

RIO ALGOM MINING LLC – AMBROSIA LAKE FACILITY DISCHARGE PERMIT – 169 (DP-169)

Semiannual Report, Second Half 2016

Prepared for:

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ACRONYMS AND ABBREVIATIONS

ACL	alternate concentration limit
BTOC	below top of casing
DP-169	Discharge Permit – 169
DTW	depth to water
NMED	New Mexico Environment Department
NRC	Nuclear Regulatory Commission
RAML	Rio Algom Mining LLC
Site	Rio Algom Mining LLC Ambrosia Lake facility
SOP	standard operating procedure
TDS	total dissolved solids

1.0 REVIEW OF DISCHARGE PERMIT – 169

This report presents the results of monitoring and sampling activities for the second half of 2016 for the Rio Algom Mining LLC (RAML) Ambrosia Lake facility (Site) as required under New Mexico Environment Department (NMED) Discharge Permit – 169 (DP-169). DP-169 was approved on November 15, 1995, and establishes monitoring requirements for the Alluvium near the former Ambrosia Lake mill. DP-169 requires semiannual monitoring of alluvial wells for depth to water, total depth, chloride, sulfate, nitrate, and total dissolved solids (TDS). In addition, it requires semiannual and annual reporting to the NMED. In a meeting between RAML and NMED on May 4, 2015, NMED approved eliminating the annual report by including the annual reporting requirements in each of the semiannual reports.

Requirements for annual and semiannual reporting per the July 12, 2000, DP-169 Renewal Request are listed below with an explanation relative to current conditions at the Site:

1. Analytical results of the 43 alluvial wells for chloride, sulfate, and nitrate.

*Analytical results for all DP-169 alluvial wells that are still in service and meet the requirements of RAML's Groundwater Monitoring Standard Operating Procedure (SOP) have been included in **Appendix A**.*

2. Time versus concentration plots depicting chloride, sulfate and TDS concentrations for all 43 alluvial wells.

*Time versus concentration plots for chloride, sulfate, and TDS concentrations in all active DP-169 alluvial wells are included in **Appendix B**.*

3. Monthly analysis of the reservoir water for chloride, sulfate, and TDS.

Monthly analysis of the reservoir is no longer applicable as the reservoir has been reclaimed.

4. Analytical results required under the Nuclear Regulatory Commission (NRC)-approved Corrective Action Program.

The NRC-approved Corrective Action Program was terminated in 2006 when Alternate Concentration Limits (ACLs) were approved. Groundwater monitoring for the ACL well network at the Site occurs semiannually. Reports containing analytical results are produced semiannually and submitted to both NRC and NMED. Analytical results from those monitoring events are submitted under separate cover and will not be included in this report.

5. Maps depicting the water level and TDS isopleths for the alluvium.

*Maps with groundwater elevations and TDS concentrations in alluvial wells are included in **Appendices C and D**.*

6. Flume discharge volumes.

Flume discharge volumes are no longer applicable due to reclamation.

7. Analytical data on computer disc.

*Laboratory data in CSV and PDF format for the second half of 2016 are included on compact disc with this submittal (**Appendix E**).*

2.0 NRC ACLS

The NRC approved ACLs for alluvial groundwater at the Site in 2006. The ACLs address byproduct material seepage from the tailings disposal area, including but not limited to chloride, nitrate, sulfate, and TDS. The alluvial ACLs were established through review and consultation between NRC, NMED, and RAML. Alluvial ACLs are presented in **Table 1**.

Table 1. NRC-Approved ACLs for Alluvium

Constituent	ACL
Molybdenum	176 mg/L
Nickel	98 mg/L
Selenium	49 mg/L
Natural Uranium	23 mg/L
Chloride	7,110 mg/L
Nitrate	351 mg/L
Sulfate	12,000 mg/L
TDS	26,100 mg/L
Gross alpha	8,402 pCi/L
Lead-210	1,247 pCi/L
Radium-226 & 228	3,167 mg/L
Thorium-230	13,627 mg/L

3.0 ALLUVIAL GROUNDWATER MONITORING

Groundwater monitoring was performed in July and August of 2016. **Appendix A** presents the DP-169 groundwater monitoring data for the second half of 2016. All results are less than the non-hazardous ACLs established for the alluvial groundwater at the Site.

Appendix B contains time versus concentration plots for DP-169 wells. **Appendix C** contains a map showing alluvial monitoring well locations with the most recent groundwater elevation measurements. Modeling predictions projected that most of the groundwater in the alluvium will dissipate within 65 years (Maxim, 2001). Decreasing groundwater elevation measurements continue to support this prediction. **Appendix D** contains a map with TDS concentrations plotted for each sampling location. **Appendix E** is the electronic data for the second half of 2016.

4.0 GROUNDWATER MONITORING IMPROVEMENTS

Several alluvial monitoring wells have been replaced in accordance with the NMED-approved Monitoring Well Replacement Work Plan. The well replacement project began in the fall of 2012, and field work was completed on February 2, 2013. The well replacement project is summarized in the Monitoring Well Replacement Report (INTERA, 2013).

In addition to conducting the well replacement program, dedicated bladder pumps have been installed in all alluvial wells that contain enough water to support that method of sample collection. **Appendix F** is a map showing all DP-169 monitoring wells and their status.

5.0 RECLAMATION ACTIVITIES PERFORMED DURING THE SECOND HALF OF 2016

No physical reclamation activities were performed during the second half of 2016. However, additional radiological characterization of soils within the LTSM was conducted during the reporting period. The results of the characterization are being used to identify areas which may require additional reclamation work and to support preparation of the Final Status Survey that will be submitted to the NRC.

6.0 REFERENCES

BHP Billiton, 2015. ESP-007 Groundwater Sampling with Calibration and Equipment Decontamination, June 2015. Revision 41.

INTERA, 2013. Monitoring Well Replacement Report, Rio Algom Mining LLC. May 2013

INTERA, 2015. Rio Algom Sampling and Analysis Plan for DP-362 Stage 1 Investigation, June 19, 2015. Revision 2.

Maxim Technologies, Inc., 2001. Application for Alternate Concentration Limits for the Alluvial Materials, Quivera Mill Facility Ambrosia Lake, New Mexico.

APPENDIX A

Analytical Results from the Second Half 2016 for DP-169 Alluvial Wells

Appendix A
Analytical Results and Field Measurements for DP-169 Monitoring Wells
Rio Algom Mining LLC - Ambrosia Lake Facility Discharge Permit - 169 (DP-169)
Semiannual Report, Second Half 2016

