

Highlands Natural Resources

Location	DJ Basin Southern Extension	Slot	Thunder 5-64 15-16-1CHZ
Field	DJ Basin Southern Extension	Well	THUNDER 5-64 15-16-1CHZ
Installation	HNR Arapahoe County Pad Updated 04.13.18 JFalls	Wellbore	THUNDER 5-64 15-16-1CHZ (PWB)

East (Feet) ->

N
GRID

-11200 -9600 -8000 -6400 -4800 -3200 -1600 0 1600
Scale 1 cm = 800 ft

Surface 0.00 N 0.00 E



THUNDER 5-64 15-16-1CHZ - BHL

THUNDER 5-64 15-16-1CHZ - T1

1600
0
-1600
-3200
Scale 1 cm = 800 ft
North (Feet)

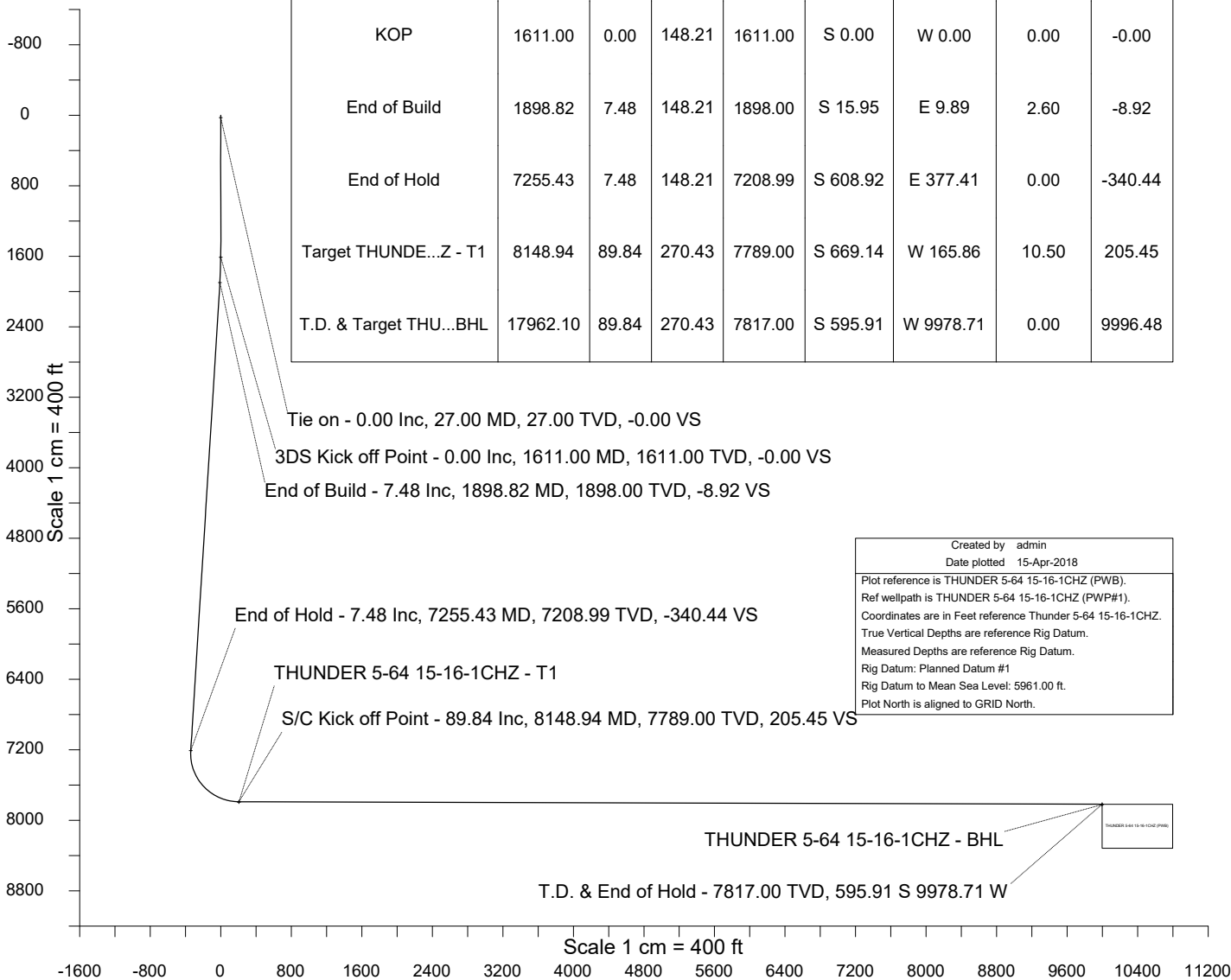
WELL PROFILE DATA

Point	MD	Inc	Azi	TVD	North	East	deg/100ft	V. Sect
Tie on	27.00	0.00	0.00	27.00	S 0.00	W 0.00		-0.00
KOP	1611.00	0.00	148.21	1611.00	S 0.00	W 0.00	0.00	-0.00
End of Build	1898.82	7.48	148.21	1898.00	S 15.95	E 9.89	2.60	-8.92
End of Hold	7255.43	7.48	148.21	7208.99	S 608.92	E 377.41	0.00	-340.44
Target THUNDE...Z - T1	8148.94	89.84	270.43	7789.00	S 669.14	W 165.86	10.50	205.45
T.D. & Target THU...BHL	17962.10	89.84	270.43	7817.00	S 595.91	W 9978.71	0.00	9996.48

Mar-2-2017

EMM-2015 [2000.0-2020.0] Dip: 66.54 deg Field: 52124.9 nT
Lat: N39 36 53.6940 Long: W104 31 51.5676 Elev: 5934.00 ft
Magnetic North is 8.60 deg East of True North
GRID North is 0.61 deg East of True North
To correct azimuth from True to GRID subtract 0.61 deg
To correct azimuth from Magnetic to GRID add 7.99 deg

<- True Vertical Depth (Feet)



Created by admin
Date plotted 15-Apr-2018
Plot reference is THUNDER 5-64 15-16-1CHZ (PWB).
Ref wellpath is THUNDER 5-64 15-16-1CHZ (PWP#1).
