

30-015-41581

RKI Exploration & Production

Eddy County (NM83E)

Sec 22-T26S-R30E

RDU 47H

Wellbore #1

Survey: MWD Surveys

Standard Survey Report

10 November, 2013

Wolverine Directional, LLC

Survey Report

Company:	RKI Exploration & Production	Local Co-ordinate Reference:	Well RDU 47H
Project:	Eddy County (NM83E)	TVD Reference:	WELL @ 0.0ft (Original Well Elev)
Site:	Sec 22-T26S-R30E	MD Reference:	WELL @ 0.0ft (Original Well Elev)
Well:	RDU 47H	North Reference:	True
Wellbore:	Wellbore #1	Survey Calculation Method:	Minimum Curvature
Design:	Wellbore #1	Database:	EDM 2003.21 Single User Db

Design	Wellbore #1			
Audit Notes:				
Version:	1.0	Phase:	ACTUAL	Tie On Depth: 0.0
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W	Direction
	(ft)	(ft)	(ft)	(°)
	0.0	0.0	0.0	176.06

Survey Program	Date 2013/11/10			
From	To	Survey (Wellbore)	Tool Name	Description
(ft)	(ft)			
207.0	12,560.0	MWD Surveys (Wellbore #1)	MWD	MWD - Standard

Survey										
Measured Depth	Inclination	Azimuth	Vertical Depth	+N/-S	+E/-W	Vertical Section	Dogleg Rate	Build Rate	Turn Rate	
(ft)	(°)	(°)	(ft)	(ft)	(ft)	(ft)	(°/100ft)	(°/100ft)	(°/100ft)	
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00	
207.0	0.70	185.70	207.0	-1.3	-0.1	1.2	0.34	0.34	0.00	
First MWD Survey										
297.0	1.00	186.70	297.0	-2.6	-0.3	2.6	0.33	0.33	1.11	
420.0	0.40	235.60	420.0	-3.9	-0.8	3.8	0.65	-0.49	39.76	
513.0	0.40	232.60	513.0	-4.3	-1.3	4.2	0.02	0.00	-3.23	
604.0	0.50	153.50	604.0	-4.8	-1.4	4.7	0.64	0.11	-86.92	
697.0	0.40	121.50	697.0	-5.4	-0.9	5.3	0.29	-0.11	-34.41	
788.0	1.10	201.00	788.0	-6.3	-0.9	6.3	1.21	0.77	87.36	
856.0	1.50	210.50	855.9	-7.7	-1.6	7.6	0.67	0.59	13.97	
947.0	1.50	202.50	946.9	-9.8	-2.7	9.6	0.23	0.00	-8.79	
1,039.0	1.70	212.90	1,038.9	-12.1	-3.9	11.8	0.38	0.22	11.30	
1,131.0	1.70	214.50	1,130.8	-14.4	-5.4	14.0	0.05	0.00	1.74	
1,223.0	1.50	208.90	1,222.8	-16.5	-6.8	16.0	0.28	-0.22	-6.09	
1,315.0	1.70	212.40	1,314.8	-18.8	-8.1	18.2	0.24	0.22	3.80	
1,408.0	1.70	182.20	1,407.7	-21.3	-8.9	20.6	0.95	0.00	-32.47	
1,500.0	1.50	177.40	1,499.7	-23.9	-8.9	23.2	0.26	-0.22	-5.22	
1,593.0	1.50	163.50	1,592.7	-26.2	-8.5	25.6	0.39	0.00	-14.95	
1,687.0	1.70	162.60	1,686.6	-28.8	-7.7	28.2	0.21	0.21	-0.96	
1,782.0	1.80	171.40	1,781.6	-31.6	-7.0	31.0	0.30	0.11	9.26	
1,877.0	1.60	158.80	1,876.5	-34.3	-6.3	33.8	0.44	-0.21	-13.26	
1,972.0	1.70	165.30	1,971.5	-36.9	-5.5	36.4	0.22	0.11	6.84	
2,067.0	1.80	186.40	2,066.5	-39.7	-5.3	39.3	0.68	0.11	22.21	
2,163.0	2.10	188.50	2,162.4	-43.0	-5.7	42.5	0.32	0.31	2.19	
2,257.0	2.00	182.20	2,256.3	-46.3	-6.1	45.8	0.26	-0.11	-6.70	
2,352.0	2.70	184.80	2,351.3	-50.2	-6.3	49.6	0.75	0.74	2.74	
2,447.0	2.70	182.90	2,446.2	-54.7	-6.6	54.1	0.09	0.00	-2.00	
2,542.0	2.90	190.20	2,541.0	-59.3	-7.1	58.6	0.43	0.21	7.68	
2,620.0	2.70	191.50	2,618.9	-63.0	-7.9	62.3	0.27	-0.26	1.67	
2,715.0	2.60	192.40	2,713.8	-67.3	-8.8	66.5	0.11	-0.11	0.95	
2,810.0	3.00	181.80	2,808.7	-71.9	-9.3	71.1	0.69	0.42	-11.16	
2,905.0	3.40	165.60	2,903.6	-77.1	-8.7	76.3	1.04	0.42	-17.05	
3,000.0	4.00	155.60	2,998.4	-82.9	-6.6	82.2	0.93	0.63	-10.53	
3,095.0	4.60	151.40	3,093.1	-89.2	-3.4	88.8	0.71	0.63	-4.42	
3,190.0	5.00	140.70	3,187.8	-95.8	1.0	95.6	1.03	0.42	-11.26	
3,285.0	6.20	132.60	3,282.3	-102.4	7.4	102.7	1.51	1.26	-8.53	
3,380.0	5.80	132.40	3,376.8	-109.1	14.7	109.9	0.42	-0.42	-0.21	
3,468.0	5.50	130.80	3,464.4	-114.9	21.2	116.1	0.39	-0.34	-1.82	
3,536.0	5.10	130.70	3,532.1	-119.0	26.0	120.5	0.59	-0.59	-0.15	

