



A GYRO TECHNOLOGIES INC. COMPANY

PO Box 261021
Corpus Christi, Texas 78426
(361) 767-0602 • (800) 606-GYRO • Fax (361) 767-0612

30-015-41810

May 15, 2014

COG Operating LLC (Concho)
One Concho Center
600 W. Illinois Avenue
Midland, TX 79701

NM OIL CONSERVATION
ARTESIA DISTRICT

AUG 04 2014

RECEIVED

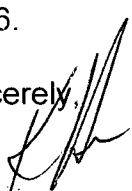
Attn: Kanicia Castillo

Re: **Marauder 31 Federal No 002H**

Please find enclosed a copy of the survey from 0' to 8,200' ran on the above referenced well.

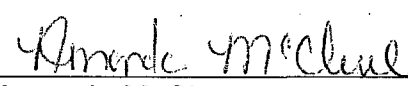
If I can be of any further service, please do not hesitate to call me at 800-606-4976.

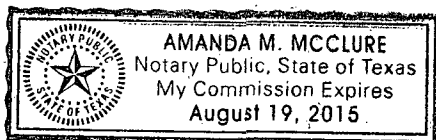
Sincerely,


Keith Havelka
Operations

STATE OF TEXAS §
 §
COUNTY OF NUECES §

This instrument was acknowledged before me on the 15 day of May, A.D., 2014, by Keith Havelka.


Amanda McClure
Notary Public, State of Texas





Company: COG OPERATING-CONCHO
Lease/Well: MARAUDER 31 FEDERAL/No 002H
Location: 13 MILES FROM CARLSBAD
Rig Name: PATRIOT #6
State/County: NEW MEXICO/EDDY
Latitude: 32.62, Longitude: -103.91
GRID North is 0.23 Degrees East of True North
VS-Azi: 0.00 Degrees



