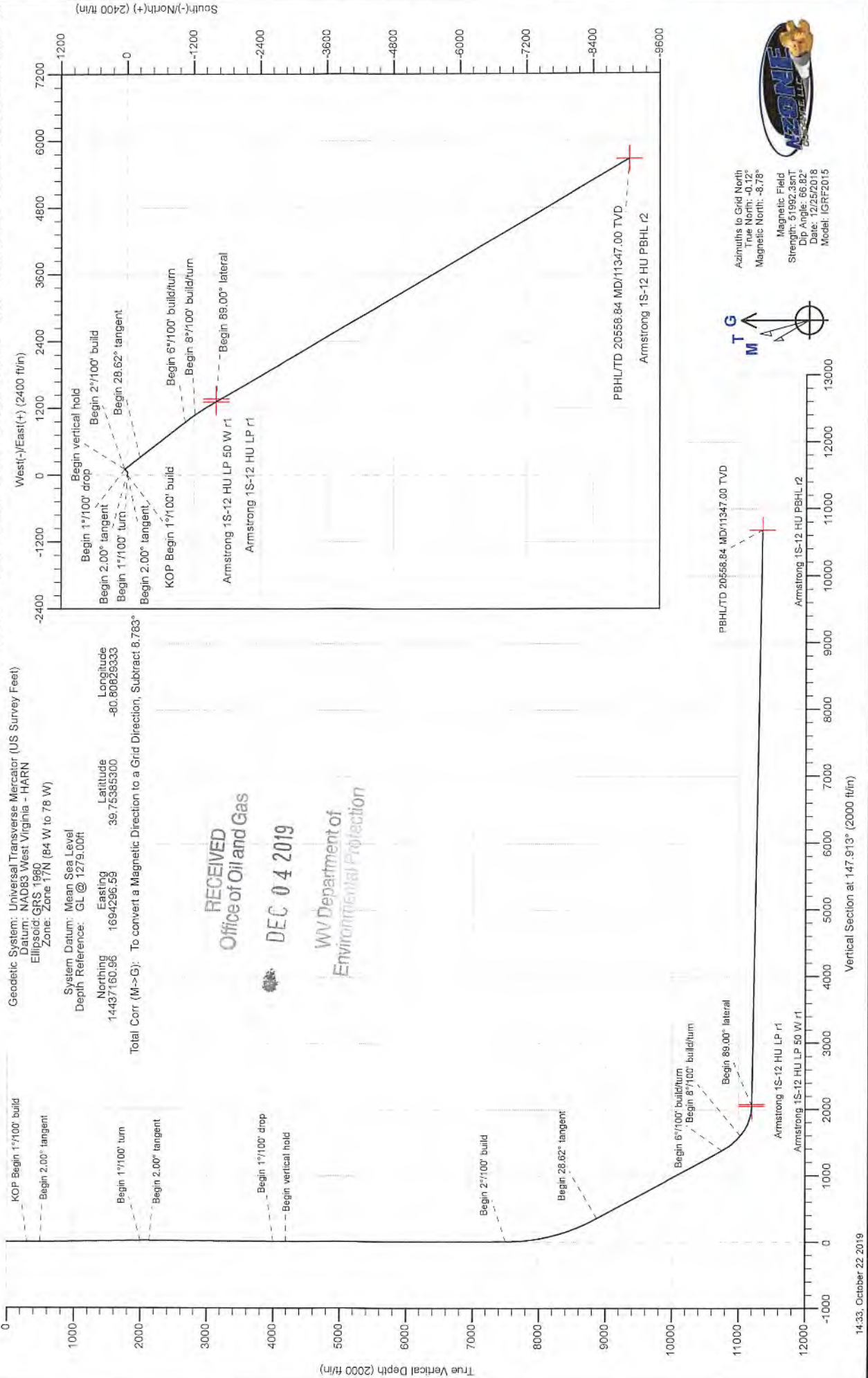




Well: Armstrong 1S-12 HU (slot N)
Site: Armstrong Pad
Project: Marshall County, West Virginia
Design: rev2
Rig:



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	300.00	0.00	0.00	300.00	0.00	0.00	0.00	0.00	0.00	KOP Begin 1°/100° build
3	500.00	2.00	85.000	499.96	0.30	0.00	1.00	85.000	1.59	Begin 2.00° tangent
4	2000.95	2.00	95.000	2000.00	4.87	55.66	0.00	0.000	25.44	Begin 1°/100° turn
5	2137.74	2.00	45.000	2136.71	6.77	59.73	1.00	109.989	25.99	Begin 2.00° tangent
6	4002.17	2.00	45.000	4000.00	52.78	105.74	0.00	0.000	11.45	Begin 1°/100° drop
7	4202.17	0.00	45.000	4199.96	55.24	108.20	1.00	160.000	10.67	Begin vertical hold
8	7502.21	0.00	45.000	7500.00	55.24	108.20	0.00	45.000	10.67	Begin 2°/100° build
9	8933.40	28.62	142.178	8872.40	-221.33	322.91	2.00	142.178	359.05	Begin 28.62° tangent
10	11075.84	50.00	142.178	10752.99	-1032.06	952.28	0.00	0.000	1380.26	Begin 6°/100° build/turn
11	11434.56	50.00	148.280	1028.98	-1216.39	1082.78	6.00	8.590	1605.76	Begin 8°/100° build/turn
12	11923.67	88.00	149.697	11197.01	-1598.28	1319.42	8.00	5.419	2055.02	Begin 89.00° lateral
13	20558.84	88.00	149.697	11347.00	-9052.53	5875.78	0.00	0.000	0684.70	PBHL/TD 20558.84 MD/11347.00 TVD

