



30-015-37828

COG Operating LLC

Eddy County, NM (NAN27 NME)

Harvard Federal #16

Harvard Federal #16

OH

Design: Actual

Standard Survey Report

04 January, 2011



Scientific Drilling
Directional Drilling Operations



Scientific Drilling
Survey Report



Company:	COG Operating LLC	Local Co-ordinate Reference:	Site Harvard Federal #16
Project:	Eddy County, NM (NAN27 NME)	TVD Reference:	KB Elev (14') @ 3755.00usft (UDI #40)
Site:	Harvard Federal #16	MD Reference:	KB Elev (14') @ 3755.00usft (UDI #40)
Well:	Harvard Federal #16	North Reference:	Grid
Wellbore:	OH	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Julio

Project	Eddy County, NM (NAN27 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	Harvard Federal #16				
Site Position:		Northing:	673,306.80 usft	Latitude:	32° 51' 1.328 N
From:	Map	Easting:	622,523.30 usft	Longitude:	103° 56' 3.716 W
Position Uncertainty:	0.00 usft	Slot Radius:	0 "	Grid Convergence:	0.22 °

Well	Harvard Federal #16					
Well Position	+N/-S	0.00 usft	Northing:	673,306.80 usft	Latitude:	32° 51' 1.328 N
	+E/-W	0.00 usft	Easting:	622,523.30 usft	Longitude:	103° 56' 3.716 W
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	3,741.00 usft

Wellbore	OH				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	2010/12/29	7.86	60.71	48,997

Design	Actual				
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		198.71

Survey Program	Date 2011/01/04				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	1,280.00	Gyro Survey (OH)	Keeper	Standard Wireline Keeper ver 1.0.2	
1,314.00	5,042.00	MWD Survey (OH)	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)	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
100.00	0.26	225.90	100.00	-0.16	-0.16	0.20	0.26	0.26	0.00	
200.00	0.29	224.74	200.00	-0.50	-0.50	0.63	0.03	0.03	-1.16	
300.00	0.65	220.08	299.99	-1.11	-1.05	1.39	0.36	0.36	-4.66	
400.00	0.97	218.99	399.98	-2.20	-1.95	2.71	0.32	0.32	-1.09	
500.00	1.01	222.66	499.97	-3.51	-3.07	4.31	0.07	0.04	3.67	
600.00	0.95	228.02	599.96	-4.71	-4.29	5.84	0.11	-0.06	5.36	
700.00	1.03	218.64	699.94	-5.97	-5.47	7.40	0.18	0.08	-9.38	
800.00	1.06	233.15	799.92	-7.22	-6.77	9.01	0.27	0.03	14.51	
900.00	0.47	198.10	899.92	-8.17	-7.63	10.19	0.73	-0.59	-35.05	



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Site:	Harvard Federal #16	MD Reference:	KB Elev (14') @ 3755.00usft (UDI #40)
Well:	Harvard Federal #16	North Reference:	Grid
Wellbore:	OH	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Julio

