ACTIVE TAILINGS AND PRODUCTION ROCK SITE
2017 ANNUAL REPORT

Hecla Greens Creek Mining Company

April 15, 2018

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1.0 OVERVIEW

This annual report has been prepared by Hecla Greens Creek Mining Company in accordance with Alaska Waste Management Permit number 2014DB0003 issued on August 11, 2014. The monitoring of sites within this report is now a part of General Plan of Operations Appendix 1 (Integrated Monitoring Plan). This annual report addresses permit requirements found in Alaska Waste Management Permit number 2014DB0003 section 2.3 and 2.4.

2.0 INTRODUCTION

This report has been prepared by Hecla Greens Creek Mining Company (HGCMC) in accordance with the General Plan of Operations (Appendix 3) approved by the United States Forest Service and the Alaska Department of Environmental Conservation (ADEC) Waste Management Permit No. 2014DB0003 (WMP), issued August 11, 2014. This report presents the results from inspections and monitoring performed during 2017 (January - December) as required by the WMP and as described in the *Hecla Greens Creek General Plan of Operations Appendix 1 – Integrated Monitoring Plan (IMP)*. Compliance monitoring of wastewater and storm water discharges, air emissions and other resources, such as Hawk Inlet monitoring, are addressed under specific permits and not included in this document.

3.0 AQUATIC BIO-MONITORING

Aquatic bio-monitoring, at Sites 48 and 54 on Greens Creek and Site 9 on Tributary Creek, is performed annually during the month of July by the Alaska Department of Fish and Game (ADFG). Results from the annual monitoring are documented in a Technical Report, prepared by ADFG. Monitoring results from 2017 are presented in Technical Report No. 18-01.

4.0 TAILINGS DISPOSAL FACILITY (TDF)

4.1 Background

The mill at the Greens Creek Mine generates approximately 1,800 dry short tons (DST) of filter-pressed tailings per day, or approximately 650,000 DST of tailings annually. These tailings are dewatered in a filter press at the mill, with about 50% of the tailings being mixed with cement and hauled back into the underground mine for disposal in mined-out areas as mine backfill. The remaining 50% of the tailings are trucked from the mill and placed in a surface tailings disposal facility. The TDF is situated near Hawk Inlet in the upper reaches of the Tributary Creek drainage. Placement utilizes dry-stack tailings disposal techniques.

4.2 Facility Operation and Management

Standard development and placement methodologies at the TDF have been established and reviewed, and will be continued for future disposal activities. A detailed description of the TDF operation and management, including standard operating procedures, are presented in GPO Appendix 3 – Tailings Disposal Facility Management Plan.

4.2.1 Material Placement Records

Table 4.2.a contains the monthly placement records for tailings, production rock and other materials at the TDF for 2017. Surveyed volumes (cubic yards) were converted to tons using a tonnage factor of 1.8 tons per cubic yard (134.2 pcf for tailings). Production rock from Site 23 used for road access and erosion control contributed approximately 24,930 tons to the facility. An additional 48,912 tons of

other material were also placed at the facility in 2017. The calculated tonnage of tailings was derived by subtracting the tons of production rock and other material from the surveyed total. Estimates of other miscellaneous materials disposed of on site are shown in Table 4.2.b. Tailings generated but not hauled to the TDF were disposed of in the underground mine. In 2017 298,413 tons (71%) of tailings were placed in the stage 3 phase 1 area (S3P1), 58,377 tons (14%) in the northeast, and 61,529 tons (15%) in the east. Approximately 22,000 tons of the total 298,413 tons placed in the S3P1 area were tailings removed from the east.

The 2013 Final Environmental Impact Statement and Record of Decision approved approximately 2.1 million cubic yards of tailings storage extending south (S3P1) of the existing TDF (Attachment G, Tailings As-built). Tailings placement in the S3P1 area started in 2016.

The pile currently contains approximately 8.7 million tons of material. Based on the survey data presented in Table 4.2.a there is a remaining capacity of approximately 4.7 million tons of the 13.4 million tons permitted for placement at the facility. It is difficult to determine the amount of time remaining before permitted space at the Tailings Facility is consumed, but approximately 7-10 years has been estimated.

Table 4.2.a Tailings Placement

2017	All Materials Monthly Total by Survey (CY)	All Materials Cumulative by Survey (CY)	All Materials Monthly Total Tonnage (Calculated tons)	All Materials Cumulative Total Tonnage (Calculated tons)	Prod Rock from Site 23 by truck count (tons)	All Other Materials (Ditch Seds and Construction) by truck count (tons)	Tailings Tonnage (Calculated tons)
1/31/2017	22,834	4,579,876	41,929	8,297,361	561	280	41,088
2/28/2017	18,703	4,598,579	34,613	8,331,246	729	1279	32,605
3/30/2017	16,021	4,614,600	30,033	8,360,271	1008	0	29,025
4/30/2017	22,245	4,636,845	41,321	8,400,572	1020	0	40,301
5/31/2017	25,349	4,662,194	50,385	8,446,497	4460	11670	34,255
6/30/2017	23,221	4,685,415	44,083	8,488,566	2014	7311	34,758
7/31/2017	22,305	4,707,720	54,401	8,536,745	6222	10300	37,879
8/31/2017	13,139	4,720,859	28,380	8,565,125	0	1570	26,810
9/30/2017	22,011	4,742,870	47,668	8,612,669	124	10308	37,236
10/31/2017	17,077	4,759,947	41,234	8,649,555	4348	4309	33,250
11/30/2017	14,882	4,774,829	32,145	8,681,701	0	1885	30,260
12/31/2017	19,224	4,794,053	45,968	8,723,224	4444	0	41,524
Totals	**237,011**	**4,794,053**	**492,161**	**8,723,224**	**24,930**	**48,912**	**418,992**

Tons calculated at 134.2 pounds per cubic foot for tailings

Table 4.2.b Miscellaneous 2017 Materials Disposal Estimates			
Surface Tailings	**CY**	**Underground**	**CY**
Pressed Sewage Sludge	13	Tires, Sump Sediment, Shop, Mine, Electrical & Mill Refuse	2,800
Pressed Water Treatment Plant Sludge	275		
Incinerator Ash	0		
Site E	1020		

4.2.2 Compaction

Tailings placement compaction is tested to monitor the performance goal of achieving 90 percent or greater compaction relative to a standard Proctor density. HGCMC staff currently utilizes the sand cone method (ASTM D1556) and the soil density gauge (ASTM D6938) for determining the density of placed tails. Dry densities are calculated and compared to laboratory measured standard Proctors.

The mean dry density for 5 sand cone samples taken throughout the year in 2017 was 143 pcf, and the average percent proctor density was 102.1%. The mean dry density for 145 soil density gauge samples taken throughout the year in 2017 was 152 pcf, and the average percent proctor density was 105.5%. Results to date confirm proctor and moisture data received from the outside materials testing lab. All of the field measurements in 2017 showed greater than 90% compaction. A summary of 2017 results are shown in Table 4.2.c.

Table 4.2.c Summary Statistics for 2017 Tailings Compaction Testing						
Method	**Compaction Variable**	**Mean**	**Max**	**Min**	**Std. Dev**	**n**
IGES Laboratory	Std. Proctor [ASTM #D698 (pcf)]	138	149	132	8	4
	Opt. Moisture (%)	11.4	13.5	8.3	2.2	4
HGCMC Lab 1-pt Proctor	Measured Dry Density (pcf)	135	142	120	7	20
	Measured Moisture (%)	13.9	15.4	12.4	1.0	20
Sand Cone Method Field Test	Measured Dry Density (pcf)	143	152	137	6	5
	Measured Moisture (%)	12.9	15.4	10.4	1.8	5
	Percent Proctor Density (%)	102.1	106.9	97.3	3.7	5
Soil Density Gauge Field Test	Measured Dry Density (pcf)	152	168	114	12	145
	Measured Moisture (%)	9.4	16.6	5.8	1.7	145
	Percent Proctor Density (%)	105.5	109.8	94.4	3.1	100

4.2.3 Inspections

Several independent inspections are carried out at the TDF throughout the year. Operators working at the site carry out daily visual work place inspections. The Surface Civil Engineer and/ or Surface Operations Shifter or designees carry out weekly visual inspections of the TDF area, as well as a checklist inspection of Pond 7. The environmental department carries out a monthly checklist inspection of the TDF.

An ADNR representative inspected the site twice in 2017 on May 24 and August 30. ADF&G representatives inspected the site twice in 2017 on July 18 and October 30. During 2017 the USFS conducted 11 routine inspections (Site inspections #380 - #390) to monitor for best management practices effectiveness and compliance to the General Plan of Operations. No issues of non-compliance or poor operations practices of the TDF were noted during the routine inspections. The USFS typically noted that the facility is being developed and operated to required operations and maintenance specifications of GPO Appendix 3.

4.2.3 Acid-Base Accounting (ABA)

Greens Creek Mine tailings contain pyritic sulfur, which through weathering processes can lead to acid generation. However, the tailings also contain significant carbonate, which neutralizes acid. Previous studies have shown that the lag time to acid generation of exposed tailings is on the order of decades. The prevention of acid generation from the TDF is one of the primary management objectives. As part of the standard operating procedure for the TDF, composite samples are collected from the mill filter press on a monthly basis for ABA analyses. Analytical results for samples collected during 2017 are shown in Table 4.2.d below. Samples collected at the TDF in 2017 had an average acid potential of 426 $tCaCO_3$/kt, average neutralization potential of 265 $tCaCO_3$/kt, and an average net neutralization of -161 $tCaCO_3$/kt.

Table 4.2.d Tailings Acid-Base Accounting ($tCaCO_3$/kt)

2017	Acid Potential	Neutralization Potential	Net Neutralization Potential
January	428.0	292.42	-135.57
February	422.2	291.42	-130.83
March	441.6	246.67	-194.95
April	431.2	276.76	-154.45
May	503.0	256.89	-246.08
June	460.3	255.96	-204.31
July	424.0	271.70	-152.34
August	475.7	286.45	-189.25
September	405.4	245.49	-159.89
October	363.1	263.67	-99.38
November	388.2	256.35	-131.82
December	373.1	240.40	-132.70
Average	**426.32**	**265.35**	**-160.96**

4.2.4 Meteorology

HGCMC maintains meteorological stations near the TDF and also at the 920 mill that record air temperature, precipitation, relative humidity, barometric pressure, wind speed and wind direction. Table 4.2.e shows temperature and precipitation data collected near the TDF during 2017. Table 4.2.f shows temperature and precipitation data collected at the 920 mill.

Table 4.2.e Meteorological Data at TDF				
Month	**Min Temp (°C)**	**Max Temp (°C)**	**Avg Temp (°C)**	**Precipitation (in)**
January	-7.13	8.60	-0.37	2.9
February	-7.33	10.44	-0.33	3.6
March	-13.32	7.92	-2.10	2.0
April	-1.12	17.19	6.37	0.9
May	1.33	21.47	9.12	2.7
June	5.42	22.49	11.05	3.6
July	8.13	23.06	12.92	5.2
August	8.94	24.96	13.52	3.7
September	4.68	20.27	10.79	5.7
October	-1.15	12.41	5.48	14.4
November	-7.87	8.29	-1.06	1.3
December	-12.36	7.71	0.15	5.4
2017			5.46	51.6

Table 4.2.f Meteorological Data at 920 Mill				
Month	**Min Temp (°C)**	**Max Temp (°C)**	**Avg Temp (°C)**	**Precipitation (in)**
January	-9.6	5.2	-2.04	5.4
February	-10.9	8.5	-2.32	4.2
March	-15.1	5.7	-3.70	3.7
April	-1.7	15.6	4.66	1.5
May	-0.8	21.6	7.73	3.8
June	3.7	20.6	9.88	4.4
July	6.2	23.4	11.63	7.0
August	6.6	25.8	12.65	7.2
September	3.8	22.0	9.73	8.4
October	-1.2	10.7	3.95	9.2
November	-10.8	4.4	-2.75	1.4
December	-15.6	11.1	-0.73	10.5
2017			4.06	66.6

4.2.5 Visual Inspections

In addition to the daily inspections performed by the Surface Operations Department, monthly inspections of the TDF are also performed by the Environmental Department. There were no unsatisfactory findings or action items during the 2017 reporting period.

4.2.6 Water Level Data

The Tailings Facility as-built is shown in Attachment G. The maximum saturated thickness (approximately 35 feet) occurs near the center of the main portion of the pile. However, this elevated water table level does not extend close to the down-slope toe of the pile. The foundations of the West Buttress and southern portion of the pile are well drained, as indicated by typically consistent unsaturated conditions in the blanket drains and at the base of the West Buttress (piezometer 74 in Attachment D). Low head elevations near the pile toe maximize the pile's geotechnical stability. Intermittent head increases in the foundation drains are localized and of short duration and should not have an adverse effect on pile stability.

4.2.7 Dust Monitoring and Abatement

Dust monitoring and abatement is a required mitigation measure in the 2013 Final Environmental Impact Statement and Record of Decision for the TDF expansion. Dust monitoring is also a requirement of the WMP. Since 2011 HGCMC has been monitoring fugitive dust emissions from the TDF using 10-liter Atmospheric Depositional Pails (ADP) mounted approximately 1.3 meters off the ground. Five ADP systems have been deployed 50-100 meters from the base of the dry stack tailings pile. Four of the ADPs loosely correlate to the cardinal points on a compass, with the fifth system in the southwest position. On an approximate two-week cycle, the ADPs are collected and filtered through a pre-weighed 90 mm glass fiber filter with a 1.5 micron pore size. The filters are then dried and weighed in order to measure the total loading. Following this process the filters are analyzed for total lead and total zinc. Results from the analysis equate to the amount of material that passes through the opening of the ADP over a known period. Therefore, it is possible to calculate the average daily load per given area.

Data presented in Tables 4.2.g through 4.2.i supports and verifies the statements made previously about the seasonality (winter) of fugitive dust emissions: the majority of the dusting occurs under cold, dry desiccating conditions with moderate wind speeds from the north or northeast. These conditions typically occur for short periods between mid-December and late February. For presentation of results (Table 4.2.g and Table 4.2.i), the annual ADP data is grouped into two general time periods, November 8th through March 8th (Period 1) and March 9th through November 7th (Period 2). This equates to a 120 day duration for Period 1 and a 245 day duration for Period 2 (Table 4.2.h). The south and southwest ADP systems, which are downwind of the TDF, historically have higher rates of loading than the others. As shown in Table 4.2.i, the vast majority of the loading in these two systems occurs during Period 1 (winter).

