



COG OPERATING LLC

Eddy County, NM (NAN27 NME)

Harvard Federal #17

Harvard Federal #17

OH - Job #32D0611510

30-015-38505

Survey: MWD Survey

SDI Standard Survey Report

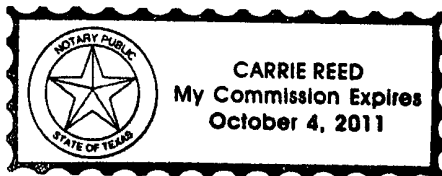
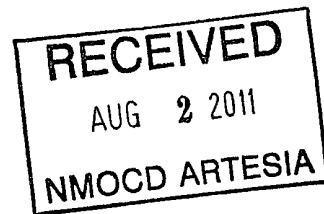
This survey is correct to the best of my knowledge and is supported by actual field data.

K. Wharton

Notarized this date 22nd of July, 2011.

Carrie Reed

Notary Signature
County of Midland
State of Texas



Scientific Drilling
Directional Drilling Operations



Scientific Drilling International, Inc.
SDI Standard Survey Report



Company:	COG OPERATING LLC	Local Co-ordinate Reference:	Site Harvard Federal #17
Project:	Eddy County, NM (NAN27 NME)	TVD Reference:	KB Elev (14') @ 3777 0usft (UDI #40)
Site:	Harvard Federal #17	MD Reference:	KB Elev (14') @ 3777 0usft (UDI #40)
Well:	Harvard Federal #17	North Reference:	Grid
Wellbore:	OH - Job #32D0611510	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Regulatory

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 #17		
Site Position:		Northing:	674,708 90 usft
From:	Map	Easting:	623,343 80 usft
Position Uncertainty:	0 0 usft	Slot Radius:	0"
		Latitude:	32° 51' 15 171 N
		Longitude:	103° 55' 54 035 W
		Grid Convergence:	0 22 °

Well	Harvard Federal #17		
Well Position	+N/-S	0 0 usft	Northing:
	+E/-W	0 0 usft	Easting:
Position Uncertainty	0 0 usft	Wellhead Elevation:	usft
		Latitude:	32° 51' 15 171 N
		Longitude:	103° 55' 54 035 W
		Ground Level:	3,763 0 usft

Wellbore	OH - Job #32D0611510				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	6/1/2011	7 81	60 71	48,958

Design	Actual			
Audit Notes:				
Version:	1 0	Phase:	ACTUAL	Tie On Depth: 0 0
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)
	0 0	0 0	0 0	332 55

Survey Program	Date 7/22/2011				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100 0	1,341 0	Gyro Survey (OH - Job #32D0611510)	Keeper	Standard Wireline Keeper ver 1 0 2	
1,466 0	4,977 0	MWD Survey (OH - Job #32D0611510)	MWD	MWD - Standard	

Survey							
Measured Depth (usft)	Inclination (°)	Azimuth (°)	True Vertical Depth	North/South (usft)	East/West (usft)	Closure Azimuth (°)	Closure Distance (usft)
0 0	0 00	0 00	0 0	0 0	0 0	0 00	0 0
100 0	0 23	111 84	100 0	-0 1	0 2	111 84	0 2
200 0	0 37	77 65	200 0	-0 1	0 7	96 66	0 7
300 0	0 54	64 46	300 0	0 2	1 4	82 35	1 4
400 0	0 74	34 90	400 0	0 9	2 2	67 42	2 4
500 0	0 82	26 11	500 0	2 1	2 9	54 20	3 6
600 0	0 56	18 59	600 0	3 2	3 4	46 53	4 7
700 0	0 75	3 37	700 0	4 3	3 6	39 60	5 6
800 0	0 80	349 39	800 0	5 7	3 5	31 61	6 6
900 0	0 67	6 24	899 9	6 9	3 4	26 26	7 7
1,000 0	0 88	355 51	999 9	8 3	3 4	22 47	9 0



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SDI Standard Survey Report



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Site:	Harvard Federal #17	MD Reference:	KB Elev (14') @ 3777 0usft (UDI #40)
Well:	Harvard Federal #17	North Reference:	Grid
Wellbore:	OH - Job #32D0611510	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Regulatory

Survey							
Measured Depth (usft)	Inclination (°)	Azimuth (°)	True Vertical Depth	North/South (usft)	East/West (usft)	Closure Azimuth (°)	Closure Distance (usft)
1,100 0	0 96	17 58	1,099 9	9 8	3 6	20 17	10 5
1,200 0	1 14	35 50	1,199 9	11 4	4 4	21 22	12 3
1,300 0	1 13	55 16	1,299 9	12 8	5 8	24 46	14 1
1,341 0	1 74	19 72	1,340 9	13 6	6 4	25 05	15 1



