



Well: Keith Stern S-19 HU (slot Q)
 Site: Keith Stern
 Project: Marshall County, West Virginia.
 Design: rev3

SECTION DETAILS

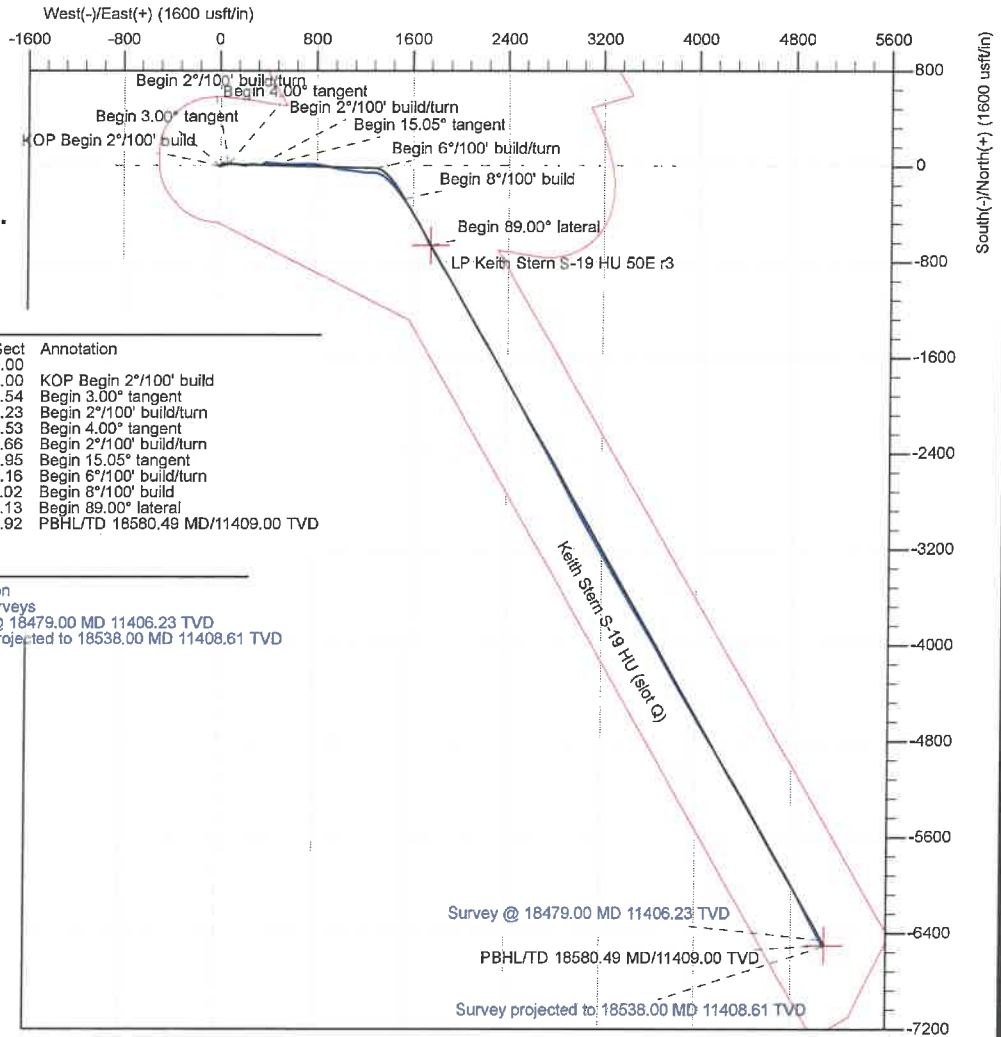
Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	Vsect	Annotation
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.00	
2	1436.00	0.00	0.00	1436.00	0.00	0.00	0.00	0.000	0.00	KOP Begin 2°/100' build
3	1586.00	3.00	75.00	1585.93	1.02	3.79	2.00	75.000	1.54	Begin 3.00° tangent
4	2986.00	3.00	75.00	2984.01	19.98	74.57	0.00	0.000	30.23	Begin 2°/100' build/turn
5	3055.84	4.00	81.67	3054.72	20.39	78.83	2.00	54.025	32.53	Begin 4.00° tangent
6	6761.14	4.00	81.67	6750.00	12.86	337.12	0.00	0.000	197.66	Begin 2°/100' build/turn
7	7313.53	15.05	81.64	7293.93	10.24	428.33	2.00	-0.042	255.95	Begin 15.05° tangent
8	10643.96	15.05	81.64	10510.16	-14.50	1292.64	0.00	0.000	808.16	Begin 6°/100' build/turn
9	11370.70	50.00	150.31	11124.57	-271.55	1536.71	6.00	71.593	1161.02	Begin 8°/100' build
10	11858.20	89.00	150.31	11292.00	-660.83	1758.53	8.00	0.000	1604.13	Begin 89.00° lateral
11	18580.49	89.00	150.31	11409.00	-6499.60	5087.48	0.00	0.000	8253.92	PBHL/TD 18580.49 MD/11409.00 TVD

ANNOTATIONS SURVEYS

MD	Inc	Azi	TVD	+N/-S	+E/-W	Vsect	Annotation
234.00	0.18	112.13	234.00	-0.14	0.34	0.32	MWD surveys
18479.00	87.69	151.24	11406.23	-6455.58	5048.89	8195.48	Survey @ 18479.00 MD 11406.23 TVD
18538.00	87.69	151.24	11408.61	-6507.26	5077.25	8253.65	Survey projected to 18538.00 MD 11408.61 TVD

True Vertical Depth (1500 usft/m)

Vertical Section at 141.95° (1500 usft/m)



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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
14444890.32	1726932.47	39.77483004	-80.69208048

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.855



Azimuths to Grid North
 True North: -0.20°
 Magnetic North: -5.98°

Magnetic Field
 Strength: 51830.8nT
 Dip Angle: 66.70°
 Date: 5/27/2020
 Model: IGRF2015



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stem S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stem	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stem S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

Project	Marshall County, West Virginia.			RECEIVED
Map System:	Universal Transverse Mercator (US Survey Feet)	System Datum:	Mean Sea Level	Office of Oil and Gas
Geo Datum:	NAD83 West Virginia - HARN			SEP 30 2022
Map Zone:	Zone 17N (84 W to 78 W)			

Site	Keith Stem				WV Department of Environmental Protection
Site Position:		Northing:	14,444,890.33 usft	Latitude:	39.77483004
From:	Lat/Long	Easting:	1,726,932.47 usft	Longitude:	-80.69208048
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.197 °

Well	Keith Stem S-19 HU (slot Q)					
Well Position	+N/-S	0.00 usft	Northing:	14,444,890.33 usft	Latitude:	39.77483004
	+E/-W	0.00 usft	Easting:	1,726,932.47 usft	Longitude:	-80.69208048
Position Uncertainty	0.00 usft		Wellhead Elevation:	usft	Ground Level:	747.00 usft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	5/27/2020	-8.788	66.698	51,830.61938088

Design	Surveys Original Hole				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.00	0.00	0.00	141.95	

Survey Program	Date 6/24/2020				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
234.00	2,202.00	MWD surf (Original Hole)	MWD	MWD - Standard	
2,322.00	9,885.00	MWD int (Original Hole)	MWD	MWD - Standard	
9,979.00	18,479.00	MWD (Original Hole)	MWD	MWD - Standard	
18,538.00	18,538.00	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	
234.00	0.18	112.13	234.00	-0.14	0.34	0.32	0.08	0.08	0.00	
MWD surveys										
265.00	0.90	333.27	265.00	0.06	0.28	0.12	3.36	2.32	-447.94	
295.00	0.22	321.93	295.00	0.32	0.13	-0.17	2.29	-2.27	-37.80	
325.00	0.31	324.74	325.00	0.43	0.05	-0.30	0.30	0.30	9.37	
372.00	0.31	345.75	372.00	0.66	-0.05	-0.55	0.24	0.00	44.70	
420.00	0.44	331.86	419.99	0.94	-0.17	-0.85	0.33	0.27	-28.94	

