STATUS REPORT FOR STAGE 1 ABATEMENT AT THE COPPER FLAT MINE SITE NEAR HILLSBORO, NEW MEXICO

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prepared for

New Mexico Copper Corporation
a wholly owned subsidiary of THEMAC Resources Group, Ltd.
2424 Louisiana Blvd NE, Suite 301
Albuquerque, New Mexico 87110

June 27, 2013

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STATUS REPORT FOR STAGE 1 ABATEMENT AT THE COPPER FLAT MINE SITE NEAR HILLSBORO, NEW MEXICO

New Mexico Copper Corporation (NMCC) contracted John Shomaker & Associates, Inc. (JSAI) to implement the approved Stage 1 Abatement Plan (Plan) for the Copper Flat Mine (as amended by JSAI, 2011). The Plan calls for four quarters of monitoring and investigation of the Copper Flat Mine facilities created by the Quintana Minerals operations in 1982. The facilities include 1) open pit area, 2) waste rock and mill site area, and 3) tailings storage facility (TSF) area (Fig. 1). This status report presents the initial results of the first two quarters of monitoring and investigation.

1.0 BACKGROUND

The Stage 1 Abatement monitoring plan can be referenced from JSAI (2011). Modifications were made to the monitoring plan after the first quarter revealed several shallow wells below the TSF were dry. Additional monitoring wells were added to the monitoring program so the extent of the TSF sulfate plume could be better defined. Details on the monitoring program modifications can be referenced from (THEMAC, 2013). The current Stage 1 monitoring points can be referenced from Table 1, and locations are shown on Figures 1 and 2.

1.1 Purpose

The first task of the Stage 1 Abatement Plan is to define the extent and nature of contamination associated with the Copper Flat Mine facilities shown on Figure 1. As described in NMAC 20.6.2.4106.C, “the purpose of Stage 1 of the abatement plan shall be to design and conduct a site investigation that will adequately define site conditions, and provide the data necessary to select and design an effective abatement option.”

Table 1. Summary of wells and well data for the Stage 1 Abatement Plan monitoring, Copper Flat Mine, Sierra County, New Mexico

well name	well type	facility area	year drilled	casing diameter (inches)	total depth (ft bgl)	screen interval (ft bgl)	measuring-point elevation (ft amsl)	geologic unit	depth to water measurement date	depth to water (ft bmp)	water-level elevation (ft amsl)
GWQ96-22A	monitoring	pit	1996	2	244	174 to 244	5,596.17	andesite	4/8/2013	55.45	5,540.72
GWQ96-22B	monitoring	pit	1996	2	380	340 to 380	5,595.95	andesite	4/8/2013	55.28	5,540.67
GWQ96-23A	monitoring	pit	1996	2	101	50 to 100	5,489.84	quartz monzonite	4/8/2013	41.09	5,448.75
GWQ96-23B	monitoring	pit	1996	2	251	150 to 250	5,489.70	quartz monzonite	4/8/2013	41.37	5,448.33
GWQ11-24A	monitoring	pit	2011	2	90	60 to 90	5,517.37	quartz monzonite	4/8/2013	58.44	5,458.93
GWQ11-24B	monitoring	pit	2011	2	250	230 to 250	5,517.26	quartz monzonite	4/8/2013	61.44	5,455.82
GWQ11-25A	monitoring	pit	2011	2	100	70 to 100	5,533.60	quartz monzonite	4/8/2013	73.25	5,460.35
GWQ11-25B	monitoring	pit	2011	2	242	222 to 242	5,533.41	quartz monzonite	4/8/2013	73.66	5,459.75
GWQ11-26	monitoring	pit	2011	4	43	23 to 43	5,539.75	alluvium	4/9/2013	41.42	5,498.33
pit	monitoring	pit	1982				5,430.00	quartz monzonite	4/8/2013	-8.60	5,438.60
GWQ-1	supply	waste rock and mill site	1972	14/12	391	100 to 391	5,195.59	Santa Fe Group	4/10/2013	7.46	5,188.13
GWQ-3	supply	waste rock and mill site	1932	40 x 43	33	10 to 33	5,252.60	alluvium/andesite	4/11/2013	24.55	5,228.05
GWQ-5R	monitoring	waste rock and mill site	2011	4	120	80 to 120	5,412.80	andesite	4/9/2013	48.25	5,364.55
GWQ-8	supply	waste rock and mill site	1931	8	148	81 to 148	5,216.94	Santa Fe Group	4/9/2013	27.53	5,189.41
GWQ-11	monitoring	tailings storage facility (TSF)	1981	3	70	na	5,196.44	alluvium/Santa Fe Group	4/10/2013	21.38	5,175.06
GWQ-12	monitoring	tailings storage facility (TSF)	1981	3	137	na	5,237.28	Santa Fe Group	4/10/2013	82.75	5,154.53
GWQ94-13	monitoring	tailings storage facility (TSF)	1994	5	106	74 to 104.5	5,200.47	Santa Fe Group	4/10/2013	16.22	5,184.25
GWQ94-14	monitoring	tailings storage facility (TSF)	1994	5	159	127.5 to 157.5	5,192.69	Santa Fe Group	4/10/2013	9.6	5,183.09
GWQ94-16	monitoring	tailings storage facility (TSF)	1994	5	46	25 to 45	5,197.41	alluvium	4/10/2013	22.62	5,174.79
GWQ94-18	monitoring	tailings storage facility (TSF)	1994	4	51	10 to 50	5,194.83	alluvium	4/10/2013	dry	<5,143.83
GWQ94-19	monitoring	tailings storage facility (TSF)	1994	4	53	10 to 50	5,203.36	alluvium	4/10/2013	dry	<5,150.36
IW-1	monitoring	tailings storage facility (TSF)	1982	4	49	na	5,198.99	alluvium	4/10/2013	dry	<5,149.99
IW-2	monitoring	tailings storage facility (TSF)	1982	4	46	na	5,208.01	alluvium	4/10/2013	dry	<5,162.01
IW-3	monitoring	tailings storage facility (TSF)	1982	4	45	na	5,213.17	alluvium	4/10/2013	dry	<5,168.17
NP-2	monitoring	tailings storage facility (TSF)	1981	4	110	na	5,192.54	Santa Fe Group	4/10/2013	35.55	5,156.99
NP-3	monitoring	tailings storage facility (TSF)	1981	4	100	na	5,199.73	Santa Fe Group	4/10/2013	15.25	5,184.48
MW-4	supply	tailings storage facility (TSF)	1975	6	1,500	123 to 1,500	5,146.12	Santa Fe Group	12/8/2011	82.2	5,063.92

ft bgl - feet below ground level
ft amsl - feet above mean sea level
ft bmp - feet below measuring point
na - not available

2.0 DATA COLLECTION METHODS

Stage 1 monitoring points are listed in Table 1. In addition to those listed in Table 1 are the pit wall seep, and storm-water sampling locations SWQ-1, SWQ, 2, and SWQ-3 (Figs. 1 and 2). The pit wall seep and storm-water sampling locations have been dry for the 1st and 2nd Quarters 2013. Well completion diagrams for most of the monitoring wells listed in Table 1 can be referenced from Appendix A.

2.1 Water-Level Elevation Measurements

Water levels were measured with a calibrated wire-line sounder or steel tape prior to well purging and sampling. Measuring points were established and surveyed prior to Stage 1 water-level measurements; measuring point elevations are listed in Table 1.

2.2 Well Purging

Monitoring wells were purged using disposable bailers, or a redi-flo submersible pump. Purged volumes are listed in Tables 2 and 3. Several wells pumped dry after the first well volume, and under those conditions, the sample is collected after the well has recovered enough for collection of a sample. Wells GWQ-1, GWQ-3, and GWQ-8 were sampled using micropurging methods (low flow pumping from the top of the screen interval). Pit samples were collected by using a disposable bailer to collect a grab sample approximately 6 ft from shore line on the south end of the pit water surface.

2.3 Field Parameters

Field parameters included temperature, specific conductance, and pH. Instruments were calibrated prior to collection of measurements. Results from 1st and 2nd Quarter sampling can be referenced from Tables 2 and 3.

2.4 Laboratory Analyses

Based on the approved amended Stage 1 Abatement Plan, two constituent lists for laboratory analysis included 1) List A for the pit area, and 2) List B for the waste rock/mill site and TSF areas. A summary of the List A and List B constituents for laboratory analysis can be referenced from Table 4. Copies of laboratory reports are in Appendix B.

Table 2. Summary of 1st Quarter field data and sample collection methods

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
pit area									
GWQ96-22A	A	2	1/9/2013	15.5	7.41	679	54.31	17	pumped off, micropurge sample in screen
GWQ96-22B	A	2	1/9/2013	19.1	6.85	1,038	53.96	6	pumped off, sampled w/ bailer after recovered
GWQ96-23A	A	2	1/11/2013	17.1	7.46	878	41.14	5	pumped off, sampled w/ bailer after recovered
GWQ96-23B	A	2	1/11/2013	16.2	7.16	737	41.16	13	pumped off, sampled w/ sample pump after recovered
GWQ11-24A	A	2	1/8/2013	18.0	4.08	2,807	57.62	20	
GWQ11-24B	A	2	1/9/2013	18.0	6.72	1,904	61.30	30	parameters stable-sampled after 1 well vol.
GWQ11-25A	A	2	1/9/2013	16.5	3.63	6,410	70.00	8	pumped off, sampled w/ bailer after recovered
GWQ11-25B	A	2	1/9/2013	19.8	6.28	2,390	72.06	84	
GWQ11-26	A	4	1/8/2013	17.4	6.81	735	41.30	8	
pit lake	A	na	1/9/2013	4.3	7.32	10,510	surface water	grab sample	
pit wall seep	A	na	1/9/2013						no seep observed

µS/cm - microSiemens per centimeter

Table 2. Summary of 1st Quarter field data and sample collection methods (concluded)

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
waste rock and mill site area									
GWQ-1	B	12	1/10/2013	19.6	7.20	659	7.26	305	parameters stable-sampled after 1 well vol.
GWQ-3	B	40 x 43							no access 1/2013
GWQ-5R	B	4	1/10/2013	16.4	7.21	624	47.78	33	pumped off, sampled w/ sample pump after recovered
GWQ-8	B	8	1/10/2013	19.1	6.77	1,358	27.35	450	parameters stable-sampled after 1 well vol.
tailings storage facility (TSF) area									
GWQ94-13	B	5	1/10/2013	19.3	6.90	1,638	15.90	145	parameters stable, sampled after 1.5 wells vol.
GWQ94-14	B	5	1/11/2013	20.7	6.97	743	9.2	210	parameters stable-sampled after 2 well vol.
GWQ94-16	B	5	1/10/2013	18.6	7.59	1,477	22.57	27	purged 3 wells vol. and sampled
GWQ94-18	B	4					dry		dry 1/10/2013
GWQ94-19	B	4					dry		dry 1/10/2013
IW-1	B	4					dry		dry 1/10/2013
IW-2	B	4	1/10/2013	18.8	7.19	3,050	42.20		purged dry; still dry 1/11/2013
IW-3	B	4					dry		dry 1/10/2013
NP-3	B	4	1/10/2013	19.5	6.36	1,605	14.80	6	pumped off, sampled w/ sample pump after recovered
MW-4	B	6					NA		no access due to frozen 1/2013

µS/cm - microSiemens per centimeter

Table 3. Summary of 2nd Quarter field data and sample collection methods

monitoring point	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
pit area									
GWQ96-22A	A	2	4/8/2013				55.45		water level only
GWQ96-22B	A	2	4/8/2013				55.28		water level only
GWQ96-23A	A	2	4/8/2013				41.09		water level only
GWQ96-23B	A	2	4/8/2013				41.37		water level only
GWQ11-24A	A	2	4/11/2013	18.6	4.48	3,662	61.44	14	bailed 3 vols., sampled, cloudy yellow color
GWQ11-24B	A	2	4/8/2013	20.1	6.18	2,470	58.44	30	parameters stable-sampled after 1 well vol. (very slow pumping)
GWQ11-25A	A	2	4/9/2013	14.4	3.30	10,120	73.25	22.5	purged 3 times, then sampled, water gray color, low pH
GWQ11-25B	A	2	4/8/2013	21.0	6.54	2,722	73.66	80	purged 3 volumes and sampled, water was clear
GWQ11-26	A	4	4/9/2013	18.5	7.05	891	41.42	5	purged 3 volumes, then sampled, water was clear
pit lake	A	na	4/8/2013	17.6	7.07	10,610	8.6	grab	surface sample from NW corner of ramp
pit wall seep	A	na	4/8/2013						no seep observed

µS/cm - microSiemens per centimeter

Table 3. Summary of 2nd Quarter field data and sample collection methods (concluded)

monitoring points	sample list	casing diameter (in.)	date sampled	temp. (°C)	pH	conductivity (µS/cm)	depth to water (ft)	volume purged (gal)	comments
waste rock and mill site									
GWQ-1	B	12	4/10/2013	20.0	7.33	723	7.46	350	pump set middle of screen, micropurged and sampled ~1 vol.
GWQ-3	B	40 x 43	4/11/2013	17.5	7.50	2,782	24.55	957	sampled after parameters stable and 1.5 well volumes
GWQ-5R	B	4	4/9/2013	19.0	7.12	771	48.25	30	sampled after parameters stable and 1 well volume
GWQ-8	B	8	4/9/2013	19.6	7.16	1,564	27.53	575	parameters stable-sampled after 1.5 well volumes
tailings storage facility (TSF) area									
GWQ-11	B	3	4/10/2013	19.8	6.73	1,351	21.38	57	purged 3 vol. & sampled; water clear
GWQ-12	B	3	4/10/2013	20.1	7.19	553	82.75	55	purged 3 vol. & sampled; water clear
GWQ94-13	B	5	4/10/2013	19.4	7.16	1,711	16.22	310	purged 3 vol. & sampled; water clear
GWQ94-14	B	5	4/10/2013	19.7	7.21	721	9.60	300	purged 3 vol. & sampled; water clear
GWQ94-16	B	4	4/10/2013	19.0	7.36	1,576	22.62	45	purged 3 vol. & sampled; water clear
GWQ94-18	B	4					dry		dry 4/10/2013
GWQ94-19	B	4					dry		dry 4/10/2013
IW-1	B	4					dry		dry 4/10/2013
IW-2	B	4					dry		dry 4/10/2013
IW-3	B	4					dry		dry 4/10/2013
NP-2	B	2	4/10/2013	19.1	7.38	1,364	35.55	30	bailed 3 volumes and sampled; cloudy to reddish-brown
NP-3	B	2	4/10/2013	18.9	6.95	2,134	15.25	7.5	pumped off, sampled w/ bailer after it recovered
MW-4	B	6	4/12/2013	19.4	8.29	427		approx. 30	stock well; sampled from tank after approx. 30 gallons pumped

µS/cm - microSiemens per centimeter

Table 4. Summary of Copper Flat Mine Stage 1 Abatement Plan constituent lists for lab analysis

List A*	List B**
pit area	**waste rock/mill site and tailings storage facility (TSF) areas**
aluminum	total dissolved solids (TDS)
cadmium	sulfate
cobalt	chloride
copper	alkalinity
manganese	calcium
selenium	magnesium
zinc	sodium
calcium	potassium
magnesium	
sodium	
potassium	
alkalinity	
total acidity	
chloride	
fluoride	
sulfate	
total dissolved solids (TDS)	

* List A metals are for dissolved metals (filtered)
** List B metals are for total metals (NOT filtered)

3.0 RESULTS

The results focus on the three areas of primary concern: 1) pit area, 2) Grayback Arroyo downgradient of the waste rock and mill site area, and 3) TDS and sulfate plume observed below the TSF.

3.1 Hydrogeologic Investigation

One task described in the amended Stage 1 Abatement Plan was to use data collected from the proposed monitoring plan to refine the hydrogeologic conceptual model for each facility. Rate of potential transport will be addressed in the refined conceptual model. The first two quarters of data collection and investigation have focused on hydrogeologic conditions along Grayback Arroyo downgradient of the waste rock and mill site area and the barrier boundary fault east of the TSF. A revised geologic map of the area of investigation is presented as Figure 3, and a hydrogeologic cross-section along Grayback Arroyo downgradient of the waste rock and mill site area is presented as Figure 4.

3.1.1 Waste Rock and Mill Site Area

Geologic mapping and well drilling data were used to construct the hydrogeologic cross-section downgradient of the waste rock and mill site area along Grayback Arroyo (Fig. 4). Between the waste rock/mill site area and GWQ-3, groundwater from the low-permeability andesite discharges to the alluvium along Grayback Arroyo. From a point upstream of GWQ-3, storm water in Grayback Arroyo recharges the alluvium, and, downstream of GWQ-3, storm water recharges the alluvium and the underlying Santa Fe Group sediments.

3.1.2 Tailings Storage Facility (TSF) Area

The south to north trending fault east of the TSF (Fig. 3) is referred to as part of the East Animas Fault Trend that forms the boundary between Animas Uplift and Palomas Basin. The fault is downthrown on the east side. The East Animas Fault Trend is either composed of several parallel faults or one fault mapped in slightly different longitude by Seager et al. (1982), Harrison et al. (1993), Beaumont (2012), and Hawley (2012).

The fault mapped by Beaumont (2012) is a barrier boundary to groundwater flow and is supported by hydraulic response in monitoring wells east of the TSF and groundwater flow model calibration (THEMAC, 2013). The barrier boundary fault must be located directly east of the monitoring points below the TSF for the hydraulic response from hydraulic loading behind the dam to be observed at the monitoring points.

3.2 Water-Level Elevation

The 2^{nd} Quarter water-level data were used to develop a groundwater elevation contour map (Fig. 5). The groundwater elevation contours are also based on regional contouring presented in the Baseline Data Report (INTERA, 2012).

3.2.1 Pit Capture Zone

Groundwater elevation data from wells in the pit area show the pit is a hydraulic sink. The pit capture zone encompasses the pit excavation area, including wells GWQ11-24 and GWQ11-25. A hydrograph for the pit is presented in Appendix C as Figure C1. The pit hydrograph consists of water levels collected from historical documents, Baseline Data Report, and Stage 1 Abatement; all data points were referenced to NMCC 2011 land surface survey. The pit filled to its maximum height in the late 1980s as a result of the corresponding period of elevated precipitation and storm-water runoff. Between 1990 and 2010, the pit level dropped 14 ft, and in the last 2 years the pit level has dropped 5.8 ft.

3.2.2 Waste Rock and Mill Site Area

In the vicinity of GWQ-5R, the groundwater elevation in the andesite is slightly higher than the bottom elevation of the alluvium in Grayback Arroyo, and the alluvium is gaining groundwater from the andesite (Fig. 5). The hydraulic gradient flattens downgradient of GWQ-3 where the alluvium recharges the underlying Santa Fe Group sediments. The direction of groundwater flow is west to east, but preferentially along Grayback Arroyo where the alluvium acts as a hydraulic drain (Fig. 5). Downgradient of GWQ-1 the hydraulic gradient steepens as a result of the barrier boundary effect of the East Animas Fault Trend mapped by Beaumont (2012). Based on the revised conceptual model for the area downgradient of the waste rock pile, discharges from the mill site area would follow Grayback Arroyo.

3.2.3 Tailings Storage Facility (TSF)

In the TSF vicinity, regional groundwater flow is from west to east, but the changes in the hydraulic gradient are controlled by the low permeability andesite, higher permeability Santa Fe Group sediments, and the East Animas Fault Trend barrier boundary (Fig. 5). Monitoring wells in the alluvial channel running east to west through the TSF (GWQ94-18, GWQ94-19, IW-1, IW-2, and IW-3), have been dry during the 1st and 2nd Quarter Stage 1 sampling events (Tables 2 and 3). This alluvial channel is also referred to as Hunkidori Gulch (Fig. 5).

3.3 Water Quality

The analyses of water-quality data include historical data and data collected during the 1st and 2nd Quarter Stage 1 sampling events. Drought conditions have prevented the collection of storm-water runoff samples from SWQ-1, SWQ-2, and SWQ-3. Auto samplers at these locations are currently in place and ready for sample collection when a storm-water event occurs. Plumbing associated with MW-4 (stock well) was frozen during the 1st Quarter sampling event and prevented sample collection. U.S. Bureau of Land Management (BLM) access to GWQ-3 was not granted until the 2nd Quarter sampling event: therefore no sample was obtained during the 1st Quarter.

A few minor laboratory issues occurred during 1st and 2nd Quarter sampling events, and have since been resolved. During 1st Quarter, the lab analyzed all of the samples for List A (except manganese), and the analysis for acidity was not performed on samples with no alkalinity.

3.3.1 Pit Area

A summary of 1st and 2nd Quarter water-quality data for the pit area monitoring points can be referenced from Table 5. Copies of lab reports are provided in Appendix B. Monitoring wells GWQ11-26 and GWQ96-22(A, B) represent upgradient water-quality conditions. Monitoring wells GWQ96-22(A, B) and GWQ96-23(A, B) are completed in the andesite rocks, which exhibit low TDS and sulfate, but relatively high alkalinity (Table 5).

As discussed in the Stage 1 Abatement Plan amendment (JSAI, 2011), the pit chemistry is influenced by the effects of evapo-concentration. Sulfate salts are precipitating along the edge of the pit water surface, but, under neutral pH conditions, concentrations of sulfate continue to increase along with chloride, sodium, and magnesium. Time-series pit water-quality data are presented as Figure 6.

Table 5. Summary of 1st and 2nd Quarter water-quality data for pit area

sample ID	date	pH	total dissolved solids (TDS)	total alkalinity	bicarbonate	carbonate	sulfate	chloride	fluoride	calcium	magnesium	sodium	potassium	aluminum	cadmium	cobalt	copper	manganese	selenium	zinc
		standard units	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NMWQCC standard*		6 to 9	1,000				600	250	1.6					5.00	0.01	0.05	1.0	0.2	0.05	10
pit wall seepage	8/19/2010	**2.00**	**13,900**	<20	<20	<2	**11,000**	21	**51.00**	470	190	<50	<50	**540.00**	**0.140**	**1.500**	**80.000**	**24.00**	**0.086**	**12.00**
pit	1/9/2013	7.73	**11,100**	112	112	< 2	**6,800**	**577**	**18.70**	500	958	1,170	44.400	0.08	**0.037**	**0.086**	0.059		0.008	0.78
pit	4/12/2013	7.07	**11,700**	122	122	<2	**6,750**	**670**	**22.10**	494	929	1,320	49.1	0.11	**0.039**	**0.069**	0.058	**31.90**	0.013	0.86
pit lake 1A**	4/12/2013	7.07	**10,500**	123	123	<2	**7,130**	**599**	**20.40**	453	859	1,230	40.2	0.11	**0.039**	**0.070**	0.061	**33.10**	0.015	0.88
GWQ96-22A	1/9/2013	7.85	521	301	301	< 2	39	61	**3.07**	41	3	147	2.34	0.02	< 0.002	< 0.006	< 0.001		< 0.001	< 0.01
GWQ96-22B	1/9/2013	7.52	722	477	477	< 2	6	101	**3.32**	70	6	193	3.66	0.04	< 0.002	< 0.006	0.003		< 0.001	0.05
GWQ96-23A	1/11/2013	8.07	693	627	627	< 2	6	12	**2.00**	129	38	71	1.37	0.03	< 0.002	< 0.006	0.001		< 0.001	< 0.01
GWQ96-23B	1/11/2013	8.03	571	502	502	< 2	< 5.0	15	**2.05**	77	21	98	1.57	< 0.02	< 0.002	< 0.006	< 0.001		< 0.001	0.01
GWQ11-24A	1/8/2013	**4.53**	**4,180**	< 20	< 20	< 2	**2,550**	30	**17.40**	464	108	129	6.98	**38.00**	**0.181**	**0.256**	**104.000**		0.029	5.72
GWQ11-24A	4/12/2013	**4.48**	**4,320**	< 20	< 20	< 2	**2,730**	30	**22.90**	468	110	126	<10	**46.00**	**0.206**	**0.290**	**126.000**	**11.40**	0.035	6.32
GWQ11-24B	1/9/2013	7.07	**2,280**	219	219	< 2	**1,280**	27	**3.39**	417	76	96	6.23	< 0.02	< 0.002	0.011	< 0.001		< 0.001	0.05
GWQ11-24B	4/12/2013	6.18	**2,440**	189	189	< 2	**1,510**	28	**3.99**	469	78	91	5.81	< 0.02	< 0.002	0.019	< 0.006	**3.54**	<0.005	0.23
GWQ11-25A	1/9/2013	**3.98**	**11,300**	< 20	< 20	< 2	**7,900**	21	**124.00**	419	149	647	< 100	**414.00**	**0.385**	**1.720**	**12.600**		**0.087**	**14.90**
GWQ11-25A	4/12/2013	**3.30**	**23,800**	< 20	< 20	< 2	**17,400**	11	**324.00**	556	<500	<500	<500	**1,730.00**	**0.656**	**3.910**	**63.900**	**77.50**	<0.500	**42.10**
GWQ11-25B	1/9/2013	6.94	**2,540**	343	343	< 2	**1,400**	27	**8.03**	493	76	139	3.9	0.34	< 0.002	< 0.006	0.002		0.002	0.02
GWQ11-25B	4/12/2013	6.54	**2,530**	339	339	< 3	**1,470**	27	**8.10**	465	81	128	4.35	0.38	< 0.002	< 0.006	< 0.006	**3.30**	0.002	0.02
GWQ11-26	1/8/2013	7.76	654	361	361	< 2	97	14	< 1.00	96	22	72	1.34	0.03	< 0.002	< 0.006	0.003		0.001	< 0.01
GWQ11-26	4/12/2013	7.05	582	354	354	< 2	98	16	0.39	93	23	68	1.73	<0.02	< 0.002	< 0.006	< 0.006	0.02	0.002	< 0.01

* may not apply to pit and pit capture area
** conformation sample

NMWQCC – New Mexico Water Quality Control Commission
mg/L – milligrams per liter

Monitoring wells GWQ11-24(A, B) and GWQ11-25(A, B) are completed in the mineralized ore-bearing quartz monzonite rocks surrounding the pit (Fig. 3). Water-quality data from the A piezometers are significantly different than the data from the deeper B piezometers (Table 5). Furthermore, water quality from GWQ11-25(A) is completely different than all other samples from the pit area, but somewhat similar to the pit wall seepage (Table 5). GWQ11-25(A) is completed in a localized zone of sulfide mineralization (see completion diagram in Appendix A), and it is suspected that air-lift development in the low-yielding formation caused oxidation of the sulfide mass in the borehole surrounding the screen interval. The other theory considered is localized infiltration of oxygenated meteoric water into sulfide-bearing fractures on the bench that are connected to the shallow piezometer. The second theory requires vertical fractures or interconnected fractures. The A piezometer purged dry after one well volume indicating low horizontal hydraulic conductivity, so vertical infiltration appears plausible. GWQ11-24(B) and GWQ11-25(B) were also developed using air-lift methods, but adequate submergence, better hydraulic conductivity, and low sulfide content in the borehole adjacent to the screen interval possibly prevented adverse water-quality effects.

Poor quality groundwater observed in GWQ11-24(A) and GWQ11-25(A) is most likely localized to the area around the wells or shallow fracture, and not a plume of acidic groundwater. All other pit area monitoring points yield neutral pH groundwater with healthy concentrations of alkalinity. Current sampling shows low pH water is located to the upper piezometers at GWQ11-24 and GWQ11-25. At these locations the formation has low horizontal hydraulic conductivity and the wells are within the hydraulic sink created by the pit. This area will be mined out and dewatered if the proposed mine plan proceeds.

3.3.2 Waste Rock and Mill Site Area

A summary of 1st and 2nd Quarter water-quality data for the waste rock and mill site area monitoring points can be referenced from Table 6. Copies of lab reports are provided in Appendix B. Monitoring well GWQ-5R represents upgradient groundwater quality conditions in the andesite rocks. Monitoring well GWQ-5R exhibits low TDS and sulfate, but relatively high alkalinity (Table 6).

Results from GWQ-1, GWQ-3, and GWQ-8 provide evidence that a sulfate-TDS plume exists in the alluvium and Santa Fe Group sediments below the waste rock and mill site area along Grayback Arroyo (Table 6). Time-series sulfate concentrations for these three wells and historical data from SWQ-1 through -3 are shown on Figure 7. The source of the sulfate-TDS plume is likely leachate from the waste rock and mill site area (Fig. 1) that has comingled with storm-water runoff and infiltrated in the alluvium along Grayback Arroyo (Figs. 3, 4, and 7).

Table 6. Summary of 1st and 2nd Quarter water-quality data for monitoring points in the waste rock/mill site and TSF areas

sample location	analysis date	pH	total dissolved solids (TDS)	total alkalinity	bicarbonate	carbonate	sulfate	chloride	fluoride	calcium	magnesium	sodium	potassium	aluminum	cadmium	cobalt	copper	selenium	zinc
		standard units	mg/L	mg/L as CaCO3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NMWQCC standard		6 to 9	1,000				600	250	1.6					5.0	0.01	0.05	1.0	0.05	10.0
waste rock and mill site area																			
GWQ-1	1/10/2013	7.87	487	164	164	< 2	152	38	0.38	63.2	17.7	65.1	2.11	< 0.02	< 0.002	< 0.006	< 0.001	< 0.001	< 0.01
GWQ-1	4/12/2013		465	195	195	< 2	120	30		57.0	13.5	60.0	2.00						
GWQ-3	4/12/2013	7.50	**3,060**	188	188	< 2.0	**1,750**	75		477.0	111.0	253.0	3.99						
GWQ-5R	1/10/2013	7.79	504	293	293	< 2	97	17	1.25	96.9	22.7	34.0	5.15	< 0.02	< 0.002	< 0.006	< 0.001	< 0.001	0.01
GWQ-5R	4/12/2013	7.12	500	285	285	< 2	101	17		87.1	20.3	30.6	4.63						
GWQ-8	1/10/2013	7.60	**1,200**	213	213	< 2	498	89	< 0.50	202.0	33.8	107.0	2.43	< 0.02	< 0.002	< 0.006	< 0.001	0.002	0.01
GWQ-8	4/12/2013	7.16	**1,190**	214	214	< 2.0	447	85		214.0	35.6	113.0	2.73						
tailings storage facility (TSF) area																			
GWQ-11	4/12/2013	6.73	952	163	163	< 2	359	142		155.0	43.0	68.6	3.34						
GWQ-12	4/12/2013	7.19	360	179	179	< 2	47	27		50.0	16.1	26.9	2.66						
GWQ94-13	1/10/2013	7.63	**1,460**	126	126	< 2	543	184	< 0.50	246.0	49.9	106.0	3.22	< 0.02	< 0.002	< 0.006	< 0.001	0.017	< 0.01
GWQ94-13	4/10/2013	7.16	**1,410**	124	124	< 2	517	177		231.0	44.2	90.7	2.73						
GWQ94-14	1/11/2013	7.78	583	218	218	< 2	140	44	0.42	90.2	24.5	45.8	1.62	< 0.02	< 0.002	< 0.006	< 0.001	0.003	< 0.01
GWQ94-14	4/10/2013	7.36	553	213	213	< 2	141	44		94.8	25.8	48.7	1.71						
GWQ94-16	1/10/2013	7.76	**1,170**	173	173	< 2	407	192	0.59	188.0	47.7	75.7	3.33	0.04	< 0.002	< 0.006	< 0.001	0.002	< 0.01
GWQ94-16	4/12/2013		**1,070**	171	171	< 2	421	191		281.0	50.7	65.0	4.78						
NP-2	4/12/2013	7.38	872	167	167	< 2	299	170		147.0	40.7	68.9	4.24						
NP-3	1/10/2013	7.24	**1,390**	54.2	54.2	< 2	557	190	< 0.10	218.0	49.5	107.0	3.23	< 0.02	< 0.002	< 0.006	0.001	0.006	1.85
NP-3	4/12/2013	6.95	**1,340**	71.4	71.4		561	191		219.0	47.5	97.9	3.41						
MW-4	4/12/2013	8.29	267	87	87	< 2.0	92	21		23.2	7.3	48.1	2.27						

NMWQCC – New Mexico Water Quality Control Commission
mg/L - milligrams per liter

The downgradient extent of the sulfate-TDS plume occurs between GWQ-8 and GWQ-1 (Table 6). Groundwater samples from monitoring wells in Grayback Arroyo have neutral pH, alkalinity, and low to non-detectable metal concentrations. TDS is slightly elevated in GWQ-1 and GWQ-8, but sulfate concentrations are below NMWQCC standard of 600 mg/L. Only one sample has been collected from GWQ-3, and additional samples from GWQ-3 are needed to confirm the elevated TDS and sulfate.

3.3.3 Tailings Storage Facility (TSF)

A summary of 1st and 2nd Quarter water-quality data for the TSF area monitoring points can be referenced from Table 6. Copies of lab reports are provided in Appendix B. Monitoring well GWQ-5R represents upgradient groundwater quality conditions in the andesite rocks, and GWQ-12 represents off-gradient groundwater quality conditions in the Santa Fe Group sediments (Table 6). Groundwater upgradient and off-gradient of the TSF exhibits low TDS and sulfate, but relatively high alkalinity (Table 6).

All samples from the monitoring network below the TSF had sulfate concentrations below the NMWQCC standard of 600 mg/L (Table 6), but monitoring wells GWQ94-13, GWQ94-16, and NP-3 had elevated TDS concentrations. Furthermore, TDS concentrations in GWQ94-13, GWQ94-16, and NP-3 are decreasing over time (Fig. 8).

4.0 DISCUSSION

4.1 Pit Area

The additional Stage 1 water-level data from wells in the pit area demonstrate the pit is a hydraulic sink, and the capture zone includes the mineralized quartz monzonite rocks. The pit chemistry has maintained a neutral pH, and significant precipitation of sulfate salts have been occurring around the water surface perimeter.

Pit water balance during the last 2 years has been dominated by evaporation. Evaporation exceeds groundwater inflow for pit level to drop. With no surface-water and groundwater inflow, the evaporation rate would equal 35 inches per year or 13.9 gpm for a 5-acre water surface.

The poorer quality groundwater observed in the shallow piezometers at GWQ11-24 and GWQ11-25 is puzzling, and is suspected to be an artifact of well development, or localized in fracture zone. The pit chemistry would be drastically different if significant rates of groundwater resembling the quality observed at GWQ11-25(A) were reporting to the pit. Both shallow piezometers are low yielding, easily pump dry after one well volume, slowly recover, and produce turbid water; therefore additional well development by bailing or pumping is impractical. Field measurements of dissolved oxygen from pit area monitoring points will be collected during the upcoming 3rd and 4th Quarter sampling events, so the chemistry at GWQ11-24(A) and GWQ11-25(A) can be evaluated in more detail.

4.2 Waste Rock and Mill Site Area

Stage 1 data from monitoring points for the waste rock and mill site area have provided a better understanding of water-quality conditions. Only GWQ-3 exceeds NMWQCC standards for both sulfate and TDS (Table 6). Groundwater along Grayback Arroyo has neutral pH and adequate concentrations of alkalinity for buffering historical discharges from the waste rock and mill site area.

The revised conceptual model and Stage 1 sampling results for the waste rock and mill site area (Figs. 4 and 7) help clarify the source for elevated sulfate and TDS, transport mechanisms, and extent of the sulfate and TDS plume. Figures 9 and 10 are maps showing the distribution of groundwater sulfate and TDS concentrations in Grayback Arroyo.

4.3 TSF Area

Analysis of the 1st and 2nd Quarter Stage 1 sampling data demonstrates the sulfate concentrations are below NMWQCC standard of 600 mg/L, and the remaining TDS plume below the TSF is decreasing in concentration and size (Figs. 10, 11, and 12). Pumping from GWQ-7 and GWQ-9 has caused drawdown and capture of the residual TDS plume below the TSF. Figure 11 is a graph of metered pumping from GWQ-7 and GWQ-9, and well locations can be referenced from Figure 9. These wells are located directly north and south of the TSF TDS plume. A total of 6 ac-ft has been pumped from GWQ-7 and GWQ-9 in the last 24 months, which has resulted in observed drawdown and TDS plume reduction.

5.0 REFERENCES

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THEMAC Resources, 2013, letter to Brad Reid with Mining Environmental Compliance Section, Ground Water Quality Bureau, regarding NMED Approval of Revised Groundwater Sampling Plan for Copper Flat Mine State 1 Abatement Plan, DP-1, Additional Requested Data: letter prepared by Katie Emmer with THEMAC Resources, April 7, 2013, 1 p. plus a table and figure.

ILLUSTRATIONS

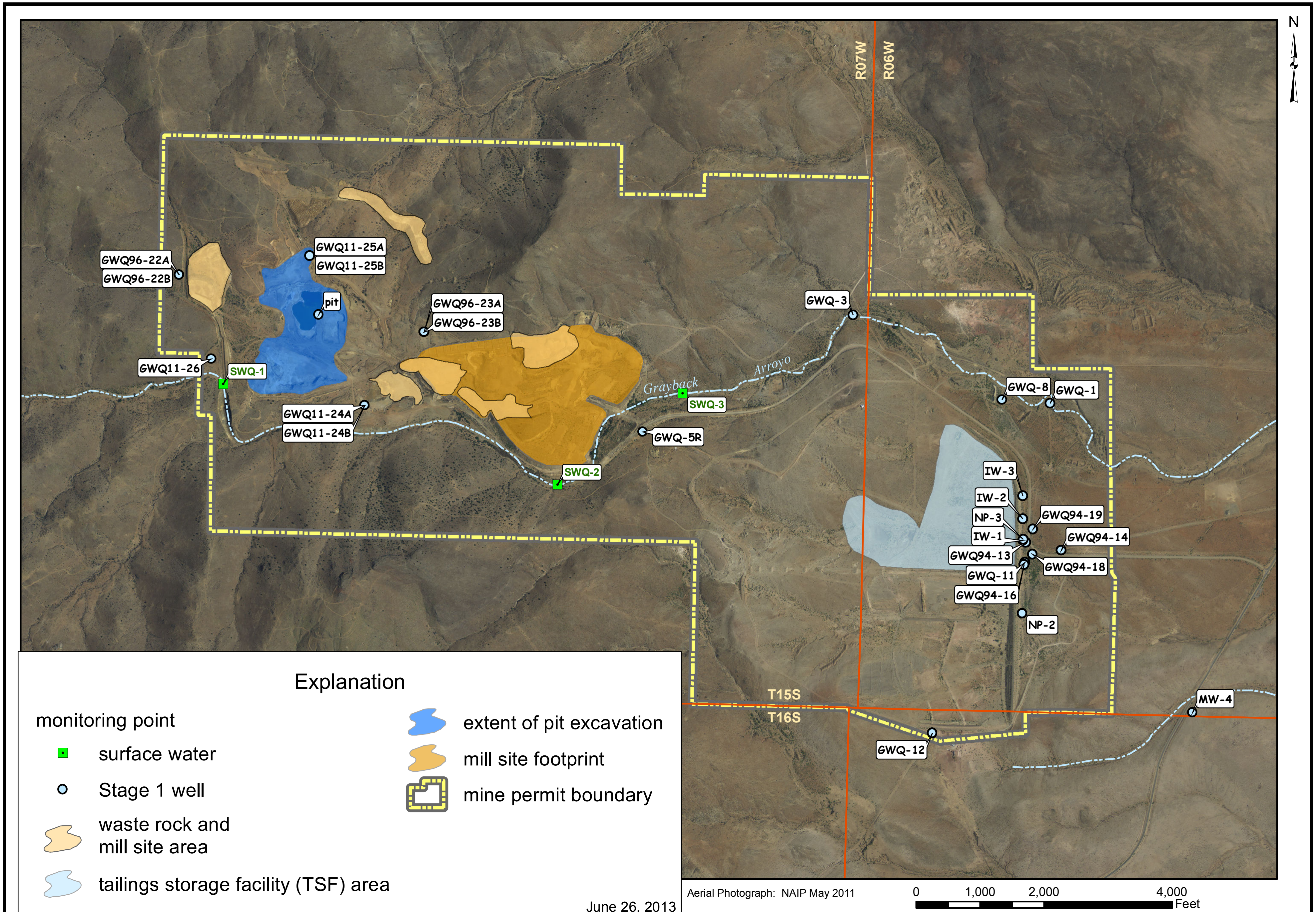

Figure 1. Aerial photograph showing locations of facilities associated with the former Copper Flat Mine operated by Quintana Minerals, Sierra County, New Mexico.

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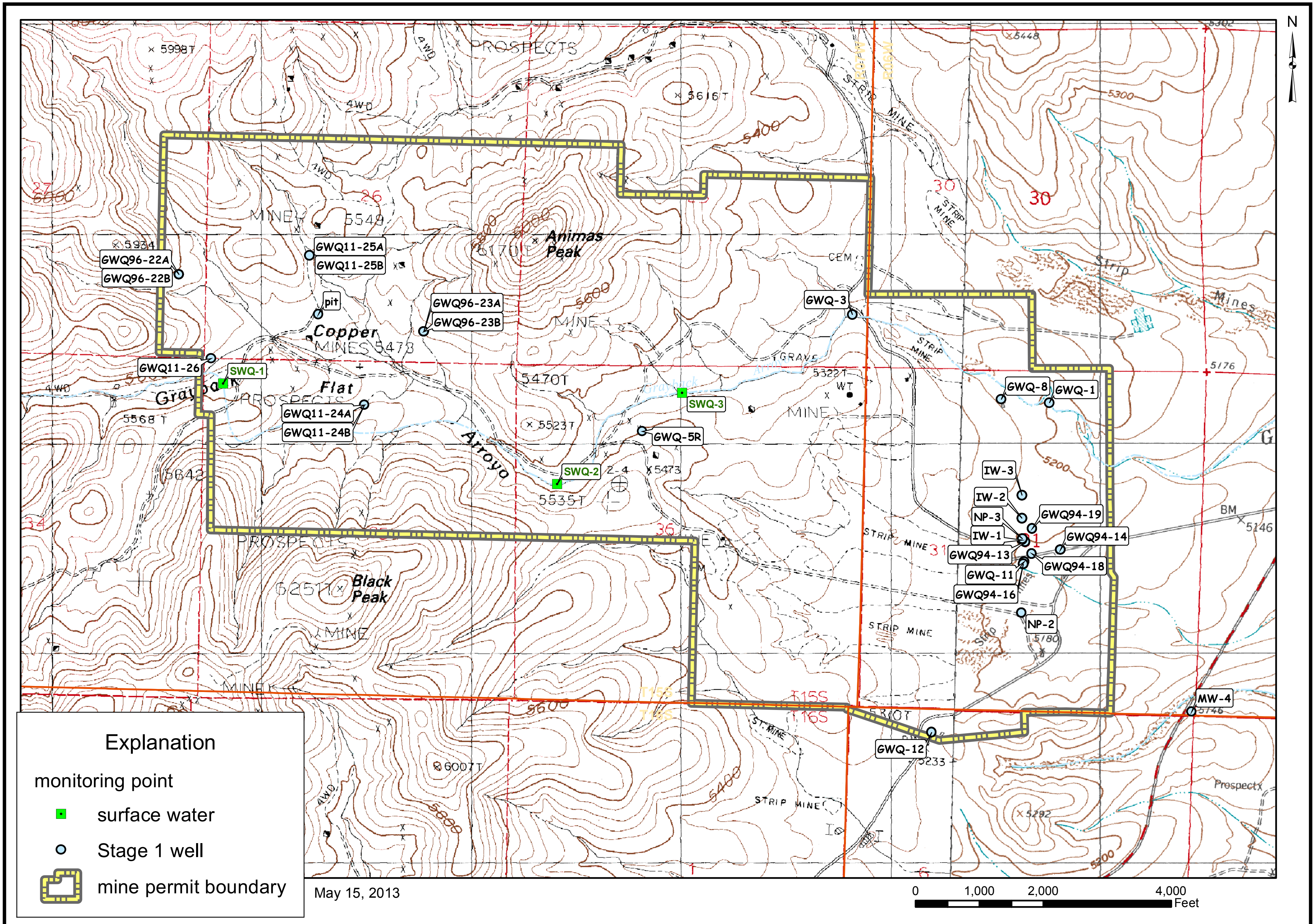

Figure 2. Topographic map showing locations of Stage 1 Abatement Plan monitoring points, Copper Flat Mine, Sierra County, New Mexico.

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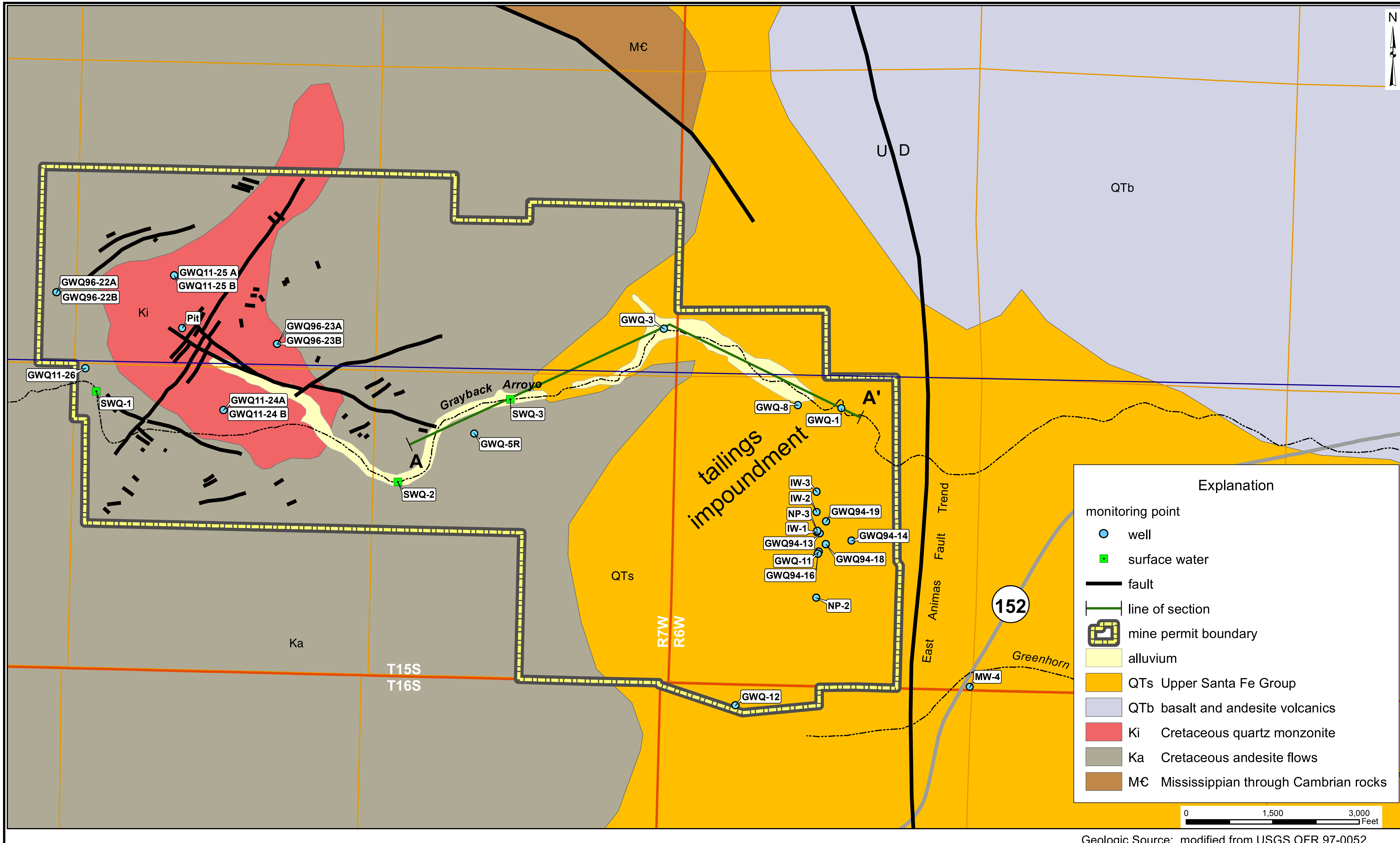

Figure 3. Geologic map showing distribution of Stage 1 Abatement Plan area, Copper Flat Mine, Sierra County, New Mexico.

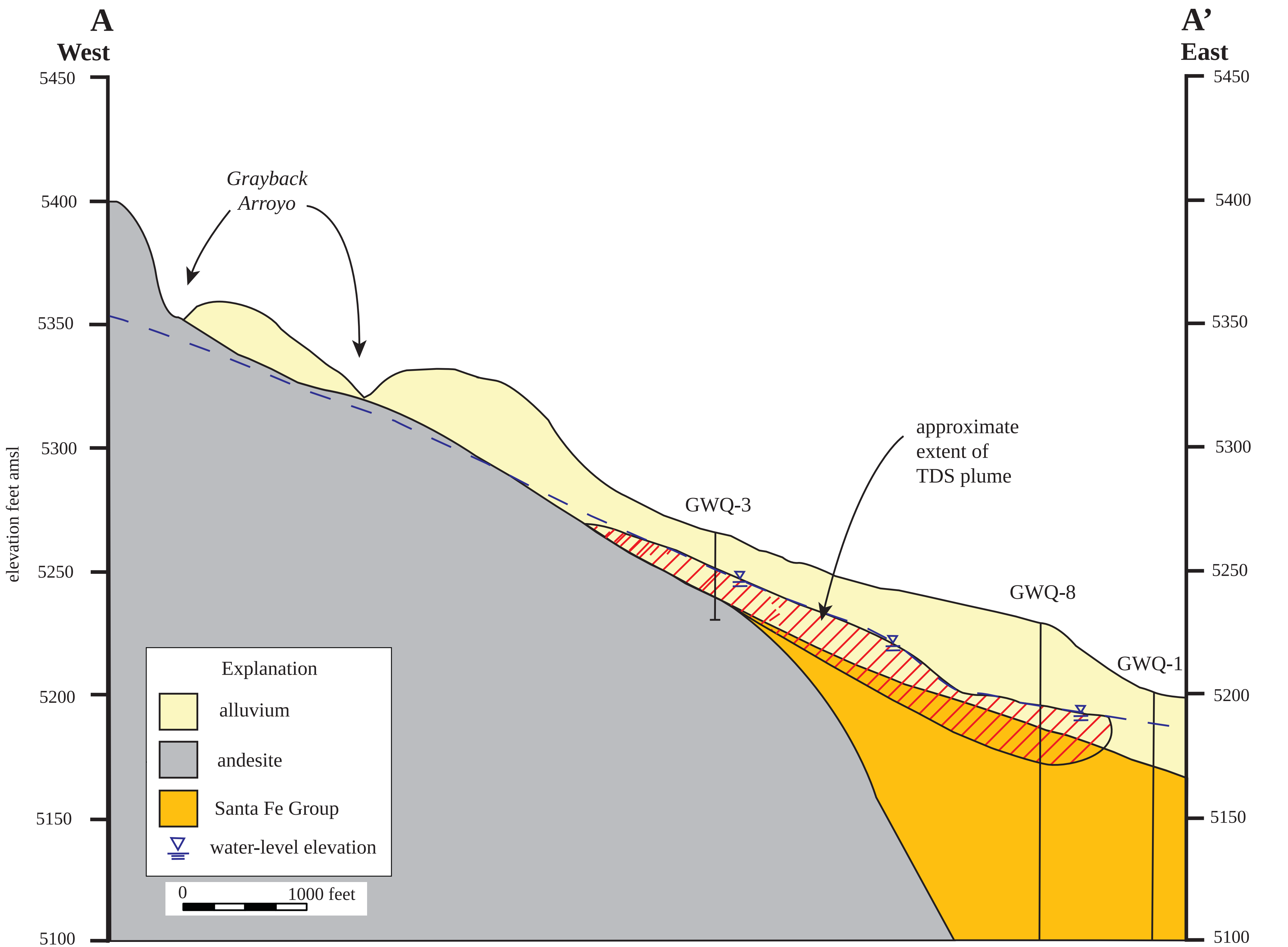

Figure 4. West to east hydrogeologic cross-section through the waste rock and mill site area, Copper Flat Mine, Sierra County, New Mexico.

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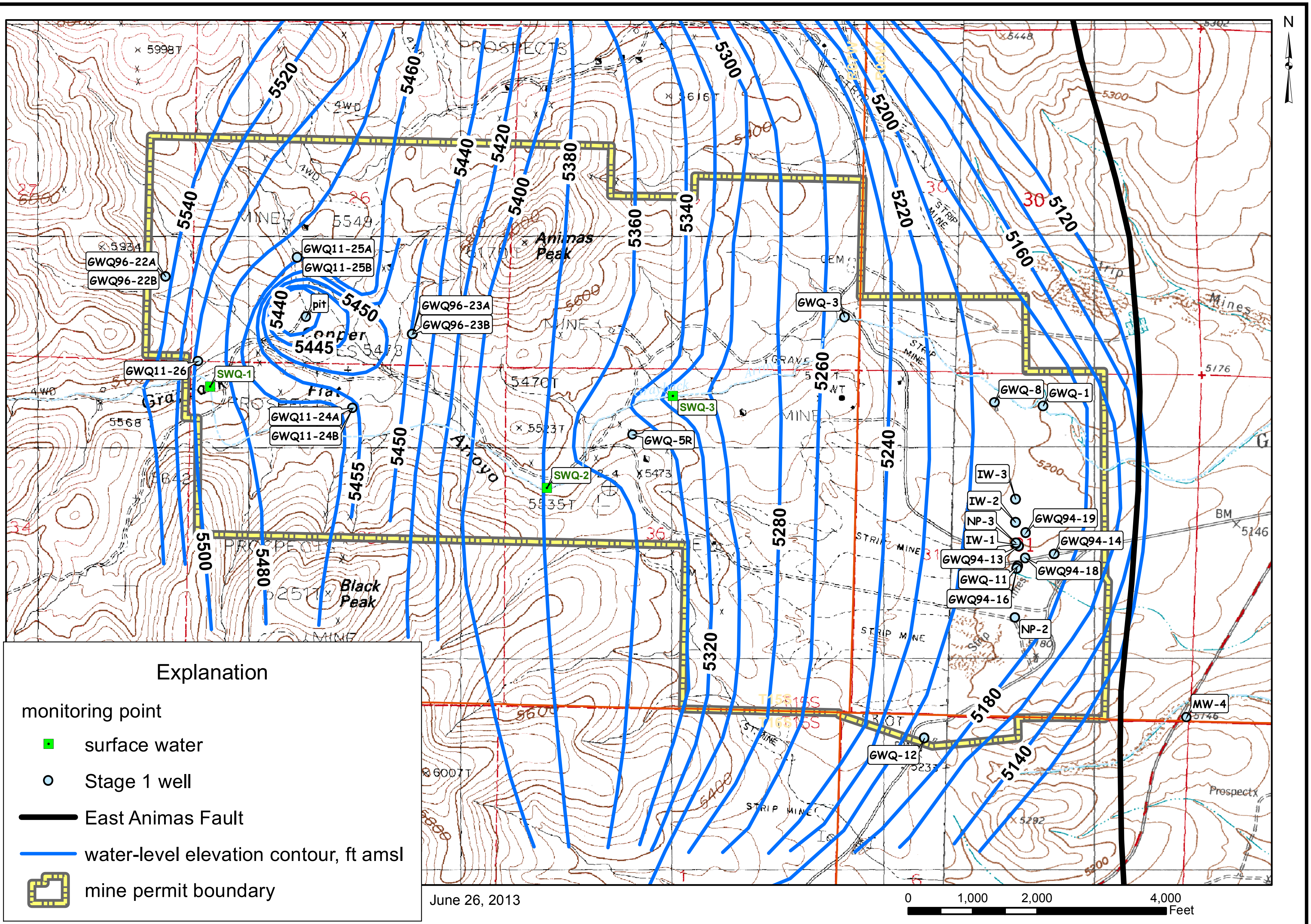

Figure 5. Water-level elevation contour map for Stage 1 Abatement Plan, 2nd Quarter 2013, Copper Flat Mine, Sierra County, New Mexico.

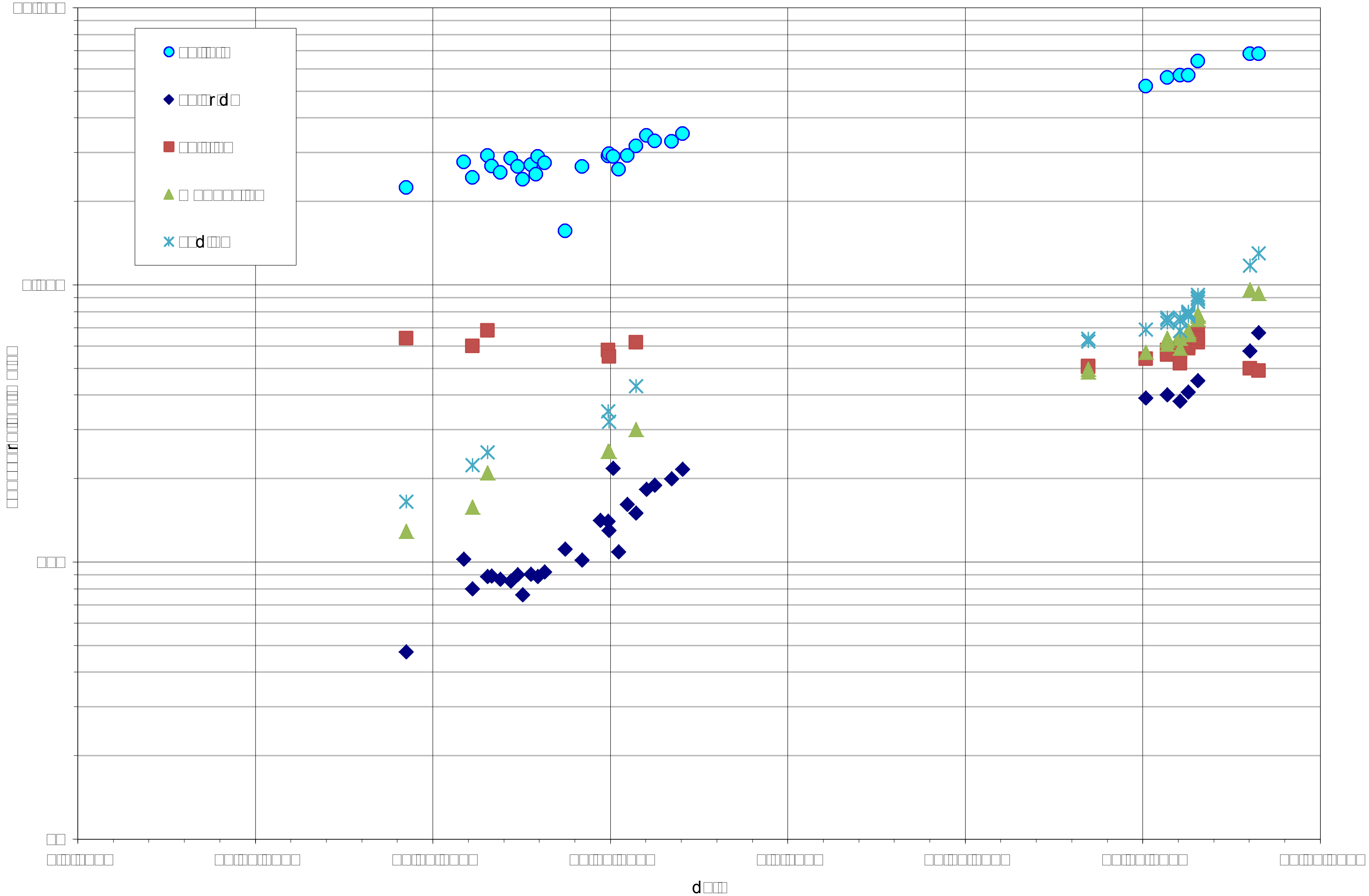

Figure 6. Time-series graph of selected water-quality data for the pit water body, Copper Flat Mine, Sierra County, New Mexico.

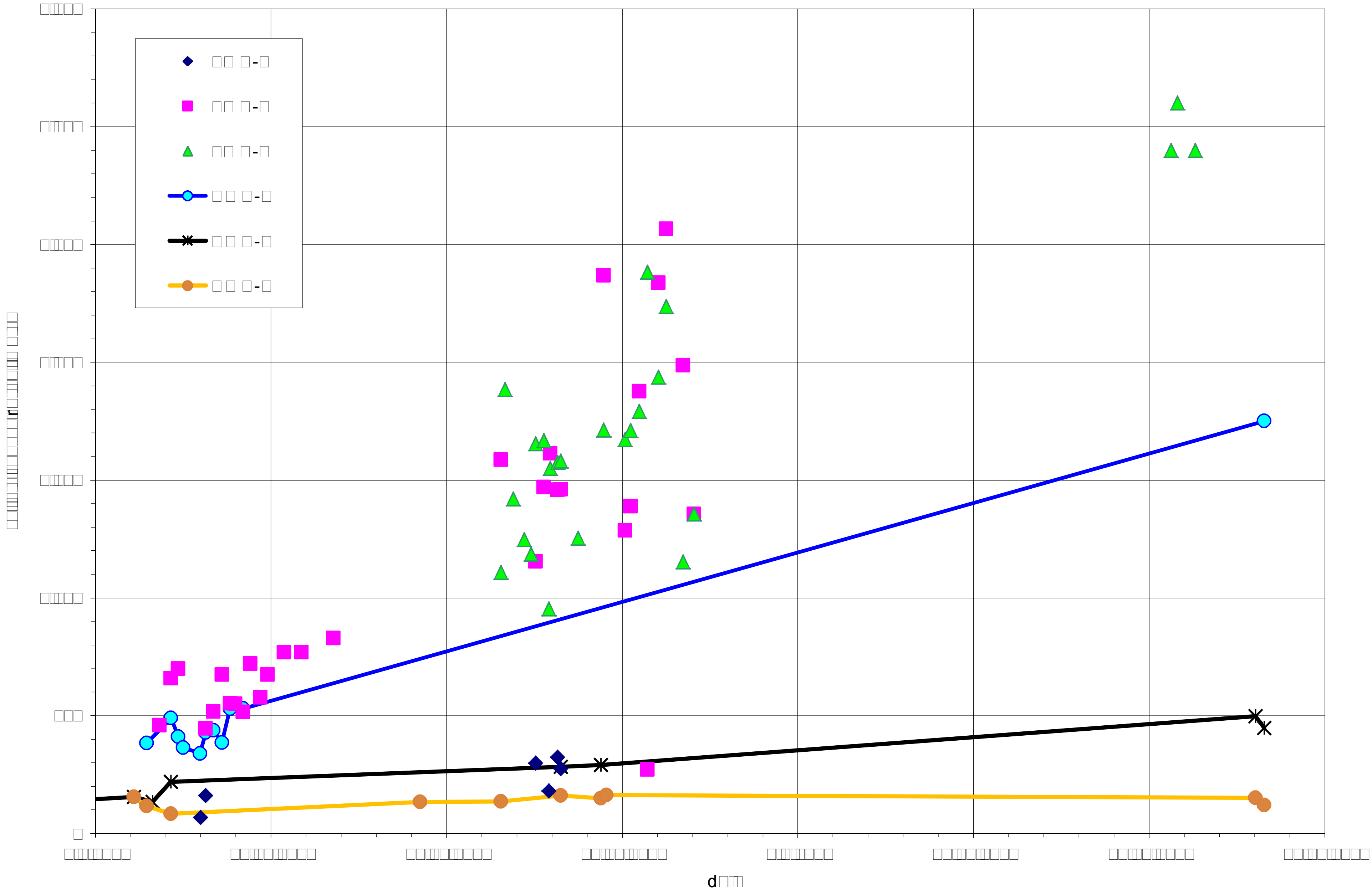

Figure 7. Time-series graph of sulfate concentrations in SWQ-1, SWQ-2, SWQ-3, and monitoring wells GWQ-1, GWQ-3, and GWQ-8 located in Grayback arroyo below waste rock and mill site area, Copper Flat Mine, Sierra County, New Mexico.

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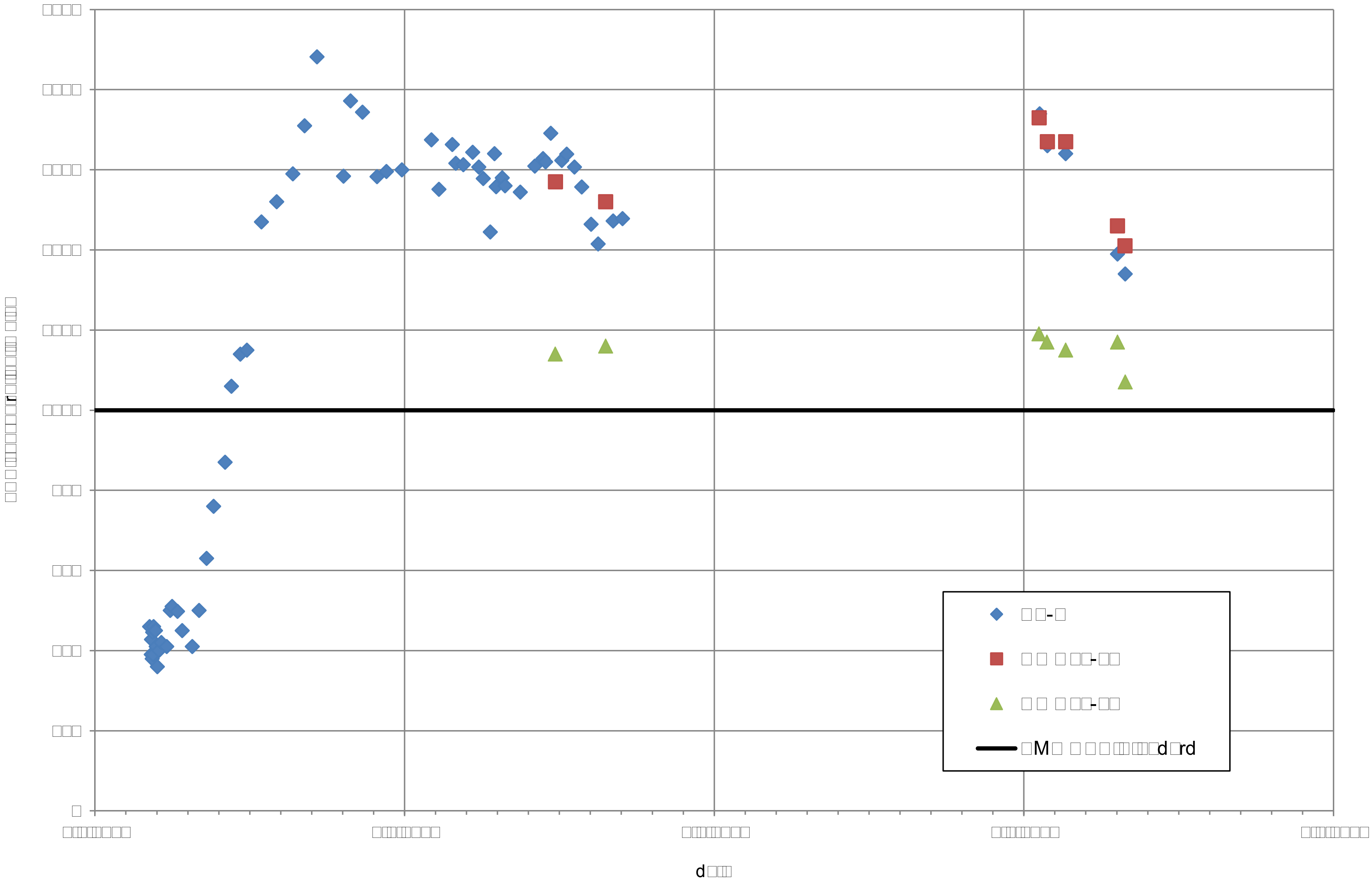

Figure 8. Time-series graph of total dissolved solids (TDS) concentrations in NP-3, GWQ94-13, and GWQ94-16, located downgradient of the tailings storage facility (TSF), Copper Flat Mine, Sierra County, New Mexico.

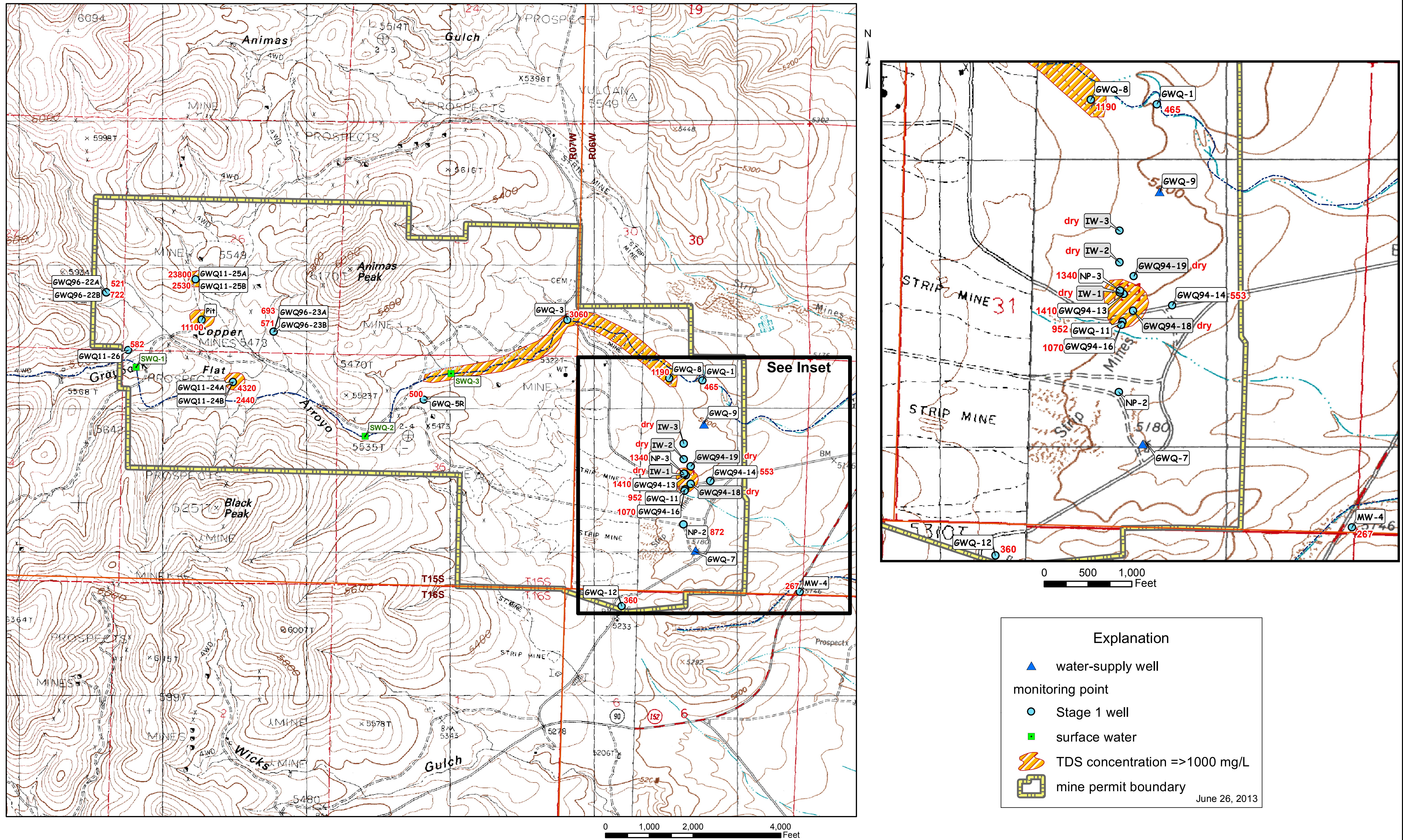

Figure 9. Map showing Stage 1 Abatement Plan monitoring points and lateral extent of 2nd Quarter 2013 TDS plumes, Copper Flat Mine, Sierra County, New Mexico.

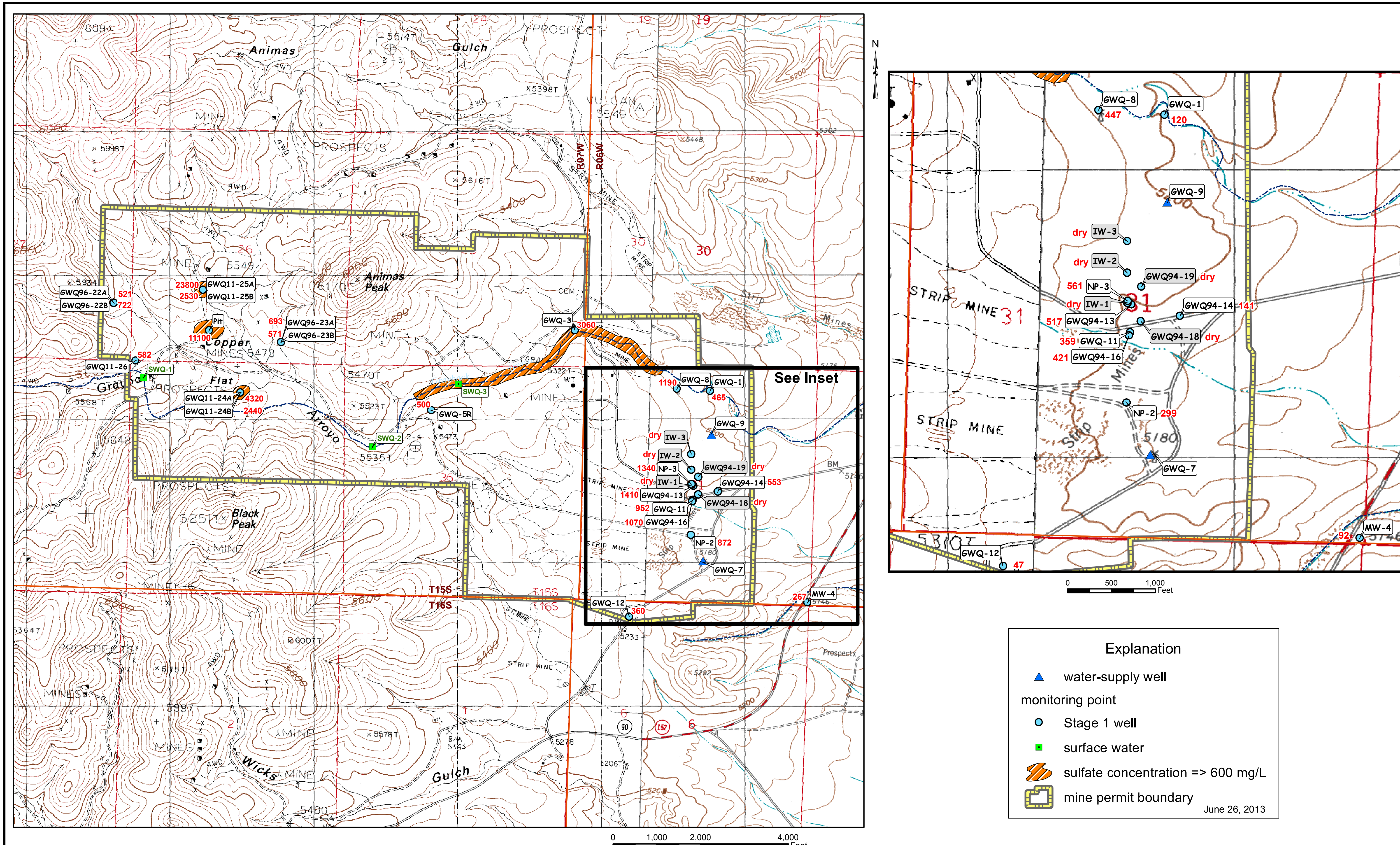

Figure 10. Map showing Stage 1 Abatement Plan monitoring points and lateral extent of 2nd Quarter 2013 sulfate plumes, Copper Flat Mine, Sierra County, New Mexico.

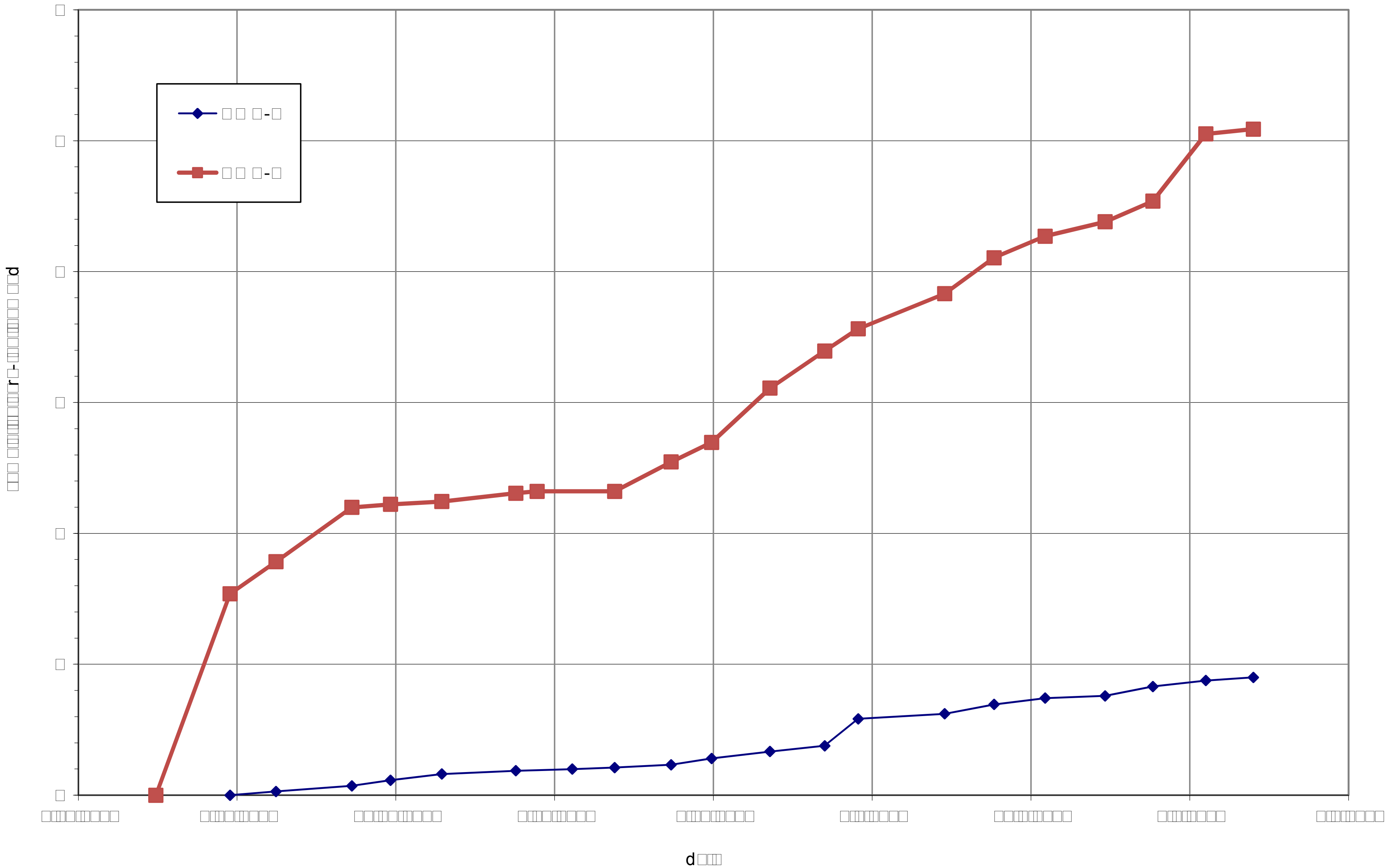

Figure 11. Graph of cumulative water pumped versus time for GWQ-7 and GWQ-9, Copper Flat Mine, Sierra County, New Mexico.

APPENDICES

Appendix A.

Well completion diagrams

Appendix A. Well completion diagrams

Appendix A figure number	well name	facility area	year drilled	comments
A1	GWQ96-22A	pit	1996	well diagram from well log
A1	GWQ96-22B	pit	1996	well diagram from well log
A2	GWQ96-23A	pit	1996	well diagram from well log
A2	GWQ96-23B	pit	1996	well diagram from well log
A3	GWQ11-24A	pit	2011	as-built well diagram
A3	GWQ11-24B	pit	2011	as-built well diagram
A4	GWQ11-25A	pit	2011	as-built well diagram
A4	GWQ11-25B	pit	2011	as-built well diagram
A5	GWQ11-26	pit	2011	as-built well diagram
n/a	pit	pit	1982	not applicable
A6	GWQ-1	waste rock and mill site	1972	simple well diagram from available information
A15	GWQ-3	waste rock and mill site	1932	Well Schedule form; no diagram
A7	GWQ-5R	waste rock and mill site	2011	as-built well diagram
A8	GWQ-8	waste rock and mill site	1931	well diagram from available information
A16	GWQ-11	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table; no diagram
A16	GWQ-12	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table; no diagram
A9	GWQ94-13	tailings storage facility (TSF)	1994	well diagram from well log
A10	GWQ94-14	tailings storage facility (TSF)	1994	well diagram from well log
A11	GWQ94-16	tailings storage facility (TSF)	1994	well diagram from well log
A12	GWQ94-18	tailings storage facility (TSF)	1994	well diagram from well log
A13	GWQ94-19	tailings storage facility (TSF)	1994	well diagram from well log
A16	IW-1	tailings storage facility (TSF)	1982	Water Quality Monitor Wells table; no diagram
A16	IW-2	tailings storage facility (TSF)	1982	Water Quality Monitor Wells table; no diagram
A16	IW-3	tailings storage facility (TSF)	1982	Water Quality Monitor Wells table; no diagram
A16	NP-2	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table; no diagram
A16	NP-3	tailings storage facility (TSF)	1981	Water Quality Monitor Wells table; no diagram
A14	MW-4	tailings storage facility (TSF)	1975	simple well diagram from available information

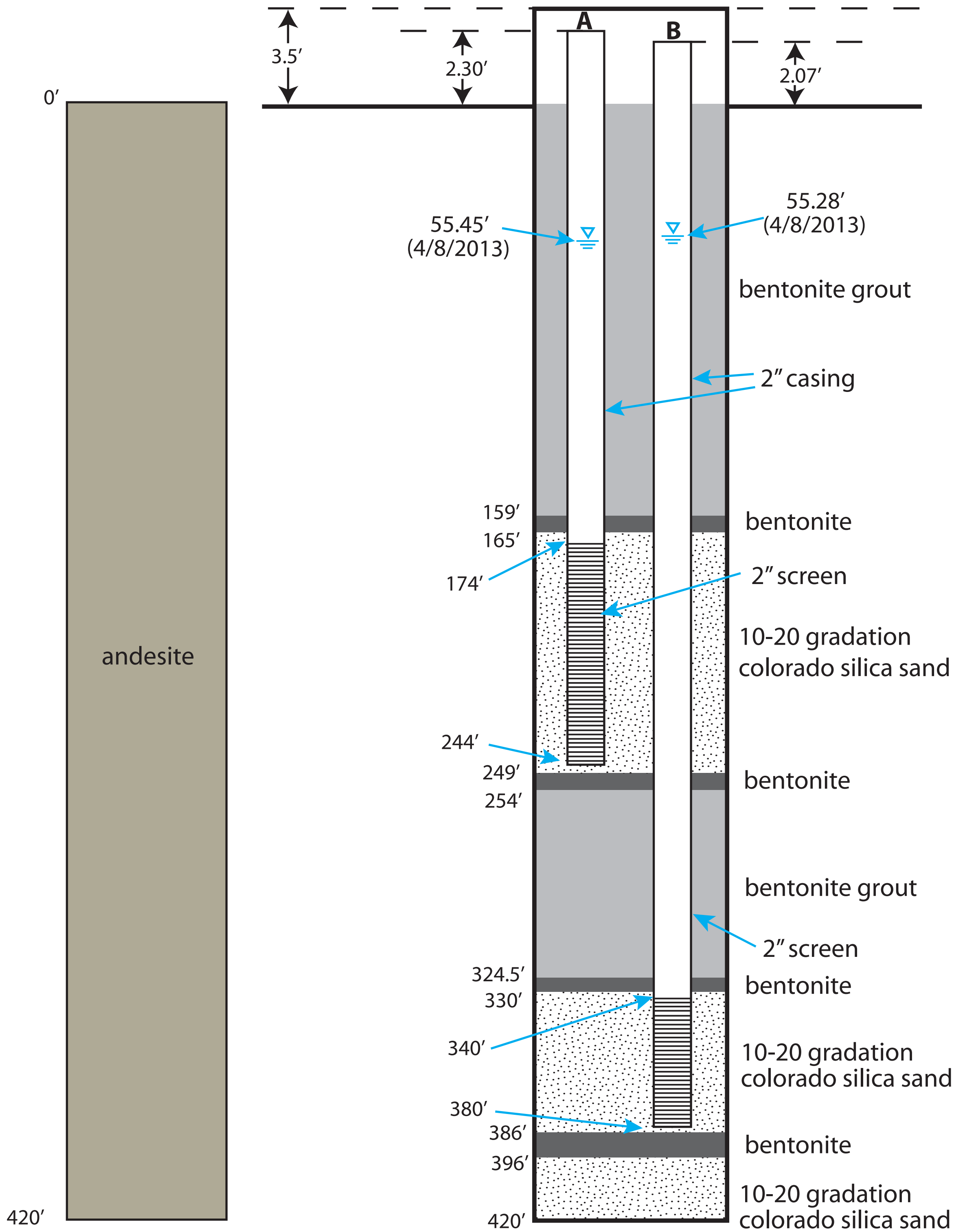

Figure A1. Well diagram, GWQ96-22, Copper Flat Mine, Sierra County, New Mexico.

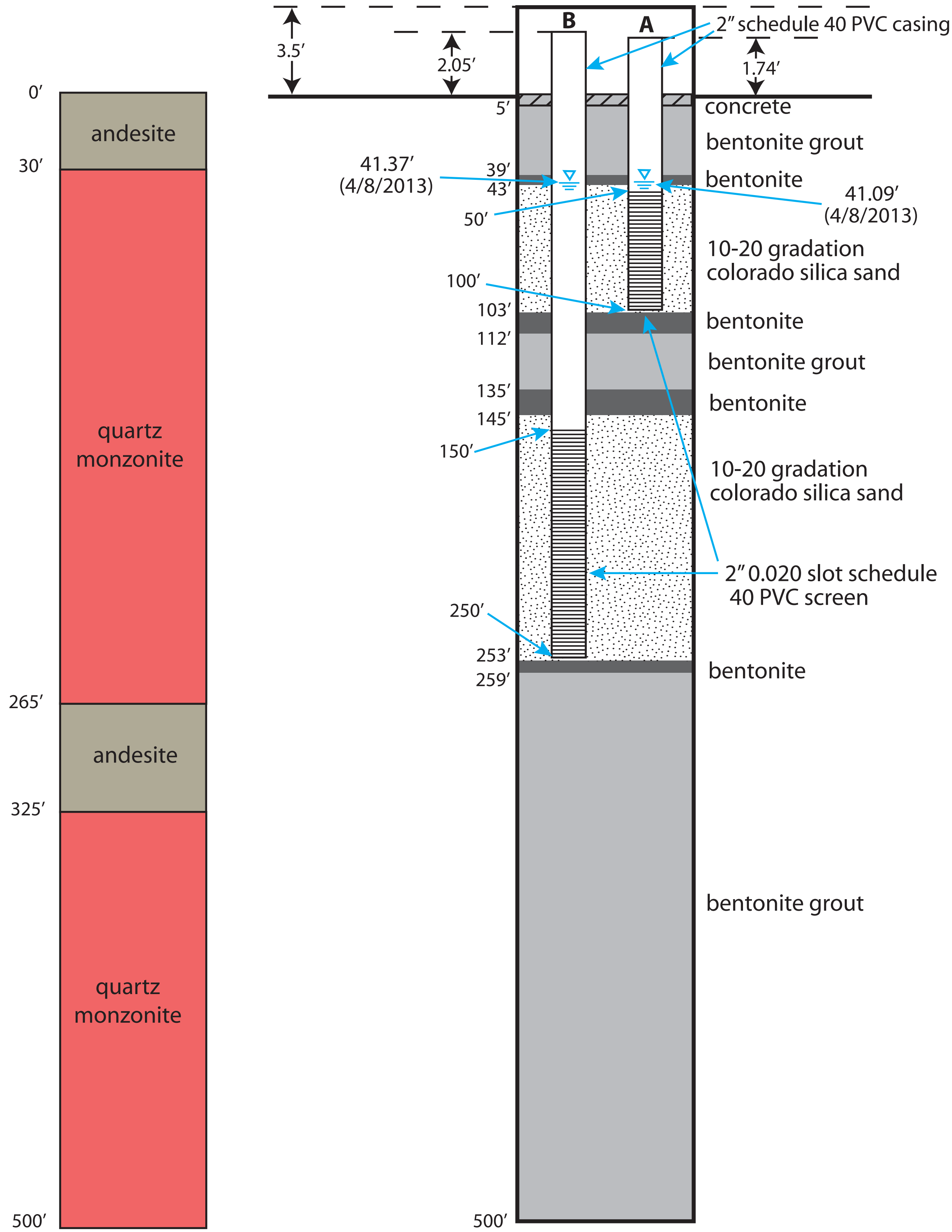

Figure A2. Well diagram, GWQ96-23, Copper Flat Mine, Sierra County, New Mexico.

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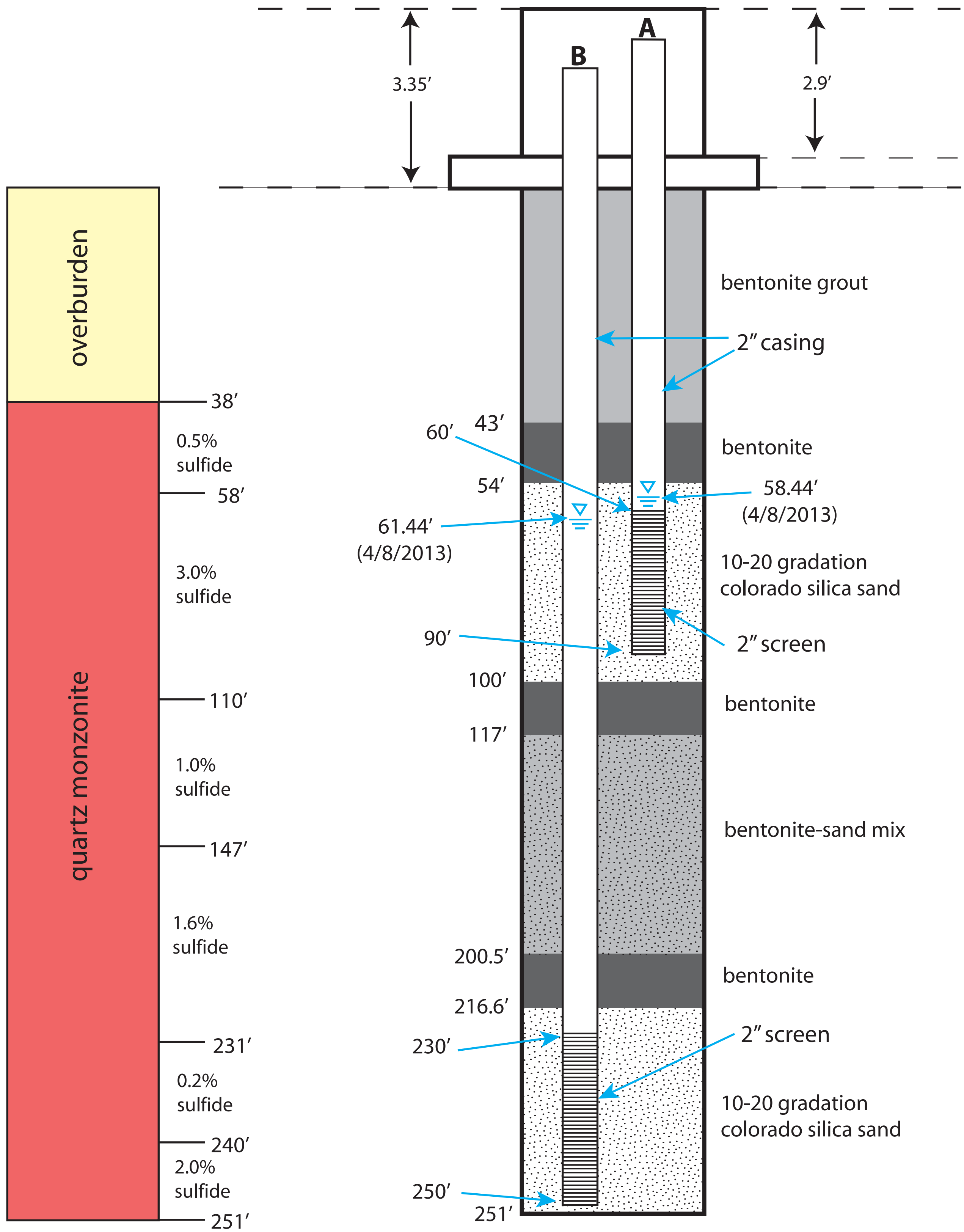

Figure A3. Well diagram, GWQ11-24, Copper Flat Mine, Sierra County, New Mexico.

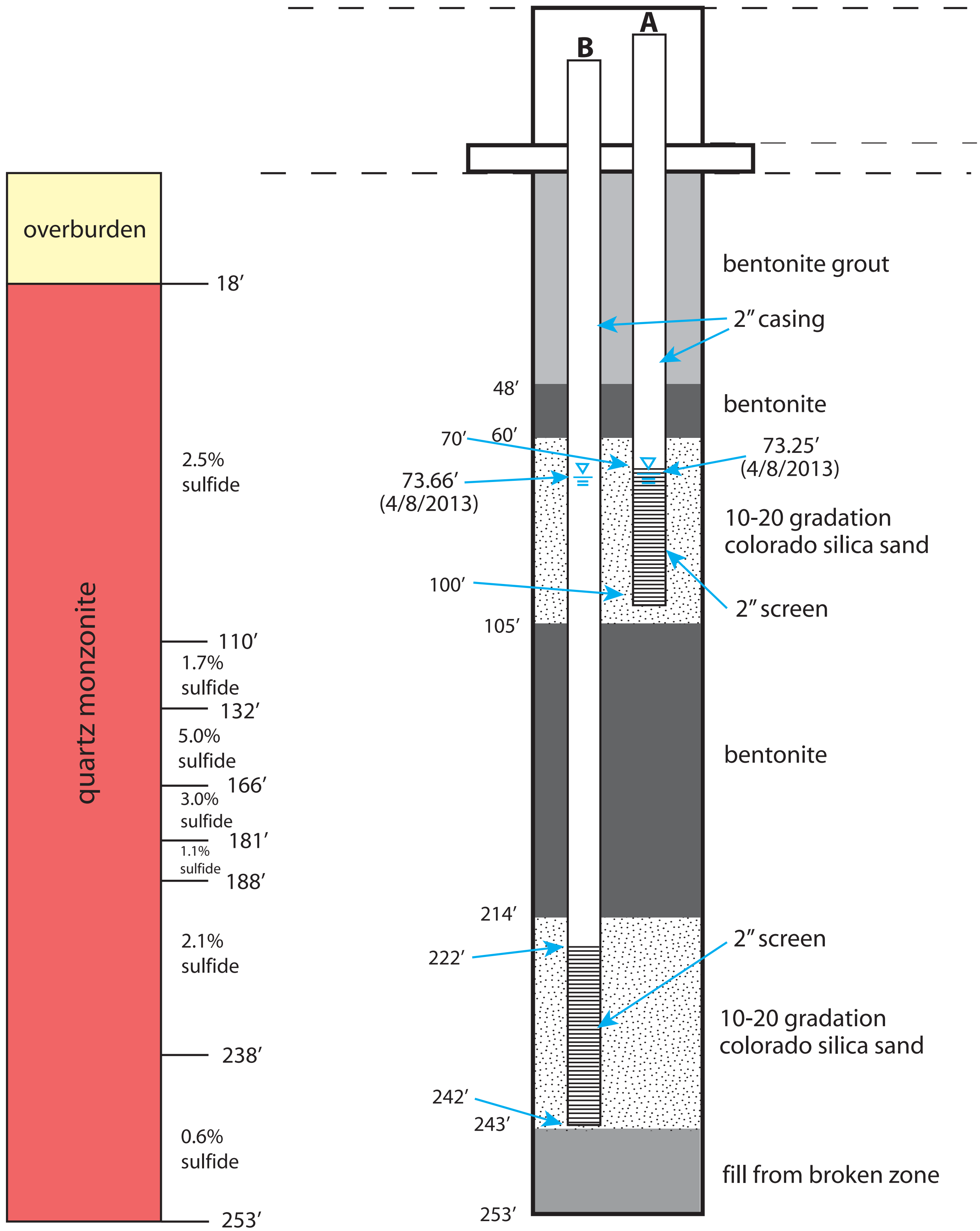

Figure A4. Well diagram, GWQ11-25, Copper Flat Mine, Sierra County, New Mexico.

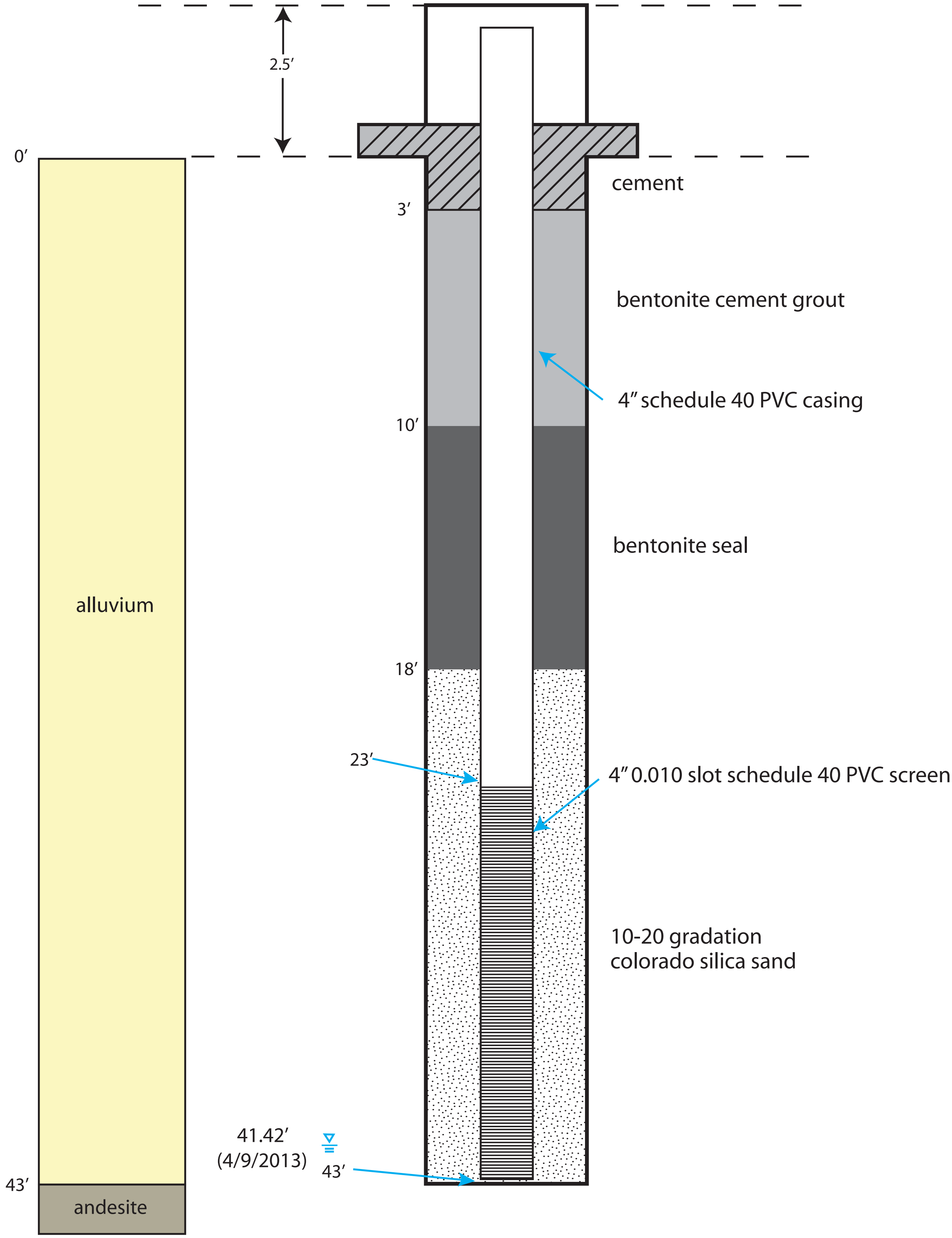

Figure A5. Well diagram, GWQ11-26, Copper Flat Mine, Sierra County, New Mexico.

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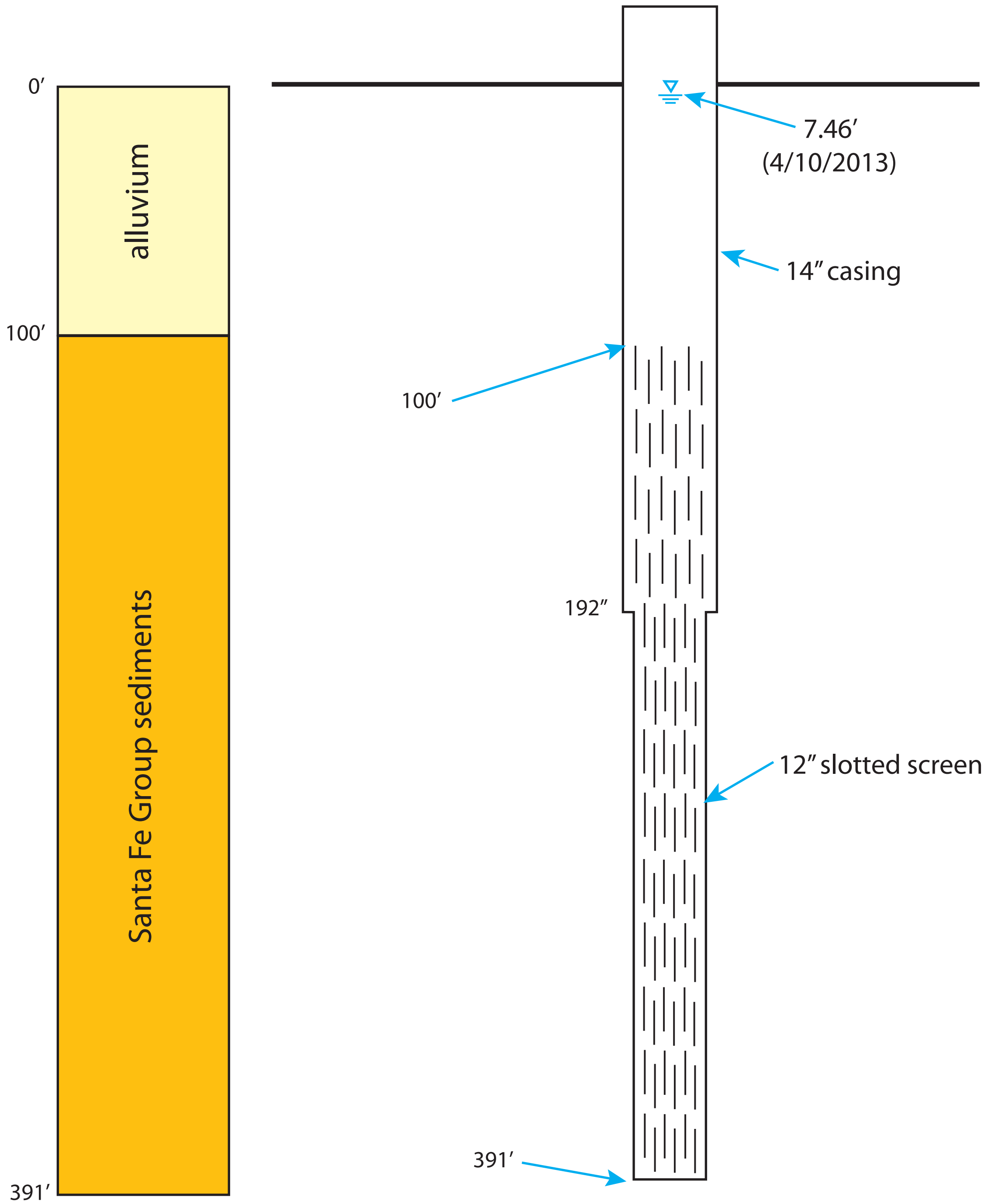

Figure A6. Well diagram, GWQ-1, Copper Flat Mine, Sierra County, New Mexico.

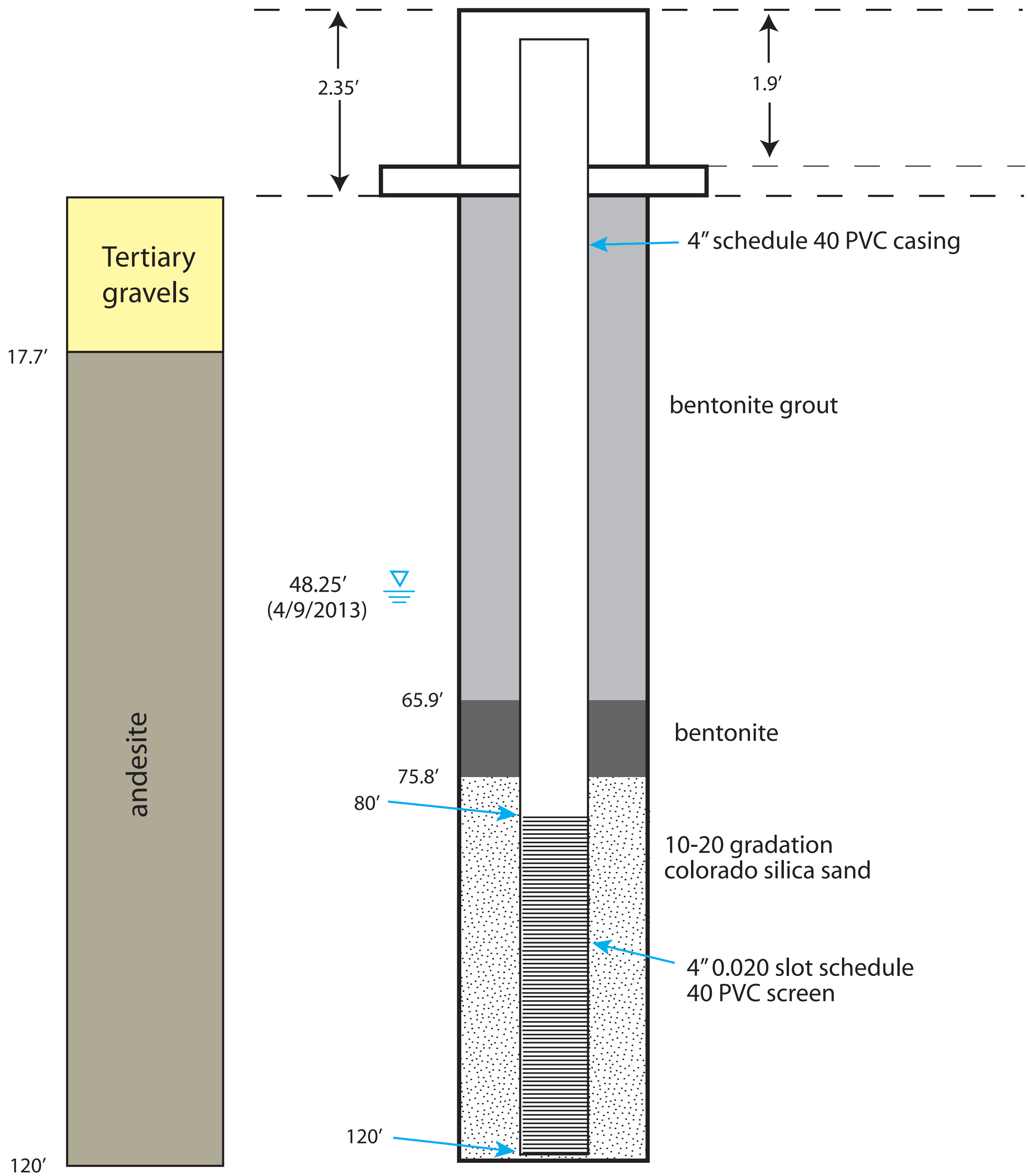

Figure A7. Well diagram, GWQ-5R, Copper Flat Mine, Sierra County, New Mexico.

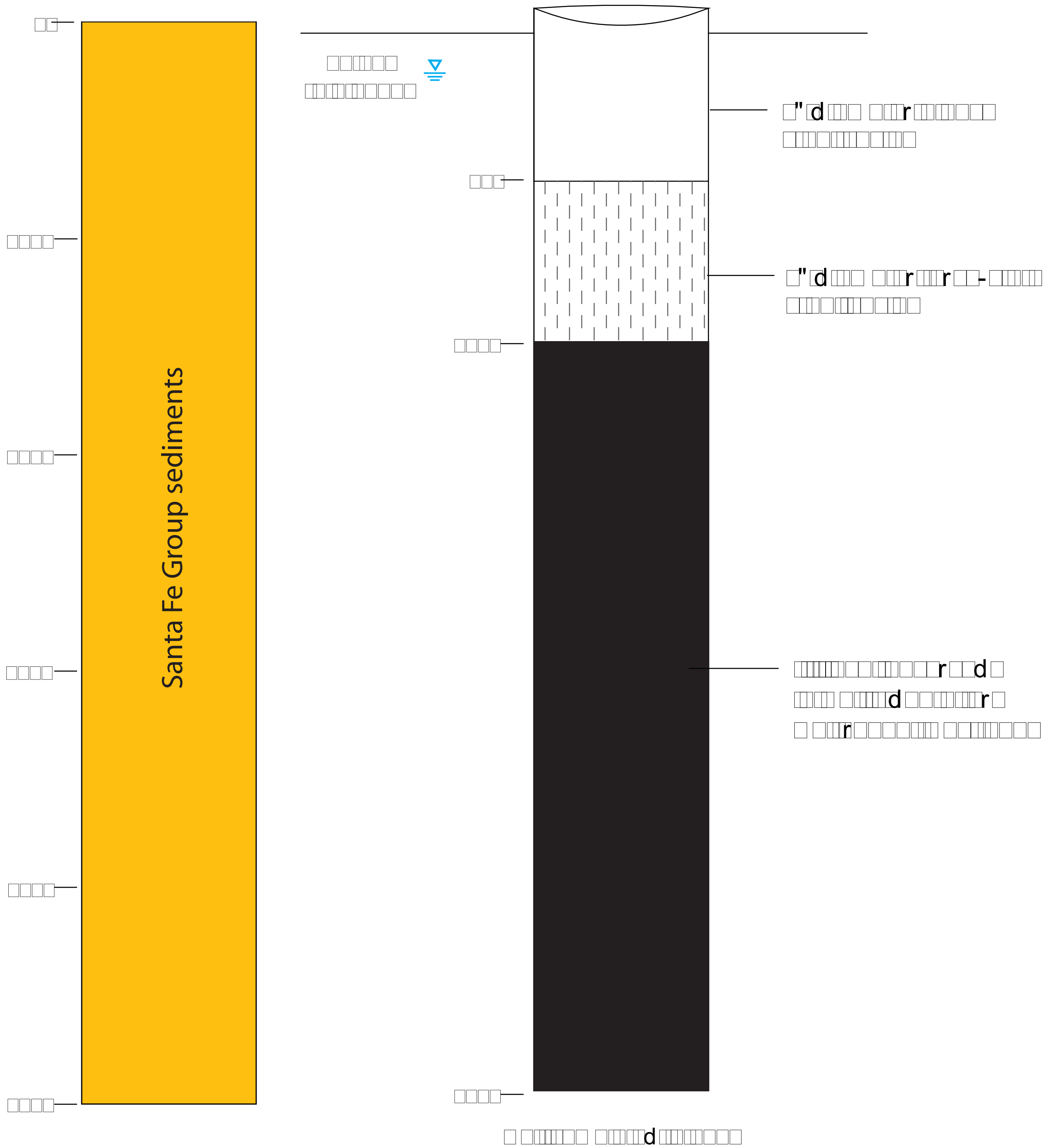

Figure A8. Well Diagram, GWQ-8 (LRG-4652-S-4), Copper Flat Mine, Sierra County, New Mexico.

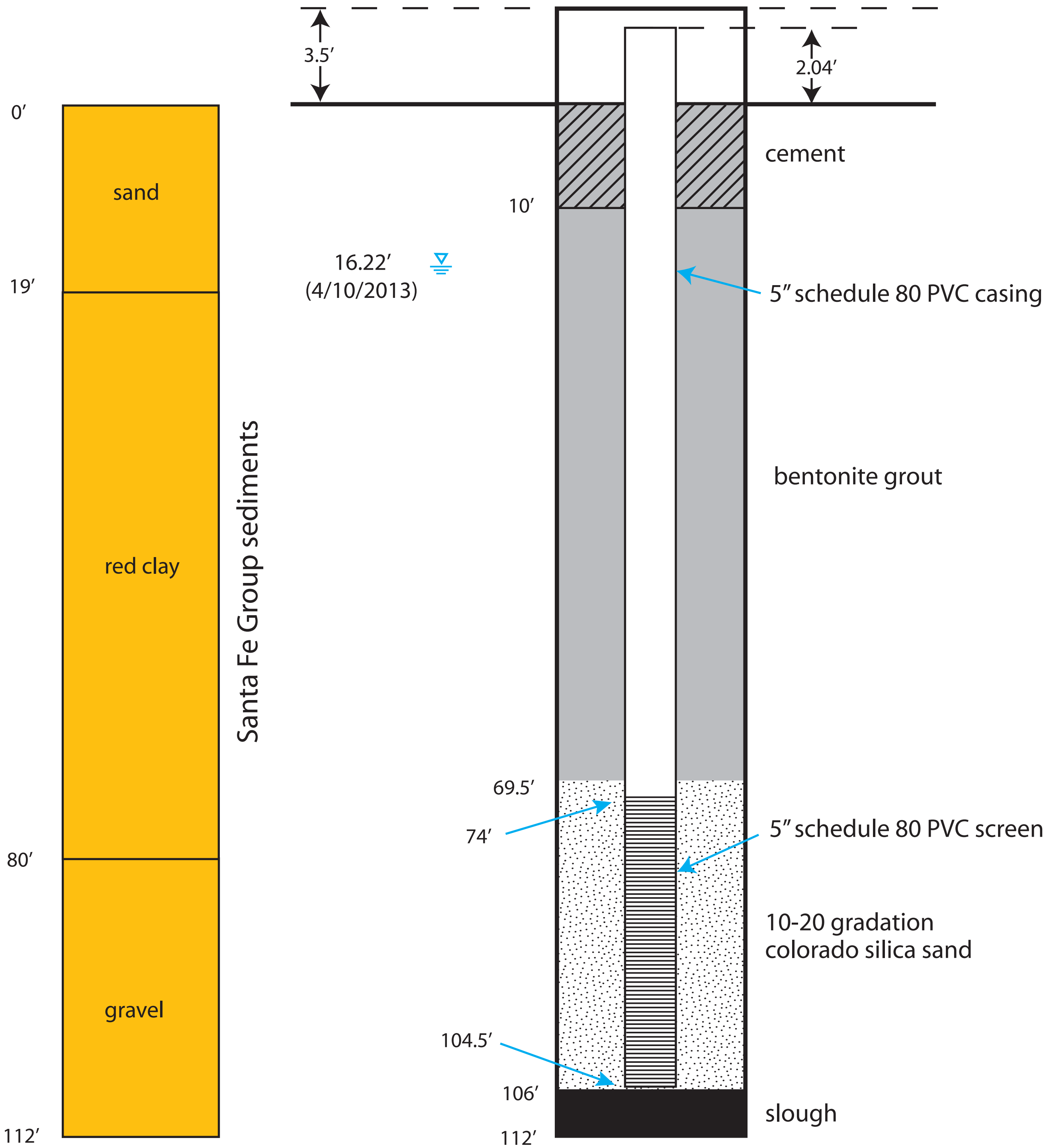

Figure A9. Well diagram, GWQ94-13, Copper Flat Mine, Sierra County, New Mexico.

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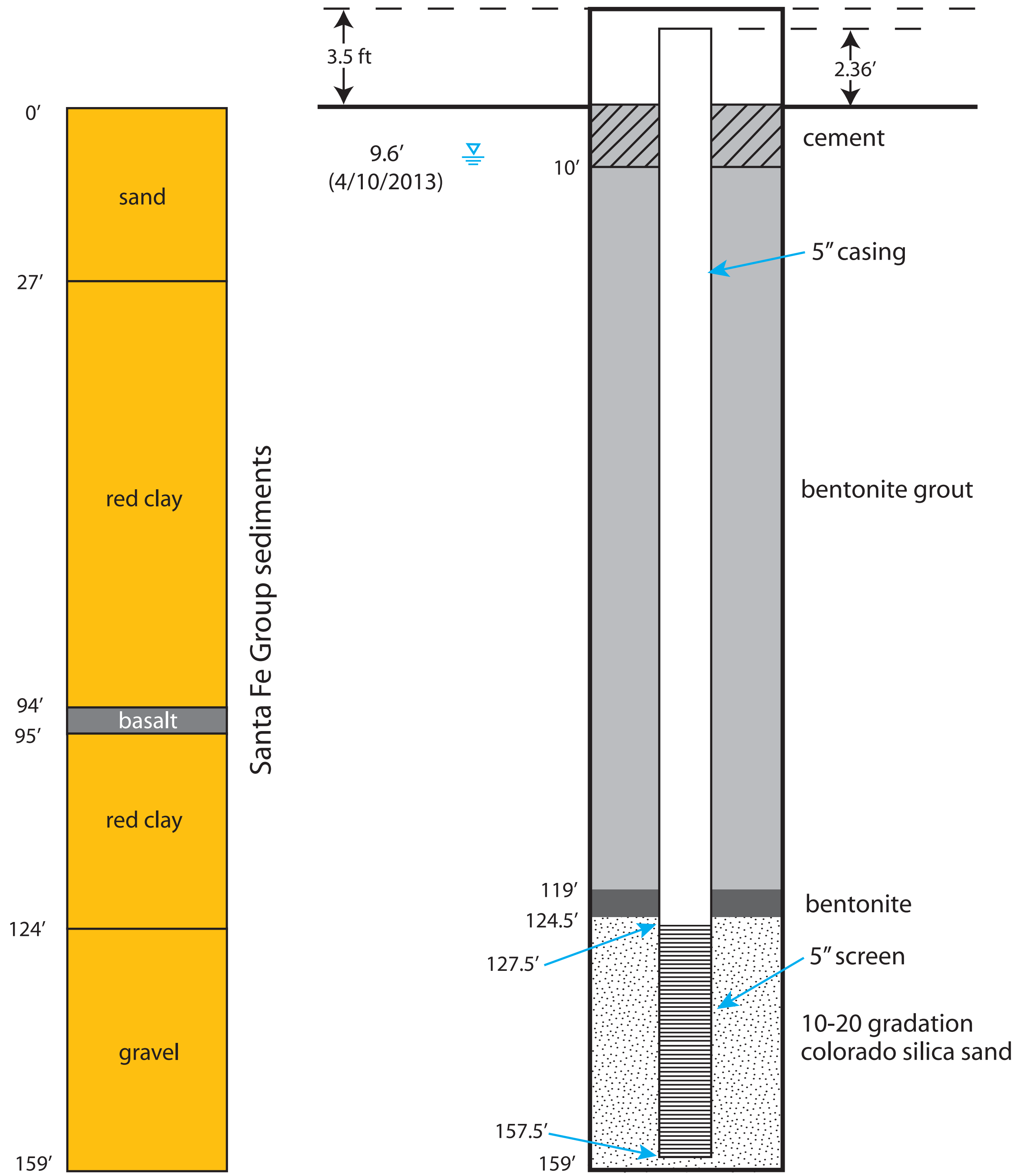

Figure A10. Well diagram, GWQ94-14, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

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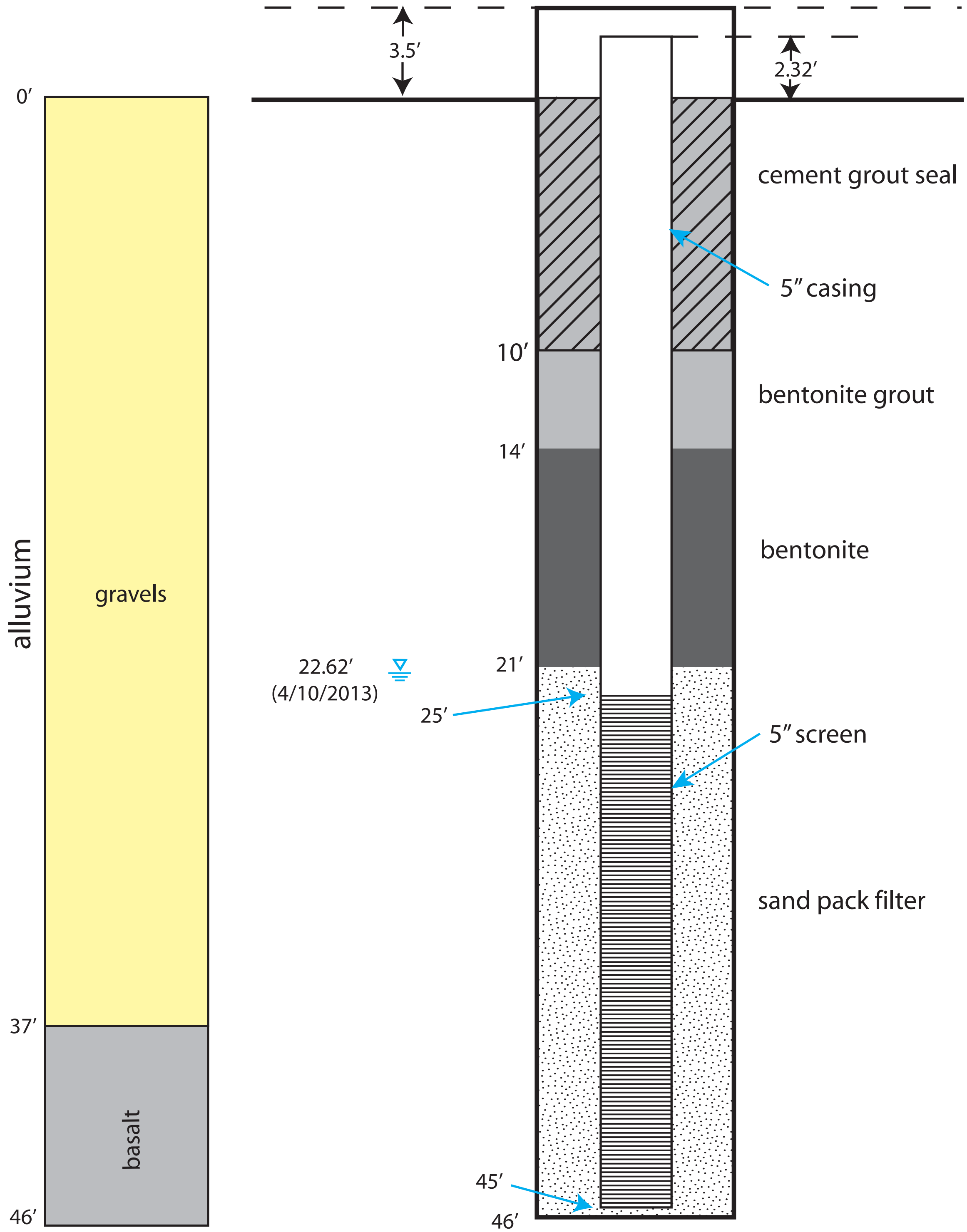

Figure A11. Well diagram, GWQ94-16, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

07489

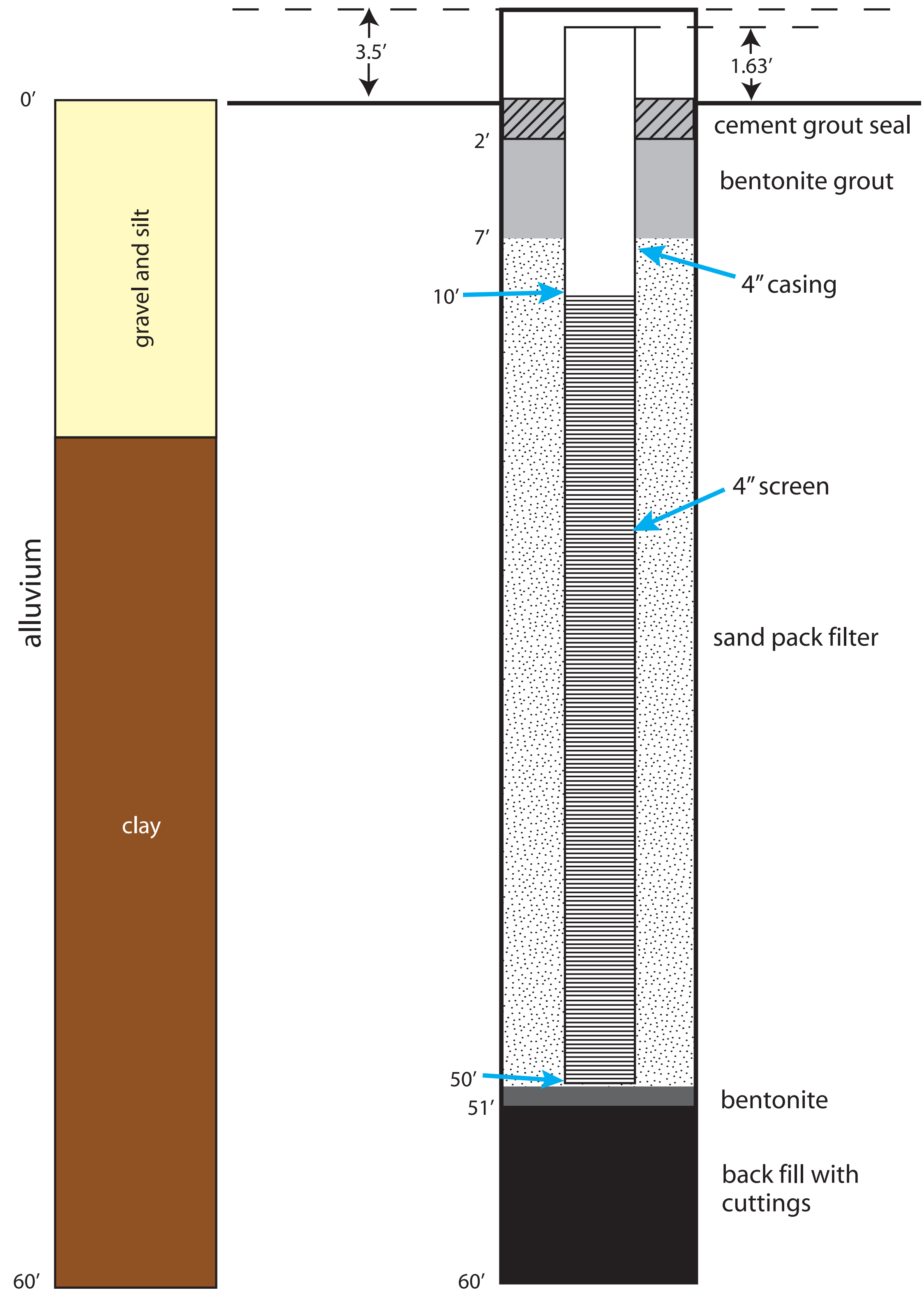

Figure A12. Well diagram, GWQ94-18, Copper Flat Mine, Sierra County, New Mexico.

6-27-2013; DA/PW

JOHN SHOMAKER & ASSOCIATES, INC.

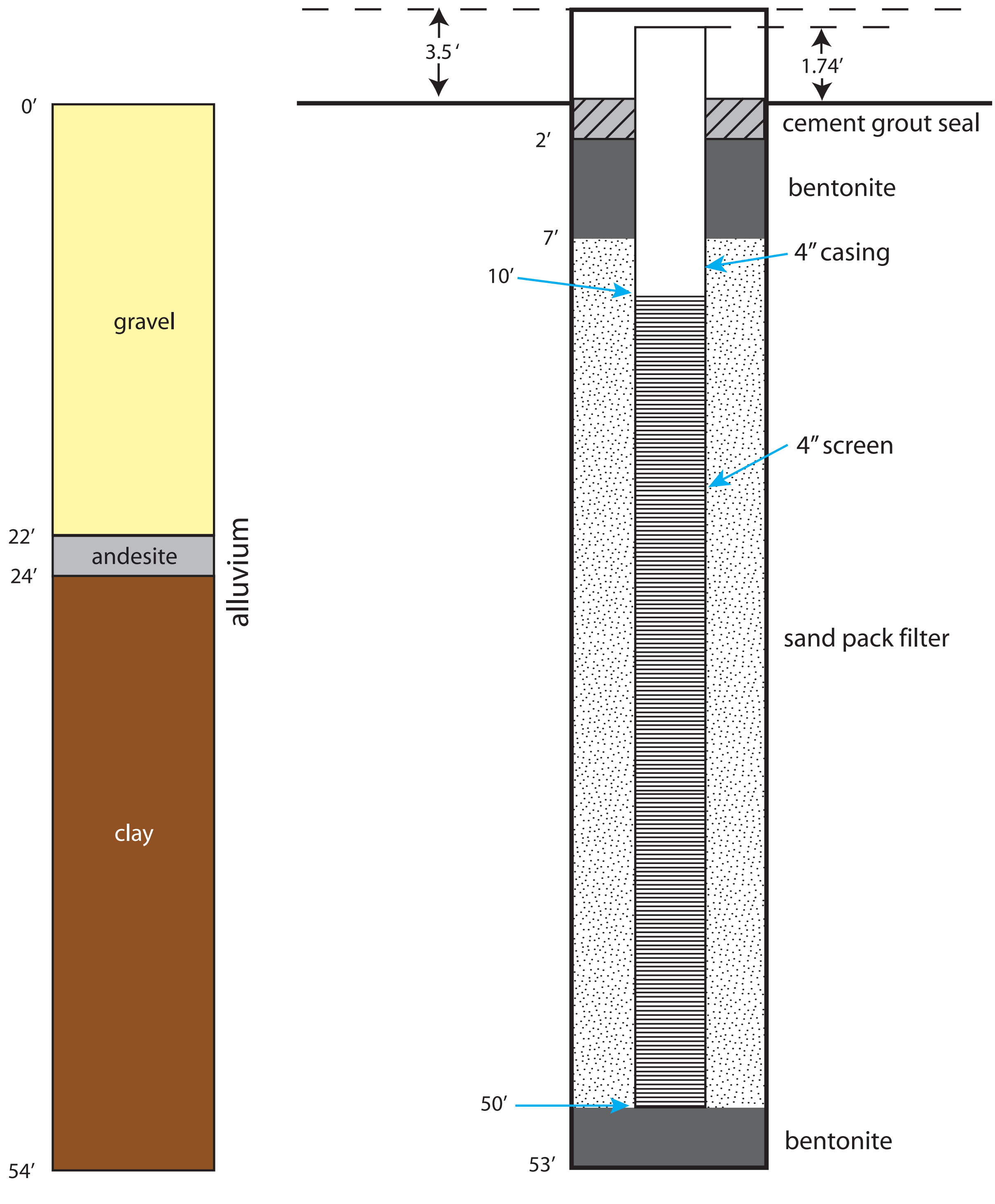

Figure A13. Well diagram, GWQ94-19, Copper Flat Mine, Sierra County, New Mexico.

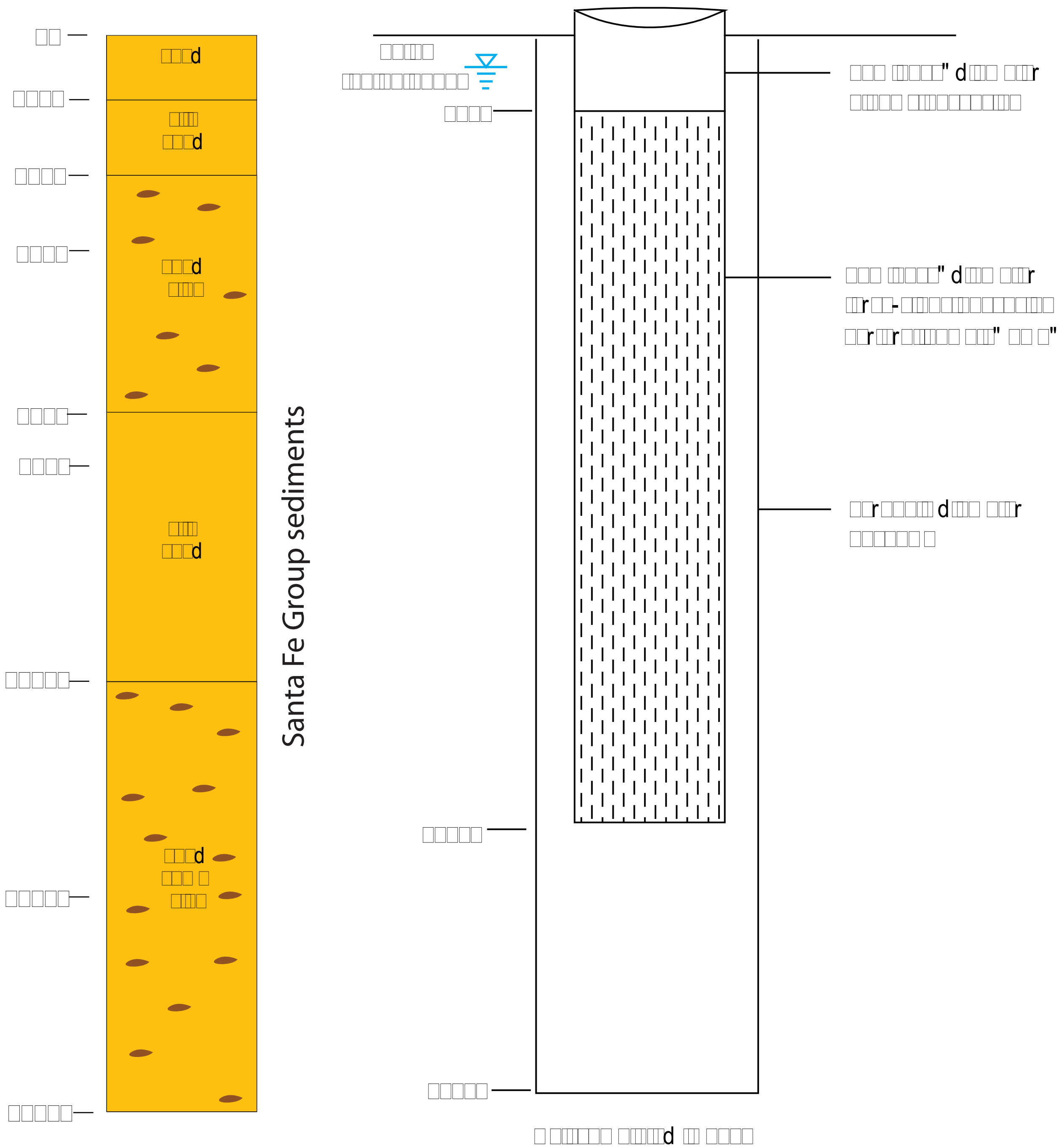

Figure A14. Well diagram, MW-4 (LRG-4652-S-13), Copper Flat Mine, Sierra County, New Mexico.

Copper Flat Project
Quintana Minerals Corporation
Sierra County, New Mexico

Well No. Shale Well GWQ-3
Other
not in NMWEES

WELL SCHEDULE

Recorded by Jim Humphrey Source of Data Observed Date 11-11-82

State New Mexico County or Town Sierra County Map Quintana Minerals

Legal Description: T 15 N, S R 7 E, W Section 25, SE¼, SE¼, NE¼

Owner Quintana Address

Depth Well 32.7 ft. (Measured) Reported By Harvey Chatfield

Depth Cased ? ft. Casing Type concrete Diameter 3.3 X 3.6

Method Drilled hand dug Date Drilled 1932 Log Yes (No)

Finish Use of Water unused

Perforations

Driller drilled for Henry Eisenheart Power none Lift

Description of M.P. 3 ft. (above) below LSD

Altitude: Land Surface M.P.

Water Level 10.6 ft. above below M.P.; 7.6 ft. above (below) LSD

Date Measured 11-11-82 Accuracy cloth type

Quality of Water Data: Field (Yes), No Lab Yes, No Date June 9, 1981

pH 6.98, Spec. Cond. 1100 micromhos, Alkalinity 275 mg/l

Salinity 0.7 ppt, Temperature 19 degrees (C) F

Figure A15. Well Schedule form, GWQ-3, Copper Flat Mine, Grant County, New Mexico.

WATER QUALITY MONITOR WELLS

Well No.	Depth	Depth Cased	Casing Type	Elevation (Top of Casing)
NP-1	115'	106'	Steel-2"	5177.0
NP-2	115'	110'	Steel-2"	5180.2
NP-3	109'6"	100'	Steel-2"	5187.6
NP-4	117'	117'	Steel-2"	5213.8
NP-5	35'	35'	Steel-2"	5187.0
GWQ-10	124'	121'	PVC-3"	5201.4
GWQ-11	80'	76'	PVC-3"	5184.4
GWQ-12	130'	130'	PVC-3"	5225.5
IW-1	49'	49'	PVC-4"	5187.8
IW-2	45'	45'	PVC-4"	5195.8
IW-3	45'	45'	PVC-4"	5201.4

The NP and GWQ wells were installed during July and August of 1981, as referenced in Sergent, Hauskins and Beckwith's "Geohydrological Evaluation for Submission of Discharge Plan, Copper Flat Project, Hillsboro, N.M.", 1981.

The IW wells were installed during May, 1982, by Quintana Minerals Corporation.

Figure A16. Water Quality Monitor Wells table, Copper Flat Mine, Grant County, New Mexico.

Appendix B.

Laboratory reports

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

February 12, 2013

Steve Finch

John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: NMCC Stage 1 OrderNo.: 1301409

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 17 sample(s) on 1/11/2013 for the analyses presented in the following report.

This report is a revised report and it replaces the original report issued January 31, 2013.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. All samples are reported as received unless otherwise indicated.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 11-24 B
Project: NMCC Stage 1 **Collection Date:** 1/9/2013 10:58:00 AM
Lab ID: 1301409-001 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	3.39	0.20000	1.00		mg/L	10	1/23/2013 12:15:53 AM
Chloride	27.1	0.66200	5.00		mg/L	10	1/14/2013 4:10:15 PM
Sulfate	1280	23.33000	50.0	*	mg/L	100	1/14/2013 4:22:40 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 1:58:25 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 1:58:25 PM
Calcium	417	0.12939	5.00		mg/L	5	1/18/2013 8:22:23 AM
Cobalt	0.0107	0.00060	0.00600		mg/L	1	1/17/2013 1:58:25 PM
Magnesium	75.9	0.06454	5.00		mg/L	5	1/18/2013 8:22:23 AM
Potassium	6.23	0.48088	1.00		mg/L	1	1/18/2013 7:59:34 AM
Sodium	95.7	1.07750	5.00		mg/L	5	1/18/2013 8:22:23 AM
Zinc	0.0522	0.00090	0.0100		mg/L	1	1/17/2013 1:58:25 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000605	0.00016	0.00100	J	mg/L	1	1/22/2013 10:40:49 AM
Selenium	0.000587	0.00055	0.00100	J	mg/L	1	1/22/2013 10:40:49 AM
SM4500-H+B: PH							Analyst: **JML**
pH	7.07	0.10000	1.68	H	pH units	1	1/14/2013 8:50:20 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	219	5.00000	20.0		mg/L CaCO3	1	1/14/2013 8:50:20 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 8:50:20 PM
Total Alkalinity (as CaCO3)	219	5.00000	20.0		mg/L CaCO3	1	1/14/2013 8:50:20 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	2280	20.11120	40.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Analytical Report
Lab Order **1301409**
Date Reported: **2/12/2013**

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 11-25 A
Project: NMCC Stage 1 **Collection Date:** 1/9/2013 5:40:00 PM
Lab ID: 1301409-002 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	124	1.00000	5.00	*	mg/L	50	1/23/2013 12:28:18 AM
Chloride	20.7	0.66200	5.00		mg/L	10	1/14/2013 4:35:05 PM
Sulfate	7900	46.66000	100	*	mg/L	200	1/15/2013 5:01:38 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	414	5.45543	10.0	*	mg/L	500	1/18/2013 4:30:15 PM
Cadmium	0.385	0.30000	1.00	J*	mg/L	500	1/18/2013 4:30:15 PM
Calcium	419	2.58780	100		mg/L	100	1/18/2013 10:37:46 AM
Cobalt	1.72	0.30000	3.00	J	mg/L	500	1/18/2013 4:30:15 PM
Magnesium	149	1.29074	100		mg/L	100	1/18/2013 10:37:46 AM
Potassium	ND	48.08831	100		mg/L	100	1/18/2013 10:37:46 AM
Sodium	647	21.55000	100		mg/L	100	1/18/2013 10:37:46 AM
Zinc	14.9	0.45000	5.00	*	mg/L	500	1/18/2013 4:30:15 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	12.6	0.16000	1.00	*	mg/L	1000	1/22/2013 11:00:33 AM
Selenium	0.087	0.02750	0.050	*	mg/L	50	2/7/2013 2:09:03 PM
SM4500-H+B: PH							Analyst: **JML**
pH	3.98	0.10000	1.68	H	pH units	1	1/14/2013 9:07:04 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	ND	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:07:04 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 9:07:04 PM
Total Alkalinity (as CaCO3)	ND	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:07:04 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	11300	100.55600	200		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: NMCC Stage 1
Lab ID: 1301409-003 **Matrix:** AQUEOUS

Client Sample ID: GWQ 11-25 B
Collection Date: 1/9/2013 2:14:00 PM
Received Date: 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	8.03	0.20000	1.00	*	mg/L	10	1/23/2013 1:05:31 AM
Chloride	27	0.66200	5.0		mg/L	10	1/14/2013 3:20:37 PM
Sulfate	1400	23.33000	50	*	mg/L	100	1/14/2013 3:57:50 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.336	0.01091	0.0200	*	mg/L	1	1/17/2013 2:40:30 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 2:40:30 PM
Calcium	493	0.25878	10.0		mg/L	10	1/18/2013 8:35:39 AM
Cobalt	0.00578	0.00060	0.00600	J	mg/L	1	1/17/2013 2:40:30 PM
Magnesium	76.2	0.01291	1.00		mg/L	1	1/18/2013 8:32:54 AM
Potassium	3.90	0.48088	1.00		mg/L	1	1/18/2013 8:32:54 AM
Sodium	139	2.15500	10.0		mg/L	10	1/18/2013 8:35:39 AM
Zinc	0.0210	0.00090	0.0100		mg/L	1	1/17/2013 2:40:30 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.00153	0.00016	0.00100		mg/L	1	1/22/2013 11:04:30 AM
Selenium	0.00161	0.00055	0.00100		mg/L	1	1/22/2013 11:04:30 AM
SM4500-H+B: PH							Analyst: **JML**
pH	6.94	0.10000	1.68	H	pH units	1	1/14/2013 9:11:19 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	343	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:11:19 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 9:11:19 PM
Total Alkalinity (as CaCO3)	343	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:11:19 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	2540	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: NMCC Stage 1
Lab ID: 1301409-004 **Matrix:** AQUEOUS

Client Sample ID: GWQ 96-22 A
Collection Date: 1/9/2013 4:53:00 PM
Received Date: 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	3.07	0.20000	1.00		mg/L	10	1/23/2013 1:17:56 AM
Chloride	60.5	0.66200	5.00		mg/L	10	1/14/2013 5:24:43 PM
Sulfate	38.6	2.33300	5.00		mg/L	10	1/14/2013 5:24:43 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0202	0.01091	0.0200		mg/L	1	1/17/2013 2:48:10 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 2:48:10 PM
Calcium	41.3	0.02588	1.00		mg/L	1	1/18/2013 8:38:18 AM
Cobalt	0.00108	0.00060	0.00600	J	mg/L	1	1/17/2013 2:48:10 PM
Magnesium	2.77	0.01291	1.00		mg/L	1	1/18/2013 8:38:18 AM
Potassium	2.34	0.48088	1.00		mg/L	1	1/18/2013 8:38:18 AM
Sodium	147	1.07750	5.00		mg/L	5	1/18/2013 8:40:54 AM
Zinc	0.00622	0.00090	0.0100	J	mg/L	1	1/17/2013 2:48:10 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000848	0.00016	0.00100	J	mg/L	1	1/22/2013 2:57:12 PM
Selenium	ND	0.00055	0.00100		mg/L	1	1/22/2013 11:16:22 AM
SM4500-H+B: PH							Analyst: **JML**
pH	7.85	0.10000	1.68	H	pH units	1	1/14/2013 9:30:25 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	301	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:30:25 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 9:30:25 PM
Total Alkalinity (as CaCO3)	301	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:30:25 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	521	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: NMCC Stage 1
Lab ID: 1301409-005 **Matrix:** AQUEOUS

Client Sample ID: GWQ 96-22 B
Collection Date: 1/9/2013 5:14:00 PM
Received Date: 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	3.32	0.20000	1.00		mg/L	10	1/23/2013 1:30:20 AM
Chloride	101	0.66200	5.00		mg/L	10	1/14/2013 5:49:32 PM
Sulfate	6.18	2.33300	5.00		mg/L	10	1/14/2013 5:49:32 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0432	0.01091	0.0200		mg/L	1	1/17/2013 3:11:33 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 3:11:33 PM
Calcium	70.2	0.02588	1.00		mg/L	1	1/18/2013 8:53:07 AM
Cobalt	0.00295	0.00060	0.00600	J	mg/L	1	1/17/2013 3:11:33 PM
Magnesium	5.51	0.01291	1.00		mg/L	1	1/18/2013 8:53:07 AM
Potassium	3.66	0.48088	1.00		mg/L	1	1/18/2013 8:53:07 AM
Sodium	193	1.07750	5.00		mg/L	5	1/18/2013 8:55:13 AM
Zinc	0.0468	0.00090	0.0100		mg/L	1	1/17/2013 3:11:33 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.00307	0.00016	0.00100		mg/L	1	1/22/2013 3:01:08 PM
Selenium	ND	0.00055	0.00100		mg/L	1	1/22/2013 11:20:18 AM
SM4500-H+B: PH							Analyst: **JML**
pH	7.52	0.10000	1.68	H	pH units	1	1/14/2013 9:47:33 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	477	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:47:33 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 9:47:33 PM
Total Alkalinity (as CaCO3)	477	5.00000	20.0		mg/L CaCO3	1	1/14/2013 9:47:33 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	722	20.11120	40.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **2/12/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** Pit
Project: NMCC Stage 1 **Collection Date:** 1/9/2013 12:00:00 PM
Lab ID: 1301409-006 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	18.7	0.20000	1.00	*	mg/L	10	1/23/2013 1:42:45 AM
Chloride	577	6.62000	50.0	*	mg/L	100	1/14/2013 6:26:45 PM
Sulfate	6800	46.66000	100	*	mg/L	200	1/15/2013 5:14:03 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0788	0.01091	0.0200		mg/L	1	1/17/2013 3:18:30 PM
Cadmium	0.0369	0.00060	0.00200	*	mg/L	1	1/17/2013 3:18:30 PM
Calcium	500	0.51756	20.0		mg/L	20	1/18/2013 9:00:53 AM
Cobalt	0.0860	0.00060	0.00600		mg/L	1	1/17/2013 3:18:30 PM
Magnesium	958	0.25815	20.0		mg/L	20	1/18/2013 9:00:53 AM
Potassium	44.4	0.48088	1.00		mg/L	1	1/18/2013 8:57:49 AM
Sodium	1170	4.31000	20.0		mg/L	20	1/18/2013 9:00:53 AM
Zinc	0.779	0.00090	0.0100		mg/L	1	1/17/2013 3:18:30 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.0586	0.00080	0.00500		mg/L	5	1/22/2013 3:20:49 PM
Selenium	0.00812	0.00055	0.00100		mg/L	1	1/22/2013 11:24:14 AM
SM4500-H+B: PH							Analyst: **JML**
pH	7.73	0.10000	1.68	H	pH units	1	1/14/2013 10:09:59 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	112	5.00000	20.0		mg/L CaCO3	1	1/14/2013 10:09:59 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 10:09:59 PM
Total Alkalinity (as CaCO3)	112	5.00000	20.0		mg/L CaCO3	1	1/14/2013 10:09:59 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	11100	100.55600	200		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **2/12/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ- 5 R
Project: NMCC Stage 1 **Collection Date:** 1/10/2013 9:21:00 AM
Lab ID: 1301409-007 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	1.25	0.20000	1.00		mg/L	10	1/23/2013 1:55:10 AM
Chloride	17.3	0.66200	5.00		mg/L	10	1/14/2013 6:39:10 PM
Sulfate	97.2	2.33300	5.00		mg/L	10	1/14/2013 6:39:10 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0159	0.01091	0.0200	J	mg/L	1	1/17/2013 3:26:47 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 3:26:47 PM
Calcium	96.9	0.02588	1.00		mg/L	1	1/18/2013 9:03:32 AM
Cobalt	0.00132	0.00060	0.00600	J	mg/L	1	1/17/2013 3:26:47 PM
Magnesium	22.7	0.01291	1.00		mg/L	1	1/18/2013 9:03:32 AM
Potassium	5.15	0.48088	1.00		mg/L	1	1/18/2013 9:03:32 AM
Sodium	34.0	0.21550	1.00		mg/L	1	1/18/2013 9:03:32 AM
Zinc	0.0111	0.00090	0.0100		mg/L	1	1/17/2013 3:26:47 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000692	0.00016	0.00100	J	mg/L	1	1/22/2013 3:05:04 PM
Selenium	0.000616	0.00055	0.00100	J	mg/L	1	1/22/2013 11:32:08 AM
SM4500-H+B: PH							Analyst: **JML**
pH	7.79	0.10000	1.68	H	pH units	1	1/14/2013 11:06:17 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	293	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:06:17 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 11:06:17 PM
Total Alkalinity (as CaCO3)	293	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:06:17 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	504	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ-8
Project: NMCC Stage 1 **Collection Date:** 1/10/2013 12:07:00 PM
Lab ID: 1301409-008 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.48	0.10000	0.50	J	mg/L	5	1/15/2013 5:26:28 PM
Chloride	88.7	0.66200	5.00		mg/L	10	1/14/2013 7:04:00 PM
Sulfate	498	23.33000	50.0	*	mg/L	100	1/14/2013 7:16:25 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 3:34:28 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 3:34:28 PM
Calcium	202	0.12939	5.00		mg/L	5	1/18/2013 9:11:35 AM
Cobalt	0.00193	0.00060	0.00600	J	mg/L	1	1/17/2013 3:34:28 PM
Magnesium	33.8	0.01291	1.00		mg/L	1	1/18/2013 9:08:50 AM
Potassium	2.43	0.48088	1.00		mg/L	1	1/18/2013 9:08:50 AM
Sodium	107	1.07750	5.00		mg/L	5	1/18/2013 9:11:35 AM
Zinc	0.0101	0.00090	0.0100		mg/L	1	1/17/2013 3:34:28 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000580	0.00016	0.00100	J	mg/L	1	1/14/2013 2:26:37 PM
Selenium	0.00197	0.00055	0.00100		mg/L	1	1/14/2013 2:26:37 PM
SM4500-H+B: PH							Analyst: **JML**
pH	7.60	0.10000	1.68	H	pH units	1	1/14/2013 11:23:19 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	213	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:23:19 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 11:23:19 PM
Total Alkalinity (as CaCO3)	213	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:23:19 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1200	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: NMCC Stage 1
Lab ID: 1301409-009 **Matrix:** AQUEOUS

Client Sample ID: GWQ-1
Collection Date: 1/10/2013 1:50:00 PM
Received Date: 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.38	0.02000	0.10		mg/L	1	1/15/2013 5:38:52 PM
Chloride	38.2	0.66200	5.00		mg/L	10	1/14/2013 7:53:39 PM
Sulfate	152	2.33300	5.00		mg/L	10	1/14/2013 7:53:39 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 3:42:09 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 3:42:09 PM
Calcium	63.2	0.02588	1.00		mg/L	1	1/18/2013 9:14:12 AM
Cobalt	0.00130	0.00060	0.00600	J	mg/L	1	1/17/2013 3:42:09 PM
Magnesium	17.7	0.01291	1.00		mg/L	1	1/18/2013 9:14:12 AM
Potassium	2.11	0.48088	1.00		mg/L	1	1/18/2013 9:14:12 AM
Sodium	65.1	0.21550	1.00		mg/L	1	1/18/2013 9:14:12 AM
Zinc	0.00597	0.00090	0.0100	J	mg/L	1	1/17/2013 3:42:09 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000364	0.00016	0.00100	J	mg/L	1	1/14/2013 2:34:29 PM
Selenium	ND	0.00055	0.00100		mg/L	1	1/14/2013 2:34:29 PM
SM4500-H+B: PH							Analyst: **JML**
pH	7.87	0.10000	1.68	H	pH units	1	1/14/2013 11:38:33 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	164	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:38:33 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 11:38:33 PM
Total Alkalinity (as CaCO3)	164	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:38:33 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	487	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 94-13
Project: NMCC Stage 1 **Collection Date:** 1/10/2013 4:45:00 PM
Lab ID: 1301409-010 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.18	0.10000	0.50	J	mg/L	5	1/15/2013 5:51:17 PM
Chloride	184	6.62000	50.0		mg/L	100	1/14/2013 8:30:53 PM
Sulfate	543	23.33000	50.0	*	mg/L	100	1/14/2013 8:30:53 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 4:05:31 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 4:05:31 PM
Calcium	246	0.12939	5.00		mg/L	5	1/18/2013 9:28:09 AM
Cobalt	0.00209	0.00060	0.00600	J	mg/L	1	1/17/2013 4:05:31 PM
Magnesium	49.9	0.01291	1.00		mg/L	1	1/18/2013 9:17:27 AM
Potassium	3.22	0.48088	1.00		mg/L	1	1/18/2013 9:17:27 AM
Sodium	106	1.07750	5.00		mg/L	5	1/18/2013 9:28:09 AM
Zinc	0.00143	0.00090	0.0100	J	mg/L	1	1/17/2013 4:05:31 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000621	0.00016	0.00100	J	mg/L	1	1/14/2013 2:38:25 PM
Selenium	0.0174	0.00055	0.00100		mg/L	1	1/14/2013 2:38:25 PM
SM4500-H+B: PH							Analyst: **JML**
pH	7.63	0.10000	1.68	H	pH units	1	1/14/2013 11:52:40 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	126	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:52:40 PM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/14/2013 11:52:40 PM
Total Alkalinity (as CaCO3)	126	5.00000	20.0		mg/L CaCO3	1	1/14/2013 11:52:40 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1460	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **2/12/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 94-16
Project: NMCC Stage 1 **Collection Date:** 1/10/2013 2:40:00 PM
Lab ID: 1301409-011 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.59	0.10000	0.50		mg/L	5	1/15/2013 6:03:41 PM
Chloride	192	0.66200	5.00		mg/L	10	1/14/2013 8:43:18 PM
Sulfate	407	2.33300	5.00	*	mg/L	10	1/14/2013 8:43:18 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0446	0.01091	0.0200		mg/L	1	1/17/2013 4:13:19 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 4:13:19 PM
Calcium	188	0.12939	5.00		mg/L	5	1/18/2013 9:33:25 AM
Cobalt	0.00148	0.00060	0.00600	J	mg/L	1	1/17/2013 4:13:19 PM
Magnesium	47.7	0.01291	1.00		mg/L	1	1/18/2013 9:30:47 AM
Potassium	3.33	0.48088	1.00		mg/L	1	1/18/2013 9:30:47 AM
Sodium	75.7	0.21550	1.00		mg/L	1	1/18/2013 9:30:47 AM
Zinc	0.00164	0.00090	0.0100	J	mg/L	1	1/17/2013 4:13:19 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000538	0.00016	0.00100	J	mg/L	1	1/14/2013 2:42:21 PM
Selenium	0.00212	0.00055	0.00100		mg/L	1	1/14/2013 2:42:21 PM
SM4500-H+B: PH							Analyst: **JML**
pH	7.76	0.10000	1.68	H	pH units	1	1/15/2013 12:05:32 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	173	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:05:32 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 12:05:32 AM
Total Alkalinity (as CaCO3)	173	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:05:32 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1170	20.11120	40.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **2/12/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** NP-3
Project: NMCC Stage 1 **Collection Date:** 1/10/2013 2:56:00 PM
Lab ID: 1301409-012 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.0890	0.02000	0.100	J	mg/L	1	1/16/2013 9:07:34 PM
Chloride	190	6.62000	50.0		mg/L	100	1/14/2013 10:34:58 PM
Sulfate	557	23.33000	50.0	*	mg/L	100	1/14/2013 10:34:58 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 4:21:00 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 4:21:00 PM
Calcium	218	0.12939	5.00		mg/L	5	1/18/2013 9:38:53 AM
Cobalt	0.00225	0.00060	0.00600	J	mg/L	1	1/17/2013 4:21:00 PM
Magnesium	49.5	0.01291	1.00		mg/L	1	1/18/2013 9:36:03 AM
Potassium	3.23	0.48088	1.00		mg/L	1	1/18/2013 9:36:03 AM
Sodium	107	1.07750	5.00		mg/L	5	1/18/2013 9:38:53 AM
Zinc	1.85	0.00450	0.0500		mg/L	5	1/17/2013 4:24:54 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.00129	0.00016	0.00100		mg/L	1	1/14/2013 2:54:11 PM
Selenium	0.00614	0.00055	0.00100		mg/L	1	1/14/2013 2:54:11 PM
SM4500-H+B: PH							Analyst: **JML**
pH	7.24	0.10000	1.68	H	pH units	1	1/15/2013 12:20:06 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	54.2	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:20:06 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 12:20:06 AM
Total Alkalinity (as CaCO3)	54.2	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:20:06 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	1390	50.27800	100		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 11-24 A
Project: NMCC Stage 1 **Collection Date:** 1/8/2013 5:00:00 PM
Lab ID: 1301409-013 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	17.4	0.20000	1.00	*	mg/L	10	1/23/2013 2:07:34 AM
Chloride	29.9	0.66200	5.00		mg/L	10	1/14/2013 10:47:23 PM
Sulfate	2550	23.33000	50.0	*	mg/L	100	1/14/2013 10:59:47 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	38.0	0.54554	1.00	*	mg/L	50	1/18/2013 4:39:33 PM
Cadmium	0.181	0.00600	0.0200	*	mg/L	10	1/18/2013 4:35:37 PM
Calcium	464	0.12939	5.00		mg/L	5	1/18/2013 9:41:32 AM
Cobalt	0.256	0.00600	0.0600		mg/L	10	1/18/2013 4:35:37 PM
Magnesium	108	0.06454	5.00		mg/L	5	1/18/2013 9:41:32 AM
Potassium	6.98	2.40442	5.00		mg/L	5	1/18/2013 9:41:32 AM
Sodium	129	1.07750	5.00		mg/L	5	1/18/2013 9:41:32 AM
Zinc	5.72	0.00900	0.100	*	mg/L	10	1/18/2013 4:35:37 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	104	0.80000	5.00	*	mg/L	5000	1/22/2013 3:24:46 PM
Selenium	0.0294	0.00055	0.00100		mg/L	1	1/22/2013 11:40:03 AM
SM4500-H+B: PH							Analyst: **JML**
pH	4.53	0.10000	1.68	H	pH units	1	1/15/2013 12:30:17 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	ND	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:30:17 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 12:30:17 AM
Total Alkalinity (as CaCO3)	ND	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:30:17 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	4180	50.27800	100		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 11-26
Project: NMCC Stage 1 **Collection Date:** 1/8/2013 1:15:00 PM
Lab ID: 1301409-014 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.760	0.20000	1.00	J	mg/L	10	1/23/2013 2:20:00 AM
Chloride	13.8	0.66200	5.00		mg/L	10	1/14/2013 11:12:12 PM
Sulfate	96.5	2.33300	5.00		mg/L	10	1/14/2013 11:12:12 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0313	0.01091	0.0200		mg/L	1	1/17/2013 4:35:53 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 4:35:53 PM
Calcium	95.5	0.02588	1.00		mg/L	1	1/18/2013 9:46:10 AM
Cobalt	0.00149	0.00060	0.00600	J	mg/L	1	1/17/2013 4:35:53 PM
Magnesium	21.5	0.01291	1.00		mg/L	1	1/18/2013 9:46:10 AM
Potassium	1.34	0.48088	1.00		mg/L	1	1/18/2013 9:46:10 AM
Sodium	72.0	0.21550	1.00		mg/L	1	1/18/2013 9:46:10 AM
Zinc	0.00334	0.00090	0.0100	J	mg/L	1	1/17/2013 4:35:53 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.00265	0.00016	0.00100		mg/L	1	1/22/2013 3:09:01 PM
Selenium	0.00149	0.00055	0.00100		mg/L	1	1/22/2013 11:43:59 AM
SM4500-H+B: PH							Analyst: **JML**
pH	7.76	0.10000	1.68	H	pH units	1	1/15/2013 12:34:53 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	361	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:34:53 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 12:34:53 AM
Total Alkalinity (as CaCO3)	361	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:34:53 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	654	20.11120	40.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: GWQ 96-23 A
Project: NMCC Stage 1
Collection Date: 1/11/2013 9:45:00 AM
Lab ID: 1301409-015
Matrix: AQUEOUS
Received Date: 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	2.00	0.20000	1.00		mg/L	10	1/23/2013 2:32:24 AM
Chloride	11.5	0.66200	5.00		mg/L	10	1/14/2013 9:08:06 PM
Sulfate	6.14	2.33300	5.00		mg/L	10	1/14/2013 9:08:06 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	0.0314	0.01091	0.0200		mg/L	1	1/17/2013 4:57:45 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 4:57:45 PM
Calcium	129	0.12939	5.00		mg/L	5	1/18/2013 10:03:45 AM
Cobalt	0.00143	0.00060	0.00600	J	mg/L	1	1/17/2013 4:57:45 PM
Magnesium	37.7	0.01291	1.00		mg/L	1	1/18/2013 9:53:12 AM
Potassium	1.37	0.48088	1.00		mg/L	1	1/18/2013 9:53:12 AM
Sodium	70.6	0.21550	1.00		mg/L	1	1/18/2013 9:53:12 AM
Zinc	0.00615	0.00090	0.0100	J	mg/L	1	1/17/2013 4:57:45 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.00113	0.00016	0.00100		mg/L	1	1/22/2013 3:12:57 PM
Selenium	ND	0.00055	0.00100		mg/L	1	1/22/2013 12:11:38 PM
SM4500-H+B: PH							Analyst: **JML**
pH	8.07	0.10000	1.68	H	pH units	1	1/15/2013 12:53:27 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	627	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:53:27 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 12:53:27 AM
Total Alkalinity (as CaCO3)	627	5.00000	20.0		mg/L CaCO3	1	1/15/2013 12:53:27 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	693	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:			
*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. | **Client Sample ID:** GWQ 94-14
Project: NMCC Stage 1 | **Collection Date:** 1/11/2013 11:50:00 AM
Lab ID: 1301409-016 | **Matrix:** AQUEOUS | **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.424	0.02000	0.100		mg/L	1	1/16/2013 9:19:59 PM
Chloride	43.6	0.66200	5.00		mg/L	10	1/14/2013 11:37:01 PM
Sulfate	140	2.33300	5.00		mg/L	10	1/14/2013 11:37:01 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 5:06:52 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 5:06:52 PM
Calcium	90.2	0.02588	1.00		mg/L	1	1/18/2013 10:06:21 AM
Cobalt	0.00114	0.00060	0.00600	J	mg/L	1	1/17/2013 5:06:52 PM
Magnesium	24.5	0.01291	1.00		mg/L	1	1/18/2013 10:06:21 AM
Potassium	1.62	0.48088	1.00		mg/L	1	1/18/2013 10:06:21 AM
Sodium	45.8	0.21550	1.00		mg/L	1	1/18/2013 10:06:21 AM
Zinc	ND	0.00090	0.0100		mg/L	1	1/17/2013 5:06:52 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000295	0.00016	0.00100	J	mg/L	1	1/14/2013 2:58:07 PM
Selenium	0.00337	0.00055	0.00100		mg/L	1	1/14/2013 2:58:07 PM
SM4500-H+B: PH							Analyst: **JML**
pH	7.78	0.10000	1.68	H	pH units	1	1/15/2013 1:19:02 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	218	5.00000	20.0		mg/L CaCO3	1	1/15/2013 1:19:02 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 1:19:02 AM
Total Alkalinity (as CaCO3)	218	5.00000	20.0		mg/L CaCO3	1	1/15/2013 1:19:02 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	583	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **2/12/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ 96-23 B
Project: NMCC Stage 1 **Collection Date:** 1/11/2013 10:15:00 AM
Lab ID: 1301409-017 **Matrix:** AQUEOUS **Received Date:** 1/11/2013 3:43:00 PM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	2.05	0.20000	1.00		mg/L	10	1/23/2013 2:44:49 AM
Chloride	15.4	0.66200	5.00		mg/L	10	1/15/2013 12:01:50 AM
Sulfate	ND	2.33300	5.00		mg/L	10	1/15/2013 12:01:50 AM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **ELS**
Aluminum	ND	0.01091	0.0200		mg/L	1	1/17/2013 5:14:36 PM
Cadmium	ND	0.00060	0.00200		mg/L	1	1/17/2013 5:14:36 PM
Calcium	76.7	0.02588	1.00		mg/L	1	1/18/2013 10:11:34 AM
Cobalt	0.00125	0.00060	0.00600	J	mg/L	1	1/17/2013 5:14:36 PM
Magnesium	21.2	0.01291	1.00		mg/L	1	1/18/2013 10:11:34 AM
Potassium	1.57	0.48088	1.00		mg/L	1	1/18/2013 10:11:34 AM
Sodium	98.2	0.21550	1.00		mg/L	1	1/18/2013 10:11:34 AM
Zinc	0.0104	0.00090	0.0100		mg/L	1	1/17/2013 5:14:36 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Copper	0.000671	0.00016	0.00100	J	mg/L	1	1/22/2013 3:16:53 PM
Selenium	ND	0.00055	0.00100		mg/L	1	1/22/2013 12:15:34 PM
SM4500-H+B: PH							Analyst: **JML**
pH	8.03	0.10000	1.68	H	pH units	1	1/15/2013 1:34:04 AM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	502	5.00000	20.0		mg/L CaCO3	1	1/15/2013 1:34:04 AM
Carbonate (As CaCO3)	ND	2.00000	2.00		mg/L CaCO3	1	1/15/2013 1:34:04 AM
Total Alkalinity (as CaCO3)	502	5.00000	20.0		mg/L CaCO3	1	1/15/2013 1:34:04 AM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **KS**
Total Dissolved Solids	571	10.05560	20.0		mg/L	1	1/18/2013 9:17:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**

12-Feb-13

Client: John Shomaker & Assoc.
Project: NMCC Stage 1

Sample ID **MB** | SampType: **MBLK** | TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** | Batch ID: **R8121** | RunNo: **8121**
Prep Date: | Analysis Date: **1/17/2013** | SeqNo: **234884** | Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Cobalt	ND	0.0060								
Zinc	ND	0.010								

Sample ID **LCS** | SampType: **LCS** | TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** | Batch ID: **R8121** | RunNo: **8121**
Prep Date: | Analysis Date: **1/17/2013** | SeqNo: **234886** | Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.47	0.020	0.5000	0	94.8	85	115			
Cadmium	0.50	0.0020	0.5000	0	100	85	115			
Cobalt	0.47	0.0060	0.5000	0	94.1	85	115			
Zinc	0.47	0.010	0.5000	0	94.4	85	115			

Sample ID **1301409-001BMS** | SampType: **MS** | TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **GWQ 11-24 B** | Batch ID: **R8121** | RunNo: **8121**
Prep Date: | Analysis Date: **1/17/2013** | SeqNo: **234906** | Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.476	0.0200	0.5000	0	95.3	70	130			
Cadmium	0.522	0.00200	0.5000	0	104	70	130			
Cobalt	0.481	0.00600	0.5000	0.01074	94.0	70	130			
Zinc	0.520	0.0100	0.5000	0.05224	93.6	70	130			

Sample ID **1301409-001BMSD** | SampType: **MSD** | TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **GWQ 11-24 B** | Batch ID: **R8121** | RunNo: **8121**
Prep Date: | Analysis Date: **1/17/2013** | SeqNo: **234910** | Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.476	0.0200	0.5000	0	95.2	70	130	0.0861	20	
Cadmium	0.513	0.00200	0.5000	0	103	70	130	1.69	20	
Cobalt	0.473	0.00600	0.5000	0.01074	92.6	70	130	1.57	20	
Zinc	0.513	0.0100	0.5000	0.05224	92.2	70	130	1.30	20	

Sample ID **MB** | SampType: **MBLK** | TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** | Batch ID: **R8137** | RunNo: **8137**
Prep Date: | Analysis Date: **1/18/2013** | SeqNo: **235375** | Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	ND	1.0								
Magnesium	ND	1.0								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT
Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**
12-Feb-13

Client: John Shomaker & Assoc.
Project: NMCC Stage 1

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R8137** RunNo: **8137**
Prep Date: Analysis Date: **1/18/2013** SeqNo: **235375** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Potassium	ND	1.0								
Sodium	ND	1.0								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R8137** RunNo: **8137**
Prep Date: Analysis Date: **1/18/2013** SeqNo: **235378** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	52	1.0	50.00	0	104	85	115			
Magnesium	52	1.0	50.00	0	104	85	115			
Potassium	50	1.0	50.00	0	100	85	115			
Sodium	51	1.0	50.00	0	102	85	115			

Sample ID **1301409-001BMS** SampType: **MS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **GWQ 11-24 B** Batch ID: **R8137** RunNo: **8137**
Prep Date: Analysis Date: **1/18/2013** SeqNo: **235389** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Potassium	55.8	1.00	50.00	6.228	99.1	70	130			

Sample ID **1301409-001BMSD** SampType: **MSD** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **GWQ 11-24 B** Batch ID: **R8137** RunNo: **8137**
Prep Date: Analysis Date: **1/18/2013** SeqNo: **235394** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Potassium	57.5	1.00	50.00	6.228	103	70	130	3.10	20	

Sample ID **1301409-001BMS** SampType: **MS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **GWQ 11-24 B** Batch ID: **R8137** RunNo: **8137**
Prep Date: Analysis Date: **1/18/2013** SeqNo: **235397** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Magnesium	321	5.00	250.0	75.93	98.2	70	130			
Sodium	338	5.00	250.0	95.72	97.0	70	130			

Sample ID **1301409-001BMSD** SampType: **MSD** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **GWQ 11-24 B** Batch ID: **R8137** RunNo: **8137**
Prep Date: Analysis Date: **1/18/2013** SeqNo: **235398** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Magnesium	325	5.00	250.0	75.93	99.7	70	130	1.13	20	
Sodium	343	5.00	250.0	95.72	98.9	70	130	1.38	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

WO#: **1301409**

Hall Environmental Analysis Laboratory, Inc.

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **PBW** Batch ID: **R8150** RunNo: **8150**

Prep Date: Analysis Date: **1/18/2013** SeqNo: **235643** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Cadmium	ND	0.0020								
Cobalt	ND	0.0060								
Zinc	0.0012	0.010								J

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R8150** RunNo: **8150**

Prep Date: Analysis Date: **1/18/2013** SeqNo: **235644** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.48	0.020	0.5000	0	95.2	85	115			
Cadmium	0.50	0.0020	0.5000	0	100	85	115			
Cobalt	0.48	0.0060	0.5000	0	95.1	85	115			
Zinc	0.48	0.010	0.5000	0.001210	96.3	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **1301409-008BMS** SampType: **MS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **GWQ-8** Batch ID: **R8032** RunNo: **8032**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232432** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	0.0236	0.00100	0.02500	0.0005800	92.2	70	130			
Selenium	0.0266	0.00100	0.02500	0.001975	98.4	70	130			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R8032** RunNo: **8032**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232436** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	0.024	0.0010	0.02500	0	97.7	85	115			
Selenium	0.023	0.0010	0.02500	0	90.4	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R8032** RunNo: **8032**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232438** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	ND	0.0010								
Selenium	ND	0.0010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R8183** RunNo: **8183**
Prep Date: Analysis Date: **1/22/2013** SeqNo: **236826** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	0.024	0.0010	0.02500	0	95.7	85	115			
Selenium	0.023	0.0010	0.02500	0	90.8	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R8183** RunNo: **8183**
Prep Date: Analysis Date: **1/22/2013** SeqNo: **236827** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	0.025	0.0010	0.02500	0	98.7	85	115			
Selenium	0.024	0.0010	0.02500	0	94.1	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R8183** RunNo: **8183**
Prep Date: Analysis Date: **1/22/2013** SeqNo: **236828** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	ND	0.0010								
Selenium	ND	0.0010								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA 200.8: Dissolved Metals**								
Client ID: **PBW**	Batch ID: **R8183**	RunNo: **8183**								
Prep Date:	Analysis Date: **1/22/2013**	SeqNo: **236829**	Units: **mg/L**							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Copper	ND	0.0010								
Selenium	ND	0.0010								

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA 200.8: Dissolved Metals**								
Client ID: **LCSW**	Batch ID: **R8513**	RunNo: **8513**								
Prep Date:	Analysis Date: **2/7/2013**	SeqNo: **245245**	Units: **mg/L**							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	95.7	85	115			

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA 200.8: Dissolved Metals**								
Client ID: **PBW**	Batch ID: **R8513**	RunNo: **8513**								
Prep Date:	Analysis Date: **2/7/2013**	SeqNo: **245246**	Units: **mg/L**							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232961** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232962** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.6	0.50	5.000	0	92.4	90	110			
Sulfate	9.1	0.50	10.00	0	91.0	90	110			

Sample ID **1301409-003AMS** SampType: **MS** TestCode: **EPA Method 300.0: Anions**
Client ID: **GWQ 11-25 B** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232964** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	76	5.0	50.00	26.62	97.9	87.8	111			

Sample ID **1301409-003AMSD** SampType: **MSD** TestCode: **EPA Method 300.0: Anions**
Client ID: **GWQ 11-25 B** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232965** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	75	5.0	50.00	26.62	97.4	87.8	111	0.375	20	

Sample ID **1301409-015AMS** SampType: **MS** TestCode: **EPA Method 300.0: Anions**
Client ID: **GWQ 96-23 A** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232992** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	58.0	5.00	50.00	11.50	93.0	87.8	111			
Sulfate	96.8	5.00	100.0	6.139	90.6	84.6	122			

Sample ID **1301409-015AMSD** SampType: **MSD** TestCode: **EPA Method 300.0: Anions**
Client ID: **GWQ 96-23 A** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **232993** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	57.1	5.00	50.00	11.50	91.2	87.8	111	1.60	20	
Sulfate	95.4	5.00	100.0	6.139	89.2	84.6	122	1.44	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/15/2013** SeqNo: **233015** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R8050** RunNo: **8050**
Prep Date: Analysis Date: **1/15/2013** SeqNo: **233016** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.9	0.50	5.000	0	97.8	90	110			
Sulfate	9.6	0.50	10.00	0	96.3	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R8074** RunNo: **8074**
Prep Date: Analysis Date: **1/15/2013** SeqNo: **233657** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Sulfate	ND	0.50								

Sample ID **LCS-B** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R8074** RunNo: **8074**
Prep Date: Analysis Date: **1/15/2013** SeqNo: **233659** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.45	0.10	0.5000	0	90.6	90	110			
Sulfate	9.4	0.50	10.00	0	94.4	90	110			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R8095** RunNo: **8095**
Prep Date: Analysis Date: **1/16/2013** SeqNo: **234152** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								

Sample ID **LCS-B** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R8095** RunNo: **8095**
Prep Date: Analysis Date: **1/16/2013** SeqNo: **234161** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.48	0.10	0.5000	0	95.8	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

WO#: **1301409**

Hall Environmental Analysis Laboratory, Inc.

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**

Client ID: **PBW** Batch ID: **R8199** RunNo: **8199**

Prep Date: Analysis Date: **1/22/2013** SeqNo: **237146** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**

Client ID: **LCSW** Batch ID: **R8199** RunNo: **8199**

Prep Date: Analysis Date: **1/22/2013** SeqNo: **237147** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.48	0.10	0.5000	0	95.9	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT
Hall Environmental Analysis Laboratory, Inc.

WO#: **1301409**
12-Feb-13

Client: John Shomaker & Assoc.
Project: NMCC Stage 1

Sample ID **1301409-006a ms** SampType: **MS** TestCode: **SM2320B: Alkalinity**
Client ID: **Pit** Batch ID: **R8053** RunNo: **8053**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **233050** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	184	20.0	80.00	111.6	91.1	65.3	113			

Sample ID **1301409-006a msd** SampType: **MSD** TestCode: **SM2320B: Alkalinity**
Client ID: **Pit** Batch ID: **R8053** RunNo: **8053**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **233051** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	184	20.0	80.00	111.6	91.0	65.3	113	0.0217	10	

Sample ID **mb-1** SampType: **MBLK** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R8053** RunNo: **8053**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **233063** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **LCS** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R8053** RunNo: **8053**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **233064** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	79	20	80.00	0	98.6	95	105			

Sample ID **mb-2** SampType: **MBLK** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R8053** RunNo: **8053**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **233087** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** SampType: **LCS** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R8053** RunNo: **8053**
Prep Date: Analysis Date: **1/14/2013** SeqNo: **233088** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	78	20	80.00	0	98.0	95	105			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

WO#: **1301409**

Hall Environmental Analysis Laboratory, Inc.

12-Feb-13

Client: John Shomaker & Assoc.

Project: NMCC Stage 1

Sample ID **MB-5677** SampType: **MBLK** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **PBW** Batch ID: **5677** RunNo: **8129**

Prep Date: **1/15/2013** Analysis Date: **1/18/2013** SeqNo: **235114** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	11.0	20.0								J

Sample ID **LCS-5677** SampType: **LCS** TestCode: **SM2540C MOD: Total Dissolved Solids**

Client ID: **LCSW** Batch ID: **5677** RunNo: **8129**

Prep Date: **1/15/2013** Analysis Date: **1/18/2013** SeqNo: **235115** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1030	20.0	1000	11.00	102	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 8710?
TEL: 505-345-3975 FAX: 505-345-410?
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name:	SHO	Work Order Number: 1301409	
Received by/date:	[signature]	01/14/13	
Logged By:	Lindsay Mangin	1/11/2013 3:43:00 PM	[signature]
Completed By:	Lindsay Mangin	1/14/2013 9:53:24 AM	[signature]
Reviewed By:	[signature]	01/14/13	

Chain of Custody

1. Were seals intact? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Coolers are present? (see 19. for cooler specific information) Yes ☑ No ☐ NA ☐
5. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
6. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
7. Sample(s) in proper container(s)? Yes ☐ No ☑
8. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
9. Are samples (except VOA and ONG) properly preserved? Yes ☐ No ☑
10. Was preservative added to bottles? Yes ☑ No ☐ NA ☐
    -008c- -012c, -016c added 0.4mL HNO3 for acceptable pH - [initials] 01/14/13
11. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
12. Were any sample containers received broken? Yes ☐ No ☑
13. Does paperwork match bottle labels? Yes ☑ No ☐
    (Note discrepancies on chain of custody)
14. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
15. Is it clear what analyses were requested? Yes ☑ No ☐
16. Were all holding times able to be met? Yes ☑ No ☐
    (If no, notify customer for authorization.)

# of preserved bottles checked for pH: 23
(<2 or >12 unless noted)
Adjusted? YES
Checked by: [initials]

Special Handling (if applicable)

17. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified:	STEVE FINCH	Date:	01/14/13
By Whom:	LINDSAY MANGIN	Via:	☐ eMail ☒ Phone ☐ Fax ☐ In Person
Regarding:	-014 SAMPLE ID & COLLECTION TIME.		
Client Instructions:	SAMPLE ID IS GWQ 11-26, COLLECTION TIME IS 1515		[initials] 01/14/13

18. Additional remarks:
    -008c- -012c, -016c Poured off/filtered/preserved in lab. -LM 01/14/13 [initials]

19. Cooler Information

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	1.6	Good	Not Present			

Chain-of-Custody Record

Client: John Shomaker + Assoc. INC

Mailing Address: 2611 Broadbent Pkwy NE
ABQ, NM 87107

Phone #: ~~ABQ~~ 505-345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:
☐ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other ____

☐ EDD (Type) ____

Turn-Around Time:
☐ Standard ☐ Rush ____

Project Name: NMCC Stage 1

Project #: 540.101

Project Manager: STF

Sampler: STF/MW/SAF

On Ice: ☑ Yes ☐ No

Sample Temperature: 1.6

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Analysis columns: BTEX + MTBE + TMB's (8021); BTEX + MTBE + TPH (Gas only); TPH 8015B (GRO / DRO / MRO); TPH (Method 418.1); EDB (Method 504.1); PAH's (8310 or 8270 SIMS); RCRA 8 Metals; Anions (F,Cl,NO_3,NO_2,PO_4,SO_4); 8081 Pesticides / 8082 PCB's; 8260B (VOA); 8270 (Semi-VOA); List B; Air Bubbles (Y or N)

Date	Time	Matrix	Sample Request ID	Container Type and # ml	Preservative Type	HEAL No. 1301409	List B	Air Bubbles (Y or N)
1/9/13	10:58	aq	GWQ 11-24B	1x500	none	-001	X	
1/9/13	10:58	aq	GWQ 11-24B	1x filtered 120	HNO_3		↓	
1/9/13	17:40	aq	GWQ 11-25A	1x500	none	-002	↓	
1/9/13	17:40	aq	GWQ 11-25A	1x filtered 120	HNO_3		↓	
1/9/13	14:14	aq	GWQ 11-25B	1x 500	none	-003	↓	
1/9/13	14:14	aq	GWQ 11-25B	1x filtered 120	HNO_3		↓	
1/9/13	16:53	aq	GWQ 96-22A	1x 500	none	-004	↓	
1/9/13	16:53	aq	GWQ 96-22A	1x filtered 120	HNO_3		↓	
1/9/13	17:14	aq	GWQ 96-22B	1x 500	none	-005	↓	
1/9/13	17:14	aq	GWQ 96-22B	1x filtered 120	HNO_3		↓	
1/9/13	12:00	aq	Pit	1x 500	None	-006	X	
1/9/13	12:00	aq	Pit	1x filtered 120	HNO_3		X	

Date:	Time:	Relinquished by:	Received by:	Date	Time
1-11-13	1543	[signature]	[signature]	01/11/13	1543

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Chain-of-Custody Record

Client: John Shomaker & Associates Inc

Mailing Address: 2611 Broadbent Pkwy NE
ABQ, NM 87107

Phone #: 505-345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:
☐ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other ______

☐ EDD (Type) ______

Turn-Around Time:
☐ Standard ☐ Rush ______

Project Name: NMCC Stage 1

Project #: 540.101

Project Manager: STF

Sampler: MW/SAF/STF

On Ice: ☒ Yes ☐ No

Sample Temperature: 1.6

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1301409	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	8310 (PNA or PAH)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	List B	List A			Air Bubbles (Y or N)
1/10/13	9:21	aq	GWQ-5R	1x500	none	-007												X				
1/10/13	9:21	aq	GWQ-5R	1x120	filtered HNO3													X				
1/10/13	12:07	aq	GWQ-8	1x500	None	-008													X			
1/10/13	12:07	aq	GWQ-8	1x120	HNO3														|			
1/10/13	13:50	aq	GWQ-1	1x500	None	-009													|			
1/10/13	13:50	aq	GWQ-1	1x120	HNO3														|			
1/10/13	16:45	aq	GWQ 94-13	1x500	None	-010													|			
1/10/13	16:45	aq	GWQ 94-13	1x120	HNO3														|			
1/10/13	14:40	aq	GWQ 94-16	1x500	None	-011													|			
1/10/13	14:40	aq	GWQ 94-16	1x120	HNO3														|			
1/10/13	14:56	aq	NP-3	1x ~~500~~ 120	HNO3	-012													|			
1/10/13	14:56	aq	NP-3	1x500	None														↓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
1-11-13	1543	[signature]	[signature]	01/11/13	1543
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks:

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Chain-of-Custody Record

Client: John Shomaker & Assoc., Inc.

Mailing Address: 2611 Broadbent Pkwy NE

ABQ, NM 87107

Phone #: 505-345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package:

☐ Standard ☐ Level 4 (Full Validation)

☐ Other ______

☐ EDD (Type) ______

Turn-Around Time:

☐ Standard ☐ Rush ______

Project Name: NMCC Stage 1

Project #: 540.101

Project Manager: STF

Sampler: MW/SAF/STF

On Ice: ☒ Yes ☐ No

Sample Temperature: 1.6

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and # ml	Preservative Type	HEAL No. 1301409	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	8310 (PNA or PAH)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	List B				Air Bubbles (Y or N)
1/8/13	17:00	aq	GWQ 11-24A	1 x 500	None	-013												X				
1/8/13	17:00	aq	GWQ 11-24A	1 x 120	filtered HNO_3													X				
1/8/13	~~17:15~~	aq	GWQ 11-26	1 x 500	None	-014												X				
1/8/13	~~17:15~~ 15:15	aq	GWQ 11-26	1 x 120	filtered HNO_3													X				
	01/14/13		01/14/13																			

Date:	Time:	Relinquished by:	Received by:	Date	Time
1-11-13	15:43	[signature]	[signature]	01/11/13	1543
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: See accompanying form for Lists. Report 3 sig. fig. for general Chemistry, ?s - please call Steve

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

07527

Chain-of-Custody Record

Client: John Shomaker + Assoc, Inc.

Mailing Address: 2611 Broadbent Pkwy NE
ABQ, NM 87107

Phone #: 505-345-3407

email or Fax#: sfinch @ shomaker.com

QA/QC Package:
☐ Standard ☐ Level 4 (Full Validation)
☐ Other ____________
☐ EDD (Type) ____________

Turn-Around Time:
☐ Standard ☐ Rush ____________

Project Name: NMCC Stage 1 Abatement

Project #: 540.101

Project Manager: STF

Sampler: MW/ STF
On Ice: ☒ Yes ☐ No
Sample Temperature: 1.6

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and # ml	Preservative Type	HEAL No. 1301409	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	8310 (PNA or PAH)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	List B	List A			Air Bubbles (Y or N)
1/11/13	9:45	aq	GWQ 96-23A	1x500	none	-015												X				
1/11/13	9:45	aq	GWQ 96-23A	1x120	Filtered HNO3													X				
1/11/13	11:50	aq	GWQ 94-14	1x500	None	-016													X			
1/11/13	11:50	aq	GWQ 94-14	1x120	HNO3														X			
1/11/13	10:15	aq	GWQ 96-23B	1x500	None	-017												X				
1/11/13	10:15	aq	GWQ 96-23B	1x120	Filtered HNO3													X				

Date:	Time:	Relinquished by:	Received by:	Date	Time
-11-13	1543	[signature]	[signature]	01/11/13	1543

Remarks:

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07528

	Constituent List A	Constituent List B	details
general chemistry	pH	pH	12 samples for List A
	alkalinity/Acidity	alkalinity/Acidity	16 samples for List B
	sulfate	sulfate	report 3 significant digits for general chemistry constituents
	chloride	chloride	
	fluoride	calcium	
	calcium	magnesium	
	magnesium	sodium	
	sodium	potassium	
	potassium	Total Dissolved Solids	
	Total Dissolved Solids		
dissolved metals	aluminum		
	cadmium		
	cobalt		
	copper		
	magnessium		
	selenium		
	zinc		

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

April 25, 2013

Steve Finch
John Shomaker & Assoc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107
TEL: (505) 345-3407
FAX (505) 345-9920

RE: Copper Flat   OrderNo.: 1304522

Dear Steve Finch:

Hall Environmental Analysis Laboratory received 19 sample(s) on 4/12/2013 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. All samples are reported as received unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-26
Project: Copper Flat **Collection Date:** 4/9/2013 1:41:00 PM
Lab ID: 1304522-001 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	0.391	0.100		mg/L	1	4/17/2013 3:35:48 AM
Chloride	16.1	0.500		mg/L	1	4/12/2013 2:39:21 PM
Sulfate	98.2	10.0		mg/L	20	4/12/2013 2:51:45 PM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	ND	0.0200		mg/L	1	4/16/2013 5:43:20 PM
Cadmium	ND	0.00200		mg/L	1	4/15/2013 9:51:30 AM
Cobalt	ND	0.00600		mg/L	1	4/15/2013 9:51:30 AM
Copper	ND	0.00600		mg/L	1	4/15/2013 9:51:30 AM
Manganese	0.0194	0.00200		mg/L	1	4/15/2013 9:51:30 AM
Zinc	ND	0.0100		mg/L	1	4/15/2013 9:51:30 AM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	92.7	1.00		mg/L	1	4/17/2013 6:03:17 PM
Magnesium	23.0	1.00		mg/L	1	4/17/2013 6:03:17 PM
Potassium	1.73	1.00		mg/L	1	4/17/2013 6:03:17 PM
Sodium	68.2	1.00		mg/L	1	4/17/2013 6:03:17 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	0.00177	0.00100		mg/L	1	4/17/2013 1:34:00 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	354	20.0		mg/L CaCO3	1	4/12/2013 12:39:14 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 12:39:14 PM
Total Alkalinity (as CaCO3)	354	20.0		mg/L CaCO3	1	4/12/2013 12:39:14 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	582	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-25A
Project: Copper Flat **Collection Date:** 4/8/2013 8:48:00 AM
Lab ID: 1304522-002 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	324	100	*	mg/L	1000	4/17/2013 4:00:38 AM
Chloride	11.0	10.0		mg/L	20	4/12/2013 3:16:35 PM
Sulfate	17400	500	*	mg/L	1000	4/17/2013 4:00:38 AM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	1730	40.0	*	mg/L	2000	4/18/2013 1:26:25 PM
Cadmium	0.656	0.400	*	mg/L	200	4/17/2013 2:46:51 PM
Cobalt	3.91	1.20		mg/L	200	4/17/2013 2:46:51 PM
Copper	63.9	1.20	*	mg/L	200	4/17/2013 2:46:51 PM
Manganese	77.5	0.400	*	mg/L	200	4/17/2013 2:46:51 PM
Silicon	68.4	16.0		mg/L	200	4/18/2013 1:24:28 PM
Zinc	42.1	2.00	*	mg/L	200	4/17/2013 2:46:51 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	556	500		mg/L	500	4/18/2013 2:18:59 PM
Magnesium	ND	500		mg/L	500	4/18/2013 2:18:59 PM
Potassium	ND	500		mg/L	500	4/18/2013 2:18:59 PM
Sodium	ND	500		mg/L	500	4/18/2013 2:18:59 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	ND	0.50	*	mg/L	500	4/22/2013 12:45:58 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	4/12/2013 12:56:20 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 12:56:20 PM
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	4/12/2013 12:56:20 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	23800	1000	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-24B
Project: Copper Flat **Collection Date:** 4/8/2013 6:20:00 PM
Lab ID: 1304522-003 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	3.99	0.100		mg/L	1	4/17/2013 4:13:02 AM
Chloride	28.4	10.0		mg/L	20	4/13/2013 12:34:57 AM
Sulfate	1510	25.0	*	mg/L	50	4/17/2013 4:25:26 AM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	ND	0.0200		mg/L	1	4/16/2013 6:00:01 PM
Cadmium	ND	0.00200		mg/L	1	4/15/2013 10:10:31 AM
Cobalt	0.0191	0.00600		mg/L	1	4/15/2013 10:10:31 AM
Copper	ND	0.00600		mg/L	1	4/15/2013 10:10:31 AM
Manganese	3.54	0.0100	*	mg/L	5	4/15/2013 10:12:56 AM
Zinc	0.233	0.0100		mg/L	1	4/15/2013 10:10:31 AM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	469	10.0		mg/L	10	4/15/2013 3:21:25 PM
Magnesium	77.7	1.00		mg/L	1	4/15/2013 3:17:55 PM
Potassium	5.81	1.00		mg/L	1	4/15/2013 3:17:55 PM
Sodium	91.4	1.00		mg/L	1	4/15/2013 3:17:55 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	ND	0.0050		mg/L	5	4/22/2013 12:53:50 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	189	20.0		mg/L CaCO3	1	4/12/2013 1:00:56 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 1:00:56 PM
Total Alkalinity (as CaCO3)	189	20.0		mg/L CaCO3	1	4/12/2013 1:00:56 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	2440	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-24A
Project: Copper Flat **Collection Date:** 4/8/2013 6:10:00 PM
Lab ID: 1304522-004 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	22.9	10.0	*	mg/L	100	4/17/2013 4:50:15 AM
Chloride	29.8	10.0		mg/L	20	4/12/2013 4:31:02 PM
Sulfate	2730	50.0	*	mg/L	100	4/17/2013 4:50:15 AM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	46.0	2.00	*	mg/L	100	4/16/2013 6:04:44 PM
Cadmium	0.206	0.0100	*	mg/L	5	4/15/2013 10:17:42 AM
Cobalt	0.290	0.0300		mg/L	5	4/15/2013 10:17:42 AM
Copper	126	1.20	*	mg/L	200	4/17/2013 12:51:12 PM
Manganese	11.4	0.0400	*	mg/L	20	4/17/2013 12:49:06 PM
Zinc	6.32	0.100	*	mg/L	10	4/16/2013 6:02:30 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	468	10.0		mg/L	10	4/17/2013 6:23:09 PM
Magnesium	110	10.0		mg/L	10	4/17/2013 6:23:09 PM
Potassium	ND	10.0		mg/L	10	4/17/2013 6:23:09 PM
Sodium	126	10.0		mg/L	10	4/17/2013 6:23:09 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	0.0351	0.00100		mg/L	1	4/17/2013 1:39:36 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	ND	20.0		mg/L CaCO3	1	4/12/2013 1:13:22 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 1:13:22 PM
Total Alkalinity (as CaCO3)	ND	20.0		mg/L CaCO3	1	4/12/2013 1:13:22 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	4320	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **4/25/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** Pit Lake 1
Project: Copper Flat **Collection Date:** 4/8/2013 2:40:00 PM
Lab ID: 1304522-005 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	22.1	5.00	*	mg/L	50	4/17/2013 5:39:53 AM
Chloride	670	25.0	*	mg/L	50	4/17/2013 5:39:53 AM
Sulfate	6750	250	*	mg/L	500	4/17/2013 5:52:17 AM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	0.109	0.0200		mg/L	1	4/16/2013 6:07:22 PM
Cadmium	0.0385	0.00200	*	mg/L	1	4/15/2013 10:19:58 AM
Cobalt	0.0688	0.00600		mg/L	1	4/15/2013 10:19:58 AM
Copper	0.0584	0.00600		mg/L	1	4/15/2013 10:19:58 AM
Manganese	31.9	0.100	*	mg/L	50	4/17/2013 12:53:36 PM
Silicon	5.08	0.400		mg/L	5	4/18/2013 1:28:22 PM
Zinc	0.864	0.0100		mg/L	1	4/15/2013 10:19:58 AM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	494	10.0		mg/L	10	4/15/2013 3:31:15 PM
Magnesium	929	10.0		mg/L	10	4/15/2013 3:31:15 PM
Potassium	49.1	1.00		mg/L	1	4/15/2013 3:25:29 PM
Sodium	1320	20.0		mg/L	20	4/15/2013 3:43:59 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	0.013	0.0050		mg/L	5	4/22/2013 12:57:46 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	122	20.0		mg/L CaCO3	1	4/12/2013 1:17:47 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 1:17:47 PM
Total Alkalinity (as CaCO3)	122	20.0		mg/L CaCO3	1	4/12/2013 1:17:47 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	11700	200	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **4/25/2013**

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ11-25B
Project: Copper Flat **Collection Date:** 4/8/2013 1:38:00 PM
Lab ID: 1304522-006 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	8.10	5.00	*	mg/L	50	4/17/2013 6:04:42 AM
Chloride	27.2	10.0		mg/L	20	4/12/2013 5:45:27 PM
Sulfate	1470	25.0	*	mg/L	50	4/17/2013 6:04:42 AM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	0.383	0.0200	*	mg/L	1	4/16/2013 6:12:49 PM
Cadmium	ND	0.00200		mg/L	1	4/15/2013 10:25:51 AM
Cobalt	ND	0.00600		mg/L	1	4/15/2013 10:25:51 AM
Copper	ND	0.00600		mg/L	1	4/15/2013 10:25:51 AM
Manganese	3.30	0.0100	*	mg/L	5	4/15/2013 10:28:16 AM
Zinc	0.0225	0.0100		mg/L	1	4/15/2013 10:25:51 AM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	465	10.0		mg/L	10	4/15/2013 4:00:10 PM
Magnesium	80.6	1.00		mg/L	1	4/15/2013 3:35:35 PM
Potassium	4.35	1.00		mg/L	1	4/15/2013 3:35:35 PM
Sodium	128	10.0		mg/L	10	4/15/2013 4:00:10 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	0.00168	0.00100		mg/L	1	4/17/2013 2:11:28 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	339	20.0		mg/L CaCO3	1	4/12/2013 1:26:35 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 1:26:35 PM
Total Alkalinity (as CaCO3)	339	20.0		mg/L CaCO3	1	4/12/2013 1:26:35 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	2530	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1304522-007
Matrix: AQUEOUS

Client Sample ID: GWQ-11
Collection Date: 4/10/2013 6:15:00 PM
Received Date: 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	142	5.00		mg/L	10	4/12/2013 6:22:42 PM
Sulfate	359	5.00	*	mg/L	10	4/12/2013 6:22:42 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	155	10.0		mg/L	10	4/15/2013 4:18:29 PM
Magnesium	43.0	1.00		mg/L	1	4/15/2013 4:12:38 PM
Potassium	3.34	1.00		mg/L	1	4/15/2013 4:12:38 PM
Sodium	68.6	1.00		mg/L	1	4/15/2013 4:12:38 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	163	20.0		mg/L CaCO3	1	4/12/2013 1:43:08 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 1:43:08 PM
Total Alkalinity (as CaCO3)	163	20.0		mg/L CaCO3	1	4/12/2013 1:43:08 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	952	20.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ94-14
Project: Copper Flat **Collection Date:** 4/10/2013 2:52:00 PM
Lab ID: 1304522-008 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	43.7	5.00		mg/L	10	4/12/2013 6:47:31 PM
Sulfate	141	5.00		mg/L	10	4/12/2013 6:47:31 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	94.8	1.00		mg/L	1	4/15/2013 4:26:30 PM
Magnesium	25.8	1.00		mg/L	1	4/15/2013 4:26:30 PM
Potassium	1.71	1.00		mg/L	1	4/15/2013 4:26:30 PM
Sodium	48.7	1.00		mg/L	1	4/15/2013 4:26:30 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	213	20.0		mg/L CaCO3	1	4/12/2013 1:53:36 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 1:53:36 PM
Total Alkalinity (as CaCO3)	213	20.0		mg/L CaCO3	1	4/12/2013 1:53:36 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	553	20.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1304522-009 **Matrix:** AQUEOUS

Client Sample ID: GWQ-12
Collection Date: 4/10/2013 4:51:00 PM
Received Date: 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	27.2	5.00		mg/L	10	4/12/2013 7:12:19 PM
Sulfate	46.9	5.00		mg/L	10	4/12/2013 7:12:19 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	50.0	1.00		mg/L	1	4/17/2013 6:42:01 PM
Magnesium	16.1	1.00		mg/L	1	4/17/2013 6:42:01 PM
Potassium	2.66	1.00		mg/L	1	4/17/2013 6:42:01 PM
Sodium	26.9	1.00		mg/L	1	4/17/2013 6:42:01 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	179	20.0		mg/L CaCO3	1	4/12/2013 2:05:17 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 2:05:17 PM
Total Alkalinity (as CaCO3)	179	20.0		mg/L CaCO3	1	4/12/2013 2:05:17 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	360	20.0		mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ94-13
Project: Copper Flat **Collection Date:** 4/10/2013 11:05:00 AM
Lab ID: 1304522-010 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	177	50.0		mg/L	100	4/12/2013 7:49:32 PM
Sulfate	517	50.0	*	mg/L	100	4/12/2013 7:49:32 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	231	10.0		mg/L	10	4/17/2013 6:54:52 PM
Magnesium	44.2	1.00		mg/L	1	4/17/2013 6:50:43 PM
Potassium	2.73	1.00		mg/L	1	4/17/2013 6:50:43 PM
Sodium	90.7	1.00		mg/L	1	4/17/2013 6:50:43 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	124	20.0		mg/L CaCO3	1	4/12/2013 2:16:00 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 2:16:00 PM
Total Alkalinity (as CaCO3)	124	20.0		mg/L CaCO3	1	4/12/2013 2:16:00 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	1410	20.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Client Sample ID: NP-3
Project: Copper Flat
Collection Date: 4/10/2013 12:09:00 PM
Lab ID: 1304522-011
Matrix: AQUEOUS
Received Date: 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	191	50.0		mg/L	100	4/12/2013 8:14:21 PM
Sulfate	561	50.0	*	mg/L	100	4/12/2013 8:14:21 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	219	10.0		mg/L	10	4/17/2013 7:03:00 PM
Magnesium	47.5	1.00		mg/L	1	4/17/2013 6:59:28 PM
Potassium	3.41	1.00		mg/L	1	4/17/2013 6:59:28 PM
Sodium	97.9	1.00		mg/L	1	4/17/2013 6:59:28 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	71.4	20.0		mg/L CaCO3	1	4/12/2013 2:25:26 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 2:25:26 PM
Total Alkalinity (as CaCO3)	71.4	20.0		mg/L CaCO3	1	4/12/2013 2:25:26 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	1340	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** NP-2
Project: Copper Flat **Collection Date:** 4/10/2013 1:21:00 PM
Lab ID: 1304522-012 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	170	5.00		mg/L	10	4/12/2013 8:51:35 PM
Sulfate	299	5.00	*	mg/L	10	4/12/2013 8:51:35 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	147	10.0		mg/L	10	4/17/2013 7:12:52 PM
Magnesium	40.7	1.00		mg/L	1	4/17/2013 7:09:15 PM
Potassium	4.24	1.00		mg/L	1	4/17/2013 7:09:15 PM
Sodium	68.6	1.00		mg/L	1	4/17/2013 7:09:15 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	167	20.0		mg/L CaCO3	1	4/12/2013 2:33:07 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 2:33:07 PM
Total Alkalinity (as CaCO3)	167	20.0		mg/L CaCO3	1	4/12/2013 2:33:07 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	872	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1304522-013
Matrix: AQUEOUS
Client Sample ID: GWQ94-16
Collection Date: 4/10/2013 11:05:00 AM
Received Date: 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	191	5.00		mg/L	10	4/12/2013 9:16:24 PM
Sulfate	421	5.00	*	mg/L	10	4/12/2013 9:16:24 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	281	10.0		mg/L	10	4/17/2013 7:20:04 PM
Magnesium	50.7	1.00		mg/L	1	4/17/2013 7:16:24 PM
Potassium	4.78	1.00		mg/L	1	4/17/2013 7:16:24 PM
Sodium	65.0	1.00		mg/L	1	4/17/2013 7:16:24 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	171	20.0		mg/L CaCO3	1	4/12/2013 2:43:35 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 2:43:35 PM
Total Alkalinity (as CaCO3)	171	20.0		mg/L CaCO3	1	4/12/2013 2:43:35 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	1070	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** MW-4
Project: Copper Flat **Collection Date:** 4/11/2013 2:30:00 PM
Lab ID: 1304522-014 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	20.8	5.00		mg/L	10	4/12/2013 9:41:12 PM
Sulfate	91.5	5.00		mg/L	10	4/12/2013 9:41:12 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	23.2	1.00		mg/L	1	4/17/2013 7:37:17 PM
Magnesium	7.27	1.00		mg/L	1	4/17/2013 7:37:17 PM
Potassium	2.27	1.00		mg/L	1	4/17/2013 7:37:17 PM
Sodium	48.1	1.00		mg/L	1	4/17/2013 7:37:17 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	87.2	20.0		mg/L CaCO3	1	4/12/2013 2:53:38 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 2:53:38 PM
Total Alkalinity (as CaCO3)	87.2	20.0		mg/L CaCO3	1	4/12/2013 2:53:38 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	267	20.0		mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ-3
Project: Copper Flat **Collection Date:** 4/11/2013 11:22:00 AM
Lab ID: 1304522-015 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	75.3	5.00		mg/L	10	4/12/2013 10:06:00 PM
Sulfate	1750	50.0	*	mg/L	100	4/12/2013 10:18:25 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	477	10.0		mg/L	10	4/15/2013 4:38:52 PM
Magnesium	111	10.0		mg/L	10	4/15/2013 4:38:52 PM
Potassium	3.99	1.00		mg/L	1	4/15/2013 4:34:39 PM
Sodium	253	10.0		mg/L	10	4/15/2013 4:38:52 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	188	20.0		mg/L CaCO3	1	4/12/2013 3:01:18 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 3:01:18 PM
Total Alkalinity (as CaCO3)	188	20.0		mg/L CaCO3	1	4/12/2013 3:01:18 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	3060	40.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc.
Project: Copper Flat
Lab ID: 1304522-016
Matrix: AQUEOUS

Client Sample ID: GWQ-8
Collection Date: 4/9/2013 4:45:00 PM
Received Date: 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	85.0	5.00		mg/L	10	4/12/2013 10:30:49 PM
Sulfate	447	50.0	*	mg/L	100	4/12/2013 10:43:14 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	214	10.0		mg/L	10	4/15/2013 4:47:14 PM
Magnesium	35.6	1.00		mg/L	1	4/15/2013 4:42:59 PM
Potassium	2.73	1.00		mg/L	1	4/15/2013 4:42:59 PM
Sodium	113	10.0		mg/L	10	4/15/2013 4:47:14 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	214	20.0		mg/L CaCO3	1	4/12/2013 3:11:49 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 3:11:49 PM
Total Alkalinity (as CaCO3)	214	20.0		mg/L CaCO3	1	4/12/2013 3:11:49 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	1190	20.0	*	mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ-5R
Project: Copper Flat **Collection Date:** 4/9/2013 12:39:00 PM
Lab ID: 1304522-017 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	17.4	5.00		mg/L	10	4/12/2013 11:20:29 PM
Sulfate	101	5.00		mg/L	10	4/12/2013 11:20:29 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	87.1	1.00		mg/L	1	4/17/2013 7:45:29 PM
Magnesium	20.3	1.00		mg/L	1	4/17/2013 7:45:29 PM
Potassium	4.63	1.00		mg/L	1	4/17/2013 7:45:29 PM
Sodium	30.6	1.00		mg/L	1	4/17/2013 7:45:29 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	285	20.0		mg/L CaCO3	1	4/12/2013 3:23:40 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 3:23:40 PM
Total Alkalinity (as CaCO3)	285	20.0		mg/L CaCO3	1	4/12/2013 3:23:40 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	500	20.0		mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** GWQ-1
Project: Copper Flat **Collection Date:** 4/11/2013 1:25:00 PM
Lab ID: 1304522-018 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Chloride	29.8	5.00		mg/L	10	4/12/2013 11:45:18 PM
Sulfate	120	5.00		mg/L	10	4/12/2013 11:45:18 PM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	57.0	1.00		mg/L	1	4/17/2013 7:54:14 PM
Magnesium	13.5	1.00		mg/L	1	4/17/2013 7:54:14 PM
Potassium	2.00	1.00		mg/L	1	4/17/2013 7:54:14 PM
Sodium	60.0	1.00		mg/L	1	4/17/2013 7:54:14 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	195	20.0		mg/L CaCO3	1	4/12/2013 3:37:20 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 3:37:20 PM
Total Alkalinity (as CaCO3)	195	20.0		mg/L CaCO3	1	4/12/2013 3:37:20 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS						Analyst: **KS**
Total Dissolved Solids	465	20.0		mg/L	1	4/15/2013 5:17:00 PM

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
	P	Sample pH greater than 2	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: John Shomaker & Assoc. **Client Sample ID:** Pit Lake 1A
Project: Copper Flat **Collection Date:** 4/8/2013 2:40:00 PM
Lab ID: 1304522-019 **Matrix:** AQUEOUS **Received Date:** 4/12/2013 9:07:00 AM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **JRR**
Fluoride	20.4	1.00	*	mg/L	10	4/17/2013 6:17:06 AM
Chloride	599	50.0	*	mg/L	100	4/13/2013 12:22:33 AM
Nitrogen, Nitrate (As N)	ND	1.00	H	mg/L	10	4/13/2013 12:10:08 AM
Sulfate	7130	100	*	mg/L	200	4/17/2013 6:29:31 AM
EPA METHOD 200.7: DISSOLVED METALS						Analyst: **JLF**
Aluminum	0.113	0.0200		mg/L	1	4/16/2013 6:15:14 PM
Cadmium	0.0391	0.00200	*	mg/L	1	4/15/2013 10:30:46 AM
Cobalt	0.0700	0.00600		mg/L	1	4/15/2013 10:30:46 AM
Copper	0.0611	0.00600		mg/L	1	4/15/2013 10:30:46 AM
Manganese	33.1	0.100	*	mg/L	50	4/17/2013 12:56:03 PM
Zinc	0.884	0.0100		mg/L	1	4/15/2013 10:30:46 AM
EPA METHOD 200.7: METALS						Analyst: **JLF**
Calcium	453	10.0		mg/L	10	4/17/2013 8:07:28 PM
Magnesium	859	10.0		mg/L	10	4/17/2013 8:07:28 PM
Potassium	40.2	1.00		mg/L	1	4/17/2013 8:02:56 PM
Sodium	1230	20.0		mg/L	20	4/18/2013 2:22:54 PM
EPA 200.8: DISSOLVED METALS						Analyst: **DBD**
Selenium	0.015	0.0050		mg/L	5	4/22/2013 1:01:42 PM
SM2320B: ALKALINITY						Analyst: **JML**
Bicarbonate (As CaCO3)	123	20.0		mg/L CaCO3	1	4/12/2013 3:47:52 PM
Carbonate (As CaCO3)	ND	2.00		mg/L CaCO3	1	4/12/2013 3:47:52 PM
Total Alkalinity (as CaCO3)	123	20.0		mg/L CaCO3	1	4/12/2013 3:47:52 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1304522**

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Metals**

Client ID: **PBW** Batch ID: **R9867** RunNo: **9867**

Prep Date: **2/22/2013** Analysis Date: **4/15/2013** SeqNo: **280774** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	ND	1.0								
Magnesium	ND	1.0								
Potassium	ND	1.0								
Sodium	ND	1.0								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Metals**

Client ID: **LCSW** Batch ID: **R9867** RunNo: **9867**

Prep Date: Analysis Date: **4/15/2013** SeqNo: **280775** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	48	1.0	50.00	0	97.0	85	115			
Magnesium	49	1.0	50.00	0	98.4	85	115			
Potassium	48	1.0	50.00	0	96.7	85	115			
Sodium	49	1.0	50.00	0	97.6	85	115			

Sample ID **MB-7014** SampType: **MBLK** TestCode: **EPA Method 200.7: Metals**

Client ID: **PBW** Batch ID: **7014** RunNo: **9947**

Prep Date: **4/17/2013** Analysis Date: **4/17/2013** SeqNo: **283253** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	ND	1.0								
Magnesium	ND	1.0								
Potassium	ND	1.0								
Sodium	ND	1.0								

Sample ID **LCS-7014** SampType: **LCS** TestCode: **EPA Method 200.7: Metals**

Client ID: **LCSW** Batch ID: **7014** RunNo: **9947**

Prep Date: **4/17/2013** Analysis Date: **4/17/2013** SeqNo: **283255** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Calcium	49	1.0	50.00	0	98.1	85	115			
Magnesium	49	1.0	50.00	0	98.3	85	115			
Potassium	48	1.0	50.00	0	96.0	85	115			
Sodium	48	1.0	50.00	0	96.8	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

WO#: **1304522**

Hall Environmental Analysis Laboratory, Inc.

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R9879** RunNo: **9879**
Prep Date: **2/22/2013** Analysis Date: **4/15/2013** SeqNo: **280993** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Cadmium	ND	0.0020								
Cobalt	ND	0.0060								
Copper	ND	0.0060								
Manganese	ND	0.0020								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R9879** RunNo: **9879**
Prep Date: Analysis Date: **4/15/2013** SeqNo: **280994** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Cadmium	0.51	0.0020	0.5000	0	101	85	115			
Cobalt	0.49	0.0060	0.5000	0	98.8	85	115			
Copper	0.52	0.0060	0.5000	0	104	85	115			
Manganese	0.52	0.0020	0.5000	0	103	85	115			
Zinc	0.48	0.010	0.5000	0	96.4	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R9910** RunNo: **9910**
Prep Date: **2/22/2013** Analysis Date: **4/16/2013** SeqNo: **281828** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Zinc	ND	0.010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R9910** RunNo: **9910**
Prep Date: Analysis Date: **4/16/2013** SeqNo: **281829** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.56	0.020	0.5000	0	113	85	115			
Zinc	0.50	0.010	0.5000	0	99.0	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R9937** RunNo: **9937**
Prep Date: Analysis Date: **4/17/2013** SeqNo: **283074** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Cadmium	0.50	0.0020	0.5000	0	100	85	115			
Cobalt	0.49	0.0060	0.5000	0	97.8	85	115			
Copper	0.51	0.0060	0.5000	0	102	85	115			

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- RL Reporting Detection Limit
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits
- S Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1304522**

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R9937** RunNo: **9937**

Prep Date: Analysis Date: **4/17/2013** SeqNo: **283074** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Manganese	0.51	0.0020	0.5000	0	101	85	115			
Zinc	0.48	0.010	0.5000	0	96.0	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **PBW** Batch ID: **R9967** RunNo: **9967**

Prep Date: **2/22/2013** Analysis Date: **4/18/2013** SeqNo: **283917** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Silicon	ND	0.080								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R9967** RunNo: **9967**

Prep Date: Analysis Date: **4/18/2013** SeqNo: **283918** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.57	0.020	0.5000	0	115	85	115			
Silicon	2.7	0.080	2.500	0	107	85	115			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1304522**

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R9934** RunNo: **9934**
Prep Date: Analysis Date: **4/17/2013** SeqNo: **283050** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.023	0.0010	0.02500	0	91.0	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R9934** RunNo: **9934**
Prep Date: Analysis Date: **4/17/2013** SeqNo: **283051** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.023	0.0010	0.02500	0	92.4	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R9934** RunNo: **9934**
Prep Date: Analysis Date: **4/17/2013** SeqNo: **283052** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R9934** RunNo: **9934**
Prep Date: Analysis Date: **4/17/2013** SeqNo: **283053** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R10026** RunNo: **10026**
Prep Date: Analysis Date: **4/22/2013** SeqNo: **285715** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.024	0.0010	0.02500	0	97.2	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW** Batch ID: **R10026** RunNo: **10026**
Prep Date: Analysis Date: **4/22/2013** SeqNo: **285717** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1304522**

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW**	Batch ID: **R10026**	RunNo: **10026**
Prep Date:	Analysis Date: **4/22/2013**	SeqNo: **285841** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	0.025	0.0010	0.02500	0	101	85	115			

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **PBW**	Batch ID: **R10026**	RunNo: **10026**
Prep Date:	Analysis Date: **4/22/2013**	SeqNo: **285842** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	ND	0.0010								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1304522**

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW**	Batch ID: **R9850**	RunNo: **9850**
Prep Date:	Analysis Date: **4/12/2013**	SeqNo: **280386** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	ND	0.50								
Nitrogen, Nitrate (As N)	ND	0.10								
Sulfate	ND	0.50								

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW**	Batch ID: **R9850**	RunNo: **9850**
Prep Date:	Analysis Date: **4/12/2013**	SeqNo: **280387** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	4.7	0.50	5.000	0	93.7	90	110			
Nitrogen, Nitrate (As N)	2.5	0.10	2.500	0	98.0	90	110			
Sulfate	9.4	0.50	10.00	0	94.2	90	110			

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW**	Batch ID: **R9925**	RunNo: **9925**
Prep Date:	Analysis Date: **4/16/2013**	SeqNo: **282646** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW**	Batch ID: **R9925**	RunNo: **9925**
Prep Date:	Analysis Date: **4/16/2013**	SeqNo: **282647** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.46	0.10	0.5000	0	92.0	90	110			
Chloride	4.7	0.50	5.000	0	94.6	90	110			
Sulfate	9.9	0.50	10.00	0	99.3	90	110			

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW**	Batch ID: **R9925**	RunNo: **9925**
Prep Date:	Analysis Date: **4/17/2013**	SeqNo: **282701** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Sulfate	ND	0.50								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1304522**

25-Apr-13

Client: John Shomaker & Assoc.
Project: Copper Flat

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW**	Batch ID: **R9925**	RunNo: **9925**
Prep Date:	Analysis Date: **4/17/2013**	SeqNo: **282702** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	98.5	90	110			
Chloride	4.8	0.50	5.000	0	95.3	90	110			
Sulfate	9.9	0.50	10.00	0	99.5	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

WO#: **1304522**

Hall Environmental Analysis Laboratory, Inc.

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **mb-1** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R9854** RunNo: **9854**
Prep Date: Analysis Date: **4/12/2013** SeqNo: **280512** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R9854** RunNo: **9854**
Prep Date: Analysis Date: **4/12/2013** SeqNo: **280513** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	79	20	80.00	0	99.2	90	110			

Sample ID **1304522-019a ms** SampType: **ms** TestCode: **SM2320B: Alkalinity**
Client ID: **Pit Lake 1A** Batch ID: **R9854** RunNo: **9854**
Prep Date: Analysis Date: **4/12/2013** SeqNo: **280533** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	195	20.0	80.00	122.6	90.8	65.3	113			

Sample ID **1304522-019a msd** SampType: **msd** TestCode: **SM2320B: Alkalinity**
Client ID: **Pit Lake 1A** Batch ID: **R9854** RunNo: **9854**
Prep Date: Analysis Date: **4/12/2013** SeqNo: **280534** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	195	20.0	80.00	122.6	90.5	65.3	113	0.123	10	

Sample ID **mb-2** SampType: **mblk** TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** Batch ID: **R9854** RunNo: **9854**
Prep Date: Analysis Date: **4/12/2013** SeqNo: **280535** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** SampType: **lcs** TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** Batch ID: **R9854** RunNo: **9854**
Prep Date: Analysis Date: **4/12/2013** SeqNo: **280536** Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	79	20	80.00	0	98.4	90	110			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

QC SUMMARY REPORT

WO#: **1304522**

Hall Environmental Analysis Laboratory, Inc.

25-Apr-13

Client: John Shomaker & Assoc.

Project: Copper Flat

Sample ID **MB-6966**	SampType: **MBLK**	TestCode: **SM2540C MOD: Total Dissolved Solids**
Client ID: **PBW**	Batch ID: **6966**	RunNo: **9871**
Prep Date: **4/14/2013**	Analysis Date: **4/15/2013**	SeqNo: **280848** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-6966**	SampType: **LCS**	TestCode: **SM2540C MOD: Total Dissolved Solids**
Client ID: **LCSW**	Batch ID: **6966**	RunNo: **9871**
Prep Date: **4/14/2013**	Analysis Date: **4/15/2013**	SeqNo: **280849** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1010	20.0	1000	0	101	80	120			

Sample ID **1304522-005AMS**	SampType: **MS**	TestCode: **SM2540C MOD: Total Dissolved Solids**
Client ID: **Pit Lake 1**	Batch ID: **6966**	RunNo: **9871**
Prep Date: **4/14/2013**	Analysis Date: **4/15/2013**	SeqNo: **280855** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	22100	200	10000	11660	104	80	120			

Sample ID **1304522-005AMSD**	SampType: **MSD**	TestCode: **SM2540C MOD: Total Dissolved Solids**
Client ID: **Pit Lake 1**	Batch ID: **6966**	RunNo: **9871**
Prep Date: **4/14/2013**	Analysis Date: **4/15/2013**	SeqNo: **280856** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	21900	200	10000	11660	102	80	120	0.957	5	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: SHO | Work Order Number: 1304522 | RcptNo: 1

Received by/date: MG	04/12/13	
Logged By: Michelle Garcia	4/12/2013 9:07:00 AM	Michelle Garcia
Completed By: Michelle Garcia	4/12/2013 9:49:42 AM	Michelle Garcia
Reviewed By: IO	04/12/2013	

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? ~~Yes~~ ☑ No ☑
9. Was preservative added to bottles? Yes ☑ ~~No~~ ☑ NA ☐

-001B - 006B - ADDED 0.5mL HNO_3 FOR ACCEPTABLE pH 04/12/13 @ 1030

10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
(Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
(If no, notify customer for authorization.)

# of preserved bottles checked for pH: 26
(<2 or >12 unless noted)
Adjusted? YES
Checked by: [signature]

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: | Date:
By Whom: | Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:
-001B - 006B - HELD IN LOGIN FOR 24 HRS AFTER PRESERVATION
18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	1.0	Good	Not Present			

Chain-of-Custody Record

List "A"

HALL ENVIRONMENTAL ANALYSIS LABORATORY
www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Client: John Shomaker + Assoc. Inc.

Mailing Address: 2611 Broadbent Pkwy. Albuquerque, NM 87107

Phone #: (505) 345-3407

email or Fax#: sfinch@shomaker.com

QA/QC Package: ☑ Standard ☐ Level 4 (Full Validation)

Accreditation ☐ NELAP ☐ Other ______

☐ EDD (Type) ______

Turn-Around Time: ☑ Standard ☐ Rush ______

Project Name: Copper Flat

Project #:

Project Manager: sfinch@shomaker.com Steve Finch

Sampler: M. Wikstrom

On Ice: ☑ Yes ☐ No

Sample Temperature: 1.0

only HNO_3 bottle

Analysis Request

Date 2013	Time	Matrix	Sample Request ID	Container ~~Type and~~ #	Preservative Type	HEAL No. 1304522	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	See List	Filtered (dissolved)	~~Not Filtered (see remarks)~~	~~[illegible]~~
4/9	13:41	H_2O	GWQ11-26	3	HNO_3 x1	-001												✓	✓		
4/8	08:48	H_2O	GWQ11-25A	3	1xHNO_3	-002												✓	✓		
4/8	18:20	H_2O	GWQ11-24B	3	1xHNO_3	-003												✓	✓		
4/8	18:10	H_2O	GWQ11-24A	3	1xHNO_3	-004												✓	✓		
4/8	14:40	H_2O	Pit Lake 1	3	1xHNO_3	-005												✓	✓		
4/8	14:40	H_2O	Pit Lake 1A	3	2xHNO_3	~~[illegible]~~ 005-0019															✓
4/8	13:38	H_2O	GWQ11-25B	3	1xHNO_3	~~007~~ 006												✓	✓		

Date:	Time:	Relinquished by:	Received by:	Date	Time
4/12	09:07	M. Wikstrom	[signature]	04/12/13	09:07
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: Please copy to ~~[illegible]~~ sfinch@shomaker.com
List "A" add diss SiO_2 to -2 and -5 [illegible]

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

Chain-of-Custody Record

Client: John Shomaker & Assoc, Inc.

Mailing Address: 2611 Broadbent Pkwy.
Albuquerque, NM 87107

Phone #: (505) 345-3407

email or Fax#: ~~sf~~ sfinch@shomaker.com

QA/QC Package:
☑ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other ________

☐ EDD (Type) ________

Turn-Around Time:
☑ Standard ☐ Rush ________

Project Name:
Copper Flat

Project #:

Project Manager:
Steve Finch
sfinch@shomaker.com

Sampler: M. Wikstrom

On Ice: ☑ Yes ☐ No

Sample Temperature: 1.0

HALL ENVIRONMENTAL ANALYSIS LABORATORY
www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

List "B"

Date 2013	Time	Matrix	Sample Request ID	Container ~~Type and~~ #	Preservative Type	HEAL No. 1304522
4/10	18:15	H_2O	GWQ-11	2	1 x HNO_3	~~008~~ 007
4/10	14:52	H_2O	GWQ94-14	2	1 x HNO_3	~~009~~ 008
4/10	16:51	H_2O	GWQ-12	2	1 x HNO_3	~~010~~ 009
4/10	11:05	H_2O	GWQ94-13	2	1 x HNO_3	~~011~~ 010
4/10	12:09	H_2O	NP-3	2	1 x HNO_3	~~012~~ 011
4/10	13:21	H_2O	NP-2	2	1 x HNO_3	~~013~~ 012
4/10	11:05	H_2O	GWQ94-16	2	1 x HNO_3	~~014~~ 013
4/11	14:30	H_2O	MW-4	2	1 x HNO_3	~~015~~ 014
						MG 04/12

Analysis Request

Sample Request ID	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	See List	Not Filtered			Air Bubbles (Y or N)
GWQ-11												✓	✓			
GWQ94-14												✓	✓			
GWQ-12												✓	✓			
GWQ94-13												✓	✓			
NP-3												✓	✓			
NP-2												✓	✓			
GWQ94-16												✓	✓			
MW-4												✓	✓			

Date:	Time:	Relinquished by:	Received by:	Date	Time
4/12	09:07	[signature] M. Wikstrom	[signature]	04/12/13	09:07
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: Please email results to:
sfinch@shomaker.com List "B"

Chain-of-Custody Record

Client: John Shomaker & Assoc. Inc.

Mailing Address: 2611 Broadbent Pkwy
Albuquerque, NM 87107

Phone #: (505) 345-3907

email or Fax#: sfinch@shomaker.com

QA/QC Package: ☑ Standard ☐ Level 4 (Full Validation)

Accreditation ☐ NELAP ☐ Other ____

☐ EDD (Type) ____

Turn-Around Time: ☑ Standard ☐ Rush ____

Project Name: Copper Flat

Project #:

Project Manager: Steve Finch

Sampler:

On Ice: ☑ Yes ☐ No

Sample Temperature: 1.0

HALL ENVIRONMENTAL ANALYSIS LABORATORY

www.hallenvironmental.com

4901 Hawkins NE - Albuquerque, NM 87109

Tel. 505-345-3975 Fax 505-345-4107

List "B"

Analysis Request

Date 2011	Time	Matrix	Sample Request ID	Container ~~Type and~~ #	Preservative Type	HEAL No. 1304522	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	See List	Not filtered.	Air Bubbles (Y or N)
4/11	11:22	H_2O	GWQ-3	2	1xHNO_3	~~016~~ 015												✓	✓	
4/9	16:45	H_2O	GWQ-8	2	1xHNO_3	~~017~~ 016												✓	✓	
4/9	12:39	H_2O	GWQ-5R	2	1xHNO_3	~~018~~ 017												✓	✓	
4/11	13:25	H_2O	GWQ-1	2	1xHNO_3	~~019~~ 018												✓	✓	

MG 04/12

Date:	Time:	Relinquished by:	Received by:	Date	Time
4/12	09:07	M. Winstrom	[signature]	04/12/13	09:07
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: Please email results to: sfinch@shomaker.com List "B"

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

07563

	Constituent List A	Constituent List B	details
general chemistry	[illegible]	[illegible]	[illegible] samples for List A —(Filtered) dissolved
	alkalinity/Acidity (total)	alkalinity/[illegible]	[illegible] samples for List B
	sulfate	sulfate	report 3 significant digits for general chemistry constituents
	chloride	chloride	
	fluoride	calcium	
	calcium	magnesium	
	magnesium	sodium	
	sodium	potassium	
	potassium	Total Dissolved Solids	
	Total Dissolved Solids		
dissolved metals	aluminum		
	cadmium		
	cobalt		
	copper		
	~~magnesium~~ Manganese		
	selenium		
	zinc		

Appendix C.

Hydrographs
(pit, pit area wells, waste rock/mill site area wells, and TSF wells)

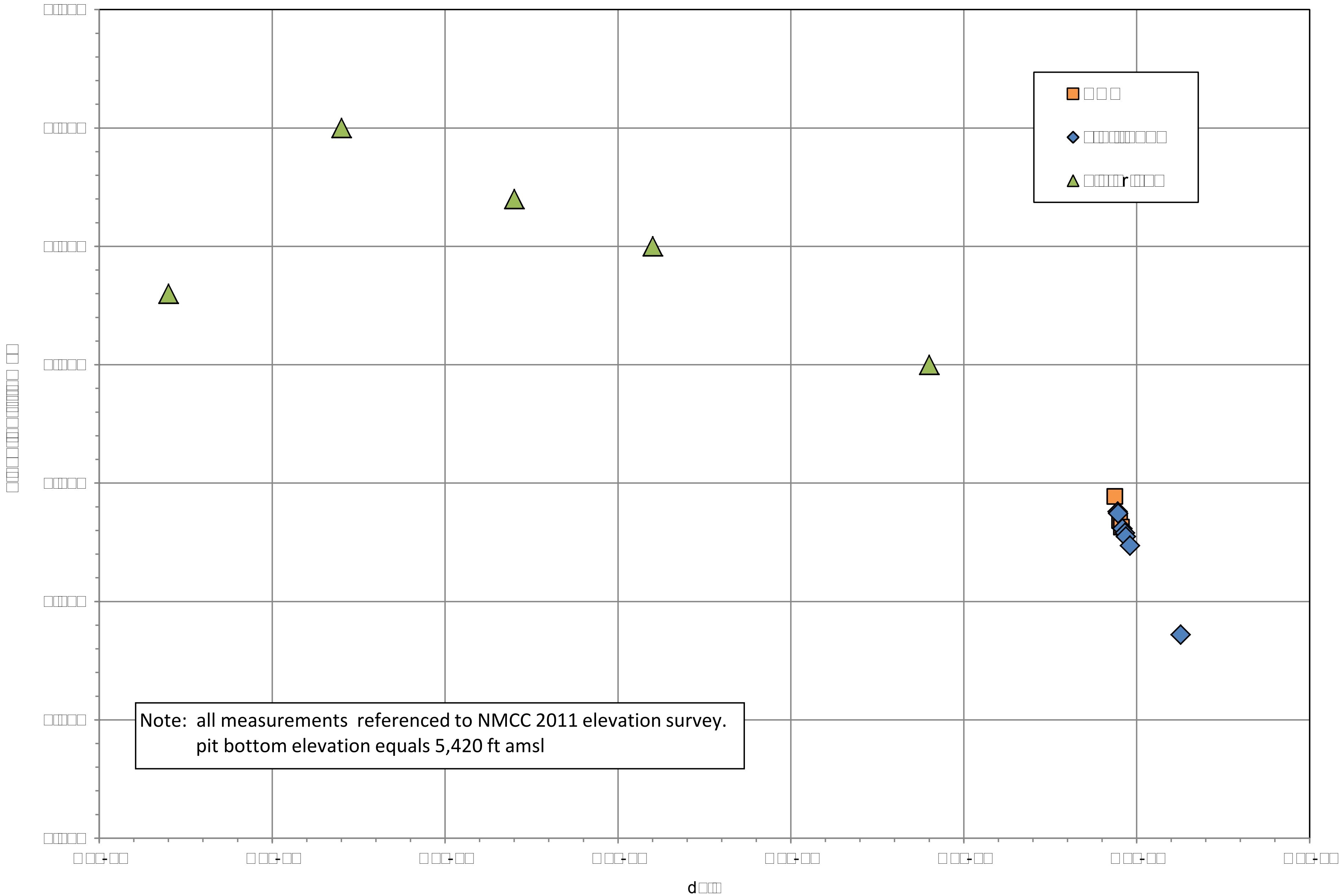


Figure C1. Hydrograph of pit water level elevation (reconstructed historical, BDR, Staff gage).

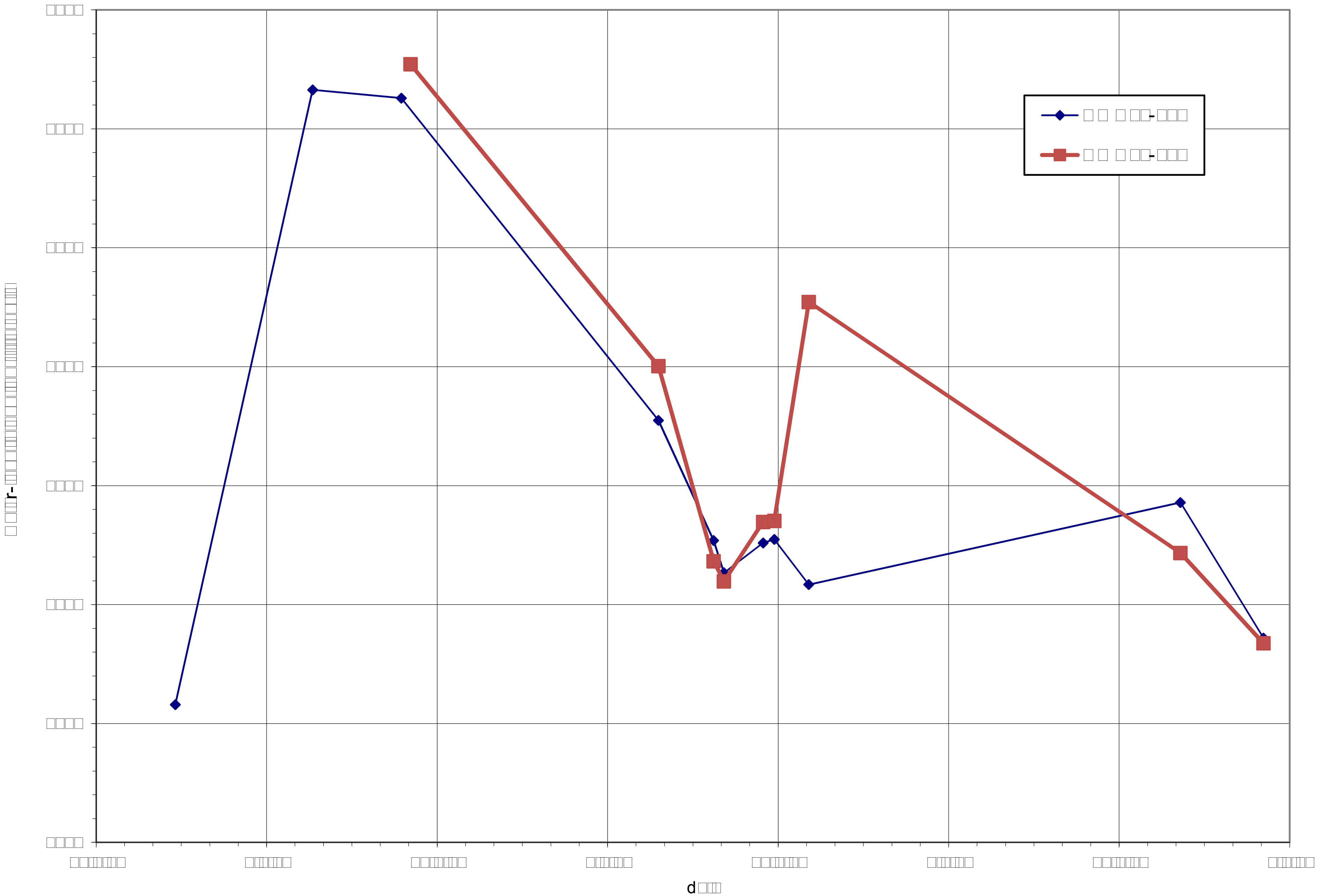


Figure C2. Hydrograph of pit area well GWQ96-22(A, B).

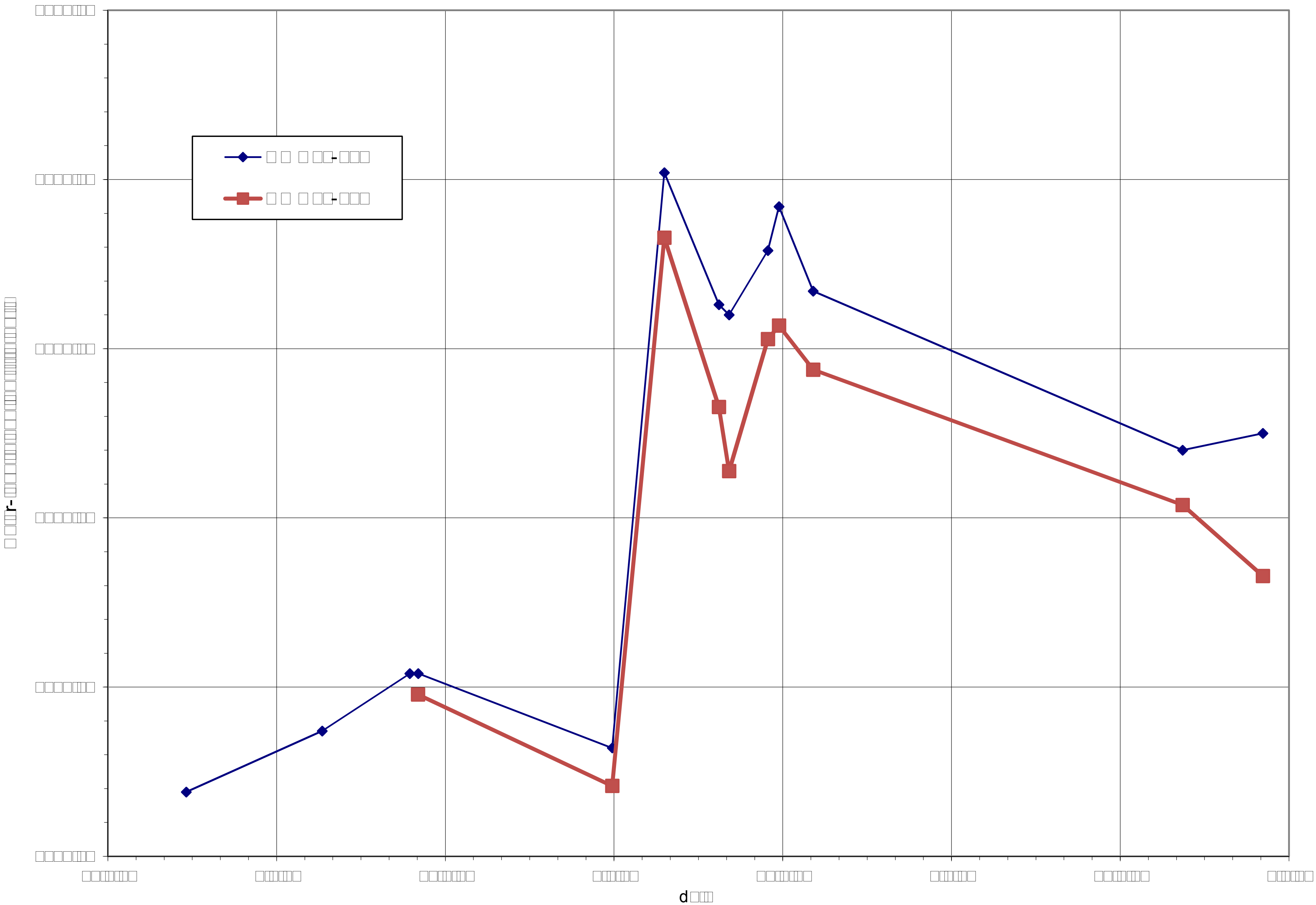


Figure C3. Hydrographs of pit area well GWQ96-23(A, B).

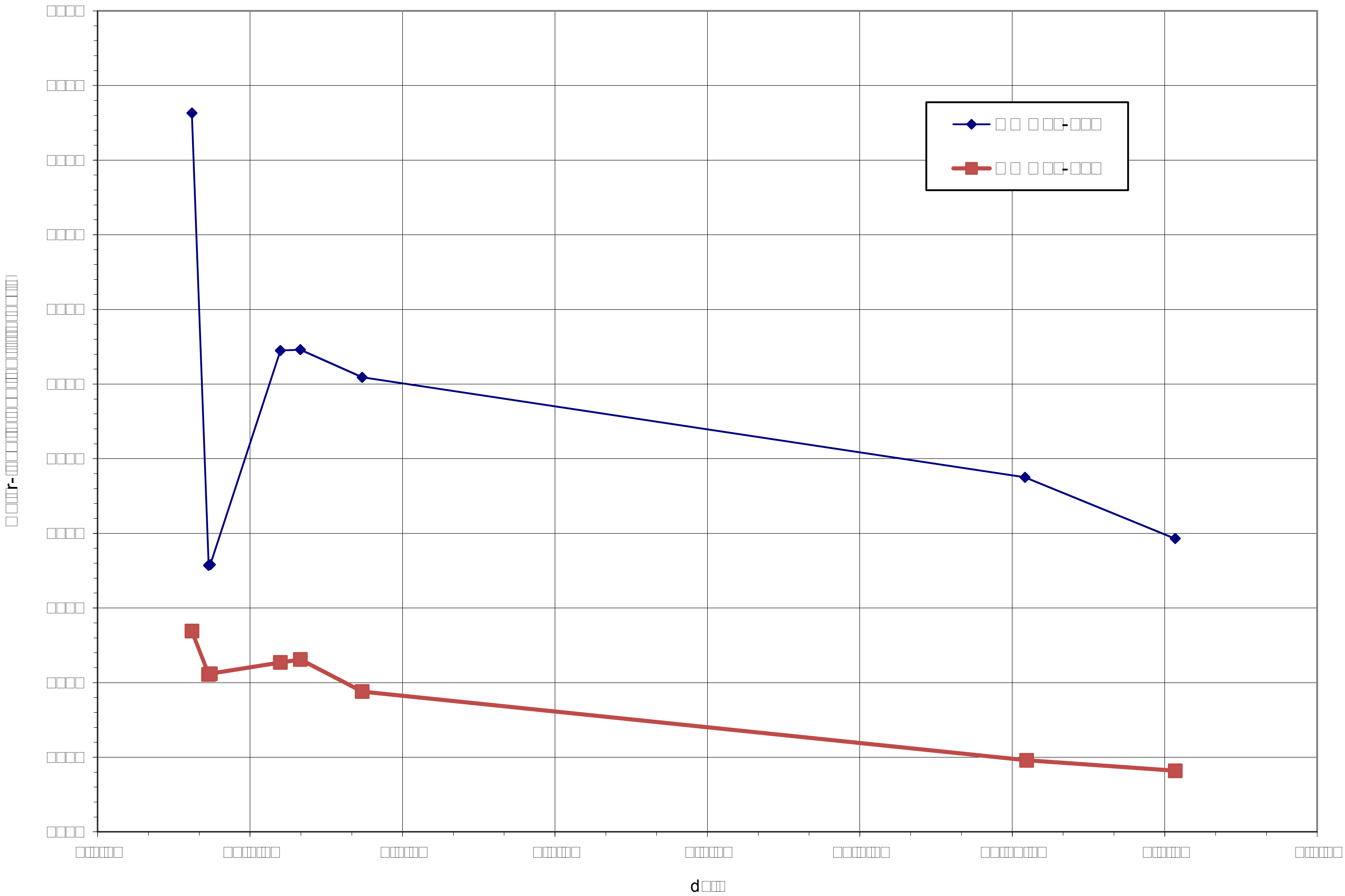


Figure C4. Hydrographs of pit area well GWQ11-24(A,B).

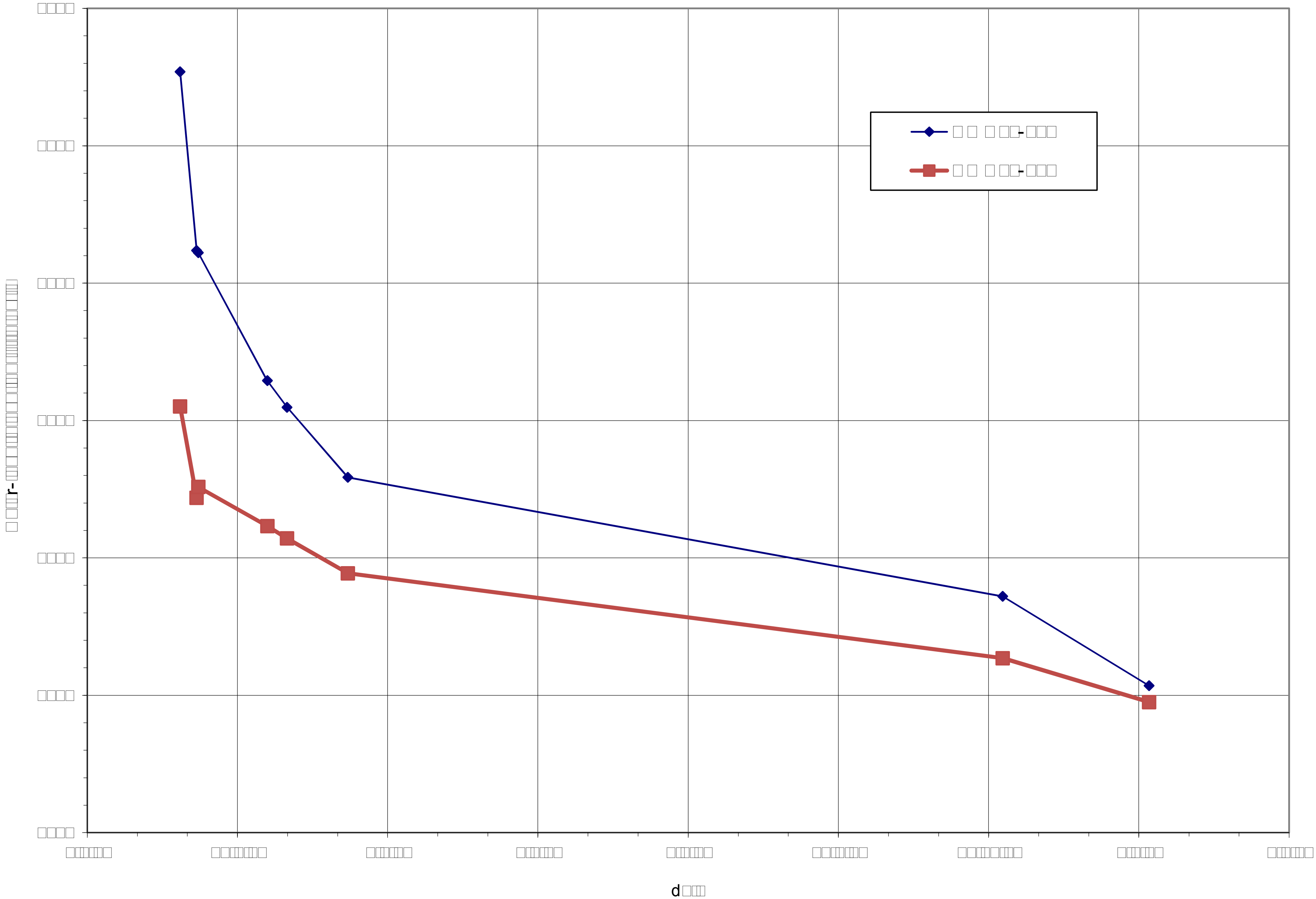


Figure C5. Hydrographs of pit area well GWQ11-25(A, B).

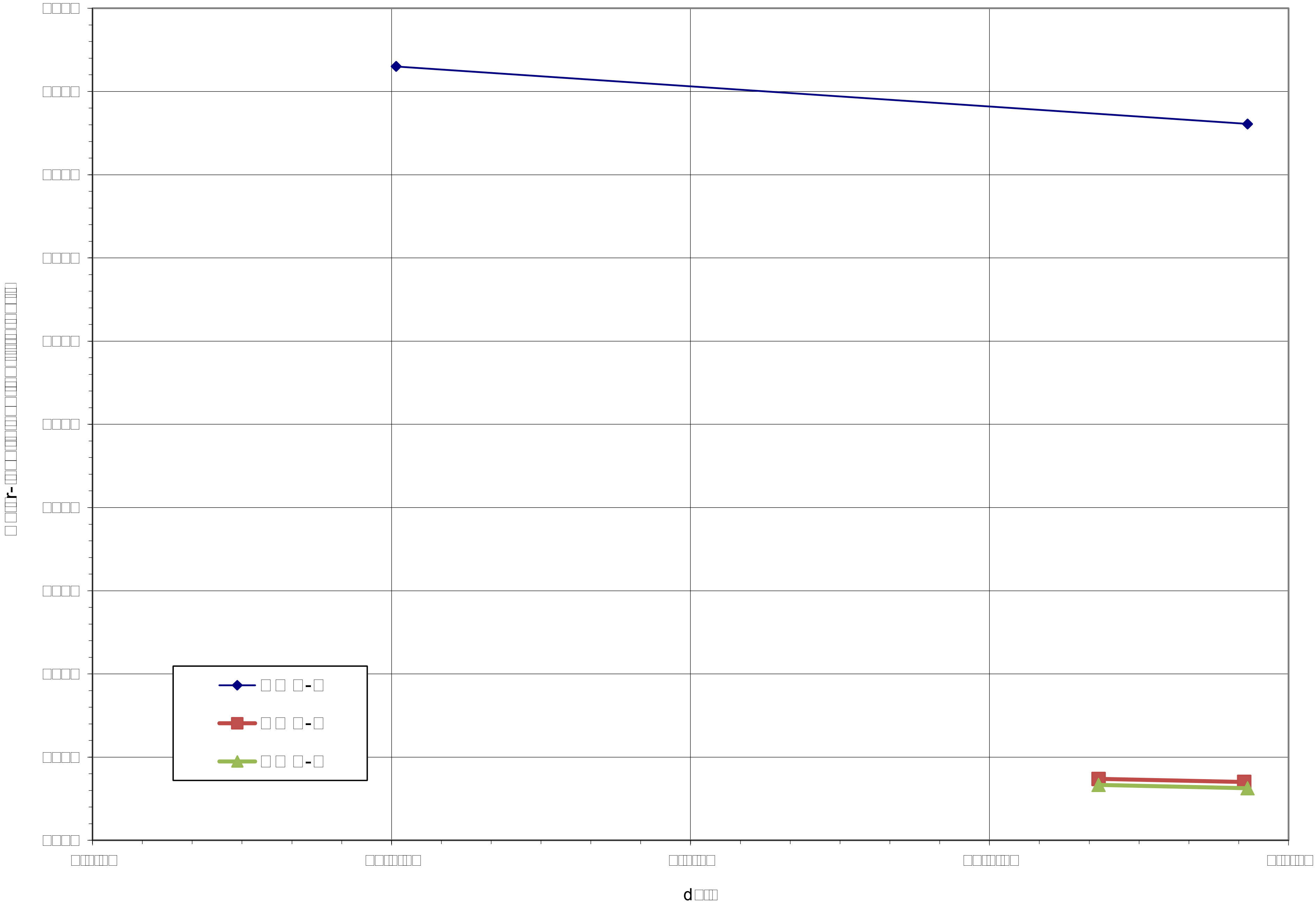


Figure C6. Hydrographs of waste rock pile area wells in GWQ-1, GWQ-3, and GWQ-8 Grayback Arroyo.

