



COG Operating LLC

Eddy County, NM (NAN27 NME)

Harvard Federal #20

Harvard Federal #20

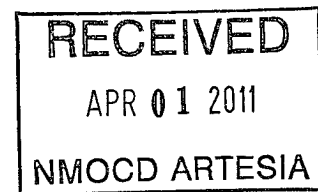
OH

30-015-37830

Design: Actual

Standard Survey Report

13 February, 2011





Scientific Drilling
Survey Report



Company:	COG Operating LLC	Local Co-ordinate Reference:	Site Harvard Federal #20
Project:	Eddy County, NM (NAN27 NME)	TVD Reference:	KB Elev (12') @ 3767.00usft (Silver Oak #5)
Site:	Harvard Federal #20	MD Reference:	KB Elev (12') @ 3767.00usft (Silver Oak #5)
Well:	Harvard Federal #20	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 #20				
Site Position:		Northing:	673,384.60 usft	Latitude:	32° 51' 2.048 N
From:	Map	Easting:	623,832.80 usft	Longitude:	103° 55' 48.362 W
Position Uncertainty:	0.00 usft	Slot Radius:	0 "	Grid Convergence:	0.22 °

Well	Harvard Federal #20					
Well Position	+N-S	0.00 usft	Northing:	673,384.60 usft	Latitude:	32° 51' 2.048 N
	+E-W	0.00 usft	Easting:	623,832.80 usft	Longitude:	103° 55' 48.362 W
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	3,755.00 usft

Wellbore	OH				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	2011/01/17	7.85	60.71	48,993

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	202.72	

Survey Program	Date 2011/02/13				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	1,279.00	Gyro Survey (OH)	Keeper	Standard Wireline Keeper ver 1.0.2	
1,365.00	4,798.00	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	0.69	189.35	100.00	-0.59	-0.10	0.59	0.69	0.69	0.00	
200.00	1.43	180.91	199.98	-2.44	-0.22	2.33	0.75	0.74	-8.44	
300.00	1.89	179.12	299.94	-5.33	-0.21	5.00	0.46	0.46	-1.79	
400.00	1.78	183.50	399.89	-8.53	-0.28	7.98	0.18	-0.11	4.38	
500.00	1.95	186.96	499.83	-11.77	-0.58	11.08	0.20	0.17	3.46	
600.00	1.65	192.00	599.78	-14.87	-1.09	14.13	0.34	-0.30	5.04	
700.00	1.35	194.91	699.75	-17.41	-1.69	16.71	0.31	-0.30	2.91	
800.00	1.40	201.34	799.72	-19.69	-2.44	19.10	0.16	0.05	6.43	
900.00	1.13	198.65	899.70	-21.76	-3.20	21.31	0.28	-0.27	-2.69	



