N-16 HU (slot F)					
<b>Well Position</b>	<b>+N/-S</b>	0.00 usft	<b>Northing:</b>	14,444,899.57 usft	<b>Latitude:</b>	39.77485561
	<b>+E/-W</b>	0.00 usft	<b>Easting:</b>	1,726,913.62 usft	<b>Longitude:</b>	-80.69214745
<b>Position Uncertainty</b>		0.00 usft	<b>Wellhead Elevation:</b>	usft	<b>Ground Level:</b>	747.00 usft

<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	3/5/2020	(°) -8.781	(°) 66.717	(nT) 51,856.76028537

<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>	
	(usft)	(usft)	(usft)	(°)	
	0.00	0.00	0.00	353.53	

<b>Survey Program</b>	Date 4/21/2020				
<b>From</b>	<b>To</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>	
170.00	698.00	MWD surf (Original Hole)	NS-GYRO-MS	North sensing gyrocompassing m/s	
792.00	2,177.00	MWD int (Original Hole)	MWD	MWD - Standard	
2,269.00	19,097.00	MWD (Original Hole)	MWD	MWD - Standard	
19,156.00	19,156.00	Projection (Original Hole)	MWD	MWD - Standard	

<b>Survey</b>										
<b>Measured Depth</b>	<b>Inclination</b>	<b>Azimuth</b>	<b>Vertical Depth</b>	<b>+N/-S</b>	<b>+E/-W</b>	<b>Map Northing</b>	<b>Map Easting</b>	<b>Latitude</b>	<b>Longitude</b>	
(usft)	(°)	(°)	(usft)	(usft)	(usft)	(usft)	(usft)			
0.00	0.00	0.00	0.00	0.00	0.00	14,444,899.57	1,726,913.62	39.77485561	-80.69214745	
170.00	0.75	330.63	170.00	0.97	-0.55	14,444,900.54	1,726,913.08	39.77485828	-80.69214938	
<b>MWD surveys</b>										
202.00	0.70	313.93	201.99	1.29	-0.79	14,444,900.86	1,726,912.83	39.77485916	-80.69215024	
233.00	0.66	314.81	232.99	1.54	-1.05	14,444,901.12	1,726,912.57	39.77485986	-80.69215118	
265.00	0.79	327.73	264.99	1.86	-1.30	14,444,901.43	1,726,912.32	39.77486074	-80.69215206	
288.00	0.75	330.37	287.99	2.13	-1.46	14,444,901.70	1,726,912.16	39.77486146	-80.69215262	
320.00	0.62	326.32	319.98	2.45	-1.66	14,444,902.02	1,726,911.96	39.77486236	-80.69215333	
352.00	0.70	311.64	351.98	2.73	-1.90	14,444,902.30	1,726,911.72	39.77486312	-80.69215418	