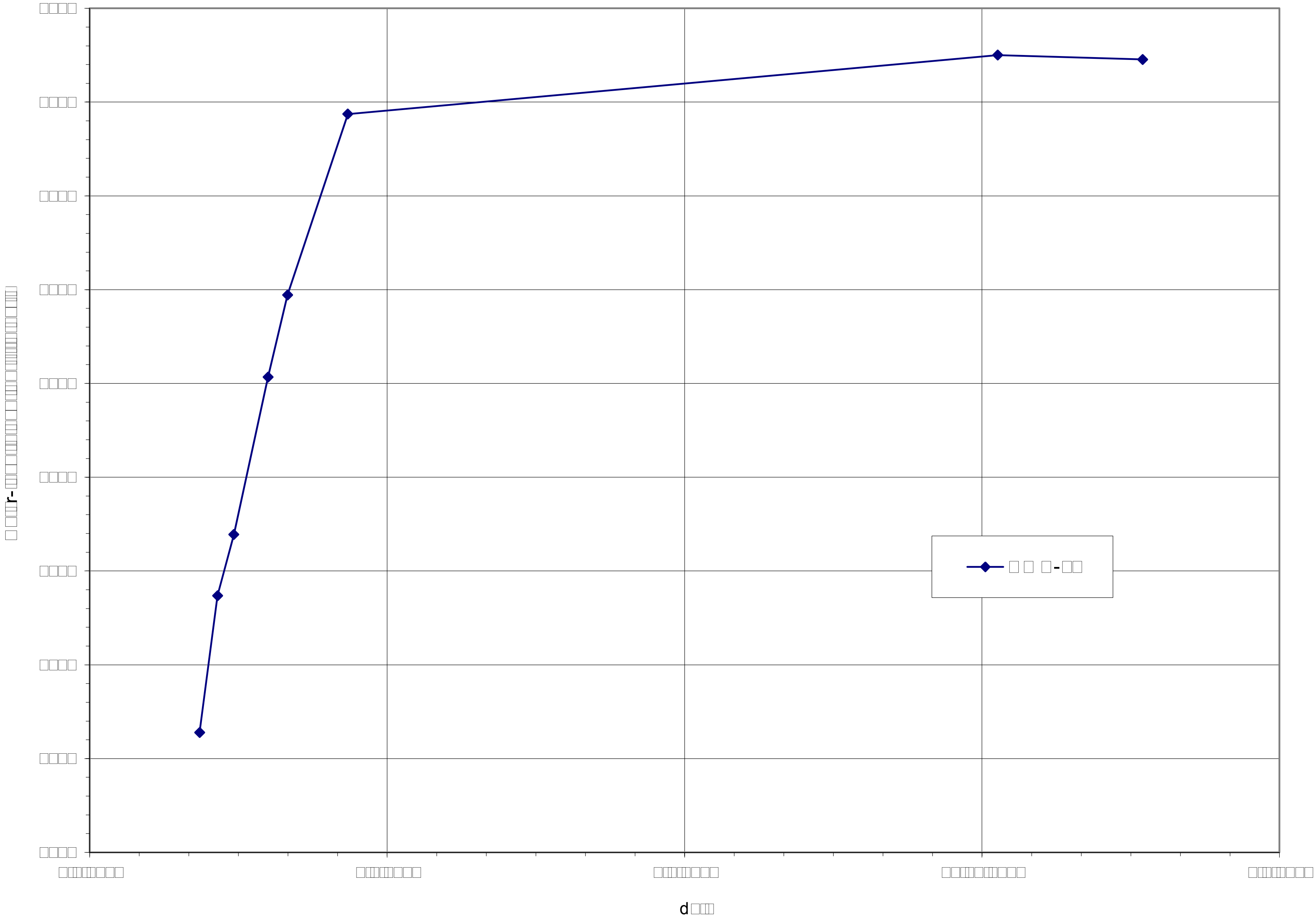


Figure C7. Hydrogrpahs of waste rock area well GWQ-5R.

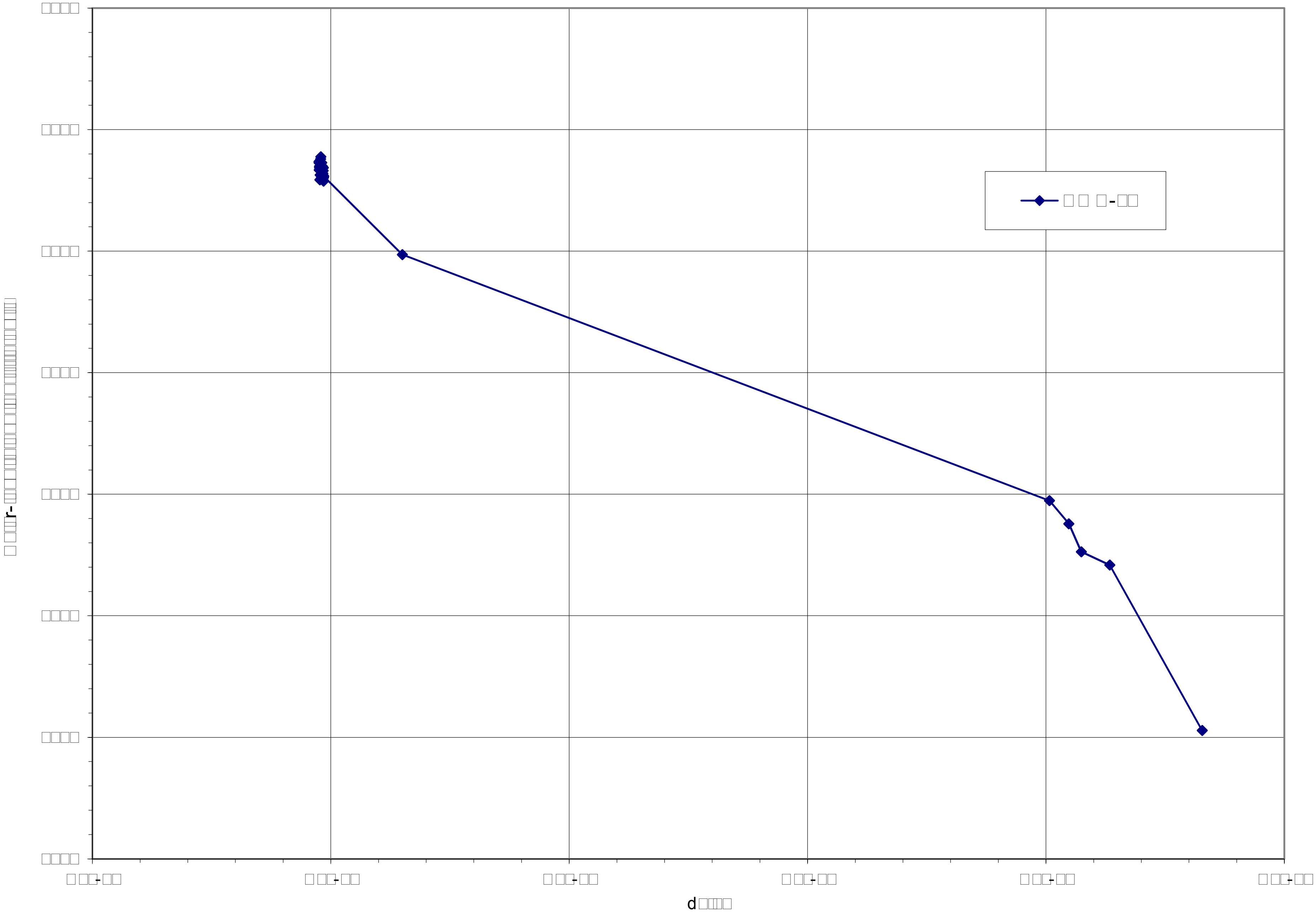


Figure C8. Hydrographs of TSF area well GWQ-11.

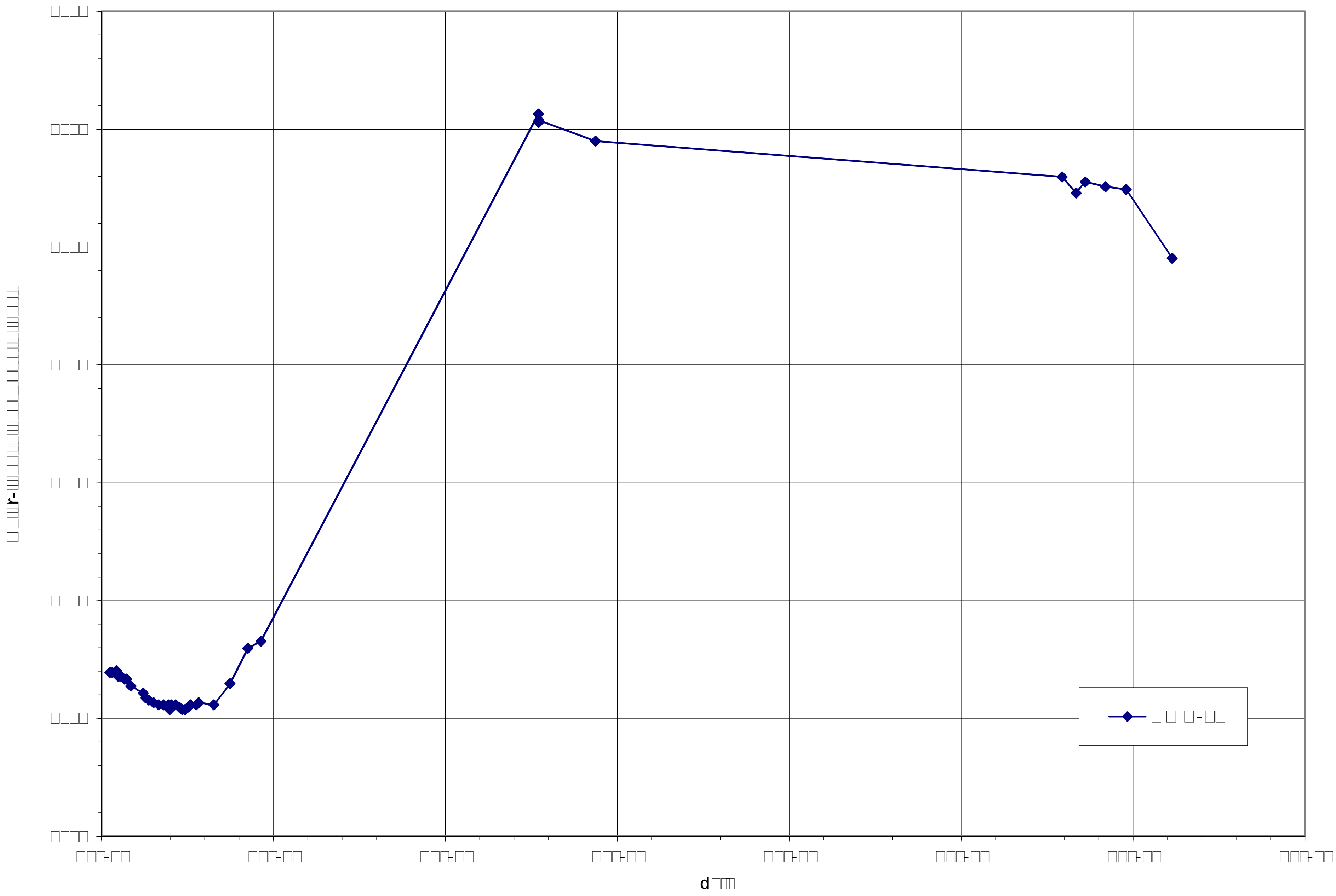


Figure C9. Hydrographs of TSF area well GWQ-12.

JOHN SHOMAKER & ASSOCIATES, INC.

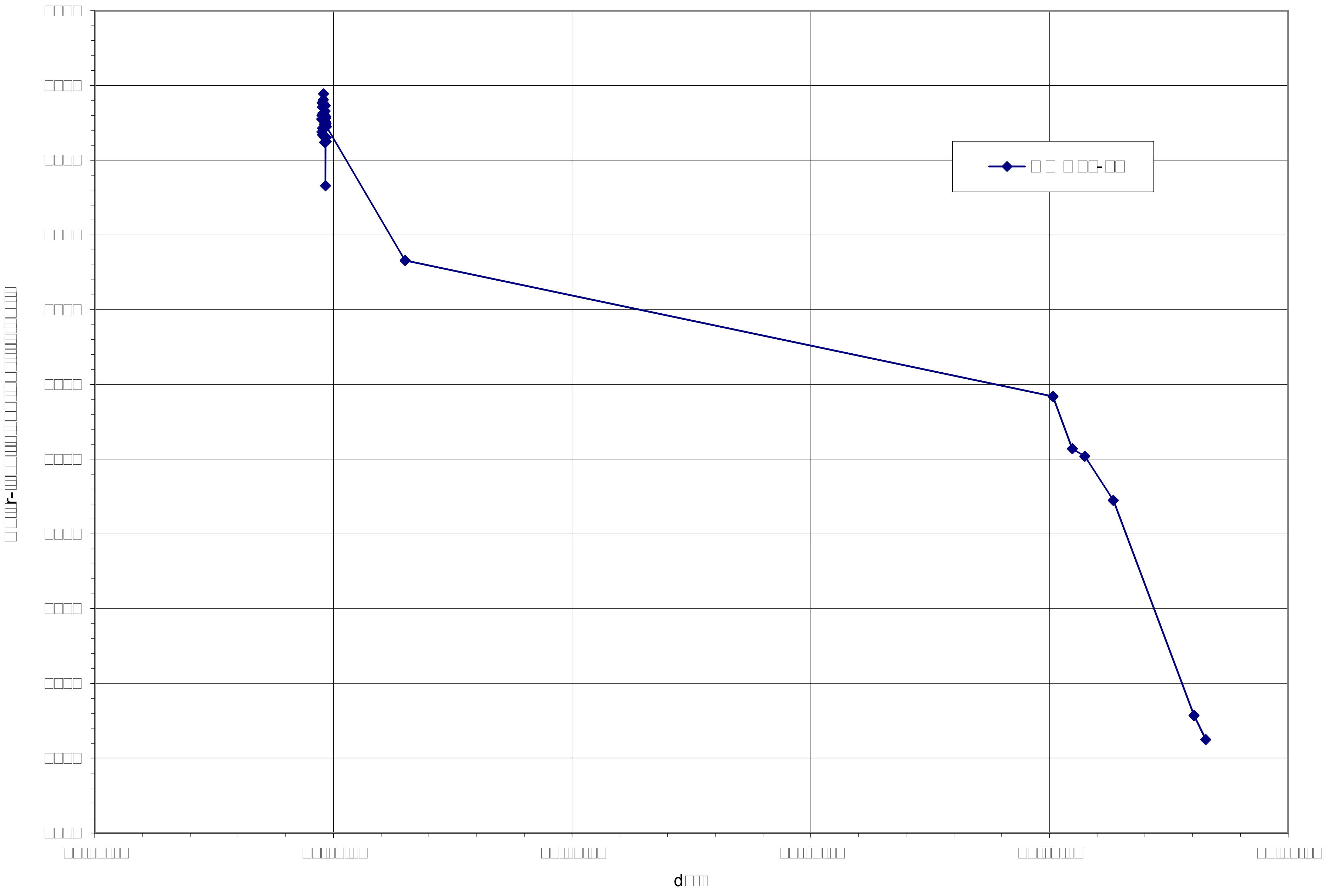


Figure C10. Hydrographs of TSF area well GWQ94-13.

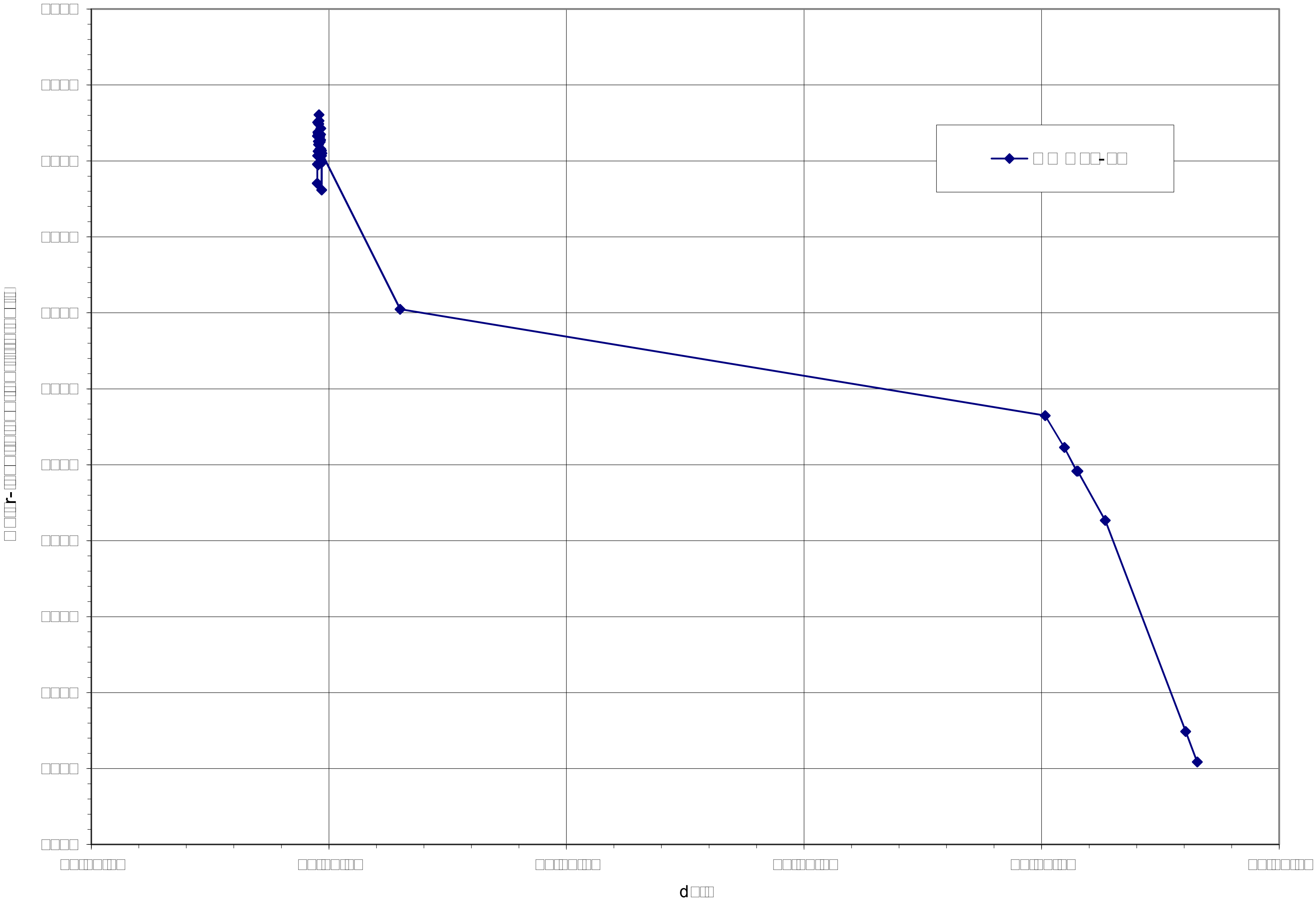


Figure C11. Hydrographs of TSF Area Well GWQ94-14.

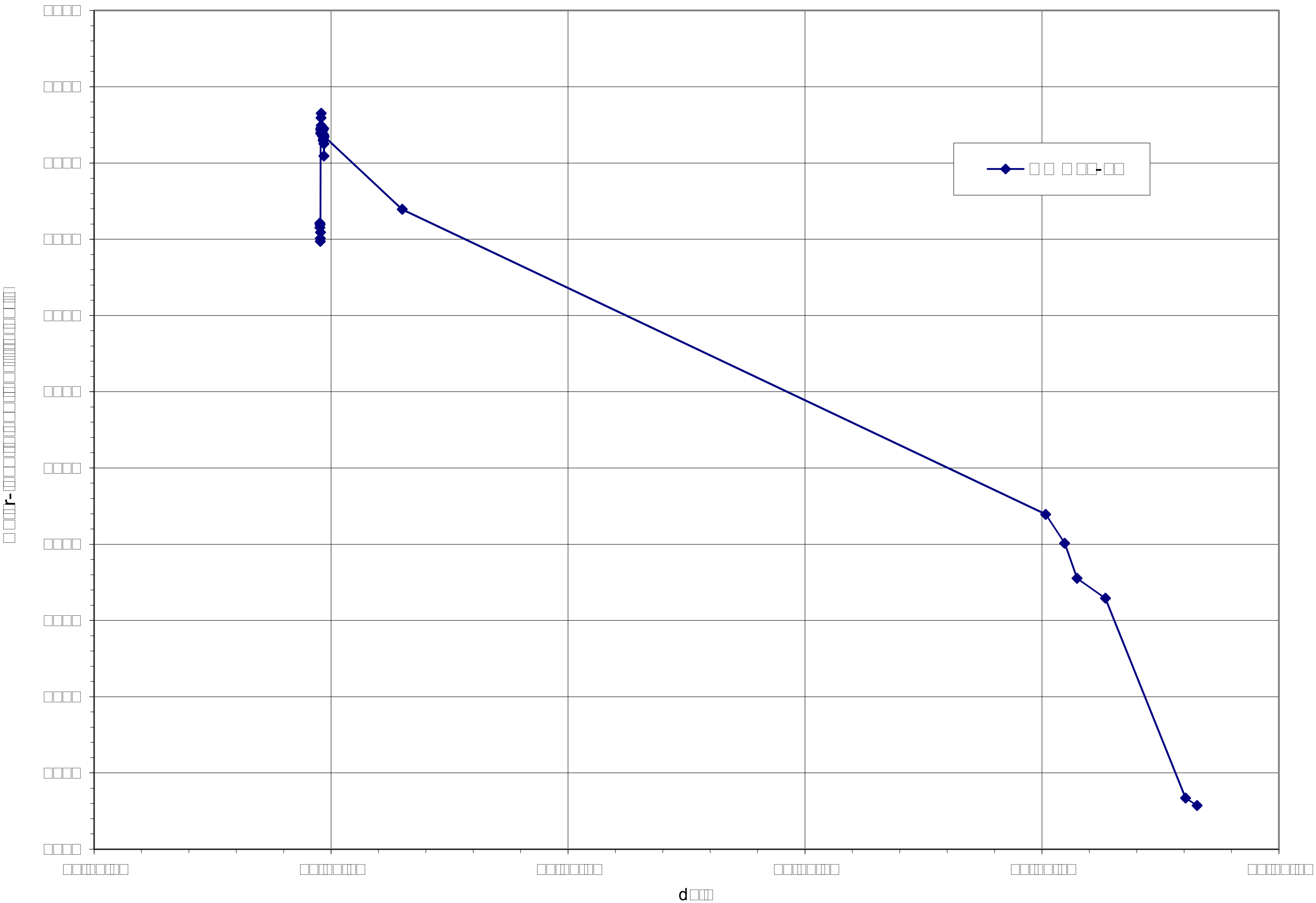


Figure C12. Hydrographs of TSF area well GWQ94-16.

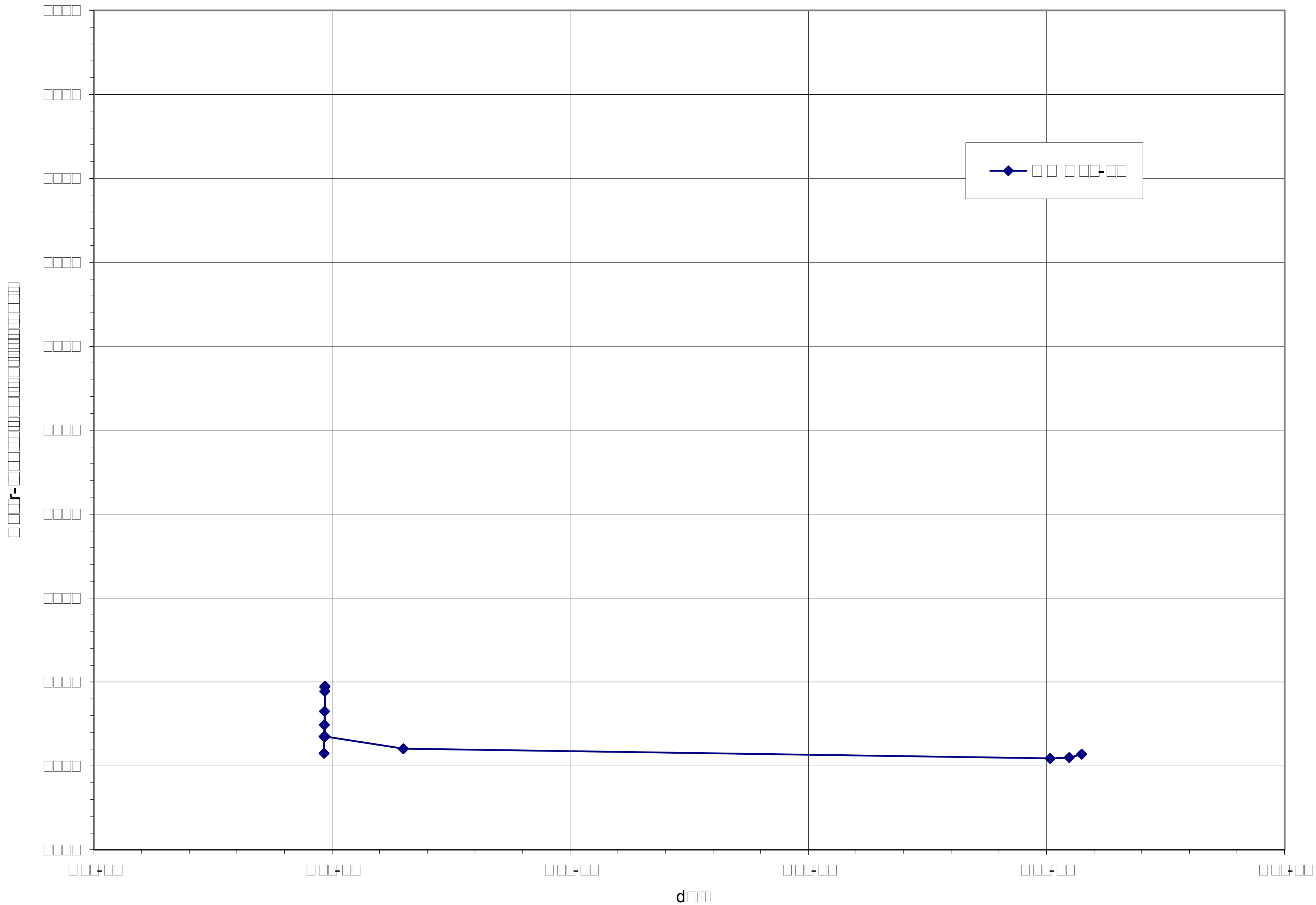


Figure C13. Hydrographs of TSF area well GWQ94-19.

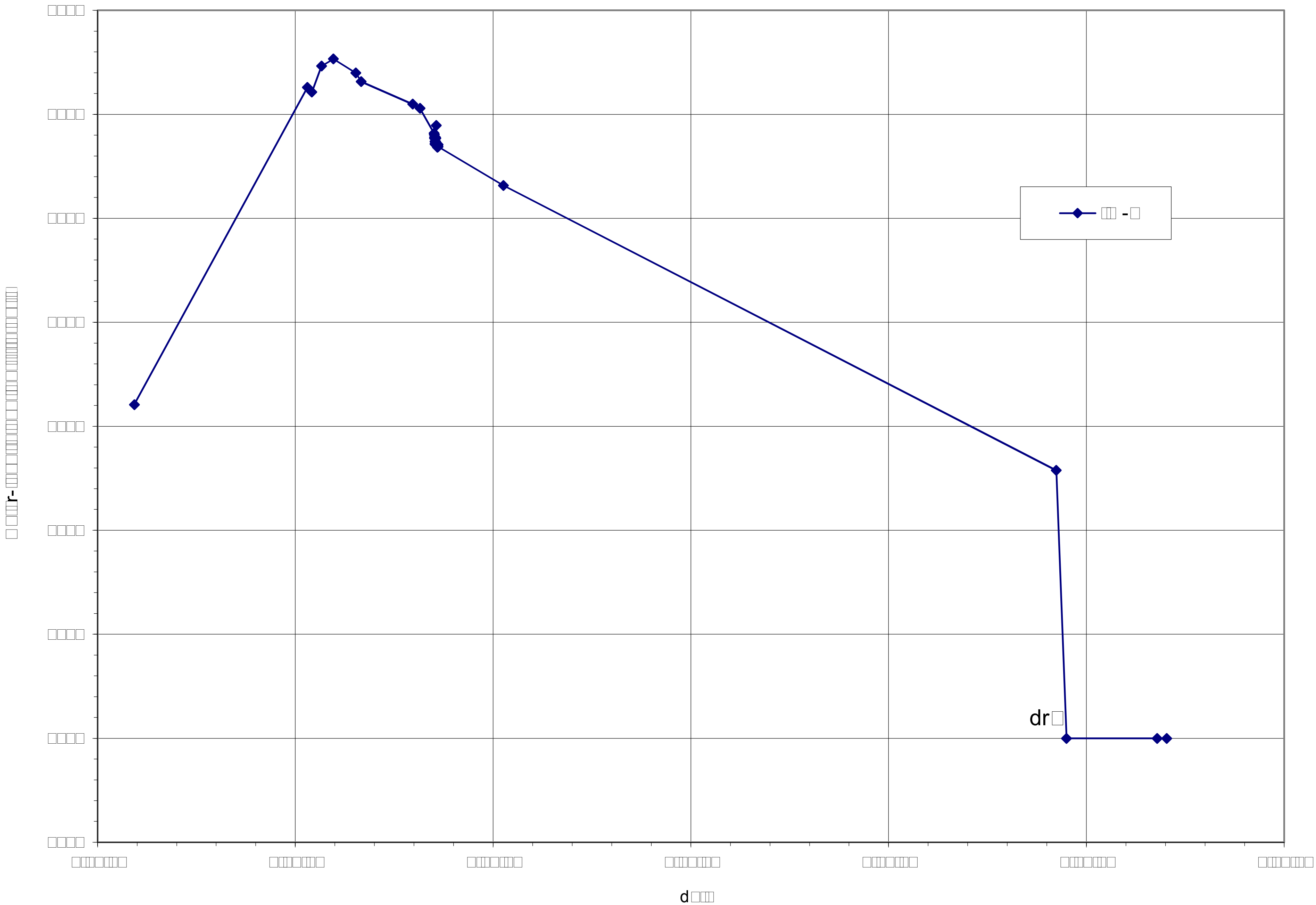


Figure C14. Hydrographs of TSF area well IW-1.

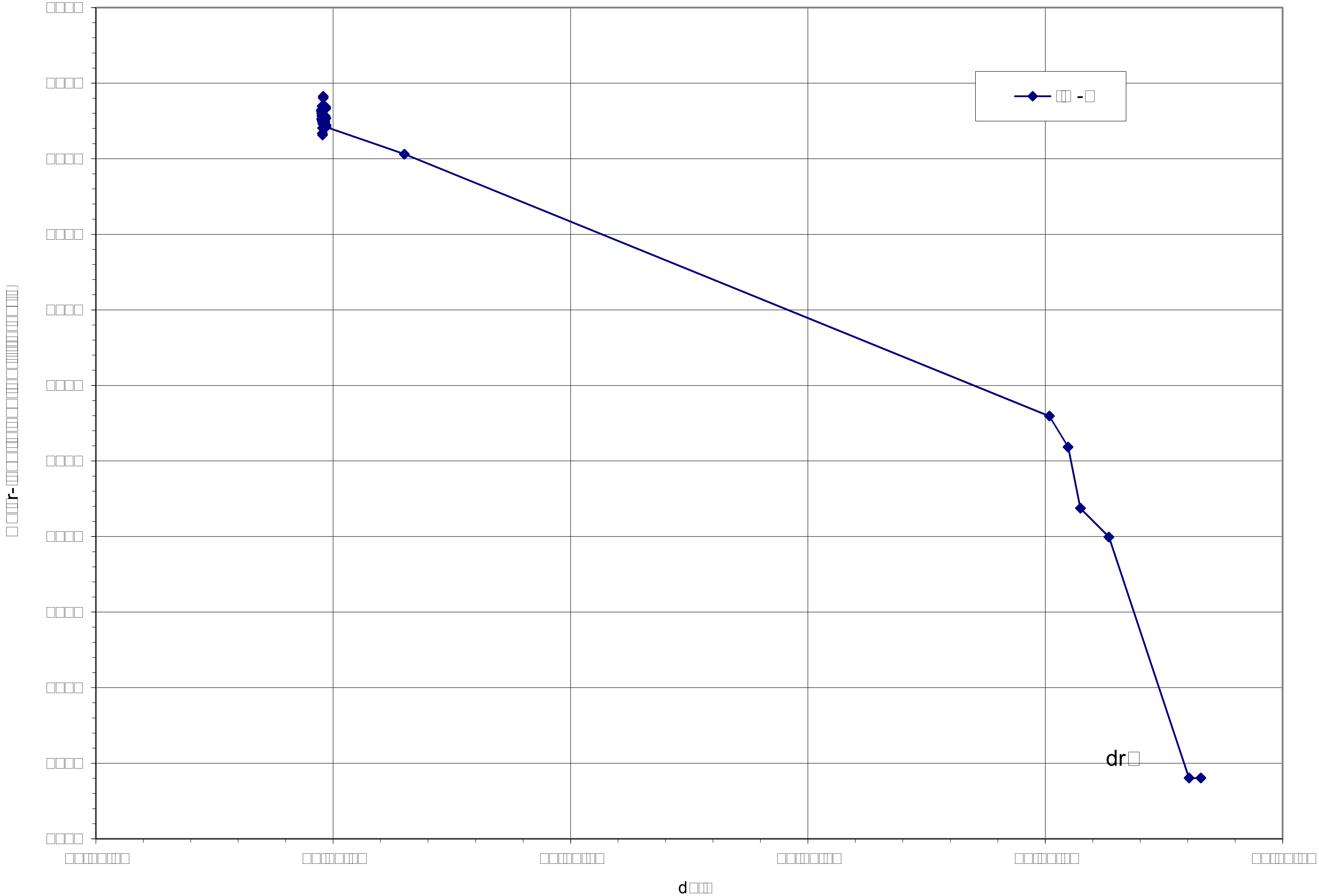


Figure C15. Hydrographs of TSF area well IW-2.

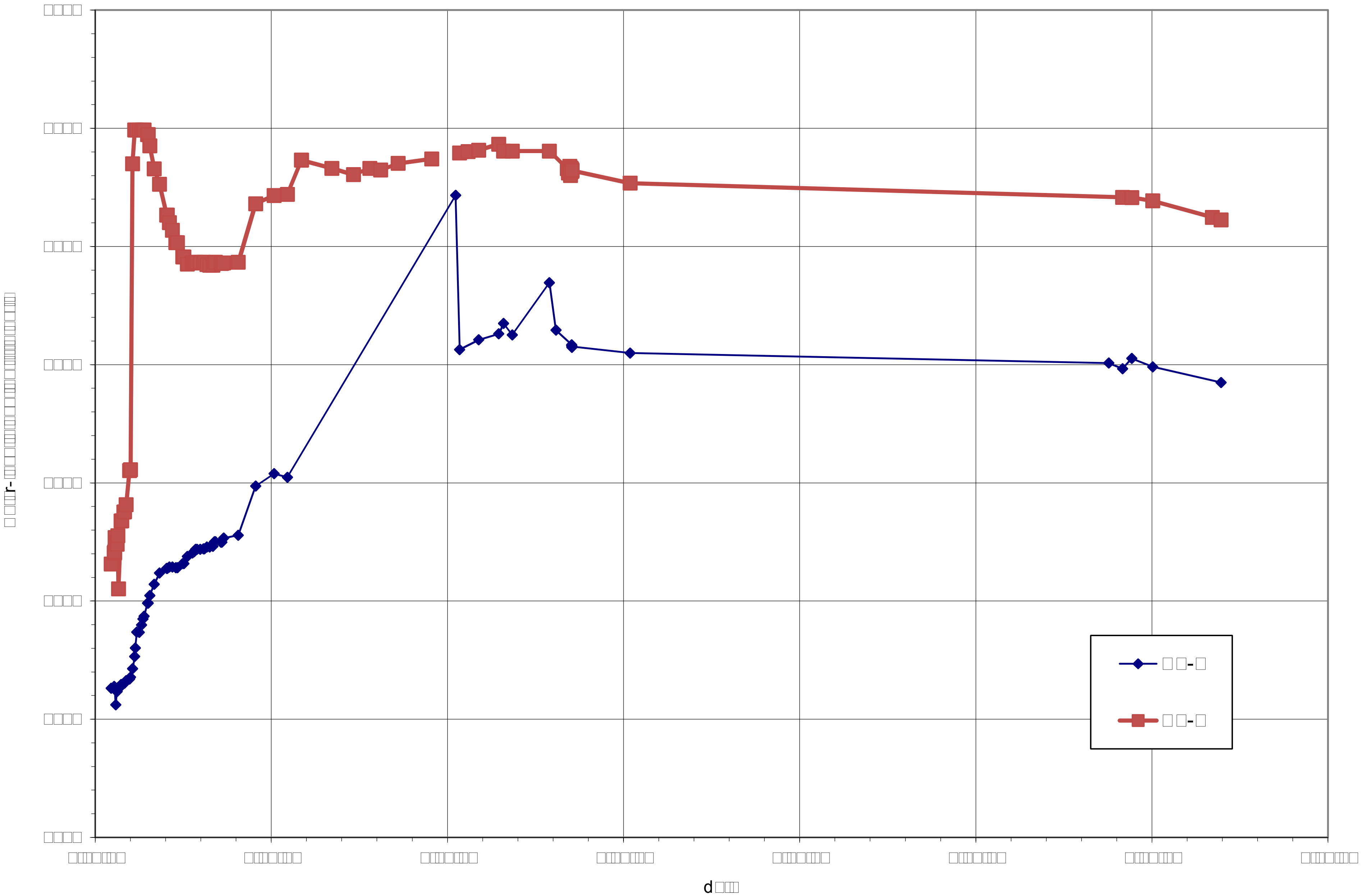


Figure C16. Hydrographs of TSF area wells NP-2 and NP-3.

THEMAC RESOURCES

COPPER FLAT MINE BASELINE DATA REPORT ADDENDUM

July 17, 2013

Prepared by:
THEMAC Resources Group, Ltd.

Contributions from:
GeoSystems Analysis, Inc.
Golder Associates Inc.
John Shomaker & Associates, Inc.
M3

Table of Contents

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
MMD Comments			
602.D.13 Baseline Data Report		These comments address the identified Sections of the BDR. The corresponding section of the Part 6 reg is also identified.	
Section 4 Vegetation, 602.D(13)(c)			
1	1	Section 4.3.1.5: Please replace "beside the arroyo" with a word of clarity (parallel to, physically next to, in addition to, etc.)	See GSA Addendum to Section 4, Vegetation
2	2	Section 4.4.1.5. Please revise to clearly describe which areas were adequately sampled through stratified sampling and which were not. Give reasoning. Provide a discussion of the # of transects statistically required for sample size adequacy and the # of transects actually conducted.	
Section 5, Wildlife, 602.D(13) (d)			
1	3	Correct or remove sentence (pg 18 MORP) that refers to a coachwhip as a lizard.	See GSA Addendum Section 5, Wildlife
Section 6 - Topsoil Survey and Sampling Results, 602.D(13) (e)			
Section 1, Introduction			
1	4	Provide a geo-referenced map, 1:6,000 scale (or better) to identify the individual soil units, 21 soil pits and 183 log sites of the soil survey. Give a supplementary table to identify the location of pits/log sites w a brief description of family-level taxonomy at each. Include any notes that identify special characteristics such as CaCO3 content, rock content, induration or gradation of character from one soil to another.	See Golder Technical Memorandum
2	5	In Table 5: Provide constituent concentrations of Na+, Mg++, Ca++ from paste extracts that were used to calculate SAR	
3	6	Provide a clarifying discussion fo the methods cited to conduct hydrometer & seive tests. It is not clear if pretreatment methods were employed to remove carbonates from samples before dispersion or sieving.	
4	7	Note whether during sieving fine and very fine sand fractions were separated and accounted for and provide more discussion. Note: the only indication fo sand size partitioning was for tailings substrate, pg. 44.	
5	8	Pg. 3 of the intro. The scale for 1:6,000 is equivalent to 1 inch = 500' rather than 0.5 inches=1,000'. Please update.	
Section 2.2 Criterial for Topdressing Suitability			
6	9	Table 1. MMD agrees w the observation, pg7: soils dominated by coarse grained materials (up to 70% rock content) can produce vigorous vegetation if the remaining fine earth fraction is sufficiently loamy. Please include stone w the cobble+gravel component for a maximum content of rock in the "fair" limit to range of 35-70%. Note: MMD regards "good", "fair" and "unsuitable" as qualifying characteristics in general, but "fair" materials, such as relatively high rock content may be more appropriate for steep slopes.	See Golder Technical Memorandum
7	10	Table 1. Hot-water extractable boron should be limited to no more than 5ppm for suitable materials. Correct Table 1 to demonstrate.	
8	11	Table 1. Calcium carbonate limits for "good" material is listed as 15% CaCo3 equivalent and for "fair" materials as 15-40%. These limits are not judged appropriate for topdressing. CaCO3 content should not be above 10% equivalent in the upper 6-12" in a reconstructed soil profile. Adjust CaCO3 limits for "good" materials to less than 10% and for "fair" materials to 10-40%. No suitable materials should be salvaged from indurated horizons that are continuously cemented, regardless of CaCO3 content.	
9	12	Table 1. MMD views available water holding capacity (AWHC) as a critical component in evaluating soil suitability. Please define AWHC as bulk volumetric water holiding capacity of soil materials to hold water between -0.033 and -1.5 Mpa of tension, corrected for rock content.	
10	13	Either as part of Table 1, or a separate table: estimate a range of values of a bulk value for each of the criteria listed in Table 1 for each soil unit &, if variation exists, for depth phases of soil units. AWHC & the method used to estimate it should be included as part of this table and discussion.	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
Section 2.2 Criterial for Topdressing Suitability Continued			
11	14	In reference to Section 3.1, with map units 102, 101 and 109 NMCC has differentiated several depth phases to estimate the median thickness of suitable salvage within individual soil unit phases. Please describe how these depth phases were determined among soil units w multiple depth phases & units which were not described by backhoe pits.	See Golder Technical Memorandum
Section 7- Geology 602.D(13)(f):			
1	15	After recipt of recent information from NMCC re: the "coarsely crystalline porphyry" rock-type, it appears that NMCC's conclusion is that this is not a unique rock-type as originally hypothesized, but is instead part of the quartz monzanite. MMD recommends modification of Table 7.2 in the BDR to reflect this updated hypothesis as it relates to the major material types in the proposed project area.	See THEMAC Memorandum
2	16	Pg 7-10, Section 7.5.2.7 states a conceptual model will describe predicted geochemical trends of reactivity from waste management facilities, final pit walls (pit lake chemistry) & the TSF. This model will be used to provide quantitative numerical predictions of the potential impacts of seepage or runoff from mining facilities to regional groundwater. Because these models should meet MMD requirement to address "probably hydrologic consequences", MMD requires submittal of this information prior to MMD being able to deem the PAP technically approvable.	
3	17	Pg 7-11, Section 7.5.1.3 states that a single comprehensive report of the complete geochemical testing program, including both static and kinetic testing analysis, and results will be provided when completed. MMD requires this document to be submitted prior to MMD being able to deem the BDR/PAP as technically appovable.	
4	18	Appendix 7-D, pg 6 states a geologic block model is required to determine the relative percentages of each material type & determine if the # of samples selected for each material type is adequate for the characterization program. MMD will require this evaluation to be submitted prior to MMD being able to deem the BDR/PAP as technically approvable.	
5	19	Appendix 7-E, Section 5 states that the 1997 & 2010 geochemical databases are comparable although the 1997 data show a trend toward having a generally greater acid generating potential than the 2010 data. A possible explanation in the appendix is there may be a bias in the '97 sample collection toward high sulfide/highly weathered materials. The opposite is also a possible explanation: there may be a bias in the 2010 sample collection toward materials that are low sulfide/low weathered materials. MMD is looking to block model analysis to shed light on the overall adequacy of the characterization program.	
Section 8 - Surface Water and GW Information 602.D(13)(g):			
1	20	pg 8-3, Section 8.1.2.1.2 states that the NMED SWQB has collected flow data along Las Animas Creek. These data should be available. Although the historical and baseline flow data (quantity data) presented appear to adequately document Las Animas flow, MMD recommends incorporation of any added quantity data form NMED SWQB related to Las Animas creek as further documentation of historic flow variability.	See JSAI Memorandum
2	21	Section 8.2.4.1. The crystalline bedrock aquifer appears adequately characterized for the BDR. MMD recommends submittal of GW quality data for GWQ-5R, GWQ11-24 A&B and GWQ11-25A&B as further documentation of GW quality within the crystalline bedrock aquifer.	
3	22	Pg 8-21, Section 8.2.4.1 states 9 wells were used for water elevations, however only 8, or 12 depending on how you count, were measured. Please correct.	
4	23	Pg 8-22 Section 8.2.4.1.1 refers to GWQ-5 as a crystalline bedrock aquifer well, Fig 8-20 refers to it as a crystalline bedrock well. However reviewer is sceptical, thinks its representative of Grayback alluvial based on completion data and location. Please correct. (Or clarify)	
5	24	Section 8.2.4.3 (Quaternary Alluvium), GW quality within the alluvial aquifer of Las Animas Creeek appears adequately characterized in the BDR w MW-11. However, the water quality of the alluvium aquifers within Percha Creek, Grayback, Hunkidori Gulch & Greenhorn Arroyo appear under characterized for the BDR.	
	25	a. Percha Creek alluvium: Provide any historic or recent GW quality data for the alluvium.	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
Section 8 - Surface Water and GW Information 602.D(13)(g) Continued:			
	26	b. Grayback alluvium: Historic water quality data for GWQ-1, GWQ-3 and GWQ-8 is provided, this may be adequate. Please provide any historic or recent GW quality data for the alluvium within the Grayback. MMD recommends providing the completion data for these 3 wells/sample locations.	See JSAI Memorandum
	27	c. Hunkidori Gulch allubium & Greenhorn alluvium: Currently no wells in these? MMD recommends installation of at least one shallow alluvial well downgradient of the proposed TSF w/in each of these alluvial systems to characterize the potential alluvial aquifer for the BDR. Or provide any historic or recent GW quality data for the alluvium w/in these systems.	
6	28	Table 8-9 identifies well "UNKNOWN" as being in the Qal aquifer system, however this well is shown in Fig 8-20 to be in the SFG aquifer. Table 8-9 or Fig 8-20 should be corrected. This well appears to be identified as "15.6.31.431" in Table 8-11. Correct name for this well between tables/figures and if 15.6.31.431 is the same as UNKNOWN please clarify.	
7	29	MMD knows results of the aquifer test and associated studies (geochemical, hydrologic modesl) are on-going. MMD withholds comments on these that will help to define the probable hydrological consequences of the proposed operation until they are complete and integrated into the PAP.	
Section 9 - Prior Mining Operations, 602.D(13)(h)			
1	30	The last sentence of Section 9.1 "Mining History" indicates that "More detail about copper explaration can be found in Section 11.3" However Section 11.3 is a soil survey w no such info. Please correct.	See THEMAC Memorandum
Section 10 - Cultural Resources Summary, 602.D(13)(i):			
1	31	Throughout Section 10 authors describe the permit area as being within the "Hillsboro Mining District" and/or/also the "Las Animas Historic District". Confusing. Seems intent is to describe the permit area as in the "Hillsboro Mining District" which is situated inside a larger "Las Animas Historic District" that is yet to be delineated or defined. Please clarify.	See THEMAC Memorandum
2	32	MMD previously provided comments… Please provide an updated Figure 10-1 (from the SAP) w the locations of the four referenced cultural resource surveys depicted.	
3	33	Describe any cultural surveys that have been conducted in the areas of the water supply pipeline and associated well field and update Figure 10-1 of the SAP to include those survey locations and submit.	
4	34	Section 10.2 "Eligibility and Management Summary" indicates that "detailed management recommendations will be presented in a future CR report" and "avoidance will most likely not be feasible for all of these resources, it is recommended that they be included in a testing and data recovery plan..." This testing and data recovery plan should be provided.	
Section 11 Present & Historic Land Use, 602.D(13)(j)			
1	35	Section 11.3 Section 11.3 "Soils Survey" seems irrelevant and out of place under "Present and Historic Land Use". This information would be better presented w/in Sect 6 "Soils Survey". Please provide clarification.	See THEMAC Memorandum
2	36	Please update this section to include a description (present & historic land use) of the water supply pipeline, associated well field, and the electrical power supply lines.	
3	37	Provide a description of land capability & productivity based on Soil Conservation Service, land use capability classes or similar classification.	
Game and Fish Comments			
BDR Chapter 4			
	117	Review Table 4-9 to verify that values were copied over correctly from Table 4-10	See GSA Addendum to Section 4, Vegetation
	118	Jurisdictional status of the Gooddings willow-dominated wetland in Grayback Arroyo is unclear; G&F states "We know that NMED considers this wetland jurisdictional under state standards. Please note state status in the final BDR, and clarify whether it is USACE jurisdictional."	

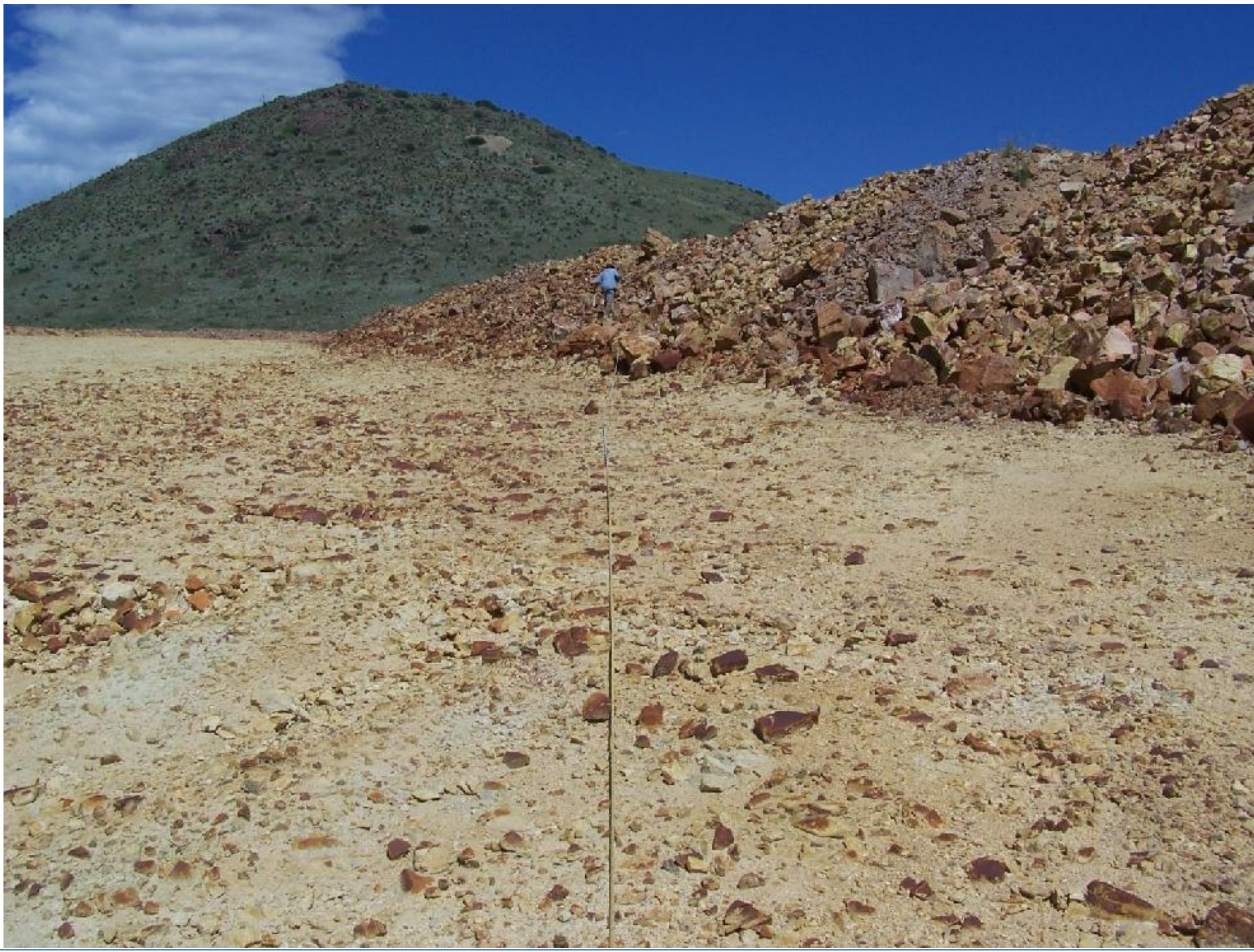
Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
BDR Chapter 5			
	119	Section 5.2.3 states isolated springs and seeps were "nearly all on private land and inaccessible," and thus were not examined. However, all these springs were sampled for flow as reported in BDR Chapter 8. Clarify that all springs are on private land and access was, and is, denied, or conduct biological resource surveys using photographs.	See GSA Addendum Section 5, Wildlife
	120	Tables 5-2 and 5-3: Show relative abundance (for example, using terms like "abundant," "common," "uncommon," "rare")	
	121	Incorporate winter observations from Appendix 5-B, Winter Bird Survey Report, into summary Tables 5-2 and 5-3	
	122	Migratory seasons should be covered by monitoring of migrating waterfowl and other birds at the pit lake, in addition to winter and summer surveys	
	123	Table 5-6 Bat Species Detected by Habitat: Include relative activity level (as indicated by calls per unit time), possibly as separate table	
BDR Chapter 5 continued			
	124	Any abandoned historic mine features comprising of more than a shallow blind shaft should be evaluated to determine use by roosting or hibernating bats, especially if the features are expected to be disturbed or destroyed by future mining	See GSA Addendum Section 5, Wildlife
	125	Section 5.4.1.3: Report in text or tabular form the relative abundance of large- or medium-size mammal sightings/sign by location or habitat type. Include a comparison to the reference plots.	
	126	Conduct a survey for raptor nests in all suitable habitat within one mile of any potential mine-related disturbance.	
	127	Conduct focused monitoring of wildlife use of the pit lake. This might include camera traps, diurnal and nocturnal passive observation sessions, track counts, or spot-lighted surveys.	
OSE Comments			
MORP Appendix B (BDR)			
	148	Table 7.1, Figures 7.1 and 7.2: Reference BLM (1999), but it would be useful to reference original authors for maps.	See THEMAC Memorandum
	149	Figure 7.5: Add description of fault systems in legend beneath label for fault (e.g., Hunter fault system N20E, Patten Fault system N50W)	
	150	Table 8-1: Reported temperature of 81.5 deg C appears to be incorrect	See JSAI Memorandum
	151	Figure 8-17: Cross-section lacks control points east of GWQ-21B	
	152	Section 8.2.4.1.5, Figures 8-22 and 8-24, Table 8-11: GWQ96-22A and -23A 2010-2011 sulfate values drop unexpectedly compared to 1996-1997 TDS and specific conductance values; lab error, typographical error or water quality has not stabilized from mixing? Further review of data needed since sulfate, TDS and specific conductance typically show strong correlation.	
	153	Section 8.2.5.2.5, Appendix 8-G Figures G through J: Text asserts no discernible trends in hydrographs for MW-2, -5, -6 and -8, but more effort would be needed to understand hydrographs in order to adequately simulate Upper Santa Fe Group. MW-5 is active stock well that shows 50 ft or more drawdown when pumped for a short duration, then water levels fully recover as showing in 2012 transducer data; Figure H has mix of USGS and other data and 1980s data may represent pumping levels or recent pumping. Additional effort should be undertaken to evaluate data quality, well construction details, lithology and other potential factors for disparate responses shown in hydrographs.	
	154	Table 8-9, Table J1 and Figure I (Appendix 8-G): Discrepancies between elevations and total depths cited (e.g., MW-6 TD); Table J1 draws upon multiple data sources; sources for tables or figures are not clearly identified; possibly bottom of screen interval has been used in place of TD	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
OSE Comments MORP Appendix B Continued			
	155	Section 8.2.4.3.5 and Figure N (Appendix 8-G): In addition to hydrograph showing responses to wetter years, the alluvial aquifer may be affected by irrigation water usage from surface water diversions from Las Animas Ck and groundwater diversions from alluvial aquifer and Santa Fe Group aquifer. Also, changes in leakage or flow from artesian wells may affect alluvial aquifer.	See JSAI Memorandum
	156	Section 8.2.4.4, Figures 8-13, 8-32 and 8-33: There may be simpler explanation for hydrologic change in artesian aquifer: artesian zones may represent solely a change in sedimentary deposition within Santa Fe Group, with lesser importance given to structural influence from faulting. It's unclear what influence Hawley and Kennedy (2004) reference has on Figures 8-13 and 8-33 given that its geologic map is located in T16S with dashed lines. Hawley section RA-RA' follows changes in lithology rather than create a confined area from dipping USF beds of laterally-extensive clay layers.	
	157	Figure 8-32: USGS 2006 reference not included at end of Chapter 8. Bottom 2/3 of faults should be dashed to represent uncertainty in locations as in Seager (1982). Fault between LA-96 and LA-115 on Figure 8-33 does not appear in plan view in Figure 8-32. NMCC should provide more supporting evidence (e.g., field observations, drilling logs, deeper wells that would provide control points) that would help justify changes to earlier geologic map. Text and figures should indicate modifications in greater detail.	
	158	Section 8.2.5.1: Pit lake levels increased from 1997 to 2011 and likely so did nearby groundwater levels. GWQ96-22 and -23 were drilled in 1990s, yet earlier water level data were not included in BDR. Historical trend of nearby groundwater levels and pit level may be worth considering rather than only 2011 measurements.	
	159	Section 8.2.5.4: Given the local gradients and geology, "stationary" groundwater may not adequately describe vertical and horizontal flow.	
	160	Section 8.2.6 and Figure 8-39: In groundwater model report, modeling objectives should be stated. Are grid and dimensions based on objectives? Will regional model adequately evaluate local impacts of pumping at production well field and open pit?	
	161	Figure 8-33 and Figure 3 (Appendix 8-H): Indicate whether clay-rich layers in Las Animas Ck wells were correlated based on depths indicated from well drilling records or whether dipping clay beds are more conceptual than from specific depths.	
	162	Table 2 (Appendix 8-H), Section 8.2.4.4.2: Artesian flow rates show decline at several wells; clarify the basis for the conclusion that dewatering by artesian well upward leakage and open flow appears to be mainly responsible for long-term decline of artesian flow rates (Appendix 8-H). In particular, what does Table 2's total artesial flow rate represent in support, if any, of conclusion about upward leakage and open flow? If wells are poorly constructed or well seal deteriorates, leakage may partially occur in subsurface, which would appear as decreased flow at surface. Would a better approach for addressing changes at artesian wells include monitoring shut-in pressure of a properly-sealed artesian well?	
	163	Figure 8-36: Shows FW-3 with initial flow rate of 125 gpm; however, declaration indicates initial flow rate of 80 gpm. Murray (1959) indicates the 125 gpm was pressure-pumped for 4 hrs to induce 115 ft of drawdown. So, FW-3 artesian flow should be 80 gpm.	

A - GSA Addendum to Section 4, Vegetation



Copper Flat Mine: Addendum to Section 4 (Vegetation) of the Baseline Data Characterization Report

6/25/2013

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Background

A detailed vegetation assessment was completed for the Copper Flat mine as part of the mine's permit application. Vegetation fieldwork was completed during the 2010 and 2011 field seasons, however, the bulk of the transects were conducted during the summer of 2010. Methods and results of the vegetation study were published in the Copper Flat Project Baseline Data Characterization Report (BDR) and the vegetation portion of the document specifically fell under Section 4. Since publication of the BDR, state agencies reviewed the BDR content as part of New Mexico Copper Corporation's (NMCC) Permit Application Package with the Mining and Mineral Division and provided comments. In response to the agency comments, NMCC contracted GeoSystems Analysis, Inc. to develop this addendum for Section 4 of the BDR. This report is organized as a list of agency comments which are followed by the response to each comment. An error on the extent and distribution of noxious weeds reported in the BDR is also corrected at the end of this addendum. A revised noxious weed location map plus more accurate descriptive text is included after the agency comments are addressed.

New Mexico Department of Game & Fish (NMG&F) Comments

Comment 1. Excellent job on this chapter.

Thanks!

Comment 2 . NMCC Comment #117. Please revise Table 4-10, values were copied over from Table 4-9.

Apologize for that oversight, an incorrect data table was pasted into the document as Table 4-10. The correct table is pasted in below.

Table 4-10A. Species Richness Based on Species Intercepts at Cover Transects for Copper Flat Mine Permit Area Strata

Stratum	Perennial Grasses	Perennial Forbs	Shrubs/Trees	Annuals	Total
Chihuahuan Desert Grassland	23	24	23	14	84
Chihuahuan Desert Shrubland	15	17	16	21	69
Tailings Pile	19	16	13	17	65
Tailings Dam	7	6	7	3	23
Pit	4	3	3	0	10
Arroyo	3	0	5	0	8

Comment 3.NMCC Comment 118. Two locations are described on p 4-22 as meeting CWA definition for wetlands. "Based on preliminary discussions with USACE", the cattails in the pit are not jurisdictional. No statement is made as to jurisdictional status of the Gooddings willow dominated wetland in Grayback Arroyo. The Biological Resources Survey Report on the pipeline and well sites, attached as Appendix 5-A to Chapter 5 of the BDR, discusses this wetland. On page 13 it states that it is not jurisdictional, however on page 14 it states that no determination was made due to lack of anticipated impact on this area. We know that NMED considers this wetland jurisdictional under state standards. Please note state status in the final BDR, and clarify whether it is ACOE jurisdictional.

The Goodding's willow community in Grayback Arroyo could be considered a jurisdictional wetland according to State of New Mexico standards. The site does have hydrophilic vegetation, hydric soils, and what appears to be perennial or at least regular standing water, and while formal wetland delineation has not been conducted, the field conditions suggest that the site would qualify as a delineated wetland. The source of the water, whether spring fed or a pool resulting from a previous event in Grayback, hasn't been formally determined and could influence whether the wetland is considered jurisdictional.

A formal delineation report for this wetland has not been submitted to the U.S. Army Corps of Engineers but in response to this NMG&F comment, the probability of jurisdictional classification was discussed with regulatory personnel at the Corps of Engineers (J. Riggs personal communication 2013). Since no formal delineation report was filed or official determination made, the possibility of jurisdiction exists but based on conversations with the Corps, jurisdictional assertion is unlikely because:

- The standing water is probably the result of a thick, impermeable clay layer deposited in an old scour hole at the bottom of Grayback Arroyo due to close proximity to a large culvert just above the site. A clear hydrological connection to a Waters of the U.S. would be difficult to defend since a connection to the Rio Grande would need to be proven, the wetland is very small, and the arroyo is extremely ephemeral and intermittent.
- Even if the wetland was spring fed, it would be difficult to defend the significant nexus assertion or assign a direct hydrological connection to a Waters of the U.S.
- The wetland is relatively unique in the Corps of Engineers system since it doesn't appear to be spring fed and there haven't been other similar wetlands reported nearby, so it would be difficult to defensibly assign a jurisdictional status. It falls in a grey area in defining jurisdictional status.

As discussed in the July 2012 Mine Operation and Reclamation Plan, NMCC plans to leave Grayback Arroyo, the diversion around the mine, and the stand of Gooding's willow trees unaltered during operations. NMCC does not anticipate any significant changes to the existing surface water flow conditions as a result of operations and would endeavor to maintain the existing hydrologic conditions that appear to support the riparian areas. All riparian areas will be managed appropriately according to state and federal requirements.

New Mexico Mining and Minerals Division Comments

Comment 1.NMCC Comment #1. Section 4.3.1.5: Please replace "beside the arroyo" with a word of clarity (parallel to, physically next to, in addition to, etc.).

The sentence from the BDR read as; "Our sampling objective was to meet statistical sampling adequacy (+/- 10 percent of the mean) for perennial plant species cover in each stratum besides the arroyo." The intention of the sentence would have been clearer if it said, "with the exception of the arroyo stratum" instead of "beside the arroyo". Only three transects were sampled in the arroyo stratum. We never expected to meet statistical sampling adequacy with such a small sample size. In comments to the Copper Flat Sampling and Analysis Plan, agencies requested that biologists install at least two transects were in the arroyo stratum. The three arroyo transects were implemented as a response to that particular suggestion.

Comment 2. NMCC Comment #2. Section 4.4.1.5: Please revise to clearly describe which areas were adequately sampled through stratified sampling and which areas were not. Give reasoning. Provide a discussion of the # of transects statistically required for sample size adequacy and the # of transects actually conducted.

The BDR write-up from Section 4.4.1.5 is pasted below along with BDR Table 4-11, which was referenced in the text:

A total of 96 vegetation monitoring transects were sampled in the Permit Area. Sampling intensity within each stratum was based on a small pilot study at the site (Parametrix, 2010b). While obtaining statistical sampling adequacy for each variable measured under this study would have been unrealistic, sometimes requiring several thousand transects per stratum, the goal was to meet statistical sampling adequacy for perennial plant species cover in each stratum with the exception of the arroyo. This goal was achieved at two of the five remaining strata (Table 4-11). Cover summary tables in Appendix 4-A also contain detailed sampling adequacy results at the lifeform level. Anomalous vegetated microsites are frequently found throughout the site because of the history of disturbance at the site, variable soil depths, unnaturally variable soil substrate from previous mining, variable water collection patterns in crevices or at the base of waste rock, and patchy earlier reclamation efforts. Vegetation communities with this distribution create variability both within a transect and across transects in a stratum. This distribution creates extreme challenges to obtaining sample adequacy. The botanists also hesitated to move transects into other strata to achieve lower standard deviation values because this could have led to underestimating the amount of heterogeneity within a stratum.

Vegetation on the tailing dam was more evenly distributed than in the disturbed area/waste rock pile stratum. Based on the cover data, 9.7 transects were adequate for meeting statistical sampling adequacy in the tailing dam stratum; therefore, the ten transects selected for study were sufficient. These ten transects were also adequate for capturing total vegetation cover and total cover. Vegetation species distribution was relatively even in the disturbed area/waste rock pile stratum as illustrated by the relatively high S-W Index. Perennial cover, however, was extremely variable between transects. Statistical *sample adequacy for perennial cover in the disturbed area/waste rock pile stratum required 104 transects. A total of 25 transects were read in this stratum.*

Any vegetation encountered in the pit stratum resulted in extremely high standard deviation values. Standard deviation values exceeded the mean cover for each lifeform in this stratum. Based on sample adequacy calculations, 3,032 transects were required in this very small stratum.

Sample adequacy was achieved in the CDG stratum for perennial plant cover, total vegetation cover, and total cover. This stratum included the majority of the projected mine footprint. In fact, according to sample adequacy calculations, this stratum was oversampled. A total of 8.9 transects were adequate whereas 29 were measured in the CDG. Total cover sample adequacy was obtained in the CDS stratum but 49 transects would have been required to adequately capture total vegetation cover. A total of 39 transects would have met statistical sample adequacy in the CDS stratum; however, only 19 were measured. Based on another review of the section, it appears that coachwhip was not referred to as a lizard in the Draft BDR; it was referred to as a reptile, which is technically correct.

Table 4-11
Number of Transects Required to Meet Sample Adequacy (as ± 10% of the mean) for Copper Flat Mine Permit Area Strata

Stratum	Sample Adequacy Perennial Plant Species Cover	Sample Adequacy All Plant Species Cover	Sample Adequacy Total Cover	Total Number of Transects Actually Recorded
Chihuahuan Desert Grassland	8.9	12.6	2.5	29
Chihuahuan Desert Shrubland	38.8	49.1	13.1	19
Waste Rock/Disturbed Areas	104.3	86.8	17.5	25
Tailings Dam	9.7	10.0	0.2	10
Pit	3,032.1	3,032.1	231.5	10
Arroyo	257.8	257.8	31.3	3
				96

The goal of the project was to obtain statistical sample adequacy for perennial plant cover in the five strata with at least ten transects. This goal was achieved in two of the strata. Table 4-11 includes the number of transects required to achieve statistical sampling adequacy for various vegetation attributes and the number of transects actually measured.

As mentioned in the BDR, transect intensity within each stratum was based on a preliminary pilot study in which transects were measured in the CDG, CDS, and disturbed strata during the 2009 field season. The pilot study used results of these data collected along the preliminary transects to run sample adequacy calculations following vegetation monitoring standards typically employed in mines throughout New Mexico (Clark 2001). According to the results, a total of six transects per stratum was predicted to yield sufficient sample adequacy (+/- 10 percent of the mean). To be conservative, a minimum of ten transects were actually measured within each stratum and transect intensity was also weighted by area – so larger strata received more transects. Theoretically, given the results of the pilot study, this sampling intensity would have greatly exceeded sample adequacy but as shown in Table 4-11, and as originally discussed in the BDR, the statistical prediction from the pilot study didn't actually yield the predicted results after the site was intensively inventoried the following field season.

Several variables could contribute to the fact that sample adequacy was not ultimately obtained, some of which include:

- The sample adequacy calculation is only intended to predict the required sampling intensity for that particular point in time, which is OK because you'd expect that perennial plant cover and intra-site variability in perennial plant cover varies from year to year, season to season, etc. As such, the calculation is only really representative for that particular sampling period. The pilot study for this project was completed in a different field season (2009) than the actual intensive study (which was implemented in 2010). This was intended to be accounted for by significantly increasing the actual number of transects measured versus what was predicted to be necessary in the pilot study.
- Some strata could have been sub-divided further to improve sample adequacy statistics, which would have also required delineating new maps of the vegetation strata. Oftentimes, the sample adequacy was not statistically obtained due to a small subset of outlier transects. Our biologists decided to leave those transects in as part of the sample for the stratum and also leaned against remapping strata because it would have been difficult to reliably discern microsites into different strata. It was preferable to leave the samples as they were and acknowledge the heterogeneity within the strata rather than attempt to redefine.
- Sample adequacy is ultimately just a statistical prediction that a certain number of transects will be required to reach the desired accuracy threshold. However, it's possible that even if this predicted sampling intensity is implemented, the statistical prediction may not hold true – which is actually what happened in this study. It's a floating target to some degree that can be greatly affected by an outlier transect and a suite of other compounding variables.
- Some strata, particularly the areas disturbed during prior mining like the Pit and Waste Rock/Disturbed Areas, have a high degree of variability within the stratum. We also question how important it is to statistically validate, from a sample adequacy standpoint at least, the results of the cover measurements in the Pit stratum. The data showed that perennial plant cover is extremely low through most of this stratum but there are widely distributed, isolated patches of perennial plants that have encroached into the area. As Table 4-11 illustrates, 3,032

transects would have been required at that time to achieve statistical sample adequacy for perennial plant cover, which was beyond the scope of this study. An outlier transect could have also been removed from the stratum to improve the results of the sample adequacy calculation but it was considered more important to capture and present the heterogeneity that is present in the stratum rather than remove descriptive samples to improve sample adequacy statistics.

- It's possible that certain strata could have been better represented statistically by a non-transect based measurement method in which an independent sample described a sample block rather than quads placed along a transect. The quad shape and size could have also been adjusted perhaps in certain strata as well. The project sample adequacy data showed that statistical adequacy was not achieved shrubland sites (CDS stratum) or heavily, irregularly disturbed areas (Waste Rock/Disturbed Areas stratum and the Pit). It's a regular practice, in range science for example, to nest a larger sampling block along the transect in shrublands or forests when trees or large shrubs can be poorly represented if measured using a similar method to grass dominated habitats. Varying the method according to habitat, however, comes with its own set of potential costs, namely measurement inconsistency between strata or between field observers, and it's also difficult to predict when a different sample method is clearly needed.

Addendum to Noxious Weed Information Published in the BDR

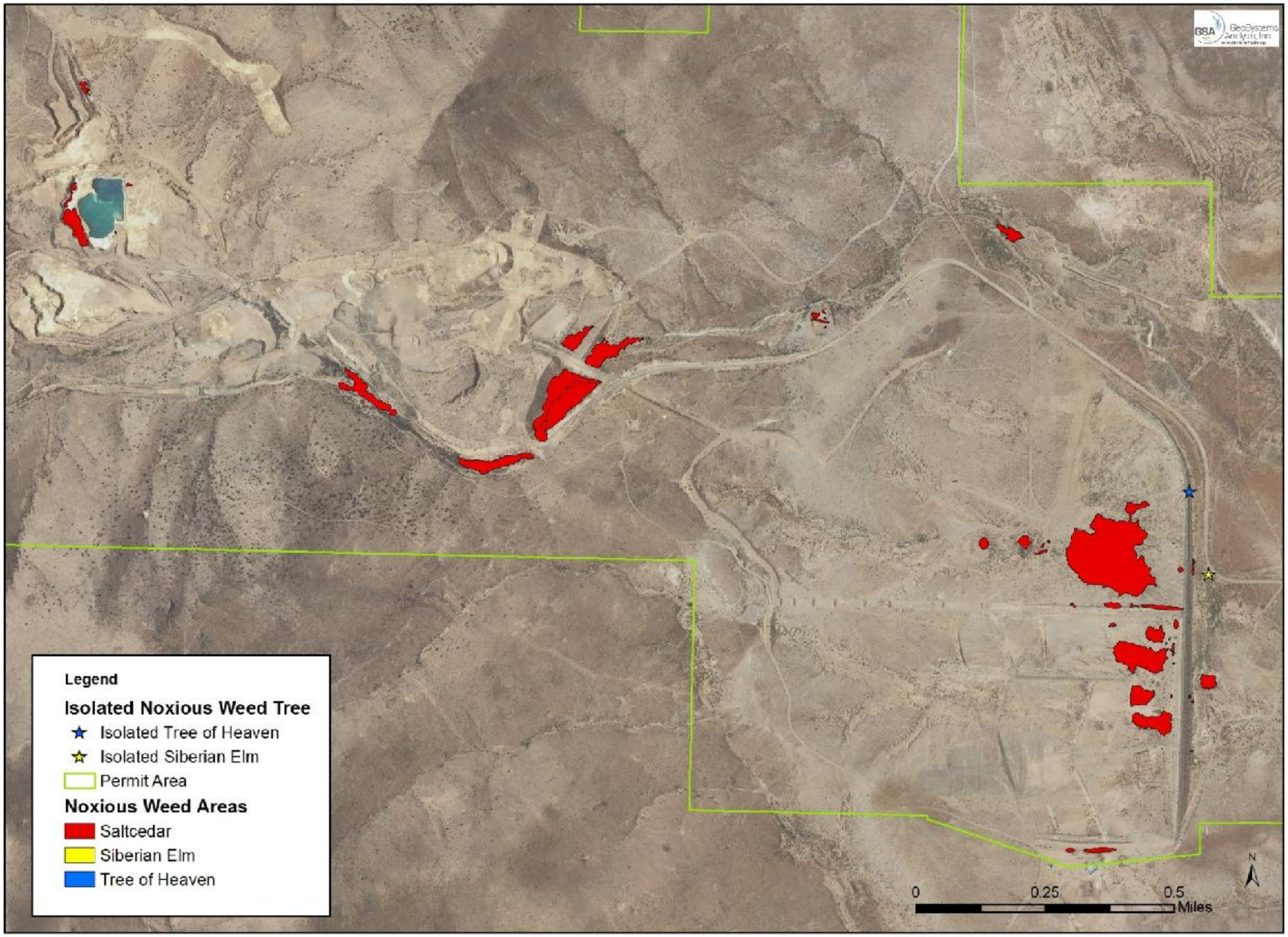
The distribution of saltcedar (*Tamarix* sp.) was under-reported in the BDR and two additional noxious weed species were also observed in the permit area since publication of the BDR. Tree of heaven (*Ailanthus altissimus*) and Siberian elm (*Ulmus pumila*) were both observed as single individuals growing at the base of the tailing dam (Figure 4A-1). Both of these unreported infestations were isolated and minimal - only one pole-sized Siberian elm tree was observed and a small patch of Tree of heaven, likely comprised of one individual connected with rhizomes belowground. The total area of saltcedar patches mapped in the permit area is approximately 30-acres. The additional saltcedar acreage is not due to population expansion, rather an outdated GIS data file was used for reporting noxious weed distribution in the BDR. The unreported patches all lie near the tailing dam.

References

Clark, D.L. 2001. Stabilization of the mean as a demonstration of sample adequacy: Albuquerque, N. Mex., American Society for Surface Mining and Reclamation Annual Meeting, June 3-7, 2001.

Parametrix, Inc. 2012. Copper Flat Baseline Data Characterization Report – Section 4 (Vegetation). Report developed under contract with New Mexico Copper Corporation.

Figure 4A-1. Copper Flat Mine Noxious Weed Map



B - GSA Addendum to Section 5, Wildlife

GSA GeoSystems Analysis, Inc.
Innovations in Hydrology

Copper Flat Mine: Addendum to Section 5 (Wildlife) of the Baseline Data Characterization Report

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Background

A suite of wildlife surveys was completed at the Copper Flat Mine site during 2011, when Parametrix, Inc. was contracted by New Mexico Copper Corporation (NMCC) to conduct a wildlife assessment at the mine permit area and off-site reference areas as part of the mine project's permit application. This study was implemented to inform development of the Copper Flat Project Baseline Data Compilation Report (BDR). A draft of the wildlife BDR chapter (Parametrix 2012) was provided to managing agencies for review and comment. The New Mexico Department of Game & Fish (NMG&F) provided a list of ten major comments to the draft report, while the New Mexico Environment Department provided one comment. GeoSystems Analysis, Inc. was later contracted by NMCC to complete additional fieldwork during the Summer 2012-Spring 2013 field season, re-analyze some of the previous data collected at the mine site, and draft this addendum to Section 5 of the BDR. The focus of the additional work was to directly and thoroughly address agency comments to the draft report. This addendum is designed as a list of individual agency comments, which are then followed by the specific approach implemented to address the comment and the results of the additional analysis.

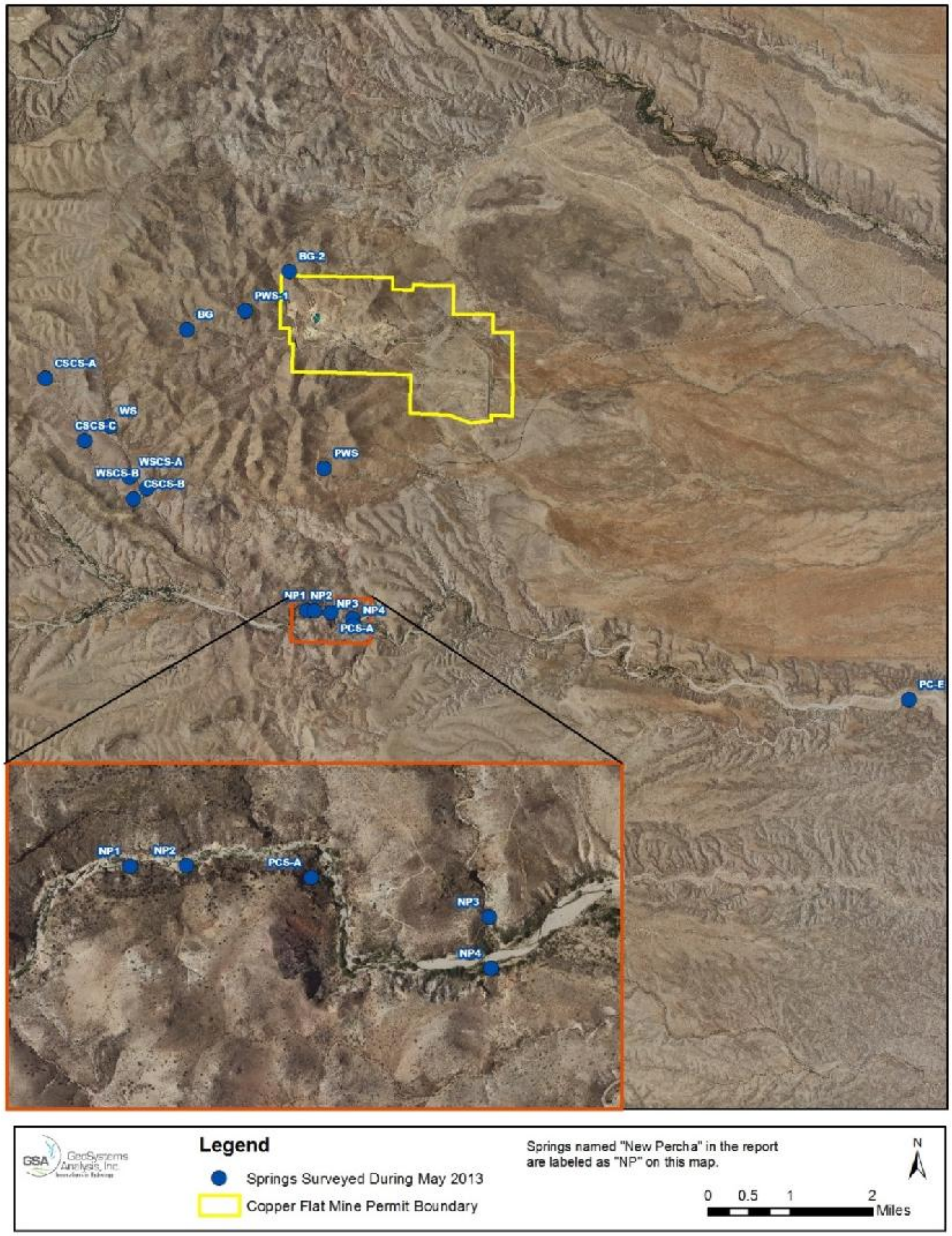
New Mexico Department of Game & Fish Comments

Comment 1. Section 5.2.3, on p 5-3, isolated springs and seeps were "nearly all on private land and inaccessible", and thus were not examined. However all of these springs were sampled for flow as reported in the BDR Chapter 8, Surface Water and Groundwater, raising the question whether any attempt was made to access these locations for vegetation or wildlife surveys. Please clarify that access was denied, or conduct at least qualitative biological resource surveys with photographs.

An attempt was made during summer 2011 to complete a qualitative wildlife habitat assessment at each of the springs that had been previously visited by hydrologists. At that time, private landowners did not grant the biologists permission to access the springs near Animas Creek or the cluster of springs near Warm Springs and Cold Springs Canyons. Access permission to the springs near Warm Springs and Cold Springs Canyon was later granted (permission was obtained during May 2013), so a field biologist completed a qualitative resource survey at these sites and also visited springs that were identified by hydrologists on public land just west of the mine permit and along Percha Creek. Access permission to the springs near Animas Creek was not obtained. Four additional seeps through Percha Box that were not identified in the hydrology section of the BDR were observed by the biologist, mapped, and assessed. These seeps not previously identified in the hydrology section were assigned a name beginning with "New Percha" and numbered according to the order they were initially observed. Each of the springs where an assessment was completed are shown in Figure 5A-1. An assessment was attempted at a total of 16 spring/seep locations but in some cases a spring or seep could not be located in or around the specific GPS location. A surrounding area of typically about 1,000 feet was searched if the spring could not be initially located. The hydrology section mentioned that several springs were also dry during 2011 fieldwork and some of the spring locations were derived historic information. It's possible that some of the dry springs haven't flowed in a long time.

A passive wildlife habitat assessment was conducted at each spring/seep site. Basic characteristics on vegetation structure, dominant vegetation species, presence of moist soil or standing water, water depth (if applicable), observations of fish or amphibians, a representative photograph, and other general notes were recorded.

Figure 5A-1. Spring and Seep Survey Locations



Surface water was observed at eight of the sites (Table 5A-1). Water depth was typically not more than a few inches, but deeper water was observed at the two developed springs. Water depth was estimated to be four feet on average in the concrete lined portion of spring WS while PC-E contained about three feet of water in the stock tank. Not surprisingly, the springs with surface water present were also typically vegetated with riparian or wetland plant species. Gooding's willow, cottonwood, and Baccharis were commonly observed at the wet springs. Cattails grew in the open water at one spring (New Percha 2). Spikerush, saltgrass, Bermuda grass, watercress, cloak fern, and bulrush were also sometimes observed growing within the aquatic habitat or in the surrounding moist soil.

Table 5-A1
Field Observations from Springs and Seeps Visited during May 2013

Name	Water Present (Y/N)	Water Depth	Dominant Vegetation	Notes
WS	Y	4 feet	One large cottonwood tree, saltgrass, spikerush, and bulrush	Source spring is concrete lined, heavy grazing outside of fence, water continues down canyon
BG	N	0	Wolfberry, scrub oak	No spring observed at GPS point. Solar pump with water tank observed nearby.
BG-2	N	0	Mesquite, tabosa grass	Spring now dry, no wetland or riparian plants observed.
PWS	N	0		Initial GPS mapped in upland, searched surrounding areas but no spring/seep evident
CSCS-A	N	0	Emory oak, mesquite	No spring/seep observed
WSCS-A	N	0	One large Goodding's willow, strip of seep willow	Initial GPS point mapped in mesquite upland, assumed that target was actually location where Goodding's willow was observed.
WSCS-B	N	0	Upland shrubs, wait a minute bush, little leaf sumac	Rill observed at original GPS point, no wetland/riparian plants nearby, searched drainage bottom and rock walls nearby but no spring/seep evident.
PWS-1	N	0	Baccharis, scrub oak	Dry area, no clear spring observed. Baccharis patch assumed to be intended location.

Name	Water Present (Y/N)	Water Depth	Dominant Vegetation	Notes
PC-E	Y	3 feet	Relatively barren, mesquite tree.	No spring observed at GPS point. Windmill nearby, assumed this was intended location.
CSCS-B	Y	2 inches	A cluster of large Goodding's willows, no wetland herbs observed	Heavily grazed and impacted by cattle
CSCS-C	N	0	Mesquite	Spring now dry.
PCS-A	Y	1 inch	Baccharis, watercress, Bermuda grass, Goodding's willow	Original GPS point slightly off. Water observed seeping from rocks up canyon about 150 feet away from navigation point. Goodding's willow, Baccharis dominated. Water continues down and connects with creek about 25 feet downhill.
New Percha 1	Y	1 inch	Velvet ash, spikerush	Seep not identified in hydrology section but observed during site visit. Water seeping from rock wall.
New Percha 2	Y	1 inch	Cottonwood, cattail, watercress, also cattails in standing water	Seep not identified in hydrology section but observed during site visit. Water seeping from rock wall. Cattails dominant in standing water portion.
New Percha 3	Y	1 inch	Goodding's willow, cottonwood, Baccharis, watercress, cloak fern	Seep not identified in hydrology section, observed in field. Water flows for about 50 feet but goes underground before reaching creek.
New Percha 4	Y	4 inches	Netleaf hackberry, Baccharis, Gooddings willow, speedwell	Spring snails observed.

Spring snails were observed in one spring (New Percha 4) but not identified to species. Biologists did not observe amphibians or fish within or near any of the springs though an unidentified fish species was common in portions of Percha Creek. The wetted extent of Percha Creek was also comparable to what was mapped in Section 4 (Vegetation) of the BDR. Spring WS appeared to have the highest potential habitat value but livestock grazing has impacted portions outside the perimeter fence. In some cases the surface water from seeps identified in Percha Box went subsurface before reaching the creek. At five sites, no spring or seep could be located at or near (within 1,000+ feet) the GPS location and no signs of isolated, increased soil moisture (riparian vegetation) were observed. In other cases, no standing water was present but standalone riparian trees were observed at or near the spring location and presumed to be the mapped location. Figure 5A-2 includes representative photos of the springs with surface water present. GPS locations were based on information provided by the project hydrologists, which sometimes represented historic information and/or non-GPS based location data. The lack of GPS-based location data, current drought, and the outdated nature of the data probably in combination explains the difficulty in locating some of the springs. Overall spring wetness observed by the biologists corresponded with observations reported by the hydrologists in Section 8 of the BDR.

Figure 5A-2. Representative Photos of the Springs/Seeps with Standing Water

Spring WS, notice difference between grazed and ungrazed sides of fence.

Spring PCE

CBCS-B

PCS-A

New Percha 1

New Percha 2

New Percha 3

New Percha 4

Comment 2. Table 5-6, Bat Species Detected by Habitat. It is quite difficult even for experts to distinguish many species by call, especially for the Myotis group of species. The list is acceptable as submitted, but precise species identifications should be considered with a grain of salt.

Understood.

Comment 3. Table 5-6, Bat Species Detected by Habitat, or on a separate table. Please show relative activity level (as indicated by calls per unit time).

As described in the BDR, the wildlife survey project area was divided into sampling strata and certain strata were measured in 2011 as both an onsite (denoted as “On” in the table below) and offsite (“Off”) analog. The primary strata measured include Chihuahuan Desert Grassland (CDG), Chihuahuan Desert Shrubland (CDS), and Arroyo; plus certain areas were stratified to generally isolate common types of features or major features left behind from prior mining at the site. Disturbed strata include the Pit, Pit Lake, Tailing Dam (TD) and Waste Rock/Disturbed Area (WR/DA). Each stratum was not necessarily represented with data collected from each individual survey protocol but habitats were still consistently described across protocols. Offsite analogs were not surveyed or compared for the disturbed strata developed to characterize previous mining.

A total of 12 species of bats were assigned by Sonobat software at the Copper Flat Mine permit area (as depicted in Table 5-5 of the BDR): pallid bat (*Antroorzous pallidus*), Townsend’s big-eared bat (*Corynorhinus townsendii*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), southern hoary bat (*Lasiurus cinereus*), western small-footed myotis (*Myotis ciliolabrum*), California myotis (*Myotis californicus*), Arizona myotis (*Myotis occultus*), fringed myotis (*Myotis thysanodes*), Yuma myotis (*Myotis yumanensis*), canyon bat (*Parastrellus hesperus*), and Mexican free-tailed bat (*Tadarida brasiliensis*). Extracted Sonobat data were used to determine the relative abundance of bat activity within the sampling strata. Since the software is not always a reliable predictor of species level information, Table 5A-2 below only shows relative activity level by stratum for all species combined. Note that instances where Sonobat could not assign a species at all were also included to calculate the mean sequences recorded in Table 5A-2 since automated data cleaning (“scrubbing”) capabilities in Sonobat were employed to remove sequences that likely resulted from noise or other non-bat acoustic signals.

The pit lake had by far the highest relative activity level measured, with over 2,000 mean echolocation sequences captured per day. The Arroyo stratum had 335 mean echolocation sequences measured per day while fewer sequences were captured per day in the CDG stratum (78). Higher activity was measured at each of the 3 on-site strata than their off-site analogs.

Table 5A-2
Mean Number of Echolocation Sequences Recorded per Day Based on Analysis of Sonobat Data

Stratum	Sequences Captured per Day
Arroyo On	335.1
Arroyo Off	49.1
CDG On	78.4
CDG Off	32.6
Pit Lake On	2,039.3
Stock Tank Off	518.6

Comment 4. Table 5-2 and 5-3, S-W diversity indices are helpful, but please also show relative abundance (for example, using terms like "abundant, "common", "uncommon" and "rare").

Revised versions of Table 5-2 and 5-3 are provided below. Relative commonality is represented according to the term ("abundant", "common", etc.) that best describes the number of times a species was encountered along transects either within the stratum or during the season. Winter observations are listed in parenthesis in the revised version of Table 5-2.

Table 5-2 - Revised
Bird Species Recorded by Habitat along Bird Transects during the 2011 Field Season

Species	Copper Flat Mine Permit Area					Reference Sites		
	A=Abundant, C=Common, U=Uncommon, R=Rare, Winter survey results in parenthesis.							
	Arroyo	CDS	CDG	Pit	DA/WR	Arroyo	CDS	CDG
American Kestrel	R	(R)	R					
American Robin	U/(R)	(U)	U					
Ash-throated Flycatcher	C	C	C		U	C		C
Barn Swallow			R	R				
Bewick's Wren	(U)	(U)	R			(R)		
Black-chinned Hummingbird	U		U			(U)		(C)
Black-throated Sparrow	A/(A)	A/(A)	A/(A)	A	A/(A)	C	A	A
Blue Gray Gnatcatcher	C		C		U			C
Blue Grosbeak			C		C			C
Brewer's Sparrow	(A)	(R)	(U)					

07611

Species	Copper Flat Mine Permit Area					Reference Sites		
	A=Abundant, C=Common, U=Uncommon, R=Rare, Winter survey results in parenthesis.							
	Arroyo	CDS	CDG	Pit	DA/WR	Arroyo	CDS	CDG
Broad-tailed Hummingbird	R				R			
Brown-headed Cowbird	U		R		R	C		
Bullock's Oriole			R					
Bushtit	(C)					(C)		
Cactus Wren	U	U	C	U	C	(U)	C	(U)
Canyon Towhee	C/(A)	(A)	C/(A)		(C)	C/(C)		A/(C)
Canyon Wren	C/(R)	(R)	C	R		C		
Chihuahua Raven		(R)	(R)		(R)	(U)	(U)	(U)
Chipping Sparrow	(A)	(A)	(U)					(A)
Common Nighthawk		U					C	
Common Raven	U	U/(C)	C/(C)		U	U	U	C/(C)
Crissal Thrasher	(U)	U/(U)		U				
Curve-billed Thrasher	U		U				U	
Dark-eyed Junco	(C)	(A)			(A)	(U)		(C)
Flycatcher sp.	U		U		U			U
Gambel's Quail	A/(A)	C/(U)	A	C	A	C	C	(U)
Golden Eagle		(R)						
Grasshopper Sparrow			(R)					
Great Horned Owl	R							
Greater Roadrunner	(R)	R	R	R				
Green-tailed Towhee	(R)							(U)
Horned Lark	(R)	(C)	R/(U)	R	(C)	(A)	(A)	U
House Finch	C/(A)	C/(A)	C/(A)	A	R/(A)			
Ladder-backed Woodpecker	(R)							
Lesser Goldfinch	U/(C)		R			U		
Loggerhead Shrike		(R)		R	R/(U)			
Meadowlark		(A)	(U)					
Montezuma Quail			R					
Mountain Bluebird	(R)	(A)	(R)					
Mourning Dove	C	C/(U)	C	C	R/(A)		C	C
Northern Flicker	(C)	(U)	R/(U)	U	(R)			R
Northern Harrier			(R)					
Northern Mockingbird	C	R	C		C	U		C

Species	Copper Flat Mine Permit Area					Reference Sites		
	A=Abundant, C=Common, U=Uncommon, R=Rare, Winter survey results in parenthesis.							
	Arroyo	CDS	CDG	Pit	DA/WR	Arroyo	CDS	CDG
Oriole sp.	U		R					
Red-naped Sapsucker		(R)						
Red-tailed Hawk	R	U	U/(R)		(R)			
Rock Wren	C/(C)	(C)	C/(C)		C/(C)	U(R)		C/(C)
Ruby-crowned Kinglet	(C)		(U)		(R)	(C)		
Rufous-crowned Sparrow	A/(A)	(C)	C/(C)		(R)			C/(U)
Sage Sparrow	(A)	(A)	(A)			(C)	(U)	
Sage Thrasher	(R)	(R)					(R)	
Say's Phoebe	C	R/(R)	C		U/(U)	C		C
Scaled Quail	C		C		(R)			
Song Sparrow		(R)			(R)			
Sparrow sp.	U		(U)					
Spotted Towhee	R/(R)	(R)	(R)					
Swainson's Hawk	R			R				
Swallow sp.					C			
Thrasher sp.	U		U			U		
Townsend’s Solitaire		(U)						(R)
Townsend's Warbler	U							
Turkey Vulture	U		U		U			U
Unknown	U	U	C		U	U		U
Verdin		(U)	(R)			(R)		
Violet-green Swallow	C	R	U		U			
Vireo sp.						(R)		
Warbler sp.	U		U					
Western Kingbird	C		C		R			C
Western Meadowlark	(R)		U		(R)			
Western Wood-Pewee	C	U	U					U
White-crowned Sparrow	(A)	(A)	(C)		(U)	(U)		
White-winged Dove	U							U
Wilson's Warbler	C							
Wren sp.			U					C
Total Species Encountered Summer	39	16	41	4	21	13	7	20

Species	Copper Flat Mine Permit Area					Reference Sites		
	A=Abundant, C=Common, U=Uncommon, R=Rare, Winter survey results in parenthesis.							
	Arroyo	CDS	CDG	Pit	DA/WR	Arroyo	CDS	CDG
Surveys:								
Shannon-Weaver Diversity Score Summer Surveys:	15.1	5.3	16.9	2.3	9.9	11.3	2.6	10.8
Total Species Encountered Winter Surveys:	29	32	23	0	19	14	5	13
Shannon-Weaver Diversity Score Winter Surveys:	10.7	13.9	11.1	0.0	7.8	9.1	1.6	6.7

Table 5-3 - Revised

Bird Species Recorded During 2011 Transects or Likely Present at Copper Flat Mine Permit Area, Las Animas Creek, and Percha Creek

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Canada Goose	○		○	○				•
Gadwall	○		○	○				•
Mallard	○		○	○	○	○	○	•
Northern Shoveler	U		○	○				•
Northern Pintail	○		○	○				•
Cinnamon Teal	R		○	○				
Blue-winged Teal	R		○	○				
Canvasback	U		○	○				
American Widgeon	R		○	○				
Green-winged Teal	○		○	○				•
Redhead	○		○	○	•			•
Ring-necked Duck	○		○	○				•
Common Merganser	○		○	○		•		•
Scaled Quail	○	○	○	R	○	○	○	•
Gambel's Quail		A			•	•	•	•
Montezuma Quail	○	○	○	○	•	○	○	•
Ring-necked Pheasant								•
Wild Turkey					•	•	○	○
Pied-billed Grebe								•
Bl.-crowned Night Heron		R				○		
Cattle Egret						○		
Snowy Egret					•		•	
Great Blue Heron	U	○	○	○	•	○	○	•
Green Heron					•			
White-faced Ibis						•		
Turkey Vulture		U				•	•	
Bald Eagle						•		•
Golden Eagle				R				
Northern Harrier		○		R	•			•

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Sharp-shinned Hawk	○	○	○	○	•	○	○	•
Cooper's Hawk	○	○	○	○	•	○	○	•
Swainson's Hawk		R					•	
Red-tailed Hawk	○	U	○	U	•	•	○	•
Ferruginous Hawk	○		○	○	○	•	○	•
Gray Hawk						•		
Zone-tailed Hawk					•	•		
Common Black Hawk					•	•		
Golden Eagle	○	○	○	R	•			
American Kestrel	○	R	○	R	•	○	•	•
Merlin	○		○	○	○		○	•
Peregrine Falcon					•	•		
Prairie Falcon	○	○	○	○				•
Sora					•			
American Coot						○		
Sandhill Crane							○	•
Killdeer	U	○	○	○	•	•	•	
Black-necked Stilt						○		
American Avocet						○		
Spotted Sandpiper	○	○	○	○		○		
Common Snipe						○		○
Ring-billed Gull								•
Rock Dove	○	○	○	○	○	○	○	•
Eur. Collared-Dove	○	○	○	○	•	○	•	•
White-winged Dove	U	U	○	○	•	•	•	•
Mourning Dove	C	C	C	C	•	•	•	•
Common Ground Dove						○		
Yellow-billed Cuckoo						•		
Greater Roadrunner	○	R	○	○	•	○	○	•
Western Screech-Owl	○	○	○	○	•	○	○	•
Great Horned Owl	○	R	○	○	•	•	○	•
Barn Owl	○	○	○	○	○	○	○	•

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Burrowing Owl	○					•		
Northern Pygmy Owl	○	○	○	○	○	○	○	•
Mexican Spotted Owl					•			
Elf Owl					•	•		
Lesser Nighthawk		○				•		
Common Poorwill		○			•	•		
White-throated Swift		R			•	•		
Bl.-chinned Hummingbird		R			•	•	•	
Br.-tailed Hummingbird		R					•	
Belted Kingfisher					•	•	•	•
Lewis's Woodpecker								•
Red-headed Woodpecker					•			•
Red-naped Sapsucker								•
Acorn Woodpecker					•	•	•	•
Red-naped Sapsucker					•		•	•
Yel.-bellied Sapsucker								•
Lad.-backed Woodpecker				R	•	•		•
Downy Woodpecker	○	○	○	○	•	○	○	•
Hairy Woodpecker	○	○	○	○	•	○	○	○
Northern Flicker	○	R	○	○	•	○	•	•
Western Wood-Pewee		C				•	•	
Hammond's Flycatcher					•			•
Willow Flycatcher					•			
Brown-crested Flycatcher						•		•
Eastern Phoebe								•
Black Phoebe		R			•	•		•
Say's Phoebe	○	C	○	U	•	•	•	•
Vermilion Flycatcher		○			•	•		•
Ash-throated Flycatcher		C				•		
Brown-crested Flycatcher						•	•	
Dusky Flycatcher					•			
Dusky-capped Flycatcher						•		

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Cassin's Kingbird						•	•	
Western Kingbird		C				•	•	
Loggerhead Shrike	○	R	○	○	•	•	○	•
Bell's Vireo						•		
Plumbeous Vireo						•		
Warbling Vireo							•	
Hutton's Vireo		○		○			•	•
Steller's Jay								•
Western Scrub-Jay	○	○	○	○	○	○	•	•
American Crow	○	○	○	○	○	○		•
Chihuahua Raven				U	•	○	•	•
Common Raven	○	C	○	C	•	○	•	•
Horned Lark	○	R	○	○	•	○	○	•
N. Rough-winged Swallow		○			•	•		
Violet-green Swallow	○	C	○		•	•	○	
Barn Swallow	○	R	○		•	•	•	
Cliff Swallow		○				•		
Mountain Chickadee				○				•
Bridled Titmouse	○	○	○	○	•	•	○	•
Juniper Titmouse	○	R	○	○				•
Verdin	R			R	•		•	•
Bushtit	○	○	○	U	○	○	○	○
Red-breasted Nuthatch								•
White-breasted Nuthatch					•	•	•	•
Brown Creeper	○	○	○	○	○	○	○	•
Cactus Wren	○	U	○	○	•	○	•	•
Rock Wren	C	C	C	C	•			•
Canyon Wren	U	C	○	○		•		
Bewick's Wren	○	○	○	U	•	•	•	•
House Wren	○							•
Winter Wren								•
Bl.-tailed Gnatcatcher	○					•		

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Blue-Gray Gnatcatcher		○					•	
Golden-crowned Kinglet								•
Ruby-crowned Kinglet	○	○	○	U	•	○	○	•
Eastern Bluebird								•
Western Bluebird	○	○	○	○	•	○	○	•
Mountain Bluebird	○	○	○	C			•	
Townsend's Solitaire				R	•			•
Hermit Thrush					•			•
Rufous-backed Robin					•			•
American Robin	○	U	○	R	•	•	○	•
Northern Mockingbird	○	C	○	○	•	•	○	•
American Dipper						•		
Curve-billed Thrasher	○	U	○	○	•		•	•
Crissal Thrasher	○	U	○	○	•			•
Bendire's Thrasher								
Brown Thrasher		R						•
Sage Thrasher				R				
European Starling	○	○	○	○	•	•	•	•
American Pipit								•
Sprague's Pipit			○					
Cedar Waxwing					•			•
Phainopepla	○	○	○	○	•	○	•	•
Orange-crowned Warbler	○	○	○				•	•
Bl.-throated Gray Warbler	○				○			
Lucy's Warbler		○			•	•		
Virginia's Warbler		○			•		•	
Grace's Warbler						•		
MacGillivray's Warbler							•	
Northern Parula					•			
Yellow-rumped Warbler	○	R	○	○	•	○	•	•
Red-faced Warbler						•		
Wilson's Warbler	○	○	○				•	

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Pine Warbler								•
Tennessee Warbler					•		•	
Yellow-breasted Chat		○				•		
Ch.-collared Longspur				R				•
Green-tailed Towhee		R		R				•
Spotted Towhee		R		R	•	○	○	•
Rufous-crowned Sparrow		A		C	•			•
Canyon Towhee		C		A	•	•	•	•
Chipping Sparrow	○	○	○	A	•	○	○	•
Brewer's Sparrow	○		○	C	•		•	•
Vesper Sparrow	○	○	○	○				•
Lark Sparrow		○					•	
Black-throated Sparrow	○	A	○	C	•		•	•
Black-chinned Sparrow	○					•		
Sage Sparrow	○		○	A				•
Baird's Sparrow	○							•
Grasshopper Sparrow				R				•
Clay-colored Sparrow								•
Lark Bunting	○		○	○	•			
Indigo Bunting						•		
Lazuli Bunting					•			
Varied Bunting						•		
Song Sparrow				R	•		•	•
Lincoln's Sparrow	○		○	○	•		•	•
White-crowned Sparrow	○		○	A	•		•	•
White-throated Sparrow								•
Swamp Sparrow								•
American Tree Sparrow								•
Dark-eyed Junco	○	○	○	C	•		•	•
Summer Tanager					•	•	•	•
Hepatic Tanager					•			
Western Tanager					•			

Species	Copper Flat Mine Permit Area				Las Animas/Percha Creeks			
	Spr	Sum	Fal	Win	Spr	Sum	Fal	Win
A=Abundant, C=Common, U=Uncommon, R=Rare; ○ = Not recorded but likely occurs in proper habitat; • = observed, observation method along Las Animas/Percha Creeks did not yield relative commonality.								
Northern Cardinal						○		
Pyrrhuloxia				○	•	•		•
Blue Grosbeak		C			•	•	•	
Red-winged Blackbird	○	○	○	○	•	○	•	•
Western Meadowlark	○	U	○	R	•	○	○	•
Yellow-headed Blackbird	○	○		○				•
Brewer's Blackbird	○	○	○	○				•
Rusty Blackbird								•
Common Grackle					•			
Great-tailed Grackle	○	○	○	○	•	○	○	•
Brown-headed Cowbird		U				•		•
Hooded Oriole	○				•	•		
Bullock's Oriole	○						•	
Scott's Oriole	○					•		
Purple Finch								•
Cassin's Finch		R	○	R				•
House Finch	○	C	○	○	•	•	•	•
Red Crossbill								•
Pine Siskin	○	○	○	○				•
Lesser Goldfinch		U		C	•	•	•	•
Lawrence's Goldfinch								•
American Goldfinch			○		•			•
Evening Grosbeak								•
House Sparrow		U			•	•	•	•

Comment 5. The pit lake may be an important resource for migrating waterfowl and other birds. The migratory seasons should be covered by monitoring in addition to winter and summer surveys.

The summer and winter 2011 surveys crossed the pit lake but focused monitoring of this feature was not completed. Morning bird surveys were conducted at the pit lake during a total of five visits between August 2012 and May 2013. On November 21, 2012 one waterfowl was flushed as the surveyor arrived at the pit lake prior to sunrise and a species could not be determined due to darkness. After nocturnal waterfowl use was observed, two nighttime bird surveys were also completed and two afternoon monitoring visits were also completed during the spring of 2013.

Six waterfowl were flushed as a surveyor arrived during a nighttime bird survey at the pit lake in April 2013. Only one bird was positively identified to species, it was a Canvasback. When returning the next day in the afternoon, 23 waterfowl were present, including Cinnamon Teals, Canvasbacks, American Widgeons, Blue-winged Teals and Northern Shoveler. Pictures of waterfowl were also captured by game cameras installed at the pit lake - mallards were captured on game cameras but never observed in person. A Great Blue Heron was observed during a May 2013 survey and heron tracks were also observed along the lake fringe during other visits. Great Blue Herons were also observed on pit lake cameras on four occasions. Killdeer were heard on two occasions during in person surveys. Spotted sandpipers were observed on one occasion and also captured once by a game camera. One morning in April 2013, a Great Horned Owl was heard calling from the hills to the west of the pit lake as the surveyor arrived at the pit lake but direct use of the lake by owls was never observed.

In general, passerine bird activity (as also observed during the winter bird survey and spring/summer surveys) was determined to be relatively low at the pit lake. One to two hour surveys often yielded very few encounters. The most active species included Rock wrens, Northern mockingbirds, Northern flickers, Common ravens, Mourning doves, White-winged doves and Gambel's quail. Most frequently, these species were heard calling from the hills surrounding the pit lake, typically from the higher tiers to the north of the lake. A Western jay, Red-tailed hawk, Eurasian collared dove, Ash-throated flycatcher, and an unidentified hummingbird were only observed once, either by a distant call or a quick fly-over.
The only passerine activity observed directly at the pit-lake were a group of 6-8 Violet-green swallows that would feed high above the pit lake, swooping down occasionally to drink from the lake. This group was observed feeding for about five minutes before returning to the tiered cliff faces to the northwest of the lake, and then returned to feed again. This behavior was only observed in May, approximately two hours after sunrise. On two occasions, once in April 2013 and once before in 2011, a large group of Turkey Vultures were observed flying down to the water's edge but drinking wasn't directly observed on either occasion. Other activity observed at the pit lake included a small flock of Horned larks landing near the boat ramp and feeding for short period. A small flock of Chipping sparrows were observed flying from the saltbush on the top tier to the south of the pit lake, to the saltcedar to the immediate west of the boat ramp. They were observed hopping to and drinking from the pit lake.

Limited overall passerine bird activity is likely attributed to the general lack of vegetation substrate in areas immediately surrounding the pit lake. Invertebrate activity was also observed to be lower than is typical at water bodies in southwestern deserts. No songbird nests were observed in the isolated saltcedar patches that occur near the lake and relatively low song bird activity was observed at all in the saltcedar patches. Passerine bird nests were also not observed in rocky, unvegetated areas surrounding the pit lake.

Comment 6. Please incorporate winter observations from Appendix 5-B, Winter Bird Survey Report, into summary Tables 5-2 and 5-3.

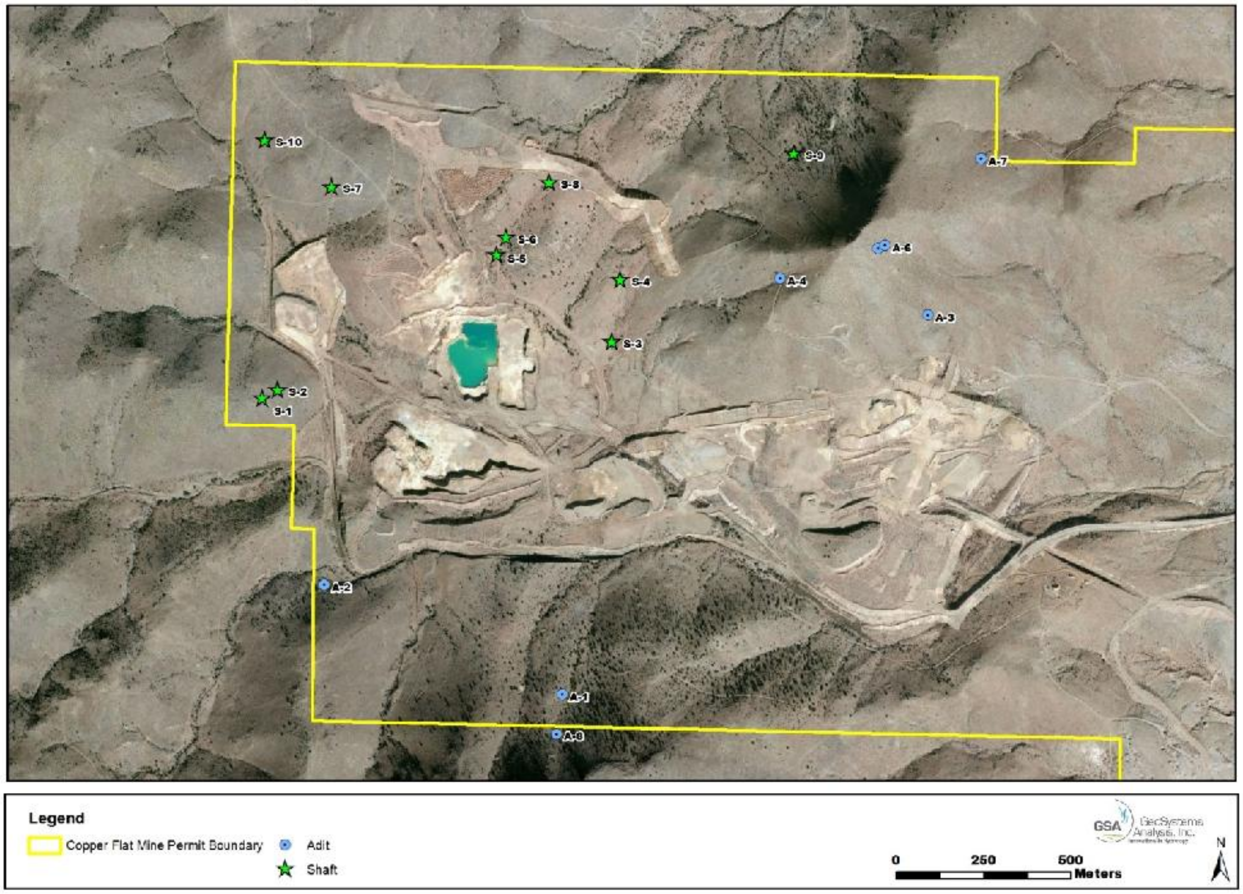
Please see the amended versions of Tables 5-2 and 5-3 included in the response to NMG&F comment #4.

Comment 7. Any abandoned historic mine features, which comprise more than a shallow blind shaft in extent, should be evaluated to determine use by roosting or hibernating bats, especially if the features are expected to be disturbed or destroyed by future mining.

Staff biologists visited all the historic mine features (shafts and adits) identified using locations provided by New Mexico Copper Corporation map (Figure 5A-3). Each historic feature was assigned a unique identifier; adits were assigned an “A” and then numbered sequentially while shafts were assigned with an “S” at the beginning of the identifier. A total of ten shafts and seven adits technically fall within the Copper Flat permit area but one additional adit (hereafter referred to as “A-8”) was also surveyed because it was only about 50 feet from the permit area boundary and it looked like a promising feature for bat use. Each adit and shaft was initially assessed during the summer of 2012, when a team of two observers initially monitored bat use at each feature from before dusk until typically at least two hours after dark. During this preliminary observation period, biologists equipped with night vision goggles and click counters, were stationed nearby (typically about 20-30 feet away) in locations with a clear view of the adit or shaft opening. Click counters were used to count the number of bats observed entering and exiting each feature. Each feature was also photographed during this initial visit and shafts that had collapsed entirely were not surveyed during future visits. Bat activity was only observed at one feature (A-2) during this initial session. Two unidentified bats were observed entering and exiting the opening. This feature was observed a second time during August 2012 but no activity was observed during the second monitoring session.

Each of the historic mine features were also visited during the hibernation season of 2013 (late February – early March) unless the entry was observed to be entirely collapsed during the initial survey. Several species of bats in New Mexico are obligate cave, mine or rock crevice species; of these, the Townsend’s big-eared bat (Corynorhinus townsendii) is a regionally listed sensitive species and was the focus of these

Figure 5A-3. Historic Mine Adits and Shafts Monitored for Bat Use



survey efforts. However, all evidence of bat use was noted, and species such as *Myotis thysanodes* (another cave, mine or rock crevice obligate) were recorded if observed.

Features were evaluated externally for stability and internal surveys were conducted where deemed safe. All adits were deemed safe to enter through external evaluation. Only adits were surveyed internally, as the logistical difficulty and relative danger involved with performing internal surveys of shafts was considered beyond the scope of this effort. However, all shafts identified by New Mexico Copper Corporation personnel were visited and evaluated for possible bat use externally. Despite the relative complexity of several adits, no colonies of hibernating bats were observed. However, warm early season temperatures at the Copper Flat site in 2013 were more reflective of spring/summer temperatures (outside ambient temperatures approached 28°C during survey efforts), and it is possible that hibernacula had already been abandoned. Other bat biologists in New Mexico reported early emergence at known hibernation sites in 2013, likely due to warn early season temperatures. Indeed, many bats in the Southwest are facultative hibernators or engage in facultative torpor bouts and may arouse at any time environmental conditions are favorable to do so (for drinking or foraging purposes, etc.). For this reason, it is difficult to fully rely on single-visit cold-season surveys to document hibernation use. Unfortunately, bats do not leave evidence of hibernaculum use in the form of feces or prey waste due to markedly decreased activity and metabolism, and the only way to confirm hibernation habitat use is to observe hibernating bats. Nonetheless, surveys were conducted in the generally optimal timeframe to observe hibernation activity, and no hibernating bats were observed in the eight adits surveyed internally. Also, several features were complex enough (with workings extending several hundred meters or more underground) to house hibernating bats despite external environmental conditions, and again, none were noted.

Internal surface temperatures of surveyed adits ranged from 11.4°C – 16.2°C. Internal ambient temperatures ranged from 15.1°C – 25.1°C. Internal relative humidity ranged from 14.1% – 50.0%. The large differences in relative humidity and internal ambient temperatures among adits is due primarily to varying feature complexity; relatively short adits with greater exposure to external conditions realize greater fluctuations in environmental variables throughout the day. All internal surface temperatures were measured using noncontact infrared digital thermometry with a Fluke Raytek Minitemp MT6. Internal and external ambient temperatures as well as relative humidity were measured using a Kestrel 3000 weather meter. Of the eight adits surveyed internally, two had strong evidence of heavy or extended bat use. Of the four shafts surveyed externally, two were identified as being possible bat habitats due to apparent relative complexity and large internal temperature gradation (as measured with noncontact infrared thermometry). However, neither of these shafts showed evidence of bat use during external surveys with night-vision equipment during previous survey work. All of the adits surveyed internally had strong evidence of use by small mammals, including middens and feces from woodrats (Neotoma spp.). Additionally, the most complex adit surveyed (A-4), located on Animas Peak, had strong evidence of long-term and heavy use by striped skunks (Mephitis mephitis), a known predator of roosting and hibernating bats.

Despite the fact that no evidence of hibernation-season use was seen, several adits did show sign of significant bat use. Heavy deposition of bat feces was identified at two complex adits located on the north slope of Black Peak (Adits A-1 and A-8). Bat feces can be distinguished from other small mammal feces by the presence of moth scales, seen as “sparkle” in crushed feces. Other evidence of bat use includes surface staining, from repeated roost use and urination, as well as the presence of prey item waste materials, including insect/beetle elytra, etc. Other adits had a small amount of sign, possibly evidence of temporary use as night roosts, etc., but this is expected of any rock crevice, cave, or mine feature in the Southwest, and not necessarily indicative of relative importance of the feature to local bat populations. The two adits identified as possibly significant habitat resources for bats at the project site were actively surveyed (using mist-netting) for bat use during the warm season of mid May 2013. As most bats are occupying breeding season habitat by this time, capture of pregnant females in close proximity to these adits would warrant assumption that these features are maternity habitats, and therefore of large, at least local population-level significance.

Active capture surveys of the two previously identified adits were conducted using mist nets placed in relative close proximity (within ~15m) of the mine feature entrance, but not in such a way as to block access to bats leaving or entering the feature, and thus possibly disturbing a colony. Adit A-8 was surveyed first, and three bats were observed leaving the feature after dusk. One of these individuals was captured – a scrotal male Townsend's big-eared bat. Both of the other observed individuals were also Townsend's big-eared bats. Townsend's big-eared bats are readily identifiable on the wing by experienced observers due to their characteristic large ears and medium body size. Because of the relatively low number of individuals discovered to be using this adit during this survey, it is safe to assume that this feature is not being utilized as maternity habitat in 2013. The evidence of heavy use recorded during the internal survey may simply have collected over many years, may be reflective of previous use as maternity habitat, or may simply indicate use as night/day roost habitat.

The second previously identified adit, A1, was surveyed after A8, also using the methodology described above. In this case, only one bat was observed leaving the mine feature, also confirmed to be a Townsend's big-eared bat in flight. It is not uncommon to have high percentages of suitable habitat features occupied by Townsend's big-eared bats, at least for roosting purposes. Indeed, at abandoned mine sites in Nevada, up to 70% of suitable features have been shown to be utilized by Townsend's at some point during the year (Sherwin et al., 2009). However, this level of occupancy generally consists of only one or two individuals, which may be highly transitory, and again, is not indicative of the relative importance of that feature on a landscape level. More important are habitats proven to be used as maternity or hibernation areas, rather than those which might simply house a few individuals for roosting purposes for a short time period.

Comment 8. Section 5.4.1.3, page 5-9, please report in text or tabular form, on the relative abundance of large and medium size mammal sightings/sign, by location or habitat type. Include a comparison to the reference plots.

Raw data from the 2011 pellet count survey at Copper Flat were reanalyzed to describe relative abundance by habitat stratum. Within strata results of pellet count transects are shown below in Table 5A-3, which summarizes the frequency that pellets of various wildlife species were encountered within individual plots placed along the stratified pellet count transects. Pellets were most frequently encountered in plots at the CDS On stratum, though the pronounced frequency of pellets in this stratum was mostly attributed to increased Jackrabbit pellets. Mule deer pellets were most frequently encountered in the CDG On and CDS On strata. Cottontail pellets were abundant across strata. Carnivore pellets (mostly coyote) were relatively uncommon throughout strata. Pellet frequency was observed to be higher in the on-site CDS and CDG strata versus their off-site comparisons. The WR/DA On stratum included pellets from each of the different wildlife pellet groups observed though pellet frequency was lower in this stratum compared to the other on-site strata. Pellets from coyotes, packrats, gray fox, and bobcats were observed either within or just outside pellet count transects.

Table 5A-3
Frequency that Pellets were tallied in Pellet Count Plots within a Transect by Stratum

Stratum	Mule Deer	Cottontail	Jackrabbit	Predator	Other
CDG Off	13%	90%	57%	0%	0%
CDS Off	32%	94%	16%	0%	0%
Arroyo On	10%	100%	50%	0%	20%
CDG On	52%	96%	40%	0%	2%
CDS On	50%	87%	77%	0%	1%
WR/DA On	18%	84%	48%	2%	0%

Similar habitats were sampled within the permit area as well as outside the permit area when relatively similar off-site analogs could be located. "On" refers to strata sampled within the permit area while "Off" refers to their offsite comparison. Acronyms are as follows; Chihuahuan Desert Grassland (CDG), Chihuahuan Desert Shrubland (CDS), and Waste Rock/Disturbed Area (WR/DA).

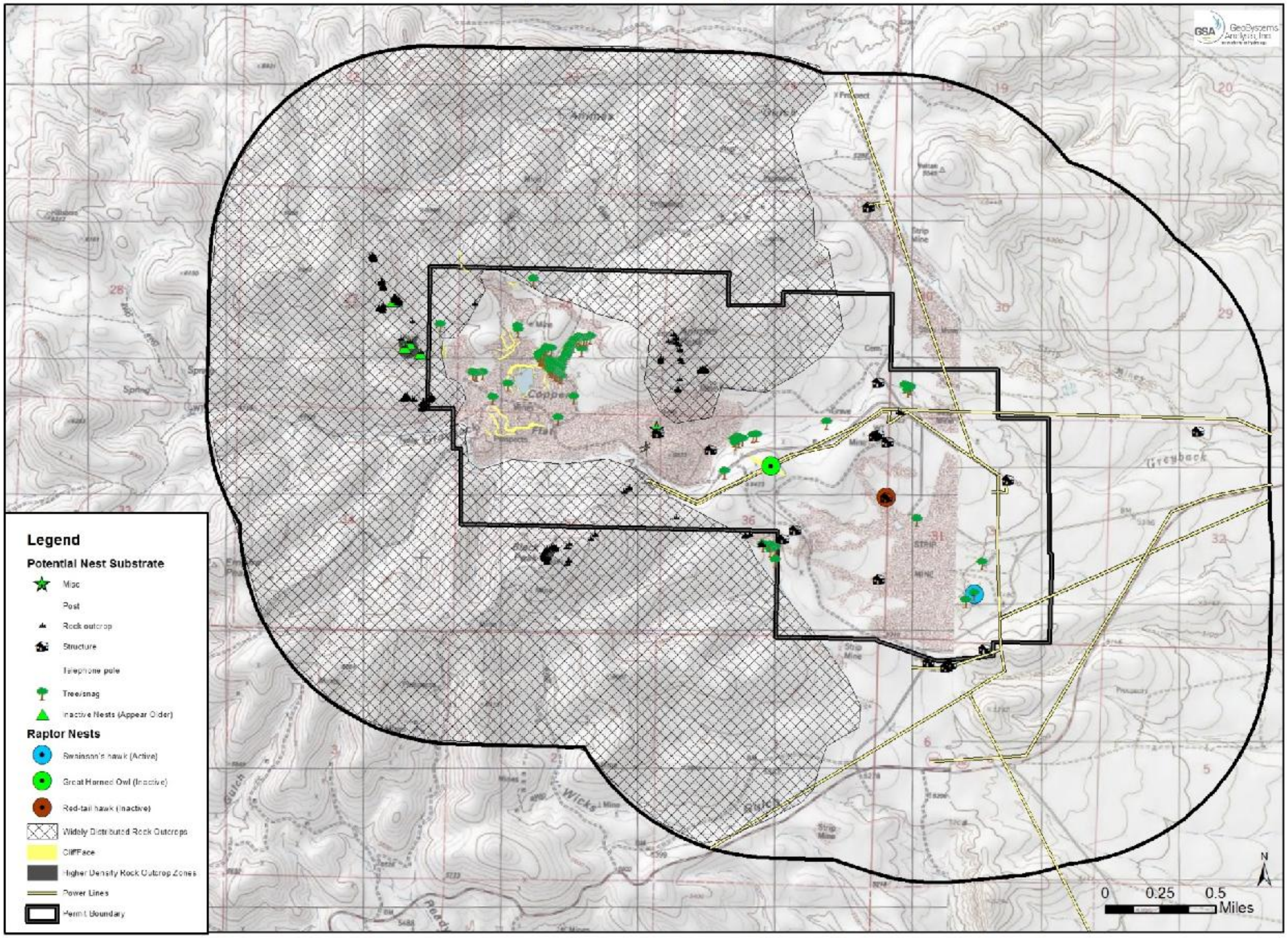
Comment 9. Please conduct a survey for raptor nests in all suitable habitat within one mile of any potential mine-related disturbance.

A raptor nest survey was completed during late-April through late-May 2013. Nests housing other birds of prey, such as owls, were also included in the survey. Potential nesting substrate including powerline poles, telephone poles, rock outcrops, large trees, snags, cliff faces, suitable structures, and towers were mapped during this effort while surveying was completed. Substrates with the highest probability for nesting were also resurveyed for the presence of nests during mid- to late-May. Raptor nests identified during the 2011 walking transects were revisited during the 2013 raptor nest survey to determine whether they were currently active since site fidelity is common in some raptor species.
A map showing suitable nesting substrate documented during field surveys is provided as Figure 5A-4. Towers still present from prior mining at Copper Flat are represented as structures on the map as are abandoned buildings. Areas with dense rock outcrop clusters are shown as either the individual surveyed rock outcrop (symbolized as a rocky point) or as a dark grey outline. When rock outcrops were observed to be more widely distributed, they are depicted with a cross-hatch on the map because individual outcrops were typically surveyed from the distance with binoculars and not always visited with a GPS. Trees and snags are both shown with the tree symbol on the map.

During the 2013 field season, only one active raptor nest was observed, as shown with a blue point on the map. This active Swainson's hawk nest was found in an isolated cottonwood tree behind the tailing dam. A mother with fledglings was observed in the nest in early-May; the same tree housed a Swainson's hawk nest during the 2011 survey. A red-tail hawk nest identified in a tower behind the tailing dam during the 2011 survey, as shown with the red point on the map, was revisited during 2013 but currently inactive. A Great Horned Owl nest that had been previously observed on a rock wall along a road cut during the 2011 survey is shown as a yellow point on the map. No activity was observed here during 2013 either. Many of the larger rock outcrops, particularly near Black Peak and areas west of the pit lake, contained significant white wash but nesting couldn't be confirmed. Portions to the west and southwest of the permit area were also difficult to survey due to the steep terrain, so it's possible that the areas are currently more active than our surveys were able to determine. Seven raptor sized stick nests, each in relatively poor condition, were observed in this general portion of the survey area (as shown with yellow triangles on the map) but activity was considered unlikely due to their poor structure and maintenance. If nothing else, the numerous rock outcrops surrounding the permit area to the south and west continue to be regular roosting habitats for a variety of raptor species.

Raptor species observed during various survey efforts in and around the mine can be determined by reviewing the revised versions of Tables 5-2 and 5-3 which are presented earlier in this addendum. Swainson's hawk and Red-tailed hawk were the only raptor species observed during the nest search. One Great Horned Owl was also observed.

Raptor Nest Survey Map



Comment 10. Please conduct focused monitoring of wildlife use of the pit lake. This might include diurnal and nocturnal passive observation sessions, track counts, or spot-lighting surveys.

Focused monitoring at the pit lake during the 2012-2013 field seasons consisted of:

- Regular bird surveys, as previously described in this addendum;
- Mist netting bats;
- Nocturnal observation sessions;
- Amphibian surveys; and
- Installation of three night vision game cameras.

In the Southwest, limiting habitat features for bats generally do not include foraging or roosting habitats, but instead center on water availability on the landscape. Nearly all bat species found in North America must drink in flight, and therefore pooled water resources are important, particularly in arid areas such as New Mexico. At Copper Flat, very little perennial pooled water exists, and of that which does, only one source is large enough to serve as a resource for all bats which might occur in the area – the pit lake. After documenting a variety of bat species through acoustic surveys, additional active survey work for bats was deemed necessary at the pit lake in order to address comments by NMDGF biologists about wildlife use of this resource. Indeed, although acoustic surveys are a well-regarded method for documenting bat occupancy and relative abundance, combining acoustic work with active capture surveys is often more effective at recording all species in a given area because some species with low amplitude echolocation calls may be missed during acoustic work.

Because water is the most common limiting feature in the Southwest, bats can be reliably captured at water sources using mist-nets. However, in order to effectively survey a water source, full-coverage of the water is necessary, which can prove difficult with large bodies of water, etc. Despite the fact that large bodies of water are difficult to fully cover with active capture methodology, any coverage of a water source can prove valuable when bats are captured as morphometric measurements can then be taken, reproductive conditions assessed, etc. In mid-April (2013), staff biologists utilized active capture methods (mist-netting) at the pit lake in an attempt to provide additional focused assessment of bat use of this resource.

On 12 April 2013, biologists erected two 18-meter mist nets near the ramp area of the pit lake. This is the most accessible area, and the lake maintains a relatively shallow depth for a number of meters from the ramp area. However, many areas of the pit lake are very deep, and working in this environment is logistically difficult due to compacted sediments, fluctuating water levels, etc. Unfortunately, although bats were present and were utilizing the resource in relatively close proximity to the nets, no bats were captured. However, several individuals observed drinking from the pit lake were identified as silver-haired bats (Lasionycteris noctivagans). Silver-haired bats can be readily identified by experienced observers due to their dark pelage (different from any other bat species found in this area), and patch of silver or frosty hair on the dorsum. Interestingly, silver-haired bats are migratory, and generally prefer forested environments. The individuals observed at the Copper Flat pit lake may have been en route to breeding grounds at higher latitudes or to higher elevation areas in New Mexico. Additionally, at least one other species was observed (multiple individuals), but could not be identified to species (likely a Myotis sp.).

On 13 April 2013, biologists again returned to the pit lake and this time erected nets on the northwest side of the lake. This area includes several small spits which extend into the lake proper, and provide an area to place mist nets that cover different drinking/foraging flyways. One 9-meter and one 12-meter net were used, but no bats were captured. Silver-haired bats were again observed utilizing the resource, as were other unidentifiable individuals of another species.

Although it is unfortunate that this survey work did not realize results in the form of captures, it was valuable in confirming that bats are utilizing the pit lake as a water resource, and in identifying at least one species which does so. Full coverage of a water source is necessary to reliably capture bats that are utilizing that specific resource, and it is functionally impossible to fully cover the pit lake when mist-netting due to its large size, extreme depths, etc. Also, little is known about bat use of water sources at active and abandoned mine sites, and verifying that bats utilize a water source such as the pit lake is valuable. It is even more interesting contextually when considering that one of the species recorded using the pit lake is migratory, and almost certainly does not utilize the Copper Flat area for breeding purposes, etc. Also, interestingly, no Townsend's big-eared bats were observed using the pit lake during two nights of netting, but this is likely due to the relative difficulty of observing bats on the wing.

An amphibian survey of the pit lake was completed over two nights and two days during late-April through mid-May 2013. During each survey, a biologist disturbed the pit lake fringe with a net to attempt to flush out any amphibians hidden along the bank and also used a spotlight to search for eye shine during nocturnal surveys. Biologists also listened for amphibian activity during other various monitoring visits to the pit lake beginning August 2012. However, amphibians were never observed at the pit lake during any of the survey visits. Other in-person nocturnal or diurnal passive observation sessions also did not yield any observations of game species or predators.

Two 8MP Bushnell Trophy Cam HD game cameras with night vision sensors were installed along the pit lake perimeter in August 2012 and left in place until May 2013. Initially, two cameras were strategically placed in locations where it was possible for mammals to approach the shoreline; much of the lake is surrounded by unstable rock walls, thus the paths selected were predicted to capture ungulate and carnivore use. These cameras also sometimes captured waterfowl use, so a third camera with a direct view of the lake surface was installed on a rock cliff along the lake during early November 2012 in order to directly assess waterfowl activity. Although the specific placement of the third camera did enable supplemental observations between in-person monitoring visits, wave movement on the pit lake sometimes caused falsely triggered photos to overwhelm data storage capacity. Game camera locations are shown in Figure 5A-5. Photos were uploaded from each of the cameras on a regular basis, typically monthly, and batteries were replaced during these visits as necessary.

Figure 5A-5. Pit Lake Game Camera Locations

After returning to the office, photos were sorted to isolate false triggers (caused by waves, wind, blowing debris, human activity, branch movement, etc.) from actual wildlife triggers. It's possible that very distant or small wildlife (particularly small birds or insects) that are sometimes difficult to see were overlooked during this review. A list of positive triggers was compiled and used to summarize visitation frequency. A biologist conservatively identified photos to the species, family, class, or order; depending on the image clarity, distance from the camera, and wildlife discernibility. When more than one species of waterfowl was present, unidentified/mixed waterfowl was attributed in the database. A table summarizing the game camera captures is included below (Table 5A-4). Figure 5A-5 includes sample photographs recorded at the lake.

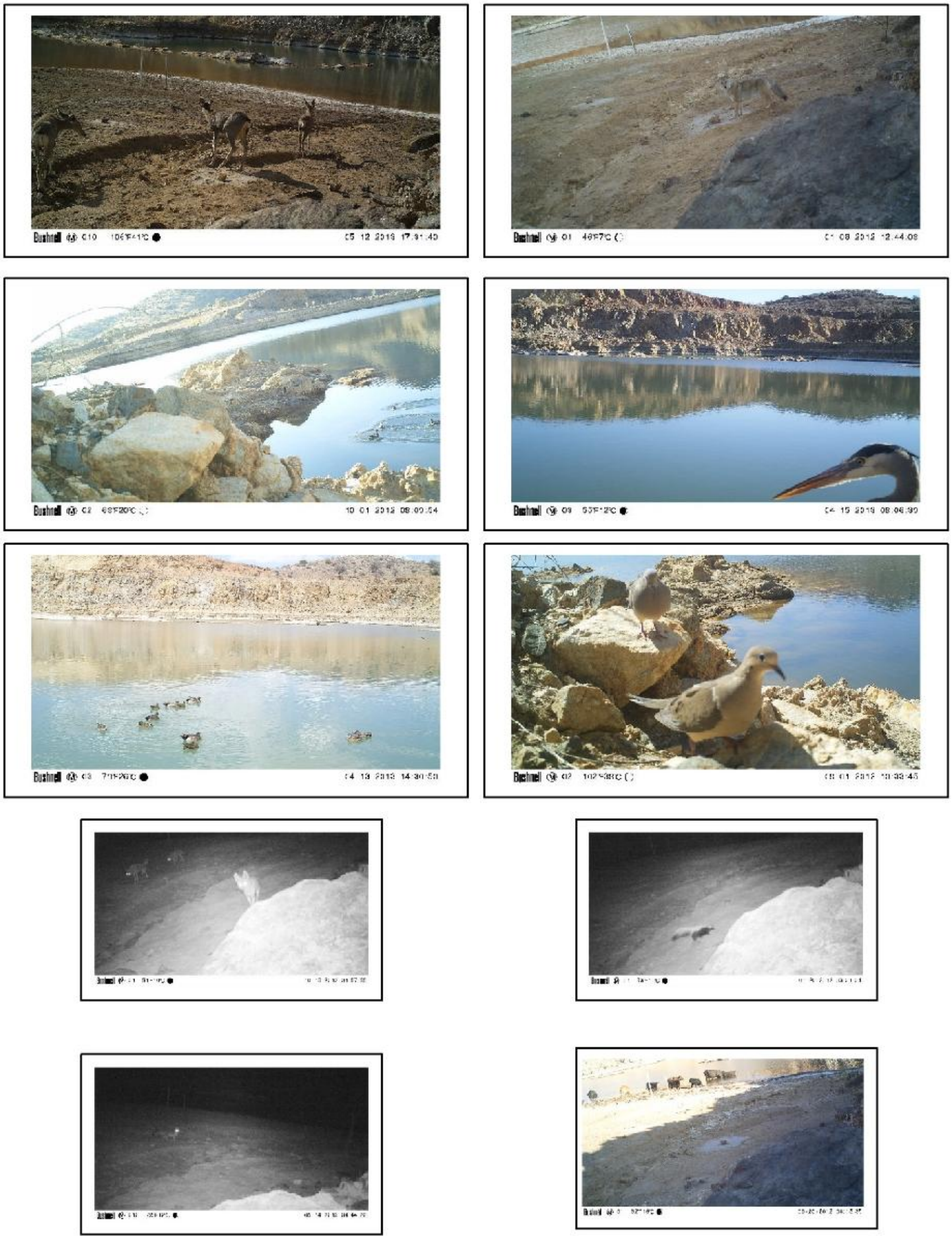
Overall, waterfowl visitation (listed in Table 5A-4 as either canvasback, mallard, or unidentified/mixed waterfowl) triggered the game cameras most frequently. Waterfowl caused the cameras to trigger more than 100 times through the capture period. The higher frequency of waterfowl captures versus other types of wildlife can be partially attributed to the fact that camera 3 was placed in a location with a clear view of the water's surface and intended to only capture waterfowl. A waterfowl photo was first captured on 3 September 2012, and visitation was photographed fairly regularly (2-6 times per month) through April 2013. Coyotes were the second most regular visitors with 37 total captures. The cameras recorded a variety of birds including Spotted sandpiper, Great blue heron, and others. Mule deer triggered the cameras a total of 11 times and were captured drinking from the lake on one photo. Cattle were regular visitors, too, particularly from September through January. Striped skunk (16 triggers), Rock squirrel (10), and mice (16) were each captured on multiple occasions. A gray fox was confirmed on one photo and another Canidae photo appeared to also capture a gray fox.

Table 5A-4
Summary of Game Camera Observations from the Pit Lake

	Sum of Individuals within a Photo	Total Number of Camera Triggers
Canine (Gray fox)	1	1
Canvasback	5	2
Chipping sparrow	1	1
Cow	89	26
Coyote	40	37
Dove	3	2
Gray fox	1	1
Great Blue Heron	11	11
Horned lark	1	1
Lepidopteran	1	1
Mallard	39	13
Mouse	16	16

	Sum of Individuals within a Photo	Total Number of Camera Triggers
Mule deer	17	11
Odonata	1	1
Rock squirrel	10	10
Rock wren	4	4
Rodent	3	3
Say's Phoebe	2	2
Spotted sandpiper	1	1
Striped skunk	16	16
Unidentified avian	14	14
Unknown close-up	3	3
White-winged dove	3	3
Unidentified/mixed waterfowl	434	103
Grand Total	716	283

Figure 5A-6. Sample Game Camera Photos from the Pit Lake



New Mexico Mining and Mineral Division Comment

Comment 1. Correct or remove sentence (pg 18 MORP) that refers to a coachwhip as a lizard.

Based on another review of the section, it appears that coachwhip was not referred to as a lizard in the Draft BDR; it was referred to as a reptile, which is technically correct.

References

Parametrix, Inc. 2012. Copper Flat Baseline Data Characterization Report – Section 5 (Wildlife). Developed under contract with New Mexico Copper Corporation.

C – Golder Technical Memorandum

TECHNICAL MEMORANDUM

Date: [illegible] **Project No.:** [illegible]

To: [illegible] **Company:** [illegible]

From: [illegible]

cc: [illegible] **Email:** [illegible]

RE: RESPONSE TO MMD COMMENTS ON THE BDR

[illegible]

[illegible]

[illegible]

1.0 RESPONSE TO COMMENTS

[illegible]

[illegible]

MMD Comment No. 1: Section 1, Introduction

"Please provide a geo-referenced map, at least 1:6,000 scale or larger to identify the individual soil units, 21 soil pits and 183 log sites of the soil survey. A supplementary table should identify the location of soil pits and log sites along with a brief description of family-level taxonomy at each location. Any notes that that identify special characteristics such as $CaCO_3$ content, rock content, induration or gradation of character from one soil to another should be included with this table."

Response:

[illegible]

MMD Comment No. 2: Section 1, Introduction

"In reference to Table 5; Please provide constituent concentrations of [Na+], [Mg++], and [Ca++] from paste extracts that were used to calculate SAR."

Response:

[illegible]

MMD Comment No. 3: Section 1, Introduction

"Please provide a clarifying discussion of the methods cited to conduct hydrometer and sieve tests as it is not clear if pretreatment methods were employed to remove carbonates from samples before dispersion or sieving."

Response:

[illegible]

MMD Comment No. 4: Section 1, Introduction

"During sieving, were fine and very fine sand fractions separated and accounted for? Please provide more discussion. Note, the only indication for sand size partitioning was for tailings substrate, on page 44."

Response:

[illegible]

MMD Comment No. 5: Section 1, Introduction

"On page 3 of the introduction, the scale for 1:6,000 is equivalent to 1 inch = 500 feet rather than 0.5 inches=1,000 feet. Please update."

Response:

[illegible]

MMD Comment No. 6: Section 2.2, Criteria for Topdressing Suitability

"Table 1. MMD agrees with the observation, p. 7 that soils dominated by coarse grained materials (up to 70% rock content) can produce vigorous vegetation if the remaining fine earth fraction is sufficiently loamy. On long steep slopes rocky substrates increase resistance to erosion. Please include stone with the cobble + gravel component for a maximum content of rock in the 'fair' limit to range of 35-70%. Please note, MMD regards 'good', 'fair' and 'unsuitable' as qualifying characteristics in general, but 'fair' materials, such as relatively high rock content may be more appropriate for steep slopes."

Response:

[illegible]

MMD Comment No. 7: Section 2.2, Criteria for Topdressing Suitability

"Table 1. Hot-water extractable boron should be limited to no more than 5 parts per million for suitable materials. Please correct Table 1 to demonstrate this."

Response:

[illegible]

MMD Comment No. 8: Section 2.2, Criteria for Topdressing Suitability

"Table 1. Calcium carbonate limits for 'good' material is listed as 15% $CaCO_3$ equivalent and for 'fair' materials as 15-40%. After review of pertinent literature, a series of discussions with other reclamation practitioners and our own experience with carbonate-rich soils materials in the field these limits are not judged appropriate for topdressing. There is a great deal of literature on the deleterious effects of $CaCO_3$ on agronomic and native plants ability to utilize P, Mg, and other metals. Elevated $CaCO_3$ in subsoil horizons may not be problematic or, may indeed increase available water to shallow rooted vegetation, in some situations. However, $CaCO_3$ content should not be above 10 percent equivalent in the upper six to twelve inches in a reconstructed soil profile. Please adjust $CaCO_3$ limits for 'good' materials to less than 10% and for 'fair' materials to 10-40%. No suitable materials should be salvaged from indurated horizons that are continuously cemented, regardless of $CaCO_3$ content."

Response:

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

MMD Comment No. 9: Section 2.2, Criteria for Topdressing Suitability

"Table 1. MMD views available water holding capacity (AWHC) as a critical component in evaluating soil suitability. Please define AWHC as bulk volumetric water holding capacity of soil materials to hold water between -0.033 and -1.5 Mpa of tension, corrected for rock content."

Response:

[illegible]

MMD Comment No. 10: Section 2.2, Criteria for Topdressing Suitability

"Either as part of Table 1 or a separate table, please estimate a range of values or a bulk value for each of the criteria listed in Table 1 for each soil unit and, if variation exists, for depth phases of soil units. AWHC and the method used to estimate it should be included as part of this table and discussion."

Response:

[illegible]

MMD Comment No. 11: Section 2.2, Criteria for Topdressing Suitability

"In reference to Section 3.1, with map units 102, 101 and 109 NMCC has differentiated several depth phases to estimate the median thickness of suitable salvage within individual soil unit phases. Please describe how these depth phases were determined among soil units with multiple depth phases and units which were not described by backhoe pits."

Response:

[illegible]

2.0 REFERENCES

[illegible]

[illegible]

[illegible]

[illegible] *Larrea tridentata* [illegible]

[illegible] *Larrea tridentata* [illegible] *Parthenium incanum* [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

ATTACHMENT 1
SUPPLEMENTAL SOILS INVESTIGATION,
JULY 8, 2013

REPORT

SUPPLEMENTAL SOILS INVESTIGATION

Copper Flat Project

Submitted To: [illegible]

[illegible]

Submitted By: [illegible]

[illegible]

Distribution: [illegible]

[illegible]

July 8, 2013 **123-80002A**

Golder Associates

Table of Contents

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1.0 INTRODUCTION

[illegible]

[illegible] *describe the environment of the proposed permit area and, to the extent practicable, the affected area* [illegible]

[illegible]

1.1 Previous Studies

[illegible]

[illegible]

[illegible]

[illegible]

1.2 General Environmental Setting

[illegible] *Prosopis gladulosa* [illegible] *Larrea tridentata* [illegible] *Flourensia cernua* [illegible]

1.3 Cover Performance Objectives

[illegible]

[illegible]

[illegible]

2.0 METHODS

[illegible]

2.1 Field Methods

[illegible]

2.2 Soil Sampling and Laboratory Methods

[illegible]

[illegible]

3.0 SOIL RESOURCES CHARACTERIZATION

[illegible]

3.1 Soils of the Tailing Storage Facility

[illegible]

[illegible]

[illegible]

[illegible]

3.2 Soils of the East WRDF

[illegible]

[illegible]

3.3 Laboratory Characterization

[illegible]

3.3.1 Physical Properties

[illegible]

[illegible]

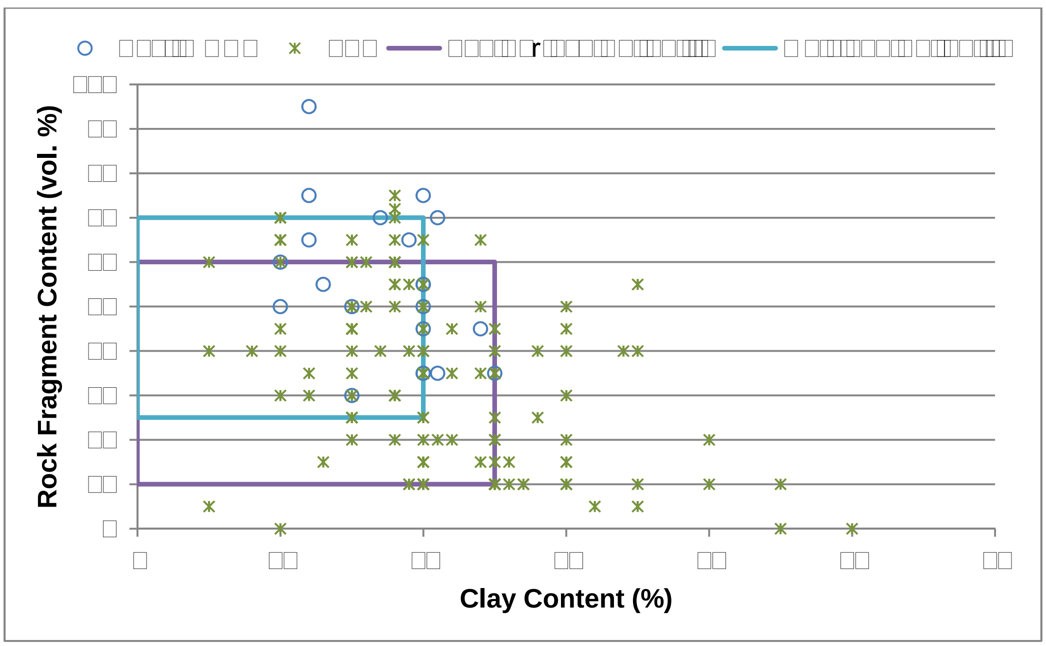
[illegible]

[illegible]

3.3.2 Chemical Properties

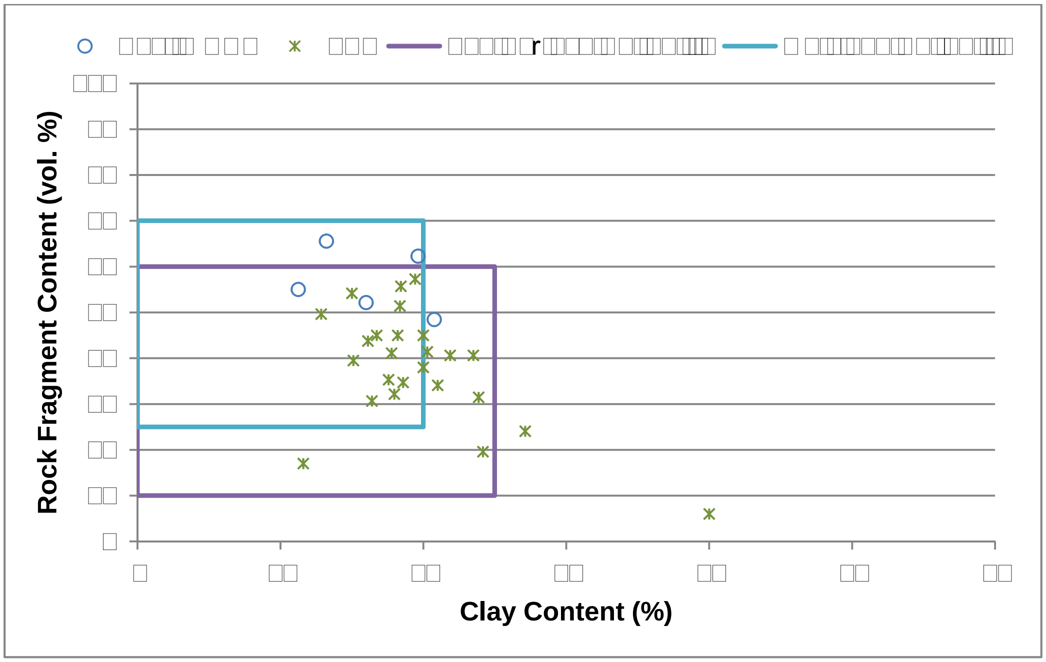
3.4 Reclamation Suitability

Chart 1: Copper Flat Soils – Clay Content vs. Rock Fragments



[illegible]

Chart 2: Copper Flat Soils - Weighted Average Clay vs. Rock Fragments



[illegible]

[illegible]

4.0 COVER VOLUMETRIC ESTIMATES

5.0 CLOSING

[illegible]

GOLDER ASSOCIATES INC.

[illegible]

6.0 REFERENCES

[illegible]

TABLES

Table 1: Analytical Methods for Chemical and Physical Soil Characterization

Analysis	Source-Method
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Table 2: Field Descriptions

Pit ID/ Depth (feet)			USDA Texture Class	Field Estimates vol %				Reaction with HCl	Color	Notes
	Sand	Clay		Gravel	Cobble	Stone	Total			
East Waste Rock Dump Facility Soils										
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	
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Table 2: Field Descriptions

Pit ID/ Depth (feet)			USDA Texture Class	Field Estimates vol %				Reaction with HCl	Color	Notes
	Sand	Clay		Gravel	Cobble	Stone	Total			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
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Table 2: Field Descriptions

Pit ID/ Depth (feet)	Sand	Clay	USDA Texture Class	Field Estimates vol %				Reaction with HCl	Color	Notes
				Gravel	Cobble	Stone	Total			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Table 2: Field Descriptions

Pit ID/ Depth (feet)	Sand	Clay	USDA Texture Class	Field Estimates vol % Gravel	Cobble	Stone	Total	Reaction with HCl	Color	Notes
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Table 2: Field Descriptions

Pit ID/ Depth (feet)			USDA Texture Class	Field Estimates vol %				Reaction with HCl	Color	Notes
	Sand	Clay		Gravel	Cobble	Stone	Total			
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	
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Table 3: Physical Properties and Secondary Interpretations

Pit ID/ Depth (feet)	Particle Size Distribution (%)			USDA Texture Class	Very Fine Sand wt%	Rock Fragments					RUSLE		AWC (in/ft)	Wind Erosion
						Lab.[1] wt %	Field Estimates vol %							
	Sand	Silt	Clay				Gravel	Cobble	Stone	Total	Kf	Kw		
East Waste Rock Dump Facility Soils														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Tailing Storage Facility Soils														
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Table 3: Physical Properties and Secondary Interpretations

Pit ID/ Depth (feet)	Particle Size Distribution (%)			USDA Texture Class	Very Fine Sand wt%	Rock Fragments					RUSLE		AWC (in/ft)	Wind Erosion
						Lab.[1] wt %	Field Estimates vol %							
	Sand	Silt	Clay				Gravel	Cobble	Stone	Total	Kf	Kw		
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Notes:

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Table 4: Chemical Properties

Pit ID/ Depth (feet)	Paste pH	Saturated Paste Extract EC (dS/m)	Saturation Percentage	Nitrate as N (mg/kg)	Phosphorus (mg/kg)	Potassium (mg/kg)	$CaCO_3$ Equivalent Percent
East Waste Rock Dump Facility Soils							
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Tailing Storage Facility Soils							
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Notes:

[illegible]

[illegible]

[illegible]

Table 5: AB-DTPA Extractable Metals for the Soil Samples

Pit ID/ Depth (feet)	AB-DTPA Extractable Metals (mg/kg)							
	Arsenic	Cadmium	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel
East Waste Rock Dump Facility Soils								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tailing Storage Facility Soils								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 6: Acid-Base Accounts

Pit ID/ Depth (feet)	Paste pH	Pyritic Sulfur Basis			Total Sulfur (%)	Extractable Sulfur Forms			Residual (%)
		ANP (t/kt)	AGP (t/kt)	ABA (t/kt)		Hot Water (%)	HCl (%)	HNO_3 (%)	
East Waste Rock Dump Facility Soils									
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tailing Storage Facility Soils									
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Notes:

[illegible]

[illegible]

[illegible]

[illegible]

Table 7: Estimated Reclamation Cover Requirements

Disturbance Type	Surface Area	Cover Thickness	Reclamation Cover Requirement
	(acres)	(ft)	(yd^3)
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]

Notes:

[illegible]

[illegible]

[illegible]

FIGURES

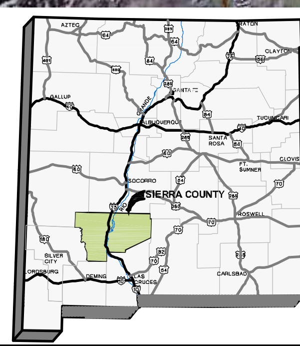
Drawing file: K:\2012 Projects\12380002A\COPPER FLAT FIG01.dwg Jun 25, 2013 - 10:47am

LEGEND

- CITY/TOWN
- SITE LOCATION
- ROAD

12 0 12

SCALE MILES



SOURCE: FIGURE 1-1 (INTERA, 2012). IMAGEERY FROM UNIVERSITY OF MARYLAND NLCD.

PROJECT
NEW MEXICO COPPER CORPORATION
COPPER FLAT PROJECT
SIERRA COUNTY, NEW MEXICO

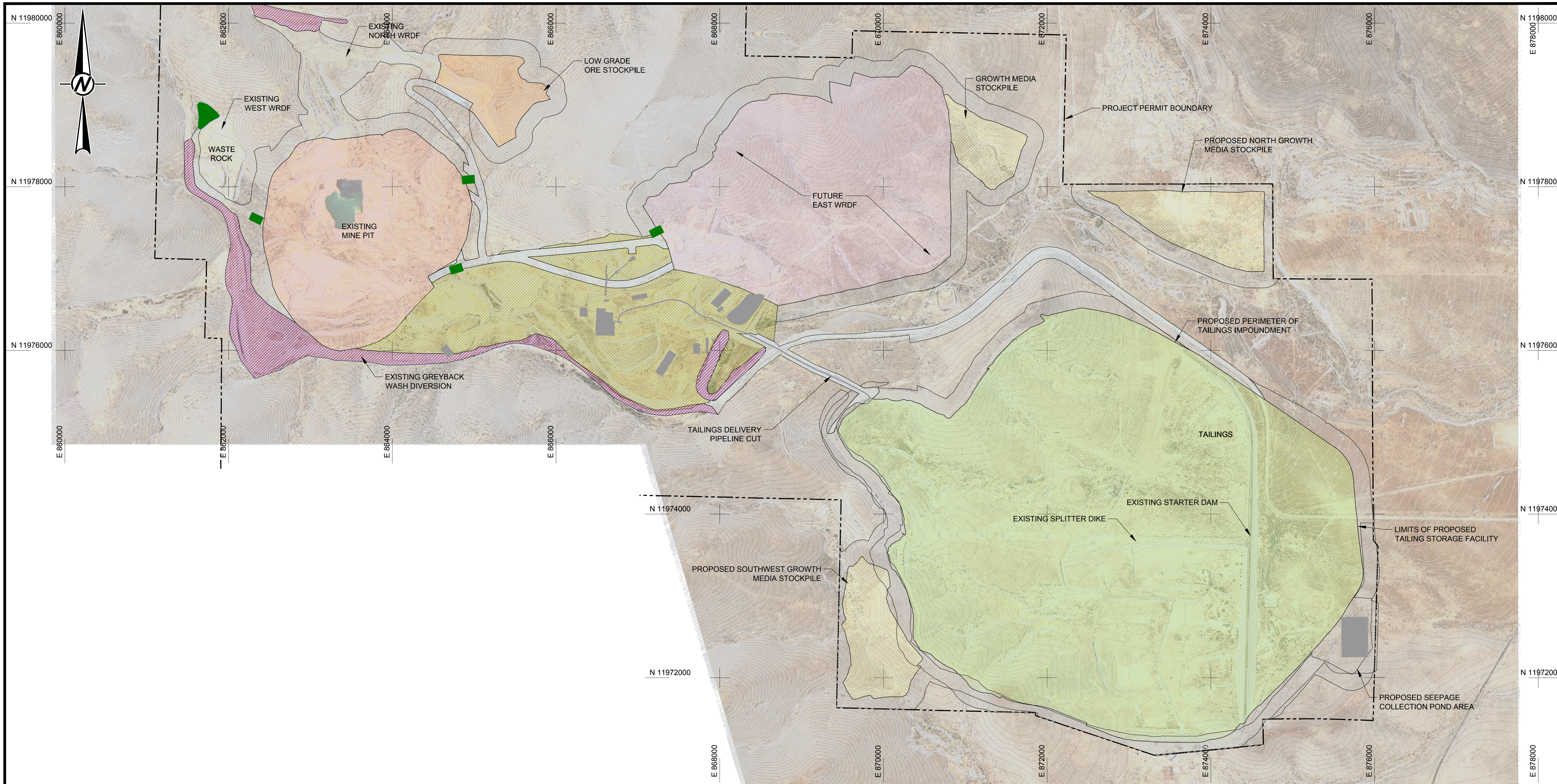
TITLE

SITE LOCATION

Golder Associates

PROJECT No.		123-80002A	FILE No. COPPER FLAT FIG01
DESIGN	EC	06/25/13	SCALE AS SHOWN REV. 0
CADD	CM	06/25/13	**FIGURE 1**
CHECK	EC	06/25/13	
REVIEW	BN	06/25/13	

07678



LEGEND

- PERMIT BOUNDARY
- PLANT FACILITY
- SEDIMENT COLLECTION PONDS
- ANCILLARY
- DIVERSION
- HAUL ROAD

NOTES

1. WRDF - WASTE ROCK DISPOSAL FACILITY.

REFERENCES

1. EXISTING FIVE (5) FOOT TOPOGRAPHY AND PERMIT BOUNDARY PROVIDED BY NEW MEXICO COPPER CORPORATION.
2. TOPOGRAPHY IN THE MINE AREA AND TAILINGS STORAGE FACILITY REPRESENTS EXISTING CONDITIONS AND DISTURBANCE ASSOCIATED WITH QUINTANA 1981-82 MINING OPERATIONS.

NOT FOR CONSTRUCTION

0 600 1200 1800
SCALE FEET

PROJECT
NEW MEXICO COPPER CORPORATION
COPPER FLAT PROJECT
SIERRA COUNTY, NEW MEXICO

TITLE
FACILITY LAYOUT

Golder Associates

PROJECT No.		123-80002A	FILE No.	SITE INVESTIGATION
DESIGN	EC	06/25/13	SCALE AS SHOWN	REV. 0
CADD	CM	06/25/13	DRAWING	
CHECK	EC	06/25/13	FIGURE 2	
REVIEW	DR	06/28/13		

PLATES

APPENDIX A
LABORATORY REPORT

ANALYTICAL SUMMARY REPORT

May 14, 2013

Golder Associates Inc
5200 Pasadena NE Ste C
Albuquerque, NM 87113

Workorder No.: B13050229 Quote ID: B2958

Project Name: 123-80002A Supplemental Soils

Energy Laboratories Inc Billings MT received the following 48 samples for Golder Associates Inc on 5/2/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
B13050229-001	TP3 0-1	12/21/12 0:00	05/02/13	Soil	ABDPTA extractable metals Metals, NH4OAc Extractable Acid/Base Potential Coarse Fragments Conductivity Nitrate as N, KCL Extract pH, Saturated Paste Phosphorus-Olsen ABDTPA extraction for metals NH4AC Soil Extraction Saturated Paste Extraction Particle Size Analysis Saturation Percentage Sulfur Forms Texture Very Fine Sand
B13050229-002	TP3 1-2	12/21/12 0:00	05/02/13	Soil	Same As Above
B13050229-003	TP3 2-7	12/21/12 0:00	05/02/13	Soil	Same As Above
B13050229-004	TP3 7-9	12/21/12 0:00	05/02/13	Soil	Same As Above
B13050229-005	TP3 9-11	12/21/12 0:00	05/02/13	Soil	Same As Above
B13050229-006	TP5 0-1	01/03/13 0:00	05/02/13	Soil	Same As Above
B13050229-007	TP5 1-3	01/03/13 0:00	05/02/13	Soil	Same As Above
B13050229-008	TP5 3-7	01/03/13 0:00	05/02/13	Soil	Same As Above
B13050229-009	TP7 0-1.5	12/17/12 0:00	05/02/13	Soil	Coarse Fragments Conductivity Lime as CaCO3, % pH, Saturated Paste Saturated Paste Extraction Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B13050229-010	TP7 1.5-4	12/17/12 0:00	05/02/13	Soil	Same As Above
B13050229-011	TP7 6-8	12/17/12 0:00	05/02/13	Soil	Same As Above
B13050229-012	TP7 8-10	12/17/12 0:00	05/02/13	Soil	Same As Above
B13050229-013	TP7 10-12	12/17/12 0:00	05/02/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

B13050229-014	TP9 6-8	12/17/12 0:00	05/02/13	Soil	ABDPTA extractable metals Metals, NH4OAc Extractable Acid/Base Potential Coarse Fragments Conductivity Nitrate as N, KCL Extract pH, Saturated Paste Phosphorus-Olsen ABDTPA extraction for metals NH4AC Soil Extraction Saturated Paste Extraction Particle Size Analysis Saturation Percentage Sulfur Forms Texture Very Fine Sand
B13050229-015	TP9 8-10	12/17/12 0:00	05/02/13	Soil	Same As Above
B13050229-016	TP9 10-11	12/17/12 0:00	05/02/13	Soil	Same As Above
B13050229-017	TP12 0-1	01/02/13 0:00	05/02/13	Soil	Same As Above
B13050229-018	TP12 1-3	01/02/13 0:00	05/02/13	Soil	Same As Above
B13050229-019	TP12 3-7	01/02/13 0:00	05/02/13	Soil	Same As Above
B13050229-020	TP12 8-11	01/02/13 0:00	05/02/13	Soil	Same As Above
B13050229-021	TP12 11-13	01/02/13 0:00	05/02/13	Soil	Same As Above
B13050229-022	TP16 0-2	12/20/12 0:00	05/02/13	Soil	Same As Above
B13050229-023	TP16 2-4	12/20/12 0:00	05/02/13	Soil	Same As Above
B13050229-024	TP16 4-7	12/20/12 0:00	05/02/13	Soil	Same As Above
B13050229-025	TP16 7-10	12/20/12 0:00	05/02/13	Soil	Same As Above
B13050229-026	TP16 10-17	12/20/12 0:00	05/02/13	Soil	Same As Above
B13050229-027	TP17 0-2	12/18/12 0:00	05/02/13	Soil	Coarse Fragments Conductivity Lime as CaCO3, % pH, Saturated Paste Saturated Paste Extraction Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B13050229-028	TP17 2-4	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-029	TP17 4-6	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-030	TP17 6-10	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-031	TP21 7-11	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-032	TP21 11-14	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-033	TP21 14-18	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-034	TP24 0-3	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-035	TP24 3-5	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-036	TP24 5-10	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-037	TP24 10-14	12/18/12 0:00	05/02/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

B13050229-038	TP24 14-16	12/18/12 0:00	05/02/13	Soil	Same As Above
B13050229-039	TP25 2-5	12/13/12 0:00	05/02/13	Soil	Same As Above
B13050229-040	TP27 0-2	12/19/12 0:00	05/02/13	Soil	ABDPTA extractable metals Metals, NH4OAc Extractable Acid/Base Potential Coarse Fragments Conductivity Nitrate as N, KCL Extract pH, Saturated Paste Phosphorus-Olsen ABDTPA extraction for metals NH4AC Soil Extraction Saturated Paste Extraction Particle Size Analysis Saturation Percentage Sulfur Forms Texture Very Fine Sand
B13050229-041	TP27 2-3	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-042	TP27 3-7	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-043	TP27 7-13	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-044	TP27 13-14	12/19/12 0:00	05/02/13	Soil	Same As Above
B13050229-045	TP31 1-2	01/03/13 0:00	05/02/13	Soil	Coarse Fragments Conductivity Lime as CaCO3, % pH, Saturated Paste Saturated Paste Extraction Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B13050229-046	TP31 2-5	01/03/13 0:00	05/02/13	Soil	Same As Above
B13050229-047	TP31 5-8	01/03/13 0:00	05/02/13	Soil	Same As Above
B13050229-048	TP31 8-16	01/03/13 0:00	05/02/13	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 1120 S 27th St., Billings, MT 59101, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

Sonya Mallett

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils
Workorder: B13050229

Report Date: 05/14/13
Date Received: 05/02/13

	Analysis	Coarse Frags	Sand	Silt	Clay	Very Fine Sand	Texture	pH	Saturation	Cond-Sat Paste	Neut Potential	Acid Potential	Acid/Base Potential	S, Total
	Units	%	%	%	%	wt%		s_u_	%	mmhos/cm	t/kt	t/kt	t/kt	%
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B13050229-001	TP3 0-1	35	49	27	24	6	SCL	7.50	31.4	0.5	206	0	206	0.01
B13050229-002	TP3 1-2	28	48	31	21	0	L	7.50	25.3	0.6	606	0	606	< 0.01
B13050229-003	TP3 2-7	35	44	37	19	1	L	7.70	27.3	1.1	422	0	422	< 0.01
B13050229-004	TP3 7-9	45	46	33	21	4	L	7.90	29.6	1.8	303	0	303	0.01
B13050229-005	TP3 9-11	46	50	33	17	3	L	7.60	29.8	4.5	331	0	331	0.07
B13050229-006	TP5 0-1	37	54	26	20	3	SCL	7.40	29.9	0.6	286	0	286	0.02
B13050229-007	TP5 1-3	27	46	34	20	0	L	7.50	30.2	0.4	456	0	456	0.01
B13050229-008	TP5 3-7	36	58	29	13	2	SL	7.60	30.4	0.4	394	0	394	< 0.01
B13050229-009	TP7 0-1.5	19	50	24	26	5	SCL	7.60	33.5	0.4				
B13050229-010	TP7 1.5-4	14	39	26	35	6	CL	7.70	46.1	0.7				
B13050229-011	TP7 6-8	31	56	22	22	4	SCL	7.80	29.4	0.9				
B13050229-012	TP7 8-10	42	64	17	19	3	SL	7.90	28.4	0.9				
B13050229-013	TP7 10-12	41	60	21	19	8	SL	7.80	34.4	1.1				
B13050229-014	TP9 6-8	35	54	29	17	6	SL	7.60	29.9	2.8	464	0	463	0.07
B13050229-015	TP9 8-10	53	66	18	16	6	SL	7.70	27.8	1.9	375	0	375	0.03
B13050229-016	TP9 10-11	42	54	28	18	8	SL	7.70	31.5	2.7	297	0	297	0.07
B13050229-017	TP12 0-1	17	60	21	19	9	SL	7.70	25.8	0.5	47	0	47	0.03
B13050229-018	TP12 1-3	20	30	43	27	4	CL	7.60	35.1	1.4	406	0	406	0.01
B13050229-019	TP12 3-7	65	59	23	18	4	SL	7.50	25.7	2.8	192	0	192	0.02
B13050229-020	TP12 8-11	21	66	22	12	10	SL	7.60	23.6	4.6	147	0	147	0.02
B13050229-021	TP12 11-13	18	52	33	15	10	L	7.40	27.9	4.8	225	0	225	0.02
B13050229-022	TP16 0-2	20	53	26	21	6	SCL	7.60	28.7	0.6	113	0	113	0.01
B13050229-023	TP16 2-4	19	40	34	26	5	L	7.70	33.7	0.6	336	0	336	< 0.01
B13050229-024	TP16 4-7	8	48	39	13	10	L	7.60	35.3	2.1	156	0	156	0.02
B13050229-025	TP16 7-10	12	29	52	19	3	SiL	7.70	31.4	1.5	189	0	189	0.01
B13050229-026	TP16 10-17	55	57	25	18	3	SL	7.70	26.2	1.2	117	0	117	0.02
B13050229-027	TP17 0-2	19	34	36	30	1	CL	7.70	44.3	0.5				
B13050229-028	TP17 2-4	14	23	45	32	0	CL	7.80	38.4	0.3				
B13050229-029	TP17 4-6	28	51	29	20	6	L	7.80	33.1	0.3				
B13050229-030	TP17 6-10	40	77	15	8	7	SL	7.90	32.2	0.4				
B13050229-031	TP21 7-11	55	51	25	24	6	SCL	7.60	42.6	4.5				
B13050229-032	TP21 11-14	39	51	25	24	7	SCL	7.50	37.0	3.3				
B13050229-033	TP21 14-18	17	49	33	18	16	L	7.60	38.5	3.2				
B13050229-034	TP24 0-3	35	35	31	34	3	CL	7.80	41.7	0.5				
B13050229-035	TP24 3-5	33	37	35	28	3	CL	7.70	37.8	0.8				
B13050229-036	TP24 5-10	15	45	33	22	7	L	7.90	31.9	1.3				
B13050229-037	TP24 10-14	36	57	25	18	4	SL	7.80	28.3	2.0				
B13050229-038	TP24 14-16	55	59	23	18	4	SL	7.70	28.6	4.0				
B13050229-039	TP25 2-5	61	67	15	18	5	SL	8.00	29.1	0.3				
B13050229-040	TP27 0-2	32	53	23	24	3	SCL	7.60	33.5	0.5	117	0	117	0.01

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils
Workorder: B13050229

Report Date: 05/14/13
Date Received: 05/02/13

	Analysis	Coarse Frags	Sand	Silt	Clay	Very Fine Sand	Texture	pH	Saturation	Cond-Sat Paste	Neut Potential	Acid Potential	Acid/Base Potential	S, Total
	Units	%	%	%	%	wt%		s_u_	%	mmhos/cm	t/kt	t/kt	t/kt	%
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
B13050229-041	TP27 2-3	42	45	27	28	4	CL	7.60	36.7	0.7	208	0	208	0.01
B13050229-042	TP27 3-7	51	62	20	18	5	SL	7.70	28.0	0.7	261	0	261	< 0.01
B13050229-043	TP27 7-13	59	67	15	18	5	SL	8.00	26.9	0.6	267	0	266	0.01
B13050229-044	TP27 13-14	51	69	15	16	4	SL	8.00	25.0	0.5	231	0	231	0.02
B13050229-045	TP31 1-2	31	48	28	24	8	L	8.10	39.2	0.6				
B13050229-046	TP31 2-5	44	63	17	20	6	SCL	8.00	31.5	0.7				
B13050229-047	TP31 5-8	53	67	13	20	6	SCL	8.00	30.4	0.6				
B13050229-048	TP31 8-16	53	61	17	22	7	SCL	7.90	33.5	0.9				

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils
Workorder: B13050229

Report Date: 05/14/13
Date Received: 05/02/13

Sample ID	Client Sample ID	S, H2O Extr	S, HCL Extr	S, HNO3 Extr	S, Residual	Lime	Phos, Olsen	Nitrate as N	Potassium	As-ABDTPA	Cd-ABDTPA	Cu-ABDTPA	Hg-ABDTPA	Mn-ABDTPA
	Units	%	%	%	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
B13050229-001	TP3 0-1	< 0.01	< 0.01	< 0.01	0.01		9	3	96	0.06	< 0.1	1.8	< 0.1	2.6
B13050229-002	TP3 1-2	< 0.01	< 0.01	< 0.01	0.01		11	2	45	0.09	< 0.1	0.9	< 0.1	1.8
B13050229-003	TP3 2-7	< 0.01	< 0.01	< 0.01	0.01		8	1	57	0.15	< 0.1	0.7	< 0.1	0.7
B13050229-004	TP3 7-9	< 0.01	< 0.01	< 0.01	0.01		7	1	91	0.10	< 0.1	0.3	< 0.1	0.4
B13050229-005	TP3 9-11	0.06	< 0.01	< 0.01	0.01		7	< 1	72	0.10	< 0.1	0.5	< 0.1	0.9
B13050229-006	TP5 0-1	< 0.01	< 0.01	< 0.01	0.01		10	9	150	0.08	< 0.1	8.0	< 0.1	6.1
B13050229-007	TP5 1-3	< 0.01	< 0.01	< 0.01	0.01		7	3	90	0.09	< 0.1	2.9	< 0.1	2.4
B13050229-008	TP5 3-7	< 0.01	< 0.01	< 0.01	0.01		7	1	69	0.11	< 0.1	0.9	< 0.1	1.1
B13050229-009	TP7 0-1.5					4.5								
B13050229-010	TP7 1.5-4					3.2								
B13050229-011	TP7 6-8					40.8								
B13050229-012	TP7 8-10					25.3								
B13050229-013	TP7 10-12					26.4								
B13050229-014	TP9 6-8	0.04	< 0.01	0.02	0.01		6	< 1	210	0.06	< 0.1	25.7	< 0.1	1.8
B13050229-015	TP9 8-10	< 0.01	< 0.01	0.01	0.01		6	< 1	56	0.10	< 0.1	10.8	< 0.1	1.2
B13050229-016	TP9 10-11	0.03	< 0.01	0.02	0.02		7	1	80	0.07	< 0.1	30.5	< 0.1	1.5
B13050229-017	TP12 0-1	< 0.01	< 0.01	0.01	0.02		7	5	260	0.08	< 0.1	4.8	< 0.1	2.6
B13050229-018	TP12 1-3	< 0.01	< 0.01	< 0.01	0.01		8	4	110	0.10	< 0.1	2.6	< 0.1	1.2
B13050229-019	TP12 3-7	< 0.01	< 0.01	< 0.01	0.02		9	3	99	0.12	< 0.1	4.4	< 0.1	1.4
B13050229-020	TP12 8-11	< 0.01	< 0.01	< 0.01	0.02		5	1	60	0.07	< 0.1	1.1	< 0.1	0.5
B13050229-021	TP12 11-13	< 0.01	< 0.01	< 0.01	0.02		6	1	86	0.10	< 0.1	1.6	< 0.1	0.9
B13050229-022	TP16 0-2	< 0.01	< 0.01	< 0.01	0.01		7	6	360	0.08	< 0.1	4.2	< 0.1	3.7
B13050229-023	TP16 2-4	< 0.01	< 0.01	< 0.01	0.01		9	2	110	0.10	< 0.1	3.9	< 0.1	2.6
B13050229-024	TP16 4-7	< 0.01	< 0.01	< 0.01	0.02		6	1	140	0.07	< 0.1	1.4	< 0.1	0.6
B13050229-025	TP16 7-10	< 0.01	< 0.01	< 0.01	0.02		6	5	120	0.23	< 0.1	1.3	< 0.1	0.4
B13050229-026	TP16 10-17	< 0.01	< 0.01	< 0.01	0.02		6	4	110	0.10	< 0.1	2.2	< 0.1	1.3
B13050229-027	TP17 0-2					16.1								
B13050229-028	TP17 2-4					61.7								
B13050229-029	TP17 4-6					36.1								
B13050229-030	TP17 6-10					37.5								
B13050229-031	TP21 7-11					6.7								
B13050229-032	TP21 11-14					10.6								
B13050229-033	TP21 14-18					20.6								
B13050229-034	TP24 0-3					14.2								
B13050229-035	TP24 3-5					26.1								
B13050229-036	TP24 5-10					39.2								
B13050229-037	TP24 10-14					24.4								
B13050229-038	TP24 14-16					20.3								
B13050229-039	TP25 2-5					11.7								
B13050229-040	TP27 0-2	< 0.01	< 0.01	< 0.01	0.01		7	6	140	0.08	< 0.1	3.5	< 0.1	2.3

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils
Workorder: B13050229

Report Date: 05/14/13
Date Received: 05/02/13

	Analysis	S, H2O Extr	S, HCL Extr	S, HNO3 Extr	S, Residual	Lime	Phos, Olsen	Nitrate as N	Potassium	As-ABDTPA	Cd-ABDTPA	Cu-ABDTPA	Hg-ABDTPA	Mn-ABDTPA
	Units	%	%	%	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ID	Client Sample ID	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
B13050229-041	TP27 2-3	< 0.01	< 0.01	< 0.01	0.01		7	3	110	0.06	< 0.1	2.2	< 0.1	1.3
B13050229-042	TP27 3-7	< 0.01	< 0.01	< 0.01	0.01		7	2	52	0.07	< 0.1	0.8	< 0.1	0.6
B13050229-043	TP27 7-13	< 0.01	< 0.01	0.01	0.01		6	< 1	42	0.07	< 0.1	0.6	< 0.1	0.6
B13050229-044	TP27 13-14	< 0.01	< 0.01	< 0.01	0.02		5	< 1	71	0.08	< 0.1	0.5	< 0.1	0.7
B13050229-045	TP31 1-2					16.9								
B13050229-046	TP31 2-5					16.1								
B13050229-047	TP31 5-8					17.8								
B13050229-048	TP31 8-16					5.2								

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils
Workorder: B13050229

Report Date: 05/14/13
Date Received: 05/02/13

	Analysis	Mo-ABDTPA	Ni-ABDTPA	Pb-ABDTPA
	Units	mg/kg	mg/kg	mg/kg
Sample ID	**Client Sample ID**	**Results**	**Results**	**Results**
B13050229-001	TP3 0-1	< 0.1	< 0.1	1.0
B13050229-002	TP3 1-2	< 0.1	< 0.1	0.9
B13050229-003	TP3 2-7	< 0.1	< 0.1	0.4
B13050229-004	TP3 7-9	< 0.1	< 0.1	0.3
B13050229-005	TP3 9-11	< 0.1	< 0.1	0.3
B13050229-006	TP5 0-1	< 0.1	0.1	1.3
B13050229-007	TP5 1-3	< 0.1	< 0.1	0.7
B13050229-008	TP5 3-7	< 0.1	< 0.1	0.3
B13050229-009	TP7 0-1.5			
B13050229-010	TP7 1.5-4			
B13050229-011	TP7 6-8			
B13050229-012	TP7 8-10			
B13050229-013	TP7 10-12			
B13050229-014	TP9 6-8	0.9	< 0.1	0.4
B13050229-015	TP9 8-10	0.2	< 0.1	0.3
B13050229-016	TP9 10-11	0.3	< 0.1	0.5
B13050229-017	TP12 0-1	< 0.1	< 0.1	1.3
B13050229-018	TP12 1-3	< 0.1	< 0.1	0.6
B13050229-019	TP12 3-7	< 0.1	0.4	0.6
B13050229-020	TP12 8-11	< 0.1	< 0.1	0.3
B13050229-021	TP12 11-13	< 0.1	< 0.1	0.5
B13050229-022	TP16 0-2	< 0.1	0.1	1.0
B13050229-023	TP16 2-4	< 0.1	< 0.1	1.0
B13050229-024	TP16 4-7	< 0.1	< 0.1	0.9
B13050229-025	TP16 7-10	< 0.1	< 0.1	0.9
B13050229-026	TP16 10-17	< 0.1	< 0.1	0.6
B13050229-027	TP17 0-2			
B13050229-028	TP17 2-4			
B13050229-029	TP17 4-6			
B13050229-030	TP17 6-10			
B13050229-031	TP21 7-11			
B13050229-032	TP21 11-14			
B13050229-033	TP21 14-18			
B13050229-034	TP24 0-3			
B13050229-035	TP24 3-5			
B13050229-036	TP24 5-10			
B13050229-037	TP24 10-14			
B13050229-038	TP24 14-16			
B13050229-039	TP25 2-5			
B13050229-040	TP27 0-2	< 0.1	< 0.1	1.4

LABORATORY ANALYTICAL REPORT

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils
Workorder: B13050229

Report Date: 05/14/13
Date Received: 05/02/13

	Analysis	Mo-ABDTPA	Ni-ABDTPA	Pb-ABDTPA
	Units	mg/kg	mg/kg	mg/kg
Sample ID	Client Sample ID	Results	Results	Results
B13050229-041	TP27 2-3	< 0.1	< 0.1	1.0
B13050229-042	TP27 3-7	< 0.1	< 0.1	0.4
B13050229-043	TP27 7-13	< 0.1	< 0.1	0.3
B13050229-044	TP27 13-14	< 0.1	< 0.1	0.2
B13050229-045	TP31 1-2			
B13050229-046	TP31 2-5			
B13050229-047	TP31 5-8			
B13050229-048	TP31 8-16			

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3								Batch: R204392	
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Conductivity, sat. paste	0.470	mmhos/cm	0.10				2.2	30	
Sample ID: B13050229-011A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Conductivity, sat. paste	0.880	mmhos/cm	0.10				1.1	30	
Sample ID: B13050229-021A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Conductivity, sat. paste	4.90	mmhos/cm	0.10				1.9	30	
Sample ID: B13050229-031A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Conductivity, sat. paste	4.56	mmhos/cm	0.10				2.0	30	
Sample ID: B13050229-041A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Conductivity, sat. paste	0.650	mmhos/cm	0.10				1.5	30	
Sample ID: LCS-1305100959	Laboratory Control Sample				Run: MISC-SOIL_130510A			05/10/13 09:59	
Conductivity, sat. paste	7.00	mmhos/cm	0.10	90	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA15-5								Batch: R204392	
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Sand	50	%	1.0				2.0	40	
Silt	27	%	1.0				0.0	40	
Clay	23	%	1.0				4.3	40	
Sample ID: B13050229-011A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Sand	56	%	1.0				0.0	40	
Silt	23	%	1.0				4.4	40	
Clay	21	%	1.0				4.7	40	
Sample ID: B13050229-021A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Sand	53	%	1.0				1.9	40	
Silt	32	%	1.0				3.1	40	
Clay	15	%	1.0				0.0	40	
Sample ID: LCS-1305100959	Laboratory Control Sample				Run: MISC-SOIL_130510A			05/10/13 09:59	
Sand	42	%	1.0	102	50	150			
Silt	34	%	1.0	97	50	150			
Clay	24	%	1.0	100	50	150			
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/13/13 09:17	
Very Fine Sand	7	wt%	1				28	50	
Sample ID: B13050229-011A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/13/13 09:17	
Very Fine Sand	4	wt%	1				23	50	
Sample ID: B13050229-021A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/13/13 09:17	
Very Fine Sand	10	wt%	1				1.0	50	
Sample ID: LCS-1305130917	Laboratory Control Sample				Run: MISC-SOIL_130510A			05/13/13 09:17	
Very Fine Sand	8	wt%	1	98	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA15-5								Batch: R204457	
Sample ID: B13050229-025A DUP	Sample Duplicate				Run: MISC-SOIL_130513A			05/13/13 08:54	
Sand	30	%	1.0				3.4	40	
Silt	51	%	1.0				1.9	40	
Clay	19	%	1.0				0.0	40	
Sample ID: B13050229-035A DUP	Sample Duplicate				Run: MISC-SOIL_130513A			05/13/13 08:54	
Sand	37	%	1.0				0.0	40	
Silt	35	%	1.0				0.0	40	
Clay	28	%	1.0				0.0	40	
Sample ID: B13050229-045A DUP	Sample Duplicate				Run: MISC-SOIL_130513A			05/13/13 08:54	
Sand	48	%	1.0				0.0	40	
Silt	28	%	1.0				0.0	40	
Clay	24	%	1.0				0.0	40	
Sample ID: LCS-1305130854	Laboratory Control Sample				Run: MISC-SOIL_130513A			05/13/13 08:54	
Sand	42	%	1.0	102	50	150			
Silt	34	%	1.0	97	50	150			
Clay	24	%	1.0	100	50	150			
Sample ID: B13050229-025A DUP	Sample Duplicate				Run: MISC-SOIL_130513A			05/13/13 08:54	
Very Fine Sand	4	wt%	1				29	50	
Sample ID: B13050229-035A DUP	Sample Duplicate				Run: MISC-SOIL_130513A			05/13/13 08:54	
Very Fine Sand	3	wt%	1				0.0	50	
Sample ID: B13050229-045A DUP	Sample Duplicate				Run: MISC-SOIL_130513A			05/13/13 08:54	
Very Fine Sand	7	wt%	1				13	50	
Sample ID: LCS-1305130854	Laboratory Control Sample				Run: MISC-SOIL_130513A			05/13/13 08:54	
Very Fine Sand	7	wt%	1	88	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5								Batch: 130508013	
Sample ID: LCS	Laboratory Control Sample				Run: FIA201-B_130508A			05/08/13 10:55	
Phosphorus, Olsen	13.8	mg/kg	1.0	103	50	150			
Sample ID: B13050229-001ADUP	Sample Duplicate				Run: FIA201-B_130508A			05/08/13 11:02	
Phosphorus, Olsen	8.38	mg/kg	1.0				9.8	30	
Sample ID: B13050229-001AMS	Sample Matrix Spike				Run: FIA201-B_130508A			05/08/13 11:03	
Phosphorus, Olsen	19.8	mg/kg	1.0	101	50	150			
Sample ID: B13050229-016ADUP	Sample Duplicate				Run: FIA201-B_130508A			05/08/13 11:22	
Phosphorus, Olsen	6.91	mg/kg	1.0				2.3	30	
Sample ID: B13050229-016AMS	Sample Matrix Spike				Run: FIA201-B_130508A			05/08/13 11:23	
Phosphorus, Olsen	18.0	mg/kg	1.0	107	50	150			
Sample ID: B13050229-026ADUP	Sample Duplicate				Run: FIA201-B_130508A			05/08/13 11:41	
Phosphorus, Olsen	6.23	mg/kg	1.0				2.6	30	
Sample ID: B13050229-026AMS	Sample Matrix Spike				Run: FIA201-B_130508A			05/08/13 11:43	
Phosphorus, Olsen	17.3	mg/kg	1.0	107	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA33-8								Batch: 13050901-NNS2	
Sample ID: LCS	Laboratory Control Sample				Run: FIA201-B_130510A			05/09/13 12:16	
Nitrate as N, KCL Extract	7.03	mg/kg	1.0	95	50	150			
Sample ID: B13042185-001ADUP	Sample Duplicate				Run: FIA201-B_130510A			05/09/13 12:19	
Nitrate as N, KCL Extract	5.43	mg/kg	1.0				3.0	30	
Sample ID: B13042185-001AMS	Sample Matrix Spike				Run: FIA201-B_130510A			05/09/13 12:20	
Nitrate as N, KCL Extract	10.5	mg/kg	1.0	94	50	150			
Sample ID: B13050229-014ADUP	Sample Duplicate				Run: FIA201-B_130510A			05/09/13 12:29	
Nitrate as N, KCL Extract	0.942	mg/kg	1.0					30	
Sample ID: B13050229-014AMS	Sample Matrix Spike				Run: FIA201-B_130510A			05/09/13 12:30	
Nitrate as N, KCL Extract	6.16	mg/kg	1.0	101	50	150			
Sample ID: B13050229-024ADUP	Sample Duplicate				Run: FIA201-B_130510A			05/09/13 12:39	
Nitrate as N, KCL Extract	1.06	mg/kg	1.0				8.8	30	
Sample ID: B13050229-024AMS	Sample Matrix Spike				Run: FIA201-B_130510A			05/09/13 12:39	
Nitrate as N, KCL Extract	6.47	mg/kg	1.0	101	50	150			
Sample ID: B13050347-001BMS	Sample Matrix Spike				Run: FIA201-B_130510A			05/09/13 12:48	
Nitrate as N, KCL Extract	1100	mg/kg-dry	10	97	50	150			
Sample ID: B13050347-001BDUP	Sample Duplicate				Run: FIA201-B_130510A			05/09/13 12:49	
Nitrate as N, KCL Extract	68.4	mg/kg-dry	10				44	30	R

Qualifiers:

RL - Analyte reporting limit.

R - RPD exceeds advisory limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3.2								Batch: R204392	
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
pH, sat. paste	7.50	s.u.	0.10				0.0	10	
Sample ID: B13050229-011A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
pH, sat. paste	7.80	s.u.	0.10				0.0	10	
Sample ID: B13050229-021A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
pH, sat. paste	7.50	s.u.	0.10				1.3	10	
Sample ID: B13050229-031A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
pH, sat. paste	7.60	s.u.	0.10				0.0	10	
Sample ID: B13050229-041A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
pH, sat. paste	7.60	s.u.	0.10				0.0	10	
Sample ID: LCS-1305100959	Laboratory Control Sample				Run: MISC-SOIL_130510A			05/10/13 09:59	
pH, sat. paste	6.90	s.u.	0.10	97	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc

Project: 123-80002A Supplemental Soils

Report Date: 05/14/13

Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: Sobek Modified									Batch: R204457
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130513A				05/10/13 10:43
Sulfur, Total	0.0148	%	0.010				0.3	50	
Sulfur, Hot Water Extractable	0.00340	%	0.010					50	
Sulfur, HCl Extractable	0.00140	%	0.010					50	
Sulfur, HNO3 Extractable	ND	%	0.010					50	
Sulfur, Residual	0.0100	%	0.010				0.0	50	
Sample ID: B13050229-016A DUP	Sample Duplicate				Run: MISC-SOIL_130513A				05/10/13 11:23
Sulfur, Total	0.0676	%	0.010				2.2	50	
Sulfur, Hot Water Extractable	0.0282	%	0.010				7.4	50	
Sulfur, HCl Extractable	ND	%	0.010					50	
Sulfur, HNO3 Extractable	0.0200	%	0.010				0.0	50	
Sulfur, Residual	0.0200	%	0.010				0.0	50	
Sample ID: B13050229-026A DUP	Sample Duplicate				Run: MISC-SOIL_130513A				05/10/13 12:04
Sulfur, Total	0.0159	%	0.010				0.6	50	
Sulfur, Hot Water Extractable	ND	%	0.010					50	
Sulfur, HCl Extractable	ND	%	0.010					50	
Sulfur, HNO3 Extractable	ND	%	0.010					50	
Sulfur, Residual	0.0200	%	0.010				0.0	50	
Sample ID: LCS-SOL0715130510122	Laboratory Control Sample				Run: MISC-SOIL_130513A				05/10/13 12:22
Sulfur, Total	0.158	%	0.010	98	50	200			
Sulfur, Hot Water Extractable	0.0495	%	0.010	124	50	200			
Sulfur, HCl Extractable	0.00800	%	0.010	80	50	200			
Sulfur, HNO3 Extractable	0.0600	%	0.010	86	50	200			
Sulfur, Residual	0.0400	%	0.010	200	50	200			
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130513A				05/10/13 10:43
Neutralization Potential	200	t/kt	0.10				1.4	50	
Acid Potential	0	t/kt	1.0					50	
Acid/Base Potential	200	t/kt					1.4	50	
The acid-base potential was calculated from the HNO3 extractable sulfur %									
Sample ID: B13050229-016A DUP	Sample Duplicate				Run: MISC-SOIL_130513A				05/10/13 11:23
Neutralization Potential	300	t/kt	0.10				0.0	50	
Acid Potential	0.62	t/kt	1.0					50	
Acid/Base Potential	300	t/kt					0.0	50	
The acid-base potential was calculated from the HNO3 extractable sulfur %									
Sample ID: B13050229-026A DUP	Sample Duplicate				Run: MISC-SOIL_130513A				05/10/13 12:04
Neutralization Potential	120	t/kt	0.10				0.5	50	
Acid Potential	0	t/kt	1.0					50	
Acid/Base Potential	120	t/kt					0.5	50	
The acid-base potential was calculated from the HNO3 extractable sulfur %									

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: Sobek Modified									Batch: R204457
Sample ID: LCS-SOL0715130510122 Laboratory Control Sample					Run: MISC-SOIL_130513A				05/10/13 12:22
Neutralization Potential	74	t/kt	0.10	92	50	200			
Acid Potential	1.9	t/kt	1.0	94	50	200			
Acid/Base Potential	72	t/kt		95	50	200			

The acid-base potential was calculated from the HNO3 extractable sulfur %

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc

Project: 123-80002A Supplemental Soils

Report Date: 05/14/13

Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 71062
Sample ID: LCS-71062	Laboratory Control Sample				Run: ICP201-B_130507A				05/07/13 18:47
Potassium	250	mg/kg	10	81	50	150			
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: ICP201-B_130507A				05/07/13 18:53
Potassium	80	mg/kg	10				18	50	
Sample ID: B13050229-002AMS2	Sample Matrix Spike				Run: ICP201-B_130507A				05/07/13 19:00
Potassium	4800	mg/kg	10	96	70	130			
Sample ID: B13050229-016A DUP	Sample Duplicate				Run: ICP201-B_130507A				05/07/13 19:40
Potassium	81	mg/kg	10				1.1	50	
Sample ID: B13050229-017AMS2	Sample Matrix Spike				Run: ICP201-B_130507A				05/07/13 19:47
Potassium	5200	mg/kg	10	98	70	130			
Sample ID: B13050229-026A DUP	Sample Duplicate				Run: ICP201-B_130507A				05/07/13 20:26
Potassium	99	mg/kg	10				9.9	50	
Sample ID: B13050229-040AMS2	Sample Matrix Spike				Run: ICP201-B_130507A				05/07/13 20:52
Potassium	4800	mg/kg	10	94	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Batch: 71085
Sample ID: LCS-71085	Laboratory Control Sample				Run: ICPMS202-B_130508A			05/08/13 13:25	
Arsenic	0.210	mg/kg	0.020	66	50	150			
Cadmium	0.108	mg/kg	0.10	108	50	150			
Copper	3.70	mg/kg	0.10	80	50	150			
Lead	2.57	mg/kg	0.10	107	50	150			
Manganese	7.78	mg/kg	0.10	63	50	150			
Molybdenum	0.291	mg/kg	0.10	141	50	150			
Nickel	0.508	mg/kg	0.10	63	50	150			
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: ICPMS202-B_130508A			05/08/13 13:31	
Arsenic	0.0572	mg/kg	0.020				0.4	30	
Cadmium	0.0192	mg/kg	0.10					30	
Copper	1.74	mg/kg	0.10				4.4	30	
Lead	0.959	mg/kg	0.10				7.1	30	
Manganese	2.41	mg/kg	0.10				6.6	30	
Mercury	0.000360	mg/kg	0.10					30	
Molybdenum	0.0162	mg/kg	0.10					30	
Nickel	0.0528	mg/kg	0.10					30	
Sample ID: B13050229-002AMS	Sample Matrix Spike				Run: ICPMS202-B_130508A			05/08/13 13:36	
Arsenic	0.634	mg/kg	0.020	109	50	150			
Cadmium	0.577	mg/kg	0.10	57	50	150			
Copper	1.52	mg/kg	0.10	57	50	150			
Lead	1.45	mg/kg	0.10	56	50	150			
Manganese	2.35	mg/kg	0.10	57	50	150			
Molybdenum	0.618	mg/kg	0.10	61	50	150			
Nickel	0.614	mg/kg	0.10	56	50	150			
Sample ID: B13050229-016A DUP	Sample Duplicate				Run: ICPMS202-B_130508A			05/08/13 14:15	
Arsenic	0.0727	mg/kg	0.020				2.5	30	
Cadmium	0.0106	mg/kg	0.10					30	
Copper	28.4	mg/kg	0.10				7.0	30	
Lead	0.479	mg/kg	0.10				4.3	30	
Manganese	1.45	mg/kg	0.10				4.5	30	
Mercury	0.000380	mg/kg	0.10					30	
Molybdenum	0.305	mg/kg	0.10				3.9	30	
Nickel	0.0340	mg/kg	0.10					30	
Sample ID: B13050229-017AMS	Sample Matrix Spike				Run: ICPMS202-B_130508A			05/08/13 14:21	
Arsenic	0.693	mg/kg	0.020	122	50	150			
Cadmium	0.670	mg/kg	0.10	64	50	150			
Copper	5.65	mg/kg	0.10		50	150			A
Lead	2.07	mg/kg	0.10	75	50	150			
Manganese	3.41	mg/kg	0.10	78	50	150			
Molybdenum	0.714	mg/kg	0.10	69	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: **SW6020**									Batch: 71085
Sample ID: **B13050229-017AMS**	Sample Matrix Spike				Run: ICPMS202-B_130508A			05/08/13 14:21	
Nickel	0.623	mg/kg	0.10	54	50	150			
Sample ID: **B13050229-026A DUP**	Sample Duplicate				Run: ICPMS202-B_130508A			05/08/13 15:00	
Arsenic	0.101	mg/kg	0.020				1.1	30	
Cadmium	0.00946	mg/kg	0.10					30	
Copper	2.27	mg/kg	0.10				2.9	30	
Lead	0.646	mg/kg	0.10				1.4	30	
Manganese	1.31	mg/kg	0.10				3.9	30	
Mercury	0.000330	mg/kg	0.10					30	
Molybdenum	0.00672	mg/kg	0.10					30	
Nickel	0.0470	mg/kg	0.10					30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte		Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: USDA23c									Batch: R204392	
Sample ID: B13050229-009A DUP	Sample Duplicate					Run: MISC-SOIL_130510A			05/10/13 09:11	
Lime as CaCO3		4.50	%	0.10				0.0	30	
Sample ID: B13050229-032A DUP	Sample Duplicate					Run: MISC-SOIL_130510A			05/10/13 09:11	
Lime as CaCO3		10.4	%	0.10				1.9	30	
Sample ID: B13050229-046A DUP	Sample Duplicate					Run: MISC-SOIL_130510A			05/10/13 09:11	
Lime as CaCO3		16.1	%	0.10				0.0	30	
Sample ID: LCS-1305100911	Laboratory Control Sample					Run: MISC-SOIL_130510A			05/10/13 09:11	
Lime as CaCO3		7.50	%	0.10	94	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Billings, MT Branch

Client: Golder Associates Inc
Project: 123-80002A Supplemental Soils

Report Date: 05/14/13
Work Order: B13050229

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: USDA27a								Batch: R204392	
Sample ID: B13050229-001A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Saturation	30.9	%	0.10				1.6	20	
Sample ID: B13050229-011A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Saturation	28.9	%	0.10				1.7	20	
Sample ID: B13050229-021A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Saturation	27.7	%	0.10				0.7	20	
Sample ID: B13050229-031A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Saturation	42.5	%	0.10				0.2	20	
Sample ID: B13050229-041A DUP	Sample Duplicate				Run: MISC-SOIL_130510A			05/10/13 09:59	
Saturation	37.3	%	0.10				1.6	20	
Sample ID: LCS-1305100959	Laboratory Control Sample				Run: MISC-SOIL_130510A			05/10/13 09:59	
Saturation	35.9	%	0.10	95	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

Golder Associates Inc — B13050229

Login completed by: Gina McCartney — Date Received: 5/2/2013

Reviewed by: BL2000\jklier — Received by: lg

Reviewed Date: 5/3/2013 — Carrier name: Return-FedEx Ground

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? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Container temperature for Cooler 1 was 15.9°C, Cooler 2 was 14.6°C, Cooler 3 was 16.1°C, Cooler 4 was 16.8°C and Cooler 5 was 17.2°C.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

PLEASE PRINT- Provide as much information as possible.

Page ____ of ____

Company Name: Golder Assoicates Inc.

Project Name, PWS, Permit, Etc.: 123-80002A Supplemental Soils

Sample Origin State: NM

EPA/State Compliance: Yes ☐ No ☐

Report Mail Address: 5200 Pasadena NE, Suite C, Albuquerque, NM 87113

Contact Name: Emily Clark

Phone/Fax: 505-821-3043

Email: eclark@golder.com

Sampler: (Please Print) Emily Clark

Invoice Address: Same

Invoice Contact & Phone: Toni Sanchez 505-821-3043

Purchase Order:

Quote/Bottle Order: B2958

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW ☐ A2LA
☐ GSA ☐ EDD/EDT(Electronic Data)
☐ POTW/WWTP Format: ________
☐ State: ________ ☐ LEVEL IV
☐ Other: ________ ☐ NELAC

Number of Containers / Sample Type: A W S V B O / Air Water Soils/Solids Vegetation Bioassay Other

ANALYSIS REQUESTED: Group 1, Group 2

SEE ATTACHED

Normal Turnaround (TAT)

RUSH — Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments: Cooler #1 15.9, #2 14.6, #3 16.1, #4 16.8, #5 17.2

Collection Dates provided per sample Containers gm 5-2-13

Shipped by: Fed Ex Ground

Cooler ID(s):

Receipt Temp ~~15.9~~ °C

On Ice: Yes (No)

Custody Seal (Y) N; Intact (Y) N; Signature Match (Y) N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Group 1	Group 2	SEE ATTACHED	LABORATORY USE ONLY
1 TP3 0-1	12-21-12				X	X	B13050229-001
2 TP3 1-2	"				X	X	-002
3 TP3 2-7	"				X	X	-003
4 TP3 7-9	"				X	X	-004
5 TP3 9-11	"				X	X	-005
6 TP5 0-1	1/3/13				X	X	-006
7 TP5 1-3	"				X	X	-007
8 TP5 3-7	"				X	X	-008
9 TP7 0-1.5	12-17-12			X		X	-009
10 TP7 1.5-4	"			X		X	-010

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Michael Petersen	09:00 4/30/13	[signature]			
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory:	5-2-13 9:00	[signature]

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page ____ of ____

PLEASE PRINT- Provide as much information as possible.

Company Name: Golder Associates Inc	Project Name, PWS, Permit, Etc. 123-80002A Supplemental Soils	Sample Origin State: NM	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: 5200 Pasadena NE, Suite C, Albuquqerque, NM 87113	Contact Name: Emily Clark; Phone/Fax: 505-821-3043; Email: eclark@golder.com		Sampler: (Please Print) Emily Clark
Invoice Address: Same	Invoice Contact & Phone: Toni Sanchez 505-821-3043	Purchase Order:	Quote/Bottle Order: B2958

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

- ☐ DW
- ☐ GSA
- ☐ POTW/WWTP
- ☐ State: ________
- ☐ Other: ________
- ☐ A2LA
- ☐ EDD/EDT(Electronic Data) Format:________
- ☐ LEVEL IV
- ☐ NELAC

Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other

ANALYSIS REQUESTED: Group 1, Group 2

SEE ATTACHED

Normal Turnaround (TAT)

RUSH — Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments: Cooler #1 15.9, #2 14.6, #3 16.1, #4 16.8, #5 17.2

Collection date provided per sample containers gms 5-2-13

Shipped by: FedEx Grd
Cooler ID(s):
Receipt Temp: See comments
On Ice: Yes (No)
Custody Seal: (Y) N
Intact: (Y) N
Signature Match: (Y) N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Group 1	Group 2	SEE ATTACHED	LABORATORY USE ONLY
1	TP7 6-8	12-17-12			X		X	B13050229-011
2	TP7 8-10	"			X		X	-012
3	TP7 10-12	"			X		X	-013
4	TP9 6-8	"				X	X	-014
5	TP9 8-10	"				X	X	-015
6	TP9 10-11	"				X	X	-016
7	TP12 0-1	1-2-13				X	X	-017
8	TP12 1-3	"				X	X	-018
9	TP12 3-7	"				X	X	-019
10	TP12 8-11	"				X	X	-020

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: ______		Lab Disposal: ______	Received by Laboratory:	Date/Time: 5-2-13 9:00	Signature: [signature]

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page ____ of ____

PLEASE PRINT- Provide as much information as possible.

Company Name: Golder Associates Inc.	Project Name, PWS, Permit, Etc. 123-80002A Supplemental Soils	Sample Origin State: NM	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: 5200 Pasadena NE, Suite C, Albuquerque, NM 87113	Contact Name: Emily Clark — Phone/Fax: 505-821-3043	Email: eclark@golder.com	Sampler: (Please Print) Emily Clark
Invoice Address: Same	Invoice Contact & Phone: Toni Sanchez 505-821-3043	Purchase Order:	Quote/Bottle Order: B2958

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW ☐ GSA ☐ POTW/WWTP ☐ State: ______ ☐ Other: ______
☐ A2LA ☐ EDD/EDT (Electronic Data) Format: ______ ☐ LEVEL IV ☐ NELAC

Number of Containers; Sample Type: A W S V B O; Air Water Soils/Solids Vegetation Bioassay Other

ANALYSIS REQUESTED: Group 1; Group 2

SEE ATTACHED | Normal Turnaround (TAT) | RUSH

Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments: Cooler #1 15.9; #2 14.6; #3 16.1; #4 16.8; #5 17.2
Collection Dates provided per Sample Containers gm 5-2-13

Shipped by: Rented Ex Gnd
Cooler ID(s):
Receipt Temp: See Comments
On Ice: Yes (No)
Custody Seal (Y) N
Intact C (Y) N
Signature Match (Y) N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Group 1	Group 2	SEE ATTACHED	LABORATORY USE ONLY
1 TP12 11-13	1-2-13				X	X	B13050229-021
2 TP16 0-2	12-20-12				X	X	-022
3 TP16 2-4	"				X	X	-023
4 TP16 4-7	"				X	X	-024
5 TP16 7-10	"				X	X	-025
6 TP16 10-17	"				X	X	-026
7 TP17 0-2	12-18-12			X		X	-027
8 TP17 2-4	"			X		X	-028
9 TP17 4-6	"			X		X	-029
10 TP17 6-10	"			X		X	-030

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Michael Petersen	9:00 4/30/2013	[signature]			
Sample Disposal: Return to Client: ____	Lab Disposal: ____		Received by Laboratory:	5-2-13 9:00	[signature]

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page ____ of ____

PLEASE PRINT- Provide as much information as possible.

Company Name: Golder Assoicates Inc.	Project Name, PWS, Permit, Etc. 123-80002A Supplemental Soils	Sample Origin State: NM	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address: 5200 Pasadena NE Suite C Albuquerque, NM 87113	Contact Name: Emily Clark Phone/Fax: 505-821-3043	Email: eclark@golder.com	Sampler: (Please Print) Emily Clark
Invoice Address: Same	Invoice Contact & Phone: Toni Sanchez 505-821-3043	Purchase Order:	Quote/Bottle Order: B2958

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

- ☐ DW
- ☐ GSA
- ☐ POTW/WWTP
- ☐ State: ________
- ☐ Other: ________
- ☐ A2LA
- ☐ EDD/EDT (Electronic Data) Format: ________
- ☐ LEVEL IV
- ☐ NELAC

Number of Containers / Sample Type: A W S V B O / Air Water Soils/Solids Vegetation Bioassay Other

ANALYSIS REQUESTED: Group 1, Group 2

RUSH — Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments: Cooler #1 15.9, #2 14.6, #3 16.1, #4 16.8, #5 17.1. Collection dates provided per sample containers gm 5-2-13

Shipped by: Rlen FedEx Grd
Cooler ID(s):
Receipt Temp: See comments
On Ice: Yes (No)
Custody Seal: (Y) N Only
Intact: (Y) N
Signature Match: (Y) N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Group 1	Group 2	SEE ATTACHED	Normal Turnaround (TAT)	RUSH	LABORATORY USE ONLY
1 TP21 7-11	12-19-12			X		X			B13050229-031
2 TP21 11-14	"			X		X			-032
3 TP21 14-18	"			X		X			-033
4 TP24 0-3	12-18-12			X		X			-034
5 TP24 3-5	"			X		X			-035
6 TP24 5-10	"			X		X			-036
7 TP24 10-14	"			X		X			-037
8 TP24 14-16	"			X		X			-038
9 TP 25 2-5	12-13-12			X		X			-039
10 TP27 0-2	12-19-12				X	X			-040

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Michael Peterson	Tue 4/30/13	[signature]			
			Received by Laboratory:	5-2-13 9:00	Laura Gancze

Sample Disposal: Return to Client: ________ Lab Disposal: ________

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LABORATORIES

Chain of Custody and Analytical Request Record

Page ____ of ____

PLEASE PRINT- Provide as much information as possible.

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
Golder Associates Inc	123-80002A Supplemental Soils	State: NM	Yes ☐ No ☐
Report Mail Address: 5200 Pasadena NE, Suite C, Albuquqerque, NM 87113	Contact Name: Emily Clark; Phone/Fax: 505-821-3043	Email: eclark@golder.com	Sampler: (Please Print) Emily Clark
Invoice Address: Same	Invoice Contact & Phone: Toni Sanchez 505-821-3043	Purchase Order:	Quote/Bottle Order: B2958

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW ☐ A2LA
☐ GSA ☐ EDD/EDT(Electronic Data)
☐ POTW/WWTP Format: ________
☐ State: ________ ☐ LEVEL IV
☐ Other: ________ ☐ NELAC

Number of Containers; Sample Type: A W S V B O; Air Water Soils/Solids Vegetation Bioassay Other

ANALYSIS REQUESTED: Group 1, Group 2

RUSH: Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments: Cooler #1 15.9; #2 14.6; #3 16.1; #4 16.8; #5 17.2. Collection Dates provided per sample containers gm 5-2-13

Shipped by: FedEx Ground
Cooler ID(s):
Receipt Temp: See comments
On Ice: Yes (No)
Custody Seal (Y) N
Intact (Y) N
Signature Match (Y) N

#	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Group 1	Group 2	SEE ATTACHED	Normal Turnaround (TAT)	RUSH	LABORATORY USE ONLY
1	TP27 2-3	12-19-12				X	X			B13050229-041
2	TP27 3-7	"				X	X			-042
3	TP27 7-13	"				X	X			-043
4	TP27 13-14	"				X	X			-044
5	TP31 1-2	1-3-13			X		X			-045
6	TP31 2-5	"			X		X			-046
7	TP31 5-8	"			X		X			-047
8	TP31 8-16	"			X		X			-048
9							X			
10							X			

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Michael Peterson	9:00 4/30/2013	[signature]			
Sample Disposal: Return to Client: ____ Lab Disposal: ____			Received by Laboratory:	5-2-13 9:00	[signature]

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Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ATTACHMENT 2
ELECTRONIC LABORATORY DATA
PROVIDED BY STETSON ENGINEERS

Attachment 2: Electronic Laboratory Data Provided by Stetson Engineers
Part 1

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Attachment 2: **Electronic Laboratory Data Provided by Stetson Engineers**
Part 2

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D – THEMAC Technical Memorandum

THEMAC RESOURCES

TECHNICAL MEMORANDUM

TO: Chris Eustice, Sr. Environmental Engineer,
New Mexico Mining and Minerals Division
FROM: New Mexico Copper Corporation
DATE: July 17, 2013
SUBJECT: Responses to Select Comments on Copper Flat Baseline Data Report

602.D.13 Baseline Data Report

Section 7- Geology 602.D.13(f)

MMD #1 / NMCC #15 comment: "After receipt of recent information from NMCC regarding the "coarsely crystalline porphyry" rock-type, it appears that NMCC's conclusion is that this is not a unique rock-type as originally hypothesized, but is instead part of the quartz monzanite [*sic*]. MMD recommends modification of Table 7.2 in the BDR to reflect this updated hypothesis as it relates to the major material types in the proposed project area."

MMD #1 / NMCC #15 response: Table 7-2 Amendment is presented below. Previous discussions on Copper Flat lithologies occurred in the Copper Flat BDR (Intera, 2012) and the April 2012 version of the Copper Flat Geochemical Characterization Report (SRK Consulting, April 2012). Both of these reports were appended to the Copper Flat Permit Application Package submitted to the New Mexico Mining and Minerals Division in July 2012. From 2009 through 2012, NMCC conducted exploration drilling and mapping projects to evolve the geologic understanding of the ore body and surrounding areas. As a result, NMCC has simplified the lithological terminology. Generally, the fundamental rock classifications reported in the BDR and April 2012 Geochemical Characterization Report are still appropriate, but the distinctions between the rock types have been simplified and the contacts found to be more gradational. Coarse crystalline porphyry (CCP) is a type of CFQM, representative of the increasing size of phenocrysts observed towards the northeast in the CFQM. Table 7-2 Amendment provides a cross reference that updates the rock lithologies from earlier interpretations to the current understanding. Additional detail about the geology at Copper Flat is presented in the *Geochemical Characterization Report for the Copper Flat Project*, prepared by SRK Consulting and submitted in June 2013.

Table 7-2 Amendment. Terminology- cross reference for Copper Flat lithologies

BDR Section 7 terminology[1]	SRK Geochemical Characterization Terminology[2]	Additional SRK sample terminology	Geology section in this report	Percentage of waste (from Geologic Block Model)	Percentage of ore (from Geologic Block Model)
Biotite Breccia	Biotite Breccia				
Quartz Breccia	Quartz Feldspar Breccia		Quartz Monzonite Breccia	5.7	22.5
-	-	K-Spar breccia			
Quartz Monzonite with potassic, argillic and/or meteoric alteration	-	-			
-	Quartz Monzonite (CFQM)	-	Quartz Monzonite (CFQM)	93.2	77.5
Coarsely Crystalline Porphyry (CCP)	Coarse Crystalline Porphyry (CCP)	-			
Andesite	Andesite	-	Andesite		
-	Dolerite	-	Diabase	1.1	0.0
-	Latite	-	Latite		

[1] Copper Flat BDR (Intera, 2012)
[2] Copper Flat Geochemical Characterization (SRK Consulting, April 2012)
CFQM – Copper Flat Quartz Monzonite

MMD #2 / NMCC #16 comment: "Pg. 7-10, Section 7.5.2.7 states a conceptual model will be developed to describe predicted geochemical trends of reactivity from waste management facilities, final pit walls (pit lake chemistry) and the tailing facility. In addition, this model will be used to provide quantitative numerical predictions of the potential impacts of seepage or runoff from mining facilities to regional groundwater. Because these models relate to the MMD requirement to address "probable hydrologic consequences", MMD will require submittal of this information in a revised or amended BDR/PAP prior to MMD being able to deem the PAP technically approvable.”

MMD #2 / NMCC #16 response: NMCC submits reports titled *Geochemical Characterization Report for the Copper Flat Project, New Mexico*, (submitted June 2013) and *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico,* (anticipated submission August/September 2013) prepared by SRK Consulting. These two reports present the predictive models for the WRDF and TSF, and the predictive model for the pit, respectively.

MMD #3 / NMCC #17 comment: “Pg. 7-11, Section 7.5.1.3 states that a single comprehensive report of the complete geochemical testing program, including both static and kinetic testing analysis, and results will be provided when completed. Because the geochemical program relates to the requirement to address “probable hydrologic consequences,” MMD will require this document to be submitted in a revised BDR, or as an addendum to the BDR, prior to MMD being able to deem the BDR/PAP as technically approvable.”

MMD #3 / NMCC #17 response: NMCC submits report titled *Geochemical Characterization Report for the Copper Flat Project, New Mexico*, prepared by SRK Consulting. This report presents the complete geochemical testing program.

MMD #4 / NMCC #18 comment: “Appendix 7-D, page 6 of 6, states that a geologic block model is required to determine the relative percentages of each material type and determine if the number of samples selected for each material type is adequate for the characterization program. MMD will require this evaluation to be submitted prior to MMD being able to deem the BDR/PAP as technically approvable.”

MMD #4 / NMCC #18 response: NMCC submits report titled *Geochemical Characterization Report for the Copper Flat Project, New Mexico*, prepared by SRK Consulting. This report presents the relative percentages of each material type according to the geologic block model, and explains that the sample set is adequate in terms of number of samples for each material type.

MMD #5 / NMCC #19 comment: “Appendix 7-E, Section 5 states that the 1997 and 2010 geochemical databases are comparable although the 1997 data show a trend toward having a generally greater acid generating potential than the 2010 data. A possible explanation in the appendix is that there may be a bias in the 1997 sample collection toward high sulfide/highly weathered materials. Although not discussed in this appendix, the opposite is also a possible explanation; that there may be a bias in the 2010 sample collection toward materials that are low sulfide/low weathered materials. Hopefully the block model analysis will shed light on the overall adequacy of the characterization program.”

MMD #5 / NMCC #19 response: NMCC submits report titled *Geochemical Characterization Report for the Copper Flat Project, New Mexico*, prepared by SRK Consulting. This report explains that the sample set is adequate and representative based on the geologic block model.

Section 9- Prior Mining Operations 602.D.13(h)

MMD # 1/ NMCC #30 comment: The last sentence of Section 9.1 "Mining History" indicates that "More detail about copper exploration can be found in Section 11.3" However, "Section 11.3 Soil Survey" neither mentions nor provides any detail about copper exploration activities. Please correct.

MMD # 1/ NMCC #30 response: The statement at the end of Section 9.1 is incorrect. However, more information about the ore body at Copper Flat can be found in Section 7.3 of the Baseline Data Report.

Section 10- Cultural Resources – Summary 602.D.13(i)

MMD #1/ NMCC #31 comment: Throughout Section 10, the authors describe the permit area as being situated within the "Las Animas Historic Mining District" that is "yet to be defined" but also seems to interchangeably define the permit area as also being situated within the "Hillsboro Mining District" and/or/also as the "Las Animas Historic District". Also, within Section 11 "Present and Historic Land Use" the area is defined as the "Hillsboro District". This is confusing and suggests that there are two separately defined Districts, and it seems as though the intent is to describe the permit area as being in the "Hillsboro Mining District" which is situated within a larger encompassing "Las Animas Historic District" that is yet to be delineated or defined. Please provide clarification.

MMD #1/ NMCC #31 response: These terms have been clarified in the final cultural resources report submitted to BLM and SHPO, which will be provided to MMD upon approval by BLM and SHPO.

MMD #2/ NMCC #32 comment: MMD previously provided comments to NMCC, upon submittal of the Sampling and Analysis Plan (SAP) suggesting that locations the four (4) referenced cultural resource surveys be depicted on Figure 10-1 of the SAP. Please provide an updated Figure 10-1 with the needed information to be inserted into the SAP.

MMD #2/ NMCC #32 response: Please see *Cultural Resource Inventory of the Copper Flat Mine Permit Area, Sierra County, New Mexico*, dated May 2012 for additional information about surveys within the permit boundary. This document is not produced for public review, but was submitted to MMD under separate cover.

MMD #3/ NMCC #33 comment: Please describe any cultural surveys that have been conducted in the areas of the water supply pipeline and associated well field and update Figure

10-1 of the SAP to include those survey locations and include with the submittal of the response to the comment above.

MMD #3/ NMCC #33 response: NMCC submits, under separate cover to MMD, *Cultural Resource Survey for Pipeline and Aquifer Testing, Copper Flat Mine, Sierra County, New Mexico*, October 2011, which details the surveys completed along the water supply pipeline as part of right of way applications with the BLM.

MMD #4/ NMCC #34 comment: Section 10.2 "Eligibility and Management Summary" indicates within the last paragraph of the Subsection that "Detailed management recommendations will be presented in a future cultural resources report" and also indicates that "avoidance will most likely not be feasible for all for all of these resources, it is recommended that they be included in a testing and data recovery plan…" This testing and data recovery plan should be provided.

MMD #4/ NMCC #34 response: The testing and data recovery plan will be developed upon approval of the final cultural resources report being reviewed by BLM and SHPO. Subsequent to approval by BLM and SHPO, a copy of this report will be provided to MMD.

Section 11 Present and Historic Land Use 602.D(13)(j)

MMD #1/ NMCC #35 comment: Section 11.3 "Soils Survey" seems out of place and makes reference within this section to a Section 6.0 "Topsoil Survey and Sampling Results" where the soils surveys are discussed in detail. Section 11.3 "Soils Survey seems irrelevant and out of place under Section 11 "Present and Historic Land Use" and perhaps this information would be better presented within Section 6 "Soils Survey." Please provide clarification.

MMD #1/ NMCC #35 response: Observation noted. Please refer to Golder memorandum and Soils Investigation Survey submitted with this BDR Amendment and Section 6.0 of the original BDR for data about soil at Copper Flat.

MMD #2/ NMCC #36 comment: Please update this section to include a description (present and historic land use) of the water supply pipeline, associated well field, and the electrical power supply lines.

MMD #2/ NMCC #36 response: The present and historic land use of the buried water supply pipeline, associated well field, and the electrical power supply lines is discussed in *Cultural Resource Survey for Pipeline and Aquifer Testing, Copper Flat Mine, Sierra County, New Mexico*, October 2011, submitted under separate cover to MMD, and touched on in Section 11.2 of the *Baseline Data Characterization Report for Copper Flat Mine, Sierra County, New Mexico*, 2012. The present and historic land use for these areas, located east of the permit boundary, is and was largely ranching. The pipeline, well field, and electrical power supply lines were developed during exploration and construction phases in the late 1970s and early 1980s by Quintana. Water from the well field was transported via the pipeline during Quintana's construction and operation of the Copper Flat mine, which began full production in March 1982. Use of the mine well field and associated water supply pipeline ceased by the end of 1985 when the Quintana mining operation was closed, however power lines, water wells and the buried water supply pipeline were left in place. The water wells and the majority of the buried water supply pipeline (with the exception of a mile length on New Mexico State Land) are on Bureau of Land Management (BLM) land and are considered the property of BLM. The electrical power supply lines are owned and maintained by local or regional power companies and are used for power supply to communities in the area.

MMD #3/ NMCC #37 comment: Please provide a description of land capability and productivity based up Soil Conservation Service land use capability classes or similar classification.

MMD #3/ NMCC #37 response: The land capability classification system was developed by the Soil Conservation Service (now the Natural Resource Conservation Service [NRCS]) and groups soils primarily on the basis their capability to produce common cultivated crops and pasture plants (SCS 1961). Soils are grouped according to their limitations for field crops, the risk of damage (i.e. erosion) if they are used for crops, and the way they respond to agricultural management. Land capability classification is not a substitute for soil interpretations for suitability and limitations for rangeland, woodland, or engineering purposes including reclamation.

Land capability classes for Copper Flat were acquired from the NRCS Soil Survey, Custom Soil Resource Report for Sierra County Area, New Mexico (Soil Survey Staff, 2013). All NRCS map unit components, including miscellaneous areas, are assigned a capability class (numerical) and subclass (letter). Risks of soil degradation or limitation for use become progressively greater from class 1 to 8.

The non-irrigated capability classes for the Copper Flat soils are 6e, 7s, and 7e. Soils occurring on the steeper slopes of the piedmont hills are classified as 7e or 7s. These soils are unsuited for cultivation because they are susceptible to erosion or have a limited rooting zone (depth to bedrock) and are stony. The soils of the fan piedmont in and around the tailing impoundment are classified as 6e and are also considered unsuitable for cultivation due to erosion susceptibility. The soils of the fan remnant along the eastern portion of the Permit Area are classified as class 7s because they are shallow (petrocalcic), droughty and/or stony. Class 6 and 7 soils have severe to very severe limitations for cultivation that restrict their uses to mainly rangeland, forestland, or wildlife habitat. There are no soils in the Copper Flat Permit Area or surrounding area that are considered prime farmland.

NMOSE #3/ NMCC #148 comment: "Table 7.1 and Figure 7.1 & Figure 7.2. These tables and figures reference BLM 1999 without referencing sources for the map: (Harley, 1934; Seager et. al., 1982; Hedlund, 1977; Alminas et.al., 1975, and possibly Dunn, 1982). This may be important consideration of the regional or local geology that are applied to the conceptual model and flow model. The BLM 1999 reference may remain, but it may not be as useful to reviewers as references for the original authors. Note that Section 8 figures are clearly referenced."

NMOSE #3/ NMCC #148 response: Table 7-1: Stratigraphy of the Copper Flat Area references BLM (1999, Tables 3-1 and 3-2). BLM (1999) *Table 3-1: Stratigraphic Column for the Project Area* references Harley (1934), Seager et al. (1982), Hedlund (1977), and Alminas et al. (1975). BLM (1999) *Table 3-2: Geologic History of the Copper Flats Area* references Harley (1934). These references are provided in the References Section, below.

Figure 7-1: Regional Surface Geology is referenced as from BLM (1999) and represents BLM (1999) *Figure 3-2: Generalized Regional Surface Geology*, which references Harley (1934), Seager et al. (1982), Hedlund (1977), and Alminas et al. (1975). These references are provided in the References Section, below.

Figure 7-2: Schematic Geologic Cross Section (A-A') is referenced as from BLM (1999) and represents BLM (1999) *Figure 3-3: Schematic Geologic Cross Section A-A'*, which references Harley (1934), Seager et al. (1982), Hedlund (1977), and Alminas et al. (1975). These references are provided in the References Section, below.

NMOSE #4/ NMCC #149 comment: "Figure 7.5. Add description of fault systems in legend beneath label for fault (e.g., Hunter fault system N20E, Patten Fault system N50W). Note that Section 8 figures have been labeled."

NMOSE #4/ NMCC #149 response: Figure 7-5 Amendment (attached) presents an updated Copper Flat Geologic Map with all faults labeled. Faults include Hunter fault/fault zone, Patten fault/fault zone, Aker fault, Olympia fault, Greer fault, and Lewellyn fault.

Three principal structural zones are present at Copper Flat and surrounding area, the most prominent of which is a northeast-striking fault that trends N 20°-40°E that includes the Hunter and parallel faults or the Hunter fault zone. In addition, west-northwest striking zones of structural weakness (N50°-70°W) are marked by the Patten, Aker, and Greer faults, and east-northeast striking zones are marked by the Olympia and Lewellyn faults. All faults have a near-vertical dip; the Hunter fault system dips 80°W, the Patten dips approximately 70°S-80°S, and both the Olympia and Lewellyn fault systems dip between 80°S and 90°S.

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Harley, G.T., 1934, The geology and ore deposits of Sierra County: New Mexico Bureau of Mines and Mineral Resources, Bulletin 10, 220 p.

Hedlund, D.C., 1977, Miscellaneous Field Studies Map MF-900A, Hillsboro and San Lorenzo Quadrangles, Sierra and Grant Counties, New Mexico: U.S. Geological Survey MF-900A.

INTERA, 2012, Baseline Data Characterization Report for Copper Flat Mine, Sierra County, New Mexico. Report prepared for New Mexico Copper Corporation, June 2012.

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Seager, W.R., R.E. Clemmons, J.W. Hawley, and R.E. Kelly, 1982, Geology of Northwest Part of Las Cruces 1° x 2° Sheet, New Mexico: New Mexico Bureau of Mines and Mineral Resources Map 53.

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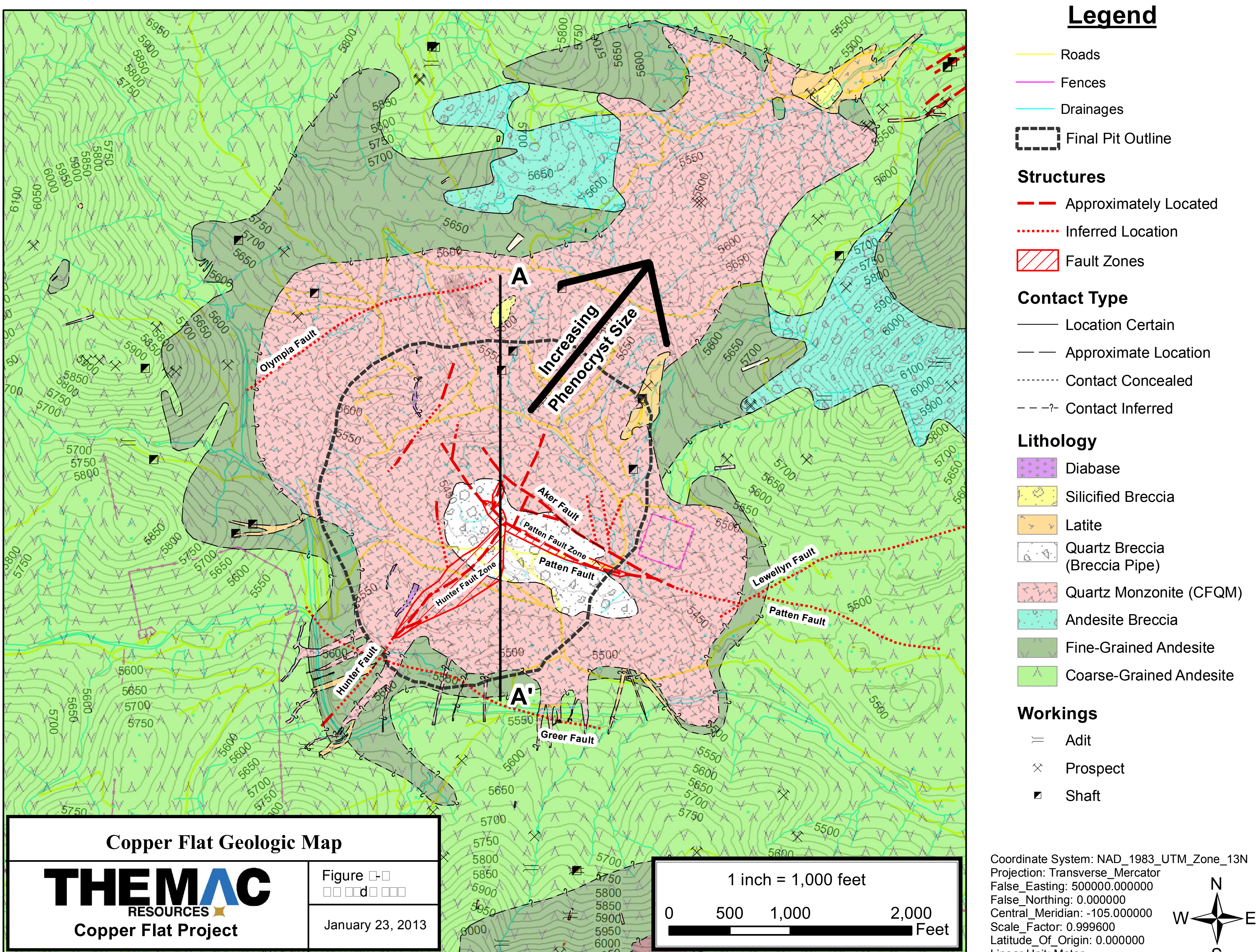
Legend
Roads
Fences
Drainages
Final Pit Outline
Structures
Approximately Located
Inferred Location
Fault Zones
Contact Type
Location Certain
Approximate Location
Contact Concealed
Contact Inferred
Lithology
Diabase
Silicified Breccia
Latite
Quartz Breccia (Breccia Pipe)
Quartz Monzonite (CFQM)
Andesite Breccia
Fine-Grained Andesite
Coarse-Grained Andesite
Workings
Adit
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Shaft
A
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Increasing Phenocryst Size
Olympia Fault
Aker Fault
Patten Fault Zone
Patten Fault
Hunter Fault Zone
Hunter Fault
Lewellyn Fault
Greer Fault
Copper Flat Geologic Map
THEMAC RESOURCES
Copper Flat Project
Figure
January 23, 2013
1 inch = 1,000 feet
0 500 1,000 2,000 Feet
Coordinate System: NAD_1983_UTM_Zone_13N
Projection: Transverse_Mercator
False_Easting: 500000.000000
False_Northing: 0.000000
Central_Meridian: -105.000000
Scale_Factor: 0.999600
Latitude_Of_Origin: 0.000000
Linear Unit: Meter
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E – John Shomaker & Associates Technical Memorandum

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TECHNICAL MEMORANDUM

To: Katie Emmer, THEMAC Resources kemmer@themacresourcesgroup.com
New Mexico Copper Corporation

From: Steven T. Finch, Jr., Principal Hydrogeologist-Geochemist
Annie McCoy, Senior Hydrogeologist

Date: July 8, 2013

Subject: Baseline data characterization report comment resolution and amendment, Copper Flat Mine

The purpose of this technical memorandum is to address Mining and Minerals Division (MMD) and Office of the State Engineer (OSE) comments on Section 8 – Surface Water and Groundwater Information in the *Baseline Data Characterization Report for Copper Flat Mine, Sierra County, New Mexico* (BDR) prepared by INTERA in February 2012, and in so doing, serve as an amendment to the BDR. This technical memorandum is organized into sections based on the reviewing state agency (MMD or OSE), and sub-sections numbered according to numbering provided in state agency review documents and numbering provided in the spreadsheet prepared by New Mexico Copper Corporation (NMCC) to address agency comments.

MMD Comments on BDR

MMD #1 / NMCC #20 comment: "Page 8-3, Section 8.1.2.1.2 states that the NMED SWQB has collected flow data along Las Animas Creek, however there are no historical data available in published reports. Although perhaps not published, this data should be available through a request for information to NMED SWQB. Although the historical and baseline flow data (quantity data) presented appear to adequately document Las Animas flow at this time, MMD recommends incorporation of any additional quantity data from NMED SWQB related to Las Animas creek as further documentation of historic flow variability."

MMD #1 / NMCC #20 resolution: All pertinent data are useful for establishing baseline conditions and the New Mexico Environmental Department Surface Water Quality Bureau (NMED SWQB) data were requested and reviewed in June of 2011 by INTERA during data collection. INTERA decided not to include the unpublished data in the Baseline Data Report, but did cite NMED SWQB's report *Water quality survey summary for the Lower Rio Grande tributaries, 2004* (NMED, 2009). Based on MMD's recommendation, flow data and water-quality data collected by NMED SWQB for Las Animas Creek and Percha Creek are summarized in the attached table, stream thermograph, and NMED SWQB report (2009).

MMD #2 / NMCC #21 comment: "Section 8.2.4.1. The crystalline bedrock aquifer appears adequately characterized for the BDR. However, MMD recommends submittal of groundwater quality data for GWQ-5R, GWQ11-24 A&B and GWQ11-25 A&B (which were all installed after the 4th quarter monitoring for the BDR) in a revised or amended BDR as further documentation of groundwater quality within the crystalline bedrock aquifer."

MMD #2 / NMCC #21 resolution: The monitoring data for GWQ-5R, GWQ11-24 (A, B), and GWQ11-25 (A, B) are part of the NMCC Stage 1 Abatement Plan, and data will be provided to NMED and MMD.

MMD #3 / NMCC #22 comment: "Pg. 8-21, Section 8.2.4.1 states that nine wells were used for water elevations, however only 8 (or 12, depending on whether you count wells like GWQ96-22A&B as one well or two) appear to have been measured (GWQ-5R, GWQ96-22A&B, GWQ96-23A&B, GWQ11-24A&B, GWQ11-25A&B, LRG 04158, LRG 04159, Pague). Please make appropriate change to this section."

MMD #3 / NMCC #22 resolution: Water-level elevations measured in four nested piezometers (GWQ96-22(A, B), GWQ96-23(A, B), GWQ11-24(A, B), and GWQ11-25(A, B)) and four additional wells (GWQ-5R, LRG 04158, LRG 04159, and Pague) completed in crystalline bedrock are presented in the Copper Flat BDR Table 8-9 (INTERA, 2012).

MMD #4 / NMCC #23 comment: "Pg. 8-22, Section 8.2.4.1.1 refers to GWQ-5 as a crystalline bedrock aquifer well and is used to compare groundwater chemistry trends to other crystalline bedrock wells. Figure 8-20 also identifies GWQ-5 as a crystalline bedrock well. However, it seems somewhat doubtful to this reviewer that GWQ-5 is a crystalline bedrock well given the description that "GWQ-5 was a 20-ft deep rock-lined hand dug well…". It seems more likely to this reviewer that GWQ-5 was representative of the Grayback alluvial aquifer system based on the description of its completion and its location in the Grayback arroyo. Please make appropriate change to this section."

MMD #4 / NMCC #23 resolution: The Copper Flat BDR Section 8.2.4.1.1 refers to groundwater chemistry from GWQ-5 as "likely representing shallow groundwater originating from the Copper Flat area that was influenced by the oxidation of the ore body prior to open pit mining…" Well GWQ-5 was a 20.5-ft-deep well buried during the Quintana mining operations; it is no longer available for monitoring. GWQ-5 was replaced by GWQ-5R, which was completed to a total depth of 120 ft with a screen interval from 80 to 120 ft. Lithologies logged for GWQ-5R include 17.7 ft of overburden overlying 102.3 ft of andesite. BDR Figure 8-20 correctly identifies GWQ-5R as a crystalline bedrock well.

MMD #5 / NMCC #24 through #27 comment: "In reference to Section 8.2.4.3 (Quaternary Alluvium), the groundwater quality within the alluvial aquifer of Las Animas Creek appears adequately characterized in the BDR through the use of monitoring well MW-11. However, the water quality of the alluvium aquifers within Percha Creek, Grayback Arroyo, Hunkidori Gulch and Greenhorn Arroyo appear to be under-characterized for the purposes of the BDR.

a. Percha Creek alluvium: Please provide any historic or recent groundwater quality data for the alluvium within these systems.

b. Grayback alluvium: Historic water quality data for wells GWQ-1, GWQ-3 and GWQ-8 is provided in the BDR, which may represent water quality from the Grayback alluvium due to their locations in or near the Grayback arroyo. However, the BDR does not appear to contain completion/construction data for these wells/sampling locations. Please provide any historic or recent groundwater quality data for the alluvium within these systems. MMD recommends providing the completion data for these three wells/sampling locations.

c. Hunkidori Gulch alluvium and Greenhorn alluvium: Currently there do not appear to be any shallow alluvial wells located within Hunkidori Gulch or Greenhorn arroyo. MMD recommends installation of at least one shallow alluvial well downgradient of the proposed tailings dam within each of these alluvial systems to characterize the potential alluvial aquifer for the BDR, or provide any historic or recent groundwater quality data for the alluvium within these systems."

MMD #5 / NMCC #24 through #27 resolution:

a. Percha Creek alluvium: Murray (1959) and Wilson et al. (1981) provide groundwater-quality data for wells completed along Percha Creek, presented in Table 1 and locations are shown on Figure 1. Several wells are described as being completed in Quaternary-age sand (Murray, 1959), and several wells are described as being completed in the Santa Fe Group (Wilson et al., 1981). Wilson et al. (1981) do not identify any wells completed in Quaternary-age alluvium along Percha Creek. The Copper Flat BDR Section 8.2.4.3 states "Logs from wells drilled along Las Animas and Percha Creeks indicate that upper alluvial gravels extend from the surface to a depth of approximately 20 to 60 ft…," whereas the wells presented in Table 1 below are completed to depths of 154 to 265 ft. The wells identified along Percha Creek in BDR Figure 8-21 and the artesian wells identified in BDR Appendix 8-H are completed in the Santa Fe Group. BDR Figure 8-12 indicates that the alluvial aquifer along Percha Creek only extends from Caballo Reservoir to about 3 miles west of the Reservoir, and there are no known water-quality data from the Percha Creek alluvium.

b. Grayback alluvium: GWQ-1 and GWQ-8 were rehabilitated in November 2012; GWQ-1 total depth is 391 ft with perforations starting at 100 ft, and GWQ-8 total depth is 148 ft with perforations starting at 81 ft. Both wells are completed in the Santa Fe Group. GWQ-3 is completed to a total depth of 33 ft in alluvium and underlying andesite. Historical water-quality data for GWQ-3 are presented in BDR Table 8-11. GWQ11-26 is completed in Grayback Arroyo alluvium up-gradient of the exiting pit, and data will be collected as part of the Stage 1 Abatement Plan monitoring program.

c. Monitoring wells in Hunkidori Gulch downgradient of the Tailings Storage Facility are dry; therefore, no samples were collected. Dry wells in the alluvium include GWQ94-18, IW-1, and IW-3. Monitoring wells in Hunkidori Gulch alluvium include GW94-16, GWQ94-19, and IW-2. Historical data are presented in the Copper Flat BDR (INTERA, 2012), and more recent data can be referenced from the NMCC Stage 1 Abatement Plan status report (due to NMED June 30, 2013).

Table 1. Summary of water quality for wells completed along Percha Creek

well*	total depth, ft	sample date	Ca, mg/L	Mg, mg/L	Na + K, mg/L	HCO_3, mg/L	SO_4, mg/L	Cl, mg/L	F, mg/L	TDS, mg/L	specific conductance, µmhos/cm	reference
16S.5W.20.244	257	-	-	-	-	190	-	8	-	-	365	Murray (1959)
16S.5W.21.144	154 [a]	-	-	-	-	166	-	8	-	-	343	Murray (1959)
16S.5W.22.420	216 [a]	6/14/46 6/7/47	21 22	4.4 2.5	59 74	169 180	36 58	13 11	1.2 1.0	219 283	360 385	Murray (1959)
16S.5W.23.300	226	7/31/47	24	1.6	73	158	52	13	1.2	283	360	Murray (1959)
16S.5W.20.243	190 [b]	5/3/74	46	5.3	-	194	29	4.3	-	-	384	Wilson et al. (1981)
16S.5W.22.313	265 [b]	5/3/74	39	4.0	36.1	181	33	5.1	0.6	242	364	Wilson et al. (1981)
16S.5W.22.412	-	7/10/74	29	2.5	50.2	174	32	6.8	1.0	240	371	Wilson et al. (1981)

* See Figure 1 for locations
[a] completed in Quaternary-age sand
[b] completed in Santa Fe Group

TDS - total dissolved solids
mg/L - milligrams per liter
µmhos/cm - micromhos per centimeter

MMD #6 / NMCC #28 comment: "Table 8-9 identifies well "UNKNOWN" as being in the Qal aquifer system, however this well is shown in Figure 8-20 to be in the Santa Fe Group aquifer. Table 8-9 or Figure 8-20 should be corrected in a revised BDR or addendum to the BDR to correct this discrepancy. Additionally, this well appears to be identified as "15.6.31.431" in Table 8-11. The naming convention for this well should be corrected between the tables and figures if well "15.6.31.431" and well "UNKNOWN" are the same well.

MMD #6 / NMCC #28 resolution: Two wells are located in 15S.6W.31.431, GWQ-7 (also referred to as the old office well) and the Birdie Irwin Well (also referred to as Irwin Well or LRG-4652-S-7), both drilled to total depth of 500 ft in the Santa Fe Group in 1932. Davie and Spiegel (1967) identify a well "15.6.31.431," owner "unknown." The well identified as "15.6.31.431" in Table 8-11 and "UNKNOWN" in Figure 8-20 likely represents GWQ-7 or the Birdie Irwin Well. The well identified as "UNKNOWN" in Table 8-9 is a well near Percha Creek that is not shown in Figure 8-20.

MMD #7 / NMCC #29 comment: "MMD recognizes that the results of the aquifer pump tests and associated studies (i.e., geochemical and hydrologic models) are on-going, therefore MMD will withhold comments on these critical studies that help to define the probable hydrological consequences of the proposed operation until they are complete and integrated into the PAP.

MMD #7 / NMCC #29 resolution: NMCC submitted *Geochemical Characterization Report for the Copper Flat Project, New Mexico* in June 2013. *Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico,* prepared by SRK Consulting, is expected to be complete and ready for submission in August 2013 and *Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico,* prepared by John Shomaker & Associates, Inc. is expected to be complete in July 2013.

<u>OSE Comments on BDR</u>

OSE #5 /NMCC #150 comment: "<u>Table 8-1, Spring/seep data</u>. Reported temperature of 81.5 degrees Celsius may be incorrect due to a units or lack of conversion from Fahrenheit. Probably this is closer to 25 degrees Celsius."

OSE #5 /NMCC #150 resolution: It appears that this temperature value was not converted from degrees Fahrenheit to Celsius, and the correct temperature is 27.5 degrees Celsius.

OSE #6 /NMCC #151 comment: "<u>Figure 8-17, Tailing impoundment cross section</u>. The proposed wells and a fault appear to be controlling the extension of a shallow water level near tailing impoundment. With respect to the water level depths, the cross section lacks control points to the east of well GWQ-21B."

OSE #6 /NMCC #151 resolution: The 2011 water-level elevation labeled on the Copper Flat BDR Figure 8-17 is based on 2011 water-level data for wells in the vicinity of the existing tailings facility and for MW-4, located about 0.7 mile southeast of the existing tailings facility.

MW-4 has been reasonably projected onto the west-to-east cross-section presented in BDR Figure 8-17 as the groundwater gradient is west-to-east at the site. The approximately 65-ft drop in water level across the inferred fault between GWQ-21B and MW-4 in BDR Figure 8-17 represents an interpretation based on available hydrogeologic data.

OSE #7 /NMCC #152 comment: "Page 8-24, Section 8.2.4.1.5; Figure 8-22; Figure 8-24; and Table 8-11 [page 14 of 34]. Several atypical results occurred in lab results for well GWQ96-22A and GWQ96-23A. In particular, for the most recent samples 2010-2011, sulfate values drop unexpectedly when compared to earlier values (1996-1997) of specific conductance and total dissolved solids. Possibly this may represent lab error, typographical error or some water quality that has not stabilized from mixing with other waters. Further review of this data seems warranted because these parameters (sulfate, TDS, specific conductance) typically show a strong correlation."

OSE #7 /NMCC #152 resolution: It is unlikely that lab error or typographical error is responsible for variations in parameter concentrations in two wells in four consecutive groundwater monitoring events; however, it is possible that such an error is responsible for total dissolved solids (TDS) in GWQ96-22A in April 1997. It should be noted that for 2010-2011 lab results for TDS and sulfate, results are reported to three significant figures as opposed to two significant figures for 1996 and 1997 lab results; this may have an effect on the correlation between TDS and sulfate. The correlation between specific conductance and TDS remained relatively constant in the two wells between 1996 and 2011, with the ratio ranging from 1.2 to 1.7 in GWQ96-22A and from 1.4 to 1.6 in GWQ96-23A. The correlation between sulfate and TDS does appear to have changed between 1996-1997 and 2010-2011 for the two wells; the ratio changed from 0.2 to 0.4, to less than 0.2. TDS and sulfate concentrations appear to be on a decreasing trend in GWQ96-22A, while the trend in GWQ96-23A is more complicated. Stage 1 Abatement Plan monitoring will help define these trends. It should be noted that TDS and sulfate concentrations measured in these two wells between 1996 and 2011 have remained below NMWQCC standards.

OSE #8 / NMCC #153 comment: "Page 8-28, Section 8.2.5.2.5; and Appendix 8-G, Figures G through J. This section asserts no discernible trends in hydrographs for MW-2, MW-5, MW-6 and MW-8. Given that this is a key calibration area for the ground water model because of its proximity to the production well field, more effort would be needed to understand hydrographs in order to adequately simulate Upper Santa Fe Group. For example, MW-5 is an active stock well that shows 50 ft or more of drawdown when pumped for a short duration, followed by water levels full recovery as shown in recent transducer data (2012). Figure H (Appendix 8-G) has a mix of USGS data and other data. It may be that the 1980s data included measure immediately following or during pumping of this well. Similarly, additional effort should be undertaken to evaluate data quality of water levels, well construction details, lithology and other potential factors for the disparate responses of hydrographs, etc."

OSE #8 / NMCC #153 resolution: NMCC submits report titled *Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico,* prepared by John Shomaker & Associates, Inc. The water-level data have been evaluated; deeper water levels measured in MW-5 in the early 1980s were due to pumping of nearby mine production wells, and the long-term rise in MW-6 is due to well construction and upwelling of deeper groundwater along fault zone.

OSE #9 / NMCC #154 comment: "Table 8-9; Table J1 (Appendix 8-G); and Figure I (Appendix 8-G). Due to different references, there are discrepancies between the elevations and total depths cited (e.g., MW-6 TDs 1000 and 1112 feet). Table J1 (Appendix 8-G) mentions multiple data sources, but the sources for tables or figures are not clearly identified. Or possibly the bottom of screened interval has be used in place of total depth."

OSE #9 / NMCC #154 resolution: Bottom of screened interval was reported in place of total depth for GWQ96-22(A), GWQ96-23(A), GWQ11-24(A), NP-1, MW-6, and MW-8 in Table J1 (Appendix 8-G of the Copper Flat BDR). In cases where measured total depth was shallower than the reported bottom of screened interval, the measured total depth was reported.

OSE #10 / NMCC #155 comment: "Page 8-31, 8.2.4.3.5 Results; and Figure N (Appendix 8-G). In addition to the hydrograph showing responses to wetter years, the alluvial aquifer may be affected by irrigation water usage from surface water diversions from Las Animas Creek and ground water diversion from alluvial aquifer and Santa Fe Group aquifer. Also, changes in leakage or flow from artesian wells may affect alluvial aquifer."

OSE #10 / NMCC #155 resolution: Observation is noted.

OSE #11 / NMCC #156 comment: "Page 8-31, Section 8.2.4.4; Figure 8-13, Figure 8-32 and Figure 8-33. While the BDR's proposed Hydrogeologic Zones (for artesian aquifer) correctly locate reaches of hydrologic change, there may be a simpler explanation. Artesian zones may represent solely a change in sedimentary deposition within Santa Fe Group, which may follow transition from unconfined to confined aquifer with lesser importance given to geological structural influence from faulting. It's unclear what influence the Hawley and Kennedy (2004) reference has on Figures 8-13 and 8-33 given that it geologic map is located in Township 16 South with dashed lines and the area of the production well field and Las Animas Creek is located in 15 South. While his cross section shows similarities BDR cross sections, the Hawley section RA-RA' follows changes in lithology rather than create a confined area from dipping USF beds of laterally-extensive clay layers."