Depth Reference : RKB:17 FEET

DRILLOG HA GYRO SURVEY CALCULATIONS

Filename: gyro survey.ut

Minimum Curvature Method

Report Date/Time: 5/15/2014 / 13:18

VES Survey International

West Texas

(432) 563-5444

Surveyor: Jordan Shelleby

Marauder 31 Federal No 002H / API 30-015-41810

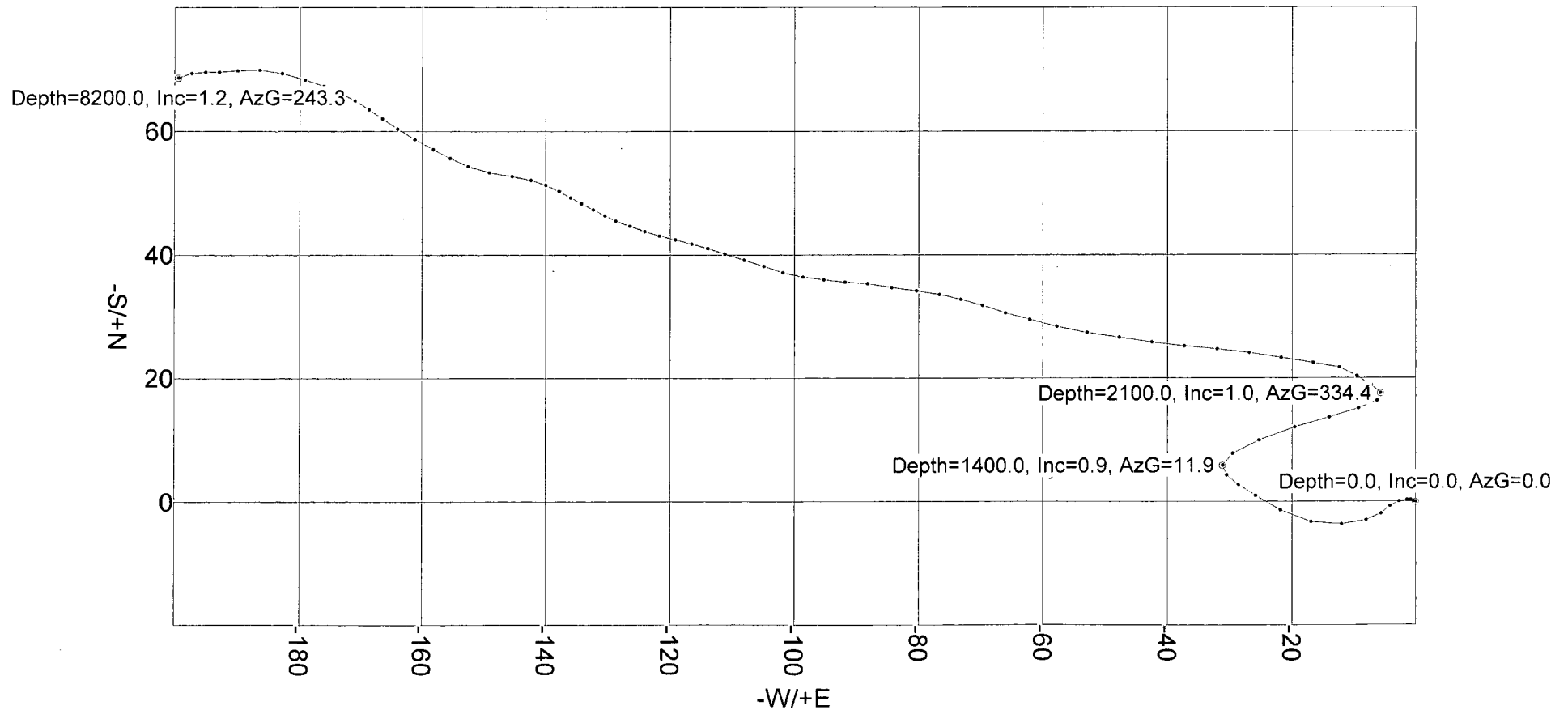
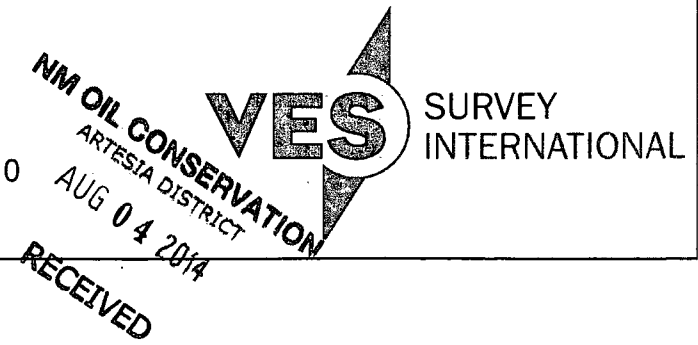
Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	****
100.00	0.40	280.74	100.00	0.06	-0.34	0.06	0.35	280.74	0.40
200.00	0.21	316.96	200.00	0.26	-0.81	0.26	0.85	288.07	0.26
300.00	0.57	258.67	300.00	0.30	-1.42	0.30	1.45	281.98	0.49
400.00	0.90	260.58	399.99	0.07	-2.68	0.07	2.68	271.60	0.34
500.00	1.10	227.31	499.97	-0.70	-4.16	-0.70	4.22	260.39	0.60
600.00	1.13	233.23	599.95	-1.94	-5.65	-1.94	5.98	251.03	0.12
700.00	1.88	254.70	699.92	-2.97	-8.02	-2.97	8.56	249.72	0.93
800.00	2.75	264.44	799.84	-3.63	-12.00	-3.63	12.53	253.16	0.95
900.00	3.02	282.60	899.71	-3.29	-16.96	-3.29	17.27	259.03	0.95
1000.00	3.11	299.71	999.57	-1.37	-21.88	-1.37	21.93	266.42	0.92
1100.00	2.19	301.45	1099.46	0.97	-25.87	0.97	25.89	272.16	0.92
1200.00	1.54	304.11	1199.41	2.73	-28.62	2.73	28.75	275.44	0.65
1300.00	1.29	314.82	1299.38	4.27	-30.53	4.27	30.83	277.97	0.37
1400.00	0.95	11.89	1399.36	5.87	-31.16	5.87	31.70	280.67	1.11
1500.00	2.05	52.60	1499.33	7.77	-29.56	7.77	30.57	284.72	1.47
1600.00	3.45	69.00	1599.21	9.93	-25.33	9.93	27.21	291.42	1.59
1700.00	3.55	71.01	1699.03	12.02	-19.59	12.02	22.98	301.54	0.16
1800.00	3.12	76.74	1798.86	13.65	-14.01	13.65	19.56	314.27	0.54

Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
1900.00	2.55	69.03	1898.73	15.07	-9.28	15.07	17.70	328.38	0.69
2000.00	1.18	63.25	1998.68	16.33	-6.29	16.33	17.50	338.95	1.38
2100.00	0.96	334.36	2098.67	17.55	-5.73	17.55	18.46	341.93	1.50
2200.00	1.47	294.01	2198.65	18.82	-7.26	18.82	20.17	338.92	0.96
2300.00	1.69	310.53	2298.61	20.30	-9.54	20.30	22.43	334.82	0.50
2400.00	2.02	284.52	2398.56	21.70	-12.37	21.70	24.98	330.31	0.90
2500.00	2.89	277.72	2498.47	22.48	-16.58	22.48	27.93	323.59	0.91
2600.00	3.09	279.91	2598.33	23.28	-21.73	23.28	31.85	316.97	0.23