Survey Report - Geographic



<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stern N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	WV Department of Environmental Protection	
								Latitude	Longitude
383.00	0.66	334.67	382.98	3.01	-2.12	14,444,902.59	1,726,911.50	39.77486391	-80.69215496
415.00	0.83	312.88	414.98	3.34	-2.37	14,444,902.91	1,726,911.25	39.77486480	-80.69215584
446.00	1.27	330.36	445.97	3.79	-2.70	14,444,903.36	1,726,910.92	39.77486604	-80.69215702
474.00	1.27	327.29	473.96	4.32	-3.02	14,444,903.89	1,726,910.60	39.77486750	-80.69215816
540.00	1.23	345.57	539.95	5.62	-3.60	14,444,905.19	1,726,910.03	39.77487108	-80.69216018
603.00	1.45	339.59	602.93	7.02	-4.04	14,444,906.60	1,726,909.58	39.77487494	-80.69216175
666.00	0.92	312.08	665.92	8.11	-4.70	14,444,907.68	1,726,908.93	39.77487793	-80.69216406
698.00	0.88	319.64	697.91	8.47	-5.05	14,444,908.04	1,726,908.58	39.77487892	-80.69216530
792.00	0.66	282.99	791.91	9.14	-6.04	14,444,908.71	1,726,907.58	39.77488077	-80.69216884
887.00	1.14	255.57	886.90	9.03	-7.49	14,444,908.60	1,726,906.13	39.77488048	-80.69217399
982.00	1.05	249.86	981.88	8.49	-9.22	14,444,908.07	1,726,904.40	39.77487902	-80.69218016
1,076.00	0.66	240.63	1,075.87	7.93	-10.50	14,444,907.50	1,726,903.12	39.77487749	-80.69218473
1,171.00	0.70	245.90	1,170.86	7.43	-11.51	14,444,907.00	1,726,902.11	39.77487611	-80.69218832
1,266.00	1.10	275.17	1,265.85	7.27	-12.95	14,444,906.84	1,726,900.68	39.77487570	-80.69219344
1,360.00	1.85	308.13	1,359.82	8.29	-15.04	14,444,907.86	1,726,898.58	39.77487852	-80.69220087
1,455.00	2.42	313.84	1,454.75	10.62	-17.69	14,444,910.20	1,726,895.93	39.77488496	-80.69221028
1,550.00	3.03	315.86	1,549.64	13.82	-20.89	14,444,913.39	1,726,892.74	39.77489375	-80.69222162
1,644.00	2.81	326.50	1,643.52	17.52	-23.89	14,444,917.09	1,726,889.73	39.77490395	-80.69223225
1,739.00	2.68	327.82	1,738.41	21.34	-26.36	14,444,920.91	1,726,887.27	39.77491447	-80.69224099
1,832.00	2.11	341.97	1,831.33	24.81	-28.04	14,444,924.38	1,726,885.58	39.77492401	-80.69224696
1,927.00	0.44	332.56	1,926.31	26.80	-28.75	14,444,926.37	1,726,884.87	39.77492947	-80.69224946
2,022.00	0.40	212.94	2,021.31	26.84	-29.10	14,444,926.41	1,726,884.52	39.77492960	-80.69225070
2,116.00	0.48	180.95	2,115.30	26.17	-29.29	14,444,925.75	1,726,884.33	39.77492777	-80.69225136
2,177.00	0.65	81.02	2,176.30	25.97	-28.95	14,444,925.54	1,726,884.67	39.77492721	-80.69225017
2,269.00	1.19	202.75	2,268.29	25.17	-28.80	14,444,924.74	1,726,884.82	39.77492501	-80.69224966
2,316.00	1.41	208.64	2,315.28	24.21	-29.27	14,444,923.79	1,726,884.35	39.77492239	-80.69225133
2,363.00	1.36	206.88	2,362.27	23.21	-29.80	14,444,922.78	1,726,883.82	39.77491963	-80.69225322
2,408.00	1.14	206.18	2,407.26	22.33	-30.24	14,444,921.90	1,726,883.38	39.77491723	-80.69225479
2,455.00	0.79	196.68	2,454.25	21.60	-30.54	14,444,921.17	1,726,883.08	39.77491522	-80.69225587
2,502.00	0.62	128.83	2,501.25	21.13	-30.43	14,444,920.70	1,726,883.19	39.77491393	-80.69225550
2,549.00	0.75	87.26	2,548.25	20.99	-29.93	14,444,920.56	1,726,883.70	39.77491353	-80.69225370
2,597.00	1.36	61.86	2,596.24	21.27	-29.11	14,444,920.84	1,726,884.51	39.77491430	-80.69225080
2,644.00	2.07	54.65	2,643.22	22.03	-27.93	14,444,921.60	1,726,885.70	39.77491636	-80.69224657
2,691.00	2.72	54.56	2,690.17	23.16	-26.33	14,444,922.74	1,726,887.30	39.77491947	-80.69224086
2,738.00	3.38	57.99	2,737.11	24.54	-24.24	14,444,924.12	1,726,889.38	39.77492324	-80.69223343
2,786.00	3.69	62.39	2,785.02	26.01	-21.67	14,444,925.58	1,726,891.95	39.77492725	-80.69222427
2,833.00	3.36	71.52	2,831.93	27.15	-19.03	14,444,926.72	1,726,894.59	39.77493034	-80.69221483
2,880.00	3.47	84.71	2,878.84	27.71	-16.30	14,444,927.29	1,726,897.32	39.77493188	-80.69220514
2,927.00	3.91	96.58	2,925.75	27.66	-13.30	14,444,927.23	1,726,900.33	39.77493171	-80.69219443
2,974.00	4.57	101.67	2,972.62	27.10	-9.87	14,444,926.67	1,726,903.75	39.77493103	-80.69218225
3,021.00	5.67	102.28	3,019.43	26.23	-5.77	14,444,925.80	1,726,907.85	39.77492769	-80.69216766
3,069.00	6.37	104.49	3,067.17	25.06	-0.87	14,444,924.63	1,726,912.75	39.77492443	-80.69215025
3,116.00	7.03	107.39	3,113.85	23.54	4.40	14,444,923.12	1,726,918.02	39.77492023	-80.69213151
3,164.00	7.56	109.67	3,161.46	21.60	10.17	14,444,921.18	1,726,923.79	39.77491485	-80.69211098
3,213.00	8.09	111.61	3,210.00	19.25	16.41	14,444,918.82	1,726,930.04	39.77490832	-80.69208880
3,261.00	8.70	112.31	3,257.49	16.63	22.91	14,444,916.20	1,726,936.53	39.77490106	-80.69206570
3,308.00	9.10	111.52	3,303.92	13.91	29.66	14,444,913.49	1,726,943.28	39.77489354	-80.69204172
3,356.00	9.58	110.64	3,351.28	11.11	36.93	14,444,910.89	1,726,950.55	39.77488579	-80.69201589
3,451.00	10.72	109.94	3,444.79	5.31	52.63	14,444,904.89	1,726,966.25	39.77486971	-80.69196007
3,545.00	11.82	110.73	3,536.98	-1.08	69.85	14,444,898.50	1,726,983.48	39.77485200	-80.69189885
3,640.00	13.27	112.92	3,629.71	-8.77	89.00	14,444,890.81	1,727,002.62	39.77483070	-80.69183081
3,734.00	14.99	115.74	3,720.86	-18.25	109.89	14,444,881.32	1,727,023.51	39.77480446	-80.69175658
3,829.00	16.52	116.53	3,812.29	-29.62	133.04	14,444,869.96	1,727,046.66	39.77477302	-80.69167432
3,924.00	17.62	113.45	3,903.11	-41.37	158.32	14,444,858.20	1,727,071.94	39.77474050	-80.69158450
4,019.00	18.76	108.71	3,993.36	-52.00	185.98	14,444,847.58	1,727,099.60	39.77471106	-80.69148618