Geodetic System: Universal Transverse Mercator (US Survey Feet)
 Datum: NAD83 West Virginia - HARN
 Ellipsoid: GRS 1960
 Zone: Zone 17N (84 W to 78 W)

System Datum: Mean Sea Level
 Depth Reference: GL @ 1279.00ft
 Northing: 14437160.96
 Easting: 1694296.39
 Latitude: 39.75385300
 Longitude: -80.80629333

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.783°



MagNETIC Field
 Strength: 51992.35nT
 Dip Angle: 66.82°
 Date: 12/25/2018
 Model: IGRF2015





Planning Report - Geographic

4705102258 *MON*

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-12 HU (slot N)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1279.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-12 HU (slot N)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

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	Armstrong Pad				
Site Position:		Northing:	14,437,151.34 usft	Latitude:	39.75382662
From:	Lat/Long	Easting:	1,694,289.43 usft	Longitude:	-80.80831890
Position Uncertainty:	0.00 ft	Slot Radius:	13-3/16 "	Grid Convergence:	0.123 °

Well	Armstrong 1S-12 HU (slot N)					
Well Position	+N/-S	0.00 ft	Northing:	14,437,160.96 usft	Latitude:	39.75385300
	+E/-W	0.00 ft	Easting:	1,694,296.59 usft	Longitude:	-80.80829333
Position Uncertainty		0.00 ft	Wellhead Elevation:		Ground Level:	1,279.00 ft

Wellbore	Original Hole				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	12/25/2018	-8.660	66.817	51,992.27170932

Design	rev2			
Audit Notes:				
Version:	Phase:	PLAN	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)
	0.00	0.00	0.00	147.913

Plan Survey Tool Program	Date	10/22/2019		
Depth From (ft)	Depth To (ft)	Survey (Wellbore)	Tool Name	Remarks
1	0.00	20,558.84 rev2 (Original Hole)	MWD MWD - Standard	

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Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-12 HU (slot N)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1279.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-12 HU (slot N)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

Plan Sections										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)	TFO (°)	Target
0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.000	
300.00	0.00	0.000	300.00	0.00	0.00	0.00	0.00	0.00	0.000	
500.00	2.00	85.000	499.96	0.30	3.48	1.00	1.00	0.00	85.000	
2,000.95	2.00	85.000	2,000.00	4.87	55.66	0.00	0.00	0.00	0.000	
2,137.74	2.00	45.000	2,136.71	6.77	59.73	1.00	0.00	-29.24	-109.989	
4,002.17	2.00	45.000	4,000.00	52.78	105.74	0.00	0.00	0.00	0.000	
4,202.17	0.00	45.000	4,199.96	55.24	108.20	1.00	-1.00	0.00	180.000	
7,502.21	0.00	45.000	7,500.00	55.24	108.20	0.00	0.00	0.00	45.000	
8,933.40	28.62	142.178	8,872.40	-221.33	322.91	2.00	2.00	6.79	142.178	
11,075.84	28.62	142.178	10,753.00	-1,032.06	952.28	0.00	0.00	0.00	0.000	
11,434.56	50.00	146.280	11,028.98	-1,216.39	1,082.78	6.00	5.96	1.14	8.590	
11,923.67	89.00	149.697	11,197.01	-1,598.28	1,319.42	8.00	7.97	0.70	5.419	
20,558.84	89.00	149.697	11,347.00	-9,052.53	5,675.78	0.00	0.00	0.00	0.000	Armstrong 1S-12 HU

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Environmental Protection



Planning Report - Geographic

4705102258 *map*

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Database: DB_Aug1919_v14
Company: Tug Hill Operating LLC
Project: Marshall County, West Virginia
Site: Armstrong Pad
Well: Armstrong 1S-12 HU (slot N)
Wellbore: Original Hole
Design: rev2

Local Co-ordinate Reference: Well Armstrong 1S-12 HU (slot N)
TVD Reference: GL @ 1279.00ft
MD Reference: GL @ 1279.00ft
North Reference: Grid
Survey Calculation Method: Minimum Curvature