2700.00	2.94	277.85	2698.19	24.10	-26.93	24.10	36.14	311.82	0.18
2800.00	3.00	275.52	2798.06	24.70	-32.08	24.70	40.49	307.59	0.14
2900.00	3.04	275.30	2897.92	25.20	-37.33	25.20	45.03	304.02	0.03
3000.00	3.02	278.43	2997.78	25.83	-42.57	25.83	49.79	301.25	0.17
3100.00	3.01	278.81	3097.64	26.62	-47.77	26.62	54.68	299.13	0.03
3200.00	2.93	277.32	3197.51	27.34	-52.89	27.34	59.54	297.34	0.11
3300.00	2.79	286.87	3297.38	28.37	-57.76	28.37	64.35	296.16	0.50
3400.00	2.37	282.01	3397.28	29.51	-62.10	29.51	68.76	295.42	0.48
3500.00	2.30	288.03	3497.20	30.56	-66.03	30.56	72.76	294.84	0.25
3600.00	2.17	288.17	3597.12	31.77	-69.74	31.77	76.64	294.49	0.13
3700.00	1.99	283.79	3697.06	32.78	-73.22	32.78	80.23	294.11	0.24
3800.00	2.05	282.14	3796.99	33.57	-76.66	33.57	83.69	293.65	0.09
3900.00	2.30	275.61	3896.92	34.14	-80.41	34.14	87.36	293.01	0.35
4000.00	2.30	280.92	3996.84	34.72	-84.38	34.72	91.24	292.37	0.21
4100.00	2.20	275.67	4096.76	35.29	-88.25	35.29	95.05	291.79	0.23
4200.00	1.97	272.31	4196.70	35.55	-91.88	35.55	98.52	291.15	0.25
4300.00	1.96	280.82	4296.64	35.94	-95.28	35.94	101.83	290.66	0.29
4400.00	1.93	275.03	4396.58	36.40	-98.64	36.40	105.14	290.26	0.20
4500.00	1.86	290.09	4496.53	37.11	-101.84	37.11	108.39	290.02	0.50
4600.00	1.85	286.85	4596.47	38.13	-104.91	38.13	111.62	289.98	0.11
4700.00	1.93	287.92	4696.42	39.12	-108.06	39.12	114.92	289.90	0.09
4800.00	1.83	289.07	4796.37	40.16	-111.17	40.16	118.21	289.86	0.11
4900.00	1.47	285.81	4896.32	41.03	-113.92	41.03	121.09	289.81	0.37
5000.00	1.58	285.12	4996.29	41.74	-116.49	41.74	123.74	289.72	0.10
5100.00	1.57	284.42	5096.25	42.44	-119.14	42.44	126.48	289.61	0.02
5200.00	1.43	282.98	5196.22	43.07	-121.69	43.07	129.09	289.49	0.14
5300.00	1.40	291.31	5296.19	43.79	-124.04	43.79	131.55	289.44	0.21
5400.00	1.55	287.11	5396.15	44.63	-126.47	44.63	134.12	289.44	0.19
5500.00	1.25	296.24	5496.12	45.51	-128.74	45.51	136.55	289.47	0.37
5600.00	1.01	293.31	5596.10	46.34	-130.54	46.34	138.52	289.55	0.24
5700.00	1.36	299.89	5696.08	47.28	-132.38	47.28	140.57	289.66	0.37

Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
5800.00	1.13	297.34	5796.06	48.33	-134.28	48.33	142.71	289.79	0.24
5900.00	1.13	297.65	5896.04	49.24	-136.03	49.24	144.67	289.90	0.01
6000.00	1.31	300.96	5996.02	50.28	-137.88	50.28	146.77	290.04	0.19
6100.00	1.38	291.42	6095.99	51.31	-139.98	51.31	149.09	290.13	0.24
6200.00	1.55	285.13	6195.96	52.10	-142.41	52.10	151.64	290.10	0.23
6300.00	1.97	278.91	6295.91	52.72	-145.41	52.72	154.67	289.93	0.46
6400.00	2.27	279.50	6395.84	53.32	-149.06	53.32	158.31	289.68	0.30
6500.00	1.97	293.49	6495.77	54.33	-152.59	54.33	161.97	289.60	0.60
6600.00	1.68	295.63	6595.72	55.65	-155.49	55.65	165.15	289.69	0.30
6700.00	1.88	298.72	6695.67	57.07	-158.25	57.07	168.22	289.83	0.22
6800.00	1.99	298.78	6795.62	58.69	-161.21	58.69	171.56	290.01	0.11
6900.00	1.79	303.53	6895.56	60.39	-164.04	60.39	174.80	290.21	0.25
7000.00	1.62	302.29	6995.52	62.01	-166.53	62.01	177.71	290.42	0.18
7100.00	1.44	305.85	7095.48	63.51	-168.75	63.51	180.30	290.62	0.20
7200.00	1.60	298.31	7195.45	64.90	-171.00	64.90	182.90	290.78	0.25
7300.00	1.63	295.98	7295.41	66.19	-173.50	66.19	185.70	290.88	0.07
7400.00	1.60	290.50	7395.37	67.30	-176.09	67.30	188.51	290.92	0.16
7500.00	2.12	286.01	7495.31	68.30	-179.18	68.30	191.76	290.87	0.54
7600.00	2.20	286.26	7595.24	69.35	-182.81	69.35	195.52	290.77	0.08
7700.00	2.04	270.65	7695.18	69.91	-186.43	69.91	199.11	290.56	0.60
7800.00	2.00	265.93	7795.11	69.80	-189.95	69.80	202.37	290.18	0.17
7900.00	1.35	265.22	7895.07	69.58	-192.87	69.58	205.04	289.84	0.65
8000.00	1.22	274.18	7995.05	69.56	-195.10	69.56	207.13	289.62	0.24
8100.00	1.33	256.77	8095.02	69.37	-197.29	69.37	209.13	289.37	0.40
8200.00	1.18	243.33	8195.00	68.65	-199.34	68.65	210.82	289.00	0.33



VES Survey International
West Texas
(432) 563-5444
Surveyor: Jordan Shelleby
Marauder 31 Federal No 002H / API 30-015-41810





Survey Report - Geographic



Company:	COG Operating LLC	Local Co-ordinate Reference:	Well Marauder 31 Federal Well No. 2H
Project:	Eddy County, New Mexico	TVD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Site:	Marauder 31 Federal	MD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Well:	Marauder 31 Federal Well No. 2H	North Reference:	Grid
Wellbore:	Original hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original hole	Database:	EDM 5000.1 Ddatabase

