



# **Apache Corporation**

**Andrews County, TX (NAD 27 TNC)**

**High Bar University Unit**

**#2H**

**WB2/Job #1311100**

**Survey: Phoenix MWD Survey**

## **Phoenix Final Survey Report**

**16 October, 2013**





**Phoenix Technology Services**  
Phoenix Final Survey Report



<b>Company:</b>	Apache Corporation	<b>Local Co-ordinate Reference:</b>	Well #2H
<b>Project:</b>	Andrews County, TX (NAD 27 TNC)	<b>TVD Reference:</b>	KB @ 3327.00usft (Pioneer 29)
<b>Site:</b>	High Bar University Unit	<b>MD Reference:</b>	KB @ 3327.00usft (Pioneer 29)
<b>Well:</b>	#2H	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	WB2/Job #1311100	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys (Pioneer 29)	<b>Database:</b>	GCR DB

<b>Project</b>	Andrews County, TX (NAD 27 TNC)		
<b>Map System:</b>	US State Plane 1927 (Exact solution)	<b>System Datum:</b>	Mean Sea Level
<b>Geo Datum:</b>	NAD 1927 (NADCON CONUS)		
<b>Map Zone:</b>	Texas North Central 4202		

<b>Site</b>	High Bar University Unit				
<b>Site Position:</b>		<b>Northing:</b>	262,166.39 usft	<b>Latitude:</b>	32° 16' 15.69318 N
<b>From:</b>	Map	<b>Easting:</b>	343,173.72 usft	<b>Longitude:</b>	102° 51' 45.18150 W
<b>Position Uncertainty:</b>	0.00 usft	<b>Slot Radius:</b>	13-3/16"	<b>Grid Convergence:</b>	-2.92 °

<b>Well</b>	#2H					
<b>Well Position</b>	<b>+N/-S</b>	0.00 usft	<b>Northing:</b>	262,166.39 usft	<b>Latitude:</b>	32° 16' 15.69318 N
	<b>+E/-W</b>	0.00 usft	<b>Easting:</b>	343,173.72 usft	<b>Longitude:</b>	102° 51' 45.18150 W
<b>Position Uncertainty</b>		0.00 usft	<b>Wellhead Elevation:</b>	usft	<b>Ground Level:</b>	3,307.00 usft

<b>Wellbore</b>	WB2/Job #1311100				
<b>Magnetics</b>	<b>Model Name</b>	<b>Sample Date</b>	<b>Declination (°)</b>	<b>Dip Angle (°)</b>	<b>Field Strength (nT)</b>
	IGRF2010_14	09/26/13	6.97	60.29	48,492

<b>Design</b>	Surveys (Pioneer 29)				
<b>Audit Notes:</b>					
<b>Version:</b>	1.0	<b>Phase:</b>	ACTUAL	<b>Tie On Depth:</b>	7,400.00
<b>Vertical Section:</b>		<b>Depth From (TVD) (usft)</b>	<b>+N/-S (usft)</b>	<b>+E/-W (usft)</b>	<b>Direction (°)</b>
		0.00	0.00	0.00	347.16

<b>Survey Program</b>	<b>Date</b>	10/16/13			
<b>From (usft)</b>	<b>To (usft)</b>	<b>Survey (Wellbore)</b>	<b>Tool Name</b>	<b>Description</b>	
100.00	7,400.00	VES Gyro/Pilot Hole (WB1/Job #1311100)	ISCWSA-GYRO-3	VES Gyro	
7,400.00	12,597.00	Phoenix MWD Survey (WB2/Job #1311100)	MWD	MWD - Standard	

