



Company:	Tug Hill Operating, LLC	Local Co-ordinate Reference:	Well 1-10H
Project:	Barber County, Kansas (NAD 83)	TVD Reference:	WELL @ 1679.00usft (Patterson 421)
Site:	Donovan	MD Reference:	WELL @ 1679.00usft (Patterson 421)
Well:	1-10H	North Reference:	Grid
Wellbore:	Wellbore #1	Survey Calculation Method:	Minimum Curvature
Design:	Surveys	Database:	Southern Region

Project	Barber County, Kansas (NAD 83)		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	Kansas Southern Zone		

Well	1-10H				
Well Position	+N-S	0.00 usft	Northing:	1,473,089.42 usft	Latitude: 37° 6' 28.6145 N
	+E-W	0.00 usft	Easting:	1,249,345.66 usft	Longitude: 98° 42' 57.548 W
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level: 1,656.00 usft

Wellbore	Wellbore #1				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	WMM_2010	11/03/12	4.98	65.16	51,767

Design	Surveys				
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	177.78	

Survey Program	Date	11/29/12			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	830.00	VES Gyro (Wellbore #1)	NS-GYRO-MS	North sensing gyrocompassing m/s	
878.00	9,301.00	MS MWD (Wellbore #1)	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)	
830.00	0.81	157.31	829.78	-11.39	12.04	11.85	0.00	0.00	0.00	
Tie-In to VES Gyro-830.00' MD										
878.00	1.00	176.80	877.77	-12.12	12.19	12.59	0.75	0.40	40.60	
970.00	1.00	165.90	969.76	-13.70	12.43	14.18	0.21	0.00	-11.85	
1,062.00	1.20	317.70	1,061.75	-13.77	11.98	14.22	2.32	0.22	165.00	
1,154.00	1.50	325.00	1,153.73	-12.07	10.64	12.47	0.38	0.33	7.93	
1,247.00	1.10	349.70	1,246.70	-10.20	9.79	10.57	0.73	-0.43	26.56	
1,339.00	0.70	338.60	1,338.69	-8.80	9.42	9.16	0.47	-0.43	-12.07	
1,431.00	0.80	335.80	1,430.68	-7.69	8.95	8.04	0.12	0.11	-3.04	
1,521.00	0.90	357.00	1,520.67	-6.42	8.66	6.75	0.36	0.11	23.56	
1,615.00	0.80	329.30	1,614.66	-5.11	8.29	5.43	0.45	-0.11	-29.47	
1,707.00	0.90	318.20	1,706.65	-4.02	7.48	4.31	0.21	0.11	-12.07	
1,799.00	0.90	324.40	1,798.64	-2.90	6.57	3.15	0.11	0.00	6.74	
1,892.00	0.90	315.90	1,891.63	-1.78	5.64	2.00	0.14	0.00	-9.14	
1,987.00	1.10	319.20	1,986.62	-0.55	4.53	0.73	0.22	0.21	3.47	



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Well:	1-10H	North Reference:	Grid
Wellbore:	Wellbore #1	Survey Calculation Method:	Minimum Curvature
Design:	Surveys	Database:	Southern Region