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SDI Standard Survey Report



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Site:	Harvard Federal #17	MD Reference:	KB Elev (14') @ 3777 0usft (UDI #40)
Well:	Harvard Federal #17	North Reference:	Grid
Wellbore:	OH - Job #32D0611510	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Regulatory

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 #17		
Site Position:		Northing:	674,708 90 usft
From:	Map	Easting:	623,343 80 usft
Position Uncertainty:	0 0 usft	Slot Radius:	0"
		Latitude:	32° 51' 15 171 N
		Longitude:	103° 55' 54 035 W
		Grid Convergence:	0 22 °

Well	Harvard Federal #17		
Well Position	+N/-S	0 0 usft	Northing:
	+E/-W	0 0 usft	Easting:
Position Uncertainty	0 0 usft	Wellhead Elevation:	usft
		Latitude:	32° 51' 15 171 N
		Longitude:	103° 55' 54 035 W
		Ground Level:	3,763 0 usft

Wellbore	OH - Job #32D0611510		
Magnetics	Model Name	Sample Date	Declination
			(°)
	IGRF2010	6/1/2011	7 81
			Dip Angle
			(°)
			60 71
			Field Strength
			(nT)
			48,958

Design	Actual		
Audit Notes:			
Version:	1 0	Phase:	ACTUAL
		Tie On Depth:	0 0
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W
	(usft)	(usft)	(usft)
	0 0	0 0	0 0
			Direction
			(°)
			332 55

Survey Program	Date 7/22/2011		
From	To	Survey (Wellbore)	Tool Name
(usft)	(usft)		
100 0	1,341 0	Gyro Survey (OH - Job #32D0611510)	Keeper
1,466 0	4,977 0	MWD Survey (OH - Job #32D0611510)	MWD
			Description
			Standard Wireline Keeper ver 1 0 2
			MWD - Standard

Survey			
Measured Depth	Inclination	Azimuth	True Vertical
(usft)	(°)	(°)	Depth
1,341 0	1 74	19 72	1,340 9
			North/South
			(usft)
			East/West
			(usft)
			Closure Azimuth
			(°)
			Closure Distance
			(usft)
			15 1
Gyro Tie-in			
1,466 0	0 72	61 90	1,465 9
1,529 0	1 21	56 94	1,528 8
1,592 0	2 07	23 56	1,591 8
1,656 0	2 78	2 15	1,655 8
1,719 0	3 60	351 69	1,718 7
1,783 0	4 35	346 68	1,782 5
1,846 0	5 28	344 18	1,845 3
1,909 0	6 65	339 38	1,907 9
1,973 0	7 56	335 22	1,971 5
			23 6
			9 9
			9 1
			7 7
			9 6
			10 1
			25 05
			26 01
			27 79
			28 47
			26 49
			22 59
			17 83
			13 06
			8 14
			3 16
			46 9



Company:	COG OPERATING LLC	Local Co-ordinate Reference:	Site Harvard Federal #17
Project:	Eddy County, NM (NAN27 NME)	TVD Reference:	KB Elev (14') @ 3777 0usft (UDI #40)
Site:	Harvard Federal #17	MD Reference:	KB Elev (14') @ 3777 0usft (UDI #40)
Well:	Harvard Federal #17	North Reference:	Grnd
Wellbore:	OH - Job #32D0611510	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Regulatory