Monitoring Well	Sample Date	Status	Depth to Water (ft)	Total Depth (ft)	Specific Cond. (uS/cm)	Temp. (°C)	pH	Cl (mg/l)	NO ₃ /NO ₂ (as N) (mg/l)	SO ₄ (mg/l)	TDS (mg/l)
30-03	3/19/2013	OOS	Plugged and abandoned during 2012/2013 Well Replacement Project								
30-04 R	8/1/2016		59.46	72.31	6576	12.4	6.7	675	7.3	3050	6050
30-46	7/28/2016	DRY	--	38.2	--	--	--	--	--	--	--
30-47	8/9/2016		57.2	77.66	5033	11.9	6.41	795	<0.4	1970	4280
30-48*	8/10/2016		61.28	73.17	4558	14.6	6.34	645	<0.2	1850	3910
30-49	8/9/2016	DRY	--	67.40	--	--	--	--	--	--	--
30-53	7/28/2016	DRY	--	49.98	--	--	--	--	--	--	--
30-68 R	7/29/2016	DRY	--	66.03	--	--	--	--	--	--	--
31-05 R	8/9/2016		53.5	66.23	7036	12.5	6.81	579	2.88	3530	6210
31-61 ALL	7/28/2016		16.57	29.1	14451	12.2	6.23	2360	2.93	6750	13800
31-63	7/17/2007	OOS	Removed from service when the interceptor trench was discontinued								
31-65 ALL	7/28/2016		13.75	41.49	15180	10.7	6.16	2630	<0.02	7660	15700
31-70 R	8/10/2016		45.44	81.09	7688	12.2	6.69	1090	60.4	2370	6410
31-71	8/9/2016		50.64	63.49	5105	12.6	7.1	542	0.76	2120	4500
32-01 R	8/9/2016		21.5	60.92	19223	13	5.83	2320	<1	9690	20000
32-02 R	8/1/2016		54.46	70.33	8390	12.6	6.58	780	4.77	3970	7970
32-41	8/10/2016		46.25	59.84	6891	22.7	5.13	1510	<1	1830	4820
32-42	8/9/2016	DRY	--	21.9	--	--	--	--	--	--	--
32-43N	8/9/2016		27.69	76.25	11340	12.7	6.23	1810	0.18	3790	10200
32-50 TRB-R**	8/10/2016		55.24	88.6	6511	12.5	6.8	582	3.13	2930	5830
32-51	8/10/2016		37.11	73.99	5388	12.4	7.37	355	4.42	2710	5040
32-52	8/10/2016		35.71	52.73	4393	14.4	6.69	219	0.03 B	2280	3660
32-56	8/9/2016	DRY	--	57.37	--	--	--	--	--	--	--
32-57	8/10/2016		49.87	53.04	6969	15.4	6.47	246	5.94	3790	6630
32-58	8/8/2016		18.57	34.48	17187	11.4	6.56	3460	43.3	5870	15400
32-59 ALL	7/28/2016		21.96	28.19	4995	12.2	7.45	539	2.06	2640	4910
32-60	8/8/2016		15.69	27.75	14739	12.4	6.3	2120	6.02	5470	13200
32-69	8/9/2016		57.37	61.05	11826	13.1	6.59	1720	21.3	4270	10800
32-72	8/9/2016		23.34	40.14	10761	12.1	6.23	276	0.34	7790	12800
5-01	8/9/2016		30.51	43.72	4472	13	6.85	151	23.7	2290	4180
5-02	8/9/2016		29.23	***	7350	14.4	6.85	1730	<0.02	1220	5120
5-03 ALL-R	7/28/2016		26.82	55.82	4679	12.6	7	543	0.41	2310	4490
5-04 ALL	7/27/2016		24.39	60.15	5919	12.57	8.18 [#]	890	<0.02	2790	5120
5-08 ALL-R	7/27/2016		37.31	76.52	4167	13	7.23	223	15	2200	3880
5-73 ALL-R	7/28/2016		21.83	35.67	6642	11.8	6.86	1180	0.64	2440	5720
AW-1	8/1/2016		58.5	81.59	79.87	12.8	6.63	762	5.21	3840	7680
AW-2	8/10/2016		34.53	86.1	6001	13	7.07	392	6.58	2810	5360
C-3	6/13/1995	OOS	Plugged and abandoned to facilitate site reclamation activities								
D-4	2/27/2006	OOS	Plugged and abandoned to facilitate site reclamation activities								
E-5	2/27/2006	OOS	Plugged and abandoned to facilitate site reclamation activities								
MW-24 ALL	7/28/2016	INW	50.15	50.35	--	--	--	--	--	--	--
S-12	8/8/2016		15.18	27.54	14678	11.9	6.45	2650	0.34	4380	12600
S-9	8/9/2016		11.46	24.66	12416	15.1	6.7	2290	2.21	4240	11400

Notes:

Reported wells are in the alluvium formation.

"R" indicated wells were replaced in 2012/2013 during the Monitoring Well Replacement Project.

"ALL" are alluvial wells also reported to the U.S. NRC in accordance with the Alternative Concentration Limit (ACL) criteria.

"<" indicates values are below the minimum detection limit (MDL).

"B" indicates that the analyte concentration was detected at a value between the MDL and the practical quantitation limit (PQL).

"OOS" indicates well is out of service

"DRY" indicates the well is dry

"INW" indicates the well contains insufficient water for sampling

* Grab sample (Failed 90% rule in 2nd Half 2015 with 0% recharge in 24 hr).

** 32-50 TRB-R is screened across the TRB-Alluvial contact.

*** Could not tag bottom due to obstruction or soft mud

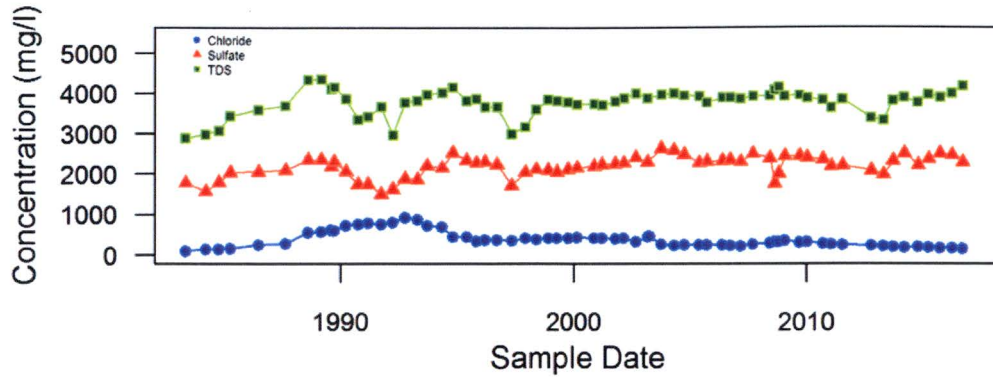
* Not measured due to pH meter malfunction, result from 1H 2016

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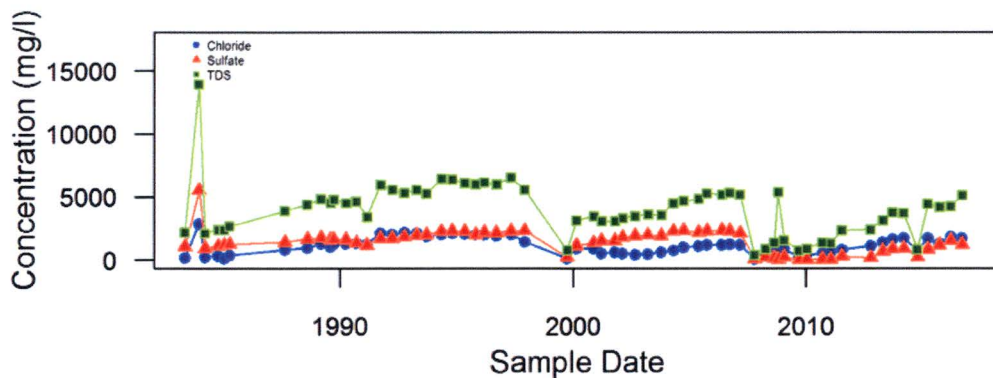
Time Concentration Plots for DP-169 Alluvial Wells

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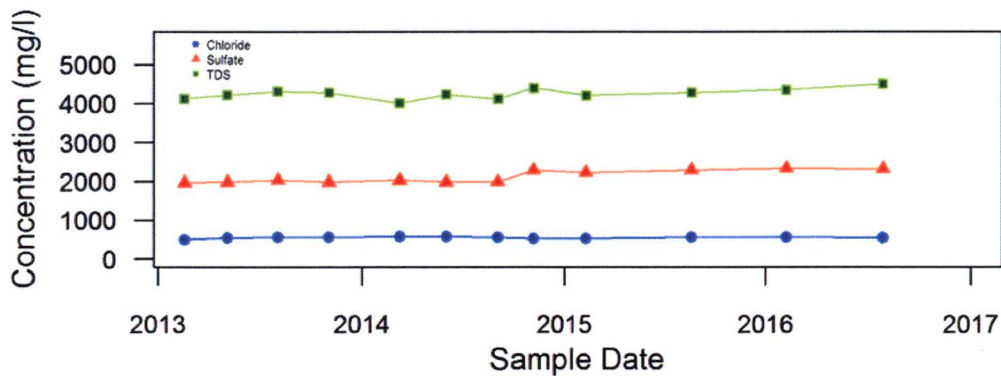
Water Quality in 5-01