OSE #11 / NMCC #156 resolution: The Copper Flat BDR Appendix 8-H is a technical memorandum describing the artesian wells in Las Animas Creek valley and vicinity. The memo states "The artesian wells are constructed in the Santa Fe Group sediments, and artesian conditions occur where there is a low-permeability confining layer, such as clay, overlying a permeable layer of silt, sand, and gravel. A west-to-east cross-section down Las Animas Creek is presented as Figure 3." Cross-section RA-RA' from Hawley and Kennedy (2004) provided guidance as to depths of transition from Upper Santa Fe Group to Middle and Lower Santa Fe Group in the region, easterly dip of Santa Fe Group units in the region, and offsets in Santa Fe Group units across faults in the region. In some cases, lateral changes in lithology (clay versus sand and gravel) over short distances, based on lithologic logs for wells within close proximity, may best be explained by offsets along faults mapped by Seager et al. (1982) and USGS (2006).

OSE #12 / NMCC #157 comment: "Figure 8-32. This figure references USGS 2006 publication, yet there is no 2006 USGS reference at the end of chapter 8. For the bottom 2/3 of this figure, the faults marked appear to be the same as Seager (1982) except that Seager used more dashes and dots to show uncertainty in the locations when compared to Figure 8-32's use of solid lines. Similarly Figure 8-33, extends fault into Las Animas Creek between LA-96 and L-115, and this does fault is not appear in plan view on Figure 8-32. Both Seager (1982) and Figure 8-32 has several disconnected segments of normal faults. Since the BDR conveys a greater confidence in the fault locations, NMCC should provide more supporting evidence (e.g. field observations, drilling logs, deeper wells that would provide control points) that would help justify the changes to the earlier geologic map. Text and figures should indicate modifications in greater detail."

OSE #12 / NMCC #157 resolution: USGS (2006) reference is included in the References section below. This reference includes a geospatial database with New Mexico faults. The faults are plotted in the Copper Flat BDR Figure 8-32 as they appear in the USGS (2006) shapefile NMfaults_lcc.shp. In BDR Figure 8-33, the fault plotted as a dashed line with question marks represents the potential extension of a fault mapped within 0.25 mile of Las Animas Creek in Figure 8-32. Using Hawley and Kennedy (2004; cross-section RA-RA') for guidance as to depths of transitions between Santa Fe Group units, and offsets in Santa Fe Group units across faults in the region, it is reasonable to consider this fault as forming a graben in which the transition from Upper Santa Fe Group to Middle and Lower Santa Fe Group is deeper and characterized by a clay layer logged at the bottom of PW boreholes.

OSE #13 / NMCC #158 comment: "Page 8-33, Section 8.2.5.1 Pit Lake. Note that pit lake water levels increased from 1997 to 2011 (5436.5 to 5442 feet), and likely so did nearby ground water levels. GWQ96-22 and GWQ96-23 wells were drilled in 1990s, yet earlier water level data was not included in BDR. Historical trend of nearby ground water levels and pit lake level may worth considering rather than only reviewing 2011 measurements."

OSE #13 / NMCC #158 resolution: Water-level data for GWQ96-22 and GWQ96-23 collected in the 1990s were reported in BLM (1999; table A2-1). Water-level data for these wells collected in 2010 and 2011 are presented in the Copper Flat BDR Table 8-9. Table 2, below, shows available water-level data from the 1990s and data collected in 2010 and 2011. Water levels were generally shallower in these wells in 1997 and 1998 compared to 2010 and 2011.

NMCC submits report titled *Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico,* prepared by John Shomaker & Associates, Inc. This report documents the historical transient calibration of the groundwater flow model, which considers historical water-level data and pit levels.

Table 2. Summary of pit area water-level data

well	measurement date	depth to water, ft	reference
GWQ96-22A	2/5/1997	44.93	BLM (1999)
	1/24/1998	45.92	BLM (1999)
	2/1/1998	46.09	BLM (1999)
	3/1/1998	46.74	BLM (1999)
	4/14/1998	47.27	BLM (1999)
	5/1/1998	47.89	BLM (1999)
	6/1/1998	48.24	BLM (1999)
	7/21/1998	46.00	BLM (1999)
	8/1/1998	45.10	BLM (1999)
	9/1/1998	46.50	BLM (1999)
	1/28/2010	53.69	BDR (INTERA, 2012)
	6/24/2010	48.52	BDR (INTERA, 2012)
	9/27/2010	48.59	BDR (INTERA, 2012)
	6/30/2011	53.62	BDR (INTERA, 2012)
	8/28/2011	54.63	BDR (INTERA, 2012)
	9/8/2011	54.90	BDR (INTERA, 2012)
GWQ96-22B	2/5/1997	45.22	BLM (1999)
	10/7/2010	48.30	BDR (INTERA, 2012)
	6/30/2011	52.95	BDR (INTERA, 2012)
	8/28/2011	54.59	BDR (INTERA, 2012)
	9/8/2011	54.76	BDR (INTERA, 2012)
GWQ96-23A	2/5/1997	35.18	BLM (1999)
	1/24/1998	35.89	BLM (1999)
	2/1/1998	35.82	BLM (1999)
	3/1/1998	35.60	BLM (1999)
	4/14/1998	35.71	BLM (1999)
	5/1/1998	35.91	BLM (1999)
	6/1/1998	35.97	BLM (1999)
	7/21/1998	36.68	BLM (1999)
	8/1/1998	36.32	BLM (1999)
	9/1/1998	36.35	BLM (1999)
	1/28/2010	42.15	BDR (INTERA, 2012)
	6/24/2010	41.97	BDR (INTERA, 2012)
	9/27/2010	41.80	BDR (INTERA, 2012)
	10/6/2010	41.80	BDR (INTERA, 2012)
	5/4/2011	42.02	BDR (INTERA, 2012)
	6/30/2011	40.32	BDR (INTERA, 2012)
	8/28/2011	40.71	BDR (INTERA, 2012)
	9/8/2011	40.74	BDR (INTERA, 2012)
GWQ96-23B	2/5/1997	36.75	BLM (1999)
	10/6/2010	41.72	BDR (INTERA, 2012)
	5/4/2011	41.99	BDR (INTERA, 2012)
	6/30/2011	40.37	BDR (INTERA, 2012)
	8/28/2011	40.87	BDR (INTERA, 2012)
	9/8/2011	41.06	BDR (INTERA, 2012)

OSE #14 / NMCC #159 comment: "Page 8-34, Section 8.2.5.4 Summary of Impacts. Given the local gradients and geology, "stationary" ground water may not adequately describe vertical and horizontal flow."

OSE #14 / NMCC #159 resolution: The Copper Flat BDR Section 8.2.5.4 states "The tailing impoundment sulfate plume appears to be stationary, and monitoring has not indicated significant migration. Evaluating the extent of potential impacts along Grayback Arroyo and directly downgradient of the tailing impoundment sulfate plume is proposed for the NMCC Stage 1 Abatement Plan." These statements were based on available hydrogeologic data, and the word "stationary" was used to describe the sulfate plume, as opposed to groundwater flow.

OSE #15 / NMCC #160 comment: "Page 8-35, Section 8.2.6 Potential Hydrologic Consequences; and Figure 8-39. In the subsequent development and refinement of a ground water model documentation report, modeling objectives should be stated. Are the model grid and dimensions of regional model based on the modeling objectives? Will the proposed regional model adequately evaluate local impacts of the pumping at the production well field and open pit?"

OSE #15 / NMCC #160 resolution: NMCC submits report titled *Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico*, prepared by John Shomaker & Associates, Inc.

OSE #16 / NMCC #161 comment: "Figure 8-33 and Fig 3(Appendix 8-H). Clarify for these figures. Indicate if the clay-rich layers in Las Animas Creek wells are correlated based on depths indicated from well drilling records or whether dipping clay beds are more conceptual than from specific depths."

OSE #16 / NMCC #161 resolution: Depth intervals of clay-rich layers are based on lithologic logs for individual wells. In some cases, clay layers could be correlated for wells within close proximity, and in some cases relatively thick clay layers could be correlated. The dipping clay beds are generally conceptual and based on the easterly dip of Santa Fe Group units in the region (e.g., Hawley and Kennedy (2004)).

OSE #17 / NMCC #162 comment: "Table 2 (Appendix 8-H), and Pages 8-33 to 8-34, Section 8.2.4.4.2 Data Gaps Addressed – Artesian Well Inventory. Artesian flow rates show a decline at several wells (limited by access issues). Clarify the basis for the conclusion that dewatering by artesian well upward leakage and open flow appears to be mainly responsible for the long-term decline of artesian flow rates (Appendix 8-H). In particular, what does Table 2's total artesian flow rate represent in support, if any, to the conclusion about upward leakage and open flow? If wells are poorly constructed or well seal deteriorates with time, the leakage may partially occur in subsurface, which would appear as decreased flow at surface. Would a better approach for assessing changes at artesian wells include monitoring shut-in pressure of a properly-sealed artesian well?"

OSE #17 / NMCC #162 resolution: The Copper Flat BDR Appendix 8-H states "…it appears a number of artesian wells were drilled without proper annular seals to prevent flow of water from the artesian zone into the overlying alluvium and stream channels. Furthermore, many of the artesian wells were never valved and therefore left open to flow continuously to the land surface." BDR Appendix 8-H concludes "Dewatering by the artesian well upward leakage and open flow, however, appear to be mainly responsible for the long-term decline in artesian flow rates." "Upward leakage," as identified in the BDR as a factor in long-term decline in artesian flow rates, refers to leakage that may occur in the subsurface into the overlying alluvium. Figure 5 in BDR Appendix 8-H shows varying trends for declining artesian flow in Percha and Las Animas Creek valleys over time. This variation is likely due to factors such as upward leakage and open flow affecting wells to varying degrees depending on original well construction, condition of casing, and spatial distribution of wells with open flow.

NMCC installed well GWQ11-27, a properly constructed artesian well in the artesian zone along Las Animas Creek and began monitoring shut-in pressure in the well in July 2012 (JSAI, 2012). These data on pressure changes in the artesian zone as monitored at GWQ11-27 have been incorporated into the groundwater flow model calibration, as documented in the report titled *Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico*, prepared by John Shomaker & Associates, Inc.

OSE #18 / NMCC #163 comment: Figure 8-36. Figure 8-36 shows FW-3 with an initial flow rate of 125 gpm, however the declaration indicate initial artesian flow at 80 gpm. Murray (1959) indicates the 125 gpm was pressure pumped for 4 hrs to induce 115 feet of drawdown. So, this FW-3 artesian flow rate should be 80 gpm."

OSE #18 / NMCC #163 resolution: Note that Murray (1959) table 1 indicates that Well 65 (*FW-2*) was pumped at 850 gpm for 4 hours to induce 115 ft of drawdown, but the well flows at 125 gpm. This is confirmed on page 12 of Murray (1959), which states "Well 65 (16.5.23.300), which has recently been completed, flows about 125 gallons a minute and is equipped with a turbine pump. The pump is reported to yield approximately 850 gallons a minute, and after 4 hours of pumping, the water level lowers to about 115 feet below the surface."

Note that Davie and Spiegel (1967) indicate a reported flow rate of 200 gpm for well 15.5.28.432 (*FW-3*) on January 22, 1966.

STF:am

Enc: References
Figure 1
Graph showing NMED SWQB stream temperature data
Table showing NMED SWQB stream water-quality data
NMED SWQB 2009 report

References

[BLM] Bureau of Land Management, 1999, Preliminary final environmental impact statement: Copper Flat project: Las Cruces, New Mexico, U.S. Department of the Interior, 491 p.

Davie, W., Jr., and Spiegel, Z., 1967, Las Animas Creek hydrographic survey report, Geology and water resources of Las Animas Creek and vicinity, Sierra County, New Mexico: New Mexico Office of the State Engineer, 34 p. plus tables and figures.

Hawley, J.W., and Kennedy, J.F., 2004, Creation of a digital hydrogeological framework model of the Mesilla Basin and southern Jornada del Muerto Basin: New Mexico Water Resources Research Institute, New Mexico State University, Technical Completion Report 332 prepared for Lower Rio Grande Water Users Organization, 105 p. plus CD-ROM including 2005 Addendum extending model into Rincon Valley and adjacent areas.

INTERA, 2012, Baseline data characterization report for Copper Flat Mine, Sierra County, New Mexico: consultant's report prepared by INTERA for New Mexico Copper Corporation, June 2012.

[JSAI] John Shomaker & Associates, Inc., 2012, Hydrogeologic analysis of proposed pumping test for New Mexico Copper Corporation supply wells (LRG-4652, LRG-4652-S, LRG-4652-S-2, and LRG-4652-S-3): consultant's report prepared by John Shomaker & Associates, Inc. for New Mexico Copper Corporation, 16 p. plus figures and attachment.

Murray, C.R., 1959, Ground-water conditions in the nonthermal artesian-water basin south of Hot Springs, Sierra County, New Mexico: New Mexico Office of the State Engineer Technical Report No. 10, 33 p.

[NMED] New Mexico Environment Department, 2009, Water quality survey summary for the Lower Rio Grande tributaries, 2004: report prepared by New Mexico Environment Department Surface Water Quality Bureau, November 2009, 19 p.

Seager, W.R., Clemons, R.E., Hawley, J.W., and Kelley, R.E., 1982, Geology of northwest part of Las Cruces 1 x 2 sheet, New Mexico: New Mexico Bureau of Geology and Mineral Resources Geologic Map 52, 1:125,000 scale.

[USGS] U.S. Geological Survey, 2006, Preliminary integrated geologic map databases for the United States: central states: Montana, Wyoming, Colorado, New Mexico, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Iowa, Missouri, Arkansas, and Louisiana: U.S. Geological Survey Open-File Report OF-2005-1351, 1:500,000 scale.

Wilson, C.A., Orr, B.R., White, R.R., and Roybal, R.G., 1981, Water resources of the Rincon and Mesilla Valleys and adjacent areas, New Mexico: New Mexico Office of the State Engineer Technical Report No. 43, 514 p.

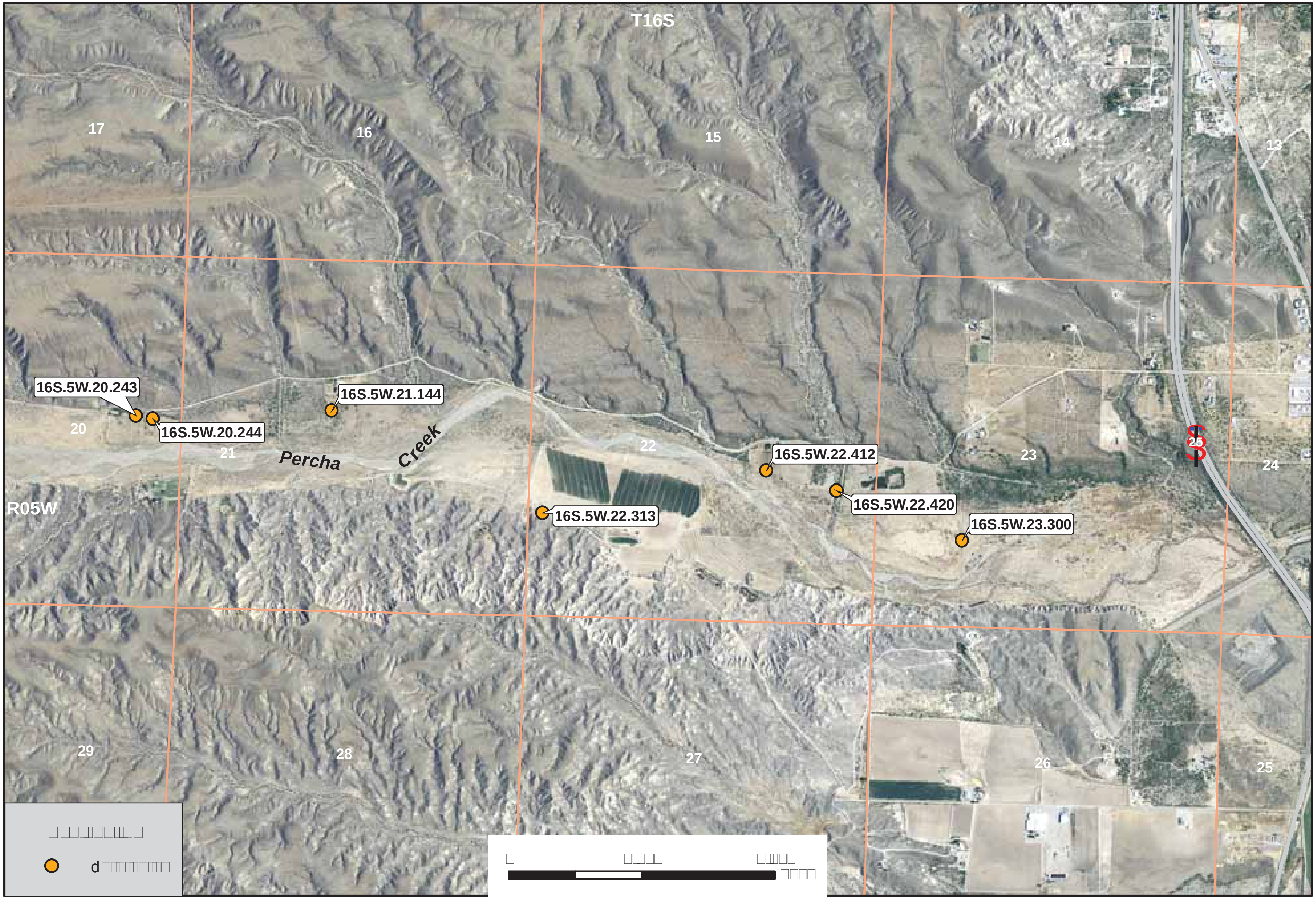
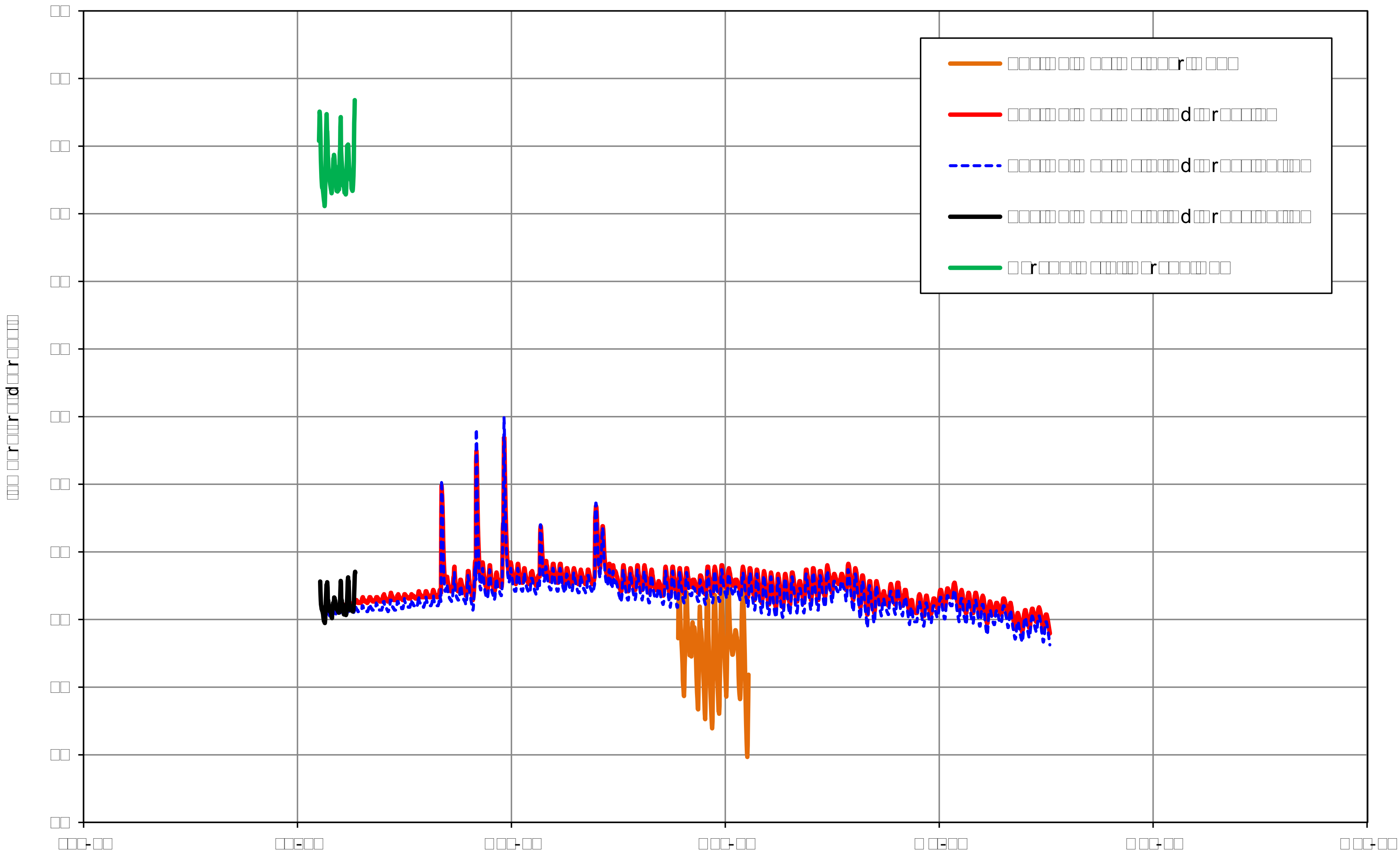


Figure 1. Aerial photograph showing the approximate locations of historical groundwater quality data points along Percha Creek, Sierra County, New Mexico.



Graph showing stream temperature data in Las Animas Creek and Percha Creek collected by New Mexico Environment Department, Surface Water Quality Bureau.

Table showing NMED SWQB stream water-quality data

location	ID	Latitude	Longitude	Date	No. of data points	Average temperature	Maximum temperature	Average specific conductance	Flow	Alkalinity	Aluminum, dissolved	Aluminum, total	Ammonia	Antimony, dissolved	Antimony, total	Arsenic, dissolved	Arsenic, total	Barium, dissolved	Barium, total
						deg F	deg F	mS/cm	cfs	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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Table showing NMED SWQB stream water-quality data

location	ID	Latitude	Longitude	Date	Beryllium, dissolved	Beryllium, total	Bicarbonate	Boron, dissolved	Boron, total	Cadmium, dissolved	Cadmium, total	Calcium	Calcium, dissolved	Carbonate	Chloride	Chromium, dissolved	Chromium, total	Cobalt, dissolved	Cobalt, total
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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Table showing NMED SWQB stream water-quality data

location	ID	Latitude	Longitude	Date	Copper, dissolved	Copper, total	Fluoride	Hardness, as CaCO3	Iron, dissolved	Iron, total	Lead, dissolved	Lead, total	Magnesium	Magnesium, dissolved	Manganese, dissolved	Manganese, total	Mercury	Molybdenum, dissolved	Molybdenum, total
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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Table showing NMED SWQB stream water-quality data

location	ID	Latitude	Longitude	Date	Nickel, dissolved	Nickel, total	Nitrate + Nitrite (N)	Phosphorus, Total	Potassium	Selenium	Selenium, dissolved	Silicon, dissolved	Silicon, total	Silver, dissolved	Silver, total	Sodium	Strontium, dissolved	Strontium, total	Sulfate
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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Table showing NMED SWQB stream water-quality data

location	ID	Latitude	Longitude	Date	Thallium, dissolved	Thallium, total	Tin, dissolved	Tin, total	Total Dissolved Solids	Total Kjehldal Nitrogen	Total Suspended Solids	Uranium-234/235/238, dissolved	Uranium-234/235/238, total	Vanadium, dissolved	Vanadium, total	Zinc, dissolved	Zinc, total
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
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WATER QUALITY SURVEY SUMMARY
FOR THE
LOWER RIO GRANDE TRIBUTARIES
2004

Prepared by
New Mexico Environment Department
Surface Water Quality Bureau

November 2009

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Water quality surveys and assessments conducted by the New Mexico Environment Department Surface Water Quality Bureau are completed to fulfill Section 106 of the Clean Water Act [33 USC 1251 et seq.], *Work Program for Water Quality Management.* This project was funded by a grant from the U.S. Environmental Protection Agency.

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ADB	Assessment Database
ºC	Degrees Celsius
CWA	Clean Water Act
DO	Dissolved Oxygen
EMAP	Environmental Monitoring and Assessment Program
ºF	Degrees Fahrenheit
GIS	Geographic Information Systems
MCWAL	Marginal Coldwater Aquatic Life
mi^2	square miles
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
QAPP	Quality Assurance Project Plan
STORET	Storage and Retrieval System
SWQB	Surface Water Quality Bureau
EPA	United States Environmental Protection Agency

1.0 EXECUTIVE SUMMARY

During 2004, the Monitoring and Assessment Section of the Surface Water Quality Bureau (SWQB) conducted water quality and biological assessment surveys of the Lower Rio Grande and its perennial tributaries from the international boundary with Mexico to Elephant Butte Reservoir. Tributaries of the Lower Rio Grande sampled during the survey included Alamosa Creek, Las Animas Creek, Palomas Creek, and Percha Creek. Sampling at the tributary stream stations was conducted on a monthly basis from June through October when water was present at the stations. Information on the water quality of the main-stem sites can be found in the *Water Quality Survey Summary for the Lower Rio Grande 2004* (NMED/SWQB 2006a).

The primary purpose of this survey was to collect chemical, physical, and biological data to identify water quality impairments within the watershed. The results of this study are summarized in the Integrated List portion of the biennial *State of New Mexico Integrated Clean Water Act §303(d)/305(b) Report.* Any assessment conclusions presented in this report are based on water quality standards and assessment protocols that existed at the time the survey was conducted. It is important to note that both the assessment protocols and water quality standards are revised periodically to incorporate new information and refinements. The U.S. Environmental Protection Agency (USEPA) uses the most recent state-developed assessment protocols and the most recent USEPA-approved water quality standards when deciding whether or not to approve impairment determinations on the biennial *New Mexico Integrated List of Assessed Surface Waters*. Therefore, the impairment conclusions in the most recent Integrated List supersede assessment conclusions in this survey report if they should differ.

Water quality monitoring at survey stations included total nutrients, total and dissolved metals, major anions and cations, and microbiological collections as determined by proximity to potential sources and/or previous survey findings. Data loggers were deployed at select stations to collect temperature, pH, dissolved oxygen (DO), conductivity, and turbidity data for an extended period of time to monitor diurnal fluctuations. Biological surveys, which included the monitoring of fecal coliform and *E. coli* as well as the collection of macroinvertebrates and physical habitat characteristics, were conducted at select stations.

Water quality in the Lower Rio Grande tributaries was found to be good. Water quality sampling at tributary stream stations found no exceedences of water quality criteria for total nutrients, total and dissolved metals, major anions and cations, bacteria, and field parameters such as dissolved oxygen, pH, and temperature. However, Percha Creek and Alamosa Creek were listed as Partially Supporting on the 1998 §303(d) list with stream bottom deposits as the cause. Additional data were collected in 2007 to confirm the historic sedimentation/siltation listings. These data were assessed according to SWQB's *Appendix D: Sedimentation/Siltation Assessment Protocol for Wadeable, Perennial Streams* (NMED/SWQB 2009). Based on the assessment, it was determined that Alamosa and Percha Creeks were fully supporting their aquatic life uses with respect to sedimentation/siltation. Consequently, NMED/SWQB intends to remove the sedimentation/siltation impairment listings for Alamosa and Percha Creeks in the 2010-2012 State of New Mexico CWA §303(d)/§305(b) Integrated Report.

2.0 INTRODUCTION

The Rio Grande originates in the San Juan Mountains of southern Colorado and follows a 1,885-mile course before flowing into the Gulf of Mexico. Along the way, the river and its tributaries drain 182,200 square miles of land. This drainage encompasses a widely varied landscape in the United States and Mexico, including mountains, forests, and deserts. The basin is home to diverse native plants and wildlife as well as some 10 million people. For approximately two-thirds of its course, the river also serves as the boundary between the United States and Mexico.

The Lower Rio Grande offers a 247-day growing season where temperatures can soar to 111 degrees Fahrenheit (°F) and plummet to –16 °F. Two-thirds of the annual precipitation (7.8 inches) is packed into the late summer and early fall (La Mar 1984). Historic and current land uses in the watershed include agriculture, recreation, and municipal related activities of Las Cruces and El Paso. At present, ranching and irrigated agriculture are major components of the economy in the basin.

Much of the land ownership adjacent to the river is private with the exception of state parks near Elephant Butte Reservoir, Caballo Reservoir, Percha Dam, and Leasburg Dam. The Bureau of Land Management and the State of New Mexico also own and manage sizable tracts of public lands in the upland portions of the watershed. The various state parks and reservoirs located along the river support activities such as hiking, mountain biking, camping, and fishing as well as water skiing and other recreational sports.

The surrounding geology was shaped by the Rio Grande Rift system. The Rio Grande Rift system is a series of grabens (fault-bounded basins) that extend from central Colorado southward through New Mexico and into western Texas and Mexico. Continental rifting was associated with crustal stretching and uplift of the southwestern United States. Grabens dropped down thousands of meters relative to adjacent uplifts, and alluvial sediment accumulated to great thickness in the basins. Intrusions and volcanic eruptions also took place within the rift valleys and throughout the surrounding region.

The Monitoring and Assessment Section (MAS) of the SWQB conducted a water quality survey of the Lower Rio Grande tributaries between June 2004 and October 2004 with additional data collections in 2007. Surface water quality monitoring stations were selected to characterize water quality of the stream reaches and determine impairment. The water quality survey for the Lower Rio Grande and its tributaries included 22 sampling sites encompassing the geographic area from Elephant Butte Reservoir to the International Boundary with Mexico (**Figure 1 and Table 1**). Monitoring these sites enabled an assessment of the cumulative influence of the physical habitat, water sources, and land management activities upstream from the sites. **Table 1** lists the location of sampling stations in each assessment unit (AU) of the Lower Rio Grande tributaries along with the station numbers, STORET identification codes, the current listings on the Integrated Clean Water Act (CWA) §303(d)/§305(b) Report, and the associated water quality segment number. Information on the water quality of the main-stem sites can be found in the *Water Quality Survey Summary for the Lower Rio Grande 2004* (NMED/SWQB 2006a).

Figure 1. Lower Rio Grande Survey Area and 2004 Sampling Stations

Table 1. Lower Rio Grande Tributaries and Associated Sampling Stations

Assessment Unit	Station No.	STORET Code	Sampling Station	Historic Impairment Listing(s)	WQS (August 2007) reference
Percha Creek (Perennial reaches Caballo Res. to M Fork)	16	41Percha025.3	Percha Creek at Percha Box	Sedimentation/ Siltation	20.6.4.103
Las Animas Creek (perennial portion R Grande to headwaters)	17	41LAnima018.6	Las Animas Creek at Rd Crossing	---	20.6.4.103
	18	41LAnima029.3	Las Animas Creek above box		
	19	41LAnima038.3	Las Animas Creek near Dunn		
Palomas Creek (perennial portion R Grande to headwaters)	20	41SPalom019.1	South Fork Palomas Creek near Hermosa	---	20.6.4.103
	21	41Paloma036.7	South Fork Palomas Creek above North Fork		
Alamosa Creek (Perennial reaches abv Monticello diversion)	22	40Alamos058.5	Alamosa Creek below USGS Gage 8360000	Sedimentation/ Siltation	20.6.4.103

3.0 NM WATER QUALITY STANDARDS

United States Environmental Protection Agency (EPA) approved water quality standards were used to determine if waterbodies throughout the watershed are supporting their designated uses. The *State of New Mexico Standards for Interstate and Intrastate Surface Waters*, which include fishable and swimmable goals set forth in the Clean Water Act §102(a), were consulted for this determination. General standards and standards applicable to attainable or designated uses for portions of the Lower Rio Grande tributaries that were surveyed in this study are set forth in sections 20.6.4.13, 20.6.4.97, 20.6.4.98, 20.6.4.99, and 20.6.4.900 of the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC 2007). Segment specific standards for the Lower Rio Grande tributaries are set forth in section 20.6.4.103, which reads as follows:

20.6.4.103 RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Caballo reservoir upstream to Elephant Butte dam and perennial reaches of tributaries to the Rio Grande in Sierra and Socorro counties.

A. Designated Uses: fish culture, irrigation, livestock watering, wildlife habitat, marginal coldwater aquatic life, secondary contact and warmwater aquatic life.

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 9.0 and temperature 25°C (77°F) or less. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of E. coli bacteria 548 cfu/100 mL or less, single sample 2507 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

C. Remarks: Flow in this reach of the Rio Grande main stem is dependent upon release from Elephant Butte dam. [20.6.4.103 NMAC - Rp 20 NMAC 6.1.2103, 10-12-00; A, 05-23-05]

4.0 METHODS

Water quality sampling methods were in accordance with the approved *Quality Assurance Project Plan (QAPP) for Water Pollution Control Programs* (NMED/SWQB 2004) and the *SWQB Standard Operating Procedures for Data Collection*. These data were assessed in accordance with protocols established in the *Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA §303(d)/§305(b) Integrated Report: Assessment Protocol* (NMED/SWQB 2006b).

5.0 SAMPLING SUMMARY

A map of the study area is provided in **Figure 1**. The station numbers, STORET identification codes, and location descriptions of sampling stations selected for this survey are provided in **Table 1**. The rational for selecting each tributary station is as follows:

Percha Creek at Percha Box was selected because it is a perennial reach of a Rio Grande tributary.
Las Animas Creek at Rd Crossing was selected because it is a perennial reach of a Rio Grande tributary.
Las Animas Creek above box was selected because it is minimally impacted site above ranch headquarters and associated activities and is considered an ecoregional reference site.
Las Animas Creek near Dunn was selected at the request of the US Forest Service because it is located near the USFS boundary.
Alamosa Creek below USGS Gage 8360000 was selected because it is a perennial reach of a Rio Grande tributary and is a possible ecoregional reference station.
South Fork Palomas Creek near Hermosa was selected at the request of the US Forest Service because it is located near the USFS boundary.
South Fork Palomas Creek above North Fork was selected because it is a perennial reach of a Rio Grande tributary and is a possible ecoregional reference station.

Water samples were analyzed for plant nutrients, ions, total and dissolved metals, fecal coliform bacteria, radionuclides, and anthropogenic organic compounds. Variables such as dissolved oxygen (DO), pH, turbidity, and specific conductance were measured in the field. Physical habitat and benthic macroinvertebrate communities were surveyed to determine the impacts of excessive nutrients and settled sediment on aquatic life within a stream. The type of monitoring done at each site is summarized in **Table 2**. The number of times each parameter (or suite of parameters) was sampled for is indicated.

Table 2. SWQB Sampling Summary

Assessment Unit / Stations	Field Data+	Ions (full suite)	Total Nutrients	Total Metals	Dissolved Metals	Fecal Coliform	E. Coli	Sonde Deployment	Thermograph Deployment
Percha Creek (Perennial reaches Caballo R to M Fork)									
Percha Creek at Percha Box	5	3	5	5	5	1	1	Yes	**
Las Animas Creek (perennial portion R Grande to headwaters)									
Las Animas Creek at Rd Crossing	5	3	3	3	3	1	1	Yes	Yes
Las Animas Creek above box	5	2	4	2	2	-	-	Yes	-
Las Animas Creek near Dunn	1	-	1	-	-	-	-	Yes	-
Alamosa Creek (Perennial reaches abv Monticello diversion)									
Alamosa Creek below USGS Gage 8360000	6	6	6	5	5	4	4	Yes	**
Palomas Creek (perennial portion R Grande to headwaters)									
South Fork Palomas Creek near Hermosa	3	-	1	1	1	-	-	-	-
South Fork Palomas Creek above North Fork	1	3	3	3	3	1	1	Yes	**

+ *Field data include dissolved oxygen (DO), pH, temperature, turbidity, specific conductance, and salinity.*
*** Thermographs were deployed but lost due to flood events.*

For many water quality analytes, the State of New Mexico maintains numeric water quality standards, whereas standards for other parameters such as plant nutrients and bottom deposits are narrative. Data are assessed for designated use attainment status for both numeric and narrative water quality standards by application of the *Assessment Protocol* (NMED/SWQB 2009). A complete dataset can be obtained by contacting the SWQB.

6.0 WATER QUALITY CRITERIA EXCEEDENCES

The following discussion includes information pertaining to exceedences of water quality standards found during the SWQB watershed survey. The purpose of this section of the report is to provide the reader with information on where current water quality standards are being exceeded within the watershed. These exceedences are used to determine designated use impairment status. Final assessment determinations as to whether or not a stream reach is considered to be meeting its designated uses depend on the overall amount and type of data available during the assessment process (Refer to SWQB's *Assessment Protocol* for additional information on the assessment process, NMED/SWQB 2009). When available, outside sources of data that meet quality assurance requirements are combined with data collected by SWQB during the watershed survey to determine final impairment status. Final designated use impairment status is housed in the Assessment Database (ADB) and is reported in the biennial *State of New Mexico CWA §303(d)/§305(b) Integrated Report* (NMED/SWQB 2008).

6.1 Water Quality Exceedences For Numeric Criteria

6.1.1 Physicochemical Data

Physicochemical water quality samples and sampling frequencies are provided in **Table 2**. It should be noted that an exceedence of a given criterion may not generate a violation of standards, triggering a listing on the 303(d) list. Details of assessment and listing procedures are available in the *Assessment Protocol* (NMED/SWQB 2006b).

Sampling for major ions, nutrients, total and dissolved metals, bacteria, and field parameters found no exceedences of water quality criteria.

6.1.2 Data from Continuous Monitoring Devices

Temperature data loggers (thermographs) were deployed at selected stations within the study area. **Table 3** summarizes temperature data from thermographs in degrees Celsius (°C). YSI multi-parameter sondes were also deployed at selected stations to examine pH and dissolved oxygen (DO). **Tables 4a and 4b** summarize sonde data collected from the Lower Rio Grande tributaries. The thermographs and sondes were programmed to record temperature, DO, and/or pH once per hour over their respective collection intervals.

Large datasets generated from data loggers (e.g., sondes and thermographs) are assessed according to protocols developed specifically for such datasets (with few exceptions). This is because, unlike grab sample data, it is not reasonable to list as not supporting on the basis of one or a few exceedences out of several hundred or thousand data points.

Temperature (given in °C) and pH assessment criteria are tied to the criteria in the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC 2007). Dissolved oxygen assessment criteria are linked to the presence of sensitive, *i.e.* early life stages, aquatic organisms and designated use, *i.e.* marginal coldwater aquatic life use. Details of large dataset assessment procedures are available in the *Assessment Protocol* (NMED/SWQB 2006b).

Table 3. Summary of Thermograph Data

Station	Data Collection Interval	WQS Temperature Criterion (°C)	Maximum Recorded Temperature (°C)	Total # of data points (n)	# / % Exceedences
Las Animas Creek at road crossing	July 8, 2004 – October 19, 2004	25 °C	19.9 °C	2022	0 / 0%

NOTES: Thermographs were deployed but lost due to flood events on Palomas, Alamosa, and Percha Creeks.

Table 4a. Summary of pH Data Collected from Sondes

Station	Data Collection Interval	Designated Use	Criterion SU	Min / Max SU	# / % Exceedences	Magnitude Violation	Frequency Violation
Las Animas Creek at road crossing	July 7-12, 2004	MCWAL	6.6-9.0	6.95/7.09	0 / 0%	No	No
Las Animas Creek above the box	October 18-27, 2006	MCWAL	6.6-9.0	7.30/7.41	0 / 0%	No	No
Las Animas Creek near Dunn	Aug 27-Sep 6, 2004	MCWAL	6.6-9.0	6.18/6.67	0 / 0%	No	No
Alamosa Creek blw USGS Gage 8360000	July 8-12, 2004	MCWAL	6.6-9.0	7.64/8.24	0 / 0%	No	No
South Fork Las Palomas abv North Fork	July 7-12, 2004	MCWAL	6.6-9.0	7.40/8.13	0 / 0%	No	No
Percha Creek at Percha Box	July 7-12, 2004	MCWAL	6.6-9.0	7.43/7.62	0 / 0%	No	No

NOTES: MCWAL = Marginal Coldwater Aquatic Life

Table 4b. Summary of Dissolved Oxygen Data Collected from Sondes

Station	Data Collection Interval	Designated Use	WQS Criterion (mg/L)	Min/Max Conc. (mg/L)	Min Sat. (% local)	Assessment Criterion	Combined Conc./Sat. Exceedences (# / %)	% Sat. Exceedences (# / %)
Las Animas Creek at road crossing*	July 7-12, 2004	MCWAL	6.0	1.69 / 2.43	20.8	OLS	121 / 100%	121 / 100%
Las Animas Creek above the box	Oct 18-27, 2006	MCWAL	6.0	8.21 / 9.64	101.7	OLS	0 / 0%	0 / 0%
Las Animas Creek near Dunn*	Aug 27-Sep 6, 2004	MCWAL	6.0	0.14 / 5.17	1.8	OLS	241 / 100%	241 / 100%
Alamosa Creek blw USGS Gage 8360000	July 8-12, 2004	MCWAL	6.0	5.88 / 7.09	87	OLS	8 / 7.6%	0 / 0%
South Fork Las Palomas abv North Fork^	July 7-12, 2004	MCWAL	6.0	---	---	---	---	---
Percha Creek at Percha Box*	July 7-12, 2004	MCWAL	6.0	4.72 / 7.49	68.1	OLS	77 / 62.6%	54 / 43.9%

NOTES: MCWAL = Marginal Coldwater Aquatic Life
OLS refers to Other Life Stages, as opposed to the more sensitive ELS, Early Life Stages
* Low dissolved oxygen results are likely the result of significant groundwater input.
^ DO probe malfunction.

As noted in **Table 4b** above, several streams have low dissolved oxygen (DO) values below the DO water quality standard. Natural inflows of groundwater often have low concentrations of DO and can therefore result in lower DO concentrations in surface waters. One way to help determine if a stream is dominated by groundwater inflows is to look at the water temperature over a period of time. Groundwater is often colder and does not exhibit the typical diurnal swings of temperature as that observed in surface waters (**Figures 2 and 3**). That is, over a period of 24 hours the temperature of a groundwater-fed stream is relatively stable. The results of this analysis indicated that the low DO values documented in Las Animas and Percha Creeks are likely the result of a significant groundwater input and therefore these sites were determined to be Fully Supporting its aquatic life use with respect to DO.

Figure 2. Example of relatively stable stream temperatures indicative groundwater input

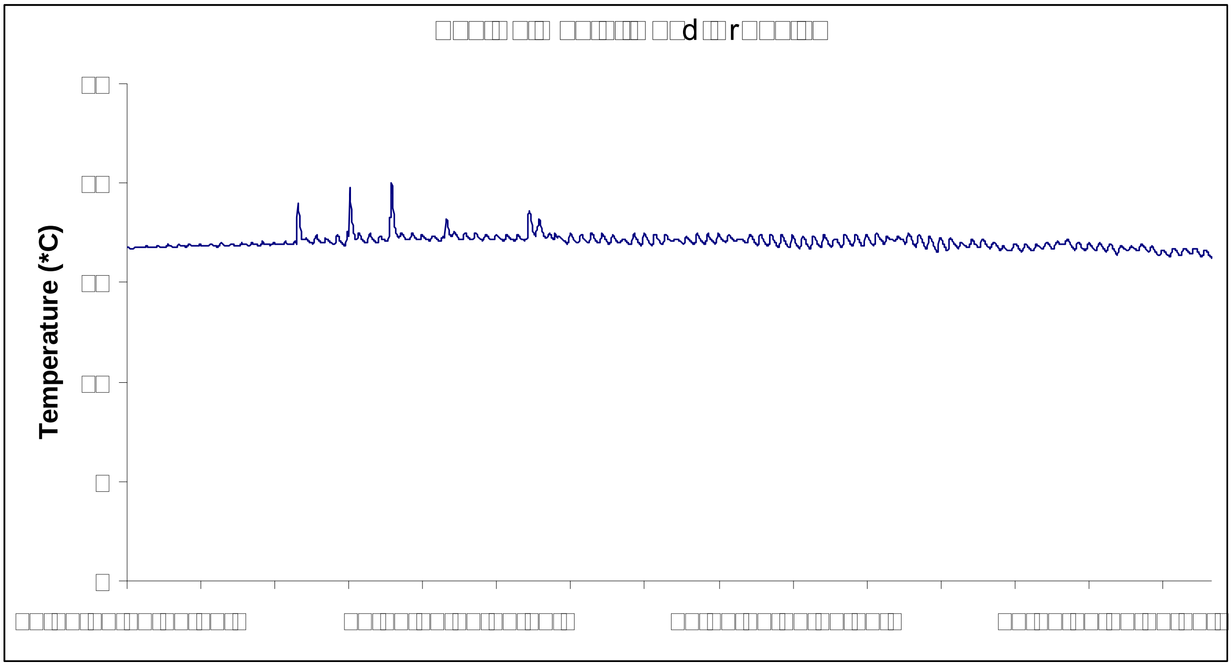
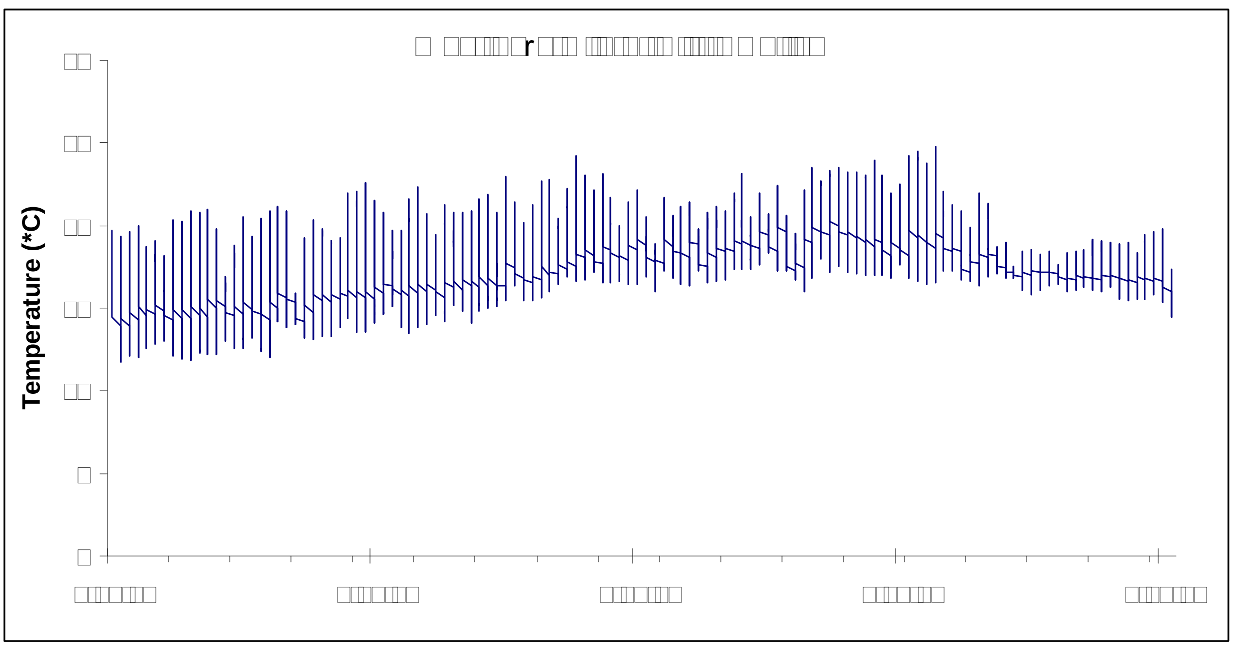


Figure 3. Example of typical diurnal fluctuations of temperature in surface water



6.2 Water Quality Exceedences For Narrative Criteria

6.2.1 Physical Habitat

It is essential to characterize the physical habitat in order to relate stream biological condition to land use impacts and potential anthropogenic disturbances. The physical habitat components most directly impacting biological communities are the stream geomorphology (physical structure), the riparian corridor that supports and protects aquatic life, and the composition of the substrate where the aquatic communities live. Streams existing in similar landscapes express similar compositions of these three attributes and can be compared to a reference site within that group. A reference site is a stream reach that has been exposed to the least amount of human disturbance within a certain landscape. **Table 5** describes the watershed size, ecoregion, and elevation of each station within the biological survey of the Lower Rio Grande Tributaries. These are the minimal data necessary to categorize the sites by landscape, and the reference sites indicated were chosen as the least disturbed by the professional judgment of the Monitoring and Assessment Biology Team.

Percha Creek and Alamosa Creek were previously listed for stream bottom deposits. Environmental Monitoring and Assessment Program (EMAP; Peck *et al.* 2003) surveys were conducted on these streams in 2007 to collect data in order to verify the historic sedimentation/siltation listings.

Table 5. Watershed Characteristics of Reference and Study Sites

Station	Latitude	Longitude	Watershed Area	Elevation	Ecoregion
West Fork Gila abv Cliff Dweller Cyn (reference)	33.2293	108.266	109 mi^2	5709 feet	AZ/NM Mountains
Alamosa Creek below USGS Gage 8360000	33.5687	107.590	401 mi^2	6181 feet	AZ/NM Mountains
Blue Creek 0.5 mile abv Gila River (reference)	32.6627	108.830	138.5 mi^2	3963 feet	Chihuahuan Desert
Percha Creek at Percha Box	32.9179	107.529	85.5 mi^2	5003 feet	Chihuahuan Desert

Substrate Composition

The size of sediment within a stream system is one of the most important physical attributes in determining the health of aquatic communities. There are two components to sediment load that impact aquatic life: suspended load and bed load. Suspended load is quantified through the measurement of turbidity and total suspended solids. Bed load describes the particles that settle to or roll along the bottom (saltation) of the channel. Larger bed load particles provide increased interstitial space between particles, thus allowing for different aquatic communities than those found among small particles with little or no space. The size of sediment within a stream has a natural progression from course, large particles in sections at high elevation with smaller watershed size gradually decreasing to sand in low elevation streams with large watersheds. Therefore, to determine whether a stream exhibits an unnaturally fine bed load, knowledge of the location of the stream segment within the watershed is necessary. Particles smaller than 2mm are considered “fines”, and “percent fines” are considered for assessment purposes (See 20.6.4.13(A) NMAC). The percent fines is calculated by adding the % sand and % silt-clay.

Geomorphology

Quantitatively identifying the current structure of a stream channel allows for a determination of the amount and variation of habitat available for aquatic communities. A natural, undisturbed stream system maintains equilibrium with the amount of water and sediment that it transports, allowing that system to remain stable. Human impacts may alter the equilibrium of a stream, causing the stream to actively attempt to restore this balance. As the stream attempts to restore equilibrium, it may cause damage to the adjacent riparian habitat or the aquatic communities within the channel.

Riparian Health

The riparian area is the corridor of vegetation surrounding the stream that provides many beneficial functions to the stream channel. Although there are many benefits to a diverse and healthy riparian area, the most direct effects are shade, soil stability, and organic inputs providing food for the aquatic communities. Two qualitative assessments were performed to provide general information on the health of the habitat and structure of the stream: the Rapid Geomorphic Assessment (RGA) and the Rapid Habitat Assessment (RHA). These observational assessments provide an indication of riparian health.

Table 6 provides a comparison of the physical habitat parameters collected at the reference reaches and study reaches during the 2007 EMAP surveys. In both cases the geomorphic and measures of riparian health are comparable with reference site conditions.

Table 6. Comparison of Physical Habitat Results between Reference Sites and Study Sites

Results	West Fork Gila (Reference)	Alamosa Creek	Blue Creek (Reference)	Percha Creek
Substrate Composition				
% Fines (< 2 mm)	8%	22%	43%	16%
D50	53 mm	18.5 mm	4.5 mm	24.5 mm
D84	121.5 mm	42.5 mm	119.5 mm	62 mm
Mean % Embeddedness	41.9%	46.6%	60.2%	49.5%
Geomorphic Data				
Slope	1.15%	1.10%	0.95%	0.83%
Width-to-Depth Ratio	47.1	29.3	33.3	26.5
Riparian Health				
Rapid Geomorphic Assessment[1] (0 – 36)	1.0	14.0	11.0	16.5
Rapid Habitat Assessment[2] (0 – 200)	177	151	133	138

NOTES: mm = millimeters

1. The Rapid Geomorphic Assessment is used to identify stable reaches and the destabilizing processes that are active in the reach. A channel stability score is determined by observing a number of channel characteristics and the stage of channel evolution based on the National Sedimentation Lab empirical model (Simon 1989). **Higher scores indicate a more unstable channel**.
2. The Rapid Habitat Assessment (Barbour, *et al.* 1999) provides a qualitative aquatic habitat score that is based primarily on observation of the quality and diversity of in stream habitats. **Higher scores indicate better habitat quality**.

6.2.2 Macroinvertebrate Community and Sedimentation Data

Since the narrative standard for bottom deposits is dependent on biological condition, the assessment of this physically-based narrative sedimentation criteria should be determined using a biological response variable that will link excess settled sediment levels to designated use attainment. The macroinvertebrate community is generally the first to show a response to certain stressors such as the fine sediment that settles to the bottom of the channel. By collecting data on the macroinvertebrate communities that are present in a stream reach SWQB can identify changes that indicate stress on the community. Depending on the ecoregion of the study site, this can be done by utilizing either the Rapid Bioassessment Protocol (RBP) or Mountain Stream Condition Index (M-SCI) as described in SWQB's main assessment protocol. Application of the biological assessment or degree of impairment is a percentage comparison of the sum of selected metric scores at the study site compared to a reference site or condition. For example, a study site in ecoregion 24 (Chihuahuan Desert) achieving a RBP score greater than 83 percent of the reference site would be deemed non-impaired (**Table 7**). Similarly, when the macroinvertebrate community at a study site in ecoregion 23 (AZ/NM Mountains) has an M-SCI score < 56.70% of the reference condition, it can be concluded that there is stress on that community and it would be deemed impaired (i.e. non-support) (**Table 8**).

Table 7. Biological Integrity Attainment Matrix using the Rapid Bioassessment Protocol Index[1] for Chihuahuan Desert Sites

% Comparison to Reference Site(s)	Biological Condition Category[2]	Attributes[1]
> 83%	Non-impaired (Full Support)	Comparable to best situation to be expected within ecoregion (watershed reference site). Balanced trophic structure. Optimum community structure (composition & dominance) for stream size and habitat quality.
79 – 54%	Slightly Impaired (Non-Support)	Community structure less than expected. Composition (species richness) lower than expected due to loss of some intolerant forms. Percent contribution of tolerant forms increases.
50 – 21%	Moderately Impaired (Non-Support)	Fewer species due to loss of most intolerant forms. Reduction in EPT index.
< 17%	Severely Impaired (Non-Support)	Few species present. Densities of organisms dominated by one or two taxa.

1. RBP Index, percentages, and biological attributes are taken from Plafkin *et al.*, 1989. Percentage values obtained that are in between the above ranges will require best professional judgment as to the correct placement.
2. New Mexico has combined all but the "Non-impaired" category into "Non-Support" per USEPA Region 6 suggestion.

Table 8. Biological Integrity Attainment Matrix using M-SCI[1] for AZ/NM Mountain Sites

% Comparison to Reference Condition	Biological Condition Category[2]
> 78.35%	Very Good (Full Support)
78.35 – 56.70%	Good (Full Support)
56.70 – 37.20%	Fair (Non-Support)
37.20 – 18.90%	Poor (Non-Support)
> 18.90%	Very Poor (Non-Support)

1. M-SCI Index and percentages based on Jacobi, *et al.* (2006)
2. New Mexico has combined the "very good" and "good" categories into "Full Support," while the remaining categories define "Non-Support."

Sedimentation/Siltation Assessment

In order to assess for excess sedimentation, the biological index score (RBP or M-SCI depending on ecoregion) and the percent fines in the stream reach are assessed independently for their support of the aquatic life use. Reference sites are currently used to determine the amount of fines appropriate for each stream reach. If a low biological index score coincides with a percent fines that is greater than 20% and this value exceeds a 28% increase from the associated reference site, excess fine sediment is indicated as a cause of impairment. If only the biological index score is low, excess fine sediment is not indicated as a cause of impairment.

Alamosa Creek had an M-SCI score in the "good" range indicating the biological community is not impaired or stressed even though the percent fine sediment in Alamosa Creek exhibited a 175% increase over the reference site (**Table 9**) and was slightly above the 20% fine threshold defined in Appendix D of the Assessment Protocol. Therefore, Alamosa Creek was determined to be Fully Supporting its aquatic life use with respect to sedimentation/siltation.

Percha Creek had a RBP score in the "moderately impaired" range indicating the biological community is stressed, however the percent fine sediment in Percha Creek was only 16% almost three times lower than the 43% fines found at its reference site (**Table 9**). According to Appendix D of the Assessment Protocol, raw percent values of ≤ 20% fines at a study site should be evaluated as "Full Support" regardless of the percent attained at the reference site. Therefore Percha Creek was determined to be Fully Supporting its aquatic life use with respect to sedimentation/siltation.

Table 9. Sedimentation Evaluations for the Lower Rio Grande Tributaries

Stations	Biological Index Score	% of Reference	% Fine Sediment	% increase over Reference
Alamosa Creek below USGS Gage 8360000	61.7*	N/A	22	175%
Percha Creek at Percha Box	46^	96%	16+	- 63%

* Mountain – Stream Condition Index (M-SCI) is used to assess AZ/NM Mountain sites.
^ Rapid Bioassessment Protocol (RBP) Index is used to assess Chihuahuan Desert sites.
+ Raw percent values of ≤20% fines at a study site should be evaluated as "Full Support" regardless of the percent attained at the reference site.

6.2.3 Periphyton Community and Nutrient Data

The periphyton community is another biological indicator that can express system stress in ways that the macroinvertebrate or fish community may not reveal. The use of periphyton community data is still in early stages of development and does not provide conclusive information on stream health at this time. Periphyton is collected in biological surveys for a community composition analysis and for the quantification of chlorophyll *a* for the second level of nutrient assessments. A Level 1 nutrient screen is performed at each survey station to determine if excess nutrients may be an issue for the reach. If necessary, a series of data is collected for the nutrient Level 2 survey to determine impairment.

Nutrient Level 2 Assessment

The primary question to be answered during a Nutrient Assessment is: **Is this reach impaired due to nutrient enrichment?** Nutrient impairment occurs where algal and/or macrophyte growth interferes with designated uses, thus preventing the reach from supporting these uses. Algal biomass is the most important indicator of nutrient enrichment, as algae cause most problems related to excessive nutrient enrichment. Algae and macrophytes may be a nuisance when 1) there are large amounts of rotting algae and macrophytes in the stream; 2) the stream substrate is choked with algae; 3) large diurnal fluctuations in DO and pH occur; and/or 4) there is a release of sediment-bound toxins.

The Assessment Protocol uses a two-tiered approach to nutrient assessment. The two levels of assessment are used in sequential order to determine if there is excessive nutrient enrichment. Level 2 nutrient surveys were conducted at the Lower Rio Grande tributary sites that the Level 1 nutrient assessment indicated the possibility of nutrient impairment or that were previously listed as impaired due to plant nutrients. The Level 2 nutrient survey consists of data collection on a number of indicators including total phosphorus, total nitrogen, dissolved oxygen, pH, and periphyton chlorophyll *a* concentration. Chlorophyll *a* is a quantitative measure of algal biomass which is the direct or indirect cause of most problems associated with nutrient impairment. The indicators are compared to the applicable criterion or threshold value to generate an exceedence ratio, or the number of exceedences divided by the total number of times the parameter was measured. For total phosphorus, total nitrogen, and chlorophyll *a*, the threshold values are dependent on the ecoregion and designated aquatic life use.

According to the *Nutrient Assessment Protocol for Wadeable, Perennial Streams* (NMED/SWQB 2009), a stream is determined to be not supporting if **three or more** indicators exceed their respective threshold values. Total phosphorus was the only indicator that exceeded its threshold value for Las Animas Creek (**Table 10**) resulting in a determination of "Full Support" for Las Animas Creek. Total phosphorus and total nitrogen exceeded their respective threshold values in both Alamosa Creek and Percha Creek, however the long term DO and pH datasets from these creeks did not exceed the criteria (**Table 10**), which resulted in a determination of "Full Support" for nutrients in both creeks. Nevertheless, since chlorophyll *a* data were not available for these streams, chlorophyll *a* data should be collected on Alamosa Creek and Percha Creek to verify the "full support" determination.

Table 10. Summary of Nutrient Data

Assessment Unit Station ID	**Ecoregion**	**Designated Aquatic Life Use**	**DO & pH – long term datasets**	**Total Nitrogen** (# and % of exceedences)	**Total Phosphorus** (# and % of exceedences)	**Chlorophyll *a* exceedence?**
Las Animas Creek (perennial portion R Grande to headwaters) Las Animas abv the box	Chihuahuan Desert	MCWAL	support MCWAL	0 / 0%	1 / 25%	N/A
Alamosa Creek (Perennial reaches abv Monticello diversion) Alamosa Creek below USGS Gage 8360000	Chihuahuan Desert	MCWAL	support MCWAL	1 / 17%	2 / 33%	N/A
Percha Creek (Perennial reaches Caballo R to M Fork) Percha Creek at Percha Box	Chihuahuan Desert	MCWAL	support MCWAL	5 / 100%	2 / 40%	N/A

NOTES: MCWAL = Marginal Coldwater Aquatic Life
N/A = not applicable because data not collected

7.0 CONCLUSIONS

Due to the large volume of data collected during this survey, it will not be included in this report. To acquire specific data, contact the SWQB or search USEPA's STORET database. All of the monitoring that was conducting by the SWQB is summarized in **Table 2**.

Sampling for major ions, nutrients, total and dissolved metals, bacteria, and field parameters found no exceedences of water quality criteria. Additionally, according to SWQB's thermograph and sonde data, there were no criteria exceedences for temperature or pH within the Lower Rio Grande's perennial tributaries. There were exceedences of the DO criteria, however these exceedences were determined to be most likely the result of significant groundwater input along the stream reach. Natural inflows of groundwater often have low concentrations of DO and will therefore lower DO concentrations in surface waters. Additional data were collected in 2007 to confirm the historic sedimentation/siltation listings on Percha Creek and Alamosa Creek. These data were assessed according to SWQB's *Appendix D: Sedimentation/Siltation Assessment Protocol For Wadeable, Perennial Streams* (NMED/SWQB 2009). Based on this assessment, it was determined that Alamosa and Percha Creeks were fully supporting their aquatic life uses with respect to sedimentation/siltation. Consequently, the sedimentation/siltation impairment listings for Alamosa and Percha Creeks will be removed in the 2010-2012 State of New Mexico CWA §303(d)/§305(b) Integrated Report.

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F – M3 Foundations Reports

TRIP REPORT No. 001

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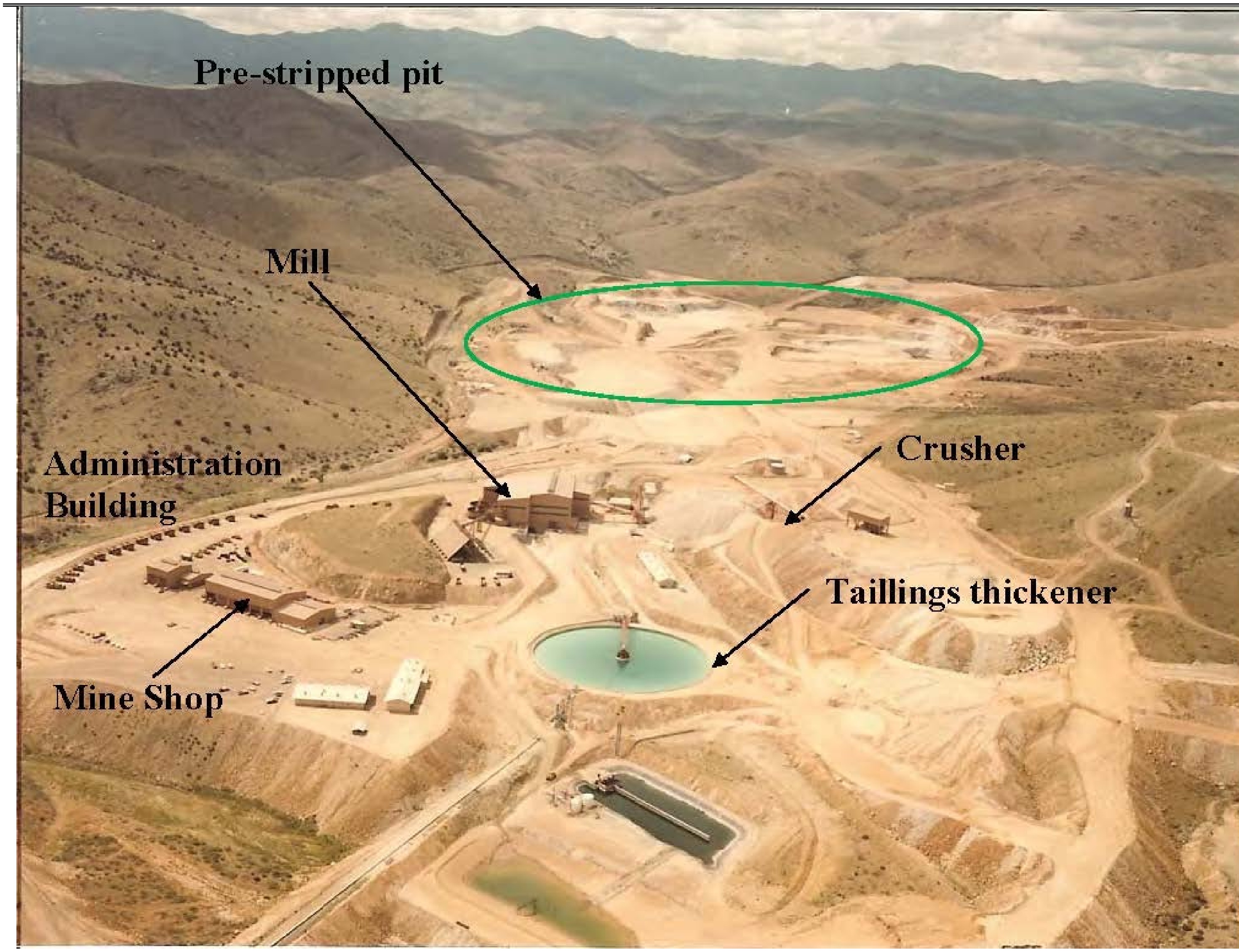
Date: October 25, 2011		**Project No.:**	**M3-PN110087**
To: Hillsboro, New Mexico site		**Project Title:**	**Copper Flat**
Company: New Mexico Copper Corporation (NMCC)		**Contacts:**	**Ann Carpenter** **Ed Fidler** **Rich Hasler**

From: Tucson, AZ. to Truth or Consequences, N.M.

M3 Personnel: Rick Zimmerman, Jim Bogan, Steve Slaby, Roger Rivers, and Justin Meislin

Purpose: Site visit to determine the value of using existing concrete slabs and to evaluate site drainage.



The Copper Flat property near Hillsboro, New Mexico was originally developed in the early 1980's as a copper concentrator by Quintana Minerals Corporation. The property only operated a short while before being shut down. In the late 1980's the equipment was sold and the buildings and all equipment were removed. The underground utilities, all floor slabs, the primary crusher concrete, the reclaim tunnel, and the tailings thickeners were left in place and then covered with a minimum of 2 feet of material with top soil and then revegetated.

New Mexico Copper Corporation (NMCC) has recently had portions of the original concrete foundations excavated so that M3 and NMCC could review the condition of this concrete to evaluate the possibility of reusing portions of these foundations. All foundations discussed in this report will be referred to by their original foundation names for clarity.

Existing Underground Utilities

There is potential to reuse portions of the existing underground utilities (Photo 20). All electrical lines after the substation were in concrete-encased duct banks. The duct banks were not exposed and the utility pull boxes were not available for inspection. One vault was open at the surface, and if emptied of the dirt, might indicate that the duct banks can be reused. The fire water and the process water systems are also buried, so they might also be able to be used, but at this time, we are assuming that they will be replaced. The tailings feed line was removed and needs to be replaced. The decant towers on the tailings pond are still in place and exposed and may be reusable, depending on the tailings placement method chosen.

The plant access road is in good condition and will need only minimal upgrading. The electrical 115 kV power line to the site needs some upgrading, mostly to extend the overhead transmission line from the last existing pole across drainage to the southwest to the new switchyard. Site grading has been done with only minimal future work will be required to uncover the remaining concrete and finalize the plant roads.

The concrete for the substation was not exposed so we did not evaluate that location for the substation. We may want to utilize that location if we find that the duct banks can be reused because that is where the main electrical was originally fed from.

Primary Crusher

(4000 cu. yd. @ $800.00/cu. yd. = $3,200,000)
(10' diameter multiplate tunnel 130 L.F. @ $500.00/l.f. = $65,800).

The concrete that was exposed on the primary crusher indicates that we can assume that it is capable of being reused. No cracking, spalling, or other structural damage was observed. The conveyor discharge tunnel is a multiplate steel tunnel section with a concrete entrance (Photos 1 and 3). The multiplate showed only minimal damage with just a few missing bolts. There was no sign of rusting or deformation in the shape of the tunnel. The poured concrete floor showed no signs of cracking or breaking away from the tunnel. Some damage was encountered above the entrance to the steel tunnel, but this seems to have happened during uncovering of the tunnel (Photo 2). This can easily be repaired and is mainly needed to cover the exposed rebar. This should be able to be reused with no more than casual maintenance.

The main portion of the primary crushing dump station was filled with rock as part of the reclamation. We were not able to go into any of this portion of the crusher, but from the minimal problems we saw on the surface and at the entry to the conveyor tunnel, we are assuming that the crusher concrete should be able to be reused if we install the same type of crusher as it had previously. We are assuming that all the platform steel and stairs were salvaged and will need to be replaced. We are assuming that only the concrete will be reused (Photo 4).

Stockpile Reclaim Tunnel

(3150 cu. yd. @ $800.00/cu. yd. = $2,520,000)
(8' cmp tunnel 120 L.F. @ $300.00/l.f. = $36,000).

The original coarse ore stockpile was an open cone stockpile with 35,000 tons live capacity. It consisted of an inclined concrete vault section (Photos 6 and 7), a short discharge conveyor concrete section, and an eight foot diameter steel corrugated pipe escape section with a concrete manway at the end (Photo 9 and 10). We were able to survey the concrete section and found only incidental concrete cracking. The embedments are rusty, but should be able to be cleaned enough to weld to for replacement of platform steel. Some of the original steel platform members and some of the steel water lines have been left in place and will need to be removed and replaced. The feeders, chute work, reclaim conveyor, electrical, and piping will have to be replaced. The existing concrete should last for this rebuild of the plant.

The draw hole opening steel was observed by flashlight from the floor of the reclaim tunnel and shows damage from rusting and corrosion and will have to be rebuilt and replaced as part of the new feeder installation (Photo 8).

There was no stockpile cover in the original plant, but the addition of a cover for this rebuild will not be affected by the existing concrete.

Concentrator

(4600 cu. yd. @ $800.00/cu. yd. = $3,600,000)

The concentrator concrete shows little sign of problems and should be able to be reused (Photo 11). The main support steel anchor bolts were torched off about three inches above the grout, so a new bed plate will have to be welded to the remaining anchor bolts. Minor column concrete bases have been damaged, and in many cases the anchor bolts have been bent over. These will take some work to renovate and make usable for future supports. Some locations may require drilling and epoxying new anchors in place. Some of the maintenance bay floor may need to be removed and redesigned to allow room for the pebble crusher to be installed inside the building so that the overhead crane can be used for maintenance of the crusher and feed conveyors. The SAG and Ball Mill pedestals have to be removed due to the different mill sizes being used today (Photo 12). The floor will have to be re-poured under the mill, but the majority of the mill and flotation area will remain as is and is in good condition. We may be able to mill mat foundation under the SAG mill and just re-pour the discharge pedestal if the concrete can be removed while leaving the majority of the rebar. The SAG mill is similar enough in length to allow this. The ball mill is bigger and for now we are assuming that it will require new mat foundation, pedestals, and final floor.

Administration Building

(355 cu. yd. @ $800.00/cu. yd. = $284,000)

The exposed administration building floor concrete and anchor bolts are in good condition and we are planning on reusing this slab (Photo 13). Some modifications of the anchor bolts will be necessary similar to the ones needed on the concentrator foundations. Some areas will have to be removed to allow for new under slab plumbing.

Truck Shop/Maintenance/Warehouse building

(1850 cu. yd. @ $800.00/cu. yd. = $1,480,000)

The exposed truck shop slab was in very good shape with no cracking noted on the floor (Photo 14). The existing floor between column line E1 thru E3 was exposed and is in good condition and should be able to be reused as a truck shop, warehouse, and maintenance area (Photo 15). The anchor bolts were also torched off at about 3” high and will take base plate modifications similar to the mill building to allow them to be used for the new truck shop (Photo 16). Some electrical floor trenches were exposed and can possibly be reused (Photo 17).

Concentrate Stockpile Slab

(750 cu. yd. @ $800.00/cu. yd. = $600,000)

The concentrate stockpile slab is in excellent condition and can be used for emergency storage of concentrate (Photo 18). At this time we do not anticipate putting a building over this slab, but it can be used to laydown of mill liners, some outdoor spare parts, or for concentrate if it is covered with tarpaulins. The concentrate would be dumped onto the slab with the intention that it is for short term use and would be reclaimed with a front end loader against the existing concrete push wall (Photo 19). Utilizing this slab necessitates relocation of the existing plan for the concentrate truck haulage road.

Existing Cover Materials

The materials used to cover the aforementioned concrete foundations and other improvements typically consist of two layers. The bottom layer consists of run-of-mine ore, waste rock, or alluvial materials. These materials were placed to cover the improvements to a depth of approximately 2 feet. The second layer consists of a darker, more organic-rich later, typically 1 to 3 feet thick, that was placed over the top to act as a growth medium. It is recommended that these layers be salvaged and stockpiled separately, where practical for reuse during construction or reclamation, as appropriate.

Tailings Thickner

The tailing thickner ring wall was exposed at the surface and in a trench that breached the wall. The floor of the thickner and the tunnel beneath the thickner were not exposed for examination. The ring wall is approximately 10 feet tall and 1 foot wide. It appears to be in good condition, except for the breached area. The thickener has been filled to the top of the ring wall and forms a flat surface with a gently sloping surface toward the center. There are no plans to reuse this thickner because it’s design is out of date.

Tank Pads

Process water and potable/fire water tank pads were observed from a distance on the side of Animas Peak, but were not examined. There were no apparent water lines leading up the the former tank locations. We assume that the tank locations will be reused, but do not assume that any foundation materials for these tanks will be reused. Further, we assume that the existing foundation for these tanks (if present) will need to be removed in preparation for pouring new tank foundations.

Small Vehicle Repair

(560 cu. yds. $800.00/cu. yd. = $448,000)

This building has not been exposed, but should be of sufficient quality to be used as a tire shop and wash area.

Ball Bunkers

It is not anticipated that the existing Ball Bunkers will be used for this Project.

Assay Laborator

It is not anticipated that the Assay Laboratory Floor Slab will be used for this Project.

Reagent Building

It is not anticipated that the Reagent Building Floor Slab will be used for this Project.

Change House

It is not anticipated that the Change House Floor Slab will be used for this Project.

Total estimated value of reused concrete - $12,234,000.

Photo 1 – Entrance to Steel Tunnel

Photo 2 – Damage at Top of Tunnel Entrance

Photo 3 – Multiplate Tunnel

Photo 4 – Primary Crusher Dump Pocket

Photo 5 – Primary Crusher – Maintenance Area

Photo 6 – Stockpile Entrance – Conveyor Gallery

Photo 7 – Vault Area

Photo 8 – Draw Hole in Vault Area

Photo 9 – Escape Tunnel from Vault

Photo 10 – Reclaim Tunnel Escape Manway and Valve Box

Photo 11 – Concentrator – Ball Mill Area

Photo 12 – Concentrator SAG Mill Footings

Photo 13 – Administrative Building

Photo 14 – Typical Column Base at E3

Photo 15 – Truck Shop Floor Slab

Photo 16 – Truck Shop, Typical Column Foundation

Photo 17 – Truck Shop – Floor Trench in Electrical Room

Photo 18 – Concentrator Stockpile Slab from Primary Crusher

Photo 19 – Concentrator Stockpile With Push Wall at Rear

Photo 20 – Underground Utility Floor Penetration

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Date: January 31, 2013 | **Project No.: M3-PN120085**

To: Hillsboro, New Mexico site | **Project Title: Copper Flat**

Company: New Mexico Copper Corporation (NMCC) | **Contacts: Jeffrey Smith, Andrew Feltman**

From: Tucson, AZ to Truth or Consequences, NM

M3 Personnel: Rick Zimmerman, Oscar Avilucea, Shannon Orr, Shelby Madrid, Tim Reiter, and Matthew Murray

Purpose: Evaluate Newly Exposed Foundations

M3 Engineering & Technology Corp. (M3) performed a visual inspection of newly excavated foundations at the Copper Flat Property on January 31, 2013. This inspection is a follow-up to the initial inspection performed by M3 in October 2011. Newly exposed portions of the Primary Crusher, Concentrator and Truck Shop foundations were reviewed during this inspection. General findings for various other existing foundations are documented in the Trip Report 001 (M3-PN110087 Oct. 2011). The purpose of this structural evaluation is to determine the feasibility of reusing these existing foundations and to provide the basis for the capital cost estimate for concrete repairs required to comply with safety and serviceability requirements for the project.

PRIMARY CRUSHER

Observations:

The Primary Crusher had been excavated to the Dump Pocket drawhole at 5551’-0” level (See Photo 1 and Ref. Quintana Dwg. 71-5401). The maintenance side had been excavated to about the 5531’-7” level (See Photo 2). The exposed concrete was visually evaluated for, structural damage, design deficiencies, construction deficiencies, and any structural deterioration occurring during the period of being buried. Concrete surfaces were visually inspected for cracks, spalling, exposed rebar, and signs of any chemical deterioration. Embedded items were also examined for corrosion and signs of deterioration. The concrete surfaces appeared to be in good conditions with some greenish-blue discolorations at the surface (See Photo 3). Embedded items around the openings and Dump Pocket liner plates were observed to have experienced significant corrosion and loss of material (See Photo 4). CMU block walls for the Electrical Room at the 5549’-4 ¾ level had been pushed over exposing wall reinforcing. Also, the elevator framing and structural steel remains were still in place with significant damage (See Photos 5 & 6). No observations were made of the Surge Pocket or levels below, because backfill material had not been excavated to these levels.

Analysis:

The Quintana Minerals Corporation set of drawings and any available reports for the existing foundations were reviewed and compared against field observations. Preliminary structural engineering calculations were performed to check the structural capacity of the concrete basement strip, floors and walls. The Plant Site

Geotechnical Investigation Report (SHB E80-1030, June 1980) could not be obtained and UBC values were assumed for checking the allowable bearing capacity of the soil below. In the absence of the soils report, M3 reviewed the existing civil cut slopes and concrete drawings for this structure and the soil beneath is presumed to be bedrock for this structure (Ref. Qunitana Dwg's. 71-3512, 71-3513 and 71-3515), which is adequate to sustain the anticipated loads. The concrete that was exposed was observed to be in reusable condition.

Recommendations:

The lower levels of the Primary Crusher structure shall be further investigated for signs of distress or deterioration once exposed. Embedded items that are badly deteriorated should be abandoned or replaced. A further investigation should be performed to identify concrete surfaces that will require repairs, such as surface coatings, where applicable.

<u>CONCENTRATOR</u>

Observations:

The existing Flotation, Grinding and Regrind Area foundations were visually inspected using the same criteria defined for the Primary Crusher. The majority of the overburden had been excavated with the exception of the Grinding Area containment slab, but the Mill Piers were able to be inspected (See Photo 7 and Ref. Quintana Dwg. 90-5402). The interior piers in the Flotation Area and building piers had significant signs of distress that occurred during excavation operations (See Photo 8). Anchor bolts and embedded items showed significant signs of corrosion and spalling (See Photos 9 thru 11). Retaining walls and slabs all appeared to be in accordance with the design documents. The floor slabs had signs of distress and may not be water-tight, if needed to provide containment.

Analysis:

The Quintana Minerals Corporation set of drawings and any available reports for the existing foundations were reviewed and compared against field observations. The existing retaining walls, mill foundations and building column piers were preliminarily evaluated for the anticipated loads using the Feasibility Study layout. As with the Primary Crusher, UBC values were assumed for checking the allowable bearing capacity of the soil below due to the absence of a soils report. In general, the state of the concrete that was observed is in a reusable condition with some repairs that would be required. Existing retaining walls, building footings and the SAG Mill Foundation are adequate to sustain the new loads with minimal repairs and modifications.

Recommendations:

The Ball Mill mat foundation shall be increased to encompass the discharge pier extension and to provide a new support for the second pinion drive. The Grinding area containment slab shall be further investigated for signs of distress or deterioration once fully exposed. Embedded items that are badly deteriorated should be abandoned or replaced. Concrete piers that are to be reused should be saw-cut down and a new pier and anchors should be doweled into the pier below where the footings are to be reused. A further investigation should be performed to identify concrete surfaces that will require repairs where excessive deterioration is present in order to allow for any required containment.

<u>TRUCK SHOP:</u>

Observations:

The existing Truck Shop foundations were visually inspected (See Photo 12) using the aforementioned criteria. Building piers had severe damage and edge distances for the anchor bolts were well below the accepted minimums which have added to the extent of spalled concrete (See Photo 13). Flooring embeds in the electrical trench were severely corroded (See Photo 14).

Analysis:

The truck shop foundation was designed for haul trucks of similar size to those planned for the current redevelopment of the project. It is assumed that wheel loads will be similar and the existing floor slab is assumed to have sufficient load bearing capacity for the planned 100-ton haul trucks.

Recommendations:

Concrete piers that are to be reused should be saw-cut down and a new pier and anchors should be doweled into the pier below where footings below are to be reused. A further investigation should be performed to identity concrete surfaces that will require repairs where excessive deterioration is present. The design criteria for the floor slab should further investigated and the existing design should be further evaluated to satisfy all conditions, including future wheel loads and loads from floor jacks. Local strengthening of the floor slab may be considered to preserve the majority of the existing foundations in the case where new loads are in excess of the existing floor slab's load bearing capacity.

Photo 1 – Primary Crusher - Excavation Progress on Crushing Side

Photo 2 – Primary Crusher – Excavation Progress on Maintenance Side

Photo 3 – Primary Crusher – Greenish-blue Discoloration at Wall Surface

Photo 4 – Primary Crusher – Corrosion on Embedded Items

Photo 5 – Primary Crusher – Remains of Structural Steel

Photo 6 – Primary Crusher –Remains of Elevator Structural Steel

Photo 7 – Concentrator – Excavation Progress

Photo 8 – Flotation Area – Existing Interior Concrete Piers

Photo 9 – Flotation Area – Spalled Concrete with Exposed Rebar and Corroded Anchor

Photo 10 – Grinding Area – Corroded Embeds at Sump Box

Photo 11 – Concentrator – Typical Building Pier

Photo 12 – Truck Shop – Excavation Progress

Photo 13 – Truck Shop – Spalled Concrete, Exposed Rebar and Corroded Anchors at Interior Concrete Pier

Photo 14 – Truck Shop – Corroded Electrical Trench Embed Angle

THEMAC RESOURCES

July 17, 2013

GROUND WATER
JUL 23 2013
BUREAU

Mr. Chris Eustice
Senior Environmental Engineer
Mining and Minerals Division
Wendell Chino Building, Third Floor
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: Baseline Data Report Amendment, Copper Flat Mine, Sierra County, New Mexico

Dear Mr. Eustice,

New Mexico Copper Corporation (NMCC), a wholly owned subsidiary of THEMAC Resources Group, Ltd. is pleased to submit six copies of the Baseline Data Report Amendment for the Copper Flat Mine in Sierra County, New Mexico. This document contains responses to agency comments dated February 18, 2013, on the Baseline Data Report dated June 29, 2012. Per our discussion, one hard copy and a CD with an electronic copy is enclosed and the same are being mailed to the CC list below.

This document presents additional data on vegetation, wildlife, soils, geology, surface water and groundwater, cultural resources, and present and historic land use at Copper Flat in Sierra County, New Mexico. A table presenting comments on the June 2012, Baseline Data Report from the Mining and Minerals Division (MMD), New Mexico Game and Fish, and the New Mexico Office of the State Engineer is attached. This table refers the reader to where each comment is addressed within the Baseline Data Report Amendment, which you will find is divided into six sections by topic and contributor. This report was prepared by NMCC with significant contributions from Geosystems Analysis, Inc., Golder Associates Inc., John Shomaker & Associates, Inc., and M3. The responses to some comments are in reports that have been or will be submitted to the MMD under separate cover. Specifically, the *Geochemical Characterization Report for the Copper Flat Project*, prepared by SRK Consulting was submitted in June 2013. We anticipate submitting *Predictive Geochemical Modeling of the Pit Lake Water Quality at the Copper Flat Project, New Mexico* in August or September 2013. Similarly we expect the *Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico*, prepared by John Shomaker & Associates, Inc., to be ready for submission in August 2013.

In addition to data requested in specific comments, as previously agreed, we are including reports on the foundation evaluations conducted by M3 at Copper Flat in October 2011 and January 2013.

A revised version of the Mine Operation and Reclamation Plan will be prepared for submission at a later date. As such, none of the agency comments on the previously submitted Mine Operation and Reclamation Plan are addressed in this submission.

A number of MMD comments addressed the Order 1 Soil Survey presented in the June 2012 Baseline Data Report. Rather than update the Order 1 Soil Survey, which did not fully address the requirements of the mine plan, NMCC elected to have Golder complete a Supplemental Soils Investigation to characterize the potential soils resources at Copper Flat. This report supersedes the report prepared by Stetson Engineers, Inc. regarding soil suitability criteria and information regarding potential salvage. The response to comments prepared by Golder does not make specific changes to Stetson's report; however, the responses address MMD's comments regarding the soils at Copper Flat with supplemental data provided.

Any questions or comments regarding this Baseline Data Report Amendment may be directed to me at jdeichmann@themacresourcesgroup.com; or by phone at 505.681.2536.

Best regards,

Jens Deichmann
Project Manager

CC: Douglas Haywood, Bureau of Land Management, Las Cruces District Office
David Henney, Mangi Environmental Group (electronic transmission only)
Rachel Jankowitz, New Mexico Game and Fish
Brad Reid and Kurt Vollbrecht, New Mexico Environment Department
Kevin Myers, New Mexico Office of the State Engineer

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
MMD Comments			
602.D.13 Baseline Data Report		These comments address the identified Sections of the BDR. The corresponding section of the Part 6 reg is also identified.	
Section 4 Vegetation, 602.D(13)(c)			
1	1	Section 4.3.1.5: Please replace "beside the arroyo" with a word of clarity (parallel to, physically next to, in addition to, etc.)	See GSA Addendum to Section 4, Vegetation
2	2	Section 4.4.1.5. Please revise to clearly describe which areas were adequately sampled through stratified sampling and which were not. Give reasoning. Provide a discussion of the # of transects statistically required for sample size adequacy and the # of transects actually conducted.	
Section 5, Wildlife, 602.D(13) (d)			
1	3	Correct or remove sentence (pg 18 MORP) that refers to a coachwhip as a lizard.	See GSA Addendum Section 5, Wildlife
Section 6 - Topsoil Survey and Sampling Results, 602.D(13) (e)			
Section 1, Introduction			
1	4	Provide a geo-referenced map, 1:6,000 scale (or better) to identify the individual soil units, 21 soil pits and 183 log sites of the soil survey. Give a supplementary table to identify the location of pits/log sites w a brief description of family-level taxonomy at each. Include any notes that identify special characteristics such as CaCO3 content, rock content, induration or gradation of character from one soil to another.	See Golder Technical Memorandum
2	5	In Table 5: Provide constituent concentrations of Na+, Mg++, Ca++ from paste extracts that were used to calculate SAR	
3	6	Provide a clarifying discussion fo the methods cited to conduct hydrometer & seive tests. It is not clear if pretreatment methods were employed to remove carbonates from samples before dispersion or sieving.	
4	7	Note whether during sieving fine and very fine sand fractions were separated and accounted for and provide more discussion. Note: the only indication fo sand size partitioning was for tailings substrate, pg. 44.	
5	8	Pg. 3 of the intro. The scale for 1:6,000 is equivalent to 1 inch = 500' rather than 0.5 inches=1,000'. Please update.	
Section 2.2 Criterial for Topdressing Suitability			
6	9	Table 1. MMD agrees w the observation, pg7: soils dominated by coarse grained materials (up to 70% rock content) can produce vigorous vegetation if the remaining fine earth fraction is sufficiently loamy. Please include stone w the cobble+gravel component for a maximum content of rock in the "fair" limit to range of 35-70%. Note: MMD regards "good", "fair" and "unsuitable" as qualifying characteristics in general, but "fair" materials, such as relatively high rock content may be more appropriate for steep slopes.	See Golder Technical Memorandum
7	10	Table 1. Hot-water extractable boron should be limited to no more than 5ppm for suitable materials. Correct Table 1 to demonstrate.	
8	11	Table 1. Calcium carbonate limits for "good" material is listed as 15% CaCo3 equivalent and for "fair" materials as 15-40%. These limits are not judged appropriate for topdressing. CaCO3 content should not be above 10% equivalent in the upper 6-12" in a reconstructed soil profile. Adjust CaCO3 limits for "good" materials to less than 10% and for "fair" materials to 10-40%. No suitable materials should be salvaged from indurated horizons that are continuously cemented, regardless of CaCO3 content.	
9	12	Table 1. MMD views available water holding capacity (AWHC) as a critical component in evaluating soil suitability. Please define AWHC as bulk volumetric water holiding capacity of soil materials to hold water between -0.033 and -1.5 Mpa of tension, corrected for rock content.	
10	13	Either as part of Table 1, or a separate table: estimate a range of values of a bulk value for each of the criteria listed in Table 1 for each soil unit &, if variation exists, for depth phases of soil units. AWHC & the method used to estimate it should be included as part of this table and discussion.	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
Section 2.2 Criterial for Topdressing Suitability Continued			
11	14	In reference to Section 3.1, with map units 102, 101 and 109 NMCC has differentiated several depth phases to estimate the median thickness of suitable salvage within individual soil unit phases. Please describe how these depth phases were determined among soil units w multiple depth phases & units which were not described by backhoe pits.	See Golder Technical Memorandum
Section 7- Geology 602.D(13)(f):			
1	15	After recipt of recent information from NMCC re: the "coarsely crystalline porphyry" rock-type, it appears that NMCC's conclusion is that this is not a unique rock-type as originally hypothesized, but is instead part of the quartz monzanite. MMD recommends modification of Table 7.2 in the BDR to reflect this updated hypothesis as it relates to the major material types in the proposed project area.	
2	16	Pg 7-10, Section 7.5.2.7 states a conceptual model will describe predicted geochemical trends of reactivity from waste management facilities, final pit walls (pit lake chemistry) & the TSF. This model will be used to provide quantitative numerical predictions of the potential impacts of seepage or runoff from mining facilities to regional groundwater. Because these models should meet MMD requirement to address "probably hydrologic consequences", MMD requires submittal of this information prior to MMD being able to deem the PAP technically approvable.	
3	17	Pg 7-11, Section 7.5.1.3 states that a single comprehensive report of the complete geochemical testing program, including both static and kinetic testing analysis, and results will be provided when completed. MMD requires this document to be submitted prior to MMD being able to deem the BDR/PAP as technically appovable.	See THEMAC Memorandum
4	18	Appendix 7-D, pg 6 states a geologic block model is required to determine the relative percentages of each material type & determine if the # of samples selected for each material type is adequate for the characterization program. MMD will require this evaluation to be submitted prior to MMD being able to deem the BDR/PAP as technically approvable.	
5	19	Appendix 7-E, Section 5 states that the 1997 & 2010 geochemical databases are comparable although the 1997 data show a trend toward having a generally greater acid generating potential than the 2010 data. A possible explanation in the appendix is there may be a bias in the '97 sample collection toward high sulfide/highly weathered materials. The opposite is also a possible explanation: there may be a bias in the 2010 sample collection toward materials that are low sulfide/low weathered materials. MMD is looking to block model analysis to shed light on the overall adequacy of the characterization program.	
Section 8 - Surface Water and GW Information 602.D(13)(g):			
1	20	pg 8-3, Section 8.1.2.1.2 states that the NMED SWQB has collected flow data along Las Animas Creek. These data should be available. Although the historical and baseline flow data (quantity data) presented appear to adequately document Las Animas flow, MMD recommends incorporation of any added quantity data form NMED SWQB related to Las Animas creek as further documentation of historic flow variability.	
2	21	Section 8.2.4.1. The crystalline bedrock aquifer appears adequately characterized for the BDR. MMD recommends submittal of GW quality data for GWQ-5R, GWQ11-24 A&B and GWQ11-25A&B as further documentation of GW quality within the crystalline bedrock aquifer.	
3	22	Pg 8-21, Section 8.2.4.1 states 9 wells were used for water elevations, however only 8, or 12 depending on how you count, were measured. Please correct.	See JSAI Memorandum
4	23	Pg 8-22 Section 8.2.4.1.1 refers to GWQ-5 as a crystalline bedrock aquifer well, Fig 8-20 refers to it as a crystalline bedrock well. However reviewer is sceptical, thinks its representative of Grayback alluvial based on completion data and location. Please correct. (Or clarify)	
5	24	Section 8.2.4.3 (Quaternary Alluvium), GW quality within the alluvial aquifer of Las Animas Creeek appears adequately characterized in the BDR w MW-11. However, the water quality of the alluvium aquifers within Percha Creek, Grayback, Hunkidori Gulch & Greenhorn Arroyo appear under characterized for the BDR.	
	25	a. Percha Creek alluvium: Provide any historic or recent GW quality data for the alluvium.	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
Section 8 - Surface Water and GW Information 602.D(13)(g) Continued:			
	26	b. Grayback alluvium: Historic water quality data for GWQ-1, GWQ-3 and GWQ-8 is provided, this may be adequate. Please provide any historic or recent GW quality data for the alluvium within the Grayback. MMD recommends providing the completion data for these 3 wells/sample locations.	See JSAI Memorandum
	27	c. Hunkidori Gulch allubium & Greenhorn alluvium: Currently no wells in these? MMD recommends installation of at least one shallow alluvial well downgradient of the proposed TSF w/in each of these alluvial systems to characterize the potential alluvial aquifer for the BDR. Or provide any historic or recent GW quality data for the alluvium w/in these systems.	
6	28	Table 8-9 identifies well "UNKNOWN" as being in the Qal aquifer system, however this well is shown in Fig 8-20 to be in the SFG aquifer. Table 8-9 or Fig 8-20 should be corrected. This well appears to be identified as "15.6.31.431" in Table 8-11. Correct name for this well between tables/figures and if 15.6.31.431 is the same as UNKNOWN please clarify.	
7	29	MMD knows results of the aquifer test and associated studies (geochemical, hydrologic modesl) are on-going. MMD withholds comments on these that will help to define the probable hydrological consequences of the proposed operation until they are complete and integrated into the PAP.	
Section 9 - Prior Mining Operations, 602.D(13)(h)			
1	30	The last sentence of Section 9.1 "Mining History" indicates that "More detail about copper exploration can be found in Section 11.3" However Section 11.3 is a soil survey w no such info. Please correct.	See THEMAC Memorandum
Section 10 - Cultural Resources Summary, 602.D(13)(i):			
1	31	Throughout Section 10 authors describe the permit area as being within the "Hillsboro Mining District" and/or/also the "Las Animas Historic District". Confusing. Seems intent is to describe the permit area as in the "Hillsboro Mining District" which is situated inside a larger "Las Animas Historic District" that is yet to be delineated or defined. Please clarify.	See THEMAC Memorandum
2	32	MMD previously provided comments... Please provide an updated Figure 10-1 (from the SAP) w the locations of the four referenced cultural resource surveys depicted.	
3	33	Describe any cultural surveys that have been conducted in the areas of the water supply pipeline and associated well field and update Figure 10-1 of the SAP to include those survey locations and submit.	
4	34	Section 10.2 "Eligibility and Management Summary" indicates that "detailed management recommendations will be presented in a future CR report" and "avoidance will most likely not be feasible for all of these resources, it is recommended that they be included in a testing and data recovery plan..." This testing and data recovery plan should be provided.	
Section 11 Present & Historic Land Use, 602.D(13)(j)			
1	35	Section 11.3 Section 11.3 "Soils Survey" seems irrelevant and out of place under "Present and Historic Land Use". This information would be better presented w/in Sect 6 "Soils Survey". Please provide clarification.	See THEMAC Memorandum
2	36	Please update this section to include a description (present & historic land use) of the water supply pipeline, associated well field, and the electrical power supply lines.	
3	37	Provide a description of land capability & productivity based on Soil Conservation Service, land use capability classes or similar classification.	
Game and Fish Comments			
BDR Chapter 4			
	117	Review Table 4-9 to verify that values were copied over correctly from Table 4-10	See GSA Addendum to Section 4, Vegetation
	118	Jurisdictional status of the Gooddings willow-dominated wetland in Grayback Arroyo is unclear; G&F states "We know that NMED considers this wetland jurisdictional under state standards. Please note state status in the final BDR, and clarify whether it is USACE jurisdictional."	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
BDR Chapter 5			
	119	Section 5.2.3 states isolated springs and seeps were "nearly all on private land and inaccessible," and thus were not examined. However, all these springs were sampled for flow as reported in BDR Chapter 8. Clarify that all springs are on private land and access was, and is, denied, or conduct biological resource surveys using photographs.	See GSA Addendum Section 5, Wildlife
	120	Tables 5-2 and 5-3: Show relative abundance (for example, using terms like "abundant," "common," "uncommon," "rare")	
	121	Incorporate winter observations from Appendix 5-B, Winter Bird Survey Report, into summary Tables 5-2 and 5-3	
	122	Migratory seasons should be covered by monitoring of migrating waterfowl and other birds at the pit lake, in addition to winter and summer surveys	
	123	Table 5-6 Bat Species Detected by Habitat: Include relative activity level (as indicated by calls per unit time), possibly as separate table	
BDR Chapter 5 continued			
	124	Any abandoned historic mine features comprising of more than a shallow blind shaft should be evaluated to determine use by roosting or hibernating bats, especially if the features are expected to be disturbed or destroyed by future mining	See GSA Addendum Section 5, Wildlife
	125	Section 5.4.1.3: Report in text or tabular form the relative abundance of large- or medium-size mammal sightings/sign by location or habitat type. Include a comparison to the reference plots.	
	126	Conduct a survey for raptor nests in all suitable habitat within one mile of any potential mine-related disturbance.	
	127	Conduct focused monitoring of wildlife use of the pit lake. This might include camera traps, diurnal and nocturnal passive observation sessions, track counts, or spot-lighted surveys.	
OSE Comments			
MORP Appendix B (BDR)			
	148	Table 7.1, Figures 7.1 and 7.2: Reference BLM (1999), but it would be useful to reference original authors for maps.	See THEMAC Memorandum
	149	Figure 7.5: Add description of fault systems in legend beneath label for fault (e.g., Hunter fault system N20E, Patten Fault system N50W)	
	150	Table 8-1: Reported temperature of 81.5 deg C appears to be incorrect	See JSAI Memorandum
	151	Figure 8-17: Cross-section lacks control points east of GWQ-21B	
	152	Section 8.2.4.1.5, Figures 8-22 and 8-24, Table 8-11: GWQ96-22A and -23A 2010-2011 sulfate values drop unexpectedly compared to 1996-1997 TDS and specific conductance values; lab error, typographical error or water quality has not stabilized from mixing? Further review of data needed since sulfate, TDS and specific conductance typically show strong correlation.	
	153	Section 8.2.5.2.5, Appendix 8-G Figures G through J: Text asserts no discernible trends in hydrographs for MW-2, -5, -6 and -8, but more effort would be needed to understand hydrographs in order to adequately simulate Upper Santa Fe Group. MW-5 is active stock well that shows 50 ft or more drawdown when pumped for a short duration, then water levels fully recover as showing in 2012 transducer data; Figure H has mix of USGS and other data and 1980s data may represent pumping levels or recent pumping. Additional effort should be undertaken to evaluate data quality, well construction details, lithology and other potential factors for disparate responses shown in hydrographs.	
	154	Table 8-9, Table J1 and Figure I (Appendix 8-G): Discrepancies between elevations and total depths cited (e.g., MW-6 TD); Table J1 draws upon multiple data sources; sources for tables or figures are not clearly identified; possibly bottom of screen interval has been used in place of TD	

Baseline Data Report Comments/Responses

Agency no.	NMCC #	Comment	Resolution
OSE Comments MORP Appendix B Continued			
	155	Section 8.2.4.3.5 and Figure N (Appendix 8-G): In addition to hydrograph showing responses to wetter years, the alluvial aquifer may be affected by irrigation water usage from surface water diversions from Las Animas Ck and groundwater diversions from alluvial aquifer and Santa Fe Group aquifer. Also, changes in leakage or flow from artesian wells may affect alluvial aquifer.	See JSAI Memorandum
	156	Section 8.2.4.4, Figures 8-13, 8-32 and 8-33: There may be simpler explanation for hydrologic change in artesian aquifer: artesian zones may represent solely a change in sedimentary deposition within Santa Fe Group, with lesser importance given to structural influence from faulting. It's unclear what influence Hawley and Kennedy (2004) reference has on Figures 8-13 and 8-33 given that its geologic map is located in T16S with dashed lines. Hawley section RA-RA' follows changes in lithology rather than create a confined area from dipping USF beds of laterally-extensive clay layers.	
	157	Figure 8-32: USGS 2006 reference not included at end of Chapter 8. Bottom 2/3 of faults should be dashed to represent uncertainty in locations as in Seager (1982). Fault between LA-96 and LA-115 on Figure 8-33 does not appear in plan view in Figure 8-32. NMCC should provide more supporting evidence (e.g., field observations, drilling logs, deeper wells that would provide control points) that would help justify changes to earlier geologic map. Text and figures should indicate modifications in greater detail.	
	158	Section 8.2.5.1: Pit lake levels increased from 1997 to 2011 and likely so did nearby groundwater levels. GWQ96-22 and -23 were drilled in 1990s, yet earlier water level data were not included in BDR. Historical trend of nearby groundwater levels and pit level may be worth considering rather than only 2011 measurements.	
	159	Section 8.2.5.4: Given the local gradients and geology, "stationary" groundwater may not adequately describe vertical and horizontal flow.	
	160	Section 8.2.6 and Figure 8-39: In groundwater model report, modeling objectives should be stated. Are grid and dimensions based on objectives? Will regional model adequately evaluate local impacts of pumping at production well field and open pit?	
	161	Figure 8-33 and Figure 3 (Appendix 8-H): Indicate whether clay-rich layers in Las Animas Ck wells were correlated based on depths indicated from well drilling records or whether dipping clay beds are more conceptual than from specific depths.	
	162	Table 2 (Appendix 8-H), Section 8.2.4.4.2: Artesian flow rates show decline at several wells; clarify the basis for the conclusion that dewatering by artesian well upward leakage and open flow appears to be mainly responsible for long-term decline of artesian flow rates (Appendix 8-H). In particular, what does Table 2's total artesial flow rate represent in support, if any, of conclusion about upward leakage and open flow? If wells are poorly constructed or well seal deteriorates, leakage may partially occur in subsurface, which would appear as decreased flow at surface. Would a better approach for addressing changes at artesian wells include monitoring shut-in pressure of a properly-sealed artesian well?	
	163	Figure 8-36: Shows FW-3 with initial flow rate of 125 gpm; however, declaration indicates initial flow rate of 80 gpm. Murray (1959) indicates the 125 gpm was pressure-pumped for 4 hrs to induce 115 ft of drawdown. So, FW-3 artesian flow should be 80 gpm.	

State of New Mexico
Energy, Minerals and Natural Resources Department

Susana Martinez
Governor

David Martin
Cabinet Secretary-Designate

Brett F. Woods, Ph.D.
Deputy Cabinet Secretary

Fernando Martinez, Director
Mining and Minerals Division

July 22, 2013

GROUND WATER
JUL 24 2013
BUREAU

Mr. Keith Ehlert, Mining Act Team Leader
Mining Environmental Compliance Section
Groundwater Quality Bureau
New Mexico Environment Department
Post Office Box 26110
Santa Fe, NM 87502

RE: Baseline Data Report Addendum, Copper Flat Mine, Permit No. SI027RN, Sierra County, New Mexico

Mr. Ehlert:

On July 19, 2013, the New Mexico Mining and Minerals Division (MMD) received a *Baseline Data Report Addendum* to the Copper Flat Mine baseline data report (BDR), as provided by New Mexico Copper Corporation (NMCC). This BDR Addendum presents additional data on vegetation, soils, geology, wildlife, surface water and groundwater, cultural resources, and present and historic land use within the proposed permit area of the Copper Flat Mine in Sierra County. Also included within the BDR Addendum is a table of the agency comments that were provided to NMCC in a MMD correspondence dated February 18, 2013, as well as reference to where each comment is addressed in the BDR Addendum. Additionally, the NMCC submitted the *Geochemical Characterization Report* in June of 2013 that is also considered to be an addendum to the BDR, as will be the anticipated submittal of both the *Predictive Geochemical Modeling of the Pit Lake Water Report* and the *Groundwater Flow Model Report*.

NMCC indicates they sent each agency a hard copy of the BDR Addendum. The BDR Addendum can also be viewed and downloaded from MMD's website at http://www.emnrd.state.nm.us/MMD/MARP/PermitSI027RN.html MMD requests that you review this addendum to the BDR and provide comments to MMD no later than 60 days after your receipt of this letter.

Please contact me at (505) 476-3438, or via email at chris.eustice@state.nm.us with any questions or comments you may have regarding the application or this request.

Sincerely,

Chris Eustice, ~~Permit~~ Permit Lead
Mining Act Reclamation Program

cc: Mine File SI027RN

THEMAC RESOURCES

New Mexico Copper Corporation Cooperating Agency Meeting
30 July 2013, 14:00 MDT
MMD Conference Room
Meeting Notes

Attendance:
MMD: Chris Eustice, Holland Shepherd
NMED: Brad Reid
NM Game & Fish: Rachel Jankowitz
NMOSE: Kevin Myers
NMCC: Katie Emmer, Steve Raugust, Jeff Smith (at the beginning only)
On the phone: BLM: Doug Haywood & Mangi: David Henney

Initial announcement: Jeff Smith, Chief Operating Officer for THEMAC joined the call to let everyone know that due to circumstances beyond our control there has been a reduction in staff at THEMAC Resources. We remain committed to bringing Copper Flat back into operation and will continue to press forward with the engineering and permitting studies in process. We hope to hold to the current schedule as much as possible.

1. Feasibility Study:
   We are very close to being done on the 43-101 report of the Feasibility Study. A draft of this document is expected by the end of next week and it will be going to the Board of Directors for review. There will be optimization work and trade-off studies over the next couple of months as we re-visit a number of items. Some elements of the mine plan are fixed and others are being discussed. The problem we are working through is that the cost isn't where we need it to be for investor interest. A posting of the final document to SEDAR around the first of October is possible, given that we are generally running about 2 months behind schedule.

   Discussion: The 43-101 document is a technical report written to specific standards in accordance with the Canadian stock exchange, there are a number of licensed individuals that have to sign off on the veracity of the contents of the report. The feasibility study is independent of the 43-101 technical report; however, the 43-101 technical report is a convenient way to communicate the results of the feasibility study and will eventually be posted on the SEDAR, where it can be accessed by the public.

   Doug Haywood requested that the BLM be notified when the 43-101 report is posted to SEDAR.

2. Low Water Use Alternatives:
   We've done a lot of work on the water balances, looking at the thickener and how it affects what use. We do have a rough idea how thickener increases costs. We also have an idea about how it impacts the tailings facility. The most important way the thickener impacts the tailings facility is it allows us to get more material into the same space. We have a low grade ore and we've looking at processing more of it. In the Pre Feasibility Study we had a 100 million ton tailings facility, in the Feasibility Study we have 125 million tons in the same tailings facility footprint, this allows us to mine more material. On the water savings side the impact of the

thickener is less than you might think. Based on our water balance models, the thickener decreases fresh make up water usage by about 8-10% depending on the scenario. The reclaimed water is a similar volume whether it's pumped from the thickener or the supernatant pond. From the thickener, the thickener underflow slurry crosses the "beach" of the tailings facility and it's the evaporation rate of the beach and its size that causes the most significant loss of water. Keeping water loss to evaporation as low as possible requires a combination of efficient management to keep the tailings distribution even and in thin lifts and minimizing water loss to evaporation. We are weighing the capital and operating costs of the thickener against its effects: water savings and creating space.

Some discussion:

- All low use water alternatives include a lined tailings storage facility
- The water balances include the water sources from tailings storage facility reclaim, the pit, site storm water, moisture in the ore, and makeup water from the production wells. The biggest water loss is water entrained in the tails. Water is also lost in concentrate, dust control, and evaporation.
- One of the most effective water savers we have incorporated in the FS tailings dam design right now is capping the size of the supernatant pond, which minimizes evaporation loss from the supernatant pond.

3. Geochemistry Reports status:
The first of two Geochemistry reports was distributed in June. The second report covers geochemistry and modeling the predicted pit lake quality. This draft report is complete and NMCC has reviewed and provided comments to SRK. SRK is still working on the model because we questioned some of the results. SRK is running additional sensitivity analyses and incorporating some new data received this week. We will incorporate that into this report. This report should be released at the end of August.

We have terminated all HCTs. We will release an addendum to give the final results of those tests that were still in progress when the June characterization report was issued.

The Geochemistry reports used the block model from the Pre Feasibility Study; we will provide SRK with the block model for the Feasibility Study, SRK will validate the geochemical characterization against the Feasibility Study mine plan and block model to identify any potential data gaps and make the appropriate recommendations.

The samples in the HCTs were collected from 2010 and 2011 drilling programs.

4. Groundwater Model update:
The Groundwater model has been developed, the report reviewed, comments are being incorporated. We are working with John Shomaker and Associates and management on how to present results. We want to get the groundwater model report away from mine plans and get the reports to present the effects of different pumping rates. We would like to create an envelope that the mine plans will fall in. We are looking at providing a relationship between pumping rates and mine plans. The final report could still be another month out, but that is an estimate. We are looking at producing a standalone report that presents the model calibration including the data collected with the aquifer test and then to produce addendums with different projections that we can give to different parties based on their needs. We know the EIS will

need the projections for the proposed action and every alternative. One thing we have seen in the preliminary model results is that projected impacts are surprisingly similar with respect to depletion effects on the Rio Grande and other streams for the various scenarios.

Discussion: The Groundwater model report prepared for Mangi will show the effects of the proposed action, the 17,500 TPD mine presented in the MPO as well as the next alternative, the 25,000 TPD mine presented in the 2012 MORP. Additional projections may also be useful for the evaluation process Mangi is going through.

5. EIS Status:
From Doug Haywood – I have nothing to report, work is basically stopped and as far as BLM is concerned the dates in the current timeline are off the table and have no value. Once NMCC can provide the groundwater model and Mangi gets back to work the timeline can be re-evaluated. Since work has basically stopped for 2-3 months the experts have had to shift to other projects and we cannot guarantee their availability the minute things get rolling again. It's possible that things we projected would take six weeks will now go to eight or ten weeks depending on when personnel can get to it.

6. Overall permit timeline shifts:
The timeline that the Board has was distributed and discussed. This is what we are aiming for; it's slipping but it is what we are working from right now.

Discussion: NMED estimates a need for at least six months after a Discharge Permit is summited to final permit issuance. There are two public notices, most likely a hearing. Right now the timeline shows only four months from when the permit is submitted to final and this is likely too optimistic.

7. Electrical substation location:
There is not enough power for the mine available at the Caballo substation. There was when they built in the 1980s, but in the intervening years, this has been picked up by other uses in the community and surrounding area. We believe we have found a solution that will cause the least amount of disturbance at the most economic cost (although it's not cheap). All we've done so far is a basic cost estimate. Our engineering team has talked to the utilities, so they are in the loop. We are looking at installing an electrical substation on state land at the intersection of the El Paso Electric line running north/south east of the mine site and the Tri-State line running west from the Caballo substation near I-25 and HWY 152. We are discussing clearing an area here that would be big enough to allow flexibility for where the substation would be built. We've discussed the possibility of 40 or 20 acres, whereas the substation would be much smaller than that. We haven't done any detailed engineering on this yet as that would require an agreement with El Paso and Tri-State and we're not ready to do that at this time. A map showing the line and the state land section was distributed.

Discussion: Is the location of the potential substation discussed in the Baseline Data Report? No. It is possible that previous Cultural Resource surveys that were done for the buried water pipeline might have serendipitously covered the same area but we need to look into that. NMCC will dialogue with Chris Eustice directly on what information he might need for the state mine permit.

8. Permit Application Package Status/ BDR Amendment:
BDR Amendment was transmitted July 18, MMD, NMED, G&F, OSE, BLM and Mangi should all have received their copies by the week of July 22, depending on delivery method. This document has a key showing where comments are answered and is made up of a series of standalone memos presenting data specifically requested by agency comments. Please note that some comment responses will come inside reports that are still forthcoming – specifically the groundwater model report and the geochemistry report on the Pit Lake. These documents are being finalized and we will pass them to you when they are ready. Next submissions to hopefully respond to all comments and take the PAP to a Technically Approvable status will be: GW Model Report, Geochemistry Pit Lake report, MORP. The MORP is mostly on hold right now, as we wait for more engineering work for a mine plan; however we will be trying to push forward with some of the work on trade off studies we have discussed – regarding topics like geomorphic reclamation, as we can in the coming months.

9. Stage I Abatement Plan: NMED, MMD, and BLM all received the status report with Q1 & Q2 Stage I data in it at the end of June. Q3 sampling event was conducted July 9-12 and things went great. The site received enough rain for all three auto samplers to trip and samples were collected from all three sample locations during our sampling event. We will attempt to collect up to four surface water samples this year, if rain allows, to be analyzed and presented in subsequent Stage I reports. Regarding the monitoring wells required by NMED – NMCC was successful in a private land acquisition and we now own the land just south of the originally proposed monitor well locations. We are preparing a scope of work to request bids for drilling one or both of these wells, in the same area just slightly south of the originally discussed locations so that we can put them on our own private land. If we can get through the bidding process quickly, we hope to drill one or both of these wells in the August/September time frame.

   Discussion: KM reminds us to be sure to apply for monitoring well permits with the OSE prior to drilling. NMCC will be sure to submit the appropriate permits to OSE and will not drill monitoring wells without OSE approval.

10. Next Meeting Date: Set for 5 September, 14:00

Reid, Brad, NMENV

From:	Eustice, Chris, EMNRD
Sent:	Thursday, August 01, 2013 8:34 AM
To:	Myers, Kevin, OSE; Katie Emmer
Cc:	Reid, Brad, NMENV; Ennis, David, EMNRD; Jankowitz, Rachel J., DGF
Subject:	RE: Addendum to BDR print versus e-version...

Thanks for the clarification Kevin.

From: Myers, Kevin, OSE
Sent: Wednesday, July 31, 2013 2:57 PM
To: Eustice, Chris, EMNRD; Katie Emmer
Cc: Reid, Brad, NMENV; Ennis, David, EMNRD; Jankowitz, Rachel J., DGF
Subject: RE: Addendum to BDR print versus e-version...

Hey Chris,

Just as a clarification to the first part of your response, the original e-version is good.
The paper copy has some minor glitches.
So, it seems unnecessary for NMCC to replace anything because (as you mentioned) everything is available on CD for the BDR Addendum.

Kevin

From: Eustice, Chris, EMNRD
Sent: Wednesday, July 31, 2013 2:27 PM
To: Myers, Kevin, OSE; Katie Emmer
Cc: Reid, Brad, NMENV; Ennis, David, EMNRD; Jankowitz, Rachel J., DGF
Subject: RE: Addendum to BDR print versus e-version...

Thanks Kevin.

Katie,
when you send out the electronic replacement pages please include Brad at NMED, Rachel at Game and Fish, Kevin at OSE, and DIJ and I here at EMNRD. MMD will post on our web site, but I believe everyone can print the replacements.

From: Myers, Kevin, OSE
Sent: Wednesday, July 31, 2013 10:00 AM
To: Katie Emmer
Cc: Eustice, Chris, EMNRD; Reid, Brad, NMENV
Subject: Addendum to BDR print versus e-version...

Hi Katie,

Please note that on the paper copy of Copper Flat BDR Addendum dated 7/17/2013 in Section E, some of the graphs and tables did not print well.
The electronic version does show the entire graph or table.
Temperature graph, table of surface water quality lab results, Figures 2 & Figure 3 of LRG Tributary survey (2004).

OSE will print pages and replace.
So, no need to send out replacement pages.

THEMAC RESOURCES

August 20, 2013

GROUND WATER
AUG 21 2013
BUREAU

Jan Walker
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Suite 1200
Dallas, TX 75202-2733

Re: New Mexico Copper Corporation NPDES Permit No. NM0031101

Dear Ms. Walker,

Enclosed please find original signed DMRs for our site from July 2012 through July of 2013, per your request. I hope these are satisfactory; if you have any questions or concerns, please do not hesitate to contact me at 505-400-7925. We had submitted a DMR detailing the discharge in December 2012 previously and believed that completed our reporting requirements. I apologize for my misunderstanding and I will plan to submit another DMR indicating no discharge for August 2013 and monthly thereafter for the duration of the NPDES permit.

The NPDES permit No. NM0031101 is valid through June 30, 2014. However, New Mexico Copper Corporation completed the aquifer test for which the permit was obtained in December of 2012. With this letter we are requesting early termination of the NPDES permit No. NM0031101 as we will not discharge at this location again between now and June 30, 2014. We would like to close the permit as soon as possible. Please advise on whether you can terminate the permit early at our request.

Thank you again for your time and direction in this matter.

Sincerely,

Katie Emmer

Katie Emmer
Project Scientist

CC: Kurt Vollbrecht and Brad Reid, New Mexico Environment Department

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
07/01/2012	07/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	Certification	SIGNATURE	TELEPHONE		DATE
Jeff Smith, Chief Operating Officer	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
07/01/2012	07/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED			AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE, Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	MM/DD/YYYY
07/01/2012	07/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE	TELEPHONE	DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505 400-7925	8.18.13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code / NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

PERMIT NUMBER	DISCHARGE NUMBER
NM0031101	001-A

MONITORING PERIOD	
MM/DD/YYYY	MM/DD/YYYY
08/01/2012	08/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		QUANTITY OR LOADING VALUE	QUANTITY OR LOADING VALUE	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith Chief Operating Officer
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400-7975	8.13.13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

PERMIT NUMBER	DISCHARGE NUMBER
NM0031101	001-A

MONITORING PERIOD	
MM/DD/YYYY	MM/DD/YYYY
08/01/2012	08/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING VALUE	QUANTITY OR LOADING VALUE	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith, COO
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400·7925	8·13·13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
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NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
08/01/2012	08/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8.13.13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
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PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
09/01/2012	09/30/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		**QUANTITY OR LOADING**			**QUALITY OR CONCENTRATION**				**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
		VALUE	**VALUE**	**UNITS**	**VALUE**	**VALUE**	**VALUE**	**UNITS**			
pH	**SAMPLE MEASUREMENT**	******	******	******		******					
00400 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	**SAMPLE MEASUREMENT**	******	******	******	******						
01000 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	**SAMPLE MEASUREMENT**	******	******	******	******						
01025 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	**SAMPLE MEASUREMENT**	******	******	******	******						
01030 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	**SAMPLE MEASUREMENT**	******	******	******	******						
01040 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	**SAMPLE MEASUREMENT**	******	******	******	******						
01049 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	**SAMPLE MEASUREMENT**	******	******	******	******						
01056 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	**TELEPHONE**		**DATE**
Jeff Smith, Chief Operating Officer		**SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT**	505	400-7925	8-13-13
TYPED OR PRINTED			**AREA Code**	**NUMBER**	**MM/DD/YYYY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
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PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
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LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
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NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
09/01/2012	09/30/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING VALUE	QUANTITY OR LOADING VALUE	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-15-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

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Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
09/01/2012	09/30/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall
No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8707931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
10/01/2012	10/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		**QUANTITY OR LOADING** VALUE	VALUE	UNITS	**QUALITY OR CONCENTRATION** VALUE	VALUE	VALUE	UNITS	**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
pH	**SAMPLE MEASUREMENT**	******	******	******		******					
00400 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	**SAMPLE MEASUREMENT**	******	******	******	******						
01000 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	**SAMPLE MEASUREMENT**	******	******	******	******						
01025 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	**SAMPLE MEASUREMENT**	******	******	******	******						
01030 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	**SAMPLE MEASUREMENT**	******	******	******	******						
01040 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	**SAMPLE MEASUREMENT**	******	******	******	******						
01049 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	**SAMPLE MEASUREMENT**	******	******	******	******						
01056 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	Certification	Signature	**TELEPHONE**		**DATE**
Jeff Smith Chief Operating Officer TYPED OR PRINTED	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	505 AREA Code	400-7925 NUMBER	8-13-13 MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*
NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
10/01/2012	10/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	Certification	Signature	TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
10/01/2012	10/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		**QUANTITY OR LOADING**			**QUALITY OR CONCENTRATION**				**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
		VALUE	**VALUE**	**UNITS**	**VALUE**	**VALUE**	**VALUE**	**UNITS**			
Flow, in conduit or thru treatment plant	**SAMPLE MEASUREMENT**				******	******	******	******			
50050 1 0 Effluent Gross	**PERMIT REQUIREMENT**	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	**SAMPLE MEASUREMENT**	******	******	******	******						
71890 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			**TELEPHONE**		**DATE**
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		**SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT**	**AREA Code**	**NUMBER**	**MM/DD/YYYY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
11/01/2012	11/30/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith, Chief Operating Officer
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400-7925	8-13-13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
11/01/2012	11/30/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		**QUANTITY OR LOADING** VALUE	VALUE	UNITS	**QUALITY OR CONCENTRATION** VALUE	VALUE	VALUE	UNITS	**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
Thallium, dissolved [as Tl]	**SAMPLE MEASUREMENT**	******	******	******	******						
01057 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	**SAMPLE MEASUREMENT**	******	******	******	******						
01060 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	**SAMPLE MEASUREMENT**	******	******	******	******						
01065 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	**SAMPLE MEASUREMENT**	******	******	******	******						
01075 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	**SAMPLE MEASUREMENT**	******	******	******	******						
01090 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	**SAMPLE MEASUREMENT**	******	******	******	******						
01106 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	**SAMPLE MEASUREMENT**	******	******	******	******						
01145 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith, COO
TYPED OR PRINTED

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Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		**DATE**
505	400-7925	8-13-13
AREA Code	**NUMBER**	**MM/DD/YYYY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787934~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
11/01/2012	11/30/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall
No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
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TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE, Ste 301 Albuquerque NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: Latitude 32.57' 42" North Longitude 107.22' 22" West

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
12/01/2012	12/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☐

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******	6.91 min	****** 7.39 AVG	7.89 max	pH units	0	1/7	grab
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******		2	ug/L	0	1/30	grab
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******		ND (<0.01)	ug/L	0	1/30	grab
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******		2.5	ug/L	0	1/30	grab
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******		0.33	ug/L	0	1/30	grab
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******		0.024	ug/L	0	1/30	grab
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******		170	ug/L	0	1/30	grab
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith Chief Op Officer	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8.13.13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
12/01/2012	12/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☐

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******		0.012	ug/L	0	1/30	grab
057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******		2	ug/L	0	1/30	grab
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******		0.22	ug/L	0	1/30	grab
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******		ND(<1.06)	ug/L	0	1/30	grab
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******		20	ug/L	0	1/30	grab
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******		ND(<10)	ug/L	0	1/30	grab
106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******		0.9	ug/L	0	1/30	grab
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	Certification	SIGNATURE	TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8.13.13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
12/01/2012	12/31/2012

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☐

PARAMETER		**QUANTITY OR LOADING**			**QUALITY OR CONCENTRATION**				**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
		VALUE	**VALUE**	**UNITS**	**VALUE**	**VALUE**	**VALUE**	**UNITS**			
Flow, in conduit or thru treatment plant	**SAMPLE MEASUREMENT**	3.07	3.7	MGD	******	******	******	******		daily	
50050 1 0 Effluent Gross	**PERMIT REQUIREMENT**	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	**SAMPLE MEASUREMENT**	******	******	******	******		ND (<0.02)	ug/L	0	1/30	grab
71890 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			**TELEPHONE**		**DATE**
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400·7925	8·13·13
TYPED OR PRINTED		**SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT**	**AREA Code**	**NUMBER**	**MM/DD/YYYY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787934~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
01/01/2013	01/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE	TELEPHONE		DATE
Jeff Smith, Chief Operating Officer	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
01/01/2013	01/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved

OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION

ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110

FACILITY: COPPER FLAT PRODUCTION WELL FIELD

LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

PERMIT NUMBER	DISCHARGE NUMBER
NM0031101	001-A

MONITORING PERIOD	
MM/DD/YYYY	MM/DD/YYYY
01/01/2013	01/31/2013

DMR Mailing ZIP CODE: 87110

MINOR

DISCHARGE GROUNDWATER

External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8707934~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
02/01/2013	02/28/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		QUANTITY OR LOADING VALUE	QUANTITY OR LOADING VALUE	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith, Chief Operating Officer
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400-7925	8-13-13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
02/01/2013	02/28/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		**QUANTITY OR LOADING** VALUE	VALUE	UNITS	**QUALITY OR CONCENTRATION** VALUE	VALUE	VALUE	UNITS	**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
Thallium, dissolved [as Tl]	**SAMPLE MEASUREMENT**	******	******	******	******						
01057 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	**SAMPLE MEASUREMENT**	******	******	******	******						
01060 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	**SAMPLE MEASUREMENT**	******	******	******	******						
01065 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	**SAMPLE MEASUREMENT**	******	******	******	******						
01075 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	**SAMPLE MEASUREMENT**	******	******	******	******						
01090 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	**SAMPLE MEASUREMENT**	******	******	******	******						
01106 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	**SAMPLE MEASUREMENT**	******	******	******	******						
01145 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith, COO
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400-7925	8.13.13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

07834

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
02/01/2013	02/28/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	TELEPHONE		DATE
Jeff Smith, COO			505	400-7925	8.13.13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
03/01/2013	03/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith, Chief Operating Officer
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400-7925	8-18-13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 108~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
03/01/2013	03/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER
Jeff Smith COO
TYPED OR PRINTED

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.

Katie Emmer
SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE		DATE
505	400-7925	8-13-13
AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
03/01/2013	03/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall
No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith, COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: ~~2425 SAN PEDRO NE, SUITE 100~~ 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
04/01/2013	04/30/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE
Jeff Smith, Chief Operating Officer	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED			AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
04/01/2013	04/30/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING VALUE	QUANTITY OR LOADING VALUE	QUANTITY OR LOADING UNITS	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION VALUE	QUALITY OR CONCENTRATION UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE	DATE
Jeff Smith, COO TYPED OR PRINTED	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	505 400-7925 AREA Code NUMBER	8-13-13 MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved

OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION

ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110

FACILITY: COPPER FLAT PRODUCTION WELL FIELD

LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
04/01/2013	04/30/2013

DMR Mailing ZIP CODE: 87110

MINOR

DISCHARGE GROUNDWATER

External Outfall

No Discharge ✓

PARAMETER		**QUANTITY OR LOADING**			**QUALITY OR CONCENTRATION**				**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
		VALUE	**VALUE**	**UNITS**	**VALUE**	**VALUE**	**VALUE**	**UNITS**			
Flow, in conduit or thru treatment plant	**SAMPLE MEASUREMENT**				******	******	******	******			
50050 1 0 Effluent Gross	**PERMIT REQUIREMENT**	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	**SAMPLE MEASUREMENT**	******	******	******	******						
71890 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	**TELEPHONE**		**DATE**
Jeff Smith, COO		**SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT**	505	400-7925	8-13-13
TYPED OR PRINTED			**AREA Code**	**NUMBER**	**MM/DD/YYYY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved

OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION

ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110

FACILITY: COPPER FLAT PRODUCTION WELL FIELD

LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
05/01/2013	05/31/2013

DMR Mailing ZIP CODE: 87110

MINOR

DISCHARGE GROUNDWATER

External Outfall

No Discharge ✓

PARAMETER		**QUANTITY OR LOADING**			**QUALITY OR CONCENTRATION**				**NO. EX**	**FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
		VALUE	**VALUE**	**UNITS**	**VALUE**	**VALUE**	**VALUE**	**UNITS**			
pH	**SAMPLE MEASUREMENT**	******	******	******		******					
00400 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	**SAMPLE MEASUREMENT**	******	******	******	******						
01000 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	**SAMPLE MEASUREMENT**	******	******	******	******						
01025 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	**SAMPLE MEASUREMENT**	******	******	******	******						
01030 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	**SAMPLE MEASUREMENT**	******	******	******	******						
01040 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	**SAMPLE MEASUREMENT**	******	******	******	******						
01049 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	**SAMPLE MEASUREMENT**	******	******	******	******						
01056 1 0 Effluent Gross	**PERMIT REQUIREMENT**	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	Certification	Signature	**TELEPHONE**		**DATE**
Jeff Smith, Chief Operating Officer	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
TYPED OR PRINTED		**SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT**	**AREA Code**	**NUMBER**	**MM/DD/YYYY**

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

PERMIT NUMBER	DISCHARGE NUMBER
NM0031101	001-A

MONITORING PERIOD	
MM/DD/YYYY	MM/DD/YYYY
05/01/2013	05/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER	Certification	SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE
Jeff Smith COO TYPED OR PRINTED	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8-13-13
			AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787031~~

NM0031101	001-A
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD	
MM/DD/YYYY	MM/DD/YYYY
05/01/2013	05/31/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE
Jeff Smith COO	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400·7925	8·13·13
TYPED OR PRINTED			AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787001~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
06/01/2013	06/30/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
pH	SAMPLE MEASUREMENT	******	******	******		******					
00400 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	6.6 MINIMUM	******	9 MAXIMUM	SU		Weekly	GRAB
Arsenic, dissolved [as As]	SAMPLE MEASUREMENT	******	******	******	******						
01000 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Cadmium, dissolved [as Cd]	SAMPLE MEASUREMENT	******	******	******	******						
01025 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Chromium, dissolved [as Cr]	SAMPLE MEASUREMENT	******	******	******	******						
01030 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Copper, dissolved [as Cu]	SAMPLE MEASUREMENT	******	******	******	******						
01040 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Lead, dissolved [as Pb]	SAMPLE MEASUREMENT	******	******	******	******						
01049 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	mg/L		Monthly	GRAB
Manganese, dissolved [as Mn]	SAMPLE MEASUREMENT	******	******	******	******						
01056 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE		DATE
Jeff Smith, Chief Operating Officer	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505	400-7925	8.13.13
TYPED OR PRINTED			AREA Code	NUMBER	MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8707931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
06/01/2013	06/30/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ✓

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
Thallium, dissolved [as Tl]	SAMPLE MEASUREMENT	******	******	******	******						
01057 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Molybdenum, dissolved [as Mo]	SAMPLE MEASUREMENT	******	******	******	******						
01060 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Nickel, dissolved [as Ni]	SAMPLE MEASUREMENT	******	******	******	******						
01065 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Silver, dissolved [as Ag]	SAMPLE MEASUREMENT	******	******	******	******						
01075 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Zinc, dissolved [as Zn]	SAMPLE MEASUREMENT	******	******	******	******						
01090 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Aluminum, dissolved [as Al]	SAMPLE MEASUREMENT	******	******	******	******						
01106 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB
Selenium, dissolved [as Se]	SAMPLE MEASUREMENT	******	******	******	******						
01145 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER			TELEPHONE		DATE
Jeff Smith, COO TYPED OR PRINTED	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	505 AREA Code	400-7925 NUMBER	8-13-13 MM/DD/YYYY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)
WHEN DISCHARGING.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

PERMITTEE NAME/ADDRESS *(Include Facility Name/Location if Different)*

NAME: NEW MEXICO COPPER CORPORATION
ADDRESS: 2424 Louisiana Blvd NE Ste 301
ALBUQUERQUE, NM 87110
FACILITY: COPPER FLAT PRODUCTION WELL FIELD
LOCATION: ~~2425 SAN PEDRO NE, SUITE 100~~
~~ALBUQUERQUE, NM 8787931~~

NM0031101	001-A
PERMIT NUMBER	**DISCHARGE NUMBER**

MONITORING PERIOD	
MM/DD/YYYY	**MM/DD/YYYY**
06/01/2013	06/30/2013

DMR Mailing ZIP CODE: 87110
MINOR

DISCHARGE GROUNDWATER
External Outfall

No Discharge ☑

PARAMETER		QUANTITY OR LOADING VALUE	QUANTITY OR LOADING VALUE	UNITS	QUALITY OR CONCENTRATION VALUE	VALUE	VALUE	UNITS	NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE
Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT				******	******	******	******			
50050 1 0 Effluent Gross	PERMIT REQUIREMENT	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	MGD	******	******	******	******		Weekly	ESTIMA
Mercury, dissolved [as Hg]	SAMPLE MEASUREMENT	******	******	******	******						
71890 1 0 Effluent Gross	PERMIT REQUIREMENT	******	******	******	******	Req. Mon. 30DA AVG	Req. Mon. DAILY MX	ug/L		Monthly	GRAB

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER		SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT	TELEPHONE	DATE
Jeff Smith, COO (TYPED OR PRINTED)	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, 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.	Katie Emmer	505 (AREA Code) 400-7925 (NUMBER)	8-18-13 (MM/DD/YYYY)

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

WHEN DISCHARGING.

NEW MEXICO COPPER CORPORATION
A WHOLLY OWNED SUBSIDIARY OF
THEMAC RESOURCES GROUP LTD
2424 LOUISIANA BLVD. NE STE. 301
ALBUQUERQUE, NM 87110
(505) 883-2510

usbank. All of us serving you®

95-231-1070

2/25/2013

PAY TO THE ORDER OF NM Mining & Mineral Division $ **USD 250.00

Two Hundred Fifty and 00/100** DOLLARS

Security features. Details on back.

NM Mining & Mineral Division
Mining Act Reclamation Bureau
1220 South St. Francis Drive
Santa Fe, NM 87505

TWO SIGNATURES REQUIRED

Raymond E. Irwin

Elena Carnes

AUTHORIZED SIGNATURE

MEMO Exploration permit, S1025EM modification

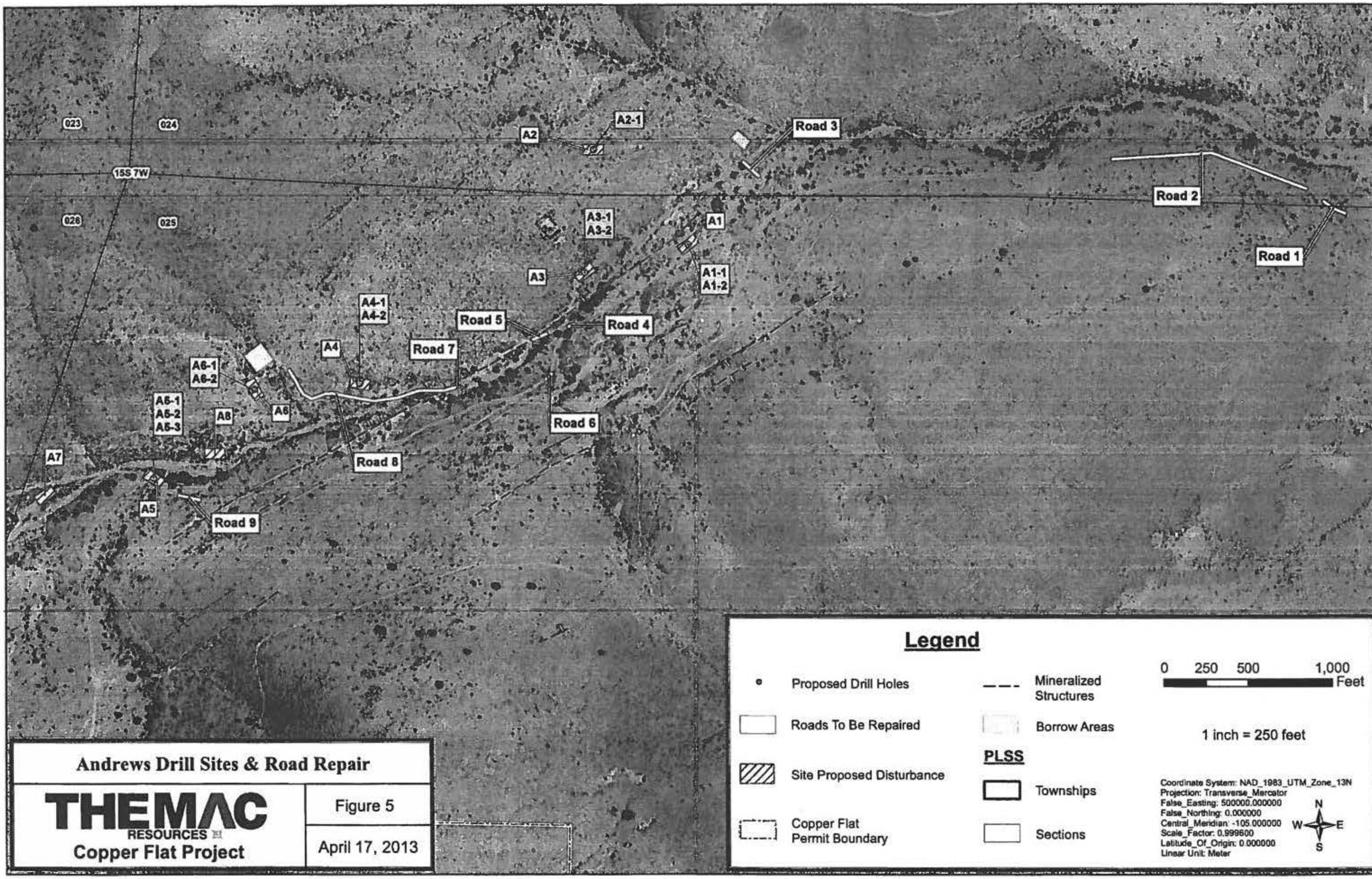
⑈002512⑈ ⑆107002312⑆ 156400197331⑈

NEW MEXICO COPPER CORPORATION 2512

NM Mining & Mineral Division 2/25/2013

Date	Type	Reference	Original Amt.	Balance Due	Discount	Payment
2/25/2013	Bill	S1025EM Mod	USD 250.00	USD 250.00		USD 250.00
					Check Amount	USD 250.00

US Bank Checking 73 Exploration permit, S1025EM modification USD 250.00



Andrews Drill Sites & Road Repair

THEMAC RESOURCES

Copper Flat Project

Figure 5

April 17, 2013

Legend

- Proposed Drill Holes
- Roads To Be Repaired
- Site Proposed Disturbance
- Copper Flat Permit Boundary
- Mineralized Structures
- Borrow Areas

PLSS

- Townships
- Sections

0 250 500 1,000 Feet

1 inch = 250 feet

Coordinate System: NAD_1983_UTM_Zone_13N
Projection: Transverse_Mercator
False_Easting: 500000.000000
False_Northing: 0.000000
Central_Meridian: -105.000000
Scale_Factor: 0.999600
Latitude_Of_Origin: 0.000000
Linear Unit: Meter

N W E S

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

January 08, 2013

Katie Emmer
New Mexico Copper Corp
2424 Louisiana Blvd NE Ste 301
Albuquerque, New Mexico 87110
TEL: (505) 400-7925
FAX

RE: NMCC PWs

OrderNo.: 1212427

Dear Katie Emmer:

Hall Environmental Analysis Laboratory received 1 sample(s) on 12/11/2012 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. All samples are reported as received unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

CLIENT: New Mexico Copper Corp — **Client Sample ID:** AT-Outfall
Project: NMCC PWs — **Collection Date:** 12/10/2012 3:15:00 PM
Lab ID: 1212427-001 — **Matrix:** AQUEOUS — **Received Date:** 12/11/2012 8:42:00 AM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS							Analyst: **JRR**
Fluoride	0.78	0.02000	0.10		mg/L	1	12/11/2012 7:08:58 PM
Chloride	25	1.32400	10		mg/L	20	12/11/2012 7:46:12 PM
Nitrogen, Nitrite (As N)	ND	0.01480	0.10		mg/L	1	12/11/2012 7:08:58 PM
Nitrogen, Nitrate (As N)	0.49	0.02260	0.10		mg/L	1	12/11/2012 7:08:58 PM
Sulfate	18	0.23330	0.50		mg/L	1	12/11/2012 7:08:58 PM
EPA METHOD 200.7: DISSOLVED METALS							Analyst: **JLF**
Aluminum	ND	0.01091	0.020		mg/L	1	12/27/2012 5:46:08 PM
Barium	0.013	0.00031	0.0020		mg/L	1	12/27/2012 5:46:08 PM
Beryllium	ND	0.00050	0.0020		mg/L	1	12/27/2012 5:46:08 PM
Boron	0.071	0.00558	0.040		mg/L	1	12/31/2012 10:25:18 AM
Calcium	26	0.02588	1.0		mg/L	1	12/27/2012 5:46:08 PM
Cobalt	0.0020	0.00044	0.0060	J	mg/L	1	12/27/2012 5:46:08 PM
Iron	0.081	0.00192	0.020		mg/L	1	12/27/2012 5:46:08 PM
Magnesium	2.2	0.01291	1.0		mg/L	1	12/27/2012 5:46:08 PM
Manganese	0.17	0.00062	0.0020	*	mg/L	1	12/27/2012 5:46:08 PM
Molybdenum	0.0020	0.00189	0.0080	J	mg/L	1	12/27/2012 5:46:08 PM
Potassium	2.9	0.48088	1.0		mg/L	1	12/31/2012 10:25:18 AM
Silicon	16	0.08245	0.40		mg/L	5	12/27/2012 5:49:54 PM
Silver	ND	0.00106	0.0050		mg/L	1	12/27/2012 5:46:08 PM
Sodium	52	0.04456	1.0		mg/L	1	12/27/2012 5:46:08 PM
Vanadium	0.0080	0.00278	0.050	J	mg/L	1	12/27/2012 5:46:08 PM
Zinc	0.020	0.00062	0.010		mg/L	1	12/27/2012 5:46:08 PM
EPA 200.8: DISSOLVED METALS							Analyst: **DBD**
Antimony	0.00017	0.00002	0.0010	J	mg/L	1	12/19/2012 2:17:12 PM
Arsenic	0.0020	0.00013	0.0010		mg/L	1	12/19/2012 2:17:12 PM
Cadmium	ND	0.00001	0.0010		mg/L	1	12/19/2012 2:17:12 PM
Chromium	0.0025	0.00013	0.0010		mg/L	1	12/19/2012 2:17:12 PM
Copper	0.00033	0.00016	0.0010	J	mg/L	1	12/19/2012 2:17:12 PM
Lead	0.000024	0.00002	0.0010	J	mg/L	1	12/19/2012 2:17:12 PM
Nickel	0.00022	0.00007	0.0010	J	mg/L	1	12/19/2012 2:17:12 PM
Selenium	0.00090	0.00055	0.0010	J	mg/L	1	12/19/2012 2:17:12 PM
Thallium	0.000012	0.00001	0.0010	J	mg/L	1	12/19/2012 2:17:12 PM
Uranium	0.0025	0.00001	0.0010		mg/L	1	12/19/2012 2:17:12 PM
EPA METHOD 245.1: MERCURY							Analyst: **TMG**
Mercury	ND	0.00002	0.00020		mg/L	1	12/13/2012 12:50:58 PM
EPA METHOD 624 - VOCS							Analyst: **RAA**
Benzene	ND	0.39862	5.0		µg/L	1	12/20/2012 10:26:00 AM
Bromodichloromethane	ND	0.33993	5.0		µg/L	1	12/20/2012 10:26:00 AM
Bromoform	ND	0.43176	5.0		µg/L	1	12/20/2012 10:26:00 AM
Bromomethane	ND	0.55803	5.0		µg/L	1	12/20/2012 10:26:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: New Mexico Copper Corp
Project: NMCC PWs
Lab ID: 1212427-001
Matrix: AQUEOUS
Client Sample ID: AT-Outfall
Collection Date: 12/10/2012 3:15:00 PM
Received Date: 12/11/2012 8:42:00 AM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 624 - VOCS							Analyst: **RAA**
Carbon tetrachloride	ND	0.36577	5.0		µg/L	1	12/20/2012 10:26:00 AM
Chlorobenzene	ND	0.38965	5.0		µg/L	1	12/20/2012 10:26:00 AM
Chloroethane	ND	0.44241	5.0		µg/L	1	12/20/2012 10:26:00 AM
2-Chloroethyl-vinyl ether	ND	0.77679	5.0		µg/L	1	12/20/2012 10:26:00 AM
Chloroform	ND	0.35371	5.0		µg/L	1	12/20/2012 10:26:00 AM
Chloromethane	ND	0.65154	5.0		µg/L	1	12/20/2012 10:26:00 AM
cis-1,2-DCE	1.2	0.34388	5.0	J	µg/L	1	12/20/2012 10:26:00 AM
cis-1,3-Dichloropropene	ND	0.56594	5.0		µg/L	1	12/20/2012 10:26:00 AM
Dibromochloromethane	ND	0.32160	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,2-Dichlorobenzene	ND	0.46552	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,3-Dichlorobenzene	ND	0.47251	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,4-Dichlorobenzene	ND	0.42788	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,1-Dichloroethane	ND	0.29775	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,2-Dichloroethane	ND	0.28693	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,1-Dichloroethene	ND	0.38066	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,2-Dichloropropane	ND	0.38741	5.0		µg/L	1	12/20/2012 10:26:00 AM
Ethylbenzene	ND	0.38153	5.0		µg/L	1	12/20/2012 10:26:00 AM
Methylene chloride	ND	0.35142	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,1,2,2-Tetrachloroethane	ND	0.61641	5.0		µg/L	1	12/20/2012 10:26:00 AM
Tetrachloroethene	ND	0.47406	5.0		µg/L	1	12/20/2012 10:26:00 AM
Toluene	ND	0.47309	5.0		µg/L	1	12/20/2012 10:26:00 AM
Total Xylenes	ND	0.53121	15		µg/L	1	12/20/2012 10:26:00 AM
trans-1,2-Dichloroethene	ND	0.32318	5.0		µg/L	1	12/20/2012 10:26:00 AM
trans-1,3-Dichloropropene	ND	0.64292	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,1,1-Trichloroethane	ND	0.38417	5.0		µg/L	1	12/20/2012 10:26:00 AM
1,1,2-Trichloroethane	ND	0.53935	5.0		µg/L	1	12/20/2012 10:26:00 AM
Trichloroethene	ND	0.30054	5.0		µg/L	1	12/20/2012 10:26:00 AM
Trichlorofluoromethane	ND	0.35446	5.0		µg/L	1	12/20/2012 10:26:00 AM
Vinyl chloride	ND	0.47747	5.0		µg/L	1	12/20/2012 10:26:00 AM
Acrolein	ND	50.00000	50		µg/L	1	12/19/2012 5:46:38 PM
Acrylonitrile	ND	50.00000	50		µg/L	1	12/19/2012 5:46:38 PM
Surr: 1,2-Dichloroethane-d4	93.1		70-130		%REC	1	12/20/2012 10:26:00 AM
Surr: 4-Bromofluorobenzene	101		70-130		%REC	1	12/20/2012 10:26:00 AM
Surr: Dibromofluoromethane	86.9		70-130		%REC	1	12/20/2012 10:26:00 AM
Surr: Toluene-d8	101		70-130		%REC	1	12/20/2012 10:26:00 AM
SM 5310B: TOC							Analyst: **LRW**
Organic Carbon, Total	0.23	0.22710	1.0	J	mg/L	1	12/13/2012 12:43:10 PM
EPA 120.1: SPECIFIC CONDUCTANCE							Analyst: **JML**
Conductivity	400	0.01000	0.010		µmhos/c	1	12/13/2012 12:39:34 PM
SM4500-H+B: PH							Analyst: **JML**

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

Hall Environmental Analysis Laboratory, Inc.

CLIENT: New Mexico Copper Corp
Project: NMCC PWs
Lab ID: 1212427-001
Matrix: AQUEOUS
Client Sample ID: AT-Outfall
Collection Date: 12/10/2012 3:15:00 PM
Received Date: 12/11/2012 8:42:00 AM

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
SM4500-H+B: PH							Analyst: **JML**
pH	7.89	0.10000	1.68	H	pH units	1	12/13/2012 12:39:34 PM
SM2320B: ALKALINITY							Analyst: **JML**
Bicarbonate (As CaCO3)	140	5.00000	20		mg/L Ca	1	12/13/2012 12:39:34 PM
Carbonate (As CaCO3)	ND	2.00000	2.0		mg/L Ca	1	12/13/2012 12:39:34 PM
Total Alkalinity (as CaCO3)	140	5.00000	20		mg/L Ca	1	12/13/2012 12:39:34 PM
SM2540C MOD: TOTAL DISSOLVED SOLIDS							Analyst: **JML**
Total Dissolved Solids	249	10.05560	20.0		mg/L	1	12/18/2012 3:49:00 PM
SM 2540D: TSS							Analyst: **JML**
Suspended Solids	ND	1.53350	4.0		mg/L	1	12/13/2012 11:41:00 AM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits
RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits

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Client: HALL ENVIRONMENTAL ANALYSIS LAB
Address: 4901 HAWKINS NE SUITE D
ALBUQUERQUE, NM 87109
Attn: ANDY FREEMAN

Batch #: 121213032
Project Name: 1212427

Analytical Results Report

Sample Number 121213032-001
Client Sample ID 1212427-001B / AT-OUTFALL
Matrix Water
Comments

Sampling Date 12/10/2012
Sampling Time 3:15 PM
Date/Time Received 12/13/2012 12:00 PM
Extraction Date 12/17/2012

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
1,2,4-Trichlorobenzene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
1,2-Dichlorobenzene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
1,2-Diphenyl hydrazine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
1,3-Dichlorobenzene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
1,4-Dichlorobenzene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
1-Methylnaphthalene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,3,4,6-Tetrachlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,3,5,6-Tetrachlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,4,5-Trichlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,4,6-Trichlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,4-Dichlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,4-Dimethylphenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,4-Dinitrophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,4-Dinitrotoluene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2,6-Dinitrotoluene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2-Chloronaphthalene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2-Chlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2-Methylnaphthalene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2-Methylphenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2-Nitroaniline	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
2-Nitrophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
3,3'-Dichlorobenzidine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	

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Attn: ANDY FREEMAN

Batch #: 121213032
Project Name: 1212427

Analytical Results Report

Sample Number 121213032-001
Client Sample ID 1212427-001B / AT-OUTFALL
Matrix Water
Comments

Sampling Date 12/10/2012
Sampling Time 3:15 PM

Date/Time Received 12/13/2012 12:00 PM
Extraction Date 12/17/2012

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
3+4-Methylphenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
3-Nitroaniline	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4,6-Dinitro-2-methylphenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4-Bromophenyl-phenylether	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4-Chloro-3-methylphenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4-Chloroaniline	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4-Chlorophenyl-phenylether	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4-Nitroaniline	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
4-Nitrophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Acenaphthene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Acenaphthylene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Aniline	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Anthracene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzidine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzo(ghi)perylene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzo[a]anthracene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzo[a]pyrene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzo[b]fluoranthene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzo[k]fluoranthene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Benzyl alcohol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
bis(2-Chloroethoxy)methane	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
bis(2-Chloroethyl)ether	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
bis(2-chloroisopropyl)ether	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	

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Address: 4901 HAWKINS NE SUITE D
ALBUQUERQUE, NM 87109
Attn: ANDY FREEMAN

Batch #: 121213032
Project Name: 1212427

Analytical Results Report

Sample Number 121213032-001
Client Sample ID 1212427-001B / AT-OUTFALL
Matrix Water
Comments

Sampling Date 12/10/2012
Sampling Time 3:15 PM
Date/Time Received 12/13/2012 12:00 PM
Extraction Date 12/17/2012

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
bis(2-Ethylhexyl)phthalate	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Butylbenzylphthalate	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Carbazole	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Chrysene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Dibenz[a,h]anthracene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Dibenzofuran	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Diethylphthalate	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Dimethylphthalate	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Di-n-butylphthalate	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Di-n-octylphthalate	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Fluoranthene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Fluorene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Hexachlorobenzene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Hexachlorobutadiene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Hexachlorocyclopentadiene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Hexachloroethane	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Indeno[1,2,3-cd]pyrene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Isophorone	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Naphthalene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Nitrobenzene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Nitrosodimethylamine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
n-Nitroso-di-n-propylamine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
n-Nitrosodiphenylamine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	

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Certifications held by Anatek Labs WA: EPA:WA00169; ID:WA00169; WA:C585; MT:Cert0095

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Client: HALL ENVIRONMENTAL ANALYSIS LAB
Address: 4901 HAWKINS NE SUITE D
ALBUQUERQUE, NM 87109
Attn: ANDY FREEMAN

Batch #: 121213032
Project Name: 1212427

Analytical Results Report

Sample Number 121213032-001
Client Sample ID 1212427-001B / AT-OUTFALL
Matrix Water
Comments

Sampling Date 12/10/2012
Sampling Time 3:15 PM

Date/Time Received 12/13/2012 12:00 PM
Extraction Date 12/17/2012

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Pentachlorophenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Phenanthrene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Phenol	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Pyrene	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	
Pyridine	ND	ug/L	0.5	12/20/2012	EMP	EPA 625	

Surrogate Data

Sample Number 121213032-001

Surrogate Standard	Method	Percent Recovery	Control Limits
2,4,6-Tribromophenol	EPA 625	84.3	53-122
2-Fluorobiphenyl	EPA 625	96.3	12-116
2-Fluorophenol	EPA 625	73.0	10-139
Nitrobenzene-d5	EPA 625	94.8	54-118
Phenol-d5	EPA 625	83.9	28-154
Terphenyl-d14	EPA 625	99.8	52-144

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Certifications held by Anatek Labs WA: EPA:WA00169; ID:WA00169; WA:C585; MT:Cert0095

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Address: 4901 HAWKINS NE SUITE D
ALBUQUERQUE, NM 87109
Attn: ANDY FREEMAN

Batch #: 121213032
Project Name: 1212427

Analytical Results Report

Sample Number	121213032-002	**Sampling Date**	12/10/2012	**Date/Time Received**	12/13/2012 12:00 PM
Client Sample ID	1212427-001C / AT-OUTFALL	**Sampling Time**	3:15 PM	**Extraction Date**	12/17/2012
Matrix	Water				
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
4,4-DDD	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
4,4-DDE	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
4,4-DDT	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Aldrin	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
alpha-BHC	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Aroclor 1016 (PCB-1016)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
Aroclor 1221 (PCB-1221)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
Aroclor 1232 (PCB-1232)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
Aroclor 1242 (PCB-1242)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
Aroclor 1248 (PCB-1248)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
Aroclor 1254 (PCB-1254)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
Aroclor 1260 (PCB-1260)	ND	ug/L	0.2	12/17/2012	MAH	EPA 608	
beta-BHC	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Chlordane	ND	ug/L	0.1	12/17/2012	MAH	EPA 608	
delta-BHC	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Dieldrin	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Endosulfan I	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Endosulfan II	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Endosulfan sulfate	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Endrin	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Endrin aldehyde	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Endrin ketone	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
gamma-BHC (Lindane)	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	

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ALBUQUERQUE, NM 87109
Attn: ANDY FREEMAN

Batch #: 121213032
Project Name: 1212427

Analytical Results Report

Sample Number	121213032-002	**Sampling Date**	12/10/2012	**Date/Time Received**	12/13/2012 12:00 PM
Client Sample ID	1212427-001C / AT-OUTFALL	**Sampling Time**	3:15 PM	**Extraction Date**	12/17/2012
Matrix	Water				
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Heptachlor	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Heptachlor epoxide	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Methoxychlor	ND	ug/L	0.01	12/17/2012	MAH	EPA 608	
Toxaphene	ND	ug/L	0.1	12/17/2012	MAH	EPA 608	

Surrogate Data

Sample Number 121213032-002

Surrogate Standard	Method	Percent Recovery	Control Limits
DCB	EPA 608	75.0	30-130

Authorized Signature

John Coddington, Lab Manager

MCL EPA's Maximum Contaminant Level
ND Not Detected
PQL Practical Quantitation Limit

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Soil/solid results are reported on a dry-weight basis unless otherwise noted.

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	121213032
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1212427
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	121213032-003	**Sampling Date**	12/10/2012	**Date/Time Received**	12/13/2012 12:00 P
Client Sample ID	1212427-001G / AT-OUTFALL	**Sampling Time**	3:15 PM		
Matrix	Water				
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/L	0.01	12/21/2012	CRW	EPA 335.4	

Authorized Signature

John Coddington, Lab Manager

MCL EPA's Maximum Contaminant Level
ND Not Detected
PQL Practical Quantitation Limit

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Pace Analytical™

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Minneapolis, MN 55414

Tel: 612-607-1700
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Method 1613B Sample Analysis Results

Client - Hall Environmental

Client's Sample ID	1212427-001F AT-Outfall		
Lab Sample ID	10215127001		
Filename	U121218B_14		
Injected By	SMT		
Total Amount Extracted	933 mL	Matrix	Water
% Moisture	NA	Dilution	NA
Dry Weight Extracted	NA	Collected	12/10/2012 15:00
ICAL ID	U121116	Received	12/12/2012 09:50
CCal Filename(s)	U121218B_01	Extracted	12/14/2012 13:45
Method Blank ID	BLANK-34901	Analyzed	12/19/2012 01:21

Native Isomers	Conc pg/L	EMPC pg/L	RL pg/L	Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDD	ND	—	10	2,3,7,8-TCDD-13C	2.00	95
				Recovery Standard 1,2,3,4-TCDD-13C	2.00	NA
				Cleanup Standard 2,3,7,8-TCDD-37Cl4	0.20	92

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
RL = Reporting Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

REPORT OF LABORATORY ANALYSIS

Pace Analytical™

1700 Elm Street - Suite 200
Minneapolis, MN 55414

Tel: 612-607-1700
Fax: 612- 607-6444

Method 1613B Blank Analysis Results

Lab Sample ID	BLANK-34901	Matrix	Water
Filename	F121218A_10	Dilution	NA
Total Amount Extracted	994 mL	Extracted	12/14/2012 13:45
ICAL ID	F121120	Analyzed	12/18/2012 15:08
CCal Filename(s)	F121218A_01	Injected By	SMT

Native Isomers	Conc pg/L	EMPC pg/L	RL pg/L	Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDD	ND	—	10	2,3,7,8-TCDD-13C	2.00	87
				Recovery Standard 1,2,3,4-TCDD-13C	2.00	NA
				Cleanup Standard 2,3,7,8-TCDD-37Cl4	0.20	87

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
RL = Reporting Limit

REPORT OF LABORATORY ANALYSIS

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Method 1613B Laboratory Control Spike Results

Lab Sample ID	LCS-34902		
Filename	F121218A_02	Matrix	Water
Total Amount Extracted	1040 mL	Dilution	NA
ICAL ID	F121120	Extracted	12/14/2012 13:45
CCal Filename	F121218A_01	Analyzed	12/18/2012 09:11
Method Blank ID	BLANK-34901	Injected By	SMT

Compound	Cs	Cr	Lower Limit	Upper Limit	% Rec.
2,3,7,8-TCDD	10	8.8	7.3	14.6	88
2,3,7,8-TCDD-37Cl4	10	9.3	3.7	15.8	93
2,3,7,8-TCDD-13C	100	99	25.0	141.0	99

Cs = Concentration Spiked (ng/mL)
Cr = Concentration Recovered (ng/mL)
Rec. = Recovery (Expressed as Percent)
Control Limit Reference: Method 1613, Table 6, 10/94 Revision
R = Recovery outside of control limits
Nn = Value obtained from additional analysis
* = See Discussion

REPORT OF LABORATORY ANALYSIS

Pace Analytical™
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Tel: 612-607-1700
Fax: 612- 607-6444

Method 1613B Laboratory Control Spike Results

Lab Sample ID	LCSD-34903		
Filename	F121218A_03	Matrix	Water
Total Amount Extracted	1010 mL	Dilution	NA
ICAL ID	F121120	Extracted	12/14/2012 13:45
CCal Filename	F121218A_01	Analyzed	12/18/2012 09:55
Method Blank ID	BLANK-34901	Injected By	SMT

Compound	Cs	Cr	Lower Limit	Upper Limit	% Rec.
2,3,7,8-TCDD	10	9.1	7.3	14.6	91
2,3,7,8-TCDD-37Cl4	10	9.1	3.7	15.8	91
2,3,7,8-TCDD-13C	100	95	25.0	141.0	95

Cs = Concentration Spiked (ng/mL)
Cr = Concentration Recovered (ng/mL)
Rec. = Recovery (Expressed as Percent)
Control Limit Reference: Method 1613, Table 6, 10/94 Revision
R = Recovery outside of control limits
Nn = Value obtained from additional analysis
* = See Discussion

REPORT OF LABORATORY ANALYSIS

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Method 1613B

Spike Recovery Relative Percent Difference (RPD) Results

Client Hall Environmental

Spike 1 ID	LCS-34902	Spike 2 ID	LCSD-34903
Spike 1 Filename	F121218A_02	Spike 2 Filename	F121218A_03

Compound	Spike 1 %REC	Spike 2 %REC	%RPD
2,3,7,8-TCDD	88	91	3.4

%REC = Percent Recovered
RPD = The difference between the two values divided by the mean value

REPORT OF LABORATORY ANALYSIS

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp

Project: NMCC PWs

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **PBW**	Batch ID: **R7746**	RunNo: **7746**	
Prep Date:	Analysis Date: **12/27/2012**	SeqNo: **225011**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	ND	0.020								
Barium	ND	0.0020								
Beryllium	ND	0.0020								
Calcium	ND	1.0								
Cobalt	ND	0.0060								
Iron	0.0020	0.020								J
Magnesium	ND	1.0								
Manganese	ND	0.0020								
Molybdenum	0.0021	0.0080								J
Silicon	ND	0.080								
Silver	ND	0.0050								
Sodium	ND	1.0								
Vanadium	ND	0.050								
Zinc	ND	0.010								

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **LCSW**	Batch ID: **R7746**	RunNo: **7746**	
Prep Date:	Analysis Date: **12/27/2012**	SeqNo: **225012**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Aluminum	0.50	0.020	0.5000	0	99.6	85	115			
Barium	0.49	0.0020	0.5000	0	99.0	85	115			
Beryllium	0.51	0.0020	0.5000	0	102	85	115			
Calcium	49	1.0	50.00	0	98.8	85	115			
Cobalt	0.49	0.0060	0.5000	0	97.2	85	115			
Iron	0.50	0.020	0.5000	0.002050	98.8	85	115			
Magnesium	50	1.0	50.00	0	101	85	115			
Manganese	0.49	0.0020	0.5000	0	97.2	85	115			
Molybdenum	0.51	0.0080	0.5000	0.002090	102	85	115			
Silicon	2.6	0.080	2.500	0	104	85	115			
Silver	0.10	0.0050	0.1000	0	100	85	115			
Sodium	50	1.0	50.00	0	99.5	85	115			
Vanadium	0.51	0.050	0.5000	0	103	85	115			
Zinc	0.49	0.010	0.5000	0	98.9	85	115			

Sample ID **MB**	SampType: **MBLK**	TestCode: **EPA Method 200.7: Dissolved Metals**	
Client ID: **PBW**	Batch ID: **R7786**	RunNo: **7786**	
Prep Date:	Analysis Date: **12/31/2012**	SeqNo: **226434**	Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	ND	0.040								
Potassium	ND	1.0								

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **PBW** Batch ID: **R7786** RunNo: **7786**
Prep Date: Analysis Date: **12/31/2012** SeqNo: **226435** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	ND	0.040								
Potassium	ND	1.0								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R7786** RunNo: **7786**
Prep Date: Analysis Date: **12/31/2012** SeqNo: **226436** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.54	0.040	0.5000	0	107	85	115			
Potassium	54	1.0	50.00	0	107	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 200.7: Dissolved Metals**
Client ID: **LCSW** Batch ID: **R7786** RunNo: **7786**
Prep Date: Analysis Date: **12/31/2012** SeqNo: **226437** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.54	0.040	0.5000	0	109	85	115			
Potassium	57	1.0	50.00	0	113	85	115			

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp

Project: NMCC PWs

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R7605** RunNo: **7605**

Prep Date: Analysis Date: **12/19/2012** SeqNo: **220893** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.025	0.0010	0.02500	0	102	85	115			
Arsenic	0.025	0.0010	0.02500	0	100	85	115			
Cadmium	0.025	0.0010	0.02500	0	101	85	115			
Chromium	0.024	0.0010	0.02500	0	95.5	85	115			
Copper	0.024	0.0010	0.02500	0	97.0	85	115			
Lead	0.025	0.0010	0.02500	0	101	85	115			
Nickel	0.024	0.0010	0.02500	0	95.1	85	115			
Selenium	0.025	0.0010	0.02500	0	98.1	85	115			
Thallium	0.025	0.0010	0.02500	0	101	85	115			
Uranium	0.027	0.0010	0.02500	0	107	85	115			

Sample ID **LCS** SampType: **LCS** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **LCSW** Batch ID: **R7605** RunNo: **7605**

Prep Date: Analysis Date: **12/19/2012** SeqNo: **220895** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.025	0.0010	0.02500	.00002435	101	85	115			
Arsenic	0.025	0.0010	0.02500	0	102	85	115			
Cadmium	0.024	0.0010	0.02500	.00001214	97.9	85	115			
Chromium	0.024	0.0010	0.02500	0.0003138	95.3	85	115			
Copper	0.025	0.0010	0.02500	0	98.9	85	115			
Lead	0.025	0.0010	0.02500	0	99.4	85	115			
Nickel	0.024	0.0010	0.02500	0	95.9	85	115			
Selenium	0.024	0.0010	0.02500	0	97.6	85	115			
Thallium	0.025	0.0010	0.02500	0	101	85	115			
Uranium	0.027	0.0010	0.02500	.00003740	110	85	115			

Sample ID **MB** SampType: **MBLK** TestCode: **EPA 200.8: Dissolved Metals**

Client ID: **PBW** Batch ID: **R7605** RunNo: **7605**

Prep Date: Analysis Date: **12/19/2012** SeqNo: **220897** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.000024	0.0010								J
Arsenic	ND	0.0010								
Cadmium	0.000012	0.0010								J
Chromium	0.00031	0.0010								J
Copper	ND	0.0010								
Lead	ND	0.0010								
Nickel	ND	0.0010								
Selenium	ND	0.0010								
Thallium	ND	0.0010								
Uranium	0.000037	0.0010								J

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **LCS**	SampType: **LCS**	TestCode: **EPA 200.8: Dissolved Metals**
Client ID: **LCSW**	Batch ID: **R7605**	RunNo: **7605**
Prep Date:	Analysis Date: **12/19/2012**	SeqNo: **220996** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	0.025	0.0010	0.02500	0	100	85	115			
Selenium	0.024	0.0010	0.02500	0	97.1	85	115			
Uranium	0.027	0.0010	0.02500	0	109	85	115			

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp

Project: NMCC PWs

Sample ID **MB-5253** SampType: **MBLK** TestCode: **EPA Method 245.1: Mercury**

Client ID: **PBW** Batch ID: **5253** RunNo: **7483**

Prep Date: **12/13/2012** Analysis Date: **12/13/2012** SeqNo: **216936** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.00020								

Sample ID **LCS-5253** SampType: **LCS** TestCode: **EPA Method 245.1: Mercury**

Client ID: **LCSW** Batch ID: **5253** RunNo: **7483**

Prep Date: **12/13/2012** Analysis Date: **12/13/2012** SeqNo: **216937** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0050	0.00020	0.005000	0	99.3	80	120			

Sample ID **1212427-001HMS** SampType: **MS** TestCode: **EPA Method 245.1: Mercury**

Client ID: **AT-Outfall** Batch ID: **5253** RunNo: **7483**

Prep Date: **12/13/2012** Analysis Date: **12/13/2012** SeqNo: **216939** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0049	0.00020	0.005000	0	99.0	75	125			

Sample ID **1212427-001HMSD** SampType: **MSD** TestCode: **EPA Method 245.1: Mercury**

Client ID: **AT-Outfall** Batch ID: **5253** RunNo: **7483**

Prep Date: **12/13/2012** Analysis Date: **12/13/2012** SeqNo: **216940** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0049	0.00020	0.005000	0	98.8	75	125	0.228	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT
Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**
08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **MB** SampType: **MBLK** TestCode: **EPA Method 300.0: Anions**
Client ID: **PBW** Batch ID: **R7442** RunNo: **7442**
Prep Date: Analysis Date: **12/11/2012** SeqNo: **215695** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	ND	0.10								
Chloride	ND	0.50								
Nitrogen, Nitrite (As N)	ND	0.10								
Nitrogen, Nitrate (As N)	ND	0.10								
Sulfate	ND	0.50								

Sample ID **LCS** SampType: **LCS** TestCode: **EPA Method 300.0: Anions**
Client ID: **LCSW** Batch ID: **R7442** RunNo: **7442**
Prep Date: Analysis Date: **12/11/2012** SeqNo: **215696** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	0.49	0.10	0.5000	0	97.6	90	110			
Chloride	4.9	0.50	5.000	0	98.5	90	110			
Nitrogen, Nitrite (As N)	0.94	0.10	1.000	0	94.2	90	110			
Nitrogen, Nitrate (As N)	2.6	0.10	2.500	0	103	90	110			
Sulfate	9.9	0.50	10.00	0	99.2	90	110			

Sample ID **1212427-001DMS** SampType: **MS** TestCode: **EPA Method 300.0: Anions**
Client ID: **AT-Outfall** Batch ID: **R7442** RunNo: **7442**
Prep Date: Analysis Date: **12/11/2012** SeqNo: **215711** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.2	0.10	0.5000	0.7833	89.6	76.6	110			
Nitrogen, Nitrite (As N)	1.0	0.10	1.000	0	102	72.5	111			
Nitrogen, Nitrate (As N)	3.1	0.10	2.500	0.4939	105	90.4	113			
Sulfate	29	0.50	10.00	17.92	108	84.6	122			

Sample ID **1212427-001DMSD** SampType: **MSD** TestCode: **EPA Method 300.0: Anions**
Client ID: **AT-Outfall** Batch ID: **R7442** RunNo: **7442**
Prep Date: Analysis Date: **12/11/2012** SeqNo: **215712** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Fluoride	1.3	0.10	0.5000	0.7833	93.7	76.6	110	1.64	20	
Nitrogen, Nitrite (As N)	0.97	0.10	1.000	0	97.2	72.5	111	4.37	20	
Nitrogen, Nitrate (As N)	3.1	0.10	2.500	0.4939	106	90.4	113	1.08	20	
Sulfate	29	0.50	10.00	17.92	111	84.6	122	0.984	20	

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: 1212427
08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **5ml-rb** SampType: **MBLK** TestCode: **EPA Method 624 - VOCs**
Client ID: **PBW** Batch ID: **R7615** RunNo: **7615**
Prep Date: Analysis Date: **12/19/2012** SeqNo: **221165** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Acrolein	ND	50								
Acrylonitrile	ND	50								

Sample ID **100ng acac icv2** SampType: **LCS** TestCode: **EPA Method 624 - VOCs**
Client ID: **LCSW** Batch ID: **R7615** RunNo: **7615**
Prep Date: Analysis Date: **12/19/2012** SeqNo: **221166** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Acrolein	160	50	200.0	0	78.9	5	305			
Acrylonitrile	340	50	200.0	0	171	5	305			

Sample ID **1212427-001a dup** SampType: **DUP** TestCode: **EPA Method 624 - VOCs**
Client ID: **AT-Outfall** Batch ID: **R7615** RunNo: **7615**
Prep Date: Analysis Date: **12/19/2012** SeqNo: **221168** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Acrolein	ND	50						0	20	
Acrylonitrile	ND	50						0	20	

Sample ID **1212427-001a acac** SampType: **MS** TestCode: **EPA Method 624 - VOCs**
Client ID: **AT-Outfall** Batch ID: **R7615** RunNo: **7615**
Prep Date: Analysis Date: **12/19/2012** SeqNo: **221169** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Acrolein	47	50	100.0	0	46.8	5	305			J
Acrylonitrile	57	50	100.0	0	57.0	5	305			

Sample ID **624 5ml-rb** SampType: **MBLK** TestCode: **EPA Method 624 - VOCs**
Client ID: **PBW** Batch ID: **R7656** RunNo: **7656**
Prep Date: Analysis Date: **12/20/2012** SeqNo: **222355** Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Benzene	ND	5.0								
Bromodichloromethane	ND	5.0								
Bromoform	ND	5.0								
Bromomethane	ND	5.0								
Carbon tetrachloride	ND	5.0								
Chlorobenzene	ND	5.0								
Chloroethane	ND	5.0								
2-Chloroethyl-vinyl ether	ND	5.0								
Chloroform	ND	5.0								
Chloromethane	ND	5.0								

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **624 5ml-rb**	SampType: **MBLK**			TestCode: **EPA Method 624 - VOCs**						
Client ID: **PBW**	Batch ID: **R7656**			RunNo: **7656**						
Prep Date:	Analysis Date: **12/20/2012**			SeqNo: **222355**		Units: **µg/L**				
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
cis-1,2-DCE	ND	5.0								
cis-1,3-Dichloropropene	ND	5.0								
Dibromochloromethane	ND	5.0								
1,2-Dichlorobenzene	ND	5.0								
1,3-Dichlorobenzene	ND	5.0								
1,4-Dichlorobenzene	ND	5.0								
1,1-Dichloroethane	ND	5.0								
1,2-Dichloroethane	ND	5.0								
1,1-Dichloroethene	ND	5.0								
1,2-Dichloropropane	ND	5.0								
Ethylbenzene	ND	5.0								
Methylene chloride	ND	5.0								
1,1,2,2-Tetrachloroethane	ND	5.0								
Tetrachloroethene	ND	5.0								
Toluene	ND	5.0								
Total Xylenes	ND	15								
trans-1,2-Dichloroethene	ND	5.0								
trans-1,3-Dichloropropene	ND	5.0								
1,1,1-Trichloroethane	ND	5.0								
1,1,2-Trichloroethane	ND	5.0								
Trichloroethene	ND	5.0								
Trichlorofluoromethane	ND	5.0								
Vinyl chloride	ND	5.0								
Surr: 1,2-Dichloroethane-d4	47		50.00		93.7	70	130			
Surr: 4-Bromofluorobenzene	55		50.00		110	70	130			
Surr: Dibromofluoromethane	42		50.00		84.8	70	130			
Surr: Toluene-d8	50		50.00		99.9	70	130			

Sample ID **100ng 624 std**	SampType: **LCS**			TestCode: **EPA Method 624 - VOCs**						
Client ID: **LCSW**	Batch ID: **R7656**			RunNo: **7656**						
Prep Date:	Analysis Date: **12/20/2012**			SeqNo: **222356**		Units: **µg/L**				
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Benzene	110	5.0	100.0	0	108	37	151			
Bromodichloromethane	110	5.0	100.0	0	108	35	155			
Bromoform	88	5.0	100.0	0	87.9	45	169			
Bromomethane	96	5.0	100.0	0	96.4	5	242			
Carbon tetrachloride	92	5.0	100.0	0	92.3	70	140			
Chlorobenzene	110	5.0	100.0	0	108	37	160			
Chloroethane	94	5.0	100.0	0	94.1	14	230			
2-Chloroethyl-vinyl ether	110	5.0	400.0	0	26.9	5	305			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp

Project: NMCC PWs

Sample ID **100ng 624 std**	SampType: **LCS**	TestCode: **EPA Method 624 - VOCs**	
Client ID: **LCSW**	Batch ID: **R7656**	RunNo: **7656**	
Prep Date:	Analysis Date: **12/20/2012**	SeqNo: **222356**	Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloroform	100	5.0	100.0	0	103	51	138			
Chloromethane	66	5.0	100.0	0	66.1	5	273			
cis-1,2-DCE	98	5.0	100.0	0	97.6	54	156			
cis-1,3-Dichloropropene	100	5.0	100.0	0	99.6	5	227			
Dibromochloromethane	96	5.0	100.0	0	95.8	53	149			
1,2-Dichlorobenzene	110	5.0	100.0	0	107	18	190			
1,3-Dichlorobenzene	110	5.0	100.0	0	110	59	156			
1,4-Dichlorobenzene	110	5.0	100.0	0	109	18	190			
1,1-Dichloroethane	97	5.0	100.0	0	97.0	59	155			
1,2-Dichloroethane	110	5.0	100.0	0	114	49	155			
1,1-Dichloroethene	110	5.0	100.0	0	115	5	234			
1,2-Dichloropropane	110	5.0	100.0	0	112	5	210			
Ethylbenzene	110	5.0	100.0	0	109	37	162			
Methylene chloride	98	5.0	100.0	0	97.9	5	221			
1,1,2,2-Tetrachloroethane	100	5.0	100.0	0	103	46	157			
Tetrachloroethene	99	5.0	100.0	0	98.7	64	148			
Toluene	110	5.0	100.0	0	111	47	150			
Total Xylenes	320	15	300.0	0	107	37	162			
trans-1,2-Dichloroethene	110	5.0	100.0	0	108	54	156			
trans-1,3-Dichloropropene	110	5.0	100.0	0	108	17	183			
1,1,1-Trichloroethane	99	5.0	100.0	0	99.0	52	162			
1,1,2-Trichloroethane	110	5.0	100.0	0	114	52	150			
Trichloroethene	99	5.0	100.0	0	98.5	71	157			
Trichlorofluoromethane	96	5.0	100.0	0	95.9	17	181			
Vinyl chloride	95	5.0	100.0	0	94.5	5	251			
Surr: 1,2-Dichloroethane-d4	160		150.0		104	70	130			
Surr: 4-Bromofluorobenzene	170		150.0		114	70	130			
Surr: Dibromofluoromethane	130		150.0		83.4	70	130			
Surr: Toluene-d8	160		150.0		107	70	130			

Sample ID **1212427-001a dup**	SampType: **DUP**	TestCode: **EPA Method 624 - VOCs**	
Client ID: **AT-Outfall**	Batch ID: **R7656**	RunNo: **7656**	
Prep Date:	Analysis Date: **12/20/2012**	SeqNo: **222367**	Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Benzene	ND	5.0						0	20	
Bromodichloromethane	ND	5.0						0	20	
Bromoform	ND	5.0						0	20	
Bromomethane	ND	5.0						0	20	
Carbon tetrachloride	ND	5.0						0	20	
Chlorobenzene	ND	5.0						0	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp

Project: NMCC PWs

Sample ID **1212427-001a dup**	SampType: **DUP**	TestCode: **EPA Method 624 - VOCs**	
Client ID: **AT-Outfall**	Batch ID: **R7656**	RunNo: **7656**	
Prep Date:	Analysis Date: **12/20/2012**	SeqNo: **222367**	Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloroethane	ND	5.0						0	20	
2-Chloroethyl-vinyl ether	ND	5.0						0	20	
Chloroform	ND	5.0						0	20	
Chloromethane	ND	5.0						0	20	
cis-1,2-DCE	1.1	5.0						16.6	20	J
cis-1,3-Dichloropropene	ND	5.0						0	20	
Dibromochloromethane	ND	5.0						0	20	
1,2-Dichlorobenzene	ND	5.0						0	20	
1,3-Dichlorobenzene	ND	5.0						0	20	
1,4-Dichlorobenzene	ND	5.0						0	20	
1,1-Dichloroethane	ND	5.0						0	20	
1,2-Dichloroethane	ND	5.0						0	20	
1,1-Dichloroethene	ND	5.0						0	20	
1,2-Dichloropropane	ND	5.0						0	20	
Ethylbenzene	ND	5.0						0	20	
Methylene chloride	ND	5.0						0	20	
1,1,2,2-Tetrachloroethane	ND	5.0						0	20	
Tetrachloroethene	ND	5.0						0	20	
Toluene	ND	5.0						0	20	
Total Xylenes	ND	15						0	20	
trans-1,2-Dichloroethene	ND	5.0						0	20	
trans-1,3-Dichloropropene	ND	5.0						0	20	
1,1,1-Trichloroethane	ND	5.0						0	20	
1,1,2-Trichloroethane	ND	5.0						0	20	
Trichloroethene	ND	5.0						0	20	
Trichlorofluoromethane	ND	5.0						0	20	
Vinyl chloride	ND	5.0						0	20	
Surr: 1,2-Dichloroethane-d4	47		50.00		94.4	70	130	0	0	
Surr: 4-Bromofluorobenzene	54		50.00		108	70	130	0	0	
Surr: Dibromofluoromethane	43		50.00		86.5	70	130	0	0	
Surr: Toluene-d8	50		50.00		100	70	130	0	0	

Sample ID **1212427-001a ms**	SampType: **MS**	TestCode: **EPA Method 624 - VOCs**	
Client ID: **AT-Outfall**	Batch ID: **R7656**	RunNo: **7656**	
Prep Date:	Analysis Date: **12/20/2012**	SeqNo: **222370**	Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Benzene	120	5.0	100.0	0	116	37	151			
Bromodichloromethane	120	5.0	100.0	0	116	35	155			
Bromoform	90	5.0	100.0	0	89.5	45	169			
Bromomethane	110	5.0	100.0	0	111	5	242			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: 1212427

08-Jan-13

Client: New Mexico Copper Corp

Project: NMCC PWs

Sample ID **1212427-001a ms**	SampType: **MS**	TestCode: **EPA Method 624 - VOCs**	
Client ID: **AT-Outfall**	Batch ID: **R7656**	RunNo: **7656**	
Prep Date:	Analysis Date: **12/20/2012**	SeqNo: **222370**	Units: **µg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Carbon tetrachloride	100	5.0	100.0	0	102	70	140			
Chlorobenzene	110	5.0	100.0	0	114	37	160			
Chloroethane	110	5.0	100.0	0	106	14	230			
2-Chloroethyl-vinyl ether	130	5.0	400.0	0	31.9	5	305			
Chloroform	110	5.0	100.0	0	106	51	138			
Chloromethane	72	5.0	100.0	0	71.7	5	273			
cis-1,2-DCE	110	5.0	100.0	1.246	105	54	156			
cis-1,3-Dichloropropene	110	5.0	100.0	0	105	5	227			
Dibromochloromethane	100	5.0	100.0	0	101	53	149			
1,2-Dichlorobenzene	110	5.0	100.0	0	112	18	190			
1,3-Dichlorobenzene	110	5.0	100.0	0	114	59	156			
1,4-Dichlorobenzene	110	5.0	100.0	0	115	18	190			
1,1-Dichloroethane	110	5.0	100.0	0	106	59	155			
1,2-Dichloroethane	120	5.0	100.0	0	123	49	155			
1,1-Dichloroethene	120	5.0	100.0	0	123	5	234			
1,2-Dichloropropane	120	5.0	100.0	0	121	5	210			
Ethylbenzene	120	5.0	100.0	0	115	37	162			
Methylene chloride	110	5.0	100.0	0	107	5	221			
1,1,2,2-Tetrachloroethane	110	5.0	100.0	0	111	46	157			
Tetrachloroethene	110	5.0	100.0	0	106	64	148			
Toluene	120	5.0	100.0	0	116	47	150			
Total Xylenes	340	15	300.0	0	113	37	162			
trans-1,2-Dichloroethene	120	5.0	100.0	0	118	54	156			
trans-1,3-Dichloropropene	110	5.0	100.0	0	113	17	183			
1,1,1-Trichloroethane	110	5.0	100.0	0	110	52	162			
1,1,2-Trichloroethane	110	5.0	100.0	0	113	52	150			
Trichloroethene	110	5.0	100.0	0	107	71	157			
Trichlorofluoromethane	110	5.0	100.0	0	107	17	181			
Vinyl chloride	110	5.0	100.0	0	111	5	251			
Surr: 1,2-Dichloroethane-d4	170		150.0		112	70	130			
Surr: 4-Bromofluorobenzene	170		150.0		115	70	130			
Surr: Dibromofluoromethane	130		150.0		89.7	70	130			
Surr: Toluene-d8	170		150.0		114	70	130			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
P	Sample pH greater than 2	R	RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **mb-1** | SampType: **MBLK** | TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** | Batch ID: **R7500** | RunNo: **7500**
Prep Date: | Analysis Date: **12/13/2012** | SeqNo: **217465** | Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-1** | SampType: **LCS** | TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** | Batch ID: **R7500** | RunNo: **7500**
Prep Date: | Analysis Date: **12/13/2012** | SeqNo: **217466** | Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	81	20	80.00	0	102	88.1	104			

Sample ID **mb-2** | SampType: **MBLK** | TestCode: **SM2320B: Alkalinity**
Client ID: **PBW** | Batch ID: **R7500** | RunNo: **7500**
Prep Date: | Analysis Date: **12/13/2012** | SeqNo: **217479** | Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	ND	20								

Sample ID **lcs-2** | SampType: **LCS** | TestCode: **SM2320B: Alkalinity**
Client ID: **LCSW** | Batch ID: **R7500** | RunNo: **7500**
Prep Date: | Analysis Date: **12/13/2012** | SeqNo: **217480** | Units: **mg/L CaCO3**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Alkalinity (as CaCO3)	82	20	80.00	0	102	88.1	104			

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **MB**	SampType: **MBLK**	TestCode: **SM 5310B: TOC**								
Client ID: **PBW**	Batch ID: **R7499**	RunNo: **7499**								
Prep Date:	Analysis Date: **12/13/2012**	SeqNo: **217448**	Units: **mg/L**							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Organic Carbon, Total	ND	1.0								

Sample ID **LCS ST9060-12006**	SampType: **LCS**	TestCode: **SM 5310B: TOC**								
Client ID: **LCSW**	Batch ID: **R7499**	RunNo: **7499**								
Prep Date:	Analysis Date: **12/13/2012**	SeqNo: **217449**	Units: **mg/L**							
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Organic Carbon, Total	4.8	1.0	4.850	0	99.4	90	110			

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**
08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **MB-5294** SampType: **MBLK** TestCode: **SM2540C MOD: Total Dissolved Solids**
Client ID: **PBW** Batch ID: **5294** RunNo: **7590**
Prep Date: **12/17/2012** Analysis Date: **12/18/2012** SeqNo: **220447** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	20.0								

Sample ID **LCS-5294** SampType: **LCS** TestCode: **SM2540C MOD: Total Dissolved Solids**
Client ID: **LCSW** Batch ID: **5294** RunNo: **7590**
Prep Date: **12/17/2012** Analysis Date: **12/18/2012** SeqNo: **220448** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids	1010	20.0	1000	0	101	80	120			

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1212427**

08-Jan-13

Client: New Mexico Copper Corp
Project: NMCC PWs

Sample ID **MB-5246** SampType: **MBLK** TestCode: **SM 2540D: TSS**
Client ID: **PBW** Batch ID: **5246** RunNo: **7489**
Prep Date: **12/12/2012** Analysis Date: **12/13/2012** SeqNo: **217032** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Suspended Solids	ND	4.0								

Sample ID **LCS-5246** SampType: **LCS** TestCode: **SM 2540D: TSS**
Client ID: **LCSW** Batch ID: **5246** RunNo: **7489**
Prep Date: **12/12/2012** Analysis Date: **12/13/2012** SeqNo: **217033** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Suspended Solids	92	4.0	96.60	0	95.2	85.8178	113.8716			

Sample ID **1212427-001DDUP** SampType: **DUP** TestCode: **SM 2540D: TSS**
Client ID: **AT-Outfall** Batch ID: **5246** RunNo: **7489**
Prep Date: **12/12/2012** Analysis Date: **12/13/2012** SeqNo: **217040** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Suspended Solids	ND	4.0						0	15	

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH greater than 2
- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: NEW MEXICO COPPER CORP — Work Order Number: 1212427

Received by/date: MG 12/11/12

Logged By: Michelle Garcia 12/11/2012 8:42:00 AM *Michelle Garcia*

Completed By: Michelle Garcia 12/11/2012 10:11:32 AM *Michelle Garcia*

Reviewed By: [signature] 12/11/12

Chain of Custody

1. Were seals intact? Yes ☐ No ☐ Not Present ☑
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? Client

Log In

4. Coolers are present? (see 19. for cooler specific information) Yes ☑ No ☐ NA ☐
5. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
6. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
7. Sample(s) in proper container(s)? ~~Yes ☑~~ No ☑
8. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
9. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
10. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
11. VOA vials have zero headspace? Yes ☑ No ☐ No VOA Vials ☐
12. Were any sample containers received broken? Yes ☐ No ☑
13. Does paperwork match bottle labels? (Note discrepancies on chain of custody) Yes ☑ No ☐
14. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
15. Is it clear what analyses were requested? Yes ☑ No ☐
16. Were all holding times able to be met? (If no, notify customer for authorization.) Yes ☑ No ☐

# of preserved bottles checked for pH: 3, 1 (<2 or >12 unless noted)
Adjusted? NO
Checked by: [signature]

Special Handling (if applicable)

17. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified:		Date:	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

18. Additional remarks:

-001I, -001D - POURED OFF INTO PROPER CONTAINERS FROM EXTRA VOLUME (1L AMBER)

[signature] 12/11/12

19. Cooler Information

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	4.9	Good	Not Present			

Chain-of-Custody Record

Client: New Mexico Copper Corporation

Mailing Address: 2424 Louisiana Blvd
Ste 300 ABQ NM 87110

Phone #: 505·400·7925

email or Fax#: kemmer@themacresourcesgroup.com

QA/QC Package:
☐ Standard ☐ Level 4 (Full Validation)

Accreditation
☐ NELAP ☐ Other ______

☐ EDD (Type) ______

Turn-Around Time:
☒ Standard ☐ Rush______

Project Name: NMCC ~~[illegible]~~ PWs

Project #:

Project Manager: Katie Emmer

Sampler: Katie Emmer

[redacted]

HALL ENVIRONMENTAL ANALYSIS LABORATORY
www.hallenvironmental.com
4901 Hawkins NE - Albuquerque, NM 87109
Tel. 505-345-3975 Fax 505-345-4107

Analysis Request

Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	[redacted]	BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gas only)	TPH 8015B (GRO / DRO / MRO)	TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270 SIMS)	RCRA 8 Metals	Anions (F,Cl,NO_3,NO_2,PO_4,SO_4)	8081 Pesticides / 8082 PCB's	8260B (VOA)	8270 (Semi-VOA)	See lists attached				Air Bubbles (Y or N)
12·10·12	15:15	water	AT-Outfall	Glass amber bottles - 4		-001												X				
				VOAs - 5	2-HCl													X				
				small filter - 1	HNO_3													X				
				1-500ml	HNO_3													X				
				1-500ml plastic	NaOH													X				
				1 plastic	H_2SO_4													X				
				1·liter														X				

Date:	Time:	Relinquished by:	Received by:	Date	Time
12·11·12	842	Katie Emmer	Michelle Garcia	12/11/12	0842
Date:	Time:	Relinquished by:	Received by:	Date	Time

Remarks: Please use lowest MQL in all cases. Call Katie Emmer @ 505·400·7925 with any question

If necessary, samples submitted to Hall Environmental may be subcontracted to other accredited laboratories. This serves as notice of this possibility. Any sub-contracted data will be clearly notated on the analytical report.

APPENDIX A of PART II

The following Minimum Quantification Levels (MQL's) are to be used for reporting pollutant data for NPDES permit applications and/or compliance reporting.

POLLUTANTS	MQL µg/l	POLLUTANTS	MQL µg/l
METALS, RADIOACTIVITY, CYANIDE and CHLORINE			
Aluminum	2.5	Molybdenum	10
Antimony	60	Nickel	0.5
Arsenic	0.5	Selenium	5
Barium	100	Silver	0.5
Beryllium	0.5	Thalllium	0.5
Boron	100	Uranium	0.1
Cadmium	1	Vanadium	50
Chromium	10	Zinc	20
Cobalt	50	Cyanide	10
Copper	0.5	Cyanide, weak acid dissociable	10
Lead	0.5	Total Residual Chlorine	33
Mercury *1	0.0005 0.005		
DIOXIN			
2,3,7,8-TCDD	0.00001		
VOLATILE COMPOUNDS			
Acrolein	50	1,3-Dichloropropylene	10
Acrylonitrile	20	Ethylbenzene	10
Benzene	10	Methyl Bromide	50
Bromoform	10	Methylene Chloride	20
Carbon Tetrachloride	2	1,1,2,2-Tetrachloroethane	10
Chlorobenzene	10	Tetrachloroethylene	10
Clorodibromomethane	10	Toluene	10
Chloroform	50	1,2-trans-Dichloroethylene	10
Dichlorobromomethane	10	1,1,2-Trichloroethane	10
1,2-Dichloroethane	10	Trichloroethylene	10
1,1-Dichloroethylene	10	Vinyl Chloride	10
1,2-Dichloropropane	10		
ACID COMPOUNDS			
2-Chlorophenol	10	2,4-Dinitrophenol	50
2,4-Dichlorophenol	10	Pentachlorophenol	5
2,4-Dimethylphenol	10	Phenol	10
4,6-Dinitro-o-Cresol	50	2,4,6-Trichlorophenol	10

POLLUTANTS	MQL µg/l	POLLUTANTS	MQL µg/l
	BASE/NEUTRAL		
Acenaphthene	10	Dimethyl Phthalate	10
Anthracene	10	Di-n-Butyl Phthalate	10
Benzidine	50	2,4-Dinitrotoluene	10
Benzo(a)anthracene	5	1,2-Diphenylhydrazine	20
Benzo(a)pyrene	5	Fluoranthene	10
3,4-Benzofluoranthene	10	Fluorene	10
Benzo(k)fluoranthene	5	Hexachlorobenzene	5
Bis(2-chloroethyl)Ether	10	Hexachlorobutadiene	10
Bis(2-chloroisopropyl)Ether	10	Hexachlorocyclopentadiene	10
Bis(2-ethylhexyl)Phthalate	10	Hexachloroethane	20
Butyl Benzyl Phthalate	10	Indeno(1,2,3-cd)Pyrene	5
2-Chloronapthalene	10	Isophorone	10
Chrysene	5	Nitrobenzene	10
Dibenzo(a,h)anthracene	5	n-Nitrosodimethylamine	50
1,2-Dichlorobenzene	10	n-Nitrosodi-n-Propylamine	20
1,3-Dichlorobenzene	10	n-Nitrosodiphenylamine	20
1,4-Dichlorobenzene	10	Pyrene	10
3,3'-Dichlorobenzidine	5	1,2,4-Trichlorobenzene	10
Diethyl Phthalate	10		
	PESTICIDES AND PCBS		
Aldrin	0.01	Beta-Endosulfan	0.02
Alpha-BHC	0.05	Endosulfan sulfate	0.02
Beta-BHC	0.05	Endrin	0.02
Gamma-BHC	0.05	Endrin Aldehyde	0.1
Chlordane	0.2	Heptachlor	0.01
4,4'-DDT and derivatives	0.02	Heptachlor Epoxide	0.01
Dieldrin	0.02	PCBs	0.2
Alpha-Endosulfan	0.01	Toxaphene	0.3

(MQL's Revised November 1, 2007)

Footnotes:

*1 Default MQL for Mercury is 0.005 unless Part I of your permit requires the more sensitive Method 1631 (Oxidation / Purge and Trap / Cold vapor Atomic Fluorescence Spectrometry), then the MQL shall be 0.0005.

PART I – REQUIREMENTS FOR NPDES PERMITS

SECTION A. LIMITATIONS AND MONITORING REQUIREMENTS

1. FINAL Effluent Limits – 3.0 MGD

During the period beginning the effective date of the permit and lasting through the expiration date of the permit (unless otherwise noted), the permittee is authorized to discharge groundwater to Grayback Arroyo thence Greenhorn Arroyo thence to Caballo Reservoir, in Segment Number 20.6.4.98, from Outfall 001. Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS Standard Units		MONITORING REQUIREMENTS	
POLLUTANT	MINIMUM	MAXIMUM	MEASUREMENT FREQUENCY	SAMPLE TYPE
pH	6.6	9.0	Once/Week (*2)	Grab

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
	lbs/day, unless noted		ug/l, unless noted (*1)			
POLLUTANT	30-DAY AVG	DAILY MAX	30-DAY AVG	DAILY MAX	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow	Report MGD	Report MGD	***	***	Once/Week (*2)	Estimate (*3)
Arsenic, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Aluminum, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Cadmium, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Chromium, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Copper, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Lead, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Manganese, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Mercury, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Molybdenum, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Nickel, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Selenium, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Silver, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Thallium, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab
Zinc, dissolved	N/A	N/A	Report	Report	Once/Month (*2)	Grab

EFFLUENT CHARACTERISTICS	DISCHARGE MONITORING	EFFLUENT CHARACTERISTICS	DISCHARGE MONITORING
POLLUTANT	Single Grab Sample, ug/l	POLLUTANT	Single Grab Sample, ug/l
1,2-Dichlorobenzene		Nitrobenzene	
1,3-Dichlorobenzene		n-Nitrodimethylamine	
1,4-Dichlorobenzene		n-Nitrosodi-n-Propylamine	
3,3-Dichlorobenzidine		n-Nitrosodiphenylamine	
Diethyl Phthalate		Pyrene	
Dimethyl Phthalate		1,2,4-Trichlorobenzene	
Dibutyl Phthalate		Aldrin	
2,4-Dinitrotoluene		Alpha-BHC	
1,2-Diphenylhydrazine		Beta-BHC	
Fluoranthene		Gamma-BHC	
Fluorene		Chlordane	
Hexachlorobenzene		4, 4'-DDT and derivatives	
Hexachlorobutadiene		Dieldrin	
Hexachlorocyclopentadiene		Alpha-Endosulfan	
Hexachloroethane		Beta-Endosulfan	
Indeno (1,2,3-cd)Pyrene		Endosulfan sulfate	
Isophorone		Endrin	

Footnotes:

*1 See **Appendix A of Part II** of the permit for minimum quantification limits.

2. Human Health Testing Requirements

Discharges from industrial facilities for permits issued to protect NMWQS human health pollutants are required to be analyzed. The following pollutants need to be sampled ONE-TIME during the first discharge, analyzed and reported with the DMR on a separate form.

EFFLUENT CHARACTERISTICS	DISCHARGE MONITORING	EFFLUENT CHARACTERISTICS	DISCHARGE MONITORING
POLLUTANT	Single Grab Sample, ug/l (*1)	POLLUTANT	Single Grab Sample, ug/l (*1)
Antimony (dissolved)		Vinyl Chloride	
Cyanide, weak acid dissociable		2-Chlorophenol	
2,3,7,8-TCDD (Dioxin)		2,4-Dichlorophenol	
Acrolein		2,4-Dimethylphenol	
Acrylonitrile		2-Methyl-4	
Benzene		6-Dinitrophenol	
Bromoform		2,4-Dinitrophenol	
Carbon Tetrachloride		Pentachlorophenol	
Chlorobenzene		Phenol	
Clorodibromomethane		2,4,6-Trichlorophenol	
Chloroform		Acenaphthene	
Dichlorobromomethane		Anthracene	
1,2-Dichloroethane		Benzidine	
1,1-Dichloroethylene		Benzidine	
1,2-Dichloropropane		Benzo(a)anthracene	
1,3-Dichloropropene		Benzo(a)pyrene	
Ethylbenzene		Benzo(b)fluoranthene	
Methyl Bromide		Benzo(k)fluoranthene	
Methylene Chloride		Bis (2-chloroethyl) Ether	
1,1,2,2-Tetrachloroethane		Bis (2-chloroisopropyl) Ether	
Tetrachloroethylene		Bis (2-ethylhexyl) Phthalate	
Toluene		Butyl Benzyl Phthalate	
1,2--trans-Dichloroethylene		2-Chloronapthalene	
1,1,2-Trichloroethane		Chrysene	
Trichloroethylene		Dibenzo(a,h)anthracene	

Table 9-3
Analytical Parameters and Analysis Methods for Groundwater Samples

Analytical Parameter	Analysis Method	Lab Detection Limit (mg/L unless noted)
Anions		
Fluoride	EPA Method 300.0	0.1
Chloride	EPA Method 300.0	0.1
Nitrogen, Nitrite (as N)	EPA Method 300.0	0.1
Nitrogen, Nitrate (as N)	EPA Method 300.0	0.1
Sulfate	EPA Method 300.0	0.5
Dissolved Metals		
Aluminum	EPA Method 200.7	0.02
Antimony	EPA Method 200.8	0.005
Arsenic	EPA Method 200.8	0.02
Barium	EPA Method 200.7	0.002
Beryllium	EPA Method 200.7	0.002
Boron	EPA Method 200.7	0.04
Cadmium	EPA Method 200.7	0.002
Calcium	EPA Method 200.7	0.50
Chromium	EPA Method 200.7	0.006
Cobalt	EPA Method 200.7	0.006
Copper	EPA Method 200.7	0.0003
Iron	EPA Method 200.7	0.02
Lead	EPA Method 200.7	0.005
Magnesium	EPA Method 200.7	0.50
Manganese	EPA Method 200.7	0.002
Mercury	EPA Method 7470 CVAA	0.0002
Molybdenum	EPA Method 200.7	0.008
Nickel	EPA Method 200.7	0.01
Potassium	EPA Method 200.7	1.0
Selenium	EPA Method 200.8	0.02
Silicon	EPA Method 200.7	0.08
Silver	EPA Method 200.7	0.005
Sodium	EPA Method 200.7	0.5

Analytical Parameter	Analysis Method	Lab Detection Limit (mg/L unless noted)
Thallium	EPA Method 200.7	0.01
Titanium	EPA Method 200.7	0.005
Uranium	EPA Method 200.8	0.01
Vanadium	EPA Method 200.7	0.005
Zinc	EPA Method 200.7	0.005
Solids		
Total Suspended Solids (TSS)	SM 2540D	1.0 µg/L
Total Dissolved Solids (TDS)	SM 2540C	10
Alkalinity		
Alkalinity, total (as $CaCO_3$)	SM 2320B	20
Carbonate	SM 2320B	20
Bicarbonate	SM 2320B	20
Other		
pH	150.1	12.45
Specific Conductance	120.1	0.01 µS/cm
Cyanide	Kelada-01	0.005

Note: NA = not applicable as sample will not be analyzed for a given parameter.

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Whole Effluent Toxicity Testing Report

THEMAC Resources Group, Ltd.

Submitted to:
Jens Deichmann
THEMAC Resources Group, Ltd.
2425 San Pedro Dr NE Suite 100
Albuquerque, NM 87110

Submitted by:
GEI Consultants, Inc.
Ecological Division
4601 DTC Boulevard, Suite 900
Denver, CO 80237

December 17, 2012
Project 121590

1.0 Test Summary

Enclosed are the results of the acute *Daphnia pulex* and *Pimephales promelas* tests performed December 11 to 13, 2012 for site PW groundwater. Acute toxicity test procedures followed methods described in your permit (NM0031101) and EPA documentation (EPA 2002).

The very hard reconstituted water control in the acute *D. pulex* test did not meet the performance criteria (90% or greater survival). The moderately hard reconstituted water control did meet the performance criteria; therefore, it was used for statistical analyses. No toxicity was detected in the acute *D. pulex* test.

No toxicity was detected in the acute *P. promelas* test and control performance criteria were met.

Report approved by:

Sarah Skigen, Laboratory Director

Natalie Love, Laboratory Manager

2.0 Test Conditions

2.1 *Daphnia pulex* 48-hour acute toxicity test

Method: EPA-821-R-02-012 -- Methods for measuring the acute toxicity of effluents . . .

Test Duration: 48 hours

Sample Collection Procedure: grab

Sample Collection Date: 12/10/12

Dilution water: very hard reconstituted water

Acclimation: cultured in moderately hard reconstituted water

Age of organisms at start: <24 hr. old

Feeding: none

End Point: mortality

Start date and time: 12/11/12 14:00

End date and time: 12/13/12 13:40

Type of exposure chamber: 60 mL disposable plastic cup

Volume of exposure chamber: 25 mL

Number of animals exposed/chamber: 8

Number of replicates/treatment: 5

Test temperature: 20.0°C ± 1.0°C

Standard toxicant used: NaCl

2.2 *Pimephales promelas* 48-hour acute toxicity test

Method: EPA-821-R-02-012 -- Methods for measuring the acute toxicity of effluents . . .

Test Duration: 48 hours

Sample Collection Procedure: grab

Sample Collection Date: 12/10/12

Dilution water: very hard reconstituted water

Age of organisms at start: 7 day old

Feeding: none

End Point: mortality

Start date and time: 12/11/12 11:55

End date and time: 12/13/12 11:15

Type of exposure chamber: 9 oz. disposable plastic cup

Volume of exposure chamber: 200 mL

Number of animals exposed/chamber: 8

Number of replicates/treatment: 5

Test temperature: 20.0°C ± 1.0°C

Standard toxicant used: NaCl

3.0 QA/QC Summary

Client: THEMAC Resources Group, Ltd.

Chain of custody received complete .... Yes

Samples received within holding times .... Yes

Samples at correct temperature (0-6°C) .... Yes

Control performance criteria met (Table 1) .... Yes

Valid concentration dose response .... Yes

Table 1: Control performance criteria requirements.

Test Species	Survival	
	Test %	Acceptable %
D. pulex	95*	90
P. promelas	97.5	90

*Moderately hard reconstituted water control used for statistical analysis.

4.0 Results

4.1 *Daphnia pulex* Acute Toxicity Test

TEST: Acute 48-hour with *Daphnia pulex* OPERATORS: JD, JC

Start: 12/11/12 14:00
End: 12/13/12 13:40
Test Substance: Site PW Groundwater
Client/Project: THEMAC Resources Group, Ltd.

Table 2: Summary results of *D. pulex* acute toxicity test

Treatment % Effluent	0	32	42	56	75	100	MH*
#alive/#exposed	32/40	39/40	38/40	35/40	36/40	36/40	38/40
% survival	80	97.5	95	87.5	90	90	95
Dissolved O_2 range (mg/L)	7.1 7.0	7.1 7.0	7.0 7.0	7.0 7.0	7.0 7.0	7.1 6.9	7.1 7.1
pH range	8.72 8.64	8.69 8.65	8.68 8.65	8.65 8.62	8.66 8.57	8.62 8.55	8.30 8.23
Conductivity range (µmho/cm)	1070 1051	926 894	835 834	758 757	651 635	447 437	397 387
Temperature range (°C)	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0

*Moderately hard reconstituted water control used for statistical analysis.

Statistical Analysis:

LC_{50} (Probit) = >100% Effluent

4.2 *Pimephales promelas* Acute Toxicity Test

TEST: Acute 48-hour with *Pimephales promelas* OPERATORS: JD, JC

Start: 12/11/12 11:55
End: 12/13/12 11:15
Test Substance: Site PW Groundwater
Client/Project: THEMAC Resources Group, Ltd.

Table 3: Summary results of *P. promelas* acute toxicity test

Treatment % Effluent	0	32	42	56	75	100	MH
#alive/#exposed	39/40	40/40	40/40	40/40	40/40	39/40	35/40
% survival	97.5	100	100	100	100	97.5	87.5
Dissolved O_2 range (mg/L)	6.8 6.7	6.7 6.6	6.7 6.6	6.7 6.6	6.6 6.5	6.7 6.4	6.7 6.7
pH range	8.66 8.52	8.60 8.49	8.57 8.50	8.52 8.47	8.54 8.44	8.49 8.41	8.37 8.03
Conductivity range (µmho/cm)	1057 1035	901 853	833 807	741 725	616 565	438 426	422 370
Temperature range (°C)	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0	20.0 20.0

Statistical Analysis:

LC_{50} (Probit) = >100% Effluent

4.3 Water Chemistry Results from Samples Received for Acute Toxicity Tests

Table 4: Wet chemistry on reconstituted waters and effluent samples used for acute toxicity tests.

Measurement	Very Hard Recon	Moderately Hard Recon	100% Effluent
Analysis Temperature °C	25.0	25.0	20.0
Total Hardness (mg $CaCO_3$/L)	332	104	82
pH	8.41	8.46	7.75
Alkalinity (mg $CaCO_3$/L)	230	68	140
Conductivity (µmho/cm)	991	350	397
Total Dissolved Solids (mg/L)	--	--	195
Dissolved Oxygen (mg/L)	6.9	6.9	7.2
Ammonia (mg NH_3/L)	--	--	0.05
Un-ionized Ammonia (mg NH_3/L)	--	--	<0.10
Total Residual Chlorine (mg/L)	--	--	<0.02
Monochloramine (mg/L)	--	--	0.20

4.4 Summary Results of Reference Toxicant Tests

Table 5: Acute *Daphnia pulex* reference toxicant test with NaCl, conducted December 4 to 6, 2012.

g NaCl/L	Control	1.0	1.5	2.0	2.5	3.0
#alive/#exposed	19/20	20/20	15/20	15/20	4/20	3/20
% survival	95	100	75	75	20	15

Survival:

LC_{50} (Spearman-Kärber) = 2.15 g NaCl/L (95% C.I. 1.87 to 2.39)

Note: This is within our accepted performance range (1.78 to 2.80) determined by 9 previous reference tests performed.

Table 6: Acute *Pimephales promelas* reference toxicant test with NaCl, conducted November 13 to 17, 2012.

g NaCl/L	Control	5.0	6.0	7.0	8.0	9.0
#alive/#exposed	40/40	40/40	36/40	32/40	6/40	0/40
% survival	100	100	90	80	15	0

Survival:

96 hour LC_{50} (Trimmed Spearman-Kärber) = 7.29 g NaCl/L (95% C.I. 7.08 to 7.49)

Note: This is within our accepted performance range (6.51 to 8.03) determined by 20 previous reference tests performed.

5.0 References

Hamilton, M.A., R.C. Russo, and R.V. Thurston. 1977. Trimmed Spearman-Kärber method for estimating median lethal concentrations in toxicity bioassays. *Environmental Science & Technology*. 11:714-719; correction 12:417 (1978).

Tidepool Scientific Software. 2000-2011. CETIS - Comprehensive Environmental Toxicity Information System. V1.8.4.4. McKinleyville, CA.

U.S. Environmental Protection Agency (EPA). 2002. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. EPA-821-R-02-013. Office of Water, Washington D.C.

Appendix A

Chain-of-custody forms and laboratory bench sheets from whole effluent toxicity tests

GEI Consultants, Inc./Ecological Division
4601 DTC BLVD., SUITE L100
DENVER, CO 80237
Main: (303) 662-0100 Lab: (303) 264-1120

NM1212

BIOASSAY LABORATORY CHAIN-OF-CUSTODY

CLIENT/PROJECT New Mexico Copper
ADDRESS 2424 Louisiana Blvd NE Ste 300
CITY Albuquerque STATE NM
ZIP 87110 PHONE # 505-400-7925
PROJ. MANAGER K. Emmer SAMPLER K. Emmer

TESTS REQUIRED

CHLORINE
Measured by:
Client ☐
Lab ☑

SAMPLE TYPE/SITE	Date Collected	Time Collected	ACUTE: CERIO	ACUTE: FATHEAD	ACUTE: DAPHNIA	ACUTE: TROUT	CHRONIC: CERIO	CHRONIC: FATHEAD	CHRONIC: ALGAE	CHRONIC: OTHER	TRC (mg/L)	Date/Time Measured	COMMENTS
NMCC PWS											<0.02	12-11-12 1035	Please test per
AI Outfall	12-10-12	15:15		X	X								NMCC NPDES
													& call K. Emmer
													w/ questions

PROJECT INFORMATION	RECEIVING INFORMATION
COURIER:	CONDITION: ~~0.5~~ OK
TOTAL NUMBER OF CONTAINERS:	TEMPERATURE (°C): 0.5
COMMENTS: custody seal broken, but doesn't appear to be due to tampering	

CLIENT RELINQUISHED BY: Katie Lee Emmer
DATE/TIME: 15:15 12-10-12

LABORATORY RECEIVED BY: [signature]
DATE/TIME: 12-11-12 10:25

1300 Blue Spruce Drive, Suite C
Fort Collins, Colorado 80524

AQUATIC BIO SYSTEMS
ABS
INC.

Toll Free: 800/331-5916
Tel: 970/484-5091 Fax:970/484-2514

[redacted]

NM1212

ORGANISM HISTORY

DATE: 12/10/2012

SPECIES: *Pimephales promelas*

AGE: 6 day

LIFE STAGE: Larvae

HATCH DATE: 12/4/2012

BEGAN FEEDING: 12/5/2012

FOOD: *Artemia* sp.

Water Chemistry Record:	Current	Range
TEMPERATURE:	24°C	--
SALINITY/CONDUCTIVITY:	--	--
TOTAL HARDNESS (as $CaCO_3$):	138 mg/l	--
TOTAL ALKALINITY (as $CaCO_3$):	85 mg/l	--
pH:	8.10	--

Comments:

Facility Supervisor

INITIAL CHEMISTRY BENCH SHEET

Client/Project: NM Copper NM1212 Samples Received: Date/Time 12-11-12 1025

Test Substance: Effluent What test/s will samples be used in? Ac D.p, P.promelas Dilution Water: (lab water) or receiving water

SAMPLE TYPE LOG NUMBER DATE COLLECTED	DATE/TIME ANALYZED	DATES USED	ANALYSES TEMP. °C	TOTAL HARDNESS mg/L	pH	TOTAL ALKALINITY mg/L	D.O. mg/L	COND. µS	TDS mg/L	TRC mg/L	AMMONIA mg/L	MONO-CHLORAMINE mg/L	ANALYST
Site PW Groundwater NM1212 12-10-12	12-11-12 1100	12-11-12 to 12-12-12	20.0	4.1 82	7.75	7.0 140	7.2	397	195	<0.02	0.05	0.20	JD

Site Daily measurements	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
pH / initials	7.75 / JD	8.02 / JC					
pH / initials							
pH / initials							
pH / initials							

COMMENTS:

Samples stored in refrigerator:

Data Checked and Approved by Laboratory Manager (Initials): NL

RECONSTITUTED SYNTHETIC LABORATORY WATER CHEMISTRY BENCH SHEET

Client/Project: NM Copper NM 12 12

Test Substance: Effluent

What test/s will samples be used in? Ac FH/DP

Analyst: AG

BATCH #	ANALYSES TEMP. °C	TOTAL HARDNESS mg/L	pH	TOTAL ALKALINITY mg/L	D.O. mg/L	COND. µS
MH 226	25.0	104	8.46	68	6.9	350
VH014	25.0	332	8.41	230	6.9	991
AVERAGE VALUE						

COMMENTS:

Data Checked and Approved by Laboratory Manager (Initials): NL

A[...]TE TOXICITY CHEMISTRY BENCH [...]ET

START Date 12/~~13~~ 11/12 FINISH Date 12/13/12

Dilution Water: VH Recon Test Substance: Well water

Client/Project: NM Copper NM 1212 Organism: D. pulex

Test Concentration	Chemical	Day of Test 1	2	3	4	
0	DO (mg/L)	7.1	7.0			
	Cond. (µS)	JD ~~387~~ 1051	1070			
	pH	8.72	8.64			
	Temp. (°C)	20.0	20.0			
32	DO (mg/L)	7.1	7.0			
	Cond. (µS)	JD ~~1051~~ 894	926			
	pH	8.69	8.65			
	Temp. (°C)	20.0	20.0			
42	DO (mg/L)	7.0	7.0			
	Cond. (µS)	834	835			
	pH	8.68	8.65			
	Temp. (°C)	20.0	20.0			
56	DO (mg/L)	7.0	7.0			
	Cond. (µS)	758	757			
	pH	8.65	8.62			
	Temp. (°C)	20.0	20.0			
75	DO (mg/L)	7.0	7.0			
	Cond. (µS)	651	635			
	pH	8.66	8.57			
	Temp. (°C)	20.0	20.0			
100	DO (mg/L)	7.1	6.9			
	Cond. (µS)	447	437			
	pH	8.62	8.55			
	Temp. (°C)	20.0	20.0			
MH	DO (mg/L)	7.1	7.1			
	Cond. (µS)	387	397			
	pH	8.23	8.30			
	Temp. (°C)	20.0	20.0			
Incubator Temperature (°C)		20.0	20.0			
ANALYST		JD	JD			
TIME ANALYZED		1330	1425			

Data Checked and Approved by Laboratory Manager (Initials): NL

ACUTE TOXICITY CHEMISTRY BENCH SHEET

START Date 12/11/12 FINISH Date 12/13/12

Dilution Water: VH Recon Test Substance: Well water

Client/Project: NM Copper NM Organism: P. promelas

Test Concentration	Chemical	Day of Test 1	2	3	4	
0	DO (mg/L)	6.8	6.7			
	Cond. (µS)	1057	JD ~~370~~ 1035			
	pH	8.~~63~~52	8.66			
	Temp. (°C)	20.0	20.0			
32	DO (mg/L)	6.7	6.6			
	Cond. (µS)	901	853			
	pH	8.49	8.60			
	Temp. (°C)	20.0	20.0			
42	DO (mg/L)	6.7	6.6			
	Cond. (µS)	833	807			
	pH	8.50	8.57			
	Temp. (°C)	20.0	20.0			
56	DO (mg/L)	6.7	6.6			
	Cond. (µS)	741	725			
	pH	8.47	JD ~~6.~~ 8.52			
	Temp. (°C)	20.0	20.0			
75	DO (mg/L)	6.5	6.6			
	Cond. (µS)	616	565			
	pH	8.44	8.54			
	Temp. (°C)	20.0	20.0			
100	DO (mg/L)	6.4	6.7			
	Cond. (µS)	438	426			
	pH	8.41	8.49			
	Temp. (°C)	20.0	20.0			
MH	DO (mg/L)	6.7	6.7			
	Cond. (µS)	422	370			
	pH	8.03	8.37			
	Temp. (°C)	20.0	20.0			
Incubator Temperature (°C)		20.0	20.0			
ANALYST		JC	JD			
TIME ANALYZED		1230	1150			

Data Checked and Approved by Laboratory Manager (Initials): NL

ACUTE TOXICITY TEST BENCH SHEET

START Date/Time 12-11-12 [illegible]00
Dilution Water: VH Recon
Client/Project: NM Copper NM1212

FINISH Date/Time 12/13/12 1340
Test Substance: Well water
Species: D. pulex

CONCENTRATION & REPLICATE		Number alive/hour of test: Start	24 hr.	48 hr.	72 hr.	96 hr.	# alive / # exposed (% survival)	COMMENTS
0	A	8	6	5			32/40	
	B	8	8	7				
	C	8	8	8			80%	
	D	8	7	6				
	E	8	8	6				
32	A	8	8	8			39/40	
	B	8	8	8				
	C	8	8	8			97.5	
	D	8	8	8				
	E	8	8	7				
42	A	8	~~X7~~ 8	8			38/40	
	B	8	8	8				
	C	8	8	7			95%	
	D	8	8	8				
	E	8	8	7				
56	A	8	7	~~10~~ ~~6~~ 7			35/40	
	B	8	7	7				
	C	8	8	7			87.5%	
	D	8	8	7				
	E	8	7	7				
75	A	8	8	8			36/40	
	B	8	8	7				
	C	8	8	8			90%	
	D	8	8	7				
	E	8	8	6				
100	A	8	8	8			36/40	
	B	8	7	6				
	C	8	8	8			90%	
	D	8	7	7 ~~8~~ JD				
	E	8	7	7				
MH	A	8	8	7			38/40	
	B	8	7	7			95%	
	C	8	8	8				
	D	8	8	8				
	E	8	8	8				
ANALYST		JD	JL	JD			template #5	
TIME FED		1130	–	–				
TIME RENEWED		1400	1250	1340				

Data Checked and Approved by Laboratory Manager (Initials): NL

ACUTE TOXICITY TEST BENCH SHEET

START Date/Time 12-11-12 11[illegible]
Dilution Water: VH Recon
Client/Project: NM Copper NM1212

FINISH Date/Time 12/13/12 1115
Test Substance: 3/4 Well water
Species: P. promelas

CONCENTRATION & REPLICATE		Start	24 hr.	48 hr.	72 hr.	96 hr.	# alive / # exposed (% survival)	COMMENTS
0	A	8	8	8			39/40 97.5%	
	B	8	8	8				
	C	8	8	8				
	D	8	8	8				
	E	8	7	7				
32	A	8	8	8			40/40 100%	
	B	8	8	8				
	C	8	8	8				
	D	8	8	8				
	E	8	8	8				
42	A	8	8	8			40/40 100%	
	B	8	8	8				
	C	8	8	8				
	D	8	8	8				
	E	8	8	8				
56	A	8	8	8			40/40 100%	
	B	8	8	8				
	C	8	8	8				
	D	8	8	8				
	E	8	8	8				
75	A	8	8	8			40/40 100%	
	B	8	8	8				
	C	8	8	8				
	D	8	8	8				
	E	8	8	8				
100	A	8	8	8			39/40 97.5%	
	B	8	8	8				
	C	8	~~8~~ JC 7	7				
	D	8	8	8				
	E	8	8	8				
MH	A	8	~~8~~ JC 3	3			35/40 87.5%	
	B	8	8	8				
	C	8	8	8				
	D	8	8	8				
	E	8	8	8				
ANALYST		JD	JC	JD			template #29	
TIME FED		820	~~1145~~ JC —	—				
TIME RENEWED		1155	1145	1115				

Data Checked and Approved by Laboratory Manager (Initials): NL

07908

Daphnia pulex 48-h Acute Survival Test — **GEI Consultants, Inc**

Batch ID:	19-8251-8199	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	11 Dec-12 14:00	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Very Hard Synthetic Water
Ending Date:	13 Dec-12 13:40	**Species:**	Daphnia pulex	**Brine:**	
Duration:	48h	**Source:**	In-House Culture	**Age:**	

Sample ID:	18-0168-1932	**Code:**	NM1212	**Client:**	New Mexico Copper
Sample Date:	10 Dec-12 15:15	**Material:**	POTW Effluent	**Project:**	WET Quarterly Compliance Test (4Q)
Receive Date:	11 Dec-12 10:25	**Source:**	NPDES Permit #NM-0031101		
Sample Age:	23h (0.5 °C)	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-6974-4196	48h Survival Rate	100	>100	NA	20.8%	1	Dunnett Multiple Comparison Test

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
11-6974-4196	48h Survival Rate	Control Resp	0.8	0.9 - NL	Yes	Below Acceptability Criteria

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	5	0.8	0.74678	0.85322	0.625	1	0.063738	0.14252	17.82%	0.0%
0	Lab Water	5	0.95	0.92443	0.97557	0.875	1	0.030619	0.068465	7.21%	-18.75%
32		5	0.975	0.95413	0.99587	0.875	1	0.025	0.055902	5.73%	-21.88%
42		5	0.95	0.92443	0.97557	0.875	1	0.030619	0.068465	7.21%	-18.75%
56		5	0.875	0.842	0.908	0.75	1	0.039528	0.088388	10.1%	-9.38%
75		5	0.9	0.86095	0.93905	0.75	1	0.046771	0.10458	11.62%	-12.5%
100		5	0.9	0.86095	0.93905	0.75	1	0.046771	0.10458	11.62%	-12.5%

CETIS Summary Report

Report Date: 19 Dec-12 10:42 (p 1 of 1)
Test Code: 67984778 | 17-3803-3016

Fathead Minnow 48-h Acute Survival Test — **GEI Consultants, Inc**

Batch ID:	09-7417-7232	**Test Type:**	Survival (48h)	**Analyst:**	
Start Date:	11 Dec-12 11:55	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Very Hard Synthetic Water
Ending Date:	13 Dec-12 11:15	**Species:**	Pimephales promelas	**Brine:**	
Duration:	47h	**Source:**	Aquatic Biosystems, CO	**Age:**	

Sample ID:	15-5003-3059	**Code:**	NM1212	**Client:**	New Mexico Copper
Sample Date:	10 Dec-12 15:15	**Material:**	POTW Effluent	**Project:**	WET Quarterly Compliance Test (4Q)
Receive Date:	11 Dec-12 10:25	**Source:**	NPDES Permit #NM-0031101		
Sample Age:	21h (0.5 °C)	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
04-3579-3447	48h Survival Rate	100	>100	NA	5.56%	1	Steel Many-One Rank Sum Test

48h Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	5	0.975	0.95413	0.99587	0.875	1	0.025	0.055902	5.73%	0.0%
0	Lab Water	5	0.875	0.77063	0.97937	0.375	1	0.125	0.27951	31.94%	10.26%
32		5	1	1	1	1	1	0	0	0.0%	-2.56%
42		5	1	1	1	1	1	0	0	0.0%	-2.56%
56		5	1	1	1	1	1	0	0	0.0%	-2.56%
75		5	1	1	1	1	1	0	0	0.0%	-2.56%
100		5	0.975	0.95413	0.99587	0.875	1	0.025	0.055902	5.73%	0.0%

Analyst: AO QA: NL

THEMAC RESOURCES

August 26, 2013

Dorothy Brown, 6WQ-NP
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Suite 1200
Dallas, TX 75202-2733

GROUND WATER
AUG 28 2013
BUREAU

Re: New Mexico Copper Corporation NPDES Permit No. NM0031101

Dear Ms. Brown,

With this letter we are requesting early termination of the NPDES permit No. NM0031101 as we will not discharge at this location again between now and June 30, 2014. We recently received correspondence from your office indicating we should consider renewing our permit if we need it and when I called Jenaie Frank to let her know we would like to terminate this permit she advised that I write to you. We would like to close the permit as soon as possible. Please let me know whether you can terminate the permit early based our request.

Also, please note that our address has changed. Additional correspondence should be sent to:

New Mexico Copper Corporation
Attention: Katie Emmer
2424 Louisiana Blvd. NE
Suite 301
Albuquerque, NM 87110

Thank you again for your time and direction in this matter.

Sincerely,

Katie Emmer

Katie Emmer
Project Scientist

CC: Kurt Vollbrecht and Brad Reid, New Mexico Environment Department

Reid, Brad, NMENV

From: Ehlert, Keith W., NMENV
Sent: Wednesday, September 25, 2013 3:13 PM
To: Schoeppner, Jerry, NMENV; Martinez, Fernando, EMNRD; Shepherd, Holland, EMNRD; Reid, Brad, NMENV; Eustice, Chris, EMNRD; Menzie, David, NMENV
Subject: Comemnts-Copper Flat Baseline Data Report Addendum
Attachments: DP1 AmdBDR comments 09-25-2013.docx

Attached.

Keith Ehlert
(505) 827-9687

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 5469, Santa Fe, NM 87502-5469
Phone (505) 827-2918 Fax (505) 827-2965
www.nmenv.state.nm.us

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

RYAN FLYNN
Secretary - Designate

BUTCH TONGATE
Deputy Secretary

MEMORANDUM

DATE: September 25, 2013

TO: Holland Shepherd, Program Manager, Mining Act Reclamation Program

FROM: Brad Reid, NMED Mining Environmental Compliance Section (MECS)

THROUGH: Keith Ehlert, NMED MECS, Acting Mining Act Team Leader
Kurt Vollbrecht, NMED MECS, Acting Program Manager KV

RE: Comments on Copper Flat Mine, Baseline Data Report Addendum, Permit No. SI027RN

The New Mexico Environment Department (NMED) Ground Water Quality Bureau received the New Mexico Copper Corporation (NMCC) Baseline Data Report Addendum, Permit No. SI027RN, from the New Mexico Mining and Minerals Division (MMD) on July 24, 2013. In addition, NMCC hand delivered the document titled, "Geochemical Characterization Report for the Copper Flat Project, New Mexico," also considered part of the Amended Baseline Data Report (BDR), to NMED on June 13, 2013. NMCC further anticipates adding to the Amended BDR additional documents as they become available for release; namely, documents titled, "Predictive Geochemical Modeling of the Pit Lake Water Quality at the Copper Flat Project, New Mexico" (to be prepared by SRK Consulting) and "Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico" (to be prepared by John Shomaker and Associates, Inc., "JSAI"). MMD requested that NMED provide comments within 60 days of receipt of the Amended BDR (i.e., by September 23, 2013). At the request of NMED, the comment period was extended to September 27, 2013. NMED has reviewed the Amended BDR and provides the following comments.

NMED Ground Water Quality Bureau and Surface Water Quality Bureau have reviewed the Amended BDR and are submitting comments jointly in this memorandum.

GROUND WATER QUALITY BUREAU COMMENTS

General Comments

The docs have been submitted as part of the DP App

The amended BDR as submitted will be incorporated into the administrative record for DP-1. Technical review of the BDR and amended BDR pursuant to the Water Quality Control Commission (WQCC) Regulations is ongoing, and NMED may have additional comments during subsequent drafting of the Ground Water Discharge Permit. Comments pertaining to the Geochemical Characterization Report and the other forthcoming reports mentioned above will be submitted under separate letterhead directly to NMCC with a copy to MMD as these reports are critical to development of the draft Ground Water Discharge Permit. NMED will coordinate response to these documents with MMD prior to issuance of a comment letter(s) to NMCC.

While it is appropriate that NMCC utilized the existing water well and/or monitoring well network at the facility to collect background water quality data for purposes of fulfilling BDR objectives, many of the wells are not properly constructed to monitor for potential impacts from mine operations. Consequently, as part of the Discharge Permit, NMED will require installation of additional monitoring wells prior to initiation of the operational phase of the mine. Table 1 is a summary evaluation of existing monitoring wells proposed by NMCC for incorporation into the monitoring well network for the operational phase of Copper Flat Mine. These wells are proposed in the document titled, "Proposed Monitoring Well Network for the Copper Flat Mine," submitted to NMED on April 5, 2013 by NMCC and prepared by JSAI.

TABLE 1. Existing Monitoring Wells Proposed as Part of Copper Flat Monitoring Plan

MW ID	TD	Screened Interval	Screen Length	Geologic Unit	Current DTW	Comments
GWQ96-22A	244	174 to 244	70	andesite	55	Intended to be upgradient of the pit. Screened too deep and screen length is too long to be an effective MW to monitor for potential impacts from mine operations. As pit is dewatered, may become a better suited monitoring point. Can be useful to verify pit is a hydrologic sink.
GWQ96-22B	380	340 to 380	40	andesite	55	Intended to be upgradient of the pit. Screened too deep to be an effective MW to monitor for potential impacts from mine operations. As pit is dewatered, may become a better monitoring point. Can be useful to verify pit is a hydrologic sink.
GWQ96-23B	251	150 to 250	100	quartz monzonite	41	Screened too deep and screen length too long to be an effective ground water quality monitoring point. Can be used to verify the hydrology of the pit. GWQ96-23A - not in the proposal - screened at a better interval for GW quality monitoring as pit is dewatered.
GWQ11-24A	90	60 to 90	30	quartz monzonite	50	This MW is adequate.
GWQ11-24B	250	230 to 250	20	quartz monzonite	57	This MW is adequate.
GWQ11-26	43	23 to 43	20	alluvium	39	This MW is adequate; however, it currently contains only 2 feet of water so may go dry.
GWQ-1	391	100 to 391	291	Santa Fe Group	5	Not an approvable MW; screened too deep and screen length is too long. Not constructed as a MW (i.e., supply well) and location is not ideal.
GWQ-5R	120	80 to 120	40	andesite	99	Intended to be downgradient of proposed Plant Site Runoff Evaporation Pond and Reclaim Water Reservoir. Located ~750 ft. SE and downgradient of these units which may be too far away for ground water monitoring.
GWQ-8	148	81 to 148	67	Santa Fe Group	7	Old windmill supply well. Not constructed as a MW. Screened interval is too long and too deep.
GWQ-12	137	unknown	unknown	Santa Fe Group	80	Screened interval unknown so hard to evaluate it for use as a MW. Suggest video log of the borehole to ascertain screened interval/depth. Location is adequate.

Specific Comments

Section E – John Shomaker & Associated Technical Memorandum

MMD #4/NMCC #22 resolution: As monitoring well GWQ-5R is intended to monitor water quality in the crystalline bedrock (andesite) aquifer, it follows that there is not an adequate well in the vicinity of GWQ-5R to monitor water quality in the shallow alluvial aquifer within Grayback Arroyo. NMED will require installation of additional monitoring wells to monitor water quality in the shallow alluvial aquifer within Grayback Arroyo as part of the Discharge Permit.

MMD #5/NMCC #24 through #27 resolution, part b) Grayback alluvium: With the exception of GWQ11-26, none of the other monitoring wells referenced in this response (i.e., GWQ-1, GWQ-3 and GWQ-8) are properly constructed monitoring wells. NMED will require that NMCC install properly constructed monitoring wells to monitor for potential impacts from mine operations in the Grayback shallow alluvial aquifer and/or regional aquifers.

OSE #6/NMCC #151 resolution: NMED anticipates that installation of the proposed monitoring wells "A" and "B" as part of the Stage One Abatement Plan/permitting activities in addition to other additional monitoring wells in the vicinity will help further constrain ground water levels around the tailings impoundment and the inferred East Animas normal fault. However, NMED seeks further clarification from NMCC on whether the inferred fault is a barrier or conduit for ground water flow. Based on Figure 8-17 of the BDR, the fault appears to be a barrier to the sulfate plume but not the pre-tailings facility water-level elevation. NMED also seeks clarification on whether the 2011 water level elevation as depicted in Figure 8-17 of the BDR shows a mounding effect from the tailings impoundment.

If you have any questions regarding these issues, please contact Brad Reid at (505) 827-2963 or Kurt Vollbrecht, Acting Program Manager of the Mining Environmental Compliance Section, at (505) 827-0195.

SURFACE WATER QUALITY BUREAU COMMENTS

TO: Keith Ehlert, Groundwater Quality Bureau, Acting Mining Act Team Leader

THROUGH: Abe Franklin, Surface Water Quality Bureau

FROM: David Menzie, Surface Water Quality Bureau

RE: **SWQB Comments Copper Flat Mine, Baseline Data Report Addendum, Permit No. SI027RN**

DATE: September 16, 2013

Mining and Minerals Division, Mining Act Reclamation Program (MARP) has requested comments from the New Mexico Environment Department (NMED) on the Copper Flat Mine, Baseline Data Report

Addendum Permit No. SI027RN. Comments are due back to the Acting Mining Act Team Leader, Keith Ehlert, by September 16, 2013. The applicant, New Mexico Copper Corporation (NMCC), a wholly owned subsidiary of THEMAC Resources Group, Ltd. (THEMAC) has submitted an addendum containing responses to agency comments dated February 18, 2013, on the Baseline Data Report dated June 29, 2012.

The one comment addressing surface water quality from the original review of the Baseline Data Report follows.

Section 8.1.2.1.2 states that the NMED SWQB has collected flow data along Las Animas Creek. These data should be available. Although the historical and baseline flow data presented appear to adequately document Las Animas flow, MMD recommends incorporation of any added quantity data from NMED SWQB related to Las Animas creek as further documentation of historic flow 20 variability.

THEMAC's response (provided by their consultant John Shomaker & Associates, Inc.) to the comment follows.

All pertinent data are useful for establishing baseline conditions and the New Mexico Environmental Department Surface Water Quality Bureau (NMED SWQB) data were requested and reviewed in June of 2011 by INTERA during data collection. INTERA decided not to include the unpublished data in the Baseline Data Report, but did cite NMED SWQB's report *Water quality survey summary for the Lower Rio Grande tributaries, 2004* (NMED, 2009). Based on MMD's recommendation, flow data and water quality data collected by NMED SWQB for Las Animas Creek and Percha Creek are summarized in the attached table, stream thermograph, and NMED SWQB report (2009).

SWQB finds this response satisfactory.

xc: Jerry Schoeppner, Chief, GWQB
Fernando Martinez, Director, EMNRD-MMD
Brad Reid, GWQB
Chris Eustice, EMNRD-MMD
Holland Shepherd, EMNRD-MMD
David Menzie, SWQB

THEMAC RESOURCES

September 27, 2013

Brad Reid and Kurt Vollbrecht
New Mexico Environment Department
Groundwater Quality Bureau
Harold Runnels Building, Room N2250
1190 St. Francis Drive
Santa Fe, NM 87505

RE: THEMAC Resources Group, Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico

Dear Messrs. Reid and Vollbrecht,

This letter transmits the report for the Copper Flat Project as referenced above. Included with this transmittal is:

- Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico Report, Prepared by SRK Consulting, hardcopy with attachments
- CD with pdf of full report and attachments

The report was prepared by Ruth Warrender, CGeol, PhD, and Amy Prestia, MSc, P.G. with Peer Review by Eur. Geol. Rob Bowell PhD C. Chem C. Geol.
SRK Consulting, Inc.

Please contact Jeff Smith or me with any questions. Please email me to confirm receipt of the report and disk. My email address is kemmer@themacresourcesgroup.com.

Sincerely,

Katie Emmer

Katie Emmer
Project Scientist

cc: Chris Eustice, Mining and Minerals Division

THEMAC RESOURCES

September 30, 2013

Brad Reid and Kurt Vollbrecht
New Mexico Environment Department
Groundwater Quality Bureau
Harold Runnels Building, Room N2250
1190 St. Francis Drive
Santa Fe, NM 87505

GROUND WATER
OCT 0 2 2013
BUREAU

RE: THEMAC Resources Group, Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico

Dear Messrs. Reid and Vollbrecht,

This letter transmits the report for the Copper Flat Project as referenced above. Included with this transmittal is:

- Model of groundwater flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico, Prepared by John Shomaker & Associates, Inc., hard copy with Appendices
- CD with pdf of full report and appendices and model files

The report was prepared by Michael A. Jones, John W. Shomaker, PhD, CPG, and Steven T. Finch, Jr. CPG, John Shomaker & Associates, Inc., dated August 22, 2013.

Please contact Jeff Smith or me with any questions. Please email me to confirm receipt of the report and disk. My email address is kemmer@themacresourcesgroup.com.

Sincerely,

Katie Emmer

Katie Emmer
Project Scientist

cc: Chris Eustice, Mining and Minerals Division

Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico

Report Prepared for

THEMAC Resources Group Ltd.

Report Prepared by

SRK Consulting (U.S.), Inc.
SRK Project Number 191000.03
September 2013

07924

Predictive Geochemical Modeling of Pit Lake Water Quality at the Copper Flat Project, New Mexico

THEMAC Resources Group Ltd.

2424 Louisiana Boulevard NE, Suite 301,
Albuquerque, NM 87110

SRK Consulting (U.S.), Inc.

5250 Neil Road
Suite 300
Reno, NV 89502
e-mail: reno@srk.com
website: www.srk.com

Tel: (775) 828-6800
Fax: (775) 828-6820

SRK Project Number 191000.03

September 2013

Authors:
Ruth Warrender, CGeol, PhD
Consultant (Geochemistry)

Amy Prestia, MSc, P.G.
Senior Consultant (Geochemistry)

Peer Reviewed by:
Eur. Geol. Rob Bowell PhD C. Chem C. Geol
Corporate Consultant (Geochemistry)

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Appendices

Executive Summary

SRK Consulting, Inc. (SRK) has undertaken a predictive geochemical modeling exercise to assess potential future pit lake chemistry associated with the Copper Flat project, New Mexico. This work has been undertaken to evaluate the future environmental impacts of the project from a National Environmental Policy Act (NEPA) perspective as well as a State regulatory compliance perspective. The work forms part of the geochemical characterization study to assess the Acid Rock Drainage and Metal Leaching (ARDML) potential of the project. This report describes the approach taken for the pit lake predictive modeling, details the assumptions made and presents the results of the pit lake geochemical predictions.

The Copper Flat project is a porphyry copper-molybdenum deposit located on the western margin of the Rio Grande Rift. The deposit also contains minor, but potentially recoverable, gold and silver mineralization. The deposit is hosted by a small quartz monzonite stock that intrudes a sequence of andesitic volcanic rocks. Geochemical testwork identified the potential for sulfide bearing rocks in the area to potentially release trace metals and sulfate and have limited generation of acidic drainage. A numerical geochemical predictive model was developed in PHREEQC and calibrated to the existing pit lake to ensure all active geochemical mechanisms could be accounted for.

Waters in the future pit lake at Copper Flat are predicted to be moderately alkaline (pH ~8), primarily due to the buffering capacity of the inflowing groundwater. During the initial stages of pit infilling (i.e., during the first six months post-closure), removal/flushing of soluble salts from the pit walls is likely to result in a flush in sulfate, cadmium, molybdenum, selenium, sodium, chloride and sulfate concentrations in the early pit lake. The effects of this initial flush will be dissipated by inflowing groundwater and precipitation and pit lake chemistry will then evolve over time, with several parameters increasing in concentration as a result of evapoconcentration effects. This is similar to the trends observed in the existing pit lake, where elemental concentrations have increased since the start of pit infilling.

The model simulations demonstrate that all of the modeled chemical parameters are expected to be below New Mexico livestock standards (NMAC 20.6.4.900) in the 100 years post closure pit lake, with the exception of selenium. Vanadium concentrations are reported above the livestock standard; however, due to limitations on mineralogical controls, the current geochemical code over predicts the concentration of vanadium, as demonstrated by the calibration model. Once this is taken into account, vanadium is not expected to exceed the livestock standard.

Mercury concentrations are anticipated to increase over time, but remain below the livestock standard (0.01 mg/L) through year 100, post closure. Mercury concentrations are predicted to be marginally above the wildlife standard of 0.00077 mg/L by year 25. However, this exceedance is minimal, and may not represent a true ecological risk to wildlife within the Copper Flat project area.

SRK has provided NMCC with a plan of action for a Screening Level Ecological Risk Assessment (SLERA) to quantitatively evaluate the potential toxicological risks posed by the future pit lake at Copper Flat. A SLERA is a Tier 1 approach that utilizes both site-specific data and published ecological data to determine if further evaluation of potential ecological risks may be warranted. However, the predicted concentrations of selenium and mercury in the future Copper Flat pit lake are unlikely to present an environmental or ecological risk.

1 Introduction

1.1 Purpose and Scope

SRK Consulting, Inc. (SRK) has undertaken a predictive geochemical modeling exercise to assess potential future pit lake chemistry associated with the Copper Flat project, New Mexico. The purpose of the exercise is to evaluate the future environmental impacts of the project from a National Environmental Policy Act (NEPA) perspective as well as a State regulatory compliance perspective. The work forms part of the geochemical characterization study to assess the Acid Rock Drainage and Metal Leaching (ARDML) potential of the project. This report describes the approach taken for the pit lake predictive modeling, details the assumptions made, and presents the results of the pit lake geochemical predictions.

1.2 Background

The Copper Flat project is a porphyry copper/molybdenum deposit located in the Las Animas Mining District in South Central New Mexico, in Sierra County located approximately 150 miles south of Albuquerque, New Mexico and approximately 20 miles southwest of Truth or Consequences, New Mexico straight-line distances). Access from Truth or Consequences is by 24 miles of paved highway and 3 miles of all-weather gravel road. The Copper Flat project location is shown in Figure 1-1.

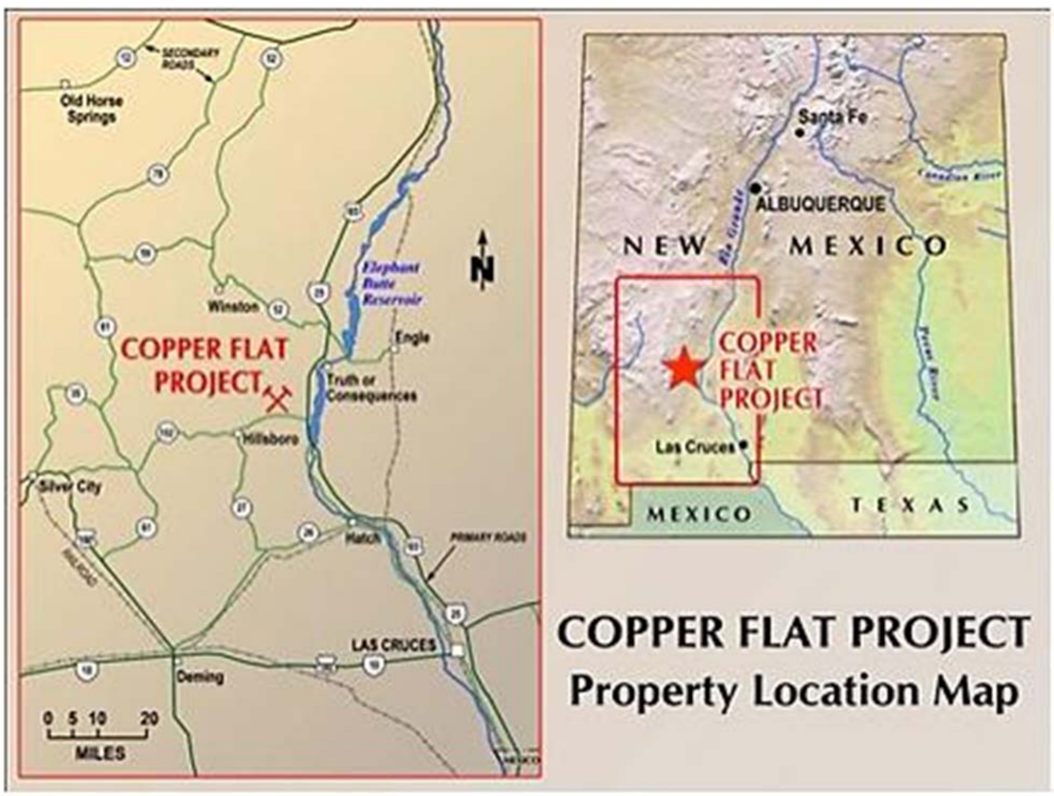


Figure 1-1: Project Location

1.2.1 Climate

The regional climate is high desert, and is generally hot with a July average of 76°F (maximum 107°F), and January average of 39°F (record minimum 1°F). The area is generally dry with about 13 inches of average annual precipitation, which occurs mostly as rainfall during July to September.

Winters are cold and dry. Snowfall is possible from October through April, but more typically occurring between December and February. The average annual total is 8 inches of snowfall. Prevailing wind direction is predominantly from the west, and secondarily from the north, and averages 10 to 15 miles per hour. Wind speeds in excess of 50 mph may occur as major storms pass through the area.

1.2.2 Prior Mining Operations

Mining activities in the Hillsboro Mining District began in the 1800s. Gold was mined from shafts and adits at the Copper Flat project and from placer workings developed along drainages to the east and southwest of Black and Animas Peaks. Gold mining was further developed during the early 1900s and continued until World War II. Today, small scale placer mining continues. Copper exploration began in the 1950s and continued to the early 1980s, when Quintana Minerals Corporation defined 60 Mt of reserves sufficient to operate for a 10 year mine life at an extraction rate of 15,000 tons per day (tpd). Operations included the development of the open pit, waste rock piles, TSF and other mine disturbances observed today, but mining stopped after 3 months due to low metal prices. No commercial mining activities have occurred at Copper Flat since 1982. The mine was under maintenance status until 1986, when mine facilities were dismantled and some areas were partially reclaimed. During the 1990s several companies submitted plans to reopen the mine but none of the plans were realized. Existing surface disturbances and facilities in the project area include the following:

- A pit lake;
- Waste rock disposal facilities (WRDFs);
- Mine and mill foundations (buildings have been removed);
- Site grading and roads;
- A 115-kilovolt power line;
- A 20-inch welded steel water line from the production well field to the base of the tailings storage facility (TSF);
- A diversion channel re-routing Grayback Arroyo around the mine site; and
- A TSF containing approximately 1.2 Mt of tailings from historic mining operations.

1.2.3 Mine Plan

The proposed project consists of an open pit mine, flotation mill, TSF, WRDFs, a low grade ore stockpile (LGOS) and ancillary facilities. The proposed project is expected to produce approximately 100 million tons of copper ore and 60 million tons of waste rock during the mine life, with extraction taking place by conventional truck and shovel methods using 30-foot high benches. Because the deposit cannot be mined sequentially, backfilling of the pit will not take place.

Beneficiation will be achieved through the use of a conventional concentrator using standard crushing, grinding and flotation technologies. Milling will also include a molybdenum processing circuit. The nominal ore throughput rate is 25,000 tpd and an operational life of approximately 11 years is projected. The proposed layout of the mine facilities is shown in Figure 1-2.

