



TUG HILL
OPERATING

Well: Knob Creek N-12HU (slot M)
Site: Knob Creek
Project: Marshall County, West Virginia.
Design: rev6
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=737+33 @ 770.00usft (Nabors X08)
Surface location

Northing	Easting	Latitude	Longitude
14443135.94	1723190.50	39.770047	-80.705419

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.85°



Azimuths to Grid North
True North: -0.19°
Magnetic North: -8.85°

Magnetic Field
Strength: 51794.7nT
Dip Angle: 66.57°
Date: 12/15/2020
Model: IGRF2020

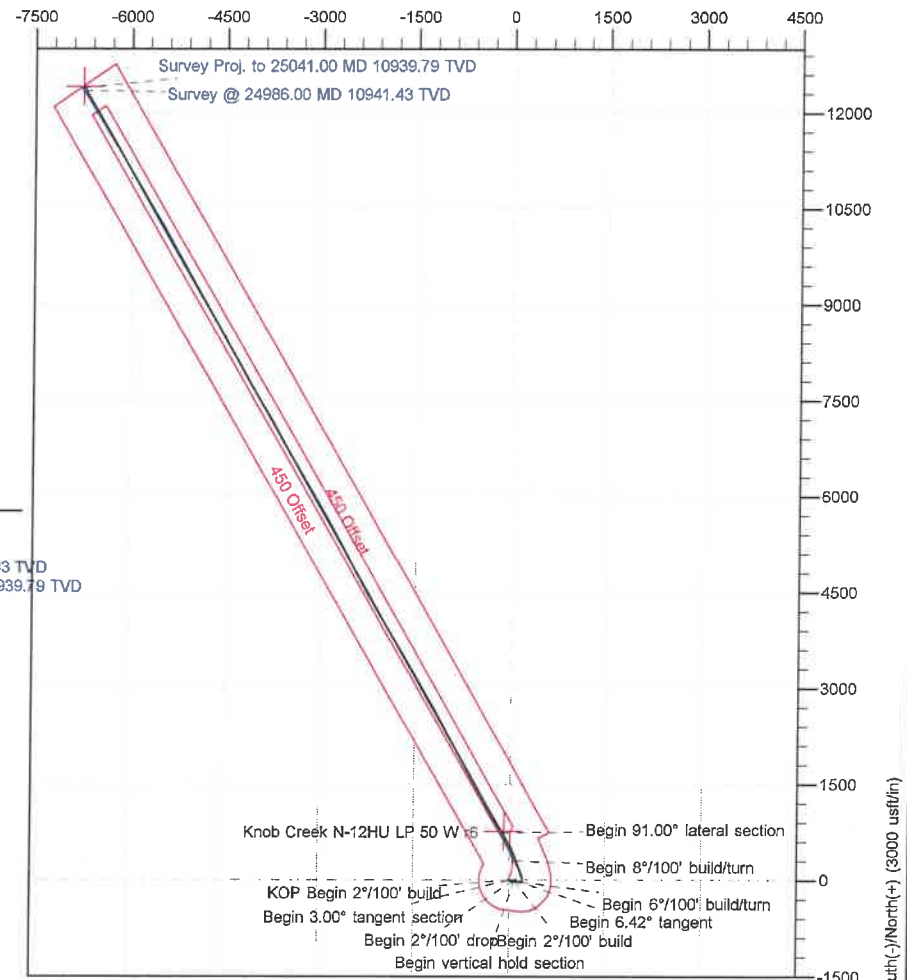
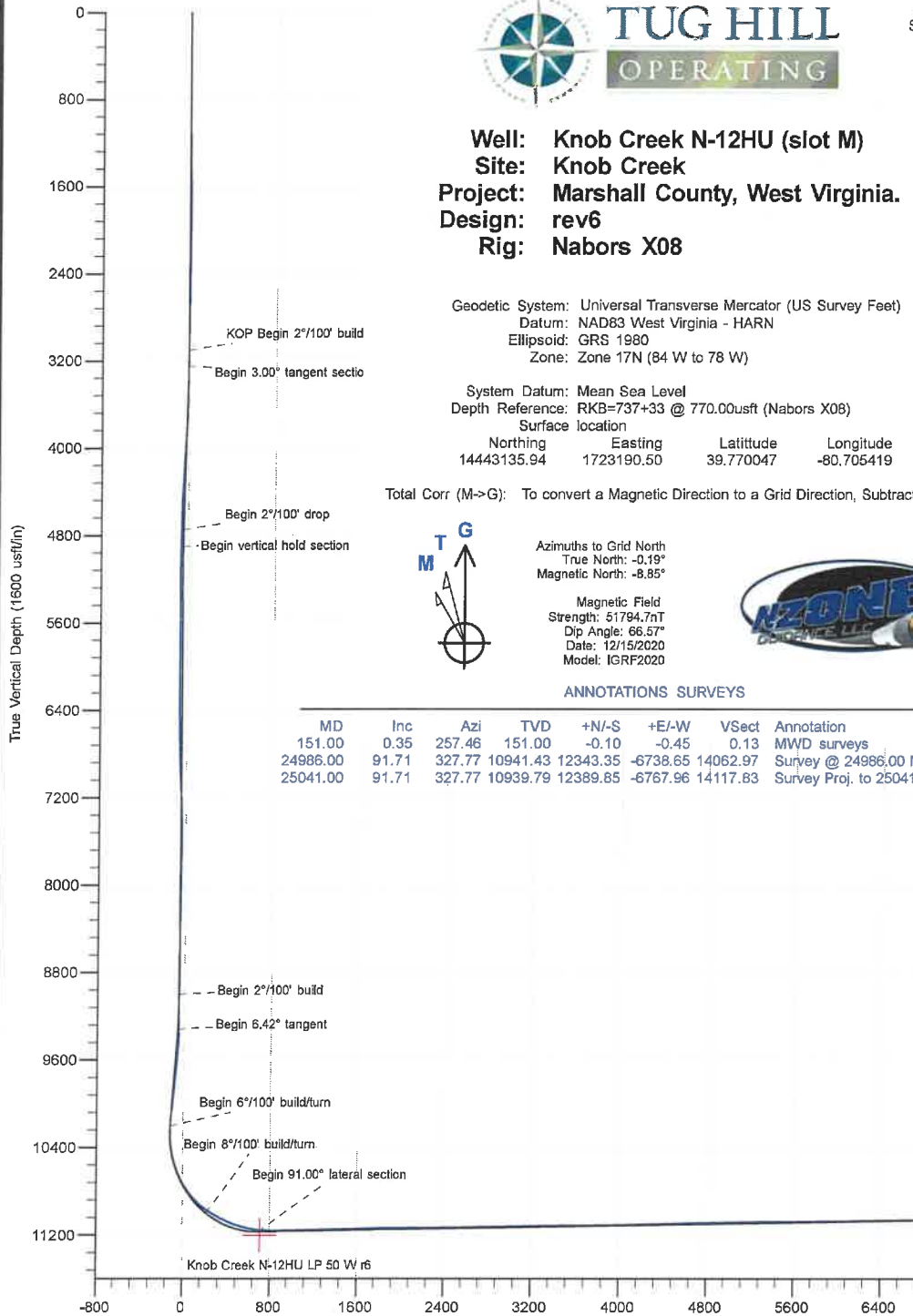


ANNOTATIONS SURVEYS

MD	Inc	Azi	TVD	+N/-S	+E/-W	Vsect	Annotation
151.00	0.35	257.46	151.00	-0.10	-0.45	0.13	MWD surveys
24986.00	91.71	327.77	10941.43	12343.35	-6738.65	14062.97	Survey @ 24986.00 MD 10941.43 TVD
25041.00	91.71	327.77	10939.79	12389.85	-6767.96	14117.83	Survey Proj. to 25041.00 MD 10939.79 TVD

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	3100.00	0.00	0.00	3100.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 2°/100' build
3	3250.00	3.00	90.00	3249.93	0.00	3.93	2.00	90.00	-1.88	Begin 3.00° tangent section
4	4750.00	3.00	90.00	4747.88	0.00	82.43	0.00	0.00	-39.38	Begin 2°/100' drop
5	4900.00	0.00	90.00	4897.81	0.00	86.36	2.00	180.00	0.00	Begin vertical hold section
6	9002.19	0.00	90.00	9000.00	0.00	86.36	0.00	90.00	-41.26	Begin 2°/100' build
7	9323.21	6.42	102.32	9320.35	-3.83	103.91	2.00	102.32	-53.01	Begin 6.42° tangent
8	10217.01	6.42	102.32	10208.54	-25.15	201.56	0.00	0.00	-118.39	Begin 6°/100' build/turn
9	11114.47	50.00	337.57	11002.19	306.68	112.79	6.00	-128.78	215.53	Begin 8°/100' build/turn
10	11633.55	91.00	330.34	11172.00	734.87	-100.91	8.00	-10.94	693.80	Begin 91.00° lateral section
11	25066.03	91.00	330.34	10938.10	12405.92	-6746.47	0.00	0.00	14121.68	PBHL/TD 25066.03 MD/10938.10 TVD



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
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Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

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	Knob Creek				
Site Position:		Northing:	14,443,053.74 usft	Latitude:	39.769822
From:	Lat/Long	Easting:	1,723,120.29 usft	Longitude:	-80.705670
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "		

Well	Knob Creek N-12HU (slot M)					
Well Position	+N/-S	0.00 usft	Northing:	14,443,135.94 usft	Latitude:	39.770047
	+E/-W	0.00 usft	Easting:	1,723,190.50 usft	Longitude:	-80.705419
Position Uncertainty	0.00 usft		Wellhead Elevation:	usft	Ground Level:	737.00 usft
Grid Convergence:	0.19 °					

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2020	12/15/2020	-8.66	66.57	51,794.65260972

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	331.46	

Survey Program	Date	1/21/2021			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
151.00	2,230.00	MWD surf (Original Hole)	MWD	MWD - Standard	
2,302.00	6,130.00	MWD int (Original Hole)	MWD	MWD - Standard	
6,261.00	24,986.00	MWD (Original Hole)	MWD	MWD - Standard	
25,041.00	25,041.00	Projection (Original Hole)	MWD	MWD - Standard	

Survey										
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	
151.00	0.35	257.46	151.00	-0.10	-0.45	0.13	0.23	0.23	0.00	
MWD surveys										
182.00	0.48	330.14	182.00	-0.01	-0.61	0.28	1.62	0.42	234.45	
213.00	0.18	297.98	213.00	0.13	-0.71	0.45	1.10	-0.97	-103.74	
243.00	0.62	318.81	243.00	0.27	-0.86	0.65	1.52	1.47	69.43	
274.00	0.40	297.10	274.00	0.45	-1.07	0.90	0.93	-0.71	-70.03	

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Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

