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Apache Corporation

Eddy County, NM (NAD27 NME)

Crow Federal

#22H

WB1/Job #1311192

Survey: Phoenix MWD Surveys

Phoenix Final Survey Report

24 September, 2013



PHOENIX
TECHNOLOGY SERVICES



Phoenix Technology Services

Phoenix Final Survey Report



Company: Apache Corporation
Project: Eddy County, NM (NAD27 NME)
Site: Crow Federal
Well: #22H
Wellbore: WB1/Job #1311192
Design: Surveys (Capstar 114)

Local Co-ordinate Reference: Well #22H
TVD Reference: KB @ 3881.00usft (Capstar 114)
MD Reference: KB @ 3881.00usft (Capstar 114)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
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 Latitude: 32° 50' 38.92796 N
From: Map Easting: 643,906.80 usft Longitude: 103° 51' 53.16689 W
Position Uncertainty: 0.00 usft Slot Radius: 13-3/16" Grid Convergence: 0.25 °

Well: #22H

Well Position +N-S 0.00 usft Northing: 673,813.20 usft Latitude: 32° 51' 5.70786 N
+E-W 0.00 usft Easting: 638,370.30 usft Longitude: 103° 52' 57.92823 W
Position Uncertainty 0.00 usft Wellhead Elevation: usft Ground Level: 3,870.00 usft

Wellbore: WB1/Job #1311192

Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010_14	09/06/13	7.50	60.66	48,733

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	89.59

Survey Program Date 09/24/13

From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
100.00	400.00	Gyrodata Survey (WB1/Job #1311192)	CB-GYRO-MS	Camera based gyro multishot
481.00	9,837.00	Phoenix MWD Surveys (WB1/Job #131119	MWD	MWD - Standard

MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
481.00	0.28	74.44	480.97	0.08	4.75	4.75	0.00
Tie-on to Gyro							
569.00	0.40	74.30	568.97	0.22	5.26	5.26	0.14
First Phoenix MWD Survey							
655.00	0.70	97.30	654.97	0.24	6.07	6.07	0.43
743.00	0.80	67.00	742.96	0.41	7.17	7.17	0.46
829.00	0.90	68.90	828.95	0.89	8.35	8.35	0.12
914.00	1.10	66.80	913.94	1.45	9.72	9.73	0.24
1,000.00	1.50	72.20	999.92	2.12	11.55	11.57	0.49
1,085.00	0.60	85.60	1,084.90	2.49	13.06	13.07	1.09
1,173.00	0.20	166.90	1,172.90	2.38	13.55	13.57	0.69



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Survey								
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	EW (usft)	V. Sec (usft)	DLeg (°/100usft)	
1,258.00	0.10	162.80	1,257.90	2.16	13.60	13.62	0.12	
1,344.00	0.70	122.20	1,343.90	1.81	14.07	14.08	0.73	
1,429.00	0.70	263.10	1,428.89	1.47	14.00	14.01	1.55	
1,515.00	1.10	252.40	1,514.88	1.16	12.69	12.70	0.50	
1,600.00	0.90	244.70	1,599.87	0.63	11.31	11.31	0.28	
1,685.00	1.00	260.40	1,684.86	0.22	9.97	9.97	0.33	
1,771.00	1.10	260.80	1,770.84	-0.04	8.42	8.42	0.12	
1,857.00	0.90	260.60	1,856.83	-0.28	6.93	6.93	0.23	
1,942.00	0.90	251.90	1,941.82	-0.60	5.64	5.64	0.16	
2,028.00	1.10	243.90	2,027.81	-1.17	4.26	4.25	0.28	
2,113.00	1.00	264.30	2,112.79	-1.60	2.79	2.78	0.45	
2,197.00	1.00	250.40	2,196.78	-1.92	1.37	1.35	0.29	
2,283.00	0.90	266.70	2,282.77	-2.21	-0.01	-0.03	0.33	
2,368.00	1.00	273.00	2,367.76	-2.21	-1.42	-1.44	0.17	
2,454.00	1.10	264.30	2,453.74	-2.25	-2.99	-3.01	0.22	
2,541.00	1.10	265.00	2,540.73	-2.41	-4.65	-4.67	0.02	
2,627.00	0.50	317.80	2,626.72	-2.20	-5.73	-5.74	1.04	
2,713.00	0.20	42.30	2,712.72	-1.81	-5.88	-5.89	0.61	
2,798.00	0.10	357.20	2,797.72	-1.63	-5.78	-5.80	0.17	
2,884.00	0.50	348.10	2,883.72	-1.19	-5.86	-5.87	0.47	
2,971.00	0.40	349.30	2,970.71	-0.52	-6.00	-6.00	0.12	
3,056.00	0.30	310.10	3,055.71	-0.08	-6.22	-6.23	0.30	
3,141.00	0.50	14.50	3,140.71	0.42	-6.30	-6.30	0.54	
3,227.00	0.50	328.40	3,226.71	1.10	-6.40	-6.40	0.46	
3,313.00	0.30	318.20	3,312.71	1.59	-6.75	-6.74	0.25	
3,364.00	0.70	350.00	3,363.70	2.00	-6.89	-6.88	0.93	
3,441.00	0.70	333.80	3,440.70	2.88	-7.18	-7.16	0.26	
3,527.00	0.70	325.40	3,526.69	3.79	-7.71	-7.69	0.12	
3,557.00	0.70	325.00	3,556.69	4.09	-7.92	-7.89	0.02	
3,612.00	0.70	331.80	3,611.69	4.66	-8.27	-8.24	0.15	
3,654.00	0.80	315.30	3,653.68	5.09	-8.60	-8.57	0.56	
3,740.00	0.90	155.00	3,739.68	4.91	-8.74	-8.70	1.95	
3,826.00	0.60	167.10	3,825.67	3.86	-8.35	-8.33	0.39	
3,911.00	0.60	164.00	3,910.67	2.99	-8.13	-8.11	0.04	
3,996.00	0.50	139.40	3,995.66	2.28	-7.77	-7.75	0.30	
4,082.00	0.70	137.90	4,081.66	1.61	-7.17	-7.16	0.23	
4,166.00	0.50	118.60	4,165.65	1.05	-6.50	-6.50	0.34	
4,254.00	0.70	121.70	4,253.65	0.59	-5.71	-5.71	0.23	
4,339.00	0.80	126.80	4,338.64	-0.04	-4.79	-4.79	0.14	
4,425.00	0.90	127.70	4,424.63	-0.81	-3.78	-3.78	0.12	
4,510.00	0.90	128.40	4,509.62	-1.64	-2.73	-2.74	0.01	
4,574.00	1.00	128.80	4,573.61	-2.30	-1.90	-1.91	0.16	
4,600.00	0.90	130.90	4,599.61	-2.57	-1.57	-1.58	0.41	
4,642.00	3.80	98.90	4,641.57	-3.01	0.06	0.04	7.32	