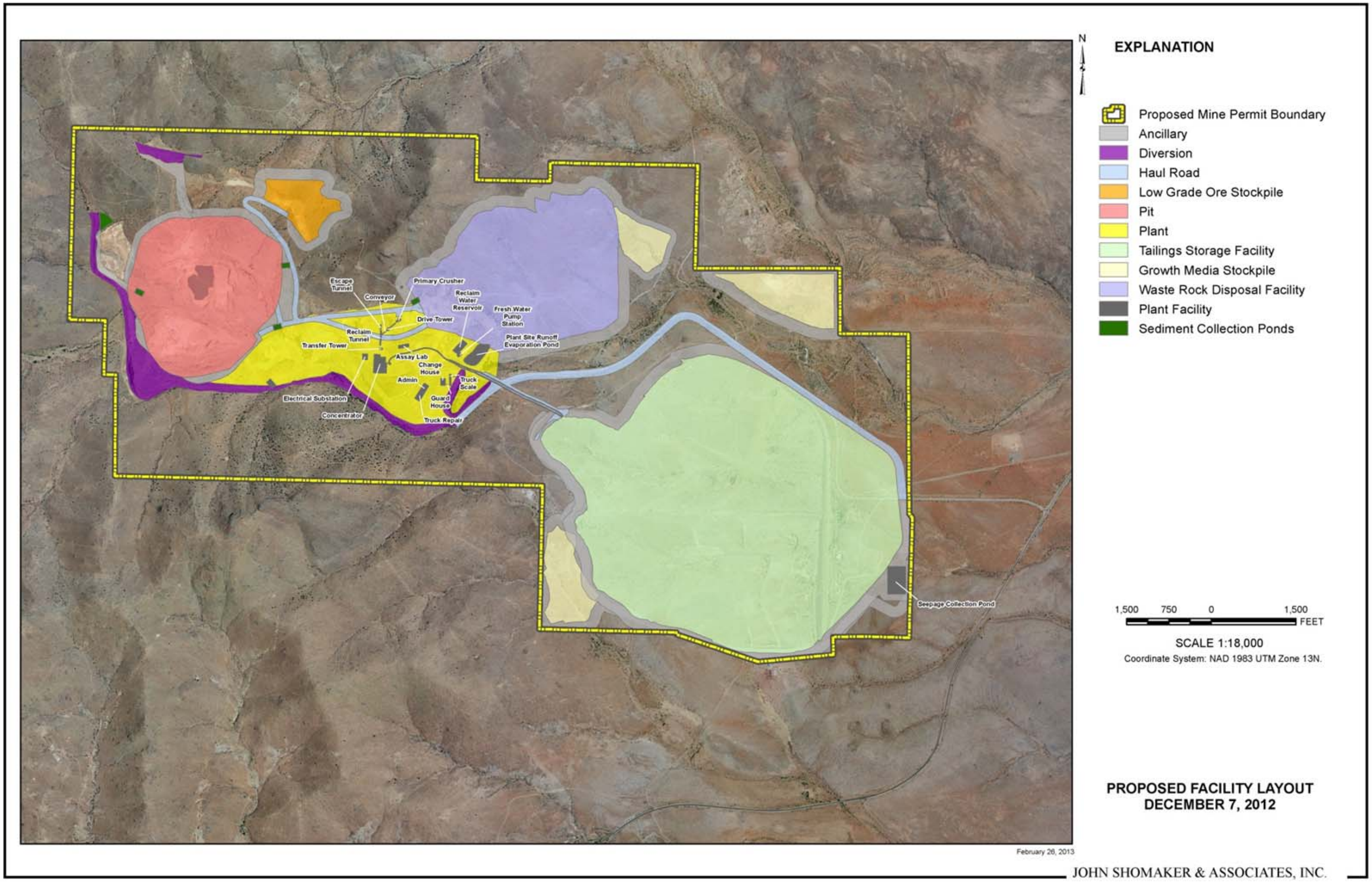


Figure 1-2: Copper Flat Facility Layout

From: THEMAC Resources Group Ltd (2012). Mine Operation and Reclamation Plan, Copper Flat Mine Project, Sierra County, New Mexico.

1.2.4 Geology and Mineralization

The Copper Flat project is a porphyry copper-molybdenum deposit located on the western margin of the Rio Grande Rift. The deposit also contains minor, but potentially recoverable, gold and silver mineralization. The deposit is hosted by a small quartz monzonite stock having a porphyritic texture that intrudes a sequence of andesitic volcanic rocks of similar age covering an area approximately 4 miles in diameter.

Regional Geology

The Copper Flat project lies within the Mexican Highlands portion of the Basin and Range Physiographic Province. The project is located in the Hillsboro Mining District in the Las Animas Hills, which are part of the Animas Uplift, a horst on the western edge of the Rio Grande valley. The Animas Uplift is separated from the Rio Grande by nearly 20 miles of Santa Fe Group alluvial sediments, referred to as the Palomas Basin of the Rio Grande valley. To the west of the Animas Uplift is the Warm Springs valley, a graben that parallels the Rio Grande valley. Further west, the Black Mountains form the backbone of the Continental Divide, rising to about 9,000 feet above sea level. The regional geology is discussed in more detail in the *Baseline Data Report for the Copper Flat Mine* (BDR) (INTERA, 2012). The focus of this report is on the local and Copper Flat ore body geology.

Basement rocks in the area consist of Precambrian granite and Paleozoic and Mesozoic sandstones, shales, limestones, and evaporites. Sedimentary units that crop out within the Animas Uplift include the Ordovician Montoya Limestone, the Silurian Fusselman Dolomite, and the Devonian Percha Shale. The Cretaceous-age Laramide orogeny, which was characterized by the intrusion of magma associated with the subduction of the Farallon plate beneath the North American plate, affected this region between 75 and 50 million years ago (Ma). Volcanic activity during the late Cretaceous and Tertiary periods resulted in localized flows, dikes, and intrusive bodies, some of which were associated with the development of the nearby Tertiary Emory and Good Sight-Cedar Hills calderas. Later basaltic flows resulted from the tectonic activity associated with the formation of the Rio Grande rift. Tertiary and Quaternary alluvial sediments of the Santa Fe Group and more recent valley fill overlie the older Paleozoic and Mesozoic units in the area.

Local Geology

The district geology described below is modified from McLemore et al. (2000) and Raugust (2003). The predominant geologic feature of the Hillsboro Mining District is the Cretaceous Copper Flat stratovolcano, a circular body of Cretaceous andesite that is 4 miles in diameter (Figure 1-3). The Hillsboro Mining District comprises the Las Animas Hills, a low range formed by the Animas Hills horst at the western edge of the Rio Grande Rift. Faults that bound the Animas Hills horst are related to the tectonic activity of the Miocene-age Rio Grande Rift (Dunn, 1982). Due to the difference in ages and in spite of its close proximity, there is no known connection between the Rio Grande rift and the Copper Flat volcanic/intrusive complex. The Copper Flat volcanic/intrusive complex has been interpreted as an eroded stratovolcano based on the presence of agglomerate and flow band textures in some of the andesite (Richards, 2003).

The Copper Flat Quartz Monzonite (CFQM) intrudes the core of the volcanic complex. The CFQM stock has a surface expression of approximately 0.4 mi^2 and has been dated by the argon-argon (40Ar/39Ar) techniques to be 74.93 ±0.66 million years old (McLemore et al., 2000). The surrounding andesite has also been dated using argon-argon techniques to be 75.4 ±3.5 million years old (McLemore et al., 2000).

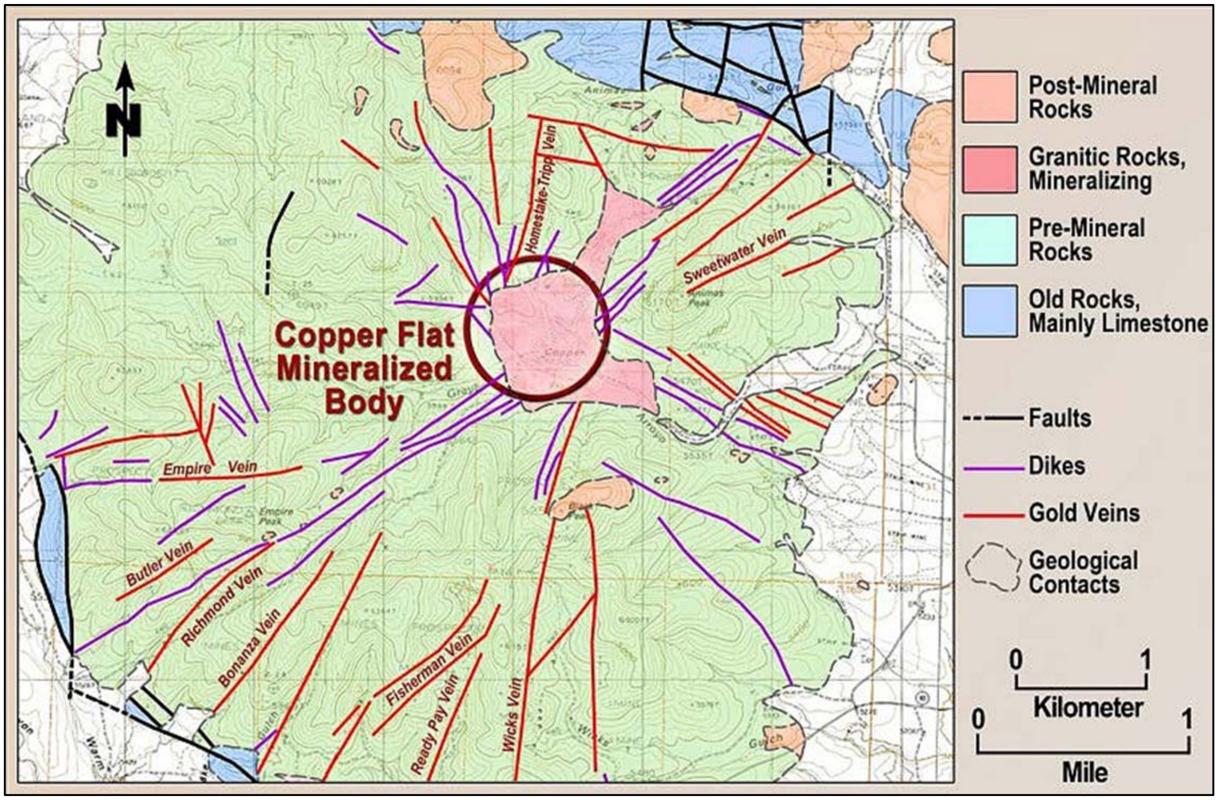


Figure 1-3: Geology of the Copper Flat Mine (Dunn, 1982)

Geology of the Copper Flat Orebody

The Copper Flat andesite is generally fine-grained with phenocrysts of plagioclase (andesine) and amphibole in a groundmass of plagioclase and potassium feldspar and rare quartz. Some agglomerates or flow breccias are locally present, but the andesite is generally massive. Magnetite is commonly associated with the mafic phenocrysts, and accessory apatite is commonly found.

Although the depth of erosion is uncertain, the center of the stratovolcano was eroded to form a topographic low. To the east of the site, this andesite body is in fault contact with Santa Fe Group sediments, which are at least 2,000 feet thick in the immediate Copper Flat area and thickening to the east. Near-vertical faults characterize the contacts on the remaining perimeter of the andesite body; these faults juxtapose the andesite with Paleozoic sedimentary rocks. Historical drill holes indicate the andesite is locally more than 3,000 feet thick. This feature, combined with the concentric fault pattern, indicate that the local geology represents a deeply eroded Cretaceous-age volcanic complex. A detailed geologic map of the Copper Flat orebody is provided in Figure 1-4 and a south-north geologic cross section through the Copper Flat orebody is provided in Figure 1-5.

Copper Flat Quartz Monzonite (CFQM) intrudes the core of the volcanic complex. Sulfide mineralization is present as veinlets and disseminations in the CFQM, but is most strongly developed in and adjacent to the west end of a steeply dipping breccia pipe that is centrally located within the CFQM stock and elongated in the northwest-southeast direction (Figure 1-5).

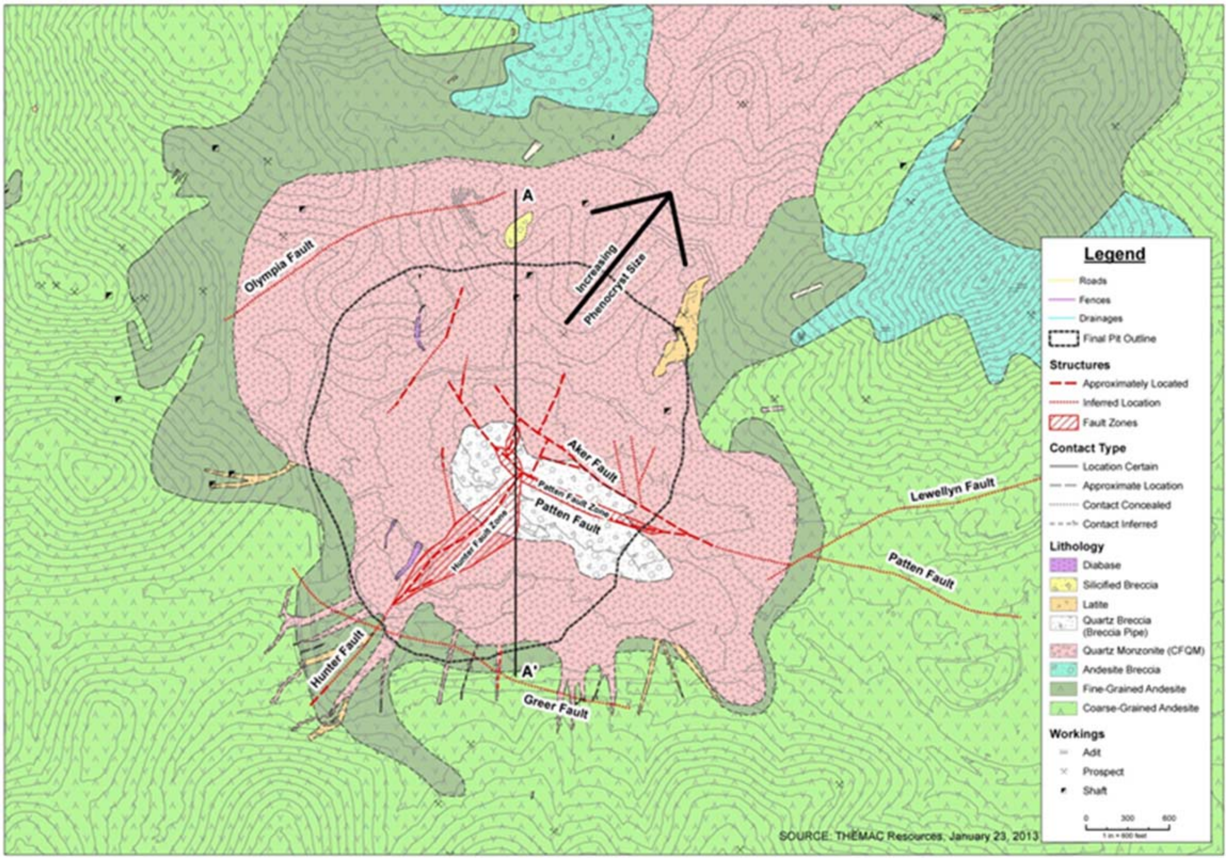


Figure 1-4: Detailed Geologic Map of the Copper Flat Orebody (THEMAC, 2013)

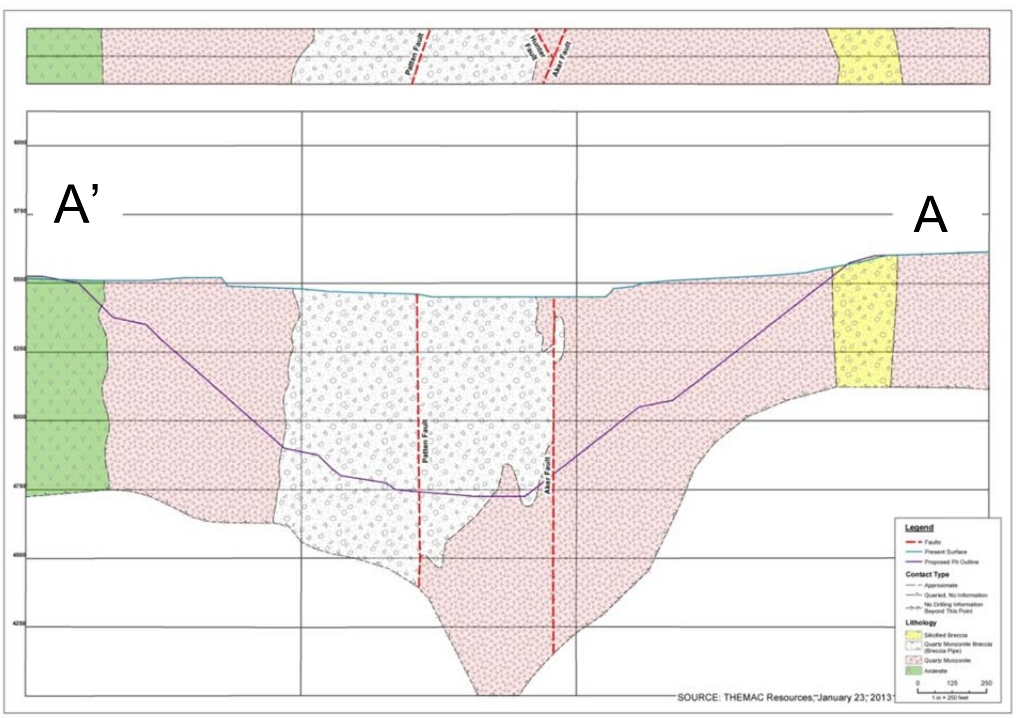


Figure 1-5: Geologic Cross Section through the Copper Flat Orebody (THEMAC, 2013)

Lithology

The CFQM intruded into the center of the andesite sequence at the intersection of two principal structures that trend respectively N50°W and N20°E. The CFQM is an irregular-shaped stock underlying a surface area of approximately 0.40 square miles and has been dated to approximately 75 Ma. In the few exposures in which the CFQM is in contact with the andesite, the andesite shows no obvious signs of contact metamorphism. The CFQM is a medium- to coarse-grained, holocrystalline porphyry composed primarily of potassium feldspar, plagioclase, hornblende, and biotite; trace amounts of magnetite, apatite, zircon, and rutile are also present, along with localized mineralized zones containing pyrite, chalcopyrite, and molybdenite. About 15 percent of the monzonite is quartz, which occurs both as small phenocrysts and as part of the groundmass; however, quartz is absent in some parts of the stock.

Numerous dikes, some of which are more than a mile in length and mostly of latite composition, radiate from and cut the CFQM stock. Most of the dikes trend to the northeast or northwest and represent late stage differentiation of the CFQM stock. Diabase has been mapped in contact with the CFQM at Copper Flat. Immediately south of the quartz monzonite, the andesite is coarse-grained, perhaps indicating a shallow intrusive phase. An irregular mass of andesite breccia along the northwestern contact of the quartz monzonite contains potassium feldspar phenocrysts and andesitic rock fragments in a matrix of sericite with minor quartz. This may represent a pyroclastic unit. Magnetite, chlorite, epidote, and accessory apatite are also present in the andesite breccia.

Structure

Three principal structural zones are present at Copper Flat, the most prominent of which is a northeast-striking fault that trends N 20°-40°E that includes the Hunter and parallel faults or the Hunter fault zone. In addition, west-northwest striking zones of structural weakness (N50°-70°W) are marked by the Patten and Greer faults, and east-northeast striking zones are marked by the Olympia and Lewellyn faults. All faults have a near-vertical dip; the Hunter fault system dips 80°W, the Patten dips approximately 70°S-80°S, and both the Olympia and Lewellyn fault systems dip between 80°S and 90°S. These three major fault zones appear to have been established prior to the emplacement of the CFQM and controlled subsequent igneous events and in the case of the Patten and Hunter controlled mineralization.

As previously stated, the CFQM emplacement is largely controlled by the three structural zones. The southern contact parallels and is cut by the Greer fault, although the contact is cut by the fault, and the southeastern and northwestern contacts are roughly parallel to the Olympia and Lewellyn faults, respectively. The CFQM stock is principally elongated along the Patten fault, as well as along the Hunter fault zone.

Although latite dikes strike in all the three principal fracture directions, most of the dikes strike northeast. The northeast trending fault zones contain a high proportion of wet gouge, often with no recognizable rock fragments. Reportedly in underground exposures the material comprising the Hunter fault zone has the same consistency as wet concrete and has been observed to flow in underground headings. Based on recent drilling the Patten fault consists of a mixture of breccia and gouge. However, the material in the east-northeast fault zones contains only highly broken rock and minor gouge. The width of individual structures in all three systems varies along strike from less than a foot to nearly 25 feet in the Patten fault east of the Project. Despite intense brecciation, the total displacement along the faults does not appear to exceed a few tens of feet. At the western edge of the CFQM intrusion, a younger porphyritic dike was emplaced in a fault that offsets an early latite dike, indicating that fault movement occurred during the time that dikes were being emplaced.

Post-dike movement is evident in all the three principal fault zones, and both the Hunter and Patten fault systems show signs of definite post-mineral movement. Fault movement has smeared sulfide deposits and offset the breccia pipe as well as the zones within the breccia pipe. Post-mineral movement along faults has resulted in wide, strongly brecciated fault zones. Some of the post-mineral dikes have been emplaced within these fault zones.

NMCC has mapped the pit area and diversion cuts in detail at 1 inch equals 40 feet (1:480) and has examined the pre- and post-mineral stress orientations in the andesite and CFQM. Findings indicate no significant difference in the stress fields before and after mineralization. During NMCC's mapping efforts, the Greer and Olympia previously mapped fault locations could not be verified; therefore, these faults were labeled as inferred.

Mineralization

The CFQM hosts mineralization dominated by pyrite and chalcopyrite with subsidiary molybdenite, minor bornite and minor but recoverable amounts of gold and silver. The mineralization is focused along intersecting northeast- and northwest-trending faults, and these intersections may have originally controlled emplacement of the CFQM.

Although copper occurs almost exclusively as chalcopyrite locally accompanied by trace amounts of bornite, minor amounts of chalcocite and copper oxide minerals are locally present near the surface and along fractures. The supergene enrichment typical of many porphyry copper deposits in the Southwest is virtually non-existent at Copper Flat. During the early mining days, a 20 to 50-foot leached oxide zone existed over the ore body, but this material was stripped during the mining activities that occurred in the early 1980s. Most of the remaining ore is unoxidized and consists primarily of chalcopyrite and pyrite with some molybdenite and locally traces of bornite, galena and sphalerite. Recently completed mineralogical studies indicate that fine grained disseminated chalcopyrite is often intergrown with pyrite and occurs interstitial to silicate minerals. Deposition of chalcopyrite and molybdenite (76.2 Ma) occurred within the same mineralizing event as the pyrite.

Sulfide mineralization is present as veinlets and disseminations in the CFQM, but is most strongly developed in and adjacent to the west end of a steeply dipping breccia pipe, that is centrally located within the CFQM stock and elongated in the northwest-southeast direction roughly along, but south of the Patten fault. The sulfide mineralization first formed in narrow veinlets and as disseminations in the quartz monzonite with weakly developed sericitic alteration. This stage of mineralization was followed by the formation of the breccia pipe with the introduction of coarse, “clotty” pyrite and chalcopyrite along with veinlet controlled molybdenite and milky quartz, and the development of strong potassic alteration.

The breccia pipe, which can best be described as a crackle breccia, consists largely of subangular fragments of mineralized CFQM, with locally abundant mineralized latite where dikes exposed in the CFQM projected into the brecciated zone that range in size from an inch to several inches in diameter. Andesite occurs only as mixed fragments partially in contact with intrusive CFQM and appears to represent the brecciation of relatively unaltered andesite xenoliths in the CFQM. The matrix contains varying proportions of quartz, biotite (phlogopite), potassium feldspar, pyrite, and chalcopyrite, with magnetite, molybdenite, fluorite, anhydrite, and calcite locally common. Apatite is a common accessory mineral. Breccia fragments are rimmed with either biotite or potassium feldspar, and the quartz and sulfide minerals have generally formed in the center of the matrix.

Two types of breccia within the quartz monzonite breccia pipe have been identified as distinguishable units based on the dominant mineral filling the matrix between clasts. Recent drilling has shown that the two breccia types, biotite breccia and feldspar breccia, grade into one another as well as with the CFQM. Interestingly, from a recovery perspective, metallurgical testing has shown that the mineralization behaves virtually the same irrespective of the lithology.

The total sulfide content ranges from 1 percent (by volume) in the eastern part of the breccia pipe and the surrounding CFQM to 5 percent in the CFQM to the south, north, and west. Sulfide content is highly variable within the breccia, with portions in the western part of the breccia containing as much as 20 percent sulfide minerals. The strongest copper mineralization is concentrated in the western half of the breccia pipe and in the adjoining stockwork veined CFQM in the vicinity of the intersection of the Patten fault and the Hunter fault zone. Sulfide mineralization is concentrated in the CFQM and breccia pipe, and drops significantly at the andesite contact. Minor pyrite mineralization extends into the andesite along the pre-mineral dikes and in quartz-pyrite-bearing structures, some of which were historically prospected for gold.

Molybdenite occurs in some steeply dipping quartz veins or as thin coatings on fractures. Minor sphalerite and galena are present in both carbonate and quartz veinlets in the CFQM stock. Preliminary 2011 evaluations of the mineralization at Copper Flat indicate that copper mineralization concentrates and trends along the N50°W structural influences, whereas the molybdenum, gold and silver appear to favor a N10°-20°E trend.

1.2.5 Hydrology

Hydrological information pertaining to the Copper Flat project has been summarized from the Baseline Data Report (INTERA, 2012) and is provided herein to provide a context for the pit lake modeling. The mine permit area is located in the Lower Rio Grande watershed, which includes approximately 5,000 square miles in Catron, Socorro, Sierra, and Doña Ana Counties and is dominated by the Rio Grande and its tributaries as well as the two large reservoirs of Elephant Butte and Caballo. Numerous tributaries drain into the Rio Grande from the west, but none contribute perennial flow to the Rio Grande. The mine permit area is drained by ephemeral streams (arroyos) within the Greenhorn Arroyo Drainage Basin. The Greenhorn Arroyo Drainage Basin is composed of Greenhorn Arroyo, Grayback Arroyo, and Hunkidori Gulch. The Grayback Arroyo passes through the permitted mine area and is diverted around the existing mine pit. Drainages within this watershed are ephemeral, flowing in response to heavy or sustained precipitation events. Water quality data for the Greyback Arroyo are summarized in Table 1-1.

Table 1-1: Summary of Hydrochemical Information in the Grayback Arroyo (INTERA, 2012)

Details	pH (s.u.)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Min	7.42	0.71	11	78
Max	7.92	130	2,900	4,500

Surface waters in the Grayback Arroyo are typically characterized by higher major ion and trace element concentrations, with sulfate concentrations up to 2,900 mg/L and TDS up to 4,500 mg/L.

1.2.6 Hydrogeology

Hydrogeological information pertaining to the Copper Flat project has been summarized from the Baseline Data Report (INTERA, 2012) and is provided herein. This report identifies three aquifers within the Copper Flat project area (Figure 1-6) including:

1. Crystalline bedrock aquifer;
2. Santa Fe Group aquifer; and
3. Quaternary alluvial aquifer.

Details of these aquifers are provided below.

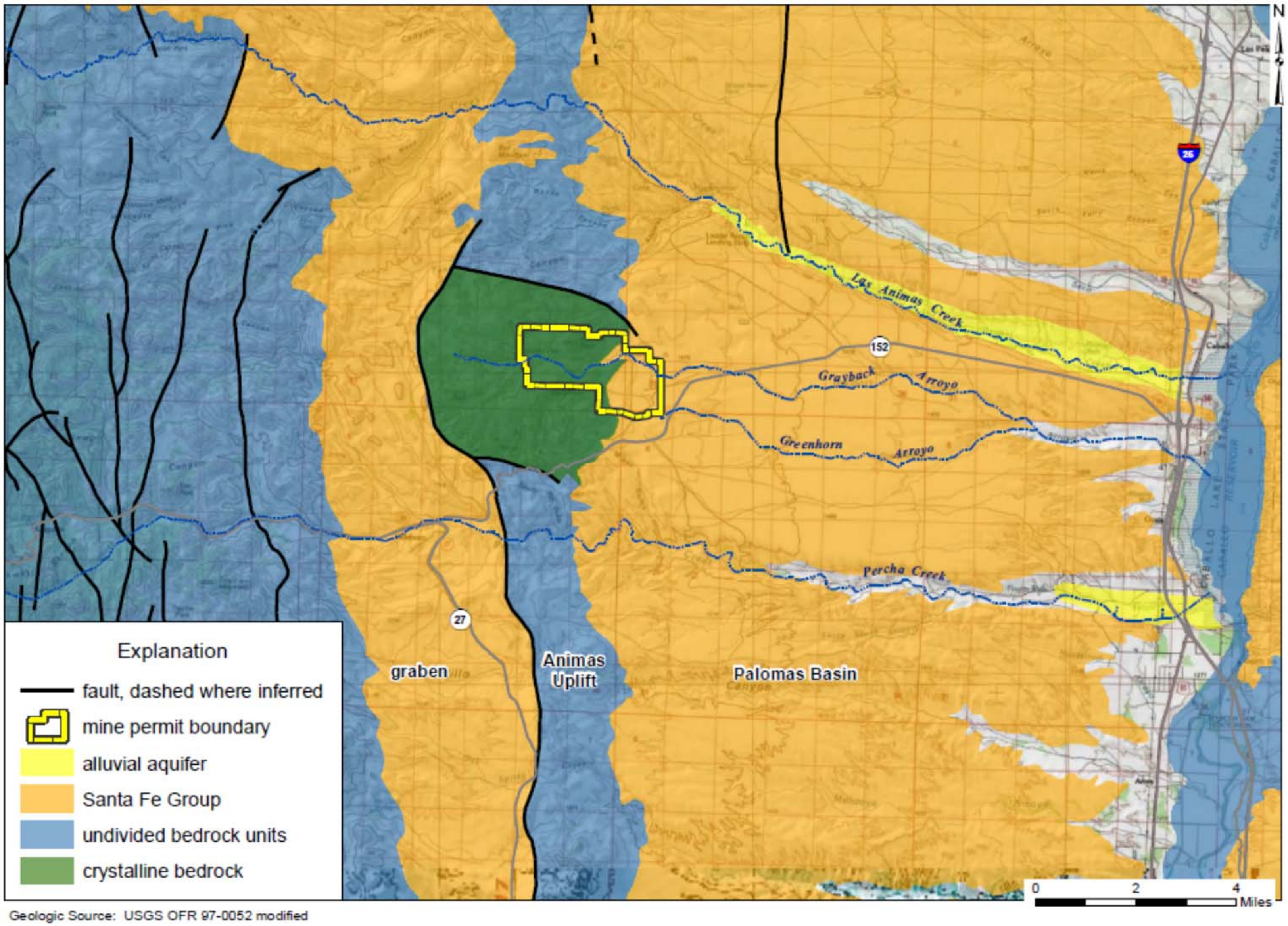


Figure 1-6: Map Showing Location of Crystalline Bedrock, Santa Fe Group Sediments and Alluvial Aquifer Zones (JSAI, 2012)

1. ***Crystalline Bedrock Aquifer:*** Groundwater is present within the crystalline volcanic rocks (quartz monzonite and andesite) that constitute much of the western portion of the mine permit area. Though the rocks themselves have practically no inter-granular permeability, faulting and jointing of the monzonite have created locally permeable zones through which water can move. Groundwater flow is generally from west to east, with the exception of the area surrounding the pit lake, which behaves as an evaporative sink. The permeability of the andesite is extremely low (<0.003 feet/day), whereas the permeability of the monzonite rocks averages 0.1 feet/day due to localized secondary porosity from fracturing. Groundwater in the Crystalline Bedrock Aquifer is characterized by moderately alkaline pH (~8 s.u.) and can generally be classed as sodium / calcium plus bicarbonate (Na / Ca + HCO_3) type waters based on their major ion signature (Figure 1-7).
2. ***Santa Fe Group Aquifer:*** Overlying and adjacent to the crystalline bedrock aquifer is the Santa Fe Group Aquifer system, which receives recharge from precipitation. The aquifer is located approximately 1 mile downgradient of the existing pit lake, and the low hydraulic conductivity of the andesite limits cross formational flow. The sediments of the Santa Fe Group are stratified, contain a wide variety of grain sizes, and, in general, dip to the east. The direction of groundwater flow is from west to east and the groundwater elevation contours indicate groundwater flows from the andesite to the alluvium and Santa Fe Group sediments. Groundwater in the Santa Fe Group Aquifer is characterized by circum-neutral to moderately alkaline pH (7 – 8 s.u.) and can generally be grouped into the calcium plus bicarbonate (Ca + HCO_3) or calcium plus sulfate (Ca + SO_4) hydrochemical facies based on major ion chemistry (Figure 1-7). The sulfate signature of some of the groundwater samples is associated with wells within the Santa Fe Group Aquifer near the existing TSF, which are known to be influenced by a sulfate plume from the historic tailings.
3. ***Quaternary Alluvial Aquifer:*** This aquifer is comprised of channel and floodplain gravels, sands and silts and represents the uppermost aquifer in the vicinity of the Copper Flat project. The alluvial aquifer is typically recharged by infiltration of rainfall.

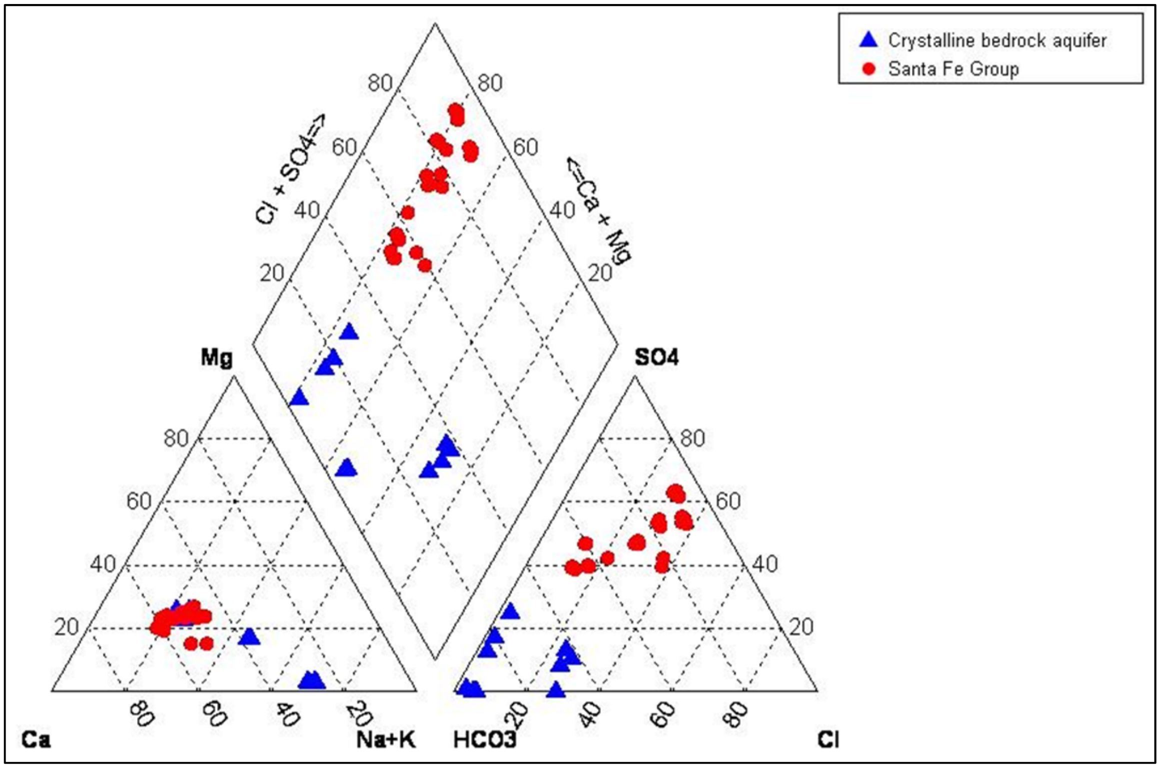


Figure 1-7: Piper Plot of Major Ion Chemistry of Groundwater in the Mine Permit Area (analyses from 2010 and 2011 only)

1.2.7 Pit Lake

During the late 1980s and early 1990s, a pit lake formed in the existing pit. During this period, the pit lake was approximately 13.8 acres, but has subsequently reduced in size as a result of evaporation and limited precipitation (i.e., drought conditions). A recent evaluation by JSAI (2011) indicates that the pit lake currently covers an area of approximately 5.2 acres and contains approximately 60 acre-feet. of water. Bathymetric measurements carried out as part of the INTERA (2012) baseline data collection program indicate that the depth of the existing pit lake varies between 28 and 36 feet. Water levels are typically highest in the winter month of January and lowest in the summer month of July. The analytical results do not indicate the presence of a chemocline or any chemical stratification in the lake. However, the temperature profiles for the winter and summer sampling showed a greater than 1^{o}C per meter change, indicating the presence of a thermocline. The pit currently represents a hydraulic sink, with evaporation from the lake surface exceeding groundwater inflow and surface runon.

Existing pit lake water quality was assessed as part of the INTERA (2012) baseline data collection program, which included collection of samples from the deepest part of the pit lake in September 2010, January 2011, April 2011 and July 2011. The results of this monitoring program are summarized in Table 1-2 and demonstrate that pit lake waters are currently characterized by circum-neutral to moderately alkaline pH (6 – 7.86 s.u.), with sulfate concentrations between 5,200 mg/L and 6,400 mg/L and total copper concentrations up to 11 mg/L. Furthermore, concentrations of sulfate, chloride, TDS, manganese, magnesium, cobalt, fluoride, sodium and potassium have all increased between 1989 and 2011. In particular, evapoconcentration effects have increased the concentrations of sulfate and chloride (Figure 1-8), resulting in supersaturation of pit lake waters and subsequent precipitation of salts (primarily gypsum) around the rim of the existing pit lake. These precipitated solids now form a thick crust on the pit walls (Figure 1-9). The pH of existing pit lake waters has generally increased over time most likely through a combination of groundwater alkalinity and localized buffering by wall rock silicate and carbonate mineralogy.

Comparison of existing pit lake chemistry in with NMAC 20.6.4900 surface water standards for livestock watering and wildlife demonstrates that both cadmium and copper are above the respective standards for these parameters (Table 1-2).

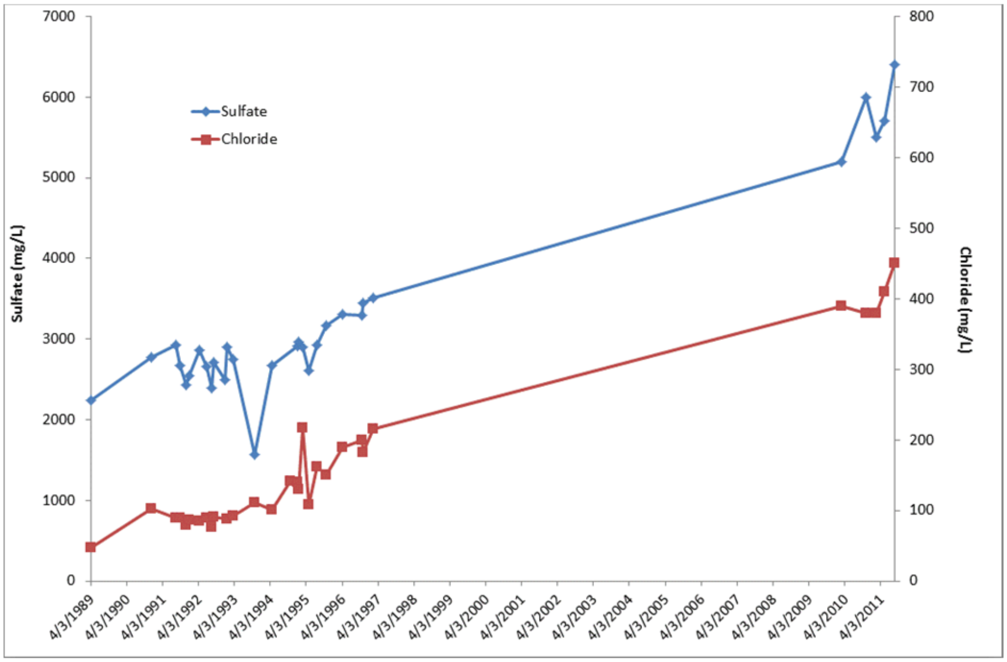


Figure 1-8: Plot of Sulfate and Chloride Concentrations in Existing Pit Lake

Figure 1-9: Precipitated Salts around Rim of Existing Pit Lake

Table 1-2: Existing Pit Lake Chemistry (Average Concentration from 2010 – 2011)

		NMAC 20.6.4.900 Surface Water Standards		Average concentration measured in period 2010 - 2011
		Livestock	*Wildlife*	
pH	s.u.	*6.6 - 9*		7.35
Bicarbonate	mg/L	-	-	35.7
Aluminum	mg/L	-	-	0.502
Arsenic	mg/L	*0.2*	-	0.003
Boron	mg/L	*5*	-	0.16
Calcium	mg/L	-	-	592
Cadmium	mg/L	*0.05*	-	0.06
Cobalt	mg/L	*1*	-	0.34
Chromium	mg/L	*1*	-	0.012
Copper	mg/L	*0.5*	-	0.60
Fluoride	mg/L	-	-	17.0
Iron	mg/L	-	-	0.04
Mercury	mg/L	*0.01*	*0.00077*	<0.002
Potassium	mg/L	-	-	31.0
Magnesium	mg/L	-	-	677
Manganese	mg/L	-	-	44.0
Molybdenum	mg/L	-	-	0.02
Sodium	mg/L	-	-	792
Nickel	mg/L	-	-	0.058
Lead	mg/L	*0.1*	-	<0.005
Antimony	mg/L	-	-	<0.001
Selenium	mg/L	*0.05*	*0.005*	0.03
Uranium	mg/L	-	-	0.12
Vanadium	mg/L	*0.1*	-	<0.05
Zinc	mg/L	*25*	-	4.87
Sulfate	mg/L	-	-	5,900
Chloride	mg/L	-	-	412

(shaded) *Indicates value is greater than NMAC 20.6.4900 surface water standard*

'-' *Indicates no standard for parameter*

2 Geochemical Characterization Testwork Summary

SRK has conducted a geochemical characterization program for the Copper Flat project, which has included the testing of 91 waste rock samples, 41 samples representative of low grade ore and 11 samples of tailings material to investigate the potential for ARDML generation. The results of this program are presented in the *Geochemical Characterization Report for the Copper Flat Project, New Mexico* (SRK 2012) and the main findings are summarized below.

Waste rock and ore sample intervals were selected from both exploration core holes drilled within the proposed pit boundaries in 2009, 2010 and 2011 and from the surface of existing WRDs and pit walls on site. Samples were selected to represent the range of waste rock and ore material types that will be encountered during future mining. Tailings samples were collected from the metallurgical program and from the existing (historic) TSF on site. The static test methods used for the geochemical characterization program include multi-element analysis using four-acid digest and ICP-MS analysis, modified Sobek Acid Base Accounting (ABA), Net Acid Generation (NAG) test and the Nevada Meteoric Water Mobility Procedure (MWMP). These static tests were selected to address total acid generation or neutralization potential of the samples and concentration of constituents in leachates derived from the material. However, these static tests do not consider the temporal variations that may occur in leachate chemistry as a result of long-term changes in oxidation, dissolution and desorption reaction rates. To address these factors, kinetic testing was also carried out as part of the geochemical characterization program and includes 32 humidity cell tests (HCTs) conducted on samples of waste rock, ore and tailings according to the ASTM D-5744-96 methodology.

The results of the characterization program demonstrate that the acid generating potential of the Copper Flat waste rock is largely dependent on the sulfide mineral content, with sulfide concentrations varying from less than analytical detection limits to a maximum of 2.52 wt%. The static testwork results indicate that the transitional waste material (i.e. mixed sulfide/oxide) is likely to be potentially acid forming based on a generally higher sulfide mineral content and the presence of secondary oxide minerals that formed as a result of supergene weathering. In contrast, the diabase, andesite and tailings are likely to be non-acid forming materials. The main material type for the project consists of sulfide (i.e., non-oxidized) Quartz Monzonite and Breccia, which typically exhibited either non-acid forming characteristics or a low potential for acid generation. This is related to the encapsulation of sulfide minerals in a quartz matrix or occasionally in potassium feldspar. In addition, the sulfide minerals in the Copper Flat deposit are crystalline and often coarse grained and as such have slow weathering reaction kinetics. It is likely that the Copper Flat materials will offer limited silicate buffering (neutralizing) capacity; although this is unlikely to be high magnitude, it may modify/buffer pH in the near neutral range.

The Copper Flat waste rock and ore materials were found to be enriched in copper, sulfur and selenium in whole rock chemistry, which relates to the primary mineralization (predominantly chalcopyrite - $CuFeS_2$). Silver, arsenic, cadmium, molybdenum, lead, thallium, uranium, tungsten, and zinc were also found to be enriched in one or more material types, with the greatest levels of enrichment occurring in the sulfide and transitional ore material types. Many of these elements are typically associated with copper porphyry deposits, which explain their enrichment in the Copper Flat materials (and more specifically in the ore grade samples). The diabase and andesite material types typically showed much lower levels of elemental enrichment, which is likely related to the lack of primary mineralization in these lithological units.

MWMP tests were conducted on a total of 49 waste rock and tailings samples to provide an indication of elemental mobility and metal(loid) release from the Copper Flat materials during meteoric rinsing. Metal mobility and release was also assessed from the results of the ongoing HCT program, the results of which are summarized in Appendix B. In general, metal leaching from the

Copper Flat materials was found to be low and the majority of leachates generated during the MWMP and HCT test programs could be classed as near-neutral, low-metal waters. However, several of the grab samples of transitional material collected from historic waste rock dumps produced acidic leachates and showed the potential for higher metal release than observed for the unoxidized sulfide materials. The higher release of acidity and metals from these samples likely represents the flushing of soluble acidic sulfate salts from the material surface that were produced by the prolonged weathering (over geological time) of the material.

3 Pit Lake Predictive Geochemical Model

During mining operations, dewatering will keep the pit operational and limited water will pond within the pit itself. At the end of open pit mining operations, dewatering will cease and a pit lake will ultimately form. Pit lake water quality predictions were made at selected time intervals (beginning when the pit lake starts to fill after mining and dewatering operations cease). Water quality predictions were made for the time periods of 0.5, 1, 2, 5, 10, 25, 50, 75, and, 100 years after the start of pit lake formation. These predictions were based on mass load mixing of waters from different sources and allowing the resulting mix to establish thermodynamic equilibrium under imposed conditions by dissolving or precipitating specified solids, with attenuation of trace elements through sorption reactions.

3.1 Conceptual Model

A conceptual geochemical model was developed for the Copper Flat pit lake from a review of background and site-specific data in addition to experience with similar projects. The conceptual model assumes that a lake will form within the pit after dewatering operations cease as a result of inflow of groundwater into the pit, direct precipitation onto the pit lake and run-off from the pit walls. Data that were used as inputs to the model were derived from the following sources:

- Geological and mine planning information from the Baseline Data Report (INTERA, 2012) and the geologic block model;
- Hydrologic and hydrogeologic information from the JSAI (2012) pit lake water balance;
- Geochemical data from laboratory humidity cell tests performed on representative waste rock lithologies and then scaled to field conditions. These data were utilized to provide source term data for chemical leaching of exposed rock in the pit walls;
- Precipitation chemistry data from long-term monitoring at the Gila Cliff Dwellings National Monument meteorological station, New Mexico; and
- Groundwater chemistry data from the ongoing groundwater monitoring program.

Full details of these input data are provided in the following sections. The conceptual geochemical model for the Copper Flat pit is provided in Figure 3-1.

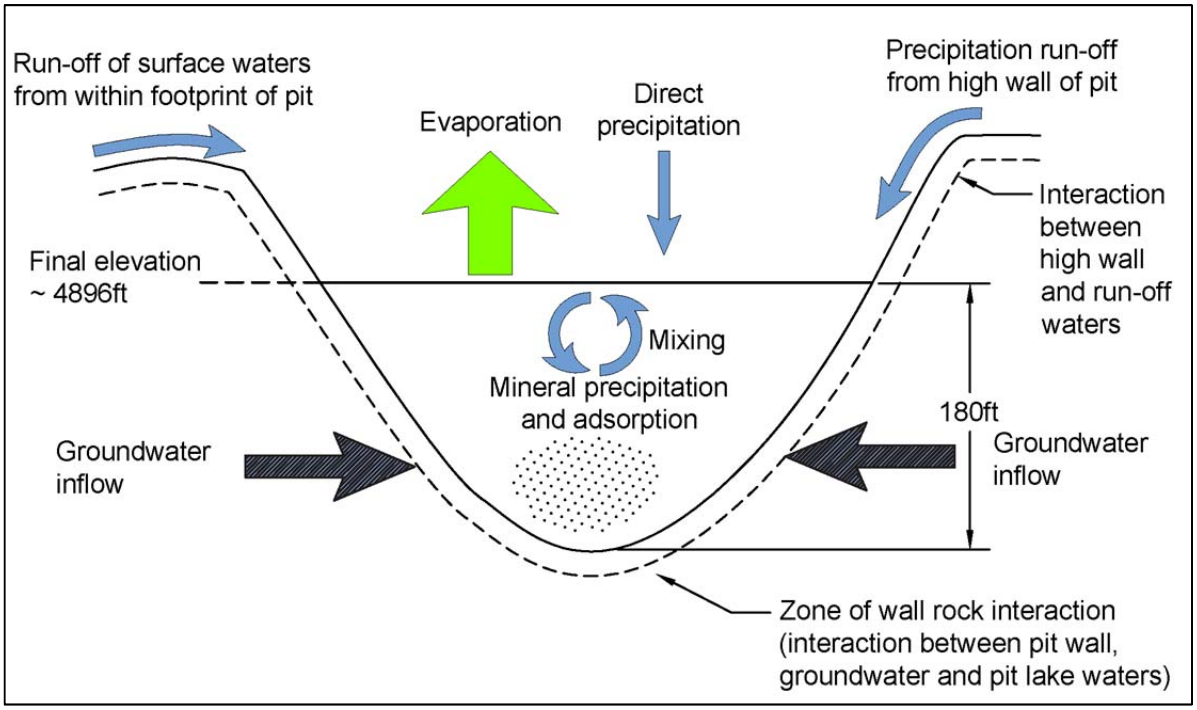


Figure 3-1: Conceptual Model

3.2 Geologic Model

3.2.1 Pit Wall Surface Areas

The proportional surface areas of the main lithologies that will be exposed in the final pit walls have been calculated from the geologic block model. The three dimensional surface areas of each lithology in the pit walls at the end of mine life are provided in Table 3-1 and are illustrated in Figure 3-2. This demonstrates that unoxidized quartz monzonite represents the dominant lithological unit that will be exposed in the final pit walls.

The geological block model was used to calculate the three dimensional surface area of each material type that will be exposed in the pit wall both above and below the water level as pit filling progresses. Three dimensional surface areas were calculated for each of the modeled time steps (i.e. for 0.5, 1, 2, 5, 10, 25, 50, 75, and 100 years after the start of pit lake formation).

Table 3-1: 3D Surface Areas of Pit Wall Rock Material Types

Material type	Oxidation	3D surface area (ft^2)	3D surface area (m^2)	Proportion
Andesite	Oxide / transitional	9,173	852	0.12%
Biotite breccia		-	-	-
Quartz feldspar breccia		6,703	623	0.09%
Quartz monzonite		79,578	7,393	1.01%
Coarse crystalline porphyry		27,277	2,534	0.35%
Undefined		47,881	4,448	0.61%
Andesite	Sulfide (non-ox)	86,611	8,046	1.10%
Biotite breccia		316,873	29,438	4.02%
Quartz feldspar breccia		491,257	45,639	6.23%
Quartz monzonite		5,794,482	538,325	73.5%
Coarse crystalline porphyry		1,022,725	95,014	13.0%
Undefined		-	-	-

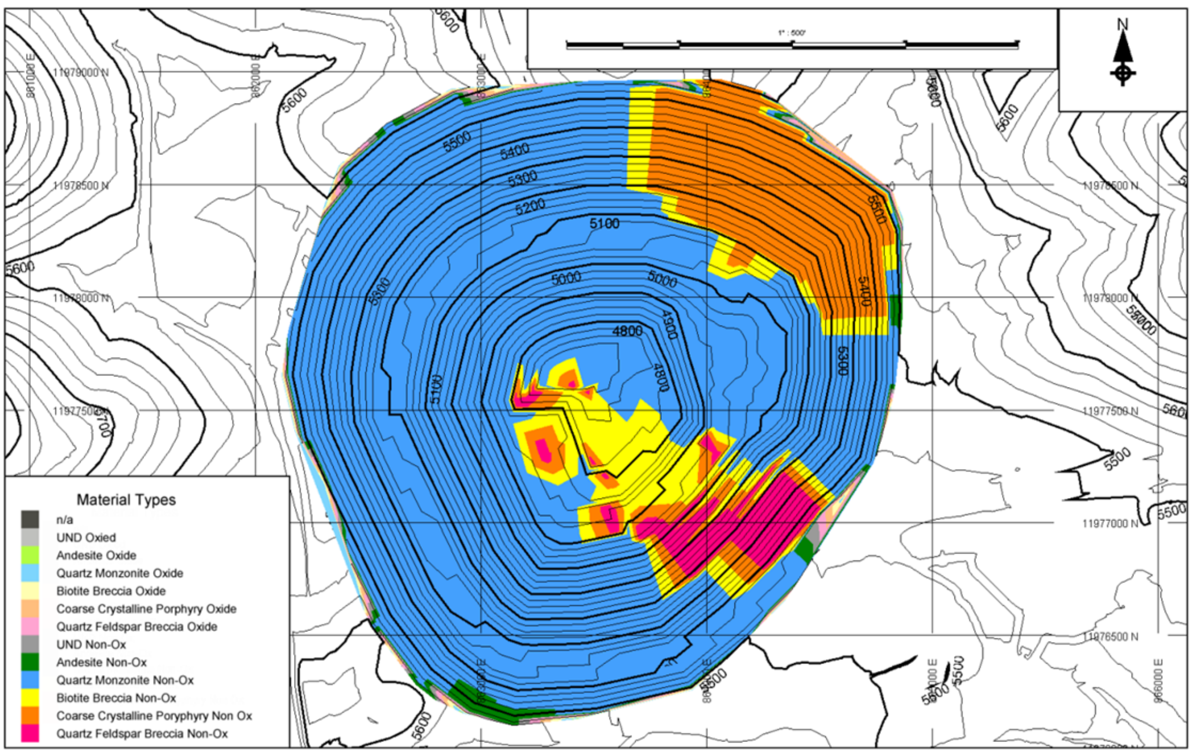


Figure 3-2: Exposed Material Types in Final Pit Walls

3.2.2 Calculation of Pit Wall Rock Available for Leaching

During the period of dewatering the pit walls will be exposed to oxygenated conditions and will weather to form secondary minerals, including soluble salts. As the pit wall resaturates during rebound of the groundwater table, soluble salts and other weathering products will dissolve into the ambient groundwater that drains into the pit. In addition, dissolution of these soluble salts by run-off waters in the unsaturated high wall of the pit may occur. In order that laboratory leach data can be used to determine the mass release of solutes under field leaching conditions, it was necessary to determine the total mass of material available for leaching in the pit walls based on the exposed surface areas of each lithology in both the unsaturated high wall and in the submerged pit walls.

1. An estimate of the reactive mass in the future pit high wall was made based on information provided by NMCC. Blasting practices at Copper Flat will include pre-split drilling and smooth wall blasting, which is considered best practice for geotechnical stability and will effectively reduce fracturing within the final pit walls. As such, a maximum estimated 1 foot thickness of reactive rock in the pit walls has been used as a conservative input to the model. It is assumed that fracturing in this zone will average 10% (Siskind and Fumanti, 1974). In addition, mineralogy work carried out by SRK on humidity cell tests undertaken on previous projects identified that particles generally show water infiltration and products of reactivity up to 0.04 feet into the rock fragments. Therefore a reactive rim of 0.04 feet thickness has also been assumed in the pit walls (Figure 3-3).

2. Water flow is assumed to be mobile within the crushed zone and oxidized rind and it is assumed that only this outermost layer is leached by precipitation that falls on the pit high wall. Therefore, the mass of rock calculated within the crushed zone and reactive rind is equivalent to the mass of rock available for leaching by surface run-off from the exposed high wall during life-of-mine (LOM) scenarios and also for the submerged high wall within the oxic pit lake zone during pit infilling. This is expanded on in Section 3.4.2. Although oxidation of sulfide minerals will occur within the fluctuation zone, it is unlikely that these oxidation products will be leached until pit infilling occurs and the inflow of groundwater becomes significant in the highwall post closure.

3. The calculated volumes were multiplied by approximate material densities to give a reactive mass of material taken for either the highwall, footwall or overburden materials. The calculations assumed an average rock density of 169 lb/ft^3 (2700 kg/m^3) (Young and Olhoeft, 1976).

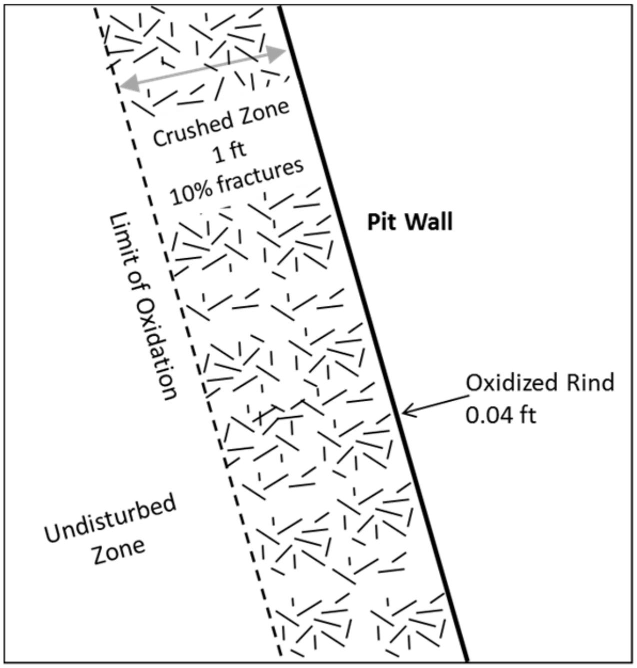


Figure 3-3: Future Pit Wall Conceptual Model

3.3 Hydrogeologic Model

Hydrogeologic modeling for the Copper Flat pit lake was undertaken by JSAI (2012). Post-mining pit water levels and a water balance were simulated assuming the pit geometry and watershed shown in Figure 3-4. The pit footprint area is 141 acres and the watershed area affecting the pit is approximately 230 acres. Upon cessation of mining, pumping will cease in and around the pit, allowing the pit to refill over a number of years (SRK, 1995). The primary solution inputs to the pit are assumed to be groundwater inflow, direct precipitation onto high walls of the pit and run-off from the pit walls (JSAI, 2012). Evaporation represents the dominant solution loss.

The final post-closure pit water elevation is estimated to be at an elevation of approximately 4,896 feet. The resulting lake would cover an area of about 17 acres with a depth of approximately 180 feet. The water level of the lake would fluctuate a few feet seasonally depending on precipitation and evaporation rates, rising during periods of lower evaporation (winter months) and decreasing during summer months.

The pit is expected to form a hydrologic sink, capturing groundwater flowing from all directions (INTERA, 2012; JSAI, 2011). Surface water from within the footprint of the pit will also be captured. Even with surface water inflows, the pit lake area is expected to be a hydraulic sink with evaporation rates greatly exceeding precipitation and groundwater inflows over most of the year (THEMAC Resources Group Ltd., 2012). Full details of the pit lake water balance can be found in the JSAI (2012) report.

Mine pit lakes can develop vertical density stratification that may be seasonal or permanent. The density of water is a function of both its temperature and its salinity or total dissolved solids (TDS) content. Freshwater is densest at a temperature of about $4^{o}C$. At a given temperature, water density increases with increasing TDS. As TDS increases, the temperature of the maximum density of water also decreases (Atkins et al., 1997; Parshley and Bowell, 2003).

Long-term (multi-year) or permanent density stratification can occur if a lake has a significant vertical variation in TDS due to large differences in the TDS of various source waters to the lake and/or to processes in the lake that increase the TDS. This in turn affects the density of the deeper water. For example, if a lake contains enough organic matter to deplete oxygen in the hypolimnion, then during the summer, ferric hydroxide that precipitates at the surface will sink, become reduced, and dissolve in the basal anoxic water, raising the TDS content and the density of the bottom water.

Water below the hypolimnion will generally become anoxic and will continuously dissolve any ferric hydroxide precipitates falling into it from above. This process further increases the TDS of the hypolimnion and strengthens the density gradient between it and the overlying layer, perpetuating the stratification. Sulfidization in the hypolimnion will lead to natural attenuation of metals and metalloids as well as sulfur. Few studies reporting site-specific limnological data have been published to date (Atkins et al., 1997; Parshley and Bowell, 2003). For Copper Flat, the presence of solute material that will modify pit lake chemistry (i.e., sulfide minerals and gypsum) will likely prevent permanent chemical stratification or layering of the lake. This was validated in the 1990s from depth sampling of the pit lake at Copper Flat (SRK, 1996), and in 2010 and 2011 from baseline data collection (INTERA, 2012). The results from this study demonstrated no stratification existed in the pit lake.

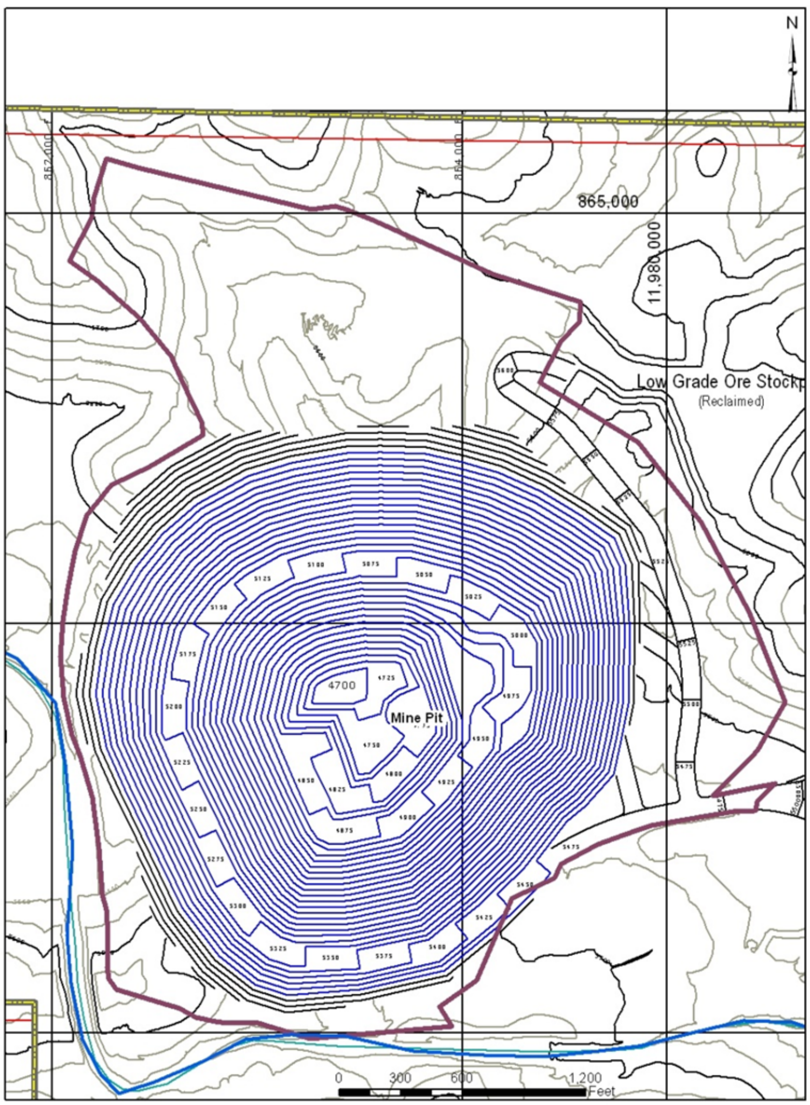


Figure 3-4: Ultimate Open Pit and Watershed

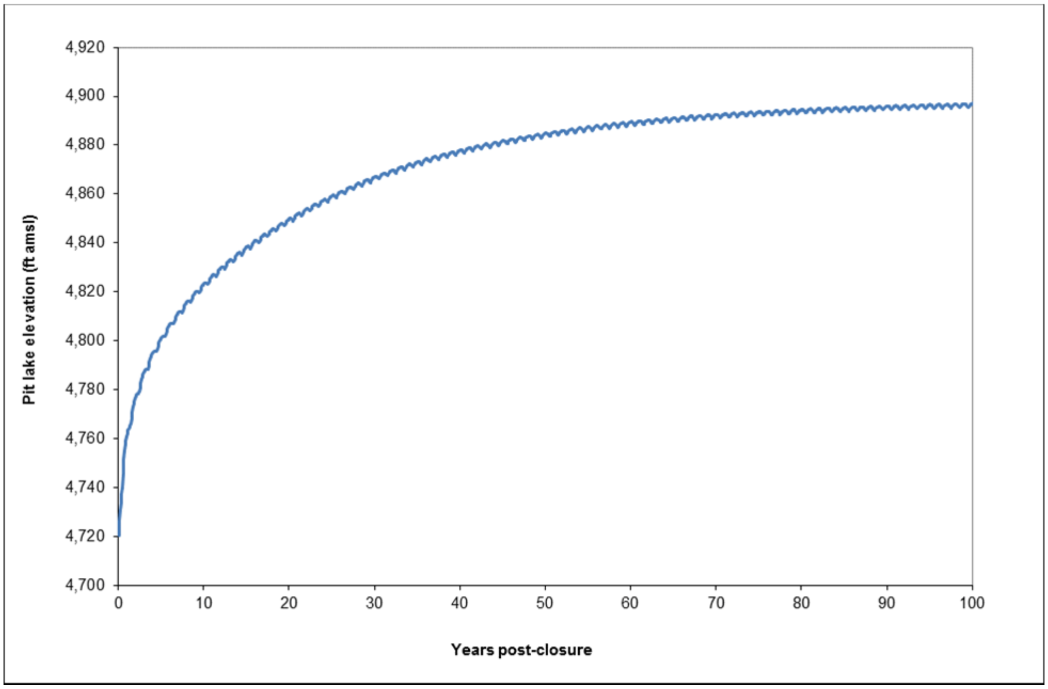


Figure 3-5: Pit Lake Elevation

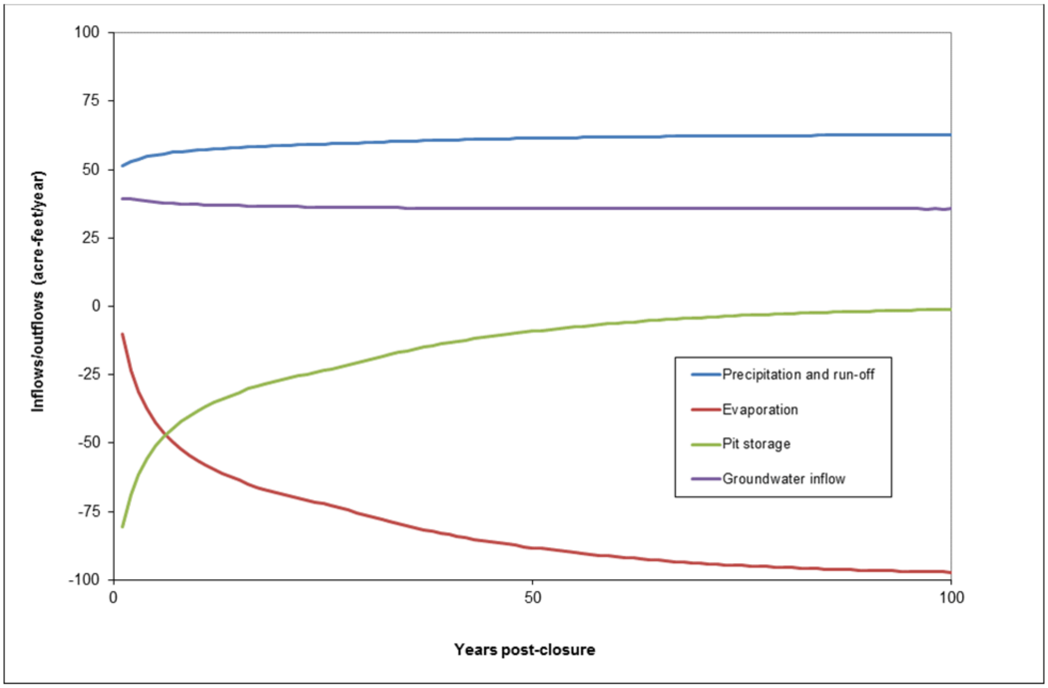


Figure 3-6: Pit Lake Flux

3.4 Solution Inputs

3.4.1 Groundwater Chemistry

Groundwater discharging into the pit lake will be a combination of inflowing regional groundwater plus additional solutes acquired through oxidation, desorption or dissolution reactions within the weathered pit walls. Therefore the chemistry of the groundwater source term for the Copper Flat pit lake model was represented by both hydrochemical data from the groundwater monitoring wells in addition to geochemical data from the ongoing HCT program.

Representative groundwater chemistry data were obtained from the groundwater monitoring program. Groundwater data collected from wells GWQ96-22A, GWQ96-22B, GWQ96-23A, and GWQ96-23B between 1996 and 2011 were used in the model, as these wells are the most representative of groundwater in the quartz monzonite and andesite bedrock. These lithologies will make up the majority of the final pit walls (Figure 3-2). Groundwater chemistry was then reacted in PHREEQC with source term for leaching of wallrock represented by the HCT leachate chemistries in the proportions defined by the geological block model (i.e. according to the surface areas of the various lithologies exposed in the final pit walls).

The average groundwater chemistry used as the input to the pit lake PHREEQC model is presented in Table 3-2 along with a comparison to NMWQCC groundwater standards and NMAC 20.6.4.900 wildlife habitat and livestock watering standards. From this comparison, all constituents are below the NMWQCC groundwater standards with the exception of fluoride, iron and manganese. In comparison to the wildlife habitat and livestock watering standards, all constituents are below the respective standards.

Table 3-2: Groundwater Chemistry used in the PHREEQC Model

Parameter	Units	NMWQCC groundwater standards*	NMAC 20.6.4.900 standards for livestock watering	NMAC 20.6.4.900 standards for wildlife	Groundwater chemistry *(average of samples collected from wells GWQ96-22A, GWQ96-22B, GWQ96-23A and GWQ96-23B between 1996 and 2013)*
pH	s.u.	6 – 9	-	-	7.85
HCO_3	mg/L	-	-	-	394
Aluminum	mg/L	5	-	-	0.41
Antimony	mg/L	-	-	-	0.002†
Arsenic	mg/L	0.1	0.2	-	0.003
Boron	mg/L	0.75	5	-	0.14
Barium	mg/L	1	-	-	0.09
Calcium	mg/L	-	-	-	87.1
Cadmium	mg/L	0.01	0.05	-	0.002†
Chloride	mg/L	250	-	-	49.1
Cobalt	mg/L	0.05	1	-	0.006†
Chromium	mg/L	0.05	1	-	0.006†
Copper	mg/L	1	0.5	-	0.014
Fluoride	mg/L	1.6	-	-	2.02
Iron	mg/L	1	-	-	1.49
Mercury	mg/L	0.002	0.01	0.00077	0.000002†
Potassium	mg/L	-	-	-	3.10
Magnesium	mg/L	-	-	-	19.8
Manganese	mg/L	0.2	-	-	0.66
Molybdenum	mg/L	1	-	-	0.02
Sodium	mg/L	-	-	-	117
Nickel	mg/L	0.2	-	-	0.025†
Lead	mg/L	0.05	0.1	-	0.005†
Sulfate	mg/L	600	-	-	96.9
Silica	mg/L	-	-	-	13.8
Silver	mg/L	0.05	-	-	0.018
Selenium	mg/L	0.05	-	0.005	0.003
Uranium	mg/L	0.03	0.05	-	0.002
Vanadium	mg/L	-	0.1	-	0.0009†
Zinc	mg/L	10	-	-	0.04
Ion balance	*%*	*-*	*-*	*-*	*0.60%*

(shaded)	*Indicates exceedance of NMWQCC*
†	*Indicates parameter is uniformly below detection limits in groundwater and was excluded from the PHREEQC input*
'-'	*Indicates no standard for parameter*

3.4.2 Wall Rock Chemistry

The mass of pit wall rock available for chemical weathering reactions in both the unsaturated high wall and the submerged pit wall was calculated from the three dimensional surface areas (Table 3-1) and using the estimated fracture density from SRK's experience with other ARD studies (see Section 3.2.2). All calculations used to determine the reactive rock mass in the pit walls assumed an average rock density of 169 lb/ft^3 (2700 kg/m^3) (Young and Olhoeft, 1976). The fracture density was used to determine the changes in run-off chemistry as precipitation that falls directly on the pit walls migrates through the reactive fracture zones. The modified chemistry of the precipitation from these pit rim reactions was then used as the source term contribution to the pit. Scaled and averaged data from kinetic humidity cell tests completed for representative samples as part of the SRK (2012) geochemical characterization program were used as the source term solutions for the pit wall run-off. The solutions used as inputs to the geochemical model are provided in Table 3-3.

3.4.3 Precipitation Chemistry

For the purposes of the geochemical model, the primary wall rock lixiviant for the high walls was assumed to be rainwater. Representative rainwater chemistry data were obtained from monthly monitoring carried out between 1985 and 2011 at the Gila Cliff Dwellings National Monument meteorological station, Catron County, New Mexico (NADP, 2012) (Figure 3-7). In the absence of any site-specific rainwater chemistry, this is considered the most representative precipitation chemistry available for use in the modeling exercise. For the purpose of the model, average rainwater chemistry data for the period 1985 to 2011 were used (see Table 3-4).

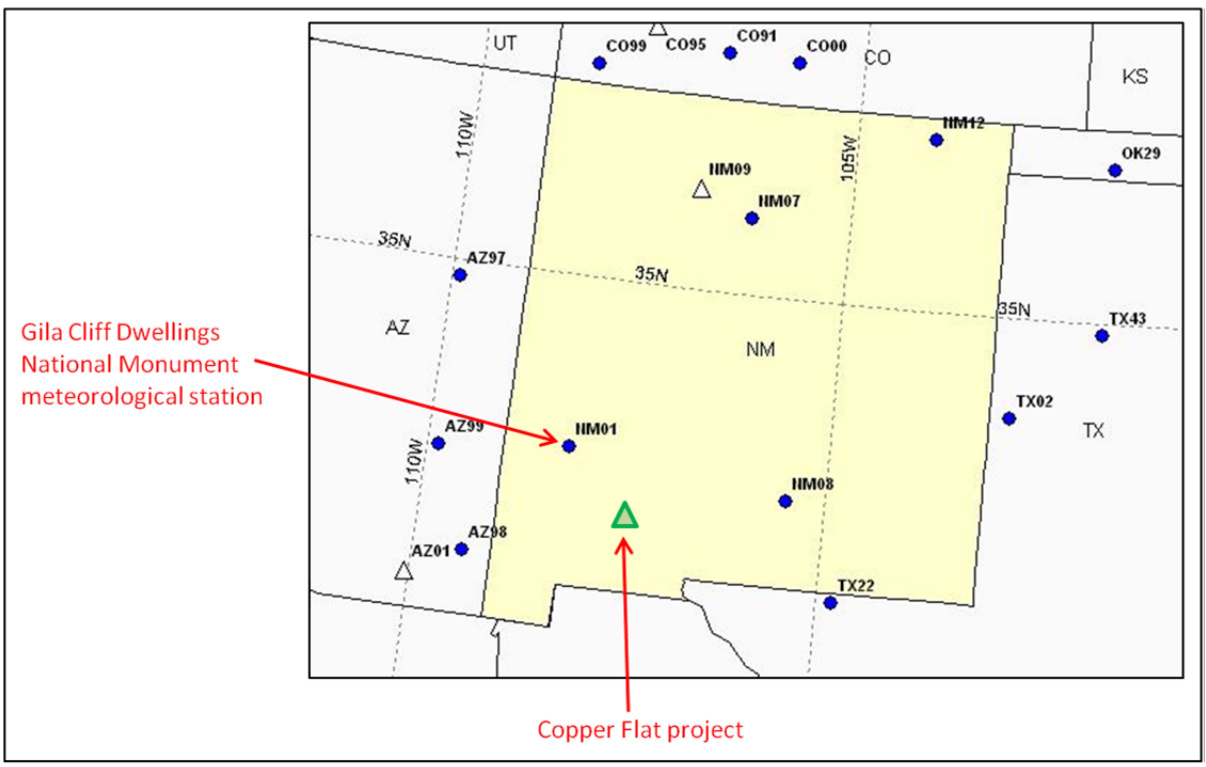


Figure 3-7: Location of Gila Cliff Dwellings National Monument Meteorological Station

Table 3-3: Source Term Chemistry for Each Material Type in the Pit Walls

	Units	Andesite	Biotite breccia - oxide/ transitional	Biotite breccia - sulfide	Quartz feldspar breccia - oxide/ transitional	Quartz feldspar breccia - sulfide	Quartz Monzonite - oxide/ transitional	Quartz Monzonite - sulfide	Coarse crystalline porphyry - oxide/ transitional	Coarse crystalline porphyry - sulfide
		Cells SRK 0864 and SRK 0866	*Cells SRK 0854 and SRK 0872*	*Cells 604811, 604854, 604862, 604867 and 605033*	*Cells 604767 and 604787*	*Cells 604767 and 604787*	*Cells 604569 and SRK 0867*	*Cells 604562, 604606, 604653, 604656, 604669, 604673 and 605153*	*Cell CF-11-02 (0-27)*	*Cell CF-11-02 (367-408)*
Percentage of waste (%)		*1.06%*	*0.05%*	*1.10%*	*0.09%*	*4.48%*	*2.78%*	*75.4%*	*0.93%*	*14.0%*
pH	s.u.	7.38	5.52	7.91	7.80	7.80	7.12	6.82	7.94	7.80
Alkalinity	mg/L as HCO_3	11.1	3.44	54.4	28.1	28.1	15.6	30.1	33.2	21.6
Aluminium	mg/L	0.008	0.27	0.01	-	-	0.05	0.01	0.01	0.05
Arsenic	mg/L	-	0.0006	0.0005	-	-	-	-	-	-
Boron	mg/L	-	-	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Calcium	mg/L	9.23	23.8	28.9	17.4	17.4	19.0	15.4	10.7	7.69
Cadmium	mg/L	-	0.002	-	-	-	0.0004	-	-	-
Chloride	mg/L	0.39	0.30	1.09	0.83	0.83	0.57	1.41	0.78	1.26
Chromium	mg/L	0.0002	-	-	-	-	-	-	-	-
Copper	mg/L	0.002	17.4	0.011	-	-	0.51	0.035	-	0.006
Fluoride	mg/L	0.46	0.31	1.23	0.92	0.92	0.66	0.71	0.94	0.60
Iron	mg/L	0.002	0.47	-	-	-	0.059	0.002	0.006	0.004
Mercury	mg/L	0.000005	-	-	-	-	-	0.00001	0.00005	0.00002
Potassium	mg/L	1.00	0.99	5.05	2.53	2.53	1.73	3.46	2.66	1.95
Magnesium	mg/L	1.41	1.41	4.17	3.92	3.92	2.46	2.76	1.95	0.53
Manganese	mg/L	0.01	0.28	0.04	0.12	0.12	0.28	0.09	0.02	0.008
Molybdenum	mg/L	0.008	0.033	0.013	0.011	0.011	0.006	0.011	0.005	0.002
Sodium	mg/L	1.91	0.40	2.93	1.94	1.94	-	3.16	2.87	2.49
Nickel	mg/L	0.0005	0.0045	0.0005	0.0006	0.0006	0.0061	-	-	-
Lead	mg/L	0.0001	0.0016	-	-	-	-	0.0003	-	0.0002
Sulfate	mg/L	23.4	97.6	52.6	39.5	39.5	51.8	32.6	13.8	8.57
Antimony	mg/L	0.0001	0.0002	0.0002	0.0002	0.0002	0.0015	0.0002	-	0.0001
Selenium	mg/L	0.0003	0.002	0.003	0.002	0.002	0.001	0.001	-	-
Uranium	mg/L	0.0005	0.003	0.008	0.022	0.022	0.004	0.008	0.004	0.003
Vanadium	mg/L	0.002	0.001	0.006	0.003	0.003	0.002	0.003	-	-
Zinc	mg/L	0.0009	0.16	0.001	0.005	0.005	0.013	0.004	0.0005	-
Ion balance (%)		*0.44%*	*-21.8%*	*0.61%*	*1.29%*	*1.29%*	*-2.57%*	*0.50%*	*1.99%*	*1.66%*

- Indicates parameter was uniformly below analytical detection limits in the HCT effluent leachates and was excluded from the PHREEQC model input for the specified material type

Table 3-4: Precipitation Chemistry used in the Model

Parameter	Units	Concentration
pH	s.u.	4.93
Ca	mg/L	0.21
Mg	mg/L	0.02
Na	mg/L	0.08
K	mg/L	0.03
Cl	mg/L	0.12
SO_4	mg/L	0.86
NH_4	mg/L	0.17
NO_3	mg/L	0.83

3.5 Mineral and Gas Phase Equilibration

For the purpose of the predictive geochemical model, it was assumed that the leachates produced from each lithology in the pit walls would mix evenly and completely. Under these circumstances the solutes in these waters will react with each other and may form chemical precipitates if the concentrations and geochemical conditions (Eh, pH, pCO_2, pO_2, and ionic strength) allow super saturation to occur. The geochemical model required the specification of a number of equilibrium phases that were allowed to precipitate if they become oversaturated. The suite of minerals chosen was based on the geology and mineralization of the deposit and an understanding of the types of minerals commonly observed in waste rock leachates.

The relative saturation of all minerals was calculated by comparing the calculated concentration of dissolved ionic pairs with their theoretical thermodynamic limit. Where these values were equal, the saturation index was zero and the solution was said to be at equilibrium with that mineral. At equilibrium, any amount of the mineral that dissolves will precipitate to maintain the relative solute: mineral balance. The minerals that were allowed to form in the geochemical model are given in Table 3-5. Precipitates will sink to the bottom of the pit lake and be removed from future chemical interactions as a sediment layer accumulates on the pit bottom. These precipitated mineral phases are unlikely to re-dissolve unless the pH or redox conditions of the pit lake change substantially. As such, the model assumes that precipitated mineral phases are removed from the system and that subsequent re-dissolution of these phases does not occur.

Table 3-5: Equilibrium Phases Included in the Pit Lake Geochemical Model

Equilibrium phase*	Ideal formula
Alunite	$KAl_3(SO_4)_2(OH)_6$
Anhydrite	$CaSO_4$
Ag_2Se	Ag_2Se
Barite	$BaSO_4$
$Ba_3(AsO_4)_2$	$Ba_3(AsO_4)_2$
Boehmite	AlOOH
Brochantite	$Cu_4^{2+}(SO_4)(OH)_6$
Brucite	$Mg(OH)_2$
Calcite	$CaCO_3$
Carnotite	$K_2(UO_2)_2(VO_4)_2.H_2O$
Cr_2O_3	Cr_2O_3
Chrysotile	$Mg_3Si_2O_5(OH_4)$
Diaspore	α-AlOOH
Epsomite	$MgSO_4.7H_2O$
Ferrihydrite	$5Fe_2O_3.9H_2O$
Fluorite	CaF_2
Gibbsite	$Al(OH)_3$
Gummite	UO_3
Gypsum	$CaSO_4.2H_2O$
HgSe	HgSe
Magnesite	$MgCO_3$
Malachite	$Cu_2^{2+}(CO_3)(OH)_2$
Mirabilite	$NaSO_4.10H_2O$
$Ni_3(AsO_4)_2.8H_2O$	$Ni_3(AsO_4)_2.8H_2O$
$NiCO_3$	$NiCO_3$
Otavite	$CdCO_3$
Pyromorphite	$Pb_5(PO_4)_3Cl$
Rhodochrosite	$Mn^{2+}CO_3$
Rutherfordine	UO_2CO_3
Schoepite	$UO_2(OH)_2.H_2O$
Sepiolite	$Mg_4Si_6O_{15}(OH)_2.6H_2O$
SiO_2 (am-ppt)	SiO_2
Tenorite	$Cu^{2+}O$
U_3O_8	U_3O_8
UO_3	UO_3
$UO_2(OH)_2$ (beta)	$UO_2(OH)_2$ (beta)

3.6 Adsorption

In solution, trace element concentrations are mostly controlled by adsorption onto common mineral phases or are removed from solution through a process of co-precipitation. The models assumed that trace metals may be removed from solution via sorption onto freshly generated mineral precipitates such as iron oxides. Ferrihydrite ($5Fe_2O_3.9H_2O$) was selected as a sorption surface because it is a common sorption substrate in oxygenated natural waters and because the trace element sorption thermodynamic properties of these reactions are well defined by numerous empirical studies. Adsorption of soluble phases to hydrous ferric oxides (HFO) is highly pH dependent as is the solubility of HFO itself. Below a pH of around 4.5, only minimal sorption of most dissolved metal species is observed (Stumm and Morgan, 1996). The mass of ferrihydrite used in the models was assumed to be identical to the mass of the mineral phase ferrihydrite precipitated in the previous model iterations and is controlled by the chemistry of the system. The model assumes that the ferrihydrite is characterized by both strong (HFO_s) and weak (HFO_w) surface adsorption sites. In order to be consistent with the properties of ferrihydrite published by Dzombak and Morel (1990) the geochemical models assumed a surface site density of 0.2 moles of weak sites and 0.005 moles of strong sites per mole of ferrihydrite.

As with mineral phase precipitation, the adsorbed mass of trace elements removed through this mechanism is assumed in the conceptual model to be permanently removed from the system following incorporation and co-precipitation with the HFO phase. In the case of a major shift in pH or redox conditions, it is possible that material adsorbed to the HFO surface may be released. However, based on the HCT results available to date, a major shift in pH conditions is not likely.

3.7 Evapoconcentration

The pit lake will lose water through direct evaporation from the pit lake surface, thus solutes within the pit lake will evapoconcentrate. The only mechanism for removing solutes within the pit lake is the formation and settling of chemical precipitates and the adsorption of trace elements onto these particulates. The only mechanism for removal of water from the lake is evaporation.

3.8 Model Logic and Coding

The conceptual model developed for the Copper Flat pit lake (Section 3.1) has been translated into a numerical model using a geochemical thermodynamic equilibrium code and several limiting and simplifying assumptions. Water chemistry predictions were made using the USGS code PHREEQC, which has been rigorously tested and is the industry standard for pit lake, waste rock dump and tailings facility geochemical predictions. The PHREEQC models used a modified version of the minteq.v4 thermodynamic database supplied with the v2.17.4761 version of PHREEQC (released August 12th 2010). This database is widely used for geochemical modeling and was selected for this study because it includes the full range of elements for consideration in this water quality prediction as well as key sorption reactions for iron oxyhydroxides. The database was modified to include sorption data for manganese species.

The PHREEQC model consists of several components including the input data file, the thermodynamic database, the executable code and the output file. The input file consists of a series of logic statements and commands that define each of the components of the system and explains how these components interact. The input file is read by the executable code and commands are executed in a stepwise manner. Influent component waters were speciated and mixed to generate a series of intermediate waters, solid phases, and adsorbed phases. Selected outputs are specified and parceled out to various output files for analysis of results.

A logic flow diagram for the structure of the input code is provided in Figure 3-8 and discussed below. An example of the PHREEQC input code is provided in Appendix A.

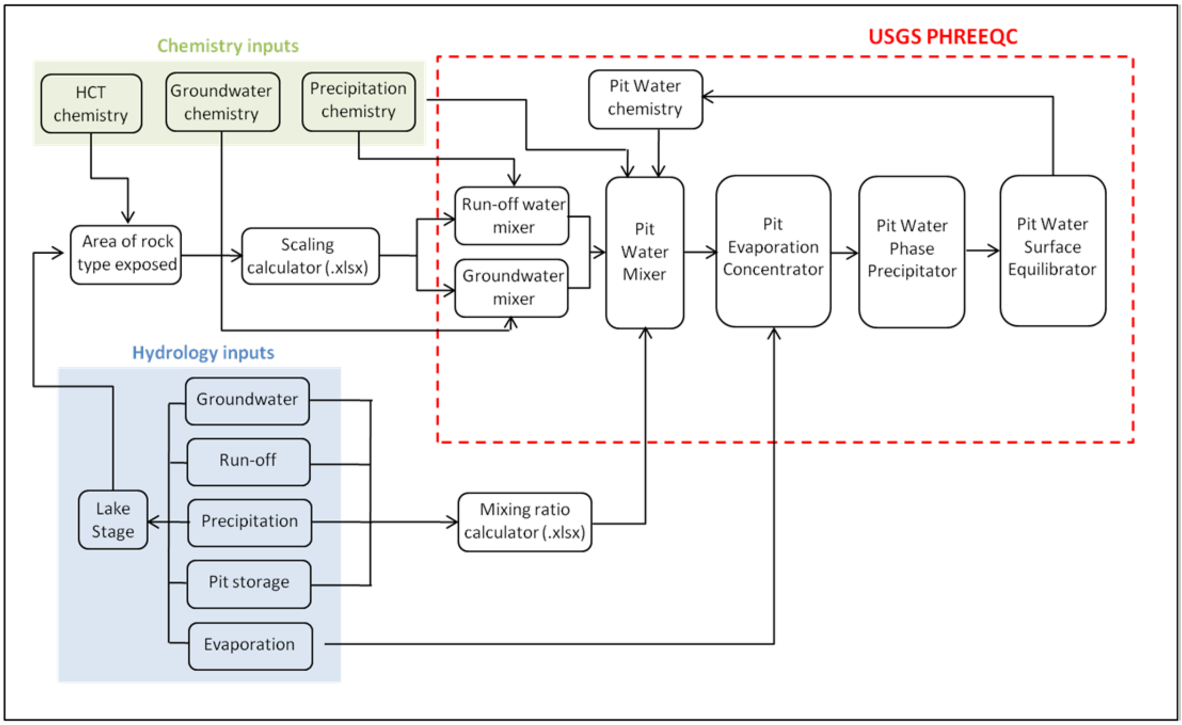


Figure 3-8: Copper Flat Pit Lake Model Execution Mechanics

The steps in the modeling process include the following items:

1. Define run-off water input specific to each exposed rock type. The run-off solution chemistries are comprised of scaled kinetic test cell leachate concentrations for each material type. These leachates are scaled to the water:rock ratio from the cell to the field based on the estimated presence of fractures in the wallrock and the thickness of the reaction rind.
2. Define the run-off solution mixing ratios. Mixing ratios are based on the amount of each material type that is sub-aerially exposed in the pit high wall at each time step.
3. Define the groundwater input. Groundwater chemistry is based on a mass addition function that combines the existing mass found within the groundwater with the mass of solute (per unit surface area and rock mass) released in the kinetic tests for specific material types exposed in the final pit walls. This is scaled to the water:rock ratio from the cell to the field, based on the estimated thickness of the reaction rind within the fractured wallrock.
4. Define groundwater solution mixing ratios based on the exposed surface area for each material type within the pit wall below the pit lake surface (i.e. within the submerged pit wallrock). As with the run-off mixing ratio, this ratio is dependent on the pit lake elevation and changes at each simulated time step.
5. Define precipitation water chemistry based on representative chemical analyses of rainwater.
6. Perform a master mixing calculation where run-off waters, groundwater, atmospheric precipitation and existing pit lake waters are mixed in ratios defined by the site-wide water balance for each time step.
7. Evapoconcentration. The resulting pit water is concentrated by a factor equivalent to the calculated evapoconcentration determined by the site-wide water balance for each determined time step. A fixed percentage of water is removed as a reverse titration of water. At the end of each titration, the volume of water is readjusted to one liter.

8. Equilibrate and precipitate. Once mixed, the model is equilibrated with atmospheric gases and select mineral phases are allowed to precipitate at the calculated pH, with pE fixed at a subatmospheric value equal to 12 – pH.
9. Calculate sorption. After mineral precipitation, trace elements were allowed to adsorb onto iron oxyhydroxides (i.e. ferrihydrite). The total mass of ferrihydrite is equivalent to the mass predicted to be generated during the previous reaction step. This assumption is conservative in that it does not account for sorption to other minerals such as aluminum oxide or clay, or to iron oxides present in the pit wallrock.
10. Save chemistry for the next time step. At the end of each time step, the predicted pit water chemistry is exported to a spreadsheet for analysis.
11. The model was terminated after sufficient iterations to simulate water quality over a 100-year filling period.

3.8.1 Treatment of Analytical Detection Limits

When analysis of HCT effluent leachates or source inflow groundwater identified certain elements to be uniformly at or below the analytical method detection limit (ADL) for a particular material type, that element was exempted from the PHREEQC evaluation. This prevents false exceedances of water quality standards that may arise as an artifact of the modeling exercise from the scaling of humidity cell data to field conditions or from equilibration of groundwater source data that are below analytical detection limits.

Nitrate was excluded from the geochemical predictions due to the lack of mineralogical controls in PHREEQC code. The exemption of nitrate is supported by the data as this parameter is consistently below analytical detection limits in both the humidity cell effluent leachates and the groundwater surrounding the pit. Nitrate is also below detection limits in the existing pit lake, supporting the assumption that this parameter is unlikely to be a problem during future operations.

3.9 Geochemical Modeling Assumptions

Despite site-specific data collection activities, several assumptions and model boundaries must be defined to construct a numerical model that predicts future water quality. Specific assumptions of the pit lake numeric models include:

1. Modeling is limited to predicting water quality under transient conditions with “steady-state” assumed for each time period modeled.
2. The geochemical model framework is defined by the water inputs and losses to/from the system.
3. The models are defined by the elements, mineral phases, gas phases, and chemical species specified in the model input files.
4. The models are limited to inorganic reactions and do not take into account the complexities associated with biologically mediated reactions.
5. The models are limited to thermodynamic equilibrium reactions and do not simulate the effects of reaction kinetics and rates.
6. The models rely on an external database of thermodynamic constants for mineral phase precipitates and sorbed surface complexes. These thermodynamic constants are valid at $25^{o}C$ and 1 atmosphere of pressure.

7. The models assume atmospheric equilibrium with oxygen and carbon dioxide gas, with pH + pE equal to 12 (based on calculations by Baas-Becking et al., 1960 to define stability limits of natural waters).
8. The models do not consider the effects associated with the formation and precipitation of mineral species other than those specified. Due to kinetic constraints, a portion of the potentially oversaturated mineral phases will not actually precipitate. A select suite of minerals is therefore specified that are allowed to precipitate based on relevance for the environment in question, site-specific knowledge, experience in evaluating kinetic constraints and relevance of key phases for given styles of mineralization (Eary, 1998).
9. The models assume that solution input chemistry can be simulated using laboratory leachate chemistries from HCT tests.

3.10 Analysis of Model Input Variability

The various parameters that have been used as data inputs for the pit lake geochemical model have been assessed to determine their relative significance in influencing the model results. For the purpose of this exercise, each parameter has been assigned a qualitative value based on the degree to which it influences the final predicted solution chemistry:

- "Minor" represents less than 1% control on the final model output;
- "Moderate" represents between 1% and 10% control on the final model output; and
- "Significant" represents between 10% and 50% control on the final model output.

The results of this exercise are displayed in Table 3-6.

Table 3-6: Analysis of Pit Lake Model Input Variability

Category	Parameter	Assumptions / data used in model	Source	Control on final model results*
Hydrogeologic information	Pit lake water balance	100-year water balance provided by JSAI, including water elevation and surface area, groundwater inflows, direct precipitation, run-off and evaporation data.	JSAI, 2012	Significant. The water balance defines the mixing ratios for the PHREEQC input solutions.
Chemical inputs	Groundwater chemistry	Baseline groundwater chemistry data from the ongoing monitoring program: • Average of data for wells GWQ96-22A, GWQ96-22B, GWQ96-23A and GWQ96-22B.	INTERA, 2012	Significant during the early years post-closure when groundwater is likely to represent the dominant solution input to the pit lake.
	Precipitation chemistry	Averaged precipitation chemistry from Gila Cliff Dwelling National Monument Meteorological Station (1985-2011)	NADP, 2012	Minor. The precipitation chemistry represents a near-pure solution chemistry. In the absence of site-specific data, published precipitation chemistry from this meteorological station in New Mexico is the best representation of precipitation chemistry in the area.
	HCT chemistry	Averaged HCT chemistry from the ongoing HCT programs.	SRK	Significant. The solutions generated by the HCT programs represent the main chemical inputs to the PHREEQC models.
Geological information	Pit wall surface area and lithologic composition	Pit wall surface areas were calculated for each simulated time step using the geologic block model and pre-feasibility study pit shell.	SRK/ THEMAC	Significant. The lithological composition of the pit wall defines the mixing ratios for the PHREEQC input solutions.
Geochemical model assumptions	Mass of pit wall rock available for reaction	Mass of future pit wall available for reaction was calculated assuming an oxidized rind of 0.04 feet thickness and a fractured zone of 1 feet thickness (with 10% fractures).	SRK/ THEMAC	Moderate. The values were assigned based on communication with NMCC regarding future blasting practices for the project and are considered a conservative estimate.
	Equilibrium/mineral phases	Alunite, Ag_2Se, albite, anhydrite, azurite, barite, boehmite, brochantite, brucite, calcite, chrysotile, Cr_2O_3, diaspore, epsomite, ferrihydrite, fluoride, gypsum, gibbsite, gummite, kaolinite, magnesite, malachite, mirabilite, otavite, pyromorphite, rhodochrosite, rutherfordine, schoepite, sepiolite, SiO_2; tenorite, U_3O_8, UO_3, $UO_2(OH)_2$	SRK	Moderate. Mineral precipitation will influence final solution chemistry. Equilibrium phases were selected based on knowledge of site-specific geologic and mineralogic conditions and were then verified and refined by calibrating with the existing pit lake chemistry.

* Minor: <1%
Moderate: 1 - 10%
Significant: 10 - 50%

3.11 Comparative Guidelines

Simulated pit lake water quality has been compared to NMAC 20.6.4.900 wildlife habitat and livestock watering standards. There is no existing or planned future use for aquatic life in the open pit water body. A Use Attainability Analysis (UAA) is being pursued to remove the designated use of aquatic life; therefore, only wildlife habitat and livestock watering standards are considered in this report. The standards used in the assessment are provided in Table 3-7.

Table 3-7: NMAC 20.6.4.900 Wildlife Habitat and Livestock Watering Standards

Parameter	NMAC 20.6.4.900 standards for livestock watering	NMAC 20.6.4.900 standards for wildlife†
As	0.2	-
B	5	-
Cd	0.05	-
Cr	1	-
Co	1	-
Cu	0.5	-
Hg	0.01*	0.00077*
Pb	0.1	-
Se	0.05	0.005*
V	0.1	-
Zn	25	-

Values in mg/L for dissolved constituent unless otherwise noted

* *Indicates standard applies to total (i.e. unfiltered) fraction*

† *'-' indicates no standard for parameter*

3.12 Existing Pit Lake Calculations

In addition to the predictions of future potential pit lake chemistry, numerical predictions have been undertaken to model the current (i.e. existing) pit lake chemistry to calibrate and verify the future pit lake geochemical predictions. A water balance for the period 1980 to 2014 was provided to SRK by JSAI and this was coupled with the results of the HCT testwork and data relating to the existing pit wall geology to carry out numerical simulations of existing pit lake water quality.

The water balance data used in the existing pit lake predictions are summarized in Figure 3-5 and Figure 3-6. In addition the pit wall surface areas (per lithology) are provided in Table 3-8.The method used to calculate existing pit lake water quality is the same as that described in Sections 3.2.2 to 3.8, above with the exception of the reactive mass assumed in the pit high wall.

During Quintana's operations, the existing pit at Copper Flat was not prepared using pre-split drilling and smooth wall blasting. Therefore, the existing pit wall has significantly deeper fracturing than predicted for the future final pit wall from the proposed operation. For this scenario, an estimate of the reactive rind thickness is provided by results from a U.S. Bureau of Mines experimental study on fracturing produced in the vicinity of large-diameter blast holes in Lithonia granite. From this study, a severely fractured zone (i.e., crushed zone) was identified that extends approximately 2 feet into the pit wall and a second zone (i.e., transition zone) characterized by a lesser degree of fracturing extends from 2 to 4 feet (Siskind and Fumanti, 1974). For this scenario it is assumed that oxygen infiltration extends no further than the predicted depth of fracturing of 2 feet, and that the percent of the rim rock mass fractured during mining will range from 5% within the crushed zone to 10% within the transition zone. This estimate of fracturing is supported by Atchison (1968). As described above, a reactive rim of 0.04 feet thickness has also been assumed in the pit walls. The conceptual model for the existing pit walls is provided in Figure 3-9.

Table 3-8: Pit Wall Surface Areas Used in the Existing Pit Lake Calculations

Material type	Oxidation	3D surface area (ft^2)	3D surface area (m^2)	Proportion
Biotite breccia	Oxide	137,327	12,758	13.2%
Quartz feldspar breccia		11,728	1,090	1.13%
Quartz monzonite		291,598	27,090	28.1%
Undefined		42,613	3,959	4.10%
Biotite breccia	Sulfide (non-ox.)	90,494	8,407	8.71%
Quartz feldspar breccia		46,096	4,282	4.44%
Quartz monzonite		414,065	38,468	38.9%
Undefined		5,154	478	0.50%

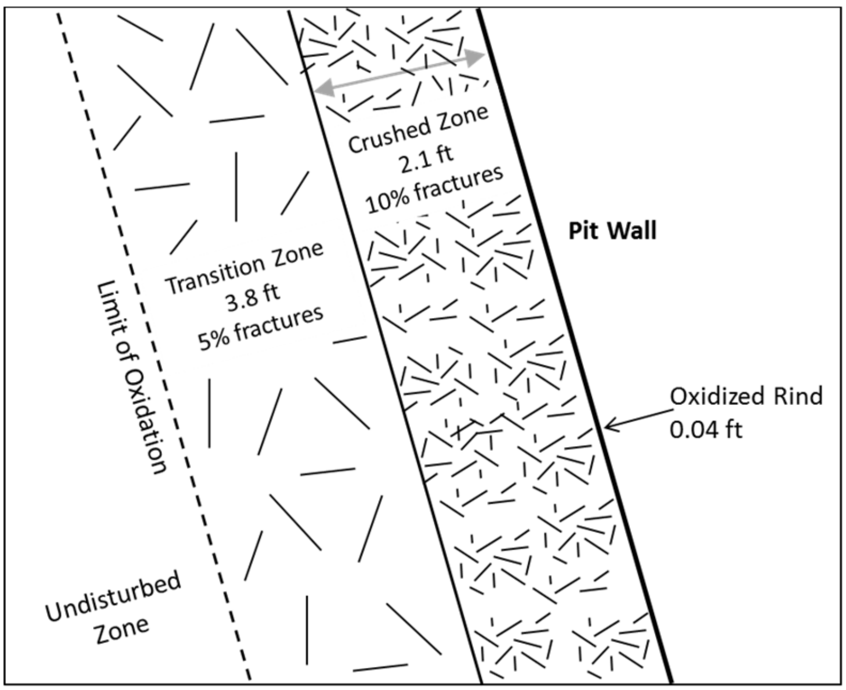


Figure 3-9: Existing Pit Wall Conceptual Model

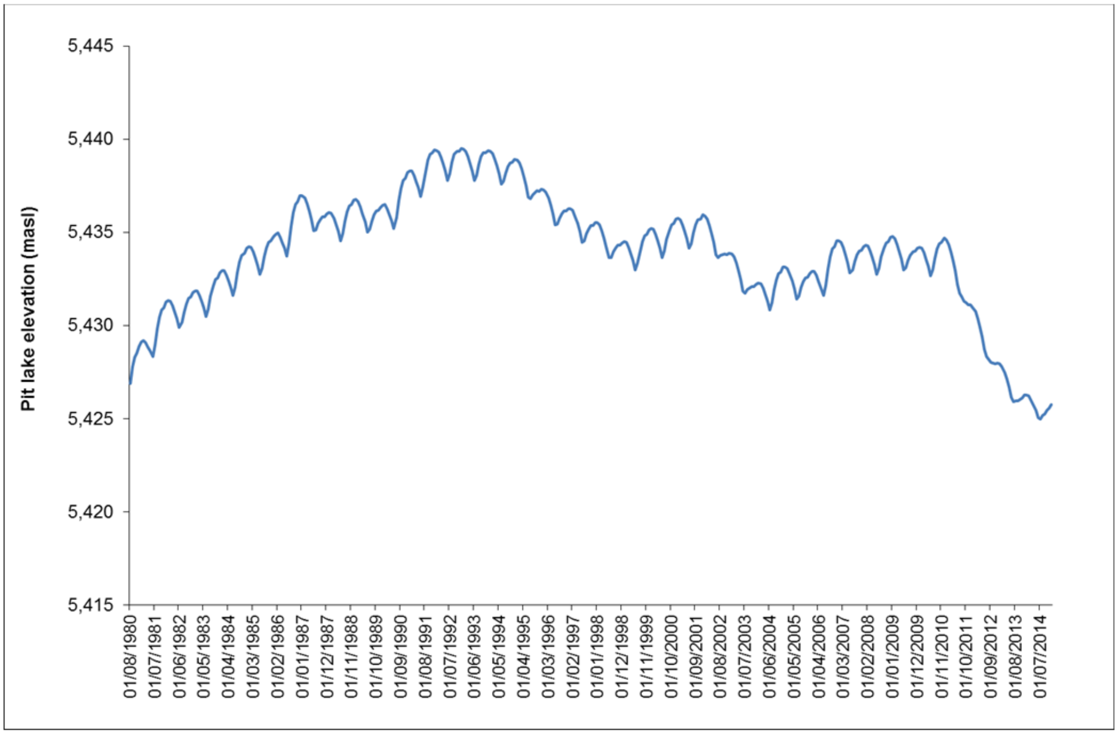


Figure 3-10: Existing Pit Lake Water Level

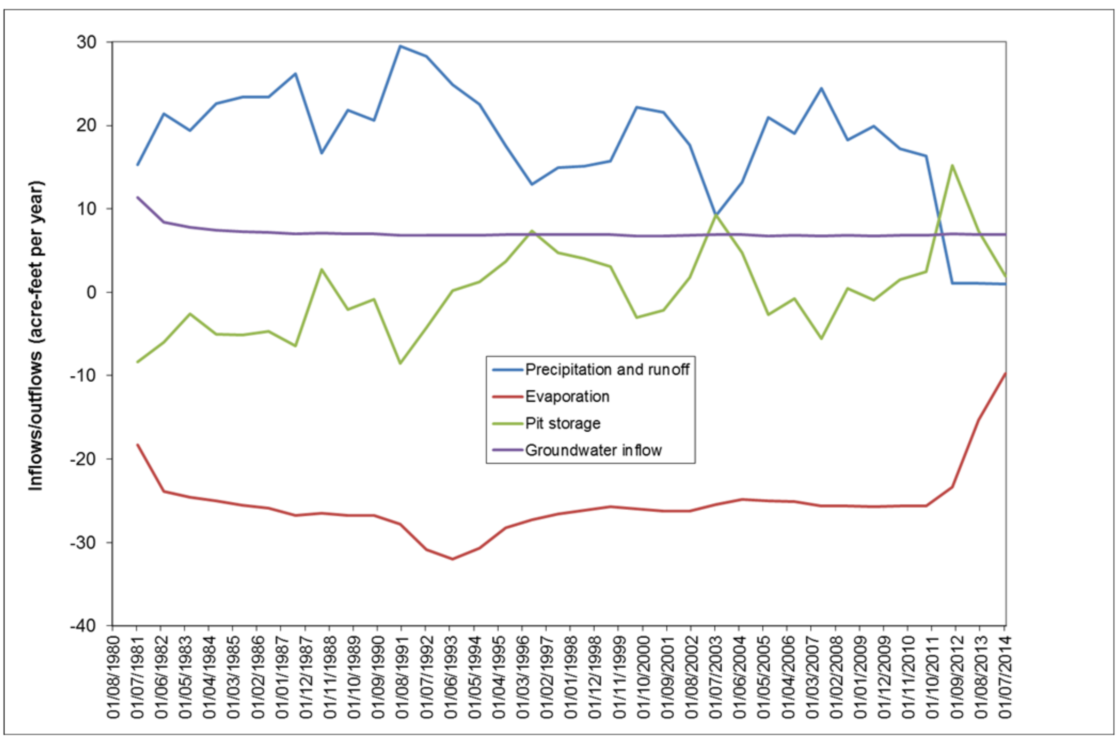


Figure 3-11: Existing Pit Lake Inflows/outflows

The results of the existing pit lake calculations are shown in Figure 3-12 and Table 3-9. The results show generally good correlation between measured and predicted pit lake water quality. This demonstrates that the input parameters used for the future pit lake water quality predictions are valid and the model approach produces generally reproducible results. However, the predicted concentrations for a number of parameters differ from the measured concentrations in the existing pit lake:

- The predicted concentrations of aluminum and iron are lower than the measured values. This discrepancy may relate to the fact that PHREEQC reports only truly dissolved phases. It is possible that aluminum and iron in the existing pit lake may exist in the form of fine-grained colloids that pass through a 0.45 µm filter, which explains the higher measured concentrations of these parameters.
- The predicted concentrations of antimony, boron, molybdenum, nickel, potassium, selenium, and vanadium are higher than the measured concentrations by an order of magnitude or more. This may relate to the lack of appropriate mineralogical controls for these elements in PHREEQC, resulting in a slight overestimate for these parameters. The over estimation and lack of attenuation or mineralogical controls is such that these elements cannot be accurately quantified by the modeling approach.

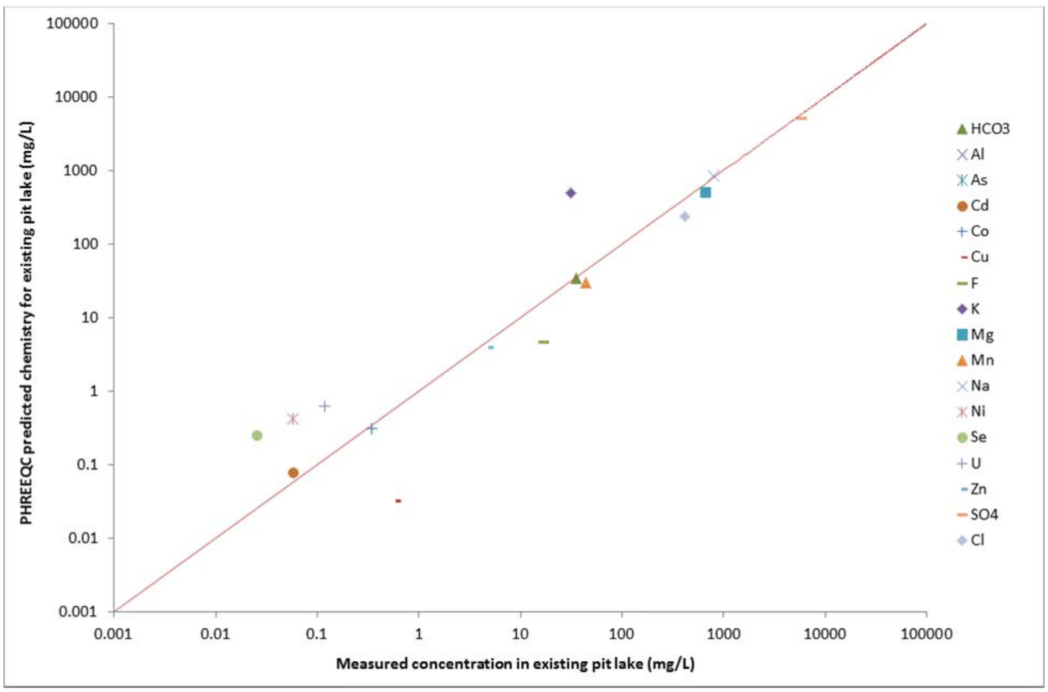


Figure 3-12: Predicted vs. Measured Pit Lake Chemistry for the Existing Pit Lake

Table 3-9: Predicted vs. Measured Pit Lake Chemistry for the Existing Pit Lake

			Measured chemistry in existing pit lake	PHREEQC predicted chemistry for existing pit lake
pH	**pH**	s.u.	7.35	7.90
pe	**pe**	s.u.	-	4.88
Alk	**Alkalinity as $CaCO_3$**	mg/L	-	74.8
HCO_3	**Bicarbonate**	mg/L	35.7	34.2
Ag	**Silver**	mg/L	<0.0025	0.001
Al	**Aluminum**	mg/L	0.502	0.0004
As	**Arsenic**	mg/L	0.003	0.0001
B	**Boron**	mg/L	0.16	2.44
Ba	**Barium**	mg/L	0.012	0.003
Ca	**Calcium**	mg/L	592	465
Cd	**Cadmium**	mg/L	0.06	0.08
Co	**Cobalt**	mg/L	0.34	0.30
Cr	**Chromium**	mg/L	0.012	0.0001
Cu	**Copper**	mg/L	0.60	0.03
F	**Fluoride**	mg/L	17.0	4.62
Fe	**Iron**	mg/L	0.04	0.0001
Hg	**Mercury**	mg/L	<0.002	0.001
K	**Potassium**	mg/L	31.0	492
Mg	**Magnesium**	mg/L	677	498
Mn	**Manganese**	mg/L	44.0	29.8
Mo	**Molybdenum**	mg/L	0.02	1.56
Na	**Sodium**	mg/L	792	831
Ni	**Nickel**	mg/L	0.058	0.42
Pb	**Lead**	mg/L	<0.005	0.00005
Sb	**Antimony**	mg/L	<0.001	0.09
Se	**Selenium**	mg/L	0.03	0.24
U	**Uranium**	mg/L	0.12	0.62
V	**Vanadium**	mg/L	<0.05	0.18
Zn	**Zinc**	mg/L	4.87	3.88
SO_4	**Sulfate**	mg/L	5,900	5,152
Cl	**Chloride**	mg/L	412	235
TDS	**Total Dissolved Solids**	mg/L	8,589	7,751

3.13 Future Pit Lake Results

The predicted pit lake chemistry for each of the post-closure time steps are summarized in Table 3-6 and are provided in Figure 3-13 to Figure 3-23 for selected parameters. These show predicted/modeled pit lake chemistry compared to New Mexico surface water standards for livestock and wildlife.

Pit lake waters are predicted to be moderately alkaline (pH ~8), with a magnesium plus sulfate (Mg + SO_4) major ion signature. During the early stages of pit infilling (i.e. first six months post-closure), the prediction is that an early flush will occur in cadmium, molybdenum, selenium, sodium, chloride, and sulfate concentrations in the pit lake. This initial flush occurs due to dissolution of soluble sulfate salts that will have developed on the pit walls during life of mine. Inflowing groundwater and direct precipitation on the pit lake surface will then provide some dilution and the effects of this initial flush will be dissipated. The pit lake chemistry is expected to evolve over time, with several parameters increasing in concentration as a result of evapoconcentration effects. This is similar to the trends observed in the existing pit lake, where elemental concentrations (particularly boron, cadmium, fluoride, magnesium, manganese, molybdenum, sodium, and sulfate) have increased over time (Figure 3-22). The macrochemistry (Mg-Na-SO_4) changes are reflected in the Piper plot in Figure 3-23, which shows a progressive change in pit lake major ion chemistry post-closure, with waters becoming increasingly dominated by sulfate and magnesium over time.

Pit lake chemistry is likely to be dominated by surface run off, evapoconcentration effects, and by equilibrium chemistry in the lake. Over time, the groundwater contribution will decrease as the pit lake is established. Both adsorption and the secondary mineral precipitation are likely to be the major controls on trace element chemistry. However, arsenic chemistry is likely to be controlled by sorption onto iron oxyhydroxides due to its strong affinity for these surfaces at the predicted pH of the pit lake.

Modeled pit lake chemistry has been compared against New Mexico surface water standards for livestock watering and wildlife and demonstrates following the initial flush post-closure, most parameters are expected to be below New Mexico livestock standards. The exception to this is selenium, which is predicted to exceed the livestock watering standard of 0.05 mg/L after 5 years. Mercury is also expected to increase in concentration over time, and is predicted to marginally exceed the stringent wildlife standard after approximately 15 years.

A number of parameters are predicted to increase in concentration over time, primarily as a result of evapoconcentration effects. The predicted increase in cadmium concentrations likely relates to both the presence of cadmium as a trace element in sphalerite in the Copper Flat mineralization (SRK, 2013) and also evapoconcentration effects over time with cadmium in the existing pit lake showing an increase from <0.005 mg/L in 1991 to 0.053 mg/L in 2011 (Appendix C). Nonetheless, cadmium concentrations are not expected to exceed the livestock watering standard of 0.05 mg/L in the future pit lake.

The predicted increase in boron concentrations over time may relate to the combined effects of evapoconcentration and the lack of appropriate mineralogical control in PHREEQC. Boron in the existing pit lake has been shown to increase slightly in concentration from <0.1 mg/L in 1989 to 0.18 mg/L in 2011 (Appendix C), indicating that marginal evapoconcentration effects may be taking place within the existing pit lake. However, the calibration model for the existing pit (Section 3.12) shows that PHREEQC overestimates boron concentrations by over fifteen-fold (over one order of magnitude), demonstrating that the mineralogical controls in PHREEQC may not be adequately controlling the boron chemistry. Although boron will be present at detectable concentrations in any future pit lake that forms, concentrations are not predicted to exceed the livestock watering standard of 5 mg/L.

Mercury concentrations are predicted to be marginally elevated above the stringent wildlife standard for approximately 15 years post-closure, with estimated concentrations between 0.001 mg/L (at year

25) and 0.003 mg/L (at year 100) compared to the wildlife standard for total mercury of 0.00077 mg/L. However, concentrations are not predicted to be elevated above the livestock watering standard of 0.01 mg/L for total mercury. The calibration model (Section 3.12) was able to accurately predict mercury concentrations in the existing pit lake, therefore the predicted future concentrations are likely to be a reasonable representation of mercury chemistry in any future pit lake that will form.

Selenium is predicted to be elevated above the wildlife standard in the future pit lake with concentrations ranging from 0.09 mg/L (at year 1) to 0.79 mg/L (at year 100) in comparison to the wildlife standard of 0.005 mg/L. This likely relates to the observed release of selenium from the sulfide humidity cells, particularly during the first 25 weeks of testwork. Selenium is present at detectable concentrations (~0.035 mg/L) in the existing pit lake and there is likely to be evapoconcentration effects over time due to the mobility of selenium at moderately alkaline pH, which will limit the formation of selenium-bearing mineral phases. However, the calibration model for the existing pit lake overestimates selenium by eight-fold (approximately one order of magnitude; Section 3.12). Most likely similar over-estimation issues will occur in the predictions for the future pit lake as well. Nonetheless, it is likely that selenium will be present at detectable concentrations in any future pit lake that forms.

The model results predict that vanadium concentrations may become marginally elevated above the livestock watering standard approximately 75 years post-closure, with predicted concentrations of 0.14 mg/L (at year 100) compared to a standard of 0.1 mg/L. Although the sulfide humidity cells showed detectable release of vanadium during the first 20 weeks of testing (Appendix B), the calibration model for the existing pit lake overestimates vanadium by approximately four-fold (Section 3.12). These results suggest the predicted exceedances for vanadium for the future pit lake relate to the lack of appropriate mineralogical controls for this element within the PHREEQC database rather than evapoconcentration. Based on the calibration model, the vanadium concentrations in the future pit lake are estimated to be approximately 25% of the predicted concentration, which reduces vanadium concentrations to below the livestock watering standard. Therefore, vanadium is predicted to be below the livestock standard in the final Copper Flat pit lake.

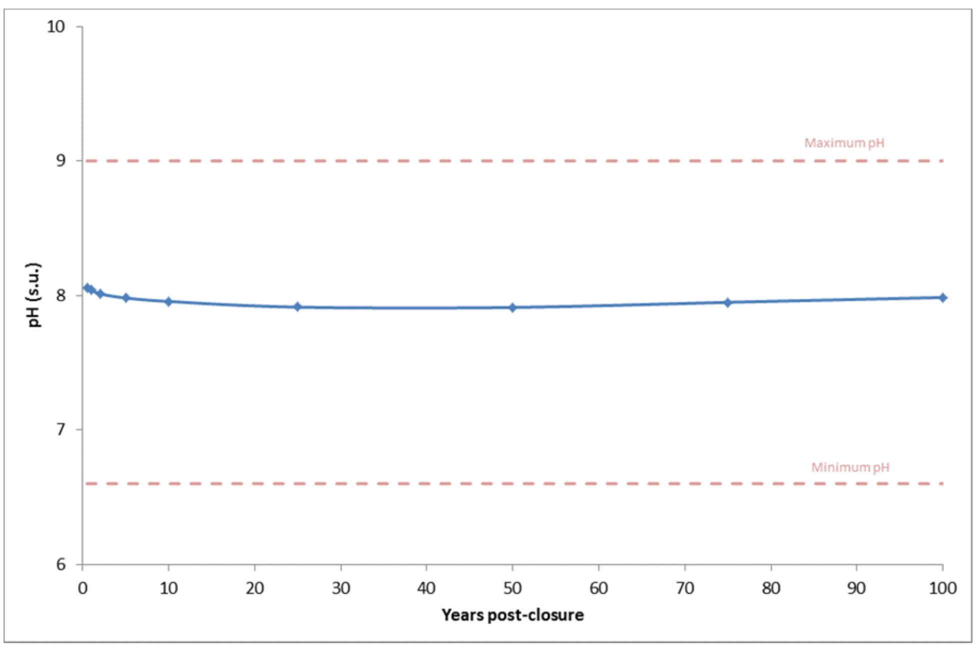


Figure 3-13: Time-series Plot of Pit Lake Predicted pH

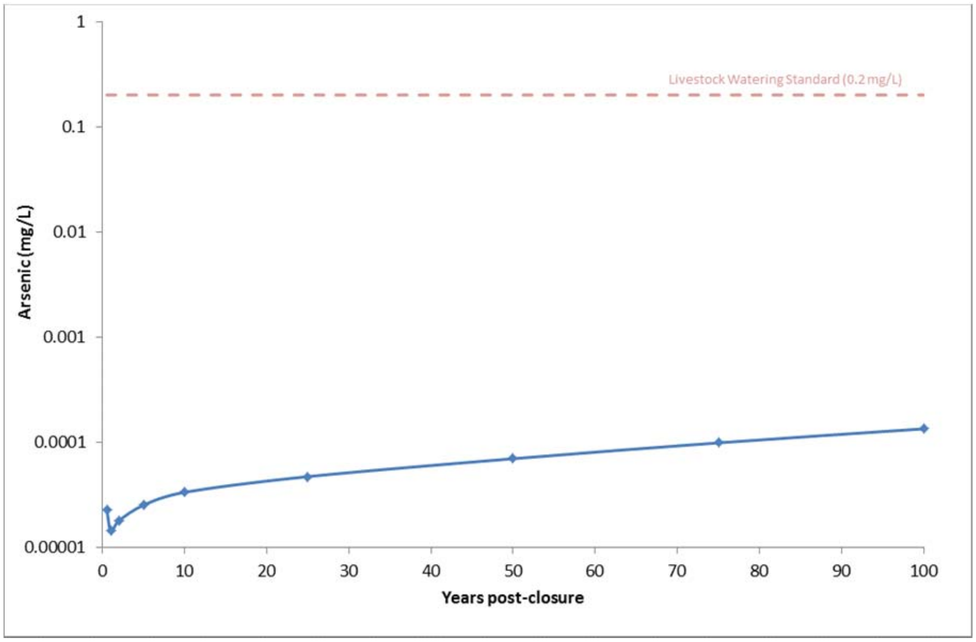


Figure 3-14: Time-series Plot of Pit Lake Predicted Arsenic

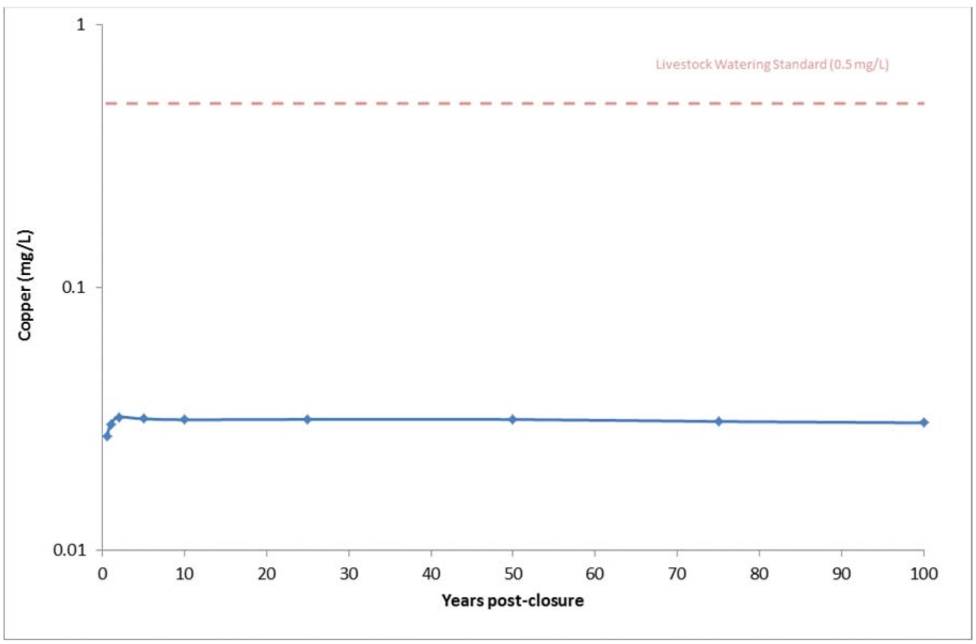


Figure 3-15: Time-series Plot of Pit Lake Predicted Copper

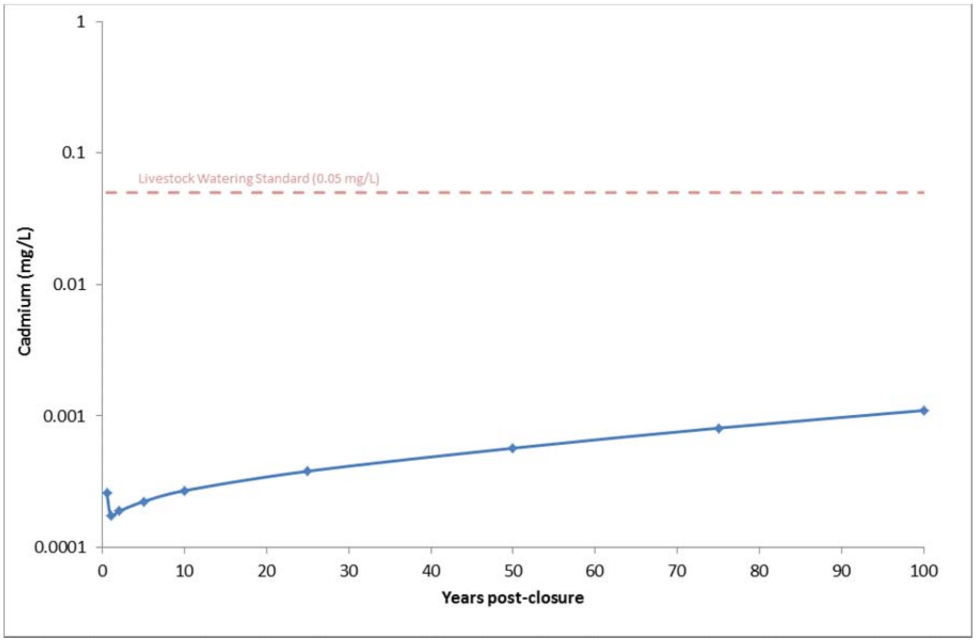


Figure 3-16: Time-series Plot of Pit Lake Predicted Cadmium

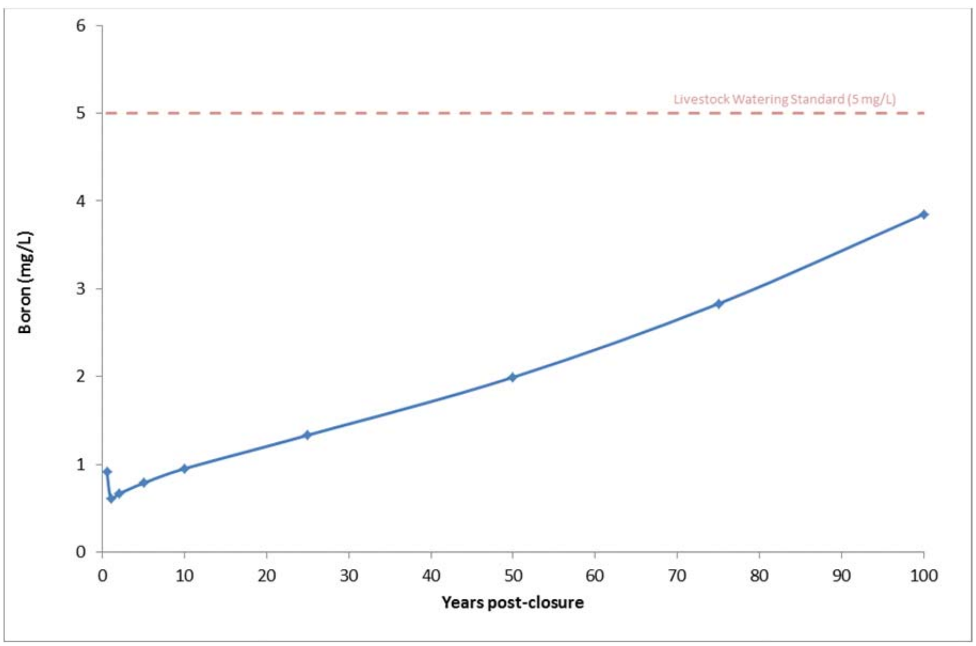


Figure 3-17: Time-series Plot of Pit Lake Predicted Boron

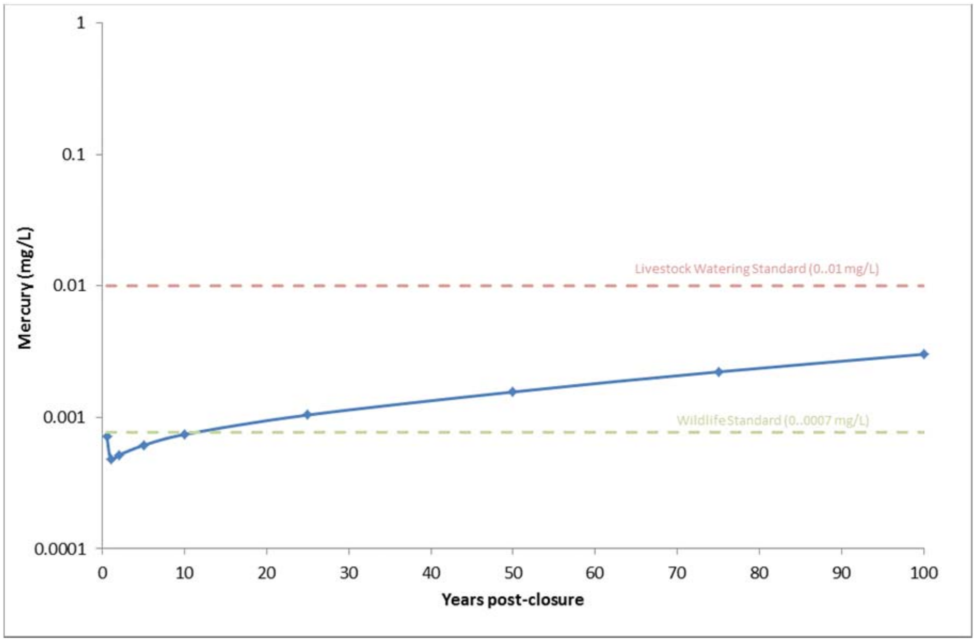


Figure 3-18: Time-series Plot of Pit Lake Predicted Mercury

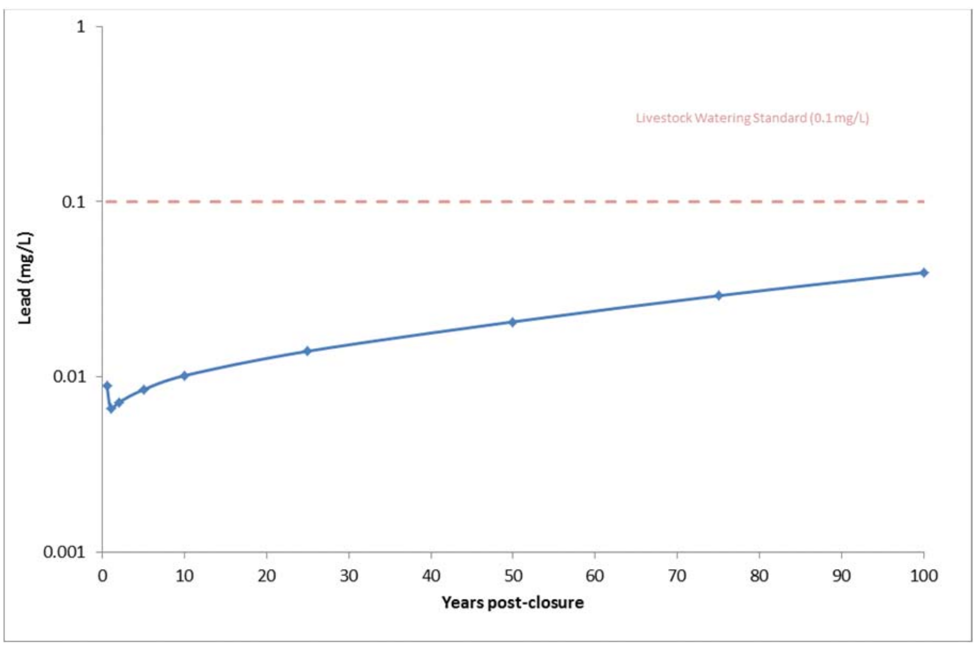


Figure 3-19: Time-Series Plot of Pit Lake Predicted Lead

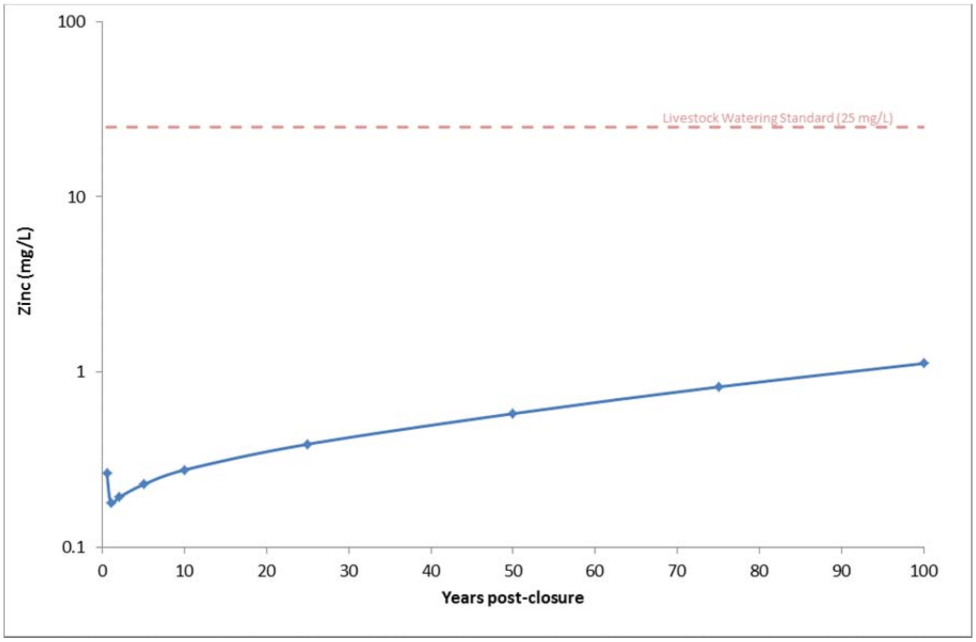


Figure 3-20: Time-Series Plot of Pit Lake Predicted Zinc

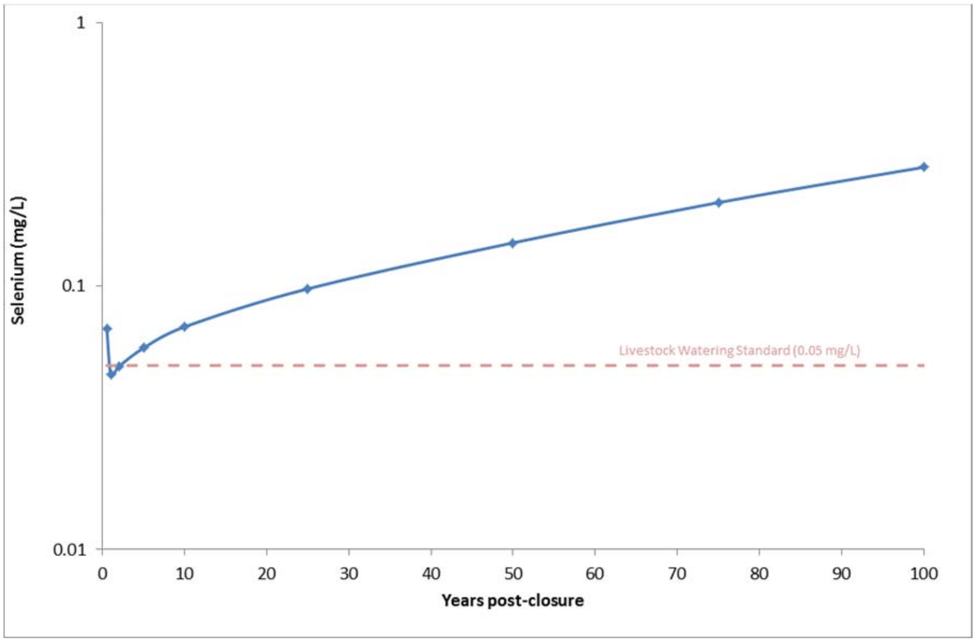


Figure 3-21: Time-Series Plot of Pit Lake Predicted Selenium

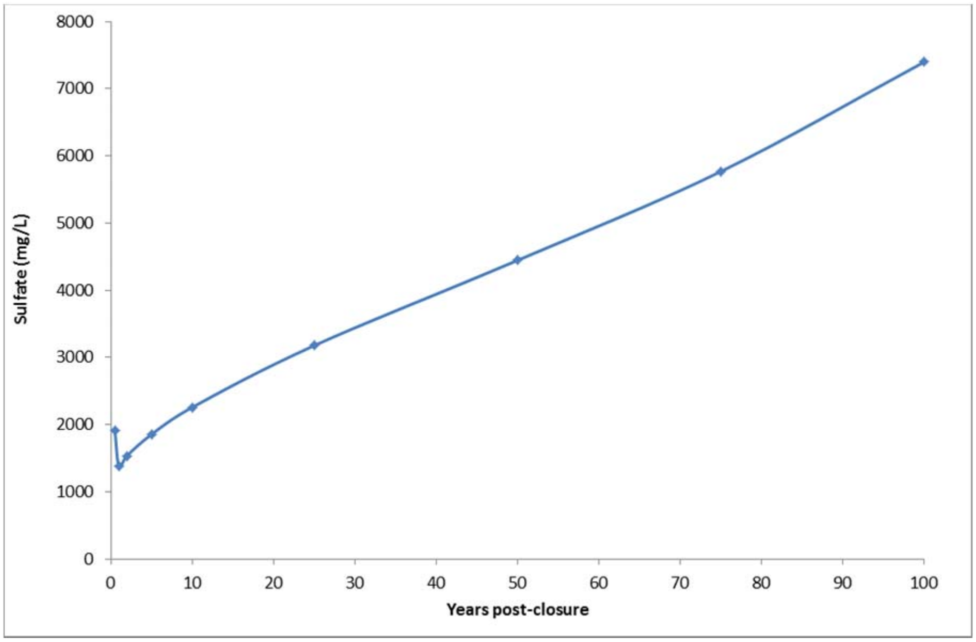


Figure 3-22: Time-Series Plot of Pit Lake Predicted Sulfate

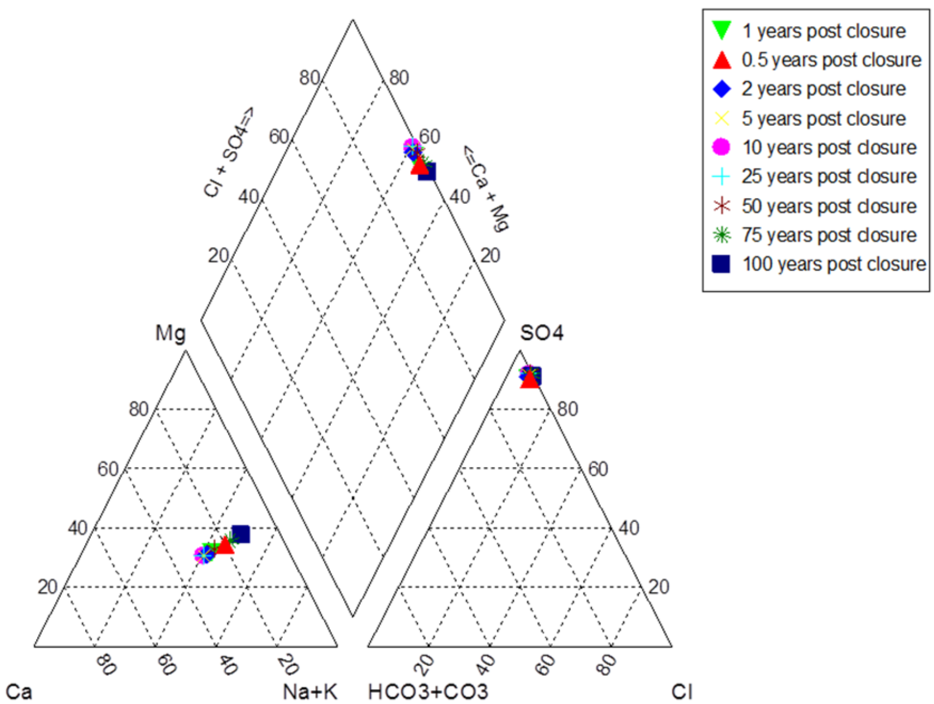


Figure 3-23: Piper Plot Showing Predicted Pit Lake Major Ion Chemistry

Table 3-10: Future Predicted Pit Lake Chemistry (Base Case Scenario)

			NMAC 20.6.4900 Surface water standards		Years post-closure								
			Livestock	*Wildlife*	0.5	1	2	5	10	25	50	75	100
pH	pH	s.u.	*6.6 - 9*		8.06	8.04	8.01	7.98	7.95	7.91	7.91	7.95	7.98
pe	pe	s.u.	-	-	4.72	4.73	4.76	4.79	4.82	4.86	4.86	4.82	4.79
Alk	Alkalinity as $CaCO_3$	mg/L	-	-	75.4	70.6	66.5	63.1	60.8	57.6	60.2	68.5	78.1
HCO_3	Bicarbonate	mg/L	-	-	44.4	41.8	39.4	37.4	35.9	33.8	34.8	39.0	43.6
Ag	Silver	mg/L	-	-	0.0006	0.0004	0.0005	0.0005	0.0006	0.0007	0.001	0.001	0.002
Al	Aluminum	mg/L	-	-	0.0006	0.0006	0.0005	0.0005	0.0005	0.0004	0.0004	0.0005	0.0005
As	Arsenic	mg/L	*0.2*	-	0.00002	0.00001	0.00002	0.00003	0.00003	0.00005	0.0001	0.0001	0.0001
B	Boron	mg/L	*5*	-	0.92	0.62	0.67	0.79	0.95	1.33	1.99	2.83	3.85
Ba	Barium	mg/L	-	-	0.005	0.006	0.006	0.005	0.005	0.004	0.004	0.003	0.003
Ca	Calcium	mg/L	-	-	173	160	193	239	292	409	480	454	431
Cd	Cadmium	mg/L	*0.05*	-	0.0003	0.0002	0.0002	0.0002	0.0003	0.0004	0.001	0.001	0.001
Co	Cobalt	mg/L	*1*	-	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02
Cu	Copper	mg/L	*0.5*	-	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
F	Fluoride	mg/L	-	-	3.96	3.97	4.19	4.02	3.93	3.82	4.15	4.94	5.84
Fe	Iron	mg/L	-	-	5.07E-05	5.08E-05	5.25E-05	5.46E-05	5.66E-05	6.03E-05	6.14E-05	5.94E-05	5.76E-05
Hg	Mercury	mg/L	*0.01*	*0.00077*	0.0007	0.0005	0.0005	0.0006	0.0007	0.001	0.002	0.002	0.003
K	Potassium	mg/L	-	-	215	145	156	185	224	314	471	669	910
Mg	Magnesium	mg/L	-	-	180	121	131	155	188	264	395	558	758
Mn	Manganese	mg/L	-	-	5.9	3.98	4.30	5.09	6.2	8.6	12.9	18.3	25.0
Mo	Molybdenum	mg/L	-	-	0.55	0.42	0.47	0.58	0.71	1.00	1.37	1.74	2.17
Na	Sodium	mg/L	-	-	329	221	239	281	338	471	701	993	1,349
Ni	Nickel	mg/L	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
Pb	Lead	mg/L	*0.1*	-	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04
Sb	Antimony	mg/L		-	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05
Se	Selenium	mg/L	*0.05*	*0.005*	0.07	0.05	0.05	0.06	0.07	0.10	0.15	0.21	0.28
U	Uranium	mg/L	-	-	0.005	0.005	0.004	0.003	0.003	0.003	0.00	0.01	0.02
V	Vanadium[1]	mg/L	*0.1*	-	0.05	0.04	0.04	0.04	0.05	0.06	0.07	0.10	0.14
Zn	Zinc	mg/L	*25*	-	0.27	0.18	0.19	0.23	0.28	0.39	0.58	0.82	1.12
SO_4	Sulfate	mg/L	-	-	1,907	1,374	1,536	1,853	2,256	3,176	4,445	5,767	7,398
Cl	Chloride	mg/L	-	-	124	83.6	90.3	107	128	179	267	378	514
TDS	Total Dissolved Solids	mg/L	-	-	2,985	2,155	2,394	2,869	3,475	4,862	6,814	8,887	11,441

Indicates exceedance of NMAC 20.6.4.900 standard for wildlife
Indicates exceedance of NMAC 20.6.4.900 standard for livestock watering

[1] Due to limitations on mineralogical controls, the geochemical code over predicts the concentration of vanadium as demonstrated by the calibration model.

'-' indicates no standard for parameter

3.14 Model Limitations

The pit water quality predictions presented herein are considered the best representation of likely future water quality associated with the Copper Flat pit lake. However, it is recognized that there are a number of limitations associated with the predictive calculations including:

- Modeling was limited to predicting water quality within the pit lake for a 100-year time period. This length of time was chosen as a period of regulatory interest, and is not intended to imply that the pit lake geochemistry or hydrogeology will achieve steady-state, hydrogeochemical equilibrium at 100-years. The lake is expected to continue to evolve hydrologically and geochemically after this period of time, but uncertainties related to extending predictions beyond the 100-year period diminish the utility of longer-term predictions.
- The model does not consider the effects associated with the formation and precipitation of mineral species other than those specified. Due to kinetic constraints, a portion of the potentially oversaturated mineral phases will not actually precipitate. A select suite of minerals is therefore specified that are allowed to precipitate, based on relevance for the environment in question, site-specific knowledge, experience in evaluating kinetic constraints and relevance of key phases for given styles of mineralization, and literature review (Eary, 1999).
- The models rely on an external database of thermodynamic constants, which have been developed under controlled laboratory conditions and are valid at 25^{o}C and 1 atmosphere of pressure. The nature of the thermodynamic databases means that the constants for all major elements and a large number of trace elements are well understood and have been rigorously tested and verified. However, constants for certain parameters (for example vanadium) are not as well understood. As such, the mineralogical controls on these elements in PHREEQC are poorly defined, which may affect their precipitation (i.e., removal) from solution in the predictive calculations. This limitation with the thermodynamic database is evidenced by the over-prediction of vanadium in the calibration model for the existing pit lake, demonstrating that the future pit lake prediction for vanadium is not a valid prediction.
- The results of the predictive calculations do not take into account site specific ecological risk. Model results indicate that mercury concentrations in the future Copper Flat pit lake are predicted to become marginally elevated above the wildlife standard approximately 15 years post-closure, with predicted concentrations between 0.001 mg/L and 0.003 mg/L compared to a standard of 0.00077 mg/L. Although above the stringent wildlife standard, the predicted mercury concentrations are uniformly (and significantly) below the livestock watering standard of 0.01 mg/L. Given that predicted mercury concentrations in the future pit lake are only marginally elevated above the wildlife standard, an ecological impact is unlikely. However, it is recommended that this is corroborated by coupling the results of the pit lake water quality predictions with site-specific ecological data to quantitatively evaluate potential toxicological risks.
- The model assumes that groundwater and surface water input chemistry can be simulated using laboratory kinetic (humidity cell) leachate chemistries, which are appropriately scaled to field conditions. The reactive surface area, ratio of water-to-rock and flushing rates in laboratory tests are different from actual field conditions. Grain size is smaller in the kinetic and static test cells and the resulting surface area for reactivity is greater. The laboratory test cells are operated at a higher water-to-rock ratio than would be expected in the field and are flushed more frequently, so that mineral-water reaction rates are enhanced. Because the future Copper Flat pit does not yet exist, field scale parameters cannot be measured, so scaling relies on published estimates of future groundwater flux and fracture density.

- The models have been developed using site-specific geochemical, hydrochemical, geological, hydrogeological and mine plan information. Therefore, changes in operational decisions may result in a change in the future pit lake water quality at Copper Flat.

4 Conclusions and Recommendations

SRK has undertaken a predictive geochemical modeling exercise to assess potential future pit lake chemistry associated with the Copper Flat project, New Mexico. The Copper Flat deposit is an alkalic copper-gold mineralized breccia pipe associated with, and genetically linked to, an alkalic porphyry system.

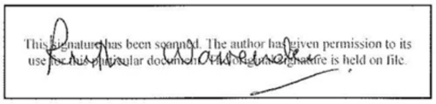
Waters in the future pit lake at Copper Flat are predicted to be moderately alkaline (pH ~8), primarily due to the buffering capacity of the inflowing groundwater. During the early stages of pit infilling (i.e., during the first six months post-closure), removal/flushing of soluble salts from the pit walls is likely to result in a flush in sulfate, cadmium, molybdenum, selenium, sodium, chloride, and sulfate concentrations in the early pit lake. The effects of this initial flush will be dissipated by inflowing groundwater and precipitation and pit lake chemistry will then evolve over time, with several parameters increasing in concentration as a result of evapoconcentration effects. This is similar to the trends observed in the existing pit lake, where elemental concentrations have increased since the start of pit infilling.

The model simulations demonstrate that all of the modeled chemical parameters are expected to be below New Mexico livestock standards (NMAC 20.6.4.900) in the 100 years post closure pit lake with the exception of selenium. Vanadium concentrations are reported above the livestock standard; however, due to limitations on mineralogical controls the current geochemical code over predicts the concentration of vanadium, as demonstrated by the calibration model. Once this is taken into account, vanadium is not expected to exceed the livestock standard.

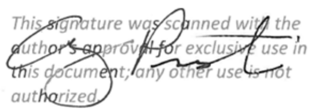
Mercury concentrations are anticipated to increase over time, but remain below the livestock standard (0.01 mg/L) through year 100, post closure. Mercury concentrations are predicted to be marginally above the wildlife standard of 0.00077 mg/L by year 25. However, this exceedance is minimal, and may not represent a true ecological risk to area wildlife within the Copper Flat project area.

SRK has provided NMCC with a plan of action for a Screening Level Ecological Risk Assessment (SLERA) to quantitatively evaluate the potential toxicological risks posed by the future pit lake at Copper Flat. A SLERA is a Tier 1 approach that utilizes both site-specific data and published ecological data to determine if further evaluation of potential ecological risks may be warranted. However, the predicted concentrations of selenium and mercury in the future Copper Flat pit lake are unlikely to present an environmental or ecological risk.

Prepared by

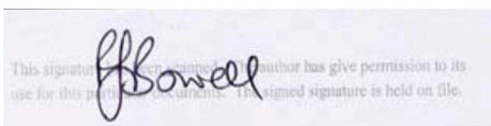


Ruth Warrender CGeol, PhD
Senior Consultant (Geochemistry)



Amy Prestia, M.Sc., P.G.
Senior Consultant (Geochemistry)

Reviewed by



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Appendix A – Example of PHREEQC Input File

```
Title Copper_Flat_base_case_v10

KNOBS
  -iterations      10000
  -convergence_tolerance 1e-007
  -tolerance       1e-016
  -step_size       100
  -pe_step_size     5
end

SELECTED_OUTPUT
  -file         Copper_Flat_base_case_v10.out
  -selected_out     true
  -high_precision    true
  -simulation      true
  -state        true
  -solution       true
  -distance       false
  -time         false
  -step         false
  -ph          true
  -pe          true
  -alkalinity      true
  -ionic_strength    false
  -water        false
  -charge_balance    false
  -totals        C(4) Ag Al As B Ba Ca Cd Co Cr
             Cu F Fe Hg K Mg Mn Mo
             Na Ni Pb Sb Se U V
             Zn S(6) Cl N(3) N(5)
  -saturation_indices  Gypsum

end

SOLUTION 1 Average rainwater chemistry (1985-2011) - Station NM01 (Gila Cliff Dwellings National
Monument), SW New Mexico. Data from National Atmospheric Deposition Program.
  temp  25
  pH    4.93
  pe    4
  redox N(-3)/N(5)
  units mg/l
  density
  Ca    0.209
  Mg    0.021
  Na    0.075
  K            0.030
  Cl    0.117
  CO2(g) -3.5
  S(6)  0.862 as SO4
  N(-3) 0.167 as NH4
  N(5)  0.826 as NO3
  C(4)  0.1
  -water  1 # kg
end

SOLUTION 2 Average groundwater chemistry for wells GWQ96-22A, GWQ96-22B, GWQ96-23A and GWQ96-23B for
samples collected between 1996 and 2011
  temp   25
  pH    7.85
  units   mg/l
  density  1
  Alkalinity 475 as HCO3
  Ag    0.019
  Al    0.406585
  As    0.0033375
  B            0.13925
  Ba    0.0908125
  Ca    87.1
  Cl    49.09090909
  Cu    0.01375
  F            2.02
```

```
  Fe   1.485666667
  K           3.1
  Mg   19.765
  Mn   0.656944444
  Mo   0.02375
  Na   116.9 charge
  S(6) 199.88 as SO4
  Se   0.002763636
  Si   13.75
  U           0.00178
  Zn   0.0431
  -water  1 # kg
end

TITLE Average HCT data

SOLUTION 3 Average HCT data for andesite oxide material (cells SRK 0864 and SRK 0866)
  temp   25
  pH    7.38
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 11.08233 as HCO3
  Al   0.00759
  Ba   0.00261
  Ca   9.22553
  Cl   0.39385
  F           0.46144
  Fe   0.00193
  K           0.99643
  Mg   1.40610
  Mn   0.00954
  Mo   0.00764
  Na   1.91012 charge
  S(6) 23.36270 as SO4
  Se   0.0003
  U           0.00047
  V           0.00169
  Zn   0.00092

  -water  1 # kg
END

SOLUTION 4 Average HCT data for biotite breccia - oxide/transitional (cells SRK 0854 and SRK 0872)
  temp   25
  pH    5.52
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 3.44165 as HCO3
  Al   0.27201
  As   0.00058
  Ba   0.00775
  Ca   23.80767
  Cd   0.00230
  Cl   0.30258
  Co   0.01016
  Cu   17.37509
  F           0.30884
  Fe   0.46664
  K           0.98984
  Mg   1.40751
  Mn   0.28452
  Mo   0.03340
  Na   0.40453 charge
  Ni   0.00445
  P           0.06138
  Pb   0.00155
  S(6) 97.56344 as SO4
  Sb   0.00018
```

```
  Se   0.00190
  U           0.00313
  V           0.00138
  Zn   0.15709

  -water  1 # kg
END

SOLUTION 5 Average HCT data for quartz feldspar breccia - oxide/transitional (cells 604767 and
604787)
  temp   25
  pH    7.80
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 28.14382 as HCO3
  B           0.01018
  Ba   0.01079
  Ca   17.42309
  Cl   0.83411
  Co   0.00078
  F           0.91743
  K           2.53353
  Mg   3.91833
  Mn   0.12244
  Mo   0.01061
  Na   1.94262 charge
  Ni   0.00064
  S(6)  39.53068 as SO4
  Sb   0.00019
  Se   0.00217
  U           0.02169
  V           0.00281
  Zn   0.00497

  -water  1 # kg
END

SOLUTION 6 Average HCT data for quartz monzonite- oxide/transitional (cells 604569, SRK 0858 and SRK
0867)
  temp   25
  pH    7.12
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 15.59277 as HCO3
  Al   0.05423
  B           0.01636
  Ba   0.00384
  Ca   18.95254
  Cd   0.00039
  Cl   0.56704
  Co   0.00388
  Cu   0.51303
  F           0.66195
  Fe   0.05913
  K           1.72751
  Mg   2.46441
  Mn   0.28491
  Mo   0.00590
  Na   2.02964 charge
  Ni   0.00609
  S(6)  51.75947 as SO4
  Sb   0.00146
  Se   0.00082
  U           0.00440
  V           0.00196
  Zn   0.01332

  -water  1 # kg
```

```
END

SOLUTION 7 Average HCT data for coarse crystalline porphyry - oxide/transitional (cell CF-11-02, 0-
27)
  temp   25
  pH    7.94
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 33.19394 as HCO3
  Al    0.01347
  B            0.01075
  Ba    0.00086
  Ca    10.69469
  Cl    0.77608
  F            0.93545
  Fe    0.00638
  Hg    0.000049
  K            2.66412
  Mg    1.95477
  Mn    0.02025
  Mo    0.00545
  Na    2.86679 charge
  S(6)  13.81598 as SO4
  U            0.00449
  Zn    0.00048

  -water  1 # kg
END

SOLUTION 8 Average HCT data for andesite sulfide material (cells SRK 0864 and SRK 0866)
  temp   25
  pH    7.38
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 11.08233 as HCO3
  Al    0.00759
  Ba    0.00261
  Ca    9.22553
  Cl    0.39385
  F            0.46144
  Fe    0.00193
  K            0.99643
  Mg    1.40610
  Mn    0.00954
  Mo    0.00764
  Na    1.91012 charge
  S(6)  23.36270 as SO4
  Se    0.00033
  U            0.00047
  V            0.00169
  Zn    0.00092

  -water  1 # kg
END

SOLUTION 9 Average HCT data for biotite breccia - sulfide (cells 604811, 604854, 604862, 604867 and
605033)
  temp   25
  pH    7.91
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 54.42849 as HCO3
  Al    0.00611
  As    0.00046
  B            0.00974
  Ba    0.00750
```

```
  Ca   28.87256
  Cl   1.09115
  Cu   0.01120
  F           1.23366
  K           5.04620
  Mg   4.17236
  Mn   0.04406
  Mo   0.01327
  Na   2.92761 charge
  Ni   0.00049
  S(6)  52.56098 as SO4
  Sb   0.00018
  Se   0.00304
  U           0.00810
  V           0.00552
  Zn   0.00135

  -water  1 # kg
END

SOLUTION 10 Average HCT data for quartz feldspar breccia - sulfide (cells 604767 and 604787)
  temp   25
  pH    7.80
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 28.14382 as HCO3
  B           0.01018
  Ba   0.01079
  Ca   17.42309
  Cl   0.83411
  Co   0.00078
  F           0.91743
  K           2.53353
  Mg   3.91833
  Mn   0.12244
  Mo   0.01061
  Na   1.94262 charge
  Ni   0.00064
  S(6)  39.53068 as SO4
  Sb   0.00019
  Se   0.00217
  U           0.02169
  V           0.00281
  Zn   0.00497

  -water  1 # kg
END

SOLUTION 11 Average HCT data for quartz monzonite - sulfide (cells 604562, 604606, 604653, 604656,
604669, 604673 and 605153)
  temp   25
  pH    6.82
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 30.08128 as HCO3
  Al   0.01335
  B           0.01290
  Ba   0.01934
  Ca   15.43303
  Cl   1.40889
  Cu   0.03484
  F           0.71091
  Fe   0.00212
  Hg   0.000011
  K           3.45609
  Mg   2.75632
  Mn   0.09332
  Mo   0.01148
```

```
  Na    3.16032
  Pb    0.00030
  S(6)  32.59944 as SO4
  Sb    0.00015
  Se    0.00109
  U            0.00841
  V            0.00312
  Zn    0.00429

  -water  1 # kg
END

SOLUTION 12 Average HCT data for coarse crystalline porphyry - sulfide (cell CF-11-02, 367-408)
  temp   25
  pH    7.80
  pe    4
  redox   pe
  units   mg/l
  density  1
  Alkalinity 21.56678 as HCO3
  Al    0.05060
  B            0.01144
  Ba    0.00414
  Ca    7.69375
  Cl    1.26366
  Cu    0.00619
  F            0.59829
  Fe    0.00380
  Hg    0.000019
  K            1.95046
  Mg    0.53321
  Mn    0.0050
  Mo    0.00163
  Na    2.49093 charge
  Pb    0.00020
  S(6)  8.57475 as SO4
  Sb    0.00012
  U            0.00261

  -water  1 # kg
END

SOLUTION 13 Average HCT data for undefined material (uses average HCT data for all sulfide cells)
  temp   25
  pH    6.76
  pe    4
  redox   pe
  units   mg/l
  density  1
  Al    0.01019
  As    0.00058
  B            0.01134
  Ba    0.01445
  Ca    19.54850
  Cl    1.18326
  Cu    0.03281
  F            0.89545
  Fe    0.00187
  Hg    0.000009
  K            3.69033
  Mg    3.36360
  Mn    0.08380
  Mo    0.01167
  Na    2.80849
  Pb    0.00028
  S(6)  39.46536 as SO4
  Sb    0.00019
  Se    0.00187
  U            0.01100
  V            0.00372
  Zn    0.00391
```

```
  -water  1 # kg
END

Title Stage 1 Groundwater mix
MIX 101
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      0.146261
10     0.137721
11     0.944512
12     0
13     0

Save solution 101
end

REACTION 101
  H2O    -1
  68.25511932 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 101
SAVE Solution 102

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 101
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
```

```
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 102
SAVE Solution 103 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 101
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 101

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 101
USE Surface 101
USE Solution 103
SAVE Solution 104 #Initial Stage 1 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 1 Run-off mix
Mix 102
1       1
3       0.164376
4       0
5       0.120106
6       1.425941
7       0.488780
8       1.551968
9       5.454143
10      8.581411
11      102.312415
12      18.326068
13      0.857964

Save solution 105
end

REACTION 102
  H2O    -1
  7738.57 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 105
SAVE Solution 106

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 102
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
```

```
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 106
SAVE Solution 107 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 102
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 102

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 102
USE Surface 102
USE Solution 107
SAVE Solution 108 #Initial Stage 1 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 1 Pit lake Mix
Mix 103
104    0.610422
108    0.379793
1      0.009786

Save solution 109
end

Title Stage 1 Pit wall interaction mix calculator
MIX 104
109    1
3      0
4      0
5      0
6      0
7      0
8      0
9      0.0034523
10     0.0032507
11     0.0222938
12     0
13     0
```

```
Save solution 110
end

REACTION 104
  H2O    -1
  1.611063077 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 110
SAVE Solution 111

End
Title Evaporate Stage 1 lake water to produce initial Stage 2 Lake water
REACTION 105

        H2O   -1
   7.70 moles   ## Removes x m3 water, but solute mass remains the same
             ## This number must be adjusted manually for each cycle
USE solution 111
Save Solution 112

END

Title Return solution back to 1L

Mix 105
       112 1.1609
save solution 113
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 105
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
```

```
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 113
SAVE Solution 114 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 105
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 105

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 105
USE Surface 105
USE Solution 114
SAVE Solution 115 #Initial Stage 1 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 106

        H2O   -0.0
   0 moles

USE solution 115
End
Title Stage 2 pit lake GW inflow
Title Stage 2 Groundwater mix
MIX 201
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      0.498800
10     0.178770
11     1.341815
12     0
13     0

Save solution 201
end

REACTION 201
  H2O    -1
  112.196996 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 201
SAVE Solution 202

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 201
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
```

```
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 202
SAVE Solution 203 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 201
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 201

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 201
USE Surface 201
USE Solution 203
SAVE Solution 204 #Initial Stage 2 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 2 Run-off mix
Mix 202
1       1
3       0.054390
4       0
5       0.039741
6       0.471822
7       0.161730
8       0.513523
9       1.609756
10      2.816288
11      33.632282
12      6.063818
13      0.283887

Save solution 205
```

```
end

REACTION 202
  H2O    -1
  2536.16 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 205
SAVE Solution 206

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 202
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 206
SAVE Solution 207 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 202
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 202

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008
```

```
USE EQUILIBRIUM_PHASES 202
USE Surface 202
USE Solution 207
SAVE Solution 208 #Initial Stage 2 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 2 Pit lake Mix
Mix 203
204     0.229607
208     0.425741
1       0.025134
115     0.319518
Save solution 209
end

Title Stage 2 Pit wall interaction mix calculator
MIX 204
209     1
3       0
4       0
5       0
6       0
7       0
8       0
9       0.0044161
10      0.0015827
11      0.0118796
12      0
13      0

Save solution 210
end

REACTION 204
  H2O    -1
  0.993325278 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 210
SAVE Solution 211

End
Title Evaporate Stage 2 lake water to produce initial Stage 2 Lake water
REACTION 205

        H2O    -1
   3.64 moles   ## Removes x m3 water, but solute mass remains the same
             ## This number must be adjusted manually for each cycle
USE solution 211
Save Solution 212

END

Title Return solution back to 1L

Mix 205
       212 1.0701
save solution 213
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 205
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
```

```
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 213
SAVE Solution 214 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 205
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 205

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 205
USE Surface 205
USE Solution 214
SAVE Solution 215 #Initial Stage 2 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 206

        H2O   -0.0
   0 moles

USE solution 215
End

Title Stage 3 pit lake GW inflow
Title Stage 3 Groundwater mix
MIX 301
2      1
3      0
4      0
5      0
```

```
6       0
7       0
8       0
9       1.040047
10      0.262434
11      1.883006
12      0
13      0

Save solution 301
end

REACTION 301
  H2O    -1
  176.9856208 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 301
SAVE Solution 302

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0


EQUILIBRIUM_PHASES 301
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 302
SAVE Solution 303 Initial Pit Water after Mineral Precipitation
```

```
SAVE EQUILIBRIUM_PHASES 301
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 301

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 301
USE Surface 301
USE Solution 303
SAVE Solution 304 #Initial Stage 3 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 3 Run-off mix
Mix 302
1       1
3       0.082928
4       0
5       0.060594
6       0.719390
7       0.246590
8       0.782971
9       2.020417
10      4.228018
11      50.854355
12      9.245537
13      0.432845

Save solution 305
end

REACTION 302
  H2O    -1
  3815.51 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 305
SAVE Solution 306

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 302
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
```

```
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0
USE solution 306
SAVE Solution 307 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 302
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 302

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 302
USE Surface 302
USE Solution 307
SAVE Solution 308 #Initial Stage 3 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 3 Pit lake Mix
Mix 303
304     0.226442
308     0.278993
1       0.027809
215     0.466756
Save solution 309
end

Title Stage 3 Pit wall interaction mix calculator
MIX 304
309     1
3       0
4       0
5       0
6       0
7       0
8       0
9       0.0045408
10      0.0011458
11      0.0082210
12      0
13      0

Save solution 310
end

REACTION 304
  H2O    -1
  0.772703721 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 310
SAVE Solution 311
```

```
End
Title Evaporate Stage 3 lake water to produce initial Stage 2 Lake water
REACTION 305

        H2O   -1
   7.43 moles   ## Removes x m3 water, but solute mass remains the same
            ## This number must be adjusted manually for each cycle
USE solution 311
Save Solution 312

END

Title Return solution back to 1L

Mix 305
       312 1.1545
save solution 313
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0


EQUILIBRIUM_PHASES 305
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 313
SAVE Solution 314 Initial Pit Water after Mineral Precipitation
```

```
SAVE EQUILIBRIUM_PHASES 305
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 305

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 305
USE Surface 305
USE Solution 314
SAVE Solution 315 #Initial Stage 3 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 306

        H2O   -0.0
   0 moles

USE solution 315
End

Title Stage 4 pit lake GW inflow
Title Stage 4 Groundwater mix
MIX 401
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      1.588204
10     0.354166
11     2.530506
12     0
13     0

Save solution 401
end

REACTION 401
  H2O    -1
  248.512974 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 401
SAVE Solution 402

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 401
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
```

```
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 402
SAVE Solution 403 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 401
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 401

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 401
USE Surface 401
USE Solution 403
SAVE Solution 404 #Initial Stage 4 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 4 Run-off mix
Mix 402
1       1
3       0.084265
4       0
5       0.061571
6       0.730989
7       0.250566
8       0.795595
9       1.624757
10      4.225841
11      51.178282
12      9.394602
13      0.439824

Save solution 405
end

REACTION 402
  H2O    -1
  3821.77 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 405
```

```
SAVE Solution 406

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 402
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 406
SAVE Solution 407 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 402
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 402

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 402
USE Surface 402
USE Solution 407
SAVE Solution 408 #Initial Stage 4 Run-off Water After Mineral Precipitation and Sorption Loss
END
```

```
Title Stage 4 Pit lake Mix
Mix 403
404     0.268452
408     0.331540
1       0.051435
315     0.348573
Save solution 409
end

Title Stage 4 Pit wall interaction mix calculator
MIX 404
409     1
3       0
4       0
5       0
6       0
7       0
8       0
9       0.0027376
10      0.0006105
11      0.0043618
12      0
13      0

Save solution 410
end

REACTION 404
  H2O    -1
  0.428362415 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 410
SAVE Solution 411

End
Title Evaporate Stage 4 lake water to produce initial Stage 5 Lake water
REACTION 405

        H2O   -1
   14.34 moles   ## Removes x m3 water, but solute mass remains the same
             ## This number must be adjusted manually for each cycle
USE solution 411
Save Solution 412

END

Title Return solution back to 1L

Mix 405
       412 1.3480
save solution 413
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 405
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
```

```
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 413
SAVE Solution 414 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 405
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 405

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 405
USE Surface 405
USE Solution 414
SAVE Solution 415 #Initial Stage 5 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 406

        H2O   -0.0
   0 moles

USE solution 415
End

Title Stage 5 pit lake GW inflow
Title Stage 5 Groundwater mix
MIX 501
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      2.044332
10     0.565829
11     3.283660
12     0
```

```
13      0

Save solution 501
end

REACTION 501
  H2O    -1
  327.4607223 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 501
SAVE Solution 502

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 501
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 502
SAVE Solution 503 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 501
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 501

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
```

```
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 501
USE Surface 501
USE Solution 503
SAVE Solution 504 #Initial Stage 5 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 5 Run-off mix
Mix 502
1       1
3       0.085744
4       0
5       0.062651
6       0.743820
7       0.254964
8       0.809559
9       1.316995
10      4.136563
11      51.519548
12      9.559504
13      0.447544

Save solution 505
end

REACTION 502
  H2O    -1
  3830.13 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 505
SAVE Solution 506

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 502
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
```

```
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 506
SAVE Solution 507 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 502
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 502

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 502
USE Surface 502
USE Solution 507
SAVE Solution 508 #Initial Stage 5 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 5 Pit lake Mix
Mix 503
504     0.237553
508     0.295248
1       0.063940
415     0.403259
Save solution 509
end

Title Stage 5 Pit wall interaction mix calculator
MIX 504
509     1
3       0
4       0
5       0
6       0
7       0
8       0
9       0.0018702
10      0.0005176
11      0.0030039
12      0
13      0

Save solution 510
end

REACTION 504
  H2O    -1
  0.299565337 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 510
SAVE Solution 511

End
Title Evaporate Stage 5 lake water to produce initial Stage 5 Lake water
REACTION 505

        H2O   -1
   18.14 moles   ## Removes x m3 water, but solute mass remains the same
```

```
             ## This number must be adjusted manually for each cycle
USE solution 511
Save Solution 512

END

Title Return solution back to 1L

Mix 505
       512 1.4846
save solution 513
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 505
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 513
SAVE Solution 514 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 505
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 505

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
```

```
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 505
USE Surface 505
USE Solution 514
SAVE Solution 515 #Stage 5 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 506

        H2O   -0.0
   0 moles

USE solution 515
End

Title Stage 6 pit lake GW inflow
Title Stage 6 Groundwater mix
MIX 601
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      2.537454
10     0.929520
11     5.109808
12     0
13     0

Save solution 601
end

REACTION 601
  H2O    -1
  476.5260208 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 601
SAVE Solution 602

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 601
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
```

```
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 602
SAVE Solution 603 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 601
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 601

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 601
USE Surface 601
USE Solution 603
SAVE Solution 604 #Initial Stage 6 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 6 Run-off mix
Mix 602
1       1
3       0.087293
4       0
5       0.063783
6       0.757257
7       0.259570
8       0.824184
9       0.987441
10      3.931922
11      51.056266
12      9.732198
13      0.455628

Save solution 605
end

REACTION 602
  H2O    -1
  3786.72 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 605
SAVE Solution 606

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
```

```
  log_k   0

EQUILIBRIUM_PHASES 602
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 606
SAVE Solution 607 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 602
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 602

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 602
USE Surface 602
USE Solution 607
SAVE Solution 608 #Initial Stage 6 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 6 Pit lake Mix
Mix 603
604    0.280031
608    0.350395
1      0.098329
515    0.271245
Save solution 609
end
```

```
Title Stage 6 Pit wall interaction mix calculator
MIX 604
609    1
3      0
4      0
5      0
6      0
7      0
8      0
9      0.0009116
10     0.0003339
11     0.0018357
12     0
13     0

Save solution 610
end

REACTION 604
  H2O    -1
  0.171190632 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 610
SAVE Solution 611

End
Title Evaporate Stage 6 lake water to produce initial Stage 7 Lake water
REACTION 605

        H2O   -1
   28.05 moles   ## Removes x m3 water, but solute mass remains the same
             ## This number must be adjusted manually for each cycle
USE solution 611
Save Solution 612

END

Title Return solution back to 1L

Mix 605
       612 2.0199
save solution 613
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 605
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
```

```
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0
USE solution 613
SAVE Solution 614 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 605
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 605

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 605
USE Surface 605
USE Solution 614
SAVE Solution 615 #Initial Stage 7 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 606

        H2O   -0.0
   0 moles

USE solution 615
End

Title Stage 7 pit lake GW inflow
Title Stage 7 Groundwater mix
MIX 701
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      2.782365
10     1.018827
11     6.705689
12     0
13     0

Save solution 701
end

REACTION 701
  H2O    -1
  583.7622718 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
```

```
USE solution 701
SAVE Solution 702

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 701
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 702
SAVE Solution 703 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 701
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 701

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 701
USE Surface 701
USE Solution 703
SAVE Solution 704 #Initial Stage 7 groundwater after Mineral Precipitation and Sorption Loss
END
```

```
Title Stage 7 Run-off mix
Mix 702
1       1
3       0.089025
4       0
5       0.065049
6       0.772284
7       0.264720
8       0.840536
9       0.849912
10      3.952694
11      50.870942
12      9.925285
13      0.464668

Save solution 705
end

REACTION 702
  H2O    -1
  3783.36 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 705
SAVE Solution 706

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 702
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
```

```
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0
USE solution 706
SAVE Solution 707 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 702
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 702

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 702
USE Surface 702
USE Solution 707
SAVE Solution 708 #Initial Stage 7 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 7 Pit lake Mix
Mix 703
704     0.265124
708     0.331499
1       0.116823
615     0.286554
Save solution 709
end

Title Stage 7 Pit wall interaction mix calculator
MIX 704
709     1
3       0
4       0
5       0
6       0
7       0
8       0
9       0.0005677
10      0.0002079
11      0.0013682
12      0
13      0

Save solution 710
end

REACTION 704
  H2O    -1
  0.119108371 moles ### Addition step. Removes HTC water but solute mass remains
           ## Retuns solution volume back to 1L
USE solution 710
SAVE Solution 711

End
Title Evaporate Stage 7 lake water to produce initial Stage 8 Lake water
REACTION 705

        H2O   -1
   33.37 moles   ## Removes x m3 water, but solute mass remains the same
           ## This number must be adjusted manually for each cycle
USE solution 711
Save Solution 712

END

Title Return solution back to 1L

Mix 705
       712 2.5036
```

```
save solution 713
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 705
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 713
SAVE Solution 714 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 705
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 705

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 705
USE Surface 705
USE Solution 714
SAVE Solution 715 #Initial Stage 8 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
```

```
REACTION 706

        H2O   -0.0
   0 moles

USE solution 715
End
Title Stage 8 pit lake GW inflow
Title Stage 8 Groundwater mix
MIX 801
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      2.923377
10     1.080869
11     7.244641
12     0
13     0

Save solution 801
end

REACTION 801
  H2O    -1
  624.9881919 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 801
SAVE Solution 802

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 801
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
```

```
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 802
SAVE Solution 803 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 801
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 801

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 801
USE Surface 801
USE Solution 803
SAVE Solution 804 #Initial Stage 8 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 8 Run-off mix
Mix 802
1      1
3      0.090239
4      0
5      0.065936
6      0.782812
7      0.268330
8      0.851999
9      0.764027
10     3.962526
11     51.169480
12     10.060637
13     0.471005

Save solution 805
end

REACTION 802
  H2O    -1
  3805.14 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 805
SAVE Solution 806

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 802
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
```

```
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 806
SAVE Solution 807 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 802
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 802

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 802
USE Surface 802
USE Solution 807
SAVE Solution 808 #Initial Stage 8 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 8 Pit lake Mix
Mix 803
804    0.234754
808    0.291649
1      0.117458
715    0.356140
Save solution 809
end

Title Stage 8 Pit wall interaction mix calculator
MIX 804
809    1
3      0
4      0
5      0
6      0
7      0
8      0
9      0.0005281
```

```
10      0.0001953
11      0.0013088
12      0
13      0

Save solution 810
end

REACTION 804
  H2O    -1
  0.11291264 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 810
SAVE Solution 811

End
Title Evaporate Stage 8 lake water to produce initial Stage 9 Lake water
REACTION 805

        H2O   -1
   33.58 moles   ## Removes x m3 water, but solute mass remains the same
             ## This number must be adjusted manually for each cycle
USE solution 811
Save Solution 812

END

Title Return solution back to 1L

Mix 805
       812 2.5275
save solution 813
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 805
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
```

```
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 813
SAVE Solution 814 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 805
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 805

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 805
USE Surface 805
USE Solution 814
SAVE Solution 815 #Initial Stage 9 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 806

        H2O   -0.0
   0 moles

USE solution 815
End

Title Stage 9 pit lake GW inflow
Title Stage 9 Groundwater mix
MIX 901
2      1
3      0
4      0
5      0
6      0
7      0
8      0
9      2.975314
10     1.099871
11     7.427096
12     0
13     0

Save solution 901
end

REACTION 901
  H2O    -1
  639.0667165 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 901
SAVE Solution 902

End
Title Precipitate oversaturated phases in groundwater
 PHASES
Fix_pe
  e-=e-
  log_k   0
```

```
EQUILIBRIUM_PHASES 901
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 902
SAVE Solution 903 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 901
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 901

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite    equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 901
USE Surface 901
USE Solution 903
SAVE Solution 904 #Initial Stage 9 groundwater after Mineral Precipitation and Sorption Loss
END

Title Stage 9 Run-off mix
Mix 902
1       1
3       0.090729
4       0
5       0.066293
6       0.787059
7       0.269786
8       0.856621
9       0.731379
```

```
10      3.970592
11      51.312498
12      10.115219
13      0.473560

Save solution 905
end

REACTION 902
  H2O    -1
  3815.51 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 905
SAVE Solution 906

End

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0

EQUILIBRIUM_PHASES 902
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0

USE solution 906
SAVE Solution 907 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 902
END

Title Determine loss of metals due to HFO sorption and sedimentation
```

```
SURFACE 902

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 902
USE Surface 902
USE Solution 907
SAVE Solution 908 #Initial Stage 9 Run-off Water After Mineral Precipitation and Sorption Loss
END

Title Stage 9 Pit lake Mix
Mix 903
904     0.224670
908     0.278220
1       0.117685
815     0.379425
Save solution 909
end

Title Stage 9 Pit wall interaction mix calculator
MIX 904
909     1
3       0
4       0
5       0
6       0
7       0
8       0
9       0.0005144
10      0.0001902
11      0.0012842
12      0
13      0

Save solution 910
end

REACTION 904
  H2O    -1
  0.110496872 moles ### Addition step. Removes HTC water but solute mass remains
             ## Retuns solution volume back to 1L
USE solution 910
SAVE Solution 911

End
Title Evaporate Stage 9 lake water

REACTION 905

        H2O   -1
   33.65 moles   ## Removes x m3 water, but solute mass remains the same
             ## This number must be adjusted manually for each cycle
USE solution 911
Save Solution 912

END

Title Return solution back to 1L

Mix 905
       912 2.5363
save solution 913
end

Title Precipitate oversaturated phases
 PHASES
Fix_pe
  e-=e-
  log_k   0
```

```
EQUILIBRIUM_PHASES 905
  Ag2Se 0 0
  Anhydrite 0 0
  Alunite  0 0
  Ba3(AsO4)2 0 0
  Barite  0 0
  Boehmite 0 0
  Brochantite 0 0
  Brucite 0 0
  Calcite  0 0
  Carnotite 0 0
  CaMoO4 0 0
  Chrysotile 0 0
  CO2(g)  -3.5 10
  Co3O4 0 0
  Cr2O3 0 0
  Diaspore 0 0
  Epsomite 0 0
  Ferrihydrite 0 0
  Fluorite 0 0
  Gummite 0 0
  Gypsum  0 0
  HgSe 0 0
  Hgmetal(l) 0 0
  Kaolinite 0 0
  Mg3(PO4)2 0 0
  Mirabilite 0 0
  O2(g)   -32 10
  NiCO3 0 0
  NiMoO4 0 0
  Ni(OH)2 0 0
  Ni3(AsO4)2:8H2O 0 0
  Otavite 0 0
  Pyromorphite 0 0
  Rutherfordine 0 0
  Schoepite 0 0
  Sepiolite 0 0
  SiO2(am-ppt) 0 0
  Tyuyamunite 0 0
  U3O8 0 0
  UO3 0 0
  UO2(OH)2(beta) 0 0
USE solution 913
SAVE Solution 914 Initial Pit Water after Mineral Precipitation
SAVE EQUILIBRIUM_PHASES 905
END

Title Determine loss of metals due to HFO sorption and sedimentation
SURFACE 905

  -equilibrate with solution 1
  Hfo_sOH Ferrihydrite  equilibrium_phase 0.005 64200
  Hfo_wOH Ferrihydrite  equilibrium_phase 0.2
  -donnan 1e-008

USE EQUILIBRIUM_PHASES 905
USE Surface 905
USE Solution 914
SAVE Solution 915 #Final Stage 9 Pit Water After Mineral Precipitation and Sorption Loss
END

Title Use solution to allow model output
REACTION 906

        H2O   -0.0
   0 moles

USE solution 915
End
```

Appendix B – Humidity Cell Elemental Release Rate Graphs

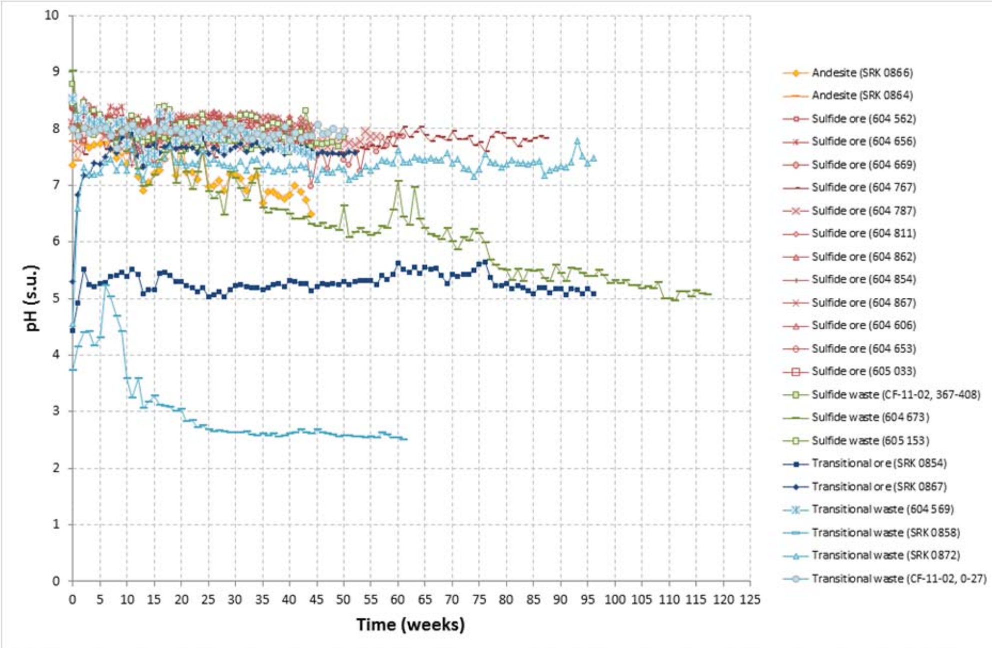

Figure B-1: Humidity Cell Effluent pH

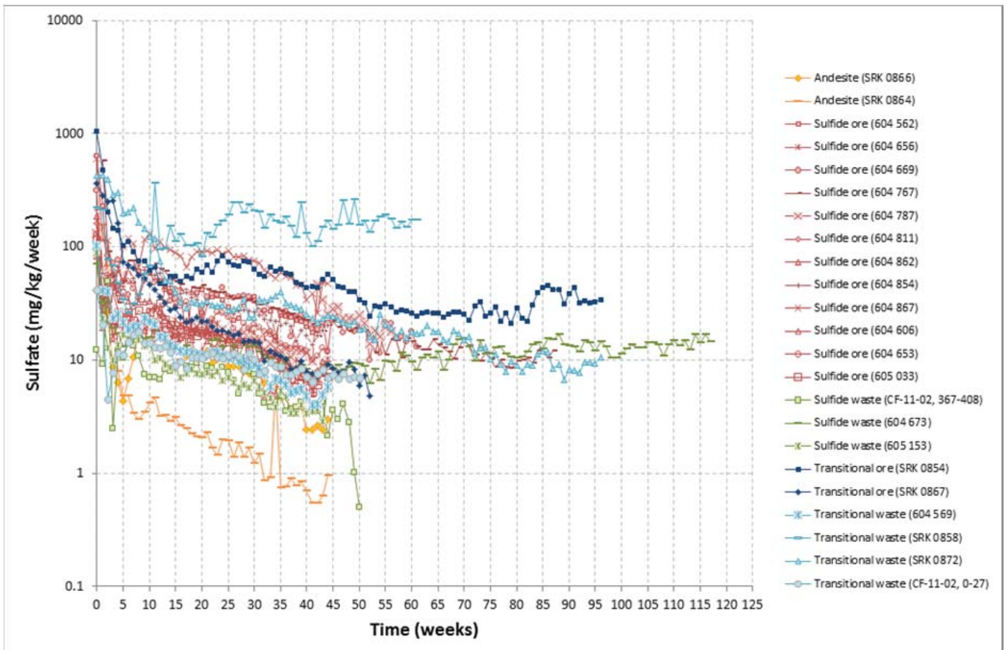

Figure B-2: Humidity Cell Effluent Sulfate

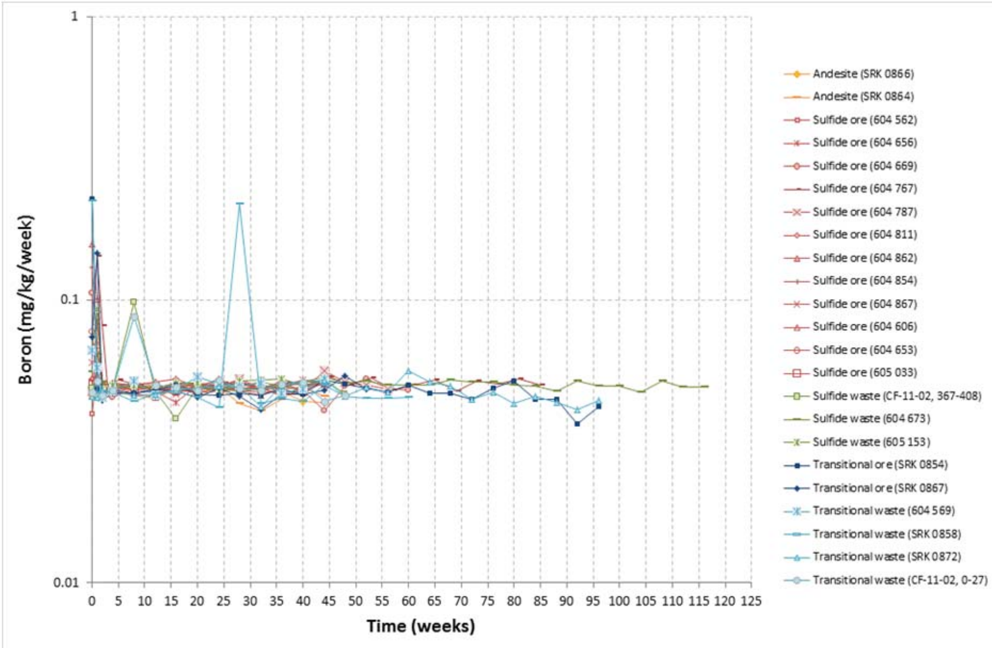

Figure B-3: Humidity Cell Effluent Boron

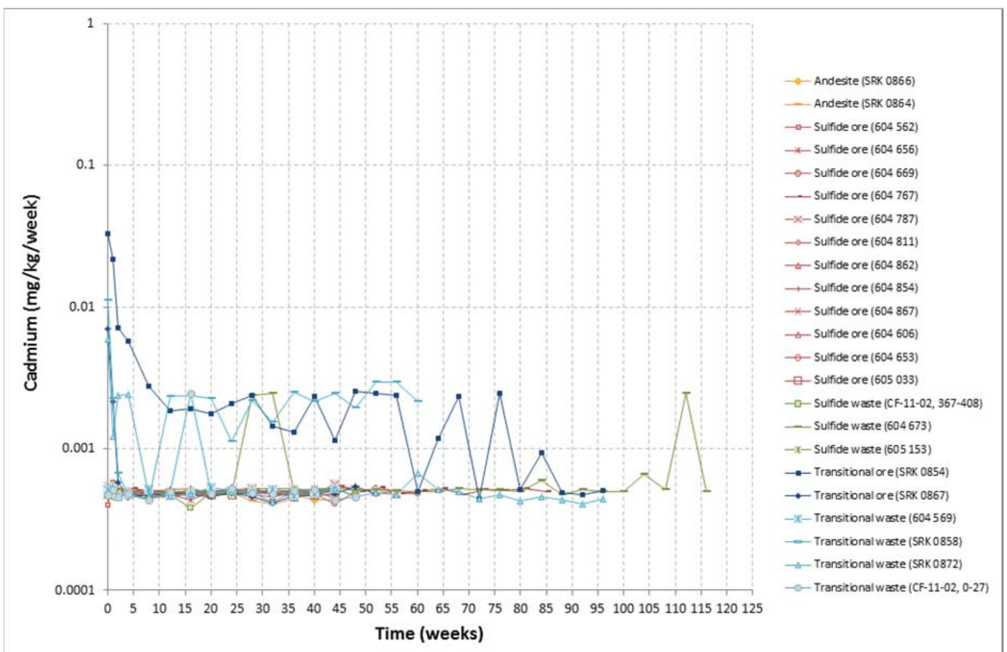

Figure B-4: Humidity Cell Effluent Cadmium

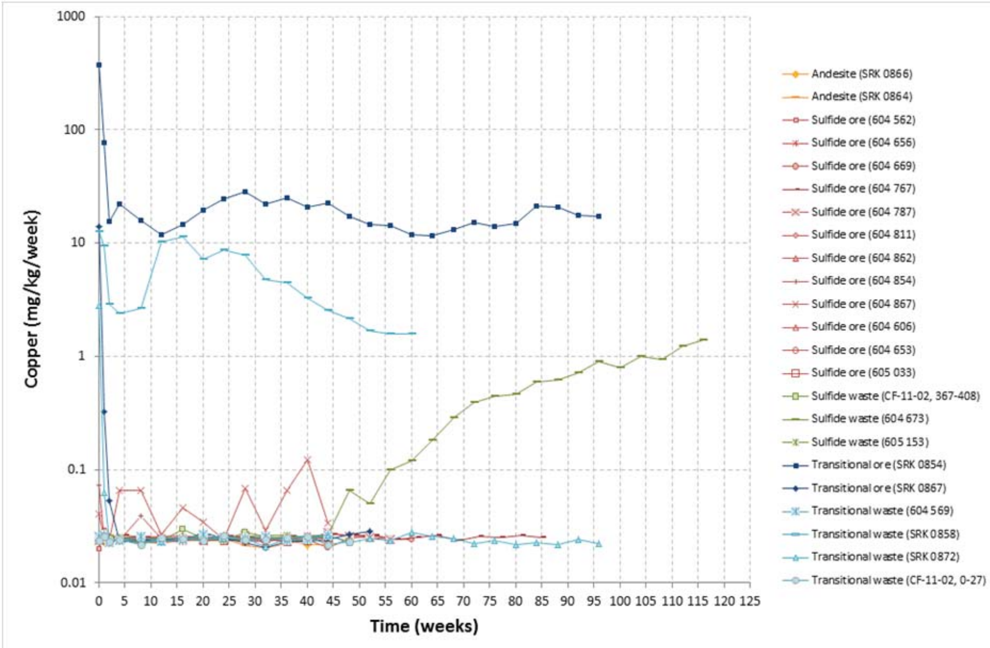

Figure B-5: Humidity Cell Effluent Copper

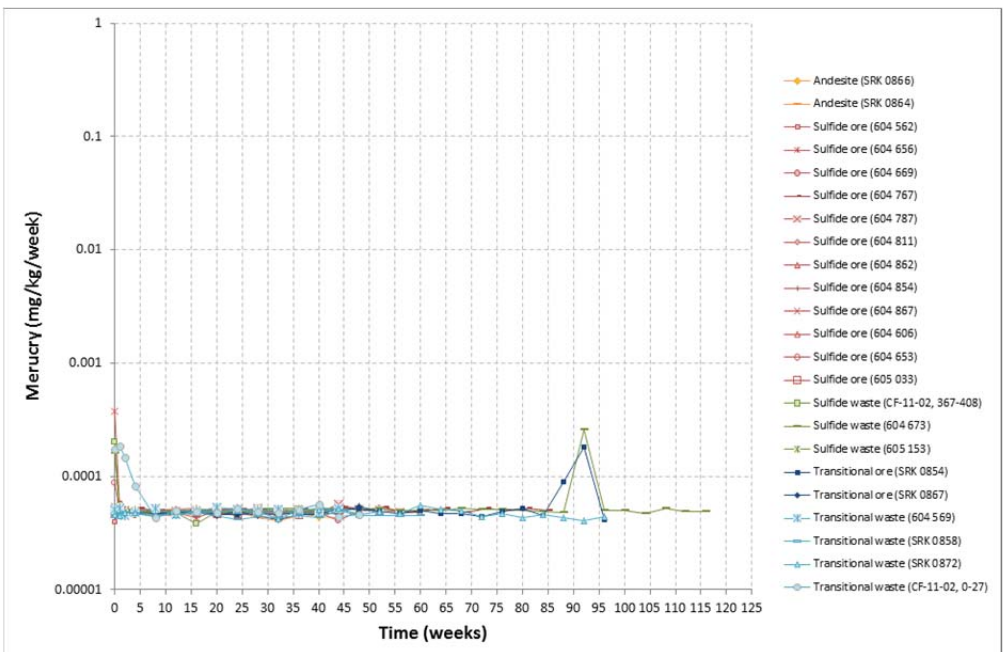

Figure B-6: Humidity Cell Effluent Mercury

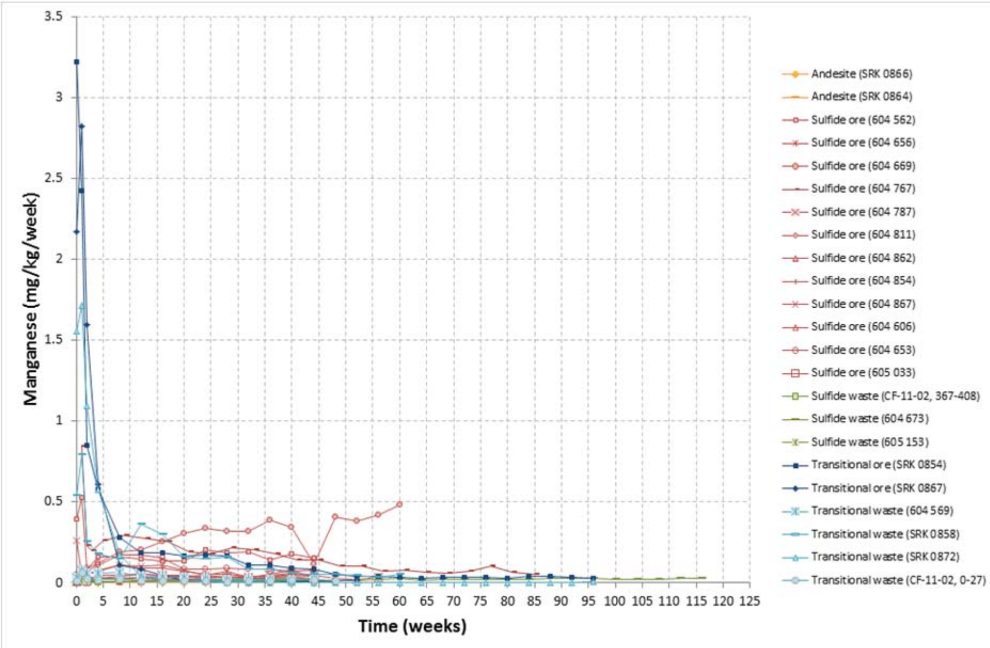

Figure B-7: Humidity Cell Effluent Manganese

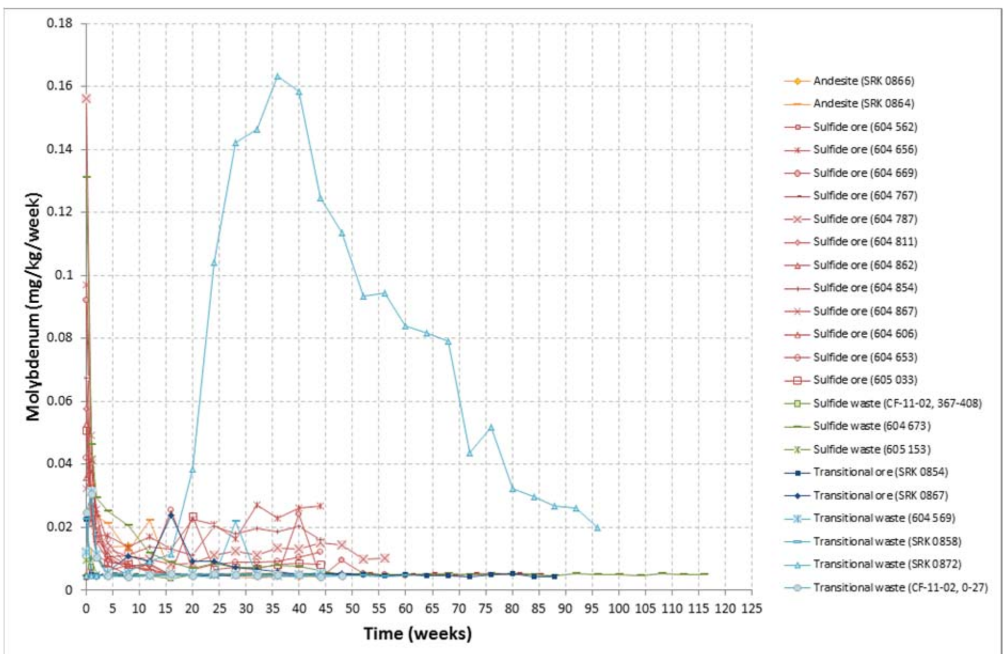

Figure B-8: Humidity Cell Effluent Molybdenum

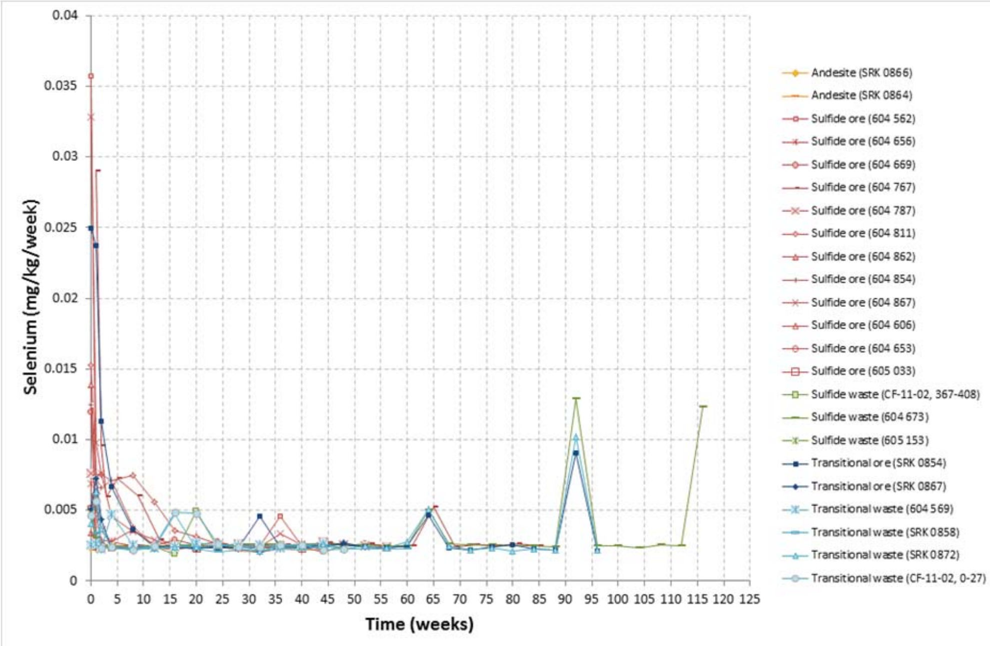

Figure B-9: Humidity Cell Effluent Selenium

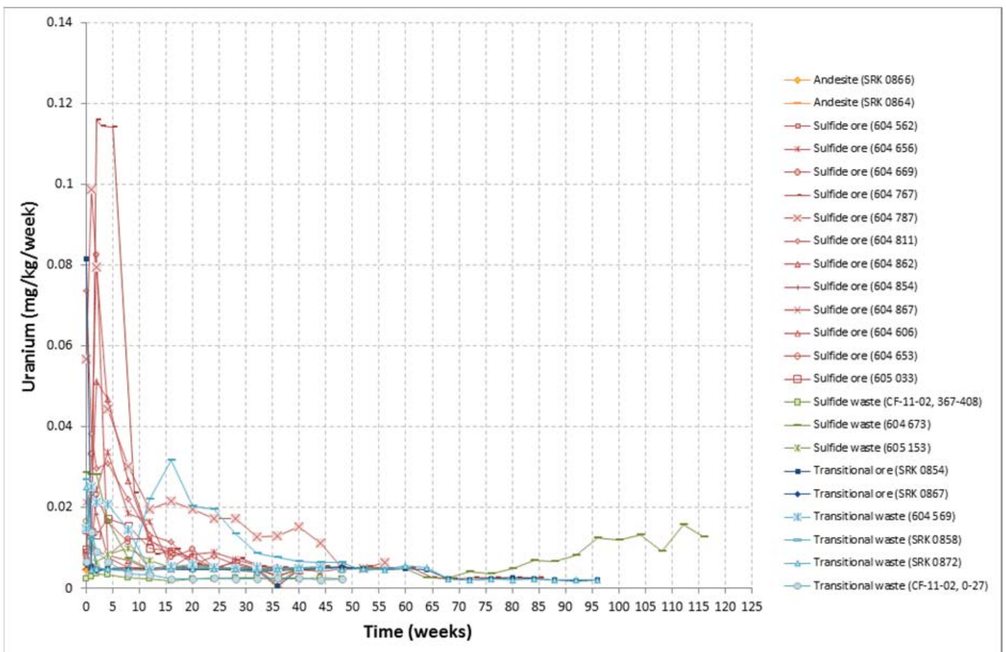

Figure B-10: Humidity Cell Effluent Uranium

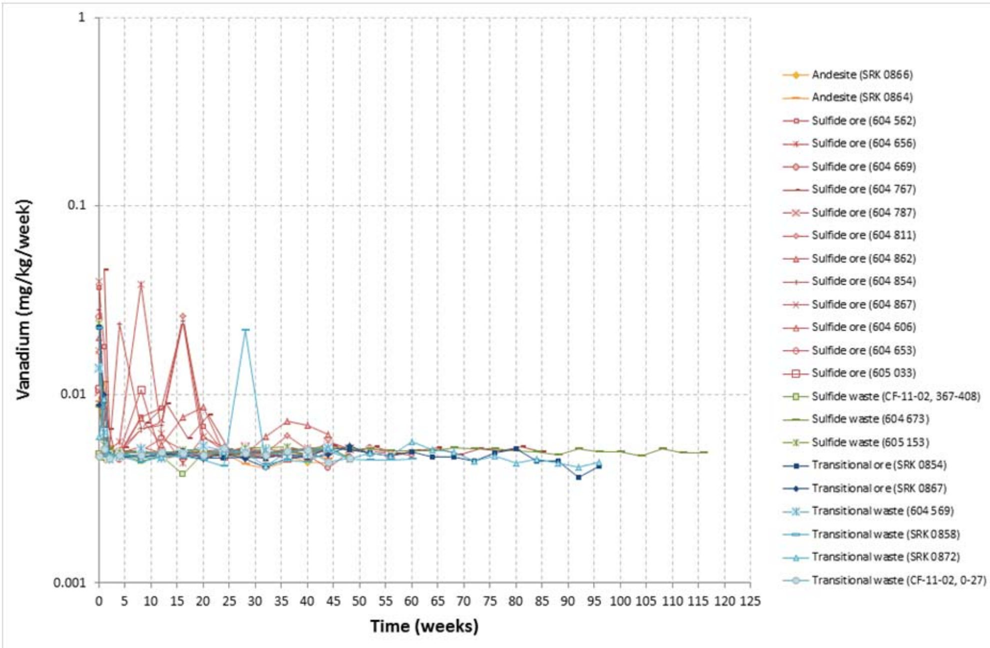

Figure B-11: Humidity Cell Effluent Vanadium

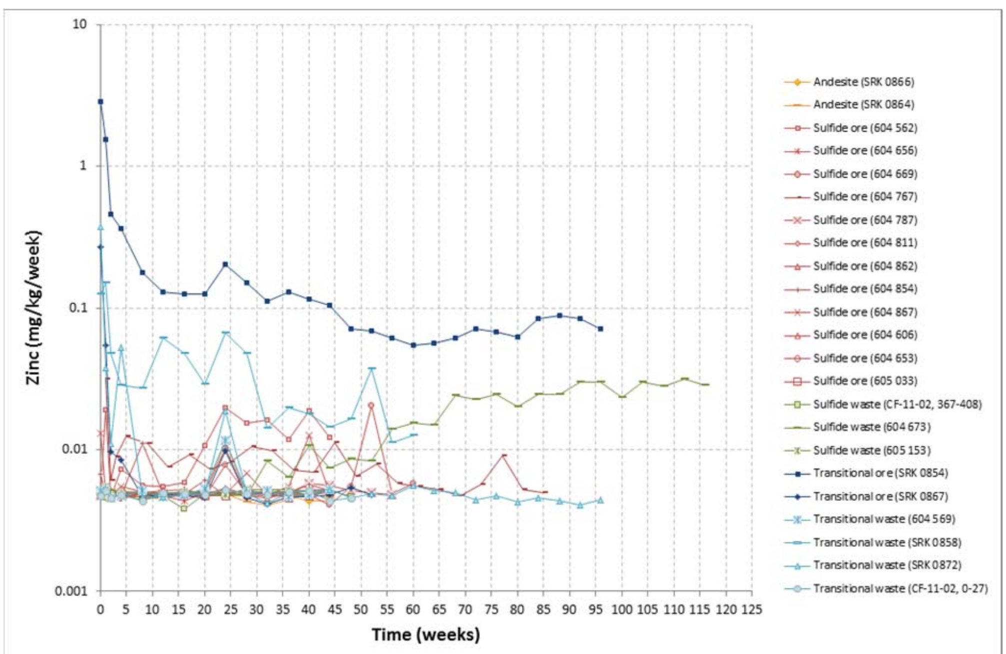

Figure B-12: Humidity Cell Effluent Zinc

Appendix C – Existing Pit Lake Chemistry

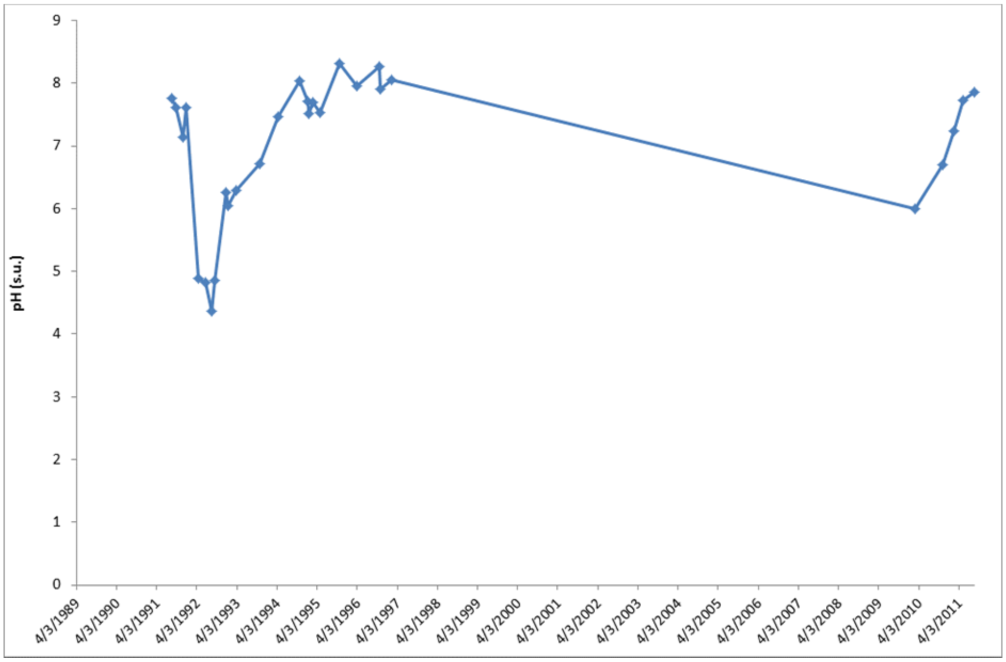

Figure C-1: pH Trends in Existing Pit Lake

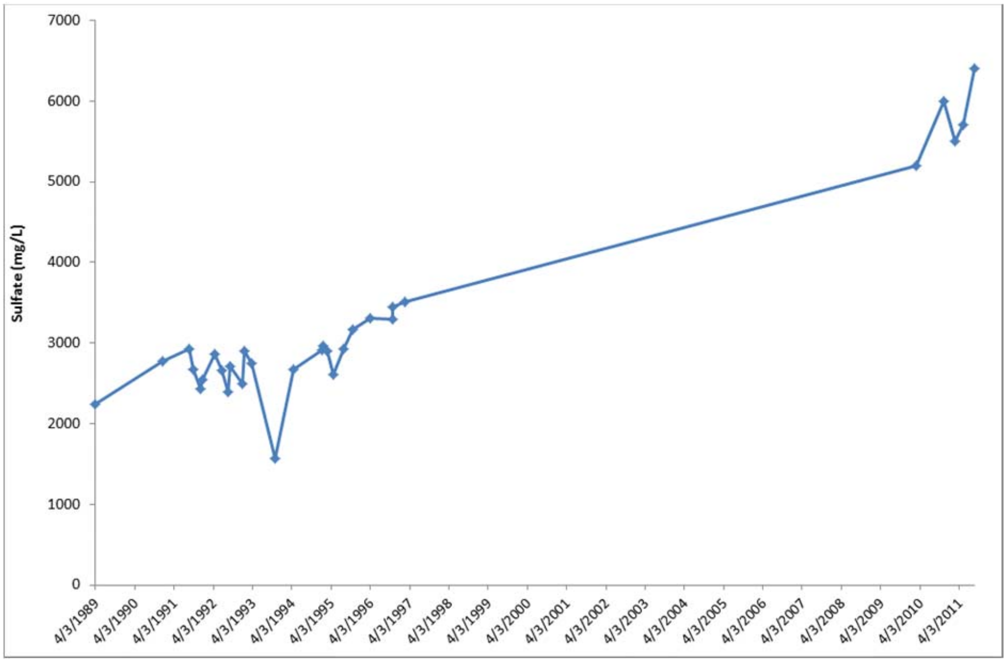

Figure C-2: Sulfate Trends in Existing Pit Lake

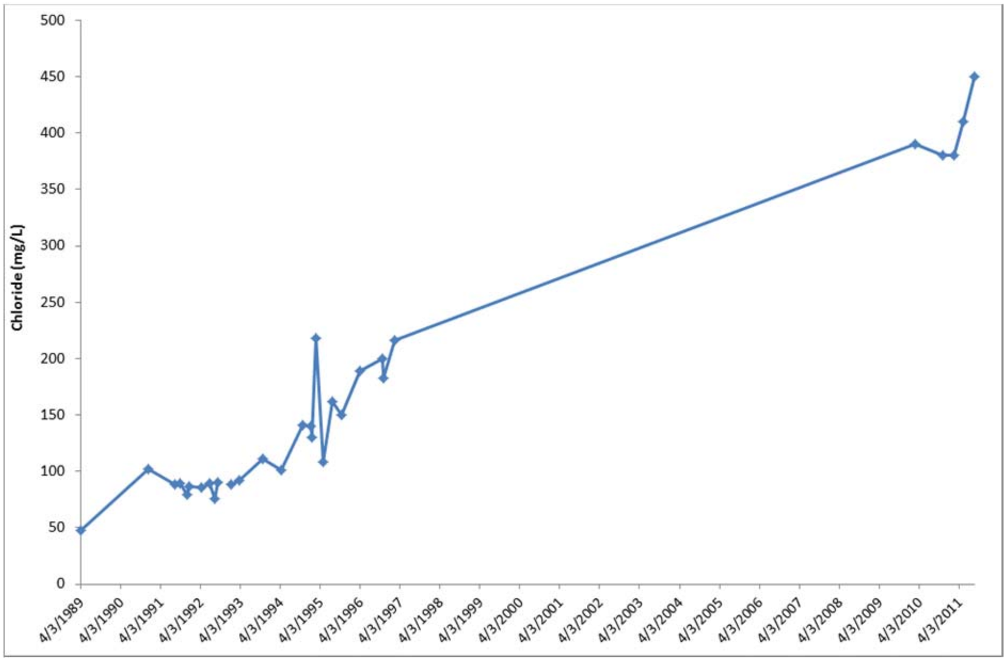

Figure C-3: Chloride Trends in Existing Pit Lake

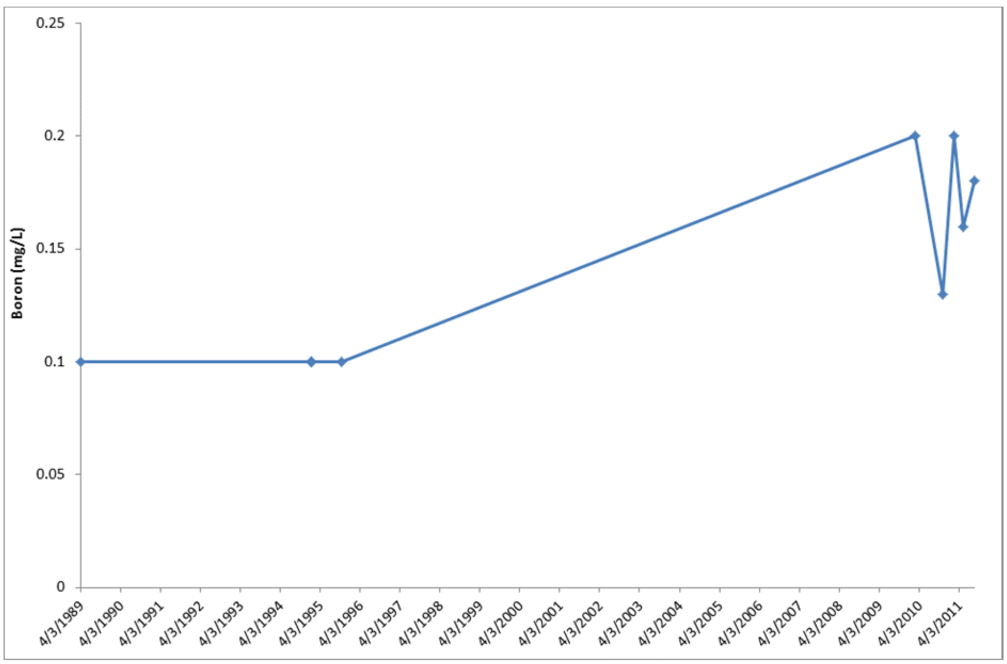

Figure C-4: Boron Trends in Existing Pit Lake

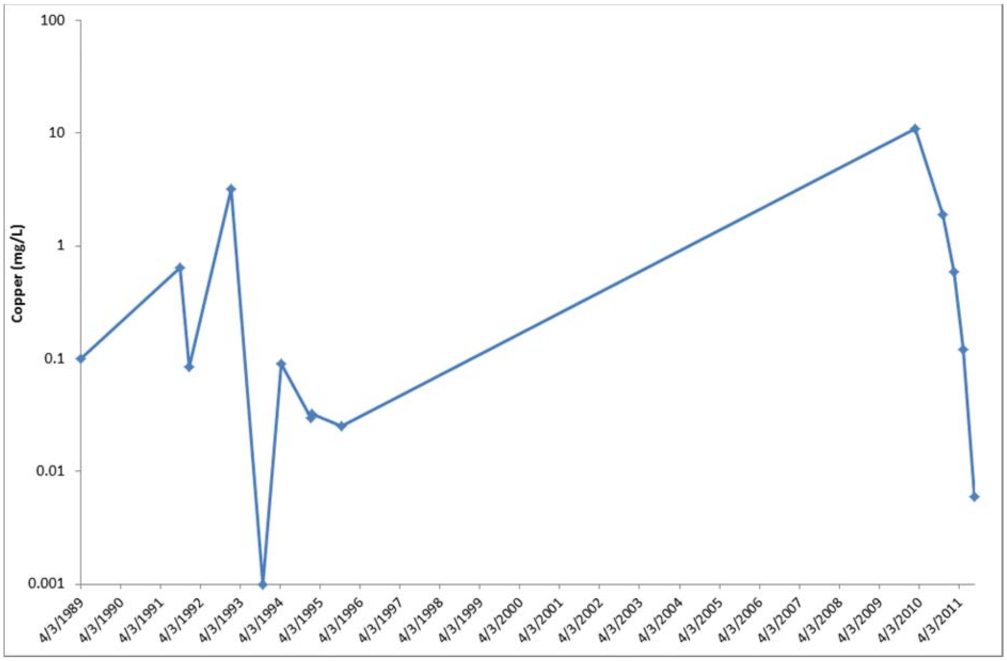

Figure C-5: Copper Trends in Existing Pit Lake

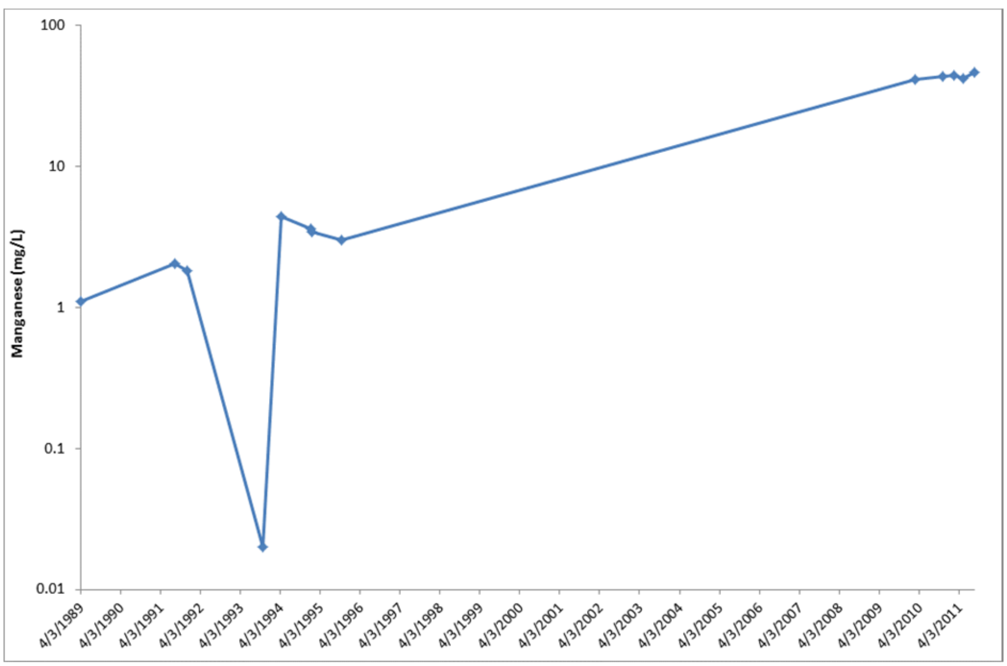

Figure C-6: Manganese Trends in Existing Pit Lake

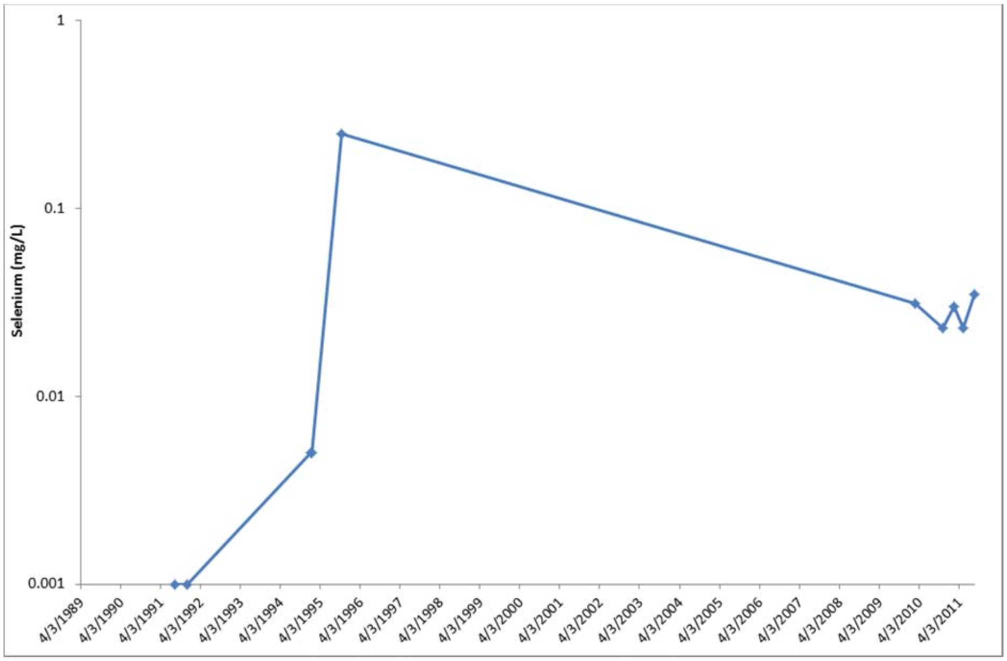

Figure C-7: Selenium Trends in Existing Pit Lake

MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

prepared by

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August 22, 2013

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MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

EXECUTIVE SUMMARY

This report documents a numerical model of groundwater flow in and around Copper Flat, near Hillsboro, New Mexico. The model was developed and calibrated based on previously available information and on new studies of the system. The calibrated model will be used to project the effects, to groundwater and surface water, of the proposed development of the Copper Flat Mine.

The report first introduces the study area then summarizes the climate and meteorology, hydrology and water balance, and geology and hydrogeology of the area. Then an overall conceptual model of the hydrological and hydrogeological system is presented, followed by a presentation of data available to confirm and calibrate the model. Next the numerical model is presented, including model structure, inputs and calibration. Finally, the sensitivity of model results to unknown parameters is evaluated.

Extensive information on the system is available, from previous studies and previous mine operations, and from new studies including the 2012 extended well field pumping test. The model accurately represents the conceptual model and accurately reproduces the calibration data, particularly the results of the 2012 well field pumping test. As a result the model is considered suitable for use in projecting the effects of future well field pumping.

The calibrated model will be used to generate projections related to the results and effects of mine development. Projections will be generated as required and reported separately. Results of interest include the following:

- Groundwater drawdown due to water-supply pumping, for selected mine development scenarios
- Effects on surface discharge to the Las Animas Creek and Rio Grande systems
- Long-term post-mining residual groundwater drawdown and effects to surface discharge
- Potential ground subsidence due to groundwater drawdown
- Open pit dewatering rates and groundwater drawdown in bedrock
- Post-mining open-pit water level and water balance
- Down-gradient migration of potential leakage from tailings and waste rock storage facilities

The large amount of information has allowed development of a model that can reliably project effects of future development. In particular, aquifer properties around the well field are relatively known, and sensitivity of the primary model projection results, groundwater drawdown and surface discharge changes due to well field pumping, to plausible variation in model inputs, is low.

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MODEL OF GROUNDWATER FLOW IN THE ANIMAS UPLIFT AND PALOMAS BASIN, COPPER FLAT PROJECT, SIERRA COUNTY, NEW MEXICO

1.0 INTRODUCTION

This report presents a numerical model of the hydrogeological system in the area of the Copper Flat Project (Project) near Truth or Consequences, New Mexico. The Project location is shown on Figure 1.1.

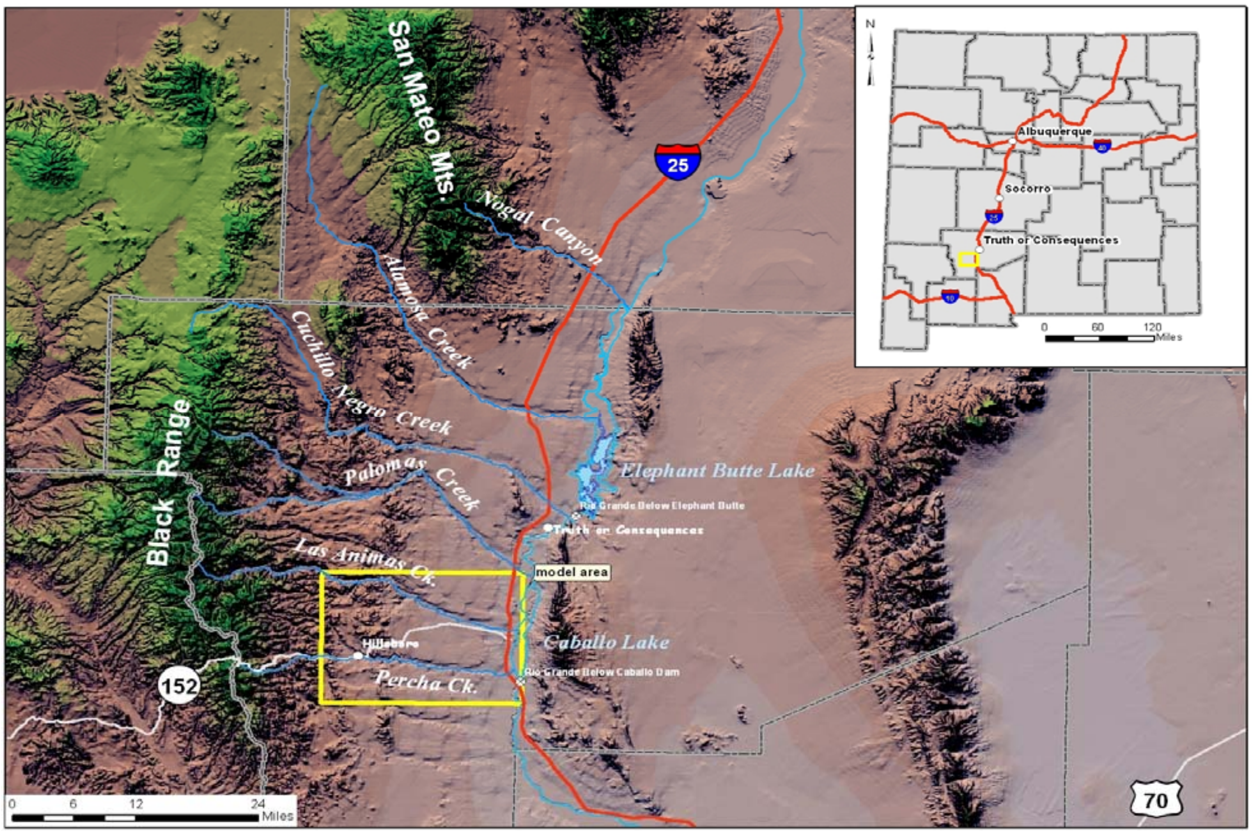


Figure 1.1. Copper Flat Project location.

This report first summarizes the climate and meteorology of the study area, then summarizes the hydrology and estimates a basin water balance. Then the geological and hydrogeological framework is presented. These are used to formulate and present a conceptual model of the system. Then the data available for model calibration are presented, followed by the details of the numerical model and results of the model calibration. Finally, model projections are presented that are used to evaluate the hydrologic and hydrogeologic effects of the proposed mining Project.

2.0 CLIMATE AND METEOROLOGY

Precipitation and evaporation in the study area are examined using data from regional meteorological stations. The station at Hillsboro, New Mexico, has a long record (with at least partial data from 1893), is located nearby (about 4 miles from the Copper Flat open pit), and is at a similar elevation (5,270 ft above mean sea level (amsl)) as the Copper Flat Mine site. Locations of the Hillsboro station and other meteorological stations along the east side of the Black Range are shown on Figure 2.1.

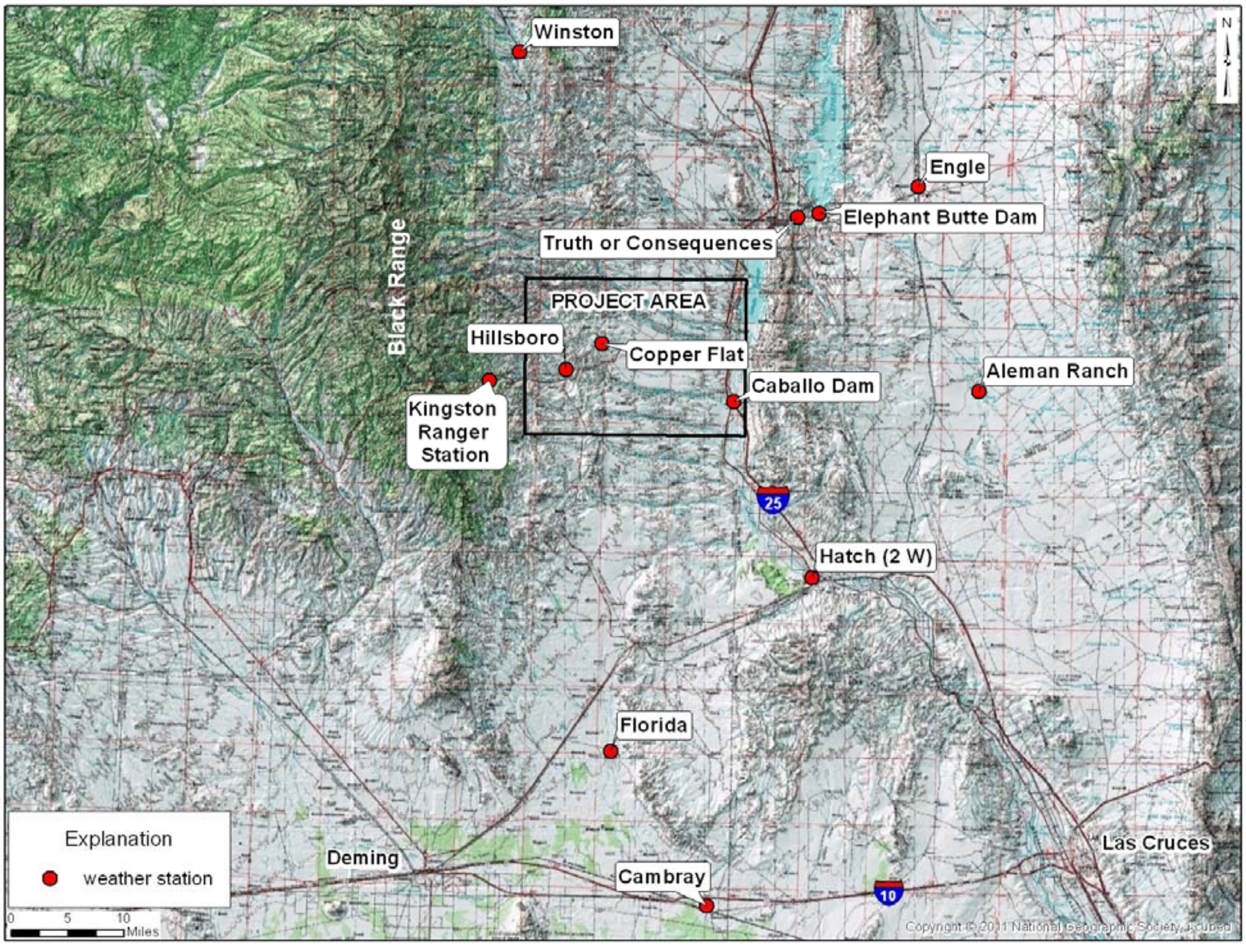


Figure 2.1. Locations of meteorological stations surrounding the Project area.

2.1 Annual Precipitation

The range of variability between wet and dry climatic conditions is seen in the annual precipitation recorded at Hillsboro from 1925 through 2010, shown on Figure 2.2. Annual precipitation ranges from less than 5 to more than 20 inches per year (in./yr) and averages about 12.5 in. Copper Flat weather station recorded 7.7 in. of precipitation in 2011, and 3.8 in. in 2012, signifying drought conditions during this period.

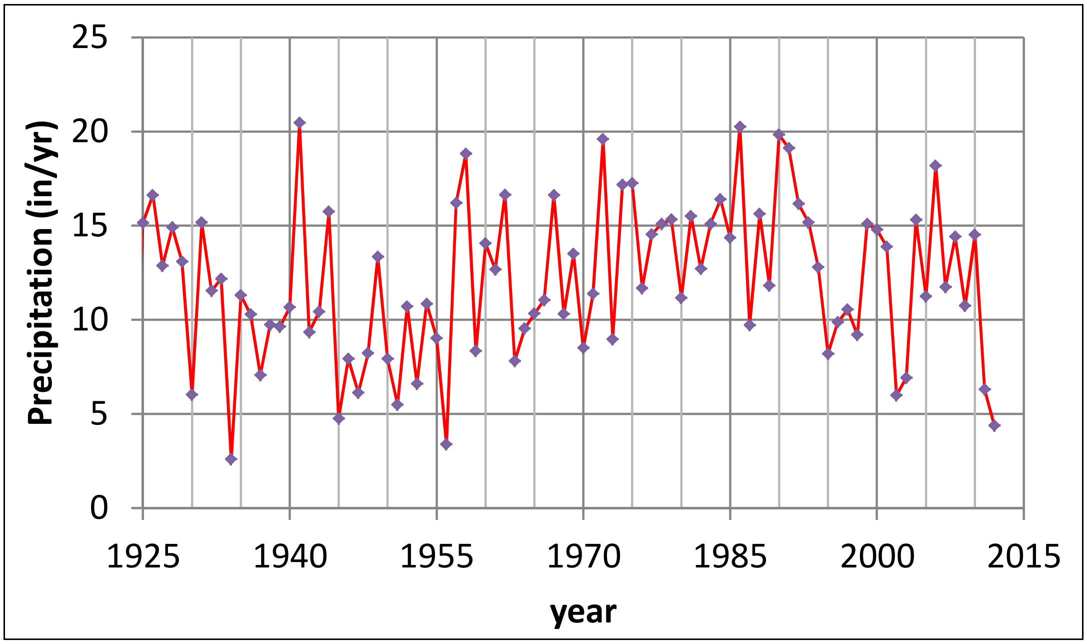


Figure 2.2. Recorded annual precipitation at Hillsboro meteorological station.

2.2 Precipitation Events

The frequency and magnitude of rainfall-runoff events are examined in the statistical distribution of daily precipitation at Hillsboro, shown on Figure 2.3. Daily precipitation of 1 in. or more occurs, on average, twice per year. Storm events of magnitude 2 in. can be expected to occur every 4 years, and the 100-year storm event is about 3.5 in.

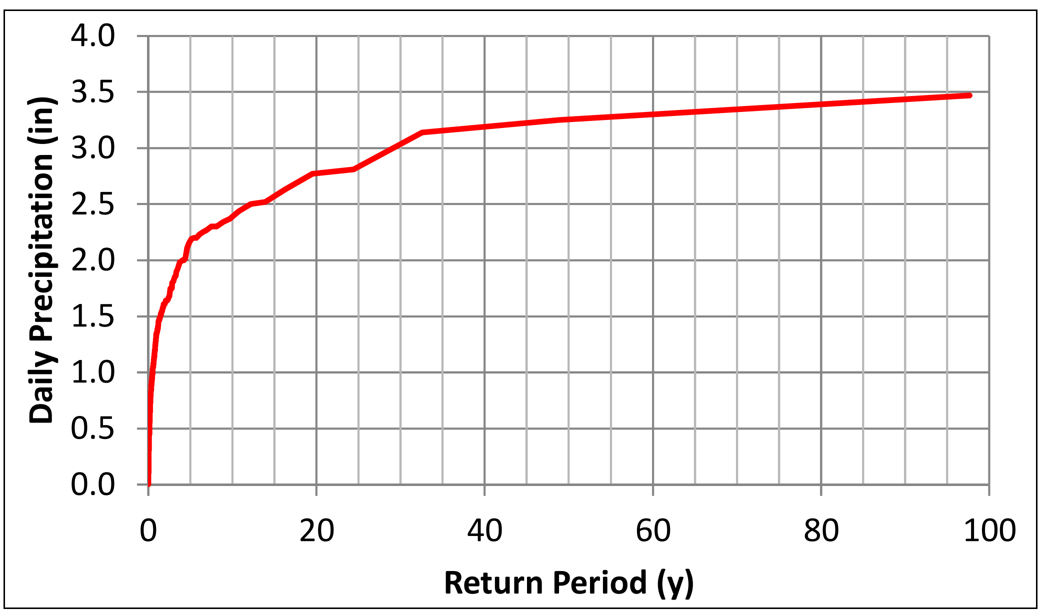


Figure 2.3. Distribution of daily precipitation at Hillsboro meteorological station.

2.3 Precipitation and Elevation

Precipitation is known to increase with elevation, and the bulk of surface-water runoff and groundwater recharge in the study area is generated by precipitation on the higher elevations of the Percha Creek and Las Animas Creek watersheds.

Mean annual precipitation was compared to elevation for other meteorological stations east of the Black Range as shown on Figure 2.4. The best-fit linear relationship estimates about 8.6 in./yr mean annual precipitation at elevation 4,000 ft amsl, and about 26.2 in./yr at elevation 10,000 ft amsl, approximately the maximum in the study area.

Given the large spatial and temporal variability of annual precipitation, the relationship shown on Figure 2.4 does not characterize precipitation patterns in any detail. It does however give realistic rates for the different elevations of the study area, which are used below to compute a realistic upper bound for basin water yield (a fraction of total precipitation over the basin).

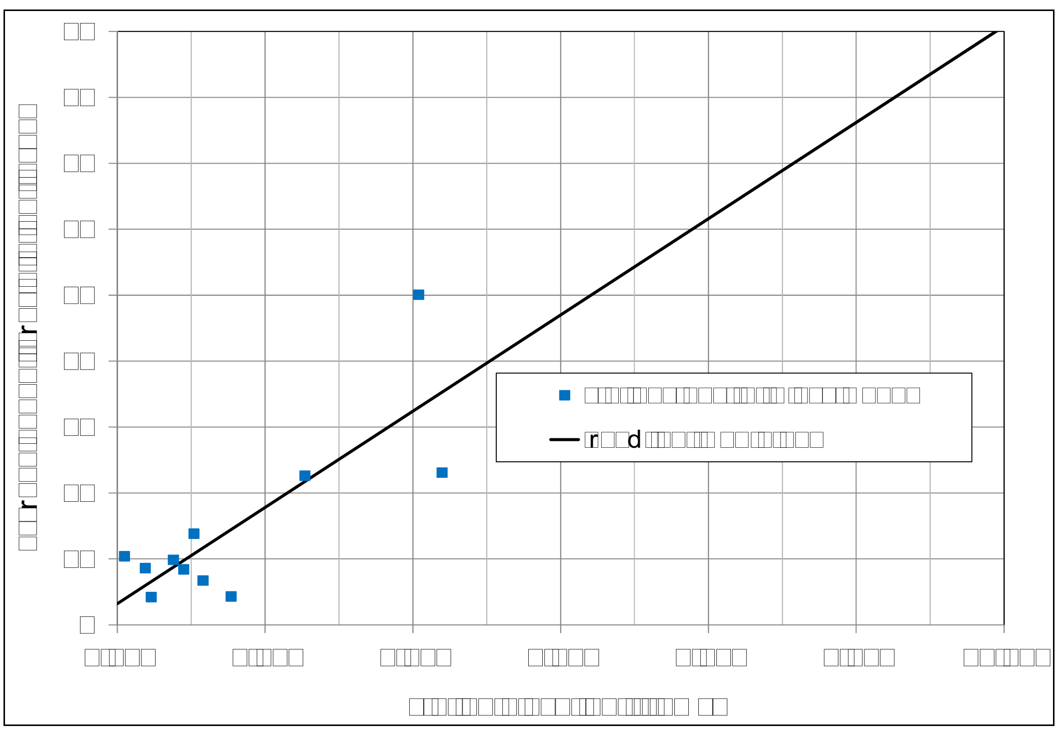


Figure 2.4. Mean annual precipitation versus elevation of meteorological station.

2.4 Evaporation and Transpiration

Most precipitation evaporates where it falls, or is consumed (transpired) by nearby vegetation. Of the remaining precipitation, most eventually discharges down-gradient as evapotranspiration (ET) from vegetated areas and open water surfaces.

Potential ET, or the maximum evaporation and plant transpiration that can occur given full availability of water, is a function of geographical and climatic conditions and is commonly estimated using the Penman-Monteith equations (Monteith, 1965). These relate maximum ET (ET_0) to meteorological parameters including temperature, relative humidity and wind speed, and to geographical parameters (latitude and time of year).

Annual ET_0 computed from results at Hillsboro meteorological station is shown on Figure 2.5 to be about 60 in./yr (discounting the anomalously low result shown for 1997 that is likely in error). This compares well to previous estimates (SRK, 1997) of 65 in./yr of potential evaporation, and 64.6 in./yr estimated as 74 percent[1] (an accepted conversion factor for the region (NOAA, 1982) between pan evaporation and evaporation from a normal open water surface) of Copper Flat pan evaporation[2] (measured between October 2010 and September 2011, except for four winter months. The missing months were estimated by extrapolation of Hillsboro ET_0 data). Actual evaporation or ET is less, depending on sun and wind exposure, ground conditions, and availability of water.

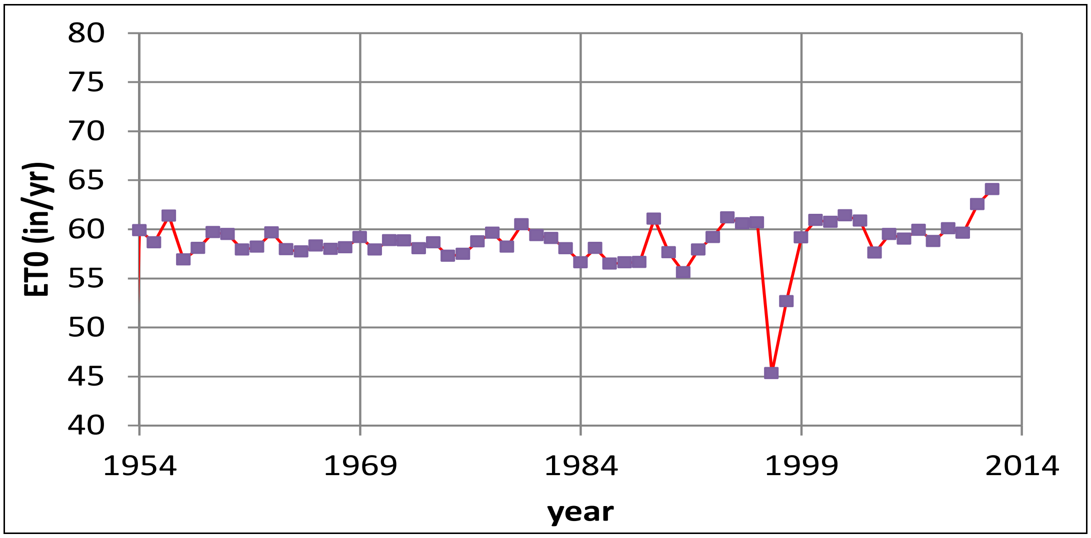


Figure 2.5. Computed Penman-Monteith evapotranspiration (ET_0) at Hillsboro meteorological station.

Evaporation in the study area is higher at lower elevations. An estimate of reservoir evaporation along the Rio Grande (Middle Rio Grande Endangered Species Collaborative, 2003) is:

$$\text{evaporation} = 135.8 \text{ in.} - (0.0135 \text{ in./ft amsl}) * Z,$$

where,

Z is elevation in feet above mean sea level (ft amsl).

The equation predicts evaporation of 62.4 in./yr at the Copper Flat open pit (elevation 5,440 ft amsl), in agreement with the above-presented estimates, and 79.1 in./yr at Caballo Lake (elevation 4,200 ft amsl), in agreement (equivalent to 74 percent of pan evaporation) with measurements at Caballo Dam (WRCC, 2012).

The estimated average evaporation, precipitation (from Fig. 2.4) and net evaporation for Caballo Lake and the Copper Flat open pit are presented in Table 2.1.

Table 2.1. Estimated average total and net reservoir evaporation

location	elevation (ft amsl)	mean annual precipitation (in.)	annual reservoir evaporation (in.)	net evaporation (in./yr)
Caballo Lake	4,200	9.2	79.1	69.9
Copper Flat open pit	5,440	12.8	64.6	51.8

ft amsl - feet above mean sea level

3.0 HYDROLOGY AND WATER BALANCE

Topographic basins of the study area are shown on Figure 3.1 and include Las Animas Creek and Percha Creek watersheds as well as the Grayback and Greenhorn Arroyo drainages. A portion of the original Grayback Arroyo watershed (approximately 230 acres) now drains to the Copper Flat open pit.

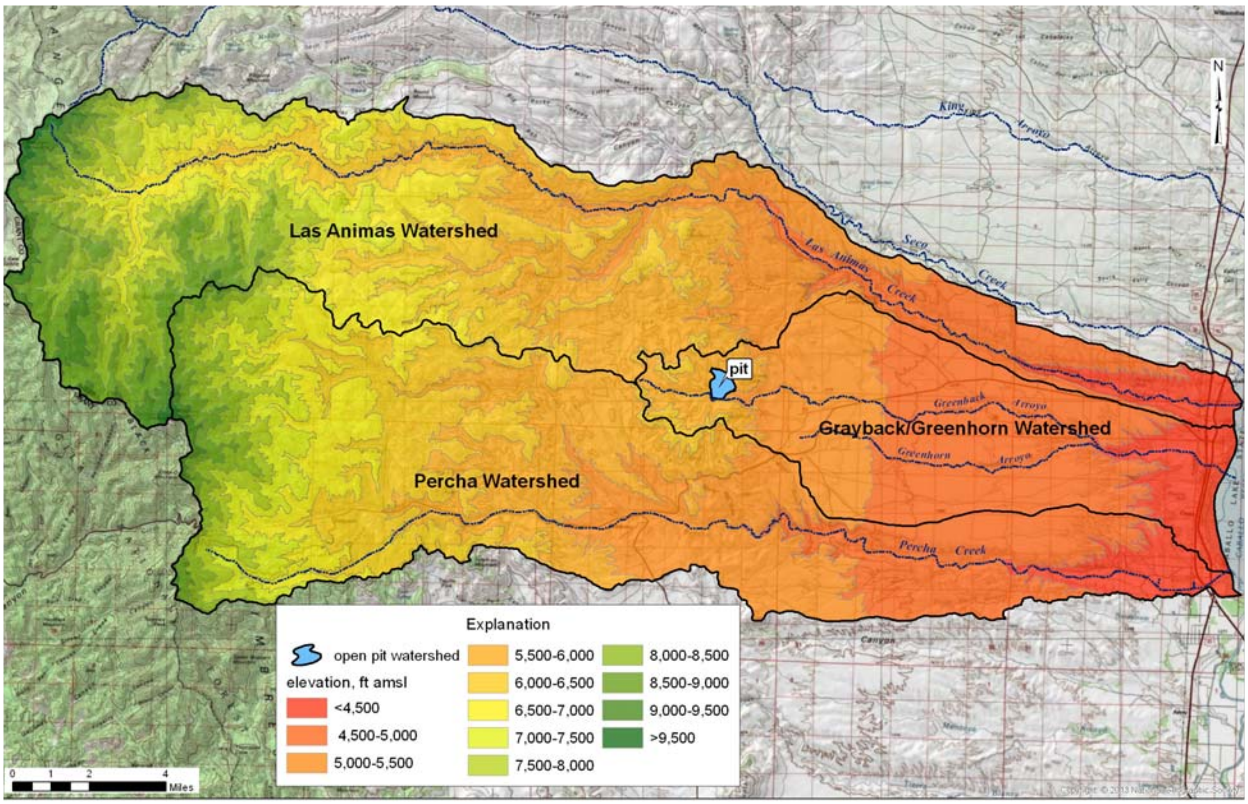


Figure 3.1. Study area watersheds.

3.1 Watershed Area and Precipitation

The areas of each of the watersheds within defined elevation bands are listed on Table 3.1. The mean annual precipitation (Fig. 2.4) estimated for the midpoint of each band is presented on Table 3.2, along with the estimated total annual volume of precipitation for each watershed.

