

PETROLEUM DEVELOPMENT CORP Weld County CO

Well Name: Thornton 17T-421

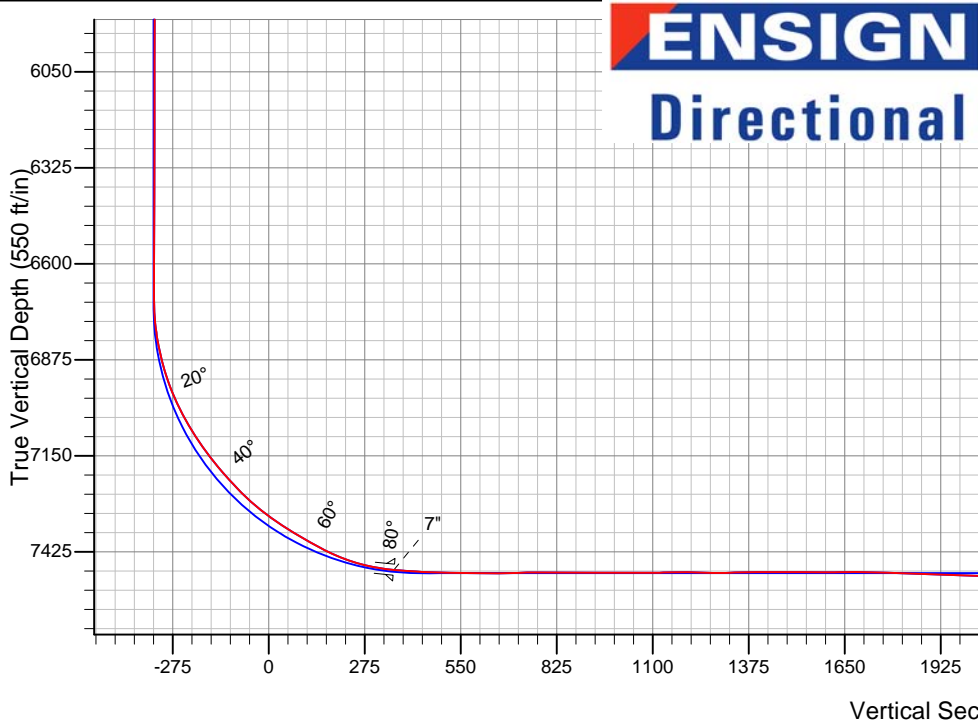
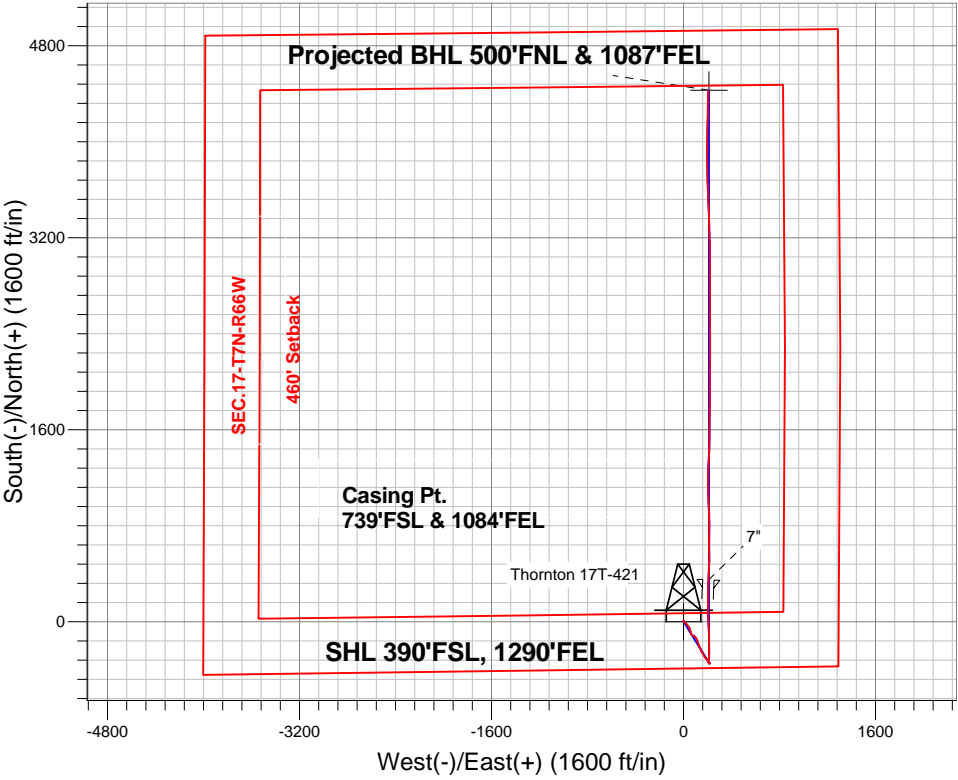
Surface Location: Thornton 17T-421 Pad Sec.17-T7N-R66W  
North American Datum 1983 , US State Plane 1983 , Colorado Northern Zone