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Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	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)
467.00	1.10	311.82	466.99	1.40	-0.59	-1.47	1.50	1.40	-42.64
514.00	1.10	315.25	513.98	2.02	-1.25	-2.36	0.14	0.00	7.30
609.00	0.83	323.33	608.97	3.22	-2.30	-3.96	0.32	-0.28	8.51
703.00	0.66	328.34	702.96	4.23	-2.99	-5.17	0.19	-0.18	5.33
798.00	0.53	313.32	797.96	5.00	-3.60	-6.15	0.21	-0.14	-15.81
892.00	0.48	279.04	891.95	5.36	-4.30	-6.87	0.32	-0.05	-36.47
986.00	0.57	297.93	985.95	5.64	-5.10	-7.59	0.21	0.10	20.10
1,081.00	0.62	302.86	1,080.94	6.14	-5.95	-8.50	0.08	0.05	5.19
1,176.00	0.26	31.10	1,175.94	6.60	-6.27	-9.07	0.70	-0.36	92.88
1,270.00	0.40	88.05	1,269.94	6.80	-5.84	-8.95	0.36	0.15	60.59
1,364.00	0.57	116.53	1,363.94	6.60	-5.09	-8.33	0.31	0.18	30.30
1,459.00	0.75	105.10	1,458.93	6.23	-4.07	-7.41	0.23	0.19	-12.03
1,554.00	0.88	109.85	1,553.92	5.82	-2.78	-6.29	0.15	0.14	5.00
1,648.00	1.01	97.72	1,647.91	5.46	-1.28	-5.09	0.25	0.14	-12.90
1,743.00	1.01	91.83	1,742.89	5.32	0.39	-3.95	0.11	0.00	-6.20
1,838.00	1.49	62.04	1,837.87	5.87	2.31	-3.20	0.83	0.51	-31.36
1,932.00	2.68	45.25	1,931.81	7.99	4.95	-3.24	1.41	1.27	-17.86
2,027.00	3.65	40.85	2,026.66	11.84	8.51	-4.08	1.05	1.02	-4.63
2,122.00	3.38	47.45	2,121.48	16.03	12.55	-4.88	0.51	-0.28	6.95
2,202.00	3.87	55.44	2,201.32	19.15	16.51	-4.90	0.88	0.61	9.99
2,322.00	4.35	56.67	2,321.01	23.95	23.65	-4.28	0.41	0.40	1.03
2,416.00	4.61	77.15	2,414.73	26.75	30.31	-2.38	1.71	0.28	21.79
2,510.00	5.36	90.60	2,508.38	27.54	38.38	1.97	1.47	0.80	14.31
2,604.00	6.15	94.20	2,601.91	27.13	47.80	8.10	0.92	0.84	3.83
2,699.00	5.76	95.79	2,696.39	26.27	57.61	14.82	0.45	-0.41	1.67
2,794.00	4.44	93.06	2,791.02	25.60	66.03	20.54	1.41	-1.39	-2.87
2,888.00	3.47	82.87	2,884.79	25.76	72.49	24.39	1.27	-1.03	-10.84
2,983.00	4.00	85.85	2,979.59	26.35	78.64	27.72	0.59	0.56	3.14
3,081.00	4.53	95.35	3,077.32	26.24	85.91	32.29	0.90	0.54	9.69
3,175.00	5.05	101.32	3,170.99	25.08	93.66	37.98	0.77	0.55	6.35
3,270.00	4.61	98.86	3,265.65	23.67	101.53	43.94	0.51	-0.46	-2.59
3,364.00	4.26	95.70	3,359.37	22.74	108.74	49.11	0.45	-0.37	-3.36
3,459.00	4.61	92.53	3,454.09	22.22	116.06	54.03	0.45	0.37	-3.34
3,553.00	5.10	95.26	3,547.75	21.67	124.00	59.36	0.58	0.52	2.90
3,648.00	5.27	99.04	3,642.36	20.60	132.51	65.45	0.40	0.18	3.98
3,742.00	5.45	102.55	3,735.95	18.95	141.13	72.06	0.40	0.19	3.73
3,837.00	4.57	102.29	3,830.59	17.17	149.23	78.46	0.93	-0.93	-0.27
3,931.00	3.91	99.92	3,924.33	15.82	156.05	83.72	0.73	-0.70	-2.52
4,026.00	4.39	101.59	4,019.08	14.53	162.80	88.90	0.52	0.51	1.76
4,120.00	5.45	105.63	4,112.73	12.60	170.62	95.24	1.19	1.13	4.30
4,215.00	5.23	100.09	4,207.32	10.63	179.23	102.10	0.59	-0.23	-5.83
4,309.00	5.63	97.10	4,300.90	9.31	188.03	108.56	0.52	0.43	-3.18
4,404.00	5.80	99.13	4,395.43	7.97	197.39	115.38	0.28	0.18	2.14

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Measured Depth (usft)	Inclination (°)	WV Department of Environmental Protection Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
4,499.00	4.70	99.86	4,490.03	6.54	205.96	121.79	1.16	-1.16	0.77
4,593.00	3.61	94.91	4,583.78	5.63	212.71	126.67	1.22	-1.16	-5.27
4,688.00	2.94	81.02	4,678.62	5.76	218.09	129.89	1.09	-0.71	-14.62
4,782.00	3.25	70.21	4,772.49	7.03	222.98	131.89	0.70	0.33	-11.50
4,877.00	4.75	64.85	4,867.25	9.62	229.08	133.62	1.63	1.58	-5.64
4,972.00	4.97	69.07	4,961.91	12.76	236.48	135.71	0.44	0.23	4.44
5,066.00	4.92	74.78	5,055.56	15.27	244.17	138.47	0.53	-0.05	6.07
5,161.00	4.83	79.61	5,150.22	17.06	252.04	141.91	0.44	-0.09	5.08
5,256.00	4.35	82.78	5,244.92	18.24	259.55	145.61	0.57	-0.51	3.34
5,351.00	6.06	83.83	5,339.52	19.23	268.11	150.10	1.80	1.80	1.11
5,449.00	6.20	91.04	5,436.96	19.69	278.54	156.17	0.80	0.14	7.36
5,544.00	5.23	102.29	5,531.49	18.67	287.90	162.74	1.56	-1.02	11.84
5,639.00	3.96	99.13	5,626.18	17.23	295.37	168.48	1.36	-1.34	-3.33
5,734.00	4.17	97.72	5,720.94	16.25	302.03	173.36	0.24	0.22	-1.48
5,829.00	5.27	94.91	5,815.62	15.41	309.80	178.81	1.18	1.16	-2.96
5,923.00	5.05	92.62	5,909.24	14.85	318.24	184.45	0.32	-0.23	-2.44
6,018.00	4.39	93.50	6,003.92	14.44	326.04	189.59	0.70	-0.69	0.93
6,113.00	4.13	90.51	6,098.66	14.19	333.09	194.13	0.36	-0.27	-3.15
6,207.00	4.00	88.58	6,192.42	14.24	339.75	198.20	0.20	-0.14	-2.05
6,297.00	4.00	83.57	6,282.20	14.67	346.01	201.71	0.39	0.00	-5.57
6,392.00	4.39	82.51	6,376.95	15.51	352.91	205.30	0.42	0.41	-1.12
6,487.00	5.19	81.02	6,471.61	16.66	360.76	209.24	0.85	0.84	-1.57
6,582.00	6.15	76.71	6,566.15	18.50	369.95	213.46	1.10	1.01	-4.54
6,676.00	6.90	69.95	6,659.54	21.59	380.16	217.31	1.14	0.80	-7.19
6,771.00	7.91	69.42	6,753.75	25.84	391.64	221.03	1.07	1.06	-0.56
6,866.00	9.27	81.72	6,847.69	29.24	405.33	226.80	2.40	1.43	12.95
6,958.00	9.18	91.57	6,938.50	30.11	420.00	235.16	1.72	-0.10	10.71
7,053.00	9.30	99.30	7,032.27	28.66	435.15	245.64	1.31	0.13	8.14
7,147.00	9.14	99.30	7,125.06	26.23	450.02	256.71	0.17	-0.17	0.00
7,242.00	8.26	95.61	7,218.96	24.34	464.25	266.97	1.10	-0.93	-3.88
7,337.00	8.39	96.66	7,312.96	22.87	477.93	276.56	0.21	0.14	1.11
7,432.00	9.05	96.05	7,406.87	21.28	492.24	286.64	0.70	0.69	-0.64
7,526.00	9.80	92.53	7,499.60	20.15	507.59	296.99	1.01	0.80	-3.74
7,621.00	11.46	91.47	7,592.96	19.55	525.10	308.25	1.76	1.75	-1.12
7,718.00	13.36	90.69	7,687.69	19.17	545.94	321.40	1.97	1.96	-0.80
7,859.00	15.95	90.69	7,824.09	18.74	581.61	343.72	1.84	1.84	0.00
7,907.00	15.73	90.42	7,870.27	18.61	594.71	351.89	0.48	-0.46	-0.56
8,002.00	15.34	88.84	7,961.80	18.77	620.15	367.45	0.61	-0.41	-1.66
8,095.00	15.95	88.75	8,051.35	19.30	645.23	382.49	0.66	0.66	-0.10
8,189.00	14.77	88.40	8,142.00	19.91	670.12	397.34	1.26	-1.26	-0.37
8,284.00	12.66	86.29	8,234.28	20.93	692.61	410.41	2.28	-2.22	-2.22
8,378.00	12.83	89.98	8,325.97	21.60	713.33	422.65	0.88	0.18	3.93
8,471.00	15.42	92.71	8,416.15	21.01	736.01	437.09	2.87	2.78	2.94
8,566.00	16.44	91.13	8,507.50	20.15	762.07	453.83	1.17	1.07	-1.66