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)	
2,082.00	0.50	195.90	2,081.61	-0.26	3.82	0.41	1.51	-0.63	-129.79	
2,176.00	1.00	189.60	2,175.60	-1.46	3.57	1.60	0.54	0.53	-6.70	
2,271.00	0.60	172.80	2,270.59	-2.77	3.49	2.91	0.48	-0.42	-17.68	
2,366.00	0.80	190.20	2,365.59	-3.92	3.44	4.05	0.30	0.21	18.32	
2,461.00	0.70	173.90	2,460.58	-5.15	3.38	5.28	0.25	-0.11	-17.16	
2,556.00	0.00	169.90	2,555.57	-5.73	3.44	5.86	0.74	-0.74	0.00	
2,650.00	0.30	216.90	2,649.57	-5.92	3.29	6.05	0.32	0.32	0.00	
2,745.00	0.10	142.80	2,744.57	-6.19	3.19	6.31	0.30	-0.21	-78.00	
2,840.00	0.10	263.60	2,839.57	-6.26	3.16	6.38	0.18	0.00	127.16	
2,936.00	0.20	177.50	2,935.57	-6.44	3.09	6.56	0.23	0.10	-89.69	
3,031.00	0.40	148.60	3,030.57	-6.89	3.27	7.01	0.26	0.21	-30.42	
3,126.00	0.30	136.70	3,125.57	-7.35	3.61	7.49	0.13	-0.11	-12.53	
3,220.00	0.40	108.70	3,219.57	-7.64	4.09	7.79	0.21	0.11	-29.79	
3,315.00	0.30	105.50	3,314.57	-7.81	4.64	7.99	0.11	-0.11	-3.37	
3,411.00	0.40	93.60	3,410.57	-7.90	5.22	8.10	0.13	0.10	-12.40	
3,506.00	0.80	110.70	3,505.56	-8.15	6.17	8.39	0.46	0.42	18.00	
3,601.00	0.70	85.60	3,600.55	-8.34	7.37	8.62	0.36	-0.11	-26.42	
3,695.00	0.70	49.20	3,694.55	-7.93	8.38	8.24	0.47	0.00	-38.72	
3,790.00	0.90	45.60	3,789.54	-7.02	9.35	7.38	0.22	0.21	-3.79	
3,883.00	0.90	45.00	3,882.52	-6.00	10.39	6.39	0.01	0.00	-0.65	
3,978.00	0.40	258.90	3,977.52	-5.53	10.59	5.94	1.32	-0.53	-153.79	
4,073.00	1.10	258.90	4,072.51	-5.77	9.37	6.13	0.74	0.74	0.00	
4,167.00	1.00	253.00	4,166.50	-6.19	7.70	6.48	0.16	-0.11	-6.28	
4,230.00	0.90	243.40	4,229.49	-6.57	6.73	6.82	0.30	-0.16	-15.24	
4,261.00	1.90	201.60	4,260.48	-7.16	6.32	7.39	4.41	3.23	-134.84	
4,293.00	4.70	195.50	4,292.42	-8.91	5.78	9.13	8.81	8.75	-19.06	
4,324.00	8.00	200.70	4,323.23	-12.15	4.68	12.33	10.79	10.65	16.77	
4,354.27	11.22	200.80	4,353.07	-16.88	2.89	16.98	10.65	10.65	0.32	
330' Hardline Intersect-4354.27' MD										
4,355.00	11.30	200.80	4,353.79	-17.01	2.84	17.11	10.65	10.65	0.23	
4,387.00	15.40	202.80	4,384.91	-23.86	0.07	23.85	12.89	12.81	6.25	
4,419.00	18.50	203.10	4,415.52	-32.45	-3.56	32.29	9.69	9.69	0.94	
4,450.00	22.50	203.10	4,444.55	-42.44	-7.82	42.10	12.90	12.90	0.00	
4,481.00	26.40	200.90	4,472.77	-54.34	-12.61	53.81	12.92	12.58	-7.10	
4,513.00	30.50	199.40	4,500.90	-68.65	-17.85	67.90	13.00	12.81	-4.69	
4,545.00	34.90	198.10	4,527.82	-85.02	-23.39	84.05	13.92	13.75	-4.06	
4,577.00	39.50	197.20	4,553.30	-103.45	-29.25	102.24	14.47	14.38	-2.81	
4,608.00	43.50	194.80	4,576.52	-123.19	-34.89	121.75	13.88	12.90	-7.74	
4,640.00	46.50	192.00	4,599.14	-145.20	-40.12	143.54	11.23	9.38	-8.75	
4,671.00	48.90	187.30	4,620.01	-167.79	-43.94	165.97	13.62	7.74	-15.16	
4,703.00	51.20	183.90	4,640.56	-192.20	-46.33	190.26	10.86	7.19	-10.63	
4,734.00	53.90	180.50	4,659.41	-216.79	-47.26	214.79	12.31	8.71	-10.97	
4,766.00	56.20	177.10	4,677.75	-243.00	-46.70	241.01	11.29	7.19	-10.63	