Ground Elevation: 4951.0

+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Slot
0.0	0.0	1450806.61	3195225.60	40.568740	-104.797280	
Ensign Rig #14 - RKB-15' WELL @ 4966.0ft (Ensign Rig #14 - RKB-15')						

FINAL SURVEY

Projected Bottom Hole Location  
11931'MD 7490'TVD 4430'N & 204'E of SHL  
90.5 degree Incl @ 1.1 degree AZM



Thornton 17T-421 Pad Sec.17-T7N-R66W  
Thornton 17T-421  
Wellbore #1  
13:19, September 05 2014

ANNOTATIONS

No annotation data is available.

LEGEND

- Thornton 17T-421, Wellbore #1, Plan #3 (8-20-14) V0
- Wellbore #1
- Survey #1



# **PETROLEUM DEVELOPMENT CORP Weld County CO**

**SEC.17-T7N-R66W**

**Thornton 17T-421 Pad Sec.17-T7N-R66W**

**Thornton 17T-421**

**Wellbore #1**

**Survey: Survey #1**

## **Standard Survey Report**

**05 September, 2014**

<b>Company:</b>	PETROLEUM DEVELOPMENT CORP Weld County CO	<b>Local Co-ordinate Reference:</b>	Well Thornton 17T-421
<b>Project:</b>	SEC.17-T7N-R66W	<b>TVD Reference:</b>	WELL @ 4966.0ft (Ensign Rig #14 - RKB-15')
<b>Site:</b>	Thornton 17T-421 Pad Sec.17-T7N-R66W	<b>MD Reference:</b>	WELL @ 4966.0ft (Ensign Rig #14 - RKB-15')
<b>Well:</b>	Thornton 17T-421	<b>North Reference:</b>	True
<b>Wellbore:</b>	Wellbore #1	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Wellbore #1	<b>Database:</b>	Landmark

<b>Project</b>	SEC.17-T7N-R66W, Weld County, Colorado		
<b>Map System:</b>	US State Plane 1983	<b>System Datum:</b>	Mean Sea Level
<b>Geo Datum:</b>	North American Datum 1983		Using Well Reference Point
<b>Map Zone:</b>	Colorado Northern Zone		Using geodetic scale factor

Site		Thornton 17T-421 Pad Sec.17-T7N-R66W			
Site Position:		Northing:	1,450,806.63ft	Latitude:	40.568740
From:	Lat/Long	Easting:	3,195,225.60ft	Longitude:	-104.797280
Position Uncertainty:	0.0 ft	Slot Radius:	"	Grid Convergence:	0.45 °

Well	Thornton 17T-421					
Well Position	+N-S	0.0 ft	Northing:	1,450,806.61 ft	Latitude:	40.568740
	+E-W	0.0 ft	Easting:	3,195,225.60 ft	Longitude:	-104.797280
Position Uncertainty		0.0 ft	Wellhead Elevation:	ft	Ground Level:	4,951.0 ft

<b>Wellbore</b>	Wellbore #1				
<b>Magnetics</b>	<b>Model Name</b>	<b>Sample Date</b>	<b>Declination (°)</b>	<b>Dip Angle (°)</b>	<b>Field Strength (nT)</b>
	IGRF2010	8/20/2014	8.47	67.07	52,880