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
0.00	0.00	0.000	0.00	0.00	0.00	14,437,160.96	1,694,296.59	39.75385300	-80.80829333	
100.00	0.00	0.000	100.00	0.00	0.00	14,437,160.96	1,694,296.59	39.75385300	-80.80829333	
200.00	0.00	0.000	200.00	0.00	0.00	14,437,160.96	1,694,296.59	39.75385300	-80.80829333	
300.00	0.00	0.000	300.00	0.00	0.00	14,437,160.96	1,694,296.59	39.75385300	-80.80829333	
KOP Begin 1°/100' build										
400.00	1.00	85.000	399.99	0.08	0.87	14,437,161.04	1,694,297.46	39.75385321	-80.80829024	
500.00	2.00	85.000	499.96	0.30	3.48	14,437,161.26	1,694,300.07	39.75385382	-80.80828096	
Begin 2.00° tangent										
600.00	2.00	85.000	599.90	0.61	6.95	14,437,161.57	1,694,303.55	39.75385463	-80.80826859	
700.00	2.00	85.000	699.84	0.91	10.43	14,437,161.87	1,694,307.02	39.75385545	-80.80825621	
800.00	2.00	85.000	799.78	1.22	13.91	14,437,162.18	1,694,310.50	39.75385626	-80.80824384	
900.00	2.00	85.000	899.72	1.52	17.38	14,437,162.48	1,694,313.98	39.75385708	-80.80823147	
1,000.00	2.00	85.000	999.65	1.83	20.86	14,437,162.78	1,694,317.45	39.75385789	-80.80821910	
1,100.00	2.00	85.000	1,099.59	2.13	24.34	14,437,163.09	1,694,320.93	39.75385871	-80.80820672	
1,200.00	2.00	85.000	1,199.53	2.43	27.81	14,437,163.39	1,694,324.41	39.75385952	-80.80819435	
1,300.00	2.00	85.000	1,299.47	2.74	31.29	14,437,163.70	1,694,327.88	39.75386034	-80.80818198	
1,400.00	2.00	85.000	1,399.41	3.04	34.77	14,437,164.00	1,694,331.36	39.75386115	-80.80816961	
1,500.00	2.00	85.000	1,499.35	3.35	38.24	14,437,164.31	1,694,334.84	39.75386197	-80.80815723	
1,600.00	2.00	85.000	1,599.29	3.65	41.72	14,437,164.61	1,694,338.31	39.75386278	-80.80814486	
1,700.00	2.00	85.000	1,699.23	3.95	45.20	14,437,164.91	1,694,341.79	39.75386360	-80.80813249	
1,800.00	2.00	85.000	1,799.17	4.26	48.67	14,437,165.22	1,694,345.27	39.75386441	-80.80812012	
1,900.00	2.00	85.000	1,899.11	4.56	52.15	14,437,165.52	1,694,348.74	39.75386523	-80.80810774	
2,000.00	2.00	85.000	1,999.05	4.87	55.63	14,437,165.83	1,694,352.22	39.75386604	-80.80809537	
2,000.95	2.00	85.000	2,000.00	4.87	55.66	14,437,165.83	1,694,352.25	39.75386605	-80.80809525	
Begin 1°/100' turn										
2,100.00	1.90	55.735	2,098.99	5.95	58.74	14,437,166.91	1,694,355.33	39.75386899	-80.80808428	
2,137.74	2.00	45.000	2,136.71	6.77	59.73	14,437,167.72	1,694,356.32	39.75387123	-80.80808077	
Begin 2.00° tangent										
2,200.00	2.00	45.000	2,198.93	8.30	61.26	14,437,169.26	1,694,357.85	39.75387544	-80.80807530	
2,300.00	2.00	45.000	2,298.87	10.77	63.73	14,437,171.73	1,694,360.32	39.75388220	-80.80806650	
2,400.00	2.00	45.000	2,398.81	13.24	66.20	14,437,174.20	1,694,362.79	39.75388897	-80.80805770	
2,500.00	2.00	45.000	2,498.75	15.71	68.67	14,437,176.66	1,694,365.26	39.75389573	-80.80804890	
2,600.00	2.00	45.000	2,598.69	18.17	71.13	14,437,179.13	1,694,367.73	39.75390249	-80.80804010	
2,700.00	2.00	45.000	2,698.63	20.64	73.60	14,437,181.60	1,694,370.19	39.75390925	-80.80803130	
2,800.00	2.00	45.000	2,798.56	23.11	76.07	14,437,184.07	1,694,372.66	39.75391602	-80.80802250	
2,900.00	2.00	45.000	2,898.50	25.58	78.54	14,437,186.54	1,694,375.13	39.75392278	-80.80801370	
3,000.00	2.00	45.000	2,998.44	28.04	81.00	14,437,189.00	1,694,377.60	39.75392954	-80.80800490	
3,100.00	2.00	45.000	3,098.38	30.51	83.47	14,437,191.47	1,694,380.06	39.75393631	-80.80799610	
3,200.00	2.00	45.000	3,198.32	32.98	85.94	14,437,193.94	1,694,382.53	39.75394307	-80.80798730	
3,300.00	2.00	45.000	3,298.26	35.45	88.41	14,437,196.41	1,694,385.00	39.75394983	-80.80797850	
3,400.00	2.00	45.000	3,398.20	37.92	90.88	14,437,198.87	1,694,387.47	39.75395659	-80.80796971	
3,500.00	2.00	45.000	3,498.14	40.38	93.34	14,437,201.34	1,694,389.94	39.75396336	-80.80796091	
3,600.00	2.00	45.000	3,598.08	42.85	95.81	14,437,203.81	1,694,392.40	39.75397012	-80.80795211	
3,700.00	2.00	45.000	3,698.02	45.32	98.28	14,437,206.28	1,694,394.87	39.75397688	-80.80794331	
3,800.00	2.00	45.000	3,797.96	47.79	100.75	14,437,208.75	1,694,397.34	39.75398364	-80.80793451	
3,900.00	2.00	45.000	3,897.89	50.25	103.21	14,437,211.21	1,694,399.81	39.75399041	-80.80792571	
4,000.00	2.00	45.000	3,997.83	52.72	105.68	14,437,213.68	1,694,402.27	39.75399717	-80.80791691	
4,002.17	2.00	45.000	4,000.00	52.78	105.74	14,437,213.73	1,694,402.33	39.75399732	-80.80791672	
Begin 1°/100' drop										
4,100.00	1.02	45.000	4,097.80	54.60	107.56	14,437,215.56	1,694,404.15	39.75400231	-80.80791022	
4,200.00	0.02	45.000	4,197.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792	
4,202.17	0.00	45.000	4,199.96	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792	
Begin vertical hold										
4,300.00	0.00	0.000	4,297.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792	