Water Quality in 5-02

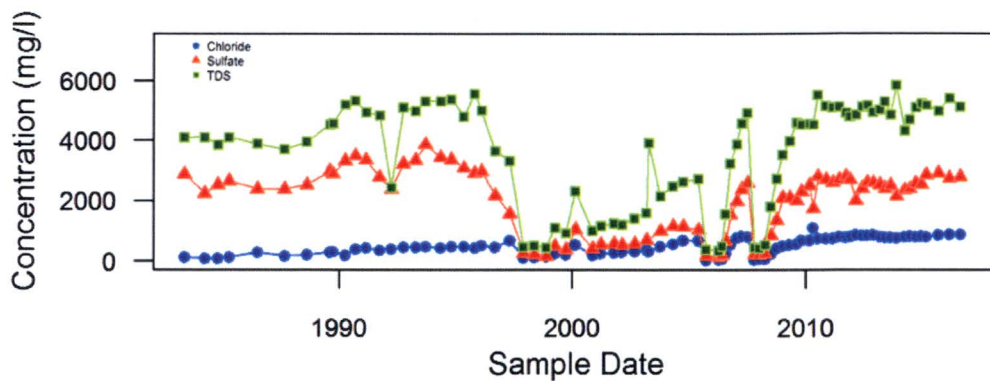


Water Quality in 5-03 ALL-R

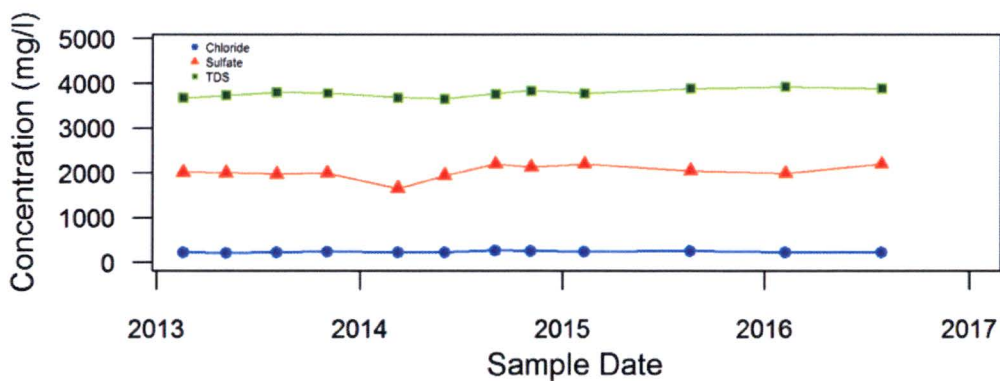


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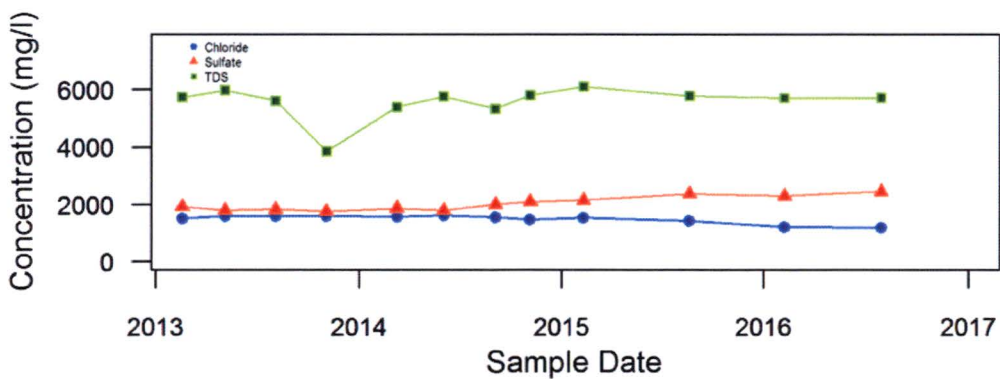
Water Quality in 5-04 ALL



Water Quality in 5-08 ALL-R

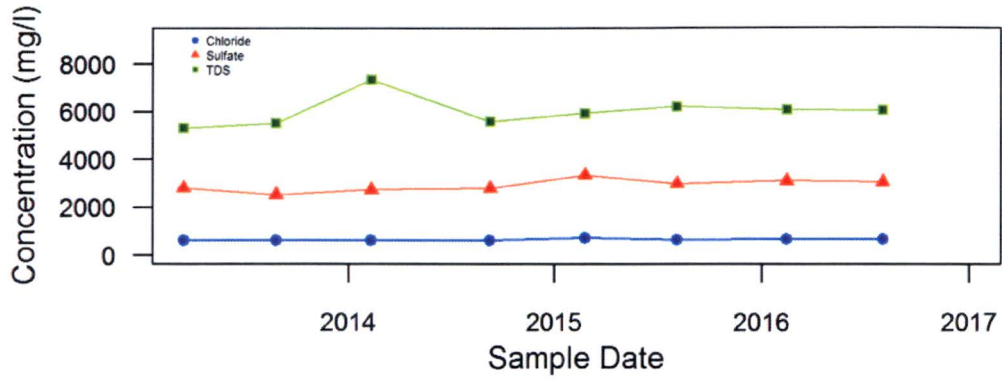


Water Quality in 5-73 ALL-R

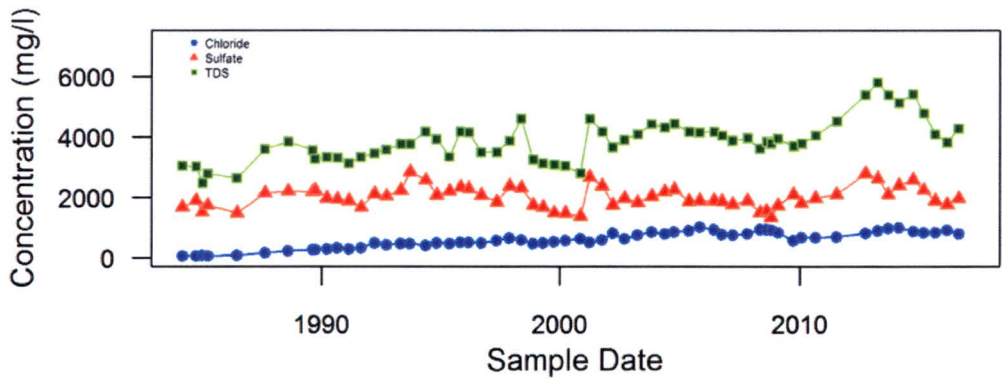


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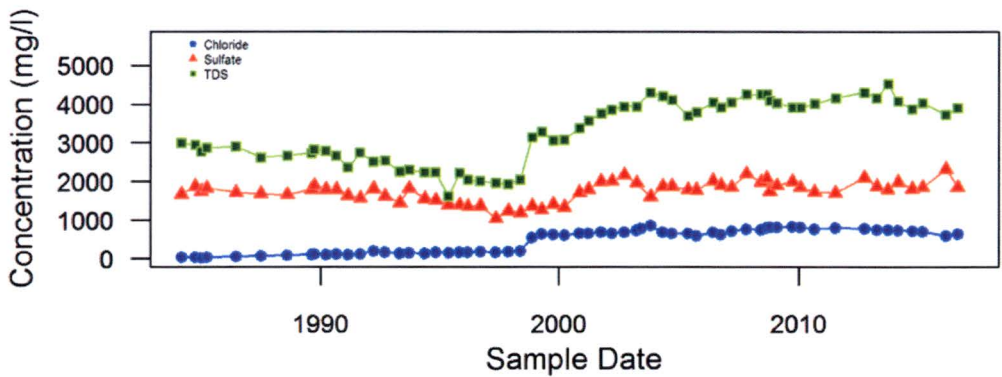
Water Quality in 30-04 R