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Survey

MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
4,685.00	9.30	88.60	4,684.27	-3.14	4.94	4.92	13.03
4,728.00	14.00	83.50	4,726.38	-2.47	13.59	13.57	11.18
4,771.00	19.20	82.80	4,767.57	-0.99	25.78	25.77	12.10
4,814.00	23.60	85.50	4,807.60	0.57	41.38	41.39	10.48
4,856.00	28.10	88.60	4,845.39	1.47	59.66	59.67	11.18
4,899.00	32.80	91.00	4,882.45	1.52	81.45	81.46	11.29
4,942.00	36.90	92.30	4,917.73	0.80	106.00	106.00	9.69
4,985.00	42.20	91.90	4,950.87	-0.20	133.35	133.35	12.34
5,027.00	48.10	90.50	4,980.48	-0.81	163.11	163.10	14.24
5,070.00	53.50	89.60	5,007.65	-0.83	196.42	196.41	12.66
5,113.00	58.20	89.30	5,031.78	-0.48	231.99	231.98	10.95
5,155.00	63.40	89.20	5,052.26	0.00	268.64	268.63	12.38
5,197.00	68.70	88.70	5,069.31	0.70	307.00	307.00	12.67
5,239.00	73.40	88.70	5,082.94	1.61	346.70	346.71	11.19
5,282.00	78.40	89.60	5,093.41	2.22	388.39	388.40	11.80
5,325.00	83.90	90.50	5,100.03	2.18	430.86	430.87	12.96
5,368.00	88.00	90.30	5,103.06	1.88	473.74	473.75	9.55
5,452.00	88.30	89.60	5,105.78	1.96	557.70	557.70	0.91
5,538.00	88.50	89.60	5,108.18	2.56	643.66	643.67	0.23
5,623.00	88.40	89.30	5,110.48	3.37	728.63	728.63	0.37
5,711.00	88.70	89.20	5,112.70	4.52	816.59	816.60	0.36
5,796.00	88.80	89.20	5,114.56	5.71	901.56	901.58	0.12
5,885.00	88.90	89.30	5,116.34	6.87	990.54	990.56	0.16
5,972.00	90.10	89.00	5,117.10	8.16	1,077.52	1,077.56	1.42
6,058.00	89.60	89.00	5,117.33	9.67	1,163.51	1,163.55	0.58
6,143.00	89.50	89.00	5,118.00	11.15	1,248.50	1,248.54	0.12
6,229.00	88.30	87.90	5,119.65	13.47	1,334.45	1,334.51	1.89
6,314.00	89.20	90.10	5,121.50	14.96	1,419.41	1,419.48	2.80
6,400.00	89.50	90.10	5,122.48	14.81	1,505.40	1,505.47	0.35
6,485.00	89.20	90.00	5,123.44	14.73	1,590.39	1,590.46	0.37
6,571.00	89.20	89.50	5,124.64	15.11	1,676.39	1,676.45	0.58
6,656.00	89.20	89.90	5,125.83	15.55	1,761.38	1,761.44	0.47
6,741.00	89.10	89.90	5,127.09	15.70	1,846.37	1,846.43	0.12
6,826.00	88.80	90.10	5,128.65	15.70	1,931.35	1,931.41	0.42
6,912.00	88.80	90.10	5,130.45	15.55	2,017.33	2,017.39	0.00
6,999.00	88.60	90.50	5,132.42	15.10	2,104.31	2,104.36	0.51
7,087.00	88.30	90.30	5,134.80	14.48	2,192.27	2,192.32	0.41
7,172.00	87.90	90.60	5,137.62	13.81	2,277.22	2,277.27	0.59
7,190.43	87.84	90.58	5,138.31	13.63	2,295.64	2,295.68	0.37
2300' VS Crow Fed 22H							
7,194.77	87.82	90.57	5,138.47	13.58	2,299.97	2,300.01	0.37
2300' VS Crow Fed 22H v2							
7,258.00	87.60	90.50	5,141.00	12.99	2,363.15	2,363.19	0.37
7,344.00	87.50	90.30	5,144.67	12.39	2,449.07	2,449.10	0.26