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)
1,000.00	0.32	97.09	999.91	-8.59	-7.49	10.54	0.62	-0.15	-101.01
1,100.00	0.80	66.75	1,099.91	-8.35	-6.57	10.02	0.55	0.48	-30.34
1,200.00	1.41	70.60	1,199.89	-7.67	-4.76	8.79	0.61	0.61	3.85
1,280.00	1.46	75.60	1,279.86	-7.09	-2.85	7.63	0.17	0.06	6.25
1,314.00	1.30	71.08	1,313.85	-6.85	-2.06	7.15	0.57	-0.47	-13.29
1,377.00	1.33	75.70	1,376.84	-6.44	-0.68	6.32	0.17	0.05	7.33
1,441.00	1.43	73.95	1,440.82	-6.04	0.81	5.46	0.17	0.16	-2.73
1,504.00	1.49	128.09	1,503.80	-6.32	2.21	5.28	2.11	0.10	85.94
1,568.00	2.61	179.62	1,567.76	-8.30	2.87	6.94	3.20	1.75	80.52
1,631.00	3.66	196.79	1,630.67	-11.66	2.30	10.30	2.22	1.67	27.25
1,694.00	4.99	197.80	1,693.49	-16.19	0.88	15.05	2.11	2.11	1.60
1,758.00	4.81	198.00	1,757.26	-21.39	-0.80	20.52	0.28	-0.28	0.31
1,821.00	4.60	196.36	1,820.04	-26.33	-2.33	25.68	0.40	-0.33	-2.60
1,884.00	4.28	202.60	1,882.86	-30.92	-3.94	30.55	0.92	-0.51	9.90
1,948.00	4.11	208.93	1,946.68	-35.13	-5.97	35.19	0.77	-0.27	9.89
2,011.00	4.14	196.24	2,009.52	-39.29	-7.70	39.69	1.45	0.05	-20.14
2,075.00	3.68	192.81	2,073.37	-43.51	-8.80	44.04	0.81	-0.72	-5.36
2,138.00	3.33	200.04	2,136.26	-47.20	-9.87	47.88	0.89	-0.56	11.48
2,201.00	3.07	198.72	2,199.16	-50.52	-11.04	51.39	0.43	-0.41	-2.10
2,265.00	3.00	199.94	2,263.07	-53.72	-12.16	54.78	0.15	-0.11	1.91
2,328.00	2.81	196.37	2,325.99	-56.75	-13.16	57.97	0.42	-0.30	-5.67
2,392.00	3.09	196.94	2,389.90	-59.91	-14.11	61.26	0.44	0.44	0.89
2,455.00	2.86	199.87	2,452.82	-63.01	-15.13	64.53	0.44	-0.37	4.65
2,519.00	3.86	202.76	2,516.71	-66.50	-16.51	68.28	1.58	1.56	4.52
2,582.00	4.05	202.65	2,579.56	-70.50	-18.19	72.61	0.30	0.30	-0.17
2,646.00	3.80	200.86	2,643.41	-74.57	-19.81	76.99	0.43	-0.39	-2.80
2,709.00	3.67	199.14	2,706.27	-78.43	-21.22	81.09	0.27	-0.21	-2.73
2,772.00	4.63	198.00	2,769.11	-82.75	-22.66	85.65	1.53	1.52	-1.81
2,836.00	4.94	199.49	2,832.88	-87.81	-24.38	90.99	0.52	0.48	2.33
2,899.00	4.64	198.46	2,895.66	-92.78	-26.09	96.25	0.50	-0.48	-1.63
2,963.00	4.62	195.63	2,959.45	-97.72	-27.61	101.41	0.36	-0.03	-4.42
3,026.00	4.52	196.48	3,022.25	-102.54	-29.00	106.42	0.19	-0.16	1.35
3,089.00	4.35	195.33	3,085.07	-107.23	-30.33	111.29	0.30	-0.27	-1.83
3,153.00	4.30	206.11	3,148.88	-111.72	-32.03	116.09	1.27	-0.08	16.84
3,216.00	4.10	205.91	3,211.71	-115.87	-34.05	120.67	0.32	-0.32	-0.32
3,280.00	4.10	204.75	3,275.55	-120.00	-36.01	125.21	0.13	0.00	-1.81
3,343.00	3.89	201.85	3,338.40	-124.03	-37.75	129.59	0.46	-0.33	-4.60
3,406.00	3.87	203.30	3,401.25	-127.97	-39.38	133.84	0.16	-0.03	2.30
3,470.00	3.80	201.40	3,465.11	-131.93	-41.01	138.11	0.23	-0.11	-2.97
3,533.00	3.94	199.82	3,527.97	-135.91	-42.51	142.36	0.28	0.22	-2.51
3,597.00	3.95	201.28	3,591.81	-140.03	-44.05	146.76	0.16	0.02	2.28
3,660.00	3.63	199.78	3,654.68	-143.93	-45.52	150.92	0.53	-0.51	-2.38
3,724.00	3.53	198.94	3,718.55	-147.70	-46.84	154.92	0.18	-0.16	-1.31