Survey Report - Geographic



<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stem N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stem	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stem N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
4,113.00	22.54	101.85	4,081.32	-60.55	217.94	14,444,839.02	1,727,131.57	39.77468727	-80.69137252
4,208.00	24.48	95.61	4,168.45	-66.21	255.36	14,444,833.36	1,727,168.98	39.77467136	-80.69123941
4,302.00	22.15	100.36	4,254.77	-71.30	292.18	14,444,828.27	1,727,205.81	39.77465703	-80.69110842
4,397.00	21.09	105.37	4,343.09	-79.06	326.29	14,444,820.52	1,727,239.91	39.77463542	-80.69098715
4,492.00	20.43	106.07	4,431.93	-88.18	358.70	14,444,811.40	1,727,272.32	39.77461006	-80.69087190
4,587.00	19.12	105.45	4,521.32	-96.91	389.63	14,444,802.66	1,727,303.25	39.77458578	-80.69076192
4,682.00	18.33	105.45	4,611.29	-105.04	419.03	14,444,794.54	1,727,332.65	39.77456319	-80.69065740
4,777.00	18.46	105.89	4,701.44	-113.13	447.89	14,444,786.44	1,727,361.51	39.77454068	-80.69055477
4,872.00	18.98	103.70	4,791.41	-120.91	477.37	14,444,778.66	1,727,390.99	39.77451904	-80.69044996
4,967.00	19.64	101.94	4,881.07	-127.87	507.99	14,444,771.70	1,727,421.62	39.77449963	-80.69034104
5,062.00	20.74	101.94	4,970.23	-134.66	540.07	14,444,764.92	1,727,453.69	39.77448070	-80.69022695
5,156.00	21.09	101.06	5,058.04	-141.34	572.95	14,444,758.23	1,727,486.58	39.77446202	-80.69011001
5,251.00	20.48	100.62	5,146.85	-147.68	606.06	14,444,751.89	1,727,519.69	39.77444429	-80.68999225
5,346.00	19.91	99.92	5,236.01	-153.53	638.33	14,444,746.04	1,727,551.95	39.77442792	-80.68987747
5,440.00	20.04	100.80	5,324.36	-159.31	669.92	14,444,740.26	1,727,583.54	39.77441176	-80.68976512
5,535.00	19.78	101.23	5,413.68	-165.49	701.68	14,444,734.08	1,727,615.30	39.77439448	-80.68965218
5,630.00	19.95	102.11	5,503.03	-172.02	733.29	14,444,727.55	1,727,646.91	39.77437625	-80.68953975
5,724.00	19.86	101.85	5,591.41	-178.66	764.60	14,444,720.91	1,727,678.22	39.77435770	-80.68942841
5,820.00	20.13	101.15	5,681.63	-185.21	796.76	14,444,714.37	1,727,710.38	39.77433943	-80.68931401
5,914.00	20.43	100.44	5,769.80	-191.31	828.77	14,444,708.26	1,727,742.39	39.77432237	-80.68920018
6,009.00	20.35	98.77	5,858.85	-196.83	861.40	14,444,702.74	1,727,775.02	39.77430689	-80.68908411
6,041.00	20.57	98.25	5,888.83	-198.49	872.46	14,444,701.09	1,727,786.08	39.77430224	-80.68904476
6,135.00	20.17	97.89	5,976.95	-203.08	904.86	14,444,696.49	1,727,818.48	39.77428931	-80.68892952
6,230.00	17.23	98.95	6,066.93	-207.52	934.98	14,444,692.05	1,727,848.61	39.77427684	-80.68882235
6,323.00	14.06	99.83	6,156.47	-211.59	959.73	14,444,687.98	1,727,873.35	39.77426542	-80.68873434
6,354.00	13.80	100.62	6,186.56	-212.91	967.07	14,444,686.66	1,727,880.69	39.77426171	-80.68870821
6,449.00	11.73	100.88	6,279.20	-216.83	987.69	14,444,682.75	1,727,901.31	39.77425077	-80.68863487
6,481.00	11.60	100.88	6,310.54	-218.05	994.05	14,444,681.52	1,727,907.67	39.77424736	-80.68861227
6,578.00	12.44	100.71	6,405.42	-221.83	1,013.89	14,444,677.74	1,727,927.51	39.77423678	-80.68854170
6,673.00	14.41	99.39	6,497.82	-225.66	1,035.61	14,444,673.91	1,727,949.23	39.77422605	-80.68846445
6,768.00	15.69	98.95	6,589.55	-229.59	1,059.96	14,444,669.98	1,727,973.58	39.77421504	-80.68837782
6,862.00	16.88	98.77	6,679.78	-233.65	1,086.01	14,444,665.93	1,727,999.63	39.77420364	-80.68828518
6,957.00	19.49	99.39	6,770.03	-238.34	1,115.28	14,444,661.24	1,728,028.90	39.77419048	-80.68818106
7,051.00	22.10	100.62	6,857.90	-244.15	1,148.13	14,444,655.42	1,728,061.76	39.77417419	-80.68806419
7,146.00	22.72	102.73	6,945.73	-251.49	1,183.59	14,444,648.08	1,728,097.22	39.77415371	-80.68793808
7,240.00	23.29	104.40	7,032.25	-260.11	1,219.30	14,444,639.46	1,728,132.92	39.77412969	-80.68781111
7,335.00	21.84	103.70	7,119.98	-268.97	1,254.66	14,444,630.60	1,728,168.28	39.77410503	-80.68768537
7,428.00	21.01	103.17	7,206.55	-276.86	1,287.70	14,444,622.71	1,728,201.32	39.77408303	-80.68756787
7,559.00	22.32	102.99	7,328.29	-287.81	1,334.81	14,444,611.77	1,728,248.43	39.77405252	-80.68740035
7,618.00	22.32	103.52	7,382.87	-292.94	1,356.62	14,444,606.63	1,728,270.24	39.77403821	-80.68732280
7,712.00	23.99	102.03	7,469.30	-301.10	1,392.67	14,444,598.47	1,728,306.29	39.77401546	-80.68719460
7,805.00	26.10	99.65	7,553.55	-308.47	1,431.33	14,444,591.10	1,728,344.95	39.77399485	-80.68705709
7,900.00	27.55	99.83	7,638.32	-315.72	1,473.58	14,444,583.85	1,728,387.20	39.77397452	-80.68690681
7,994.00	26.41	99.92	7,722.09	-323.04	1,515.59	14,444,576.53	1,728,429.22	39.77395403	-80.68675737
8,101.00	25.75	103.34	7,818.20	-332.50	1,561.65	14,444,567.07	1,728,475.27	39.77392760	-80.68659357
8,182.00	27.69	100.97	7,890.55	-340.14	1,597.25	14,444,559.43	1,728,510.88	39.77390627	-80.68646696
8,277.00	27.11	100.62	7,974.89	-348.33	1,640.20	14,444,551.24	1,728,553.82	39.77388337	-80.68631422
8,371.00	27.42	102.64	8,058.45	-357.02	1,682.37	14,444,542.56	1,728,595.99	39.77385912	-80.68616424
8,465.00	26.67	101.59	8,142.17	-365.99	1,724.16	14,444,533.58	1,728,637.78	39.77383407	-80.68601563
8,558.00	24.13	102.90	8,226.18	-374.43	1,763.14	14,444,525.14	1,728,676.76	39.77381052	-80.68587700
8,652.00	23.20	103.61	8,312.27	-383.08	1,799.86	14,444,516.50	1,728,713.49	39.77378642	-80.68574640
8,746.00	23.95	105.28	8,398.43	-392.46	1,836.27	14,444,507.11	1,728,749.89	39.77376029	-80.68561697
8,841.00	23.99	105.89	8,485.23	-402.83	1,873.44	14,444,496.74	1,728,787.06	39.77373146	-80.68548479
8,936.00	25.44	105.36	8,571.53	-413.52	1,911.69	14,444,486.05	1,728,825.31	39.77370172	-80.68534879
9,031.00	25.80	107.21	8,657.19	-425.04	1,951.12	14,444,474.53	1,728,864.74	39.77366970	-80.68520862

