



30-015-40990

Apache Corporation

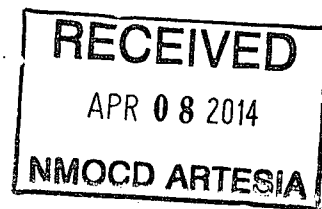
Eddy County, NM (NAD27 NME)

Crow Federal

#16H

OH/Job #1310959

Survey: Phoenix MWD Surveys



Standard Survey Report

21 August, 2013





Phoenix Technology Services

Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #16H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3849.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3849.00usft (Capstar 114)
Well:	#16H	North Reference:	Grid
Wellbore:	OH/Job #1310959	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

Project	Eddy County, NM (NAD27 NME)		
Map System:	US State Plane 1927 (Exact solution)	System Datum:	Mean Sea Level
Geo Datum:	NAD 1927 (NADCON CONUS)		
Map Zone:	New Mexico East 3001		

Site	Crow Federal		
Site Position:		Northing:	671,130.90 usft
From:	Map	Easting:	643,906.80 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "
		Latitude:	32° 50' 38.92796 N
		Longitude:	103° 51' 53.16689 W
		Grid Convergence:	0.25 °

Well	#16H		
Well Position	+N/-S	0.00 usft	Northing: 671,957.60 usft
	+E/-W	0.00 usft	Easting: 638,480.80 usft
Position Uncertainty	0.00 usft	Wellhead Elevation:	usft
		Latitude:	32° 50' 47.34188 N
		Longitude:	103° 52' 56.72576 W
		Ground Level:	3,838.00 usft

Wellbore	OH/Job #1310959				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010_14	07/30/13	7.52	60.66	48,741

Design	Surveys (Capstar 114)				
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	89.63	

Survey Program	Date	08/21/13			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	472.00	Gyro (OH/Job #1310959)	CB-GYRO-MS	Camera based gyro multishot	
531.00	9,626.00	Phoenix MWD Surveys (OH/Job #1310959)	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)
472.00	1.81	92.83	471.90	-0.53	7.68	7.68	0.00	0.00	0.00
Tie-on to Gyro									
531.00	2.10	97.60	530.87	-0.72	9.69	9.68	0.56	0.49	8.08
First Phoenix MWD Survey									
606.00	1.80	101.80	605.82	-1.14	12.20	12.19	0.44	-0.40	5.60
691.00	0.80	135.30	690.80	-1.84	13.93	13.91	1.43	-1.18	39.41
777.00	1.00	284.40	776.80	-2.08	13.62	13.61	2.02	0.23	173.37
862.00	1.50	286.00	861.78	-1.59	11.83	11.82	0.59	0.59	1.88
948.00	1.60	288.40	947.75	-0.90	9.61	9.61	0.14	0.12	2.79



Phoenix Technology Services

Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #16H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3849.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3849.00usft (Capstar 114)
Well:	#16H	North Reference:	Grid
Wellbore:	OH/Job #1310959	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

