



Company: COG Operating

Lease/Well: Caverns Federal Com No./004H

30-015-43291

Rig Name: Latshaw 44

State/County: New Mexico/Eddy

VS-Azi: 0.00 Degrees

Latitude: 32.03400, Longitude: -104.40721

Grid North = True North +0.04 degs (NAD 27)

Grid Correction Applied = +0.04 degs

VES SURVEY

Depth Reference : RKB = 25 Feet

DRILLOG HA GYRO SURVEY CALCULATIONS

Filename: e-line gyro-de\_01.ut

Minimum Curvature Method

Report Date/Time: 4/10/2017 / 16:04

VES SURVEY INTERNATIONAL

MIDLAND, TEXAS

432-563-5444

Surveyor: JAMES NEIL BATES

Caverns Federal Com No. 004H / API 30-015-43291

NM OIL CONSERVATION

ARTESIA DISTRICT

SEP 15 2017

RECEIVED

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
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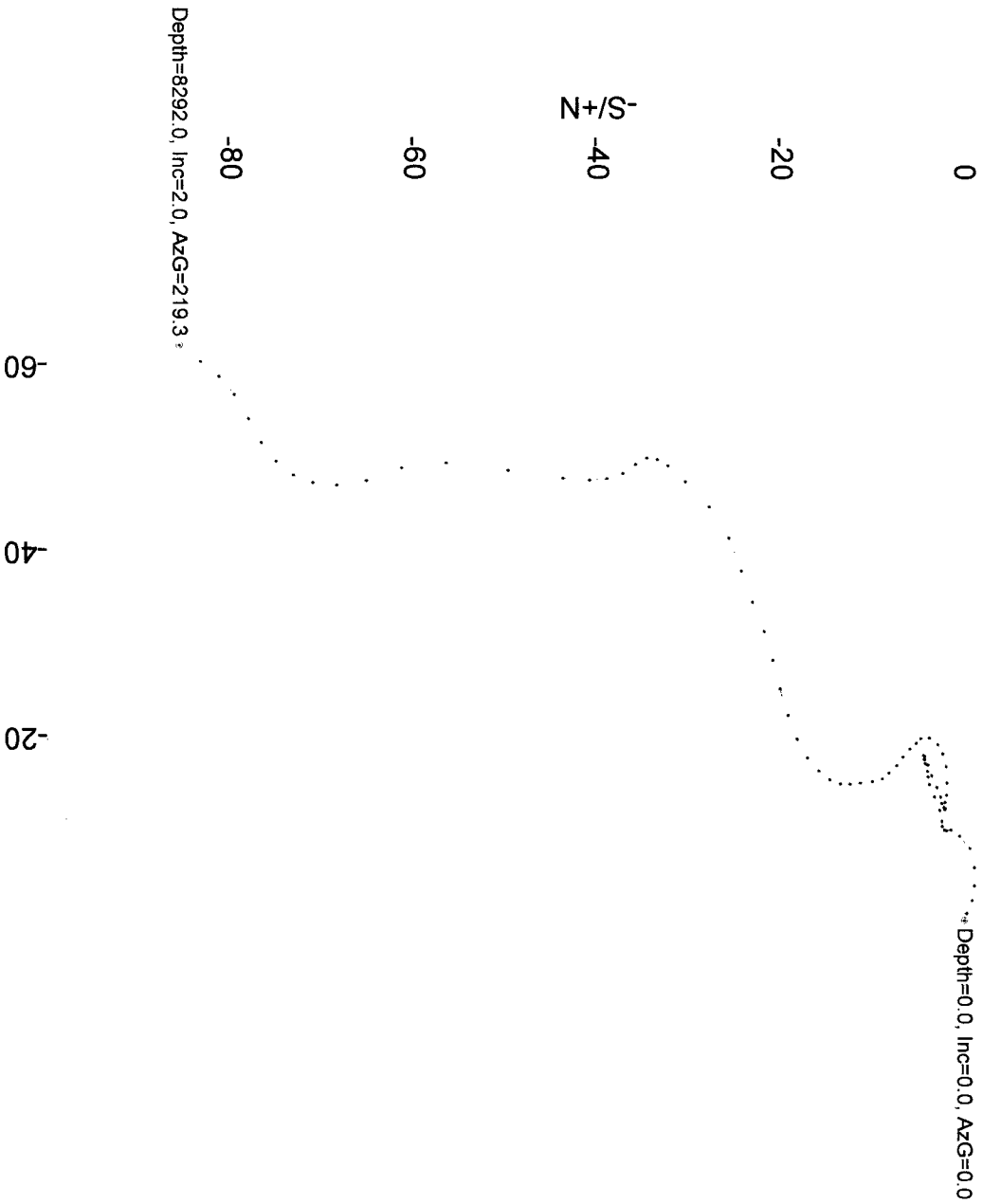
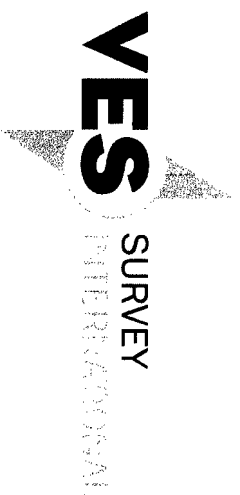
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	****
100.00	0.97	287.39	100.00	0.25	-0.81	0.25	0.85	287.39	0.97