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)
305.00	0.53	299.10	304.99	0.57	-1.29	1.11	0.42	0.42	6.45
335.00	0.62	300.70	334.99	0.72	-1.55	1.37	0.30	0.30	5.33
366.00	0.57	314.24	365.99	0.91	-1.81	1.66	0.48	-0.16	43.68
397.00	0.31	340.16	396.99	1.10	-1.95	1.89	1.04	-0.84	83.61
427.00	0.13	299.82	426.99	1.19	-2.00	2.00	0.76	-0.60	-134.47
458.00	0.22	316.17	457.99	1.25	-2.08	2.09	0.33	0.29	52.74
489.00	0.22	287.25	488.99	1.31	-2.17	2.19	0.35	0.00	-93.29
513.00	0.22	176.86	512.99	1.28	-2.21	2.18	1.51	0.00	-459.96
610.00	0.62	250.87	609.99	0.92	-2.70	2.10	0.62	0.41	76.30
701.00	0.48	218.26	700.98	0.46	-3.40	2.03	0.37	-0.15	-35.84
795.00	0.18	273.37	794.98	0.16	-3.79	1.95	0.43	-0.32	58.63
889.00	0.18	290.33	888.98	0.22	-4.08	2.14	0.06	0.00	18.04
984.00	0.53	267.83	983.98	0.25	-4.66	2.45	0.39	0.37	-23.68
1,078.00	0.53	297.19	1,077.98	0.44	-5.48	3.00	0.29	0.00	31.23
1,171.00	0.57	283.21	1,170.97	0.74	-6.31	3.66	0.15	0.04	-15.03
1,265.00	0.35	323.46	1,264.97	1.08	-6.94	4.26	0.40	-0.23	42.82
1,359.00	0.70	296.48	1,358.97	1.56	-7.62	5.01	0.45	0.37	-28.70
1,453.00	1.27	319.42	1,452.95	2.61	-8.81	6.50	0.73	0.61	24.40
1,547.00	1.10	315.99	1,546.93	4.05	-10.12	8.39	0.20	-0.18	-3.65
1,642.00	0.83	324.43	1,641.92	5.27	-11.15	9.95	0.32	-0.28	8.88
1,736.00	0.44	325.31	1,735.91	6.12	-11.75	10.99	0.42	-0.41	0.94
1,831.00	1.01	82.29	1,830.91	6.53	-11.13	11.05	1.34	0.60	123.14
1,925.00	1.54	71.83	1,924.88	7.03	-9.11	10.53	0.61	0.56	-11.13
2,019.00	1.45	55.74	2,018.85	8.10	-6.93	10.42	0.46	-0.10	-17.12
2,114.00	1.27	87.74	2,113.83	8.82	-4.88	10.08	0.81	-0.19	33.68
2,207.00	1.45	99.87	2,206.80	8.65	-2.69	8.89	0.36	0.19	13.04
2,230.00	1.63	111.21	2,229.79	8.49	-2.10	8.46	1.54	0.78	49.30
2,302.00	1.63	95.04	2,301.76	8.03	-0.13	7.11	0.64	0.00	-22.46
2,398.00	1.71	88.88	2,397.72	7.93	2.67	5.70	0.20	0.08	-6.42
2,493.00	1.41	91.26	2,492.69	7.94	5.25	4.46	0.32	-0.32	2.51
2,587.00	1.54	71.66	2,586.66	8.31	7.61	3.66	0.55	0.14	-20.85
2,681.00	1.32	72.54	2,680.63	9.03	9.84	3.23	0.24	-0.23	0.94
2,776.00	1.14	81.50	2,775.61	9.50	11.82	2.70	0.28	-0.19	9.43
2,870.00	0.97	115.34	2,869.59	9.30	13.46	1.73	0.68	-0.18	36.00
2,964.00	0.92	104.00	2,963.58	8.77	14.91	0.58	0.21	-0.05	-12.06
3,057.00	0.79	116.31	3,056.57	8.31	16.21	-0.45	0.24	-0.14	13.24
3,152.00	0.75	75.96	3,151.56	8.17	17.40	-1.14	0.56	-0.04	-42.47
3,245.00	0.48	95.65	3,244.55	8.28	18.38	-1.51	0.36	-0.29	21.17
3,339.00	1.14	114.11	3,338.54	7.86	19.62	-2.47	0.75	0.70	19.64
3,433.00	1.27	98.29	3,432.52	7.32	21.51	-3.84	0.38	0.14	-16.83
3,528.00	1.63	120.00	3,527.49	6.50	23.72	-5.63	0.68	0.38	22.85
3,622.00	1.67	112.53	3,621.45	5.30	26.14	-7.83	0.23	0.04	-7.95
3,716.00	2.20	116.31	3,715.40	3.98	29.03	-10.37	0.58	0.56	4.02
3,810.00	2.55	127.56	3,809.32	1.91	32.30	-13.76	0.62	0.37	11.97

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3,903.00	2.86	129.14	3,902.22	-0.82	35.74	-17.80	0.34	0.33	1.70
3,996.00	3.38	124.66	3,995.08	-3.84	39.80	-22.39	0.62	0.56	-4.82
4,090.00	3.74	124.74	4,088.90	-7.17	44.59	-27.60	0.38	0.38	0.09
4,184.00	3.87	119.91	4,182.69	-10.50	49.86	-33.04	0.37	0.14	-5.14
4,278.00	4.44	115.25	4,276.44	-13.63	55.90	-38.68	0.70	0.61	-4.96
4,372.00	4.53	104.00	4,370.16	-16.08	62.80	-44.13	0.94	0.10	-11.97
4,466.00	3.87	97.76	4,463.90	-17.41	69.54	-48.52	0.85	-0.70	-6.64
4,561.00	3.47	87.13	4,558.71	-17.70	75.59	-51.66	0.83	-0.42	-11.19
4,655.00	3.12	83.70	4,652.56	-17.27	80.97	-53.86	0.43	-0.37	-3.65
4,750.00	2.99	88.18	4,747.42	-16.91	86.02	-55.95	0.29	-0.14	4.72
4,844.00	2.90	89.85	4,841.30	-16.83	90.85	-58.19	0.13	-0.10	1.78
4,939.00	2.99	89.50	4,936.17	-16.80	95.73	-60.49	0.10	0.09	-0.37
5,033.00	2.68	90.47	5,030.06	-16.79	100.38	-62.71	0.33	-0.33	1.03
5,128.00	1.80	73.15	5,124.98	-16.38	104.03	-64.09	1.16	-0.93	-18.23
5,222.00	1.32	51.18	5,218.95	-15.27	106.28	-64.20	0.81	-0.51	-23.37
5,317.00	1.45	55.93	5,313.92	-13.91	108.13	-63.89	0.18	0.14	5.00
5,411.00	1.05	55.66	5,407.90	-12.76	109.83	-63.68	0.43	-0.43	-0.29
5,505.00	0.92	24.11	5,501.89	-11.59	110.85	-63.14	0.59	-0.14	-33.56
5,598.00	1.01	33.16	5,594.87	-10.22	111.60	-62.30	0.19	0.10	9.73
5,692.00	0.62	25.43	5,688.86	-9.07	112.27	-61.61	0.43	-0.41	-8.22
5,786.00	0.18	325.49	5,782.86	-8.49	112.41	-61.16	0.59	-0.47	-63.77
5,880.00	0.26	6.36	5,876.86	-8.15	112.35	-60.84	0.18	0.09	43.48
5,974.00	0.57	91.70	5,970.86	-7.95	112.84	-60.90	0.65	0.33	90.79
6,067.00	0.26	83.35	6,063.86	-7.94	113.51	-61.21	0.34	-0.33	-8.98
6,130.00	0.35	75.26	6,126.85	-7.88	113.84	-61.31	0.16	0.14	-12.84
6,261.00	0.75	76.84	6,257.85	-7.58	115.06	-61.63	0.31	0.31	1.21
6,354.00	0.75	57.42	6,350.84	-7.11	116.17	-61.75	0.27	0.00	-20.88
6,448.00	0.53	87.57	6,444.83	-6.77	117.12	-61.90	0.42	-0.23	32.07
6,541.00	0.75	331.20	6,537.83	-6.21	117.25	-61.48	1.18	0.24	-125.13
6,635.00	1.32	290.94	6,631.82	-5.29	115.95	-60.04	0.95	0.61	-42.83
6,729.00	2.02	290.77	6,725.78	-4.31	113.39	-57.96	0.74	0.74	-0.18
6,824.00	3.30	284.97	6,820.67	-3.01	109.18	-54.81	1.38	1.35	-6.11
6,917.00	4.04	278.38	6,913.48	-1.84	103.35	-51.00	0.91	0.80	-7.09
7,011.00	4.66	272.49	7,007.21	-1.20	96.26	-47.04	0.81	0.66	-6.27
7,104.00	3.60	278.46	7,099.97	-0.60	89.60	-43.34	1.23	-1.14	6.42
7,198.00	2.42	315.03	7,193.84	1.24	85.28	-39.66	2.34	-1.26	38.90
7,293.00	1.76	330.58	7,288.78	3.93	83.14	-36.27	0.91	-0.69	16.37
7,386.00	1.19	22.61	7,381.75	6.06	82.81	-34.24	1.50	-0.61	55.95
7,479.00	1.41	64.10	7,474.73	7.45	84.21	-33.69	1.01	0.24	44.61
7,573.00	1.89	48.19	7,568.69	8.99	86.41	-33.38	0.70	0.51	-16.93
7,667.00	1.93	66.47	7,662.64	10.66	89.02	-33.17	0.65	0.04	19.45
7,761.00	1.45	72.01	7,756.60	11.66	91.60	-33.52	0.54	-0.51	5.89
7,855.00	1.49	79.83	7,850.57	12.24	93.93	-34.13	0.22	0.04	8.32

