

Tug Hill Operating LLC

Hodgeman County, Kansas (NAD 83)

Sec 20, T23S, R22W

Gleason # 1-20H

Original Wellbore

Survey: MWD Survey

Survey Report - Geographic

14 November, 2012



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Site Sec 20, T23S, R22W
Project:	Hodgeman County, Kansas (NAD 83)	TVD Reference:	WELL @ 2355.0usft (Original Well Elev)
Site:	Sec 20, T23S, R22W	MD Reference:	WELL @ 2355.0usft (Original Well Elev)
Well:	Gleason # 1-20H	North Reference:	True
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Project	Hodgeman 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		

Site	Sec 20, T23S, R22W				
Site Position:		Northing:	1,811,134.42 usft	Latitude:	38° 1' 47.468 N
From:	Map	Easting:	950,852.94 usft	Longitude:	99° 45' 18.188 W
Position Uncertainty:	0.0 usft	Slot Radius:	13-3/16 "	Grid Convergence:	-0.77 °

Well	Gleason # 1-20H					
Well Position	+N/-S	0.0 usft	Northing:	1,811,134.42 usft	Latitude:	38° 1' 47.468 N
	+E/-W	0.0 usft	Easting:	950,852.94 usft	Longitude:	99° 45' 18.188 W
Position Uncertainty		0.0 usft	Wellhead Elevation:	23.0 usft	Ground Level:	2,332.0 usft

Wellbore	Original Wellbore				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	10/23/2012	5.65	65.80	52,199

Design	Original Wellbore				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.0
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.0	0.0	0.0		0.00

Survey Program	Date	11/14/2012			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.0	830.0	Gyro Survey (Original Wellbore)	NS-GYRO-SS	NS Gyro single shots	
897.0	9,144.0	MWD Survey (Original Wellbore)	MWD	MWD - Standard	

Measured Depth (usft)	Inclination	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
830.0	0.95	192.80	830.0	-5.4	1.1	1,811,128.96	950,854.01	38° 1' 47.414 N	99° 45' 18.174 W
897.0	0.40	223.20	897.0	-6.2	0.9	1,811,128.25	950,853.72	38° 1' 47.407 N	99° 45' 18.177 W
First MWD Survey									
991.0	0.30	226.10	991.0	-6.6	0.5	1,811,127.85	950,853.31	38° 1' 47.403 N	99° 45' 18.182 W
1,086.0	0.40	218.10	1,086.0	-7.0	0.1	1,811,127.42	950,852.92	38° 1' 47.398 N	99° 45' 18.187 W
1,180.0	0.20	218.60	1,180.0	-7.4	-0.2	1,811,127.04	950,852.61	38° 1' 47.395 N	99° 45' 18.191 W
1,274.0	0.40	193.30	1,274.0	-7.8	-0.4	1,811,126.59	950,852.42	38° 1' 47.390 N	99° 45' 18.193 W
1,366.0	0.50	179.20	1,366.0	-8.5	-0.5	1,811,125.88	950,852.35	38° 1' 47.383 N	99° 45' 18.194 W
1,459.0	0.60	173.10	1,459.0	-9.4	-0.4	1,811,124.99	950,852.40	38° 1' 47.374 N	99° 45' 18.193 W
1,551.0	0.40	170.10	1,551.0	-10.2	-0.3	1,811,124.19	950,852.50	38° 1' 47.367 N	99° 45' 18.192 W
1,643.0	0.40	181.70	1,643.0	-10.9	-0.3	1,811,123.55	950,852.54	38° 1' 47.360 N	99° 45' 18.191 W