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Wellbore:	OH	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Julio

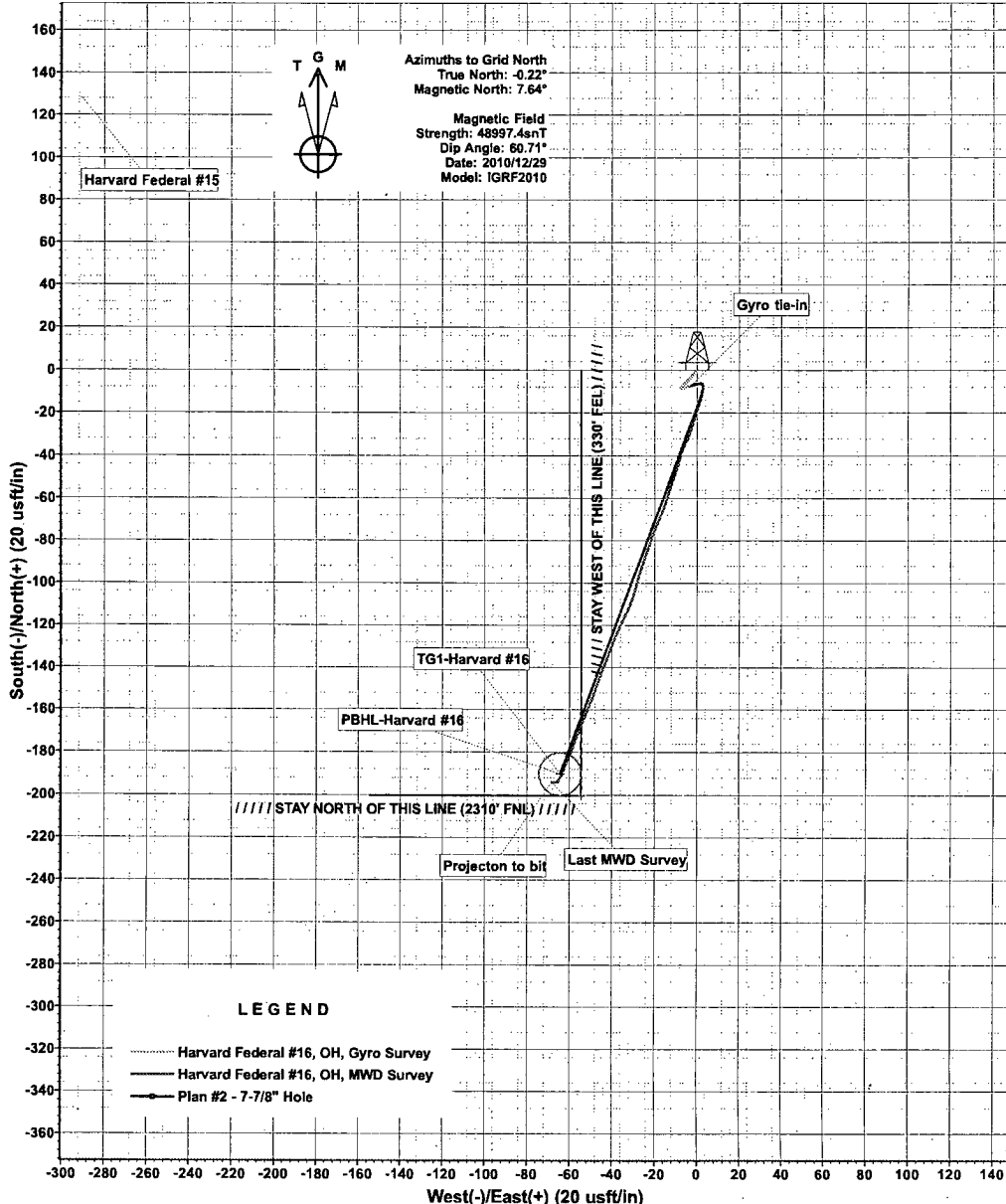
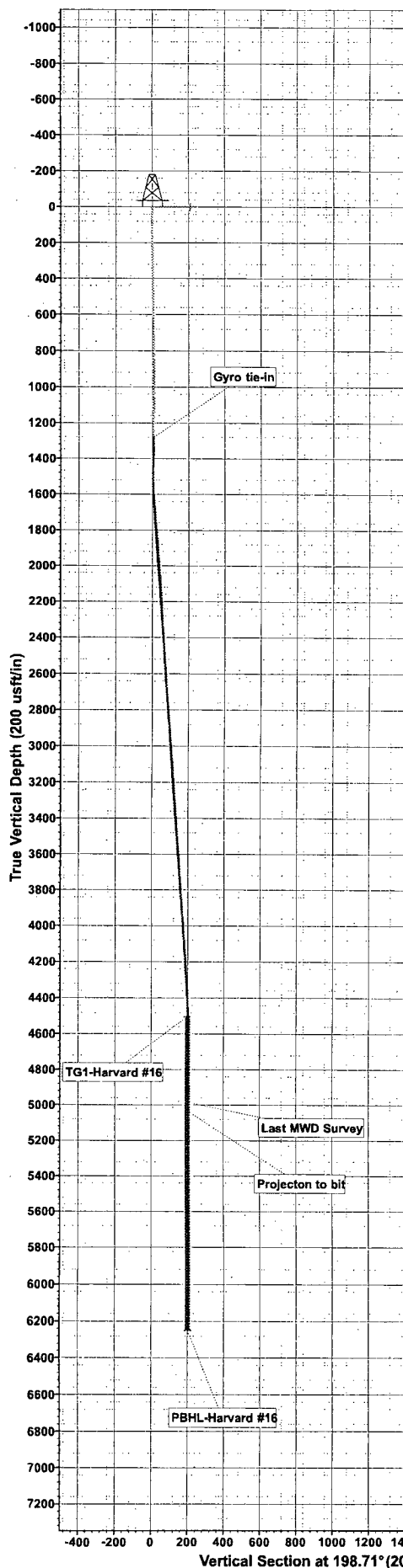
Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
3,787.00	3.56	199.82	3,781.43	-151.37	-48.13	158.81	0.10	0.05	1.40	
3,850.00	3.63	201.04	3,844.31	-155.07	-49.51	162.76	0.16	0.11	1.94	
3,914.00	3.68	203.57	3,908.18	-158.85	-51.06	166.83	0.26	0.08	3.95	
3,977.00	3.78	201.58	3,971.04	-162.63	-52.63	170.92	0.26	0.16	-3.16	
4,041.00	3.60	201.38	4,034.91	-166.46	-54.14	175.04	0.28	-0.28	-0.31	
4,104.00	3.56	203.64	4,097.79	-170.10	-55.65	178.96	0.23	-0.06	3.59	
4,167.00	3.58	199.63	4,160.67	-173.74	-57.09	182.88	0.40	0.03	-6.37	
4,231.00	3.58	201.85	4,224.54	-177.48	-58.51	186.87	0.22	0.00	3.47	
4,294.00	3.50	199.13	4,287.42	-181.12	-59.87	190.76	0.30	-0.13	-4.32	