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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)
1,000.00	0.45	167.15	999.69	-23.08	-3.42	22.61	0.78	-0.68	-31.50
1,100.00	0.22	143.78	1,099.68	-23.62	-3.22	23.03	0.26	-0.23	-23.37
1,200.00	0.67	109.01	1,199.68	-23.96	-2.56	23.09	0.51	0.45	-34.77
1,279.00	0.82	113.48	1,278.68	-24.34	-1.60	23.07	0.20	0.19	5.66
Gyro Tie-in									
1,365.00	0.71	147.34	1,364.67	-25.03	-0.75	23.38	0.53	-0.13	39.37
1,429.00	0.58	178.15	1,428.66	-25.69	-0.53	23.90	0.57	-0.20	48.14
1,492.00	1.39	260.83	1,491.66	-26.13	-1.27	24.59	2.28	1.29	131.24
1,566.00	2.98	240.19	1,565.60	-27.23	-3.82	26.59	2.36	2.15	-27.89
1,620.00	3.61	232.94	1,619.51	-28.95	-6.40	29.18	1.40	1.17	-13.43
1,684.00	4.36	222.64	1,683.36	-31.96	-9.66	33.21	1.62	1.17	-16.09
1,747.00	4.56	213.72	1,746.17	-35.80	-12.67	37.92	1.14	0.32	-14.16
1,811.00	4.69	202.67	1,809.96	-40.33	-15.09	43.03	1.40	0.20	-17.27
1,907.00	4.81	198.21	1,905.63	-47.78	-17.86	50.97	0.40	0.13	-4.65
2,002.00	4.21	198.08	2,000.34	-54.87	-20.19	58.41	0.63	-0.63	-0.14
2,105.00	4.13	199.27	2,103.06	-61.97	-22.58	65.88	0.11	-0.08	1.16
2,201.00	4.91	201.13	2,198.76	-69.07	-25.20	73.44	0.83	0.81	1.94
2,296.00	4.54	201.40	2,293.44	-76.36	-28.04	81.26	0.39	-0.39	0.28
2,392.00	4.39	201.91	2,389.15	-83.30	-30.80	88.74	0.16	-0.16	0.53
2,488.00	3.98	198.01	2,484.89	-89.88	-33.20	95.73	0.52	-0.43	-4.06
2,583.00	4.20	205.35	2,579.65	-96.16	-35.71	102.49	0.60	0.23	7.73
2,679.00	3.85	203.39	2,675.42	-102.30	-38.49	109.23	0.39	-0.36	-2.04
2,775.00	4.50	198.02	2,771.16	-108.84	-40.94	116.20	0.79	0.68	-5.59
2,870.00	4.34	200.78	2,865.88	-115.74	-43.37	123.51	0.28	-0.17	2.91
2,966.00	4.26	198.70	2,961.61	-122.51	-45.80	130.70	0.18	-0.08	-2.17
3,062.00	4.91	202.12	3,057.30	-129.70	-48.49	138.36	0.73	0.68	3.56
3,157.00	4.78	202.61	3,151.96	-137.12	-51.54	146.38	0.14	-0.14	0.52
3,253.00	4.68	203.35	3,247.63	-144.41	-54.63	154.30	0.12	-0.10	0.77
3,348.00	4.43	205.50	3,342.33	-151.27	-57.75	161.84	0.32	-0.26	2.26
3,444.00	4.61	206.54	3,438.04	-158.07	-61.07	169.39	0.21	0.19	1.08
3,539.00	4.50	205.40	3,532.74	-164.85	-64.37	176.92	0.15	-0.12	-1.20
3,635.00	4.50	207.49	3,628.44	-171.60	-67.73	184.44	0.17	0.00	2.18
3,730.00	4.66	207.52	3,723.14	-178.33	-71.23	192.00	0.17	0.17	0.03
3,826.00	4.54	208.24	3,818.83	-185.13	-74.83	199.67	0.14	-0.13	0.75
3,921.00	4.48	208.16	3,913.53	-191.71	-78.36	207.10	0.06	-0.06	-0.08
4,017.00	4.60	209.22	4,009.23	-198.38	-82.01	214.66	0.15	0.13	1.10
4,113.00	4.34	208.78	4,104.94	-204.92	-85.64	222.10	0.27	-0.27	-0.46
4,208.00	4.03	211.10	4,199.69	-210.93	-89.09	228.97	0.37	-0.33	2.44
4,303.00	4.23	211.38	4,294.44	-216.78	-92.64	235.74	0.21	0.21	0.29
4,399.00	4.01	209.37	4,390.19	-222.73	-96.13	242.57	0.27	-0.23	-2.09
4,463.00	3.00	206.70	4,454.07	-226.18	-97.98	246.47	1.60	-1.58	-4.17
4,527.00	1.59	208.27	4,518.02	-228.45	-99.15	249.02	2.21	-2.20	2.45
4,591.00	0.27	295.78	4,582.01	-229.17	-99.71	249.90	2.50	-2.06	136.73



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Survey Report



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Site:	Harvard Federal #20	MD Reference:	KB Elev (12') @ 3767.00usft (Silver Oak #5)
Well:	Harvard Federal #20	North Reference:	Grid
Wellbore:	OH	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Julio