Planning Report - Geographic

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Database: DB_Aug1919_v14
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Project: Marshall County, West Virginia
Site: Armstrong Pad
Well: Armstrong 1S-12 HU (slot N)
Wellbore: Original Hole
Design: rev2

Local Co-ordinate Reference: Well Armstrong 1S-12 HU (slot N)
TVD Reference: GL @ 1279.00ft
MD Reference: GL @ 1279.00ft
North Reference: Grid
Survey Calculation Method: Minimum Curvature

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
4,400.00	0.00	45.000	4,397.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
4,500.00	0.00	0.000	4,497.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
4,600.00	0.00	45.000	4,597.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
4,700.00	0.00	0.000	4,697.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
4,800.00	0.00	45.000	4,797.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
4,900.00	0.00	0.000	4,897.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,000.00	0.00	0.000	4,997.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,100.00	0.00	0.000	5,097.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,200.00	0.00	45.000	5,197.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,300.00	0.00	45.000	5,297.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,400.00	0.00	0.000	5,397.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,500.00	0.00	45.000	5,497.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,600.00	0.00	0.000	5,597.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,700.00	0.00	0.000	5,697.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,800.00	0.00	0.000	5,797.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
5,900.00	0.00	45.000	5,897.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,000.00	0.00	0.000	5,997.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,100.00	0.00	45.000	6,097.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,200.00	0.00	45.000	6,197.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,300.00	0.00	0.000	6,297.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,400.00	0.00	0.000	6,397.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,500.00	0.00	0.000	6,497.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,600.00	0.00	45.000	6,597.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,700.00	0.00	0.000	6,697.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,800.00	0.00	45.000	6,797.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
6,900.00	0.00	0.000	6,897.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,000.00	0.00	45.000	6,997.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,100.00	0.00	0.000	7,097.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,200.00	0.00	0.000	7,197.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,300.00	0.00	45.000	7,297.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,400.00	0.00	0.000	7,397.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,500.00	0.00	45.000	7,497.79	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
7,502.21	0.00	45.000	7,500.00	55.24	108.20	14,437,216.20	1,694,404.80	39.75400408	-80.80790792
Begin 2°/100' build									
7,600.00	1.96	142.178	7,597.77	53.92	109.23	14,437,214.88	1,694,405.82	39.75400045	-80.80790429
7,700.00	3.96	142.178	7,697.63	49.85	112.39	14,437,210.81	1,694,408.98	39.75398925	-80.80789307
7,800.00	5.96	142.178	7,797.26	43.03	117.69	14,437,203.99	1,694,414.28	39.75397048	-80.80787427
7,900.00	7.96	142.178	7,896.51	33.46	125.11	14,437,194.42	1,694,421.70	39.75394416	-80.80784793
8,000.00	9.96	142.178	7,995.29	21.17	134.66	14,437,182.13	1,694,431.25	39.75391034	-80.80781406
8,100.00	11.96	142.178	8,093.46	6.15	146.31	14,437,167.11	1,694,442.90	39.75386904	-80.80777271
8,200.00	13.96	142.178	8,190.91	-11.55	160.06	14,437,149.40	1,694,456.65	39.75382033	-80.80772393
8,300.00	15.96	142.178	8,287.52	-31.94	175.88	14,437,129.02	1,694,472.48	39.75376425	-80.80766778
8,400.00	17.96	142.178	8,383.17	-54.97	193.77	14,437,105.98	1,694,490.36	39.75370088	-80.80760433
8,500.00	19.96	142.178	8,477.74	-80.63	213.68	14,437,080.33	1,694,510.28	39.75363030	-80.80753366
8,600.00	21.96	142.178	8,571.12	-108.88	235.61	14,437,052.08	1,694,532.21	39.75355259	-80.80745584
8,700.00	23.96	142.178	8,663.20	-139.69	259.53	14,437,021.27	1,694,556.12	39.75346784	-80.80737099
8,800.00	25.96	142.178	8,753.86	-173.02	285.40	14,436,987.94	1,694,581.99	39.75337617	-80.80727919
8,900.00	27.96	142.178	8,842.99	-208.82	313.20	14,436,952.14	1,694,609.79	39.75327767	-80.80718057
8,933.40	28.62	142.178	8,872.40	-221.33	322.90	14,436,939.63	1,694,619.50	39.75324327	-80.80714613
Begin 28.62° tangent									
9,000.00	28.62	142.178	8,930.86	-246.53	342.47	14,436,914.43	1,694,639.06	39.75317394	-80.80707671
9,100.00	28.62	142.178	9,018.64	-284.37	371.85	14,436,876.59	1,694,668.44	39.75306985	-80.80697248
9,200.00	28.62	142.178	9,106.41	-322.21	401.22	14,436,838.75	1,694,697.81	39.75296575	-80.80686825
9,300.00	28.62	142.178	9,194.19	-360.05	430.60	14,436,800.91	1,694,727.19	39.75286165	-80.80676402



Planning Report - Geographic

4705102258 MOD

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Office of Oil and Gas
DEC 04 2019
WV Department of Environmental Protection