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Well:	Gleason # 1-20H	North Reference:	True
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Survey											
Measured Depth (usft)	Inclination (n)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude		
1,734.0	0.40	199.80	1,734.0	-11.5	-0.4	1,811,122.94	950,852.41	38° 1' 47.354 N	99° 45' 18.193 W		
1,826.0	0.40	186.90	1,825.9	-12.1	-0.5	1,811,122.32	950,852.26	38° 1' 47.348 N	99° 45' 18.194 W		
1,918.0	0.30	209.10	1,917.9	-12.6	-0.7	1,811,121.79	950,852.09	38° 1' 47.343 N	99° 45' 18.196 W		
2,011.0	0.20	212.40	2,010.9	-13.0	-0.9	1,811,121.45	950,851.88	38° 1' 47.339 N	99° 45' 18.199 W		
2,103.0	0.40	235.30	2,102.9	-13.3	-1.2	1,811,121.13	950,851.53	38° 1' 47.336 N	99° 45' 18.203 W		
2,195.0	0.30	293.80	2,194.9	-13.4	-1.7	1,811,121.05	950,851.04	38° 1' 47.335 N	99° 45' 18.209 W		
2,287.0	0.30	296.50	2,286.9	-13.2	-2.2	1,811,121.26	950,850.61	38° 1' 47.337 N	99° 45' 18.215 W		
2,380.0	0.40	281.50	2,379.9	-13.0	-2.7	1,811,121.44	950,850.08	38° 1' 47.339 N	99° 45' 18.221 W		
2,472.0	0.20	283.10	2,471.9	-12.9	-3.2	1,811,121.55	950,849.61	38° 1' 47.340 N	99° 45' 18.227 W		
2,564.0	0.70	9.60	2,563.9	-12.3	-3.2	1,811,122.14	950,849.55	38° 1' 47.346 N	99° 45' 18.228 W		
2,656.0	1.00	4.80	2,655.9	-11.0	-3.1	1,811,123.49	950,849.73	38° 1' 47.359 N	99° 45' 18.226 W		
2,748.0	0.80	5.50	2,747.9	-9.5	-2.9	1,811,124.93	950,849.88	38° 1' 47.374 N	99° 45' 18.225 W		
2,841.0	0.80	356.40	2,840.9	-8.2	-2.9	1,811,126.23	950,849.92	38° 1' 47.386 N	99° 45' 18.224 W		
2,932.0	1.00	355.30	2,931.9	-6.8	-3.0	1,811,127.65	950,849.83	38° 1' 47.400 N	99° 45' 18.226 W		
3,025.0	0.90	354.10	3,024.9	-5.3	-3.2	1,811,129.19	950,849.71	38° 1' 47.416 N	99° 45' 18.227 W		
3,118.0	0.90	3.80	3,117.9	-3.8	-3.2	1,811,130.64	950,849.71	38° 1' 47.430 N	99° 45' 18.228 W		
3,213.0	0.70	40.90	3,212.9	-2.6	-2.8	1,811,131.82	950,850.15	38° 1' 47.442 N	99° 45' 18.222 W		
3,307.0	0.40	46.50	3,306.9	-2.0	-2.1	1,811,132.47	950,850.77	38° 1' 47.448 N	99° 45' 18.215 W		
3,402.0	0.60	181.30	3,401.9	-2.2	-1.9	1,811,132.20	950,851.00	38° 1' 47.446 N	99° 45' 18.212 W		
3,497.0	0.40	180.30	3,496.9	-3.1	-1.9	1,811,131.37	950,850.98	38° 1' 47.437 N	99° 45' 18.212 W		
3,591.0	0.40	190.50	3,590.8	-3.7	-2.0	1,811,130.72	950,850.91	38° 1' 47.431 N	99° 45' 18.213 W		
3,685.0	0.40	221.00	3,684.8	-4.3	-2.3	1,811,130.16	950,850.62	38° 1' 47.425 N	99° 45' 18.216 W		
3,780.0	0.40	195.60	3,779.8	-4.9	-2.6	1,811,129.59	950,850.31	38° 1' 47.420 N	99° 45' 18.220 W		
3,875.0	0.50	310.90	3,874.8	-4.9	-3.0	1,811,129.55	950,849.91	38° 1' 47.419 N	99° 45' 18.225 W		
3,969.0	0.80	324.60	3,968.8	-4.1	-3.7	1,811,130.36	950,849.23	38° 1' 47.427 N	99° 45' 18.234 W		
4,064.0	4.10	349.50	4,063.7	-0.2	-4.7	1,811,134.26	950,848.27	38° 1' 47.465 N	99° 45' 18.246 W		