<b>Design</b>	Wellbore #1				
<b>Audit Notes:</b>					
<b>Version:</b>	1.0	<b>Phase:</b>	ACTUAL	<b>Tie On Depth:</b>	0.0
<b>Vertical Section:</b>	<b>Depth From (TVD) (ft)</b>	<b>+N-S (ft)</b>	<b>+E-W (ft)</b>	<b>Direction (°)</b>	
	0.0	0.0	0.0	2.73	

<b>Survey Program</b>	<b>Date</b>	9/5/2014			
<b>From (ft)</b>	<b>To (ft)</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>	
155.0	11,931.0	Survey #1 (Wellbore #1)	MWD	MWD - Standard	

<b>Survey</b>										
<b>Measured Depth (ft)</b>	<b>Inclination (°)</b>	<b>Azimuth (°)</b>	<b>Vertical Depth (ft)</b>	<b>+N-S (ft)</b>	<b>+E-W (ft)</b>	<b>Vertical Section (ft)</b>	<b>Dogleg Rate (°/100ft)</b>	<b>Build Rate (°/100ft)</b>	<b>Turn Rate (°/100ft)</b>	
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00	
1.0	0.01	353.50	1.0	0.0	0.0	0.0	0.65	0.65	0.00	
<b>SHL 390'FSL, 1290'FEL</b>										
155.0	1.00	353.50	155.0	1.3	-0.2	1.3	0.65	0.65	0.00	
276.0	1.30	5.00	276.0	3.8	-0.2	3.7	0.31	0.25	9.50	
397.0	0.40	355.80	397.0	5.5	-0.1	5.5	0.75	-0.74	-7.60	
518.0	0.40	10.90	518.0	6.4	0.0	6.4	0.09	0.00	12.48	
640.0	0.80	339.30	639.9	7.6	-0.2	7.6	0.41	0.33	-25.90	
762.0	1.60	136.30	761.9	7.2	0.6	7.2	1.93	0.66	128.69	
890.0	2.20	138.90	889.9	4.0	3.5	4.2	0.47	0.47	2.03	
976.0	2.80	135.40	975.8	1.3	6.0	1.6	0.72	0.70	-4.07	
1,098.0	4.80	140.10	1,097.5	-4.8	11.4	-4.2	1.66	1.64	3.85	

<b>Company:</b>	PETROLEUM DEVELOPMENT CORP Weld County CO	<b>Local Co-ordinate Reference:</b>	Well Thornton 17T-421
<b>Project:</b>	SEC.17-T7N-R66W	<b>TVD Reference:</b>	WELL @ 4966.0ft (Ensign Rig #14 - RKB-15')
<b>Site:</b>	Thornton 17T-421 Pad Sec.17-T7N-R66W	<b>MD Reference:</b>	WELL @ 4966.0ft (Ensign Rig #14 - RKB-15')
<b>Well:</b>	Thornton 17T-421	<b>North Reference:</b>	True
<b>Wellbore:</b>	Wellbore #1	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Wellbore #1	<b>Database:</b>	Landmark

Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
1,219.0	6.60	141.00	1,217.9	-14.0	19.0	-13.1	1.49	1.49	0.74
1,369.0	6.10	138.40	1,367.0	-26.7	29.8	-25.3	0.38	-0.33	-1.73
1,521.0	6.10	145.60	1,518.1	-39.4	39.7	-37.5	0.50	0.00	4.74
1,704.0	5.70	158.40	1,700.2	-55.9	48.5	-53.5	0.75	-0.22	6.99
1,886.0	4.90	162.30	1,881.4	-71.7	54.2	-69.0	0.48	-0.44	2.14
2,042.0	5.40	167.60	2,036.8	-85.2	57.8	-82.4	0.44	0.32	3.40
2,199.0	5.70	158.60	2,193.0	-99.7	62.2	-96.6	0.59	0.19	-5.73
2,388.0	5.20	116.20	2,381.2	-112.2	73.4	-108.6	2.10	-0.26	-22.43
2,609.0	4.30	120.10	2,601.5	-120.8	89.5	-116.4	0.43	-0.41	1.76
2,735.0	4.90	138.90	2,727.1	-127.2	97.1	-122.4	1.28	0.48	14.92
2,861.0	5.40	154.00	2,852.6	-136.6	103.3	-131.5	1.14	0.40	11.98
2,987.0	6.90	159.30	2,977.8	-149.0	108.5	-143.7	1.27	1.19	4.21
3,177.0	7.10	157.20	3,166.4	-170.5	117.1	-164.7	0.17	0.11	-1.11
3,367.0	6.70	155.60	3,355.1	-191.4	126.3	-185.2	0.23	-0.21	-0.84
3,556.0	5.60	157.50	3,543.0	-210.0	134.3	-203.3	0.59	-0.58	1.01
3,746.0	6.70	159.30	3,731.9	-228.9	141.8	-221.9	0.59	0.58	0.95
3,936.0	7.20	149.40	3,920.5	-249.5	151.8	-242.0	0.68	0.26	-5.21
4,157.0	8.40	149.40	4,139.4	-275.3	167.1	-267.1	0.54	0.54	0.00
4,346.0	8.00	145.80	4,326.5	-298.1	181.5	-289.1	0.34	-0.21	-1.90
4,536.0	7.10	141.40	4,514.9	-318.2	196.2	-308.5	0.56	-0.47	-2.32
4,726.0	5.50	147.00	4,703.7	-335.0	208.5	-324.7	0.90	-0.84	2.95
4,853.0	3.50	153.50	4,830.3	-343.6	213.6	-333.1	1.62	-1.57	5.12
4,979.0	1.20	176.50	4,956.2	-348.4	215.4	-337.7	1.94	-1.83	18.25
5,074.0	0.70	8.30	5,051.2	-348.8	215.5	-338.1	1.99	-0.53	-177.05
5,263.0	1.00	9.35	5,240.2	-346.0	215.9	-335.3	0.16	0.16	0.56
5,484.0	1.30	353.00	5,461.1	-341.6	216.0	-331.0	0.20	0.14	-7.40
5,673.0	0.80	344.70	5,650.1	-338.2	215.3	-327.6	0.28	-0.26	-4.39
5,862.0	0.30	242.10	5,839.1	-337.2	214.6	-326.6	0.48	-0.26	-54.29
6,051.0	0.40	272.00	6,028.1	-337.4	213.5	-326.9	0.11	0.05	15.82
6,240.0	0.50	263.20	6,217.1	-337.5	212.0	-327.0	0.06	0.05	-4.66
6,430.0	0.40	232.90	6,407.1	-338.0	210.6	-327.6	0.13	-0.05	-15.95
6,620.0	0.60	263.50	6,597.1	-338.5	209.1	-328.1	0.17	0.11	16.11
6,683.0	0.50	267.00	6,660.1	-338.5	208.5	-328.2	0.17	-0.16	5.56
6,714.0	0.60	264.90	6,691.1	-338.6	208.2	-328.3	0.33	0.32	-6.77
6,746.0	1.50	340.90	6,723.0	-338.2	207.9	-327.9	4.61	2.81	237.50
6,777.0	4.10	359.00	6,754.0	-336.7	207.8	-326.4	8.76	8.39	58.39
6,809.0	7.30	4.30	6,785.8	-333.5	207.9	-323.2	10.12	10.00	16.56
6,841.0	10.20	6.50	6,817.5	-328.7	208.4	-318.4	9.12	9.06	6.88
6,872.0	11.70	6.70	6,847.9	-322.8	209.0	-312.5	4.84	4.84	0.65
6,904.0	14.30	6.70	6,879.1	-315.7	209.9	-305.3	8.13	8.13	0.00
6,936.0	16.90	6.50	6,909.9	-307.1	210.9	-296.7	8.13	8.13	-0.63
6,967.0	19.60	5.30	6,939.3	-297.5	211.9	-287.0	8.79	8.71	-3.87
6,999.0	22.40	2.70	6,969.2	-286.0	212.6	-275.6	9.22	8.75	-8.13
7,030.0	25.10	359.50	6,997.6	-273.5	212.9	-263.1	9.65	8.71	-10.32
7,062.0	27.60	358.80	7,026.3	-259.3	212.6	-248.9	7.87	7.81	-2.19
7,094.0	29.50	359.50	7,054.4	-244.1	212.4	-233.7	6.03	5.94	2.19
7,126.0	31.80	359.70	7,081.9	-227.7	212.3	-217.4	7.19	7.19	0.63
7,157.0	34.10	0.00	7,107.9	-210.9	212.3	-200.5	7.44	7.42	0.97
7,189.0	36.40	359.90	7,134.0	-192.4	212.3	-182.1	7.19	7.19	-0.31
7,220.0	38.30	359.90	7,158.7	-173.6	212.2	-163.3	6.13	6.13	0.00
7,252.0	39.80	359.20	7,183.5	-153.5	212.1	-143.2	4.89	4.69	-2.19
7,283.0	41.10	358.60	7,207.1	-133.3	211.7	-123.1	4.38	4.19	-1.94
7,315.0	43.00	358.30	7,230.9	-111.9	211.1	-101.7	5.97	5.94	-0.94
7,346.0	44.80	357.90	7,253.2	-90.4	210.4	-80.3	5.87	5.81	-1.29

