



**NM OIL CONSERVATION
ARTESIA DISTRICT**

JAN 23 2018

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Apache Corporation

Eddy County, NM (NAD 83 NME)

Cedar Lake Federal CA

301H

30-015-43561

OH / Job #61480

Survey: Phoenix MWD Surveys

Standard Survey Report

21 July, 2017





Phoenix Technology Services LP

Survey Report



Company: Apache Corporation
Project: Eddy County, NM (NAD 83 NME)
Site: Cedar Lake Federal CA
Well: 301H
Wellbore: OH / Job #61480
Design: Surveys (Trinidad 436)

Local Co-ordinate Reference: Well 301H
TVD Reference: KB @ 3968.50usft (Trinidad 436)
MD Reference: KB @ 3968.50usft (Trinidad 436)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

Project	Eddy County, NM (NAD 83 NME)		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	New Mexico Eastern Zone		

Site	Cedar Lake Federal CA		
Site Position:		Northing:	675,068.30 usft
From:	Map	Easting:	689,764.00 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "
		Latitude:	32° 51' 17.46895 N
		Longitude:	103° 50' 59.94191 W
		Grid Convergence:	0.26 °

Well	301H		
Well Position	+N/-S	0.00 usft	Northing:
	+E/-W	0.00 usft	Easting:
Position Uncertainty	0.00 usft	Wellhead Elevation:	0.00 usft
		Latitude:	32° 51' 56.49646 N
		Longitude:	103° 51' 55.89966 W
		Ground Level:	3,952.00 usft

Wellbore	OH / Job #61480				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	HDGM	8/1/2017	7.38	60.80	48,393

Design	Surveys (Trinidad 436)				
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 (°)	
	5,138.00	0.00	0.00	269.62	

Survey Program	Date 7/21/2017				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
57.00	647.00	Phoenix Gyro Surveys (OH / Job #61480)	SPT_GTD	Continuous north-seeking gyro	
721.00	10,137.00	Phoenix MWD Surveys (OH / Job #61480)	MWD+HDGM	OWSG Rev.2 MWD + HDGM	

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Buid Rate (°/100usft)	Turn Rate (°/100usft)	
647.00	0.62	275.80	646.99	-0.09	-2.93	2.93	0.00	0.00	0.00	
Tie In										
721.00	0.77	263.55	720.98	-0.10	-3.82	3.82	0.28	0.20	-16.56	
First Phoenix Survey										
847.00	0.95	263.73	846.97	-0.31	-5.70	5.70	0.14	0.14	0.14	
971.00	0.63	229.34	970.96	-0.87	-7.24	7.25	0.45	-0.26	-27.73	
1,159.00	0.74	182.27	1,158.95	-2.76	-8.07	8.09	0.30	0.06	-25.04	
1,284.00	0.82	184.19	1,283.94	-4.45	-8.17	8.20	0.07	0.06	1.54	
1,409.00	0.73	187.61	1,408.92	-6.14	-8.34	8.38	0.08	-0.07	2.74	