200.00	0.75	298.44	199.98	0.82	-2.19	0.82	2.34	290.47	0.27
300.00	1.13	268.00	299.97	1.10	-3.75	1.10	3.91	286.28	0.61
400.00	1.27	271.30	399.95	1.09	-5.84	1.09	5.94	280.54	0.16
500.00	1.23	241.39	499.93	0.60	-7.88	0.60	7.91	274.35	0.64
600.00	0.94	221.13	599.91	-0.53	-9.36	-0.53	9.38	266.77	0.47
700.00	0.40	193.18	699.90	-1.49	-9.98	-1.49	10.09	261.52	0.61
800.00	0.23	131.98	799.90	-1.96	-9.91	-1.96	10.11	258.81	0.35
900.00	0.25	244.12	899.90	-2.19	-9.97	-2.19	10.20	257.61	0.40
1000.00	0.26	235.04	999.90	-2.42	-10.35	-2.42	10.63	256.85	0.04
1100.00	0.42	281.18	1099.90	-2.48	-10.90	-2.48	11.18	257.18	0.30
1200.00	1.01	249.59	1199.89	-2.72	-12.08	-2.72	12.38	257.33	0.69
1300.00	0.82	247.43	1299.88	-3.30	-13.57	-3.30	13.96	256.34	0.19
1400.00	0.81	247.01	1399.87	-3.85	-14.88	-3.85	15.37	255.50	0.01
1500.00	0.24	309.27	1499.86	-3.99	-15.69	-3.99	16.19	255.72	0.73
1600.00	0.56	246.21	1599.86	-4.06	-16.30	-4.06	16.80	256.01	0.50