Table 4.2.g Summary of 2017 Lead Loading by Period at the TDF						
	Period Start Date	**West µg/m²/period (Lead)**	**Southwest µg/m²/period (Lead)**	**South µg/m²/period (Lead)**	**Northeast µg/m²/period (Lead)**	**East µg/m²/period (Lead)**
Period 1	5-Jan-17	86	87	322	38	222
	11-Jan-17	137	106	236	105	166
	19-Jan-17	173	439	1,155	40	120
	26-Jan-17	256	65	251	103	146
	2-Feb-17	290	365	7,163	211	848
	9-Feb-17	285	207	1,771	400	147
	16-Feb-17	51	77	117	120	161
	22-Feb-17	162	202	655	153	176
	2-Mar-17	458	568	1,684	137	368
Period 2	9-Mar-17	690	1,903	15,252	188	936
	23-Mar-17	242	409	573	160	270
	6-Apr-17	446	353	738	268	1,004
	20-Apr-17	375	230	614	353	368
	6-May-17	478	326	482	607	485
	18-May-17	236	422	307	361	1,384
	1-Jun-17	256	339	660	792	434
	15-Jun-17	Damaged	378	Damaged	Damaged	Damaged
	6-Jul-17	288	Damaged	353	302	
	26-Jul-17	288	235	538	463	738
	9-Aug-17	346	1,016	711	385	392
	24-Aug-17	251	509	473	251	356
	6-Sep-17	258	220	268	251	209
	20-Sep-17	246	218	224	268	270
	7-Oct-17	220	179	297	186	129
	26-Oct-17	261	181	436	172	283
Period 1	8-Nov-17	339	602	18,956	223	400
	22-Nov-17	553	780	27,288	137	263
	6-Dec-17	237	139	312	146	115
	18-Dec-17	945	6,408	57,500	223	619
	Total	**8,852**	**16,963**	**139,338**	**7,043**	**11,008**
		µg/m²/year	µg/m²/year	µg/m²/year	µg/m²/year	µg/m²/year

Damaged - depostional collection system not functional, likely a result of bear activity.

The data collected to date shows that the zinc loading from fugitive dust emissions is consistently nearly double the quantity of lead loading, as is illustrated graphically in Attachment K. This is due to the tailings composition, which typically contain at least two times the amount of zinc compared to lead. However, this report focuses on the lead loading data because monitoring performed under the FWMP has identified lead levels in three shallow peat wells south (Site 27) and west (Site 29 and Site 32) of the TDF that approach or exceed Alaska water quality standards. The formation water in these wells is generally very dilute (low conductivity and hardness) and acidic (due to the organic acids), which is ideal for promoting lead mobility. Dust from the tailings pile may contribute to the lead levels observed in

these wells. Table 4.2.g presents the lead loading data from all five ADP systems in 2017. Table 4.2.h presents a summary of the standard dust loading periods and Table 4.2.i yearly lead loading data from the west, southwest and south ADP's.

Table 4.2.h Summary of Dust Loading Periods

Period	Date Range	Days	Percentage of Year
1	Winter: January 1st through March 14th and November 15th through December 31st	120	33%
2	Spring, Summer, Fall: March 15th through November 14th	245	67%

Table 4.2.i Summary of Yearly Lead Loading at the west, southwest, and south ADPs at the TDF

Year	Period	West Lead µg/m²/year	Percent	Southwest Lead µg/m²/year	Percent	South Lead µg/m²/year	Percent
2011	1	181,257	94%	34,440	92%	207,232	98%
	2	11,189	6%	2,803	8%	3,938	2%
	Total	**192,446**	µg/m²/year	**37,243**	µg/m²/year	**211,170**	µg/m²/year
2012	1	96,076	89%	36,224	83%	48,645	70%
	2	11,343	11%	7,261	17%	20,820	30%
	Total	**107,418**	µg/m²/year	**43,485**	µg/m²/year	**69,465**	µg/m²/year
2013	1	114,149	90%	36,475	91%	74,841	94%
	2	12,707	10%	3,793	9%	4,518	6%
	Total	**126,856**	µg/m²/year	**40,268**	µg/m²/year	**79,359**	µg/m²/year
2014	1	50,121	83%	25,819	74%	109,552	97%
	2	10,202	17%	8,871	26%	3,771	3%
	Total	**60,323**	µg/m²/year	**34,691**	µg/m²/year	**113,323**	µg/m²/year
2015	1	66,646	75%	75,122	92%	203,723	97%
	2	22,257	25%	6,684	8%	5,401	3%
	Total	**88,904**	µg/m²/year	**81,806**	µg/m²/year	**209,124**	µg/m²/year
2016	1	5,059	42%	3,606	53%	73,926	91%
	2	7,016	58%	3,154	47%	7,180	9%
	Total	**12,075**	µg/m²/year	**6,760**	µg/m²/year	**81,106**	µg/m²/year
2017	1	3,973	45%	10,044	59%	117,410	84%
	2	4,879	55%	6,919	41%	21,928	16%
	Total	**8,852**	µg/m²/year	**16,963**	µg/m²/year	**139,338**	µg/m²/year

For 2017, the south ADP had the highest yearly accumulative lead load of 139,338 µg/m^2 followed by the southwest system with accumulative lead load of 16,963 µg/m^2. The west, east and northeast systems were comparable with values between 7,000 and 11,000 µg/m^2 (Table 4.2.g).

Based on the predominant winds out of the north/northeast and the fact that tailings placement occurred mostly in the S3P1 area (71%) the expected area of loading would occur to the south of the TDF as supported by the data. Construction season activities at the TDF in 2017 contributed to Period 2 loading values. Reduced activity in the west and northwest portions of the TDF and placement of interim organic cover on the north side of the TDF led to lower loading in the west system relative to previous years.

The following measures are taken to reduce dust loss from the tailings pile:

- Snow fence were installed on the north and south crests of the tailings pile
- Three rows of wind fence were installed on the northern border of the TDF with an additional one placed on the southern end at the upper elevation of the pile
- Wind fence was installed along the south perimeter S3P1 TDF area
- Snow removal is limited to only active placement areas
- Interim slopes are covered with rock
- Outer slopes are hydroseeded where appropriate
- Water is applied to areas of tailings during below freezing temperatures to create an ice layer
- Open surfaces are kept at a minimum

4.3 Internal Water Quality Monitoring

Internal water quality monitoring refers to sampling conducted within the boundaries of the TDF. Sample locations include suction lysimeters installed within the tailings pile and wet wells that collect flows from above liner and below liner drains. This water is contained within the TDF and is routed to treatment facilities prior to discharge under the HGCMC APDES permit. Therefore, water quality data is not compared to AWQS. The objective of the monitoring is to provide a continuing perspective on in-pile geochemical processes.

Monitoring performed during this reporting period includes Wet Well 3 (Site 380), Wet Well A (Site 1789), the East Ridge Expansion above liner drains - north (Site 1424), and the Pond 7 underdrain (Site 396). Graphs of the available monitoring results from each of these sites over the past five years are provided in Attachment A. The current year results are consistent with past years and a detailed analysis of water quality within the TDF can be found in the *Tailings and Production Rock Site 2014 Annual Report.*

4.4 Site as-built

As-built drawings for the Tailings Facility are presented in Attachment G. The drawings depict the year-end topography, water management features, monitoring device locations and other significant features of the site. An additional tailings drawing includes cross sections that show the following information:

- existing topographic surface
- prepared ground upon which the pile was constructed

4.5 Reclamation / Closure Plan

HGCMC maintains and periodically updates its reclamation plan and cost estimate for closure, reclamation and long-term maintenance and monitoring (GPO Appendix 14 with attachments). The elements of the plan encompass the entire mine site, and also include reclamation performance monitoring and facility maintenance after final closure according to the Waste Disposal Permit standards.

The renewed Waste Management Permit (Permit Number 2014DB0003) included the increased disturbance from the Stage 3 Tailings Expansion. The reclamation cost detailed in GPO 14 Reclamation Plan is approximately $72,881,187.

HGCMC has conducted a review of the adequacy of the financial responsibility and based upon the review is updating the bond calculation in the Standard Reclamation Cost Estimator (SRCE) model. HGCMC will provide a letter detailing the changes to the SRCE model along with an updated model by 15 July 2018. Once approved by the agencies HGCMC will provide financial instruments to cover the increase.

4.5.1 Reclamation Projects

HGCMC continued using interim reclamation measures, such as hydroseeding and various erosion controls at the TDF, to improve and maintain established site controls. HGCMC also continued the use of other sediment control measures including silt fencing, jute mat, rock check dams, solid and flexible runoff collection pipes, coarse-rock slope armoring and slope contouring throughout the site. HGCMC is committed to the continued use of site controls as the operation has consistently demonstrated the benefits of these interim reclamation programs to reduce impacts during the operational period.

5.0 WASTE ROCK SITE 23

5.1 Background

Site 23 was constructed in 1995 and is currently the only active surface placement area for waste rock besides the TDF. The site boundary covers approximately 18 acres and has an estimated capacity to receive up to 1.2 million cubic yards of waste rock. See the Site 23 as-built in Attachment H for facility layout. The site is under the regulatory authority of the Forest Service and also the ADEC.

5.2 Site 23 Operation and Management

HGCMC manages Site 23 to safely receive material during production, maintain pile stability and reduce impacts to the receiving environment. This is accomplished through proper classification and segregation of waste rock, placement methodologies, and implementation of best management practices to control surface drainage. A detailed description of Site 23 operation and management, including standard operating procedures, is presented in GPO Appendix 11 – Waste Rock Management Plan.

5.2.1 Inspections

Several independent inspections are carried out at Site 23 throughout the year. Operators working at the site carry out daily visual work place inspections. The Senior Civil Engineer, Junior Civil Engineer and or Surface Operations Shifter carry out weekly visual inspections. The Environmental department carries

out a monthly checklist inspection. No visible signs of physical instability were observed at Site 23 during this report period.

An ADNR representative inspected the site twice in 2017 on May 24 and August 30. ADF&G representatives inspected the site twice in 2017 on July 18, and October 30. During 2017 the USFS conducted 11 routine inspections (Site inspections #380 - #390) to monitor for best management practices effectiveness and compliance to the General Plan of Operations. No issues of non-compliance or poor operations practices of the Site 23 were noted during the routine inspections. The USFS typically noted that the facility is being developed and operated to required operations and maintenance specifications of GPO Appendix 11.

5.2.2 Placement Records

Table 5.2.a shows the quantity of waste rock placed at Site 23 during this reporting period. This represents the combined total of Class 1, Class 2 and Class 3 waste rock, as determined by the underground geologists. Class 4 waste rock remains underground as backfill.

Table 5.2.a Site 23 Placement

	PRODUCTION ROCK PLACED AT SITE 23				**ADDITIONAL PRODUCTION ROCK HAULED**					
2017	**Surveyed (cy)**		**Surveyed (tons) From UG Truck Counts (tons)**		**Hauled to Tails from Site 23 (tons)**		**From UG Truck Counts (tons)**			
Date	Monthly	Total	Monthly	Total	Monthly	Cumulative	Class 1	Class 2	Class 3	Total
1/31/2017	5,113	979,663	8,655	1,658,364	561	320,648	4,134	1,477	2,681	8,292
2/27/2017	5,857	985,520	9,915	1,668,278	729	321,377	6,003	2,235	2,435	10,673
3/29/2017	1,074	986,594	1,818	1,670,096	1,008	322,385	140	949	866	1,955
4/30/2017	3,433	990,027	5,811	1,675,908	1,020	323,405	755	1,949	3,095	5,799
5/31/2017	7,336	997,363	12,418	1,688,326	4,460	327,865	5,334	6,488	2,345	14,167
6/30/2017	7,069	1,004,432	11,966	1,700,292	2,014	329,879	4,771	4,421	121	9,313
7/31/2017	1,572	1,006,004	2,661	1,702,953	6,222	336,101	2,930	633	670	4,233
8/31/2017	6,147	1,012,151	10,406	1,713,359	0	336,101	3,667	7,870	2,022	13,559
9/30/2017	9,637	1,021,788	16,313	1,729,672	124	336,225	6,114	11,795	530	18,439
10/31/2017	6,762	1,028,550	11,447	1,741,119	4,348	340,573	3,508	9,420	600	13,528
11/30/2017	0	1,028,550	0	1,741,119	0	340,573	1,870	4,572	28	6,470
12/31/2017	10,650	1,039,200	18,028	1,759,147	4,444	345,017	4,669	6,289	614	11,572
TOTAL	**64,650**	**1,039,200**	**109,147**	**1,759,147**	**24,930**		**43,895**	**58,098**	**16,007**	**118,000**

5.2.3 Acid-Base Accounting (ABA)

Waste rock from the mine generally consists of two varieties, argillite and phyllite. Characterization of Greens Creek Mine argillite and phyllite using ABA and other laboratory and field testing indicates that argillite is clearly not acid generating and that most samples of phyllite are potentially acid generating.

Due to these characteristics, management objectives have been established for management of waste rock materials.

Management and routing of waste rock initiates in the underground mine. Production geologists visually inspect the active mining face and muck piles to determine the waste rock lithology and pyrite content, estimate the Net Neutralization Potential value and assign the heading a class (1-4). Chip samples of the headings are collected and sent to a lab for ABA analysis. The ABA results help document the types of material produced and validates the visual classification system. Attachment E shows the results from the monitoring period visual inspections. Development occurred in ore zones hosted by Class 1 and Class 2 rock. No Class 3 or Class 4 rock was identified by geologists or in laboratory analyses. Results show a correct class determination of 35.9 percent, with 56.4 percent overestimation and a 7.7 percent underestimation out of a total of 39 samples. The overestimation results indicate that the geologist responsible for conducting the visual class determination categorized the rock as a rock with a higher acid generating potential when in fact the laboratory result indicated that the rock had a higher carbonate buffering capacity and a lower acid generating potential. Results for the monitoring period are consistent with previous year's conservative visual inspections. Samples are also collected on a quarterly basis from the active placement areas on Site 23. These results are shown in Attachment E.

The ABA results from samples of Class 1 and Class 2/3 waste rock collected from Site 23 during the monitoring period are shown in Table 5.2.b below and in graph form in Attachment E.

Table 5.2.b Site 23 Acid-Base Accounting ($tCaCO_3/kt$)

Class / Sample Date	Acid Potential	Neutralization Potential	Net Neutralization Potential
Class 1 – 03/28/17	95.6	402.3	306.7
Class 1 – 03/28/17	94.1	384.3	290.2
Class 1 – 06/29/17	68.4	300.9	232.5
Class 1 – 06/29/17	52.8	297.2	244.4
Class 1 – 9/19/17	112.2	380.2	268.0
Class 1 – 9/19/17	89.4	393.9	304.5
Class 1 – 10/25/17	78.1	470.7	392.6
Class 1 – 10/25/17	71.3	478.0	406.8
Class 1 Average	**82.7**	**388.4**	**305.7**
Class 2/3 – 03/28/17	55	85.7	30.7
Class 2/3 – 03/28/17	53.4	84.3	30.9
Class 2/3 – 06/29/17	48.1	170.8	122.7
Class 2/3 – 06/29/17	48.4	182.7	134.3
Class 2/3 – 9/19/17	139.7	232.3	92.6
Class 2/3 – 9/19/17	66.6	241.5	174.9
Class 2/3 – 10/25/17	174.7	220.1	45.4
Class 2/3 – 10/25/17	167.5	221.3	53.8
Class 2/3 Average	**94.2**	**179.8**	**85.7**

5.2.4 Stability

The design, construction, placement methodologies, and implementation of best management practices to control surface runoff ensure the stability of Site 23. The facility is constructed from the bottom up on a prepared foundation. As the height increases, native material is excavated from the backslope and

the excavated volume is replaced with production rock. The production rock is placed in 0.6 meter lifts with a dozer and compacted with a 12 ton drum compactor at the end of each shift. Exterior slopes are constructed with a 3H:1V maximum overall slope. Drainage of the foundation is facilitated by a series of finger drains. Upslope diversion ditches route non-contact runoff water around the facility. Surface runoff and drainage from the pile is collected and routed to treatment facilities.