4,096.0	6.90	351.50	4,095.6	2.8	-5.2	1,811,137.29	950,847.82	38° 1' 47.495 N	99° 45' 18.252 W		
4,127.0	9.20	353.80	4,126.3	7.1	-5.7	1,811,141.60	950,847.34	38° 1' 47.538 N	99° 45' 18.259 W		
4,159.0	11.70	353.90	4,157.7	12.9	-6.3	1,811,147.38	950,846.79	38° 1' 47.595 N	99° 45' 18.267 W		
4,191.0	14.20	355.70	4,188.9	20.0	-7.0	1,811,154.53	950,846.25	38° 1' 47.666 N	99° 45' 18.275 W		
4,222.0	16.80	356.20	4,218.8	28.3	-7.5	1,811,162.80	950,845.78	38° 1' 47.747 N	99° 45' 18.282 W		
4,253.0	19.70	358.00	4,248.2	38.0	-8.0	1,811,172.50	950,845.43	38° 1' 47.843 N	99° 45' 18.288 W		
4,284.0	22.70	0.10	4,277.1	49.2	-8.2	1,811,183.71	950,845.41	38° 1' 47.954 N	99° 45' 18.290 W		
4,316.0	25.30	1.10	4,306.4	62.2	-8.1	1,811,196.72	950,845.73	38° 1' 48.083 N	99° 45' 18.289 W		
4,348.0	28.50	0.80	4,334.9	76.7	-7.8	1,811,211.19	950,846.16	38° 1' 48.226 N	99° 45' 18.286 W		
4,379.0	31.70	359.40	4,361.7	92.2	-7.8	1,811,226.73	950,846.39	38° 1' 48.379 N	99° 45' 18.285 W		
4,411.0	34.70	359.00	4,388.5	109.7	-8.0	1,811,244.25	950,846.38	38° 1' 48.553 N	99° 45' 18.288 W		
4,442.0	37.70	359.90	4,413.5	128.0	-8.2	1,811,262.55	950,846.45	38° 1' 48.734 N	99° 45' 18.291 W		
4,474.0	41.20	0.40	4,438.2	148.4	-8.2	1,811,282.88	950,846.78	38° 1' 48.934 N	99° 45' 18.290 W		
4,505.0	44.60	0.80	4,460.9	169.5	-7.9	1,811,303.97	950,847.29	38° 1' 49.143 N	99° 45' 18.287 W		
4,537.0	47.80	0.80	4,483.1	192.6	-7.6	1,811,327.06	950,847.92	38° 1' 49.371 N	99° 45' 18.283 W		
4,568.0	51.30	0.60	4,503.2	216.1	-7.3	1,811,350.64	950,848.53	38° 1' 49.605 N	99° 45' 18.279 W		
4,600.0	54.40	0.60	4,522.5	241.6	-7.1	1,811,376.13	950,849.14	38° 1' 49.857 N	99° 45' 18.276 W		
4,631.0	57.60	1.00	4,539.8	267.3	-6.7	1,811,401.82	950,849.84	38° 1' 50.111 N	99° 45' 18.272 W		
4,663.0	59.00	0.80	4,556.6	294.6	-6.3	1,811,429.03	950,850.64	38° 1' 50.380 N	99° 45' 18.266 W		
4,694.0	59.30	0.60	4,572.5	321.2	-5.9	1,811,455.64	950,851.32	38° 1' 50.643 N	99° 45' 18.262 W		
4,726.0	59.70	0.30	4,588.8	348.7	-5.7	1,811,483.20	950,851.91	38° 1' 50.915 N	99° 45' 18.259 W		
4,757.0	60.90	0.30	4,604.1	375.7	-5.6	1,811,510.13	950,852.41	38° 1' 51.182 N	99° 45' 18.258 W		
4,789.0	64.20	0.60	4,618.9	404.1	-5.4	1,811,538.51	950,853.02	38° 1' 51.462 N	99° 45' 18.255 W		
4,820.0	67.50	1.00	4,631.6	432.3	-5.0	1,811,566.79	950,853.80	38° 1' 51.742 N	99° 45' 18.250 W		
4,852.0	70.60	1.30	4,643.0	462.2	-4.4	1,811,596.65	950,854.80	38° 1' 52.037 N	99° 45' 18.242 W		
4,883.0	74.30	1.30	4,652.4	491.8	-3.7	1,811,626.18	950,855.87	38° 1' 52.329 N	99° 45' 18.234 W		
4,914.0	77.90	1.30	4,659.8	521.8	-3.0	1,811,656.25	950,856.95	38° 1' 52.627 N	99° 45' 18.226 W		
4,946.0	81.70	0.60	4,665.5	553.3	-2.5	1,811,687.72	950,857.90	38° 1' 52.938 N	99° 45' 18.219 W		
4,978.0	85.60	0.10	4,669.0	585.1	-2.3	1,811,719.51	950,858.52	38° 1' 53.252 N	99° 45' 18.217 W		