Table 3.1. Study area watershed areas and hypsometry

elevation range (ft amsl)	Las Animas watershed	Percha watershed	Grayback / Greenhorn watershed	open pit watershed
	area (acres)			
<4,500	2,888	3,576	4,539	
4,500-5,000	7,030	11,035	17,095	
5,000-5,500	8,412	12,614	9,708	230
5,500-6,000	14,539	14,072	2,864	
6,000-6,500	12,369	13,030	635	
6,500-7,000	10,279	8,219		
7,000-7,500	6,507	5,355		
7,500-8,000	5,808	4,159		
8,000-8,500	6,160	3,021		
8,500-9,000	6,362	1,749		
>9,000	3,305	509		
total	**83,659**	**77,339**	**34,840**	**230**

ft amsl - feet above mean sea level

Table 3.2. Study area precipitation by watershed and elevation band

midpoint elevation (ft amsl)	precipitation (in./yr)	Las Animas watershed	Percha watershed	Grayback / Greenhorn watershed	open pit watershed
		precipitation (ac-ft/yr)			
4,350	9.7	2,326	2,880	3,655	
4,750	10.8	6,345	9,961	15,431	
5,250	12.3	8,617	12,921	9,944	236
5,750	13.8	16,661	16,126	3,282	
6,250	15.2	15,679	16,516	804	
6,750	16.7	14,279	11,417		
7,250	18.1	9,832	8,091		
7,750	19.6	9,482	6,790		
8,250	21.0	10,805	5,298		
8,750	22.5	11,933	3,280		
9,500	24.7	6,802	1,048		
total		**112,760**	**94,328**	**33,116**	**236**

ft amsl - feet above mean sea level
ac-ft/yr - acre-feet per year

3.2 Runoff and Groundwater Recharge

Basin water yield (surface water runoff plus groundwater recharge) is estimated here following the method of Maxey and Eakin (1949), in which estimated mean annual precipitation, a function of elevation, is correlated with an independent estimate of discharge. The result is a set of recharge factors, defined as the proportion of precipitation that becomes runoff or recharge (excess precipitation), for a given level of mean annual precipitation (an elevation band).

Some example sets of recharge factors are presented in Table 3.3. These include the formulation of Bennett and Finch (2002) used to estimate recharge in the trans-Pecos region of Texas, that was subsequently used to estimate recharge to the Salt Basin in New Mexico and Texas (JSAI, 2010), and the Davis Mountains/Salt Basin in Texas (LBG-Guyton, 2004).

Another example is that of Maxey and Eakin (1949), which studied dry, closed basins in southern Nevada, estimating discharge as playa ET. This example was modified by McDonald-Morrissey (1998) in BLM (2000), in a study of wetter, exoreic (outflowing) basins along the Carlin Trend in northern Nevada. Total basin discharge was estimated from gaged surface flows and from ET in vegetated areas.

Table 3.3. Published recharge factors

midpoint elevation (ft amsl)	precipitation (in./yr)	portion of precipitation that becomes runoff and/or recharge		
		Bennett and Finch (2002)	Maxey - Eakin (1949)	BLM (2000)
4,350	9.7	0.00	0.03	0.03
4,750	10.8	0.00	0.03	0.03
5,250	12.3	0.00	0.07	0.07
5,750	13.8	0.02	0.07	0.07
6,250	15.2	0.03	0.15	0.3
6,750	16.7	0.04	0.15	0.3
7,250	18.1	0.05	0.15	0.3
7,750	19.6	0.07	0.15	0.3
8,250	21.0	0.08	0.25	0.45
8,750	22.5	0.09	0.25	0.45
9,500	24.7	0.11	0.25	0.45

ft amsl - feet above mean sea level
BLM - U.S. Bureau of Land Management

Actual runoff and recharge are influenced by site-specific conditions including topography and surface geology. However, in the absence of an independent estimate of discharge, the previously published estimates may indicate a potential range of basin water yield.

The above formulas suggest, respectively, a study-area water balance of 8,000 ac-ft/yr (Bennett and Finch), 30,000 ac-ft/yr (Maxey and Eakin) and 51,000 ac-ft/yr (BLM). In the absence of other information, water yield of the study area is anticipated to be within the range of these estimates, or between about 8,000 and 50,000 ac-ft/yr. This range of yield is compared below to a basin-specific estimate of discharge.

3.3 Discharge

Discharge from the study area occurs mainly as groundwater and surface-water discharge to Caballo Lake and the Rio Grande, and as ET discharge from riparian and irrigated areas along Las Animas and Percha Creeks. Areas of open-water evaporation and of ET discharge, in and near the study area, are shown on Figure 3.2.

The Caballo Lake and North Caballo Lake discharge areas shown on Figure 3.2 are only partly supplied from the study area. Water is also provided by:

- Direct contribution from the Rio Grande upstream; based on average daily discharge below Elephant Butte dam (U.S. Geological Survey (USGS) station No. 08361000) and below Caballo dam (USGS station No. 08362500) from 1938 through 2010, an average of 12,364 ac-ft/yr more water is released from Elephant Butte (into Caballo) than from Caballo.
- Runoff from the watersheds east of Caballo Lake. These basins lack large high-altitude catchment areas and yield less water than basins west of the lake. They will, however, contribute water to Caballo after major precipitation events.
- Contribution from the Palomas Creek (catchment area 233,942 ac) and Cuchillo Creek (catchment area 235,493 ac) basins north of the study area, with similar hypsometry to the study area basins. Assuming water yield proportional to (elevation-weighted) catchment area (Table 3.1), Palomas and Cuchillo Creek basins would be expected to produce about 71 percent of the total yield from the basins west of Caballo, with the study area basins contributing the remainder.

Evaporation/ET for Caballo Lake and for the study area watersheds is estimated on Table 3.4; ET from irrigated crops or riparian vegetation was estimated at 36 in./yr. Net evaporation for Caballo Lake, estimated at about 70 in./yr (Table 2.1), was rounded down to 60 in./yr, to account for runoff from the east side of the lake. Net evaporation for North Caballo Lake and ET for Rio Grande riparian areas were estimated as the average of combined net Caballo evaporation and riparian ET rate, or 48 in./yr.

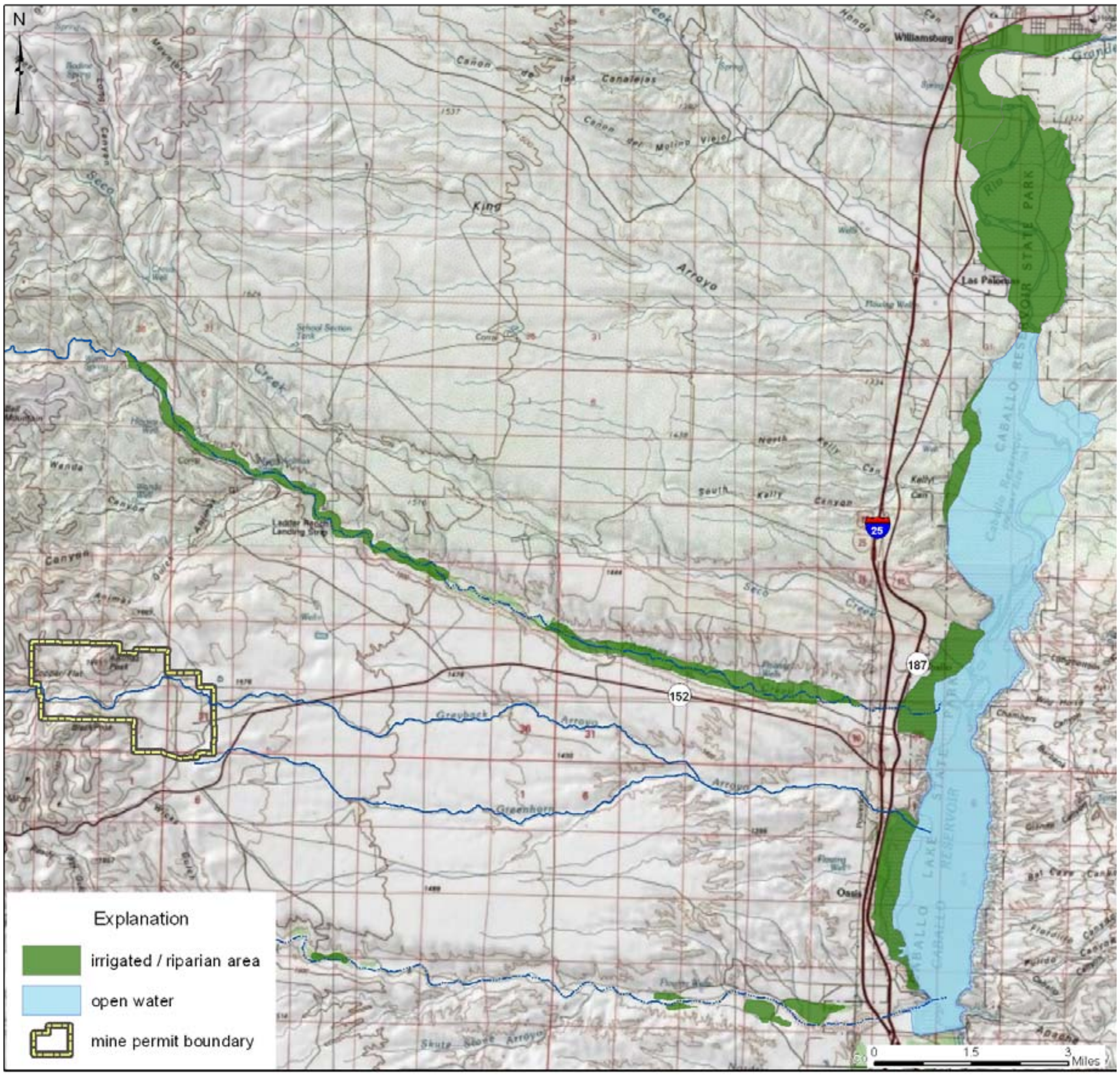


Figure 3.2. Discharge areas.

Table 3.4. Estimated evaporation and evapotranspiration (ET)

	area (acre)	net evaporation and ET (ft/yr)	net evaporation and ET (ac-ft/yr)
Caballo Lake (water surface at 4,200 ft amsl)	6,344	5	31,719
North Caballo Lake / Rio Grande riparian area	5,214	4	20,858
Las Animas Creek irrigated / riparian area	1,421	3	4,262
Percha Creek irrigated / riparian area	280	3	839
Copper Flat open pit water surface	5	4	20
total			**57,698**

ac-ft/yr - acre-feet per year ft amsl - feet above mean sea level

3.4 Water Balance

The Caballo Lake and North Caballo Lake discharge components in Table 3.4, totaling 52,577 acre-feet per year (ac-ft/yr), are only partly supplied from the study area. In order to estimate the portion provided from the study area, the following adjustments were made:

- Based on USGS gage data discussed above (Sec. 3.3), 12,364 ac-ft/yr is assumed to be provided by the Rio Grande upstream of Caballo Lake.
- The estimated rate of evaporation from Caballo Lake was rounded down to account for runoff from the watersheds east of the lake as described above.
- Of the remaining Caballo Lake and North Caballo Lake discharge (40,213 ac-ft/yr), 71 percent was assumed to be provided by the Palomas and Cuchillo Creek Basins, as discussed above. The remainder was assumed to be generated within the study area.

Based on the discharge estimates in Table 3.4 and the adjustments listed above, an estimated water balance for the study area is presented in Table 3.5. The water balance shown on Table 3.5 of about 17,000 ac-ft/yr falls within the range of water yield (8,000-50,000 ac-ft/yr) estimated above.

Table 3.5. Estimated water balance

runoff and recharge (ac-ft/yr)	
Las Animas Creek	10,709
Percha Creek	6,074
Grayback and Greenhorn Arroyos	201
Copper Flat open pit	1
total	**16,984**
discharge (ac-ft/yr)	
Las Animas Creek irrigated and riparian area	4,262
Percha Creek irrigated and riparian area	839
discharge to Rio Grande and Caballo Reservoir	11,850
Copper Flat open pit	20
total	**16,971**

ac-ft/yr - acre-feet per year

The water balance in Table 3.5 may also be compared with the water balance of the Upper Mimbres Basin, located on the opposite side of the Black Range from the study area, with a similar distribution of elevations. The average yield of the 300,000-acre basin above the Faywood gaging station is estimated (based on gaged flows) at 26,700 ac-ft/yr (White, 1930). The same per-acre water yield in the study area would be 17,450 ac-ft/yr, similar to the estimate given in Table 3.5.

4.0 GEOLOGY AND HYDROGEOLOGY

The surface-water basins discussed above are shown on Figure 4.1, along with the smaller groundwater-flow model domain. Although most of the precipitation that recharges the groundwater system originates in the upper part of the watersheds (left-hand side of Fig. 4.1, outside of the groundwater study area), the main groundwater systems are found in sedimentary deposits downstream.

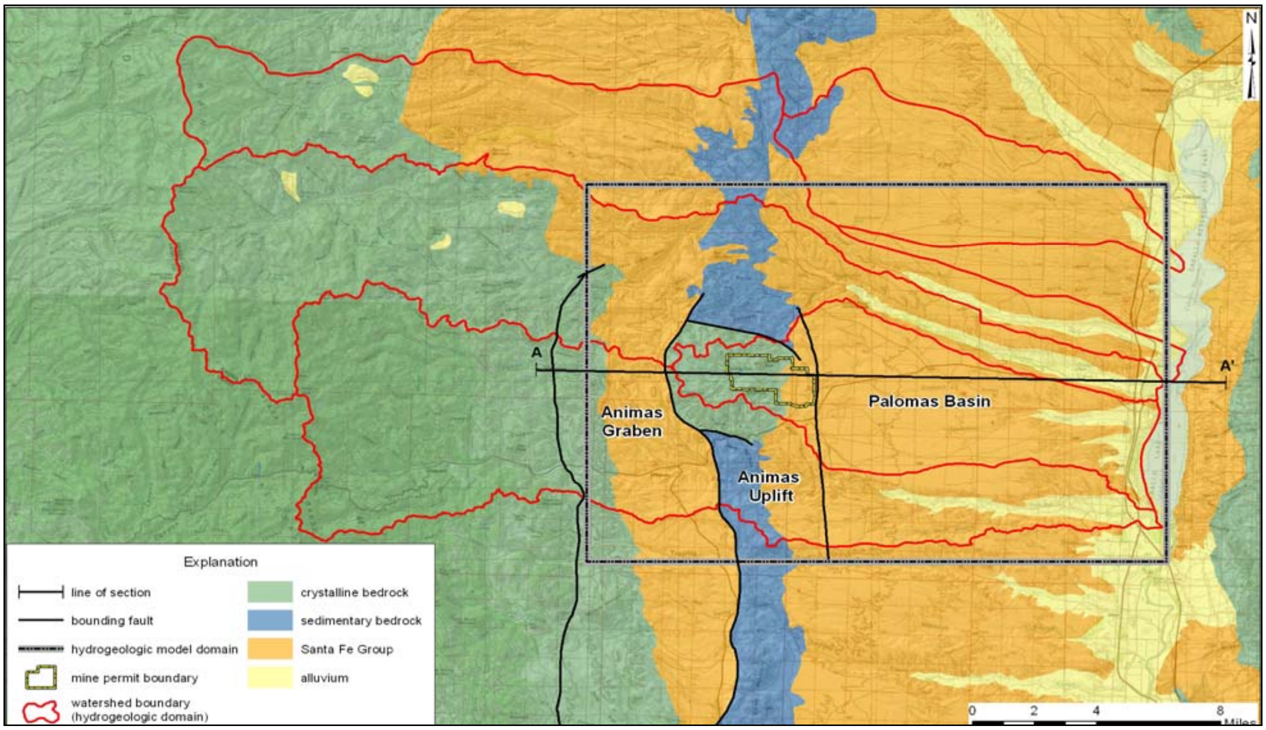


Figure 4.1. Hydrogeologic zones.

The study area consists of three major hydrogeologic zones (Fig. 4.1), shown in west-east cross-section on Figure 4.2. The three zones are 1) Animas Uplift, the bedrock in which the ore body is located, 2) the sediment-filled Animas Graben west of the Animas Uplift and east of the Black Range mountain block, and 3) the Palomas Basin, the main sedimentary basin along the Rio Grande rift east of the Animas Uplift, in which the mine water-supply wells are located.

The Animas Uplift in the vicinity of Copper Flat (Fig. 4.1) consists of crystalline bedrock that conducts little water. The Copper Flat open pit and the main part of the other Project facilities, including waste rock and tailings storage facilities, would be located on the Animas Uplift. To the north and south of the Copper Flat area the Animas Uplift consists of sedimentary rocks that conduct more groundwater flow.

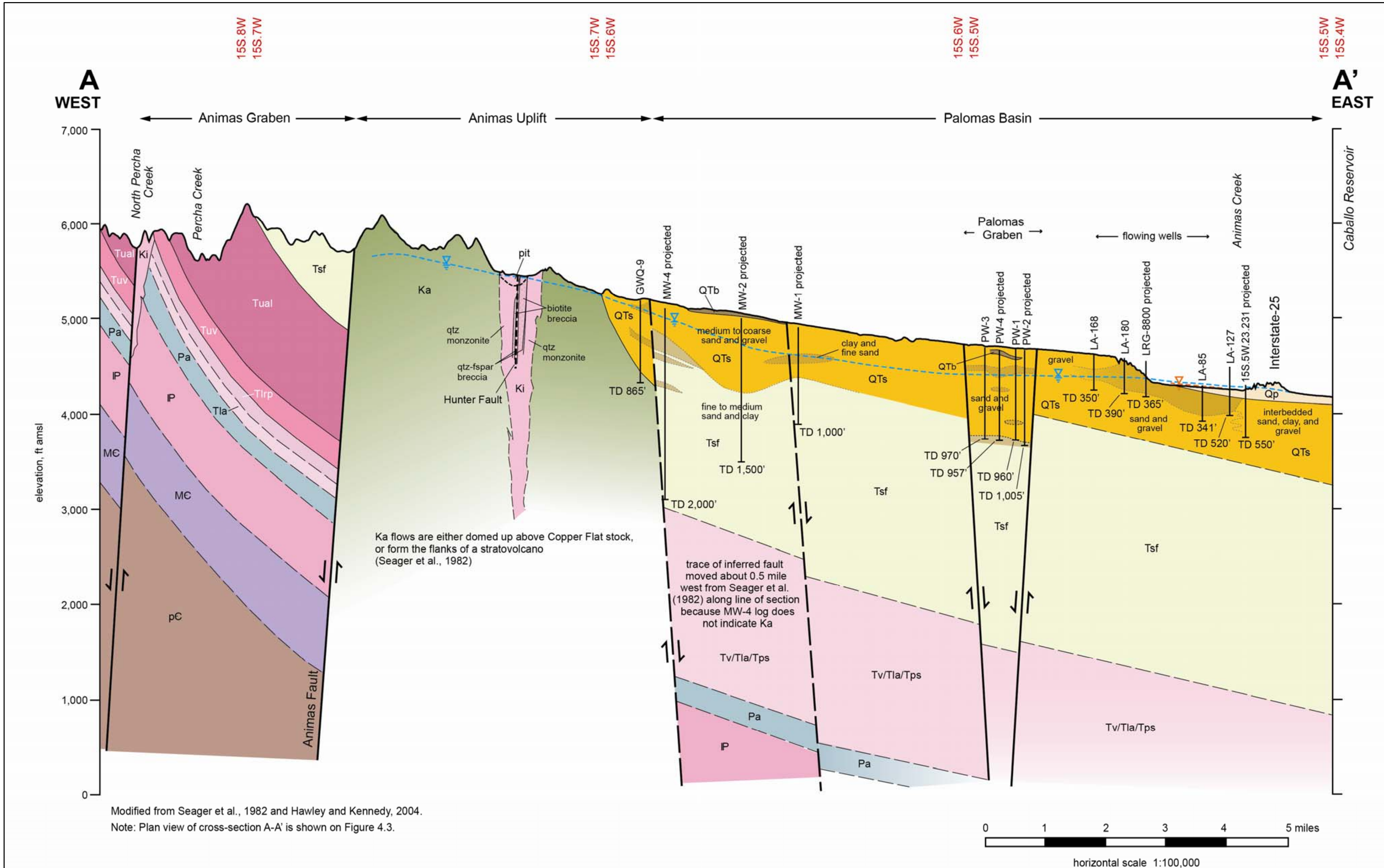


Figure 4.2. Hydrogeologic zones, west-to-east cross-section.

The Animas Graben between the Black Range and the Animas Uplift drains north to Animas Creek and south to Percha Creek via Warm Springs Valley. Santa Fe Group (SFG) sedimentary deposits overlie older sedimentary bedrock units (Fig. 4.2).

The Palomas (geologic) Basin lies within the Lower Rio Grande Underground Water (administrative) Basin. The Project water-supply wells are completed within the SFG aquifer between Las Animas Creek and Percha Creek (Fig. 4.1), and will be the main source of groundwater and surface-water effects of the Project. Parts of the waste rock and tailings storage facilities would also be located overlying the western margin of the Palomas Basin.

4.1 Geology

The geologic description is adapted from Shomaker (1993), who cites Harley (1934), Hedlund (1975), Dunn (1982), and Seager et al. (1982). An extended bibliography of geology references is presented as Appendix A. The geologic map of the study area is presented on Figure 4.3. Three major geologic subdivisions (Figs. 4.1 and 4.2), the Animas Uplift, the Animas Graben east of the Black Range, and the Palomas Basin, are described below.

4.1.1 Animas Uplift

The Animas Uplift is an upthrown block, ranging from less than 2 to about 4 miles wide, bounded by north-south trending faults (Fig. 4.1). The Copper Flat ore body is located within a nearly circular remnant of a Cretaceous-age andesite volcano about 4 miles in diameter that is part of the Animas Uplift. Drilling has shown that andesite is present to a depth of more than 3,000 ft (Dunn, 1982, p. 314).

The hills surrounding Copper Flat, referred to as the Hillsboro Hills, consist of Cretaceous-age andesite flows, breccias, and volcaniclastic rocks that were erupted from the volcano (McLemore, 2001; Raugust and McLemore, 2004). The andesite is bounded on the north and south by Paleozoic-age limestone, and on the east by the SFG sediments of the Palomas Basin, in fault contact. On the west, the andesite body is in fault contact with Paleozoic-age limestone, Tertiary-age volcanic rocks, and overlying SFG sediments of the Animas Graben (Fig. 4.2).

The ore body itself is in the Copper Flat quartz monzonite stock, within the body of andesite. The quartz monzonite porphyry intruded the vent of the volcano, and then dikes and mineralized veins intruded the monzonite porphyry and radiated outward from the porphyry into faults and fracture zones in the andesite. The porphyry copper deposit is concentrated within a breccia pipe in the quartz monzonite stock.

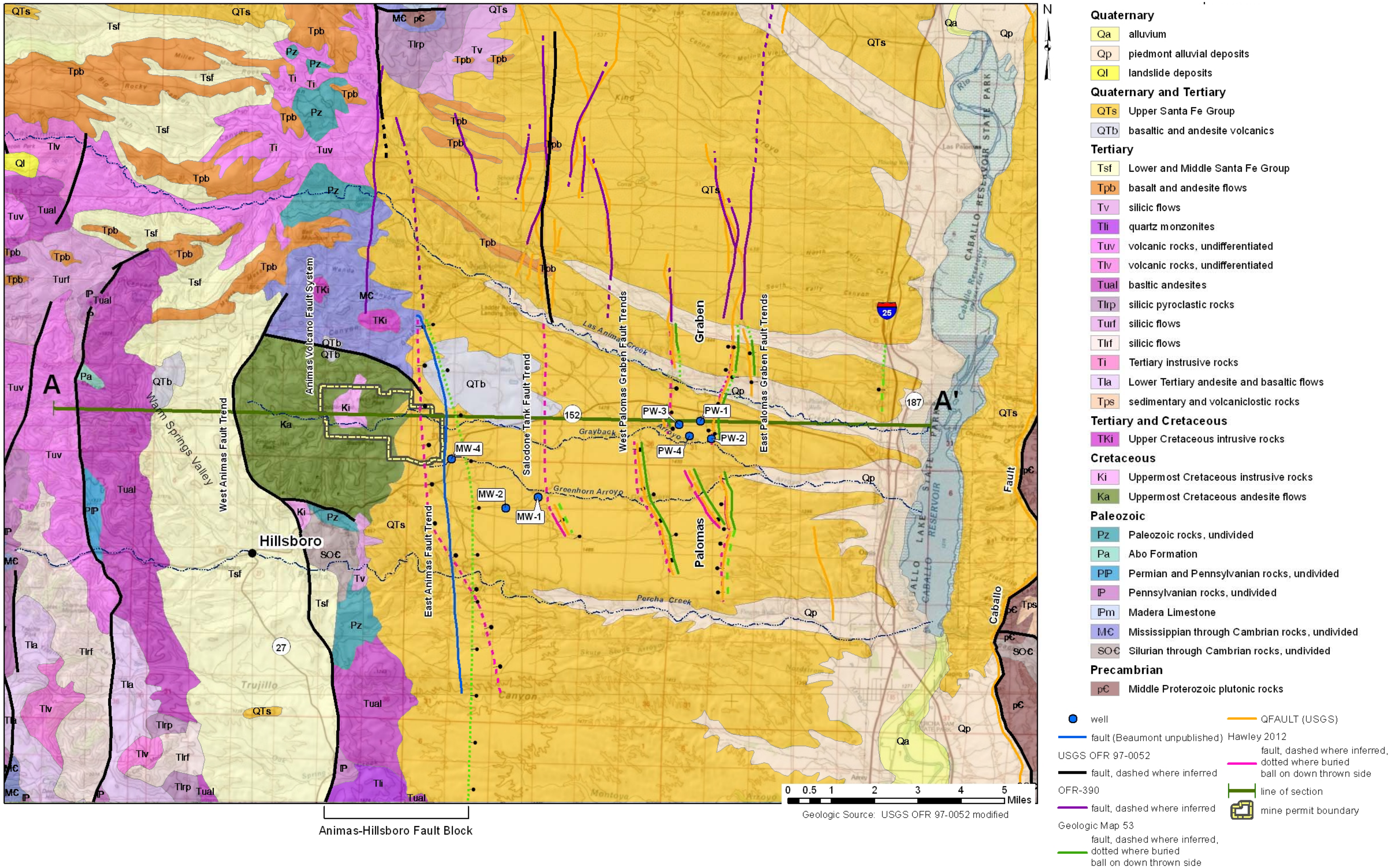


Figure 4.3. Geologic map of study area.

4.1.2 Graben West of Animas Uplift

West of the Animas Uplift, between it and the Black Range, lies a half-graben in which Tertiary-age alluvial-fan deposits, sandstones, and mudstones of the SFG overlie Tertiary-age volcanic rocks and Paleozoic-age sedimentary rocks. Dips are eastward, and the half-graben is bounded on the east by normal faults. The Santa Fe beds may reach a thickness of 1,000 ft on the east side of the half-graben (Seager et al., 1982, sheet 2).

4.1.3 Palomas Basin

The Palomas Basin is a sediment-filled structural trough about 35 miles long by 12 miles wide. It is part of the Rio Grande rift, a north-south trending zone of approximately east-west oriented extension that bisects the state of New Mexico. The extension is caused by the Colorado Plateau crustal block pulling away from the High Plains block, which stretches and thins the Earth's crust in the area of the rift (Seager and Morgan, 1979).

Rio Grande rift extension began in southern New Mexico about 36 million years ago in late Eocene time, with the rate of extension peaking between 16 and 10 million years ago, in Miocene time (Lozinsky, 1986; Mack, 2004). The axial basins (such as the Palomas Basin) are in the form of half-grabens that are tilted strongly toward the east or the west, depending on which side of the main rift fault the basin is located.

The Palomas Basin is an eastward-tilted half graben as evidenced by gravity data and by geologic mapping of eastward dips of Santa Fe Group beds along the western edge of the basin (Lozinsky, 1986). The basin is defined between the north-south trending Caballo and Animas-Hillsboro fault blocks (Fig 4.3; Kelley, 1955; Kelley and Silver, 1952). Most of the displacement has occurred on the east side of the Palomas Basin along the Caballo Fault (the main rift fault system).

Basin-fill thickness is probably greater than 6,000 ft along the eastern side of the Palomas Basin (Lozinsky, 1986). Basin-fill thickness is greater than 2,000 ft at well MW-4 (Fig. 4.3), located near the western edge near the Animas Uplift.

The sedimentation of the Palomas Basin occurred contemporaneously with the down-dropping of the half graben and the rise of the Animas Uplift (Mack, 2004). Las Animas and Percha Creeks were established prior to structural development of the Animas Uplift and maintained the water course by channel cutting through the bedrock units, and downstream deposition of fluvial sediments in the Palomas Basin (Mack, 2004).

North-south extensional faulting followed the formation of the Palomas Basin and deposition of the majority of the Santa Fe Group sediments. North-south faults within the Santa Fe Group Sediments have been mapped by Kelley et al. (unpublished, 1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (unpublished, 2012).

North-south extensional faulting formed a mini-graben that filled with sediments that are coarser-grained than the Santa Fe Group sediments on either side; this mini graben is referred to here as the Palomas Graben. The Palomas Graben was identified as a productive aquifer, and the Copper Flat well field was completed within it in the mid-1970s (Figs. 4.2 and 4.3).

The faults forming the Palomas Graben are mapped from Percha Creek north to about Palomas Creek. However, similar north-south trending faults mapped by Harrison et al. (1993) suggest the Palomas Graben may continue as far north as the San Mateo Mountains (Hawley, personal communication, 2012).

A summary of faults shown on Figure 4.3, from west to east, follows:

1. West Animas Fault Trend – north-south fault that forms boundary between Animas half-graben and west side of Animas Uplift. Normal fault downthrown on the west side. Primary references Murray (1959); Hedlund (1975).

2. Animas Volcano Fault System – faults formed around andesite volcano, downthrown on exterior side of volcano. Primary references Harley (1934); Hedlund (1975); Dunn (1982).

3. East Animas Fault Trend – north-south normal fault that forms boundary between Animas Uplift and Palomas Basin. Downthrown on east side. Mapped as inferred fault at slightly different longitude by Seager et al. (1982) than by Hawley (2012). Key references include Harrison et al. (1993), Beaumont (2011), JSAI (2011a), and Hawley (2012). Work performed by JSAI (2011a) and Beaumont (2011) is based on analysis of well logs and lineaments identified from aerial photographs.

4. Saladone Tank Fault Trend – north-south normal fault down thrown on the east side. Mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

5. West Palomas Graben Fault Trends – north-south normal faults downthrown on the east side. Forms western boundary of the Palomas Graben. Faults mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

6. East Palomas Graben Fault Trends – north-south normal faults downthrown on the west side. Forms eastern boundary of the Palomas Graben. Faults mapped by Kelley et al. (1979), Seager et al. (1982), Harrison et al. (1993), and Hawley (2012).

4.2 Hydrogeology

Hydrogeologic units, aquifer characteristics, and recharge and discharge locations are discussed below for the three geologic subdivisions of the study area. A hydrogeologic map of the study area is shown with surface water features and mapped springs on Figure 4.4.

Some of the mapped springs, such as "Las Animas Creek Community Spring" (Murray, 1959) and "LA-52" (Davie and Spiegel, 1967), were identified long ago and may no longer flow. However, the locations identified within the Santa Fe Group lie along the main faults, demonstrating the structural controls on groundwater flow.

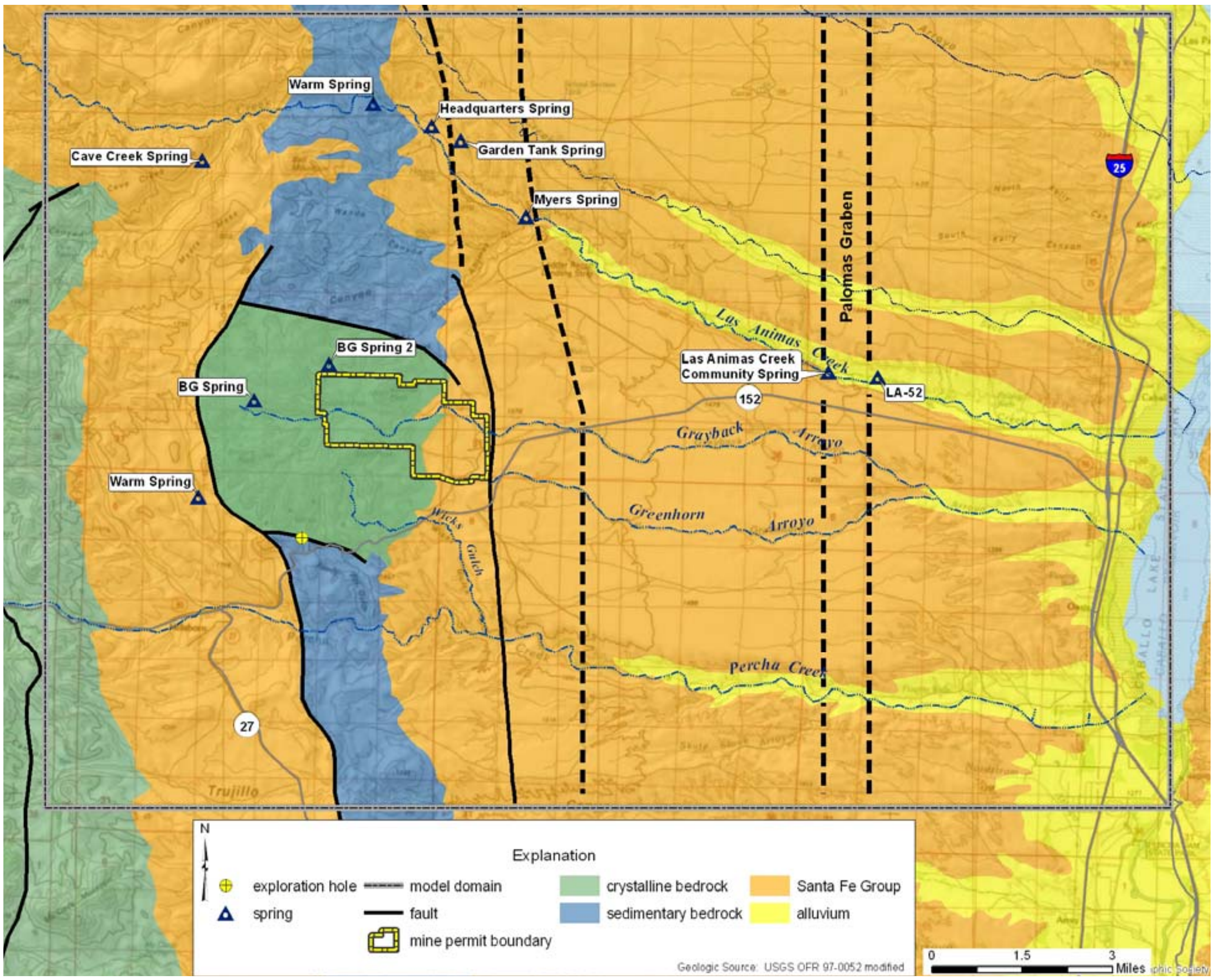


Figure 4.4. Hydrogeologic units and mapped spring locations.

4.2.1 Animas Uplift

Hydrogeologic units in the Animas Uplift include the relatively impermeable andesite and monzonite of the Copper Flat area and the relatively permeable carbonate rocks and other sedimentary rocks to the north and south of Copper Flat.

Groundwater recharge from local precipitation to the quartz monzonite and andesite is limited by low hydraulic conductivity. Recharge to the limestone outcrop areas north and south of the andesite is greater. Recharge to the limestone also includes infiltration of runoff generated at higher elevation, from the Las Animas Creek and Percha Creek watersheds.

Groundwater discharges from the limestone at the foot of the uplift, as spring flow (Fig. 4.4) and base flow to Percha and Las Animas Creeks. Groundwater discharges from the andesite as subsurface flow across the fault contacts with the Palomas Basin, and as evaporation from the open pit.

The existing Copper Flat open pit, which the New Mexico Copper Corporation (NMCC) proposes to expand, was excavated in 1982 by Quintana Minerals. The Quintana pit was excavated to a maximum depth corresponding to elevation 5,400 ft amsl. The current water level in the pit is about 5,439 ft amsl (April 2013). The pre-mining groundwater level (without lake evaporation) was about 5,450 ft amsl (JSAI, 2011b).

The low hydraulic conductivity of the quartz monzonite and andesite is reflected in the low pumping rates required in 1982 to dewater the Quintana pit. The dewatering rate required to maintain the greater-than 45-ft drawdown, in an excavation about 100 ft by 200 ft in area at maximum depth, was estimated at 22 gallons per minute (gpm) (Shomaker, 1993). SRK (1997) reports pumping rates up to 50 gpm. The range in reported dewatering rates was likely due to the variability of precipitation and runoff to the pit.

The low conductivity of the andesite and monzonite are confirmed below in the evaluation of the pit water balance (Sec. 5.4) and in the results of the 2011 pit-area pressure-injection testing (Sec. 5.4.1). It can be expected that the hydraulic conductivity of rock deeper in the andesite and quartz monzonite will have still lower hydraulic conductivity, because of the decrease in weathering effects and the closing of fractures with depth. The andesite acts as a hydrologic containment vessel for the existing and proposed open pits.

The radiating dikes and veins may be inferred to have relatively low conductivity as well. Several mine shafts in Wicks Gulch (Fig. 4.4) were examined, and found to be almost full of water; if there were significant hydraulic conductivity, either along fractures or through the rock matrix, water levels would be closer to the elevation of nearby surface channels.

Away from the andesite body, where the Animas Uplift consists of fractured, predominantly limestone and dolomite bedrock, it is likely that significant permeability has developed by the combination of fracturing and enlargement of fracture-openings by dissolution of carbonate minerals. This hypothesis is supported by the account of an air-drilled exploration hole (Fig. 4.4) in SW/4 SE/4 Sec. 3, T. 16 S., R. 7 W, which was abandoned because large water production overcame the capacity of the compressor to continue circulation (Sonny Hale, personal communication). The well is close to the fault which offsets the andesite against the predominantly limestone Paleozoic-age section.

4.2.2 Graben West of Animas Uplift

Local precipitation, and runoff from the Black Range, provide groundwater recharge to the graben. Discharge occurs mainly as spring flow and possibly also as subsurface discharge to the Animas Uplift. Spring flow in the Warm Springs drainage discharges as base flow to Percha Creek. The emergence of water at Warm Springs (Fig. 4.4) at the eastern edge of the graben demonstrates that the andesite of the Animas Uplift acts at depth as a barrier to flow from the graben. Groundwater in the graben flows west to east across the Animas Uplift, south toward Percha Creek and north toward Las Animas Creek, flowing around the body of low-permeability andesite (Fig. 4.4).

The contrast between the chemical makeup of water from Warm Springs, as compared with water from wells and springs within the Animas Uplift (Newcomer and Finch, 1993), indicates that the source of Warm Springs water is not within the uplift, as might otherwise be inferred from the relative heads at the spring and at wells and springs within the uplift (Fig. 4.4).

4.2.3 Palomas Basin

Water recharges the Palomas Basin at its western edge, through alluvial fans at the edge of the Animas Uplift, including infiltration of runoff from Greenhorn and Grayback Arroyos and as infiltration of base flow and runoff from the upper catchments of Las Animas and Percha Creeks. Groundwater flows east toward the Rio Grande and Caballo Lake. Besides discharging to the Rio Grande and Caballo, groundwater discharges by pumping, from flowing wells, and as evapotranspiration from irrigated and riparian vegetated areas along Las Animas and Percha Creeks.

The principal water-bearing sediments of the Palomas Basin are (1) alluvial-fan deposits, and fluvial sands and gravels of the Santa Fe Group, and (2) alluvium in the inner valleys of the Rio Grande and principal tributaries (Hawley and Kennedy, 2004).

Davie and Spiegel (1967, p. 9) describe the Santa Fe Group in Las Animas Creek area as consisting of (a) an alluvial fan facies, interfingering eastward with (b) a clay facies, possibly representing the distal or deltaic beds of the alluvial fan facies, which in turn interfingers with (c) an axial river facies consisting of well-sorted sand and gravel containing well-rounded quartzite pebbles. The sediments are stratified and in general dip to the east.

Geologic logs from wells along Las Animas Creek provide evidence that the coarse-grained sediments in the Palomas Graben are overlain by a clay layer that creates perched groundwater conditions in the alluvium along Animas Creek.

Stratification and heterogeneity of the SFG creates confined conditions at depth in the lower Palomas Basin. Seepage along Percha Creek, Grayback Arroyo, Greenhorn Arroyo, and Las Animas Creek alluvial systems recharges the SFG sediments in the upper basin and the recharge hydraulically loads the more permeable zones down-dip. Overlying clay beds create artesian conditions in the basin down-dip of recharge zones.

Artesian pressures are relatively low, generally less than 10 ft of head above land surface. A survey of artesian wells (Shomaker, unpublished) from 1993 has been updated, indicating reduction of artesian flow and pressure over 18 years. The history and effects of artesian discharge are discussed further below.

4.3 Hydrogeologic Conceptual Model

The hydrogeologic system described above is summarized on Figure 4.5, a map of hydrogeologic units, and on Figure 4.6, a map of the boundary conditions (inflows and outflows of water) on the system. The hydrogeologic units and boundary conditions presented form the basis of the numerical groundwater-flow model.

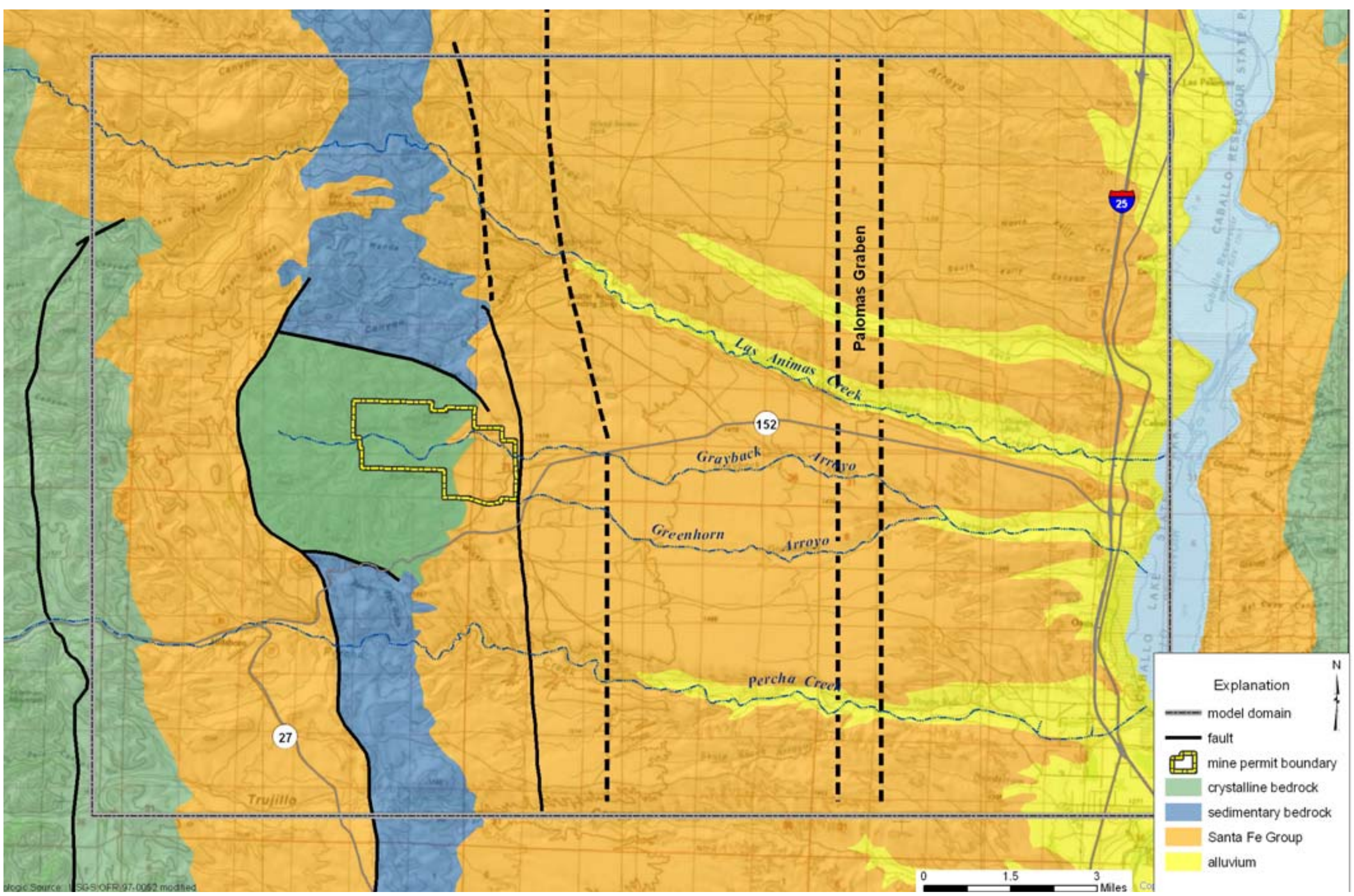


Figure 4.5. Hydrogeologic map of study area.

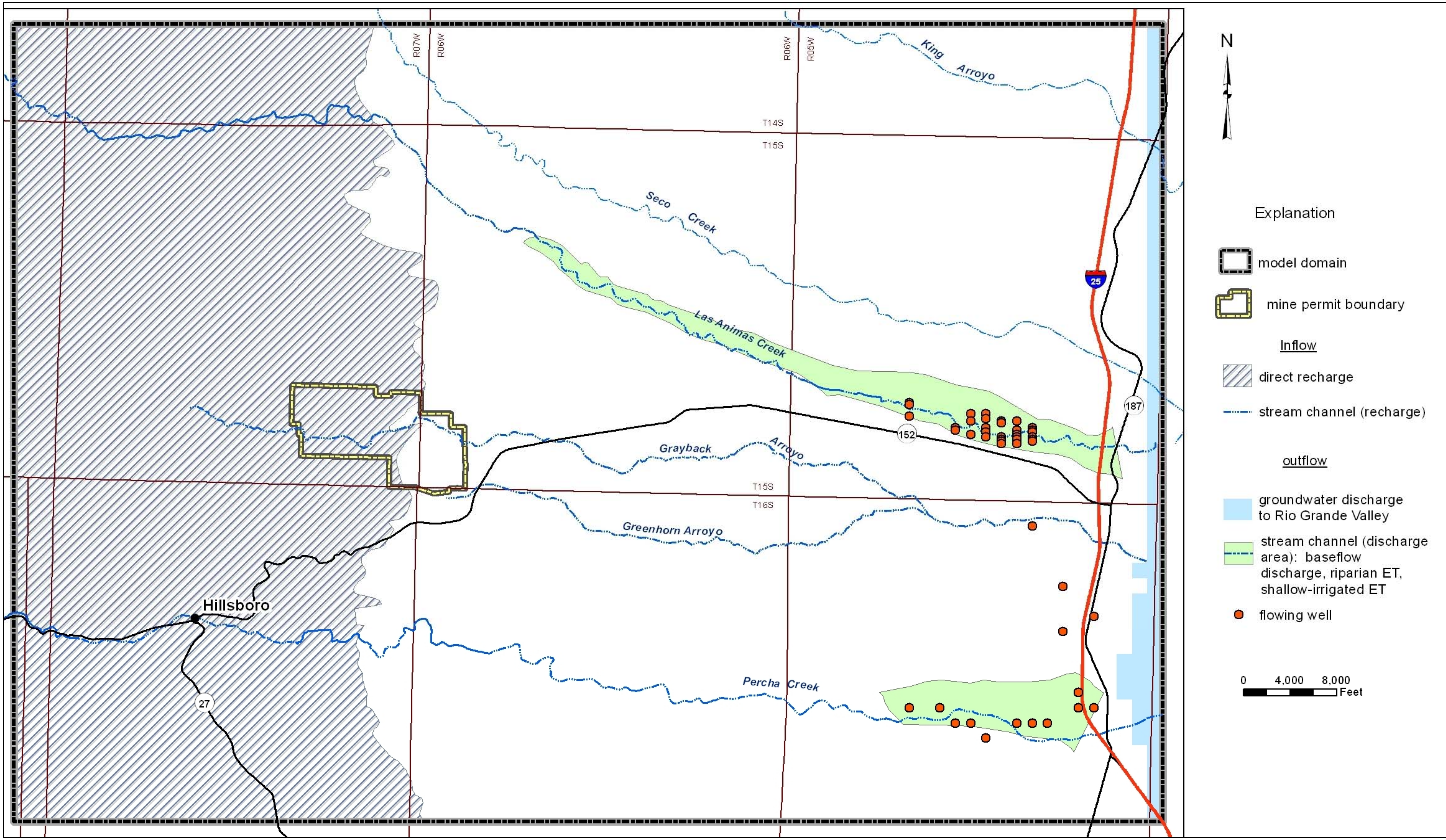


Figure 4.6. Hydrogeologic boundary conditions

5.0 CALIBRATION DATA

This section describes the data on aquifer stresses and responses available to guide the development and calibration of a numerical groundwater-flow model. These include information on (1) regional water levels, (2) the Palomas Graben and the area of the water-supply wells (well field), (3) the former tailings facility, (4) the open pit, and (5) the artesian zone in the lower Las Animas Creek and lower Percha Creek basins.

5.1 Regional Water Levels

Locations of wells and water-level measurements are presented with recent (December, 2012) potentiometric surface contours on Figure 5.1. Interpreted contours are shown for three aquifers: (1) bedrock and SFG of the Animas Uplift and Animas Graben, (2) the SFG aquifer of the Palomas Basin, and (3) the shallow alluvial aquifer along Las Animas Creek. Groundwater levels range from above 5,800 ft amsl at the western edge of the Animas graben to about 4,200 ft amsl at Caballo Lake.

Piezometers and production wells discussed below are shown on Figure 5.2. Available well construction diagrams are shown in Appendix B.

5.2 Well Field Area

The NMCC water supply wells (PW-1, PW-2, PW-3, and PW-4) were constructed and tested in 1975-80 (Green and Halpenny, 1976, 1980). Local transmissivity of the SFG aquifer is estimated below from the PW-1 and PW-2 test data. Effects of the period of well field operation, from March through June 1982, are then discussed. Next, results of a 1994 pumping test of MW-9, evaluating vertical transmission of effects, is presented. Finally, results of a 2012 aquifer test are discussed.

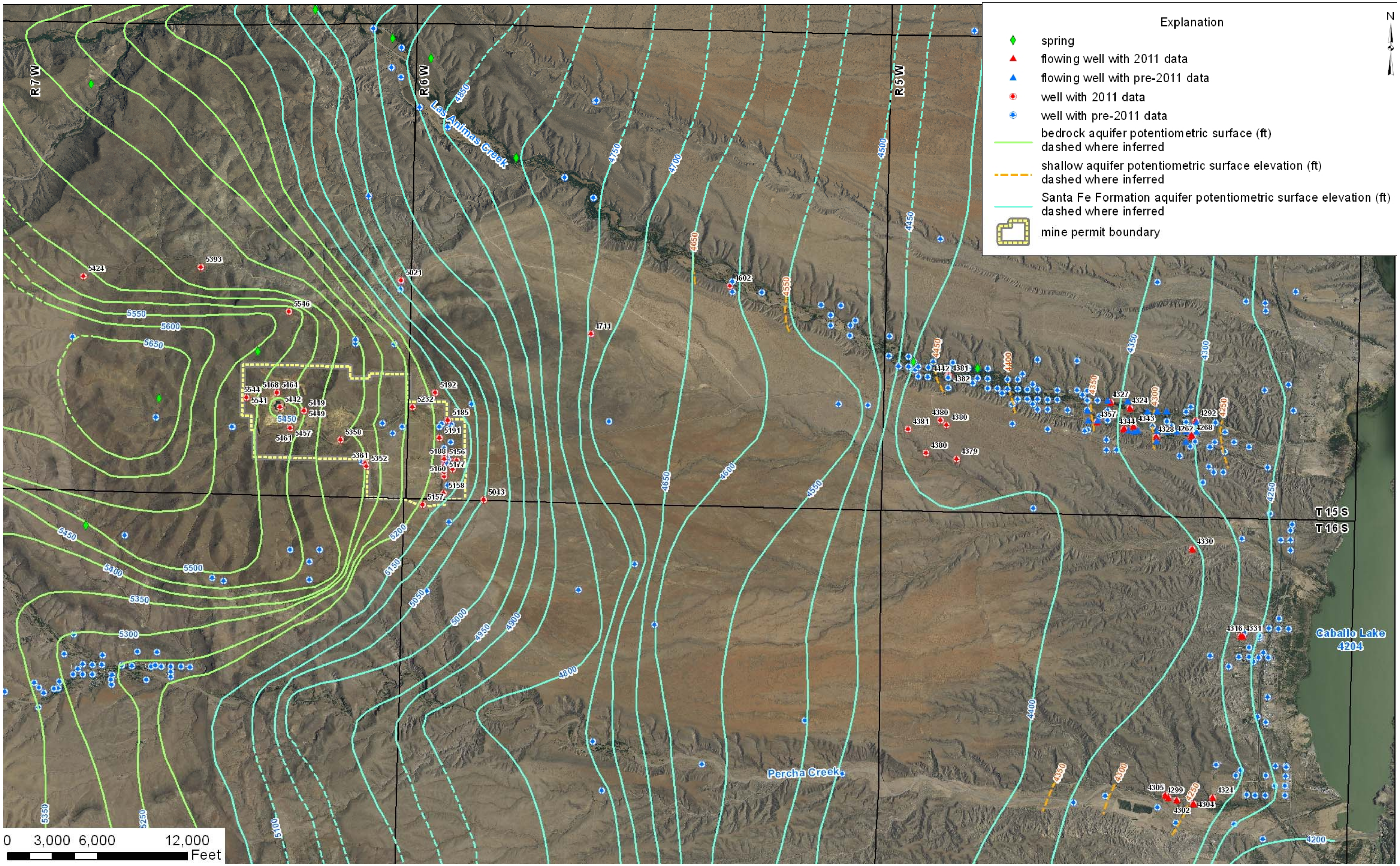


Figure 5.1. Regional water-level measurements and potentiometric surface contours.

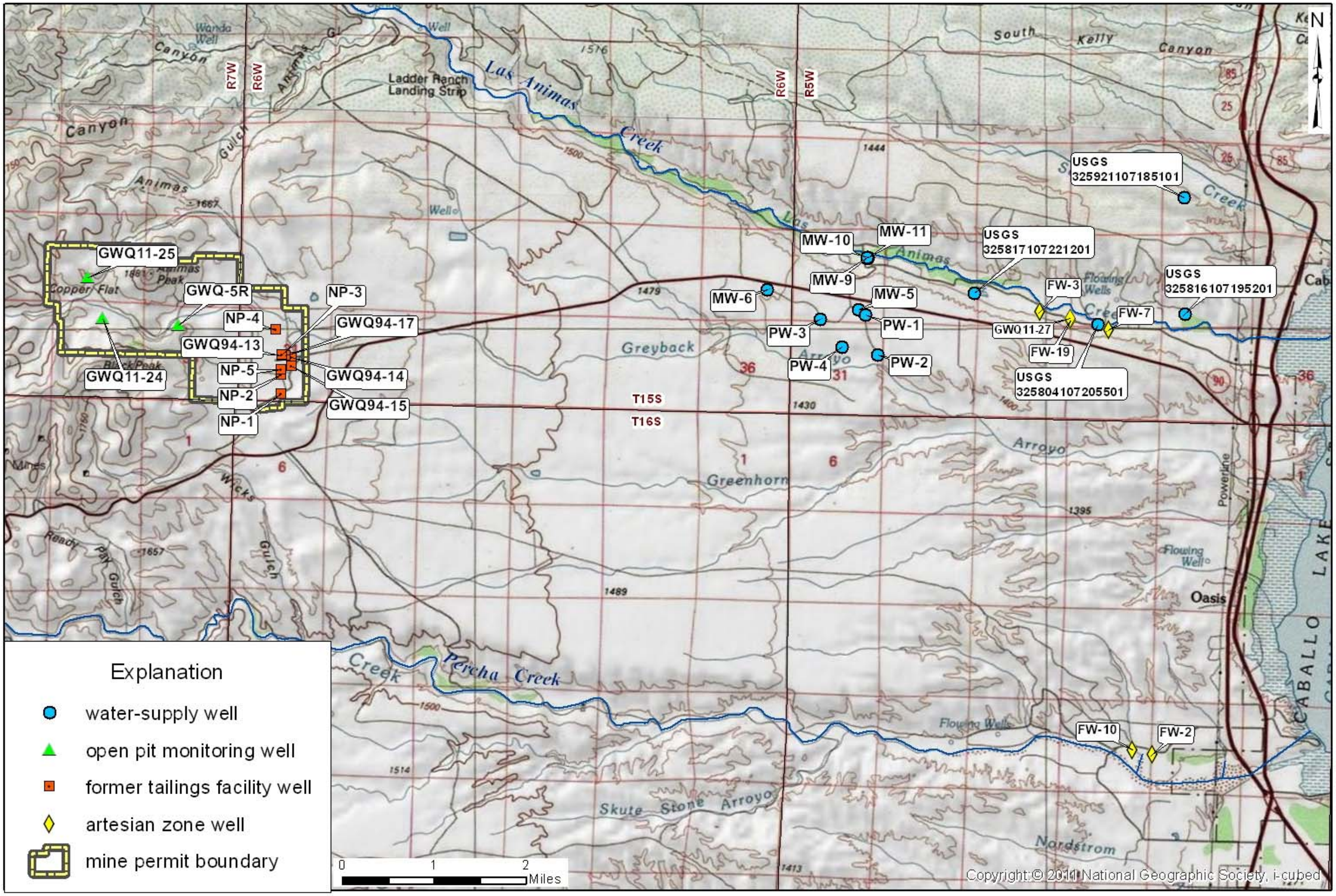


Figure 5.2. Well locations.

5.2.1 Initial Production Well Testing, 1975-1976

PW-2 was pumped at 2,020 gpm for 72 hours in January 1976 (Appendix C1). Measured drawdown and recovery at observation wells PW-1 and MW-5 are shown on Figures 5.3 and 5.4. Aquifer transmissivity is estimated at about 20,000 ft^2/day by matching the solution of Theis (1938) to measured drawdown and recovery at PW-1 and MW-5 (WDC, 1976).

Measured drawdown and recovery at the pumping well PW-2, is shown on Figure 5.5, along with the Theis solution match. In addition, because the PW-2 curves exhibit a shape characteristic of a leaky confined aquifer, the modified Theis solution of Hantush (1956) is shown as an alternate analysis.

PW-1 was pumped at 1,500 gpm for 70 hours in December 1975 (WDC, 1976). Measured drawdown and recovery at observation well MW-5 are shown on Figure 5.6. Aquifer transmissivity of about 17,000 ft^2/day is estimated by matching the solution of Theis (1938) to measured drawdown and recovery at MW-5, and to measured recovery at the pumping well PW-1, shown on Figure 5.7. In addition, the PW-1 curves exhibit a “leaky” shape and a Hantush curve match is shown as an alternate analysis.

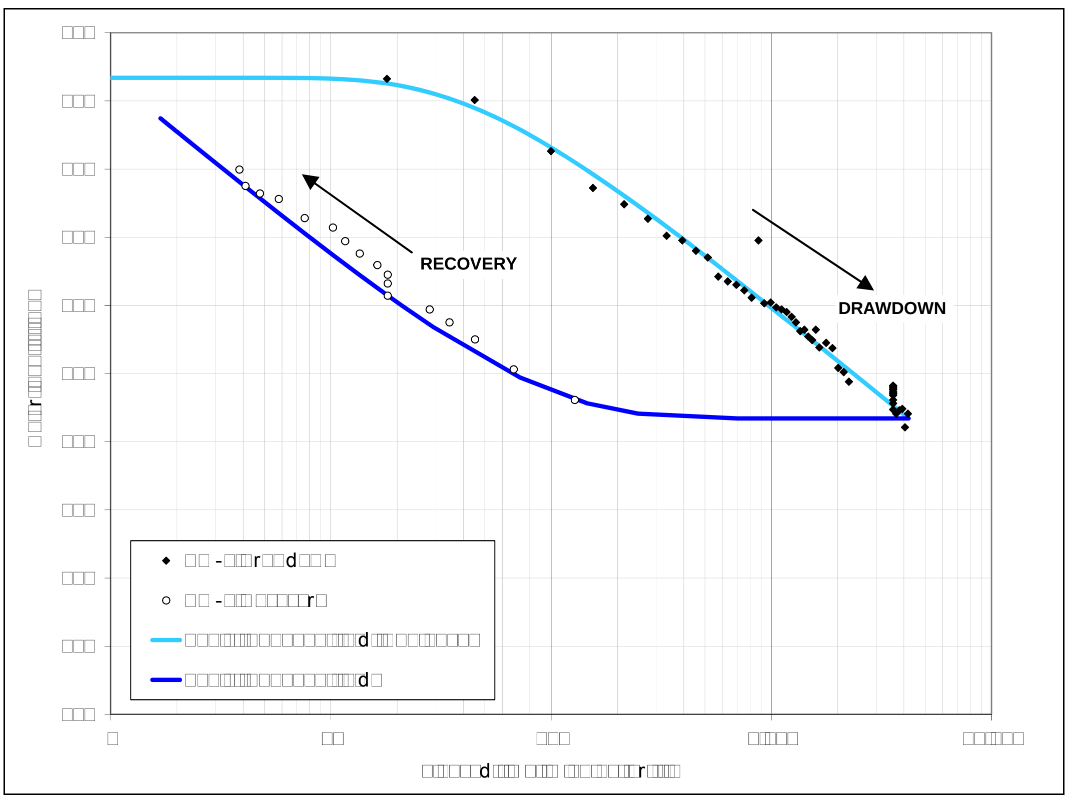


Figure 5.3. Drawdown and recovery in PW-1 during January 1976 PW-2 pumping test.

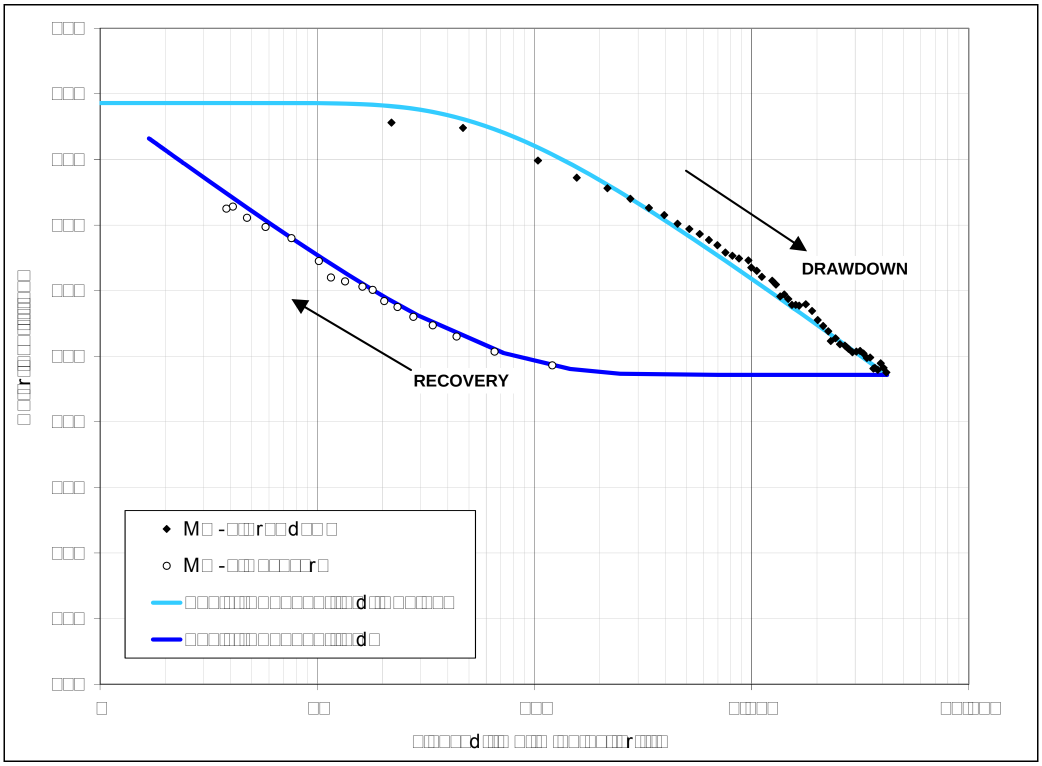


Figure 5.4. Drawdown and recovery in MW-5 during January 1976 PW-2 pumping test.

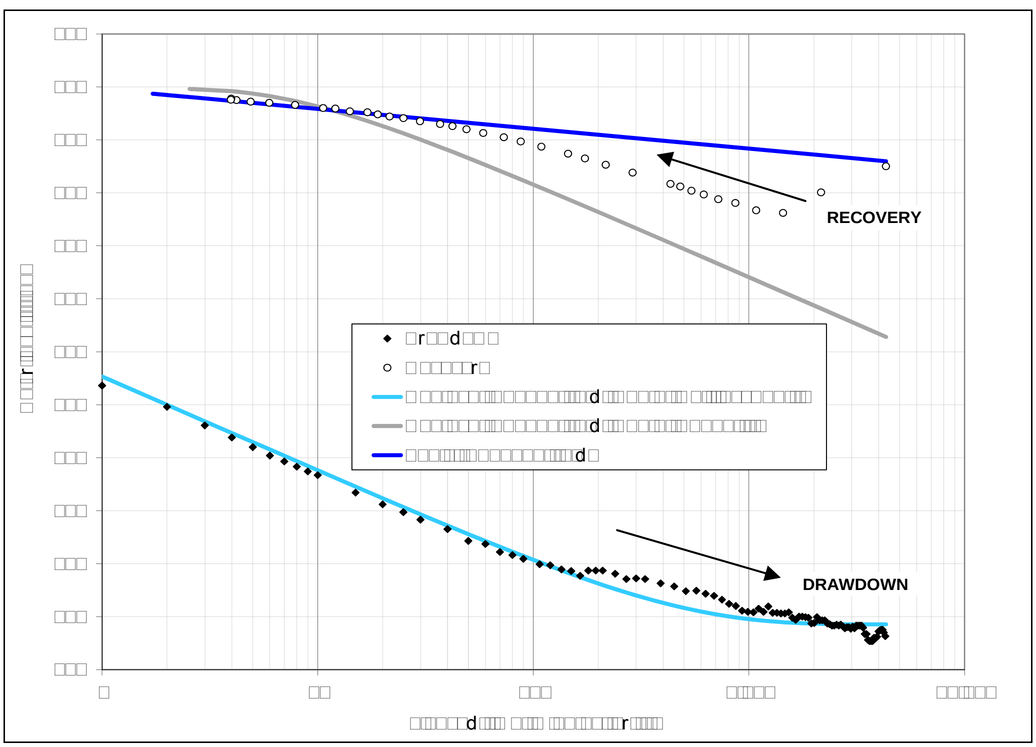


Figure 5.5. Drawdown and recovery in PW-2 during January 1976 PW-2 pumping test.

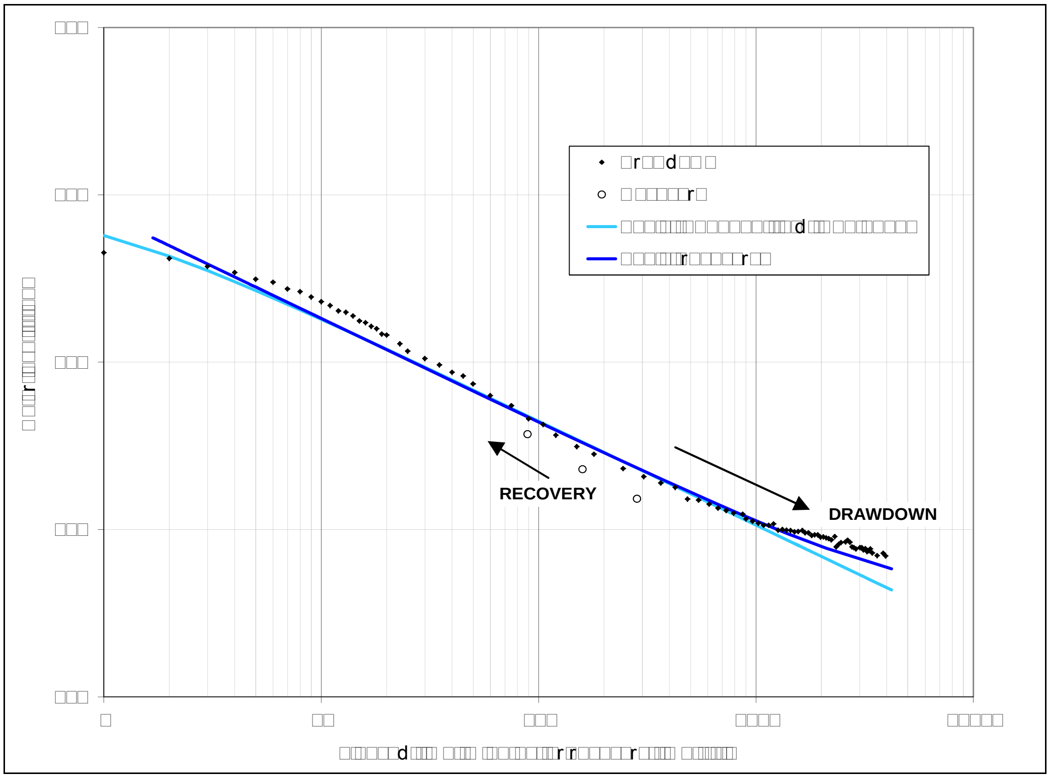


Figure 5.6. Drawdown and recovery in MW-5 during December 1975 PW-1 pumping test.

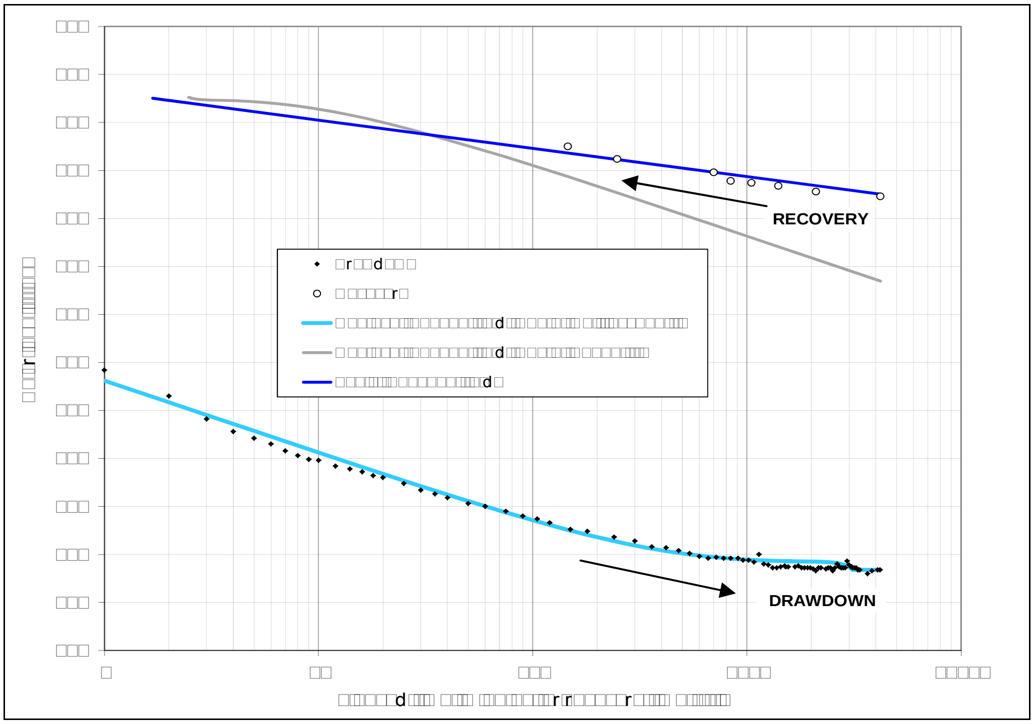


Figure 5.7. Drawdown and recovery in PW-1 during December 1975 PW-1 pumping test.

5.2.2 Period of Mine Operation, 1982

The well field was operated for 4 months from March through June 1982, at an average pumping rate of 2,272 gpm. Some pumping, averaging 40 gpm, continued for 16 months more. Average pumping rates (Bailey, 2010) are presented in Table 5.1. Total pumped for 1980-83 was 1,317 ac-ft.

Water levels measured in MW-5, in the immediate area of the production wells, are shown along with well field pumping on Figure 5.8, showing about 20 ft of water level drawdown due to pumping.

West of the well field, no response to pumping can be seen in water levels at MW-6, shown on Figure 5.9.

Long-term water-level trends from MW-6 show a slow rise of approximately 170 ft over 30 years. When compared to other wells in the region, water-quality data indicates groundwater from MW-6 has an anomalously high sodium chloride component. Furthermore, there are mapped north-south fault traces in the immediate vicinity of MW-6 (Seager, et al. 1982; Hawley, 2012). Water Development Corporation (1975) reported the following: "the anomalous highs to which the water level recovered indicated that the well was being recharged by an unknown source of water (either perched water or possibly slow seepage up the well bore from the sand stringers underlying the clay layer) and that the aquifer materials were too plugged with drilling mud to allow this water to move freely into the formation." Over time, as MW-6 was pumped, the well slowly developed and became hydraulically connected to sodium-chloride groundwater locally upwelling along an extensional fault zone. Sodium-chloride groundwater is known to upwell along structures in the Rio Grande Rift (Witcher et al., 2004). In conclusion, the observed groundwater head and water level trend from MW-6 is not representative of the regional Santa Fe Group aquifer system.

Table 5.1. Recorded average well field pumping in gallons per minute

1980	1	Jul-82	70	Mar-83	29
1981	1	Aug-82	43	Apr-83	31
Jan-82	29	Sep-82	60	May-83	68
Feb-82	29	Oct-82	34	Jun-83	26
Mar-82	1,817	Nov-82	40	Jul-83	43
Apr-82	3,042	Dec-82	43	Aug-83	25
May-82	1,501	Jan-83	43	Sep-83	16
Jun-82	2,727	Feb-83	48	Oct-83	29

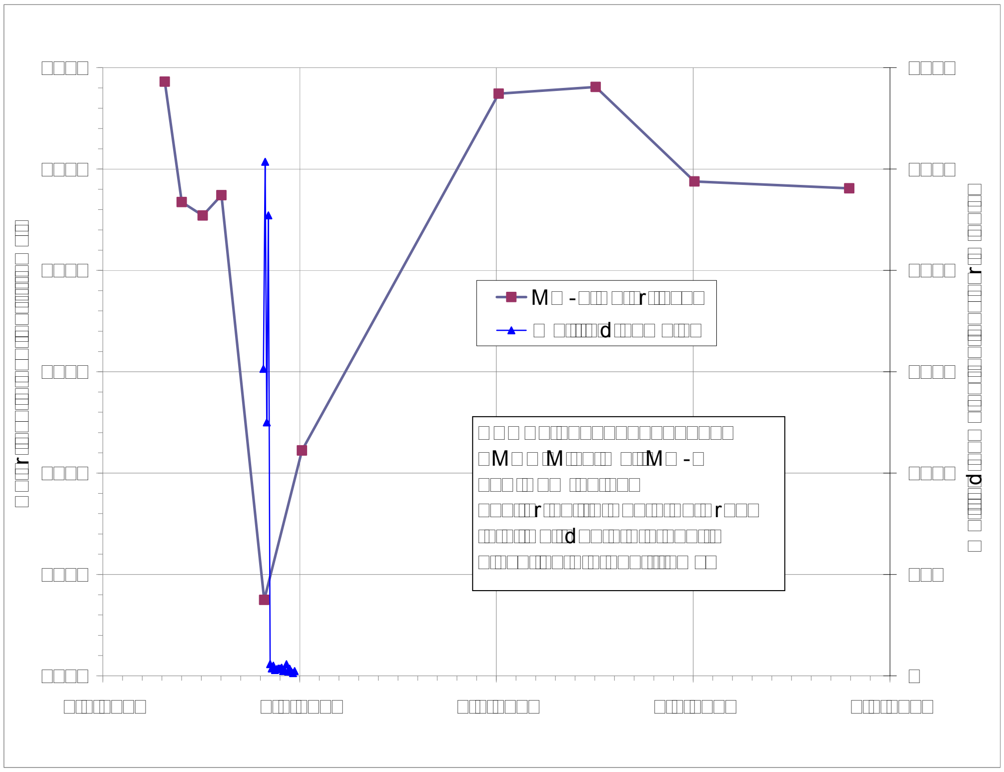


Figure 5.8. Well field pumping history and water level in MW-5.

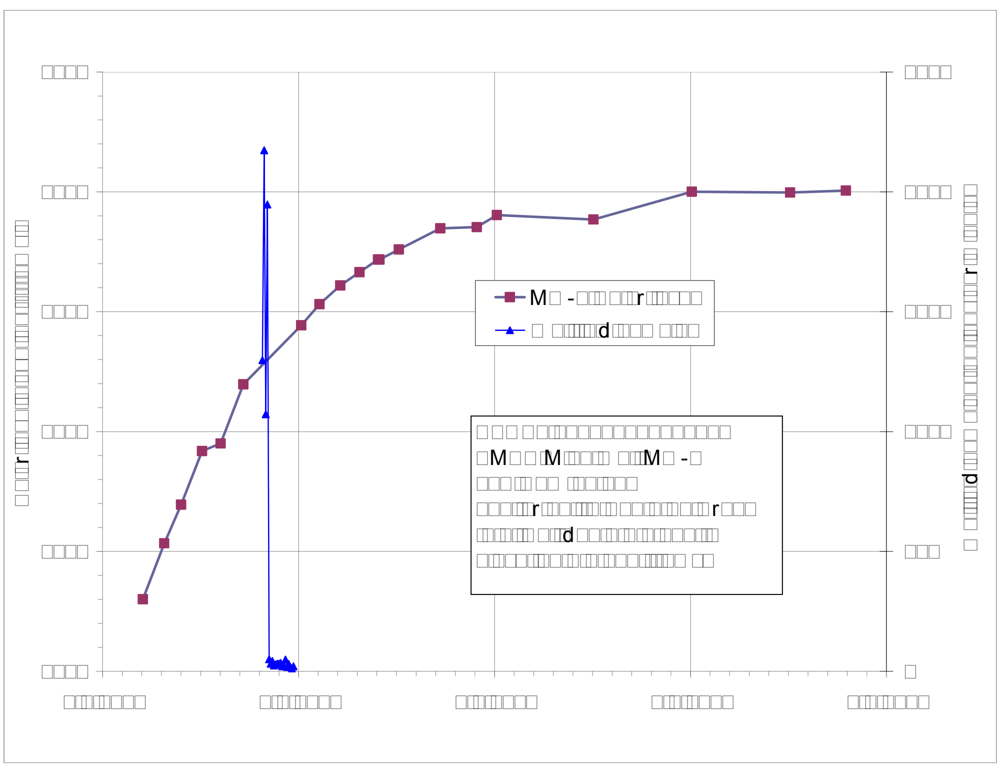


Figure 5.9. Well field pumping history and water level in MW-6.

Water levels in four wells monitored by the USGS located east of the well field along Las Animas Creek and Seco Creek (Fig. 5.2), are shown on Figure 5.10 along with the recorded well field pumping. There is no clear response to pumping in any of the wells.

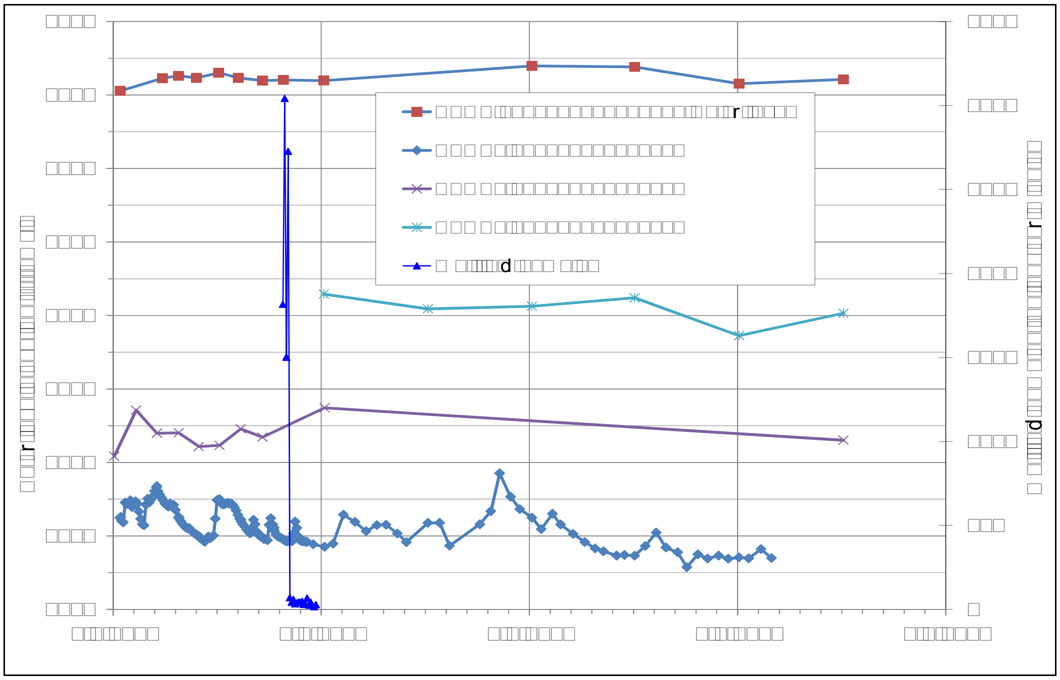


Figure 5.10. Well field pumping history and water level in USGS wells.

5.2.3 MW-9 Test, October 1994

Well MW-9, near Las Animas Creek (Fig. 5.2.), is completed at a depth of about 250 ft. MW-10 and MW-11 are each about 50 horizontal ft from MW-9. MW-10 is completed at a depth of 125 ft and MW-11 at 37 ft. Responses at MW-10 and MW-11 to pumping at MW-9 therefore characterize the resistance to vertical flow through the SFG and alluvial aquifers.

In order to characterize vertical hydraulic communication between the SFG and alluvial aquifers (Adrian Brown Consultants, 1996), MW-9 was pumped at 90 gpm for 24 hours (Appendix C2). Drawdown and recovery at MW-9 are presented on Figure 5.11 along with a matching Hantush leaky-aquifer type-curve corresponding with transmissivity of 900 ft^2/day.

Drawdown and recovery in MW-10 are shown on Figure 5.12, showing a small response (<1 ft) to pumping, indicating possible limited vertical transmission of effects, but also showing more fluctuation due to background influences than drawdown in response to pumping. No response to pumping was detected in the shallow alluvium well MW-11; water levels rose during the test, as shown on Figure 5.13 (no analytical curves are shown on Figures 5.12 and 5.13, as the measured data show no drawdown-recovery trends to analyze).

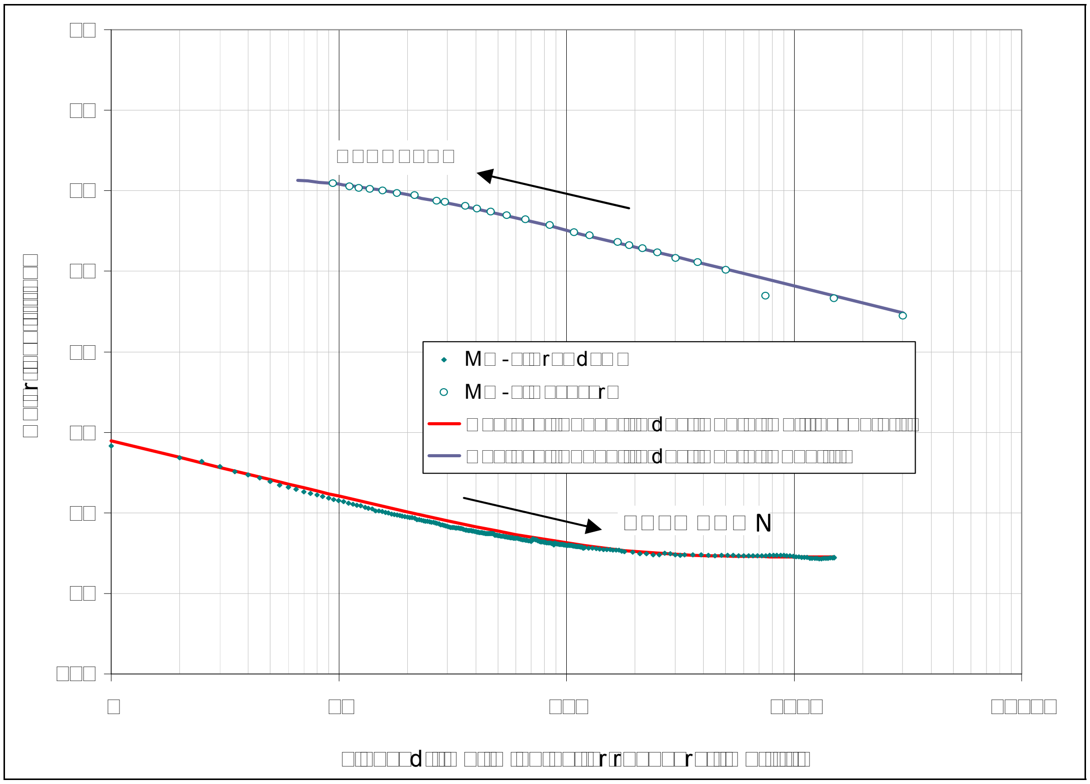


Figure 5.11. Drawdown and recovery in MW-9 during 1994 pumping test.

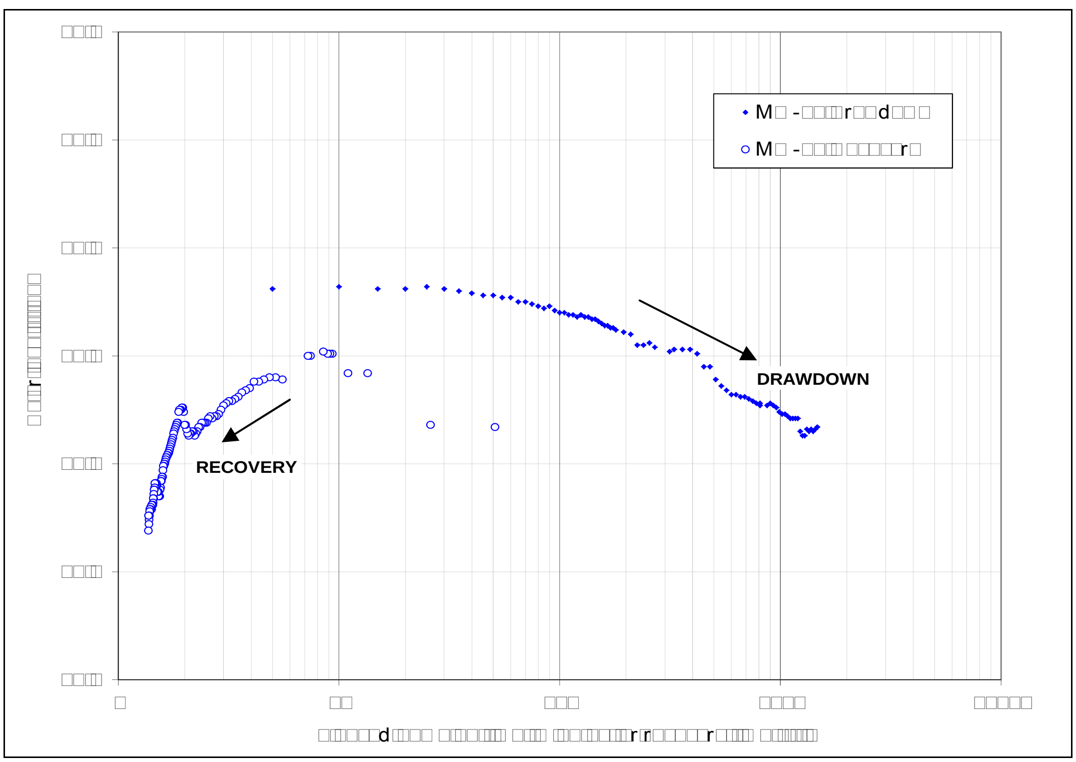


Figure 5.12. Drawdown and recovery in MW-10 during and after 1994 pumping of MW-9.

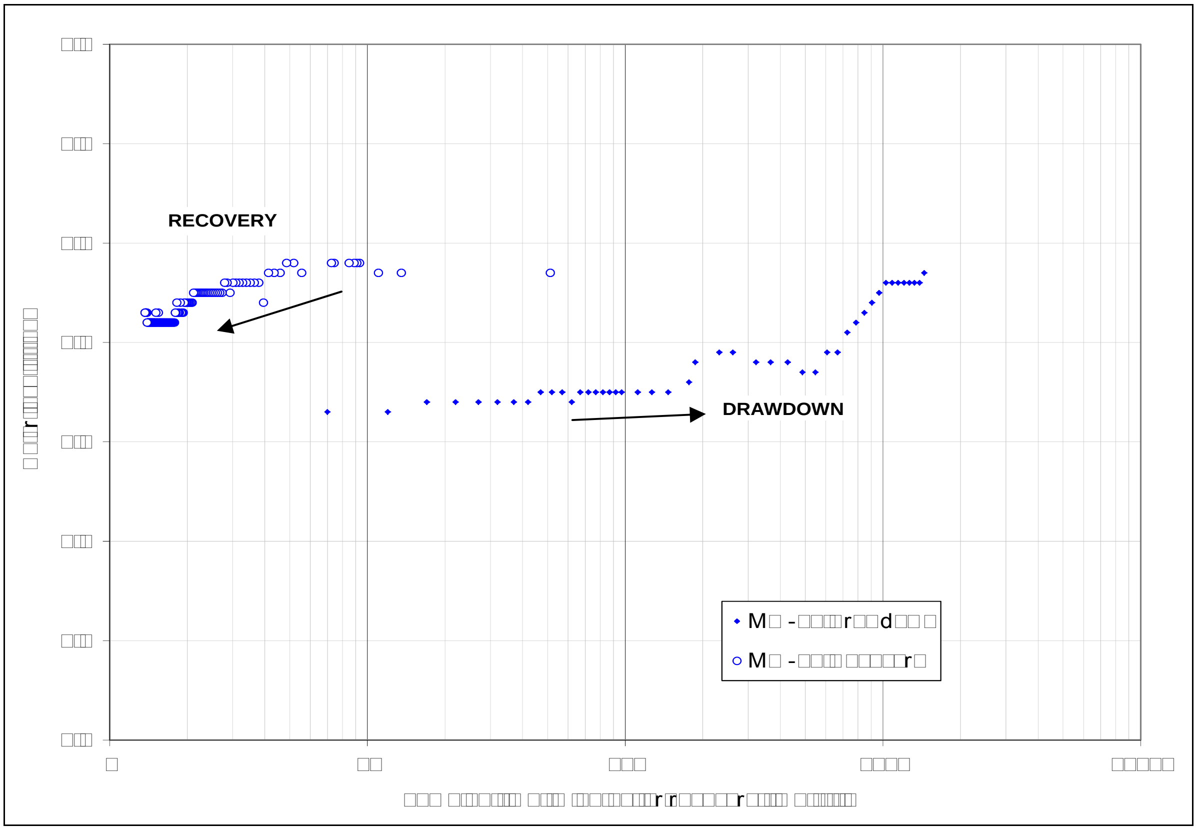


Figure 5.13. Drawdown and recovery in MW-11 during and after 1994 pumping of MW-9.

5.2.4 December, 2012 Aquifer Test

Pumping of wells PW-1 and PW-3 began on 19 November 2012 with initial testing of the pumps, circuitry and plumbing. Sustained pumping began on 3 December, was interrupted by technical difficulties on 8 December, resumed on 10 December and continued until 21 December 2012. Recorded pumping periods and rates are shown on Figure 5.14. Measured pumping-well and observation-well water levels are presented in Appendix C3.

Due to the multiple pumping wells, periods and rates, the 2012 aquifer test is not easily characterized using the analytical type curves shown on Figures 5.3 through 5.7 and 5.11 above. Instead, the 2012 test is analyzed using the numerical model. Measured responses to pumping in the pumping and observation wells shown on Figure 5.15 were used to calibrate the numerical model presented below.

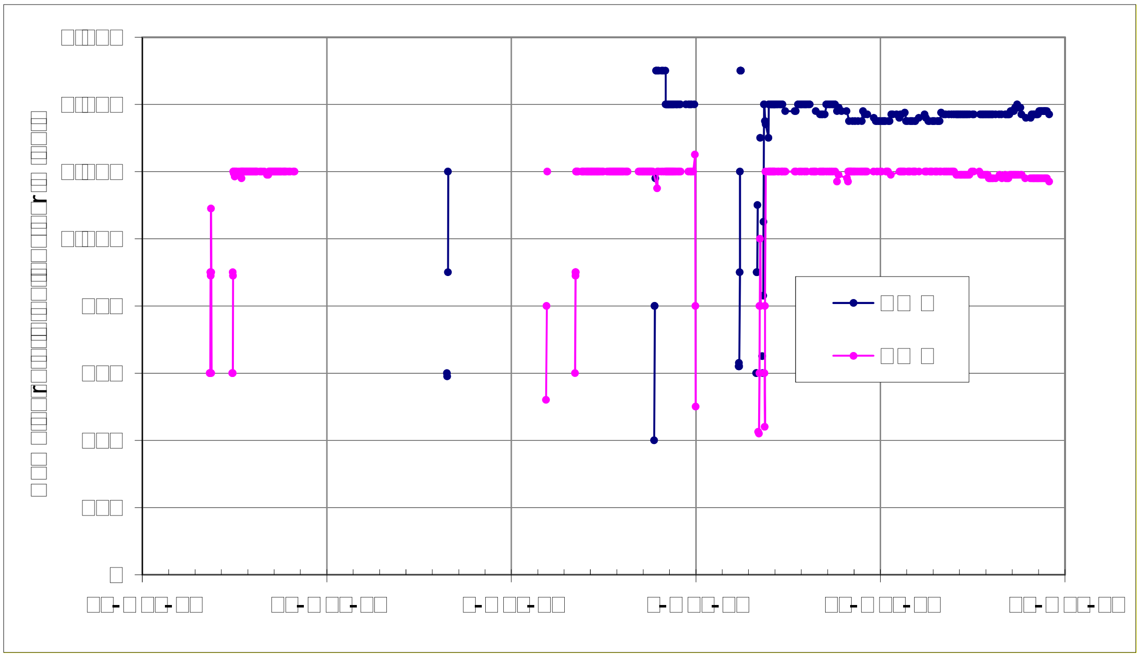


Figure 5.14. Measured aquifer test pumping rates.

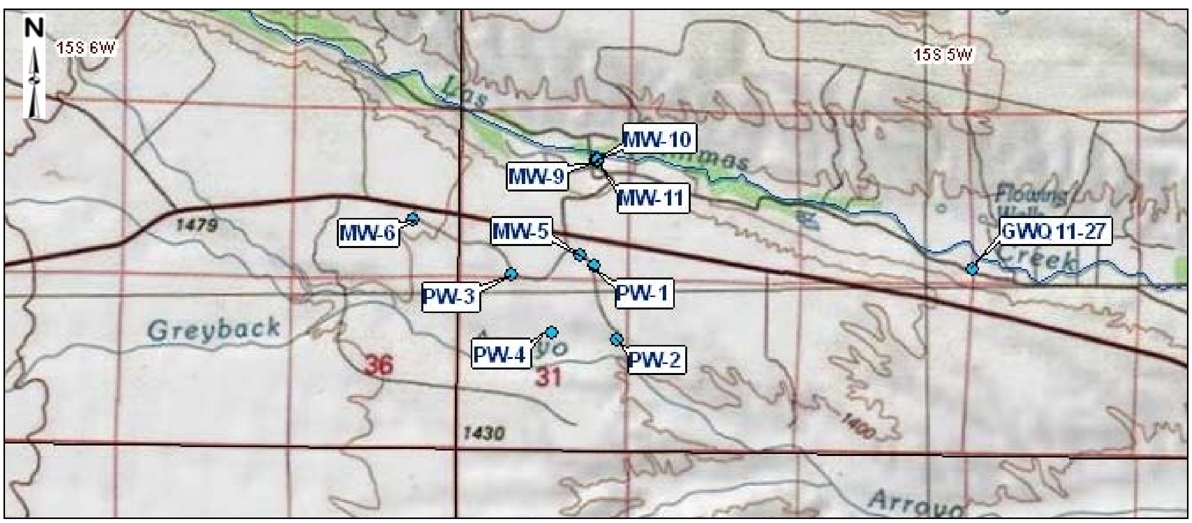


Figure 5.15. Aquifer test pumping and observation wells.

5.3 Tailings Impoundment Area

During and after the period of mine operations in 1982, the groundwater system beneath the unlined tailings facility was recharged by seepage from the tailings, in the portion of the impoundment overlying alluvium. Measured tailings-area (Fig. 5.2) water levels, shown on Figure 5.16, indicate 60 to 70 ft of water level rise that has persisted to the present, indicating a fault, or other barrier to flow, holding the water in place.

Transmissivity in the range of 100 to 240 ft^2/day is estimated for this area at the edge of the SFG aquifer, based on the results of a 1994 aquifer test at well GWQ94-17, presented below.

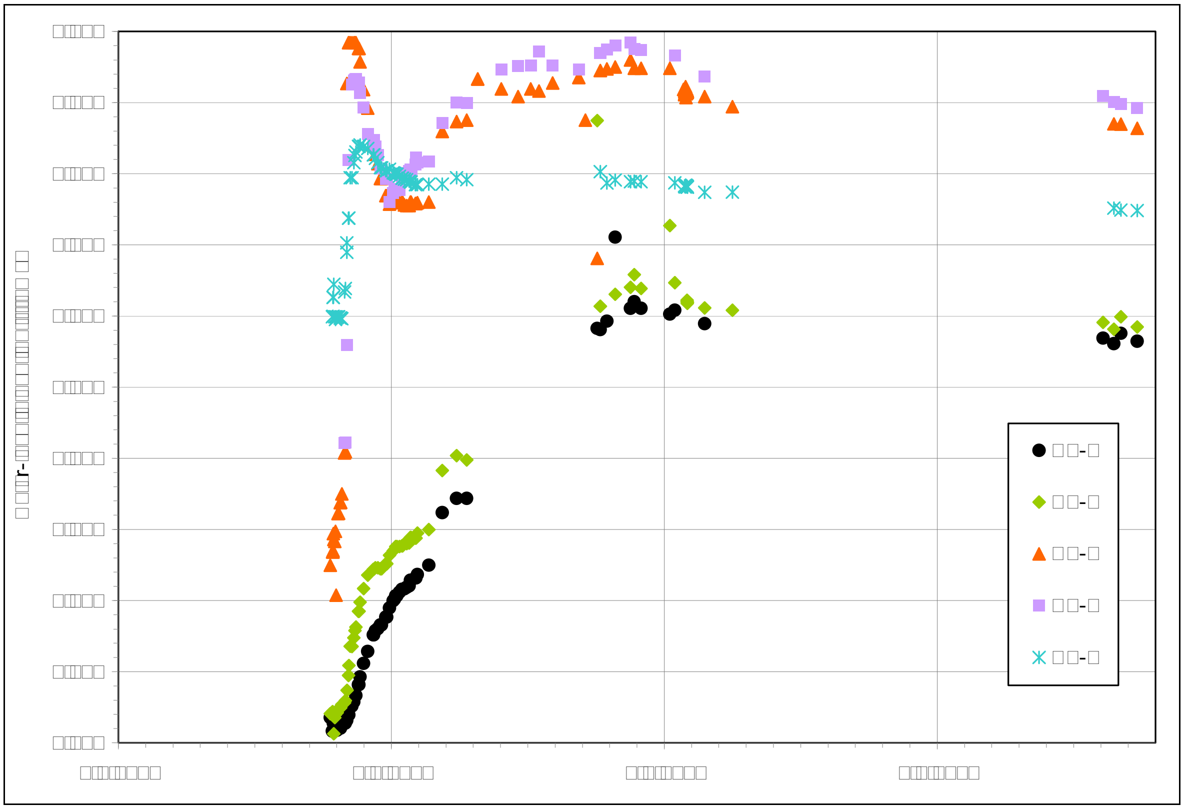


Figure 5.16. Tailings-area water levels.

5.3.1 GWQ94-17 Test, November 1994

As part of an investigation of leakage from, and groundwater flow beneath, the existing tailings impoundment (Adrian Brown Consultants, 1996), well GWQ94-17 was pumped at 23 gpm for 4,688 minutes (3.3 days), with responses measured in GWQ-13, GWQ-14 and GWQ-15 (Fig. 5.2). Complete test results are presented as Appendix C4.

Drawdown and recovery in GWQ-13 and GWQ-14 are presented on Figures 5.17 and 5.18 respectively, along with analytical (Theis, 1938) solutions. Drawdown in GWQ-15 is presented on Figure 5.19 (recovery data were unavailable). Recovery in the pumping well GWQ-17 is presented on Figure 5.20 (pumping water level was constant at about 123 ft).

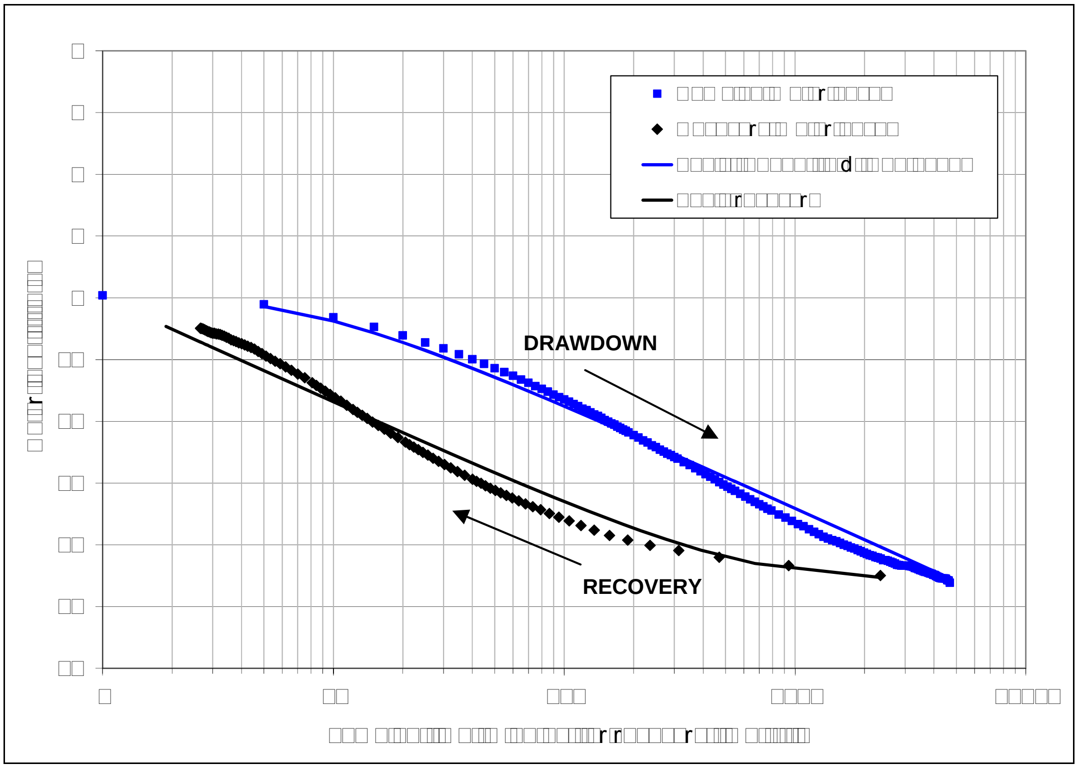


Figure 5.17. Drawdown and recovery in GWQ-13 during 1994 GWQ-17 pumping test.

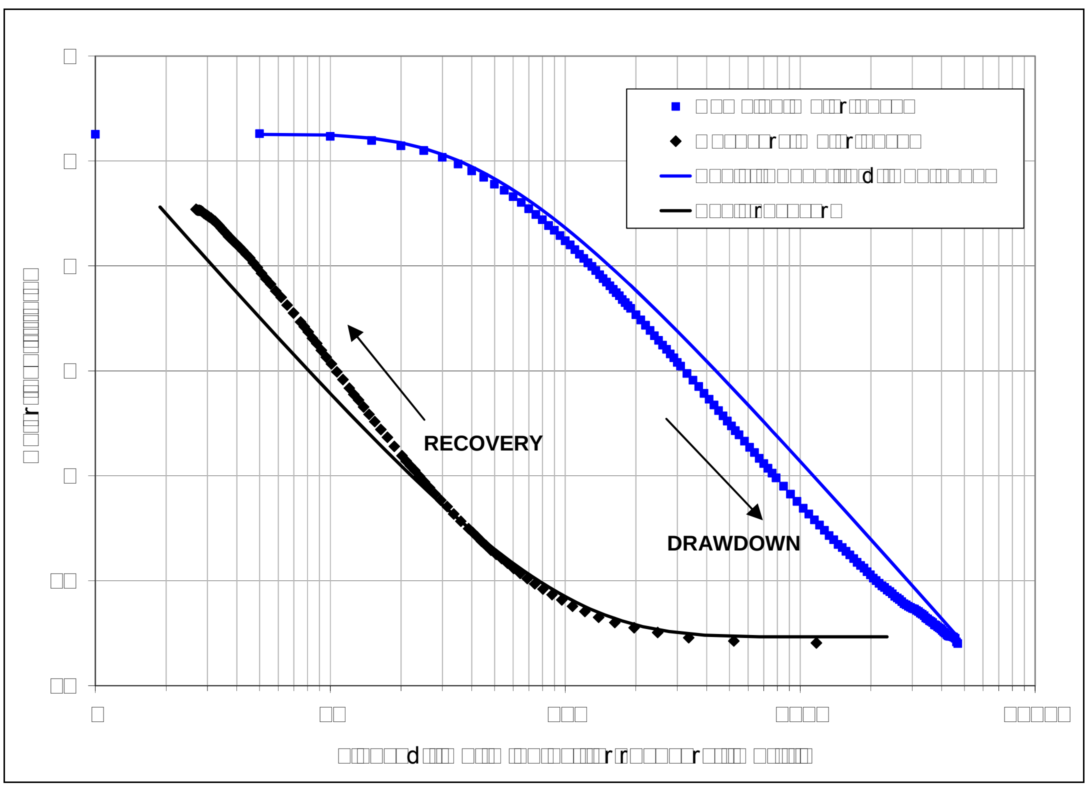


Figure 5.18. Drawdown and recovery in GWQ-14 during 1994 GWQ-17 pumping test.

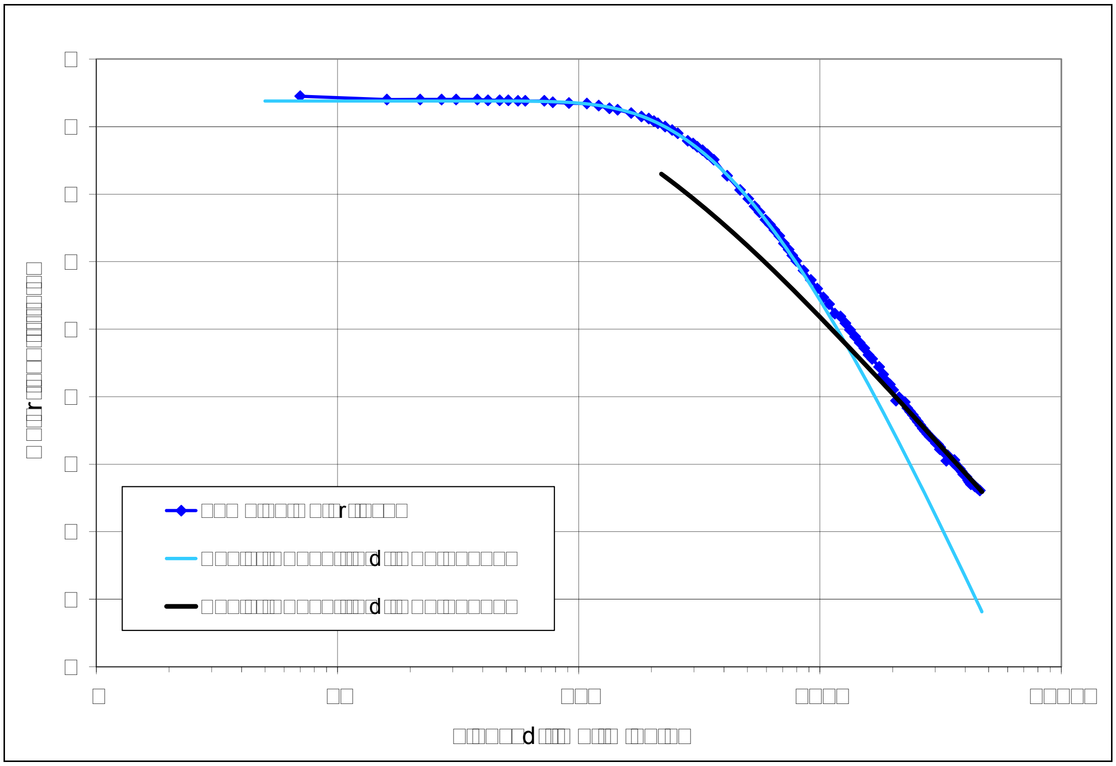


Figure 5.19. Drawdown in GWQ-15 during 1994 GWQ-17 pumping test.

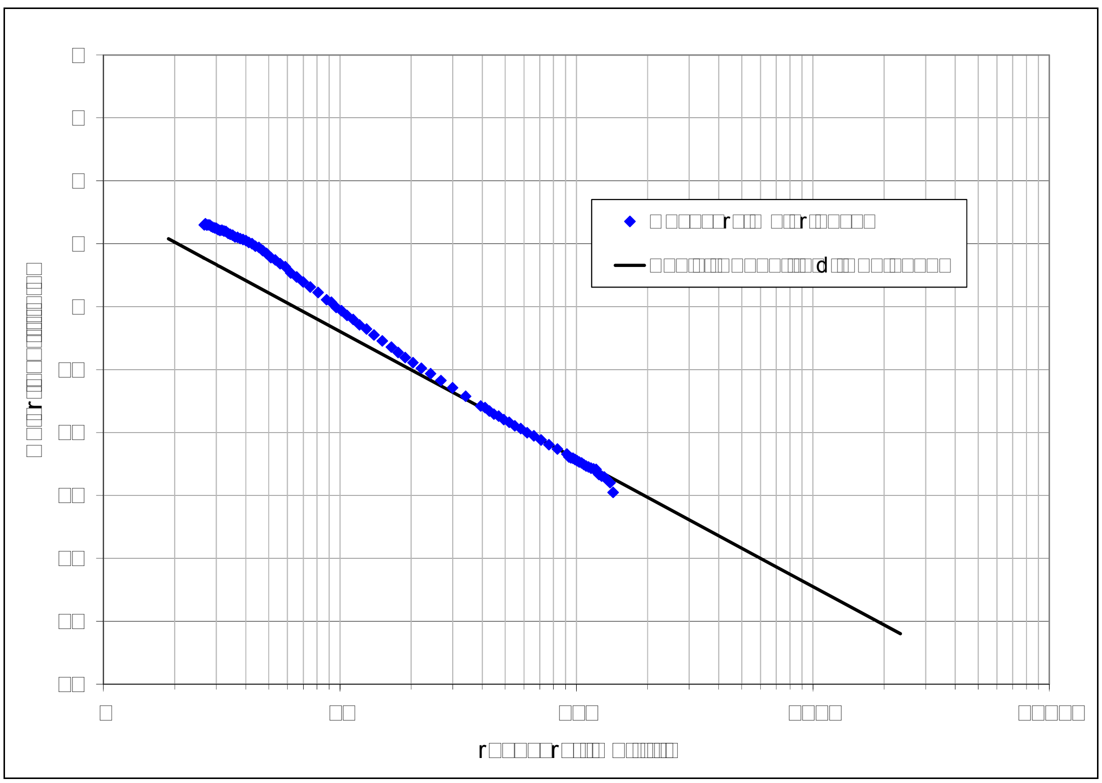


Figure 5.20. Recovery in GWQ-17 after 1994 pumping test.

5.4 Open Pit Area

The historical water level in the open pit has ranged between 5,435 and 5,450 ft amsl, corresponding to a water-surface area between 5 and 14 acres. Based on an evaporation rate of 64.6 in./yr (Table 2.1), annual average open-pit evaporation rate ranges from about 16 gpm to 45 gpm.

This discharge is supported by a combination of groundwater inflow, direct precipitation and runoff. Based on precipitation records it is estimated that the annual pit water balance (16 to 45 gpm of discharge by evaporation) is provided by 6 to 10 gpm of groundwater inflow and the rest (6 to 40 gpm) by precipitation and runoff.

The groundwater inflow component would increase with future pit expansion and dewatering. The post-mining open pit, larger and deeper than the existing pit, would have a larger groundwater inflow and larger evaporation.

Current pit water levels are below 5,440 ft amsl, with water balance in the low range of the estimate. The pit is a hydrologic sink, as shown on the contour map of the local piezometric surface, Figure 5.21.

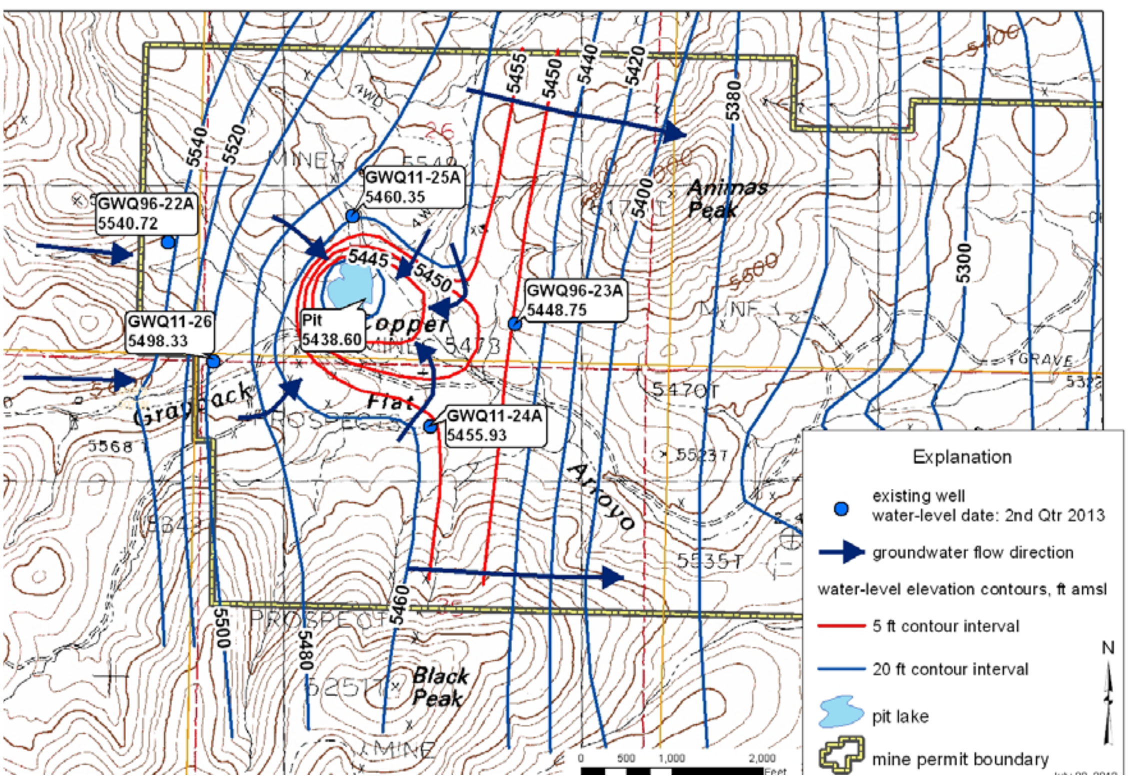


Figure 5.21. Measured pit-area groundwater levels.

5.4.1 Pit Area Pressure-Injection Tests, September 2011

Pressure-injection testing in the bedrock around the pit, in wells GWQ 5-R, GWQ 11-24, and GWQ 11-25 (Appendix C5), is summarized in Table 5.2. Apparent permeability of the bedrock ranges from near zero, to about 0.1 ft/day in the most fractured zones.

Table 5.2. Summary of pressure-injection test results

borehole and zone	depth interval (ft)	apparent permeability	
		(cm/sec)	(ft/day)
GWQ 5-R, Zone 1	64-100	~0	~0
GWQ 11-24, Zone 1	100-147	7×10^{-6}	0.02
GWQ 11-24, Zone 2	150-197	3.0×10^{-5}	0.085
GWQ 11-24, Zone 3	204-251	4.9×10^{-5}	0.14
GWQ 11-25, Zone 1	100-148	~0	~0
GWQ 11-25, Zone 2	150-198	2.9×10^{-5}	0.081
GWQ 11-25, Zone 3	207-251	2.6×10^{-5}	0.074

cm/sec - centimeters per second

5.5 Flowing Wells

The first artesian wells in the study area were drilled in the late 1930s. Most of the artesian wells were drilled prior to the New Mexico Office of the State Engineer (NMOSE) declaration of Las Animas Creek and Lower Rio Grande Underground Water Basins in 1968 and 1980, respectively.

Flow from selected artesian wells (Fig. 5.2) has been measured by Murray (1959), Davie and Spiegel (1967), JSAI (1995), and JSAI (2011c). A summary of aggregate measured artesian flow rates is presented in Table 5.3.

Table 5.3. Summary of measured artesian flow rates

source	number of wells	year	total artesian flow (gpm)	comments
Murray (1959)	23	1946	460	included Percha, Las Animas Creek, and Oasis areas
Davie and Spiegel (1967)	29	1966	1,186	Las Animas Creek area only
JSAI (1995)	12	1995	1,319	survey limited to accessible wells with owner permission
JSAI (2011c)	21	2011	222	survey limited to accessible wells with owner permission

JSAI - John Shomaker & Associates, Inc. gpm - gallons per minute

Construction details for the artesian wells are limited, but it appears a number of artesian wells were drilled without proper annular seals to prevent flow of water from the artesian zone into the overlying alluvium and stream channels. Furthermore, many of the artesian wells were never valved, and therefore left open to flow continuously at the land surface. Valves to regulate artesian flow, and metering, have been conditions to permits since the State Engineer declaration of the basin.

Over the last 50 years significant changes in flow rates have been observed in the few artesian wells that have time-series data. Measured artesian flow rates over time are presented in Figure 5.22, showing declines in flow rates from individual wells (except, apparently, from FW-7) along Percha and Las Animas Creeks.

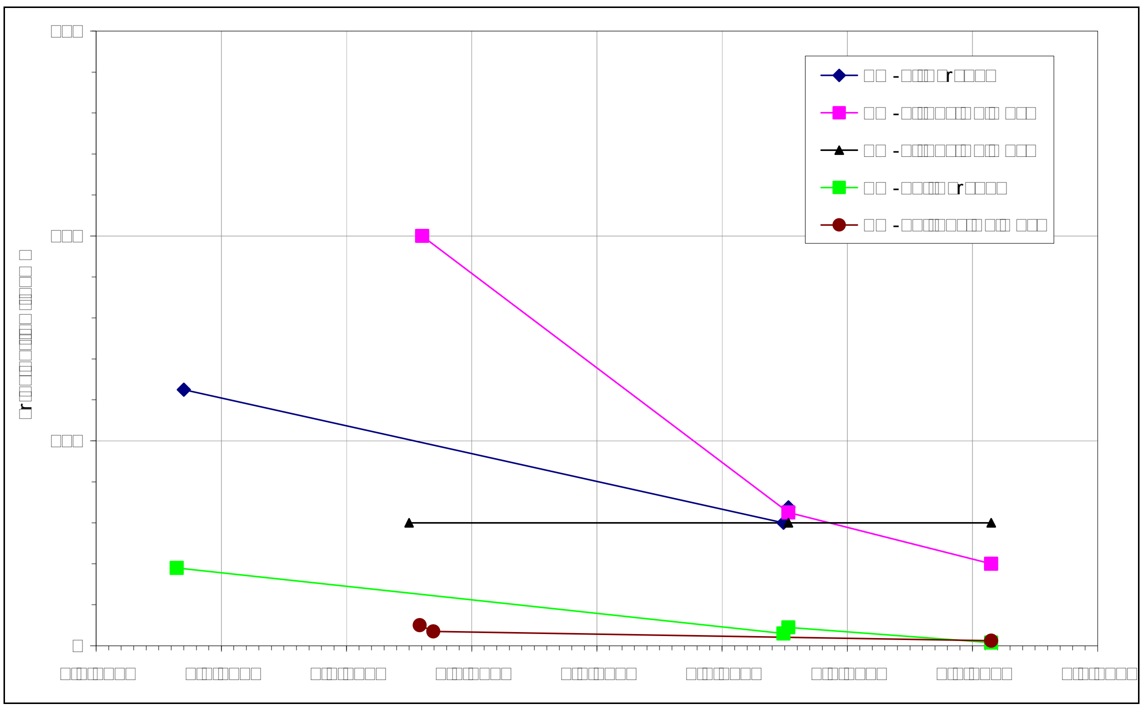


Figure 5.22. Measured artesian flow rates.

There are many factors that affect artesian flow, including climatic conditions and water level in Caballo Reservoir. Upward leakage via artesian wells and open flow, however, appear to be mainly responsible for the long-term decline in artesian flow rates.

6.0 NUMERICAL MODEL

The computer program used for the hydrologic model is a version of the U.S. Geological Survey *Modular Three-Dimensional Finite Difference Ground-Water Flow Model, MODFLOW* (McDonald and Harbaugh, 1988). Modifications to the original computer program are documented in Appendix D.

Inputs to the model include (1) hydraulic parameters that control the flow of water within the model domain, and (2) boundary conditions that control the addition and removal of water to and from the model domain.

Several model simulations were developed representing different time periods and conditions:

1. **Steady-state**: Represents hypothetical pre-development steady conditions, used as starting condition for the pre-mining transient simulation.

2. **Pre-mining** (transient): Simulates the period 1940 to mid-1980, including the effect of flowing artesian wells on the system.

3. **Mining and post-mining**: Simulates the period from mid-1980 through November, 2012 including the brief period of mine operation in 1982 and the post-mining period.

4. **Aquifer test**: Simulates the period from the start of the 2012 well-field pumping test (late November, 2012), through year 2014.

5. **Future-mining scenarios**: Simulate the estimated water demand for selected scenarios. In addition, a no-mining scenario simulates continued background conditions. The effects of each mining scenario, including groundwater level drawdown and surface-discharge reduction, were evaluated by comparing results of each simulation to the equivalent results of the no-mining scenario.

6. **Future-post-mining scenarios**: Simulate the post-mining period for each scenario listed above, including continued surface-discharge effects and recovery of water levels in the SFG aquifer and in the open pit.

6.1 Model Discretization

The model grid, consisting of 87 rows, 109 columns, and 4 layers, is shown on Figure 6.1. Horizontal grid spacing ranges from 200 ft in the pit area, increasing to 1/4 mile (1,320 ft) away from the mine. Layer 1 is active only along lower Las Animas and Percha Creeks and near the axis of the Rio Grande, representing the shallow aquifer composed of alluvium and SFG sediments, with modeled thickness ranging from 100 to 200 ft. Layers 2 through 4 represent the SFG aquifer and different bedrock units, with modeled thicknesses ranging from 500 to 3,000 ft (Table 6.1).

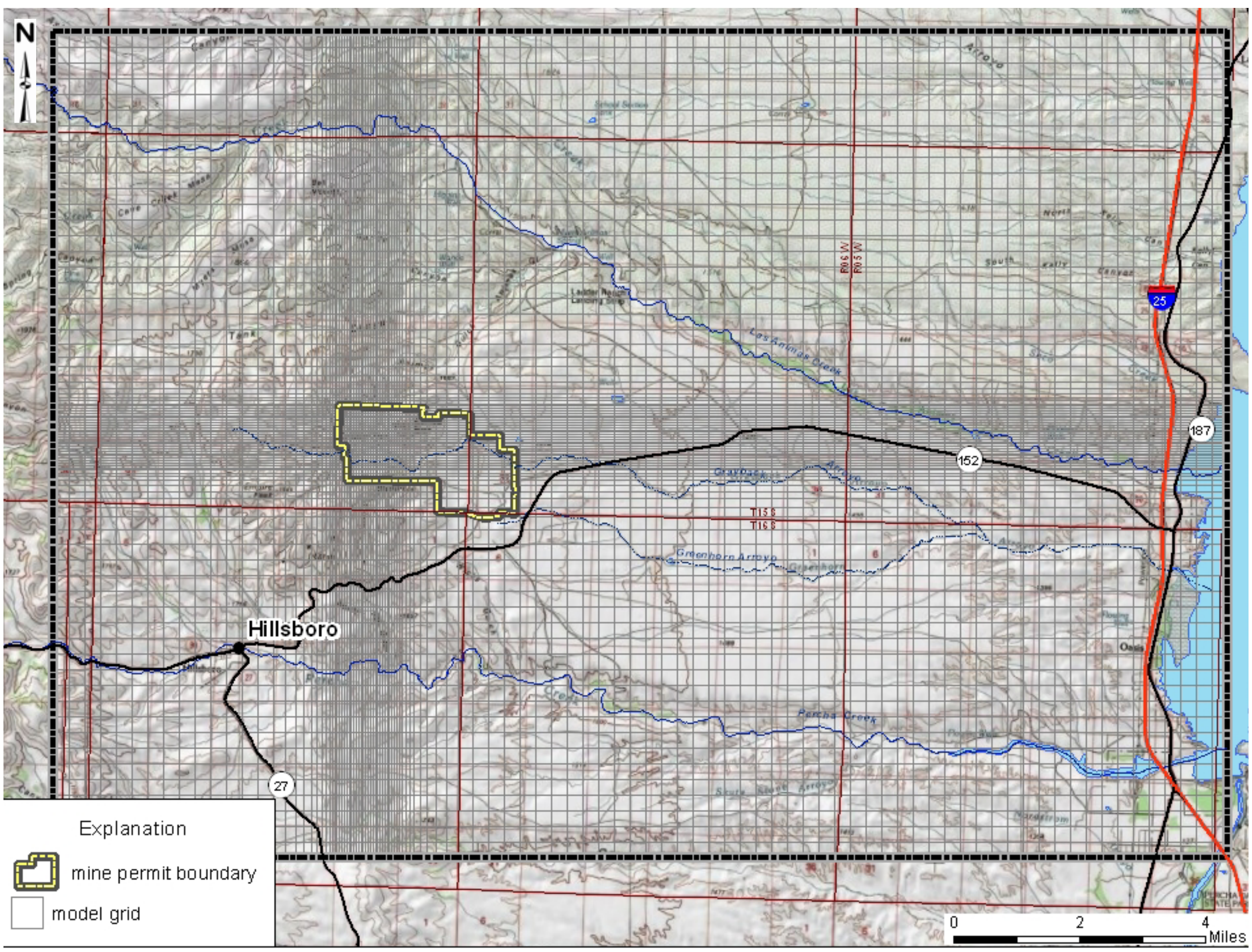


Figure 6.1. Model domain and grid.

6.2 Aquifer Parameters

Hydrogeologic units and fault barriers represented in each model layer are shown for layers 1 and 2 on Figures 6.2 and 6.3, and for layers 3 and 4 Figures 6.4 and 6.5. Modeled aquifer parameters for each unit are shown on Table 6.1. Conductances of modeled fault barriers are shown on Table 6.2.

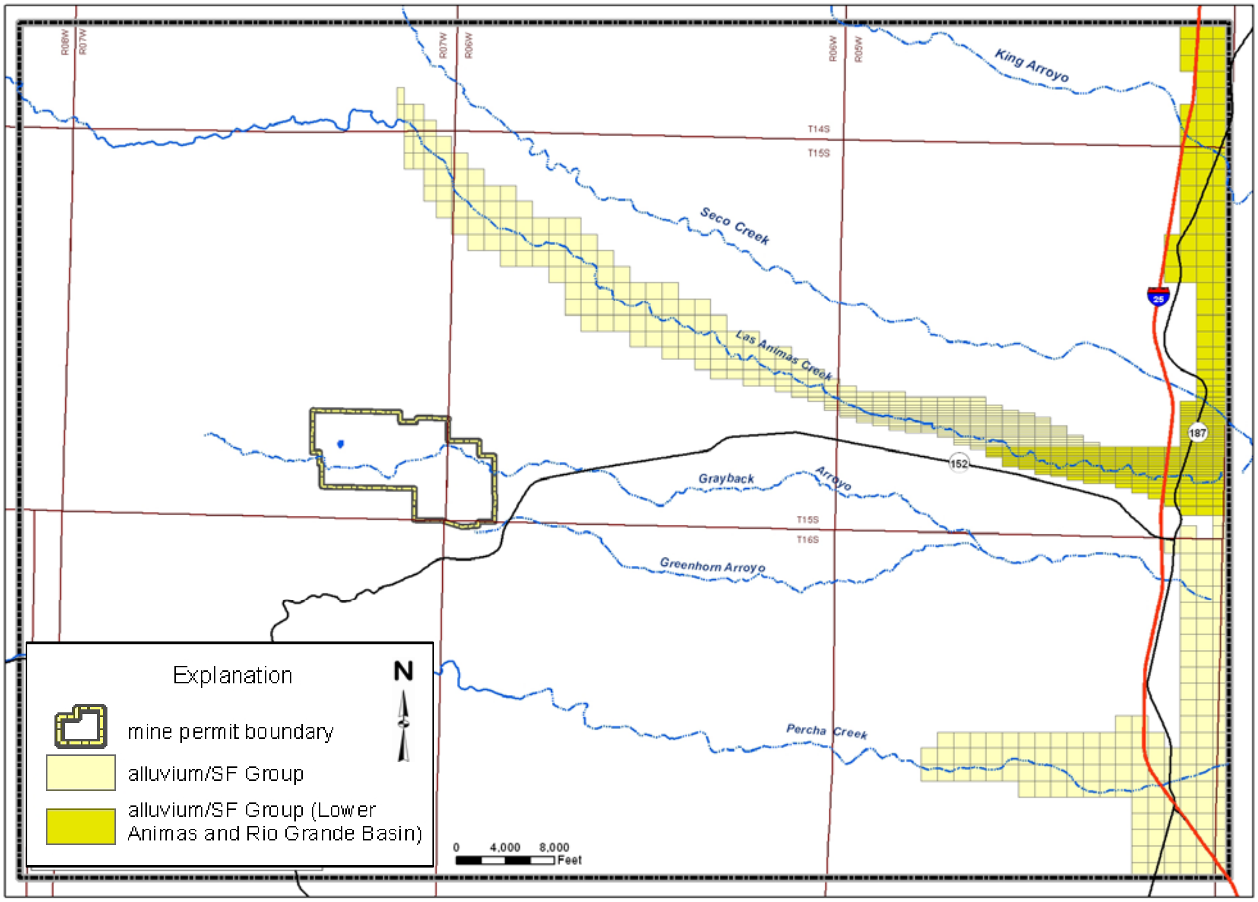


Figure 6.2. Layer 1 hydrogeologic zones

The layer 1 zones shown on Figure 6.2 include the shallow aquifer alluvium-SFG package along Las Animas Creek and a second, thicker zone along lower Animas, lower Percha and the Rio Grande Valley. Modeled aquifer parameters are shown on Table 6.1.

The modeled aquifer parameters (Table 6.1) include a high-transmissivity zone representing the Palomas Graben (Figs. 6.3, 4, and 5). The 2012 aquifer test results and subsequent model calibration further support the existence of the feature.

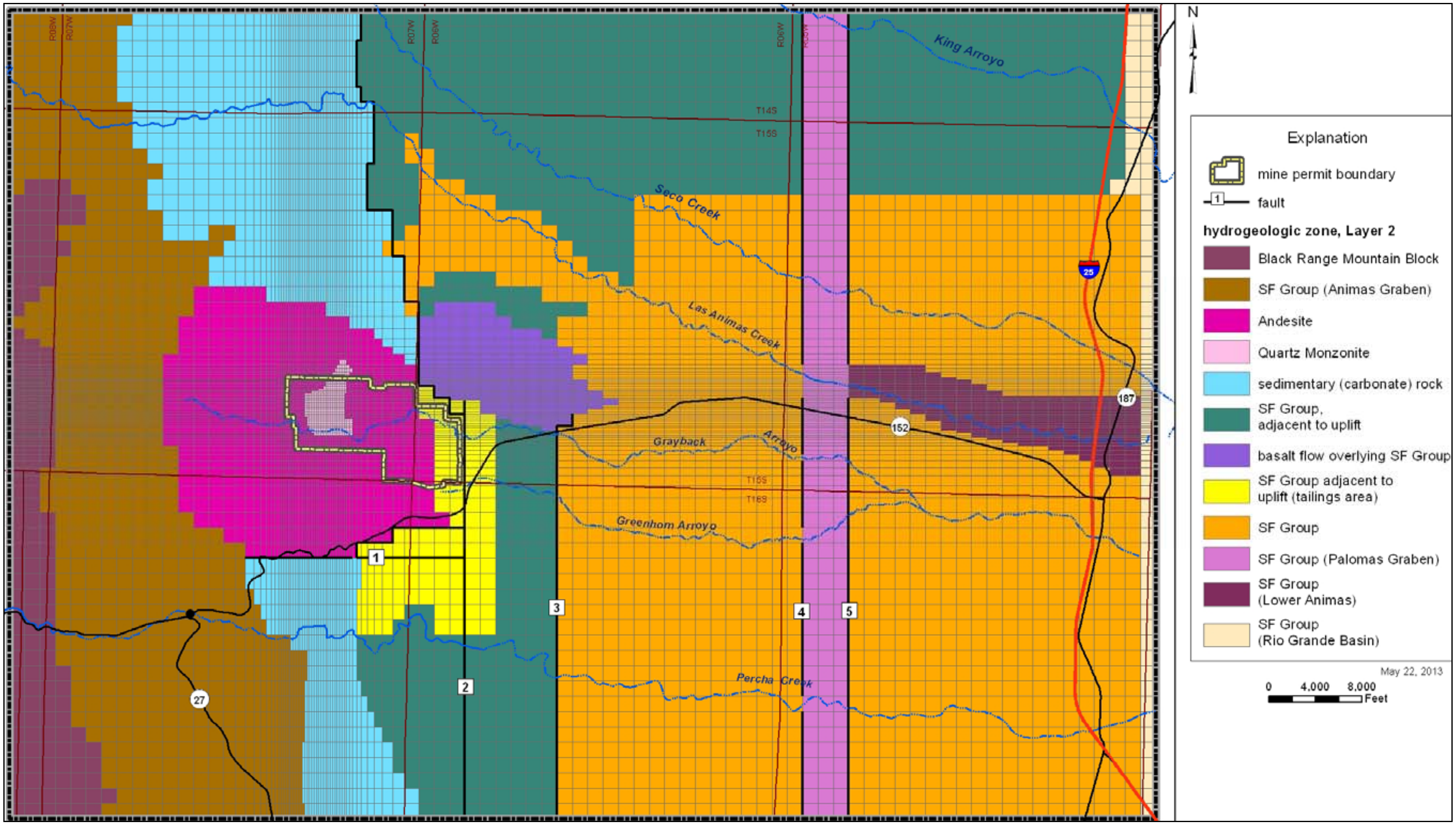


Figure 6.3. Layer 2 hydrogeologic zones.

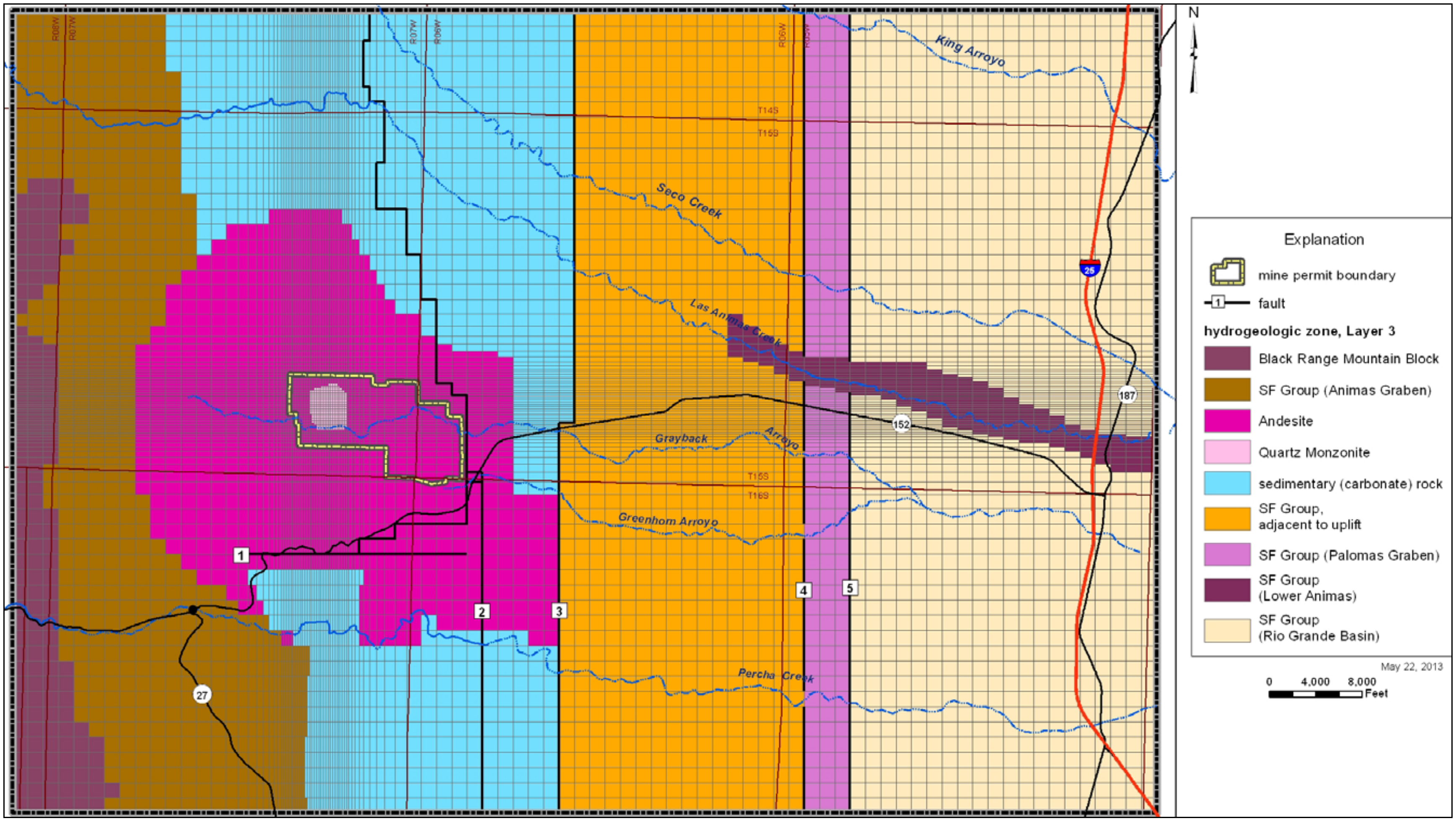


Figure 6.4. Layer 3 hydrogeologic zones.

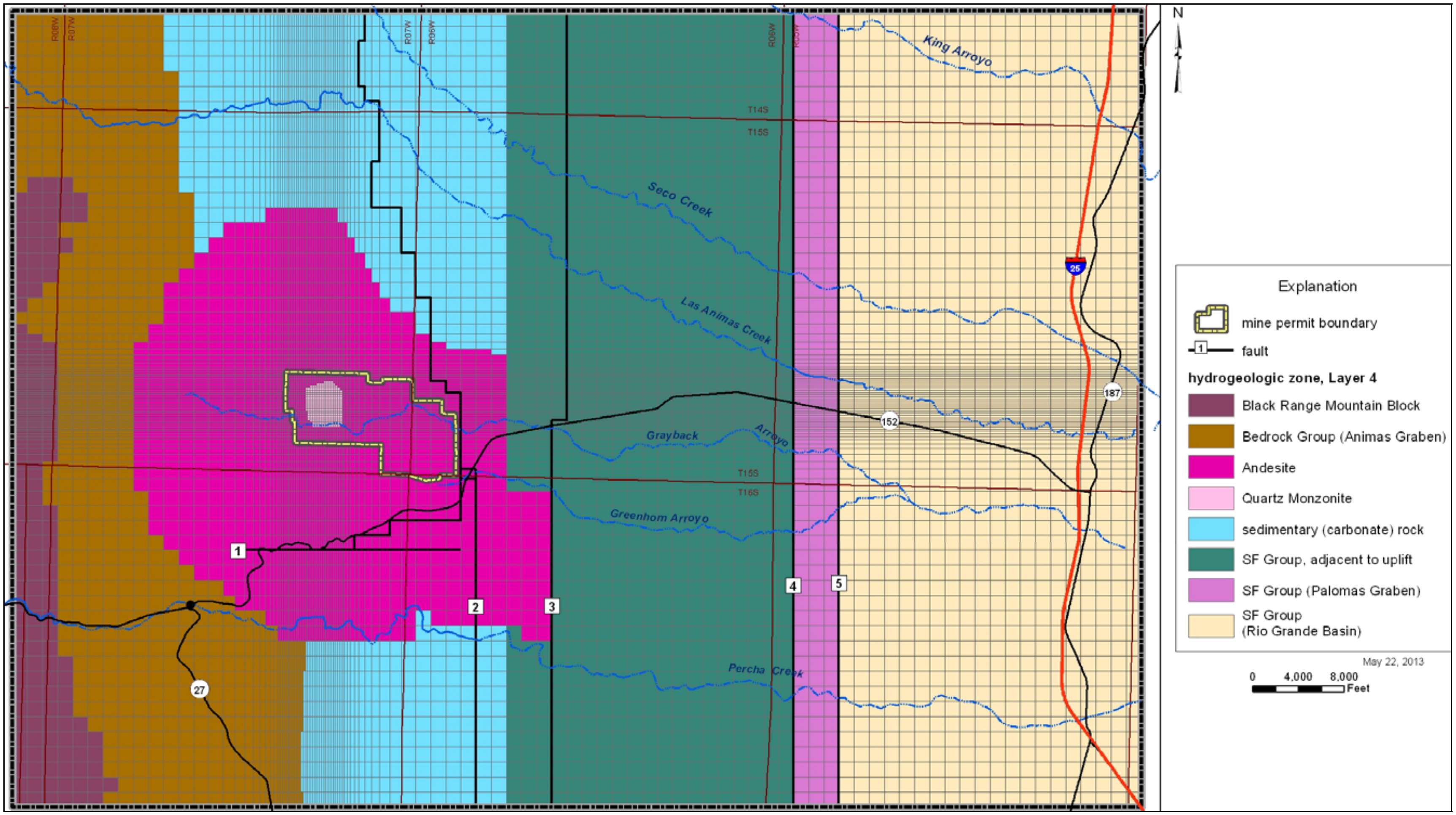


Figure 6.5. Layer 4 hydrogeologic zones.

The modeled aquifer parameters shown on Table 1 are based primarily on calibration of the model as a representation of the real system that is consistent with the different sources of information presented in Sections 3, 4 and 5 above. The model calibration results are presented below.

Different aquifer parameters are known with different degrees of certainty. Plausible ranges for different parameters, and the sensitivity of model results to variation of parameters within the plausible range, are discussed in Section 7 below.

Table 6.1. Modeled aquifer parameters

Hydrogeologic Unit	Transmissivity (ft^2/dy)	Saturated Thickness (ft)	Hydraulic Conductivity (ft/dy)	Vertical Anisotropy (ratio)	Specific Yield (%)	Storage Coefficient (%)
Layer 1						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Layer 2						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Layer 3						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Layer 4						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

The modeled fault barriers are based on geologic interpretation, on model calibration and on results of the 2012 aquifer test. The barriers mainly represent a series of parallel north-south trending faults (Hawley, personal communication, 2012). The barriers shown on Figures 6.3 through 6.5 are simulated with conductance (transmissivity / fault thickness) shown on Table 6.2. The fault barriers include (Fig. 6.3):

1. A fault along the south side of the andesite cone, separating andesite from carbonate rock (Animas volcano fault system).
2. The mountain front fault (East Animas fault trend), generally following the bedrock / SFG contact, but running east of an embayment of SFG in the area of the 1982 tailings impoundment.
3. A parallel fault, east of the mountain front (Saladone Tank fault trend).
4. The west boundary of the Palomas Graben (West Palomas Graben Fault trend).
5. The east boundary of the Palomas Graben (East Palomas Graben Fault trend).

Table 6.2. Modeled fault barrier conductance

	fault	section	layer 2 conductance (ft/day)	layers 3-4 conductance (ft/day)
1.	andesite south boundary		1.0E-04	2.0E-05
2.	mountain-front fault	north	8.0E-02	1.2E-01
		mountain front center: andesite, TSF embayment	5.0E-03	1.0E-10
		south	5.0E-08	2.0E-07
3.	east of mountain front		1.0E-03	1.0E-03
4.	Palomas Graben west		1.0E-08	1.0E-08
5.	Palomas Graben east		1.0E+00	1.0E+00

6.3 Boundary Conditions

Model boundary conditions fall under the categories of (1) natural boundary conditions including direct recharge, stream-channel runoff and infiltration, base flow discharge, evapotranspiration and groundwater discharge to the Rio Grande Basin, and (2) anthropogenic boundary conditions including flowing wells, mine water-supply wells, the current and future open pits, and infiltration from the 1982 tailings impoundment.

The natural boundary conditions are applied to all model simulations: steady-state, historical pre-mining, historical mining and post-mining, aquifer test, future mining and future post-mining.

The anthropogenic boundary conditions are applied to the historical pre-mining (flowing wells only) and historical mining and post-mining (flowing wells, mine water-supply wells, open pit and tailings infiltration) simulations as described below.

Different anthropogenic boundary conditions (future water-supply pumping, future open pit) apply to the future mining and future post-mining simulations which are described in Section 7.0 (model projections) below.

6.3.1 Natural Boundary Conditions

Natural boundary conditions represented in the model are shown on Figure 6.6 and include the following:

- Direct recharge of precipitation to groundwater is represented as a specified-flow boundary condition, using MODFLOW module RCH. Direct recharge rates are shown on Figure 6.6.
- Stream-channel runoff, infiltration of stream flow to groundwater, and discharge of groundwater to stream channels, are represented using module RIV2. In addition to simulation of Las Animas Creek, Percha Creek, and Grayback and Greenhorn Arroyos, model calibration required representation of runoff in Seco Creek and King Arroyo to the north of the main study area watersheds.
- Evaporation and ET of groundwater along Animas and Percha Creeks is represented using module EVT.
- Groundwater discharge to the Rio Grande Basin and Caballo Reservoir is simulated with head-dependent boundary conditions using module GHB.
- Groundwater flow in the Palomas Graben, into the model domain at the north end and out at the south end, is simulated with head-dependent boundary conditions using module GHB.

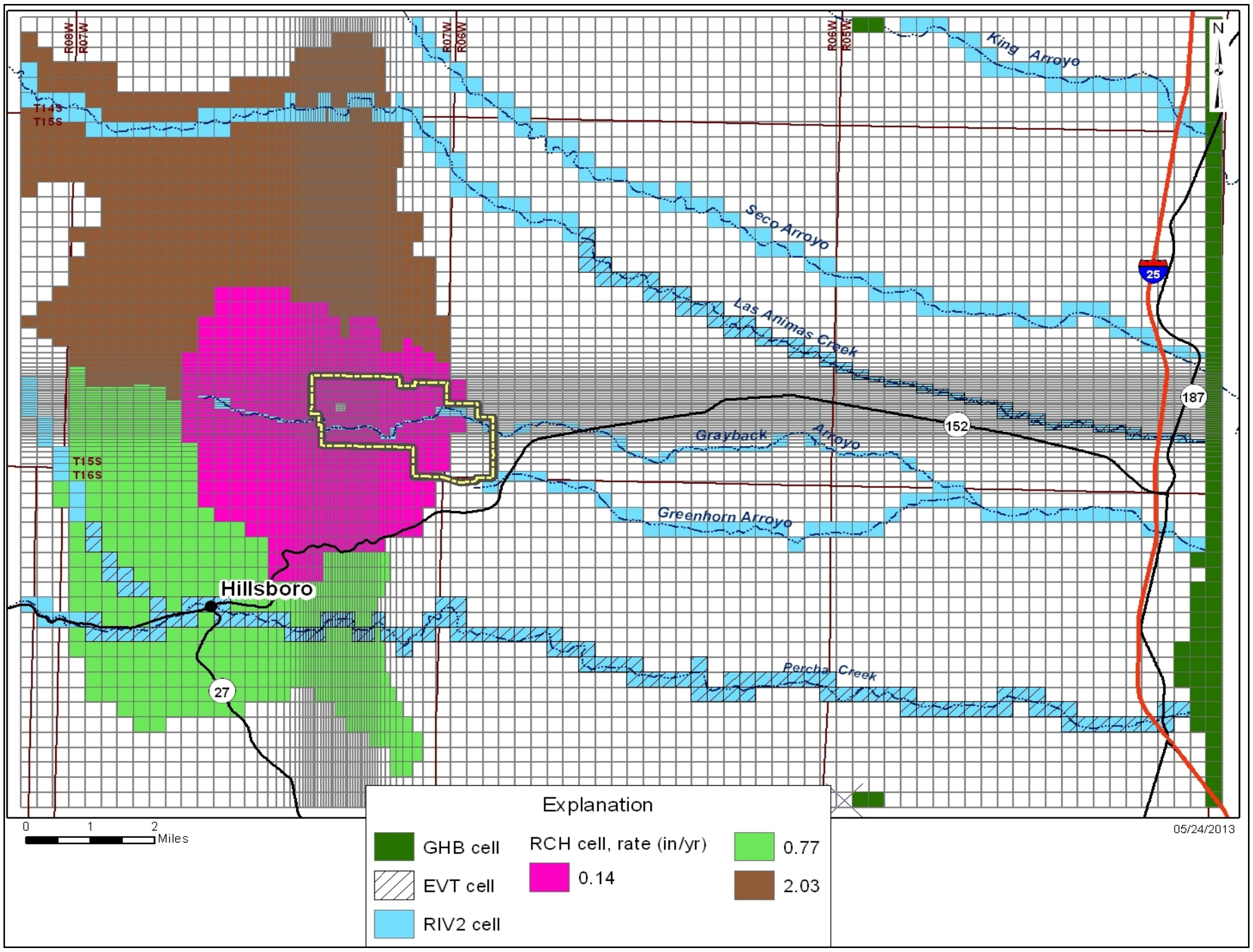


Figure 6.6. Natural boundary conditions.

RIV2 cells are grouped into reaches to define the stream network; each reach defines a length of stream, with a defined downstream reach, and total flow is tracked downstream. Infiltration to groundwater from RIV2 cells is limited to the simulated stream flow. Base flow discharge from groundwater to RIV2 cells is added to the total flow available for infiltration downstream.

Runoff is added at the upstream end of each reach. For each cell within a reach, infiltration to groundwater or discharge from groundwater is computed, and the resulting total flow, if any, is passed to the next cell downstream.

Flow between RIV2 cells and the corresponding aquifer model cell is computed based on RIV2 cell conductance, multiplied by either (1) the stream stage-aquifer head difference (aquifer in contact with stream bed) or (2) the stream stage-streambed bottom difference (aquifer below stream bed). Infiltration to the aquifer is further limited to the amount of simulated flow available in the stream.

The model reproduces the observed pattern of stream flow in the region; runoff is generated in the mountain watersheds, flows downstream until it crosses the mountain front, where it recharges the Santa Fe Group aquifer. Farther below the mountain front, streams flow only after storm events. Still further downstream, near the bottom of the basin, the streams emerge again as groundwater enters the channels as base flow.

The stream reaches defined are listed on Table 6.3, along with simulated annual runoff to each reach. RIV2 cell parameters include elevation and conductance. Conductance is computed from the length of stream in each cell and from hydraulic conductivity of the underlying material. Modeled RIV2 cell hydraulic conductivities are listed by reach and material, in downstream order, on Table 6.3. Elevation for RIV2 cells was determined from USGS topographic maps. Thickness of streambed was assumed at 1 ft.

EVT cell parameters include ET surface elevation, annual average potential ET rate of 64.6 in./yr and extinction depth of 15 ft. ET from each EVT cell is computed as the potential ET rate whenever water level is at or above the ET surface elevation (depth-to-water of zero), decreasing linearly to zero at the extinction depth. ET is zero for water levels below the extinction depth.

GHB cells simulate groundwater flow from the model area to the Rio Grande basin. GHB cell parameters include elevation, specified at 4,200 ft amsl, and conductance, calibrated at 100 ft^2/day in the north part (rows 1-60), 10,000 ft^2/day along the axis of Las Animas Creek (rows 61-73), and 1,000 ft^2/day in the south part, adjacent to Caballo Reservoir. Flow is computed as the product of GHB conductance and the difference between GHB elevation and aquifer head in the model cell.

Table 6.3. Stream reach specifications

reach No.	name	downstream reach	runoff (ac-ft/yr)	streambed hydraulic conductivity (ft/day)	underlying material
1	Upper Percha	2	5,249	0.001 1	bedrock SFG (graben)
2	Lower Percha	none	0	0.001 1 0.1 10 20	bedrock SFG (graben) carbonate bedrock (uplift) SFG alluvium
3	Las Animas	none	7,898	1 0.1 1 24	SFG (graben) carbonate bedrock (uplift) SFG alluvium
4	Grayback	6	74	0.001 1	bedrock SFG
5	Upper Greenhorn	6	66	1	SFG
6	Lower Greenhorn	none	0	10	alluvium
7	Seco Creek	none	18	0.15 0.8 20	SFG SFG (Las Animas Creek) alluvium
8	King Arroyo	none	0	0.15 20	SFG alluvium

ac-ft/yr - acre-feet per year
SFG - Santa Fe Group

6.3.2 Anthropogenic Boundary Conditions

Anthropogenic boundary conditions represented in the model include discharge from artesian wells, pumping from mine water supply wells, infiltration beneath the 1982 (historical) tailings impoundment, and the open pit. Locations of model-simulated anthropogenic boundary conditions are shown on Figure 6.7.

Flow from artesian wells was simulated as drain (head-dependent, outflow only) boundary conditions with MODFLOW module DRN. Flow from each DRN cell is computed as the product of DRN conductance (assumed at 1,000 ft^2/day, or 5.2 gpm/ft of head above the discharge elevation) and aquifer cell head minus DRN elevation. Flow is zero when aquifer cell head is below DRN elevation.

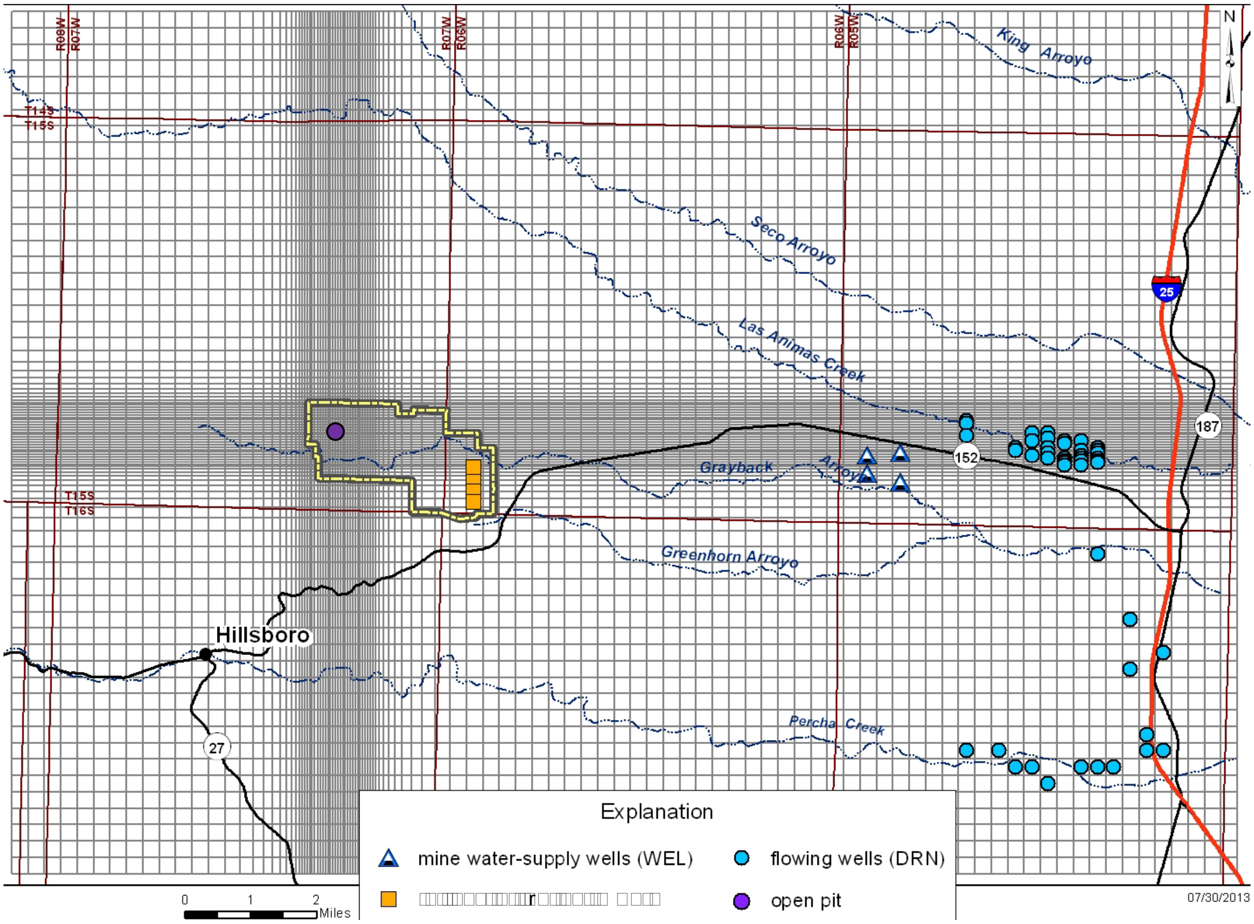


Figure 6.7. Anthropogenic boundary conditions.

Pumping from mine water supply wells was simulated as specified-flow boundary conditions with MODFLOW module WEL. Pumping rates were specified from Table 5.1.

Infiltration from the historical tailings impoundment was also simulated as specified-flow boundary conditions using WEL. Infiltration rates were estimated based on model calibration, constrained by an upper limit based on the amount of water actually added to the impoundment (Fig. 6.8).

Water level and water balance of the open pit were simulated using MODFLOW module LAK2. The geometry of the existing pit is represented in the historical post-mining simulation, as shown by the actual and simulated pit water stage – area curves shown on Figure 6.9 (Note that Figure 6.9 does not represent model calibration; it simply verifies the accurate simulation of the current pit geometry.).

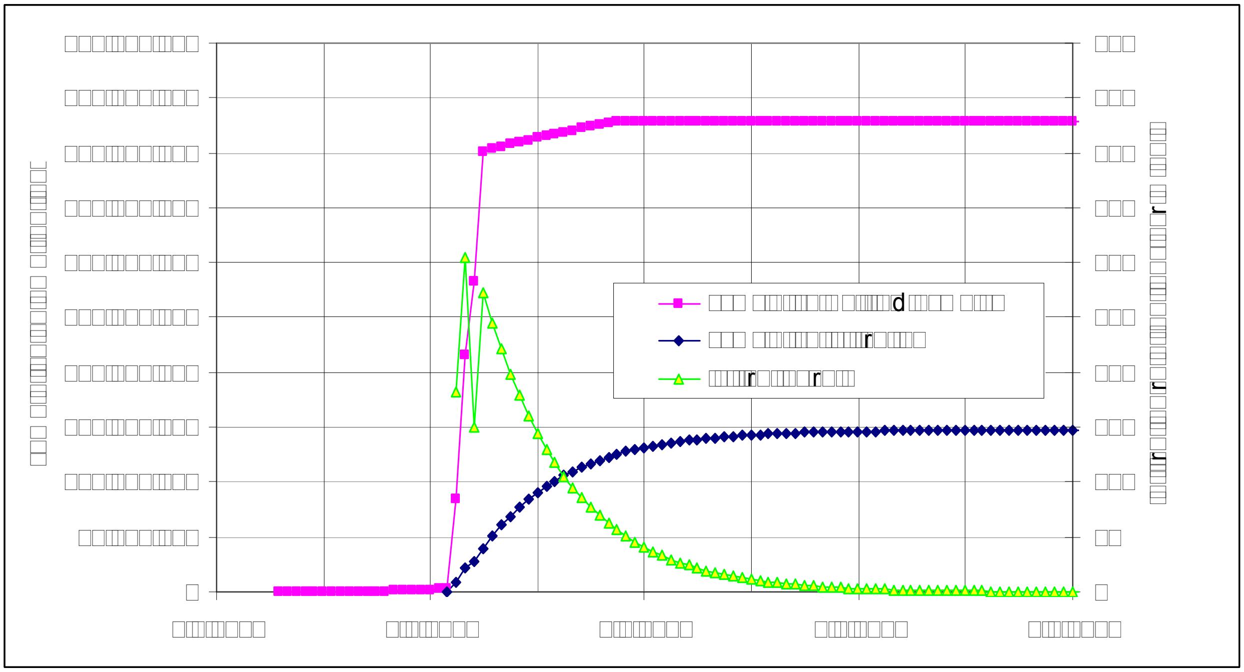


Figure 6.8. Modeled historical tailings infiltration.

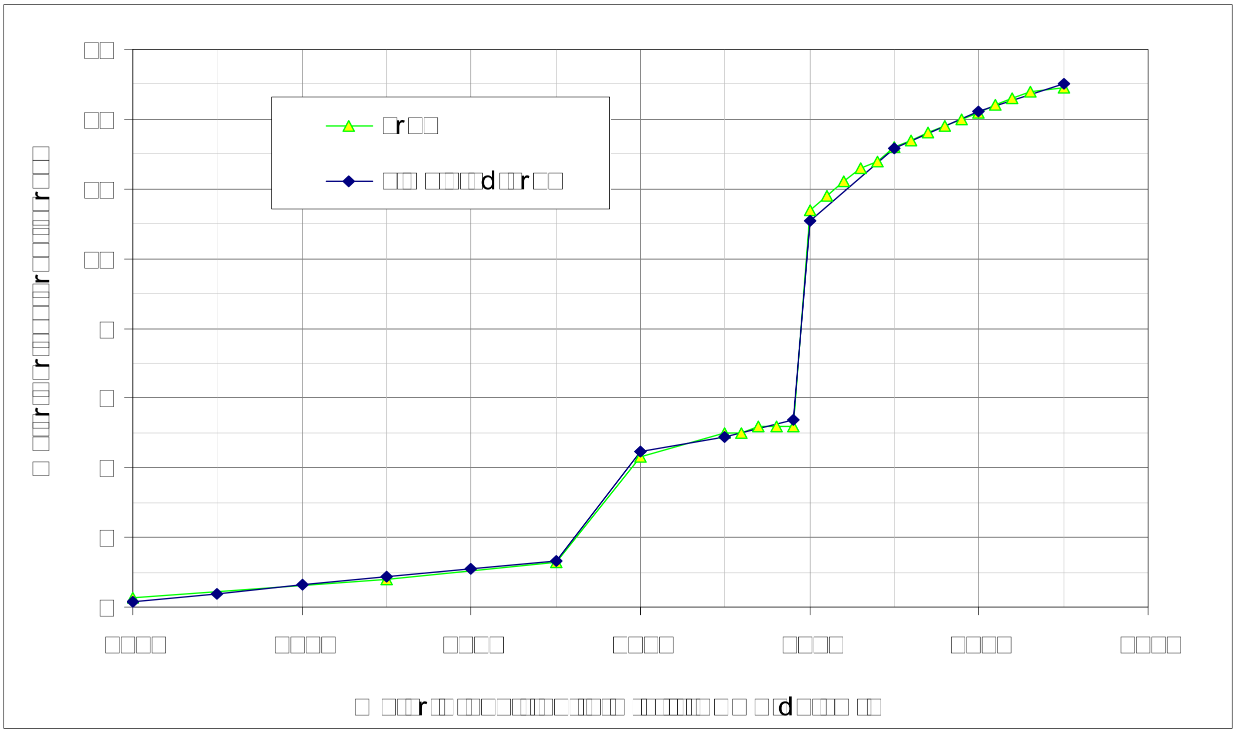


Figure 6.9. Existing open pit water elevation - water surface area relationship.

Hydrologic parameters for the open pit, including monthly average precipitation and evaporation rates, and runoff coefficients for the pit walls and for the 230-acre pit watershed, are listed on Table 6.4.

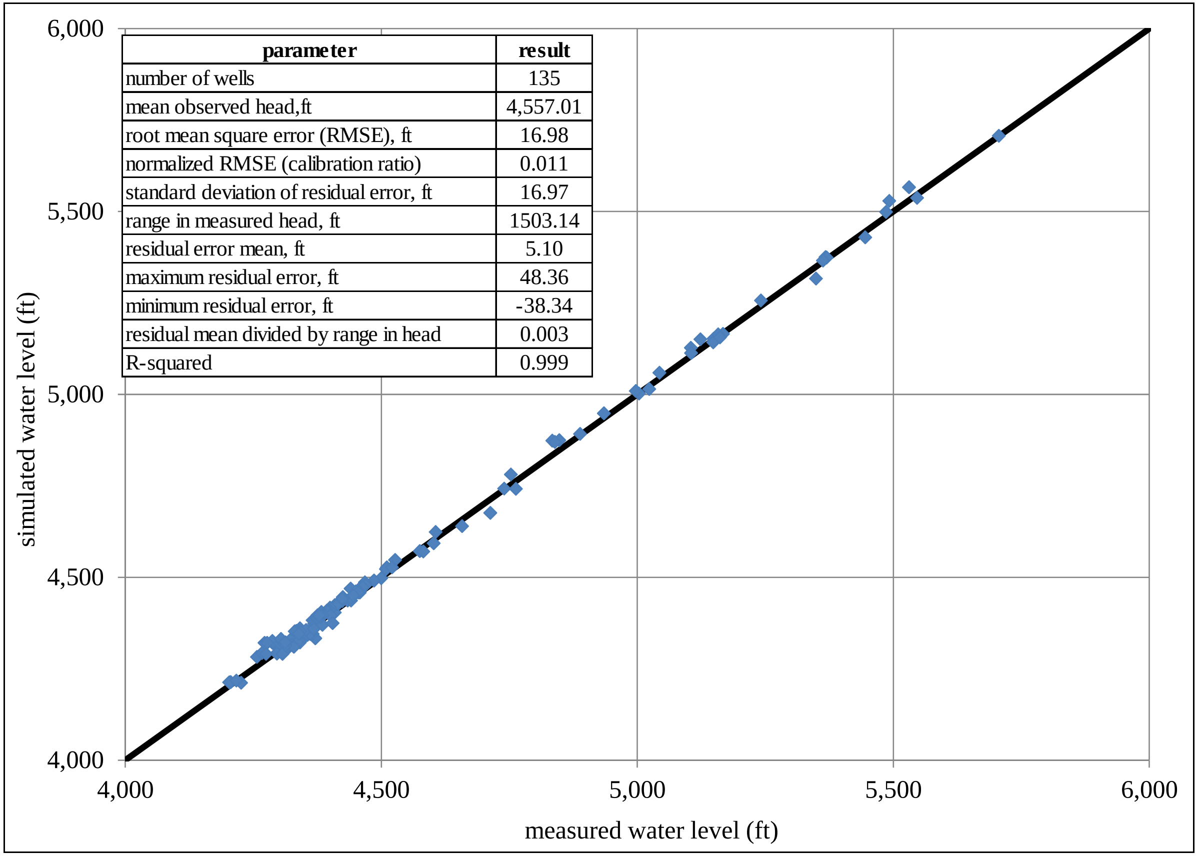
Table 6.4. Simulated open-pit hydrologic parameters

meteorological parameters		
month	**average precipitation (inches)**	**average evaporation (inches)**
Jan	0.6	3.2
Feb	0.6	4.2
Mar	0.4	6.4
Apr	0.3	7.1
May	0.5	8.4
Jun	0.7	10.7
Jul	2.3	7.8
Aug	2.5	4.5
Sep	2.1	4.6
Oct	1.2	3.0
Nov	0.6	2.8
Dec	0.8	2.1
total	12.5	64.6
runoff coefficients		**(percent of precipitation)**
pit wall		0.30
watershed		0.05

6.4 Model Results and Calibration

6.4.1 Steady-State Simulation

Estimated and simulated steady-state water levels are compared on Figure 6.10. The simulated steady-state basin water balance is shown on Table 6.5. Contours of the simulated steady-state water table are shown on Figure 6.11.



parameter	result
number of wells	135
mean observed head,ft	4,557.01
root mean square error (RMSE), ft	16.98
normalized RMSE (calibration ratio)	0.011
standard deviation of residual error, ft	16.97
range in measured head, ft	1503.14
residual error mean, ft	5.10
maximum residual error, ft	48.36
minimum residual error, ft	-38.34
residual mean divided by range in head	0.003
R-squared	0.999

Figure 6.10. Comparison of measured and simulated water levels.

Table 6.5. Simulated steady-state water balance

	watershed				TOTAL
	Animas	**Percha**	**Grayback / Greenhorn**	**Seco / King**	
direct recharge	2,811	825	61	0	3,697
runoff	7,898	5,249	140	18	13,305
groundwater inflow	0	0	0	1,861	1,861
TOTAL IN (ac-ft/yr)					**18,863**
evapotranspiration	2,588	1,706	0	0	4,294
groundwater discharge	7,923	1,260	2,162	1,932	13,277
surface-water discharge	949	344	0	0	1,293
TOTAL OUT (ac-ft/yr)					**18,864**

ac-ft/yr - acre-feet per year

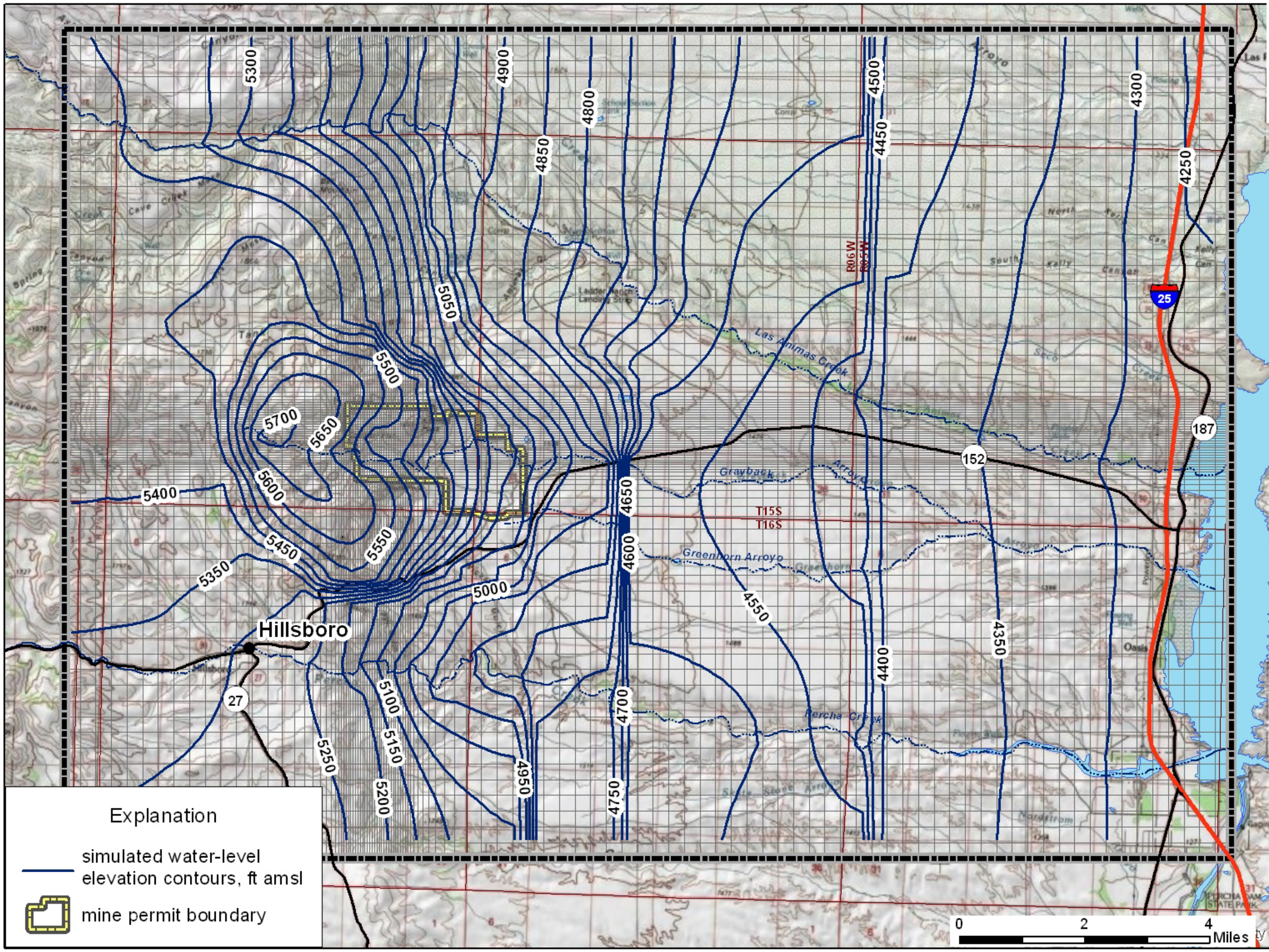


Figure 6.11. Contours of simulated 2012 groundwater levels.

6.4.2 Historical Transient Simulation

The historical transient simulations include the pre-mining (1940 to June 1980), and mining and post-mining (June 1980 to November 2012) simulations. Measured and simulated water-level hydrographs are compared for calibration well locations shown on Figure 6.12. Measured and simulated water levels are presented on Figures 6.13 through 6.27.

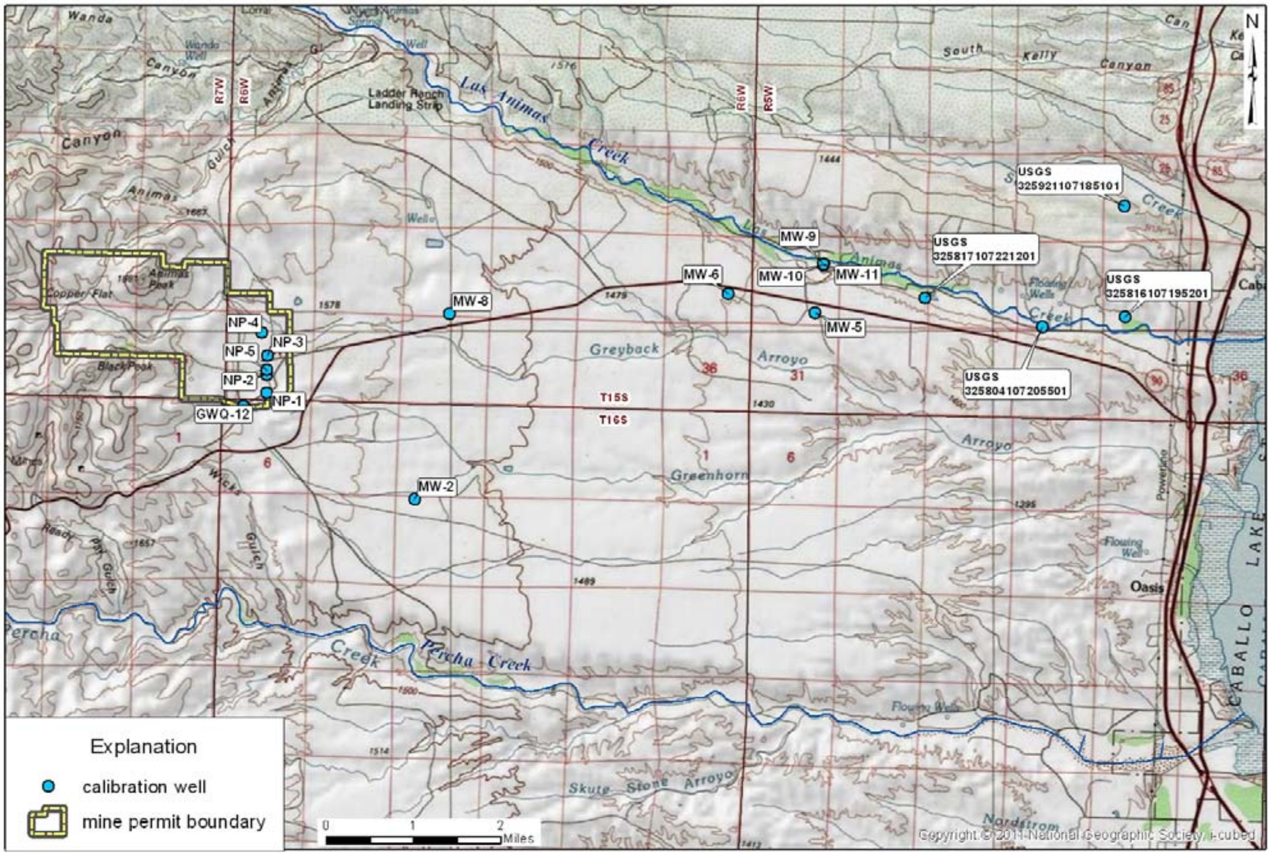


Figure 6.12. Locations of measured water-level hydrographs.

Measured and simulated water levels near the well field, at MW-5, are shown on Figure 6.13, showing drawdown and recovery in response to the period of well field operation in 1982.

Measured and simulated water levels west of the well field, at MW-6, are shown on Figure 6.14. The 35-year, 175-ft rise in the measured MW-6 water level (discussed in Section 5.2.2 above) is not simulated in the model.

Measured and simulated water levels north of the well field along Las Animas Creek, at MW-9, -10 and -11, are shown on Figure 6.15. The measured water levels include data from the mid-1990s as well as data from 2012. The vertical gradient measured between the shallow well (MW-11) and the deeper wells (MW-10 and -9) is reproduced in the model.

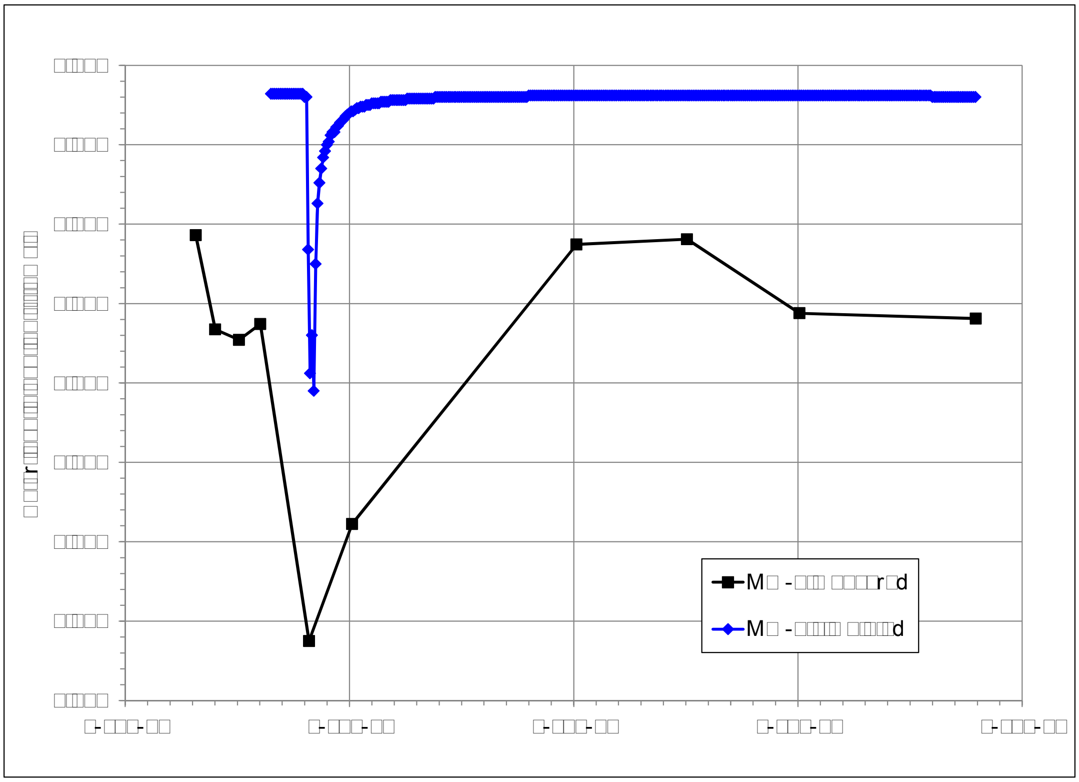


Figure 6.13. Measured and simulated water-level hydrographs in MW-5.

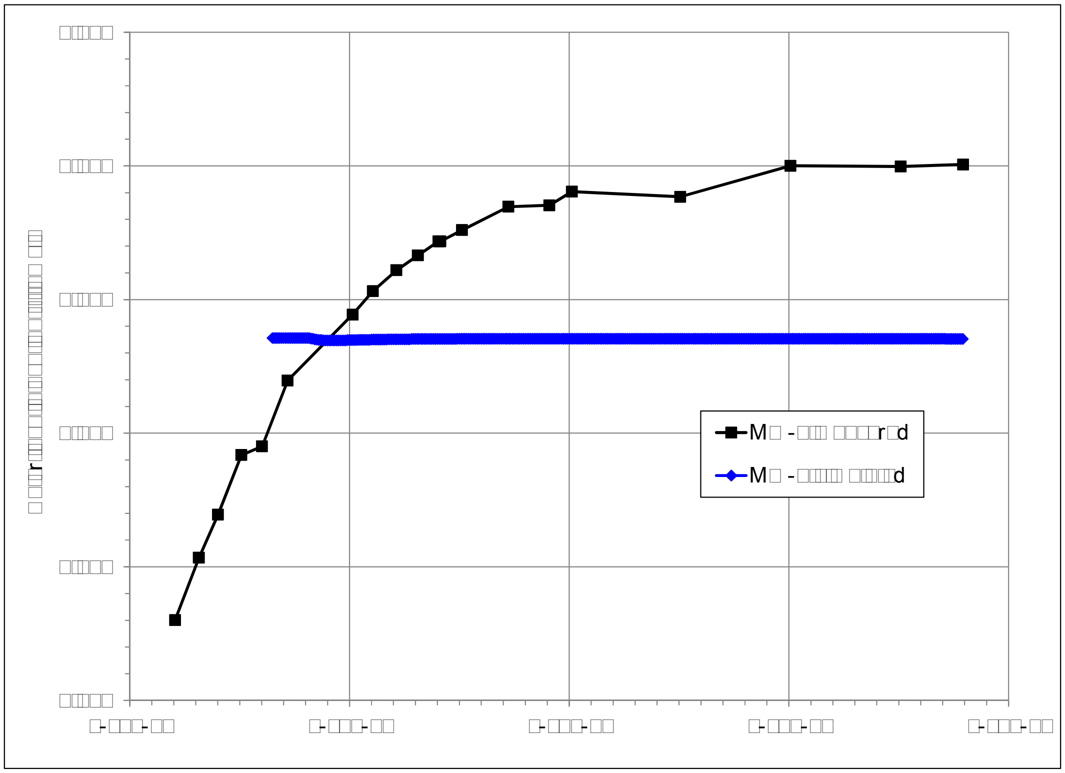


Figure 6.14. Measured and simulated water-level hydrographs in MW-6.

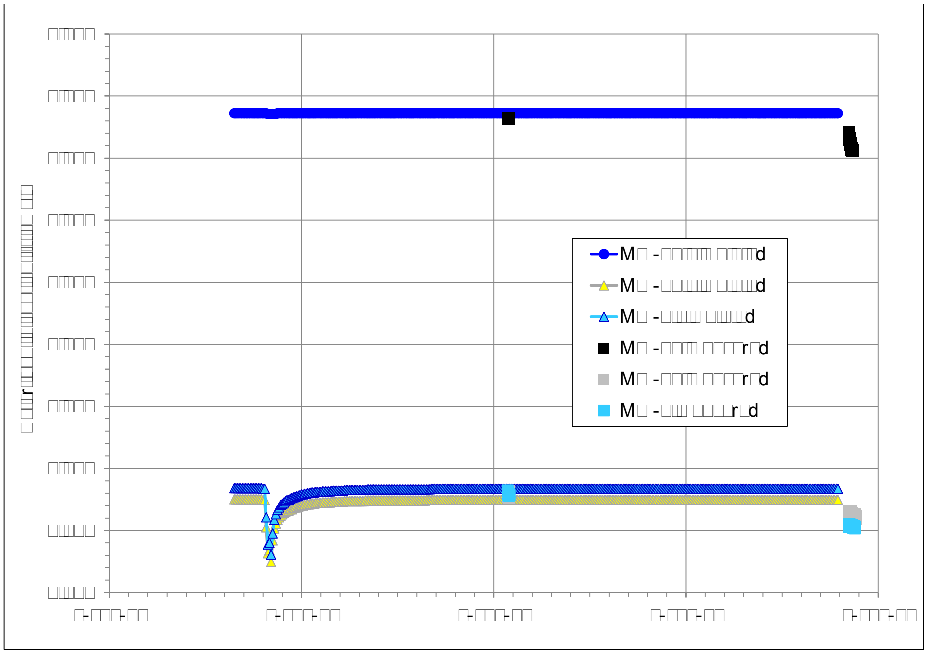


Figure 6.15. Measured and simulated water-level hydrographs in MW-9, MW-10, and MW-11.

Measured and simulated water levels farther down Las Animas Creek (Fig. 5.2) are shown on Figures 6.16 through 6.19. The background variation in the measured water levels reflects unidentified local and temporal stresses that are not simulated in the model. The model simulates the measured water levels generally within the range of water-level variation found in a single model cell in this area. The simulation is acceptably accurate considering the water-level variation within a single cell and the not-simulated local processes affecting the measured water level.

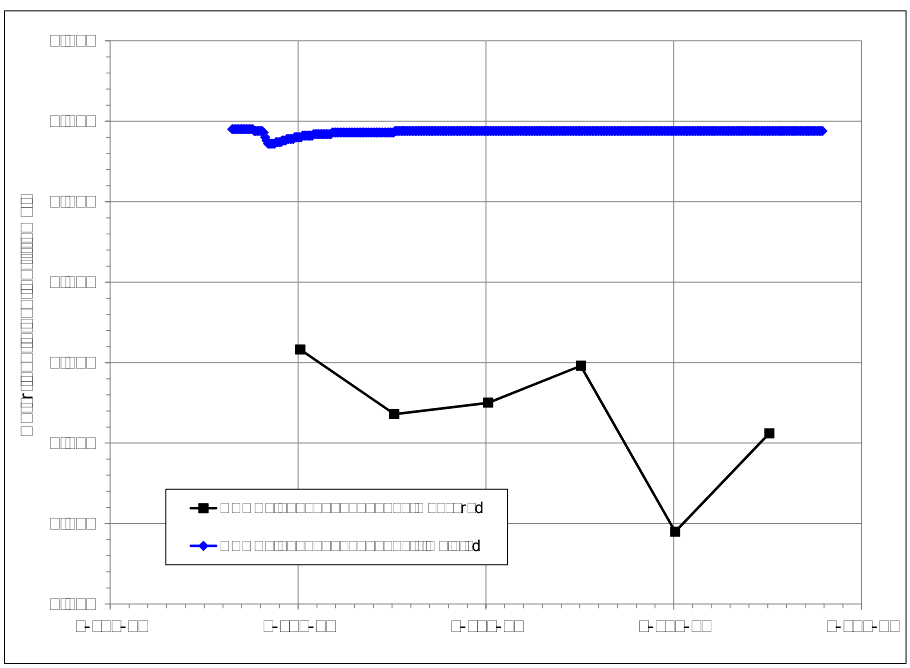


Figure 6.16. Measured and simulated water-level hydrographs in USGS #325804107205501.

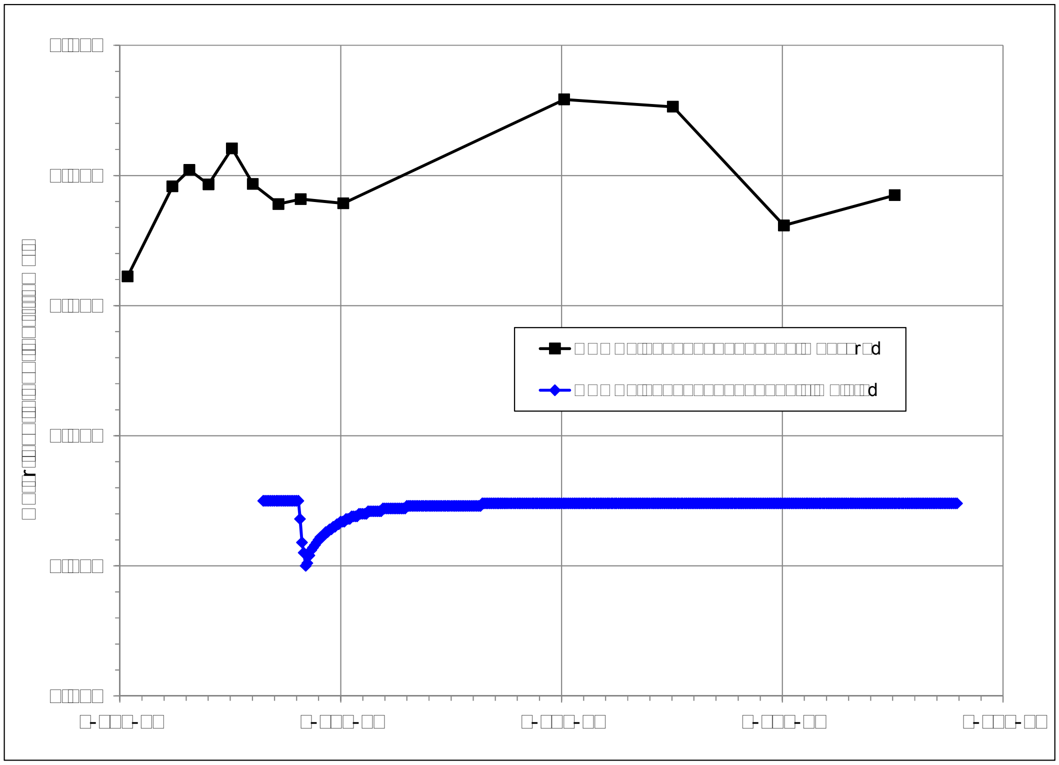


Figure 6.17. Measured and simulated water-level hydrographs in USGS #325817107221201.

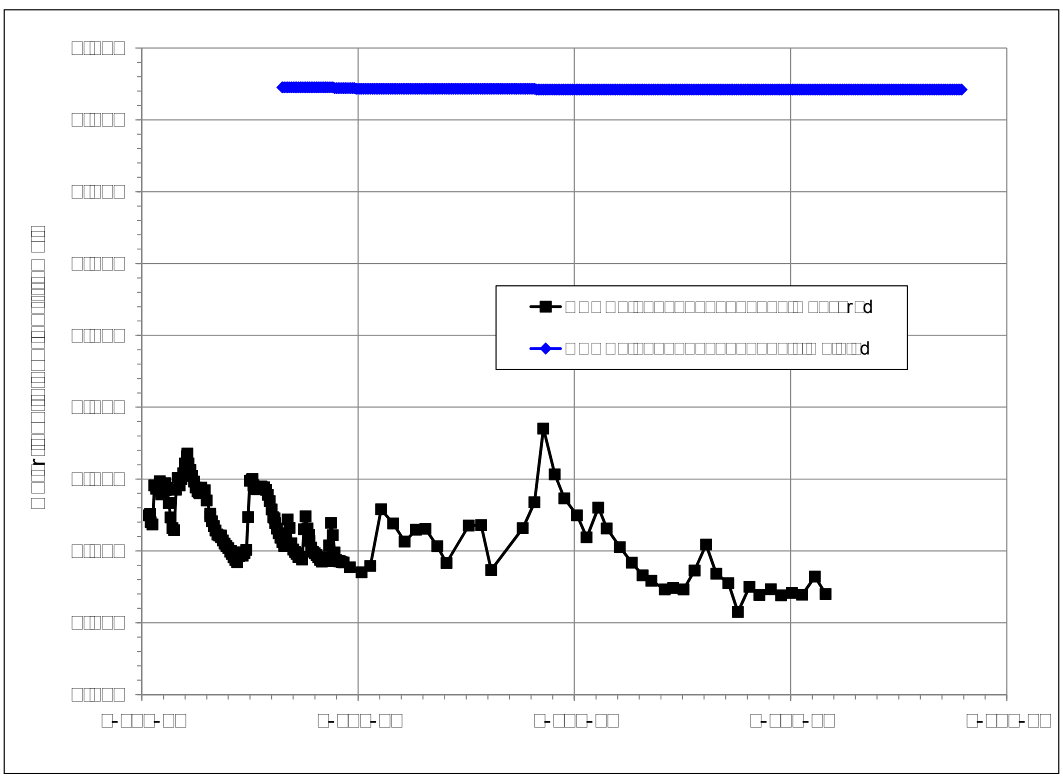


Figure 6.18. Measured and simulated water-level hydrographs in USGS #325921107185101.

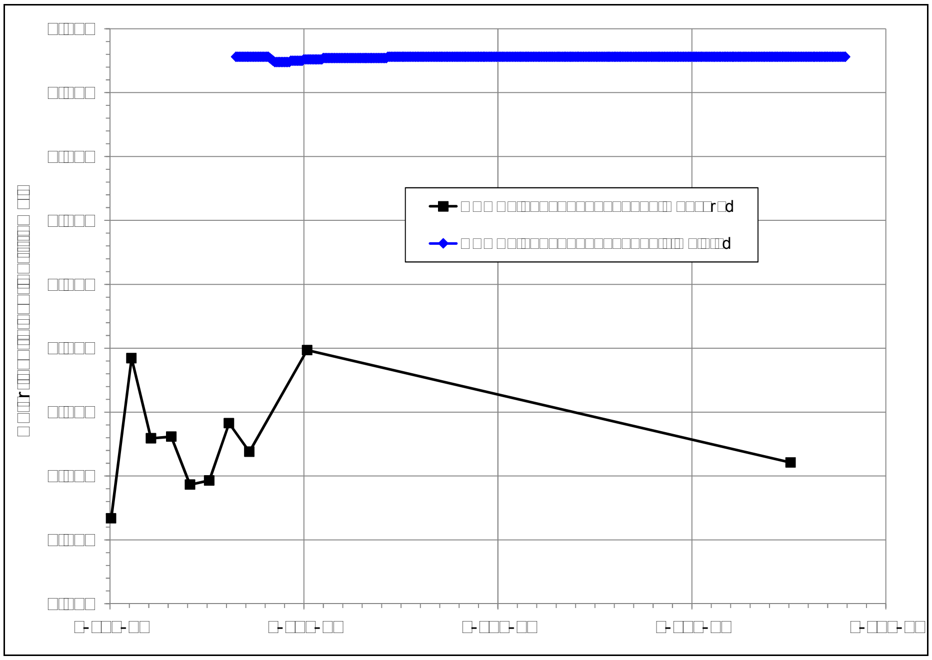


Figure 6.19. Measured and simulated water-level hydrographs in USGS #325816107195201.

Measured and simulated water levels downstream of the tailings impoundment (Fig. 5.2), at MW-2 and MW-8, are shown on Figures 6.20 and 6.21, also showing substantial background water-level fluctuations not simulated in the model. The simulation is acceptably accurate considering the amount of water-level variation within a single cell and the not-simulated local processes affecting the measured water level.

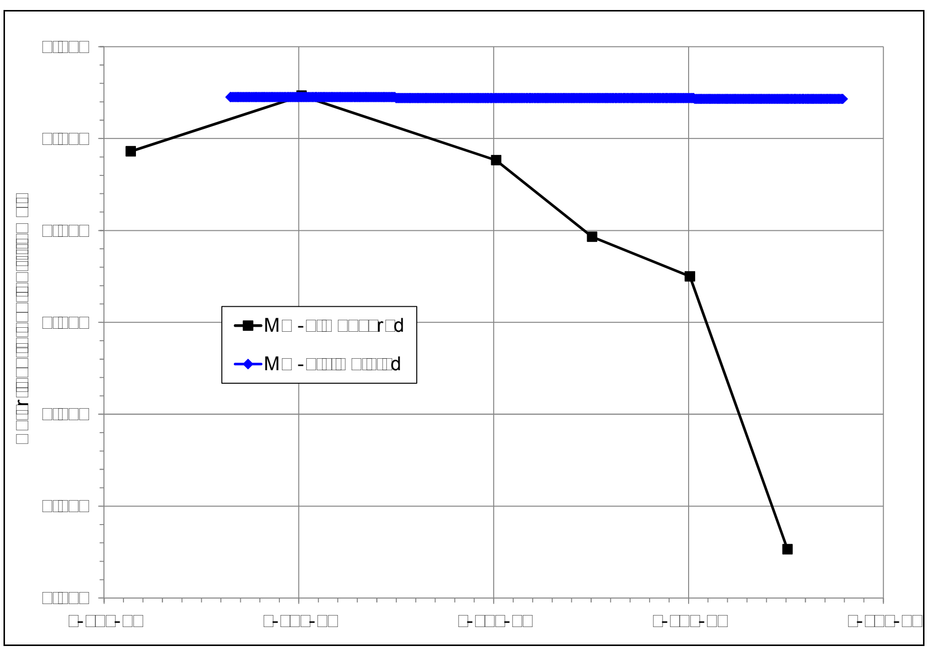


Figure 6.20. Measured and simulated water-level hydrographs in MW-2.

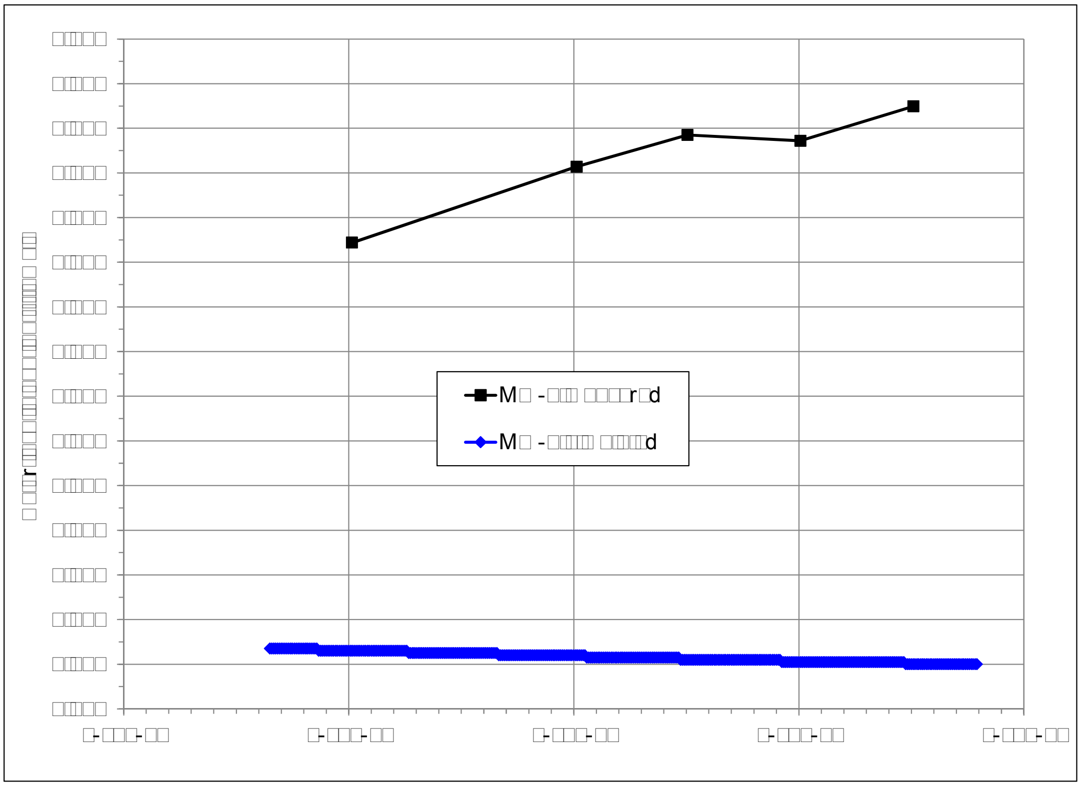


Figure 6.21. Measured and simulated water-level hydrographs in MW-8.

Measured and simulated water levels in the vicinity of the 1982 tailings impoundment (Fig. 5.2) are shown on Figures 6.22 through 6.27. The model reproduces the phenomenon of sustained elevated water levels measured in the vicinity of the impoundment, caused by a fault barrier to the east. The barrier appears to largely contain seepage from the tailings within the fault-bounded block.

Simulated water levels do not exactly match the measured, which indicate even less flow across the fault barrier than is simulated. The measured water levels also reflect unknown local processes and uncertainty in measurements taken over several periods. However the major feature, that of sustained elevated water levels caused by the dam effect of the fault barrier, is reproduced. Seepage from the tailings has mainly been contained behind the fault and has not flowed down gradient.

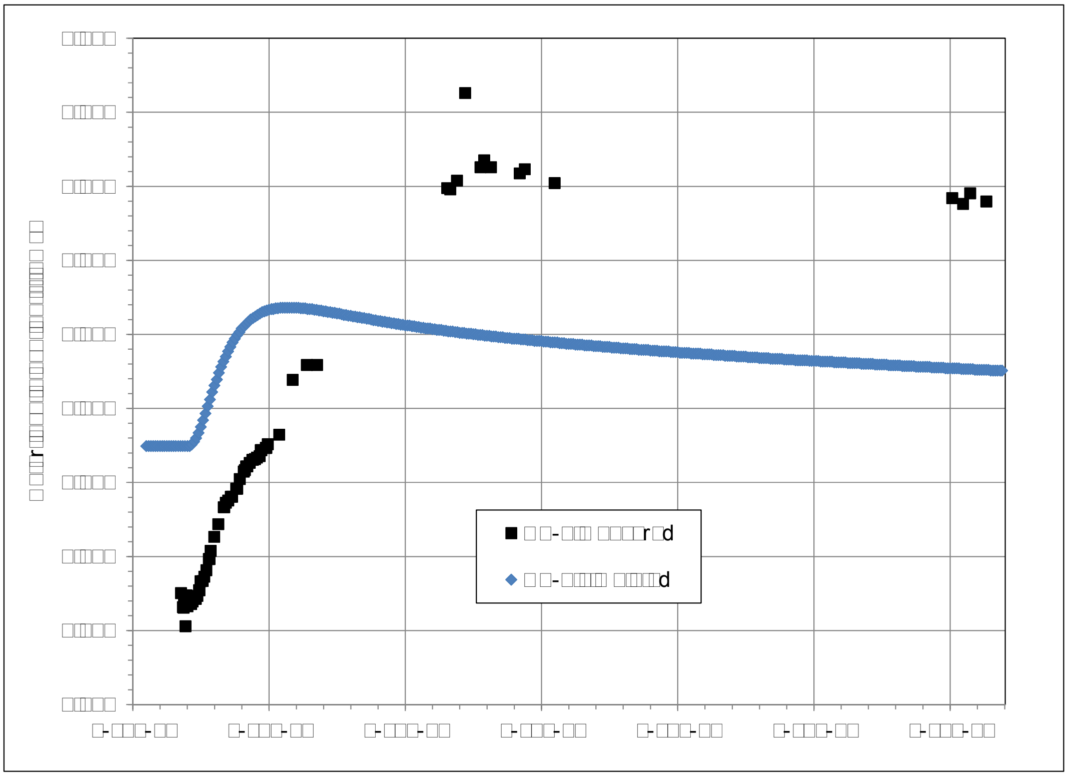


Figure 6.22. Measured and simulated water-level hydrographs in NP-1.

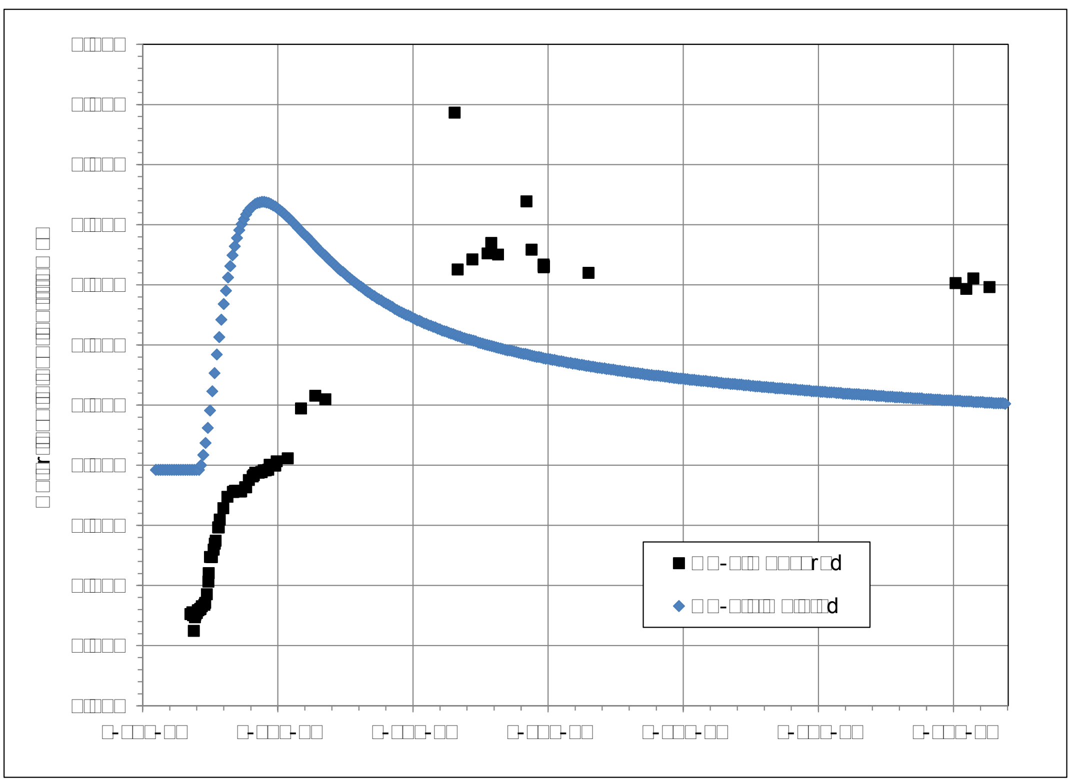


Figure 6.23. Measured and simulated water-level hydrographs in NP-2.

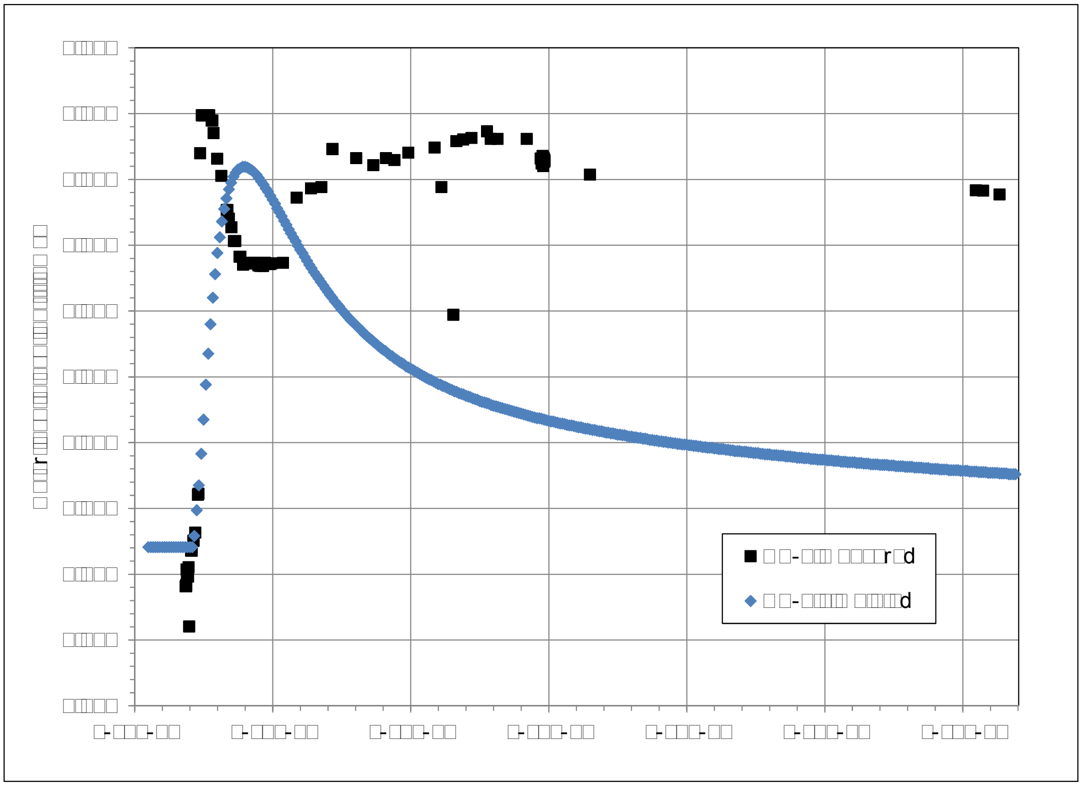


Figure 6.24. Measured and simulated water-level hydrographs in NP-3.

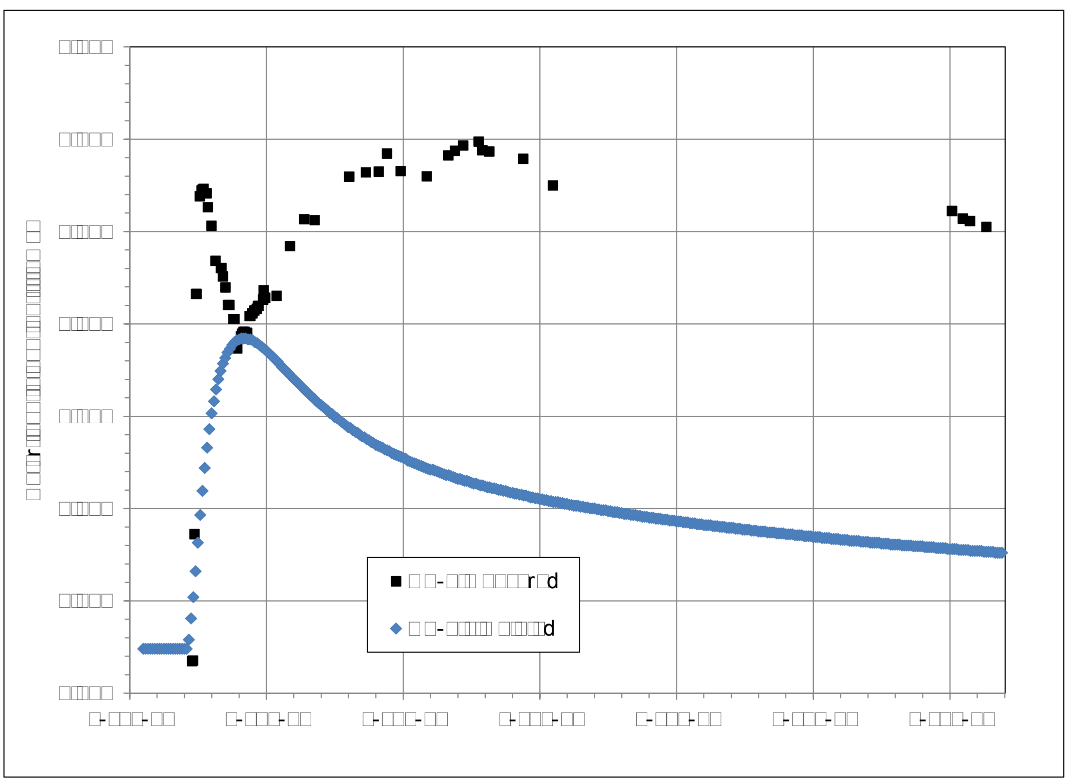


Figure 6.25. Measured and simulated water-level hydrographs in NP-4.

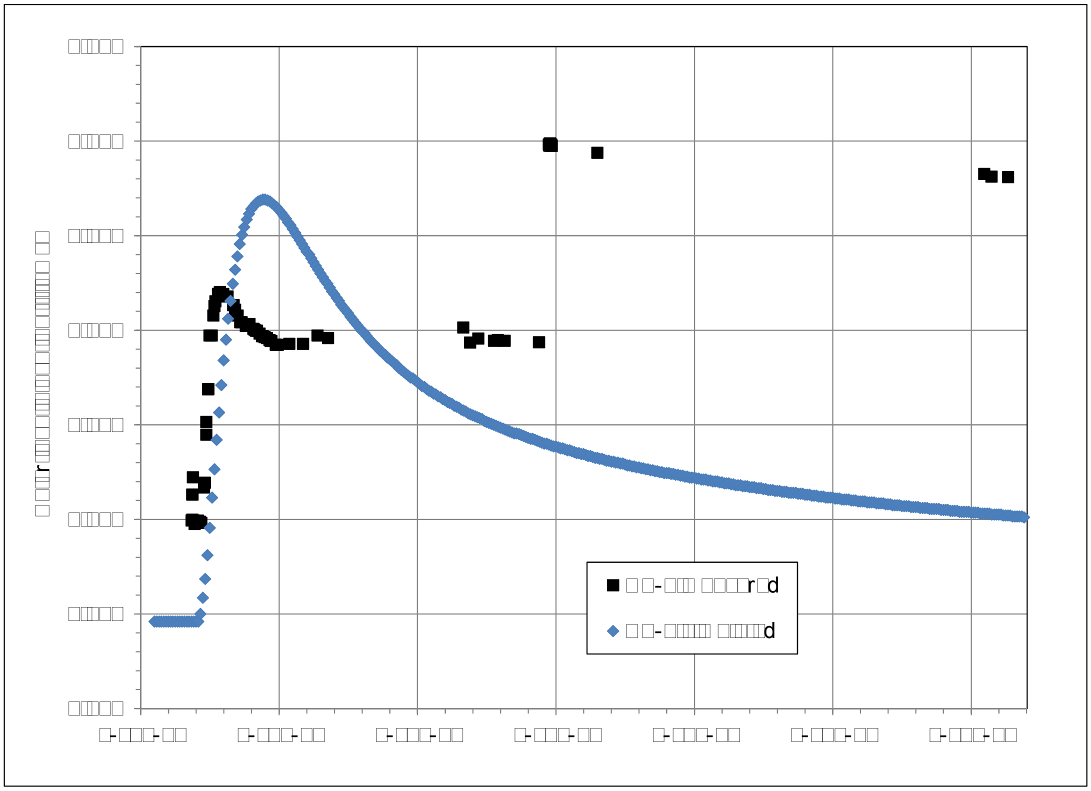


Figure 6.26. Measured and simulated water-level hydrographs in NP-5.

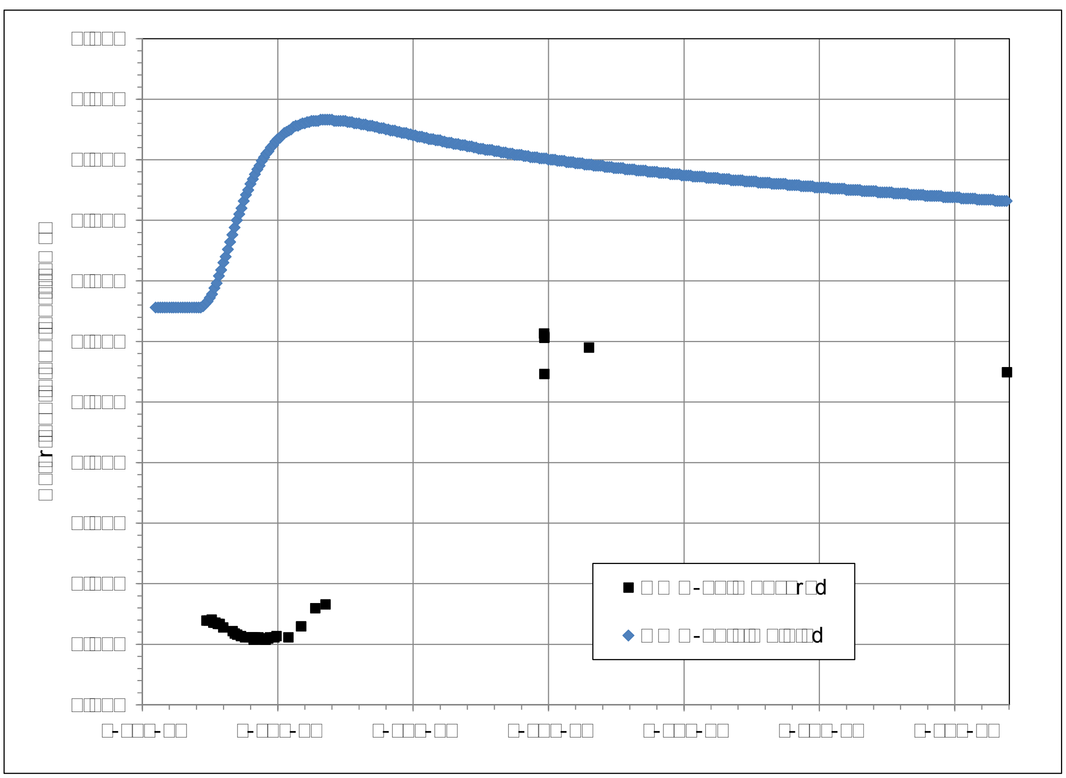


Figure 6.27. Measured and simulated water-level hydrographs in GWQ-12.

Simulated water level and water balance for the current open pit are shown on Table 6.6, indicating general agreement with current measured pit water level and estimated pit water balance. The future (larger and deeper) open pit, both during dewatering and after mining, will have more groundwater inflow with a larger water surface and more evaporation.

Table 6.6. Simulation results for current open pit

water level (ft amsl)	5,433	
water surface area (acres)	4.8	
simulated annual average water balance		
-	**ac-ft/yr**	**gpm**
precipitation and runoff	18.4	11.4
groundwater inflow	6.7	4.2
TOTAL IN (ac-ft/yr)	**25.1**	**15.5**
evaporation out	25.1	15.5
TOTAL OUT (ac-ft/yr)	**25.1**	**15.5**

Simulated total flowing-well discharge for the study area is shown on Figure 6.28. There are no data for calibrating the total flowing-well discharge, but the model result represents the known background (independent of the Project) trend of drawdown in the model area.

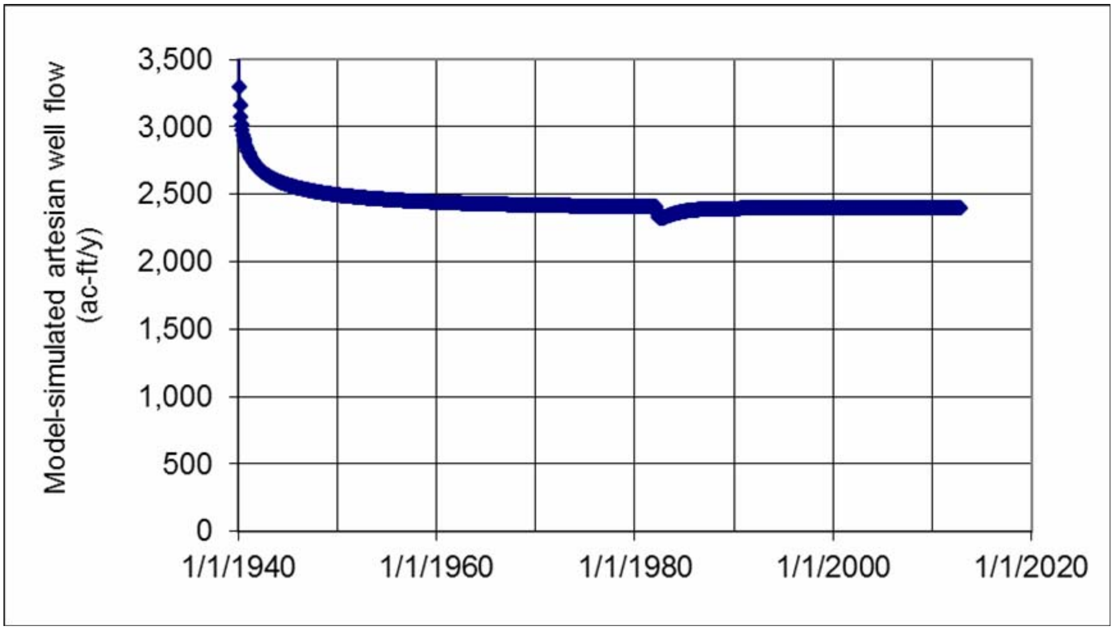


Figure 6.28. Simulated artesian well discharge.

6.4.3 Aquifer Test Simulation

Pumping of wells PW-1 and PW-3 began in late November 2012 and continued, with two stops and starts, until 21 December, 2012. Recorded pumping periods and rates (Fig. 5.14) were simulated in the model using MODFLOW module LAK2 (JSAI, 2010), which simulates water level inside the pumping bores in addition to the withdrawal from the aquifer. Water-level responses were measured at locations shown on Figure 6.29. Measured and simulated aquifer test drawdown and recovery are presented on Figures 6.30 through 6.38.

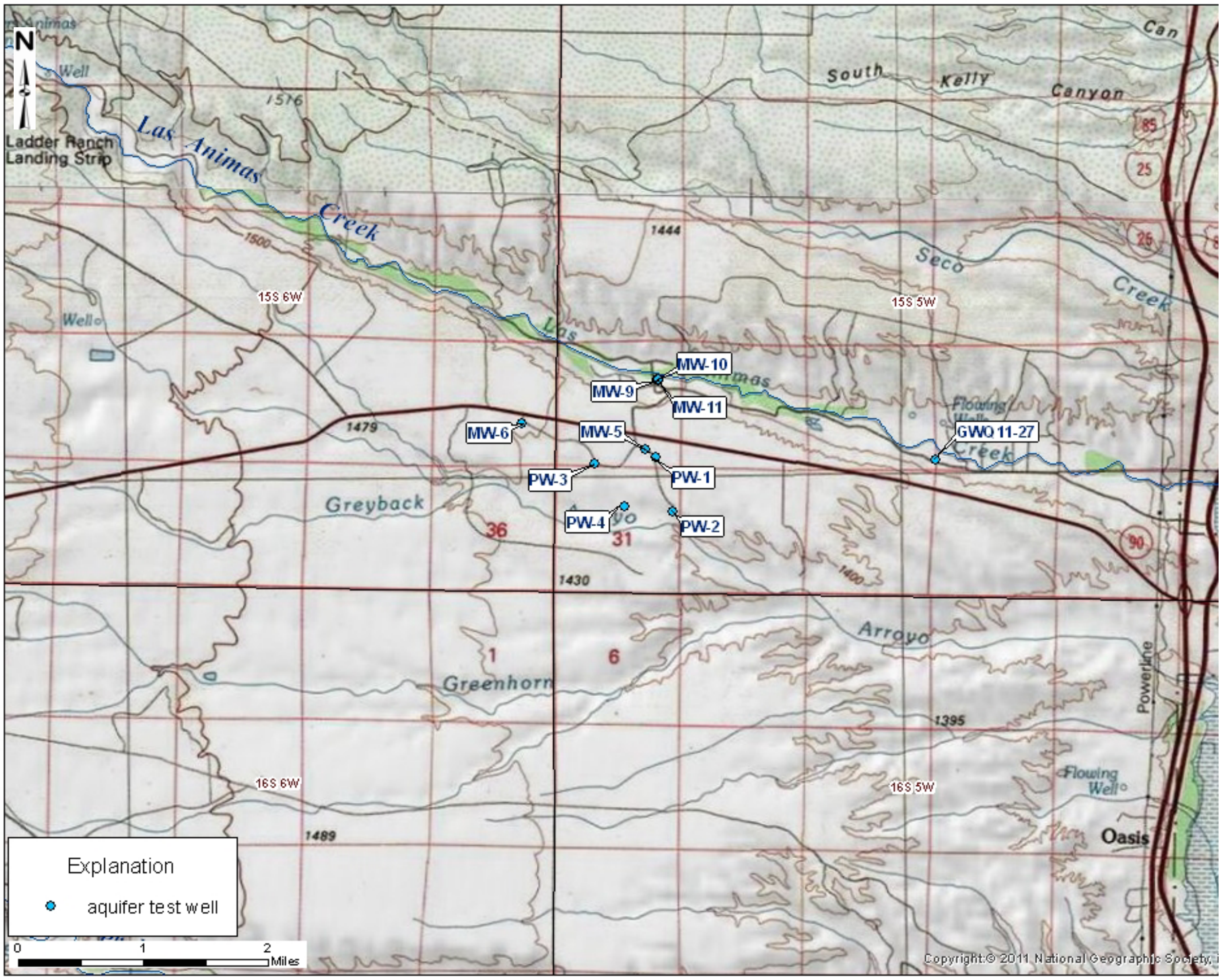


Figure 6.29. 2012 aquifer test pumping and observation locations.

Measured and simulated drawdown in the pumping wells, PW-1 and PW-3, are shown on Figures 6.30 and 6.31. Simulated water levels in the well-bore, and in the adjacent aquifer, are shown on both figures. The simulated and measured well-bore water levels agree. The difference between well-bore and aquifer water levels characterizes the well losses and pumping efficiency of PW-1 and PW-3.

Measured and simulated drawdown elsewhere in the well field area, at PW-2, PW-4 and MW-5, are shown on Figures 6.32, 6.33 and 6.34. The rapid drawdown and recovery measured in the well field area is reproduced in the model.

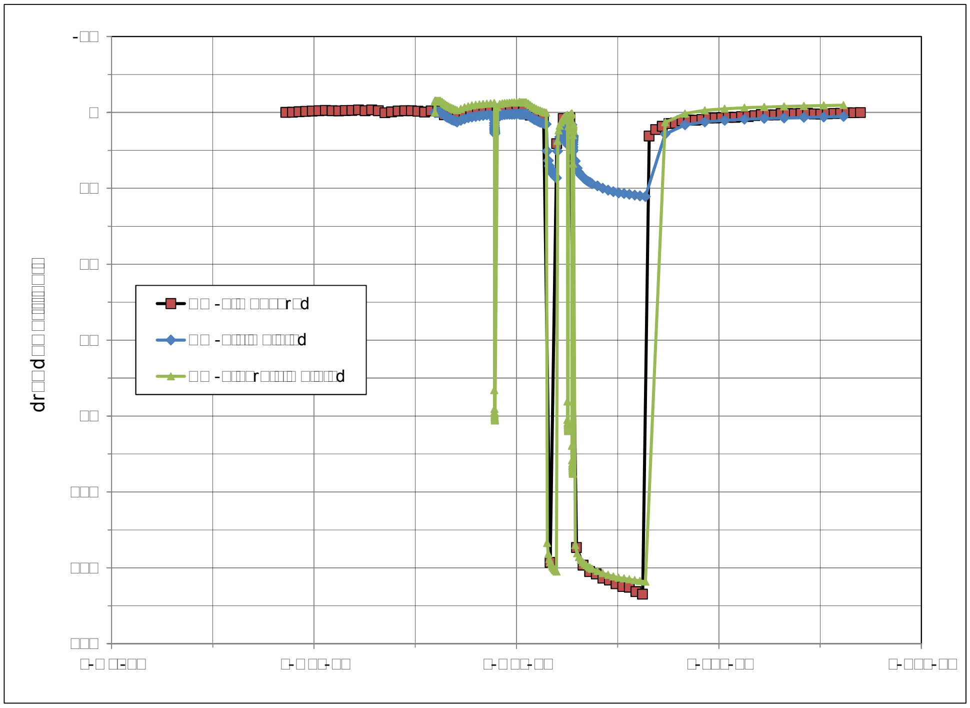


Figure 6.30. Measured and simulated water-level hydrographs in PW-1.

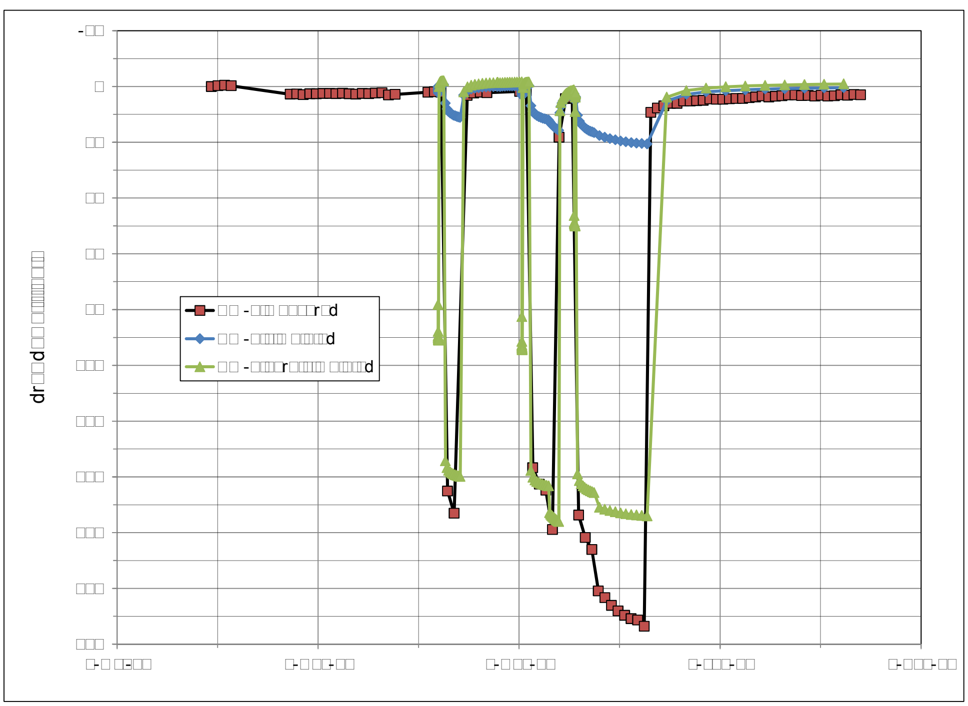


Figure 6.31. Measured and simulated water-level hydrographs in PW-3.

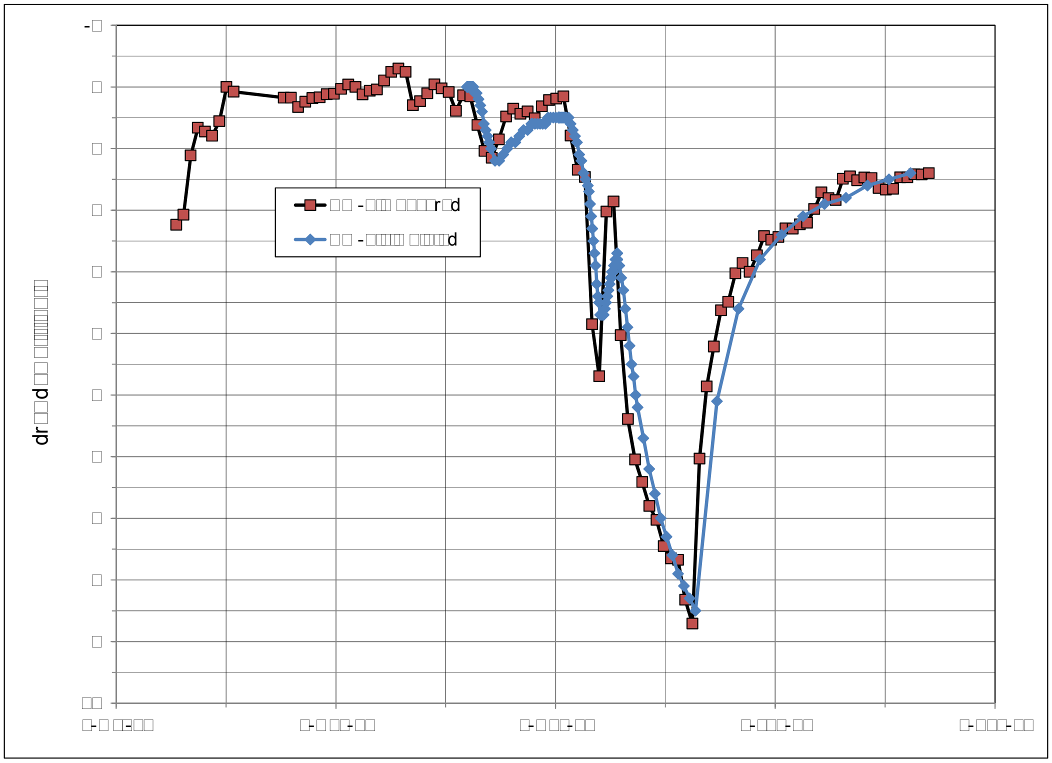


Figure 6.32. Measured and simulated water-level hydrographs in PW-2.

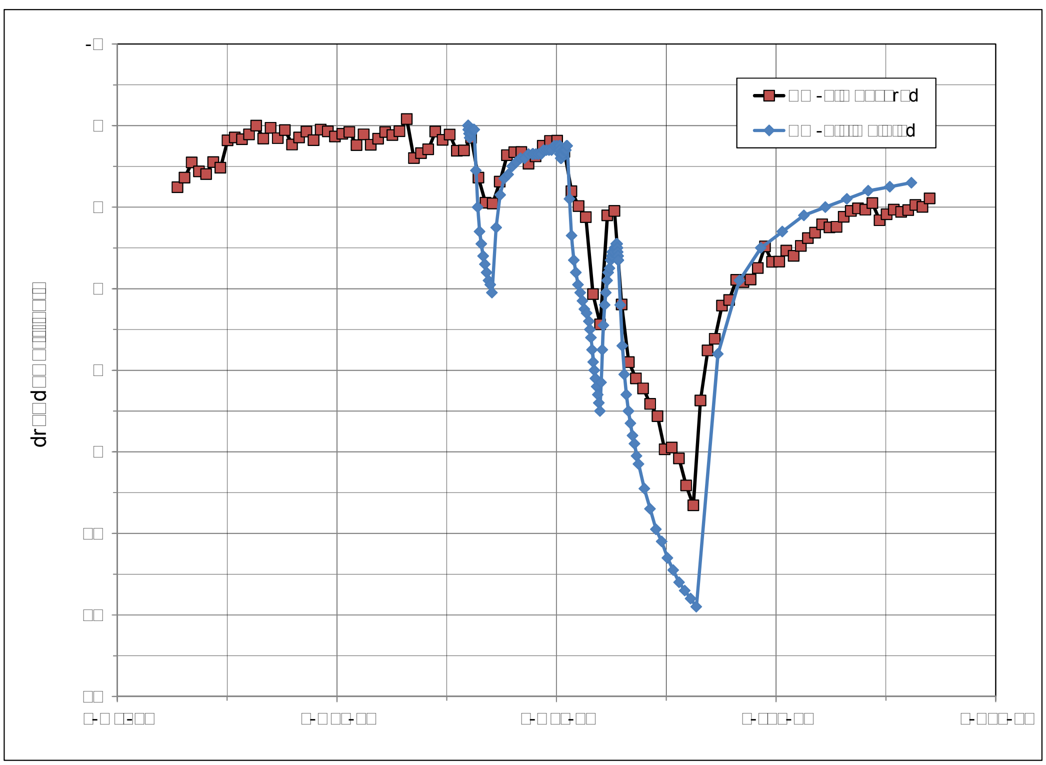


Figure 6.33. Measured and simulated water-level hydrographs in PW-4.

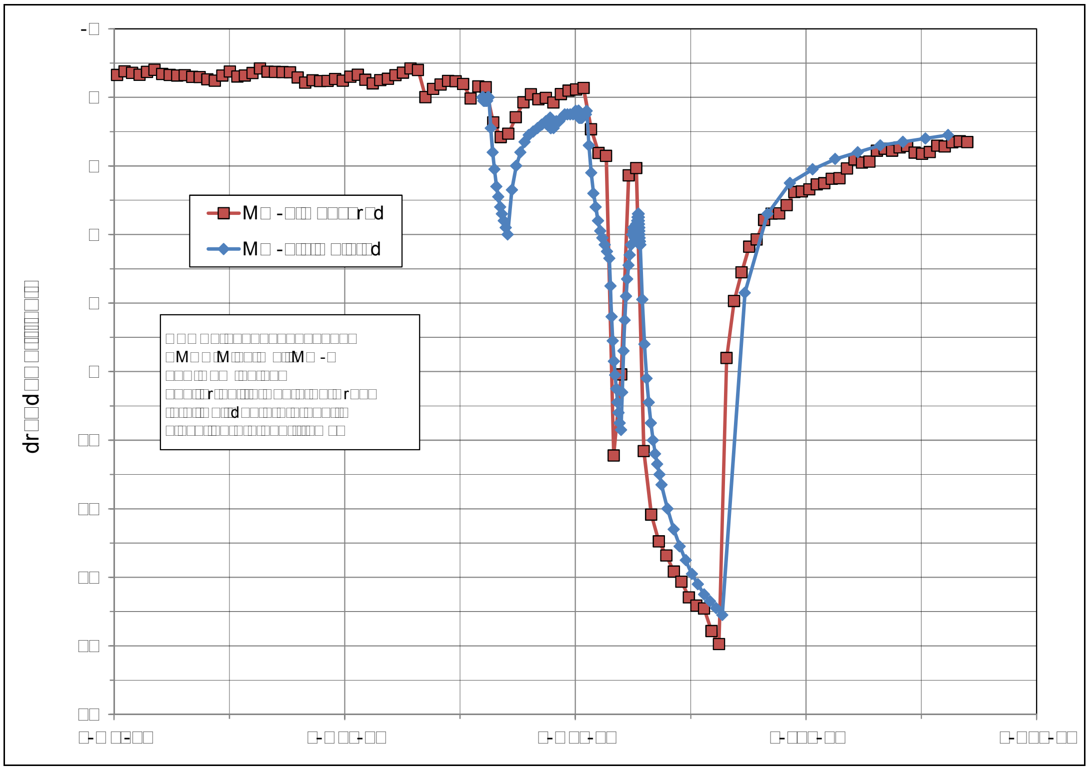


Figure 6.34. Measured and simulated water-level hydrographs in MW-5.

Measured and simulated drawdown north of the well field along Las Animas Creek (Fig. 6.29) is shown for the SFG aquifer (wells MW-9 and MW-10) on Figure 6.35 and for the alluvium (well MW-11) on Figure 6.36. The sharp drawdown and recovery in the SFG aquifer, and the lack of response in the alluvium, are both reproduced in the model.

Instead of responding to the aquifer test, measured water levels in the very shallow (37 ft) well MW-11 (Fig. 6.36) can be seen to be rising before and throughout the test, due to some local influence, such as a neighboring well stopping pumping.

Measured and simulated drawdown east of the well field, at GWQ11-27 (Fig. 6.29), is shown on Figure 6.37. The model-simulated response is not as rapid or as large as the apparent measured response, but the figure also shows substantial background water-level fluctuation that is not part of the aquifer test response.

Measured and simulated drawdown west of the well field, at MW-6 (Fig. 6.29), is shown on Figure 6.38. The measured data shown on the figure consist of the highest water level measured each day; actual water levels in MW-6, an actively-used pumping well, fluctuate over tens of feet as the pump starts and stops. The data shown on the figure correspond to the water level measured each morning, just before the pump was started.

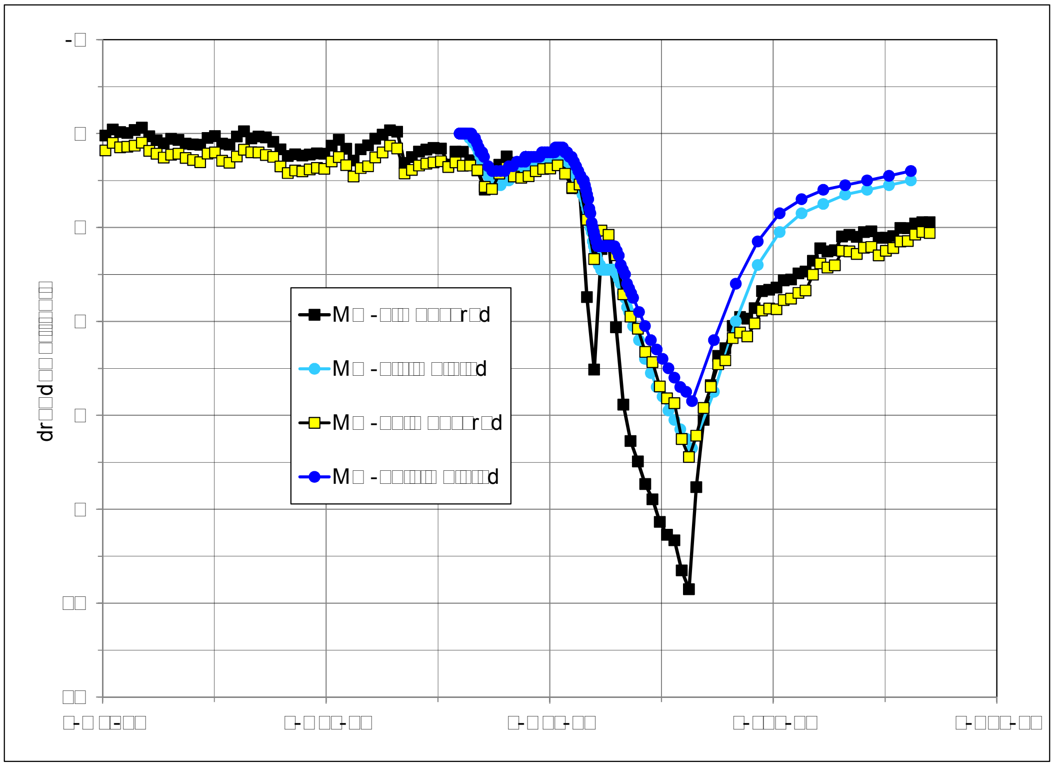


Figure 6.35. Measured and simulated water-level hydrographs in MW-9 and MW-10.

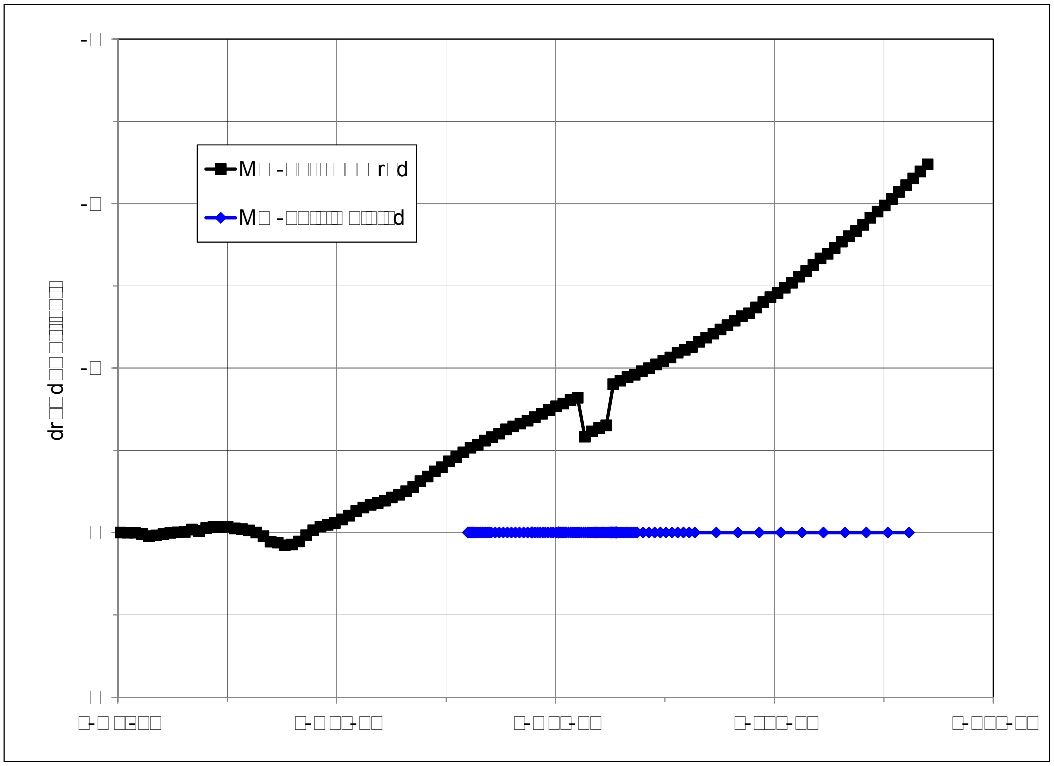


Figure 6.36. Measured and simulated water-level hydrographs in MW-11.

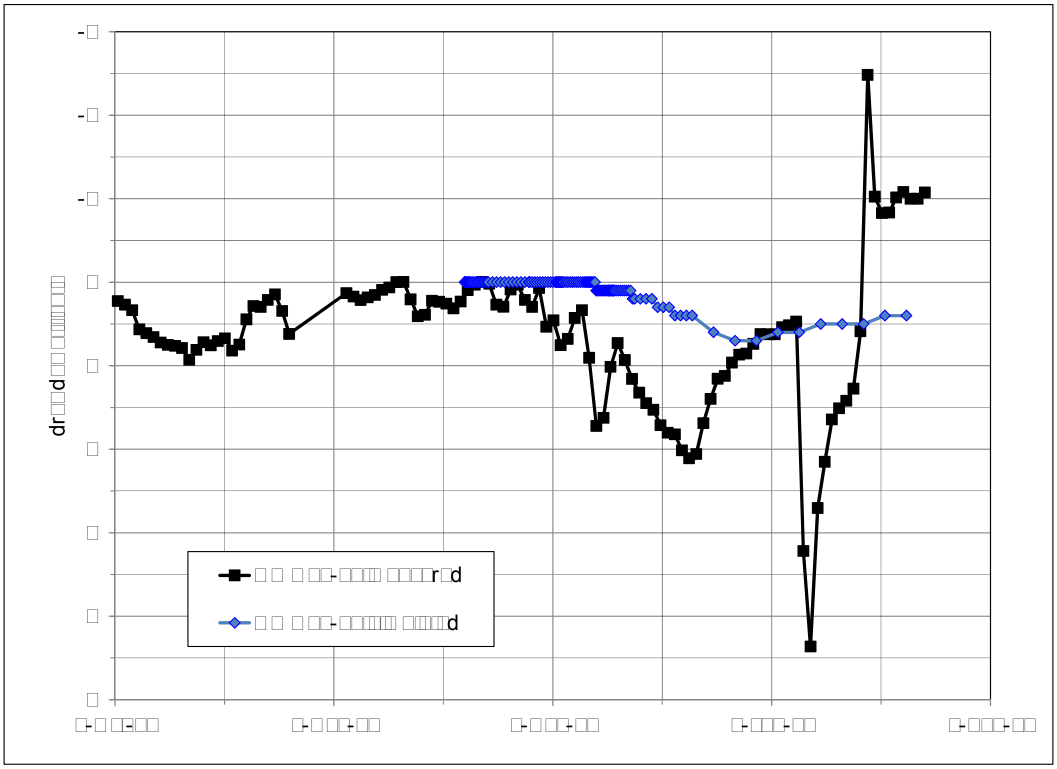


Figure 6.37. Measured and simulated water-level hydrographs in GWQ11-27.

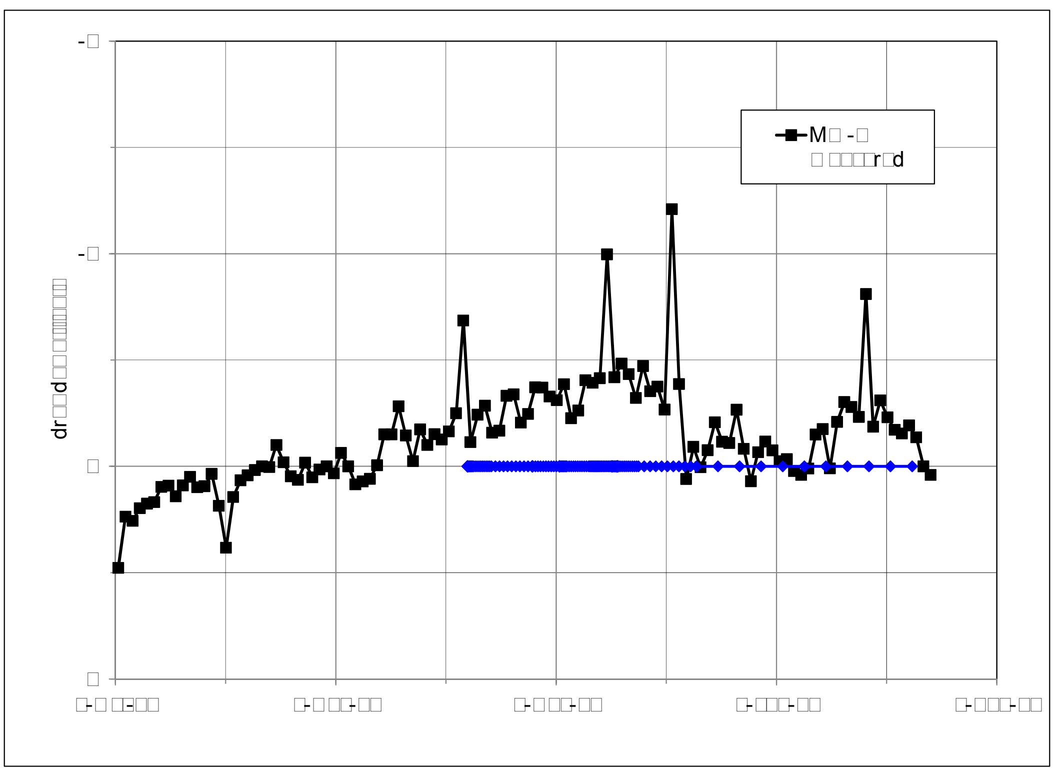


Figure 6.38. Measured and simulated water-level hydrographs in MW-6.

7.0 SENSITIVITY OF MODEL RESULTS

The sensitivity of model results to different parameters is discussed below.

First, the sensitivity of calibration results to model parameters is presented. These indicate which parameters are known with more confidence, or better constrained by data, and which are more unknown or uncertain. This helps to define a range of plausible values for each parameter.

Then the sensitivity of model projection results, within the plausible range of values for different parameters, is evaluated, to indicate a probable range of results. This quantifies the level of uncertainty in the model predictions and defines a range of likely outcomes.

7.1 Sensitivity of Calibration Results

The sensitivity of results to changes in model parameters was investigated during development of the model, in order to improve model calibration. An example of this is given on Figure 7.1, showing the simulation of the 2012 aquifer test for different modeled levels of vertical anisotropy in the Palomas Graben.

The results suggest important vertical flow upward into the strata from which the wells pump. The sediments filling the Palomas Graben are therefore modeled as an isotropic unit, with equal horizontal and vertical permeability (Table 6.1).