5.2.5 Slope Monitoring

Geotechnical investigations have concluded that Site 23 is constructed on top of a large regional block slide or sackung, which is defined as a deep seated gravitational deformation. Four inclinometers have been installed to monitor the movement of the slide. Based on stability analysis, geotechnical engineers have recommended a trigger level for the amount of movement that would warrant an immediate data review and potential remedial action. The recommended trigger is 25.4 millimeters of movement per month or 76.2 millimeters total at the slide plane. Table 5.2.c lists the inclinometers, their general location, the amount of movement measured from October 2016 through October 2017, and the total movement since installation.

Table 5.2.c Site 23 Inclinometers

Inclinometer ID	Location	Movement 10/2016 – 10/2017	Primary Total Movement since Initial Reading	Primary Movement Depth (bgs)	Initial Reading Date
IN-23-10-01	Site D	0 mm	0 mm	n/a	Nov. 2010
IN-23-05-01	Central Site 23	6.0 mm	38.5 mm	79.3 ft	Oct. 2006
IN-23-10-02	West of Site 23	2.0 mm	13.8 mm	114.4 ft	Nov. 2010
IN-23-10-08	Above Site 23	1.4 mm	10.2 mm	131.8 ft	Sep. 2010

Note: 1-inch = 25.4 mm; bgs = below ground surface

Inclinometer IN-23-05-01 was installed at Site 23 at the end of 2005 to aid with stability monitoring at Site 23/D. This inclinometer, located at the central area of the site, has been monitored since 2006, with the baseline reading taken in October 2006. The monitoring instrument was most recently calibrated in May 2016. The measurements are presented as incremental displacement and a time plot (Attachment I). A positive deviation on the A axis and a negative deviation on the B axis indicate southerly (downslope) and easterly deviations, respectively. The incremental displacement chart (Attachment I) shows the location and magnitude of displacement since the initial 2006 reading. Displacements at the top of the hole are attributed to frost heaving, grout settling, and damage from bear activity. The incremental displacement view shows the amount of movement has been approximately 38.5 mm (from 2006 through October 2017; less than approximately 1.5-inch total movement, refer to time plot). The movement rate increased from an average 3 mm/year (May 2013) to 5.2 mm (May 2013 – Oct 2014) Approximately 6 mm of movement was observed from October 2016 to October 2017. Movement appears to be confined to a surface approximately 79.3 feet below ground surface (864.8 ft elevation). This depth roughly corresponds to the base of the slide/colluvium unit and the top of the dense till in the foundation.

Three additional inclinometers were installed at Site 23 during the summer of 2010 and baseline readings were taken September and November (after instrument calibration). Readings in inclinometers IN-23-10-01, IN-23-10-02, and IN-23-10-08 are consistent with the data obtained previously from IN-23-05-01. Inclinometer IN-23-10-01 was installed in the lower portion of Site D and no movement has been

observed in this inclinometer. Inclinometer IN-23-10-02 was installed west of the mid-slope of Site 23 and approximately 2.0 mm of movement was observed at approximately 114.4 ft bgs from October 2016 to October 2017 (approximately 13.8 mm total incremental movement since November 2010). This movement is along a silty sand lens between silt and the glacial till. Inclinometer IN-23-10-08 was installed at the top of Site 23 and the movement zone ranges from 125.8 to 135.8 ft bgs. This movement zone is below the landslide materials and just above the glacial till. The maximum movement in this zone was about 1.4 mm at 131.8 ft bgs from October 2016 to October 2017, with rate remaining relatively constant (approximately 10.2 mm total incremental movement since November 2010).

The 2011 (KCB, 2012) Site 23/D stability update provided recommendations for trigger level monitoring for inclinometer movement rates and piezometer water levels for instrumentation installed at Site 23/D, to ensure stable static site conditions. More frequent monitoring and site reassessment for stability becomes necessary if movement is documented along the slide plane in excess of 1 inch (25.4 mm) per month, or 3 inches (76.2 mm) total. Immediate notification and response action is necessary if movement along the slide plane in excess of 4 inches (101.6 mm) per month is documented. For water levels, the general guidelines are that if water levels are trending 5-ft above the winter average for a given piezometer, that the Surface Operations Manager should notify the Design Engineer for further assessment. If the water levels are trending 10-ft above the winter average for a given piezometer, appropriate emergency response notifications and actions shall be implemented. Piezometer levels are discussed further in the next section of this report.

5.2.6 Water Level Data

Well and piezometer water level data are provided in Attachment F. The lack of significant pressure in piezometers installed close to the base of Site 23 demonstrates that the pile remains free draining. This is consistent with the construction of a network of finger drains under the pile and a blanket drain at the pile toe. The lack of pore pressure at the toe indicates that pile stability has been maximized. The inferred water table is 30 to 60 feet below the base of the production rock pile material up-slope of the Site 23 active placement area and 5 to 20 feet below the base of material placed in Site D and the toe of Site 23, respectively. Observations from wells completed in the colluvium below the sites indicate that perched water tables and braided flow paths exist beneath the site (e.g. compare MW-23-A2D and MW-23-A2S). This unit also shows large (up to 10 feet) fluctuations in head levels, which are consistent with perched, confined conditions and channel-like flow. There is a distinct seasonal pattern to the water level fluctuations beneath Site 23/D, particularly in the alluvial sands (MW-23-A4 and MW-D-94-D3).

The silty/clay till that underlies the colluvial unit impedes downward flow and has an upward hydrologic gradient caused by its confining the more permeable bedrock below it. MW-23-98-01 is completed in the till unit and indicates a water table near the top of the till, which is approximately 100 feet below the existing topographic surface. Alluvial sands occur between the colluvial unit and the silt/clay till near the toe of Site 23 and under Site D. Data from MW-23-A4 and MW-D-94-D3 indicate that the sands are saturated. A curtain drain installed in between Site D and Site 23 in 1994 collects water that flows at the base of the colluvial unit and the top of the alluvial sands (see as-built and sections in Attachment H). This drain helps reduce pore pressures in the foundation of Site D, as well as capturing infiltration waters from Site 23.

5.2.7 Hydrology

Surface and groundwater are managed using a network of drains, ditches and ponds at both Site D and Site 23. See the Site 23 as-built (Attachment H) for locations of these features. Water that is collected

in the finger drains beneath Site 23 is routed to Pond 23 along with Site 23 runoff via a lined ditch. Pond 23 also periodically receives stormwater via pipeline from the 920 area. A curtain drain below the toe of Site 23 captures groundwater from the colluvial unit beneath the site and reports to the Pond D wet well via pipelines. Pond D also captures surface water and drainage from seeps near the toe of Site D. Pond D water is returned to the Pond 23 pump station where it is either sent to the Mill or down to the Pond 7 water treatment facility. An 18" HDPE pipeline was installed in 2008 to carry stormwater from Pond 23 (which receives water from Pond D) to the Pond 7 water treatment facility. This pipeline, along with the installation of new pumps, increased the stormwater handling capacity of Site 23/D to a 25-year 24-hour storm. Monthly temperature and precipitation data at the Mill are provided in Table 4.2.f.

5.3 Internal Water Quality Monitoring

Internal water quality monitoring refers to sampling conducted within the boundaries of Site 23. Sample locations include the finger drains beneath Site 23, outlets of the curtain drain that was installed below the toe of Site 23, and three monitoring wells in Site 23 and Site D. The finger drains have been monitored extensively since 1999, and are currently monitored on a quarterly schedule. The curtain drain outlets have been monitored since 2003 and are sampled at least annually. The finger drains and curtain drain outlets with sufficient flow were sampled during this reporting period. Water quality graphs showing the past five years of monitoring data for the Site 23 finger drains (site numbers 310 – 316) are included as Attachment B. Water quality graphs for the Site D drain outlets (site numbers 317, 319 and 328 – 330) are included in Attachment C. These flows are captured and routed to treatment facilities. For a detailed analysis of water quality within the Site 23 / D see the *Tailings and Production Rock Site 2014 Annual Report.* The current year results are consistent with past years and suggest that carbonate minerals in the waste rock continue to maintain near-neutral to alkaline conditions in the drainage from Site 23/D.

6.0 UNDERGROUND MINE WASTE DISPOSAL

Disposal of wastes in the underground workings as backfill is authorized under the WMP. The majority of the backfill consists of cemented tailings and Class 4 waste rock. Other wastes include tires, steel, and small quantities of inert wastes as authorized in the WMP. Table 6.0.a lists the quantities of tailings and waste rock disposed in the underground mine during this reporting period.

Table 6.0.a Quantities of Wastes Disposed in Underground Mine			
2017	**Tailings (DST)**	**% of tailings generated**	**Waste Rock (tons)**
January	29,470	43.4%	11,471
February	28,907	46.8%	10,673
March	32,139	52.8%	8,075
April	34,215	47.7%	12,632
May	32,252	47.5%	13,229
June	34,111	49.5%	9,968
July	34,589	47.1%	9,370
August	46,219	66.1%	4,498
September	34,439	49.0%	7,772
October	36,183	54.2%	9,820
November	41,846	57.5%	3,983
December	32,708	44.9%	4,613
Total	**417,078**		**100,530**

7.0 POND 7

7.1 Background

Pond 7 is a 31.5 acre-ft (10,260,000 gallon) off channel impoundment designed to retain direct surface runoff and underdrain flows from the TDF, and water via pipelines from the Hawk Inlet Port Facility, Waste Rock Site 23, and the 920 facilities. The design capacity is for containment of the 25-yr/24-hr storm event for the TDF (not including the S3P1 area) and Site 23, and the 10-yr/24-hr storm event for Hawk Inlet and the 920 facilities. The pond is located southwest of the TDF.

Pond 7 was constructed in 2005. It consists of rock fill embankments on the west and southwest sides. The pond bottom and other embankments are bedrock excavations. The pond was constructed with 80-mil HDPE liner placed over a sand bedding layer, and has an underdrain collection system. Pond 7 and its embankments are regulated by the Alaska Department of Natural Resources (ADNR) as a Class III Dam (NID No. AK 00307). As required by the ADNR – Dam Safety and Construction Unit, HGCMC prepared an Operation and Maintenance Manual for Pond 7 that lists the operational, maintenance, monitoring and inspection records for the dam and all supporting infrastructure.

7.2 Stability

Pond 7 embankment stability is assessed by conducting annual GPS surveys of nine permanently embedded concrete monuments. Surveys were conducted at a higher frequency until 2011, and then reduced to annual surveys due to the limited movement measured. Key performance parameters require a horizontal movement of less than 3 inches per year and a vertical movement of less than 6 inches per year. Since 2007, the total horizontal and vertical movement has been well below the threshold.

7.3 Visual Inspections

Visual inspections of Pond 7 and the embankments are performed on a weekly basis, and following significant precipitation and seismic events. Records of the inspections (checklists) are retained at the Pond 7 WTP. There were no unusual findings or observations during this reporting period.

7.4 Water Balance

All waters captured by containment systems and waste waters generated by facility processes are collected in Pond 7 for subsequent treatment and discharge to Hawk Inlet under the HGCMC APDES permit. As required by the APDES permit, HGCMC performs continuous monitoring of effluent discharge flows. The primary sources that make up the Pond 7 volume include mill process water, Pond 23 flow (all combined groundwater and storm water collected from the underground mine, 920 area and Site 23), the Hawk Inlet port facilities (combined storm water, waste water from the camp facilities and truck wash water), and flows from the TDF area (surface runoff, underdrain collection systems and the truck wash).

Flows from individual sources are highly variable on a day-to-day basis depending on site operations and weather conditions. Operational experience has shown that the percentage of Pond 7 flow from the primary sources is within consistent ranges when longer time periods, such as monthly, are viewed. These ranges are as follows:

- 40 – 50%: Mill process water
- 30 – 40%: Pond 23
- 15 – 20%: Tailings area
- 1 – 3%: Hawk Inlet facilities

Process water generated by the mill remains fairly consistent on a monthly basis. Typically, about 50% of the process water is recycled through the mill and the remainder is sent to Pond 7 for further treatment. The long term average flow rate of process water to Pond 7 is about 500 gpm.

Underdrains from a large portion of the tailings facility are routed to Wet Well 3 and Wet Well A. The monthly total volume and average flow rate from each wet well is shown in Table 7.4.a.

The total volume of Pond 7 water and average flow in gallons per minute that was treated and discharged during this reporting period is shown in 7.4.a.

Table 7.4.a Tailings Facility Underdrain Flows and Pond 7 Treated Volume						
2017	**Wet Well 3 Flow Data**		**Wet Well A Flow Data**		**Pond 7 Treated Volume Flow Data**	
Month	**Total Gallons/Month**	**Average Flow GPM**	**Total Gallons/Month**	**Average Flow GPM**	**Total Gallons/Month**	**Average Flow GPM**
January	Totalizer not functioning		1,122,800	25.2	52,700,000	1,180.6
February			856,600	20.5	43,680,000	1,083.3
March			708,600	15.9	39,370,000	881.9
April			849,700	19.7	40,200,000	930.6
May	349,800	7.8	637,500	14.3	33,900,000	784.7
June	354,800	8.2	681,600	15.8	35,400,000	819.4
July	485,600	10.9	1,268,900	28.4	35,030,000	784.7
August	442,000	9.9	1,120,200	25.1	47,430,000	1,062.5
September	685,600	15.9	1,451,800	33.6	65,400,000	1,513.9
October	664,900	14.9	1,322,600	29.6	64,170,000	1,437.5
November	489,700	11.3	960,500	22.2	39,000,000	902.8
December	990,900	22.2	1,406,100	31.5	64,480,000	1,444.4

8.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC) Division of Air and Water Quality, Waste Water Discharge Program. *Waste Management Permit 2014DB0003, Hecla Greens Creek Mining Company.* August 11, 2014.

Hecla Greens Creek Mining Company (HGCMC), 2015. General Plan of Operations (GPO), Appendix 3: Tailings Disposal Facility Management Plan, February 2015.

Hecla Greens Creek Mining Company, 2014. Greens Creek Mine Integrated Monitoring Plan, GPO Appendix 1, November 2014.