<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stern N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stern	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stern N-16 HU (slot F)	<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_Aug1919_v14

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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	WV Department of Environmental Protection	
								Latitude	Longitude
9,125.00	26.89	108.71	8,741.43	-437.92	1,990.79	14,444,461.66	1,728,904.41	39.77363397	-80.68506757
9,219.00	26.63	110.81	8,825.36	-452.22	2,030.62	14,444,447.35	1,728,944.24	39.77359430	-80.68492601
9,313.00	25.53	110.29	8,909.79	-466.73	2,069.31	14,444,432.64	1,728,982.93	39.77355408	-80.68478848
9,408.00	25.22	108.53	8,995.62	-480.26	2,107.70	14,444,419.31	1,729,021.33	39.77351655	-80.68465201
9,503.00	25.00	107.12	9,081.65	-492.60	2,146.08	14,444,406.97	1,729,059.70	39.77348229	-80.68451559
9,597.00	24.43	106.68	9,167.04	-504.03	2,183.68	14,444,395.54	1,729,097.30	39.77345054	-80.68438190
9,692.00	24.35	103.43	9,253.56	-514.22	2,221.55	14,444,385.36	1,729,135.17	39.77342220	-80.68424725
9,787.00	25.18	102.20	9,339.83	-523.04	2,260.36	14,444,376.54	1,729,173.98	39.77339760	-80.68410926
9,881.00	25.58	100.97	9,424.75	-531.12	2,299.82	14,444,368.45	1,729,213.45	39.77337501	-80.68396890
9,975.00	24.74	101.76	9,509.83	-538.99	2,339.00	14,444,360.58	1,729,252.63	39.77335301	-80.68382956
10,069.00	24.74	101.59	9,595.21	-546.96	2,377.53	14,444,352.62	1,729,291.15	39.77333078	-80.68369255
10,164.00	24.92	100.80	9,681.43	-554.70	2,416.66	14,444,344.87	1,729,330.28	39.77330913	-80.68355337
10,259.00	25.44	101.15	9,767.40	-562.40	2,456.34	14,444,337.18	1,729,369.96	39.77328761	-80.68341225
10,353.00	25.27	100.18	9,852.34	-569.85	2,495.90	14,444,329.73	1,729,409.52	39.77326677	-80.68327156
10,447.00	24.92	101.67	9,937.47	-577.40	2,535.04	14,444,322.17	1,729,448.66	39.77324565	-80.68313235
10,530.00	25.05	101.67	10,012.70	-584.49	2,569.37	14,444,315.08	1,729,483.00	39.77322584	-80.68301025
10,624.00	25.54	103.78	10,097.69	-593.34	2,608.54	14,444,306.23	1,729,522.17	39.77320115	-80.68287095
10,655.00	25.76	100.18	10,125.64	-596.12	2,621.67	14,444,303.45	1,729,535.29	39.77319338	-80.68282429
10,702.00	25.80	99.13	10,167.96	-599.55	2,641.82	14,444,300.02	1,729,555.44	39.77318377	-80.68275262
10,750.00	24.40	90.16	10,211.44	-601.24	2,662.05	14,444,298.33	1,729,575.67	39.77317894	-80.68268062
10,797.00	23.78	80.40	10,254.37	-599.68	2,681.11	14,444,299.89	1,729,594.73	39.77318302	-80.68261277
10,844.00	23.74	71.79	10,297.40	-595.15	2,699.45	14,444,304.43	1,729,613.07	39.77318531	-80.68254746
10,891.00	22.42	63.79	10,340.64	-588.23	2,716.48	14,444,311.34	1,729,630.10	39.77321414	-80.68248675
10,939.00	21.89	63.79	10,385.10	-580.23	2,732.72	14,444,319.34	1,729,646.34	39.77323593	-80.68242885
10,986.00	21.85	57.29	10,428.72	-571.64	2,747.94	14,444,327.94	1,729,661.56	39.77325940	-80.68237456