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<b>Site:</b>	Thornton 17T-421 Pad Sec.17-T7N-R66W	<b>MD Reference:</b>	WELL @ 4966.0ft (Ensign Rig #14 - RKB-15')
<b>Well:</b>	Thornton 17T-421	<b>North Reference:</b>	True
<b>Wellbore:</b>	Wellbore #1	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Wellbore #1	<b>Database:</b>	Landmark

Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
7,378.0	47.40	357.60	7,275.4	-67.4	209.5	-57.4	8.15	8.13	-0.94
7,410.0	50.30	357.70	7,296.5	-43.3	208.5	-33.4	9.07	9.06	0.31
7,441.0	53.10	357.60	7,315.7	-19.0	207.5	-9.1	9.04	9.03	-0.32
7,473.0	55.40	357.60	7,334.4	6.9	206.4	16.7	7.19	7.19	0.00
7,504.0	57.20	357.40	7,351.6	32.7	205.3	42.4	5.83	5.81	-0.65
7,536.0	58.70	357.90	7,368.5	59.8	204.2	69.4	4.87	4.69	1.56
7,568.0	59.40	358.30	7,385.0	87.2	203.3	96.8	2.44	2.19	1.25
7,599.0	60.60	358.80	7,400.5	114.1	202.6	123.6	4.12	3.87	1.61
7,631.0	62.80	359.20	7,415.7	142.2	202.1	151.7	6.96	6.88	1.25
7,662.0	65.40	359.70	7,429.2	170.1	201.8	179.5	8.51	8.39	1.61
7,694.0	68.50	0.90	7,441.7	199.5	202.0	208.9	10.28	9.69	3.75
7,726.0	71.50	0.70	7,452.7	229.6	202.4	239.0	9.39	9.38	-0.63
7,757.0	75.40	2.00	7,461.5	259.3	203.1	268.7	13.21	12.58	4.19
7,789.0	79.30	2.00	7,468.5	290.5	204.2	299.9	12.19	12.19	0.00
7,814.0	82.10	2.30	7,472.6	315.2	205.1	324.6	11.26	11.20	1.20
7,848.5	84.24	2.49	7,476.7	349.4	206.5	358.8	6.24	6.22	0.54
7"									
7,851.0	84.40	2.50	7,476.9	351.9	206.6	361.3	6.24	6.22	0.54
7,882.0	85.90	2.70	7,479.5	382.7	208.1	392.2	4.88	4.84	0.65
7,914.0	86.70	2.50	7,481.6	414.6	209.5	424.1	2.58	2.50	-0.63
7,945.0	87.80	2.30	7,483.1	445.6	210.8	455.1	3.61	3.55	-0.65
7,977.0	88.60	2.00	7,484.1	477.5	212.0	487.1	2.67	2.50	-0.94
8,008.0	89.00	1.60	7,484.7	508.5	213.0	518.1	1.82	1.29	-1.29
8,040.0	89.00	0.40	7,485.3	540.5	213.5	550.0	3.75	0.00	-3.75
8,072.0	89.20	359.70	7,485.8	572.5	213.6	582.0	2.27	0.63	-2.19