4,357.00	3.53	205.39	4,350.30	-184.69	-61.33	194.60	0.61	0.05	9.94	
4,421.00	2.84	198.93	4,414.20	-187.97	-62.69	198.15	1.21	-1.08	-10.09	
4,484.00	1.96	209.25	4,477.15	-190.39	-63.72	200.77	1.55	-1.40	16.38	
4,548.00	1.36	207.04	4,541.12	-192.02	-64.60	202.59	0.94	-0.94	-3.45	
4,611.00	1.16	205.67	4,604.11	-193.26	-65.22	203.97	0.32	-0.32	-2.17	
4,674.00	0.29	273.38	4,667.10	-193.82	-65.66	204.64	1.72	-1.38	107.48	
4,738.00	0.47	268.14	4,731.10	-193.82	-66.08	204.78	0.29	0.28	-8.19	
4,801.00	0.36	264.24	4,794.10	-193.85	-66.54	204.95	0.18	-0.17	-6.19	
4,896.00	0.74	249.68	4,889.09	-194.09	-67.41	205.46	0.42	0.40	-15.33	
4,992.00	0.32	317.39	4,985.09	-194.11	-68.17	205.72	0.71	-0.44	70.53	
Last MWD Survey										
5,042.00	0.32	317.39	5,035.09	-193.91	-68.36	205.59	0.00	0.00	0.00	
Projection to bit										