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Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
4,798.00	58.60	174.60	4,694.99	-269.88	-44.74	267.95	9.98	7.50	-7.81
4,829.00	59.70	173.20	4,710.89	-296.34	-41.91	294.50	5.26	3.55	-4.52
4,861.00	60.00	173.10	4,726.96	-323.82	-38.61	322.08	0.98	0.94	-0.31
4,893.00	60.20	171.80	4,742.91	-351.32	-34.96	349.70	3.58	0.63	-4.06
4,925.00	60.40	171.00	4,758.76	-378.80	-30.81	377.32	2.26	0.63	-2.50
4,957.00	62.70	169.10	4,774.01	-406.51	-25.94	405.20	8.88	7.19	-5.94
4,989.00	66.00	166.80	4,787.86	-434.71	-19.91	433.61	12.18	10.31	-7.19
5,021.00	68.90	165.90	4,800.13	-463.43	-12.94	462.58	9.43	9.06	-2.81
5,053.00	72.30	166.90	4,810.76	-492.76	-5.84	492.16	11.03	10.63	3.13
5,084.00	74.30	168.90	4,819.67	-521.79	0.38	521.41	8.93	6.45	6.45
5,116.00	77.30	171.10	4,827.52	-552.33	5.76	552.14	11.50	9.38	6.88
5,147.00	81.50	173.20	4,833.22	-582.51	9.92	582.46	15.10	13.55	6.77
5,179.00	85.00	173.00	4,836.98	-614.05	13.73	614.13	10.96	10.94	-0.63
5,211.00	86.80	173.00	4,839.27	-645.73	17.62	645.93	5.63	5.63	0.00
5,242.00	87.30	173.20	4,840.86	-676.47	21.34	676.79	1.74	1.61	0.65
5,274.00	89.00	172.90	4,841.90	-708.22	25.21	708.66	5.39	5.31	-0.94
5,301.00	90.80	172.80	4,841.94	-735.00	28.57	735.56	6.68	6.67	-0.37
5,332.00	91.50	175.30	4,841.32	-765.83	31.79	766.49	8.37	2.26	8.06
5,420.00	92.90	175.80	4,837.94	-853.50	38.61	854.35	1.69	1.59	0.57
5,514.00	89.80	176.30	4,835.73	-947.24	45.08	948.27	3.34	-3.30	0.53
5,609.00	88.70	178.50	4,836.97	-1,042.12	49.39	1,043.25	2.59	-1.16	2.32
5,704.00	88.50	177.60	4,839.29	-1,137.04	52.62	1,138.22	0.97	-0.21	-0.95
5,799.00	89.00	179.00	4,841.37	-1,231.97	55.44	1,233.19	1.56	0.53	1.47
5,894.00	87.50	178.80	4,844.27	-1,326.91	57.26	1,328.13	1.59	-1.58	-0.21
5,989.00	90.20	177.70	4,846.17	-1,421.83	60.16	1,423.10	3.07	2.84	-1.16
6,084.00	90.70	176.80	4,845.43	-1,516.72	64.72	1,518.09	1.08	0.53	-0.95
6,179.00	90.60	176.00	4,844.35	-1,611.52	70.69	1,613.05	0.85	-0.11	-0.84
6,274.00	88.40	176.40	4,845.18	-1,706.31	76.98	1,708.01	2.35	-2.32	0.42
6,369.00	89.50	179.10	4,846.92	-1,801.21	80.71	1,802.98	3.07	1.16	2.84
6,464.00	91.30	178.40	4,846.26	-1,896.18	82.78	1,897.96	2.03	1.89	-0.74
6,559.00	89.40	178.50	4,845.68	-1,991.14	85.35	1,992.95	2.00	-2.00	0.11
6,654.00	90.50	176.20	4,845.76	-2,086.03	89.74	2,087.94	2.68	1.16	-2.42
6,749.00	88.70	176.90	4,846.42	-2,180.85	95.46	2,182.91	2.03	-1.89	0.74
6,843.00	89.80	179.80	4,847.65	-2,274.79	98.17	2,276.88	3.30	1.17	3.09
6,938.00	91.10	179.80	4,846.91	-2,369.78	98.50	2,371.82	1.37	1.37	0.00
7,032.00	88.30	179.80	4,847.40	-2,463.77	98.82	2,465.75	2.98	-2.98	0.00
7,128.00	90.40	180.30	4,848.49	-2,559.76	98.74	2,561.66	2.25	2.19	0.52
7,222.00	91.00	179.70	4,847.34	-2,653.75	98.74	2,655.59	0.90	0.64	-0.64
7,317.00	90.50	179.70	4,846.10	-2,748.74	99.24	2,750.52	0.53	-0.53	0.00
7,412.00	87.70	177.60	4,847.59	-2,843.69	101.48	2,845.49	3.68	-2.95	-2.21
7,507.00	88.00	177.60	4,851.15	-2,938.54	105.45	2,940.42	0.32	0.32	0.00
7,601.00	90.80	176.90	4,852.14	-3,032.42	109.96	3,034.40	3.07	2.98	-0.74
7,696.00	90.20	177.40	4,851.31	-3,127.29	114.68	3,129.39	0.82	-0.63	0.53
7,790.00	88.80	176.40	4,852.13	-3,221.15	119.77	3,223.37	1.83	-1.49	-1.06