Wolverine Directional, LLC

Survey Report

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Site:	Sec 22-T26S-R30E	MD Reference:	WELL @ 0.0ft (Original Well Elev)
Well:	RDU 47H	North Reference:	True
Wellbore:	Wellbore #1	Survey Calculation Method:	Minimum Curvature
Design:	Wellbore #1	Database:	EDM 2003.21 Single User Db

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)
3,631.0	4.90	131.00	3,626.7	-124.4	32.2	126.3	0.21	-0.21	0.32
3,725.0	4.00	127.30	3,720.5	-129.0	37.9	131.3	1.00	-0.96	-3.94
3,821.0	4.00	127.00	3,816.2	-133.1	43.2	135.7	0.02	0.00	-0.31
3,915.0	3.00	143.80	3,910.0	-137.0	47.3	140.0	1.51	-1.06	17.87
4,010.0	1.30	137.00	4,005.0	-139.8	49.5	142.9	1.81	-1.79	-7.16
4,105.0	1.20	134.50	4,099.9	-141.3	50.9	144.5	0.12	-0.11	-2.63
4,200.0	1.40	135.90	4,194.9	-142.9	52.4	146.1	0.21	0.21	1.47
4,295.0	1.60	139.10	4,289.9	-144.7	54.1	148.1	0.23	0.21	3.37
4,390.0	1.30	140.50	4,384.9	-146.5	55.7	150.0	0.32	-0.32	1.47
4,486.0	1.20	144.50	4,480.8	-148.2	57.0	151.7	0.14	-0.10	4.17
4,581.0	1.20	143.80	4,575.8	-149.8	58.1	153.4	0.02	0.00	-0.74
4,676.0	1.10	144.50	4,670.8	-151.3	59.2	155.1	0.11	-0.11	0.74
4,771.0	1.10	145.40	4,765.8	-152.8	60.3	156.6	0.02	0.00	0.95
4,866.0	1.00	147.20	4,860.8	-154.3	61.2	158.1	0.11	-0.11	1.89
4,961.0	1.00	145.90	4,955.8	-155.7	62.2	159.6	0.02	0.00	-1.37
5,056.0	1.00	141.40	5,050.7	-157.0	63.1	161.0	0.08	0.00	-4.74
5,151.0	1.00	143.70	5,145.7	-158.3	64.2	162.4	0.04	0.00	2.42
5,246.0	1.00	152.80	5,240.7	-159.7	65.0	163.8	0.17	0.00	9.58
5,341.0	1.10	165.10	5,335.7	-161.3	65.6	165.5	0.26	0.11	12.95
5,436.0	1.10	167.40	5,430.7	-163.1	66.1	167.3	0.05	0.00	2.42
5,531.0	1.10	169.10	5,525.7	-164.9	66.4	169.1	0.03	0.00	1.79
5,627.0	1.10	178.30	5,621.6	-166.7	66.6	170.9	0.18	0.00	9.58
5,722.0	1.20	176.70	5,716.6	-168.6	66.7	172.8	0.11	0.11	-1.68
5,817.0	1.20	177.60	5,811.6	-170.6	66.8	174.8	0.02	0.00	0.95
5,912.0	1.20	177.80	5,906.6	-172.6	66.9	176.8	0.00	0.00	0.21
6,007.0	1.20	171.40	6,001.6	-174.6	67.1	178.8	0.14	0.00	-6.74
6,102.0	1.10	173.70	6,096.5	-176.5	67.3	180.7	0.12	-0.11	2.42
6,197.0	1.20	177.60	6,191.5	-178.4	67.5	182.6	0.13	0.11	4.11
6,292.0	1.10	183.40	6,286.5	-180.3	67.5	184.5	0.16	-0.11	6.11
6,387.0	1.20	184.40	6,381.5	-182.2	67.3	186.4	0.11	0.11	1.05
6,482.0	1.10	179.90	6,476.5	-184.1	67.3	188.3	0.14	-0.11	-4.74
6,577.0	1.20	180.60	6,571.4	-186.0	67.3	190.2	0.11	0.11	0.74
6,672.0	1.20	180.60	6,666.4	-188.0	67.2	192.2	0.00	0.00	0.00
6,767.0	1.40	181.30	6,761.4	-190.1	67.2	194.3	0.21	0.21	0.74
6,862.0	1.40	182.20	6,856.4	-192.4	67.1	196.6	0.02	0.00	0.95
6,957.0	1.40	184.80	6,951.3	-194.8	67.0	198.9	0.07	0.00	2.74
7,053.0	1.60	178.50	7,047.3	-197.3	66.9	201.4	0.27	0.21	-6.56
7,147.0	1.70	180.00	7,141.3	-200.0	67.0	204.1	0.12	0.11	1.60
7,242.0	1.80	185.70	7,236.2	-202.9	66.8	207.0	0.21	0.11	6.00
7,337.0	1.60	183.40	7,331.2	-205.7	66.6	209.8	0.22	-0.21	-2.42
7,432.0	1.30	186.60	7,426.2	-208.1	66.4	212.1	0.33	-0.32	3.37
7,527.0	1.30	193.20	7,521.1	-210.2	66.0	214.2	0.16	0.00	6.95
7,618.0	1.10	194.60	7,612.1	-212.0	65.6	216.1	0.22	-0.22	1.54
7,649.0	2.50	164.60	7,643.1	-213.0	65.7	217.0	5.30	4.52	-96.77
7,681.0	4.80	153.00	7,675.0	-214.8	66.5	218.9	7.51	7.19	-36.25
7,713.0	6.80	153.70	7,706.9	-217.7	67.9	221.9	6.25	6.25	2.19
7,745.0	8.20	156.00	7,738.6	-221.5	69.7	225.8	4.47	4.38	7.19
7,777.0	9.70	153.30	7,770.2	-226.0	71.8	230.4	4.87	4.69	-8.44
7,809.0	11.70	153.50	7,801.6	-231.3	74.5	235.9	6.25	6.25	0.63
7,841.0	14.60	157.20	7,832.8	-238.0	77.5	242.7	9.43	9.06	11.56
7,872.0	18.10	160.90	7,862.5	-246.1	80.6	251.1	11.77	11.29	11.94
7,904.0	21.50	165.10	7,892.6	-256.5	83.7	261.6	11.51	10.63	13.13
7,936.0	24.80	169.50	7,922.1	-268.7	86.4	274.1	11.64	10.31	13.75
7,968.0	28.10	172.70	7,950.7	-282.8	88.6	288.3	11.23	10.31	10.00