Design Annotations					
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates			
		+N/-S (usft)	+E/-W (usft)	Comment	
4,992.00	4,985.09	-194.11	-68.17	Last MWD Survey	
5,042.00	5,035.09	-193.91	-68.36	Projection to bit	

Checked By: _____ Approved By: _____ Date: _____



Scientific Drilling for COG Operating LLC
Site: Eddy County, NM (NAN27 NME)
Well: Harvard Federal #16
Wellbore: OH
Design: Plan #2 - 7-7/8" Hole



WELLBORE TARGET DETAILS (MAP CO-ORDINATES)									
Name	TVD	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Shape	
East HL-Harvard #16	0.00	-200.20	-54.40	673106.60	622468.90	32°50' 59.349 N	103°56' 4.362 W	Rectangle (Sides : L:200.00 W:0.00)	
North HL-Harvard #16	0.00	-200.20	-54.40	673106.60	622468.90	32°50' 59.349 N	103°56' 4.362 W	Rectangle (Side s: L:0.00 W:100.00)	
TG1-Harvard #16	4500.00	-190.20	-64.40	673116.60	622458.90	32°50' 59.448 N	103°56' 4.479 W	Point	
PBHL-Harvard #16	6250.00	-190.20	-64.40	673116.60	622458.90	32°50' 59.448 N	103°56' 4.479 W	Circle (Radius: 10.00)	

SECTION DETAILS										
Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	Vsect	Target
1	1280.00	1.46	75.60	1279.86	-7.09	-2.85	0.00	0.00	7.63	
2	1450.00	1.46	75.60	1449.81	-6.01	1.35	0.00	0.00	5.26	
3	1698.75	4.00	200.41	1698.37	-13.35	1.39	2.00	138.72	12.20	
4	4307.12	4.00	200.41	4300.40	-183.68	-61.97	0.00	0.00	193.85	
5	4506.88	0.00	0.00	4500.00	-190.20	-64.40	2.00	180.00	200.81	TG1-Harvard #16
6	6256.88	0.00	0.00	6250.00	-190.20	-64.40	0.00	0.00	200.81	PBHL-Harvard #16

WELL DETAILS: Harvard Federal #16

Ground Level: 3741.00			
+N/-S	+E/-W	Northing	Easting
0.00	0.00	673306.80	622523.30
		Latitude	Longitude
		32°51' 1.328 N	103°56' 3.716 W

PROJECT DETAILS: Eddy County, NM (NAN27 NME) Plan: Plan #2 - 7-7/8" Hole (Harvard Federal #16/OH)
Geodetic System: US State Plane 1927 (Exact solution) Created By: Julio Pina Date: 29-Dec-10
Datum: NAD 1927 (NADCON CONUS)
Ellipsoid: Clarke 1866 Checked: Date:
Zone: New Mexico East 3001 Reviewed: Date:
System Datum: Mean Sea Level Approved: Date: