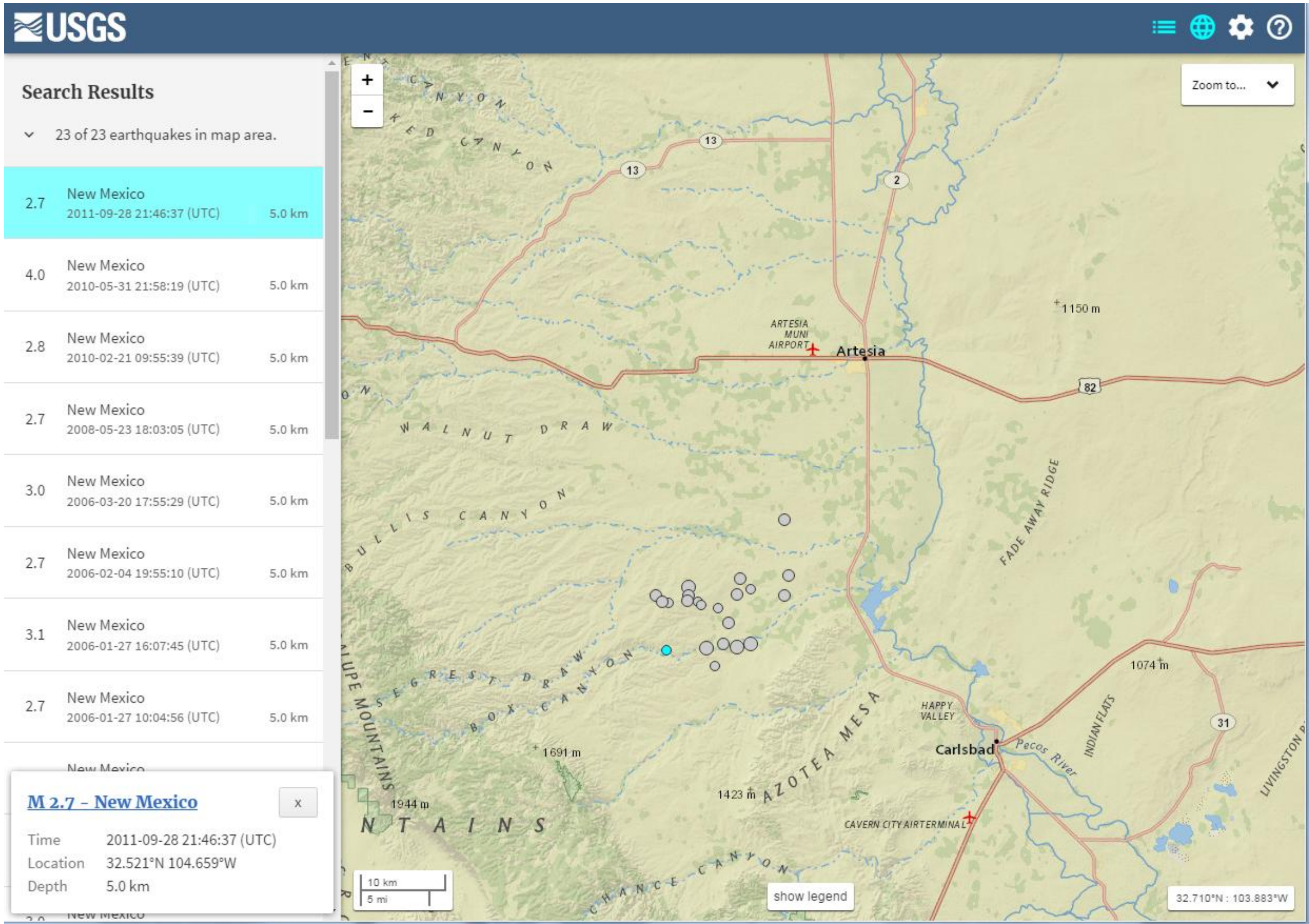
UIC - I - 8-1, 2 & 3

WDWs-1, 2 & 3 PERMITS, RENEWALS, & MODS (16 of 18)

2017



Blue highlight indicates most recent seismic event.

Source: USGS, 2017. *Earthquake Catalog.*
https://earthquake.usgs.gov/earthquakes/search

WSP | PARSONS BRINCKERHOFF

Appendix C

SEISMIC ACTIVITY NEAR ARTESIA

DATED: 1/16/2017	APPROVED BY:	JOB NO. 50904D
DRAWN BY: GEM	CHECKED BY:	SCALE: N/A

Appendix C
Seismic Activity
1999 - 2011

time	latitude	longitude	depth	mag	magType	nst	gap	rms	net	id	updated	place	type	magNst	status	locationSource	magSource
2011-09-28T21:46:37.550Z	32.521	-104.659	5	2.7	mblg	8	102.1	0.83	us	usp000j8pv	2014-11-07T01:45:57.965Z	New Mexico	earthquake		reviewed	us	us
2010-05-31T21:58:19.170Z	32.524	-104.607	5	4	ml	16	83.8	1.09	us	usp000hdec	2014-11-07T01:41:34.416Z	New Mexico	earthquake		reviewed	us	us
2010-02-21T09:55:39.770Z	32.571	-104.613	5	2.8	mblg	21	51.7	1.07	us	usp000h7hr	2014-11-07T01:40:44.022Z	New Mexico	earthquake		reviewed	us	us
2008-05-23T18:03:05.860Z	32.504	-104.596	5	2.7	mblg	11	90.5	0.98	us	usp000g7k8	2014-11-07T01:36:04.867Z	New Mexico	earthquake		reviewed	us	us
2006-03-20T17:55:29.120Z	32.6	-104.563	5	3	ml	7	98	0.75	us	usp000ecjj	2014-11-07T01:28:33.765Z	New Mexico	earthquake		reviewed	us	us
2006-02-04T19:55:10.680Z	32.575	-104.617	5	2.7	ml	9	148.1	1.13	us	usp000e9fv	2014-11-07T01:28:16.284Z	New Mexico	earthquake		reviewed	us	us
2006-01-27T16:07:45.840Z	32.551	-104.577	5	3.1	mblg	9	148.3	0.91	us	usp000e8yn	2014-11-07T01:28:10.026Z	New Mexico	earthquake		reviewed	us	us
2006-01-27T10:04:56.450Z	32.589	-104.549	5	2.7	mblg	8	127.9	1.44	us	usp000e8ya	2014-11-07T01:28:10.009Z	New Mexico	earthquake		reviewed	us	us
2005-12-22T14:30:11.670Z	32.583	-104.566	5	3.6	mblg	15	52	0.98	us	usp000e6mh	2014-11-07T01:27:55.770Z	New Mexico	earthquake		reviewed	us	us
2005-12-19T20:27:40.370Z	32.528	-104.549	5	4.1	mwr	45	54.4	0.85	us	usp000e6f9	2015-03-24T01:48:26.590Z	New Mexico	earthquake		reviewed	us	slm
2004-10-28T02:59:04.820Z	32.604	-104.499	5	3	mblg	11	140.2	0.52	us	usp000d77p	2014-11-07T01:23:49.973Z	New Mexico	earthquake		reviewed	us	us
2004-08-26T18:45:18.620Z	32.582	-104.505	5	3.4	ml	11	131.8	0.67	us	usp000d2x7	2014-11-07T01:23:16.071Z	New Mexico	earthquake		reviewed	us	us
2004-06-22T08:55:28.230Z	32.528	-104.584	5	3.7	mblg	12	82.5	0.65	us	usp000cygp	2014-11-07T01:22:40.419Z	New Mexico	earthquake		reviewed	us	us
2004-05-23T09:22:05.280Z	32.525	-104.566	5	4	mb	19	68.2	0.74	us	usp000cvz7	2015-03-24T01:59:38.918Z	New Mexico	earthquake	2	reviewed	us	us
2003-06-21T02:03:09.560Z	32.665	-104.505	5	3.6	mblg	15	130.9	0.94	us	usp000c0e4	2014-11-07T01:18:58.170Z	New Mexico	earthquake		reviewed	us	us
2002-09-17T23:34:19.350Z	32.576	-104.631	10	3.1	md	17			us	usp000bchy	2014-11-07T01:16:32.406Z	New Mexico	earthquake		reviewed	snm	snm
2002-09-17T15:45:14.470Z	32.581	-104.63	10	3.4	md	23			us	usp000bcgs	2014-11-07T01:16:32.321Z	New Mexico	earthquake		reviewed	snm	snm
2000-02-02T07:14:20.260Z	32.582	-104.629	5	2.7	mblg			0.88	us	usp0009myc	2014-11-07T01:09:25.504Z	New Mexico	earthquake		reviewed	us	us
1999-08-09T06:51:22.970Z	32.568	-104.591	5	2.9	md			0.64	us	usp0009ctq	2014-11-07T01:08:15.290Z	New Mexico	earthquake		reviewed	us	snm
1999-05-30T19:04:25.600Z	32.575	-104.664	10	3.9	md				us	usp000991w	2014-11-07T01:07:44.921Z	New Mexico	earthquake		reviewed	snm	snm
1999-03-17T12:29:23.110Z	32.582	-104.672	1	3.5	md				us	usp00094ny	2014-11-07T01:07:14.229Z	New Mexico	earthquake		reviewed	snm	snm
1999-03-14T22:43:17.970Z	32.591	-104.63	1	4	md				us	usp00094hc	2014-11-07T01:07:13.801Z	New Mexico	earthquake		reviewed	snm	snm
1999-03-01T08:00:23.500Z	32.573	-104.656	1	2.7	md				us	usp00093nw	2014-11-07T01:07:07.639Z	New Mexico	earthquake		reviewed	snm	snm

NEIC: Earthquake Search Results

U. S. GEOLOGICAL SURVEY

EARTHQUAKE DATA BASE

FILE CREATED: Mon Jun 4 16:13:25 2012
Circle Search Earthquakes= 225
Circle Center Point Latitude: 32.772N Longitude: 104.233W
Radius: 321.860 km
Catalog Used: PDE
Data Selection: Historical & Preliminary Data

CAT	YEAR	MO	DA	ORIG TIME	LAT	LONG	DEP	MAGNITUDE	IEM NFO TF	DTSVNWG	DIST km
PDE	1973	09	22	233835.80	34.47	-106.95	5	3.1 MLGS	...	....	314
PDE	1974	11	28	033520.50	32.31	-104.14	5	3.7 MLGS	...	....	51
PDE	1975	08	01	072757.30	31.42	-104.01	5	3.0 LgTUL	.F.	....	150
PDE	1976	01	19	040330.50	31.90	-103.08	1	3.5 MDGS	.F.	....	145
PDE	1976	01	22	072157	31.90	-103.07	1	2.8 MDGS	...	....	145
PDE	1976	01	25	044827.90	31.90	-103.08	2	3.9 MDGS	5F.	....	145
PDE	1977	01	04	183137.60	32.36	-106.92	5	3.2 MLGS	5F.	....	256
PDE	1977	04	26	090307.30	31.90	-103.08	4	3.3 MLGS	.F.	....	144
PDE	1977	11	28	014050.50	32.95	-100.84	5	3.5 MLGS	...	....	318
PDE	1978	03	02	100452.70	31.56	-102.51	11	3.5 MLGS	.F.	....	210
PDE	1979	07	05	010501	32.95	-100.89	4	2.7 UKTUL	.H.	....	312
PDE	1980	03	22	004912.50	34.60	-105.92	5	3.4 MLGS	4F.	....	255
PDE	1981	05	09	123550.80	33.99	-107.03	5	3.1 MLGS	5F.	....	293
PDE	1982	01	04	165608.05	31.18	-102.49	5	3.9 LgTUL	3F.	....	240
PDE	1982	03	16	110302.67	35.36	-103.27	5	3.1 LgTUL	3F.	....	300
PDE	1982	04	26	083147.79	33.02	-100.84	5	2.8 LgGS	...	....	318
PDE	1982	05	18	060008.50	34.17	-106.95	9	2.8 MLGS	.F.	....	296
PDE	1982	05	18	060838.40	34.20	-106.90	6	2.8 MLGS	.F.	....	293
PDE	1982	05	24	063251.70	34.17	-106.95	6	2.9 MLGS	.F.	....	295
PDE	1982	09	20	035517.20	33.95	-107.06	11	3.5 LgTUL	4F.	....	293
PDE	1982	10	07	124125.99	34.31	-106.82	4	2.4 MLGS	.F.	....	294
PDE	1982	11	28	023648.51	33.00	-100.84	5	3.3 LgTUL	4F.	....	318
PDE	1983	03	02	232219.40	34.30	-106.89	8	4.3 LgTUL	6D.	....	299
PDE	1983	04	30	073420.18	33.32	-106.44	7	3.5 MLGS	...	....	214
PDE	1983	09	15	232536.05	35.14	-104.39	5	3.2 LgTUL	5F.	....	263
PDE	1983	09	29	074408.43	35.24	-104.30	5	2.7 MDGS	...	....	274
PDE	1984	05	21	133113.54	35.07	-102.23	5	3.1 LgTUL	...	....	314
PDE	1984	08	26	021954	34.31	-106.80	5	2.9 MLGS	.F.	....	292
PDE	1984	12	04	203636.02	32.26	-103.56	5	2.9 MLGS	...	....	84
PDE	1985	06	05	103600.60	32.56	-106.92	6	2.9 MLGLD	4F.	....	252
PDE	1985	06	27	182000.03	33.62	-106.47	0	3.4 LgGS	...	....E..	229
PDE	1985	08	16	145652.96	34.13	-106.83	7	4.1 MLGS	6D.	....	284

PDE	1985	09	06	052246.20	32.54	-106.94	5	2.6	MDGLD	.F.	....	255
PDE	1985	12	15	071452.23	35.28	-104.64	5	3.6	LgTUL	.F.	....	280
PDE	1986	04	17	210430.30	32.59	-106.91	5	2.7	MDGLD	.F.	....	251
PDE	1986	04	28	130016	34.01	-106.82	5	2.6	MDGLD	.F.	....	276
PDE	1986	08	27	180656.38	35.16	-105.09	5	3.2	MLGS	.F.	....	276
PDE	1987	05	14	155958.46	33.54	-106.52	0	2.9	MLGS	...	....E..	229
PDE	1988	12	25	075233.93	35.12	-105.96	0	2.8	MDSNM	.F.	....	304
PDE	1989	01	29	050715.33	35.22	-104.09	7	3.4	MDSNM	...	....	271
PDE	1989	11	29	065438.50	34.46	-106.89	13	4.7	MDSNM	5F.	....	309
PDE	1990	01	29	131610.68	34.46	-106.88	12	4.8	LgTUL	6D.	....	308
PDE	1990	01	31	010819.29	34.44	-106.86	10	4.0	LgTUL	5F.	....	306
PDE	1990	02	21	120219.34	34.01	-106.54	5	3.6	MLGS	.F.	....	255
PDE	1990	02	27	132322	33.95	-106.59	5	3.9	MDSNM	4F.	....	255
PDE	1990	05	05	162622.89	34.45	-106.88	6	3.6	MDSNM	.F.	....	307
PDE	1990	07	21	192822.79	34.46	-106.86	11	3.0	MDSNM	...	....	306
PDE	1990	07	21	203031.34	34.46	-106.86	7	3.1	MDSNM	...	....	306
PDE	1990	07	21	234804.92	34.45	-106.85	7	3.2	MDSNM	...	....	306
PDE	1990	07	22	212705.13	34.84	-106.01	10	3.7	MDSNM	...	....	281
PDE	1990	07	31	073240.18	34.46	-106.86	7	3.3	MDSNM	.F.	....	307
PDE	1990	11	08	104653.77	34.45	-106.86	6	4.3	MDSNM	4F.	....	306
PDE	1990	11	08	110346.51	34.45	-106.86	8	3.1	MDSNM	.F.	....	306
PDE	1990	11	10	121816.85	34.45	-106.85	7	3.1	MDSNM	...	....	305
PDE	1990	11	15	072524.38	34.46	-106.86	6	3.6	MDSNM	4F.	....	306
PDE	1990	12	05	033644.30	34.45	-106.86	8	2.6	MDSNM	...	....	306
PDE	1991	03	05	201711.40	34.44	-106.87	9	2.9	MDSNM	3F.	....	306
PDE	1991	03	06	143659.07	34.44	-106.88	7	2.5	MDSNM	...	....	307
PDE	1991	06	05	184414.90	34.45	-106.85	4	3.0	MDSNM	.F.	....	305
PDE	1991	06	20	1605	33.62	-106.47	0	3.5	MLGS	...	....E..	229
PDE	1991	12	09	124716.50	34.85	-106.55	14	3.1	LgTUL	3F.	....	314
PDE	1992	01	02	114535.61	32.33	-103.10	5	5.0	LgTUL	5F.	....	116
PDE	1992	02	23	161752.51	30.65	-105.51	5	3.4	LgTUL	...	....	264
PDE	1992	08	24	012535.20	34.01	-106.86	5	2.6	MDSNM	.F.	....	280
PDE	1992	08	26	032452.67	32.17	-102.71	5	3.0	LgGS	...	....	157
PDE	1993	03	24	023203.50	35.39	-104.19	5	3.0	LgGS	2F.	....	290
PDE	1993	06	10	1510	33.62	-106.47	0	3.2	MLGS	...	....E..	229
PDE	1993	06	23	032312.28	31.35	-102.51	5	2.8	MDSNM	...	....	226
PDE	1993	12	22	192511.39	33.33	-105.68	10	3.2	MDSNM	...	....	148
PDE	1994	01	01	025131.29	34.44	-106.98	10	2.5	MDSNM	...	....	314
PDE	1995	03	19	183643.97	35.00	-104.21	5	3.3	LgGS	...	....	246
PDE	1995	04	14	003256.17	30.28	-103.35	17	5.7	MwGS	6CM	....	287
PDE	1995	04	14	011148.40	30.30	-103.35	10	2.7	LgGS	...	....	286
PDE	1995	04	14	021426	30.30	-103.35	10	2.8	LgGS	...	....	286
PDE	1995	04	14	021938.50	30.30	-103.35	10	3.3	LgGS	.F.	....	286
PDE	1995	04	14	034842	30.30	-103.35	10	2.6	LgGS	.F.	....	286
PDE	1995	04	14	041116	30.30	-103.35	10	2.4	LgGS	.F.	....	286
PDE	1995	04	14	055339	30.30	-103.35	10	2.7	LgGS	...	....	286
PDE	1995	04	14	073936.50	30.30	-103.35	10	2.4	LgGS	.F.	....	286
PDE	1995	04	14	082712.50	30.30	-103.35	10	2.8	LgGS	.F.	....	286
PDE	1995	04	14	100258	30.30	-103.35	10	2.9	LgGS	.F.	....	286
PDE	1995	04	14	105720.40	30.30	-103.35	10	2.3	LgGS	.F.	....	286
PDE	1995	04	15	031805	30.30	-103.35	10	2.4	LgGS	.F.	....	286
PDE	1995	04	15	143329.51	30.27	-103.32	10	4.0	LgGS	6D.	....	290
PDE	1995	04	16	004043.30	30.30	-103.35	10	2.3	LgGS	...	....	286
PDE	1995	04	16	102625.50	30.30	-103.35	10	2.5	LgGS	...	....	286
PDE	1995	04	16	161609.60	30.30	-103.35	10	2.4	LgGS	...	....	286
PDE	1995	04	17	085000.50	30.30	-103.35	10	2.5	LgGS	...	....	286
PDE	1995	04	21	044144	30.30	-103.35	10	2.9	LgGS	3F.	....	286
PDE	1995	06	01	010615.70	30.30	-103.35	10	3.5	LgGS	4F.	....	286
PDE	1995	07	06	024151	30.30	-103.35	10	2.7	LgGS	.F.	....	286
PDE	1995	07	06	024704	30.30	-103.35	10	2.6	LgGS	.F.	....	286

PDE	1995	08	28	151339.05	34.21	-106.94	3	2.8	LgGS	5F.	....	297
PDE	1995	11	12	174559.40	30.30	-103.35	10	3.6	LgGS	.F.	....	286
PDE	1996	03	15	131757.22	33.59	-105.69	10	2.9	LgGS	.F.	....	163
PDE	1996	03	24	201612.70	34.26	-105.68	10	3.5	LgGS	.F.	....	212
PDE	1996	03	24	201923.10	34.27	-105.69	10	3.7	LgGS	.F.	....	214
PDE	1996	07	22	100614.98	34.20	-105.71	10	3.5	LgGS	.F.	....	209
PDE	1997	05	20	094105.82	34.19	-105.74	10	3.2	LgGS	.F.	....	210
PDE	1997	12	31	132830.05	34.53	-106.15	5	3.5	MLGS	.F.	....	264
PDE	1997	12	31	133206.60	34.55	-106.15	5	3.5	MLGS	...	....	265
PDE	1997	12	31	133358.90	34.55	-106.15	5	3.4	MLGS	...	....	265
PDE	1998	01	04	080531.87	34.55	-106.19	5	4.0	MLGS	.F.	....	268
PDE	1998	04	15	103342.42	30.19	-103.30	10	3.6	LgGS	.F.	....	299
PDE	1998	07	14	053848.75	35.34	-103.47	5	3.0	MDSNM	.F.	....	293
PDE	1999	03	01	080023.50	32.57	-104.66	1	2.9	LgGS	...	....	45
PDE	1999	03	14	224317.97	32.59	-104.63	1	4.0	MDSNM	.F.	....	42
PDE	1999	03	17	122923.11	32.58	-104.67	1	3.5	MDSNM	...	....	46
PDE	1999	05	30	190425.60	32.58	-104.66	10	3.9	MDSNM	...	....	45
PDE	1999	08	09	065122.97	32.57	-104.59	5	2.9	MDSNM	...	....	40
PDE	2000	02	02	071420.26	32.58	-104.63	5	2.7	LgGS	...	....	42
PDE	2000	02	26	030100.83	30.24	-103.61	5	2.8	LgGS	.F.	....	286
PDE	2001	06	02	015553.72	32.33	-103.14	5	3.3	LgGS	...	....	113
PDE	2001	11	22	000708.02	31.79	-102.63	5	3.1	LgGS	...	....	186
PDE	2002	09	17	154514.47	32.58	-104.63	10	3.5	LgGS	...	....	42
PDE	2002	09	17	233419.35	32.58	-104.63	10	3.3	LgGS	...	....	43
PDE	2003	06	21	020309.56	32.67	-104.50	5	3.6	LgGS	...	....	28
PDE	2004	05	23	092205.28	32.53	-104.57	5	4.0	mbGS	3F.	....	41
PDE	2004	05	24	213628.56	34.47	-106.90	5	3.5	MLGS	.F.	....	310
PDE	2004	06	22	085528.23	32.53	-104.58	5	3.7	LgGS	.F.	....	42
PDE	2004	08	26	184518.62	32.58	-104.50	5	3.4	MLGS	...	....	33
PDE	2004	10	28	025904.82	32.60	-104.50	5	3.0	LgGS	...	....	31
PDE	2004	11	14	212749.90	33.25	-106.20	5	3.5	LgGS	...	....	191
PDE	2005	10	30	025734.81	34.07	-106.98	5	2.4	MLGS	.F.	....	292
PDE	2005	12	19	202740.37	32.53	-104.55	5	4.1	MwSLM	3FM	....	40
PDE	2005	12	22	143011.67	32.58	-104.57	5	3.6	LgGS	.F.	....	37
PDE	2006	01	27	100456.45	32.59	-104.55	5	2.7	LgGS	...	....	35
PDE	2006	01	27	160745.84	32.55	-104.58	5	3.1	LgGS	...	....	40
PDE	2006	02	04	195510.68	32.58	-104.62	5	2.7	MLGS	...	....	42
PDE	2006	03	04	171458.25	30.29	-103.67	5	2.7	LgGS	...	....	280
PDE	2006	03	20	175529.12	32.60	-104.56	5	3.0	MLGS	...	....	36
PDE	2006	04	08	180835.23	31.95	-101.42	5	2.9	MLGS	...	....	279
PDE	2006	08	12	104909.67	32.90	-100.89	5	2.8	LgGS	.F.	....	312
PDE	2007	05	23	051655.15	34.07	-106.94	5	3.4	MLGS	3F.	....	289
PDE	2008	01	29	102453.24	32.90	-100.84	5	3.3	LgGS	.F.	....	317
PDE	2008	02	18	1415	32.27	-101.42	0	2.1	LgGS	.C.	....E..	269
PDE	2008	04	16	090604.36	33.66	-106.06	5	2.7	MLGS	...	....	196
PDE	2008	05	23	180305.86	32.50	-104.60	5	2.7	LgGS	...	....	45
PDE	2008	07	18	173109.40	32.89	-100.84	5	2.7	LgGS	...	....	317
PDE	2008	12	28	205659.99	30.44	-103.36	5	2.6	MLGS	...	....	271
PDE	2009	01	30	014121.66	32.50	-104.61	5	2.7	LgGS	...	....	46
PDE	2009	06	05	171732.94	31.35	-105.98	0	2.4	MLEPT	.F.	....	227
PDE	2009	06	05	181023.63	31.35	-105.98	0	2.6	MLEPT	.F.	....	227
PDE	2009	08	20	015723.10	34.03	-106.87	5	2.7	MLGS	3F.	....	282
PDE	2009	08	30	003100.29	34.22	-106.89	5	2.5	MLGS	.F.	....	293
PDE	2009	08	30	063947.47	34.16	-106.86	5	2.6	MLGS	.F.	....	289
PDE	2009	08	30	070943.72	34.19	-106.88	5	2.1	MLGS	.F.	....	291
PDE	2009	11	17	185306.84	32.43	-104.64	5	3.0	LgGS	...	....	54
PDE	2010	01	27	045933.05	32.90	-100.83	5	3.1	LgGS	.F.	....	318
PDE	2010	02	21	095539.77	32.57	-104.61	5	2.8	LgGS	...	....	41
PDE	2010	03	28	000355.08	32.44	-104.50	4	4.1	MwRMT	3FM	....	44
PDE	2010	04	11	195632.67	32.41	-101.06	5	2.9	LgGS	...	....	300

PDE	2010	04	12	002005.97	32.94	-100.88	5	2.8	LgGS	...	....	314
PDE	2010	05	09	071807.37	34.04	-106.83	5	2.1	MLGS	.F.	....	279
PDE	2010	05	27	204721.87	31.11	-105.58	5	3.7	MLGS	...	....	223
PDE	2010	05	31	215819.17	32.52	-104.61	5	4.0	MLGS	...	....	44
PDE	2010	08	08	011238.07	32.90	-100.85	5	3.4	MwRMT	2FM	....	316
PDE	2010	08	25	020514.32	32.95	-100.86	5	2.8	LgGS	...	....	315
PDE	2010	08	29	124836.61	32.91	-100.92	5	2.6	LgGS	...	....	310
PDE-W	2010	10	09	074227.63	32.93	-100.89	5	3.1	LgGS	...	....	313
PDE-W	2010	10	26	065629.79	32.92	-100.85	5	3.1	LgGS	...	....	316
PDE-W	2010	11	01	091058.42	33.00	-100.82	5	2.8	LgGS	...	....	320
PDE-W	2011	01	11	043415.77	34.39	-106.99	5	2.7	MLGS	...	....	312
PDE-W	2011	02	17	182534.41	30.11	-103.30	5	3.3	LgGS	...	....	307
PDE-W	2011	03	01	033012.76	32.88	-100.84	5	3.1	LgGS	2F.	....	317
PDE-W	2011	03	01	063159.89	32.84	-100.80	5	2.5	LgGS	...	....	321
PDE-W	2011	03	12	152200.86	32.88	-100.90	5	3.0	LgGS	...	....	312
PDE-W	2011	03	14	001948.80	32.96	-100.81	5	3.0	LgGS	...	....	320
PDE-W	2011	03	28	091211.95	32.91	-100.82	5	3.0	LgGS	...	....	320
PDE-W	2011	04	06	233835.45	34.40	-107.02	5	3.2	MLGS	...	....	315
PDE-W	2011	04	25	165631.88	32.82	-100.84	5	2.5	LgGS	...	....	317
PDE-W	2011	04	28	010341.97	30.74	-105.71	6	4.4	mbGS	.F.	....	264
PDE-W	2011	04	28	035625.61	30.74	-105.78	10	4.0	mbGS	...	....	268
PDE-W	2011	04	28	045834.59	30.68	-105.75	9	3.6	MwRMT	.FM	....	272
PDE-W	2011	04	28	074903.45	30.82	-105.80	5	3.1	LgGS	...	....	262
PDE-W	2011	04	28	075418.94	30.58	-105.85	5	2.7	LgGS	...	....	286
PDE-W	2011	04	30	010716.82	30.76	-105.75	10	4.6	MDUNM	...	....	265
PDE-W	2011	05	02	114328.24	30.73	-105.72	10	4.2	MwRMT	2FM	....	266
PDE-W	2011	05	02	115836.35	30.74	-105.70	10	3.3	MLGS	...	....	264
PDE-W	2011	05	02	134032.64	30.69	-105.75	10	3.3	MLGS	...	....	271
PDE-W	2011	05	02	135536.79	30.73	-105.67	5	4.4	mbGS	2F.	....	264
PDE-W	2011	05	03	025830.18	30.67	-105.73	10	3.8	MwRMT	.FM	....	273
PDE-W	2011	05	03	114203.84	30.49	-105.68	10	2.8	MLGS	...	....	287
PDE-W	2011	05	04	162627.03	30.71	-105.79	10	3.7	MwRMT	..M	....	271
PDE-W	2011	05	05	052010.02	30.79	-105.76	10	3.6	MLGS	...	....	262
PDE-W	2011	05	06	002426.09	30.75	-105.73	10	2.8	MLGS	...	....	264
PDE-W	2011	05	06	004559.26	30.81	-105.71	10	2.8	MLGS	...	....	258
PDE-W	2011	05	07	045100.88	30.64	-105.73	10	4.1	MDUNM	2F.	....	275
PDE-W	2011	05	08	132449.65	30.75	-105.81	10	3.1	MLGS	...	....	269
PDE-W	2011	05	08	134616.49	30.72	-105.76	10	3.2	MLGS	...	....	269
PDE-W	2011	05	08	135758.52	30.71	-105.75	10	2.9	MLGS	...	....	269
PDE-W	2011	05	08	190732.13	30.81	-105.31	10	3.0	MLGS	...	....	239
PDE-W	2011	05	08	225459.93	30.74	-105.74	10	3.3	MLGS	...	....	266
PDE-W	2011	05	09	064019.15	30.76	-105.69	10	3.9	MDUNM	.F.	....	261
PDE-W	2011	05	10	184118.44	30.72	-105.72	10	3.4	MLGS	...	....	267
PDE-W	2011	05	13	124916.26	30.76	-105.45	10	2.6	MLGS	...	....	250
PDE-W	2011	05	14	220751.11	30.82	-105.74	10	3.9	MDUNM	.F.	....	259
PDE-W	2011	05	17	200820	30.75	-105.74	10	4.2	MDUNM	...	....	265
PDE-W	2011	05	19	103523.51	30.80	-105.69	10	3.4	MwRMT	..M	....	258
PDE-W	2011	05	19	115649.90	30.72	-105.59	10	2.9	MLGS	...	....	260
PDE-W	2011	05	20	231419.06	30.20	-105.55	10	2.7	MLGS	...	....	310
PDE-W	2011	05	25	100301.09	30.70	-105.63	10	2.8	MLGS	...	....	264
PDE-W	2011	05	27	014128.20	30.80	-105.76	10	3.6	MLGS	...	....	261
PDE-W	2011	05	27	014908.92	30.98	-105.78	10	3.0	MLGS	...	....	246
PDE-W	2011	07	14	102913.60	32.93	-100.81	5	2.5	LgGS	...	....	321
PDE-W	2011	09	11	183635.11	32.74	-100.84	5	2.5	LgGS	3F.	....	318
PDE-W	2011	09	11	203158.11	32.89	-100.85	5	2.8	LgGS	2F.	....	316
PDE-W	2011	09	12	003149.11	32.80	-100.88	5	2.7	LgGS	2F.	....	314
PDE-W	2011	09	12	022931.34	32.73	-100.85	5	2.5	LgGS	.H.	....	317
PDE-W	2011	09	12	091946.71	32.85	-100.85	5	2.6	LgGS	...	....	316
PDE-W	2011	09	12	092612.90	32.76	-100.84	5	2.7	LgGS	2F.	....	317
PDE-W	2011	09	12	141834.05	32.82	-100.87	7	3.4	LgGS	3F.	....	314

PDE-W	2011	09	28	214637.55	32.52	-104.66	5	2.7	LgGS	...	....	48
PDE-W	2011	11	24	064959.99	32.95	-100.81	5	2.8	LgGS	...	....	320
PDE-W	2011	11	24	231549.01	32.94	-100.85	5	3.1	LgGS	...	....	317
PDE-W	2011	12	09	184733.24	32.94	-100.86	5	3.5	LgGS	3F.	....	315
PDE-W	2011	12	17	144658.46	32.81	-100.85	5	3.2	LgGS	3F.	....	316
PDE-W	2011	12	29	061907.64	32.81	-100.91	5	2.5	LgGS	...	....	311
PDE-W	2011	12	29	114808.28	32.88	-100.83	5	2.5	LgGS	.F.	....	318
PDE-W	2012	01	15	092901.68	31.23	-103.61	5	2.7	LgGS	2F.	....	181
PDE-W	2012	01	24	182102.61	30.32	-103.38	5	3.6	LgGS	4F.	....	283
PDE-W	2012	02	06	040024.75	32.09	-104.91	5	2.7	LgGS	...	....	98
PDE-W	2012	03	06	031149.71	31.81	-106.31	5	2.5	MLGS	3F.	....	223
PDE-W	2012	03	18	105722.43	32.28	-103.89	5	3.1	LgGS	...	....	63
PDE-Q	2012	04	05	091115.95	31.57	-106.09	5	2.9	MLGS	.F.	....	219

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APPENDIX D

INJECTION FLUID ANALYTICAL DATA

29-Mar-2013

Aaron Strange
Navajo Refining Company
PO Box 159
Artesia, NM 88211

Tel: (575) 748-6733
Fax: (575) 746-5421

Re: Injection Well Quarterly | Work Order: **1303855**

Dear Aaron,

ALS Environmental received 2 samples on 22-Mar-2013 09:30 AM for the analyses presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

The total number of pages in this report is 40.

If you have any questions regarding this report, please feel free to call me.

Sincerely,

Electronically approved by: Jumoke M. Lawal

Sonia West
Project Manager

Certificate No: T104704231-12-10

ALS Environmental

Date: 29-Mar-13

Client: Navajo Refining Company
Project: Injection Well Quarterly
Work Order: **1303855**

Work Order Sample Summary

Lab Samp ID	Client Sample ID	Matrix	Tag Number	Collection Date	Date Received	Hold
1303855-01	WW Effluent	Liquid		3/21/2013 14:55	3/22/2013 09:30	☐
1303855-02	Trip Blank - 021813-56	Water		3/21/2013	3/22/2013 09:30	☑

Client: Navajo Refining Company
Project: Injection Well Quarterly
Work Order: 1303855

Case Narrative

The result for pH is flagged with H indicating that the holding time was exceeded. Per 40CFR136, the holding time for pH is "immediate."

The analysis for specific gravity was performed at Texas Oil Tech located in Houston, Texas.

Batch 68699, Total Metals, Sample 1303846-05D: MS/MSD is for an unrelated sample.

Batch 68756, Semivolatile Organics 8270, Sample SLCSDW2-130327: Insufficient sample was received for MS/MSD.

Batch R144692, Volatile Organics 8260, Sample 1303880-02A: MS/MSD is for an unrelated sample.

ALS Environmental

Date: *29-Mar-13*

Client: Navajo Refining Company
Project: Injection Well Quarterly **Work Order:** 1303855
Sample ID: WW Effluent **Lab ID:** 1303855-01
Collection Date: 3/21/2013 02:55 PM **Matrix:** LIQUID

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Prep	Date Analyzed
MERCURY-SW7470A			**SW7470**				Analyst: **OFO**
Mercury	ND		0.000200	mg/L	1	3/27/2013	3/27/2013 01:13 PM
METALS			**SW6020**				Analyst: **ALR**
Aluminum	**1.34**		**0.0200**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Arsenic	**0.0404**	*	**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Barium	**0.0860**		**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Beryllium	ND		0.00400	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Boron	**0.722**		**0.100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Cadmium	ND		0.00400	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Calcium	**110**		**1.00**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Chromium	ND		0.0100	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Cobalt	ND		0.0100	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Copper	ND		0.0100	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Iron	**0.793**		**0.400**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Lead	ND		0.0100	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Magnesium	**37.2**		**0.400**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Manganese	**0.0832**		**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Molybdenum	**0.182**		**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Nickel	**0.0153**		**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Potassium	**107**		**0.400**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Selenium	**0.924**	*	**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Silver	ND		0.0100	mg/L	1	3/26/2013	3/27/2013 06:39 PM
Sodium	**1,400**		**4.00**	**mg/L**	10	3/26/2013	3/27/2013 07:09 PM
Vanadium	**0.0221**		**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
Zinc	**0.0737**		**0.0100**	**mg/L**	1	3/26/2013	3/27/2013 06:39 PM
SEMIVOLATILES - SW8270D			**SW8270**				Analyst: **JLJ**
1,2,4-Trichlorobenzene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2,4,5-Trichlorophenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2,4,6-Trichlorophenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2,4-Dinitrotoluene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2-Methylnaphthalene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2-Methylphenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2-Nitroaniline	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
2-Nitrophenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
3&4-Methylphenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
3-Nitroaniline	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
4-Nitroaniline	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
4-Nitrophenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Acenaphthene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Client: Navajo Refining Company
Project: Injection Well Quarterly **Work Order:** 1303855
Sample ID: WW Effluent **Lab ID:** 1303855-01
Collection Date: 3/21/2013 02:55 PM **Matrix:** LIQUID

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Prep	Date Analyzed
Acenaphthylene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Aniline	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Anthracene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Benz(a)anthracene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Benzidine	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Hexachlorobenzene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Hexachloroethane	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Indeno(1,2,3-cd)pyrene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Isophorone	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Naphthalene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Nitrobenzene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
N-Nitrosodimethylamine	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
N-Nitrosodi-n-propylamine	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
N-Nitrosodiphenylamine	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Pentachlorophenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Phenanthrene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Phenol	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Pyrene	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Pyridine	ND		0.0050	mg/L	1	3/27/2013	3/27/2013 07:55 PM
Surr: 2,4,6-Tribromophenol	*114*		*42-124*	*%REC*	1	3/27/2013	3/27/2013 07:55 PM
Surr: 2-Fluorobiphenyl	*73.5*		*48-120*	*%REC*	1	3/27/2013	3/27/2013 07:55 PM
Surr: 2-Fluorophenol	*69.2*		*20-120*	*%REC*	1	3/27/2013	3/27/2013 07:55 PM
Surr: 4-Terphenyl-d14	*87.7*		*51-135*	*%REC*	1	3/27/2013	3/27/2013 07:55 PM
Surr: Nitrobenzene-d5	*67.3*		*41-120*	*%REC*	1	3/27/2013	3/27/2013 07:55 PM
Surr: Phenol-d6	*75.7*		*20-120*	*%REC*	1	3/27/2013	3/27/2013 07:55 PM
VOLATILES - SW8260C			**SW8260**				Analyst: **PC**
1,1,1-Trichloroethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
1,1,2,2-Tetrachloroethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
1,1,2-Trichloroethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
1,1-Dichloroethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
1,1-Dichloroethene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
1,2-Dichloroethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
2-Butanone	ND		0.010	mg/L	1		3/27/2013 02:05 PM
2-Chloroethyl vinyl ether	ND		0.010	mg/L	1		3/27/2013 02:05 PM
2-Hexanone	ND		0.010	mg/L	1		3/27/2013 02:05 PM
4-Methyl-2-pentanone	ND		0.010	mg/L	1		3/27/2013 02:05 PM
Acetone	**0.016**		**0.010**	**mg/L**	1		3/27/2013 02:05 PM
Benzene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Bromodichloromethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Bromoform	ND		0.0050	mg/L	1		3/27/2013 02:05 PM

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Environmental

Date: *29-Mar-13*

Client: Navajo Refining Company
Project: Injection Well Quarterly **Work Order:** 1303855
Sample ID: WW Effluent **Lab ID:** 1303855-01
Collection Date: 3/21/2013 02:55 PM **Matrix:** LIQUID

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Prep	Date Analyzed
Bromomethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Carbon disulfide	ND		0.010	mg/L	1		3/27/2013 02:05 PM
Carbon tetrachloride	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Chlorobenzene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Chloroethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Chloroform	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Chloromethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
cis-1,3-Dichloropropene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Dibromochloromethane	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Ethylbenzene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
m,p-Xylene	ND		0.010	mg/L	1		3/27/2013 02:05 PM
Methylene chloride	ND		0.010	mg/L	1		3/27/2013 02:05 PM
Styrene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Tetrachloroethene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Toluene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
trans-1,3-Dichloropropene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Trichloroethene	ND		0.0050	mg/L	1		3/27/2013 02:05 PM
Vinyl acetate	ND		0.010	mg/L	1		3/27/2013 02:05 PM
Vinyl chloride	ND		0.0020	mg/L	1		3/27/2013 02:05 PM
Xylenes, Total	ND		0.015	mg/L	1		3/27/2013 02:05 PM
Surr: 1,2-Dichloroethane-d4	*104*		*70-125*	*%REC*	1		3/27/2013 02:05 PM
Surr: 4-Bromofluorobenzene	*98.1*		*72-125*	*%REC*	1		3/27/2013 02:05 PM
Surr: Dibromofluoromethane	*108*		*71-125*	*%REC*	1		3/27/2013 02:05 PM
Surr: Toluene-d8	*101*		*75-125*	*%REC*	1		3/27/2013 02:05 PM
REACTIVE CYANIDE			**SW-846**				Analyst: **HN**
Reactive Cyanide	*See Attached*		40.0	mg/Kg	1		3/28/2013 09:45 AM
REACTIVE SULFIDE			**SW-846**				Analyst: **HN**
Reactive Sulfide	*See Attached*		40.0	mg/Kg	1		3/28/2013 09:45 AM
MISCELLANEOUS ANALYSIS			**NA**				Analyst: **SUB**
Miscellaneous Analysis	**See Attached**				1		3/28/2013
ANIONS - EPA 300.0 (1993)			**E300**				Analyst: **JKP**
Bromide	**2.60**		**0.500**	**mg/L**	5		3/28/2013 05:02 PM
Chloride	**647**		**50.0**	**mg/L**	100		3/28/2013 05:23 PM
Fluoride	**22.8**		**0.500**	**mg/L**	5		3/28/2013 05:02 PM
Sulfate	**2,630**		**50.0**	**mg/L**	100		3/28/2013 05:23 PM
Surr: Selenate (surr)	*97.3*		*85-115*	*%REC*	100		3/28/2013 05:23 PM
Surr: Selenate (surr)	*111*		*85-115*	*%REC*	5		3/28/2013 05:02 PM
ALKALINITY-SM2320B			**SM2320B**				Analyst: **KL**

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Environmental

Date: *29-Mar-13*

Client: Navajo Refining Company
Project: Injection Well Quarterly **Work Order:** 1303855
Sample ID: WW Effluent **Lab ID:** 1303855-01
Collection Date: 3/21/2013 02:55 PM **Matrix:** LIQUID

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Prep	Date Analyzed
Alkalinity, Bicarbonate (As CaCO3	**366**		**6.00**	**mg/L**	1		3/26/2013 11:18 AM
Alkalinity, Carbonate (As CaCO3)	ND		6.00	mg/L	1		3/26/2013 11:18 AM
Alkalinity, Hydroxide (As CaCO3)	ND		6.00	mg/L	1		3/26/2013 11:18 AM
Alkalinity, Total (As CaCO3)	**366**		**6.00**	**mg/L**	1		3/26/2013 11:18 AM
SPECIFIC CONDUCTIVITY			**M2510 B**				Analyst: **KL**
Specific Conductivity	**8,110**		**1.00**	**µmhos/cm**	1		3/26/2013 02:07 PM
IGNITIBILITY			**SW1010**				Analyst: **KL**
Ignitability	*> 212*		50.0	°F	1		3/27/2013 12:00 PM
PH - SW9040C			**SW9040**				Analyst: **KL**
pH	**7.98**	H	**0.100**	**pH units**	1		3/26/2013 11:18 AM
TOTAL DISSOLVED SOLIDS			**M2540C**				Analyst: **KAH**
Total Dissolved Solids (Residue, Filterable)	**5,500**		**10.0**	**mg/L**	1		3/26/2013 06:05 PM

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Environmental

Date: 29-Mar-13

Client: Navajo Refining Company

Work Order: 1303855

Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68699** Instrument ID **ICP7500** Method: **SW6020**

MBLK Sample ID: **MBLKW2-032613-68699** Units: **mg/L** Analysis Date: **3/26/2013 09:30 PM**

Client ID: Run ID: **ICP7500_130326A** SeqNo: **3153091** Prep Date: **3/26/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	ND	0.010								
Arsenic	ND	0.0050								
Barium	ND	0.0050								
Beryllium	ND	0.0020								
Boron	ND	0.050								
Cadmium	ND	0.0020								
Calcium	ND	0.50								
Chromium	ND	0.0050								
Cobalt	ND	0.0050								
Copper	ND	0.0050								
Iron	ND	0.20								
Lead	ND	0.0050								
Magnesium	ND	0.20								
Manganese	ND	0.0050								
Molybdenum	ND	0.0050								
Nickel	ND	0.0050								
Potassium	ND	0.20								
Silver	ND	0.0050								
Sodium	ND	0.20								
Vanadium	ND	0.0050								
Zinc	ND	0.0050								

MBLK Sample ID: **MBLKW2-032613-68699** Units: **mg/L** Analysis Date: **3/27/2013 04:53 PM**

Client ID: Run ID: **ICP7500_130327A** SeqNo: **3154491** Prep Date: **3/26/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Selenium	ND	0.0050								

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68699** Instrument ID **ICP7500** Method: **SW6020**

LCS Sample ID: **MLCSW2-032613-68699** Units: **mg/L** Analysis Date: **3/26/2013 09:35 PM**

Client ID: Run ID: **ICP7500_130326A** SeqNo: **3153092** Prep Date: **3/26/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.1068	0.010	0.1	0	107	80-120	0			
Arsenic	0.046	0.0050	0.05	0	92	80-120	0			
Barium	0.05079	0.0050	0.05	0	102	80-120	0			
Beryllium	0.05012	0.0020	0.05	0	100	80-120	0			
Boron	0.501	0.050	0.5	0	100	80-120	0			
Cadmium	0.05025	0.0020	0.05	0	100	80-120	0			
Calcium	4.655	0.50	5	0	93.1	80-120	0			
Chromium	0.04537	0.0050	0.05	0	90.7	80-120	0			
Cobalt	0.04537	0.0050	0.05	0	90.7	80-120	0			
Copper	0.04618	0.0050	0.05	0	92.4	80-120	0			
Iron	4.768	0.20	5	0	95.4	80-120	0			
Lead	0.04924	0.0050	0.05	0	98.5	80-120	0			
Magnesium	5.105	0.20	5	0	102	80-120	0			
Manganese	0.04744	0.0050	0.05	0	94.9	80-120	0			
Molybdenum	0.04742	0.0050	0.05	0	94.8	80-120	0			
Nickel	0.04539	0.0050	0.05	0	90.8	80-120	0			
Potassium	5.074	0.20	5	0	101	80-120	0			
Silver	0.05002	0.0050	0.05	0	100	80-120	0			
Sodium	5.057	0.20	5	0	101	80-120	0			
Vanadium	0.04575	0.0050	0.05	0	91.5	80-120	0			
Zinc	0.04974	0.0050	0.05	0	99.5	80-120	0			

LCS Sample ID: **MLCSW2-032613-68699** Units: **mg/L** Analysis Date: **3/27/2013 04:58 PM**

Client ID: Run ID: **ICP7500_130327A** SeqNo: **3154492** Prep Date: **3/26/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Selenium	0.04697	0.0050	0.05	0	93.9	80-120	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68699** Instrument ID **ICP7500** Method: **SW6020**

MS Sample ID: **1303846-05DMS** Units: **mg/L** Analysis Date: **3/27/2013 06:04 PM**

Client ID: Run ID: **ICP7500_130327A** SeqNo: **3154505** Prep Date: **3/26/2013** DF: **2**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.1684	0.020	0.1	0.0651	103	80-120	0			
Arsenic	0.04742	0.010	0.05	0.002868	89.1	80-120	0			
Barium	0.06544	0.010	0.05	0.021	88.9	80-120	0			
Beryllium	0.0481	0.0040	0.05	0.0003478	95.5	80-120	0			
Boron	1.671	0.10	0.5	1.231	88.1	80-120	0			
Cadmium	0.06756	0.0040	0.05	0.0228	89.5	80-120	0			
Calcium	88.26	1.0	5	79.32	179	80-120	0			SO
Chromium	0.04292	0.010	0.05	0.0008358	84.2	80-120	0			
Cobalt	0.04426	0.010	0.05	0.001916	84.7	80-120	0			
Copper	0.04364	0.010	0.05	0.000758	85.8	80-120	0			
Iron	4.544	0.40	5	0.05926	89.7	80-120	0			
Lead	0.04498	0.010	0.05	0.002284	85.4	80-120	0			
Magnesium	98.7	0.40	5	90.9	156	80-120	0			SO
Manganese	0.7488	0.010	0.05	0.6738	150	80-120	0			SO
Molybdenum	15.33	0.010	0.05	14.64	1380	80-120	0			SEO
Nickel	0.04574	0.010	0.05	0.004562	82.4	80-120	0			
Potassium	7.952	0.40	5	3.454	90	80-120	0			
Selenium	0.0572	0.010	0.05	0.002686	109	80-120	0			
Silver	0.04278	0.010	0.05	0.000395	84.8	80-120	0			
Sodium	ND	0.40	5	0	0	80-120	0			SX
Vanadium	0.07002	0.010	0.05	0.0257	88.6	80-120	0			
Zinc	0.04656	0.010	0.05	0.002674	87.8	80-120	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68699** Instrument ID **ICP7500** Method: **SW6020**

MSD Sample ID: **1303846-05DMSD** Units: **mg/L** Analysis Date: **3/27/2013 06:09 PM**
Client ID: Run ID: **ICP7500_130327A** SeqNo: **3154506** Prep Date: **3/26/2013** DF: **2**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.167	0.020	0.1	0.0651	102	80-120	0.1684	0.811	15	
Arsenic	0.0497	0.010	0.05	0.002868	93.7	80-120	0.04742	4.7	15	
Barium	0.0648	0.010	0.05	0.021	87.6	80-120	0.06544	0.983	15	
Beryllium	0.04798	0.0040	0.05	0.0003478	95.3	80-120	0.0481	0.25	15	
Boron	1.673	0.10	0.5	1.231	88.6	80-120	1.671	0.132	15	
Cadmium	0.06806	0.0040	0.05	0.0228	90.5	80-120	0.06756	0.737	15	
Calcium	85.4	1.0	5	79.32	122	80-120	88.26	3.29	15	SO
Chromium	0.04178	0.010	0.05	0.0008358	81.9	80-120	0.04292	2.69	15	
Cobalt	0.0429	0.010	0.05	0.001916	82	80-120	0.04426	3.12	15	
Copper	0.04132	0.010	0.05	0.000758	81.1	80-120	0.04364	5.46	15	
Iron	4.424	0.40	5	0.05926	87.3	80-120	4.544	2.68	15	
Lead	0.04468	0.010	0.05	0.002284	84.8	80-120	0.04498	0.669	15	
Magnesium	96.64	0.40	5	90.9	115	80-120	98.7	2.11	15	O
Manganese	0.7256	0.010	0.05	0.6738	104	80-120	0.7488	3.15	15	O
Molybdenum	15.06	0.010	0.05	14.64	840	80-120	15.33	1.78	15	SEO
Nickel	0.04486	0.010	0.05	0.004562	80.6	80-120	0.04574	1.94	15	
Potassium	7.822	0.40	5	3.454	87.4	80-120	7.952	1.65	15	
Selenium	0.05088	0.010	0.05	0.002686	96.4	80-120	0.0572	11.7	15	
Silver	0.04192	0.010	0.05	0.000395	83	80-120	0.04278	2.03	15	
Sodium	ND	0.40	5	0	0	80-120	0	0	15	SX
Vanadium	0.06808	0.010	0.05	0.0257	84.8	80-120	0.07002	2.81	15	
Zinc	0.0462	0.010	0.05	0.002674	87.1	80-120	0.04656	0.776	15	

DUP Sample ID: **1303846-05DDUP** Units: **mg/L** Analysis Date: **3/27/2013 05:08 PM**
Client ID: Run ID: **ICP7500_130327A** SeqNo: **3154494** Prep Date: **3/26/2013** DF: **100**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Molybdenum	13.95	0.50	0	0	0	0-0	13.56	2.84	25	
Sodium	1874	20	0	0	0	0-0	1846	1.51	25	

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68699** Instrument ID **ICP7500** Method: **SW6020**

DUP Sample ID: **1303846-05DDUP** Units: **mg/L** Analysis Date: **3/27/2013 05:54 PM**

Client ID: Run ID: **ICP7500_130327A** SeqNo: **3154503** Prep Date: **3/26/2013** DF: **2**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.06508	0.020	0	0	0	0-0	0.0651	0.0307	25	
Arsenic	ND	0.010	0	0	0	0-0	0.002868	0	25	
Barium	0.01995	0.010	0	0	0	0-0	0.021	5.15	25	
Beryllium	ND	0.0040	0	0	0	0-0	0.0003478	0	25	
Boron	1.222	0.10	0	0	0	0-0	1.231	0.701	25	
Cadmium	0.02212	0.0040	0	0	0	0-0	0.0228	3.03	25	
Calcium	79.3	1.0	0	0	0	0-0	79.32	0.0252	25	
Chromium	ND	0.010	0	0	0	0-0	0.0008358	0	25	
Cobalt	ND	0.010	0	0	0	0-0	0.001916	0	25	
Copper	ND	0.010	0	0	0	0-0	0.000758	0	25	
Iron	ND	0.40	0	0	0	0-0	0.05926	0	25	
Lead	ND	0.010	0	0	0	0-0	0.002284	0	25	
Magnesium	90.02	0.40	0	0	0	0-0	90.9	0.973	25	
Manganese	0.6718	0.010	0	0	0	0-0	0.6738	0.297	25	
Nickel	ND	0.010	0	0	0	0-0	0.004562	0	25	
Potassium	3.424	0.40	0	0	0	0-0	3.454	0.872	25	
Selenium	ND	0.010	0	0	0	0-0	0.002686	0	25	
Silver	ND	0.010	0	0	0	0-0	0.000395	0	25	
Vanadium	0.02582	0.010	0	0	0	0-0	0.0257	0.466	25	
Zinc	ND	0.010	0	0	0	0-0	0.002674	0	25	

The following samples were analyzed in this batch: 1303855-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68749** Instrument ID **Mercury** Method: **SW7470**

MBLK Sample ID: **GBLKW1-032713-68749** Units: **mg/L** Analysis Date: **3/27/2013 12:15 PM**
Client ID: Run ID: **MERCURY_130326A** SeqNo: **3153512** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	ND	0.00020								

LCS Sample ID: **GLCSW1-032713-68749** Units: **mg/L** Analysis Date: **3/27/2013 12:20 PM**
Client ID: Run ID: **MERCURY_130326A** SeqNo: **3153513** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00536	0.00020	0.005	0	107	85-115	0			

MS Sample ID: **1303777-01DMS** Units: **mg/L** Analysis Date: **3/27/2013 12:25 PM**
Client ID: Run ID: **MERCURY_130326A** SeqNo: **3153516** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00519	0.00020	0.005	-0.000005	104	85-115	0			

MSD Sample ID: **1303777-01DMSD** Units: **mg/L** Analysis Date: **3/27/2013 12:27 PM**
Client ID: Run ID: **MERCURY_130326A** SeqNo: **3153517** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00517	0.00020	0.005	-0.000005	104	85-115	0.00519	0.386	20	

DUP Sample ID: **1303777-01DDUP** Units: **mg/L** Analysis Date: **3/27/2013 12:23 PM**
Client ID: Run ID: **MERCURY_130326A** SeqNo: **3153515** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	ND	0.00020	0	0	0	0-0	-0.000005	0	20	

The following samples were analyzed in this batch: 1303855-01B

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68756** Instrument ID **SV-3** Method: **SW8270**

MBLK Sample ID: **SBLKW2-130327-68756** Units: **µg/L** Analysis Date: **3/27/2013 07:00 PM**

Client ID: Run ID: **SV-3_130327A** SeqNo: **3155049** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,2,4-Trichlorobenzene	ND	5.0								
2,4,5-Trichlorophenol	ND	5.0								
2,4,6-Trichlorophenol	ND	5.0								
2,4-Dinitrotoluene	ND	5.0								
2-Methylnaphthalene	ND	5.0								
2-Methylphenol	ND	5.0								
2-Nitroaniline	ND	5.0								
2-Nitrophenol	ND	5.0								
3&4-Methylphenol	ND	5.0								
3-Nitroaniline	ND	5.0								
4-Nitroaniline	ND	5.0								
4-Nitrophenol	ND	5.0								
Acenaphthene	ND	5.0								
Acenaphthylene	ND	5.0								
Aniline	ND	5.0								
Anthracene	ND	5.0								
Benz(a)anthracene	ND	5.0								
Benzidine	ND	5.0								
Hexachlorobenzene	ND	5.0								
Hexachloroethane	ND	5.0								
Indeno(1,2,3-cd)pyrene	ND	5.0								
Isophorone	ND	5.0								
Naphthalene	ND	5.0								
Nitrobenzene	ND	5.0								
N-Nitrosodimethylamine	ND	5.0								
N-Nitrosodi-n-propylamine	ND	5.0								
N-Nitrosodiphenylamine	ND	5.0								
Pentachlorophenol	ND	5.0								
Phenanthrene	ND	5.0								
Phenol	ND	5.0								
Pyrene	ND	5.0								
Pyridine	ND	5.0								
Surr: 2,4,6-Tribromophenol	94.74	5.0	*100*	0	*94.7*	*42-124*	0			
Surr: 2-Fluorobiphenyl	107	5.0	*100*	0	*107*	*48-120*	0			
Surr: 2-Fluorophenol	79.61	5.0	*100*	0	*79.6*	*20-120*	0			
Surr: 4-Terphenyl-d14	94.22	5.0	*100*	0	*94.2*	*51-135*	0			
Surr: Nitrobenzene-d5	91.09	5.0	*100*	0	*91.1*	*41-120*	0			
Surr: Phenol-d6	70.94	5.0	*100*	0	*70.9*	*20-120*	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68756** Instrument ID **SV-3** Method: **SW8270**

LCS Sample ID: **SLCSW2-130327-68756** Units: **µg/L** Analysis Date: **3/27/2013 05:34 PM**

Client ID: Run ID: **SV-3_130327A** SeqNo: **3155047** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,2,4-Trichlorobenzene	49.68	5.0	50	0	99.4	50-120	0			
2,4,5-Trichlorophenol	88.8	5.0	100	0	88.8	50-120	0			
2,4,6-Trichlorophenol	87.66	5.0	100	0	87.7	50-120	0			
2,4-Dinitrotoluene	40.23	5.0	50	0	80.5	50-120	0			
2-Methylnaphthalene	39.69	5.0	50	0	79.4	55-120	0			
2-Methylphenol	71.05	5.0	100	0	71.1	50-120	0			
2-Nitroaniline	48.2	5.0	50	0	96.4	55-125	0			
2-Nitrophenol	88.78	5.0	100	0	88.8	55-120	0			
3&4-Methylphenol	101.7	5.0	150	0	67.8	45-120	0			
3-Nitroaniline	19.35	5.0	50	0	38.7	25-120	0			
4-Nitroaniline	34.79	5.0	50	0	69.6	50-120	0			
4-Nitrophenol	64.27	5.0	100	0	64.3	45-120	0			
Acenaphthene	45.43	5.0	50	0	90.9	55-120	0			
Acenaphthylene	45.76	5.0	50	0	91.5	55-120	0			
Aniline	18.75	5.0	50	0	37.5	30-120	0			
Anthracene	46.49	5.0	50	0	93	55-120	0			
Benz(a)anthracene	49.81	5.0	50	0	99.6	55-120	0			
Benzidine	20.46	5.0	50	0	40.9	10-120	0			
Hexachlorobenzene	46.03	5.0	50	0	92.1	55-120	0			
Hexachloroethane	41.25	5.0	50	0	82.5	55-120	0			
Indeno(1,2,3-cd)pyrene	47.39	5.0	50	0	94.8	55-120	0			
Isophorone	43.91	5.0	50	0	87.8	55-120	0			
Naphthalene	44.86	5.0	50	0	89.7	55-120	0			
Nitrobenzene	44.14	5.0	50	0	88.3	55-120	0			
N-Nitrosodimethylamine	36.13	5.0	50	0	72.3	45-120	0			
N-Nitrosodi-n-propylamine	34.59	5.0	50	0	69.2	50-120	0			
N-Nitrosodiphenylamine	48.17	5.0	50	0	96.3	55-120	0			
Pentachlorophenol	86.13	5.0	100	0	86.1	55-120	0			
Phenanthrene	45.79	5.0	50	0	91.6	55-120	0			
Phenol	73.5	5.0	100	0	73.5	50-120	0			
Pyrene	50.95	5.0	50	0	102	55-120	0			
Pyridine	30.36	5.0	50	0	60.7	35-120	0			
Surr: 2,4,6-Tribromophenol	81.62	5.0	*100*	0	*81.6*	*42-124*	0			
Surr: 2-Fluorobiphenyl	95.81	5.0	*100*	0	*95.8*	*48-120*	0			
Surr: 2-Fluorophenol	86.76	5.0	*100*	0	*86.8*	*20-120*	0			
Surr: 4-Terphenyl-d14	94.07	5.0	*100*	0	*94.1*	*51-135*	0			
Surr: Nitrobenzene-d5	95.81	5.0	*100*	0	*95.8*	*41-120*	0			
Surr: Phenol-d6	77.52	5.0	*100*	0	*77.5*	*20-120*	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **68756** Instrument ID **SV-3** Method: **SW8270**

LCSD Sample ID: **SLCSDW2-130327-68756** Units: **µg/L** Analysis Date: **3/27/2013 05:55 PM**

Client ID: Run ID: **SV-3_130327A** SeqNo: **3155048** Prep Date: **3/27/2013** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,2,4-Trichlorobenzene	46.64	5.0	50	0	93.3	50-120	49.68	6.3	20	
2,4,5-Trichlorophenol	85.18	5.0	100	0	85.2	50-120	88.8	4.16	20	
2,4,6-Trichlorophenol	84.54	5.0	100	0	84.5	50-120	87.66	3.63	20	
2,4-Dinitrotoluene	39.66	5.0	50	0	79.3	50-120	40.23	1.44	20	
2-Methylnaphthalene	37.18	5.0	50	0	74.4	55-120	39.69	6.52	20	
2-Methylphenol	65.48	5.0	100	0	65.5	50-120	71.05	8.17	20	
2-Nitroaniline	44.48	5.0	50	0	89	55-125	48.2	8.04	20	
2-Nitrophenol	84.41	5.0	100	0	84.4	55-120	88.78	5.05	20	
3&4-Methylphenol	92.04	5.0	150	0	61.4	45-120	101.7	9.99	20	
3-Nitroaniline	19.94	5.0	50	0	39.9	25-120	19.35	3.03	20	
4-Nitroaniline	34.39	5.0	50	0	68.8	50-120	34.79	1.15	20	
4-Nitrophenol	63.61	5.0	100	0	63.6	45-120	64.27	1.04	20	
Acenaphthene	43.04	5.0	50	0	86.1	55-120	45.43	5.41	20	
Acenaphthylene	43.25	5.0	50	0	86.5	55-120	45.76	5.66	20	
Aniline	17.91	5.0	50	0	35.8	30-120	18.75	4.58	20	
Anthracene	44.23	5.0	50	0	88.5	55-120	46.49	4.99	20	
Benz(a)anthracene	45.91	5.0	50	0	91.8	55-120	49.81	8.15	20	
Benzidine	20.73	5.0	50	0	41.5	10-120	20.46	1.31	20	
Hexachlorobenzene	44.09	5.0	50	0	88.2	55-120	46.03	4.3	20	
Hexachloroethane	38.38	5.0	50	0	76.8	55-120	41.25	7.2	20	
Indeno(1,2,3-cd)pyrene	42.28	5.0	50	0	84.6	55-120	47.39	11.4	20	
Isophorone	40.17	5.0	50	0	80.3	55-120	43.91	8.9	20	
Naphthalene	42.22	5.0	50	0	84.4	55-120	44.86	6.07	20	
Nitrobenzene	41.46	5.0	50	0	82.9	55-120	44.14	6.27	20	
N-Nitrosodimethylamine	36.24	5.0	50	0	72.5	45-120	36.13	0.308	20	
N-Nitrosodi-n-propylamine	30.03	5.0	50	0	60.1	50-120	34.59	14.1	20	
N-Nitrosodiphenylamine	47.01	5.0	50	0	94	55-120	48.17	2.44	20	
Pentachlorophenol	82.01	5.0	100	0	82	55-120	86.13	4.9	20	
Phenanthrene	43.58	5.0	50	0	87.2	55-120	45.79	4.96	20	
Phenol	69.04	5.0	100	0	69	50-120	73.5	6.26	20	
Pyrene	47.14	5.0	50	0	94.3	55-120	50.95	7.76	20	
Pyridine	30.05	5.0	50	0	60.1	35-120	30.36	1.02	20	
Surr: 2,4,6-Tribromophenol	76.73	5.0	*100*	0	*76.7*	*42-124*	81.62	*6.18*	*20*	
Surr: 2-Fluorobiphenyl	89.6	5.0	*100*	0	*89.6*	*48-120*	95.81	*6.7*	*20*	
Surr: 2-Fluorophenol	82.43	5.0	*100*	0	*82.4*	*20-120*	86.76	*5.11*	*20*	
Surr: 4-Terphenyl-d14	87.05	5.0	*100*	0	*87.1*	*51-135*	94.07	*7.74*	*20*	
Surr: Nitrobenzene-d5	87.58	5.0	*100*	0	*87.6*	*41-120*	95.81	*8.97*	*20*	
Surr: Phenol-d6	71.04	5.0	*100*	0	*71*	*20-120*	77.52	*8.73*	*20*	

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client:	Navajo Refining Company	
Work Order:	1303855	
Project:	Injection Well Quarterly	

QC BATCH REPORT

Batch ID: **68756** Instrument ID **SV-3** Method: **SW8270**

The following samples were analyzed in this batch: 1303855-01F

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144692** Instrument ID **VOA1** Method: **SW8260**

MBLK Sample ID: **VBLKW-130327-R144692** Units: **µg/L** Analysis Date: **3/27/2013 12:01 PM**

Client ID: Run ID: **VOA1_130327A** SeqNo: **3153674** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	ND	5.0								
1,1,2,2-Tetrachloroethane	ND	5.0								
1,1,2-Trichloroethane	ND	5.0								
1,1-Dichloroethane	ND	5.0								
1,1-Dichloroethene	ND	5.0								
1,2-Dichloroethane	ND	5.0								
2-Butanone	ND	10								
2-Chloroethyl vinyl ether	ND	10								
2-Hexanone	ND	10								
4-Methyl-2-pentanone	ND	10								
Acetone	ND	10								
Benzene	ND	5.0								
Bromodichloromethane	ND	5.0								
Bromoform	ND	5.0								
Bromomethane	ND	5.0								
Carbon disulfide	ND	10								
Carbon tetrachloride	ND	5.0								
Chlorobenzene	ND	5.0								
Chloroethane	ND	5.0								
Chloroform	ND	5.0								
Chloromethane	ND	5.0								
cis-1,3-Dichloropropene	ND	5.0								
Dibromochloromethane	ND	5.0								
Ethylbenzene	ND	5.0								
m,p-Xylene	ND	10								
Methylene chloride	ND	10								
Styrene	ND	5.0								
Tetrachloroethene	ND	5.0								
Toluene	ND	5.0								
trans-1,3-Dichloropropene	ND	5.0								
Trichloroethene	ND	5.0								
Vinyl acetate	ND	10								
Vinyl chloride	ND	2.0								
Xylenes, Total	ND	15								
Surr: 1,2-Dichloroethane-d4	48.56	5.0	*50*	0	*97.1*	*70-125*	0			
Surr: 4-Bromofluorobenzene	49.7	5.0	*50*	0	*99.4*	*72-125*	0			
Surr: Dibromofluoromethane	50.63	5.0	*50*	0	*101*	*71-125*	0			
Surr: Toluene-d8	50.65	5.0	*50*	0	*101*	*75-125*	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144692** Instrument ID **VOA1** Method: **SW8260**

LCS Sample ID: **VLCSW-130327-R144692** Units: **µg/L** Analysis Date: **3/27/2013 10:47 AM**

Client ID: Run ID: **VOA1_130327A** SeqNo: **3153673** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	53.72	5.0	50	0	107	80-120	0			
1,1,2,2-Tetrachloroethane	51.85	5.0	50	0	104	72-120	0			
1,1,2-Trichloroethane	53.1	5.0	50	0	106	80-120	0			
1,1-Dichloroethane	50.79	5.0	50	0	102	76-120	0			
1,1-Dichloroethene	53.7	5.0	50	0	107	73-124	0			
1,2-Dichloroethane	56.13	5.0	50	0	112	78-120	0			
2-Butanone	102	10	100	0	102	58-132	0			
2-Chloroethyl vinyl ether	110.8	10	100	0	111	74-120	0			
2-Hexanone	95.73	10	100	0	95.7	61-130	0			
4-Methyl-2-pentanone	100.9	10	100	0	101	65-127	0			
Acetone	100.7	10	100	0	101	59-137	0			
Benzene	55.45	5.0	50	0	111	73-121	0			
Bromodichloromethane	57.11	5.0	50	0	114	80-120	0			
Bromoform	54.58	5.0	50	0	109	79-120	0			
Bromomethane	63.78	5.0	50	0	128	60-145	0			
Carbon disulfide	107.4	10	100	0	107	68-141	0			
Carbon tetrachloride	52.32	5.0	50	0	105	75-124	0			
Chlorobenzene	48.25	5.0	50	0	96.5	80-120	0			
Chloroethane	63.88	5.0	50	0	128	70-130	0			
Chloroform	56.86	5.0	50	0	114	80-120	0			
Chloromethane	56.47	5.0	50	0	113	67-123	0			
cis-1,3-Dichloropropene	56.88	5.0	50	0	114	80-120	0			
Dibromochloromethane	52.37	5.0	50	0	105	80-120	0			
Ethylbenzene	50.83	5.0	50	0	102	80-120	0			
m,p-Xylene	107.3	10	100	0	107	78-121	0			
Methylene chloride	58.65	10	50	0	117	65-133	0			
Styrene	54.45	5.0	50	0	109	80-120	0			
Tetrachloroethene	48.75	5.0	50	0	97.5	79-120	0			
Toluene	51.05	5.0	50	0	102	80-120	0			
trans-1,3-Dichloropropene	57.12	5.0	50	0	114	80-120	0			
Trichloroethene	53.05	5.0	50	0	106	80-120	0			
Vinyl acetate	112.6	10	100	0	113	67-139	0			
Vinyl chloride	61.31	2.0	50	0	123	70-127	0			
Xylenes, Total	160.3	15	150	0	107	80-120	0			
Surr: 1,2-Dichloroethane-d4	52.17	5.0	*50*	0	*104*	*70-125*	0			
Surr: 4-Bromofluorobenzene	49	5.0	*50*	0	*98*	*72-125*	0			
Surr: Dibromofluoromethane	53.46	5.0	*50*	0	*107*	*71-125*	0			
Surr: Toluene-d8	49.09	5.0	*50*	0	*98.2*	*75-125*	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144692** Instrument ID **VOA1** Method: **SW8260**

MS Sample ID: **1303880-02AMS** Units: **µg/L** Analysis Date: **3/27/2013 04:07 PM**

Client ID: Run ID: **VOA1_130327A** SeqNo: **3154160** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	53.16	5.0	50	0	106	80-120	0			
1,1,2,2-Tetrachloroethane	50.78	5.0	50	0	102	72-120	0			
1,1,2-Trichloroethane	53.3	5.0	50	0	107	80-120	0			
1,1-Dichloroethane	55.4	5.0	50	0	111	76-120	0			
1,1-Dichloroethene	49.99	5.0	50	0	100	73-124	0			
1,2-Dichloroethane	51.09	5.0	50	0	102	78-120	0			
2-Butanone	118.8	10	100	0	119	58-132	0			
2-Chloroethyl vinyl ether	ND	10	100	0	0	74-120	0			S
2-Hexanone	112.2	10	100	0	112	61-130	0			
4-Methyl-2-pentanone	122.2	10	100	0	122	65-127	0			
Acetone	105	10	100	0	105	59-137	0			
Benzene	48.55	5.0	50	0	97.1	73-121	0			
Bromodichloromethane	52.48	5.0	50	0	105	80-120	0			
Bromoform	53.38	5.0	50	0	107	79-120	0			
Bromomethane	40.05	5.0	50	0	80.1	60-145	0			
Carbon disulfide	99.1	10	100	0	99.1	68-141	0			
Carbon tetrachloride	46.5	5.0	50	0	93	75-124	0			
Chlorobenzene	48.96	5.0	50	0	97.9	80-120	0			
Chloroethane	57.33	5.0	50	0	115	70-130	0			
Chloroform	53.98	5.0	50	0	108	80-120	0			
Chloromethane	41.3	5.0	50	0	82.6	67-123	0			
cis-1,3-Dichloropropene	48.53	5.0	50	0	97.1	80-120	0			
Dibromochloromethane	54.02	5.0	50	0	108	80-120	0			
Ethylbenzene	46.34	5.0	50	0	92.7	80-120	0			
m,p-Xylene	97.8	10	100	0	97.8	78-121	0			
Methylene chloride	59.97	10	50	0	120	65-133	0			
Styrene	52.33	5.0	50	0	105	80-120	0			
Tetrachloroethene	42.49	5.0	50	0	85	79-120	0			
Toluene	50.72	5.0	50	0	101	80-120	0			
trans-1,3-Dichloropropene	52.03	5.0	50	0	104	80-120	0			
Trichloroethene	45.51	5.0	50	0	91	80-120	0			
Vinyl acetate	118.1	10	100	0	118	67-139	0			
Vinyl chloride	50.68	2.0	50	0	101	70-127	0			
Xylenes, Total	147.4	15	150	0	98.3	80-120	0			
Surr: 1,2-Dichloroethane-d4	51.5	5.0	*50*	0	*103*	*70-125*	0			
Surr: 4-Bromofluorobenzene	52.78	5.0	*50*	0	*106*	*72-125*	0			
Surr: Dibromofluoromethane	54.24	5.0	*50*	0	*108*	*71-125*	0			
Surr: Toluene-d8	50.68	5.0	*50*	0	*101*	*75-125*	0			

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144692** Instrument ID **VOA1** Method: **SW8260**

MSD Sample ID: **1303880-02AMSD** Units: **µg/L** Analysis Date: **3/27/2013 04:32 PM**

Client ID: Run ID: **VOA1_130327A** SeqNo: **3154161** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	52.35	5.0	50	0	105	80-120	53.16	1.53	20	
1,1,2,2-Tetrachloroethane	47.84	5.0	50	0	95.7	72-120	50.78	5.97	20	
1,1,2-Trichloroethane	55.66	5.0	50	0	111	80-120	53.3	4.33	20	
1,1-Dichloroethane	53.79	5.0	50	0	108	76-120	55.4	2.97	20	
1,1-Dichloroethene	49.14	5.0	50	0	98.3	73-124	49.99	1.72	20	
1,2-Dichloroethane	52.85	5.0	50	0	106	78-120	51.09	3.38	20	
2-Butanone	106.7	10	100	0	107	58-132	118.8	10.7	20	
2-Chloroethyl vinyl ether	ND	10	100	0	0	74-120	0	0	20	S
2-Hexanone	116.6	10	100	0	117	61-130	112.2	3.85	20	
4-Methyl-2-pentanone	119.3	10	100	0	119	65-127	122.2	2.36	20	
Acetone	94.96	10	100	0	95	59-137	105	10.1	20	
Benzene	48.8	5.0	50	0	97.6	73-121	48.55	0.498	20	
Bromodichloromethane	51.3	5.0	50	0	103	80-120	52.48	2.29	20	
Bromoform	54.41	5.0	50	0	109	79-120	53.38	1.92	20	
Bromomethane	43.99	5.0	50	0	88	60-145	40.05	9.37	20	
Carbon disulfide	99.03	10	100	0	99	68-141	99.1	0.0691	20	
Carbon tetrachloride	49.81	5.0	50	0	99.6	75-124	46.5	6.88	20	
Chlorobenzene	46.31	5.0	50	0	92.6	80-120	48.96	5.56	20	
Chloroethane	54.21	5.0	50	0	108	76-121	57.33	5.6	20	
Chloroform	53.92	5.0	50	0	108	80-120	53.98	0.111	20	
Chloromethane	41.96	5.0	50	0	83.9	67-123	41.3	1.59	20	
cis-1,3-Dichloropropene	52.97	5.0	50	0	106	80-120	48.53	8.74	20	
Dibromochloromethane	54.57	5.0	50	0	109	80-120	54.02	1.01	20	
Ethylbenzene	50.09	5.0	50	0	100	80-120	46.34	7.76	20	
m,p-Xylene	102.8	10	100	0	103	78-121	97.8	4.98	20	
Methylene chloride	55.34	10	50	0	111	65-133	59.97	8.03	20	
Styrene	52.71	5.0	50	0	105	80-120	52.33	0.717	20	
Tetrachloroethene	45.86	5.0	50	0	91.7	79-120	42.49	7.61	20	
Toluene	52.2	5.0	50	0	104	80-120	50.72	2.88	20	
trans-1,3-Dichloropropene	52.07	5.0	50	0	104	80-120	52.03	0.0724	20	
Trichloroethene	46.98	5.0	50	0	94	80-120	45.51	3.18	20	
Vinyl acetate	107.9	10	100	0	108	67-139	118.1	9.06	20	
Vinyl chloride	51.41	2.0	50	0	103	70-127	50.68	1.42	20	
Xylenes, Total	152.2	15	150	0	101	78-121	147.4	3.18	20	
Surr: 1,2-Dichloroethane-d4	52.3	5.0	*50*	0	*105*	*70-125*	51.5	*1.54*	*20*	
Surr: 4-Bromofluorobenzene	55.23	5.0	*50*	0	*110*	*72-125*	52.78	*4.54*	*20*	
Surr: Dibromofluoromethane	52.95	5.0	*50*	0	*106*	*71-125*	54.24	*2.41*	*20*	
Surr: Toluene-d8	51	5.0	*50*	0	*102*	*75-125*	50.68	*0.633*	*20*	

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client:	Navajo Refining Company	
Work Order:	1303855	
Project:	Injection Well Quarterly	

QC BATCH REPORT

Batch ID: **R144692** Instrument ID **VOA1** Method: **SW8260**

The following samples were analyzed in this batch: 1303855-01A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144618** Instrument ID **ManTech01** Method: **M2510 B** **(Dissolve)**

MBLK Sample ID: **WBLKW1-130326-R144618** Units: **µmhos/cm** Analysis Date: **3/26/2013 02:02 PM**
Client ID: Run ID: **MANTECH01_130326B** SeqNo: **3152044** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Specific Conductivity	ND	1.0								

LCS Sample ID: **LCS-COND-R144618** Units: **µmhos/cm** Analysis Date: **3/26/2013 02:03 PM**
Client ID: Run ID: **MANTECH01_130326B** SeqNo: **3152045** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Specific Conductivity	1440	1.0	1413	0	102	80-120	0			

DUP Sample ID: **1303819-01HDUP** Units: **µmhos/cm** Analysis Date: **3/26/2013 02:06 PM**
Client ID: Run ID: **MANTECH01_130326B** SeqNo: **3152047** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Specific Conductivity	225.8	1.0	0	0	0		225.8	0	20	

The following samples were analyzed in this batch: 1303855-01C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144619** Instrument ID **ManTech01** Method: **SM2320B** **(Dissolve)**

MBLK Sample ID: **WBLKW1-130326-R144619** Units: **mg/L** Analysis Date: **3/26/2013 10:41 AM**
Client ID: Run ID: **MANTECH01_130326C** SeqNo: **3151868** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (As CaCO3)	ND	6.0								
Alkalinity, Carbonate (As CaCO3)	ND	6.0								
Alkalinity, Hydroxide (As CaCO3)	ND	6.0								
Alkalinity, Total (As CaCO3)	ND	6.0								

LCS Sample ID: **WLCSW1-130326-R144619** Units: **mg/L** Analysis Date: **3/26/2013 10:47 AM**
Client ID: Run ID: **MANTECH01_130326C** SeqNo: **3151869** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Total (As CaCO3)	1091	6.0	1000	0	109	80-120	0			

DUP Sample ID: **1303819-01HDUP** Units: **mg/L** Analysis Date: **3/26/2013 11:12 AM**
Client ID: Run ID: **MANTECH01_130326C** SeqNo: **3151875** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (As CaCO3)	93.73	6.0	0	0	0	0-0	92.43	1.4	0	
Alkalinity, Carbonate (As CaCO3)	ND	6.0	0	0	0	0-0	0	0	0	
Alkalinity, Hydroxide (As CaCO3)	ND	6.0	0	0	0	0-0	0	0	0	
Alkalinity, Total (As CaCO3)	93.73	6.0	0	0	0	0-0	92.43	1.4	20	

The following samples were analyzed in this batch: 1303855-01D

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144637** Instrument ID **ManTech01** Method: **SW9040** **(Dissolve)**

LCS Sample ID: **LCS-PH-R144637** Units: **pH units** Analysis Date: **3/26/2013 10:50 AM**
Client ID: Run ID: **MANTECH01_130326D** SeqNo: **3152391** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
pH	6.51	0.10	6	0	108	90-110	0			

DUP Sample ID: **1303819-01ZDUP** Units: **pH units** Analysis Date: **3/26/2013 11:12 AM**
Client ID: Run ID: **MANTECH01_130326D** SeqNo: **3152396** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
pH	8.27	0.10	0	0	0	0-0	8.28	0.121	20	

The following samples were analyzed in this batch: 1303855-01C

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144691** Instrument ID **WetChem** Method: **SW1010** **(Dissolve)**

LCS Sample ID: **WLCSW1-130327-R144691** Units: **°F** Analysis Date: **3/27/2013 12:00 PM**
Client ID: Run ID: **WETCHEM_130327D** SeqNo: **3153656** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ignitability	85	50	84	0	101	80-120	0			

DUP Sample ID: **1303824-01DDUP** Units: **°F** Analysis Date: **3/27/2013 12:00 PM**
Client ID: Run ID: **WETCHEM_130327D** SeqNo: **3153660** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Ignitability	ND	50	0	0	0	0-0	0	0	25	

The following samples were analyzed in this batch: 1303855-01E

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

QC BATCH REPORT

Batch ID: **R144712** Instrument ID **Balance1** Method: **M2540C** **(Dissolve)**

MBLK Sample ID: **WBLK-032613-R144712** Units: **mg/L** Analysis Date: **3/26/2013 06:05 PM**
Client ID: Run ID: **BALANCE1_130326C** SeqNo: **3154077** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Fil	ND	10								

LCS Sample ID: **WLCS-032613-R144712** Units: **mg/L** Analysis Date: **3/26/2013 06:05 PM**
Client ID: Run ID: **BALANCE1_130326C** SeqNo: **3154078** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Fil	1022	10	1000	0	102	85-115	0			

DUP Sample ID: **1303714-01FDUP** Units: **mg/L** Analysis Date: **3/26/2013 06:05 PM**
Client ID: Run ID: **BALANCE1_130326C** SeqNo: **3154070** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Fil	464	10	0	0	0	0-0	456	1.74	20	

DUP Sample ID: **1303876-01FDUP** Units: **mg/L** Analysis Date: **3/26/2013 06:05 PM**
Client ID: Run ID: **BALANCE1_130326C** SeqNo: **3155604** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Fil	472	10	0	0	0	0-0	476	0.844	20	

The following samples were analyzed in this batch: 1303855-01D

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: Navajo Refining Company
Work Order: 1303855
Project: Injection Well Quarterly

QC BATCH REPORT

Batch ID: **R144819** Instrument ID **ICS3K2** Method: **E300** **(Dissolve)**

MBLK Sample ID: **WBLKW1-R144819** Units: **mg/L** Analysis Date: **3/28/2013 12:15 PM**
Client ID: Run ID: **ICS3K2_130328A** SeqNo: **3156592** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	ND	0.10								
Chloride	ND	0.50								
Fluoride	ND	0.10								
Sulfate	ND	0.50								
Surr: Selenate (surr)	4.899	0.10	*5*	0	*98*	*85-115*	0			

LCS Sample ID: **WLCSW1-R144819** Units: **mg/L** Analysis Date: **3/28/2013 12:37 PM**
Client ID: Run ID: **ICS3K2_130328A** SeqNo: **3156593** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	3.848	0.10	4	0	96.2	90-110	0			
Chloride	20.42	0.50	20	0	102	90-110	0			
Fluoride	3.645	0.10	4	0	91.1	90-110	0			
Sulfate	19.09	0.50	20	0	95.5	90-110	0			
Surr: Selenate (surr)	4.847	0.10	*5*	0	*96.9*	*85-115*	0			

MS Sample ID: **1303813-45DMS** Units: **mg/L** Analysis Date: **3/28/2013 04:18 PM**
Client ID: Run ID: **ICS3K2_130328A** SeqNo: **3156599** Prep Date: DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	10.62	0.50	10	0	106	80-120	0			
Chloride	72.64	2.5	50	24.99	95.3	80-120	0			
Fluoride	8.866	0.50	10	0.139	87.3	80-120	0			
Sulfate	155.8	2.5	50	106	99.6	80-120	0			
Surr: Selenate (surr)	22.85	0.50	*25*	0	*91.4*	*85-115*	0			

MSD Sample ID: **1303813-45DMSD** Units: **mg/L** Analysis Date: **3/28/2013 04:40 PM**
Client ID: Run ID: **ICS3K2_130328A** SeqNo: **3156600** Prep Date: DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	10.65	0.50	10	0	106	80-120	10.62	0.244	20	
Chloride	72.71	2.5	50	24.99	95.4	80-120	72.64	0.1	20	
Fluoride	8.976	0.50	10	0.139	88.4	80-120	8.866	1.23	20	
Sulfate	156.8	2.5	50	106	101	80-120	155.8	0.582	20	
Surr: Selenate (surr)	23.07	0.50	*25*	0	*92.3*	*85-115*	22.85	*0.949*	*20*	

The following samples were analyzed in this batch: 1303855-01D

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

ALS Environmental

Date: 29-Mar-13

Client: Navajo Refining Company
Project: Injection Well Quarterly
WorkOrder: **1303855**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Units Reported	Description
°F	Farenheit degrees
µmhos/cm	
mg/Kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
pH units	

ALS Environmental

Sample Receipt Checklist

Client Name: **NAVAJO REFINING** Date/Time Received: **22-Mar-13 09:30**

Work Order: **1303855** Received by: **RDN**

Checklist completed by Paresh M. Giga (eSignature) 25-Mar-13 (Date) Reviewed by: Sonia West (eSignature) 26-Mar-13 (Date)

Matrices: Water

Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	2.1c C/U	IR1	
Cooler(s)/Kit(s):	2896		
Date/Time sample(s) sent to storage:	3/25/13 16:50		
Water - VOA vials have zero headspace?	Yes ☑	No ☐	No VOA vials submitted ☐
Water - pH acceptable upon receipt?	Yes ☑	No ☐	N/A ☐
pH adjusted?	Yes ☐	No ☐	N/A ☑
pH adjusted by:	-		

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

CorrectiveAction:

SRC Page 1 of 1

☑ ALS Laboratory Group
10450 Stancliff Rd. #210
Houston, Texas 77099
(Tel) 281.530.5656
(Fax) 281.530.5887

Chain of Custody Fo

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1303855

NAVAJO REFINING: Navajo Refining Company

Project: Injection Well Quarterly

ALS Project Manager: Pat Lynch

Customer Information		Project Information	
Purchase Order		Project Name	Injection Well Quarterly
Work Order		Project Number	
Company Name	Navajo Refining Company	Bill To Company	Navajo Refining Company
Send Report To	Aaron Strange	Invoice Attn.	Aaron Strange
Address	P. O. Box 159	Address	501 East Main
City/State/Zip	Artesia, New Mexico 88211-0159	City/State/Zip	Artesia, New Mexico 88210
Phone	(575) 748-3311	Phone	(575) 748-3311
Fax	(575) 746-5451	Fax	(575) 746-5451
e-Mail Address	Aaron.Strange@hollyfrontier.com	e-Mail Address	Aaron.Strange@hollyfrontier.com

A	VOC (8260) Select
B	SVOC (8270) Select
C	Total Metals (6020 / 7000) NM GW Metals + Ca, K, Mg, Na
D	R.C.I. Profile
E	Anions (300) F, Cl, SO4, Br
F	Alkalinity
G	pH
H	Conductivity
I	TDS
J	Specific Gravity

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	WW Effluent	3/21/13	14:55	Liquid	Yes	10	X	X	X	X	X	X	X	X	X	X	
2	Temperature Blank					1											
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Sampler(s): Please Print & Sign: Aaron Strange

Shipment Method: FedEx

Required Turnaround Time: ☑ STD 10 Wk Days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour ☐ Other ____

Results Due Date:

Relinquished by:	Date:	Time:	Received by:
Aaron Strange	3/21/2013	16:15	
Relinquished by:	**Date:**	**Time:**	**Received by (Laboratory):**
	3/22/13	09:30	RN AS
Logged by (Laboratory):	**Date:**	**Time:**	**Checked by (Laboratory):**

Notes: See attachment for more detail.

Cooler Temp.:

QC Package: (Check Box Below)

- ☐ Level II: Standard QC
- ☐ Level III: Std QC + Raw Data
- ☐ Level IV: SW846 CLP-Like
- ☐ TRRP-Checklist
- ☐ TRRP Level IV
- ☐ Other: ____

Preservative Key: 1-HCL 2-HNO3 3-H2SO4 4-NaOH 5-Na2S2O3 6-NaHSO4 7-Other 8-4 degrees C 9-5035

Note: Any changes must be made in writing once samples and COC Form have been submitted to ALS Laboratory Group.

ALS Group USA, Corp

Date: 28-Mar-13

Client: ALS Environmental
Project: 1303855
Work Order: **1303831**

Work Order Sample Summary

Lab Samp ID	Client Sample ID	Matrix	Tag Number	Collection Date	Date Received	Hold
1303831-01	1303855-01H	Liquid		3/21/2013 14:55	3/26/2013 09:30	☐

ALS Group USA, Corp

Date: 28-Mar-13

Client: ALS Environmental
Project: 1303855
WorkOrder: **1303831**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL

Acronym	Description
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
RPD	Relative Percent Difference
TDL	Target Detection Limit
A	APHA Standard Methods
D	ASTM
E	EPA
SW	SW-846 Update III

Units Reported	Description
mg/Kg	Milligrams per Kilogram

ALS Group USA, Corp

Date: *28-Mar-13*

Client: ALS Environmental
Project: 1303855 **Work Order:** 1303831
Sample ID: 1303855-01H **Lab ID:** 1303831-01
Collection Date: 3/21/2013 02:55 PM **Matrix:** LIQUID

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
CYANIDE, REACTIVE			**SW7.3.3.2**			Analyst: **EE**
Cyanide, Reactive	ND		40.0	mg/Kg	1	3/28/2013 09:45 AM
SULFIDE, REACTIVE			**SW7.3.4.2**			Analyst: **EE**
Sulfide, Reactive	ND		40.0	mg/Kg	1	3/28/2013 09:45 AM

Note: See Qualifiers page for a list of qualifiers and their definitions.

ALS Group USA, Corp

Date: 28-Mar-13

Client: ALS Environmental
Work Order: 1303831
Project: 1303855

QC BATCH REPORT

Batch ID: **R118051** Instrument ID **WETCHEM** Method: **SW7.3.4.2**

MBLK Sample ID: **WBLKW1-032813-R118051** Units: **mg/Kg** Analysis Date: **3/28/2013 09:45 AM**
Client ID: Run ID: **WETCHEM_130328I** SeqNo: **2252596** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide, Reactive	ND	40								

LCS Sample ID: **WLCSW1-032813-R118051** Units: **mg/Kg** Analysis Date: **3/28/2013 09:45 AM**
Client ID: Run ID: **WETCHEM_130328I** SeqNo: **2252597** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide, Reactive	699.2	40	1075	0	65	60-120	0			

The following samples were analyzed in this batch: 1303831-01A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

Client: ALS Environmental
Work Order: 1303831
Project: 1303855

QC BATCH REPORT

Batch ID: **R118052** Instrument ID **WETCHEM** Method: **SW7.3.3.2**

MBLK Sample ID: **WBLKW1-032813-R118052** Units: **mg/Kg** Analysis Date: **3/28/2013 09:45 AM**
Client ID: Run ID: **WETCHEM_130328J** SeqNo: **2252608** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Cyanide, Reactive	ND	40								

LCS Sample ID: **WLCSW1-032813-R118052** Units: **mg/Kg** Analysis Date: **3/28/2013 09:45 AM**
Client ID: Run ID: **WETCHEM_130328J** SeqNo: **2252609** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Cyanide, Reactive	234.9	40	250	0	94	75-125	0			

MS Sample ID: **1303827-01A MS** Units: **mg/Kg** Analysis Date: **3/28/2013 09:45 AM**
Client ID: Run ID: **WETCHEM_130328J** SeqNo: **2252611** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Cyanide, Reactive	218.9	40	250	0	87.6	50-150	0			

MSD Sample ID: **1303827-01A MSD** Units: **mg/Kg** Analysis Date: **3/28/2013 09:45 AM**
Client ID: Run ID: **WETCHEM_130328J** SeqNo: **2252612** Prep Date: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Cyanide, Reactive	233.5	40	250	0	93.4	50-150	218.9	6.45	35	

The following samples were analyzed in this batch: 1303831-01A

Note: See Qualifiers Page for a list of Qualifiers and their explanation.

1303831

Subcontractor:
ALS Laboratory Group
3352 128th Ave.
Holland, MI 49424

TEL: (616) 399-6070
FAX: (616) 399-6185
Acct #:

CHAIN-OF-CUSTODY RECORD

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Date: 25-Mar-13
COC ID: 13717
Due Date 28-Mar-13

Salesperson: Mala H. Belmonte

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	1303855	A	Reactive Cyanide (SW-846)
Work Order		Project Number		B	Reactive Sulfide (SW-846)
Company Name	ALS Group USA, Corp.	Bill To Company	ALS Group USA, Corp.	C	
Send Report To	Sonia West	Inv Attn	Accounts Payable	D	
Address	10450 Stancliff Rd, Suite 210	Address	10450 Stancliff Rd, Suite 210	E	
				F	
City/State/Zip	Houston, Texas 77099-4338	City/State/Zip	Houston, Texas 77099-4338	G	
Phone	(281) 530-5656	Phone	(281) 530-5656	H	
Fax	(281) 530-5887	Fax	(281) 530-5887	I	
eMail Address	Sonia.West@alsglobal.com	eMail CC		J	

Sample ID	Matrix	Collection Date 24hr	Bottle	A	B	C	D	E	F	G	H	I	J
1303855-01H (WW Effluent)	Liquid	21/Mar/2013 14:55	(1) 250PNEAT	X	X								

Comments: Please analyze for reactive cyanide & reactive sulfide. Due on 3/28/13. Send report to sonia.west@alsglobal.com & cc : results to jumoke.lawal@alsglobal.com & luke.hernandez@alsglobal.com

Relinquished by:	Date/Time	Received by:	Date/Time	Cooler IDs	Report/QC Level
	3/25/13 1800				Std
Relinquished by:	Date/Time	Received by:	Date/Time		
			3/26/13 0930		

3.2°C

ALS Group USA, Corp

Sample Receipt Checklist

Client Name: **ALS - HOUSTON**

Date/Time Received: **26-Mar-13 09:30**

Work Order: **1303831**

Received by: **DS**

Checklist completed by Diane Shaw (eSignature) 26-Mar-13 (Date)

Reviewed by: Bill Carey (eSignature) 26-Mar-13 (Date)

Matrices: Liquid

Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	

Temperature(s)/Thermometer(s): 3.2 c

Cooler(s)/Kit(s):

Date/Time sample(s) sent to storage: 3/26/2013 1:31:30 PM

Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑
pH adjusted?	Yes ☐	No ☐	N/A ☑

pH adjusted by: -

Login Notes:

Client Contacted:

Date Contacted:

Person Contacted:

Contacted By:

Regarding:

Comments:

CorrectiveAction:

SRC Page 1 of 1

ALS Environmental
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887

CUSTODY SEAL

Date: [illegible] Time:
Name: [illegible]
Company: [illegible]

Seal Broken By:
Date:

ALS Environmental
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887

CUSTODY SEAL

Date: [illegible]
Name: [illegible]
Company: ALS [illegible]

Seal Broken By:
Date:

Certificate of Analysis

SINCE 1985
Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77099
P.O. BOX 741905, HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410

CLIENT:	ALS Group USA, Corp.	**REQUESTED BY:**	Ms. Sonia West
CLIENT PROJECT:	1303855-01G	**PURCHASE ORDER NO:**	10-2125597
LABORATORY NO:	70395	**REPORT DATE:**	March 28, 2013
SAMPLE:	1303855-01G (WW Effluent)		

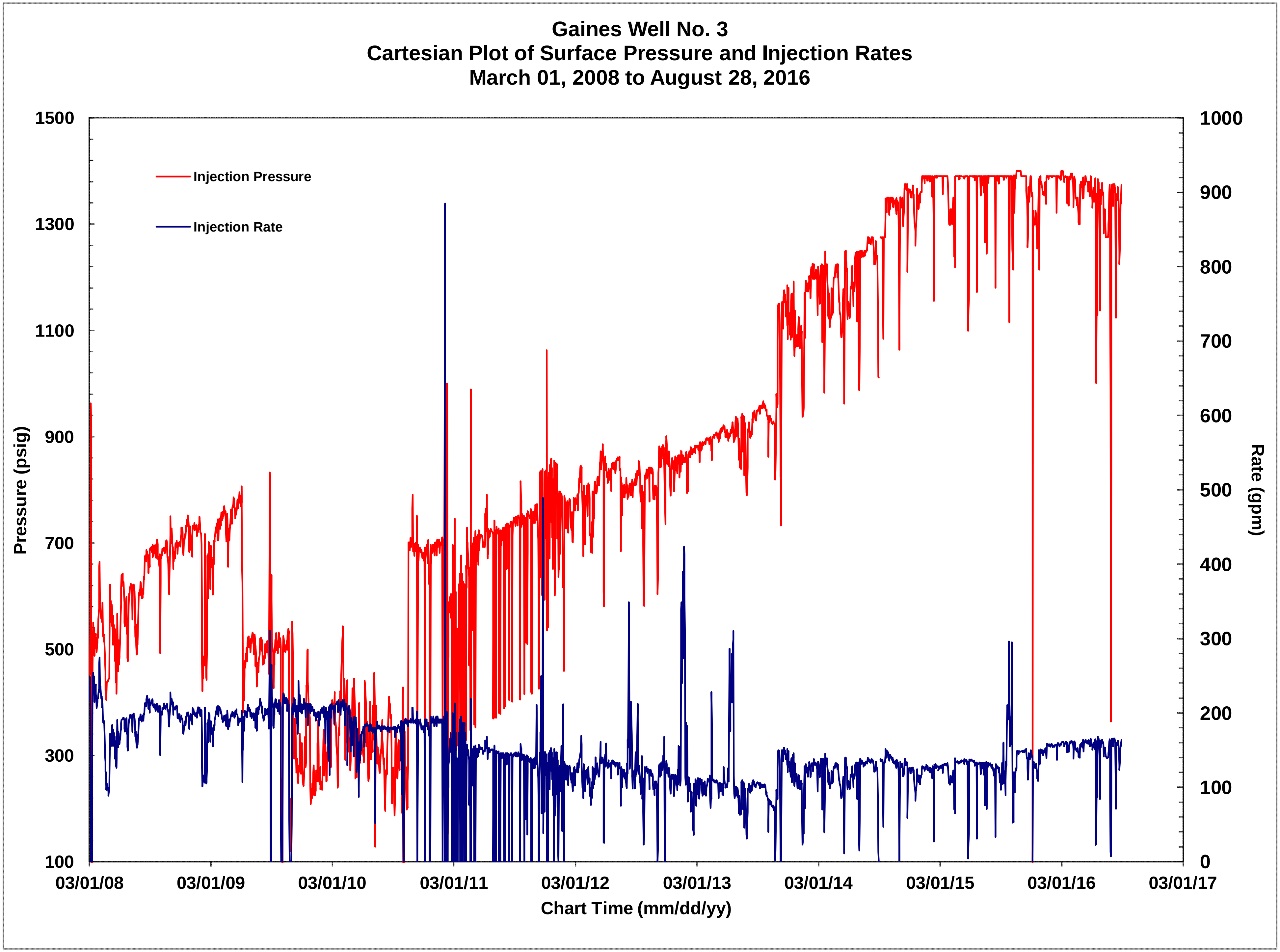
TEST **RESULT**

API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity), ASTM D 1298

	Results
Specific Gravity @ 60°F(15°C)	0.9998
Density, g/cm³	0.9958

Respectfully submitted
For Texas OilTech Laboratories, L.P.