Coordinates are in Feet reference Thunder 5-64 15-16-1CHZ.
True Vertical Depths are reference Rig Datum.
Measured Depths are reference Rig Datum.
Rig Datum: Planned Datum #1
Rig Datum to Mean Sea Level: 5961.00 ft.
Plot North is aligned to GRID North.



SYSDRILL
Well Design Combined Report
Wellbore: THUNDER 5-64 15-16-1CHZ (PWB)



Wellhead Details

Name	Latitude	Longitude	Northing	Easting	North	East	Slot Elevation Above Ground
Thunder 5-64 15-16-1CHZ	39.61464100	-104.53099700	1650217.2870	3272986.9832	99.82S	0.63W	0.00

Declination

Date	Source	Time
Mar-2-2017	EMM-2015 [2000.0-2020.0]	14:57

Installation Details

Name	Installation Position (Latitude)	Installation Position (Longitude)	Northing	Easting	Coord System Name	North Alignment
HNR Arapahoe County Pad Updated 04.13.18 JFalls	39.61491500	-104.53099100	1650317.1047	3272987.6089	CO83-CF on NORTH AMERICAN DATUM 1983 datum	Grid

Summary Wellpath

MD[ft]	Inc[deg]	Azi[deg]	TVD[ft]	North[ft]	East[ft]	Dogleg [deg/100ft]	Vertical Section[ft]	Northing	Easting
27.00	0.00	0.000	27.00	0.00N	0.00E		0.00	1650217.29	3272986.98
1611.00	0.00	148.210	1611.00	0.00N	0.00E	==>	0.00	1650217.29	3272986.98
1898.82	7.48	148.210	1898.00	15.95S	9.89E	2.60	-8.92	1650201.33	3272996.87
7255.43	7.48	148.210	7208.99	608.92S	377.41E	==>	-340.44	1649608.39	3273364.39
8148.94	89.84	270.430	7789.00	669.14S	165.86W	10.50	205.45	1649548.17	3272821.13
17962.10	89.84	270.430	7817.00	595.91S	9978.71W	==>	9996.48	1649621.39	3263008.54