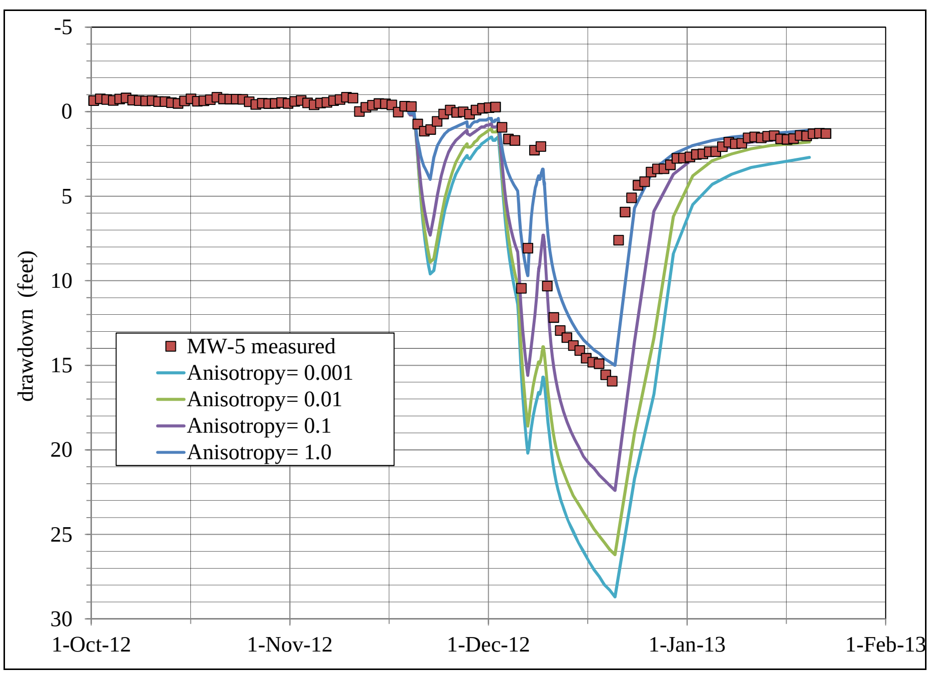


Figure 7.1. Simulated aquifer-test drawdown in well MW-5 for different vertical anisotropy values.

A related example is shown on Figure 7.2, showing the simulation of the 2012 aquifer test for different horizontal permeability of the Palomas Graben. Results show improved calibration for higher permeability. The final modeled permeability was 10 ft/d for the strata in which the well field is completed, with a total aquifer transmissivity of 20,000 ft^2/d (Table 6.1).

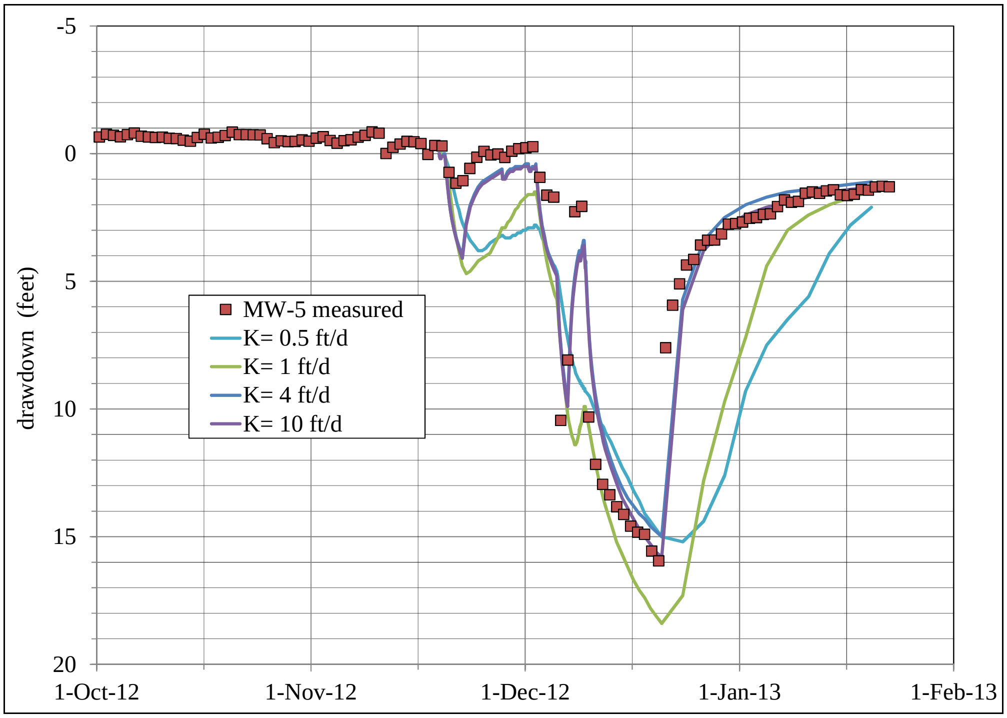


Figure 7.2. Simulated aquifer-test drawdown in well MW-5 for different hydraulic conductivity values.

Based on the sensitivity results above, the transmissivity and vertical anisotropy of the highly-transmissive Palomas Graben are considered to be relatively well-known parameters, whose range of possible values is constrained by data.

Away from the Palomas Graben, the properties of the SFG aquifer are less well-known. However, based on aquifer test results and model calibration information the SFG aquifer along Animas Creek (Fig. 6.2) is identified to be similarly transmissive (Table 6.1).

The properties of the alluvial aquifer along Animas Creek are not known in detail, but the alluvium can be assumed to be conductive and to have substantial storage capacity. Measured historical water levels at MW-9, MW-10 and MW-11, results of the 1994 MW-9 pumping test (Fig. 5.13), and results of the 2012 well field pumping test (Fig. 6.36), all show that the alluvial aquifer does not respond readily to pumping in the underlying SFG aquifer.

To summarize the constraints on parameters:

1. Properties of the SFG sediments in the Palomas Graben are reasonably well-known based on calibration to aquifer test results. The graben aquifer is relatively transmissive both horizontally and vertically.

2. Properties of the SFG sediments along Animas Creek are somewhat known based on aquifer test results and other model calibration. The SFG aquifer along Animas Creek is also relatively transmissive.

3. Properties of the alluvial aquifer along Animas Creek are somewhat known, based on overall model calibration and on general material properties. Multiple aquifer test results (Sec. 5.2.2, 5.2.3, 5.2.4) indicate that the alluvial aquifer is substantially isolated from the SFG aquifer.

The above constraints narrow the plausible ranges of the main model result (the projection of groundwater drawdown and surface discharge reduction, resulting from proposed operation of the well field). The sensitivity of this result to variation of model parameters within plausible ranges is discussed below.

7.2 Sensitivity of Projection Results

The sensitivity of model projections to unknown parameters is of importance in evaluating the effects of the proposed project. Because this report does not present specific projections, the sensitivity of projection results is discussed only generally. Detailed evaluation of sensitivities for specific projection scenarios will be presented as needed in the reporting of model projections.

The main effects of the project would be associated with pumping of the well field, including groundwater drawdown and surface discharge changes. The high-transmissivity features of the Palomas Graben and the SFG aquifer along Animas Creek largely control the pattern of groundwater drawdown and the effects on discharge. The projected groundwater drawdown spreads throughout the high-transmissivity features, and magnitude of drawdown is proportional to the total volume of water pumped. The discharge effects develop over the life of mine and dissipate over a similar period.

This basic result is controlled by the known high-transmissivity features. Variations of aquifer parameters for these features, within plausible ranges, do not change the basic result, and can only marginally affect the shape and size of the drawdown cone and the timing of the discharge changes.

The low sensitivity of the basic result, to plausible variation of aquifer parameter values, has been confirmed informally by the similarity of results obtained, for different (unpublished) sample projections, for different mining scenarios, run using different preliminary model versions.

While the basic result is insensitive to changes in aquifer parameter values, variation in model boundary conditions can have more effect. An example is the sensitivity of projected surface-discharge changes to the boundary conditions that control groundwater discharge to the Rio Grande Basin (MODFLOW module GHB). The conductance of the GHB boundaries (Sec. 6.3.1) were adjusted both up and down one order of magnitude, and results of a sample projection compared to the calibrated model. An increase in the already-large conductance does not substantially change model results; the GHB boundaries are simulated with sufficiently large conductance that they function essentially as constant-head boundary conditions, maintaining a constant water level along the east edge of the model domain.

A decrease in GHB conductance, however, reduces simulated discharge to the Rio Grande system, and increases simulated discharge to the Animas Creek and Percha Creek systems. Projected effects on discharge to the Rio Grande system are smaller, and projected effects on discharge to the Animas Creek and Percha Creek systems are larger. Total discharge and total effect on discharge are unchanged.

In summary, the aquifer properties near the well field are relatively well-known, due to the 2012 aquifer test. The aquifer properties farther away do not substantially affect the size or shape of the predicted groundwater drawdown cone, or its rate of dissipation. The identified high-transmissivity units govern the propagation of groundwater drawdown and the resulting water balance effects.

Reasonable variation in boundary condition parameters such as GHB conductance do not substantially change the overall projected effects, but can affect the predicted distribution of those effects between groundwater discharge to the Rio Grande system and discharge to the Animas Creek and Percha Creek systems.

8.0 CONCLUSIONS

A numerical model of groundwater flow in and around Copper Flat, near Hillsboro, New Mexico was developed and calibrated based on previously available information and on new studies of the system. The calibrated model will be used to project the effects, to groundwater and surface water, of the proposed development of the Copper Flat mine.

First, the climate and meteorology, hydrology and water balance, and geology and hydrogeology, of the study area were summarized. Then a conceptual model of the hydrological and hydrogeological system was presented. Important hydrogeological features are the high-transmissivity Palomas Graben and a high-transmissivity zone along the axis of Animas Creek.

Next, the data available to confirm and calibrate the model were presented. Extensive information is available, from previous studies and previous mine operations, and from new studies including the 2012 extended well field test and the 2011 pit-area pressure-injection testing. The large amount of information has allowed development of a model that can reliably project effects of future development.

Next the numerical model was presented, including model structure, inputs and calibration. The model accurately represents the conceptual model and accurately reproduces the calibration data, particularly the results of the 2012 extended well field pumping test. As a result the model is considered suitable for use in projecting the effects of future well field pumping.

Finally the sensitivity of model results to unknown parameters was evaluated. The existing information, including the 2012 aquifer test, characterizes the main SFG aquifer units and narrows the range of parameter uncertainty in the vicinity of the well field. Sensitivity of the primary model projection results, groundwater drawdown and surface discharge changes due to well field pumping, is low.

Sensitivity of specific projection results will be evaluated quantitatively as needed and included in the reporting of individual model projections.

The calibrated model will be used to generate projections related to the results and effects of mine development. Projections will be generated as required and reported separately. Results of interest include the following:

- Groundwater drawdown due to water-supply pumping, for selected mine development scenarios
- Effects on surface discharge to the Las Animas Creek and Rio Grande systems
- Long-term post-mining residual groundwater drawdown and effects to surface discharge
- Potential ground subsidence due to groundwater drawdown
- Open pit dewatering rates and groundwater drawdown in bedrock
- Post-mining open-pit water level and water balance
- Down-gradient migration of potential leakage from tailings and waste rock storage facilities

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APPENDICES

Appendix A.

Geological Bibliography

Selected References on the Caballo–Copper Flat Area
and Adjacent Parts of the Palomas Basin and Rincon Valley,
Sierra and Doña Ana Counties, New Mexico

August 2012 Compilation by John W. Hawley, Ph.D., Senior Hydrogeologist,
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Appendix B.

Well Construction Diagrams

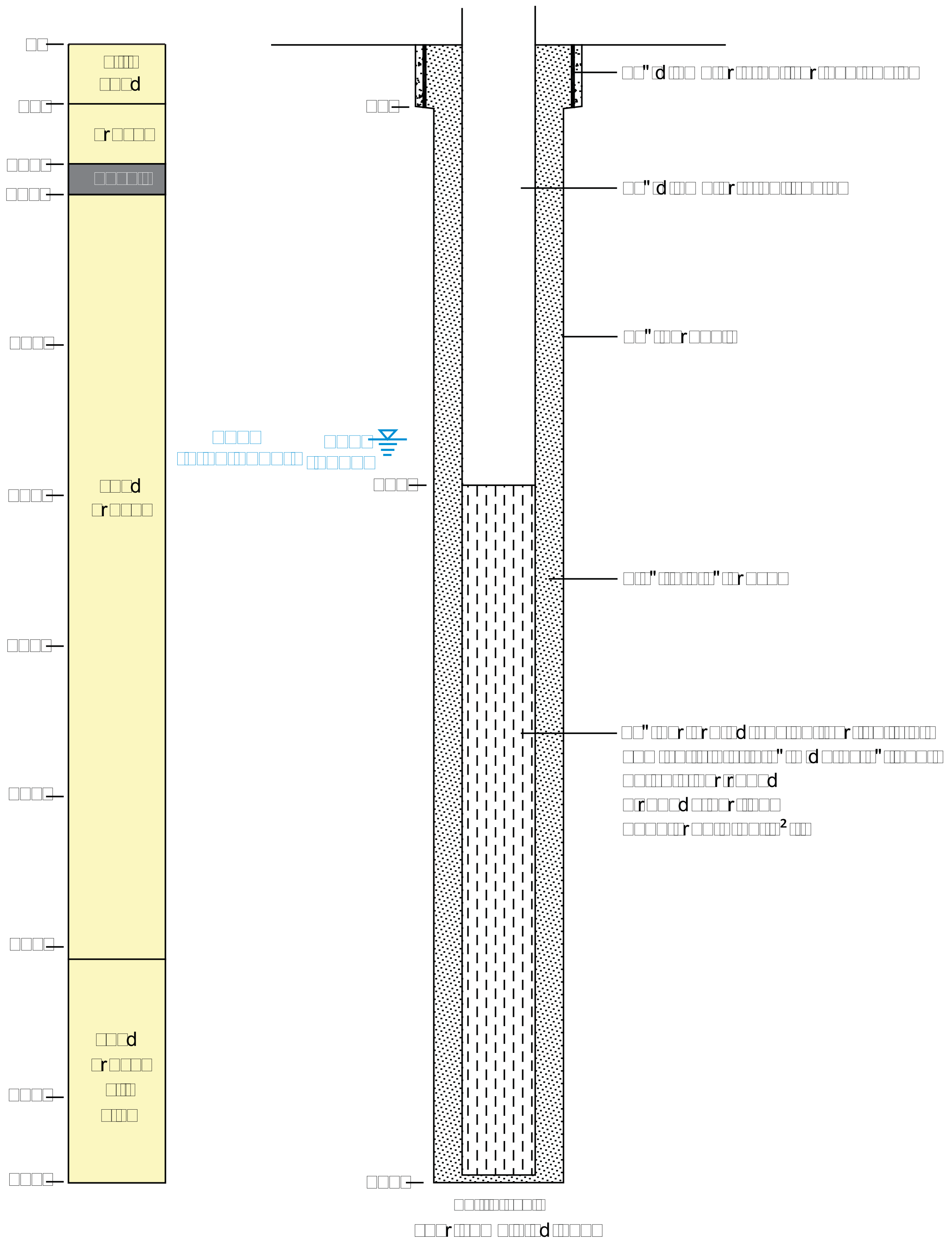

Figure B1. Well completion diagram for LRG-4652 (PW-1),
Copper Flat Mine, Sierra County, New Mexico.

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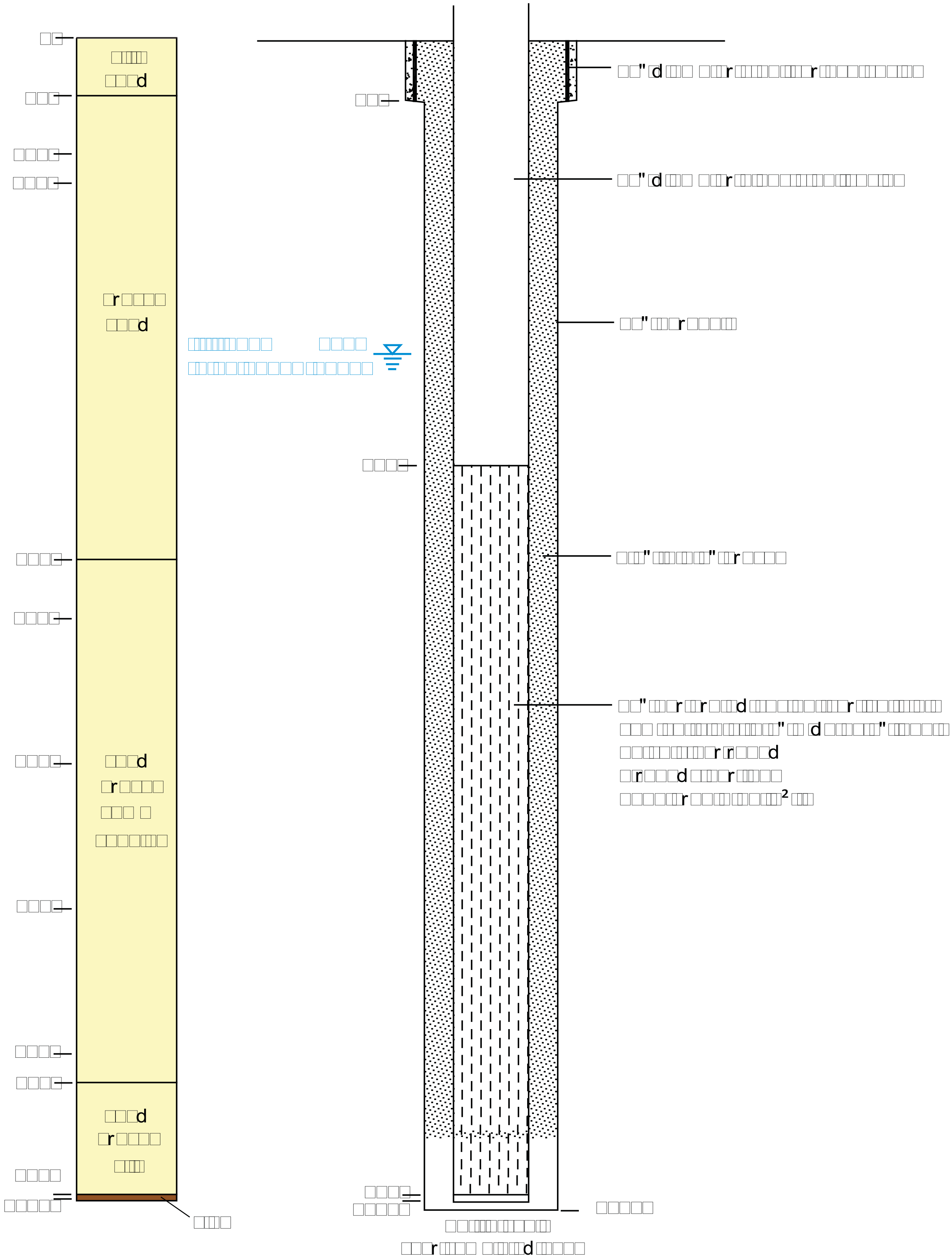

Figure B2. Well completion diagram for LRG-4652-S (PW-2), Copper Flat Mine, Sierra County, New Mexico.

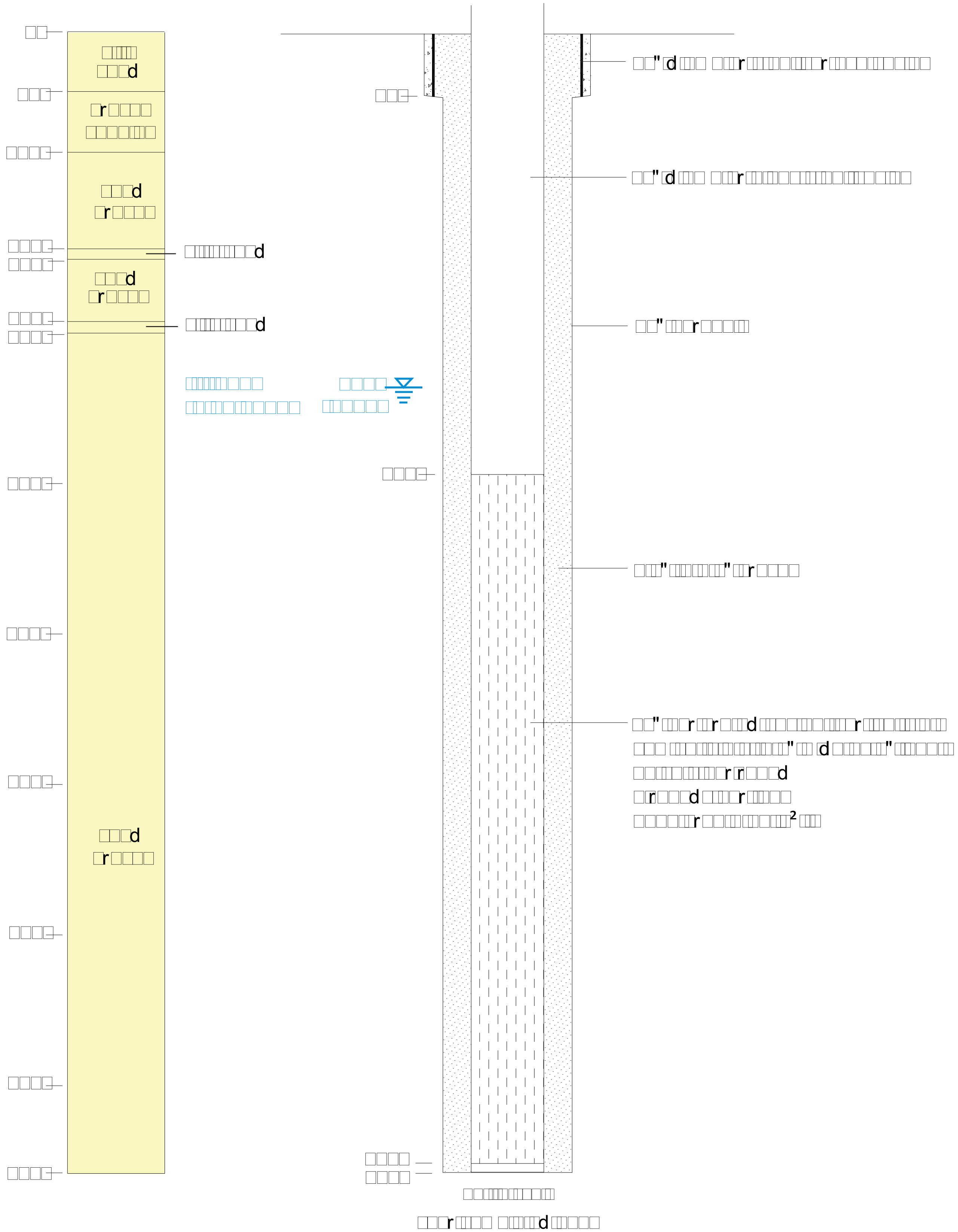

Figure B3. Well completion diagram for LRG-4652-S-2 (PW-3),
Copper Flat Mine, Sierra County, New Mexico.

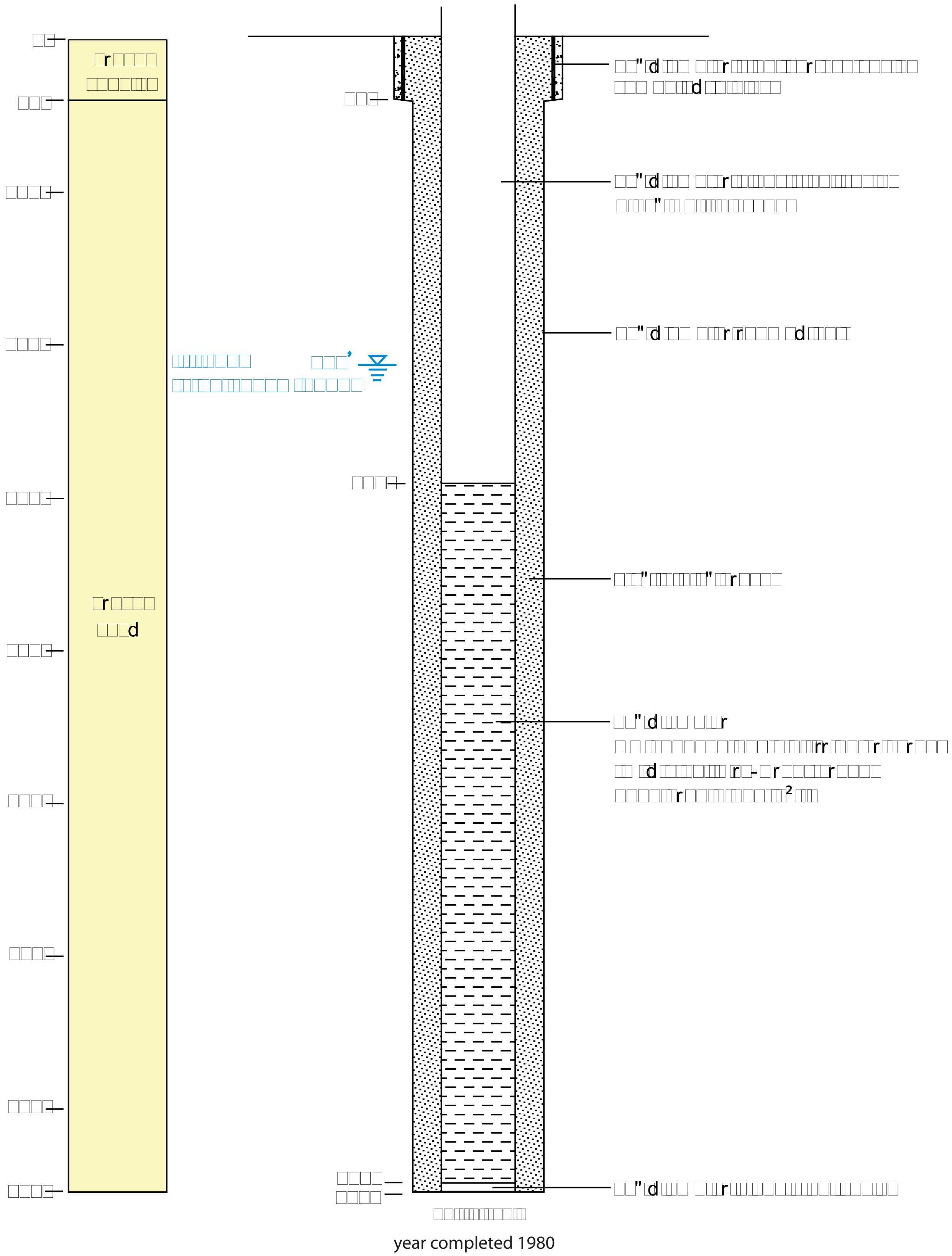

Figure B4. Well completion diagram for LRG-4652-S-3 (PW-4), Copper Flat Mine, Sierra County, New Mexico.

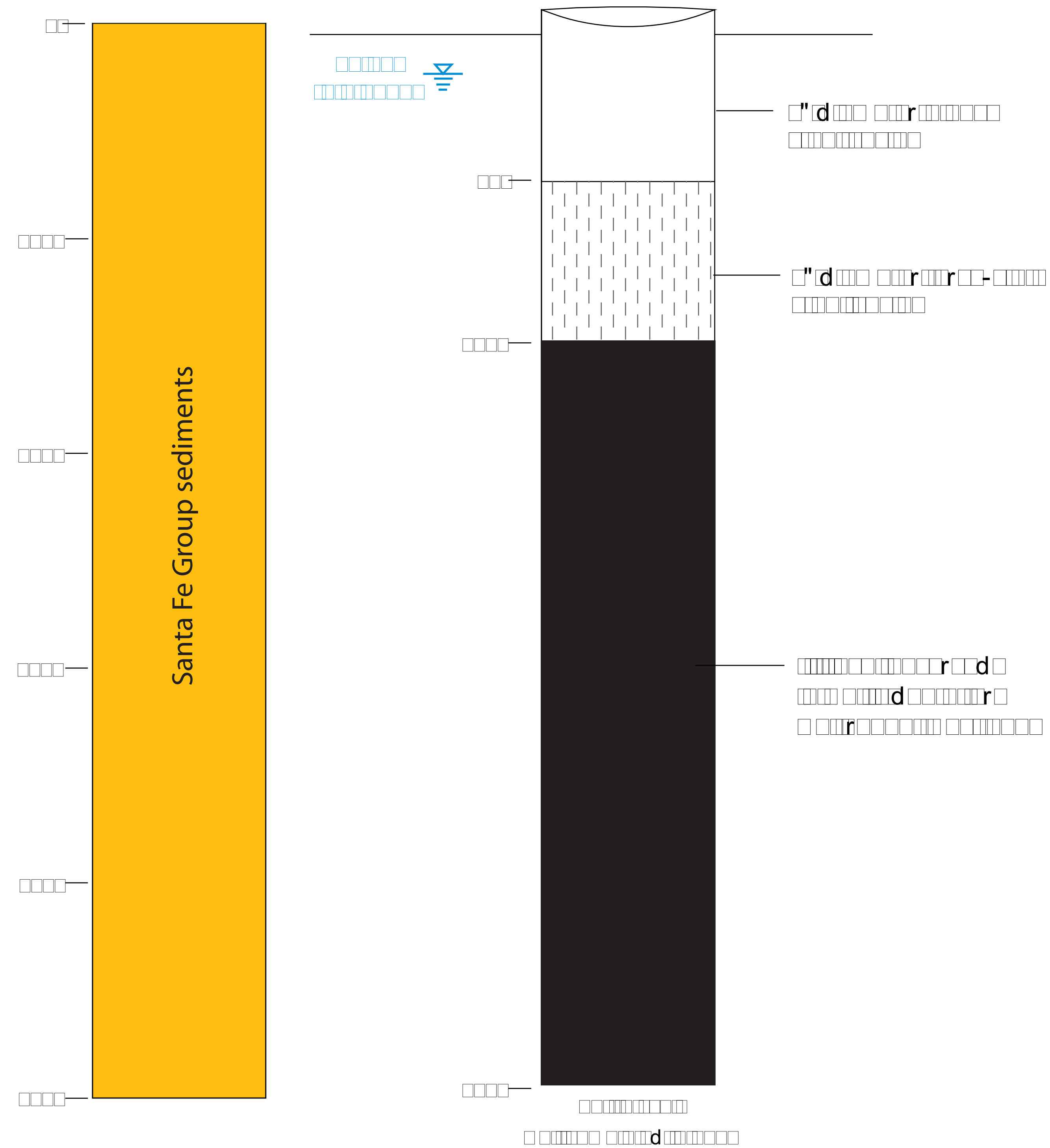

Figure B5. Well completion diagram for LRG-4652-S-4 (GWQ-8),
Copper Flat Mine, Sierra County, New Mexico.

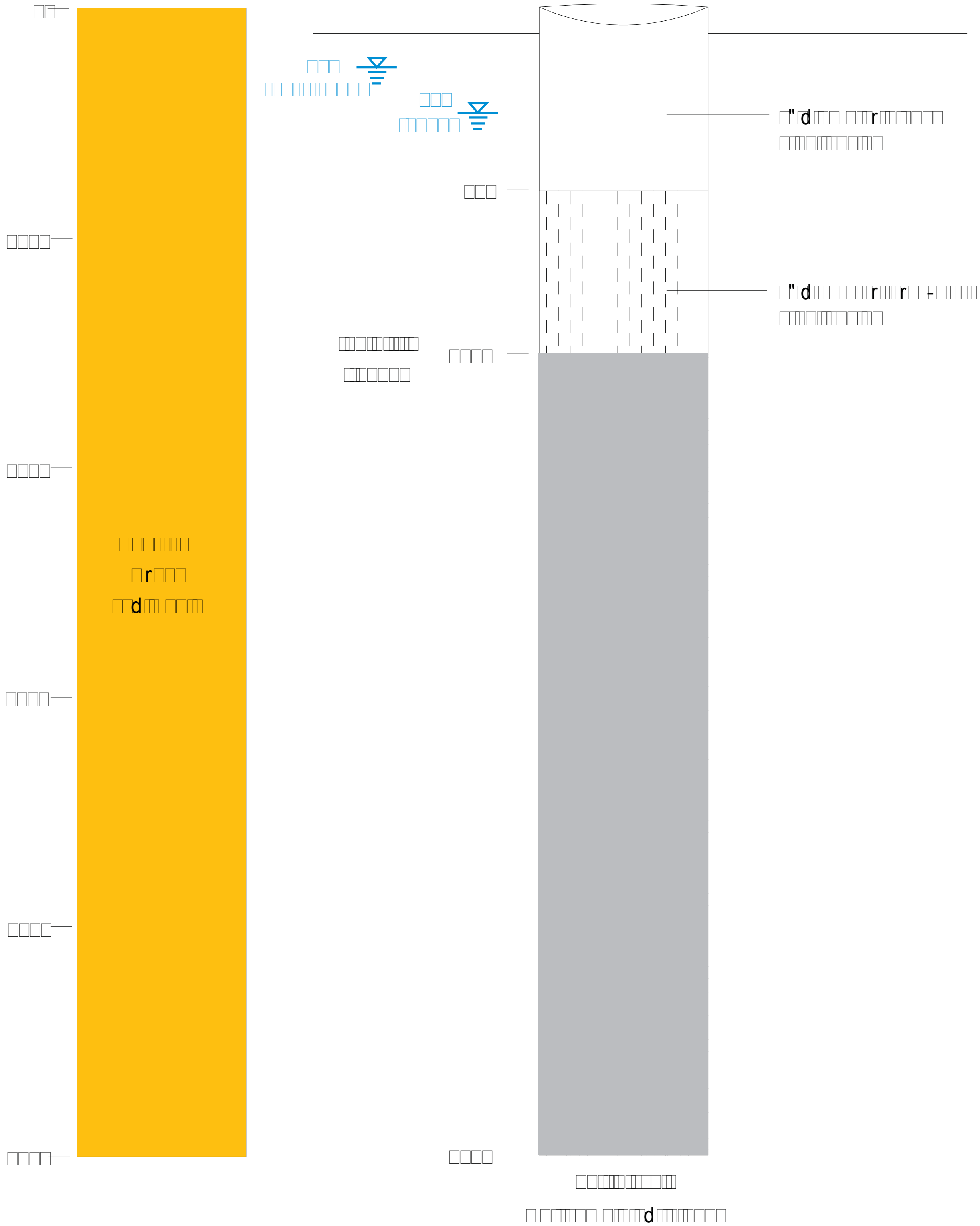

Figure B6. Well completion diagram for LRG-4652-S-5 (McCravery-Grayback), Copper Flat Mine, Sierra County, New Mexico.

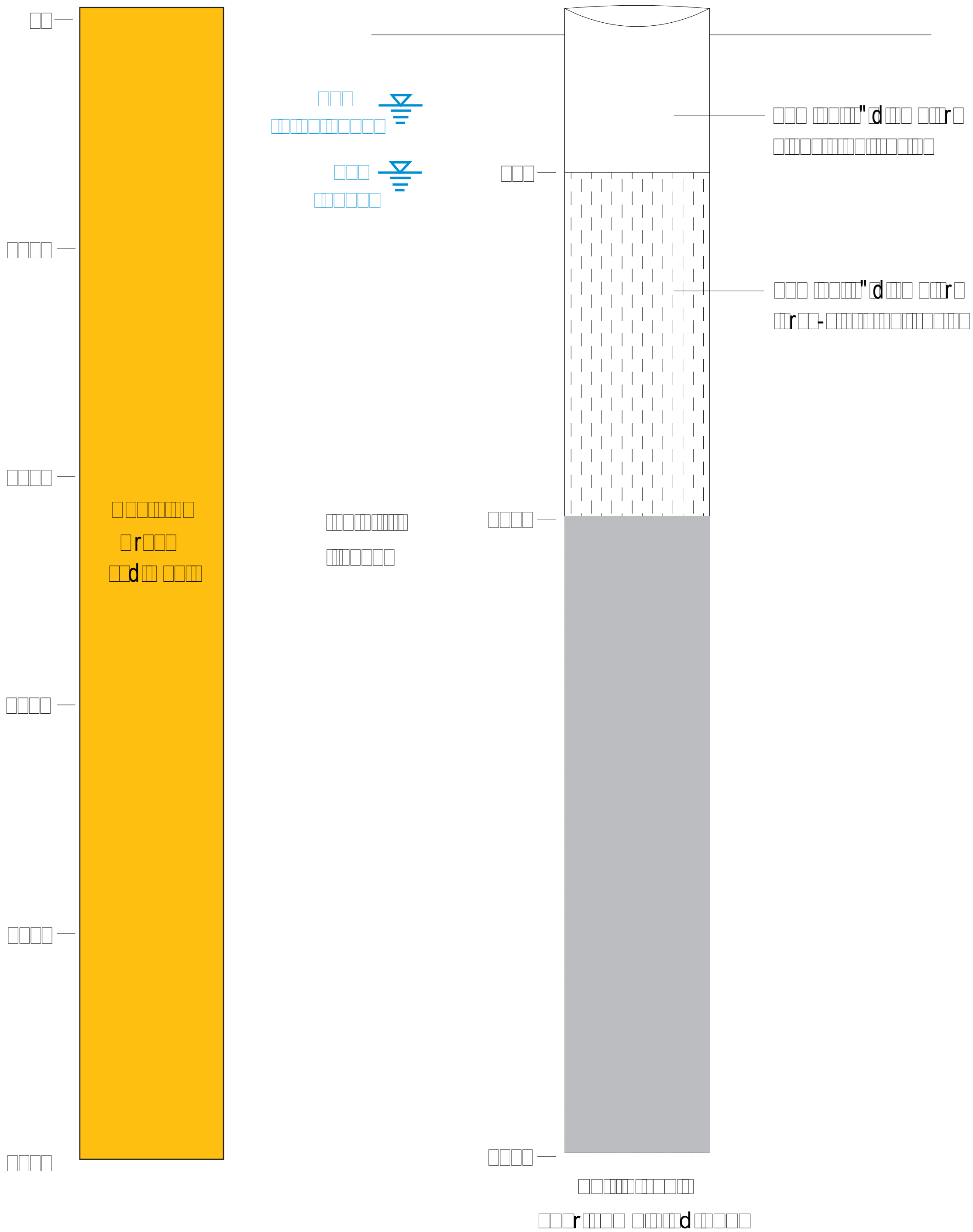

Figure B7. Well completion diagram for LRG-4652-S-6 (GWQ-2),
Copper Flat Mine, Sierra County, New Mexico.

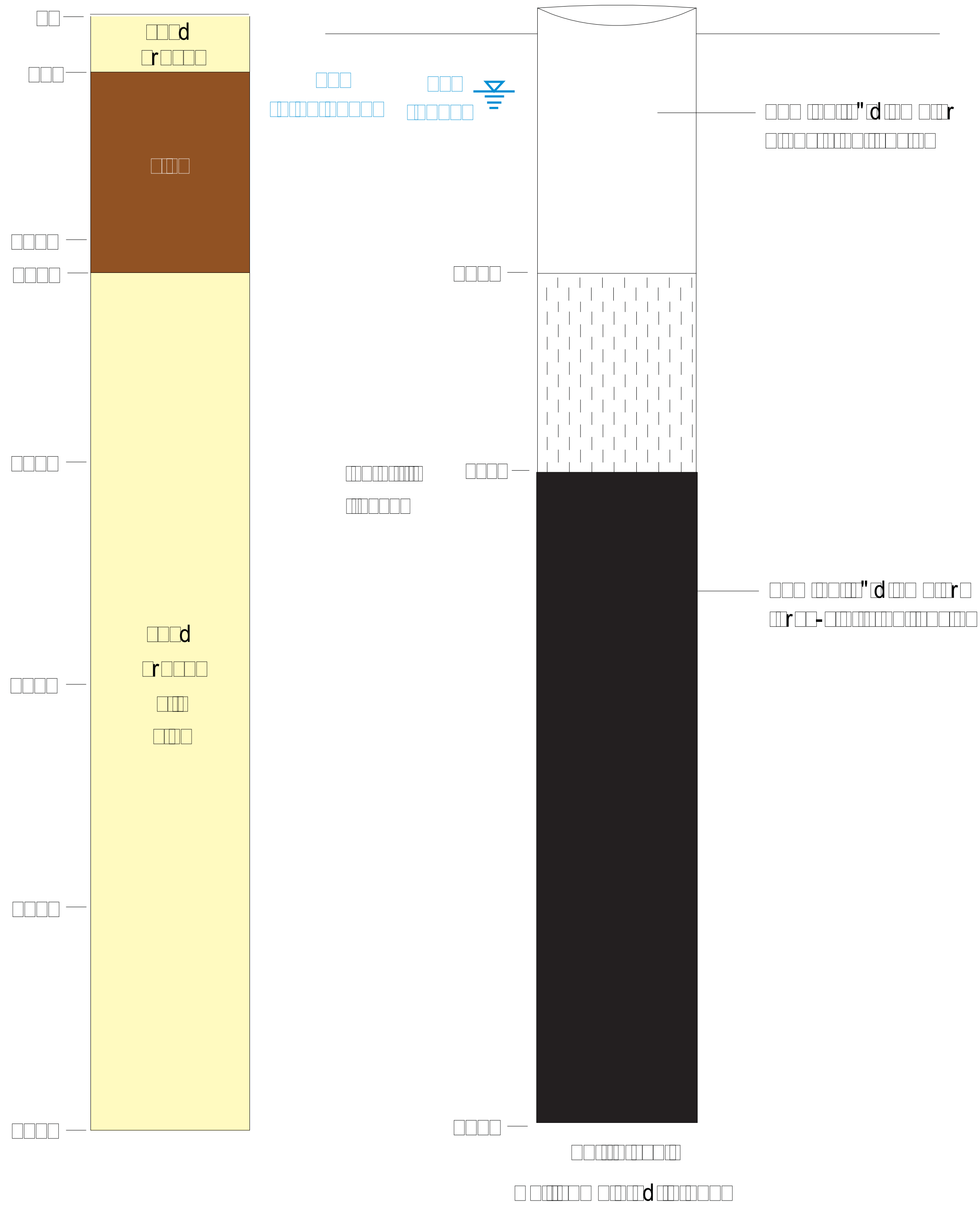

Figure B8. Well completion diagram for LRG-4652-S-7 (Irwin Well), Copper Flat Mine, Sierra County, New Mexico.

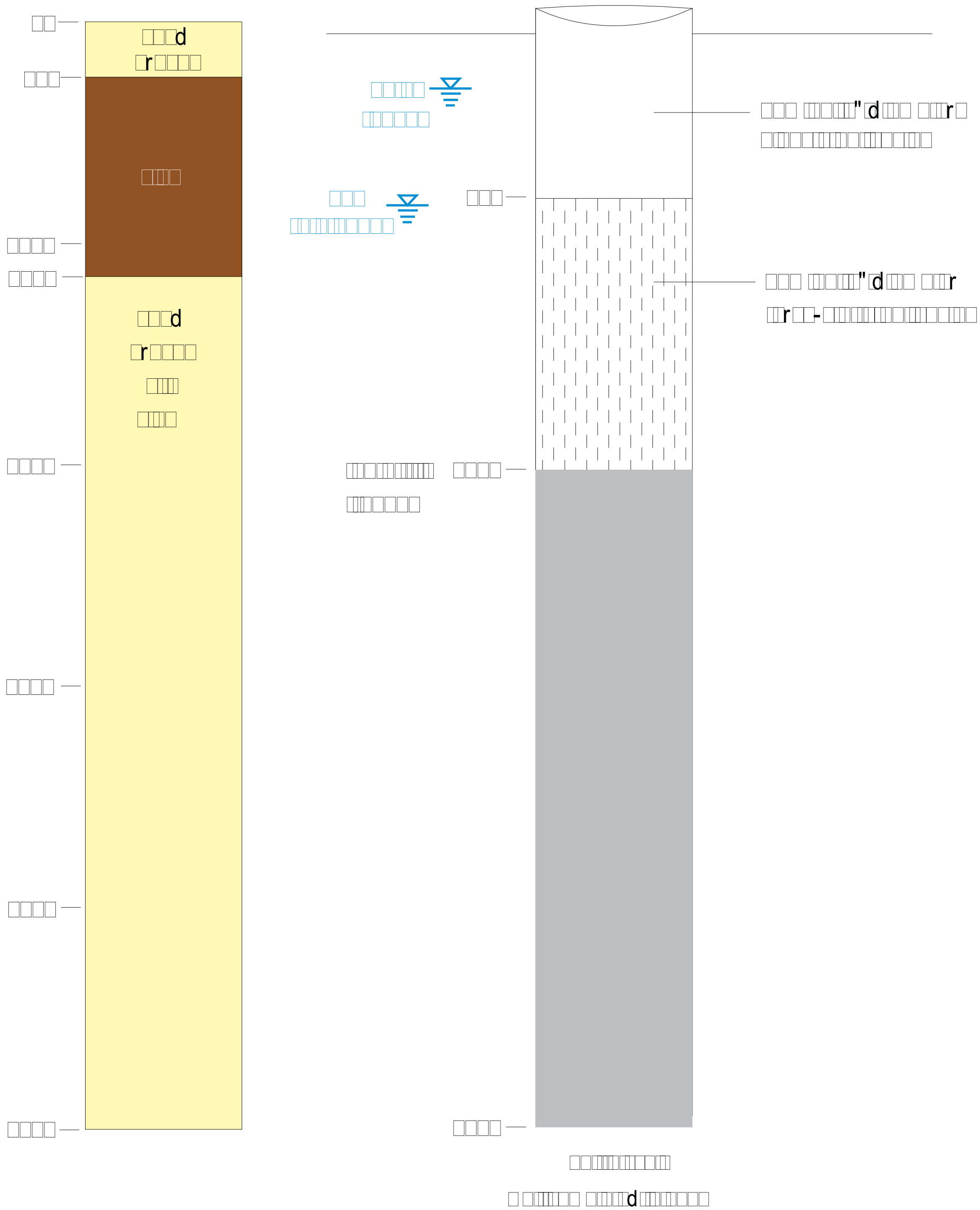

Figure B9. Well completion diagram for LRG-4652-S-8 (GWQ-7, Office Well), Copper Flat Mine, Sierra County, New Mexico.

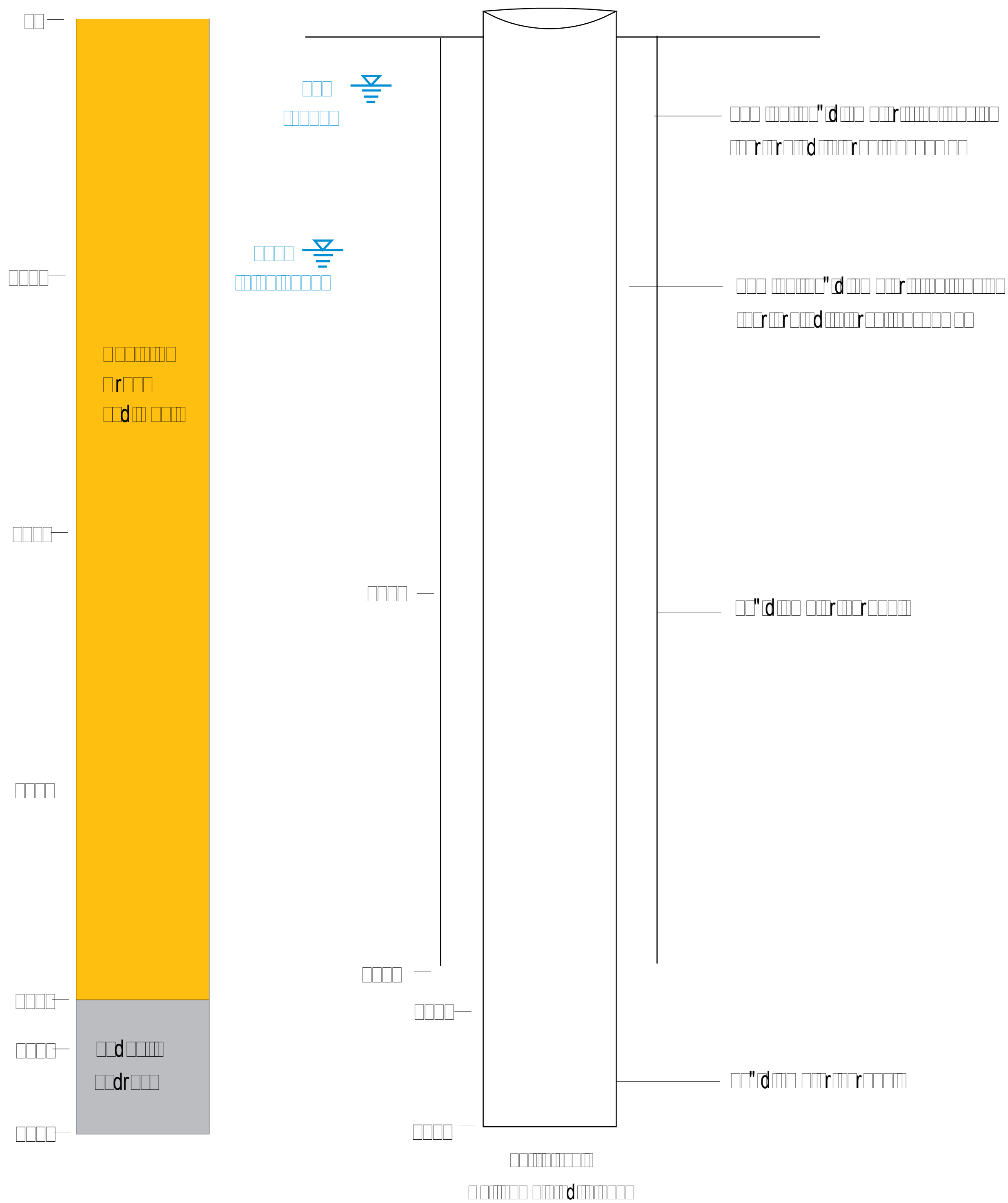

Figure B10. Well completion diagram for LRG-4652-S-9 (GWQ-9, South Inspiration, Well IDW-1), Copper Flat Mine, Sierra County, New Mexico.

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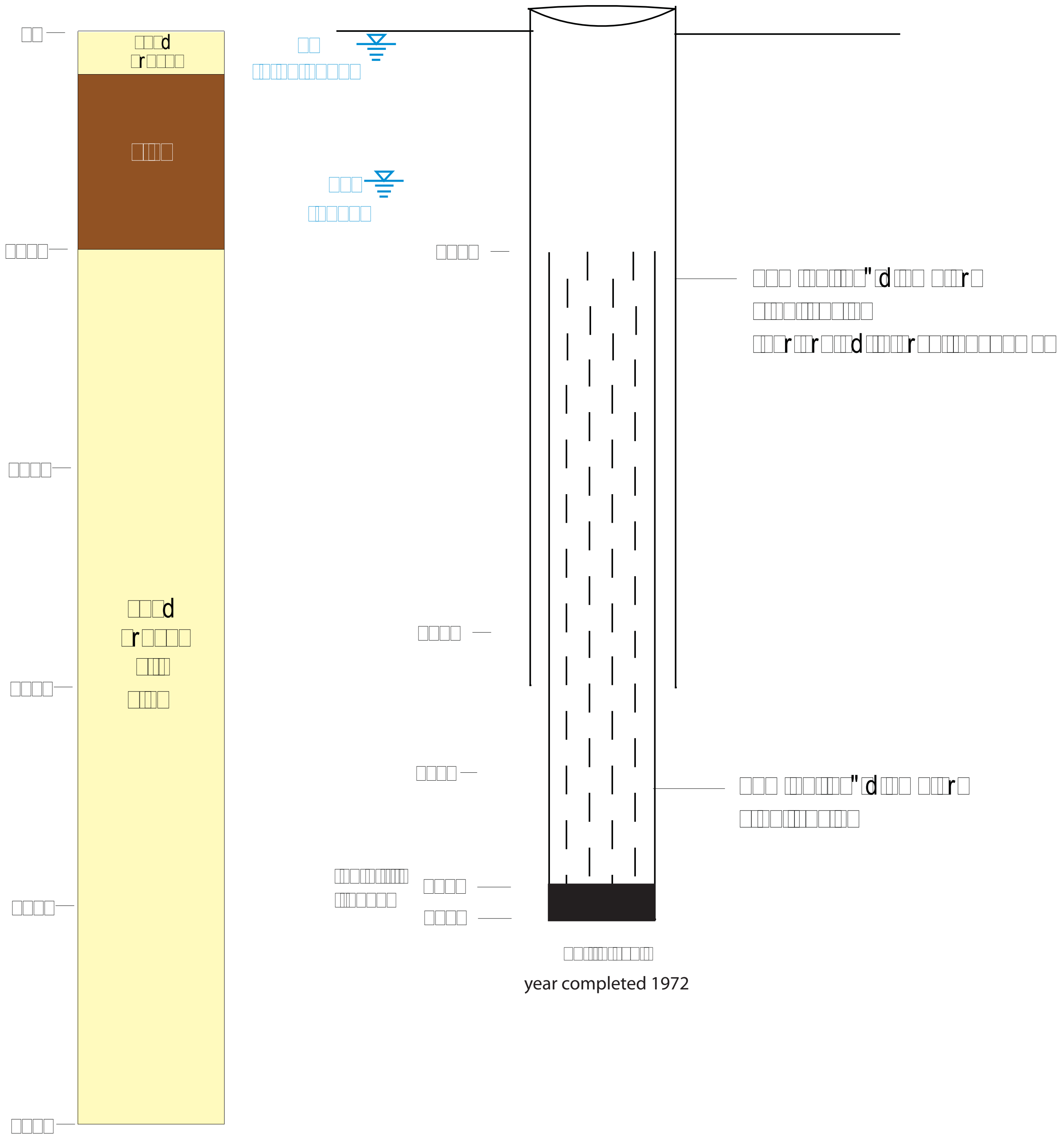

Figure B11. Well completion diagram for LRG-4652-S-10 (GWQ-1, North Inspiration, Well IDW-2, S-10), Copper Flat Mine, Sierra County, New Mexico.

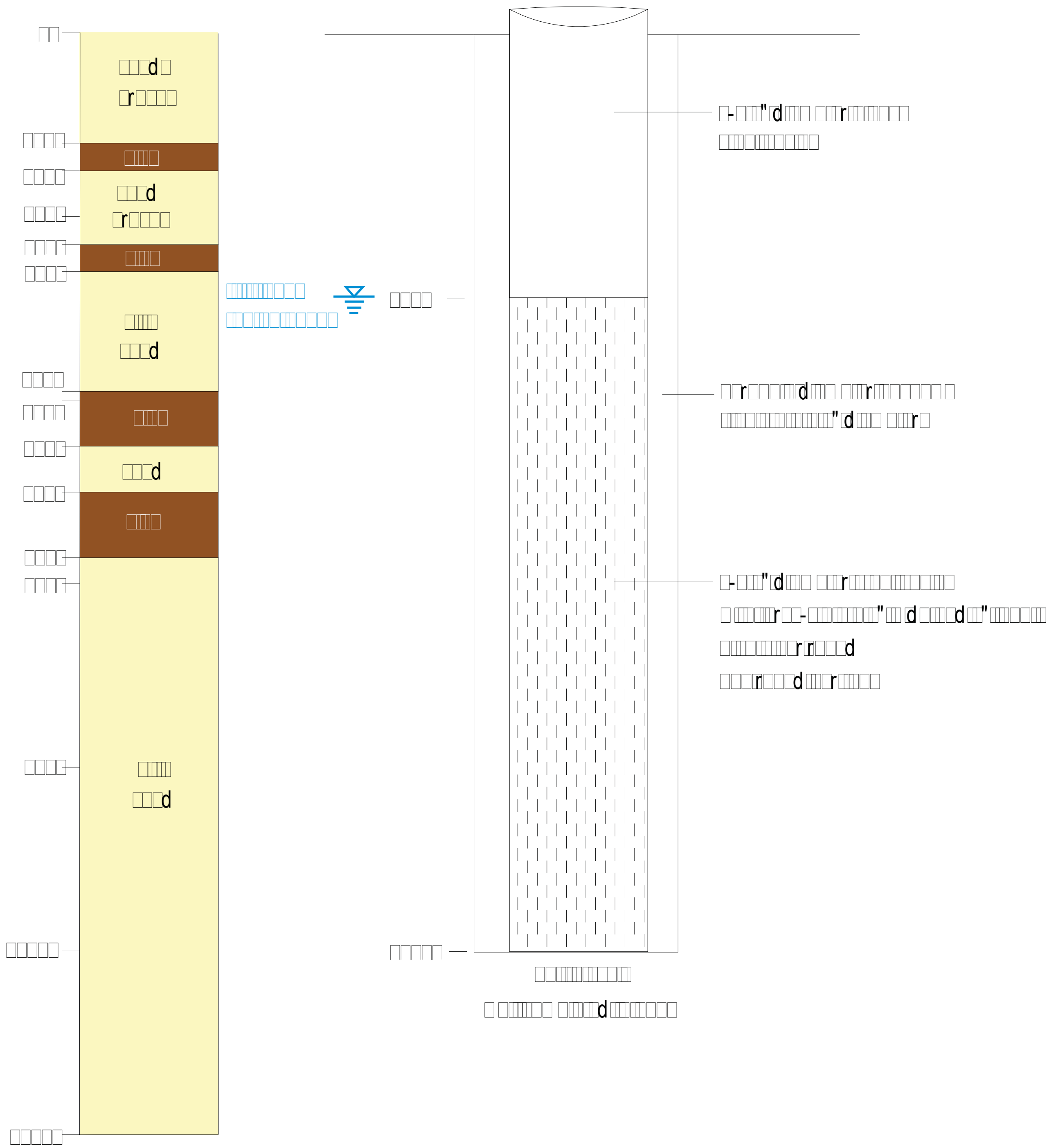

Figure B12. Well completion diagram for LRG-4652-S-11 (MW-1),
Copper Flat Mine, Sierra County, New Mexico.

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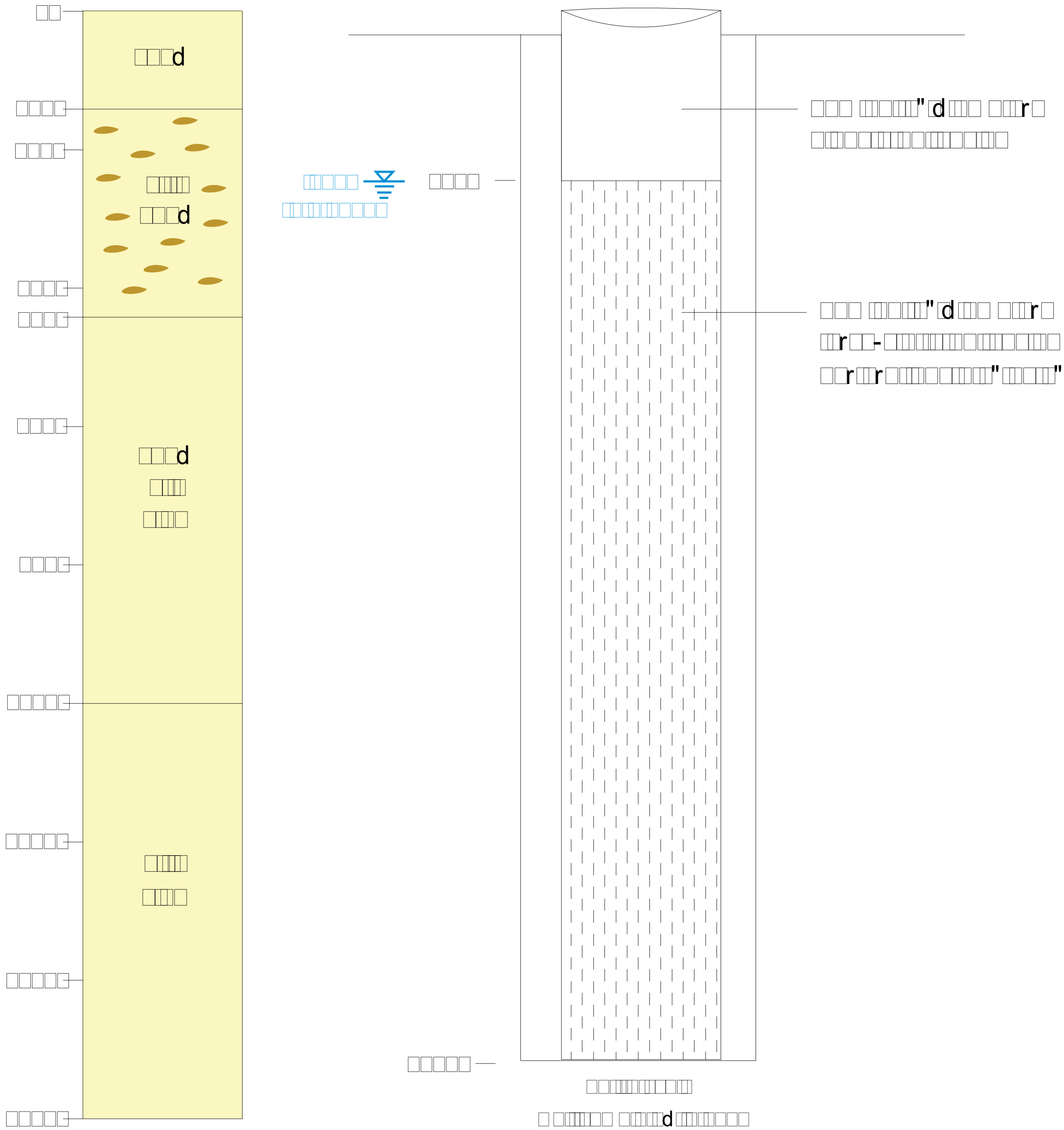

Figure B13. Well completion diagram for LRG-4652-S-12 (MW-2), Copper Flat Mine, Sierra County, New Mexico.

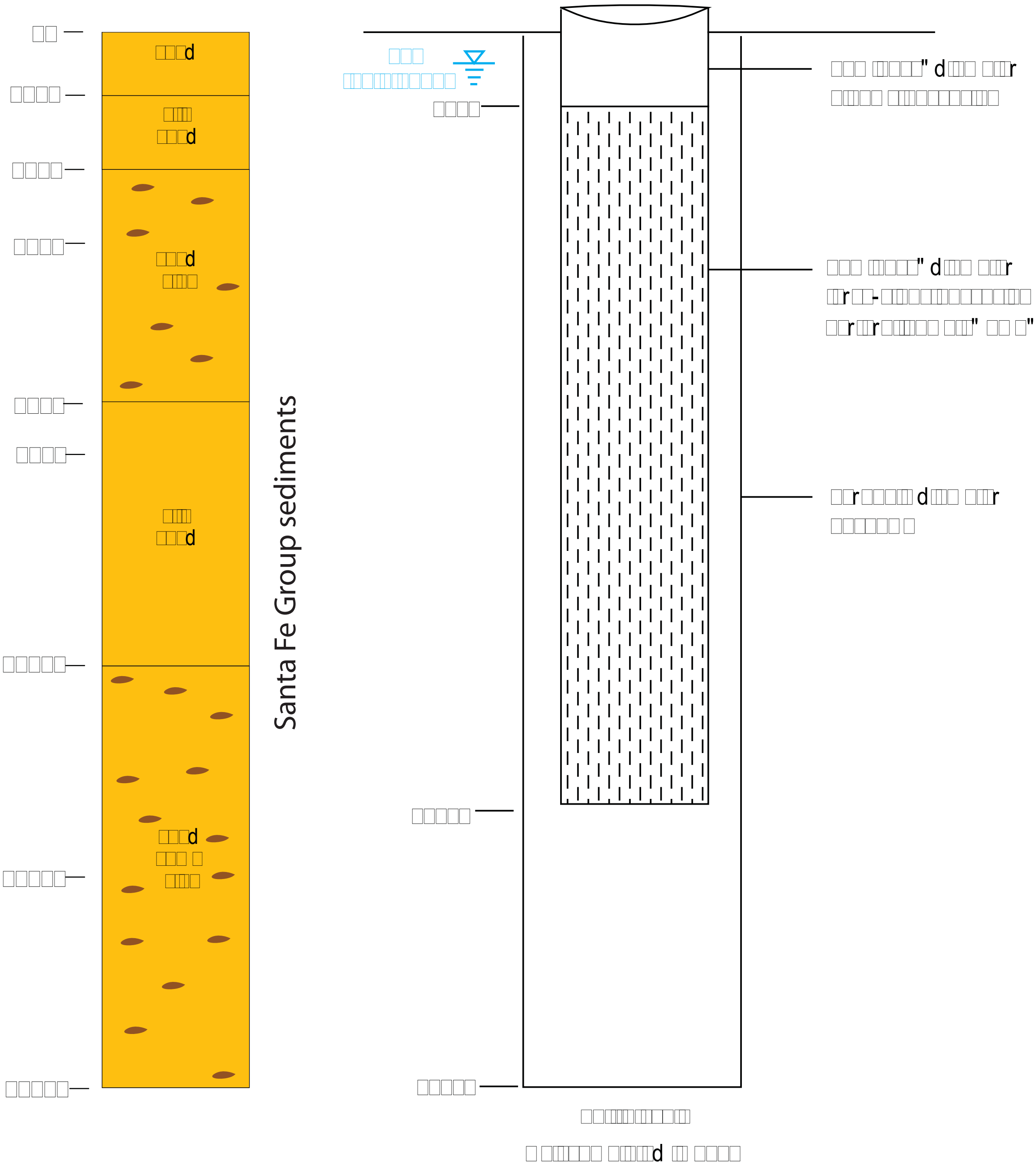

Figure B14. Well completion diagram for LRG-4652-S-13 (MW-4),
Copper Flat Mine, Sierra County, New Mexico.

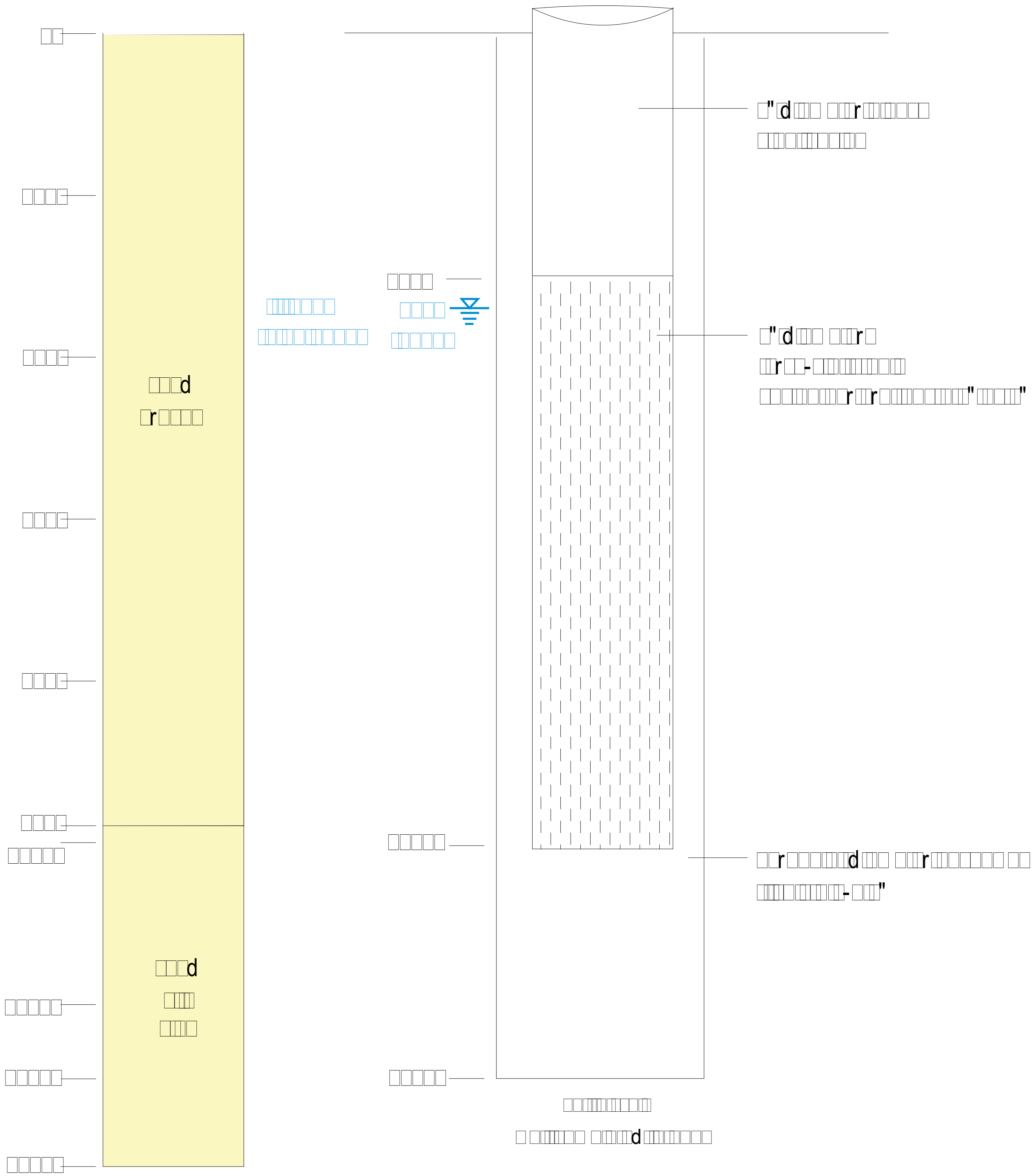

Figure B15. Well completion diagram for LRG-4652-S-14 (MW-5), Copper Flat Mine, Sierra County, New Mexico.

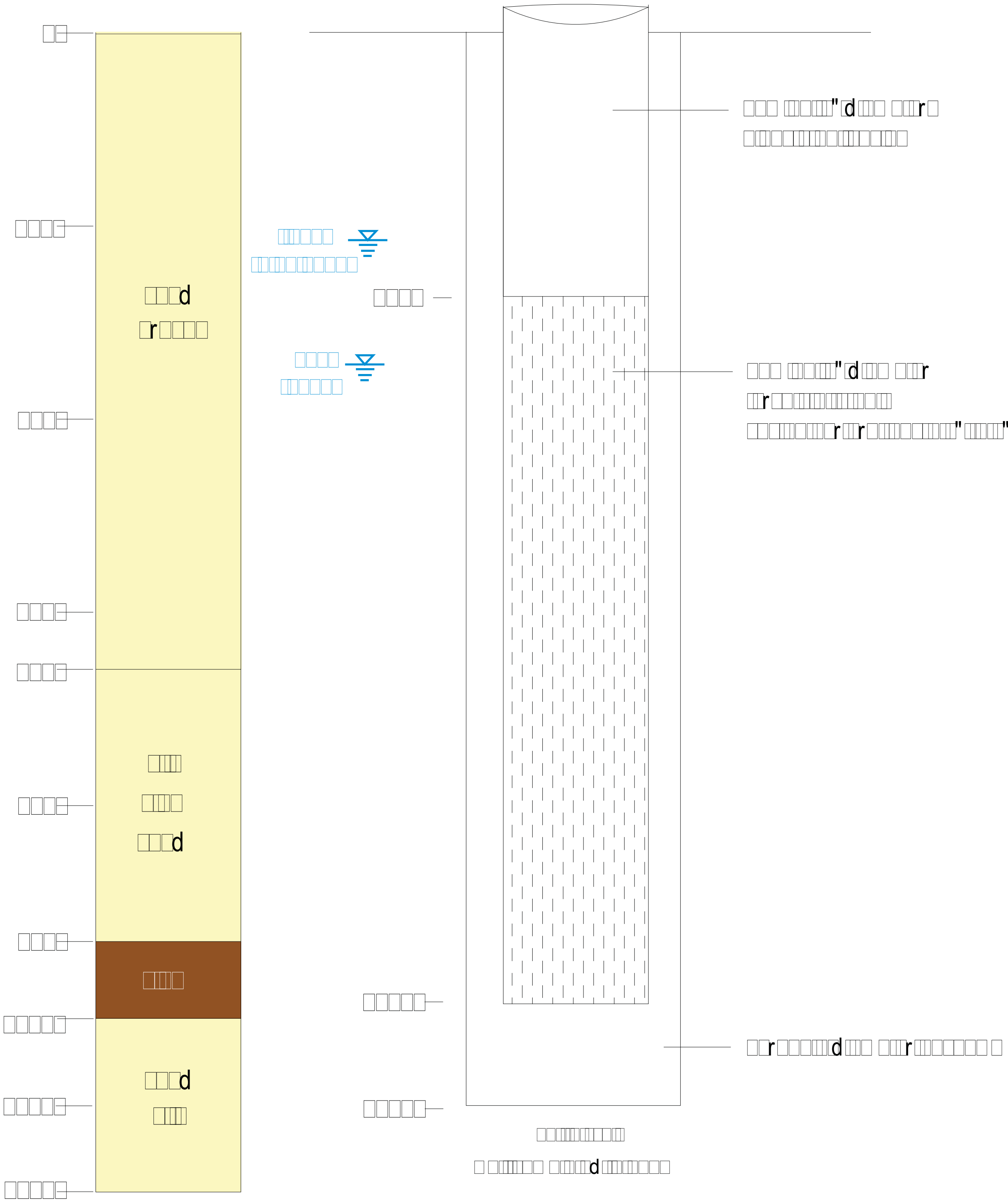

Figure B16. Well completion diagram for LRG-4652-S-15 (MW-6), Copper Flat Mine, Sierra County, New Mexico.

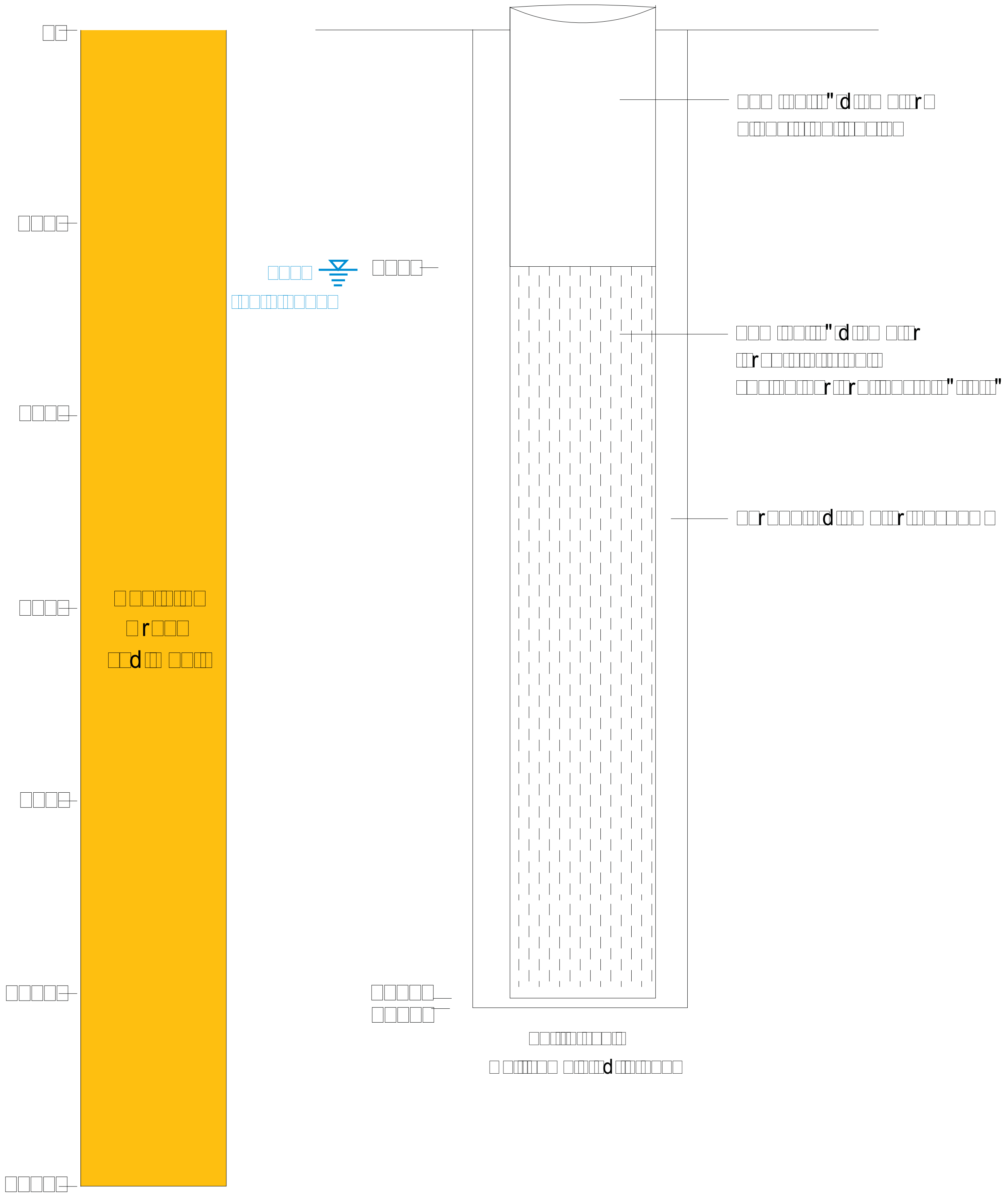

Figure B17. Well completion diagram for LRG-4652-S-16 (MW-8), Copper Flat Mine, Sierra County, New Mexico.

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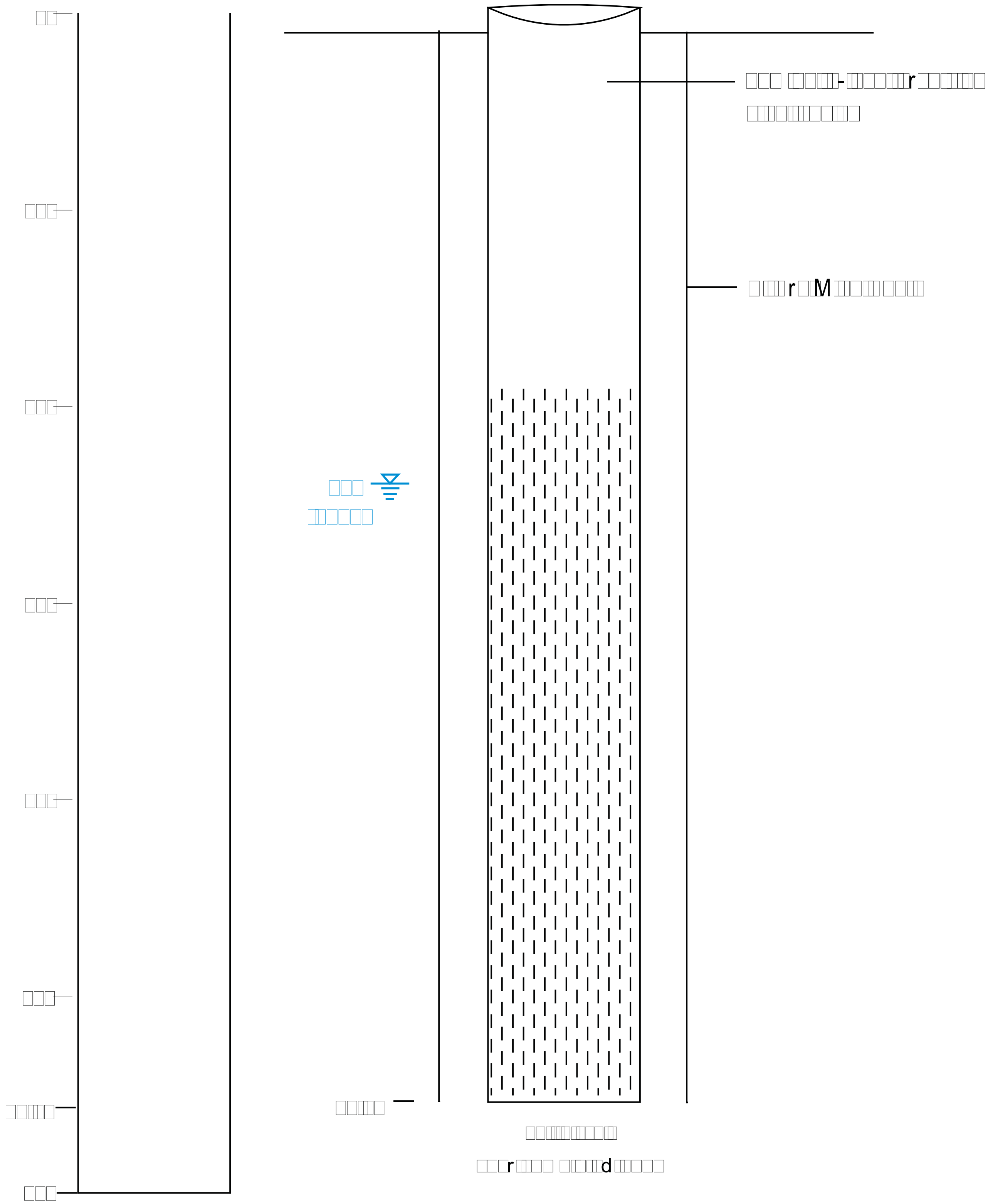

Figure B18. Well completion diagram for LRG-4654 (Old El Oro, Dolores), Copper Flat Mine, Sierra County, New Mexico.

Appendix C1.

Initial PW- Well Pumping Tests, 1975-1980

BD - 1

P.G.D - 1

NB - 1

MHM - 1

Water Development Corporation

CONSULTANTS IN WATER RESOURCES

RECEIVED FEB 19 1976 QUINTANA

3938 Santa Barbara Avenue
Tucson, Arizona 85711

Phone: 602-326-1133
Cable: WADEVCO, Tucson

February 17, 1976

W. E. S.
FEB 20 1976

Mr. W. E. Saegart , President
Quintana Minerals Corporation
2475 North Jack Rabbit Avenue
Tucson, Arizona 85705

Dear Bill:

The purpose of this letter is to give a brief summary of the test results for the three production wells drilled for Quintana's Copper Flat Project.

Production Well No. 1 was tested for 70 hours at 1,500 gpm. Initial static water level was 331.8 feet. The final pumping water level was 381.6 feet giving a drawdown of 49.8 feet and a specific capacity of 30.1 gpm per foot of drawdown. Water levels were measured in MW-5 during the test on Production Well No. 1. At the end of 70 hours of pumping the decline in MW-5 amounted to 9.10 feet.

Production Well No. 2 was tested for 72 hours at a discharge rate of 2,020 gpm. Static water level at the beginning of the test was 310.4 feet and the final pumping water level was 413.7 feet giving a drawdown of 103.3 feet and a specific capacity of 19.6 gpm per foot of drawdown. During the test on Production Well No. 2 water levels were measured in MW-5 and Production Well No. 1. During the 72 hours of pumping the decline in MW-5 amounted to 3.82 feet and the decline in Production Well No. 1 amounted to 4.93 feet.

Production Well No. 3 was tested at a rate of 1,500 gpm for 72 hours Initial static water level was 350.8 feet and the final pumping water level was 454.2 feet. Drawdown amounted to 103.4 feet giving a specific capacity of 14.5 gpm per foot of drawdown. Water levels were measured in MW-5, MW-6, and Production Wells 1 and 2 during the test on Production Well No. 3. After 72 hours of pumping the declines were 2.07 feet in Production Well No. 1, 1.46 feet in Production Well No. 2, 2.04 feet in MW-5, and 0.51 feet in MW-6. Prior to and during the early stage of the test water levels were rising in MW-6. As MW-6 had recently been used to supply water for drilling the data for MW-6 are not considered valid.

In terms of specific capacity, Production Well No. 1 is the best well and we consider that this well could be operated at a discharge in the range of 1,800 to 2,000 gpm if necessary. We could not test it at this rate due to pump limitations and for the subsequent tests a larger pump was installed. Well No. 2 is the next best well. At a discharge rate of 2,020 gpm entrained air was beginning to appear in this well and we consider that a more reasonable pumping rate for this well would be in the range of 1,600 to 1,800 gpm. Well No. 3 was producing considerable entrained air at 1,500 gpm and we recommend that, unless necessary, this well not be pumped at a rate in excess of 1,000 to 1,200 gpm. During development this well had a specific capacity of about 20 gpm per foot of drawdown at 1,000 gpm.

The source of entrained air encountered in Production Wells 2 and 3 is from cascading water coming through the perforations and falling to the pumping water level. The deeper the pumping water level is below the top of the perforations the greater the amount of entrained air. We anticipated that this would be a problem in all of the production wells but due to the excellent specific capacity of Production Well No. 1 there was no entrained air at a discharge rate of 1,500 gpm. With a higher discharge rate it is considered likely that some air will appear in the discharge of this well.

The only guaranteed way to eliminate all entrained air from a well discharge is to install blank casing to a depth greater than the anticipated pumping water level. Due to the lenticular nature of the water bearing materials and the indication from the geophysical logs that some of the more productive materials were the shallower sediments, this would result in a substantial reduction in discharge and specific capacity. Thus, if maximum quantity of water is desired, it becomes necessary to produce some entrained air also. By going to deep pump settings a portion of the entrained air can be forced out of the water before it reaches the pump intake.

We are presently preparing a basic-data report on the production wells and an interpretive report related to the effect of operating the well field for a sustained period of time using aquifer coefficients as calculated from the test data. Based on raw data from the well tests we consider at the present time that the existing well field has the following range of capacity:

62, 4

Production Well No. 1	1,800 gpm to 2,000 gpm
Production Well No. 2	1,600 gpm to 1,800 gpm
Production Well No. 3	1,000 gpm to 1,200 gpm
Total	4,400 gpm to 5,000 gpm

Upon completion of our calculations related to well interference and long-term operation of the well field it may be necessary to modify the above figures. The modification, if necessary, is not considered likely to be substantial. Final selection of pumps and rates at which to operate each well should be delayed until reasonably accurate figures for mill water requirements are available.

Sincerely yours,

Don

Donald K. Greene

DKG/cm

GPM x 60 x 24 x 60% = GPD

1 FT = 43,560 FT^2/ACRE x 7.5 GAL/FT^3

326,700 GAL/AC-FT.

6700 GPM x 60 x 24 x 60% x 3
3,112,912,000 GPY Allowed.
6467 AC-FT/YR.

2374

PW 1
PW 2
PW 3

WATER DEVELOPMENT CORPORATION

BASIC-DATA REPORT
QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT
PRODUCTION WELLS, HILLSBORO, NEW MEXICO

By
D. K. Greene and L. C. Halpenny

Tucson, Arizona
April 1976

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FIGURES

BASIC-DATA REPORT

QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT PRODUCTION WELLS
HILLSBORO, NEW MEXICO

By

D. K. Greene and L. C. Halpenny

GENERAL INFORMATION

A total of three production wells have been drilled to furnish the water supply for ore processing and other uses at the Copper Flat Project. Locations of the wells are shown on Figure 1 and legal descriptions are as follows:

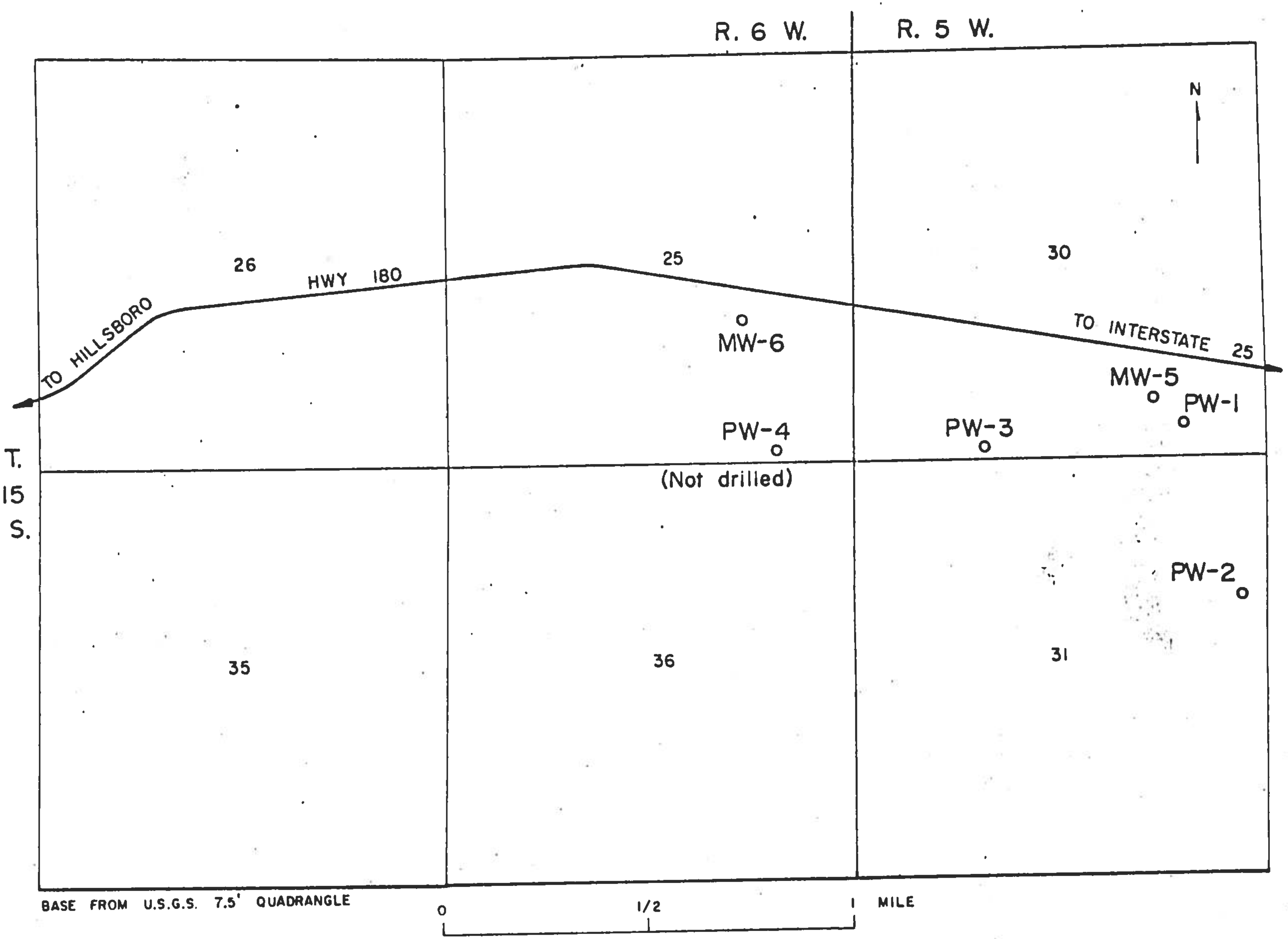

FIGURE 1.--MAP OF A PORTION OF TOWNSHIP 15 SOUTH, RANGES 5 AND 6 WEST, SIERRA COUNTY, NEW MEXICO, SHOWING LOCATIONS OF PRODUCTION WELLS AND MW-5 AND MW-6.

Production Well No. 1 (PW-1) SW$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 30, T. 15 S., R. 5 W.

Production Well No. 2 (PW-2) NE$\frac{1}{4}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 31, T. 15 S., R. 5 W.

Production Well No. 3 (PW-3) SW$\frac{1}{4}$ SE$\frac{1}{4}$ SW$\frac{1}{4}$, Sec. 30, T. 15 S., R. 5 W.

The well field is located approximately 7.5 miles east of the proposed concentrator site and it will be necessary to pipe water this distance.

The wells were drilled by B. C. & M. Drilling, Inc. of Mesa, Arizona using reverse air rotary equipment, during the period December 1975-January 1976. Prior to start of drilling 30 feet of 30-inch diameter, 5/16-inch wall thickness, surface pipe was installed and cemented in at each site using an auger rig. During this phase of work a site for a fourth production well (PW-4) (see Figure 1) was prepared. This site was not drilled.

The general procedure in constructing the production wells was to drill a 26-inch diameter hole in one pass, install a 16-inch, 5/16-inch wall thickness, blank and perforated casing assembly with centering guides approximately every 100 feet, gravel pack the annular space with 1/8 to 3/8-inch gravel, and develop the well with the drilling rig by jetting and washing with the compressor. The perforations were vertical saw-cut slots 1/8-inch wide by 3-inches long with 36 cuts per round and two rounds per foot. Total open area amounted to about 27 square inches per foot.

Details on depth drilled, casing installed, etc., for each of the three production wells are as follows:

Production Well No. 1

Depth drilled	960 feet
Casing installed	
Blank	0 to 368 feet
Perforated	368 to 951 feet
Gravel installed	109 yards
Rig development time	33.5 hours
Gravel slippage during rig development	41 feet

Production Well No. 2

Depth drilled	1,005 feet
Casing installed	
Blank	0 to 376 feet
Perforated	376 to 995 feet
Gravel installed	116 yards
Rig development time	28 hours
Gravel slippage during rig development	43 feet

Production Well No. 3

Depth drilled	970 feet
Casing installed	
Blank	0 to 380 feet
Perforated	380 to 965 feet
Gravel installed	116 yards
Rig development time	35.5 hours
Gravel slippage during rig development	17 feet

Following completion of rig development each well was further developed and then tested with a diesel powered turbine pump supplied by Western Pump and Supply Company of Deming, New Mexico. Data obtained during this phase of the investigation are included in the following sections of this report along with logs and water analyses for each production well.

Quintana Minerals Corporation

2475 NORTH JACK RABBIT AVENUE
TUCSON, ARIZONA 85705

602/622-4801

Bob Donegan
Property Manager

FILE MEMORANDUM

TO:	W. E. Saegart P. G. Dunn M. W. Hood	April 26, 1976 Hillsboro-Copper Flat Water Wells
FROM:	B. G. Donegan	

Following are corrected elevations for the water wells given by Gordon McLain in telephone conversation today:

	PW 1	4693
	PW 2	4670
	PW 3	4717
(Proposed)	PW 4	4745
	MW 5	4700

The above are based on QMC elevation datum.

Bob Donegan

Bob Donegan

BD/ln

Hillsboro - Water
Extra file copies

Water Development Corporation

CONSULTANTS IN WATER RESOURCES

3938 Santa Barbara Avenue
Tucson Arizona 85711

May 16, 1977

Phone 602-326-1133
Cable WADEVCO Tucson

Mr. W. F. Saegart - President
Quintana Minerals Corporation
2475 North Jack Rabbit Avenue
Tucson, Arizona 85705

Re: Copper Flat Project, effect of pumping from wells

Dear Mr. Saegart:

In reply to your request for our opinion on the hydrology of the area of the Copper Flat Project water well field and the effect of pumping for 15 years from that well field, we submit the following information as an addendum to the opinions given in our April 1976 report entitled "Report on development of ground-water supply for Quintana Minerals Corporation Copper Flat Project, Hillsboro, New Mexico":

Extent of Cone of Depression

The aquifer characteristics of the Santa Fe Formation in the vicinity of the well field were developed from extended pumping of Production Wells 1, 2, and 3, and in our opinion are as follows:

Coefficient of transmissivity:	100,000 gal/day/ft
Long-term coefficient of storage:	0.10 dimensionless

The aquifer is less permeable westward toward the mountain front, based on data from test holes drilled during the exploration phase of the water well-field development program. The change toward finer-grained materials westward is gradual. No sharp barrier was found. The mathemathics of evaluating behavior of aquifers are amenable to analysis when a "negative barrier" of impermeable bedrock, or partially permeable materials occurs in one direction or more from a center of well pumping. However, for a gradational change in one or more directions it is necessary to assume the change is abrupt and is at a specified distance from the center of pumping. For this well field we have assumed that at a distance of one mile west of the center of pumping there is an abrupt change in the coefficient of transmissivity from 100,000 gpd/ft on the east side of a north-south line to 20,000 gpd/ft on the west side. The method for evaluating the effect upon water levels in an aquifer of a complete or partial line barrier is to assume the existence of an "image well" at a site on a line from the center of pumping perpendicular across the barrier, at a distance from the center of pumping equal to twice the distance from the center of pumping to the barrier.

We have made calculations of the drawdowns in water level in the Santa Fe aquifer along a north-south line through the center of pumping. These calculations are based on withdrawal of water from the well field during the first year at 6,000 gpm and for the next 14 years at 2,000 gpm. The calculations include the effect of the partial negative barrier westward. The results of the calculations are as follows:

Distance From the Center of Pumping (ft)	Decline of Water Levels in the Santa Fe Formation	
	After 1 Year (ft)	After 15 Years (ft)
5,000	13.6	18.5
10,000	5.4	13.7
20,000	.3	7.6
30,000	--	4.5
40,000	--	2.6
50,000	--	1.4
60,000	--	.6
70,000	--	.3
100,000	--	--

Decline of water levels eastward from the center of pumping would be less than the preceding tabulated figures because the effects of the assumed barrier decrease eastward.

Source of Recharge for Santa Fe Aquifer

The data given in our 1976 report include sea-level elevations of the water table (p. 18) and a discussion of the various factors affecting the water levels as determined (p. 19-21). The gradient of the water table as indicated by the water levels discussed in the report is clearly downward from west to east toward the Rio Grande, flattening eastward from about 200 feet per mile near the mountain front, decreasing to about 100 feet per mile and then to about 10 feet per mile in the vicinity of the well field. The eastward down-gradient direction of the water table indicates that ground water in the Santa Fe Formation is moving eastward, which in turn indicates that the sources of ground-water recharge are to the west. The north-south alignment of the water table contours indicates that the recharge is fairly uniform and is not concentrated in one place. In the western United States, hydrologic investigations during the past half century have indicated that ground-water recharge from rain falling directly on the desert floors is not great but that runoff in desert washes and mountain-front recharge are the major factors in replenishing the ground-water supply. In our opinion, the sources of recharge for the Santa Fe aquifer in the vicinity of the well field are infiltration of runoff from desert flood flows in Greyback Arroyo, Greenhorn Arroyo, Las Animas Creek, and Percha Creek plus mountain-front recharge.

Effect Upon Water Levels Along Animas Creek

Our April 1976 report discusses the fact that water levels in wells in the valley of Animas Creek are shallower than water levels in deep wells in the Santa Fe Formation by about 80 to 150 feet (p. 21-22). We consider that, although Las Animas Creek is a source of recharge to the Santa Fe Formation aquifer system, the low vertical permeability in the upper part of the Santa Fe Formation slows down the vertical percolation and permits existence of a perched shallow water table in the permeable younger sediments of the ancestral Las Animas Creek.

When water is moving vertically downward underground, the hydraulic head that is a component of that movement is 100 percent, one foot per foot. The factor that controls the downward rate of movement is the permeability of the materials through which the water is moving. If the upper portion of the Santa Fe Formation were highly permeable, all water in the younger alluvium along Las Animas Wash would readily sink, leaving the Las Animas Creek sediments dry and causing a higher water level in the underlying Santa Fe deposits.

Because of the existence of this blanket of finer-grained sediments between the coarse materials underlying Las Animas Creek and the permeable facies of the Santa Fe Formation from which the well field will produce, a water-level decline of about 18 feet in the Santa Fe Formation beneath the axis of Las Animas Creek after 15 years of pumping is not likely to lower water levels in shallow wells tapping the younger Las Animas Creek shoestring aquifer. The vertical gradient cannot increase above 100 percent and that is the gradient now, based on the data collected during the investigation in 1975-1976.

The chapter on quality of water in our 1976 report indicated a difference in chemical character exists between the shallow ground water along Las Animas Creek and the deeper ground water in the Santa Fe Formation (p. 24 and 27, Fig. 10 on p. 26). This confirms our opinion that there is not a direct connection between ground water in the two aquifer systems.

Subsurface Channels Within Santa Fe Formation

Geological field work during the course of our investigation in 1975-1976 indicated the existence of a coarser facies within the uppermost part of the Santa Fe Formation along an axis roughly from north-northwest to south-southeast visible in the canyon walls of Las Animas Creek and Lower Percha Creek. The Quintana well field is situated within this zone. The uppermost visible coarse-grained portion of the formation is underlain by a finer-grained zone which in turn is underlain by a coarser zone. The Quintana wells produce from the lower coarse zone. It is not known whether the trend of this lower coarse zone also is northwest-southeast. We have found no geological nor hydrological evidence of an "underground stream" trending in any direction. Instead the data indicate the well field is situated in a more permeable zone within the Santa Fe Formation, with ground water movement from west to east.

Were there to exist an underground stream along an axis from north-northwest to south-southeast, with recharge from a source somewhere to the north-northwest, pumping from the well field would not affect water levels upgradient beyond about 13 miles as shown in the tabulation set forth in a preceding part of this letter.

Respectfully submitted,
Water Development Corporation

By ______________________
Leonard C. Halpenny, President

PRODUCTION WELL NO. 1
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	50				30%	60%	10%
50	70	40%	50%	10%			
70	90	Minor	70%-80%	20%-30%	Minor	Minor	Minor
90	110	60%	30%	10%			
110	140	Minor	40%	40%	10%	5%	5%
140	160	60%	30%	10%			
160	180	20%	70%	10%			
180	200		Minor	20%	30%	30%	20%
200	220	10%	50%	40%			
220	240		Minor	20%	30%	20%	30%
240	250		60%	30%	Minor	5%	5%
250	270			Minor	10%-20%	40%	40%-50%
270	290	20%	40%	35%	Minor	Minor	5%
290	300		Minor	20%	30%	20%	30%
300	340		60%	30%	Minor	5%	5%
340	360		Minor	20%	20%	30%	30%
360	620	Minor	40%-70%	10%-30%	Minor	5%-15%	5%-15%
620	640		5%	5%	20%	30%	40%
640	660		40%	40%	Minor	10%	10%-20%
660	670	30%	40%	20%			10%
670	760	20%	40%	20%	Minor	5%	15%
760	770		5%	5%	20%	30%	40%
770	790	20%	40%	20%	Minor	5%	15%
790	800		Minor	10%	20%	40%	30%
800	960		40%-60%	10%-30%	5%	5%	20%

Well cuttings 360-620 feet generally uniform with coarse material (0.5mm) 60%-90%.

A few peanut-sized gravel at 880-890 feet with less amount of fine material; marked increase of fine material at 910-920 feet.

PRODUCTION WELL NO. 1
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 m

PRODUCTION WELL NO. 1
DRILLERS LOG

Depth From (ft)	To	Sample Description
30	45	Fine silt.
45	50	Sand and silt.
50	55	Very hard rock.
55	90	Sand and rock.
90	105	Gravel and trace of clay.
105	115	Basalt, sand, little clay.
115	125	Basalt, sand.
125	135	Sand, clay, and some basalt.
135	155	Sand and rock.
155	165	Rock and some sand.
165	175	Small gravel and sand.
175	185	Clay with 5% sand.
185	195	Clay with 25% sand, some gravel.
195	206	Clay with gravel, 5% sand.
206	216	Gravel pediment with sand.
216	218	Clay.
218	222	Gravel pediment with 5% sand.
222	245	Clay.
245	255	Sand with cobbles, very hard.
255	265	Clay with 2% sand.
265	275	Sandy clay.
275	285	Sand and gravel.
285	295	Gravel and sand.
295	305	Sand and gravel with 80% clay.
305	315	Sand, gravel, and clay.
315	320	Gravel and clay.
320	325	Gravel, rock, and clay.
325	335	Basalt and rock.
335	340	Gravel and rock.
340	345	Clay and gravel.
345	355	Clay.
355	360	Clay and sand.
360	375	Sand and rock.
375	390	Sand, gravel, and clay.
390	406	Sand, rock, and clay.
406	415	Clay, sand, and gravel.
415	435	Sand and gravel.

PRODUCTION WELL NO. 1
DRILLERS LOG
(continued)

Depth From - To (ft)	Sample Description
435 - 445	Sand and some gravel.
445 - 469	Sand and little clay.
469 - 475	Sand and rock.
475 - 495	Pediment gravels, some sand.
495 - 505	Clay, 20% gravel.
505 - 525	Clay and gravel.
525 - 555	Sand and gravel.
555 - 565	Sand and 80% clay.
565 - 575	Sand, gravel, and some clay.
575 - 585	Sand and gravel.
585 - 590	Clay, sand, and gravel.
590 - 595	Sand and gravel.
595 - 605	Gravel and clay.
605 - 615	Clay, sand, and gravel.
615 - 620	Gravel and sand.
620 - 625	Sand.
625 - 630	Sand, gravel, 90% clay.
630 - 635	Clay.
635 - 645	Sand, 95% clay.
645 - 655	Sand, 35% clay.
655 - 665	Clay 50%, sand 50%.
665 - 675	Coarse sand 35%, gravel 35%, clay 30%.
675 - 685	Coarse sand, gravel.
685 - 709	Coarse sand 50%, gravel 20%, clay 30%.
709 - 715	Coarse sand 50%, gravel 10%, clay 40%.
715 - 725	Coarse sand 70%, gravel 20%, clay 10%
725 - 765	Gravel, clay, and sand.
765 - 785	Clay and gravel.
785 - 797	Sand, gravel, and clay.
797 - 805	Clay, sand, and gravel.
805 - 815	Sand 75%, gravel 10%, clay 15%.
815 - 835	Sand, gravel, and clay.
835 - 845	Sand 80%, gravel 15%, clay 5%.
845 - 850	Sand, clay, and gravel.
850 - 858	Sand and clay.
858 - 860	Clay and sand.
860 - 875	Sand.
875 - 888	Sand, some clay.

PRODUCTION WELL NO. 1
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
888	895	Sand, gravel, and clay.
895	905	Sand and clay.
905	917	Sand and gravel.
917	935	Clay 85%, gravel 5%, sand 10%.
935	947	Clay, gravel, and sand.
947	960	Clay, sand, and gravel.

PRODUCTION WELL NO. 1

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	09:48	329.3		Measuring with sounder. Measuring point top of 3/4-inch tube 1.65 feet above top of surface pipe. Surface pipe approximately 0.2 feet above land surface.
	10:00			Pump on. Eight-inch pump with bowls set at 550 feet. Discharge pipe 10-inch, orifice 6-inch.
	10:01	357.9		Decreasing RPM.
	10:02	348.9	370	Muddy, silty.
	10:03	345.3	395	
	10:04	344.4	370	Trace of sand.
	10:12	346.3	395	Clearing some.
	10:13			Increased RPM.
	10:14	350.0	500	
	10:15	350.6	500	Some mud, silt, trace of sand.
	10:20	352.1	500	
	10:27	352.4	500	
	10:44	353.1	500	Clearing.
	10:55			Surge.
	10:58			Lowering impellers.
	11:00			Pump on.
	11:05	350.3	500	Some color.
	11:12			Fairly clear, surge twice.
	11:18		760	Muddy, silty, no sand.
	11:19	358.8		
	11:25	360.8	760	Considerable color, silty.
	11:40	362.3	773	Clearing.
	11:45			T = 76° F, K = 350 micromhos.
	11:50	362.7	773	Fairly clear, surge twice.
	11:56			Silty.
	11:58		760	Clearing.
	12:00	356.9	760	

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	12:15	358.7	760	Fairly clear.
	12:22	359.0	760	T = 76° F, K = 340+ micromhos.
	12:23			Surge twice.
	12:30			Little mud and silt.
	12:33			Clearing.
	12:35	355.9	760	Fairly clear.
	12:40			Surge twice.
	12:47			Some color, no sand.
	12:50			Clearing.
	13:19	356.7	760	Surge twice.
	14:07	356 2	760	Clear, surge twice.
	14:15			Little color.
	14:18	353.1	760	Clear.
	14:20			Surge, change to 8-inch orifice.
	14:27			Pump on.
	14:29			Some color, no sand.
	14:30	358.4	1,040	
	14:35	361.6		
	14:52	363.7	1,060	Slight color.
	14:58	364.2	1,060	Surge.
	15:05			Fair amount of color, silt, no sand.
	15:08			Clearing.
	15:10	362.1	1,040	T = 76° F, K = 350 micromhos.
	15:30	363.8	1,050	Surge.
	15:35			Fair amount of color, silt.
	15:40			Clearing.
	15:58	361.8	1,030	Clear, surge twice.
	16:03			Some color, silt.
	16:28	363.5	1,060	Clear, surge twice.
	16:33			Some color, silt.
	16:37			Clearing.
	17:00	362.8	1,050	

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-18-75	17:05	378.6	1,500	Some color, no sand.
	17:10			Considerable color, silt.
	17:13	382.5	1,471	Lot of color, silt, <0.1 cc/l sand.
	17:19	382.2	1,438	
	17:28	382.6	1,421	
	17:38	382.5	1,404	Surge.
	17:45			Some color, silt.
	18:00	387.0	1,500	Surge twice.
	18:30		1,500	Surge.
	19:00		1,500	Surge.
	19:30		1,500	Surge.
	19:50	386.0	1,500	
	20:10			Surge twice.
	20:15		1,500	Some color.
	20:38	385.1	1,500	Clear, surge.
	21:07	383.6	1,493	Clear, surge twice.
	21:12			Some color, no sand.
	21:38	382.0	1,486	T = 76^{o}F, K = 340 micromhos, clear, surge twice.
	21:45			Some color.
	22:20	381.2	1,493	Clear, surge twice.
	22:25			Some color.
	23:04	381.2	1,507	Clear, surge twice.
	23:10			Some color, silt.
	23:35	379.9	1,500	Clear, surge twice.
	23:40			Some color.
12-19-75	00:05	378.9	1,493	Clear, surge twice.
	00:10			Little color.
	00:30	378.4	1,493	Clear, surge twice.
	00:34	375.1	1,500	
	00:55	378.9	1,500	Clear, surge twice.
	01:05	375.7	1,500	Clear.
	01:40	378.6	1,500	Clear, surge twice.
	02:10	377.8	1,500	Clear, surge twice.

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-19-75	02:40	377.4	1,493	Clear, surge twice.
	03:10	377.0	1,500	Clear, surge twice.
	03:40	376.6	1,486	Clear, surge twice.
	04:10	376.3	1,493	Clear, surge twice.
	04:45	376.3	1,500	Clear, surge twice.
	05:15	375.7	1,493	Clear, surge twice.
	05:45	376.1	1.500	Clear, surge twice.
	06:15	376.6	1,500	Clear, surge twice.
	06:45	376.6	1,500	Clear, surge twice.
	07:00	377.0	1,500	Clear, surge twice.
	07:05			Very little color.
	07:30	376.0	1,493	Clear.
	07:35			T = 76° F, K = 340 microm-hos.
	08:28	376.0	1,500	Clear.
	08:29			Increase RPM.
	08:30	380.9	1,641	
	08:32			Some color.
	08:33			Clearing.
	08:45	382.1	1,641	Clear, surge.
	08:50			Some color, then clear.
	09:00	381.5	1,634	Clear.
	09:15	381.9	1,634	Clear.
	09:18			T = 76° F, K = 340 microm-hos.
	09:30	382.2	1,627	
	09:50	382.5	1,627	Clear.
	10:00			Pump off.
	10:01	338.4		
	10:02	338.1		
	10:03	339.8		
	10:04	339.3		
	10:05	338.6		
	10:06	338.3		
	10:07	337.8		

PRODUCTION WELL NO. 1

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-19-75	10:08	337.5		
	10:09	337.2		
	10:10	336.8		
	10:15	335.7		
	10:20	335.0		
	10:30	334.1		
	10:38	333.4		
	12:09	330.4		
	13:18	329.8		
	14:03	329.5		
	15:40	329.1		
	15:47	332.77		Measured with chain.

PRODUCTION WELL NO. 1

TEST DATA

cofpw1.wk1

time (min) C6..c98
WL d6..d98
MW-5 WL e6..e98

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-20-75	08:00	331.82		Measured with chain. Same measuring point as for development.
	09:22	331.82		Measured with chain.
	09:32	331.8		Set sounder at 331.8.
	11:00	331.8 −1.85 = 330.0 GL		Pump on. Same setting as for development.
	11:01	360.8	1,500	
	11:02	363.5	1,500	
	11:03	365.9	1,500	
	11:04	367.2	1,500	
	11:05	367.9	1,500	
	11:06	368.5	1,500	Clear.
	11:07	369.2	1,500	
	11:08	369.7	1,500	
	11:09	370.1	1,500	
	11:10	370.2	1,500	
	11:12	370.8	1,500	
	11:14	371.1	1,500	
	11:16	371.4	1,500	
	11:18	371.8	1,500	
	11:20	372.0	1,500	
	11:25	372.6	1,500	
	11:30	373.3	1,500	
	11:35	373.7	1,500	
	11:40	374.1	1,500	
	11:50	374.7	1,500	
	12:00	375.0	1,500	
	12:15	375.5	1,500	
	12:30	376.0	1,500	
	12:45	376.3	1,500	
	13:00	376.7	1,500	
	13:30	377.4	1,500	
	14:00	377.6	1,500	
	15:00	378.2	1,500	

PRODUCTION WELL NO. 1

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-20-75	16:00	378.6	1,500	Clear.
	17:00	379.2	1,500	
	18:00	379.3	1,500	
	19:00	379.6	1,500	
	20:00	379.9	1,500	
	21:00	380.2	1,500	
	22:00	380.4	1,500 +	Decrease RPM.
	23:00	380.3	1,500	
	24:00	380.4	1,500	
12-21-75	01:00	380.4	1,500	
	01:50			T = 76° F, K = 340 microm-hos.
	02:10	380.4	1,500	
	03:00	380.6	1,500	
	04:00	380.6	1,500	
	05:00	380.8	1,500	
	06:00	380.0	1,486	Increase RPM.
	06:50			T = 76° F, K = 340 microm-hos.
	07:00	381.0	1,500	
	08:00	381.1	1,500	
	09:00	381.4	1,500	
	10:00	381.4	1,500 +	Decrease RPM.
	11:00	381.3	1,500	
	12:00	381.2	1,500	
	13:00	381.3	1,500	
	13:15			T = 76° F, K = 340 microm-hos.
	14:20	381.3	1,500 -	Increase RPM.
	15:00	381.3	1,500	
	16:00	381.2	1,500	
	17:00	381.4	1,500	
	18:00	381.4	1,500	
	19:00	381.4	1,500	
	20:00	381.4	1,500	

PRODUCTION WELL NO. 1

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-21-75	21:00	381.5	1,500	
	22:00	381.7	1,500 +	Decrease RPM.
	23:00	381.4	1,500	
	24:00	381.4	1,500	
12-22-75	02:00	381.5	1,500	
	03:00	381 4	1,500	
	04:00	381.4	1,500	
	05:00	381.7	1,500	
	06:00	381.4	1,486	Increase RFM.
	07:00	381.0	1,500	
	08:00	381.3	1,500	
	09:00	381.4	1,500 +	Decrease RPM.
	10:00	381.4	1,500	
	11:00	381.4	1,500	
	12:00	380.7	1,500 -	Increase RPM.
	13:00	381.1	1,500	
	14:00	381.3	1,500	
	14:30	381.3	1,500	
	15:00	381.4	1,500	
	16:00	381.4	1,500	
	17:00	381.4	1,500	
	18:00	381.6	1,500	
	19:10	381.6	1,500	
	24:00	382.0	1,500	
12-23-75	03:00	381.7	1,500	
	07:00	381.6	1,500	
	08:45	381.6	1,500	T = 76° F, K = 340 micromhos. Collected water samples
	09:00			Pump off.
	09:01	340.9		
	09:02	342.7		
	09:03	342.2		
	09:04	341.6		
	09:05	341.3		
	09:06	341.1		
	09:07	340.2		
	09:18	338.8		
	09:30	337.5		

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
12-18-75	07:55	335.58	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	08:10	335.57	Measured with chain. Set sounder with tape mark at 335.57.
	10:00		PW-1 pump on for development.
	10:52	337.15	
	14:48	339.33	
12-19-75	07:40	344.03	
	09:12	344.54	
	10:00		PW-1 pump off.
	10:24	342.18	
	12:06	338.91	
	13:22	338.22	
	14:10	337.95	
	15:32	337.63	
12-20-75	07:43	336.73	Measured with chain. Set sounder with tape mark at 336.73.
	09:46	336.69	
	11:00	336-69	PW-1 pump on for test.
	11:01	336.73	
	11:02	336.90	
	11:03	337.14	
	11:04	337.32	
	11:05	337.52	
	11:06	337.61	
	11:07	337.81	
	11:08	337.89	
	11:09	338.05	
	11:10	338.19	
	11:11	338.31	
	11:12	338.47	
	11:13	338.51	
	11:14	338.62	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-20-75	11:15	338.77	
	11:16	338.82	
	11:17	338.93	
	11:18	339.00	
	11:19	339.16	
	11:20	339.19	
	11:23	339.45	
	11:25	339.67	
	11:30	339.89	
	11:35	340.08	
	11:40	340.30	
	11:45	340.41	
	11:50	340.65	
	12:00	341.00	
	12:15	341.30	
	12:30	341.69	
	12:45	341.86	
	13:00	342.18	
	13:30	342.52	
	14:00	342.75	
	15:05	343.18	
	16:05	343.42	
	17:05	343.61	
	18:05	343.74	
	19:05	344.09	
	20:05	344.12	
	21:10	344.24	
	22:10	344.36	
	23:10	344.43	
12-21-75	00:10	344.51	
	01:30	344.54	
	02:00	344.68	
	03:05	344.75	
	04:05	344.81	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-21-75	05:05	344.87	
	06:05	344.87	
	07:05	344.83	
	08:05	345.02	
	09:05	345.00	
	10:05	345.02	
	11:05	345.03	
	12:05	345.07	
	13:05	345.06	
	14:15	345.03	
	15:05	345.10	
	16:05	345.10	
	17:05	345.18	
	18:05	345.16	
	19:05	345.16	
	20:05	345.23	
	21:05	345.22	
	22:05	345.25	
	23:05	345.27	
12-22-75	00:05	345.31	
	01:25	345.21	
	02:00	345.52	
	03:05	345.44	
	04:05	345.39	
	06:05	345.37	
	07:05	345.32	
	08:05	345.38	
	09:05	345.52	
	10:05	345.54	
	11:05	345.58	
	13:10	345.54	
	14:10	345.54	
	15:05	345.61	
	16:05	345.57	

PRODUCTION WELL NO. 1

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-22-75	17:05	345.66	
	18:05	345.63	
	19:05	345.58	
12-23-75	00:10	345.70	
	03:10	345.78	
	07:10	345.71	
	08:50	345.79	
	09:00		PW-1 pump cff.
	09:14	344.08	
	09:25	343.20	
	09:45	342.15	

BC

LABORATORIES Inc.

OIL - CORES - SOIL - WATER

3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475

J. J. EGLIN, Reg. Chem. Engr.

Submitted By: Water Development Corporation
3839 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 1/16/76
Date Received: 1/8/76
Laboratory No.: 9939

Marked: Quintana No. 1 12/23/75 08:45 T: 76° K: 340

WATER ANALYSIS

Sample Description:

pH	7.8
E.C. Micromhos/cm (K x 10^6) @ 25°C (salinity)	
Resistivity, Ohm M^2/M	

Constituents, P. P. M. (parts per million)

Boron, (B)	
Calcium, (Ca)	22.
Magnesium, (Mg)	2.8
Sodium, (Na)	38.
Potassium, (K)	4.5
Carbonates, (CO_3)	0.
Bicarbonates, (HCO_3)	144.6
Chlorides, (Cl)	16.3
Sulphates, (SO_4)	10.
Nitrate, (NO_3)	3.53
Fluoride, (F)	0.46
Total Iron, (Fe)	
Copper, (Cu)	
Manganese, (Mn)	
Chromium, (Cr)	
Zinc, (Zn)	
Aluminum, (Al)	
Silica, (SiO_2)	
Lithium, (Li)	
Lead, (Pb)	
Phenol	
Sulfides as H_2S	
Total Hardness as $CaCO_3$	
Oil (chloroform extractable)	
Total Dissolved Solids	217. @ 180°F.
Total Suspended Solids	

B C LABORATORIES Inc.

By: J. J. Eglin

08193

PRODUCTION WELL NO. 2
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	40			50%	20%	10%	20%
40	100	Minor	40%-60%	30%-50%			Minor
100	110		40%	10%	10%	20%	20%
110	150		40%	40%	5%	5%	10%
150	160		10%	20%	20%	25%	25%
160	210	Minor	50%-60%	40%-50%			Minor
210	250			10%	20%	30%	40%
250	260	Minor	60%	20%	5%	5%	10%
260	270			10%	20%	40%	30%
270	290	20%	60%	20%			Minor
290	300		10%	30%	20%	20%	20%
300	310	20%	70%	10%			Minor
310	330	Minor	30%	50%	5%	5%	10%
330	370		Minor	20%	20%	30%	30%
370	440		30%	40%	10%	10%	10%
440	450			Minor	30%	50%	20%
450	900	0%-20%	20%-40%	20%-30%	0%-10%	10%-20%	10%-20%
900	910		5%	15%	20%	20%	30%
910	920	20%	50%	Minor	Minor	10%	20%
920	960	Minor	20%-30%	30%-40%	10%	10%-20%	20%
960	970	Minor	50%	30%	Minor	Minor	20%
970	990		20%	20%	10%	20%	30%
990	1005			Minor	Minor	Minor	90%

No sample from 530-540 feet; 20% pebble at 610-620 feet.

Average for the above interval 450-900 feet:

	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
450-900	10%	30%	30%	5%	10%	15%

PRODUCTION WELL NO. 2
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm)
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm - 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 mm

PRODUCTION WELL NO. 2
DRILLERS LOG

Depth From (ft)	To	Sample Description
45	65	Sand, rock, and gravel.
65	105	Sand and gravel.
105	115	Clay and sand.
115	125	Sand and gravel.
125	135	Sand, gravel, and clay.
135	145	Sand and gravel.
145	155	Sand, gravel, and clay.
155	165	Clay and gravel.
165	215	Sand and gravel.
215	225	Clay and fine sand.
225	250	Clay and sand.
250	255	Clay and gravel.
255	265	Cobbles, gravel, and sand.
265	275	Clay with 10% rock.
275	285	Gravel and sand.
285	295	Sand and gravel.
295	305	Clay and sand.
305	315	Sand and gravel.
315	325	Sand, gravel, and 2% clay.
325	335	Sand, gravel, and 15% clay.
335	345	Clay.
345	355	Clay and 5% sand.
355	365	Clay, sand, and gravel.
365	375	Clay and fine sand.
375	385	Clay, sand, and gravel.
385	415	Sand, gravel, and clay.
415	435	Sand, gravel, and trace of clay.
435	445	Sand and clay.
445	455	Clay with sand.
455	465	Clay 50%, sand 50%.
465	475	Clay and sand.
475	485	Sand 60%, gravel 35%, clay 5%.
485	495	Sand 90%, clay 10%.
495	505	Sand, clay, and gravel.
505	515	Sandy clay with caliche, gravel.
515	525	Sandy clay with caliche, some gravel.

PRODUCTION WELL NO. 2
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
525	540	Sand and clay.
540	550	Gravel 90%, clay 10%.
550	553	Gravel 70%, clay 30%.
553	555	Gravel 80%, clay 20%.
555	560	Gravel and clay.
560	565	Gravel 60%, clay 40%.
565	575	Sand and gravel.
575	580	Sand 80%, clay 20%.
580	583	Gravel 70%, clay 30%.
583	585	Gravel 80%, clay 20%.
585	590	Clay 70%, sand 30%.
590	600	Rock, clay, and gravel.
600	605	Rock 50%, clay 50%.
605	610	Gravel.
610	613	Gravel 10%, clay.
613	620	Sand, 20% clay.
620	625	Clay and gravel, hard.
625	635	Gravel, 5% clay.
635	640	Rock, 10% clay, and sand.
640	643	Rock, basalt, hard.
643	645	Clay and some sand.
645	675	Gravel 50%, clay 50%
675	701	Clay, sand, and gravel.
701	705	Gravel 65%, clay 35%.
705	710	Gravel 50%, clay 50%.
710	720	Clay 55%, gravel 45%.
720	725	Gravel 60%, clay 40%.
725	735	Gravel 65%, clay 35%.
735	750	Gravel 70%, clay 30%.
750	765	Sand,80%, clay 20%.
765	775	Gravel 80%, clay 20%.
775	789	Gravel 90%, clay 10%.
789	795	Clay, sand, and gravel.
795	800	Sand and clay.
800	805	Clay and sand.
805	835	Sand and gravel, clay 65%.
835	855	Clay, sand, and gravel.

PRODUCTION WELL NO. 2
DRILLERS LOG
(continued)

Depth From (ft)	To	Sample Description
855	865	Gravel.
865	885	Gravel 85%, clay 15%.
885	905	Coarse sand,85%, clay 15%.
905	915	Clay 65%, coarse sand 35%.
915	925	Gravel, sand, and clay, equal amounts.
925	935	Clay 40%, gravel 30%, sand 30%.
935	945	Clay 75%, sand 25%.
945	955	Clay 90%, sand 10%.
955	965	Gravel, sand, clay stringers.
965	975	Gravel and sand, 10% clay.
975	985	Gravel 50%, clay 50%.
985	995	Sand 60%, clay 40%.
995	1005	Clay.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	12:36	309.4		Measuring with sounder. Measuring point top of 3/4-inch tube 0.95 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
	12:44	309.4		
	12:45			Pump on. Ten-inch pump with bowls set at 460 feet Discharge pipe 10-inch, orifice 6-inch.
	12:47	331.8	550	Dirty.
	12:48	331.3		
	12:50	331.7		Lot of color, 0.5 cc/l, fine sand, soapy.
	12:58	332.2	550	Color decreasing, 0.1 cc/l fine sand, soapy.
	13:08	333.3	568	Color decreasing, 0.1 cc/l fine sand,
	13:09			Pump off.
	13:11	284.3		
	13:12	305.7		
	13:13	309.7		
	13:14	310.5		
	13:15	310.8		
	13:19	310.6		
	13:20			Pump on.
	13:24	333.0	550	Lot of color, 0.3 cc/l fine sand.
	13:30	333.7	550	Clearing some, 0.1 cc/l fine sand.
	13:40	334.6	559	Muddy, silty.
	14:00		550	Fairly clear, surge once.
	14:07		550	Lot of color, 0.3 cc/l fine sand.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	14:35	332.4	520	Fairly clear, surge once, change to 8" orifice.
	14:42	374.7	1,040	
	14:45			Lot of color, less than 0.1 cc/l sand.
	15:00	351.4	1,016	Fairly clear, surge once.
	15:05			Lot of color, silt, less than 0.1 cc/l fine sand.
	15:30	352.3	1,040	Fairly clear, surge twice.
	15:37			Lot of color, silt, 0.1 cc/l fine sand.
	16:00	351.4	1,040	Fairly clear, surge twice.
	16:08			Lot of color, silt, 0.2 cc/l fine sand.
	16:30	349.8	1,040	Fairly clear, surge twice.
	16:47			Lot of color, silt, 0.3 cc/l fine sand.
	17:00	349.2	1,016	Fairly clear, surge twice.
	17:10	365.9	1,500	Lot of color, silt, 0.1 cc/l fine sand.
	17:30	373.2	1,500	Fairly clear, surge twice.
	17:38			Lot of color, silt, 0.1 cc/l fine sand. T = 74^{o}F, K = 370 micromhos.
	18:00	372.1	1,486	Fairly clear, surge twice.
	18:07			Lot of color, silt.
	18:30	371.9	1,486	Fairly clear, surge twice.
	19:00	371.4	1,486	Surge twice.
	19:30	370.9	1,500	Surge twice.
	20:00	367.4	1,486	Surge twice.
	20:30	369.4	1,500	Fairly clear, surge twice.
	20:35			Less than 0.01 cc/l fine sand.
	21:00	369.1	1,486	Surge twice, straw color, clears quickly.
	21:30	369.0	1,486	Surge twice, slight color.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-10-76	22:00	369.0	1,500	Surge twice, clear.
	22:30	369.0	1,486	Surge twice, straw color.
	23:00	368.4	1,486	Surge twice, clear.
	23:30	369.0	1,500	Surge twice, clear.
	24:00	368.4	1,486	Surge twice, straw color. Increase RPM.
01-11-76	00:30	394.6	1,940	Surge twice, some color.
	01:00	395.0	1,928	Surge twice, straw color, clears quickly. Entrained air showing in discharge.
	01:30	395.8	1,928	Surge twice, straw color.
	02:00	396.7	1,928	Surge twice, straw color.
	02:30	397.4	1,928	Surge twice, straw color.
	03:00	398.0	1,928	Surge twice, straw color.
	03:30	399.9	1,928	Surge twice, straw color.
	04:00	400.0	1,920	Surge twice, straw color, clears quickly.
	04:30	399.9	1,928	Surge twice, some color.
	05:00	399.8	1,928	Surge twice, some color.
	05:30	398.1	1,928	Surge twice, some color.
	06:00	397.4	1,928	Surge twice, straw color, clears quickly.
	06:30	400.0	1,970	Surge twice, some color.
	07:00	404.4	1,970	Surge twice, considerable color.
	07:30	400.9	1,940	Fairly clear, surge twice.
	07:37			Some color, silt.
	08:00	398.2	1,920	Clear, surge twice.
	08:06			Some color, clearing within 2 minutes.
	08:30	399.0	1,940	Clear, surge twice
	09:07			Some color, increase RPM.
	09:10		2,115	Clearing.
	09:15	412.0	2,212	More color showing, no sand.
	09:30	419.0	2,200	Clear, surge twice.

PRODUCTION WELL NO. 2

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-11-76	09:37			Some color, clearing in 2 minutes.
	10:00	419.0	2,200	Clear, surge twice.
	10:08			Some color, less than 0.1 cc/l sand. Clearing in 2 minutes.
	10:30	418.7	2,212	Clear.
	10:37			Some color, clearing in 2 minutes, no sand.
	10:40			T = 76° F, K = 350 microm-hos.
	11:00	418.0	2,200	Clear, surge twice.
	11:07			Some color, clearing in 2 minutes, no sand.
	11:30	417.6	2,200	Clear, surge twice.
	11:37			Some color, clearing in 2 minutes, no sand.
	12:00	418.7	2,200	Clear, surge twice.
	12:07			Some color, clearing in 2 minutes, no sand.
	12:40	412.7	2,115	Clear.
	12:45			Pump off.
	12:46	321.9		
	12:47	326.5		
	12:48	330.6		
	12:49	330.0		
	12:50	328.9		
	12:51	328.0		
	12:52	327.3		
	12:53	326.5		
	12:54	325.8		
	12:55	325.2		
	13:00	322.8		
	13:05	321.3		
	13:10	320.2		
	13:15	319.3		
	13:51	316.1		
	16:06	312.8		

PRODUCTION WELL NO. 2

cvfpw2.wk1

TEST DATA

time = c6..c102
Pwl = d6..d102

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-12-76	08:46	310.4 ~1.45= 309.0 GL		Measuring with sounder. Same measuring point as for development.
	09:30			Pump on. Same setting as for development.
	09:31	366.4	2,020	Clear.
	09:32	370.4	2,020	
	09:33	373.9	2,020	
	09:34	376.2	2,020	
	09:35	378.0	2,020	
	09:36	379.6	2,020	
	09:37	380.7	2,020	
	09:38	381.7	2,020	
	09:39	382.6	2,020	
	09:40	383.3	2,020	
	09:45	386.6	2,020	
	09:50	388.8	2,020 +	Decrease RPM.
	09:55	390.3	2,020	
	10:00	391.7	2,020	Entrained air in discharge.
	10:10	393.5	2,020	
	10:20	395.7	2,020	
	10:30	396.3	2,020	
	10:40	397.8	2,020	
	10:50	398.4	2,020	
	11:00	399.1	2,020	
	11:17	400.1	2,020	
	11:30	400.3	2,020	
	11:45	401.1	2,020	
	12:00	401.4	2,020	
	12:15	402.3	2,040	Decrease RPM.
	12:30	401.3	2,020	
	12:45	401.3	2,020	
	13:00	401.3	2,020	
	13:17			T = 75°F, K = 335 micromhos.

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-12-76	13:30	401.9	2,020	
	14:00	402.9	2,020	
	14:30	402.8	2,020 -	Increase RPM.
	15:00	402.9	2,020	
	16:00	403.7	2,020	
	17:00	404.3	2,020 -	Increase RPM.
	18:00	405.2	2,020	
	19:00	405.1	2,020	
	20:00	405.7	2,020	
	21:00	406.1	2,020	
	22:00	406.8	2,020	
	23:00	407.6	2,020	
	24:00	408.0	2,020	
01-13-76	01:00	408.9	2,020	
	02:00	409.1	2,020	
	03:00	409.2	2,020 +	Decrease RPM.
	04:00	408.5	2,020	
	05:00	409.1	2,020	
	06:00	408.1	2,020 -	Increase RPM.
	07:00	409.3	2,020	
	08:00	409.3	2,020	
	09:00	409.4	2,020	
	10:00	409.4	2,020	
	11:00	409.2	2,020	
	12:00	410.2	2,020	
	13:00	410.6	2,020	
	13:50		2,020 +	T = 76° F, K = 350 micromhos. Decrease RPM.
	14:00	410.0	2,020	
	15:00	410.0	2,020	
	16:00	410.1	2,020	
	17:00	410.2	2,020	
	18:00	411.3	2,020	
	19:00	411.2	2,020	
	20:00	410.1	2,020	

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-13-76	21:00	410.7	2,020	
	22:00	410.7	2,020	
	23:00	410.7	2,020	
	24:00	411.3	2,020	
01-14-76	01:00	411.4	2,020	
	02:00	411.7	2,020	
	03:00	411.7	2,020	
	04:00	411.5	2,020	
	05:00	411.7	2,020	
	06:00	411.5	2,020 -	Increase RPM.
	07:15	411.9	2,020	
	08:00	412.2	2,020	
	09:00	412.0	2,020	
	10:00	412.0	2,020	
	11:00	412.3	2,020	
	12:00	411.9	2,020	
	13:00	412.2	2,020	
	14:00	411.7	2,020	
	15:00	411.7	2,020	
	16:00	411.7	2,020	
	17:00	411.7	2,020	
	18:00	412.1	2,020	
	19:00	413.3	2,020 +	Decrease RPM.
	20:00	413.3	2,020 +	Decrease RPM.
	20:05			T = 76^{o} F, K = 350 n. hos.
	21:00	414.4	2,020	
	22:00	414.6	2,020	
	23:00	414.6	2,020 +	Decrease RPM.
	24:00	414.6	2,020	
01-15-76	01:00	414.0	2,020	
	02:00	414.1	2,020	
	03:00	413.8	2,020	
	04:00	412.8	2,020	
	05:00	412.6	2,020	

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-15-76	06:00	412.5	2,020	
	07:00	412.5	2,020	
	08:00	413.0	2,020	
	08:30			T = 76° F, K = 350 micromhos. Collected water samples.
	09:00	413.7	2,020	
	09:30			Pump off.
	09:31	325.0		
	09:32	329.9		
	09:33	333.8		
	09:34	333.3		
	09:35	331.9		
	09:36	331.2		
	09:37	330.3		
	09:38	329.6		
	09:39	328.8		
	09:40	328.3		
	09:45	326.2		
	09:50	324.7		
	09:55	323.5		
	10:00	322.6		
	10:10	321.3		
	10:20	320.3		
	10:30	319.5		
	10:45	318.7		
	11:00	318.0		
	11:15	317.4		
	11:30	317.0		
	12:00	316.5		
	12:30	315.9		
	13:00	315.6		
	13:30	315.2		
	14:00	314.8		
	15:00	314.6		

PRODUCTION WELL NO. 2

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-15-76	16:00	314.1		
	17:00	314.0		
	20:00	313.4		
	24:00	313.0		
01-16-76	04:00	312.8		
	08:00	312.5		
	09:45	312.2		
	09:50	312.42		Measured with chain.

PRODUCTION WELL NO. 2.

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-11-76	13:28	333.36	Measured with chain, spotty. Measuring point hole in plate 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
	13:35	333.24	Measured with chain, spotty.
	16:00	332.04	Measured with chain. Water level is recovering from development of PW-2.
01-12-76	08:27	330.76	Measured with chain. Set sounder with tape mark at 330.76.
	09:11	330.66	
	09:30		PW-2 pump on for test.
	09:48	330.68	
	10:15	330.99	
	11:10	331.74	
	12:05	332.28	
	13:05	332.52	
	14:05	332.73	
	15:05	332.98	
	16:05	333.05	
	17:05	333.20	
	18:05	333.30	
	19:05	333.58	
	20:05	333.65	
	21:05	333.70	
	22:05	333.78	
	23:05	333.89	
01-13-76	00:05	334.05	
	01:00	333.97	
	02:05	333.96	
	03:05	334.03	
	04:05	334.06	
	05:05	334.10	
	06:08	334.17	
	07:05	334.25	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-13-76	08:05	334.38	
	09:05	334.36	
	10:05	334.46	
	11:05	334.51	
	12:05	334.36	
	13:05	334.62	
	15:05	334.55	
	17:07	334.63	
	19:05	334.92	
	21:05	334.98	
	23:05	335.12	
01-14-76	01:05	335.19	
	03:05	335.23	
	05:05	335.27	
	07:20	335.18	
	08:05	335.21	
	09:05	335.24	
	11:05	335.29	
	13;05	335.30	
	15:05	335.29	
	17:05	335.32	
	19:05	335.39	
	21:05	335.44	
	23:05	335.53	
01-15-76	01:05	335.59	
	03:05	335.54	
	05:05	335.52	
	07:05	335.49	
	09:05	335.59	
	09:30		PW-2 pump off.
	10:03	335.39	
	10:33	334.94	
	11:05	334.50	
	11:35	334.25	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-15-76	12:05	334.06	
	12:35	333.86	
	13:05	333.68	
	13:35	333:55	
	14:05	333.41	
	15:05	333.24	
	16:05	333.06	
	17:05	332.86	
	20:05	332.72	
01-16-76	00:05	332.44	
	04:05	332.36	
	08:05	332.25	
	10:04	332.01	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-11-76	13:45	338.14	Measured with chain, Measuring point top of 6-inch casing approximately 1 foot above land surface.
	15:54	337.57	Measured with chain. Water level is recovering from development of PW-2.
01-12-76	08:00	336.52	Measured with chain. Set sounder with tape mark at 336.52.
	09:15	336.43	
	09:30		PW-2 pump on for test.
	09:52	336.44	
	10:17	336.52	
	11:14	337.02	
	12:07	337.28	
	13:07	337.44	
	14:07	337.60	
	15:07	337.74	
	16:07	337.85	
	17:07	337.98	
	18:07	338.06	
	19:07	338.14	
	20:07	338.23	
	21:07	338.31	
	22:08	338.42	
	23:07	338.47	
01-13-76	00:07	338.51	
	01:37	338.54	
	02:07	338.65	
	03:07	338.70	
	04:07	338.79	
	06:16	338.85	
	07:07	338.91	
	08:07	339.09	
	09:07	339.06	
	10:07	339.13	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-13-76	11:07	339.22	
	12:07	339.22	
	13:07	339.23	
	15:07	339.21	
	17:09	339.31	
	19:07	339.45	
	21:07	339.54	
	23:07	339.62	
01-14-76	01:07	339.77	
	03:07	339.73	
	05:07	339.82	
	07:22	339.84	
	08:07	339.86	
	09:07	339.89	
	11:07	339.94	
	13:07	339.93	
	15:10	339.92	
	17:07	339.96	
	19:07	340.03	
	21:07	340.02	
	23:07	340.19	
01-15-76	01:07	340.18	
	03:07	340.21	
	05:07	340.11	
	07:07	340.18	
	09:07	340.25	
	09:30		PW-2 pump off.
	10:05	340.14	
	10:35	339.93	
	11:08	339.70	
	11:37	339.53	
	12:07	339.40	
	12:37	339.25	
	13:07	339.16	

PRODUCTION WELL NO. 2

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-15-76	13:37	338.99	
	14:07	338.94	
	15:07	338.86	
	16:07	338.80	
	17:07	338.55	
	20:05	338.20	
01-16-76	00:07	338.03	
	04:07	337.89	
	08:07	337.72	
	10:19	337.75	

BC
LABORATORIES Inc.
OIL - CORES - SOIL - WATER
3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475
J. J. EGLIN, Reg. Chem. Engr.

ubmitted By: Water Development Corp.
3938 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 2/16/76
Date Received: 2/3/76
Laboratory No.: 10752

larked: Quintana #2 1/15/76 08:30 T: 76°F. K: 350

WATER ANALYSIS

ample Description:

pH		8.1
E.C. Micromhos/cm (K x 10^6) @ 25°C (salinity)		310.
Resistivity, Ohm M^2/M		

Constituents, P. P. M. (parts per million)

(B)		-
Calcium, (Ca)		21.
Magnesium, (Mg)		3.4
Sodium, (Na)		39.
Potassium, (K)		4.3
Carbonates, (CO_3)		0.
Bicarbonates, (HCO_3)		153.1
Chlorides, (Cl)		17.0
Sulphates, (SO_4)	(-)	5.
Nitrate, (NO_3)		3.53
Fluoride, (F)		0.66
Total Iron, (Fe)		
Copper, (Cu)		
Manganese, (Mn)		
Chromium, (Cr)		
Zinc, (Zn)		
Aluminum, (Al)		
Silica, (SiO_2)		
Lithium, (Li)		
Lead, (Pb)		
Phenol		
Sulfides as H_2S		
Total Hardness as $CaCO_3$		
Oil (chloroform extractable)		
Dissolved Solids		257. @ 180°F.
Suspended Solids		

BC LABORATORIES Inc.
By J. J. Eglin

PRODUCTION WELL NO. 3
CUTTING LOG

(Prepared by B. Y. Kim, Geologist, Quintana Minerals Corporation)

Depth From (ft)	To	Pebble	Granule	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay
30	50		30%	50%	5%	5%	10%
50	60	90%	10%				
60	80	Minor	60%	20%	Minor	5%	15%
80	100	90%	10%				
100	180	10%-30%	50%-70%	5%-15%	Minor	5%	10%
180	190			Minor	20%	40%	40%
190	210	Minor	40%	30%	5%	5%	20%
210	220			10%	20%	40%	20%
220	240	Minor	50%	40%			10%
240	250			10%	20%	40%	30%
250	260		50%	40%	Minor		10%
260	270		10%	20%	10%	20%	20%
270	330	10%-20%	50%-60%	20%	Minor	Minor	10%
330	350		10%	30%-40%	0%-10%	20%	30%
350	380	0%-10%	40%-50%	30%-40%	Minor	Minor	0%-10%
380	390		10%	30%	10%	20%	20%
390	450		30%-40%	30%-40%	0%-10%	0%-10%	10%-20%
450	460			10%	30%	30%	30%
460	760	Minor	20%-40%	20%-30%	0%-10%	10%-20%	10%-30%
(Representative Sample:		Minor	30%	30%	5%	10%	20%)
760	830		10%-20%	30%-40%	0%-10%	10%-20%	20%
830	910		20%-30%	30%-40%	10%	20%	10%
910	970		10%-20%	20%-30%	10%-20%	10%-20%	20%

Peanut-size angular pebbles at 80-100 feet, probably broken pieces from larger boulder.

Sample 120-180 missing.

Pebble-containing samples:

670-680 (20%)
710-720 (10%)
610-620 (5%)

Toward the bottom of the hole, gradual decrease of coarse material (granule and coarse sand) has been noticed.

PRODUCTION WELL NO. 3
CUTTING LOG
(continued)

The following size ranges have been established from Wentworth Scale for classification of clastic sedimentary rock. The above log has been done by visual estimation according to the scale.

Pebble	Above 4 mm
Granule	2 mm - 4 mm
Coarse Sand	Very coarse - 1 mm - 2 mm Coarse - 0.5 mm - 1 mm (1/2 mm - 1 mm)
Medium Sand	0.25 mm - 0.5 mm (1/4 mm - 1/2 mm)
Fine Sand	Fine - 0.125 mm - 0.25 mm (1/4 mm - 1/8 mm) Very fine - 0.0625 mm - 0.125 mm (1/8 mm - 1/16 mm)
Silt and Clay	Less than 0.0625 mm (less than 1/16 mm)

PRODUCTION WELL NO. 3
DRILLERS LOG

Depth From (ft)	Depth To (ft)	Sample Description
40	55	Sand 85%, gravel.
55	65	Gravel, 10% sand.
65	75	Gravel, 20% sand.
75	165	Sand and gravel.
165	185	Sand 70%, gravel 25%, clay 5%.
185	195	Clay.
195	200	Sand, 5% clay.
200	205	Clay.
205	215	Sand, 50%, gravel 45%, clay 5%.
215	225	Clay, 10% sand.
225	235	Sand 55%, gravel 40%, clay 5%.
235	250	Sand and gravel.
250	255	Sand, 80% clay.
255	265	Sand and gravel, 5% clay.
265	275	Sand, 70% clay.
275	339	Sand and gravel.
339	345	Clay 80%, sand 20%.
345	355	Clay 75%, sand 20%, gravel 5%.
355	369	Sand 90%, gravel 10%.
369	375	Clay 60%, gravel 30%, sand 10%.
375	385	Sand 65%, clay 25%, gravel 10%.
385	399	Clay 60%, sand 40%.
399	405	Sand 90%, clay 10%.
405	415	Sand 50%, gravel 50%.
415	425	Sand 50%, gravel 40%, clay 10%.
425	429	Sand, gravel, and clay.
429	435	Gravel 65%, sand 30%, clay 5%.
435	455	Sand, gravel, and clay.
455	465	Clay and little sand.
465	475	Clay, gravel, and sand.
475	495	Gravel 60%, sand 20%, clay 20%.
495	505	Sand and gravel.
505	525	Sand 50%, clay 50%.
525	535	Gravel 50%, sand 50%.
535	545	Sand 65%, clay 25%, gravel 10%.
545	555	Sand 50%, clay 50%.
555	565	Sand, 30% clay.

PRODUCTION WELL NO. 3
DRILLERS LOG
(continued)

Depth From - To (ft)	Sample Description
565 - 575	Sand and gravel.
575 - 590	Sand, gravel, and clay.
590 - 595	Sand and gravel, some clay.
595 - 605	Sand, gravel, and clay.
605 - 615	Sand and gravel, some clay.
615 - 625	Sand and gravel, 70% clay.
625 - 655	Sand and gravel.
655 - 665	Sand 70%, clay 30%.
665 - 675	Sand 85%, gravel 10%, clay 5%.
675 - 685	Gravel 60%, sand 20%, clay 20%.
685 - 699	Sand 50%, gravel 25%, clay 25%.
699 - 705	Sand 50%, gravel 48%, clay 2%.
705 - 715	Gravel 45%, coarse sand 45%, clay 10%.
715 - 728	Sand 80%, gravel 10%, clay 10%.
728 - 745	Sand, gravel, and clay.
745 - 756	Sand 85%, clay.
756 - 817	Sand, gravel, and clay.
817 - 835	Clay 80%, gravel 10%, sand 10%.
835 - 847	Sandy clay 98%, gravel 2%.
847 - 855	Sand 70%, gravel 30%.
855 - 865	Sand 80%, gravel 15%, clay 5%.
865 - 878	Clay 55%, gravel 35%, sand 10%.
878 - 895	Sand, gravel, and clay.
895 - 905	Sand and gravel.
905 - 945	Gravel 50%, sand 30%, clay 20%.
945 - 955	Clay 50%, sand 30%, gravel 20%.
955 - 965	Clay 95%, sand 5%.
965 - 970	Clay 90%, sand 10%.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	12:54	350.6		Measuring with sounder. Measuring point top of 3/4-inch tube 0.95 feet above top of surface pipe. Surface pipe approximately 1 foot above land surface.
	13:00			Pump on. Ten-inch pump with bowls set at 500 feet. Discharge pipe 10-inch, orifice 6-inch.
	13:02	391.8	520	
	13:03	390.1		Dirty, lot of color.
	13:04	389.7	520	
	13:05	389.3		
	13:07	390.1	520	Lot of color, silt, 0.5 cc/l sand and silt.
	13:10	390.6		
	13:15	390.9	520	Clearing, less than 0.1 cc/l sand.
	13:20			Surge.
	13:25			Some color and silt, less than 0.1 cc/l fine sand.
	13:30	391.2	520	Clearing.
	13:36			Fairly clear, surge twice.
	13:44			Considerable color, 0.2 cc/l fine sand.
	13:47	386.4	520	
	13:55	388.6	520	Fairly clear, surge twice.
	14:05			Some color, silt.
	14:15	385.4	520	Fairly clear, surge twice.
	14:23			Some color, silt, less than 0.1 cc/l fine sand.
	14:30	383.3	520	Fairly clear, surge twice.
	14:37			Some color, silt, 0.1 cc/l fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	14:45	382.0	520	Fairly clear, surge twice.
	14:58			Some color, silt, less than 0.1 cc/l fine sand.
	15:00	380.4	520	Fairly clear, silt, surge twice.
	15:08			Some color, no sand.
	15:15	379.4	520	Fairly clear, surge twice.
	15:30	378.4	520	Fairly clear, surge twice.
	15:45	377.9	520	Fairly clear, surge twice.
	16:00	377.7	520	Fairly clear, surge twice.
	16:15	377.6	520	Fairly clear, surge twice.
	16:30	377.4	520	Fairly clear, surge twice, change to 8-inch orifice.
	16:33			Pump on, increase RPM.
	16:35	402.7	1,000	Considerable color, 0.1 cc/l fine sand.
	16:40	403.0	1,000	
	16:45	403.8	1,000	Fairly clear, surge twice.
	16:53			Considerable color, silt, 0.1 cc/l fine sand.
	17:00	403.8	1,000	Fairly clear, surge twice.
	17:07			Considerable color, silt, 0.1 cc/l fine sand.
	17:10			T = 76^{o}F, K = 370 micromhos.
	17:15	403.1	1,000	Fairly clear, surge twice.
	17:22			Considerable color, silt, 0.1 cc/l fine sand.
	17:30	402.5	1,000	Fairly clear, surge twice.
	17:37			Considerable color, silt, 0.1 cc/l fine sand.
	17:45	401.4	1,000	Fairly clear, surge twice.
	17:52			Some color, silt, 0.15 cc/l fine sand.
	18:00	402.0	1,000	Fairly clear, surge twice.
	18:07			Some color, silt, 0.15 cc/l fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	18:15 18:22	400.6	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	18:30 18:37	399.7	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	18:45 18:52	399.7	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	19:00 19:08	399.4	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	19:15 19:22	399.2	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	19:30 19:37	398.3	1,000	Fairly clear, surge twice. Some color, silt, 0.1 cc/l fine sand.
	19:45 19:52	398.4	1,000	Fairly clear, surge twice. Some color, silt, less than 0.1 cc/l fine sand.
	20:00	398.6	1,000	Fairly clear, surge twice, in-crease RPM.
	20:07	428.5	1,500	Considerable color, 0.1 cc l fine sand.
	20:09	438.7		
	20:15	446.6	1,500	Dirty, 0.1 cc/l fine sand, co-siderable entrained air in [illegible] charge.
	20:30 20:37	447.0	1,486	Clearing, surge twice. Lot of color, silt, 0.2 cc/l fine sand.
	20:45 20:52	443.9	1,455	Fairly clear, surge twice. Lot of color, silt, 0.2 cc.l fine sand.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-22-76	21:00	446.1	1,500	Fairly clear, surge twice.
	21:07			Lot of color, silt, 0.1 cc/l fine sand.
	21:15	444.8	1,500	Fairly clear, surge twice.
	21:22			Lot of color, silt, less than 0.1 cc/l fine sand.
	21:30	444.1	1,500	Fairly clear, surge twice.
	21:37			Lot of color, silt.
	21:45	441.1	1,471	Fairly clear, surge twice.
	21:53			Considerable color, silt, less than 0.1 cc/l fine sand.
	22:00	442.0	1,486	Fairly clear, surge twice.
	22:30	446.6	1,500	Fairly clear, surge twice.
	23:00	446.5	1,500	Fairly clear, surge twice.
	23:30	446.9	1,486	Fairly clear, surge twice.
	23:38			Considerable color, silt, no sand.
	24:00	446.4	1,500	Fairly clear, surge twice.
01-23-76	00:07			Lot of color, silt, no sand.
	00:30	446.9	1,500	Fairly clear, surge twice.
	00:38			Lot of color, silt, no sand.
	01:00	447.0	1,500	Fairly clear, surge twice.
	01:07			Lot of color, silt.
	01:30			Engine stopped, broken throttle linkage.
	01:36			Throttle repaired, second surg
	01:40			Lot of color, silt, no sand.
	02:00	447.1	1,500	Fairly clear, surge twice.
	02:07			Lot of color, silt, no sand.
	02:30	447.2	1,500	Fairly clear, surge twice.
	03:00	447.8	1,500	Fairly clear, surge twice.
	03:37		1,500	
	04:00	448.0	1,500	Fairly clear, surge twice.
	04:07		1,500	
	04:30	447.4	1,500	Fairly clear, surge twice.

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-23-76	04:37		1,500	
	05:00	447.2	1,500	Fairly clear, surge twice.
	05:07		1,500	
	05:30	447.3	1,500	Fairly clear, surge twice.
	05:37		1,500	
	06:00	449.3	1,500	Fairly clear, surge twice.
	06:07		1,500	
	06:30	447.4	1,500	Fairly clear, surge twice.
	06:37		1,500	Considerable color, silt, no sand.
	07:00	447.4	1,500	Clear, surge twice, increase RPM.
	07:09	463.1	1,809	Fairly dirty, 0.3 cc/l fine sand.
	07:11	470.2	1,809	Fairly dirty, lot of entrained air.
	07:15			Ohmmeter fluctuating badly. Starts at 460 feet.
	07:31		1,641	Manometer ± 1 inch, well is not surging.
	07:33			Fairly clear, surge twice.
	08:30	454.7	1,669	Clear, Ohmmeter and Manometer fluctuating, surge twice.
	08:32			Some color, silt, no sand.
	09:00	452.1	1,543	Clear, surge twice.
	09:08			Some color, silt, no sand.
	09:10			Engine stopped, broken throttle linkage.
	09:15			Throttle repaired.
	09:30	453.1	1,613	Clear, surge twice, reduce RP
	10:02			Little color, silt, no sand.
	10:04		1,500	
	10:30	448.2	1,515	Clear, reduce RPM.
	11:00	448.0	1,500	

PRODUCTION WELL NO. 3

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-23-76	11:11			T = 76° F, K = 360 microm-hos.
	11:30	448.0	1,500	Clear.
	11:58	448.4	1,500	Clear.
	12:00			Pump off.
	12:01	421.1		
	12:02	396.3		
	12:03	365.2		
	12:04	354.0		
	12:05	354.2		
	12:16	352.7		
	12:15	352.1		

PRODUCTION WELL NO. 3

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-24-76	07:46	350.8		Measuring with sounder. Same measuring point as for development.
	08:59	350.8 -1.95 = 348.9 GL		
	09:00			Pump on. Same setting as for development.
	09:01	421.4	1,500	
	09:02	424.6	1,500	Some color.
	09:03	428.2	1,500	
	09:04	431.1	1,500	
	09:05	432.6	1,500	Clear.
	09:06	433.5	1,500	
	09:07	434.5	1,500	
	09:08	435.6	1,500	
	09:09	436.2	1,500	
	09:10	436.9	1,500	
	09:11	437.6	1,500	
	09:12	437.8	1,500	
	09:13	438.0	1,500	
	09:14	438.5	1,500	
	09:15	439.0	1,500	
	09:16	440.0	1,515	Decrease RPM.
	09:17	439.6	1,500	
	09:18	439.6	1,500	
	09:19	439.8	1,500	
	09:20	440.0	1,500	
	09:25	441.0	1,500	
	09:30	441.6	1,500	
	09:35	441.9	1,500	
	09:40	442.0	1,500	
	09:50	443.4	1,500	
	10:00	443.5	1,500	
	10:15	444.5	1,500 -	Increase RPM.
	10:30	445.0	1,500	Considerable entrained air in discharge.
	10:45	445.9	1,500	

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-24-76	11:00	446.0	1,500 +	Decrease RPM.
	11:30	446.6	1,500	
	12:00	446.6	1,500	
	12:03			T = 76°, K = 360 microm-hos.
	12:30	448.4	1,500	
	13:00	449.5	1,500	
	13:30	449.0	1,500 -	Increase RPM.
	14:00	449.1	1,500	
	15:00	448.7	1,500 +	Decrease RPM.
	16:00	448.9	1,500	
	17:00	449.8	1,515	Decrease RPM.
	18:00	448.4	1,486	Increase RPM.
	19:00	499.4	1,500	
	20:00	450.4	1,500	
	21:00	450.9	1,500	
	22:00	451.5	1,500	
	23:00	451.8	1,500	
	24:00	452.2	1,500	
01-25-76	01:00	452.2	1,500	
	02:00	452.2	1,500	
	03:00	452.4	1,500	
	04:00	452.4	1,500	
	05:00	452.7	1,500	
	06:00	453.0	1,500	
	07:00	453.7	1,500	
	08:00	452.3	1,500	
	09:00	451.7	1,486	Increase RPM.
	10:00	452.4	1,500	
	11:00	452.4	1,500	
	12:00	453.0	1,500 -	Increase RPM.
	12:25	453.2	1,500	
	12:36	453.2	1,500	Changed sounders.
	13:00	453.86	1,500	
	14:00	454.83	1,500 +	Decrease RPM.

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-25-76	14:40			T = 76°, K = 360 micromhos.
	15:00	452.50	1,500	
	16:00	452.59	1,500	
	17:00	453.81	1,500	
	18:00	454.26	1,500	
	19:00	453.73	1,500	
	20:00	454.16	1,500	
	21:00	455.38	1,500	
	22:00	456.12	1,500 +	Decrease RPM.
	23:00	456.36	1,500	
	24:00	456.46	1,500	
01-26-76	01:00	455.86	1,500	
	02:01	455.71	1,500	
	03:00	455.76	1,500	
	04:00	455.71	1,500	
	05:00	455.66	1,500	
	06:00	455.46	1,500	
	07:00	455.56	1,500 +	Decrease RPM.
	08:00	454.49	1,500	
	09:00	454.86	1,500	
	10:00	455.40	1,500	
	11:00	455.34	1,500	
	12:00	455.50	1,500	
	13:00	455.80	1,500	
	13:40		1,500 +	Decrease RPM.
	14:00	455.77	1,500	
	15:00	455.76	1,500	
	16:00	456.87	1,500	
	17:00	455.70	1,500	
	18:00	455.42	1,486	Increase RPM.
	19:00	456.19	1,500 -	Increase RPM.
	20:00	457.03	1,500	
	21:00	457.14	1,500	
	22:00	457.14	1,500	

PRODUCTION WELL NO. 3

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
01-26-76	23:00	457.31	1,500	
	24:00	457.0	1,500	
01-27-76	01:00	456.96	1,500	
	02:00	456.98	1,500	
	03:00	455.66	1,500	
	04:00	455.96	1,500	
	05:00	455.96	1,500	
	06:05	457.66	1,500	
	07:00	455.26	1,500	
	08:00	453.71	1,500	
	08:50			T = 76°, K = 360 micromhos. Collected water samples.
	08:55	454.16	1,500	
	09:00			Pump off.
	09:01	337.06		
	09:02	346.23		
	09:03	356.86		
	09:04	356.38		
	09:05	356.46		
	09:06	356.35		
	09:07	356.09		
	09:08	355.90		
	09:09	355.72		
	09:10	355.54		
	09:15	354.84		
	09:20	354.32		
	09:25	354.02		
	09:30	353.80		
	09:40	353.53		
	09:50	353.32		
	10:00	352.98		
	10:15	352.89		
	11:00	352.49		
	18:44	351.24		
01-28-76	07:42	350.66		

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:49	330.91	Measured with chain, Measuring point hole in plate over casing 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	10:55	331.94	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	08:13	330.77	Measured with chain. Set sounder with tape mark at 330.77.
	09:00		PW-3 pump on for test.
	09:10	330.77	
	09:30	330.87	
	09:45	330.96	
	10:00	330.98	
	10:15	331.10	
	10:35	331.10	
	11:05	331.22	
	11:55	331.33	
	13:12	331.42	
	14:15	331.45	
	15:15	331.51	
	16:15	331.55	
	17:18	331.62	
	18:23	331.67	
	20:13	331.77	
	22:13	331.85	
01-25-76	00:13	331.96	
	02:13	332.11	
	04:13	332.11	
	06:15	332.13	
	08:15	332.08	
	10:15	332.15	
	12:15	332.13	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	14:15	332.11	
	16:12	332.15	
	18:15	332.21	
	20:15	332.27	
	22:50	332.36	
01-26-76	00:30	332.37	
	02:30	332.38	
	06:30	332.49	
	08:28	332.58	
	10:13	332.74	
	12:17	332.72	
	14:11	332.67	
	16:10	332.66	
	18:15	332.68	
	20:05	332.70	
01-27-76	00:10	332.74	
	02:15	332.76	
	05:55	332.78	
	08:20	332.84	
	09:00		PW-3 pump off.
	10:35	332.44	
	18:55	331.73	
01-28-76	08:06	331.47	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-2 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:58	309.93	Measured with chain. Measuring point hole in plate above casing 0.7 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	10:45	310.31	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	08:31	309.67	Measured with chain. Set sounder with tape mark at 309.67.
	09:00		PW-3 pump on for test.
	09:05	309.67	
	09:25	309.67	
	09:40	309.67	
	09:55	309.71	
	10:10	309.74	
	10:25	309.75	
	10:40	309.77	
	11:00	309.81	
	11:50	309.84	
	13:16	309.89	
	14:20	309.91	
	15:20	309.94	
	16:20	309.98	
	17:24	310.02	
	18:30	310.07	
	20:16	310.12	
	22:16	310.18	
01-25-76	00:16	310.22	
	02:16	310.27	
	04:18	310.31	
	06:20	310.40	
	08:20	310.42	
	10:20	310.46	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well PW-2 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	12:20	310.46	
	14:20	310.43	
	16:16	310.43	
	18:20	310.48	
	20:20	310.55	
	23:00	310.67	
01-26-76	00:35	310.65	
	02:35	310.72	
	06:35	310.83	
	08:33	310.90	
	10:17	311.01	
	12:23	311.00	
	14:15	310.92	
	16:15	310.96	
	18:20	310.99	
	20:10	311.01	
01-27-76	00:15	311.04	
	02:20	311.11	
	06:00	311.12	
	08:25	311.13	
	09:00		PW-3 pump off.
	10:40	311.04	
	19:00	310.65	
01-28-76	08:17	310.43	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-5 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	11:41	336.67	Measured with chain. Measuring point top of 6-inch casing approximately 1 foot above land surface.
	13:00		PW-3 pump on for development.
01-23-76	11:03	337.68	Measured with chain.
	12:00		PW-3 pump off.
01-24-76	07:57	336.52	Measured with chain. Set sounder wit· tape mark at 336.52.
	09:00		PW-3 pump on for test.
	09:13	336.52	
	09:34	336.64	
	09:50	336.70	
	10:04	336.71	
	10:24	336.77	
	10:36	336.83	
	11:07	336.91	
	11:57	337.01	
	13:10	337.07	
	14:12	337.11	
	15:12	337.14	
	16:12	337.24	
	17:15	337.29	
	18:20	337.33	
	20:08	337.42	
	22:08	337.49	
01-25-76	00:08	337.53	
	02:08	337.60	
	04:08	337.67	
	06:10	337.76	
	08:10	337.76	
	10:10	337.83	
	12:10	337.82	
	14:10	337.79	
	16:10	337.90	
	18:10	337.82	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-5 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-25-76	20:10	337.94	
	22:50	338.01	
01-26-76	00:25	338.03	
	02:25	338.06	
	06:25	338.17	
	08:25	338.26	
	10:10	338.28	
	12:12	338.29	
	14:09	338.28	
	16:08	338.30	
	18:10	338.34	
	20:00	338.39	
01-27-76	00:05	338.41	
	02:10	338.42	
	05:50	338.43	
	08:10	338.56	
	09:00		PW-3 pump off.
	10:30	338.18	
	18:50	337.41	
01-28-76	07:54	337.10	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-6 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
01-22-76	12:22	386.84	Measuring with sounder. Inside of casing too wet to use chain. Measuring point top of 6-inch casing approximately 1 foot above land surface. MW-6 was used to supply drilling water for drilling production wells.
	13:00		PW-3 pump on for development.
01-23-76	10:14	386.67	
	12:00		PW-3 pump off.
01-24-76	07:34	386.41	
	09:00		PW-3 pump on for test.
	09:20	386.41	
	11:06	386.40	
	12:08	386.38	
	13:04	386.33	
	14:07	386.33	
	15:07	386.33	
	16:07	386.32	
	17:09	386.35	
	18:09	386.34	
	20:05	386.32	
	22:05	386.29	
01-25-76	00:05	386.32	
	02:05	386.35	
	04:05	386.39	
	06:05	386.43	
	08:05	386.49	
	10:05	386.53	
	12:05	386.50	
	14:05	386.47	
	16:05	386.41	
	18:05	386.46	
	20:05	386.54	
	22:24	386.63	

PRODUCTION WELL NO. 3

TEST DATA

(Observation Well MW-6 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
01-26-76	00:15	386.64	
	02:15	386.63	
	06:20	386.74	
	08:20	386.80	
	10:06	386.82	
	12:07	386.82	
	14:05	386.78	
	16:04	386.79	
	18:05	386.77	
	19:56	386.84	
	24:00	386.86	
01-27-76	02:05	386.87	
	05:45	386.88	
	08:05	386.92	
	09:00		PW-3 pump off.
	10:10	386.87	
	18:38	386.81	
01-28-76	07:29	386.77	

BC
LABORATORIES Inc.
OIL - CORES - SOIL - WATER
3016 UNION AVENUE
BAKERSFIELD, CALIFORNIA 93305
Phone (805) 325-7475
J. J. EGLIN, Reg. Chem. Engr.

Submitted By: Water Development Corp.
3938 Santa Barbara Ave.
Tucson, Arizona 85711

Date Reported: 2/16/76
Date Received: 2/3/76
Laboratory No.: 10753

Marked: Quintana #3 1/27/76 08:50 T: 76°F. K: 360

WATER ANALYSIS

Sample Description:

pH	8.0
E.C. Micromhos/cm (K x 10^6) @ 25°C (salinity)	330.
Resistivity, Ohm M^2/M	

Constituents, P. P. M. (parts per million)

(B)	
Calcium, (Ca)	22.5
Magnesium, (Mg)	2.7
Sodium, (Na)	44.
Potassium, (K)	5.1
Carbonates, (CO_3)	0.
Bicarbonates, (HCO_3)	158.0
Chlorides, (Cl)	24.1
Sulphates, (SO_4)	(-) 5
Nitrate, (NO_3)	2.60
Fluoride, (F)	0.64
Total Iron, (Fe)	
Copper, (Cu)	
Manganese, (Mn)	
Chromium, (Cr)	
Zinc, (Zn)	
Aluminum, (Al)	
Silica, (SiO_2)	
Lithium, (Li)	
Lead, (Pb)	
Phenol	
Sulfides as H_2S	
Total Hardness as $CaCO_3$	
Oil (chloroform extractable)	
[illegible] Dissolved Solids	243. @ 180°F.
[illegible] Suspended Solids	

BC LABORATORIES Inc.

By: J. J. Eglin

WATER DEVELOPMENT CORPORATION

BASIC-DATA REPORT
QUINTANA MINERALS CORPORATION
COPPER FLAT PROJECT
PRODUCTION WELL NO. 4,
HILLSBORO, NEW MEXICO

By
D.K. Greene and L. C. Halpenny

Tucson, Arizona
December 1980

BASIC-DATA REPORT

QUINTANA MINERALS CORPORATION
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D. K. Greene and L. C. Halpenny

GENERAL INFORMATION

A fourth production well (PW-4) has been drilled to assist in furnishing the water supply for ore processing and other uses at the Copper Flat Project. Location of PW-4 along with PW-1, PW-2, and PW-3, is shown on Figure 1. The legal description of PW-4 is as follows:

NW$\frac{1}{4}$ SW$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 31, T. 15 S., R. 5 W.

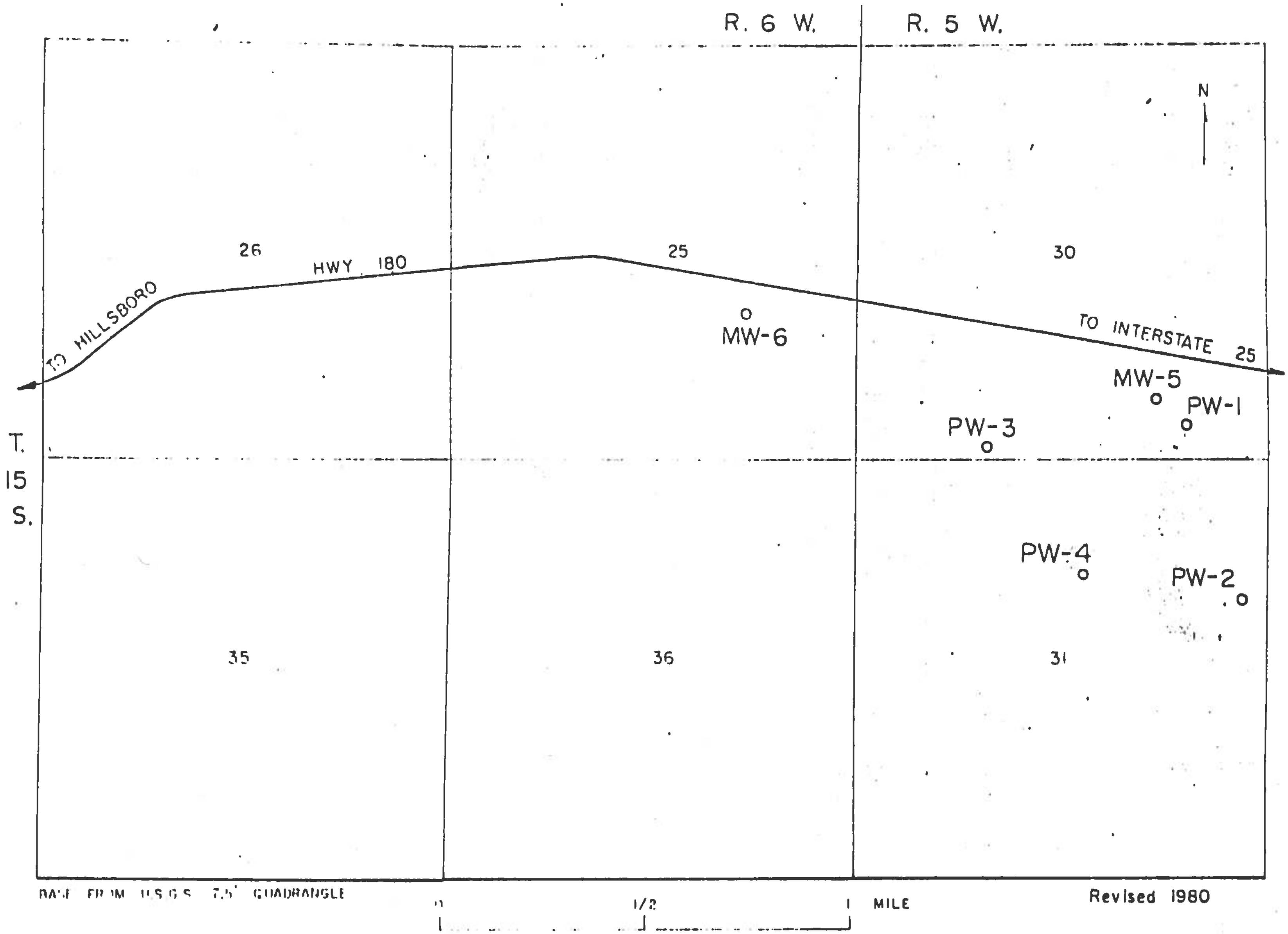

FIGURE 1.--MAP OF A PORTION OF TOWNSHIP 15 SOUTH, RANGES 5 AND 6 WEST, SIERRA COUNTY, NEW MEXICO, SHOWING LOCATIONS OF PRODUCTION WELLS AND MW-5 AND MW-6.

PW-4 was drilled by R. L. Guffey, Inc., Drilling Contractors of Las Cruces, New Mexico using rotary equipment and the conventional method of drilling. Considerable difficulty was encountered in drilling the upper 100 feet of hole due to boulders. A 12-inch pilot hole was drilled through this section and down to 400 feet. From 400 feet a 9-7/8-inch pilot hole was drilled to bottom depth of 957 feet. Following pilot hole drilling a 23-foot joint of 30-inch diameter surface pipe was set and cemented in place. The hole was then reamed to an ultimate diameter of 26 inches to a depth of 954 feet. An 18-inch pilot bit extended ahead of the 22-inch bit giving a hole diameter of 18-inches from 954 to 957 feet.

The hole was cased with 16-inch OD, 5/16-inch wall thickness, blank casing and 16-inch OD Johnson 100 slot Irrigator Screen. Open area in the Irrigator Screen amounts to 217 square inches per lineal foot. A 3-foot section of 16-inch OD, 5/16 inch wall thickness, blank casing was welded to the bottom of the Irrigator Screen.. This section of casing is tapered on the bottom end. The annular space was gravel packed with 1/8 to 3/8-inch gravel and the well was developed with the drilling rig by washing, jetting, and bailing.

Details on depth drilled, casing installed, etc., for PW-4 are as follows:

Depth drilled	957 feet
Casing installed	
Blank	0 to 354 feet
Screen	354 to 954 feet
Blank	954 to 957 feet
Gravel installed	110 yards
Rig development time	39 hours
Gravel slippage during rig development	55 feet

Upon completion of rig development the well was further developed and tested with a diesel powered turbine pump furnished by Western Pump and Supply Company of Deming, New Mexico. Data obtained during this phase of work are included in the following sections of this report along with logs for the well.

PRODUCTION WELL NO. 4
DRILLER'S LOG

(Prepared by R. L. Guffey, Inc. Drilling Contractors)

Depth From (ft)	To	Sample Description
0	23	Boulder gravel some clay
23	38	Hard black rock stks, clay
38	56	Stks. hard black rock gravel boulder some clay
56	73	Gravel some boulders and clay
73	96	Gravel and clay with boulders
96	156	Clay and gravel stks gravel
156	198	Gravel some sand with clay and clay stks.
198	233	Gravel and sand stks of red clay
233	275	Clay (red) stks gravel
275	281	Sand sandy clay
281	293	Clay stks gravel embedded in clay
293	309	Gravel some sand stks clay
309	407	Sand small gravel stks clay (sandy)
407	422	Clay stks gravel calcareous and sand
422	446	Clay some gravel embedded
446	532	Gravel and sand some clay stks
532	560	Gravel (larger) with clay
560	610	Gravel sand with some clay
610	764	Gravel some (clean) with clay stks, drilled tight
764	783	Gravel, gravel embedded in clay
783	805	Gravel some sand with clay
805	825	Gravel and clay (Bentonite)
825	835	Gravel clean with sand
835	877	Clay with gravel embedded
877	896	Gravel clean some clay lens
896	925	Gravel fine with sand (some clean)
925	957	Gravel embedded in clay

PRODUCTION WELL NO. 4

WADEVCO LOG

Depth (ft) From	To	Sample Description
0	20	Angular fragments of boulders which are exposed at land surface, 1/4" to 1/2" +.
20	30	Angular fragments of boulders, 1/4" to 1/2" +. Small amount of medium to coarse sand.
30	40	Angular fragments of boulders, 1/4" to 1/2" +.
40	50	Angular rock fragments, 1/8" to 1/4". Some silt and very fine sand.
50	70	Angular rock fragments, 1/4" to 1/2" +.
70	90	Angular rock fragments, 1/8" to 1/2" +. Some fine to medium sand.
90	100	Angular rock fragments, 1/8" to 1/2" +.
100	110	Angular rock fragments, 1/8" to 1/2" +. Some silt and clay.
110	120	Primarily angular rock fragments, 1/8" to 1/2". Few fragments are rounded.
120	130	Primarily angular rock fragments, 1/4" to 1/2". Several fragments of clay with embedded sand and gravel.
130	140	Angular rock fragments, $\pm$ 1/8". Some medium to very fine sand, silt, and clay.
140	160	Angular rock fragments, 1/8" to 1/4". Some medium to very fine sand, silt, and clay.
160	170	Angular rock fragments, 1/8" to 1/4". Some coarse to very fine sand.
170	180	Angular rock fragments, $\pm$ 1/8". Some coarse to very fine sand.
180	200	Medium to very coarse sand and gravel up to 1/8". Some silt.
200	220	Angular rock fragments, $\pm$ 1/8". Some coarse to very fine sand.
220	230	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.
230	240	Angular rock fragments, $\pm$ 1/8". Some very coarse to fine sand.
240	250	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
250	260	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand and silt. Several fragments of clay ± 1/8".
260	280	Angular rock fragments, ± 1/8". Some very coarse to fine sand.
280	300	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand.
300	310	Angular rock fragments, 1/8" to 1/4". Some very coarse to fine sand. Several clay fragments ± 1/8".
310	330	Gravel up to ± 1/8" with fine to very coarse sand. Several rock fragments ± 1/4". Several clay fragments ± 1/8".
330	340	Medium to very coarse sand with gravel up to 1/8". Few angular rock fragments ± 1/4".
340	360	Fine to very coarse sand and gravel. Some silt.
360	390	Very coarse sand and gravel. Some fine to medium sand.
390	400	Very coarse sand and gravel. Some fine to medium sand. Few small fragments of clay.
400	420	Angular rock fragments 1/4" to 1/2". Some medium to very coarse sand and gravel.
420	450	Very coarse sand and gravel to ± 1/8". Few rock fragments ± 1/4". Some medium to coarse sand.
450	460	Very coarse sand and gravel to ± 1/8". Some medium to fine sand. Few fragments of clay. Some silt.
460	490	Very coarse sand and gravel to ± 1/8". Some medium to fine sand.
490	500	Very coarse sand and gravel to ± 1/8". Some medium to fine sand. Several fragments of black vesicular material with sand grains embedded in some vesicles.
500	530	Very coarse sand and gravel to ± 1/8". Some medium to fine sand.
530	560	Angular rock fragments, 1/8" to 1/2" with fine to very coarse sand. Some silt.

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
560	590	Very coarse sand and gravel to ± 1/8". Fair number of angular rock fragments in 1/4" to 1/2" range. Several fragments of clay up to 1/2". Some silt.
590	620	Very coarse sand and gravel up to ± 1/8". Some medium to very fine sand and silt.
620	700	Very coarse sand and gravel up to ± 1/8". Some medium to fine sand.
700	730	Medium to very coarse sand with some gravel up to ± 1/8". Some fine sand and silt.
730	740	Medium to very coarse sand with some gravel up to ± 1/8". Some fine sand, silt, and clay fragments.
740	750	Medium to very coarse sand with some gravel up to ± 1/8".
750	760	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand.
760	780	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand. Several fragments of clay.
780	800	Very coarse sand and gravel up to ± 1/8". Some medium to fine sand.
800	810	Coarse to very coarse sand with some gravel up to ± 1/8". Some fine to medium sand. Few fragments of clay.
810	820	Very coarse sand and gravel up to ± 1/8". Several angular rock fragments ± 1/4". Some fine to medium sand and silt.
820	840	Very coarse sand and gravel up to ± 1/8". Some fine to medium sand.
840	850	Medium to very coarse sand and gravel up to ± 1/8". Several rock fragments ± 1/4". Silt and numerous fragments of clay.
850	870	Very fine to medium sand and silt with fragments of clay. Some coarse to very coarse sand with gravel up to ± 1/8".

PRODUCTION WELL NO. 4

WADEVCO LOG
(continued)

Depth From (ft)	To	Sample Description
870	880	Coarse to very coarse sand and gravel up to ± 1/8". Some fine to medium sand.
880	900	Coarse to very coarse sand. Some fine to medium sand.
900	910	Very fine to coarse sand.
910	920	Very fine to medium sand with some coarse sand.
920	957	Samples missing. Refer to Driller's Log.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
11-30-80	16:15	290.82		Measured with chain. Measuring point top of 3/4-inch pipe 0.86 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
12-01-80	07:35	290.87		Measured with chain.
	07:50	290.9		Measuring with sounder.
	09:50	290.9		
	10:15			Pump on. Ten-inch pump to 350-feet. Eight inch pump 350 to 550 feet. Top of 13.5 inch bowls set at 550 feet. Discharge pipe 10-inch. Orifice 7-inch.
	10:16	326.6		
	10:17	309.4	550	
	10:20	309.2		
	10:21	309.2	550	
	10:24		550	Lot of mud. 2.5 cc/l fine to very fine sand.
	10:25	309.5		
	10:28		550	Clearing some. 0.3 cc/l fine to very fine sand.
	10:30	309.4		
	10:38	309.4		
	10:40			Fairly clear. Slight mud color. < 0.1 cc/l very fine sand.
	10:44		550	Fairly clear. < 0.1 cc/l very fine sand.
	10:45	309.7		
	10:47			Surge once.
	10:52			Lot of mud. 1.5 cc/l medium to very fine sand.
	10:55			Lot of mud. 2.5 cc/l fine to very fine sand.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	10:56	310.6		
	11:05	310.7		Lot of mud. <0.1 cc/l very fine sand.
	11:11		550	Clearing some. <0.1 cc/l very fine sand.
	11:12	310.7		
	11:19			Fairly clear. <0.1 cc/l very fine sand.
	11:20			Surge once.
	11:25		550	Lot of mud. 2.5 cc/l fine to very fine sand.
	11:27			Still lot of mud. 1.0 cc/l fine to very fine sand.
	11:29	310.5		
	11:32			Less mud. <0.1 cc/l very fine sand.
	11:38	310.6		
	11:40		550	Less mud. <0.1 cc/l very fine sand.
	11:49			Fairly clear. Surge once.
	11:54		550	Lot of mud. 1.3 cc/l fine to very fine sand.
	11:56			Lot of mud. 0.9 cc/l fine to very fine sand.
	11:58			Lot of mud. 0.15 cc/l fine to very fine sand.
	12:00	310.9	550	
	12:11		550	Still muddy. <0.1 cc/l very fine sand.
	12:15			Fairly clear. Surge once.
	12:19		812	Lot of mud. 1.5 cc/l medium to very fine sand.
	12:21			Lot of mud. 0.5 cc/l fine to very fine sand.
	12:23	324.1		
	12:27		812	Still muddy. <0.1 cc/l fine to very fine sand.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	12:32	324.7		
	12:34			Fairly clear. Surge once.
	12:37			Lot of mud. 0.6 cc/l medium to very fine sand.
	12:38			Lot of mud. 1.2 cc/l fine to very fine sand.
	12:40		812	Lot of mud. 0.3 cc/l fine to very fine sand.
	12:34	324.0		
	12:52	324.4		
	12:53			Fairly clear. < 0.1 cc/l very fine sand.
	12:54			Surge twice.
	12:59			Lot of mud. 1.0 cc/l fine to very fine sand.
	13:00			Lot of mud. 0.6 cc/l fine to very fine sand.
	13:01		812	Lot of mud. 0.1 cc/l fine to very fine sand.
	13:03			Still muddy. 0.1 cc/l fine to very fine sand.
	13:12	323.8		
	13:15			Fairly clear. Surge twice.
	13:21			Lot of mud. 1.5 cc/l medium to very fine sand.
	13:23		812	Lot of mud. 0.1 cc/l fine to very fine sand.
	13:27			Still muddy. < 0.1 cc/l fine to very fine sand.
	13:29	323.1		
	13:31			Fairly clear. Surge twice.
	13:36			Lot of mud. 1.0 cc/l medium to fine sand.
	13:38			Lot of mud. 0.9 cc/l very fine sand and silt.
	13:47	322.5	812	Fairly clear. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-1-80	13:53		812	Lot of mud. 1.5 cc/l medium to very fine sand.
	13:55			Lot of mud. 0.15 cc/l fine to very fine sand.
	13:59		812	Still some mud. < 0.1 cc/l very fine sand.
	14:02	321.8		
	14:03			Fairly clear. Surge twice.
	14:08			Lot of mud. 0.5 cc/l medium to very fine sand.
	14:10		812	Lot of mud. 0.2 cc/l very fine sand and silt.
	14:18	321.2		
	14:20		812	Clearing some.
	14:22			Fairly clear. Surge twice.
	14:27		1,001	Lot of mud. 0.3 cc/l medium to very fine sand.
	14:28			Lot of mud. 0.3 cc/l medium to very fine sand.
	14:30			Still muddy. 0.1 cc/l very fine sand.
	14:32	329.0		
	14:40	329.8	1,001	
	14:41			Fairly clear. Surge twice.
	14:46			Lot of mud. 0.6 cc/l medium to very fine sand.
	14:48			Lot of mud. 0.1 cc/l very fine sand and silt.
	14:58	329.2	1,001	
	14:59			Fairly clear. Surge twice.
	15:04			Considerable mud and color. 0.5 cc/l medium to very fine sand.
	15:06		1,001	Considerable mud and color. 0.1 cc/l very fine sand.
	15:14	328.2	1,001	

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	15:15			Fairly clear. Surge twice.
	15:20			Considerable mud and color. 0.2 cc/l medium to fine sand.
	15:22		1,001	Considerable mud and color. 0.1 cc/l very fine sand.
	15:29	327.8	1,001	
	15:30			Fairly clear. Surge twice.
	15:35			Considerable mud and color. 0.2 cc/l fine to very fine sand.
	15:37			Considerable mud and color. < 0.1 cc/l very fine sand.
	15:44	327.2	1,001	
	15:45			Fairly clear. Surge twice.
	15:50			Considerable mud and silt. 0.2 cc/l medium to very fine sand.
	15:52			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	15:59	326.5	1,001	
	16:00			Fairly clear. Surge twice.
	16:05			Considerable mud and silt. 0.1 cc/l fine to very fine sand.
	16:07			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	16:14	326.2	1,001	
	16:15			Fairly clear. Surge twice.
	16:17			Considerable mud and silt. 0.2 cc/l fine to very fine sand.
	16:19			Considerable mud and silt. 0.1 cc/l very fine sand and silt.
	16:29	326.1	1,001	
	16:30			Fairly clear. Surge twice.
	16:35		1,251	Lot of mud and silt. 0.2 cc/l fine to very fine sand.
	16:44	335.9		
	16:45			Fairly clear. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	16:50			Lot of mud and color. 0.15 cc/l fine to very fine sand.
	16:52			Lot of mud and silt. < 0.1 cc/l very fine sand.
	16:59	335.9	1,251	
	17:00			Fairly clear. Surge twice.
	17:29	336.7	1,251	
	17:30			Fairly clear. Surge twice.
	17:35			Lot of color. 0.1 cc/l very fine sand.
	17:44	335.5	1,251	
	17:45			Fairly clear. Surge twice.
	17:59	335.4	1,251	Surge twice.
	18:00		1,404	Changed to 8-inch orifice.
	18:05	337.9	1,404	Fairly clear.
	19:00	341.2		Surge twice. Some color 0.1 cc/l very fine sand.
	19:15	339.9	1,370	Some color. 0.1 cc/l very fine sand.
	19:39	339.6	1,370	Surge twice. Some color.
	19:43		1,404	Some color. 0.2 cc/l very fine sand.
	20:00	339.9	1,387	Surge twice.
	20:05		1,404	Clear, then some color.
	20:30	339.5	1,370	Clearing.
	20:35		1,529	Clear, then some color.
	21:00	346.9	1,543	Some color. Surge twice.
	21:07			T = 76°F; K = 360 micromhos. < 0.1 cc/l very fine sand.
	21:30	346.7	1,500	Clearing. Surge twice.
	21:37			Clear, then color. < 0.1 cc/l very fine sand.
	22:03	345.9	1,500	Clear. Surge twice.
	22:10		1,529	Clear, then some color. 0.1 cc/l very fine sand.
	22:30	345.2	1,529	Clearing. Very little color. Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-01-80	23:07		1,613	Color, clearing fast. No sand.
12-02-80	01:00	348.3	1,585	Clear. Surge twice.
	01:07		1,613	Color, < 0.1 cc/l very fine sand.
	01:30	346.5	1,557	Clear. Surge twice.
	01:37	[illegible]	1,613	Some color. Clearing fast. < 0.1 cc/l very fine sand.
	02:00	345.0	1,529	Clear. Surge twice.
	02:05		1,613	Clear, then some color. < 0.1 cc/l very fine sand.
	02:35	350.2	1,627	Clear. Surge twice.
	02:40		1,697	Clear, then color. < 0.1 cc/l very fine sand.
	03:30	352.6	1,697	Clear. Surge twice.
	03:35			Color. Clearing. No sand. T = 76°F; K = 380 micromhos.
	04:00	352.7	1,711	Surge twice.
	04:07			Color. No sand.
	04:30	352.3	1,711	Surge twice.
	04:37		1,791	Clear, then some color. No sand.
	05:30	355.9	1,791	Clear. Surge twice.
	05:37		1,791	Some color. No sand.
	06:00	356.2	1,791	Clear. Surge twice.
	06:07		1,791	Color. No sand.
	06:30	356.9	1,795	
	07:10	356.2	1,791	Clear. Surge twice.
	07:15		1,865	Color. No sand.
	07:24	357.4	1,865	Clear. Surge twice.
	07:30			Color. No sand.
	07:31			Starting to clear.
	07:42	358.3	1,865	Clear. Surge twice.
	07:48			Color. No sand.
	07:52	357.2	1,865	Clear. Surge twice.
	07:57			Color. No sand.
	07:59			Clearing.
	08:05			Surge twice.

PRODUCTION WELL NO. 4

DEVELOPMENT DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-02-80	08:11			Color. No sand.
	08:15	357.0	1,865	Surge twice.
	08:21		2,005	Color. No sand.
	08:23		1,975	Clear.
	08:25	359.2		
	08:28		1,975	Clear. Surge twice.
	08:31		1,975	Slight color.
	08:32			Clearing.
	08:34			Clear.
	08:35	359.0	1,975	
	08:36			Reduced rpm.
	08:39	355.7	1,809	Clear.
	08:48			T = 76^{o}F; K = 380 micromhos.
	08:53	356.8		
	09:23	357.6	1,823	Clear.
	09:40	357.5	1,809	Clear. No sand.
	09:55	357.6	1,809	Clear. No sand.
	10:05	357.7	1,808	Clear. No sand.
	10:15			Pump off.
	10:16	292.2		
	10:17	299.7		
	10:18	299.4		
	10:19	298.9		
	10:20	298.4		
	10:32	295.7		
	10:45	295.2		

PRODUCTION WELL NO. 4

TEST DATA

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	07:25	291.75		Measured with chain. Same measuring point as for development.
	07:30	291.7 -1.36 = 290.3 GL		Measuring with sounder.
	07:45	291.7		
	08:00			Pump on. Same setting as for development.
	08:01	337.8	1,711	Some color.
	08:02	341.9		Some color. Trace of sand.
	08:03	343.4	1,711	Clearing. No sand.
	08:04	344.4		
	08:05	344.9	1,711	
	08:06	345.5		Slight mud color. Few grains of sand.
	08:07	345.9		
	08:08	346.3	1,711	
	08:09	346.5		Clear. No sand.
	08:10	346.7	1,711	
	08:11	346.9		
	08:12	347.2		
	08:13	347.6		
	08:14	347.6	1,711	
	08:15	347.6		
	08:16	347.6		
	08:17	348.0		
	08:18	348.2	1,711	Clear. No sand.
	08:19	348.3		
	08:20	348.3		
	08:21	348.4		
	08:22	348.5	1,711	
	08:24	348.8		
	08:26	348.9		
	08:28	348.9		
	08:30	349.0		
	08:32	349.0		
	08:34	349.2	1,711	

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	08:36	349.6		
	08:38	349.7		
	08:40	349.7		
	08:44	349.9		Clear. No sand.
	08:46	349.9	1,711	
	08:48	350.1		T = 76°F; K = 380 micromhos.
	08:50	350.3		
	08:52	350.3		
	08:54	350.4		
	08:56	350.5	1,711	
	08:58	350.7	1,711 +	Decreased rpm slightly.
	09:00	350.6		
	09:05	350.4		
	09:10	350.6		
	09:15	351.1	1,725	Decreased rpm slightly.
	09:20	351.0	1,711 +	Decreased rpm slightly.
	09:25	351.0		
	09:30	351.1		
	09:35	351.2	1,711 +	Decreased rpm slightly.
	09:40	351.2	1,711	
	09:50	351.3	1,711	
	10:00	351.5	1,711	
	10:10	351.5	1,711	
	10:20	351.8	1,711 +	Decreased rpm slightly.
	10:30	351.7	1,711 +	Decreased rpm slightly.
	10:40	351.7	1,711	
	10:50	351.9	1,711	
	11:00	351.8	1,711 -	Increased rpm slightly.
	11:20	351.9	1,711	
	11:30	352.3	1,711	
	11:45	352.3	1,711 +	Decreased rpm slightly.
	12:00	352.3	1,711	
	12:15	352.5	1,711 +	Decreased rpm slightly.
	12:30	352.4	1,711	
	13:00	352.7	1,711	

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-03-80	13:30	352.7	1,711	
	14:00	352.8	1,711	
	14:30	352.8	1,711	
	15:00	353.0	1,711	
	15:30	353.0	1,711	
	16:00	353.2	1,711	
	16:05			T = 76°F; K = 380 micromhos.
	16:30	353.3	1,711	
	17:00	353.4	1,711	
	17:30	353.4	1,711	
	18:00	353.5	1,711	
	18:30	353.4	1,711	
	19:00	353.4	1,711	
	19:30	353.4	1,711	
	20:00	353.9	1,711 +	Decreased rpm slightly.
	20:30	353.7	1,711	
	21:00	353.4	1,697	Increased rpm slightly.
	21:30	353.6	1,711	
	22:00	353.9	1,711	
	22:30	353.8	1,711	
	23:00	353.8	1,711	T = 76°F; K = 380 micromhos.
	23:30	354.1	1,711	
12-04-80	00:00	354.5	1,711	
	00:30	354.6	1,711	
	01:00	354.9	1,711	
	01:30	355.0	1,711 +	Decreased rpm slightly.
	02:00	355.3	1,711 +	Decreased rpm slightly.
	02:30	355.5	1,725	Decreased rpm slightly.
	03:00	354.5	1,711	
	03:30	354.5	1,711 +	Decreased rpm slightly.
	04:00	354.3	1,711	
	04:30	354.3	1,711	
	04:46			Engine stopped, wire to fuel pump solenoid broke.

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-04-80	04:50	298.9		
	04:51	298.7		
	04:52	298.3		
	04:53	298.1		
	04:54	297.9		
	04:55	297.7		
	04:56	297.6		Pump back on.
	05:00	348.7	1,711	
	05:22	352.8	1,711	
	05:30	353.1	1,711	
	06:00	353.7	1,711	
	06:30	354.0	1,711 +	Decreased rpm slightly.
	07:00	353.7	1,711	
	07:30	353.9	1,711	
	07:45			T = 76°F; K = 380 micromhos. Collected samples.
	07:55	353.4	1,711	
	08:00			Pump off.
	08:01	283.1		
	08:02	299.0		
	08:03	299.8		
	08:04	299.4		
	08:05	299.1		
	08:06	298.7		
	08:07	298.5		
	08:08	298.3		
	08:09	298.0		
	08:10	297.8		
	08:11	297.6		
	08:12	297.5		
	08:13	297.4		
	08:14	297.2		
	08:15	297.2		
	08:20	296.7		
	08:25	296.2		
	08:30	296.0		

PRODUCTION WELL NO. 4

TEST DATA
(continued)

Date	Hour	Depth to Water (ft)	Discharge (gpm)	Remarks
12-04-80	08:35	295.8		
	08:40	295.5		
	08:45	295.5		
	08:50	295.2		
	08:55	295.1		
	09:00	295.0		
	09:10	294.9		
	09:20	294.6		
	09:30	294.5		
	09:40	294.4		
	09:50	294.3		
	10:00	294.2		
	10:15	294.0		
	10:30	293.8		
	10:45	293.8		
	11:00	293.7		
	11:30	293.5		

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-1 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:35	329.04	Measured with chain. Measuring point hole in plate over casing 0.87 foot above top of surface pipe. Surface pipe approximately 0.2 foot above land surface.
11-30-80	15:08	328.76	Measured with chain.
	15:28		Set wire with tape mark at 328.76.
12-01-80	08:09	328.68	
	10:15		PW-4 on for development.
	17:18	329.24	
12-02-80	02:15	330.21	
	09:07	330.70	
	10:15		PW-4 off.
12-03-80	07:25	329.44	
	08:00		PW-4 on for test.
	08:28	329.49	
	09:00	329.71	
	09:20	329.82	
	09:35	329.90	
	09:50	329.94	
	10:10	330.02	
	10:25	330.06	
	10:45	330.13	
	11:25	330.24	
	11:40	330.26	
	12:40	330.42	
	13:40	330.51	
	14:40	330.61	
	15:40	330.68	
	16:40	330.76	
	17:40	330.86	
	19:10	330.95	
	20:10	331.06	
	21:10	331.13	
	22:10	331.43	
	23:10	331.22	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-1 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-04-80	00:10	331.24	
	01:10	331.25	
	02:10	331.30	
	03:10	331.33	
	04;10	331.34	
	05:10	331.29	
	06:10	331.32	
	07:10	331.39	
	08:00		PW-4 off.
	08:45	331.21	
	09:00	331.14	
	09:15	331.07	
	09:30	331.00	
	10:15	330.85	
	10:30	330.78	
	11:10	330.67	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-2 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:50	307.46	Measured with chain. Measuring point hole in plate over casing 0.90 foot above top of surface pipe. Surface pipe approximately 0.5 foot above land surface.
11-30-80	15:40	307.29	Measured with chain.
	15:55		Set wire with tape mark at 307.29.
12-01-80	08:15	307.32	
	10:15		PW-4 on for development.
	17:22	307.97	
12-02-80	02:25	309.74	
	06:50	310.40	
	09:15	310.71	
	10:15		PW-4 off.
12-03-80	07:32	308.79	
	08:00		PW-4 on for test.
	08:33	308.94	
	09:05	309.10	
	09:25	309.18	
	09:40	309.23	
	09:55	309.31	
	10:15	309.42	
	10:30	309.49	
	10:50	309.57	
	11:30	309.71	
	11:45	309.77	
	12:45	310.01	
	13:45	310.13	
	14:45	310.35	
	15:45	310.52	
	16:45	310.73	
	17:45	310.92	
	19:15	311.17	
	20:15	311.30	
	21:15	311.46	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-2 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-03-80	22:15	311.58	
	23:15	311.67	
12-04-80	00:15	311.76	
	01:15	311.83	
	02:15	311.91	
	03:15	311.98	
	04:15	312.07	
	05:15	312.04	
	06:15	312.17	
	07:15	312.22	
	08:00		PW-4 off.
	08:50	312.01	
	09:05	311.93	
	09:20	311.82	
	09:35	311.74	
	10:20	311.44	
	10:35	311.33	
	11:30	311.10	

PRODUCTION WELL NO. 4

TEST DATA

(Observation Well PW-3 Water Levels)

Date	Hour	Depth to Water (ft)	Remarks
11-17-80	11:10	353.22	Measured with chain. Measuring point hole in plate over casing 1.3 feet above surface pipe. Surface pipe approximately 1 foot above land surface.
11-30-80	14:23	352.92	Measured with chain.
	14:55		Set wire with tape at 352.92.
12-01-80	08:03	352.80	
	10:15		PW-4 on for development.
	17:13	353.18	
12-02-80	02:15	353.93	
	06:44	354.20	
	09:00	354.29	
	10:15		PW-4 off.
12-03-80	07:39	353.43	
	08:00		PW-4 on for test.
	08:23	353.47	
	08:55	353.64	
	09:30	353.77	
	09:45	353.79	
	10:00	353.83	
	10:20	353.86	
	10:35	353.91	
	11:20	353.98	
	11:35	354.01	
	12:35	354.06	
	13:35	354.12	
	14:35	354.16	
	15:35	354.24	
	16:35	354.28	
	17:35	354.34	
	19:05	354.41	
	20:05	354.48	
	21:05	354.57	
	22:05	354.59	
	23:05	354.65	

PRODUCTION WELL NO. 4

TEST DATA
(Observation Well PW-3 Water Levels)
(continued)

Date	Hour	Depth to Water (ft)	Remarks
12-04-80	00:05	354.63	
	01:05	354.65	
	02:05	354.68	
	03:05	354.69	
	04:05	354.74	
	05:05	354.67	
	06:05	354.74	
	07:05	354.78	
	08:00		PW-4 off.
	08:55	354.60	
	09:10	354.55	
	09:25	354.51	
	10:10	354.40	
	10:25	354.37	
	10:45	354.31	

Appendix C2.

MW-9 Pumping Test, 1994

APPENDIX C

LAS ANIMAS CREEK

PUMPING TEST

Prepared for:

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September 12, 1996
Report 1356A/960912

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LIST OF ATTACHMENTS

1. INTRODUCTION

Water supply for the Copper Flat project is to be drawn from Santa Fe Formation alluvium in the valley of the Rio Grande. Water is to be removed from four wells approximately one mile north of the Las Animas Creek valley. This valley contains a shallow aquifer and an intermittent stream, which supply water for a wide range of agricultural and water supply activities, as well as support a major stand of deciduous trees.

In order to evaluate the extent to which the stream flow and the water in the shallow aquifer may be affected by the drawdown from the nearby pumping wells, a major pumping test was designed and performed in Animas Creek. This test comprised the installation of a pumping well in the main Santa Fe aquifer, located some 200 feet below the ground surface in the valley. Water was pumped from this well to create a drawdown which would simulate the drawdown expected from the production pumping. The response to this pumping was monitored in one well completed at the top of the saturated section in the Santa Fe formation, at a depth of approximately 80 feet. In addition, the response of the overlying Las Animas Creek shallow aquifer was monitored by one specially completed shallow monitor well, as well as a total of seven other shallow private wells in the area. The pumping test was performed in October, 1994. This appendix presents the test approach, test results, and an interpretation of the results.

2. APPROACH

The pumping test was performed in the Las Animas Creek Valley at the point closest to the mine's water supply wells, as shown in Figure 1. The test location geology comprises 20-60 feet of reworked gravels which form a recent alluvium layer, overlying several thousand feet of Santa Fe Group gravels, sands, and silts.

A number of nearby private wells draw water from the Las Animas Creek alluvium, most are less than 100 feet deep, tapping the recent alluvium. Water levels in these wells are typically within a few feet of ground surface, and appear to be associated with stream levels (when the stream flows). This aquifer provides groundwater for domestic and stock watering wells in the area. Several wells are completed at approximately 100 feet or greater. These wells display a chemical signature distinct from the alluvial well water and a water level about 50 feet lower than the shallow wells.

Las Animas Creek is an intermittent stream. The stream was flowing when sampled in August 1994, but was not flowing at the time of the pumping test in October 1994. Water quality is generally good.

3. TEST ARRANGEMENT

Figure 2 shows the locations of the three wells which were installed for the test. Details of each well are provided in Attachment 1. The three wells were completed as follows:

1. Pumping well MW-9. The pumping well is MW-9. This well is drilled to a depth of 252.5 feet through the Las Animas Creek alluvium into the Santa Fe Formation. It is open to the formation from 194 feet to total depth. The well was screened with 4 ½ inch Schedule 80

slotted PVC, and cased with 4 ½ inch Schedule 80 blank PVC pipe. The well was fitted with a 100 gpm submersible pump.

2. Monitor well MW-10. MW-10 is located approximately 50 feet east of MW-9. It was drilled to a depth of 125 feet, and screened between 76.5 feet and total depth in the Santa Fe alluvium.

3. Monitor well MW-11. MW-11 is located approximately 50 feet southeast of MW-9. MW-11was initially drilled to a depth of 65 feet. After logging the hole, it was backfilled to a depth of 37 feet, sealed with bentonite, and screened from 7 to 37 feet BGS with a gravel pack.

Figure 3 shows the generalized geology of the three wells. The initial water levels are shown for reference.

In addition to these three wells, the test was monitored by measuring water levels in nearby domestic, irrigation, and water supply wells. The wells used were as follows:

Well Name	Location Relative to MW-9	Drilling method	Approx. Depth (ft)
Irwin House- "Birdie"	250 feet southwest	Hand dug	40
Irwin Yard- "Concrete"	150 feet due south	Hand dug	30
Exten	1250 feet west	Hand dug	25
Nicholson	1350 feet east	Hand dug	25
Cox	2200 feet east	Drilled	112
Darling	2700 feet east	Hand dug	25
PW-1	3400 feet south	Drilled	1000

4. TEST RESULTS

4.1 Pre-test activities

Prior to the test, all wells were measured daily for 17 days, to establish a trend for groundwater levels (if any).

4.2 Pumping Test Operation

The test was operated by starting the pump generator on October 13, 1994 at 12:30 p.m. Initially water was discharged to a location approximately 200 feet from the well. It was discovered that this location was too close to the monitor wells, as the water level began to rise slightly in MW-11. The test was temporarily shut down on October 14 from 13:32 to 16:30 to change the location of the discharge, with the new discharge point being located approximately one mile from the pumping well. During operating periods, the pumped flow rate averaged 90 gpm. Flows are shown on Figure 4. The test ended at 09:00 on October 17. Water levels were measured every day for 12 days following the test.

Water levels were monitored using water level sounders, which were calibrated against each other to the nearest one hundredth foot. Reading frequency depended on the changes in the levels; pre- and post-test levels were generally read daily, while test rates ranged from hourly to once per shift. Results of water level monitoring are presented in Attachment 2.

4.3 Rainfall event

On October 14, a nearby rain gauge measured 1 inch of rain in 2.5 hours in the Las Animas Creek drainage basin. The creek began to flow, and water levels in the wells changed in response to the rain and the flow.

5. RESULTS

5.1 Flows

Flows from the pumped well (MW-09) were recorded using a flow meter. The results are presented in Figure 4. The flow fluctuated somewhat, with an average flow rate of 90 gpm.

5.2 Heads

Heads were measured in all project wells, but were measured more frequently in the three main wells installed for the project. The results are as follows:

1. MW-09. The initial water level elevation in the pumping well was approximately 4,375 feet. The response of MW-9 to pumping is indicated in Figure 5. As can be seen, drawdown was rapid and reversible, and reached approximately 24 feet at the end of the test. Specific capacity of the well was 3.75 gpm/ft.
2. MW-10. The initial water level elevation in the deeper of the two monitor wells was 4,376 feet, about the same as the pumping well. The response to the pumping is indicated in Figure 6. A drawdown of approximately 1 foot was recorded at the well, although it is possible that this value was affected by the rainfall which occurred late in the test.
3. MW-11. The initial water elevation in the shallowest well, completed in the Las Animas Creek alluvium, was 4,435 feet, approximately 60 feet higher than the two deeper wells. The response of the level in MW-11 during the test is presented in Figure 7 (note very expanded vertical scale on this graph). The rise in water level after the start of the test on October 14 is due to the local discharge of water on the ground nearby. There is no evidence that pumping in MW-9 effected a head change in MW-11 at any time during the test; the level in the well was falling prior to the test, and continued to fall after it.

In addition to monitoring the three main wells, a total of seven other wells were monitored. All were relatively shallow, and all were near the pumping well. Figure 9 presents a magnified view of the pumping test wells' head responses. The general trend of these well results is as follows:

1. a small rise for the first few days after pumping began
2. a return to the previous rate of decrease after the rise.

Prior to the pumping test, the "Birdie" shallow aquifer well was falling at 0.02 ft/day. After the discharge incident, the rate of decline remained the same. There is no identifiable evidence of any impact on these wells of the drawdown created by MW-09.

5.3 PW-1 Response

To check if there was any effect of the drawdown in the extraction wells, pumping well PW-1 was monitored. This well is located 3500 feet to the south of MW-9. The water level elevation in this well was 4375 feet for the period during which the test was run. During the test, the water level in PW-1 did not change in any way attributable to MW-9.

6. ANALYSIS OF RESPONSES

6.1 MW-09 response

The hydraulic characteristics of the aquifer tapped by MW-09 have been estimated by a variety of non-equilibrium methods, using the Aqtesolve Package (Gerahty and Miller, 1995). Three approaches were used to analyze the first 24 hour drawdown period, with the following results (Figure 10, Figure 11, and Figure 12):

Method	Cooper-Jacob	Theis	Hantush	Average
Transmissivity (ft^2/min)	0.6086	0.5779	0.5666	0.5700
Storage Coefficient	$3.3x10^{-5}$	$6.1x10^{-5}$	$7.3x10^{-5}$	$5x10^{-5}$
Horizontal hydraulic conductivity (ft/yr)	6,400	6,075	5,960	6,000
Vertical hydraulic conductivity (ft/yr)	n/a	n/a	60	60

The Hantush analysis is particularly interesting, as the fit is good between the observed and the predicted behavior. In this analysis, it is assumed that there is leaky flow through an aquitard (on the bottom or top of the aquifer, or both). The vertical hydraulic conductivity of the leaky aquitards can be estimated from the response. The value obtained is 60 ft/yr. The vertical to horizontal anisotropy ratio obtained for the test is 100:1.

In summary, it would appear that MW-09 is located in a material with a hydraulic conductivity of approximately 6,000 ft/yr, with a storage coefficient of $5x10^{-5}$, and a ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity of 100:1. These values are very similar to the calibrated values which have been used in the modeling (Appendix D).

6.2 Las Animas Creek aquitard conductivity

The conductivity of the aquitard below the Las Animas Creek alluvium can be estimated by consideration of the head difference in the aquifer. The vertical head gradient between MW-11 (completed in the Las Animas Creek alluvium) and MW-10 (completed in the Santa Fe Formation) can be computed as follows: 60'?

Head difference MW-10 to MW-11 = 23 feet

Thickness of low permeability layer = 50 feet

Head gradient = 23/50 = 0.46

This is a substantial vertical gradient. From modeling, it appears that there is approximately 13 miles of Las Animas Creek bottom land, with an average width of 2,000 feet. The total flow down the valley appears to be in the order of 2,000 gpm. If half of the water were to seep from the upper alluvium to the lower through the low permeability layer between the two wells above, then the hydraulic conductivity would have to be: evidence? but in the lower part, it seeps up!

$$K = Q/iA$$

where: K = hydraulic conductivity (ft/yr)

Q = flow (1,000 gpm or 70×10^6 cuft/yr)

i = hydraulic gradient = 0.46

A = flow area (5 square miles or 150×10^6 square feet)

Applying the values produces a vertical hydraulic conductivity estimate of 1.0 ft/yr, or about 10^{-6} cm/sec. This is the vertical conductivity of a clayey material.

6.3 Water Chemistry

As a part of the evaluation, water chemistry was sampled from the test wells. The results are included in the data presented in Appendix E. The chemistry of the water is summarized below:

Parameter	Units	MW-9	MW-10	MW-11	PW-1
TDS	mg/L	190	310	314	217
HCO_3	mg/L	149	262	263	144
SO_4	mg/L	12	25	21	10
Ca	mg/L	12	59	63	22
Na	mg/L	54	29	23	38
Mg	mg/L	1	8	10	n/a

The chemistry of wells MW-10 and MW-11 are very similar, indicating that the water in the upper portion of the Santa Fe aquifer is provided by seepage from the overlying Las Animas Creek alluvium through a low permeability layer to the MW-10 level. Conversely, the chemistry of MW-9 differs from MW-10 and MW-11, and is very similar to PW-1. This suggests MW-9 comprises underflow beneath Las Animas Creek, not flow from it.

6.4 Conceptual Model

Based on the observations from the Las Animas Creek pump test a conceptual flow model of this system has been developed and quantified:

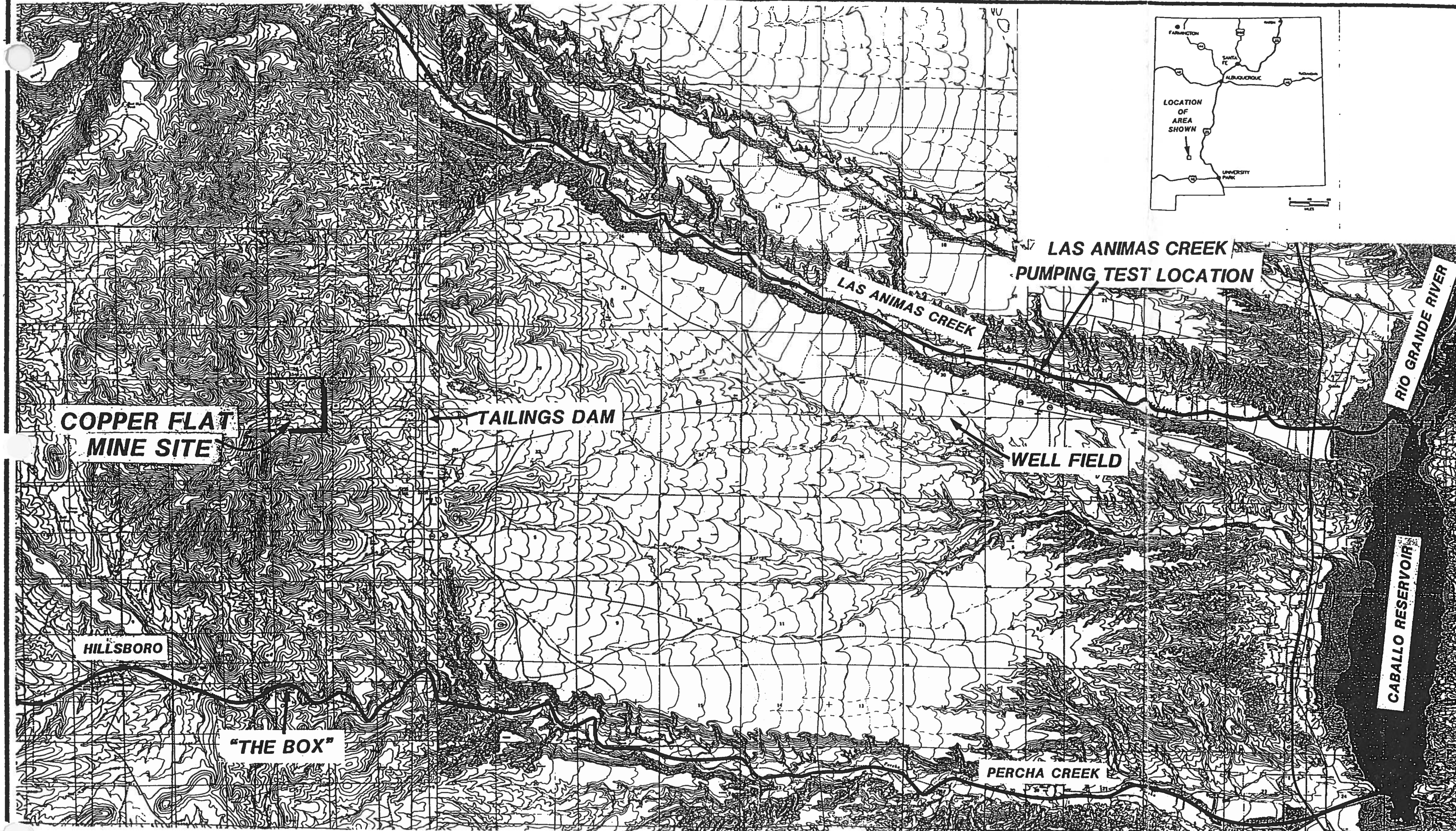
1. Water flows along Las Animas Creek, filling the associated alluvial aquifer.
2. Water leaks from the Las Animas Creek alluvial aquifer through the underlying clayey material. Analysis of this flow and the head gradient identified in the test produces a vertical hydraulic conductivity of 1 ft/yr.
3. This infiltrating water then meets with, and mixes with, water in the main Santa Fe aquifer. This aquifer is made up of relatively high permeability material, with a lateral hydraulic conductivity of about 6,000 ft/yr. The vertical permeability of this material is approximately 100 times less than its effective horizontal conductivity.

This system provides the explanation as to why the Las Animas alluvium remains saturated; the low conductivity of the underlying clayey material is sufficiently low to prevent water from leaving the alluvium, even under the strong vertical head which exists through the layer.

7. CONCLUSIONS

The Las Animas Creek alluvial system pump test has established that the creek and the associated alluvium is prevented from leaving the valley by a low permeability zone beneath the alluvial aquifer. This zone is estimated to have an hydraulic conductivity of no more than 1 ft/yr. The lower material in the Santa Fe aquifer is comprised of layers of high horizontal hydraulic conductivity materials (K = 6,000 ft/yr) and layers of low vertical conductivity aquitards (K = 60 ft/yr, or 1/100 of the horizontal conductivity).

While there is some evidence to suggest that the material between the Las Animas Creek alluvium is unsaturated (Attachment 1) the testing data does not provide a demonstration of a widespread unsaturated material beneath the creek bed.



ADRIAN BROWN CONSULTANTS, INC.

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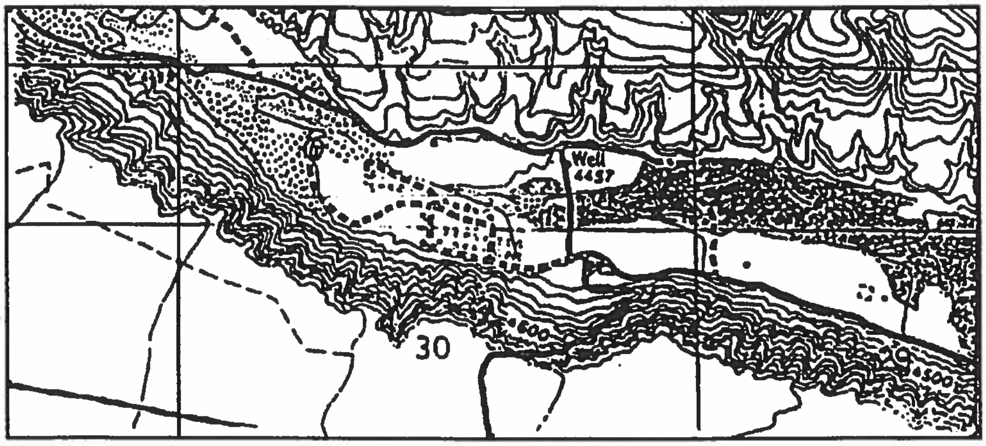
LOCATION MAP

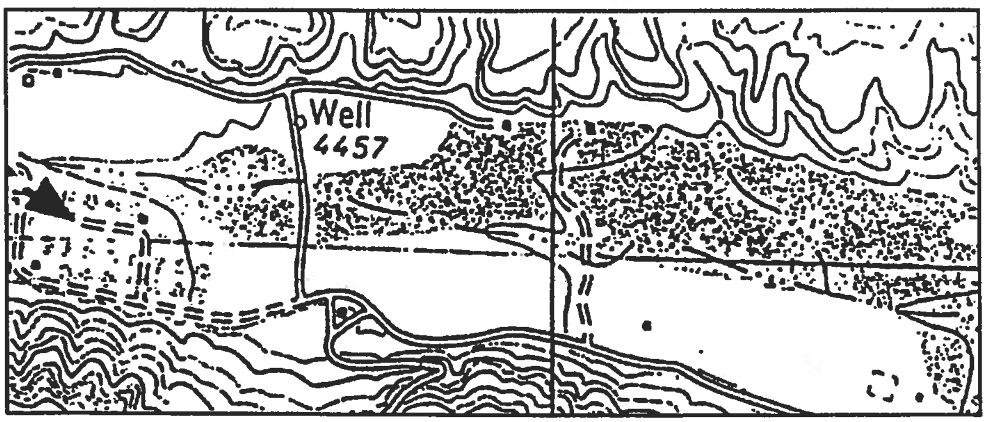
Figure 1

08276

Figure 2 Pump test location map



1" = 2000'



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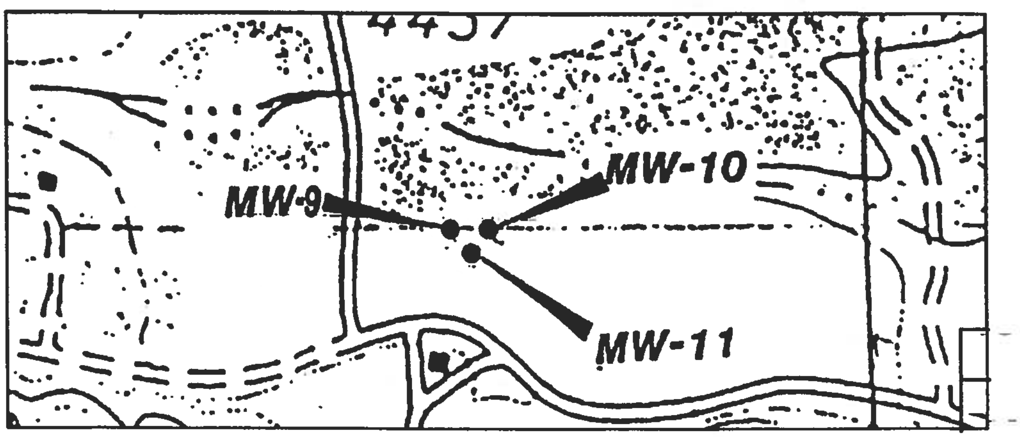


1" = 500'

Figure 3 Generalized geology of pumping test wells

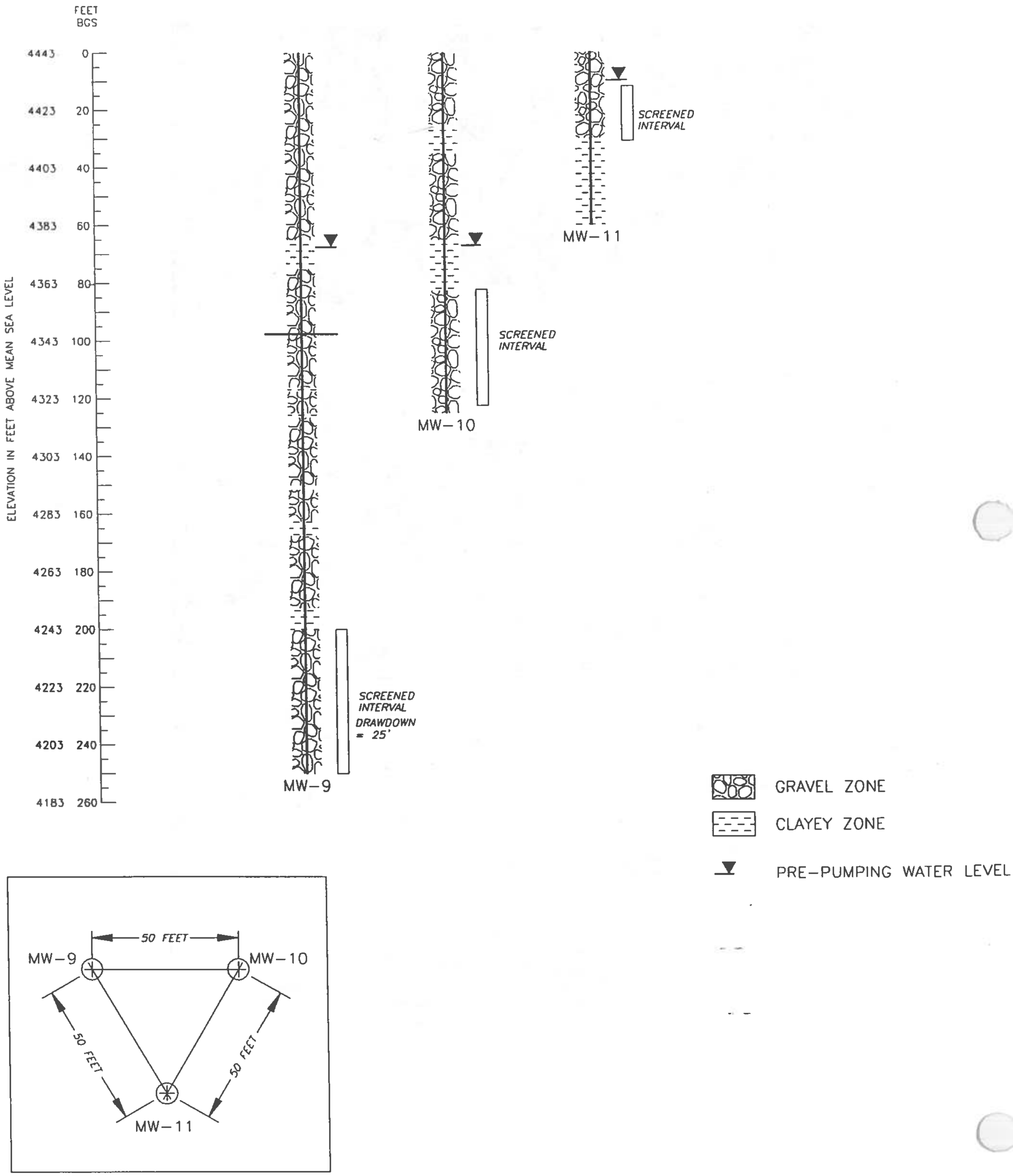


Figure 4 Flow from MW-9

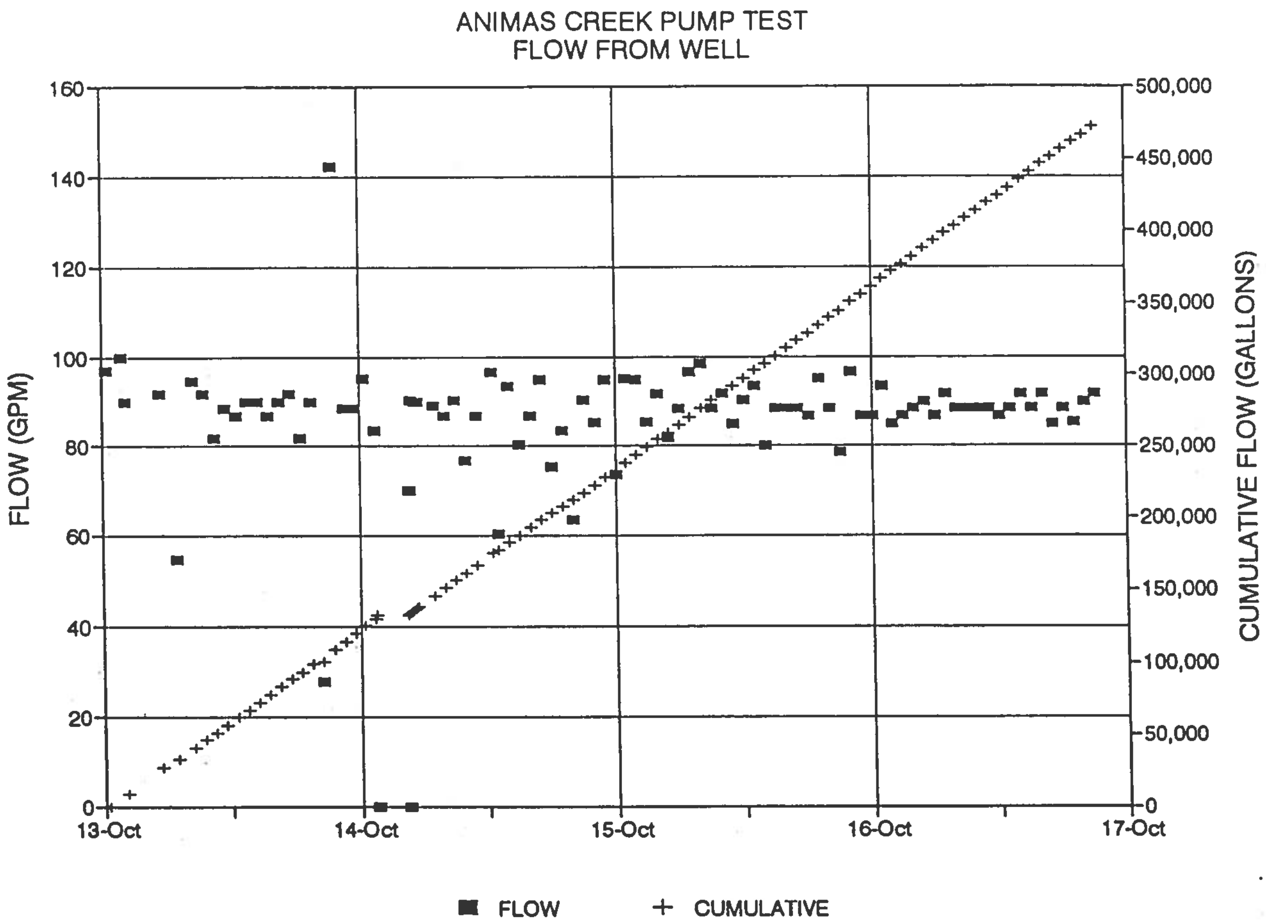


Figure 5 Drawdown in MW-9

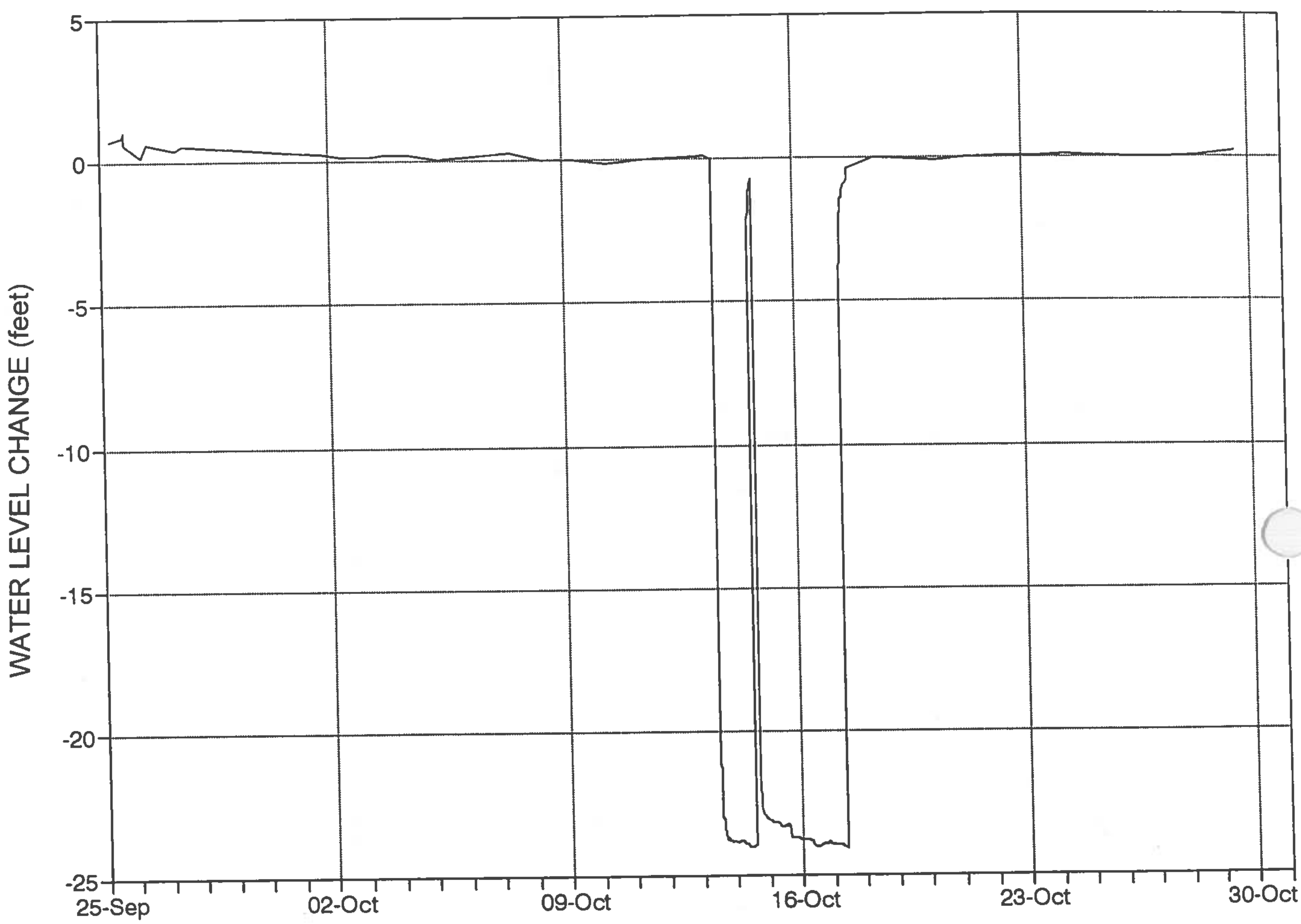


Figure 6 Drawdown in MW-10

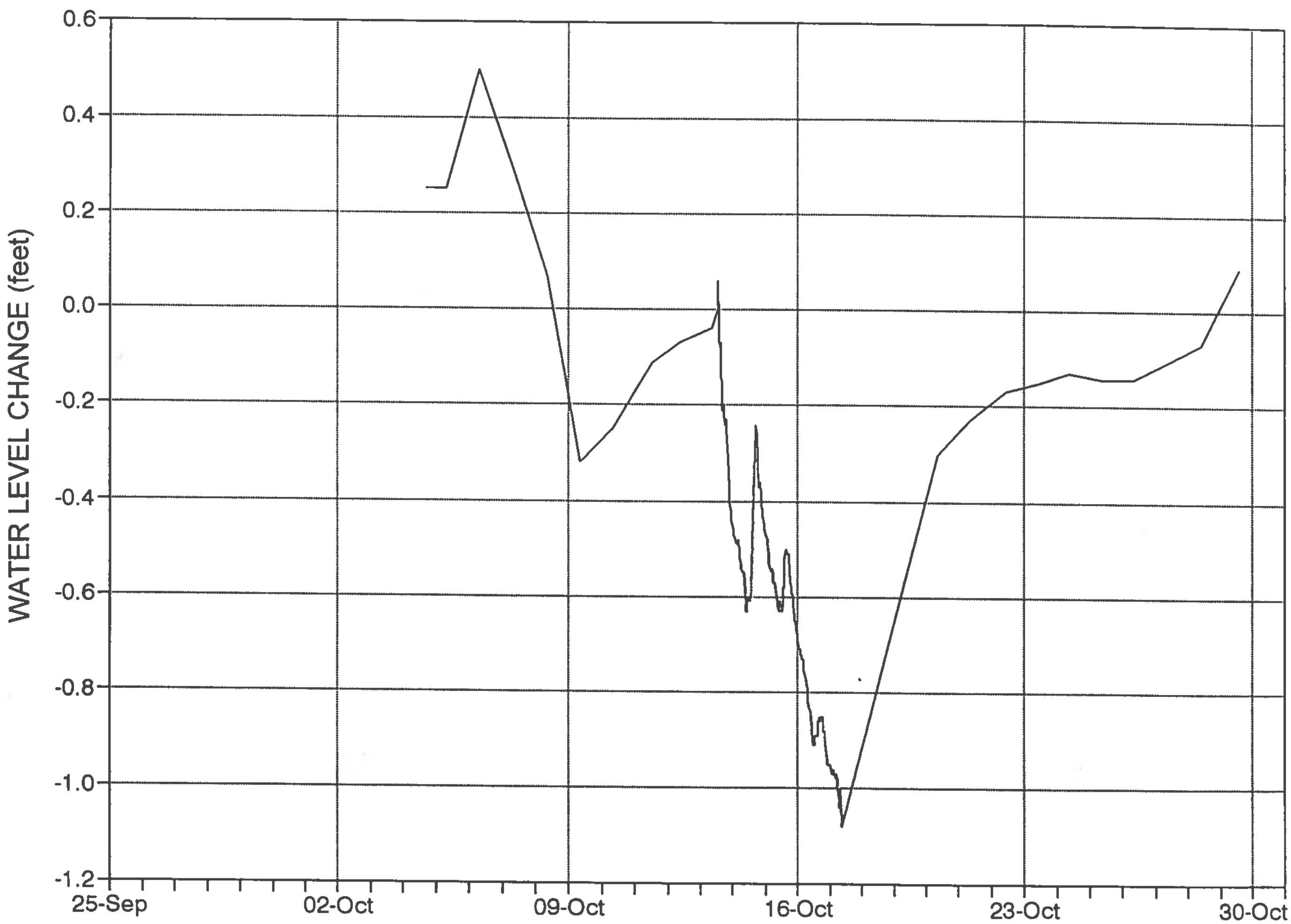


Figure 7 Drawdown in MW-11

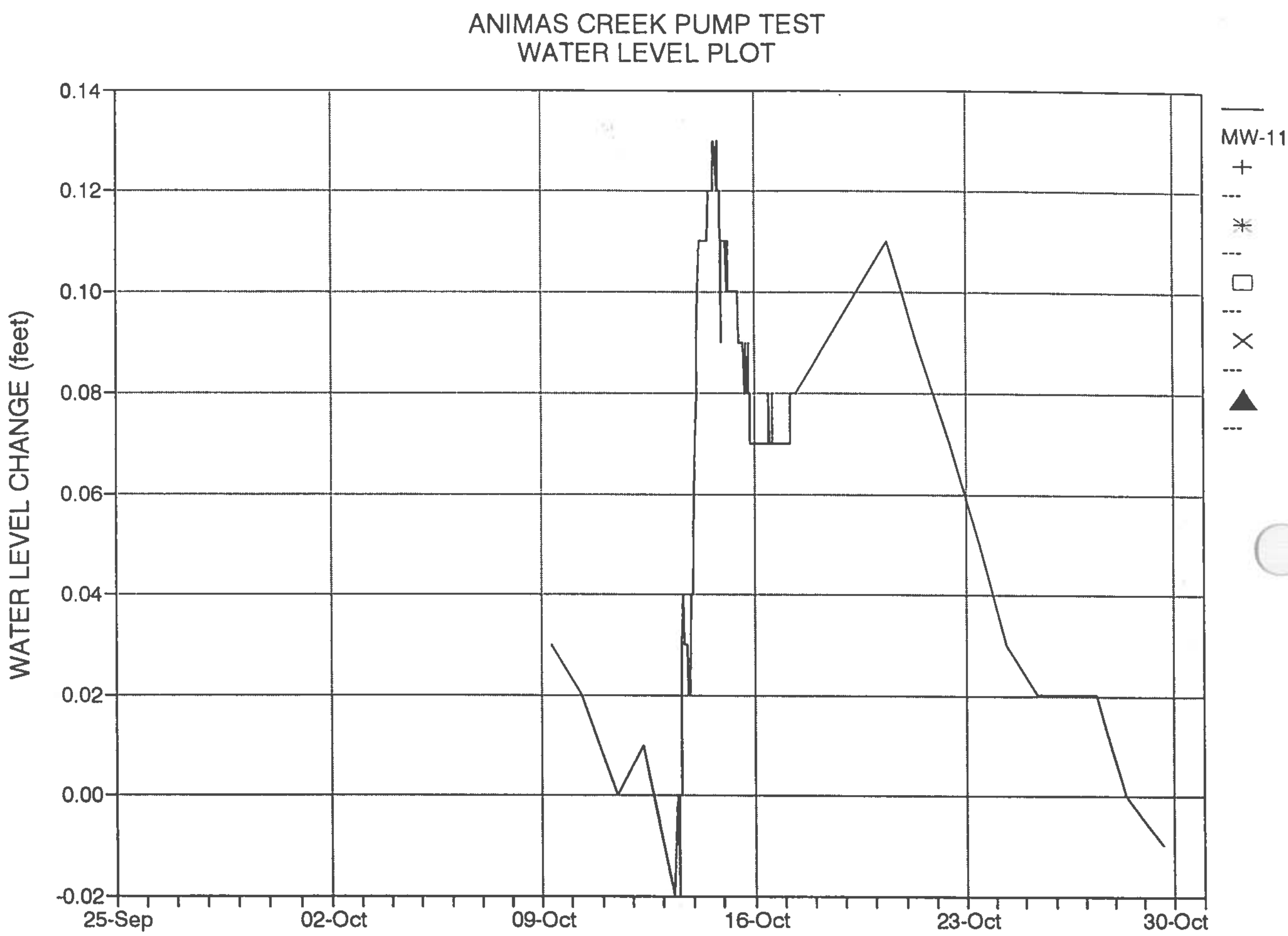


Figure 8 Water elevations in test wells

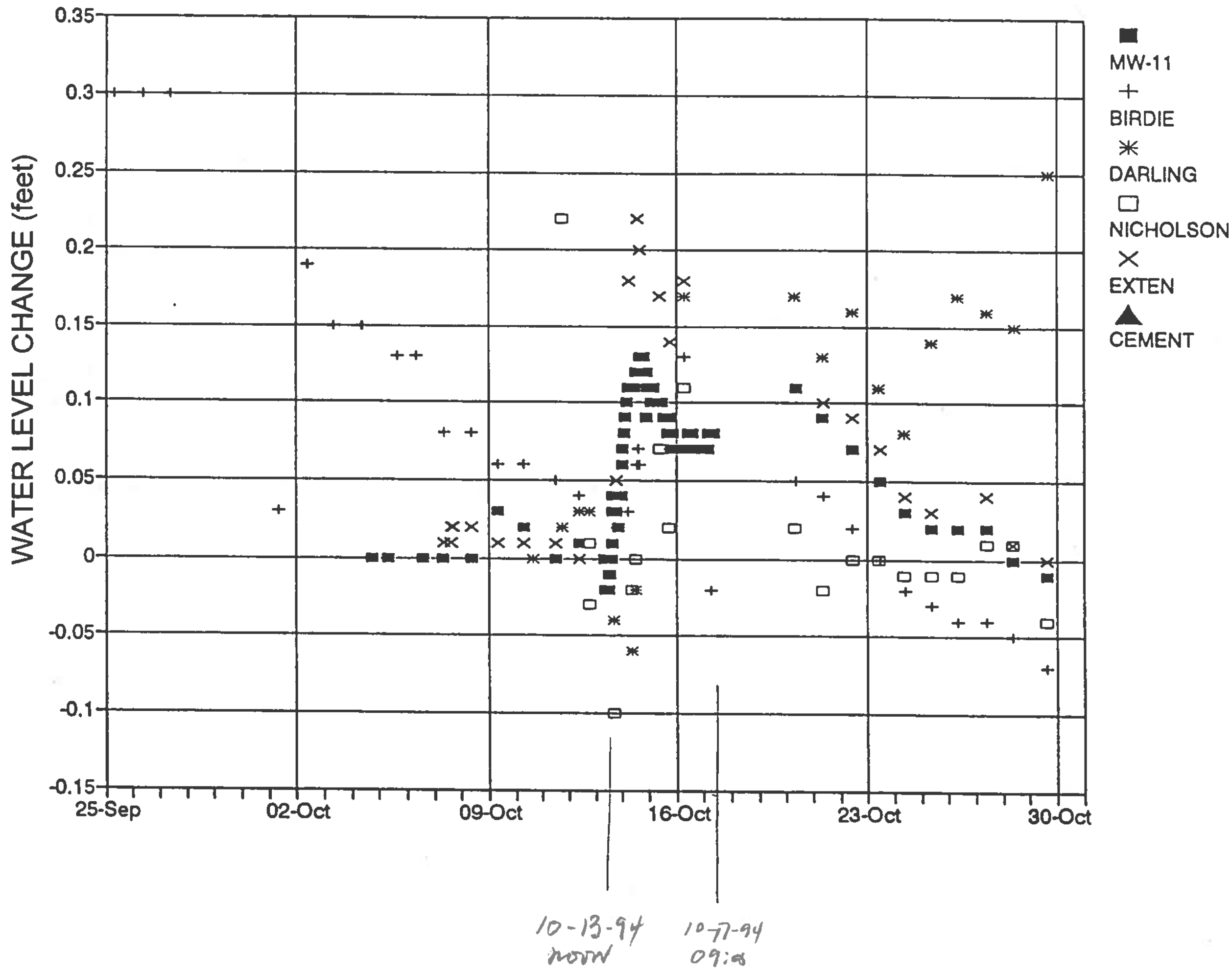


Figure 9 Head changes for test wells

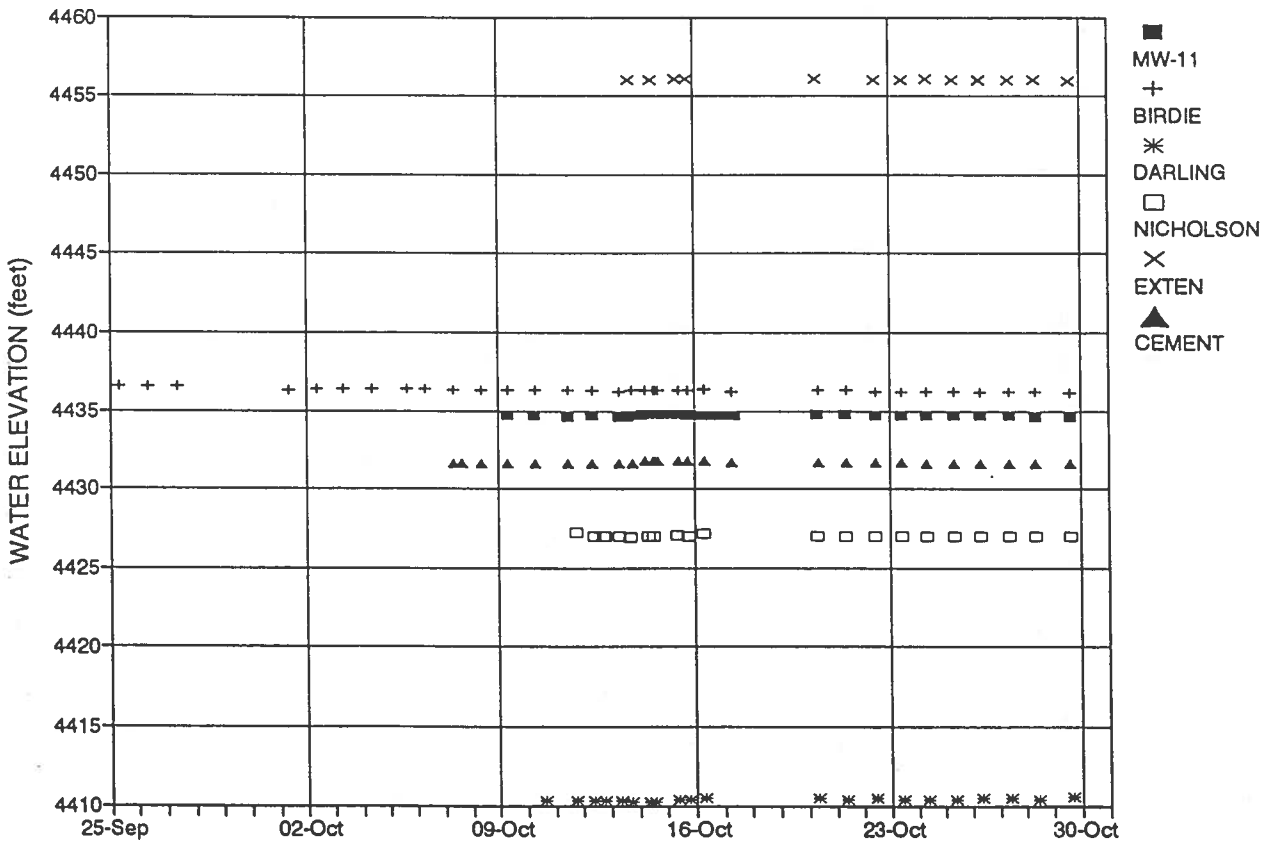
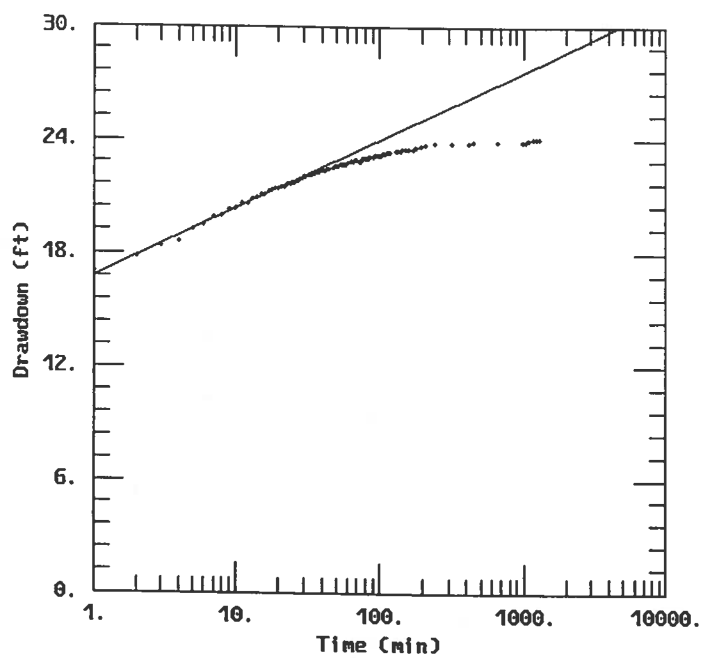


Figure 10 Cooper- Jacob drawdown analysis plot

CLIENT: Alta Gold Company	COMPANY: Adrian Brown Consultants, Inc.
LOCATION: Animas Creek, New Mexico	PROJECT: 1356A

Las Animas Creek Pump Test



DATA SET:
LAS.DAT
09/12/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper-Jacob

PROJECT DATA:
test date: October 14-17, 1994
test well: MW-9
obs. well: MW-9

TEST DATA:
Q = 12.03 ft^3/min
r = 1. ft
r_c= 0.1875 ft
r_w= 0.375 ft
b = 75. ft

PARAMETER ESTIMATES:
T = 0.6086 ft^2/min
S = 3.288E-05

AQTESOLV

Figure 11 Theis drawdown analysis plot

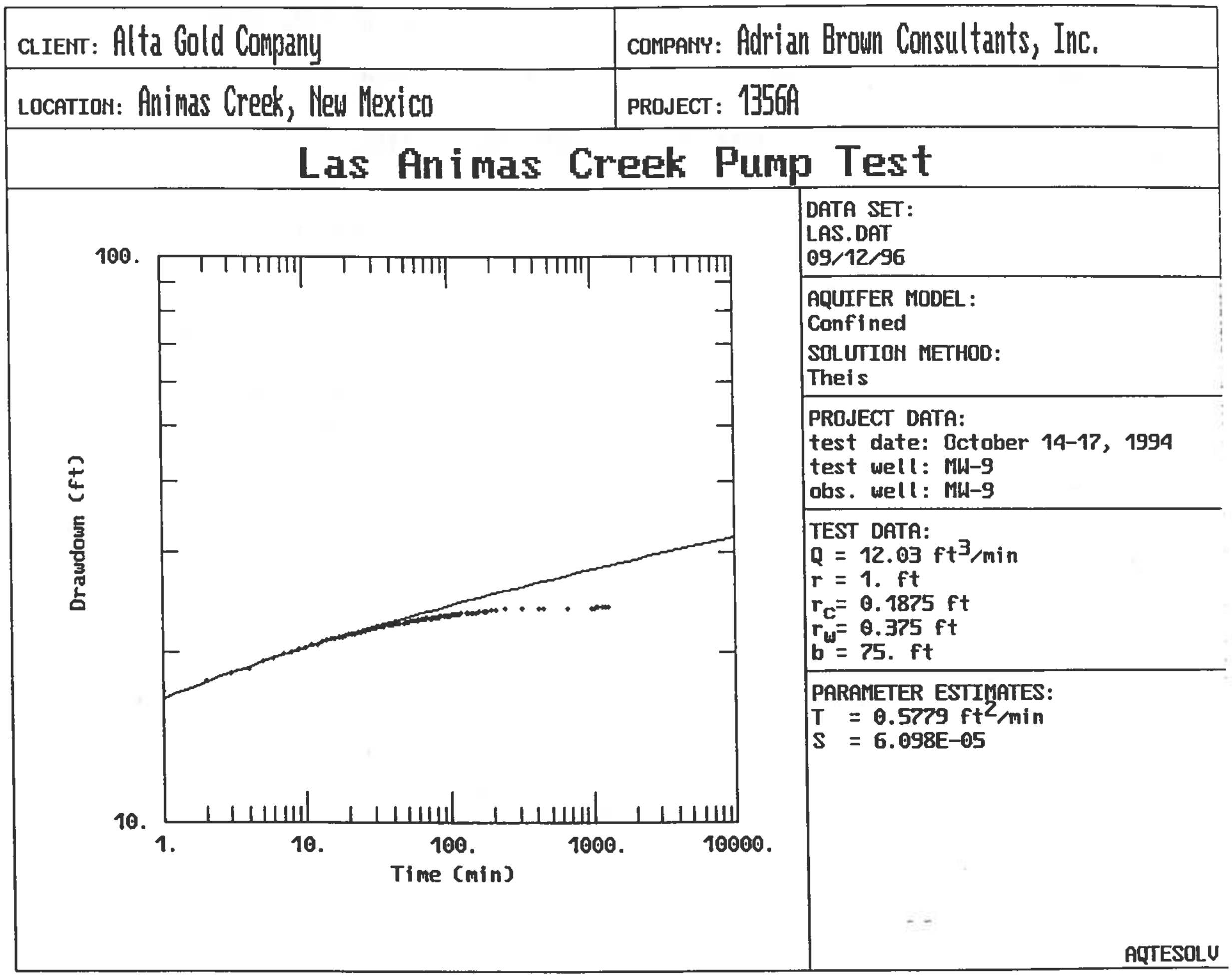
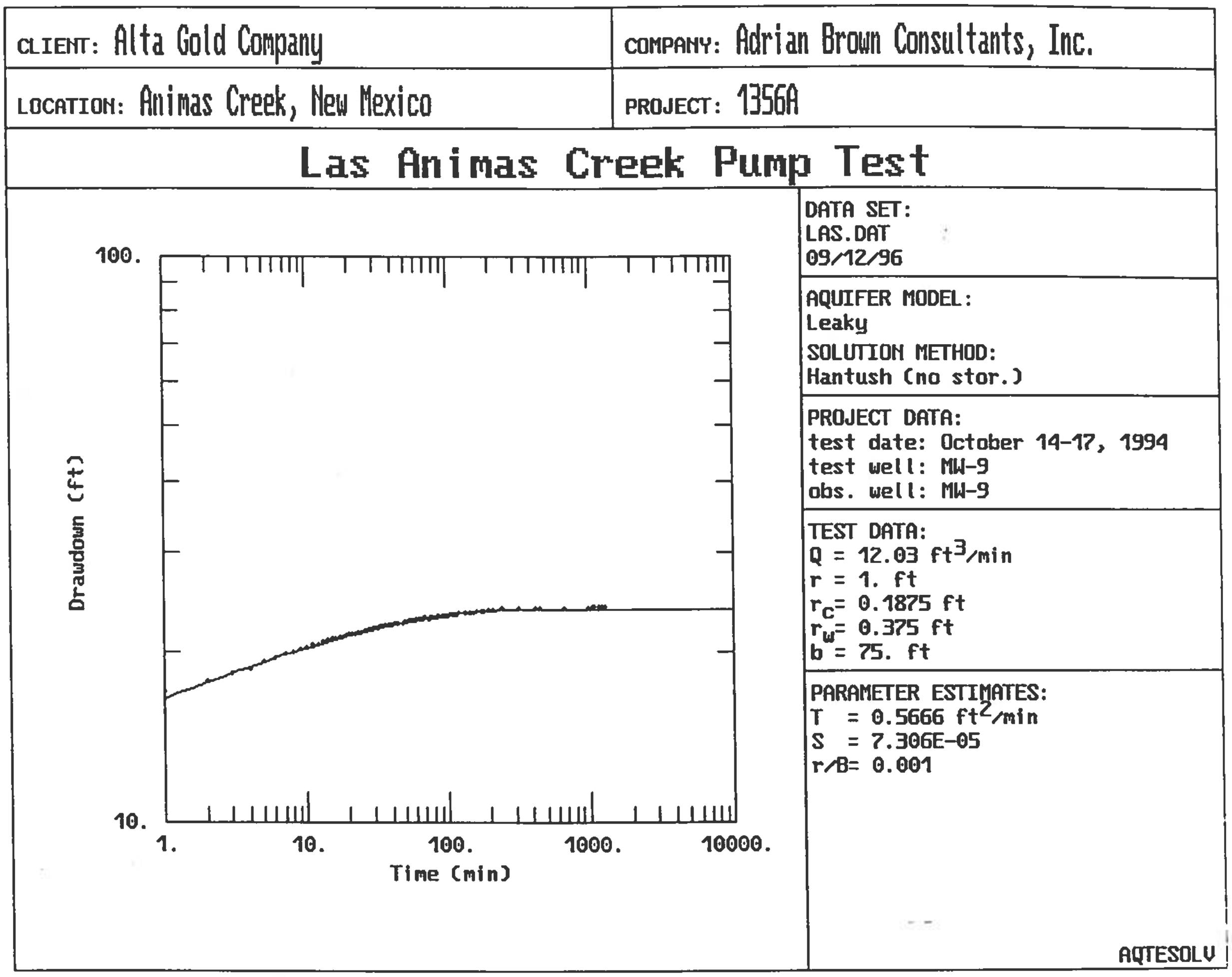


Figure 12 Hantush leaky aquifer drawdown analysis plot



Appendix C3.