<b>Survey</b>								
<b>MD (usft)</b>	<b>Inc (°)</b>	<b>Azi (azimuth) (°)</b>	<b>TVD (usft)</b>	<b>N/S (usft)</b>	<b>E/W (usft)</b>	<b>V. Sec (usft)</b>	<b>DLeg (°/100usft)</b>	
7,400.00	0.14	171.07	7,399.40	-5.79	36.84	-13.83	0.00	
<b>Tie-on to Gyro</b>								
7,466.00	2.20	336.00	7,465.39	-4.71	36.34	-12.67	3.54	
<b>First Phoenix MWD Survey</b>								
7,497.00	5.30	339.90	7,496.32	-2.82	35.60	-10.67	10.03	
7,529.00	8.60	343.30	7,528.08	0.86	34.41	-6.81	10.39	
7,561.00	12.30	345.60	7,559.54	6.45	32.87	-1.01	11.63	
7,592.00	16.30	346.30	7,589.58	13.88	31.02	6.64	12.92	
7,624.00	20.30	347.20	7,619.95	23.66	28.72	16.68	12.53	
7,656.00	24.30	347.00	7,649.55	35.49	26.01	28.82	12.50	
7,687.00	27.90	345.20	7,677.39	48.72	22.72	42.46	11.89	



# Phoenix Technology Services

## Phoenix Final Survey Report



<b>Company:</b>	Apache Corporation	<b>Local Co-ordinate Reference:</b>	Well #2H
<b>Project:</b>	Andrews County, TX (NAD 27 TNC)	<b>TVD Reference:</b>	KB @ 3327.00usft (Pioneer 29)
<b>Site:</b>	High Bar University Unit	<b>MD Reference:</b>	KB @ 3327.00usft (Pioneer 29)
<b>Well:</b>	#2H	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	WB2/Job #1311100	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys (Pioneer 29)	<b>Database:</b>	GCR DB

Survey								
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)	
7,719.00	31.40	344.30	7,705.19	63.99	18.55	58.27	11.03	
7,750.00	35.30	344.70	7,731.08	80.41	14.00	75.29	12.60	
7,782.00	39.20	344.50	7,756.55	99.08	8.86	94.64	12.19	
7,813.00	42.80	344.30	7,779.94	118.67	3.39	114.95	11.62	
7,845.00	46.20	343.50	7,802.76	140.21	-2.83	137.34	10.77	
7,877.00	49.50	343.00	7,824.23	162.93	-9.67	161.00	10.38	
7,907.00	53.00	343.20	7,843.01	185.31	-16.47	184.34	11.68	
7,939.00	56.90	343.70	7,861.38	210.42	-23.93	210.47	12.25	
7,970.00	60.40	344.60	7,877.51	235.88	-31.16	236.91	11.56	
8,002.00	64.70	345.50	7,892.26	263.31	-38.47	265.28	13.67	
8,034.00	68.70	345.90	7,904.91	291.79	-45.73	294.65	12.55	
8,065.00	72.90	346.00	7,915.10	320.18	-52.84	323.91	13.55	