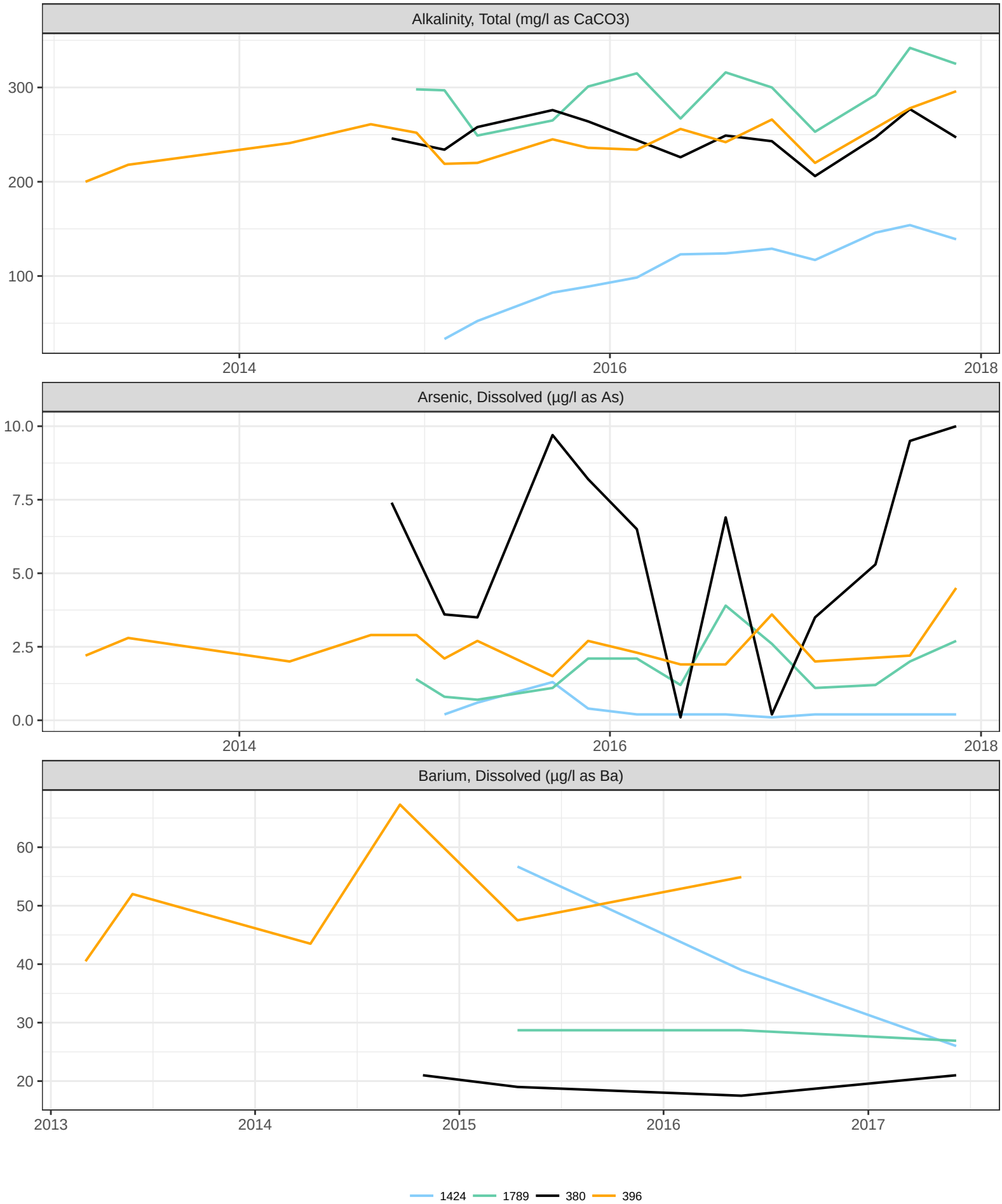
Hecla Greens Creek Mining Company, 2014. Greens Creek Mine Tailings Disposal Facility Management Plan, GPO Appendix 3, November 2014.

Hecla Greens Creek Mining Company, 2014. Greens Creek Mine Waste Rock Management Plan, GPO Appendix 11, November 2014.

USDA, Forest Service, 2013 Greens Creek Mine Tailings Disposal Facility Expansion, Final Environmental Impact Statement and Record of Decision, Vol 1. September 2013.

Zutz, J. 2018. Aquatic biomonitoring at Greens Creek Mine, 2017. Technical Report No. 18-01. Alaska Department of Fish and Game, Douglas, AK.

ATTACHMENT A
Tailings Area Underdrains



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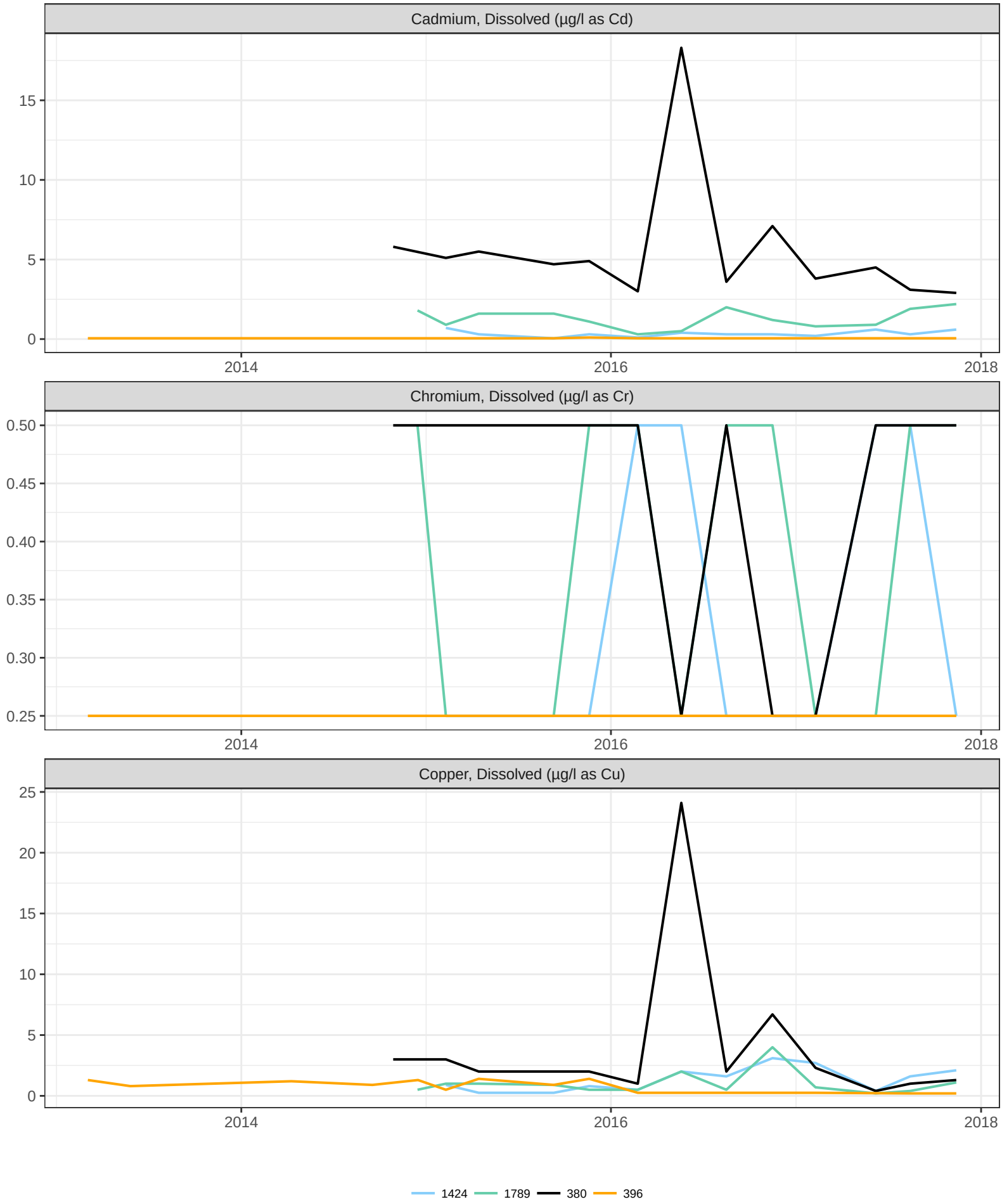

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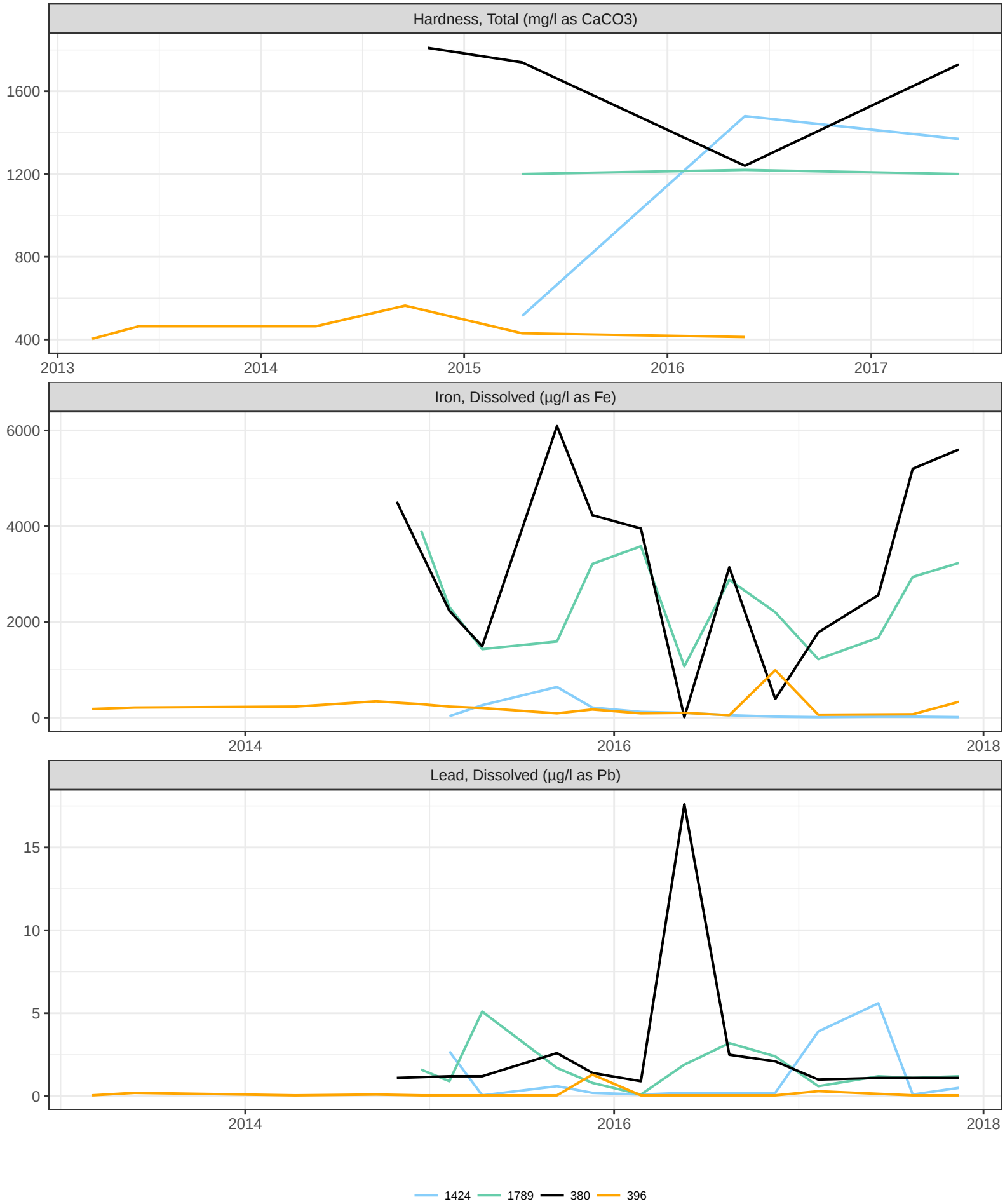

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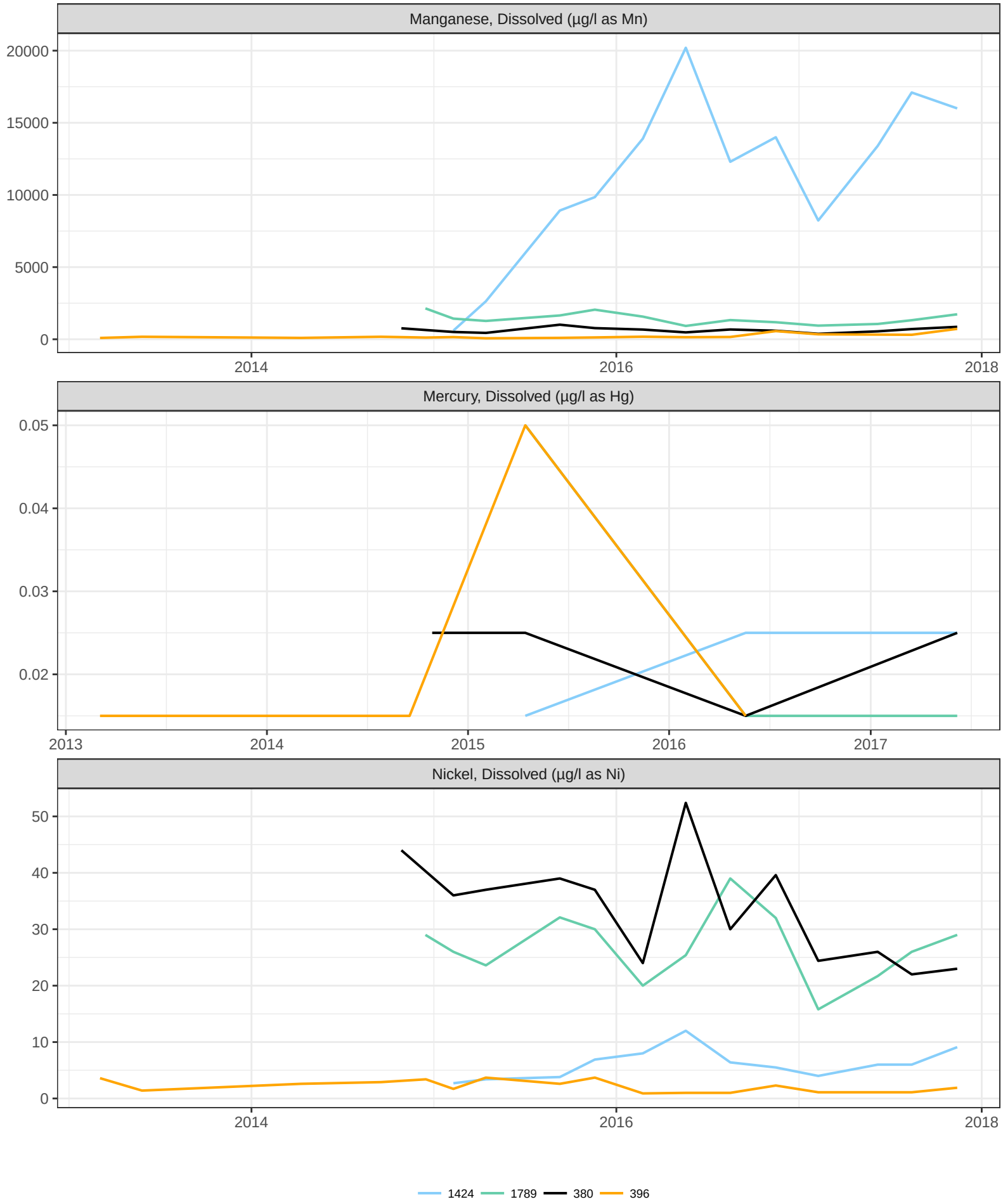