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1,534.00	0.70	189.20	1,533.91	-7.68	-8.57	8.62	0.03	-0.02	1.27
1,658.00	0.62	179.42	1,657.91	-9.10	-8.68	8.74	0.11	-0.06	-7.89
1,783.00	0.60	156.41	1,782.90	-10.37	-8.41	8.48	0.20	-0.02	-18.41
1,908.00	0.61	166.68	1,907.89	-11.62	-8.00	8.07	0.09	0.01	8.22
2,033.00	0.62	163.91	2,032.88	-12.92	-7.66	7.74	0.03	0.01	-2.22
2,158.00	0.54	181.29	2,157.88	-14.16	-7.48	7.58	0.15	-0.06	13.90
2,283.00	0.58	181.71	2,282.87	-15.38	-7.51	7.62	0.03	0.03	0.34
2,408.00	0.46	180.11	2,407.87	-16.51	-7.53	7.64	0.10	-0.10	-1.28
2,533.00	0.38	187.89	2,532.86	-17.42	-7.59	7.71	0.08	-0.06	6.22
2,658.00	0.39	197.39	2,657.86	-18.24	-7.78	7.90	0.05	0.01	7.60
2,783.00	0.39	204.67	2,782.86	-19.03	-8.08	8.21	0.04	0.00	5.82
2,908.00	0.29	228.70	2,907.86	-19.63	-8.50	8.63	0.14	-0.08	19.22
3,033.00	0.39	234.45	3,032.85	-20.08	-9.08	9.21	0.08	0.08	4.60
3,158.00	0.48	261.56	3,157.85	-20.41	-9.94	10.08	0.18	0.07	21.69
3,282.00	0.58	261.79	3,281.85	-20.57	-11.08	11.21	0.08	0.08	0.19
3,407.00	0.53	272.09	3,406.84	-20.64	-12.28	12.42	0.09	-0.04	8.24
3,470.00	0.63	265.86	3,469.84	-20.66	-12.92	13.06	0.19	0.16	-9.89
3,587.00	0.67	278.64	3,586.83	-20.60	-14.24	14.37	0.13	0.03	10.92
3,712.00	0.28	232.14	3,711.82	-20.68	-15.20	15.34	0.41	-0.31	-37.20
3,838.00	0.25	237.85	3,837.82	-21.02	-15.68	15.82	0.03	-0.02	4.53
3,964.00	0.11	246.85	3,963.82	-21.21	-16.02	16.16	0.11	-0.11	7.14
4,089.00	0.29	195.08	4,088.82	-21.56	-16.21	16.36	0.19	0.14	-41.42
4,213.00	0.34	218.12	4,212.82	-22.15	-16.52	16.67	0.11	0.04	18.58
4,337.00	0.34	197.66	4,336.82	-22.79	-16.86	17.01	0.10	0.00	-16.50
4,462.00	0.14	178.74	4,461.82	-23.30	-16.97	17.12	0.17	-0.16	-15.14
4,587.00	0.47	183.60	4,586.81	-23.96	-17.00	17.16	0.26	0.26	3.89
4,678.00	0.21	149.00	4,677.81	-24.48	-16.94	17.10	0.35	-0.29	-38.02
4,700.00	0.28	161.55	4,699.81	-24.57	-16.90	17.06	0.40	0.32	57.05
4,763.00	5.33	280.70	4,762.72	-24.17	-19.73	19.89	8.69	8.02	189.13
4,827.00	12.82	283.90	4,825.88	-21.91	-29.56	29.70	11.73	11.70	5.00
4,889.00	18.20	285.06	4,885.60	-17.74	-45.59	45.71	8.69	8.68	1.87
4,953.00	24.90	282.60	4,945.09	-12.19	-68.42	68.50	10.56	10.47	-3.84
5,016.00	26.32	278.38	5,001.91	-7.26	-95.18	95.23	3.67	2.25	-6.70
5,079.00	34.93	271.52	5,056.08	-4.74	-127.10	127.13	14.73	13.67	-10.89
5,142.00	41.28	269.95	5,105.63	-4.28	-165.95	165.98	10.20	10.08	-2.49
5,167.00	44.82	269.03	5,123.90	-4.44	-183.02	183.04	14.39	14.17	-3.70
Section Crossing 5167°MD, 44.82° Inc, 269.03° Azm									
5,206.00	50.36	267.79	5,150.19	-5.25	-211.79	211.82	14.39	14.20	-3.17
5,269.00	60.66	267.95	5,185.82	-7.18	-263.61	263.65	16.35	16.35	0.25
5,333.00	69.73	268.73	5,212.64	-8.84	-321.62	321.67	14.21	14.17	1.22
5,395.00	77.27	271.12	5,230.24	-8.90	-381.02	381.07	12.71	12.16	3.85
5,453.00	83.38	271.22	5,239.98	-7.73	-438.15	438.20	10.54	10.53	0.17
5,531.00	91.46	271.27	5,243.49	-6.04	-515.99	516.02	10.36	10.36	0.06
5,592.00	91.99	272.01	5,241.65	-4.29	-576.94	576.95	1.49	0.87	1.21