8,096.00	76.50	345.90	7,923.28	349.18	-60.09	353.80	11.62	
8,128.00	79.80	345.70	7,929.85	379.54	-67.78	385.11	10.33	
8,160.00	82.70	345.70	7,934.72	410.18	-75.59	416.72	9.06	
8,191.00	85.80	345.40	7,937.83	440.05	-83.28	447.55	10.05	
8,211.00	87.30	345.50	7,939.03	459.37	-88.30	467.51	7.52	
8,243.00	89.10	346.20	7,940.04	490.38	-96.12	499.48	6.03	
8,274.00	89.50	346.30	7,940.41	520.49	-103.48	530.47	1.33	
8,305.00	89.60	346.30	7,940.66	550.61	-110.83	561.47	0.32	
8,401.00	90.20	346.50	7,940.82	643.92	-133.40	657.46	0.66	
8,495.00	90.40	346.70	7,940.33	735.36	-155.18	751.45	0.30	
8,591.00	90.80	346.30	7,939.33	828.70	-177.59	847.44	0.59	
8,685.00	91.40	346.40	7,937.52	920.03	-199.77	941.42	0.65	
8,779.00	92.20	347.80	7,934.57	1,011.60	-220.75	1,035.37	1.71	
8,874.00	92.60	348.10	7,930.59	1,104.43	-240.56	1,130.27	0.53	
8,968.00	91.90	346.10	7,926.90	1,195.98	-261.53	1,224.20	2.25	
9,063.00	91.80	346.30	7,923.83	1,288.19	-284.18	1,319.13	0.24	
9,158.00	92.60	346.30	7,920.19	1,380.42	-306.66	1,414.05	0.84	
9,253.00	92.20	347.10	7,916.21	1,472.79	-328.50	1,508.96	0.94	
9,347.00	90.00	345.60	7,914.40	1,564.11	-350.68	1,602.93	2.83	
9,442.00	89.50	345.70	7,914.82	1,656.14	-374.22	1,697.89	0.54	
9,536.00	89.60	345.60	7,915.56	1,747.21	-397.52	1,791.86	0.15	
9,631.00	88.90	345.30	7,916.80	1,839.15	-421.38	1,886.81	0.80	
9,726.00	89.30	345.30	7,918.29	1,931.03	-445.49	1,981.75	0.42	
9,822.00	88.80	345.90	7,919.88	2,024.00	-469.36	2,077.70	0.81	
9,916.00	88.90	345.90	7,921.77	2,115.15	-492.25	2,171.65	0.11	
10,011.00	90.10	347.10	7,922.60	2,207.52	-514.43	2,266.64	1.79	
10,106.00	91.00	347.20	7,921.69	2,300.14	-535.55	2,361.64	0.95	
10,202.00	91.20	347.20	7,919.85	2,393.73	-556.82	2,457.62	0.21	
10,297.00	92.00	347.50	7,917.19	2,486.39	-577.61	2,552.58	0.90	
10,391.00	91.90	348.30	7,913.99	2,578.25	-597.31	2,646.52	0.86	
10,486.00	90.80	349.50	7,911.76	2,671.44	-615.59	2,741.44	1.71	
10,581.00	90.30	349.60	7,910.84	2,764.86	-632.82	2,836.36	0.54	