Interpolated Wellpath

MD[ft]	Inc[deg]	Azi[deg]	TVD[ft]	North[ft]	East[ft]	Dogleg [deg/100ft]	Vertical Section[ft]	All Station Comments
0.00	0.00	0.000	0.00	0.00N	0.00E		0.00	Rig Datum
27.00	0.00	0.000	27.00	0.00N	0.00E	==>	0.00	Slot Datum
100.00	0.00	0.000	100.00	0.00N	0.00E	==>	0.00	
200.00	0.00	0.000	200.00	0.00N	0.00E	==>	0.00	
300.00	0.00	0.000	300.00	0.00N	0.00E	==>	0.00	
400.00	0.00	0.000	400.00	0.00N	0.00E	==>	0.00	
500.00	0.00	0.000	500.00	0.00N	0.00E	==>	0.00	
600.00	0.00	0.000	600.00	0.00N	0.00E	==>	0.00	
700.00	0.00	0.000	700.00	0.00N	0.00E	==>	0.00	
800.00	0.00	0.000	800.00	0.00N	0.00E	==>	0.00	
900.00	0.00	0.000	900.00	0.00N	0.00E	==>	0.00	
1000.00	0.00	0.000	1000.00	0.00N	0.00E	==>	0.00	
1100.00	0.00	0.000	1100.00	0.00N	0.00E	==>	0.00	
1200.00	0.00	0.000	1200.00	0.00N	0.00E	==>	0.00	
1300.00	0.00	0.000	1300.00	0.00N	0.00E	==>	0.00	
1400.00	0.00	0.000	1400.00	0.00N	0.00E	==>	0.00	
1500.00	0.00	0.000	1500.00	0.00N	0.00E	==>	0.00	
1501.00	0.00	0.000	1501.00	0.00N	0.00E	==>	0.00	
1601.00	0.00	0.000	1601.00	0.00N	0.00E	==>	0.00	
1701.00	2.34	148.210	1700.97	1.56S	0.97E	2.60	-0.87	
1801.00	4.94	148.210	1800.76	6.96S	4.31E	2.60	-3.89	
1901.00	7.48	148.210	1900.16	16.19S	10.04E	==>	-9.05	
2001.00	7.48	148.210	1999.31	27.26S	16.90E	==>	-15.24	
2101.00	7.48	148.210	2098.46	38.33S	23.76E	==>	-21.43	
2201.00	7.48	148.210	2197.61	49.40S	30.62E	==>	-27.62	
2301.00	7.48	148.210	2296.76	60.47S	37.48E	==>	-33.81	
2401.00	7.48	148.210	2395.91	71.54S	44.34E	==>	-40.00	
2501.00	7.48	148.210	2495.05	82.61S	51.20E	==>	-46.19	
2601.00	7.48	148.210	2594.20	93.68S	58.07E	==>	-52.38	
2701.00	7.48	148.210	2693.35	104.75S	64.93E	==>	-58.57	
2801.00	7.48	148.210	2792.50	115.82S	71.79E	==>	-64.76	
2901.00	7.48	148.210	2891.65	126.89S	78.65E	==>	-70.95	

All data is in Feet unless otherwise stated
Coordinates are from Slot MD's are from Rig and TVD's are from Rig (Planned Datum #1 5961.0ft above Mean Sea Level)
Vertical Section is from 0.00N 0.00E on azimuth 266.580 degrees
Bottom hole distance is 9996.48 Feet on azimuth 266.58 degrees from Wellhead
Calculation method uses Minimum Curvature method
Prepared by Microsoft
Date Printed: 15-Apr-2018



SYS DRILL
Well Design Combined Report
Wellbore: THUNDER 5-64 15-16-1CHZ (PWB)