11,034.00	21.32	55.97	10,473.36	-561.93	2,762.69	14,444,337.65	1,729,676.31	39.77328592	-80.68232196
11,081.00	22.59	54.92	10,516.95	-551.96	2,777.16	14,444,347.62	1,729,690.78	39.77331316	-80.68227034
11,128.00	22.33	48.24	10,560.39	-540.82	2,791.21	14,444,358.75	1,729,704.83	39.77334361	-80.68222019
11,175.00	22.68	43.49	10,603.82	-528.30	2,804.11	14,444,371.27	1,729,717.73	39.77337787	-80.68217413
11,223.00	24.70	41.21	10,647.77	-514.04	2,817.08	14,444,385.53	1,729,730.71	39.77341690	-80.68212776
11,270.00	25.58	36.81	10,690.32	-498.53	2,829.63	14,444,401.05	1,729,743.26	39.77345938	-80.68208290
11,317.00	26.86	28.64	10,732.50	-481.08	2,840.81	14,444,418.50	1,729,754.43	39.77350719	-80.68204292
11,364.00	28.70	20.11	10,774.10	-461.15	2,849.78	14,444,438.42	1,729,763.40	39.77356183	-80.68201073
11,412.00	31.60	16.16	10,815.60	-438.24	2,857.25	14,444,461.33	1,729,770.87	39.77362467	-80.68198387
11,459.00	33.89	13.43	10,855.13	-413.67	2,863.72	14,444,485.91	1,729,777.34	39.77369210	-80.68196053
11,507.00	36.44	10.53	10,894.37	-386.63	2,869.43	14,444,512.95	1,729,783.05	39.77376630	-80.68193985
11,554.00	38.55	5.96	10,931.67	-358.33	2,873.50	14,444,541.24	1,729,787.13	39.77384397	-80.68192499
11,601.00	40.31	1.39	10,967.98	-328.56	2,875.39	14,444,571.02	1,729,789.02	39.77392572	-80.68191789
11,648.00	42.42	358.75	11,003.25	-297.50	2,875.42	14,444,602.07	1,729,789.04	39.77401099	-80.68191742
11,696.00	45.32	356.73	11,037.85	-264.27	2,874.09	14,444,635.50	1,729,787.71	39.77410227	-80.68192172
11,743.00	49.41	357.35	11,069.68	-229.75	2,872.31	14,444,669.82	1,729,785.93	39.77419710	-80.68192761
11,790.00	51.43	356.38	11,099.63	-193.58	2,870.33	14,444,705.99	1,729,783.95	39.77429644	-80.68193422
11,837.00	53.19	354.36	11,128.36	-156.52	2,867.32	14,444,743.06	1,729,780.94	39.77439826	-80.68194447
11,884.00	57.36	350.49	11,155.14	-118.25	2,862.19	14,444,781.32	1,729,775.82	39.77450340	-80.68196221
11,931.00	62.11	347.33	11,178.82	-78.44	2,854.36	14,444,821.14	1,729,767.98	39.77461281	-80.68198958
11,979.00	65.36	342.49	11,200.07	-36.91	2,843.14	14,444,862.67	1,729,756.76	39.77472698	-80.68202900
12,026.00	68.57	341.44	11,218.46	4.21	2,829.75	14,444,903.79	1,729,743.37	39.77484003	-80.68207615
12,074.00	70.24	342.41	11,235.34	46.93	2,815.81	14,444,946.50	1,729,729.43	39.77495747	-80.68212522
12,121.00	73.41	341.00	11,250.00	89.32	2,801.79	14,444,988.89	1,729,715.41	39.77507402	-80.68217458
12,169.00	78.07	338.63	11,261.82	132.96	2,785.73	14,445,032.53	1,729,699.35	39.77519404	-80.68223118
12,216.00	79.91	335.20	11,270.80	175.39	2,767.64	14,445,074.96	1,729,681.26	39.77531074	-80.68229502
12,263.00	81.27	332.04	11,278.49	216.92	2,747.04	14,445,116.50	1,729,660.66	39.77542500	-80.68236782
12,286.00	82.33	331.42	11,281.77	236.97	2,736.26	14,445,136.55	1,729,649.88	39.77548016	-80.68240594
12,318.00	83.03	331.24	11,285.85	264.82	2,721.03	14,445,164.39	1,729,634.65	39.77555679	-80.68245978
12,343.00	83.03	331.24	11,288.88	286.58	2,709.09	14,445,186.15	1,729,622.71	39.77561665	-80.68250200