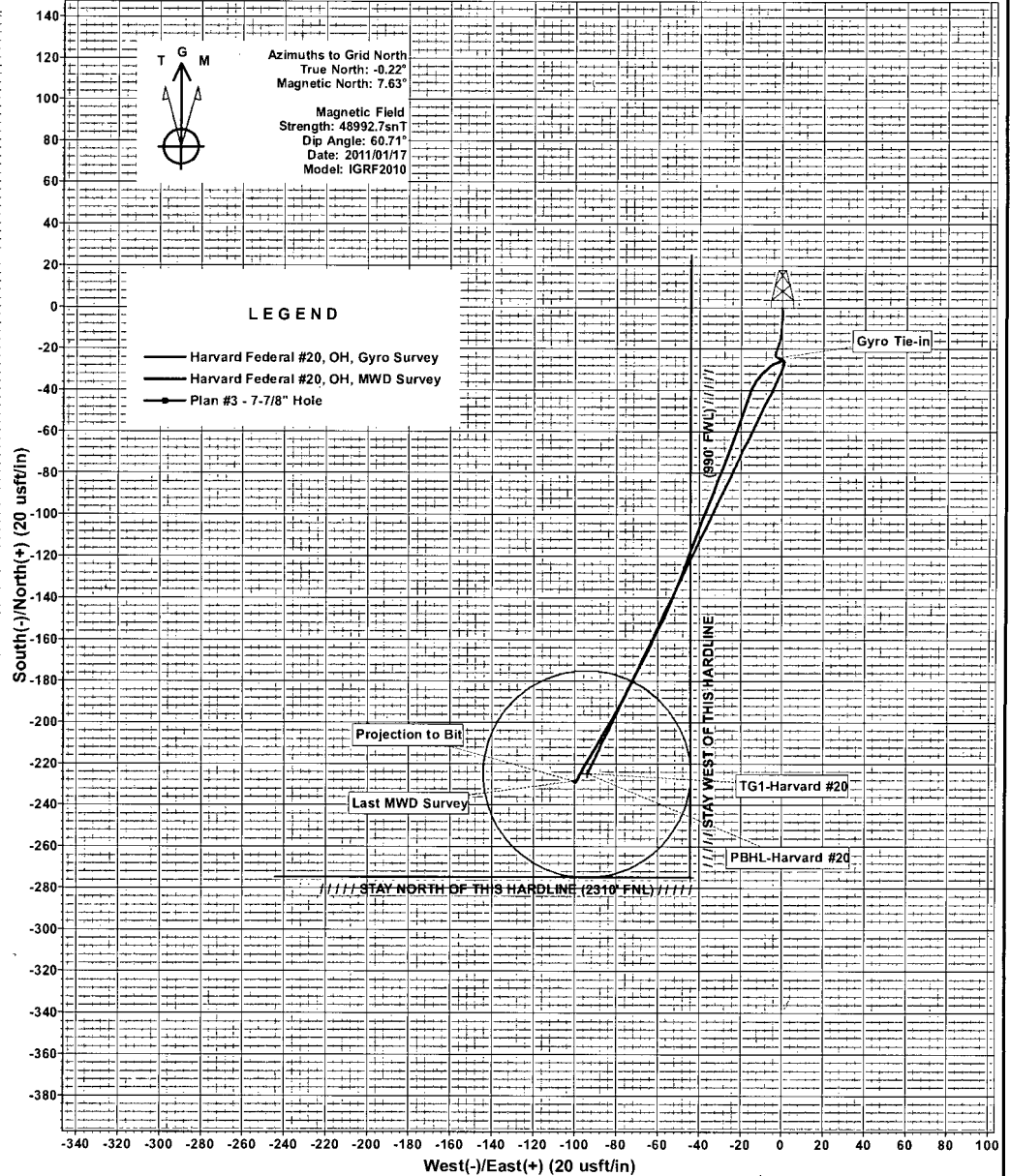
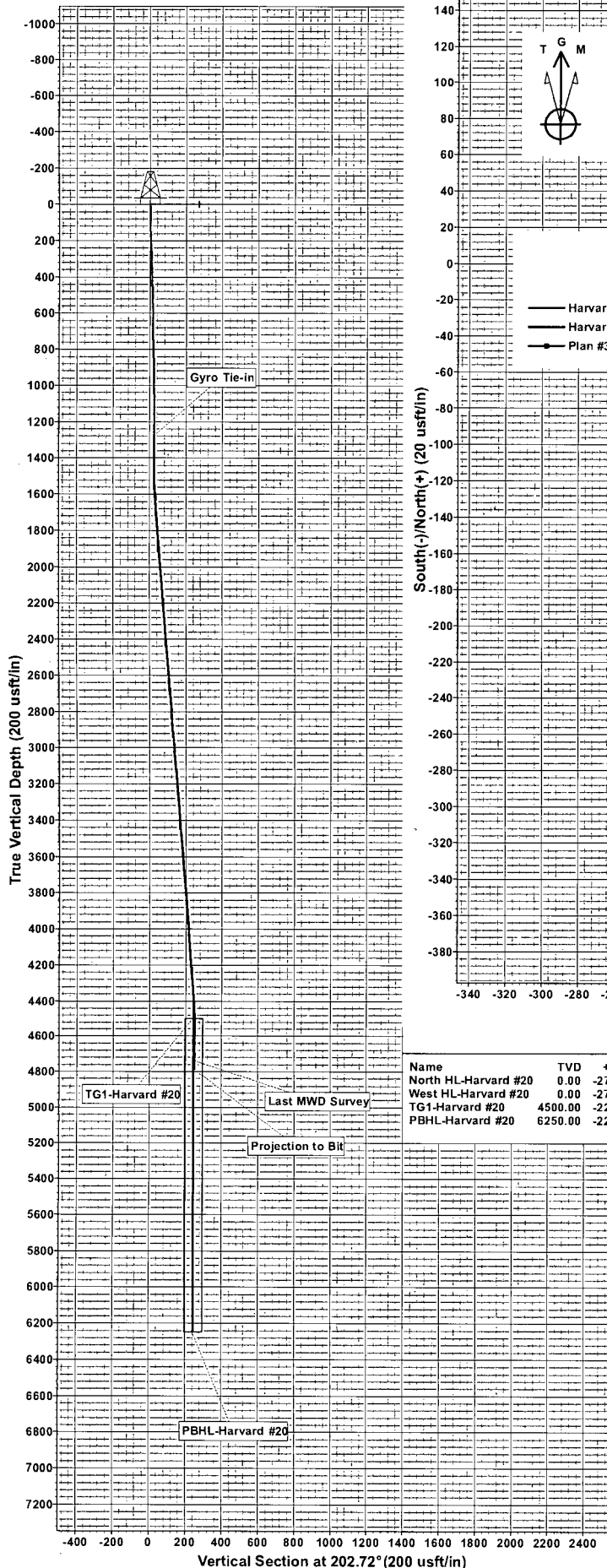
Survey									
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
4,686.00	0.46	322.52	4,677.01	-228.77	-100.14	249.70	0.26	0.20	28.15
4,750.00	0.30	287.09	4,741.01	-228.52	-100.46	249.59	0.43	-0.25	-55.36
Last MWD Survey									
4,798.00	0.30	287.09	4,789.01	-228.44	-100.70	249.61	0.00	0.00	0.00
Projection to Bit									