Water Quality in 30-47

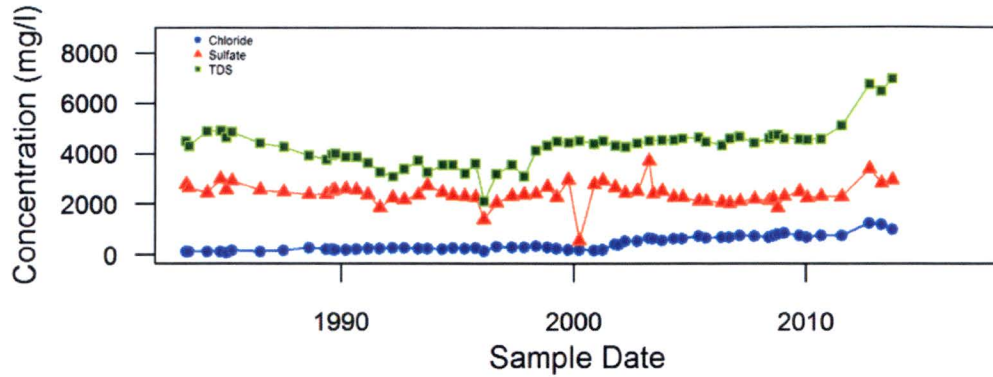


Water Quality in 30-48

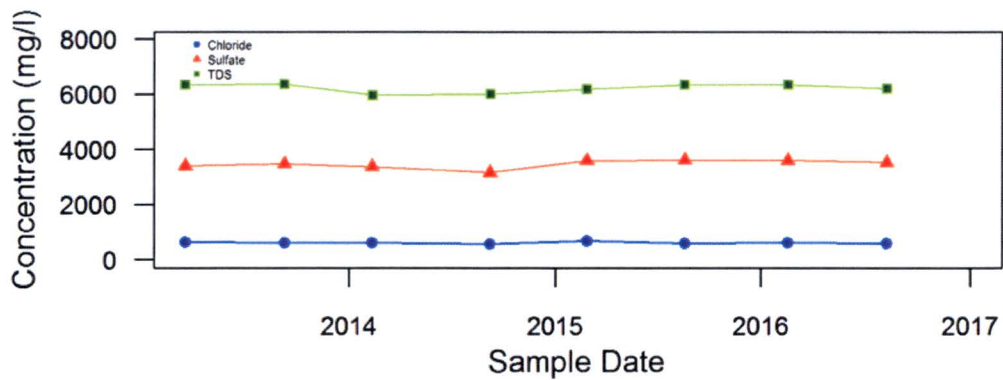


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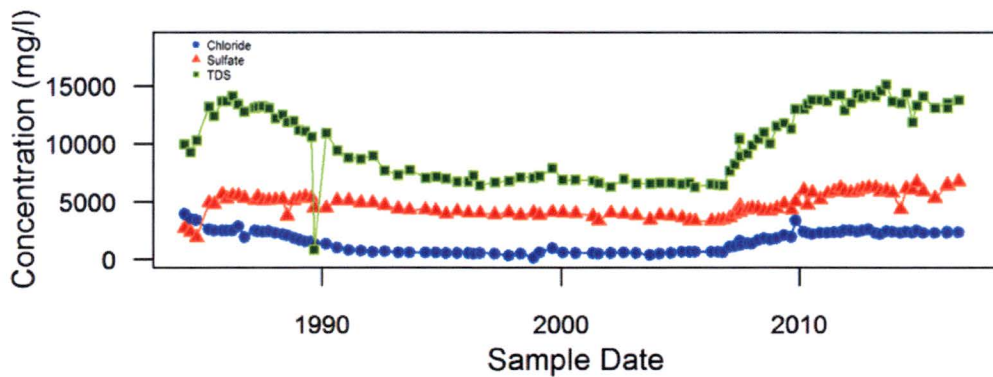
Water Quality in 30-49



Water Quality in 31-05 R

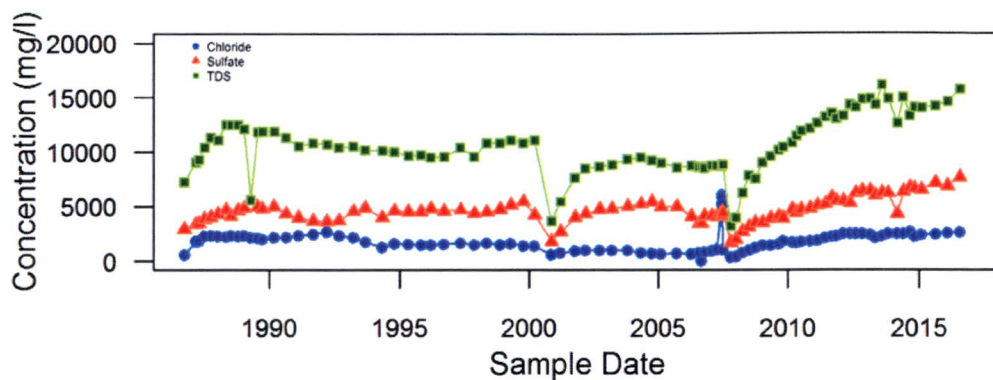


Water Quality in 31-61 ALL

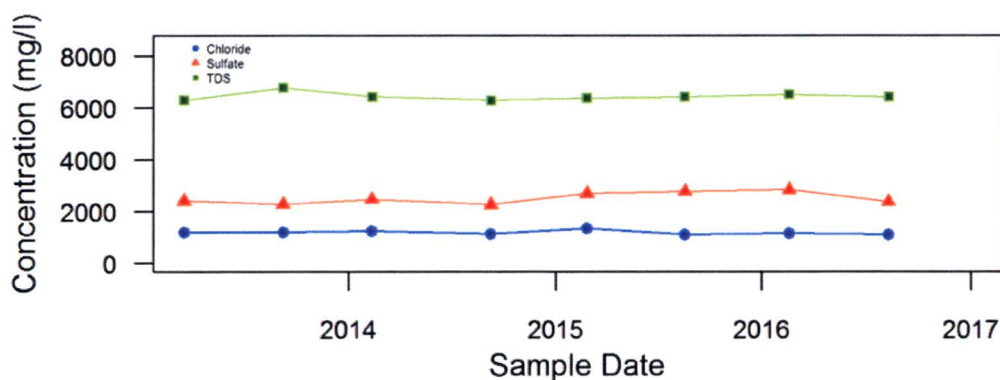


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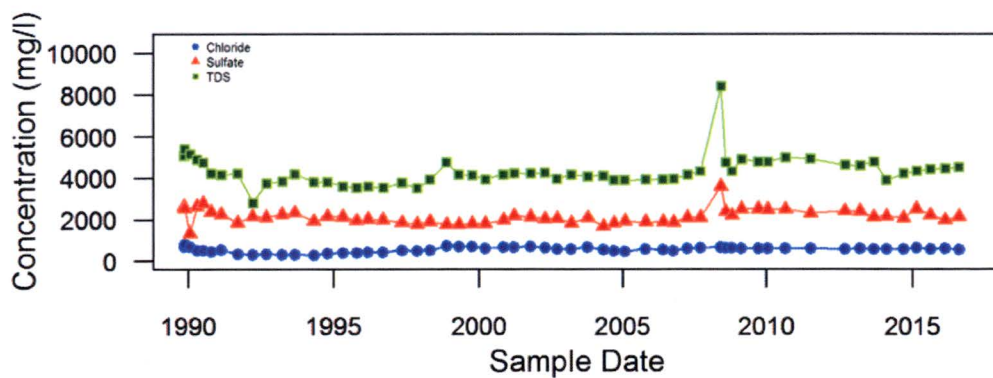
Water Quality in 31-65 ALL