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Site:	Sec 20, T23S, R22W	MD Reference:	WELL @ 2355.0usft (Original Well Elev)
Well:	Gleason # 1-20H	North Reference:	True
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
5,013.0	88.00	0.10	4,671.0	620.1	-2.2	1,811,754.45	950,859.05	38° 1' 53.598 N	99° 45' 18.216 W	
5,045.0	88.70	359.70	4,671.9	652.0	-2.3	1,811,786.44	950,859.43	38° 1' 53.914 N	99° 45' 18.217 W	
5,077.0	88.50	359.70	4,672.7	684.0	-2.5	1,811,818.43	950,859.69	38° 1' 54.230 N	99° 45' 18.219 W	
5,108.0	89.30	0.30	4,673.3	715.0	-2.5	1,811,849.42	950,860.11	38° 1' 54.537 N	99° 45' 18.219 W	
5,174.0	89.70	0.60	4,673.8	781.0	-1.9	1,811,915.40	950,861.51	38° 1' 55.189 N	99° 45' 18.212 W	
5,267.0	90.80	0.30	4,673.4	874.0	-1.2	1,812,008.38	950,863.49	38° 1' 56.109 N	99° 45' 18.203 W	
5,359.0	92.20	1.50	4,671.0	966.0	0.2	1,812,100.30	950,866.18	38° 1' 57.018 N	99° 45' 18.185 W	
5,451.0	89.10	359.90	4,670.0	1,057.9	1.4	1,812,192.25	950,868.54	38° 1' 57.927 N	99° 45' 18.171 W	
5,543.0	90.20	359.70	4,670.5	1,149.9	1.0	1,812,284.24	950,869.46	38° 1' 58.836 N	99° 45' 18.175 W	
5,635.0	92.90	0.40	4,668.1	1,241.9	1.1	1,812,376.19	950,870.77	38° 1' 59.746 N	99° 45' 18.174 W	
5,727.0	88.50	0.10	4,666.9	1,333.9	1.5	1,812,468.15	950,872.41	38° 2' 0.655 N	99° 45' 18.169 W	
5,818.0	88.50	359.60	4,669.3	1,424.8	1.3	1,812,559.11	950,873.40	38° 2' 1.554 N	99° 45' 18.172 W	
5,911.0	88.50	0.10	4,671.7	1,517.8	1.0	1,812,652.07	950,874.41	38° 2' 2.473 N	99° 45' 18.175 W	
6,003.0	89.60	359.40	4,673.3	1,609.8	0.6	1,812,744.06	950,875.24	38° 2' 3.383 N	99° 45' 18.180 W	
6,095.0	90.80	0.40	4,672.9	1,701.8	0.5	1,812,836.05	950,876.32	38° 2' 4.292 N	99° 45' 18.182 W	
6,187.0	92.00	0.60	4,670.7	1,793.8	1.3	1,812,927.99	950,878.36	38° 2' 5.201 N	99° 45' 18.172 W	
6,280.0	91.80	359.60	4,667.6	1,886.7	1.4	1,813,020.93	950,879.77	38° 2' 6.120 N	99° 45' 18.170 W	
6,373.0	93.50	0.60	4,663.3	1,979.6	1.6	1,813,113.82	950,881.19	38° 2' 7.039 N	99° 45' 18.168 W	
6,464.0	93.80	0.60	4,657.5	2,070.4	2.5	1,813,204.61	950,883.36	38° 2' 7.936 N	99° 45' 18.156 W	
6,557.0	90.70	0.10	4,653.9	2,163.3	3.1	1,813,297.50	950,885.18	38° 2' 8.855 N	99° 45' 18.149 W	
6,650.0	89.70	359.60	4,653.5	2,256.3	2.9	1,813,390.50	950,886.19	38° 2' 9.774 N	99° 45' 18.152 W	
6,740.0	90.20	359.60	4,653.6	2,346.3	2.2	1,813,480.49	950,886.77	38° 2' 10.664 N	99° 45' 18.160 W	
6,833.0	91.30	359.40	4,652.4	2,439.3	1.4	1,813,573.48	950,887.21	38° 2' 11.583 N	99° 45' 18.170 W	
6,927.0	90.30	359.40	4,651.1	2,533.3	0.4	1,813,667.47	950,887.49	38° 2' 12.513 N	99° 45' 18.182 W	
7,021.0	89.10	359.00	4,651.6	2,627.3	-0.9	1,813,761.47	950,887.44	38° 2' 13.442 N	99° 45' 18.199 W	
7,116.0	89.20	358.20	4,653.0	2,722.2	-3.2	1,813,856.45	950,886.40	38° 2' 14.381 N	99° 45' 18.228 W	