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8,660.00	17.23	95.08	8,597.47	18.66	789.23	471.75	1.48	0.84	4.20
8,754.00	17.84	98.16	8,687.11	15.38	817.35	491.66	1.18	0.65	3.28
8,849.00	17.89	100.18	8,777.53	10.74	846.12	513.05	0.65	0.05	2.13
8,943.00	17.75	102.11	8,867.02	5.18	874.34	534.82	0.65	-0.15	2.05
9,038.00	17.89	102.73	8,957.46	-1.07	902.73	557.25	0.25	0.15	0.65
9,132.00	17.71	102.64	9,046.96	-7.39	930.77	579.49	0.19	-0.19	-0.10
9,224.00	17.40	104.40	9,134.68	-13.87	957.75	601.23	0.67	-0.34	1.91
9,319.00	16.39	100.27	9,225.58	-19.79	984.69	622.50	1.65	-1.06	-4.35
9,413.00	14.72	99.92	9,316.13	-24.21	1,009.51	641.28	1.78	-1.78	-0.37
9,507.00	13.58	97.63	9,407.28	-27.74	1,032.21	658.04	1.35	-1.21	-2.44
9,602.00	13.27	96.75	9,499.68	-30.50	1,054.09	673.71	0.39	-0.33	-0.93
9,697.00	12.83	94.99	9,592.23	-32.70	1,075.43	688.59	0.62	-0.46	-1.85
9,790.00	12.17	97.46	9,683.03	-34.87	1,095.44	702.63	0.91	-0.71	2.66
9,885.00	12.04	97.37	9,775.91	-37.44	1,115.19	716.83	0.14	-0.14	-0.09
9,979.00	11.12	96.31	9,868.00	-39.69	1,133.92	730.15	1.00	-0.98	-1.13
10,074.00	10.68	98.42	9,961.29	-41.99	1,151.74	742.94	0.63	-0.46	2.22
10,169.00	10.90	100.18	10,054.61	-44.87	1,169.29	756.02	0.42	0.23	1.85
10,193.00	11.07	99.48	10,078.17	-45.65	1,173.79	759.41	0.90	0.71	-2.92
10,276.00	12.70	101.85	10,159.38	-48.83	1,190.58	772.27	2.05	1.96	2.86
10,371.00	14.46	92.36	10,251.74	-51.47	1,212.66	787.95	2.98	1.85	-9.99
10,465.00	13.89	89.46	10,342.88	-51.84	1,235.67	802.43	0.97	-0.61	-3.09
10,559.00	14.68	88.40	10,433.97	-51.40	1,258.86	816.37	0.89	0.84	-1.13
10,606.00	14.64	87.44	10,479.44	-50.97	1,270.74	823.36	0.52	-0.09	-2.04
10,654.00	16.35	94.47	10,525.70	-51.23	1,283.54	831.45	5.29	3.56	14.65
10,701.00	18.95	103.70	10,570.49	-53.55	1,297.56	841.92	8.11	5.53	19.64
10,749.00	21.41	110.90	10,615.55	-58.52	1,313.32	855.55	7.27	5.13	15.00
10,796.00	23.82	113.28	10,658.93	-65.34	1,330.05	871.23	5.48	5.13	5.06
10,843.00	24.26	118.55	10,701.86	-73.70	1,347.25	888.42	4.66	0.94	11.21
10,890.00	25.41	124.26	10,744.52	-84.00	1,364.07	906.89	5.66	2.45	12.15
10,938.00	27.69	128.66	10,787.46	-96.76	1,381.30	927.56	6.27	4.75	9.17
10,985.00	29.49	134.19	10,828.73	-111.65	1,398.12	949.65	6.81	3.83	11.77
11,033.00	32.04	137.18	10,869.98	-129.23	1,415.25	974.05	6.19	5.31	6.23
11,080.00	35.30	137.97	10,909.09	-148.47	1,432.82	1,000.03	7.00	6.94	1.68
11,127.00	38.68	139.64	10,946.62	-169.75	1,451.43	1,028.26	7.50	7.19	3.55
11,174.00	41.63	140.52	10,982.54	-193.00	1,470.87	1,058.55	6.39	6.28	1.87
11,221.00	44.88	141.93	11,016.77	-218.11	1,491.03	1,090.75	7.21	6.91	3.00
11,268.00	47.96	143.86	11,049.17	-245.27	1,511.55	1,124.79	7.20	6.55	4.11
11,316.00	50.51	144.83	11,080.51	-274.81	1,532.74	1,161.10	5.53	5.31	2.02
11,363.00	53.23	146.76	11,109.52	-305.38	1,553.51	1,197.98	6.63	5.79	4.11
11,411.00	56.75	147.47	11,137.06	-338.40	1,574.85	1,237.13	7.43	7.33	1.48
11,458.00	59.25	148.87	11,161.96	-372.26	1,595.86	1,276.75	5.89	5.32	2.98
11,505.00	62.29	149.40	11,184.91	-407.46	1,616.90	1,317.44	6.54	6.47	1.13
11,552.00	65.49	150.10	11,205.59	-443.92	1,638.15	1,359.25	6.94	6.81	1.49