Water Quality in 31-70 R

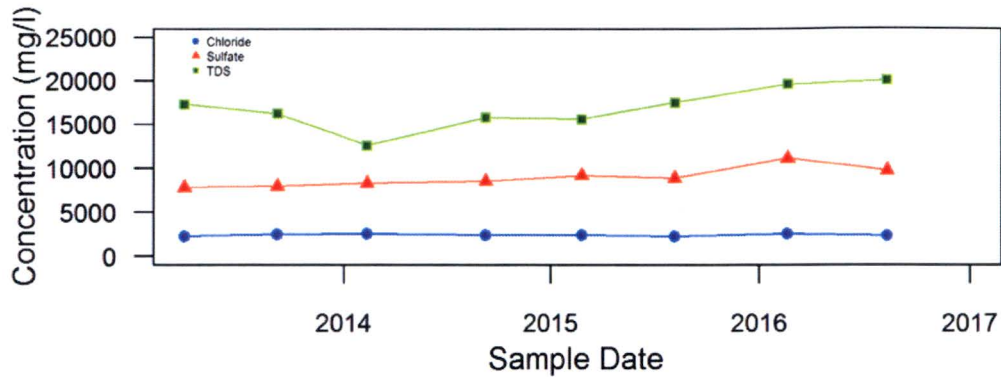


Water Quality in 31-71

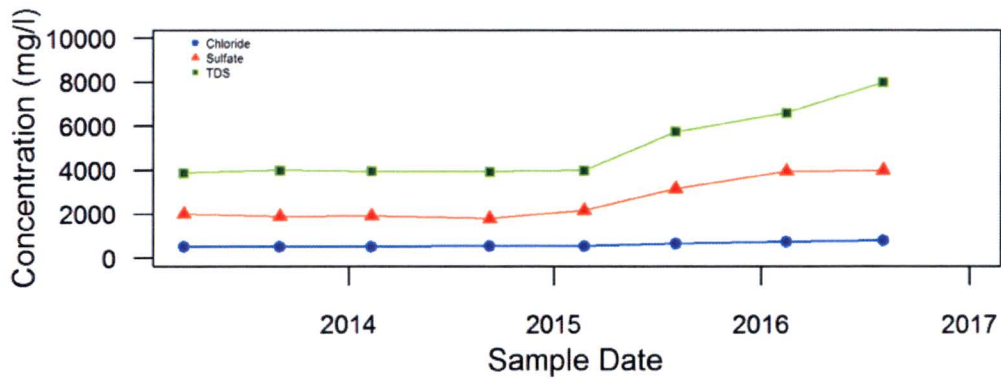


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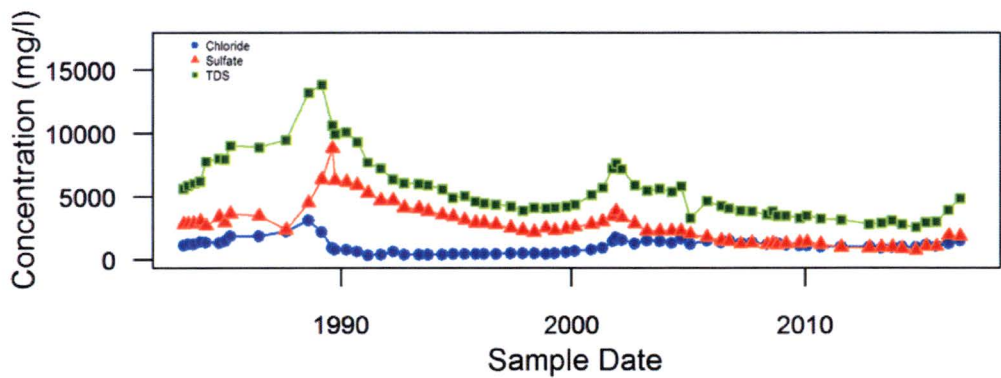
Water Quality in 32-01 R



Water Quality in 32-02 R

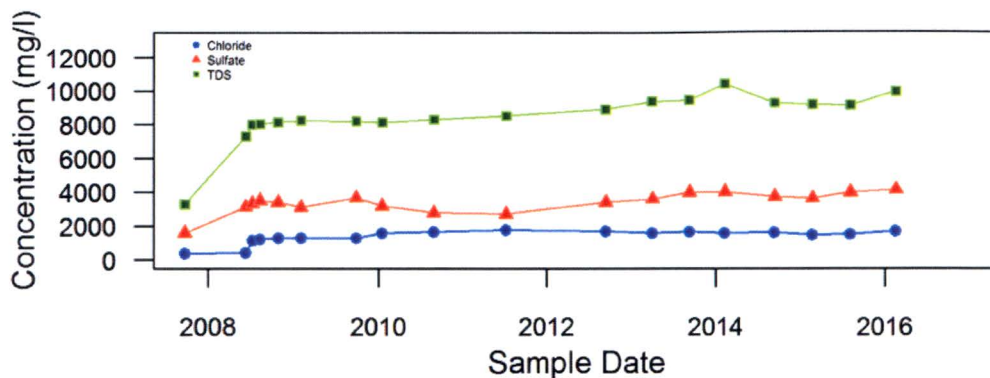


Water Quality in 32-41

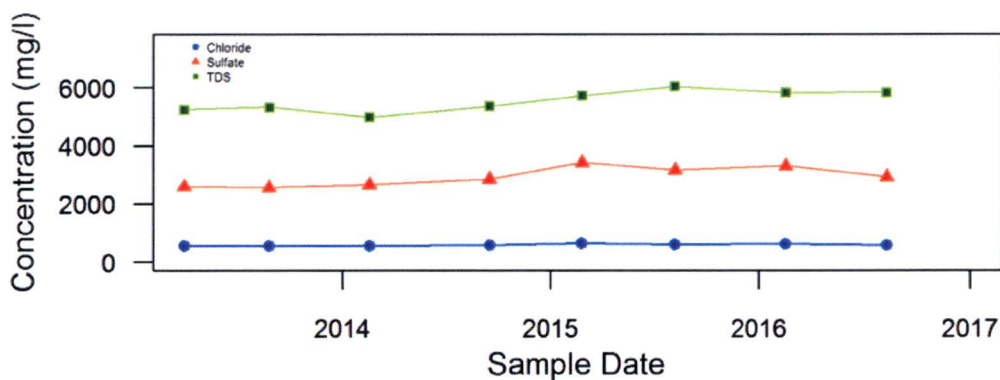


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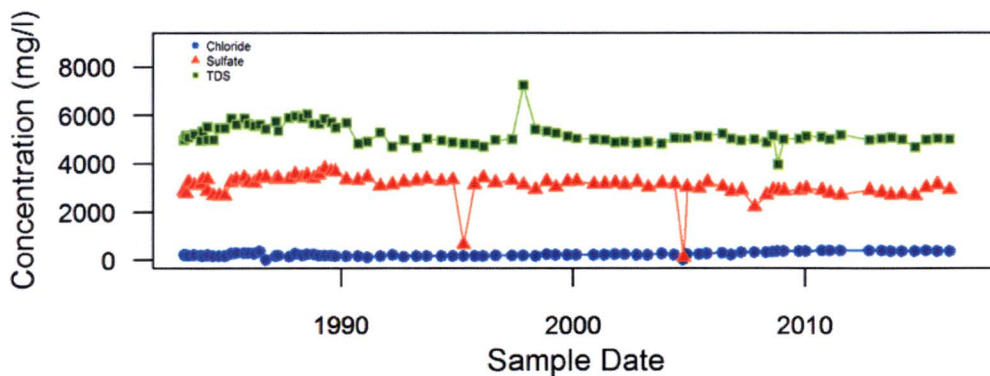
Water Quality in 32-43N



Water Quality in 32-50 TRB-R

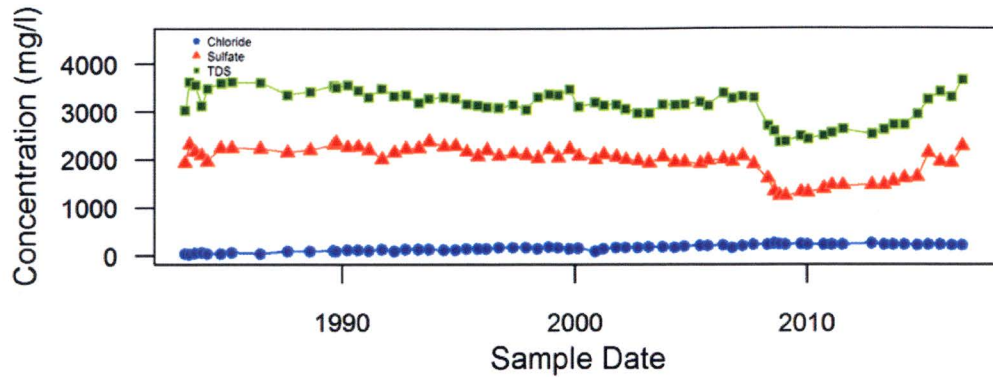


Water Quality in 32-51

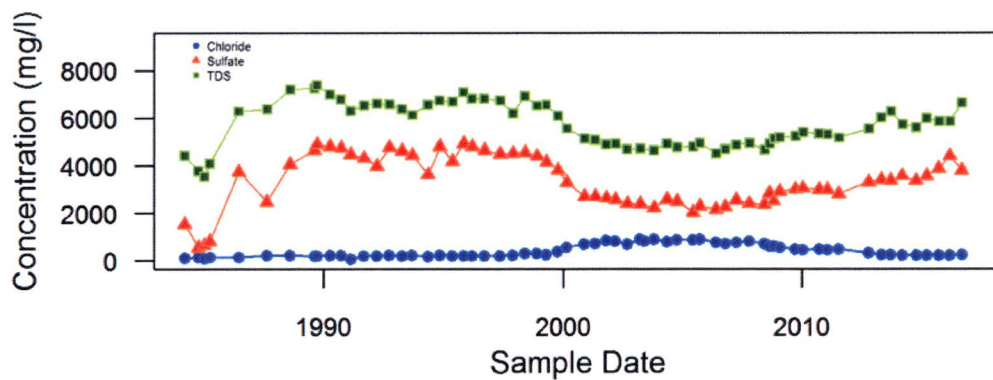


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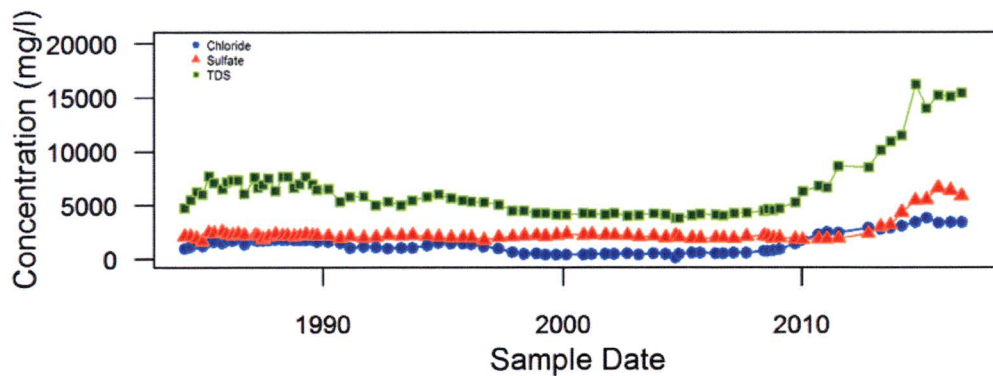
Water Quality in 32-52