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)	
1,033.00	1.50	292.90	1,032.71	-0.09	7.46	7.46	0.19	-0.12	5.29	
1,119.00	1.20	300.70	1,118.69	0.81	5.65	5.66	0.41	-0.35	9.07	
1,205.00	1.00	305.90	1,204.68	1.71	4.27	4.28	0.26	-0.23	6.05	
1,290.00	0.80	313.60	1,289.66	2.55	3.24	3.25	0.27	-0.24	9.06	
1,378.00	0.80	321.00	1,377.66	3.45	2.41	2.43	0.12	0.00	8.41	
1,463.00	0.50	315.30	1,462.65	4.18	1.77	1.80	0.36	-0.35	-6.71	
1,549.00	0.30	319.70	1,548.65	4.62	1.36	1.39	0.24	-0.23	5.12	
1,634.00	0.30	321.50	1,633.65	4.96	1.08	1.11	0.01	0.00	2.12	
1,723.00	0.30	312.30	1,722.65	5.30	0.76	0.80	0.05	0.00	-10.34	
1,808.00	0.30	294.80	1,807.64	5.54	0.40	0.43	0.11	0.00	-20.59	
1,893.00	0.40	298.30	1,892.64	5.78	-0.07	-0.03	0.12	0.12	4.12	
1,978.00	0.40	307.10	1,977.64	6.10	-0.57	-0.53	0.07	0.00	10.35	
2,064.00	0.40	303.40	2,063.64	6.44	-1.06	-1.01	0.03	0.00	-4.30	
2,150.00	0.50	309.20	2,149.64	6.85	-1.60	-1.55	0.13	0.12	6.74	
2,235.00	0.80	311.40	2,234.63	7.47	-2.33	-2.28	0.35	0.35	2.59	
2,321.00	0.90	308.70	2,320.62	8.29	-3.31	-3.25	0.13	0.12	-3.14	
2,406.00	0.20	248.30	2,405.62	8.65	-3.97	-3.91	0.96	-0.82	-71.06	
2,492.00	0.40	203.30	2,491.62	8.32	-4.22	-4.17	0.34	0.23	-52.33	
2,577.00	0.40	222.50	2,576.61	7.83	-4.54	-4.49	0.16	0.00	22.59	
2,663.00	0.40	221.60	2,662.61	7.39	-4.94	-4.90	0.01	0.00	-1.05	
2,749.00	0.70	234.60	2,748.61	6.86	-5.57	-5.53	0.38	0.35	15.12	
2,834.00	0.40	244.20	2,833.60	6.43	-6.26	-6.22	0.37	-0.35	11.29	
2,920.00	0.20	241.70	2,919.60	6.23	-6.66	-6.62	0.23	-0.23	-2.91	
3,005.00	0.30	270.50	3,004.60	6.16	-7.02	-6.98	0.19	0.12	33.88	
3,091.00	0.30	274.40	3,090.60	6.18	-7.47	-7.43	0.02	0.00	4.53	
3,179.00	0.20	252.10	3,178.60	6.15	-7.84	-7.80	0.16	-0.11	-25.34	
3,265.00	0.30	270.20	3,264.60	6.10	-8.21	-8.17	0.15	0.12	21.05	
3,349.00	0.20	276.20	3,348.60	6.12	-8.58	-8.54	0.12	-0.12	7.14	
3,434.00	0.50	282.30	3,433.60	6.21	-9.09	-9.05	0.36	0.35	7.18	
3,558.00	0.30	289.50	3,557.59	6.44	-9.92	-9.88	0.17	-0.16	5.81	
3,643.00	1.00	170.90	3,642.59	5.78	-10.01	-9.98	1.38	0.82	-139.53	
3,732.00	1.10	195.60	3,731.58	4.19	-10.12	-10.09	0.52	0.11	27.75	
3,817.00	1.80	140.00	3,816.55	2.38	-9.48	-9.47	1.75	0.82	-65.41	
3,903.00	1.80	140.90	3,902.51	0.30	-7.76	-7.76	0.03	0.00	1.05	
3,988.00	1.30	51.80	3,987.49	-0.14	-6.16	-6.16	2.59	-0.59	-104.82	
4,074.00	1.50	43.20	4,073.46	1.28	-4.62	-4.62	0.34	0.23	-10.00	
4,163.00	1.20	101.80	4,162.44	1.94	-2.91	-2.90	1.51	-0.34	65.84	
4,252.00	1.00	104.50	4,251.42	1.56	-1.25	-1.24	0.23	-0.22	3.03	
4,341.00	0.70	107.90	4,340.41	1.19	0.02	0.03	0.34	-0.34	3.82	
4,426.00	0.90	100.20	4,425.41	0.92	1.17	1.18	0.27	0.24	-9.06	
4,475.00	1.00	96.00	4,474.40	0.80	1.97	1.98	0.25	0.20	-8.57	
4,519.00	1.00	89.10	4,518.39	0.77	2.74	2.74	0.27	0.00	-15.68	
4,559.00	3.20	79.00	4,558.36	0.99	4.18	4.19	5.56	5.50	-25.25	



Phoenix Technology Services

Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #16H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3849.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3849.00usft (Capstar 114)
Well:	#16H	North Reference:	Grid
Wellbore:	OH/Job #1310959	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