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stem S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stem	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stem S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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)
11,600.00	66.73	150.37	11,225.03	-482.01	1,659.94	1,402.67	2.63	2.58	0.56
11,647.00	70.15	151.07	11,242.30	-520.14	1,681.31	1,445.87	7.41	7.28	1.49
11,694.00	72.48	152.30	11,257.36	-559.33	1,702.42	1,489.74	5.54	4.96	2.62
11,741.00	77.01	152.74	11,269.72	-599.55	1,723.34	1,534.31	9.68	9.64	0.94
11,789.00	82.02	152.21	11,278.45	-641.39	1,745.15	1,580.70	10.49	10.44	-1.10
11,883.00	87.74	149.75	11,286.84	-723.22	1,790.55	1,673.12	6.62	6.09	-2.62
11,978.00	87.65	149.75	11,290.66	-805.21	1,838.37	1,767.16	0.09	-0.09	0.00
12,072.00	89.45	149.66	11,293.04	-886.35	1,885.77	1,860.27	1.92	1.91	-0.10
12,168.00	89.19	149.57	11,294.18	-969.16	1,934.32	1,955.40	0.29	-0.27	-0.09
12,262.00	89.23	150.28	11,295.48	-1,050.49	1,981.43	2,048.49	0.76	0.04	0.76
12,356.00	88.70	149.93	11,297.17	-1,131.97	2,028.27	2,141.52	0.68	-0.56	-0.37
12,451.00	88.53	149.93	11,299.47	-1,214.16	2,075.86	2,235.57	0.18	-0.18	0.00
12,545.00	87.96	149.49	11,302.35	-1,295.29	2,123.24	2,328.67	0.77	-0.61	-0.47
12,640.00	89.54	150.45	11,304.42	-1,377.52	2,170.77	2,422.71	1.95	1.66	1.01
12,735.00	88.97	150.54	11,305.66	-1,460.19	2,217.56	2,516.65	0.61	-0.60	0.09
12,829.00	89.36	151.07	11,307.03	-1,542.24	2,263.40	2,609.52	0.70	0.41	0.56
12,924.00	91.03	150.19	11,306.70	-1,625.02	2,309.99	2,703.42	1.99	1.76	-0.93
13,018.00	90.90	150.10	11,305.12	-1,706.54	2,356.78	2,796.45	0.17	-0.14	-0.10
13,113.00	90.59	150.72	11,303.88	-1,789.14	2,403.69	2,890.41	0.73	-0.33	0.65
13,207.00	89.10	150.28	11,304.14	-1,870.95	2,449.97	2,983.36	1.65	-1.59	-0.47
13,302.00	88.04	150.63	11,306.51	-1,953.57	2,496.80	3,077.29	1.18	-1.12	0.37
13,396.00	87.43	150.81	11,310.22	-2,035.50	2,542.74	3,170.11	0.68	-0.65	0.19
13,491.00	89.01	150.98	11,313.17	-2,118.46	2,588.93	3,263.91	1.67	1.66	0.18
13,585.00	88.79	150.63	11,314.98	-2,200.50	2,634.77	3,356.77	0.44	-0.23	-0.37
13,680.00	88.40	151.16	11,317.31	-2,283.48	2,680.96	3,450.59	0.69	-0.41	0.56
13,775.00	88.00	151.60	11,320.29	-2,366.83	2,726.45	3,544.26	0.63	-0.42	0.46
13,870.00	89.58	151.60	11,322.30	-2,450.38	2,771.62	3,637.89	1.66	1.66	0.00
13,964.00	88.88	151.51	11,323.56	-2,533.02	2,816.39	3,730.56	0.75	-0.74	-0.10
14,058.00	88.62	151.33	11,325.61	-2,615.55	2,861.35	3,823.26	0.34	-0.28	-0.19
14,153.00	88.22	151.77	11,328.23	-2,699.04	2,906.59	3,916.89	0.63	-0.42	0.46
14,247.00	88.97	151.60	11,330.54	-2,781.77	2,951.16	4,009.51	0.82	0.80	-0.18
14,342.00	88.97	151.33	11,332.24	-2,865.22	2,996.53	4,103.19	0.28	0.00	-0.28
14,437.00	88.66	151.33	11,334.21	-2,948.55	3,042.10	4,196.90	0.33	-0.33	0.00
14,531.00	88.84	150.89	11,336.26	-3,030.83	3,087.50	4,289.68	0.51	0.19	-0.47
14,626.00	88.40	150.45	11,338.55	-3,113.63	3,134.02	4,383.55	0.65	-0.46	-0.46
14,720.00	89.67	150.10	11,340.13	-3,195.25	3,180.62	4,476.55	1.40	1.35	-0.37
14,814.00	89.85	149.57	11,340.52	-3,276.52	3,227.86	4,569.66	0.60	0.19	-0.56
14,909.00	89.41	149.40	11,341.14	-3,358.36	3,276.09	4,663.83	0.50	-0.46	-0.18
15,003.00	89.19	149.57	11,342.29	-3,439.33	3,323.82	4,757.01	0.30	-0.23	0.18
15,098.00	88.57	149.93	11,344.14	-3,521.38	3,371.67	4,851.12	0.75	-0.65	0.38
15,192.00	88.00	150.19	11,346.96	-3,602.80	3,418.56	4,944.14	0.67	-0.61	0.28
15,287.00	88.48	149.14	11,349.87	-3,684.75	3,466.52	5,038.23	1.21	0.51	-1.11
15,382.00	88.31	149.22	11,352.54	-3,766.30	3,515.17	5,132.44	0.20	-0.18	0.08

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stem S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stem	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stem S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	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)
15,476.00	89.32	149.66	11,354.48	-3,847.23	3,562.96	5,225.61	1.17	1.07	0.47
15,570.00	88.70	149.14	11,356.10	-3,928.13	3,610.80	5,318.81	0.86	-0.66	-0.55
15,665.00	89.71	150.81	11,357.42	-4,010.37	3,658.33	5,412.86	2.05	1.06	1.76
15,760.00	89.67	150.89	11,357.94	-4,093.33	3,704.60	5,506.72	0.09	-0.04	0.08
15,854.00	89.27	150.54	11,358.81	-4,175.31	3,750.58	5,599.61	0.57	-0.43	-0.37
15,949.00	88.31	150.37	11,360.81	-4,257.94	3,797.41	5,693.55	1.03	-1.01	-0.18
16,044.00	90.24	149.93	11,362.01	-4,340.33	3,844.69	5,787.56	2.08	2.03	-0.46
16,138.00	90.42	149.49	11,361.47	-4,421.49	3,892.10	5,880.70	0.51	0.19	-0.47
16,233.00	90.15	149.31	11,361.00	-4,503.26	3,940.46	5,974.90	0.34	-0.28	-0.19
16,328.00	89.85	150.01	11,361.00	-4,585.25	3,988.45	6,069.04	0.80	-0.32	0.74
16,422.00	89.67	149.57	11,361.39	-4,666.48	4,035.75	6,162.16	0.51	-0.19	-0.47
16,517.00	89.58	149.75	11,362.01	-4,748.47	4,083.73	6,256.30	0.21	-0.09	0.19
16,612.00	88.44	149.57	11,363.66	-4,830.45	4,131.71	6,350.42	1.21	-1.20	-0.19
16,706.00	87.69	149.05	11,366.83	-4,911.24	4,179.66	6,443.59	0.97	-0.80	-0.55
16,801.00	89.10	148.70	11,369.49	-4,992.52	4,228.75	6,537.86	1.53	1.48	-0.37
16,896.00	89.10	149.31	11,370.98	-5,073.95	4,277.66	6,632.13	0.64	0.00	0.64
16,990.00	88.66	149.40	11,372.82	-5,154.81	4,325.56	6,725.33	0.48	-0.47	0.10
17,085.00	87.78	149.31	11,375.77	-5,236.50	4,373.96	6,819.49	0.93	-0.93	-0.09
17,180.00	88.92	150.98	11,378.51	-5,318.85	4,421.23	6,913.48	2.13	1.20	1.76
17,274.00	89.19	150.45	11,380.06	-5,400.83	4,467.21	7,006.37	0.63	0.29	-0.56
17,369.00	89.05	149.84	11,381.52	-5,483.21	4,514.49	7,100.38	0.66	-0.15	-0.64
17,463.00	88.18	150.28	11,383.79	-5,564.64	4,561.39	7,193.42	1.04	-0.93	0.47
17,558.00	88.70	149.75	11,386.37	-5,646.89	4,608.85	7,287.44	0.78	0.55	-0.56
17,652.00	88.40	150.19	11,388.75	-5,728.25	4,655.88	7,380.49	0.57	-0.32	0.47
17,746.00	89.67	150.54	11,390.34	-5,809.94	4,702.35	7,473.46	1.40	1.35	0.37
17,841.00	88.88	151.07	11,391.54	-5,892.86	4,748.69	7,567.32	1.00	-0.83	0.56
17,936.00	89.19	151.33	11,393.14	-5,976.10	4,794.45	7,661.07	0.43	0.33	0.27
18,030.00	88.92	152.48	11,394.69	-6,059.01	4,838.71	7,753.64	1.26	-0.29	1.22
18,125.00	88.84	152.39	11,396.55	-6,143.21	4,882.66	7,847.04	0.13	-0.08	-0.09
18,220.00	88.62	152.56	11,398.65	-6,227.44	4,926.56	7,940.42	0.29	-0.23	0.18
18,314.00	88.92	152.04	11,400.67	-6,310.65	4,970.24	8,032.87	0.64	0.32	-0.55
18,409.00	87.74	151.33	11,403.44	-6,394.24	5,015.28	8,126.46	1.45	-1.24	-0.75
18,479.00	87.69	151.24	11,406.23	-6,455.58	5,048.89	8,195.48	0.15	-0.07	-0.13
Survey @ 18479.00 MD 11406.23 TVD									
18,538.00	87.69	151.24	11,408.61	-6,507.26	5,077.25	8,253.65	0.00	0.00	0.00
Survey projected to 18538.00 MD 11408.61 TVD									

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
234.00	234.00	-0.14	0.34	MWD surveys
18,479.00	11,406.23	-6,455.58	5,048.89	Survey @ 18479.00 MD 11406.23 TVD

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stern S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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Project	Marshall County, West Virginia		
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)		