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7,949.00	2.24	72.71	7,944.52	13.00	96.89	-34.87	0.83	0.80	-7.57
8,043.00	1.36	73.68	8,038.47	13.86	99.71	-35.46	0.94	-0.94	1.03
8,138.00	0.97	81.77	8,133.45	14.29	101.59	-35.98	0.44	-0.41	8.52
8,231.00	1.27	60.67	8,226.44	14.91	103.27	-36.24	0.54	0.32	-22.69
8,326.00	0.66	128.96	8,321.42	15.08	104.61	-36.73	1.26	-0.64	71.88
8,420.00	1.05	169.30	8,415.41	13.90	105.19	-38.05	0.74	0.41	42.91
8,515.00	1.98	185.30	8,510.38	11.41	105.20	-40.24	1.07	0.98	16.84
8,608.00	1.49	197.96	8,603.34	8.66	104.68	-42.41	0.67	-0.53	13.61
8,703.00	1.41	212.90	8,698.31	6.50	103.67	-43.82	0.41	-0.08	15.73
8,798.00	2.02	217.03	8,793.26	4.18	102.02	-45.07	0.65	0.64	4.35
8,892.00	1.93	241.55	8,887.21	2.10	99.63	-45.75	0.90	-0.10	26.09
8,987.00	2.20	252.89	8,982.15	0.81	96.48	-45.39	0.51	0.28	11.94
9,082.00	2.94	253.94	9,077.05	-0.40	92.40	-44.50	0.78	0.78	1.11
9,176.00	1.01	289.89	9,171.00	-0.79	89.30	-43.36	2.34	-2.05	38.24
9,270.00	0.97	75.26	9,264.99	-0.30	89.29	-42.93	2.01	-0.04	154.65
9,364.00	2.55	97.44	9,358.94	-0.37	92.14	-44.35	1.80	1.68	23.60
9,457.00	4.75	98.73	9,451.75	-1.23	98.00	-47.90	2.37	2.37	1.39
9,550.00	7.25	102.51	9,544.23	-3.08	107.53	-54.08	2.72	2.69	4.06
9,644.00	7.47	104.62	9,637.46	-5.91	119.24	-62.16	0.37	0.23	2.24
9,738.00	7.87	106.20	9,730.62	-9.25	131.33	-70.87	0.48	0.43	1.68
9,831.00	7.65	108.40	9,822.77	-12.98	143.32	-79.87	0.40	-0.24	2.37
9,924.00	7.82	107.78	9,914.92	-16.86	155.21	-88.97	0.20	0.18	-0.67
9,984.00	8.22	108.04	9,974.33	-19.44	163.18	-95.04	0.67	0.67	0.43
10,061.00	9.15	111.74	10,050.45	-23.41	174.10	-103.75	1.41	1.21	4.81
10,155.00	8.00	96.79	10,143.41	-26.95	187.54	-113.28	2.66	-1.22	-15.90
10,202.00	7.12	86.07	10,190.00	-27.14	193.69	-116.38	3.53	-1.87	-22.81
10,249.00	7.03	72.19	10,236.65	-26.06	199.34	-118.13	3.63	-0.19	-29.53
10,296.00	7.65	54.96	10,283.27	-23.38	204.64	-118.31	4.85	1.32	-36.66
10,343.00	8.53	37.73	10,329.81	-18.83	209.33	-116.56	5.46	1.87	-36.66
10,390.00	10.29	26.31	10,376.18	-12.31	213.33	-112.74	5.44	3.74	-24.30
10,436.00	11.43	11.54	10,421.36	-4.16	216.06	-106.88	6.51	2.48	-32.11
10,483.00	14.07	2.58	10,467.20	6.11	217.25	-98.43	7.00	5.62	-19.06
10,530.00	16.53	356.07	10,512.54	18.50	217.05	-87.45	6.38	5.23	-13.85
10,577.00	19.08	350.97	10,557.28	32.76	215.39	-74.13	6.35	5.43	-10.85
10,625.00	21.81	346.40	10,602.26	49.17	212.06	-58.12	6.58	5.69	-9.52
10,672.00	24.89	345.53	10,645.40	67.24	207.53	-40.08	6.59	6.55	-1.85
10,720.00	27.87	344.82	10,688.40	87.85	202.07	-19.36	6.24	6.21	-1.48
10,767.00	30.43	340.78	10,729.45	109.70	195.27	3.08	6.87	5.45	-8.60
10,814.00	32.89	337.61	10,769.45	132.75	186.49	27.51	6.32	5.23	-6.74
10,861.00	35.96	334.98	10,808.22	157.06	175.79	53.98	7.26	6.53	-5.60
10,908.00	39.31	331.99	10,845.44	182.71	162.96	82.65	8.12	7.13	-6.36
10,955.00	42.91	330.58	10,880.85	209.80	148.10	113.55	7.91	7.66	-3.00
11,003.00	46.78	329.88	10,914.87	239.18	131.29	147.38	8.13	8.06	-1.46

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey									
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)
11,050.00	50.83	329.88	10,945.82	269.76	113.55	182.73	8.62	8.62	0.00
11,096.00	54.78	330.58	10,973.62	301.56	95.36	219.36	8.67	8.59	1.52
11,143.00	57.68	333.22	10,999.75	336.03	76.98	258.42	7.74	6.17	5.62
11,190.00	59.97	334.63	11,024.08	372.15	59.31	298.59	5.51	4.87	3.00
11,237.00	62.70	334.63	11,046.62	409.41	41.64	339.76	5.81	5.81	0.00
11,284.00	65.33	333.57	11,067.21	447.40	23.19	381.96	5.95	5.60	-2.26
11,331.00	67.88	333.22	11,085.87	485.97	3.87	425.07	5.47	5.43	-0.74
11,377.00	70.61	333.40	11,102.17	524.40	-15.45	468.06	5.95	5.93	0.39
11,424.00	72.98	333.75	11,116.86	564.38	-35.32	512.67	5.09	5.04	0.74
11,471.00	75.36	333.75	11,129.68	604.93	-55.31	557.85	5.06	5.06	0.00
11,518.00	78.44	333.75	11,140.33	645.98	-75.56	603.58	6.55	6.55	0.00
11,565.00	80.37	333.92	11,148.97	687.44	-95.93	649.74	4.12	4.11	0.36
11,612.00	82.83	334.10	11,155.83	729.23	-116.30	696.19	5.25	5.23	0.38
11,658.00	85.21	334.28	11,160.63	770.42	-136.22	741.88	5.19	5.17	0.39
11,753.00	89.87	330.76	11,164.70	854.58	-180.00	836.73	6.14	4.91	-3.71
11,848.00	92.15	330.41	11,163.03	937.32	-226.65	931.70	2.43	2.40	-0.37
11,942.00	91.80	330.06	11,159.79	1,018.87	-273.29	1,025.62	0.53	-0.37	-0.37
12,037.00	91.71	330.23	11,156.88	1,101.22	-320.55	1,120.56	0.20	-0.09	0.18
12,131.00	92.24	330.94	11,153.64	1,183.05	-366.69	1,214.49	0.94	0.56	0.76
12,225.00	91.19	331.11	11,150.83	1,265.25	-412.21	1,308.44	1.13	-1.12	0.18
12,319.00	91.01	330.76	11,149.02	1,347.39	-457.87	1,402.42	0.42	-0.19	-0.37
12,413.00	91.10	330.23	11,147.29	1,429.19	-504.15	1,496.39	0.57	0.10	-0.56
12,508.00	91.10	330.41	11,145.47	1,511.71	-551.18	1,591.35	0.19	0.00	0.19
12,602.00	91.10	330.23	11,143.66	1,593.36	-597.72	1,685.32	0.19	0.00	-0.19
12,696.00	91.54	330.41	11,141.50	1,675.01	-644.25	1,779.27	0.51	0.47	0.19
12,789.00	90.04	330.41	11,140.22	1,755.87	-690.17	1,872.25	1.61	-1.61	0.00
12,883.00	89.87	330.58	11,140.29	1,837.68	-736.46	1,966.23	0.26	-0.18	0.18
12,977.00	89.96	330.94	11,140.43	1,919.70	-782.38	2,060.23	0.39	0.10	0.38
13,071.00	89.96	331.11	11,140.50	2,001.94	-827.92	2,154.22	0.18	0.00	0.18
13,165.00	90.84	331.46	11,139.84	2,084.37	-873.08	2,248.22	1.01	0.94	0.37
13,260.00	91.19	331.64	11,138.16	2,167.89	-918.33	2,343.20	0.41	0.37	0.19
13,354.00	91.19	331.99	11,136.20	2,250.72	-962.71	2,437.18	0.37	0.00	0.37
13,448.00	91.54	331.99	11,133.97	2,333.69	-1,006.85	2,531.15	0.37	0.37	0.00
13,542.00	91.71	331.99	11,131.30	2,416.65	-1,050.97	2,625.11	0.18	0.18	0.00
13,636.00	90.57	331.46	11,129.43	2,499.41	-1,095.49	2,719.09	1.34	-1.21	-0.56
13,730.00	90.92	331.29	11,128.21	2,581.91	-1,140.52	2,813.08	0.41	0.37	-0.18
13,824.00	91.19	331.29	11,126.48	2,664.34	-1,185.67	2,907.06	0.29	0.29	0.00
13,918.00	91.19	330.94	11,124.52	2,746.63	-1,231.07	3,001.04	0.37	0.00	-0.37
14,012.00	91.54	330.76	11,122.29	2,828.70	-1,276.84	3,095.01	0.42	0.37	-0.19
14,127.00	91.80	330.76	11,118.93	2,929.01	-1,332.99	3,209.95	0.23	0.23	0.00
14,221.00	90.40	329.00	11,117.13	3,010.30	-1,380.15	3,303.89	2.39	-1.49	-1.87
14,315.00	90.57	329.35	11,116.33	3,091.01	-1,428.32	3,397.81	0.41	0.18	0.37
14,409.00	90.31	329.35	11,115.61	3,171.88	-1,476.23	3,491.75	0.28	-0.28	0.00
14,503.00	90.22	329.35	11,115.18	3,252.75	-1,524.15	3,585.68	0.10	-0.10	0.00

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey									
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)
14,598.00	90.75	329.53	11,114.37	3,334.55	-1,572.45	3,680.62	0.59	0.56	0.19
14,692.00	90.92	330.23	11,113.00	3,415.85	-1,619.62	3,774.57	0.77	0.18	0.74
14,786.00	90.75	330.06	11,111.63	3,497.36	-1,666.41	3,868.54	0.26	-0.18	-0.18
14,879.00	90.75	329.88	11,110.42	3,577.87	-1,712.95	3,961.50	0.19	0.00	-0.19
14,974.00	91.19	329.70	11,108.81	3,659.96	-1,760.74	4,056.45	0.50	0.46	-0.19
15,067.00	91.19	329.70	11,106.88	3,740.24	-1,807.65	4,149.38	0.00	0.00	0.00
15,161.00	90.84	329.70	11,105.21	3,821.38	-1,855.07	4,243.32	0.37	-0.37	0.00
15,255.00	91.01	329.88	11,103.69	3,902.60	-1,902.36	4,337.27	0.26	0.18	0.19
15,349.00	91.36	329.88	11,101.75	3,983.89	-1,949.52	4,431.21	0.37	0.37	0.00
15,444.00	91.36	329.35	11,099.49	4,065.82	-1,997.56	4,526.14	0.56	0.00	-0.56
15,539.00	91.80	329.18	11,096.87	4,147.45	-2,046.09	4,621.03	0.50	0.46	-0.18
15,633.00	92.07	329.00	11,093.70	4,228.05	-2,094.35	4,714.90	0.35	0.29	-0.19
15,727.00	92.15	329.18	11,090.24	4,308.65	-2,142.61	4,808.75	0.21	0.09	0.19
15,822.00	91.19	329.35	11,087.47	4,390.27	-2,191.14	4,903.64	1.03	-1.01	0.18
15,916.00	90.48	330.41	11,086.10	4,471.56	-2,238.30	4,997.59	1.36	-0.76	1.13
16,011.00	91.10	330.76	11,084.79	4,554.31	-2,284.95	5,092.57	0.75	0.65	0.37
16,105.00	90.31	331.29	11,083.64	4,636.54	-2,330.49	5,186.56	1.01	-0.84	0.56
16,200.00	89.87	331.29	11,083.49	4,719.86	-2,376.12	5,281.56	0.46	-0.46	0.00
16,273.00	90.04	331.29	11,083.54	4,783.88	-2,411.19	5,354.56	0.23	0.23	0.00
16,367.00	90.66	331.29	11,082.97	4,866.32	-2,456.34	5,448.56	0.66	0.66	0.00
16,462.00	91.10	331.46	11,081.51	4,949.70	-2,501.85	5,543.55	0.50	0.46	0.18
16,556.00	91.01	331.64	11,079.78	5,032.34	-2,546.62	5,637.53	0.21	-0.10	0.19
16,650.00	90.75	331.64	11,078.34	5,115.04	-2,591.27	5,731.52	0.28	-0.28	0.00
16,744.00	91.10	331.99	11,076.82	5,197.89	-2,635.66	5,825.51	0.53	0.37	0.37
16,838.00	90.66	331.81	11,075.37	5,280.80	-2,679.93	5,919.49	0.51	-0.47	-0.19
16,932.00	90.31	331.64	11,074.58	5,363.58	-2,724.46	6,013.49	0.41	-0.37	-0.18
17,026.00	90.13	331.64	11,074.22	5,446.30	-2,769.11	6,107.49	0.19	-0.19	0.00
17,120.00	91.01	330.94	11,073.28	5,528.73	-2,814.26	6,201.48	1.20	0.94	-0.74
17,214.00	91.10	330.94	11,071.55	5,610.89	-2,859.91	6,295.46	0.10	0.10	0.00
17,308.00	90.66	330.76	11,070.11	5,692.97	-2,905.69	6,389.44	0.51	-0.47	-0.19
17,402.00	91.36	329.88	11,068.45	5,774.63	-2,952.23	6,483.41	1.20	0.74	-0.94
17,496.00	91.36	329.70	11,066.22	5,855.84	-2,999.51	6,577.34	0.19	0.00	-0.19
17,590.00	90.84	329.70	11,064.42	5,936.98	-3,046.93	6,671.28	0.55	-0.55	0.00
17,684.00	90.48	329.35	11,063.33	6,017.99	-3,094.60	6,765.22	0.53	-0.38	-0.37
17,778.00	90.48	329.35	11,062.55	6,098.85	-3,142.52	6,859.15	0.00	0.00	0.00
17,871.00	91.45	329.00	11,060.98	6,178.70	-3,190.17	6,952.06	1.11	1.04	-0.38
17,964.00	90.92	329.35	11,059.06	6,258.55	-3,237.81	7,044.97	0.68	-0.57	0.38
18,057.00	91.36	328.83	11,057.21	6,338.32	-3,285.57	7,137.87	0.73	0.47	-0.56
18,151.00	91.63	329.18	11,054.75	6,418.87	-3,333.96	7,231.75	0.47	0.29	0.37
18,244.00	91.45	328.83	11,052.25	6,498.57	-3,381.84	7,324.63	0.42	-0.19	-0.38
18,338.00	91.36	329.53	11,049.95	6,579.27	-3,429.98	7,418.53	0.75	-0.10	0.74
18,432.00	90.92	330.41	11,048.08	6,660.63	-3,477.02	7,512.48	1.05	-0.47	0.94
18,526.00	90.75	331.29	11,046.71	6,742.72	-3,522.80	7,606.46	0.95	-0.18	0.94