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)
4,604.00	7.50	74.00	4,603.16	2.04	8.24	8.26	9.60	9.56	-11.11
4,646.00	15.30	79.30	4,644.30	3.82	16.34	16.36	18.72	18.57	12.62
4,689.00	24.00	83.20	4,684.76	5.92	30.62	30.66	20.45	20.23	9.07
4,732.00	30.40	87.40	4,722.98	7.45	50.20	50.24	15.53	14.88	9.77
4,775.00	35.90	90.30	4,758.97	7.88	73.69	73.74	13.31	12.79	6.74
4,818.00	40.50	91.40	4,792.76	7.47	100.27	100.32	10.81	10.70	2.56
4,860.00	44.30	92.40	4,823.77	6.52	128.57	128.61	9.19	9.05	2.38
4,903.00	46.40	93.20	4,853.99	5.02	159.12	159.15	5.06	4.88	1.86
4,946.00	51.70	93.00	4,882.16	3.27	191.54	191.56	12.33	12.33	-0.47
4,987.00	56.80	91.70	4,906.10	1.92	224.77	224.78	12.70	12.44	-3.17
5,030.00	59.50	90.50	4,928.79	1.22	261.29	261.29	6.71	6.28	-2.79
5,072.00	65.20	88.90	4,948.28	1.43	298.47	298.48	13.98	13.57	-3.81
5,115.00	70.10	88.90	4,964.62	2.19	338.23	338.23	11.40	11.40	0.00
5,157.00	74.90	89.90	4,977.25	2.61	378.27	378.28	11.65	11.43	2.38
5,200.00	78.90	91.20	4,987.00	2.20	420.14	420.14	9.76	9.30	3.02
5,243.00	83.00	91.10	4,993.76	1.35	462.58	462.58	9.54	9.53	-0.23
5,286.00	87.20	91.70	4,997.43	0.30	505.40	505.40	9.87	9.77	1.40
5,374.00	87.30	90.80	5,001.65	-1.61	593.28	593.26	1.03	0.11	-1.02
5,463.00	86.90	90.20	5,006.15	-2.39	682.16	682.13	0.81	-0.45	-0.67
5,549.00	86.90	90.20	5,010.81	-2.69	768.04	768.00	0.00	0.00	0.00
5,634.00	86.90	89.60	5,015.40	-2.54	852.91	852.88	0.70	0.00	-0.71
5,719.00	86.80	89.30	5,020.07	-1.73	937.78	937.75	0.37	-0.12	-0.35
5,804.00	87.20	89.40	5,024.52	-0.76	1,022.66	1,022.63	0.49	0.47	0.12
5,892.00	88.80	89.60	5,027.59	0.00	1,110.60	1,110.57	1.83	1.82	0.23
5,977.00	89.30	89.50	5,029.00	0.67	1,195.58	1,195.56	0.60	0.59	-0.12
6,063.00	88.80	89.60	5,030.43	1.35	1,281.57	1,281.55	0.59	-0.58	0.12
6,148.00	88.80	88.80	5,032.21	2.53	1,366.54	1,366.53	0.94	0.00	-0.94
6,234.00	89.10	88.20	5,033.78	4.78	1,452.50	1,452.50	0.78	0.35	-0.70
6,320.00	87.70	89.20	5,036.18	6.73	1,538.44	1,538.45	2.00	-1.63	1.16
6,405.00	87.30	89.10	5,039.89	7.99	1,623.35	1,623.36	0.49	-0.47	-0.12
6,491.00	87.30	88.10	5,043.94	10.09	1,709.22	1,709.25	1.16	0.00	-1.16
6,576.00	87.20	87.80	5,048.02	13.13	1,794.07	1,794.12	0.37	-0.12	-0.35
6,662.00	87.50	87.30	5,052.00	16.80	1,879.90	1,879.97	0.68	0.35	-0.58
6,747.00	88.70	87.60	5,054.82	20.58	1,964.77	1,964.86	1.46	1.41	0.35
6,833.00	88.10	88.80	5,057.22	23.28	2,050.69	2,050.80	1.56	-0.70	1.40
6,917.00	87.70	89.80	5,060.30	24.31	2,134.63	2,134.74	1.28	-0.48	1.19
7,002.00	87.50	90.40	5,063.86	24.16	2,219.55	2,219.66	0.74	-0.24	0.71
7,087.00	87.10	89.80	5,067.86	24.01	2,304.46	2,304.56	0.85	-0.47	-0.71
7,172.00	87.20	90.80	5,072.09	23.57	2,389.35	2,389.45	1.18	0.12	1.18
7,257.00	86.60	90.70	5,076.68	22.46	2,474.22	2,474.31	0.72	-0.71	-0.12
7,345.00	88.40	91.30	5,080.52	20.92	2,562.12	2,562.20	2.16	2.05	0.68
7,431.00	87.50	90.60	5,083.60	19.50	2,648.05	2,648.12	1.33	-1.05	-0.81
7,516.00	87.20	89.70	5,087.53	19.27	2,732.96	2,733.02	1.12	-0.35	-1.06
7,601.00	86.80	88.90	5,091.98	20.31	2,817.83	2,817.90	1.05	-0.47	-0.94