Water Quality in 32-57

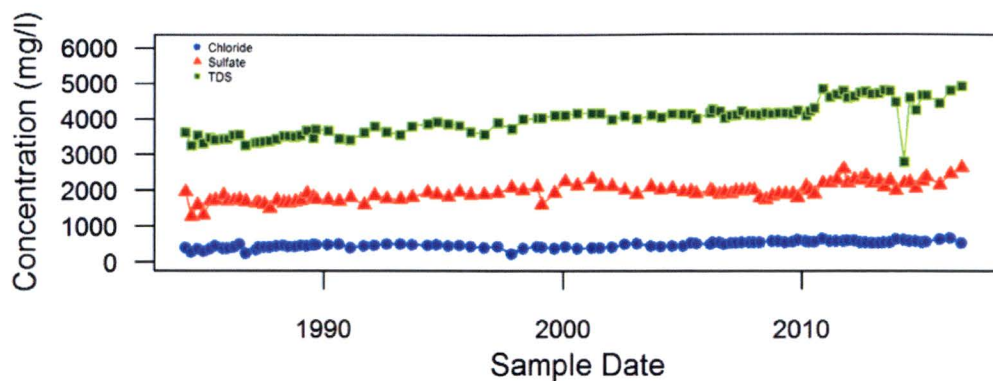


Water Quality in 32-58

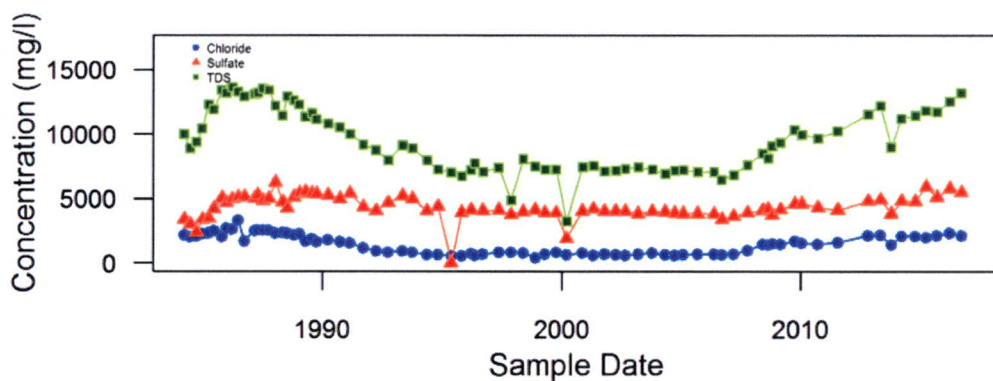


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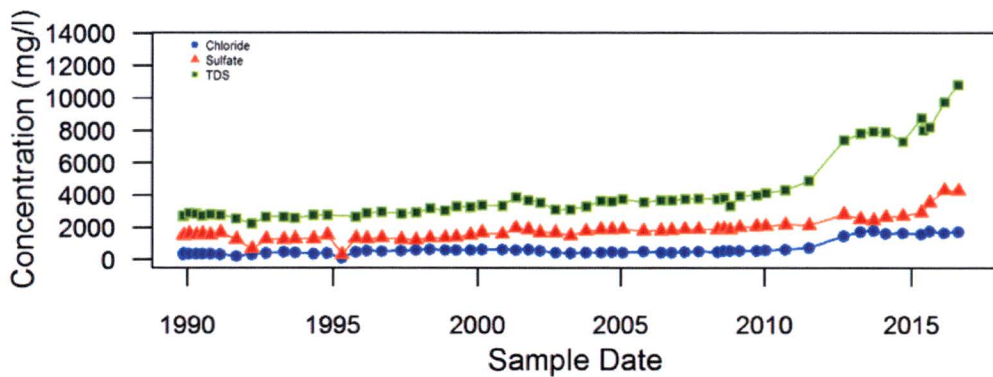
Water Quality in 32-59 ALL



Water Quality in 32-60

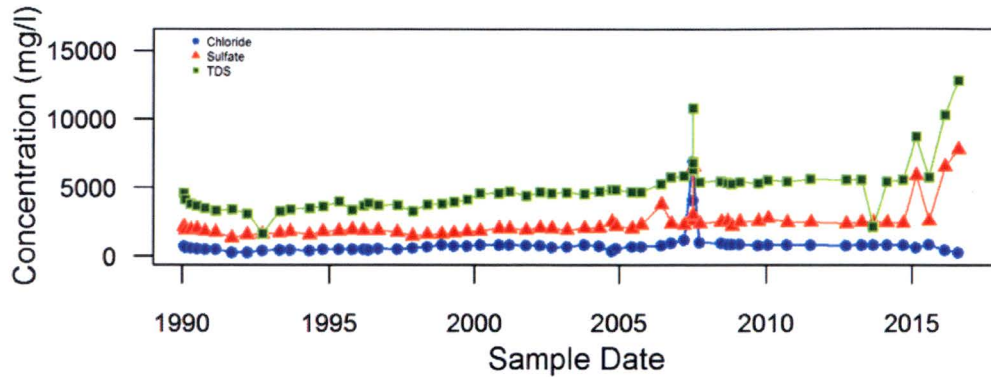


Water Quality in 32-69

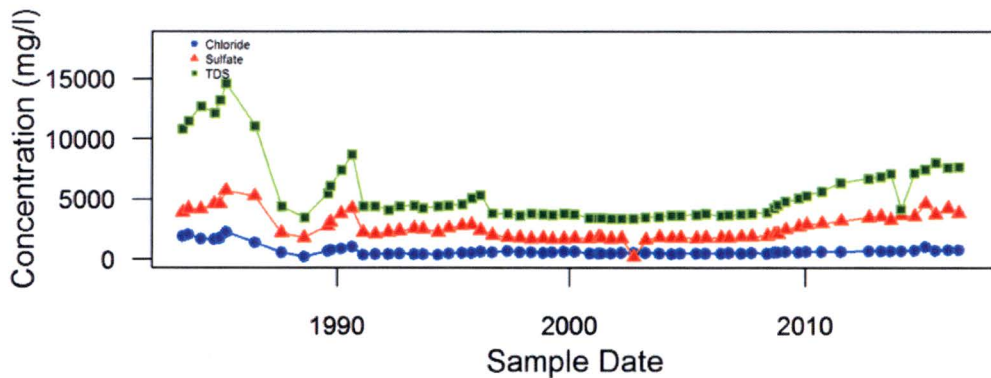


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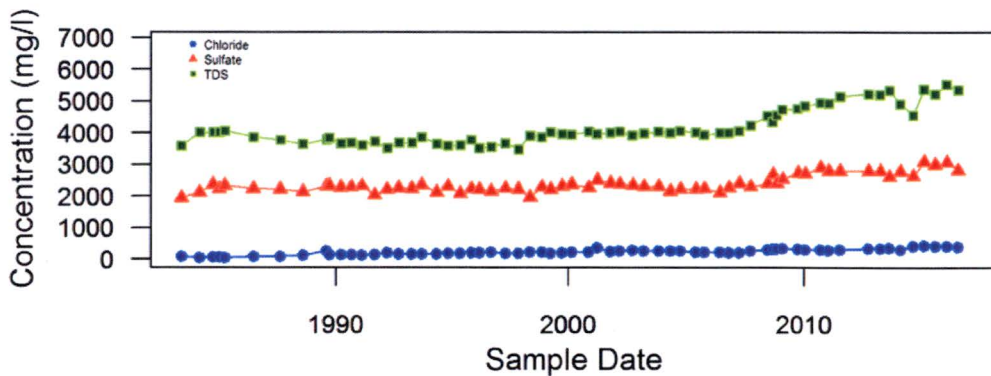
Water Quality in 32-72