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey									
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)
18,620.00	90.57	331.11	11,045.63	6,825.08	-3,568.08	7,700.46	0.27	-0.19	-0.19
18,714.00	90.75	331.11	11,044.54	6,907.38	-3,613.49	7,794.45	0.19	0.19	0.00
18,808.00	91.71	331.29	11,042.53	6,989.73	-3,658.76	7,888.42	1.04	1.02	0.19
18,902.00	91.98	331.11	11,039.50	7,072.06	-3,704.03	7,982.37	0.35	0.29	-0.19
18,996.00	91.10	329.88	11,036.97	7,153.84	-3,750.30	8,076.32	1.61	-0.94	-1.31
19,090.00	90.84	329.53	11,035.38	7,234.99	-3,797.71	8,170.27	0.46	-0.28	-0.37
19,185.00	91.10	330.06	11,033.77	7,317.08	-3,845.50	8,265.21	0.62	0.27	0.56
19,279.00	91.36	330.76	11,031.76	7,398.80	-3,891.91	8,359.17	0.79	0.28	0.74
19,373.00	90.31	328.47	11,030.39	7,479.88	-3,939.44	8,453.11	2.68	-1.12	-2.44
19,466.00	90.40	328.47	11,029.81	7,559.15	-3,988.08	8,545.98	0.10	0.10	0.00
19,560.00	90.75	329.00	11,028.87	7,639.49	-4,036.86	8,639.87	0.68	0.37	0.56
19,654.00	91.36	329.88	11,027.14	7,720.42	-4,084.65	8,733.79	1.14	0.65	0.94
19,748.00	90.48	331.11	11,025.63	7,802.21	-4,130.93	8,827.76	1.61	-0.94	1.31
19,842.00	90.75	330.58	11,024.62	7,884.30	-4,176.72	8,921.75	0.63	0.29	-0.56
19,936.00	90.92	330.76	11,023.25	7,966.24	-4,222.76	9,015.73	0.26	0.18	0.19
20,029.00	91.19	330.58	11,021.53	8,047.31	-4,268.31	9,108.71	0.35	0.29	-0.19
20,124.00	91.36	331.11	11,019.42	8,130.25	-4,314.58	9,203.68	0.59	0.18	0.56
20,217.00	91.36	331.29	11,017.21	8,211.72	-4,359.37	9,296.65	0.19	0.00	0.19
20,310.00	90.57	330.58	11,015.65	8,293.00	-4,404.54	9,389.63	1.14	-0.85	-0.76
20,404.00	90.57	330.58	11,014.71	8,374.87	-4,450.72	9,483.62	0.00	0.00	0.00
20,498.00	90.84	331.29	11,013.56	8,457.03	-4,496.38	9,577.61	0.81	0.29	0.76
20,592.00	91.01	331.11	11,012.04	8,539.39	-4,541.66	9,671.59	0.26	0.18	-0.19
20,685.00	90.75	330.41	11,010.61	8,620.53	-4,587.08	9,764.57	0.80	-0.28	-0.75
20,780.00	90.84	330.06	11,009.29	8,702.99	-4,634.24	9,859.54	0.38	0.09	-0.37
20,874.00	91.54	329.35	11,007.34	8,784.13	-4,681.64	9,953.48	1.06	0.74	-0.76
20,967.00	90.84	329.53	11,005.41	8,864.20	-4,728.92	10,046.40	0.78	-0.75	0.19
21,061.00	91.10	330.94	11,003.82	8,945.78	-4,775.58	10,140.36	1.53	0.28	1.50
21,155.00	91.54	331.29	11,001.65	9,028.07	-4,820.97	10,234.33	0.60	0.47	0.37
21,249.00	90.66	330.58	10,999.85	9,110.21	-4,866.63	10,328.31	1.20	-0.94	-0.76
21,342.00	91.01	331.11	10,998.49	9,191.42	-4,911.93	10,421.30	0.68	0.38	0.57
21,436.00	89.96	330.94	10,997.70	9,273.65	-4,957.46	10,515.29	1.13	-1.12	-0.18
21,530.00	90.22	331.29	10,997.55	9,355.96	-5,002.87	10,609.29	0.46	0.28	0.37
21,624.00	90.92	331.46	10,996.61	9,438.46	-5,047.90	10,703.28	0.77	0.74	0.18
21,717.00	90.48	331.11	10,995.48	9,520.02	-5,092.58	10,796.27	0.60	-0.47	-0.38
21,811.00	91.19	331.46	10,994.11	9,602.45	-5,137.74	10,890.26	0.84	0.76	0.37
21,905.00	90.66	331.29	10,992.59	9,684.95	-5,182.76	10,984.25	0.59	-0.56	-0.18
21,999.00	90.22	330.76	10,991.87	9,767.18	-5,228.30	11,078.24	0.73	-0.47	-0.56
22,093.00	90.40	330.76	10,991.36	9,849.20	-5,274.21	11,172.24	0.19	0.19	0.00
22,186.00	91.19	330.76	10,990.07	9,930.34	-5,319.64	11,265.22	0.85	0.85	0.00
22,280.00	91.36	330.58	10,987.98	10,012.27	-5,365.67	11,359.19	0.26	0.18	-0.19
22,373.00	91.54	330.58	10,985.62	10,093.25	-5,411.34	11,452.15	0.19	0.19	0.00
22,467.00	91.71	330.58	10,982.96	10,175.10	-5,457.49	11,546.10	0.18	0.18	0.00
22,560.00	90.84	329.88	10,980.89	10,255.80	-5,503.66	11,639.05	1.20	-0.94	-0.75

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey

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)
22,654.00	89.69	329.53	10,980.45	10,336.96	-5,551.07	11,733.00	1.28	-1.22	-0.37
22,747.00	90.92	329.18	10,979.96	10,416.97	-5,598.48	11,825.94	1.38	1.32	-0.38
22,841.00	91.36	329.00	10,978.09	10,497.61	-5,646.75	11,919.84	0.51	0.47	-0.19
22,935.00	91.98	328.83	10,975.35	10,578.07	-5,695.26	12,013.71	0.68	0.66	-0.18
23,029.00	91.10	328.83	10,972.82	10,658.47	-5,743.90	12,107.57	0.94	-0.94	0.00
23,123.00	90.40	328.83	10,971.59	10,738.90	-5,792.55	12,201.46	0.74	-0.74	0.00
23,217.00	91.01	328.65	10,970.44	10,819.24	-5,841.32	12,295.35	0.68	0.65	-0.19
23,310.00	91.01	329.88	10,968.80	10,899.17	-5,888.84	12,388.27	1.32	0.00	1.32
23,404.00	91.63	330.06	10,966.63	10,980.53	-5,935.87	12,482.21	0.69	0.66	0.19
23,498.00	90.57	330.58	10,964.83	11,062.18	-5,982.41	12,576.17	1.26	-1.13	0.55
23,592.00	90.75	330.41	10,963.74	11,143.98	-6,028.70	12,670.15	0.26	0.19	-0.18
23,687.00	90.22	329.88	10,962.94	11,226.37	-6,075.99	12,765.12	0.79	-0.56	-0.56
23,782.00	90.66	329.70	10,962.21	11,308.47	-6,123.79	12,860.08	0.50	0.46	-0.19
23,877.00	91.63	329.35	10,960.31	11,390.32	-6,171.96	12,955.00	1.09	1.02	-0.37
23,972.00	91.01	329.53	10,958.12	11,472.11	-6,220.25	13,049.92	0.68	-0.65	0.19
24,067.00	90.40	329.18	10,956.95	11,553.83	-6,268.67	13,144.85	0.74	-0.64	-0.37
24,162.00	90.92	329.18	10,955.86	11,635.41	-6,317.34	13,239.77	0.55	0.55	0.00
24,257.00	90.48	330.06	10,954.70	11,717.36	-6,365.38	13,334.71	1.04	-0.46	0.93
24,352.00	90.75	330.06	10,953.68	11,799.68	-6,412.79	13,429.68	0.28	0.28	0.00
24,447.00	91.19	329.53	10,952.07	11,881.77	-6,460.57	13,524.62	0.73	0.46	-0.56
24,542.00	90.75	329.53	10,950.46	11,963.63	-6,508.74	13,619.55	0.46	-0.46	0.00
24,637.00	91.45	329.18	10,948.64	12,045.35	-6,557.15	13,714.47	0.82	0.74	-0.37
24,732.00	90.75	329.00	10,946.82	12,126.84	-6,605.95	13,809.37	0.76	-0.74	-0.19
24,827.00	91.01	328.65	10,945.36	12,208.11	-6,655.12	13,904.26	0.46	0.27	-0.37
24,922.00	91.54	328.30	10,943.24	12,289.07	-6,704.78	13,999.11	0.67	0.56	-0.37
24,986.00	91.71	327.77	10,941.43	12,343.35	-6,738.65	14,062.97	0.87	0.27	-0.83
Survey @ 24986.00 MD 10941.43 TVD									
25,041.00	91.71	327.77	10,939.79	12,389.85	-6,767.96	14,117.83	0.00	0.00	0.00
Survey Proj. to 25041.00 MD 10939.79 TVD									