# Phoenix Technology Services

## Phoenix Final Survey Report



<b>Company:</b>	Apache Corporation	<b>Local Co-ordinate Reference:</b>	Well #2H
<b>Project:</b>	Andrews County, TX (NAD 27 TNC)	<b>TVD Reference:</b>	KB @ 3327.00usft (Pioneer 29)
<b>Site:</b>	High Bar University Unit	<b>MD Reference:</b>	KB @ 3327.00usft (Pioneer 29)
<b>Well:</b>	#2H	<b>North Reference:</b>	Grid
<b>Wellbore:</b>	WB2/Job #1311100	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Design:</b>	Surveys (Pioneer 29)	<b>Database:</b>	GCR DB

Survey								
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)	
10,676.00	89.50	347.80	7,911.01	2,858.01	-651.43	2,931.32	2.07	
10,770.00	88.70	347.00	7,912.49	2,949.74	-671.94	3,025.30	1.20	
10,866.00	88.80	347.00	7,914.58	3,043.26	-693.53	3,121.28	0.10	
10,961.00	89.00	347.00	7,916.40	3,135.80	-714.89	3,216.26	0.21	
11,056.00	89.30	347.00	7,917.81	3,228.36	-736.26	3,311.25	0.32	
11,151.00	89.60	347.20	7,918.73	3,320.96	-757.47	3,406.25	0.38	
11,246.00	89.90	347.50	7,919.14	3,413.65	-778.27	3,501.24	0.45	
11,341.00	89.70	347.70	7,919.47	3,506.43	-798.67	3,596.24	0.30	
11,436.00	90.90	348.10	7,918.97	3,599.32	-818.59	3,691.23	1.33	
11,531.00	90.90	348.20	7,917.48	3,692.28	-838.09	3,786.20	0.11	
11,626.00	90.30	347.90	7,916.49	3,785.22	-857.76	3,881.19	0.71	
11,720.00	89.80	347.50	7,916.41	3,877.06	-877.79	3,975.18	0.68	
11,815.00	90.10	347.50	7,916.49	3,969.81	-898.35	4,070.18	0.32	
11,910.00	90.40	347.20	7,916.07	4,062.50	-919.15	4,165.18	0.45	
12,005.00	90.70	347.90	7,915.16	4,155.26	-939.63	4,260.17	0.80	
12,100.00	90.80	348.20	7,913.92	4,248.19	-959.30	4,355.15	0.33	
12,195.00	90.40	347.00	7,912.92	4,340.97	-979.70	4,450.14	1.33	
12,290.00	90.80	346.60	7,911.93	4,433.46	-1,001.39	4,545.13	0.60	
12,386.00	90.00	346.50	7,911.26	4,526.82	-1,023.72	4,641.13	0.84	
12,480.00	89.90	346.50	7,911.34	4,618.22	-1,045.66	4,735.12	0.11	
12,542.00	89.80	346.30	7,911.50	4,678.48	-1,060.24	4,797.11	0.36	
<b>Last Phoenix MWD Survey</b>								
12,597.00	89.80	346.30	7,911.69	4,731.92	-1,073.27	4,852.11	0.00	
<b>Projection to TD</b>								