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

Well	Keith Stern S-19 HU (slot Q)					
Well Position	+N/-S	0.00 usft	Northing:	14,444,890.33 usft	Latitude:	39.77483004
	+E/-W	0.00 usft	Easting:	1,726,932.47 usft	Longitude:	-80.69208048
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	747.00 usft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	5/27/2020	-8.788	66.698	51,830.61938088

Design	Surveys Original Hole				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.00	0.00	0.00	141.95	

Survey Program	Date 6/24/2020			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
234.00	2,202.00	MWD surf (Original Hole)	MWD	MWD - Standard
2,322.00	9,885.00	MWD int (Original Hole)	MWD	MWD - Standard
9,979.00	18,479.00	MWD (Original Hole)	MWD	MWD - Standard
18,538.00	18,538.00	Projection (Original Hole)	MWD	MWD - Standard

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
0.00	0.00	0.00	0.00	0.00	0.00	14,444,890.33	1,726,932.47	39.77483004	-80.69208048	
234.00	0.18	112.13	234.00	-0.14	0.34	14,444,890.19	1,726,932.81	39.77482966	-80.69207927	
MWD surveys										
265.00	0.90	333.27	265.00	0.06	0.28	14,444,890.39	1,726,932.75	39.77483021	-80.69207950	
295.00	0.22	321.93	295.00	0.32	0.13	14,444,890.64	1,726,932.60	39.77483091	-80.69208000	
325.00	0.31	324.74	325.00	0.43	0.05	14,444,890.75	1,726,932.52	39.77483122	-80.69208029	
372.00	0.31	345.75	372.00	0.66	-0.05	14,444,890.98	1,726,932.42	39.77483184	-80.69208066	
420.00	0.44	331.86	419.99	0.94	-0.17	14,444,891.27	1,726,932.30	39.77483263	-80.69208108	
467.00	1.10	311.82	466.99	1.40	-0.59	14,444,891.73	1,726,931.88	39.77483390	-80.69208257	



Survey Report - Geographic



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stern S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	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
514.00	1.10	315.25	513.98	2.02	-1.25	14,444,892.35	1,726,931.22	39.77483561	-80.69208489
609.00	0.83	323.33	608.97	3.22	-2.30	14,444,893.55	1,726,930.17	39.77483892	-80.69208862
703.00	0.66	328.34	702.96	4.23	-2.99	14,444,894.56	1,726,929.48	39.77484169	-80.69209107
798.00	0.53	313.32	797.96	5.00	-3.60	14,444,895.32	1,726,928.87	39.77484380	-80.69209322
892.00	0.48	279.04	891.95	5.36	-4.30	14,444,895.68	1,726,928.17	39.77484480	-80.69209573
986.00	0.57	297.93	985.95	5.64	-5.10	14,444,895.97	1,726,927.37	39.77484558	-80.69209858
1,081.00	0.62	302.86	1,080.94	6.14	-5.95	14,444,896.47	1,726,926.52	39.77484696	-80.69210159
1,176.00	0.26	31.10	1,175.94	6.60	-6.27	14,444,896.93	1,726,926.20	39.77484823	-80.69210273
1,270.00	0.40	88.05	1,269.94	6.80	-5.84	14,444,897.12	1,726,926.63	39.77484876	-80.69210117
1,364.00	0.57	116.53	1,363.94	6.60	-5.09	14,444,896.93	1,726,927.38	39.77484821	-80.69209851
1,459.00	0.75	105.10	1,458.93	6.23	-4.07	14,444,896.55	1,726,928.40	39.77484718	-80.69209488
1,554.00	0.88	109.85	1,553.92	5.82	-2.78	14,444,896.14	1,726,929.69	39.77484604	-80.69209030
1,648.00	1.01	97.72	1,647.91	5.46	-1.28	14,444,895.79	1,726,931.19	39.77484505	-80.69208497
1,743.00	1.01	91.83	1,742.89	5.32	0.39	14,444,895.65	1,726,932.86	39.77484465	-80.69207904
1,838.00	1.49	62.04	1,837.87	5.87	2.31	14,444,896.20	1,726,934.78	39.77484615	-80.69207217
1,932.00	2.68	45.25	1,931.81	7.99	4.95	14,444,898.32	1,726,937.42	39.77485195	-80.69206275
2,027.00	3.65	40.85	2,026.66	11.84	8.51	14,444,902.17	1,726,940.98	39.77486249	-80.69205005
2,122.00	3.38	47.45	2,121.48	16.03	12.55	14,444,906.35	1,726,945.02	39.77487393	-80.69203561
2,202.00	3.87	55.44	2,201.32	19.15	16.51	14,444,909.48	1,726,948.98	39.77488248	-80.69202148
2,322.00	4.35	56.67	2,321.01	23.95	23.65	14,444,914.28	1,726,956.12	39.77489559	-80.69199602
2,416.00	4.61	77.15	2,414.73	26.75	30.31	14,444,917.07	1,726,962.78	39.77490321	-80.69197227
2,510.00	5.36	90.60	2,508.38	27.54	38.38	14,444,917.87	1,726,970.85	39.77490532	-80.69194353
2,604.00	6.15	94.20	2,601.91	27.13	47.80	14,444,917.45	1,726,980.27	39.77490409	-80.69191004
2,699.00	5.76	95.79	2,696.39	26.27	57.61	14,444,916.60	1,726,990.08	39.77490165	-80.69187510
2,794.00	4.44	93.06	2,791.02	25.60	66.03	14,444,915.92	1,726,998.50	39.77489971	-80.69184516
2,888.00	3.47	82.87	2,884.79	25.76	72.49	14,444,916.08	1,727,004.96	39.77490009	-80.69182218
2,983.00	4.00	85.85	2,979.59	26.35	78.64	14,444,916.68	1,727,011.11	39.77490167	-80.69180026
3,081.00	4.53	95.35	3,077.32	26.24	85.91	14,444,916.57	1,727,018.38	39.77490129	-80.69177441
3,175.00	5.05	101.32	3,170.99	25.08	93.66	14,444,915.41	1,727,026.13	39.77489804	-80.69174684
3,270.00	4.61	98.86	3,265.65	23.67	101.53	14,444,914.00	1,727,034.00	39.77489409	-80.69171884
3,364.00	4.26	95.70	3,359.37	22.74	108.74	14,444,913.07	1,727,041.21	39.77489147	-80.69169320
3,459.00	4.61	92.53	3,454.09	22.22	116.06	14,444,912.55	1,727,048.53	39.77488998	-80.69166713
3,553.00	5.10	95.26	3,547.75	21.67	124.00	14,444,912.00	1,727,056.47	39.77488840	-80.69163890
3,648.00	5.27	99.04	3,642.36	20.60	132.51	14,444,910.93	1,727,064.98	39.77488537	-80.69160862
3,742.00	5.45	102.55	3,735.95	18.95	141.13	14,444,909.28	1,727,073.60	39.77488076	-80.69157796
3,837.00	4.57	102.29	3,830.59	17.17	149.23	14,444,907.49	1,727,081.70	39.77487578	-80.69154914
3,931.00	3.91	99.92	3,924.33	15.82	156.05	14,444,906.15	1,727,088.52	39.77487201	-80.69152490
4,026.00	4.39	101.59	4,019.08	14.53	162.80	14,444,904.86	1,727,095.27	39.77486841	-80.69150088
4,120.00	5.45	105.63	4,112.73	12.60	170.62	14,444,902.93	1,727,103.09	39.77486305	-80.69147306
4,215.00	5.23	100.09	4,207.32	10.63	179.23	14,444,900.96	1,727,111.70	39.77485754	-80.69144245
4,309.00	5.63	97.10	4,300.90	9.31	188.03	14,444,899.64	1,727,120.50	39.77485383	-80.69141117
4,404.00	5.80	99.13	4,395.43	7.97	197.39	14,444,898.30	1,727,129.86	39.77485007	-80.69137786
4,499.00	4.70	99.86	4,490.03	6.54	205.96	14,444,896.87	1,727,138.43	39.77484607	-80.69134736
4,593.00	3.61	94.91	4,583.78	5.63	212.71	14,444,895.96	1,727,145.18	39.77484350	-80.69132338
4,688.00	2.94	81.02	4,678.62	5.76	218.09	14,444,896.08	1,727,150.56	39.77484379	-80.69130421
4,782.00	3.25	70.21	4,772.49	7.03	222.98	14,444,897.36	1,727,155.45	39.77484725	-80.69128679
4,877.00	4.75	64.85	4,867.25	9.62	229.08	14,444,899.94	1,727,161.55	39.77485429	-80.69126507
4,972.00	4.97	69.07	4,961.91	12.76	236.48	14,444,903.09	1,727,168.95	39.77486285	-80.69123868
5,066.00	4.92	74.78	5,055.56	15.27	244.17	14,444,905.60	1,727,176.64	39.77486968	-80.69121127
5,161.00	4.83	79.61	5,150.22	17.06	252.04	14,444,907.39	1,727,184.51	39.77487452	-80.69118325
5,256.00	4.35	82.78	5,244.92	18.24	259.55	14,444,908.56	1,727,192.02	39.77487767	-80.69115652
5,351.00	6.06	83.83	5,339.52	19.23	268.11	14,444,909.56	1,727,200.58	39.77488031	-80.69112604
5,449.00	6.20	91.04	5,436.96	19.69	278.54	14,444,910.02	1,727,211.01	39.77488148	-80.69108890
5,544.00	5.23	102.29	5,531.49	18.67	287.90	14,444,909.00	1,727,220.37	39.77487860	-80.69105560
5,639.00	3.96	99.13	5,626.18	17.23	295.37	14,444,907.56	1,727,227.84	39.77487457	-80.69102903