A. Phillip Sorurbakhsh
Director of Laboratory Operations



Gaines Well No. 3
Cartesian Plot of Surface Pressure and Injection Rates
March 01, 2008 to August 28, 2016
Injection Pressure
Injection Rate
Pressure (psig)
Rate (gpm)
Chart Time (mm/dd/yy)
1500
1300
1100
900
700
500
300
100
1000
900
800
700
600
500
400
300
200
100
0
03/01/08
03/01/09
03/01/10
03/01/11
03/01/12
03/01/13
03/01/14
03/01/15
03/01/16
03/01/17

PREDICTW - RESERVOIR PRESSURE INCREASE PROGRAM

The pressure response for radial flow of a slightly compressible fluid in a planar (porous) injection layer with spatially-constant properties is determined by the well-known diffusivity equation (Lee, 1982):

$$\frac{\partial^2 p}{\partial r^2} + \frac{1}{r}\frac{\partial p}{\partial r} = \frac{\phi \mu c_t}{0.000264k}\frac{\partial p}{\partial t}\ , \qquad \text{Equation 1}$$

where ϕ, μ, c_t, and k refer to porosity, viscosity (cp), compressibility (psi^{-1}), and permeability (md), respectively. The pressure, p, is expressed in psi; radial distance, r, is in feet; and time, t, is indicated in hours. For an infinite reservoir of thickness h (ft) with $p \rightarrow p_o$ (initial pressure) as $r \rightarrow \infty$, the transient pressure, p (r, t), for a single line source injector at r = 0 is determined from Equation 1 as (Muskat, 1937):

$$p\ (r,t) = p_o - \frac{70.6\ q\mu}{kh}\ Ei\left(\frac{-39.5\phi\mu c_t r^2}{kt}\right)\ , \qquad \text{Equation 2}$$

where Ei represents the exponential integral defined by:

$$Ei\ (-x) = -\int_x^{\infty} \frac{e^{-\varepsilon}}{\varepsilon}\ d\varepsilon\ ,$$

and q represents the (constant) injection rate in barrels per day (bbl/day). Time, t, in Equation 2 is expressed in days.

For the general case of multiple wells in a single layer, in which injection from each is represented by a succession of piece-wise constant flow rate intervals, the pressure response is readily obtained by superposition of elementary solutions given by Equation 1. In terms of Cartesian coordinates, the pressure transient at an arbitrary point (x, y) is given by:

$$p(x,y,t) = p_o + \sum_{j=1}^{N} \frac{70.6\, q_1^j \mu}{kh}\ Ei\left(\frac{-39.5\phi\mu c_t\left[(x-x_j)^2 + (y-y_j)^2\right]}{kt}\right)$$

$$+ \sum_{j=1}^{N}\sum_{i=1}^{n_{j-1}} \frac{70.6\,[(q_{i+1}^j - q_i^j)\mu\,]}{kh}\ Ei\left(\frac{-39.5\phi\mu c_t\left[(x-x_j)^2 + (y-y_j)^2\right]}{k(t-t_i^j)}\right)$$

Equation 3

for all $t_i^j < t$. In Equation 3, the following notation is employed:

N = number of wells injecting into the reservoir
n_j = number of constant flow rate increments for well j operative over time t
i = flow rate summation index ($1 < i < n_j$)
j = well number summation index ($1 < j < N$)
t_i^j = cumulative time corresponding to the end of injection rate interval i for well j
x_j, y_j = cartesian coordinates of well j
q_i^j = flow rate from well j during flow increment i

Equation 3 forms the basis for determining the cone of influence for a general multi-well system.

To determine shutin or flowing pressures at a generic wellbore location, Equation 3 is modified to include a dimensionless skin factor, s_b, which reflects the effects of altered properties in the near-wellbore region (Van Everdingen, 1953). The associated augmentation, Δp_{skin}^b, of the theoretical flowing pressure is assumed to be of the form:

$$\Delta p_{skin}^b \text{ (psi)} = 141.2 \frac{q_i^b \mu}{kh} s_b \qquad \text{Equation 4}$$

Incorporation of Equation 4 into Equation 3 and replacement of the quantity $[(x-x_b)^2 + (y-y_b)^2]$ in the Ei-function argument by $r_{w,b}^2$ (wellbore radius squared) leads to the following expression for the transient flowing pressure at a generic wellbore (b):

$$\begin{aligned} p_{wf}^b(x_b, y_b, t) = {} & p_o + \sum_{j=1}^{N} \frac{70.6\, q_1^j \mu}{kh} \mathrm{Ei}\left(\frac{-39.5 \phi \mu c_t [(x_b - x_j)^2 + (y_b - y_j)^2]}{kt} \right) \\ & + \sum_{j=1 (j \neq b)}^{N} \sum_{i=1}^{n_{j-1}} \frac{70.6 (q_{i+1}^j - q_i^j) \mu}{kh} \mathrm{Ei}\left(\frac{-39.5 \phi \mu c_t [(x_b - x_j)^2 + (y_b - y_j)^2]}{k(t - t_i^j)} \right) \\ & + \frac{70.6\, q_1^b \mu}{kh} \left[\mathrm{Ei}\left(\frac{-39.5 \phi \mu c_t r_{w,b}^2}{kt} \right) - 2 s_b \right] \\ & + \sum_{i=1}^{n_{j-1}} \frac{70.6 (q_{i+1}^b - q_i^b) \mu}{kh} \left[\mathrm{Ei}\left(\frac{-39.5 \phi \mu c_t r_{w,b}^2}{k(t - t_i^b)} \right) - 2 s_b \right] \end{aligned}$$

Equation 5

where x_b, y_b denote the wellbore coordinates at well b where the pressure response is evaluated.

Application of Equations 3 and 5 to address actual operational conditions often requires inclusion of many wells (including image injectors), each having several hundred flow rate increments. Accordingly, a Visual Basic computer program, PREDICTW, was created to evaluate these equations. When isobaric contours at a given time in a given injection zone are desired, Equation 3, actually $p - p_o$, is evaluated at each node of a predefined uniform grid. The resulting Δp-x-y array is then input into a 3-D graphics routine, SURFER (®Golden Software, Inc.), to generate selected isobaric contours. When transient wellbore responses are desired to determine flowing pressures at a given well or to simulate pressure falloff tests, Equation 5 is utilized. The output for this case consists of a record of $\Delta p = p - p_o$ at a single well location over a specified time interval.

REFERENCES:

Lee, J., 1982, Well Testing: SPE Textbook Series, Vol. 1, Dallas, Texas.

Muskat, M., 1937, The Flow of Homogeneous Fluids Through Porous Media: McGraw Hill.

Van Everdingen, A. F., 1953, The Skin Effect and Its Influence on the Productive Capacity of a Well: SPE, Presented at the Petroleum Branch Fall Meeting, Fall 1953.

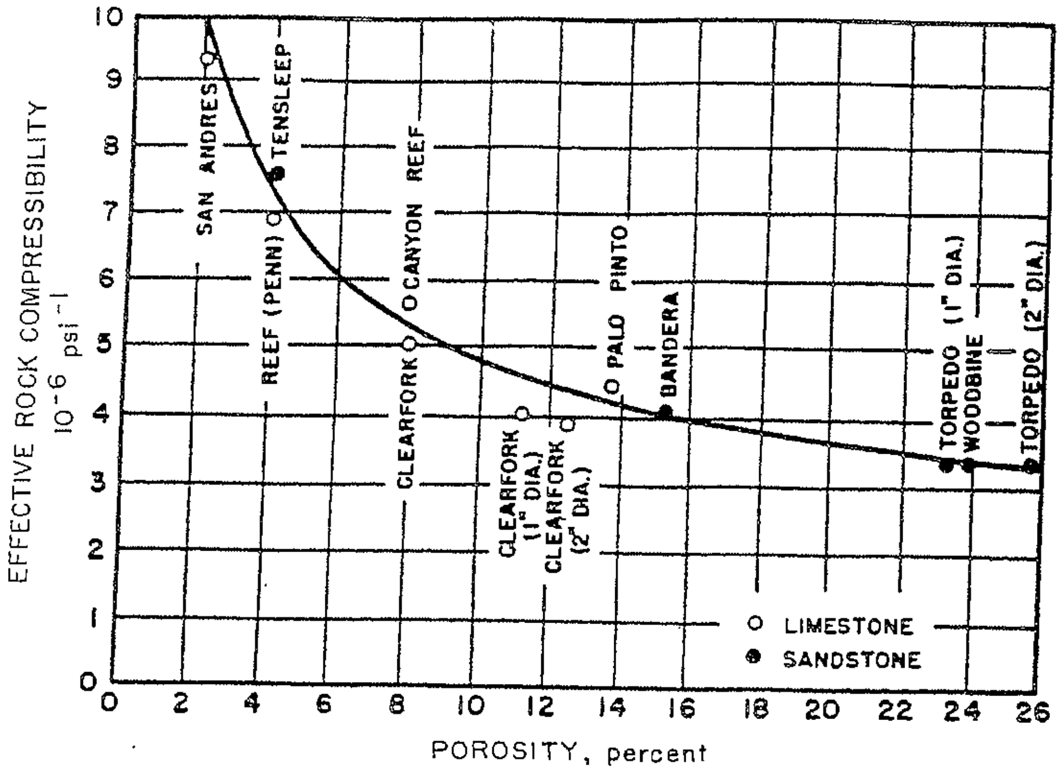


Fig. G.5 Effective formation (rock) compressibility. From Hall, *Trans.*, AIME (1953) **198**, 309.

Source: Matthews and Russell, 1967, Pressure Buildup and Flow Tests in Wells

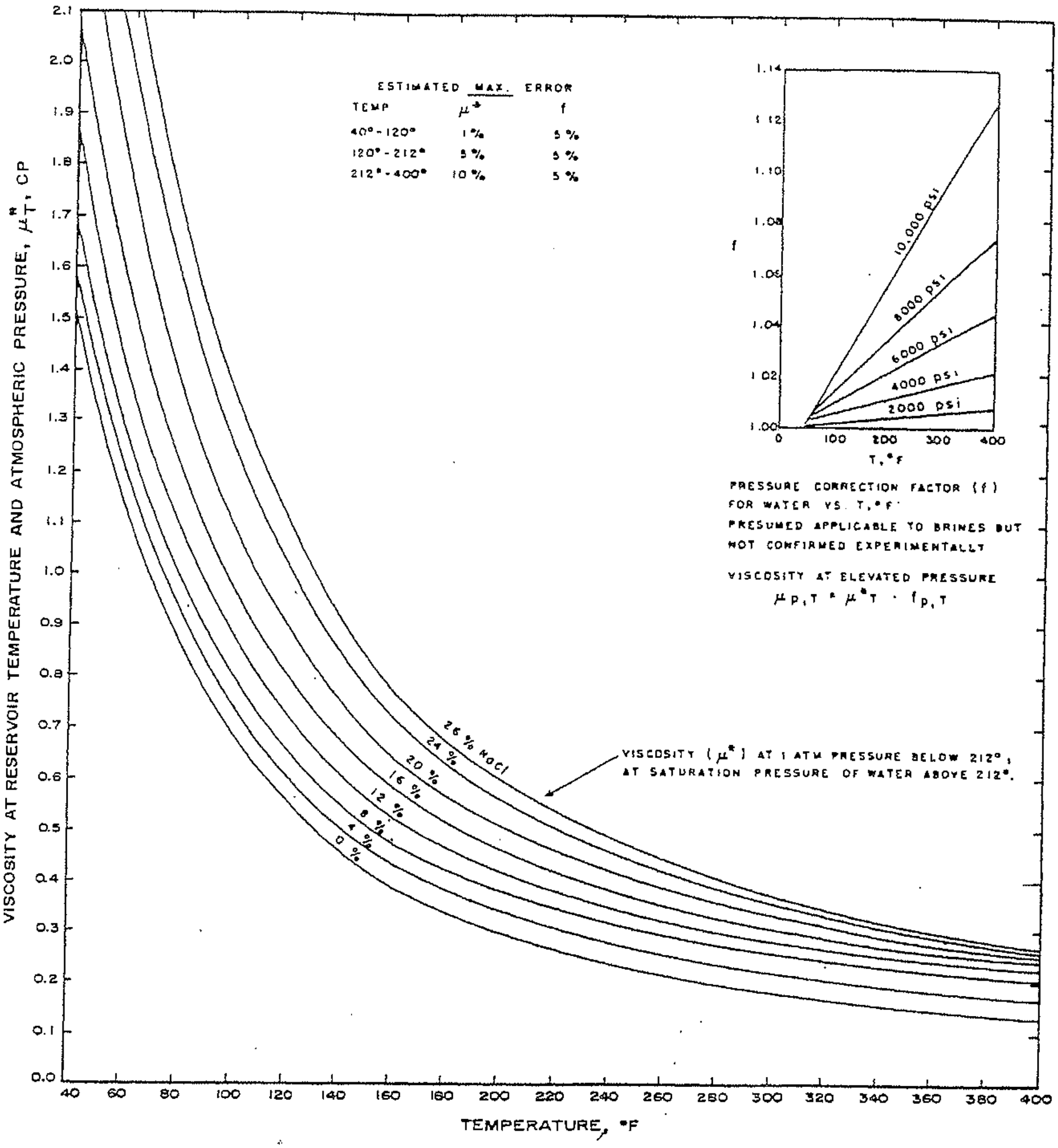


Fig. D.35 Water viscosity at various salinities and temperatures. After Matthews and Russell, data of Chesnut.[18]

FROM: Earlougher, R.C., 1977, "Advances in Well Test Analysis", SPE of AIME, Dallas, Texas

APPENDIX E-5

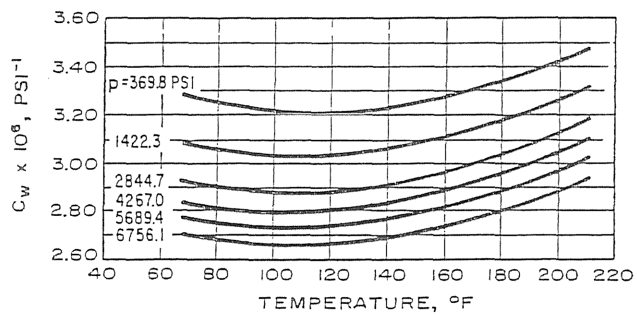


Fig. D.16 Average compressibility of distilled water. After Long and Chierici.[13]

Source: Earlougher, 1977, Advances in Well Test Analysis

COMPRESSIBILITY OF PORE VOLUME AND DISTILLED WATER

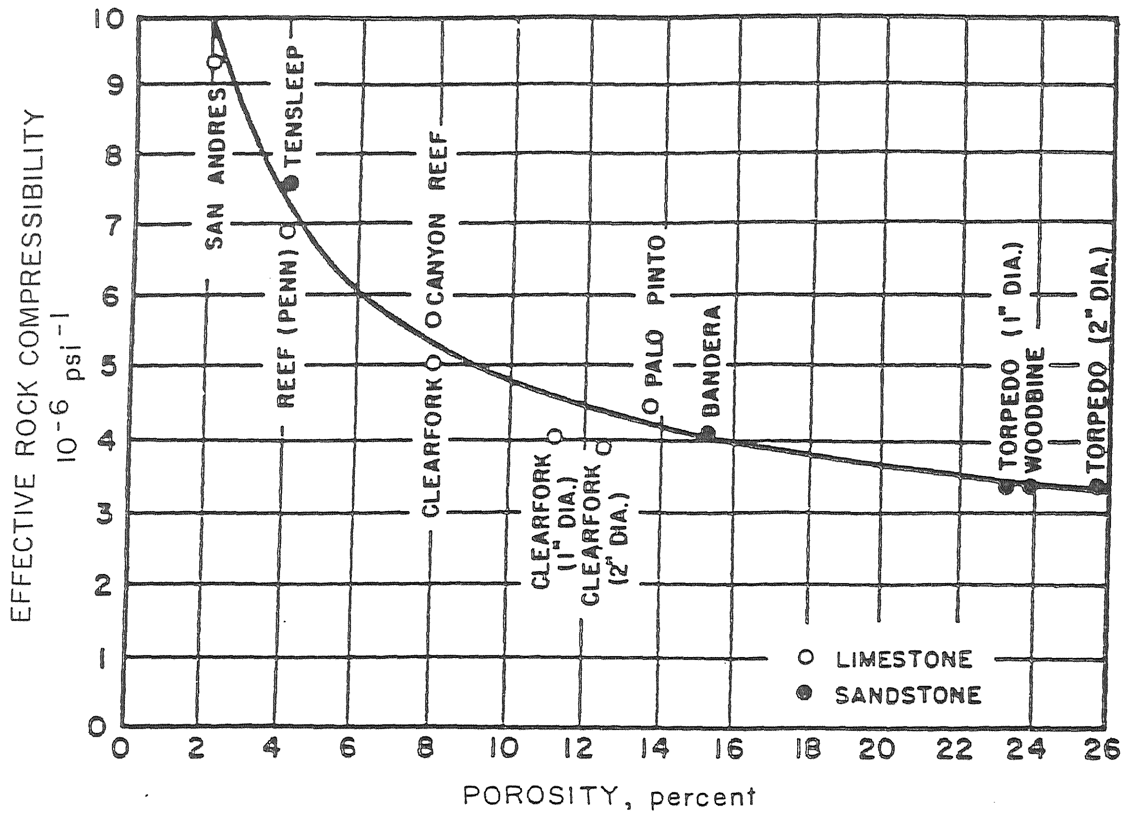


Fig. G.5 Effective formation (rock) compressibility. From Hall, *Trans.*, AIME (1953) 198, 309.

Source: Matthews and Russell, 1967, Pressure Buildup and Flow Tests in Wells

APPENDIX E-5

Predicted Increase in Bottomhole Pressure
Navajo Refining Company, L.L.C.

Permeability	251	md	Thickness	85	feet	Datum Depth:	Well No. 1	7924	feet
Compressibility	8.40E-06	psi^{-1}	Porosity	10	%		Well No. 2	7570	feet
							Well No. 3	7660	feet

	Injection Rate Case A			Injection Rate Case B			Injection Rate Case C			Injection Rate Case D		
	Well No. 1	Well No. 2	Well No. 3	Well No. 1	Well No. 2	Well No. 3	Well No. 1	Well No. 2	Well No. 3	Well No. 1	Well No. 2	Well No. 3
Injection Rate (gpm)	400	400	0	400	0	400	0	400	400	266.6	266.6	266.6

Date	Simulation Time	Increase in Bottomhole Pressure at Datum Depth (psi)											
		Injection Rate Case A			Injection Rate Case B			Injection Rate Case C			Injection Rate Case D		
(mm/dd/yyyy)	(days)	Well No. 1	Well No. 2	Well No. 3	Well No. 1	Well No. 2	Well No. 3	Well No. 1	Well No. 2	Well No. 3	Well No. 1	Well No. 2	Well No. 3
01/31/2017	6424	700.26	706.54	247.63	713.64	233.14	721.04	187.78	764.45	387.22	533.79	567.93	296.23
02/28/2017	6452	717.29	723.16	264.99	732.25	249.43	738.71	202.88	784.27	396.42	550.70	585.50	305.15
03/31/2017	6483	728.80	734.51	276.65	744.38	260.67	750.49	213.65	796.85	402.35	562.16	597.22	310.97
04/30/2017	6513	736.73	742.38	284.66	752.61	268.48	758.56	221.25	805.31	406.36	570.08	605.26	314.93
05/31/2017	6544	743.11	748.72	291.09	759.18	274.79	765.02	227.42	812.01	409.56	576.45	611.71	318.09
06/30/2017	6574	748.17	753.75	296.19	764.36	279.80	770.14	232.34	817.28	412.07	581.50	616.81	320.58
07/31/2017	6605	752.60	758.17	300.64	768.88	284.20	774.61	236.67	821.86	414.26	585.93	621.28	322.75
08/31/2017	6636	756.44	761.99	304.50	772.79	288.01	778.48	240.44	825.82	416.15	589.76	625.14	324.63
09/30/2017	6666	759.73	765.27	307.80	776.12	291.28	781.79	243.67	829.19	417.76	593.04	628.44	326.24
10/31/2017	6697	762.77	768.30	310.86	779.21	294.31	784.85	246.67	832.30	419.25	596.09	631.50	327.72
11/30/2017	6727	765.45	770.97	313.54	781.91	296.97	787.54	249.30	835.03	420.56	598.76	634.18	329.03
12/31/2017	6758	767.97	773.49	316.07	784.47	299.48	790.08	251.80	837.61	421.80	601.28	636.72	330.26
01/31/2018	6789	770.30	775.81	318.41	786.82	301.80	792.42	254.10	839.98	422.93	603.61	639.05	331.39
02/28/2018	6817	772.26	777.77	320.37	788.79	303.75	794.38	256.04	841.96	423.89	605.56	641.02	332.34
03/31/2018	6848	774.28	779.79	322.40	790.84	305.77	796.42	258.05	844.02	424.87	607.59	643.05	333.32
04/30/2018	6878	776.12	781.62	324.25	792.69	307.61	798.26	259.87	845.89	425.77	609.43	644.89	334.21
05/31/2018	6909	777.91	783.41	326.04	794.50	309.39	800.06	261.64	847.70	426.64	611.21	646.69	335.08
06/30/2018	6939	779.55	785.04	327.68	796.14	311.02	801.70	263.27	849.36	427.44	612.85	648.33	335.88
07/31/2018	6970	781.15	786.65	329.29	797.76	312.62	803.31	264.86	850.98	428.21	614.45	649.94	336.65
08/31/2018	7001	782.68	788.17	330.81	799.29	314.14	804.84	266.37	852.52	428.95	615.98	651.46	337.39
09/30/2018	7031	784.09	789.57	332.22	800.71	315.55	806.25	267.77	853.94	429.64	617.38	652.87	338.07
10/31/2018	7062	785.48	790.96	333.61	802.11	316.93	807.64	269.15	855.35	430.31	618.77	654.26	338.75
11/30/2018	7092	786.76	792.25	334.90	803.40	318.22	808.94	270.43	856.65	430.94	620.06	655.55	339.37
12/31/2018	7123	788.04	793.52	336.18	804.69	319.49	810.22	271.70	857.94	431.56	621.33	656.83	339.99
01/31/2019	7154	789.27	794.75	337.41	805.92	320.72	811.45	272.92	859.17	432.15	622.56	658.06	340.58
02/28/2019	7182	790.34	795.82	338.49	807.00	321.79	812.52	273.99	860.25	432.67	623.63	659.14	341.10
03/31/2019	7213	791.48	796.96	339.63	808.14	322.93	813.67	275.12	861.41	433.23	624.77	660.28	341.65
04/30/2019	7243	792.55	798.03	340.70	809.22	324.00	814.74	276.19	862.48	433.74	625.84	661.35	342.17
05/31/2019	7274	793.62	799.10	341.77	810.29	325.06	815.81	277.25	863.56	434.26	626.91	662.42	342.69
06/30/2019	7304	794.62	800.10	342.78	811.30	326.06	816.81	278.25	864.57	434.75	627.91	663.43	343.17
07/31/2019	7335	795.63	801.10	343.78	812.31	327.07	817.82	279.25	865.58	435.23	628.92	664.43	343.66
08/31/2019	7366	796.60	802.08	344.76	813.28	328.04	818.79	280.22	866.56	435.70	629.89	665.41	344.13
09/30/2019	7396	797.52	802.99	345.67	814.20	328.95	819.71	281.13	867.48	436.15	630.81	666.32	344.57
10/31/2019	7427	798.44	803.91	346.59	815.13	329.87	820.63	282.05	868.41	436.59	631.73	667.24	345.01
11/30/2019	7457	799.31	804.78	347.46	816.00	330.74	821.50	282.91	869.28	437.01	632.59	668.11	345.43
12/31/2019	7488	800.18	805.65	348.34	816.87	331.61	822.38	283.78	870.16	437.44	633.47	668.99	345.86
01/31/2020	7519	801.03	806.50	349.19	817.73	332.46	823.23	284.63	871.01	437.85	634.32	669.84	346.27
02/29/2020	7548	801.81	807.28	349.97	818.51	333.24	824.01	285.40	871.80	438.22	635.09	670.61	346.64
03/31/2020	7579	802.62	808.09	350.78	819.32	334.05	824.82	286.21	872.61	438.61	635.90	671.43	347.03
04/30/2020	7609	803.38	808.85	351.54	820.09	334.81	825.59	286.98	873.38	438.99	636.67	672.19	347.40
05/31/2020	7640	804.16	809.63	352.32	820.87	335.59	826.36	287.75	874.16	439.36	637.44	672.97	347.78
06/30/2020	7670	804.89	810.36	353.05	821.60	336.32	827.10	288.48	874.90	439.72	638.18	673.70	348.13
07/31/2020	7701	805.63	811.10	353.80	822.35	337.06	827.84	289.22	875.64	440.07	638.92	674.44	348.49
08/31/2020	7732	806.36	811.83	354.52	823.07	337.79	828.57	289.94	876.37	440.42	639.64	675.17	348.84
09/30/2020	7762	807.05	812.52	355.21	823.76	338.47	829.26	290.63	877.06	440.76	640.33	675.86	349.17
10/31/2020	7793	807.75	813.21	355.91	824.46	339.17	829.96	291.33	877.77	441.09	641.03	676.56	349.51
11/30/2020	7823	808.41	813.88	356.57	825.13	339.83	830.62	291.99	878.43	441.41	641.69	677.22	349.83
12/31/2020	7854	809.08	814.55	357.25	825.80	340.50	831.29	292.66	879.10	441.74	642.36	677.89	350.15
01/31/2021	7885	809.74	815.21	357.90	826.46	341.16	831.95	293.31	879.77	442.06	643.02	678.55	350.47
02/28/2021	7913	810.32	815.79	358.49	827.05	341.74	832.54	293.90	880.35	442.34	643.60	679.14	350.75
03/31/2021	7944	810.96	816.43	359.13	827.68	342.38	833.17	294.53	880.99	442.65	644.24	679.77	351.06
04/30/2021	7974	811.56	817.03	359.73	828.29	342.98	833.78	295.13	881.60	442.94	644.85	680.38	351.35
05/31/2021	8005	812.18	817.65	360.35	828.91	343.60	834.39	295.75	882.22	443.24	645.46	680.99	351.65
06/30/2021	8035	812.76	818.23	360.93	829.49	344.18	834.98	296.33	882.80	443.52	646.04	681.58	351.93
07/31/2021	8066	813.36	818.82	361.53	830.09	344.78	835.57	296.92	883.40	443.81	646.64	682.17	352.22
08/31/2021	8097	813.94	819.41	362.11	830.68	345.36	836.16	297.51	883.99	444.09	647.22	682.76	352.50
09/30/2021	8127	814.50	819.97	362.67	831.23	345.92	836.72	298.06	884.55	444.36	647.78	683.32	352.77
10/31/2021	8158	815.07	820.53	363.24	831.80	346.49	837.29	298.63	885.12	444.63	648.35	683.88	353.04
11/30/2021	8188	815.61	821.07	363.78	832.34	347.03	837.83	299.17	885.66	444.89	648.89	684.43	353.30
12/31/2021	8219	816.16	821.62	364.33	832.90	347.58	838.38	299.72	886.21	445.16	649.44	684.98	353.57

APPENDIX E-6

Predicted Plume Calculations

Plume with Dispersion (Warner and Lehr - 1977)

$$r_{waste} = \sqrt{\frac{0.1337\,V}{\pi h(0.8\,\phi)}}$$

where

r_{waste}	=	radial distance of waste front (feet)
0.1337	=	factor to convert gallons to cubic feet
V	=	cumulative volume of injected wastewater (gallons)
h	=	reservoir thickness (feet)
$0.8\,\phi$	=	effective porosity

$$r_{dispersed} = r_{waste} + 2.3\,\sqrt{D\,r_{waste}}$$

where

$r_{dispersed}$	=	radial distance of waste front with dispersion (feet)
D	=	dispersion coefficient; 3 ft for sandstone and 65 ft for carbonate

using the following parameters:

ϕ	=	0.1
h	=	85
D	=	65

	Current Plume Size (January 1, 2017)			Plume Size at End of Permit Period (+5 Years)		
	V	r_{waste}	$r_{dispersed}$	V	r_{waste}	$r_{dispersed}$
	Total Volume Injected (gallons)	Radial Distance of Waste Front (feet)	Radial Distance of Waste Front with Dispersion (feet)	Total Volume Injected (gallons)	Radial Distance of Waste Front (feet)	Radial Distance of Waste Front with Dispersion (feet)
Well 1 (Mewbourne)	1,658,353,240	3222	4274	2,709,553,240	4118	5308
Well 2 (Chukka)	1,196,702,400	2737	3707	2,247,902,400	3751	4886
Well 3 (Gaines)	683,350,989	2068	2911	1,734,550,989	3295	4359

APPENDIX F-1

FORMATION FLUID ANALYTICAL DATA
NAVAJO REFINING COMPANY, L.L.C.
ARTESIA, NEW MEXICO

Chemical	Mewbourne Well No. 1	Chukka Well No. 2	Gaines Well No. 3	Average
Date	July 31, 1998	June 14, 1999	Nov 8, 2006	
Fluoride (mg/l)	2.6	9.7	Not Detected	6.15
Chloride (mg/L)	19,000	15,000	10,447	14,815.67
NO3-N (mg/L)	<10	<10	--	<10
SO4 (mg/L)	2,200	2000	1,908	2,036
CaCO3 (mg/L)	1000	1210	--	1105
Specific Gravity (g/L)	1.034	1.0249	--	1.0295
TDS (mg/L)	33,000	20,000	--	26,500
Specific Conductance (uMHOs/cm)	52,000	43,000	--	47,500
Potassium (mg/L)	213	235	85.5	177.83
Magnesium (mg/L)	143	128	155	142
Calcium (mg/L)	390	609	393	464
Sodium (mg/L)	12,770	8,074	6,080	8,974.67
pH (s.u.)	8.1	7.2	--	7.65

The data in the above table was referenced from "Discharge Plan Application and Application for Authorization to Inject per Oil Conservation Division Form C-108, into Class I Wells WDW-1 and Proposed WDW-2 and WDW-3" and the "Discharge Permit Approval Conditions", "Reentry and Completion Report Waste Disposal Well No. 2", and "Reentry and Completion Report Waste Disposal Well No. 3".

COMPATABILITY STUDY
NAVAJO REFINING COMPANY

Artesia, New Mexico

December 2016

PB Energy Storage Services
Houston, TX

A Company of

WSP | PARSONS BRINCKERHOFF

Project No. 50904B

Prepared by Brenda Love   Reviewed by Oliver Man

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1.0 Compatibility Analyses

Compatibility tests for Navajo's waste stream were performed by analyzing the chemical reactions between different mixtures of the secondary reverse osmosis reject fluid and the waste water and flue gas scrubber mixture. All testing and analysis were performed by Intertek Group PLC (Intertek) who provide chemical testing and analyses to understand the composition of chemical substances and materials that are used in products, industrial processes and manufacturing. Intertek is located in Houston, Texas. Intertek's report is included as Attachment 1.

2.0 Analyzed Waste Streams

The waste stream to be injected into the waste disposal wells will be comprised of three different fluids from the different processes in the refinery: Secondary Reverse Osmosis reject (SRO), Flue Gas Scrubber fluid (FGS), and Waste Water and Flue Gas Scrubber fluid (WWFGS). Since Navajo can't separate the waste water from the flue gas scrubber fluid prior to injecting it, an analysis of the waste water could not be performed.

2.1 Secondary Reverse Osmosis Reject Stream

The SRO was synthesized by taking the existing Reverse Osmosis (RO) reject and evaporating this fluid to 75% of the existing volume of the RO. This reduction left behind a large amount of residue as shown in Figure 1. After the initial evaporation to create the SRO, the SRO was filtered through a 0.45 micron filter. The residue leftover after the filtering process was tested as "pretest" material and was analyzed using the scanning electron microscope (SEM). A copy of Intertek's SEM analyses of the pretest SRO material is included as Table 1.

2.2 Flue Gas Scrubber Fluid

The FGS fluid was milky in color with a large amount of suspended solids. The color and amount of suspended solids in the FGS is because the FGS is not being treated through the knockout boxes and centrifuges. Before testing, the FGS was filtered through a 0.45 micron filter. The suspended solids content was 0.97 grams/liter. The SEM analysis of the pretest FGS is included in Table 2. The FGS fluid is shown in Figure 2, Figure 3, and Figure 4.

2.3 Wastewater and Flue Gas Scrubber Mix

The final fluid provided to the lab for testing was the WWFGS fluid. Prior to Navajo mixing the FGS with the wastewater the suspended solids in the FGS are removed using two knockout boxes and a centrifuge. As a result of this process, the WWFGS is clearer and contains considerably less suspended solids as compared to the FGS. The WWFGS is shown in Figure 5.

3.0 Mass Concentration of the Precipitates of SRO, FGS, and WWFGS

The blends of injectate tested were as follows:

- 100% SRO
- 100% FGS
- 100% WWFGS
- 75%:25% SRO:FGS
- 50%:50% SRO:FGS
- 25%:75% SRO:FGS
- 75%:25% SRO:WWFGS
- 50%:50% SRO:WWFGS
- 25%:75% SRO:WWFGS

Each blend was put into a one liter stainless steel piston cylinder and brought to downhole conditions of 150°F at a pressure of 5000 psi and left undisturbed for 20 days. After 20 days, the vessels were gradually brought back to surface conditions in which the pressure was bled off and allowed to cool to ambient room temperature. The solutions were then run through a 0.45 micron filter to capture any precipitate that may have formed during the incubation period. After filtration, any solids which precipitated out of solution were weighed and subsequently analyzed using the SEM.

The mass concentration of the precipitates along with photographs of the precipitated solids are presented in Table 3. The anticipated waste stream to be injected will be a blend of the SRO and WWFGS. As shown in the Table 3, the mixture of the anticipated waste stream with the least amount of suspended solids was the 50:50 SRO:WWFGS at 0.4050 grams/liter followed by the 25:75 SRO:WWFGS at 0.4450 grams/liter and then the 75:25 SRO:WWFGS at 0.4667 grams/liter.

4.0 SEM of SRO, FGS, and WWFGS

The samples precipitated out of solution were analyzed using the SEM. The weight percent of the individual elements of the SRO, FGS, and WWFGS prior to mixing are shown in Table 4, Table 5, and Table 6, respectively. The weight percent of the individual elements of the solids precipitated out of the different blends of the tested fluids described in Section 3.0 are shown in Table 7.

5.0 Acid Solubility of SRO, FGS, and WWFGS

Acid solubility testing was conducted using the samples of the precipitates described in Section 3.0.

A known amount of solids were placed in 20 milliliter glass vials to which a minimum of 2 milliliters of 37% concentrated hydrochloric acid (HCl) was added. The vials were allowed to sit undisturbed for three days. After three days, the samples were photographed and filtered to remove any residual solids. Any residual solids recovered were dried overnight at 105°F, then cooled to room temperature and weighed both before being treated with acid and then after being treated with acid. The results of the acid solubility testing are shown in Table 8.

With the exception of the pretest SRO and pretest WWFGS solutions it appears that all of the solids filtered from the different combinations of the tested fluids were, for the most part, completely dissolved in the HCl acid. Periodic acid stimulation of the disposal wells will therefore be a viable option for controlling potential skin issues in the wellbore.

6.0 Conclusions

In conclusion, all of the waste streams tested precipitated some amount of solids out of solution. The anticipated waste stream to be injected into the disposal wells will be a combination of the SRO and WWFGS (SRO:WWFGS). The waste stream mixture that yielded the least amount of suspended solids was the 50:50 SRO:WWFGS mix, which yielded 0.4050 grams/liter of precipitate followed by the 25:75 SRO:WWFGS at 0.4450 grams/liter, and finally the 75:25 SRO:WWFGS at 0.4667 grams/liter.

All of the different combinations of the tested fluids were, for the most part, completely dissolved using between 2 milliliters and 8 milliliters of 37% HCl acid. Only the SRO pretest solids and the FGS pretest solids were not totally acid soluble.

It is reasonable to conclude that the precipitates formed from all of the mixtures tested can be dissolved by periodically acidizing the formation receiving the waste stream. By dissolving the precipitates through acidization the overall life of the well should not be adversely affected.

Because of the acid solubility of the precipitates formed during the testing, additional studies should be conducted to determine if adjusting the pH of the fluid will reduce the amount of solids that precipitate out of the injectate prior to injecting the waste fluids into the disposal wells.

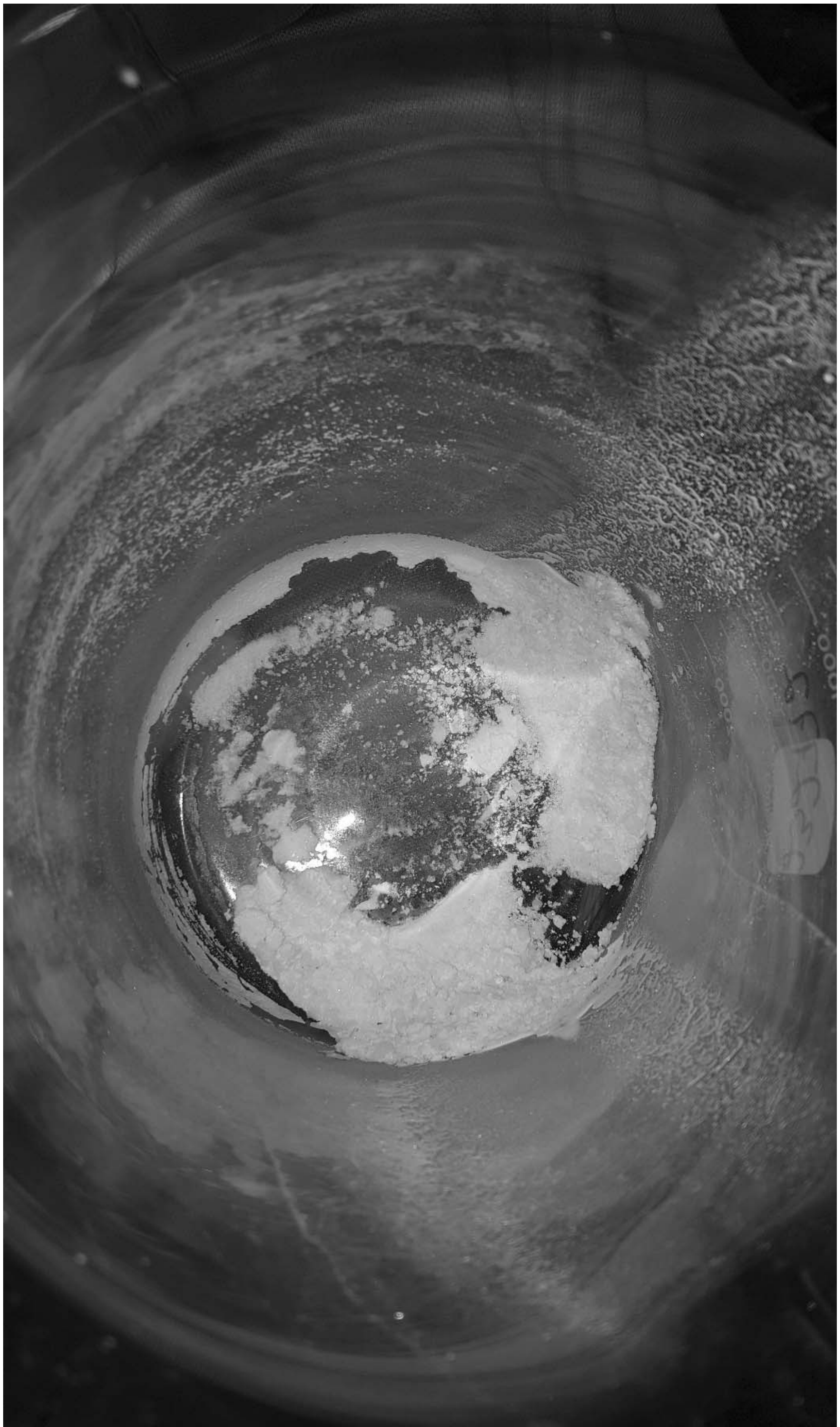

FIGURE 1: SRO Residue After Evaporation

FIGURE 2: FGS Sample Prior to Initial Filtering

FIGURE 3: FGS Filtering Process

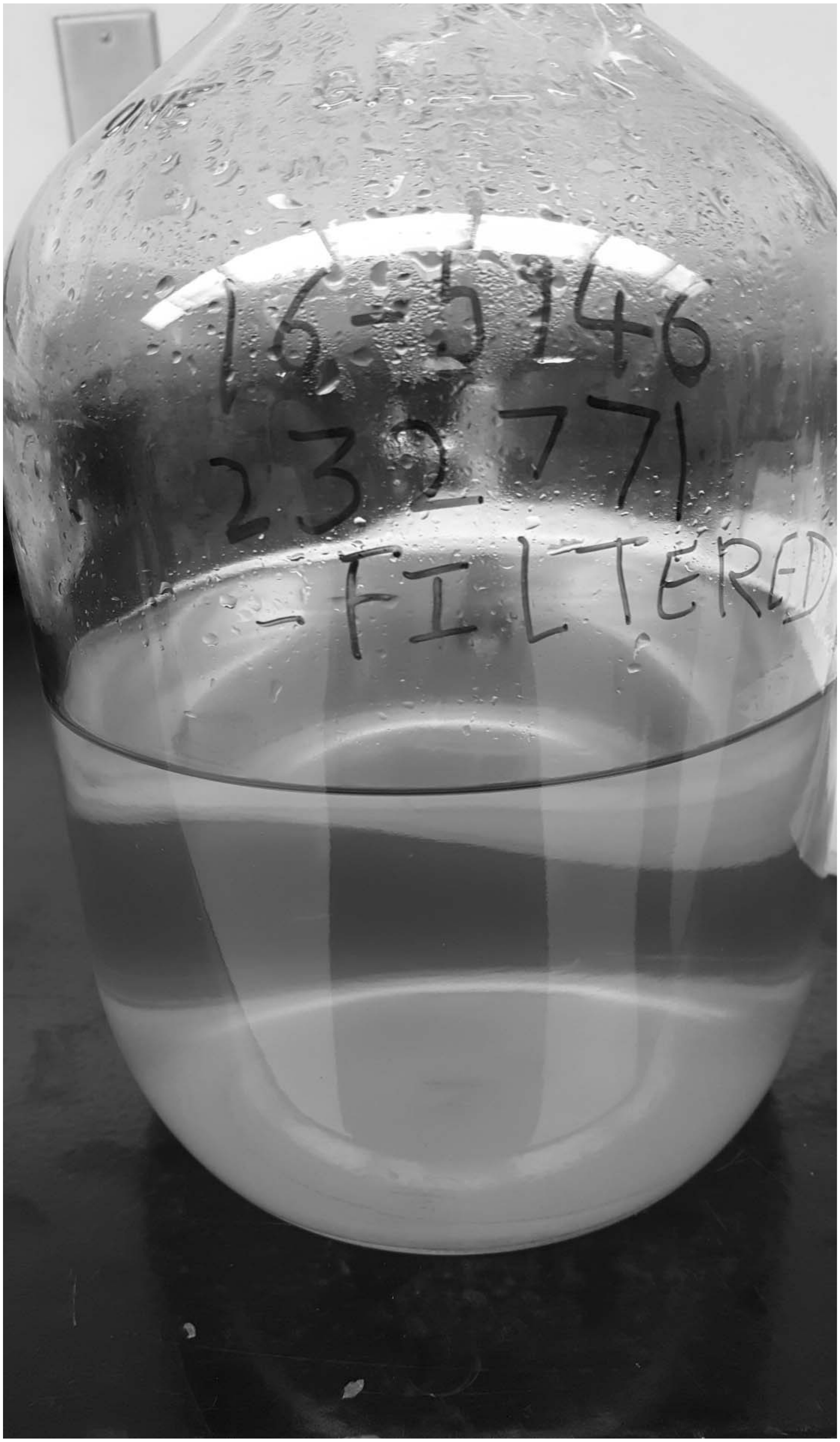

FIGURE 4: FGS After Filtering

FIGURE 5: WWFGS Fluid from the Plant

TABLE 1: SEM Analysis of the Pretest SRO Sample

Navajo Waste Stream Characteristics	
Element	Weight Percent
Oxygen	56.91
Calcium	22.13
Sulfur	13.93
Carbon	2.97
Magnesium	2.14
Silicon	1.92
Nitrogen	0.00
Fluorine	0.00
Sodium	0.00
Aluminum	0.00
Phosphorus	0.00
Chloride	0.00
Chromium	0.00
Manganese	0.00
Titanium	0.00

TABLE 2: SEM Analysis of the Pretest FGS Sample

Navajo Waste Stream Characteristics	
Element	Weight Percent
Oxygen	39.39
Aluminum	27.94
Silicon	22.00
Sulfur	21.00
Lanthanum	2.79
Carbon	2.47
Magnesium	1.91
Cerium	1.35
Iron	0.76
Sodium	0.54
Titanium	0.44
Calcium	0.20
Nitrogen	0.00
Fluorine	0.00
Phosphorus	0.00

TABLE 3: Mass Concentration of the Precipitated Solids

Test	Mass Concentration (grams/liter)
50:50 SRO:FGS	0.9083
75:25 SRO:FGS	0.8033
100% SRO	0.6217
100% WWFGS	0.5267
75:25 SRO:WWFGS	0.4667
25:75 SRO:WWFGS	0.4450
25:75 SRO:FGS	0.4050
50:50 SRO:WWFGS	0.4050
100% FGS	0.3750

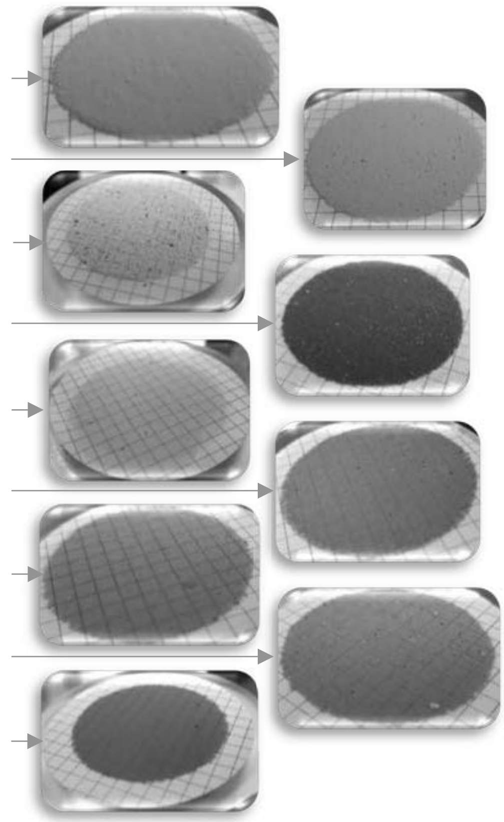

TABLE 4: SEM Analysis of the SRO Sample

Navajo Waste Stream Characteristics	
Element	Weight Percent
Element	
Oxygen	45.52
Calcium	21.5
Carbon	9.05
Nickel	8.23
Silicon	6.87
Magnesium	4.40
Sulfur	3.72
Iron	0.51
Phosphorus	0.20
Nitrogen	0.00
Fluorine	0.00
Sodium	0.00
Aluminum	0.00
Chloride	0.00
Chromium	0.00

TABLE 5: SEM Analysis of the FGS Sample

Navajo Waste Stream Characteristics	
Element	Weight Percent
Element	
Oxygen	34.96
Nickel	23.35
Carbon	17.43
Sodium	6.77
Sulfur	6.59
Aluminum	4.86
Iron	2.05
Silicon	1.86
Magnesium	1.32
Phosphorus	0.47
Calcium	0.24
Chloride	0.10
Nitrogen	0.00
Fluorine	0.00
Chromium	0.00

TABLE 6: SEM Analysis of the WWFGS Sample

Navajo Waste Stream Characteristics	
Element	Weight Percent
Nickel	32.23
Oxygen	29.53
Carbon	18.65
Iron	9.89
Phosphorus	1.87
Sulfur	1.41
Chromium	1.34
Calcium	1.13
Zinc	0.94
Aluminum	0.73
Copper	0.72
Silicon	0.64
Magnesium	0.45
Sodium	0.31
Chloride	0.15

TABLE 7: SEM Analysis

Sample	SRO Pretest Sample	FGS Pretest Sample	FGS Sample	SRO Sample	WWFGS Sample	25:75 SRO:FGS Sample	50:50 SRO:FGS Sample	75:25 SRO:FGS Sample	25:75 SRO:WWFGS Sample	50:50 SRO:WWFGS Sample	75:25 SRO:WWFGS Sample
Element											
Carbon	2.97	2.47	17.43	9.05	18.65	8.2	8.57	9.4	9.87	10.09	8.96
Nitrogen	0	0	0	0	0	0	2.19	0	0	0	0
Fluorine	0	0	0	0	0	0	0	0	0	0	0
Oxygen	56.91	39.39	34.96	45.52	29.53	46.87	45.91	48.14	42.58	37.5	42.17
Sodium	0	0.54	6.77	0	0.31	0.39	0	1.33	0	0	0.15
Magnesium	2.14	1.91	1.32	4.4	0.45	1.73	1.35	2.97	11.86	8.35	7.39
Aluminum	0	27.94	4.86	0	0.73	0.26	0	1.36	0	0.35	0.68
Silicon	1.92	22	1.86	6.87	0.64	2.17	2.37	3.55	19.27	15.85	13.87
Phosphorus	0	0	0.47	0.2	1.87	0	0	0.16	0	0.32	0.27
Sulfur	13.93	21	6.59	3.72	1.41	0.78	0.67	1.65	0.54	0.73	1.3
Chloride	0	0	0.1	0	0.15	0	0	0	0	0	0.29
Calcium	22.13	0.2	0.24	21.5	1.13	35.11	38.95	23.7	6.95	3.42	7.37
Chromium	0	0	0	0	1.34	0	0	0	0	0	0
Manganese	0	0	0	0	0	0	0	0	0	0	0
Titanium	0	0.44	0	0	0	0	0	0	0	0	0
Vanadium	0	0	0	0	0	0	0	0	0	0	0
Iron	0	0.76	2.05	0.51	9.89	0.28	0	0.99	0.51	0.91	1.06
Nickel	0	0	23.35	8.23	32.23	3.14	0	5.76	8.41	22.49	15.45
Copper	0	0	0		0.72	0	0	0	0	0	0
Zinc	0	0	0	0	0.94	0	0	1	0	0	1.05
Strontium	0	0	0	0	0	1.07	0	0	0	0	0
Barium	0	0	0	0	0	0	0	0	0	0	0
Lanthanum	0	2.79	0	0	0	0	0	0	0	0	0
Cerium	0	1.35	0	0	0	0	0	0	0	0	0

TABLE 8: Acid Solubility

Precipitate Sample	Starting Weight	Amount of Acid Added	Final Weight	Acid Solubility
	grams	milliliters	grams	Percent
SRO	0.0481	8	0.0016	96.67
FGS	0.0012	2	0	100
WWFGS	0.0098	8	0	100
75:25 SRO:FGS	0.0014	2	0	100
50:50 SRO:FGS	0.0594	2	0	100
25:75 SRO:FGS	0.0621	2	0	100
75:25 SRO:WWFGS	0.0052	2	0	100
50:50 SRO:WWFGS	0.0082	2	0	100
25:75 SRO:WWFGS	0.0056	2	0	100
SRO Pretest	0.1647	14	0.0377	77.11
FGS Pretest	0.1268	14	0.1148	9.46

ATTACHMENT 1: Intertek Analysis

Intertek

FLUID / FLUID COMPATIBILITY TESTING

F I N A L R E P O R T

Prepared for

PARSONS BRICKERHOFF

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December 9, 2016

SAMPLE ANALYSIS

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INTRODUCTION

At the request of Parsons Brinckerhoff, high pressure high temperature fluid/fluid compatibility testing was conducted. The solids obtained from the testing were analyzed using Scanning Electron Microcope Energy Dispersive Microchemical Analysis (SEM-EDS) and dissolved in concentrated hydrochloric acid.

EXPERIMENTAL

FLUID/FLUID COMPATIBILITY TESTING

Nine fluid / fluid compatibility tests (100% Secondary Reverse Osmosis (SRO), 100% filtered Flue Gas Scrubber Solution (FGS), 100% Waste Water Flue Gas Scrubber Mixture (WWFGS), 75%:25% Secondary Reverse Osmosis: Flue Gas Scrubber Solution (SRO:FGS), 50%:50% Secondary Reverse Osmosis: Flue Gas Scrubber Solution (SRO:FGS), 25%:75% Secondary Reverse Osmosis: Flue Gas Scrubber Solution (SRO:FGS), 75%:25% Secondary Reverse Osmosis:Waste Water Flue Gas Scrubber Mixture (SRO:WWFGS), 50%:50% Secondary Reverse Osmosis:Waste Water Flue Gas Scrubber Mixture (SRO:WWFGS), and 25%:75% Secondary Reverse Osmosis:Waste Water Flue Gas Scrubber Mixture (SRO:WWFGS) were conducted in one liter stainless steel piston cylinders at 150°F and 5000 psi for twenty days. After twenty days, the cylinders were allowed to cool to room temperature and de-pressurized. After de-pressurization, the cylinders were open one by one and the resulting solutions were filtered to collect the solids which had formed as a result of the testing.

SCANNING ELECTRON MICROSCOPE / ENERGY DISPERSIVE MICROCHEMICAL ANALYSIS (SEM/EDS)

A subsample of each of the samples was transferred from cellulose filter paper to a stub coated with double-faced carbon tape and the sample was then gold-coated. The samples were examined, described and photographed using a Joel scanning electron microscope equiped with an energy-dispersive X-ray analyzer.

HYDROCHLORIC ACID SOLUBILITY TESTING

A known amount of solid from each of the samples was added to 20 milliliter glass vials to which a minimum of 2 milliliters of 12.1 M hydrochloric acid was added. The vials were allowed to set undisturbed for three days. After three days, the samples were photographed and filtered to remove any residual solids. Any residual solids recovered were dried overnight at 105°C, cooled to room temperature and weighed.

RESULTS AND DISCUSSION

The concentrations of the precipitates produced as a results of the liquid / liquid compatibility testing are present in Table 1. The results of the hydrochloric acid solubility testing are presented in Table 2 and Figures 109 - 112. A summary of the SEM-EDS data is presented in Table 3. Photographs of the precipitates, SEM photomicrographs, SEM-EDS data are presented in Figures 1 - 108.

Scanning Electron Microscope photomicrographs of a subsample of the SRO pretest sample are presented in Figures 2 and 7. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 3-6 and Figure 8 and indicate that the sample mainly contains O, Ca, S, C, Mg, and Si which suggests that the sample may contain calcium sulfate, magnesium sulfate, magnesium oxide,and silicon dioxide.

Scanning Electron Microscope photomicrographs of a subsample of the FGS pretest sample are presented in Figures 10 and 17. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 11-16 and Figures 18-22 and indicate that the sample mainly contains O, Al, Si, S, La, C, Mg, Ce, Fe, Na, Ti, and Ca which suggests that the sample may contain aluminium oxide, aluminium sulfate, silicon dixoide, magnesium sulfate, magnesium oxide, lanthanum oxide, cerium oxide, and iron oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 100% FGS post test sample are presented in Figures 24 and 29. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 25-28 and Figures 30-32 and indicate that the sample mainly contains O, Ni, C, Na, S, Al, Fe, Si, Mg, P, Ca, and Cl which suggests that the sample may contain nickel oxide, nickel carbonate, aluminium oxide, aluminium sulfate, silicon dioxide, magnesium sulfate, magnesium oxide, and iron oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 100% SRO post test sample are presented in Figures 34 and 39. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 35-38 and Figures 40-43 and indicate that the sample mainly contains O, Ca, C, Ni, Si, Mg, S, Fe, and P which suggests that the sample may contain calcium carbonate, calcium sulfate, nickel oxide, nickel carbonate, magnesium sulfate, magnesium oxide, magnesium carbonate, silicon dioxide, and iron oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 100% WWFGS post test sample are presented in Figures 45 and 49. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 46-48 and Figures 50-52 and indicate that the sample mainly contains Ni, O, C, Fe, P, S, Cr, Ca, Zn, Al, Cu, Si, Mg, and Na which suggests that the sample may contain nickel carbonate, nickel oxide, and iron oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 25%:75% SRO:FGS post test sample are presented in Figures 54 and 57. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 55-56 and Figures 58-61 and indicate that the sample mainly contains O, Ca, C, Ni, Si, Mg, Sr, S, Na, Fe, and Al which suggests that the sample may contain calcium carbonate, calcium sulfate, strontium carbonate, strontium sulfate, silicon dioxide, magnesium oxide, nickel carbonate, and nickel oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 50%:50% SRO:FGS post test sample are presented in Figures 63 and 67. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 64-66 and Figures 68-71 and indicate that the sample mainly contains O, Ca, C, Si, N, and S which suggests that the sample may contain calcium carbonate, calcium sulfate, silicon dioxide, and magnesium oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 75%:25% SRO:FGS post test sample are presented in Figures 73 and 77. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 74-76 and Figures 78-82 and indicate that the sample mainly contains O, Ca, C, Ni, Si, Mg, S, Al, Na, Zn, Fe, and P which suggests that the sample may contain calcium carbonate, calcium sulfate, nickel carbonate, nickel oxide, silicon dioxide, zinc oxide, iron oxide, and magnesium oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 25%:75% SRO:WWFGS post test sample are presented in Figures 84 and 88. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 85-87 and Figures 89-90 and indicate that the sample mainly contains O, Si, Mg, C, Ni, Ca, S, and Fe which suggests that the sample may contain silicon dioxide, nickel carbonate, nickel oxide, magnesium carbonate, magnesium oxide, calcium carbonate, and iron oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 50%:50% SRO:WWFGS post test sample are presented in Figures 92 and 96. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 93-95 and Figures 97-99 and indicate that the sample mainly contains O, Ni, Si, C, Mg, Ca, Fe, S, Al, and P which suggests that the sample may contain silicon dioxide, nickel carbonate, nickel oxide, magnesium carbonate, magnesium oxide, calcium carbonate, and iron oxide.

Scanning Electron Microscope photomicrographs of a subsample of the 75%:25% SRO:WWFGS post test sample are presented in Figures 101 and 105. The EDS micro-chemical analysis of the selected parts of the subsample are presented in Figures 102-104 and Figures 106-108 and indicate that the sample mainly contains O, Ni, Si, C, Mg, Ca, S, Fe, Zn, Cl, P, and Na which suggests that the sample may contain silicon dioxide, nickel carbonate, nickel oxide, magnesium carbonate, magnesium oxide, calcium carbonate, iron oxide, and zinc oxide.

TABLE 1

CONCENTRATIONS OF PRECIPITATE PRODUCED AS A RESULT OF THE TWENTY DAY FLUID / FLUID COMPATIBILITY TESTING

Test Sample	Concentration of Precipitate Produced
SRO	0.6217 grams/liter
FGS	0.3750 grams/liter
WWFGS	0.5267 grams/liter
75:25 SRO:FGS	0.8033 grams/liter
50:50 SRO:FGS	0.9083 grams/liter
25:75 SRO:FGS	0.4050 grams/liter
75:25 SRO:WWFGS	0.4667 grams/liter
50:50 SRO:WWFGS	0.4050 grams/liter
25:75 SRO:WWFGS	0.4450 grams/liter
FGS Pretest	0.9700 grams/liter

TABLE 2

RESULTS OF THE ACID SOLUBILITY TESTING OF THE PRODUCED PRECIPITATES WITH 12.1 M HYDROCHLORIC ACID

Precipitate Sample	Starting Weight	Amout of Acid Added	Final Weight	Acid Solubility
	grams	milliliters	grams	Percent
SRO	0.0481	8	0.0016	96.67
FGS	0.0012	2	0	100
WWFGS	0.0098	8	0	100
75:25 SRO:FGS	0.0014	2	0	100
50:50 SRO:FGS	0.0594	2	0	100
25:75 SRO:FGS	0.0621	2	0	100
75:25 SRO:WWFGS	0.0052	2	0	100
50:50 SRO:WWFGS	0.0082	2	0	100
25:75 SRO:WWFGS	0.0056	2	0	100
SRO Pretest	0.1647	14	0.0377	77.11
FGS Pretest	0.1268	14	0.1148	9.46

TABLE 3
SUMMARY OF THE SCANNING ELECTRON MICROSCOPE ENERGY DISPERSIVE MICROCHEMICAL ANALYSIS OF SUBSAMPLES OF THE PRODUCED SOLIDS

Sample		SRO Pretest Sample	FGS Pretest Sample	FGS Sample	SRO Sample	WWFGS Sample	25:75 SRO:FGS Sample	50:50 SRO:FGS Sample	75:25 SRO:FGS Sample	25:75 SRO:WWFGS Sample	50:50 SRO:WWFGS Sample	75:25 SRO:WWFGS Sample
Element	**Unit**											
Carbon	**weight percent**	2.97	2.47	17.43	9.05	18.65	8.20	8.57	9.40	9.87	10.09	8.96
Nitrogen	**weight percent**	0.00	0.00	0.00	0.00	0.00	0.00	2.19	0.00	0.00	0.00	0.00
Fluorine	**weight percent**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oxygen	**weight percent**	56.91	39.39	34.96	45.52	29.53	46.87	45.91	48.14	42.58	37.50	42.17
Sodium	**weight percent**	0.00	0.54	6.77	0.00	0.31	0.39	0.00	1.33	0.00	0.00	0.15
Magnesium	**weight percent**	2.14	1.91	1.32	4.40	0.45	1.73	1.35	2.97	11.86	8.35	7.39
Aluminium	**weight percent**	0.00	27.94	4.86	0.00	0.73	0.26	0.00	1.36	0.00	0.35	0.68
Silicon	**weight percent**	1.92	22.00	1.86	6.87	0.64	2.17	2.37	3.55	19.27	15.85	13.87
Phosphorus	**weight percent**	0.00	0.00	0.47	0.20	1.87	0.00	0.00	0.16	0.00	0.32	0.27
Sulfur	**weight percent**	13.93	21.00	6.59	3.72	1.41	0.78	0.67	1.65	0.54	0.73	1.30
Chloride	**weight percent**	0.00	0.00	0.10	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.29
Calcium	**weight percent**	22.13	0.20	0.24	21.50	1.13	35.11	38.95	23.70	6.95	3.42	7.37
Chromium	**weight percent**	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00
Manganese	**weight percent**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Titanium	**weight percent**	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vanadium	**weight percent**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron	**weight percent**	0.00	0.76	2.05	0.51	9.89	0.28	0.00	0.99	0.51	0.91	1.06
Nickel	**weight percent**	0.00	0.00	23.35	8.23	32.23	3.14	0.00	5.76	8.41	22.49	15.45
Copper	**weight percent**	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00
Zinc	**weight percent**	0.00	0.00	0.00	0.00	0.94	0.00	0.00	1.00	0.00	0.00	1.05
Strontium	**weight percent**	0.00	0.00	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00
Barium	**weight percent**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lanthanum	**weight percent**	0.00	2.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cerium	**weight percent**	0.00	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

FIGURE 1
PHOTOGRAPH OF THE SRO PRETEST SAMPLE

FIGURE 2
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE SRO PRETEST SAMPLE

FIGURE 3
EDS MICROCHEMICAL ANALYSIS OF THE SRO PRETEST SAMPLE PARTICLES SHOWN IN FIGURE 2

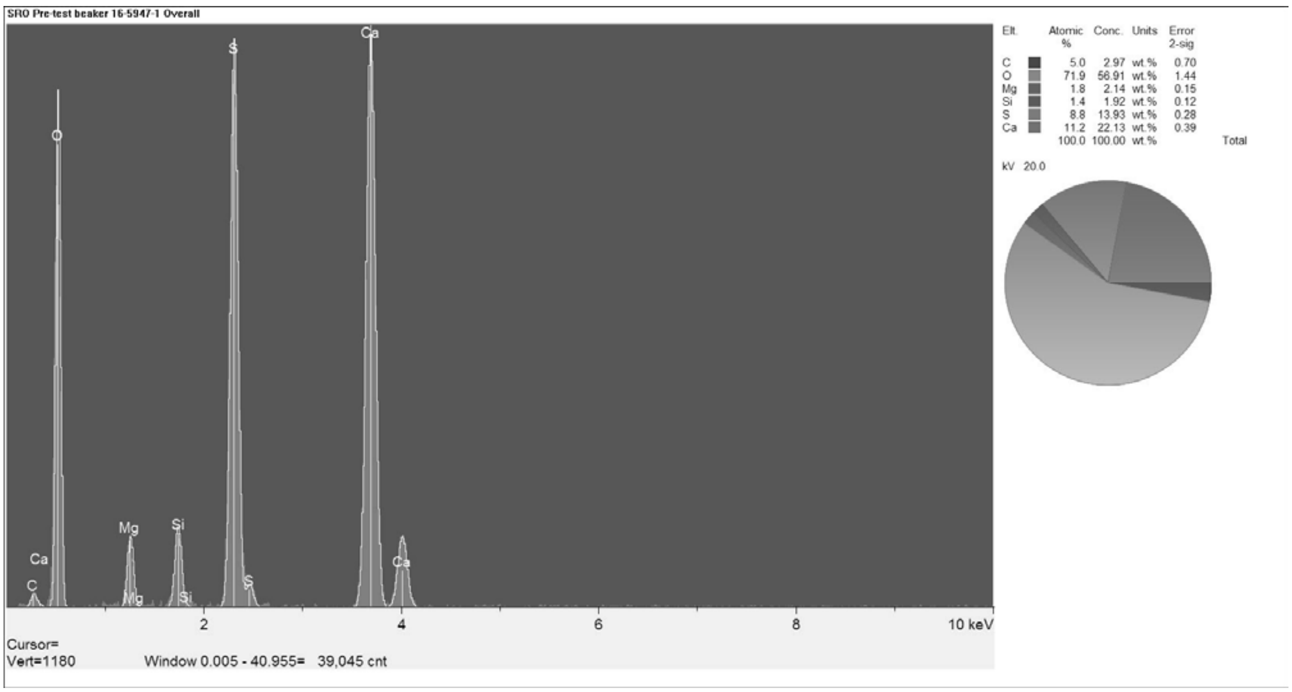

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FIGURE 4
EDS MICROCHEMICAL ANALYSIS OF THE SRO PRETEST SAMPLE PARTICLES LABELED #1 IN FIGURE 2

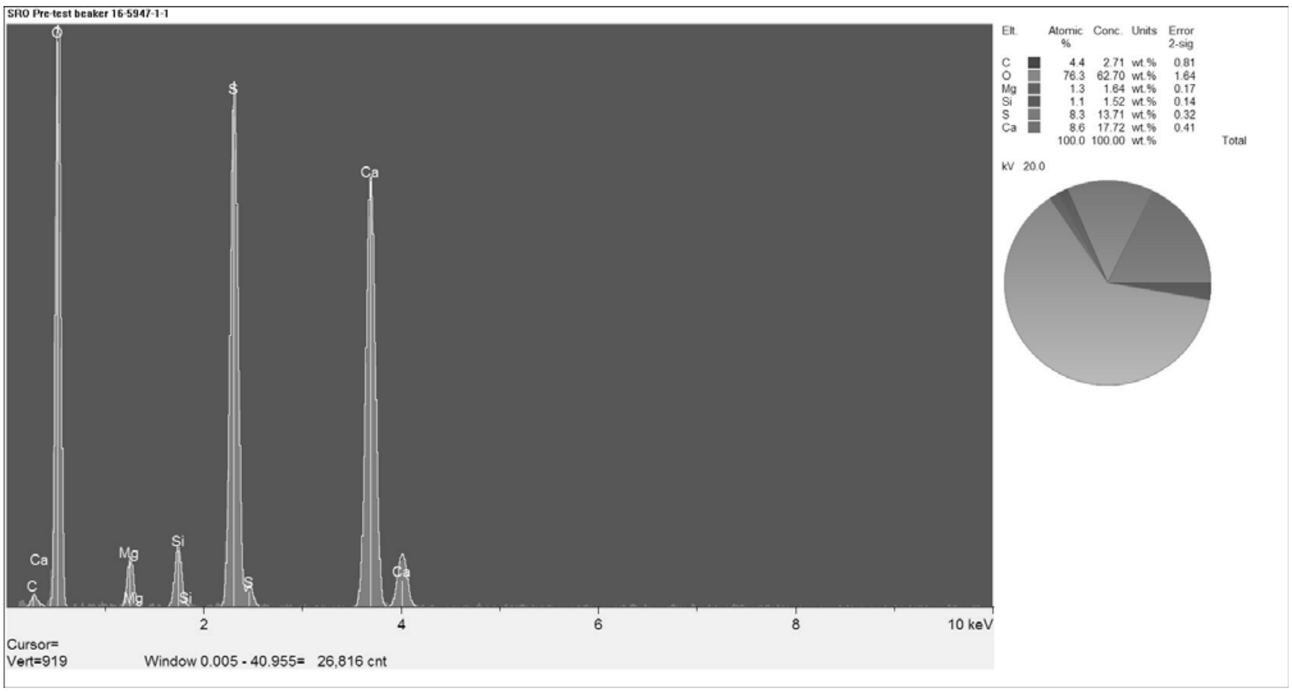


FIGURE 5
EDS MICROCHEMICAL ANALYSIS OF THE SRO PRETEST SAMPLE PARTICLES LABELED #2 IN FIGURE 2

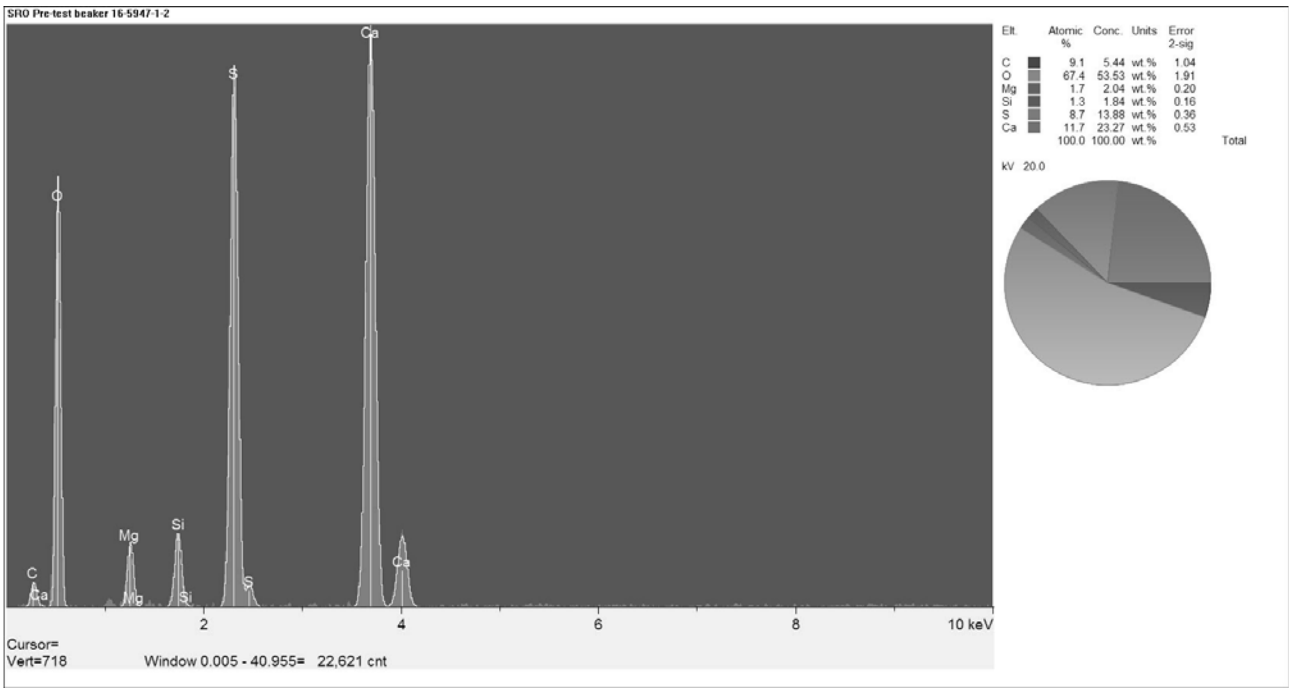


FIGURE 6
EDS MICROCHEMICAL ANALYSIS OF THE SRO PRETEST SAMPLE PARTICLES LABELED #3 IN FIGURE 2

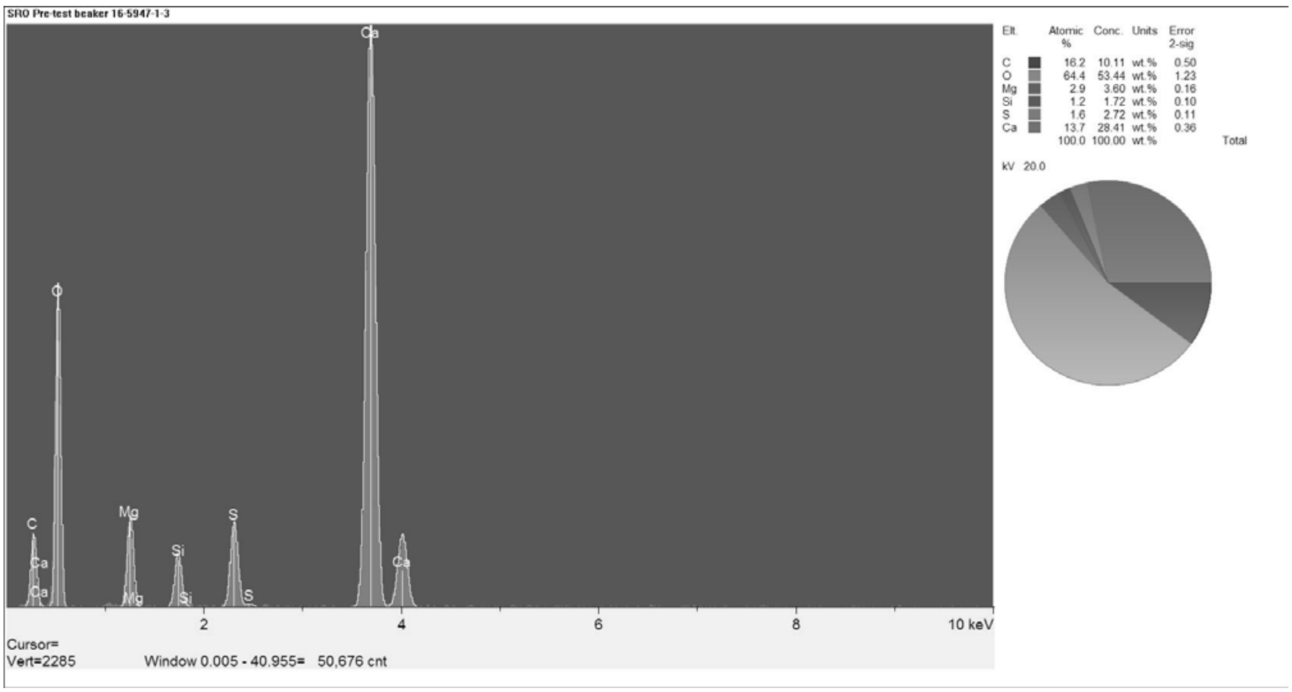


FIGURE 7
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE SRO PRETEST SAMPLE

FIGURE 8
EDS MICROCHEMICAL ANALYSIS OF THE SRO PRETEST SAMPLE PARTICLES LABELED #1 IN FIGURE 7

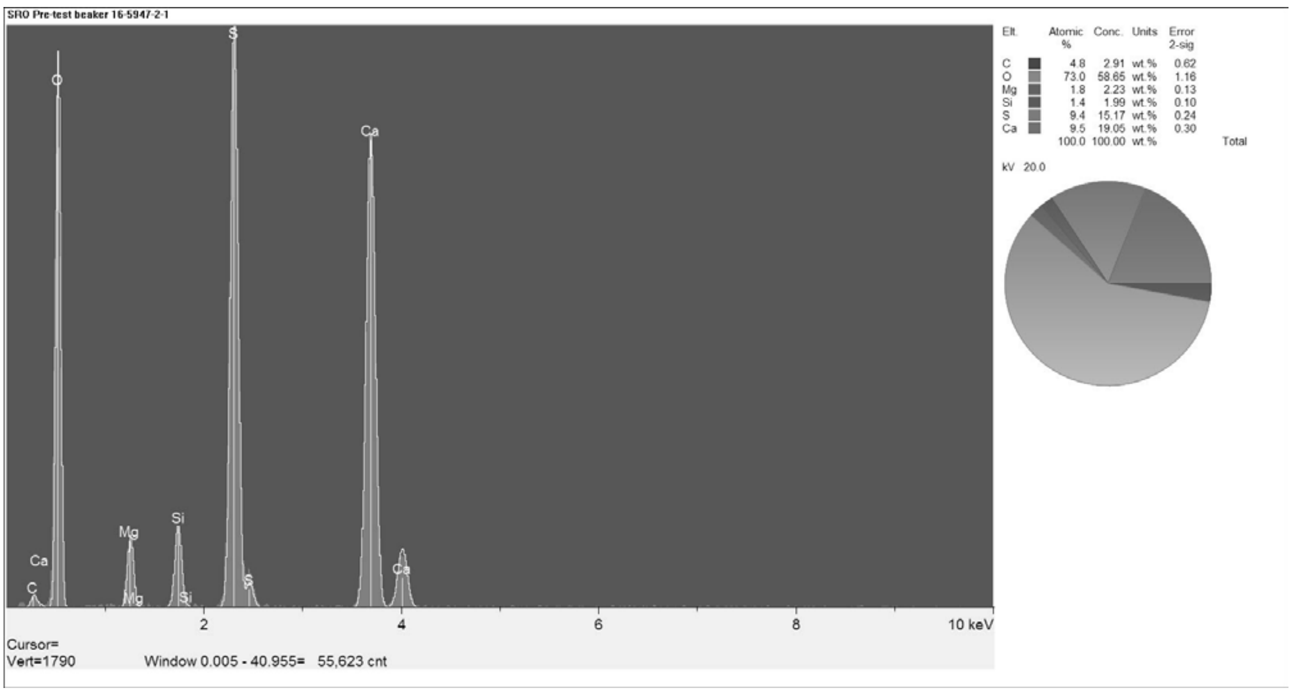


FIGURE 9
PHOTOGRAPH OF THE FGS PRETEST SAMPLE

FIGURE 10
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE FGS PRETEST SAMPLE

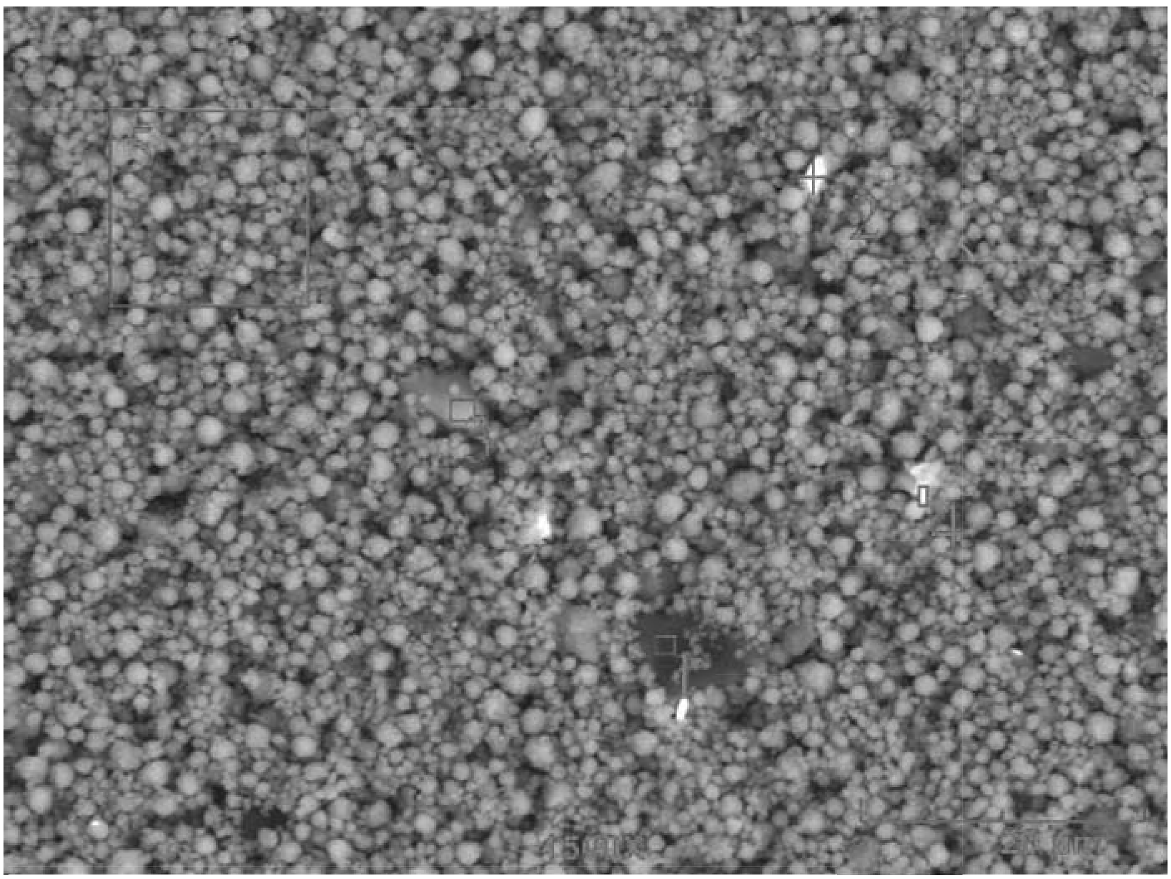


FIGURE 11
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES SHOWN IN FIGURE 10

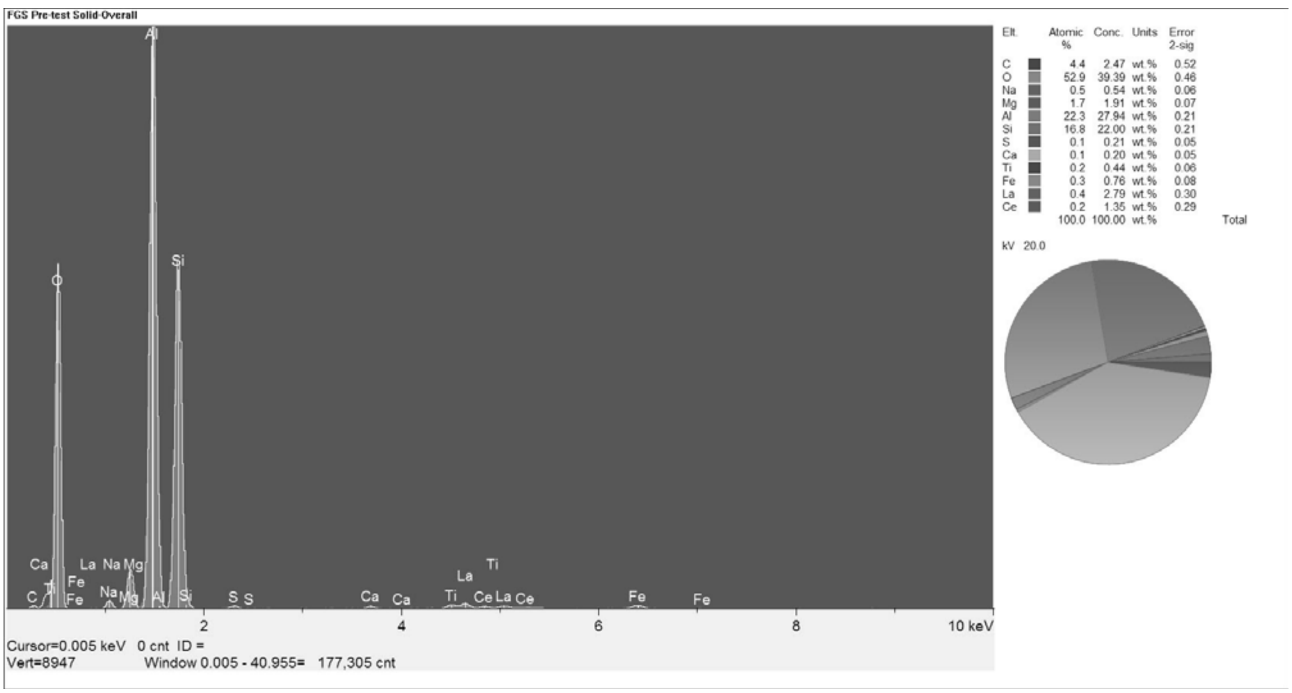


FIGURE 12
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #1 IN FIGURE 10

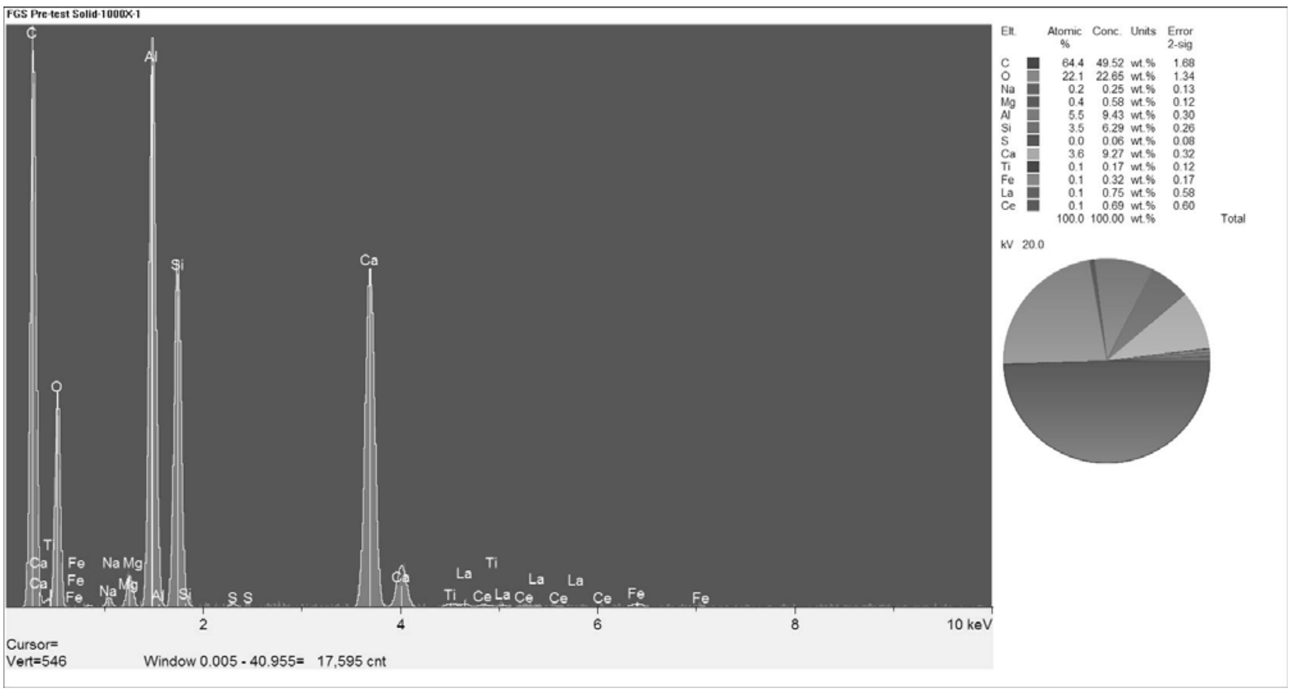


FIGURE 13
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #2 IN FIGURE 10

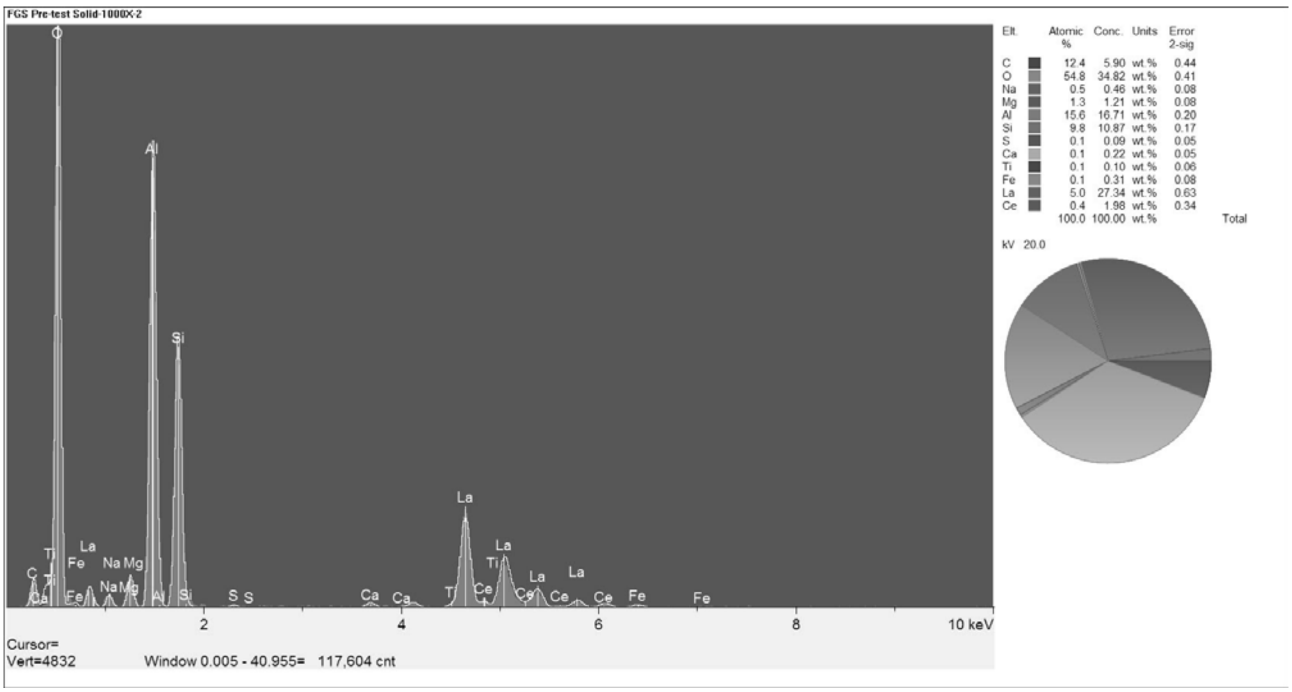


FIGURE 14
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #3 IN FIGURE 10

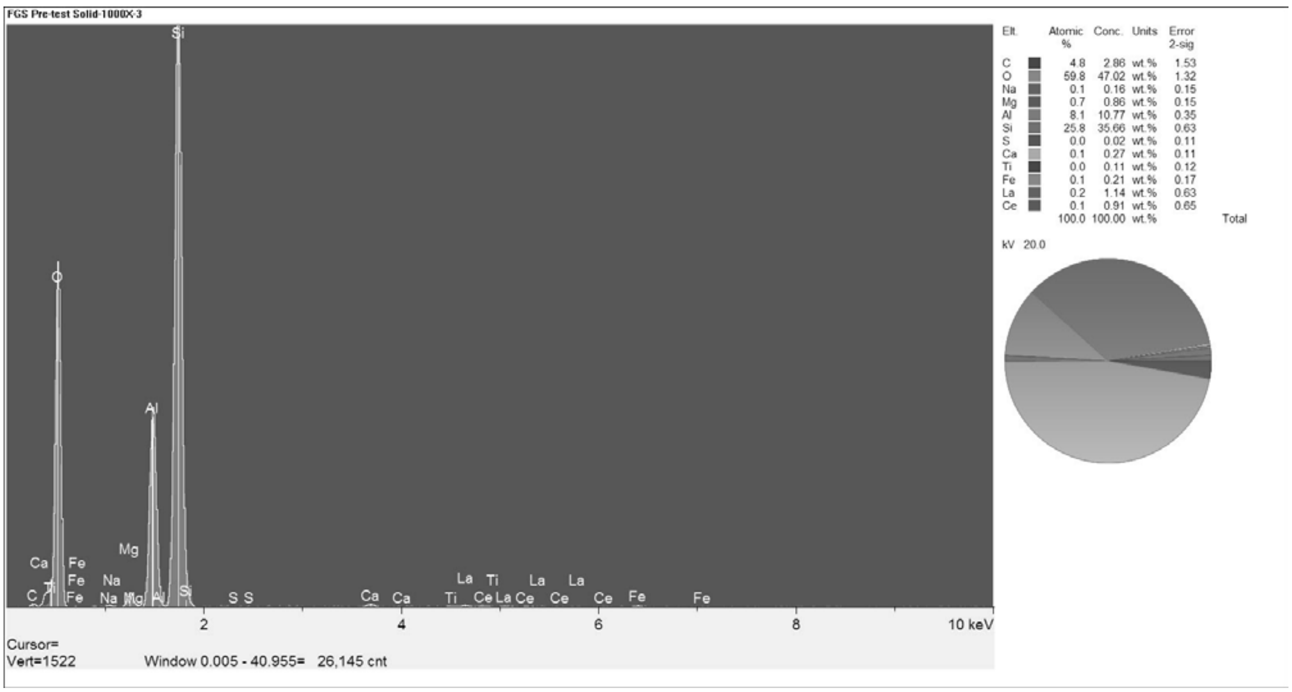
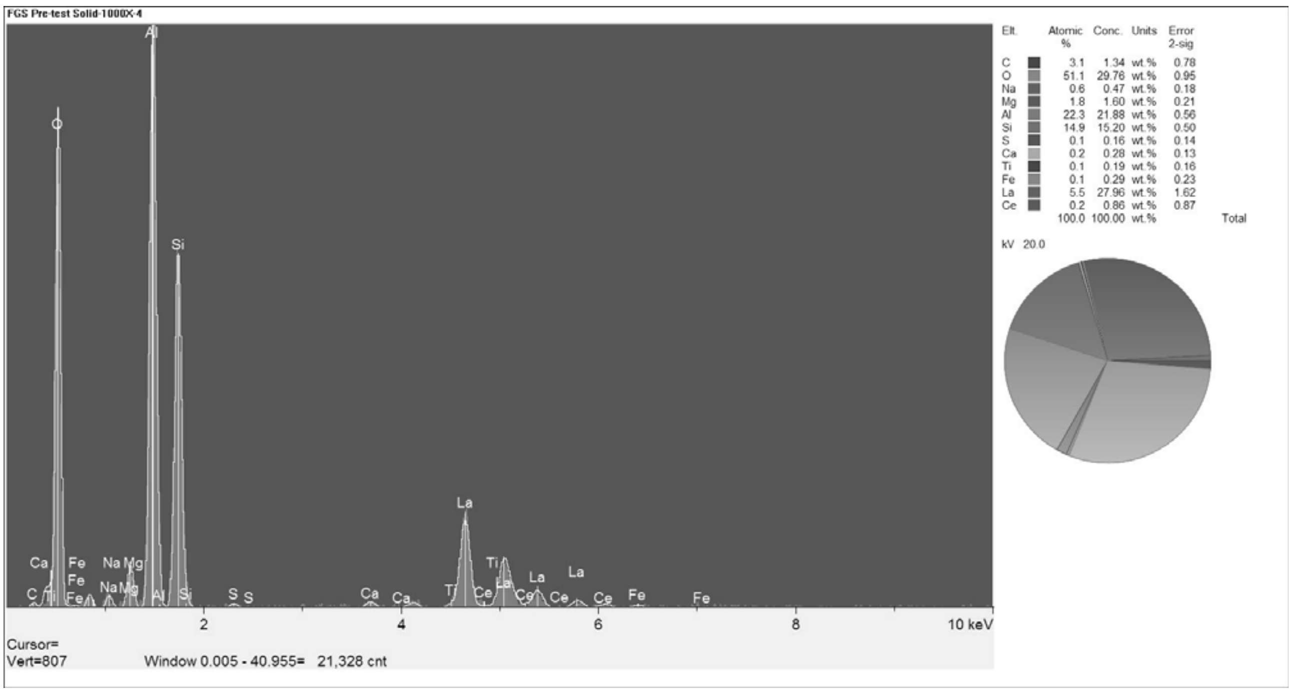


FIGURE 15
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #4 IN FIGURE 10



Elt.	Atomic %	Conc.	Units	Error 2-sig
C	3.1	1.34	wt.%	0.78
O	51.1	29.76	wt.%	0.95
Na	0.6	0.47	wt.%	0.18
Mg	1.8	1.60	wt.%	0.21
Al	22.3	21.88	wt.%	0.56
Si	14.9	15.20	wt.%	0.50
S	0.1	0.16	wt.%	0.14
Ca	0.2	0.28	wt.%	0.13
Ti	0.1	0.19	wt.%	0.16
Fe	0.1	0.29	wt.%	0.23
La	5.5	27.96	wt.%	1.62
Ce	0.2	0.86	wt.%	0.87
	100.0	100.00	wt.%	Total