Survey Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
7,400.00	7,399.40	-5.79	36.84	Tie-on to Gyro
7,466.00	7,465.39	-4.71	36.34	First Phoenix MWD Survey
12,542.00	7,911.50	4,678.48	-1,060.24	Last Phoenix MWD Survey
12,597.00	7,911.69	4,731.92	-1,073.27	Projection to TD

Checked By: \_\_\_\_\_ Approved By: \_\_\_\_\_ Date: \_\_\_\_\_



**Company:** Apache Corporation  
**Rig:** Pioneer #29  
**Latitude:** 32.327  
**Longitude:** -102.804  
**API #** 42-003-45550  
**Date:** 9/24/13

**Well:** High Bar University #2H  
**Location:** Andrews Co., TX  
**North Reference:** 2.89  
**Depth Reference:** RKB=20 ft.  
**Surveyor:** Joshua Kirby  
**VS:** 0.000

Field copy only not definitive.

Depth	Inc	AzG	N/-S	E/-W	TVD	DL	VS	CD	Cbrg
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	0.58	190.59	-0.5	-0.09	100	0.58	-0.47	0.51	190.59
200	0.86	192.37	-1.73	-0.35	199.99	0.28	-1.61	1.77	191.35
300	0.53	190.2	-2.92	-0.59	299.98	0.33	-2.72	2.98	191.43
400	0.89	192.13	-4.13	-0.84	399.97	0.35	-3.85	4.22	191.42
500	0.65	190.31	-5.45	-1.1	499.97	0.24	-5.07	5.56	191.41
600	0.42	188.11	-6.37	-1.25	599.96	0.23	-5.93	6.49	191.12
700	0.86	186.96	-7.48	-1.39	699.95	0.44	-6.98	7.61	190.57
800	0.6	193.87	-8.73	-1.61	799.95	0.27	-8.15	8.88	190.46
900	0.44	170.38	-9.62	-1.67	899.94	0.26	-9.01	9.76	189.86
1000	0.36	158.97	-10.29	-1.49	999.94	0.11	-9.7	10.4	188.26
1100	0.72	176.74	-11.22	-1.35	1099.94	0.39	-10.64	11.3	186.84
1200	0.54	191.26	-12.3	-1.4	1199.93	0.24	-11.68	12.38	186.5
1300	0.8	193.29	-13.45	-1.66	1299.92	0.26	-12.74	13.55	187.02
1400	0.97	198.89	-14.93	-2.09	1399.91	0.19	-14.09	15.08	187.97
1500	0.83	191.49	-16.44	-2.51	1499.9	0.18	-15.47	16.63	188.67
1600	0.77	184.49	-17.81	-2.7	1599.89	0.11	-16.76	18.01	188.63
1700	0.58	183.27	-18.98	-2.78	1699.88	0.19	-17.88	19.18	188.34
1800	0.54	183.5	-19.95	-2.84	1799.88	0.04	-18.82	20.15	188.1
1900	0.75	147.75	-20.98	-2.52	1899.87	0.44	-19.89	21.13	186.85
2000	0.78	105.55	-21.71	-1.51	1999.86	0.55	-20.83	21.76	183.99
2100	0.82	111.65	-22.16	-0.19	2099.85	0.09	-21.56	22.16	180.5
2200	0.86	101.43	-22.57	1.21	2199.84	0.16	-22.27	22.6	176.94
2300	0.77	86.73	-22.68	2.62	2299.83	0.23	-22.7	22.83	173.41
2400	1.08	82.58	-22.52	4.23	2399.82	0.31	-22.9	22.91	169.36
2500	1.18	88.6	-22.37	6.2	2499.8	0.16	-23.19	23.22	164.52
2600	1.8	85.41	-22.22	8.79	2599.77	0.62	-23.62	23.9	158.42
2700	1.86	77.33	-21.74	11.94	2699.71	0.27	-23.85	24.8	151.23
2800	1.71	76.88	-21.05	14.98	2799.67	0.15	-23.85	25.83	144.56
2900	2.02	79.74	-20.39	18.16	2899.61	0.32	-23.92	27.31	138.31
3000	1.46	76.44	-19.78	21.14	2999.57	0.56	-23.98	28.95	133.1
3100	0.92	66.97	-19.17	23.12	3099.54	0.58	-23.82	30.03	129.66
3200	1.08	57.91	-18.35	24.66	3199.53	0.23	-23.37	30.74	126.65
3300	1.03	56.36	-17.35	26.21	3299.51	0.06	-22.74	31.43	123.5
3400	0.75	50.08	-16.43	27.46	3399.5	0.29	-22.12	32	120.9
3500	0.72	53.33	-15.64	28.46	3499.49	0.05	-21.57	32.48	118.78
3600	0.59	23.69	-14.79	29.17	3599.49	0.36	-20.9	32.71	116.88
3700	0.59	63.27	-14.09	29.84	3699.48	0.4	-20.37	33	115.27