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
1700.00	0.48	262.50	1699.86	-4.31	-17.16	-4.31	17.69	255.89	0.17
1800.00	0.07	227.76	1799.86	-4.41	-17.62	-4.41	18.16	255.95	0.43
1900.00	0.10	288.68	1899.85	-4.42	-17.74	-4.42	18.28	256.01	0.09
2000.00	0.29	248.23	1999.85	-4.49	-18.06	-4.49	18.61	256.05	0.23
2100.00	0.44	57.85	2099.85	-4.37	-17.97	-4.37	18.49	256.32	0.73
2200.00	0.75	75.41	2199.85	-4.00	-17.00	-4.00	17.47	256.76	0.36
2300.00	0.68	66.22	2299.84	-3.60	-15.82	-3.60	16.23	257.19	0.14
2400.00	0.89	64.46	2399.83	-3.02	-14.58	-3.02	14.89	258.29	0.21
2500.00	0.42	79.05	2499.82	-2.62	-13.52	-2.62	13.77	259.04	0.49
2600.00	0.37	79.85	2599.82	-2.49	-12.84	-2.49	13.07	259.02	0.05
2700.00	0.24	31.23	2699.82	-2.25	-12.40	-2.25	12.61	259.71	0.28
2800.00	0.04	119.98	2799.82	-2.09	-12.26	-2.09	12.44	260.34	0.24
2900.00	0.09	129.19	2899.82	-2.16	-12.17	-2.16	12.36	259.95	0.06
3000.00	0.28	260.61	2999.82	-2.25	-12.34	-2.25	12.55	259.67	0.35
3100.00	0.45	294.14	3099.82	-2.13	-12.94	-2.13	13.12	260.66	0.27
3200.00	0.50	270.91	3199.81	-1.96	-13.74	-1.96	13.88	261.88	0.20
3300.00	1.00	272.30	3299.81	-1.92	-15.05	-1.92	15.17	262.74	0.50
3400.00	1.05	262.66	3399.79	-2.00	-16.83	-2.00	16.95	263.23	0.18
3500.00	0.65	239.34	3499.78	-2.41	-18.23	-2.41	18.39	262.48	0.52
3600.00	0.66	243.20	3599.77	-2.95	-19.23	-2.95	19.45	261.27	0.05
3700.00	0.77	196.64	3699.77	-3.86	-19.93	-3.86	20.30	259.05	0.57
3800.00	0.49	138.21	3799.76	-4.82	-19.84	-4.82	20.42	256.34	0.66
3900.00	0.30	131.06	3899.76	-5.31	-19.36	-5.31	20.07	254.65	0.19
4000.00	0.76	140.13	3999.75	-5.99	-18.73	-5.99	19.67	252.25	0.46
4100.00	0.55	116.79	4099.75	-6.72	-17.88	-6.72	19.10	249.40	0.33
4200.00	0.72	137.54	4199.74	-7.41	-17.02	-7.41	18.56	246.49	0.29
4300.00	0.65	130.54	4299.73	-8.24	-16.16	-8.24	18.14	242.98	0.11
4400.00	0.49	153.41	4399.73	-9.00	-15.54	-9.00	17.95	239.93	0.27
4500.00	0.78	171.81	4499.72	-10.05	-15.25	-10.05	18.26	236.60	0.35
4600.00	0.75	175.04	4599.71	-11.38	-15.10	-11.38	18.90	232.99	0.05
4700.00	0.55	172.13	4699.71	-12.50	-14.97	-12.50	19.51	230.14	0.21
4800.00	0.67	188.85	4799.70	-13.55	-15.00	-13.55	20.21	227.90	0.21
4900.00	0.79	211.19	4899.69	-14.72	-15.44	-14.72	21.33	226.38	0.30
5000.00	0.98	224.94	4999.68	-15.91	-16.40	-15.91	22.85	225.87	0.28
5100.00	1.20	232.38	5099.66	-17.15	-17.83	-17.15	24.74	226.12	0.26
5200.00	1.46	247.11	5199.64	-18.28	-19.83	-18.28	26.97	227.33	0.43
5300.00	1.71	250.89	5299.60	-19.26	-22.41	-19.26	29.55	229.32	0.27
5400.00	1.72	254.04	5399.55	-20.16	-25.26	-20.16	32.32	231.40	0.10
5500.00	1.91	257.34	5499.50	-20.94	-28.33	-20.94	35.23	233.53	0.21

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
5600.00	1.81	248.69	5599.45	-21.88	-31.43	-21.88	38.30	235.15	0.30
5700.00	2.10	246.65	5699.39	-23.18	-34.58	-23.18	41.64	236.17	0.30
5800.00	2.01	254.18	5799.33	-24.39	-37.95	-24.39	45.11	237.28	0.28
5900.00	2.38	244.89	5899.26	-25.75	-41.52	-25.75	48.86	238.20	0.51
6000.00	2.22	228.89	5999.18	-27.90	-44.86	-27.90	52.83	238.12	0.66
6100.00	2.07	224.91	6099.11	-30.45	-47.60	-30.45	56.51	237.39	0.21
6200.00	0.83	215.18	6199.07	-32.33	-49.29	-32.33	58.94	236.74	1.26
6300.00	0.76	202.81	6299.06	-33.53	-49.96	-33.53	60.17	236.14	0.19
6400.00	0.60	171.46	6399.06	-34.66	-50.14	-34.66	60.95	235.35	0.40
6500.00	1.06	138.70	6499.05	-35.87	-49.45	-35.87	61.09	234.05	0.64
6600.00	0.93	149.76	6599.03	-37.26	-48.44	-37.26	61.11	232.43	0.23
6700.00	1.22	172.80	6699.01	-39.02	-47.90	-39.02	61.78	230.84	0.52
6800.00	0.93	177.66	6799.00	-40.88	-47.73	-40.88	62.85	229.42	0.31
6900.00	2.41	186.85	6898.95	-43.78	-47.95	-43.78	64.93	227.61	1.50
7000.00	4.52	188.48	6998.76	-49.76	-48.78	-49.76	68.69	224.43	2.12
7100.00	3.26	184.29	7098.53	-56.51	-49.58	-56.51	75.17	221.26	1.29
7200.00	2.47	158.98	7198.41	-61.36	-49.02	-61.36	78.53	218.62	1.48
7300.00	2.19	163.71	7298.32	-65.20	-47.71	-65.20	80.79	216.19	0.34
7400.00	1.58	181.45	7398.27	-68.42	-47.21	-68.42	83.12	214.60	0.84
7500.00	1.47	190.37	7498.24	-71.06	-47.47	-71.06	85.46	213.75	0.26
7600.00	1.20	215.09	7598.21	-73.17	-48.30	-73.17	87.68	213.43	0.63
7700.00	1.55	220.63	7698.18	-75.05	-49.78	-75.05	90.06	213.56	0.37
7800.00	1.44	243.06	7798.15	-76.65	-51.78	-76.65	92.50	214.04	0.59
7900.00	1.92	240.58	7898.10	-78.04	-54.37	-78.04	95.11	214.86	0.49
8000.00	1.58	236.99	7998.06	-79.62	-56.98	-79.62	97.91	215.59	0.37
8100.00	1.40	220.50	8098.02	-81.30	-58.93	-81.30	100.41	215.94	0.46
8200.00	1.55	215.49	8197.99	-83.33	-60.51	-83.33	102.98	215.99	0.19
8292.00	2.05	219.31	8289.94	-85.61	-62.27	-85.61	105.86	216.03	0.56



VES SURVEY INTERNATIONAL  
MIDLAND, TEXAS  
432-563-5444  
Surveyor: JAMES NEIL BATES  
Caverns Federal Com No. 004H / API 30-015-43291



VES SURVEY DATE: 4/2/2017



I James Neil Bates certify that I am employed by VES Survey International. That I did on the day(s) of 04/02/17 through 04/02/17 conduct or supervise the taking of a Rate Gyro survey from a depth of 0.00 feet to a depth of 8,292.00 feet; that the data is true, correct, complete and within the limitations of the tool as set forth by Vaughn Energy Services, that I am authorized and qualified to make this report; that this survey was conducted at the request of COG Operating for the Caverns FED COM Well # #4H API # 30-015-43291 in Eddy County / Parish New Mexico; and that I have reviewed this report and find that it conforms to the principles and procedures as set forth by VES Survey International.

A handwritten signature in black ink, appearing to read "James Neil Bates". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

James Neil Bates  
Service Technician  
VES Survey International