Database: DB_Aug1919_v14
Company: Tug Hill Operating LLC
Project: Marshall County, West Virginia
Site: Armstrong Pad
Well: Armstrong 1S-12 HU (slot N)
Wellbore: Original Hole
Design: rev2

Local Co-ordinate Reference: Well Armstrong 1S-12 HU (slot N)
TVD Reference: GL @ 1279.00ft
MD Reference: GL @ 1279.00ft
North Reference: Grid
Survey Calculation Method: Minimum Curvature

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
9,400.00	28.62	142.178	9,281.97	-397.90	459.97	14,436,763.07	1,694,756.57	39.75275755	-80.80665979
9,500.00	28.62	142.178	9,369.75	-435.74	489.35	14,436,725.22	1,694,785.94	39.75265345	-80.80655556
9,600.00	28.62	142.178	9,457.53	-473.58	518.73	14,436,687.38	1,694,815.32	39.75254936	-80.80645133
9,700.00	28.62	142.178	9,545.31	-511.42	548.10	14,436,649.54	1,694,844.69	39.75244526	-80.80634711
9,800.00	28.62	142.178	9,633.08	-549.26	577.48	14,436,611.70	1,694,874.07	39.75234116	-80.80624288
9,900.00	28.62	142.178	9,720.86	-587.10	606.86	14,436,573.86	1,694,903.45	39.75223706	-80.80613865
10,000.00	28.62	142.178	9,808.64	-624.95	636.23	14,436,536.02	1,694,932.82	39.75213296	-80.80603442
10,100.00	28.62	142.178	9,896.42	-662.79	665.61	14,436,498.17	1,694,962.20	39.75202886	-80.80593019
10,200.00	28.62	142.178	9,984.20	-700.63	694.99	14,436,460.33	1,694,991.58	39.75192476	-80.80582597
10,300.00	28.62	142.178	10,071.98	-738.47	724.36	14,436,422.49	1,695,020.95	39.75182066	-80.80572174
10,400.00	28.62	142.178	10,159.75	-776.31	753.74	14,436,384.65	1,695,050.33	39.75171656	-80.80561751
10,500.00	28.62	142.178	10,247.53	-814.15	783.12	14,436,346.81	1,695,079.71	39.75161247	-80.80551329
10,600.00	28.62	142.178	10,335.31	-852.00	812.49	14,436,308.97	1,695,109.08	39.75150837	-80.80540906
10,700.00	28.62	142.178	10,423.09	-889.84	841.87	14,436,271.12	1,695,138.46	39.75140427	-80.80530484
10,800.00	28.62	142.178	10,510.87	-927.68	871.24	14,436,233.28	1,695,167.84	39.75130017	-80.80520061
10,900.00	28.62	142.178	10,598.65	-965.52	900.62	14,436,195.44	1,695,197.21	39.75119607	-80.80509639
11,000.00	28.62	142.178	10,686.42	-1,003.36	930.00	14,436,157.60	1,695,226.59	39.75109197	-80.80499216
11,075.84	28.62	142.178	10,753.00	-1,032.06	952.28	14,436,128.90	1,695,248.87	39.75101302	-80.80491312
Begin 6°/100' build/turn									
11,100.00	30.06	142.610	10,774.06	-1,041.44	959.50	14,436,119.52	1,695,256.09	39.75098722	-80.80488749
11,200.00	36.01	144.066	10,857.86	-1,085.18	991.99	14,436,075.78	1,695,288.58	39.75086691	-80.80477225
11,300.00	41.97	145.156	10,935.55	-1,136.46	1,028.37	14,436,024.50	1,695,324.96	39.75072584	-80.80464319
11,400.00	47.94	146.019	11,006.29	-1,194.74	1,068.26	14,435,966.22	1,695,364.85	39.75056557	-80.80450173
11,434.56	50.00	146.280	11,028.98	-1,216.39	1,082.78	14,435,944.57	1,695,379.37	39.75050602	-80.80445024
Begin 8°/100' build/turn									
11,500.00	55.21	146.881	11,068.71	-1,259.77	1,111.40	14,435,901.19	1,695,407.99	39.75038670	-80.80434876
11,600.00	63.18	147.668	11,119.87	-1,331.99	1,157.77	14,435,828.97	1,695,454.36	39.75018810	-80.80418432
11,700.00	71.16	148.351	11,158.64	-1,410.10	1,206.55	14,435,750.86	1,695,503.14	39.74997328	-80.80401140
11,800.00	79.14	148.972	11,184.25	-1,492.60	1,256.77	14,435,668.36	1,695,553.36	39.74974642	-80.80383336
11,900.00	87.12	149.560	11,196.20	-1,577.87	1,307.46	14,435,583.09	1,695,604.05	39.74951194	-80.80365367
11,923.67	89.00	149.697	11,197.01	-1,598.28	1,319.42	14,435,562.68	1,695,616.01	39.74945582	-80.80361128
Begin 89.00° lateral									
12,000.00	89.00	149.697	11,198.33	-1,664.17	1,357.93	14,435,496.79	1,695,654.52	39.74927463	-80.80347479
12,100.00	89.00	149.697	11,200.07	-1,750.49	1,408.38	14,435,410.47	1,695,704.97	39.74903725	-80.80329598
12,200.00	89.00	149.697	11,201.81	-1,836.82	1,458.83	14,435,324.14	1,695,755.42	39.74879988	-80.80311717
12,300.00	89.00	149.697	11,203.54	-1,923.14	1,509.28	14,435,237.82	1,695,805.87	39.74856250	-80.80293836
12,400.00	89.00	149.697	11,205.28	-2,009.47	1,559.73	14,435,151.50	1,695,856.32	39.74832512	-80.80275955
12,500.00	89.00	149.697	11,207.02	-2,095.79	1,610.18	14,435,065.17	1,695,906.76	39.74808775	-80.80258074
12,600.00	89.00	149.697	11,208.75	-2,182.12	1,660.62	14,434,978.85	1,695,957.21	39.74785037	-80.80240194
12,700.00	89.00	149.697	11,210.49	-2,268.44	1,711.07	14,434,892.52	1,696,007.66	39.74761299	-80.80222313
12,800.00	89.00	149.697	11,212.23	-2,354.76	1,761.52	14,434,806.20	1,696,058.11	39.74737561	-80.80204433
12,900.00	89.00	149.697	11,213.96	-2,441.09	1,811.97	14,434,719.88	1,696,108.56	39.74713824	-80.80186553
13,000.00	89.00	149.697	11,215.70	-2,527.41	1,862.42	14,434,633.55	1,696,159.01	39.74690086	-80.80168673
13,100.00	89.00	149.697	11,217.44	-2,613.74	1,912.87	14,434,547.23	1,696,209.46	39.74666348	-80.80150793
13,200.00	89.00	149.697	11,219.18	-2,700.06	1,963.32	14,434,460.90	1,696,259.91	39.74642610	-80.80132913
13,300.00	89.00	149.697	11,220.91	-2,786.39	2,013.77	14,434,374.58	1,696,310.36	39.74618872	-80.80115033
13,400.00	89.00	149.697	11,222.65	-2,872.71	2,064.22	14,434,288.25	1,696,360.80	39.74595134	-80.80097154
13,500.00	89.00	149.697	11,224.39	-2,959.03	2,114.67	14,434,201.93	1,696,411.25	39.74571396	-80.80079274
13,600.00	89.00	149.697	11,226.12	-3,045.36	2,165.11	14,434,115.61	1,696,461.70	39.74547658	-80.80061395
13,700.00	89.00	149.697	11,227.86	-3,131.68	2,215.56	14,434,029.28	1,696,512.15	39.74523920	-80.80043516
13,800.00	89.00	149.697	11,229.60	-3,218.01	2,266.01	14,433,942.96	1,696,562.60	39.74500182	-80.80025637
13,900.00	89.00	149.697	11,231.33	-3,304.33	2,316.46	14,433,856.63	1,696,613.05	39.74476444	-80.80007758
14,000.00	89.00	149.697	11,233.07	-3,390.66	2,366.91	14,433,770.31	1,696,663.50	39.74452706	-80.79989879
14,100.00	89.00	149.697	11,234.81	-3,476.98	2,417.36	14,433,683.99	1,696,713.95	39.74428968	-80.79972000