3800	0.32	32.47	-13.62	30.45	3799.48	0.35	-20.05	33.35	114.11
3900	0.14	71.26	-13.35	30.71	3899.48	0.23	-19.84	33.48	113.5
4000	0.57	69.96	-13.14	31.29	3999.47	0.43	-19.77	33.94	112.78
4100	0.6	56.37	-12.68	32.19	4099.47	0.14	-19.52	34.6	111.51
4200	0.67	49.84	-12.02	33.07	4199.46	0.1	-19.07	35.18	109.98
4300	0.73	65.23	-11.38	34.09	4299.46	0.2	-18.67	35.94	108.46
4400	1.12	74.76	-10.85	35.61	4399.44	0.42	-18.5	37.23	106.95
4500	0.56	70.77	-10.44	37.02	4499.43	0.57	-18.4	38.46	105.74
4600	0.47	67.87	-10.12	37.86	4599.43	0.09	-18.28	39.19	104.97
4700	0.44	65.4	-9.81	38.58	4699.42	0.04	-18.14	39.81	104.26
4800	0.44	81.33	-9.59	39.31	4799.42	0.12	-18.09	40.46	103.71
4900	0.19	99.1	-9.56	39.85	4899.42	0.26	-18.18	40.98	103.49
5000	0.16	18.34	-9.45	40.05	4999.42	0.23	-18.12	41.15	103.28
5100	0.29	36.9	-9.12	40.25	5099.42	0.14	-17.84	41.27	102.77
5200	0.1	306.82	-8.87	40.32	5199.42	0.3	-17.61	41.29	102.4
5300	0.2	349.16	-8.65	40.22	5299.42	0.14	-17.37	41.14	102.13
5400	0.15	46.81	-8.39	40.28	5399.42	0.17	-17.13	41.15	101.77
5500	0.09	246.65	-8.33	40.31	5499.42	0.23	-17.08	41.16	101.68
5600	0.18	339.29	-8.22	40.18	5599.42	0.21	-16.94	41.01	101.56
5700	0.21	334.46	-7.9	40.04	5699.42	0.03	-16.6	40.81	101.16
5800	0.4	335.76	-7.42	39.82	5799.42	0.18	-16.08	40.51	100.55
5900	0.08	36.3	-7.05	39.72	5899.41	0.36	-15.7	40.34	100.06
6000	0.3	311.66	-6.82	39.57	5999.41	0.3	-15.44	40.15	99.78
6100	0.47	312.97	-6.36	39.07	6099.41	0.17	-14.89	39.58	99.25
6200	0.34	320.15	-5.85	38.58	6199.41	0.14	-14.28	39.02	98.63
6300	0.21	295.63	-5.54	38.22	6299.41	0.18	-13.9	38.62	98.25
6400	0.33	300.45	-5.32	37.81	6399.41	0.12	-13.59	38.18	98.01
6500	0.33	248.21	-5.28	37.29	6499.41	0.29	-13.43	37.66	98.06
6600	0.22	281.85	-5.35	36.84	6599.4	0.19	-13.4	37.23	98.26
6700	0.12	311.64	-5.24	36.58	6699.4	0.13	-13.24	36.95	98.15
6800	0.05	119.79	-5.19	36.54	6799.4	0.17	-13.19	36.91	98.09
6900	0.03	103.45	-5.22	36.61	6899.4	0.02	-13.23	36.98	98.12
7000	0.1	144.5	-5.3	36.69	6999.4	0.08	-13.32	37.07	98.22
7100	0.11	287.32	-5.35	36.65	7099.4	0.2	-13.36	37.04	98.3
7200	0.13	115.99	-5.37	36.66	7199.4	0.24	-13.38	37.06	98.33
7300	0.15	167.67	-5.55	36.8	7299.4	0.12	-13.59	37.21	98.57
7400	0.14	171.07	-5.79	36.84	7399.4	0.02	-13.83	37.3	98.93
7500	0.21	200.7	-6.07	36.8	7499.4	0.11	-14.1	37.3	99.37
7600	0.23	207.3	-6.42	36.64	7599.4	0.03	-14.4	37.2	99.93
7700	0.59	192.87	-7.09	36.44	7699.4	0.37	-15.01	37.12	101.01
7800	0.69	201.14	-8.15	36.11	7799.39	0.14	-15.97	37.02	102.72
7900	0.35	237.67	-8.87	35.64	7899.39	0.46	-16.57	36.72	103.98
8000	0.67	243	-9.3	34.85	7999.39	0.33	-16.82	36.08	104.95
8100	0.5	255.94	-9.68	33.91	8099.38	0.22	-16.97	35.27	105.92
8200	1.18	250.18	-10.13	32.52	8199.37	0.69	-17.1	34.06	107.3
8300	0.96	255.1	-10.69	30.74	8299.35	0.24	-17.26	32.55	109.18
8400	0.94	258.55	-11.07	29.13	8399.34	0.06	-17.27	31.17	110.81

8500	1.16	261.94	-11.38	27.33	8499.32	0.23	-17.17	29.6	112.6
8600	1.33	263.65	-11.65	25.17	8599.3	0.18	-16.95	27.74	114.83
8700	1.19	264.96	-11.87	22.98	8699.27	0.15	-16.68	25.87	117.31
8800	1.46	268.62	-11.99	20.67	8799.25	0.29	-16.28	23.9	120.11
8900	1.26	269.33	-12.03	18.3	8899.22	0.21	-15.8	21.9	123.33
9000	1.16	271.11	-12.03	16.19	8999.2	0.1	-15.32	20.17	126.6
9100	1.17	273.03	-11.95	14.16	9099.18	0.04	-14.8	18.53	130.16
9200	1.16	260.09	-12.07	12.15	9199.15	0.26	-14.47	17.13	134.82
9240	1.24	259.81	-12.22	11.32	9239.15	0.2	-14.43	16.66	137.17