8,135.0	89.40	358.80	7,486.6	635.5	212.7	644.9	1.46	0.32	-1.43
8,198.0	92.40	2.00	7,485.6	698.5	213.2	707.8	6.96	4.76	5.08
8,230.0	91.50	0.90	7,484.5	730.4	214.0	739.8	4.44	-2.81	-3.44
8,261.0	89.90	359.70	7,484.1	761.4	214.1	770.7	6.45	-5.16	-3.87
8,293.0	89.60	359.30	7,484.2	793.4	213.9	802.7	1.56	-0.94	-1.25
8,324.0	90.00	358.80	7,484.4	824.4	213.3	833.6	2.07	1.29	-1.61
8,387.0	88.90	357.90	7,485.0	887.4	211.5	896.4	2.26	-1.75	-1.43
8,450.0	90.60	357.70	7,485.2	950.3	209.1	959.2	2.72	2.70	-0.32
8,513.0	90.70	357.70	7,484.5	1,013.3	206.6	1,022.0	0.16	0.16	0.00
8,577.0	89.10	358.30	7,484.6	1,077.2	204.4	1,085.7	2.67	-2.50	0.94
8,622.0	91.40	0.40	7,484.4	1,122.2	203.8	1,130.7	6.92	5.11	4.67
8,685.0	89.90	0.00	7,483.7	1,185.2	204.1	1,193.6	2.46	-2.38	-0.63
8,748.0	87.90	0.20	7,484.9	1,248.2	204.2	1,256.5	3.19	-3.17	0.32
8,811.0	92.30	4.60	7,484.8	1,311.1	206.8	1,319.5	9.88	6.98	6.98
8,874.0	90.30	2.10	7,483.4	1,374.0	210.5	1,382.4	5.08	-3.17	-3.97
8,938.0	89.90	1.80	7,483.3	1,437.9	212.7	1,446.4	0.78	-0.63	-0.47
9,001.0	90.50	1.60	7,483.1	1,500.9	214.5	1,509.4	1.00	0.95	-0.32
9,064.0	88.70	359.00	7,483.5	1,563.9	214.9	1,572.4	5.02	-2.86	-4.13
9,128.0	91.50	1.80	7,483.4	1,627.9	215.3	1,636.3	6.19	4.38	4.38
9,191.0	89.30	0.90	7,482.9	1,690.9	216.8	1,699.3	3.77	-3.49	-1.43
9,254.0	88.50	0.40	7,484.2	1,753.9	217.5	1,762.2	1.50	-1.27	-0.79
9,317.0	87.70	359.50	7,486.2	1,816.8	217.5	1,825.1	1.91	-1.27	-1.43
9,380.0	87.90	359.30	7,488.7	1,879.8	216.8	1,888.0	0.45	0.32	-0.32
9,444.0	87.30	359.90	7,491.3	1,943.7	216.4	1,951.8	1.33	-0.94	0.94
9,507.0	88.10	0.40	7,493.9	2,006.7	216.5	2,014.7	1.50	1.27	0.79
9,570.0	89.30	0.70	7,495.3	2,069.6	217.1	2,077.6	1.96	1.90	0.48
9,633.0	90.00	1.10	7,495.7	2,132.6	218.1	2,140.6	1.28	1.11	0.63
9,697.0	90.00	1.30	7,495.7	2,196.6	219.5	2,204.6	0.31	0.00	0.31

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<b>Design:</b>	Wellbore #1	<b>Database:</b>	Landmark