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7,429.00	87.10	89.70	5,148.68	12.39	2,533.98	2,534.00	0.85
7,515.00	87.00	89.30	5,153.10	13.14	2,619.86	2,619.89	0.48
7,600.00	88.00	88.60	5,156.81	14.70	2,704.76	2,704.80	1.44
7,686.00	88.10	88.60	5,159.74	16.80	2,790.69	2,790.74	0.12
7,772.00	87.90	88.50	5,162.74	18.97	2,876.61	2,876.67	0.26
7,857.00	88.40	88.60	5,165.48	21.12	2,961.54	2,961.61	0.60
7,943.00	88.70	89.50	5,167.66	22.55	3,047.50	3,047.58	1.10
8,028.00	88.50	89.30	5,169.74	23.44	3,132.47	3,132.55	0.33
8,114.00	90.00	90.00	5,170.86	23.96	3,218.45	3,218.54	1.92
8,199.00	89.70	89.90	5,171.08	24.03	3,303.45	3,303.54	0.37
8,285.00	89.20	89.20	5,171.91	24.71	3,389.45	3,389.54	1.00
8,370.00	88.50	88.80	5,173.61	26.19	3,474.42	3,474.51	0.95
8,456.00	90.00	89.60	5,174.74	27.39	3,560.40	3,560.50	1.98
8,541.00	89.70	89.30	5,174.96	28.21	3,645.39	3,645.50	0.50
8,627.00	89.50	89.00	5,175.56	29.49	3,731.38	3,731.50	0.42
8,712.00	89.00	89.30	5,176.68	30.75	3,816.36	3,816.49	0.69
8,798.00	88.70	89.00	5,178.40	32.02	3,902.34	3,902.47	0.49
8,883.00	88.60	88.70	5,180.40	33.73	3,987.30	3,987.44	0.37
8,972.00	88.30	88.60	5,182.81	35.82	4,076.24	4,076.39	0.36
9,057.00	87.80	87.90	5,185.70	38.42	4,161.15	4,161.32	1.01
9,143.00	89.70	89.60	5,187.58	40.29	4,247.10	4,247.28	2.96
9,228.00	89.80	89.70	5,187.95	40.81	4,332.10	4,332.28	0.17
9,314.00	89.80	90.00	5,188.25	41.04	4,418.10	4,418.28	0.35
9,399.00	90.00	90.10	5,188.40	40.96	4,503.10	4,503.28	0.26
9,485.00	90.10	90.10	5,188.32	40.81	4,589.10	4,589.27	0.12
9,571.00	90.00	90.10	5,188.25	40.66	4,675.10	4,675.27	0.12
9,656.00	90.50	89.90	5,187.88	40.66	4,760.10	4,760.27	0.63
9,742.00	89.50	89.60	5,187.88	41.04	4,846.09	4,846.26	1.21
9,783.00	89.50	89.60	5,188.24	41.32	4,887.09	4,887.26	0.00
Last Phoenix MWD Survey							
9,836.50	89.50	89.60	5,188.70	41.70	4,940.59	4,940.76	0.00
BHL v2 Crow Fed 22H							
9,836.69	89.50	89.60	5,188.71	41.70	4,940.78	4,940.95	0.00
BHL Crow Fed 22H							
9,837.00	89.50	89.60	5,188.71	41.70	4,941.09	4,941.26	0.00
Projection to TD - BHL v3 Crow Fed 22H							



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Survey Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		
		+N/-S (usft)	+E/-W (usft)	Comment
481.00	480.97	0.08	4.75	Tie-on to Gyro
569.00	568.97	0.22	5.26	First Phoenix MWD Survey
9,783.00	5,188.24	41.32	4,887.09	Last Phoenix MWD Survey
9,837.00	5,188.71	41.70	4,941.09	Projection to TD

Checked By: _____ Approved By: _____ Date: _____