FIGURE 16
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #5 IN FIGURE 10

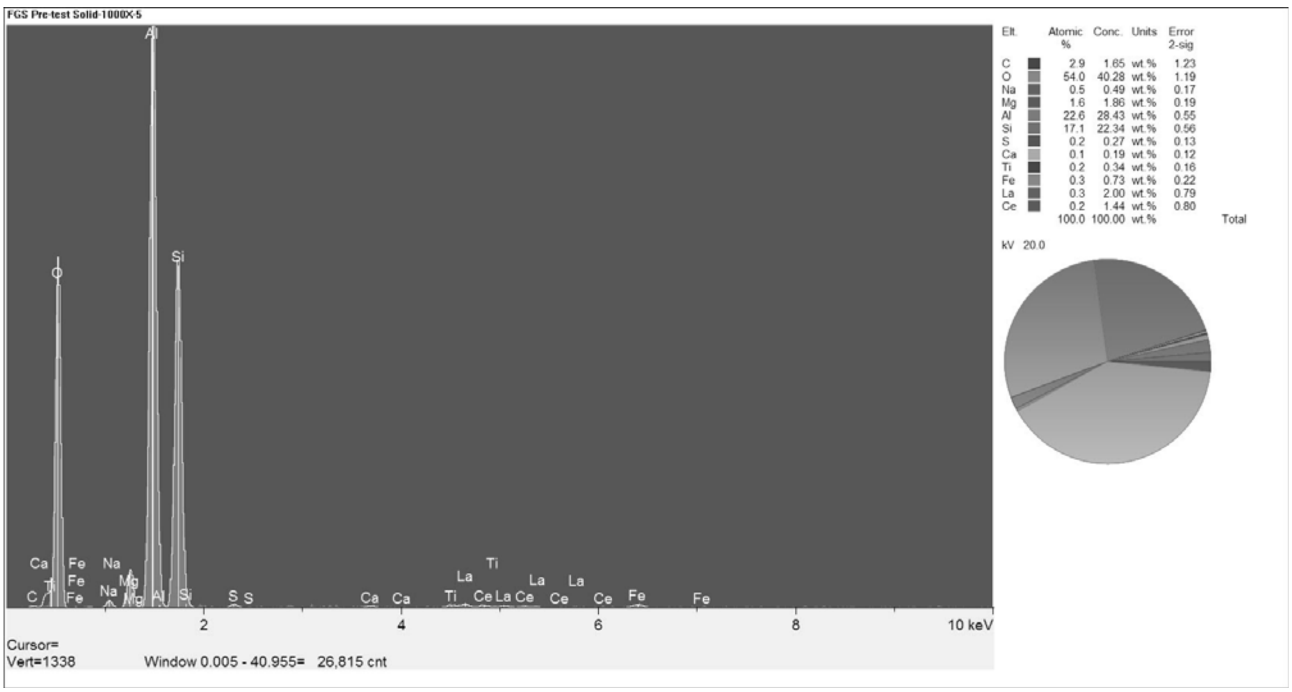


FIGURE 17
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE FGS PRETEST SAMPLE

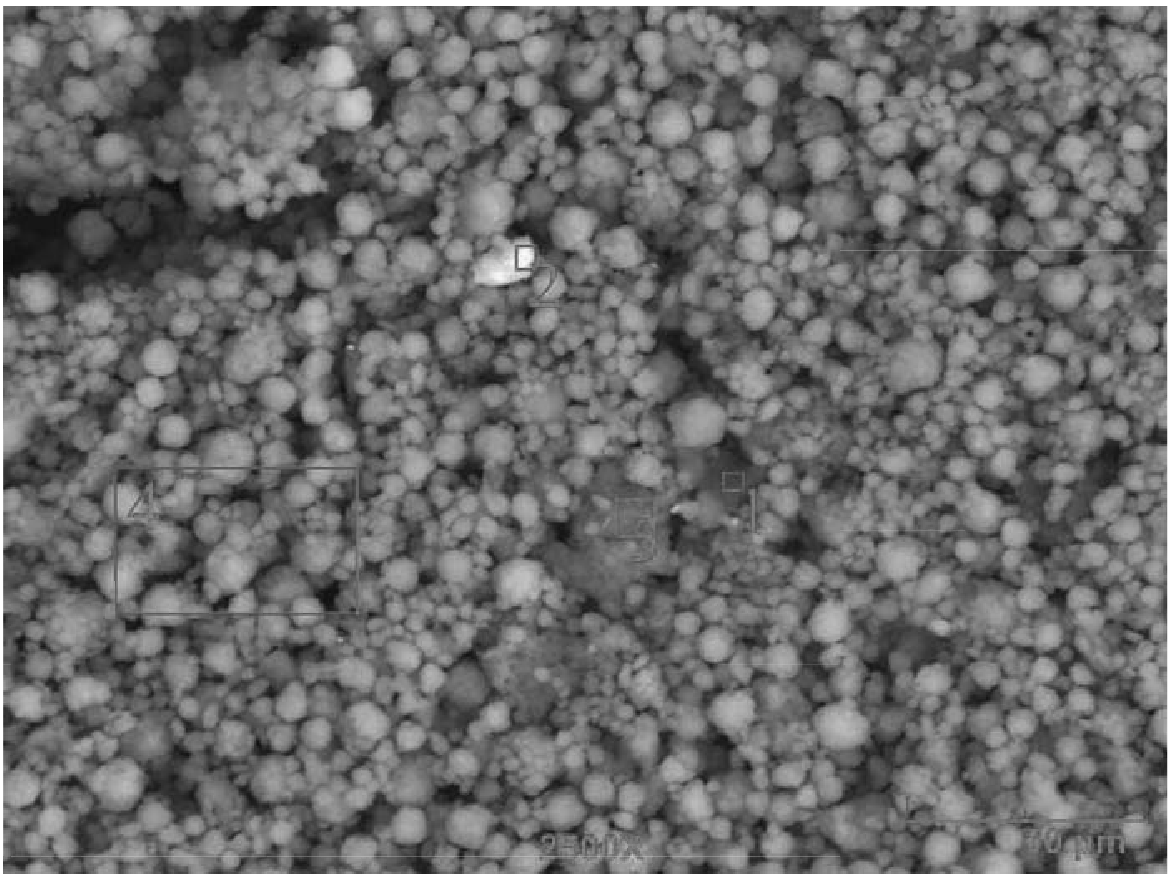


FIGURE 18
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES SHOWN IN FIGURE 17

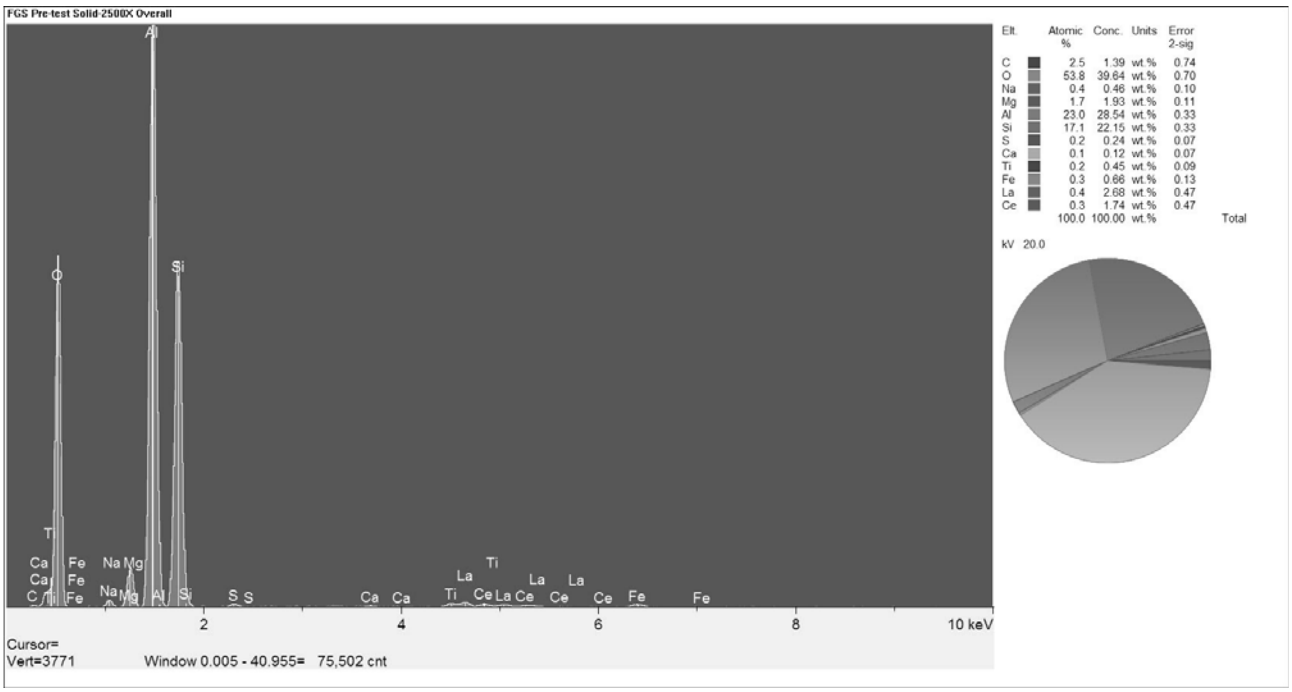


FIGURE 19
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #1 IN FIGURE 17

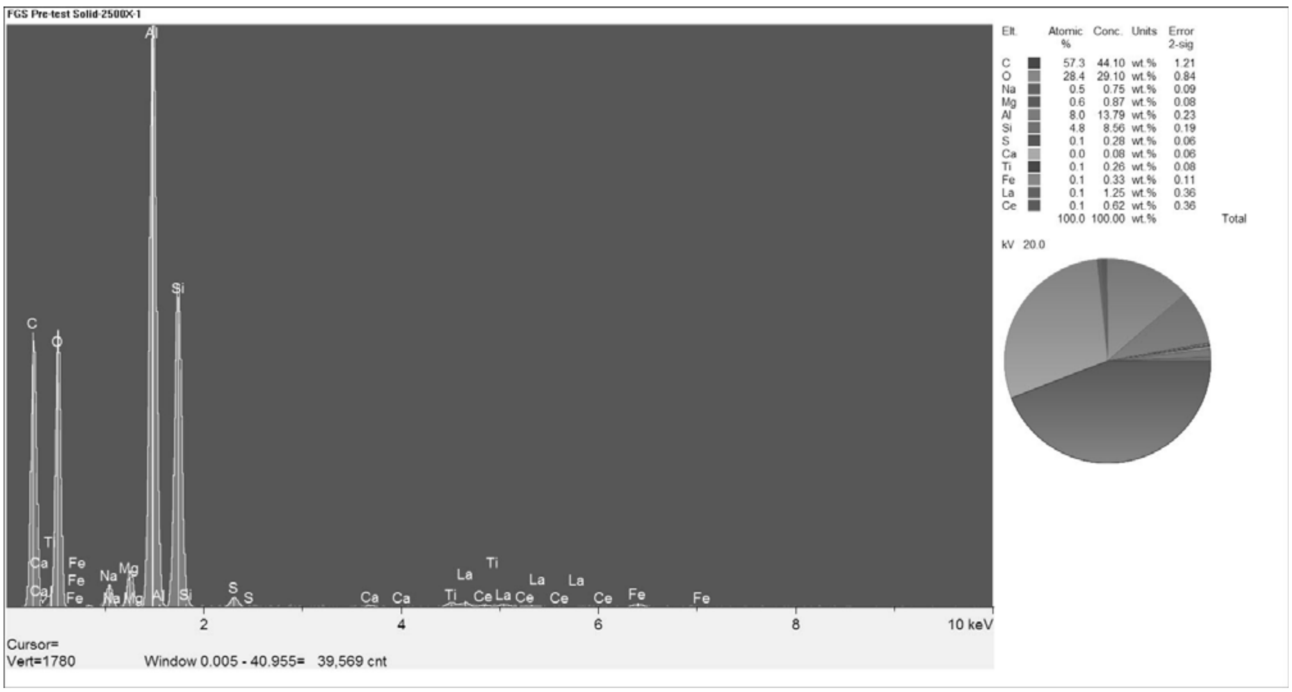


FIGURE 20
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #2 IN FIGURE 17

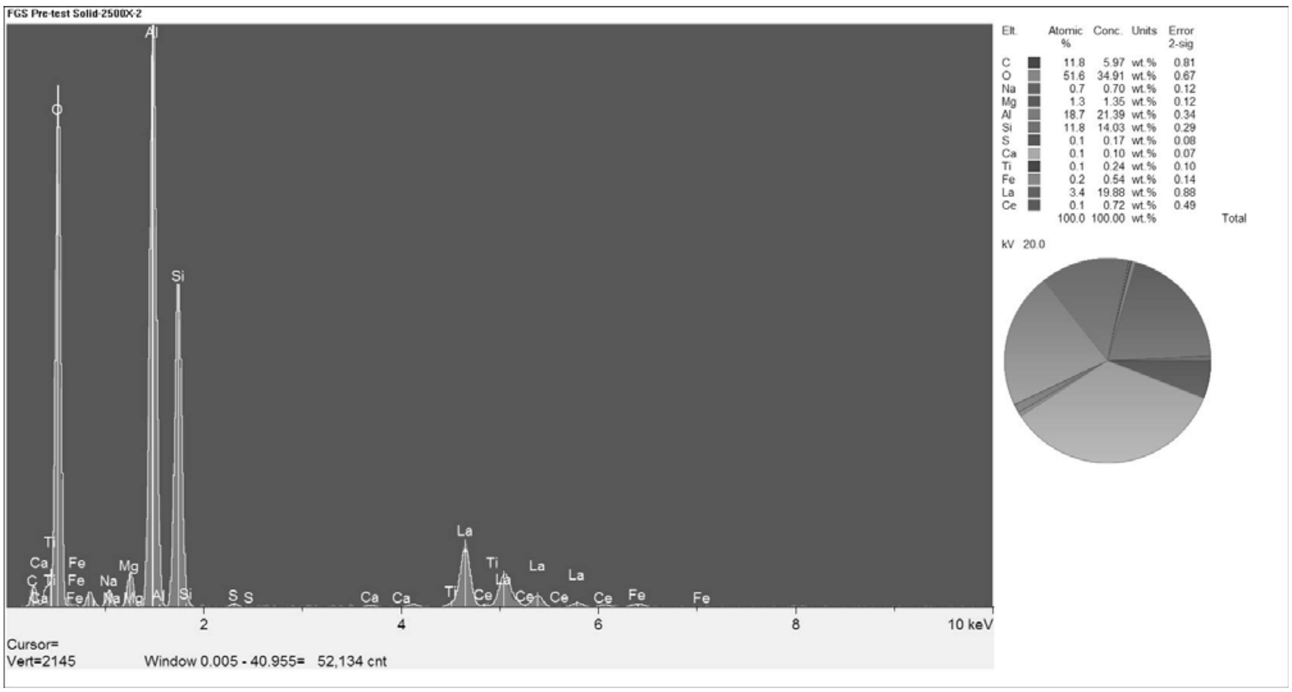


FIGURE 21
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #3 IN FIGURE 17

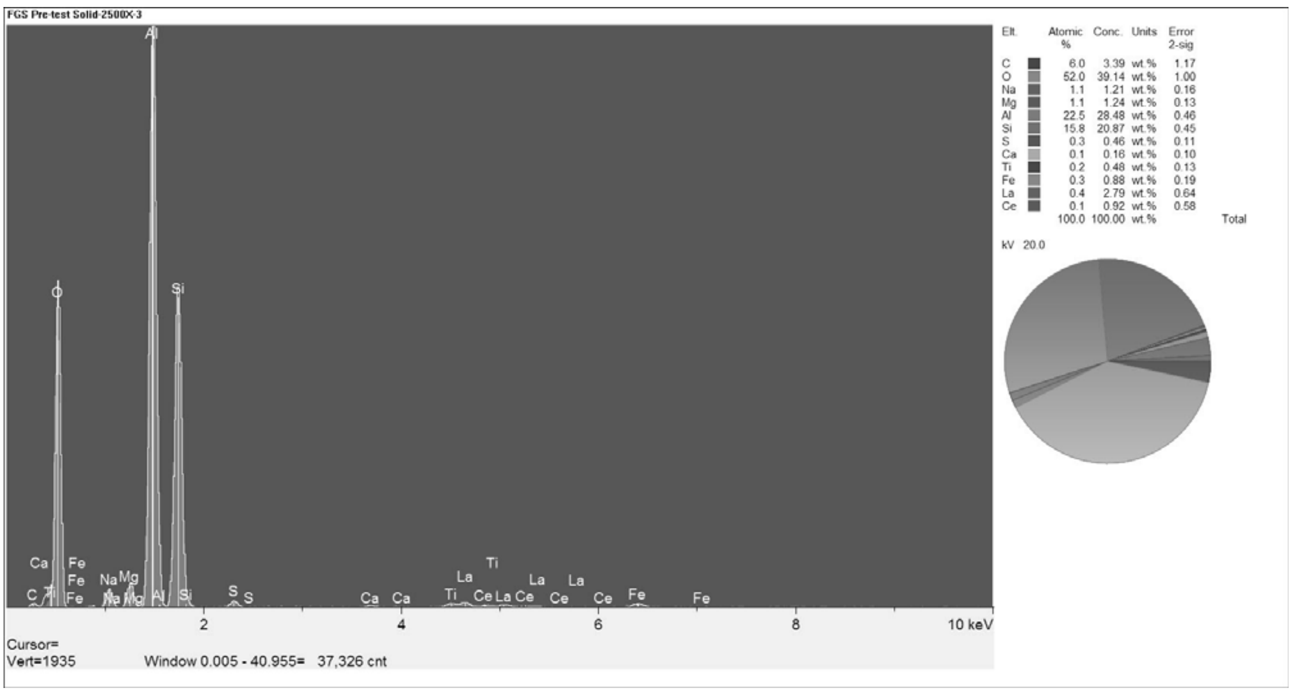


FIGURE 22
EDS MICROCHEMICAL ANALYSIS OF THE FGS PRETEST SAMPLE PARTICLES LABELED #4 IN FIGURE 17

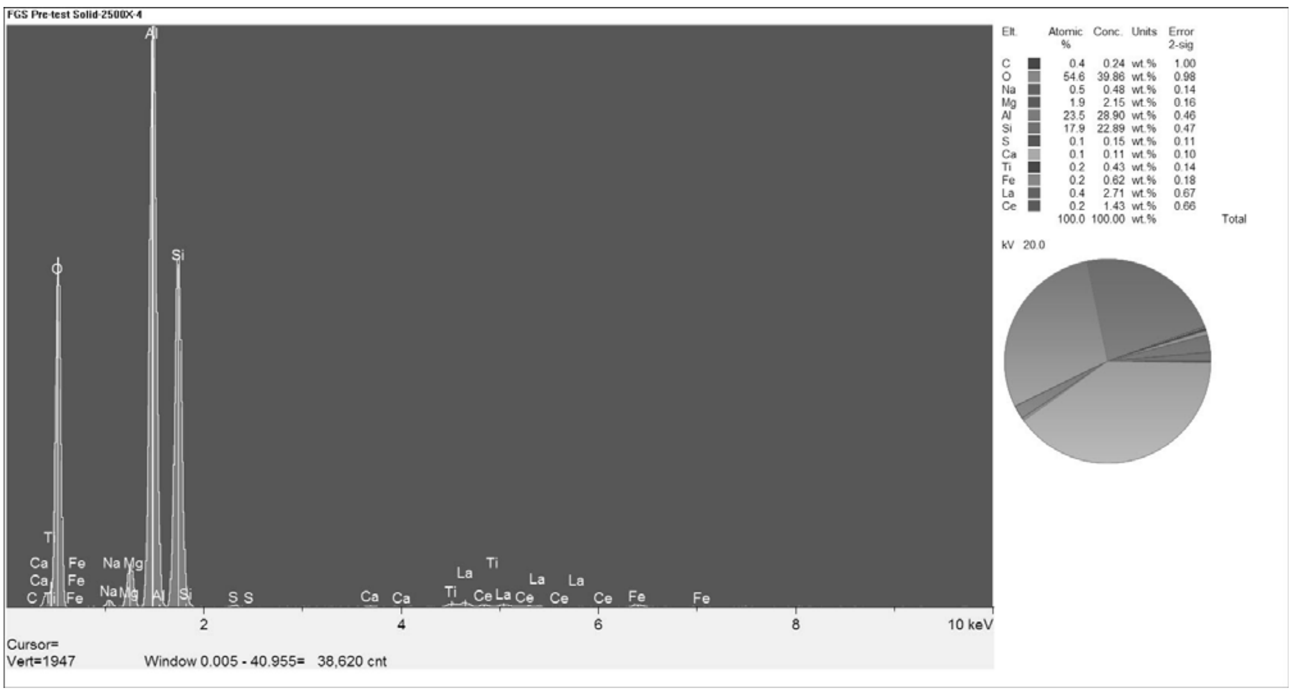


FIGURE 23
PHOTOGRAPH OF THE FGS SAMPLE PRECIPITATE

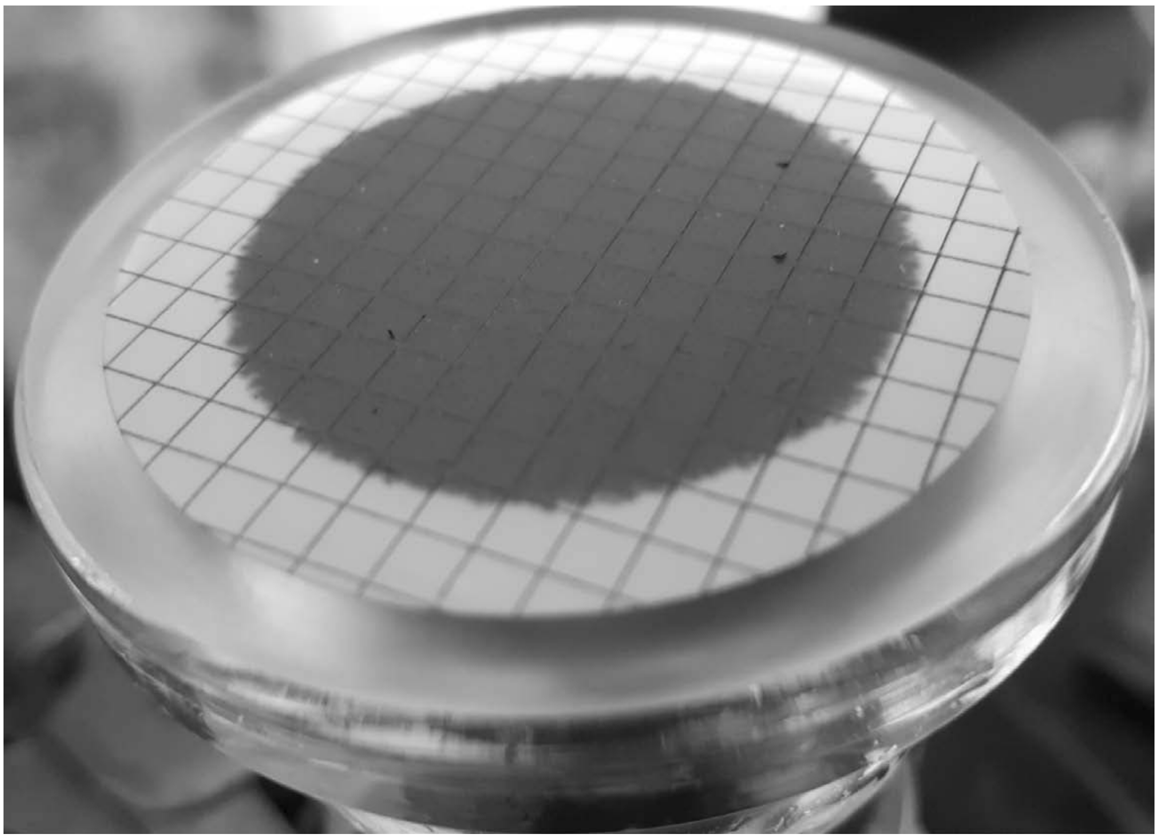


FIGURE 24
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE FGS SAMPLE PRECIPITATE

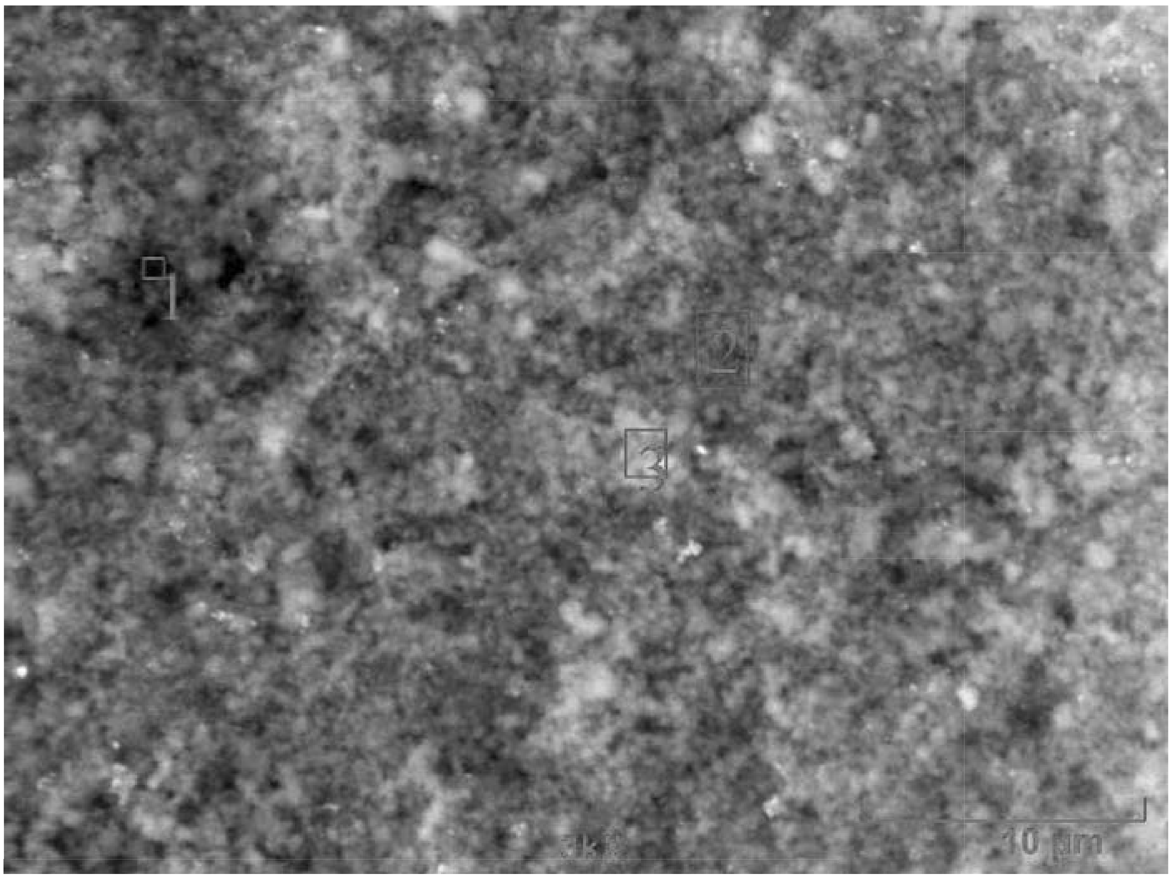


FIGURE 25
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 24

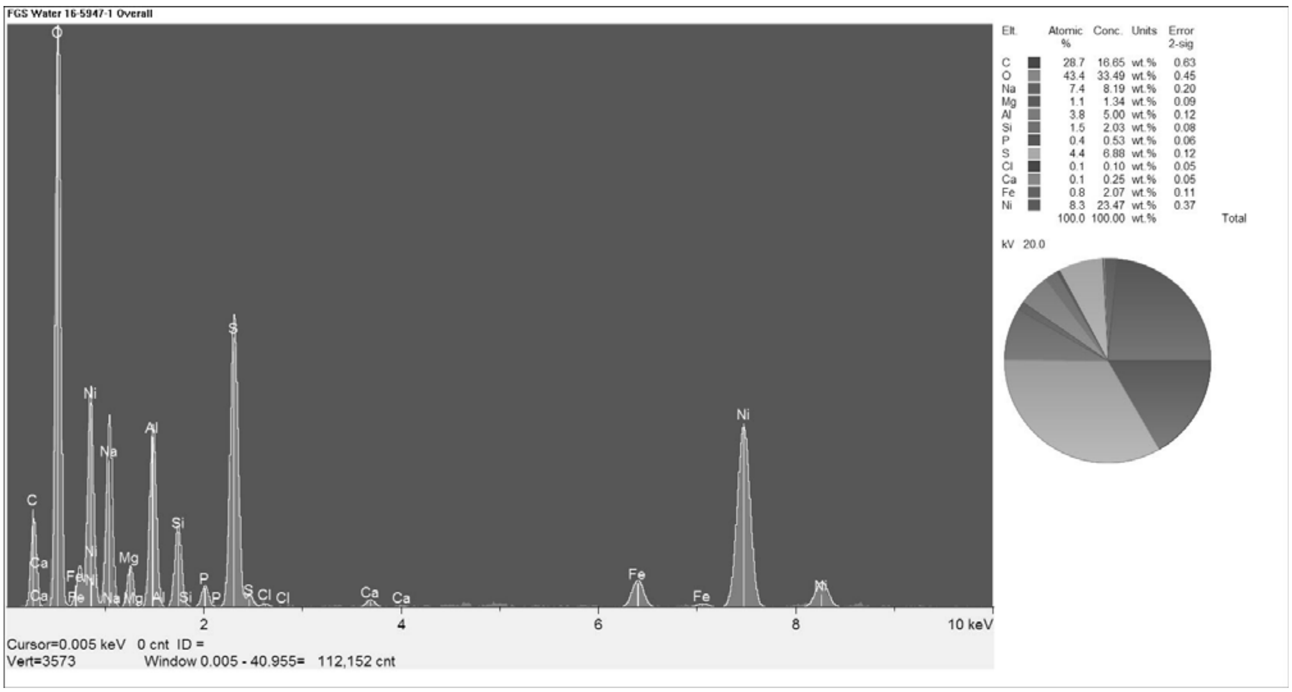


FIGURE 26
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 24

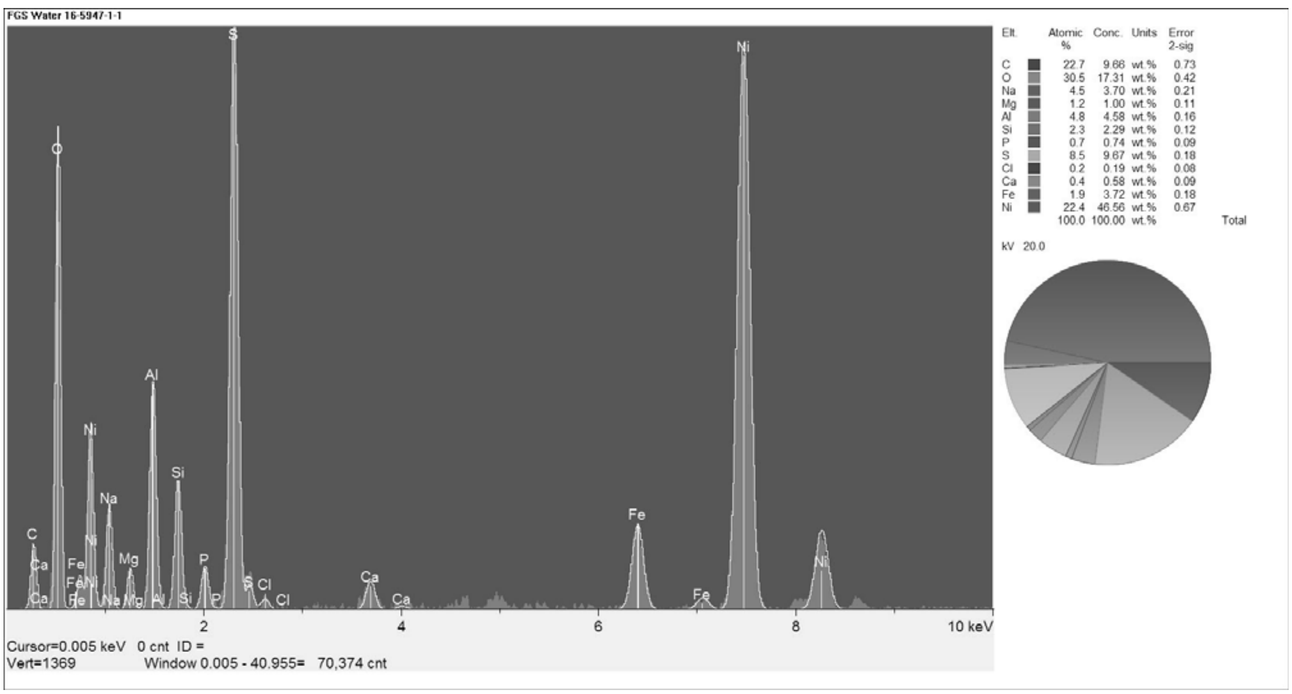


FIGURE 27
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 24

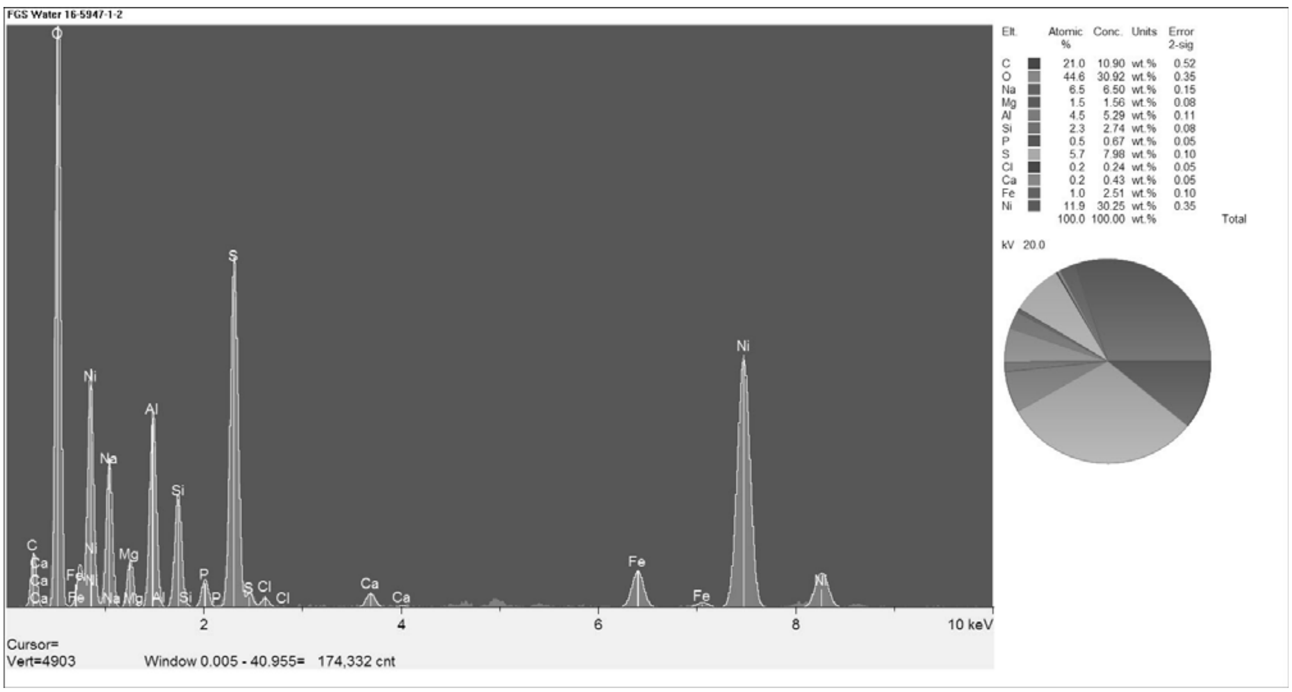


FIGURE 28
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES LABELED #3 IN FIGURE 24

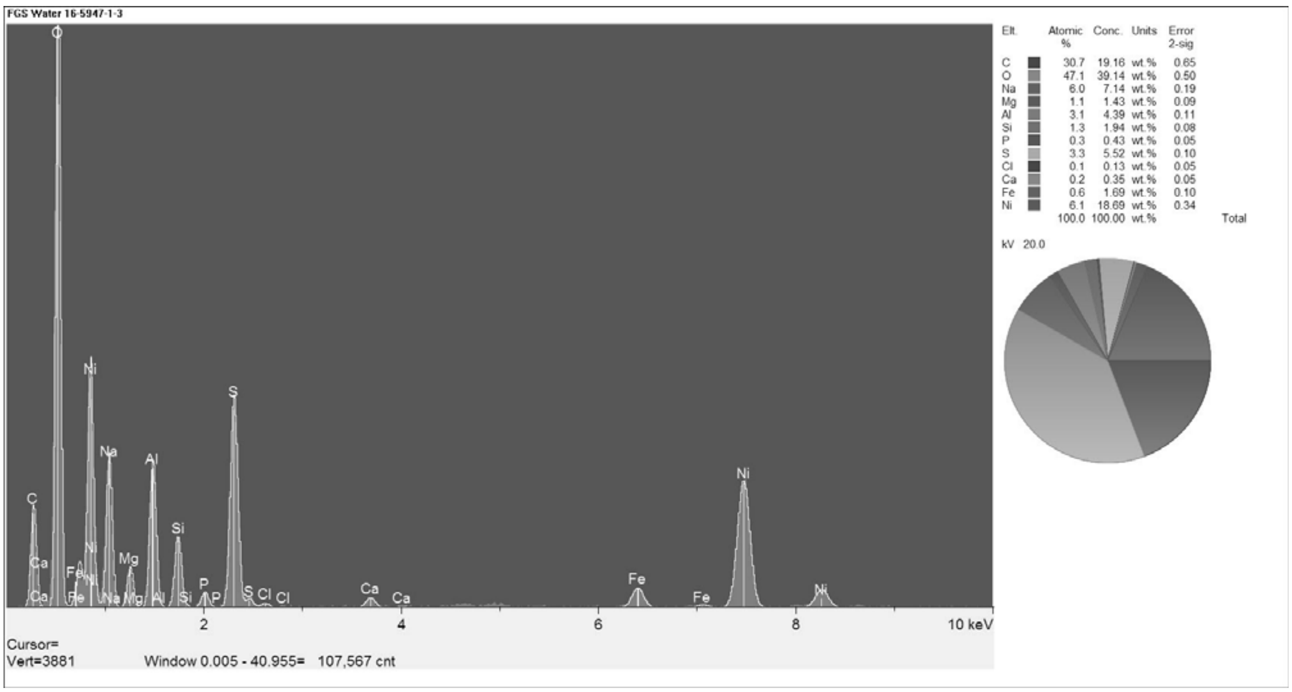


FIGURE 29
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE FGS SAMPLE PRECIPITATE

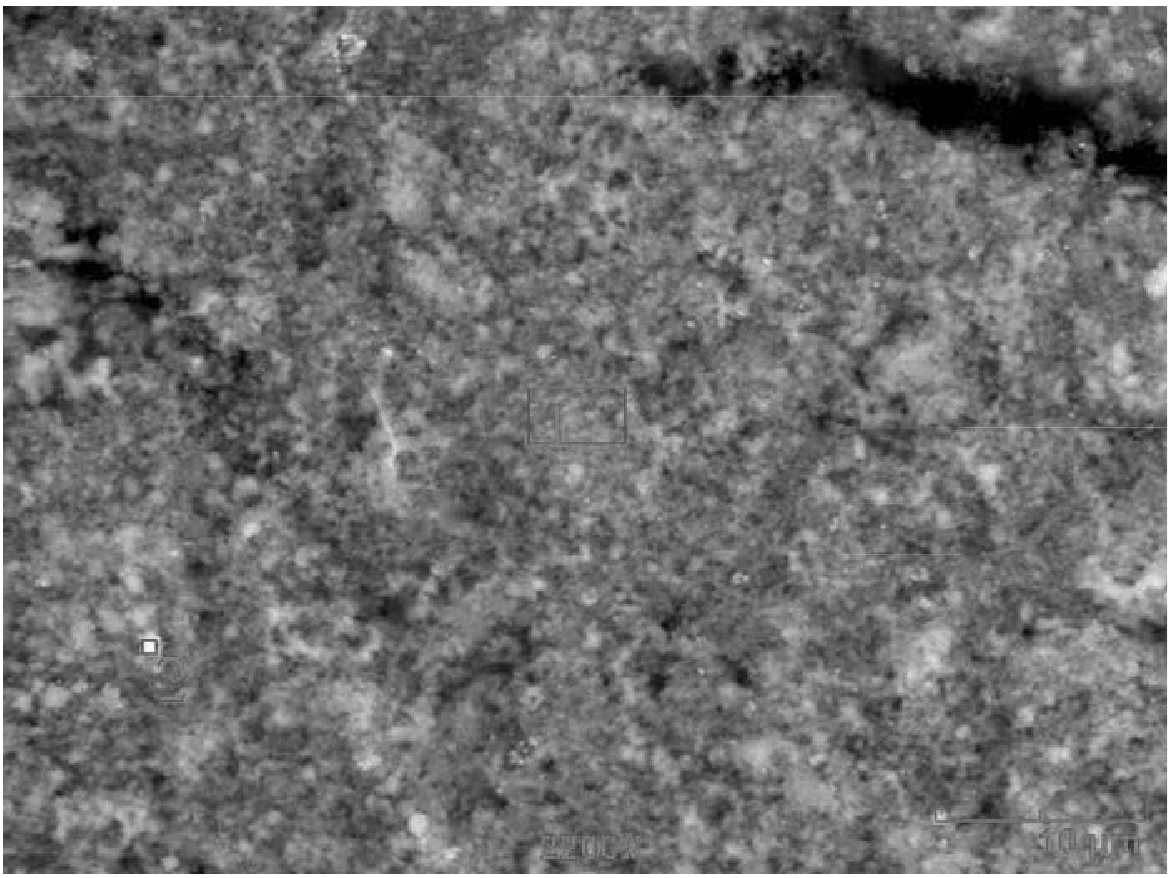


FIGURE 30
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 29

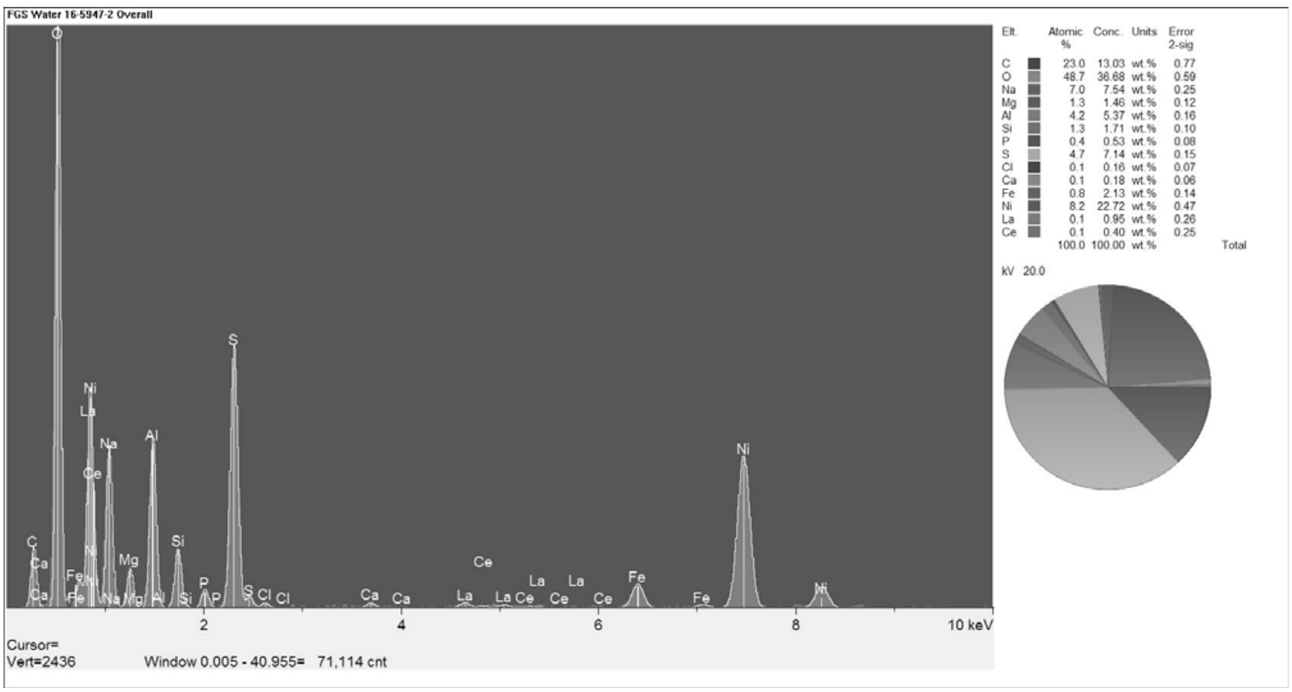
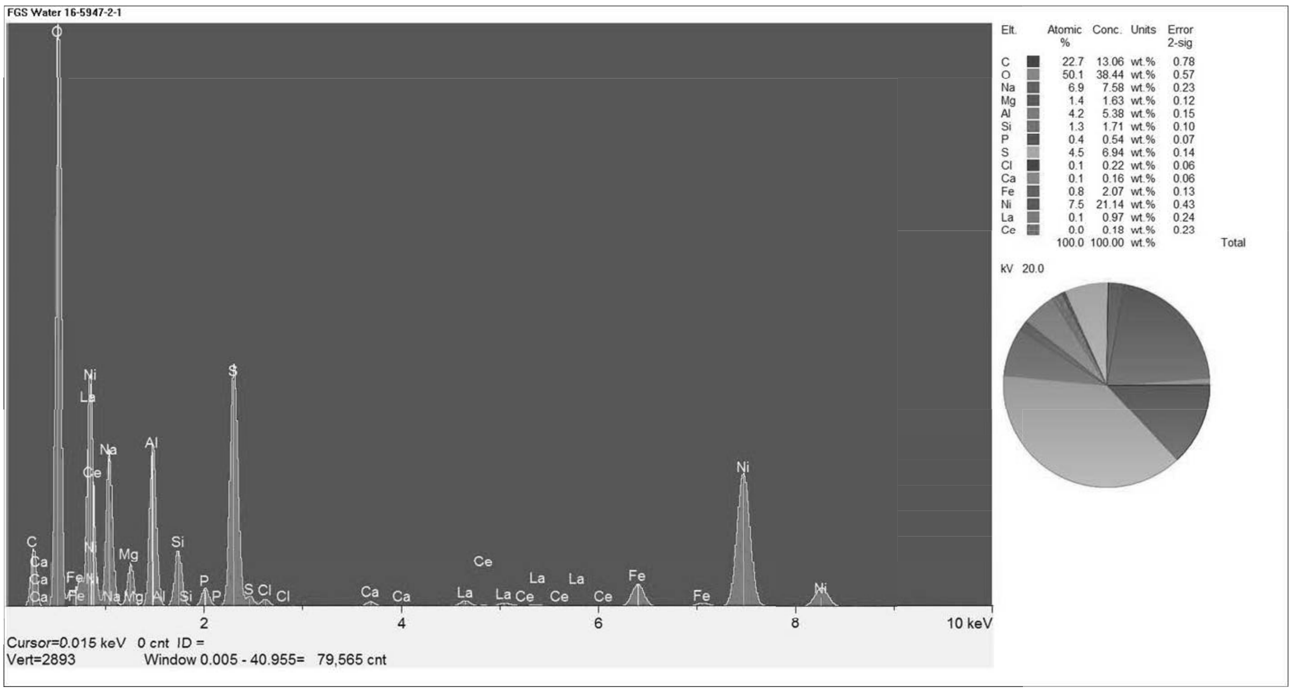


FIGURE 31
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 29



Elt.	Atomic %	Conc.	Units	Error 2-sig
C	22.7	13.06	wt.%	0.78
O	50.1	38.44	wt.%	0.57
Na	6.9	7.58	wt.%	0.23
Mg	1.4	1.63	wt.%	0.12
Al	4.2	5.38	wt.%	0.15
Si	1.3	1.71	wt.%	0.10
P	0.4	0.54	wt.%	0.07
S	4.5	6.94	wt.%	0.14
Cl	0.1	0.22	wt.%	0.06
Ca	0.1	0.16	wt.%	0.06
Fe	0.8	2.07	wt.%	0.13
Ni	7.5	21.14	wt.%	0.43
La	0.1	0.97	wt.%	0.24
Ce	0.0	0.18	wt.%	0.23
	100.0	100.00	wt.%	Total

FIGURE 32
EDS MICROCHEMICAL ANALYSIS OF THE FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 29

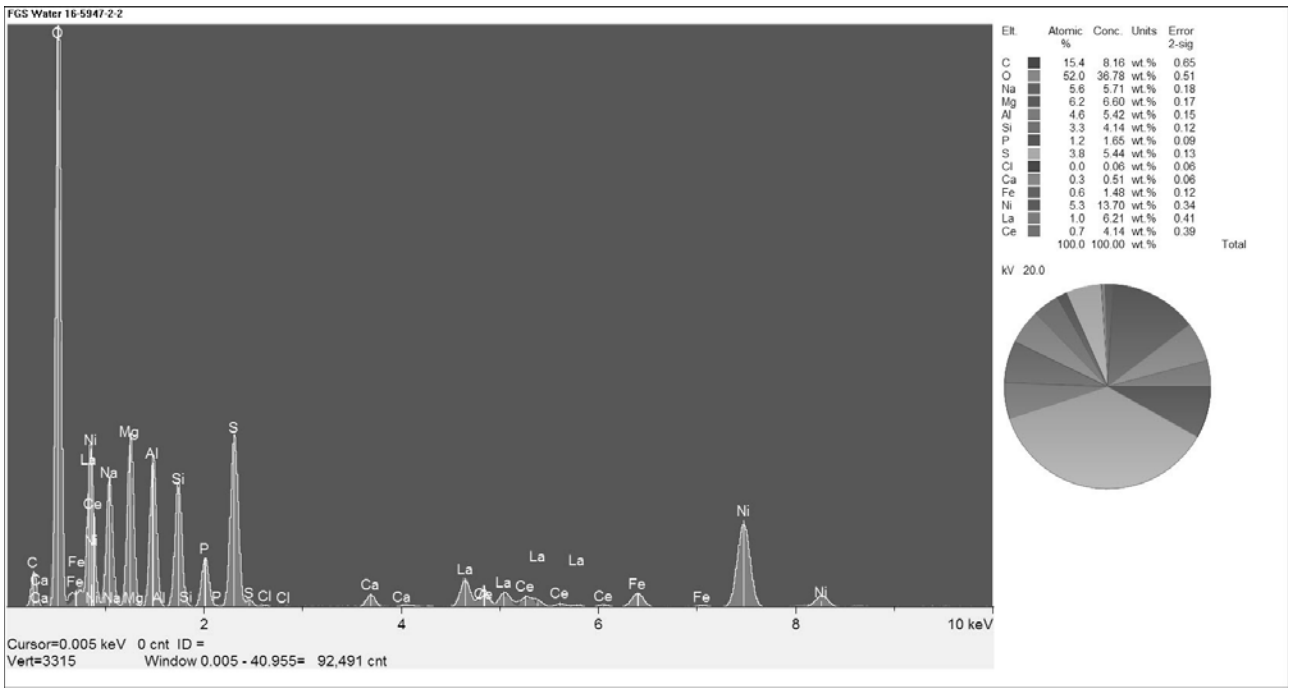


FIGURE 33
PHOTOGRAPH OF THE SRO SAMPLE PRECIPITATE

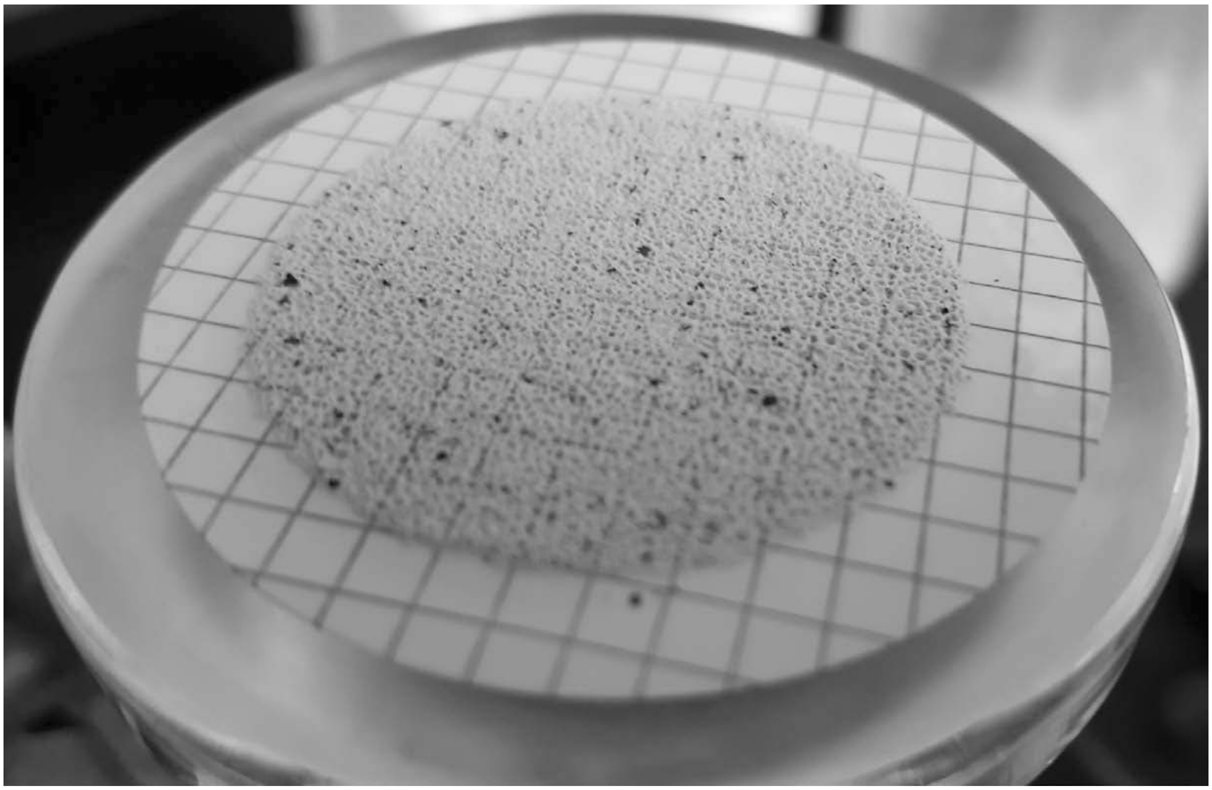


FIGURE 34
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE SRO SAMPLE PRECIPITATE

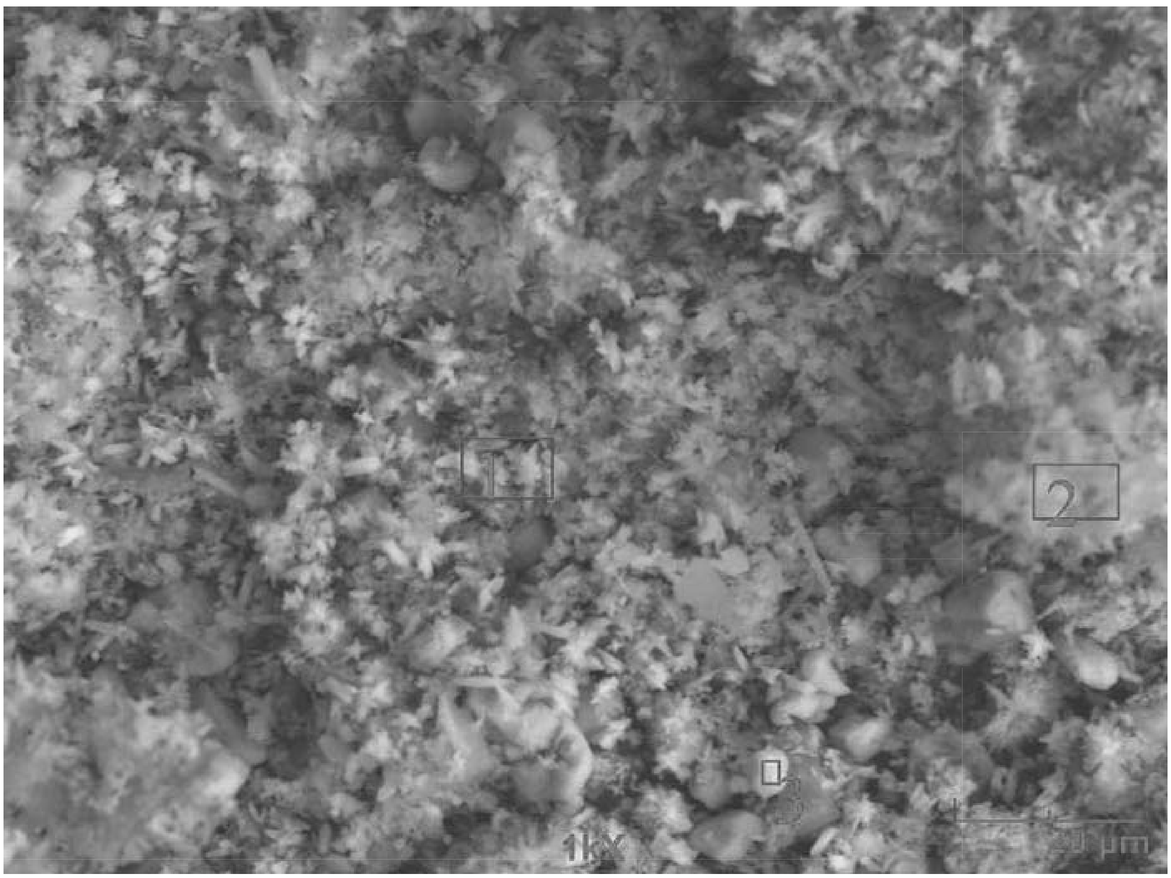


FIGURE 35
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 34

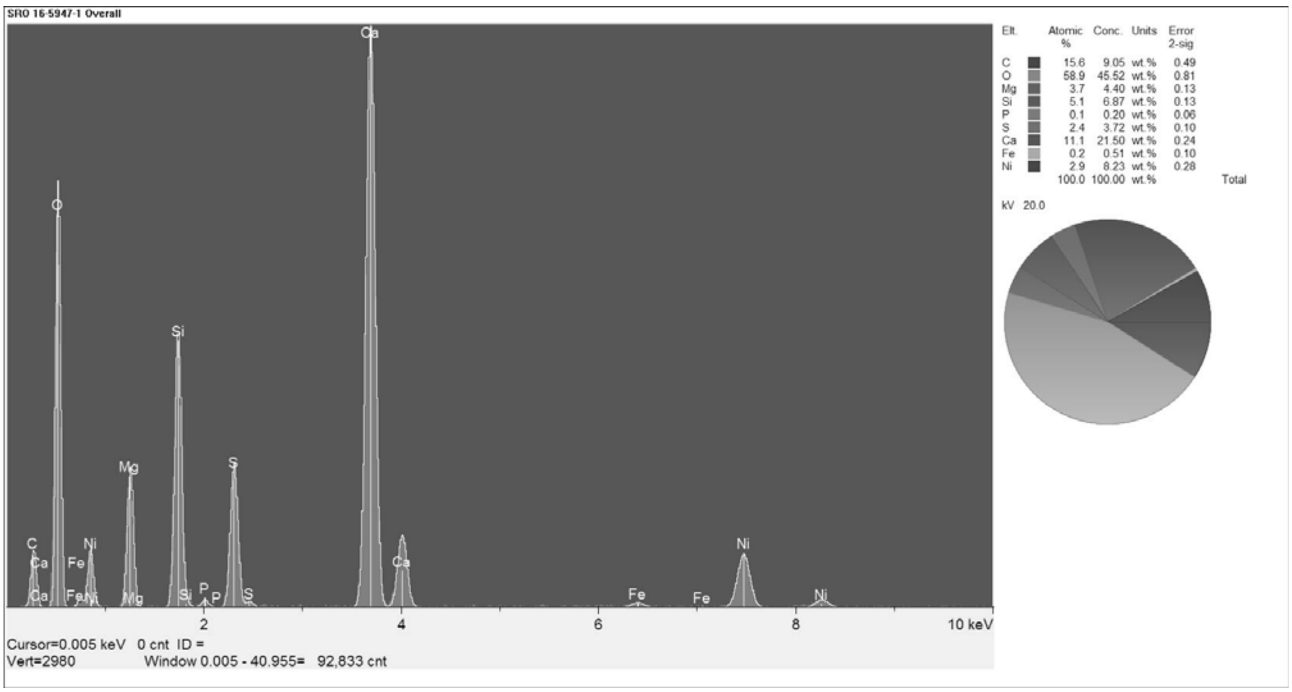


FIGURE 36
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 34

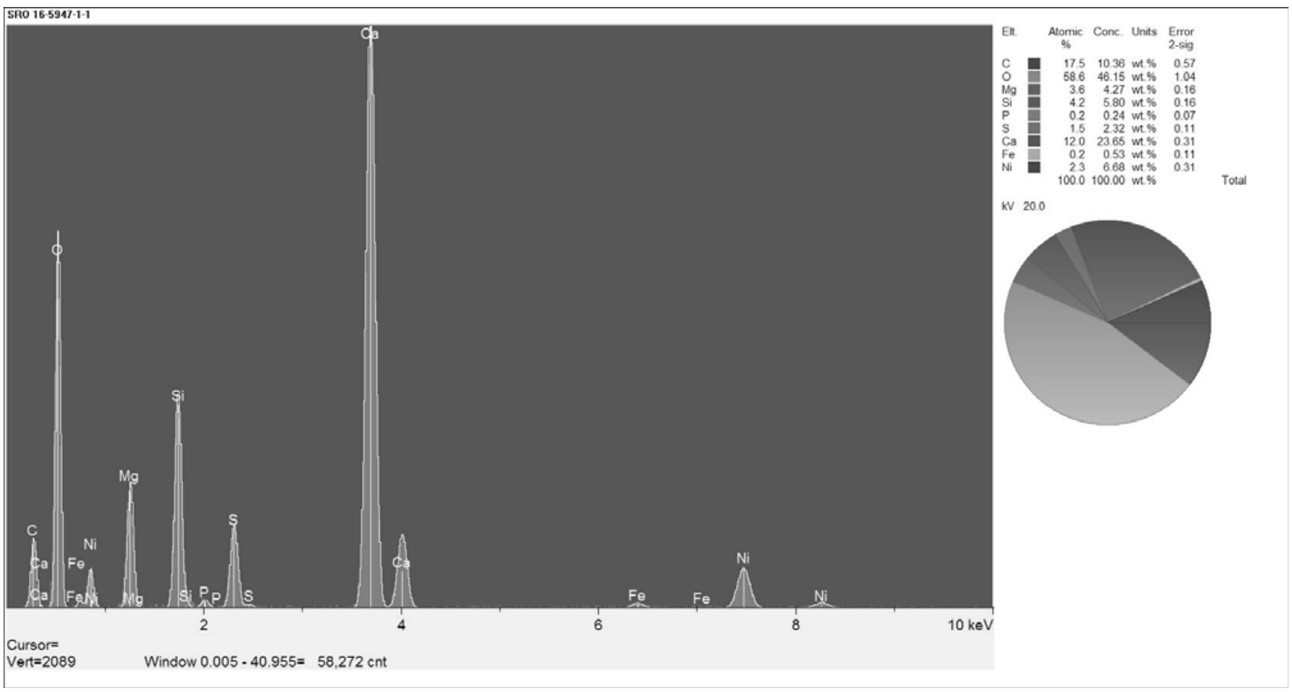


FIGURE 37
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 34

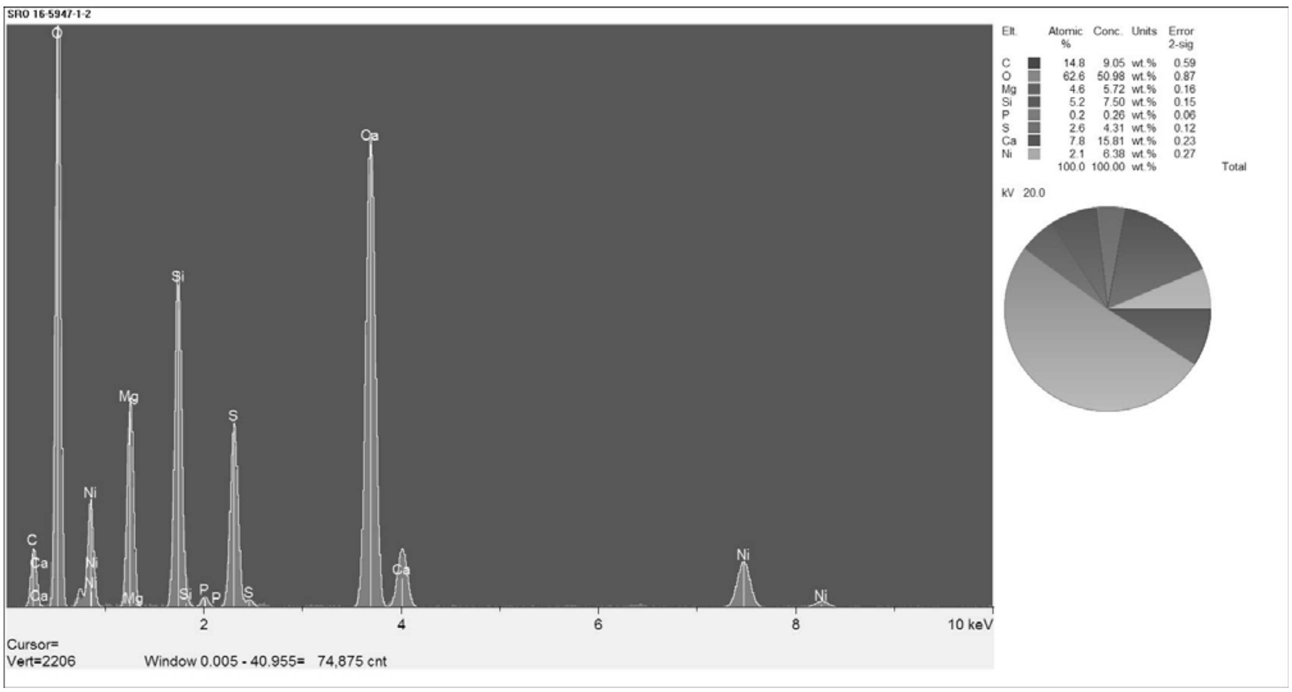


FIGURE 38
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES LABELED #3 IN FIGURE 34

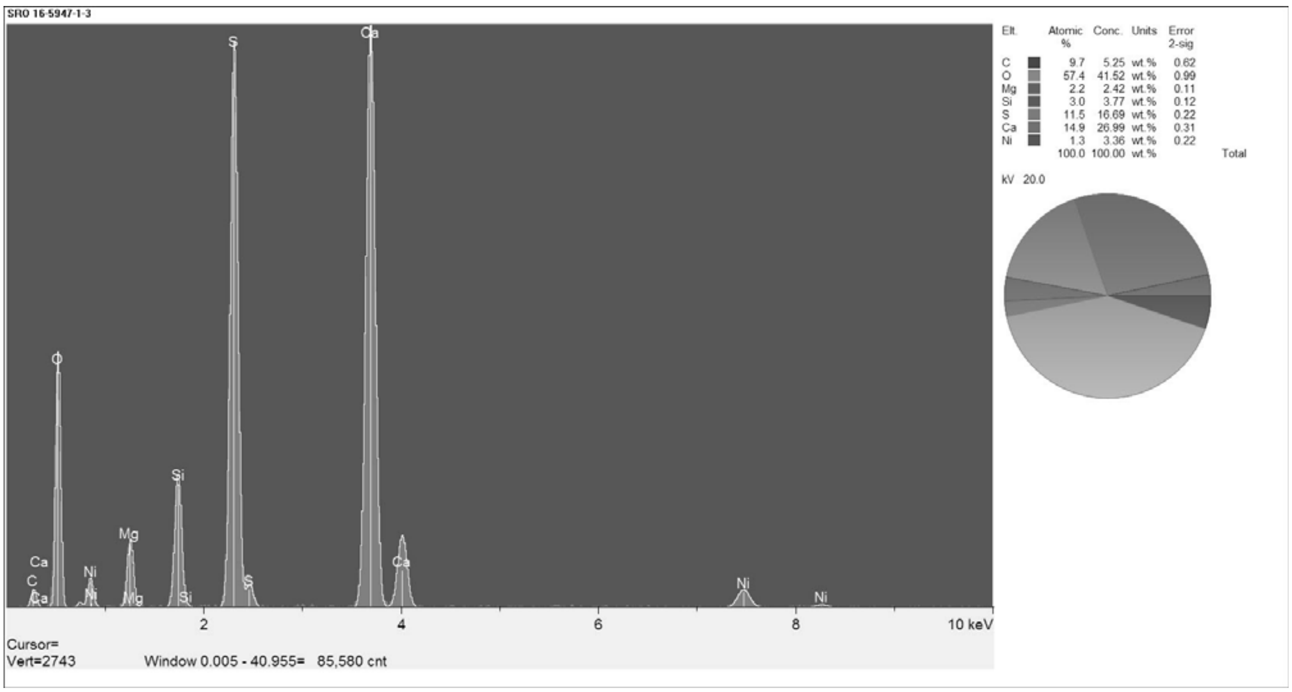


FIGURE 39
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE SRO SAMPLE PRECIPITATE

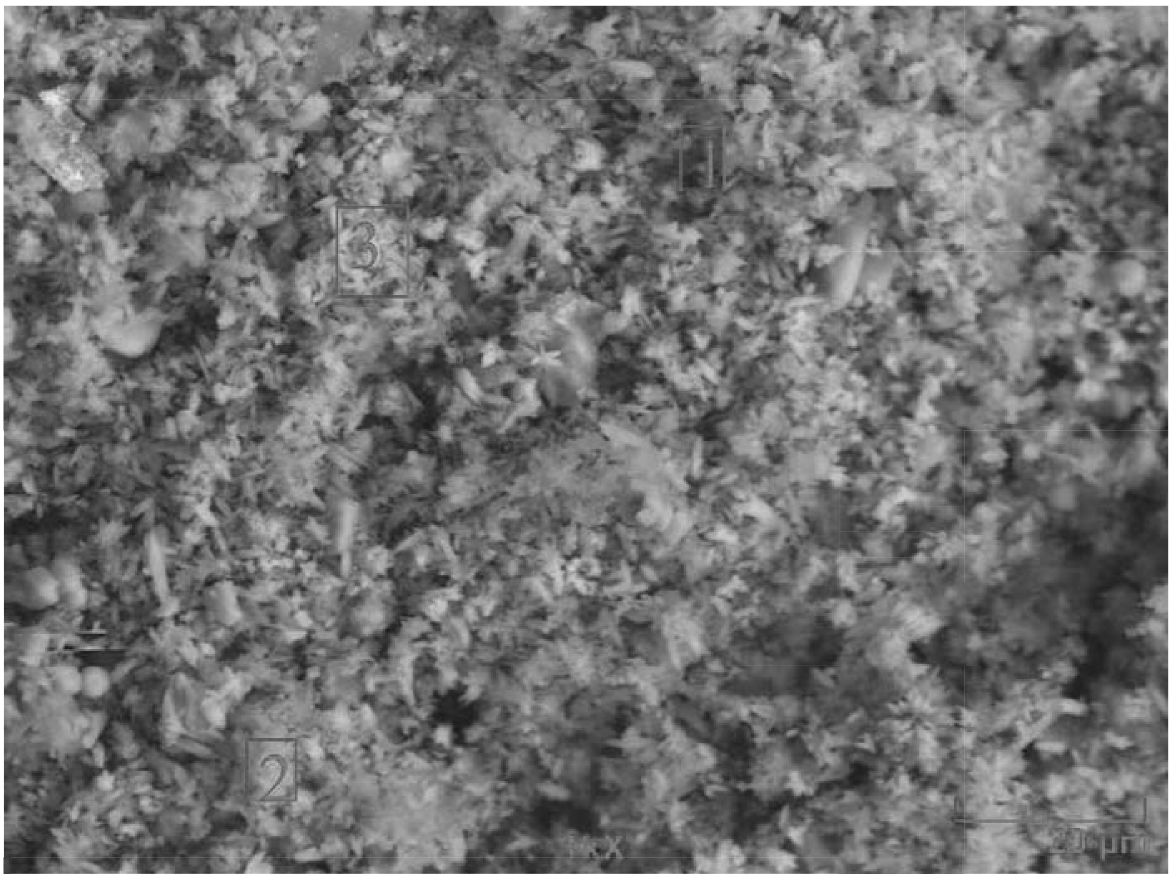


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FIGURE 40
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 39

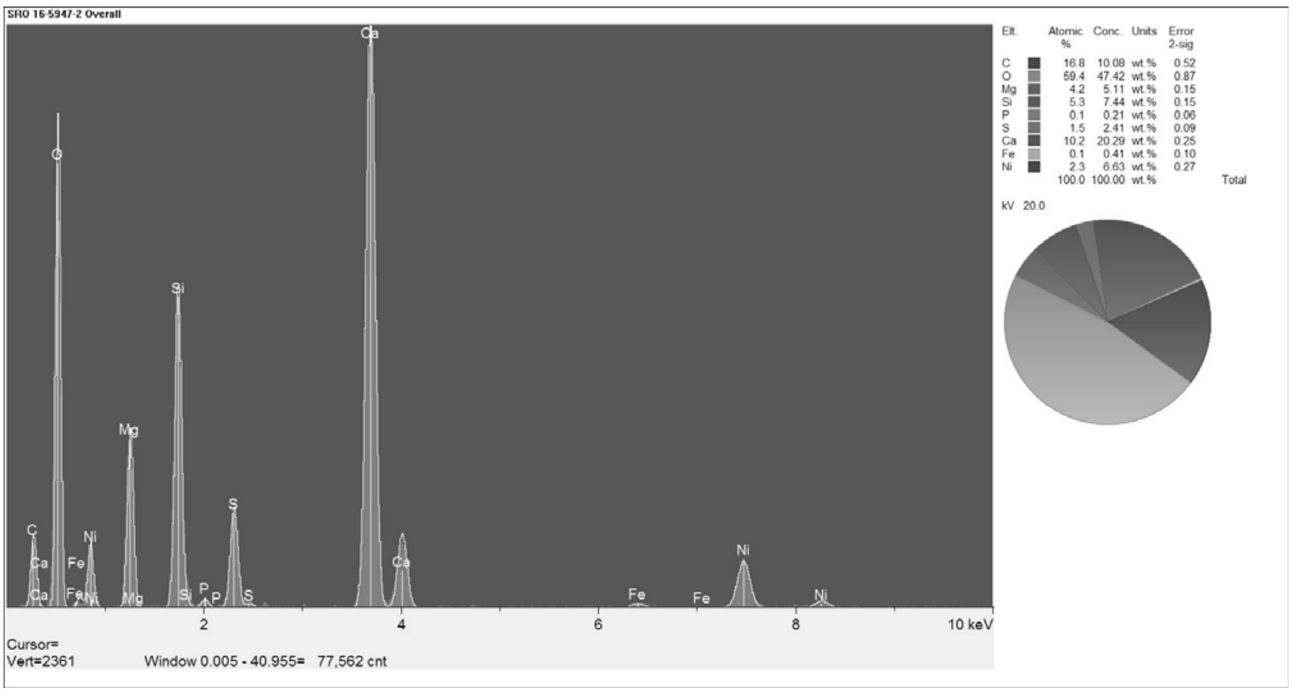

FIGURE 41
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 39

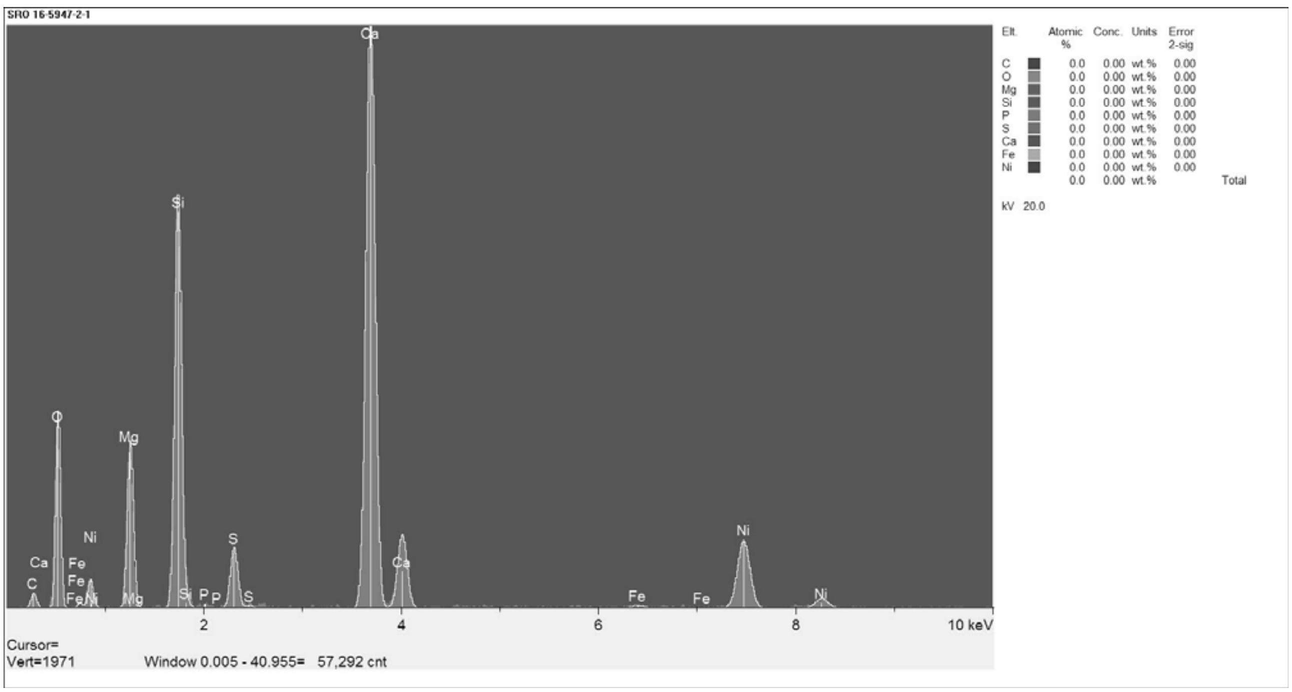

FIGURE 42
EDS MICROCHEMICAL ANALYSIS OF THE SRO SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 39

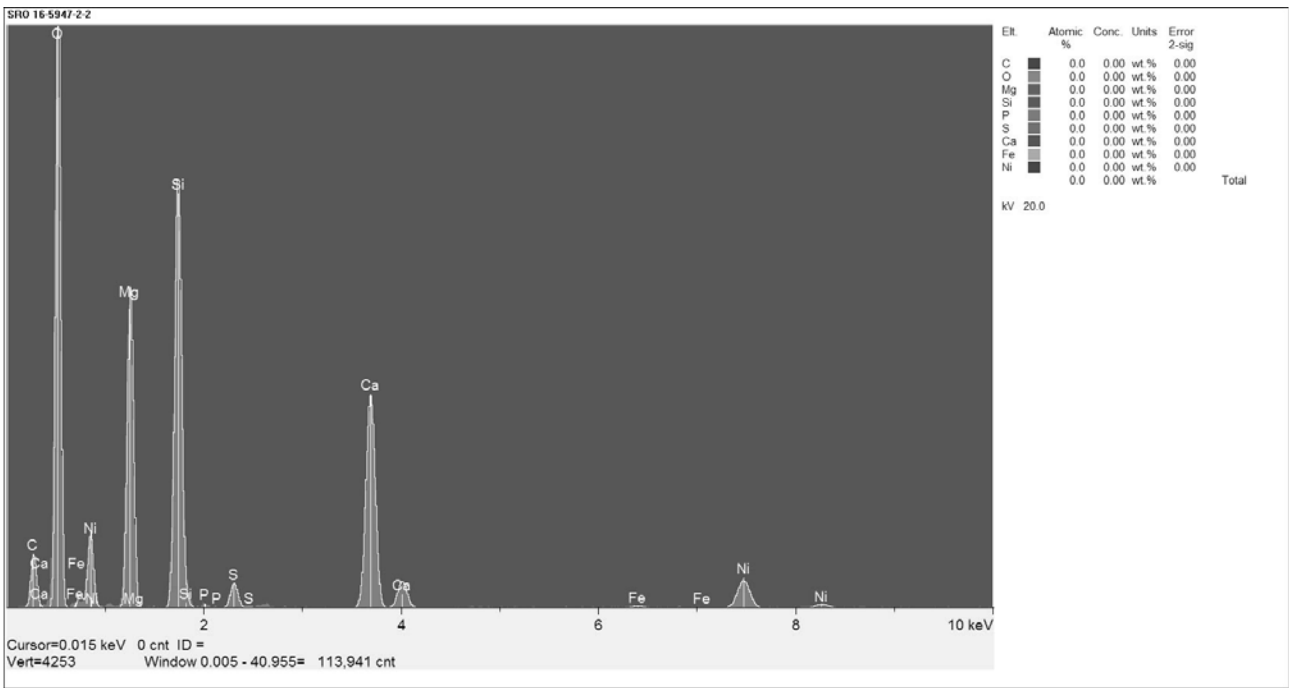

FIGURE 43
EDS MICROCHEMICAL ANALYSIS OF THE PARTICLES LABELED #3 IN FIGURE 39

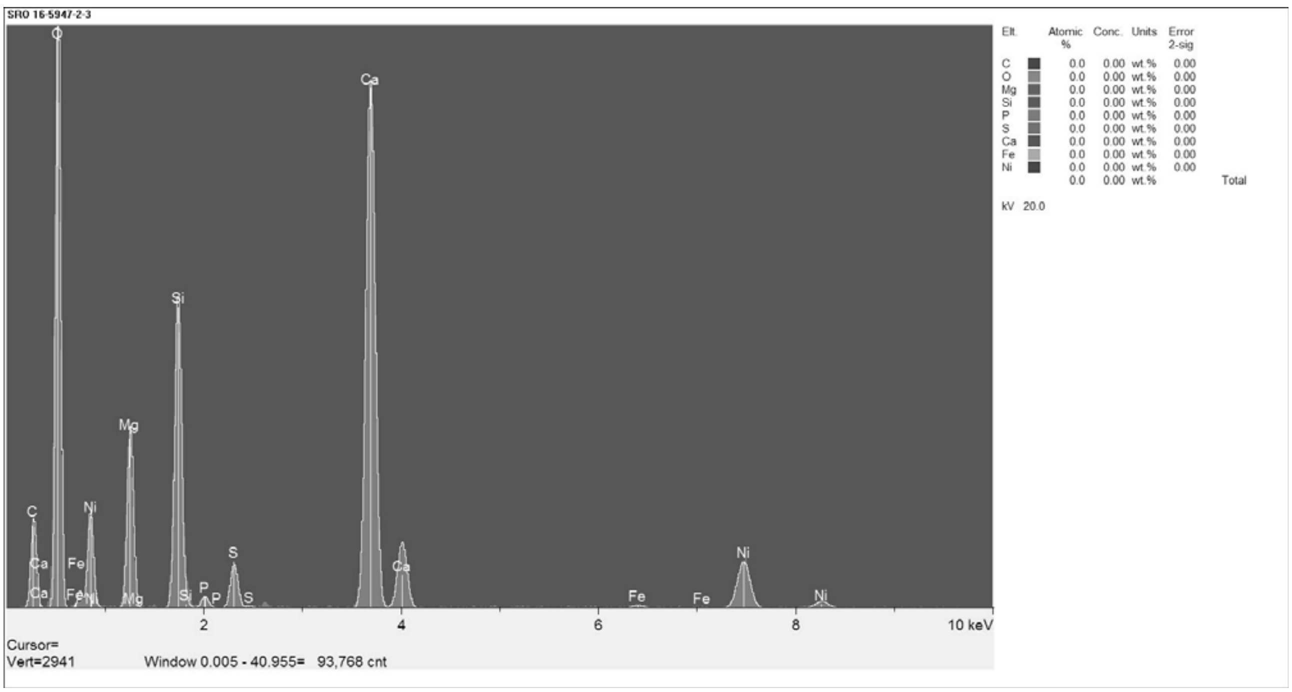

FIGURE 44
PHOTOGRAPH OF THE WWFGS SAMPLE PRECIPITATE

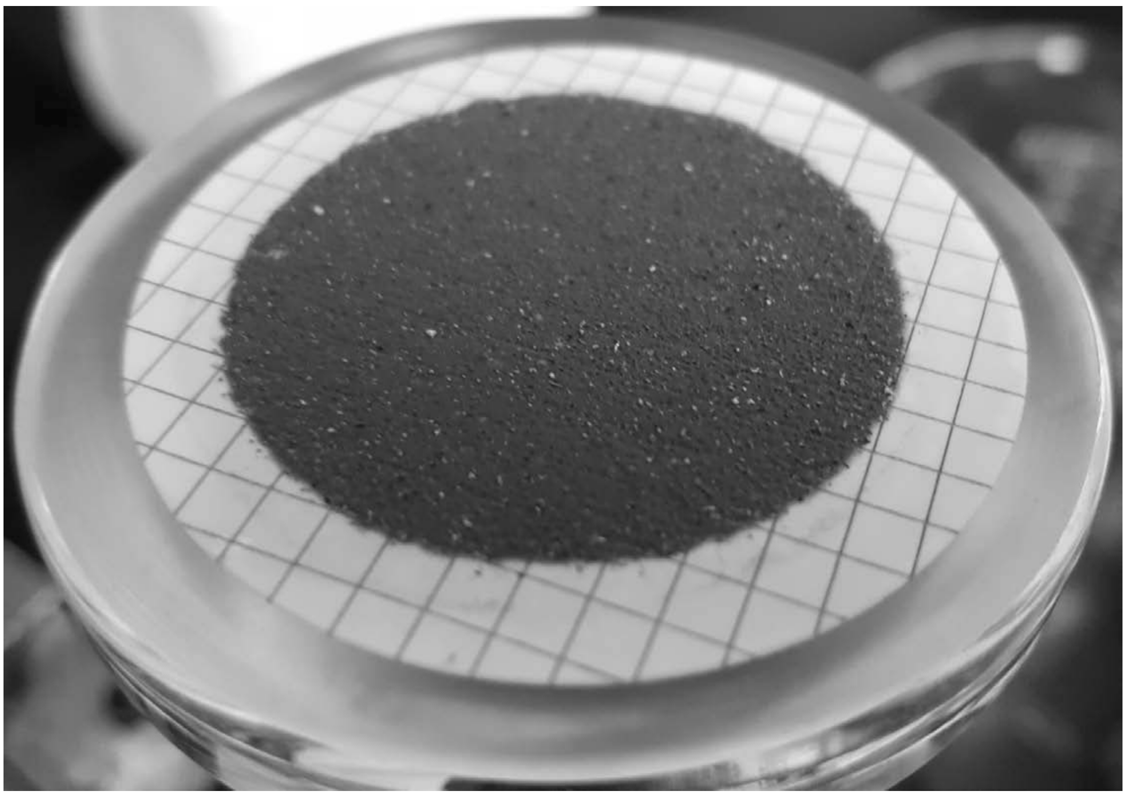

FIGURE 45
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE WWFGS SAMPLE PRECIPITATE

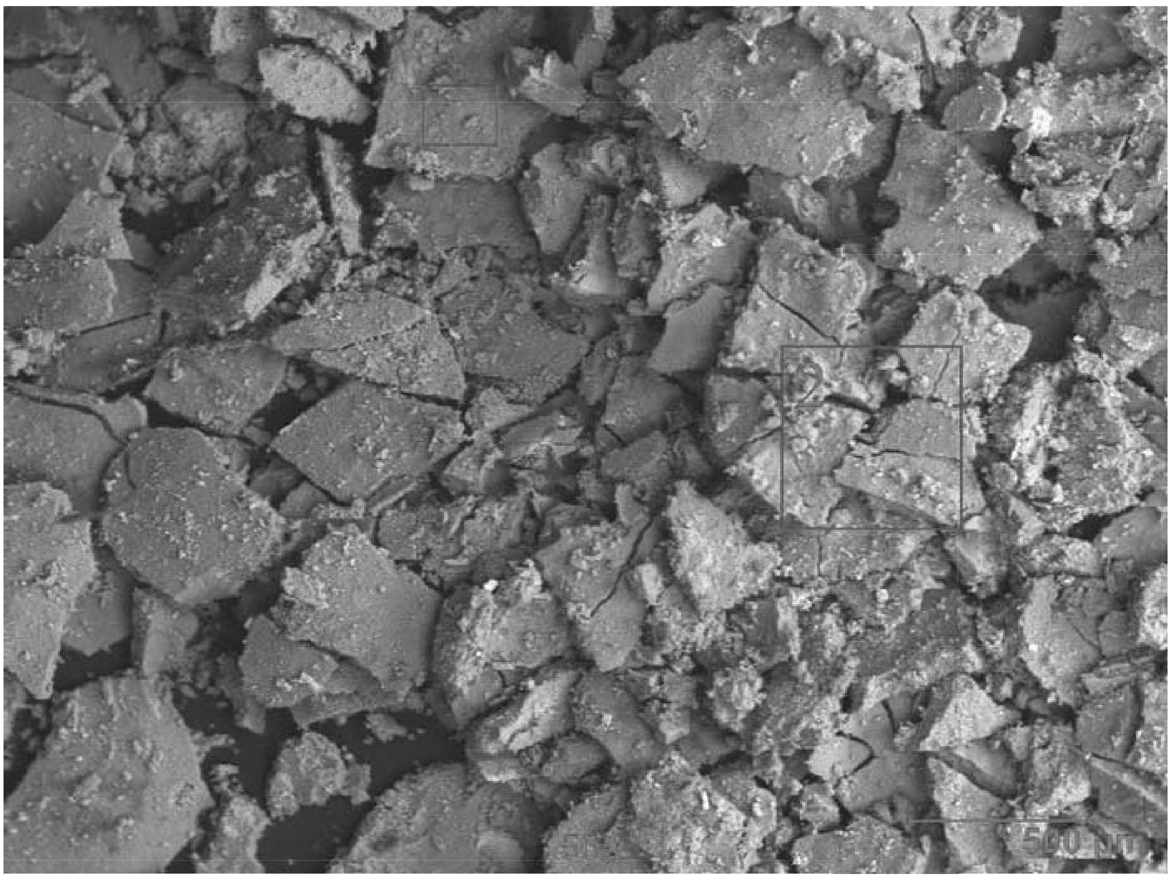

FIGURE 46
EDS MICROCHEMICAL ANALYSIS OF THE WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 45

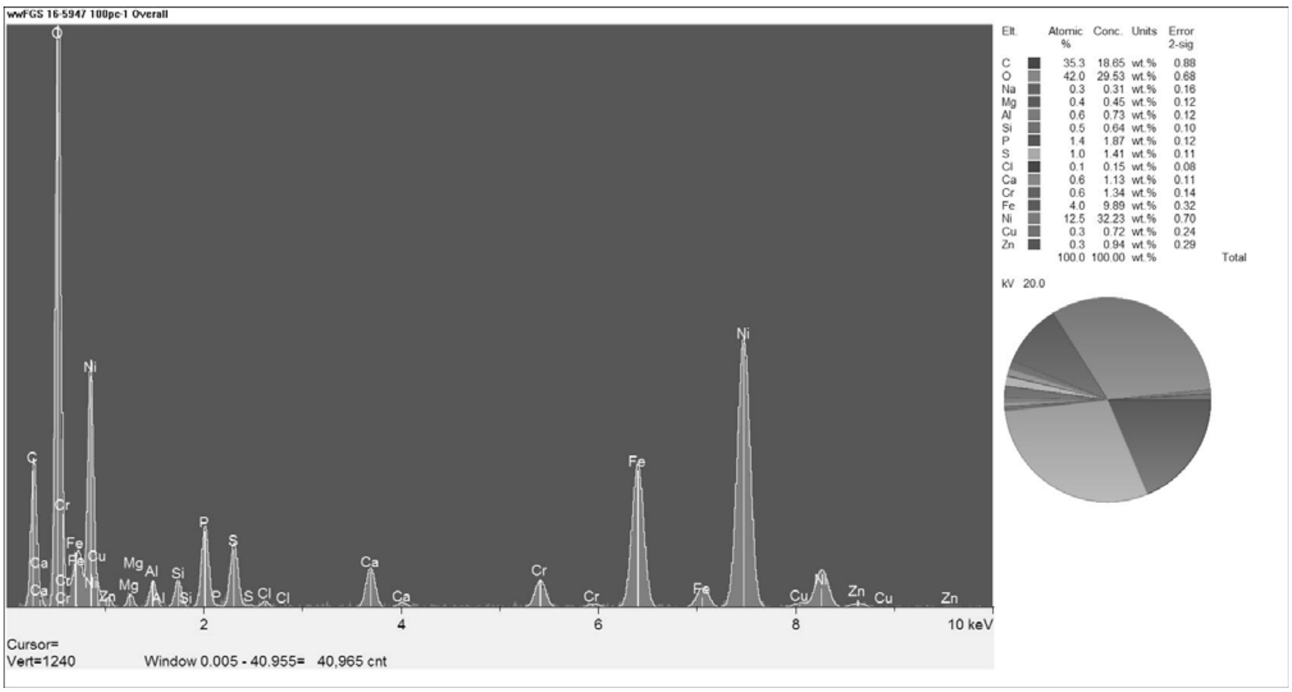

FIGURE 47
EDS MICROCHEMICAL ANALYSIS OF THE WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 45

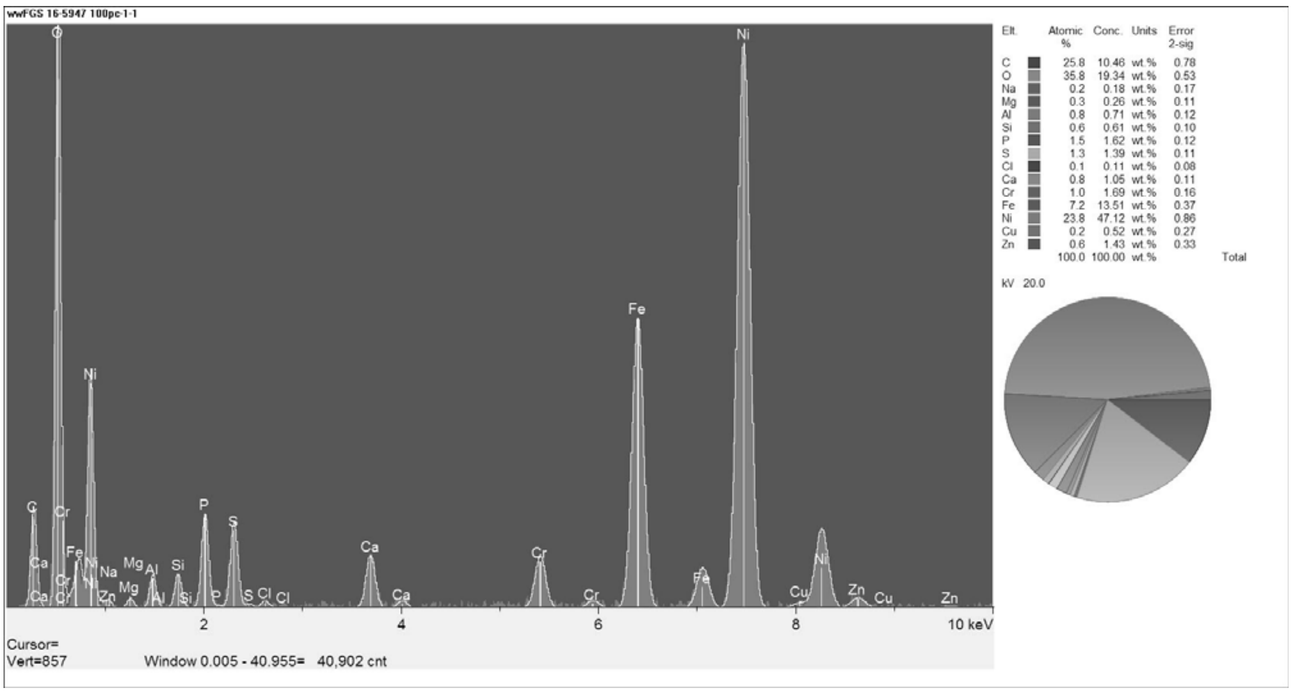

FIGURE 48

EDS MICROCHEMICAL ANALYSIS OF THE WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 45

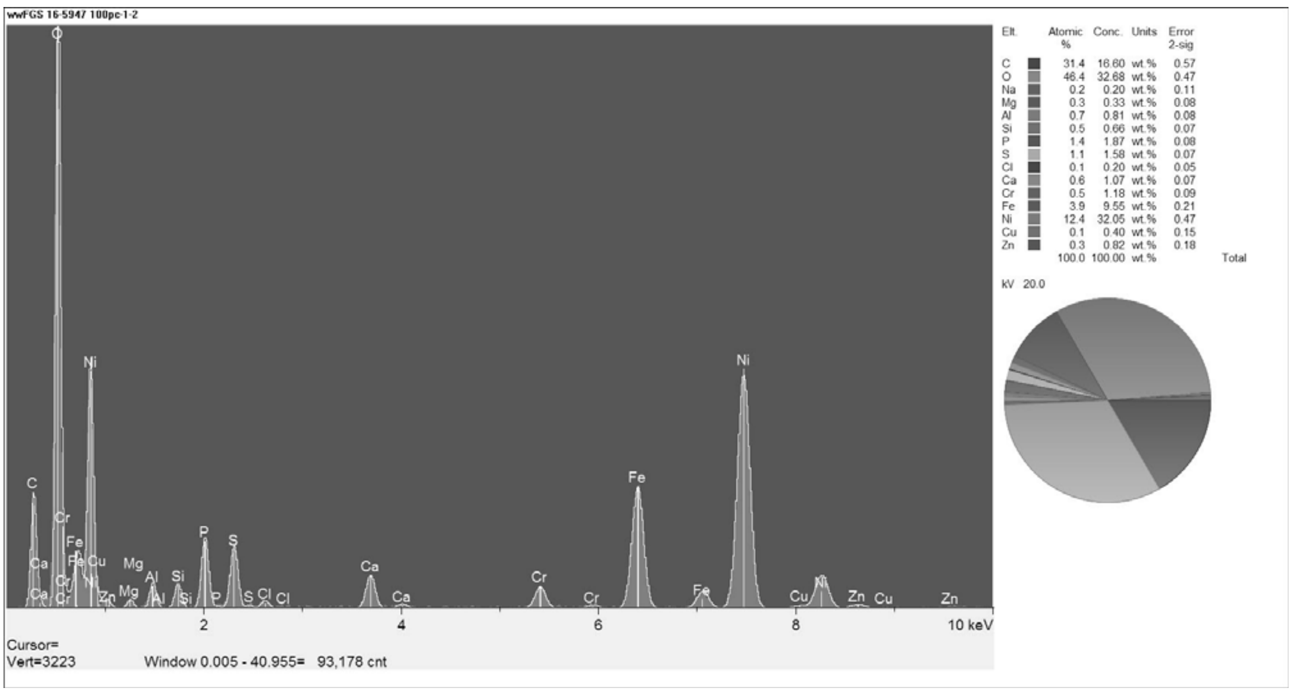

FIGURE 49
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE WWFGS SAMPLE PRECIPITATE