TSF-Area Pumping Test, 1994

APPENDIX G
TAILINGS DAM AREA PUMPING TEST

Prepared for:

Steffen Robertson and Kirsten
1755 East Plumb Lane, Suite 241
Reno, Nevada 89502

Prepared by:

Adrian Brown Consultants, Inc.
155 South Madison Street, #230
Denver, Colorado 80209

September 9, 1996
Project #1356A

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G.1 INTRODUCTION

A seven-day aquifer test was conducted in the vicinity of the tailings dam of the Copper Flat Mine, to determine the hydraulic characteristics of the aquifer(s) in this area. This section describes the pump test activities, and includes a discussion of the selection of the pumping well and observation wells, schedule of operations, operation of the test, water discharge and water quality issues. The aquifer test analysis is summarized in Section G.4 of this report.

An understanding of the site-specific geology is critical to the interpretation of the pumping test results. The deposits in the vicinity of the tailings dam are comprised of relatively recent sands and gravel contained within a clay/silt matrix, all of which overlie the Santa Fe Group sediments, which are similar in nature. A distinctive clay/silty clay unit is found at depths ranging from approximately 10 to 30 feet below ground surface and ranges in thickness from 25 to over 100 feet. This clay/silty clay unit, characterized by a distinctive red to red-brown color and dry to slightly moist with uniform composition and consistency, provides an effective hydrologic barrier between the upper alluvial sediments and those representing the Santa Fe Group.

Volcanic rocks (basalt and/or rhyolite) were commonly encountered above the clay unit during the drilling of the project boreholes. One borehole (GWQ94-16), however, encountered basalt beneath the clay. Unlike the clay observed in other boreholes, the clay/silty clay in GWQ94-16 was uncharacteristically thinner and was accompanied by significant amounts of gravel and moisture. Based on the gravelly nature of the clay, the relative superposition in the borehole, and the eastward dip of the sediments, the relatively shallow clay/silty clay located above the basalt in borehole GWQ94-16 may actually be reworked material from an upgradient clay source which was deposited over the basalt. The stratigraphy observed in all other boreholes clearly indicates that basalt and/or rhyolite was flowed out above the thick clay unit.

The alluvial units above and below the clay unit are similar in nature, although the gravel unit below the clay contains more matrix material. Because of the abundant matrix material, the lower unit is more poorly sorted and the lower aquifer has a lower permeability in those zones where clay or silty clay predominate.

G.2 WELL SELECTION

One pumping well and 13 observation wells were employed during the aquifer test. Figure G-1 shows the well locations and Table G-1 presents pertinent information for each of the wells used for data collection.

G.2.1 Pumping Well

Well GWQ94-17 was drilled and completed in October 1994. The borehole was drilled to a total depth of 158 feet and the well is screened from 120-150 feet below ground surface. Static water level in the well is on the order of 3 feet below ground surface. Well GWQ94-17 was chosen for pumping for the following reasons:

1. Central location relative to observation wells.

2. Casing diameter (4") was sufficient for pump installation.

3. Discharge water could be easily routed to discharge point.

4. Sulfate concentrations were low enough to pump without concern of immediately exceeding discharge standards.

5. Screened in a horizon of suitable water production.

6. Screen located beneath the red clay aquitard that separates the shallow aquifer from the underlying aquifer.

Discharge water from GWQ94-17 was piped through 600 feet of 3-inch layflat vinyl pipe that passed under the county road through a corrugated-steel culvert to a concrete sump. The sump is connected by an underground concrete culvert to a concrete-lined pit, located approximately 1500 feet southwest of the pumping well. Figure G-2 shows a schematic of the system.

G.2.2 Observation Wells

Observation wells were selected based on their proximity to the pumping well, their screened intervals, and their potential to exhibit a response in water levels during the pumping test.

The nearest observation well, GWQ94-13, is located 190 feet west-southwest of the pumping well, and is screened from 75 to 105 feet below ground surface. Observation well GWQ94-14, located 390 feet east-southeast of the pumping well, is screened from 127.5 to 157.5 feet. Observation well GWQ94-15 is 713 feet southeast of the pumping well, and is screened from 112 to 142 feet. Well GWQ94-16 is among the shallowest observation wells (screened from 25 to 45 feet below ground surface) and is located 423 feet southwest of pumping well GWQ94-17. The deepest observation well, GWQ94-20, is screened from 288 to 338 feet, and is located 264 feet northwest of the pumping well. Observation well GWQ94-21 has separate completions at

213-263 feet (A) and 285-315 feet (B), and is located 621 feet east of the pumping well.

Limited completion information was available for the six observation wells installed prior to the 1994 field program. Observation well GWQ-11 is located approximately 405 feet southwest of the pumping well and is completed to a depth of 76 feet. Observation wells NP-2 and NP-5 are located approximately 1130 and 735 feet south-southwest of the pumping well, and have total depths of 110 and 41 feet, respectively. Observation well IW-1 has a total depth of 67 feet and is located 239 feet west of the pumping well. Observation well IW-2, 248 feet northwest of the pumping well, is completed to 45 feet.

Water levels in wells GWQ94-18 and GWQ94-19 were not monitored during the pumping test since both wells were dry or nearly dry.

G.3 AQUIFER TEST

G.3.1 Aquifer Pumping Test Operations

Well GWQ94-17 was pumped for a total of 78.14 hours, starting at 10:50 on Tuesday, November 8, 1994 and ending at 16:58 on Friday, November 11, 1994. The average flow rate during the test was 23 gpm. The flowrate was not sufficient to activate the inline flowmeter at the wellhead, so flowrate was measured at the concrete sump discharge point approximately hourly using a bucket and stopwatch. The flowrate remained steady throughout the test until the pump was shut off.

G.3.2 Monitoring

Water level changes during the pumping portion of the aquifer test were monitored manually for wells GWQ94-17, GWQ-11, GWQ94-15, GWQ94-16, GWQ94-21A, GWQ94-21B, NP-2, NP-3, NP-5, IW-1, and IW-2 using an electronic water level sounder. The remaining wells (GWQ94-13, GWQ94-14, and GWQ94-20) were monitored automatically, during the pumping portion of the aquifer test, using pressure transducers attached to data logging units. Manual readings were collected every 5 to 10 minutes for about the first hour, every 15 to 20 minutes for the next 3 to 4 hours, and at least hourly for the remainder of the test. Automatic pressure transducer readings were collected every minute during the pumping period.

During the recovery portion of the test, water levels were measured at 5-minute intervals in wells GWQ94-14 and GWQ94-13 using pressure transducers. The pressure transducer that was set in GWQ94-20 during the pumping period of the test was transferred to GWQ94-21A for the recovery test. Water level recovery was also monitored in the pumping well at 5-minute intervals, using a pressure transducer. Recovery was monitored for 2.5 days, from 16:58 on Friday, November 11, 1994 to approximately 16:00 on Sunday, November 13.

A summary of these monitoring activities is presented in Figure G-3. The pre-pumping static water level data and aquifer test water level data are presented in the Attachments A-5 and G-2, respectively. A major storm event occurred, in which 6.5 inches of rain were gauged at the tailings dam from the morning of November 11, 1994 to the evening of November 12, 1994 (Irwin, personal communication). This recharge event may have affected the recovery of the water levels in the observation wells.

G.3.3 Observations

G.3.3.1 Pumping Well GWQ94-17

Well GWQ94-17 was pumped at a rate of 23 gpm for a total of 78.14 hours. The steady-state drawdown of 125 feet was acheived in 31 minutes of pumping. The plot of drawdown versus time, presented in Figure G-4, indicates that the pump operated continuously during the test.

G.3.3.2 Discharge

The well discharged a total of just under 108,000 gallons into the concrete-lined pit, located approximately 1500 feet south-southwest of the pumping well. Observation well NP-2, located approximately 50 feet from the northwest corner of the pit, was monitored during the test to determine whether the concrete pit was leaking and if so, how much effect it had on the local groundwater table. The water levels in NP-2 during the test period are shown in Figure G-5, and do not exhibit effects from leakage. However, the drop in water level in the concrete pit after the pump was shut off indicated that the pit leaked approximately 5000 gallons/day.

G.3.3.3 Water Quality

The quality of the discharge water was monitored periodically during the test. Sulfate ranged from a low of 180 mg/l to a high of 360 mg/l, with concentrations peaking eight hours into the test and decreasing as the test progressed. Temperature readings were affected by the sun incidence on the discharge pipe and were not representative of the groundwater temperature. The pH of the water stabilized at approximately 7.4 and the conductivity ranged from a low of 990 μS to a high of 1110 μS. Water quality parameters measured at the discharge pipe are summarized in Table G-2.

G.3.4 Test Results

G.3.4.1 Shallow Aquifer System

The shallow aquifer system hosts numerous wells, including the shallow (<80 feet) monitoring wells near the tailings dam.

None of the shallow observation wells monitored during the pumping test showed a response to pumping at GWQ94-17, indicating that in this area there is no hydraulic connection between the upper, shallow alluvial aquifer and the lower aquifer in the Santa Fe Group. The plots of drawdown in the observation wells versus time during the pumping test are presented in Attachment G-1. The shallow observation wells are IW-1, IW-2, NP-5, GWQ-11, and GWQ94-16.

G.3.4.2 Santa Fe Group Aquifer System

Two types of response were observed in the Santa Fe Group aquifer system due to stressing by pumping at GWQ94-17. Theis type responses were demonstrated at wells GWQ94-13, GWQ94-14, GWQ94-21A, GWQ94-21B and NP-3. An attenuated response was demonstrated at observation well GWQ94-15, in the form of a slower, flatter drawdown curve.

The response in observation well GWQ94-20 was influenced by recharge of the well following development on November 3, 1994. The well is completed in a low-permeability zone and is slow to equilibrate following pumping/development. Therefore, data collected from GWQ94-20 during the pumping test are considered invalid for analysis purposes. The water level plots versus time for all other monitoring wells observed during the aquifer test are shown in the Attachment G-1.

G.3.4.3 Bedrock Flow System

Although no deep bedrock wells were installed or monitored during this study, some knowledge of the deep bedrock system is discernible through investigation of the local geology of the area. Water that enters the various limestone beds of the upper Paleozoic rocks in the north-trending Animas Uplift moves downdip along bedding plane and solution openings until it reaches the zone of saturation, then moves laterally along the strike of permeable strata toward points of discharge in the principal stream valleys, which in this case are Las Animas Creek and Seco Creek (Davies and Spiegel, 1967).

G.4 ANALYSIS AND INTERPRETATION

The transmissivity of the aquifer appears to be approximately 1400 gpd/ft with a storage coefficient of 2.5 x 10^{-4}, based on a Theis analysis, and is representative of a confined aquifer of moderate permeability. Plots from the Theis evaluation are presented in Figures G-6 and G-7. The estimated efficieny of the pumping well, GWQ94-17, is approximately 25% based on the drawdown in the pumping well versus the water levels in the observation wells. This suggests that the aquifer is sufficiently tight to create large head losses in the formation as the groundwater flows radially into the wellbore. Additional well losses could be caused by the well design and completion.

The aquifer test did not positively identify any fixed-head or no-flow boundaries. The test did confirm that wells that penetrate the clay layer are hydraulically connected to the pumping well. Response of those observation wells were, in general, well-modeled by a Theis-type response. Wells that are completed above the confining clay layer (shallow aquifer) were not affected by the pumping activity at GWQ94-17.

Well GWQ94-14 displayed an unusually quick response and more rapid drawdown possibly indicating the presence of a higher permeability paleo-channel that connects GWQ94-14 to GWQ94-17.

In addition to performing an integrated, detailed Theis analysis on the suite of observation wells, data from individual observation wells were analyzed using the aquifer test analysis software package, AQTESOLV (Geraghty and Miller, Inc.). Table G-3 presents the transmissivity and storativity values derived using various methods, and the plots of drawdown versus time are included in Attachment G-1.

Table G-1 Observations Wells Used During the Tailings Dam Area Aquifer Test

WELL ID	TD (feet)	ELEV. (toc) QMC[3]	r (feet)	TOP OF SCREEN (feet bgs)	BOTTOM OF SCREEN (feet bgs)	SCREEN LENGTH (feet)	PIPE DIAM. (in.)	STATIC WATER LEVEL (feet btoc) 11/7/94
GWQ-11	76	5174.87	≈405	na	na	na	3	17.04
GWQ94-13	112	5179.05	190	75	105	30	4.5	8.02
GWQ94-14	158	5171.41	390	127.5	157.5	30	4.5	1.585
GWQ94-15	148	5161.64	713	112	142	30	4	0.63
GWQ94-16	48	5176.02	423	25	45	20	4	18.23
GWQ94-17[1]	158	5176.97	0	120	150	30	4	5.32
GWQ94-20	340	5181.97	264	288	338	50	4.5	20.315
GWQ94-21A	320	5171.28	621	213	263	50	2	4.58
GWQ94-21B	320	5170.79	621	285	315	30	2	3.945
NP-2	110	5171.38	≈1130	na	na	na	2	29.46
NP-3	79.3[2]	5178.42	≈239	na	na	na	2	7.07
NP-5	41.2[2]	5177.45	≈735	na	na	na	2	19.67
IW-1	67[2]	5177.68	239	na	na	na	4	20.55
IW-2	45	5186.54	438	na	na	na	4	33.585

[1] Pumping well
[2] Measured prior to groundwater sampling
[3] Elevations relative to project datum (Quintana Minerals Corp.)
TD = total depth of borehole
r = distance to the pumping well (feet)
bgs = below ground surface
toc = top of casing
btoc = below top of casing
na = information not available

Table G-2 Summary of Water Quality during Pumping of GWQ94-17

DATE	TIME	TEMPERATURE (deg-C)	pH	CONDUCTIVITY (um/cm)	SULFATE CONCENTRATION (mg/l)
11/8/94	12:14	21	7.4	1110	225
11/8/94	13:22	21	7.4	1050	180
11/8/94	15:15	19.5	7.4	1050	210
11/8/94	17:25	19	7.4	1030	350
11/8/94	18:10	18	7.4	1030	360
11/9/94	07:18	--	7.3	1050	300
11/9/94	12:24	--	7.3	1020	240
11/9/94	14:35	--	7.3	990	250
11/9/94	13:57	--	7.3	1010	240
11/10/94	12:40	--	7.4	1030	280
11/10/94	14:35	--	7.4	1000	220

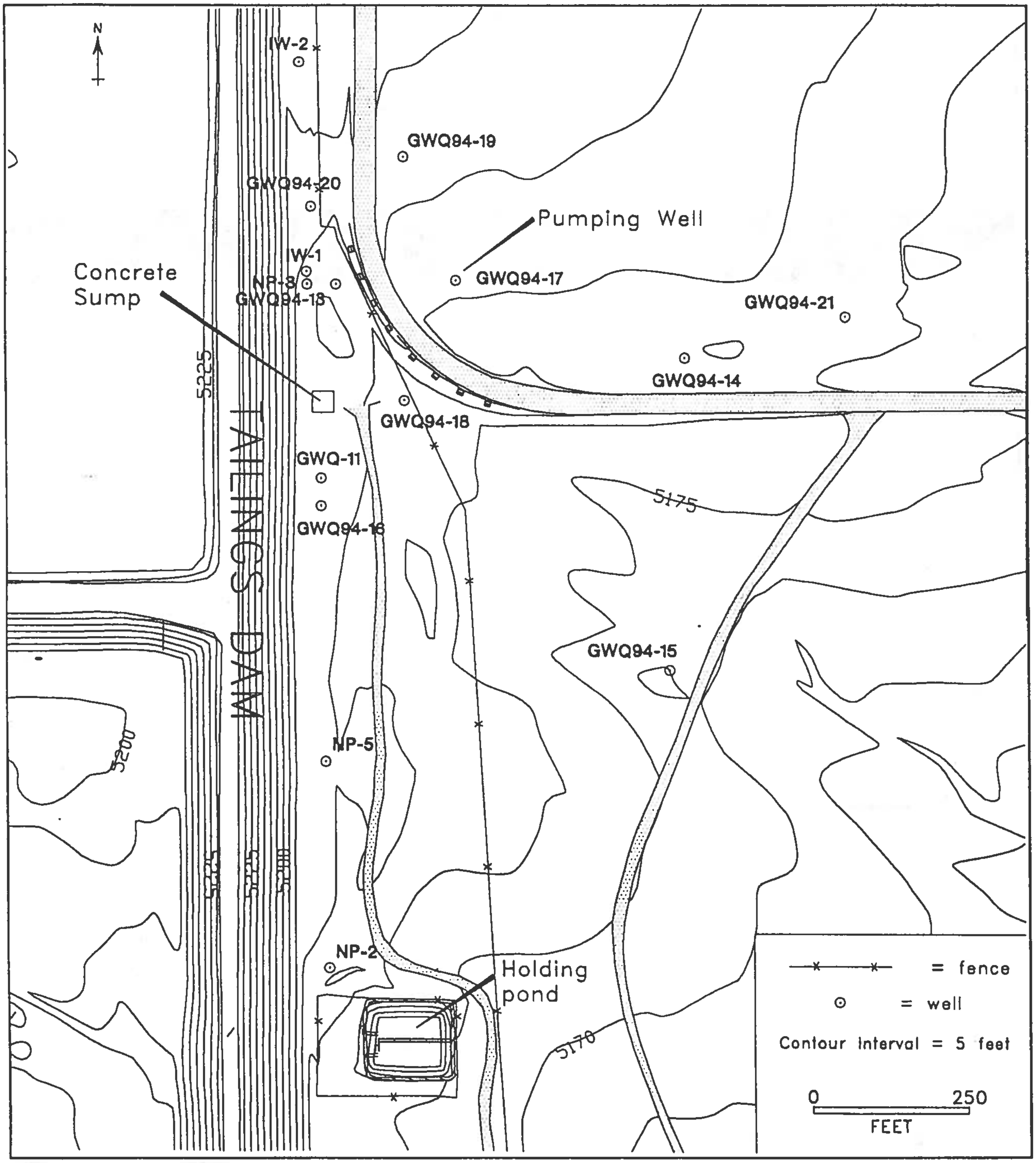


Figure G-1 Well location map for tailings dam area pumping test

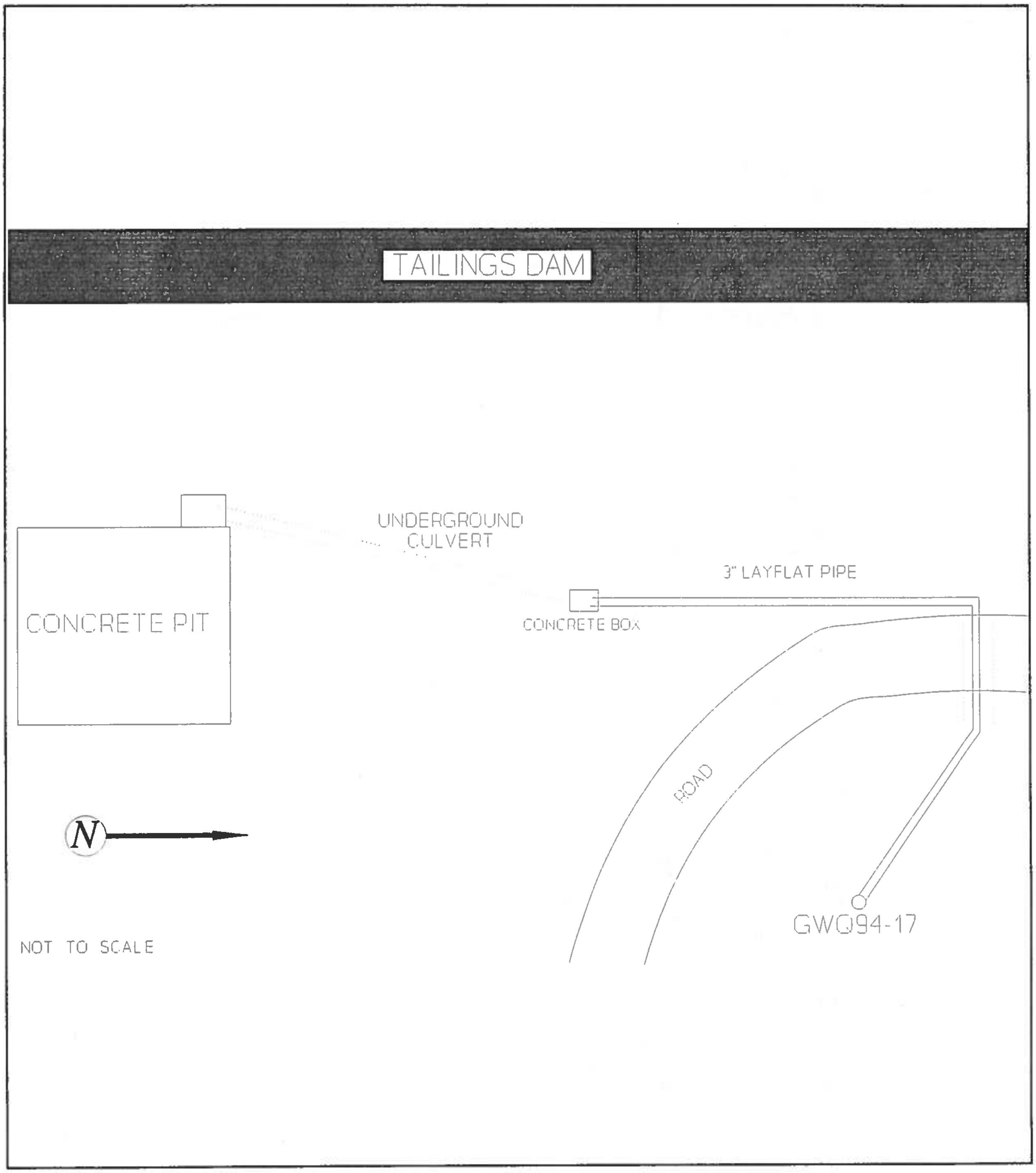


Figure G-2 Schematic of pumping test system

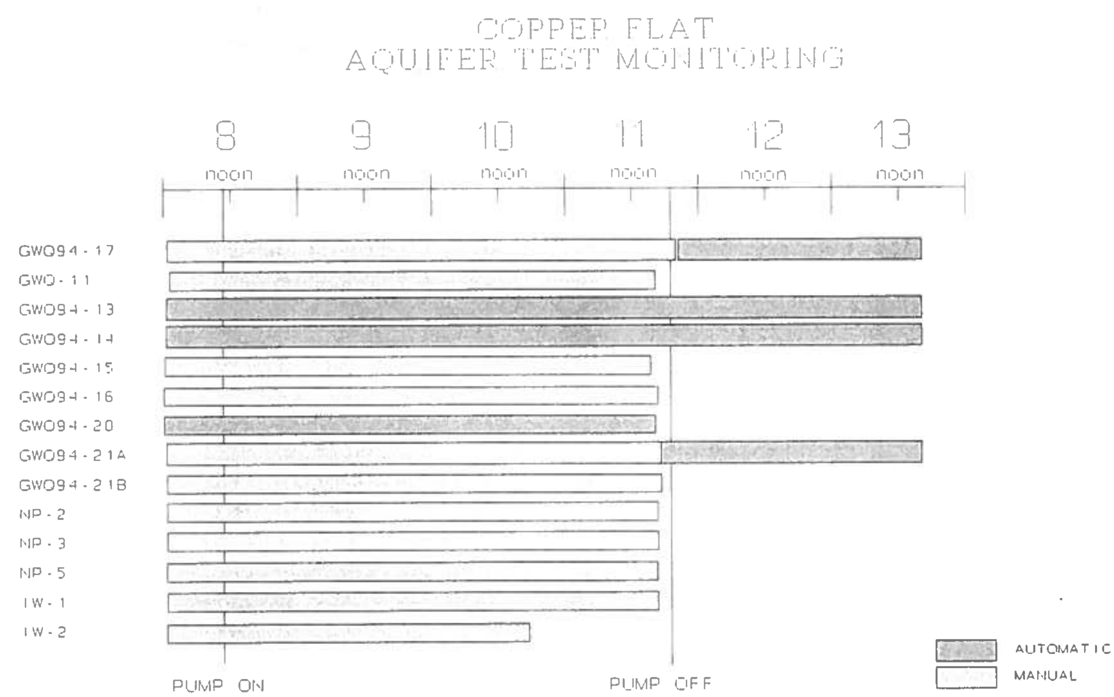
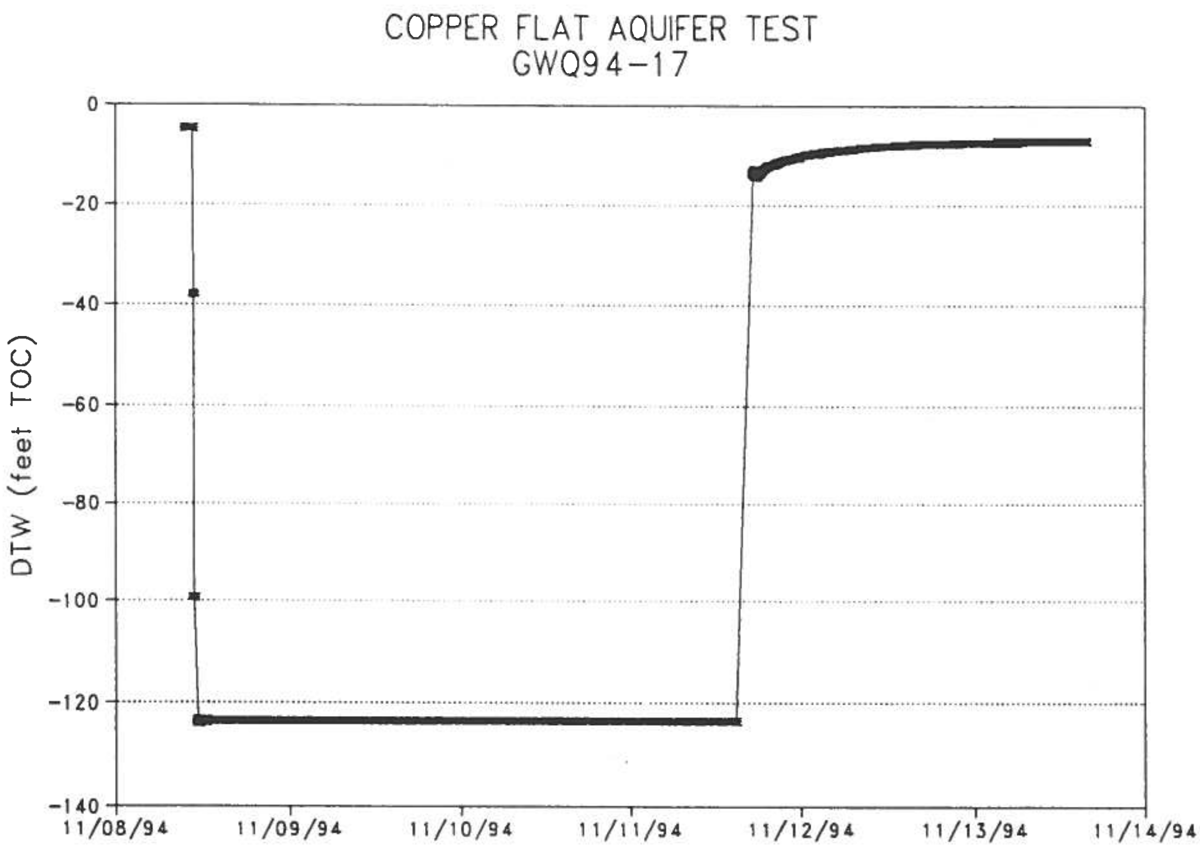


Figure G-3 Copper Flat tailings dam aquifer test monitoring


COPPER FLAT AQUIFER TEST
GWQ94-17
DTW (feet TOC)
0
-20
-40
-60
-80
-100
-120
-140
11/08/94
11/09/94
11/10/94
11/11/94
11/12/94
11/13/94
11/14/94

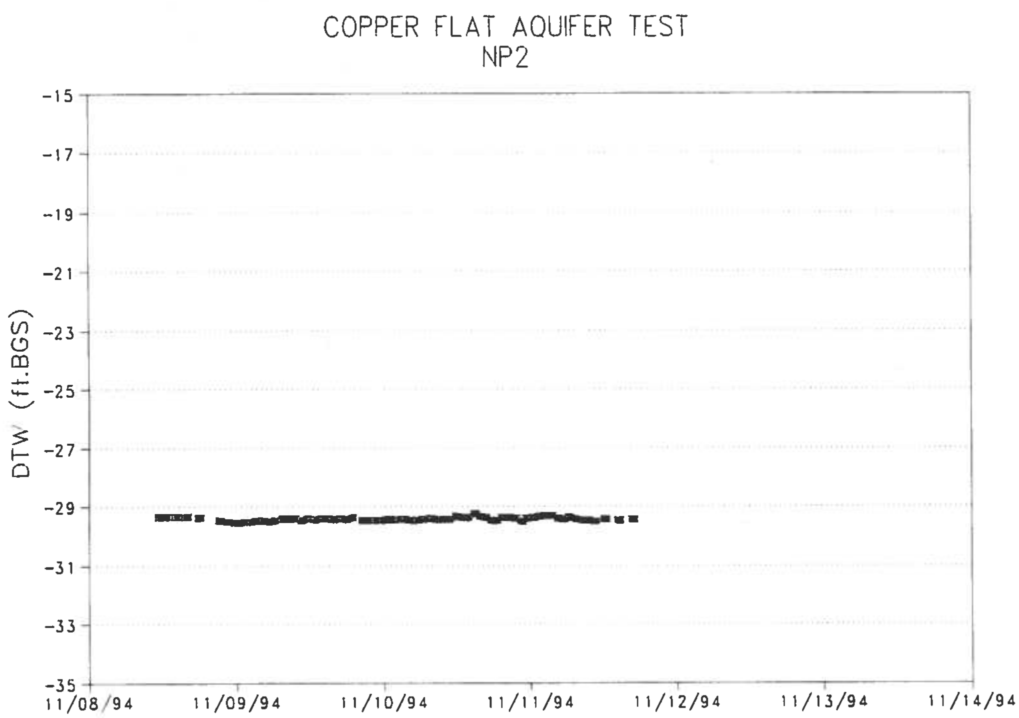


Figure G-5 Water levels in observation well NP-2

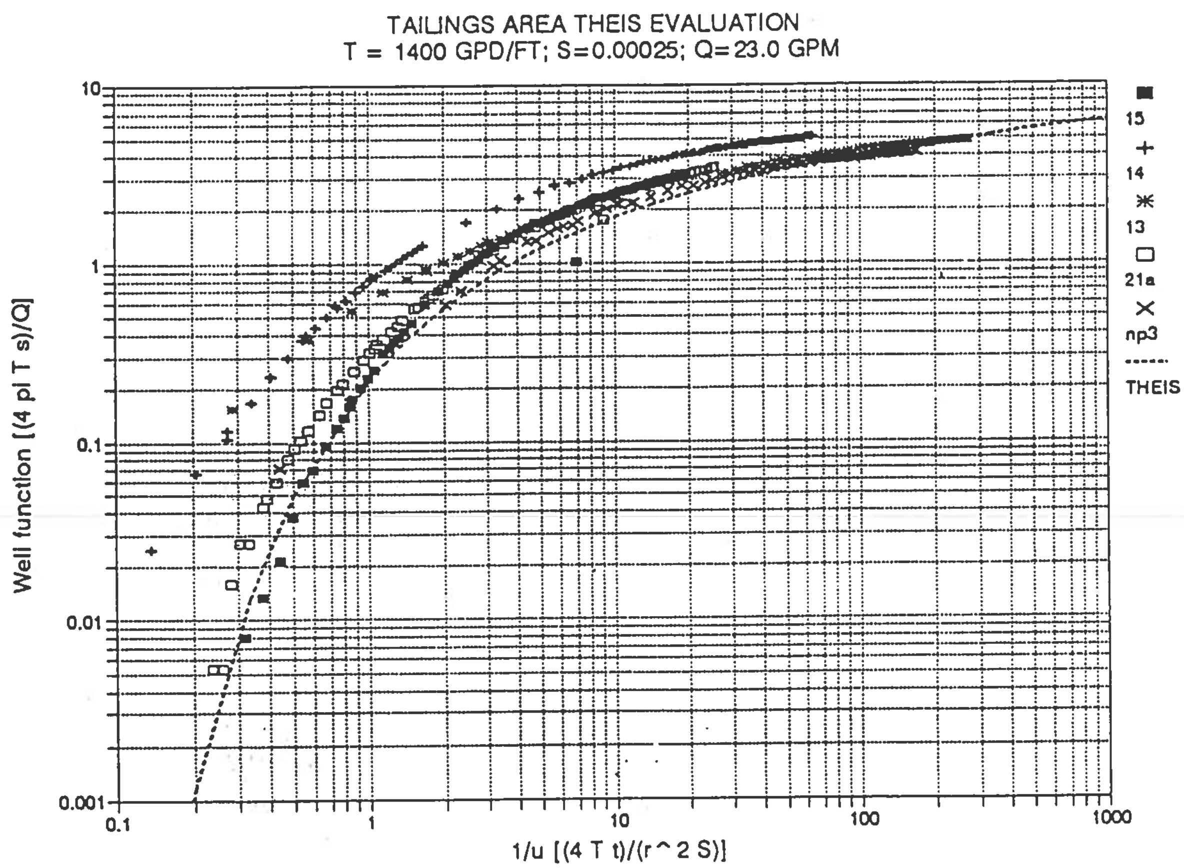


Figure G-6 Theis evaluation for tailings dam area pumping test, T=1400 gpd/ft

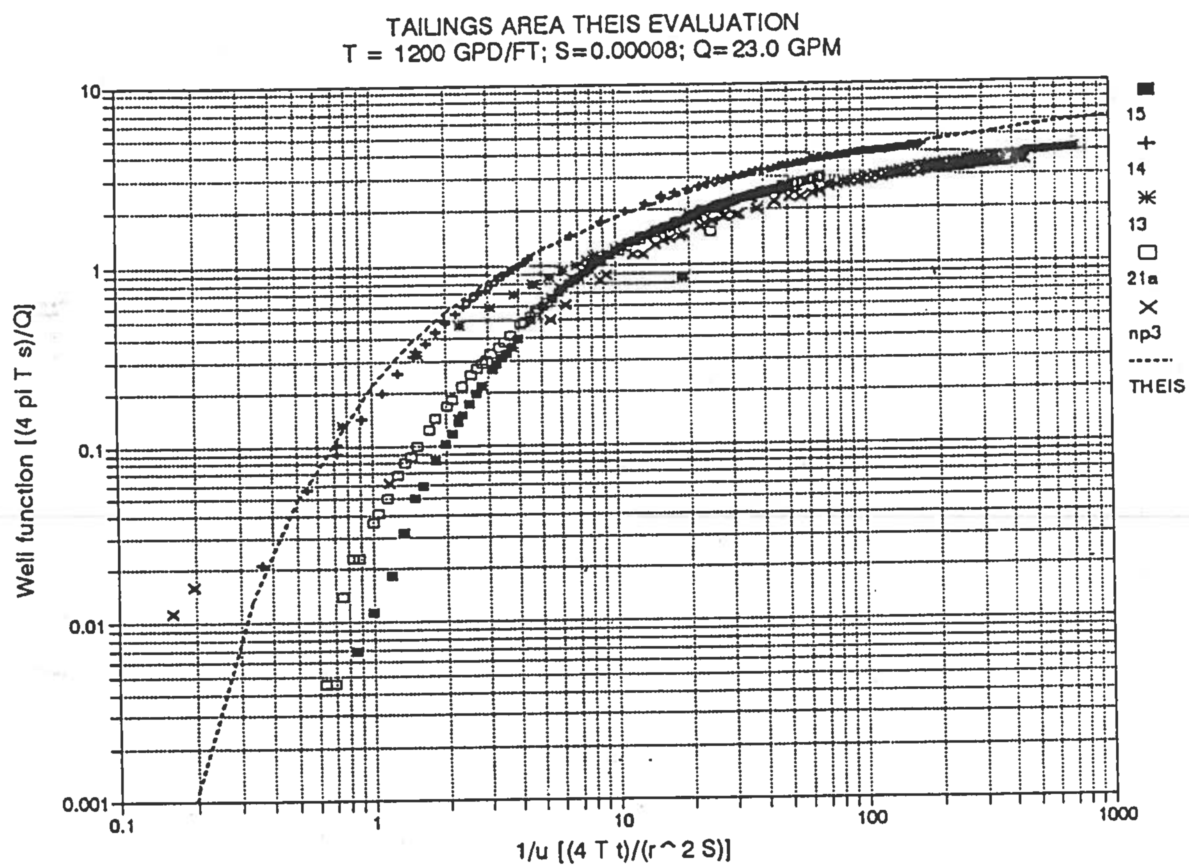


Figure G-7 Theis evaluation for tailings dam area pumping test, T=1200 gpd/ft

Table G-3 Aquifer Test Analysis Results

WELL ID	SOLUTION	TRANSMISSIVITY (gpd/ft)	STORATIVITY
GWQ94-13	Theis	1658	1.1×10^{-4}
	Jacob-Cooper straight-line	1540	1.2×10^{-4}
GWQ94-14	Theis	1148	8.1×10^{-5}
	Jacob-Cooper straight-line	1177	6.9×10^{-5}
GWQ94-15	Theis	1259	1.5×10^{-4}
	Hantush - leaky con. w/o storage	1168	1.7×10^{-4}
	Jacob-Cooper straight-line	1299	1.3×10^{-4}
GWQ94-21A	Theis	1147	1.7×10^{-4}
	Jacob-Cooper straight-line	1272	1.4×10^{-4}
GWQ94-21B	Theis	1068	2.8×10^{-4}
	Jacob-Cooper straight-line	1086	2.4×10^{-4}
Integrated Approach[1]	Theis	1400	2.5×10^{-4}

[1]See text and Figures B-6 and B-7

Appendix C4.

2012 Aquifer Test Results

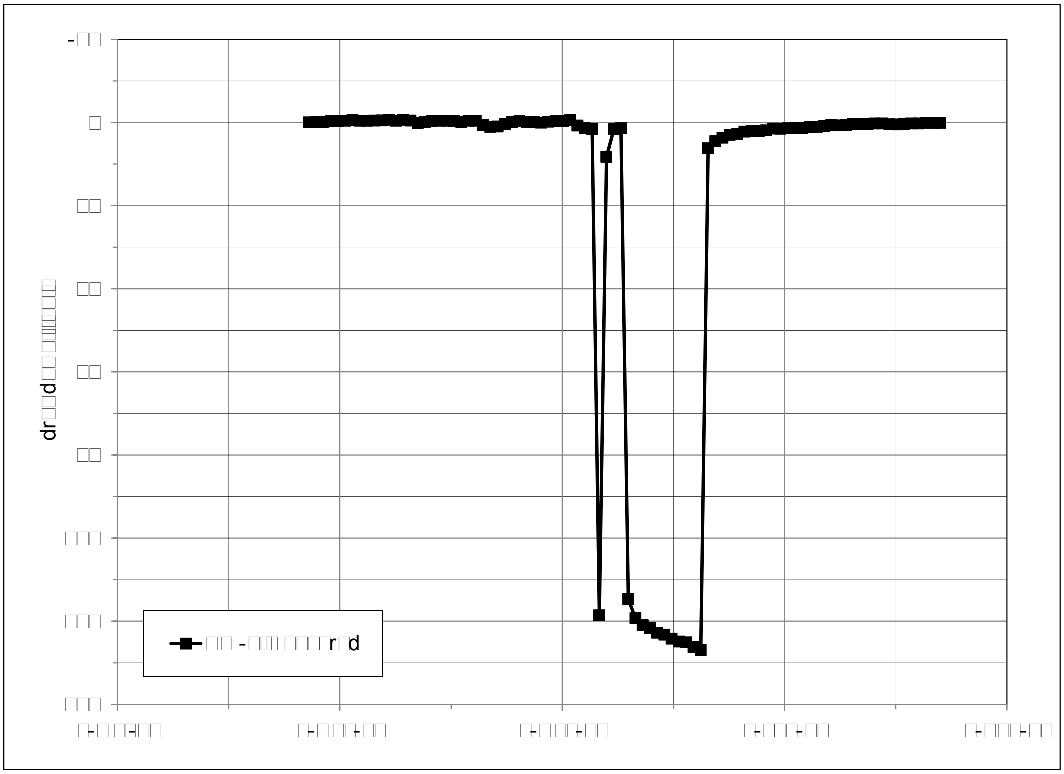


Figure C4-1. Aquifer test hydrograph PW-1.

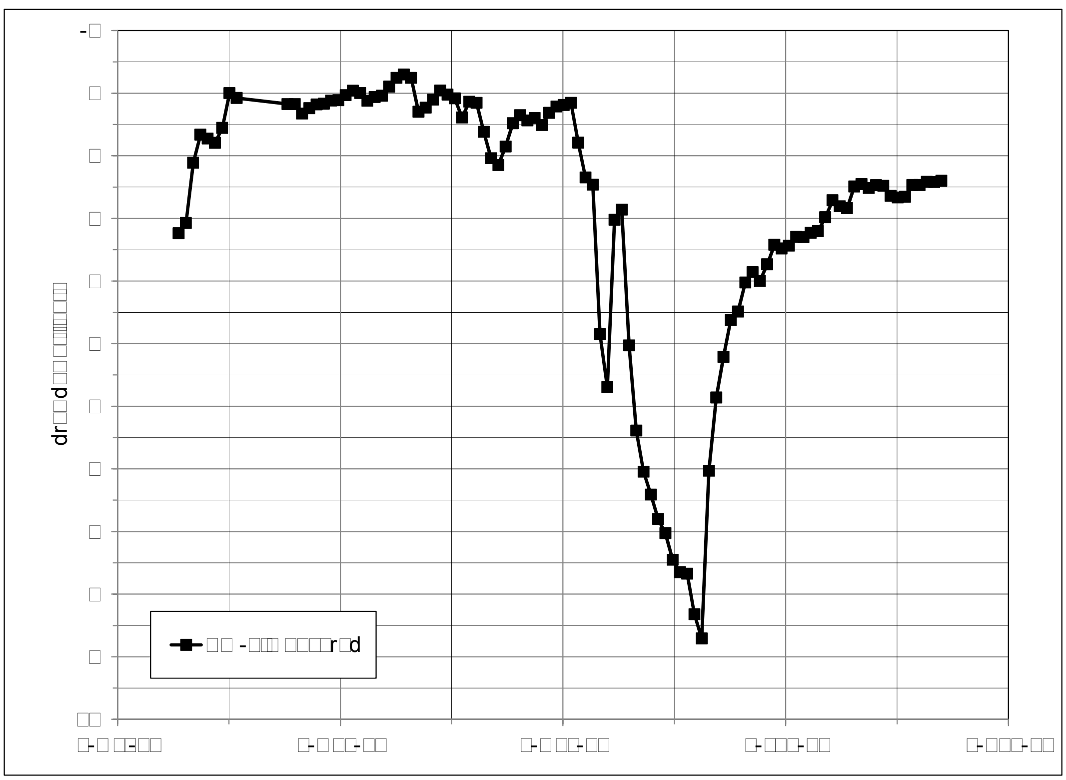


Figure C4-2. Aquifer test hydrograph PW-2.

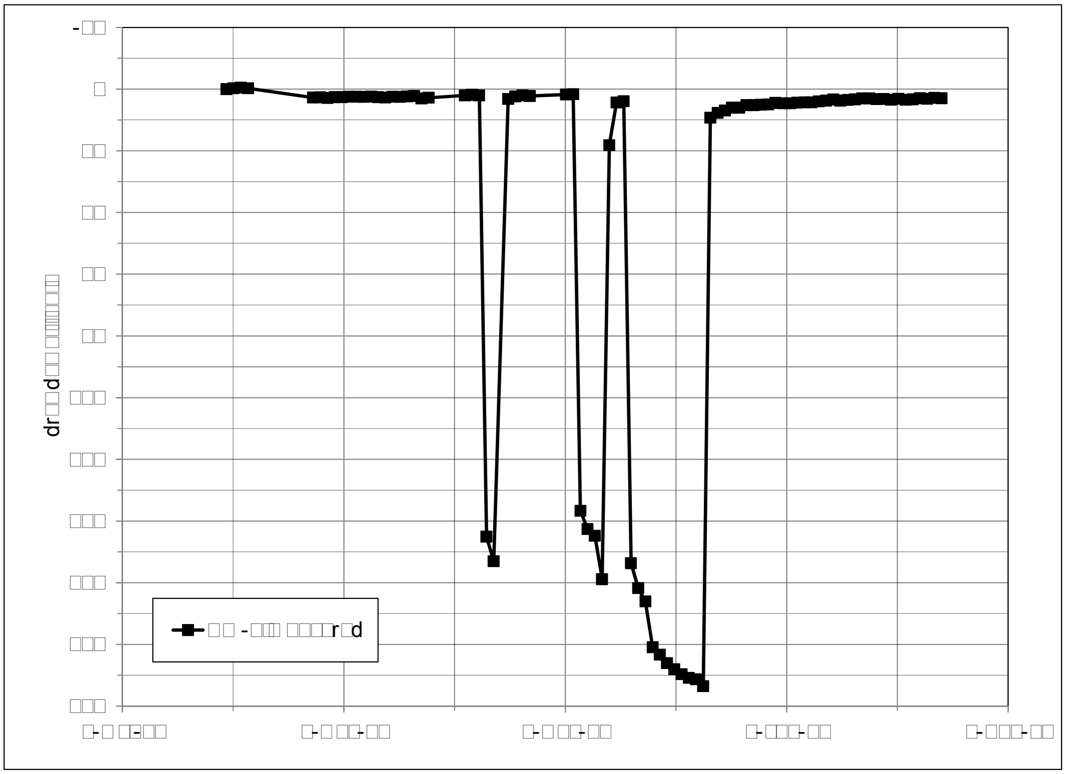


Figure C4-3. Aquifer test hydrograph PW-3.

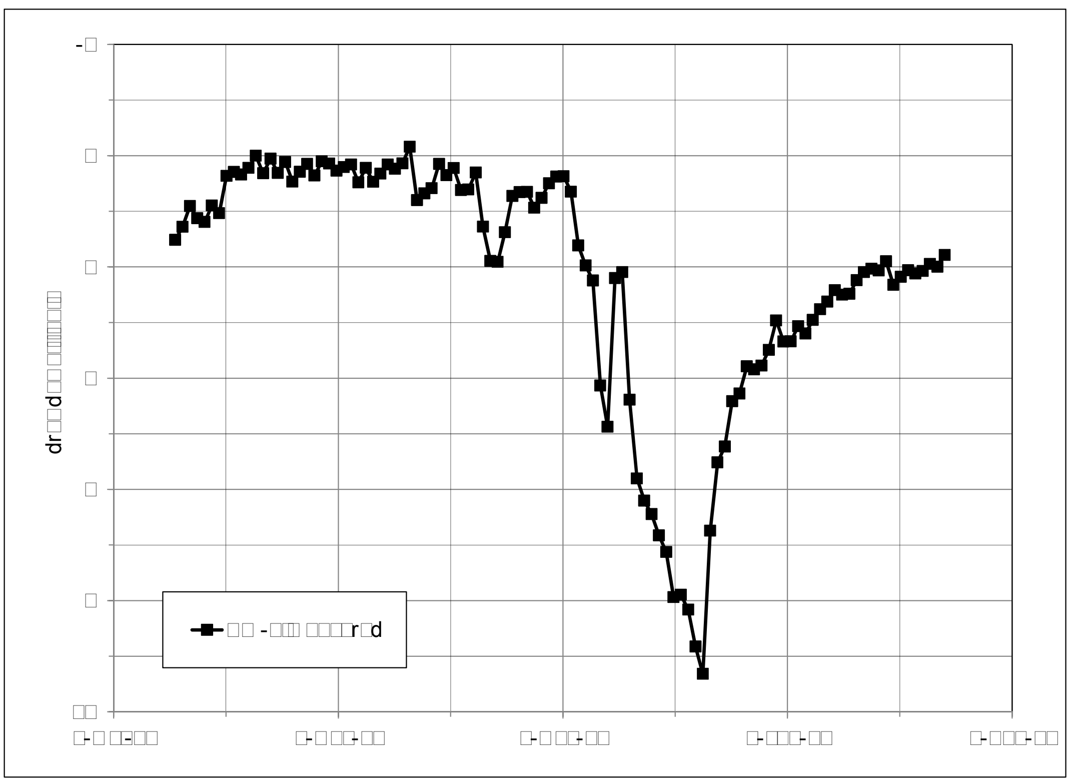


Figure C4-4. Aquifer test hydrograph PW-4.

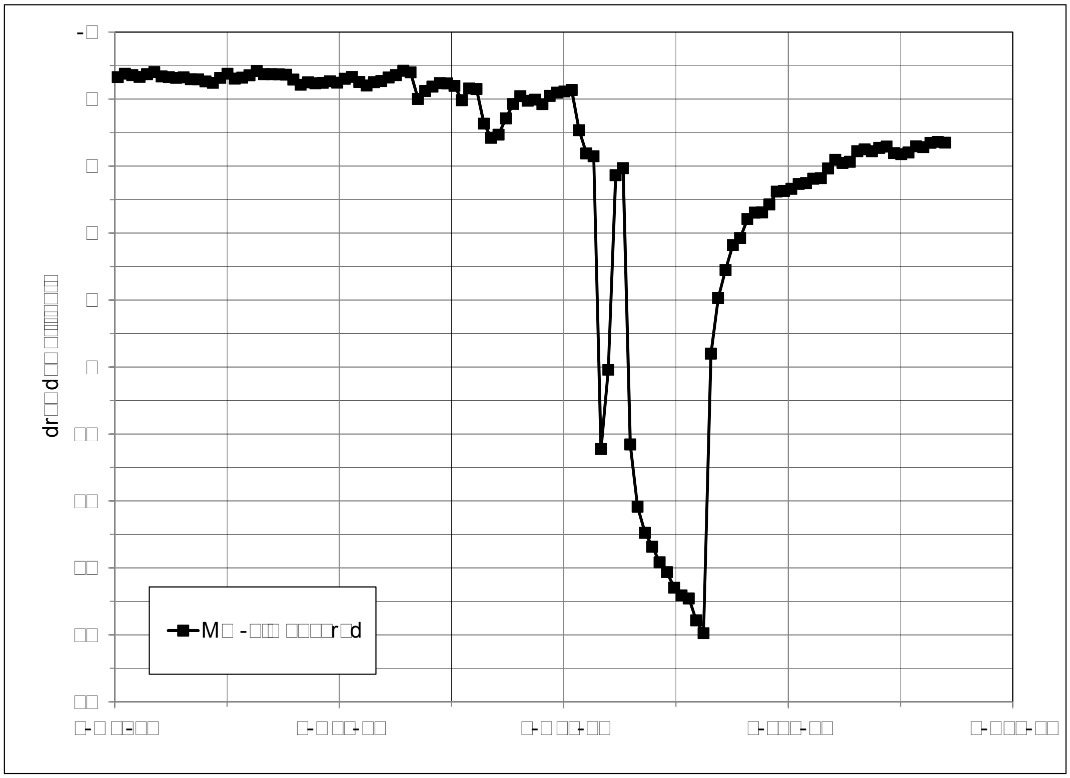


Figure C4-5. Aquifer test hydrograph MW-5.

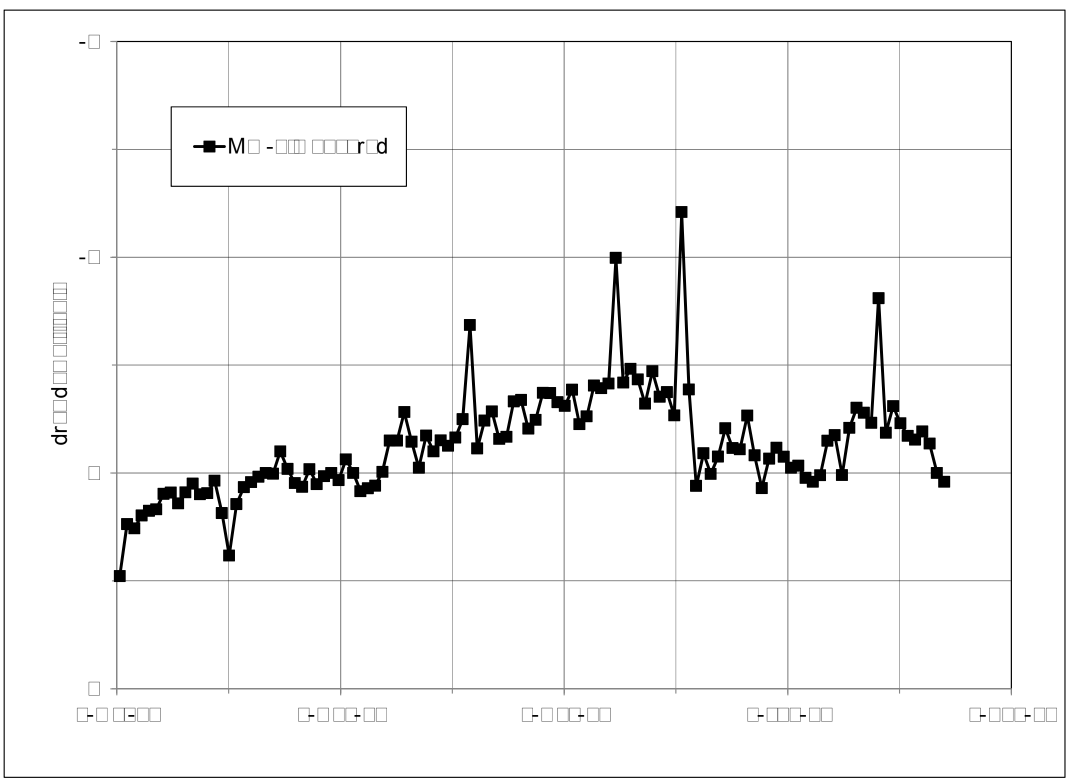


Figure C4-6. Aquifer test hydrograph MW-6.

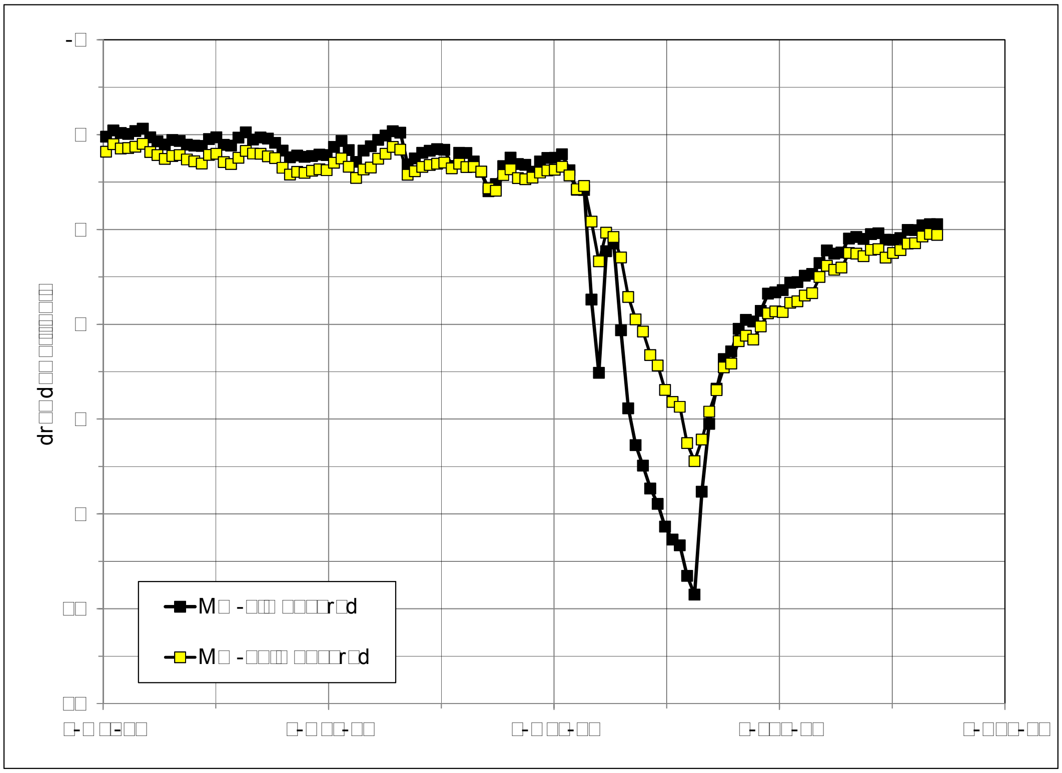


Figure C4-7. Aquifer test hydrograph MW-10.

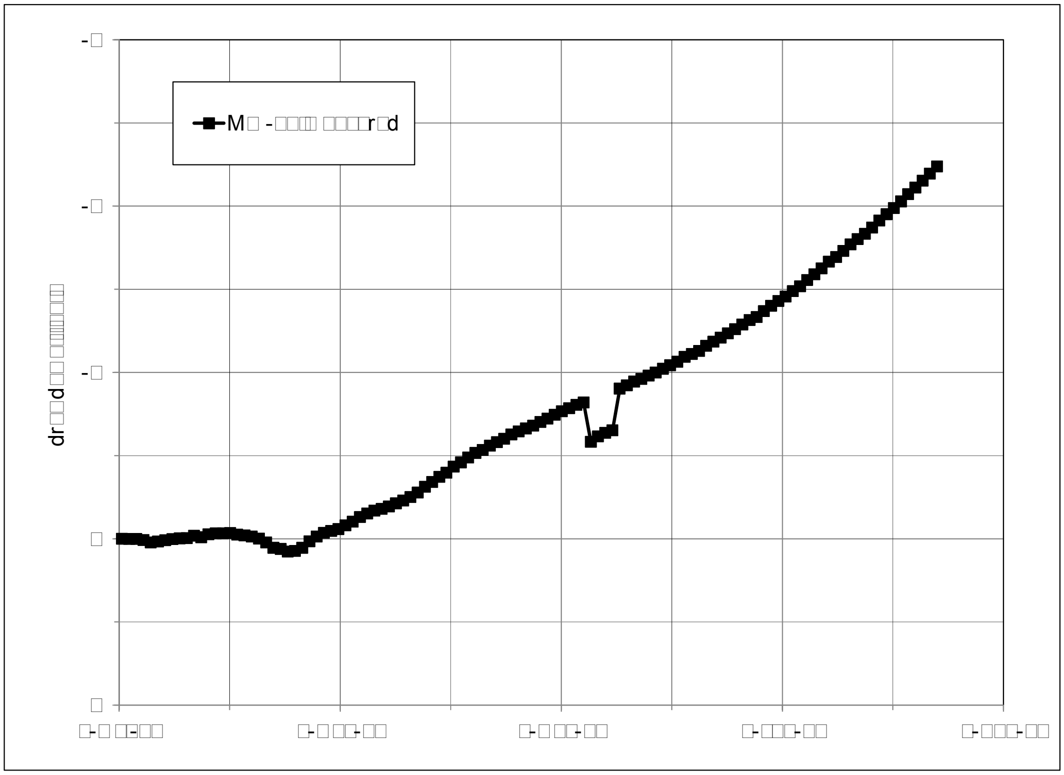


Figure C4-8. Aquifer test hydrograph MW-11.

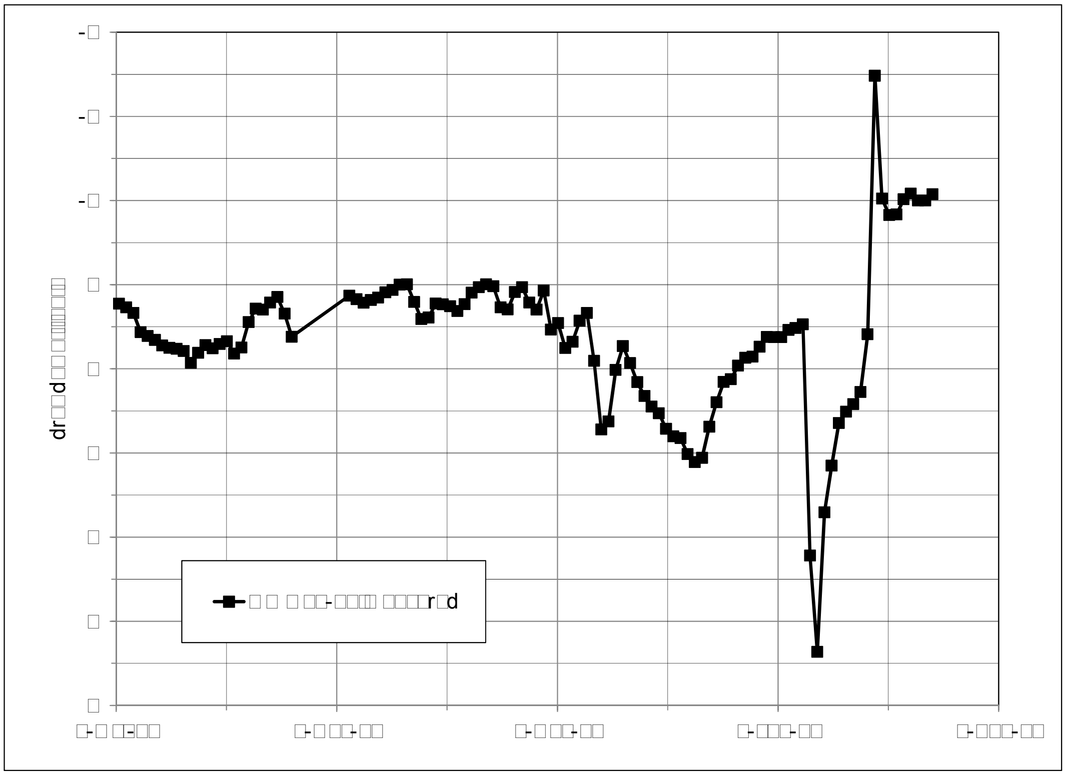


Figure C4-9. Aquifer test hydrograph GWQ11-27.

Appendix C5.

Pit Area Pressure-Injection Tests, September 2011

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25 COPPER FLAT MINE SIERRA COUNTY, NEW MEXICO

by

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September 2011

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25 COPPER FLAT MINE SIERRA COUNTY, NEW MEXICO

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Albuquerque, New Mexico 87110

September 2011

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ILLUSTRATIONS

(follow text)

APPENDIX

(follow illustrations)

Basic data for pressure-injection tests

ESTIMATED HYDRAULIC CONDUCTIVITY OF PRESSURE-INJECTION TEST ZONES BOREHOLES GWQ 5-R, GWQ 11-24, AND GWQ 11-25 COPPER FLAT MINE, SIERRA COUNTY, NEW MEXICO

INTRODUCTION

Pressure-injection tests were conducted during drilling of three boreholes (later reamed and completed as monitor wells), New Mexico Copper GWQ 5-R, GWQ-11-24, and GWQ-11-25. One zone was tested in GWQ 5-R, and three zones were tested in each of the other two boreholes. The tests were carried out between July 27 and August 31, 2011. Test equipment was provided and operated by the drilling contractor, WDC Exploration. Jeffrey J. Kelsch of John Shomaker & Associates recorded the data. Figure 1 is a map showing the locations.

The locations, logs and descriptions of the three monitor wells may be found in other reports. Well GWQ 5-R is completed in Cretaceous-age andesite, in the SE/4 NE/4 NW/4, Sec. 36, T. 15 S., R. 7 W. GWQ 11-24 and GWQ 11-25 are completed in Cretaceous-age intrusive rocks, in the SE/4 NE/4 NW/4 of Sec. 35, and the SW/4 NE/4 SW/4 of Sec. 26, respectively, of T. 15 S., R. 7 W.

TEST METHOD AND INTERPRETATION

The tests were conducted using a variation on the standard Lugeon test (Lugeon, 1933; Houlsby, 1976), for estimating average hydraulic conductivity of rock masses. In each of the three vertical, 3-3/4-in. boreholes, one or more zones were isolated between the bottom of the hole as it was at the time of the test, and a packer run on 1-in. standard-pipe tubing. In all but one case (GWQ 5-R), the test zone was below the water table and the rock mass was saturated at the beginning of the test.

For most of the tests, a Moyno progressing-cavity pump, reportedly rated at 10 gpm maximum flow and 350 psi maximum pressure, was used to inject water. One test employed a centrifugal pump, which was then replaced by the Moyno pump. The lengths of the test zones ranged from 36 ft to 48 ft, as indicated in Table 1 below. The injection rate was metered as clear water was pumped through the tubing into the open interval of the borehole at constant pressure, in 10-minute steps, first at increasing pressure and then at decreasing pressure. Basic data from the tests are given in the Appendix. In most cases, three series of measurements, at the same injection-pressure steps, were taken.

Injection rate was measured with a new, calibrated meter. Pressure in the tubing was measured with a 4-1/2-in.-dial, 0-300 psi, NIST certified gauge with 10-psi increments. Data were recorded each minute during each 10-minute pumping step.

The standard Lugeon test method is based on a sequence of five, 10-minute measurements of injection rate, three at increasing pressure, followed by two at decreasing pressure. The procedure for this project differed from the standard method in that many more measurements were made, with smaller increments of pressure between them, as suggested by Quiñones-Rozo (2010). This variation provides data for a more complete interpretation. In all cases, the higher pressures in the sequence of steps exceeded the fracture-gradient pressure at the depth of the open interval of the borehole, and existing fractures were dilated as water was pumped into them, or new fractures were created.

For each step, total head above the pre-test water level in the borehole was calculated as the sum of the gauge pressure in the tubing, the height of the gauge above ground level, and the depth to the static water level in the borehole, less the friction loss in the tubing at the specific injection rate. The friction loss was calculated by the standard Hazen-Williams formula with a constant for steel pipe of 100.

Hydraulic conductivity was calculated using the Lugeon relationship, which is empirically defined as the conductivity required for maintenance of an injection rate of 1 liter per minute per meter of open interval in the borehole, under a reference water pressure of 10 bars. One Lugeon unit is equivalent to 1.3 x 10^{-5} cm/sec, 0.03685 ft/day (Fell et al., 2005). For convenience, the calculations were made in terms of total added head in pounds per square inch (psi), and injection rates in gallons per minute (gpm).

Plots of injection rate versus total head above the pre-test water level in the borehole, and of apparent hydraulic conductivity (permeability) against total head, are given in Figures 1 through 12 for the tests in which the pumping rate was measurable.

RESULTS AND CONCLUSIONS

GWQ 5-R

One injection zone, from the bottom of the packer at 64 ft to the bottom of the borehole at 100 ft, was tested. Although the hole was almost full of fluid at the time of the test, later water-level measurements indicate that the natural static water level is about 48 ft. No flow was measured until the total head above the water level at the beginning of the test (5.6 ft below land surface, probably more than 40 ft above the natural water level) had reached more than 200 ft of water (87 psi; see Fig. 1). The injection rate was small, but increased rapidly, above that pressure. In a pressure step at 120 psi gauge pressure, fluid began to move up the hole above the packer, and the well began to flow, indicating that the packer seal had failed. An attempt was made to complete the test, but only very small injection rates could be maintained and it is clear from Figure 1 that any measurable fluid injected was entering dilated fractures. The test interval took no more fluid at declining pressures after the total head fell below about 340 ft of water, at about 110 psi gauge pressure.

The apparent hydraulic conductivity (permeability) was calculated at zero for the steps up to a head of about 200 ft of water, and then rose rapidly at higher pressures (Fig. 2). All of the measured injection that did occur was undoubtedly into fractures dilated by the high test pressures, and the actual hydraulic conductivity (permeability) is extremely low. This conclusion is reinforced by the fact that, at the beginning of the test, the water level in the borehole was 5.6 ft below land surface, even though later measurements in the completed well indicate that the hole would have been dry to a depth of 48 ft. No attempt was made to replicate the test.

Table 1. Summary of hydraulic conductivity (permeability) estimates

borehole and zone	depth interval, ft	apparent permeability		
		Lugeon units	cm/sec	ft/day
GWQ 5-R, Zone 1	64-100	~0	~0	~0
GWQ 11-24, Zone 1	100-147	0.5	7×10^{-6}	0.02
GWQ 11-24, Zone 2	150-197	2.3	3.0×10^{-5}	0.085
GWQ 11-24, Zone 3	204-251	3.8	4.9×10^{-5}	0.14
GWQ 11-25, Zone 1	100-148	~0	~0	~0
GWQ 11-25, Zone 2	150-198	2.2	2.9×10^{-5}	0.081
GWQ 11-25, Zone 3	207-251	2.0	2.6×10^{-5}	0.074

GWQ 11-24, Zone 1

This zone extended from the packer, at 100 ft, to 147 ft. Three series of injection tests were conducted, the first two with a centrifugal pump and the third with the Moyno positive-displacement pump. Plots of injection rate against total head are shown on Figure 3. In Series 1, the injection rates at increasing pressure were close to a line passing through the origin of the graph (Fig. 1), indicating that dilation of fractures was not significant until total head exceeded 200 ft or more, and the apparent permeability (Fig. 2) was roughly constant at around 0.5 Lugeon units (7×10^{-6} cm/sec, or 0.02 ft/day). Late in the first series, above total heads of around 210 ft of water, with about 75 psi gauge pressure, the injection rates began to increase sharply (Fig. 3), and it is probable that dilation of fractures was occurring.

In the subsequent two series of injection measurements, the rates were successively higher at corresponding pressures, and apparent permeability was greater (Fig. 4). In the third series, at the highest injection rates, the decreasing trend of apparent permeability indicates that head loss due to turbulent flow, as water flowed to and entered discrete fractures, played a significant role. The value of around 0.5 Lugeon units (7×10^{-6} cm/sec, or 0.02 ft/day), based on the first series of measurements, is likely to be most nearly representative.

GWQ 11-24, Zone 2

The packer was set at 150 ft and the bottom of the hole was at 197 ft. The injection rates in the first series of measurements were high compared with the other tests (see Fig. 5), but the plot of injection rates against total head does not extrapolate back through the origin. This may be attributable to turbulent-flow losses, or to significant dilation of fractures that occurred, and flow into the rock mass begun, even as the hole was filling and before pressure began to show on the gauge. This seems improbable at such low total heads. Although not reflected in the field notes, a more probable explanation is that some leakage around the packer was occurring.

In the second series of measurements (Fig. 5), the injection rates were directly proportional to total head, and the increasing-pressure plot extrapolates back almost through the origin, suggesting that the packer was sealing properly. Injection rates were somewhat greater during the decreasing-pressure part of the series, which may be attributable to some fracture dilation that occurred at the highest pressures during the increasing-pressure part of the test, and persisted.

The plot of apparent permeability against total head (Fig. 6) shows a steep decline with increasing injection rate for the first series of measurements, which might be indicative of large and increasing influence of turbulent flow, but is more likely a consequence of leakage around the packer as mentioned above. In the second series, in contrast, the apparent permeability is nearly constant, representing nearly laminar-flow conditions, at about 2.3 Lugeon units for increasing pressures. The representative permeability is likely to be 2.3 Lugeon units (3.0 x 10^{-5} cm/sec, or 0.085 ft/day).

GWQ 11-24, Zone 3

In this zone, the packer was set at 204 ft and the bottom of the borehole was at 251 ft. For the first four steps at increasing pressure in the first series of measurements, for total head up to about 170 ft, the injection rates plot approximately on a line that extrapolates back through the origin (Fig. 7), indicating that no fracture-dilation occurred. The apparent-permeability plot, projected back to the value at zero head (Fig. 8) suggests a value of about 0.6 Lugeon units, and a small turbulent-flow effect.

After total head exceeded about 170 ft in the first series of measurement, the injection rate increased markedly (Fig. 7), indicating that a fracture or fractures had opened under the increasing pressure, or more probably in this case, that temporary clogging of a fracture or the skin effect of drilling-fluid solids had been overcome. The pattern of injection rates as the pressures continued to increase and then decrease in the first series of measurements, and the identical pattern in the second and third series of measurements (see Fig. 7), suggest that fracture(s) did not close as the pressure was reduced, and that the initial sharp rise in injection rates during the first series was attributable to clearing of clogging or skin effect.

The plots of injection rate against total head for points representing measurements after the original breakthrough do not, however, extrapolate back through the origin. A loss of about 1.6 gpm, equivalent to about 93 ft of head differential, is indicated. The water level in the well at the beginning of the test, however, compares closely with later measurements, and it is not likely that a difference between the natural head and the head at the beginning of the test would account for the discrepancy. The most likely explanation seems to be that some water leaked around the packer, perhaps through a fracture open at both ends of the packer element.

Figure 8 shows the calculated values of permeability versus total head. Discounting the earliest measurements in Series 1, and assuming that turbulent-flow conditions account for the negative slope of the plot, and also assuming that the leakage around the packer is actually proportional to the injection rate, leads to a projection at zero total head, where no turbulence or leakage would exist, of about 3.8 Lugeon units (4.9 x 10^{-5} cm/sec, or 0.14 ft/day).

GWQ 11-25, Zone 1

A zone from 100 to 148 ft was isolated between the packer and the bottom of the borehole. No water was measured as being injected into the test zone until the gauge pressure reached 150 psi, representing a total head above the water level in the hole at the beginning of the test of about 375 ft, equivalent to 163 psi. This pressure is far in excess of any probable fracture-gradient pressure at 100 ft, and it seems clear that the hydraulic conductivity of the rock was extremely low before fractures were induced or opened by the injection pressure. The remainder of the test was not considered valid for estimation of permeability.

GWQ 11-25, Zone 2

Zone 2 extended from the packer at 150 ft to the bottom of the hole at 198 ft. Injection rates during the first series of measurements were approximately proportional to total head, except for a relative rise in injection rate at heads above about 240 ft (Fig. 9). In the second and third series of measurements, injection rates increased and became directly proportional to total head, and the plot of injection rate against total head extrapolates back through the origin, with zero flow at zero additional head. Probably this sequence reflects some clearing of clogging by drilling-fluid solids.

The apparent permeability plot (Fig. 10) appears to reflect a decrease in turbulent-flow effects from Series 1 to Series 3. Projection of the apparent permeability for Series-3 measurements back to the value at zero additional head, where no turbulent-flow effect would be seen, suggests a representative permeability of about 2.2 Lugeon units (2.9 x 10^{-5} cm/sec or 0.081 ft/sec).

GWQ 11-25, Zone 3

This zone extended from the packer at 207 ft to the bottom of the hole at 251 ft. The injection rate was approximately proportional to total head at values of head up to about 180 ft during the first series of measurements (Fig. 11), but the plot appears to project back to a rate greater than zero at zero head, suggesting some leakage. At higher pressures, the injection rate increased very sharply, indicating dilation of fractures, and the injection rates at descending values of total head fell below the rates at corresponding heads during the increasing-pressure phase of the test, suggesting that some plugging of fractures had occurred. In the second and third series of measurements, the injection-rate versus total-head plots were very similar, and in each series they were similar for increasing and decreasing rates. The sharp rise in rate indicative of fracture dilation occurred at a higher total head, and projections of the plots pass nearly through the origin.

The apparent-permeability plot (Fig. 12) shows the influence of turbulent flow in all three series. Projection of the low total-head points back to a value at zero total head, suggests that a representative permeability may be about 2.0 Lugeon units (2.6 x 10^{-5} cm/sec or 0.074 ft/day).

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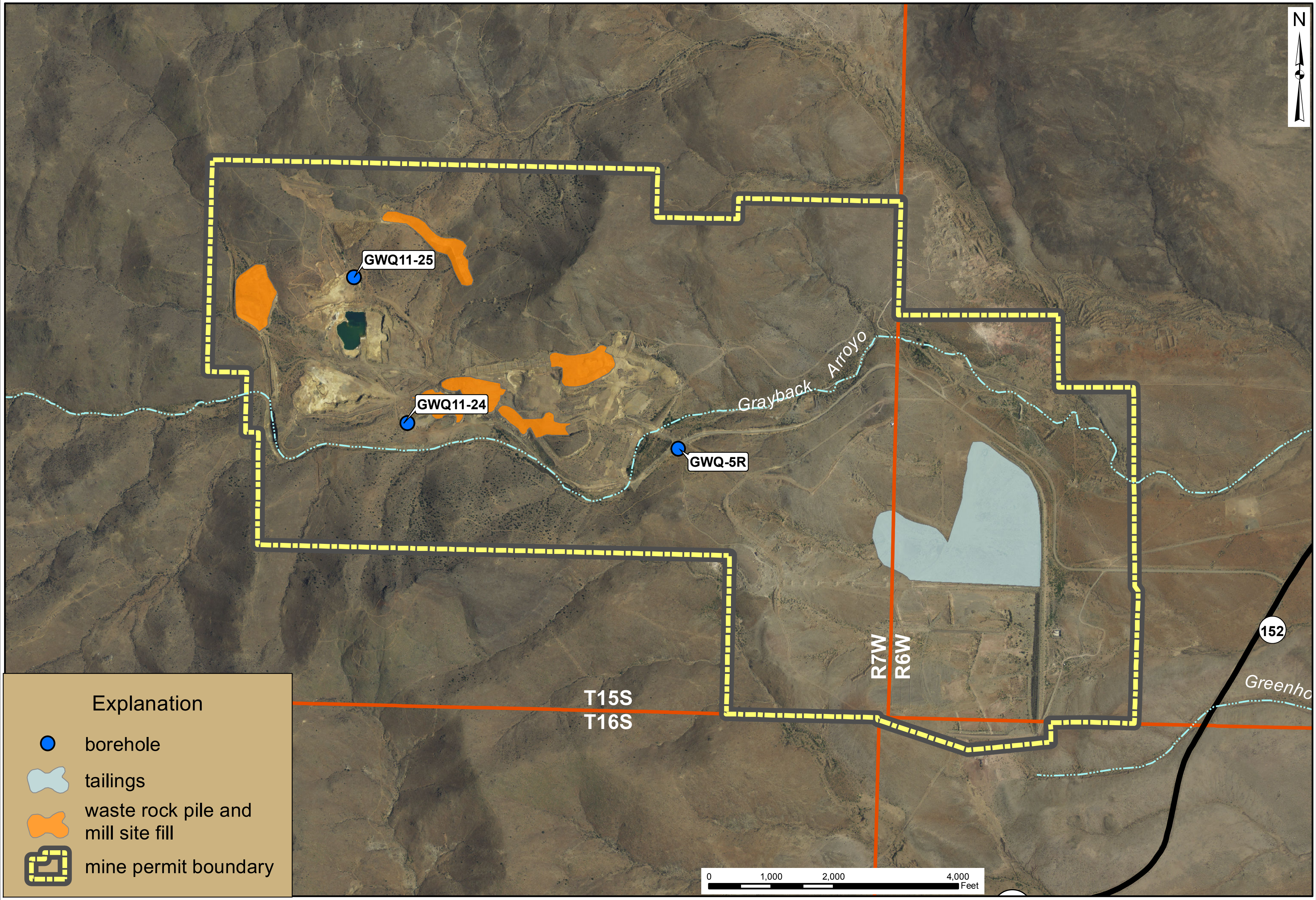
Quiñones-Rozo, C., 2010, Lugeon test interpretation, revisited: United States Society on Dams, 30th Annual Conference Proceedings, pp. 405-414.

ILLUSTRATIONS



Aerial Photograph: NAIP 2011

July 26, 2013

Figure 1. Aerial photograph showing locations of three boreholes and facilities associated with the former Copper Flat Mine operated by Quintana Minerals, Sierra County, New Mexico.

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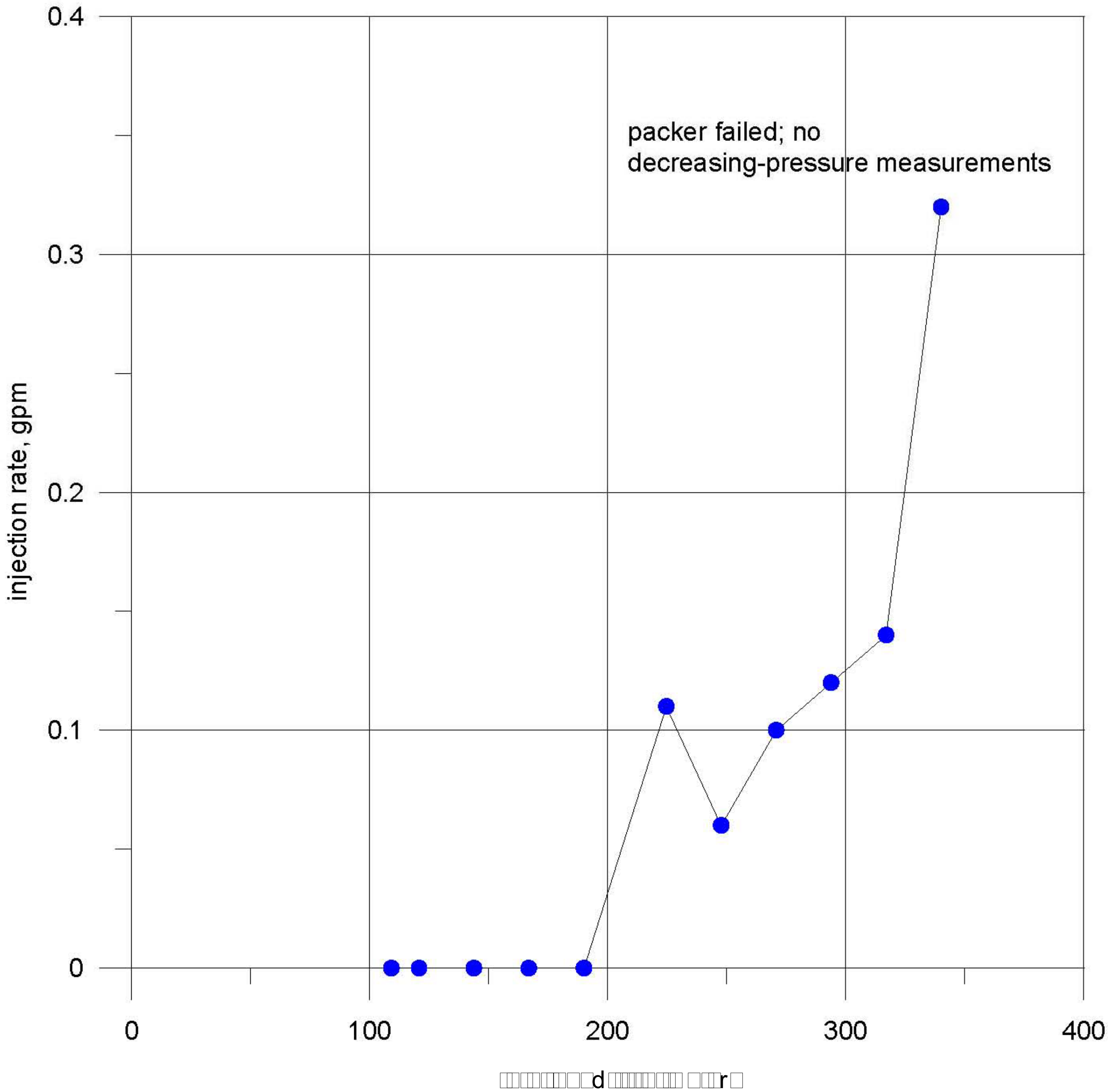

Figure 2. Pressure injection test, New Mexico Copper GWQ 5-R, Zone 1 (64-100 ft), Series 1, August 31, 2011.

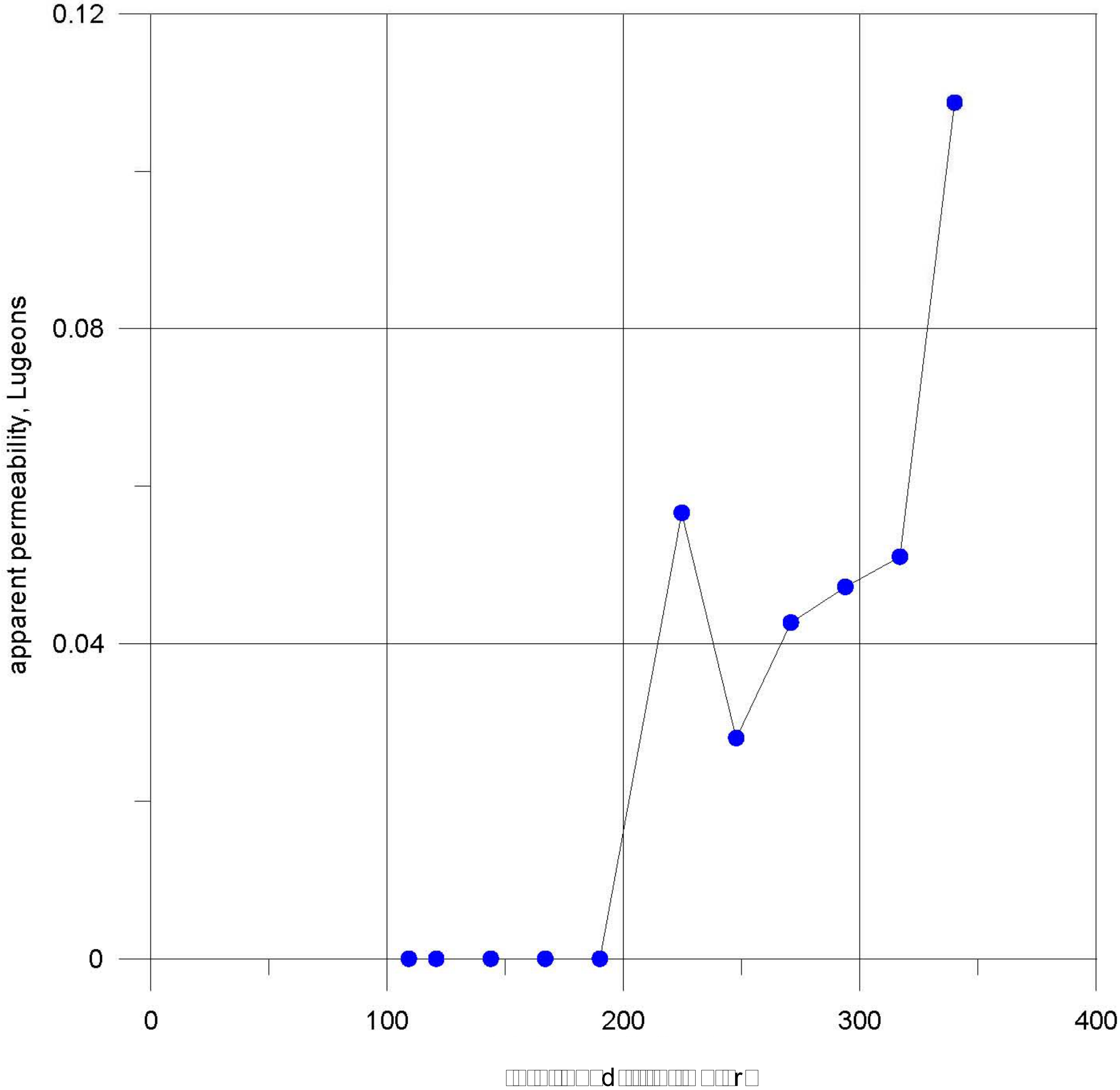

Figure 3. Apparent permeability from pressure injection test, New Mexico Copper GWQ 5-R, Zone 1 (64-100 ft), Series 1, August 31, 2011.

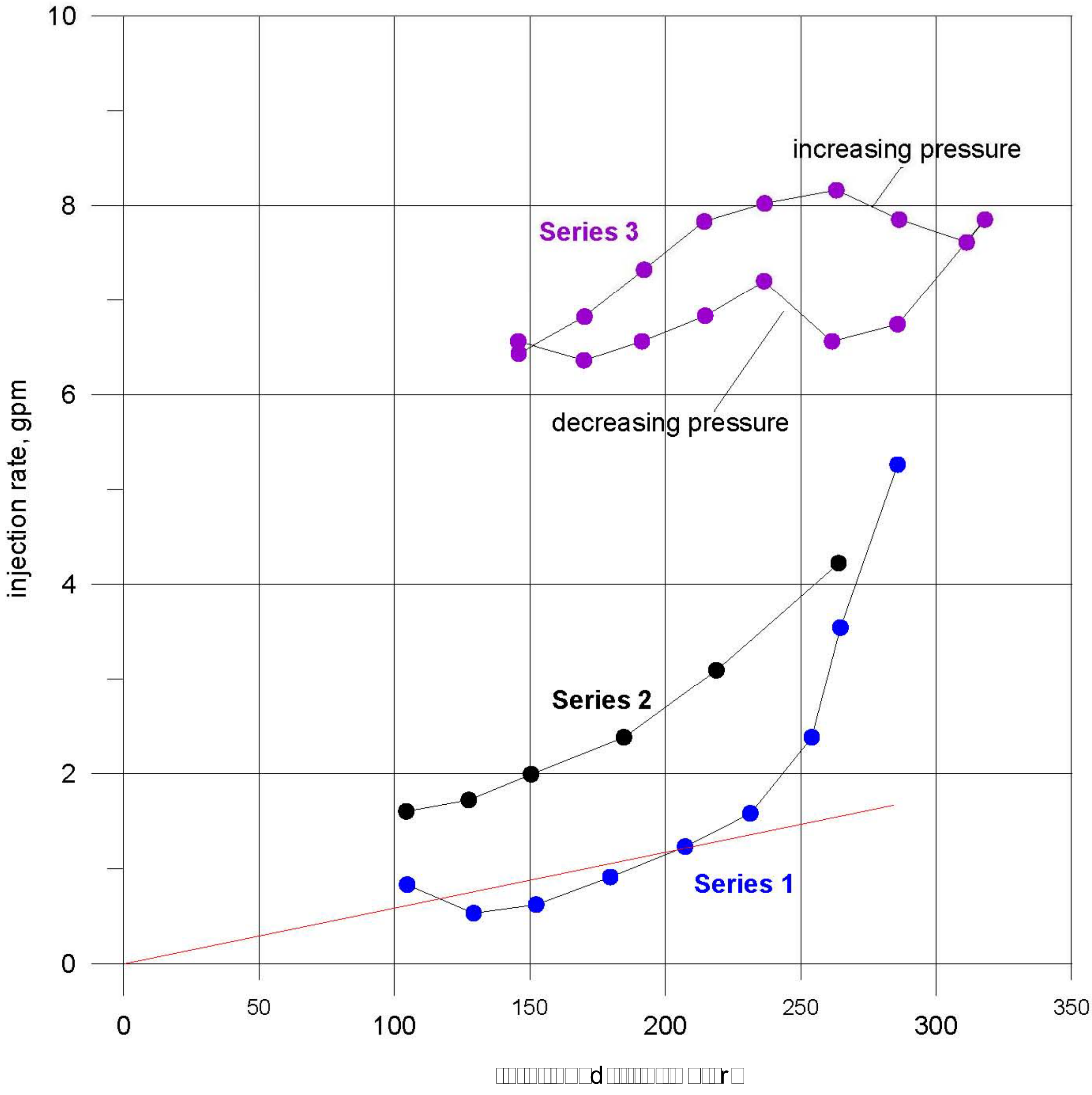

Figure 4. Pressure injection tests, New Mexico Copper GWQ 11-24, Zone 1 (100-147 ft), Series 1 and 2 (centrifugal pump), and Series 3 (positive displacement pump), July 27, 2011.

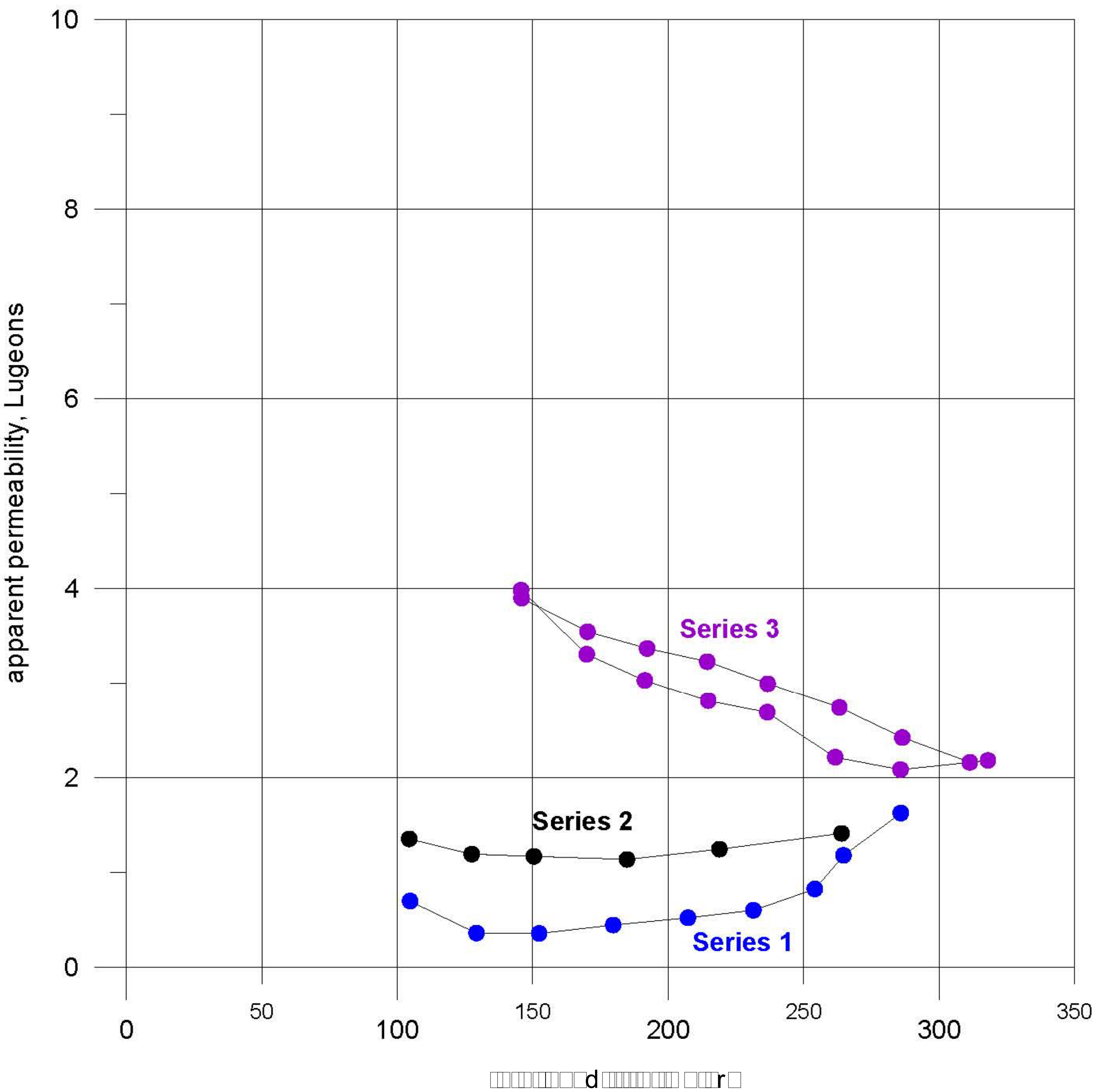

Figure 5. Apparent permeability from pressure injection tests, New Mexico Copper GWQ 11-24, Zone 1 (100-147 ft), Series 1 and 2 (centrifugal pump), and Series 3 (positive displacement pump), July 27, 2011.

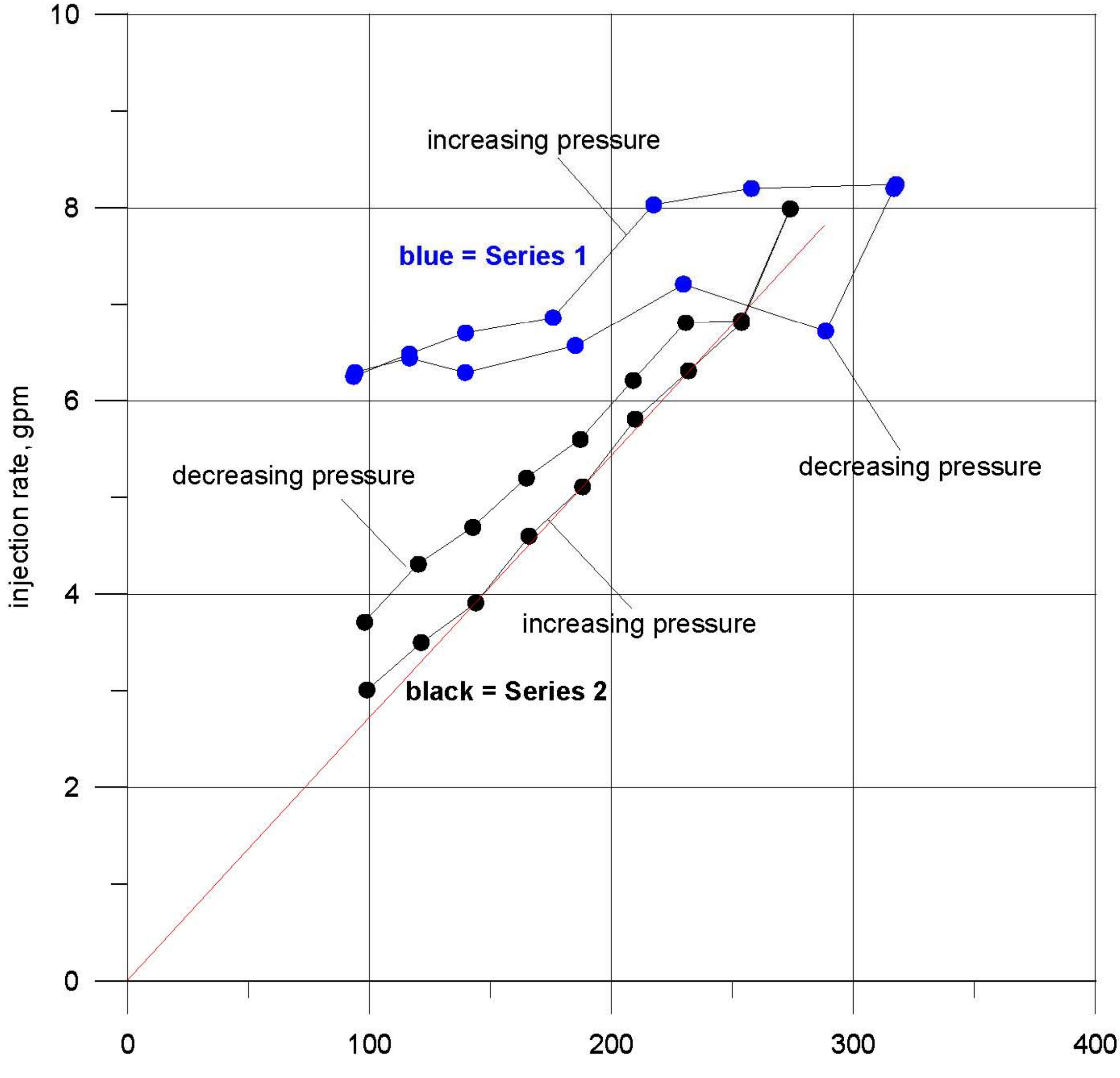

Figure 6. Pressure injection test, New Mexico Copper GWQ 11-24, Zone 2 (150-197 ft), Series 1 and 2, July 30, 2011.

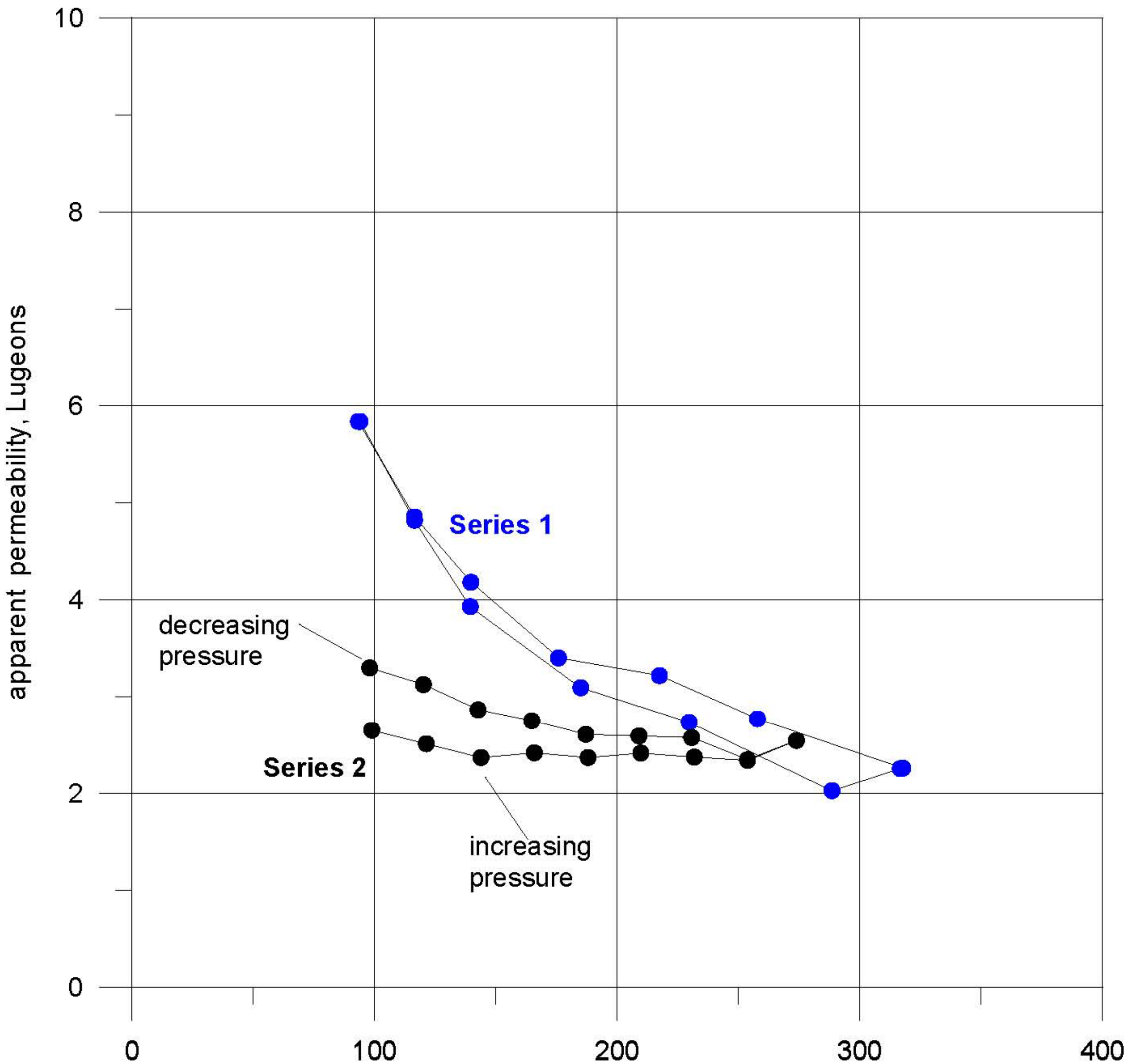

Figure 7. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-24, Zone 2 (150-197 ft), Series 1 and 2, July 30, 2011.

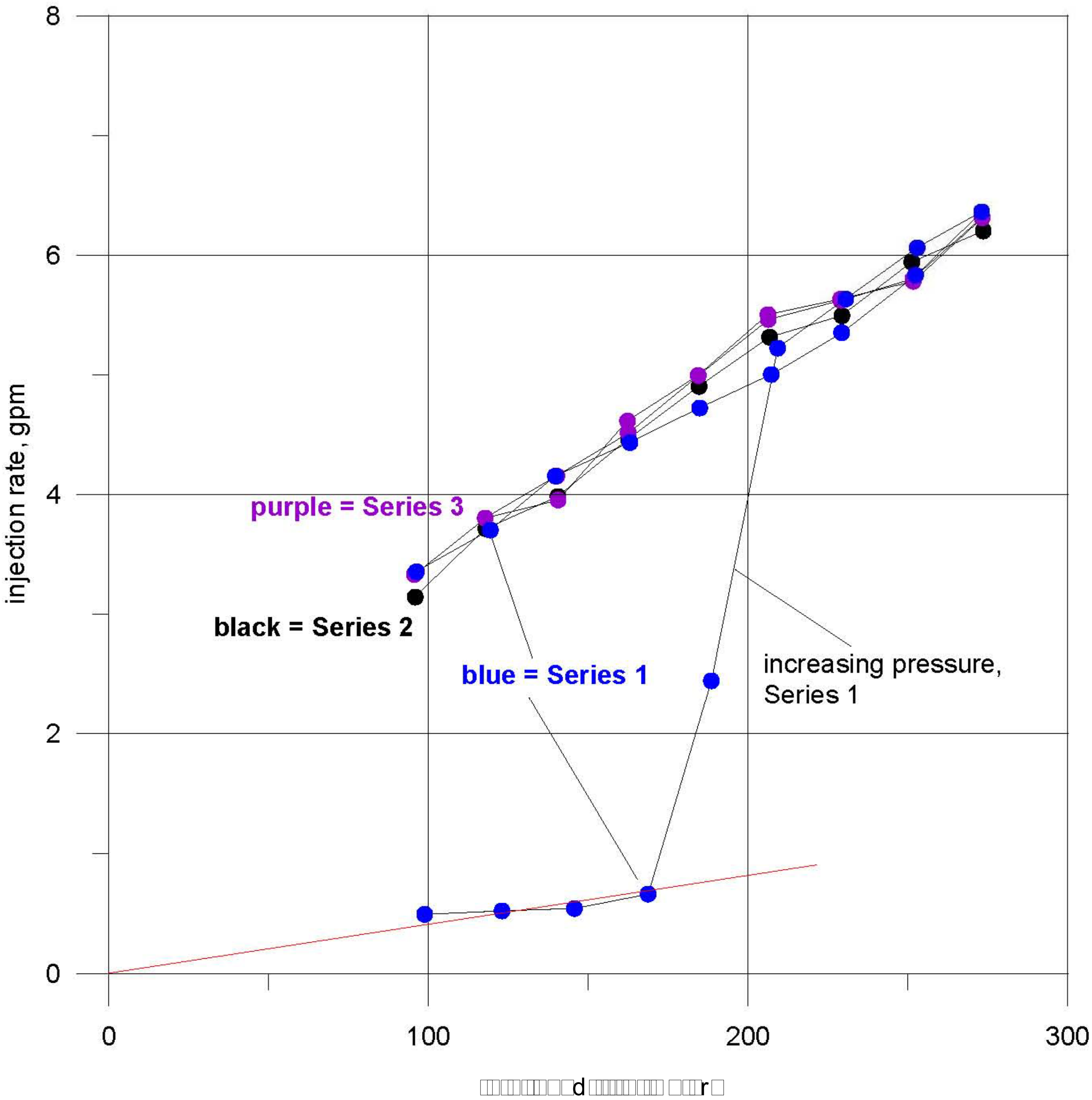

Figure 8. Pressure injection test, New Mexico Copper GWQ 11-24, Zone 3 (204-251 ft), Series 1, 2, and 3, August 1, 2011.

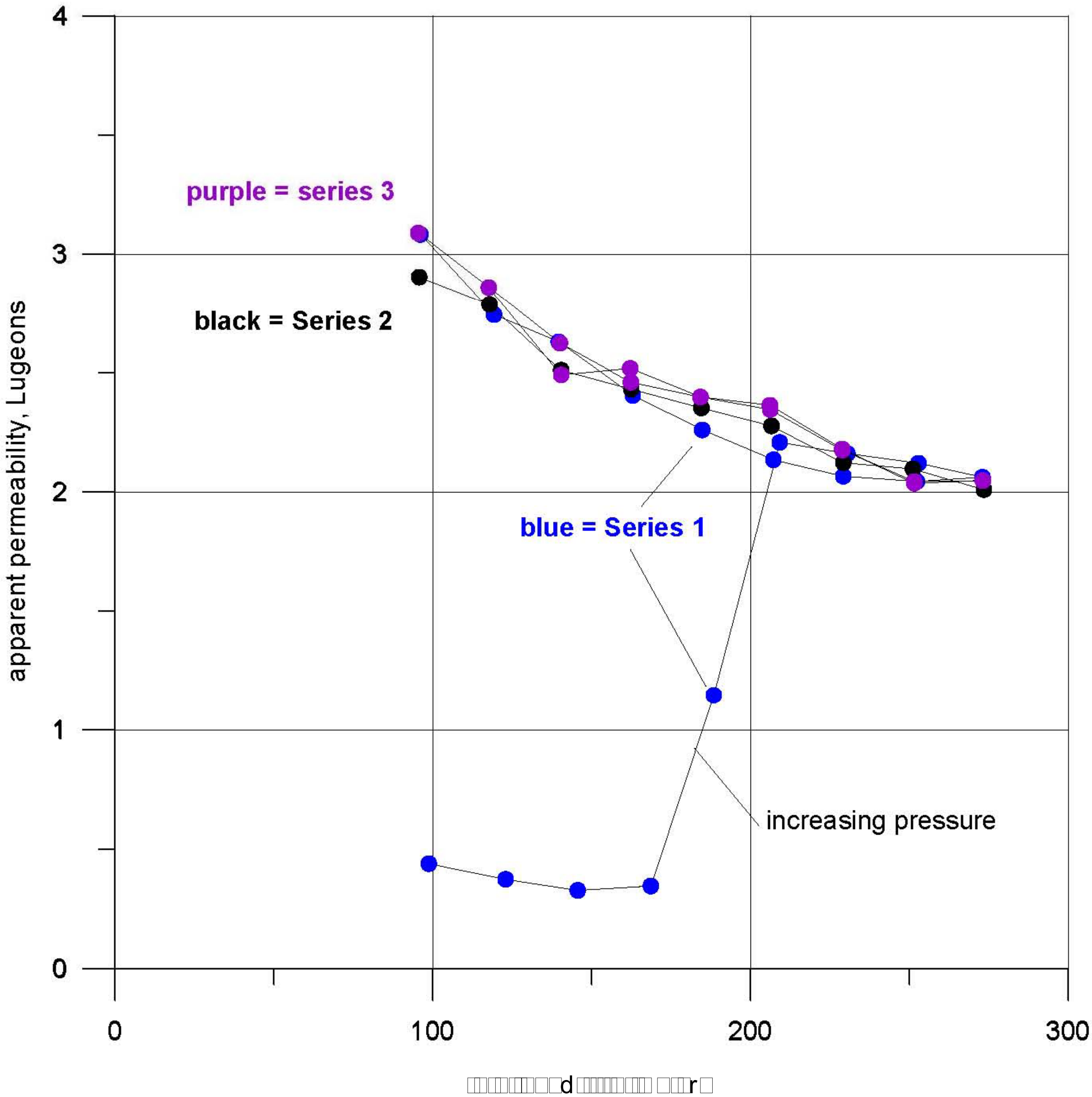

Figure 9. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-24, Zone 3 (204-251 ft), Series 1, 2, and 3, August 1, 2011.

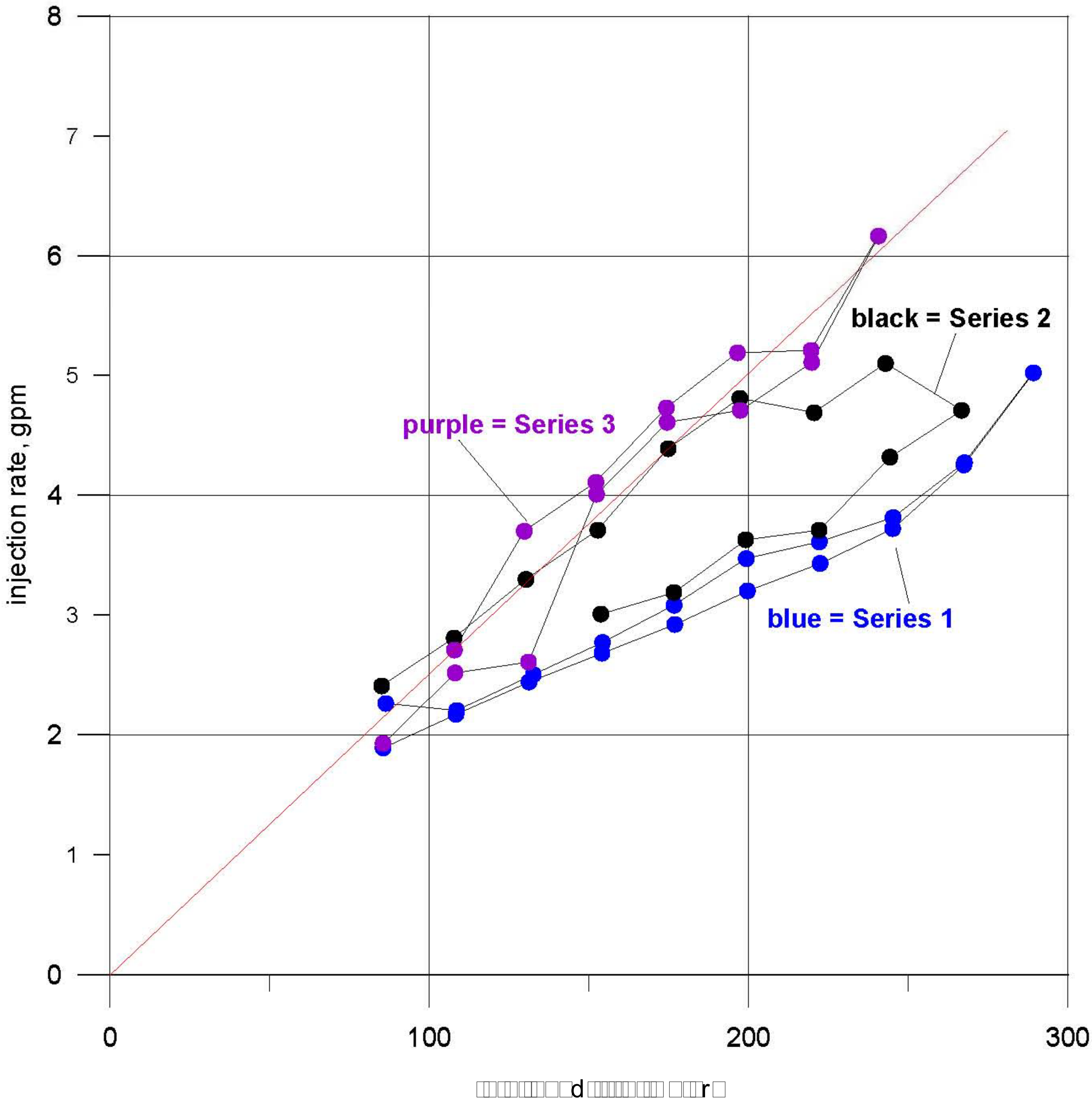

Figure 10. Pressure injection test, New Mexico Copper GWQ 11-25, Zone 2 (150-197.7 ft), Series 1, 2, and 3, August 16, 2011.

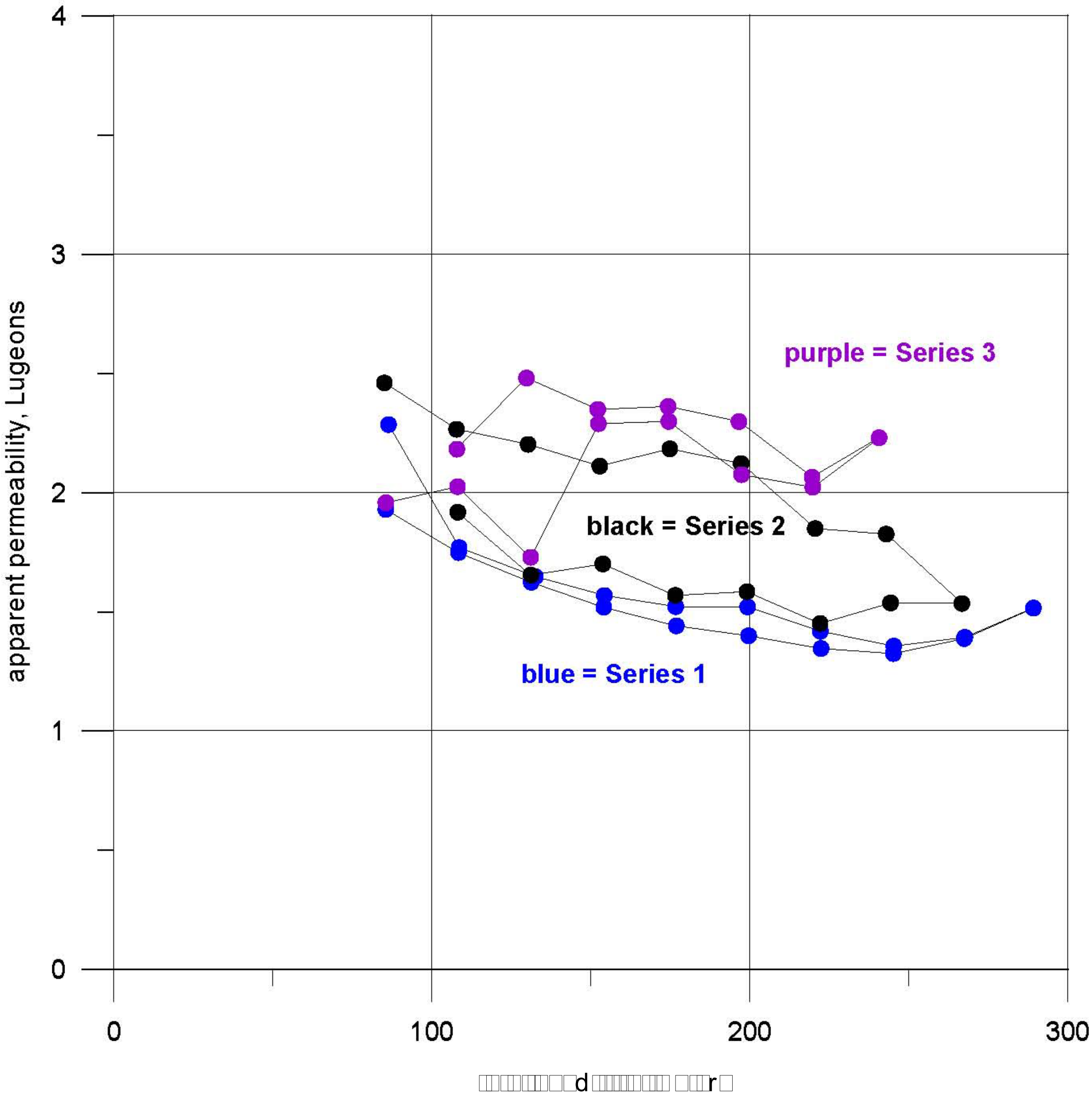

Figure 11. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-25, Zone 2 (150-197.7 ft), Series 1, 2, and 3, August 16, 2011.

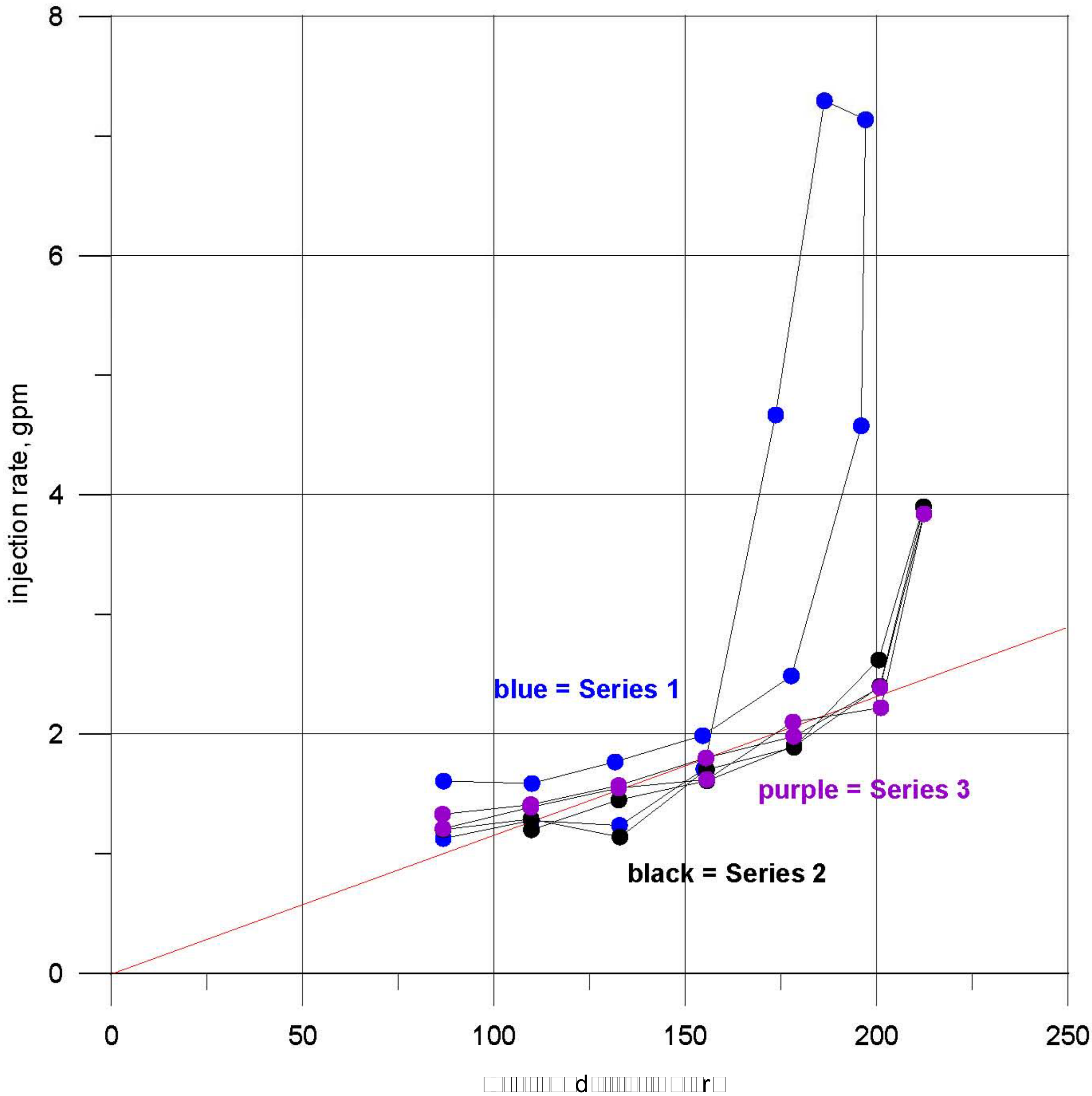

Figure 12. Pressure injection test, New Mexico Copper GWQ 11-25, Zone 3 (207-251 ft), Series 1, 2 and 3, August 24, 2011.

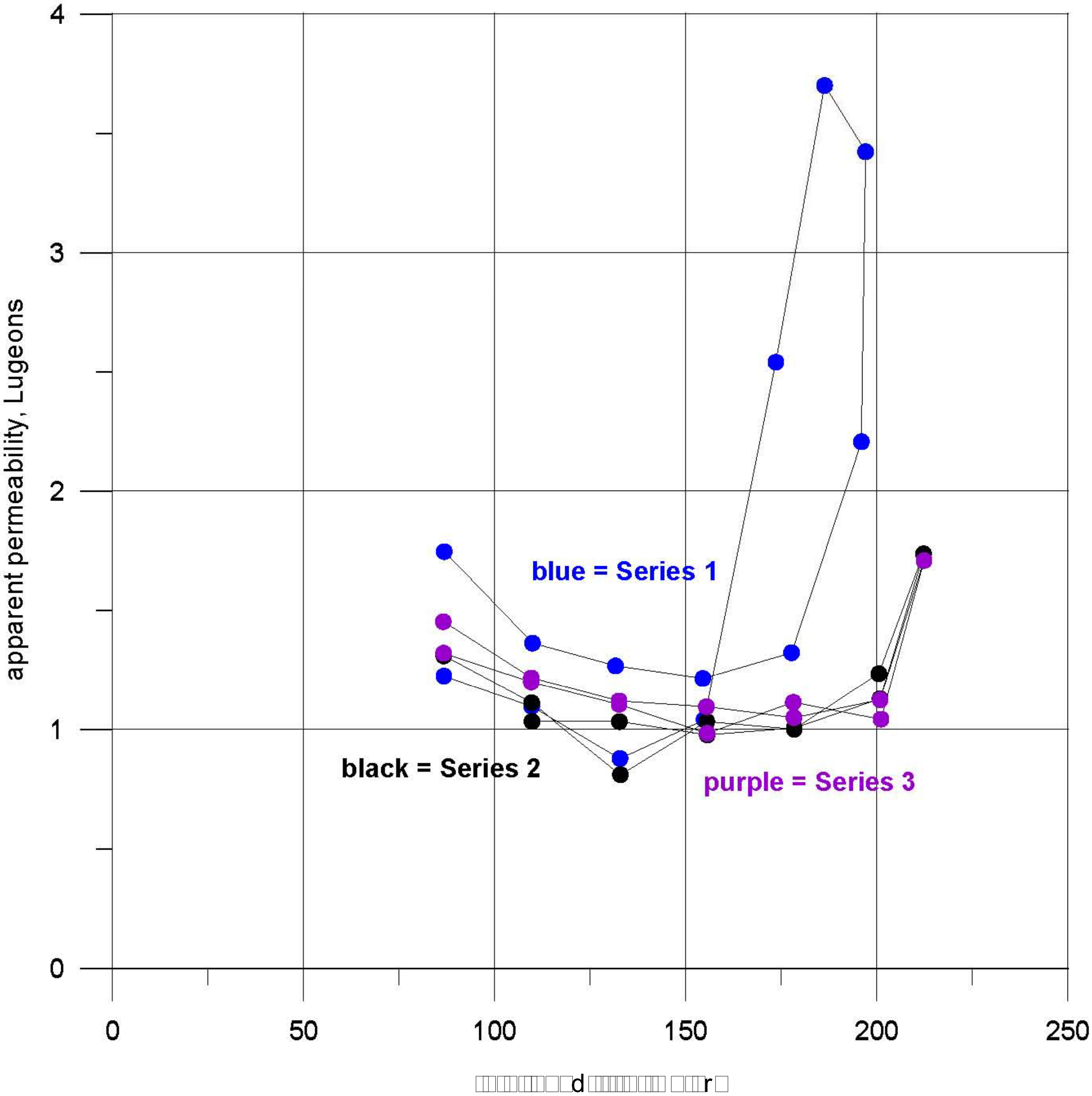

Figure 13. Apparent permeability from pressure injection test, New Mexico Copper GWQ 11-25, Zone 3 (207-251 ft), Series 1, 2, and 3, August 24, 2011.

APPENDIX

Appendix.

Basic data for pressure-injection tests

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Date	8/31/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 5-R
Hydrologist	JJK

later WLs indicate dry to 100 ft; use (64+100)/2

Starting Water Level (ft bgl)	5.6 (not representative of Static)
Elevation (ft GL)	
Injection Interval (ft bgl)	64 to 100
Bore/Casing Depth (ft bgl)	100

Packer Dia	2 inch
Bore/Casing Dia	3-3/4 inch
Injection Pipe Dia	1 inch
Pressure gauge height above GL	4 ft

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:25	0		6000		10	0	Packer at 200 psi
11:26	1	1	6000	0.00	10	0	
11:27	2	2	6000	0.00	10	0	
11:28	3	3	6000	0.00	10	0	
11:29	4	4	6000	0.00	10	0	
11:30	5	5	6000	0.00	10	0	
11:31	6	1	6000	0.00	20	0	
11:32	7	2	6000	0.00	20	0	
11:33	8	3	6000	0.00	20	0	
11:34	9	4	6000	0.00	20	0	
11:35	10	5	6000	0.00	20	0	
11:36	11	1	6000	0.00	30	0	
11:37	12	2	6000	0.00	30	0	
11:38	13	3	6000	0.00	30	0	
11:39	14	4	6000	0.00	30	0	
11:40	15	5	6000	0.00	30	0	
11:41	16	1	6000	0.00	40	0	
11:42	17	2	6000	0.00	40	0	
11:43	18	3	6000	0.00	40	0	
11:44	19	4	6000	0.00	40	0	
11:45	20	5	6000	0.00	40	0	
11:46	21	1	6000	0.00	50	0	
11:47	22	2	6000	0.00	50	0	
11:48	23	3	6000	0.00	50	0	
11:49	24	4	6000	0.00	50	0	
11:50	25	5	6000	0.00	50	0	
11:51	26	1	6000	0.00	60	0	
11:52	27	2	6000	0.00	60	0	
11:53	28	3	6000.3	0.30	60	0.3	
11:54	29	4	6000.3	0.00	60	0.3	
11:55	30	5	6000.5	0.20	60	0.5	
11:56	31	1	6000.7	0.2	60	0.7	
11:57	32	2	6000.9	0.2	60	0.9	
11:58	33	3	6001	0.1	60	1	
11:59	34	4	6001.1	0.1	60	1.1	
12:00	35	5	6001.1	0	60	1.1	
12:01	36	1	6001.2	0.1	70	1.2	
12:02	37	2	6001.2	0	70	1.2	
12:03	38	3	6001.2	0	70	1.2	
12:04	39	4	6001.3	0.1	70	1.3	
12:05	40	5	6001.3	0	70	1.3	
12:06	41	6	6001.5	0.2	70	1.5	
12:07	42	7	6001.5	0	70	1.5	
12:08	43	8	6001.5	0	70	1.5	
12:09	44	9	6001.7	0.2	70	1.7	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:10	45	10	6001.7	0	70	1.7	
12:11	46	1	6001.9	0.2	80	1.9	
12:12	47	2	6002	0.1	80	2	
12:13	48	3	6002.1	0.1	80	2.1	
12:14	49	4	6002.1	0	80	2.1	
12:15	50	5	6002.1	0	80	2.1	
12:16	51	6	6002.4	0.3	80	2.4	
12:17	52	7	6002.4	0	80	2.4	
12:18	53	8	6002.5	0.1	80	2.5	
12:19	54	9	6002.7	0.2	80	2.7	
12:20	55	10	6002.7	0	80	2.7	
12:21	56	1	6002.8	0.1	90	2.8	
12:22	57	2	6003	0.2	90	3	
12:23	58	3	6003	0	90	3	
12:24	59	4	6003.2	0.2	90	3.2	
12:25	60	5	6003.2	0	90	3.2	
12:26	61	6	6003.3	0.1	90	3.3	
12:27	62	7	6003.4	0.1	90	3.4	
12:28	63	8	6003.6	0.2	90	3.6	
12:29	64	9	6003.7	0.1	90	3.7	
12:30	65	10	6003.9	0.2	90	3.9	
12:31	66	1	6004	0.10	100	4	
12:32	67	2	6004.2	0.20	100	4.2	
12:33	68	3	6004.2	0.00	100	4.2	
12:34	69	4	6004.5	0.30	100	4.5	
12:35	70	5	6004.7	0.20	100	4.7	
12:36	71	1	6004.7	0	100	4.7	
12:37	72	2	6004.9	0.2	100	4.9	
12:38	73	3	6005.1	0.2	100	5.1	
12:39	74	4	6005.1	0	100	5.1	
12:40	75	5	6005.3	0.2	100	5.3	
12:41	76	1	6005.7	0.4	110	5.7	
12:42	77	2	6006	0.3	110	6	
12:43	78	3	6006.4	0.4	110	6.4	
12:44	79	4	6006.6	0.2	110	6.6	
12:45	80	5	6006.9	0.3	110	6.9	
12:46	81	6	6007.3	0.4	110	7.3	
12:47	82	7	6007.7	0.4	110	7.7	
12:48	83	8	6007.9	0.2	110	7.9	
12:49	84	9	6008.2	0.3	110	8.2	
12:50	85	10	6008.5	0.3	110	8.5	
12:51	86	1	6011.2	2.7	120	11.2	Fluid moving up hole
12:52	87	2	6013.8	2.6	122	13.8	
12:53	88	3	6016.2	2.4	115	16.2	Fluid at top of conductor
12:54	89	4	6021.2	5	113	21.2	
12:55	90	5	6026.3	5.1	110	26.3	
12:56	91	6	6032	5.7	110	32	
12:57	92	7	6037.6	5.6	110	37.6	
12:58	93	8	6043.5	5.9	110	43.5	
12:59	94	9	6049.2	5.7	110	49.2	Approximatly 5 + gallons flowing at surface
13:00	95	10	6055	5.8	110	55	Stop pump
13:01	96		6055	0		NA	Packer pressure has dropped to 160
13:02	97		6055	0		NA	
13:03	98		6055	0		NA	
13:04	99		6055	0		NA	
13:05	100		6055	0		NA	
13:06	101		6055	0		NA	Attempt to reinflate packer and stabilize

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:07	102		6055	0		NA	
13:08	103		6055	0		NA	
13:09	104		6055	0		NA	
13:10	105		6055	0		NA	Unable to stabilize packer psi
13:11	106		6055	0		NA	
13:12	107		6055	0		NA	
13:13	108		6055	0		NA	
13:14	109		6055	0		NA	
13:15	110		6055	0		NA	
13:16	111		6055	0		NA	
13:17	112		6055	0		NA	
13:18	113		6055	0		NA	
13:19	114		6055	0		NA	
13:20	115		6055	0		NA	Pull and replace packer
13:21	116		6055	0		NA	
13:22	117		6055	0		NA	
13:23	118		6055	0		NA	
13:24	119		6055	0		NA	
13:25	120		6055	0		NA	
13:26	121		6055	0		NA	
13:27	122		6055	0		NA	
13:28	123		6055	0		NA	
13:29	124		6055	0		NA	
13:30	125		6055	0		NA	
13:31	126		6055	0		NA	
13:32	127		6055	0		NA	
13:33	128		6055	0		NA	
13:34	129		6055	0		NA	
13:35	130		6055	0		NA	
13:36	131		6055	0		NA	
13:37	132		6055	0		NA	
13:38	133		6055	0		NA	
13:39	134		6055	0		NA	
13:40	135		6055	0		NA	
13:41	136		6055	0		NA	
13:42	137		6055	0		NA	
13:43	138		6055	0		NA	
13:44	139		6055	0		NA	
13:45	140		6055	0		NA	
13:46	141		6055	0		NA	
13:47	142		6055	0		NA	
13:48	143		6055	0		NA	
13:49	144		6055	0		NA	
13:50	145		6055	0		NA	
13:51	146		6055	0		NA	
13:52	147		6055	0		NA	
13:53	148		6055	0		NA	
13:54	149		6055	0		NA	
13:55	150		6055	0		NA	
13:56	151		6055	0		NA	
13:57	152		6055	0		NA	
13:58	153		6055	0		NA	
13:59	154		6055	0		NA	New packer installed and inflated to 200 psi
14:00	155	1	6057	2	100	55	Filling hose and 1 inch
14:01	156	2	6057.4	0.4	110		
14:02	157	3	6057.5	0.1	110		
14:03	158	4	6057.5	0	125		
14:04	159	5	6057.5	0	123		

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
14:05	160	6	6057.5	0	120		
14:06	161	7	6057.5	0	120		Pump shear pin fails
14:07	162	8	6057.5	0	0		Stop to repair pump
14:08	163		6057.5	0	0		
14:09	164		6057.5	0	0		
14:10	165		6057.5	0	0		
14:11	166		6057.5	0	0		
14:12	167		6057.5	0	0		
14:13	168		6057.5	0	0		
14:14	169		6057.5	0	0		
14:15	170		6057.5	0	0		
14:16	171		6057.5	0	0		
14:17	172		6057.5	0	0		
14:18	173		6057.5	0	0		
14:19	174		6057.5	0	0		
14:20	175		6057.5	0	0		
14:21	176		6057.5	0	0		
14:22	177		6057.5	0	0		
14:23	178		6057.5	0	0		
14:24	179		6057.5	0	0		
14:25	180		6057.5	0	0		
14:26	181		6057.5	0	0		
14:27	182		6057.5	0	0		
14:28	183		6057.5	0	0		
14:29	184		6057.5	0	0		
14:30	185		6057.5	0	0		
14:31	186		6057.5	0	0		
14:32	187		6057.5	0	0		
14:33	188		6057.5	0	0		
14:34	189		6057.5	0	0		
14:35	190		6057.5	0	0		
14:36	191		6057.5	0	0		
14:37	192		6057.5	0	0		
14:38	193		6057.5	0	0		
14:39	194		6057.5	0	0		
14:40	195		6057.5	0	0		
14:41	196		6057.5	0	0		
14:42	197		6057.5	0	0		
14:43	198		6057.5	0	0		
14:44	199		6057.5	0	0		
14:45	200		6057.5	0	0		
14:46	201		6057.5	0	0		
14:47	202		6057.5	0	0		
14:48	203		6057.5	0	0		
14:49	204		6057.5	0	0		
14:50	205		6057.5	0	0		
14:51	206		6057.5	0	0		
14:52	207		6057.5	0	0		
14:53	208		6057.5	0	0		
14:54	209		6057.5	0	0		
14:55	210		6057.5	0	0		
14:56	211		6057.5	0	0		
14:57	212		6060	2.5	0		Test pump to ground
14:58	213		6067.5	7.5	0		
14:59	214		6075	7.5	0		
15:00	215		6082.5	7.5	0		
15:01	216		6082.5	0	0		
15:02	217		6082.5	0	0		

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:03	218		6082.5	0	0		
15:04	219		6082.5	0	0		
15:05	220		6082.5	0	0		
15:06	221		6082.5	0	0		
15:07	222		6082.5	0	0		
15:08	223		6082.5	0	0		
15:09	224		6082.5	0	0		
15:10	225		6082.5	0	0		
15:11	226	1	6082.7	0.2	120	55.2	
15:12	227	2	6082.9	0.2	120	55.4	
15:13	228	3	6083	0.1	120	55.5	
15:14	229	4	6083	0	120	55.5	
15:15	230	5	6083.2	0.2	120	55.7	
15:16	231	6	6083.3	0.1	120	55.8	
15:17	232	7	6083.3	0	120	55.8	
15:18	233	8	6083.3	0	120	55.8	
15:19	234	9	6083.3	0	120	55.8	
15:20	235	10	6083.3	0	120	55.8	
15:21	236	1	6083.3	0	130	28.3	
15:22	237	2	6083.3	0	130	28.3	
15:23	238	3	6083.4	0.1	130	28.4	
15:24	239	4	6083.4	0	130	28.4	
15:25	240	5	6083.4	0	130	28.4	
15:26	241	6	6083.4	0	130	28.4	
15:27	242	7	6083.4	0	130	28.4	
15:28	243	8	6083.4	0	130	28.4	
15:29	244	9	6083.5	0.1	130	28.5	
15:30	245	10	6083.5	0	130	28.5	
15:31	246	1	6083.5	0	150	28.5	
15:32	247	2	6083.5	0	150	28.5	
15:33	248	3	6083.6	0.1	150	28.6	1 inch injection pipe pushing up
15:34	249	4	6083.7	0.1	150	28.7	
15:35	250	5	6083.7	0	150	28.7	Packer pressure moving up 240
15:36	251	6	6083.7	0	150	28.7	
15:37	252	7	6083.7	0	150	28.7	Packer pressure moving up 260
15:38	253	8	6083.7	0	150	28.7	
15:39	254	9	6083.9	0.2	150	28.9	Packer pressure moving up 290
15:40	255	10	6084	0.1	150	29	
15:41	256	1	6084	0	130	29	
15:42	257	2	6084	0	130	29	
15:43	258	3	6084.2	0.2	130	29.2	
15:44	259	4	6084.2	0	130	29.2	
15:45	260	5	6084.2	0	130	29.2	Packer pressure down to 260
15:46	261	6	6084.2	0	130	29.2	
15:47	262	7	6084.3	0.1	130	29.3	
15:48	263	1	6084.3	0	120	29.3	
15:49	264	2	6084.3	0	120	29.3	
15:50	265	3	6084.3	0	120	29.3	
15:51	266	4	6084.3	0	120	29.3	
15:52	267	5	6084.3	0	120	29.3	
15:53	268	6	6084.3	0	120	29.3	
15:54	269	7	6084.3	0	120	29.3	
15:55	270	8	6084.3	0	120	29.3	
15:56	271	9	6084.3	0	120	29.3	
15:57	272	10	6084.4	0.1	120	29.4	
15:58	273	1	6084.4	0	110	29.4	
15:59	274	2	6084.4	0	110	29.4	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
16:00	275	3	6084.4	0	110	29.4	
16:01	276	4	6084.5	0.1	110	29.5	
16:02	277	5	6084.5	0	110	29.5	
16:03	278	1	6084.5	0	100	29.5	
16:04	279	2	6084.5	0	100	29.5	
16:05	280	3	6084.5	0	100	29.5	
16:06	281	4	6084.5	0	100	29.5	
16:07	282	5	6084.5	0	100	29.5	
16:08	283	1	6084.5	0	90	29.5	
16:09	284	2	6084.5	0	90	29.5	
16:10	285	3	6084.5	0	90	29.5	
16:11	286	4	6084.5	0	90	29.5	
16:12	287	5	6084.5	0	90	29.5	
16:13	288	1	6084.5	0	80	29.5	
16:14	289	2	6084.5	0	80	29.5	
16:15	290	3	6084.5	0	80	29.5	
16:16	291	4	6084.5	0	80	29.5	
16:17	292	5	6084.5	0	80	29.5	
16:18	293	1	6084.5	0	70	29.5	
16:19	294	2	6084.5	0	70	29.5	
16:20	295	3	6084.5	0	70	29.5	
16:21	296	4	6084.5	0	70	29.5	
16:22	297	5	6084.5	0	70	29.5	
16:23	298	1	6084.5	0	60	29.5	
16:24	299	2	6084.5	0	60	29.5	
16:25	300	3	6084.5	0	60	29.5	
16:26	301	4	6084.5	0	60	29.5	
16:27	302	5	6084.5	0	60	29.5	
16:28	303	1	6084.5	0	50	29.5	
16:29	304	2	6084.5	0	50	29.5	
16:30	305	3	6084.5	0	50	29.5	
16:31	306	4	6084.5	0	50	29.5	
16:32	307	5	6084.5	0	50	29.5	
16:33	308	1	6084.5	0	40	29.5	
16:34	309	2	6084.5	0	40	29.5	
16:35	310	3	6084.5	0	40	29.5	
16:36	311	4	6084.5	0	40	29.5	
16:37	312	5	6084.5	0	40	29.5	
16:38	313	1	6084.5	0	30	29.5	
16:39	314	2	6084.5	0	30	29.5	
16:40	315	3	6084.5	0	30	29.5	
16:41	316	4	6084.5	0	30	29.5	
16:42	317	5	6084.5	0	30	29.5	
16:43	318	6	6084.5	0	20	29.5	
16:44	319	7	6084.5	0	20	29.5	
16:45	320	8	6084.5	0	20	29.5	
16:46	321	9	6084.5	0	20	29.5	
16:47	322	10	6084.5	0	20	29.5	

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
								No duplicat test performed

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Date	**7/21/2011**
Client	**New Mexico Copper Corp**
Project	**Copper Flat**
Well Name	**GWQ 11-24 Zone 1**
Hydrologist	**JJK**

Starting Water Level (ft bgl)	**54.61**	**Packer Dia**	**2 inch**
Elevation (ft GL)		**Bore/Casing Dia**	**3-3/4 inch**
Injection Interval (ft bgl)	**100 to 147**	**Injection Pipe Dia**	**1 inch**
Bore/Casing Depth (ft bgl)	**147**	**Pressure gauge height above GL**	**4 ft**

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:25	0		9		20	0	20 psi
8:26	1	1	9.8	0.80	20	0.8	
8:27	2	2	10.59	0.79	20	1.59	
8:28	3	3	11.4	0.81	20	2.4	
8:29	4	4	12.2	0.80	20	3.2	
8:30	5	5	13.1	0.90	20	4.1	
8:31	6	6	14	0.90	20	5	
8:32	7	7	14.8	0.80	20	5.8	
8:33	8	8	15.6	0.80	20	6.6	
8:34	9	9	16.5	0.90	20	7.5	
8:35	10	10	17.3	0.80	20	8.3	Average 0.83 gpm
8:36	11	1	17.8	0.5	30	8.8	30 psi
8:37	12	2	18.3	0.5	32	9.3	
8:38	13	3	18.9	0.6	30	9.9	
8:39	14	4	19.6	0.7	31	10.6	
8:40	15	5	20	0.4	30	11	
8:41	16	6	20.5	0.5	32	11.5	
8:42	17	7	21	0.5	31	12	
8:43	18	8	21.5	0.5	30	12.5	
8:44	19	9	22.1	0.6	30	13.1	
8:45	20	10	22.6	0.5	30	13.6	Average 0.53 gpm
8:46	21	1	23.22	0.62	40	14.22	Attempt 40 psi. Oscillating + - 5 psi
8:47	22	2	23.8	0.58	40	14.8	
8:48	23	3	24.4	0.6	40	15.4	
8:49	24	4	25	0.6	40	16	
8:50	25	5	25.6	0.6	40	16.6	
8:51	26	6	26.3	0.7	40	17.3	
8:52	27	7	26.9	0.6	40	17.9	
8:53	28	8	27.5	0.6	40	18.5	
8:54	29	9	28.1	0.6	42	19.1	
8:55	30	10	28.8	0.7	44	19.8	Average 0.62 gpm
8:56	31	1	29.7	0.9	50-55	20.7	Attempt 50 psi. Oscillating + - 5 psi
8:57	32	2	30.6	0.9	50-55	21.6	
8:58	33	3	31.5	0.9	50-55	22.5	
8:59	34	4	32.4	0.9	50-55	23.4	
9:00	35	5	33.3	0.9	50-55	24.3	
9:01	36	6	34.3	1	50-55	25.3	
9:02	37	7	35.2	0.9	50-55	26.2	
9:03	38	8	36.2	1	50-55	27.2	
9:04	39	9	37	0.8	50-55	28	
9:05	40	10	37.9	0.9	50-55	28.9	Average 0.91 gpm
9:06	41	1	39.1	1.2	60	30.1	Attempt 60 psi. Oscillating + - 8 psi
9:07	42	2	40.3	1.2	65	31.3	
9:08	43	3	41.5	1.2	65	32.5	
9:09	44	4	42.8	1.3	65	33.8	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:10	45	5	44	1.2	65	35	
9:11	46	6	45.3	1.3	65	36.3	
9:12	47	7	46.6	1.3	65	37.6	
9:13	48	8	47.8	1.2	65	38.8	
9:14	49	9	49	1.2	65	40	
9:15	50	10	50.2	1.2	65	41.2	Average 1.23 gpm
9:16	51	1	51.8	1.6	75	42.8	Attempt 70 psi Oscillating + - 10 to 12 psi
9:17	52	2	53.4	1.6	75	44.4	
9:18	53	3	55	1.6	75	46	
9:19	54	4	56.5	1.5	75	47.5	
9:20	55	5	58	1.5	75	49	
9:21	56	6	59.6	1.6	75	50.6	
9:22	57	7	61	1.4	75	52	
9:23	58	8	62.5	1.5	75	53.5	
9:24	59	9	64.1	1.6	75	55.1	
9:25	60	10	66	1.9	75	57	Average 1.58 gpm
9:26	61	1	68.4	2.4	85	59.4	Attempt 80 psi Oscillating + - 10 to 20 psi
9:27	62	2	70.7	2.3	85	61.7	
9:28	63	3	73	2.3	85	64	
9:29	64	4	75.5	2.5	85	66.5	
9:30	65	5	78	2.5	85	69	
9:31	66	6	80.3	2.3	85	71.3	
9:32	67	7	82.7	2.4	85	73.7	
9:33	68	8	85	2.3	85	76	
9:34	69	9	87.4	2.4	85	78.4	
9:35	70	10	89.8	2.4	85	80.8	Average 2.38 gpm
9:36	71	1	93.32	3.52	90	84.32	Attempt 90 psi Oscillating + - 20 to 30 psi
9:37	72	2	96.8	3.48	90	87.8	
9:38	73	3	100	3.2	90	91	
9:39	74	4	103.5	3.5	90	94.5	
9:40	75	5	107	3.5	90	98	
9:41	76	6	110.5	3.5	90	101.5	
9:42	77	7	114.2	3.7	90	105.2	
9:43	78	8	117.8	3.6	90	108.8	
9:44	79	9	121.4	3.6	90	112.4	
9:45	80	10	125.2	3.8	90	116.2	Average 3.54 gpm
9:46	81	1	130.4	5.2	100	121.4	Valve fully open readings on gauge 85 to 118
9:47	82	2	135.8	5.4	100	126.8	Test abandoned at 90 minutes due to excess
9:48	83	3	141	5.2	100	132	fluctuation in pressure gauge.
9:49	84	4	146.3	5.3	100	137.3	
9:50	85	5	151.5	5.2	100	142.5	
9:51	86	6	156.8	5.3	100	147.8	
9:52	87	7	162	5.2	100	153	
9:53	88	8	167.3	5.3	100	158.3	
9:54	89	9	172.5	5.2	100	163.5	
9:55	90	10	177.8	5.3	100	168.8	Average 5.26 gpm

Second attempt on 7-26-2011 with centrifugal pump

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:44	0		180				
7:45	1	1	181.6	3.8	20	1.6	
7:46	2	2	183.1	1.5	20	3.1	
7:47	3	3	184.7	1.6	20	4.7	
7:48	4	4	186.4	1.7	20	6.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:49	5	5	188	1.6	20	8	
7:50	6	6	189.7	1.7	20	9.7	
7:51	7	7	191.2	1.5	20	11.2	
7:52	8	8	192.8	1.6	20	12.8	
7:53	9	9	194.5	1.7	20	14.5	
7:54	10	10	196	1.5	20	16	Average 1.6 gpm
7:55	11	1	197.7	1.7	30	17.7	
7:56	12	2	199.5	1.8	30	19.5	
7:57	13	3	201.3	1.8	30	21.3	
7:58	14	4	203	1.7	30	23	
7:59	15	5	204.6	1.6	30	24.6	
8:00	16	6	206.4	1.8	30	26.4	
8:01	17	7	208	1.6	30	28	
8:02	18	8	209.7	1.7	30	29.7	
8:03	19	9	211.5	1.8	30	31.5	
8:04	20	10	213.2	1.7	30	33.2	Average 1.72 gpm
8:05	21	1	215.2	2	40	35.2	
8:06	22	2	217.3	2.1	40	37.3	
8:07	23	3	219.2	1.9	40	39.2	
8:08	24	4	221	1.8	40	41	
8:09	25	5	223	2	40	43	
8:10	26	6	225.1	2.1	40	45.1	
8:11	27	7	227.2	2.1	40	47.2	
8:12	28	8	229.3	2.1	40	49.3	
8:13	29	9	231.1	1.8	40	51.1	
8:14	30	10	233.1	2	40	53.1	Average 1.99 gpm
8:15	31	1	235.5	2.4	50 - 60	55.5	Gauge reading from 45 to 65 psi
8:16	32	2	237.9	2.4	50 - 60	57.9	
8:17	33	3	240	2.1	50 - 60	60	
8:18	34	4	242.4	2.4	50 - 60	62.4	
8:19	35	5	244.9	2.5	50 - 60	64.9	
8:20	36	6	247.2	2.3	50 - 60	67.2	
8:21	37	7	249.6	2.4	50 - 60	69.6	
8:22	38	8	252	2.4	50 - 60	72	
8:23	39	9	254.5	2.5	50 - 60	74.5	
8:24	40	10	256.9	2.4	50 - 60	76.9	Average 2.38 gpm
8:25	41	1	260	3.1	65 - 75	80	Gauge reading from 60 to 80 psi
8:26	42	2	263.1	3.1	65 - 75	83.1	
8:27	43	3	266.3	3.2	65 - 75	86.3	
8:28	44	4	269.3	3.1	65 - 75	89.3	
8:29	45	5	272.3	3	65 - 75	92.3	
8:30	46	6	275.4	3.1	65 - 75	95.4	
8:31	47	7	278.4	3	65 - 75	98.4	
8:32	48	8	281.5	3.1	65 - 75	101.5	
8:33	49	9	284.7	3.2	65 - 75	104.7	
8:34	50	10	287.8	3.1	65 - 75	107.8	Average 3.09 gpm
8:35	51	1	292	4.2	80 - 100	112	Gauge reading from 65 to 115
8:36	52	2	296.1	4.1	80 - 100	116.1	Test abandoned at 60 minutes due to excess
8:37	53	3	300	3.9	80 - 100	120	fluctuation in pressure gauge
8:38	54	4	304.2	4.2	80 - 100	124.2	
8:39	55	5	308.5	4.3	80 - 100	128.5	
8:40	56	6	312.9	4.4	80 - 100	132.9	
8:41	57	7	317.2	4.3	80 - 100	137.2	
8:42	58	8	321.5	4.3	80 - 100	141.5	
8:43	59	9	325.8	4.3	80 - 100	145.8	
8:44	60	10	330	4.2	80 - 100	150	Average 4.22 gpm

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
Third attempt on 7-27-2011 with screw pump							
Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:20	0	0	350		40	0	
11:21	1	1	356.2	6.2	40	6.2	
11:22	2	2	362.73	6.53	40	12.73	
11:23	3	3	369.3	6.57	40	19.3	
11:24	4	4	375.8	6.5	40	25.8	
11:25	5	5	382.3	6.5	40	32.3	
11:26	6	6	388.6	6.3	40	38.6	
11:27	7	7	395.1	6.5	40	45.1	
11:28	8	8	401.6	6.5	40	51.6	
11:29	9	9	408	6.4	40	58	
11:30	10	10	414.3	6.3	41	64.3	6.43 average gpm
11:31	11	1	421.1	6.8	50	71.1	Gauge oscillating + - 3 psi
11:32	12	2	427.9	6.8	50	77.9	
11:33	13	3	434.8	6.9	51	84.8	
11:34	14	4	441.7	6.9	51	91.7	
11:35	15	5	448.6	6.9	52	98.6	
11:36	16	6	455.4	6.8	50	105.4	
11:37	17	7	462.2	6.8	52	112.2	
11:38	18	8	469	6.8	51	119	
11:39	19	9	475.8	6.8	50	125.8	
11:40	20	10	482.5	6.7	52	132.5	6.82 average gpm
11:41	21	1	489.9	7.4	60	139.9	Gauge oscillating + - 3 psi
11:42	22	2	497.2	7.3	61	147.2	
11:43	23	3	504.4	7.2	61	154.4	
11:44	24	4	511.8	7.4	62	161.8	
11:45	25	5	519.2	7.4	62	169.2	
11:46	26	6	526.4	7.2	61	176.4	
11:47	27	7	533.7	7.3	60	183.7	
11:48	28	8	541	7.3	60	191	
11:49	29	9	548.3	7.3	60	198.3	
11:50	30	10	555.7	7.4	61	205.7	7.32 average gpm
11:51	31	1	563.6	7.9	70	213.6	Gauge oscillating + - 3 psi
11:52	32	2	571.4	7.8	71	221.4	
11:53	33	3	579.1	7.7	70	229.1	
11:54	34	4	587	7.9	70	237	
11:55	35	5	594.9	7.9	71	244.9	
11:56	36	6	602.9	8	72	252.9	
11:57	37	7	610.7	7.8	72	260.7	
11:58	38	8	618.5	7.8	70	268.5	
11:59	39	9	626.3	7.8	70	276.3	
12:00	40	10	634	7.7	72	284	7.83 average gpm
12:01	41	1	642	8	81	292	Gauge oscillating + - 3 psi
12:02	42	2	650.1	8.1	81	300.1	
12:03	43	3	658.2	8.1	80	308.2	
12:04	44	4	666	7.8	80	316	
12:05	45	5	674	8	80	324	
12:06	46	6	682.2	8.2	80	332.2	
12:07	47	7	690.3	8.1	81	340.3	
12:08	48	8	698.2	7.9	82	348.2	
12:09	49	9	706.1	7.9	80	356.1	
12:10	50	10	714.2	8.1	81	364.2	8.02 average gpm

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:11	51	1	722.4	8.2	90	372.4	Gauge oscillating + - 4 psi
12:12	52	2	730.5	8.1	92	380.5	
12:13	53	3	738.5	8	94	388.5	
12:14	54	4	746.8	8.3	95	396.8	
12:15	55	5	755	8.2	92	405	
12:16	56	6	763.1	8.1	92	413.1	
12:17	57	7	771.3	8.2	91	421.3	
12:18	58	8	779.3	8	92	429.3	
12:19	59	9	787.5	8.2	93	437.5	
12:20	60	10	795.8	8.3	91	445.8	8.16 average gpm
12:21	61	1	803.7	7.9	100	453.7	Gauge oscillating + - 5 psi
12:22	62	2	811.4	7.7	101	461.4	
12:23	63	3	819.2	7.8	102	469.2	
12:24	64	4	827	7.8	101	477	
12:25	65	5	834.9	7.9	103	484.9	
12:26	66	6	842.8	7.9	104	492.8	
12:27	67	7	850.9	8.1	102	500.9	
12:28	68	8	858.6	7.7	104	508.6	
12:29	69	9	866.5	7.9	102	516.5	
12:30	70	10	874.3	7.8	101	524.3	7.85 average gpm
12:31	71	1	881.9	7.6	110	531.9	Gauge oscillating + - 5 psi
12:32	72	2	889.3	7.4	112	539.3	
12:33	73	3	896.9	7.6	114	546.9	
12:34	74	4	904.7	7.8	112	554.7	
12:35	75	5	912.3	7.6	115	562.3	
12:36	76	6	919.9	7.6	112	569.9	
12:37	77	7	927.6	7.7	112	577.6	
12:38	78	8	935	7.4	112	585	
12:39	79	9	942.7	7.7	113	592.7	
12:40	80	10	950.4	7.7	114	600.4	7.61 average gpm
12:41	81	1	958.3	7.9	115	608.3	Gauge oscillating + - 5 psi
12:42	82	2	966	7.7	116	616	
12:43	83	3	973.9	7.9	115	623.9	
12:44	84	4	981.8	7.9	116	631.8	
12:45	85	5	989.6	7.8	117	639.6	
12:46	86	6	997.7	8.1	115	647.7	
12:47	87	7	1005.4	7.7	115	655.4	
12:48	88	8	1013.1	7.7	117	663.1	
12:49	89	9	1021	7.9	115	671	
12:50	90	10	1028.9	7.9	116	678.9	7.85 average gpm
12:51	91	1	1035.6	6.7	101	685.6	Gauge oscillating + - 5 psi
12:52	92	2	1042.4	6.8	100	692.4	
12:53	93	3	1049	6.6	102	699	
12:54	94	4	1055.8	6.8	101	705.8	
12:55	95	5	1062.6	6.8	100	712.6	
12:56	96	6	1069.4	6.8	102	719.4	
12:57	97	7	1076.2	6.8	100	726.2	
12:58	98	8	1083	6.8	101	733	
12:59	99	9	1089.7	6.7	102	739.7	
13:00	100	10	1096.3	6.6	100	746.3	6.74 average gpm
13:01	101	1	1102.9	6.6	90	752.9	Gauge oscillating + - 4 psi
13:02	102	2	1109.5	6.6	89	759.5	
13:03	103	3	1116	6.5	90	766	
13:04	104	4	1122.6	6.6	89	772.6	
13:05	105	5	1129	6.4	90	779	
13:06	106	6	1135.5	6.5	91	785.5	
13:07	107	7	1142	6.5	90	792	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:08	108	8	1148.6	6.6	92	798.6	
13:09	109	9	1155.2	6.6	91	805.2	
13:10	110	10	1161.9	6.7	91	811.9	6.56 average gpm
13:11	111	1	1169	7.1	80	819	Gauge oscillating + - 4 psi
13:12	112	2	1176.2	7.2	79	826.2	
13:13	113	3	1183.4	7.2	80	833.4	
13:14	114	4	1190.5	7.1	81	840.5	
13:15	115	5	1197.8	7.3	81	847.8	
13:16	116	6	1205	7.2	80	855	
13:17	117	7	1212.3	7.3	78	862.3	
13:18	118	8	1219.6	7.3	80	869.6	
13:19	119	9	1226.7	7.1	79	876.7	
13:20	120	10	1233.9	7.2	81	883.9	7.2 average gpm
13:21	121	1	1240.9	7	68	890.9	Gauge oscillating + - 3 psi
13:22	122	2	1247.8	6.9	69	897.8	
13:23	123	3	1254.6	6.8	70	904.6	
13:24	124	4	1261.3	6.7	71	911.3	
13:25	125	5	1268	6.7	70	918	
13:26	126	6	1274.9	6.9	71	924.9	
13:27	127	7	1281.9	7	70	931.9	
13:28	128	8	1288.7	6.8	70	938.7	
13:29	129	9	1295.5	6.8	71	945.5	
13:30	130	10	1302.2	6.7	72	952.2	6.86 average gpm
13:31	131	1	1308.9	6.7	60	958.9	Gauge oscillating + - 3 psi
13:32	132	2	1315.5	6.6	60	965.5	
13:33	133	3	1322	6.5	59	972	
13:34	134	4	1328.5	6.5	60	978.5	
13:35	135	5	1335.1	6.6	60	985.1	
13:36	136	6	1341.6	6.5	60	991.6	
13:37	137	7	1348	6.4	59	998	
13:38	138	8	1354.7	6.7	61	1004.7	
13:39	139	9	1361.2	6.5	60	1011.2	
13:40	140	10	1367.8	6.6	60	1017.8	6.56 average gpm
13:41	141	1	1374.2	6.4	50	1024.2	
13:42	142	2	1380.9	6.7	50	1030.9	
13:43	143	3	1387	6.1	50	1037	
13:44	144	4	1393.2	6.2	50	1043.2	
13:45	145	5	1399.6	6.4	51	1049.6	
13:46	146	6	1406	6.4	50	1056	
13:47	147	7	1412	6	50	1062	
13:48	148	8	1418.5	6.5	51	1068.5	
13:49	149	9	1424.9	6.4	52	1074.9	
13:50	150	10	1431.4	6.5	51	1081.4	6.36 average gpm
13:51	151	1	1438	6.6	40	1088	
13:52	152	2	1444.5	6.5	40	1094.5	
13:53	153	3	1451	6.5	40	1101	
13:54	154	4	1457.7	6.7	39	1107.7	
13:55	155	5	1464.2	6.5	40	1114.2	
13:56	156	6	1470.8	6.6	40	1120.8	
13:57	157	7	1477.3	6.5	41	1127.3	
13:58	158	8	1483.9	6.6	41	1133.9	
13:59	159	9	1490.4	6.5	40	1140.4	
14:00	160	10	1497	6.6	40	1147	6.56 average gpm

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Date	**7/30/2011**
Client	**New Mexico Copper Corp**
Project	**Copper Flat**
Well Name	**GWQ 11-24 Zone 2**
Hydrologist	**JJK**

Starting Water Level (ft bgl)	**53.5**	**Packer Dia**	**2 inch**
Elevation (ft GL)		**Bore/Casing Dia**	**3-3/4 inch**
Injection Interval (ft bgl)	**150 to 197**	**Injection Pipe Dia**	**1 inch**
Bore/Casing Depth (ft bgl)	**197**	**Pressure gauge height above GL**	**1 ft**

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:00	0		70				New meter
11:01	1	1	76.2	6.2	20	6.2	
11:02	2	2	82.3	6.1	20	12.3	
11:03	3	3	88.5	6.2	20	18.5	
11:04	4	4	94.7	6.2	20	24.7	
11:05	5	5	100.8	6.1	20	30.8	
11:06	6	6	107.2	6.4	20	37.2	
11:07	7	7	113.4	6.2	20	43.4	
11:08	8	8	119.6	6.2	20	49.6	
11:09	9	9	126	6.4	20	56	
11:10	10	10	132.5	6.5	20	62.5	6.25 gpm average for 20 psi
11:11	11	1	139	6.5	30	69	Up to approximately 30 psi
11:12	12	2	145.5	6.5	30	75.5	
11:13	13	3	152.1	6.6	30	82.1	
11:14	14	4	158.4	6.3	30	88.4	
11:15	15	5	164.9	6.5	30	94.9	
11:16	16	6	171.2	6.3	30	101.2	
11:17	17	7	177.7	6.5	30	107.7	
11:18	18	8	184	6.3	30	114	
11:19	19	9	190.5	6.5	32	120.5	
11:20	20	10	197.3	6.8	30	127.3	6.48 gpm average for 30 psi
11:21	21	1	204	6.70	40	134	Up to approximately 40 psi
11:22	22	2	210.6	6.60	40	140.6	
11:23	23	3	217.3	6.70	41	147.3	
11:24	24	4	224	6.70	40	154	
11:25	25	5	230.4	6.40	40	160.4	
11:26	26	6	237.1	6.70	41	167.1	
11:27	27	7	243.9	6.80	42	173.9	
11:28	28	8	250.6	6.70	41	180.6	
11:29	29	9	257.4	6.80	40	187.4	
11:30	30	10	264.3	6.90	40	194.3	6.70 gpm average for 40 psi
11:31	31	1	271.2	6.9	55	201.2	Up to approximately 55 psi
11:32	32	2	278.1	6.9	55	208.1	
11:33	33	3	285.0	6.9	55	215	
11:34	34	4	291.8	6.8	55	221.8	
11:35	35	5	298.5	6.7	56	228.5	
11:36	36	6	305.4	6.9	55	235.4	
11:37	37	7	312.4	7	56	242.4	
11:38	38	8	319.3	6.9	59	249.3	
11:39	39	9	326	6.7	59	256	
11:40	40	10	332.9	6.9	58	262.9	6.86 gpm average for 55 psi
11:41	41	1	340.4	7.5	70	270.4	Up to approximately 75 psi
11:42	42	2	348.5	8.1	75	278.5	
11:43	43	3	356.7	8.2	76	286.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:44	44	4	364.6	7.9	76	294.6	
11:45	45	5	372.8	8.2	76	302.8	
11:46	46	6	380.7	7.9	76	310.7	
11:47	47	7	388.9	8.2	76	318.9	
11:48	48	8	397	8.1	77	327	
11:49	49	9	405	8	77	335	
11:50	50	10	413.2	8.2	77	343.2	8.03 gpm average for 75 psi
11:51	51	1	421.5	8.3	90	351.5	Up to approximately 95 psi
11:52	52	2	429.8	8.3	90	359.8	
11:53	53	3	438	8.2	91	368	
11:54	54	4	446.1	8.1	93	376.1	
11:55	55	5	454.3	8.2	94	384.3	
11:56	56	6	462.6	8.3	95	392.6	
11:57	57	7	470.6	8	95	400.6	
11:58	58	8	478.8	8.2	96	408.8	
11:59	59	9	486.9	8.1	95	416.9	
12:00	60	10	495.2	8.3	94	425.2	8.2 gpm average for 95 psi
12:01	61	1	503.4	8.2	115	433.4	Up to approximately 120 psi
12:02	62	2	511.7	8.3	118	441.7	
12:03	63	3	520	8.3	120	450	
12:04	64	4	528.3	8.3	120	458.3	
12:05	65	5	536.7	8.4	120	466.7	
12:06	66	6	545	8.3	120	475	
12:07	67	7	553.2	8.2	120	483.2	
12:08	68	8	561.5	8.3	120	491.5	
12:09	69	9	569.5	8	120	499.5	
12:10	70	10	577.6	8.1	120	507.6	8.24 gpm average for 120 psi
12:11	71	1	585.8	8.2	120 to 123	515.8	Valve fully open.
12:12	72	2	594	8.2	120 to 123	524	
12:13	73	3	602.2	8.2	120 to 124	532.2	
12:14	74	4	610.4	8.2	120 to 122	540.4	
12:15	75	5	618.7	8.3	119 to 121	548.7	
12:16	76	6	626.8	8.1	119	556.8	
12:17	77	7	635	8.2	118	565	
12:18	78	8	643.2	8.2	118	573.2	
12:19	79	9	651.5	8.3	119	581.5	
12:20	80	10	659.6	8.1	120	589.6	8.2 gpm average for 120 psi
12:21	81	1	666.3	6.7	105	596.3	Down to approximately 100 psi
12:22	82	2	673.1	6.8	100 to 105	603.1	
12:23	83	3	679.8	6.7	100 to 105	609.8	
12:24	84	4	686.4	6.6	100 to 105	616.4	
12:25	85	5	693.2	6.8	100 to 105	623.2	
12:26	86	6	700	6.8	100 to 105	630	
12:27	87	7	706.7	6.7	100 to 105	636.7	
12:28	88	8	713.5	6.8	100 to 105	643.5	
12:29	89	9	720.1	6.6	100 to 105	650.1	
12:30	90	10	726.8	6.7	100 to 105	656.8	6.72 gpm average for 100 psi
12:31	91	1	734	7.2	80	664	Down to approximately 80 psi
12:32	92	2	741.2	7.2	80	671.2	
12:33	93	3	748.3	7.1	75 to 80	678.3	
12:34	94	4	755.6	7.3	75 to 80	685.6	
12:35	95	5	762.9	7.3	75 to 80	692.9	
12:36	96	6	770.1	7.2	75 to 80	700.1	
12:37	97	7	777.4	7.3	75 to 80	707.4	
12:38	98	8	784.6	7.2	75 to 80	714.6	
12:39	99	9	791.7	7.1	75 to 80	721.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:40	100	10	798.9	7.2	75 to 80	728.9	7.21 gpm average for 80 psi
12:41	101	1	805.5	6.6	60	735.5	Down to approximately 60 psi
12:42	102	2	812.1	6.6	55 to 60	742.1	
12:43	103	3	818.9	6.8	55 to 60	748.9	
12:44	104	4	825.3	6.4	55 to 60	755.3	
12:45	105	5	831.9	6.6	55 to 60	761.9	
12:46	106	6	838.4	6.5	55 to 60	768.4	
12:47	107	7	845	6.6	55 to 60	775	
12:48	108	8	851.5	6.5	55 to 60	781.5	
12:49	109	9	858.2	6.7	55 to 60	788.2	
12:50	110	10	864.6	6.4	55 to 60	794.6	6.57 gpm average for 60 psi
12:51	111	1	871	6.4	40	801	Down to approximately 40 psi
12:52	112	2	877.3	6.3	40	807.3	
12:53	113	3	883.6	6.3	40	813.6	
12:54	114	4	890	6.4	40	820	
12:55	115	5	896.3	6.3	40	826.3	
12:56	116	6	902.3	6	40	832.3	
12:57	117	7	908.5	6.2	40	838.5	
12:58	118	8	914.8	6.3	40	844.8	
12:59	119	9	921.1	6.3	40	851.1	
13:00	120	10	927.5	6.4	40	857.5	6.29 gpm average for 40 psi
13:01	121	1	933.92	6.42	30	863.92	Down to approximately 30 psi
13:02	122	2	940.4	6.48	30	870.4	
13:03	123	3	946.8	6.4	30	876.8	
13:04	124	4	953.2	6.4	31	883.2	
13:05	125	5	959.6	6.4	30	889.6	
13:06	126	6	966	6.4	30	896	
13:07	127	7	972.5	6.5	31	902.5	
13:08	128	8	979	6.5	30	909	
13:09	129	9	985.4	6.4	30	915.4	
13:10	130	10	991.9	6.5	30	921.9	6.44 gpm average for 30 psi
13:11	131	1	998.3	6.4	20	928.3	Down to approximately 20 psi
13:12	132	2	1004.6	6.3	20	934.6	
13:13	133	3	1010.9	6.3	20	940.9	
13:14	134	4	1017.3	6.4	21	947.3	
13:15	135	5	1023.5	6.2	22	953.5	
13:16	136	6	1029.8	6.3	20	959.8	
13:17	137	7	1036.1	6.3	20	966.1	
13:18	138	8	1042.3	6.2	20	972.3	
13:19	139	9	1048.5	6.2	20	978.5	
13:20	140	10	1054.8	6.3	20	984.8	6.29 gpm average for 20 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
3.00	20.0	6.82	90.0					Set pressure. Wait 1 minute
3.49	30.0	6.80	80.0					average over 2 minutes. Repeat
3.90	40.0	6.20	70.0					
4.59	50.0	5.59	60.0					
5.10	60.0	5.19	50.0					
5.80	70.0	4.68	40.0					
6.30	80.0	4.30	30.0					
6.80	90.0	3.70	20.0					
7.98	100.0							

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Date	8/1/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 11-24 Zone 3
Hydrologist	JJK

Starting Water Level (ft bgl)	51.42	Packer Dia	2 inch
Elevation (ft GL)		Bore/Casing Dia	3-3/4 inch
Injection Interval (ft bgl)	204 to 251	Injection Pipe Dia	1 inch
Bore/Casing Depth (ft bgl)	251	Pressure gauge height above GL	1 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
11:50	0		2910		20	0	
11:51	1	1	2911	1.00	20	1	
11:52	2	2	2912.1	1.10	20	2.1	
11:53	3	3	2913	0.90	20	3	
11:54	4	4	2913.3	0.30	20	3.3	
11:55	5	5	2913.5	0.20	20	3.5	
11:56	6	6	2913.8	0.30	20	3.8	
11:57	7	7	2914.1	0.30	20	4.1	
11:58	8	8	2914.4	0.30	20	4.4	
11:59	9	9	2914.7	0.30	21	4.7	
12:00	10	10	2914.9	0.20	20	4.9	0.49 gpm average for 20 psi
12:01	11	1	2915.4	0.5	30	5.4	Up to approximately 30 psi
12:02	12	2	2915.9	0.5	31	5.9	
12:03	13	3	2916.4	0.5	30	6.4	
12:04	14	4	2917.1	0.7	31	7.1	
12:05	15	5	2917.6	0.5	31	7.6	
12:06	16	6	2918.1	0.5	31	8.1	
12:07	17	7	2918.7	0.6	31	8.7	
12:08	18	8	2919.2	0.5	30	9.2	
12:09	19	9	2919.6	0.4	31	9.6	
12:10	20	10	2920.1	0.5	30	10.1	0.52 gpm average for 30 psi
12:11	21	1	2920.8	0.7	38	10.8	Up to approximately 40 psi
12:12	22	2	2921.4	0.6	40	11.4	
12:13	23	3	2921.9	0.5	40	11.9	
12:14	24	4	2922.3	0.4	40	12.3	
12:15	25	5	2922.8	0.5	39	12.8	
12:16	26	6	2923.3	0.5	41	13.3	
12:17	27	7	2923.8	0.5	40	13.8	
12:18	28	8	2924.4	0.6	43	14.4	
12:19	29	9	2924.9	0.5	41	14.9	
12:20	30	10	2925.5	0.6	42	15.5	0.54 gpm average for 40 psi
12:21	31	1	2926.3	0.8	50	16.3	Up to approximately 50 psi
12:22	32	2	2927.2	0.9	51	17.2	
12:23	33	3	2928	0.8	52	18	
12:24	34	4	2928.6	0.6	50	18.6	
12:25	35	5	2929.2	0.6	50	19.2	
12:26	36	6	2929.8	0.6	50	19.8	
12:27	37	7	2930.4	0.6	50	20.4	
12:28	38	8	2931	0.6	50	21	
12:29	39	9	2931.5	0.5	51	21.5	
12:30	40	10	2932.1	0.6	50	22.1	0.66 gpm average for 50 psi
12:31	41	1	2932.6	0.5	59	22.6	
12:32	42	2	2933.4	0.8	60	23.4	
12:33	43	3	2934	0.6	60	24	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
12:34	44	4	2934.8	0.8	60 to 25	24.8	psi drops to 25
12:35	45	5	2935.5	0.7	25 to 60	25.5	adjust valves to maintain 60 psi
12:36	46	6	2940	4.5	60	30	
12:37	47	7	2943.5	3.5	50 to 60	33.5	adjust valves to maintain 60 psi
12:38	48	8	2947.2	3.7	50 to 60	37.2	adjust valves to maintain 60 psi
12:39	49	9	2952	4.8	60	42	
12:40	50	10	2956.5	4.5	59	46.5	2.44 gpm average for 60 psi
12:41	51	1	2961.5	5	70	51.5	
12:42	52	2	2968.8	7.3	71	58.8	
12:43	53	3	2971	2.2	72	61	
12:44	54	4	2973.9	2.9	70 to 60	63.9	psi drops to 60
12:45	55	5	2981.5	7.6	60 to 70	71.5	adjust valves to maintain 70 psi
12:46	56	6	2987	5.5	70	77	
12:47	57	7	2992.5	5.5	72	82.5	
12:48	58	8	2998	5.5	72	88	
12:49	59	9	3003.5	5.5	70	93.5	
12:50	60	10	3008.7	5.2	71	98.7	5.22 gpm average for 70 psi
12:51	61	1	3015	6.3	81	105	
12:52	62	2	3020.5	5.5	82	110.5	
12:53	63	3	3026	5.5	82	116	
12:54	64	4	3032	6	81	122	
12:55	65	5	3037.5	5.5	82	127.5	
12:56	66	6	3042.9	5.4	82	132.9	
12:57	67	7	3048.8	5.9	80	138.8	
12:58	68	8	3054	5.2	79	144	
12:59	69	9	3059.5	5.5	79	149.5	
13:00	70	10	3065	5.5	79	155	5.63 gpm average for 80 psi
13:01	71	1	3071	6	92	161	Gauge is oscillating + or - 3 psi
13:02	72	2	3077.5	6.5	90	167.5	
13:03	73	3	3083.6	6.1	92	173.6	
13:04	74	4	3090	6.4	92	180	
13:05	75	5	3095.9	5.9	92	185.9	
13:06	76	6	3102	6.1	90	192	
13:07	77	7	3108.7	6.7	90	198.7	
13:08	78	8	3113.8	5.1	90	203.8	
13:09	79	9	3119.9	6.1	90	209.9	
13:10	80	10	3125.6	5.7	91	215.6	6.06 gpm average for 90 psi
13:11	81	1	3132	6.4	100	222	Gauge is oscillating + or - 5 psi
13:12	82	2	3138.5	6.5	100	228.5	
13:13	83	3	3145	6.5	100	235	
13:14	84	4	3151.4	6.4	100	241.4	
13:15	85	5	3157.5	6.1	100	247.5	
13:16	86	6	3163.7	6.2	100	253.7	
13:17	87	7	3170.3	6.6	100	260.3	
13:18	88	8	3176.3	6	100	266.3	
13:19	89	9	3182.8	6.5	100	272.8	
13:20	90	10	3189.2	6.4	100	279.2	6.36 gpm average for 100 psi
13:21	91	1	3195	5.8	91	285	Gauge is oscillating + or - 3 psi
13:22	92	2	3201	6	90	291	
13:23	93	3	3206.6	5.6	90	296.6	
13:24	94	4	3212.5	5.9	91	302.5	
13:25	95	5	3218.5	6	89	308.5	
13:26	96	6	3224	5.5	90	314	
13:27	97	7	3229.8	5.8	91	319.8	
13:28	98	8	3235.5	5.7	91	325.5	
13:29	99	9	3241.4	5.9	91	331.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
13:30	100	10	3247.5	6.1	90	337.5	5.83 gpm average for 90 psi
13:31	101	1	3252.5	5	80	342.5	psi down to 80
13:32	102	2	3257.8	5.3	80	347.8	
13:33	103	3	3263	5.2	80	353	
13:34	104	4	3268.5	5.5	81	358.5	
13:35	105	5	3273.8	5.3	80	363.8	
13:36	106	6	3279.4	5.6	80	369.4	
13:37	107	7	3284.5	5.1	79	374.5	
13:38	108	8	3290	5.5	79	380	
13:39	109	9	3295.1	5.1	80	385.1	
13:40	110	10	3301	5.9	79	391	5.35 gpm average for 80 psi
13:41	111	1	3305.5	4.5	70	395.5	psi down to 70
13:42	112	2	3310.9	5.4	70	400.9	
13:43	113	3	3315.7	4.8	71	405.7	
13:44	114	4	3321	5.3	70	411	
13:45	115	5	3325.7	4.7	69	415.7	
13:46	116	6	3331	5.3	69	421	
13:47	117	7	3335.7	4.7	70	425.7	
13:48	118	8	3340.9	5.2	70	430.9	
13:49	119	9	3345.7	4.8	70	435.7	
13:50	120	10	3351	5.3	70	441	5.0 gpm average for 70 psi
13:51	121	1	3355.5	4.5	60	445.5	psi down to 60
13:52	122	2	3360.2	4.7	58	450.2	
13:53	123	3	3364.9	4.7	60	454.9	
13:54	124	4	3369.7	4.8	60	459.7	
13:55	125	5	3374.4	4.7	60	464.4	
13:56	126	6	3379.2	4.8	60	469.2	
13:57	127	7	3383.9	4.7	61	473.9	
13:58	128	8	3389	5.1	60	479	
13:59	129	9	3393.5	4.5	60	483.5	
14:00	130	10	3398.2	4.7	60	488.2	4.72 gpm average for 60 psi
14:01	131	1	3402.6	4.4	51 to 52	492.6	psi to 50
14:02	132	2	3407.5	4.9	52 to 50	497.5	
14:03	133	3	missed		52 to 50		
14:04	134	4	3416	4.25	50	506	
14:05	135	5	3420.7	4.7	50	510.7	
14:06	136	6	3425	4.3	50	515	
14:07	137	7	3429.4	4.4	48 to 50	519.4	
14:08	138	8	3433.7	4.3	51	523.7	
14:09	139	9	3438.2	4.5	50	528.2	
14:10	140	10	3442.5	4.3	50	532.5	4.43 gpm average for 50 psi
14:11	141	1	3447	4.5	40	537	psi to 40
14:12	142	2	3451.1	4.1	40	541.1	
14:13	143	3	3454.8	3.7	40	544.8	
14:14	144	4	3459	4.2	40	549	
14:15	145	5	3463	4	40	553	
14:16	146	6	3467.1	4.1	40	557.1	
14:17	147	7	3471.3	4.2	41	561.3	
14:18	148	8	3475.4	4.1	39	565.4	
14:19	149	9	3479.7	4.3	38	569.7	
14:20	150	10	3484	4.3	40	574	4.15 gpm average for 40 psi
14:21	151	1	3487.4	3.4	34	577.4	psi to 30
14:22	152	2	3491.2	3.8	30	581.2	
14:23	153	3	3494.8	3.6	30	584.8	
14:24	154	4	3498.7	3.9	29	588.7	
14:25	155	5	3502.3	3.6	30	592.3	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
14:26	156	6	3506	3.7	30	596	
14:27	157	7	3509.8	3.8	29	599.8	
14:28	158	8	3513.3	3.5	31	603.3	
14:29	159	9	3517	3.7	31	607	
14:30	160	10	3521	4	32	611	3.7 gpm average for 30 psi
14:31	161	1	3524.2	3.2	20	614.2	psi to 20
14:32	162	2	3527.6	3.4	20	617.6	
14:33	163	3	3531.1	3.5	21	621.1	
14:34	164	4	3534.3	3.2	21	624.3	
14:35	165	5	3538	3.7	20	628	
14:36	166	6	3541.4	3.4	20	631.4	
14:37	167	7	3544.6	3.2	20	634.6	
14:38	168	8	3548	3.4	20	638	
14:39	169	9	3551.4	3.4	20	641.4	
14:40	170	10	3554.5	3.1	21	644.5	3.35 gpm average for 20 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
3.14	20.0	3.14	20.0	3.80	30.0	5.78	90.0	Set pressure. Wait 1 minute
3.71	30.0	3.71	30.0	3.95	40.0	5.63	80.0	average over 2 minutes. Repeat
3.98	40.0	3.98	40.0	4.61	50.0	5.50	70.0	
4.46	50.0	4.46	50.0	4.99	60.0	4.99	60.0	
4.90	60.0	4.90	60.0	5.46	70.0	4.51	50.0	
5.31	70.0	5.31	70.0	5.62	80.0	4.15	40.0	
5.49	80.0	5.49	80.0	5.80	90.0	3.80	30.0	
5.94	90.0	5.94	90.0	6.31	100.0	3.33	20.0	
6.20	100.0	6.20	100.0					

same data as "increase" series

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Date	8/13/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 11-25 Zone 1
Hydrologist	JJK

Starting Water Level (ft bgl)	29.0 (not representative of Static)	**Packer Dia**	2 inch
Elevation (ft GL)		**Bore/Casing Dia**	3-3/4 inch
Injection Interval (ft bgl)	100 to 147.7	**Injection Pipe Dia**	1 inch
Bore/Casing Depth (ft bgl)	147.7	**Pressure gauge height above GL**	3 ft

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:00	0		4400		10	0	
15:01	1	1	4400	0.00	10	0	
15:02	2	2	4400	0.00	10	0	
15:03	3	3	4400	0.00	10	0	
15:04	4	4	4400	0.00	10	0	
15:05	5	5	4400	0.00	10	0	
15:06	6	6	4400	0.00	10	0	
15:07	7	7	4400	0.00	10	0	
15:08	8	8	4400	0.00	10	0	
15:09	9	9	4400	0.00	10	0	
15:10	10	10	4400	0.00	10	0	
15:11	11	1	4400	0.00	20	0	
15:12	12	2	4400	0.00	20	0	
15:13	13	3	4400	0.00	20	0	
15:14	14	4	4400	0.00	20	0	
15:15	15	5	4400	0.00	20	0	
15:16	16	6	4400	0.00	20	0	
15:17	17	7	4400	0.00	20	0	
15:18	18			0.00		0	Break out meter to verify operation of same
15:19	19			0.00		0	
15:20	20			0.00		0	Operating to spec
15:21	21	1	4410	0.00	30	0	
15:22	22	2	4410	0.00	30	0	
15:23	23	3	4410	0.00	30	0	
15:24	24	4	4410	0.00	30	0	
15:25	25	5	4410	0.00	30	0	
15:26	26	1	4410	0.00	40	0	
15:27	27	2	4410	0.00	40	0	
15:28	28	3	4410	0.00	40	0	
15:29	29	4	4410	0.00	40	0	
15:30	30	5	4410	0.00	40	0	
15:31	31	1	4410	0	50	0	
15:32	32	2	4410	0	50	0	
15:33	33	3	4410	0	50	0	
15:34	34	4	4410	0	50	0	
15:35	35	5	4410	0	50	0	
15:36	36	1	4410	0	60	0	
15:37	37	2	4410	0	60	0	
15:38	38	3	4410	0	60	0	
15:39	39	4	4410	0	60	0	
15:40	40	5	4410	0	60	0	
15:41	41	1	4410	0	70	0	
15:42	42	2	4410	0	70	0	
15:43	43	3	4410	0	70	0	
15:44	44	4	4410	0	70	0	
15:45	45	5	4410	0	70	0	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
15:46	46	1	4410	0	80	0	
15:47	47	2	4410	0	80	0	
15:48	48	3	4410	0	80	0	
15:49	49	4	4410	0	80	0	
15:50	50	5	4410	0	80	0	
15:51	51	1	4410	0	90	0	
15:52	52	2	4410	0	90	0	
15:53	53	3	4410	0	90	0	
15:54	54	4	4410	0	90	0	
15:55	55	5	4410	0	90	0	
15:56	56	1	4410	0	100	0	
15:57	57	2	4410	0	100	0	
15:58	58	3	4410	0	100	0	
15:59	59	4	4410	0	100	0	
16:00	60	5	4410	0	100	0	
16:01	61	1	4410	0	110	0	
16:02	62	2	4410	0	110	0	
16:03	63	3	4410	0	110	0	
16:04	64	4	4410	0	110	0	
16:05	65	5	4410	0	110	0	
16:06	66	6	4410	0.00	110	0	
16:07	67	7	4410	0.00	110	0	
16:08	68	8	4410	0.00	110	0	
16:09	69	9	4410	0.00	110	0	
16:10	70	10	4410	0.00	110	0	
16:11	71	1	4410	0	120	0	
16:12	72	2	4410	0	120	0	
16:13	73	3	4410	0	120	0	
16:14	74	4	4410	0	120	0	
16:15	75	5	4410	0	120	0	
16:16	76	6	4410	0	120	0	
16:17	77	7	4410	0	120	0	
16:18	78	8	4410	0	120	0	
16:19	79	9	4410	0	120	0	
16:20	80	10	4410	0	120	0	
16:21	81	1	4410	0	130	0	
16:22	82	2	4410	0	130	0	
16:23	83	3	4410	0	130	0	
16:24	84	4	4410	0	130	0	
16:25	85	5	4410	0	130	0	
16:26	86	6	4410	0	130	0	
16:27	87	7	4410	0	130	0	
16:28	88	8	4410	0	130	0	
16:29	89	9	4410	0	130	0	
16:30	90	10	4410	0	130	0	
16:31	91	1	4410	0	140	0	
16:32	92	2	4410	0	140	0	
16:33	93	3	4410	0	140	0	
16:34	94	4	4410	0	140	0	
16:35	95	5	4410	0	140	0	
16:36	96	6	4410	0	140	0	
16:37	97	7	4410	0	140	0	
16:38	98	8	4410	0	140	0	
16:39	99	9	4410	0	140	0	
16:40	100	10	4410	0	140	0	Lightning on site forces suspension of test
Resume test on 8-14-2011							
6:00	101	1	4420	0	0	0	Slow repeat of previous ramp up
6:01	102	2	4420	0	40	0	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
6:02	103	3	4420	0	40	0	
6:03	104	4	4420	0	40	0	
6:04	105	5	4420	0	40	0	
6:05	106	1	4420	0	50	0	
6:06	107	2	4420	0	50	0	
6:07	108	3	4420	0	50	0	
6:08	109	4	4420	0	50	0	
6:09	110	5	4420	0	50	0	
6:10	111	1	4420	0	60	0	
6:11	112	2	4420	0	60	0	
6:12	113	3	4420	0	60	0	
6:13	114	4	4420	0	60	0	
6:14	115	5	4420	0	60	0	
6:15	116	1	4420	0	70	0	
6:16	117	2	4420	0	70	0	
6:17	118	3	4420	0	70	0	
6:18	119	4	4420	0	70	0	
6:19	120	5	4420	0	70	0	
6:20	121	1	4420	0	80	0	
6:21	122	2	4420	0	80	0	
6:22	123	3	4420	0	80	0	
6:23	124	4	4420	0	80	0	
6:24	125	5	4420	0	80	0	
6:25	126	1	4420	0	90	0	
6:26	127	2	4420	0	90	0	
6:27	128	3	4420	0	90	0	
6:28	129	4	4420	0	90	0	
6:29	130	5	4420	0	90	0	
6:30	131	1	4420	0	100	0	
6:31	132	2	4420	0	100	0	
6:32	133	3	4420	0	100	0	
6:33	134	4	4420	0	100	0	
6:34	135	5	4420	0	100	0	
6:35	136	1	4420	0	110	0	
6:36	137	2	4420	0	110	0	
6:37	138	3	4420	0	110	0	
6:38	139	4	4420	0	110	0	
6:39	140	5	4420	0	110	0	
6:40	141	1	4420	0	120	0	
6:41	142	2	4420	0	120	0	
6:42	143	3	4420	0	120	0	
6:43	144	4	4420	0	120	0	
6:44	145	5	4420	0	120	0	
6:45	146	1	4420	0	130	0	
6:46	147	2	4420	0	130	0	
6:47	148	3	4420	0	130	0	
6:48	149	4	4420	0	130	0	
6:49	150	5	4420	0	130	0	
6:50	151	1	4420	0	140	0	
6:51	152	2	4420	0	140	0	
6:52	153	3	4420	0	140	0	
6:53	154	4	4420	0	140	0	
6:54	155	5	4420	0	140	0	
6:55	156	1	4420	0	150	0	
6:56	157	2	4420	0	150	0	
6:57	158	3	4420	0	146	0	First injection
6:58	159	4	4422.9	2.9	150	2.9	All 150 psi readings are approximate.
6:59	160	5	4425.9	3	150	5.9	Gauge oscillating from 140 to 158

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:00	161	6	4428.7	2.8	150	8.7	
7:01	162	7	4431.5	2.8	150	11.5	
7:02	163	8	4434.5	3	150	14.5	
7:03	164	9	4437.4	2.9	150	17.4	
7:04	165	10	4440.3	2.9	150	20.3	
7:05	166	11	4443.1	2.8	150	23.1	
7:06	167	12	4444	0.9	150	24	
7:07	168	13	4447.2	3.2	150	27.2	
7:08	169	14	4450.1	2.9	150	30.1	
7:09	170	15	4452.8	2.7	150	32.8	2.73 average for 150 psi
7:10	171	0	4457.1	4.3	130	37.1	Attempt to stabilize at 140 psi. abandon
7:11	172	1	4459.3	2.2	130	39.3	All 130 psi readings are approximate.
7:12	173	2	4461.2	1.9	130	41.2	Gauge oscillating from 125 to 137
7:13	174	3	4464.1	2.9	130	44.1	
7:14	175	4	4466.3	2.2	130	46.3	
7:15	176	5	4468.1	1.8	130	48.1	
7:16	177	6	4470.9	2.8	130	50.9	
7:17	178	7	4473.2	2.3	130	53.2	
7:18	179	8	4475.2	2	130	55.2	
7:19	180	9	4477.1	1.9	130	57.1	
7:20	181	10	4478.9	1.8	130	58.9	2.18 average for 130 psi
7:21	182	1	4480.9	2	100	60.9	
7:22	183	2	4482.7	1.8	100	62.7	
7:23	184	3	4484.6	1.9	100	64.6	
7:24	185	4	4486.4	1.8	100	66.4	
7:25	186	5	4488.2	1.8	100	68.2	
7:26	187	6	4490.1	1.9	100	70.1	
7:27	188	7	4491.9	1.8	100	71.9	
7:28	189	8	4493.9	2	100	73.9	
7:29	190	9	4495.7	1.8	100	75.7	
7:30	191	10	4497.6	1.9	100	77.6	1.87 average for 100 psi
7:31	192	1	4499.5	1.9	90	79.5	
7:32	193	2	4500.7	1.2	90	80.7	
7:33	194	3	4502.7	2	90	82.7	
7:34	195	4	4504.7	2	90	84.7	
7:35	196	5	4506.5	1.8	90	86.5	
7:36	197	6	4508.2	1.7	90	88.2	
7:37	198	7	4510	1.8	90	90	
7:38	199	8	4511.6	1.6	90	91.6	
7:39	200	9	4513.5	1.9	90	93.5	
7:40	201	10	4515.2	1.7	90	95.2	1.76 average for 90 psi
7:41	202	1	4516.6	1.4	80	96.6	
7:42	203	2	4518.2	1.6	80	98.2	
7:43	204	3	4519.9	1.7	80	99.9	
7:44	205	4	4521.3	1.4	80	101.3	
7:45	206	5	4523	1.7	80	103	
7:46	207	6	4524.7	1.7	80	104.7	
7:47	208	7	4526.4	1.7	80	106.4	
7:48	209	8	4528.2	1.8	80	108.2	
7:49	210	9	4530.1	1.9	80	110.1	
7:50	211	10	4531.9	1.8	80	111.9	1.67 average for 80 psi
7:51	212	1	4533.5	1.6	70	113.5	
7:52	213	2	4535.2	1.7	70	115.2	
7:53	214	3	4536.7	1.5	70	116.7	
7:54	215	4	4538.5	1.8	70	118.5	
7:55	216	5	4540.2	1.7	70	120.2	
7:56	217	6	4541.1	0.9	70	121.1	
7:57	218	7	4542.4	1.3	70	122.4	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:58	219	8	4544.3	1.9	70	124.3	
7:59	220	9	4545.9	1.6	70	125.9	
8:00	221	10	4547.5	1.6	70	127.5	1.56 average for 70 psi
8:01	222	1	4548.9	1.4	60	128.9	
8:02	223	2	4550.5	1.6	60	130.5	
8:03	224	3	4552.1	1.6	60	132.1	
8:04	225	4	4553.8	1.7	60	133.8	
8:05	226	5	4555.3	1.5	60	135.3	
8:06	227	6	4556.9	1.6	60	136.9	
8:07	228	7	4558.5	1.6	60	138.5	
8:08	229	8	4560	1.5	60	140	
8:09	230	9	4561.6	1.6	60	141.6	
8:10	231	10	4563.3	1.7	60	143.3	1.58 average for 60 psi
8:11	232	1	4564.7	1.4	50	144.7	
8:12	233	2	4566	1.3	50	146	
8:13	234	3	4567.3	1.3	50	147.3	
8:14	235	4	4568.6	1.3	50	148.6	
8:15	236	5	4570	1.4	50	150	
8:16	237	6	4571.4	1.4	50	151.4	
8:17	238	7	4572.8	1.4	50	152.8	
8:18	239	8	4574.2	1.4	50	154.2	
8:19	240	9	4575.3	1.1	50	155.3	
8:20	241	10	4576.5	1.2	50	156.5	1.32 average for 50 psi
8:21	242	1	4577.6	1.1	40	157.6	
8:22	243	2	4578.9	1.3	40	158.9	
8:23	244	3	4580.2	1.3	40	160.2	
8:24	245	4	4581.5	1.3	40	161.5	
8:25	246	5	4582.8	1.3	40	162.8	
8:26	247	6	4584.1	1.3	40	164.1	
8:27	248	7	4585.4	1.3	40	165.4	
8:28	249	8	4586.5	1.1	40	166.5	
8:29	250	9	4587.6	1.1	40	167.6	
8:30	251	10	4588.9	1.3	40	168.9	1.24 average for 40 psi
8:31	252	1	4590	1.1	30	170	
8:32	253	2	4591.2	1.2	30	171.2	
8:33	254	3	4592.3	1.1	30	172.3	
8:34	255	4	4593.2	0.9	30	173.2	
8:35	256	5	4594.6	1.4	30	174.6	
8:36	257	6	4595.7	1.1	30	175.7	
8:37	258	7	4596.8	1.1	30	176.8	
8:38	259	8	4597.9	1.1	30	177.9	
8:39	260	9	4599	1.1	30	179	
8:40	261	10	4600.1	1.1	30	180.1	1.12 average for 30 psi
8:41	262	1	4601.2	1.1	20	181.2	
8:42	263	2	4602.1	0.9	20	182.1	
8:43	264	3	4603.3	1.2	20	183.3	
8:44	265	4	4604.4	1.1	20	184.4	
8:45	266	5	4605.4	1	20	185.4	
8:46	267	6	4606.3	0.9	20	186.3	
8:47	268	7	4607.4	1.1	20	187.4	
8:48	269	8	4608.4	1	20	188.4	
8:49	270	9	4609.4	1	20	189.4	
8:50	271	10	4610.5	1.1	20	190.5	1.04 average for 20 psi
8:51	272	1	4611.4	0.9	10	191.4	
8:52	273	2	4612.4	1	10	192.4	
8:53	274	3	4613.3	0.9	10	193.3	
8:54	275	4	4614.2	0.9	10	194.2	
8:55	276	5	4615.1	0.9	10	195.1	

Time 24 hr.	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:56	277	6	4616	0.9	10	196	
8:57	278	7	4617	1	10	197	
8:58	279	8	4617.9	0.9	10	197.9	
8:59	280	9	4618.7	0.8	10	198.7	
9:00	281	10	4619.6	0.9	10	199.6	0.91 average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
0.98	10	2.31	130	1.02	10	2.45	130	Set pressure. Wait 1 minute
1.12	20	2.24	100	1.18	20	2.23	100	average over 2 minutes. Repeat
1.15	30	2.05	90	1.18	30	2.1	90	
1.26	40	1.8	80	1.29	40	1.82	80	
1.55	50	1.81	70	1.56	50	1.8	70	
1.78	60	1.78	60	1.8	60	1.83	60	
1.81	70	1.56	50	1.83	70	1.54	50	
1.81	80	1.31	40	1.82	80	1.33	40	
2.02	90	1.21	30	2.01	90	1.2	30	
2.20	100	1.13	20	2.19	100	1.14	20	
2.21	130	1	10	2.23	130	1.02	10	
2.98	150			3.12	150			
0.00	1	4	6084.5	0	60	1664.5		
0.00	2	5	6084.5	0	60	1664.5		
0.69	303	1	6084.5	0	50	1664.5		
0.69	304	2	6084.5	0	50	1664.5		
0.69	305	3	6084.5	0	50	1664.5		
0.69	306	4	6084.5	0	50	1664.5		
0.69	307	5	6084.5	0	50	1664.5		
0.69	308	1	6084.5	0	40	1664.5		
0.69	309	2	6084.5	0	40	1664.5		
0.69	310	3	6084.5	0	40	1664.5		
0.69	311	4	6084.5	0	40	1664.5		
0.69	312	5	6084.5	0	40	1664.5		
0.69	313	1	6084.5	0	30	1664.5		
0.69	314	2	6084.5	0	30	1664.5		
0.69	315	3	6084.5	0	30	1664.5		
0.70	316	4	6084.5	0	30	1664.5		
0.70	317	5	6084.5	0	30	1664.5		
0.70	318	6	6084.5	0	20	1664.5		
0.70	319	7	6084.5	0	20	1664.5		
0.70	320	8	6084.5	0	20	1664.5		
0.70	321	9	6084.5	0	20	1664.5		
0.70	322	10	6084.5	0	20	1664.5		

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	Injection rate, gals	Injection pressure, psi	
								No duplicat test performed

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Date	8/16/2011
Client	New Mexico Copper Corp
Project	Copper Flat
Well Name	GWQ 11-25 Zone 2
Hydrologist	JJK

Starting Water Level (ft bgl)	60.2
Elevation (ft GL)	
Injection Interval (ft bgl)	150 to 197.7
Bore/Casing Depth (ft bgl)	197.7

Packer Dia	2 inch
Bore/Casing Dia	3-3/4 inch
Injection Pipe Dia	1 inch
Pressure gauge height above GL	3 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
7:25	0		4700		10	0	
7:26	1	1	4704.5	4.50	12	4.5	
7:27	2	2	4707	2.50	10	7	
7:28	3	3	4709	2.00	10	9	
7:29	4	4	4711	2.00	12	11	
7:30	5	5	4712.9	1.90	10	12.9	
7:31	6	6	4714.9	2.00	10	14.9	
7:32	7	7	4717	2.10	11	17	
7:33	8	8	4718.8	1.80	10	18.8	
7:34	9	9	4720.7	1.90	10	20.7	
7:35	10	10	4722.6	1.90	10	22.6	2.26 gpm average for 10 psi
7:36	11	1	4724.8	2.2	20	24.8	
7:37	12	2	4727.1	2.3	20	27.1	
7:38	13	3	4729.2	2.1	21	29.2	
7:39	14	4	4731.4	2.2	20	31.4	
7:40	15	5	4733.6	2.2	19	33.6	
7:41	16	6	4735.8	2.2	20	35.8	
7:42	17	7	4738	2.2	20	38	
7:43	18	8	4740.2	2.2	21	40.2	
7:44	19	9	4742.4	2.2	20	42.4	
7:45	20	10	4744.6	2.2	20	44.6	2.20 gpm average for 20 psi
7:46	21	1	4747.1	2.5	30	47.1	
7:47	22	2	4749.6	2.5	31	49.6	
7:48	23	3	4752.3	2.7	31	52.3	
7:49	24	4	4754.8	2.5	32	54.8	
7:50	25	5	4757.2	2.4	31	57.2	
7:51	26	6	4759.7	2.5	30	59.7	
7:52	27	7	4762.3	2.6	30	62.3	
7:53	28	8	4764.7	2.4	31	64.7	
7:54	29	9	4767.2	2.5	30	67.2	
7:55	30	10	4769.6	2.4	30	69.6	2.50 gpm average for 30 psi
7:56	31	1	4772.4	2.8	38	72.4	
7:57	32	2	4775.3	2.9	40	75.3	
7:58	33	3	4778.2	2.9	41	78.2	
7:59	34	4	4781	2.8	40	81	
8:00	35	5	4783.8	2.8	40	83.8	
8:01	36	6	4786.4	2.6	40	86.4	
8:02	37	7	4789.1	2.7	40	89.1	
8:03	38	8	4791.9	2.8	41	91.9	
8:04	39	9	4794.2	2.3	40	94.2	
8:05	40	10	4797.3	3.1	41	97.3	2.77 gpm average for 40 psi
8:06	41	1	4800.5	3.2	50	100.5	Oscilating = or - 3 to 4 psi
8:07	42	2	4803.6	3.1	50	103.6	
8:08	43	3	4806.6	3	50	106.6	
8:09	44	4	4809.7	3.1	50	109.7	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:10	45	5	4812.8	3.1	50	112.8	
8:11	46	6	4815.8	3	50	115.8	
8:12	47	7	4818.9	3.1	50	118.9	
8:13	48	8	4822	3.1	50	122	
8:14	49	9	4825	3	50	125	
8:15	50	10	4828.1	3.1	50	128.1	3.08 gpm average for 50 psi
8:16	51	1	4831.6	3.5	60	131.6	Oscilating = or - 3 to 4 psi
8:17	52	2	4834.9	3.3	60	134.9	
8:18	53	3	4838	3.1	60	138	
8:19	54	4	4841.8	3.8	60	141.8	
8:20	55	5	4844.9	3.1	60	144.9	
8:21	56	6	4848.3	3.4	60	148.3	
8:22	57	7	4851.9	3.6	60	151.9	
8:23	58	8	4855.5	3.6	60	155.5	
8:24	59	9	4859.1	3.6	60	159.1	
8:25	60	10	4862.8	3.7	60	162.8	3.47 gpm average for 60 psi
8:26	61	1	4866.4	3.6	70	166.4	Oscilating = or - 3 to 4 psi
8:27	62	2	4870.2	3.8	70	170.2	
8:28	63	3	4874	3.8	70	174	
8:29	64	4	4877.5	3.5	70	177.5	
8:30	65	5	4881	3.5	70	181	
8:31	66	6	4884.6	3.6	70	184.6	
8:32	67	7	4888.1	3.5	70	188.1	
8:33	68	8	4891.7	3.6	70	191.7	
8:34	69	9	4895.5	3.8	70	195.5	
8:35	70	10	4898.9	3.4	70	198.9	3.61 gpm average for 70 psi
8:36	71	1	4903	4.1	80	203	Oscilating = or - 3 to 4 psi
8:37	72	2	4906.8	3.8	80	206.8	
8:38	73	3	4910.4	3.6	80	210.4	
8:39	74	4	4914.2	3.8	81	214.2	
8:40	75	5	4918	3.8	80	218	
8:41	76	6	4921.9	3.9	80	221.9	
8:42	77	7	4925.6	3.7	80	225.6	
8:43	78	8	4929.3	3.7	80	229.3	
8:44	79	9	4933.1	3.8	80	233.1	
8:45	80	10	4937	3.9	80	237	3.81 gpm average for 80 psi
8:46	81	1	4941.1	4.1	90	241.1	Oscilating = or - 5 psi
8:47	82	2	4945.4	4.3	90	245.4	
8:48	83	3	4949.6	4.2	90	249.6	
8:49	84	4	4954	4.4	91	254	
8:50	85	5	4958.1	4.1	90	258.1	
8:51	86	6	4962.3	4.2	90	262.3	
8:52	87	7	4966.6	4.3	90	266.6	
8:53	88	8	4971.2	4.6	90	271.2	
8:54	89	9	4975.3	4.1	90	275.3	
8:55	90	10	4979.7	4.4	90	279.7	4.27 gpm average for 90 psi
8:56	91	1	4984.8	5.1	100	284.8	Oscilating = or - 6 psi
8:57	92	2	4989.9	5.1	100	289.9	
8:58	93	3	4995	5.1	100	295	
8:59	94	4	5000	5	100	300	
9:00	95	5	5005.1	5.1	100	305.1	
9:01	96	6	5010	4.9	100	310	
9:02	97	7	5015.1	5.1	100	315.1	
9:03	98	8	5020	4.9	100	320	
9:04	99	9	5025	5	100	325	
9:05	100	10	5029.9	4.9	100	329.9	5.02 gpm average for 100 psi
9:06	101	1	5034	4.1	90	334	Oscilating = or - 5 psi

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:07	102	2	5038	4	90	338	
9:08	103	3	5042.1	4.1	90	342.1	
9:09	104	4	5046.5	4.4	90	346.5	
9:10	105	5	5050.7	4.2	90	350.7	
9:11	106	6	5055	4.3	90	355	
9:12	107	7	5059.2	4.2	90	359.2	
9:13	108	8	5063.4	4.2	90	363.4	
9:14	109	9	5067.7	4.3	90	367.7	
9:15	110	10	5072.4	4.7	90	372.4	4.25 gpm average for 90 psi
9:16	111	1	5076.2	3.8	80	376.2	Oscilating = or - 5 psi
9:17	112	2	5079.9	3.7	80	379.9	
9:18	113	3	5083.5	3.6	80	383.5	
9:19	114	4	5087.1	3.6	80	387.1	
9:20	115	5	5090.5	3.4	80	390.5	
9:21	116	6	5094.3	3.8	80	394.3	
9:22	117	7	5098	3.7	80	398	
9:23	118	8	5101.8	3.8	80	401.8	
9:24	119	9	5105.6	3.8	80	405.6	
9:25	120	10	5109.6	4	80	409.6	3.72 gpm average for 80 psi
9:26	121	1	5113	3.4	70	413	Oscilating = or - 3 to 4 psi
9:27	122	2	5116.2	3.2	70	416.2	
9:28	123	3	5119.8	3.6	70	419.8	
9:29	124	4	5123	3.2	70	423	
9:30	125	5	5126.5	3.5	70	426.5	
9:31	126	6	5130.2	3.7	70	430.2	
9:32	127	7	5133.7	3.5	70	433.7	
9:33	128	8	5137.2	3.5	70	437.2	
9:34	129	9	5140.4	3.2	70	440.4	
9:35	130	10	5143.9	3.5	70	443.9	3.43 gpm average for 70 psi
9:36	131	1	5147	3.1	60	447	Oscilating = or - 3 to 4 psi
9:37	132	2	5150.1	3.1	60	450.1	
9:38	133	3	5153.5	3.4	60	453.5	
9:39	134	4	5156.5	3	60	456.5	
9:40	135	5	5159.7	3.2	60	459.7	
9:41	136	6	5163	3.3	60	463	
9:42	137	7	5166.2	3.2	60	466.2	
9:43	138	8	5169.4	3.2	60	469.4	
9:44	139	9	5172.7	3.3	60	472.7	
9:45	140	10	5175.9	3.2	60	475.9	3.20 gpm average for 60 psi
9:46	141	1	5178.7	2.8	50	478.7	Oscilating = or - 3 to 4 psi
9:47	142	2	5181.6	2.9	50	481.6	
9:48	143	3	5184.7	3.1	50	484.7	
9:49	144	4	5187.5	2.8	50	487.5	
9:50	145	5	5190.3	2.8	50	490.3	
9:51	146	6	5193.3	3	50	493.3	
9:52	147	7	5196.1	2.8	50	496.1	
9:53	148	8	5199	2.9	50	499	
9:54	149	9	5202.1	3.1	50	502.1	
9:55	150	10	5205.1	3	50	505.1	2.92 gpm average for 50 psi
9:56	151	1	5207.8	2.7	40	507.8	
9:57	152	2	5210.1	2.3	40	510.1	
9:58	153	3	5212.8	2.7	40	512.8	
9:59	154	4	5215.6	2.8	40	515.6	
10:00	155	5	5218.1	2.5	40	518.1	
10:01	156	6	5221	2.9	40	521	
10:02	157	7	5223.8	2.8	40	523.8	
10:03	158	8	5226.4	2.6	40	526.4	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
10:04	159	9	5229	2.6	40	529	
10:05	160	10	5231.9	2.9	40	531.9	2.68 gpm average for 40 psi
10:06	161	1	5234.2	2.3	30	534.2	
10:07	162	2	5236.5	2.3	30	536.5	
10:08	163	3	5238.9	2.4	30	538.9	
10:09	164	4	5241.4	2.5	30	541.4	
10:10	165	5	5244	2.6	30	544	
10:11	166	6	5246.3	2.3	30	546.3	
10:12	167	7	5248.7	2.4	30	548.7	
10:13	168	8	5251.2	2.5	30	551.2	
10:14	169	9	5253.7	2.5	30	553.7	
10:15	170	10	5256.3	2.6	30	556.3	2.44 gpm average for 30 psi
10:16	171	1	5258.2	1.9	20	558.2	
10:17	172	2	5260.2	2	20	560.2	
10:18	173	3	5262.6	2.4	20	562.6	
10:19	174	4	5264.8	2.2	20	564.8	
10:20	175	5	5267	2.2	20	567	
10:21	176	6	5269.1	2.1	20	569.1	
10:22	177	7	5271.3	2.2	20	571.3	
10:23	178	8	5273.6	2.3	20	573.6	
10:24	179	9	5275.9	2.3	20	575.9	
10:25	180	10	5278	2.1	20	578	2.17 gpm average for 20 psi
10:26	181	1	5279.7	1.7	10	579.7	
10:27	182	2	5281.6	1.9	10	581.6	
10:28	183	3	5283.5	1.9	10	583.5	
10:29	184	4	5285.4	1.9	10	585.4	
10:30	185	5	5287.2	1.8	10	587.2	
10:31	186	6	5289.1	1.9	10	589.1	
10:32	187	7	5291	1.9	10	591	
10:33	188	8	5293	2	10	593	
10:34	189	9	5295	2	10	595	
10:35	190	10	5296.9	1.9	10	596.9	1.89 gpm average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
NA	10.0	(*)	90.0	2.70	20.0	(*)	90.0	Set pressure. Wait 1 minute
2.38	20.0	5.09	80.0	3.69	30.0	(*)	80.0	average over 2 minutes. Repeat
2.49	30.0	4.68	70.0	4.10	40.0	5.10	70.0	
3.00	40.0	4.80	60.0	4.72	50.0	4.70	60.0	
3.18	50.0	4.38	50.0	5.18	60.0	4.60	50.0	
3.62	60.0	3.70	40.0	5.20	70.0	4.00	40.0	
3.70	70.0	3.29	30.0	6.16	80.0	2.60	30.0	
4.31	80.0	2.80	20.0	(*)	90.0	2.51	20.0	
4.70	90.0	2.40	10.0	(*)	100.0	1.92	10.0	
(*)	100.0							

(*) unable to maintain pressure

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Date 8/24/2011
Client New Mexico Copper Corp
Project Copper Flat
Well Name GWQ 11-25, Zone 3
Hydrologist JJK

Starting Water Level (ft bgl) 60.00
Elevation (ft GL)
Injection Interval (ft bgl) 207 to 251
Bore/Casing Depth (ft bgl) 251

Packer Dia 2 inch
Bore/Casing Dia 3-3/4 inch
Injection Pipe Dia 1 inch
Pressure gauge height above GL 4 ft

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:10	0		5463		11	0	
8:11	1	1	5465	2.00	10	2	
8:12	2	2	5465.7	0.70	11	2.7	
8:13	3	3	5468.3	2.60	11	5.3	
8:14	4	4	5470	1.70	10	7	
8:15	5	5	5471.4	1.40	10	8.4	
8:16	6	6	5472.8	1.40	10	9.8	
8:17	7	7	5474.4	1.60	10	11.4	
8:18	8	8	5475.9	1.50	10	12.9	
8:19	9	9	5477.4	1.50	10	14.4	
8:20	10	10	5479	1.60	10	16	1.6 gpm average for 10 psi
8:21	11	1	5480.5	1.5	20	17.5	
8:22	12	2	5482.2	1.7	20	19.2	
8:23	13	3	5483.5	1.3	20	20.5	
8:24	14	4	5485.2	1.7	20	22.2	
8:25	15	5	5486.7	1.5	21	23.7	
8:26	16	6	5488.4	1.7	20	25.4	
8:27	17	7	5490	1.6	20	27	
8:28	18	8	5491.6	0	20	28.6	
8:29	19	9	5493.1	1.5	20	30.1	
8:30	20	10	5494.8	1.7	21	31.8	1.58 gpm average for 20 psi
8:31	21	1	5496.5	1.7	30	33.5	
8:32	22	2	5498.1	1.6	29	35.1	
8:33	23	3	5499.9	1.8	30	36.9	
8:34	24	4	5501.5	1.6	30	38.5	
8:35	25	5	5503.1	1.6	30	40.1	
8:36	26	6	5505	1.9	30	42	
8:37	27	7	5506.6	1.6	30	43.6	
8:38	28	8	5508.6	2	30	45.6	
8:39	29	9	5510.4	1.8	29	47.4	
8:40	30	10	5512.4	2	29	49.4	1.76 gpm average for 30 psi
8:41	31	1	5514.3	1.9	40	51.3	
8:42	32	2	5516.2	1.9	40	53.2	
8:43	33	3	5518.3	2.1	40	55.3	
8:44	34	4	5520.4	2.1	40	57.4	
8:45	35	5	5522.3	1.9	40	59.3	
8:46	36	6	5524.3	2	40	61.3	
8:47	37	7	5526.3	2	40	63.3	
8:48	38	8	5528.2	1.9	39	65.2	
8:49	39	9	5530.2	2	39	67.2	
8:50	40	10	5532.2	2	39	69.2	1.98 gpm average for 40 psi
8:51	41	1	5534.4	2.2	50	71.4	All 50 psi readings are approximate
8:52	42	2	5536.6	2.2	50	73.6	pressure gauge is oscillating + - 3 to 4 psi
8:53	43	3	5539.1	2.5	50	76.1	
8:54	44	4	5541.6	2.5	50	78.6	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
8:55	45	5	5544.1	2.5	50	81.1	
8:56	46	6	5546.6	2.5	50	83.6	
8:57	47	7	5549.2	2.6	50	86.2	
8:58	48	8	5551.7	2.5	50	88.7	
8:59	49	9	5554.3	2.6	50	91.3	
9:00	50	10	5557	2.7	50	94	2.48 gpm average for 50 psi
9:01	51	1	0	-5557	60	-5463	All 60 psi readings are approximate
9:02	52	2	5565.1	5565.1	60	102.1	pressure gauge is oscillating + - 3 to 4 psi
9:03	53	3	5569.7	4.6	60	106.7	
9:04	54	4	5573.9	4.2	60	110.9	
9:05	55	5	5578.5	4.6	60	115.5	
9:06	56	6	5583.4	4.9	60	120.4	
9:07	57	7	5587.4	4	58	124.4	
9:08	58	8	5592.2	4.8	58	129.2	
9:09	59	9	5597.4	5.2	60	134.4	
9:10	60	10	5602.7	5.3	60	139.7	4.57 gpm average for 60 psi
9:11	61	1	5609	6.3	65	146	Valve fully open. Water moving past packer
9:12	62	2	5616.1	7.1	65	153.1	
9:13	63	3	5623.1	7	65	160.1	
9:14	64	4	5630.3	7.2	65	167.3	
9:15	65	5	5637.6	7.3	65	174.6	
9:16	66	6	5645.1	7.5	63	182.1	Water at surface
9:17	67	7	5652.3	7.2	62	189.3	
9:18	68	8	5659.8	7.5	62	196.8	
9:19	69	9	5666.9	7.1	60	203.9	
9:20	70	10	5674	7.1	60	211	7.13 gpm average for 65 psi
9:21	71	1	5681.4	7.4	60	218.4	
9:22	72	2	5688.6	7.2	60	225.6	
9:23	73	3	5696	7.4	59	233	
9:24	74	4	5703.2	7.2	59	240.2	
9:25	75	5	5710.6	7.4	58	247.6	
9:26	76	6	5717.8	7.2	58	254.8	
9:27	77	7	5725	7.2	58	262	
9:28	78	8	5732.3	7.3	58	269.3	
9:29	79	9	5739.5	7.2	59	276.5	
9:30	80	10	5746.9	7.4	59	283.9	7.29 gpm average for 60 psi
9:31	81	1	5752.3	5.4	50	289.3	Water now moving down casing
9:32	82	2	5757	4.7	50	294	
9:33	83	3	5761.3	4.3	50	298.3	
9:34	84	4	5766	4.7	50	303	
9:35	85	5	5770.5	4.5	50	307.5	
9:36	86	6	5775	4.5	50	312	
9:37	87	7	5779.7	4.7	50	316.7	
9:38	88	8	5784.3	4.6	50	321.3	
9:39	89	9	5788.8	4.5	50	325.8	
9:40	90	10	5793.5	4.7	50	330.5	4.66 average for 50 psi
9:41	91	1	5796.5	3	40	333.5	
9:42	92	2	5798	1.5	40	335	
9:43	93	3	5799.9	1.9	40	336.9	
9:44	94	4	5801.2	1.3	39	338.2	
9:45	95	5	5802.8	1.6	40	339.8	
9:46	96	6	5804.4	1.6	39	341.4	
9:47	97	7	5806	1.6	40	343	
9:48	98	8	5807.5	1.5	40	344.5	
9:49	99	9	5809.2	1.7	40	346.2	
9:50	100	10	5810.5	1.3	39	347.5	1.7 average for 40 psi
9:51	101	1	5812.1	1.6	30	0	

Time 24 hr	Elapsed minutes	Injection period	Water meter reading, gals	Injection rate, gals	Injection pressure, psi	total water injected, gals	Remarks
9:52	102	2	5813.4	1.3	30	1.3	
9:53	103	3	5814.8	1.4	30	2.7	
9:54	104	4	5816.3	1.5	30	4.2	
9:55	105	5	5817.6	1.3	30	5.5	
9:56	106	6	5818.9	1.3	30	6.8	
9:57	107	7	5820.3	1.4	30	8.2	
9:58	108	8	5821.8	1.5	30	9.7	
9:59	109	9	5823	1.2	30	10.9	
10:00	110	10	5824.4	1.4	30	12.3	1.39 average for 30 psi
10:01	111	1	5825.7	1.3	20	13.6	
10:02	112	2	5827	1.3	20	14.9	
10:03	113	3	5828.3	1.3	20	16.2	
10:04	114	4	5829.5	1.2	20	17.4	
10:05	115	5	5830.8	1.3	20	18.7	
10:06	116	6	5832.1	1.3	20	20	
10:07	117	7	5833.3	1.2	20	21.2	
10:08	118	8	5834.6	1.3	20	22.5	
10:09	119	9	5835.9	1.3	20	23.8	
10:10	120	10	5837.1	1.2	20	25	1.27 average for 20 psi
10:11	121	1	5838.2	1.1	10	26.1	
10:12	122	2	5839.3	1.1	10	27.2	
10:13	123	3	5840.3	1	10	28.2	
10:14	124	4	5841.8	1.5	10	29.7	
10:15	125	5	5842.7	0.9	10	30.6	
10:16	126	6	5843.8	1.1	10	31.7	
10:17	127	7	5845	1.2	10	32.9	
10:18	128	8	5846.1	1.1	10	34	
10:19	129	9	5847.2	1.1	10	35.1	
10:20	130	10	5848.3	1.1	10	36.2	1.12 average for 10 psi

Repeated steps summarized

psi increased		psi decreased		psi increased		psi decreased		Notes
Injection rate, gals	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	**Injection rate, gals**	**Injection pressure, psi**	
NA	10.0	NA	65.0	1.21	10.0	NA	65.0	Set pressure. Wait 1 minute
1.20	20.0	2.62	60.0	1.39	20.0	2.39	60.0	average over 2 minutes. Repeat
1.45	30.0	1.89	50.0	1.55	30.0	1.98	50.0	
1.61	40.0	1.70	40.0	1.62	40.0	1.80	40.0	
1.90	50.0	1.14	30.0	2.10	50.0	1.57	30.0	
2.40	60.0	1.29	20.0	2.22	60.0	1.41	20.0	
3.90	66.0	1.20	10.0	3.84	66.0	1.33	10.0	

Appendix D.

MODFLOW Code Documentation

DOCUMENTATION FOR MODFLOW CODE VERSION

The following report first presents general details and documentation for the MODFLOW version titled maj10_12mar10. Documentation for LAK2 is presented as an Appendix.

DOCUMENTATION FOR MODFLOW CODE VERSION

page

DOCUMENTATION FOR MODFLOW CODE VERSION

INTRODUCTION

This report documents a version of the US Geological Survey modular ground-water flow model, or MODFLOW (McDonald and Harbaugh, 1988). Major non-standard features include:

- Modifications to module BCF2 and other modules involving the treatment of perched aquifers, dry cells and cell rewetting. These modifications preserve continuity of the governing equations of flow and also preserve mass balance accounting.
- Module RIV2 (adapted from Miller, 1988). The original program has been revised to improve the surface water mass balance accounting, to improve I/O options and to accommodate the sub-module DIV1.
- RIV2 sub-module DIV1. This module simulates the diversion of surface water and the optional re-injection of diverted water into the groundwater system.
- Module LAK2. This module is used to simulate lakes, well bores and other open water bodies connected to groundwater systems.
- Module OUT1 manages output control.
- Module ZON1 computes and outputs zone-by-zone budgets

Minor features include:

- Additional options for the formatting of input arrays (from Zheng, 1989, Appendix B)
- The Drain Package, DRN1, has been modified to also perform the functions of the WEL module, in addition to the DRN function. In addition, a second copy of the DRN module has been implemented in the code. These modifications are useful in simulating complex, multi-component and highly variable pumping regimes.
- The Well Package, WEL1, has been modified to optionally transfer pumping to the next layer down when a pumping cell goes dry.
- The Output Control (OC1) sub-module of the Basic Package, BAS has been modified to include the output of hydrographs and to allow the output of volumetric budget terms to a separate file
- Addition of a repeating seasonal input option to the Evapotranspiration (EVT1) and Recharge (RCH1) modules.

GENERAL DOCUMENTATION

Modules

MODFLOW packages are invoked using the IUNIT array (McDonald and Harbaugh, 1988, ch. 4). This particular version contains the following selection of modules:

IUNIT#	PACKAGE	TYPE	
1	BCF2	G	Block-Centered Flow Package BCF2 (McDonald et al., 1991) modified
2	WEL	B	Well Package modified
3	DRN	B	Drain Package modified
4	RIV	B	River Package
5	EVT	B	Evapotranspiration Package, modified
6	RIV2	S	River Package 2 (adapted from Miller, 1988)
7	GHB	B	General Head Boundary Package
8	RCH	B	Recharge Package, modified
9	SIP	M	Strongly Implicit Procedure solver Package
10	PCG	M	Preconditioned Conjugate Gradient solver Package (Hill, 1990)
11	SOR1	M	Slice-successive OverRelaxation solver Package
12	OC	O	Output Control Option, modified
13	LAK2	S	Lake Package
14	DRN	B	Drain Package modified (second entry)
15	NCF1	G	Node-Centered Flow Package (Jones, 1997)
16	SOL1	M	ITPACK2C matrix solvers (Kincaid et al., 1992)
17	CHD1	B	Time-variant Constant HeaD Package (Leake and Prudic, 1988, Appendix C)
18	OUT1	O	Output Control Package
19	HFB	G	Horizontal Flow Barrier Package (Hsieh and Freckleton, 1992)
20	ZON1	O	Zone Budget Package
21	(unused)		
2	LKMT	O	Package creates interface files to MT3D, modified
23	LKMP1	O	Package creates interface files to MODPATH
24	(unused)		

Types
G: Groundwater flow domain / Aquifer properties
B: Boundary conditions to Groundwater domain
S: Surface water flow / Boundary conditions to Groundwater domain
O: Output control
M: Matrix inversion/ solution

Name file

MODFLOW has been modified to run from a single input file (the Name file) containing a list of input and output file names and unit numbers. The file is equivalent to the ".NAM" file of MODFLOW96 and later, though with different format. In addition to providing instructions to the program, the Name file serves to define the simulation and is a useful file for record keeping. File names needed include

the BAS input file (unit 1),
the main output file (unit 2),
all input file units specified in the IUNIT array,
all output units specified in individual input files (including modules OC1, OUT1, ZON1, LAK2, etc.)

When MODFLOW.EXE is run, the program first reads the console for the name of the Name file. The Name file consists of one line for each file to be used during the simulation, in the following format:

Input Records

RECORD1 : read once for each file to be opened during simulation.

variable:	**KUNIT**	**FNAME**	**UNFC**
format:	I5	A20	A1

Explanation of Variables

KUNIT : Unit number of file to be opened.
FNAME : Name of file to be opened.
UNFC : Format flag.
If UNFC = 'U' or 'u', the file is opened as unformatted.
Otherwise the file is opened as formatted.

Array Readers

Input instructions throughout MODFLOW refer to the input formats U2DREL , U1DREL , and U2DINT. These "formats" are utility package array reading subroutines. Options for the format of input arrays have been added to the original MODFLOW routines, following Zheng (1989). One option not in Zheng (1989) has also been added.

Options for the format of input arrays are characterized here by the value of an input variable, LOCAT (see below). The options available with 1988 MODFLOW are

LOCAT<0
LOCAT>0

The options added by (Zheng, 1989) are

LOCAT = 100
LOCAT = 101
LOCAT = 102
LOCAT = 103

one more option has been added:

LOCAT<-100

The file opening aspects of the (Zheng, 1989) subroutines have not been utilized.

Input Records

When called to read a data array from an input file, the array readers first read an array control record. The data array may then be read in various formats from the same file or from a different file, depending on specifications in the array control record

For the real array readers (U2DREL, U1DREL)
Array control record

variable:	**LOCAT**	**CNSTNT**	**FMTIN**	**IPRN**
format:	I10	F10.0	5A4	I10

For the integer array readers (U2DINT)
Array control record

variable:	**LOCAT**	**ICONST**	**FMTIN**	**IPRN**
format:	I10	F10.0	5A4	I10

The data array may or may not follow the input control record, depending on the value of LOCAT.

Explanation of Variables

LOCAT : Data location and format style.

if LOCAT<-100, the array is read from unit (-LOCAT-100) using format FMTIN. The array input unit is then rewound, so that the same array may be used later.

if -100<LOCAT<0, the array is read unformatted from unit -LOCAT.

if LOCAT=0, the array is set to the constant CNSTNT/ICONST.

if LOCAT>0, but LOCAT does not take the values 100, 101, 102 or 103, the array is read from unit LOCAT using format FMTIN.

if LOCAT=100, the array is read from the current unit (the file from which the array control record was read) using format FMTIN.

if LOCAT=101, the array is read from the current unit using a block format (Zheng, 1989).

if LOCAT=102, the array is read from the current unit using a zone format (Zheng, 1989).

if LOCAT=103, the array is read from the current unit using a list-directed or free format (Zheng, 1989).

CNSTNT/ICONST : constant.
if LOCAT=0, each element of the array is set to CNSTNT/ICONST.
if LOCAT≠0, each element of the array is multiplied by CNSTNT/ICONST.

FMTIN : Input format, enclosed in parenthesis.

IPRN : Printout flag and format.
If IPRN<0, the array is not printed.
Otherwise, the array is printed in the main output file, using a format determined by the value of IPRN:

IPRN	U1/2DREL	U2DINT
0	10G11.4	10I11
1	11G10.3	60I1
2	9G13.6	40I2
3	15F7.1	30I3
4	15F7.2	25I4
5	15F7.3	20I5
6	15F7.4	
7	20F5.0	
8	20F5.1	
9	20F5.2	
10	20F5.3	
11	20F5.4	
12	10G11.4	

OUTPUT CONTROL MODULES

The modifications and new modules described below perform output control functions and are not directly related to the numerical computations of water levels and flows. They are, however valuable for viewing, evaluating and presenting model results.

Modifications to module BAS1/OC1

The Basic Package has been modified from its original version (McDonald and Harbaugh, 1988). The Output Control Option has been modified to output hydrographs and to output volumetric budget information to a separate file. The modified option is referred to here as OC2. OC2 will not correctly read unmodified OC1 input files. OC2 capabilities are identical to those of OC1, with the following exceptions:

(1) OC2 allows the specification of a number of cells/nodes as observed head locations: For each time step the user may specify a list of cells/nodes whose hydraulic head will be printed to the file number JHEDUN.

(2) OC2 allows output of the volumetric budget to file number IBUD, as well as to the main output file.

To work correctly with the modified model, input files created for OC1 must be modified. To convert an older file, insert input record 1, with a value of zero, at the beginning of the file:

sample OC1 input file

4	4	81	82
0	1	1	0
0	0	1	0

modified input file

0			
4	4	81	82
0	1	1	0
0	0	1	0

Input Records

Record 1 is read by module OC1AL and *is read once for a simulation*.

record 1: Maximum number of individual head values (observed heads) to be printed to unit JHEDUN in any one time step.
variable: MXHEADS
format: I10

Record 2 is read by module BAS1RP and *is read once for a simulation*.

record 2: Print formats for head and drawdown, unit numbers for head, drawdown, observed heads and volumetric budget.

variable:	IHEDFM	IDDNFM	IHEDUN	IDDNUN	JHEDUN	IBUD
format:	I10	I10	I10	I10	I10	I10

Records 3, 4 and 5 are read by module BAS1OC and *are read once for each time step*.

record 3: Flag for layer-by-layer head and drawdown output requests, flags for head/drawdown, volumetric budget and cell-by-cell or node-by-node flow components, number of observed heads for this time step.

variable:	INCODE	IHDDFL	IBUDFL	ICBCFL	NHEADS
format:	I10	I10	I10	I10	I10

record 4: Layer, row and column of observed heads. Read NHEADS times when NHEADS is greater than zero.

variable:	LAYER	ROW	COLUMN
format:	I10	I10	I10

record 5: Layer-by-layer output specifications for head and drawdown. Read zero, one or NLAY times, depending on the value of INCODE.

variable:	HDPR	DDPR	HDSV	DDSV
format:	I10	I10	I10	I10

Explanation of Variables

Record 1

MXHEADS : Maximum number of individual head values, or observed heads, to be written to unit JHEDUN in any one time step.

Record 2

IHEDFM : Format code for printing heads.
IDDNFM : Format code for printing drawdowns.

Format codes have the same meaning for head and drawdown. A positive entry indicates wrap format, a negative entry strip format. The absolute value of IDDNFM specifies the printout format as follows:

0 - 10G11.4	7 - 20F5.0
1 - 11G10.3	8 - 20F5.1
2 - 9G13.6	9 - 20F5.2
3 - 15F7.1	10 - 20F5.3
4 - 15F7.2	11 - 20F5.4
5 - 15F7.3	12 - 10G11.4
6 - 15F7.4	

IHEDUN : Unit number to which heads are written, if they are saved.
IDDNUN : Unit number to which drawdowns are written, if they are saved.
JHEDUN : Unit number to which observed head values are to be written.
IBUD : Unit number to which volumetric budget is to be written when flag IBUDFL is set. A value of zero indicates the budget is written to the main output file.

Record 3

INCODE : Head/drawdown output code. Determines the number of times record 5 is read. If INCODE is:

< 0 : layer-by-layer specifications from last time step are used. Record 5 is not read.
= 0 : all layers are treated the same way. Record 5 is read once.
> 0 : Input record 5 is read for each layer.

IHDDFL : Head/drawdown output flag. If IHDDFL is nonzero, heads and drawdowns will be printed or saved according to the flags for each layer specified in input record 5.
IBUDFL : Budget print flag. If IBUDFL is nonzero, overall volumetric budget is printed. Exception: The budget is always printed at the end of a stress period.
ICBCFL : node-by-node flow-term flag. If ICBCFL is nonzero, node-by-node flow terms are printed or saved according to flags set in the individual packages.
NHEADS : Number of individual head values to be written to unit JHEDUN for current time step. If NHEADS<0, the list of individual heads from the previous time step is reused.

Record 4

LAYER, ROW, COLUMN : Layer, row, and column of individual head to be written to unit JHEDUN. (Read NHEADS times, when NHEADS>0).

Record 5

HDPR : Flag for head printing. Head is printed if HDPR is nonzero.
DDPR : Flag for drawdown printing. Drawdown is printed if DDPR is nonzero.
HDSV : Flag for head saving to disk. Head is saved if HDSV is nonzero.
DDSV : Flag for drawdown saving to disk. Drawdown is saved if DDSV is nonzero.

Changes to BAS1 Code

Changes to the BAS1 code are listed below by BAS1 module subroutine.

OC1AL

OC1AL is a new subroutine added to allocate array space for hydrograph output using the Output Control package.

BAS1RP

Subroutine BAS1RP has been modified to reserve values of IBOUND and to accommodate hydrograph and budget output. The parameters JHEDUN and IBUD, unit numbers for hydrograph and budget output, have been added. Special IBOUND values (currently 30000 and 99) are reserved in bold text following comment **C5a**. The call statement to subroutine SBAS1I is indicated in bold text following comment **C8**.

BAS1ST

BAS1ST has been modified to include the stress period length (variable PERLEN) as a subroutine argument. This makes this variable available for use by other subroutines.

SBAS1I

Subroutine SBAS1I has been modified to read unit numbers for hydrograph output (JHEDUN) and budget output (IBUD). The parameters JHEDUN and IBUD have been added. The unit numbers are read in the bold text following comment **C2**.

BAS1OC

Subroutine BAS1OC has been modified to read output hydrograph data. The parameters MXHEDS and NHEADS and the array XHEDMT have been added. Hydrograph cell locations are read from the output control input file in the bold text following comments **C3** and **C3a**.

BAS1OT

Subroutine BAS1OT has been modified to accommodate hydrograph and budget output. The parameters JHEDUN, IBUD, MXHEDS and NHEADS and the array XHEDMT have been added. The call statement to subroutine SBAS1H has been modified in the bold text following comment **C3**. A call statement to subroutine SBAS1B has been added in the bold text following comment **C4**.

SBAS1H

Subroutine SBAS1H has been modified to output hydrograph data. The parameters JHEDUN, MXHEDS and NHEADS and the array XHEDMT have been added. Hydrograph data are output in the bold text following comment **C0**.

SBAS1B

SBAS1B is a new subroutine added to print the volumetric budget to a separate output file.

DOCUMENTATION FOR OUT1

OUT1 is an output control package for MODFLOW that generates a user-specified set of output. OUT1 is activated in IUNIT(18) of the BAS input file in MODFLOW version **maj6x5**. Output is specified in a format similar to MODAFT. OUT1 performs the functions of MODAFT and STARTHED.

Input Records

Record 1 is read by module OUT1AL and *is read once for a simulation*.

variable: KOUTOP MXOTRC
format: I10 I10

Record 2 is read by module OUT1OT and is read:

once for each time step when KOUTOP=0.
once for each stress period when KOUTOP>0.
variable: ITMP
format: I10

Records 3 and 4 are read by module OUT1OT a combined total of ITMP times when ITMP>0.

record 3 Read up to ITMP times when ITMP>0. Not read when ITMP≤0.
variable: KCOM KSUB KNDX KFRM KFIL
format: I10 I10 I10 I10 I10

record 4 Read KNDX times when KSUB=4. Not read otherwise.
variable: KLAY KROW KCOL
format: I10 I10 I10

Explanation of Variables

1. KOUTOP : Output control option.
   If KOUTOP=0, output control specifications are read for each time step.
   Output is generated for each time step.
   If KOUTOP=1, output control specifications are read for each stress period.
   Output is generated for each time step.
   If KOUTOP=2, output control specifications are read for each stress period.
   Output is generated for the last time step of each stress period.

   MOTRC: Maximum number of output control records. Must be greater than or equal to the largest value of ITMP (Record 2) within a simulation.

2. ITMP: Number of output control records.
   If ITMP <0, output control specifications from the previous time step or stress period are re-used.
   If ITMP>0, ITMP output control records (combined total of records 3 and 4) are read.
   If ITMP=0, no output is generated for the current time step or stress period.

3. KCOM: Component of output desired:

If KCOM =0, **hydraulic head** is output.
=1, "**storage**" flow is output.
=2, "**constant head**" flow is output.
=3, "**flow right face**" is output.
=4, "**flow front face**" is output.
=5, "**flow lower face**" is output.
=6, "**wells**" (WEL1) flow is output.
=7, "**drains**" flow (DRN1, copy 1, IUNIT 3) is output.
=8, "**recharge**" (RCH1) flow is output.
=9, "**ET**" (EVT1) flow is output.
=10, "**river leakage**" (RIV1 flow) is output.
=11, "**head dependent bounds**" (GHB) flow is output.
=12, "**river 2 leakage**" (RIV2 flow to groundwater) is output.
=13, "**lake seepage**" (LAK2 flow to groundwater) is output.
=14, "**drains**" flow (DRN1, copy 2, IUNIT 14) is output.
=15, "**river 2 downstream flow**" (RIV2 surface flow) is output.
=16, **hydraulic head** is output (same as KCOM=0).
=17, (inactive, reserved for NCF1 "diagonal flow")
=18, "**river 2 reinjection**" (DIV1 injection of diverted surface flow) is output
=19, (inactive, reserved for "drawdown")

KSUB: Subset of output desired:

If KSUB=0, the entire array is output
=1, a layer of the array is output
=2, a row of the array is output
=3, a column of the array is output
=4, a selection of points from the array is output

KNDX: Index number for KSUB:

If KSUB=0, KNDX is not used.
If KSUB=1, KNDX is the layer number output
If KSUB=2, KNDX is the row number output
If KSUB=3, KNDX is the column number output
If KSUB=4, KNDX is the number of points to be output (read in Record 4)

KFRM: format of output. KFRM is discussed below.

KFIL: Unit number for output file. Output described by KCOM, KSUB, KNDX and KFRM is output to unit KFIL.

4. KLAY KROW KCOL

The layer, row, column indices of specific points to be output.
Read KNDX times when KSUB=4.

Explanation of KFRM

KFRM is the format of output. Its meaning is dependent on the value of KSUB.

If KSUB=0 (entire array output):

If KFRM=0, the array is output as a list of records in the form of *layer, row, column, value*

=1, the array is output in UBUDSV format (3 dimensional unformatted output, used in MODFLOW for unformatted cell-by-cell flow output).

=2, the array is output in ULASAV format (layer by layer unformatted output, used in MODFLOW for unformatted head output). Use this format to generate starting head files.

=3, the array is output as a list of records in the form of *row, column, period, step, time, value*

If KSUB=1 (one layer output):

If KFRM=0, the layer is output as a list of records in the form of layer*, row, column, value*

=1, the layer is output as a list of records in the form of *row, column, value*

=2, the layer is output in ULASAV format (layer by layer unformatted MODFLOW output).

=3, the layer is output as a list of records in the form of *row, column, period, step, time, value*

>11, the layer is output in wrap/strip format (ULAPRW and ULAPRS, used by mudflow to print heads). The format number used is determined by computing KFRM1=KFRM-24: If KFRM1<0, strip format (ULAPRS) is used, with format number –KFRM1. Otherwise, wrap format (ULAPRW) is used, with format number KFRM1:

KFRM1	U1/2DREL	U2DINT
0	10G11.4	10I11
1	11G10.3	60I1
2	9G13.6	40I2
3	15F7.1	30I3
4	15F7.2	25I4
5	15F7.3	20I5
6	15F7.4	
7	20F5.0	
8	20F5.1	
9	20F5.2	
10	20F5.3	
11	20F5.4	
12	10G11.4	

If KSUB=2 (one row output):

If KFRM=0, the row is output as a list of records in the form of *layer, row, column, value*

=1, the row is output as a list of records in the form of *layer, column, value*

=2, the row is output as a list of records in the form of *layer, column, period, step, value*

=3, the row is output as a list of records in the form of *layer, column, period, step, time, value*

=4, the row is output as a list of records in the form of *layer, column, time, value*

If KSUB=3 (one column output):

If KFRM=0, the column is output as a list of records in the form of *layer, row, column, value*

=1, the column is output as a list of records in the form of *layer, row, value*

=2, the column is output as a list of records in the form of *layer, row, time, value*

=3, the column is output as a list of records in the form of *layer, row, period, step, value*

=4, the column is output as a list of records in the form of *layer, row, period, step, time, value*

If KSUB=4 (list of points output):

If KFRM=0, output is generated in hydrograph format: Each line of the output file contains stress period and time step numbers and a value for each point. The header of the file contains the layer, row and column location of each point.

=1, output is generated in list format: Each line of the output file contains information in the form of *period, step, layer, row, column, value*

DOCUMENTATION FOR ZON1

ZON1 is an output control package for MODFLOW that generates zone budgets. ZON1 is activated in IUNIT(20) of the BAS input file in MODFLOW version **maj6x5**. ZON1 uses the memory allocated by OUT1 (IUNIT(18)), and will not run if OUT1 is not also activated.

Input Records

Record 1 is read by module ZON1AL and *is read once for a simulation*.

variable:	NZONES	KZONOP	KZONOT
format:	I10	I10	I10

Record 2 is read by module ZON1OT and *is read once for each layer*.

variable:	IZON (NCOL,NROW)
format:	(U2DINT)

Record 3 is read by module ZON1OT and *is read* *once for each stress period if KZONOP>0*,
once for each time step if KZONOP=0

variable:	ITMP
format:	(I10)

Record 4 is read by module ZON1OT when ITMP > 0

variable:	ICODES (NZONES)
format:	(50I2)

Explanation of Variables

1. NZONES: The number of zones in the model grid. Set NZONES equal to the highest number in the zone array, IZON.

   KZONOP: Options for zone budget output

If KZONOP=0	Record 3 is read each time step. Output is generated each time step.
=1	Record 3 is read each stress period. Output is generated each time step.
=2	Record 3 is read each stress period. Output is generated on the last time step of each stress period.

   KZONOT: Unit number for zone budget output.

2. IZON: Zone designation for each cell. One array is read for each layer

3. ITMP: Flag for reading output specifications (Record 4)

If ITMP>0	Record 4 is read. Output is generated based on flags set in Record 4.
=0	Record 4 is not read. No output is generated.
<0	Record 4 is not read. Output is generated based on the previous reading of Record 4.

4. ICODES: Output flag for each zone. If ICODES(K) is not zero, output is generated for zone K.

MODIFICATIONS TO LKMT

The LKMT package has been added to enable use of MT3D (Zheng, 1996). The LKMT package saves MODFLOW output in the format used for MT3D input.