Project	Eddy County, New Mexico		
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	Marauder 31 Federal		
Site Position:		Northing:	590,651.80 usft
From:	Map	Easting:	631,946.80 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "
		Latitude:	32.62307409
		Longitude:	-103.90476956
		Grid Convergence:	0.23 °

Well	Marauder 31 Federal Well No. 2H		
Well Position	+N/-S	0.00 usft	Northing:
	+E/-W	0.00 usft	Easting:
Position Uncertainty	0.00 usft	Wellhead Elevation:	usft
		Latitude:	32.62305906
		Longitude:	-103.91071635
		Ground Level:	3,408.50 usft

Wellbore	Original hole		
Magnetics	Model Name	Sample Date	Declination
			(°)
	IGRF2010	4/24/2014	7.42
			Dip Angle
			(°)
			60.43
			Field Strength
			(nT)
			48,534

Design	Surveys Original hole		
Audit Notes:			
Version:	1.0	Phase:	ACTUAL
		Tie On Depth:	0.00
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W
	(usft)	(usft)	(usft)
	0.00	0.00	0.00
			Direction
			(°)
			177.23

Survey Program	Date 5/22/2014		
From (usft)	To (usft)	Survey (Wellbore)	Tool Name
100.00	8,200.00	Gyro (Original hole)	NS-GYRO-MS
8,245.00	13,259.00	MWD (Original hole)	MWD
			Description
			North sensing gyrocompassing m/s
			MWD - Standard

Survey										
Measured			Vertical			Map	Map			
Depth	Inclination	Azimuth	Depth	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	
(usft)	(°)	(°)	(usft)	(usft)	(usft)	(usft)	(usft)			
0.00	0.00	0.00	0.00	0.00	0.00	590,639.00	630,115.90	32.62305906	-103.91071635	
100.00	0.40	280.74	100.00	0.07	-0.34	590,639.07	630,115.56	32.62305925	-103.91071747	
Gyro										
200.00	0.21	316.96	200.00	0.26	-0.81	590,639.27	630,115.09	32.62305980	-103.91071898	
300.00	0.57	258.67	300.00	0.30	-1.42	590,639.30	630,114.48	32.62305990	-103.91072097	
400.00	0.90	260.58	399.99	0.07	-2.69	590,639.08	630,113.22	32.62305930	-103.91072508	
500.00	1.10	227.31	499.97	-0.71	-4.17	590,638.30	630,111.74	32.62305717	-103.91072990	
600.00	1.13	233.23	599.95	-1.95	-5.66	590,637.06	630,110.24	32.62305377	-103.91073477	
700.00	1.88	254.70	699.92	-2.97	-8.03	590,636.03	630,107.87	32.62305099	-103.91074249	
800.00	2.75	264.44	799.84	-3.63	-12.00	590,635.37	630,103.90	32.62304920	-103.91075539	
900.00	3.02	282.60	899.71	-3.29	-16.96	590,635.71	630,098.94	32.62305020	-103.91077149	



Survey Report - Geographic



Company:	COG Operating LLC	Local Co-ordinate Reference:	Well Marauder 31 Federal Well No. 2H
Project:	Eddy County, New Mexico	TVD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Site:	Marauder 31 Federal	MD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Well:	Marauder 31 Federal Well No. 2H	North Reference:	Grid
Wellbore:	Original hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original hole	Database:	EDM 5000.1 Ddatabase