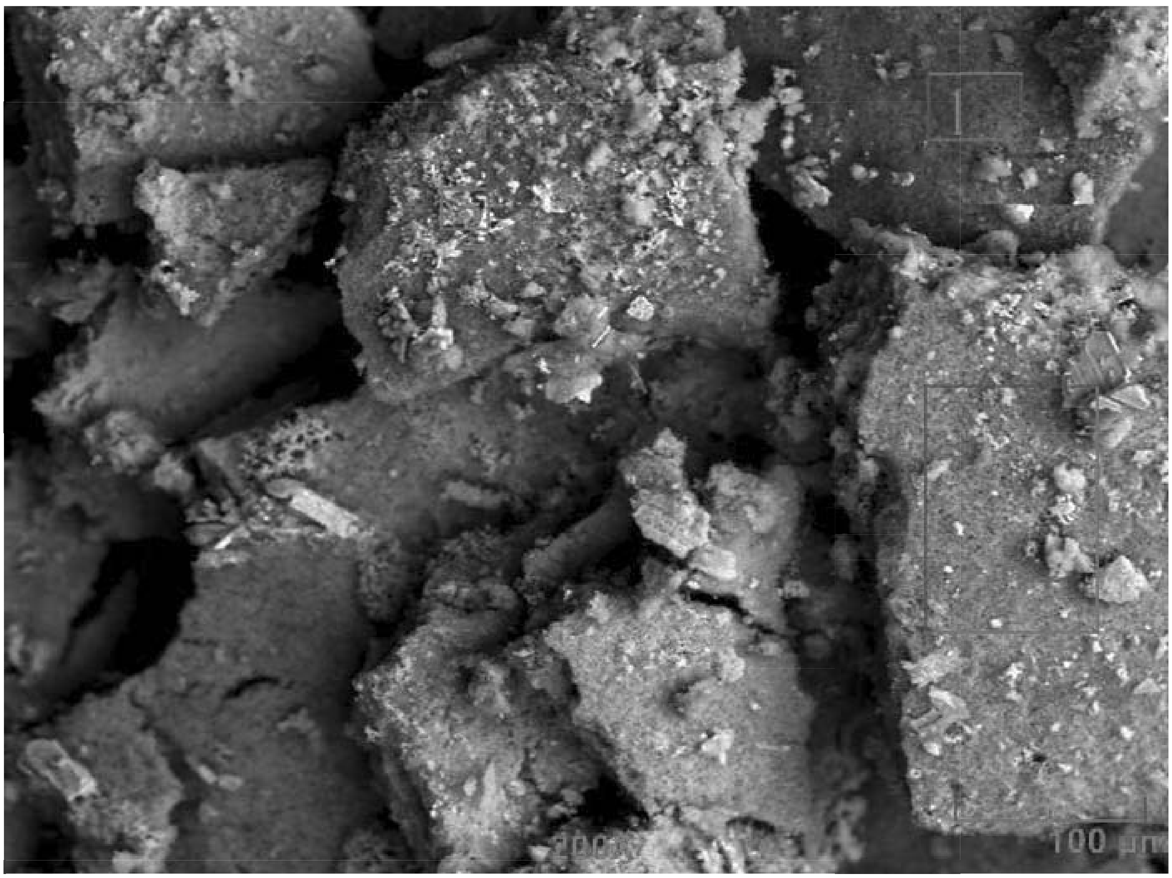

FIGURE 50
EDS MICROCHEMICAL ANALYSIS OF THE WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 49

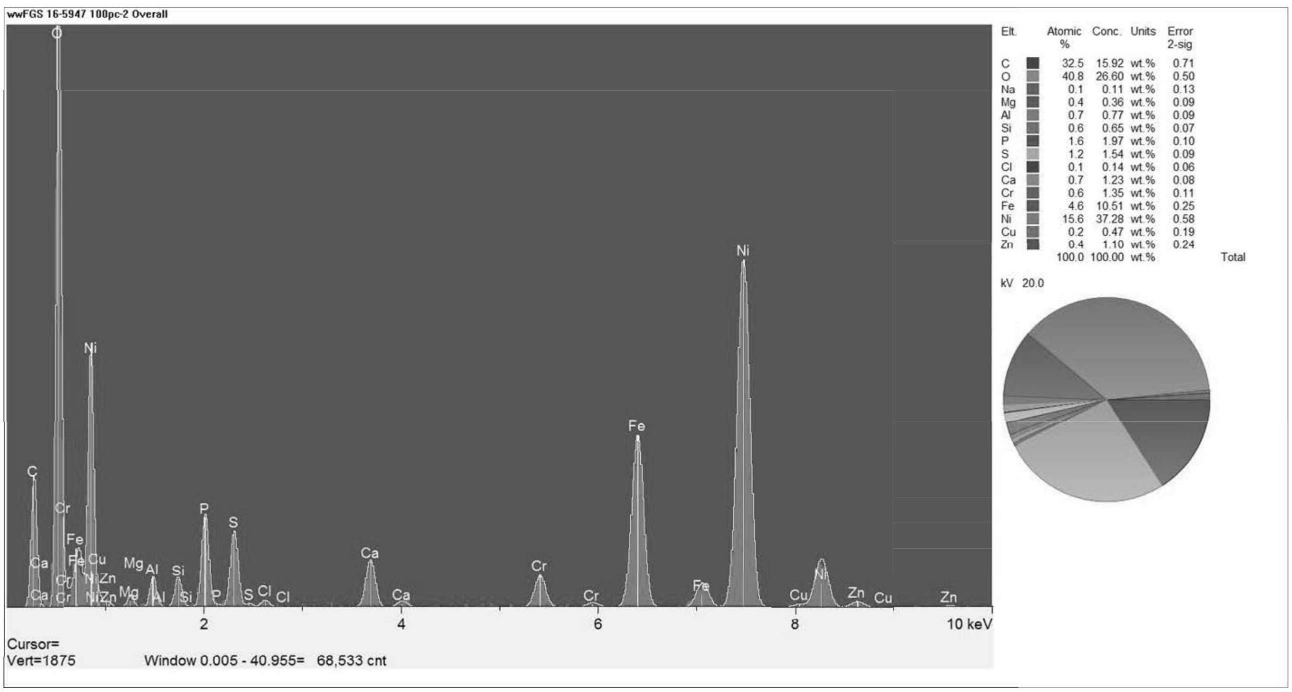

FIGURE 51
EDS MICROCHEMICAL ANALYSIS OF THE WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 49

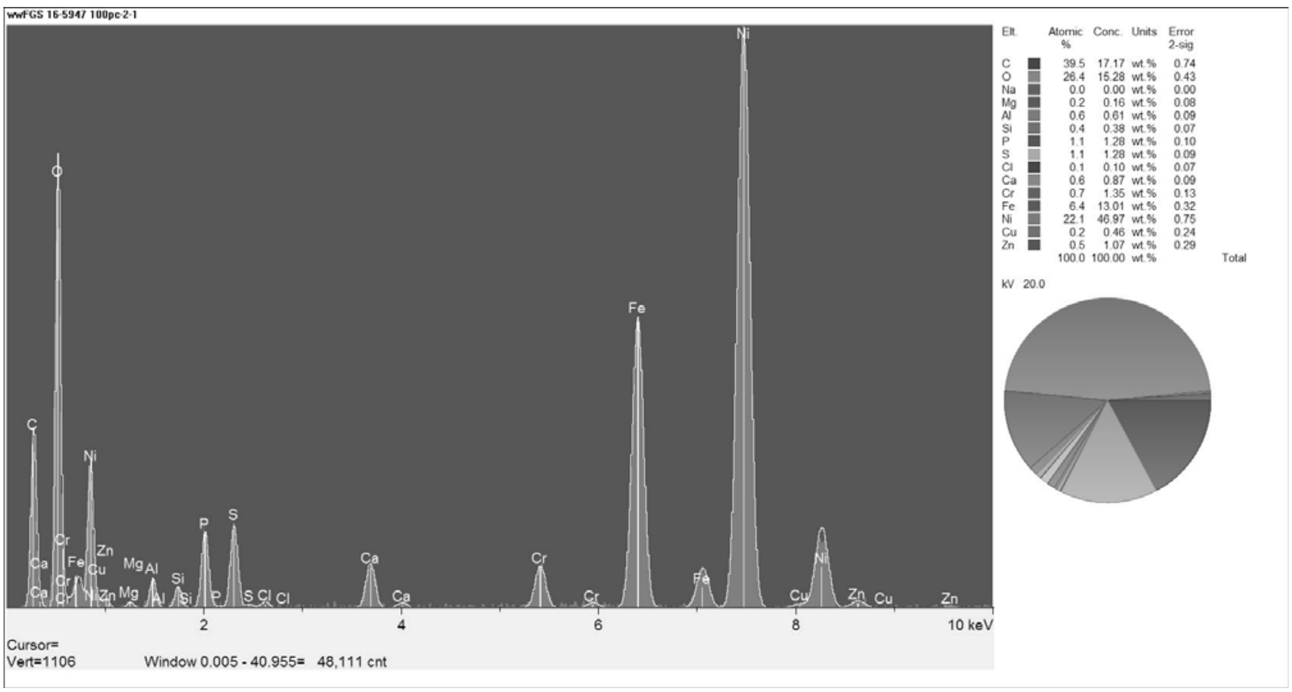

FIGURE 52
EDS MICROCHEMICAL ANALYSIS OF THE WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 49

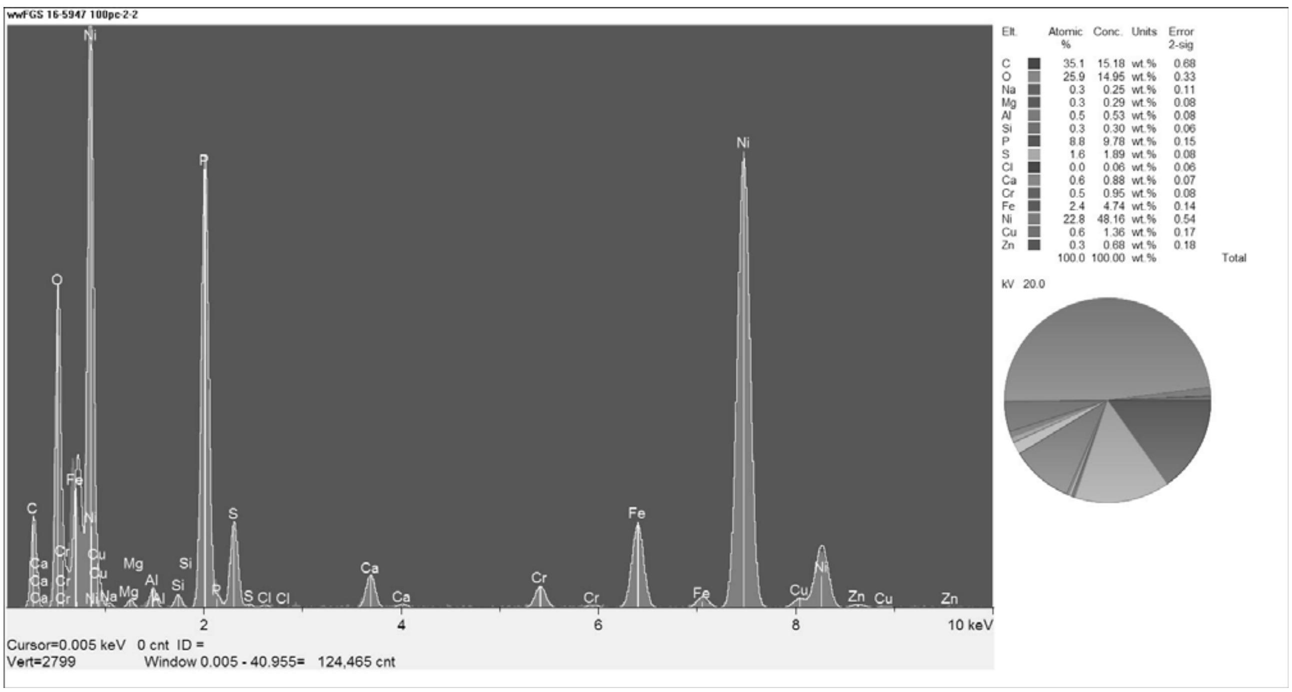

FIGURE 53
PHOTOGRAPH OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE

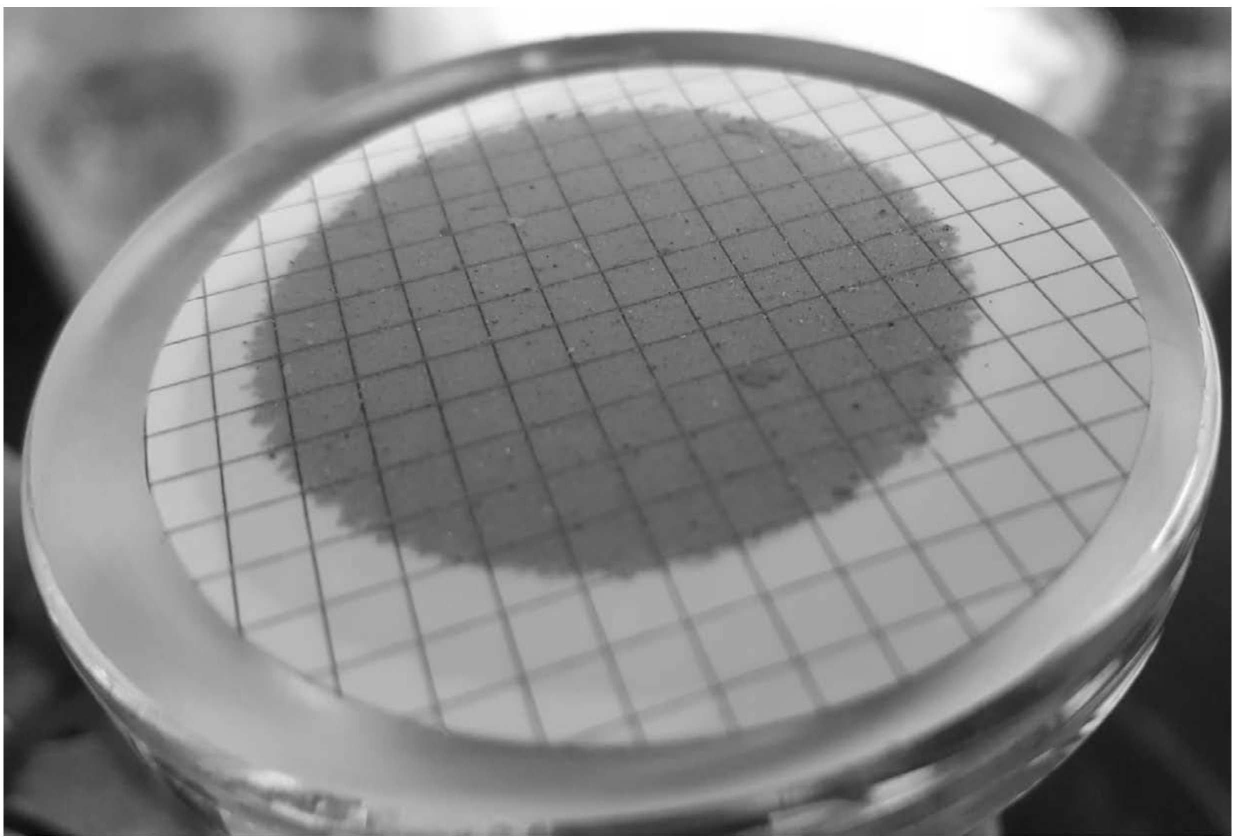

FIGURE 54
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE

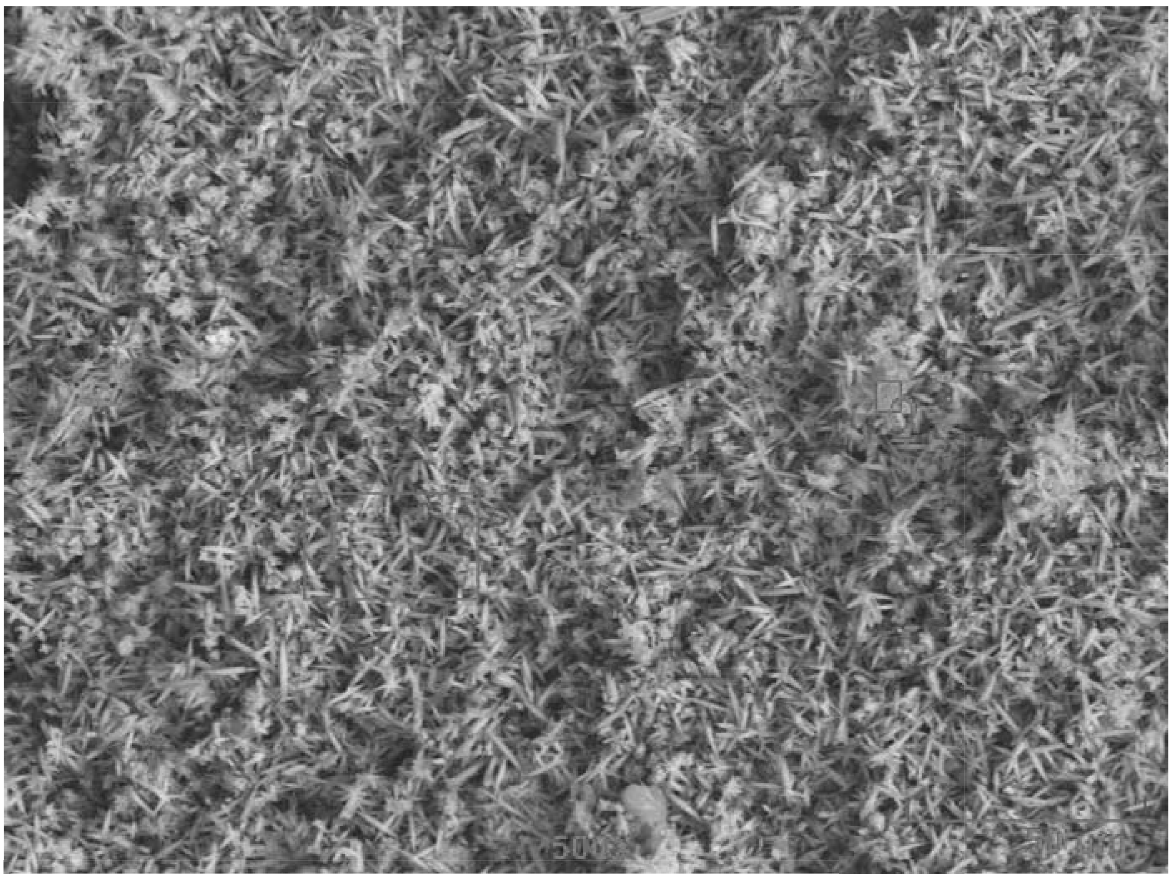

FIGURE 55
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 54

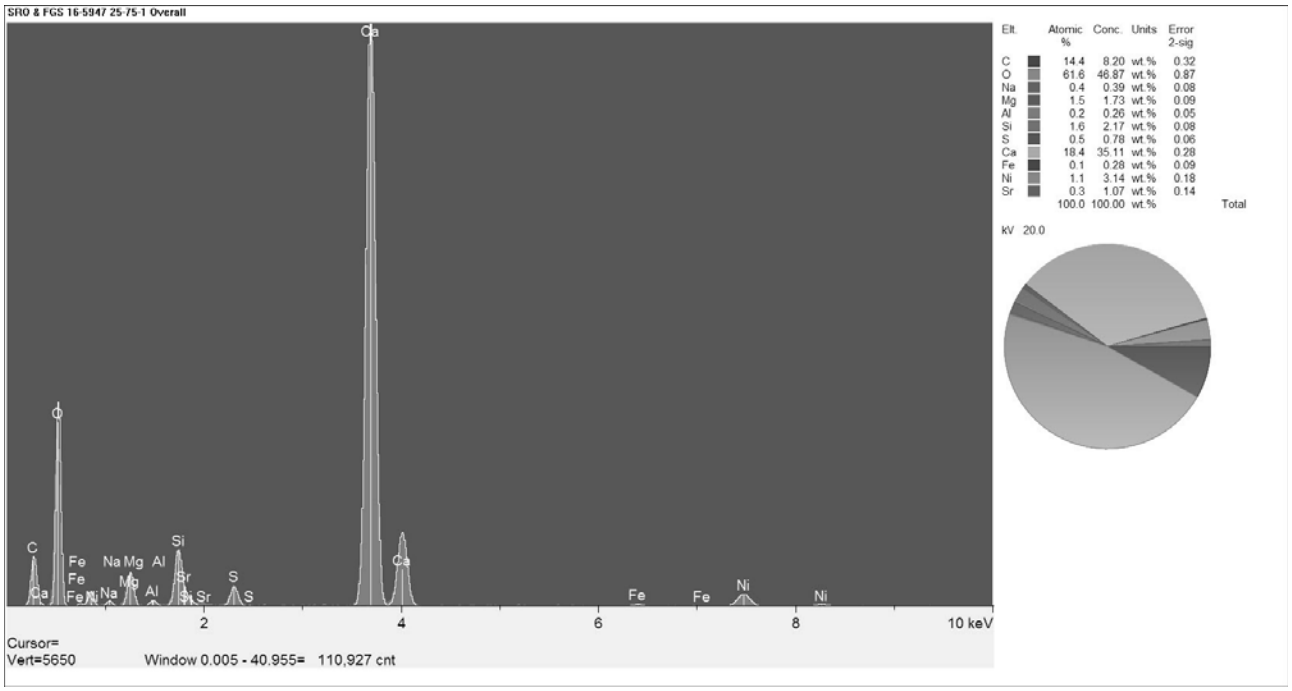

FIGURE 56

EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 54

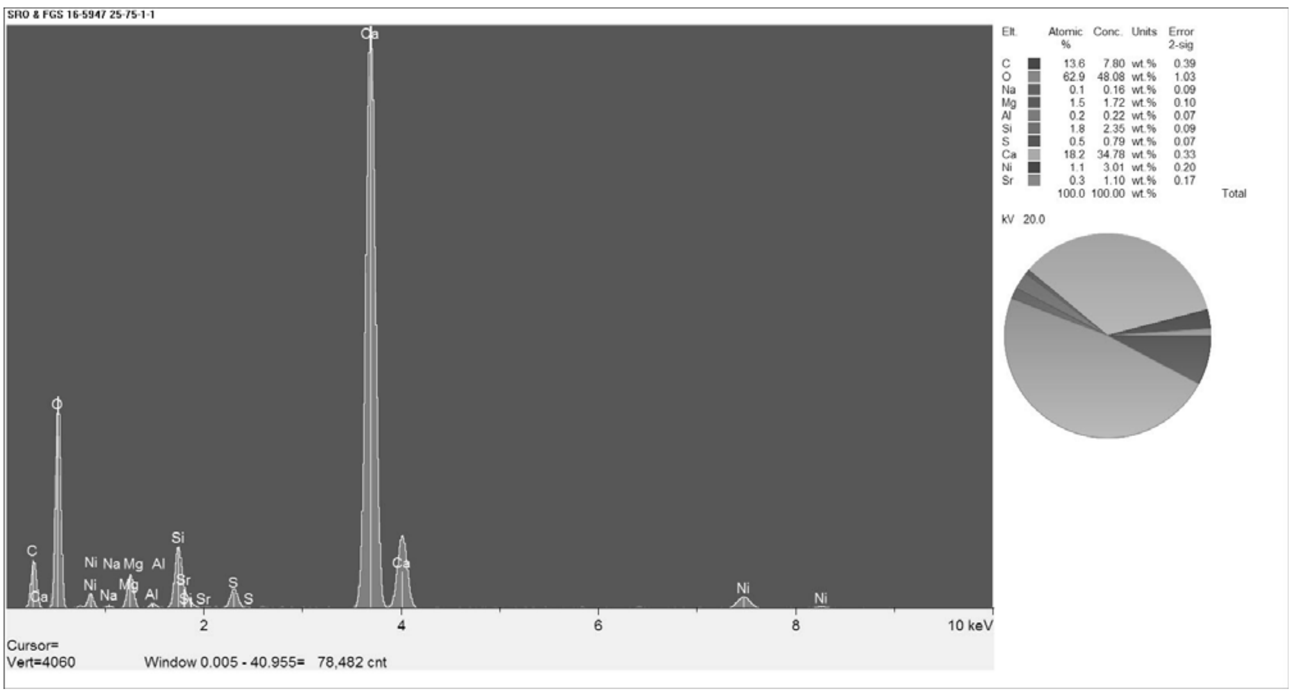

FIGURE 57
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE

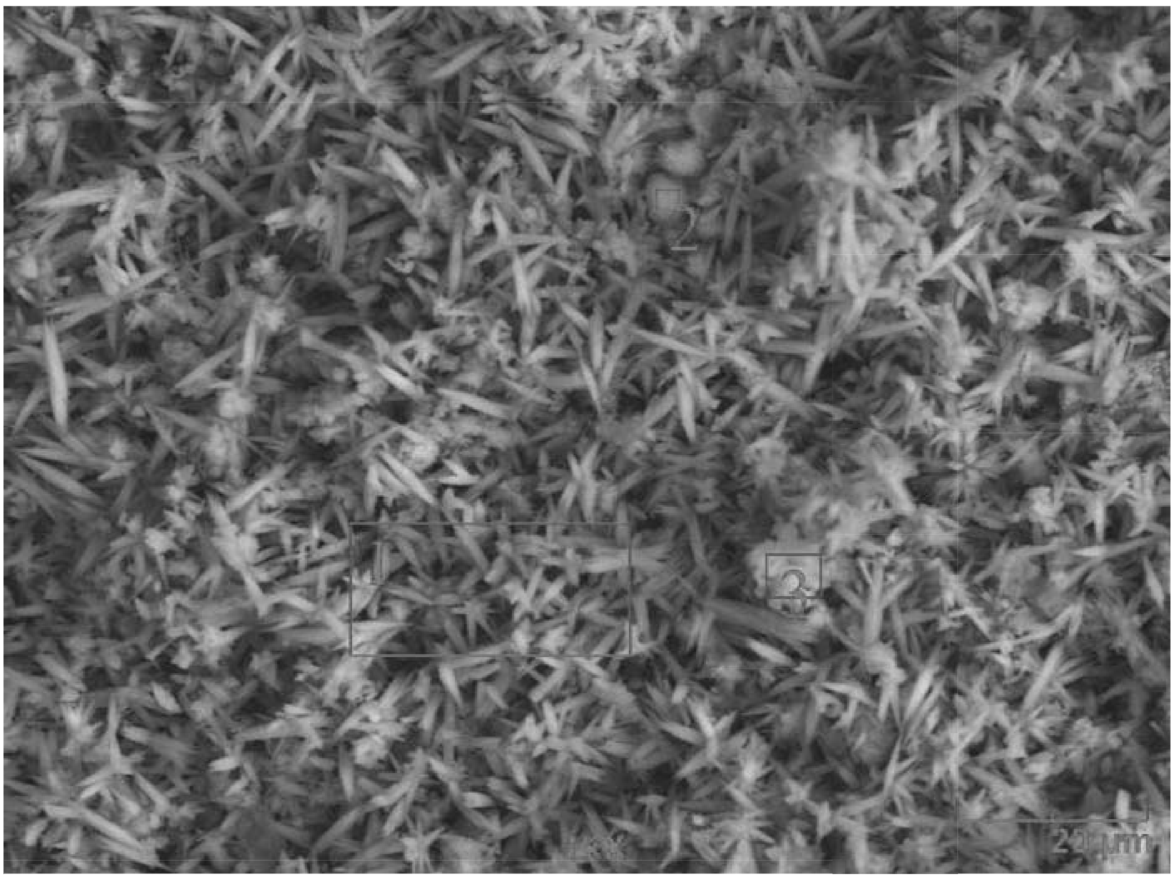

FIGURE 58

EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 57

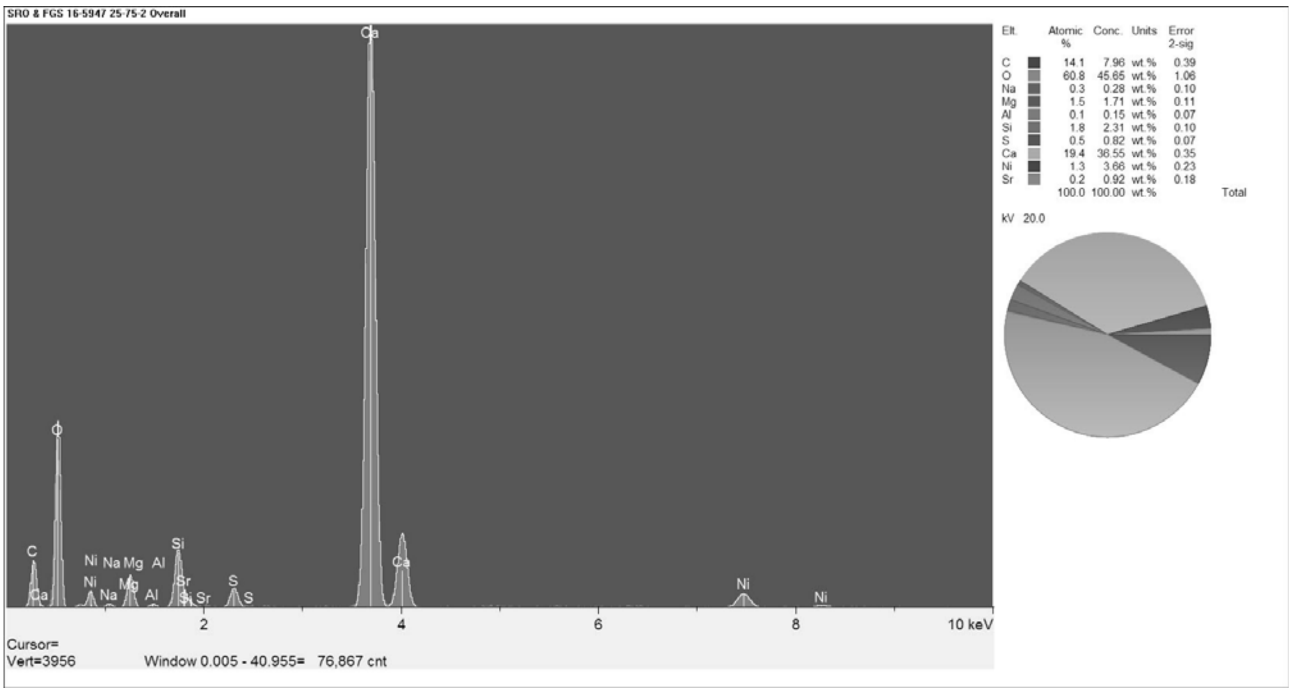

FIGURE 59

EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 57

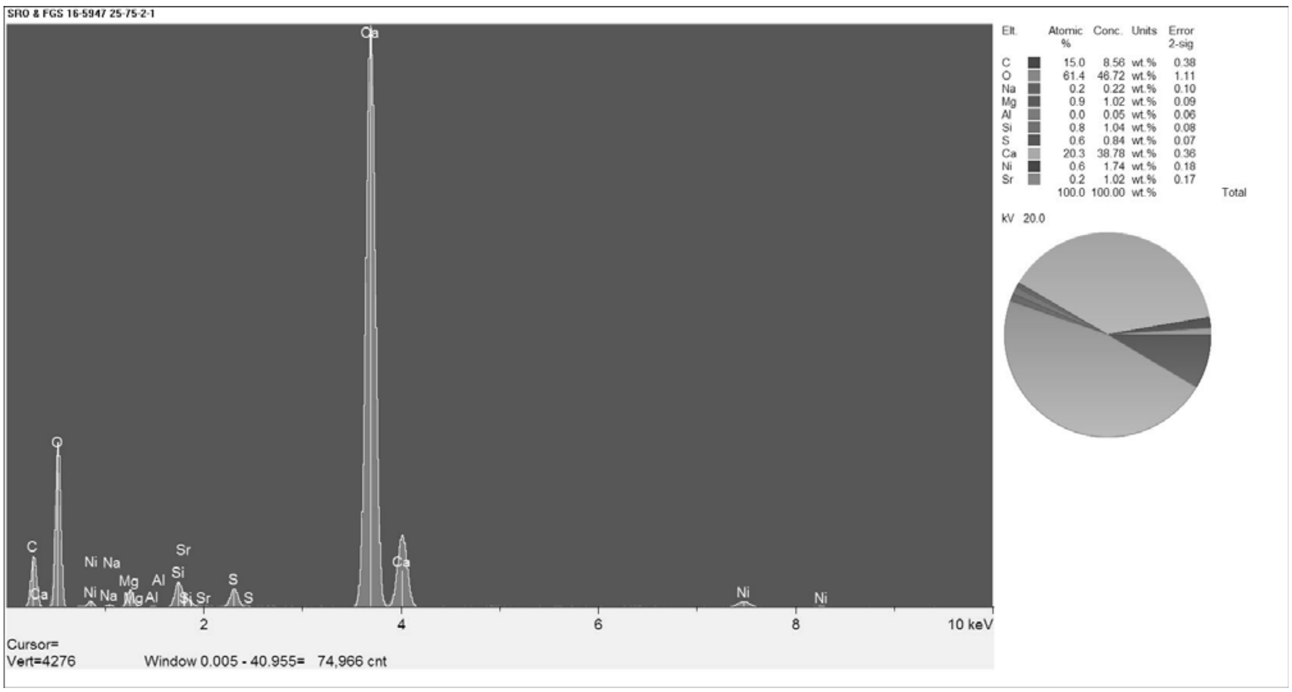

FIGURE 60
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 57

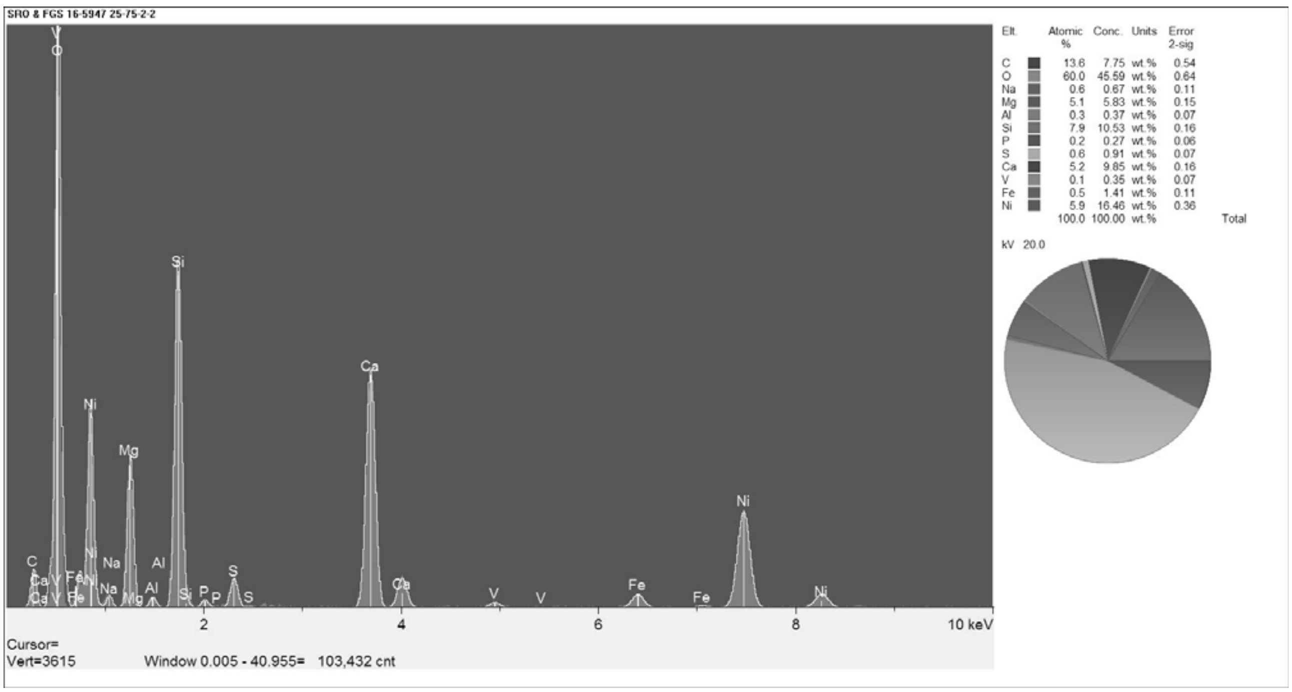

FIGURE 61
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #3 IN FIGURE 57

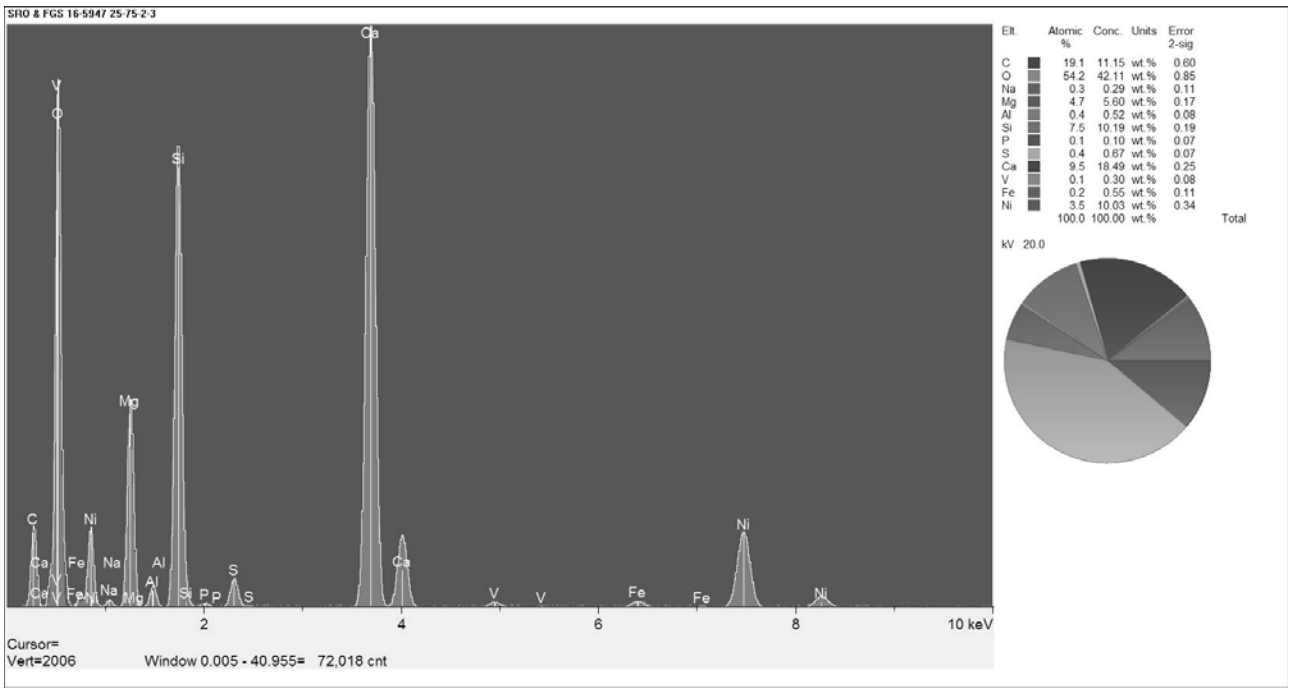

FIGURE 62
PHOTOGRAPH OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE

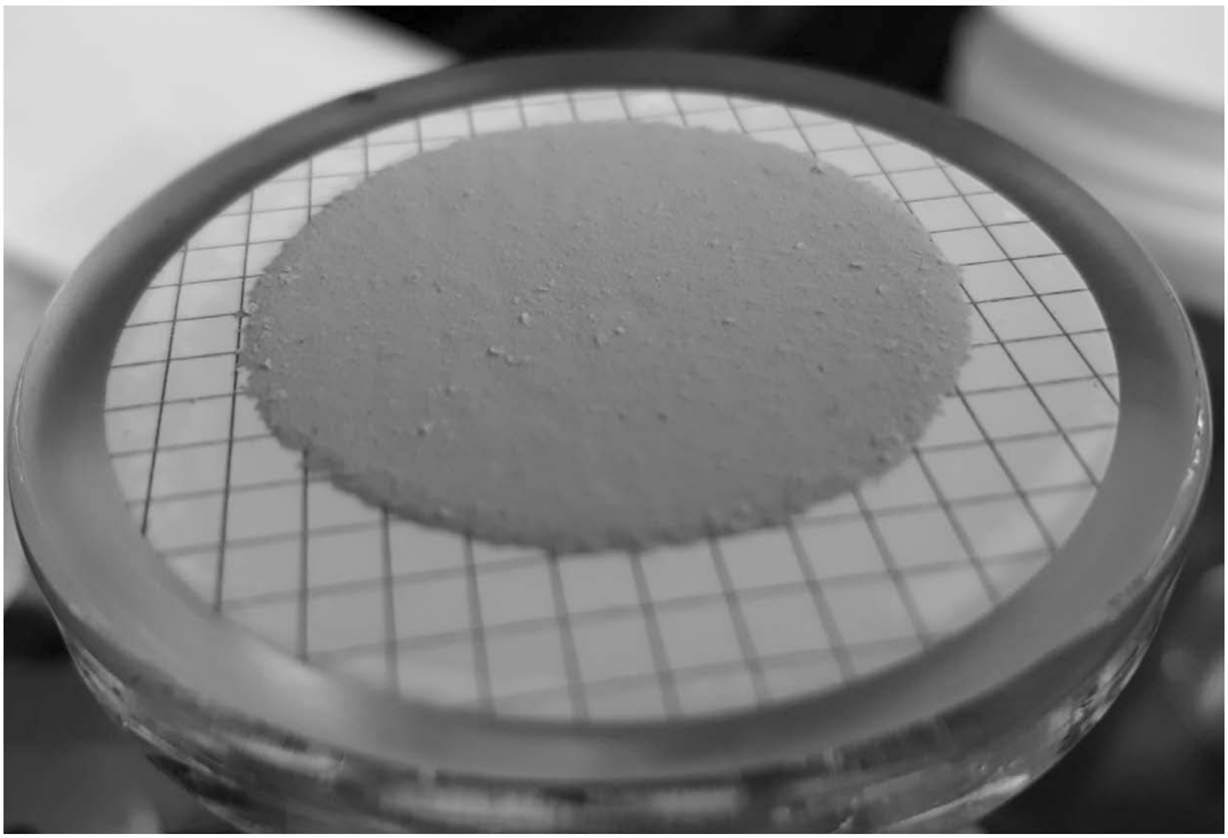

FIGURE 63
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE

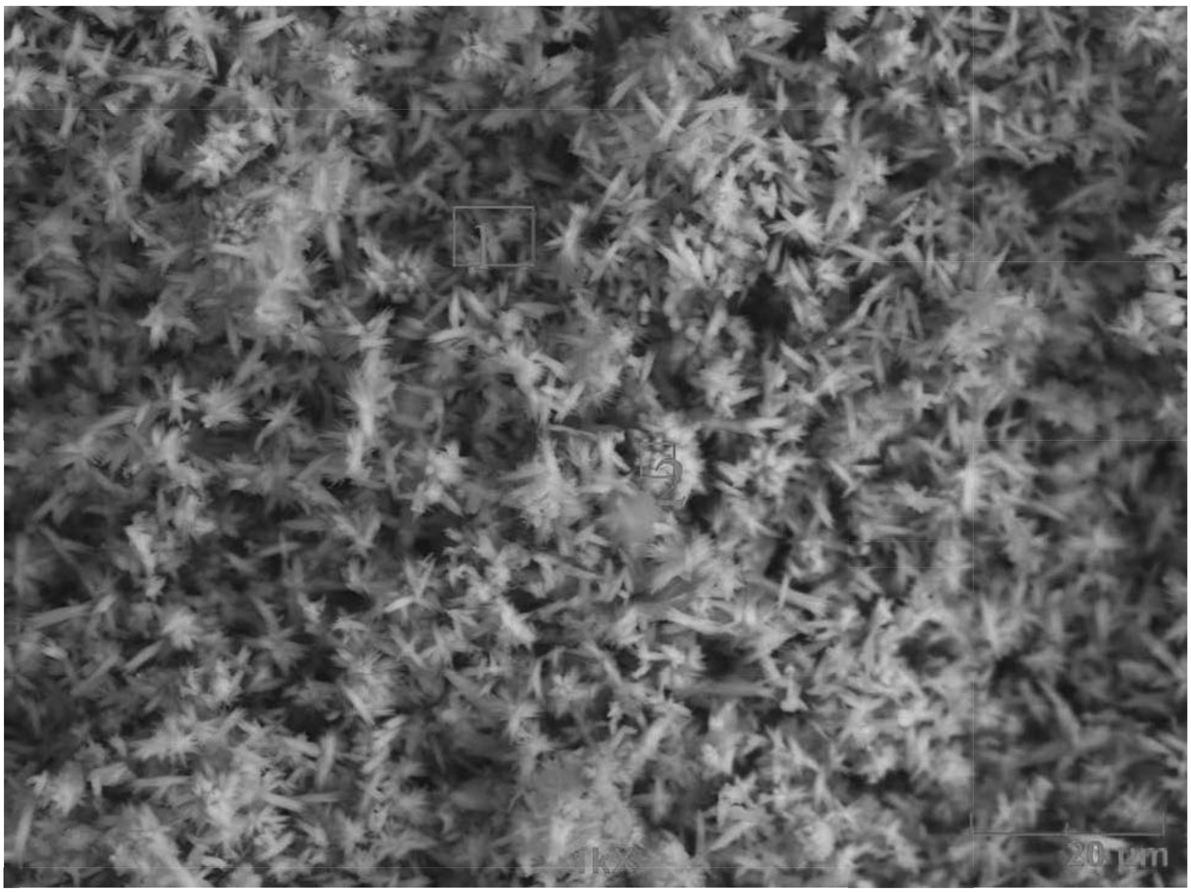

FIGURE 64
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 63

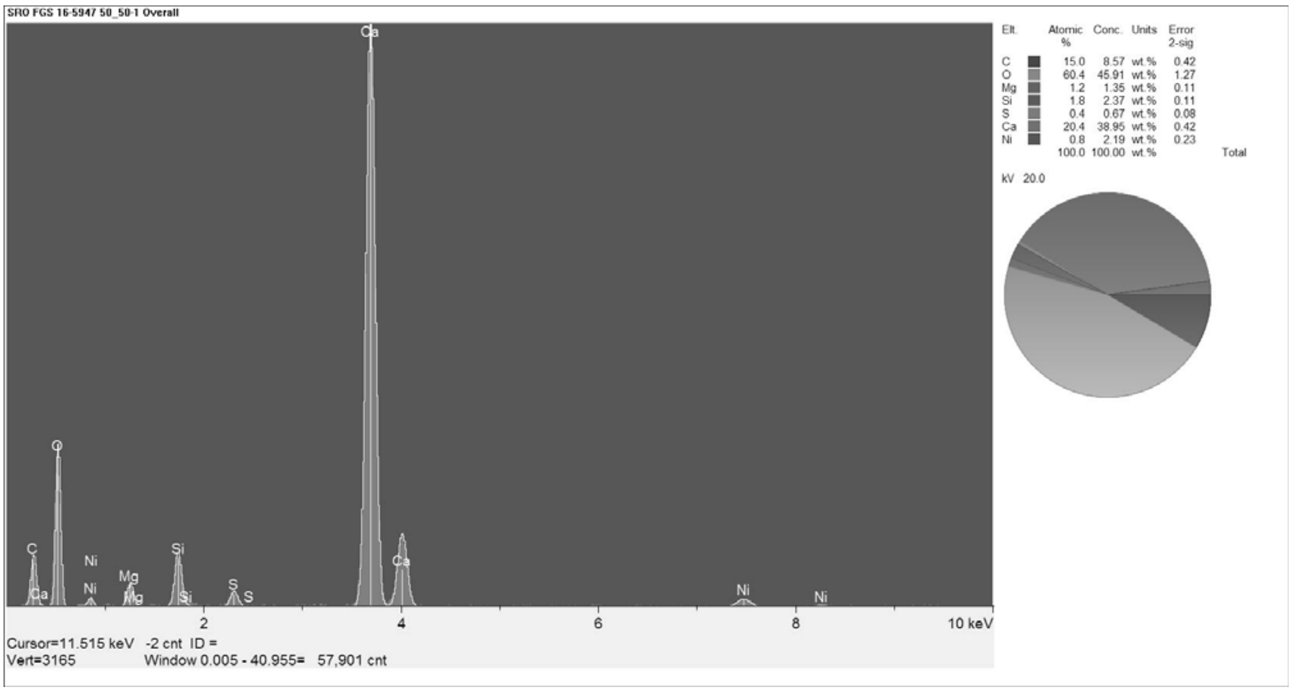

FIGURE 65
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 63

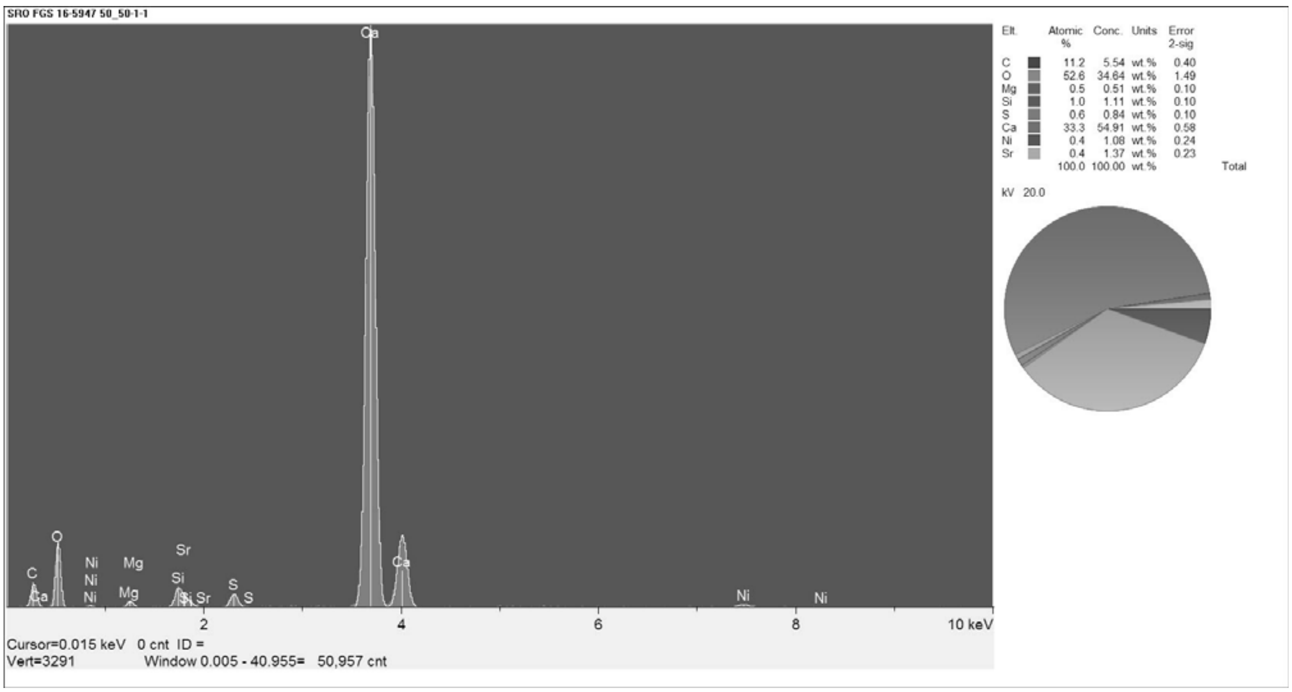

FIGURE 66

EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 63

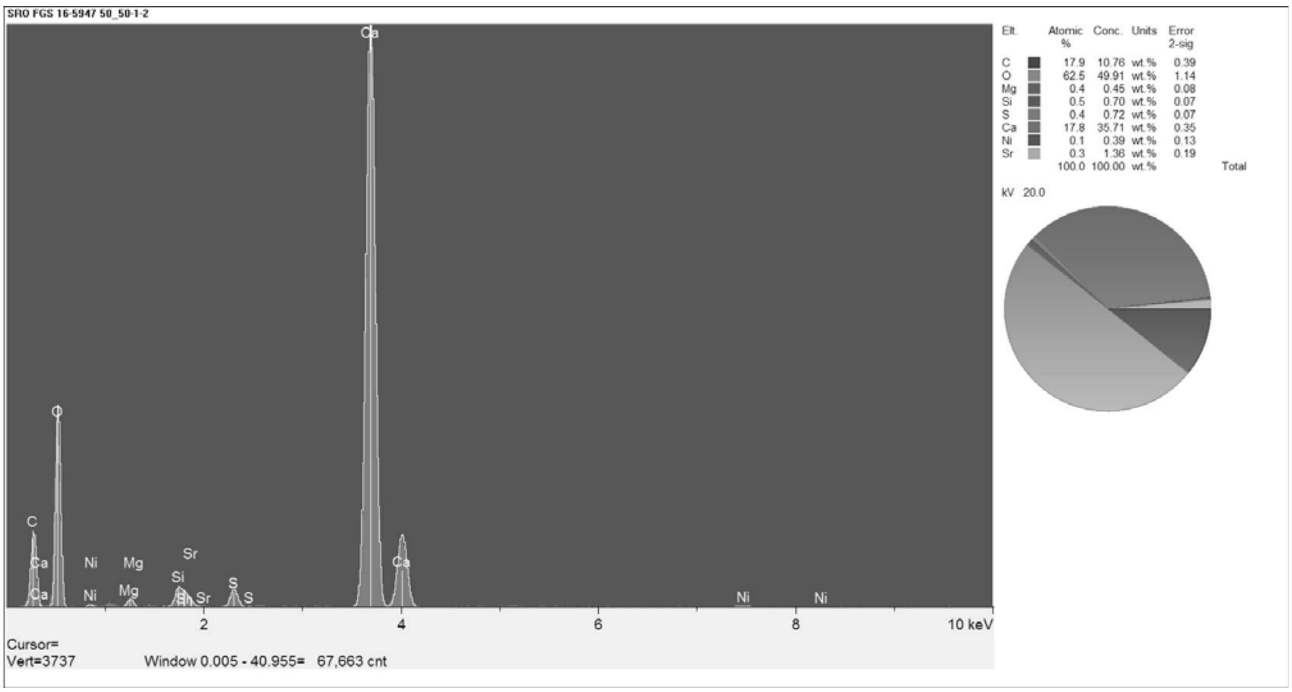

FIGURE 67
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE

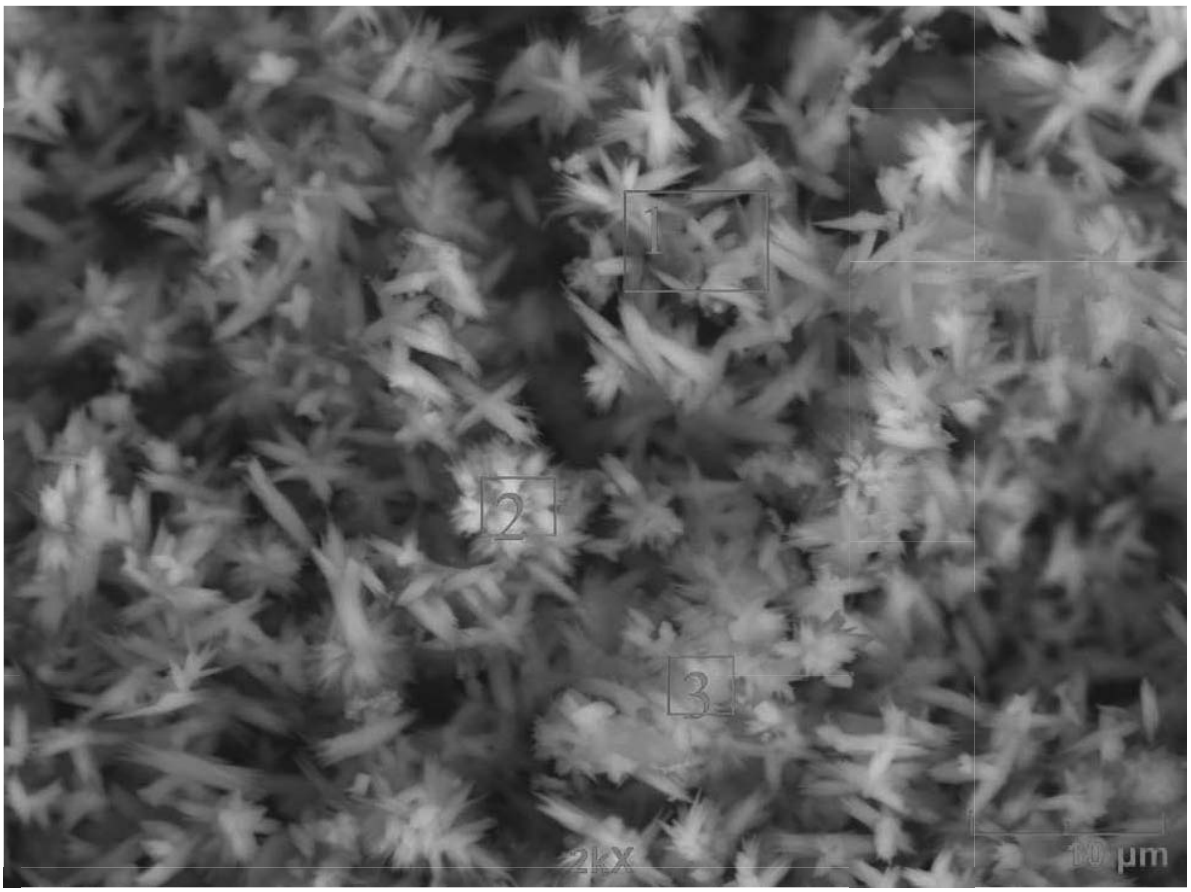

FIGURE 68
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 67

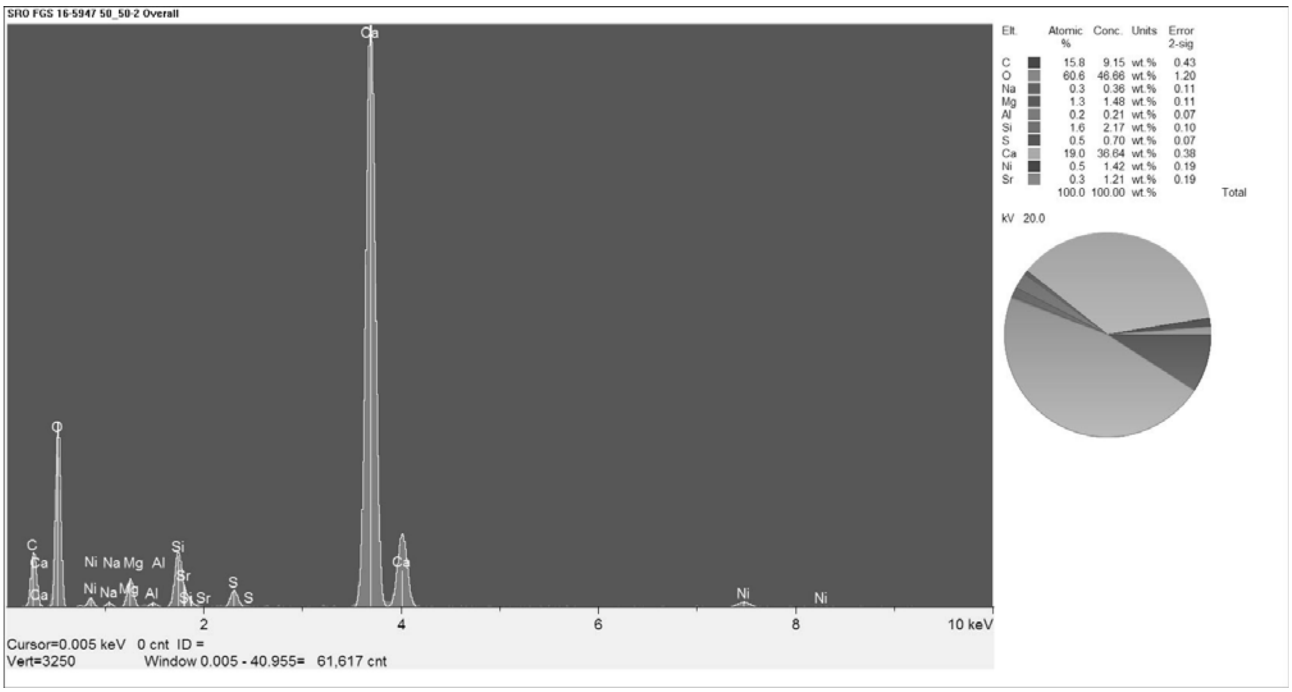

FIGURE 69
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 67

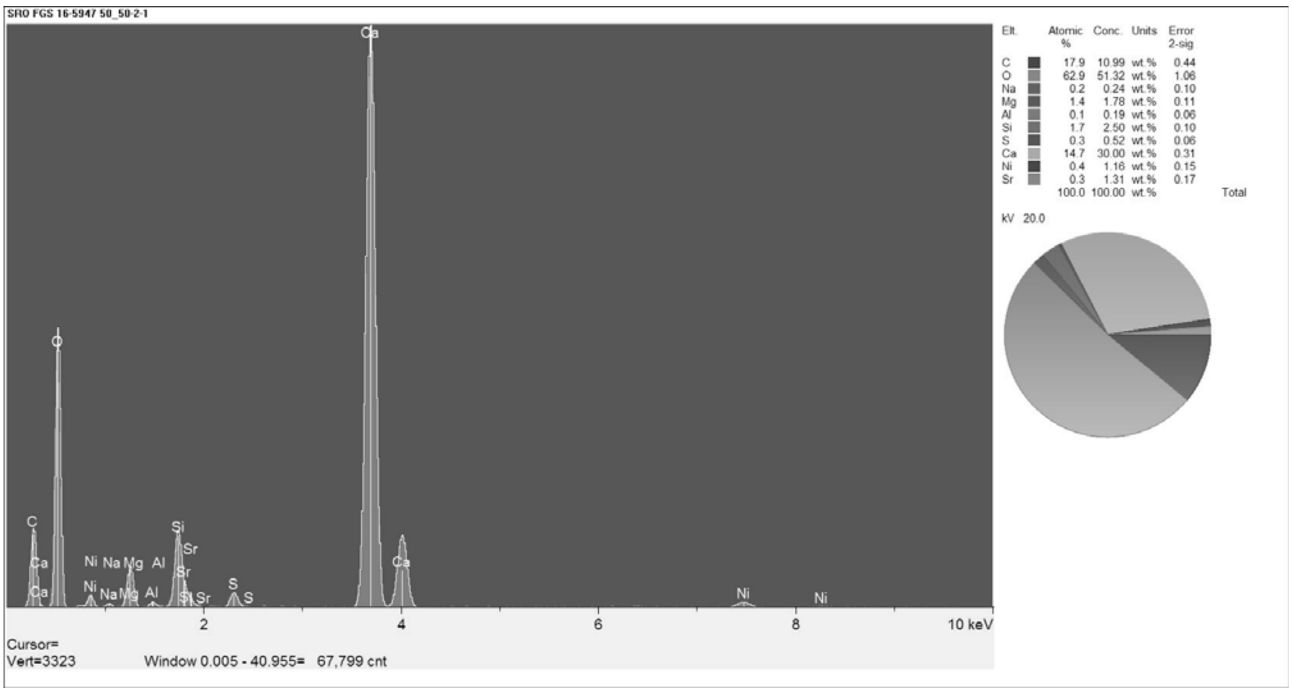

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FIGURE 70
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 67

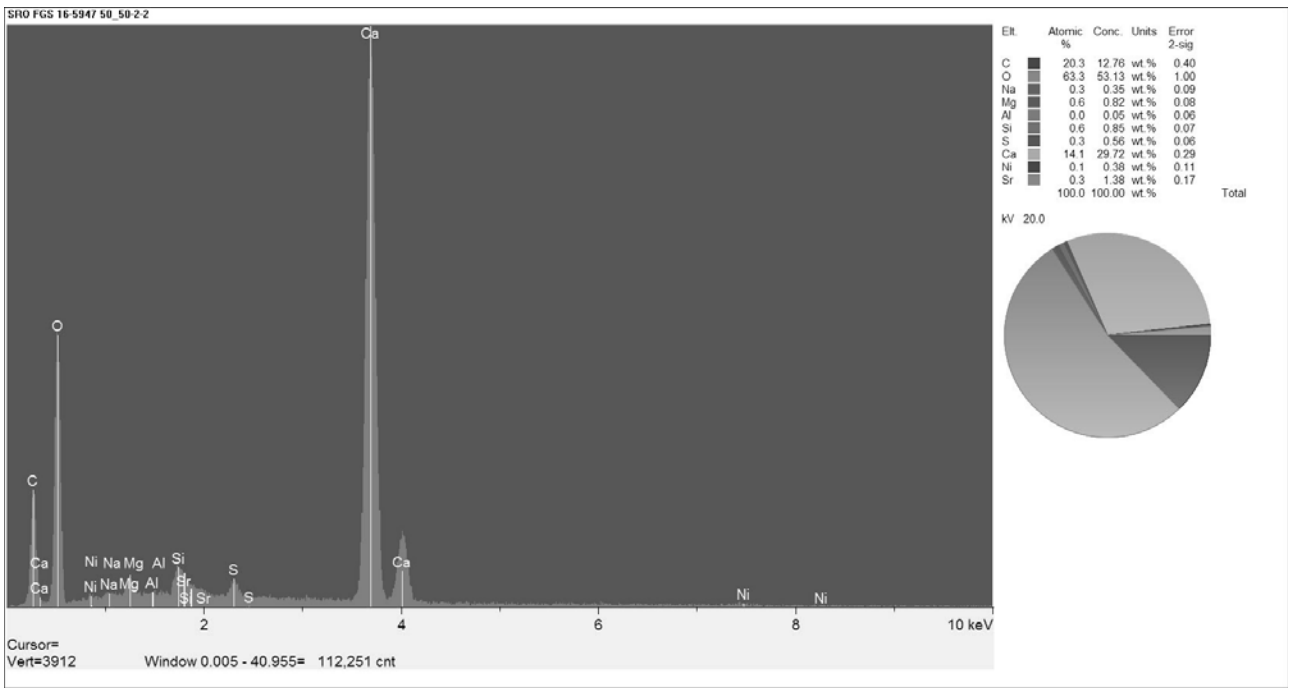


FIGURE 71
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #3 IN FIGURE 67

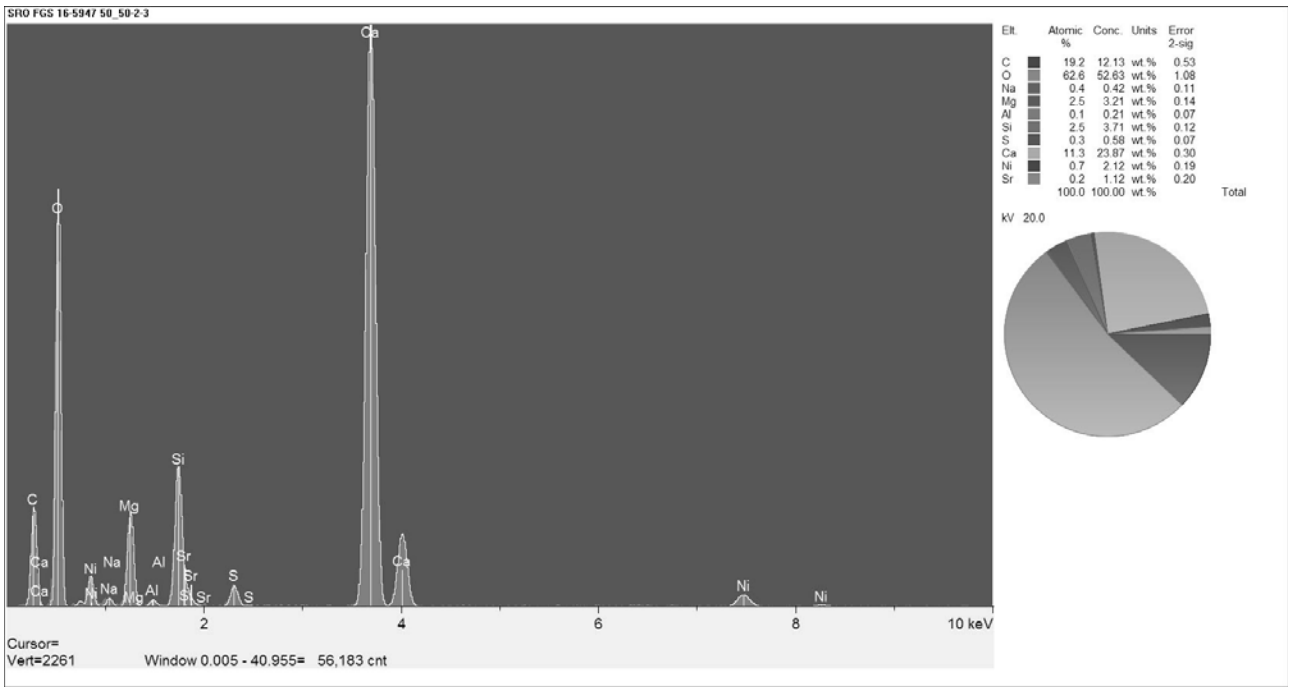


FIGURE 72
PHOTOGRAPH OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE

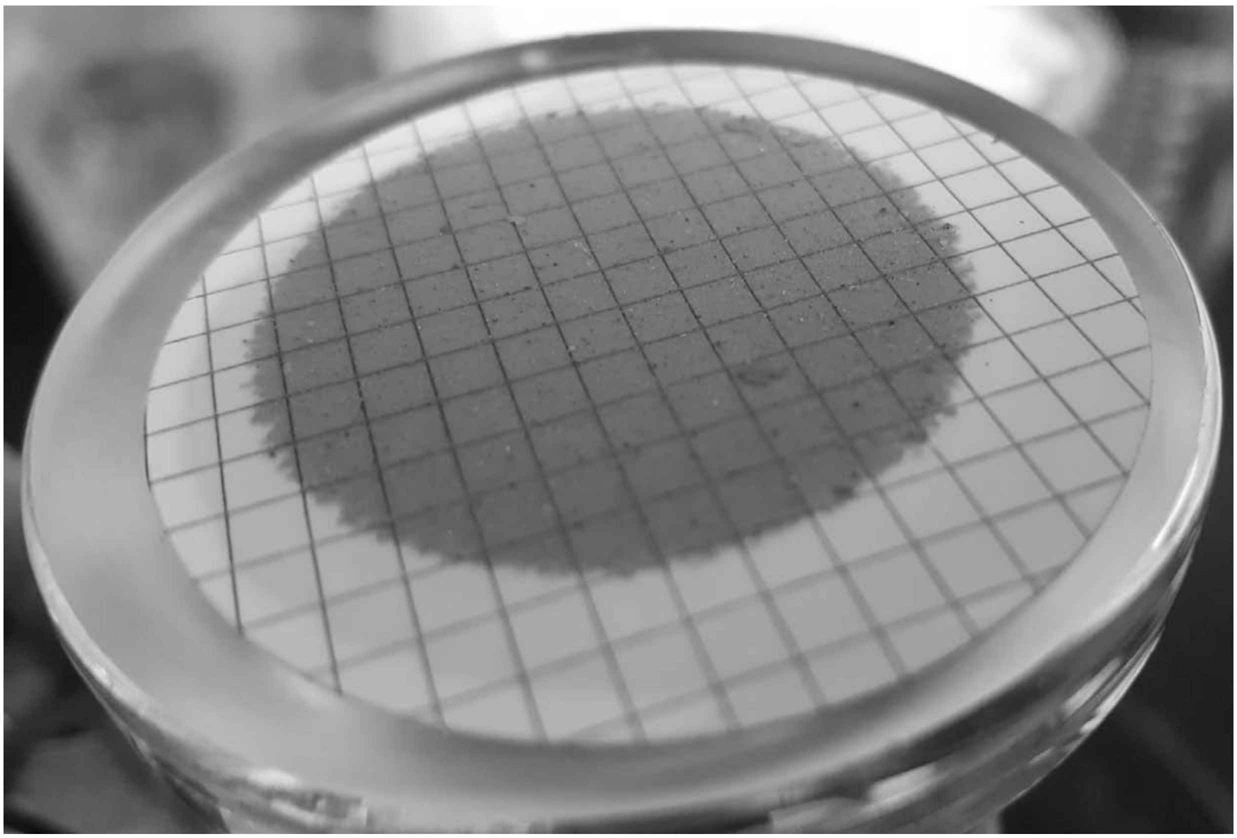


FIGURE 73
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE

FIGURE 74
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 73

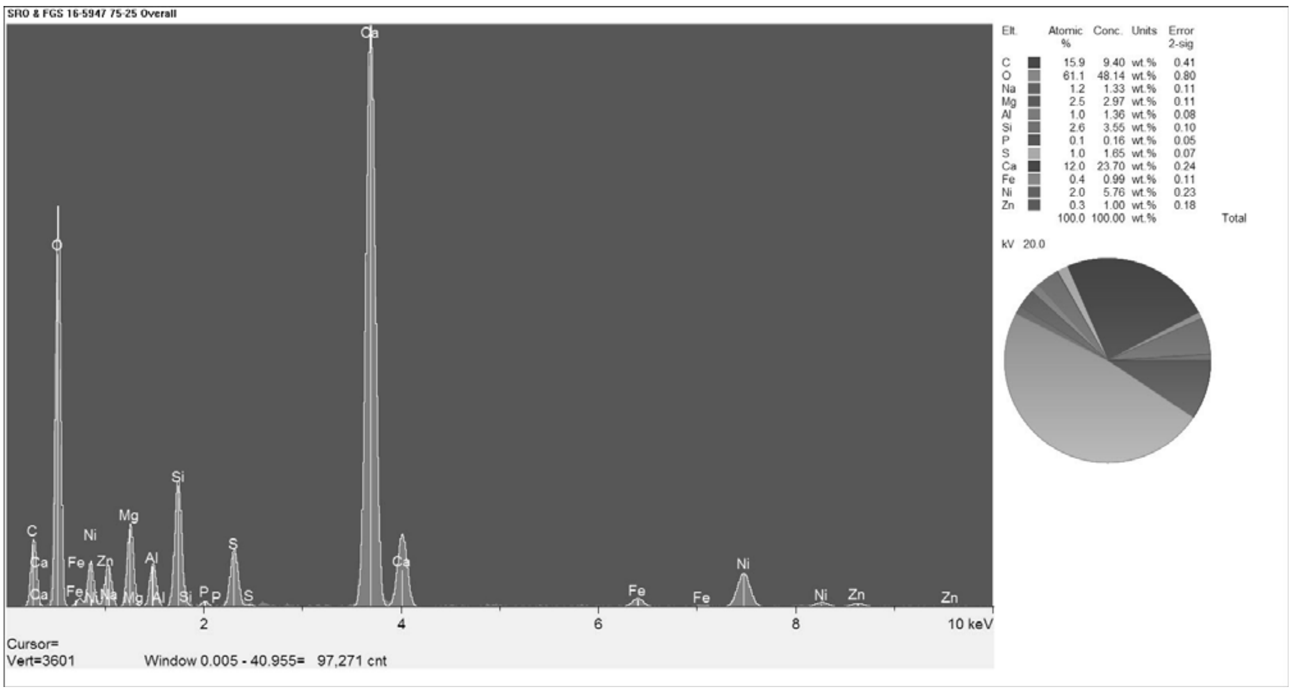
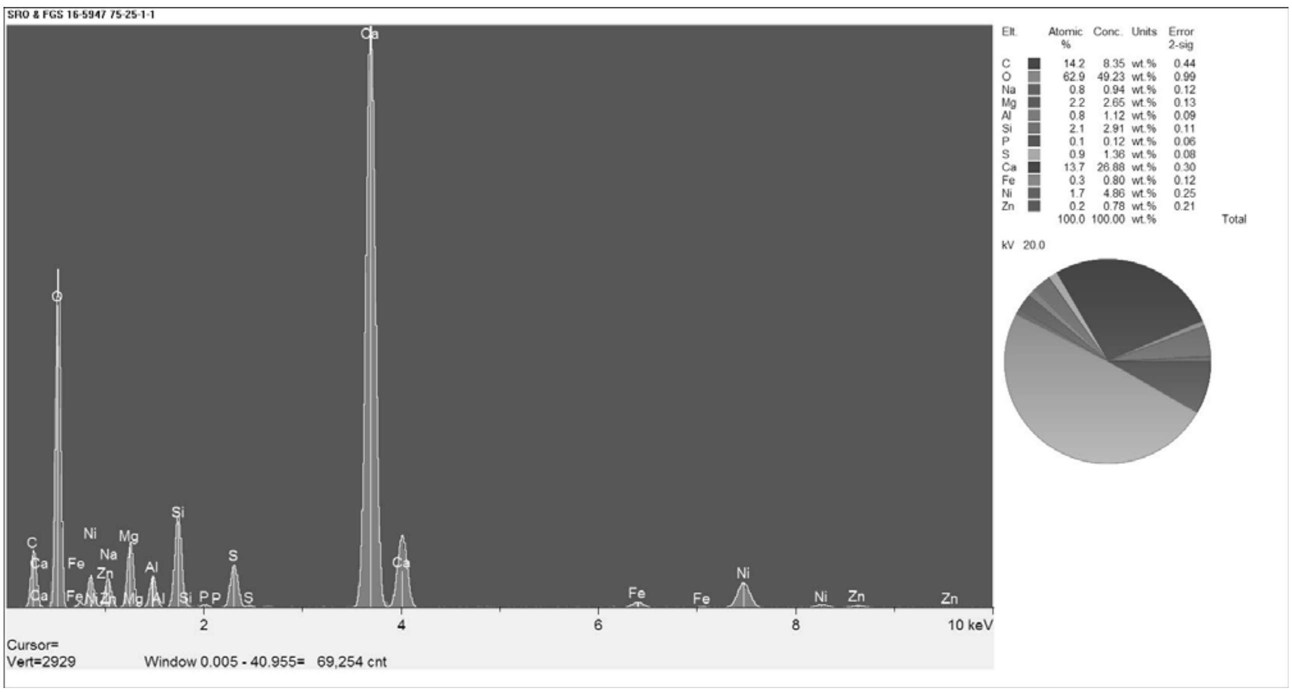


FIGURE 75
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 73



Elt.	Atomic %	Conc.	Units	Error 2-sig	
C	14.2	8.35	wt.%	0.44	
O	62.9	49.23	wt.%	0.99	
Na	0.8	0.94	wt.%	0.12	
Mg	2.2	2.65	wt.%	0.13	
Al	0.8	1.12	wt.%	0.09	
Si	2.1	2.91	wt.%	0.11	
P	0.1	0.12	wt.%	0.06	
S	0.9	1.36	wt.%	0.08	
Ca	13.7	26.88	wt.%	0.30	
Fe	0.3	0.80	wt.%	0.12	
Ni	1.7	4.86	wt.%	0.25	
Zn	0.2	0.78	wt.%	0.21	
	100.0	100.00	wt.%		Total