Wolverine Directional, LLC

Survey Report

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8,000.0	31.60	174.40	7,978.5	-298.6	90.4	304.2	11.25	10.94	5.31	
8,031.0	35.90	176.70	8,004.2	-315.8	91.7	321.4	14.47	13.87	7.42	
8,063.0	40.00	178.60	8,029.5	-335.5	92.5	341.0	13.32	12.81	5.94	
8,095.0	43.50	181.30	8,053.3	-356.8	92.5	362.3	12.29	10.94	8.44	
8,127.0	46.20	183.40	8,076.0	-379.3	91.6	384.7	9.62	8.44	6.56	
8,158.0	49.10	182.70	8,096.9	-402.2	90.3	407.5	9.50	9.35	-2.26	
8,190.0	52.90	182.00	8,117.0	-427.0	89.3	432.2	12.00	11.88	-2.19	
8,222.0	57.50	181.60	8,135.3	-453.3	88.5	458.3	14.41	14.38	-1.25	
8,254.0	62.60	182.20	8,151.3	-481.0	87.6	485.9	16.02	15.94	1.88	
8,285.0	67.50	182.70	8,164.3	-509.1	86.4	513.8	15.87	15.81	1.61	
8,317.0	72.10	182.20	8,175.4	-539.1	85.1	543.6	14.45	14.38	-1.56	
8,349.0	76.00	181.60	8,184.2	-569.8	84.1	574.2	12.32	12.19	-1.88	
8,381.0	79.70	180.40	8,190.9	-601.1	83.5	605.4	12.13	11.56	-3.75	
8,412.0	83.60	178.50	8,195.4	-631.7	83.8	636.0	13.97	12.58	-6.13	
8,444.0	87.90	178.30	8,197.8	-663.6	84.7	667.9	13.45	13.44	-0.63	
8,476.0	90.90	178.10	8,198.1	-695.6	85.7	699.9	9.40	9.38	-0.63	
8,508.0	91.50	177.90	8,197.4	-727.6	86.9	731.8	1.98	1.88	-0.63	
8,539.0	91.70	177.80	8,196.6	-758.6	88.0	762.8	0.72	0.65	-0.32	
8,571.0	92.20	177.80	8,195.5	-790.5	89.2	794.8	1.56	1.56	0.00	
8,603.0	92.50	177.60	8,194.2	-822.5	90.5	826.7	1.13	0.94	-0.63	
8,698.0	91.50	175.80	8,190.9	-917.2	96.0	921.7	2.17	-1.05	-1.89	
8,794.0	93.50	174.90	8,186.7	-1,012.8	103.8	1,017.6	2.28	2.08	-0.94	
8,889.0	91.50	174.10	8,182.5	-1,107.3	112.9	1,112.4	2.27	-2.11	-0.84	
8,984.0	91.80	176.00	8,179.8	-1,201.9	121.1	1,207.4	2.02	0.32	2.00	
9,079.0	90.10	175.10	8,178.2	-1,296.6	128.4	1,302.4	2.02	-1.79	-0.95	
9,174.0	92.90	173.90	8,175.7	-1,391.1	137.5	1,397.3	3.21	2.95	-1.26	
9,273.0	92.30	173.70	8,171.2	-1,489.4	148.2	1,496.1	0.64	-0.61	-0.20	