Survey

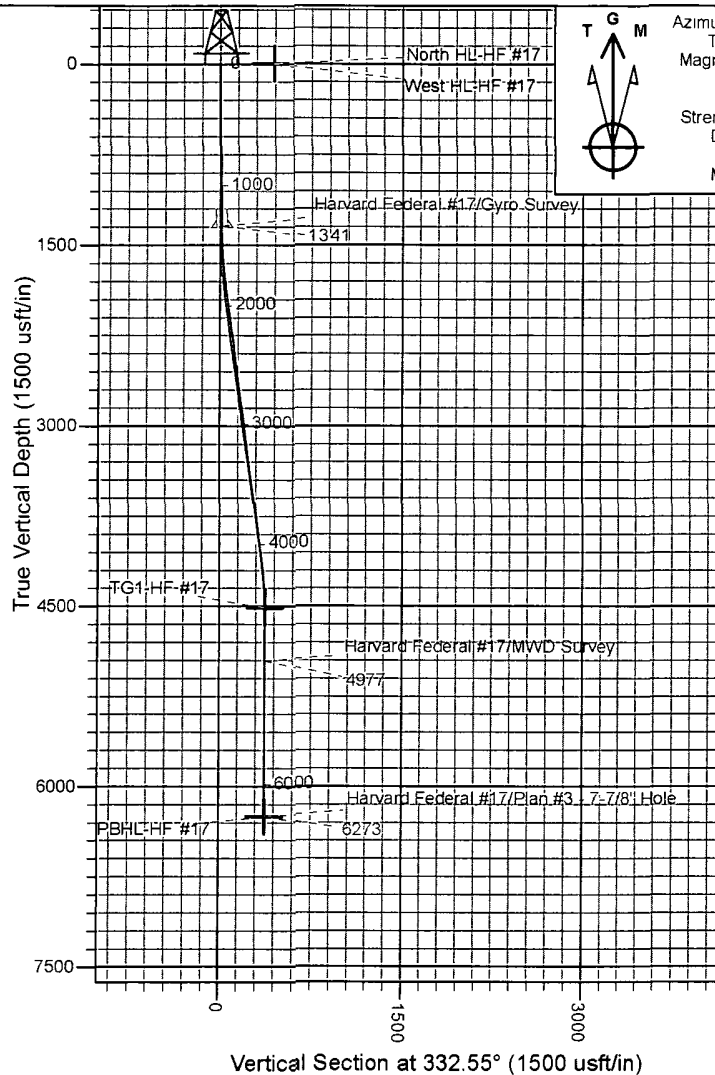
Measured Depth (usft)	Inclination (°)	Azimuth (°)	True Vertical Depth	North/South (usft)	East/West (usft)	Closure Azimuth (°)	Closure Distance (usft)
2,036 0	8 29	329 78	2,033 9	54 5	-1 4	358 49	54 5
2,100 0	8 04	327 50	2,097 2	62 2	-6 2	354 34	62 6
2,195 0	8 05	331 21	2,191 3	73 7	-12 9	350 04	74 8
2,290 0	7 31	332 31	2,285 4	84 9	-19 0	347 41	87 0
2,385 0	8 41	331 90	2,379 5	96 3	-25 0	345 43	99 5
2,481 0	7 80	333 10	2,474 6	108 3	-31 3	343 89	112 8
2,576 0	7 74	331 10	2,568 7	119 7	-37 3	342 69	125 4
2,671 0	7 97	328 80	2,662 8	130 9	-43 8	341 50	138 1
2,766 0	7 28	328 70	2,757 0	141 7	-50 3	340 44	150 4
2,868 0	8 38	327 31	2,858 0	153 5	-57 7	339 39	164 0
2,963 0	8 27	326 15	2,952 0	165 0	-65 3	338 42	177 4
3,058 0	7 95	324 78	3,046 1	176 0	-72 8	337 52	190 5
3,153 0	8 63	327 12	3,140 1	187 4	-80 5	336 75	203 9
3,248 0	8 55	326 51	3,234 0	199 3	-88 3	336 11	217 9
3,343 0	8 48	325 44	3,327 9	210 9	-96 1	335 49	231 8
3,439 0	8 57	323 63	3,422 9	222 5	-104 4	334 86	245 8
3,534 0	8 31	323 63	3,516 9	233 7	-112 7	334 26	259 5
3,629 0	7 42	327 27	3,611 0	244 4	-120 1	333 84	272 3
3,724 0	7 32	326 60	3,705 2	254 6	-126 7	333 54	284 4
3,819 0	7 17	326 00	3,799 4	264 6	-133 4	333 25	296 3
3,914 0	7 67	328 53	3,893 6	274 9	-140 0	333 02	308 5
4,009 0	7 64	328 73	3,987 8	285 7	-146 6	332 84	321 1
4,104 0	7 53	328 88	4,081 9	296 5	-153 1	332 69	333 6
4,199 0	6 89	328 22	4,176 2	306 6	-159 3	332 55	345 5
4,294 0	5 21	332 94	4,270 7	315 3	-164 2	332 49	355 5
4,390 0	3 50	335 48	4,366 4	321 9	-167 4	332 51	362 8
4,485 0	1 55	321 59	4,461 3	325 5	-169 4	332 50	367 0
4,580 0	0 50	251 10	4,556 3	326 4	-170 6	332 40	368 3
4,675 0	0 58	246 05	4,651 3	326 0	-171 5	332 26	368 4
4,770 0	0 27	243 40	4,746 3	325 8	-172 1	332 15	368 4
4,865 0	0 29	261 06	4,841 3	325 6	-172 5	332 08	368 5
4,928 0	0 39	271 52	4,904 3	325 6	-172 9	332 03	368 7
Last MWD Survey							
4,977 0	0 39	271 52	4,953 3	325 6	-173 2	331 98	368 8
Projection to bit							

Survey Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
1,341 0	1,340 9	13 6	6 4	Gyro Tie-in
4,928 0	4,904 3	325 6	-172 9	Last MWD Survey
4,977 0	4,953 3	325 6	-173 2	Projection to bit



Project: Eddy County, NM (NAN27 NME)
 Site: Harvard Federal #17
 Well: Harvard Federal #17
 Wellbore: OH - Job #32D0611510
 Design: Plan #3 - 7-7/8" Hole