FIGURE 76
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 73

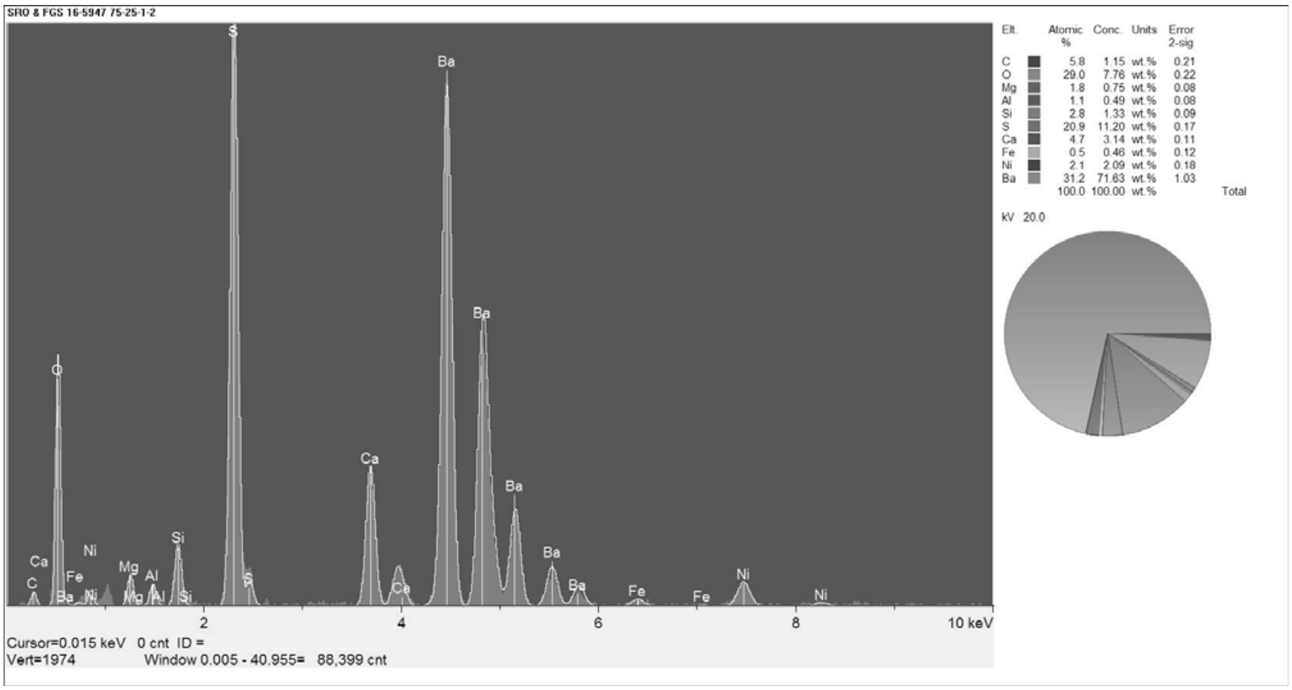


FIGURE 77
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE

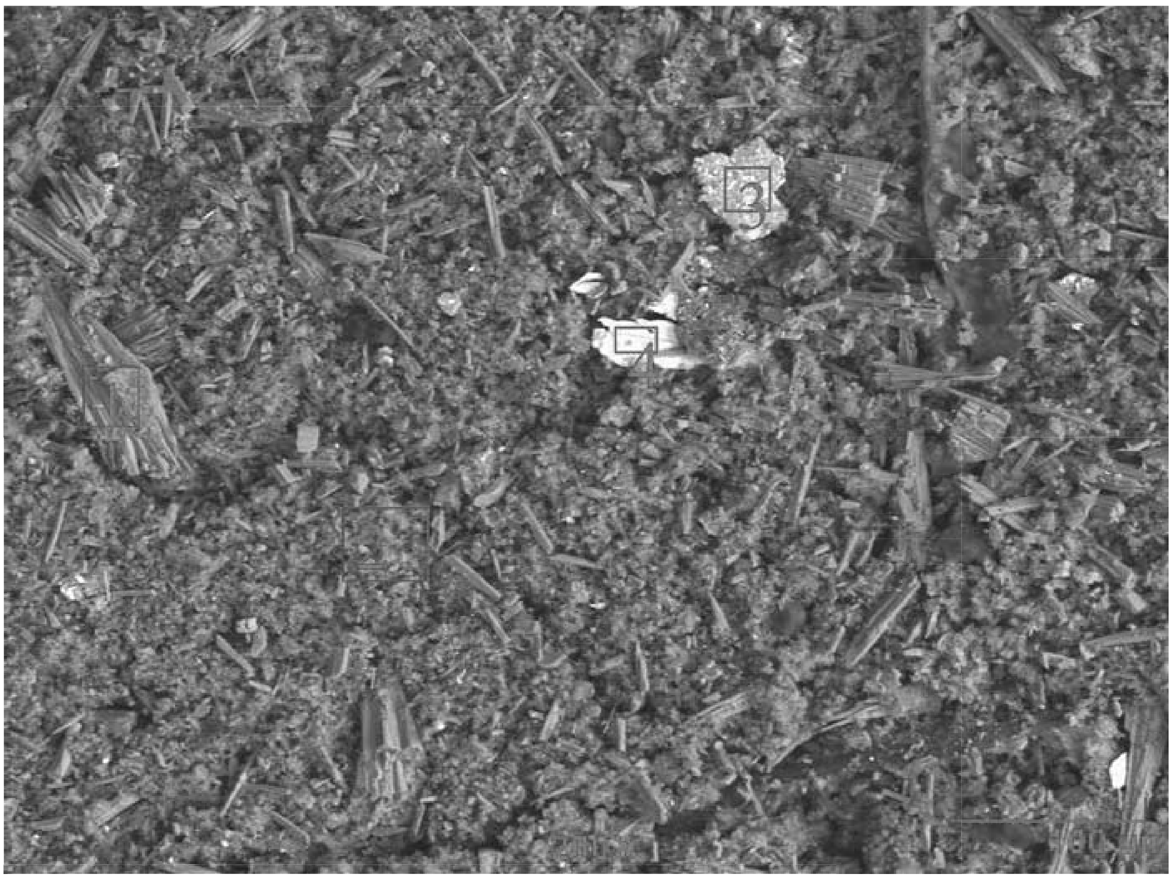


FIGURE 78
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 77

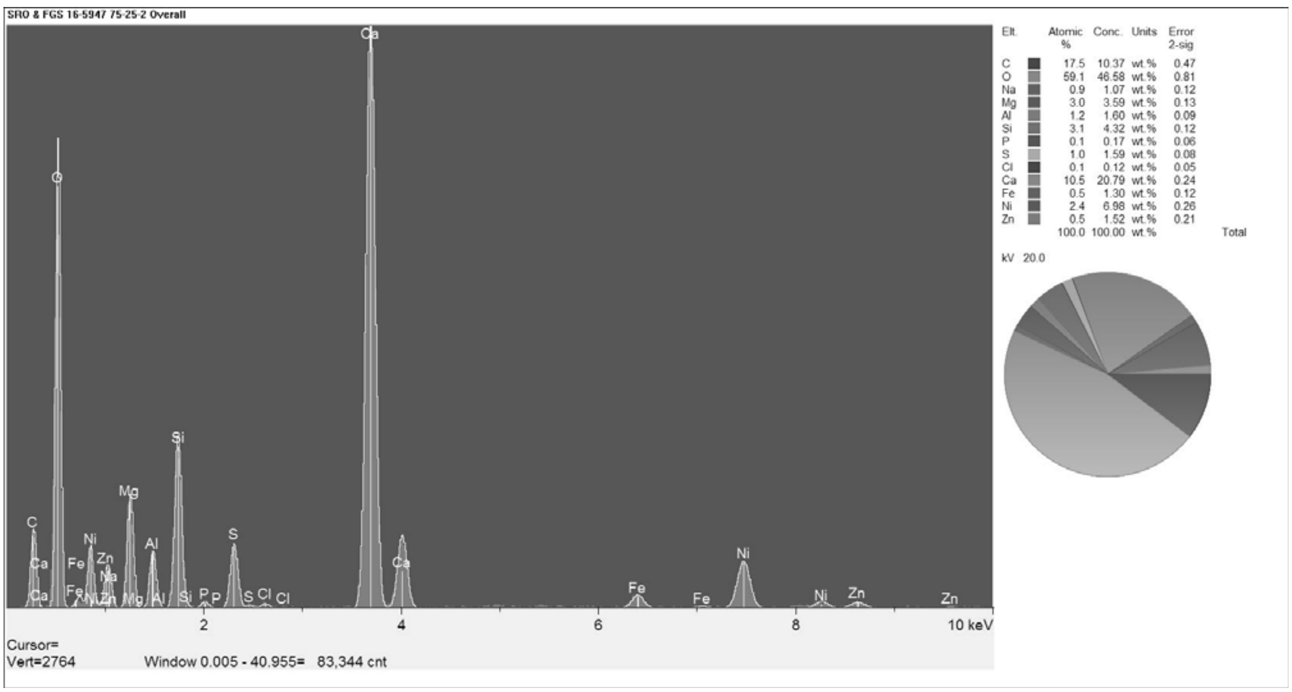


FIGURE 79
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 77

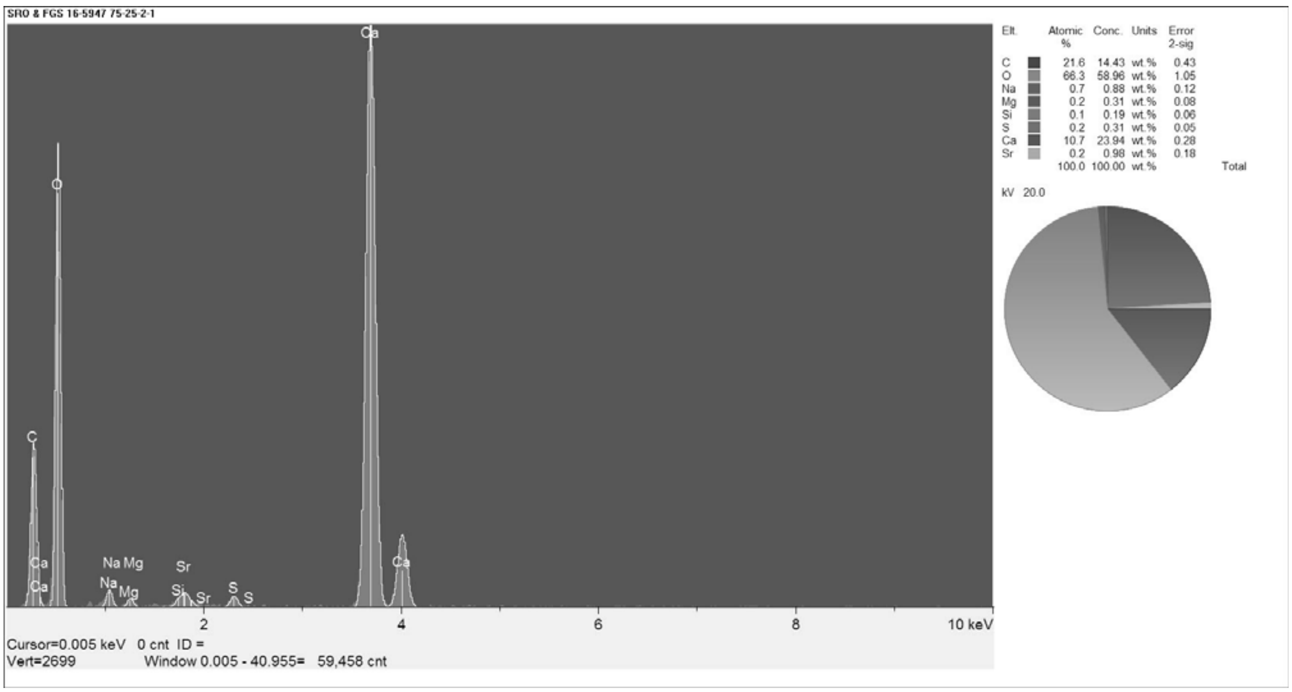


FIGURE 80
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 77

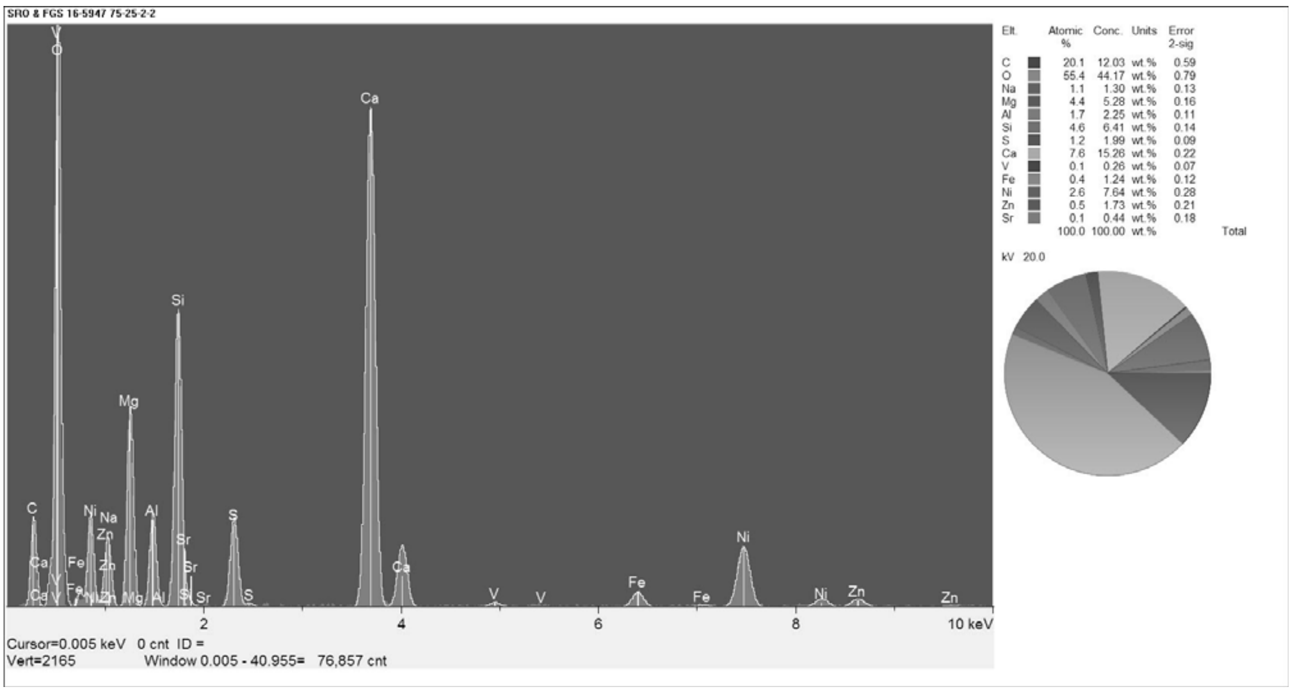


FIGURE 81
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #3 IN FIGURE 77

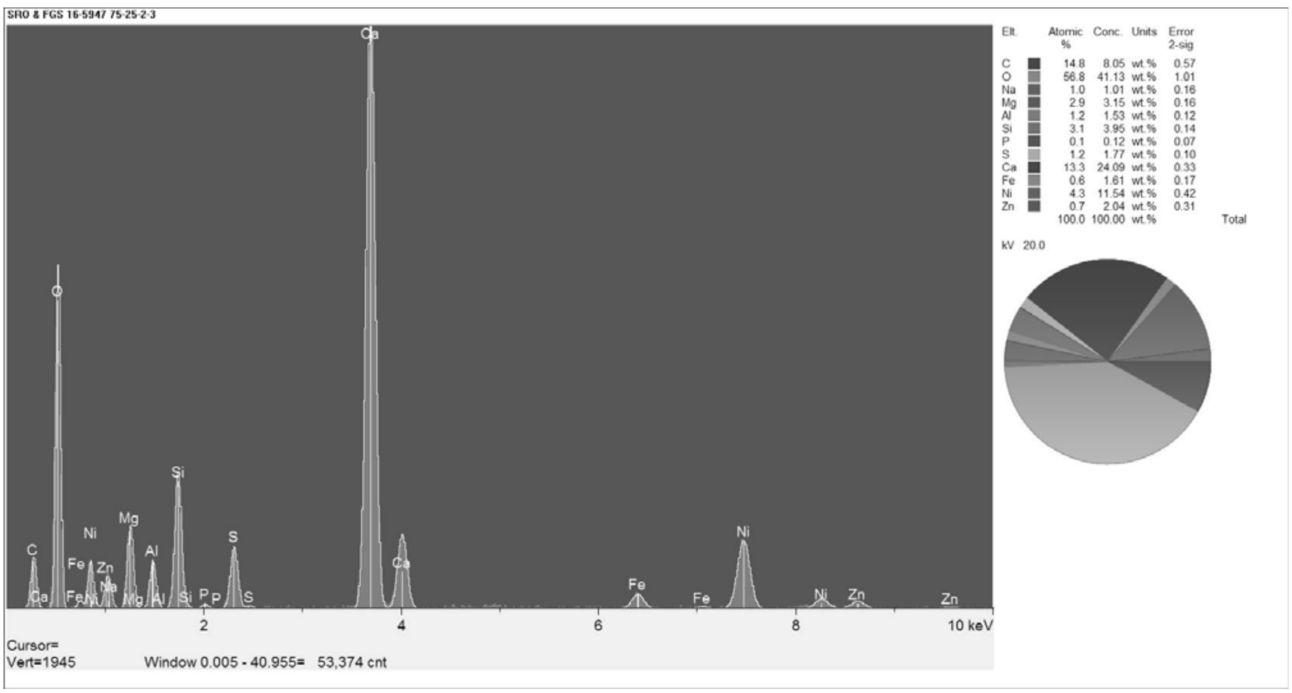


FIGURE 82
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:FGS SAMPLE PRECIPITATE PARTICLES LABELED #4 IN FIGURE 77

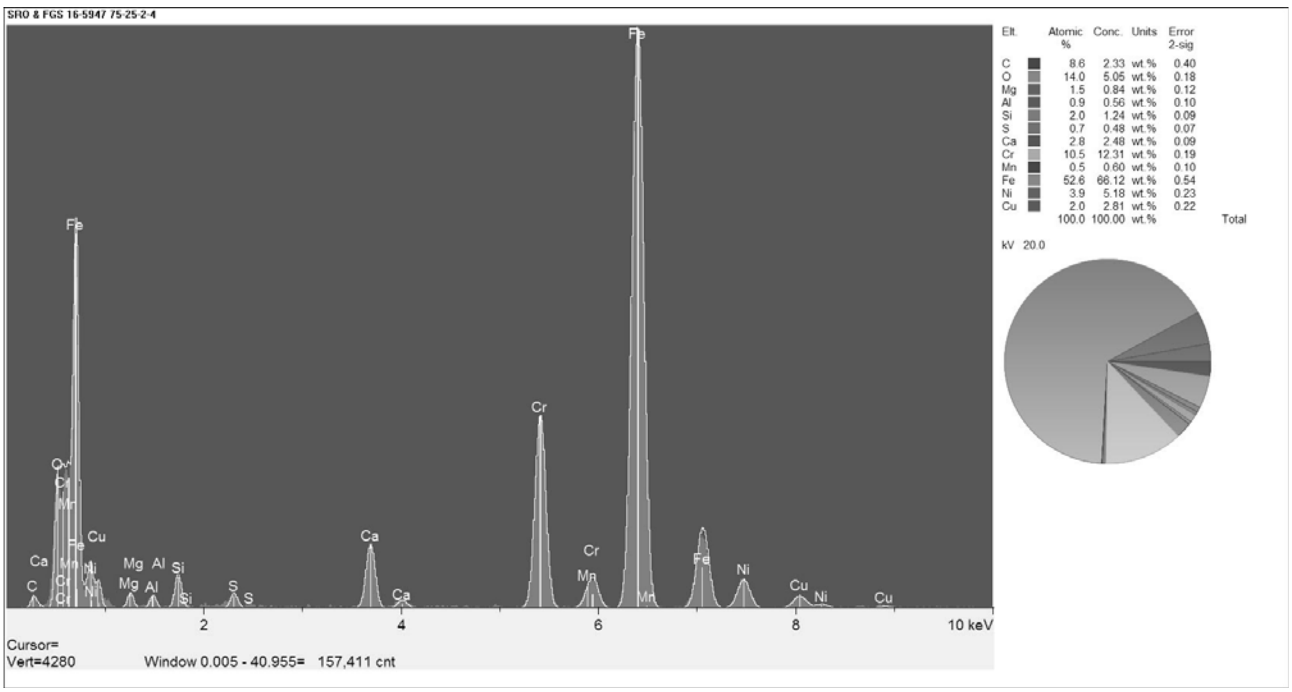


FIGURE 83
PHOTOGRAPH OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE

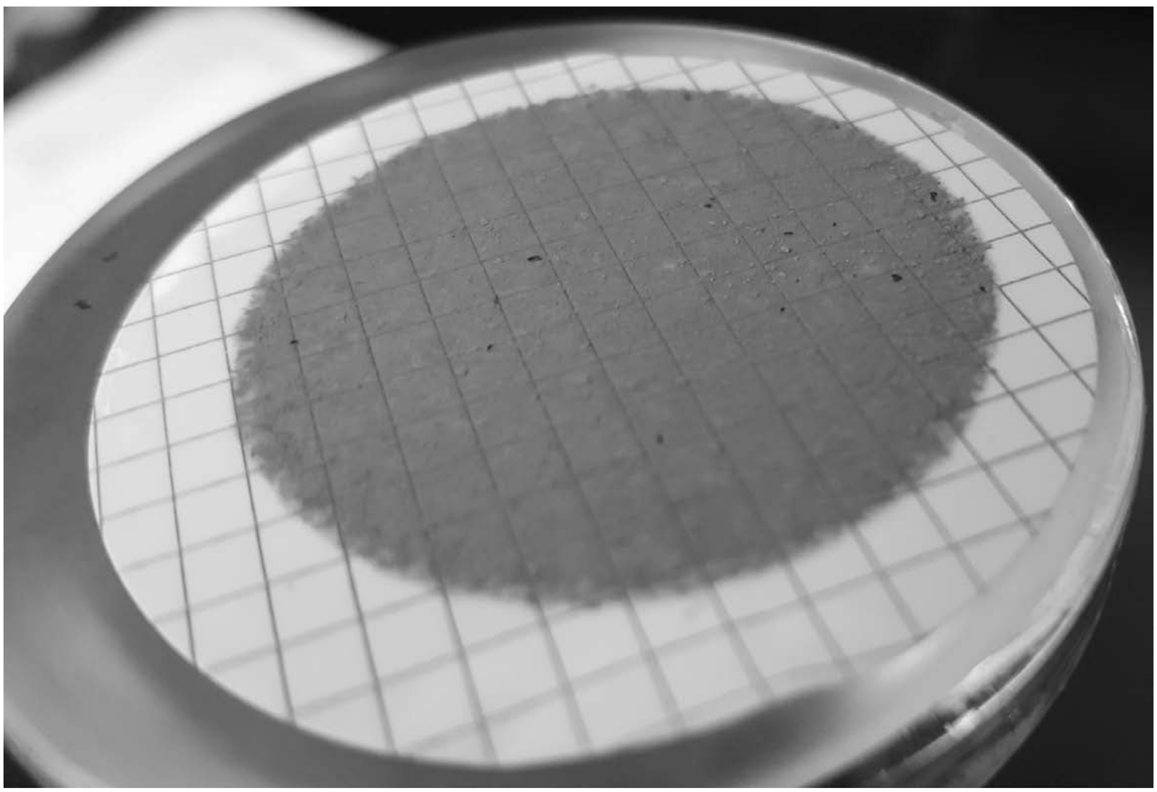


FIGURE 84
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE

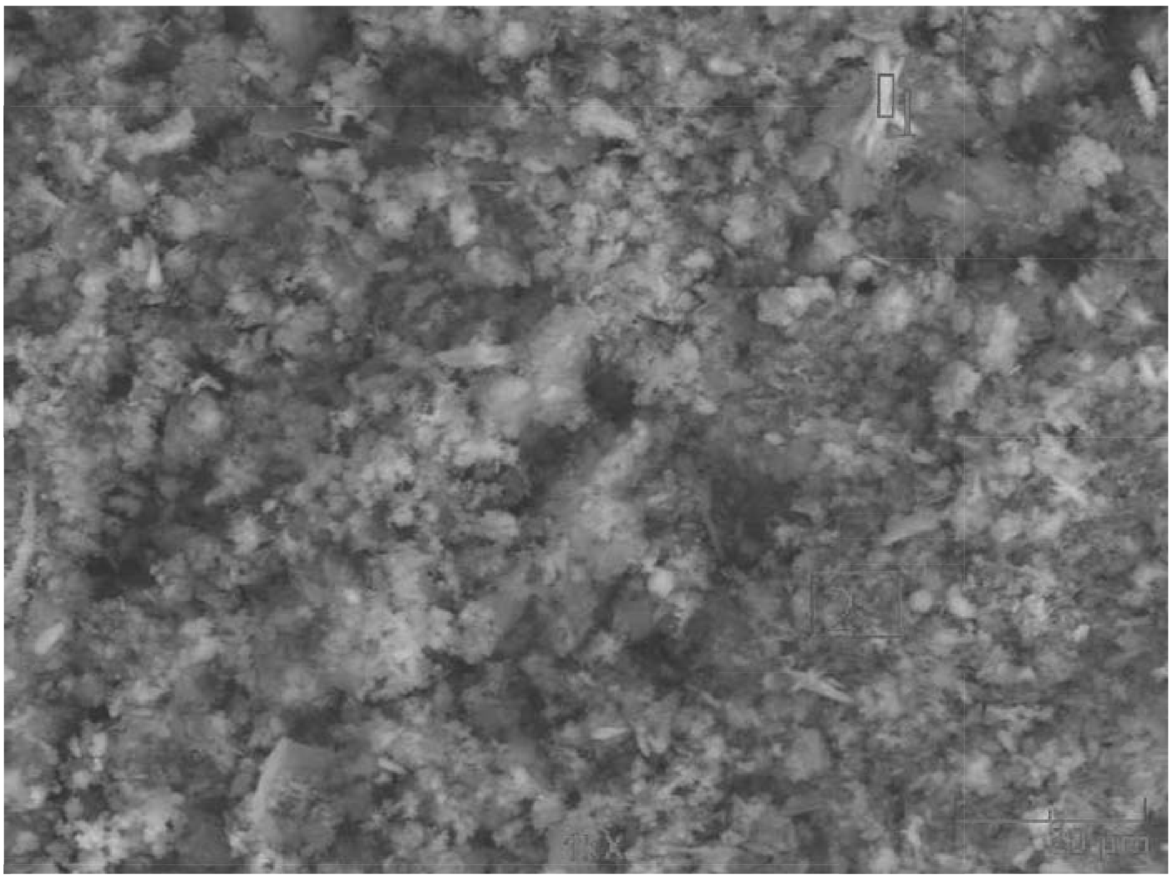


FIGURE 85

EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 84

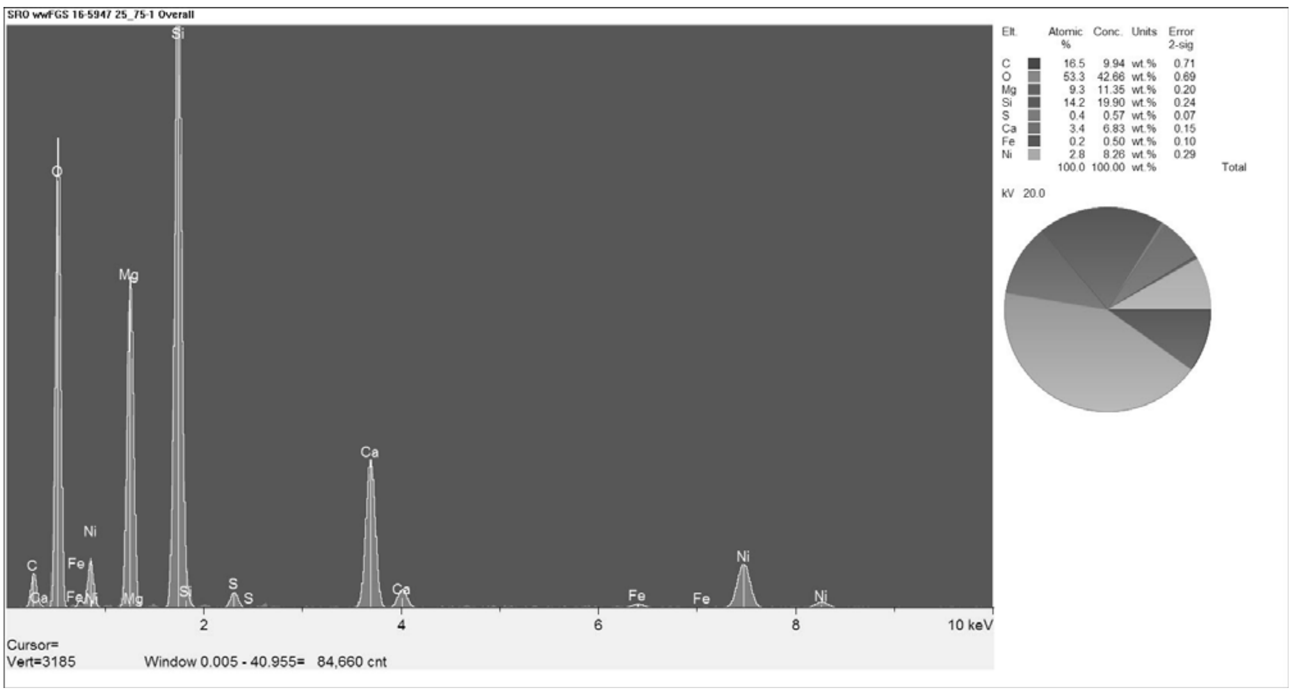


FIGURE 86
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 84

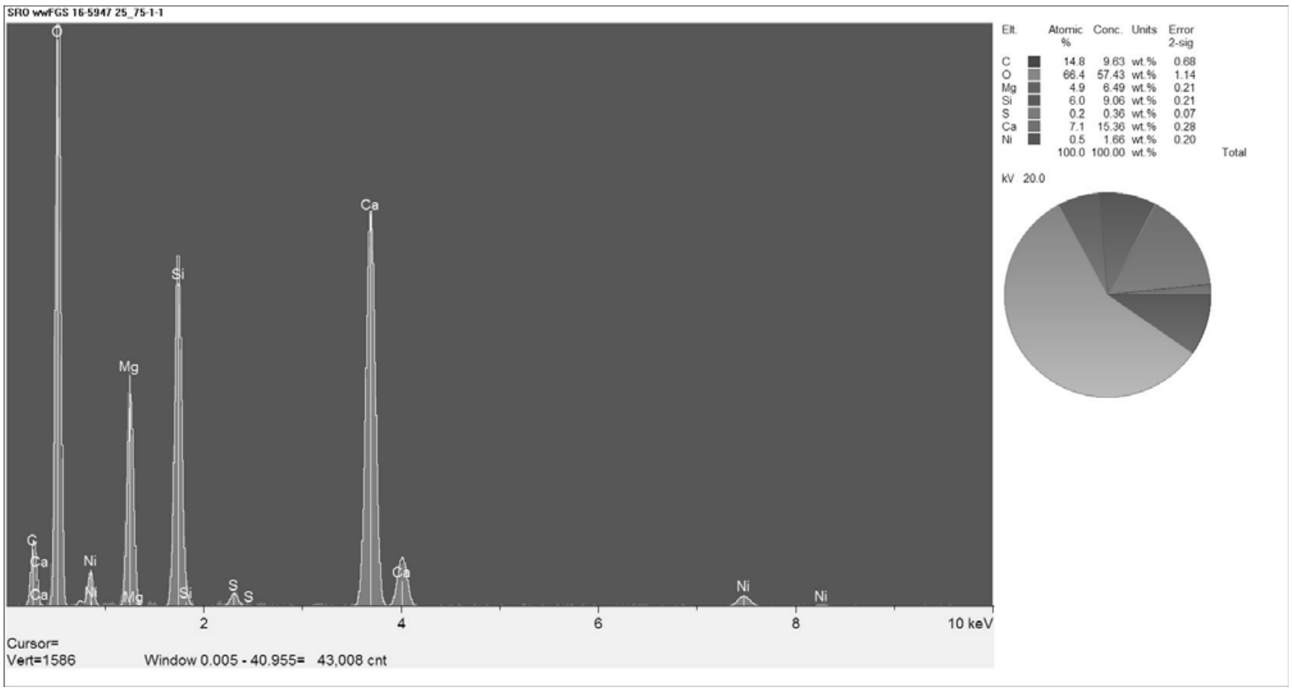


FIGURE 87
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 84

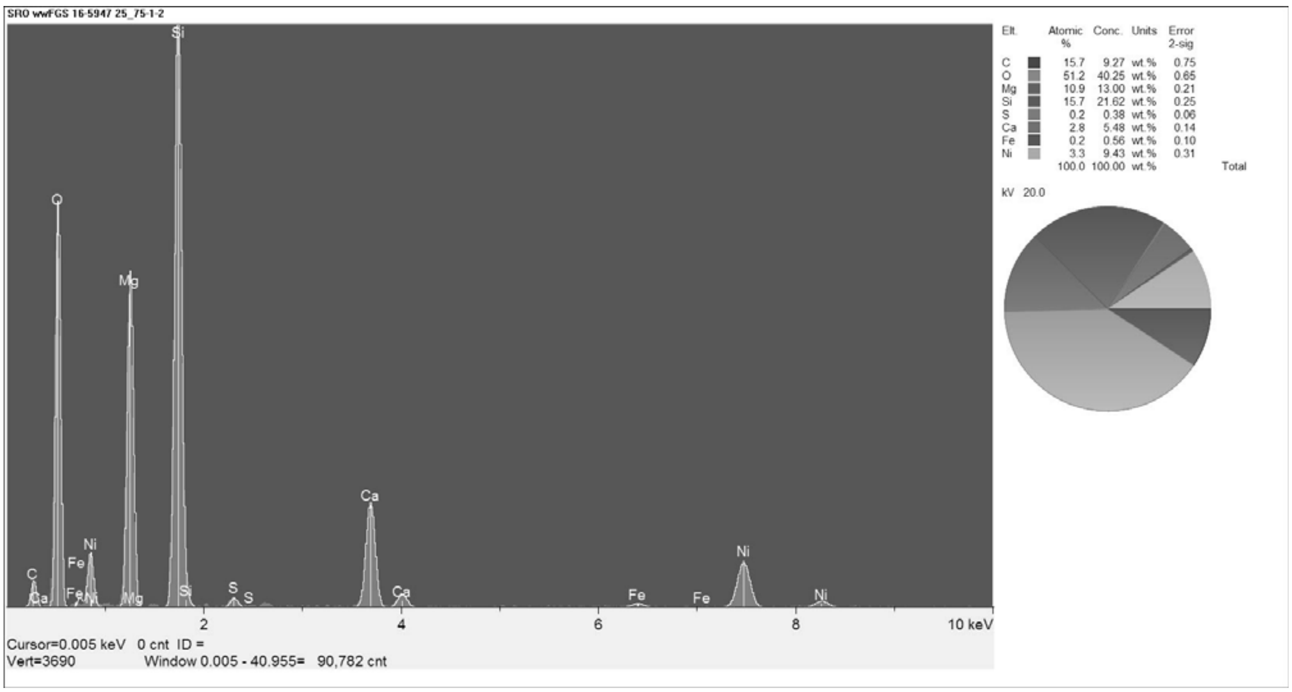


FIGURE 88
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE

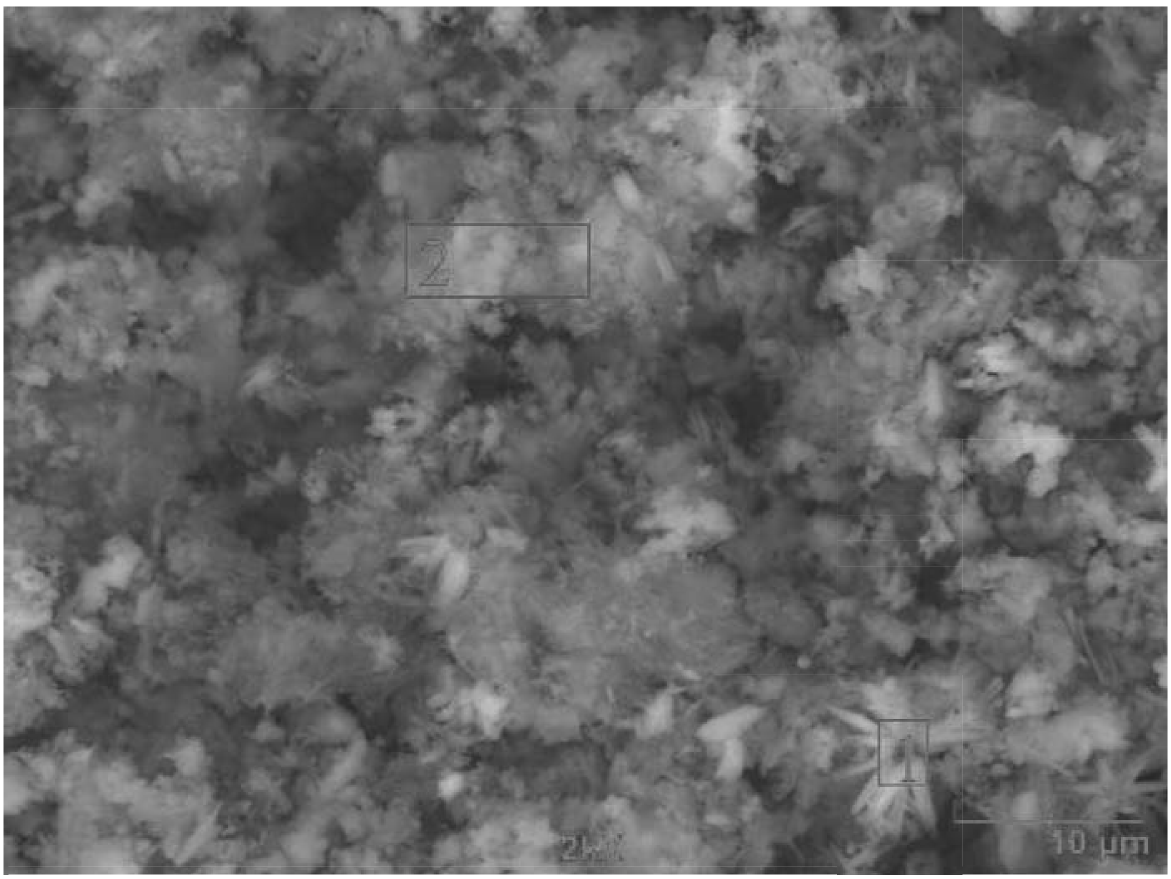


FIGURE 89
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 88

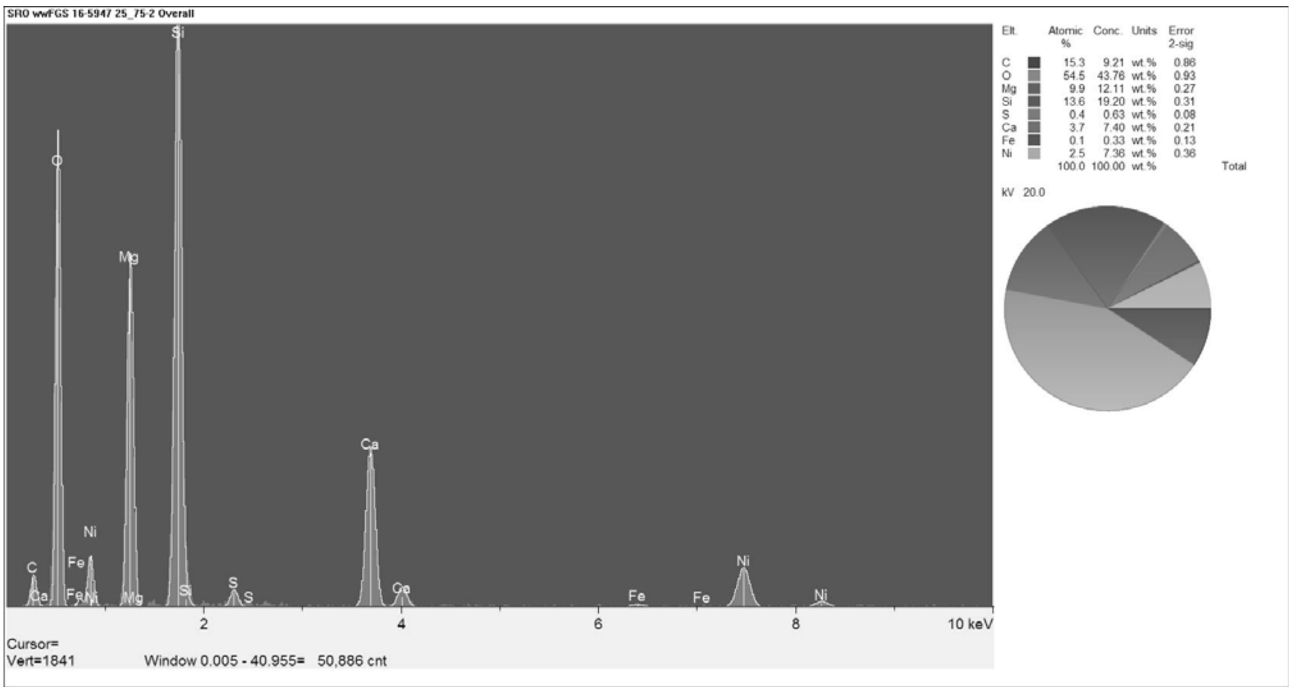


FIGURE 90
EDS MICROCHEMICAL ANALYSIS OF THE 25:75 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 88

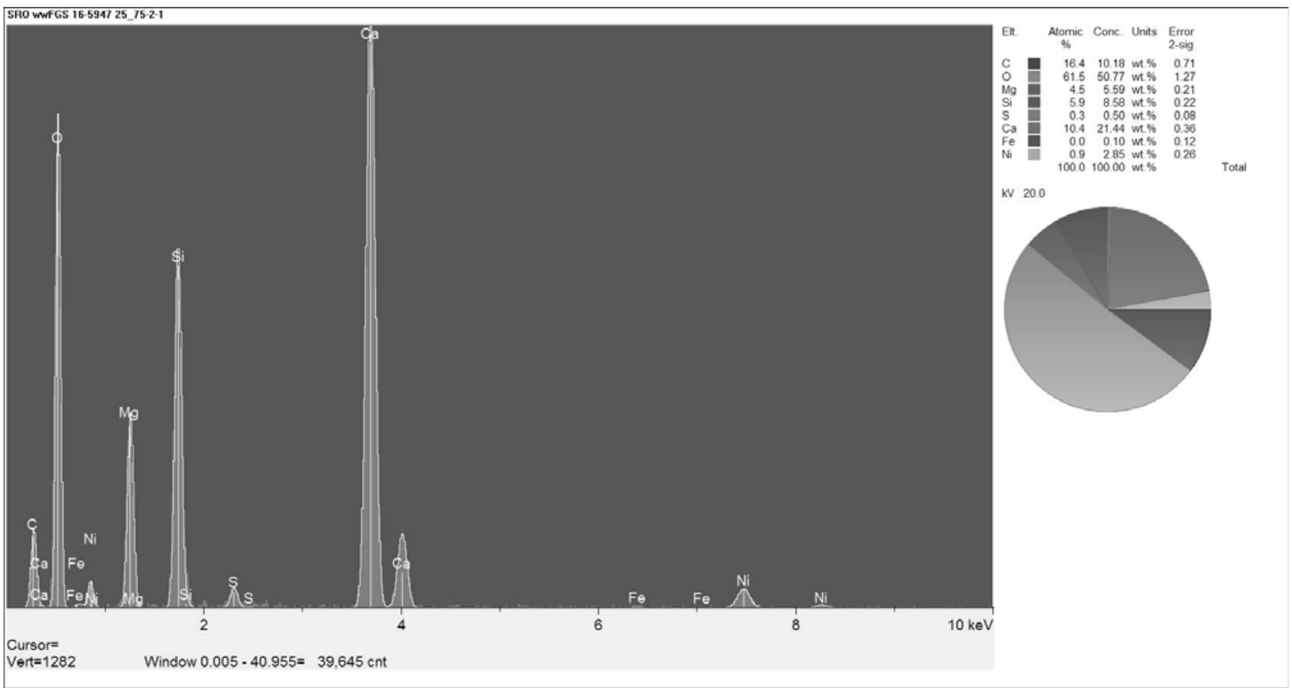


FIGURE 91
PHOTOGRAPH OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE

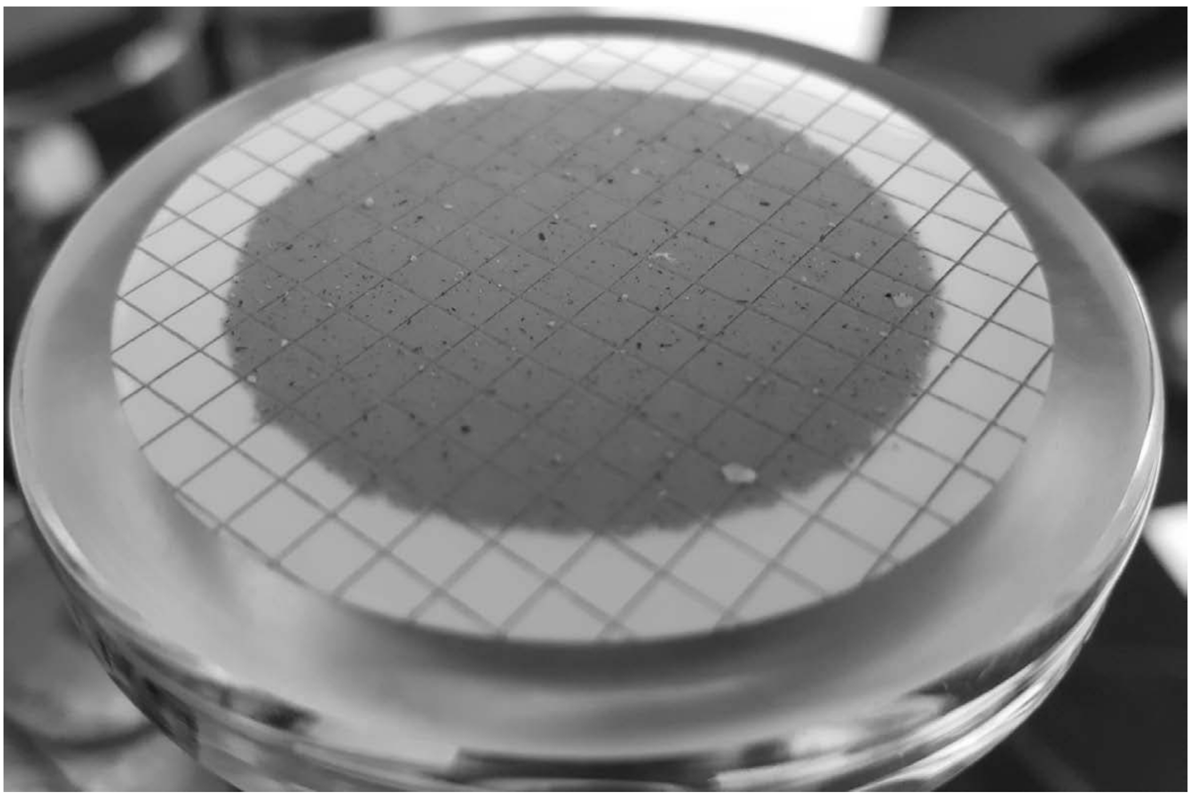


FIGURE 92
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE

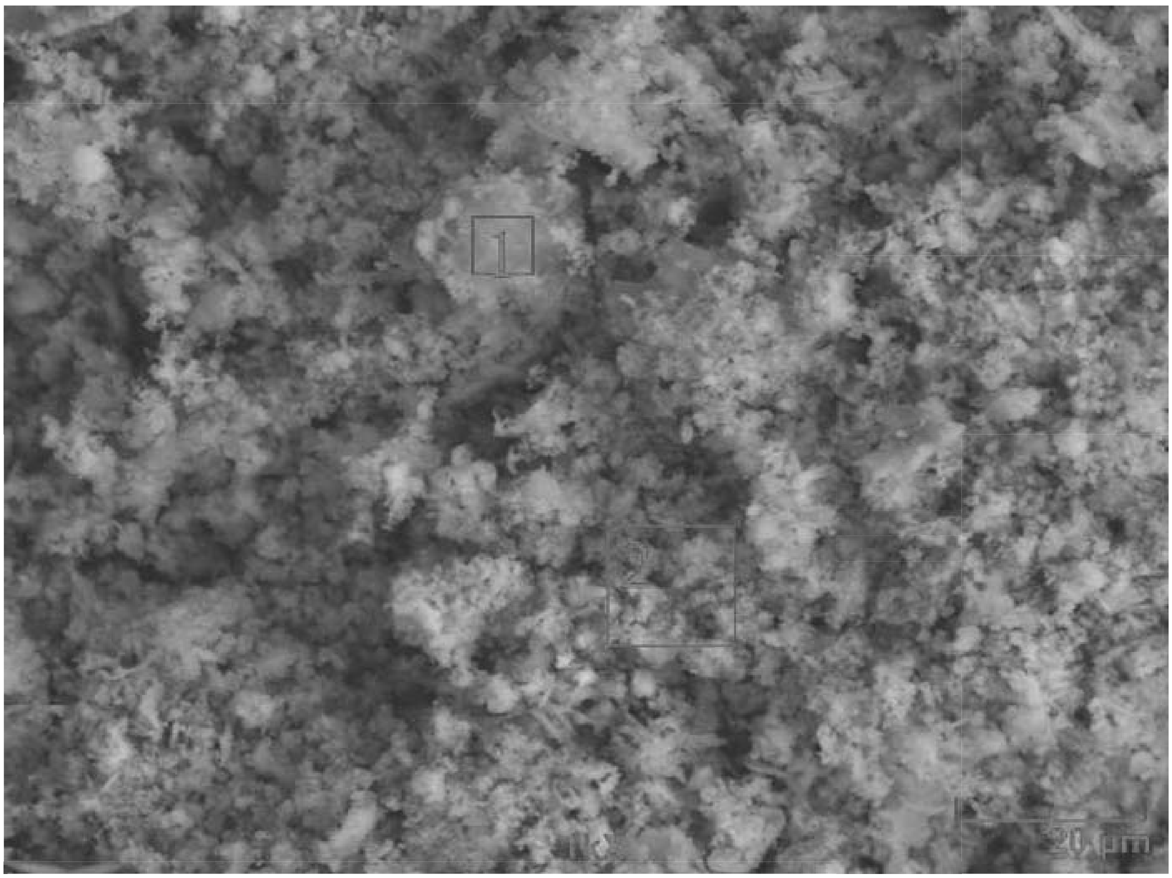


FIGURE 93
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 92

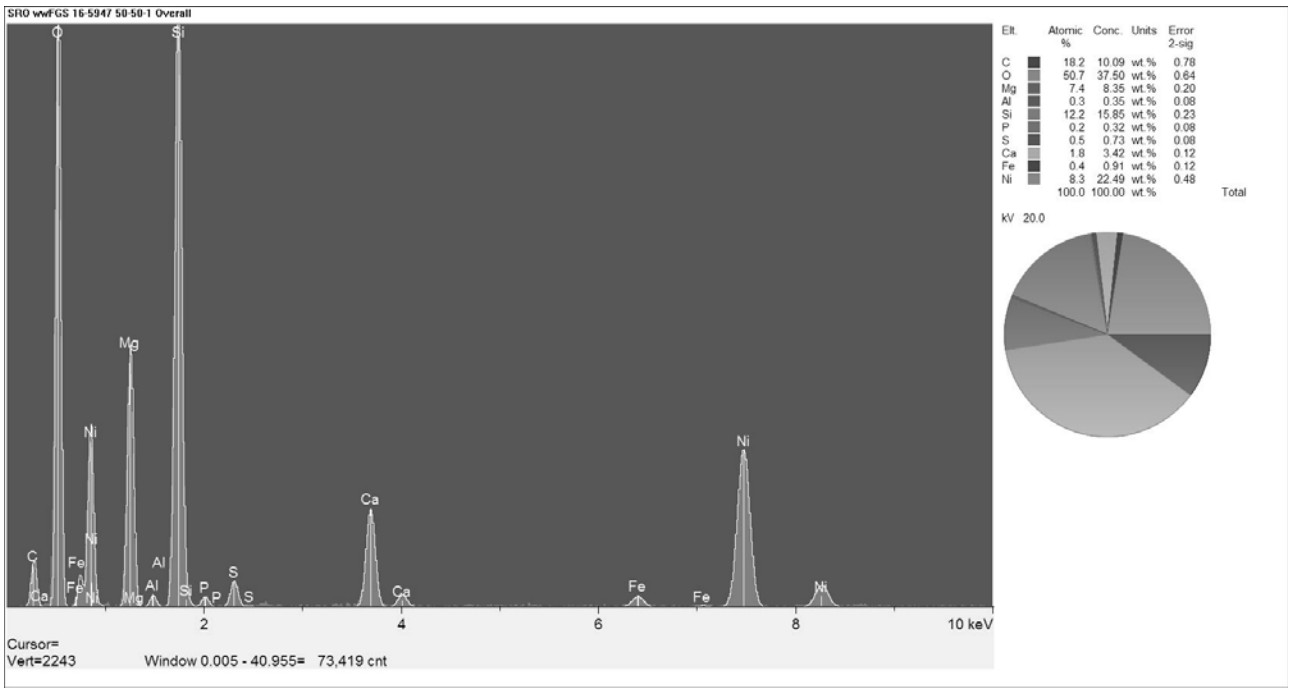


FIGURE 94
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 92

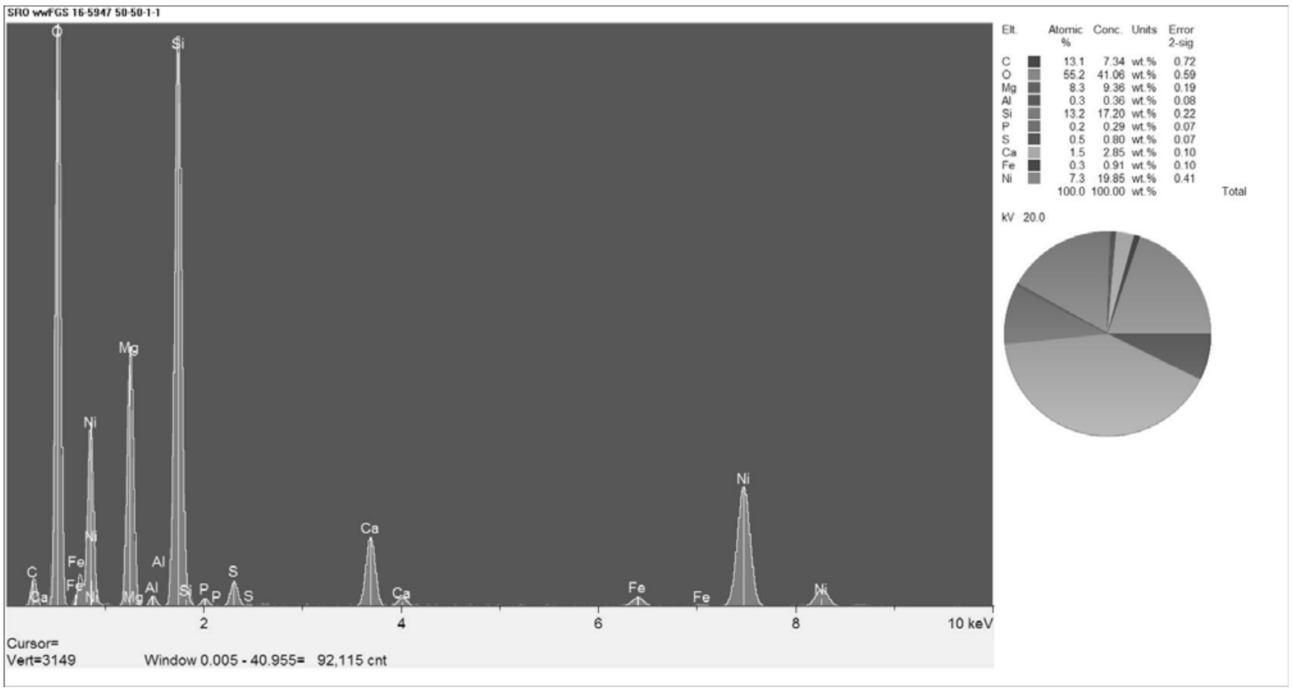


FIGURE 95
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 92

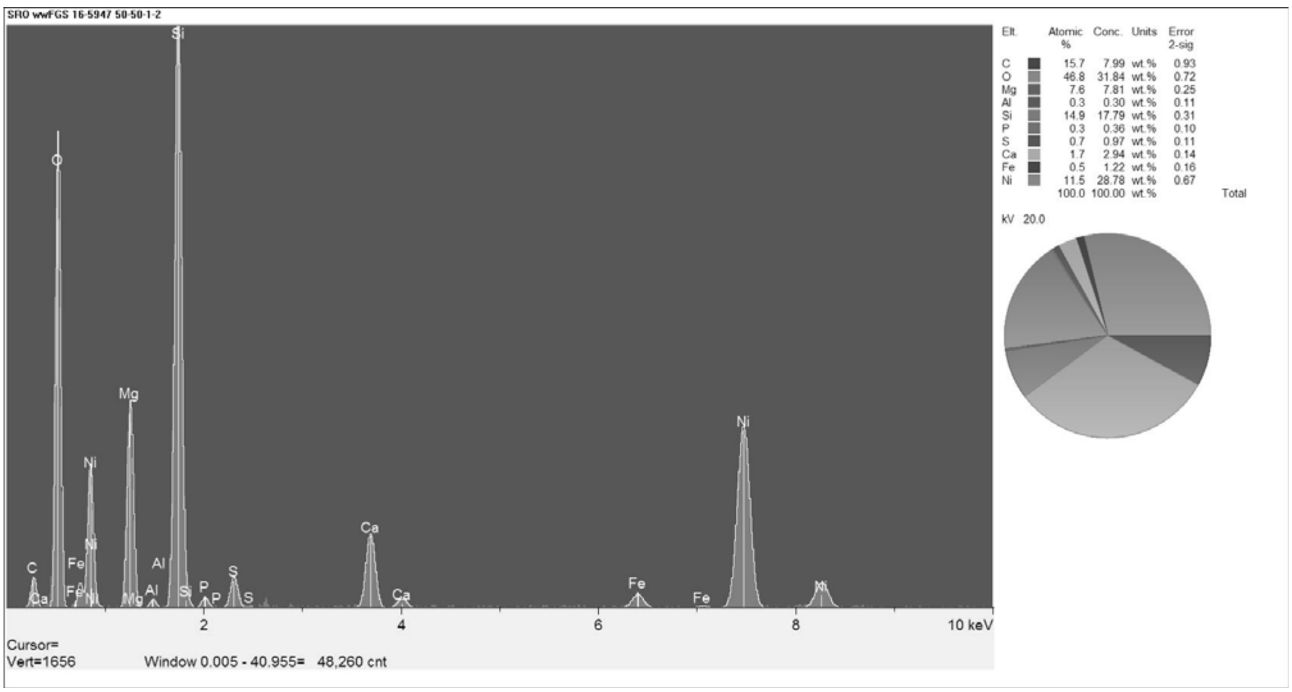


FIGURE 96
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE

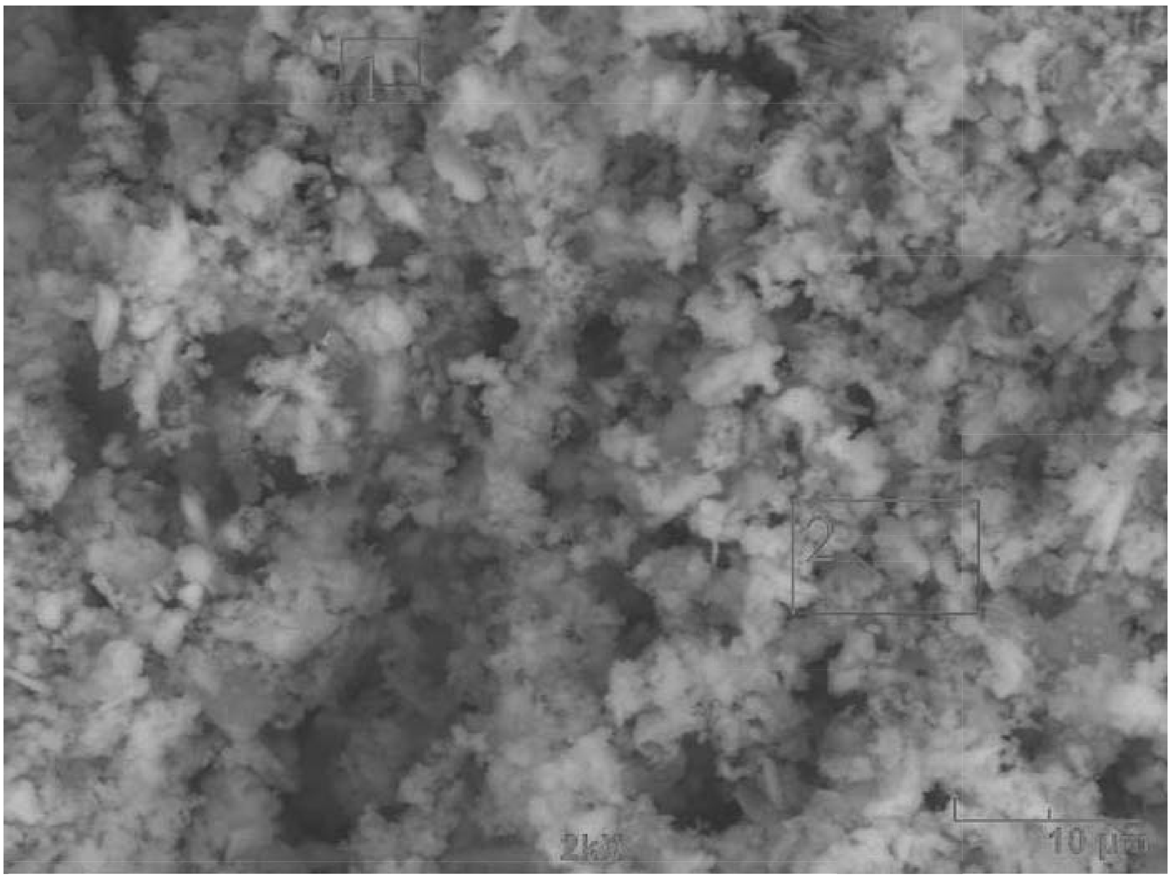


FIGURE 97
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 96

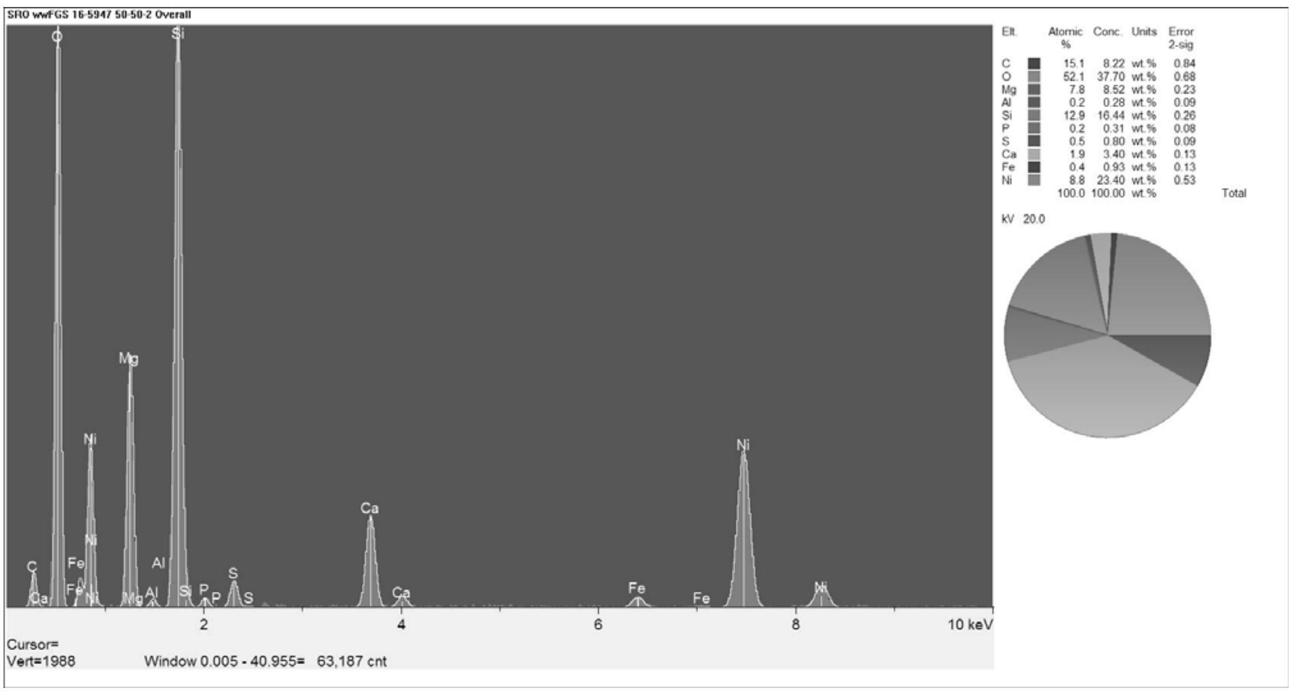


FIGURE 98
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 96

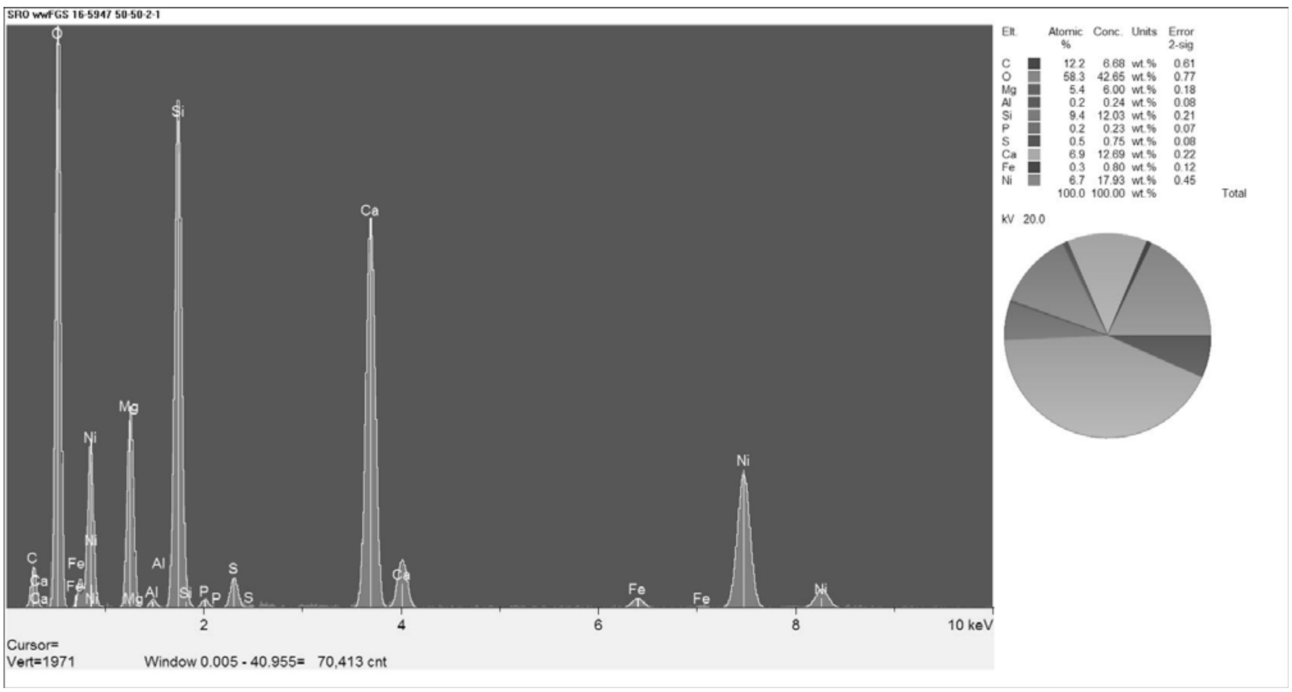


FIGURE 99
EDS MICROCHEMICAL ANALYSIS OF THE 50:50 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 96

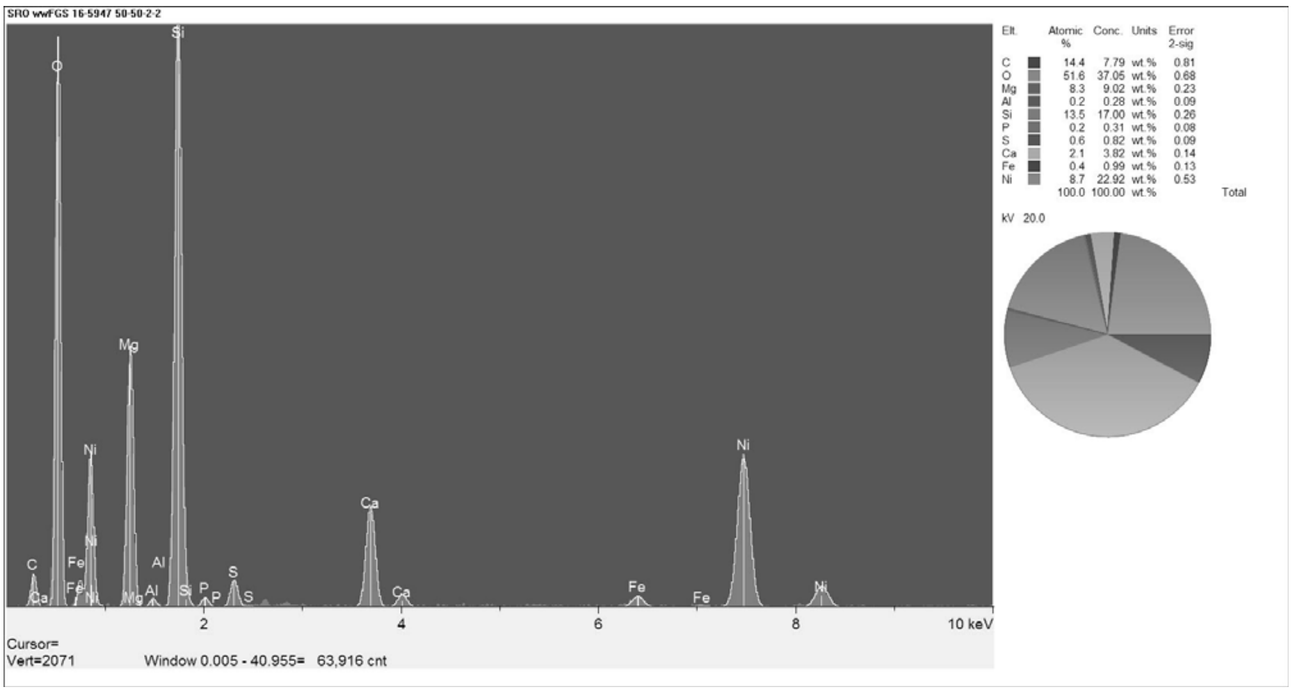


FIGURE 100
PHOTOGRAPH OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE
\

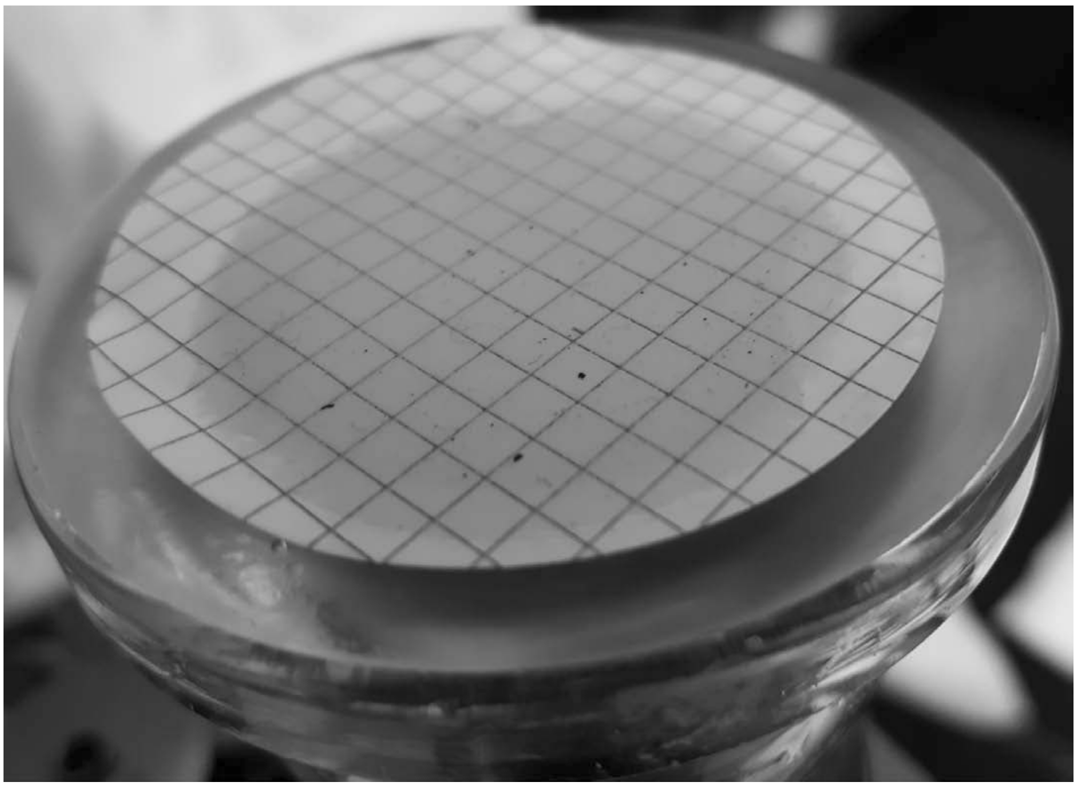


FIGURE 101
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE

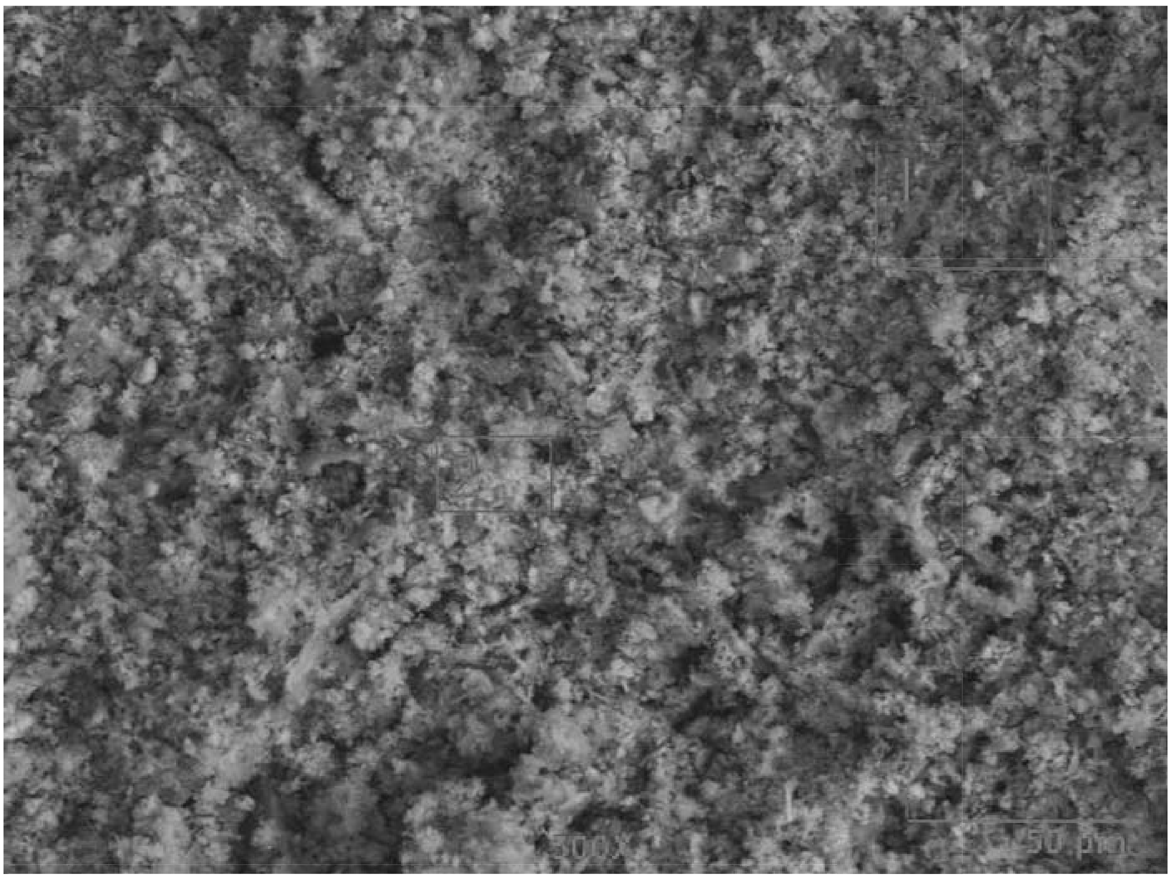


FIGURE 102
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 101

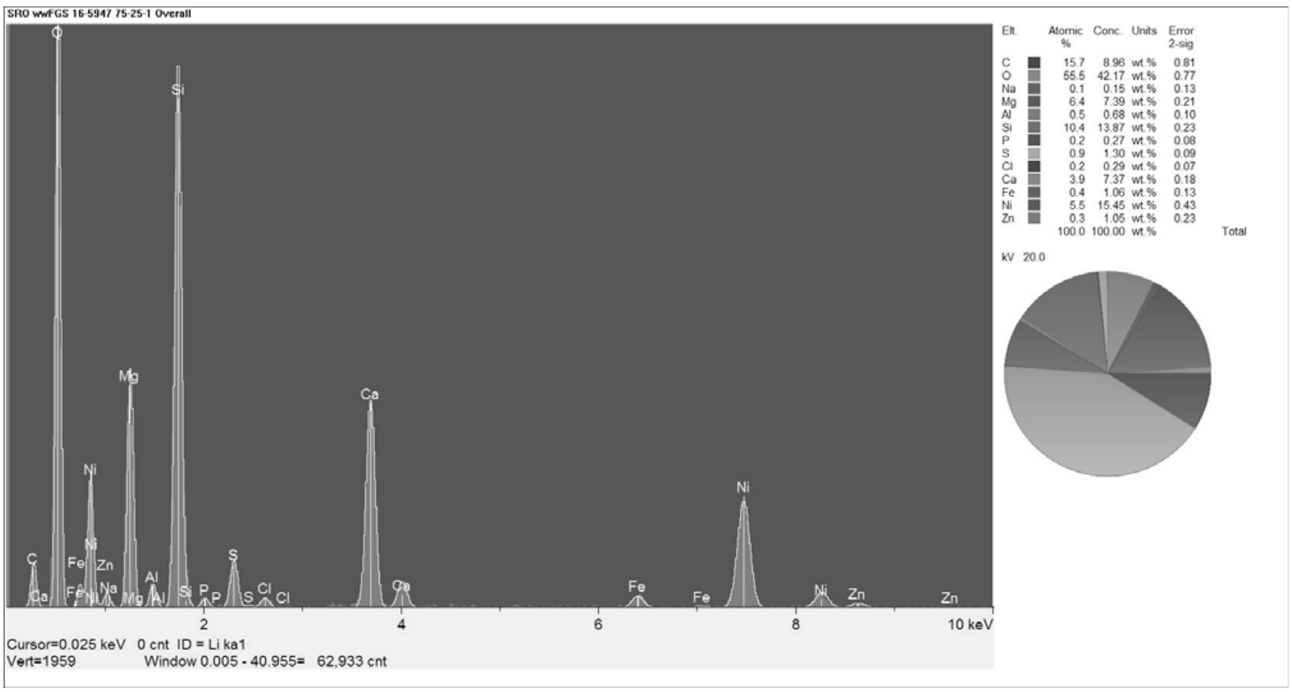


FIGURE 103
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 101

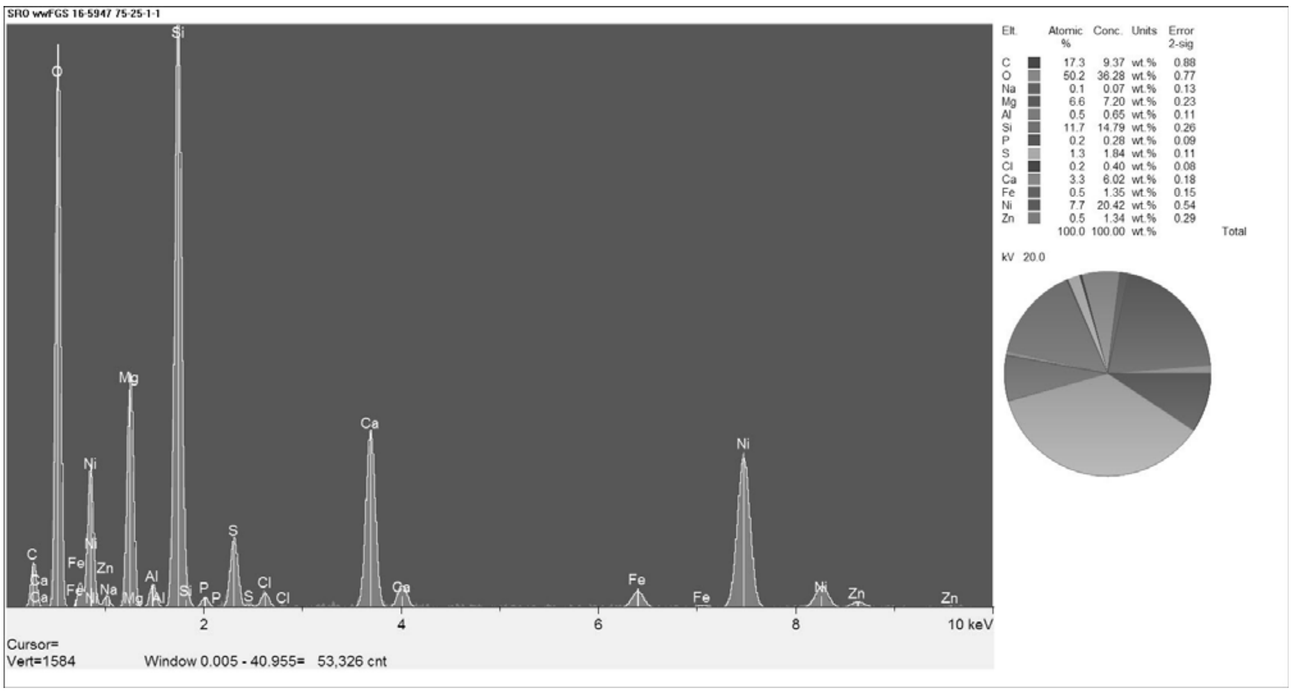


FIGURE 104
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 101

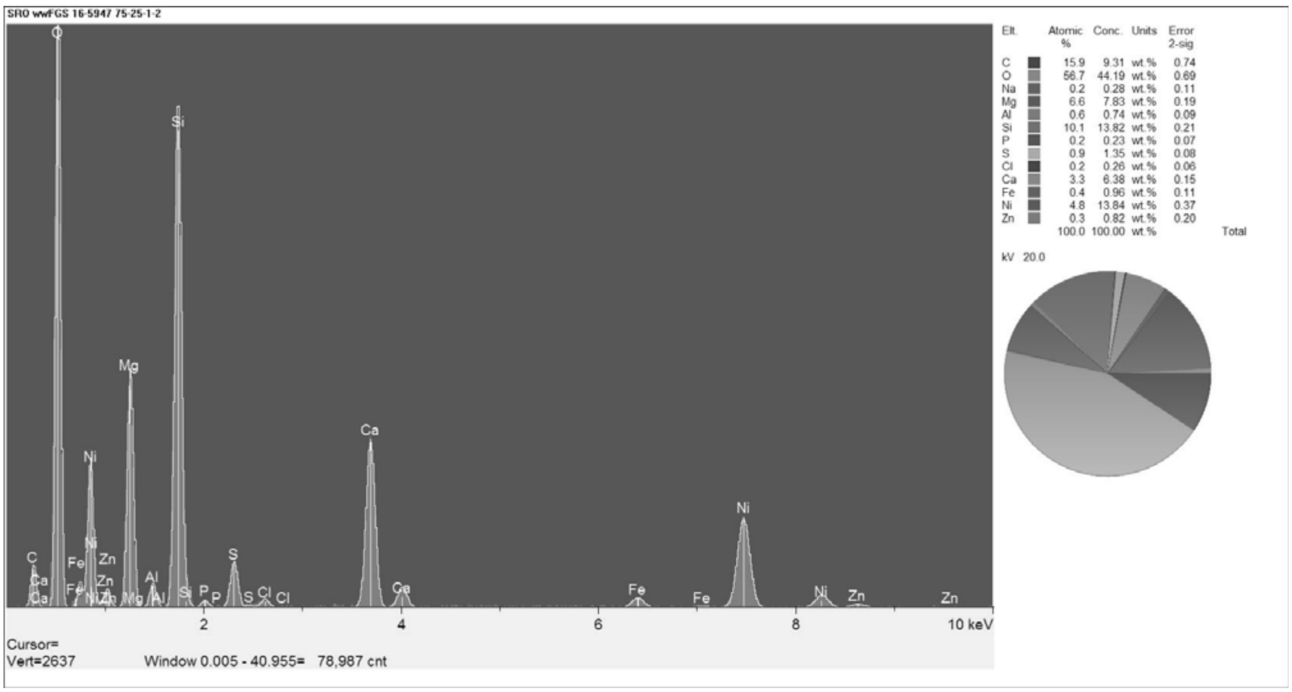


FIGURE 105
SCANNING ELECTRON MICROSCOPE PHOTOMICROGRAPH OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE

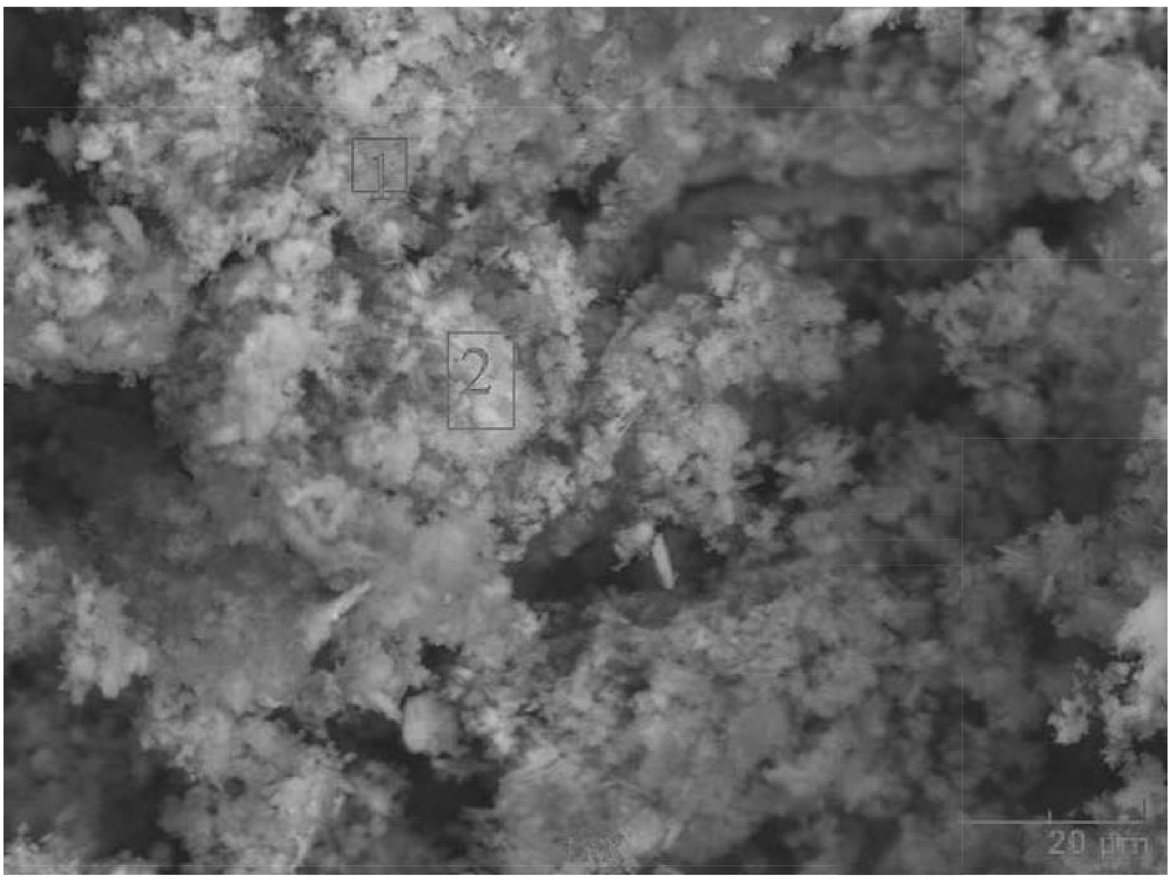


FIGURE 106
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES SHOWN IN FIGURE 105

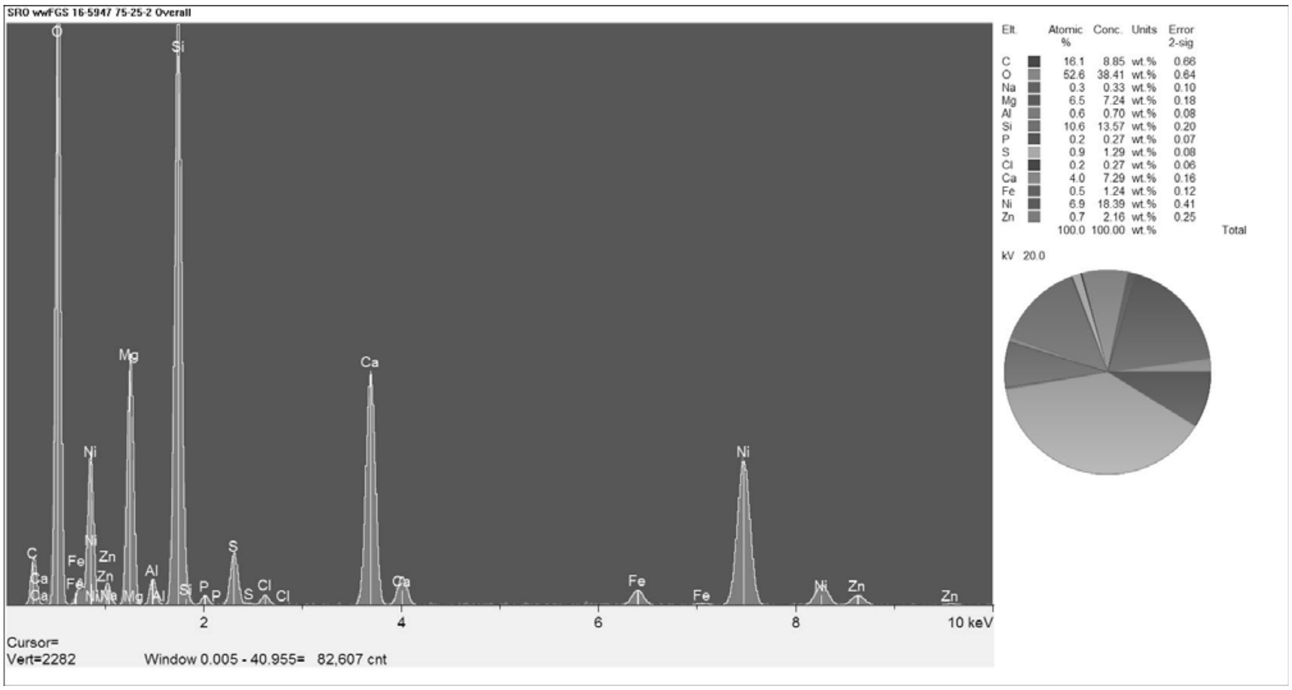


FIGURE 107
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #1 IN FIGURE 105

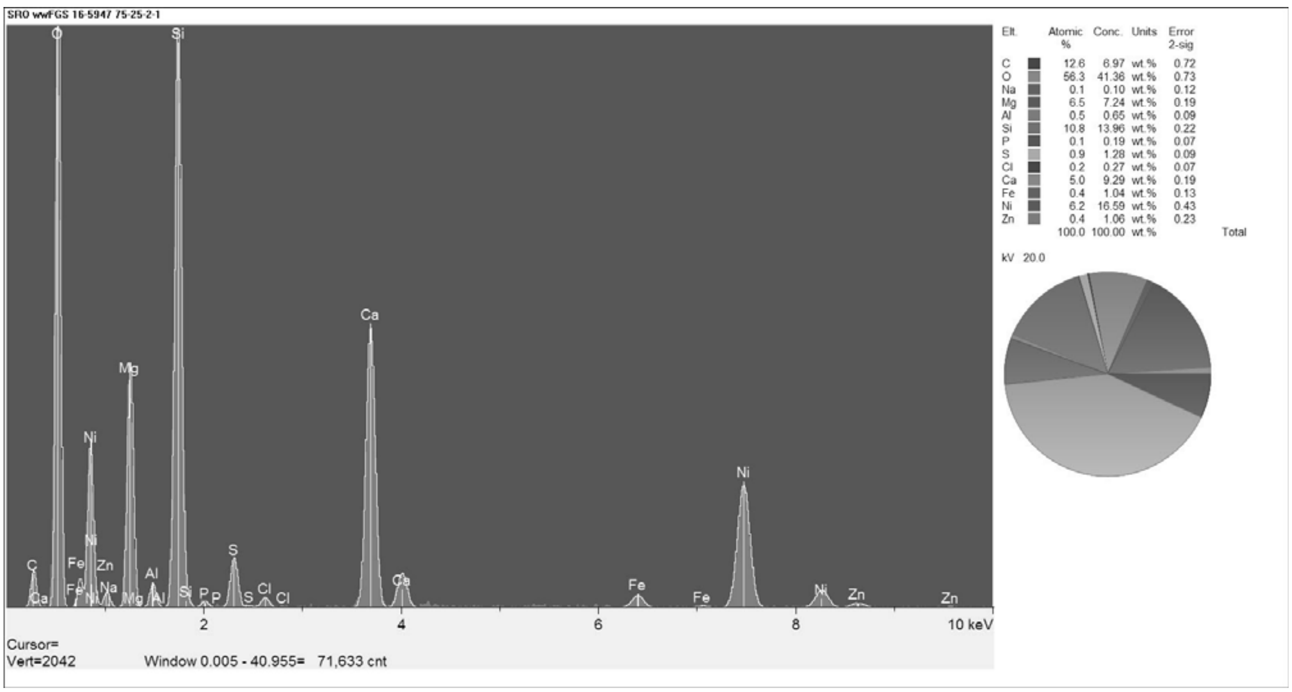


FIGURE 108
EDS MICROCHEMICAL ANALYSIS OF THE 75:25 SRO:WWFGS SAMPLE PRECIPITATE PARTICLES LABELED #2 IN FIGURE 105

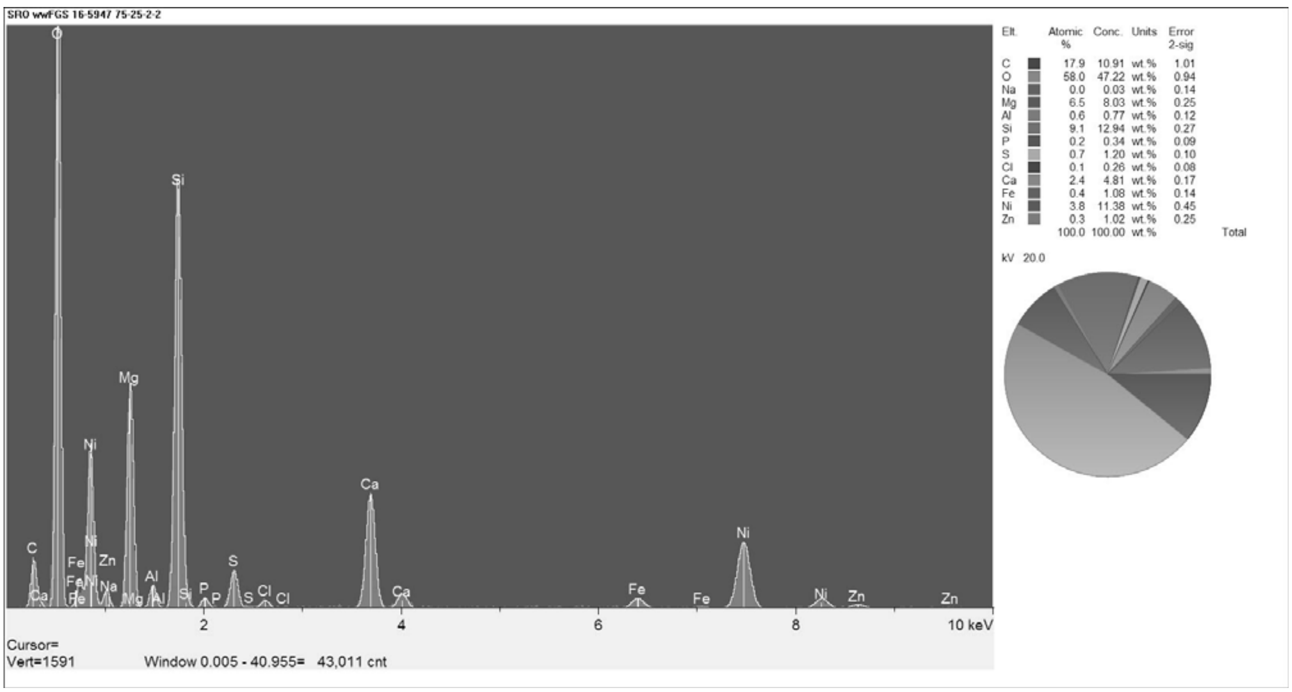


FIGURE 109

PHOTOGRAPH SHOWING THE SOLUBILITY OF THE SRO PRETEST PRECIPITATE, THE FGS PRETEST PRECIPITATE, AND THE 100% FGS POST TEST SAMPLE IN 12.1 M HYDROCHLORIC ACID

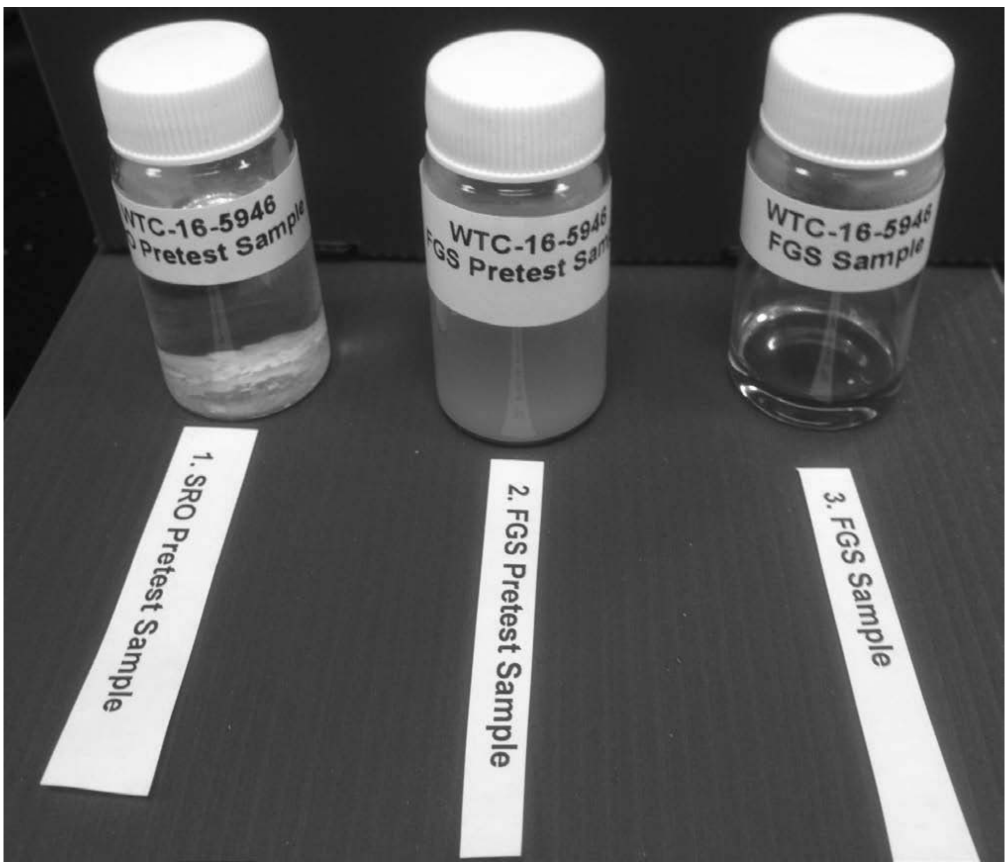


FIGURE 113

PHOTOGRAPH SHOWING THE SOLUBILITY OF THE 100% SRO POST TEST PRECIPITATE, THE 100% WWFGS POST TEST PRECIPITATE, AND THE 25%: 75% SRO:FGS POST TEST SAMPLE IN 12.1 M HYDROCHLORIC ACID

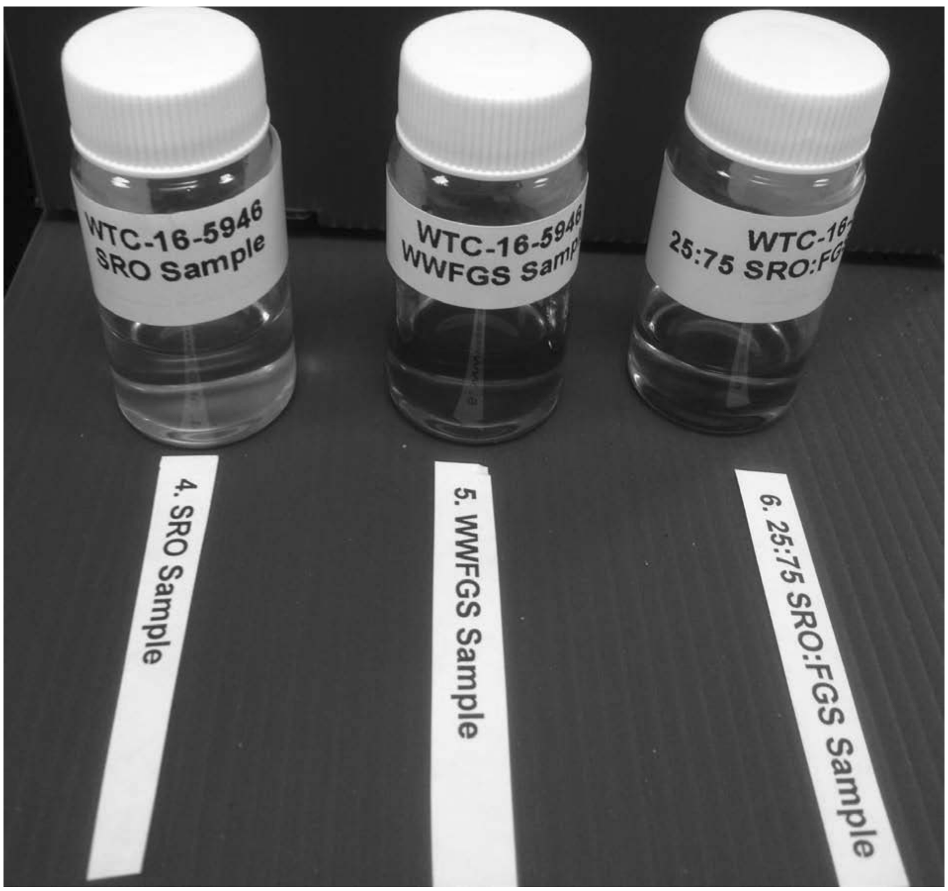


FIGURE 111

PHOTOGRAPH SHOWING THE SOLUBILITY OF THE 50%:50% SRO:FGS POST TEST PRECIPITATE, THE 75%:25% SRO:FGS POST TEST PRECIPITATE, AND THE 25%:75% SRO:WWFGS POST TEST PRECIPITATE IN 12.1 M HYDROCHLORIC ACID

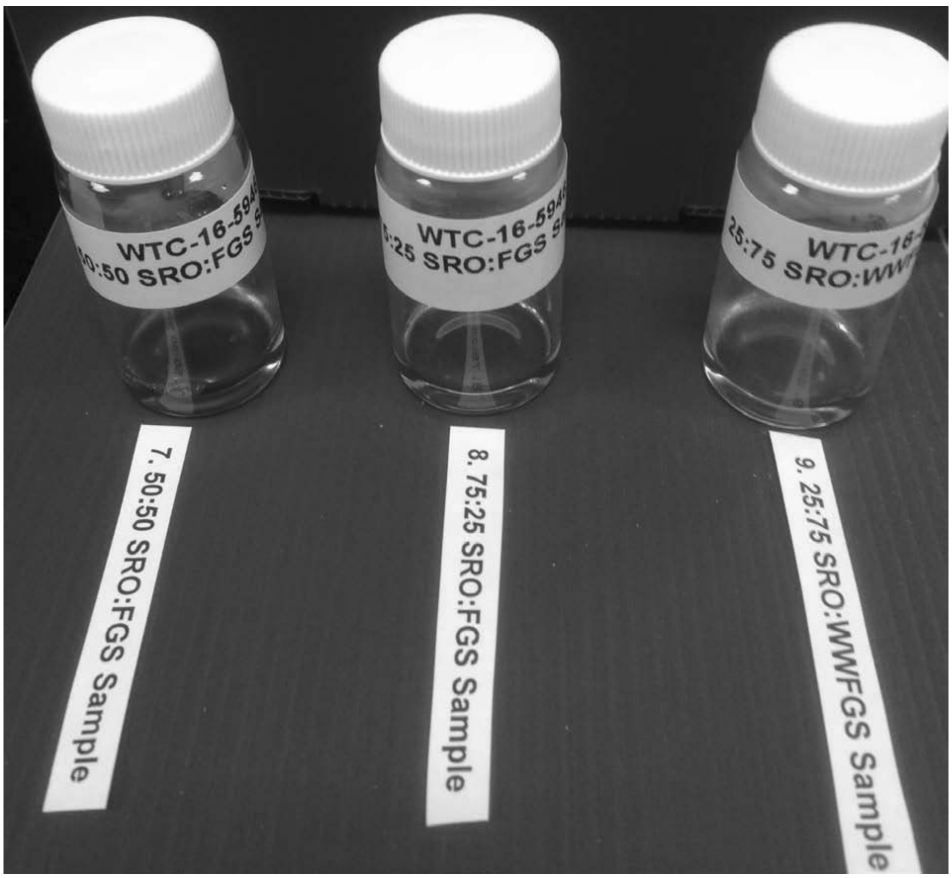
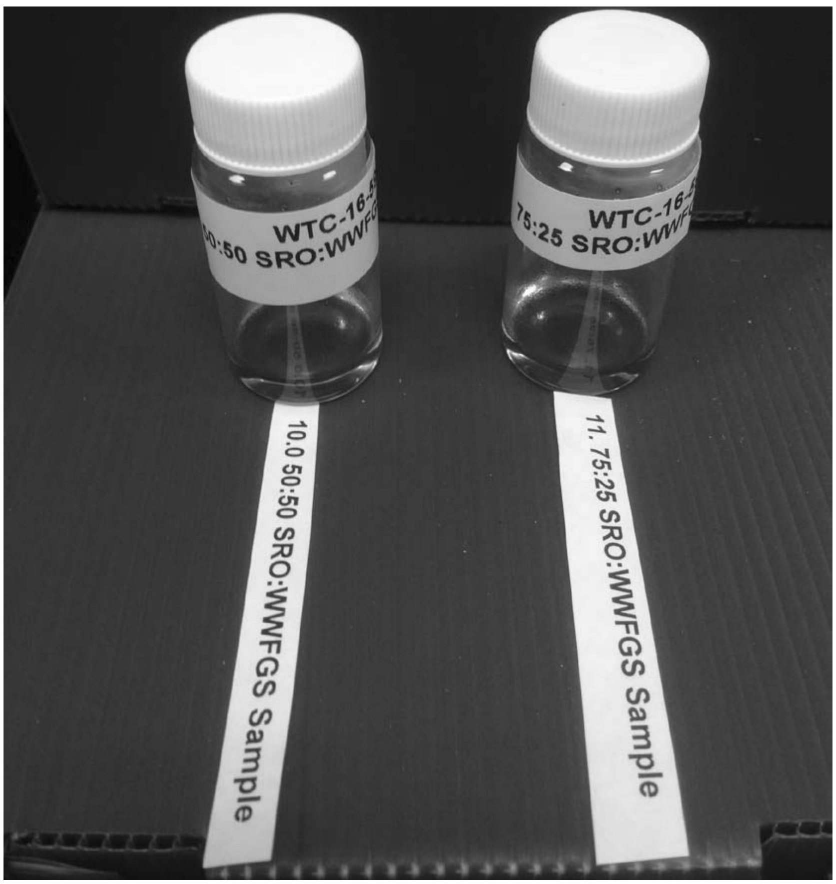


FIGURE 112

PHOTOGRAPH SHOWING THE SOLUBILITY OF THE 50%:50% SRO:WWFGS POST TEST PRECIPITATE AND THE 75%:25% SRO:WWFGS POST TEST PRECIPITATE IN 12.1 M HYDROCHLORIC ACID



2015 ANNULUS PRESSURE TEST (MIT)
NAVAJO REFINING

WDW NO. 1 MEWBOURNE (30-015-27592)
WDW NO. 2 CHUKKA (30-015-20894)
WDW NO. 3 GAINES (30-015-26575)

ARTESIA,NM

SEPTEMBER 21, 2015

SUBSURFACE TECHNOLOGY, INC.

Houston, TX

A Company of

WSP | PARSONS BRINCKERHOFF

Project No. 185818-7176

Prepared by Tim Jones

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Subsurface Construction Corp. (Subsurface) conducted annulus pressure tests (MITs) on WDW-1 Mewbourne, WDW-2 Chukka, and WDW-3 Gaines on Monday, September 21, 2015. The tests were not witnessed by a NM OCD representative. The tests were witnessed by Hank Lichtenwaldt for Subsurface. All annulus pressure tests were successful.

1.0 ANNULUS PRESSURE TEST FOR WDW-1

On September 21, a 1000 psig chart recorder, with spring weight 0-1000 psig, was rigged up to the casing-tubing annulus via a 2 inch bull plug with ½” NPT connection. The annulus line from the well annulus monitoring system (WAMS) to the wellhead was blocked in and the annulus pressure was recorded from 1352 hours to 1423 hours. During this 30-minute test, the annulus pressure increased from 645 psig to 655 psig. The 10 psig change in annulus pressure is within the NM OCD maximum allowable ± 10% annulus pressure change. The change in annulus pressure was 1.55%. This successful annulus pressure chart can be found in Appendix A. The chart calibration sheet can be found in Appendix D.

2.0 ANNULUS PRESSURE TEST FOR WDW-2

On September 21, a 1000 psig chart recorder, with spring weight 0 - 1000 psig, was rigged up to the casing-tubing annulus via a 2 inch bull plug with ½” NPT connection. The annulus line from the well annulus monitoring system (WAMS) to the wellhead was blocked in and the annulus pressure was recorded from 1502 hours to 1534 hours. During this 30 minute test, the annulus pressure decreased from 315 psig to 305 psig. The 10 psig change in annulus pressure is within the NM OCD maximum allowable ± 10% annulus pressure change. The change in annulus pressure was 3.17%. This successful annulus pressure chart can be found in Appendix B. The chart calibration sheet can be found in Appendix D.

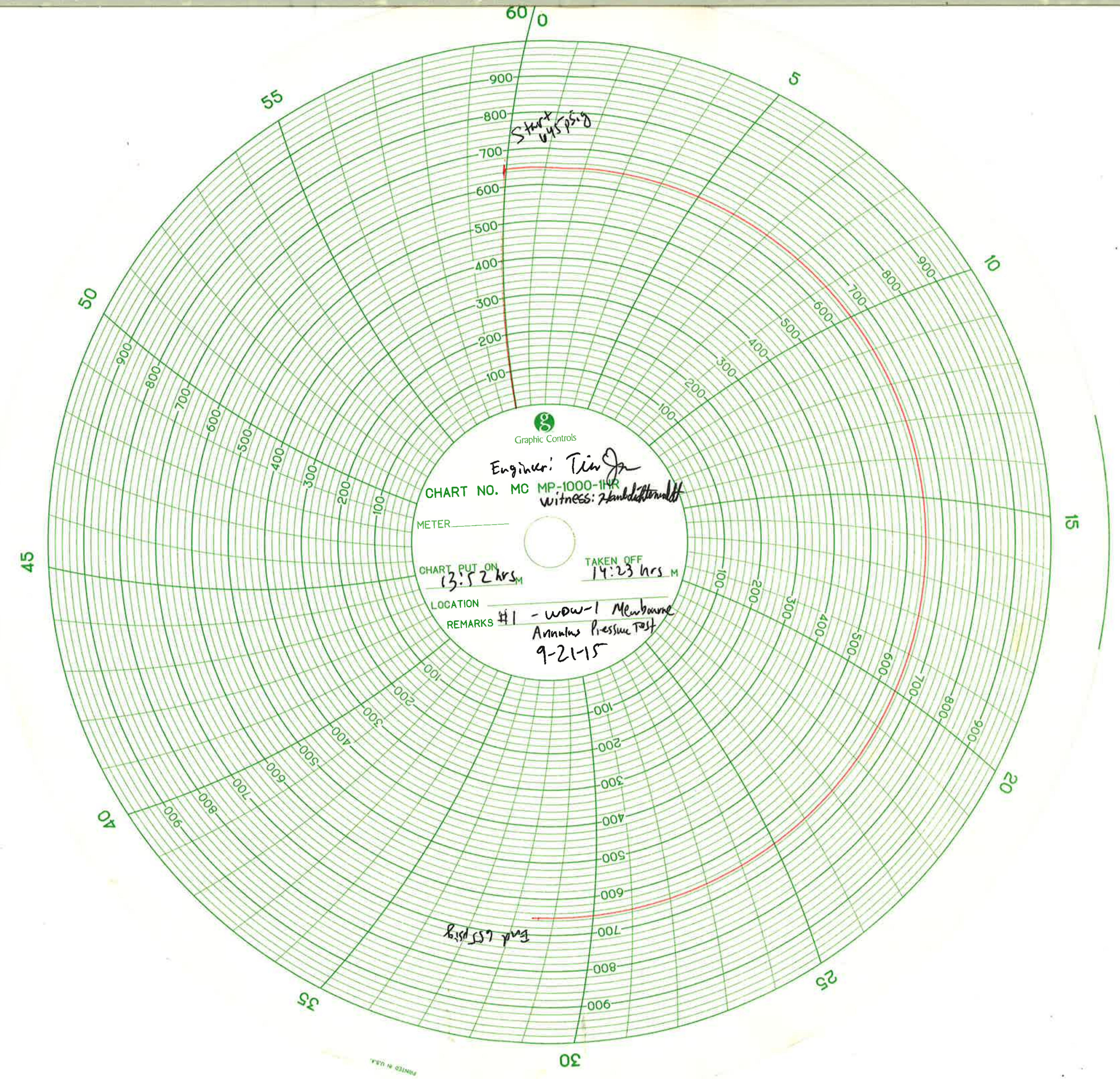
3.0 ANNULUS PRESSURE TEST FOR WDW-3

On September 21, a 1000 psig chart recorder, with spring weight 0 - 1000 psig, was rigged up to the casing-tubing annulus via a 2 inch bull plug with ½” NPT connection. The annulus line from the well annulus monitoring system (WAMS) to the wellhead was blocked in and the annulus pressure was recorded from 1632 hours to 1703 hours. During this 30 minute test, the annulus pressure increased from 705 psig to 710 psig. The 5 psig change in annulus pressure is within the NM OCD maximum allowable ± 10% annulus pressure change. The change in annulus pressure was 0.71%. This successful annulus pressure chart can be found in Appendix C. The chart calibration sheet can be found in Appendix D.

4.0 CONCLUSIONS

The annulus pressure tests (MITs) were successful for all three disposal wells. Please refer to Appendix A-C for the pressure charts and Appendix D for the chart calibration sheet.

APPENDIX A


Start 645 psig
Graphic Controls
Engineer: Tim Jr
CHART NO. MC MP-1000-1HR
Witness:
METER
CHART PUT ON 13:52 hrs M
TAKEN OFF 14:23 hrs M
LOCATION
REMARKS #1 - WDW-1 Membourne Annulus Pressure Test
9-21-15
End 655 psig

APPENDIX B

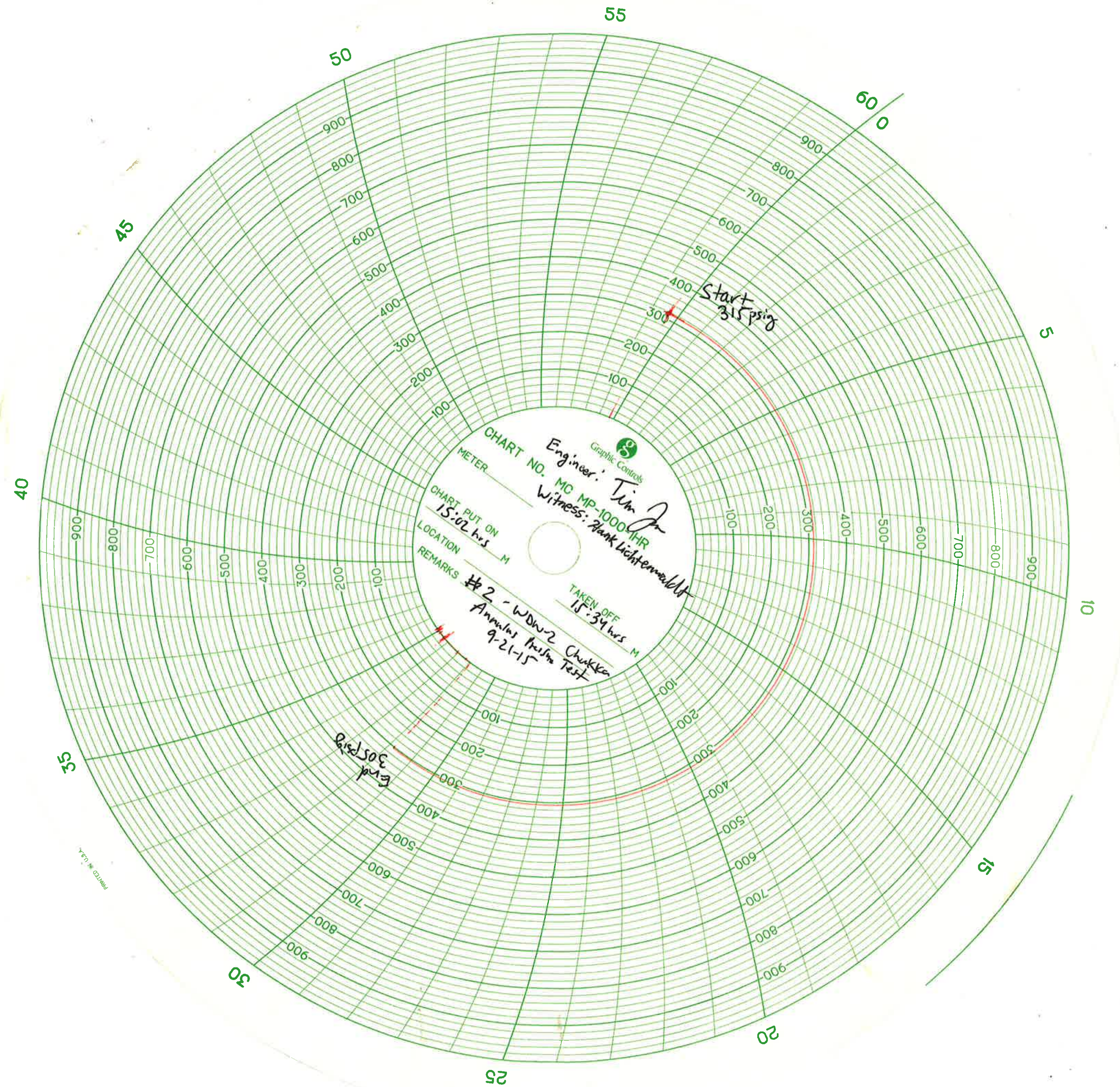
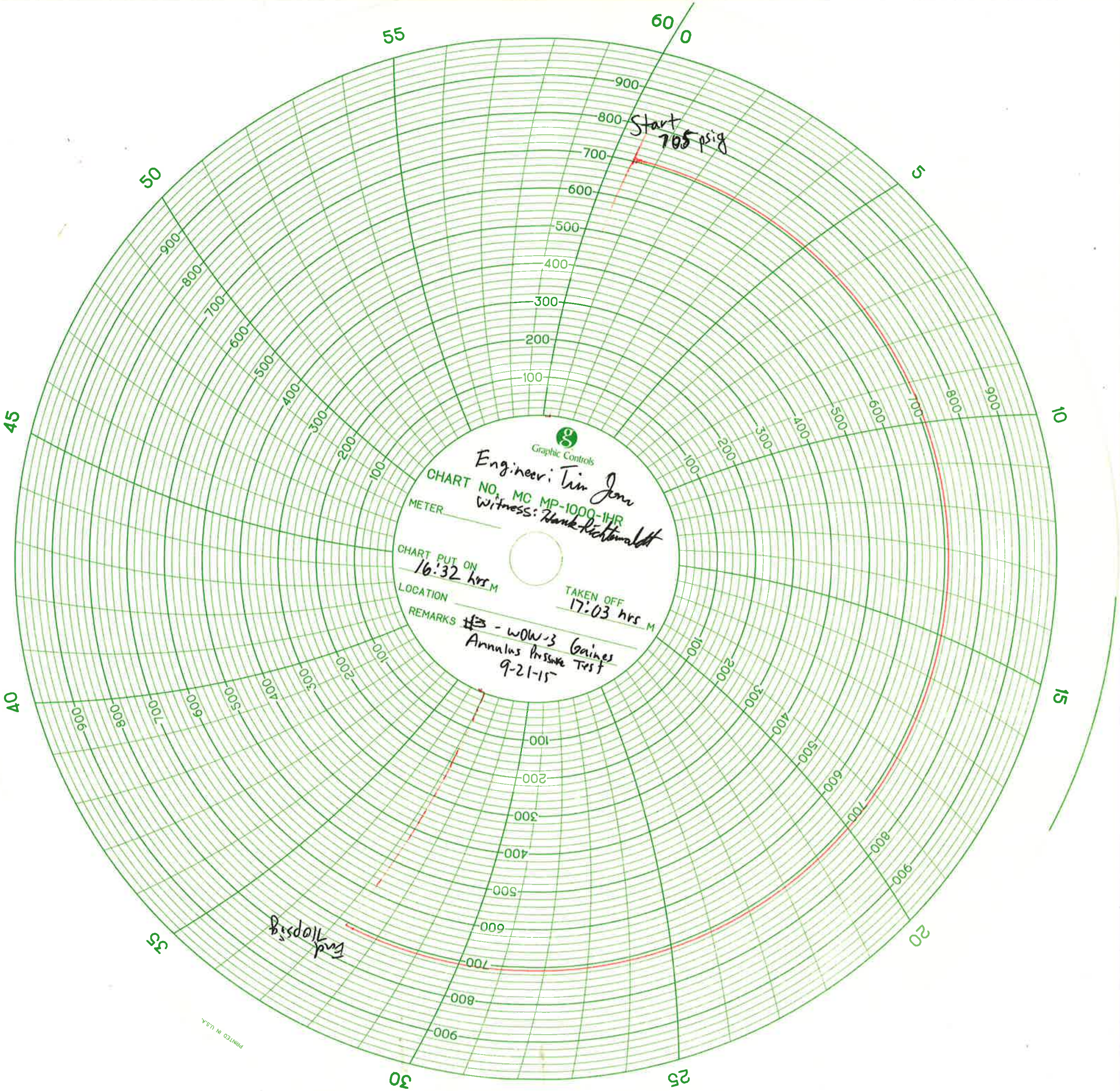


CHART NO. MC MP-1000-1HR
Graphic Controls
Engineer: Tim
Witness: Hank Lichtenwaldt
CHART PUT ON 15:02 hrs
TAKEN OFF 15:34 hrs
REMARKS #2 - WDW-2 Chukka Annulus Pressure Test 9-21-15
Start 315 psig
End 305 psig

APPENDIX C



Graphic Controls
Engineer: Tim Jones
CHART NO. MC MP-1000-1HR
Witness: Hank Richtermaltt
METER
CHART PUT ON 16:32 hrs M
TAKEN OFF 17:03 hrs M
LOCATION
REMARKS #3 - WOW-3 Gaines Annulus Pressure Test 9-21-15
Start 705 psig
End 710 psig
PRINTED IN U.S.A.