9,367.0	91.30	175.30	8,168.3	-1,582.9	157.2	1,590.0	2.01	-1.06	1.70	
9,462.0	90.10	176.40	8,167.1	-1,677.7	164.1	1,685.0	1.71	-1.26	1.16	
9,557.0	90.40	176.90	8,166.7	-1,772.5	169.6	1,780.0	0.61	0.32	0.53	
9,651.0	91.20	176.20	8,165.4	-1,866.3	175.3	1,874.0	1.13	0.85	-0.74	
9,746.0	91.60	178.80	8,163.1	-1,961.2	179.4	1,968.9	2.77	0.42	2.74	
9,840.0	92.90	178.50	8,159.4	-2,055.1	181.6	2,062.7	1.42	1.38	-0.32	
9,934.0	90.50	178.60	8,156.6	-2,149.0	184.0	2,156.6	2.56	-2.55	0.11	
10,028.0	91.50	178.60	8,155.0	-2,243.0	186.3	2,250.5	1.06	1.06	0.00	
10,113.0	90.00	179.00	8,153.9	-2,328.0	188.1	2,335.4	1.83	-1.76	0.47	
10,207.0	90.60	179.20	8,153.4	-2,421.9	189.6	2,429.3	0.67	0.64	0.21	
10,302.0	92.10	179.00	8,151.1	-2,516.9	191.1	2,524.1	1.59	1.58	-0.21	
10,396.0	91.50	178.10	8,148.2	-2,610.8	193.4	2,618.0	1.15	-0.64	-0.96	
10,490.0	90.80	177.80	8,146.3	-2,704.8	196.8	2,711.9	0.81	-0.74	-0.32	
10,584.0	91.90	177.20	8,144.1	-2,798.6	200.9	2,805.8	1.33	1.17	-0.64	
10,678.0	90.70	176.20	8,141.9	-2,892.5	206.3	2,899.8	1.66	-1.28	-1.06	
10,771.0	93.00	175.70	8,138.9	-2,985.2	212.9	2,992.7	2.53	2.47	-0.54	
10,866.0	91.30	175.70	8,135.4	-3,079.8	220.0	3,087.7	1.79	-1.79	0.00	
10,961.0	90.70	176.20	8,133.7	-3,174.6	226.7	3,182.6	0.82	-0.63	0.53	
11,055.0	91.30	175.30	8,132.1	-3,268.3	233.7	3,276.6	1.15	0.64	-0.96	
11,149.0	90.80	176.70	8,130.3	-3,362.1	240.2	3,370.6	1.58	-0.53	1.49	
11,243.0	92.00	175.10	8,128.1	-3,455.8	246.9	3,464.6	2.13	1.28	-1.70	
11,337.0	91.90	177.10	8,124.9	-3,549.5	253.3	3,558.5	2.13	-0.11	2.13	
11,430.0	92.80	176.90	8,121.0	-3,642.3	258.2	3,651.4	0.99	0.97	-0.22	
11,525.0	91.60	177.60	8,117.4	-3,737.1	262.8	3,746.3	1.46	-1.26	0.74	
11,619.0	89.70	177.60	8,116.3	-3,831.0	266.7	3,840.3	2.02	-2.02	0.00	
11,711.0	90.50	176.70	8,116.2	-3,922.9	271.3	3,932.3	1.31	0.87	-0.98	
11,804.0	92.20	176.40	8,114.0	-4,015.7	276.9	4,025.2	1.86	1.83	-0.32	