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 Offices of Oil and Gas
 DEC 04 2019
 WV Department of Environmental Protection

Database: DB_Aug1919_v14
 Company: Tug Hill Operating LLC
 Project: Marshall County, West Virginia
 Site: Armstrong Pad
 Well: Armstrong 1S-12 HU (slot N)
 Wellbore: Original Hole
 Design: rev2

Local Co-ordinate Reference: Well Armstrong 1S-12 HU (slot N)
 TVD Reference: GL @ 1279.00ft
 MD Reference: GL @ 1279.00ft
 North Reference: Grid
 Survey Calculation Method: Minimum Curvature

Planned Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
14,200.00	89.00	149.697	11,236.55	-3,563.30	2,467.81	14,433,597.66	1,696,764.40	39.74405230	-80.79954121
14,300.00	89.00	149.697	11,238.28	-3,649.63	2,518.26	14,433,511.34	1,696,814.84	39.74381492	-80.79936243
14,400.00	89.00	149.697	11,240.02	-3,735.95	2,568.71	14,433,425.01	1,696,865.29	39.74357754	-80.79918365
14,500.00	89.00	149.697	11,241.76	-3,822.28	2,619.16	14,433,338.69	1,696,915.74	39.74334015	-80.79900486
14,600.00	89.00	149.697	11,243.49	-3,908.60	2,669.60	14,433,252.37	1,696,966.19	39.74310277	-80.79882608
14,700.00	89.00	149.697	11,245.23	-3,994.93	2,720.05	14,433,166.04	1,697,016.64	39.74286539	-80.79864730
14,800.00	89.00	149.697	11,246.97	-4,081.25	2,770.50	14,433,079.72	1,697,067.09	39.74262800	-80.79846852
14,900.00	89.00	149.697	11,248.71	-4,167.57	2,820.95	14,432,993.39	1,697,117.54	39.74239062	-80.79828975
15,000.00	89.00	149.697	11,250.44	-4,253.90	2,871.40	14,432,907.07	1,697,167.99	39.74215324	-80.79811097
15,100.00	89.00	149.697	11,252.18	-4,340.22	2,921.85	14,432,820.74	1,697,218.44	39.74191585	-80.79793219
15,200.00	89.00	149.697	11,253.92	-4,426.55	2,972.30	14,432,734.42	1,697,268.88	39.74167847	-80.79775342
15,300.00	89.00	149.697	11,255.65	-4,512.87	3,022.75	14,432,648.10	1,697,319.33	39.74144108	-80.79757465
15,400.00	89.00	149.697	11,257.39	-4,599.20	3,073.20	14,432,561.77	1,697,369.78	39.74120370	-80.79739588
15,500.00	89.00	149.697	11,259.13	-4,685.52	3,123.64	14,432,475.45	1,697,420.23	39.74096631	-80.79721711
15,600.00	89.00	149.697	11,260.86	-4,771.84	3,174.09	14,432,389.12	1,697,470.68	39.74072893	-80.79703834
15,700.00	89.00	149.697	11,262.60	-4,858.17	3,224.54	14,432,302.80	1,697,521.13	39.74049154	-80.79685957
15,800.00	89.00	149.697	11,264.34	-4,944.49	3,274.99	14,432,216.48	1,697,571.58	39.74025416	-80.79668080
15,900.00	89.00	149.697	11,266.08	-5,030.82	3,325.44	14,432,130.15	1,697,622.03	39.74001677	-80.79650204
16,000.00	89.00	149.697	11,267.81	-5,117.14	3,375.89	14,432,043.83	1,697,672.48	39.73977938	-80.79632327
16,100.00	89.00	149.697	11,269.55	-5,203.47	3,426.34	14,431,957.50	1,697,722.92	39.73954200	-80.79614451
16,200.00	89.00	149.697	11,271.29	-5,289.79	3,476.79	14,431,871.18	1,697,773.37	39.73930461	-80.79596575
16,300.00	89.00	149.697	11,273.02	-5,376.11	3,527.24	14,431,784.86	1,697,823.82	39.73906722	-80.79578699
16,400.00	89.00	149.697	11,274.76	-5,462.44	3,577.69	14,431,698.53	1,697,874.27	39.73882983	-80.79560823
16,500.00	89.00	149.697	11,276.50	-5,548.76	3,628.13	14,431,612.21	1,697,924.72	39.73859245	-80.79542947
16,600.00	89.00	149.697	11,278.23	-5,635.09	3,678.58	14,431,525.88	1,697,975.17	39.73835506	-80.79525071