APPENDIX D

Wildcat Measurement Service, Inc.

416 East Main Street
P.O. Box 1836
Artesia, New Mexico 88211
Office: (575)746-3481
Toll Free: 1-888-421-9453

Calibration Certificate

Company Name: Globe Energy.
Recorder Type: Barton.
Recorder Serial:# 242A-8717.

Recorder Pressure Range: 0-1000# Accuracy +/-: 0.2% PSIG
Temperature Range:__________ Deg F.

Increasing Pressure			Decreasing Pressure		
Applied Pressure	Indicated Pressure	Error%	Applied Pressure	Indicated Pressure	Error%
0.0#	0.0#	0	800#	800#	0
100#	100#	0	600#	600#	0
300#	300#	0	400#	400#	0
500#	500#	0	200#	200#	0
700#	700#	0	0.0#	0.0#	0
1000#	1000#	0			

Temperature Test		
Applied Temperature	Indicated Temperature	Error%

Certified Calibration Instrument Used
Gauge: Crystal.
Deadweight:__________.

Remarks:__________

Calibration Date: 08/11/2015.
Technician: [signature] Jonnie Aldrich

2016 ANNUAL BOTTOM-HOLE PRESSURE SURVEY AND PRESSURE FALLOFF TEST REPORT

NAVAJO REFINING

MEWBOURNE WELL NO. 1

Artesia, New Mexico

August 2016

Parsons Brinckerhoff

Houston, TX

A Company of

WSP | PARSONS BRINCKERHOFF

Project No. 50904A

Prepared by Brenda Love

Brenda Love

Reviewed by Tim Jones

Tim Jones

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CERTIFICATION STATEMENT

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Client: Navajo Refining
Well Name: WDW-1
Test Date(s): June 10 – 15, 2016

Name: Scott Shifflett
Title: Drilling and Completion Manager

Phone Number: 281-589-5900

Signature , P.E. Date Signed 8/30/2016
New Mexico Registration No. 19678

SCOTT C. SHIFFLETT
NEW MEXICO
19678
PROFESSIONAL ENGINEER

EXECUTIVE SUMMARY

WSP | Parsons Brinckerhoff was contracted by Navajo Refining Company (Navajo) to perform a pressure falloff test and bottom-hole pressure survey on Navajo's Mewbourne Well No. 1. The test was performed according to New Mexico Oil Conservation Division (OCD) falloff test guidelines (*New Mexico Oil Conservation Division UIC Class I Well Fall-Off Test Guidance, December 3, 2007*).

The test provides the state regulatory agency with the necessary information to access the validity of requested or existing injection well permit conditions and satisfy the permitting objective of protecting the underground sources of drinking water (USDW). Specifically, 40 CFR Part 146 states "the Director shall require monitoring of the pressure buildup in the injection zone annually, including at a minimum, a shutdown of the well for a time sufficient to conduct a valid observation of the pressure fall-off curve" (40 CFR§146.13 for Non-hazardous Class I Wells).

The falloff testing was conducted according to the testing plan submitted to and approved by the NM OCD. The testing plan stated that, all offset wells that inject into the injection interval would be shut-in for the duration of the test period. The testing consisted of a 111-hour injection period and a 32-hour falloff period. Bottom-hole pressure gauges were also placed in the offset wells Gaines Well No. 3 and Chukka Federal Well No. 2. These wells are owned by Navajo and are used to inject plant waste into the same intervals as the Mewbourne Well No. 1.

As prescribed by the guidelines, the report discusses supporting and background information in Sections 1 through 9. The one mile area of review (updated since the 2015 falloff testing) is discussed in Section 10 and geology in Section 11. Information on the offset wells is discussed in Section 12, daily testing activities in Section 13, and point of shut-in, in Section 14. The pressure falloff testing and analysis results are discussed in Section 15. The OCD required record keeping statement is discussed in Section 16.

1. FACILITY INFORMATION

a. Name: Navajo Refining Company (subsidiary of the Holly Corporation)
b. Facility Location: Highway 82 East, Artesia, New Mexico 88211
c. Operator's Oil and Gas Remittance Identifier (OGRID) Number: 223518

2. WELL INFORMATION

a. OCD UIC Permit Number: UIC-CLI-008-1
b. Well Classification: Class I Non-hazardous
c. Well Name and Number: Mewbourne Well No. 1
d. API Number: 30-015-27592
e. Well Legal Location: 660 FSL, 2310 FEL

3. CURRENT WELLBORE SCHEMATIC

The Mewbourne Well No. 1 wellbore schematic is presented in Figure 1. The schematic has all data as requested by the guidelines and includes the following:

a. Tubing: 4 ½ inch, 11.6 pound per foot, steel construction, API grade N-80, with long thread connections (LT&C).

b. Packer: Arrow X-1, 7 inch by 3 ½ inch set in tension at 7879 feet.

c. Tubing Length: 7879 feet. There are no profile nipples in the tubing or the packer as this was not a requirement of the permit.

d. Size, Type, and Depth of Casing: There are three casing strings in the well. The information for these casing strings was obtained from OCD records on file with the state and geophysical logs. The casing strings are:

   i. 13 3/8 inch, 48 pound per foot (lb/ft), steel construction, API grade J-55, with short thread connections (ST&C), set at a depth of 390 feet. The casing was cemented to the surface with 525 sacks of cement. The casing was set in open hole with a diameter of 17.5 inches. This information was obtained from OCD records.

   ii. 9 5/8 inch, 36 lb/ft, steel construction, API grade J-55, ST&C, set at a depth of 2555 feet. The casing was cemented to the surface with 1000 sacks of cement. The casing was set in open hole with a diameter of 12.25 inches. This information was obtained from OCD records.

iii. 7-inch, 26 lb/ft and 29 lb/ft, steel construction, API grade N-80 and P-110, LT&C, set at a depth of 9094 feet. The casing was cemented to surface in two stages with 1390 sacks of cement. The casing was set in open hole with a diameter of 8.75 inches. The top cement was verified with a CBL run on July 23, 1998. The remainder of the information was obtained from OCD records.

iv. A cement plug at 9004 feet isolates the lower section of the original borehole. This information was obtained from OCD records.

e. The top of cement was determined from a CBL run in the 7-inch casing string on July 23, 1998. The top of cement in the 7 inch casing was found at the surface. The top of cement in the 9 5/8 inch and 13 3/8 inch casing strings was verified through OCD records and volume calculations.

f. The 7 inch casing was perforated on July 24 and July 27, 1998. The casing was perforated with a 0.5 inch diameter hole at 2 shots per foot on a 60° phasing. The perforations are located between 7924 feet and 8188 feet and from 8220 feet to 8476 feet.

g. The total depth of the well is 10,200 feet with the plug back depth at 9004 feet. On September 22, 2015, fill was tagged at 8995 feet.

The bottom-hole pressure gauge run in the Mewbourne Well No. 1 for the pressure falloff testing consisted of one memory (top of the perforations) (MRO) pressure gauge that was placed at 7924 feet.

4. ELECTRIC LOG ENCOMPASSING THE COMPLETED INTERVAL

The dual induction log is presented in Appendix A and encompasses the completed interval between 7924 feet and 8476 feet. The dual induction log was submitted to the OCD with the original permit after the well was drilled by the Mewbourne Oil Company. The log was resubmitted to the OCD when the well was re-permitted as a Class I injection well.

5. RELEVANT PORTIONS OF THE POROSITY LOG USED TO ESTIMATE FORMATION POROSITY

The neutron density log is presented in Appendix B and encompasses the completed interval between 7924 feet and 8476 feet. The neutron density log was submitted to the OCD with the original permit after the well was drilled by Mewbourne Oil Company. The log was resubmitted to the OCD when the well was re-permitted as a Class I injection well. The porosity of the formation, 10%, and the reservoir thickness, 175 feet, were determined from this log. These values were used in the analysis of the pressure falloff data (Section 15). Additional information concerning the geology of the injection reservoir is discussed in Section 11.

6. PVT DATA OF THE FORMATION AND INJECTION FLUID

The Mewbourne Well No. 1 was recompleted in July 1998, prior to the issuance of the current well testing guidelines (December 3, 2007). At the time, no directives were in place to test formation fluids or derive formation characteristics from cores. However, reservoir fluid samples were obtained during the recompletion and the average density and average total dissolved solids (TDS) were measured at 1.03 g/l and 26,500 mg/l, respectively. The analytical results of the analysis of the formation fluid are summarized in Table I.

The viscosity of the formation fluid, formation water compressibility, and total system compressibility were estimated in reference to bottom-hole temperature using industry accepted correlations. These correlations are found in the Society of Petroleum Engineer's "Advances in Well Test Analysis, Monograph Volume 5" and "Pressure Buildup and Flow Tests in Wells, Monograph Volume 1".

a. Estimation of formation fluid and reservoir rock compressibility:

   The fluid compressibility of the formation brine was estimated for a sodium chloride solution (26,500 mg/l) at the bottom-hole temperature of 127°F using Appendix C (Figure D.16 SPE Monograph 5). This value was 2.9 x 10^{-6} psi^{-1}. The formation pore volume compressibility was estimated using Appendix D (Figure G.5 SPE Monograph 1). This value was 5.5 x 10^{-6} psi^{-1}. The total system compressibility is the sum of the fluid compressibility and the pore volume compressibility, 8.4 x 10^{-6} psi^{-1}. The temperature used with the correlations was recorded during the temperature survey conducted in the Mewbourne Well No. 1 on July 23, 1998, and included in this report as Appendix E.

b. Formation fluid viscosity with reference temperature:

   The formation fluid had a TDS concentration of 26,500 mg/l. This equates to an approximate equivalent percentage of NaCl of 4.5%. The average viscosity of the formation fluid was estimated using Appendix F (Figure D.35 SPE Monograph 5). This value was 0.57 centipoise (cp) at 127°F.

c. Formation fluid specific gravity/density with reference temperature:

   The average formation fluid density was measured at 1.03 g/l at 70°F (Table I).

d. Injection fluid specific gravity, viscosity and compressibility with reference temperature:

   The specific gravity and pH of the refinery waste water were measured during the injection portion of the reservoir testing. The specific gravity was 1.01 (8.41 pounds per gallon). This equates to an approximate equivalent percentage of NaCl of 4%. Using the same methodology described above, the viscosity of the injected fluid was 0.54 cp at 127°F. The compressibility of the injected plant waste was 2.9 x 10^{-6} psi^{-1} at 127°F.

7. DAILY RATE HISTORY DATA (MINIMUM OF ONE MONTH PRECEDING THE FALLOFF TEST)

The rate history used in the analysis of the pressure falloff data began on March 31, 2016 and ends on June 15, 2016. The daily rate history is summarized in Appendix G.

8. CUMULATIVE INJECTION INTO THE FORMATION FROM TEST WELL AND OFFSET WELLS

The total volume of fluid injected into all three wells as of June 15, 2016, was 3,352,496,910 gallons. The volume of fluid injected into the Mewbourne Well No. 1 was 1,671,316,978 gallons. The volume of fluid injected into the Chukka Well No. 2 was 1,097,019,675 gallons. The volume of fluid injected into the Gaines Well No. 3 was 584,160,257 gallons. The area of review (AOR) indicates that there are two wells injecting into the intervals in which the Navajo wells inject. The volumes injected were obtained from plant records.

9. PRESSURE GAUGES

One (1) downhole pressure gauge (with two readings) was used for the Mewbourne Well No. 1 buildup and falloff testing. The downhole pressure gauge was set at 7,924 feet. Bottom-hole pressure gauges were also placed in each of the offset wells: Gaines Well No. 3 and Chukka Well No. 2. The pressure gauges were set at 7660 feet in the Gaines Well No. 3 and at 7570 feet in the Chukka Well No. 2.

a. Describe the type of downhole surface pressure readout gauge used including manufacture and type:

   In the Mewbourne Well No. 1, an MRO pressure gauge was used to record the pressure and temperature data during the injection/falloff testing. The gauge was a sapphire crystal gauge. The manufacturer of the MRO pressure gauge (Serial No. SP-79240R) is Spartek Systems.

   In the Gaines Well No. 3, an MRO pressure gauge was used to monitor the bottom-hole pressure and temperature during the testing of the Mewbourne Well No. 1. The gauge was a sapphire crystal gauge with Serial No. SP-78527. The gauge is manufactured by Spartek Systems.

   In the Chukka Well No. 2, an MRO pressure gauge was used to monitor the bottom-hole pressure and temperature during the testing of the Mewbourne Well No. 1. The gauge was a sapphire crystal gauge with Serial No. SP-21726. The gauge is manufactured by Spartek Systems.

b. List the full range, accuracy and resolution of the gauge:

In Mewbourne Well No. 1, the MRO pressure gauge, Serial No. SP-79240R has a full range of 15 psi to 15,000 psi, an accuracy of 0.050% of full scale, and a resolution of 0.01% of full scale. A surface pressure gauge was not installed during testing.

In Gaines Well No. 3, the MRO pressure gauge, Serial No. SP-78527, has a full range of 50 psi to 14.996.63 psi, an accuracy of 0.022% of full scale, and a resolution of 0.01% of full scale.

In Chukka Well No. 2, the MRO pressure gauge, Serial No. SP-21726, has a full range of 13.14 psi to 16,001.81 psi, an accuracy of 0.020% of full scale, and a resolution of 0.01% of full scale.

c. Provide the manufacturer's recommended frequency of calibration and a calibration certificate showing date the gauge was last calibrated:

The certificate of calibration for each of the pressure gauges used during the testing are included as Appendix H. The manufacturer's recommended calibration frequency is one year.

10. ONE MILE AREA OF REVIEW (AOR)

Federal Abstract Company was contracted by WSP | Parsons Brinckerhoff and instructed to undertake a review of well changes made within a one-mile area of review (AOR) of the Mewbourne Well No. 1, Chukka Well No. 2, and Gaines Well No. 3. In 2009, an update of the original AOR, submitted with the Discharge Application Permit 2003, was completed within the one-mile AOR for all three wells. The current update includes all existing wells within the one-mile AOR and any changes that have occurred to these wells since the 2015 update.

No new fresh water wells were reported within the search area since the submittal of the 2015 report. The discharge application lists the water wells located in the Area of Review.

a. Identify wells located within the one mile AOR:

Table II also contains a listing of all wells within the one-mile AOR of Mewbourne Well No. 1, Chukka Well No. 2, and Gaines Well No. 3. Figure 6 is a Midland Map Company base map of the area containing the one mile AOR.

b. Ascertain the status of wells within the one mile AOR:

Table II contains a listing of all wells within the one-mile AOR, with their current status. Tables III through XII contain a list of all wells within the one-mile AOR that have had modifications to the current permit or have had new drilling and/or completion permits issued since the 2015 pressure falloff report.

Fifty-nine (59) wells were found in which the owner had changed. No new plugged and abandoned oil and gas well was found. One (1) well was placed in temporarily abandoned status. No wells were found that were returned to production status. One (1) well was found that had been recompleted.

There were sixty-six (66) new drills and permits to drill, of which none penetrated the Wolfcamp interval. All plugged and abandoned wells were successfully plugged and isolated from the Mewbourne Well No. 1, Chukka Well No. 2, and Gaines Well No. 3 injection intervals according to current OCD records.

c. Provide details on any offset producers and injectors completed in the same interval:

Navajo has two injection wells in the same interval. Mewbourne Well No. 1 is listed as ID No. 59 in Table II and no changes have occurred to this well. Chukka Well No. 2 is listed as ID No. 120 in Table II and no changes have occurred to this well. The Gaines Well No. 3 is listed as ID No. 861 in Table XI. The wellbore schematics for the Gaines Well No. 3 and Chukka Well No. 2 are presented as Figure 3 and Figure 4, respectively.

11. GEOLOGY

The injection zones are porous carbonates of the lower portion of the Wolfcamp Formation, the Cisco Formation, and the Canyon Formation. These formations occur in the Mewbourne Well No. 1, the Chukka Well No. 2, and the Gaines Well No. 3 at the depths shown in the table below.

Injection Zone Formation	Mewbourne Well No. 1 (KB = 3,693 ft)		Chukka Well No. 2 (KB = 3,623 ft)		Gaines Well No. 3 (KB = 3,625 ft)	
	MD below KB (ft)	SS Depth (ft)	MD below KB (ft)	SS Depth (ft)	MD below KB (ft)	SS Depth (ft)
Lower Wolfcamp	7450	-3757	7270	-3647	7303	-3678
Cisco	7816	-4123	7645	-4022	7650	-4025
Canyon	8,475	-4,782	8,390	-4767	8390	-4765
Base of Injection Zone (base of Canyon)	9016	-5323	8894	-5271	8894	-5269

d. Description of the geological environment of the injection interval:

The lower portion of the Wolfcamp Formation (Lower Wolfcamp) is the shallowest porous unit in the proposed injection interval. The Wolfcamp Formation (Permian-Wolf campaign age) consists of light brown to tan, fine to medium-grained, fossiliferous limestones with variegated shale interbeds (Meyer, 1966, page 69). The top of the Wolfcamp Formation was correlated for this study to be below the base of the massive, dense dolomites of the overlying Abo Formation. The base of the Wolfcamp coincides with the top of the Cisco Formation. The thickness of log porosity greater than 5% in the entire Wolfcamp Formation ranges from 0 feet to 295 feet in a band three miles wide that trends northeast-southwest across the study area.

The Cisco Formation (Pennsylvanian-Virgilian age) of the Northwest Shelf is described by Meyer (1966, page 59) as consisting of uniform, light colored, chalky, fossiliferous limestones interbedded with variegated shales. Meyer (1966, page 59) also describes the Cisco at the edge of the Permian basin as consisting of bio thermal (mound) reefs composed of thick, porous, coarse-grained dolomites. Locally, the Cisco consists of porous dolomite that is 745 feet thick in Chukka Well No. 2, 659 feet thick in Mewbourne Well No. 1, and 720 feet in Gaines Well No. 3. The total thickness of intervals with log porosity greater than 5% is approximately 310 feet in Mewbourne Well No. 1, 580 feet in Chukka Well No. 2, and 572 feet in Gaines Well No. 3. The total thickness with log porosity greater than 10% is approximately 100 feet in Mewbourne Well No. 1, 32 feet in Chukka Well No. 2, and 65 feet in Gaines Well No. 3. The thickness of the porous intervals in the Cisco ranges from 0 feet in the northwestern part of the study area to nearly 700 feet in a band three miles wide that trends northeast-southwest.

The Canyon Formation (Pennsylvanian-Missourian age) consists of white to tan to light brown fine grained, chalky, fossiliferous limestone with gray and red shale interbeds (Meyer, 1966, page 53). Locally, the Canyon occurs between the base of the Cisco dolomites and the top of the Strawn Formation (Pennsylvanian-Desmoinesian age). The total thickness of intervals with log porosity greater than 5% is 34 feet in Mewbourne Well No. 1, 30 feet in Chukka Well No. 2, and 10 feet in Gaines Well No. 3. No intervals appear to have log porosity greater than 10% in any of the three injection wells.

e. Discuss the presence of geological features, i.e., pinchouts, channels, and faults, if applicable:

From the geological study completed and submitted in the Discharge Plan Application and Application for Authorization to Inject, the reservoir appears to be continuous, with the possibility of anisotropic conditions extending to the west-southwest. The injection intervals that were studied are well confined by the Abo and Yeso low porosity carbonate beds, Tubbs shale, and Salado salt. The Cisco and Wolfcamp formations follow the Vacuum arch and have a southeasterly dip. No faults existed in the study area although, the study also shows that faulting occurs via the K-M fault located 6 miles northwest of Artesia and trends northeast-southwest. The distance to this fault line occurs no closer than 16 miles. No faults are known to exist in the confining zone within the AOR.

f. Provide a portion of relevant structure map, if necessary:

The structure map for Strawn is presented as Appendix I. The structure map for the Wolfcamp presented as Appendix J. The structure map for the Cisco is presented as Appendix K.

12. OFFSET WELLS

There are only four offset wells identified in the AOR that inject into the same interval: The Federal No. 1, the Chalk Bluff Federal Com No. 3, the Gaines Well No. 3 and the Chukka Well No. 2. The Gaines and Chukka were shut-in during the buildup and falloff portions of the testing.

a. Identify the distance between the test well and any offset well completed in the same injection interval:

The Mewbourne Well No. 1 is approximately 7900 feet from Gaines Well No. 3, the test well. The Chukka Well No. 2 is approximately 10,860 feet from the Mewbourne Well No. 1.

b. Report the status of the offset wells during both the injection and shut-in portions of the test:

Both the Gaines Well No. 3 and Chukka Well No. 2 were shut-in during the buildup and falloff portions of the testing. Bottom-hole pressure gauges were lowered into each well approximately 48 hours before shutting in the Mewbourne Well No. 1. The bottom-hole pressure and temperature data are graphically depicted in Figure 5 for the Gaines Well No. 3 and Figure 2 for the Chukka Well No. 2.

c. Describe the impact, if any, the offset wells had on the testing:

The offset wells were shut in prior to beginning the 30-hour injection period and remained shut-in during the falloff portion of the testing.

13. CHRONOLOGICAL LISTING OF THE DAILY TESTING ACTIVITIES (OPERATIONS LOG)

Appendix L contains the formal Chronology of Field Activities. This chronology was developed from the field activity reports.

a. Date of the testing:

The buildup portion of the testing started at 5:38 a.m. on June 9, 2016 at 9:31 a.m. and continued until June 14, 2016, at 5:38 a.m., when the Mewbourne Well No. 1 was shut-in. The falloff test ended on June 15, 2016 at 8:26 a.m. The total depth of the well was tagged at 8990 feet and five-minute gradient stops were made while pulling the pressure gauges out of the wellbore. After the pressure gauges were pulled out of the well on June 15, 2016, the well was turned over to Navajo plant operations personnel.

b. Time of the injection period:

The buildup portion of the testing began on June 9, 2016 when the injection rate was set at an average injection rate of 139 gallons per minute (gpm). The injection rate was held constant for 110.58 hours.

c. Type of injection fluid:

The injected fluid was non-hazardous waste water from the plant. The density of the injection fluid was periodically measured and averaged 8.34 pounds per gallon during the 110.58-hour injection period.

d. Final injection pressure and temperature prior to shutting in the well:

The final flowing pressure (P_{wf}) and temperature (T_{wf}) were 4,764.32 psia and 96.69°F, respectively.

e. Total shut-in time:

The Mewbourne Well No. 1 was shut-in, while offset wells shut-in, for 32.34 hours.

f. Final static pressure and temperature at the end of the fall-off portion of the test:

The final static pressure at 7924 feet was 4,440.62 psia. The final temperature was 100.44°F.

14. DESCRIBE THE LOCATION OF THE SHUT-IN VALVE USED TO CEASE FLOW TO THE WELL FOR THE SHUT-IN PORTION OF THE TEST

On the pipeline to the Mewbourne Well No. 1, there are two, 4 inch motor controlled valves installed on the incoming pipeline before the pod filters. Two 4 inch valves are installed between the pod filters and the wellhead. There is one 6 inch valve installed in the main line between the pod filters and the booster pump. A 4 1/16 inch wing valve is installed on the wellhead. All valves were closed during the falloff portion of the testing. A diagram of the wellhead is shown in Figure 7 and a diagram of the valve locations are shown in Figure 8.

15. PRESSURE FALLOFF ANALYSIS

The following discussion of the analysis of the pressure data recorded during the falloff testing of the Mewbourne Well No. 1 satisfies Sections 15 through 19 of Section IX, Report Components, of the OCD's falloff test guidelines. Where appropriate, the specific guideline addressed is annotated. Specific parameters used in the equations and discussed previously in this report are also annotated. The plots included with this report are summarized in Table VIII. The inclusion of these plots in this report satisfies OCD Guideline Section IX.18.

The pressure data obtained during the falloff test were analyzed using the commercially available pressure transient analysis software program PanSystem©. Appendix M contains the output from this software program. Figure 9 shows the pressure data recorded by the bottom-hole pressure gauge from the time the tool was in place through the 32.34 hour total shut-in period. Figure 10 shows the pressure and temperature data recorded by the bottom-hole pressure gauge from the time the tool was in place through the 32.34 hour falloff shut-in period. Figure 11 is a Cartesian plot of the injection rates versus time for the injection period used in the pressure falloff analysis. The superposition time function was used to account for all rate changes during the injection period. Figure 12 is a plot of the historical injection rates and surface pressures versus calendar time.

Figure 13 is a log-log diagnostic plot of the falloff data, showing change in pressure and pressure derivative versus equivalent shut-in time. The different flow regimes, wellbore storage, radial flow and change in reservoir characteristics, are indicated on the log-log plot and the superposition Horner plot (OCD Guideline Section IX.18.c and IX.18.d)

Wellbore storage begins at 0.017 hours and continues to an elapsed shut in time of 0.076 hours. Radial flow begins at an elapsed shut in time of 9.96 hours and continues until 19.40 hours (OCD Guideline Section IX.15.b).

The reservoir permeability was determined from the radial flow region of the superposition semi-log plot, Figure 14. The radial flow regime begins at a Superposition time of 2.198 and continues until a Superposition time of 1.908 at which time the pressure data departs the semi-log straight-line. Figure 15 shows an expanded view of the radial flow regime. The slope of the radial flow period, as calculated by the analysis software, 4.85777 psi/cycle (OCD Guideline Section IX.15.c). The injection rate just prior to shut in was 139.13 gpm which is equivalent to 4770 barrels per day (bbl/day).

An estimate of mobility-thickness (transmissibility, OCD Guideline Section IX.15.d), kh/μ, for the reservoir was determined to be 159,662 md-ft/cp using the following equation:

$$\frac{k\ h}{\mu} = 162.6\,\frac{q\ B}{m}$$

where,

kh/μ	=	formation mobility-thickness, millidarcy-feet/centipoise
q	=	rate prior to shut in, bpd
B	=	formation volume factor, reservoir volume/surface volume
m	=	slope of radial flow period, psi/cycle

$$\frac{k\ h}{\mu} = 162.6\,\frac{(4,770)(1.0)}{4.85777}$$

$$= 159,662\ \text{md} - \text{ft / cp}$$

The permeability-thickness (flow capacity, OCD Guideline Section IX.15.i), kh, was determined to be 91,007 md-ft by multiplying the mobility-thickness, kh/μ, by the viscosity of the reservoir fluid (see Section 6), $\mu_{reservoir}$, of 0.57 centipoises:

$$kh = \left(\frac{kh}{\mu}\right)\mu_{reservoir}$$

$$= (159,662) * (0.57)$$

$$= 91,007\ \text{md} - \text{ft}$$

The reservoir permeability (OCD Guideline Section IX.15.e) using the total thickness (see Section 5 and Section 11) of 175 feet was 520 md:

$$k = \frac{kh}{h}$$

$$= \frac{91,007}{175}$$

$$= 520\ \text{md}$$

To determine whether the proper viscosity was used in arriving at this permeability, the travel time for a pressure transient to pass beyond the waste front needs to be calculated (OCD Guideline Section VIII.5). The distance to the waste front is determined from the following equation:

$$r_{waste} = \left(\frac{0.13368\ V}{\pi\, h\ \phi}\right)^{1/2}$$

where,

r_{waste}	=	radius to waste front, feet
V	=	total volume injected into the injection interval, gallons
h	=	formation thickness, feet
ϕ	=	formation porosity, fraction
0.13368	=	constant

A cumulative volume of approximately 1,671,316,978 gallons of waste has been injected into Mewbourne Well No. 1 (see Section 8). The formation has a porosity of 0.10 (see Section 5 and Section 11).

The distance to the waste front was determined to be 2016 feet:

$$r_{waste} = \left(\frac{(0.13368)(1,671,316,978)}{(\pi)(175)(0.10)} \right)$$

$$= 2016 \text{ feet}$$

The time necessary for a pressure transient to traverse this distance is calculated from the following equation:

$$t_{waste} = 948 \frac{\phi \, \mu_{waste} \, c_t \, r^2_{waste}}{k}$$

where,

t_{waste}	=	time for pressure transient to reach waste front, hours
ϕ	=	formation porosity, fraction
μ_{waste}	=	viscosity of the waste at reservoir conditions, centipoise
r_{waste}	=	radius to waste front, feet
c_t	=	total compressibility of the formation and fluid, psi
k	=	formation permeability, millidarcies
948	=	constant

The pore volume compressibility is 8.4 x 10^{-6} psi^{-1} (see Section 6). The time necessary for a pressure transient to traverse the distance from the wellbore to the leading edge of the waste front would be 3.55 hours:

$$t_{waste} = 948 \frac{(0.10)(0.57)(8.4x10^{-6})(2016)^2}{520}$$

$$= 3.55 \text{ hours}$$

Since the time required to pass through the waste is less than the 9.96 hours required to reach the beginning of the radial flow period, the assumption that the pressure transient was traveling through reservoir fluid during the period of the semi-log straight line was correct.

The near wellbore skin damage (OCD Guideline Section IX.15.f) was determined from the following equation:

$$s = 1.151\left[\frac{p_{wf} - p_{1hr}}{m_1} - \log\left(\frac{k}{\phi\ \mu\ c_t\ r_w^2}\right) + 3.23\right]$$

where,

s	=	formation skin damage, dimensionless
1.151	=	constant
p_{wf}	=	flowing pressure immediately prior to shut in, psi
p_{1hr}	=	pressure determined from extrapolating the first radial flow semi-log line to a Δt of one hour, psi
m_1	=	slope of the first radial flow semi-log line, psi/cycle
k	=	permeability of the formation, md
ϕ	=	porosity of the injection interval, fraction
μ	=	viscosity of the fluid the pressure transient is traveling through, cp
c_t	=	total compressibility of the formation plus fluid, psi^{-1}
r_w	=	radius of the wellbore, feet
3.23	=	constant

The final measured flowing pressure was 4,764.32 psia. The pressure determined by extrapolating the radial flow semi-log line to a Δt of one hour, p_{1hr}, was 4,448.09 psia (calculated from the analysis software). The wellbore radius, r_w, is 0.3646 feet (completion records). Using these values in addition to the previously discussed parameters results in a skin of 67.09:

$$s = 1.151\left[\frac{4,764.32 - 4,448.09}{4.85777} - \log\left(\frac{520}{(0.10)(0.57)(8.4x10^{-6})(0.3646)^2}\right) + 3.23\right]$$

$$= 67.09$$

The change in pressure, Δp_{skin}, in the wellbore associated with the skin factor (OCD Guideline Section IX.15.g) was calculated using the following equation:

$$\Delta p_{skin} = 0.869(m)(s)$$

where,

0.869	=	constant
m	=	slope from superposition plot of the well test, psi/cycle
s	=	skin factor calculated from the well test

The change in pressure, Δp_{skin}, using the previously calculated and defined values was determined to be 283.21 psi:

$$\Delta p_{skin} = 0.869(m)(s)$$

$$= 0.869(4.85777)(67.09)$$

$$= 283.21\,\text{psi}$$

The flow efficiency (E, OCD Guideline Section IX.15.h) was determined from the following equation:

$$E = \frac{p_{wf} - \Delta p_{skin} - p_{static}}{p_{wf} - p_{static}}$$

where,

E	=	flow efficiency, fraction
p_{wf}	=	flowing pressure prior to shutting in the well for the fall-off test,
p_{static}	=	final pressure from the pressure falloff test
Δp_{skin}	=	pressure change due to skin damage

Using the previously determined parameters, the flow efficiency was calculated to be 0.13:

$$E = \frac{4,764.32 - 283.21 - 4,440.62}{4,764.32 - 4,440.62}$$

$$= 0.13$$

The radius of investigation (OCD Guideline Section IX.15.a) was calculated using the following equation:

$$R_{inv} = 0.029\sqrt{\frac{k\ \Delta t_s}{\phi\ \mu\ C_t}}$$

where,

k	=	formation permeability, millidarcies
Δt_s	=	elapsed shut-in time, hours
ϕ	=	formation porosity, fraction
μ	=	viscosity of the fluid the pressure transient is traveling through, cp
c_t	=	total compressibility of the formation plus fluid, psi^{-1}
0.029	=	constant

The radius of investigation, r_{inv}, using the previously defined values was determined to be 5435 feet:

$$R_{inv} = 0.029\sqrt{\frac{(520)(32.34)}{(0.10)(0.57)(8.4 \times 10^{6})}}$$

$$R_{inv} = 5,435 \text{ feet}$$

As indicated on Figure 13, the pressure data departs the radial flow region at an elapsed time from shut in of 19.40 hours. No pressure or temperature anomalies were noted that would cause this type of pressure response observed on the derivative log-log plot (OCD Guideline Section VIII.9). A review of the geology of the injection zones (see Section 11) indicates that all three of the formations in which the Mewbourne Well No. 1 injects into have varying thicknesses and porosities within the mapped area. Changes in formation thickness, porosity, and fluid viscosity can cause the slope changes seen on the derivative log-log plot. Because these changes occurred during the duration of the pressure falloff test, the reservoir analysis results are considered heterogeneous as opposed to homogeneous (OCD Guideline Section IX.17.b).

The Hall plot (OCD Guideline Section IX.18.h) is presented as Figure 16. No slope changes are seen in the plotted data.

A comparison of the current analysis results with previous analysis results as well as with the reservoir parameters submitted with the permit application is presented in Table IX (OCD Guideline Section IX.19).

On June 15, 2016, a static pressure gradient survey was conducted while pulling the pressure gauges out of the well. Static gradient stops were conducted at 7924 feet, 7000 feet, 6000 feet, 5000 feet, 4000 feet, 3000 feet, 2000 feet, 1000 feet, and at the surface. The bottom-hole pressure and temperature, after 32.34 hours of shut-in at 7924 feet, were 4440.62 psia and 100.44°F, respectively. The gradient survey is summarized in Table X. The data are graphically depicted in Figure 17.

16. NEW MEXICO OIL CONSERVATION DIVISION THREE YEAR RECORDING KEEPING STATEMENT

Navajo will keep the raw test data, generated during the testing, on file for a minimum of three years. The raw test data will be made available to OCD upon request.

TABLES

FIGURES

APPENDICES

TABLE I

FORMATION WATER ANALYSIS SUMMARY

Chemical	Mewbourne Well No. 1	Chukka Well No. 2	Gaines Well No. 3	Average
Date	July 31, 1998	June 14, 1999	Nov 8, 2006	
Fluoride (mg/l)	2.6	9.7	Not Detected	6.15
Chloride (mg/L)	19,000	15,000	10,447	14,815.67
NO3-N (mg/L)	<10	<10	--	<10
SO4 (mg/L)	2,200	2000	1,908	2,036
CaCO3 (mg/L)	1000	1210	--	1105
Specific Gravity (g/L)	1.034	1.0249	--	1.0295
TDS (mg/L)	33,000	20,000	--	26,500
Specific Conductance (uMHOs/cm)	52,000	43,000	--	47,500
Potassium (mg/L)	213	235	85.5	177.83
Magnesium (mg/L)	143	128	155	142
Calcium (mg/L)	390	609	393	464
Sodium (mg/L)	12,770	8,074	6,080	8,974.67
pH (s.u.)	8.1	7.2	--	7.65

The data in the above table was referenced from "Discharge Plan Application and Application for Authorization to Inject per Oil Conservation Division Form C-108, into Class I Wells WDW-1 and Proposed WDW-2 and WDW-3" and the "Discharge Permit Approval Conditions", "Reentry and Completion Report Waste Disposal Well No. 2", and "Reentry and Completion Report Waste Disposal Well No. 3".

TABLE II TABULATION OF WELLS WITHIN 1 MILE OF THE INJECTION WELLS

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1	30-015-00693	GEORGE A CHASE & C SERVICE DELHI #001	36 17S 27E A 330N 330E	528	T/A O	8/30/1941
2	30-015-00694	DELHI OIL CORP. STATE #013	36 17S 27E A 990N 990E	1993	P&A O	6/24/1948 6/24/1948
3	30-015-00646	GEORGE A CHASE & C SERVICE DELHI #007	36 17S 27E A 990N 330E	540	T/A O	4/21/1950
4	30-015-00668	LEGACY RESERVES OPERATING, LP SOUTH RED LAKE GRAYBURG UNIT #010	36 17S 27E G 1650N 2310E	1736	SHUT IN O	12/6/1947
5	30-015-00690	GEORGE A CHASE & C SERVICE CONKLIN #002	36 17S 27E G 1830N 2205E	532	ACTIVE O	3/6/1949
6	30-015-00667	FAIRWAY RESOURCES OPERATING INC SOUTH RED LAKE GRAYBURG UNIT #011	36 17S 27E G 2310N 2310E	1733	ACTIVE I	3/23/1949
7	30-015-00666	GEORGE A CHASE & C SERVICE CONKLIN #001	36 17S 27E G 2310N 2310E	533	ACTIVE 1/12/10 P&A 9/10/07 O	1/10/1942 9/10/2007
8	30-015-00689	GEORGE A CHASE JR & C SERVICE GATES STATE #001	36 17S 27E H 1650N 330E	557	ACTIVE O	8/4/1950
9	30-015-00647	ASPEN OIL INC GATES STATE #002	36 17S 27E H 1650N 990E	551	ACTIVE O	10/21/2003 10/21/2003
10	30-015-00669	GEORGE A CHASE JR & C SERVICE HOMAN #001	36 17S 27E H 2310N 330E	1804	P&A O	5/6/2008 5/6/2008
11	30-015-00688	KERSEY & CO RAMAPO #001	36 17S 27E I 2310S 330E	590	P&A O	10/28/1941 10/28/1941
12	30-015-00670	KERSEY & CO RAMAPO #003	36 17S 27E I 2970N 330E	1857	P&A O	1/3/1950 1/3/1950
13	30-015-00687	KERSEY & CO RAMAPO #002	36 17S 27E I 2310S 990E	1900	P&A G	5/7/1948 5/7/1948

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
14	30-015-00685	ARCO OIL & GAS EMPIRE ABO UNIT G #020	36 17S 27E I 1650S 330E	5980	P&A O	7/10/1989 7/10/1989
15	30-015-00671	ROJO GRANDE COMPANY LLC RAMAPO #003	36 17S 27E J 2310S 2310E	591	ZONE ABAN O	2/13/1942 1/24/2000
16	30-015-01221	MCQUADRANGLE, LC SOUTH RED LAKE GRAYBURG UNIT #023	36 17S 27E J 2300S 2300E	1790	ZONE ABAN O	2/27/1948 8/13/2002
17		MARTIN YATES III DOOLEY STATE #3	36 17S 27E J	5865		4/22/1961
18	30-015-05934	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #019A	36 17S 27E J 1650S 1650E	5970	ACTIVE O	2/26/1961
19	30-015-01220	MCQUADRANGLE, LC SOUTH RED LAKE GRAYBURG UNIT #022	36 17S 27E K 2310S 2330W	1747	ZONE ABAN O	2/3/1949 7/17/2002
20	30-015-00674	ROJO GRANDE COMPANY LLC RAMAPO #002	36 17S 27E K 2310S 2310W	514	ACTIVE O	5/15/1947
21	30-015-01219	MCQUADRANGLE, LC SOUTH RED LAKE GRAYBURG UNIT #021	36 17S 27E K 2310S 1650W	1710	ACTIVE I	1/20/1948
22	30-015-23913	MCQUADRANGLE, LC SOUTH RED LAKE GRAYBURG UNIT #043	36 17S 27E K 1650S 1650W	1785	ACTIVE O	12/11/1981
23		MARTIN YATES III DOOLEY STATE ABO #3	36 17S 27E K	5865	ACTIVE O	4/19/1961
24	30-015-00673	ROJO GRANDE COMPANY LLC RAMAPO #001	36 17S 27E K 1650S 2310W	510	ZONE ABAN O	1/24/2000 1/24/2000
25	30-015-00682	ROJO GRANDE COMPANY LLC RAMAPO #004	36 17S 27E N 990S 1650W	541	ZONE ABAN O	1/24/2000 1/24/2000
26	30-015-00683	FAIRWAY RESOURCES OPERATING INC SOUTH RED LAKE GRAYBURG UNIT #028	36 17S 27E N 965S 1650W	1812	ACTIVE I	4/16/1948
27	30-015-01218	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #018	36 17S 27E N 330S 2310W	5925	P&A O	3/11/2009 3/11/2009

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
28	30-015-00684	BURNHAM OIL COMPANY STATE B-6961 NO. 1-A	36 17S 27E O 990S 2310E	1500	P&A O	5/13/1947 5/13/1947
29	30-015-01251	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #019	36 17S 27E O 660S 1980E	6200	P&A O	9/8/1959 4/27/2009
30			36 17S 27E I		MISPLOT OF 14	
31	30-015-00677	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #020	36 17S 27E P 330S 990E	6013	P&A O	4/13/2009 4/10/2009
32	30-015-01616	C F M OIL CO BLAKE STATE #001	30 17S 28E P 330S 990E	615	ACTIVE O	3/7/1953
33	30-015-01638	ALAMO PERMIAN RESOURCES LLC STATE NO. 1	31 17S 28E A 330N 990E	2004	ACTIVE O	7/15/1952 7/15/1952
34	30-015-21594	FINNEY OIL COMPANY POWCO STATE #001	31 17S 28E B 330N 1650E	652	ACTIVE O	11/15/1975
35	30-015-01636	BEDINGFIELD, J E DELHI-STATE NO. 1	31 17S 28E C 330N 2310E	637	P&A O	12/23/1952 12/23/1952
36	30-015-25621	FINNEY OIL COMPANY POWCO STATE #002	31 17S 28E B 980N 1620E	747	ACTIVE O	7/15/1986
37	30-015-01633	GEORGE A CHASE JR DBA G AND C SERVIC ASTON & FAIR A #001	31 17S 28E D 330N 330W	531	ACTIVE O	6/23/1942
38	30-015-01634	ASTON & FAIR STATE 31 NO. 1X	31 17S 28E D 350N 345W	525	NO COMPL O	1/5/1946
39	30-015-01645	MCLAUGHLIN, C T BEDINGFIELD STATE 1 NO. 1	31 17S 28E F 990N 990W	2307	P&A O	2/16/1950 2/16/1950
40	30-015-02666	DORAL ENERGY CORP. HUDSON SAIKIN STATE #001	31 17S 28E E 2310N 330W	1816	ACTIVE O	5/29/1948
41	30-015-24887	DORAL ENERGY CORP. HUDSON SAIKIN STATE #002	31 17S 28E E 2310N 990W	1950	ACTIVE O	7/7/1984

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
42	30-015-01643	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022	31 17S 28E F 2310N 2260W	5971	P&A O	6/7/1960 7/10/2009
43	30-015-01635	GEORGE A CHASE JR DBA G AND C SERVIC ASTON & FAIR #001Y	31 17S 28E F 2310N 2310W	1926	ACTIVE O	5/8/1948
44	30-015-01637	GEORGE A CHASE JR DBA G AND C SERVIC MALCO STATE #001	31 17S 28E G 2310N 2310E	1852	ACTIVE O	10/12/1953
45	30-015-01652	KERSEY & CO BOLING #001	31 17S 28E G 2288N 1625E	6025	ACTIVE O	8/10/1960
46	30-015-10537	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #004	31 17S 28E H 2277N 330E	6180	ACTIVE O	9/23/1965
47	30-015-10833	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #010	31 17S 28E I 1980S 660E	1945	ACTIVE O	6/17/1966
48	30-015-01644	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #024A	31 17S 28E I 1650S 330E	6106	P&A O	4/29/1960 6/12/2009
49	30-015-01642	DORAL ENERGY CORP. STATE FW #001	31 17S 28E J 1650S 2310E	1937	ACTIVE O	12/23/1962
50	30-015-01650	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #023A	31 17S 28E J 1650S 1958E	6094	P&A O	9/17/2003 9/17/2003
51	30-015-01651	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022B	31 17S 28E K 1650S 2387W	6046	P&A O	4/10/1960 10/22/2009
52	30-015-01640	DORAL ENERGY CORP. RAMPO #002	31 17S 28E L 2310S 330W	1996	ACTIVE O	7/16/1955
53	30-015-01648	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #021A	31 17S 28E L 1651S 1089E	5971	ZONE ABAN O	8/24/2002 8/24/2002
54	30-015-01639	DORAL ENERGY CORP. RAMPO #001	31 17S 28E M 990S 330W	1975	ACTIVE O	5/1/1948
55	30-015-01647	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #021	31 17S 28E M 660S 660W	6006	P&A O	1/31/1960 7/23/2005

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
56	30-015-01646	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022A	31 17S 28E N 660S 2082W	6050	P&A O	1/22/1960
57	30-015-10118	DORAL ENERGY CORP. STATE FV #001	31 17S 28E N 766S 2188W	1938	ACTIVE O	3/1/1963
58	30-015-01653	OTIS A ROBERTS PARKER-STATE NO. 1	31 17S 28E O 990S 1650E	742	P&A O	1/18/1942 1/18/1942
59	30-015-27592	NAVAJO REFINING CO. PIPELINE DIVISION WDW #001	31 17S 28E 660S 2310E	10200	ACTIVE I	8/4/1998
60	30-015-01649	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #023	31 17S 28E O 660S 1939E	6094	P&A O	2/24/1960 8/14/2009
61	30-015-20042	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #011	31 17S 28E P 990S 660E	2012	ACTIVE O	5/8/1967
62	30-015-01641	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #024	31 17S 28E P 660S 660E	6122	ACTIVE O	3/12/1960
63	30-015-01654	BEDINGFIELD, J E ASTON-STATE NO. 1	32 17S 28E D 330N 330W	651	P&A O	5/12/1953 5/12/1953
64	30-015-01671	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #025B	32 17S 28E E 2280N 978W	6013	P&A O	9/13/1960 8/14/2008
65	30-015-01657	MARBOB ENERGY CORP AA STATE NO. 1	32 17S 28E F 2280N 1980W	6171	ACTIVE O	8/24/1960
66	30-015-10818	SDX RESOURCES INC NORTHWEST ARTESIA UNIT #008	32 17S 28E K 2310S 2105W	2003	P&A O	11/6/2006 11/6/2006
67	30-015-01661	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #026B	32 17S 28E K 1650S 2310W	6083	ACTIVE O	3/27/1960
68	30-015-10795	LIME ROCK RESOURCES A, LP NORTHWEST ARTESIA UNIT #009	32 17S 28E L 2310S 660W	1930	P&A O	5/15/1966 5/28/2008
69	30-015-01662	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #025A	32 17S 28E L 1650S 990W	6075	ACTIVE O	4/13/1960

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
70	30-015-20043	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #012	32 17S 28E M 990S 760W	1998	ACTIVE O	5/9/1967
71	30-015-01660	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #025	32 17S 28E M 660S 660W	6132	P&A O	3/5/1960 1/14/2009
72	30-015-10834	SDX RESOURCES INC NORTHWEST ARTESIA UNIT #013	32 17S 28E N 990S 2030W	1954	P&A O	9/15/2006 9/15/2006
73	30-015-01659	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #026A	32 17S 28E N 660S 1980W	6172	ACTIVE O	2/14/1960
74	30-015-21539	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #261	32 17S 28E N 150S 1400W	6220	ACTIVE O	7/25/1975
75	30-015-22009	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #272	32 17S 28E O 330S 2481E	6370	ACTIVE O	7/18/1977
76	30-015-02606	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #026E	5 18S 28E C 330N 1941W	6254	ACTIVE O	7/18/1960
77	30-015-22697	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #261A	5 18S 28E C 1080N 1914W	6350	P&A O	1/4/1979 6/16/2009
78	30-015-02607	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #025C	5 18S 28E D 660N 660W	6273	ACTIVE O	3/27/1960
79	30-015-22750	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #251	5 18S 28E D 660N 150W	6250	SHUT IN O	1/12/1979
80	30-015-02608	CONOCOPHILLIPS COMPANY STATE E AI #001	5 18S 28E E 1660N 330W	6265	P&A O	1/13/2006 1/13/2006
81	30-015-24485	CONOCOPHILLIPS COMPANY ILLINOIS CAMP A COM #001	5 18S 28E E 1980N 990W	10450	ACTIVE G	8/10/1983
82	30-015-02602	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #026D	5 18S 28E F 1650N 1650W	6265	ACTIVE O	12/30/1959
83	30-015-25522	I & W INC WALTER SOLT STATE #001	5 18S 28E L 2240S 400W	8500	ACTIVE S	8/12/1983

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
84	30-015-10244	MACK ENERGY CORP STATE AG #001	5 18S 28E L 2310S 330W	6365	ZONE ABAN O	3/27/2001 3/27/2001
87	30-015-20019	LIME ROCK RESOURCES A, LP NORTHWEST ARTESIA UNIT #016	6 18S 28E A 330N 330E	3280	ACTIVE O	3/14/1967
88	30-015-02615	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #024B	6 18S 28E A 660N 660E	6241	ACTIVE O	2/29/1960
89	30-015-02625	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #023C	6 18S 28E B 470N 2170E	6194	T/A O	12/21/1959
90	30-015-21542	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #231	6 18S 28E B 1260N 1580E	6250	ACTIVE O	11/1/1975
91	30-015-02621	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022E	6 18S 28E C 660N 1980W	6033	ACTIVE O	12/29/1959
92	30-015-21626	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #231A	6 18S 28E G 1361N 2531E	6380	SHUT IN O	10/22/1975
93	30-015-02613	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #021B	6 18S 28E D 990N 660W	6119	ACTIVE O	12/30/1959
94	30-015-23116	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #213	6 18S 28E E 2050N 100W	6225	ACTIVE O	6/2/1980
95	30-015-02619	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #021C	6 18S 28E E 1990N 660W	6202	ACTIVE O	10/30/1959
96	30-015-22637	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #212	6 18S 28E E 2450N 400W	6267	ACTIVE O	12/28/1978
97	30-015-21395	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #211	6 18S 28E E 2630N 1300W	6200	ACTIVE O	2/11/1975
98	30-015-22012	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #222	6 18S 28E F 1350N 1572W	6303	ACTIVE O	3/13/1977
99	30-015-02626	SARKIN, DAVID C & OLIVER, HENRY F STATE NO. 1	6 18S 28E F 1650N 1650W	705	P&A O	2/21/1942 2/21/1942

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
100	30-015-10107	DORAL ENERGY CORP STATE FX #001	6 18S 28E F 1874N 1874W	1985	ACTIVE O	8/8/1963
101	30-015-02620	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022D	6 18S 28E F 1990N 2082W	6206	ACTIVE O	11/26/1959
102	30-015-22527	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #223	6 18S 28E F 2630N 1930W	6250	ACTIVE O	5/19/1978
103	30-015-21746	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #221	6 18S 28E F 2610N 2713W	6305	ACTIVE O	4/23/1976
104	30-015-22913	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #235	6 18S 28E G 1750N 1600E	6300	ACTIVE O	7/8/1979
105	30-015-22593	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #234	6 18S 28E G 1900N 2441E	6260	P&A O	8/27/1978 12/3/2008
106	30-015-02614	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #023B	6 18S 28E G 1980N 1980E	6242	ACTIVE O	1/26/1960
107	30-015-21737	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #232	6 18S 28E G 2253N 1576E	6345	P&A O	4/13/1976 5/7/2009
108			6 18S 28E H		MISPLOT OF 107	
109	30-015-22490	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #233	6 18S 28E G 2550N 2050E	6300	P&A O	6/5/1978 4/3/2009
110	30-015-02616	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #024C	6 18S 28E H 1650N 990E	6253	ACTIVE O	3/24/1960
111	30-015-23547	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #241	6 18S 28E H 1950N 660E	6386	P&A O	4/12/1981 9/19/2008
112	30-015-02617	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #024K	6 18S 28E I 2310S 990E	6350	P&A O	12/12/2002 12/12/2002
113	30-015-22528	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #232A	6 18S 28E J 2300S 1570E	6350	P&A O	2/5/1979 4/7/2009

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
114	30-015-02611	BARNEY COCKBURN STATE NO. 1	6 18S 28E J 2310S 2310E	2095	P&A O	8/15/1949 8/15/1949
115	30-015-02628	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #023D	6 18S 28E J 2260S 2270E	6310	ACTIVE O	5/23/1979
116	30-015-22491	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #231B	6 18S 28E J 1700S 2350E	6350	P&A O	8/13/1978 9/2/2009
117	30-015-02618	MILLER BROS OIL CO CAPITOL STATE NO. 1	6 18S 28E J 1647S 2076E	2396	P&A G	3/21/1955 3/21/1955
118	30-015-02623	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022F	6 18S 28E K 2248S 2075W	6210	ACTIVE O	2/22/1960
119			6 18S 28E K		MISPLOT	
120		NAVAJO REFINING COMPANY WDW-2 (ORIGINAL LOCATION)	6 18S 28E L			
121	30-015-02622	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #021D	6 18S 28E L 2219S 660W	6194	ACTIVE O	1/23/1960
122	30-015-23548	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #211A	6 18S 28E L 1950S 1000W	6312	ACTIVE O	7/17/1980
123	30-015-02627	RUTH OIL CO, LLC STATE M-AI #002	6 18S 28E M 949S 990W	6225	ACTIVE O	10/21/1960
124	30-015-26943	MEWBOURNE OIL CO CHALK BLUFF 6 STATE #001	6 18S 28E M 990S 730W	10200	ACTIVE G	4/16/1992
125	30-015-02610	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #022C	6 18S 28E N 955S 1750W	6243	ACTIVE O	8/5/1960
126	30-015-02624	PAN AMERICAN PETROLEUM CO STATE CD NO. 1	6 18S 28E O 968S 2270E	6412	P&A O	5/1/1961 5/1/1961
127	30-015-25503	DICKSON PETROLEUM CO KIMBERLY STATE NO. 1	6 18S 28E P 660S 330E	1750	P&A O	12/30/1985 12/30/1985

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
128	30-015-02612	D & H OIL CO STATE NO. 1	6 18S 28E P 330S 330E	2246	P&A O	5/13/1952 5/13/1952
129	30-015-01215	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #020D	1 18S 27E A 667N 666E	6118	ACTIVE O	11/5/1959
130	30-015-00708	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #019B	1 18S 27E B 660N 1980E	6078	ACTIVE O	7/7/1959
131		MALCO REFINERIES HILL #4	1 18S 27E C	1840	P&A	5/10/1948 5/10/1948
132			1 18S 27E C		MISPLOT	
133	30-015-00710	MARBOB ENERGY CORP AAO FEDERAL No. 013	1 18S 27E C 660N 1980W	6173	ACTIVE O	7/21/2004
134	30-015-26741	MEWBOURNE OIL CO CHALK BLUFF FEDERAL COM #002	1 18S 27E F 1650N 1350W	10140	ACTIVE G	8/24/1991
135	30-015-00706	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #018A	1 18S 27E F 2310N 1980W	6087	ACTIVE O	5/31/1959
136	30-015-00709	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #019C	1 18S 27E G 1980N 1980E	6205	ACTIVE O	8/2/1959
137			1 18S 27E G		MISPLOT	
138	30-015-21552	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #191	1 18S 27E G 2500N 2500E	6259	ACTIVE O	9/7/1975
139	30-015-00711	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #020C	1 18S 27E H 1980N 660E	6218	ACTIVE O	10/13/1959
140	30-015-21783	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #202	1 18S 27E H 2490N 1299E	6296	ACTIVE O	5/13/1976
141	30-015-22656	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #203	1 18S 27E H 2400N 700E	6225	ACTIVE O	10/10/1978

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
142		MANHATTAN OIL CRONIN #1	1 18S 27E H	2900	P&A	7/1/1927 7/1/2027
143	30-015-21553	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #201	1 18S 27E H 2501N 20E	6225	ACTIVE O	7/19/1975
144	30-015-27163	MEWBOURNE OIL CO CHALK BLUFF FEDERAL COM #003	1 18S 27E I 1980S 990E	10150	ACTIVE G	1/16/1993
145	30-015-00697	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #020K	1 18S 27E I 1980S 660E	6185	P&A O	1/5/2003 1/5/2003
146	30-015-22657	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #193	1 18S 27E J 2490S 2200E	6225	ACTIVE O	10/26/1978
147	30-015-00696	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #019Q	1 18S 27E J 1980S 1980E	6180	ACTIVE O	8/20/1959
148	30-015-22560	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #192	1 18S 27E J 220S 1390E	6250	ACTIVE O	6/25/1978
149	30-015-21873	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #191A	1 18S 27E J 1526S 1470E	6350	ACTIVE O	9/23/1976
150	30-015-22658	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #194	1 18S 27E J 1500S 2130E	6325	ACTIVE O	11/14/1978
151	30-015-22559	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #184	1 18S 27E K 2290S 2445W	6200	SHUT IN O	7/25/1978
152	30-015-22096	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #183	1 18S 27E K 2370S 1510W	6210	ACTIVE O	7/24/1977
153	30-015-21554	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #181	1 18S 27E K 1367S 1440W	6203	P&A O	4/17/2003 4/17/2003
154	30-015-00707	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #018B	1 18S 27E K 1980S 1980W	6163	ACTIVE O	5/22/1959
155	30-015-21792	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #182	1 18S 27E K 1533S 2370W	6369	ACTIVE O	6/1/1976

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
156	30-015-00713	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #018D	1 18S 27E N 995S 1644W	6174	P&A O	9/27/2003 9/27/2003
157	30-015-26575	NAVAJO REFINING COMPANY WDW-3	1 18S 27E N 790S 2250W	10120	ACTIVE I	3/7/1991
158	30-015-20394	HUMBLE OIL & REFINING CO EMPIRE ABO FEDERAL NO. 5	1 18S 27E O 953S 2197E	6300	P&A O	4/9/1971 4/9/1971
159	30-015-00698	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #191	1 18S 27E O 660S 1980E	6365	ACTIVE S	11/8/1959
160	30-015-00699	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #020B	1 18S 27E P 940S 330E	6250	ACTIVE O	12/2/1961
161	30-015-26404	DEVON ENERGY PRODUCTION COMPANY L FEDERAL T #001	12 18S 27E A 660N 990E	10141	ACTIVE I	9/13/1990
162	30-015-25099	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #006	12 18S 27E H 1809N 990E	1652	ACTIVE O	9/11/1985
165	30-015-25997	EASTLAND OIL CO LAUREL STATE #001	7 18S 28E C 940N 1757W	1690	ACTIVE O	2/23/1987
166	30-015-25675	EASTLAND OIL CO LAUREL STATE #002	7 18S 28E E 940N 1757W	1690	ACTIVE O	11/10/1988
167	30-015-25236	MOREXCO INC STATE BY #001	7 18S 28E F 1980N 1980W	10400	ACTIVE O	6/10/1985
168	30-015-22636	DYAD PE PRE-ONGUARD WELL #213	7 18S 28E J 1950N 1300W		ABAN LOCATION O	
169	30-015-22635	DYAD PE PRE-ONGUARD WELL #212	8 18S 28E J 1900N 100W		ABAN LOCATION O	
170	30-015-24372	DYAD PE PRE-ONGUARD WELL #001	8 18S 28E J 1980S 990E		ABAN LOCATION O	
171	30-015-27636	PHILLIPS PETROLEUM CHALK BLUFF 6 STATE #002	7 18S 28E H 2310N 810E		ABAN LOCATION O	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
353	30-015-27286	MEWBOURNE OIL CO CHALK BLUFF 36 STATE #001	36 17S 27E M 660S 990W	10060	ACTIVE O	3/30/1993
354	30-015-24612	PRONGHORN MANAGEMENT CORP STATE M #001	36 17S 27E M 790S 990W	1451	P&A O	10/11/1983 4/21/2009
355	30-015-00676	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #017	36 17S 27E M 330N 990W	5797	ACTIVE O	
356	30-015-10184	ASPEN OIL INC STATE #006	36 17S 27E M 330S 920W	1343	ACTIVE O	
358	30-015-21623	GEORGE A CHASE JR & C SERVICE STATE #007	36 17S 27E M 360S 455W	1366	ACTIVE O	
359	30-015-00662	ACREY, B L & F D STATE NO. 2	36 17S 27E M 330S 330W	592	P&A O	10/15/1942 10/15/1942
595	30-015-02605	BP AMERICA PRODUCTION UNIT EMPIRE ABO UNIT NO. 27 E	5 18S 28E B 930N 2271E	6261	P&A O	3/30/1960 6/12/2009
748	30-015-00701	FAIRWAY RESOURCES OPERATING LLC SOUTH RED LAKE GRAYBURG UNIT 37 WIW	1 18S 27E D 330N 330W	1835	ACTIVE O	
748	30-015-00715	MCQUADRANGLE, LC SOUTH RED LAKE GRAYBURG UNIT #037	1 18S 27E D 330N 330W	1835	ACTIVE I	
749	30-015-00712	ARCO OIL & GAS EMPIRE ABO UNIT I NO. 17	1 18S 27E D 647N 667W	5900	P&A O	1/24/1987 1/24/1987
750		JONES BRAINARD	1 18S 27E E 1650N 330W	481	P&A O	5/10/1939 5/10/1939
751	30-015-00704	ARCO OIL & GAS EMPIRE ABO UNIT J NO. 17	1 18S 27E E 1980N 660W	5960	P&A O	3/26/1959 3/26/1959
752	30-015-00703	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #017A	1 18S 27E L 1980S 660W	6091	P&A O	5/22/1995 3/27/2009
753	30-015-22815	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #171	1 18S 27E M 670S 330W	6300	ACTIVE O	5/22/1979

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
754			1 18S 27E M		MISPLOT OF 756	
755	30-015-00714	VALLEY REFINING CO HILL #1	1 18S 27E N	2404	P&A	12/20/1943 12/20/1943
756	30-015-00705	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #017B	1 18S 27E M 990S 660W	6150	P&A O	6/25/1959 7/21/2004
757		BRAINARD & GUY STATE 2	2 18S 27E A 330N 610E	530	NO COMPL	1/31/1942 1/31/1942
758	30-015-00721	FAIRWAY RESOURCES OPERATING LLC SOUTH RED LAKE GRAYBURG UNIT #036	2 18S 27E A 330N 990E	1705	SHUT IN O	11/6/1947
765	30-015-00724	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #016B	2 18S 27E A 990N 330E	5920	ACTIVE O	
766	30-015-00737	FAIRWAY RESOURCES OPERATING LLC SOUTH RED LAKE GRAYBURG UNIT #038	2 18S 27E B 905N 1601E	1722	ACTIVE O	5/23/1948
772	30-015-00745	MACK ENERGY CORPORATION STATE H #001	2 18S 27E H 1980N 660E	6140	P&A O	3/7/2008 3/7/2008
773	30-015-00742	S&J OPERATING COMPANY SOUTH RED LAKE GRAYBURG UNIT 39 WIW	2 18S 27E H 1650N 990E	1742	P&A O	2/8/1991 2/8/1991
774	30-015-00740	MCQUADRANGLE, LC SOUTH RED LAKE GRAYBURG UNIT #040	2 18S 27E G 1650N 2197E	1707	P&A I	7/10/2002 7/10/2002
778		RUTTER & WILBANKS HUDSON #2	2 18S 27E G 2310N 1650E		O	1/1/1957
779	30-015-00741	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #015B	2 18S 27E G 2310N 1980E	5880	ACTIVE O	6/6/1959
781		MALCO REFINING CO STATE B-2	2 18S 27E J 2310S 2310E	4164	P&A O	1/1/1947 1/1/1947
785	30-015-00717	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #016	2 18S 27E I 1980S 660E	6114	ACTIVE O	2/6/1995

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
786	30-015-00716	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #015	2 18S 27E J 1980S 1830E	6100	ACTIVE O	3/23/1959
789	30-015-22896	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #143A	2 18S 27E K 1820S 2550W	6108	ACTIVE O	5/13/1979
791	30-015-22914	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #161	2 18S 27E I 1310S 590E	6225	ACTIVE O	9/13/1979
792			2 18S 27E O		MISPLOT OF 814	
793	30-015-22609	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #143	2 18S 27E N 1200S 1900W	6093	ACTIVE O	12/20/1978
795			2 18S 27E P		MISPLOT OF 765	
796	30-015-21544	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #151	2 18S 27E O 1110S 1322E	6285	T/A O	11/4/1975
797	30-015-22885	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #155	2 18S 27E O 1040S 2025E	6202	T/A O	5/1/1979
799	30-015-00722	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #016A	2 18S 27E P 660S 660E	6115	P&A O	1/20/1959 2/24/2009
800	30-015-22808	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #156	2 18S 27E O 600S 1330E	6225	P&A O	4/12/1979 2/5/2009
801	30-015-00731	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #015A	2 18S 27E O 660S 1980E	6220	P&A O	11/19/1958 2/11/2009
802	30-015-22669	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #154	2 18S 27E O 800S 2500E	6200	P&A O	12/4/1978 1/27/2009
805	30-015-22013	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #153	2 18S 27E O 90S 1456E	6303	P&A O	4/20/1977 10/30/2008
806	30-015-21825	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #152	2 18S 27E O 320S 2602E	6335	T/A O	6/17/1976

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
807	30-015-22608	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #142	2 18S 27E N 100S 1950W	6200	P&A (No Info on dates) O	
808	30-015-21807	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #132	2 18S 27E M 275S 1243W	6200	ACTIVE O	7/1/1976
812	30-015-00730	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #014	2 18S 27E N 660S 1980W	6112	ACTIVE O	10/21/1958
813	30-015-00720	BP AMERICA PRODUCTION COMPANY RIVERWOLF UNIT #004	2 18S 27E A 990N 1650E	5881	P&A O	10/21/1959 12/12/2008
814	30-015-22051	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #141A	2 18S 27E K 1370S 2445W	6203	ACTIVE O	5/17/1977
836	30-015-00869	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #016C	11 18S 27E A 330N 653E	6211	P&A O	10/25/2004 10/25/2004
837	30-015-22568	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #151B	11 18S 27E B 400N 1450E	6310	P&A O	8/16/2006 8/16/2006
838	30-015-22838	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #153B	11 18S 27E B 200N 1925E	6252	P&A O	5/6/1979 1/4/2009
839	30-015-00868	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #015C	11 18S 27E B 660N 1980E	6260	P&A O	7/16/2004 7/16/2004
840	30-015-22569	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #152B	11 18S 27E B 560N 2588E	6300	P&A O	8/23/1978 9/24/2008
841	30-015-22834	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #141B	11 18S 27E C 225N 2280W	6225	ACTIVE O	5/21/1979
842	30-015-00864	ARCO OIL & GAS EMPIRE ABO UNIT M NO. 14	11 18S 27E C 660N 1980W	6315	P&A O	9/5/1957 9/5/1957
843	30-015-22833	BP AMERICA PRODUCTION COMPANY EMPIRE ABO UNIT #133B	11 18S 27E D 450N 1175W	6225	ACTIVE O	5/23/1979
844	30-015-00867	ARCO OIL & GAS EMPIRE ABO UNIT M NO. 13	11 18S 27E D 660N 660W	6114	P&A O	4/26/1958 4/26/1958

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
846	30-015-22556	ARCO OIL & GAS EMPIRE ABO UNIT M NO. 131	11 18S 27E D 1100N 1200W	6325	P&A O	7/10/1978 7/10/1978
848	30-015-20510	AMOCO PRODUCTION CO MALCO S NO. 1	11 18S 27E F 1650N 1653W	10168	P&A O	10/16/1971 10/16/1971
849	30-015-00865	ARCO OIL & GAS EMPIRE ABO UNIT N NO. 14	11 18S 27E F 1650N 1980W	6208	P&A O	2/3/1961 2/3/1961
850	30-015-00866	ARCO OIL & GAS EMPIRE ABO UNIT N NO. 131	11 18S 27E E 1980N 660W	6120	P&A O	3/27/1958 3/27/1958
851	30-015-00870	AMOCO PRODUCTION CO SMITH-MCPHERSON NO. 1	11 18S 27E J 1980S 1980E	7270	P&A O	9/1/1956 9/1/1956
852	30-015-01201	OSCAR HOWARD AN ETZ #3	11 18S 27E N	1828	P&A	 4/15/2027
853	30-015-01202	OSCAR HOWARD AN ETZ #2	11 18S 27E O	1827	P&A	 2/4/2027
854	30.015-00863	B.R. POLK, JR. VICKERS #1	11 18S 27E N	1794	P&A	10/14/1949 10/14/1949
855	30-015-24857	CHESAPEAKE OPERATING INC FEDERAL DH GAS COM #001	11 18S 27E M 700S 990W	11915	ACTIVE G	5/18/1984
856	30-015-20535	ROBERT G COX FEDERAL EA 2	12 18S 27E D 330N 455W	6248	P&A O	8/7/1973 8/7/1973
857	30-015-00871	RHONDA OPERATING CO FEDERAL EA #001	12 18S 27E D 330N 330W	6253	P&A O	4/12/1994 4/12/1994
858	30-015-23115	RHONDA OPERATING CO FEDERAL EA NO. 3	12 18S 27E D 330N 380W	6295	D&A O	3/16/1980 3/16/1980
859	30-015-25738	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #009	12 18S 27E G 2310N 2310E	1586	ACTIVE O	4/25/1987
860	30-015-25270	BILL MILLER CHUKKA FEDERAL #001	12 18S 27E F 2310N 2310W	1600	ACTIVE O	4/23/1985

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
861	30-015-20894	NAVAJO REFINING COMPANY WDW #002	12 18S 27E E 1980N 660W	10372	ACTIVE I	7/18/1973
862	30-015-00874	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #007	12 18S 27E J 2310S 2355E	3664	ACTIVE O	6/29/1948
863	30-015-00872	MCKEE-JONES MAGRUDER NO. 1	12 18S 27E L 310S 990W	594	D&A O	 2/18/1943
864	30-015-25201	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #002	12 18S 27E K 1650S 1770W	1600	ACTIVE O	3/16/1985
865	30-015-25649	FRED POOL DRILLING CO COMSTOCK FEDERAL NO. 8	12 18S 27E L 1650S 990W	2000	D&A O	 10/10/1986
866	30-015-25545	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #003	12 18S 27E M 990S 990W	1530	ACTIVE O	5/19/1986
867	30.015-00873	R.E. McKEE ET AL MAGRUDER #2	12 18S 27E M	2510	P&A	2/27/1945 2/27/1945
868	30-015-26017	EASTLAND OIL CO COMSTOCK FEDERAL #010	12 18S 27E N 990S 1650W	2040	P&A O	1/23/2003 1/23/2003
869	30-015-25100	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #001	12 18S 27E N 330S 1650W	2400	ACTIVE O	12/10/1984
870	30-015-25202	HARLOW ENTERPRISES LLC COMSTOCK FEDERAL #005	12 18S 27E O 330S 2310E	1625	ACTIVE O	4/19/1985
871	30-015-06171	PILCHER OIL & GAS MICHAEL CRONIN NO. 3	12 18S 27E I 1069S 251E	2200	P&A O	 5/20/2026
872		PILCHER OIL & GAS MICHAEL CRONIN #1	12 18S 27E P	2002	P&A	2/15/1932 2/15/1932
873	30-015-00875	CITIES SERVICE OIL CO MAGRUDER NO. B-4	12 18S 27E P 330S 330E	2000	P&A O	7/30/1952 7/30/1952
874	30-015-00876	ROBERT E MCKEE MAGRUDER NO. 5	12 18S 27E P 100S 500E	1994	P&A O	2/8/1954 2/8/1954

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875	30-015-06170	PILCHER OIL & GAS MICHAEL CRONIN NO. 2	12 18S 27E P 200S 200E	2004	P&A O	 2/22/2026
876	30-015-01200	HASSENFUSH-DONNELLY STATE NO. 1	13 18S 27E A 0 0	2030	P&A O	 1/1/2026
877	30-015-06137	EASTLAND OIL CO STATE NO. 2	13 18S 27E A 250N 990E	2696	D&A O	 1/1/2026
878	30-015-25394	BILL MILLER ARTESIA STATE #002	13 18S 27E C 330N 2310W	1613	ACTIVE O	9/28/1985
879	30-015-25241	BILL MILLER ARTESIA STATE #001	13 18S 27E C 330N 1650W	1575	ACTIVE O	4/13/1985
880	30-015-00884	DALE RESLER STATE NO. 3	13 18S 27E C 990N 1650W	2047	P&A O	1/29/1945 1/29/1945
881	30-015-25370	CBS OPERATING CORP ARTESIA STATE UNIT #002A	13 18S 27E D 480N 940W	1608	ACTIVE O	8/27/1985
882	30-015-00883	CBS OPERATING CORP ARTESIA STATE UNIT #001	13 18S 27E D 990N 990W	1950	ACTIVE O	12/11/1944
883	30-015-00880	DALE RESLER - JONES STATE NO. 1	13 18S 27E E 1650N 990W	2353	P&A O	1/26/1945 1/26/1945
884	30-015-24881	DAVID G HAMMOND ANADARKO 13 FEDERAL #001	13 18S 27E F 1880N 1830W	3020	ACTIVE O	6/18/1984
885	30-015-00888	RALPH NIX & JERRY CURTIS PAGE NO. 1	13 18S 27E F 1980N 1650W	2000	P&A O	11/28/1954 11/28/1954
886	30-015-00879	DALE RESLER JONES-GOVT NO. 1	13 18S 27E F 2310N 1650W	2000	D&A O	3/14/1945 3/14/1945
888	30-015-25078	DICKSON PETROLEUM, INC ANADARKO 13 FEDERAL NO. 1	13 18S 27E G 1724N 2279E	2150	D&A O	12/30/1984 12/30/1984
895	30-015-00891	ANADARKO PETROLEUM CORP ARTESIA STATE UNIT TRACT 4 NO. 1	14 18S 27E A 990N 330E	2060	P&A O	6/30/1944 6/30/1944

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
896	30-015-00893	RESLER STATE NO. 1	14 18S 27E G 1650N 1650E	2375	D&A O	1/1/1900 1/1/1900
897	30-015-00895	CBS OPERATING CORP ARTESIA STATE UNIT #001B	14 18S 27E H 1650N 330E	1888	ACTIVE O	2/8/1945
901	30-015-00695	WILLIAM & EDWARD HUDSON HILL NO. 1	1 18S 27E L 1650S 330W	1763	D&A O	6/18/1948 6/18/1948
910	30-015-00744	COMPTON-SMITH STATE 1	2 18S 27E J 2310S 1640E	1080	P&A O	
911	30-015-31123	LIME ROCK RESOURCES A, LP NO BLUFF 36 STATE COM #002	36 17S 27E H 1980N 760E	10050	ACTIVE G	
912	30-015-31036	GEORGE A CHASE JR & C SERVICE GATES STATE #003	36 17S 27E H 2310N 990E	614	ACTIVE O	
916	30-015-31592	ROJO GRANDE COMPANY LLC RAMAPO #007	36 17S 27E N 330S 2310E	612	P&A O	12/21/2001 12/21/2001
917	30-015-30784	VANGUARD OPERATING LLC NW STATE #012	31 17S 28E A 330N 480E	3300	ACTIVE O	
918	30-015-30893	VANGUARD OPERATING LLC NW STATE #028	31 17S 28E A 973N 959E	2808	ACTIVE O	
919	30-015-32162	VANGUARD OPERATING LLC ENRON STATE #004	31 17S 28E D 460N 990W	3460	ACTIVE O	4/3/2003
920	30-015-30783	VANGUARD OPERATING LLC NW STATE #011	31 17S 28E H 1650N 330E	3205	ACTIVE O	
921	30-015-30849	VANGUARD OPERATING LLC NW STATE #009	31 17S 28E I 2310S 270E	3195	ACTIVE O	
922	30-015-30760	VANGUARD OPERATING LLC NW STATE #010	31 17S 28E P 735S 330E	3210	ACTIVE O	
923	30-015-31920	VANGUARD OPERATING LLC ENRON STATE #002	32 17S 28E D 990N 990W	4030	ACTIVE O	

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924	30-015-30781	LIME ROCK RESOURCES A, LP NW STATE #005	32 17S 28E K 1900S 2146W	3190	ACTIVE I	
925	30-015-30777	VANGUARD OPERATING LLC NW STATE #006	32 17S 28E L 2310S 990W	3204	ACTIVE O	
926	30-015-30685	VANGUARD OPERATING LLC NW STATE #007	32 17S 28E M 990S 990W	3220	ACTIVE O	
927	30-015-30815	VANGUARD OPERATING LLC NW STATE #008	32 17S 28E N 1090S 2126W	3310	ACTIVE I	
928	30-015-32310	MARBOB ENERGY CORP AAO FEDERAL #004	1 18S 27E A 990N 990E	4000	ACTIVE O	5/4/2004
929	30-015-32309	MARBOB ENERGY CORP AAO FEDERAL #003	1 18S 27E B 330N 1690E	4125	ACTIVE O	4/10/2003
930	30-015-32308	MARBOB ENERGY CORP AAO FEDERAL #002	1 18S 27E C 430N 2310W	4150	ACTIVE O	9/19/2002
931	30-015-32307	MARBOB ENERGY CORP AAO FEDERAL #001	1 18S 27E D 330N 990W	3851	ACTIVE O	12/10/2002
932	30-015-22816	ARCO OIL & GAS EMPIRE ABO UNIT L #192	1 18S 27E O 1120S 1440E	6350	ABAN LOCATION O	6/28/1980 6/23/1980
933	30-015-20388	ARCO OIL & GAS EMPIRE ABO #5	1 18S 27E N 990S 2297E	6300	SAME AS 158 O	 12/31/9999
934	30-015-27719	MEWBOURNE OIL CO CHALK BLUFF 12 FED #001	12 18S 27E 1650S 990E		ABAN LOCATION G	
935	30-015-27437	YATES PETROLEUM CORPORATION BEAUREGARD ANP STATE COM #001	14 18S 27E B 660N 1980E	0	ABAN LOCATION G	
936	30-015-31086	MARBOB ENERGY CORP LP STATE #001	5 18S 28E E 1650N 990W	4503	P&A O	3/11/2008 3/11/2008
937	30-015-31109	MARBOB ENERGY CORP LP STATE #002	5 18S 28E E 2301N 230W	0	PROPOSED O	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
938	30-015-30785	LIME ROCK RESOURCES A, LP NW STATE #015	6 18S 28E A 430N 330E	3225	ACTIVE O	
939	30-015-00264	BARNEY COCKBURN CAPITAL STATE NO. 1	6 18S 28E J 2310S 2310E	2095	SAME AS 114 O	5/23/1979
940	30-015-31087	MARBOB ENERGY CORP LP STATE #003	6 18S 28E M 990S 330W	4466	P&A O	7/15/2000 3/17/2008
941	30-015-31088	MARBOB ENERGY CORP LP STATE #004	6 18S 28E M 330S 990W	0	PROPOSED O	
942	30-015-06250	BP AMERICA PRODUCTION COMPANY	6 18S 28E O 470S 2170E	0	SAME AS 89 O	
943	30-015-31319	EASTLAND OIL CO LAUREL STATE #003	7 18S 28E E 2310N 330W	1630	ACTIVE O	1/31/2001
944	30-015-26575	NAVAJO REFINING COMPANY WDW-3 (ORIGINAL LOC.)	6 18S 28E D 778N 995W		ACTIVE I	
945	30-015-32959	MARBOB ENERGY CORP AAO FEDERAL #005	1 18S 27E E 1650N 875W	3900	ACTIVE O	10/12/2004
946	30-015-33473	MARBOB ENERGY CORP AAO FEDERAL #007	1 18S 27E G 1750N 1650S	4100	ACTIVE O	4/4/2005
947	30-015-33784	MARBOB ENERGY CORP AAO FEDERAL #008	1 18S 27E H 1650N 330W	4310	ACTIVE O	2/25/2005
948	30-015-34071	MARBOB ENERGY CORP AAO FEDERAL #006	1 18S 27E F 2169N 1963W	4000	ACTIVE O	8/5/2005
949	30-015-34387	MARBOB ENERGY CORP AAO FEDERAL #009	1 18S 27E L 1980S 630W	3950	ACTIVE O	1/17/2006
950	30-015-34555	MARBOB ENERGY CORP AAO FEDERAL #011	1 18S 27E M 890S 660W	4100	ACTIVE O	3/9/2006
951	30-015-34576	MARBOB ENERGY CORP AAO FEDERAL #010	1 18S 27E K 2060S 2160W	4000	ACTIVE O	10/26/2006

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952	30-015-34998	MARBOB ENERGY CORP AAO FEDERAL #012	1 18S 27E N 890S 1650W	4075	ACTIVE O	9/21/2006
953	30-015-34028	BP AMERICA PRODUCTION COMPANY SLIDER 6 STATE NO. 001	6 18S 28E G 2285N 1366E	10433	P&A O	12/17/2006 12/17/2006
954	30-015-35050	VANGUARD OPERATING LLC ENRON STATE NO 012	32 17S 28E D 330N 500W	3810	ACTIVE O	12/21/2006
955	30-015-36939	YATES PETROLEUM CORP VIOLET BIV STATE COM #1	14 18S 27E A 660N 990E	10500	EXT PERMIT TO DRILL O	2/20/2009
956	30-015-33994	EDGE PETROLEUM OPERATING COMPANY, RED LAKE 36 A STATE #2	36 17S 27E A 915N 420E	3650	ACTIVE O	4/20/2005
957	30-015-36116	LEGACY RESERVES OPERATING LP SOUTH RED LAKE UNIT II #57	36 17S 27E G 2305N 1650E	2100	ACTIVE O	6/6/2008
958	30-015-32946	MARBOB ENERGY CORPORATION SCBP STATE #1	2 18S 27E J 2210S 1650E	3880	ACTIVE O	4/26/2005
959	30-015-35814	MACK ENERGY CORPORATION STATE H NO 2	2 18S 27E H 2063N 441E	7545	ACTIVE O	1/11/2008
960	30-015-36343	GEORGE A CHASE JR DBA G AND C SERVIC MALCO STATE NO. 002	31 17S 28E G 1650N 2310E	633	ACTIVE O	7/9/2008
961	30-015-36978	VANGUARD OPERATING LLC ENRON STATE NO. 015	31 17S 28E D 990N 330W	3700	ACTIVE O	7/3/2009
962	30-015-36554	VANGUARD OPERATING LLC NW STATE NO. 029	32 17S 28E L 1770S 550W	3450	ACTIVE O	1/30/2009
963	30-015-36989	VANGUARD OPERATING LLC NW STATE NO. 030	32 17S 28E K 1630S 1710W	3405	ACTIVE O	7/14/2009
964	30-015-37057	VANGUARD OPERATING LLC NW STATE NO. 031	32 17S 28E N 330S 1750W	3500	ACTIVE O	7/28/2009
965	30-015-37058	VANGUARD OPERATING LLC NW STATE NO. 032	32 17S 28E M 330S 330W	3425	ACTIVE O	8/23/2009

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
966	30-015-37428	G&C SERVICE MALCO STATE NO. 3	31 17S 28E G 1980N 1980E	650	ACTIVE O	2/10/2010
967	30-015-38203	COG OPERATING LLC MAPLE STATE 008	30 17S 28E N 330S 990W	4750	PERMIT TO DRILL O	
968	30-015-39029	G AND C SERVICE CONKLIN STATE NO. 1-Y	36 17S 27E G 2210N 2310E	4850	NEW DRILL	
969	30-015-39321	COG OPERATING LLC BIG BOY STATE NO. 1	36 17S 27E M 990S 890W		PERMIT TO DRILL	
970	30-015-39322	COG OPERATING LLC BIG BOY STATE NO. 3	36 17S 27E M 840S 425W		PERMIT TO DRILL	
971	30-015-39323	COG OPERATING LLC BIG BOY STATE NO. 5	36 17S 27E O 870S 1560E		PERMIT TO DRILL	
972	30-015-39324	COG OPERATING LLC BIG BOY STATE NO. 6	36 17S 27E O 480S 2210E		PERMIT TO DRILL	
973	30-015-39325	COG OPERATING LLC BIG BOY STATE NO. 7	36 17S 27E O 990S 2210E		PERMIT TO DRILL	
974	30-015-39326	COG OPERATING LLC BIG BOY STATE NO. 8	36 17S 27E O 275S 1560E		PERMIT TO DRILL	
975	30-015-39401	APACHE CORP EMPIRE ABO UNIT NO. 417	36 17S 27E P 1110S 630E		PERMIT TO DRILL	
976	30-015-39009	APACHE CORP EMPIRE ABO UNIT NO. 415	2 18S 27E G 1650N 2430E		PERMIT TO DRILL	
977	30-015-39066	APACHE CORP EMPIRE ABO UNIT NO. 416	2 18S 27E L 2551S 1170W		PERMIT TO DRILL	
978	30-015-38234	VANGUARD OPERATING LLC ANTHONY NO. 2	30 17S 28E P 430S 800E	4823	ACTIVE	
979	30-015-39299	COG OPERATING LLC MAPLE STATE NO. 5	30 17S 28E M 990S 990W		PERMIT TO DRILL	

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980	30-015-39300	COG OPERATING LLC MAPLE STATE NO. 6	30 17S 28E M 330S 330W		PERMIT TO DRILL	
981	30-015-38512	LIME ROCK RESOURCES ENRON STATE NO. 16	30 17S 28E D 990N 940W	3658	ACTIVE	
982	30-015-39004	APACHE CORP EMPIRE ABO UNIT NO. 401	31 17S 28E P 150S 1300E		PERMIT TO DRILL	
983	30-015-39011	APACHE CORP EMPIRE ABO UNIT NO. 419	31 17S 28E O 1190S 1320E		PERMIT TO DRILL	
984	30-015-39020	APACHE CORP EMPIRE ABO UNIT NO. 408	31 17S 28E O 140S 2560E		T&A	
985	30-015-38513	VANGUARD OPERATING LLC JEFFERS 32 STATE NO. 3	32 17S 28E J 2310S 2032E	5093	ACTIVE	
986	30-015-39006	APACHE CORP EMPIRE ABO UNIT NO. 407	32 17S 28E J 2400S 2450E		PERMIT TO DRILL	
987	30-015-39007	APACHE CORP EMPIRE ABO UNIT NO. 409	32 17S 28E M 70S 100W		PERMIT TO DRILL	
988	30-015-39064	APACHE CORP EMPIRE ABO UNIT NO. 403	32 17S 28E O 1175S 1310E		PERMIT TO DRILL	
989	30-015-39008	APACHE CORP EMPIRE ABO UNIT NO. 410	6 18S 28E D 160N 1300W		PERMIT TO DRILL	
990	30-015-39021	APACHE CORP EMPIRE ABO UNIT NO. 411	6 18S 28E D 40N 145W		PERMIT TO DRILL	
991	30-015-32946	APACHE CORP SCBP STATE NO. 001	2 18S 27E J 2210S 1650E	3880	ACTIVE	
992	30-015-00715	LEGACY RESERVES OPERATING LP SOUTH RED LAKE UNIT NO. 37	1 18S 27E D 330N 330W		ACTIVE	
993	30-015-32307	APACHE CORP AAO FEDERAL NO. 1	1 18S 27E 4 330N 990W		ACTIVE	

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994	30-015-32959	APACHE CORP AAO FEDERAL NO. 5	1 18S 27E E 1650N 875W		ACTIVE	
995	30-015-33473	APACHE CORP AAO FEDERAL NO. 7	1 18S 27E G 1750N 1650E		ACTIVE	
996	30-015-33784	APACHE CORP AAO FEDERAL NO. 8	1 18S 27E H 1650N 330E		ACTIVE	
997	30-015-34071	APACHE CORP AAO FEDERAL NO. 6	1 18S 27E F 2169N 1963W		ACTIVE	
998	30-015-34555	APACHE CORP AAO FEDERAL NO. 11	1 18S 27E M 890S 660W		ACTIVE	
999	30-015-34576	APACHE CORP AAO FEDERAL NO. 10	1 18S 27E K 2060S 2160W		ACTIVE	
1005	30-015-40428	LRE OPERATING LLC BIG BOY STATE NO 2	36 17S 28E M 200S 485W	4934	ACTIVE	
1023	30-015-39927	LRE OPERATING LLC AB STATE 647	32 17S 28E K 1750S 1765W	5016	ACTIVE	
1024	30-015-40339	VANGUARD OPERATING LLC ENRON STATE 18	32 17S 28E D 990N 330W	4250	ACTIVE	
1025	30-015-00643	LEGACY RESERVES OPERATING LLC SOUTH RED LAKE GRAYBURG UNIT NO 26	35 17S 27E O 990S 2310E		ACTIVE	
1026	30-015-37783	TARCO ENERGY LC RUSSELL C 003	35 17S 27E O 990S 2225E		ACTIVE	
1027	30-015-00644	LEGACY RESERVES OPERATING LP SOUTH RED LAKE GRABURG UNIT 31	35 17S 27E N 330S 2310W		ACTIVE	
1028	30-015-20104	LEGACY RESERVES OPERATING LP SOUTH RED LAKE GRAYBURG UNIT 41	35 17S 27E P 990S 990E		ACTIVE	
1029	30-015-34626	LRE OPERATING LLC JEFFERS 36 STATE #4t	36 17S 27E M 935N 2260E	4000	ACTIVE	