Company:	Tug Hill Operating LLC	RECEIVED Office of Oil and Gas SEP 30 2022 <i>WV Department of Environmental Protection</i>	Local Co-ordinate Reference:	Well Keith Stern S-19 HU (slot Q)
Project:	Marshall County, West Virginia.		TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)	
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid	
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature	
Design:	Surveys Original Hole	Database:	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
5,734.00	4.17	97.72	5,720.94	16.25	302.03	14,444,906.57	1,727,234.50	39.77487181	-80.69100533
5,829.00	5.27	94.91	5,815.62	15.41	309.80	14,444,905.74	1,727,242.27	39.77486943	-80.69097769
5,923.00	5.05	92.62	5,909.24	14.85	318.24	14,444,905.18	1,727,250.71	39.77486782	-80.69094768
6,018.00	4.39	93.50	6,003.92	14.44	326.04	14,444,904.76	1,727,258.51	39.77486661	-80.69091990
6,113.00	4.13	90.51	6,098.66	14.19	333.09	14,444,904.51	1,727,265.56	39.77486585	-80.69089481
6,207.00	4.00	88.58	6,192.42	14.24	339.75	14,444,904.56	1,727,272.22	39.77486593	-80.69087110
6,297.00	4.00	83.57	6,282.20	14.67	346.01	14,444,904.99	1,727,278.48	39.77486705	-80.69084883
6,392.00	4.39	82.51	6,376.95	15.51	352.91	14,444,905.84	1,727,285.38	39.77486930	-80.69082427
6,487.00	5.19	81.02	6,471.61	16.66	360.76	14,444,906.98	1,727,293.23	39.77487237	-80.69079632
6,582.00	6.15	76.71	6,566.15	18.50	369.95	14,444,908.82	1,727,302.42	39.77487734	-80.69076356
6,676.00	6.90	69.95	6,659.54	21.59	380.16	14,444,911.92	1,727,312.63	39.77488574	-80.69072720
6,771.00	7.91	69.42	6,753.75	25.84	391.64	14,444,916.17	1,727,324.11	39.77489731	-80.69068629
6,866.00	9.27	81.72	6,847.69	29.24	405.33	14,444,919.57	1,727,337.80	39.77490652	-80.69063751
6,958.00	9.18	91.57	6,938.50	30.11	420.00	14,444,920.44	1,727,352.47	39.77490876	-80.69058529
7,053.00	9.30	99.30	7,032.27	28.66	435.15	14,444,918.99	1,727,367.62	39.77490464	-80.69053139
7,147.00	9.14	99.30	7,125.06	26.23	450.02	14,444,916.55	1,727,382.49	39.77489781	-80.69047852
7,242.00	8.26	95.81	7,218.96	24.34	464.25	14,444,914.67	1,727,396.72	39.77489250	-80.69042787
7,337.00	8.39	96.66	7,312.96	22.87	477.93	14,444,913.20	1,727,410.40	39.77488833	-80.69037921
7,432.00	9.05	96.05	7,406.87	21.28	492.24	14,444,911.61	1,727,424.71	39.77488382	-80.69032829
7,526.00	9.80	92.53	7,499.60	20.15	507.59	14,444,910.47	1,727,440.06	39.77488057	-80.69027369
7,621.00	11.46	91.47	7,592.96	19.55	525.10	14,444,909.87	1,727,457.57	39.77487875	-80.69021137
7,718.00	13.36	90.69	7,687.69	19.17	545.94	14,444,909.49	1,727,478.41	39.77487751	-80.69013720
7,859.00	15.95	90.69	7,824.09	18.74	581.61	14,444,909.06	1,727,514.08	39.77487599	-80.69001026
7,907.00	15.73	90.42	7,870.27	18.61	594.71	14,444,908.94	1,727,527.18	39.77487551	-80.68996364
8,002.00	15.34	88.84	7,961.80	18.77	620.15	14,444,909.10	1,727,552.62	39.77487571	-80.68987309
8,095.00	15.95	88.75	8,051.35	19.30	645.23	14,444,909.62	1,727,577.70	39.77487692	-80.68978384
8,189.00	14.77	88.40	8,142.00	19.91	670.12	14,444,910.24	1,727,602.59	39.77487838	-80.68969525
8,284.00	12.66	86.29	8,234.28	20.93	692.61	14,444,911.25	1,727,625.08	39.77488094	-80.68961517
8,378.00	12.83	89.98	8,325.97	21.60	713.33	14,444,911.92	1,727,645.80	39.77488259	-80.68954143
8,471.00	15.42	92.71	8,416.15	21.01	736.01	14,444,911.34	1,727,668.48	39.77488077	-80.68946072
8,566.00	16.44	91.13	8,507.50	20.15	762.07	14,444,910.48	1,727,694.54	39.77487816	-80.68936799
8,660.00	17.23	95.08	8,597.47	18.66	789.23	14,444,908.98	1,727,721.70	39.77487379	-80.68927132
8,754.00	17.84	98.16	8,687.11	15.38	817.35	14,444,905.71	1,727,749.82	39.77486453	-80.68917128
8,849.00	17.89	100.18	8,777.53	10.74	846.12	14,444,901.06	1,727,778.59	39.77485150	-80.68906895
8,943.00	17.75	102.11	8,867.02	5.18	874.34	14,444,895.50	1,727,806.81	39.77483597	-80.68896858
9,038.00	17.89	102.73	8,957.46	-1.07	902.73	14,444,889.25	1,727,835.20	39.77481852	-80.68886761
9,132.00	17.71	102.64	9,046.96	-7.39	930.77	14,444,882.94	1,727,863.24	39.77480092	-80.68876791
9,224.00	17.40	104.40	9,134.68	-13.87	957.75	14,444,876.46	1,727,890.22	39.77478286	-80.68867198
9,319.00	16.39	100.27	9,225.58	-19.79	984.69	14,444,870.54	1,727,917.16	39.77476634	-80.68857614
9,413.00	14.72	99.92	9,316.13	-24.21	1,009.51	14,444,866.11	1,727,941.98	39.77475396	-80.68848787
9,507.00	13.58	97.63	9,407.28	-27.74	1,032.21	14,444,862.59	1,727,964.68	39.77474407	-80.68840712
9,602.00	13.27	96.75	9,499.68	-30.50	1,054.09	14,444,859.83	1,727,986.56	39.77473627	-80.68832927
9,697.00	12.83	94.99	9,592.23	-32.70	1,075.43	14,444,857.63	1,728,007.90	39.77473003	-80.68825336
9,790.00	12.17	97.46	9,683.03	-34.87	1,095.44	14,444,855.46	1,728,027.91	39.77472388	-80.68818218
9,885.00	12.04	97.37	9,775.91	-37.44	1,115.19	14,444,852.89	1,728,047.66	39.77471663	-80.68811191
9,979.00	11.12	96.31	9,868.00	-39.69	1,133.92	14,444,850.63	1,728,066.39	39.77471026	-80.68804526
10,074.00	10.68	98.42	9,961.29	-41.99	1,151.74	14,444,848.34	1,728,084.21	39.77470378	-80.68798189
10,169.00	10.90	100.18	10,054.61	-44.87	1,169.29	14,444,845.46	1,728,101.76	39.77469571	-80.68791947
10,193.00	11.07	99.48	10,078.17	-45.65	1,173.79	14,444,844.68	1,728,106.26	39.77469353	-80.68790344
10,276.00	12.70	101.85	10,159.38	-48.83	1,190.58	14,444,841.49	1,728,123.05	39.77468462	-80.68784373
10,371.00	14.46	92.36	10,251.74	-51.47	1,212.66	14,444,838.86	1,728,145.13	39.77467717	-80.68776519
10,465.00	13.89	89.46	10,342.88	-51.84	1,235.67	14,444,838.48	1,728,168.14	39.77467592	-80.68768330
10,559.00	14.68	88.40	10,433.97	-51.40	1,258.86	14,444,838.92	1,728,191.33	39.77467690	-80.68760077
10,606.00	14.64	87.44	10,479.44	-50.97	1,270.74	14,444,839.35	1,728,203.21	39.77467797	-80.68755846
10,654.00	16.35	94.47	10,525.70	-51.23	1,283.54	14,444,839.10	1,728,216.01	39.77467715	-80.68751291