Survey

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
1,000.00	3.11	299.71	999.57	-1.37	-21.89	590,637.63	630,094.01	32.62305553	-103.91078747
1,100.00	2.19	301.45	1,099.46	0.97	-25.88	590,639.97	630,090.03	32.62306201	-103.91080038
1,200.00	1.54	304.11	1,199.41	2.72	-28.62	590,641.72	630,087.29	32.62306865	-103.91080927
1,300.00	1.29	314.82	1,299.38	4.27	-30.53	590,643.27	630,085.37	32.62307112	-103.91081546
1,400.00	0.95	11.89	1,399.36	5.87	-31.16	590,644.87	630,084.75	32.62307554	-103.91081747
1,500.00	2.05	52.60	1,499.33	7.77	-29.57	590,646.77	630,086.34	32.62308074	-103.91081228
1,600.00	3.45	69.00	1,599.21	9.93	-25.33	590,648.94	630,090.57	32.62308664	-103.91079851
1,700.00	3.55	71.01	1,699.03	12.02	-19.60	590,651.02	630,096.31	32.62309231	-103.91077985
1,800.00	3.12	76.74	1,798.86	13.65	-14.02	590,652.65	630,101.88	32.62309674	-103.91076172
1,900.00	2.55	69.03	1,898.74	15.07	-9.30	590,654.07	630,106.61	32.62310059	-103.91074635
2,000.00	1.18	63.25	1,998.68	16.33	-6.30	590,655.33	630,109.60	32.62310402	-103.91073660
2,100.00	0.96	334.36	2,098.67	17.55	-5.74	590,656.55	630,110.16	32.62310736	-103.91073478
2,200.00	1.47	294.01	2,198.65	18.83	-7.28	590,657.83	630,108.63	32.62311089	-103.91073974
2,300.00	1.69	310.53	2,298.61	20.31	-9.57	590,659.31	630,106.34	32.62311498	-103.91074717
2,400.00	2.02	284.52	2,398.56	21.71	-12.40	590,660.71	630,103.51	32.62311886	-103.91075633
2,500.00	2.89	277.72	2,498.47	22.49	-16.60	590,661.49	630,099.30	32.62312105	-103.91076998
2,600.00	3.09	279.91	2,598.33	23.29	-21.75	590,662.29	630,094.15	32.62312332	-103.91078671
2,700.00	2.94	277.85	2,698.19	24.10	-26.95	590,663.11	630,088.96	32.62312561	-103.91080357
2,800.00	3.00	275.52	2,798.06	24.71	-32.09	590,663.71	630,083.81	32.62312732	-103.91082027
2,900.00	3.04	275.30	2,897.92	25.20	-37.34	590,664.21	630,078.57	32.62312874	-103.91083730
3,000.00	3.02	278.43	2,997.78	25.83	-42.58	590,664.84	630,073.32	32.62313054	-103.91085433
3,100.00	3.01	278.81	3,097.64	26.62	-47.79	590,665.62	630,068.12	32.62313276	-103.91087121
3,200.00	2.93	277.32	3,197.51	27.35	-52.91	590,666.35	630,062.99	32.62313482	-103.91088786
3,300.00	2.79	286.87	3,297.38	28.38	-57.78	590,667.38	630,058.13	32.62313771	-103.91090365
3,400.00	2.37	282.01	3,397.28	29.52	-62.13	590,668.52	630,053.77	32.62314088	-103.91091777
3,500.00	2.30	288.03	3,497.20	30.57	-66.06	590,669.57	630,049.84	32.62314381	-103.91093052
3,600.00	2.17	288.17	3,597.12	31.78	-69.77	590,670.78	630,046.14	32.62314718	-103.91094254
3,700.00	1.99	283.79	3,697.06	32.78	-73.25	590,671.79	630,042.65	32.62314998	-103.91095385
3,800.00	2.05	282.14	3,796.99	33.57	-76.69	590,672.58	630,039.22	32.62315219	-103.91096500
3,900.00	2.30	275.61	3,896.92	34.15	-80.43	590,673.15	630,035.47	32.62315380	-103.91097715
4,000.00	2.30	280.92	3,996.84	34.72	-84.40	590,673.73	630,031.50	32.62315543	-103.91099003
4,100.00	2.20	275.67	4,096.76	35.29	-88.28	590,674.30	630,027.62	32.62315704	-103.91100263
4,200.00	1.97	272.31	4,196.70	35.55	-91.91	590,674.55	630,024.00	32.62315779	-103.91101441
4,300.00	1.96	280.82	4,296.64	35.94	-95.30	590,674.95	630,020.60	32.62315890	-103.91102543
4,400.00	1.93	275.03	4,396.58	36.41	-98.66	590,675.41	630,017.24	32.62316022	-103.91103633
4,500.00	1.86	290.09	4,496.53	37.12	-101.86	590,676.12	630,014.04	32.62316220	-103.91104672
4,600.00	1.85	286.85	4,596.48	38.14	-104.93	590,677.14	630,010.97	32.62316505	-103.91105668
4,700.00	1.93	287.92	4,696.42	39.13	-108.08	590,678.13	630,007.82	32.62316779	-103.91106688
4,800.00	1.83	289.07	4,796.37	40.17	-111.19	590,679.17	630,004.71	32.62317069	-103.91107698
4,900.00	1.47	285.81	4,896.33	41.04	-113.93	590,680.04	630,001.97	32.62317311	-103.91108587
5,000.00	1.58	285.12	4,996.29	41.75	-116.50	590,680.75	629,999.40	32.62317509	-103.91109420
5,100.00	1.57	284.42	5,096.25	42.45	-119.16	590,681.45	629,996.75	32.62317704	-103.91110282
5,200.00	1.43	282.98	5,196.22	43.07	-121.70	590,682.07	629,994.20	32.62317878	-103.91111107
5,300.00	1.40	291.31	5,296.19	43.79	-124.05	590,682.80	629,991.85	32.62318080	-103.91111871
5,400.00	1.55	287.11	5,396.15	44.64	-126.48	590,683.64	629,989.42	32.62318314	-103.91112659
5,500.00	1.25	296.24	5,496.12	45.52	-128.76	590,684.52	629,987.15	32.62318558	-103.91113395
5,600.00	1.01	293.31	5,596.11	46.35	-130.54	590,685.35	629,985.36	32.62318788	-103.91113975
5,700.00	1.36	299.89	5,696.08	47.29	-132.38	590,686.29	629,983.52	32.62319049	-103.91114571
5,800.00	1.13	297.34	5,796.06	48.33	-134.29	590,687.33	629,981.62	32.62319338	-103.91115188
5,900.00	1.13	297.65	5,896.04	49.24	-136.04	590,688.24	629,979.87	32.62319590	-103.91115755
6,000.00	1.31	300.96	5,996.02	50.29	-137.89	590,689.29	629,978.02	32.62319880	-103.91116356
6,100.00	1.38	291.42	6,095.99	51.31	-139.99	590,690.32	629,975.91	32.62320164	-103.91117037
6,200.00	1.55	285.13	6,195.96	52.11	-142.42	590,691.11	629,973.49	32.62320385	-103.91117824
6,300.00	1.97	278.91	6,295.91	52.73	-145.42	590,691.73	629,970.48	32.62320558	-103.91118799
6,400.00	2.27	279.50	6,395.84	53.32	-149.07	590,692.32	629,966.83	32.62320725	-103.91119984