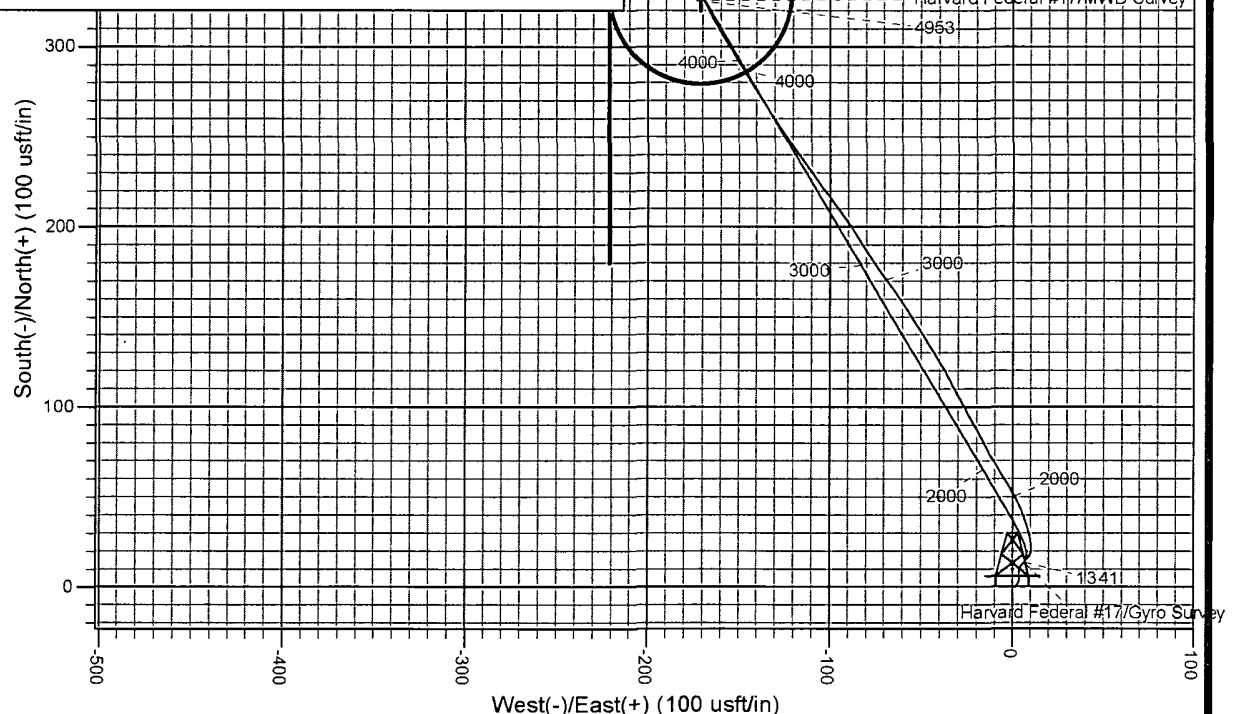


Azimuths to Grid North
 True North -0 22°
 Magnetic North 7 59°
 Magnetic Field
 Strength 48957 5snT
 Dip Angle 60 71°
 Date 6/1/2011
 Model IGRF2010

+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Slope
0.0	0.0	674708 90	623343.80	32° 51' 15.171 N	103° 55' 54.035 W	

WELL DETAILS: Harvard Federal #17
 KB Elev (14') @ 3777.0usft (UDI #40)
 Ground Level: 3763 0

REFERENCE INFORMATION
 Co-ordinate (N/E) Reference: Site Harvard Federal #17, Grid North
 Vertical (TVD) Reference KB Elev (14') @ 3777 0usft (UDI #40)
 Section (VS) Reference Slot - (0.0N, 0.0E)
 Measured Depth Reference KB Elev (14') @ 3777.0usft (UDI #40)
 Calculation Method Minimum Curvature



COMPANY DETAILS: COG OPERATING LLC
 223032

Calculation Method: Minimum Curvature
 Error System: ISCWSA
 Scan Method: Closest Approach 3D
 Error Surface: Elliptical Conic
 Warning Method: Error Ratio

PROJECT DETAILS: Eddy County, NM (NAN27 NME)
 Geodetic System: US State Plane 1927 (Exact solution)
 Datum: NAD 1927 (NADCON CONUS)
 Ellipsoid: Clarke 1866
 Zone: New Mexico East 3001
 System Datum: Mean Sea Level

SITE DETAILS: Harvard Federal #17
 Site Centre Latitude: 32° 51' 15.171 N
 Longitude: 103° 55' 54.035 W
 Positional Uncertainty: 0.0
 Convergence: 0.22
 Local North: Grid