16,700.00	89.00	149.697	11,279.97	-5,721.41	3,729.03	14,431,439.56	1,698,025.62	39.73811767	-80.79507196
16,800.00	89.00	149.697	11,281.71	-5,807.74	3,779.48	14,431,353.23	1,698,076.07	39.73788028	-80.79489321
16,900.00	89.00	149.697	11,283.45	-5,894.06	3,829.93	14,431,266.91	1,698,126.52	39.73764289	-80.79471445
17,000.00	89.00	149.697	11,285.18	-5,980.38	3,880.38	14,431,180.59	1,698,176.96	39.73740550	-80.79453570
17,100.00	89.00	149.697	11,286.92	-6,066.71	3,930.83	14,431,094.26	1,698,227.41	39.73716811	-80.79435695
17,200.00	89.00	149.697	11,288.66	-6,153.03	3,981.28	14,431,007.94	1,698,277.86	39.73693072	-80.79417820
17,300.00	89.00	149.697	11,290.39	-6,239.36	4,031.73	14,430,921.61	1,698,328.31	39.73669333	-80.79399945
17,400.00	89.00	149.697	11,292.13	-6,325.68	4,082.18	14,430,835.29	1,698,378.76	39.73645594	-80.79382071
17,500.00	89.00	149.697	11,293.87	-6,412.01	4,132.62	14,430,748.97	1,698,429.21	39.73621855	-80.79364196
17,600.00	89.00	149.697	11,295.60	-6,498.33	4,183.07	14,430,662.64	1,698,479.66	39.73598116	-80.79346322
17,700.00	89.00	149.697	11,297.34	-6,584.65	4,233.52	14,430,576.32	1,698,530.11	39.73574377	-80.79328447
17,800.00	89.00	149.697	11,299.08	-6,670.98	4,283.97	14,430,489.99	1,698,580.56	39.73550638	-80.79310573
17,900.00	89.00	149.697	11,300.82	-6,757.30	4,334.42	14,430,403.67	1,698,631.00	39.73526898	-80.79292699
18,000.00	89.00	149.697	11,302.55	-6,843.63	4,384.87	14,430,317.35	1,698,681.45	39.73503159	-80.79274825
18,100.00	89.00	149.697	11,304.29	-6,929.95	4,435.32	14,430,231.02	1,698,731.90	39.73479420	-80.79256951
18,200.00	89.00	149.697	11,306.03	-7,016.28	4,485.77	14,430,144.70	1,698,782.35	39.73455681	-80.79239077
18,300.00	89.00	149.697	11,307.76	-7,102.60	4,536.22	14,430,058.37	1,698,832.80	39.73431941	-80.79221204
18,400.00	89.00	149.697	11,309.50	-7,188.92	4,586.67	14,429,972.05	1,698,883.25	39.73408202	-80.79203330
18,500.00	89.00	149.697	11,311.24	-7,275.25	4,637.11	14,429,885.72	1,698,933.70	39.73384463	-80.79185457
18,600.00	89.00	149.697	11,312.97	-7,361.57	4,687.56	14,429,799.40	1,698,984.15	39.73360723	-80.79167584
18,700.00	89.00	149.697	11,314.71	-7,447.90	4,738.01	14,429,713.08	1,699,034.60	39.73336984	-80.79149711
18,800.00	89.00	149.697	11,316.45	-7,534.22	4,788.46	14,429,626.75	1,699,085.05	39.73313244	-80.79131838
18,900.00	89.00	149.697	11,318.19	-7,620.55	4,838.91	14,429,540.43	1,699,135.49	39.73289505	-80.79113965
19,000.00	89.00	149.697	11,319.92	-7,706.87	4,889.36	14,429,454.10	1,699,185.94	39.73265765	-80.79096092
19,100.00	89.00	149.697	11,321.66	-7,793.19	4,939.81	14,429,367.78	1,699,236.39	39.73242026	-80.79078220
19,200.00	89.00	149.697	11,323.40	-7,879.52	4,990.26	14,429,281.46	1,699,286.84	39.73218286	-80.79060347
19,300.00	89.00	149.697	11,325.13	-7,965.84	5,040.71	14,429,195.13	1,699,337.29	39.73194547	-80.79042475
19,400.00	89.00	149.697	11,326.87	-8,052.17	5,091.16	14,429,108.81	1,699,387.74	39.73170807	-80.79024602
19,500.00	89.00	149.697	11,328.61	-8,138.49	5,141.60	14,429,022.48	1,699,438.19	39.73147067	-80.79006730
19,600.00	89.00	149.697	11,330.34	-8,224.82	5,192.05	14,428,936.16	1,699,488.64	39.73123328	-80.78988858