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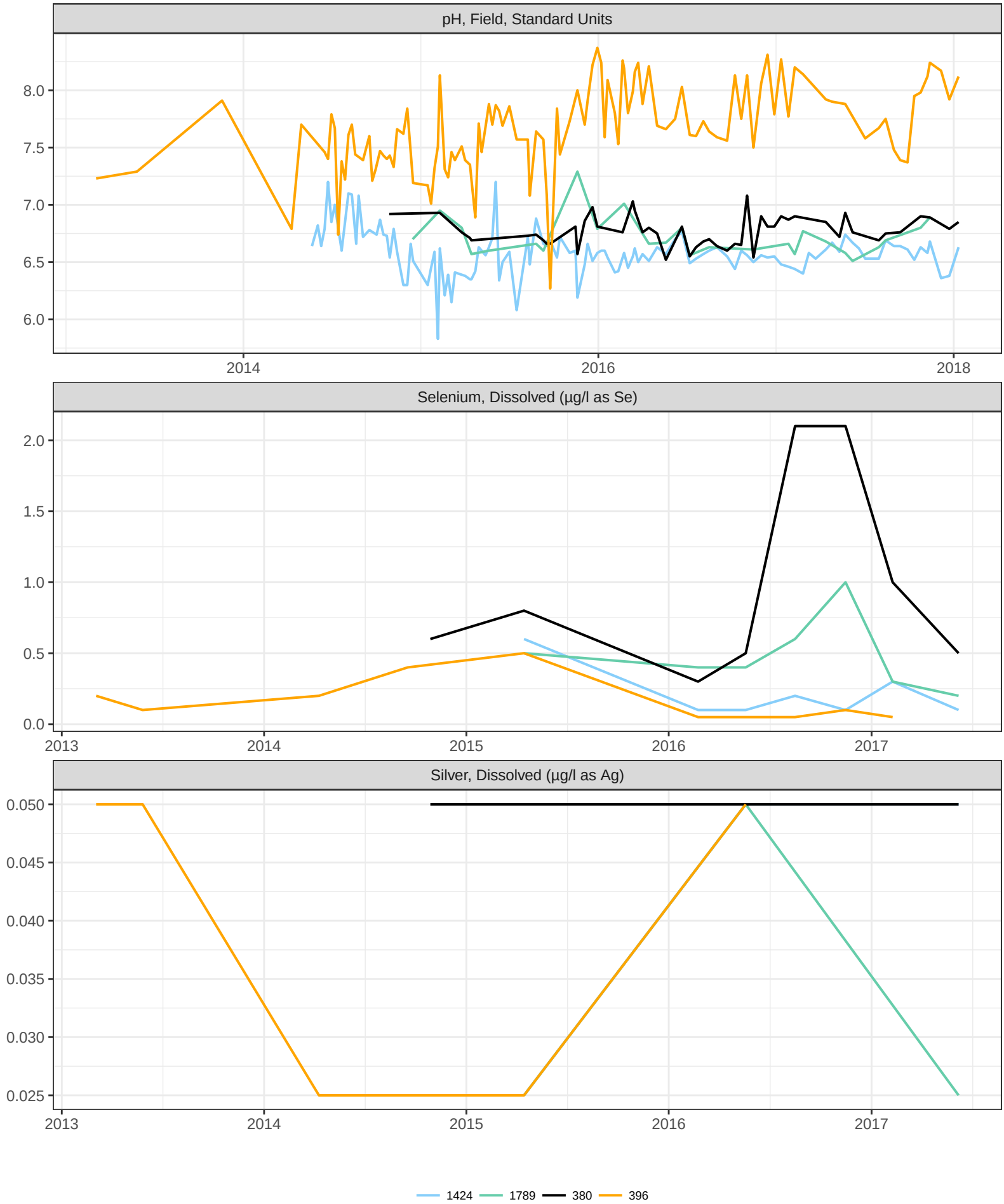

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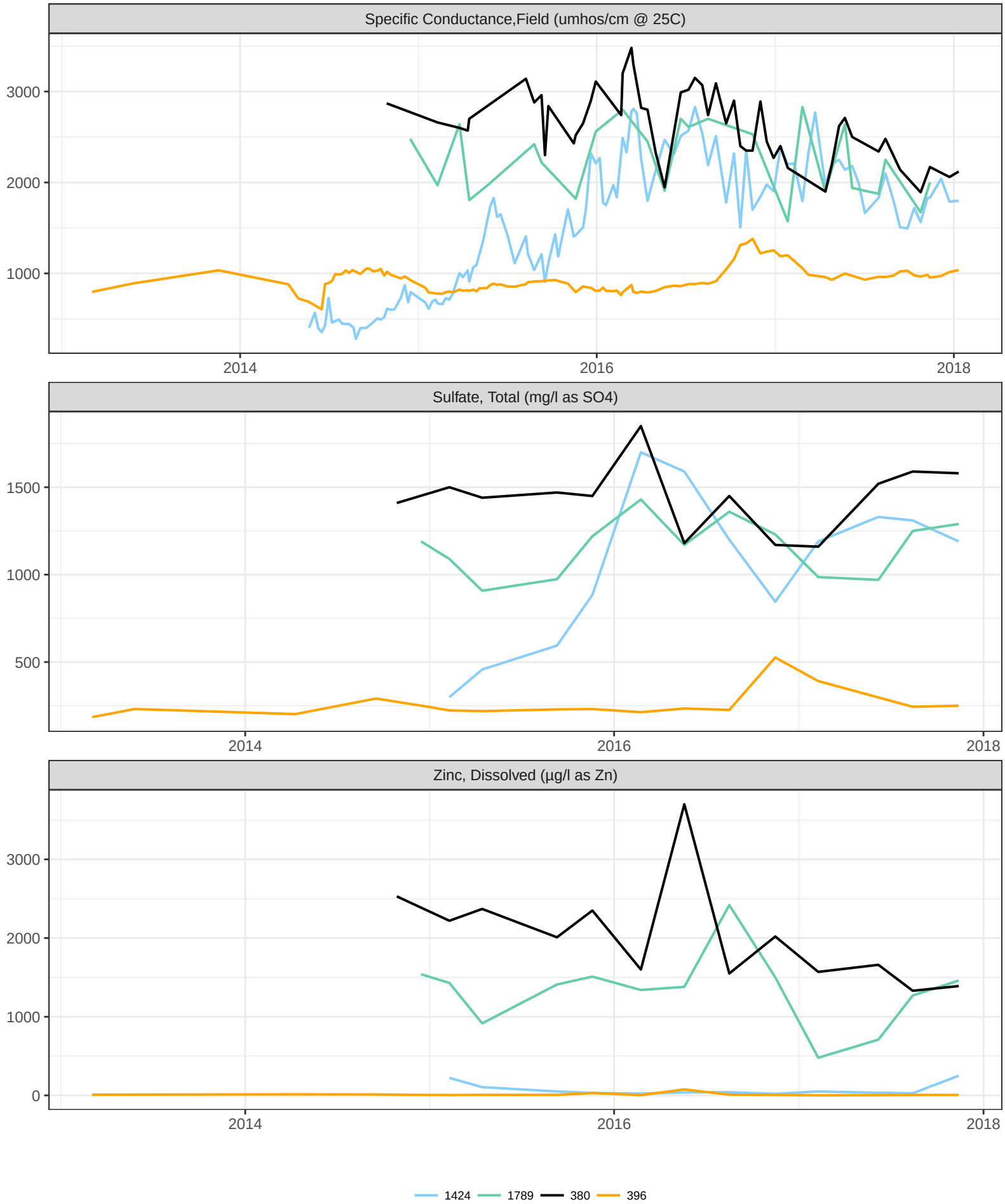
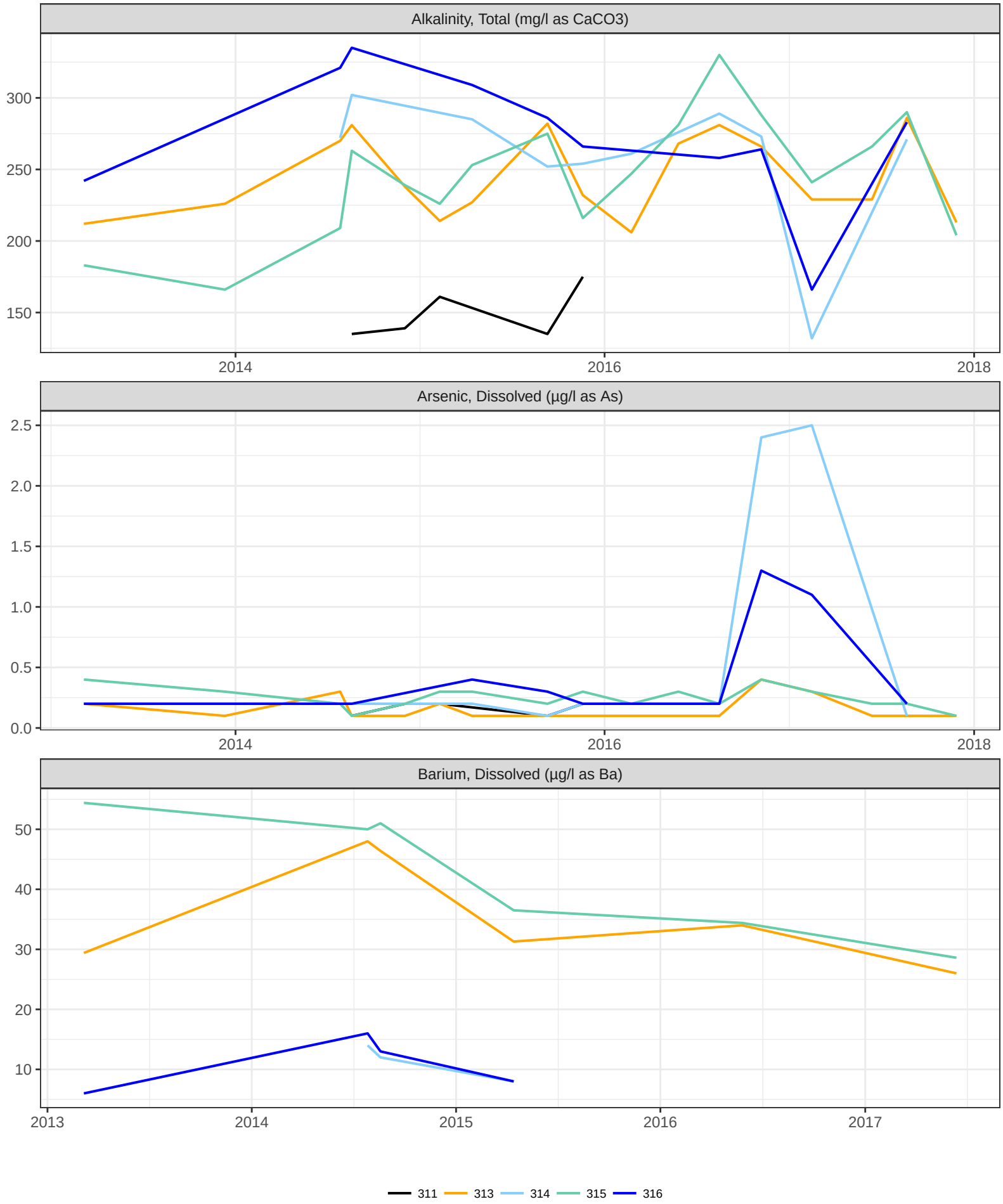
Tailings Area Underdrains



ATTACHMENT B
Site 23 Finger Drains



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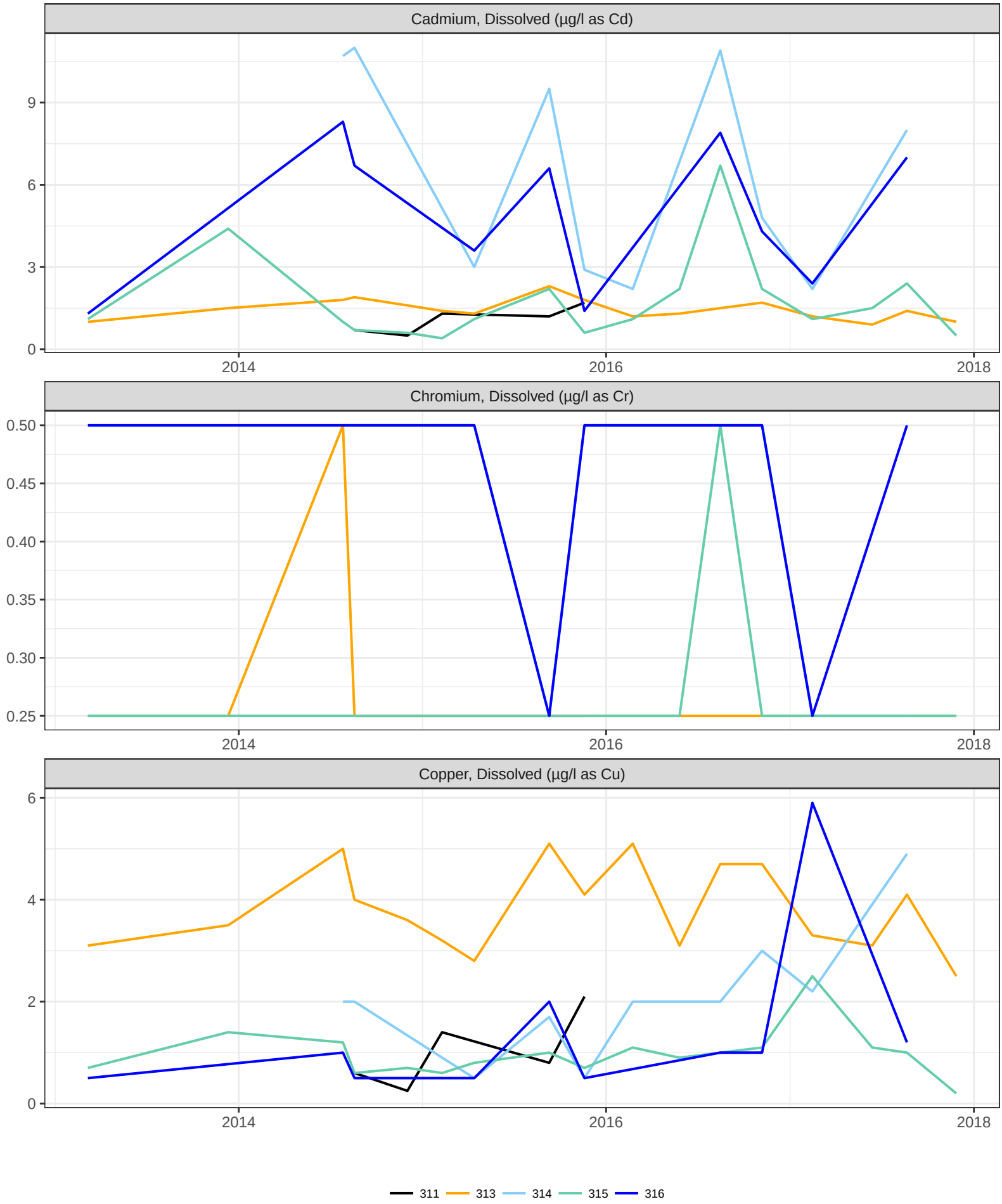