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
151.00	151.00	-0.10	-0.45	MWD surveys
24,986.00	10,941.43	12,343.35	-6,738.65	Survey @ 24986.00 MD 10941.43 TVD
25,041.00	10,939.79	12,389.85	-6,767.96	Survey Proj. to 25041.00 MD 10939.79 TVD

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

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	Knob Creek				
Site Position:		Northing:	14,443,053.74 usft	Latitude:	39.769822
From:	Lat/Long	Easting:	1,723,120.29 usft	Longitude:	-80.705670
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.19 °

Well	Knob Creek N-12HU (slot M)					
Well Position	+N/-S	0.00 usft	Northing:	14,443,135.94 usft	Latitude:	39.770047
	+E/-W	0.00 usft	Easting:	1,723,190.50 usft	Longitude:	-80.705419
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	737.00 usft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination	Dip Angle	Field Strength
	IGRF2020	12/15/2020	(°)	(°)	(nT)
			-8.66	66.57	51,794.65260972

Design	Surveys Original Hole				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W	Direction	
	(usft)	(usft)	(usft)	(°)	
	0.00	0.00	0.00		331.46

Survey Program	Date	1/21/2021			
From	To	Survey (Wellbore)	Tool Name	Description	
(usft)	(usft)				
151.00	2,230.00	MWD surf (Original Hole)	MWD	MWD - Standard	
2,302.00	6,130.00	MWD int (Original Hole)	MWD	MWD - Standard	
6,261.00	24,986.00	MWD (Original Hole)	MWD	MWD - Standard	
25,041.00	25,041.00	Projection (Original Hole)	MWD	MWD - Standard	

Survey										
Measured	Inclination	Azimuth	Vertical	+N/-S	+E/-W	Map	Map	Latitude	Longitude	
Depth	(°)	(°)	Depth	(usft)	(usft)	Northing	Easting			
(usft)			(usft)			(usft)	(usft)			
0.00	0.00	0.00	0.00	0.00	0.00	14,443,135.94	1,723,190.50	39.770047	-80.705419	
151.00	0.35	257.46	151.00	-0.10	-0.45	14,443,135.84	1,723,190.05	39.770046	-80.705421	
MWD surveys										
182.00	0.48	330.14	182.00	-0.01	-0.61	14,443,135.94	1,723,189.89	39.770047	-80.705421	
213.00	0.18	297.98	213.00	0.13	-0.71	14,443,136.07	1,723,189.78	39.770047	-80.705422	
243.00	0.62	318.81	243.00	0.27	-0.86	14,443,136.22	1,723,189.63	39.770047	-80.705422	
274.00	0.40	297.10	274.00	0.45	-1.07	14,443,136.39	1,723,189.43	39.770048	-80.705423	
305.00	0.53	299.10	304.99	0.57	-1.29	14,443,136.51	1,723,189.21	39.770048	-80.705424	
335.00	0.62	300.70	334.99	0.72	-1.55	14,443,136.66	1,723,188.94	39.770049	-80.705425	