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1030	30-015-41829	LRE OPERATING LLC ENRON FEDERAL NO 18	25 17S 27E O 985S 2310E	3157	ACTIVE	
1031	30-015-41890	VANGUARD OPERATING LLC WILLIAMS A FEDERAL NO 12	29 17S 28E N 330S 2200N	3700	ACTIVE	
1032	30-015-40807	LIME ROCK RESOURCES A, LP LOGAN B "35" N FEDERAL #18	35 17S 27E N 330N 2310W	4000	ACTIVE	
1033	30-015-40808	LRE OPERATING LLC LOGAN 35 P FEDERAL #19	35 17S 27E P 970S 990E	4000	ACTIVE	
1034	30-015-41435	LIME ROCK RESOURCES A LP LOGAN 35 FEDERAL 10	35 17S 27E O 720S 1770E	4000	ACTIVE	
1035	30-015-42003	APACHE CORPORATION SB STATE 004	2 18S 27E E 2515N 800W	4114	ACTIVE	
1036	30-015-42002	APACHE COPORATION SB STATE 002	2 18S 27E E 1900N 990W	4115	ACTIVE	
1037	30-015-36979	VANGUARD OPERATING LLC ENRON STATE NO 14	32 17S 28E C 990N 2035W	4205	ACTIVE	
1038	30-015-41833	VANGUARD OPERATING LLC ENRON STATE 19	32 17S 28E C 990N 1700W	4206	ACTIVE	
1039	30-015-39996	VANGUARD OPERATING LLC ENRON STATE 17	32 17S 28E C 230N 2420W	4215	ACTIVE	
1040	30-015-41511	APACHE CORP AB State 647 016	32 17S 28E N 330S 2365W	4297	ACTIVE	
1041	30-015-41498	APACHE CORP Ab State 647 014	32 17S 28E M 330S 1090W	4300	ACTIVE	
1042	30-015-41493	APACHE CORP Ab State 647 009	32 17S 28E N 1080S 2535W	4300	ACTIVE	
1043	30-015-41491	APACHE CORP Ab State 647 007	32 17S 28E L 1650S 950W	4300	ACTIVE	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1044	30-015-41492	APACHE CORP Ab State 647 008	32 17S 28E K 1375S 2320W	4323	ACTIVE	
1045	30-015-40783	LIME ROCK RESOURCES A LP LOGAN 2c STATE NO. 4	2 18S 27E C 990N 1500W	4776	ACTIVE	
1046	30-015-38420	COG OPERATING LLC KIOWA STATE	36 17S 27E G 1460N 1539E	4873	ACTIVE	
1048	30-015-41500	APACHE CORP Ab State 647 002	32 17S 28E K 2355S 2600W	5013	ACTIVE	
1049	30-015-41501	APACHE CORP Ab State 647 003	32 17S 28E K 2370S 1650W	5027	ACTIVE	
1050	30-015-41505	APACHE CORP Ab State 647 004	32 17S 28E L 2250S 1185W	5046	ACTIVE	
1051	30-015-41502	APACHE CORP Ab State 647 005	32 17S 28E L 2310S 330W	5060	ACTIVE	
1052	30-015-41504	APACHE CORP Ab State 647 15	32 17S 28E N 330S 1650W	5063	ACTIVE	
1053	30-015-41497	APACHE CORP Ab State 647 013	32 17S 28E M 220S 350W	5065	ACTIVE	
1054	30-015-41503	APACHE CORP Ab State 647 006	32 17S 28E L 1730S 430W	5065	ACTIVE	
1055	30-015-41495	APACHE CORP Ab State 647 011	32 17S 28E M 920S 960W	5070	ACTIVE	
1056	30-015-41494	APACHE CORP Ab State 647 010	32 17S 28E N 1140S 1650W	5076	ACTIVE	
1057	30-015-41496	APACHE CORP Ab State 647 012	32 17S 28E M 910S 930W	5080	ACTIVE	
1058	30-015-40679	LIME ROCK RESOURCES A LP BLAKE STATE NO. 4	2 18S 27E B 968N 2300E	530	ACTIVE	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1059	30-015-40621	TARCO ENERGY LC BRAD STATE NO. 4	2 18S 27E C 968N 1650W	550	ACTIVE	
1060	30-015-31530	VANGUARD OPERATING LLC ENRON STATE NO. 1	32 17S 28E C 530N 1650W	4000	ACTIVE	
1061	30-015-00681	LEGACY RESERVES OPERATING LP SOUTH RED LAKE GRAYBURG UNIT 027	36 17S 27E M 990S 330W	1200	PLUGGED	
1062	30-015-22526	DEVON ENERGY LOGAN 2c STATE #3	2 18S 27E I 530N 2310W		ACTIVE	
1063	30-015-22536	APACHE CORP EMPIRE ABO UNIT "I" 272a	5 18S 28E B 1300N 2345E		T/A	
1064	30-015-32070	APACHE CORP Bb State Com #1	2 18S 27E I 660S 990W		T/A	
1065	30-015-32899	APACHE CORP Bm State #1	2 18S 27E I 2310S 2310W		T/A	
1066	30-015-32900	APACHE CORP Tdf State #2	2 18S 27E I 1650N 2305W		T/A	
1068	30-015-36513	VANGUARD OPERATING LLC WILLIAMS A FEDERAL NO. 8	29 17S 28E N 1090S 1550W	3150	ACTIVE	
1069	30-015-33232	VANGUARD OPERATING LLC WILLIAMS A FEDERAL NO. 5	29 17S 28E M 690S 530W	3250	RECOMPLETED	
1070	30-015-40480	VANGUARD OPERATING LLC WILLIAMS A FEDERAL NO 10	29 17S 28E M 600S 645W	3800	ACTIVE	
1071	30-015-40677	TARCO ENERGY LC BLAKE STATE NO 1	2 18S 27E B 380N 1650E		PERMIT TO DRILL	
1072	30-015-40678	TARCO ENERGY LC BLAKE STATE NO 2	2 18S 27E B 330N 2300E		PERMIT TO DRILL	
1073	30-015-41766	APACHE CORP LIBBY STATE No. 001	5 18S 28E F 1910N 1505W		PERMIT TO DRILL	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1074	30-015-41767	APACHE CORP LIBBY STATE NO. 002	5 18S 28E F 1570N 2245W		PERMIT TO DRILL	
1075	30-015-41768	APACHE CORP LIBBY STATE NO. 003	5 18S 28E F 1570N 2245W		PERMIT TO DRILL	
1076	30-015-41770	APACHE CORP T REX STATE 001	31 17S 28E B 330N 2270E		PERMIT TO DRILL	
1077	30-015-41771	APACHE CORP T REX STATE 002	31 17S 28E B 575N 1650E		PERMIT TO DRILL	
1078	30-015-41772	APACHE CORP T REX STATE 003	31 17S 28E B 875N 2430E		PERMIT TO DRILL	
1079	30-015-41774	APACHE CORP T REX STATE 004	31 17S 28E B 890N 1750E		PERMIT TO DRILL	
1080	30-015-41892	VANGUARD OPERATING LLC WILLIAMS A FEDERAL 15	29 17S 28E M 330S 975W		ACTIVE	
1081	30-015-41959	APACHE CORP BM State 002	2 18S 27E K 2310S 1750W		PERMIT TO DRILL	
1082	30-015-42024	APACHE CORP AAO FEDERAL #14	1 18S 27E 1 126N 141E		PERMIT TO DRILL	
1083	30-015-42025	APACHE CORP AAO FEDERAL #15	1 18S 27E 1 1130N 2408E		PERMIT TO DRILL	
1084	30-015-42026	APACHE CORP AAO FEDERAL #16	1 18S 27E 1 1305N 2455W		PERMIT TO DRILL	
1085	30-015-42029	APACHE CORP AAO FEDERAL #17	1 18S 27E 1 1650N 865E		PERMIT TO DRILL	
1086	30-015-42035	APACHE CORP AAO FEDERAL #18	1 18S 27E 1 2310N 1650E		PERMIT TO DRILL	
1087	30-015-42036	APACHE CORP AAO FEDERAL #20	1 18S 27E 1 2188N 909W		PERMIT TO DRILL	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1088	30-015-42051	APACHE CORP AAO FEDERAL #19	1 18S 27E 1 2310N 2310W		PERMIT TO DRILL	
1089	30-015-42116	VANGUARD OPERATING LLC WILLIAMS A FEDERAL 16	29 17S 28E M 990S 2160W		ACTIVE	
1090	30-015-42121	TARCO ENERGY LLC BRADE STATE NO. 5	2 18S 27E C 658N 1984W		PERMIT TO DRILL	
1091	30-015-42156	VANGUARD OPERATING LLC ENRON STATE 21	32 17S 28E D 385N 900W		ACTIVE	
1092	30-015-42334	APACHE CORP AAO FEDERAL #21	1 18S 27E 1 1005N 1630W		PERMIT TO DRILL	
1093	30-015-42335	APACHE CORP AAO FEDERAL #22	1 18S 27E 1 790N 330W		PERMIT TO DRILL	
1094	30-015-42336	APACHE CORP AAO FEDERAL #23	1 18S 27E 1 2265N 330E		PERMIT TO DRILL	
1095	30-015-42337	APACHE CORP AAO FEDERAL #24	1 18S 27E 1 984N 243E		PERMIT TO DRILL	
1096	30-015-42338	APACHE CORP AAO FEDERAL #26	1 18S 27E 1 2270S 1650W		PERMIT TO DRILL	
1097	30-015-42339	APACHE CORP AAO FEDERAL #29	1 18S 27E 1 360S 990W		PERMIT TO DRILL	
1098	30-015-42358	APACHE CORP AAO FEDERAL #28	1 18S 27E 1 183S 2497W		PERMIT TO DRILL	
1099	30-015-42359	APACHE CORP AAO FEDERAL #27	1 18S 27E 1 1960S 2063W		PERMIT TO DRILL	
1100	30-015-42360	APACHE CORP AAO FEDERAL #30	1 18S 27E 1 1261S 281W		PERMIT TO DRILL	
1101	30-015-42361	APACHE CORP AAO FEDERAL #25	1 18S 27E 1 2000S 1022W		PERMIT TO DRILL	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1102	30-015-42372	VANGUARD OPERATING LLC ENRON STATE #20	31 17S 28E D 330N 430W		ACTIVE	
1103	30-015-42555	APACHE CORP OUTLAW STATE #005	29 17S 28E O 330S 2310E		ACTIVE	
1104	30-015-42863	APACHE CORP JACKRABBIT STATE #004	32 17S 28E B 330S 2310E		PERMIT TO DRILL	
1105	30-015-42864	APACHE CORP JACKRABBIT STATE #005	32 17S 28E B 1010N 2540E		PERMIT TO DRILL	
1106	30-015-42985	APACHE CORP JACKRABBIT STATE #012	32 17S 28E G 1470N 2405E		PERMIT TO DRILL	
1107	30-015-42986	APACHE CORP JACKRABBIT STATE #013	32 17S 28E G 2460N 2280E		PERMIT TO DRILL	
1108	30-015-42726	VANGUARD OPERATING LLC STALEY STATE #029	30 17S 28E O 505S 2140E		ACTIVE	
1109	30-015-40983	VANGUARD OPERATING LLC STALEY STATE #020	30 17S 28E O 330S 1650E		ACTIVE	
1110	30-015-42597	APACHE CORP RANGER STATE #001	31 17S 28E A 570N 250E		PERMIT TO DRILL	
1111	30-015-42598	APACHE CORP RANGER STATE #002	31 17S 28E A 445N 1090E		PERMIT TO DRILL	
1113	30-015-42599	APACHE CORP RANGER STATE #001	31 17S 28E B 905N 1385E		PERMIT TO DRILL	
1114	30-015-42600	APACHE CORP RANGER STATE #004	31 17S 28E A 645N 250E		PERMIT TO DRILL	
1115	30-015-42673	APACHE CORP RANGER STATE #006	31 17S 28E H 1650N 990E		PERMIT TO DRILL	
1117	30-015-42674	APACHE CORP RANGER STATE #007	31 17S 28E H 2310N 990E		PERMIT TO DRILL	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1118	30-015-42675	APACHE CORP RANGER STATE #008	31 17S 28E H 1875N 110E		PERMIT TO DRILL	
1119	30-015-42677	APACHE CORP RANGER STATE #010	31 17S 28E I 2310S 1130E		PERMIT TO DRILL	
1120	30-015-42676	APACHE CORP RANGER STATE #009	31 17S 28E H 2520N 195E		PERMIT TO DRILL	
1121	30-015-42678	APACHE CORP RANGER STATE #011	31 17S 28E I 1535S 760E		PERMIT TO DRILL	
1122	30-015-42679	APACHE CORP RANGER STATE #012	31 17S 28E I 1760S 245E		PERMIT TO DRILL	
1123	30-015-42680	APACHE CORP RANGER STATE #013	31 17S 28E I 1710S 245E		PERMIT TO DRILL	
1124	30-015-42681	APACHE CORP RANGER STATE #014	16 17S 28E P 225S 1300E		PERMIT TO DRILL	
1125	30-015-42806	APACHE CORP RANGER STATE #016	31 17S 28E P 245S 90E		NEW	
1126	30-015-42682	APACHE CORP RANGER STATE #015	31 17S 28E P 260S 1250E		PERMIT TO DRILL	
1127	30-015-42602	LRE OPERATING LLC JEFFERS 36 STATE #005	36 17S 27E B 330N 2210E		PERMIT TO DRILL	
1128	30-015-42899	LRE OPERATING LLC JEFFERS 36 STATE #006	36 17S 27E B 890N 1655E		PERMIT TO DRILL	
1129	30-015-42027	APACHE CORP AAO FEDERAL #017	1 18S 27E H 1650N 865E		PERMIT TO DRILL	
1130	30-015-42549	APACHE CORP AAO FEDERAL SWD #001	1 18S 27E G 2470N 2380E		PERMIT TO DRILL	
1131	30-015-25270	BILL L MILLER CHUKKA FEDERAL #001	12 18S 27E F 2310N 2310W		PERMIT TO DRILL	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1132	30-015-36252	VANGUARD OPERATING LLC Staley State #004	30 17S 28E N 990S 1980W		ACTIVE	
1133	30-015-37691	VANGUARD OPERATING LLC Anthoney #1	30 17S 28E P 1050S 330E		ACTIVE	
1134	30-015-40028	LRE Operating LLC Anthoney State #4	30 17S 28E P 540S 837E		RECOMPLETE	
1135	30-015-40338	VANGUARD OPERTING LLC Staley State #016	30 17S 28E O 990S 2310E		ACTIVE	
1136	30-015-41065	LRE Operating LLC Staley State #24	30 17S 28E N 990S 2335W		RECOMPLETE	
1137	30-015-40723	Lime Rock Resources II-A LP Logan 2C State #4	30 18S 28E C 990N 1500W		COMPLETED	
1138	30-015-43066	Lime Rock Resources II-A LP Logan B 35 N Federal 24	30 17S 27E N 870S 1640W		PERMIT TO DRILL	
1139	30-015-43252	Lime Rock Resources II-A LP Logan 35 O Federal 22	30 17S 27E O 720S 1670E		PERMIT TO DRILL	
1140	30-015-42556	Apache Corporation The Outlaw State #006	30 17S 28E O 990S 1650E		COMPLETED	
1141	30-015-42557	Apache Corporation The Outlaw State #007	30 17S 28E O 330S 1650E		COMPLETED	
1142	30-015-42558	Apache Corporation The Outlaw State #008	30 17S 28E O 990S 2310E		COMPLETED	
1143	30-015-42725	VANGUARD OPERATING LLC STALEY STATE #28	30 17S 28E O 685S 1630E		ACTIVE	
1144	30-015-42727	VANGUARD OPERATING LLC STALEY STATE #30	30 17S 28E O 850S 1680W		ACTIVE	
1145	30-015-42601	APACE CORPORATION RANGER STATE #005	30 17S 28E H 1825N 110E		PERMIT TO DRILL	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1146	30-015-42984	APACHE CORPORATION JACK RABBIT STATE #11	30 17S 28E G 1535N 1680E		PERMIT TO DRILL	
1147	30-015-32554	VANGUARD OPERATING LLC WILLIAMS A FEDERAL #001Z	29 17S 28E N 590S 2185W		ACTIVE	
1148	30-015-42556	APACHE CORPORATION OUTLAW STATE #006	29 17S 28E O 990S 1650E		ACTIVE	
1149	30-015-42557	APACHE CORPORATION OUTLAW STATE #007	29 17S 28E O 330S 1650E		ACTIVE	
1150	30-015-42558	APACHE CORPORATION OUTLAW STATE #008	29 17S 28E O 990S 2310E		ACTIVE	
1151	30-015-31285	VANGUARD OPERATING LLC STALEY STATE #002	30 17S 28E O 890S 1650E		ACTIVE	
1152	30-015-36564	VANGUARD OPERATING LLC STALEY STATE #009	30 17S 28E O 330S 2210E		ACTIVE	
1153	30-015-37673	VANGUARD OPERATING LLC STALEY STATE #012	30 17S 28E N 330S 1650W		ACTIVE	
1154	30-015-39638	VANGUARD OPERATING LLC ANTHONEY STATE #003	30 17S 28E P 412S 679E		ACTIVE	
1155	30-015-40026	VANGUARD OPERATING LLC STALEY STATE #017	30 17S 28E N 330S 2410W		ACTIVE	
1156	30-015-38512	VANGUARD OPERATING LLC ENRON STATE #016	31 17S 28E P 990N 940W		ACTIVE	
1157	30-015-01665	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #014	32 17S 28E O 940S 1650E		ACTIVE	
1158	30-015-02312	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #005	32 17S 28E G 1980N 1650E		ACTIVE	
1159	30-015-10109	VANGUARD OPERATING LLC NORTHWEST ARTESIA UNIT #003	32 17S 28E B 990N 1650E		ACTIVE	

ID NO	API	OPERATOR, WELL NAME, NUMBER	SEC, TWP, RGE, UL	DEPTH	STATUS TYPE	COMP. DATE PLUG DATE
1160	30-015-30684	VANGUARD OPERATING LLC NW STATE #003	32 17S 28E G 1650N 1650E		ACTIVE	
1161	30-015-30734	VANGUARD OPERATING LLC NW STATE #004	32 17S 28E B 1140N 2277E		ACTIVE	
1162	30-015-30887	VANGUARD OPERATING LLC JEFFERS 32 STATE #001	32 17S 28E J 2141S 1665E		ACTIVE	
1163	30-015-30890	VANGUARD OPERATING LLC NW STATE #016	32 17S 28E B 330N 1650E		ACTIVE	
1164	30-015-31934	VANGUARD OPERATING LLC NW STATE #018	32 17S 28E G 2272N 2273E		ACTIVE	
1165	30-015-34148	VANGUARD OPERATING LLC ASPEN 32 STATE COM #001	32 17S 28E J 1370S 1609E		ACTIVE	
1166	30-015-37045	VANGUARD OPERATING LLC JEFFERS 32 STATE #002	32 17S 28E J 1563S 2207E		ACTIVE	
1167	30-015-39927	APACHE CORPORATION AB STATE 647 #001	32 17S 28E K 1750S 1765W		ACTIVE	

TABLE III

Well Changes in the Combined One Mile Area of Review Since the 2015 PFO TEST for Navajo's WDW-1, WDW-2, and WDW-3

ID	API No.			Unit	Sect	Town	Range	Footages	Well Name	Operator	Changes
33	30	15	32554	29	N	17S	28E	590S 2185W	WILLIAMS A FEDERAL #001Z	VANGUARD OPERATING LLC	NEW OPERATOR
46	30	15	33232	29	M	17S	28E	690S 530W	WILLIAMS A FEDERAL #005	VANGUARD OPERATING LLC	NEW OPERATOR AND RECOMPLETED
47	30	15	36513	29	N	17S	28E	1090S 1550W	WILLIAMS A FEDERAL #008	VANGUARD OPERATING LLC	NEW OPERATOR
61	30	15	40480	29	M	17S	28E	600S 645W	WILLIAMS A FEDERAL #010	VANGUARD OPERATING LLC	NEW OPERATOR
70	30	15	41890	29	N	17S	28E	330S 2200N	WILLIAMS A FEDERAL #012	VANGUARD OPERATING LLC	NEW OPERATOR
917	30	15	41892	29	M	17S	28E	330S 975W	WILLIAMS A FEDERAL #015	VANGUARD OPERATING LLC	NEW OPERATOR
918	30	15	42116	29	M	17S	28E	990S 2160W	WILLIAMS A FEDERAL #016	VANGUARD OPERATING LLC	NEW OPERATOR
919	30	15	42555	29	O	17S	28E	330S 2310E	OUTLAW STATE #005	APACHE CORPORATION	NOW ACTIVE
920	30	15	42556	29	O	17S	28E	990S 1650E	OUTLAW STATE #006	APACHE CORPORATION	NEW
921	30	15	42557	29	O	17S	28E	330S 1650E	OUTLAW STATE #007	APACHE CORPORATION	NEW
922	30	15	42558	29	O	17S	28E	990S 2310E	OUTLAW STATE #008	APACHE CORPORATION	NEW
923	30	15	31285	30	O	17S	28E	890S 1650E	STALEY STATE #002	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
925	30	15	36252	30	N	17S	28E	990S 1980W	STALEY STATE #004	VANGUARD OPERATING LLC	NEW OPERATOR
926	30	15	36564	30	O	17S	28E	330S 2210E	STALEY STATE #009	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
927	30	15	37673	30	N	17S	28E	330S 1650W	STALEY STATE #012	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
954	30	15	37691	30	P	17S	28E	1050S 330E	ANTHONEY #001	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
961	30	15	38234	30	P	17S	28E	430S 800E	ANTHONEY #002	VANGUARD OPERATING LLC	NEW OPERATOR
962	30	15	39638	30	P	17S	28E	412S 679E	ANTHONEY STATE #003	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
963	30	15	40026	30	N	17S	28E	330S 2410W	STALEY STATE #017	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
964	30	15	40338	30	O	17S	28E	990S 2310E	STALEY STATE #016	VANGUARD OPERATING LLC	NEW OPERATOR
965	30	15	40983	30	O	17S	28E	330S 1650E	STALEY STATE #020	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
978	30	15	42725	30	O	17S	28E	685S 1630E	STALEY STATE #028	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
984	30	15	42726	30	O	17S	28E	505S 2140E	STALEY STATE #029	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
985	30	15	42727	30	O	17S	28E	850S 1680W	STALEY STATE #030	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1024	30	15	1638	31	A	17S	28E	330N 990E	STATE FW #001	ALAMO PERMIAN RESOURCES LLC	NOW ACTIVE AND NEW OPERATOR
1031	30	15	10537	31	H	17S	28E	2277N 330E	NORTHWEST ARTESIA UNIT #004	VANGUARD OPERATING LLC	NEW OPERATOR
1037	30	15	10833	31	I	17S	28E	1980S 660E	NORTHWEST ARTESIA UNIT #010	VANGUARD OPERATING LLC	NEW OPERATOR
1038	30	15	20042	31	P	17S	28E	990S 660E	NORTHWEST ARTESIA UNIT #011	VANGUARD OPERATING LLC	NEW OPERATOR
1039	30	15	30760	31	P	17S	28E	735S 330E	NW STATE #010	VANGUARD OPERATING LLC	NEW OPERATOR
1060	30	15	30783	31	H	17S	28E	1650N 330E	NW STATE #011	VANGUARD OPERATING LLC	NEW OPERATOR
1068	30	15	30784	31	A	17S	28E	330N 480E	NW STATE #012	VANGUARD OPERATING LLC	NEW OPERATOR
1069	30	15	30849	31	I	17S	28E	2310S 270E	NW STATE #009	VANGUARD OPERATING LLC	NEW OPERATOR
1070	30	15	30893	31	A	17S	28E	973N 959E	NW STATE #028	VANGUARD OPERATING LLC	NEW OPERATOR
1080	30	15	32162	31	D	17S	28E	460N 990W	ENRON STATE #004	VANGUARD OPERATING LLC	NEW OPERATOR
1089	30	15	36978	31	D	17S	28E	990N 330W	ENRON STATE#015	VANGUARD OPERATING LLC	NEW OPERATOR
1091	30	15	38512	31	P	17S	28E	990N 940W	ERNORN STATE #016	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1102	30	15	39020	31	O	17S	28E	140S 2560E	EMPIRE ABO UNIT #408	APACHE CORPORATION	TEMPORARILY PLUGGED AND AG ABANDONED
1103	30	15	42372	31	D	17S	28E	330N 430W	ENRON STATE #20	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1108	30	15	42806	31	P	17S	28E	245S 90E	RANGER STATE #016	APACHE CORPORATION	NEW
1109	30	15	1665	32	O	17S	28E	940S 1650E	NORTHWEST ARTESIA UNIT #014	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1125	30	15	2312	32	G	17S	28E	1980N 1650E	NORTHWEST ARTESIA UNIT #005	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1132	30	15	10109	32	B	17S	28E	990N 1650E	NORTHWEST ARTESIA UNIT #003	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1133	30	15	20043	32	M	17S	28E	990S 760W	NORTHWEST ARTESIA UNIT #12	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1135	30	15	30684	32	G	17S	28E	1650N 1650E	NW STATE #003	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1143	30	15	30685	32	M	17S	28E	990S 990W	NW STATE #007	VANGUARD OPERATING LLC	NEW OPERATOR
1144	30	15	30734	32	B	17S	28E	1140N 2277E	NW STATE #004	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1147	30	15	30777	32	L	17S	28E	2310S 990W	NW STATE#006	VANGUARD OPERATING LLC	NEW OPERATOR
1148	30	15	30815	32	N	17S	28E	1090S 2126W	NW STATE #008	VANGUARD OPERATING LLC	NEW OPERATOR
1149	30	15	30887	32	J	17S	28E	2141S 1665E	JEFFERS 32 STATE #001	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1150	30	15	30890	32	B	17S	28E	330N 1650E	NW STATE #016	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR

1151	30	15	31530	32	C	17S	28E	530N 1650W	ENRON STATE #001	VANGUARD OPERATING LLC	NEW OPERATOR
1152	30	15	31920	32	D	17S	28E	990N 990W	ENRON STATE #002	VANGUARD OPERATING LLC	NEW OPERATOR
1153	30	15	31934	32	G	17S	28E	2272N 2273E	NW STATE #018	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1154	30	15	35050	32	D	17S	28E	330N 500W	ENRON STATE #012	VANGUARD OPERATING LLC	NEW OPERATOR
1155	30	15	36554	32	L	17S	28E	1770S 550W	NW STATE #029	VANGUARD OPERATING LLC	NEW OPERATOR
1156	30	15	36979	32	C	17S	28E	990N 2035W	ENRON STATE #014	VANGUARD OPERATING LLC	NEW OPERATOR
1157	30	15	36989	32	K	17S	28E	1630S 1710W	NW STATE #030	VANGUARD OPERATING LLC	NEW OPERATOR
1158	30	15	37045	32	J	17S	28E	1563S 2207E	JEFFERS 32 STATE #002	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1159	30	15	37057	32	N	17S	28E	330S 1750W	NW STATE #031	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1160	30	15	37058	32	M	17S	28E	330S 330W	NW STATE #032	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1161	30	15	38513	32	J	17S	28E	2310S 2032E	JEFFERS 32 STATE #003	VANGUARD OPERATING LLC	NEW OPERATOR
1162	30	15	39927	32	K	17S	28E	1750S 1765W	AB STATE 647 #001	APACHE CORPORATION	NEW
1163	30	15	39996	32	C	17S	28E	230N 2420W	ENRON STATE #017	VANGUARD OPERATING LLC	NEW OPERATOR
1164	30	15	40339	32	D	17S	28E	990N 330W	ENRON STATE #018	VANGUARD OPERATING LLC	NEW OPERATOR
1166	30	15	42156	32	D	17S	28E	385N 900W	ENRON STATE #021	VANGUARD OPERATING LLC	NEW OPERATOR
1167	30	15	41833	32	C	17S	28E	990N 1700W	ENRON STATE #019	VANGUARD OPERATING LLC	NEW OPERATOR

TABLE IV
Wells that have been Plugged and Abandoned since the 2015 PFO REPORT
Well Changes in the Combined One Mile Area of Review for Navajo's WDW-1, WDW-2, and WDW-3

ID	API No.			Unit	Sect	Town	Range	Footages	Well Name	Operator	Changes

TABLE V

Wells that have been Temporally Abandoned since the 2015 PFO REPORT

Well Changes in the Combined One Mile Area of Review for Navajo's WDW-1, WDW-2, and WDW-3

ID	API No.			Unit	Sect	Town	Range	Footages	Well Name	Operator	Changes
984	30	15	39020	31	O	17S	28E	140S 2560E	EMPIRE ABO UNIT #408	APACHE CORPORATION	TEMPORARILY PLUGGED AND AG ABANDONED

TABLE VI
Wells that have been Recompleted in Upper Zones since the 2015 PFO REPORT
Well Changes in the Combined One Mile Area of Review for Navajo's WDW-1, WDW-2, and WDW-3

ID	API No.			Unit	Sect	Town	Range	Footages	Well Name	Operator	Changes
1069	30	15	33232	29	M	17S	28E	690S 530W	WILLIAMS A FEDERAL #005	VANGUARD OPERATING LLC	NEW OPERATOR AND RECOMPLETED

TABLE VII
Newly Drilled Wells in the Area of Review since the 2015 PFO REPORT
Well Changes in the Combined One Mile Area of Review for Navajo's WDW-1, WDW-2, and WDW-3

ID	API No.			Unit	Sect	Town	Range	Footages	Well Name	Operator	Changes
33	30	15	32554	29	N	17S	28E	590S 2185W	WILLIAMS A FEDERAL #001Z	VANGUARD OPERATING LLC	NEW OPERATOR
46	30	15	33232	29	M	17S	28E	690S 530W	WILLIAMS A FEDERAL #005	VANGUARD OPERATING LLC	NEW OPERATOR AND RECOMPLETED
47	30	15	36513	29	N	17S	28E	1090S 1550W	WILLIAMS A FEDERAL #008	VANGUARD OPERATING LLC	NEW OPERATOR
61	30	15	40480	29	M	17S	28E	600S 645W	WILLIAMS A FEDERAL #010	VANGUARD OPERATING LLC	NEW OPERATOR
70	30	15	41890	29	N	17S	28E	330S 2200N	WILLIAMS A FEDERAL #012	VANGUARD OPERATING LLC	NEW OPERATOR
917	30	15	41892	29	M	17S	28E	330S 975W	WILLIAMS A FEDERAL #015	VANGUARD OPERATING LLC	NEW OPERATOR
918	30	15	42116	29	M	17S	28E	990S 2160W	WILLIAMS A FEDERAL #016	VANGUARD OPERATING LLC	NEW OPERATOR
919	30	15	42555	29	O	17S	28E	330S 2310E	OUTLAW STATE #005	APACHE CORPORATION	NOW ACTIVE
920	30	15	42556	29	O	17S	28E	990S 1650E	OUTLAW STATE #006	APACHE CORPORATION	NEW
921	30	15	42557	29	O	17S	28E	330S 1650E	OUTLAW STATE #007	APACHE CORPORATION	NEW
922	30	15	42558	29	O	17S	28E	990S 2310E	OUTLAW STATE #008	APACHE CORPORATION	NEW
923	30	15	31285	30	O	17S	28E	890S 1650E	STALEY STATE #002	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
925	30	15	36252	30	N	17S	28E	990S 1980W	STALEY STATE #004	VANGUARD OPERATING LLC	NEW OPERATOR
926	30	15	36564	30	O	17S	28E	330S 2210E	STALEY STATE #009	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
927	30	15	37673	30	N	17S	28E	330S 1650W	STALEY STATE #012	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
954	30	15	37691	30	P	17S	28E	1050S 330E	ANTHONEY #001	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
961	30	15	38234	30	P	17S	28E	430S 800E	ANTHONY #002	VANGUARD OPERATING LLC	NEW OPERATOR
962	30	15	39638	30	P	17S	28E	412S 679E	ANTHONEY STATE #003	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
963	30	15	40026	30	N	17S	28E	330S 2410W	STALEY STATE #017	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
964	30	15	40338	30	O	17S	28E	990S 2310E	STALEY STATE #016	VANGUARD OPERATING LLC	NEW OPERATOR
965	30	15	40983	30	O	17S	28E	330S 1650E	STALEY STATE #020	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
978	30	15	42725	30	O	17S	28E	685S 1630E	STALEY STATE #028	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
984	30	15	42726	30	O	17S	28E	505S 2140E	STALEY STATE #029	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
985	30	15	42727	30	O	17S	28E	850S 1680W	STALEY STATE #030	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1024	30	15	1638	31	A	17S	28E	330N 990E	STATE FW #001	ALAMO PERMIAN RESOURCES LLC	NOW ACTIVE AND NEW OPERATOR
1031	30	15	10537	31	H	17S	28E	2277N 330E	NORTHWEST ARTESIA UNIT #004	VANGUARD OPERATING LLC	NEW OPERATOR
1037	30	15	10833	31	I	17S	28E	1980S 660E	NORTHWEST ARTESIA UNIT #010	VANGUARD OPERATING LLC	NEW OPERATOR
1038	30	15	20042	31	P	17S	28E	990S 660E	NORTHWEST ARTESIA UNIT #011	VANGUARD OPERATING LLC	NEW OPERATOR
1039	30	15	30760	31	P	17S	28E	735S 330E	NW STATE #010	VANGUARD OPERATING LLC	NEW OPERATOR
1060	30	15	30783	31	H	17S	28E	1650N 330E	NW STATE #011	VANGUARD OPERATING LLC	NEW OPERATOR
1068	30	15	30784	31	A	17S	28E	330N 480E	NW STATE #012	VANGUARD OPERATING LLC	NEW OPERATOR
1069	30	15	30849	31	I	17S	28E	2310S 270E	NW STATE #009	VANGUARD OPERATING LLC	NEW OPERATOR
1070	30	15	30893	31	A	17S	28E	973N 959E	NW STATE #028	VANGUARD OPERATING LLC	NEW OPERATOR
1080	30	15	32162	31	D	17S	28E	460N 990W	ENRON STATE #004	VANGUARD OPERATING LLC	NEW OPERATOR
1089	30	15	36978	31	D	17S	28E	990N 330W	ENRON STATE#015	VANGUARD OPERATING LLC	NEW OPERATOR
1091	30	15	38512	31	P	17S	28E	990N 940W	ERNORN STATE #016	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1102	30	15	39020	31	O	17S	28E	140S 2560E	EMPIRE ABO UNIT #408	APACHE CORPORATION	TEMPORARILY PLUGGED AND AG ABANDONED
1103	30	15	42372	31	D	17S	28E	330N 430W	ENRON STATE #20	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1108	30	15	42806	31	P	17S	28E	245S 90E	RANGER STATE #016	APACHE CORPORATION	NEW
1109	30	15	1665	31	O	17S	28E	940S 1650E	NORTHWEST ARTESIA UNIT #014	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1125	30	15	2312	32	G	17S	28E	1980N 1650E	NORTHWEST ARTESIA UNIT #005	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1132	30	15	10109	32	B	17S	28E	990N 1650E	NORTHWEST ARTESIA UNIT #003	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1133	30	15	20043	32	M	17S	28E	990S 760W	NORTHWEST ARTESIA UNIT #12	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1135	30	15	30684	32	G	17S	28E	1650N 1650E	NW STATE #003	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1143	30	15	30685	32	M	17S	28E	990S 990W	NW STATE #007	VANGUARD OPERATING LLC	NEW OPERATOR
1144	30	15	30734	32	B	17S	28E	1140N 2277E	NW STATE #004	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1147	30	15	30777	32	L	17S	28E	2310S 990W	NW STATE#006	VANGUARD OPERATING LLC	NEW OPERATOR
1148	30	15	30815	32	N	17S	28E	1090S 2126W	NW STATE #008	VANGUARD OPERATING LLC	NEW OPERATOR
1149	30	15	30887	32	J	17S	28E	2141S 1665E	JEFFERS 32 STATE #001	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1150	30	15	30890	32	B	17S	28E	330N 1650E	NW STATE #016	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR

1151	30	15	31530	32	C	17S	28E	530N 1650W	ENRON STATE #001	VANGUARD OPERATING LLC	NEW OPERATOR
1152	30	15	31920	32	D	17S	28E	990N 990W	ENRON STATE #002	VANGUARD OPERATING LLC	NEW OPERATOR
1153	30	15	31934	32	G	17S	28E	2272N 2273E	NW STATE #018	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1154	30	15	35050	32	D	17S	28E	330N 500W	ENRON STATE #012	VANGUARD OPERATING LLC	NEW OPERATOR
1155	30	15	36554	32	L	17S	28E	1770S 550W	NW STATE #029	VANGUARD OPERATING LLC	NEW OPERATOR
1156	30	15	36979	32	C	17S	28E	990N 2035W	ENRON STATE #014	VANGUARD OPERATING LLC	NEW OPERATOR
1157	30	15	36989	32	K	17S	28E	1630S 1710W	NW STATE #030	VANGUARD OPERATING LLC	NEW OPERATOR
1158	30	15	37045	32	J	17S	28E	1563S 2207E	JEFFERS 32 STATE #002	VANGUARD OPERATING LLC	NEW AND NEW OPERATOR
1159	30	15	37057	32	N	17S	28E	330S 1750W	NW STATE #031	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1160	30	15	37058	32	M	17S	28E	330S 330W	NW STATE #032	VANGUARD OPERATING LLC	NOW ACTIVE AND NEW OPERATOR
1161	30	15	38513	32	J	17S	28E	2310S 2032E	JEFFERS 32 STATE #003	VANGUARD OPERATING LLC	NEW OPERATOR
1162	30	15	39927	32	K	17S	28E	1750S 1765W	AB STATE 647 #001	APACHE CORPORATION	NEW
1163	30	15	39996	32	C	17S	28E	230N 2420W	ENRON STATE #017	VANGUARD OPERATING LLC	NEW OPERATOR
1164	30	15	40339	32	D	17S	28E	990N 330W	ENRON STATE #018	VANGUARD OPERATING LLC	NEW OPERATOR
1166	30	15	42156	32	D	17S	28E	385N 900W	ENRON STATE #021	VANGUARD OPERATING LLC	NEW OPERATOR
1167	30	15	41833	32	C	17S	28E	990N 1700W	ENRON STATE #019	VANGUARD OPERATING LLC	NEW OPERATOR

TABLE VIII

FIGURES INCLUDED IN THE REPORT

Figure	Description	OCD Reference
1	Mewbourne Well #1 Schematic	Section VI.1 and IX.3
2	Plot of Bottom Hole Pressure and Temperature Data Chukka Well #2	n/a
3	Gaines Well #3 Schematic	n/a
4	Chukka Well #2 Schematic	n/a
5	Plot of Bottom Hole Pressure and Temperature Data Gaines Well #3	n/a
6	Midland Map of One Mile Area of Review	n/a
7	Mewbourne Well #1 Wellhead Schematic	Section IX.14
8	Diagram of Valve Locations for Shut-in on Mewbourne Well #1	Section IX.14
9	Mewbourne Well #1 Test Overview	Section IX.18.f
10	Mewbourne Well #1 Cartesian Plot of Bottom-Hole Pressure and Temperature vs. Time	Section IX.18.a
11	Mewbourne Well #1 Cartesian Plot of Injection Rate vs. Time	Section IX.18.b
12	Historical Surface Pressure and Injection Rates vs. Calendar Time	Section IX.18.g

TABLE VIII (cont.)

Figure	Description	OCD Reference
13	Mewbourne Well #1 Derivative Log-Log Plot	Section IX.18.c
14	Mewbourne Well #1 Superposition Horner (Semi-Log) Plot	Section IX.18.d
15	Mewbourne Well #1 Expanded Superposition Horner (Semi-Log) Plot	Section IX.18.d
16	Mewbourne Well #1 Hall Plot	Section IX.18.h
17	Mewbourne Well #1 Static Pressure Gradient Survey	n/a

TABLE IX

Comparison of Permeability, Transmissibility, Skin, False Extrapolated Pressure, and Fill Depth

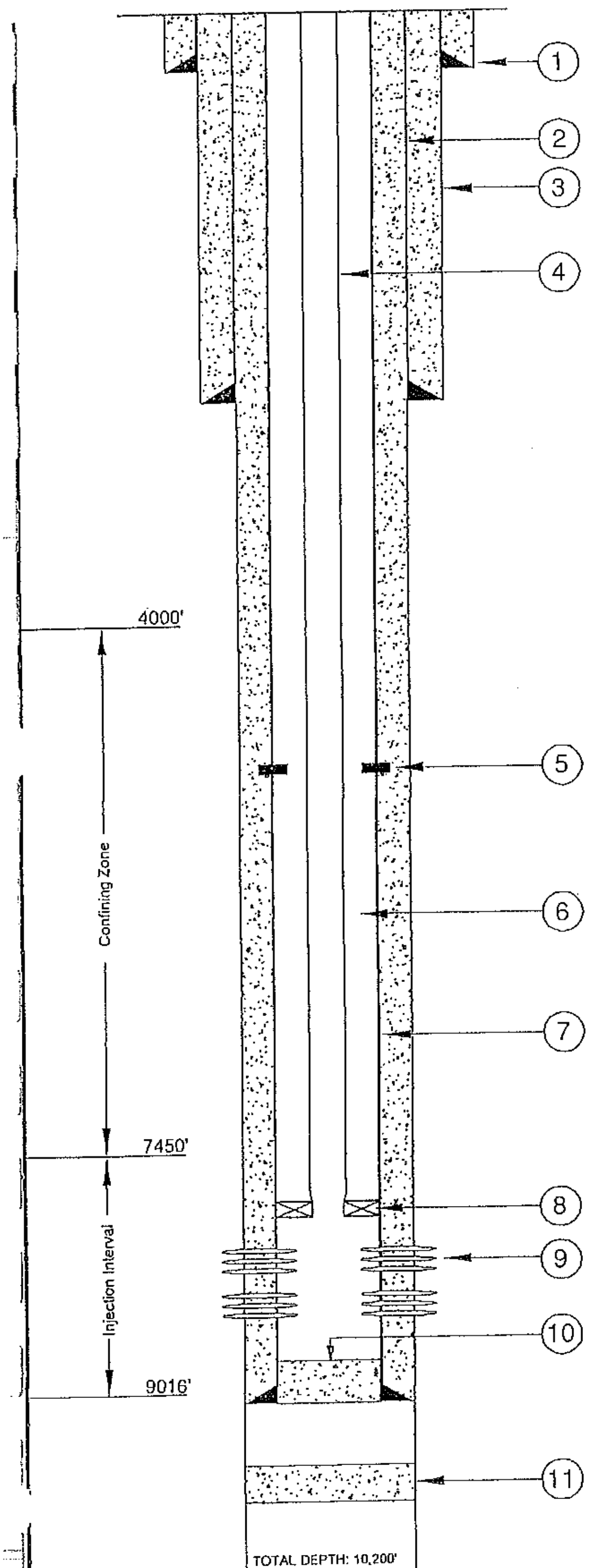
Date of Test	Permeability (k)	Transmissibility (kh/u)	Skin (s)	False Extrapolated Pressure (p*)	Fill Depth
June 12 – 15, 2016	520 md	159,662 md-ft/cp	67.09	4433.19 psia	8,890 feet
September 25, 2015	423 md	130,002 md-ft/cp	44.42	4542.81 psia	8,995 feet
May 15–18, 2014	546 md	167,698 md-ft/cp	44.99	4404.70 psia	8,990 feet
September 21-23, 2012	661 md	202,929 md-ft/cp	36.1	4007.98 psia	9,018 feet
November 10-13, 2011	685 md	210,441 md-ft/cp	68.5	3846.18 psia	9,001 feet
December 16-21, 2010	521 md	159,979 md-ft/cp	92.7	3716.9 psia	9,001 feet
October 26-29, 2009	883 md	271,155 md-ft/cp	77	3,591.62 psia	9,001 feet
April 3-4, 2008	1,592 md	488,655 md-ft/cp	262	3,527.37 psia	N/A
Permit Parameters	250 md	40,094 md-ft-cp	0	N/A	N/A

TABLE X

NAVAJO REFINING COMPANY
STATIC PRESSURE GRADIENT SURVEY – MEWBOURNE WELL #1
June 15, 2016

Depth (ft)	Pressure (psia)	Pressure Gradient (psi/ft)	Temperature (°F)
7924	4440.62	0.436	100.44
7000	4038.03	0.435	103.85
6000	3603.00	0.436	100.30
5000	3167.48	0.436	96.47
4000	2731.63	0.433	92.81
3000	2298.37	0.433	89.68
2000	1865.16	0.434	86.30
1000	1430.92	0.435	83.38
0	995.50	0.00	97.05

BELOW GROUND DETAILS



All depths are referenced to the Kelly bushing elevation of 12.5' above ground level. Ground level elevation is 3,678' above mean sea level.

1. Surface Casing: 13 ⅜", 48 lb/ft, J-55, ST&C set at 390' in a 17 ½" hole. Cemented with 150 sx Class C with 3 % calcium chloride, 375 sx Class C Litewate w/3 % calcium chloride and ½ lb/sx flocele. Circulated 86 sx to surface.

2. Intermediate Casing: 9 ⅝", 36 lb/ft, J-55, ST&C set at 2,555' in a 12 ¼ " hole. Cemented w/800 sx of Class C Lite w/ ½ lb/sx flocele and 2 lb/sx Gilsonite and 12 % salt. Followed by 200 sx of Class C w/2 % calcium chloride. Circulated 133 sx to surface.

3. Base of the USDW at 493'.

4. Injection Tubing: 4 ½", 11.6 lb/ft, N-80, SMLS, R3, LT&C set at 7,879'.

5. DV Tool: at 5,498'.

6. Annulus Fluid: 8.7 lb/gal brine water mixed w/UniChem Techni-Hib 370 corrosion inhibitor.

7. Protection Casing: 7", 29 lb/ft, N-80, LT&C: 9094' to 7031'. 7", 29 lb/ft, P-110, LT&C: 7031' to 5845'. 7", 26 lb/ft, P-110, LT&C; 5845' to surface. Casing cemented in two stages as follows:

   First Stage - 600 sx modified Class H w/0.4 % CFR-3, 5 lb/sx Gilsonite, 0.5% Halad-344, and 1 lb/sx salt mixed at 13.0 ppg. Opened DV tool at 5498' and circulated 142 sx to surface.

   Second Stage - Lead Slurry: 220 sx Interfill "C" (35:65:6) mixed at 11.7 ppg. Tail Slurry: 550 sx modified Class H w/0.4 % CFR-3, 5 lb/sx, Gilsonite, 0.5 % Halad-344, 0.1 % HR-7, and 1 lb/sx mixed at 13.0 ppg. Circulated 75 sx to surface. Top out w/20 sx permium plus 3 % calcium chloride.

8. Packer: 7" x 3.5" EVI Oil Tools (Arrow), Model X-1 retrievable packer set at 7879'. Minimum I.D. is 3.0". Wireline re-entry guide on bottom. To release: turn ¼ turn to the right and pick up.

9. Perforations (2 SPF):

   Upper Zone - 7924-7942', 7974-8030', 8050-8056', 8066-8080', 8118-8127', 8132-8140', 8160-8164', 8170-8188'.

   Lower Zone - 8220-8254', 8260-8270', 8280-8302', 8360-8366', 8370-8378', 8400-8410', 8419-8423', 8430-8446', 8460-8464', 8470-8476'.

10. PBTD: 9004'.

11. Cement Plug: 45 sx Class H from 9624' to 9734'.

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

NAVAJO REFINING COMPANY
ARTESIA, NEW MEXICO

BELOW GROUND DETAILS
WASTE DISPOSAL WELL NO. 1

DATE: 07/13/01	CHECKED BY:	JOB NO: 70D5256
DRAWN BY: WDL	APPROVED BY:	DWG. NO:

FIGURE 1

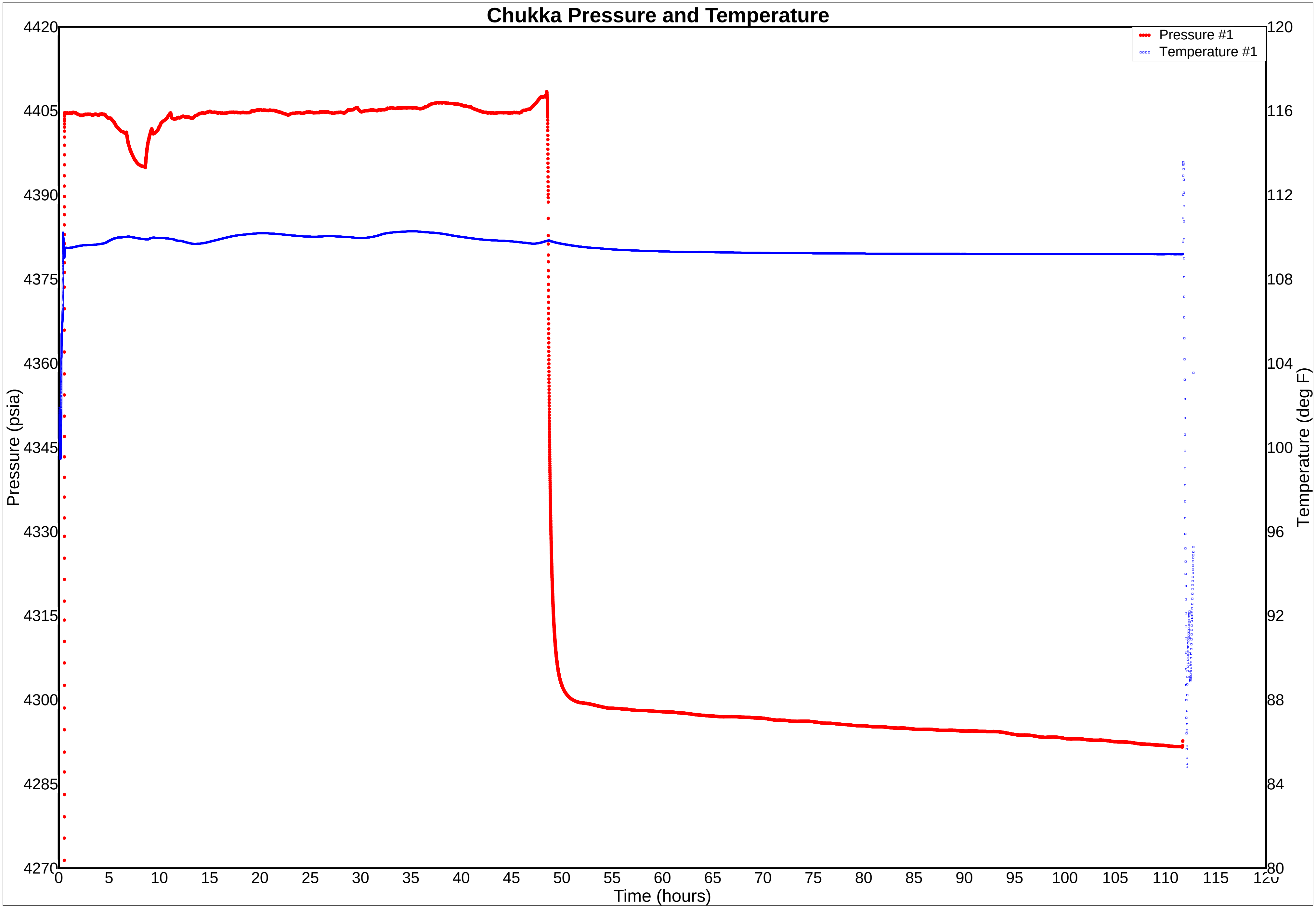
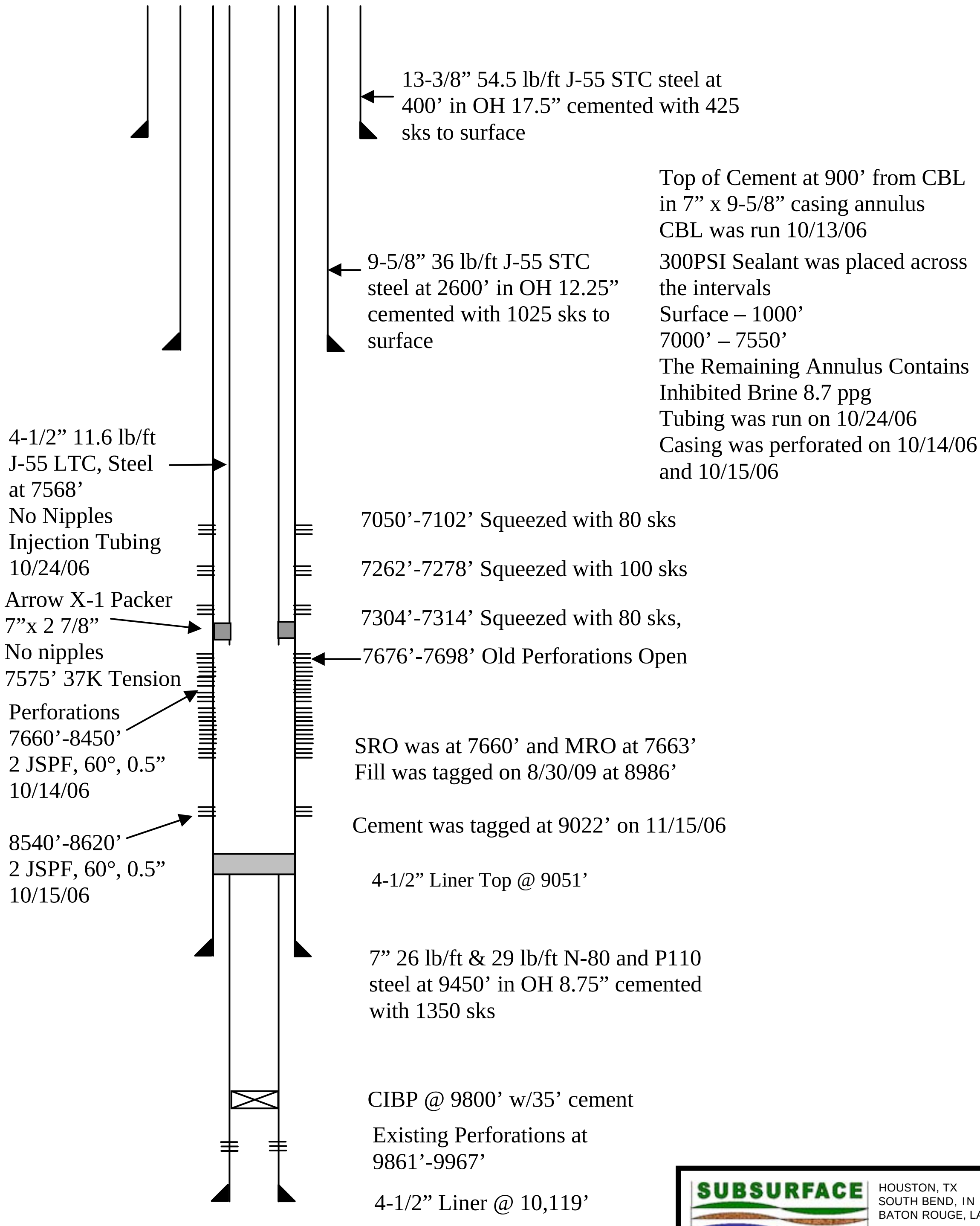

Chukka Pressure and Temperature
Pressure #1
Temperature #1
Pressure (psia)
Temperature (deg F)
Time (hours)
4420
4405
4390
4375
4360
4345
4330
4315
4300
4285
4270
120
116
112
108
104
100
96
92
88
84
80
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120

FIGURE 2



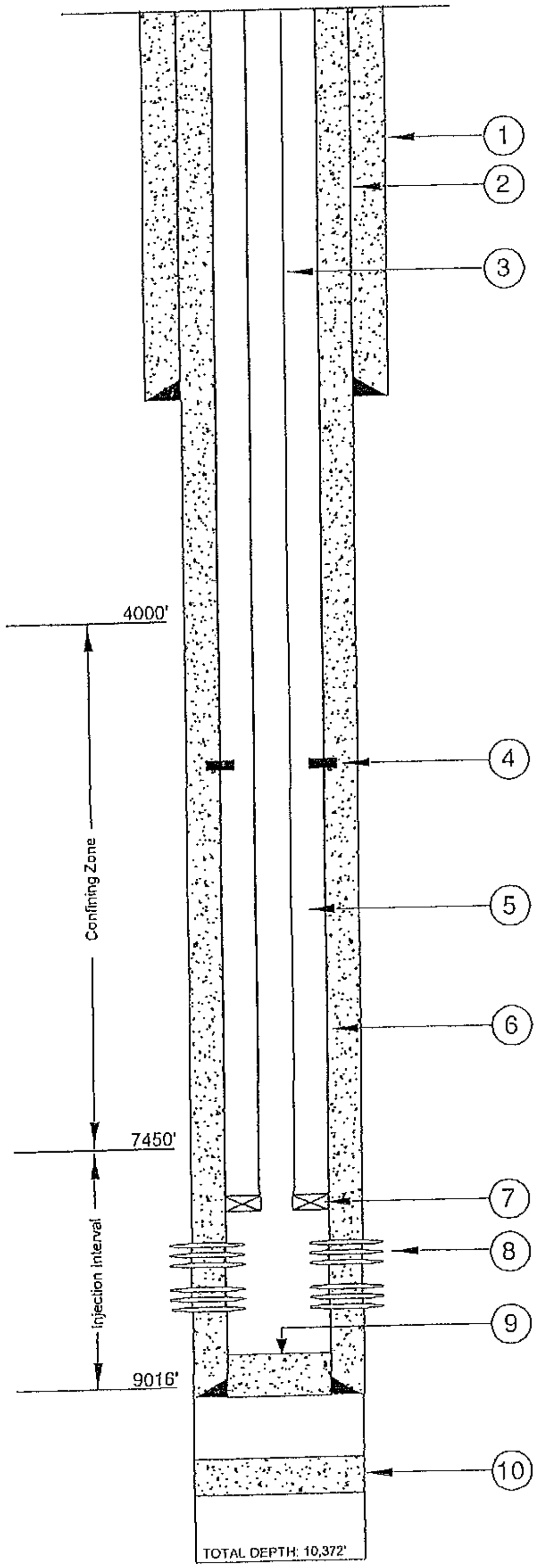
API# 30-015-26575
UIC-CLI-008-3
S1-T18S-R27E
Gaines Well #3 Formally Chalk Bluff Federal #1
Not to Scale

SUBSURFACE
HOUSTON, TX
SOUTH BEND, IN
BATON ROUGE, LA

Figure
Gaines Well #3
Navajo Refining

DATED: 9/8/09	APPROVED BY:	JOB NO. 70A6365
DRAWN BY: rls	CHECKED BY:rls	SCALE: N/A

FIGURE 3



BELOW GROUND DETAILS

All depths are referenced to the Kelly bushing elevation of 13' above ground level. Ground level elevation is 3610' above mean sea level.

1. Base of the USDW at 473'.
2. Surface Casing: 8 ⅝", 32 lb/ft, set at 1995' in an 11" hole. Cemented to surface with 800 sacks of cement.
3. Injection Tubing: 3 ½", 9.2 lb/ft, J-55, smls, NUE 10 rd. set at 7528'.
4. DV Tool: at 5,785'.
5. Annulus Fluid: 8.7 lb/gal brine water mixed w/UniChem Techni-Hib 370 corrosion inhibitor.
6. Protection Casing: 5 ½", 17 lb/ft, L-80, LT&C; 8869' to the surface and set in a 7 ⅞" hole. Casing cemented in two stages as follows:

   First Stage - 575 sacks of modified Class "H" with 0.4 % CFR-3, 5 lb/sk Gilsonite, 0.5 % Halad-344, and 3 lb/sk salt. Mixed at 13.0 ppg. Opened DV tool at 5785 and circulated 20 sacks to surface.

   Second Stage - Lead Slurry: 300 sacks of Interfill "C" (35:65:6) mixed at 11.7 ppg. Tail slurry: 695 sacks modified Class "H" with 0.4% CFR-3, 5 lb/sk Gilsonite, 0.5 % Halad-344 and 3 lb/sk salt mixed at 13.0 ppg. Circulated 150 sacks to surface. Topped out with 10 yards of Redi-mix.

7. Packer: 5 ½" x 2 ⅞" Weatherford Completion Tools (Arrow) Model X-1 retrievable packer set at 7528'. Minimum ID is 2.4375". Wireline re-entry guide is on bottom. To release: turn ¼ turn to the right and pick up.
8. Perforations (2 SPF):

   Zone 1: 7570-7620', 7676-7736'

   Zone 2: 7826-7834', 7858-7880', 7886-7904', 7916-7936', 7944-7964', 7990-8042', 8096-8116', 8191-8201', 8304-8319',8395-8399'.

9. PBTD: 8770'
10. Cement Plug: 45 sacks from 9675' to 9775'.

SUBSURFACE

HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.

NAVAJO REFINING COMPANY
ARTESIA, NEW MEXICO

BELOW GROUND DETAILS
WASTE DISPOSAL WELL NO. 2

DATE: 07/13/01	CHECKED BY:	JOB NO: 7005256
DRAWN BY: WDL	APPROVED BY:	DWG. NO:

FIGURE 4

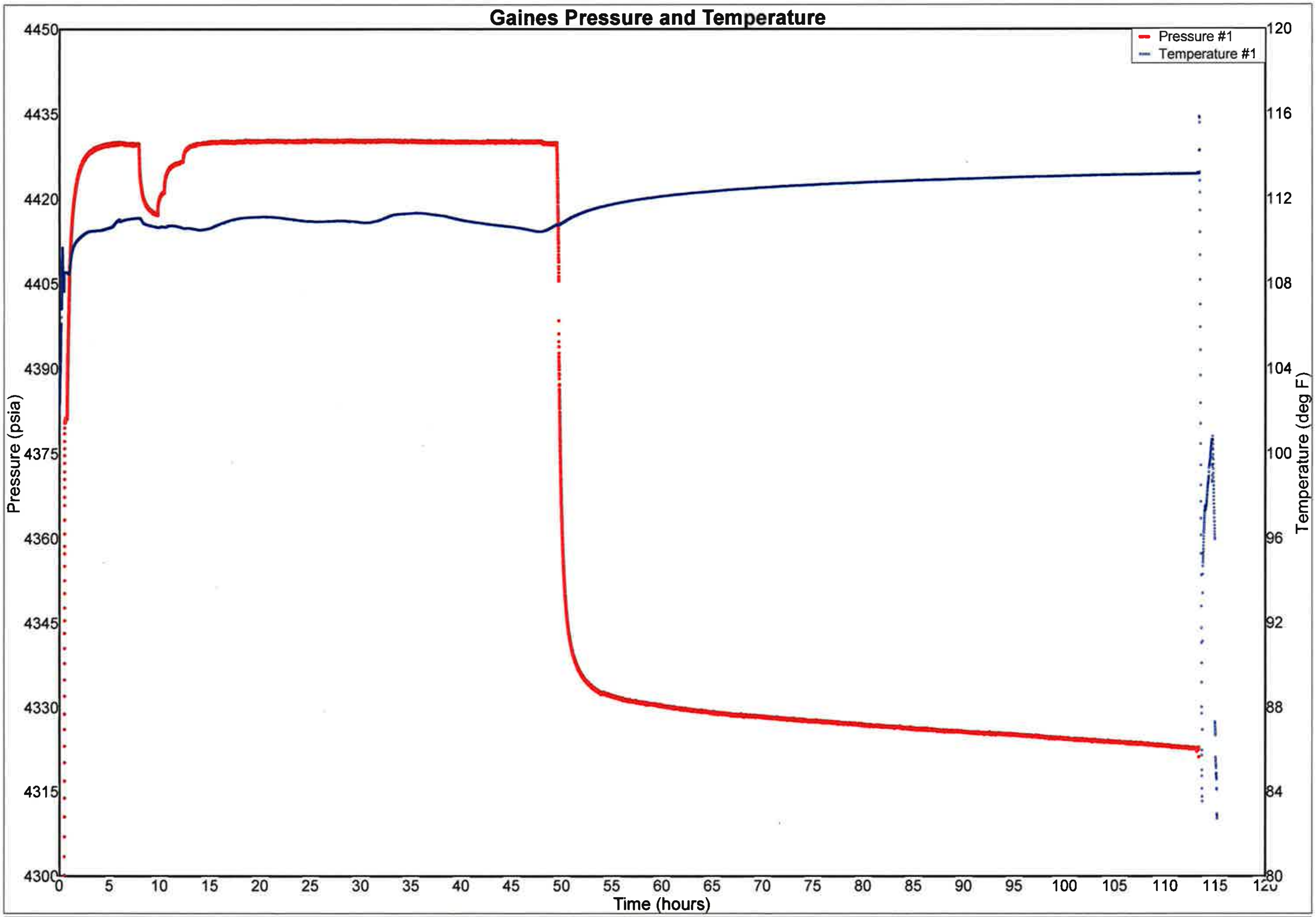

Gaines Pressure and Temperature
Pressure #1
Temperature #1
Pressure (psia)
4450
4435
4420
4405
4390
4375
4360
4345
4330
4315
4300
Temperature (deg F)
120
116
112
108
104
100
96
92
88
84
80
Time (hours)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120

FIGURE 5

SUBSURFACE TECHNOLOGY

FIGURE 7

WELL: NAVAJO REFINING MEWBOURNE WELL NO. 1

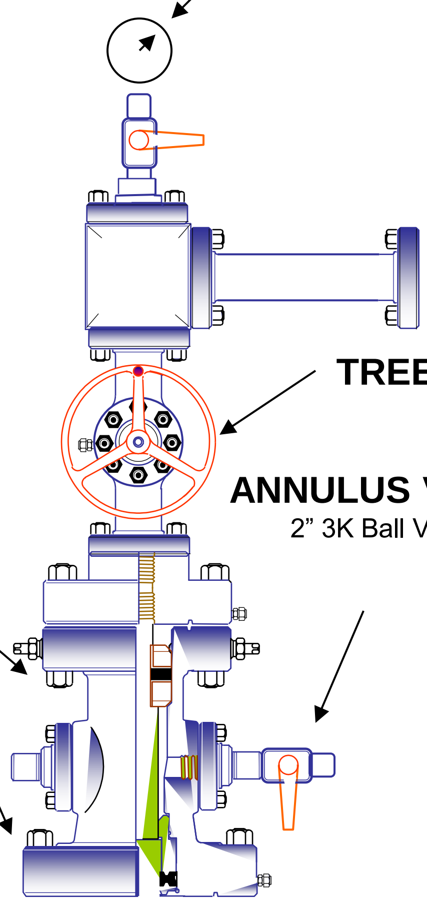
TOP CONNECTION
2-3/8” 8rd x 4-1/16” 3K
2” x 2-3/8” Ball Valve
2-3/8” Bull Plug 1/2” NPT
5000 LB Pressure Guage

UPPER TREE ASSEMBLY
A5PP,4-1/2” 3K X 4-1/16” 3K

TREE GATE VALVE
4-1/16” 3K

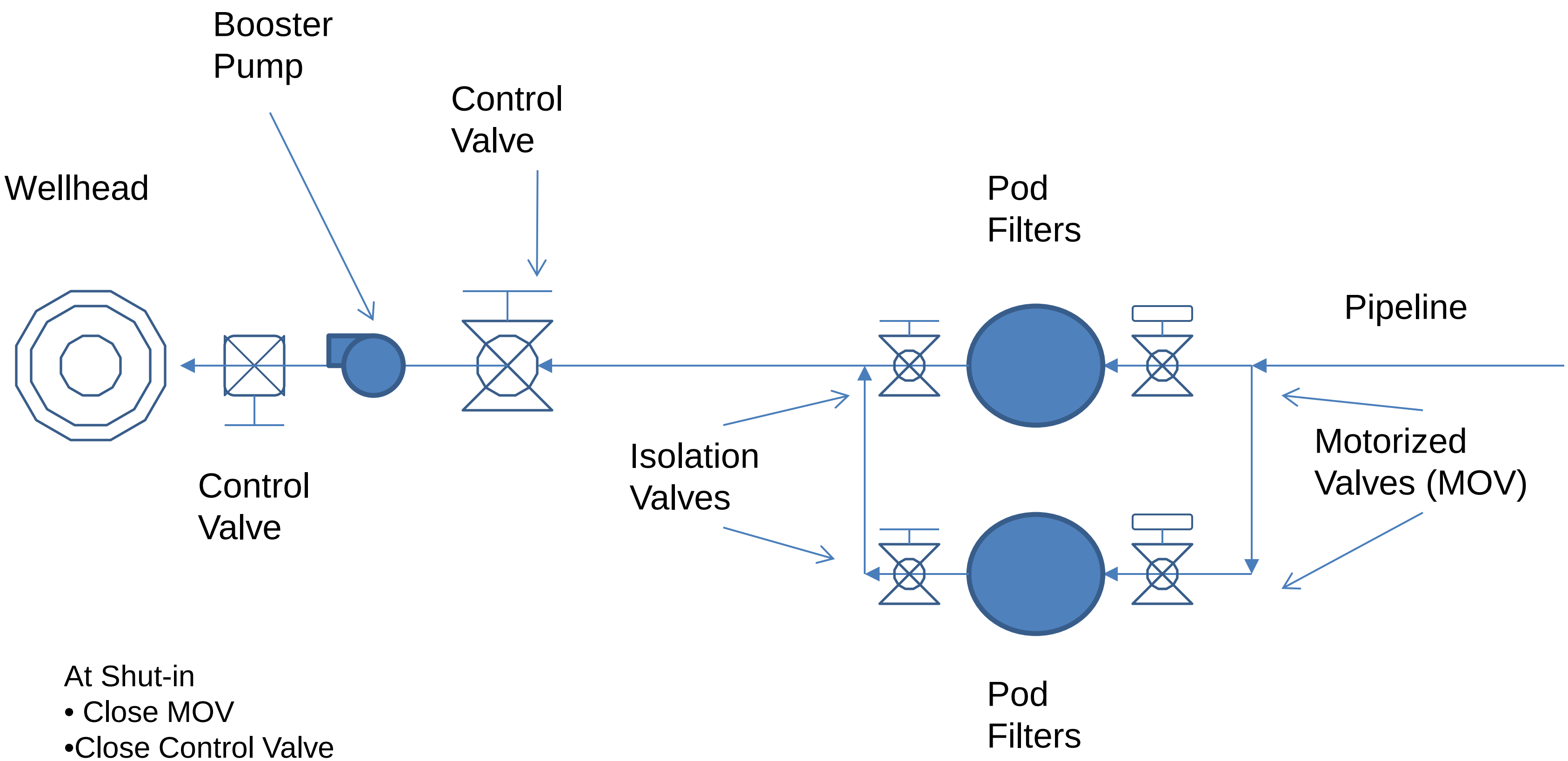
ANNULUS VALVE
2” 3K Ball Valve

FLANGE
7-1/16”, 3-1/2” 3K X 4-1/16” UPTBG 3K

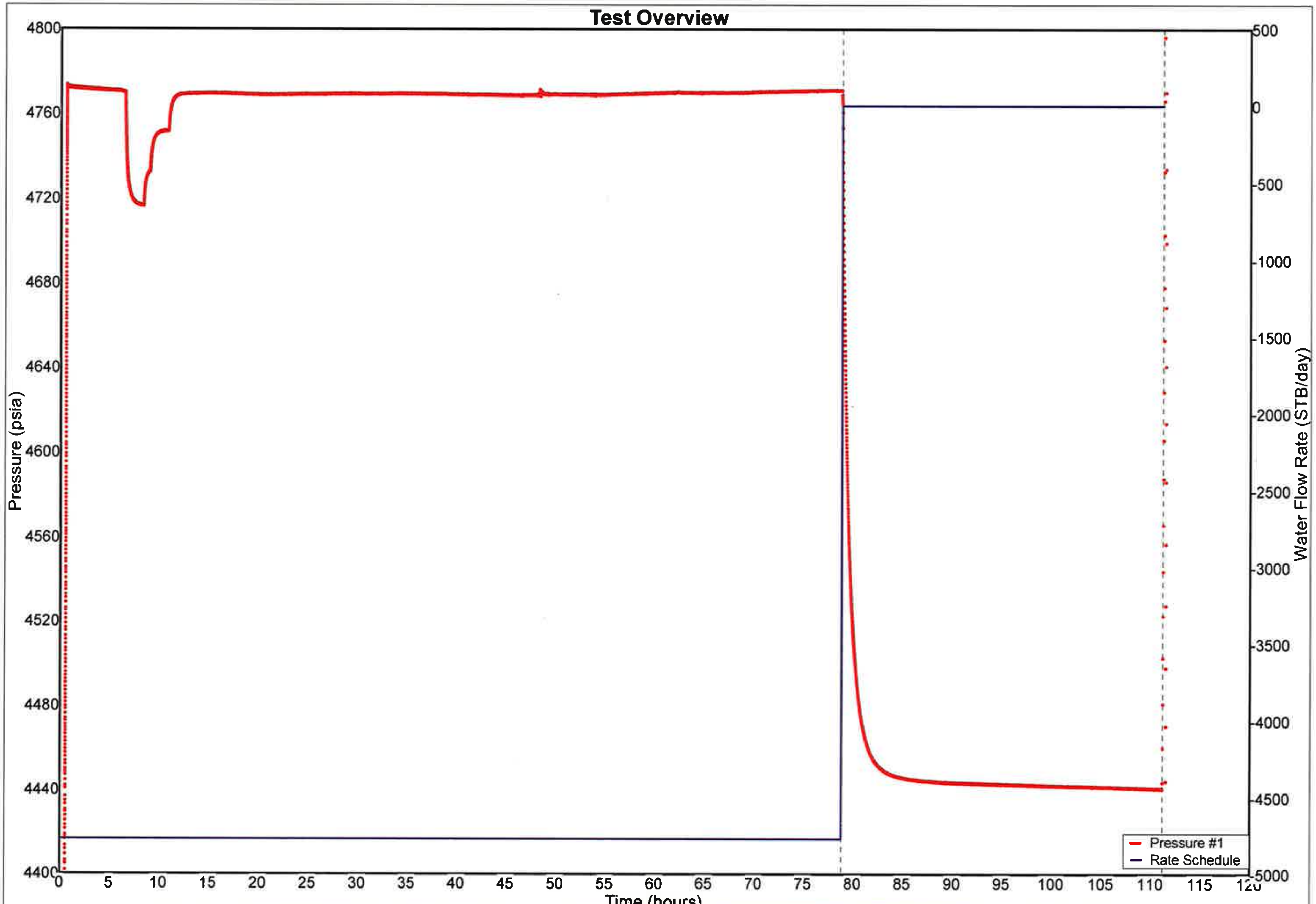


SUPERIOR WELLHEAD

FIGURE 8
Mewbourne Well No. 1
Diagram of Shut-in Valve Control



At Shut-in
- Close MOV
- Close Control Valve
- Close Isolation Valves
- Close Control Valve
- Drain POD Filters



Test Overview
Pressure (psia)
4800
4760
4720
4680
4640
4600
4560
4520
4480
4440
4400
Water Flow Rate (STB/day)
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
-4500
-5000
Time (hours)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120
Pressure #1
Rate Schedule

FIGURE 9

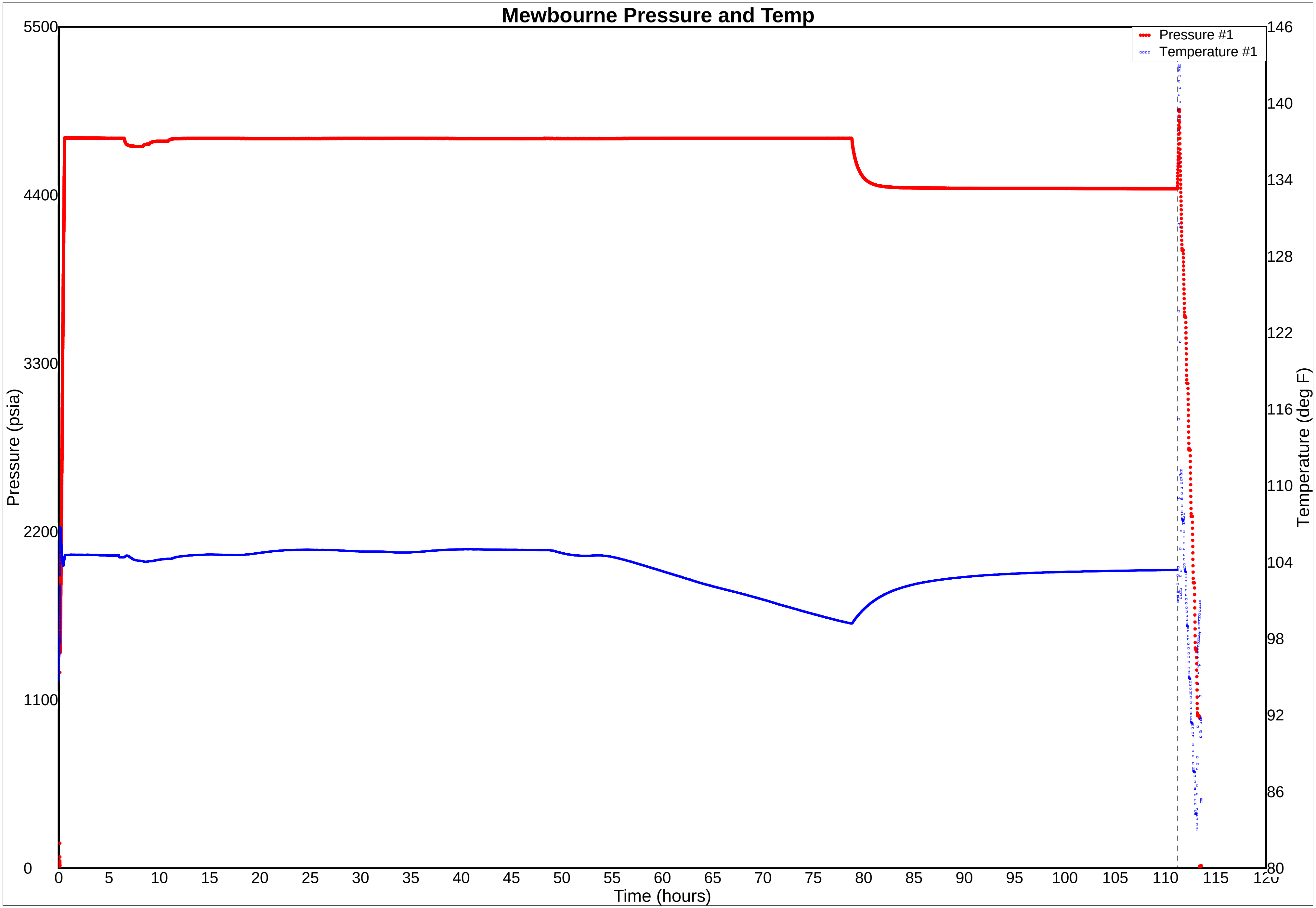

Mewbourne Pressure and Temp
Pressure #1
Temperature #1
Pressure (psia)
Temperature (deg F)
Time (hours)
5500
4400
3300
2200
1100
0
146
140
134
128
122
116
110
104
98
92
86
80
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120

FIGURE 10

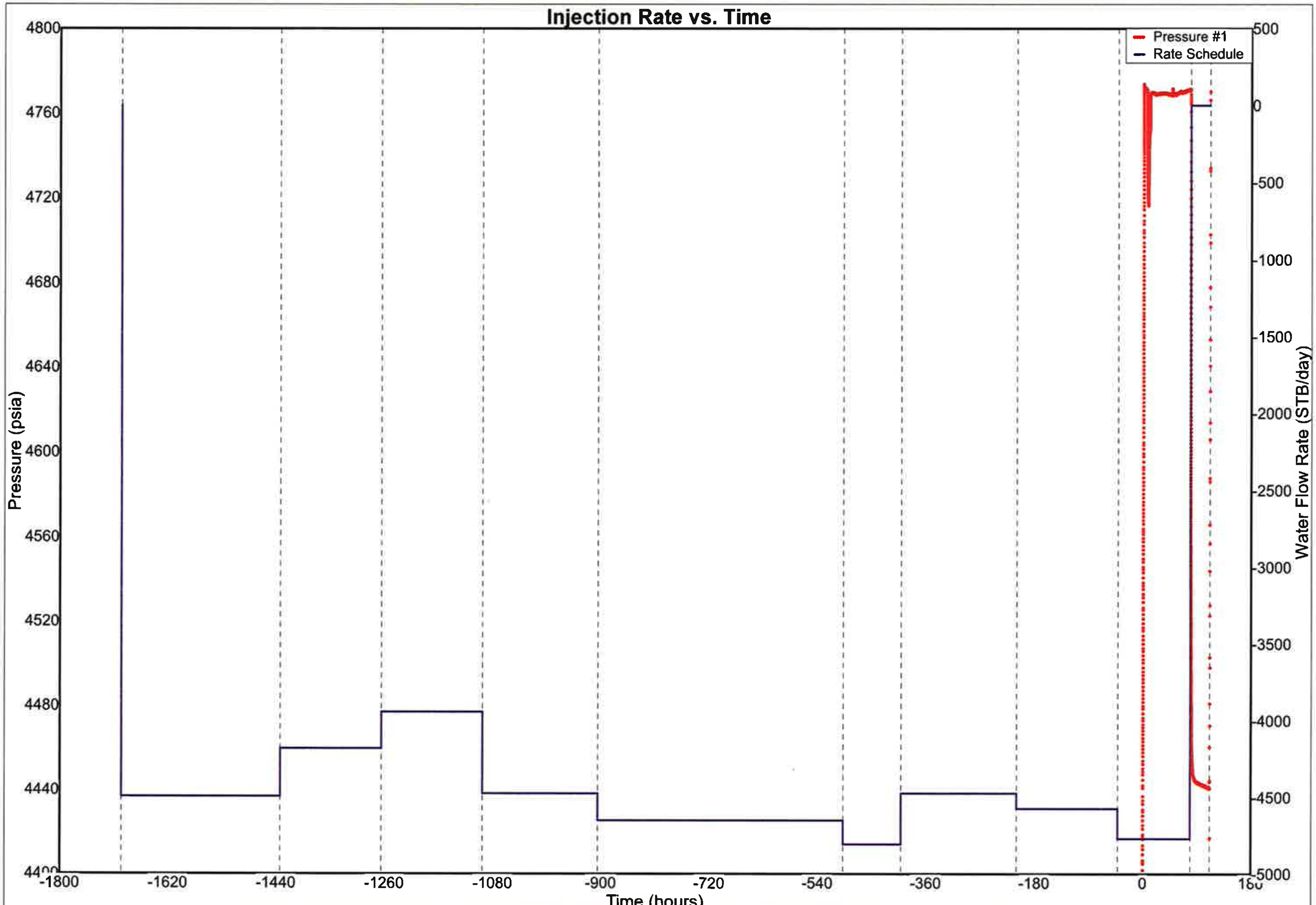
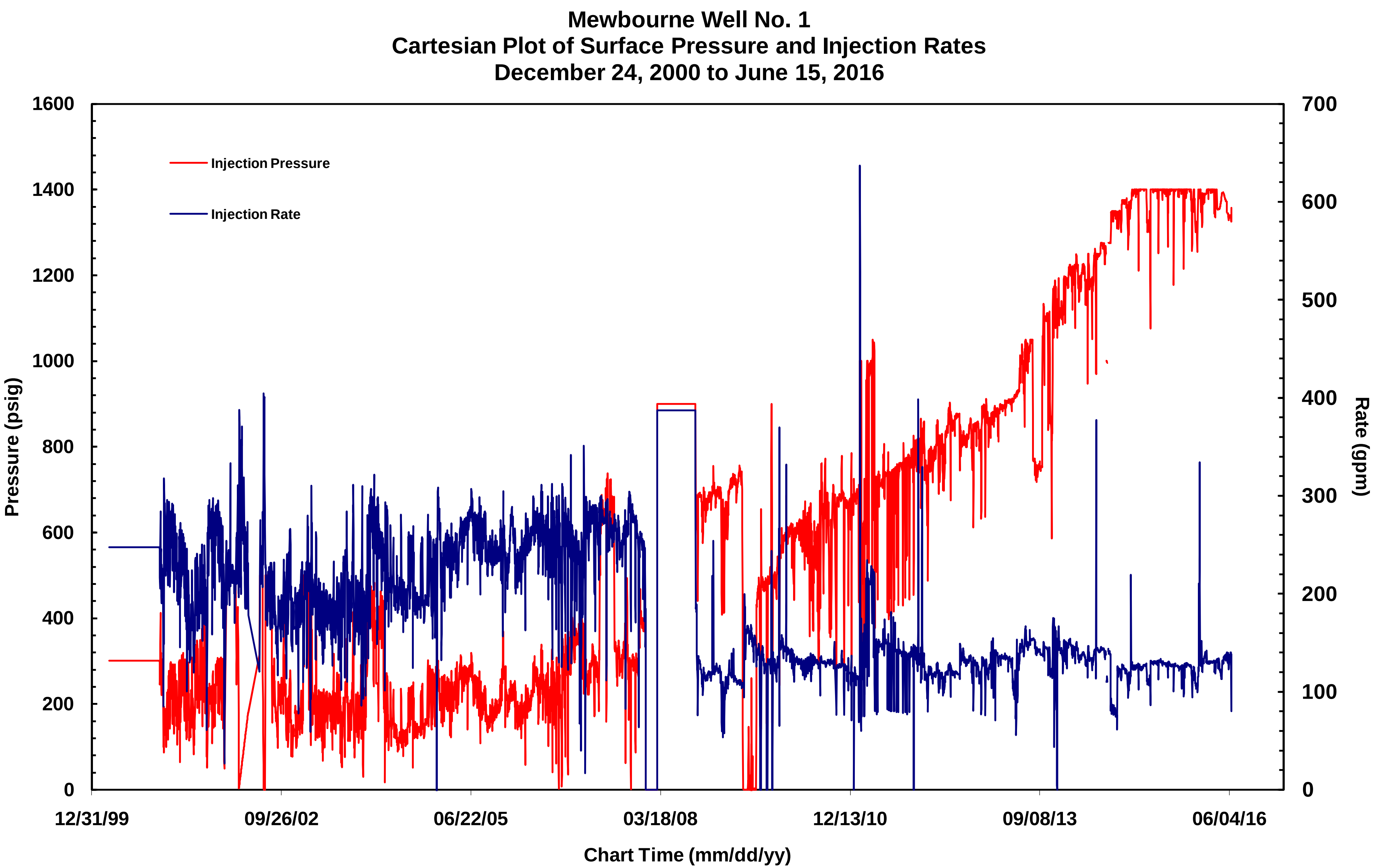

Injection Rate vs. Time
Pressure #1
Rate Schedule
Pressure (psia)
Water Flow Rate (STB/day)
Time (hours)
4800
4760
4720
4680
4640
4600
4560
4520
4480
4440
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
-4500
-5000
-1800
-1620
-1440
-1260
-1080
-900
-720
-540
-360
-180
0

FIGURE 11



Mewbourne Well No. 1
Cartesian Plot of Surface Pressure and Injection Rates
December 24, 2000 to June 15, 2016
Injection Pressure
Injection Rate
Pressure (psig)
Rate (gpm)
1600
1400
1200
1000
800
600
400
200
0
700
600
500
400
300
200
100
0
12/31/99
09/26/02
06/22/05
03/18/08
12/13/10
09/08/13
06/04/16
Chart Time (mm/dd/yy)

FIGURE 12

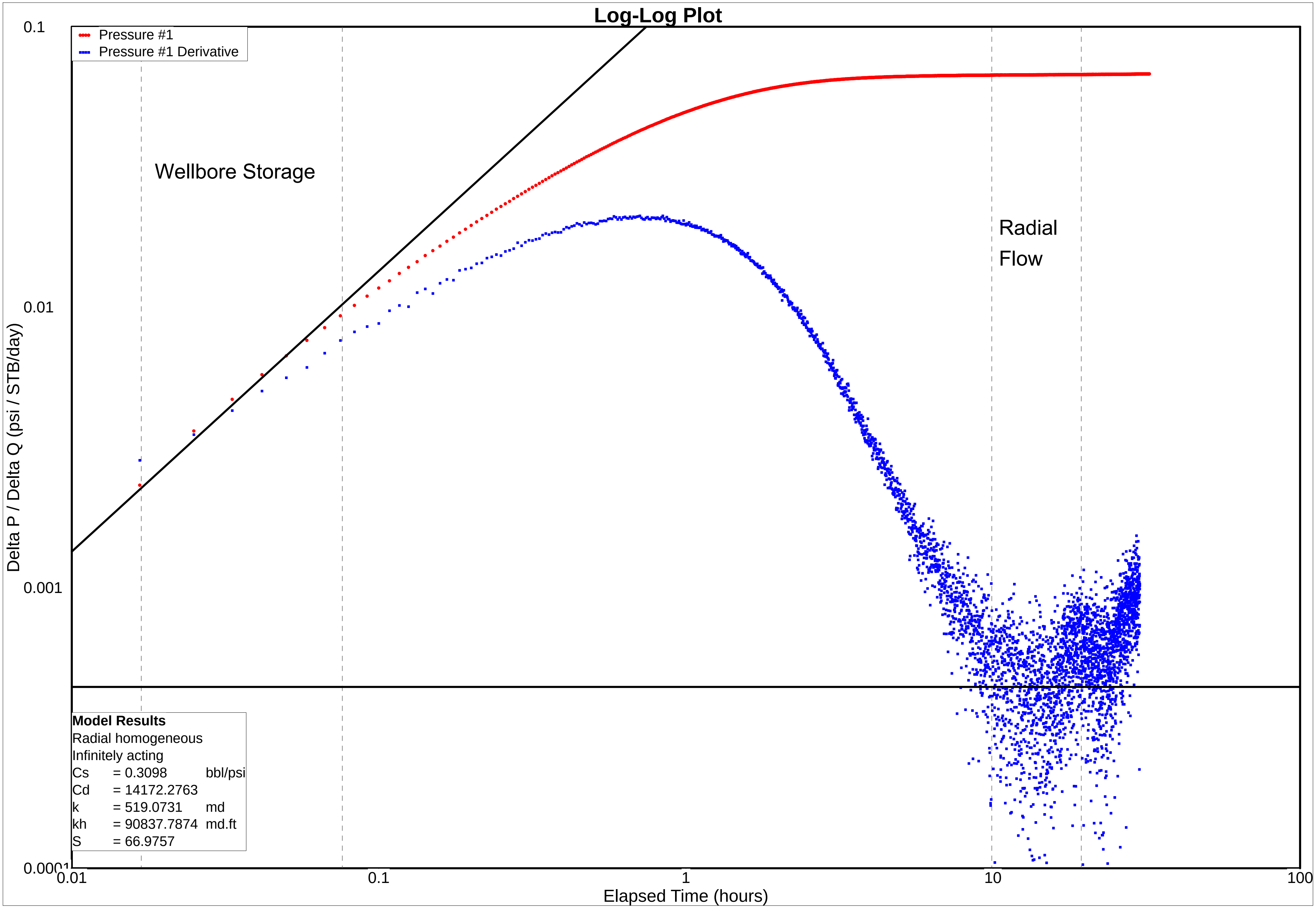
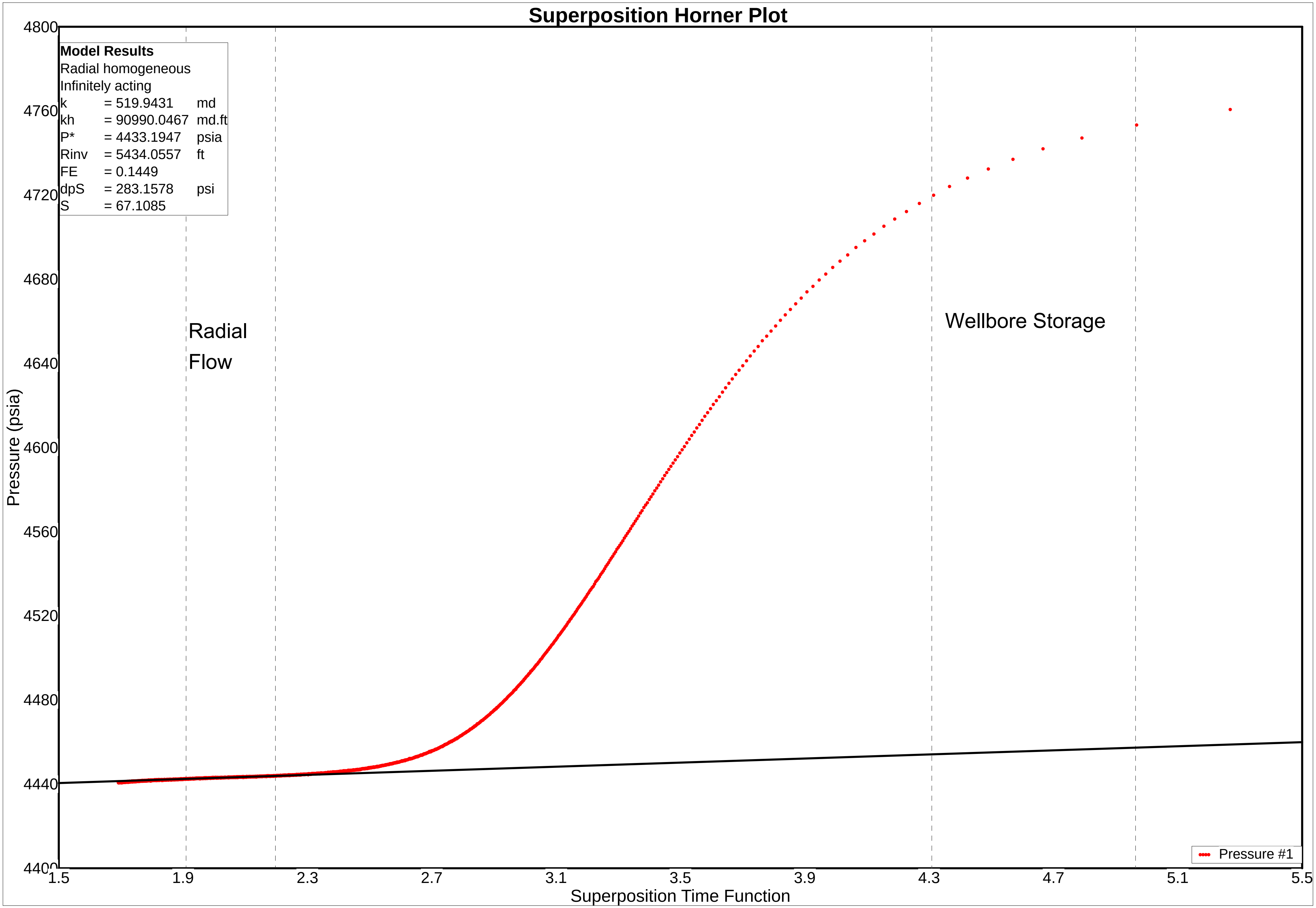

Log-Log Plot
Pressure #1
Pressure #1 Derivative
Wellbore Storage
Radial
Flow
Model Results
Radial homogeneous
Infinitely acting
Cs = 0.3098 bbl/psi
Cd = 14172.2763
k = 519.0731 md
kh = 90837.7874 md.ft
S = 66.9757
0.1
0.01
0.001
0.0001
0.01
0.1
1
10
100
Delta P / Delta Q (psi / STB/day)
Elapsed Time (hours)

FIGURE 13



Superposition Horner Plot
Model Results
Radial homogeneous
Infinitely acting
k = 519.9431 md
kh = 90990.0467 md.ft
P* = 4433.1947 psia
Rinv = 5434.0557 ft
FE = 0.1449
dpS = 283.1578 psi
S = 67.1085
Radial Flow
Wellbore Storage
Pressure (psia)
4800
4760
4720
4680
4640
4600
4560
4520
4480
4440
4400
1.5
1.9
2.3
2.7
3.1
3.5
3.9
4.3
4.7
5.1
5.5
Superposition Time Function
Pressure #1

FIGURE 14

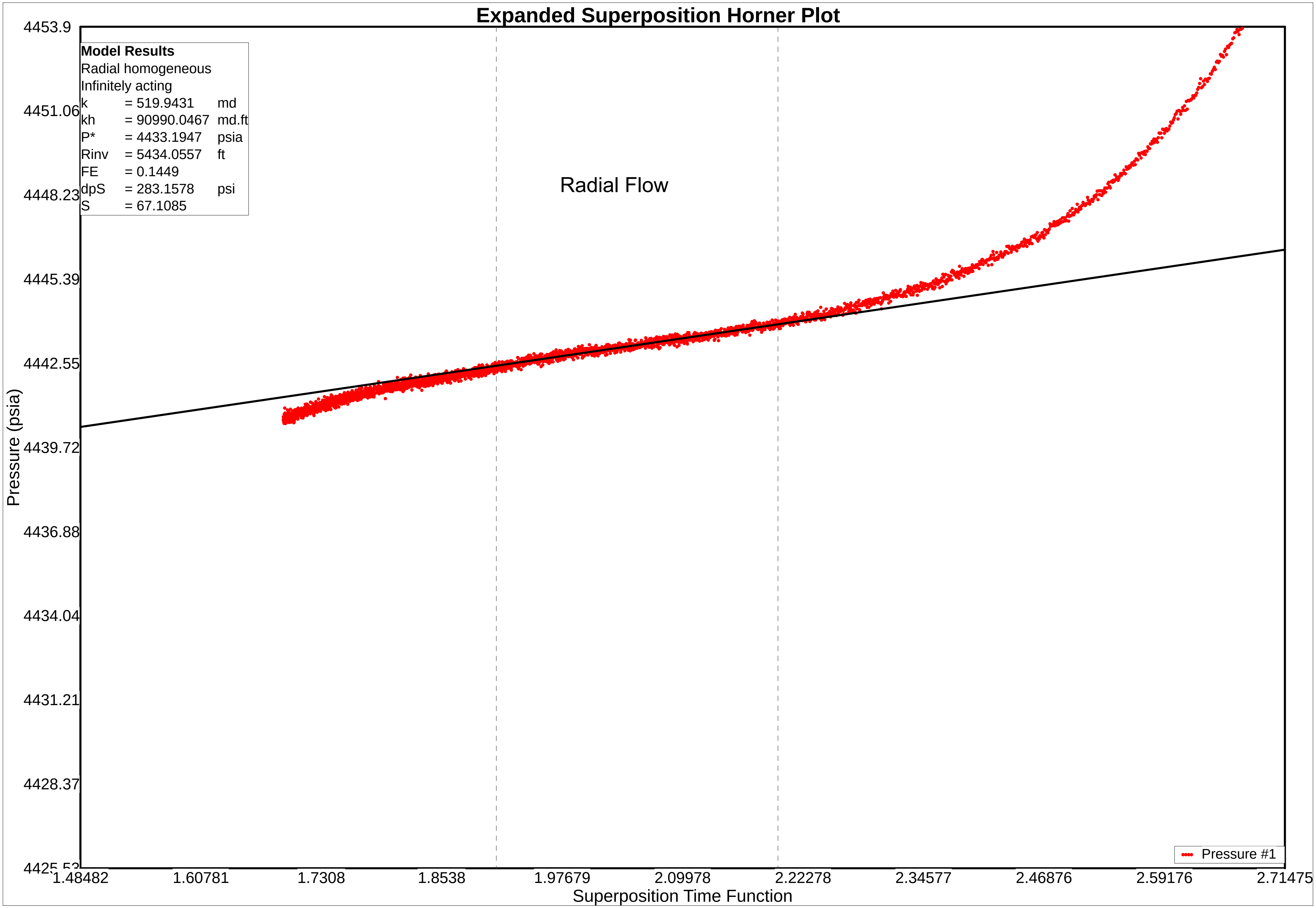

Expanded Superposition Horner Plot
Model Results
Radial homogeneous
Infinitely acting
k = 519.9431 md
kh = 90990.0467 md.ft
P* = 4433.1947 psia
Rinv = 5434.0557 ft
FE = 0.1449
dpS = 283.1578 psi
S = 67.1085
Radial Flow
Pressure #1
Pressure (psia)
4453.9
4451.06
4448.23
4445.39
4442.55
4439.72
4436.88
4434.04
4431.21
4428.37
4425.53
1.48482
1.60781
1.7308
1.8538
1.97679
2.09978
2.22278
2.34577
2.46876
2.59176
2.71475
Superposition Time Function

FIGURE 15

Navajo Refining Company
Mewbourne Well No. 1
April 21, 2016 to June 10, 2016
Hall Plot

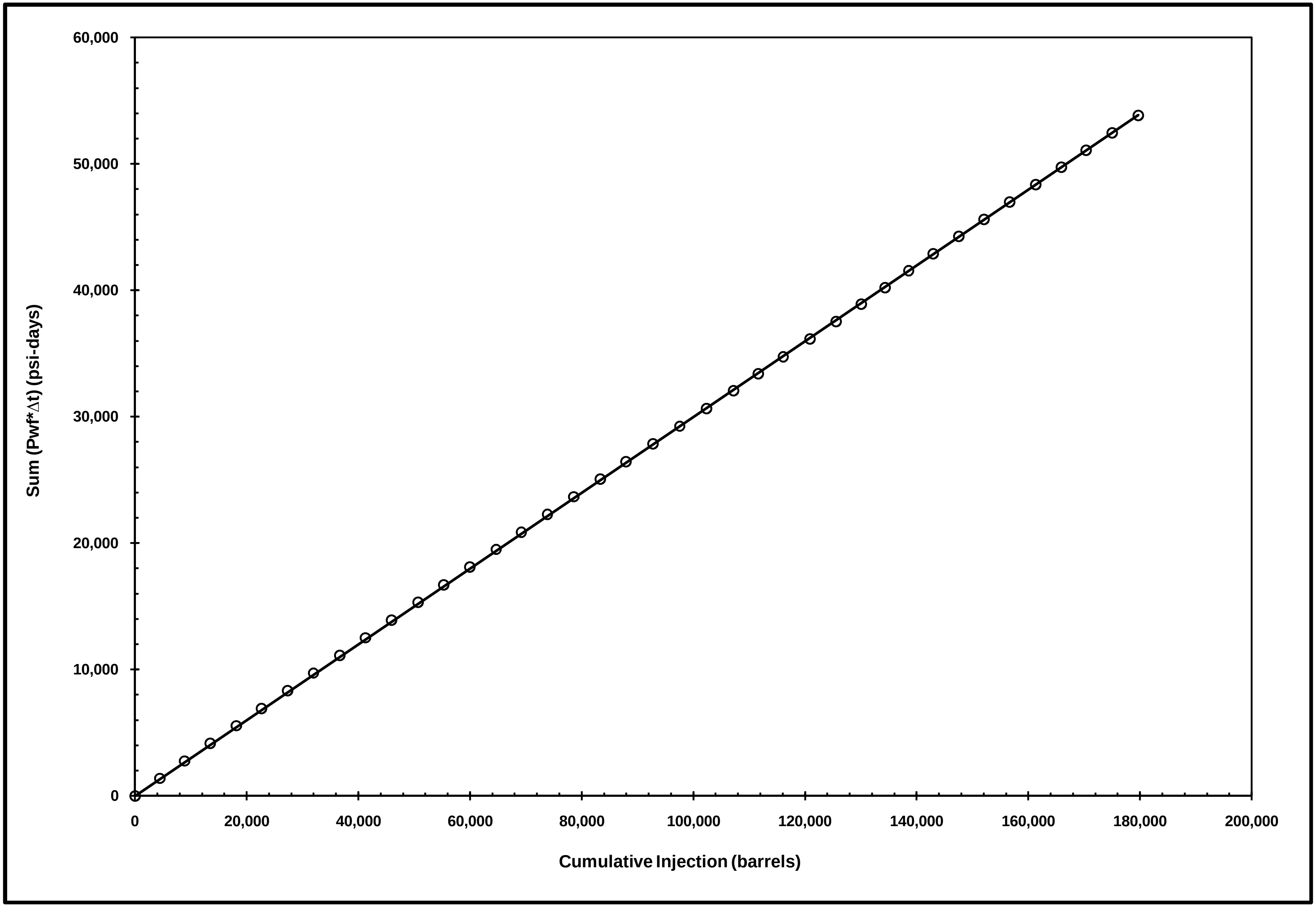
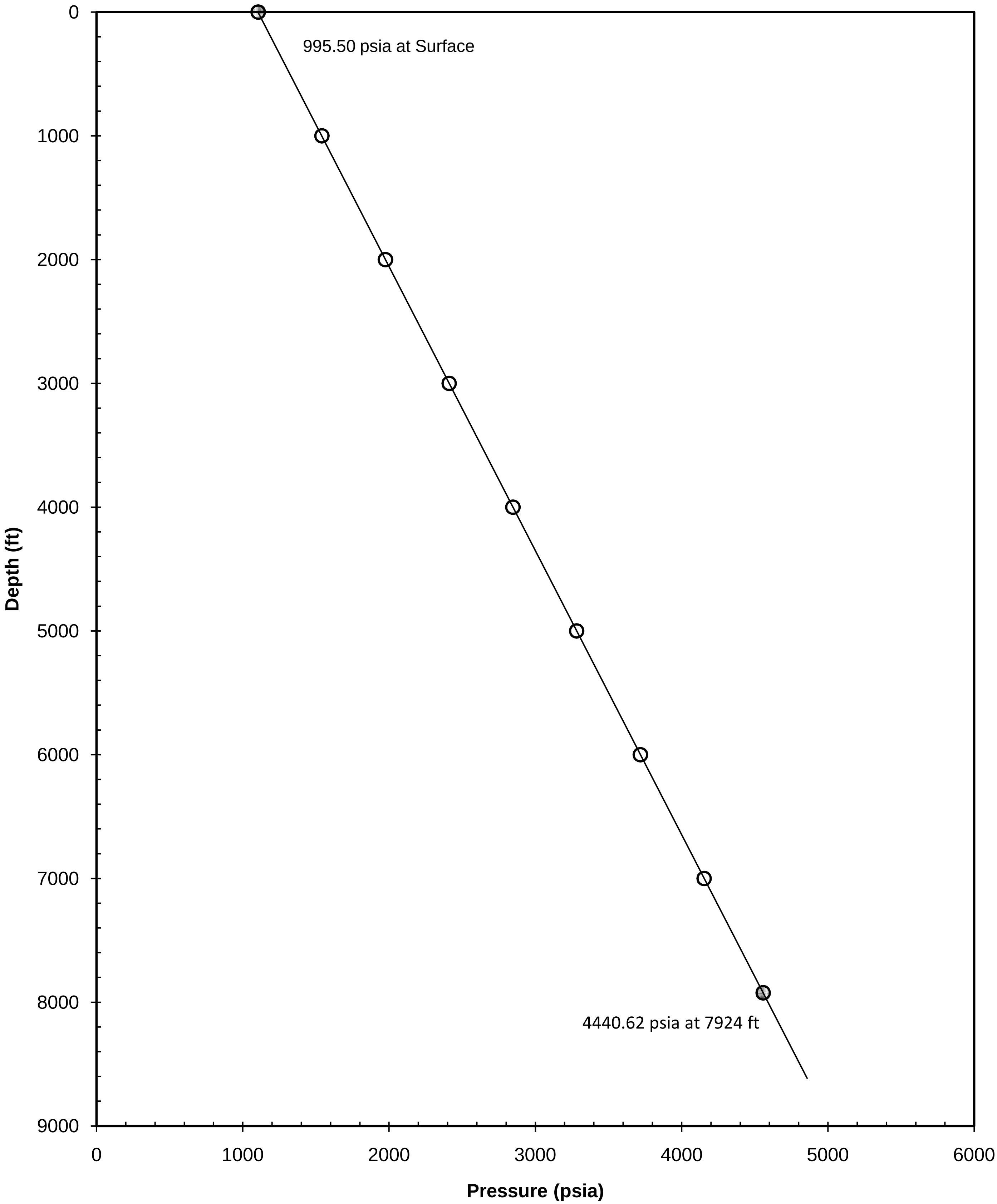


FIGURE 16

FIGURE 17

Navajo Refining Company
Static Pressure Gradient Survey
Mewbourne Well No. 1
June 15, 2016



APPENDIX A

DUAL INDUCTION LOG SECTIONS FROM 7924 FEET TO 8476 FEET

APPENDIX B

NEUTRON DENSITY LOG SECTIONS FROM 7924 FEET TO 8476 FEET

APPENDIX C

COMPRESSIBILITY OF FLUID

APPENDIX C

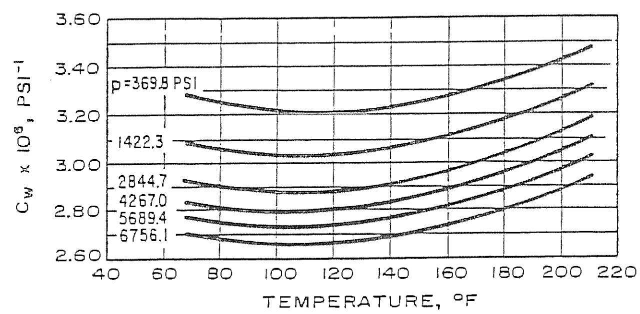


Fig. D.16 Average compressibility of distilled water. After Long and Chierici.[13]

Source: Earlougher, 1977, Advances in Well Test Analysis

COMPRESSIBILITY OF PORE VOLUME AND DISTILLED WATER

APPENDIX D

COMPRESSIBILITY OF PORE VOLUME

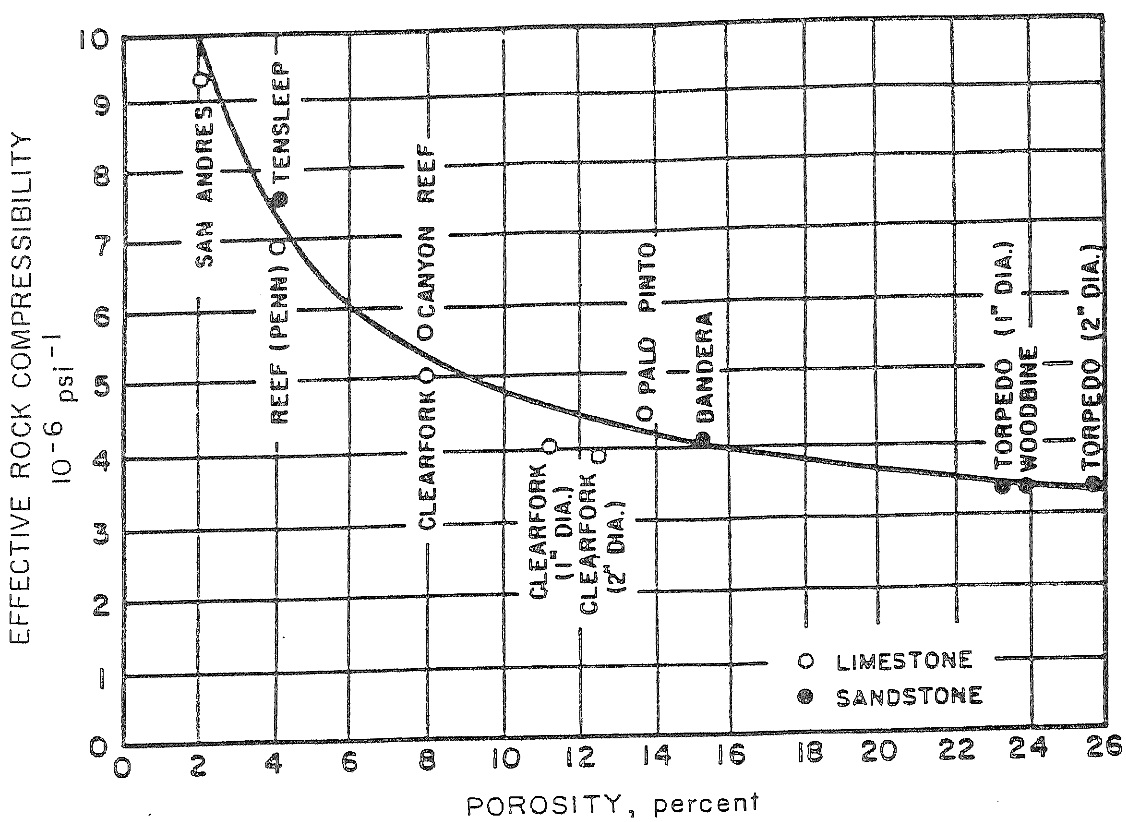


Fig. G.5 Effective formation (rock) compressibility. From Hall, *Trans.*, AIME (1953) 198, 309.