Phoenix Technology Services
Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #16H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3849.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3849.00usft (Capstar 114)
Well:	#16H	North Reference:	Grid
Wellbore:	OH/Job #1310959	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

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)
7,686.00	86.90	89.70	5,096.65	21.35	2,902.70	2,902.77	0.95	0.12	0.94
7,774.00	85.90	88.30	5,102.17	22.88	2,990.51	2,990.59	1.95	-1.14	-1.59
7,859.00	86.60	89.40	5,107.73	24.58	3,075.30	3,075.40	1.53	0.82	1.29
7,943.00	87.10	90.80	5,112.35	24.43	3,159.18	3,159.27	1.77	0.60	1.67
8,028.00	88.70	91.00	5,115.46	23.10	3,244.11	3,244.19	1.90	1.88	0.24
8,112.00	88.40	91.00	5,117.59	21.64	3,328.07	3,328.14	0.36	-0.36	0.00
8,197.00	88.10	90.60	5,120.18	20.45	3,413.02	3,413.08	0.59	-0.35	-0.47
8,283.00	87.90	90.30	5,123.19	19.77	3,498.96	3,499.02	0.42	-0.23	-0.35
8,368.00	87.90	90.00	5,126.30	19.55	3,583.90	3,583.96	0.35	0.00	-0.35
8,452.00	87.30	89.20	5,129.82	20.14	3,667.83	3,667.88	1.19	-0.71	-0.95
8,537.00	87.60	88.90	5,133.60	21.55	3,752.73	3,752.79	0.50	0.35	-0.35
8,622.00	87.70	89.10	5,137.08	23.03	3,837.65	3,837.72	0.26	0.12	0.24
8,707.00	88.50	91.40	5,139.90	22.66	3,922.59	3,922.66	2.86	0.94	2.71
8,791.00	88.30	91.40	5,142.25	20.60	4,006.54	4,006.58	0.24	-0.24	0.00
8,876.00	88.60	91.10	5,144.55	18.75	4,091.48	4,091.52	0.50	0.35	-0.35
8,960.00	88.80	90.50	5,146.45	17.58	4,175.45	4,175.48	0.75	0.24	-0.71
9,045.00	88.30	89.80	5,148.60	17.36	4,260.43	4,260.45	1.01	-0.59	-0.82
9,130.00	88.30	89.60	5,151.13	17.80	4,345.39	4,345.41	0.24	0.00	-0.24
9,214.00	88.20	89.30	5,153.69	18.61	4,429.34	4,429.37	0.38	-0.12	-0.36
9,298.00	88.00	89.00	5,156.48	19.85	4,513.29	4,513.32	0.43	-0.24	-0.36
9,383.00	88.00	88.80	5,159.44	21.48	4,598.22	4,598.26	0.24	0.00	-0.24
9,467.00	88.20	88.80	5,162.23	23.24	4,682.16	4,682.21	0.24	0.24	0.00
9,555.00	88.70	88.70	5,164.61	25.16	4,770.10	4,770.17	0.58	0.57	-0.11
9,572.00	88.70	88.60	5,164.99	25.56	4,787.09	4,787.16	0.59	0.00	-0.59
Last Phoenix MWD Survey									
9,626.00	88.70	88.60	5,166.22	26.88	4,841.06	4,841.14	0.00	0.00	0.00
Projection to TD									

Survey Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
472.00	471.90	-0.53	7.68	Tie-on to Gyro
531.00	530.87	-0.72	9.69	First Phoenix MWD Survey
9,572.00	5,164.99	25.56	4,787.09	Last Phoenix MWD Survey
9,626.00	5,166.22	26.88	4,841.06	Projection to TD

Checked By: _____ Approved By: _____ Date: _____