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Company:	RKI Exploration & Production	Local Co-ordinate Reference:	Well RDU 47H
Project:	Eddy County (NM83E)	TVD Reference:	WELL @ 0.0ft (Original Well Elev)
Site:	Sec 22-T26S-R30E	MD Reference:	WELL @ 0.0ft (Original Well Elev)
Well:	RDU 47H	North Reference:	True
Wellbore:	Wellbore #1	Survey Calculation Method:	Minimum Curvature
Design:	Wellbore #1	Database:	EDM 2003.21 Single User Db

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)	
11,898.0	91.40	176.70	8,111.0	-4,109.5	282.5	4,119.2	0.91	-0.85	0.32	
11,991.0	88.90	176.40	8,110.8	-4,202.3	288.1	4,212.2	2.71	-2.69	-0.32	
12,084.0	88.70	175.30	8,112.7	-4,295.0	294.8	4,305.2	1.20	-0.22	-1.18	
12,177.0	90.00	175.30	8,113.8	-4,387.7	302.5	4,398.1	1.40	1.40	0.00	
12,271.0	91.50	174.90	8,112.6	-4,481.4	310.5	4,492.1	1.65	1.60	-0.43	
12,366.0	92.00	173.70	8,109.7	-4,575.9	319.9	4,587.0	1.37	0.53	-1.26	
12,459.0	93.80	173.70	8,104.9	-4,668.2	330.1	4,679.8	1.94	1.94	0.00	
12,513.0	94.90	173.40	8,100.8	-4,721.7	336.2	4,733.6	2.11	2.04	-0.56	
Last MWD Survey										
12,560.0	94.90	173.40	8,096.8	-4,768.2	341.5	4,780.4	0.00	0.00	0.00	
Proj to TD - RDU #47H PBHL										

Survey Annotations					
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment	
		+N/-S (ft)	+E/-W (ft)		
207.0	207.0	-1.3	-0.1	First MWD Survey	
12,513.0	8,100.8	-4,721.7	336.2	Last MWD Survey	
12,560.0	8,096.8	-4,768.2	341.5	Proj to TD	

Checked By: _____	Approved By: _____	Date: _____
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