Database:	DB_Aug1919_v14	Local Co-ordinate Reference:	Well Armstrong 1S-12 HU (slot N)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1279.00ft
Project:	Marshall County, West Virginia	MD Reference:	GL @ 1279.00ft
Site:	Armstrong Pad	North Reference:	Grid
Well:	Armstrong 1S-12 HU (slot N)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Original Hole		
Design:	rev2		

Planned Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
19,700.00	89.00	149.697	11,332.08	-8,311.14	5,242.50	14,428,849.84	1,699,539.08	39.73099588	-80.78970986
19,800.00	89.00	149.697	11,333.82	-8,397.46	5,292.95	14,428,763.51	1,699,589.53	39.73075848	-80.78953115
19,900.00	89.00	149.697	11,335.56	-8,483.79	5,343.40	14,428,677.19	1,699,639.98	39.73052109	-80.78935243
20,000.00	89.00	149.697	11,337.29	-8,570.11	5,393.85	14,428,590.86	1,699,690.43	39.73028369	-80.78917372
20,100.00	89.00	149.697	11,339.03	-8,656.44	5,444.30	14,428,504.54	1,699,740.88	39.73004629	-80.78899500
20,200.00	89.00	149.697	11,340.77	-8,742.76	5,494.75	14,428,418.21	1,699,791.33	39.72980889	-80.78881629
20,300.00	89.00	149.697	11,342.50	-8,829.09	5,545.20	14,428,331.89	1,699,841.78	39.72957149	-80.78863758
20,400.00	89.00	149.697	11,344.24	-8,915.41	5,595.65	14,428,245.57	1,699,892.23	39.72933409	-80.78845887
20,500.00	89.00	149.697	11,345.98	-9,001.73	5,646.09	14,428,159.24	1,699,942.68	39.72909669	-80.78828016
20,558.84	89.00	149.697	11,347.00	-9,052.53	5,675.78	14,428,108.45	1,699,972.36	39.72895701	-80.78817501

PBHL/TD 20558.84 MD/11347.00 TVD

Design Targets									
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (usft)	Easting (usft)	Latitude	Longitude
Armstrong 1S-12 HU LP - hit/miss target - Shape	0.00	0.000	11,197.00	-1,598.24	1,369.37	14,435,562.73	1,695,665.96	39.74945563	-80.80343357
- plan misses target center by 43.15ft at 11948.83ft MD (11197.44 TVD, -1620.00 N, 1332.12 E)									
- Point									
Armstrong 1S-12 HU LP - plan misses target center by 0.02ft at 11923.61ft MD (11197.00 TVD, -1598.22 N, 1319.39 E)	0.00	0.000	11,197.00	-1,598.24	1,319.37	14,435,562.73	1,695,615.96	39.74945593	-80.80361147
- Point									
Armstrong 1S-12 HU PB - plan hits target center - Point	0.00	0.000	11,347.00	-9,052.53	5,675.78	14,428,108.45	1,699,972.36	39.72895700	-80.78817500

Plan Annotations				
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment
		+N/-S (ft)	+E/-W (ft)	
300.00	300.00	0.00	0.00	KOP Begin 1°/100' build
500.00	499.96	0.30	3.48	Begin 2.00° tangent
2,000.95	2,000.00	4.87	55.66	Begin 1°/100' turn
2,137.74	2,136.71	6.77	59.73	Begin 2.00° tangent
4,002.17	4,000.00	52.78	105.74	Begin 1°/100' drop
4,202.17	4,199.96	55.24	108.20	Begin vertical hold
7,502.21	7,500.00	55.24	108.20	Begin 2°/100' build
8,933.40	8,872.40	-221.33	322.90	Begin 28.62° tangent
11,075.84	10,753.00	-1,032.06	952.28	Begin 6°/100' build/turn
11,434.56	11,028.98	-1,216.39	1,082.78	Begin 8°/100' build/turn
11,923.67	11,197.01	-1,598.28	1,319.42	Begin 89.00° lateral
20,558.84	11,347.00	-9,052.53	5,675.78	PBHL/TD 20558.84 MD/11347.00 TVD

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