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stern S-19 HU (slot Q)
Project:	Marshall County, West Virginia	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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SEP 30 2022
WV Department of
Environmental Protection

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
10,701.00	18.95	103.70	10,570.49	-53.55	1,297.56	14,444,836.77	1,728,230.03	39.77467063	-80.68746306
10,749.00	21.41	110.90	10,615.55	-58.52	1,313.32	14,444,831.80	1,728,245.79	39.77465682	-80.68740703
10,796.00	23.82	113.28	10,658.93	-65.34	1,330.05	14,444,824.99	1,728,262.52	39.77463796	-80.68734755
10,843.00	24.26	118.55	10,701.86	-73.70	1,347.25	14,444,816.62	1,728,279.72	39.77461481	-80.68728644
10,890.00	25.41	124.26	10,744.52	-84.00	1,364.07	14,444,806.33	1,728,296.54	39.77458638	-80.68722671
10,938.00	27.69	128.66	10,787.46	-96.76	1,381.30	14,444,793.56	1,728,313.77	39.77455116	-80.68716556
10,985.00	29.49	134.19	10,828.73	-111.65	1,398.12	14,444,778.67	1,728,330.59	39.77451011	-80.68710586
11,033.00	32.04	137.18	10,869.98	-129.23	1,415.25	14,444,761.10	1,728,347.72	39.77446167	-80.68704512
11,080.00	35.30	137.97	10,909.09	-148.47	1,432.82	14,444,741.86	1,728,365.29	39.77440867	-80.68698282
11,127.00	38.68	139.64	10,946.62	-169.75	1,451.43	14,444,720.57	1,728,383.90	39.77435004	-80.68691686
11,174.00	41.63	140.52	10,982.54	-193.00	1,470.87	14,444,697.33	1,728,403.34	39.77428601	-80.68684796
11,221.00	44.88	141.93	11,016.77	-218.11	1,491.03	14,444,672.22	1,728,423.50	39.77421685	-80.68677653
11,268.00	47.96	143.86	11,049.17	-245.27	1,511.55	14,444,645.06	1,728,444.02	39.77414208	-80.68670382
11,316.00	50.51	144.83	11,080.51	-274.81	1,532.74	14,444,615.52	1,728,465.21	39.77406075	-80.68662879
11,363.00	53.23	146.76	11,109.52	-305.38	1,553.51	14,444,584.94	1,728,485.98	39.77397658	-80.68655525
11,411.00	56.75	147.47	11,137.06	-338.40	1,574.85	14,444,551.93	1,728,507.32	39.77388571	-80.68647972
11,458.00	59.25	148.87	11,161.96	-372.26	1,595.86	14,444,518.07	1,728,528.33	39.77379251	-80.68640536
11,505.00	62.29	149.40	11,184.91	-407.46	1,616.90	14,444,482.86	1,728,549.36	39.77369563	-80.68633093
11,552.00	65.49	150.10	11,205.59	-443.92	1,638.15	14,444,446.41	1,728,570.62	39.77359531	-80.68625574
11,600.00	66.73	150.37	11,225.03	-482.01	1,659.94	14,444,408.31	1,728,592.41	39.77349048	-80.68617867
11,647.00	70.15	151.07	11,242.30	-520.14	1,681.31	14,444,370.19	1,728,613.78	39.77338558	-80.68610308
11,694.00	72.48	152.30	11,257.36	-559.33	1,702.42	14,444,331.00	1,728,634.89	39.77327774	-80.68602843
11,741.00	77.01	152.74	11,269.72	-599.55	1,723.34	14,444,290.78	1,728,655.81	39.77316709	-80.68595449
11,789.00	82.02	152.21	11,278.45	-641.39	1,745.15	14,444,248.94	1,728,677.62	39.77305197	-80.68587740
11,833.00	87.74	149.75	11,286.84	-723.22	1,790.55	14,444,167.11	1,728,723.02	39.77282682	-80.68571683
11,978.00	87.65	149.75	11,290.66	-805.21	1,838.37	14,444,085.11	1,728,770.84	39.77260117	-80.68554767
12,072.00	89.45	149.66	11,293.04	-886.35	1,885.77	14,444,003.98	1,728,818.24	39.77237790	-80.68537999
12,168.00	89.19	149.57	11,294.18	-969.16	1,934.32	14,443,921.17	1,728,866.79	39.77215002	-80.68520822
12,262.00	89.23	150.28	11,295.48	-1,050.49	1,981.43	14,443,839.83	1,728,913.90	39.77192619	-80.68504161
12,356.00	88.70	149.93	11,297.17	-1,131.97	2,028.27	14,443,758.35	1,728,960.74	39.77170198	-80.68487592
12,451.00	88.53	149.93	11,299.47	-1,214.16	2,075.86	14,443,676.16	1,729,008.33	39.77147580	-80.68470759
12,545.00	87.96	149.49	11,302.35	-1,295.29	2,123.24	14,443,595.04	1,729,055.71	39.77125254	-80.68453996
12,640.00	89.54	150.45	11,304.42	-1,377.52	2,170.77	14,443,512.81	1,729,103.24	39.77102627	-80.68437184
12,735.00	88.97	150.54	11,305.66	-1,460.19	2,217.56	14,443,430.14	1,729,150.03	39.77079878	-80.68420638
12,829.00	89.36	151.07	11,307.03	-1,542.24	2,263.40	14,443,348.09	1,729,195.87	39.77057301	-80.68404425
12,924.00	91.03	150.19	11,306.70	-1,625.02	2,309.99	14,443,265.30	1,729,242.46	39.77034520	-80.68387948
13,018.00	90.90	150.10	11,305.12	-1,706.54	2,356.78	14,443,183.79	1,729,289.25	39.77012089	-80.68371400
13,113.00	90.59	150.72	11,303.88	-1,789.14	2,403.69	14,443,101.19	1,729,336.16	39.76989359	-80.68354811
13,207.00	89.10	150.28	11,304.14	-1,870.95	2,449.97	14,443,019.38	1,729,382.44	39.76966847	-80.68338441
13,302.00	88.04	150.63	11,306.51	-1,953.57	2,496.80	14,442,936.76	1,729,429.27	39.76944112	-80.68321879
13,396.00	87.43	150.81	11,310.22	-2,035.50	2,542.74	14,442,854.83	1,729,475.21	39.76921568	-80.68305634
13,491.00	89.01	150.98	11,313.17	-2,118.46	2,588.93	14,442,771.87	1,729,521.40	39.76898740	-80.68289303
13,585.00	88.79	150.63	11,314.98	-2,200.50	2,634.77	14,442,689.83	1,729,567.24	39.76876164	-80.68273092
13,680.00	88.40	151.16	11,317.31	-2,283.48	2,680.96	14,442,606.85	1,729,613.43	39.76853331	-80.68256757
13,775.00	88.00	151.60	11,320.29	-2,366.83	2,726.45	14,442,523.50	1,729,658.92	39.76830396	-80.68240676
13,870.00	89.58	151.60	11,322.30	-2,450.38	2,771.62	14,442,439.95	1,729,704.09	39.76807408	-80.68224706
13,964.00	88.88	151.51	11,323.56	-2,533.02	2,816.39	14,442,357.31	1,729,748.86	39.76784669	-80.68208878
14,058.00	88.62	151.33	11,325.61	-2,615.55	2,861.35	14,442,274.78	1,729,793.82	39.76761961	-80.68192983
14,153.00	88.22	151.77	11,328.23	-2,699.04	2,906.59	14,442,191.29	1,729,839.06	39.76739897	-80.68176989
14,247.00	88.97	151.60	11,330.54	-2,781.77	2,951.16	14,442,108.56	1,729,883.63	39.76716224	-80.68161232
14,342.00	88.97	151.33	11,332.24	-2,865.22	2,996.53	14,442,025.11	1,729,929.00	39.76693263	-80.68145191
14,437.00	88.66	151.33	11,334.21	-2,948.55	3,042.10	14,441,941.78	1,729,974.57	39.76670333	-80.68129080
14,531.00	88.84	150.89	11,336.26	-3,030.83	3,087.50	14,441,859.49	1,730,019.97	39.76647692	-80.68113027
14,626.00	88.40	150.45	11,338.55	-3,113.63	3,134.02	14,441,776.70	1,730,066.49	39.76624908	-80.68096577
14,720.00	89.67	150.10	11,340.13	-3,195.25	3,180.62	14,441,695.08	1,730,113.09	39.76602448	-80.68080097