Water Quality in AW-1

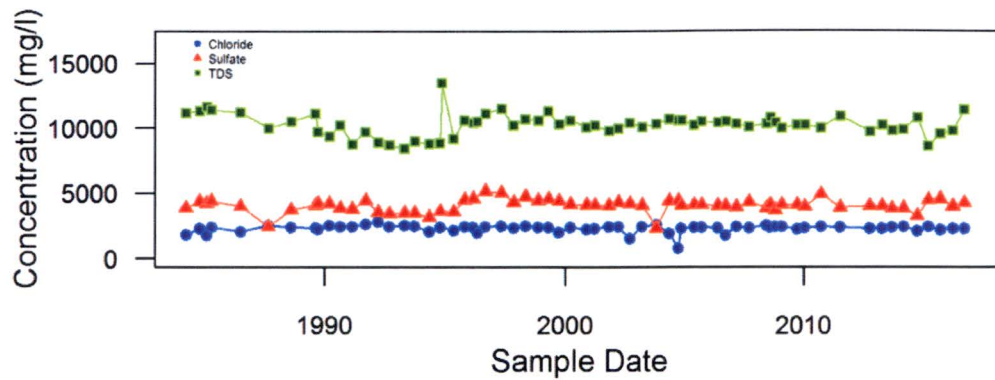


Water Quality in AW-2

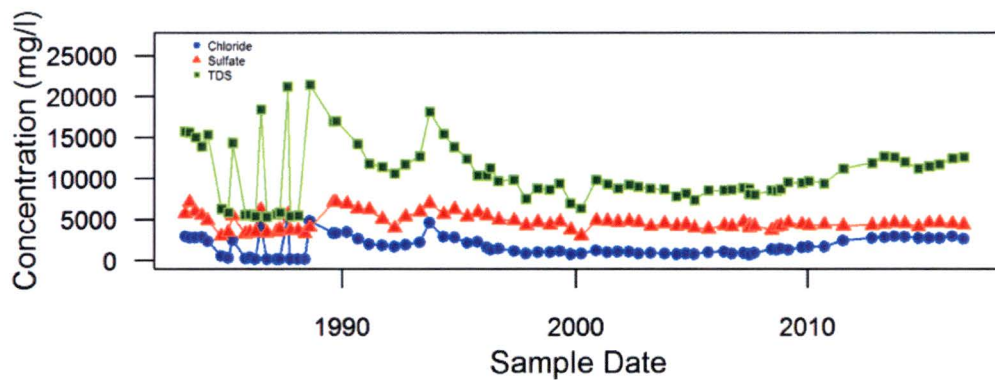


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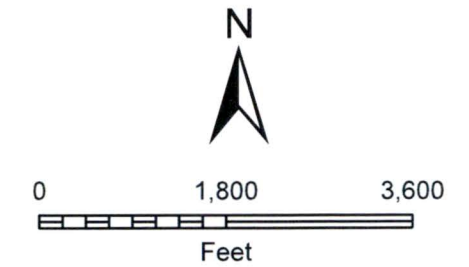
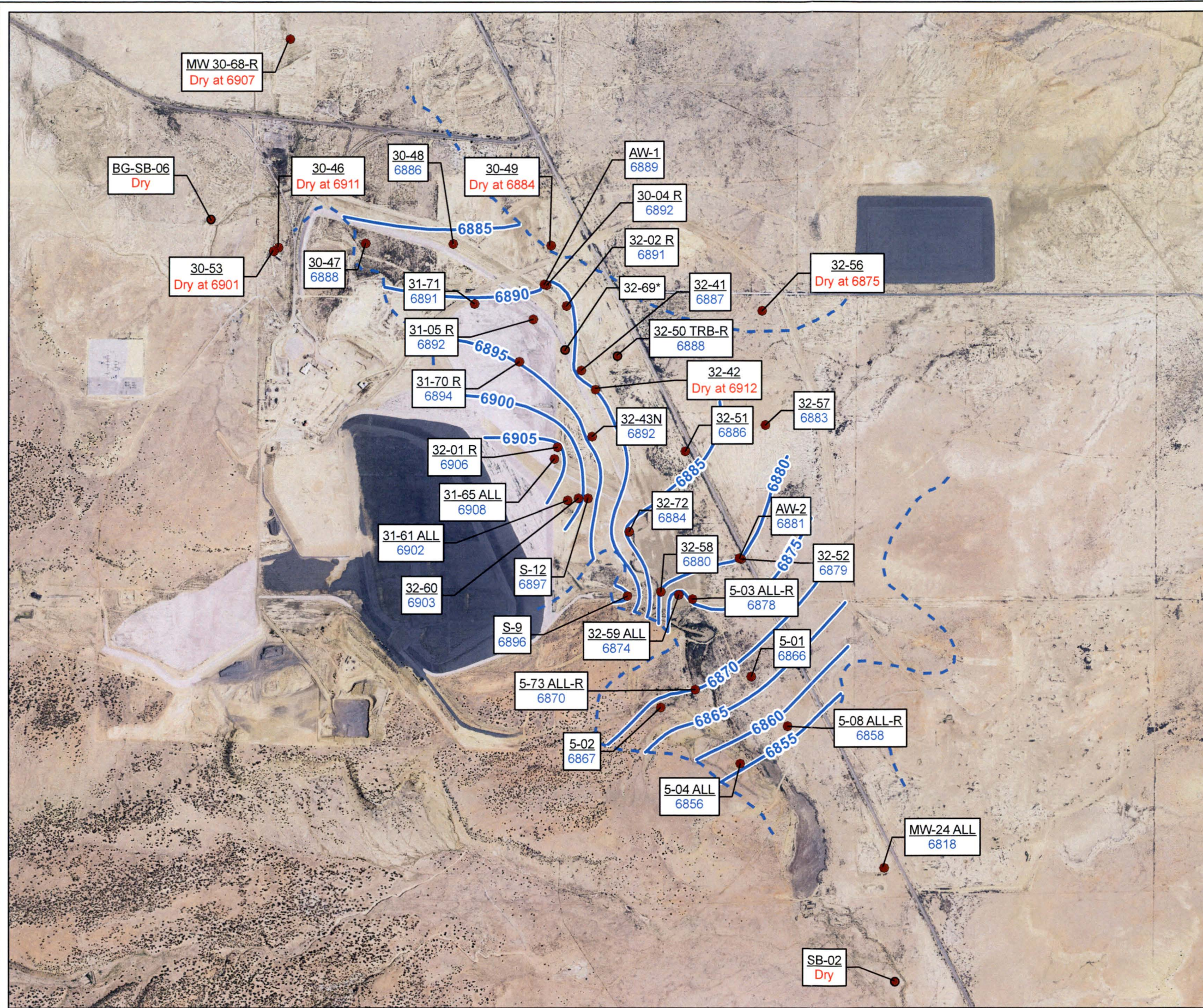
Water Quality in S-9



Water Quality in S-12



APPENDIX C
Alluvial Groundwater Elevation Contour Map



Aerial – NAIP imagery, dated 2014

Legend

- Alluvial Monitoring Well Location
- Alluvial Groundwater Surface Elevation (ft amsl)
- Estimated Boundary of Saturated Alluvium

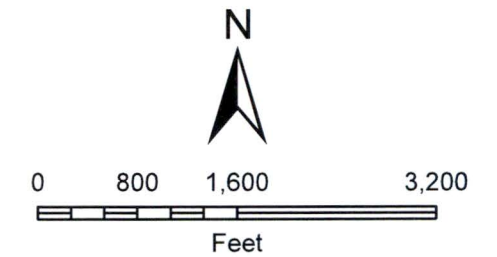
Well ID

Groundwater Surface Elevation (ft amsl)

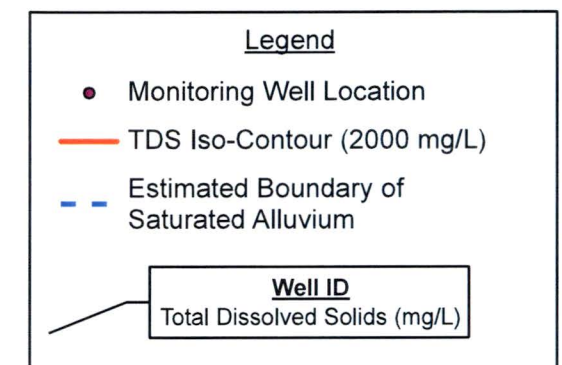
Notes:
All data collected 2nd quarter, 2016.
* = Water level at well not used for contouring due to inaccurate TOC survey.