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5,654.00	92.16	272.07	5,239.41	-2.09	-638.86	638.86	0.29	0.27	0.10
5,716.00	90.28	270.85	5,238.09	-0.51	-700.82	700.81	3.61	-3.03	-1.97
5,778.00	90.56	271.00	5,237.64	0.49	-762.81	762.79	0.51	0.45	0.24
5,840.00	91.09	272.05	5,236.74	2.14	-824.78	824.75	1.90	0.85	1.69
5,901.00	91.29	272.42	5,235.48	4.52	-885.72	885.67	0.69	0.33	0.61
5,963.00	90.92	271.39	5,234.28	6.58	-947.68	947.61	1.76	-0.60	-1.66
6,026.00	91.40	272.03	5,233.00	8.46	-1,010.63	1,010.56	1.27	0.76	1.02
6,090.00	91.51	271.03	5,231.38	10.17	-1,074.59	1,074.50	1.57	0.17	-1.56
6,153.00	92.02	271.20	5,229.44	11.39	-1,137.55	1,137.45	0.85	0.81	0.27
6,217.00	91.12	269.38	5,227.69	11.72	-1,201.52	1,201.42	3.17	-1.41	-2.84
6,281.00	91.57	269.81	5,226.18	11.26	-1,265.50	1,265.40	0.97	0.70	0.67
6,344.00	91.96	270.41	5,224.24	11.39	-1,328.47	1,328.37	1.14	0.62	0.95
6,407.00	90.84	269.20	5,222.70	11.17	-1,391.45	1,391.34	2.62	-1.78	-1.92
6,471.00	91.34	268.70	5,221.49	10.00	-1,455.43	1,455.33	1.10	0.78	-0.78
6,534.00	90.79	267.48	5,220.32	7.90	-1,518.38	1,518.29	2.12	-0.87	-1.94
6,598.00	91.18	267.46	5,219.21	5.07	-1,582.31	1,582.24	0.61	0.61	-0.03
6,662.00	91.57	268.00	5,217.68	2.54	-1,646.24	1,646.18	1.04	0.61	0.84
6,726.00	91.88	267.60	5,215.75	0.08	-1,710.16	1,710.12	0.79	0.48	-0.63
6,789.00	92.21	268.23	5,213.50	-2.21	-1,773.08	1,773.05	1.13	0.52	1.00
6,853.00	92.69	268.35	5,210.77	-4.11	-1,836.99	1,836.98	0.77	0.75	0.19
6,916.00	92.13	267.97	5,208.12	-6.14	-1,899.90	1,899.90	1.07	-0.89	-0.60
6,979.00	92.72	268.30	5,205.45	-8.18	-1,962.81	1,962.82	1.07	0.94	0.52
7,043.00	91.46	269.27	5,203.12	-9.54	-2,026.75	2,026.77	2.48	-1.97	1.52
7,106.00	92.02	269.79	5,201.21	-10.06	-2,089.72	2,089.74	1.21	0.89	0.83
7,169.00	90.39	269.49	5,199.88	-10.45	-2,152.70	2,152.73	2.63	-2.59	-0.48
7,233.00	90.70	269.45	5,199.27	-11.04	-2,216.70	2,216.72	0.49	0.48	-0.06
7,297.00	91.20	269.53	5,198.21	-11.61	-2,280.69	2,280.71	0.79	0.78	0.13
7,360.00	91.49	269.18	5,196.73	-12.32	-2,343.67	2,343.70	0.72	0.46	-0.56
7,423.00	89.94	268.94	5,195.95	-13.36	-2,406.65	2,406.69	2.49	-2.46	-0.38
7,487.00	90.67	269.53	5,195.61	-14.21	-2,470.64	2,470.68	1.47	1.14	0.92
7,550.00	90.59	270.08	5,194.91	-14.42	-2,533.64	2,533.68	0.88	-0.13	0.87
7,613.00	90.70	269.92	5,194.20	-14.42	-2,596.63	2,596.67	0.31	0.17	-0.25
7,677.00	90.87	270.45	5,193.33	-14.22	-2,660.63	2,660.66	0.87	0.27	0.83
7,739.00	90.92	270.22	5,192.36	-13.86	-2,722.62	2,722.65	0.38	0.08	-0.37
7,803.00	91.07	270.83	5,191.25	-13.27	-2,786.61	2,786.63	0.98	0.23	0.95
7,866.00	91.31	271.39	5,189.94	-12.05	-2,849.58	2,849.60	0.97	0.38	0.89
7,929.00	90.36	269.95	5,189.02	-11.31	-2,912.57	2,912.58	2.74	-1.51	-2.29
7,993.00	90.84	270.66	5,188.35	-10.97	-2,976.56	2,976.57	1.34	0.75	1.11
8,056.00	91.15	270.03	5,187.26	-10.59	-3,039.55	3,039.56	1.11	0.49	-1.00
8,119.00	91.51	270.55	5,185.79	-10.27	-3,102.53	3,102.53	1.00	0.57	0.83
8,183.00	91.20	270.01	5,184.28	-9.96	-3,166.51	3,166.51	0.97	-0.48	-0.84
8,246.00	91.51	270.55	5,182.79	-9.65	-3,229.50	3,229.49	0.99	0.49	0.86
8,309.00	91.96	270.53	5,180.88	-9.06	-3,292.46	3,292.45	0.71	0.71	-0.03