7,210.0	88.40	359.20	4,655.0	2,816.2	-5.3	1,813,950.43	950,885.53	38° 2' 15.309 N	99° 45' 18.254 W	
7,305.0	87.60	358.90	4,658.3	2,911.1	-6.9	1,814,045.37	950,885.24	38° 2' 16.248 N	99° 45' 18.274 W	
7,400.0	88.30	359.20	4,661.7	3,006.0	-8.5	1,814,140.31	950,884.94	38° 2' 17.186 N	99° 45' 18.294 W	
7,494.0	91.20	0.60	4,662.1	3,100.0	-8.6	1,814,234.29	950,886.04	38° 2' 18.116 N	99° 45' 18.296 W	
7,589.0	91.50	0.40	4,659.9	3,195.0	-7.8	1,814,329.24	950,888.15	38° 2' 19.054 N	99° 45' 18.285 W	
7,682.0	93.60	2.00	4,655.7	3,287.9	-5.9	1,814,422.08	950,891.34	38° 2' 19.973 N	99° 45' 18.261 W	
7,777.0	95.20	1.80	4,648.4	3,382.5	-2.7	1,814,516.69	950,895.76	38° 2' 20.909 N	99° 45' 18.222 W	
7,871.0	93.40	0.40	4,641.4	3,476.3	-0.9	1,814,610.37	950,898.82	38° 2' 21.835 N	99° 45' 18.199 W	
7,966.0	91.50	359.90	4,637.3	3,571.2	-0.7	1,814,705.27	950,900.34	38° 2' 22.773 N	99° 45' 18.196 W	
8,061.0	87.80	359.70	4,637.9	3,666.1	-1.0	1,814,800.25	950,901.29	38° 2' 23.712 N	99° 45' 18.200 W	
8,155.0	87.70	359.40	4,641.6	3,760.1	-1.7	1,814,894.17	950,901.82	38° 2' 24.641 N	99° 45' 18.210 W	
8,250.0	87.50	358.30	4,645.6	3,855.0	-3.6	1,814,989.09	950,901.19	38° 2' 25.579 N	99° 45' 18.233 W	
8,344.0	88.90	359.20	4,648.5	3,948.9	-5.7	1,815,083.03	950,900.41	38° 2' 26.508 N	99° 45' 18.259 W	
8,439.0	90.80	359.60	4,648.8	4,043.9	-6.7	1,815,178.03	950,900.69	38° 2' 27.447 N	99° 45' 18.271 W	
8,533.0	92.50	359.40	4,646.1	4,137.8	-7.5	1,815,271.98	950,901.13	38° 2' 28.376 N	99° 45' 18.282 W	
8,627.0	95.70	359.60	4,639.3	4,231.6	-8.3	1,815,365.73	950,901.58	38° 2' 29.302 N	99° 45' 18.292 W	
8,722.0	89.40	359.00	4,635.1	4,326.4	-9.5	1,815,460.59	950,901.69	38° 2' 30.240 N	99° 45' 18.306 W	
8,817.0	91.60	359.60	4,634.3	4,421.4	-10.6	1,815,555.58	950,901.81	38° 2' 31.179 N	99° 45' 18.321 W	
8,911.0	92.80	359.00	4,630.7	4,515.3	-11.8	1,815,649.51	950,901.93	38° 2' 32.108 N	99° 45' 18.335 W	
9,006.0	89.40	1.70	4,628.9	4,610.3	-11.2	1,815,744.45	950,903.79	38° 2' 33.046 N	99° 45' 18.328 W	
Last MWD Survey										
9,144.0	89.40	1.70	4,630.3	4,748.2	-7.1	1,815,882.31	950,909.74	38° 2' 34.410 N	99° 45' 18.277 W	
PTB - TD										

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Site Sec 20, T23S, R22W
Project:	Hodgeman County, Kansas (NAD 83)	TVD Reference:	WELL @ 2355.0usft (Original Well Elev)
Site:	Sec 20, T23S, R22W	MD Reference:	WELL @ 2355.0usft (Original Well Elev)
Well:	Gleason # 1-20H	North Reference:	True
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Survey Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
897.0	897.0	-6.2	0.9	First MWD Survey
9,006.0	4,628.9	4,610.3	-11.2	Last MWD Survey
9,144.0	4,630.3	4,748.2	-7.1	PTB - TD

Checked By: _____ Approved By: _____ Date: _____