Survey Report - Geographic



<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stem N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stem	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stem N-16 HU (slot F)	<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_Aug1919_v14

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Latitude

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
12,381.00	83.08	330.45	11,293.47	319.52	2,690.72	14,445,219.09	1,729,604.34	39.77570729	-80.68256699
12,412.00	84.66	330.54	11,296.78	346.34	2,675.54	14,445,245.91	1,729,589.16	39.77587811	-80.68262068
12,444.00	88.35	330.72	11,298.73	374.17	2,659.87	14,445,273.74	1,729,573.49	39.77585769	-80.68267607
12,475.00	90.95	331.42	11,298.92	401.30	2,644.88	14,445,300.87	1,729,558.50	39.77593234	-80.68272910
12,570.00	93.67	329.93	11,295.10	484.05	2,598.40	14,445,383.62	1,729,512.02	39.77616004	-80.68289349
12,664.00	92.92	329.84	11,289.69	565.23	2,551.31	14,445,464.80	1,729,464.93	39.77638343	-80.68306005
12,759.00	91.52	330.19	11,286.01	647.45	2,503.87	14,445,547.02	1,729,417.49	39.77660969	-80.68322787
12,853.00	91.56	329.14	11,283.49	728.55	2,456.41	14,445,628.12	1,729,370.03	39.77683287	-80.68339576
12,948.00	90.77	330.89	11,281.55	810.81	2,408.95	14,445,710.38	1,729,322.57	39.77705925	-80.68356366
13,042.00	89.63	328.61	11,281.23	892.00	2,361.60	14,445,791.58	1,729,275.22	39.77728269	-80.68373117
13,137.00	89.58	328.78	11,281.88	973.17	2,312.24	14,445,872.74	1,729,225.86	39.77750607	-80.68390583
13,231.00	88.84	328.78	11,283.18	1,053.55	2,263.52	14,445,953.12	1,729,177.14	39.77772729	-80.68407822
13,326.00	89.45	328.61	11,284.59	1,134.71	2,214.16	14,446,034.28	1,729,127.78	39.77795065	-80.68425287
13,421.00	90.55	329.31	11,284.59	1,216.11	2,165.18	14,446,115.68	1,729,078.80	39.77817466	-80.68442619
13,515.00	92.75	329.66	11,281.89	1,297.05	2,117.47	14,446,196.62	1,729,031.09	39.77839741	-80.68459498
13,610.00	92.35	330.01	11,277.66	1,379.10	2,069.78	14,446,278.67	1,728,983.40	39.77862321	-80.68476369
13,705.00	92.26	330.37	11,273.84	1,461.46	2,022.59	14,446,361.04	1,728,936.21	39.77884985	-80.68493061
13,799.00	91.78	329.31	11,270.53	1,542.69	1,975.40	14,446,442.26	1,728,889.02	39.77907337	-80.68509758
13,894.00	92.13	329.75	11,267.29	1,624.52	1,927.25	14,446,524.09	1,728,840.87	39.77929856	-80.68526792
13,988.00	91.69	329.14	11,264.15	1,705.42	1,879.49	14,446,604.99	1,728,793.11	39.77952120	-80.68543690
14,082.00	90.42	328.78	11,262.42	1,785.95	1,831.03	14,446,685.52	1,728,744.65	39.77974281	-80.68560838
14,177.00	90.37	328.70	11,261.77	1,867.15	1,781.73	14,446,766.72	1,728,695.36	39.77996630	-80.68578283
14,271.00	91.03	329.14	11,260.62	1,947.65	1,733.21	14,446,847.22	1,728,646.83	39.78018784	-80.68595453
14,366.00	89.98	329.75	11,259.78	2,029.45	1,684.92	14,446,929.03	1,728,598.54	39.78041296	-80.68612540
14,461.00	89.80	329.75	11,259.96	2,111.52	1,637.06	14,447,011.09	1,728,550.68	39.78063879	-80.68629472