Survey									
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
9,760.0	90.00	0.40	7,495.7	2,259.6	220.4	2,267.5	1.43	0.00	-1.43
9,823.0	90.20	359.50	7,495.6	2,322.6	220.3	2,330.5	1.46	0.32	-1.43
9,886.0	91.00	359.70	7,494.9	2,385.6	219.9	2,393.4	1.31	1.27	0.32
9,950.0	91.30	0.00	7,493.6	2,449.6	219.7	2,457.3	0.66	0.47	0.47
10,013.0	90.60	0.00	7,492.6	2,512.6	219.7	2,520.2	1.11	-1.11	0.00
10,076.0	90.80	359.90	7,491.8	2,575.6	219.7	2,583.1	0.35	0.32	-0.16
10,139.0	90.60	359.90	7,491.0	2,638.6	219.6	2,646.0	0.32	-0.32	0.00
10,202.0	90.30	359.20	7,490.6	2,701.6	219.1	2,708.9	1.21	-0.48	-1.11
10,265.0	90.90	359.70	7,489.9	2,764.6	218.5	2,771.8	1.24	0.95	0.79
10,328.0	90.70	0.00	7,489.0	2,827.6	218.3	2,834.7	0.57	-0.32	0.48
10,392.0	90.70	0.60	7,488.2	2,891.5	218.6	2,898.7	0.94	0.00	0.94
10,455.0	89.60	0.70	7,488.1	2,954.5	219.3	2,961.6	1.75	-1.75	0.16
10,518.0	89.20	0.20	7,488.7	3,017.5	219.8	3,024.6	1.02	-0.63	-0.79
10,581.0	88.70	358.60	7,489.9	3,080.5	219.2	3,087.5	2.66	-0.79	-2.54
10,644.0	90.40	358.50	7,490.4	3,143.5	217.6	3,150.3	2.70	2.70	-0.16
10,707.0	91.20	358.60	7,489.5	3,206.5	216.0	3,213.1	1.28	1.27	0.16
10,771.0	89.10	358.30	7,489.3	3,270.4	214.3	3,276.9	3.31	-3.28	-0.47
10,834.0	88.40	358.10	7,490.7	3,333.4	212.3	3,339.7	1.16	-1.11	-0.32
10,897.0	89.00	357.60	7,492.1	3,396.3	209.9	3,402.5	1.24	0.95	-0.79
10,960.0	89.90	357.60	7,492.7	3,459.3	207.3	3,465.2	1.43	1.43	0.00
11,024.0	90.60	358.30	7,492.5	3,523.2	205.0	3,529.0	1.55	1.09	1.09
11,087.0	91.10	358.30	7,491.5	3,586.2	203.1	3,591.8	0.79	0.79	0.00
11,150.0	91.70	358.50	7,490.0	3,649.2	201.4	3,654.6	1.00	0.95	0.32
11,214.0	90.40	358.50	7,488.8	3,713.1	199.7	3,718.4	2.03	-2.03	0.00
11,277.0	89.60	357.90	7,488.8	3,776.1	197.7	3,781.2	1.59	-1.27	-0.95
11,340.0	89.00	358.10	7,489.6	3,839.0	195.5	3,844.0	1.00	-0.95	0.32
11,403.0	88.00	1.60	7,491.2	3,902.0	195.3	3,906.9	5.78	-1.59	5.56
11,467.0	88.50	1.30	7,493.2	3,966.0	197.0	3,970.8	0.91	0.78	-0.47
11,530.0	89.30	1.10	7,494.4	4,028.9	198.3	4,033.8	1.31	1.27	-0.32
11,593.0	90.00	1.30	7,494.8	4,091.9	199.6	4,096.8	1.16	1.11	0.32
11,658.0	90.80	0.40	7,494.3	4,156.9	200.6	4,161.7	1.85	1.23	-1.38
11,719.0	90.70	0.20	7,493.5	4,217.9	200.9	4,222.7	0.37	-0.16	-0.33
11,782.0	91.50	0.70	7,492.3	4,280.9	201.4	4,285.6	1.50	1.27	0.79
11,845.0	90.80	1.40	7,491.1	4,343.9	202.5	4,348.6	1.57	-1.11	1.11
11,876.0	90.50	1.10	7,490.7	4,374.9	203.2	4,379.6	1.37	-0.97	-0.97
11,931.0	90.50	1.10	7,490.2	4,429.8	204.3	4,434.5	0.00	0.00	0.00

BHL 500'FNL & 1080'FEL

Casing Points				
Measured Depth (ft)	Vertical Depth (ft)	Name	Casing Diameter (")	Hole Diameter (")
7,848.5	7,476.7	7"	7	7-1/2

Checked By: \_\_\_\_\_ Approved By: \_\_\_\_\_ Date: \_\_\_\_\_