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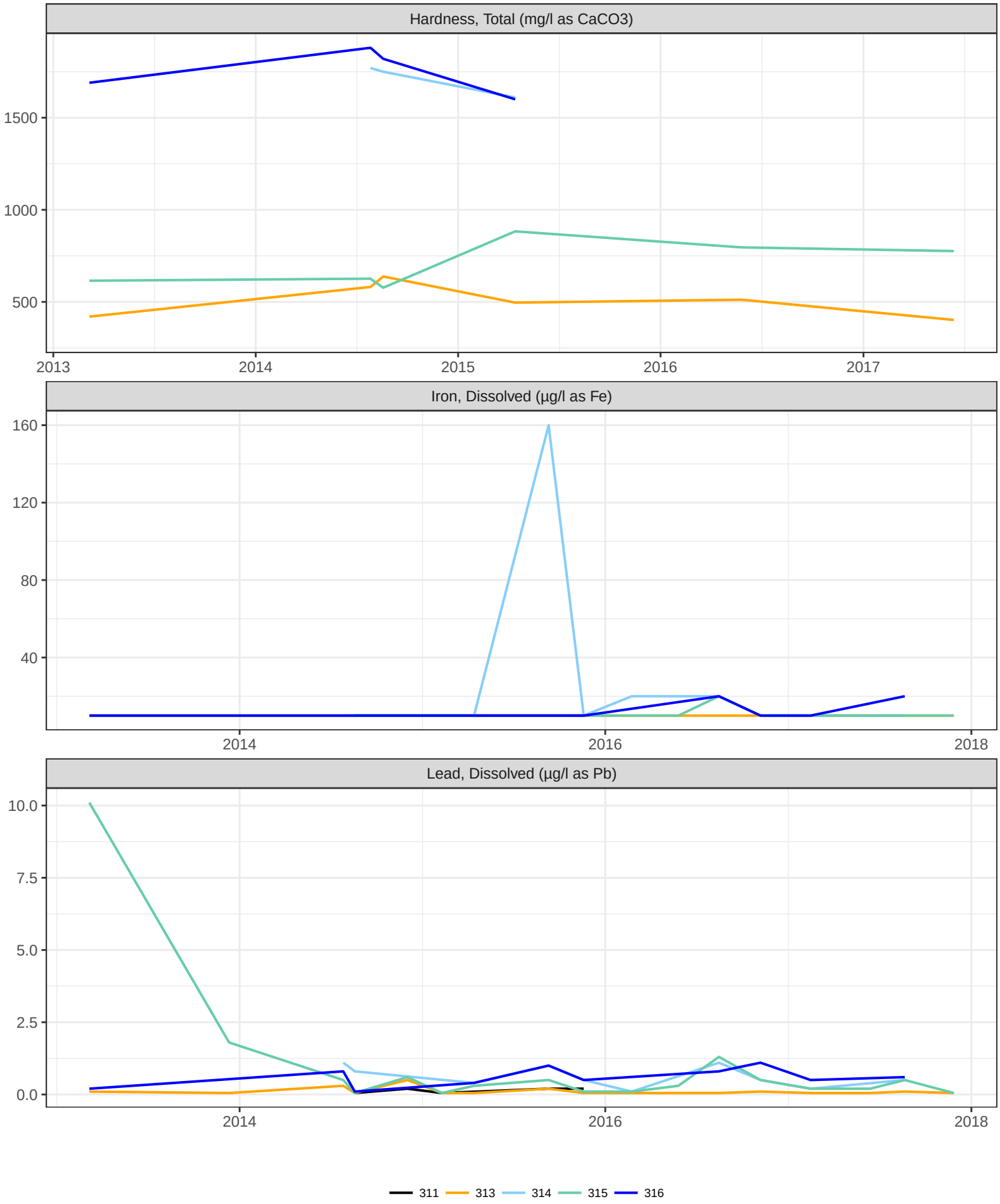

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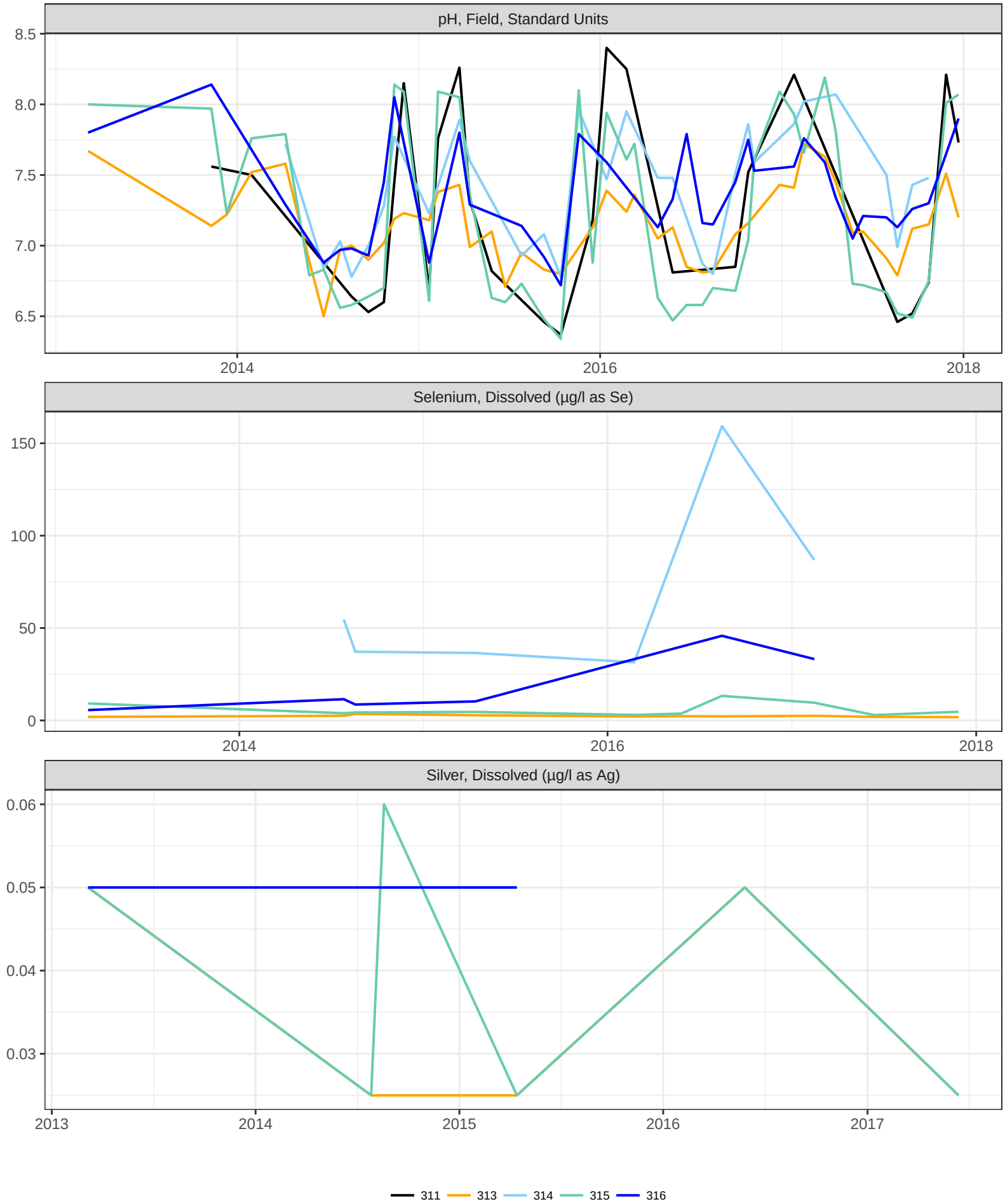

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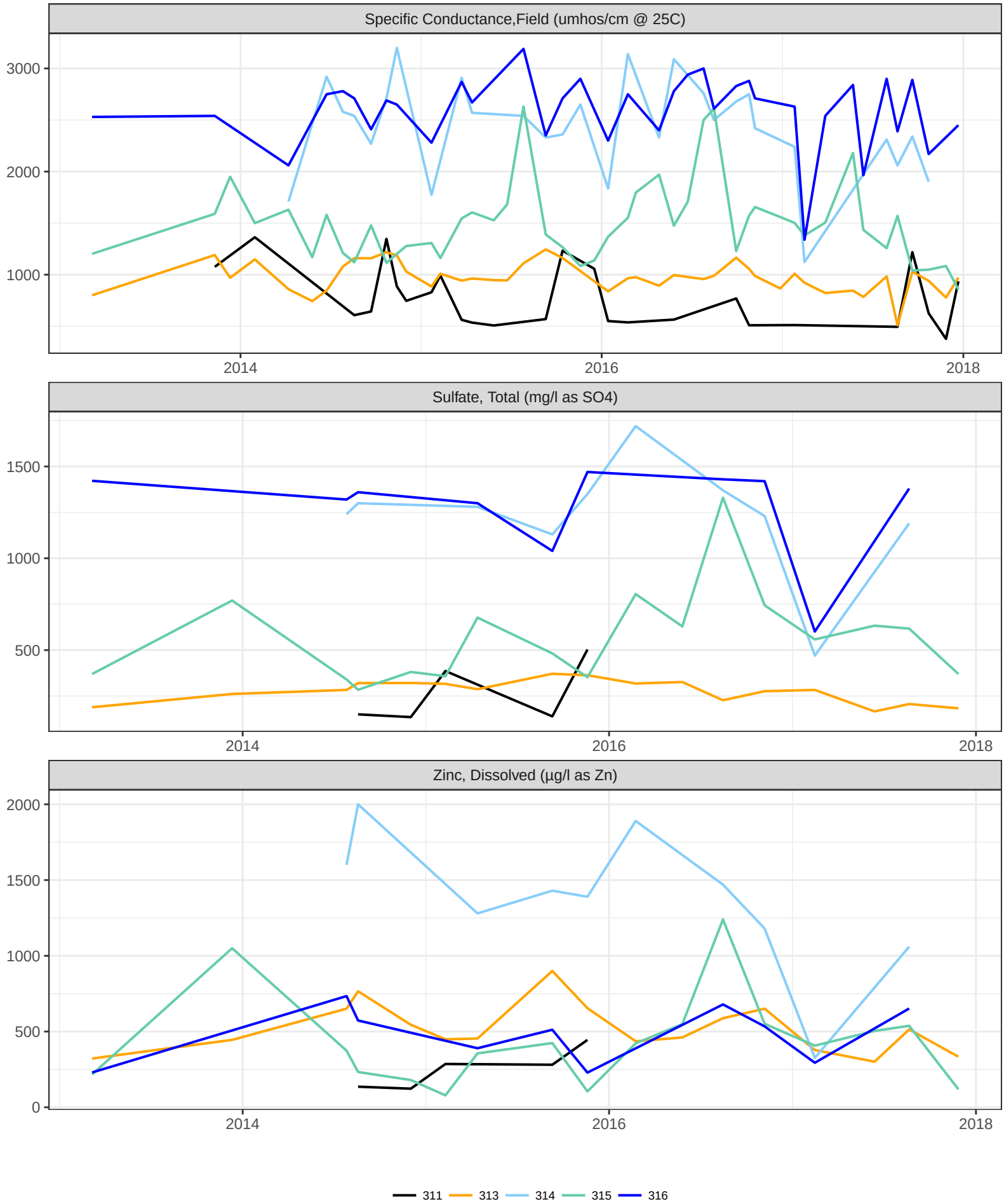
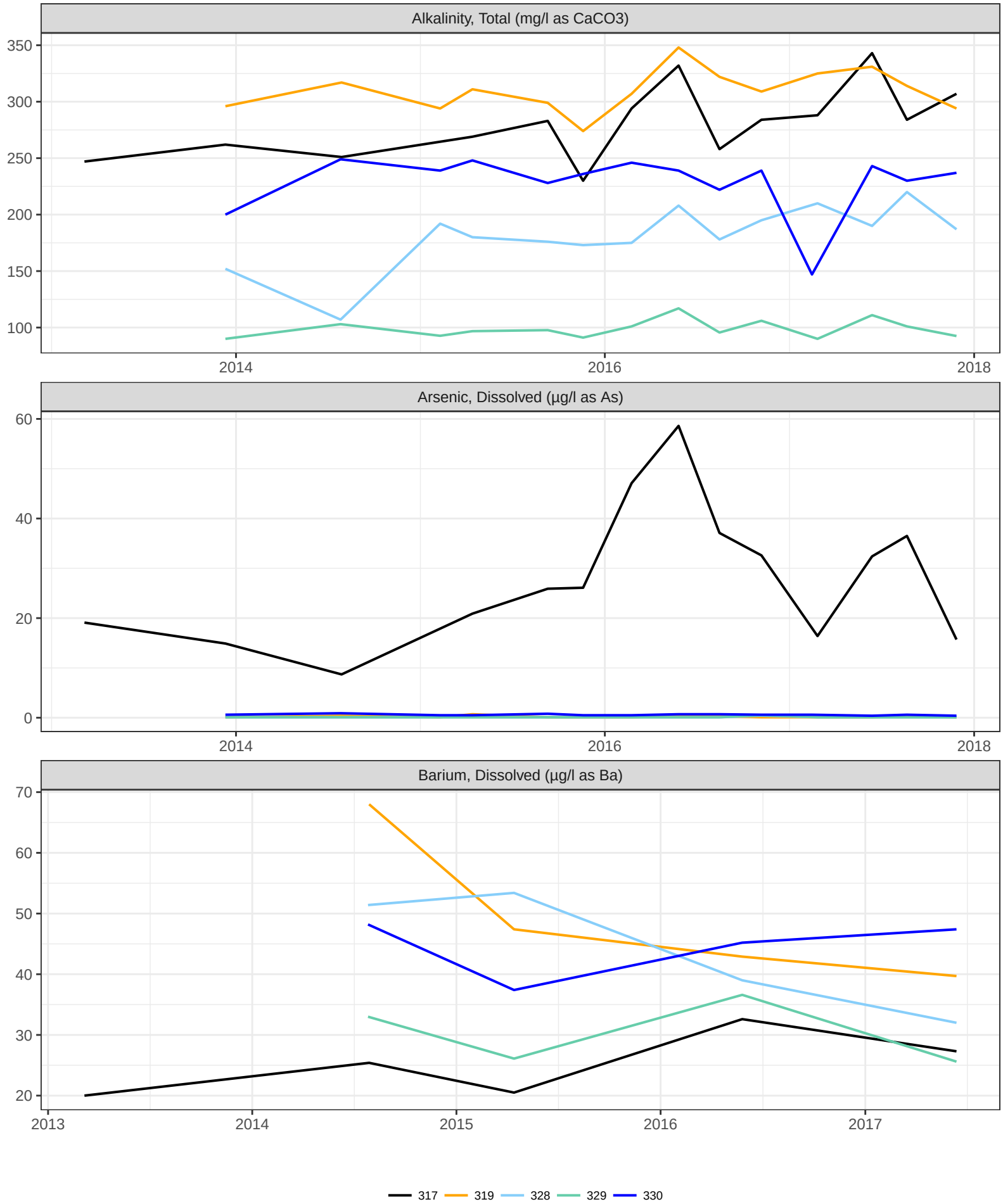