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Site:	Donovan	MD Reference:	WELL @ 1679.00usft (Patterson 421)
Well:	1-10H	North Reference:	Grid
Wellbore:	Wellbore #1	Survey Calculation Method:	Minimum Curvature
Design:	Surveys	Database:	Southern Region

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)	
7,886.00	89.80	176.70	4,853.30	-3,316.97	125.54	3,319.34	1.09	1.04	0.31	
7,980.00	89.00	177.10	4,854.29	-3,410.82	130.63	3,413.32	0.95	-0.85	0.43	
8,075.00	89.80	178.00	4,855.28	-3,505.73	134.69	3,508.32	1.27	0.84	0.95	
8,169.00	91.00	178.30	4,854.62	-3,599.68	137.72	3,602.31	1.32	1.28	0.32	
8,264.00	88.50	178.40	4,855.04	-3,694.63	140.46	3,697.30	2.63	-2.63	0.11	
8,359.00	89.10	178.60	4,857.03	-3,789.58	142.94	3,792.27	0.67	0.63	0.21	
8,454.00	89.30	179.60	4,858.35	-3,884.55	144.43	3,887.23	1.07	0.21	1.05	
8,549.00	89.60	178.80	4,859.27	-3,979.54	145.76	3,982.20	0.90	0.32	-0.84	
8,642.00	89.20	176.10	4,860.24	-4,072.43	149.90	4,075.18	2.93	-0.43	-2.90	
8,738.00	89.40	176.00	4,861.41	-4,168.20	156.51	4,171.13	0.23	0.21	-0.10	
8,833.00	89.20	177.00	4,862.57	-4,263.01	162.31	4,266.10	1.07	-0.21	1.05	
8,928.00	88.10	177.60	4,864.81	-4,357.88	166.78	4,361.07	1.32	-1.16	0.63	
9,023.00	89.50	176.60	4,866.80	-4,452.73	171.59	4,456.04	1.81	1.47	-1.05	
9,094.00	88.30	175.10	4,868.16	-4,523.53	176.73	4,526.98	2.71	-1.69	-2.11	
9,190.00	88.70	176.30	4,870.68	-4,619.22	183.92	4,622.88	1.32	0.42	1.25	
9,242.00	88.70	177.10	4,871.86	-4,671.12	186.91	4,674.86	1.54	0.00	1.54	
9,261.43	88.70	177.10	4,872.30	-4,690.52	187.90	4,694.28	0.00	0.00	0.00	
330' Hardline Intersect-9261.43' MD										
9,301.00	88.70	177.10	4,873.20	-4,730.03	189.90	4,733.84	0.00	0.00	0.00	
Projection to TD-9301.00' MD										

Survey Annotations					
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment	
		+N/-S (usft)	+E/-W (usft)		
830.00	829.78	-11.39	12.04	Tie-In to VES Gyro-830.00' MD	
4,354.27	4,353.07	-16.88	2.89	330' Hardline Intersect-4354.27' MD	
9,261.43	4,872.30	-4,690.52	187.90	330' Hardline Intersect-9261.43' MD	
9,301.00	4,873.20	-4,730.03	189.90	Projection to TD-9301.00' MD	