14,555.00	89.89	330.19	11,260.22	2,192.90	1,590.02	14,447,092.47	1,728,503.64	39.78086273	-80.68646114
14,650.00	89.93	331.07	11,260.37	2,275.69	1,543.43	14,447,175.26	1,728,457.05	39.78109054	-80.68662595
14,744.00	90.68	329.31	11,259.87	2,357.25	1,496.70	14,447,256.82	1,728,410.32	39.78131496	-80.68679125
14,838.00	91.03	330.63	11,258.46	2,438.62	1,449.66	14,447,338.19	1,728,363.29	39.78153888	-80.68695766
14,933.00	90.90	330.63	11,256.86	2,521.39	1,403.08	14,447,420.97	1,728,316.70	39.78176666	-80.68712245
15,028.00	90.73	330.81	11,255.51	2,604.25	1,356.62	14,447,503.82	1,728,270.24	39.78199464	-80.68728678
15,122.00	90.51	330.63	11,254.50	2,686.23	1,310.65	14,447,585.81	1,728,224.27	39.78222024	-80.68744939
15,216.00	90.51	330.72	11,253.66	2,768.19	1,264.61	14,447,667.76	1,728,178.24	39.78244574	-80.68761224
15,311.00	90.07	330.28	11,253.18	2,850.87	1,217.83	14,447,750.44	1,728,131.46	39.78267325	-80.68777772
15,406.00	91.25	330.72	11,252.08	2,933.54	1,171.06	14,447,833.12	1,728,084.68	39.78290075	-80.68794319
15,500.00	90.73	330.10	11,250.46	3,015.27	1,124.65	14,447,914.84	1,728,038.27	39.78312564	-80.68810737
15,594.00	90.33	330.37	11,249.59	3,096.87	1,077.99	14,447,996.44	1,727,991.61	39.78335017	-80.68827246
15,689.00	92.18	330.54	11,247.51	3,179.49	1,031.15	14,448,079.06	1,727,944.78	39.78357752	-80.68843814
15,784.00	91.78	330.63	11,244.23	3,262.19	984.52	14,448,161.77	1,727,898.15	39.78380509	-80.68860309
15,879.00	91.69	330.63	11,241.35	3,344.95	937.95	14,448,244.52	1,727,851.57	39.78403279	-80.68876784
15,973.00	91.34	330.90	11,238.87	3,426.94	892.06	14,448,326.52	1,727,805.68	39.78425842	-80.68893018
16,068.00	90.90	331.33	11,237.01	3,510.11	846.18	14,448,409.68	1,727,759.80	39.78448725	-80.68909247
16,163.00	91.47	330.90	11,235.05	3,593.27	800.30	14,448,492.84	1,727,713.92	39.78471607	-80.68925475
16,257.00	91.56	330.28	11,232.56	3,675.13	754.16	14,448,574.70	1,727,667.78	39.78494131	-80.68941799
16,352.00	91.34	330.28	11,230.16	3,757.61	707.07	14,448,657.18	1,727,620.70	39.78516826	-80.68958457
16,447.00	92.18	330.46	11,227.24	3,840.14	660.13	14,448,739.72	1,727,573.75	39.78539538	-80.68975065
16,541.00	91.78	330.02	11,223.99	3,921.70	613.50	14,448,821.27	1,727,527.12	39.78561979	-80.68991564
16,636.00	91.65	330.02	11,221.15	4,003.95	566.05	14,448,903.52	1,727,479.67	39.78584612	-80.69008353
16,731.00	91.78	330.90	11,218.30	4,086.56	519.23	14,448,986.13	1,727,432.85	39.78607345	-80.69024916
16,825.00	91.08	331.07	11,215.96	4,168.74	473.65	14,449,068.31	1,727,387.27	39.78629956	-80.69041039
16,920.00	92.35	331.69	11,213.12	4,252.09	428.17	14,449,151.66	1,727,341.79	39.78652890	-80.69057127
17,015.00	91.91	329.84	11,209.58	4,334.93	381.81	14,449,234.50	1,727,295.43	39.78675683	-80.69073529
17,109.00	91.21	329.66	11,207.02	4,416.10	334.47	14,449,315.67	1,727,248.09	39.78698019	-80.69090280
17,204.00	90.64	329.93	11,205.49	4,498.19	286.68	14,449,397.76	1,727,200.30	39.78720609	-80.69107190
17,298.00	92.13	329.93	11,203.22	4,579.51	239.60	14,449,479.09	1,727,153.22	39.78742987	-80.69123851