Source: Matthews and Russell, 1967, Pressure Buildup and Flow Tests in Wells

APPENDIX E

MEWBOURNE WELL NO. 1, JULY 23, 1998, TEMPERATURE LOG

APPENDIX F

WATER VOSCOSITIES AT VARIOUS SALINTIES AND TEMPERATURES

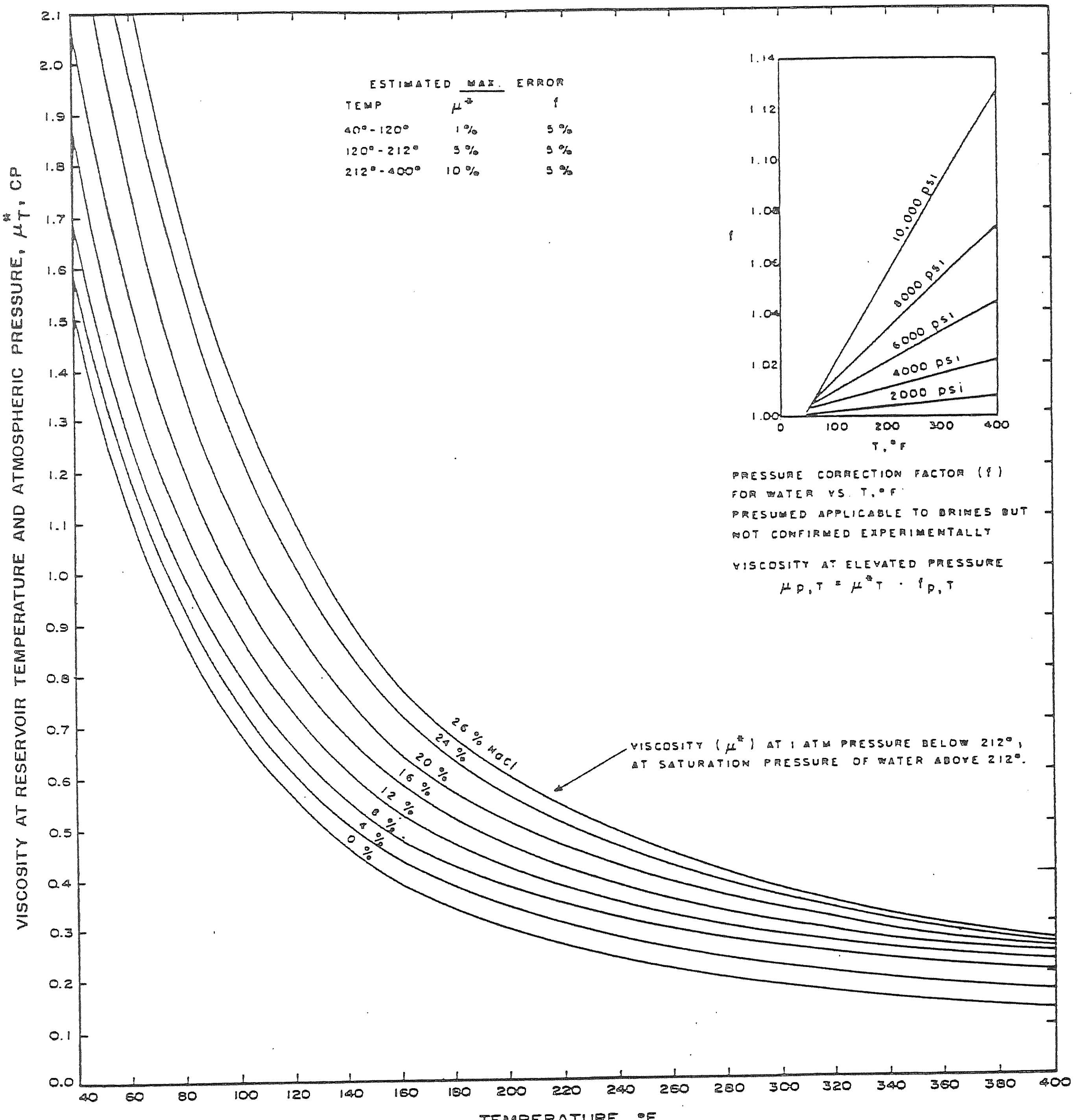


Fig. D.35 Water viscosity at various salinities and temperatures. After Matthews and Russell, data of Chesnut.[18]

FROM: Earlougher, R.C., 1977, "Advances in Well Test Analysis", SPE of AIME, Dallas, Texas

APPENDIX G

DAILY RATE HISTORY DATA

Appendix G Daily Rate History Data

Date mm/dd/yyyy	Rate gpm	Pressure psig
09/26/2015	103.17	1395.95
09/27/2015	126.91	1400.23
09/28/2015	127.08	1400.20
09/29/2015	126.32	1400.15
09/30/2015	127.02	1400.19
10/01/2015	126.83	1400.17
10/02/2015	125.87	1400.19
10/03/2015	123.44	1400.17
10/04/2015	124.35	1344.97
10/05/2015	113.46	1260.06
10/06/2015	96.54	1246.84
10/07/2015	95.28	1214.53
10/08/2015	98.51	1397.02
10/09/2015	126.69	1400.14
10/10/2015	128.54	1399.15
10/11/2015	128.11	1325.59
10/12/2015	113.75	1400.16
10/13/2015	128.97	1386.56
10/14/2015	127.39	1400.24
10/15/2015	128.23	1395.78
10/16/2015	127.64	1400.21
10/17/2015	128.70	1400.17
10/18/2015	129.11	1400.22
10/19/2015	129.18	1380.31
10/20/2015	124.88	1392.67
10/21/2015	127.19	1400.21
10/22/2015	129.23	1400.21
10/23/2015	128.53	1392.01
10/24/2015	126.67	1400.28
10/25/2015	127.97	1400.23
10/26/2015	128.91	1400.22
10/27/2015	127.33	1400.15
10/28/2015	127.58	1400.21
10/29/2015	127.31	1400.20
10/30/2015	127.30	1400.17
10/31/2015	127.95	1400.21
11/01/2015	128.08	1400.18
11/02/2015	127.91	1400.20
11/03/2015	127.97	1400.25
11/04/2015	127.38	1400.20
11/05/2015	126.27	1400.16
11/06/2015	125.69	1400.19
11/07/2015	125.88	1394.91
11/08/2015	126.80	1400.29
11/09/2015	127.67	1400.17
11/10/2015	127.29	1400.20
11/11/2015	126.37	1400.23
11/12/2015	126.79	1400.21
11/13/2015	126.96	1400.17
11/14/2015	127.19	1375.30
11/15/2015	124.33	1395.59
11/16/2015	125.48	1365.63
11/17/2015	118.50	1350.09
11/18/2015	114.77	1350.12
11/19/2015	114.93	1340.24
11/20/2015	110.51	1256.48
11/21/2015	94.27	1274.28
11/22/2015	98.66	1376.40
11/23/2015	121.27	1368.38
11/24/2015	118.73	1350.06
11/25/2015	116.10	1350.06
11/26/2015	111.72	1347.45
11/27/2015	111.53	1379.42
11/28/2015	119.78	1400.19
11/29/2015	125.50	1400.22
11/30/2015	125.08	1400.12
12/01/2015	124.71	1383.69
12/02/2015	121.93	1366.69
12/03/2015	118.02	1378.80
12/04/2015	119.92	1368.74
12/05/2015	118.07	1328.78
12/06/2015	108.91	1325.08
12/07/2015	109.16	1303.78
12/08/2015	106.99	1303.98
12/09/2015	106.18	1300.10
12/10/2015	105.54	1300.11
12/11/2015	103.15	1300.09
12/12/2015	103.38	1317.52
12/13/2015	107.92	1325.10
12/14/2015	108.08	1320.77
12/15/2015	108.09	1300.14
12/16/2015	105.45	1285.39
12/17/2015	103.48	1254.00
12/18/2015	99.35	1275.18
12/19/2015	99.26	1284.79
12/20/2015	106.18	1353.03
12/21/2015	114.58	1353.48
12/22/2015	115.61	1399.07
12/23/2015	124.46	1400.17
12/24/2015	124.09	1390.71
12/25/2015	121.06	1379.22
12/26/2015	210.55	1390.13
12/27/2015	166.49	1390.13
12/28/2015	179.78	1381.92
12/29/2015	239.49	1390.12
12/30/2015	334.25	1392.76
12/31/2015	208.87	1400.16
01/01/2016	132.34	1400.14
01/02/2016	126.91	1395.66
01/03/2016	129.14	1399.95
01/04/2016	136.09	1399.45
01/05/2016	136.07	1382.47
01/06/2016	133.00	1346.59
01/07/2016	125.99	1358.39
01/08/2016	128.16	1376.74
01/09/2016	151.76	1354.53
01/10/2016	126.60	1324.62
01/11/2016	120.56	1325.05
01/12/2016	120.29	1312.29
01/13/2016	119.88	1323.30
01/14/2016	122.86	1391.48
01/15/2016	133.57	1390.18
01/16/2016	133.20	1386.78
01/17/2016	131.96	1390.18
01/18/2016	133.08	1390.18
01/19/2016	133.57	1365.99
01/20/2016	128.76	1390.15
01/21/2016	133.69	1385.20
01/22/2016	134.46	1390.20
01/23/2016	134.37	1390.18
01/24/2016	135.87	1369.33
01/25/2016	135.55	1390.12
01/26/2016	136.85	1390.13
01/27/2016	140.76	1390.22
01/28/2016	140.35	1390.14
01/29/2016	138.26	1390.19
01/30/2016	137.52	1390.18
01/31/2016	136.23	1388.14
02/01/2016	137.91	1390.13
02/02/2016	132.27	1390.16
02/03/2016	129.78	1390.17
02/04/2016	134.92	1390.15
02/05/2016	142.00	1396.04
02/06/2016	128.84	1400.15
02/07/2016	129.60	1400.17
02/08/2016	128.74	1400.24
02/09/2016	128.95	1400.22
02/10/2016	129.03	1400.26
02/11/2016	128.83	1399.36
02/12/2016	128.70	1400.22
02/13/2016	128.78	1400.20
02/14/2016	128.59	1378.18
02/15/2016	129.05	1400.17
02/16/2016	130.87	1400.17
02/17/2016	131.14	1400.13
02/18/2016	131.20	1398.60
02/19/2016	130.73	1398.67
02/20/2016	129.95	1400.22
02/21/2016	129.63	1398.90
02/22/2016	128.43	1397.74
02/23/2016	128.91	1398.11
02/24/2016	129.02	1399.97
02/25/2016	129.97	1400.20
02/26/2016	130.74	1400.22
02/27/2016	131.28	1391.78
02/28/2016	129.81	1400.19
02/29/2016	129.88	1400.17
03/01/2016	130.63	1400.24
03/02/2016	130.20	1400.17
03/03/2016	130.40	1399.67
03/04/2016	129.71	1400.19
03/05/2016	130.55	1392.81
03/06/2016	129.30	1400.27
03/07/2016	130.79	1399.95
03/08/2016	130.70	1397.56
03/09/2016	130.27	1399.41
03/10/2016	130.70	1396.10
03/11/2016	130.73	1399.98
03/12/2016	131.73	1400.21
03/13/2016	132.06	1400.24
03/14/2016	131.97	1400.25
03/15/2016	132.14	1400.01
03/16/2016	131.84	1343.45
03/17/2016	119.79	1400.24
03/18/2016	130.80	1373.29
03/19/2016	125.07	1351.14
03/20/2016	121.70	1336.23
03/21/2016	118.90	1334.98
03/22/2016	118.62	1371.62
03/23/2016	125.55	1400.18
03/24/2016	131.90	1400.21
03/25/2016	131.74	1394.40
03/26/2016	129.79	1391.30
03/27/2016	130.55	1387.99
03/28/2016	130.23	1400.27
03/29/2016	133.06	1400.24
03/30/2016	132.06	1364.89
03/31/2016	132.75	1360.70
04/01/2016	132.02	1356.58
04/02/2016	133.47	1353.19
04/03/2016	131.59	1352.77
04/04/2016	133.43	1352.87
04/05/2016	123.76	1353.00
04/06/2016	130.10	1355.02
04/07/2016	131.32	1355.26
04/08/2016	133.86	1355.73
04/09/2016	132.55	1355.03
04/10/2016	131.56	1354.08
04/11/2016	128.31	1354.27
04/12/2016	122.23	1354.62
04/13/2016	123.19	1355.57
04/14/2016	122.70	1357.66
04/15/2016	121.17	1359.69
04/16/2016	119.48	1362.13
04/17/2016	122.17	1364.32
04/18/2016	122.80	1366.41
04/19/2016	119.23	1368.49
04/20/2016	116.89	1371.05
04/21/2016	113.99	1374.51
04/22/2016	113.12	1378.56
04/23/2016	113.40	1381.38
04/24/2016	112.95	1385.55
04/25/2016	115.68	1389.72
04/26/2016	130.00	1393.19
04/27/2016	131.04	1392.65
04/28/2016	132.00	1392.96
04/29/2016	132.33	1392.96
04/30/2016	127.88	1392.95
05/01/2016	131.88	1393.51
05/02/2016	130.57	1391.30
05/03/2016	128.75	1390.12
05/04/2016	134.43	1391.25
05/05/2016	135.23	1390.81
05/06/2016	132.40	1389.30
05/07/2016	135.71	1387.39
05/08/2016	135.12	1384.22
05/09/2016	136.80	1382.17
05/10/2016	134.88	1380.90
05/11/2016	136.68	1379.39
05/12/2016	137.25	1378.08
05/13/2016	135.05	1377.51
05/14/2016	136.14	1376.31
05/15/2016	137.71	1374.22
05/16/2016	131.50	1372.58
05/17/2016	136.25	1373.12
05/18/2016	136.94	1372.90
05/19/2016	138.61	1372.91

Appendix G Daily Rate History Data

Date	Rate	Pressure	Date	Rate	Pressure	Date	Rate	Pressure
mm/dd/yyyy	gpm	psig	mm/dd/yyyy	gpm	psig	mm/dd/yyyy	gpm	psig
05/20/2016	135.34	1372.52						
05/21/2016	140.11	1356.64						
05/22/2016	140.32	1347.15						
05/23/2016	140.18	1345.68						
05/24/2016	140.29	1345.38						
05/25/2016	129.43	1343.56						
05/26/2016	130.67	1344.06						
05/27/2016	139.77	1344.57						
05/28/2016	136.46	1341.40						
05/29/2016	131.23	1337.00						
05/30/2016	125.03	1328.23						
05/31/2016	122.79	1331.30						
06/01/2016	128.50	1334.48						
06/02/2016	133.74	1336.45						
06/03/2016	130.25	1337.56						
06/04/2016	134.23	1339.30						
06/05/2016	137.78	1340.41						
06/06/2016	132.80	1340.27						
06/07/2016	130.30	1339.23						
06/08/2016	134.63	1338.74						
06/09/2016	136.74	1337.70						
06/10/2016	140.21	1335.54						
06/11/2016	140.24	1332.42						
06/12/2016	139.34	1328.65						
06/13/2016	80.00	1324.99						
06/14/2016	110.70	1345.52						
06/15/2016	138.27	1357.06						

APPENDIX H

GAUGE CALIBRATION SHEETS

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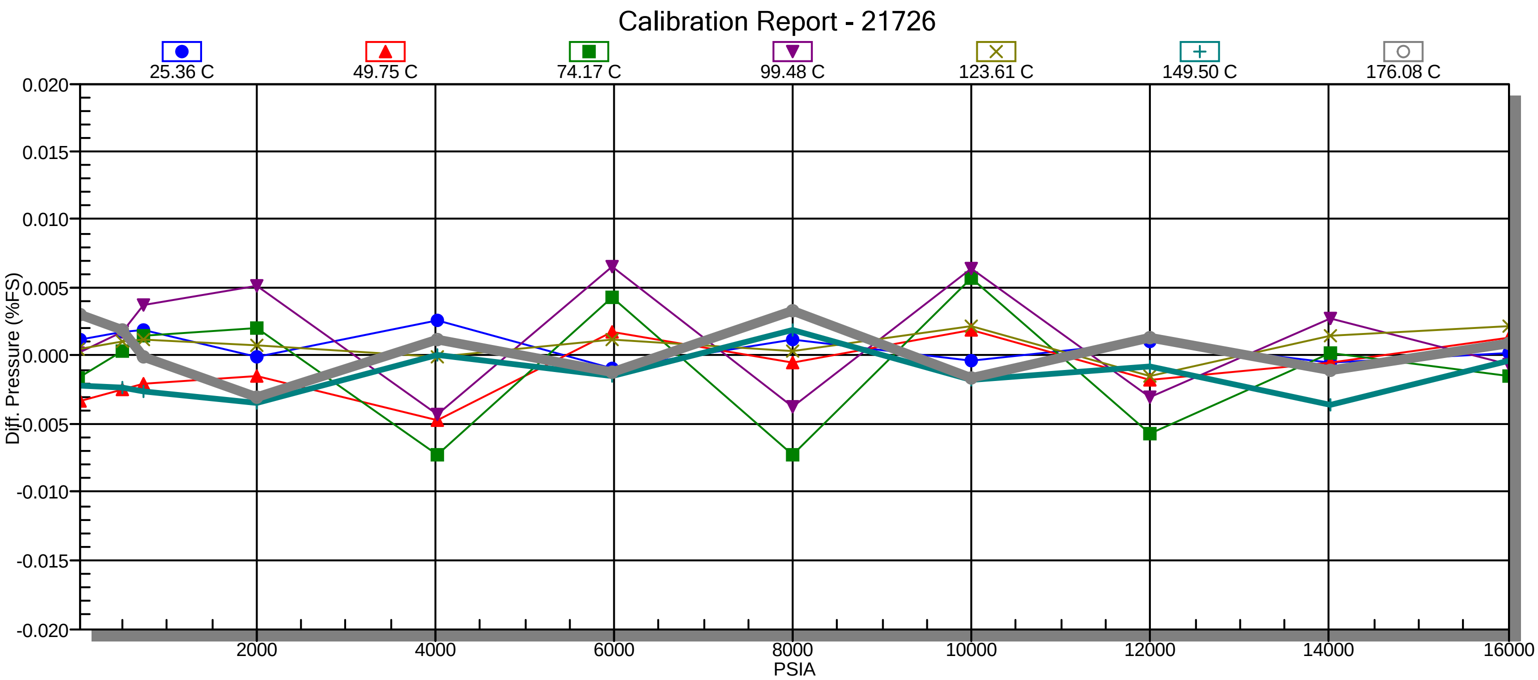
Pressure Gauge Certificate of Calibration



GAUGE NUMBER: 21726

2-D POLYNOMIAL LMS CURVEFIT

	Pres	Temp	
Source of f:	Pres	Temp	Pressure Equation:
Fit Order:	3	3	Pressure (PSI) = A + xp(B + xp(C + xp(D)))
Prescale:	xp = m * (fp - fp0)	xt = m * (ft - ft0)	
m:	0.01	0.01	Temperature Compensation:
	fp0 = 16759	ft0 = 64464	A = A0 + xt(A1 + xt(A2 + xt(A3 + xt(A4))))
			B = B0 + xt(B1 + xt(B2 + xt(B3 + xt(B4))))
			C = C0 + xt(C1 + xt(C2 + xt(C3 + xt(C4))))
			D = D0 + xt(D1 + xt(D2 + xt(D3 + xt(D4))))

0	1	2	3	4
Pressure (psi) STANDARD FIT COEFFICIENTS:				
A 13.09857717	0.127974273	-0.0186245155	1.046101332E-05	41.65885005
B -0.02111438644	2.462165166E-05	-5.793793432E-08	-0.001862508604	1.174064763E-05
C -2.608216969E-08	6.391731223E-11	4.460150877E-07	-6.422382048E-09	1.390778757E-11
D -2.509008954E-14	1	-13.5	25.33	176.11
Temperature (C) STANDARD FIT COEFFICIENTS				
A 25.4075362				
B -0.723763381				
C -0.0008530980666				
D -6.801162841E-07				

Error File: Gauge # 21726

Pressure psi	Temperature Deg. C	Count (Pres)	Count (Temp)	DIFF (press) psi
13.14	25.36	16759.58	64464.11	0.20
506.90	25.40	17945.65	64463.05	0.28
740.66	25.38	18507.57	64465.61	0.30
1992.36	25.39	21520.14	64466.13	-0.02
4010.72	25.33	26396.85	64468.40	0.42
5985.66	25.40	31185.37	64464.48	-0.14
8006.60	25.34	36107.33	64466.94	0.19
9993.61	25.35	40963.28	64463.78	-0.07
11996.07	25.37	45876.52	64463.48	0.18
14010.78	25.38	50836.37	64464.11	-0.08
16001.81	25.41	55755.36	64462.74	0.02
13.15	49.75	16823.05	60969.38	-0.54
506.91	49.75	17987.91	60970.17	-0.39
740.67	49.71	18539.91	60970.00	-0.33
1992.38	49.72	21500.59	60971.49	-0.23
4010.75	49.73	26292.40	60970.50	-0.74
5985.69	49.72	31007.22	60970.83	0.28
8006.64	49.77	35850.39	60965.11	-0.07
9993.65	49.74	40635.70	60970.02	0.30
11996.11	49.74	45475.78	60968.01	-0.27
14010.83	49.73	50367.00	60965.86	-0.07
16001.85	49.74	55219.50	60964.93	0.21
13.12	74.17	17020.30	57135.56	-0.26
506.88	74.13	18160.96	57136.28	0.06
740.64	74.15	18701.56	57138.37	0.25
1992.34	74.11	21601.25	57140.60	0.33
4010.72	74.18	26296.00	57137.43	-1.17
5985.66	74.16	30923.44	57136.78	0.69
8006.62	74.13	35675.53	57134.25	-1.15
9993.63	74.12	40381.43	57138.07	0.90
11996.10	74.18	45137.45	57133.32	-0.92
14010.82	74.14	49952.23	57138.42	0.04
16001.85	74.13	54727.45	57135.74	-0.24
13.12	99.48	17402.82	52764.11	0.03
506.89	99.49	18513.60	52765.01	0.28
740.64	99.44	19040.47	52766.66	0.59
1992.35	99.42	21866.83	52769.57	0.81
4010.73	99.46	26447.35	52762.61	-0.69
5985.69	99.49	30966.64	52766.79	1.05
8006.65	99.47	35613.60	52761.18	-0.60
9993.67	99.42	40218.28	52766.21	1.02
11996.15	99.47	44878.26	52762.29	-0.47
14010.88	99.44	49598.31	52764.78	0.44
16001.91	99.46	54282.83	52763.30	-0.09
13.12	123.61	17978.62	48174.80	0.09
506.88	123.58	19055.91	48175.42	0.16
740.64	123.55	19566.85	48174.89	0.19
1992.34	123.56	22310.53	48176.23	0.12
4010.72	123.59	26766.17	48172.09	0.00
5985.66	123.59	31161.53	48176.51	0.18
8006.61	123.57	35694.26	48169.28	0.06
9993.61	123.56	40184.20	48178.46	0.34
11996.09	123.54	44738.58	48170.05	-0.24
14010.80	123.56	49353.01	48174.25	0.23
16001.83	123.57	53939.45	48172.15	0.36
13.14	149.50	18879.80	42723.01	-0.34
506.90	149.50	19915.53	42721.54	-0.37
740.66	149.46	20406.01	42725.10	-0.42
1992.36	149.44	23046.06	42726.60	-0.56
4010.74	149.45	27341.17	42727.88	0.00
5985.68	149.45	31584.06	42729.59	-0.23
8006.64	149.51	35969.30	42724.43	0.31
9993.64	149.50	40316.58	42727.97	-0.29
11996.11	149.49	44736.68	42721.54	-0.12
14010.83	149.46	49217.30	42725.13	-0.58
16001.86	149.47	53679.47	42721.21	-0.05
13.18	176.08	20177.19	36469.09	0.49
506.94	176.11	21162.22	36468.21	0.30
740.70	176.04	21629.28	36467.58	-0.01
1992.40	176.04	24142.94	36471.28	-0.49

4010.76	176.06	28242.32	36470.96	0.20
5985.71	176.08	32300.04	36471.41	-0.18
8006.65	176.10	36503.31	36468.08	0.54
9993.66	176.04	40677.92	36472.38	-0.26
11996.12	176.11	44931.99	36469.42	0.21
14010.84	176.02	49251.81	36472.07	-0.16
16001.86	176.07	53560.72	36466.48	0.16

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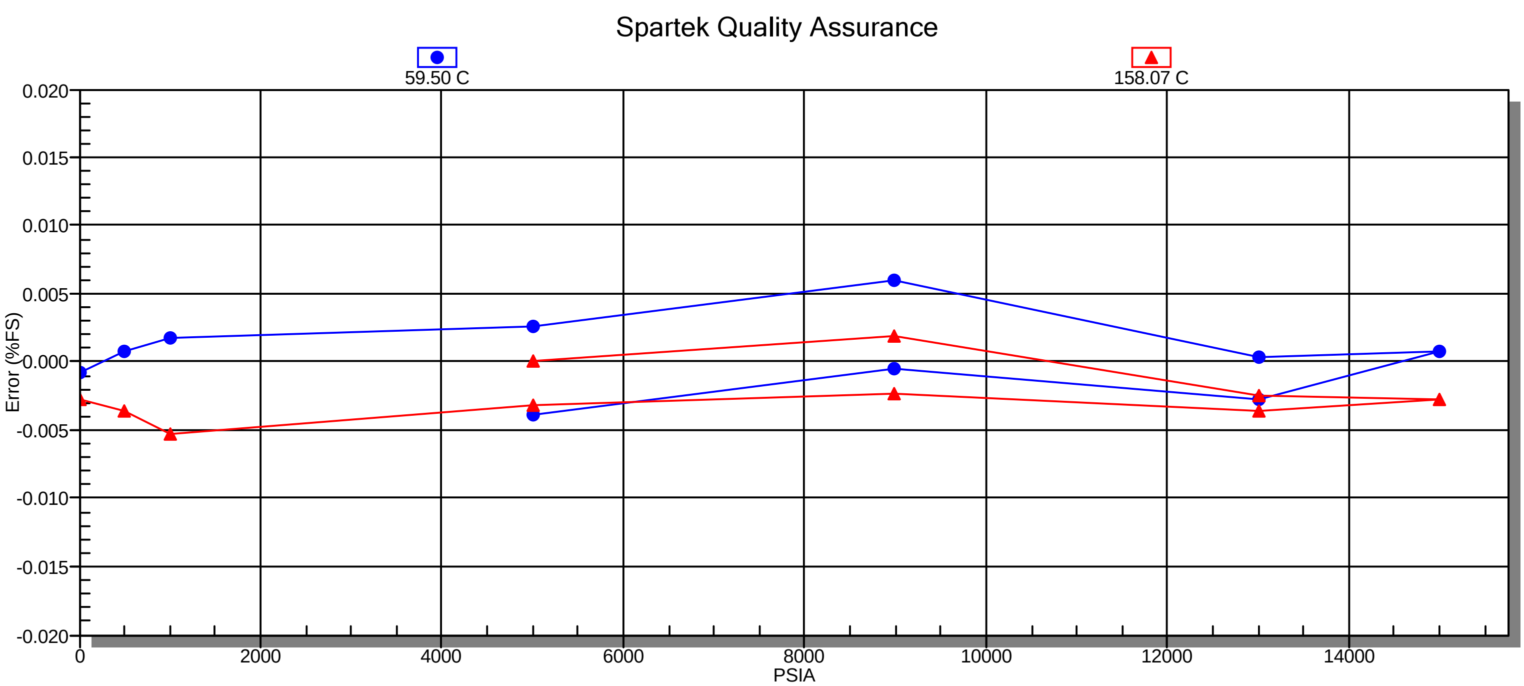
Pressure Gauge Certificate of Conformance

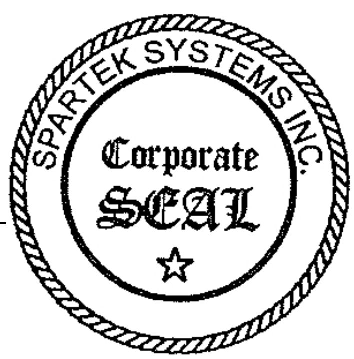
SERIAL NUMBER	21726	CALIBRATION DATE	JUN 01/15
MODEL NUMBER	1251 FF3	TRACEABILITY DOC.	CAL-STANDARD-001
PRESSURE RANGE	13.14 - 16001.81 psi	PRESSURE REFERENCE	NIST Traceable
TEMP. RANGE	25.36 - 176.08 °C	TEMP. REFERENCE	NIST Traceable

Testing and Verification Completed on JUN 02/15. The instrument response is within the stated specifications for this type of pressure gauge.

As shown in the graph below, this Spartek Gauge conformed to within +/- 0.020 %F.S. of the pressure standard used in calibration, which is accurate to within +/- 0.01% of reading. This gives an overall accuracy of +/-(0.020%F.S. + 0.01% of reading)

NOTE
Units calibrated with a bellows meet performance specifications from 200 psi to full scale. Operating range is from 0 to full scale.





Accepted By: ______

Date: JUN 05/15

Ramp report: Serial # 21726
Gauge range = 16001.910 PSI. Max. DIFF. = 3.200
Ramp check result: PASS, Max Err = 0.006% F.S.

DW Pressure	Gauge Pressure	RPM4 Pressure	Differential	%F.S.	Oven Temp.	Gauge Temp.
4999.88	4999.25	4999.83	-0.63	0.0039	59.50	59.45
8990.61	8990.54	8990.19	-0.07	0.0004	59.50	59.46
12997.68	12997.25	12996.95	-0.43	0.0027	59.47	59.46
14999.84	14999.96	14998.87	0.12	0.0007	59.48	59.46
12997.68	12997.73	12996.82	0.05	0.0003	59.51	59.45
8990.61	8991.58	8990.29	0.97	0.0061	59.49	59.45
4999.87	5000.28	4999.80	0.41	0.0026	59.45	59.45
1002.92	1003.21	1003.08	0.29	0.0018	59.44	59.45
506.88	507.00	507.10	0.12	0.0008	59.48	59.45
13.11	13.00	13.11	-0.11	0.0007	59.51	59.46
4999.91	4999.92	4999.87	0.01	0.0001	158.07	158.01
8990.64	8990.93	8990.08	0.29	0.0018	158.12	158.02
12997.70	12997.31	12996.87	-0.39	0.0024	158.08	158.03
14999.87	14999.44	14998.81	-0.43	0.0027	158.10	158.02
12997.70	12997.13	12996.84	-0.57	0.0036	158.08	158.01
8990.63	8990.26	8990.23	-0.37	0.0023	158.08	157.99
4999.90	4999.40	4999.84	-0.50	0.0031	158.07	157.99
1002.95	1002.10	1003.05	-0.85	0.0053	158.02	157.97
506.91	506.34	507.14	-0.57	0.0036	158.05	157.98
13.15	12.72	13.25	-0.43	0.0027	158.01	157.97

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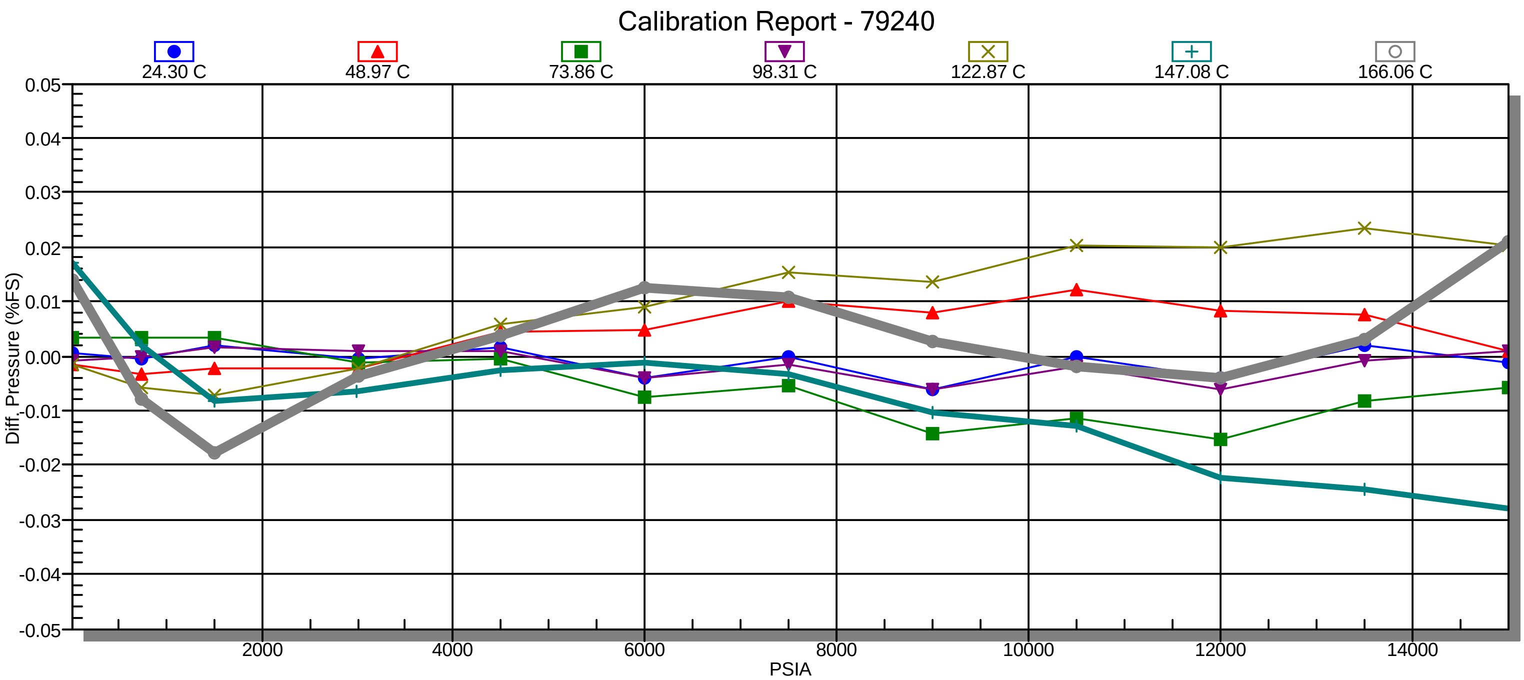

GAUGE NUMBER: 79240

2-D POLYNOMIAL LMS CURVEFIT

Source of f:	Pres	Temp	Pressure Equation:
Fit Order:	3	4	Pressure (PSI) = A + xp(B + xp(C + xp(D)))
Prescale:	xp = m * (fp - fp0)	xt = m * (ft - ft0)	
m:	0.01	0.01	Temperature Compensation:
	fp0 = 706553	ft0 = 169216	A = A0 + xt(A1 + xt(A2 + xt(A3 + xt(A4))))
			B = B0 + xt(B1 + xt(B2 + xt(B3 + xt(B4))))
			C = C0 + xt(C1 + xt(C2 + xt(C3 + xt(C4))))
			D = D0 + xt(D1 + xt(D2 + xt(D3 + xt(D4))))

Pressure (psi) STANDARD FIT COEFFICIENTS:

0	1	2	3	4
A 15.06048423	0.1062621715	0.0006790385736	2.808885004E-06	3.612388973E-09
B 4.349500759	-0.002783187053	5.350177499E-07	1.29123029E-10	3.256089021E-12
C -2.079242425E-05	-1.117988109E-07	-1.865025164E-09	-7.893310697E-12	-1.042701479E-14
D 4.069851823E-10	2.993582973E-11	4.839127738E-13	2.04517194E-15	2.658842901E-18

Temperature (C) STANDARD FIT COEFFICIENTS

A 24.37226014

B -0.2791985605

C 7.045336281E-05

D -2.514563987E-08

Error File: Gauge # 79240

Pressure psi	Temperature Deg. C	Count (Pres)	Count (Temp)	DIFF (press) psi
15.00	24.30	706553.33	169216.75	0.08
750.00	24.36	723464.50	169252.00	-0.10
1500.00	24.33	740763.17	169251.13	0.31
3000.00	24.22	775432.17	169287.50	-0.10
4500.00	24.32	810214.17	169274.88	0.23
6000.00	24.34	845094.50	169285.63	-0.61
7500.00	24.48	880059.83	169242.38	-0.02
9000.00	24.39	915109.17	169222.63	-0.93
10500.00	24.46	950202.50	169144.75	-0.03
12000.00	24.36	985373.00	169090.50	-0.60
13500.00	24.51	1020545.17	168982.75	0.30
15000.00	24.40	1055782.67	168894.00	-0.20
15.05	48.97	706672.00	160659.75	-0.21
750.00	48.95	722686.67	160691.75	-0.49
1500.00	49.08	739062.33	160687.75	-0.32
3000.00	49.03	771895.00	160731.63	-0.34
4500.15	49.12	804832.50	160720.13	0.66
6000.00	49.15	837856.83	160739.13	0.70
7500.00	49.05	870948.33	160703.88	1.52
9000.00	49.03	904126.17	160695.00	1.21
10500.00	49.05	937345.17	160638.00	1.85
12000.00	49.10	970631.67	160597.50	1.22
13500.00	49.02	1003926.00	160515.38	1.12
15000.00	48.99	1037276.50	160443.75	0.11
15.05	73.86	706753.50	152254.50	0.51
750.00	73.80	721956.33	152282.00	0.51
1500.00	73.78	737495.50	152283.88	0.51
3000.00	73.78	768648.00	152327.38	-0.19
4500.00	73.95	799893.83	152314.25	-0.10
5999.95	73.84	831234.50	152348.63	-1.11
7500.00	73.88	862627.17	152306.13	-0.80
9000.00	73.80	894104.83	152315.00	-2.13
10500.00	73.81	925604.50	152256.88	-1.69
12000.00	73.98	957191.67	152240.88	-2.29
13500.00	73.91	988769.33	152168.63	-1.24
15000.00	73.84	1020403.00	152118.50	-0.85
15.05	98.31	706822.33	144288.38	-0.14
750.00	98.31	721285.17	144315.38	-0.04
1500.00	98.35	736069.67	144315.13	0.22
3000.00	98.33	765707.67	144358.63	0.12
4500.00	98.49	795419.83	144351.50	0.13
6000.00	98.27	825218.67	144378.63	-0.62
7500.00	98.46	855072.83	144349.50	-0.22
9000.00	98.40	885010.83	144362.13	-0.93
10500.00	98.39	914966.50	144315.00	-0.31
12000.00	98.32	945004.67	144310.63	-0.93
13500.00	98.55	975017.67	144243.50	-0.12
15000.00	98.30	1005120.67	144216.25	0.13
15.05	122.87	706901.83	136781.88	-0.26
750.00	122.92	720665.17	136806.38	-0.87
1500.05	123.06	734737.83	136804.63	-1.10
3000.00	122.86	762976.00	136846.88	-0.34
4500.00	122.91	791285.00	136836.25	0.88
6000.00	123.01	819679.00	136868.50	1.35
7500.00	122.98	848108.50	136842.25	2.28
8999.95	122.95	876621.83	136861.75	2.02
10500.05	122.95	905158.67	136824.13	3.05
12000.00	122.92	933760.83	136815.63	2.96
13500.00	123.23	962364.17	136767.88	3.51
15000.00	122.91	991036.17	136748.00	3.03
15.15	147.08	706979.33	129830.13	2.58
750.00	147.12	720076.50	129852.88	0.31
1500.00	147.02	733478.67	129851.25	-1.22
2999.95	147.02	760418.50	129891.00	-1.00
4500.00	147.18	787432.17	129878.63	-0.37
6000.00	147.39	814540.33	129912.13	-0.18
7500.00	147.14	841670.50	129891.00	-0.49
9000.00	147.14	868890.67	129913.75	-1.56
10500.00	147.23	896110.17	129874.25	-1.95
12000.00	147.05	923422.33	129885.25	-3.38

13500.00	147.16	950713.83	129840.13	-3.68
15000.05	147.20	978091.33	129830.75	-4.20
15.10	166.06	706900.33	124222.75	2.07
750.00	165.85	719464.33	124239.00	-1.17
1500.00	166.23	732347.33	124240.75	-2.67
3000.00	165.99	758301.67	124278.50	-0.55
4500.00	166.15	784327.67	124267.00	0.54
6000.00	166.31	810482.00	124306.00	1.87
7500.00	166.32	836644.00	124282.75	1.63
9000.00	166.23	862907.00	124317.50	0.41
10500.00	166.30	889152.00	124279.50	-0.28
12000.00	165.93	915495.33	124290.25	-0.59
13500.00	166.21	941814.00	124254.00	0.44
15000.00	166.16	968210.33	124248.25	3.16

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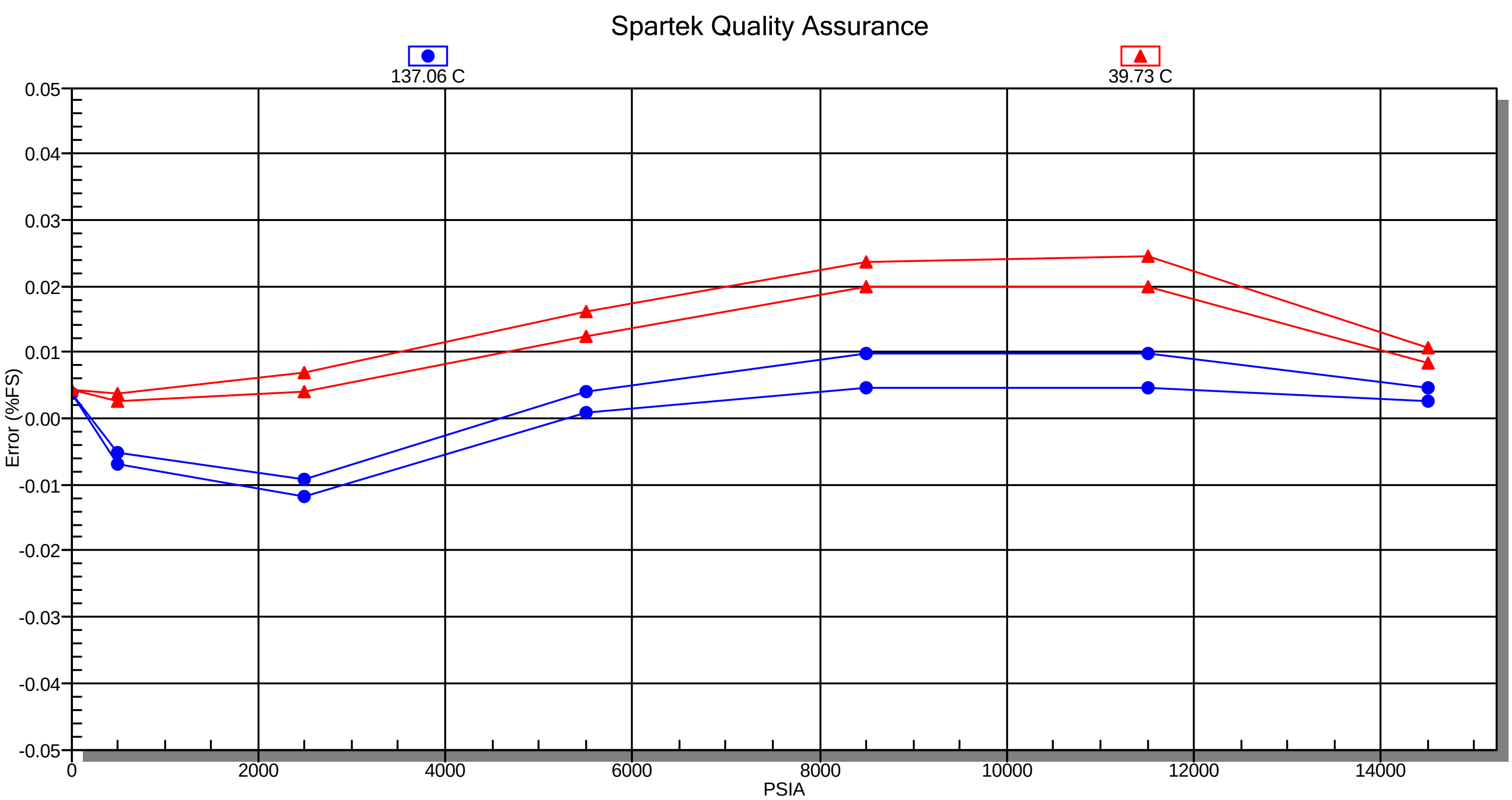
Pressure Gauge Certificate of Conformance

SERIAL NUMBER	79240	CALIBRATION DATE	MAR 09/16
MODEL NUMBER	1227 FF3	TRACEABILITY DOC.	CAL-STANDARD-001
PRESSURE RANGE	15.00 - 15000.00 psi	PRESSURE REFERENCE	NIST Traceable
TEMP. RANGE	24.30 - 166.06 °C	TEMP. REFERENCE	NIST Traceable

Testing and Verification Completed on MAR 03/16. The instrument response is within the stated specifications for this type of pressure gauge.

As shown in the graph below, this Spartek Gauge conformed to within +/- 0.050 %F.S. of the pressure standard used in calibration, which is accurate to within +/- 0.01% of reading. This gives an overall accuracy of +/-(0.050%F.S. + 0.01% of reading)



Accepted By:

Date: MAR 16/16

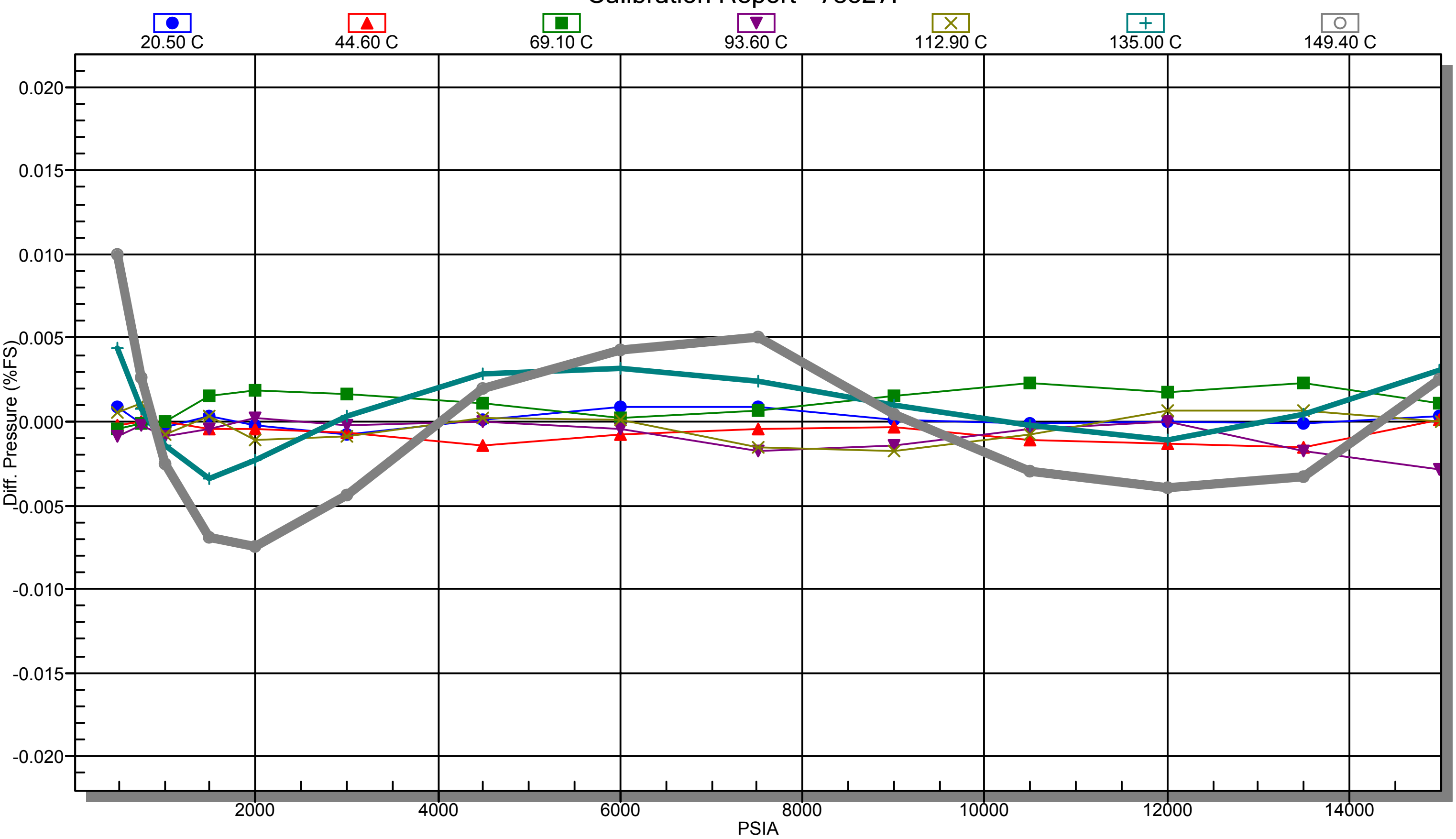
Ramp report: Serial # 79240
Gauge range = 15000.050 PSI. Max. DIFF. = 7.500
Ramp check result: PASS, Max Err = 0.025% F.S.

DW Pressure	Gauge Pressure	RPM4 Pressure	Differential	%F.S.	Oven Temp.	Gauge Temp.
14500.00	14500.39	14500.07	0.39	0.0026	137.06	137.38
11500.00	11500.68	11500.26	0.68	0.0045	137.09	137.19
8500.00	8500.70	8500.30	0.70	0.0047	136.76	137.09
5500.00	5500.14	5500.39	0.14	0.0009	136.89	137.09
2500.00	2498.21	2500.12	-1.79	0.0119	136.79	137.20
500.00	498.95	499.75	-1.05	0.0070	137.01	137.33
15.10	15.67	14.68	0.57	0.0038	136.81	137.40
500.00	499.20	499.72	-0.80	0.0053	136.89	137.36
2500.00	2498.63	2499.96	-1.37	0.0092	137.05	137.28
5500.00	5500.59	5500.21	0.59	0.0039	137.05	137.18
8500.00	8501.48	8500.09	1.48	0.0099	137.07	137.18
11500.00	11501.45	11500.07	1.45	0.0097	137.10	137.29
14500.00	14500.70	14499.99	0.70	0.0047	136.94	137.43
14500.00	14501.25	14500.03	1.25	0.0083	39.73	39.56
11500.00	11502.99	11500.21	2.99	0.0199	39.65	39.12
8500.00	8502.98	8500.19	2.98	0.0199	39.63	38.82
5500.00	5501.84	5500.28	1.84	0.0123	39.71	38.71
2500.00	2500.59	2499.95	0.59	0.0039	39.78	38.78
500.00	500.40	499.66	0.40	0.0027	39.73	38.92
15.00	15.65	14.58	0.65	0.0044	39.89	38.97
500.00	500.55	499.71	0.55	0.0036	39.78	38.94
2500.00	2501.06	2500.03	1.06	0.0070	39.88	38.83
5500.00	5502.42	5500.22	2.42	0.0161	39.80	38.79
8500.00	8503.54	8500.11	3.54	0.0236	39.83	38.91
11500.00	11503.68	11500.06	3.68	0.0246	39.85	39.20
14500.00	14501.59	14500.12	1.59	0.0106	39.89	39.63

Spartek Systems
#1 Thevenaz Ind. Tr.
Sylvan Lake, AB, Ca, T4S 1P5
Phone (403) 887-2443
Fax (403) 887-4050

Pressure Gauge
Certificate of Calibration

Calibration Report - 78527.



GAUGE NUMBER: 78527

2-D POLYNOMIAL LMS CURVEFIT

Source of f:	Pres	Temp	Pressure Equation:
Fit Order:	3	4	Pressure (PSI) = A + xp(B + xp(C + xp(D)))
Prescale:	xp = m * (fp - fp0)	xt = m * (ft - ft0)	
m:	0.01	0.01	Temperature Compensation:
	fp0 = 690829	ft0 = 149063	A = A0 + xt(A1 + xt(A2 + xt(A3 + xt(A4))))
			B = B0 + xt(B1 + xt(B2 + xt(B3 + xt(B4))))
			C = C0 + xt(C1 + xt(C2 + xt(C3 + xt(C4))))
			D = D0 + xt(D1 + xt(D2 + xt(D3 + xt(D4))))

Pressure (psi) STANDARD FIT COEFFICIENTS:

0	1	2	3	4
A 492.8927344	-0.1140480423	0.0001173403626	-8.634862992E-07	-1.568094118E-09
B 5.137265618	-0.004253659152	6.919611456E-08	4.783816734E-10	1.158369822E-11
C -1.124332832E-05	4.304456416E-08	-3.537545481E-10	-4.531192772E-12	-1.073483766E-14
D 3.648417738E-10	-1.112609937E-11	4.697256201E-14	9.395194696E-16	2.422805716E-18

Temperature (C) STANDARD FIT COEFFICIENTS

A 20.72189773

B -0.3664520773

C -5.299327756E-05

D -3.448809106E-07

0 points eliminated.
Error File: Gauge # 78527

Pressure psi	Temperature Deg. C	Count (Pres)	Count (Temp)	DIFF (press) psi
492.76	20.50	690829.00	149063.50	0.13
754.15	20.40	695916.33	149087.25	-0.02
1001.65	20.30	700737.00	149096.25	-0.04
1494.94	20.50	710345.00	149070.75	0.05
2002.70	20.40	720251.67	149120.50	-0.04
3004.63	20.40	739812.33	149160.00	-0.11
4498.34	20.30	769010.67	149187.25	0.01
5993.80	20.30	798273.33	149194.75	0.14
7504.15	20.40	827879.33	149217.00	0.13
8999.67	20.30	857224.33	149230.50	0.01
10494.17	20.30	886545.00	149216.75	-0.01
12005.53	20.40	916225.33	149204.75	0.00
13501.13	20.30	945628.00	149196.75	-0.02
14996.62	20.30	974990.33	149161.50	0.05
492.76	44.60	690673.00	142443.75	-0.04
754.16	44.60	695498.00	142449.25	-0.01
1001.65	44.60	700067.67	142455.75	0.00
1494.95	44.60	709178.33	142464.75	-0.06
2002.70	44.60	718563.67	142477.75	-0.07
3004.63	44.70	737098.33	142494.50	-0.10
4498.33	44.60	764772.00	142525.75	-0.22
5993.79	44.60	792523.33	142548.25	-0.12
7504.13	44.60	820585.67	142564.50	-0.06
8999.63	44.60	848394.33	142569.50	-0.05
10494.11	44.60	876215.33	142577.50	-0.16
12005.45	44.60	904354.33	142570.50	-0.20
13501.03	44.60	932208.67	142558.00	-0.23
14996.49	44.60	960073.33	142542.50	0.01
492.73	69.10	690495.33	135742.25	-0.06
754.12	69.10	695077.00	135752.25	-0.01
1001.61	69.10	699416.00	135759.50	0.00
1494.90	69.10	708070.00	135760.00	0.23
2002.65	69.10	716982.33	135776.75	0.28
3004.57	69.10	734580.00	135794.75	0.25
4498.24	69.10	760851.67	135821.50	0.16
5993.70	69.10	787191.67	135841.00	0.03
7504.02	69.10	813831.33	135856.00	0.10
8999.51	69.10	840239.00	135866.25	0.23
10493.98	69.20	866651.67	135871.50	0.35
12005.32	69.10	893376.67	135871.75	0.27
13500.89	69.10	919833.00	135864.25	0.35
14996.35	69.10	946292.33	135853.75	0.17
492.72	93.60	690299.67	129284.75	-0.13
754.11	93.50	694662.00	129290.00	-0.03
1001.61	93.50	698790.33	129293.75	-0.13
1494.90	93.50	707024.67	129293.50	-0.07
2002.66	93.60	715507.33	129305.00	0.03
3004.58	93.50	732254.33	129324.50	-0.04
4498.28	93.50	757256.00	129351.75	-0.01
5993.75	93.60	782316.00	129368.00	-0.07
7504.10	93.60	807657.67	129385.50	-0.26
8999.62	93.50	832787.33	129403.50	-0.22
10494.11	93.50	857920.33	129412.00	-0.06
12005.47	93.50	883350.67	129413.25	0.00
13501.07	93.50	908515.33	129404.50	-0.26
14996.56	93.60	933698.00	129396.50	-0.43
492.70	112.90	690145.67	124390.50	0.09
754.09	112.80	694345.67	124397.50	0.17
1001.59	112.80	698317.67	124403.75	-0.12
1494.89	112.90	706247.33	124400.50	0.04
2002.65	112.90	714410.33	124416.50	-0.17
3004.58	112.90	730534.33	124430.75	-0.13
4498.30	112.80	754602.67	124452.25	0.03
5993.78	112.80	778725.00	124466.75	0.01
7504.14	112.80	803120.00	124488.00	-0.22
8999.67	112.80	827300.00	124500.00	-0.26
10494.17	112.80	851487.00	124507.50	-0.11
12005.54	112.80	875969.33	124513.00	0.10
13501.14	112.80	900203.67	124511.75	0.10

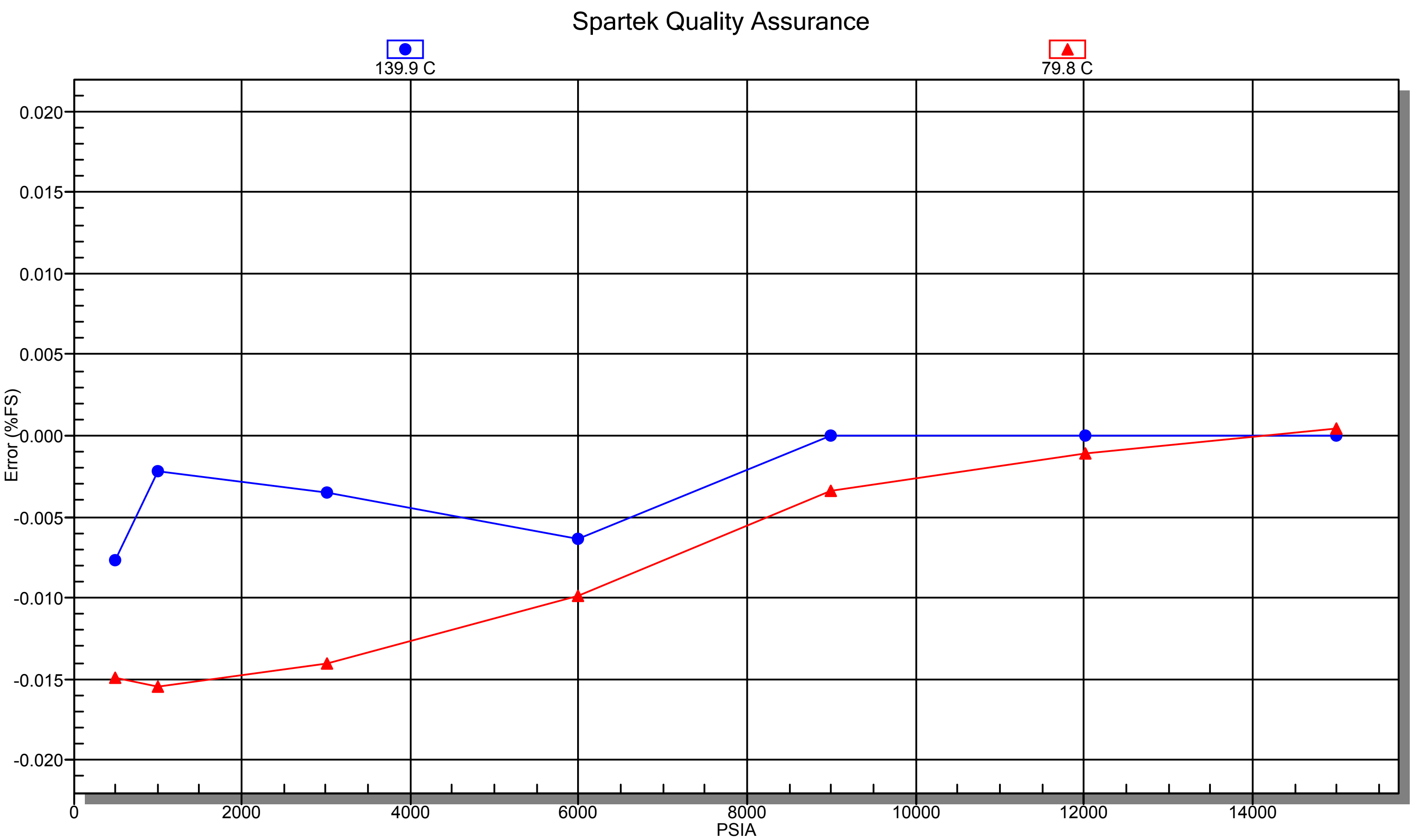
14996.63	112.90	924446.00	124506.75	0.01
492.69	135.00	689983.33	119038.00	0.66
754.09	135.00	693995.67	119039.50	0.12
1001.58	135.10	697798.67	119044.25	-0.22
1494.88	134.90	705388.00	119052.00	-0.51
2002.64	135.10	713211.33	119058.50	-0.34
3004.58	134.90	728663.33	119074.00	0.04
4498.29	135.00	751727.67	119095.75	0.43
5993.76	135.00	774849.00	119116.75	0.47
7504.12	135.10	798228.33	119134.75	0.37
8999.63	135.00	821400.33	119148.00	0.15
10494.13	135.10	844580.00	119159.75	-0.04
12005.50	135.10	868032.00	119163.00	-0.16
13501.10	135.00	891265.33	119168.75	0.06
14996.59	135.00	914502.00	119167.75	0.46
492.70	149.40	689896.67	115737.25	1.50
754.09	149.40	693789.33	115741.00	0.40
1001.59	149.40	697480.33	115743.00	-0.38
1494.88	149.50	704854.67	115749.75	-1.04
2002.65	149.50	712459.33	115754.00	-1.12
3004.58	149.40	727492.00	115770.50	-0.66
4498.29	149.50	749941.33	115787.00	0.29
5993.76	149.40	772452.33	115810.75	0.63
7504.12	149.50	795213.00	115825.00	0.76
8999.64	149.50	817763.00	115835.25	0.07
10494.14	149.50	840321.33	115843.75	-0.45
12005.50	149.50	863149.33	115846.00	-0.58
13501.10	149.50	885752.67	115847.25	-0.49
14996.58	149.50	908374.00	115849.25	0.38

Spartek Systems
#1 Thevenaz Ind. Tr.
Sylvan Lake, AB, Ca, T4S 1P5
Phone (403) 887-2443
Fax (403) 887-4050

Pressure Gauge
Certificate of Conformance

MODEL	1139	REVISION	0
SERIAL NUMBER	78527	DEADWEIGHT USED	Piston Cylinder No. 528
CALIBRATED	FEB13/09	E.U.B. CERT. DATE	May 09 2007
PRESSURE RANGE	14996.63 psi	TEMPERATURE RANGE	149.50 Deg. C

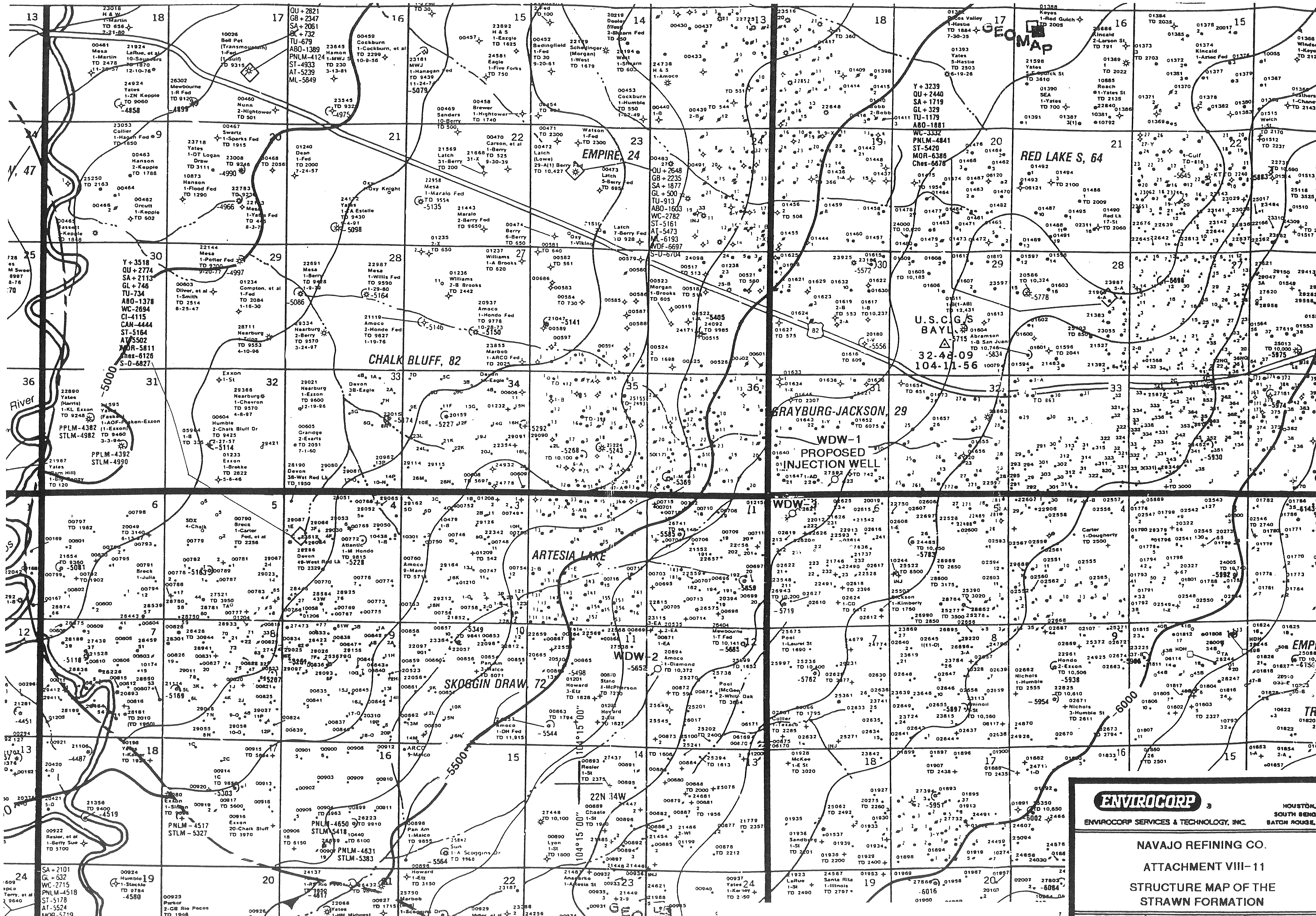
ACCURACY
As shown in the graph below, this Spartek Gauge conformed to within +/- 0.022 %F.S. of the pressure standard used in calibration, which is accurate to within +/- 0.01% of reading. This gives an overall accuracy of +/-(0.022%F.S. + 0.01% of reading)



Accepted By: ______________________ Date: Wednesday, February 18, 2009

APPENDIX I

STRAWN STRUCTURE MAPS



ENVIROCORP	ENVIROCORP SERVICES & TECHNOLOGY, INC.	HOUSTON, TX. SOUTH BEND, IN. BATON ROUGE, LA.

NAVAJO REFINING CO.

ATTACHMENT VIII-11

STRUCTURE MAP OF THE STRAWN FORMATION

DATE: REV 4/99	CHECKED BY:	JOB NO:
DRAWN BY:	APPROVED BY:	DWG. NO:

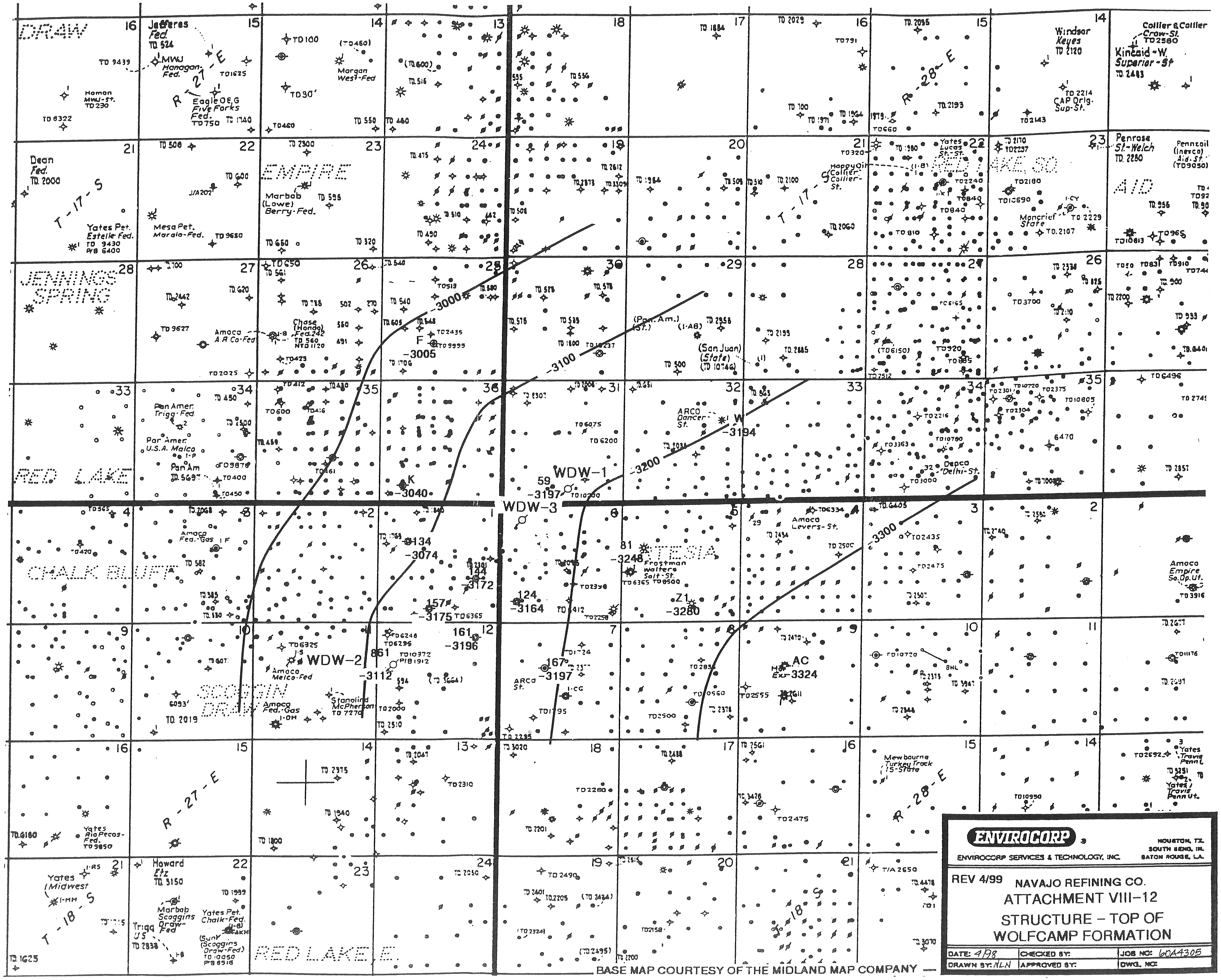
STRUCTURE MAP COURTESY OF THE GEOMAP COMPANY
Poster July 1997

APPENDIX I

APPENDIX J

WOLFCAMP STRUCTURE MAPS

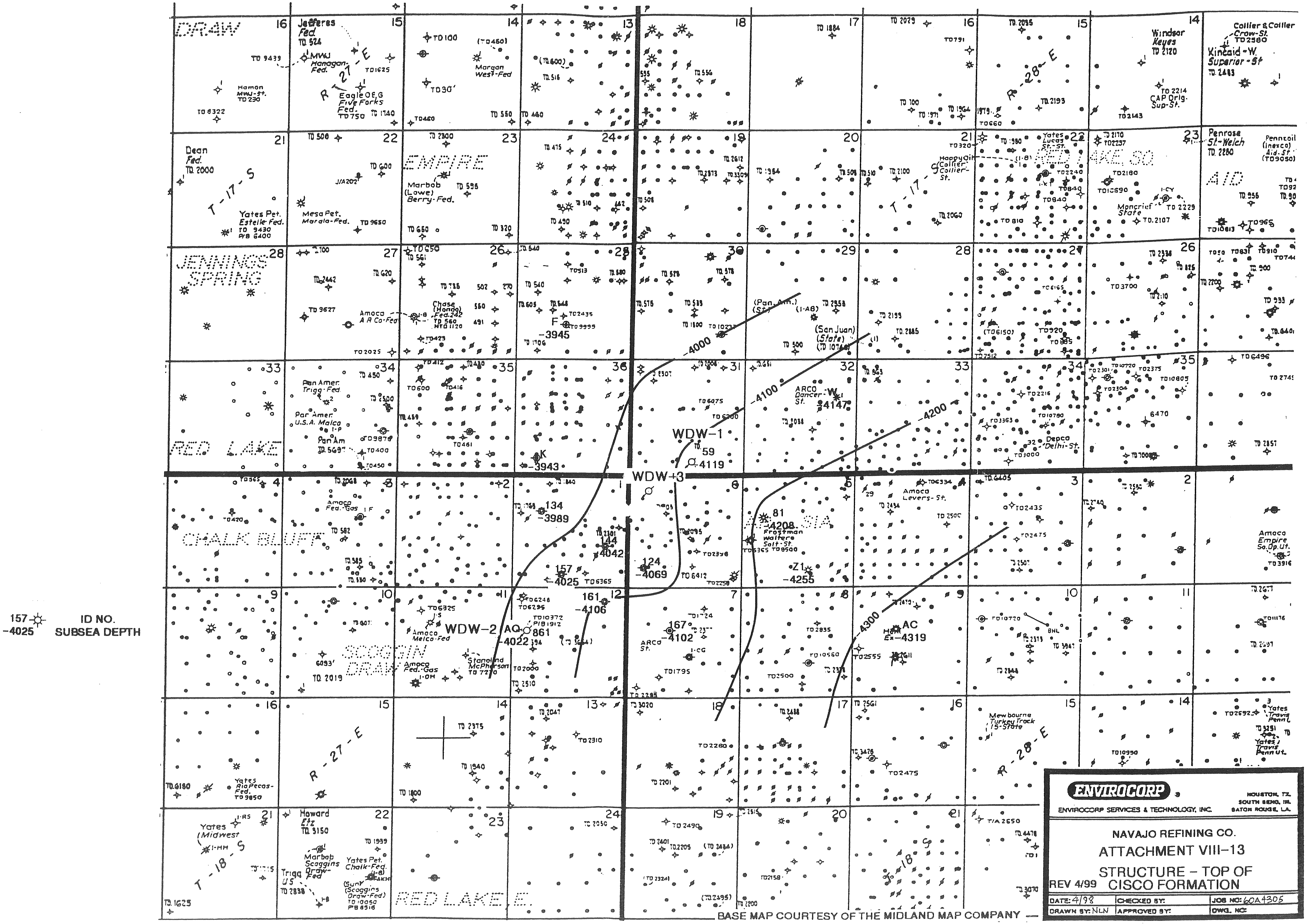
157 ☼ ID NO.
-4025 SUBSEA DEPTH



APPENDIX J

APPENDIX K

CISCO STRUCTURE MAPS


157 -4025
ID NO.
SUBSEA DEPTH
WDW-1
WDW-2
WDW-3
-4000
-4100
-4200
-4300
RED LAKE
CHALK BLUFF
SCOGGIN DRAW
EMPIRE
JENNINGS SPRING
RED LAKE, E.
T-17-S
T-18-S
R-27-E
R-28-E
BASE MAP COURTESY OF THE MIDLAND MAP COMPANY
ENVIROCORP
ENVIROCORP SERVICES & TECHNOLOGY, INC.
HOUSTON, TX.
SOUTH BEND, IN.
BATON ROUGE, LA.
NAVAJO REFINING CO.
ATTACHMENT VIII-13
STRUCTURE - TOP OF CISCO FORMATION
REV 4/99
DATE: 4/98
CHECKED BY:
JOB NO: 60A4305
DRAWN BY: NLN
APPROVED BY:
DWG. NO:

APPENDIX K

APPENDIX L

CHRONOLOGY OF FIELD ACTIVITIES

APPENDIX L

CHRONOLOGY OF FIELD ACTIVITIES

Thursday, June 9, 2016

Hank Lichtenwaldt:

Traveled to Artesia, NM from Houston, TX.

Friday, June 10, 2016

Hank Lichtenwaldt:

Traveled to WDW-1. Rigged up wireline and completed dummy runs (using sinker bar) on the wells. Tagged bottom in WDW-1 at 8994.5 feet KB. Set bottom-hole pressure recorders on all three wells. Set at the following depths; WDW-1: 7924 feet KB at 10:15 hours, WDW-2: 7570 feet KB at 1154 hours, WDW-3: 7660 feet KB at 1100 hours. Secured well and well sites. Returned chart recorder to Wildcat Measurement. Refueled. Left location and returned to Houston, TX.

Tuesday, June 14, 2016

Hank Lichtenwaldt:

Traveled to Artesia, NM from Houston, TX.

Wednesday, June 15, 2016

Hank Lichtenwaldt:

Traveled and arrived on site at WDW-1. Held JSA meeting. Waited on permit. Started pulling bottom-hole gauges out of WDW-1 and conducted 7-minute static gradient stops at 7000 feet, 6000 feet, 5000 feet, 4000 feet, 3000 feet, 2000 feet, 1000 feet, and at surface (0 feet). Rigged down at WDW-1. Fesco crews pulled the tools out of WDW-2 and WDW-3 while conducting gradient stops at WDW-1. Secured wells and returned to Navajo to begin injection operations. Drove from Artesia, NM to Houston, TX.

Thursday, June 16, 2016

Hank Lichtenwaldt:

Arrived in Houston, TX.

APPENDIX M

PANSYSTEM© ANALYSIS OUTPUT

Production Optimization Systems	Report File:	2016 WDW-1 Mewbourne PFO.par
PanSystem Version 3.5	Analysis Date:	7/26/2016
Well Test Analysis Report		

Company	Navajo Refining Company
Location	Artesia, New Mexico
Well Name	Mewbourne Well No. 1
Testing Date	June 10 - 15, 2016
Gauge Depth	7924 feet
Injection Interval	7924 feet - 8476 feet
Completion Type	Perforations
Top Of Fill	8990 feet
Analyst	TLJ
Subsurface Project No	50904A

Remarks:

Reservoir Description
Fluid type : Water
Well orientation : Vertical
Number of wells : 1
Number of layers : 1

Layer Parameters Data

	Layer 1
Formation thickness	175.0000 ft
Average formation porosity	0.1000
Water saturation	0.0000
Gas saturation	0.0000
Formation compressibility	0.000000 psi-1
Total system compressibility	8.4000e-6 psi-1
Layer pressure	0.000000 psia
Temperature	0.000000 deg F

Well Parameters Data

	Well 1
Well radius	0.3646 ft
Distance from observation to active well	0.000000 ft
Wellbore storage coefficient	0.0000 bbl/psi
Storage Amplitude	0.000000 psi
Storage Time Constant	0.000000 hr
Second Wellbore Storage	0.000000 bbl/psi
Time Change for Second Storage	0.000000 hr
Well offset - x direction	0.0000 ft
Well offset - y direction	0.0000 ft

Fluid Parameters Data

	Layer 1
Oil gravity	0.000000 API
Gas gravity	0.000000 sp grav
Gas-oil ratio (produced)	0.000000 scf/STB
Water cut	0.000000
Water salinity	0.000000 ppm
Check Pressure	0.000000 psia
Check Temperature	0.000000 deg F
Gas-oil ratio (solution)	0.000000 scf/STB
Bubble-point pressure	0.000000 psia
Oil density	0.000 lb/ft3
Oil viscosity	0.000 cp
Oil formation volume factor	0.000 RB/STB
Gas density	0.000 lb/ft3
Gas viscosity	0.0 cp
Gas formation volume factor	0.000 ft3/scf
Water density	0.000 lb/ft3
Water viscosity	0.570 cp
Water formation volume factor	1.000 RB/STB
Oil compressibility	0.000000 psi-1
Initial Gas compressibility	0.000000 psi-1
Water compressibility	0.000000 psi-1

Layer 1 Correlations
Not Used

Layer Boundaries Data
Layer 1 Boundary Type : Infinitely acting

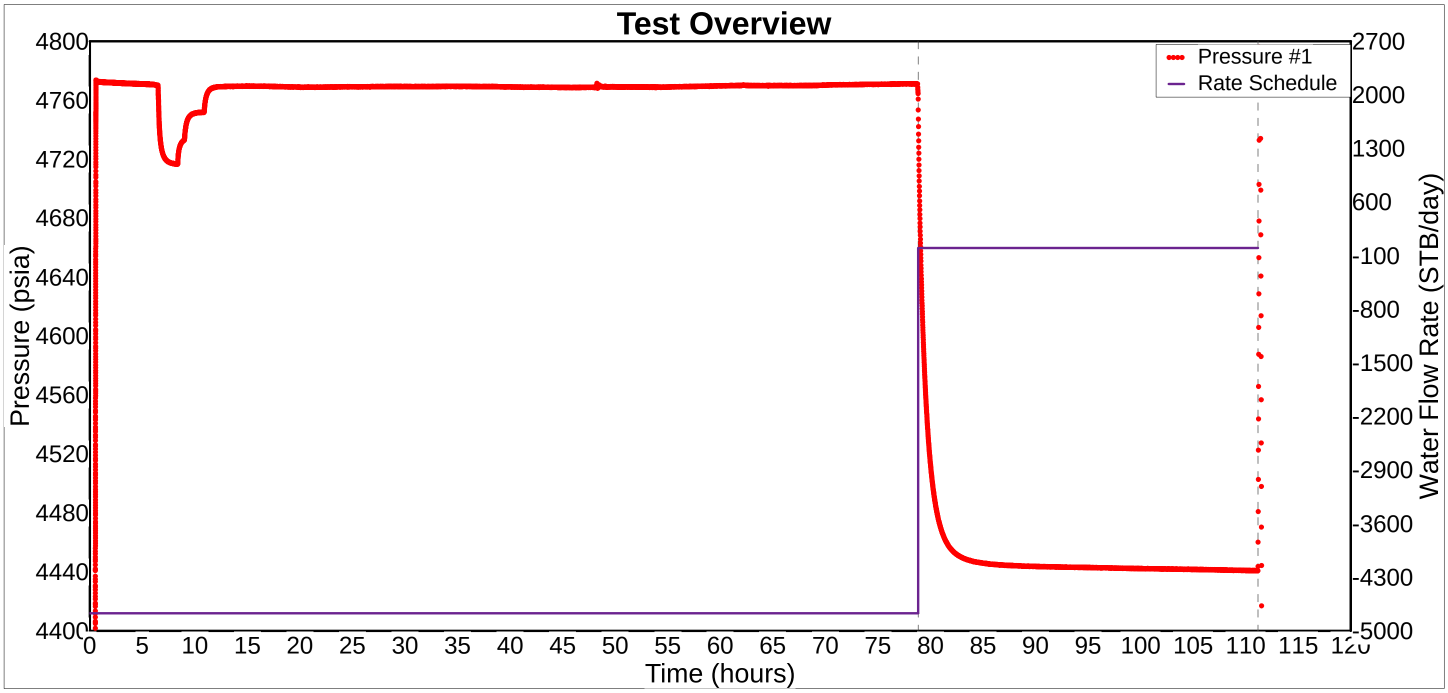
	Layer 1
L1	0.000000 ft
L2	0.000000 ft
L3	0.000000 ft
L4	0.000000 ft
Drainage area	0.000000 acres
Dietz shape factor	0.000000

Layer 1 Model Data
Layer 1 Model Type : Radial homogeneous

	Layer 1
Permeability	0.0000 md
Skin factor (Well 1)	0.0000

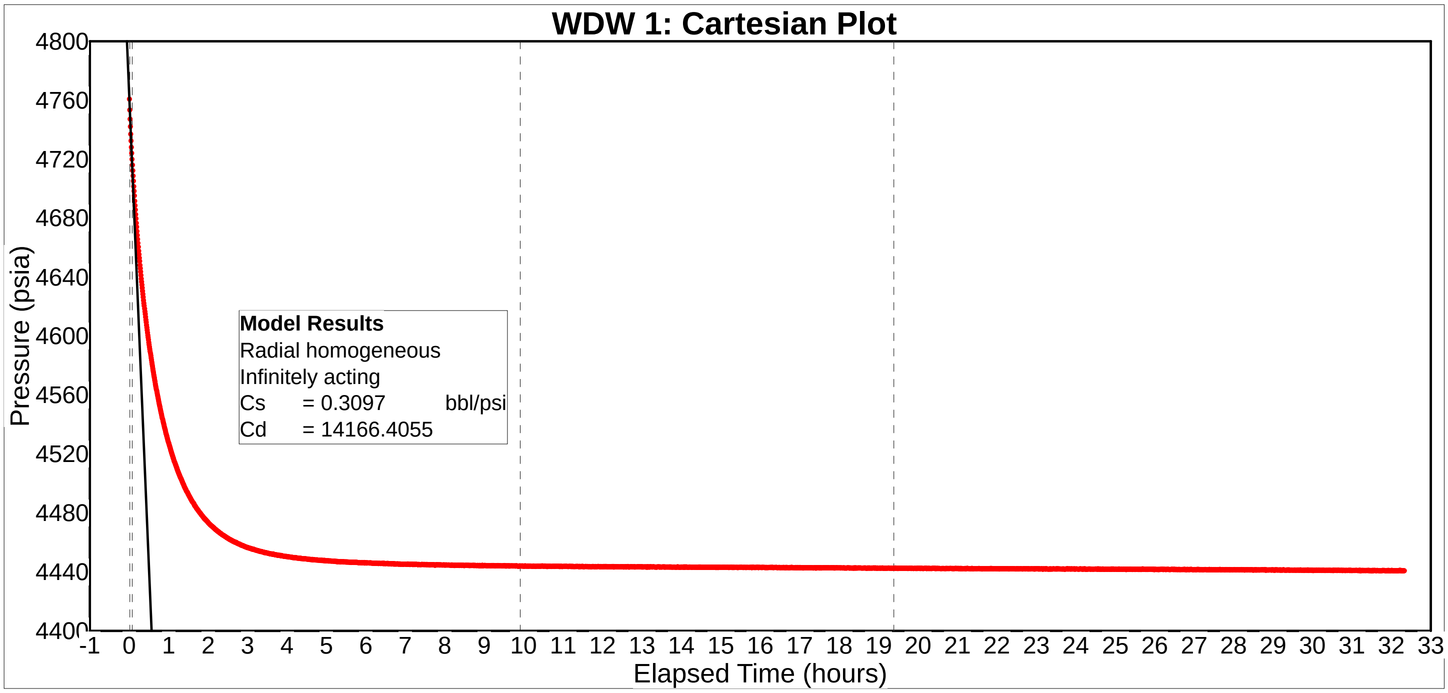
Rate Change Data

Time Hours	Pressure psia	Rate STB/day
-1697.253889	0.000000	0.000000
-1433.253611	0.000000	-4494.379886
-1265.253611	0.000000	-4181.577194
-1097.253611	0.000000	-3944.183087
-905.253611	0.000000	-4476.163152
-497.253611	0.000000	-4650.786242
-401.253611	0.000000	-4807.680404
-209.253611	0.000000	-4473.758045
-41.253611	0.000000	-4573.376265
78.840278	4764.319400	-4770.188170
111.181944	4440.619200	0.000000



Test Overview
Pressure #1
Rate Schedule
Pressure (psia)
4800
4760
4720
4680
4640
4600
4560
4520
4480
4440
4400
Water Flow Rate (STB/day)
2700
2000
1300
600
-100
-800
-1500
-2200
-2900
-3600
-4300
-5000
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120
Time (hours)

FIGURE 9



WDW 1: Cartesian Plot Model Results

Radial homogeneous - Infinitely acting

Classic Wellbore Storage

	Value
Wellbore storage coefficient	0.309651 bbl/psi
Dimensionless wellbore storage	1.4166e4

WDW 1: Cartesian Plot Line Details

Line type : Wellbore storage

Slope : -641.876

Intercept : 4764.27

Coefficient of Determination : 0.991343

Number of Intersections = 0

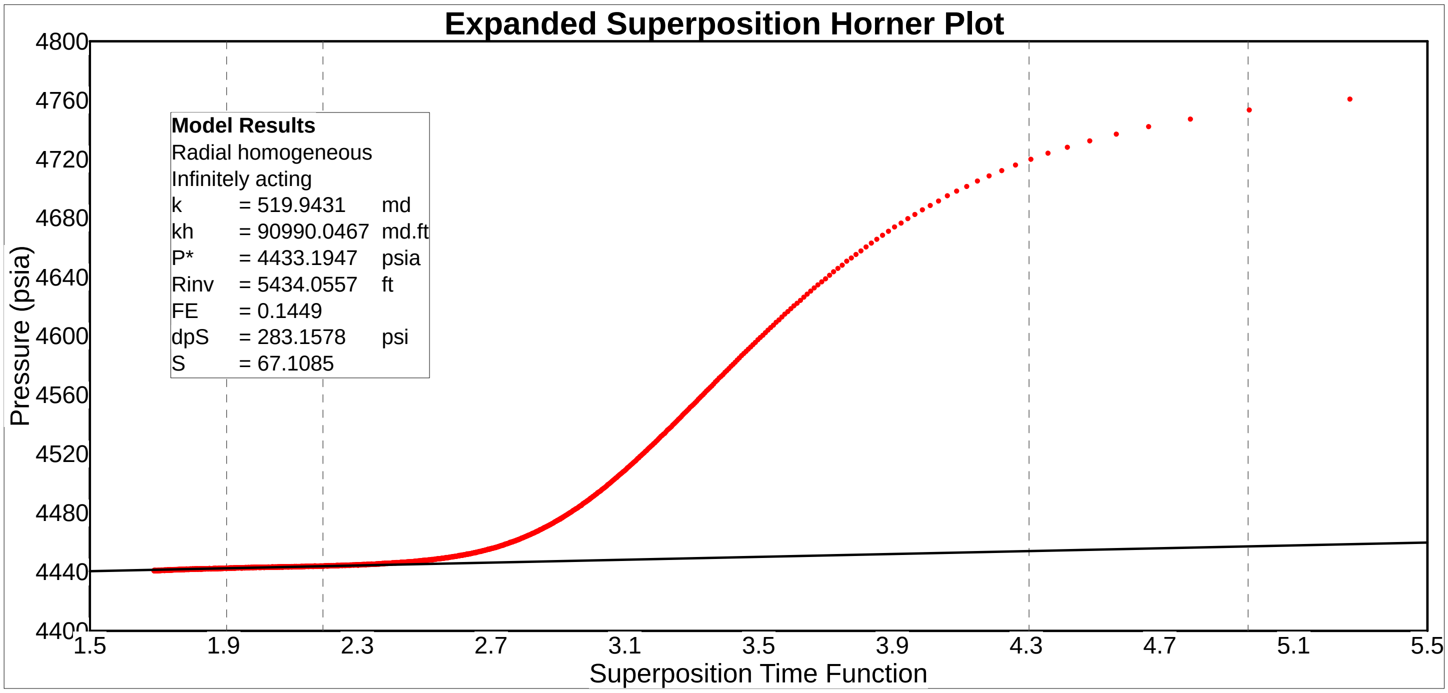


FIGURE 15

Expanded Superposition Horner Plot Model Results
Radial homogeneous - Infinitely acting

Classic Wellbore Storage

	Value
Permeability	519.943124 md
Permeability-thickness	9.0990e4 md.ft
Extrapolated pressure	4433.194740 psia
Radius of investigation	5434.055681 ft
Flow efficiency	0.144860
dP skin (constant rate)	283.157838 psi
Skin factor	67.108482

Expanded Superposition Horner Plot Line Details
Line type : Radial flow
Slope : 4.85777
Intercept : 4433.19
Coefficient of Determination : 0.95331

	Radial flow
Extrapolated pressure	4433.194740 psia
Pressure at dt = 1 hour	4448.690644 psia

Number of Intersections = 0

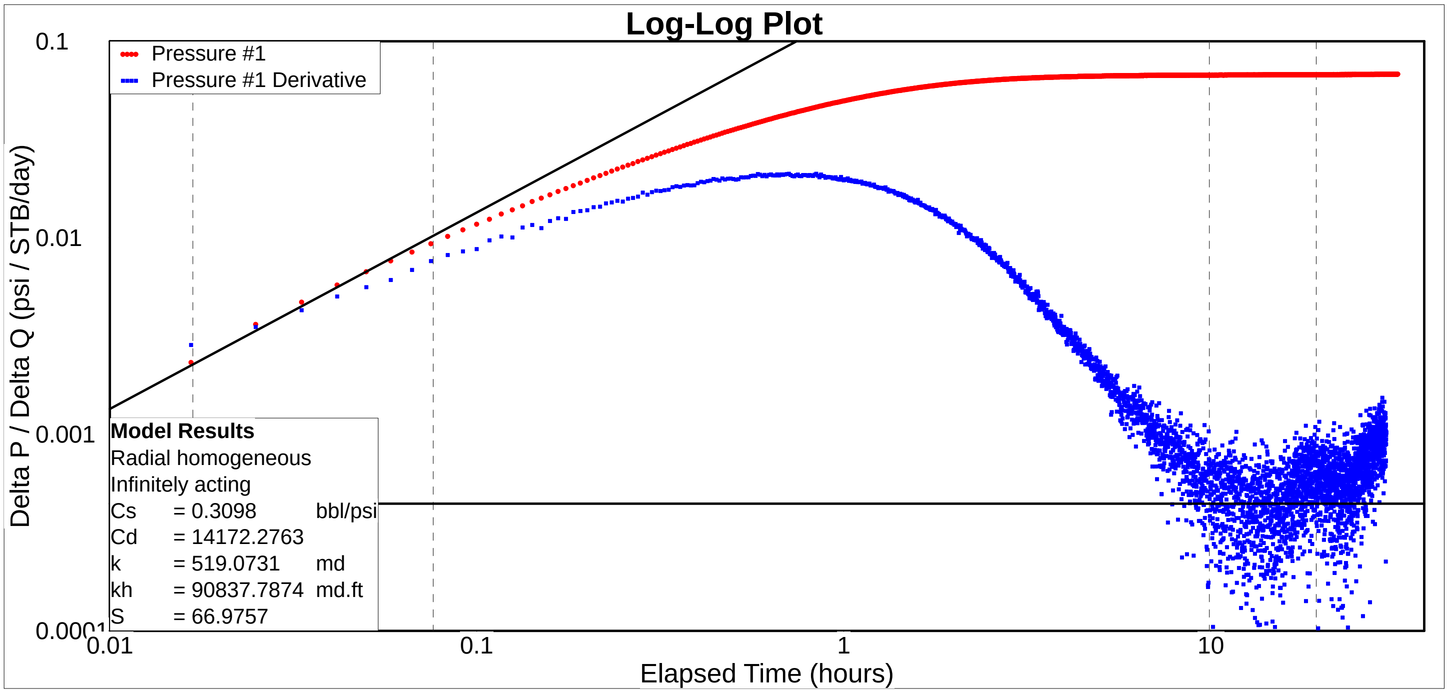


FIGURE 13

Log-Log Plot Model Results
Radial homogeneous - Infinitely acting

Classic Wellbore Storage

	Value
Wellbore storage coefficient	0.30978 bbl/psi
Dimensionless wellbore storage	1.4172e4
Permeability	519.073071 md
Permeability-thickness	9.0838e4 md.ft
Skin factor	66.975729

Log-Log Plot Line Details
Line type : Radial flow
Slope : 0
Intercept : 0.000443009
Coefficient of Determination : Not Used

Line type : Wellbore storage
Slope : 1
Intercept : 0.134504
Coefficient of Determination : Not Used

Number of Intersections = 0

LOGS

- **Dual Induction Log Sections from 7924 feet to 8476 feet**
- **Neutron Density Log Sections from 7924 feet to 8476 feet**
- **Mewbourne Well No. 1, July 23, 1998, Temperature Log**