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
366.00	0.57	314.24	365.99	0.91	-1.81	14,443,136.85	1,723,188.69	39.770049	-80.705426	
397.00	0.31	340.16	396.99	1.10	-1.95	14,443,137.04	1,723,188.55	39.770050	-80.705426	
427.00	0.13	299.82	426.99	1.19	-2.00	14,443,137.13	1,723,188.49	39.770050	-80.705426	
458.00	0.22	316.17	457.99	1.25	-2.08	14,443,137.19	1,723,188.42	39.770050	-80.705427	
489.00	0.22	287.25	488.99	1.31	-2.17	14,443,137.25	1,723,188.32	39.770050	-80.705427	
513.00	0.22	176.86	512.99	1.28	-2.21	14,443,137.22	1,723,188.28	39.770050	-80.705427	
610.00	0.62	250.87	609.99	0.92	-2.70	14,443,136.86	1,723,187.80	39.770049	-80.705429	
701.00	0.48	218.26	700.98	0.46	-3.40	14,443,136.40	1,723,187.10	39.770048	-80.705431	
795.00	0.18	273.37	794.98	0.16	-3.79	14,443,136.10	1,723,186.70	39.770047	-80.705433	
889.00	0.18	290.33	888.98	0.22	-4.08	14,443,136.16	1,723,186.42	39.770047	-80.705434	
984.00	0.53	267.83	983.98	0.25	-4.66	14,443,136.20	1,723,185.84	39.770047	-80.705436	
1,078.00	0.53	297.19	1,077.98	0.44	-5.48	14,443,136.38	1,723,185.02	39.770048	-80.705439	
1,171.00	0.57	283.21	1,170.97	0.74	-6.31	14,443,136.68	1,723,184.19	39.770049	-80.705442	
1,265.00	0.35	323.46	1,264.97	1.08	-6.94	14,443,137.02	1,723,183.56	39.770050	-80.705444	
1,359.00	0.70	296.48	1,358.97	1.56	-7.62	14,443,137.51	1,723,182.87	39.770051	-80.705446	
1,453.00	1.27	319.42	1,452.95	2.61	-8.81	14,443,138.55	1,723,181.68	39.770054	-80.705450	
1,547.00	1.10	315.99	1,546.93	4.05	-10.12	14,443,139.99	1,723,180.38	39.770058	-80.705455	
1,642.00	0.83	324.43	1,641.92	5.27	-11.15	14,443,141.21	1,723,179.34	39.770061	-80.705459	
1,736.00	0.44	325.31	1,735.91	6.12	-11.75	14,443,142.06	1,723,178.74	39.770064	-80.705461	
1,831.00	1.01	82.29	1,830.91	6.53	-11.13	14,443,142.47	1,723,179.37	39.770065	-80.705459	
1,925.00	1.54	71.83	1,924.88	7.03	-9.11	14,443,142.98	1,723,181.39	39.770066	-80.705451	
2,019.00	1.45	55.74	2,018.85	8.10	-6.93	14,443,144.04	1,723,183.57	39.770069	-80.705444	
2,114.00	1.27	87.74	2,113.83	8.82	-4.88	14,443,144.76	1,723,185.62	39.770071	-80.705436	
2,207.00	1.45	99.87	2,206.80	8.65	-2.69	14,443,144.60	1,723,187.80	39.770071	-80.705429	
2,230.00	1.63	111.21	2,229.79	8.49	-2.10	14,443,144.43	1,723,188.40	39.770070	-80.705427	
2,302.00	1.63	95.04	2,301.76	8.03	-0.13	14,443,143.97	1,723,190.37	39.770069	-80.705420	
2,398.00	1.71	88.88	2,397.72	7.93	2.67	14,443,143.88	1,723,193.16	39.770068	-80.705410	
2,493.00	1.41	91.26	2,492.69	7.94	5.25	14,443,143.88	1,723,195.75	39.770068	-80.705400	
2,587.00	1.54	71.66	2,586.66	8.31	7.61	14,443,144.25	1,723,198.10	39.770069	-80.705392	
2,681.00	1.32	72.54	2,680.63	9.03	9.84	14,443,144.97	1,723,200.34	39.770071	-80.705384	
2,776.00	1.14	81.50	2,775.61	9.50	11.82	14,443,145.44	1,723,202.31	39.770073	-80.705377	
2,870.00	0.97	115.34	2,869.59	9.30	13.46	14,443,145.24	1,723,203.96	39.770072	-80.705371	
2,964.00	0.92	104.00	2,963.58	8.77	14.91	14,443,144.72	1,723,205.41	39.770071	-80.705366	
3,057.00	0.79	116.31	3,056.57	8.31	16.21	14,443,144.25	1,723,206.71	39.770069	-80.705361	
3,152.00	0.75	75.96	3,151.56	8.17	17.40	14,443,144.11	1,723,207.90	39.770069	-80.705357	
3,245.00	0.48	95.65	3,244.55	8.28	18.38	14,443,144.22	1,723,208.88	39.770069	-80.705354	
3,339.00	1.14	114.11	3,338.54	7.86	19.62	14,443,143.80	1,723,210.12	39.770068	-80.705349	
3,433.00	1.27	98.29	3,432.52	7.32	21.51	14,443,143.27	1,723,212.01	39.770067	-80.705343	
3,528.00	1.63	120.00	3,527.49	6.50	23.72	14,443,142.44	1,723,214.22	39.770064	-80.705335	
3,622.00	1.67	112.53	3,621.45	5.30	26.14	14,443,141.25	1,723,216.64	39.770061	-80.705326	
3,716.00	2.20	116.31	3,715.40	3.98	29.03	14,443,139.92	1,723,219.52	39.770057	-80.705316	
3,810.00	2.55	127.56	3,809.32	1.91	32.30	14,443,137.85	1,723,222.80	39.770052	-80.705304	
3,903.00	2.86	129.14	3,902.22	-0.82	35.74	14,443,135.12	1,723,226.24	39.770044	-80.705292	
3,996.00	3.38	124.66	3,995.08	-3.84	39.80	14,443,132.10	1,723,230.29	39.770036	-80.705278	
4,090.00	3.74	124.74	4,088.90	-7.17	44.59	14,443,128.78	1,723,235.09	39.770027	-80.705261	
4,184.00	3.87	119.91	4,182.69	-10.50	49.86	14,443,125.45	1,723,240.36	39.770017	-80.705242	
4,278.00	4.44	115.25	4,276.44	-13.63	55.90	14,443,122.31	1,723,246.40	39.770009	-80.705220	
4,372.00	4.53	104.00	4,370.16	-16.08	62.80	14,443,119.86	1,723,253.29	39.770002	-80.705196	
4,466.00	3.87	97.76	4,463.90	-17.41	69.54	14,443,118.54	1,723,260.04	39.769998	-80.705172	
4,561.00	3.47	87.13	4,558.71	-17.70	75.59	14,443,118.25	1,723,266.09	39.769997	-80.705150	
4,655.00	3.12	83.70	4,652.56	-17.27	80.97	14,443,118.67	1,723,271.47	39.769999	-80.705131	
4,750.00	2.99	88.18	4,747.42	-16.91	86.02	14,443,119.03	1,723,276.52	39.769999	-80.705113	
4,844.00	2.90	89.85	4,841.30	-16.83	90.85	14,443,119.12	1,723,281.35	39.770000	-80.705096	
4,939.00	2.99	89.50	4,936.17	-16.80	95.73	14,443,119.15	1,723,286.23	39.770000	-80.705079	
5,033.00	2.68	90.47	5,030.06	-16.79	100.38	14,443,119.15	1,723,290.88	39.770000	-80.705062	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
5,128.00	1.80	73.15	5,124.98	-16.38	104.03	14,443,119.56	1,723,294.52	39.770001	-80.705049	
5,222.00	1.32	51.18	5,218.95	-15.27	106.28	14,443,120.67	1,723,296.78	39.770004	-80.705041	
5,317.00	1.45	55.93	5,313.92	-13.91	108.13	14,443,122.03	1,723,298.63	39.770008	-80.705034	
5,411.00	1.05	55.66	5,407.90	-12.76	109.83	14,443,123.18	1,723,300.33	39.770011	-80.705028	
5,505.00	0.92	24.11	5,501.89	-11.59	110.85	14,443,124.36	1,723,301.34	39.770014	-80.705025	
5,598.00	1.01	33.16	5,594.87	-10.22	111.60	14,443,125.72	1,723,302.10	39.770018	-80.705022	
5,692.00	0.62	25.43	5,688.86	-9.07	112.27	14,443,126.88	1,723,302.77	39.770021	-80.705020	
5,786.00	0.18	325.49	5,782.86	-8.49	112.41	14,443,127.46	1,723,302.90	39.770022	-80.705019	
5,880.00	0.26	6.36	5,876.86	-8.15	112.35	14,443,127.79	1,723,302.84	39.770023	-80.705019	
5,974.00	0.57	91.70	5,970.86	-7.95	112.84	14,443,127.99	1,723,303.34	39.770024	-80.705018	
6,067.00	0.26	83.35	6,063.86	-7.94	113.51	14,443,128.00	1,723,304.01	39.770024	-80.705015	
6,130.00	0.35	75.26	6,126.85	-7.88	113.84	14,443,128.07	1,723,304.34	39.770024	-80.705014	
6,261.00	0.75	76.84	6,257.85	-7.58	115.06	14,443,128.36	1,723,305.56	39.770025	-80.705010	
6,354.00	0.75	57.42	6,350.84	-7.11	116.17	14,443,128.83	1,723,306.66	39.770026	-80.705006	
6,448.00	0.53	87.57	6,444.83	-6.77	117.12	14,443,129.18	1,723,307.62	39.770027	-80.705002	
6,541.00	0.75	331.20	6,537.83	-6.21	117.25	14,443,129.73	1,723,307.75	39.770029	-80.705002	
6,635.00	1.32	290.94	6,631.82	-5.29	115.95	14,443,130.66	1,723,306.44	39.770031	-80.705007	
6,729.00	2.02	290.77	6,725.78	-4.31	113.39	14,443,131.63	1,723,303.88	39.770034	-80.705016	
6,824.00	3.30	284.97	6,820.67	-3.01	109.18	14,443,132.93	1,723,299.68	39.770037	-80.705031	
6,917.00	4.04	278.38	6,913.48	-1.84	103.35	14,443,134.10	1,723,293.85	39.770041	-80.705051	
7,011.00	4.66	272.49	7,007.21	-1.20	96.26	14,443,134.75	1,723,286.76	39.770043	-80.705077	
7,104.00	3.60	278.46	7,099.97	-0.60	89.60	14,443,135.34	1,723,280.10	39.770044	-80.705100	
7,198.00	2.42	315.03	7,193.84	1.24	85.28	14,443,137.18	1,723,275.77	39.770049	-80.705116	
7,293.00	1.76	330.58	7,288.78	3.93	83.14	14,443,139.87	1,723,273.64	39.770057	-80.705123	
7,386.00	1.19	22.61	7,381.75	6.06	82.81	14,443,142.01	1,723,273.31	39.770063	-80.705124	
7,479.00	1.41	64.10	7,474.73	7.45	84.21	14,443,143.40	1,723,274.71	39.770066	-80.705119	
7,573.00	1.89	48.19	7,568.69	8.99	86.41	14,443,144.94	1,723,276.91	39.770071	-80.705112	
7,667.00	1.93	66.47	7,662.64	10.66	89.02	14,443,146.60	1,723,279.51	39.770075	-80.705102	
7,761.00	1.45	72.01	7,756.60	11.66	91.60	14,443,147.60	1,723,282.10	39.770078	-80.705093	
7,855.00	1.49	79.83	7,850.57	12.24	93.93	14,443,148.18	1,723,284.43	39.770079	-80.705085	
7,949.00	2.24	72.71	7,944.52	13.00	96.89	14,443,148.95	1,723,287.39	39.770082	-80.705074	
8,043.00	1.36	73.68	8,038.47	13.86	99.71	14,443,149.80	1,723,290.21	39.770084	-80.705064	
8,138.00	0.97	81.77	8,133.45	14.29	101.59	14,443,150.24	1,723,292.09	39.770085	-80.705057	
8,231.00	1.27	60.67	8,226.44	14.91	103.27	14,443,150.85	1,723,293.77	39.770087	-80.705051	
8,326.00	0.66	128.96	8,321.42	15.08	104.61	14,443,151.03	1,723,295.11	39.770087	-80.705047	
8,420.00	1.05	169.30	8,415.41	13.90	105.19	14,443,149.84	1,723,295.69	39.770084	-80.705045	
8,515.00	1.98	185.30	8,510.38	11.41	105.20	14,443,147.35	1,723,295.70	39.770077	-80.705045	
8,608.00	1.49	197.96	8,603.34	8.66	104.68	14,443,144.60	1,723,295.18	39.770070	-80.705047	
8,703.00	1.41	212.90	8,698.31	6.50	103.67	14,443,142.44	1,723,294.16	39.770064	-80.705050	
8,798.00	2.02	217.03	8,793.26	4.18	102.02	14,443,140.13	1,723,292.52	39.770057	-80.705056	
8,892.00	1.93	241.55	8,887.21	2.10	99.63	14,443,138.05	1,723,290.13	39.770052	-80.705065	
8,987.00	2.20	252.89	8,982.15	0.81	96.48	14,443,136.75	1,723,286.98	39.770048	-80.705076	
9,082.00	2.94	253.94	9,077.05	-0.40	92.40	14,443,135.54	1,723,282.90	39.770045	-80.705090	
9,176.00	1.01	289.89	9,171.00	-0.79	89.30	14,443,135.15	1,723,279.80	39.770044	-80.705101	
9,270.00	0.97	75.26	9,264.99	-0.30	89.29	14,443,135.64	1,723,279.79	39.770045	-80.705101	
9,364.00	2.55	97.44	9,358.94	-0.37	92.14	14,443,135.57	1,723,282.64	39.770045	-80.705091	
9,457.00	4.75	98.73	9,451.75	-1.23	98.00	14,443,134.72	1,723,288.49	39.770042	-80.705070	
9,550.00	7.25	102.51	9,544.23	-3.08	107.53	14,443,132.86	1,723,298.03	39.770037	-80.705037	
9,644.00	7.47	104.62	9,637.46	-5.91	119.24	14,443,130.04	1,723,309.73	39.770029	-80.704995	
9,738.00	7.87	106.20	9,730.62	-9.25	131.33	14,443,126.70	1,723,321.83	39.770020	-80.704952	
9,831.00	7.65	108.40	9,822.77	-12.98	143.32	14,443,122.97	1,723,333.81	39.770010	-80.704909	
9,924.00	7.82	107.78	9,914.92	-16.86	155.21	14,443,119.08	1,723,345.71	39.769999	-80.704867	
9,984.00	8.22	108.04	9,974.33	-19.44	163.18	14,443,116.51	1,723,353.68	39.769992	-80.704839	
10,061.00	9.15	111.74	10,050.45	-23.41	174.10	14,443,112.53	1,723,364.60	39.769981	-80.704800	
10,155.00	8.00	96.79	10,143.41	-26.95	187.54	14,443,108.99	1,723,378.04	39.769971	-80.704752	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
10,202.00	7.12	86.07	10,190.00	-27.14	193.69	14,443,108.80	1,723,384.19	39.769970	-80.704730	
10,249.00	7.03	72.19	10,236.65	-26.06	199.34	14,443,109.88	1,723,389.84	39.769973	-80.704710	
10,296.00	7.65	54.96	10,283.27	-23.38	204.64	14,443,112.56	1,723,395.14	39.769981	-80.704691	
10,343.00	8.53	37.73	10,329.81	-18.83	209.33	14,443,117.11	1,723,399.83	39.769993	-80.704674	
10,390.00	10.29	26.31	10,376.18	-12.31	213.33	14,443,123.63	1,723,403.83	39.770011	-80.704660	
10,436.00	11.43	11.54	10,421.36	-4.16	216.06	14,443,131.79	1,723,406.56	39.770033	-80.704650	
10,483.00	14.07	2.58	10,467.20	6.11	217.25	14,443,142.06	1,723,407.75	39.770062	-80.704646	
10,530.00	16.53	356.07	10,512.54	18.50	217.05	14,443,154.44	1,723,407.55	39.770096	-80.704646	
10,577.00	19.08	350.97	10,557.28	32.76	215.39	14,443,168.70	1,723,405.88	39.770135	-80.704652	
10,625.00	21.81	346.40	10,602.26	49.17	212.06	14,443,185.12	1,723,402.55	39.770180	-80.704664	
10,672.00	24.89	345.53	10,645.40	67.24	207.53	14,443,203.19	1,723,398.03	39.770229	-80.704680	
10,720.00	27.87	344.82	10,688.40	87.85	202.07	14,443,223.80	1,723,392.57	39.770286	-80.704699	
10,767.00	30.43	340.78	10,729.45	109.70	195.27	14,443,245.65	1,723,385.77	39.770346	-80.704723	
10,814.00	32.89	337.61	10,769.45	132.75	186.49	14,443,268.69	1,723,376.99	39.770410	-80.704754	
10,861.00	35.96	334.98	10,808.22	157.06	175.79	14,443,293.00	1,723,366.29	39.770476	-80.704792	
10,908.00	39.31	331.99	10,845.44	182.71	162.96	14,443,318.66	1,723,353.46	39.770547	-80.704837	
10,955.00	42.91	330.58	10,880.85	209.80	148.10	14,443,345.75	1,723,338.60	39.770622	-80.704890	
11,003.00	46.78	329.88	10,914.87	239.18	131.29	14,443,375.12	1,723,321.79	39.770702	-80.704949	
11,050.00	50.83	329.88	10,945.82	269.76	113.55	14,443,405.70	1,723,304.05	39.770787	-80.705012	
11,096.00	54.78	330.58	10,973.62	301.56	95.36	14,443,437.51	1,723,285.86	39.770874	-80.705076	
11,143.00	57.68	333.22	10,999.75	336.03	76.98	14,443,471.97	1,723,267.48	39.770969	-80.705141	
11,190.00	59.97	334.63	11,024.08	372.15	59.31	14,443,508.09	1,723,249.81	39.771068	-80.705204	
11,237.00	62.70	334.63	11,046.62	409.41	41.64	14,443,545.35	1,723,232.14	39.771171	-80.705266	
11,284.00	65.33	333.57	11,067.21	447.40	23.19	14,443,583.35	1,723,213.68	39.771275	-80.705331	
11,331.00	67.88	333.22	11,085.87	485.97	3.87	14,443,621.91	1,723,194.37	39.771381	-80.705400	
11,377.00	70.61	333.40	11,102.17	524.40	-15.45	14,443,660.34	1,723,175.05	39.771487	-80.705468	
11,424.00	72.98	333.75	11,116.86	564.38	-35.32	14,443,700.32	1,723,155.18	39.771597	-80.705538	
11,471.00	75.36	333.75	11,129.68	604.93	-55.31	14,443,740.87	1,723,135.18	39.771709	-80.705609	
11,518.00	78.44	333.75	11,140.33	645.98	-75.56	14,443,781.92	1,723,114.94	39.771821	-80.705680	
11,565.00	80.37	333.92	11,148.97	687.44	-95.93	14,443,823.39	1,723,094.57	39.771935	-80.705753	
11,612.00	82.83	334.10	11,155.83	729.23	-116.30	14,443,865.18	1,723,074.20	39.772050	-80.705825	
11,658.00	85.21	334.28	11,160.63	770.42	-136.22	14,443,906.36	1,723,054.28	39.772164	-80.705895	
11,753.00	89.87	330.76	11,164.70	854.58	-180.00	14,443,990.52	1,723,010.50	39.772395	-80.706050	
11,848.00	92.15	330.41	11,163.03	937.32	-226.65	14,444,073.26	1,722,963.85	39.772623	-80.706215	
11,942.00	91.80	330.06	11,159.79	1,018.87	-273.29	14,444,154.81	1,722,917.21	39.772847	-80.706380	
12,037.00	91.71	330.23	11,156.88	1,101.22	-320.55	14,444,237.16	1,722,869.94	39.773074	-80.706547	
12,131.00	92.24	330.94	11,153.64	1,183.05	-366.69	14,444,319.00	1,722,823.80	39.773299	-80.706710	
12,225.00	91.19	331.11	11,150.83	1,265.25	-412.21	14,444,401.19	1,722,778.29	39.773525	-80.706871	
12,319.00	91.01	330.76	11,149.02	1,347.39	-457.87	14,444,483.34	1,722,732.63	39.773751	-80.707033	
12,413.00	91.10	330.23	11,147.29	1,429.19	-504.15	14,444,565.13	1,722,686.35	39.773976	-80.707197	
12,508.00	91.10	330.41	11,145.47	1,511.71	-551.18	14,444,647.66	1,722,639.31	39.774203	-80.707363	
12,602.00	91.10	330.23	11,143.66	1,593.36	-597.72	14,444,729.31	1,722,592.78	39.774428	-80.707528	
12,696.00	91.54	330.41	11,141.50	1,675.01	-644.25	14,444,810.95	1,722,546.25	39.774653	-80.707692	
12,789.00	90.04	330.41	11,140.22	1,755.87	-690.17	14,444,891.81	1,722,500.33	39.774875	-80.707855	
12,883.00	89.87	330.58	11,140.29	1,837.68	-736.46	14,444,973.62	1,722,454.03	39.775100	-80.708019	
12,977.00	89.96	330.94	11,140.43	1,919.70	-782.38	14,445,055.65	1,722,408.12	39.775326	-80.708181	
13,071.00	89.96	331.11	11,140.50	2,001.94	-827.92	14,445,137.88	1,722,362.58	39.775552	-80.708342	
13,165.00	90.84	331.46	11,139.84	2,084.37	-873.08	14,445,220.32	1,722,317.42	39.775779	-80.708502	
13,260.00	91.19	331.64	11,138.16	2,167.89	-918.33	14,445,303.83	1,722,272.17	39.776009	-80.708662	
13,354.00	91.19	331.99	11,136.20	2,250.72	-962.71	14,445,386.67	1,722,227.78	39.776236	-80.708819	
13,448.00	91.54	331.99	11,133.97	2,333.69	-1,006.85	14,445,469.63	1,722,183.65	39.776465	-80.708975	
13,542.00	91.71	331.99	11,131.30	2,416.65	-1,050.97	14,445,552.59	1,722,139.52	39.776693	-80.709131	
13,636.00	90.57	331.46	11,129.43	2,499.41	-1,095.49	14,445,635.35	1,722,095.00	39.776921	-80.709289	
13,730.00	90.92	331.29	11,128.21	2,581.91	-1,140.52	14,445,717.86	1,722,049.98	39.777148	-80.709448	
13,824.00	91.19	331.29	11,126.48	2,664.34	-1,185.67	14,445,800.29	1,722,004.83	39.777374	-80.709608	