<b>Company:</b>	Tug Hill Operating LLC	<b>Local Co-ordinate Reference:</b>	Well Keith Stem N-16 HU (slot F)
<b>Project:</b>	Marshall County, West Virginia.	<b>TVD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Site:</b>	Keith Stem	<b>MD Reference:</b>	RKB=747+33 @ 780.00usft (Nabors X08)
<b>Well:</b>	Keith Stem N-16 HU (slot F)	<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_Aug1919_v14

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
17,393.00	91.78	330.10	11,199.98	4,661.75	192.15	14,449,561.32	1,727,105.77	39.78765616	-80.69140641
17,488.00	91.38	330.02	11,197.36	4,744.04	144.75	14,449,643.61	1,727,058.37	39.78788260	-80.69157412
17,582.00	91.03	330.37	11,195.38	4,825.59	98.04	14,449,725.16	1,727,011.66	39.78810699	-80.69173940
17,676.00	90.86	330.54	11,193.83	4,907.35	51.69	14,449,806.93	1,726,965.31	39.78833198	-80.69190338
17,770.00	91.25	330.90	11,192.10	4,989.33	5.73	14,449,888.90	1,726,919.35	39.78855754	-80.69206600
17,865.00	90.86	329.49	11,190.35	5,071.75	-41.48	14,449,971.32	1,726,872.14	39.78878433	-80.69223305
17,960.00	90.81	330.10	11,188.97	5,153.84	-89.27	14,450,053.41	1,726,824.35	39.78901023	-80.69240216
18,055.00	91.82	329.23	11,186.79	5,235.81	-137.24	14,450,135.38	1,726,776.38	39.78923579	-80.69257191
18,149.00	91.78	328.70	11,183.83	5,316.31	-185.68	14,450,215.89	1,726,727.94	39.78945733	-80.69274336
18,244.00	91.91	328.61	11,180.78	5,397.41	-235.07	14,450,296.98	1,726,678.55	39.78968050	-80.69291820
18,338.00	91.69	328.96	11,177.82	5,477.76	-283.76	14,450,377.33	1,726,629.86	39.78990162	-80.69309055
18,433.00	91.47	329.23	11,175.20	5,559.24	-332.54	14,450,458.81	1,726,581.09	39.79012585	-80.69326319
18,528.00	91.34	328.17	11,172.87	5,640.39	-381.87	14,450,539.96	1,726,531.75	39.79034916	-80.69343784
18,623.00	90.95	326.76	11,170.98	5,720.46	-432.96	14,450,620.03	1,726,480.67	39.79056954	-80.69361870
18,717.00	91.12	327.73	11,169.28	5,799.50	-483.80	14,450,699.07	1,726,429.82	39.79078708	-80.69379876
18,812.00	91.03	327.73	11,167.50	5,879.81	-534.52	14,450,779.38	1,726,379.10	39.79100812	-80.69397831
18,907.00	90.95	327.29	11,165.85	5,959.93	-585.54	14,450,859.50	1,726,328.08	39.79122862	-80.69415897
19,002.00	90.29	327.29	11,164.83	6,039.86	-636.87	14,450,939.43	1,726,276.75	39.79144861	-80.69434074
19,097.00	90.02	327.12	11,164.57	6,119.72	-688.33	14,451,019.29	1,726,225.29	39.79166840	-80.69452295
<b>Survey @ 19097.00 MD 11164.57 TVD</b>									
19,156.00	90.02	327.12	11,164.55	6,169.27	-720.36	14,451,068.84	1,726,193.26	39.79180478	-80.69463637
<b>Survey projected to 19156.00 MD 11164.55 TVD</b>									

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
170.00	170.00	0.97	-0.55	MWD surveys
19,097.00	11,164.57	6,119.72	-688.33	Survey @ 19097.00 MD 11164.57 TVD
19,156.00	11,164.55	6,169.27	-720.36	Survey projected to 19156.00 MD 11164.55 TVD

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**SEP 30 2022**  
  
 WV Department of  
 Environmental Protection