ATTACHMENT C
Site 23/D Curtain Drains



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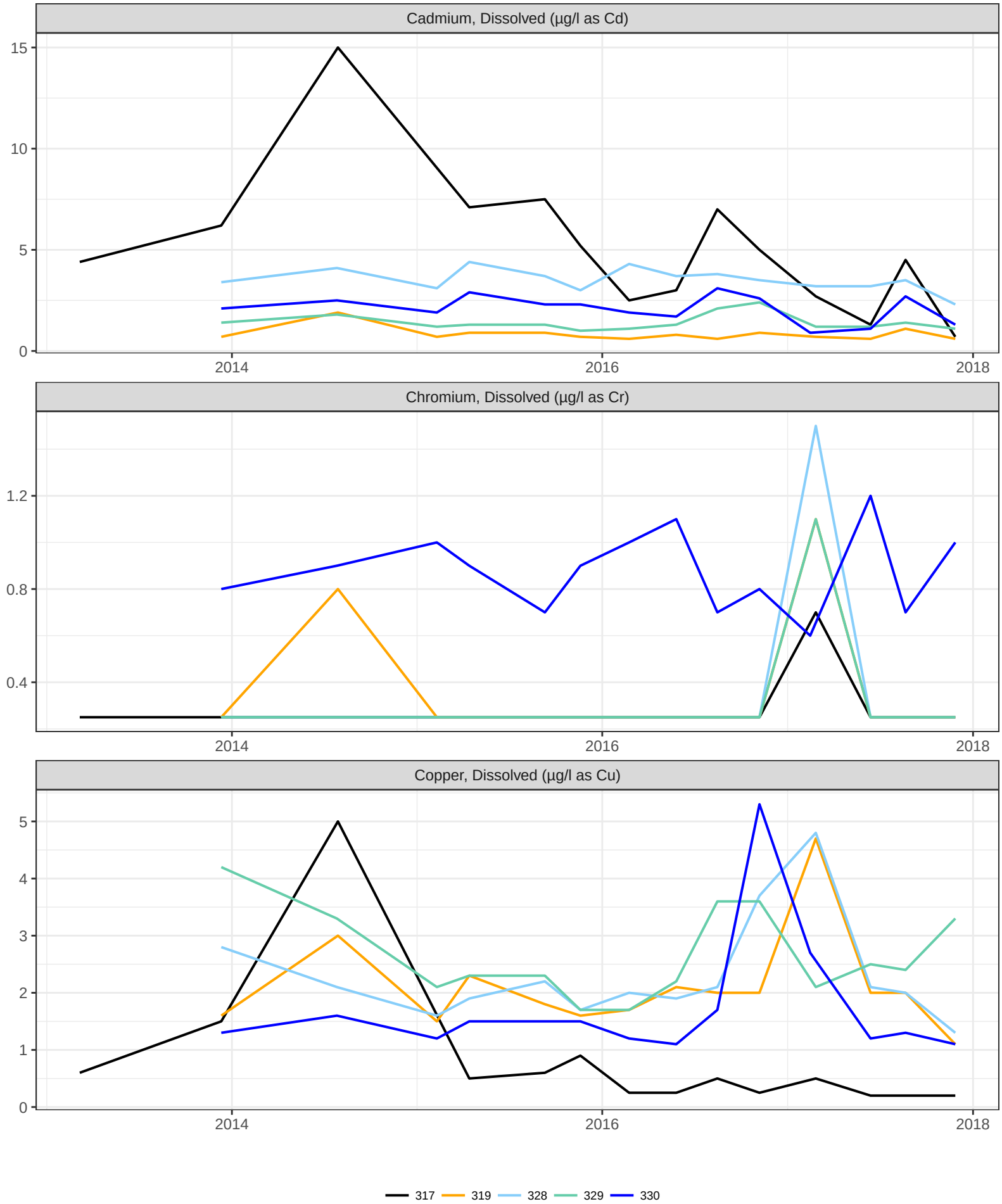

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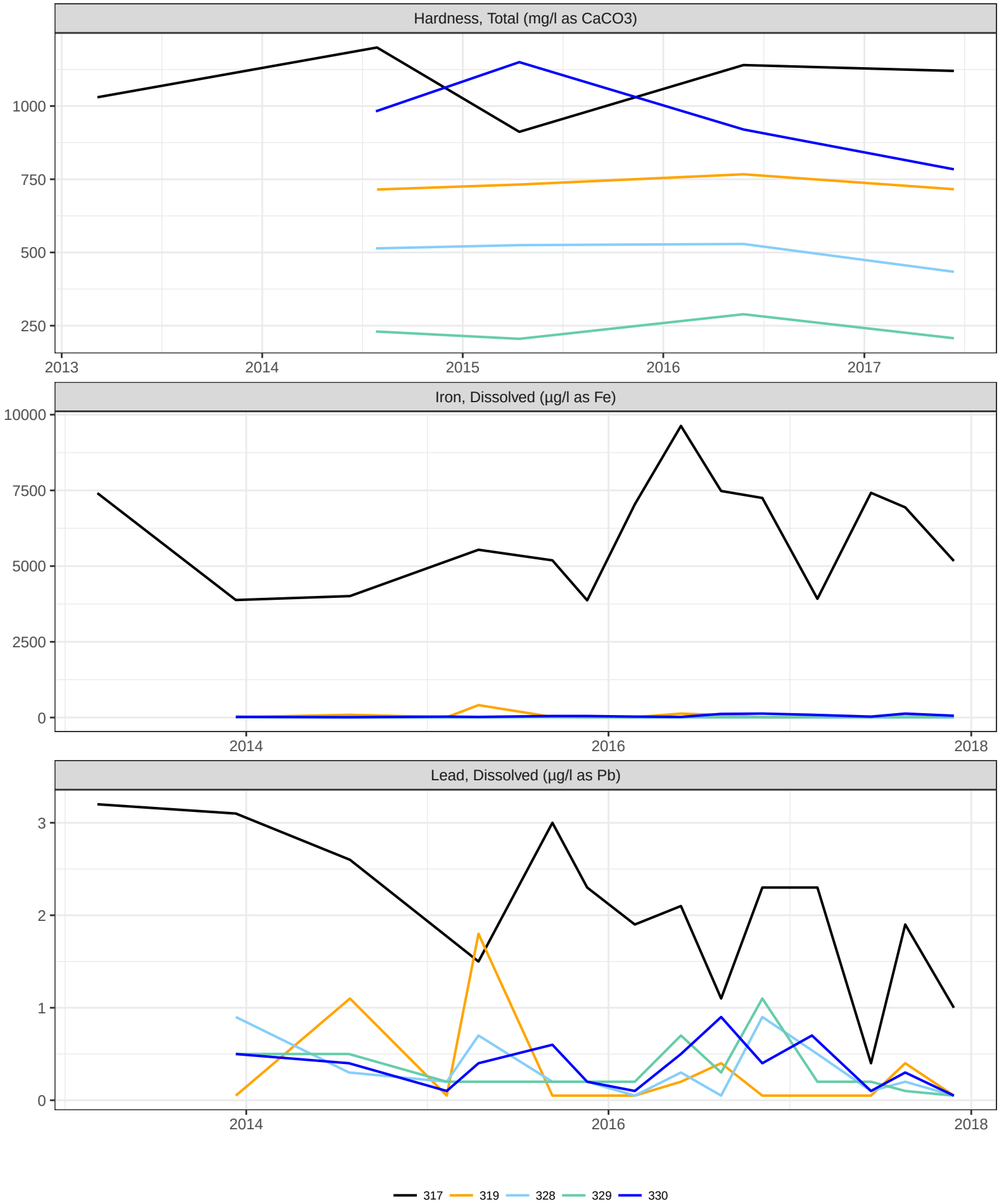

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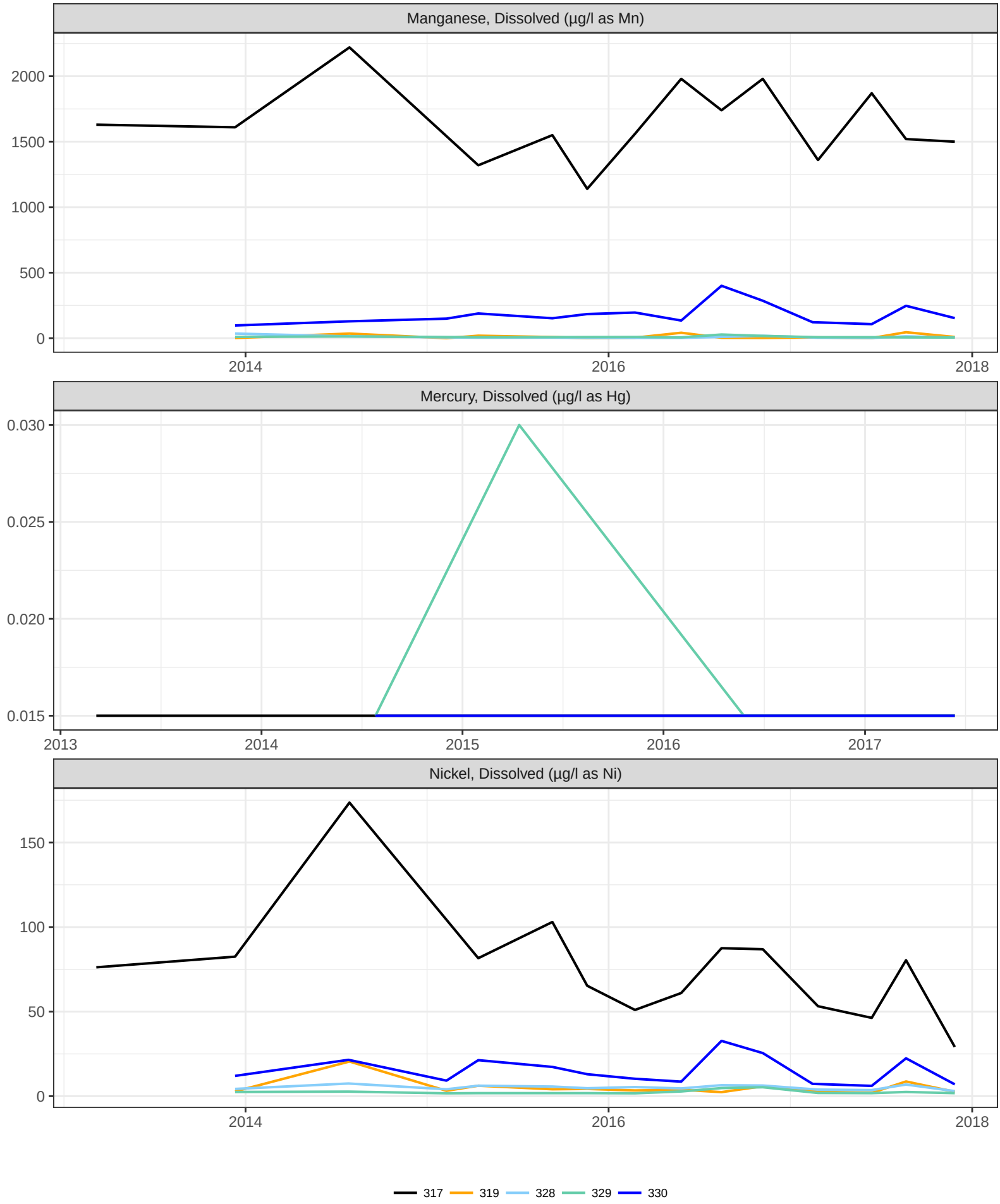

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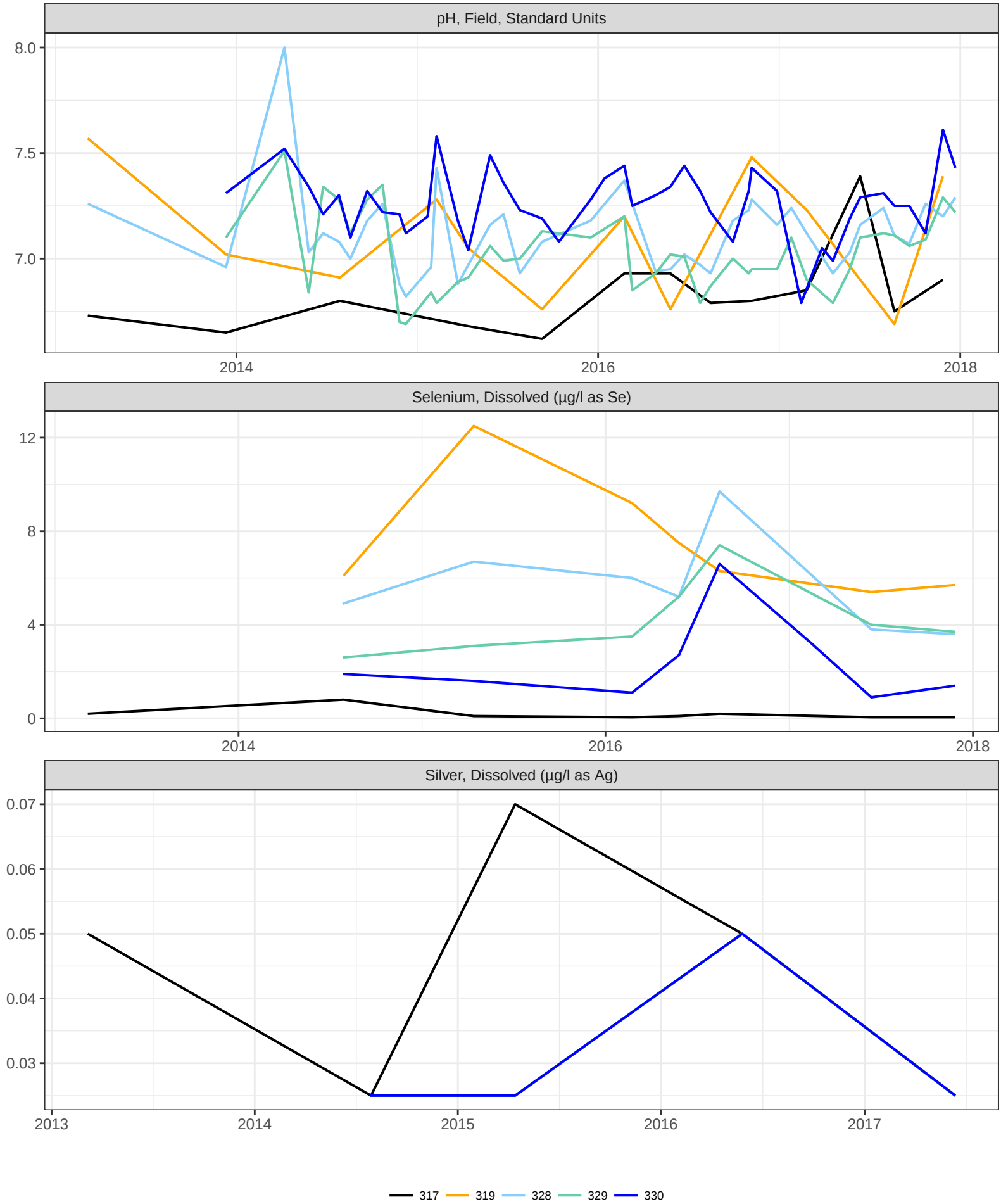
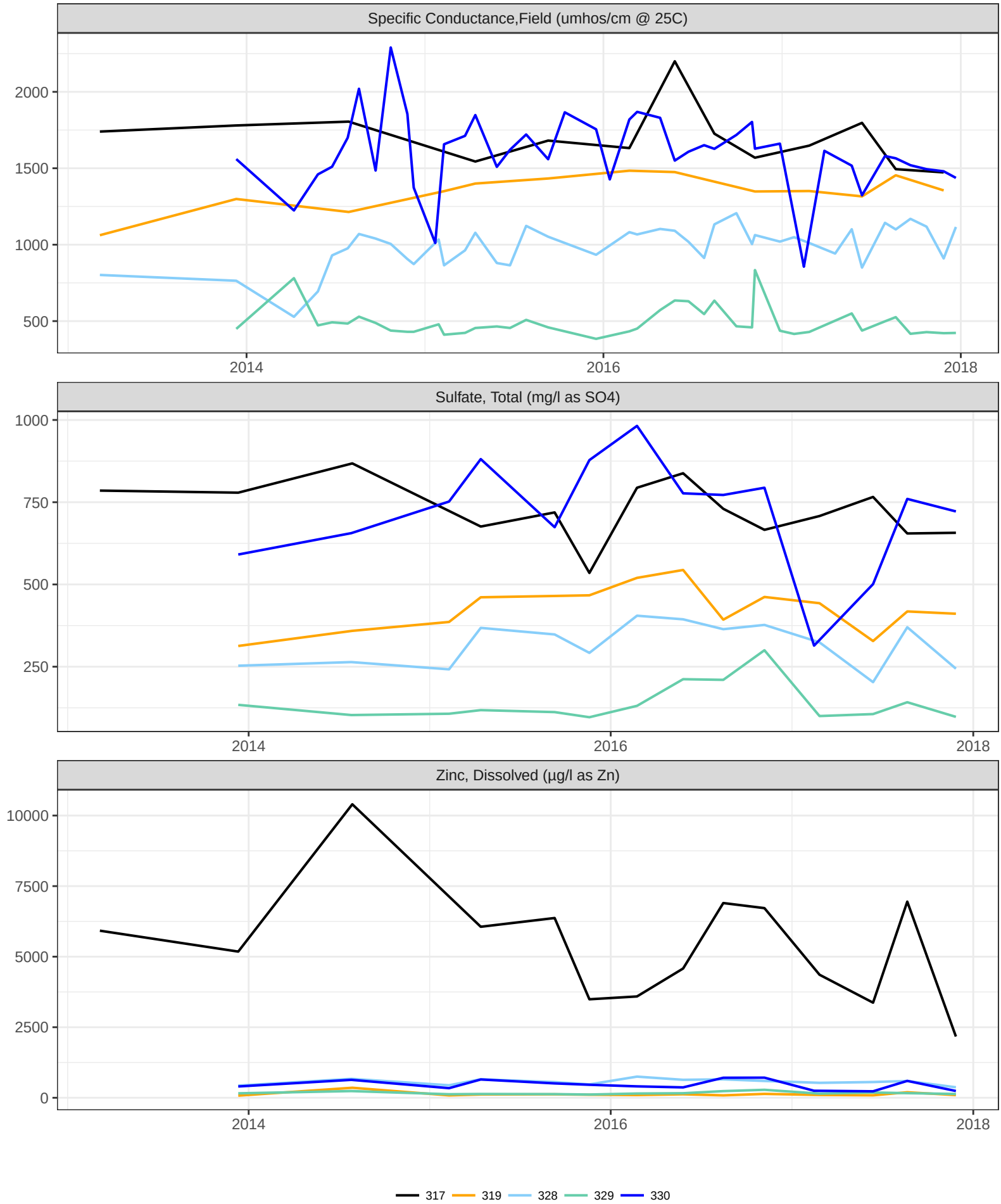
Site 23/D Curtain Drains