Survey Report - Geographic



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
13,918.00	91.19	330.94	11,124.52	2,746.63	-1,231.07	14,445,882.58	1,721,959.43	39.777601	-80.709769
14,012.00	91.54	330.76	11,122.29	2,828.70	-1,276.84	14,445,964.65	1,721,913.66	39.777827	-80.709931
14,127.00	91.80	330.76	11,118.93	2,929.01	-1,332.99	14,446,064.95	1,721,857.51	39.778102	-80.710129
14,221.00	90.40	329.00	11,117.13	3,010.30	-1,380.15	14,446,146.24	1,721,810.35	39.778326	-80.710296
14,315.00	90.57	329.35	11,116.33	3,091.01	-1,428.32	14,446,226.96	1,721,762.18	39.778548	-80.710467
14,409.00	90.31	329.35	11,115.61	3,171.88	-1,476.23	14,446,307.82	1,721,714.26	39.778771	-80.710636
14,503.00	90.22	329.35	11,115.18	3,252.75	-1,524.15	14,446,388.69	1,721,666.34	39.778993	-80.710806
14,598.00	90.75	329.53	11,114.37	3,334.55	-1,572.45	14,446,470.49	1,721,618.04	39.779218	-80.710977
14,692.00	90.92	330.23	11,113.00	3,415.85	-1,619.62	14,446,551.79	1,721,570.88	39.779442	-80.711144
14,786.00	90.75	330.06	11,111.63	3,497.36	-1,666.41	14,446,633.31	1,721,524.09	39.779666	-80.711309
14,879.00	90.75	329.88	11,110.42	3,577.87	-1,712.95	14,446,713.81	1,721,477.55	39.779888	-80.711474
14,974.00	91.19	329.70	11,108.81	3,659.96	-1,760.74	14,446,795.90	1,721,429.76	39.780114	-80.711643
15,067.00	91.19	329.70	11,106.88	3,740.24	-1,807.65	14,446,876.18	1,721,382.85	39.780335	-80.711809
15,161.00	90.84	329.70	11,105.21	3,821.38	-1,855.07	14,446,957.33	1,721,335.43	39.780558	-80.711977
15,255.00	91.01	329.88	11,103.69	3,902.60	-1,902.36	14,447,038.55	1,721,288.14	39.780781	-80.712145
15,349.00	91.36	329.88	11,101.75	3,983.89	-1,949.52	14,447,119.84	1,721,240.98	39.781005	-80.712312
15,444.00	91.36	329.35	11,099.49	4,065.82	-1,997.56	14,447,201.77	1,721,192.94	39.781230	-80.712482
15,539.00	91.80	329.18	11,096.87	4,147.45	-2,046.09	14,447,283.39	1,721,144.41	39.781455	-80.712653
15,633.00	92.07	329.00	11,093.70	4,228.05	-2,094.35	14,447,364.00	1,721,096.15	39.781677	-80.712824
15,727.00	92.15	329.18	11,090.24	4,308.65	-2,142.61	14,447,444.59	1,721,047.89	39.781898	-80.712995
15,822.00	91.19	329.35	11,087.47	4,390.27	-2,191.14	14,447,526.21	1,720,999.36	39.782123	-80.713167
15,916.00	90.48	330.41	11,086.10	4,471.56	-2,238.30	14,447,607.51	1,720,952.20	39.782347	-80.713334
16,011.00	91.10	330.76	11,084.79	4,554.31	-2,284.95	14,447,690.25	1,720,905.54	39.782574	-80.713499
16,105.00	90.31	331.29	11,083.64	4,636.54	-2,330.49	14,447,772.48	1,720,860.01	39.782801	-80.713660
16,200.00	89.87	331.29	11,083.49	4,719.86	-2,376.12	14,447,855.80	1,720,814.38	39.783030	-80.713822
16,273.00	90.04	331.29	11,083.54	4,783.88	-2,411.19	14,447,919.83	1,720,779.31	39.783206	-80.713946
16,367.00	90.66	331.29	11,082.97	4,866.32	-2,456.34	14,448,002.27	1,720,734.15	39.783433	-80.714106
16,462.00	91.10	331.46	11,081.51	4,949.70	-2,501.85	14,448,085.65	1,720,688.65	39.783662	-80.714267
16,556.00	91.01	331.64	11,079.78	5,032.34	-2,546.62	14,448,168.28	1,720,643.87	39.783889	-80.714425
16,650.00	90.75	331.64	11,078.34	5,115.04	-2,591.27	14,448,250.99	1,720,599.23	39.784117	-80.714583
16,744.00	91.10	331.99	11,076.82	5,197.89	-2,635.66	14,448,333.83	1,720,554.84	39.784345	-80.714740
16,838.00	90.66	331.81	11,075.37	5,280.80	-2,679.93	14,448,416.74	1,720,510.57	39.784573	-80.714897
16,932.00	90.31	331.64	11,074.58	5,363.58	-2,724.46	14,448,499.52	1,720,466.04	39.784801	-80.715054
17,026.00	90.13	331.64	11,074.22	5,446.30	-2,769.11	14,448,582.24	1,720,421.39	39.785028	-80.715212
17,120.00	91.01	330.94	11,073.28	5,528.73	-2,814.26	14,448,664.68	1,720,376.24	39.785255	-80.715372
17,214.00	91.10	330.94	11,071.55	5,610.89	-2,859.91	14,448,746.83	1,720,330.59	39.785481	-80.715534
17,308.00	90.66	330.76	11,070.11	5,692.97	-2,905.69	14,448,828.92	1,720,284.81	39.785707	-80.715696
17,402.00	91.36	329.88	11,068.45	5,774.63	-2,952.23	14,448,910.57	1,720,238.27	39.785932	-80.715860
17,496.00	91.36	329.70	11,066.22	5,855.84	-2,999.51	14,448,991.78	1,720,190.98	39.786155	-80.716028
17,590.00	90.84	329.70	11,064.42	5,936.98	-3,046.93	14,449,072.92	1,720,143.57	39.786378	-80.716196
17,684.00	90.48	329.35	11,063.33	6,017.99	-3,094.60	14,449,153.93	1,720,095.90	39.786601	-80.716364
17,778.00	90.48	329.35	11,062.55	6,098.85	-3,142.52	14,449,234.80	1,720,047.98	39.786824	-80.716534
17,871.00	91.45	329.00	11,060.98	6,178.70	-3,190.17	14,449,314.65	1,720,000.33	39.787043	-80.716703
17,964.00	90.92	329.35	11,059.06	6,258.55	-3,237.81	14,449,394.49	1,719,952.69	39.787263	-80.716872
18,057.00	91.36	328.83	11,057.21	6,338.32	-3,285.57	14,449,474.27	1,719,904.92	39.787483	-80.717041
18,151.00	91.63	329.18	11,054.75	6,418.87	-3,333.96	14,449,554.82	1,719,856.53	39.787704	-80.717212
18,244.00	91.45	328.83	11,052.25	6,498.57	-3,381.84	14,449,634.51	1,719,808.66	39.787923	-80.717382
18,338.00	91.36	329.53	11,049.95	6,579.27	-3,429.98	14,449,715.21	1,719,760.51	39.788145	-80.717552
18,432.00	90.92	330.41	11,048.08	6,660.63	-3,477.02	14,449,796.58	1,719,713.48	39.788369	-80.717719
18,526.00	90.75	331.29	11,046.71	6,742.72	-3,522.80	14,449,878.66	1,719,667.70	39.788595	-80.717881
18,620.00	90.57	331.11	11,045.63	6,825.08	-3,568.08	14,449,961.03	1,719,622.42	39.788822	-80.718041
18,714.00	90.75	331.11	11,044.54	6,907.38	-3,613.49	14,450,043.32	1,719,577.01	39.789048	-80.718202
18,808.00	91.71	331.29	11,042.53	6,989.73	-3,658.76	14,450,125.68	1,719,531.73	39.789275	-80.718362
18,902.00	91.98	331.11	11,039.50	7,072.06	-3,704.03	14,450,208.01	1,719,486.47	39.789501	-80.718522
18,996.00	91.10	329.88	11,036.97	7,153.84	-3,750.30	14,450,289.78	1,719,440.19	39.789726	-80.718686