Modifications

(a) the LKMT package has been made into a subroutine; (b) the LKMT package is distributed as an included block in the main MODFLOW program; (c) subroutine LKMT contains the code from the included block; (d) subroutines LAK2MT and RIV2MT have been added to the LKMT package to allow MT3D interfaces for the LAK2 and RIV2 packages.

DOCUMENTATION FOR LKMP1

The LKMP1 package has been added to facilitate the use of MODPATH (Pollock, 1994), a particle tracking program. The LKMP1 package saves MODFLOW output in the format used for MODPATH input. LKMP1 generates a MODPATH input file, the Composite Budget File (*.cbf),

LKMP1 is activated by setting IUNIT(23) in the .BAS file to a non-zero unit number, then listing a file (*.cbf) with the same unit number in the master input file (".NAM" file). The CBF file will be saved to the unit number (IUNIT[23]) and filename specified.

PERCHED WATER, DRY CELLS, AND REWETTING

This group of modifications to MODFLOW was inspired by conditions encountered along the Carlin Trend of Northern Nevada. A highly-transmissive carbonate rock aquifer (the carbonate aquifer) has been dewatered for mining. The carbonate aquifer is represented using multiple model layers, with some cells becoming dry during the course of dewatering. These cells are rewet during the simulation of post-mining water level recovery.

The Carlin Formation overlies the carbonate aquifer in parts of the model area. It is composed of Tertiary-aged alluvial deposits with much lower permeability than the carbonate aquifer. Over the course of dewatering the carbonate water level has dropped below the bottom of the Carlin Formation and created a perched Carlin water table overlying a zone of desaturated carbonate rock.

Water drains through the dewatered but highly transmissive carbonate rock. Components of recharge to the carbonate aquifer that pass through the dewatered part of the aquifer include:

a) Recharge from the Carlin formation. Water drains from the Carlin Formation downward, through the dewatered carbonate rock, to the carbonate water table below.

b) Recharge from stream networks. Stream channels including Brush Creek, Rodeo Creek, Boulder Creek, and Bell Creek directly recharge the carbonate in outcrop areas.

c) Areal recharge. Direct infiltration of precipitation occurs over carbonate outcrops.

In order to properly represent the above conditions, the following modifications were made to the MODFLOW code.

Vertical Leakage Transfer

The BCF2 package (McDonald et al., 1991) has been modified to (optionally) transmit vertical leakage from above a dry cell to a lower, active layer. Thus the Carlin formation in Layer 1, initially leaking water to the carbonate aquifer in Layer 2, will leak water to the carbonate in Layer 3 after Layer 2 is dry.

Without modifications, MODFLOW already simulates perched aquifer units: Under non-perched conditions, vertical flow between two layers is calculated based on the difference in head between the two layers. As water level in the lower layer drops below the bottom of the upper layer, MODFLOW switches to calculating a flow based on water head in the upper layer only, assuming gravity drainage through the unsaturated zone to the water table below in the lower layer.

A problem arises as the Layer 2 carbonate aquifer cells become dry. Without modification, MODFLOW stops simulating drainage from the perched Carlin Formation to the carbonate water table below. This discontinuity in the equations used to calculate flow produced unrealistic results in the simulated carbonate aquifer water balance and in the simulated Carlin Formation water level trends and water balance.

With the modification, water continues draining at the same rate it was before the Layer 2 carbonate aquifer cells became dry. This restores continuity to the equations used to simulate groundwater flow.

The transfer of vertical leakage is appropriate to apply to the situation along the Carlin Trend, where a lower permeability unit is perched above a higher permeability unit. In some cases, the use of the unmodified algorithm, in which drainage stops as Layer 2 becomes dry, would be more appropriate. In other cases, the use of an unsaturated flow algorithm to represent Layer 2 may be most appropriate.

Vertical Transfer of Recharge and River Leakage

The RCH1 package (McDonald and Harbaugh, 1988) was already equipped with an option (NRCHOP=3) to add areal recharge to the uppermost active layer; therefore, no modifications were necessary to simulate recharge to a lower layer when the uppermost carbonate layers are dry.

The RIV2 package was similarly equipped with a feature that adds stream infiltration to the uppermost active layer. Thus rivers initially recharging the carbonate aquifer in Layer 1 will recharge the Layer 2 carbonate when Layer 1 is dry (and Layer 3 when Layer 2 is dry).

Vertical Transfer of Pumping

Historical pumping rates are modeled as specified flows using the module WEL1. Without modifications, MODFLOW removes pumping from the model when a pumping cell becomes dry. The WEL1 package has been modified to (optionally) shift pumping to the next layer down when a pumping cell becomes dry. This option preserves specified pumping rates.

The approach can be appropriate for representing dewatering wells that are completed in multiple layers, or wells that are assumed to be replaced when pumping levels become too low, and it eliminates the need to re-partition pumping between layers and re-specify WEL package input every time a cell becomes dry.

Transfer of Residual Storage

In a model time step in which a cell becomes dry, MODFLOW normally ignores the water stored in the cell at the beginning of the time step. This volume of water is lost to the model mass balance accounting. In the carbonate aquifer, however, this volume of water would percolate to the water table below. The BCF2 package has been modified to (optionally) transfer the residual storage volume from a dry cell to a lower, active cell, thus preserving the mass-balance accounting of aquifer storage.

Cell Rewetting

A simplified rewetting method allows dry cells to be rewet with a zero rewetting threshold, resulting in smoother rewetting and better continuity of groundwater flow equations. Dry cells are rewet when head in an underlying or adjacent cell is above the bottom of a dry cell. Cells may be rewet with a zero saturated thickness and cells can remain wet with a small saturated thickness.

MODIFICATIONS TO MODULE BCF2

The BCF2 package (McDonald et al., 1991) has been modified from its original version for the purpose of simulating conditions of drawdown and recovery of a high-permeability formation underlying a low-permeability formation. The modifications allow the simulation of a perched leaky aquifer by allowing the vertical flow of water through inactive high-permeability cells to a water table in the underlying active cells.

Modifications

The modifications to BCF2 provide an option for vertical transfer of flow, including:

The transfer of vertical flow from an active cell, goes through the underlying inactive cells to the uppermost active cell below. The transfer of vertical flow allows the simulation of a perched water table.

The transfer of storage flow from of a cell, in the time step in which it goes dry, to the uppermost active cell below. The vertical transfer of storage improves computation of cumulative mass balance.

The input parameter IWETIT, previously not used for rewetting simulations with vertical transfer, now is a cutoff iteration for rewetting. When IWETIT is greater than zero, cells are not rewet after iteration IWETIT.

The vertical transfer option may be used with or without rewetting. Vertical transfer simulations use a simplified rewetting algorithm appropriate to high-permeability material: A dry cell is rewet at the beginning of any iteration in which the cell below has a head higher than the bottom of the dry cell. The initial head of the rewet cell is set equal to the cell bottom.

Input Records

Input records for the modified BCF2 are unchanged from the original BCF2. Explanations of input parameters are unchanged except for the following:

IWDFLG rewetting/flux transfer flag.
- if IWDFLG=0, cell rewetting and transfer of BCF2 flux components are not enabled.
- if IWDFLG>0, BCF2 cell rewetting is enabled.
- if IWDFLG<0, vertical transfer of BCF2 flux components is enabled.
- if IWDFLG=-2, cell rewetting and vertical transfer of BCF2 flux components are enabled.

WETDRY rewetting array.
- When IWDFLG=0 or -1, WETDRY is not read.
- When IWDFLG>0 WETDRY is the rewetting array as originally used in BCF2.
- When IWDFLG<-1 WETDRY is a rewetting flag: A cell may be rewet if WETDRY for the cell is not equal to zero.

Changes to BCF2 Code

BCF2AL

Subroutine BCF2AL has been modified to reflect vertical transfer of flow. The vertical transfer option is identified in bold text following comment **C2a**. The condition for allocation of array WETDRY is changed in the bold text following comment **C7a**.

BCF2RP

Changes to subroutine BCF2RP accommodating the vertical transfer option are indicated in bold text following comment **C2H**.

SBCF2N

Changes to subroutine SBCF2N accommodating the vertical transfer option are indicated in bold text following comments **C4B1** and **C4B4**.

BCF2AD

Subroutine BCF2AD has been modified to initialize HOLD for inactive cells during simulations using vertical transfer. The parameters KPER and KSTP have been added. New code is indicated in bold text following comment **C1**. Modified code is indicated in bold text following comment **C1a**.

BCF2FM

Transfer of Flux Components

BCF2 has been modified to transfer storage from dry cells to lower layers. Storage is transferred in subroutine BCF2FM in the bold text following comments **C4a**, **C4b** and **C5d**. BCF2 has also been modified to transfer vertical leakage from above to a lower layer from cells that desaturate. Vertical leakage is transferred in subroutine BCF2FM in the bold text following comments **C6** and **C6a**.

Secondary Modifications

Transfer of storage and vertical leakage is invoked in subroutine BCF2FM by an IBOUND value of 99, set in SBCF2H. Cells with an IBOUND value of 99 are deactivated in subroutine BCF2FM in the bold text following comment **C8d**.

SBCF2H

Rewetting

In transient simulations, vertical transfer of flux components from dry cells maintains the head in dry cells at the layer bottom. Dry cells may be rewet with a zero saturated thickness by ending transfer of flux components and restoring vertical conductance values. No wetting threshold is required, allowing cells to remain wet with a small saturated thickness. Dry cells are rewet when head in the layer below is above the bottom of the dry cell. The rewetting criteria are therefore equivalent to the bottom wetting option in BCF2 (WETDRY<0) with a rewetting interval of 1 (IWETIT=1) and a zero wetting threshold (WETFCT=0 and WETDRY=0). Cells are rewet in the bold text following comment **C2c**.

Secondary Modifications

Transfer of storage and vertical leakage is invoked in subroutine BCF2FM by an IBOUND value of 99. SBCF2H sets the IBOUND value of dry cells to 99 when the flux transfer option is invoked. Head in dry cells is set at the layer bottom elevation to allow computation of storage in dry cells. Dry cells entering SBCF2H are assigned IBOUND values of 99 in the bold text following comment **C2b**. As in the unmodified BCF2, horizontal and vertical conductance terms are set to zero. Unlike unmodified BCF2, vertical conductance from above is not set to zero (bold text following comment **C2d**), enabling the transfer of vertical leakage to lower layers. IBOUND values and heads are assigned to cells that become dry in the bold text following comment **C6c**.

BCF1BD

Subroutine BCF1BD has been modified to recognize the vertical transfer of storage from dry cells to lower layers. Flag IWDFLG and array CVWD have been added to the subroutine parameters. Modifications are contained in bold text in the subroutine header and in bold text following comments **C6** and **C6aa** and in the call statement to subroutine SBCF1F

SBCF1F

Subroutine SBCF1F has been modified to recognize the transfer of vertical flow through dry cells during computation of constant head flows. Flag IWDFLG and array CVWD have been added to the subroutine parameters. Modifications are contained in bold text following comments **C6E1** and **C6F1**.

Verification of Changes Made to BCF2

The modifications to BCF2 were verified using the example problems described in the BCF2 Package documentation (McDonald, Harbaugh, Orr, and Ackerman, 1991). Following is a brief description of the example problems and a comparison of the model results using both BCF2 and modified BCF2:

Problem 1 A steady-state problem, referred to as Problem 1 in the BCF2 Package documentation, was run. First the original problem was duplicated employing the modified BCF2 Package, with IWDFLG>0. The problem was then run with the flux transfer/rewetting option (IWDFLG=-2). Results closely matched the published Problem 1 results, computing the same number and location of active cells and a maximum head difference between simulations of .02 feet.

Problem 2a A steady-state problem, referred to as Problem 2a in the BCF2 Package documentation, was run. First the original problem was run, with IWDFLG>0. Results were confirmed to be identical to the published BCF2 results.

In a second simulation the problem was modified by the specification of absolute values of .0001 for WETDRY and WETFCT. The small wetting values approximate the zero wetting values of the flux transfer/rewetting option (IWDFLG=-2). Results were close to the published 2A results, with 2 more active cells in Layer 2, 3 more active cells in Layer 5 and head differences of up to .1 feet.

In a third simulation the problem was run with the flux-transfer/rewetting option (IWDFLG=-2). Results were identical to those of the second simulation.

Problem 2d A transient problem, 2d, was run. First the original problem was run, with IWDFLG>0. Results were confirmed to be identical to the published BCF2 results.

Second the problem was modified by the specification of absolute values of .0001 for WETDRY and WETFCT. The small wetting values approximate the zero wetting values of the flux transfer/rewetting option (IWDFLG=-2). The results of changing WETDRY and WETFCT for problem 2d resembled the results of changing WETDRY and WETFCT for problem 2a, with several more active nodes and head differences of up to .1 feet.

Third the problem was run with the flux-transfer/rewetting option (IWDFLG=-2). Results were identical to those of the second simulation.

Fourth, the problem was modified to test the transfer of vertical leakage. The recharge package was turned off and replaced with an initially wet Layer 1. The flux transfer option without rewetting (IWDFLG=-1) was enabled. Layer 1 was specified as active, with an initial head of 70 feet and a bottom of 65 feet. The last row and the last column of Layer 1 were de-activated to avoid vertical transfer of flow directly into constant head cells. Layers 2-9 were specified as inactive, unable to be rewet. Layers 10-14 were specified as active, with an initial head of 25 feet. Layer 1 is thus separated from the rest of the grid by inactive layers. The problem was run for 50 1-day time steps. As a perched aquifer, Layer 1 should drain according to the equation

$$Sy\frac{\partial h}{\partial t} = Vc(h-b),$$

where,

h is hydraulic head
Sy=0.2 is specific yield
Vc=0.05/dy is vertical conductance
b=65 ft is layer bottom,

with a solution of $h = 65\,ft + (5\,ft)e^{-t/4dy}$

A comparison of numerical and analytical solutions is shown on the figure below:

.

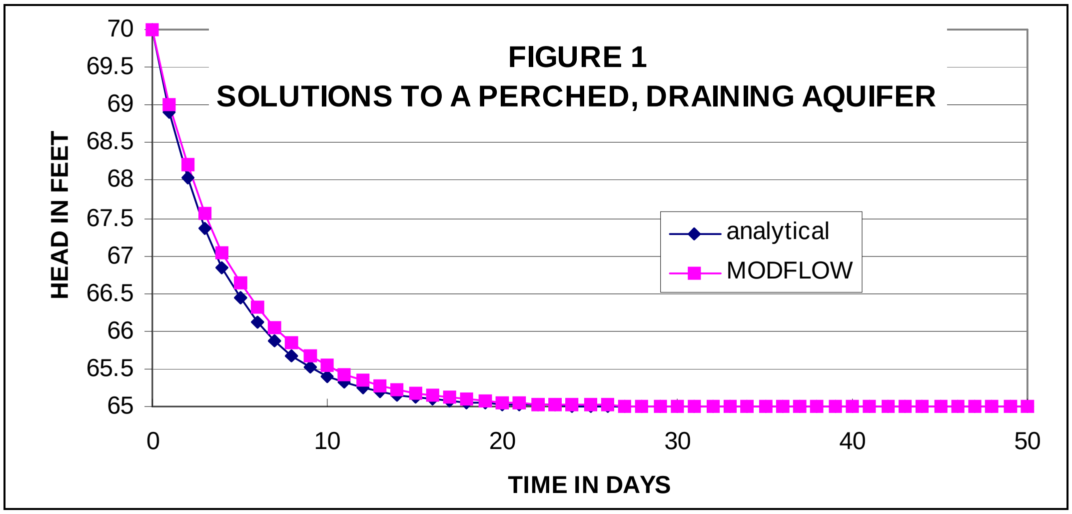

Figure 1 shows that the isolated layer drains as expected, with a reasonable match of the analytical solution. Furthermore, a 1-point implicit finite difference spreadsheet solution exactly matched the MODFLOW solution. Inspection of the mass balance table in the simulation output also shows that the water from Layer 1 enters aquifer storage or exits through constant heads in the active Layers 10-14.

Fifth, the problem was modified to test the transfer of storage. The bottom of Layer 1 is re-specified at 69.1 feet. The simulation is run for a 1 day time step, during which Layer 1 goes dry. Inspection of the mass balance table in the simulation output shows that the correct volume of storage flows from Layer 1:

$$(39 \text{ rows}) \times (39 \text{ columns}) \times (125 \text{ ft})^2 \times (0.9 \text{ ft}) \times (0.2) = 4.2778 \times 10^6 \text{ft}^3$$

The Layer 1 storage entering the model exits the model as storage or constant head flow in the active Layers 10-14.

MODIFICATIONS TO BOUNDARY CONDITION MODULES

The following sections describe mostly minor modifications that are used to specify boundary conditions to a groundwater flow domain, including modules RCH1, EVT1, WEL1 and DRN1.

Modifications to Module WEL1

The original WEL package (McDonald and Harbaugh, 1988) has been modified to shift pumping down to the uppermost active layer when the assigned cell for a well is dry. This vertical flux transfer serves to maintain the total specified pumping flow for a simulated well that is completed in several layers. Prior to modification, MODFLOW removes pumping from the simulation when a cell goes dry; vertical flux transfer therefore eliminates the need to re-partition pumping between layers and re-specify WEL package input every time a cell goes dry. Vertical flux transfer is accomplished by means of an extra variable in the WELL array that serves as a flag indicating whether vertical transfer is to be used for a given well. Modifications to WEL1AL, WEL1RP, WEL1FM and WEL1BD are indicated in bold text.

Modifications

In subroutine WEL1AL the dimensioning of array WELL is 5* MXWEL instead of 4* MXWEL. Modified code is indicated by bold text in the line following comment **C4**. The new dimension of WELL is also indicated by bold text in the DIMENSION statements of WEL1RP, WEL1FM and WEL1BD.

In subroutine WEL1RP the READ statement in the fifth line following comment **C5** has been modified to also read a vertical transfer flag. Modified code is indicated by bold text.

In subroutine WEL1FM, vertical transfer is performed in the bold text following comment **C2aa**.

In subroutine WEL1BD, vertical transfer is performed in the bold text following comment **C5aa**.

Input Records

Record 1 is read by module WEL1AL and *is read once for a simulation*.

record 1 variable: MXWEL IWELCB
format: I10 I10

Records 2 and 3 are read by module WEL1RP and *are read once for each stress period*.

record 2 variable: ITMP
format: I10

record 3 Read ITMP times when ITMP>0. Not read when ITMP≤0.
variable: LAYER ROW COLUMN RATE IVTF
format: I10 I10 I10 F10.0 I10

Explanation of Variables

1. MXWEL : Maximum number of wells in any stress period.
   IWELCB : Flag and unit number for node-by-node WEL output.
   If IWELB>0, well flows are saved unformatted on unit number IWELCB whenever the flag ICBCFL from the OC Package is nonzero.
   If IWELCB<0, well flows are printed to the main output file. In the future they will be printed to unit number -IWELCB.
   If IWELCB=0, well flows are not printed or saved.
2. ITMP : If ITMP≥0, ITMP is the number of wells used in the current stress period.
   If ITMP<0, the well list from the previous stress period is reused.
3. LAYER : Layer of well cell/node.
   ROW : Row of well cell/node.
   COLUMN : Column of well cell/node.
   RATE : Pumping rate of well.
   IVTF : Vertical transfer flag for well.
   If IVTF is not equal to zero, vertical transfer is performed.
   If IVTF is equal to zero, vertical transfer is not used.

Modifications to Module DRN1

The Drain Package has been modified from its original version (McDonald and Harbaugh, 1988). The function of the Well Package has been incorporated into the Drain Package. The modification allows a convenient representation of pumping wells, in which a well may pump a specified rate or a head-dependent rate. Vertical flow transfer may be used with the Well package function of DRN.

Modifications

In subroutine DRN1AL a vertical transfer is read following comment **C2**. The dimension of array DRAI is 6* MXDRN instead of 5* MXDRN. Modified code is indicated by bold text in the line following comment **C4**. The new dimension of DRAI is also indicated by bold text in the DIMENSION statements of DRN1RP, DRN1FM and DRN1BD.

In subroutine DRN1RP the READ statement in the fifth line following comment **C7** has been modified to also read a pumping rate. Modified code is indicated by bold text.

In subroutine DRN1FM the function of the Well Package is performed in the bold text following comment **C3b**. Vertical transfer for the Well package function is performed in the bold text following comment **C3a**.

In subroutine DRN1BD the function of the Well Package is performed in the bold text following comment **C5c** and indicated by bold text in the lines following comments **C5a** and **C9**. Vertical transfer for the Well package function is performed in the bold text following comment **C5b**.

Input Records

Record 1 is read by module DRN1AL and *is read once for a simulation*.

record 1	variable:	MXDRN	IDRNCB	ID1VT			
	format:	I10	I10	I10			

Records 2 and 3 are read by module DRN1RP and *are read once for each stress period*.

record 2	variable:	ITMP					
	format:	I10					
record 3	Read ITMP times when ITMP>0. Not read when ITMP≤0.						
	variable:	LAYER	ROW	COLUMN	HEAD	COND	RATE
	format:	I10	I10	I10	(3F10.0)		

Explanation of Variables

1. MXDRN : Maximum number of drains in any stress period.

   IDRNCB : flag and unit number for node-by-node DRN output.

   If IDRNCB>0, drain flows are saved unformatted on unit number IDRNCB whenever the flag ICBCFL from the OC Package is nonzero.

   If IDRNCB<0, drain flows are printed to the main output file. In the future they will be printed to unit number -IDRNCB.

   If IDRNCB=0, drain flows are not printed or saved.

   ID1VT : Vertical transfer flag. If ID1VT is not zero, vertical transfer is used for the well function part
of DRN : Pumping (RATE in record 3) is placed in the uppermost active layer.
2. ITMP : If ITMP≥0, ITMP is the number of drains used in the current stress period.

   If ITMP<0, the drain list from the previous stress period is reused.
3. LAYER : Layer of drain cell/node.

   ROW : Row of drain cell/node.

   COLUMN : Column of drain cell/node.

   HEAD : Elevation of drain.

   COND : Conductance of drain.

   RATE : Pumping rate of well

Modifications to Module RCH1

The areal Recharge Package, version 1, RCH1 (McDonald and Harbaugh, 1988), has been modified to include a seasonal input option. When the seasonal option is invoked, the RCH1 input file is rewound and recharge data from the first stress period are used. The seasonal option may be seen in subroutine RCH1RP in the bold text following comment **C2**. Following are revised input instructions. The seasonal input option is described in Record 2 (INRECH).

Input Records

Record 1 is read by module RCH1AL and *is read once for a simulation.*

record 1.

variable:	NRCHOP	IRCHCB
format:	I10	I10

Records 2-4 are read by module RCH1RP and *are read once for each stress period.*

record 2.

variable:	INRECH	INIRCH
format:	I10	I10

record 3. Read if INRECH is greater than or equal to 0.

variable: RECH(NCOL,NROW)
format: U2DREL

record 4. Read if NRCHOP=2 and INIRCH is greater than or equal to 0.

variable: IRCH(NCOL,NROW)
format: U2DINT

Explanation of Variables

record 1

NRCHOP : RCH option.

If NRCHOP=1, recharge is specified for the top layer.
If NRCHOP=2, the user specifies the recharge layer at each horizontal location using array IRCH.
If NRCHOP=3, recharge is applied to the top-most active layer. If the top-most active layer at a given horizontal location is a constant head cell/node, recharge is not applied to that location.

IRCHCB : flag and unit number for node-by-node RCH output.

When IRCHCB>0, node-by-node terms are recorded on unit IRCHCB.

record 2

INRECH : recharge rate (RECH) read flag.

If INRECH is greater than or equal to 0, RECH is read.
If INRECH=-1, RECH from the previous stress period is used.
If INRECH<-1, the input file is rewound and RCH input for the first stress period is read.

INIRCH : Layer indicator (IRCH) read flag.

If NRCHOP=2 and INIRCH is greater than or equal to 0, IRCH is read. Otherwise (if NRCHOP=2), IRCH from the previous stress period is used.

record 3

RECH : recharge rate (L/t).

record 4

IRCH : Layer indicator array. Used if NRCHOP=2. At each horizontal location, IRCH indicates the layer to which recharge is applied.

Modifications to Module EVT1

The Evapotranspiration Package, version 1, EVT1 (McDonald and Harbaugh, 1988), has been modified to include a seasonal input option. When the seasonal option is invoked, the EVT1 input file is rewound and recharge data from the first stress period are used. The seasonal option may be seen in subroutine EVT1RP in the bold text following comment **C2**. Following are revised input instructions. The seasonal input option is described in Record 2 (INSURF).

Input Records

Record 1 is read by module EVT1AL and *is read once for a simulation.*

record 1.

variable:	NEVTOP	IEVTCB
format:	I10	I10

Records 2-6 are read by module EVT1RP and *are read once for each stress period.*

record 2.

variable:	INSURF	INEVTR	INEXDP	INIEVT
format:	I10	I10	I10	I10

record 3. Read if INSURF greater than or equal to 0.
variable: SURF(NCOL,NROW)
format: U2DREL

record 4. Read if INEVTR greater than or equal to 0.
variable: EVTR(NCOL,NROW)
format: U2DREL

record 5. Read if INEXDP greater than or equal to 0.
variable: EXDP(NCOL,NROW)
format: U2DREL

record 6. Read if NEVTOP=2 and INIEVT greater than or equal to 0.
variable: IEVT(NCOL,NROW)
format: U2DINT

Explanation of Variables:

record 1.

NEVTOP : ET option.
1 - ET is calculated for the top layer.
2 - the user specifies the ET layer at each horizontal location using array IEVT.

IEVTCB : flag and unit number for node-by-node EVT output.
When IEVTCB>0, node-by-node terms are recorded on unit IEVTCB.

record 2.

INSURF : ET surface (SURF) read flag.

If INSURF greater than or equal to 0, SURF is read.

If INSURF=-1, SURF from the previous stress period is used.

If INSURF<-1, the input file is rewound and EVT input for the first stress period is read and used.

INEVTR : Maximum ET rate (EVTR) read flag. If INEVTR is greater than or equal to 0, EVTR is read.

Otherwise, EVTR from the previous stress period is used.

INEXDP : Extinction depth (EXDP) read flag. If INEXDP is greater than or equal to 0, EXDP is read.

Otherwise, EXDP from the previous stress period is used.

INIEVT : Layer indicator (IEVT) read flag. If NEVTOP=2 and INIEVT greater than or equal to 0, IEVT is read. Otherwise (if NEVTOP=2), IEVT from the previous stress period is used.

record 3: SURF : ET surface elevation.

record 4: EVTR : Maximum ET rate.

record 5: EXDP : Extinction depth.

record 6: IEVT : Layer indicator array. Used if NEVTOP=2.

At each horizontal location, IEVT indicates the layer from which ET is taken.

DOCUMENTATION FOR RIV2

The River Package, version 2 (RIV2), developed by the USGS (Miller, 1988) is a FORTRAN package for the U.S. Geological Survey Modular Groundwater Flow Model, MODFLOW (McDonald and Harbaugh, 1988). RIV2 has been modified to allow unformatted output of streamflow, to include a seasonal input option, to allow input of new river reach data while repeating river node data and to allow input of new river node data while repeating river reach data. In addition, river recharge is now placed in the uppermost active layer. The capability to simulate diversion of river flow and optional transfer and re-injection of diverted flow to a new location has also been added. This diversion capability was added through a set of subroutines that all include the characters "DIV1" in their names. Input data for the diversion capability is in a file that is separate from the RIV2 input file.

RIV2 Narrative (from Miller, 1988)

The main features of RIV2 are:

1. The river system is divided into reaches and simulated river discharge is routed from one reach to another in a specified sequence. Within a reach, river discharge is routed from one node to the next.
2. Inflow (river discharge) entering the upstream end of a reach can be specified.
3. More than one river can be represented at one node and rivers can cross, as when representing a siphon.
4. The quantity of leakage to or from the aquifer at a given node is proportional to the hydraulic-head difference between that specified for the river and that calculated for the aquifer. Also, the quantity of leakage to the aquifer at any node can be limited by the user and, within this limit, the maximum leakage to the aquifer is the discharge available in the river. This feature allows for the simulation of intermittent rivers and drains that have no discharge routed to their upstream reaches.
5. An accounting of river discharge is maintained.

Neither stage-discharge relations nor storage in the river or river banks is simulated.

The modeling concepts necessary for the operation of RIV2 differ little from those for RIV1. The differences are largely due to features adapted from the modeling code of Posson et al. (1980) and Hearne (1982). The RIV2 code represents a number of nodes that simulate leakage from or to an overlying river. Certain features of a river that would be essential in a surface-water model, such as storage in the channel or banks, are not represented because RIV2, like RIV1, is considered to be a boundary condition in a ground-water model, not a surface-water model.

The rate of leakage at each node is directly proportional to the difference between the hydraulic head in the aquifer and the stage of the river, but is limited to the lesser of either a user-specified maximum or the intermittent and ephemeral rivers. Leakage from the aquifer to the river is not limited in RIV2.

The user needs to supply the hydraulic-connection coefficient, the limiting maximum rate of leakage to the aquifer, and the river stage for each node. It is possible for the user to re-specify the river characteristics (stage, hydraulic-connection coefficient, and limiting maximum rate of leakage to the aquifer and river stage) for each stress period. They hydraulic-connection coefficient, CRIV, may be defined as the conductance of the reach of the riverbed with units of length squared per unit time:

$$CRIV = K'\ A'/b$$

where K’ = vertical hydraulic conductivity of the riverbed material
A’ = area of the river channel; and
b = thickness of the riverbed material

The river discharge for a node is equal to the river discharge into the node minus the leakage to the aquifer or plus the leakage from the aquifer. The river stage, the wetted perimeter of the river channel, and the conductance of the riverbed material in a river vary with the discharge of the river. The constant values used in RIV2 limit its accuracy, but the error probably is not as great as it would be if the aquifer were allowed to gain more water from the river than the river contained.

The river-discharge-routing procedure in RIV2 uses a higher order structure that is not used in RIV1. A river, as represented in the framework of the model, consists of one or more reaches, and each reach consists of one or more nodes. (This definition of the term “reach” is distinctly different from that of RIV1.) A node may be part of more than one river reach. The river discharge at the upstream end of a reach consists of the river discharge from upstream reaches plus any user-specified tributary inflow. The river discharge from the downstream end of a reach may be routed to any downstream reach. The structure allows representation of tributaries.

RIV2, like RIV1, separates the leakage term into explicit and implicit parts. The explicit part of the leakage term is added to the variable RHS. (RHS is the right side of a finite-difference equation and is an accumulation of the terms that are independent of hydraulic head at the current time step. Terms in RHS are defined by various model packages.) The term added to RHS may have either of two forms. If the hydraulic head computed for the aquifer during the previous iteration was greater that the hydraulic head required to produce the limiting value of leakage to the aquifer, then the following FORTRAN assignment is made:

$$RHS = CRIV * HRIV$$

where, HRIV is the river stage, and other terms are as previously defined. If the hydraulic head computed for the aquifer during the previous iteration was less than or equal to the hydraulic head required to produce the limiting value of leakage to the aquifer, then the assignment is:

$$RHS = RHS - CRIV * (HRIV - HMIN)$$

where, HMIN is the hydraulic head required to produce the limiting value of leakage to the aquifer, and other terms are as previously defined.

The implicit part of the leakage term is added to the variable HCOF. (HCOF) is the coefficient of hydraulic head for the node (J, I, K) in the finite-difference equation.) The implicit term may, like the explicit term, have either of two forms. If the hydraulic head computed for the aquifer during the previous iteration was greater than the hydraulic head required to produce the limiting value of leakage to the aquifer, then the following FORTRAN assignment is made:

$$HCOF = HCOF - CRIV$$

where, all terms are as previously defined. The implicit term is zero when the hydraulic head computed for the aquifer during the previous iteration was less than or equal to the hydraulic head necessary to produce the limiting value of leakage to the aquifer. In this instance, the leakage term included in the solution algorithm is explicit.

Modifications

The following are modifications to the original RIV2 Package:

The River Package, version 2, RIV2, has been modified to allow unformatted output of streamflow. Streamflow for each river node is saved when the flag IDQ (record 1) is set.

RIV2 has been modified to include a seasonal input option. The RIV2 input file is rewound, and river data from the first stress period re-read, when the flag ITMP (record 3) is less than -1.

RIV2 has been modified to allow input of new river reach data while repeating river node data. River reach data will be read, and river node data repeated, when the flag IREAC (record 3) is set.

RIV2 has been modified to allow river leakage to be placed in the uppermost active model layer. The flux transfer option is invoked by the flag IR2VT in record 1 below.

DIV1**,** which is a subpackage to RIV2, has been developed to expand the capabilities of the River Package. DIV1 permits a portion of existing river flow to be diverted and routed to another location in the model. Streamflow is subtracted from a user specified river node. All or part of the flow is added directly to the RHS vector of a user specified model cell.

Input Records

Records 1 and 2 are read by module RIV2AL and are *read once for a simulation*:

<u>record 1</u>

Data:	MXRIVR	IRIVCB	IDQ	IDIV	IR2VT
Format:	I10	I10	I10	I10	I10

<u>record 2</u>

Data:	MXREAC
Format:	I10

Records 3, 4, 5 and 6 are read by module RIV2RP and are *read each stress period*.

<u>record 3</u>

Data:	ITMP	IREAC
Format:	I10	I10

<u>record 4</u>

Data:	NR
Format:	I10

<u>record 5</u> read NR times.

Data:	NREA	NNRE	RQIN	NADD
Format:	I10	I10	F1O.0	I10

(record 5 consists of one record for each river reach active during the current stress period. The reaches need to be specified in downstream order.)

<u>record 6</u> read ITMP times, when ITMP>0.

Data:	Layer	Row	Column	STAGE	COND	QMAX
Format:	I10	I10	I10	F10.0	F10.0	F10.0

(record 6 consists of one record for each river node active during the current stress period. The nodes need to be specified in downstream order, consistent with the specification of the river reaches.)

Explanation of Variables

record 1
MXRIVR is the maximum number of river nodes active at one time.
IRIVCB is a flag and a unit number.
If IRIVCB > 0, then node-by-node flow terms will be recorded on unit IRIVCB whenever ICBCFL (see Output Control) is set.
If IRIVCB = 0, then node-by-node flow terms will be neither printed nor recorded.
If IRIVCB < 0, then river leakage for each reach will be printed whenever ICBCFL is set.

IDQ is a flag indicating whether downstream flows are to be saved.
If IDQ ≠ 0, then streamflow for each river node will be recorded on unit IRIVCB whenever ICBCFL (see Output Control) is set.
If IDQ = 0, then streamflow will not be recorded.

IDIV is a flag and a unit number activating the DIV1 subpackage for river diversions.
If IDIV > 0 then DIVI is unit number from which DIV1 input is read (see input instructions below).

IR2VT is a flag for vertical transfer of river leakage.
If IR2VT=0, vertical transfer is not used: River leakage is placed in the specified layer, if active.
If IR2VT≠ 0, vertical transfer is used: River leakage is placed in the uppermost active layer.

record 2 MXREAC is the maximum number of river reaches active at one time.

record 3
ITMP is a flag and a counter.
If ITMP <-1, the input file is rewound. River node data and river reach data from the first stress period are used.
If ITMP =-1, then river node data from last stress period will be re-used.
If ITMP ≥ 0, ITMP is the number of river nodes active during the current stress period.
IREAC is a flag for reading river reach data when ITMP=-1.
If IREAC = 0 and ITMP=-1, river reach data and river node data from the previous stress period are re-used. Records 4, 5 and 6 are not read.
If IREAC ≠ 0 and ITMP=-1, river reach data is read, but river node data from the previous stress period are re-used. Records 4 and 5 are read, and record 6 is not read.

record 4 NR if NR<0, river reach data from the previous stress period are re-used.
if NR>0, NR is the number of river reaches active in the current stress period.

record 5 **river reach data**
NREA is the river-reach number.
NNRE is the number of river nodes in the reach.
RQIN is the river discharge added at the upstream end of the reach.
NADD is the number of the downstream reach (zero, if none).

record 6 **river node data**
LAYER is the layer number of the river node.
ROW is the row number of the river node.
COLUMN is the column number of the river node.
STAGE is the hydraulic head in the river.
COND is the riverbed hydraulic conductance.
QMAX is the maximum allowable leakage to the aquifer.

DOCUMENTATION FOR DIV1

DIV1 enables water to be diverted from a river channel and permits the optional transfer of the diverted water to another location within the model. This feature allows the simulation of processes such as the extraction of river water for application to agricultural lands, direct recharge of a reservoir or unspecified municipal/industrial use. Multiple diversions may be made, each being extracted from a single river node and re-injected into a single model cell. Each diversion is specified using the following variables:

NODE = RIV2 node from which water is to be diverted. NODE$\in$(1,MXRIVR)

Qd = maximum rate of water to be diverted. The actual flow diverted by DIV1 is the minimum of Qd and available river flow.

Qa = That portion of Qd assumed to be accounted for elsewhere, not to be re-injected by DIV1. Qa may represent water put into the model by other MODFLOW packages or water removed from the simulation. The amount of water diverted over Qa is re-injected.

ILAY, IROW, ICOL = The layer, row and column indices of the cell into which diverted water is re-injected.

For each RIV2 node (node number) to be diverted from, subroutine DIV1RP sets a flag in MXRIVR(7,NODE) to indicate the diversion. As subroutine RIV2FM is looping through river nodes it checks the flag for diversions. When diversions are found, RIV2FM calls subroutine DIV1FM to perform the diversion.

The amount of water diverted is computed as the minimum of Qd and available river flow:

Qdiverted = min(Qd,Q(NODE))

where, Q(NODE) is the streamflow at the river node.

The amount of water re-injected is the difference between the amount diverted and Qa:

Qreinjected = max (0, Qdiverted-Qa)

Input Records

Records 1 is read by module DIV1AL and is read *once for a simulation*:

record 1

Data:	MXDIV	IDIVOT
Format:	I10	I10

Records 2, and 3 are read by module RIV2RP and are read *each stress period*

record 2

Data:	ITMP
Format:	I10

record 3

Read ITMP times when ITMP ≥ 0

Data:	NODE	ILAY	IROW	ICOL	QD	QA
Format:	I10	I10	I10	I10	F10.0	F10.0

Explanation of Variables

record 1
MXDIV is the maximum number of river diversions occurring during the simulation.
IDIVOT is a flag and a unit number.

If IDIVOT > 0, then node-by-node flow terms will be recorded on unit IDIVOT whenever ICBCFL (see Output Control) is set.

If IDIVOT = 0, then node-by-node flow terms will be neither printed nor recorded.

record 2
ITMP is a flag and a counter.

If ITMP <0, information from the previous stress period is repeated. River reach data from the first stress period is used.

If ITMP ≥ 0, ITMP is the number of river nodes active during the current stress period.

record 3
NODE is the river node number as defined in RIV2 (from 1 to MXRIVR) from which water is to be diverted.
ILAY is the layer number of the location for the re-injection of diverted water
IROW is the row number of the location for the re-injection of diverted water
ICOL is the column number of the location for the re-injection of diverted water
QD is the volume of water diverted from the river
QA is the volume of water re-injected into the modeled system

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APPENDIX: DOCUMENTATION FOR MODULE LAK2

DOCUMENTATION OF LAK2: A COMPUTER PROGRAM TO SIMULATE THE PRESENCE OF LAKES AND OTHER OPEN WATER BODIES WITHIN A GROUNDWATER FLOW SYSTEM USING THE MODFLOW GROUNDWATER FLOW MODEL

ABSTRACT

LAK2 is a module for the U.S. Geological Survey Modular Groundwater Flow Model (MODFLOW) that simulates the interconnection between a groundwater system and an adjacent open water body such as a lake, an open pit or a well bore.

The module has been in use since 1998. Although other modules have subsequently been published (lake package, USGS OFR 00-4167 and Multi-Node Well Package, USGS OFR 02-293) that perform some of the same functions, these only provide stable and accurate solutions for a limited range of problems, and break down under strongly transient or nonlinear conditions, when aquifer water level and "lake" water level are each sensitive to the other.

The main difference between LAK2 and other modules is the method used to solve two parallel but interdependent (coupled) sets of equations governing (1) groundwater levels and flows and (2) "lake" water levels and flows. Other modules solve partially decoupled forms of the equations with good results for a limited range of problems, but with slow convergence, instability and mass balance errors for other applications. LAK2 solves the fully coupled system of equations and provides efficient, stable, convergent solutions without mass balance errors.

LAK2 was first reviewed and accepted for use in the state of Nevada for simulation of post-mining water level recovery in an open pit (BLM, 2000). LAK2 has since been applied to pit-filling simulations for sites in Nevada, New Mexico, Canada, Chile, and Tanzania. Other applications have involved modeling borehole hydraulics and wells intersecting multiple model cells. Further applications potentially include the representation of natural lakes, caverns or other open spaces linked to a groundwater system.

This report presents LAK2 documentation and selected applications including:

- Module documentation: Presentation of algorithm, input instructions and simple test case.
- Archimedes pit: Demonstration of the representation of lake (pit) geometry and water balance, projection of future water level and water balance.
- Ortiz pit: Calibration of a groundwater flow model to historical pit water levels, post-audit of water level projections.
- Belen municipal well: Representation of a well pumping from multiple layers, correcting the erratic numerical solution previously obtained.
- Fan Sediments aquifer test: Simulation of borehole water levels for analysis of aquifer test results and projection of future pumping water levels.

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DOCUMENTATION OF LAK2: A COMPUTER PROGRAM TO SIMULATE THE PRESENCE OF LAKES AND OTHER OPEN WATER BODIES WITHIN A GROUNDWATER FLOW SYSTEM USING THE MODFLOW GROUNDWATER FLOW MODEL

INTRODUCTION

This report describes a module that has been used since 1998 to solve the fully coupled system of equations describing groundwater flow and lake/water body mass balance. The module applies to both larger-scale water bodies such as open pits and smaller-scale bodies such as well bores.

Previous Work

Software for modeling of lakes in conjunction with surrounding groundwater systems, using the U.S. Geological Survey Modular Groundwater Flow Model (MODFLOW), dates back to at least 1993 (Cheng and Anderson, 1993). Other lake modules developed for MODFLOW include those by HSI Geotrans (Council, 1999) and most recently by USGS (Merritt and Konikow, 2000). Another module was developed to represent well bores intersecting multiple model cells (Halford and Hanson, 2002).

All of these modules utilize an algorithm that treats the mass balance equation governing lake stage as if it were decoupled from the equations governing the groundwater system. They have been successfully used to represent natural lakes with little change, or slow change, in water level and they work acceptably well for a range of applications where lake stage does not strongly influence groundwater heads and where simulation time steps are sufficiently small so that the lake stage does not change too much in a single time step.

The decoupling of equations is done as follows: MODFLOW iteratively solves the system of equations governing groundwater head. The equation governing lake stage is then solved, after the iterative process has finished. Because groundwater head and lake stage are mutually dependent variables, errors result in both groundwater and lake solutions.

The decoupled solution algorithms break down for strongly transient problems, such as recovery of water level in an open pit after mining has ceased, or for highly sensitive problems where lake stage strongly influences groundwater levels. Mass balance errors become large and stability or convergence limits require impractically short time step lengths with long model run times.

The module described here solves the fully coupled system of equations describing groundwater flow and lake mass balance. The equations governing lake stage are solved at each iterative step of the groundwater flow solution process, thus simultaneously solving for lake stage and groundwater head. The algorithm produces stable, efficient and convergent solutions without mass balance error.

Structure of Report

This report includes the following chapters:

1. Module documentation: Presentation of algorithm, input instructions and simple test case.
2. Application: Archimedes pit. Representation of lake (pit) geometry and water balance, projection of future water level and water balance.
3. Application: Ortiz pit. Calibration of a groundwater flow model to historical pit water levels, post-audit of water level projections.
4. Application: Belen municipal well. Representation of a well pumping from multiple layers, correcting the erratic numerical solution previously obtained.
5. Application: Fan Sediments aquifer test. Simulation of borehole water levels for analysis of aquifer test results and projection of future pumping water levels.

1.0 DOCUMENTATION

1.1 LAKE WATER BALANCE

Groundwater flow systems can be influenced by stationary surface water features (lakes) including natural lakes, constructed reservoirs, retired mine pits and wetlands. Lakes can function as hydraulic sinks with groundwater inflow, as hydraulic sources of groundwater recharge or as flow-through lakes with both groundwater inflow and groundwater outflow. A lake may serve to connect distinct parts of a groundwater flow system.

Lake water balance components are illustrated on Figure 1.1 and can include:

- direct precipitation and runoff from surface catchment
- evaporation of water from lake surface
- groundwater inflow
- inflow from surface streams
- groundwater outflow
- surface water outflow

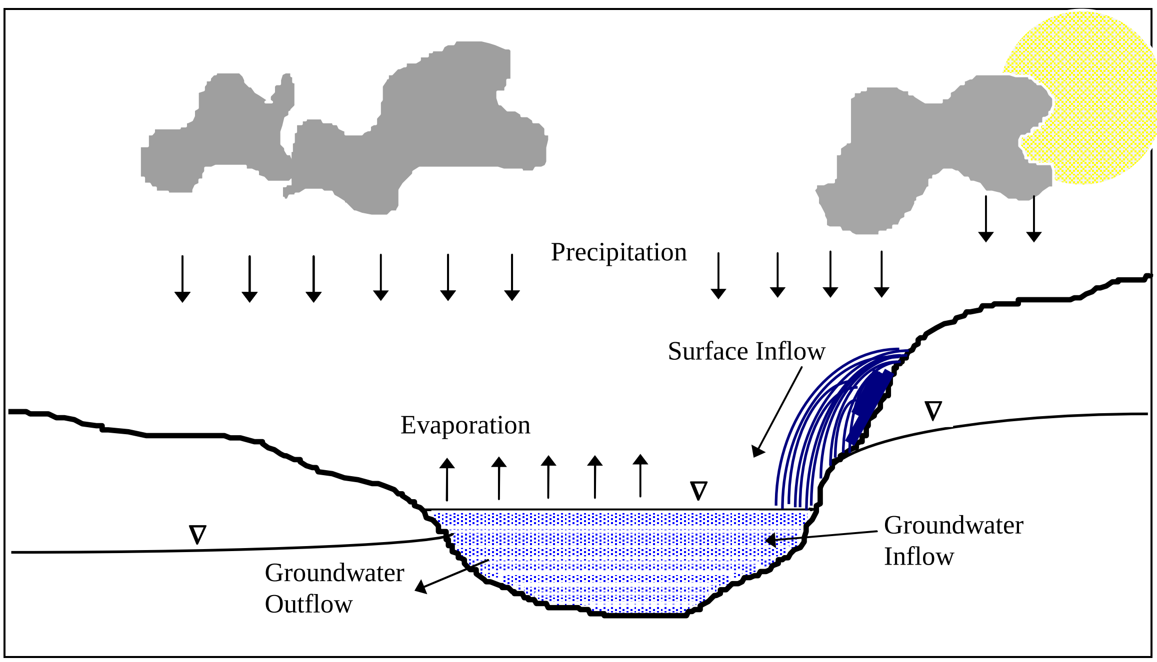

Figure 1.1 Components of lake water balance.

The governing equation for lake stage used by LAK2 is

$$\frac{\partial H_{LAKE}}{\partial t} = \frac{1}{A_{LAKE}}\{Q_{str\,in} - Q_{str\,out} + P - E + Q_{gw} - W\} \qquad (1)$$

where:

H_{LAKE} is the lake water surface elevation (L).
A_{LAKE} is the water surface area of the lake at stage HLAKE (L^2).
Q_{strin} is the rate of streamflow into the lake (L^3/t).
Q_{strout} is the rate of streamflow out of the lake (L^3/t).
P is the rate of precipitation inflow to the lake (L^3/t).
E is the rate of evaporation from the lake (L^3/t).
Q_{gw} is the net rate of groundwater flow to the lake (L^3/t).
W is the rate of pumping or other diversion out of or into the lake (L^3/t).

1.1.1 Geometric Representation of Lake

A lake is defined by a list of cells (lake cells) in the groundwater flow domain that are connected to the lake. A conceptual view is shown on Figure 1.2, indicating lake cells (groundwater cells connected to the lake) and inactive cells (not part of the groundwater domain).

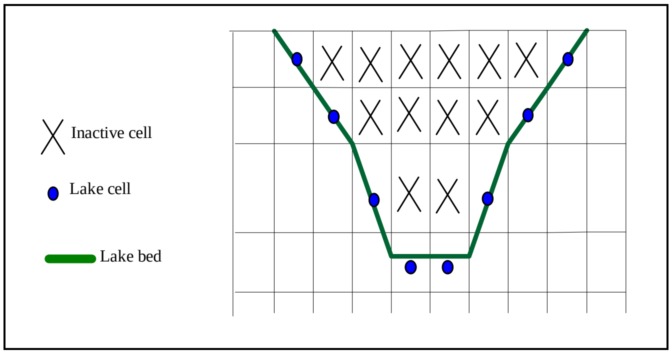

Figure 1.2. Cross-sectional view of a lake in a MODFLOW grid.

Each lake cell is specified with a lakebed minimum elevation, lakebed maximum elevation and maximum water surface area.

Water surface area of the lake is computed by summing the contribution of each cell to the total water surface. The contribution for a cell is equal to zero when lake water level is at or below the lakebed minimum elevation, increasing linearly with lake water level to the maximum water surface area when lake water level is at or above the lakebed maximum elevation.

The bottom of a lake is the lowest lakebed minimum elevation among the lake nodes. Two options exist for representation of the lake bottom:

1. A flat bottom lake is defined when the lakebed minimum elevation is equal to lakebed maximum elevation for the lowermost cell(s) of the lake.
2. A non-flat bottom lake is defined when the lakebed minimum elevation is lower than the lakebed maximum elevation for the lowermost cell(s) of the lake.

The two types of lake bottom have different implications for Equation (1) above when water level is near the lake bottom elevation. For a non-flat bottom, the water surface area A_{LAKE} approaches zero as water level approaches bottom elevation. For a flat bottom, the water surface area A_{LAKE} approaches a nonzero constant as water level approaches bottom elevation. For both types, A_{LAKE} is zero when the lake is dry (water level equal to bottom elevation) and Equation (1) is undefined. Lake bottom type is considered in the computation of the components of Equation (1) and in the handling and rewetting of dry lakes.

1.1.2 Stream Connections

LAK2 is configured to recognize surface water inflows and outflows simulated using the streamflow routing package RIV2 (Miller, 1988, Jones, 2010). RIV2 has been developed to provide the streamflow routing function in an efficient and simple way without surface water mass balance errors. Other streamflow routing modules for Modflow could readily be utilized by LAK2 with minor code changes.

A list of RIV2 reaches may be specified to flow into a LAK2 lake. The simulated streamflow at the bottom node of each inflowing reach is added to Q_{strin} in Equation (1).

A single RIV2 reach may be specified to flow out of a lake at a specified spill elevation. Spill from the lake, Q_{strout} in Equation (1), is computed by setting water level equal to spill elevation and then computing the resulting water surplus. The simulated inflow at the top node of the outflowing reach is set equal to spill from the lake.

Note: Other lake modules including (Merritt and Konikow, 2000) have used a Manning equation to estimate a spill rating curve and thus compute spill as a function of water level above spill elevation. To date, the models to which LAK2 has been applied have not been concerned with the small margin of water level above spill elevation. A Manning equation-based spill computation could be readily implemented into LAK2 with minor code changes.

1.1.3 Precipitation

Total precipitation inflow to a lake consists of direct precipitation on the water surface as well as runoff from the surface catchment above the lake water level. A runoff coefficient for each lake cell is specified to define the portion of precipitation that runs off to the lake from areas above the lake water level.

Total precipitation inflow to the lake is computed as precipitation multiplied by water surface area, plus precipitation multiplied by runoff coefficient multiplied by catchment area above the lake water level, or

$$P=p[\ \alpha A_{MAX} + (1- \alpha)\ A_{LAKE}] \qquad (2)$$

where

p is precipitation rate over the lake (L/t).
α is runoff coefficient for the lake cell.
A_{MAX} is the maximum water surface area of the lake cell (L^2).
A_{LAKE} is the actual water surface area of the lake cell (L^2).

Note that the right-hand side of equation (2) represents a summation over the individual lake cells defining a lake, each cell having its own α, A_{MAX} and contribution to A_{LAKE}.

1.1.4 Evaporation

Lake evaporation is computed as

$$E = eA_{LAKE} \qquad (3)$$

where

e is evaporation rate over the lake (L/t).

<u>Evaporation/Evapotranspiration from ephemeral, flat-bottom lakes</u>

If groundwater level is close to a flat lake bottom, groundwater evapotranspiration (ET) may occur when the lake is dry. LAK2 recognizes this condition and adds boundary conditions to each lake cell on a dry lake bottom equivalent to those added by the EVT1 module (McDonald and Harbaugh, 1988). An extinction depth is specified for each flat bottom lake to define the reduction of ET with depth. ET is zero if the lake is not dry. ET rate is equal to e when groundwater head is at the lakebed elevation, decreasing linearly to zero when groundwater head drops to extinction depth below the lake bottom. Simulated ET is included as part of the “groundwater inflow” and “evaporation” components of the lake water balance.

Other considerations arise in the computation of evaporation over a discrete time step in which a flat bottom lake is dry or becomes dry. Evaporation in this case is reduced from the maximum rate by limiting evaporation to lake inflow, reflecting the evaporation of all available water in only part of the time step. If, in addition, groundwater levels are close to the lake bottom, maximum ET rate is specified such that the sum of lake evaporation and maximum ET rate is equal to the evaporation rate e, reflecting evaporation for one part of the time step and ET for the other part.

1.1.5 Groundwater Flow

Groundwater flow into and out of the lake is computed based on the difference between lake water level and groundwater head at each lake cell, multiplied by lake cell conductance. The conductance of each lake cell is specified as described in Numerical Implementation below.

Conductance for each lake cell is adjusted based on water levels. Conductance is equal to the specified (maximum) conductance when either lake water level or groundwater level is above the lakebed maximum elevation. Conductance is equal to zero when water level is below the lakebed minimum elevation. Conductance decreases linearly for water levels between the lakebed maximum and lakebed minimum elevations.

Groundwater flow to or from lake cell n is computed as

$$Q_n = -C_n(\max[H_{LAKE}, BOTLK_n] - \max[H_n, BOTLK_n])$$

where

Q_n is the groundwater flux into the lake at lake cell n (L3/t).
C_n is the conductance of lake cell n (L2/t).
H_n is the groundwater head in lake cell n (L).
$BOTLK_n$ is the lakebed minimum elevation in lake cell n (L): If HLAKE > $BOTLK_n$, the lake is wet at lake cell n. If HLAKE < $BOTLK_n$, the lake is dry at lake cell n.

Total groundwater inflow and outflow to the lake are equal to the respective sum of inflows and outflows from each lake cell. Net rate of groundwater flow to the lake is computed as $Q_{gw} = \sum_n Q_n$.

1.2 NUMERICAL IMPLEMENTATION

1.2.1 Discrete Equation

The discrete equation for lake stage used by LAK2 for a MODFLOW time step may be written as

$$\frac{\Delta S}{\Delta t} = P - E + Q_{gw} + Q_{strin} - Q_{strout}$$

(1)

where

$\Delta S = \int_{t0}^{t0+\Delta t} A_{LAKE} \frac{\partial H_{LAKE}}{\partial t} dt$ is the change in lake storage during the time step
t_0 is the beginning of the time step
Δt is the length of the time step

1.2.2 Change in Lake Storage

Change in lake storage is computed as

$$\Delta S = \sum_{n=1}^{N} \left[\int_{h1_n}^{h2_n} A_n dh \right]$$

where

$Hnew_{LAKE}$ is lake stage at the end of the time step
$Hold_{LAKE}$ is lake stage at the beginning of the time step

$h1_n = \max[Hold_{LAKE}, BOTLK_n]$

$h2_n = \max[Hnew_{LAKE}, BOTLK_n$

The above equation can be written in the form

(2) $$\Delta S = D_0 + D_1 Hnew_{LAKE} + D_2\ Hold_{LAKE}$$

where

$$D_0 = \sum_{\{n\in[1,N]\,|\,Hnew_{LAKE}<BOTLK_n\}} A_n BOTLK_n - \sum_{\{n\in[1,N]\,|\,Hold_{LAKE}<BOTLK_n\}} A_n BOTLK_n$$

$$D_1 = \sum_{\{n\in[1,N]\,|\,Hnew_{LAKE}>BOTLK_n\}} A_n$$

$$D_2 = -\sum_{\{n\in[1,N]\,|\,Hold_{LAKE}>BOTLK_n\}} A_n$$

1.2.3 Precipitation

As above, lake precipitation is computed as

(3) $$P = p\alpha A_{MAX} + p(1-\alpha)A_{LAKE}$$

1.2.4 Evaporation

As above, lake evaporation is computed as

(4) $$E = eA_{LAKE}$$

1.2.5 Groundwater Flow

Groundwater flow to a lake is defined to be the sum of groundwater flow to each lake node:

(i) $$Q_{gw} = \sum_{n=1}^{N} Q_n$$

where

Q_n is the groundwater flux to lake node n (L^3/t).

(ii) $$Q_n = -C_n(\max[H_{LAKE}, BOTLK_n] - \max[H_n, BOTLK_n])$$

where

H_n is the groundwater head in lake node n

C_n is the lake bed conductance at lake node n (L^2/t).

Equation (ii) may be written in the form

(iv) $$Q_n = R_n + \gamma_n H_{LAKE} + \beta_n H_n$$

where

βn	=Cn	if	Hn>BOTLKn		
	=0	if	Hn<BOTLKn		
γn	= -Cn	if	HLAKE>BOTLKn		
	=0	if	HLAKE<BOTLKn		
Rn	=CnBOTLKn	if	Hn<BOTLKn	and	HLAKE>BOTLKn
	= -CnBOTLKn	if	Hn>BOTLKn	and	HLAKE<BOTLKn
	=0	if	Hn,HLAKE<BOTLKn	or	

$H_n, H_{LAKE} > BOTLK_n$

Combining equations (i) and (iv) yields an equation of the form

$$Q_{gw} = \alpha + \beta_0 \mathrm{H}_{\mathrm{LAKE}} + \sum_{n=1}^{N} \beta_n \mathrm{H}_n \tag{5}$$

where

$$\beta_0 = \sum_{n=1}^{N} \gamma_n$$

$$\alpha = \sum_{n=1}^{N} R_n$$

1.2.6 Lakebed Conductance

Lakebed conductance is specified by the LAK2 user. Conductance may be computed externally to the simulation as

C_n = (lakebed area)x(hydraulic conductivity)/(bed thickness).

Three models of lakebed conductance are shown on Figures 1.3a, b and c.

Lakebed area: If the lakebed is horizontal, then lakebed area is equal to lake cell surface area. Lakebed area may also be computed as lake cell surface area divided by the cosine of the average angle of lakebed inclination.

Hydraulic conductivity: Effective hydraulic conductivity for the zone crossed by the bold line in Figures 1.3a, b or c may be specified to compute conductance. If the lakebed is horizontal, a vertical hydraulic conductivity should be used. If the lakebed is vertical, a horizontal hydraulic conductivity should be used.

Bed thickness: Bed thickness for each of the three conductance models is indicated by the bold line in Figures 1.3a, b and c.

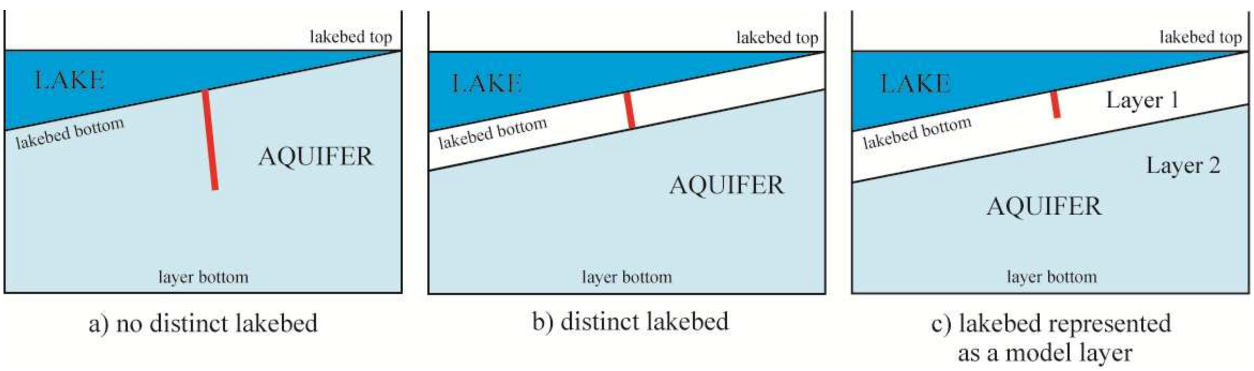

Figure 1.3. Models of lakebed conductance.

LAK2 adjusts conductance for each node to reflect partial saturation:

Let X= max (H_n,H_{LAKE}). Let $TOPLK_n$ = lakebed max elevation in lake cell n

1. If X≥$TOPLK_n$, C_n is set to the user-specified conductance.
2. If $BOTLK_n$< X<$TOPLK_n$, C_n is set equal to the user-specified conductance times the factor

$$\left[\frac{\mathrm{X} - \mathrm{BOTLK}_n}{\mathrm{TOPLK}_n - \mathrm{BOTLK}_n}\right]$$

3. If X≤$BOTLK_n$, C_n is set equal to zero

1.2.7 Interpolation of HLAKE

The lake stage used for computing Qgw in equations (3), (4) and (5) is defined by

(6) $$H_{LAKE} = \theta Hnew_{LAKE} + (1-\theta)Hold_{LAKE} ,$$

where

θ is a specified explicit/implicit parameter, with 0≤θ≤1.

θ=0 is the explicit formulation of lake stage,
θ =1 is the implicit formulation of lake stage and
0<θ<1 is an intermediate formulation of lake stage.

In the explicit formulation, lake stage at the beginning of a time step is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each time step. The explicit formulation converges most easily, but is unstable for large time steps.

In the implicit formulation, lake stage at the end of a time step is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each iteration of the groundwater flow equation.

In an intermediate formulation, an intermediate stage is used to compute flow between the lake and the aquifer. Lake stage is updated at the end of each iteration of the groundwater flow equation.

The implicit formulation is used for all of the applications presented here, matching the implicit formulation of groundwater flow equations used by the Modflow module BCF.

1.2.8 Numerical Equation

The LAK2 code substitutes equations (2), (3), (4), (5) and (6) into equation (1) to get an equation for lake stage in the following form:

$$\alpha_0 Hnew_{LAKE} + \sum_{n=1}^{N} \beta_n H_n = RHS_{LAKE}$$

(7)

where

$$\alpha_0 = \frac{D_1}{\Delta t} + \theta\beta_0$$

$$RHS_{LAKE} = \frac{D_0}{\Delta t} + \frac{D_2}{\Delta t} Hold_{LAKE} + P - E + Q_{strin} - Q_{strout} + \alpha + (1-\theta)\beta_0 Hold_{LAKE}$$

equation (7) may be solved as

$$Hnew_{LAKE} = \frac{1}{\alpha_0}\{RHS_{LAKE} - \sum_{n=1}^{N} \beta_n H_n\}$$

.

Because the equations for lake stage are nonlinear, equation (7) is formulated iteratively. Equation (7) is formulated and solved until computed lake stage in successive iterations changes by less than a specified tolerance, or until the specified maximum number of iterations are performed.

After completing iteration of equation (7), LAK2 modifies the groundwater flow equation for each lake node to reflect flow between aquifer and lake. Inserting equation (6) into equation (iv) above yields a modified form of equation (iv):

(iv')

$$Q_n = R'_n + \gamma'_n Hnew_{LAKE} + \beta_n H_n$$

where

$\gamma'_n = \gamma_n \theta$

$R'_n = R_n + \gamma_n (1-\theta) Hold_{LAKE}$

LAK2 modifies the MODFLOW equation for each lake node according to equation (iv') by adding boundary conditions to the HCOF and RHS arrays of the MODFLOW equation:

β_n is added to the HCOF entry for lake node n.

The term $R'_n + \gamma'_n Hnew_{LAKE}$ is added to the RHS array entry for lake node n.

On the subsequent iteration of the main MODFLOW equation, the iterative formulation and solution of lake stage is repeated and the MODFLOW equation is again modified.

1.3 Input Instructions

Input consists of parameters for the entire simulation, parameters for each lake, parameters for each lake and stress period and parameters for each lake node.

Parameters for the entire simulation include the following:

1. Total number of lake cells.
2. Number of lakes.
3. Unit number for main lake output file.
4. Unit number for cell by cell output.
5. Unit number for lakebed zone budget output.
6. Explicit/implicit parameter THETA.
7. Head change convergence criteria used in lake stage computation.
8. Maximum number of iterations allowed in lake stage computation.
9. Flow change convergence criteria, used when lake stage is at spill elevation.
10. Total number of river reaches flowing into lakes

Parameters for each lake include the following:

1. Number of lake cells
2. Initial water stage
3. Listing of inflowing river reaches, if any
4. Identification of outflowing river reach, if any
5. Spill elevation (lakes with outflowing river reaches only)
6. ET extinction depth (flat bottomed lakes only).

Parameters for each lake and stress period include the following:

1. Precipitation (L),
2. Evaporation (L) and
3. Pumping to/from the lake(L^3/t)

The following are input for each lake cell:

1. Lakebed maximum elevation (L),
2. Lakebed minimum elevation (L),
3. Water surface area (L^2),
4. Conductance (L^2/t)
5. Runoff coefficient ()
6. Zone number, for groundwater zone budgets. Groundwater flow to and from lake nodes may be broken down by zones. This allows, for example, computation of pit lake chemical balances based on groundwater flow from different rock types. Each lake node is assigned a zone number. Flow totals into and out of each zone are computed.

1.3.1 Input Records

For Each Simulation:
Record 1.

variable:	MXLKND	NLAKES	ILKC1	ILKC2	ILKC3	THETA	TOL	MXITER	TOL2	MXRIVIN
format:	I10	I10	I10	I10	I10	F10.0	F10.0	I10	F10.0	I10

For Each Lake:
Record 2. Read NLAKES times.

variable:	NODES	STAGE0	NRVIN	KRVOT	XSPIL	EXDP
format:	I10	F10.0	I10	I10	F10.0	F10.0

Record 3: Read when NRVIN > 0.

variable:	IRI(NRVIN)
format:	*

For Each Lake Node:
Record 4. Read MXLKND times.

variable:	ILAY	IROW	ICOL	COND	BOT	TOP	XAREA	IBZON	RUNCOF
format:	I10	I10	I10	F10.0	F10.0	F10.0	F10.0	I10	

For Each Stress Period:
Record 5.

variable:	ITMP
format:	I10

Record 6. Read NLAKES times.

variable:	XEVAP	XPREC	Q
format:	F10.0	F10.0	F10.0

1.3.2 Explanation of Variables

Record 1. Read once for a simulation/
MXLKND: total number of lake nodes.
NLAKES: number of lakes.
ILKC1: unit number for main lake output file.
ILKC2: flag and unit number for cell by cell output.
ILKC3: flag and unit number for lakebed zone budget output.
THETA: explicit/implicit parameter.
TOL: head change convergence criteria used in lake stage computation.
MXITER: maximum number of iterations allowed in lake stage computation.
TOL2: flow change convergence criteria, used when lake stage equals spill elevation.
MXRIVIN: total number of river reaches flowing into lakes

Record 2. Read NLAKES times.
NODES: number of nodes representing lake.
STAGE0: initial lake stage.
NRVIN: number of RIV2 reaches flowing into lake.
KRVOT: reach number of RIV2 reach flowing out of lake.
XSPIL: spill elevation for lake (L).
EXDP: extinction depth for playa surface.

Record 3. Read when NRVIN > 0.
IRI(NRVIN): reach numbers of RIV2 reaches flowing into lake.

Record 4. Read MXLKND times.
ILAY: layer of lake node.
IROW: row of lake node.
ICOL: column of lake node.
COND: maximum conductance of lake node (L2/t)
BOT: lowest lake bed elevation within lake node.
TOP: highest lake bed elevation within lake node.
XAREA: maximum area of horizontal water surface for node.
IBZON: zone number of lake node, used in computation of lakebed zone budget.
RUNCOF: runoff coefficient for lake node, defined to be the fraction of precipitation falling draining directly to lake ().

Record 5. Read once for each stress period.
ITMP: flag for reading evaporation rate, precipitation rate, and spill elevatiion.
If ITMP>0, record 7 is read.
If ITMP<0, values from the previous stress period are used.

Record 6. Read NLAKES times when ITMP>0.
EVAP: lake evaporation rate for stress period (L/t)
PRECIP: lake precipitation rate for stress period (L/t)
Q: pumping/withdrawal rate from lake (L3/t). A negative value signifies addition of water to the lake.

1.4 CODE VERIFICATION

1.4.1 Example 0: Large-diameter well recovery

The LAK2 stage computation is tested using a pair of MODFLOW simulations. Water level recovery in a large diameter well is simulated in two different ways, with and without LAK2. Results are then compared to confirm the basic functioning of the code.

1.4.2 Example 0a: Without LAK2

A sample grid is constructed with 100 rows, 100 columns and 2 layers. Each column and row has a width of 1000 units. A confined layer type (type 0) is specified. Initial head is specified as 0, except for a group of four layer 1 cells in the center of the grid (Fig. 1.4). The initial head at these cells is specified as -100. Storage coefficient is specified as 1 at the four cells and .001 everywhere else, Transmissivity for each layer is specified everywhere as .001 square units per second. Vertical conductance is specified as 10-9 /second. A 100 year recovery is simulated. By symmetry, head in each of the group of four cells is the same.

1.4.3 Example 0b: With LAK2

The model grid and aquifer parameters from the large diameter well recovery are retained. The four cells are specified as inactive cells. A lake is specified using twelve LAK2 cells as shown in Figure 1.4. An implicit lake stage computation is selected. Initial lake stage is specified as -100. Lake evaporation and precipitation are specified as 0. The four lake cells in the center are placed in layer 2 and are considered to lie underneath a horizontal lake bed. The eight cells on the perimeter are placed in layer 1 and are considered to lie next to a vertical lake bed.

Area of each of the four lake cells in the center is specified as row width times column width, or 10^6 square units. Area of the eight remaining lake cells is specified as zero.

Conductance of each of the four lake cells in the center is specified as vertical conductance times cell area, or 10^{-3} square units per second. Conductance of the eight lake cells on the perimeter is specified as transmissivity times row width divided by column width, also 10^{-3} square units per second. Lakebed minimum and maximum for each lake cell are specified at a level below initial stage, leading to constant conductance for each lake cell throughout the simulation.

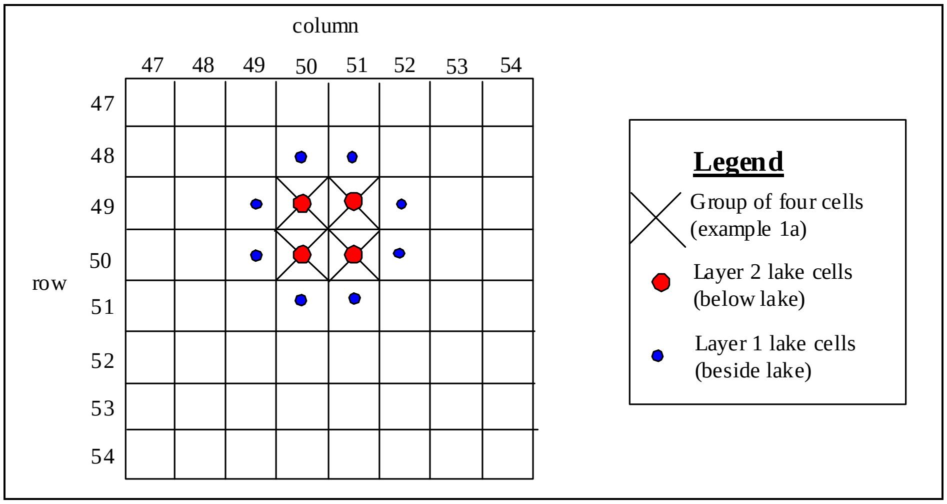

Figure 1.4. Layout of examples 0a and 0b.

1.4.4 Comparison of Results

The results of example 0a and example 0b are expected to be identical because

1. The specified area of the lake cells in example 0b matches the specified area of the group of four cells in example 0a. The storage coefficient of the group of four cells is specified as 1. The storage capacity of the lake is therefore identical to that of the group of four cells.
2. The specified conductances of the lake nodes match the specified horizontal and vertical conductances of Example 0a. In addition the lake node conductances are constant because lakebed elevations are specified below lake stage. Water is therefore transmitted to the lake at the same rate as to the group of four cells.
3. Heads in the group of four cells in example 0a are symmetric. The group of four cells is therefore represented by a single head, analogous to lake stage.
4. An implicit lake stage computation is used in example 0b. Example 0a, like most MODFLOW simulations, uses an implicit computation.

Head in the group of four cells of example 0a and stage in the lake of example 0b, both shown on Figure 1.5, are identical. Further inspection confirms that budget terms for the two simulations are also identical.

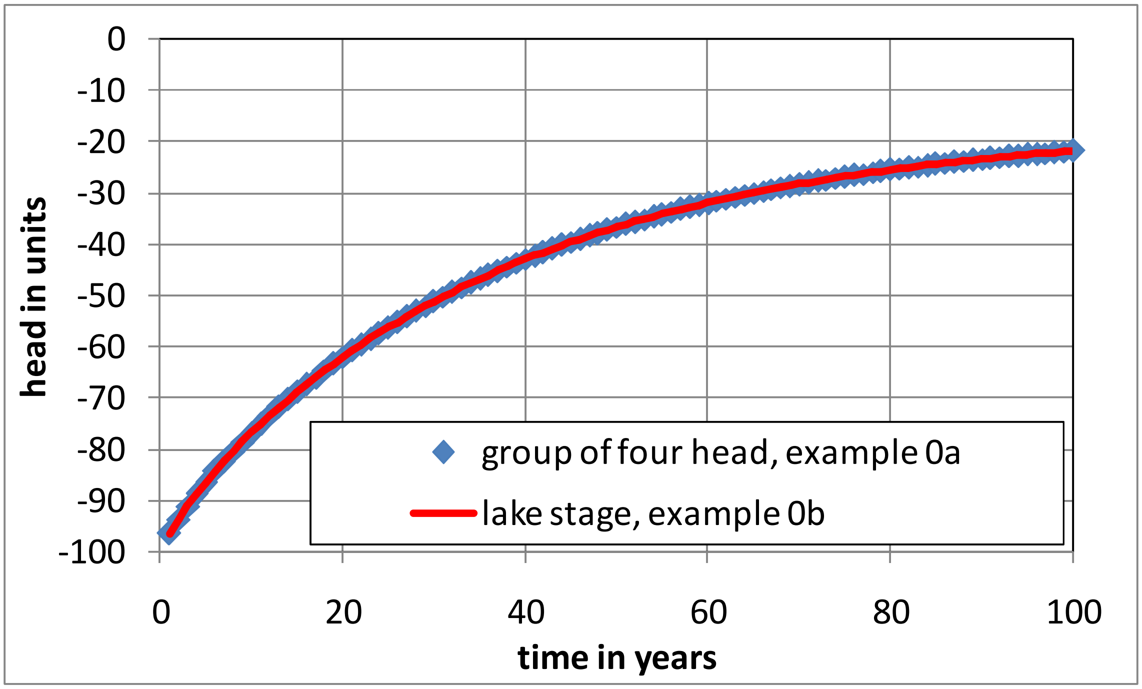

Figure 1.5. Comparison of water levels in examples 1a and 1b.

2.0 APPLICATION: ARCHIMEDES PIT

LAK2 was used to project the post-mining recovery of water level in the Archimedes pit near Eureka, Nevada. The pit bottom topography and pit surface catchment area are shown on Figure 2.1.

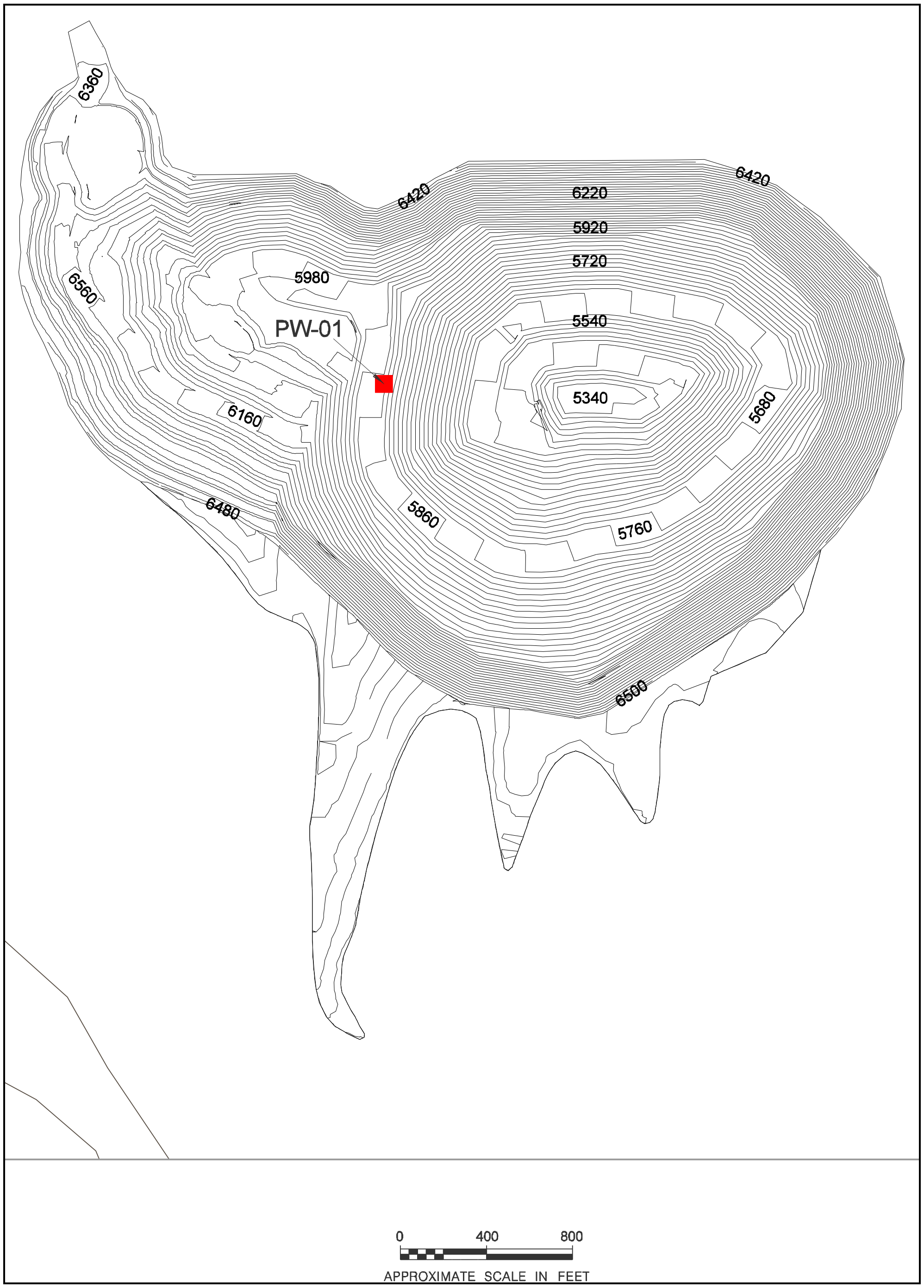

Figure 2.1. Ultimate pit contours.

The pit geometry was represented using LAK2 as described in Section 1 above, as a list of model cell locations. For each cell location, the following geometric parameters are spedified:

- Lowest pit bottom elevation within cell
- Highest pit bottom elevation within cell
- Maximum water surface area of each cell

The contribution of each cell to total open water surface area increases linearly from zero at the lowest pit bottom elevation, to the maximum area at the highest pit bottom elevation. Total water surface is computed as the sum of the area contributed by each cell.

The lowest and highest pit bottom elevations were initially assigned based on the contour map. Maximum open water surface was initially assigned to be the plan area of the MODFLOW finite difference grid cell.

The geometric parameters were then calibrated. The simulated lake bed elevations were adjusted to best reflect the actual increase of area with elevation for the portion of pit bottom within each cell. The measured and modeled pit stage-area-volume relationship is shown on Figure 2.2.

In addition to the pit geometry, the following inputs were required to simulate pit filling:

- Annual precipitation was estimated at 11.72 inches, based on records from the Eureka weather station (Western Regional Climate Center, 2004).
- A runoff coefficient of 0.15 was assumed for the pit catchment of about 210 acres.
- Annual lake evaporation was estimated at 45 inches (NOAA, 2004).

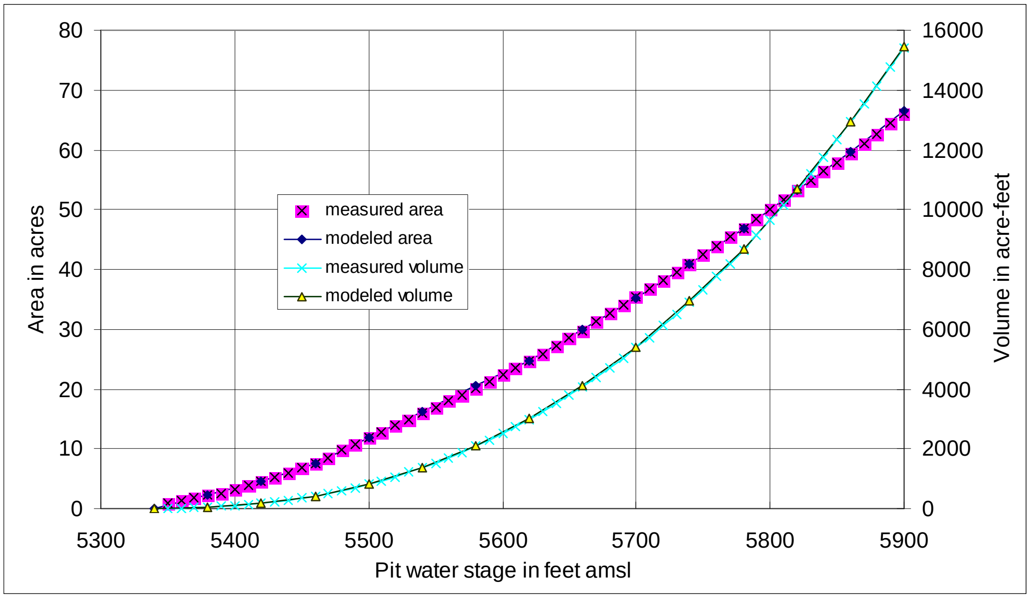

Figure 2.2. Measured and modeled pit stage-area-volume.

2.1 Changes to Original Groundwater Flow Model

Changes were also made to the specifications of aquifer geometry in MODFLOW module BCF, to reflect the presence of the pit: The layer top elevation, at which water level the layer becomes confined, was set equal to the mean of the low and high pit bottom elevations for each LAK2 cell.

2.2 Pit Filling

Recovery of water level after the end of active dewatering was simulated as described above. The projected pit water level is presented on Figure 2.3. The final equilibrium pit elevation is predicted to be 5861 feet amsl. The pit is projected to fill to 95% of recovery (elevation 5835 feet amsl) about 39 years after the end of active dewatering.

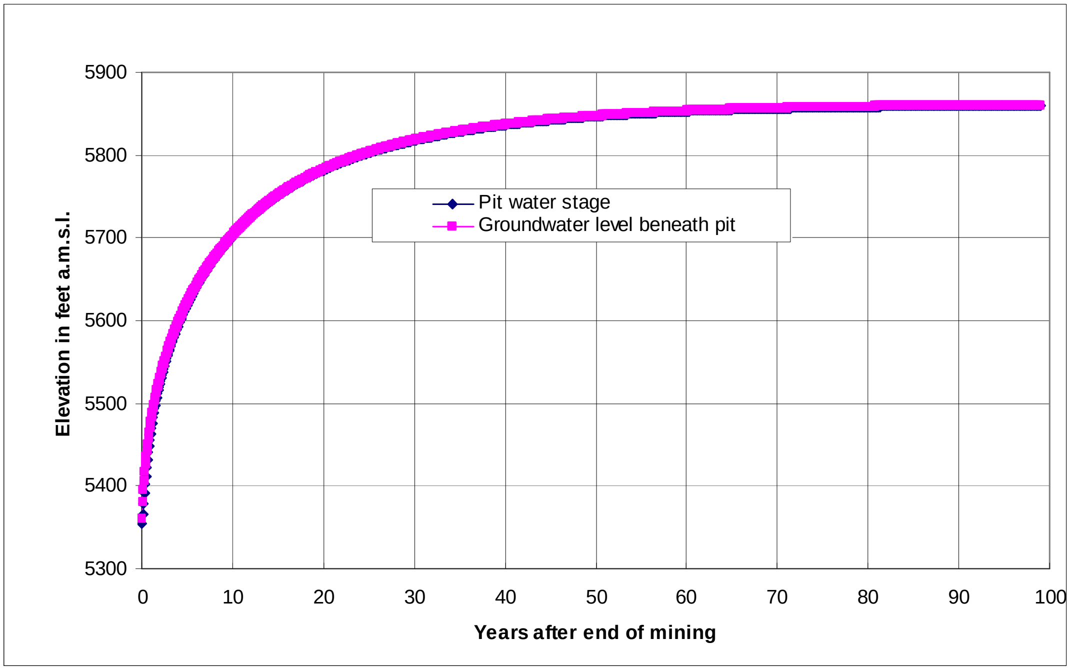

Figure 2.3. Projected pit water stage.

The projected pit water surface area and volume are presented on Figure 2.4. The final pit water surface area is predicted to be 60 acres. The final pit water volume is predicted to be 13,000 acre-feet.

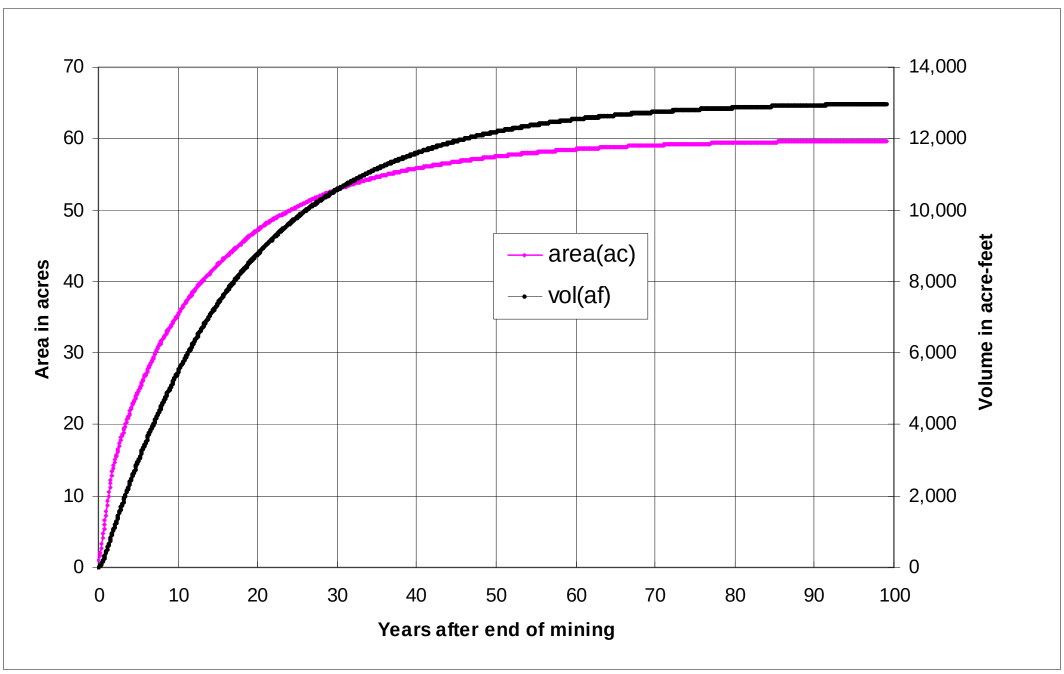

Figure 2.4. Projected pit water surface area and volume.

The projected pit water budget components are presented on Figure 2.5. The final average annual pit evaporation is predicted to be about 140 gpm. Groundwater outflow is predicted to be zero.

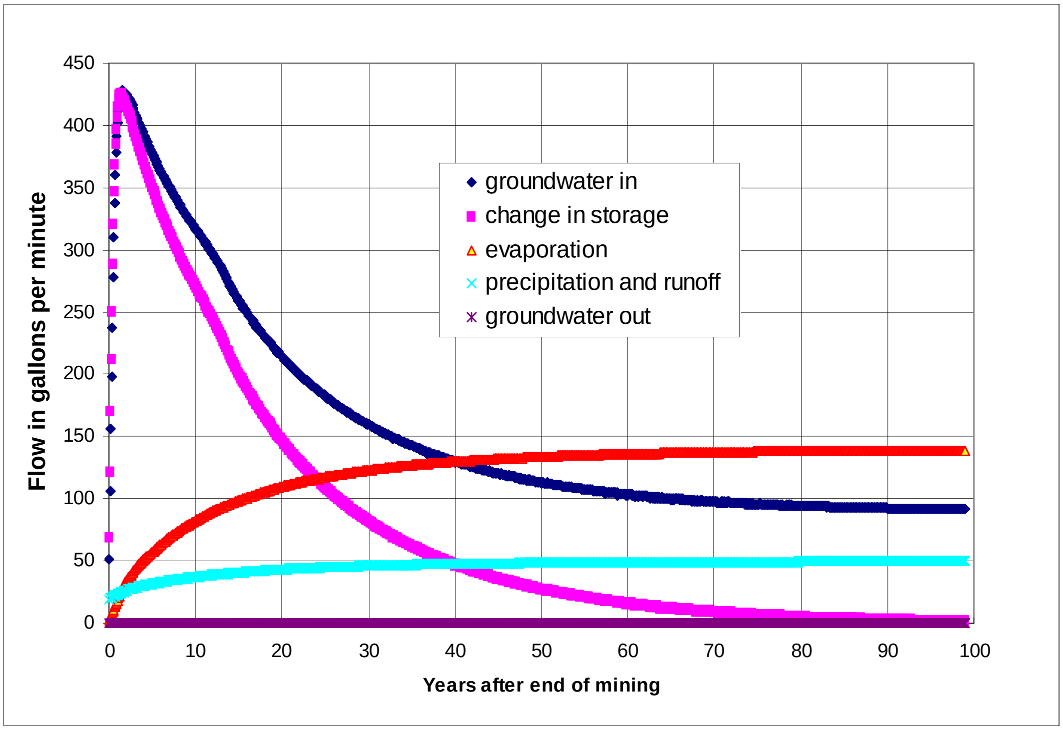

Figure 2.5. Projected pit water budget.

A map of the geochemical types exposed in the pit was provided. The units include:

- Oxide limestone (OgO)
- Oxide intrusive (KgO)
- Sulfide limestone (OgS)
- Sulfide intrusive (KgS)
- Alluvium (Qtal)
- Volcanic Tuff

The map of geochemical types was used to estimate the portions of pit inflow attributable to each unit, for use in projections of pit water chemistry. Groundwater inflow from each geochemical type is shown on Figure 2.6. Inflow from direct precipitation and from runoff over each geochemical type is shown on Figure 2.7.

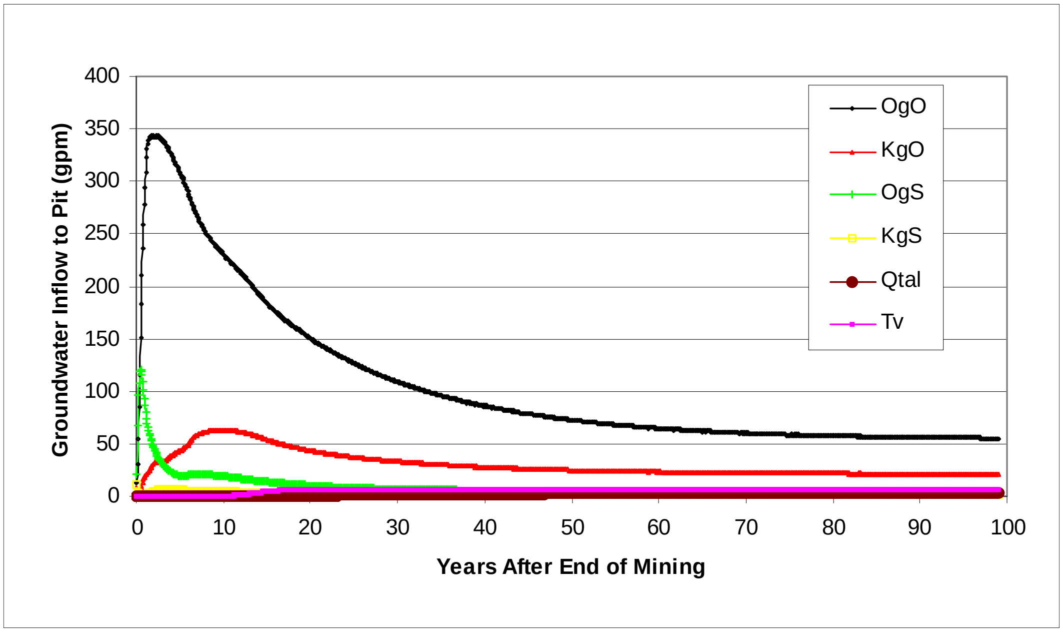

Figure 2.6. Groundwater inflow to pit by geochemical type.

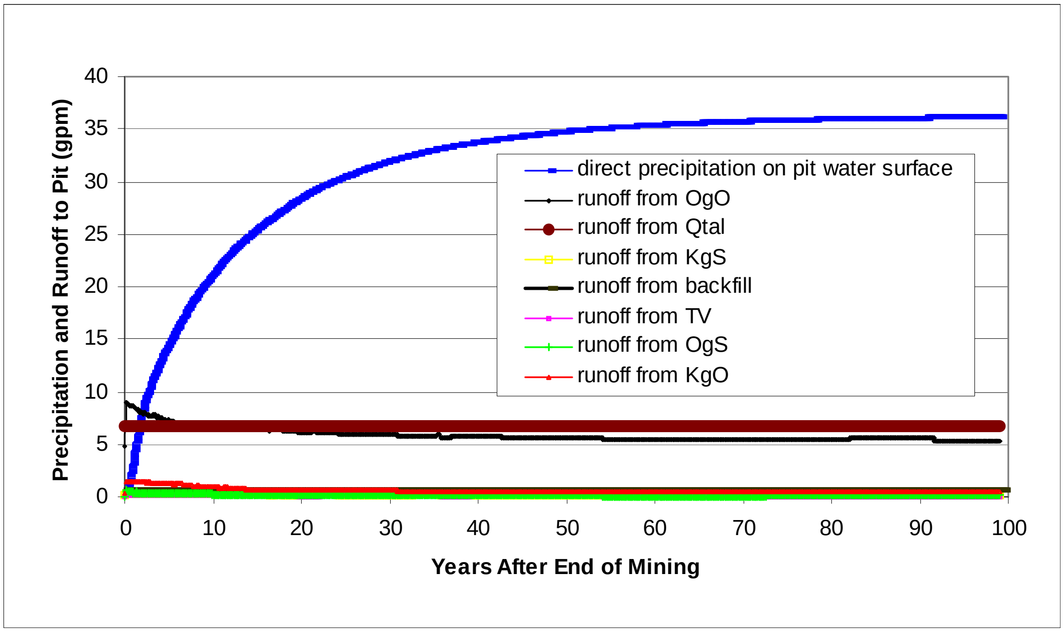

Figure 2.7. Precipitation and runoff to pit by geochemical type.

3.0 APPLICATION: ORTIZ PIT

LAK2 was used to calibrate a groundwater flow model to the measured history of mine dewatering and post-mining water level recovery in the Ortiz pit, near Cerrillos, New Mexico. Measured and simulated groundwater levels during mine dewatering, and measured and simulated post-mining pit water levels, are shown on Figure 3.1.

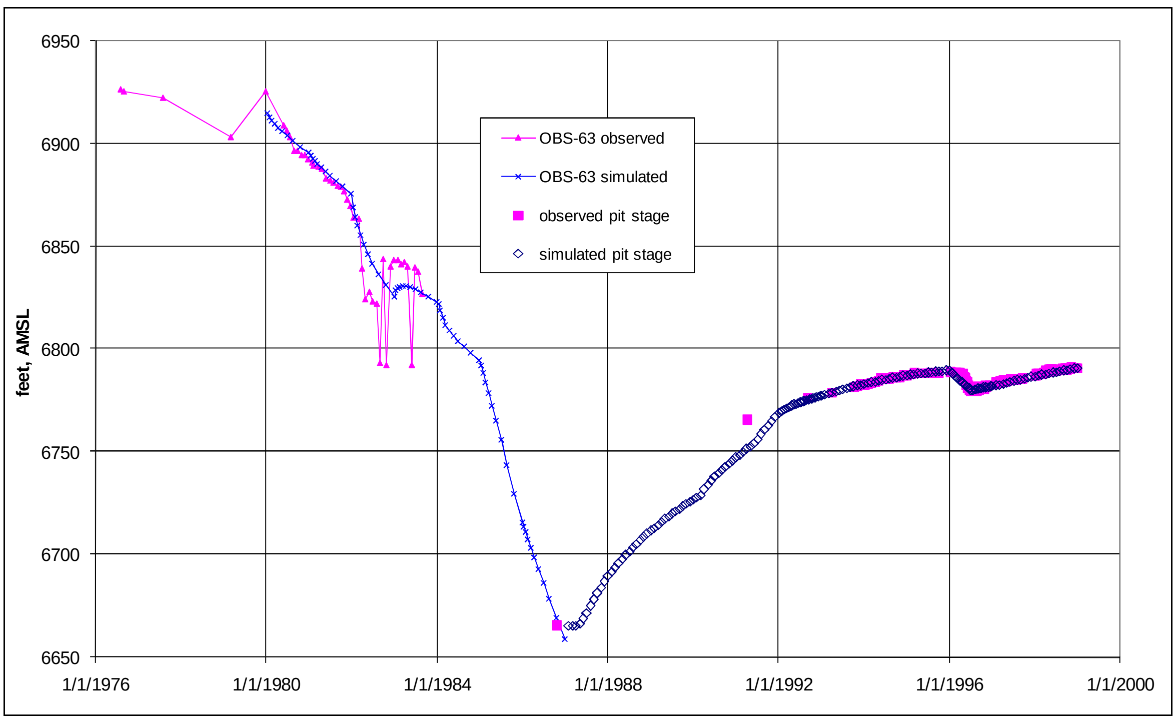

Figure 3.1. Measured and simulated historical water levels (JSAI, 1999).

The model was then used to project long-term water levels and the effect of diverting runoff from the up-gradient watershed into the pit, in order to submerge the acid seeps on the pit wall, which were adversely impacting pit water quality. Runoff from the watershed was estimated using the SCS curve number method. A series of projections of water level was developed, including, “normal”, “wet” and “dry” scenarios

4.0 APPLICATION: BELEN MUNICIPAL WELL

This section describes a problem that occurred with an application of the Middle Rio Grande Administrative (MRGA) model (Barroll, 2001), used to administer water rights in the Middle Rio Grande basin of New Mexico. The problem and its cause are analyzed and a solution is presented that utilizes LAK2 to more accurately represent pumping from a well.

4.1 The Problem

The Middle Rio Grande Administrative model (Barroll, 2001) has been employed in an attempt to evaluate the depletion effects of an additional 325 afy of groundwater pumping from the Belen municipal wells.

The results of the exercise are shown on Figure 4.1 which presents the simulated depletion, computed as the sum of the differences in total streamflow gain, streamflow loss and evapotranspiration between the base case model simulation and a simulation including the additional 325 afy of groundwater pumping. Also shown on Figure 4.1 is the portion of the additional pumping supplied by groundwater storage, rather than by depletion.

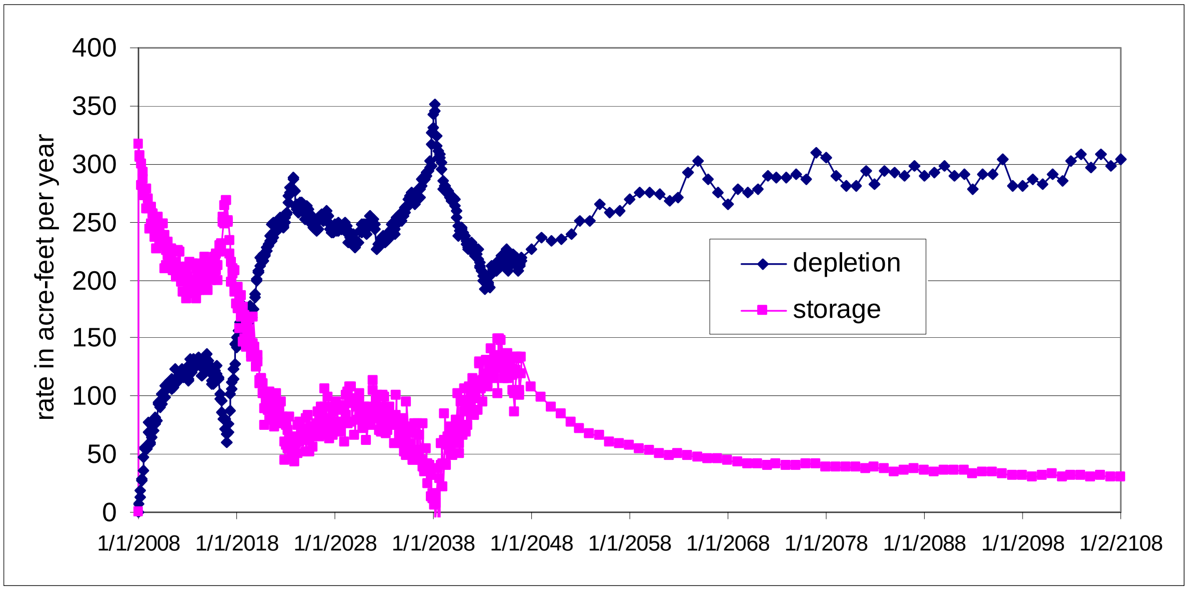

Figure 4.1. Model simulated depletion resulting from 325 afy additional pumping from belen municipal wells.

As can be seen in Figure 4.1, the results are suspicious. Instead of a steady increase in depletion from zero to 325 afy, with a corresponding decrease in the storage component from 325 afy to zero, the graph includes periods of increasing and decreasing depletion, with minima and maxima in between.

4.2 The Cause

The unexpected features of the graph shown on Figure 4.2 are the result of a dry cell in layer 2, row 100, column 37 of the model grid (corresponding to City of Belen Well 1). The cell becomes dry in both the base case simulation, in April 2038, and in the simulation with 325 afy additional pumping, in January 2017.

Simulated water levels for the cell that becomes dry, and for the cells immediately above and below, are presented for the base case ("without") and for the simulation with additional pumping ("with") in Figure 4.2.

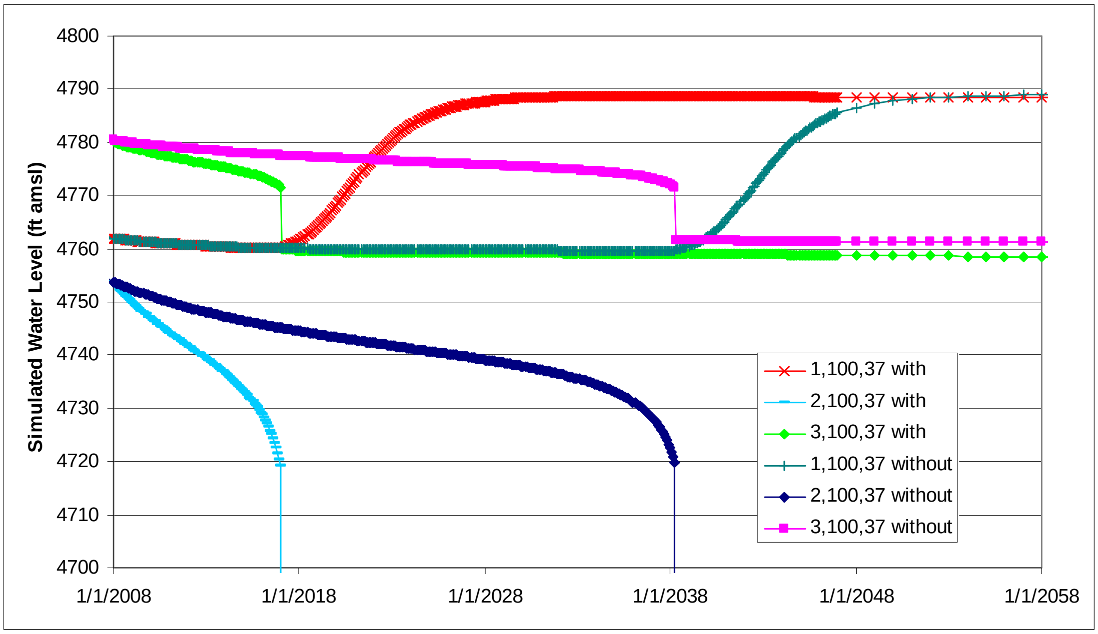

Figure 4.2. Simulated water levels in model cells in row 100, column 37.

In order to preserve simulated pumping rates, the convention adopted with the MRGA model is to shift pumping down a layer whenever a cell becomes dry (Barroll, 2001). Consequently a sharp drop in the layer 3 water level is shown on Figure 2 at the point when layer 2 becomes dry. In addition, the removal of the connection to layer 2 causes water level in layer 1 to begin to rise at the same time.

The correlation between the simulated depletion curve on Figure 4.1 and the simulated water levels on Figure 4.2 is shown graphically on Figure 4.3. Essentially, the dry cell causes discontinuities in the equations used to describe the groundwater flow system. The discontinuities occur at different times in the two simulations, impacting the depletion calculation (the difference between the two simulations) at both times.

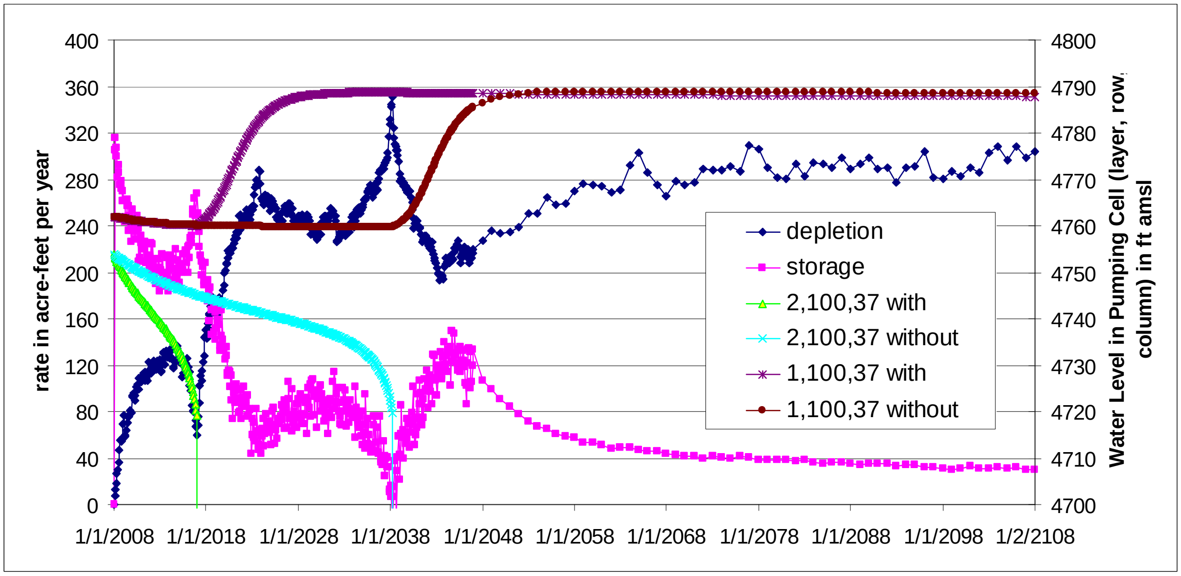

Figure 4.3. Simulated depletion and water levels.

4.3 A Solution

The problem can be addressed by restoring continuity to the equations describing the groundwater flow system. One way to do this is to represent the pumping in both layers 2 and 3. A difficulty with this approach is that results can be sensitive to the division of pumping between the layers. Proper division of pumping should be proportional to the conductivity of each layer, to the saturated screened interval and, if pumping water level is above the bottom of the screened interval, the difference between groundwater level in each cell and water level in the well bore.

The two model simulations were repeated representing the pumping in both layer 2 and layer 3. In order to properly partition the pumping, the well bore was explicitly represented in the model using LAK2 as a generic tool to represent open spaces, including well bores, connecting multiple model cells. Flows between model cells and the well are computed based on conductance terms, groundwater level in the cell, water level in the open space and elevation of the interface between the cell and the open space. The mass balance equation for the well considers the geometry of the space (a function of bore radius) and source/sink terms (pumping rate).

Results are presented in Figure 4.4.

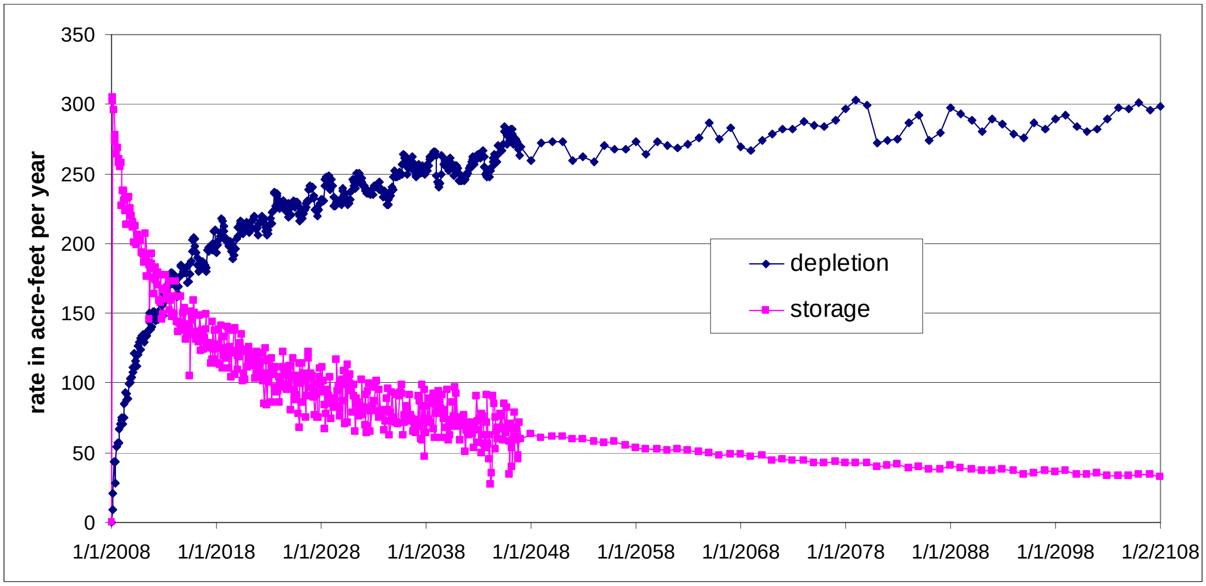

Figure 4.4. Model simulated depletion resulting from 325 afy additional pumping from Belen municipal wells, with pumping from two layers.

The oscillations remaining in the simulated depletion curve are a result of the small mass balance errors in the underlying groundwater flow simulation. These can be reduced through tighter convergence criteria, more iterations and longer run times.

5.0 APPLICATION: FAN SEDIMENTS AQUIFER TEST

LAK2 was used to simulate in-bore water levels in the analysis of aquifer test results. A numerical model was prepared to characterize the “Fan Sediments” colluvial aquifer .

A 21-day aquifer test was conducted. Three production bores, FSWW004-PB, FSWW013-PB, and FSWW020-PB, were pumped simultaneously at an average rate of about 35 liters per second each. Drawdown and recovery were measured in a total of 24 bores including:

- three pumping bores
- an observation bore located near each pumping bore, completed at a similar depth
- an observation bore located near each pumping bore, completed at a shallow depth
- a shallow observation bore located about 1 km from each pumping bore, in the area of the infiltration of pumped water
- regional observation bores, with deeper completions

A numerical model was developed to analyze the aquifer test in detail, considering saturated units above and below the production zone and responses measured in shallow, intermediate, and deep piezometers.

An observation bore is located near each pumping bore, within the same model cell, completed at a similar depth as the pumping bore. The drawdown at each model cell with a pumping bore was calibrated to match drawdown at the nearby observation bore.

In addition, water level in the pumping bore was represented directly using LAK2, in order to characterize the bore efficiency component of drawdown and to characterize the potential range of in-bore head losses that may be encountered in future production bores. The conductivity of each bore skin (the resistance to flow between aquifer and bore hole) was calibrated to match the measured pumping bore drawdown.

The water levels in observation bores FSWW012-MB and FSWW022-MB were also represented with the LAK2 module. Response in both bores to aquifer test pumping was found to be impacted by borehole problems, the first with an apparently blocked annulus and the second with apparent borehole leakage from a deeper formation. The LAK2 results help to confirm the explanation of borehole processes as the cause of each bore’s anomalous response.

Measured and simulated drawdown in pumping bore FSWW004-PB and in nearby monitoring bore FSWW003-MB are shown in Figures 5.1 and 5.2.

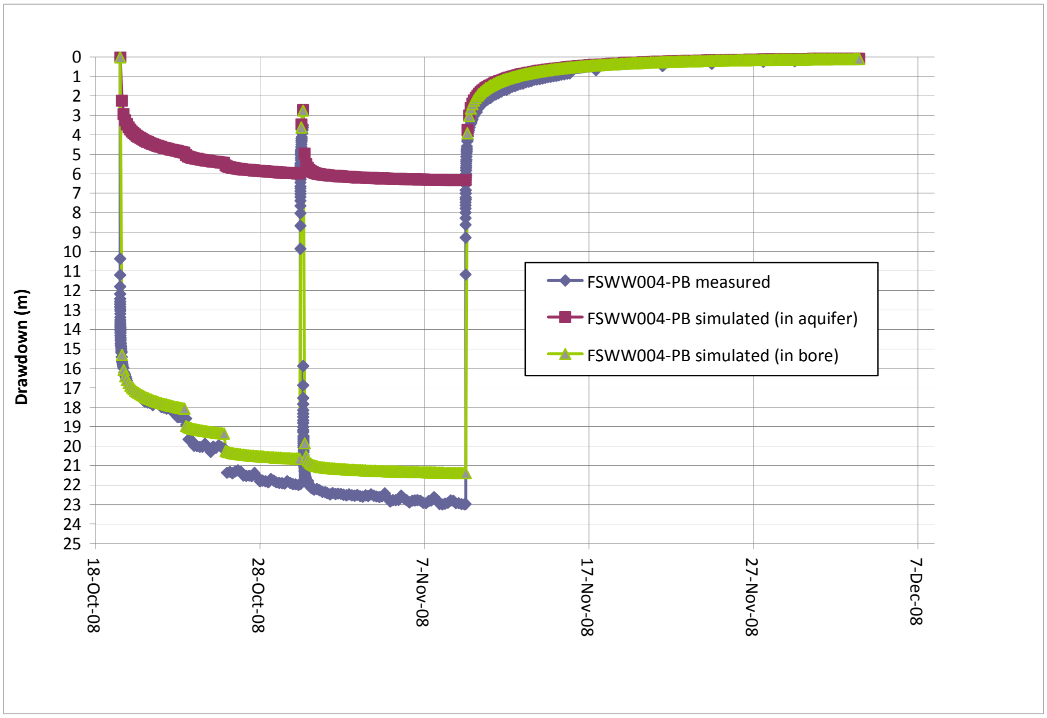

Figure 5.1. Measured and simulated aquifer test drawdown, FSWW004-PB.

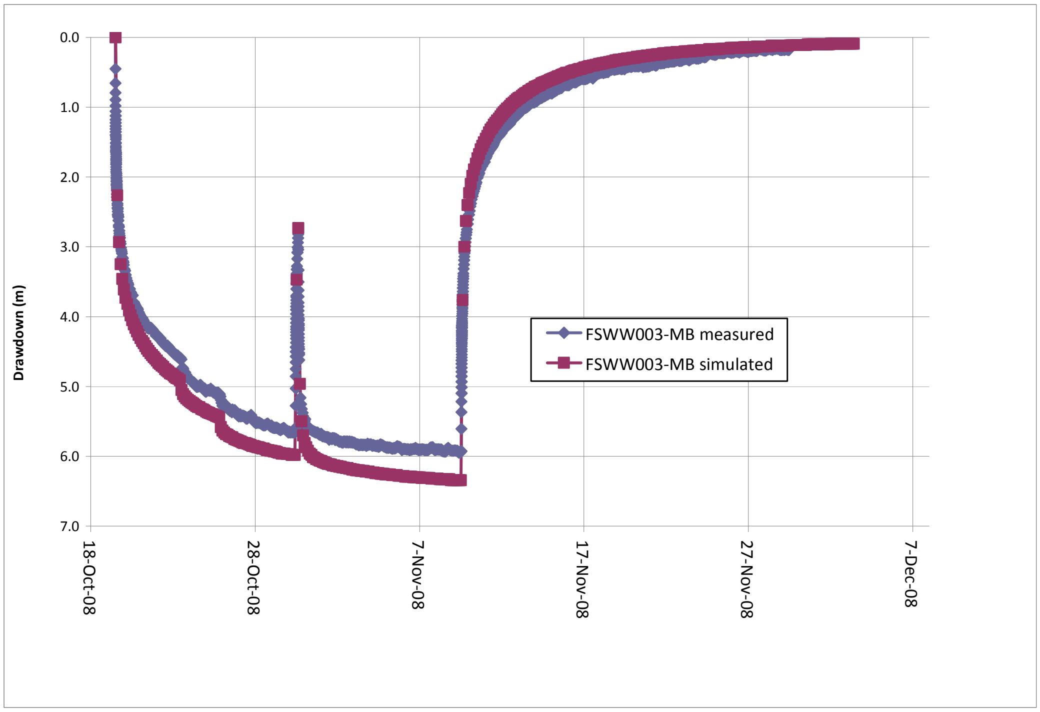

Figure 5.2. Measured and simulated aquifer test drawdown, FSWW003-MB.

Measured and simulated drawdown in pumping bore FSWW013-PB and in nearby monitoring bore FSWW010-MB are shown in Figures 5.3 and 5.4.

Measured and simulated drawdown in shallow observation bore FSWW022-MB is shown in Figure 5.5. The rapid and sharp response is characteristic of borehole leakage rather than water table drawdown. The apparent vertical connection observed in FSWW022-PB is likely a local borehole phenomenon. This was verified using LAK2 to simulate a bore in hydraulic communication with both Layers 1 and 2, resulting in a reasonably close reproduction of measured water levels.

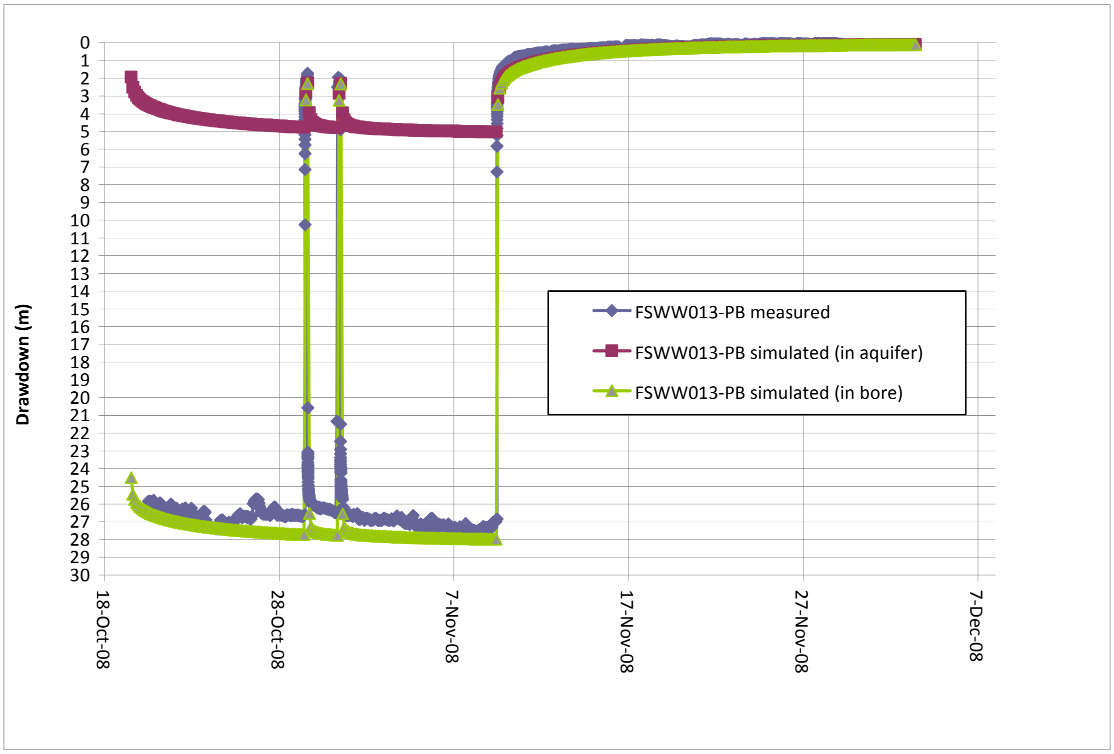

Figure 5.3. Measured and simulated aquifer test drawdown, FSWW013-PB.

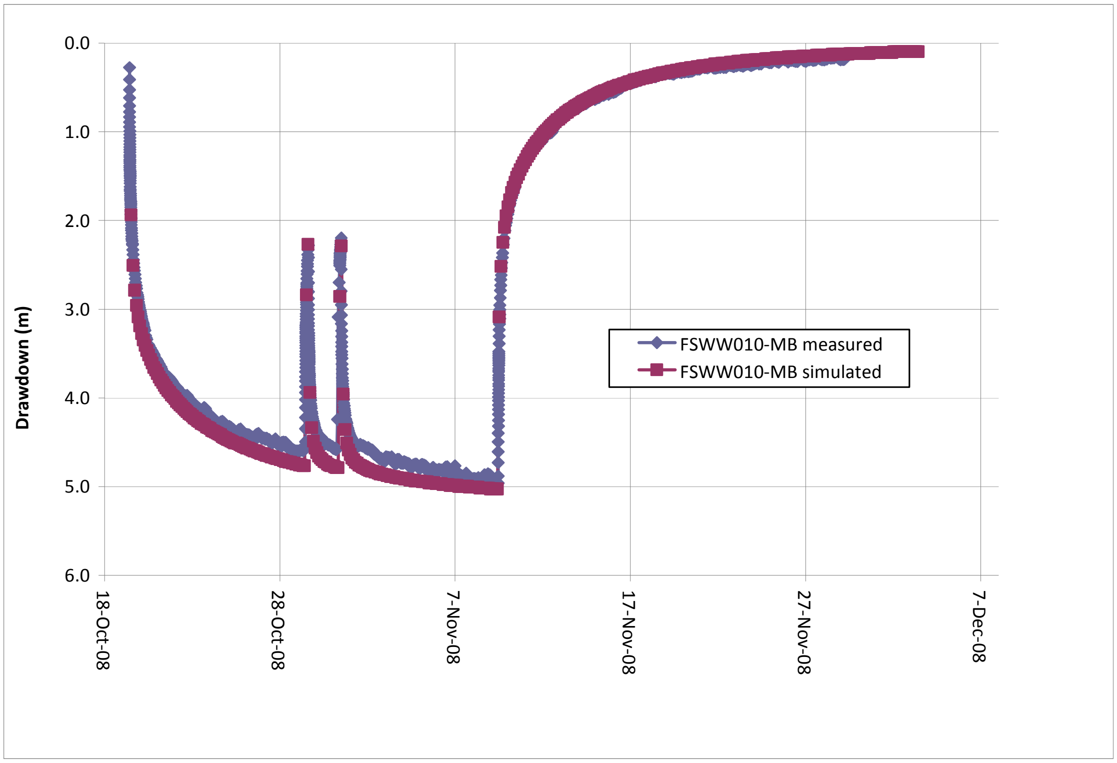

Figure 5.4. Measured and simulated aquifer test drawdown, FSWW010-MB.

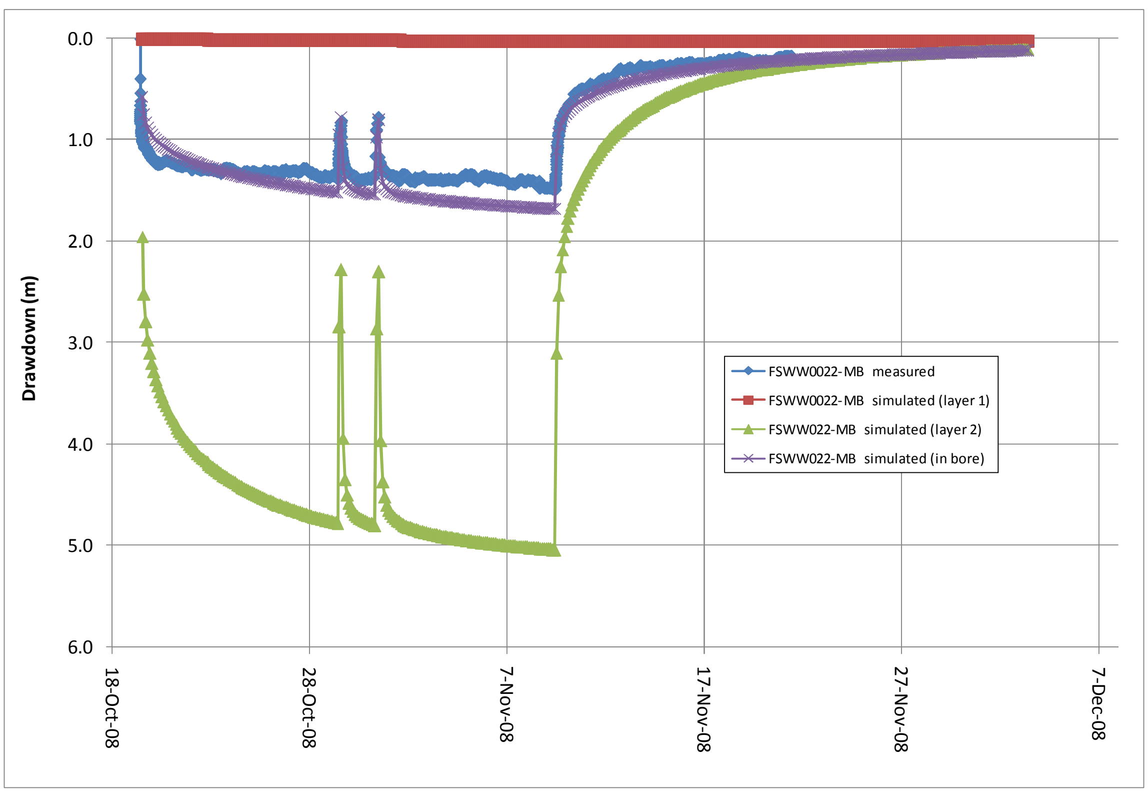

Figure 5.5. Measured and simulated aquifer test drawdown, FSWW022-MB.

Measured and simulated drawdown in pumping bore FSWW020-PB and in nearby monitoring bore FSWW018-MB are shown in Figures 5.6 and 5.7.

Farther away, water level in FSWW012-MB did not respond to pumping, as would be expected from the aquifer parameters indicated by the other observation bore responses. It was concluded, based on drilling results , that FSWW012-MB is isolated from the neighboring aquifer due to difficulties encountered during well construction and development. The lack of response at FSWW012-MB was simulated using the LAK2 module to represent an inefficient bore. Measured and simulated aquifer test drawdown at FSWW012-MB is shown on Figure 5.8.

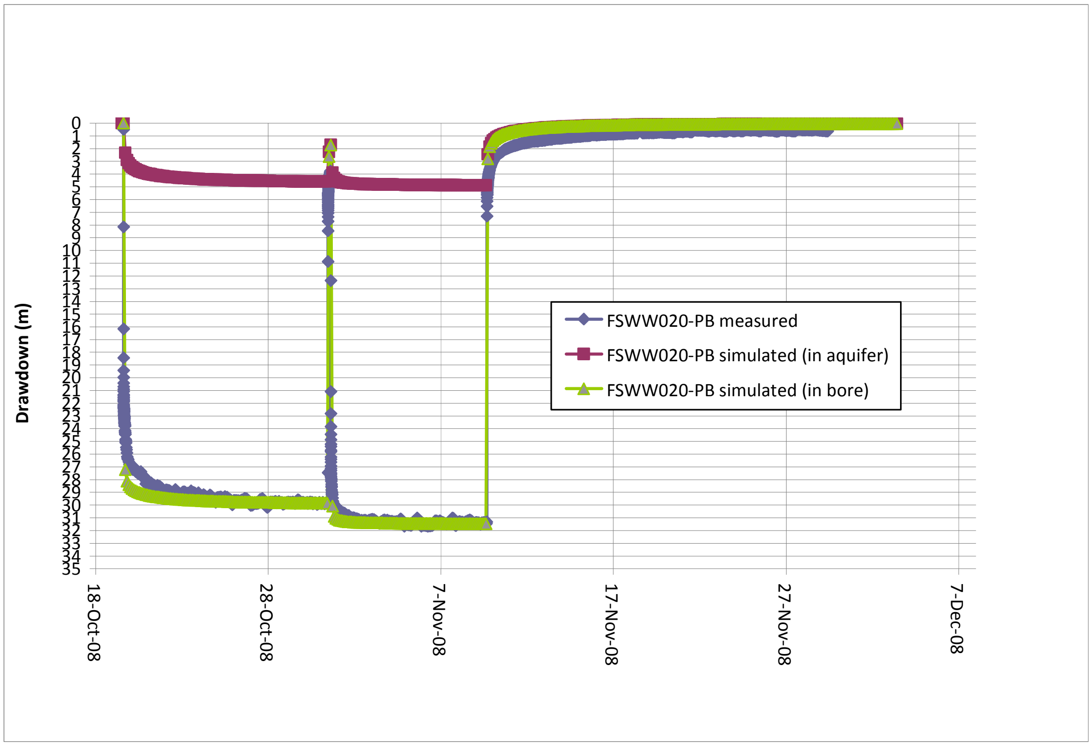

Figure 5.6. Measured and simulated aquifer test drawdown, FSWW020-PB.

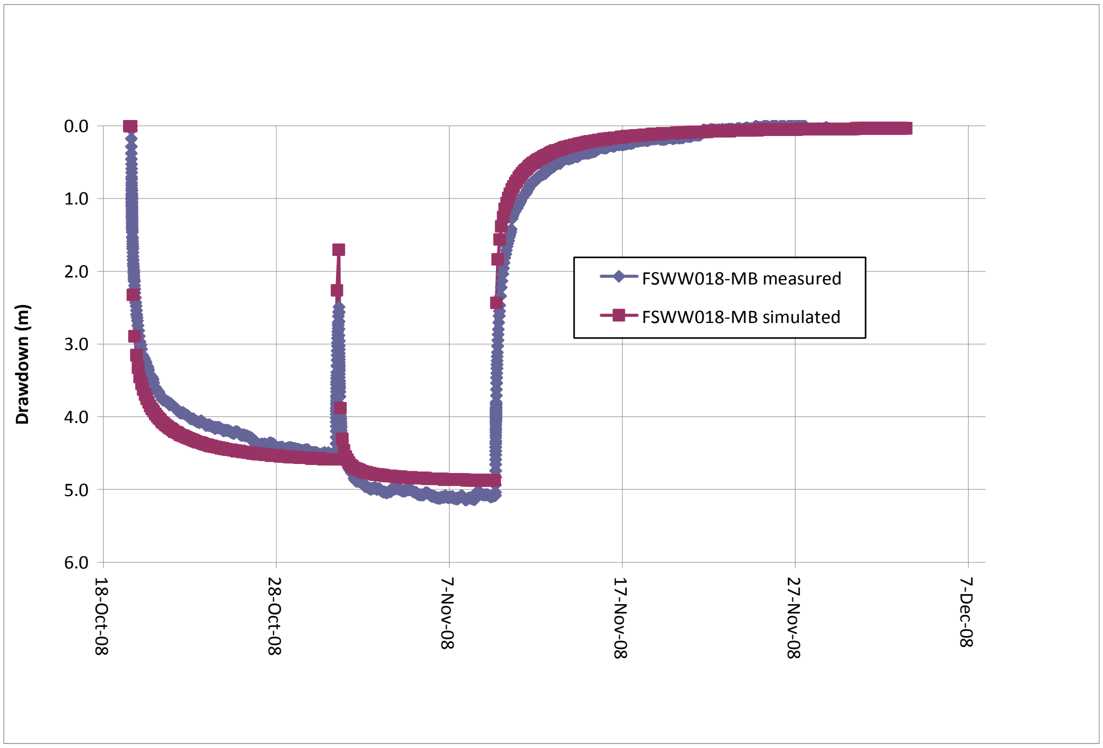

Figure 5.7. Measured and simulated aquifer test drawdown, FSWW018-MB.

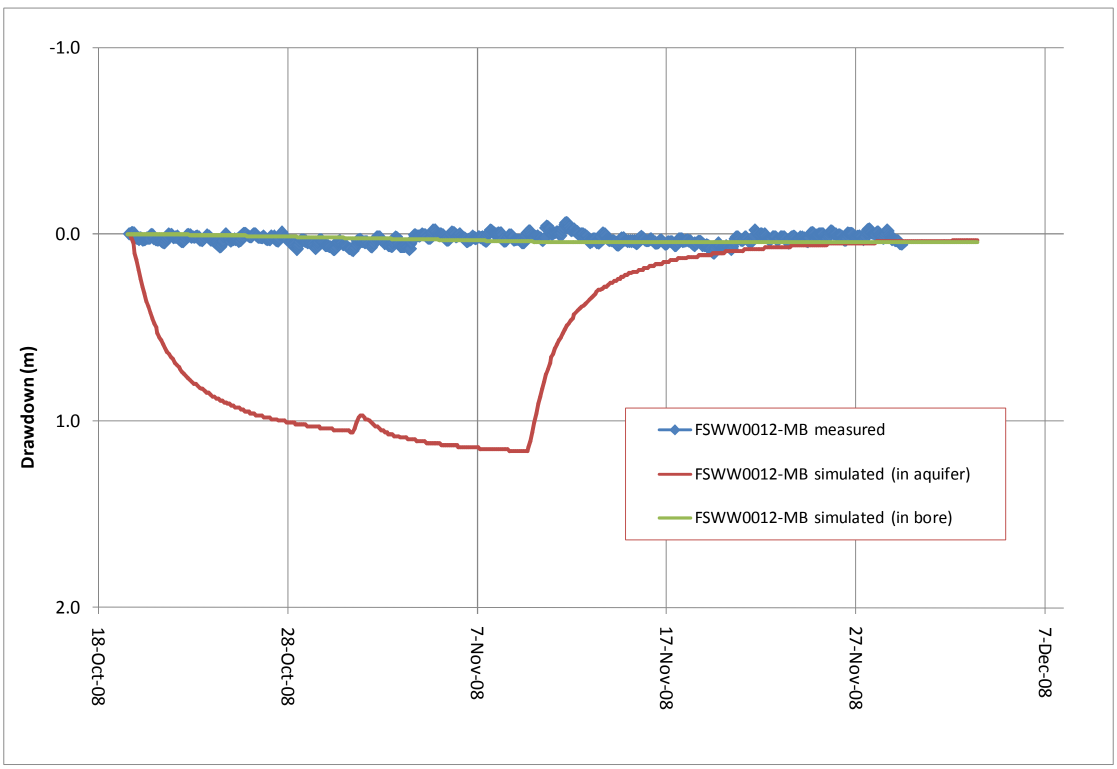

Figure 5.8. Measured and simulated aquifer test drawdown, FSWW012-MB.

6.0 REFERENCES

Barroll, 2001, "Documentation of the Administrative Groundwater Model for the Middle Rio Grande Basin", NM Office of the State Engineer Hydrology Bureau report 99-3.

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Western Regional Climate Center, 2004, internet "http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nveure"

• Details on expected pit capture zone
shared copies for Patrick Longmire

Cooperating Agencies - NMCC Meeting Notes
8 October 2013 14:00 MDT

Attendees:
Mangi Enviornmental Group: Dave Henney via phone
MMD: Chris Eustice, Holland Shepherd, DJ Ennis
NMED: Brad Reid, Kurt Vollbrecht
NMG&F: Rachel Jankowitz
NMCC: Katie Emmer, Steve Raugust via phone

Note: Kevin Myers of OSE could not attend, he was out of town
Doug Haywood of BLM was not on the phone due to government shut down

1. Feasibility Study information – Steve

   - NMCC has been working on the draft Feasibility Study, which, at the end of September, had capital costs that were too high and a rate of return that was below our required threshold of 15%. This sent us back to the drawing board; we've been working on economic evaluations, revising our design to make the economics work better.
   - We are settling on a slightly smaller through put rate than the 30,000 ton per day mine plan we are working on for the EIS Alternative2 mine plan. HS question: What is the basic adjustment to the mine plan?
     SR response: We found that the 12 million tons in the high low grade ore stockpile and the low low grade ore stockpiles were not economic to mill. We are foregoing processing these stockpiles, dropping our planned milling from 125 million tons to 113 million tons.
     DHenney: So is this a change from the EIS Alternative2?
     KE: I'd like to clarify here: NMCC is preparing an EIS Alternative2 that is designed to answer concerns from BLM, Mangi, and NMCC that the EIS have the information needed to process the largest possible footprint mine. This is not a regulatory document, but a mine plan we know the Feasibility Study, or the mine we ultimately want to permit with the state, could fit within. The mine plan in the EIS Alternative2 will be very similar to what's in the Feasibility Study, but slightly bigger.
     CE: Will you file a new 43-101 report?
     SR: The 43-101 report will reflect the press release, which went out Oct 8, 2013.
     HS: Does the press release contain the whole Feasibility Study?
     SR: The press release contains excerpts from the Feasibility Study. The Feasibility Study is an engineering report with more than 360 drawings. The 43-101 report is a summary of the Feasibility Study for the Canadian Stock Exchange SEDAR site.

2. Geochemistry Reports status – Steve

   - The Geochemistry Pit Lake report went out at the end of September, we are assuming there is no feedback on this report or the other geochemistry report yet.

   CE: That is correct. MMD will get the geochemistry reports out to the agencies and request their comments, they will have 60 days to make comments.
   KV: I recall a conversation about asking Mangi to do a third party review of the geochemistry. This is something NMED did for Roca Honda.

CE: Yes, we wanted to discuss it but when we brought it up Mangi was not on contract at the time.
Discussion: NMED and MMD would both like to tap Mangi for a third party review of the geochemistry reports, this is possible under established MOUs. This work would be coordinated through the BLM. NMCC would not oversee this work but would authorize and pay for it.
KE: Request a scope of work be prepared by NMED and MMD so that Mangi can prepare a cost estimate and schedule and NMCC may authorize this and make sure Mangi gets paid for this work.
KV will work with MMD to prepare a scope of work needed. Would like to discuss a schedule next month in November cooperating agency meeting.
Discussion: Mangi can't make managerial decisions until BLM is back to work.

3. Groundwater model update – Steve

- The Groundwater model report and executable model files were delivered to the agencies at the end of September, received early October.
- NMCC is working on groundwater model projections for the BLM and Mangi to use in the EIS evaluation. These projections will stay with these entities and will be available when the draft EIS comes out.

4. EIS status – Dave

- Mangi Environmental Group got back to work on the EIS on 1 October.
- Mangi would like to prepare a water conservation alternative, hopefully to be derived from what NMCC submits.

SR: NMCC has done a lot of work on our water balances and we have found that throughput rates and time frames have the biggest impact on water use. It may be that NMCC can help describe low water use strategies to assist Mangi in this concern.
DH: We need to find a way to put low water use in a public frame so that the public can see that comments regarding water use have been answered in the document.
CE: Is NMCC building the alternatives to fit around the amount of water OSE agrees you have?
KE/SR: NMCC is building alternatives that fit within the NMCC declared water right. These water rights are in mediation with the OSE.

  - Mangi's first task starting back to work has been to distribute documents to the team. Their next steps have been to make sure they have the alternatives all pinned down and written up.
    - It has been difficult to go back and re-write sections as things have changed, this was a decision made at the beginning, although no one recognized at the time how much delay there would be in getting documents.
  - Mangi wants to make sure that they have all of the alternatives pinned down, they will be looking at the timeline from there.

5. Overall permit timeline shifts – Katie

- We have received a revised timeline from Mangi Environmental Group. Mangi got back to work 1 October and has estimated a DEIS publish date of April 18, 2014 with possible public meetings in early May 2014. Mangi's currently projected final ROD date is 17 months from now, February 2015.

- We know Mangi has had a five month disruption and understand they will be getting back up to speed in October, schedule may flex due to:
  - Government shut down
  - Additional data needs
  - Unforeseen circumstances
- NMCC has provided Mangi with the Ground Water Model report and executable file, both Geochemistry Reports, and will deliver an EIS Alternative 2 description as well as Ground water model projections for the base case (MPO 2010), EIS Alt1 (MORP 2012), and EIS Alt2 (Largest footprint expected) this week. We believe this will complete the major deliverables Mangi needs for the EIS analysis, we anticipate there will still be questions to answer as we go.
- We are working on a timeline to show how we think the state permit process can fold within the next 17 months of the EIS process. Even considering that we have a few major submissions left to provide and public hearings to account for, we believe there's time within the next 17 months to accomplish this. We have some work to do to finish the Feasibility Study within 45 days of the press release, and as that finishes the next steps for the state process will come into focus. We will let agencies know prior to submitting major documents.

6. Permit Application Package Status– Katie

- A few major submissions have come in:
  - Geochemistry Report: Waste Rock and Tailings Facility- June 2013
  - Baseline Data Report Response to comments/Addendum – July 2013
  - Geochemistry Report – Pit Lake – September 2013
  - Groundwater Model Report and model itself – September 2013
- Next major submissions will be:
  - A revised MORP presenting the mine NMCC wants to permit and build. This will be very close to but potentially slightly smaller than the EIS Alternative2 that Mangi is receiving a description of this week. It will be very similar to, if not exactly like the mine plan in the Feasibility Study 43101 Report that must be filed within 45 days of this week's press release, which is 21 November, 2013 if anyone is counting.
  - Discharge Permit – Revised application will require new public notice

HS: We may need to get the comments on all of the documents considered part of the BDR done before NMCC turns in a revised MORP.

Discussion: Comments may not be necessary before a revised MORP goes in, however they could help NMCC write the MORP more effectively. Given that geochemistry comments are being requested now, they could be done by the end of November, early December. This would give NMCC time to review and address these comments before a revised MORP would be ready to go in anyway.

7. Stage I Abatement Plan status/monitoring wells – Katie

    - NMCC submitted a Status Report regarding the results of Q1 and Q2 sampling on June 27, 2013.
    - Q3 sampling was conducted in July 2013.
    - Earlier this year, NMCC purchased private land just south of BLM land where the proposed monitoring wells were located and we have been pursuing drilling on this land.
    - NMCC received the OSE monitoring well permit for the two proposed monitoring wells east of the TSF on 27 September.
    - Drilling the first of these two wells is scheduled to start tomorrow morning, 9 October, 2013. Depending on how deep the first well must be to reach water, drilling may go into the weekend.
    - Based on field analysis, if this well shows sulfate/TDS impact, a second well will be drilled further west of the first.
    - Q4 sampling is scheduled for the week of October 21, 2013.

8. Next meeting date – Tuesday, November 12 at 2 pm MDT.

From: Katie Emmer <kemmer@themacresourcesgroup.com>
Sent: Thursday, October 10, 2013 8:46 AM
To: Reid, Brad, NMENV
Cc: Vollbrecht, Kurt, NMENV; 'Steve Finch'
Subject: RE: MW-A at Copper Flat

Good morning Brad,

I'll try to get a message to Marco that you will be there at 11 or 12. He doesn't have phone signal where they are drilling (phone service is notoriously bad at Copper Flat), so I'd rather not ask him to leave the rig and go find signal to call when they hit water and/or TD, but I will pass that information along when I receive it.

Marco reported that they had gotten to 115' bgl last night, all dry so far. He also reports cuttings have been cobbles, boulders, hard drilling, mostly gravel/rock shards so far.

Just to confirm: I have been retained at the office this morning for another pressing matter so I will not be able to get down to the site today.

Safe travels!

Katie

From: Reid, Brad, NMENV [mailto:brad.reid@state.nm.us]
Sent: Wednesday, October 09, 2013 5:23 PM
To: Katie Emmer
Cc: Vollbrecht, Kurt, NMENV
Subject: RE: MW-A at Copper Flat

Just an FYI - I will probably still head down there in the AM and hope to arrive between 11 and 12. I'll have a state-issued cell phone with me – 505-795-1401. Have Marco give me a call if they hit water and/or TD. Thanks, Brad

---

From: Reid, Brad, NMENV
Sent: Wednesday, October 09, 2013 5:12 PM
To: 'Katie Emmer'
Subject: RE: MW-A at Copper Flat

Thanks for the info - any fault sightings?

From: Katie Emmer [mailto:kemmer@themacresourcesgroup.com]
Sent: Wednesday, October 09, 2013 5:10 PM
To: Reid, Brad, NMENV
Subject: MW-A at Copper Flat

Brad,

They had the spud in at 14:37 and were at 70' at 16:40, seeing a lot of cobbles, some boulders.

I have hit a snag here at my office; I will not be able to head south first thing tomorrow morning. If I can I will be down tomorrow afternoon, or I might go Friday if they are still drilling. Given how far they got today, who knows, maybe they will be at TD tomorrow morning.

Katie Emmer | Project Scientist

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THEMAC RESOURCES

New Mexico Environment Department
Ground Water Quality Bureau

Inspection Report

Inspection Date: 10/10/13 **DP #:** 1

Facility Name: Copper Flat Mine

Facility Contact Information – Scheduling Inspection

☑ **Scheduled Inspection - provide contact information** ☐ **Unannounced Inspection**

Person Contacted:
Marco Wikstrom,
Geologist

Phone Number:

Facility Description

Waste Type: Other

Directions to Facility: 6 miles NE of Hillsboro along Hwy 152

Inspection Information

Start Time: 11:15 am **End Time:** 2:30 pm

NMED Inspector(s): Brad Reid

Verify that NMED identification was presented: ☑ Yes ☐ No

Facility Representative(s) present during the Inspection/Discussion: Marco Wikstrom (John Shoemaker & Associates)

Reason for Inspection: other

Discussion, Observations and Information Obtained

NMED staff met Marco Wikstrom from John Shoemaker & Associates to oversee construction of MW GWQ13-28 east of the tailings dam. The drillers were making steady progress at the time of arrival. Following are observations:

1) Drill method is reverse air rotary with casing advance (casing is temporary and will be pulled after PVC casing is emplaced).
2) Cuttings started getting slightly moist at 156 ft. Water at 175. Drillers let borehole equilibrate during lunch and depth-to-water after lunch was 154 ft. Water level rose from 175 feet in ~45 minutes. TD of well = 198 ft. below ground surface. 1st conductivity reading = 632 mS ~ 400-500 mg/L TDS
3) Lithology pretty consistent throughout = sand, cobbles and boulders. A 3.5 foot diameter boulder was drilled through earlier in the AM.

Photographic Documentation

Photos Taken? 3 DP1 2013-10-10 01 through DP1 2013-01-10 3 ☑ Yes - see attached ☐ No

Sample Information

Samples Collected? ☐ Yes ☑ No

Samples Collected by: N/A

Sample Id #s and locations:

Were samples split between permittee and NMED? ☐ Yes ☐ No ☑ N/A

Did the Facility Representative request copies of NMED's sampling results? ☐ Yes ☐ No ☑ N/A

Monitoring Well Camera Inspection

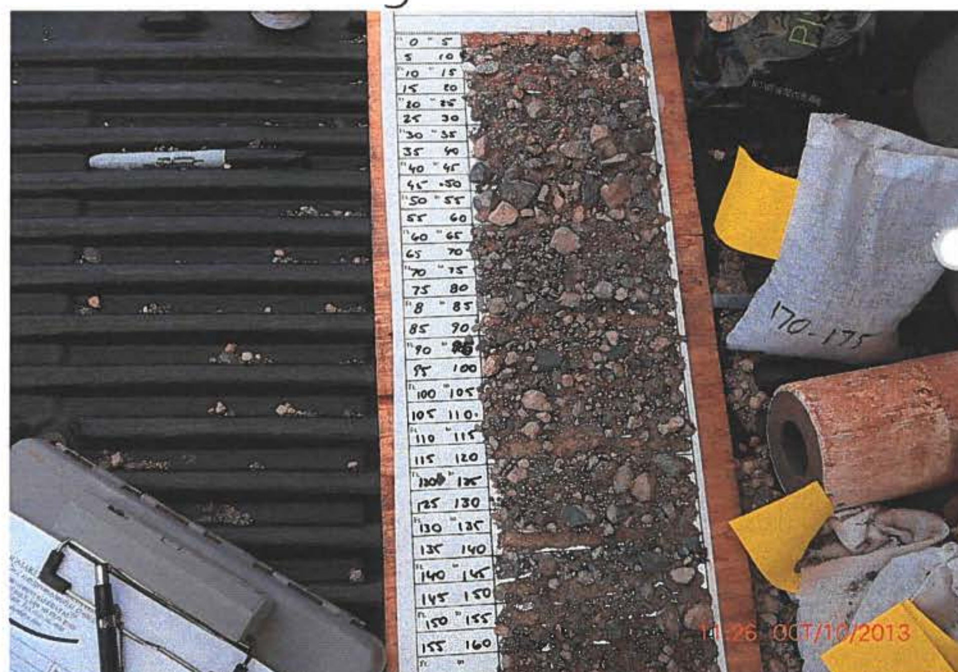
Monitoring well camera inspection conducted? ☐ Yes - see attached report(s) ☑ No

Initials of Report Preparer: ________________

Cuttings, 1st Water

Drill rig

Hitting 1st Water



Representative drill cuttings

From: Katie Emmer <kemmer@themacresourcesgroup.com>
Sent: Thursday, October 17, 2013 1:38 PM
To: Reid, Brad, NMENV
Cc: 'Steve Finch'; Vollbrecht, Kurt, NMENV
Subject: RE: Copper Flat - Dry wells

Thanks Brad.

From: Reid, Brad, NMENV [mailto:brad.reid@state.nm.us]
Sent: Thursday, October 17, 2013 1:36 PM
To: Katie Emmer
Cc: 'Steve Finch'; Vollbrecht, Kurt, NMENV
Subject: RE: Copper Flat - Dry wells

Hi Katie,

NMED approves this for the final quarterly sampling event pursuant to the abatement plan and contingent upon the following:

If other monitoring wells in the vicinity of the wells listed below show appreciable water table increases from the recent rains, NMCC shall check water levels and, if ground water is present, sample them.

Brad Reid, Geologist
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
P.O. Box 5469
Santa Fe, NM 87502
Phone: 505.827.2963; Fax: 505.827.2965
E-mail: brad.reid@state.nm.us

From: Katie Emmer [mailto:kemmer@themacresourcesgroup.com]
Sent: Thursday, October 17, 2013 12:14 PM
To: Reid, Brad, NMENV
Cc: 'Steve Finch'
Subject: Copper Flat - Dry wells

Brad,

As we discussed on the phone this morning, there are a number of wells that have been dry all year. I am writing to request NMED no longer ask that we check these wells for water during quarterly sampling. If you approve, we will discontinue checking these wells immediately, which will save time during sampling events. Thank you.

The following wells have been observed dry or too dry to sample in January, April and July 2013:

GWQ94-18
GWQ94-19
IW-1
IW-2
IW-3

Katie Emmer | Project Scientist

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THEMAC RESOURCES

State of New Mexico
Energy, Minerals and Natural Resources Department

Susana Martinez
Governor

David Martin
Cabinet Secretary-Designate

Brett F. Woods, Ph.D.
Deputy Cabinet Secretary

Fernando Martinez, Director
Mining and Minerals Division

November 1, 2013

Mr. Kurt Vollbrecht, Manager
Mining Environmental Compliance Section
Groundwater Quality Bureau
New Mexico Environment Department
Post Office Box 26110
Santa Fe, NM 87502

RE: Baseline Data Report Addendum 2, Copper Flat Mine, Permit No. SI027RN, Sierra County, New Mexico

Mr. Vollbrecht:

On October 2, 2013, the New Mexico Mining and Minerals Division ("MMD") received two reports from New Mexico Copper Corporation ("NMCC") that are considered additions to the *Baseline Data Report* ("BDR") for the Copper Flat Mine permit application package. The titles of the reports provided by NMCC are:

1. *Predictive Modeling of Pit Lake Water Quality at the Copper Flat Project;*
2. *Model of Ground Water Flow in the Animas Uplift and Palomas Basin, Copper Flat Project.*

The two subject reports are in addition to the *Baseline Data Report Addendum* that your agency provided written comments to the MMD in a correspondence dated September 25, 2013. Collectively these two additional reports are referred to as "Baseline Data Report Addendum 2" as part of the permit application package as submitted by NMCC for the proposed Copper Flat Mine

This BDR Addendum 2 presents additional data on surface water and groundwater within the proposed permit area of the Copper Flat Mine in Sierra County. NMCC indicates they sent each agency a hard copy of the two subject reports listed above. The BDR Addendum can also be viewed and downloaded from MMD's website at: http://www.emnrd.state.nm.us/MMD/MARP/PermitSI027RN.html MMD requests that you review this second addendum to the BDR and provide comments to MMD no later than 60 days after your receipt of this letter.

Please contact me at (505) 476-3438, or via email at chris.eustice@state.nm.us with any questions or comments you may have regarding the application or this request.

Sincerely,

Chris Eustice, Permit Lead
Mining Act Reclamation Program

cc: Mine File SI027RN
David Ennis, MMD

From:	Katie Emmer <kemmer@themacresourcesgroup.com>
Sent:	Monday, November 18, 2013 11:46 AM
To:	Eustice, Chris, EMNRD; Shepherd, Holland, EMNRD; Ennis, David, EMNRD; Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Jankowitz, Rachel J., DGF; Myers, Kevin, OSE; Haywood, Doug; Dave Henney (dhenney@mangi.com)
Cc:	Jeffrey Smith; Steve Raugust
Subject:	NMCC Cooperating Agency Meeting Notes, 12 Nov 2013
Attachments:	NMCC_Agency_Mtg_ 12November2013.pdf

Attached please find notes from the NMCC Cooperating Agency Meeting at the MMD on 12 November, 2013. If you note anything that is incorrect, please let me know so we can correct it.

Thank you for your time last week! Our next meeting is scheduled for 17 December, 2013, 14:00 MST, in Santa Fe.

Best regards,

Katie Emmer | Permitting & Environmental Compliance Manager

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THEMAC RESOURCES

Cooperating Agencies - NMCC Meeting Notes
12 November 2013 14:00 MST
Call in: 605-475-4000 PIN 422-765

Attendees:
BLM: Doug Haywood (for a portion of the call, via phone)
Mangi Environmental Group: Dave Henney via phone
MMD: Chris Eustice, Holland Shepherd, DJ Ennis
NMED: Brad Reid
NMG&F: Rachel Jankowitz
NMCC: Katie Emmer, Steve Raugust (via phone for a portion of the call)
OSE: K.Myers was not able to attend this meeting.

1. Feasibility Study information
   SR: We are pulling the 43-101 report together for a deadline of 21 November for the report to be online. The goal is to get the report done by 15 November so that it can get processed by legal and formatted. The report is not a regulatory document but it can be downloaded off of SEDAR once it has been posted.

2. Geochemistry Reports status
   SR: We wrapped up our Characterization report and the Pit Lake reports, these have been delivered to the agencies. Katie received an email from BLM that they do not have comments on the geochemistry reports.
   CE: MMD sent those reports to NMED. The GW model was sent to OSE and NMED. MMD has requested comments within 60 days, as these were sent around 1 November, MMD expects agency comment back by the end of the year.
   BR: Patrick Longmire of NMED will be reviewing these documents, he would like to have them as hard copies, NMED would like to request one additional copy of each of the geochemistry reports and the groundwater model report for Patrick to review.
   SR: SRK is still working on deliverables for NMCC. There were a few humidity cell tests (HCTs) that were still running when the geochemical characterization report was submitted in June, specifically 3 on-going waste rock samples and 8 on-going tailings samples. These were terminated in July based on SRKs recommendations that they were stable. SRK is preparing an addendum report that extends the data presented in the characterization report through termination along with a discussion that indicates the results of the characterization will not change. This was done to keep the information flowing in a timely manner while working around the long HCT test durations. NMCC expects a draft of this addendum report in Mid-December.
   CE/DJE: Some discussion about this latest geochemistry report – it will be part of Baseline Data and MMD will likely call it BDR Addendum 3 for internal tracking reasons. A copy will go to NMED.
   SR: There is another task SRK is completing. They now have a block model for the Feasibility Study pit (this is slightly smaller than the Pre-Feasibility Pit). The Feasibility Study pit is 129 acres and 50' deeper than the Pre-Feasibility pit, which is 143 acres. SRK will be asked to identify if there are any data gap(s) between these two pits and if data gap(s) are identified, make recommendations to address the data gap.

CE: Can you provide a statement of conclusions to the geochemical characterization addendum report?
SR: NMCC will be able to state how the results of the geochemical addendum report do not change the results and conclusions of previous geochemical characterization report.
HS: We [MMD] will have Patrick Longmire do the work on the geochemistry and will not need to lean on Mangi for this step.
KE: So P. Longmire will cover the geochemistry review for NMED and MMD and no scope of work is being created for this task?
HS: Correct. We may lean on Mangi for groundwater and surface water balance review. We still need to talk to Kevin Myer's regarding what they will do. The question of the hydrologic balance keeps coming up.
BR: NMED will want to see what the expected pit capture zone is and if they pit lake will remain a hydrologic sink.
RJ: Game and Fish doesn't need to see the geochemistry model reports, however we have some concerns about mine operation impact to surface water. Game and Fish would like to see the results of the groundwater model.
HS: We need a determination of the hydrologic balance.
SR: You will get that with the groundwater projections.

3. Groundwater model update
   SR: NMCC did issue a projection memo for BLM however just last week we identified some inconsistencies between our annualized summary water balance and the seasonal data that JSAI actually modeled. Right now the 43-101 has to be our priority; however, we are working with JSAI about this consistency issue and JSAI will have to fix this and re-issue the model projections memo. There may be minor effects to the results.
   CE: Will this impact the baseline?
   SR: No the baseline is already there. You have the baseline conditions in the BDR and the Conceptual Groundwater Model Report. The next step for the State will be the impacts, which will be the result of the model projections. The model results will show impacts to the mine pit, Animas and Percha Creeks, and the Rio Grande.
   HS: Does the 43-101 Feasibility Study report involve an economic analysis?
   SR: It does present a life of mine economic analysis; it will be public on the 21st of November.
   HS: In another regulatory process we've asked operators for economic analysis and have had a lot of problems.
4. EIS status
   D. Henney:
   - Mangi is working on Chapter 2 – Proposed Action and alternatives before giving it to experts. We want to discuss water use/conservation. NMCC is working on a summary of techniques employed to conserve water and we believe this is necessary to complete Chapter 2 and answer public concerns about water use.
   - In NMCC's original MPO they use thickened tails but this is not in subsequent plans. NMCC will be providing details on why that's not in later mine plans
   - While waiting on NMCC deliverables, Mangi is working on the GW model, Lee Wilson feels the model is something they can work with, he is waiting on OSE response.
   - CDM is looking at the geochemistry; Mark Nelson should have some comments.

D. Haywood: I am going to talk to OSE on Thursday regarding where we need to go with the model.
CE: What is OSE's role with the model?
DHenney: We are working to establish a common understanding regarding the sufficiency of the model.
DHaywood: (Re: the schedule) We'll see how things go.
HS: What is the EIS looking at regarding the hydrologic balance?
DHenney: We will look at information NMCC will provide re: water savings. LWA is looking at GW impacts. We expect LWA will give a summary of their analysis to other experts whose sections are impacted by water use: vegetation, wildlife
HS: Does the EIS take into account GW standards?
DHenney: CDM is looking at regulations and looking at geochemistry.
CE: There should be an opportunity for the state to look at surface water and groundwater.
BR: If they are looking at geochemistry, water quality, we should discuss to see how to coordinate.
RJ: Is BLM doing an administrative draft that can be reviewed by agencies before the Draft EIS comes out?
DHenney: It is in the plan to do an administrative draft.
CE: Can we get an extension on time to review the administrative draft?
DHenney: I think an extension can be given.
Discssussion re: possibility of public IPRA on an administrative draft, the use of a secured ftp site with the document available only online.

5. Overall permit timeline shifts – Katie

- Re-Cap: We have received a revised timeline from Mangi Environmental Group. Mangi got back to work 1 October and has estimated a DEIS publish date of April 18, 2014 with possible public meetings in early May 2014. Mangi's currently projected final ROD date is 16 months from now, February 2015.
- NMCC has provided Mangi with:
    - Description of EIS Alternative 2, delivered 10 Oct, 2013
    - Groundwater model projections delivered 11 Oct, 2013
    - Model files for groundwater projections, delivered 8 November, 2013
- At Mangi's request we are working on a deliverable that will outline water saving strategies that are being incorporated into all of the mine plans. All of the mine plans include strategies to recycle 75 of the total water demand; this memo will help Mangi address public comments regarding water use at the site.
- We have found a few errors and adjustments in previous mine plans and are preparing a simple correction memo for Mangi
- We will get these deliverables to Mangi as soon as possible; however the 43-101 report deadline has taken priority and given our limited resources, these have had to be post-poned.

6. Permit Application Package Status– Katie

- Re-cap: Major submissions have come in:
    - Geochemistry Report: Waste Rock and Tailings Facility- June 2013

08466

- Baseline Data Report Response to comments/Addendum – July 2013
    - Geochemistry Report – Pit Lake – September 2013
    - Groundwater Model Report and model itself – September 2013
- Discussion regarding when agency comments will come back to NMCC
    - MMD has agency comments on the BDR Addendum from OSE, G&F, NMED but needs to corral MMD comments. KE: It would be helpful to us to get your comments as soon as possible.
    - As previously noted, the MMD solicited agency comments on the geochemistry reports and groundwater model reports on or around 1 November, gave 60 days for comment, so these should be back to MMD by the end of the year.
- Next major submissions will be:
    - A revised MORP presenting the mine NMCC wants to permit and build. This will be very close to but potentially slightly smaller than the EIS Alternative2 that Mangi received. It will be very similar to, if not exactly like the mine plan in the Feasibility Study 43101 Report that must be filed within 45 days of this week's press release, which is 21 November, 2013.
    - Discharge Permit – Revised application will require new public notice
    - We don't have a permitting timeline solidified yet but we expect a new MORP and DP would be coming in February or March 2014, we'll give you a long lead time notice before these are ready.

7. Stage I Abatement Plan status/monitoring wells – Katie

- One new monitoring well east of the TSF, named GWQ13-28, was drilled the week of October 9 and this well was included in the subsequent Q4 sampling event. Field tests showed no high TDS evidence so a second well was not deemed necessary. Conductivity was 0.900 mS/cm, pH 7.83, and field SO4 test indicated 200 mg/L.
- Q4 sampling was conducted in October 2013; we are still waiting on lab analyses for all of the wells sampled however the first lab results on cations/anions east of the dam are in and the new well east of the tailing dam showed background concentrations for sulfate and TDS.
- We will be working with JSAI to create a summary of sampling in 2013 and prepare recommendations for either additional characterization or abatement strategies in the go forward.

Next meeting date – 17 December, 2013 14:00 MST

11/21/13

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TSXV: MAC

THEMAC Resources Group Files Positive Feasibility Study For Copper Flat Project

Vancouver, British Columbia – November 21, 2013 – THEMAC Resources Group Limited (TSX.V: MAC– "THEMAC") is pleased to announce that it has filed a technical report titled "Copper Flat Project, Form NI 43-101F1 Technical Report Feasibility Study, Sierra County, New Mexico, USA" dated November 21, 2013 (the "Report").

Copper Flat is a former producing mine located in Sierra County, New Mexico, USA, approximately 150 miles south of Albuquerque and 20 miles southwest of the town of Truth or Consequences, New Mexico. The project land package comprises 4,741 acres, with the majority of the mineral reserves located on patented mining claims that are wholly-owned by THEMAC.

The Report summarizes the results of a feasibility study on the Copper Flat copper-gold project, which results were first reported by the Company in a news release dated October 7, 2013. The Report was prepared by M3 Engineering & Technology Corporation.

The Report is available on SEDAR (www.sedar.com) and is also posted on the Company's website (www.themacresourcesgroup.com). All amounts below are in United States Dollars and all quantities are presented in US standard units unless stated otherwise.

FINANCIAL SUMMARY

The Feasibility Study includes financial analysis on three scenarios with varying metal prices: 1) The base case uses a long term copper price of \$3.00/lb; 2) A price upside case based on a \$3.25/lb long term copper price (all other metal prices held constant); and 3) a price downside case based on a \$2.75/lb long term copper price.

The financial return table below is after tax, unlevered and with no escalation in commodity prices.

FINANCIAL RETURNS

Case	NPV@0% (US\$000)	NPV@8% (US\$000)	IRR (%)	Payback (Years)
Base Case	\$457,000	\$187,000	20.0	3.6
Upside Price	\$564,000	\$253,000	23.8	3.3
Downside Price	\$348,000	\$118,000	15.8	4.1

Base Case: Copper \$3.00/lb, Moly \$9.50/lb, Gold \$1,350/oz and Silver \$22.00/oz
Upside Sensitivity: Copper \$3.25/lb, Moly \$9.50/lb, Gold \$1,350/oz and Silver \$22.00/oz
Downside Sensitivity: Copper \$2.75/lb, Moly \$9.50/lb, Gold \$1,350/oz and Silver \$22.00/oz

"I would like to thank all involved for their efforts in to completing an excellent study. We are pleased that the results indicate Copper Flat is a viable project. Now that the feasibility is complete, we will be focusing on progressing engineering design works and gaining the remaining permits required to develop the mine." said Andrew Maloney, CEO.

MINERAL RESERVES AND RESOURCE

Copper Flat's proven and probable mineral reserves increased by 15%, or 15 million tons, to 113.1 million tons, when compared to the previous 2012 mineral reserve. This material contains 675 million pounds of copper, 20 million pounds of molybdenum, 340 thousand ounces of gold and 6.8 million ounces of silver, and has an average copper equivalent grade of 0.39%. Copper equivalent factors used account for metal price, metallurgical recovery and smelter payable factors. Listed below are Copper Flat mineral reserves and mineral resources as of April 2, 2013.

Mineral Reserves
October 7, 2013

Classification	Cutoff Grade NSR/Ton	Mineral Reserves Ktons	Copper %	Moly %	Gold Oz/ton	Silver Oz/ton	Contained Metal Copper Lbs x 1000	Moly Lbs x 1000	Gold ozs x1000	Silver ozs x 1000
	Variable By Year									
Proven	$12.75 to $6.11	78,857	0.32	0.010	0.003	0.07	504,685	15,771	237	5,520
Probable	$12.75 to $6.11	34,227	0.25	0.007	0.003	0.04	171,135	4,792	103	1,369
Total P&P		113,084	0.30	0.009	0.003	0.06	675,820	20,563	340	6,889

Notes: Mineral reserves equal the total ore planned for processing from the mine plan
Ktons means 1000 short tons. Short tons = 2000 lbs
Copper and Molybdenum grades are percent of dry weight
Gold and Silver are reported in Troy ounces / short ton
Metal Prices: $3.00 Copper; $8.00 Moly; $1,350 Gold; $20.00 Silver
No Economic Credit to Inferred

The total measured and indicated mineral resource (inclusive of mineral reserves) has increased by 35% or 79 million tons to 305 million tons, when compared to the previous 2012 mineral resource estimate.

Total Mineral Resource
October 7, 2013

Classification	Cutoff Grade NSR/Ton	Tonnage and Grade Ktons	Copper %	Moly %	Gold Oz/ton	Silver Oz/ton	Contained Metal Copper Lbs x 1000	Moly Lbs x 1000	Gold ozs x1000	Silver ozs x 1000
Measured	$6.11	126,655	0.28	0.009	0.003	0.06	709,268	22,798	380	7,599
Indicated	$6.11	178,571	0.19	0.005	0.002	0.04	678,570	17,857	357	7,143
Meas + Ind		305,226	0.23	0.007	0.002	0.05	1,387,838	40,655	737	14,742
Inferred	$6.11	27,646	0.20	0.004	0.001	0.02	110,584	2,212	28	553

Notes: Mineral Resources stated above include the mineral reserve
Mineral Resources are contained within a floating cone pit geometry at prices listed below.
Ktons means 1000 short tons. Short tons = 2000 lbs
Copper and Molybdenum grades are percent of dry weight
Gold and Silver are reported in Troy ounces / short ton
Metal Prices: $3.00 Copper; $8.00 Moly; $1,350 Gold; $20.00 Silver

The mineral reserves and mineral resources have been developed from a computerized block model that is based on a drill hole database incorporating a total of 233 drill holes and 181,326 feet of drilling that continued through to the end of 2012. In addition to the drilling program, the company re-assayed more than 6,000 historical pulps to obtain gold and silver data. The mineral reserve has benefited from additional geotechnical drills holes that allowed the pit wall slopes to steepen due to improved rock conditions.

OPERATING COSTS

Average cash operating costs, net of by-product revenue, and using the base case pricing scenario, are estimated at US$0.93 per pound of copper recovered into concentrate before smelter deductions during the first five years of production and US$1.15 per pound of copper recovered into concentrate before smelter deductions over the full life-of-mine. On an equivalent copper basis, cash operating costs average $1.56 per equivalent pound of copper recovered into concentrate before smelter deductions over the life-of-mine.

On a cost per ton basis, cash operating costs are estimated at $11.29 per ton processed, excluding by-product credits. Cash operating costs include mining, processing, site general and administration, treatment and refining, and concentrate transportation costs.

LIFE-OF-MINE OPERATING COST

Operating Cost	$/Ton of Ore	$/lb of Cu
Mining Cost	$2.61	$0.47
Process Cost	$4.83	$0.87
General Administration Cost	$0.56	$0.10
Treatment & Refining Charges	$3.29	$0.59
Total Operating Cost	$11.29	$2.03
By-Product Revenue		($0.88)
Total Operating Cost Net of By Product Revenue		$1.15

CAPITAL COSTS

The total initial capital cost for construction, mine pre-development, commissioning and owner's cost is estimated to be $360.5 million. Sustaining capital will total $63 million over the life of the operation.

The project is a brownfield redevelopment project in a stable region with excellent access to existing infrastructure. The project will realize savings through the reuse of significant infrastructure that remains from the original Quintana Mine, which provides an estimated $53.9 million in value to the Project.

INITIAL AND SUSTAINING CAPITAL

Initial Capital	Amount ($1000)
Mine	$15,300
Plant	$310,200
Owner Cost	$35,000
Total	**$360,500**

Sustaining Capital	Amount ($1000)
Mine	$24,900
Process	$34,600
G&A	$3,000
Total	**$62,500**

MINING AND PROCESSING

Copper Flat is a porphyry copper-gold deposit that is located in close proximity to the surface and amenable to open pit mining methods. The pit operations are planned to use standard mining equipment, including: 45,000 lb., single pass rotary blast hole drills, 19-cu-yd front-end loaders, and 100 ton off-highway haul trucks. The Mine plan includes a mine support fleet comprised of track and rubber-tired dozers, motor graders, and 10,000-gallon water trucks. Material mined totals 158 million tons of ore and waste over the life-of-mine at an average stripping ratio of 0.40 tons of waste per ton of ore. The mining rate peaks at 17.5 million tons of total material per year.

The construction program benefits from the use of existing infrastructure and the timeframe expected to construct and commission the project is estimated to require 18 months. Following construction, the project schedule includes 11.1 years of ore processing and four years for reclamation and closure.

Ore will be processed through a standard crushing, grinding and sulfide flotation concentrator to produce a copper-gold-silver concentrate and a molybdenum concentrate. The Copper Flat concentrator is scheduled to process 10.8 million tons per year for the first five years of production and 9.9 million tons per year for the remainder of the mine life when harder ores are encountered at depth in the deposit. Copper recovery to concentrate is projected to average 70 million pounds per year during the first five years of operation and 57 million pounds per year when averaged over the full life-of-mine.

The Copper Flat ore lends itself to common crushing and grinding practice and standard flotation reagents and the mill is designed to have a simple gyratory crusher and SAG/ball mill grinding circuit followed by a conventional floatation circuit to produce separate copper and molybdenum concentrates. Metallurgical testing shows the Copper Flat ore contains coarse gold that is recoverable through physical separation and gravity separation equipment, this equipment is included in the process flow sheet to improve gold recovery. As a result of metallurgical test work, the expected life-of-mine process recoveries are projected to be: 93.1% copper; 78.0% molybdenum; 73.7% gold; and 82.7% silver.

The mine will produce approximately 100,000 tons of copper concentrate and 1,300 tons of molybdenum concentrates per year for the life-of-mine. The copper concentrate is expected to assay 27% to 30% copper based on lab tests and actual plant performance achieved by Quintana Minerals in the past operation. The molybdenum concentrate is expected to assay 50% to 60% molybdenum oxide. ICP analysis of the copper concentrate determined that the concentrate is expected to contain very low concentrations of potential smelter penalty elements

PRODUCTION METRICS

Mine Life (Years)	11.1
Strip Ratio (Waste Tons : Ore Tons)	0.4:1
LOM annual processing rate (Ktons)	10,200
Copper equivalent LOM annual production (Klbs)	73,800
Copper equivalent LOM production (Klbs)	819,000
Copper LOM annual production (Klbs)	56,600
Copper LOM production (Klbs)	628,000
Gold LOM annual production (Ktrozs)	20
Gold LOM production (Ktrozs)	227
Copper equivalent LOM average grade	0.39%

Note: The Moly and Silver LOM annual production and LOM production are not included in table above.

TECHNICAL REPORT

The complete Feasibility Study National Instrument ("NI") 43-101 Technical Report has been filed on SEDAR at www.sedar.com and is also be available on the Company's website at www.themacresourcesgroup.com

ABOUT M3 ENGINEERING & TECHNOLOGY CORPORATION

The feasibility study was prepared by M3 Engineering & Technology Corporation of Tucson, Arizona, under the supervision of Conrad Huss, P.E., an Independent Qualified Person as defined under Canadian NI 43-101. M3 Engineering & Technology Corporation (M3) provides professional EPCM services and is now recognized as an industry leader in Feasibility Studies and associated NI 43-101's.

ABOUT INDEPENDENT MINING CONSULTANTS

Mineral resources and reserves were calculated by IMC of Tucson, Arizona under the supervision of John Marek, P.E., IMC President, an Independent Qualified Person as defined under Canadian NI 43-101. Since 1983 Independent Mining Consultants, Inc. (IMC) has been recognized worldwide for its expertise in Open Pit Mine Design and Mine Planning as well as Ore Reserve Estimation and Mineral Economics. IMC has worked for large international mining conglomerates, medium sized mines, multiple commodity producers, and exploration firms.

ABOUT GOLDER ASSOCIATES

Engineering and design of the tailings storage facility for Copper Flat was prepared under the supervision of Gene Muller, P.E., an Independent Qualified Person as defined under Canadian NI43-101. Employee owned since being founded in 1960, Golder Associates Inc. provides engineering and environmental consulting services to mining, energy and natural resource industries. Golder has conducted similar studies and engineering evaluations in the southwestern US and internationally.

ABOUT SRK CONSULTING

The mine reclamation plan and closure cost estimate was developed by SRK Consulting (U.S.), Inc. under the supervision of Mark A. Willow, SME-RM, an Independent Qualified Person as defined under Canadian NI 43-101. Originally formed in 1974, SRK is an independent, international organization that provides professional consulting services and expert advice, mainly in the fields of mining, geotechnics, water, waste, and the environment. SRK services clients across a range of industries that are primarily natural resource development oriented.

TECHNICAL INFORMATION AND QUALIFIED PERSONS

Standard procedures for core handling were in place during the entire drilling program, and a geologist was on site for all sample preparation and shipping.

Assaying for the 2012 drilling program was undertaken at the Skyline Laboratory in Tucson, AZ. Copper and molybdenum values were determined by ICP/MS, gold by fire assay with AA finish, and silver by AA. Reference standards and blanks were inserted in the sample streams, and every tenth sample is being objectively validated by ALS Minerals, Reno, Nevada using similar methodologies.

An Appendix of tables and figures for this news release is available on THEMAC's website at www.themacresourcesgroup.com.

Technical information in this news release has been read and approved by Conrad Huss, P.E. (M3 Engineering), John Marek, P.E. (Independent Mining Associates), Gene Muller, P.E. (Golder Associates), Mark Willow, SME-RM (SRK), and J. Steven Raugust, C.P.G., Resource Development Manager (THEMAC Resources) all of whom are Qualified Persons under Canadian NI 43-101.

ABOUT THEMAC RESOURCES GROUP LIMITED

THEMAC is a copper development company with a strong management team which acquired the Copper Flat copper-molybdenum-gold-silver project in New Mexico, USA in May 2011. We are committed to bringing the closed copper mine, Copper Flat, in Sierra County, New Mexico back into production with innovation and a sustainable approach to mining development and production, local economic opportunities and the best reclamation practices for our unique environment. The Company is listed on the TSX Venture Exchange (ticker: MAC) and has issued share capital of 75,300,122 common shares (fully diluted share capital 132,537,777).

For more information please visit www.themacresourcesgroup.com or review the Company's filings on SEDAR (www.sedar.com).

FORWARD LOOKING STATEMENTS

Certain information contained or incorporated by reference in this press release, including any information as to THEMAC's future financial or operating performance, the likelihood and timing of commercial production, construction of plant, and obtaining required permits, statements with respect to the estimation of mineral resources and reserves, expanding mineral reserves and mineral resources, the realization of mineral reserve and mineral resource estimates, the timing and amount of estimated future production, capital costs, costs of production, metal or mineral recoveries, mine life and production rates, capital expenditures and success of mining operations, expected IRR and NPV constitute "forward-looking statements". All statements, other than statements of historical fact, are forward-looking statements. The words "believe", "expect", "anticipate", "contemplate", "target", "plan", "intends", "continue", "budget", "estimate", "may", "will", "schedule" and similar expressions identify forward-looking statements. Forward-looking statements are necessarily based upon a number of estimates and assumptions that, while considered reasonable by THEMAC, are inherently subject to significant business, economic and competitive uncertainties and contingencies. Such assumptions include the specific assumptions set out in this press release and in the Report, that future capital and operating costs will be in line with THEMAC'S assumptions, that mineral resource and mineral reserve estimates prove accurate, permits required to commence production will be obtained on a timely basis, copper, molybdenum, gold and silver prices will remain consistent with THEMAC's expectations, that there are no changes in THEMAC's development plans as new information is received, that THEMAC will be able to access financing, equipment and sufficient labour to carry out its planned business. Known and unknown factors could cause actual results to differ materially from those projected in the forward- looking statements. Such factors include, but are not limited to: fluctuations in the currency markets; fluctuations in the spot and forward price of copper, molybdenum, gold, and silver; volatility in the price of fuel and electricity; changes in national and local government legislation, taxation, controls, regulations and political or economic developments in Canada and the USA; business opportunities that may be pursued by THEMAC; operating or technical difficulties in connection with mining or development activities; employee relations; litigation; the speculative nature of exploration and development, including the risks of obtaining necessary licenses and permits; uncertainty surrounding the availability of water rights required for mining operations which, if not secured, could result in changes to the proposed plan for development of Copper Flat; contests over title to properties, particularly title to undeveloped properties; failure of processing and mining equipment to perform as expected; labor disputes; supply problems; uncertainty of production and cost estimates; the interpretation of drill results; the assumptions upon which the estimation of mineral resources and reserves prove inaccurate, which could lead to a restatement of reserves and resources;; changes in project parameters as plans continue to be refined; possible variations in ore reserves, grade of mineralization or recovery rates may differ from what is indicated and the difference may be material; legal and regulatory proceedings and community actions; accidents, title matters; regulatory restrictions; permitting and licensing; volatility of the market price of Common Shares; insurance; competition; and hedging activities. In addition, there are risks and hazards associated with the business of exploration, development and mining, including environmental hazards, industrial accidents, unusual or unexpected formations, pressures, cave - ins, flooding and the risk of inadequate insurance, or inability to obtain insurance, to cover these risks. Many of these uncertainties and contingencies can affect actual results and could cause actual results to differ materially from those expressed or implied in any forward-looking statements made by, or on behalf of, THEMAC. Readers are cautioned that forward-looking statements are not guarantees of future performance. All of the forward-looking statements made in this press release are qualified by these cautionary statements. THEMAC disclaims any intention or obligation to update or revise any forward-looking statements whether as a result of new information, future events or otherwise, except to the extent required by applicable laws.

"Operating cost per pound of copper", "Life-of-mine sustaining capital", "IRR" and similar terms are alternative performance measures. These performance measures are included because these statistics are key performance measures that management may use to monitor performance. Management may use these statistics in future to assess how THEMAC is performing to plan and to assess the overall effectiveness and efficiency of mining operations. These performance measures do not have a meaning within International Financial Reporting Standards ("IFRS") and, therefore, amounts presented may not be comparable to similar data presented by other mining companies. These performance measures should not be considered in isolation as a substitute for measures of performance in accordance with IFRS.

For further information contact:

THEMAC Resources Group Limited
Andrew Maloney, CEO
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Neither the TSX Venture Exchange (the "TSXV") nor its Regulation Services Provider (as that term is defined in the policies of the TSXV) has reviewed, nor do they accept responsibility for the adequacy or accuracy of, this release.

State of New Mexico
Energy, Minerals and Natural Resources Department

Susana Martinez
Governor

David F. Martin
Cabinet Secretary - Designate

Brett F. Woods, Ph.D.
Deputy Cabinet Secretary

Fernando Martinez, Director
Mining and Minerals Division

December 3, 2103

Mr. Ray Irwin
New Mexico Copper Corporation
2424 Louisiana Blvd., N.E., Suite 301
Albuquerque, NM 87110

RE: Approval of Permit Modification 13-1 to, Permit No. SI025EM

Mr. Irwin:

The New Mexico Mining and Minerals Division (MMD) received a permit modification proposal from New Mexico Copper Corporation ("NMCC"), dated May 7, 2013, proposing to modify Permit No. SI025EM. Please find enclosed NMCC's copy of the signed and approved Modification 13-1 to Permit No. SI025EM. Also enclosed is a copy of the associated and newly executed financial assurance Agreement for $133,200.00, and the original, and now released, financial assurance Agreement for $241,710.00.

If you have any questions, please contact me at (505) 476-3438.

Sincerely,

Chris Eustice, Permit Lead
Mining Act Reclamation Program (MARP)

Enclosures

Cc: Fernando Martinez, Director, MMD
Holland Shepherd, Program Manager, MARP
Kurt Vollbrecht, NMED
Joseph Navarro, BLM-Las Cruces
Mine File SI025EM

MODIFICATION 13-1 TO PERMIT NO. SI025EM
COPPER FLAT EXPLORATION 2 PROJECT
MINIMAL IMPACT EXPLORATION OPERATION

MINING AND MINERALS DIVISION
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

Permit Modification 13-1 to Permit No. SI025EM ("Permit") is issued by the Director of the Mining and Minerals Division ("MMD") of the New Mexico Energy, Minerals and Natural Resources Department to:

New Mexico Copper Corporation
Whose correct address is: 2424 Louisiana Boulevard, NE. Suite 301
Albuquerque, New Mexico 87110

("Permittee") for the Copper Flat Exploration 2 Project, located in Sierra County, New Mexico. The Permittee has proposed relocating eight (8) previously approved drill pads to accommodate twelve (12) drill holes, and the construction of additional access roads. These relocated drill pads and drill holes are in addition to the remaining four (4) of the forty-nine (49) previously permitted drill pads that have yet to be constructed or utilized. The Permit Area is located on lands administered by the United States Bureau of Land Management ("BLM").

This Modification 13-1:

Relocates eight (8) previously permitted drill pads to accommodate twelve (12) drill holes to be drilled to a maximum depth of 2,000 feet below ground surface, and;

- Drill Pad and Borehole Identification and locations: The eight (8) drill pads (formerly known as drill pads 21, 25A, 8A, 17, B, W6, CNI-2, and 30; now identified as A1, A2, A3, A4, A5, A6, A7, and A8) to accommodate twelve (12) drill holes (identified as drill holes A1-1, A1-2, A2-1, A3-1, A3-2, A4-1, A4-2, A5-1, A5-2, A5-3, A6-1, A6-2,) , to be moved to locations as shown in Figure 5 of the Request for Permit Modification letter.

Reduces the required financial assurance ("FA") amount associated with this Permit from $241,710.00 to $133,200.00 in acknowledgement of the plugging and abandonment of forty-five (45) previously approved drill holes, and the reclamation of the associated and previously approved drill pads.

- FA amount to be reduced: Certificate of Deposit number 7658769315, in the amount of $133,200.00, and issued on November 7, 2013 by Wells Fargo Bank of Albuquerque, New Mexico, New Mexico, will replace Certificate of Deposit number 0124190728 in the amount of $241,710.00 issued by Citizens Bank of Las Cruces, New Mexico as the new financial assurance instrument.

Authorizes the Permittee to disturb an additional 0.12 acres for the constructing of the needed access roads to the eight (8) re-located drill pads.

- Increased acreage: the incremental disturbed acreage (0.12 acres) is the result of constructing the needed access roads to the re-located drill pads resulting in a cumulative permitted disturbance of 3.07 acres for the entirety of this minimal impact exploration Permit No. SI025EM.

In order to accomplish the approval contemplated by this Modification 13-1, the following subparagraphs are added to Permit No. SI025EM:

Section 1 (13-1). **STATUTES AND REGULATIONS**

A. This Permit Modification is issued pursuant to the New Mexico Mining Act, NMSA 1978, §69-36-1, et seq. (1993, as amended through 2009) ("Act") and New Mexico Mining Act Rules, Title 19, Chapter 10 of the New Mexico Administrative Code ("NMAC" or "Rules" or "Regulations")

B. This Permit Modification is subject to the Act, the Rules and any other regulations which are now or hereafter in force under the Act; and all such regulations are made a part of this Permit by this reference.

Section 2 (13-1). **PERMIT APPLICATION PACKAGE**

A. A request titled *Copper Flat Exploration 2 (SI025EM) Modification 4* was received by MMD from the Permittee, on May 7, 2013, proposing to alter the scope of drilling originally approved in the Permit and associated Modifications. Specifically, this Modification request includes relocating eight (8) drill pads to accommodate twelve (12) drill holes and reducing the amount of financial assurance. This Permit Modification Proposal Package contains a map ("Figure 5") that identifies the new locations of the drill pads.

B. *Acknowledgement of Notice Modification*, dated September 11, 2013, as issued by the United States Bureau of Land Management – Las Cruces District Office.

C. Response letter from Ray Irwin, dated August 6, 2013: *Response to August 2, 2013 Technical Comments on Application for Modification 13-1 to Permit No. SIO25EM, Copper Flat Exploration 2 Project*, providing responses to MMD's August 2, 2013 Technical Comments letter to the Permittee.

Section 4 (13-1). **FINDINGS OF FACT**

A. The Permittee has paid the minimal impact operation modification fee of $250.00 as required by Subsection I of 19.10.2.201 NMAC.

B. The Permittee has provided satisfactory financial assurance ("FA"), in accordance with

Subsection A of 19.12.1201 NMAC, in the amount of $133,200.00 (one hundred thirty-three thousand two hundred dollars). FA has been posted in the form of a Certificate of Deposit No. 7658769315, administered by Wells Fargo Bank of Albuquerque, New Mexico.

C. The application for a permit modification has been reviewed in accordance with 19.10.3.302.J NMAC and 19.10.4.406 NMAC. The application for permit modification is complete, accurate, and complies with the requirements for permit modifications under 19.10.4.406 NMAC.

D. Pursuant to 19.10.4.406.C NMAC, the proposed changes would not authorize an expansion of the disturbed area beyond that currently authorized by the Permit, nor significantly depart from the nature or scale of the permit, nor result in a significant increase in the amount of financial assurance, nor fall within the exclusions in 19.10.1.7.M(2) NMAC. The proposed changes meet the standards of a "minimal impact mining operation" addressed in Subsection M, Paragraph 2 of 19.10.1. 7 NMAC.

E. The Director has provided notice of the permit modification request to other government agencies deemed appropriate (the NM Environment Department, the NM Department of Game and Fish, the NM Department of Cultural Affairs, the Office of the State Engineer, and the U.S. Bureau of Land Management), in accordance with 19.10.4.406.C(3) NMAC, and requested comments from these agencies. MMD provided the Permittee with comments from these agencies through a letter, dated August 2, 2013.

F. The Permittee is not in violation of the terms of the Permit, or any other permit issued by the Director, nor is in violation of a substantial environmental law or substantive regulation at another mining operation, nor has forfeited or had forfeited financial assurance in connection with another mining, reclamation or exploration permit, nor has demonstrated a pattern of willful violations of the Act or other New Mexico environmental statutes.

G. The Permit and Permit Modification do not grant or create any property rights. Nor does MMD, by issuing this Permit or otherwise, make any comment on the surface or mineral rights that the Permittee may or may not have in the area covered by the permit; only that the Permittee has provided a statement of basis on which the Permittee has a right to enter the property to conduct mining and reclamation. Permittee is solely responsible to take whatever steps are necessary to ensure that Permittee has property rights sufficient to support the activities contemplated by the Permit.

H. **This permit is to expire June 6, 2014** [§19.10.405.4.A (1) NMAC]. If NMCC decides to continue exploration and/or reclamation activities beyond that date, a request to renew the permit must be submitted at least 30 days before the date of expiration [§19.10.4.405.C (2) NMAC]. In addition, at the end of the project, NMCC will need to file a termination report based on the requirements of 19.10.4.407 NMAC.

Section 11 (13-1). CONCLUSIONS OF LAW

A. The Request for Permit Modification is complete, accurate and complies with the requirements of the Act and 19.10.3.302 NMAC.
B. The request for replacement of FA is complete and accurate and complies with the requirements of the Act and 19.10.12.1209 NMAC.

All other provisions, modifications, and revisions for exploration, mining, and reclamation contained in the Copper Flat 2 Project, Permit No. SI025EM, remain unchanged. This Permit will expire on

CERTIFICATION

I certify that I have read, understand and will comply with the requirements of the Permit and Permit Modification. I further certify that I am not in violation of the Act or 19.10 NMAC. I also agree to comply with the performance and reclamation standards and requirements of the Permit, the Rules, and the Act, and allow the Director to enter the Permit Area without delay for the purpose of conducting inspections during exploration and reclamation.

Raymond Irwin
Authorized Representative of the Permittee

V.P of Eploration____________________
Title

New Mexico Copper Corporation____________________
Company Name

Subscribed and sworn to before me this 7th day of November, 2013

[signature]
Notary Public

My Commission Expires

1-27, '16

Official Seal
DARLENE D. GUTIERREZ
Notary Public
State of New Mexico
My Commission Expires 1-27-16

ORDER

NOW THEREFORE, IT IS HEREBY ORDERED that Permit Modification 13-1 to Permit No. SI025EM, which changes the locations of eight (8) previously approved drill pads, and allows for a reduction of the required financial assurance amount, is approved. The Permit may not be transferred without approval by the Director. The Permit is subject to all conditions set out in the Director's Findings of Fact, Conditions and Conclusions of Law.

By Order of the Director, Mining and Minerals Division, Energy, Minerals and Natural Resources Department, of the State of New Mexico.

By: ______________________
Fernando Martinez, Director
Mining and Minerals Division
Energy, Minerals and Natural Resources Department

Date: 12/3/2013

Mine Name: _Copper Flat Mine_____________
Permit No. _S1025EM, Permit Modification 13-1________________

Energy Minerals and Natural Resources Department
Mining and Minerals Division
Mining Act Reclamation Program
1220 South St. Francis Drive
Santa Fe, NM 87505

Re: Certificate of Deposit Agreement for Financial Assurance for Copper Flat Mine, MMD Permit No. S1025EM, Permit Modification 13-1

A. Agreement Established

This Agreement between Wells Fargo Bank of Albuquerque, NM and New Mexico Copper Corporation, and the State of New Mexico, Mining and Minerals Division of the Energy, Minerals and Natural Resources Department (MMD) or its successor agencies, and the U.S. Bureau of Land Management (BLM) or their successor agencies, establishes financial assurance for the operations and reclamation of the Copper Flat Exploration Project owned by New Mexico Copper Corporation pursuant to MMD Permit No. S1025EM according to the New Mexico Mining Act and the New Mexico Mining Act Rules (19.10NMAC). The Operator is a sole proprietor and its principal place of business is Albuquerque, NM.

B. Instrument

The Operator hereby assigns and pledges to MMD, and the BLM, the Instrument, together with all renewals and extensions thereof, described below to guarantee the Operator's performance of the requirements of the New Mexico Mining Act and the New Mexico Mining Act Rules for the above referenced permit and associated closeout plan. The Instrument is a Certificate of Deposit issued by the Bank in the initial deposit face amount of $133,200.00, together with all interest earned thereon which shall accrue to the Certificate of Deposit and shall be applied to increase its face amount upon all renewals at conclusion of maturity periods. The Instrument is identified by the Bank as follows:

Certificate of Deposit No. 7658769315, Issued on November 7, 2013, in the initial deposit amount of $133,200.00, together with all interest earned thereon which shall become part of the Certificate of Deposit.

The Certificate of Deposit shall be deposited with the Bank by the Operator, shall be pledged and assigned to the State of New Mexico, and shall be placed on hold by the Bank and held by the Bank for the benefit of MMD and BLM until such time as MMD and BLM may consent to release of the Certificate of Deposit by the Bank. Funds pledged and assigned must be the property of the Operator. MMD and BLM shall not accept any third party or multi-party instruments. The Certificate of Deposit provides financial assurance, in part, to MMD and BLM for Operator's obligations under the New Mexico Mining Act and the New Mexico Mining Act Rules. MMD may require Operator to pledge additional final assurance pursuant to the New Mexico Mining Act and the New Mexico Mining Act Rules. The funds represented by the Certificate of Deposit may only be accessed for withdrawal by MMD and BLM pursuant to Paragraphs C, D, E and/or F, below and may not be withdrawn or cancelled except upon the approval of MMD and BLM.

C. Terms

The Bank and Operator hereby agree to, and the MMD and BLM, approve the following:

1) The original Certificate of Deposit shall be in the possession of the Bank. The funds identified in paragraph B, above, shall be maintained in federally-insured (FDIC or equivalent) accounts until release or forfeiture of the deposited funds pursuant to Paragraphs D or E, below;

2) the Operator shall be responsible for payment of all maintenance fees associated with the Certificate of Deposit;

3) the Operator shall be responsible for payment of all federal and state taxes on interest earned by the Certificate of Deposit;

4) for the duration of this Agreement and any renewals, the Bank waives all rights of set off and liens or any other claims which it now has or might, in the future, have against the Certificate of Deposit;

5) the Bank shall notify the U.S. Internal Revenue Service that Operator is responsible for federal taxes on interest earned by the Certificate of Deposit;

6) the Bank shall automatically renew the Certificate of Deposit, at conclusion of all maturity periods, for the same term as that for which originally issued;

7) All interest earned by the Certificate of Deposit shall accrue to the Certificate of Deposit and shall be applied by the Bank to regularly increase the face amount of the Certificate of Deposit upon automatic renewals, at conclusion of all maturity periods, and the Bank shall notify MMD in writing of the increased face amount of the Certificate of Deposit upon all renewals;

8) the Bank and the Operator shall comply with paragraphs D and E, below;

9) the Bank and the Operator authorize MMD and BLM to present the original financial assurance agreement and to withdraw any portion or all of the moneys of the Certificate of Deposit from the Bank at any time, if conditions of paragraphs D or E, as appropriate, are met;

10) the Bank acknowledges that the Certificate of Deposit is pledged and assigned to the State of New Mexico and the United States and may be collected by MMD and BLM according to the terms of this paragraph C or the requirements of paragraph E, as appropriate, below;

11) the Bank acknowledges and agrees to act as a custodian of the funds represented by the Certificate of Deposit and as agent for MMD and BLM.

D. Conditions for Release

Once all reclamation obligations under the Permit have been completed and approved by MMD and BLM, the period of liability for the financial assurance has expired, and the requirements of 1210.A, 1210.B, 1210.D and 1210.G of the New Mexico Mining Act Rules been met, MMD and BLM will release to the Operator all or part of the financial assurance for the entire permit area, or incremental area, for the mining operations conducted by the Operator under Permit No. S1025EM with MMD. The Operator shall make a written request to MMD and BLM for such release.

E. Conditions for Forfeiture

Pursuant to 1201.C and 1207.C of the New Mexico Mining Act Rules, financial assurance is conditioned upon the performance of all the requirements of the New Mexico Mining Act, Subpart 12 of the New Mexico Mining Act Rules, and the mine permit and closeout plan designated as Permit No, S1025EM with MMD. If the Operator refuses or is unable to conduct or complete obligations under the permits, if the terms of the permits are not met, or if the Operator defaults on the conditions under which the financial assurance was accepted, MMD and BLM shall take action pursuant to 1211 of the New Mexico Mining Act Rules to forfeit all or part of the instruments identified in paragraph B, above. The Bank shall pay MMD and BLM upon written demand by MMD and BLM and presentation of this Agreement, without further notice to, consent of, or endorsement by the Operator. Any delay by MMD and BLM in enforcing their rights to the Certificate of Deposit shall not affect MMD's and BLM's rights to the funds. This Agreement shall terminate upon written release of the Certificate of Deposit by MMD and BLM, according to paragraph D, above, or upon forfeiture of the Instrument as provided in this paragraph E.

F. Access to Financial Assurance Instruments

The Certificate of Deposit identified in paragraph B, above, may be accessed by the MMD and BLM for: (a) the purpose of releasing all or part of the funds contained therein back to the Operator once the requirements in paragraph D, above, have been met, or (b) for the purpose of forfeiting all or part of the funds contained therein to MMD and BLM if the requirements in paragraph E, above, are met.

G. Bank Liability

Pursuant to 1207.E of the New Mexico Mining Act Rules, the Bank shall provide prompt notice to MMD, BLM, and the Operator by certified mail of any administrative or judicial action filed or initiated involving the insolvency or bankruptcy of the Bank or alleging any violations which would result in suspension or revocation of the Bank's charter or license, and upon the incapacity of the Bank by reason of bankruptcy, insolvency, suspension or revocation of the Bank's charter or license or for any other reason, the Operator will be deemed to be without financial assurance. The Bank will not be held liable for any dispute between the Operator and MMD and BLM. The Bank shall be liable to MMD and BLM for any and all losses to the principal amount of the funds caused in any manner whatsoever during the term of this agreement.

Agreement by Bank and Operator:

The foregoing instrument is agreed upon as shown below by signatures of authorized representatives.

______________________	Raymond Irwin
Authorized Bank Agent	Authorized Agent for Operator
Wells Fargo of Albuquerque	Tax I.D. No. **80-0612011**
Philip Le	Raymond Irwin, V.P. Exploration
Business Development Officer	
Printed Name, Authorized Bank Agent	Printed Name, Authorized Agent

Acknowledgement of Authorized Bank Agent:

On this 7th day of November, 2013, before me appeared Raymond Irwin to me personally known, who, being by me duly sworn, did depose and say that he is a duly authorized official of the **Wells Fargo of Albuquerque**, that the Agreement was signed on behalf of the Bank by the authority of its board of Directors, and acknowledged said Agreement to be a free act and deed of the Bank.

In witness whereof I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written,

OFFICIAL SEAL
DAVID B. TETRAULT
Notary Public
State of New Mexico
My Commission Expires 03/04/2015

____
Notary Public

My Commission Expires: 03/04/2015

Acknowledgement of Authorized Agent of the Operator:

On this 7th day of November, 2013, before me appeared Raymond Irwin, to me personally known, who, being duly sworn, did depose and say that he signed the attached Agreement and acknowledged said Agreement to be a free act and deed.

In witness whereof I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

____
Notary Public

Official Seal
DARLENE D. GUTIERREZ
Notary Public
State of New Mexico
My Commission Expires 1-27-16

My Commission Expires: 1-27-16

Approval by Authorized Representative of Mining and Minerals Division:

The foregoing instrument was approved by me this 3rd day of December, 2013.

By: ______________________
Director, Mining and Minerals Division

Printed Name: Fernando Martinez
Director, Mining and Minerals Division

Approval by Authorized Representative of the Bureau of Land Management:

The foregoing instrument was approved by me this 3rd day of December, 2013.

By: Ida T. Viarreal
U.S. Bureau of Land Management

Printed Name: Ida T. Viarreal
U.S. Bureau of Land Management

Mine Name: Copper Flat Mine
Permit No.: SI025EM

Energy Minerals and Natural Resources Department
Mining and Minerals Division
Mining Act Reclamation Program
1220 South St. Francis Drive
Santa Fe, NM 87505

Re: **Certificate of Deposit Agreement for Financial Assurance for New Mexico Copper Corp, Exploration Project, MMD Permit No. SI025EM**

A. Agreement Established

This Agreement between Citizens Bank (Bank) of Las Cruces, NM and New Mexico Copper Corporation (Operator), and the State of New Mexico, Mining and Minerals Division of the Energy, Minerals and Natural Resources Department (MMD) or its successor agencies, and the U.S. Bureau of Land Management (BLM) or their successor agencies, establishes financial assurance for the operations and reclamation of the Copper Flat Exploration Project owned by New Mexico Copper Corporation pursuant to MMD Permit No. SI025EM according to the New Mexico Mining Act and the New Mexico Mining Act Rules (19.10NMAC). The Operator is a corporation and its principal place of business is Albuquerque, NM.

B. Instrument

The Operator hereby assigns and pledges to MMD, and the BLM, the Instrument, together with all renewals and extensions thereof, described below to guarantee the Operator's performance of the requirements of the New Mexico Mining Act and the New Mexico Mining Act Rules for the above referenced permit and associated closeout plan. The Instrument is a Certificate of Deposit issued by the Bank in the initial deposit face amount of $241,710.00 together with all interest earned thereon which shall accrue to the Certificate of Deposit and shall be applied to increase its face amount upon all renewals at conclusion of maturity periods. The Instrument is identified by the Bank as follows:

Certificate of Deposit No. 0124190728, Issued on May 2, 2012, in the initial deposit amount of $241,710.00, together with all interest earned thereon which shall become part of the Certificate of Deposit.

The Certificate of Deposit shall be deposited with the Bank by the Operator, shall be pledged and assigned to the State of New Mexico, and shall be placed on hold by the Bank and held by the Bank for the benefit of MMD and BLM until such time as MMD and BLM may consent to release of the Certificate of Deposit by the Bank. Funds pledged and assigned must be the property of the Operator. MMD and BLM shall not accept any third party or multi-party instruments. The Certificate of Deposit provides financial assurance, in part, to MMD and BLM for Operator's obligations under the New Mexico Mining Act and the New Mexico Mining Act Rules. MMD may require Operator to pledge additional final assurance pursuant to the New Mexico Mining Act and the New Mexico Mining Act Rules. The funds represented by the Certificate of Deposit may only be accessed for withdrawal by MMD and BLM pursuant to Paragraphs C, D, E and/or F, below and may not be withdrawn or cancelled except upon the approval of MMD and BLM.

C. Terms

The Bank and Operator hereby agree to, and the MMD and BLM, approve the following:

1) The original Certificate of Deposit shall be in the possession of the Bank. The funds identified in paragraph B, above, shall be maintained in federally-insured (FDIC or equivalent) accounts until release or forfeiture of the deposited funds pursuant to Paragraphs D or E, below;

2) The Operator shall be responsible for payment of all maintenance fees associated with the Certificate of Deposit;

3) the Operator shall be responsible for payment of all federal and state taxes on interest earned by the Certificate of Deposit;

4) for the duration of this Agreement and any renewals, the Bank waives all rights of set off and liens or any other claims which it now has or might, in the future, have against the Certificate of Deposit;

5) the Bank shall notify the U.S. Internal Revenue Service that Operator is responsible for federal taxes on interest earned by the Certificate of Deposit;

6) the Bank shall automatically renew the Certificate of Deposit, at conclusion of all maturity periods, for the same term as that for which originally issued;

7) All interest earned by the Certificate of Deposit shall accrue to the Certificate of Deposit and shall be applied by the Bank to regularly increase the face amount of the Certificate of Deposit upon automatic renewals, at conclusion of all maturity periods, and the Bank shall notify MMD in writing of the increased face amount of the Certificate of Deposit upon all renewals;

8) the Bank and the Operator shall comply with paragraphs D and E, below;

9) the Bank and the Operator authorize MMD and BLM to present the original financial assurance agreement and to withdraw any portion or all of the moneys of the Certificate of Deposit from the Bank at any time, if conditions of paragraphs D or E, as appropriate, are met;

10) the Bank acknowledges that the Certificate of Deposit is pledged and assigned to the State of New Mexico and the United States and may be collected by MMD and BLM according to the terms of this paragraph C or the requirements of paragraph E, as appropriate, below;

11) the Bank acknowledges and agrees to act as a custodian of the funds represented by the Certificate of Deposit and as agent for MMD and BLM.

D. Conditions for Release

Once all reclamation obligations under the Permit have been completed and approved by MMD and BLM, the period of liability for the financial assurance has expired, and the requirements of 1210.A, 1210.B, 1210.D and 1210.G of the New Mexico Mining Act Rules been met, MMD and BLM will release to the Operator all or part of the financial assurance for the entire permit area, or incremental area, for the mining operations conducted by the Operator under Permit No. SI025EM with MMD. The Operator shall make a written request to MMD and BLM for such release.

E. Conditions for Forfeiture

Pursuant to 1201.C and 1207.C of the New Mexico Mining Act Rules, financial assurance is conditioned upon the performance of all the requirements of the New Mexico Mining Act, Subpart 12 of the New Mexico Mining Act Rules, and the mine permit and closeout plan designated as Permit No. SI025EM with MMD. If the Operator refuses or is unable to conduct or complete obligations under the permits, if the terms of the permits are not met, or if the Operator defaults on the conditions under which the financial assurance was accepted, MMD and BLM shall take action pursuant to 1211 of the New Mexico Mining Act Rules to forfeit all or part of the instruments identified in paragraph B, above. The Bank shall pay MMD and BLM upon written demand by MMD and BLM and presentation of this Agreement, without further notice to, consent of, or endorsement by the Operator. Any delay by MMD and BLM in enforcing their rights to the Certificate of Deposit shall not affect MMD's and BLM's rights to the funds. This Agreement shall terminate upon written release of the Certificate of Deposit by MMD and BLM, according to paragraph D, above, or upon forfeiture of the Instrument as provided in this paragraph E.

F. Access to Financial Assurance Instruments

The Certificate of Deposit identified in paragraph B, above, may be accessed by the MMD and BLM for: (a) the purpose of releasing all or part of the funds contained therein back to the Operator once the requirements in paragraph D, above, have been met, or (b) for the purpose of forfeiting all or part of the funds contained therein to MMD and BLM if the requirements in paragraph E, above, are met.

G. Bank Liability

Pursuant to 1207.E of the New Mexico Mining Act Rules, the Bank shall provide prompt notice to MMD, BLM, and the Operator by certified mail of any administrative or judicial action filed or initiated involving the insolvency or bankruptcy of the Bank or alleging any violations which would result in suspension or revocation of the Bank's charter or license, and upon the incapacity of the Bank by reason of bankruptcy, insolvency, suspension or revocation of the Bank's charter or license or for any other reason, the Operator will be deemed to be without financial assurance. The Bank will not be held liable for any dispute between the Operator and MMD and BLM. The Bank shall be liable to MMD and BLM for any and all losses to the principal amount of the funds caused in any manner whatsoever during the term of this agreement.

Agreement by Bank and Operator:

The foregoing instrument is agreed upon as shown below by signatures of authorized representatives.

Authorized Bank Agent	Authorized Agent for Operator
Name of Bank	Tax I.D. No. **80-0612011**
Citizens Bank of Las Cruces	
[signature]	[signature]
Jerry Stagner	Raymond Irwin,
Printed Name, Authorized Bank Agent	Printed Name, Authorized Agent

Acknowledgement of Authorized Bank Agent:

On this 3rd day of May, 2012, before me appeared Jerry Stagner to me personally known, who, being by me duly sworn, did depose and say that he is a duly authorized official of Citizens Bank of Las Cruces, that the Agreement was signed on behalf of the Bank by the authority of its board of Directors, and acknowledged said Agreement to be a free act and deed of the Bank.

In witness whereof I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written,

[signature]
Notary Public

My Commission Expires: 5-28-2012

Acknowledgement of Authorized Agent of the Operator:

On this 3 day of May, 2012, before me appeared Raymond Irwin, to me personally known, who, being duly sworn, did depose and say that he signed the attached Agreement and acknowledged said Agreement to be a free act and deed.

In witness whereof I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

[signature]
Notary Public

My Commission Expires: 9/12/13

Approval by Authorized Representative of Mining and Minerals Division:

The foregoing instrument was approved by me this 8th day of May, 2012.

By: ____________________
Director, Mining and Minerals Division

Printed Name: Fernando Martinez
Director, Mining and Minerals Division

Approval by Authorized Representative of the Bureau of Land Management:

The foregoing instrument was approved by me this 8th day of May, 2012.

By: Ida T. Viarreal
U.S. Bureau of Land Management

Printed Name: Ida T. Viarreal
U.S. Bureau of Land Management

Reid, Brad, NMENV

From:	Katie Emmer <kemmer@themacresourcesgroup.com>
Sent:	Thursday, December 05, 2013 11:48 AM
To:	Myers, Kevin, OSE; cuddy, alan, OSE
Cc:	Haywood, Doug; Dave Henney (dhenney@mangi.com); Nash, Mohammad H (mhnash@blm.gov); Durr, Corey W (CDurr@blm.gov); Catherine Robinson; ctd@lrpa-usa.com; Michael Jones (mjones@shomaker.com); Steve Raugust; Jeffrey Smith; Vollbrecht, Kurt, NMENV; Reid, Brad, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD
Subject:	CuFlat: Comment Resolution re GW model report
Attachments:	NMCuGwModelCommentResponse2013Dec5.pdf

Kevin and Alan,

Attached please find JSAI's responses and resolutions to OSE comments, received in your letter to Chris Eustice of MMD dated November 22, 2013, regarding the report *Model of groundwater flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra Count, New Mexico*. A hard copy along with a CD with data will follow via FedEx.

We are pleased to hear that you agree that overall the revised numerical model will be an adequate tool for future simulations of the proposed Copper Flat Project. As noted in the attached document, JSAI has revised the numerical model per OSE comments and rerun simulations; results were nearly identical to previous results.

We anticipate revising the groundwater model report after all interested agencies have submitted comments. If you have additional comments after you review these responses, please don't hesitate to contact us and we'll respond as quickly as possible.

I have copied BLM, Mangi, NMED and MMD on this transmission so that these groups may be familiar with your comments and JSAI responses.

If anyone has questions please feel free to contact me.

Best regards,

Katie Emmer | Permitting & Environmental Compliance Manager

M: +1 505.400.7925| **F:** +1 505.881.4616

A: 2424 Louisiana Blvd. NE, Suite 301, Albuquerque, NM 87110

W: themacresourcesgroup.com | **E:** kemmer@themacresourcesgroup.com

THEMAC RESOURCES

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www.shomaker.com

TECHNICAL MEMORANDUM

To: Katie Emmer, THEMAC Resources kemmer@themacresourcesgroup.com
New Mexico Copper Corporation

From: Michael A. Jones, Principal Hydrologist

Date: December 5, 2013

Subject: Groundwater model report comment resolution, Copper Flat Mine

The purpose of this memorandum is to address N.M. Office of the State Engineer (OSE) comments on the report *Model of groundwater flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico* (groundwater model report) prepared by John Shomaker & Associates, Inc. (JSAI) on August 22, 2013, and on the numerical groundwater flow model that the report documents.

Below are the OSE comments, followed by responses in blue text. These suggestions will be gathered together with responses to any other review comments, for an eventual revision of the report. Changes to the model (as opposed to changes that only affect the report) are noted in **bold blue text**.

JSAI will revise and re-issue the report once comments from all interested agencies are received. The report re-issue date is anticipated to be in January 2014.

General Comments

After revising the numerical model based on comments below, JSAI should rerun the steady-state, historical transient and aquifer test model simulations. In all likelihood, the changes are not substantive enough to significantly modify the results provided in the Report and existing numerical model files. Overall, the revised numerical model will be an adequate tool for future simulations of the proposed Copper Flat Project. However, NMOSE will review the revised numerical model, simulation results, and responses to comments. JSAI has revised the numerical model and rerun the simulations. Results were nearly identical to the previous. The revised model input files have been sent to OSE. The changes to the model are noted below in **bold blue text**.

The prominent feature of a 13-mile continuous north to south graben (Palomas Graben) with high transmissivity in Layer 2 and Layer 3 appears to control the drawdown and surface depletion results. The Palomas Graben in the conceptual model and geologic map appears to have fault segments a few miles in length with trends varying from north northeast to north northwest. The model makes a reasonable fit between the simulated water levels and water levels observed during the 2012 aquifer test using adjusted aquifer properties near the Palomas Graben and the wellfield. However, NMCC should provide more justification for the presence of the Palomas Graben throughout the full north to south extent of the numerical model with emphasis on whether the geology, hydrology and well control support the graben's presence. Alternatively, the vertical and horizontal extent and properties for the Palomas Graben may have greater uncertainty than is suggested by the Report. JSAI will further elaborate the basis of the conceptual model. Some of this is reflected in responses to comments below.

Specific Comments

Numerical Model Geology

1. Layer 2, Rows 14 thru 26, Columns 20 thru 47; and Rows 71 thru 76, Columns 17 thru 54. Older Paleozoic sedimentary formations overlie younger andesite. Provide a correction or an explanation for this layering of units within the numerical model consistent with the conceptual model. The andesite volcano intruded through the Paleozoic sequence. As the base of the volcano becomes wider with depth, the andesite necessarily underlies the older Paleozoic sequence. JSAI will include in the final report any available well data that show andesite beneath Paleozoics.
2. Layer 3, Columns 68 thru 71. Most of the numerical model has Paleozoic sedimentary formations overlying Cenozoic age Santa Fe Group. Provide a correction or an explanation for this layering of units within the numerical model consistent with the conceptual model. **The model designation in layer 4 has been corrected.**
3. Layer 3, Row 20, Column 84; and Layer 3, Row 21, Column 85. Two isolated cells of sedimentary rocks may have incorrectly been assigned this rock type and should be Santa Fe Group. **The model designation of the cells has been corrected**
4. Layers 3 and 4, Row 65, Column 65. Explain the rationale for the box faults that isolate these model cells. This feature was developed experimentally in the evaluation of water-level calibration at MW-4. MW-4 is located close to the fault that impounds water beneath the tailings impoundment (Fig. 4.3), and the measured water levels do not match those on either side of the fault. The feature was left in the model as a better reproduction of the intermediate water level at MW-4, but is not significant to any other model results.
5. Layers 3 and 4. The thicknesses in these layers extend 4,000 feet below the nearest well control for Santa Fe Group thicknesses. Other than geologic cross section in Figure 4-2, provide subsurface info that justifies a Santa Fe Group total thickness of up to 6,000 feet. Section 4.1.3 references Lozinsky (1986). JSAI will elaborate.
6. Layers 2, 3 and 4. The Palomas Graben does not seem realistic in terms of geology and hydrology. Provide a plausible explanation of the conceptual model (geologic setting and depositional environment) for the resultant geometry and aquifer characteristics for the Palomas Graben 13-mile-long zone of high transmissivity. The Rio Grande rift consists of a series of North-South-trending faults that step down from the uplift on the west to the axis of the Rio Grande on the east. Mini-grabens can form between the faulted blocks and lead to south-flowing drainages parallel to the Rio Grande, as occurs with the Rio Puerco in the Albuquerque Basin.

   It is reasonable to assume that the parallel sets of faults would have a similar north-south extent as the Animas Uplift. Section 4.1.3 references faults mapped by Harrison et al. (1993) as evidence of the northward extension of the graben. JSAI will expand further the discussion of the existence and extent of the graben.

Numerical Model Hydraulic Conductivity (K)

7. Layer 2, Row 25, Column 85 and vicinity. Modify split zones of hydraulic conductivity (K) that create a low K in layer 2 between high K of Layers 1 and 3. **This feature has been eliminated from the model, while still simulating the large vertical gradients in the area.**
8. Layers 2 and 3, Rows 1 thru 9, Columns 8 thru 11. Modify low permeability Paleozoic sediments over higher permeability bedrock. **The model designation of cells in this area has been homogenized between the layers.**
9. Layer 1, Columns 107 thru 109. Explain rationale for vertical anisotropy being extremely low. This area, at the bottom of the valley, has a large thickness of bedded sediments, with the occurrence of extensive fine-grained beds. Bedded sediments are automatically anisotropic, with vertical permeability most influenced by the lowest-permeability layers. Anisotropy also increases with thickness of the sequence. The model is calibrated to reproduce the vertical gradients in the area.
10. Layers 2, 3 and 4. Explain rationale for vertical anisotropy being too high (e.g., 1) for some zones of the Santa Fe Group (the Palomas Graben, for example). The Palomas Graben is interpreted as filled with coarser-grained sediments than the surrounding Santa Fe Group deposits. Section 7.1 discusses the sensitivity of simulated aquifer test results to anisotropy in the Palomas Graben, indicating the graben has large vertical permeability. The graben is therefore simulated as an isotropic unit.

Numerical Model River Cells

11. Layer 1, Rows 56 & 57, Column 109. River cells present in Layer 1, yet these model cells are already general head boundaries representing the Rio Grande. This is redundant. It is redundant. Removal of either the RIV2 or the GHB boundary conditions (but not of both) would not change model results.
12. Layer 1, eastern portion. Identify what river cells (e.g., portions of Las Animas Creek and other Rio Grande Tributaries within model grid) have perennial surface flow near the Rio Grande. The model was designed with steady-state (not seasonal) boundary conditions for the river cells. The river cells therefore provide recharge along the entire length of the streams, and locations of perennial and intermittent reaches are not simulated in the model.

    Seasonal boundary conditions (monthly runoff inputs) would be required to distinguish between perennial and intermittent reaches within the model. These were not used, for simplicity of computing effects, and because information does not exist to usefully represent the surface flow component of the shallow groundwater-surface-water system along Las Animas Creek, with interrelated water balance components including runoff from storm events, seasonal runoff from snowmelt, diversion of surface flows, return flows, discharge from flowing wells, pumping of shallow wells and consumption by riparian and irrigated vegetation.

    The model therefore treats the shallow system along Animas Creek as a single system, computing changes in flow to the system and changes in discharge (ET, baseflow, wells) from it.

Numerical Model General Head Boundaries (GHBs)

13. Layers 2, and 3, Palomas Graben. Provide a hydrologic justification of the GHBs at the north and south ends of the Palomas Graben. JSAI will include discussion of these in the sensitivity section, and in the general discussion of the existence/extent of the graben.
14. Rio Grande GHBs; Rows 58 thru 64; Figure 6.6 and Page 52. Provide explanation of how the conductances were calculated for the Rio Grande GHBs, and explain variation in Rows 58 thru 64. The GHB conductances were set large enough to nearly act as constant-head boundaries, so projection results are not sensitive to GHB conductance. The highest-transmissivity section of aquifer is along the axis of Animas Creek, so GHB conductances are larger in this section.

Numerical Model Drains

15. Layer 2. Identify which drain cells represent actively-flowing artesian wells. JSAI will identify which of the model-simulated artesian well locations actually simulate flow at the end of 2013.

Model Report

16. Page 11, Figure 3.2, Table 3.4. Explain process to estimate irrigated and riparian acreages along Percha Creek, Las Animas Creek and Caballo Lake. The areas shown on Figure 3.2 were delineated based on visual examination of satellite images, and are approximate, as are the effective evapotranspiration rates estimated on Page 10, last paragraph.
17. Page 18, Figure 4.3 and Figure 4.4 Figure 4.4 transforms the segments of faults into continuous north-south features for Las Palomas Graben. Provide more explanation for the significant extension of Las Palomas Graben faults represented in Figure 4.4 when compared to Geologic map in Figure 4.3. JSAI will elaborate further on the extent of the structural features and their role in the conceptual model of groundwater flow.
18. Page 22. Text cites relative low artesian pressures at less than 10 feet head above land surface. However, the LA-228 well pressure was about 26 feet above land surface or 12 psi. Note that the variability of declining pressures may be, at least in part, due to deterioration or lack of sealant. Surface discharge declines may not represent a corresponding decline in pressures without knowing adequacy and integrity of well seal. The observation is correct; artesian pressures and flows are highly variable for unknown local well-specific reasons that are not reflected in the model. The operation of artesian wells, their construction details, and the degree of hydraulic communication between each well and deep and shallow aquifers are unknown. Therefore effects on individual artesian wells are difficult to distinguish from effects on ET or river discharge.
19. Pages 40-41; Figure 5.22; and Table 5.3. As mentioned as a caution by Davie and Spiegel (1967), note that seasonality of measurements is not accounted for in the limited time series data for measured artesian flow rates. As shown in Table 1 in Appendix 8-H of NMCC BDR, flow rates may span 2 to 4 seasons for the wells shown in Figure 5.22. Local impacts from nearby wells may be more likely during irrigation season. Based on changes in total depth and well diameter, some Figure 5.22 wells were re-drilled or recompleted. The observation is correct; JSAI will add to the discussion, thereby putting into context model results involving flowing wells.
20. Page 42; Pages 34-35, Section 5.2.4; and Appendix C.4. The 2012 to 2013 aquifer test has a two paragraph description in Section 5.2.4 that lacks qualitative observations and

quantitative interpretation of data. The use of the model to interpret the aquifer test in Section 6.4.3 comes after aquifer properties are tabulated in Table 6.1. The Section 6.4.3 model analyses of the aquifer test does not indicate what aquifer properties were determined from fitting simulated to observed water levels. Since the aquifer test results have not previously been reported, supplement the existing text with more specific observations and analysis of the aquifer test. JSAI will elaborate in section 5.2.4 on the results of the aquifer test, in order to connect with, and put in context, section 6.4.3 and table 6.1.

21. Page 42. Model simulation numbers 5 and 6 do not indicate a duration for simulation of new mining or post-mining period. These simulations are not part of the Report. Model projections involve potential scenarios of varying duration and production rates, and so are reported separately as required.
22. Table 6.2. Table 6.2 shows Palomas Graben East fault is not a significant barrier to groundwater flow based on the fault barrier conductance of 1. In contrast, Palomas Graben West fault is a significant barrier to groundwater flow. As written, the text provides multiple sources of information that may have contributed to the estimation of fault barrier conductances. If these properties are based in part on the 2012-2013 aquifer test, there should be specific mention of this interpretation. JSAI will elaborate on the role of fault barriers and conductances, versus the role of permeability contrasts, in the sensitivity section and in the discussion of the aquifer test interpretation.
23. Page 68, and Figure 6.28. The model estimates 2,400 af/yr of flow from artesian well discharge. Text indicates no data to support this quantity of flow. Provide citation to NMCC Base Line Data Report, which has some information regarding estimates of artesian flows. JSAI will elaborate the discussion of model results and available data to compare with.
24. Section 7.2, page 78. Informal, unpublished sensitivity analyses are not reviewable by OSE. Provide table of parameters and ranges of values used for the sensitivity results described in this section. The sensitivity analysis is formal and published in Section 7.2. The details of the sample projection used were not discussed at length, to avoid confusion with published projections. JSAI will elaborate discussion of the sensitivity analysis in order to demonstrate the conclusions without confusing the reader about different mining scenarios.
25. Section 7.2. Provide more detail about placement of GHB boundaries at north and south ends of Las Palomas Graben. Provide sensitivity results that show aquifer test calibration when Palomas Graben GHB boundaries are removed. JSAI will add discussion of the north-south GHB's to chapter 6, and add the north-south GHBs to the sensitivity section.
26. Figure 6.4 and Figure 6.5 (similar to comment 2 above). Between faults 2 and 3, Paleozoic Age carbonate rock in layer 3 appears above layer 4 Cenozoic Age Santa Fe Group. Figure 6.5 will be updated to reflect the response to comment 2 above.

Appendices:

27. Appendix Cl. Cutting log (by geologist) and drillers log show silt and clay layers that approach 30 to 50 percent in the production wells PW-1, PW-2, PW-3 and PW-4. Provide explanation how the clay content fits conceptual model of Palomas Graben that translates into numerical model with vertical anisotropy of 1. Silt and clay are found in the PW logs, with different estimates in the driller's logs and cutting logs. There is no identification in these logs of continuous aquitard layers, and the aquifer test responses indicate the clay units do not form extensive flow-impeding layers.

Data Request

28. Aquifer Test 2012-2013: Provide data in electronic format (preferably Excel) used to create Report graphs associated with the measured flow rates and water levels for the aquifer test data. The requested electronic files are attached.

Cooperating Agencies - NMCC Meeting Notes

17 December 2013 14:00 MST
Call in: 605-475-4000 PIN 422-765

Attendee	Company	Initial	Present
Doug Haywood	BLM	D.Haywood	X
Rachel Jankowitz	NM G&F	RJ	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	
Kevin Myers	NMOSE	KM	X
Dave Henney	Mangi	D.Henney	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X
Jeff Smith	THEMAC	JS	X

Action Items from Meeting

A. NMED and THEMAC to schedule a conversation regarding Geochemistry to allow Patrick Longmire to ask questions. This call will include SRK and MMD if possible.
B. Geochemistry Addendum Reports will be finalized and submitted by THEMAC to agencies as soon as they are ready.
C. Groundwater Model Report will be revised with comments from BLM and NMOSE, likely in January 2014. We learned in this meeting LWA does not have comments. The revised report will be distributed to agencies when it's ready.
D. THEMAC is preparing a memorandum detailing Water Saving Strategies for Mangi
E. THEMAC is preparing a permitting schedule in MS Project to be discussed with agencies once it's available
F. MMD is preparing comments on THEMAC's Baseline Data Report Addendum, expected completion: end of January 2014.
G. THEMAC will give the agencies an idea of when a revised MORP and new Discharge Permit will be submitted as soon as it's known.
H. NMED and THEMAC to meet and discuss how the Copper Rule effects Discharge Permit applications, at the NMED's convenience
I. THEMAC is preparing a Stage I Abatement Plan report summarizing findings from 2013, to be submitted in early 2013.
J. NMOSE has requested access to GWQ11-27 along Animas Creek for USGS work; THEMAC agrees to this and can provide a key or contact the landowner if either is needed.
K. Next meeting date: 4 February, 14:00 MST

Discussion

1. Feasibility Study information
   JS: The 43-101 report, a summary of the Feasibility Study, has been filed with SEDAR, dated 21 November 2013. This report is available for download from SEDAR and off of THEMAC Resources website.

CE: Do the basic parameters of the Feasiblity Study match the EIS?
JS: The overall plan is the same. The processing rate has increased over time. Copper Flat has always been a low grade deposit and we are doing what we can to push down cost and increase throughput rates. The 43-101 report has a through put of just less than 30,000 TPD for the first five years, 27,000 TPD following that, slightly more than 11 years of mine life, two years construction prior to that. The Canadian stock exchange requires economic analysis; this analysis was done by the design engineer, M3. Reclamation costs were done by SRK.
CE: Is the cost third party or in house?
JS: I'd need to check but I'm pretty sure it's Davis Bacon rates – 3rd party labor costs, current salary surveys, equipment hours.
KM: Does the EIS consider the Feasibility Study?
KE: Mangi has been given a write up of what we called EIS Alt2 – this is a mine plan that is based on the Feasibility Study but slightly bigger.

2. Geochemistry Reports status
   KE:
   - As I understand it, MMD requested comments around 1 November on geochemistry reports and Patrick Longmire is working through these documents. At Patrick's request we are working to set up a call between SRK and Patrick to discuss a few questions, however our team is in the US and UK, not sure if it will be possible to do that call before the holidays.
   - Steve Raugust has addendums from SRK that he is reviewing and we hope to get to the agencies in January. These will not change the outcome of the previous reports, it will just summarize the last of the data from the last of the HCTs that were shut down in 2013.

   CE: Keep me in the loop on that conversation as it may satisfy some of MMD requirements
   Discussion: THEMAC and NMED will try to arrange a call this week, if not in January. THEMAC will let MMD know when a call is arranged so they can participate if possible.

3. Groundwater model update
   KE:
   - We have received comments from both BLM and OSE regarding the groundwater model. We have responded to comments formally in both cases and JSAI has made requested changes to the model. JSAI was going to meet with OSE to discuss how to read model results with OSE tomorrow, however Alan Cuddy has been called to jury duty. As I understand it, JSAI will meet with OSE in mid-January to take up conversations on model results.
   - BLM, OSE and Lee Wilson (Mangi's subcontractor) have all indicated that the model will suffice for the evaluation of the mine.
   - We would like to wait to revise the groundwater model report when we have comments from everyone. I understand from Kurt that NMED will not have substantial comments on the report. We expect that Lee Wilson may have comments and are hoping to receive them soon so that the groundwater model report can be revised, perhaps in January.

D.Henney: I inquired on this and have heard from Lee Wilson, he does not have comments on the Groundwater model report.

KM: OSE may do their own run of results on the groundwater model, perhaps their own sensitivity analysis.

Discussion: JSAI will be meeting with NMOSE in January regarding the model.

4. EIS status

   D.Henney: Mangi is waiting on information regarding water conservation measures, once we have that we'll be off and running. LWA has done some work on the groundwater model, CDM has been reviewing geochemistry, we've had some discussion of blasting areas in regards to cultural resources.

   HS: What are the water conservation measures being considered?
   JS: The biggest is reclaimed water from the TSF, at least 60% of the water will be recycled. The next biggest water consumption goes to dust suppression, so surfactants can decrease the water used for dust suppression. We are looking at water trucks with the technology to manage and monitor water applied to the road. We will try to manage the supernatant pond to keep it as small as possible to minimize evaporation. We will harvest storm water and the site and use it. We will have a small package treatment plant (rather than a septic tank and leach field) and treated water will go to the TSF and then be recycled in the mine. We will filter concentrates to get as much water as we can out of them before shipping.
   CE: What about the thickener and the dry stack options?
   KE: The dry stack option has been ruled out.
   JS: There is not a thickener in the Feasibility Study mine plan. Studies show thickeners do not save a lot of water in the end.
   BR: Will your package treatment plan be less than 2,000 gallons per day?
   JS: No. We figure 300 employees, although not all there at the same time. An estimate of 50 gallons per person per day x 200 people yields 10,000 gallons per day. We think the estimate is high but the plant will be sized for 10,000 gallons per day.

5. Overall permit timeline shifts

   KE: At Mangi's request we are working on a deliverable that will outline water saving strategies that are being incorporated into all of the mine plans. This memo will help Mangi address public comments regarding water use at the site. Mangi has been waiting on this information to forge ahead on their development of chapter 2.

6. Permit Application Package Status

   Discussion: MMD comments on the BDR addendum should be ready by the end of January.

   BR: The Copper Rule is more specific to copper mining, we should probably have a meeting before you turn in the revised Discharge Permit application to talk about how the Copper Rule impacts discharge permits.

Discussion: Is the Copper Rule in force, there has been a petition for a stay, they may schedule a hearing, the rule must be published in the state record to be in force, the NMED believes there are some good things about the Copper Rule.

HS: The FA rules aren't in the Copper Rule, they are in the Mining act
CE: You have probably seen the permit to drill for the exploration holes in Andrews, do you know if you will be doing that in the next month?
JS: We do not plan to drill Andrews until perhaps the second half of 2014
CE: That permit expires in 2014, if you'd like to renew we need to receive your renewal 30 days in advance.
KE: Ok, we'll keep an eye on that.

KE: Next major submissions will be:

- A revised MORP
- Discharge Permit – Revised application
- We don't have a permitting timeline solidified yet but we expect a new MORP and DP could be coming in March 2014, we'll give you a long lead time notice before these are ready.

7. Stage I Abatement Plan status

- We will be working with JSAI to create a summary of sampling results in 2013 and prepare recommendations for either additional characterization or abatement strategies in the go forward.

KM: NMOSE looks at water levels around the state and this winter the USGS will be looking at Las Animas Creek. I have requested that THEMAC's artesian well (GWQ11-27) be included along with 10 other wells.
KE: That should be no problem. Ryan Serrano has a key to that well, however if you need anything else please let us know.

Next meeting date – 4 February, 2013, 14:00 MST

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 5469, Santa Fe, NM 87502-5469
Phone (505) 827-2918 Fax (505) 827-2965
www.nmenv.state.nm.us

RYAN FLYNN
Secretary - Designate

BUTCH TONGATE
Deputy Secretary

MEMORANDUM

DATE: December 31, 2013

TO: Holland Shepherd, Program Manager, Mining Act Reclamation Program

FROM: Brad Reid, NMED Mining Environmental Compliance Section (MECS)

THROUGH: Keith Ehlert, NMED MECS, Acting Mining Act Team Leader
Kurt Vollbrecht, NMED MECS, Acting Program Manager KV

RE: Comments on Copper Flat Mine, Baseline Data Report Addendum 2, Permit No. SI027RN

On October 2, 2013, the New Mexico Copper Corporation (NMCC) submitted two documents to both the Mining and Minerals Division (MMD) and New Mexico Environment Department (NMED) Ground Water Quality Bureau titled "Predictive Geochemical Modeling of the Pit Lake Water Quality at the Copper Flat Project, New Mexico" (prepared by SRK Consulting) and "Model of Groundwater Flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico" (prepared by John Shomaker and Associates, Inc.). MMD defines these submittals the *Baseline Data Report Addendum 2* and consider them additions to the Baseline Data Report for the Copper Flat Mine permit application package, Permit No. SI027RN. On November 1, 2013, MMD sent a letter to NMED requesting that NMED provide comments on the *Baseline Data Report Addendum 2* within 60 days of receipt of said letter. NMED provides the following comments.

General Comments

The *Baseline Data Report Addendum 2* is considered part of the NMED Discharge Permit application and will be incorporated into the administrative record for DP-1. Technical review of the *Baseline Data Report Addendum 2* pursuant to the Water Quality Control Commission (WQCC) Regulations is ongoing, and as such, comments will be submitted under separate letterhead directly to NMCC with copy to MMD as these reports are critical to development of the draft Ground Water Discharge Permit. NMED will coordinate response to these documents with MMD prior to issuance of a comment letter(s) to NMCC.

If you have any questions regarding these issues, please contact Brad Reid at (505) 827-2963 or Kurt Vollbrecht, Acting Program Manager of the Mining Environmental Compliance Section, at (505) 827-0195.

Cc: Jerry Schoeppner, Bureau Chief, NMED GWQB
Kurt Vollbrecht, Acting Program Manager, NMED MECS

Reid, Brad, NMENV

From: Reid, Brad, NMENV
Sent: Monday, January 13, 2014 3:54 PM
To: 'Prestia, Amy'; 'Katie Emmer'; 'Steve Raugust'; 'Warrender, Ruth'; 'Bowell, Rob'; Vollbrecht, Kurt, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD; Longmire, Patrick, NMENV
Subject: RE: Copper Flat geochemistry 14 January 9:30 conference call - TALKING POINTS

2014-01-13 prelim Cu Flat geoc...

All,

In advance of tomorrow's conference call, NMED attaches some additional topics for discussion. Please note that these talking points are preliminary and pertain to the Geochemical Characterization Report and not the Geochemical Modeling of the Pit Lake Report. Many of the topics are germane to both reports, however. Please also note that it will likely take upwards of an hour or so to discuss these topics; hopefully the anticipated longer duration is amenable to everyone's schedule. Brad

---

From: Reid, Brad, NMENV
Sent: Tuesday, January 07, 2014 1:49 PM
To: 'Prestia, Amy'; 'Katie Emmer'; Steve Raugust; Warrender, Ruth; Bowell, Rob; Vollbrecht, Kurt, NMENV; Eustice, Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD; Longmire, Patrick, NMENV
Subject: RE: Copper Flat geochemistry 14 January 9:30 conference call

Here are proposed topics to discuss during the 14 January 9:30 a.m. MST conference call:

1) Mineralogical controls and input parameters used for the PHREEQC modeling
2) Results of the simulation
3) General questions on the various leaching techniques

Please note that we will largely be discussing the document titled, "Geochemical Modeling of the Pit Lake Water Quality at the Copper Flat Project, New Mexico". As such, we will likely have additional questions upon review of the Geochemical Characterization Report and the Model of Groundwater Flow. NMED anticipates that this first discussion should take no more than 30 minutes. Thanks, Brad

Brad Reid, Geologist
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
P.O. Box 5469
Santa Fe, NM 87502
Phone: 505.827.2963; Fax: 505.827.2965
E-mail: brad.reid@state.nm.us

-----Original Appointment-----
From: Prestia, Amy [mailto:aprestia@srk.com]
Sent: Friday, January 03, 2014 12:47 PM
To: 'Katie Emmer'; Reid, Brad, NMENV; Steve Raugust; Warrender, Ruth; Bowell, Rob; Vollbrecht, Kurt, NMENV; Eustice,

Chris, EMNRD; Ennis, David, EMNRD; Shepherd, Holland, EMNRD
Subject: Copper Flat geochemistry
When: Tuesday, January 14, 2014 8:30 AM-9:30 AM (UTC-08:00) Pacific Time (US & Canada).
Where: conference call

A call to discuss the Copper Flat geochemistry is scheduled for Tuesday, January 14th at 9:30 a.m. MST. This corresponds to 8:30 a.m in Reno and 4:30 p.m. in Cardiff. The call-in information is provided below.

US
1-866-321-0159
Pin: 996783#

UK
0800 2794047
Pin – 996783#

Regards,
Amy

Amy Prestia M.S., P.G.
Senior Consultant (Geochemistry)

<< File: ATT11656 1.jpg >>

SRK Consulting (U.S.), Inc.

Suite 300, 5250 Neil Road, Reno, NV, 89502, USA

Tel: +1-775-828-6800
Fax: +1-775-828-6820
Mobile: +1-775-230-3552
Email: aprestia@srk.com

Preliminary Comments on Geochemical Characterization and Geochemical Modeling of Copper Flat Project, New Mexico

Prepared by Patrick Longmire
DOE Oversight Bureau, NMED

January 13, 2014

Geochemical Characterization Report (May 2013), SRK Consulting.

Mineralogical characterization using XRD analysis can quantify the mass of calcite present in all rock types and tailings to evaluate neutralization of sulfide phases during oxidation along with results from laboratory testing.

Are XRD results available from HCT on the various samples?

Was Eh or ORP measured during the static and kinetic tests?

Was speciation of iron(II, III), sulfur, and manganese(II, III, IV) conducted on the leachate samples to quantify redox conditions? It is likely that Eh is controlled by mixed redox potentials and speciation can help to constrain redox conditions in the field.

Were the leachates filtered (0.45 micrometer membranes) prior to ICP-MS and ICP-OES analyses?

Table 5-3. Summary of Waste Rock Acid Base Accounting Results (pg. 37)
Check acid neutralization classification of material type in legend for potentially acid forming (PAF) and non acid forming (NAF). They are switched.

Table 8-7. Equilibrium Phases (pg. 93)
Were XRD and other mineralogical characterization results used in defining the minerals listed in Table 8-7? Uranium minerals listed are of U(IV, VI) oxidation states, suggesting variable redox conditions. Have these phases been identified at Copper Flat?

Were selective extractions performed on the samples to quantify masses of ferric hydroxide-ferrihydrite used in the surface complexation-adsorption calculations?

A table showing results of mass transfer (precipitation-dissolution) calculations of equilibrated mineral phases would be useful in the discussion on simulated water chemistries.

A measured molal concentration of $CaCO_3$ (calcite) as part of model input would help quantify neutralization processes for the PHREEQC simulations.

A value of pe = 12 – pH probably is too low for aqueous solutions equilibrated with atmospheric gases (CO_2 and O_2) in the vadose zone. Values of pe = 18 – pH or pe = 20 – pH are more representative of oxidizing conditions resulting from sulfide oxidation under acidic conditions. pe = 21 – pH defines the upper stability field for water at 25°C.

Precipitation in the form of rain would have a higher pe value than 4 based on the partial pressure of oxygen gas (21 percent by volume, 0.21 atm). pe values around 13 are more representative for rainwater under acidic conditions.

Groundwater, pit lake, and tailing pore water may have pe values greater than 4, especially during oxidation of sulfide phases.

08517

Reid, Brad, NMENV

From: Katie Emmer <kemmer@themacresourcesgroup.com>
Sent: Tuesday, January 14, 2014 3:13 PM
To: Reid, Brad, NMENV; Steve Raugust
Cc: Vollbrecht, Kurt, NMENV
Subject: RE: geochemistry discussion

Understood. We do have a copy of the Copper Rule and we'll let you know if we think a sit down meeting to discuss the rule would be helpful in advance of a revised application submittal.

Thank you,

Katie

From: Reid, Brad, NMENV [mailto:brad.reid@state.nm.us]
Sent: Friday, January 10, 2014 5:12 PM
To: Katie Emmer; Steve Raugust
Cc: Vollbrecht, Kurt, NMENV
Subject: RE: geochemistry discussion

Katie,

I agree that it is probably prudent for us to get together to discuss how the Copper Rule will impact permitting of Copper Flat Mine. The Copper Rule is in effect, however, and so you guys do need to submit your application as outlined in Section 20.6.7.11 NMAC of the Supplemental Permitting Requirements for Copper Mine Facilities (link provided below).

http://www.nmenv.state.nm.us/gwb/documents/2067NMACfinal.pdf

The way Kurt envisions submittal of the application under the rule is to cite the applicable application requirement and then follow that with the necessary info. Example:

20.6.7.11.B -
B. Contact information. An application shall include:
(1) applicant's name, title and affiliation with the copper mine facility, mailing address, and telephone number;
(2) the name, mailing address and telephone number of each owner and operator of the copper mine facility;
(3) if different than the applicant, the application preparer's name, title and affiliation with the copper mine facility, mailing address, telephone number and signature;
(4) the mailing address and telephone number of any independent contractor authorized to assist the copper mine facility with compliance with the Water Quality Act and 20.6.2 NMAC and 20.6.7 NMAC; and
(5) if the person submitting the application is not the owner or operator of the copper mine facility, a certification that the person is duly authorized to submit the application on behalf of the owner or operator.

(Put Your Contact Information here).

So, take a look at the application requirements and then after that we can sit down and discuss things (if NMCC needs additional input).

Have a great weekend. Brad

From: Katie Emmer [mailto:kemmer@themacresourcesgroup.com]
Sent: Thursday, December 19, 2013 9:36 AM

To: Reid, Brad, NMENV; Steve Raugust
Cc: Vollbrecht, Kurt, NMENV
Subject: RE: geochemistry discussion

Thanks Brad, it was worth a try.

Are there some days and times you could give us that would work for geochemistry discussions after 6 January? We can start working on setting something up with you and us and SRK.

Also, I'm wondering if you'd like to schedule a time when I could come up and discuss with you and Kurt how the Copper Rule relates to the upcoming Discharge Permit application as you suggested at the meeting this week. If there are days and times that would work for you after 6 January, I am happy to put it on the calendar now.

Have a great holiday and Happy New Year!

Katie

From: Reid, Brad, NMENV [mailto:brad.reid@state.nm.us]
Sent: Thursday, December 19, 2013 8:26 AM
To: Steve Raugust
Cc: Katie Emmer; Vollbrecht, Kurt, NMENV
Subject: geochemistry discussion

Hey Guys,

Looks like it will be best to discuss the geochemistry after the New Year as working out scheduling has proven to be predictably tricky for this time of year. Have a happy holiday break everyone.

Brad Reid, Geologist
Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
P.O. Box 5469
Santa Fe, NM 87502
Phone: 505.827.2963; Fax: 505.827.2965
E-mail: brad.reid@state.nm.us

Cooperating Agencies - NMCC Meeting Notes
4 February 2014 14:00 MST

Attendee	Company	Initial	Present
Doug Haywood (via phone)	BLM	D.Haywood	X
Rachel Jankowitz	NM G&F	RJ	X
Brad Reid	NMED	BR	X
Kurt Vollbrecht	NMED	KV	X
Kevin Myers	NMOSE	KM	X
Dave Henney (via phone)	Mangi	D.Henney	X
DJ Ennis	MMD	DJE	X
Chris Eustice	MMD	CE	X
Holland Shepherd	MMD	HS	X
Katie Emmer	THEMAC	KE	X

Action Items for 4 Feb Meeting

- Proposed Meetings
  - Pit Lake Geochem call with NMED, Mangi, MMD – BR to check on scheduling
  - Site visit with Patrick Longmire – BR to let NMCC know when this would be good.
  - Technical call with Mangi, BLM, NMCC: either 7 or 8 Feb or the week of 17 Feb
  - NMCC to arrange a meeting with NMED when Stage I Report is being submitted to discuss – February or March
  - Bud Brock from OSE Dam Safety will want to do a site visit in March
- NMCC Upcoming Deliverables
  - Geochemistry addendums: By 14 Feb
  - Re-vised Groundwater Model Report: in February hopefully
  - Stage I Abatement Report on 2013 sampling: February or March
- MMD Deliverables
  - Comments on BDR expected by end of February
  - MMD to send NMED comments from OSE re: Pit Lake Report

Meeting Agenda as Discussed

1. Review and report on previous 17 December meeting action items
   - Proposed meetings
     a. Geochem call: conducted 14 Jan 2014
     b. Pit Lake geochem call: NMCC would like to schedule
     c. Copper Rule conversation: postponed until NMCC has questions
   - NMCC deliverables
     a. Water Savings Strategies and Water Balance information sent to Mangi/BLM in January
     b. Permitting schedule: still up in the air

- MMD comments on BDR: CE reports the agency comments were received by MMD in September 2013, MMD comments are being collected and should be ready by the end of February 2014.

2. Geochemistry Reports status
KE: This is being finalized this week. I will transmit to the agencies as soon as it's available, this should be before mid Feb
Discuss: NMCC would like to schedule a call to discuss P. Longmire's comments on the Pit Lake report, to include NMED, Mangi, NMCC, SRK, and MMD. Agreed it worked to set time that suits SRK and NMED and invite MMD with as much lead time as possible.
KM: Notes he provided MMD with some notes/comments on the Pit Lake report, these should be passed to NMED so that P. Longmire can review them.

3. Groundwater model: Revised Report
    - Revised Groundwater Model Report with incorporated changes (per BLM and OSE comments) is being finalized; NMCC hopes to have the report to the agencies in Feb.
    - Understand NMCC still needs to provide projections to agencies as part of required BDR

4. EIS status – Doug, Dave
D.Henney: Received a number of documents per data requests in January, had a call on the 23rd of January with BLM & THEMAC that was helpful. Mangi is working on Chapter 2 this week, then it will go to Sr. editing and from there to BLM and analysts and a curtsey copy will be provided to NMCC.
D.Haywood: I've already sent an email about this but want to reiterate that the alternatives are BLM's decision. NMCC should hold the alternatives document in confidentiality.
KE: Understood.
D.Henney: There has been a lot of information passed between LWA and JSAI, LWA will be out much of March so we're trying to get them through as much as possible now. Lee Wilson has some concern that what the has now may not match final projections, but we'll just have to see. NMCC seems confident that there will not be substantial changes.
CE: What are the alternatives being considered?
D.Henney:
The Proposed action is based on the 2010 MPO, [editor's note: 17,500 TPD total 100 Mt mine]
The 1st alternative is based on the 2012 MORP, [editor's note: 25,000 TPD 100Mt mine]
The 2nd alt is based on a document from NMCC [editor's note: 30,000 TPD, 125 Mt mine]
CE: Is there a third alternative?
D.Henney: No.
D.Haywood: But we could do some mixture of the elements from any of the alternatives.
KE: The alternatives to be evaluated are up to the BLM. We did provide the last description based on the Definitive Feasibility Study and it's based on economic analysis. It's the largest of the plans and it is the mine we'd like to build. Of course we know that what gets approved is based on the ROD and then mine permit conditions placed by MMD.

Discussion: Timeline for federal and state processes and overlap or lack thereof between them, the 2012 MORP is not what NMCC wants to build, so the revised MORP will reflect this larger mine footprint.
KV: If you turn in the largest EIS evaluated mine plan to the state in the Revised MORP, that may be better as people won't be upset if what you build is a little smaller
KE: You have a good point, we'll have to consider that.
D.Haywood: Dave, do you think you will be able to revisit the timeline soon?
D.Henney: After this next technical call I think it will be a good time to reconsider the schedule. Mangi is ready to have a follow up technical call, propose either Thursday or Friday this week, or the week of the 17th of February.

5. Overall permit timeline: This is still a question mark. Need to have internal conversations with THEMAC and understand how EIS schedule will gel once Mangi has this clear.

6. Permit Application Package Status
   - Need to submit:
     a. Geochem addendums
     b. Revised GW Model Report
     c. GW Projections
     d. MORP
   - Discussion: Revised DP Application will also be submitted, this is for the NMED and technically not part of MMD's Permit Application Package

   KE: We are interested in finding the end to comments and resolutions for BDR. Hopeful any comments on the BDR addendum can be quickly resolved. Don't want to be stuck in this loop forever. Do you anticipate any of the comments on the BDR Addendum will be substantial?
   CE: I don't believe so.
   Discussion: MMD has provided comments on the MORP, Joe Vinson may have additional comments on soils, which get mixed whether it's for the MORP or the BDR, we'll have to see what Joe's comments are.

7. Stage I Abatement Plan status: JSAI is preparing this report this month, I'll let NMED know when I have a clear submission date.
   KV: It might be good for you guys to come up once you have that report and we can sit down and have a meeting about it.
   KE: Sure, we'll call you when it's ready and we can schedule that. JSAI is working on it now, I'd expect the report in February or March.

Added discussion: KM noted that OSE dam safety bureau has assigned Bud Brock to Copper Flat. Bud will be calling Steve Raugust to set up a site visit, may want to visit the site in March.

8. Next meeting date: Upon discussion, 18 March, 14:00. Same place/call in number.