Design Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
1,279.00	1,278.68	-24.34	-1.60	Gyro Tie-in
4,750.00	4,741.01	-228.52	-100.46	Last MWD Survey
4,798.00	4,789.01	-228.44	-100.70	Projection to Bit

Checked By: _____	Approved By: _____	Date: _____
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Scientific Drilling for COG Operating LLC
Site: Eddy County, NM (NAN27 NME)
Well: Harvard Federal #20
Wellbore: OH
Design: Plan #3 - 7-7/8" Hole



WELLBORE TARGET DETAILS (MAP CO-ORDINATES)

Name	TVD	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Shape
North HL-Harvard #20	0.00	-275.00	-44.20	673109.60	623788.60	32°50' 59.329 N	103°55' 48.893 W	Rectangle (Side s: L0.00 W200.00)
West HL-Harvard #20	0.00	-275.00	-44.20	673109.60	623788.60	32°50' 59.329 N	103°55' 48.893 W	Rectangle (Side s: L300.00 W0.00)
TG1-Harvard #20	4500.00	-225.00	-94.20	673159.60	623738.60	32°50' 59.825 N	103°55' 49.476 W	Point
PBHL-Harvard #20	6250.00	-225.00	-94.20	673159.60	623738.60	32°50' 59.825 N	103°55' 49.476 W	Circle (Radius: 50.00)

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSect	Target
1	1279.00	0.82	113.48	1278.68	-24.34	-1.60	0.00	0.00	23.07	
2	21450.00	0.82	113.48	1449.66	-25.31	0.64	0.00	0.00	23.10	
3	1679.25	4.48	205.83	1678.67	-34.03	-1.75	2.00	102.62	32.06	
4	4284.87	4.48	205.83	4276.34	-217.13	-90.39	0.00	0.00	235.19	
5	4508.76	0.00	0.00	4500.00	-225.00	-94.20	2.00	180.00	243.92	TG1-Harvard #20
6	6258.76	0.00	0.00	6250.00	-225.00	-94.20	0.00	0.00	243.92	PBHL-Harvard #20

WELL DETAILS: Harvard Federal #20

+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Slot
0.00	0.00	673384.60	623832.80	32°51' 2.048 N	103°55' 4 8.362 W	

PROJECT DETAILS: Eddy County, NM (NAN27 NME) Plan: Plan #3 - 7-7/8" Hole (Harvard Federal #20/OH)

Geodetic System: US State Plane 1927 (Exact solution) Created By: Julio Pina Date: 17-Jan-11
Datum: NAD 1927 (NADCON CONUS)
Ellipsoid: Clarke 1866
Zone: New Mexico East 3001
System Datum: Mean Sea Level
Checked: _____ Date: _____
Reviewed: _____ Date: _____
Approved: _____ Date: _____