Interpolated Wellpath								
MD[ft]	Inc[deg]	Azi[deg]	TVD[ft]	North[ft]	East[ft]	Dogleg [deg/100ft]	Vertical Section[ft]	All Station Comments
3001.00	7.48	148.210	2990.80	137.96S	85.51E	==>	-77.13	
3101.00	7.48	148.210	3089.94	149.03S	92.37E	==>	-83.32	
3201.00	7.48	148.210	3189.09	160.10S	99.23E	==>	-89.51	
3301.00	7.48	148.210	3288.24	171.17S	106.09E	==>	-95.70	
3401.00	7.48	148.210	3387.39	182.24S	112.96E	==>	-101.89	
3501.00	7.48	148.210	3486.54	193.31S	119.82E	==>	-108.08	
3601.00	7.48	148.210	3585.68	204.38S	126.68E	==>	-114.27	
3701.00	7.48	148.210	3684.83	215.45S	133.54E	==>	-120.46	
3801.00	7.48	148.210	3783.98	226.52S	140.40E	==>	-126.65	
3901.00	7.48	148.210	3883.13	237.59S	147.26E	==>	-132.84	
4001.00	7.48	148.210	3982.28	248.66S	154.12E	==>	-139.02	
4101.00	7.48	148.210	4081.43	259.73S	160.98E	==>	-145.21	
4201.00	7.48	148.210	4180.57	270.80S	167.84E	==>	-151.40	
4301.00	7.48	148.210	4279.72	281.87S	174.71E	==>	-157.59	
4401.00	7.48	148.210	4378.87	292.94S	181.57E	==>	-163.78	
4501.00	7.48	148.210	4478.02	304.01S	188.43E	==>	-169.97	
4601.00	7.48	148.210	4577.17	315.08S	195.29E	==>	-176.16	
4701.00	7.48	148.210	4676.32	326.15S	202.15E	==>	-182.35	
4801.00	7.48	148.210	4775.46	337.22S	209.01E	==>	-188.54	
4901.00	7.48	148.210	4874.61	348.29S	215.87E	==>	-194.73	
5001.00	7.48	148.210	4973.76	359.36S	222.73E	==>	-200.92	
5101.00	7.48	148.210	5072.91	370.43S	229.59E	==>	-207.10	
5201.00	7.48	148.210	5172.06	381.50S	236.46E	==>	-213.29	
5301.00	7.48	148.210	5271.21	392.57S	243.32E	==>	-219.48	
5401.00	7.48	148.210	5370.35	403.64S	250.18E	==>	-225.67	
5501.00	7.48	148.210	5469.50	414.71S	257.04E	==>	-231.86	
5601.00	7.48	148.210	5568.65	425.78S	263.90E	==>	-238.05	
5701.00	7.48	148.210	5667.80	436.85S	270.76E	==>	-244.24	
5801.00	7.48	148.210	5766.95	447.91S	277.62E	==>	-250.43	
5901.00	7.48	148.210	5866.10	458.98S	284.48E	==>	-256.62	
6001.00	7.48	148.210	5965.24	470.05S	291.35E	==>	-262.81	
6101.00	7.48	148.210	6064.39	481.12S	298.21E	==>	-269.00	
6201.00	7.48	148.210	6163.54	492.19S	305.07E	==>	-275.18	
6301.00	7.48	148.210	6262.69	503.26S	311.93E	==>	-281.37	
6401.00	7.48	148.210	6361.84	514.33S	318.79E	==>	-287.56	
6501.00	7.48	148.210	6460.99	525.40S	325.65E	==>	-293.75	
6601.00	7.48	148.210	6560.13	536.47S	332.51E	==>	-299.94	
6701.00	7.48	148.210	6659.28	547.54S	339.37E	==>	-306.13	
6801.00	7.48	148.210	6758.43	558.61S	346.23E	==>	-312.32	
6901.00	7.48	148.210	6857.58	569.68S	353.10E	==>	-318.51	
7001.00	7.48	148.210	6956.73	580.75S	359.96E	==>	-324.70	
7101.00	7.48	148.210	7055.88	591.82S	366.82E	==>	-330.89	
7201.00	7.48	148.210	7155.02	602.89S	373.68E	==>	-337.08	
7301.00	6.39	187.660	7254.25	613.96S	378.64E	10.50	-341.37	
7401.00	12.94	241.520	7352.95	624.84S	368.03E	10.50	-330.12	
7501.00	22.66	255.010	7448.08	635.19S	339.50E	10.50	-301.03	
7601.00	32.85	260.540	7536.48	644.65S	294.01E	10.50	-255.06	
7701.00	43.18	263.650	7615.16	652.92S	233.08E	10.50	-193.74	
7801.00	53.56	265.740	7681.51	659.72S	158.75E	10.50	-119.14	
7901.00	63.97	267.340	7733.29	664.81S	73.52E	10.50	-33.76	
8001.00	74.40	268.670	7768.77	668.02S	19.77W	10.50	59.55	
8101.00	84.83	269.870	7786.77	669.26S	117.98W	10.50	157.67	
8201.00	89.84	270.430	7789.15	668.75S	217.91W	==>	257.39	
8301.00	89.84	270.430	7789.43	668.00S	317.91W	==>	357.17	
8401.00	89.84	270.430	7789.72	667.25S	417.91W	==>	456.94	
8501.00	89.84	270.430	7790.00	666.51S	517.91W	==>	556.72	
8601.00	89.84	270.430	7790.29	665.76S	617.90W	==>	656.49	
8701.00	89.84	270.430	7790.58	665.02S	717.90W	==>	756.27	
8801.00	89.84	270.430	7790.86	664.27S	817.90W	==>	856.04	