Survey Report - Geographic



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
19,090.00	90.84	329.53	11,035.38	7,234.99	-3,797.71	14,450,370.94	1,719,392.78	39.789949	-80.718854
19,185.00	91.10	330.06	11,033.77	7,317.08	-3,845.50	14,450,453.03	1,719,345.00	39.790475	-80.719023
19,279.00	91.36	330.76	11,031.76	7,398.80	-3,891.91	14,450,534.75	1,719,298.59	39.790400	-80.719187
19,373.00	90.31	328.47	11,030.39	7,479.88	-3,939.44	14,450,615.82	1,719,251.05	39.790623	-80.719356
19,466.00	90.40	328.47	11,029.81	7,559.15	-3,988.08	14,450,695.09	1,719,202.42	39.790841	-80.719528
19,560.00	90.75	329.00	11,028.87	7,639.49	-4,036.86	14,450,775.43	1,719,153.64	39.791062	-80.719701
19,654.00	91.36	329.88	11,027.14	7,720.42	-4,084.65	14,450,856.36	1,719,105.85	39.791285	-80.719870
19,748.00	90.48	331.11	11,025.63	7,802.21	-4,130.93	14,450,938.16	1,719,059.56	39.791510	-80.720034
19,842.00	90.75	330.58	11,024.62	7,884.30	-4,176.72	14,451,020.24	1,719,013.77	39.791736	-80.720096
19,936.00	90.92	330.76	11,023.25	7,966.24	-4,222.76	14,451,102.19	1,718,967.73	39.791961	-80.720359
20,029.00	91.19	330.58	11,021.53	8,047.31	-4,268.31	14,451,183.25	1,718,922.19	39.792184	-80.720520
20,124.00	91.36	331.11	11,019.42	8,130.25	-4,314.58	14,451,266.19	1,718,875.92	39.792412	-80.720684
20,217.00	91.36	331.29	11,017.21	8,211.72	-4,359.37	14,451,347.67	1,718,831.13	39.792637	-80.720842
20,310.00	90.57	330.58	11,015.65	8,293.00	-4,404.54	14,451,428.94	1,718,785.95	39.792860	-80.721002
20,404.00	90.57	330.58	11,014.71	8,374.87	-4,450.72	14,451,510.82	1,718,739.78	39.793085	-80.721166
20,498.00	90.84	331.29	11,013.56	8,457.03	-4,496.38	14,451,592.97	1,718,694.12	39.793311	-80.721327
20,592.00	91.01	331.11	11,012.04	8,539.39	-4,541.66	14,451,675.33	1,718,648.84	39.793538	-80.721488
20,685.00	90.75	330.41	11,010.61	8,620.53	-4,587.08	14,451,756.47	1,718,603.42	39.793761	-80.721648
20,780.00	90.84	330.06	11,009.29	8,702.99	-4,634.24	14,451,838.93	1,718,556.26	39.793988	-80.721815
20,874.00	91.54	329.35	11,007.34	8,784.13	-4,681.64	14,451,920.08	1,718,508.85	39.794211	-80.721983
20,967.00	90.84	329.53	11,005.41	8,864.20	-4,728.92	14,452,000.14	1,718,461.58	39.794432	-80.722151
21,061.00	91.10	330.94	11,003.82	8,945.78	-4,775.58	14,452,081.73	1,718,414.92	39.794656	-80.722316
21,155.00	91.54	331.29	11,001.65	9,028.07	-4,820.97	14,452,164.01	1,718,369.53	39.794882	-80.722477
21,249.00	90.66	330.58	10,999.85	9,110.21	-4,866.63	14,452,246.16	1,718,323.87	39.795108	-80.722638
21,342.00	91.01	331.11	10,998.49	9,191.42	-4,911.93	14,452,327.36	1,718,278.57	39.795332	-80.722799
21,436.00	89.96	330.94	10,997.70	9,273.65	-4,957.46	14,452,409.59	1,718,233.04	39.795558	-80.722960
21,530.00	90.22	331.29	10,997.55	9,355.96	-5,002.87	14,452,491.90	1,718,187.63	39.795784	-80.723121
21,624.00	90.92	331.46	10,996.61	9,438.46	-5,047.90	14,452,574.41	1,718,142.60	39.796011	-80.723280
21,717.00	90.48	331.11	10,995.48	9,520.02	-5,092.58	14,452,655.96	1,718,097.92	39.796236	-80.723438
21,811.00	91.19	331.46	10,994.11	9,602.45	-5,137.74	14,452,738.39	1,718,052.76	39.796463	-80.723598
21,905.00	90.66	331.29	10,992.59	9,684.95	-5,182.76	14,452,820.89	1,718,007.73	39.796689	-80.723757
21,999.00	90.22	330.76	10,991.87	9,767.18	-5,228.30	14,452,903.12	1,717,962.20	39.796916	-80.723919
22,093.00	90.40	330.76	10,991.36	9,849.20	-5,274.21	14,452,985.14	1,717,916.28	39.797141	-80.724081
22,186.00	91.19	330.76	10,990.07	9,930.34	-5,319.64	14,453,066.29	1,717,870.86	39.797365	-80.724242
22,280.00	91.36	330.58	10,987.98	10,012.27	-5,365.67	14,453,148.22	1,717,824.83	39.797590	-80.724405
22,373.00	91.54	330.58	10,985.62	10,093.25	-5,411.34	14,453,229.20	1,717,779.16	39.797813	-80.724567
22,467.00	91.71	330.58	10,982.96	10,175.10	-5,457.49	14,453,311.04	1,717,733.01	39.798038	-80.724730
22,560.00	90.84	329.88	10,980.89	10,255.80	-5,503.66	14,453,391.75	1,717,686.84	39.798260	-80.724894
22,654.00	89.69	329.53	10,980.45	10,336.96	-5,551.07	14,453,472.91	1,717,639.42	39.798483	-80.725062
22,747.00	90.92	329.18	10,979.96	10,416.97	-5,598.48	14,453,552.92	1,717,592.02	39.798703	-80.725229
22,841.00	91.36	329.00	10,978.09	10,497.61	-5,646.75	14,453,633.55	1,717,543.74	39.798925	-80.725400
22,935.00	91.98	328.83	10,975.35	10,578.07	-5,695.26	14,453,714.02	1,717,495.23	39.799147	-80.725572
23,029.00	91.10	328.83	10,972.82	10,658.47	-5,743.90	14,453,794.42	1,717,446.60	39.799368	-80.725745
23,123.00	90.40	328.83	10,971.59	10,738.90	-5,792.55	14,453,874.84	1,717,397.95	39.799589	-80.725917
23,217.00	91.01	328.65	10,970.44	10,819.24	-5,841.32	14,453,955.19	1,717,349.18	39.799810	-80.726090
23,310.00	91.01	329.88	10,968.80	10,899.17	-5,888.84	14,454,035.11	1,717,301.65	39.800030	-80.726258
23,404.00	91.63	330.06	10,966.63	10,980.53	-5,935.87	14,454,116.47	1,717,254.62	39.800254	-80.726424
23,498.00	90.57	330.58	10,964.83	11,062.18	-5,982.41	14,454,198.12	1,717,208.09	39.800478	-80.726589
23,592.00	90.75	330.41	10,963.74	11,143.98	-6,028.70	14,454,279.93	1,717,161.80	39.800703	-80.726753
23,687.00	90.22	329.88	10,962.94	11,226.37	-6,075.99	14,454,362.31	1,717,114.51	39.800930	-80.726921
23,782.00	90.66	329.70	10,962.21	11,308.47	-6,123.79	14,454,444.41	1,717,066.71	39.801156	-80.727090
23,877.00	91.63	329.35	10,960.31	11,390.32	-6,171.96	14,454,526.27	1,717,018.54	39.801381	-80.727261
23,972.00	91.01	329.53	10,958.12	11,472.11	-6,220.25	14,454,608.05	1,716,970.25	39.801606	-80.727432
24,067.00	90.40	329.18	10,956.95	11,553.83	-6,268.67	14,454,689.78	1,716,921.83	39.801831	-80.727603
24,162.00	90.92	329.18	10,955.86	11,635.41	-6,317.34	14,454,771.35	1,716,873.16	39.802056	-80.727776

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Well Knob Creek N-12HU (slot M)
Project:	Marshall County, West Virginia.	TVD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Site:	Knob Creek	MD Reference:	RKB=737+33 @ 770.00usft (Nabors X08)
Well:	Knob Creek N-12HU (slot M)	North Reference:	Grid
Wellbore:	Original Hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original Hole	Database:	DB_Dec2220_v16

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
24,257.00	90.48	330.06	10,954.70	11,717.36	-6,365.38	14,454,853.30	1,716,825.12	39.802281	-80.727946
24,352.00	90.75	330.06	10,953.68	11,799.68	-6,412.79	14,454,935.62	1,716,777.71	39.802507	-80.728114
24,447.00	91.19	329.53	10,952.07	11,881.77	-6,460.57	14,455,017.71	1,716,729.92	39.802733	-80.728283
24,542.00	90.75	329.53	10,950.46	11,963.63	-6,508.74	14,455,099.58	1,716,681.76	39.802958	-80.728454
24,637.00	91.45	329.18	10,948.64	12,045.35	-6,557.15	14,455,181.29	1,716,633.34	39.803183	-80.728625
24,732.00	90.75	329.00	10,946.82	12,126.84	-6,605.95	14,455,262.79	1,716,584.55	39.803408	-80.728798
24,827.00	91.01	328.65	10,945.36	12,208.11	-6,655.12	14,455,344.06	1,716,535.38	39.803631	-80.728972
24,922.00	91.54	328.30	10,943.24	12,289.07	-6,704.78	14,455,425.02	1,716,485.72	39.803854	-80.729148
24,986.00	91.71	327.77	10,941.43	12,343.35	-6,738.65	14,455,479.29	1,716,451.85	39.804003	-80.729268
Survey @ 24986.00 MD 10941.43 TVD									
25,041.00	91.71	327.77	10,939.79	12,389.85	-6,767.96	14,455,525.79	1,716,422.53	39.804131	-80.729372
Survey Proj. to 25041.00 MD 10939.79 TVD									

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
151.00	151.00	-0.10	-0.45	MWD surveys
24,986.00	10,941.43	12,343.35	-6,738.65	Survey @ 24986.00 MD 10941.43 TVD
25,041.00	10,939.79	12,389.85	-6,767.96	Survey Proj. to 25041.00 MD 10939.79 TVD