Survey Report - Geographic



Company:	COG Operating LLC	Local Co-ordinate Reference:	Well Marauder 31 Federal Well No. 2H
Project:	Eddy County, New Mexico	TVD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Site:	Marauder 31 Federal	MD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Well:	Marauder 31 Federal Well No. 2H	North Reference:	Grid
Wellbore:	Original hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original hole	Database:	EDM 5000.1 Ddatabase

Survey									
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
6,500.00	1.97	293.49	6,495.77	54.33	-152.60	590,693.34	629,963.30	32.62321007	-103.91121129
6,600.00	1.68	295.63	6,595.72	55.65	-155.50	590,694.65	629,960.40	32.62321373	-103.91122069
6,700.00	1.88	298.72	6,695.68	57.07	-158.26	590,696.08	629,957.64	32.62321767	-103.91122963
6,800.00	1.99	298.78	6,795.62	58.70	-161.22	590,697.70	629,954.68	32.62322217	-103.91123923
6,900.00	1.79	303.53	6,895.56	60.40	-164.04	590,699.40	629,951.86	32.62322687	-103.91124838
7,000.00	1.62	302.29	6,995.52	62.01	-166.54	590,701.02	629,949.36	32.62323134	-103.91125647
7,100.00	1.44	305.85	7,095.48	63.50	-168.75	590,702.51	629,947.15	32.62323547	-103.91126364
7,200.00	1.60	298.31	7,195.45	64.90	-171.00	590,703.91	629,944.90	32.62323933	-103.91127092
7,300.00	1.63	295.98	7,295.41	66.19	-173.51	590,705.19	629,942.39	32.62324289	-103.91127905
7,400.00	1.60	290.50	7,395.37	67.30	-176.10	590,706.30	629,939.81	32.62324598	-103.91128743
7,500.00	2.12	286.01	7,495.32	68.30	-179.18	590,707.30	629,936.72	32.62324876	-103.91129744
7,600.00	2.20	286.26	7,595.25	69.35	-182.80	590,708.35	629,933.10	32.62325168	-103.91130919
7,700.00	2.04	270.65	7,695.18	69.90	-186.42	590,708.91	629,929.48	32.62325325	-103.91132094
7,800.00	2.00	265.93	7,795.12	69.80	-189.94	590,708.80	629,925.96	32.62325300	-103.91133238
7,900.00	1.35	265.22	7,895.07	69.58	-192.86	590,708.58	629,923.05	32.62325242	-103.91134185
8,000.00	1.22	274.18	7,995.05	69.56	-195.09	590,708.56	629,920.81	32.62325239	-103.91134911
8,100.00	1.33	256.77	8,095.02	69.37	-197.29	590,708.37	629,918.62	32.62325190	-103.91135623
8,200.00	1.18	243.33	8,195.00	68.64	-199.34	590,707.65	629,916.57	32.62324992	-103.91136290
8,245.00	1.80	242.30	8,239.98	68.11	-200.38	590,707.11	629,915.53	32.62324846	-103.91136628
MWD surveys									
8,277.00	2.90	211.90	8,271.96	67.18	-201.25	590,706.19	629,914.66	32.62324593	-103.91136913
8,308.00	6.90	189.50	8,302.84	64.68	-201.97	590,703.68	629,913.93	32.62323906	-103.91137151
8,340.00	10.30	182.00	8,334.48	59.92	-202.39	590,698.93	629,913.52	32.62322599	-103.91137292
8,372.00	13.70	178.30	8,365.77	53.28	-202.38	590,692.28	629,913.53	32.62320771	-103.91137297
8,403.00	16.40	173.70	8,395.71	45.25	-201.79	590,684.26	629,914.12	32.62318566	-103.91137116
8,435.00	20.30	170.90	8,426.08	35.28	-200.41	590,674.28	629,915.49	32.62315823	-103.91136682
8,467.00	25.00	169.70	8,455.60	23.14	-198.32	590,662.14	629,917.58	32.62312483	-103.91136020
8,498.00	28.80	169.90	8,483.24	9.34	-195.84	590,648.34	629,920.06	32.62308687	-103.91135231
8,530.00	31.00	170.70	8,510.98	-6.39	-193.16	590,632.62	629,922.75	32.62304362	-103.91134380
8,562.00	33.90	171.40	8,537.98	-23.35	-190.49	590,615.66	629,925.41	32.62299697	-103.91133536
8,593.00	37.60	170.70	8,563.13	-41.23	-187.67	590,597.77	629,928.23	32.62294778	-103.91132642
8,625.00	41.60	170.20	8,587.79	-61.34	-184.28	590,577.66	629,931.62	32.62289246	-103.91131568
8,657.00	44.10	169.50	8,611.24	-82.76	-180.44	590,556.24	629,935.46	32.62283354	-103.91130349
8,689.00	46.90	168.80	8,633.67	-105.17	-176.15	590,533.83	629,939.76	32.62277189	-103.91128982
8,720.00	50.10	168.10	8,654.21	-127.92	-171.49	590,511.08	629,944.41	32.62270932	-103.91127500
8,752.00	53.40	168.80	8,674.02	-152.54	-166.47	590,486.47	629,949.44	32.62264160	-103.91125899
8,783.00	56.20	170.20	8,691.89	-177.44	-161.86	590,461.56	629,954.05	32.62257309	-103.91124434
8,815.00	59.20	170.70	8,708.98	-204.11	-157.37	590,434.89	629,958.53	32.62249973	-103.91123012
8,847.00	62.30	171.40	8,724.62	-231.69	-153.03	590,407.31	629,962.87	32.62242388	-103.91121637
8,878.00	65.10	171.80	8,738.35	-259.18	-148.97	590,379.82	629,966.93	32.62234827	-103.91120355
8,890.00	66.41	171.72	8,743.28	-270.01	-147.40	590,369.00	629,968.50	32.62231849	-103.91119860
330 Hard line intercept @ 8890 MD									
8,910.00	68.60	171.60	8,750.93	-288.29	-144.72	590,350.71	629,971.18	32.62226821	-103.91119013
8,942.00	71.20	171.80	8,761.93	-318.02	-140.39	590,320.98	629,975.52	32.62218643	-103.91117642
8,973.00	72.90	171.60	8,771.48	-347.20	-136.13	590,291.80	629,979.77	32.62210617	-103.91116297
9,005.00	75.50	171.40	8,780.19	-377.65	-131.58	590,261.35	629,984.33	32.62202242	-103.91114859
9,037.00	78.00	171.30	8,787.53	-408.45	-126.89	590,230.56	629,989.01	32.62193774	-103.91113377
9,068.00	78.30	171.30	8,793.89	-438.44	-122.31	590,200.57	629,993.60	32.62185525	-103.91111925
9,100.00	79.70	170.90	8,800.00	-469.47	-117.45	590,169.53	629,998.46	32.62176990	-103.91110387
9,132.00	83.40	170.20	8,804.70	-500.69	-112.25	590,138.32	630,003.66	32.62168403	-103.91108739
9,163.00	86.40	171.40	8,807.46	-531.16	-107.31	590,107.84	630,008.59	32.62160021	-103.91107175
9,258.00	89.30	173.70	8,811.02	-625.28	-95.01	590,013.73	630,020.90	32.62134137	-103.91103300
9,353.00	89.80	173.50	8,811.77	-719.68	-84.42	589,919.32	630,031.49	32.62108176	-103.91099983
9,480.00	90.40	173.70	8,811.54	-845.89	-70.26	589,793.11	630,045.64	32.62073469	-103.91095548
9,575.00	90.60	173.50	8,810.71	-940.29	-59.67	589,698.71	630,056.23	32.62047508	-103.91092231