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8,372.00	92.27	270.72	5,178.56	-8.37	-3,355.42	3,355.40	0.58	0.49	0.30
8,435.00	91.09	270.62	5,176.71	-7.64	-3,418.38	3,418.36	1.88	-1.87	-0.16
8,498.00	91.31	270.46	5,175.39	-7.04	-3,481.37	3,481.34	0.43	0.35	-0.25
8,562.00	91.34	269.28	5,173.91	-7.19	-3,545.35	3,545.32	1.84	0.05	-1.84
8,625.00	91.71	269.50	5,172.24	-7.86	-3,608.32	3,608.30	0.68	0.59	0.35
8,688.00	90.92	268.06	5,170.79	-9.20	-3,671.29	3,671.27	2.61	-1.25	-2.29
8,752.00	91.04	267.81	5,169.70	-11.51	-3,735.24	3,735.23	0.43	0.19	-0.39
8,815.00	91.31	268.40	5,168.40	-13.59	-3,798.19	3,798.20	1.03	0.43	0.94
8,879.00	91.29	268.25	5,166.95	-15.46	-3,862.15	3,862.17	0.24	-0.03	-0.23
8,942.00	91.29	268.47	5,165.53	-17.26	-3,925.11	3,925.13	0.35	0.00	0.35
9,005.00	91.49	268.34	5,164.01	-19.01	-3,988.06	3,988.10	0.38	0.32	-0.21
9,068.00	91.46	268.21	5,162.38	-20.91	-4,051.01	4,051.06	0.21	-0.05	-0.21
9,132.00	91.77	268.84	5,160.58	-22.56	-4,114.97	4,115.03	1.10	0.48	0.98
9,194.00	92.16	269.31	5,158.45	-23.56	-4,176.92	4,176.99	0.98	0.63	0.76
9,258.00	90.79	268.26	5,156.81	-24.91	-4,240.88	4,240.96	2.70	-2.14	-1.64
9,321.00	90.92	268.18	5,155.87	-26.87	-4,303.85	4,303.93	0.24	0.21	-0.13
9,385.00	90.98	268.28	5,154.81	-28.85	-4,367.81	4,367.90	0.18	0.09	0.16
9,448.00	89.89	267.49	5,154.33	-31.17	-4,430.76	4,430.87	2.14	-1.73	-1.25
9,511.00	90.22	268.22	5,154.27	-33.53	-4,493.72	4,493.84	1.27	0.52	1.16
9,575.00	90.39	268.15	5,153.93	-35.56	-4,557.68	4,557.82	0.29	0.27	-0.11
9,637.00	90.59	268.17	5,153.40	-37.55	-4,619.65	4,619.80	0.32	0.32	0.03
9,700.00	91.15	268.36	5,152.44	-39.46	-4,682.61	4,682.77	0.94	0.89	0.30
9,764.00	91.37	268.78	5,151.03	-41.05	-4,746.58	4,746.74	0.74	0.34	0.66
9,827.00	91.51	268.79	5,149.45	-42.39	-4,809.54	4,809.72	0.22	0.22	0.02
9,891.00	91.74	269.28	5,147.63	-43.46	-4,873.51	4,873.69	0.85	0.36	0.77
9,954.00	92.10	269.45	5,145.52	-44.16	-4,936.47	4,936.65	0.63	0.57	0.27
10,017.00	91.96	269.10	5,143.29	-44.96	-4,999.42	4,999.61	0.60	-0.22	-0.56
10,065.00	92.16	269.24	5,141.57	-45.65	-5,047.39	5,047.58	0.51	0.42	0.29
Final Phoenix MWD Survey									
10,137.00	92.16	269.24	5,138.85	-46.61	-5,119.33	5,119.53	0.00	0.00	0.00
Projection to TD									

Survey Annotations

Measured Depth (usft)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Comment
647.00	646.99	-0.09	-2.93	Tie In
721.00	720.98	-0.10	-3.82	First Phoenix Survey
5,167.00	5,123.90	-4.44	-183.02	Section Crossing 5167°MD, 44.82° Inc, 269.03° Azm
10,065.00	5,141.57	-45.65	-5,047.39	Final Phoenix MWD Survey
10,137.00	5,138.85	-46.61	-5,119.33	Projection to TD