Appendix C
Alluvial Groundwater Elevation
Contour Map
Rio Algom DP-169 Semi-Annual Report

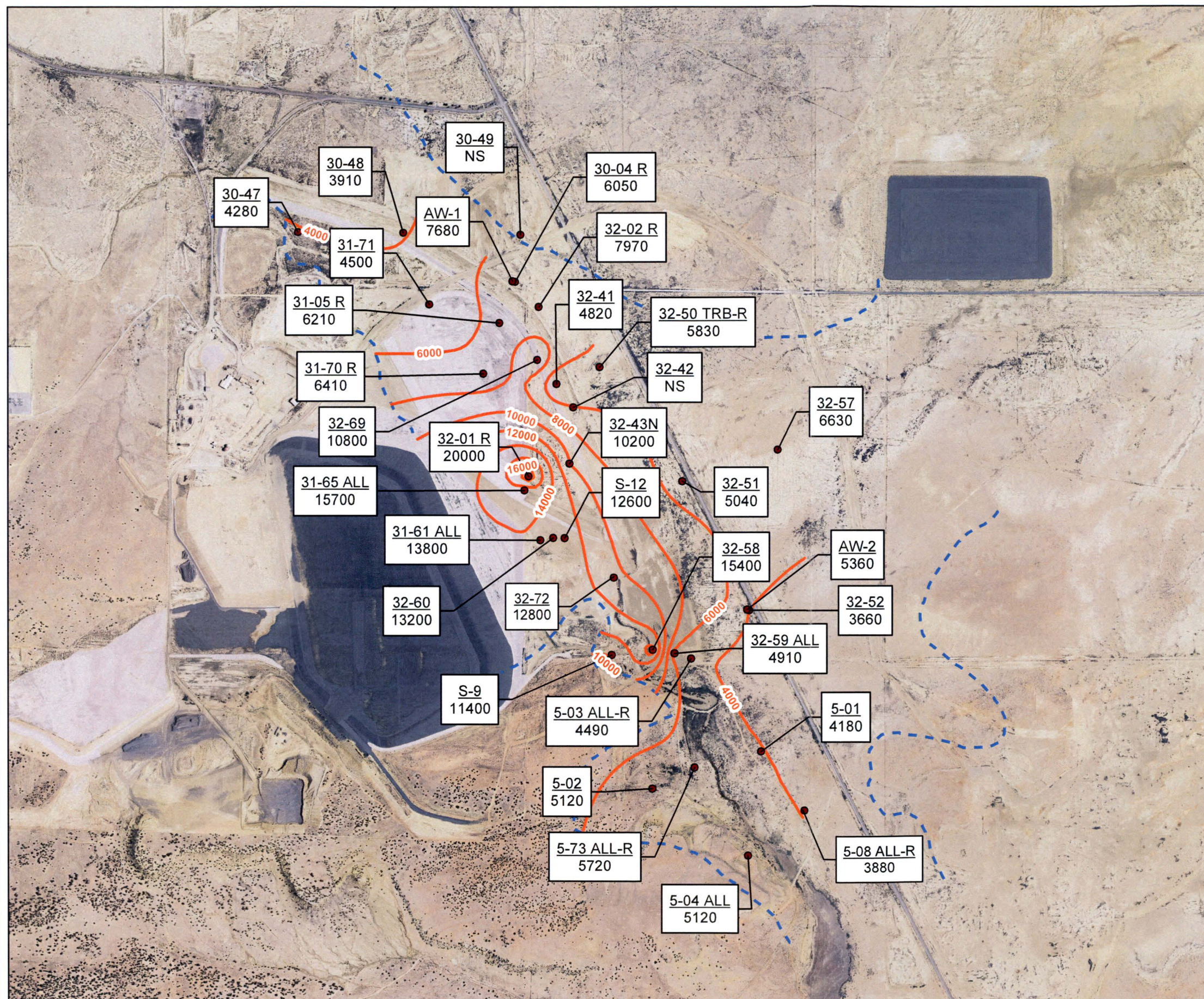
APPENDIX D
Total Dissolved Solids Iso-Contour Map



Aerial – NAIP imagery, dated 2014



Notes:
All data collected 3rd quarter, 2016.
NS = Not Sampled

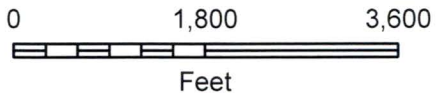


Appendix D
Total Dissolved Solids
Iso-Contour Map
Rio Algom DP-169 Semi-Annual Report

APPENDIX E

**DP-169 Electronic Data – Second Half 2016
(CD included with NMED copy only)**

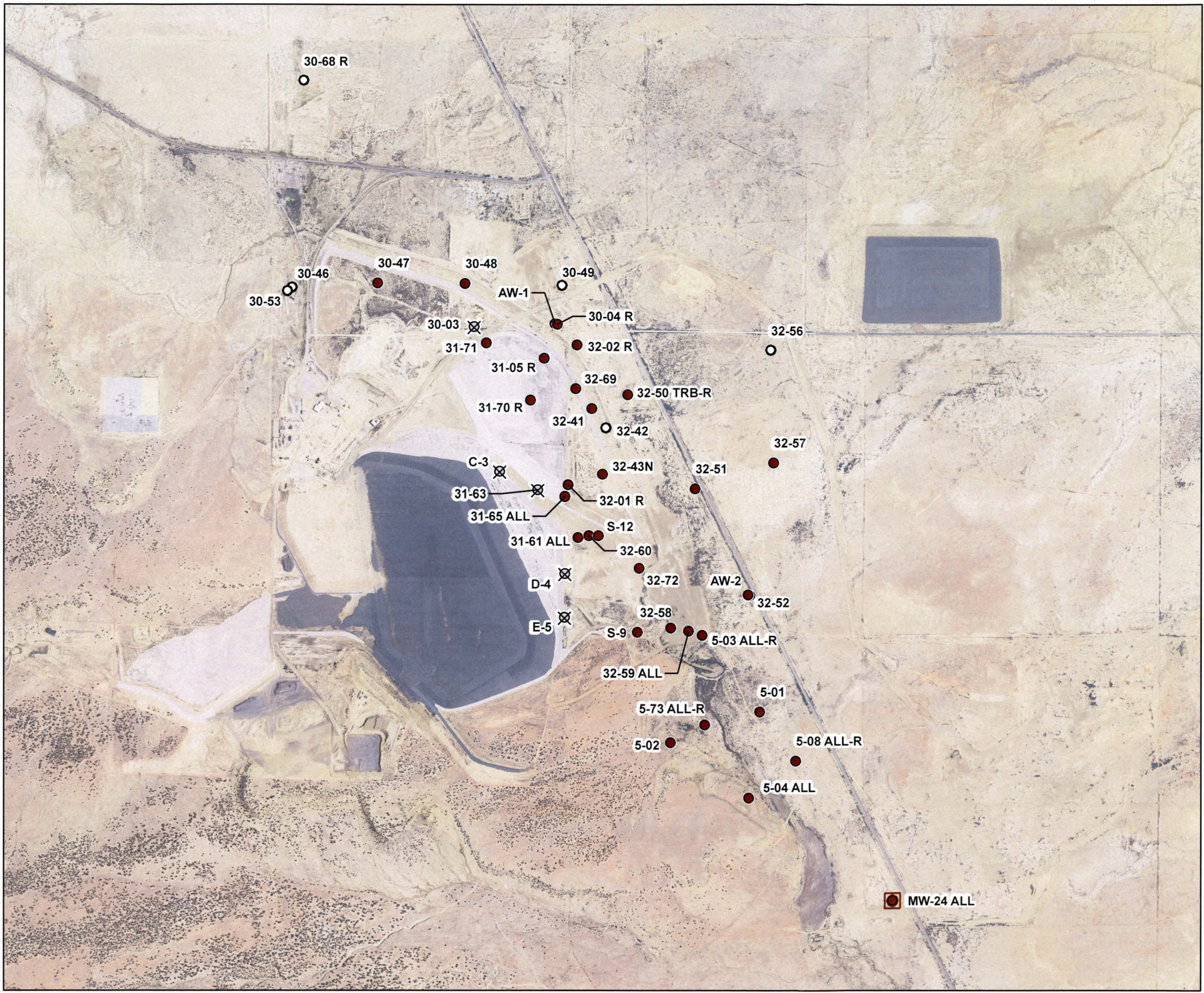
APPENDIX F
DP-169 Well Status Map



Aerial – NAIP imagery, dated 2014

Legend

- In Service - Dedicated Pump
- ⊗ Out of Service
- In Service - Dry
- ◼ In Service - Insufficient Water



Appendix F
DP-169 Well Status Map
Rio Algom DP-169 Semi-Annual Report