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Vertical Section is from 0.00N 0.00E on azimuth 266.580 degrees
Bottom hole distance is 9996.48 Feet on azimuth 266.58 degrees from Wellhead
Calculation method uses Minimum Curvature method
Prepared by Microsoft
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Well Design Combined Report
Wellbore: THUNDER 5-64 15-16-1CHZ (PWB)



Interpolated Wellpath								
MD[ft]	Inc[deg]	Azi[deg]	TVD[ft]	North[ft]	East[ft]	Dogleg [deg/100ft]	Vertical Section[ft]	All Station Comments
8901.00	89.84	270.430	7791.15	663.52S	917.89W	==>	955.81	
9001.00	89.84	270.430	7791.43	662.78S	1017.89W	==>	1055.59	
9101.00	89.84	270.430	7791.72	662.03S	1117.89W	==>	1155.36	
9201.00	89.84	270.430	7792.00	661.29S	1217.88W	==>	1255.14	
9301.00	89.84	270.430	7792.29	660.54S	1317.88W	==>	1354.91	
9401.00	89.84	270.430	7792.57	659.79S	1417.88W	==>	1454.69	
9501.00	89.84	270.430	7792.86	659.05S	1517.87W	==>	1554.46	
9601.00	89.84	270.430	7793.14	658.30S	1617.87W	==>	1654.24	
9701.00	89.84	270.430	7793.43	657.55S	1717.87W	==>	1754.01	
9801.00	89.84	270.430	7793.71	656.81S	1817.86W	==>	1853.78	
9901.00	89.84	270.430	7794.00	656.06S	1917.86W	==>	1953.56	
10001.00	89.84	270.430	7794.28	655.32S	2017.86W	==>	2053.33	
10101.00	89.84	270.430	7794.57	654.57S	2117.85W	==>	2153.11	
10201.00	89.84	270.430	7794.86	653.82S	2217.85W	==>	2252.88	
10301.00	89.84	270.430	7795.14	653.08S	2317.85W	==>	2352.66	
10401.00	89.84	270.430	7795.43	652.33S	2417.84W	==>	2452.43	
10501.00	89.84	270.430	7795.71	651.58S	2517.84W	==>	2552.21	
10601.00	89.84	270.430	7796.00	650.84S	2617.84W	==>	2651.98	
10701.00	89.84	270.430	7796.28	650.09S	2717.83W	==>	2751.75	
10801.00	89.84	270.430	7796.57	649.35S	2817.83W	==>	2851.53	
10901.00	89.84	270.430	7796.85	648.60S	2917.83W	==>	2951.30	
11001.00	89.84	270.430	7797.14	647.85S	3017.83W	==>	3051.08	
11101.00	89.84	270.430	7797.42	647.11S	3117.82W	==>	3150.85	
11201.00	89.84	270.430	7797.71	646.36S	3217.82W	==>	3250.63	
11301.00	89.84	270.430	7797.99	645.62S	3317.82W	==>	3350.40	
11401.00	89.84	270.430	7798.28	644.87S	3417.81W	==>	3450.18	
11501.00	89.84	270.430	7798.56	644.12S	3517.81W	==>	3549.95	
11601.00	89.84	270.430	7798.85	643.38S	3617.81W	==>	3649.73	
11701.00	89.84	270.430	7799.14	642.63S	3717.80W	==>	3749.50	
11801.00	89.84	270.430	7799.42	641.88S	3817.80W	==>	3849.27	
11901.00	89.84	270.430	7799.71	641.14S	3917.80W	==>	3949.05	
12001.00	89.84	270.430	7799.99	640.39S	4017.79W	==>	4048.82	
12101.00	89.84	270.430	7800.28	639.65S	4117.79W	==>	4148.60	
12201.00	89.84	270.430	7800.56	638.90S	4217.79W	==>	4248.37	
12301.00	89.84	270.430	7800.85	638.15S	4317.78W	==>	4348.15	
12401.00	89.84	270.430	7801.13	637.41S	4417.78W	==>	4447.92	
12501.00	89.84	270.430	7801.42	636.66S	4517.78W	==>	4547.70	
12601.00	89.84	270.430	7801.70	635.92S	4617.77W	==>	4647.47	
12701.00	89.84	270.430	7801.99	635.17S	4717.77W	==>	4747.24	
12801.00	89.84	270.430	7802.27	634.42S	4817.77W	==>	4847.02	
12901.00	89.84	270.430	7802.56	633.68S	4917.76W	==>	4946.79	
13001.00	89.84	270.430	7802.84	632.93S	5017.76W	==>	5046.57	
13101.00	89.84	270.430	7803.13	632.18S	5117.76W	==>	5146.34	
13201.00	89.84	270.430	7803.42	631.44S	5217.76W	==>	5246.12	
13301.00	89.84	270.430	7803.70	630.69S	5317.75W	==>	5345.89	
13401.00	89.84	270.430	7803.99	629.95S	5417.75W	==>	5445.67	
13501.00	89.84	270.430	7804.27	629.20S	5517.75W	==>	5545.44	
13601.00	89.84	270.430	7804.56	628.45S	5617.74W	==>	5645.22	
13701.00	89.84	270.430	7804.84	627.71S	5717.74W	==>	5744.99	
13801.00	89.84	270.430	7805.13	626.96S	5817.74W	==>	5844.76	
13901.00	89.84	270.430	7805.41	626.21S	5917.73W	==>	5944.54	
14001.00	89.84	270.430	7805.70	625.47S	6017.73W	==>	6044.31	
14101.00	89.84	270.430	7805.98	624.72S	6117.73W	==>	6144.09	
14201.00	89.84	270.430	7806.27	623.98S	6217.72W	==>	6243.86	
14301.00	89.84	270.430	7806.55	623.23S	6317.72W	==>	6343.64	
14401.00	89.84	270.430	7806.84	622.48S	6417.72W	==>	6443.41	
14501.00	89.84	270.430	7807.12	621.74S	6517.71W	==>	6543.19	
14601.00	89.84	270.430	7807.41	620.99S	6617.71W	==>	6642.96	
14701.00	89.84	270.430	7807.70	620.25S	6717.71W	==>	6742.73	

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Wellbore: THUNDER 5-64 15-16-1CHZ (PWB)