Company:	COG Operating LLC	Local Co-ordinate Reference:	Well Marauder 31 Federal Well No. 2H
Project:	Eddy County, New Mexico	TVD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Site:	Marauder 31 Federal	MD Reference:	RKB=3408.5+18 @ 3426.50usft (Patriot 6)
Well:	Marauder 31 Federal Well No. 2H	North Reference:	Grid
Wellbore:	Original hole	Survey Calculation Method:	Minimum Curvature
Design:	Surveys Original hole	Database:	EDM 5000.1 Ddatabase

Survey

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N-S (usft)	+E-W (usft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
9,670.00	89.00	175.80	8,811.05	-1,034.87	-50.82	589,604.13	630,065.09	32.62021502	-103.91089476
9,765.00	88.60	175.50	8,813.04	-1,129.58	-43.61	589,509.43	630,072.29	32.61995462	-103.91087259
9,860.00	91.00	176.40	8,813.37	-1,224.33	-36.90	589,414.67	630,079.00	32.61969409	-103.91085202
9,955.00	89.90	175.30	8,812.62	-1,319.08	-30.03	589,319.93	630,085.88	32.61943359	-103.91083092
10,050.00	90.20	175.80	8,812.54	-1,413.79	-22.66	589,225.21	630,093.25	32.61917317	-103.91080820
10,145.00	90.40	175.80	8,812.04	-1,508.53	-15.70	589,130.47	630,100.20	32.61891266	-103.91078683
10,240.00	90.60	176.00	8,811.21	-1,603.29	-8.91	589,035.72	630,107.00	32.61865214	-103.91076599
10,335.00	90.50	175.70	8,810.30	-1,698.03	-2.03	588,940.97	630,113.87	32.61839163	-103.91074489
10,430.00	90.70	175.80	8,809.31	-1,792.77	5.01	588,846.24	630,120.91	32.61813115	-103.91072325
10,525.00	90.70	175.70	8,808.14	-1,887.50	12.05	588,751.51	630,127.95	32.61787068	-103.91070161
10,620.00	88.80	176.20	8,808.56	-1,982.25	18.76	588,656.75	630,134.66	32.61761015	-103.91068104
10,741.00	87.70	177.20	8,812.25	-2,102.99	25.72	588,536.01	630,141.62	32.61727819	-103.91065999
10,836.00	89.40	177.40	8,814.66	-2,197.85	30.19	588,441.15	630,146.09	32.61701739	-103.91064669
10,931.00	90.60	176.50	8,814.66	-2,292.72	35.25	588,346.29	630,151.15	32.61675658	-103.91063149
11,026.00	90.70	174.90	8,813.58	-2,387.44	42.37	588,251.56	630,158.27	32.61649613	-103.91060959
11,121.00	90.00	175.10	8,813.00	-2,482.08	50.65	588,156.93	630,166.55	32.61623591	-103.91058392
11,216.00	89.90	175.50	8,813.08	-2,576.76	58.43	588,062.25	630,174.34	32.61597557	-103.91055986
11,311.00	89.30	175.70	8,813.75	-2,671.47	65.72	587,967.53	630,181.62	32.61571514	-103.91053742
11,406.00	90.20	176.50	8,814.16	-2,766.25	72.18	587,872.75	630,188.08	32.61545455	-103.91051766
11,501.00	91.40	176.70	8,812.83	-2,861.07	77.81	587,777.93	630,193.72	32.61519385	-103.91050059
11,596.00	91.50	177.40	8,810.43	-2,955.92	82.70	587,683.09	630,198.61	32.61493310	-103.91048594
11,691.00	91.10	177.90	8,808.28	-3,050.81	86.60	587,588.19	630,202.50	32.61467221	-103.91047452
11,786.00	91.20	177.60	8,806.37	-3,145.72	90.32	587,493.28	630,206.23	32.61441129	-103.91046363
11,881.00	89.90	177.10	8,805.46	-3,240.61	94.72	587,398.39	630,210.62	32.61415041	-103.91045060
11,976.00	90.30	175.80	8,805.29	-3,335.43	100.60	587,303.58	630,216.50	32.61388972	-103.91043272
12,071.00	89.60	174.80	8,805.37	-3,430.11	108.38	587,208.90	630,224.29	32.61362939	-103.91040866
12,166.00	90.10	174.10	8,805.62	-3,524.66	117.57	587,114.34	630,233.48	32.61336939	-103.91038005
12,261.00	89.70	174.20	8,805.79	-3,619.16	127.25	587,019.84	630,243.16	32.61310951	-103.91034982
12,356.00	90.80	174.60	8,805.37	-3,713.71	136.52	586,925.30	630,252.43	32.61284953	-103.91032094
12,451.00	91.00	174.40	8,803.88	-3,808.26	145.63	586,830.74	630,261.53	32.61258953	-103.91029259
12,546.00	92.00	174.80	8,801.39	-3,902.80	154.57	586,736.20	630,270.47	32.61232956	-103.91026479
12,672.00	89.90	172.30	8,799.31	-4,027.97	168.72	586,611.03	630,284.62	32.61198535	-103.91022045
12,766.00	90.00	173.00	8,799.39	-4,121.20	180.74	586,517.81	630,296.65	32.61172896	-103.91018260
12,861.00	89.60	173.20	8,799.72	-4,215.51	192.15	586,423.49	630,308.06	32.61146960	-103.91014676
12,956.00	91.00	173.20	8,799.22	-4,309.84	203.40	586,329.17	630,319.31	32.61121019	-103.91011145
13,083.00	90.70	173.70	8,797.34	-4,435.99	217.89	586,203.01	630,333.79	32.61086326	-103.91006604
13,259.00	90.70	173.70	8,795.19	-4,610.92	237.20	586,028.09	630,353.10	32.61038222	-103.91000559

Survey projected to 13259.00 MD

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N-S (usft)	+E-W (usft)	
100.00	100.00	0.07	-0.34	Gyro
8,245.00	8,239.98	68.11	-200.38	MWD surveys
8,890.00	8,743.28	-270.01	-147.40	330 Hard line intercept @ 8890 MD
13,259.00	8,795.19	-4,610.92	237.20	Survey projected to 13259.00 MD



COG Operating LLC

Well: Marauder 31 Federal Well No. 2H
 Site: Marauder 31 Federal
 Project: Eddy County, New Mexico
 Design: rev3
 Rig: Patriot 6

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	Vsect	Annotation
1	8200.00	1.18	243.33	8195.00	68.64	-199.34	0.00	0.00	-78.20	Survey @ 8200.00 MD
2	8339.27	1.18	243.33	8334.24	67.35	-201.90	0.00	0.00	-77.04	KOP Begin 12°/100' build/turn
3	8379.24	5.00	170.00	8374.15	65.45	-201.96	12.00	-86.93	-75.15	Begin 12°/100' build
4	9087.57	90.00	170.00	8810.00	-402.97	-119.37	12.00	0.00	396.72	Begin 3°/100' turn
5	9269.82	90.00	175.47	8810.00	-583.68	-96.33	3.00	90.00	578.34	Begin 90.00° lateral
6	13321.91	90.00	175.47	8810.00	-4623.10	223.90	0.00	0.00	4628.52	PBHL/TD

ANNOTATIONS

TVD	MD	Inc	Azi	+N/-S	+E/-W	Vsect	Departure	Annotation
100.00	100.00	0.40	280.74	0.07	-0.34	-0.08	0.35	Gyro
8239.98	8245.00	1.80	242.30	68.11	-200.38	-77.71	270.25	MWD surveys
8743.28	8890.00	66.41	171.72	-270.01	-147.40	262.57	613.76	330 Hard line intercept @ 8890 MD
8795.19	13259.00	90.70	173.70	-4610.92	237.20	4616.99	4973.44	Survey projected to 13259.00 MD

Surface Location: RKB=3408.5+18 @ 3426.50usft (Patriot 6)

US State Plane 1927 (Exact solution)

New Mexico East 3001

Northing 590639.00 Easting 630115.90 Latitude 32.62305906 Longitude -103.91071635
 Total Correction (M => G) To convert a Magnetic Direction to a Grid Direction, Add 7.19°



Azimuths to Grid North
 True North: -0.23°
 Magnetic North: 7.19°

Magnetic Field
 Strength: 48533.6snT
 Dip Angle: 60.43°
 Date: 4/24/2014
 Model: IGRF2010