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stern S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	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
14,814.00	89.85	149.57	11,340.52	-3,276.52	3,227.86	14,441,613.81	1,730,160.33	39.76580083	-80.68063392
14,909.00	89.41	149.40	11,341.14	-3,358.36	3,276.09	14,441,531.97	1,730,208.56	39.76557560	-80.68046330
15,003.00	89.19	149.57	11,342.29	-3,439.33	3,323.82	14,441,450.99	1,730,256.29	39.76535276	-80.68029449
15,098.00	88.57	149.93	11,344.14	-3,521.38	3,371.67	14,441,368.95	1,730,304.14	39.76512696	-80.68012526
15,192.00	88.00	150.19	11,346.96	-3,602.80	3,418.56	14,441,287.53	1,730,351.03	39.76490290	-80.67995942
15,287.00	88.48	149.14	11,349.87	-3,684.75	3,466.52	14,441,205.57	1,730,398.99	39.76467737	-80.67978981
15,382.00	88.31	149.22	11,352.54	-3,766.30	3,515.17	14,441,124.02	1,730,447.64	39.76445293	-80.67961771
15,476.00	89.32	149.66	11,354.48	-3,847.23	3,562.96	14,441,043.10	1,730,495.43	39.76423022	-80.67944870
15,570.00	88.70	149.14	11,356.10	-3,928.13	3,610.80	14,440,962.20	1,730,543.27	39.76400758	-80.67927949
15,665.00	89.71	150.81	11,357.42	-4,010.37	3,658.33	14,440,879.96	1,730,590.80	39.76378126	-80.67911140
15,760.00	89.67	150.89	11,357.94	-4,093.33	3,704.60	14,440,796.99	1,730,637.07	39.76355296	-80.67894780
15,854.00	89.27	150.54	11,358.81	-4,175.31	3,750.58	14,440,715.01	1,730,683.05	39.76332736	-80.67878523
15,949.00	88.31	150.37	11,360.81	-4,257.94	3,797.41	14,440,632.38	1,730,729.88	39.76309998	-80.67861963
16,044.00	90.24	149.93	11,362.01	-4,340.33	3,844.69	14,440,550.00	1,730,777.16	39.76287326	-80.67845244
16,138.00	90.42	149.49	11,361.47	-4,421.49	3,892.10	14,440,468.83	1,730,824.57	39.76264989	-80.67828477
16,233.00	90.15	149.31	11,361.00	-4,503.26	3,940.46	14,440,387.06	1,730,872.93	39.76242485	-80.67811374
16,328.00	89.85	150.01	11,361.00	-4,585.25	3,988.45	14,440,305.07	1,730,920.92	39.76219922	-80.67794403
16,422.00	89.67	149.57	11,361.39	-4,666.48	4,035.75	14,440,223.84	1,730,968.22	39.76197567	-80.67777677
16,517.00	89.58	149.75	11,362.01	-4,748.47	4,083.73	14,440,141.85	1,731,016.20	39.76175003	-80.67760706
16,612.00	88.44	149.57	11,363.66	-4,830.45	4,131.71	14,440,059.88	1,731,064.18	39.76152443	-80.67743738
16,706.00	87.69	149.05	11,366.83	-4,911.24	4,179.66	14,439,979.09	1,731,112.13	39.76130209	-80.67726780
16,801.00	89.10	148.70	11,369.49	-4,992.52	4,228.75	14,439,897.80	1,731,161.22	39.76107837	-80.67709418
16,896.00	89.10	149.31	11,370.98	-5,073.95	4,277.66	14,439,816.38	1,731,210.13	39.76085427	-80.67692116
16,990.00	88.66	149.40	11,372.82	-5,154.81	4,325.56	14,439,735.52	1,731,258.03	39.76063174	-80.67675174
17,085.00	87.78	149.31	11,375.77	-5,236.50	4,373.96	14,439,653.83	1,731,306.43	39.76040691	-80.67658057
17,180.00	88.92	150.98	11,378.51	-5,318.85	4,421.23	14,439,571.47	1,731,353.70	39.76018028	-80.67641343
17,274.00	89.19	150.45	11,380.06	-5,400.83	4,467.21	14,439,489.50	1,731,399.68	39.75995470	-80.67625090
17,369.00	89.05	149.84	11,381.52	-5,483.21	4,514.49	14,439,407.12	1,731,446.96	39.75972798	-80.67608370
17,463.00	88.18	150.28	11,383.79	-5,564.64	4,561.39	14,439,325.69	1,731,493.86	39.75950389	-80.67591786
17,558.00	88.70	149.75	11,386.37	-5,646.89	4,608.85	14,439,243.43	1,731,541.32	39.75927752	-80.67575004
17,652.00	88.40	150.19	11,388.75	-5,728.25	4,655.88	14,439,162.08	1,731,588.35	39.75905363	-80.67558376
17,746.00	89.67	150.54	11,390.34	-5,809.94	4,702.35	14,439,080.39	1,731,634.82	39.75882883	-80.67541945
17,841.00	88.88	151.07	11,391.54	-5,892.86	4,748.69	14,438,997.46	1,731,681.16	39.75860063	-80.67525565
17,936.00	89.19	151.33	11,393.14	-5,976.10	4,794.45	14,438,914.22	1,731,726.92	39.75837159	-80.67509389
18,030.00	88.92	152.48	11,394.69	-6,059.01	4,838.71	14,438,831.31	1,731,771.18	39.75814345	-80.67493748
18,125.00	88.84	152.39	11,396.55	-6,143.21	4,882.66	14,438,747.11	1,731,815.13	39.75791178	-80.67478217
18,220.00	88.62	152.56	11,398.65	-6,227.44	4,926.56	14,438,662.89	1,731,859.03	39.75768003	-80.67462708
18,314.00	88.92	152.04	11,400.67	-6,310.65	4,970.24	14,438,579.68	1,731,902.71	39.75745109	-80.67447272
18,409.00	87.74	151.33	11,403.44	-6,394.24	5,015.28	14,438,496.08	1,731,947.75	39.75722106	-80.67431354
18,479.00	87.69	151.24	11,406.23	-6,455.58	5,048.89	14,438,434.74	1,731,981.36	39.75705226	-80.67419476
Survey @ 18479.00 MD 11406.23 TVD									
18,538.00	87.69	151.24	11,408.61	-6,507.26	5,077.25	14,438,383.06	1,732,009.72	39.75691005	-80.67409451
Survey projected to 18538.00 MD 11408.61 TVD									

Measured Depth (usft)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Comment
234.00	234.00	-0.14	0.34	MWD surveys
18,479.00	11,406.23	-6,455.58	5,048.89	Survey @ 18479.00 MD 11406.23 TVD
18,538.00	11,408.61	-6,507.26	5,077.25	Survey projected to 18538.00 MD 11408.61 TVD

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Keith Stern S-19 HU (slot Q)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Site:	Keith Stern	MD Reference:	RKB=747+33 @ 780.00usft (Nabors X08)
Well:	Keith Stern S-19 HU (slot Q)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Aug1919_v14

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