Interpolated Wellpath								
MD[ft]	Inc[deg]	Azi[deg]	TVD[ft]	North[ft]	East[ft]	Dogleg [deg/100ft]	Vertical Section[ft]	All Station Comments
14801.00	89.84	270.430	7807.98	619.50S	6817.70W	==>	6842.51	
14901.00	89.84	270.430	7808.27	618.75S	6917.70W	==>	6942.28	
15001.00	89.84	270.430	7808.55	618.01S	7017.70W	==>	7042.06	
15101.00	89.84	270.430	7808.84	617.26S	7117.69W	==>	7141.83	
15201.00	89.84	270.430	7809.12	616.51S	7217.69W	==>	7241.61	
15301.00	89.84	270.430	7809.41	615.77S	7317.69W	==>	7341.38	
15401.00	89.84	270.430	7809.69	615.02S	7417.68W	==>	7441.16	
15501.00	89.84	270.430	7809.98	614.28S	7517.68W	==>	7540.93	
15601.00	89.84	270.430	7810.26	613.53S	7617.68W	==>	7640.71	
15701.00	89.84	270.430	7810.55	612.78S	7717.68W	==>	7740.48	
15801.00	89.84	270.430	7810.83	612.04S	7817.67W	==>	7840.25	
15901.00	89.84	270.430	7811.12	611.29S	7917.67W	==>	7940.03	
16001.00	89.84	270.430	7811.40	610.54S	8017.67W	==>	8039.80	
16101.00	89.84	270.430	7811.69	609.80S	8117.66W	==>	8139.58	
16201.00	89.84	270.430	7811.98	609.05S	8217.66W	==>	8239.35	
16301.00	89.84	270.430	7812.26	608.31S	8317.66W	==>	8339.13	
16401.00	89.84	270.430	7812.55	607.56S	8417.65W	==>	8438.90	
16501.00	89.84	270.430	7812.83	606.81S	8517.65W	==>	8538.68	
16601.00	89.84	270.430	7813.12	606.07S	8617.65W	==>	8638.45	
16701.00	89.84	270.430	7813.40	605.32S	8717.64W	==>	8738.22	
16801.00	89.84	270.430	7813.69	604.58S	8817.64W	==>	8838.00	
16901.00	89.84	270.430	7813.97	603.83S	8917.64W	==>	8937.77	
17001.00	89.84	270.430	7814.26	603.08S	9017.63W	==>	9037.55	
17101.00	89.84	270.430	7814.54	602.34S	9117.63W	==>	9137.32	
17201.00	89.84	270.430	7814.83	601.59S	9217.63W	==>	9237.10	
17301.00	89.84	270.430	7815.11	600.84S	9317.62W	==>	9336.87	
17401.00	89.84	270.430	7815.40	600.10S	9417.62W	==>	9436.65	
17501.00	89.84	270.430	7815.68	599.35S	9517.62W	==>	9536.42	
17601.00	89.84	270.430	7815.97	598.61S	9617.61W	==>	9636.20	
17701.00	89.84	270.430	7816.25	597.86S	9717.61W	==>	9735.97	
17801.00	89.84	270.430	7816.54	597.11S	9817.61W	==>	9835.74	
17901.00	89.84	270.430	7816.83	596.37S	9917.61W	==>	9935.52	
17962.10	89.84	270.430	7817.00	595.91S	9978.71W	==>	9996.48	

All data is in Feet unless otherwise stated
Coordinates are from Slot MD's are from Rig and TVD's are from Rig (Planned Datum #1 5961.0ft above Mean Sea Level)
Vertical Section is from 0.00N 0.00E on azimuth 266.580 degrees
Bottom hole distance is 9996.48 Feet on azimuth 266.58 degrees from Wellhead
Calculation method uses Minimum Curvature method
Prepared by Microsoft
Date Printed: 15-Apr-2018



SYSDRILL
Well Design Combined Report
Wellbore: THUNDER 5-64 15-16-1CHZ (PWB)



Targets							
Name	North[ft]	East[ft]	TVD[ft]	Latitude	Longitude	Northing	Easting
THUNDER 5-64 15-16-1CHZ - BHL	595.91S	9978.71W	7817.00	39.61329200	-104.56643600	1649621.39	3263008.54
THUNDER 5-64 15-16-1CHZ - T1	669.14S	165.86W	7789.00	39.61280900	-104.53161100	1649548.17	3272821.13

Survey Tool Program					
Reference	Survey Name	MD[ft]	TVD[ft]	Survey Tool	Error Model
564286	Planned	1501.00	1501.00	WdW Rate Gyro	Standard
564285	Planned	17962.10	7817.00	ISCWSA MWD	Rev 4 + SAG + FLT

Notes