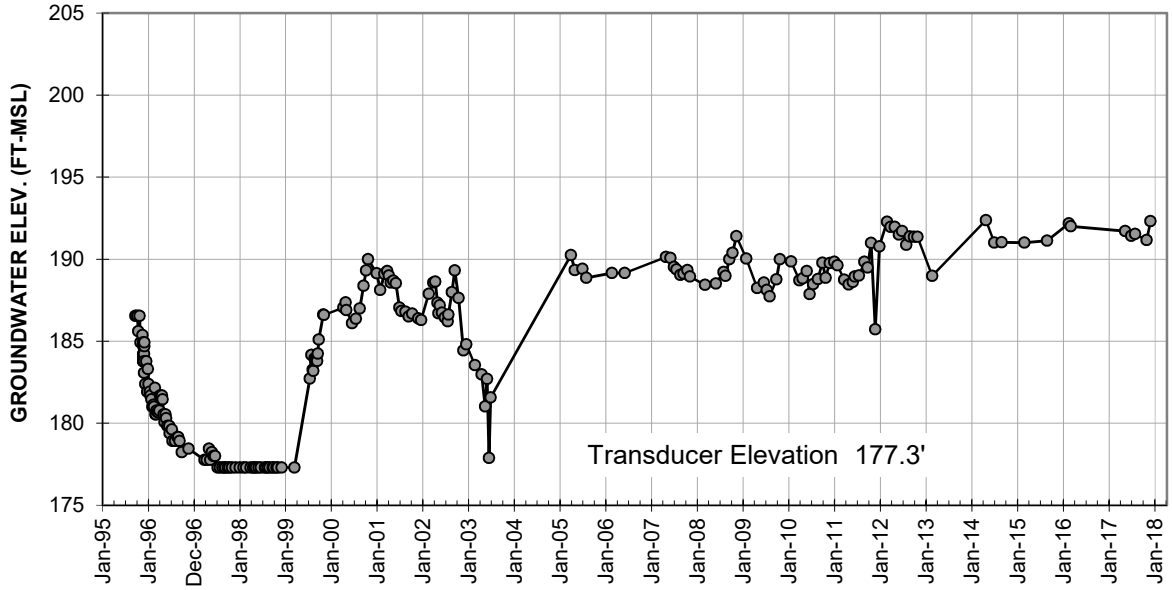
ATTACHMENT C
Site 23/D Curtain Drains



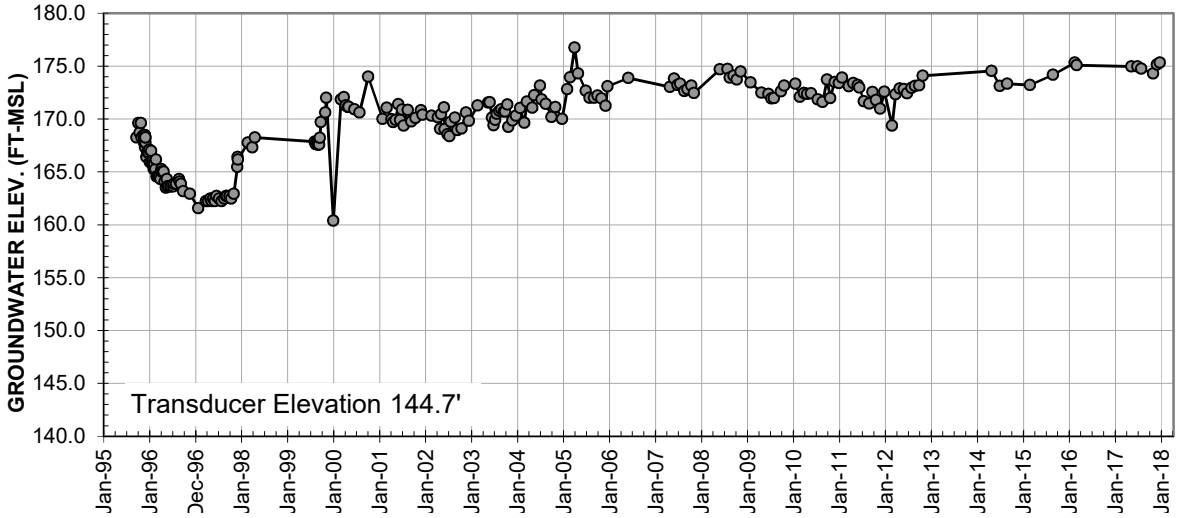
ATTACHMENT D

Piezometer Data at the TDF

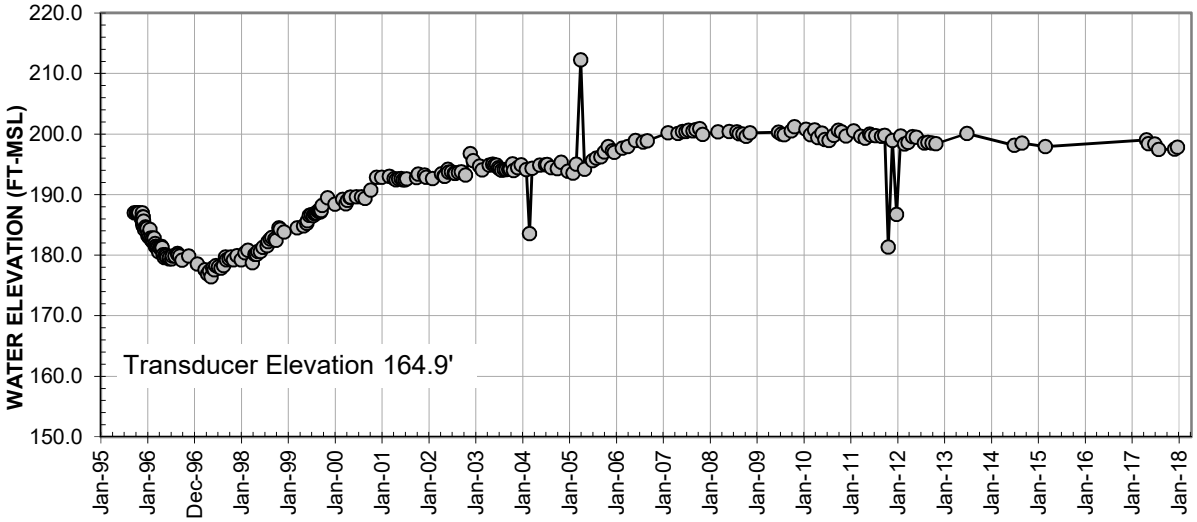
Water Level Data for Piezometer 44



Water Level Data for Piezometer 47



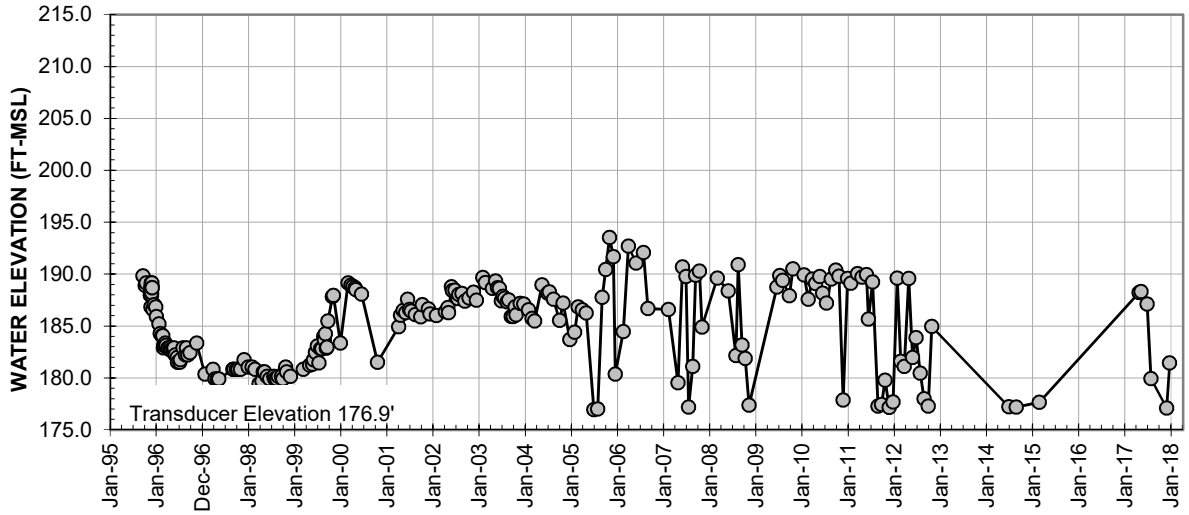
Water Level Data for Piezometer 50



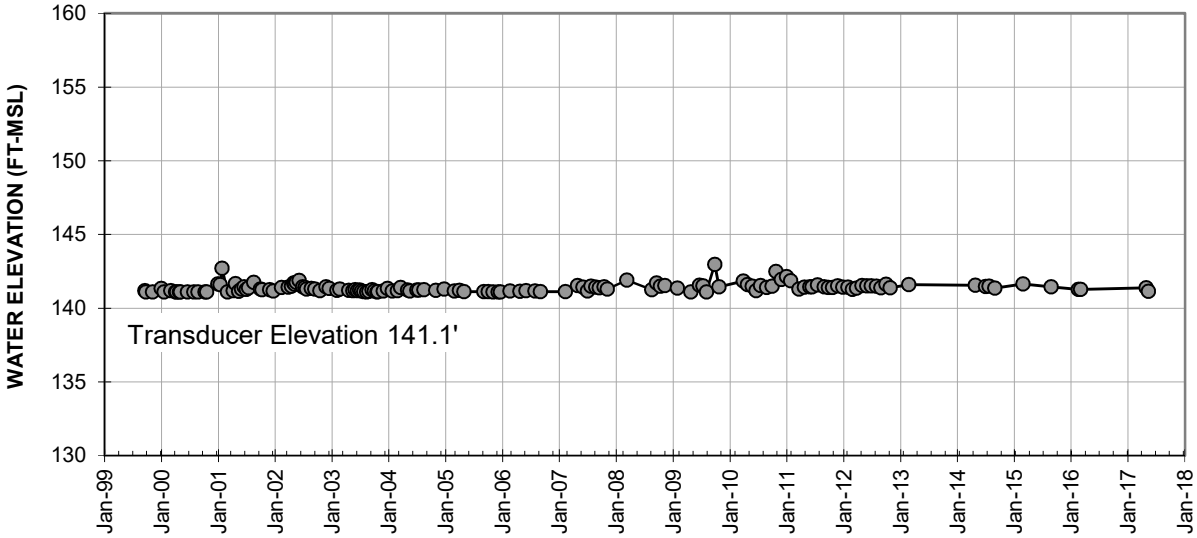
ATTACHMENT D

Piezometer Data at the TDF

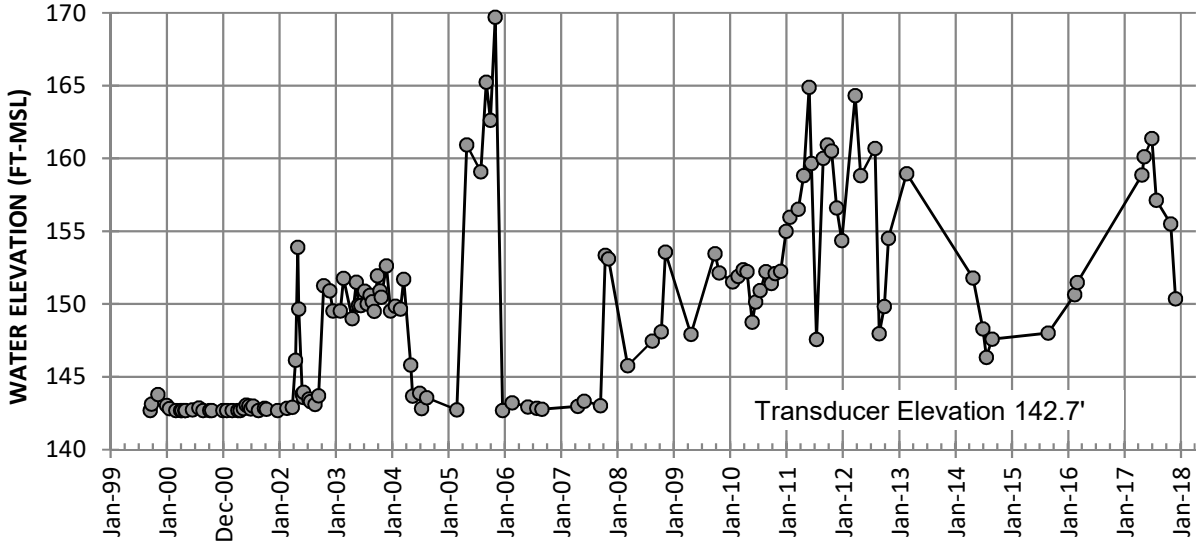
Water Level Data for Piezometer 51



Water Level Data for Piezometer 74



Water Level Data for Piezometer 76



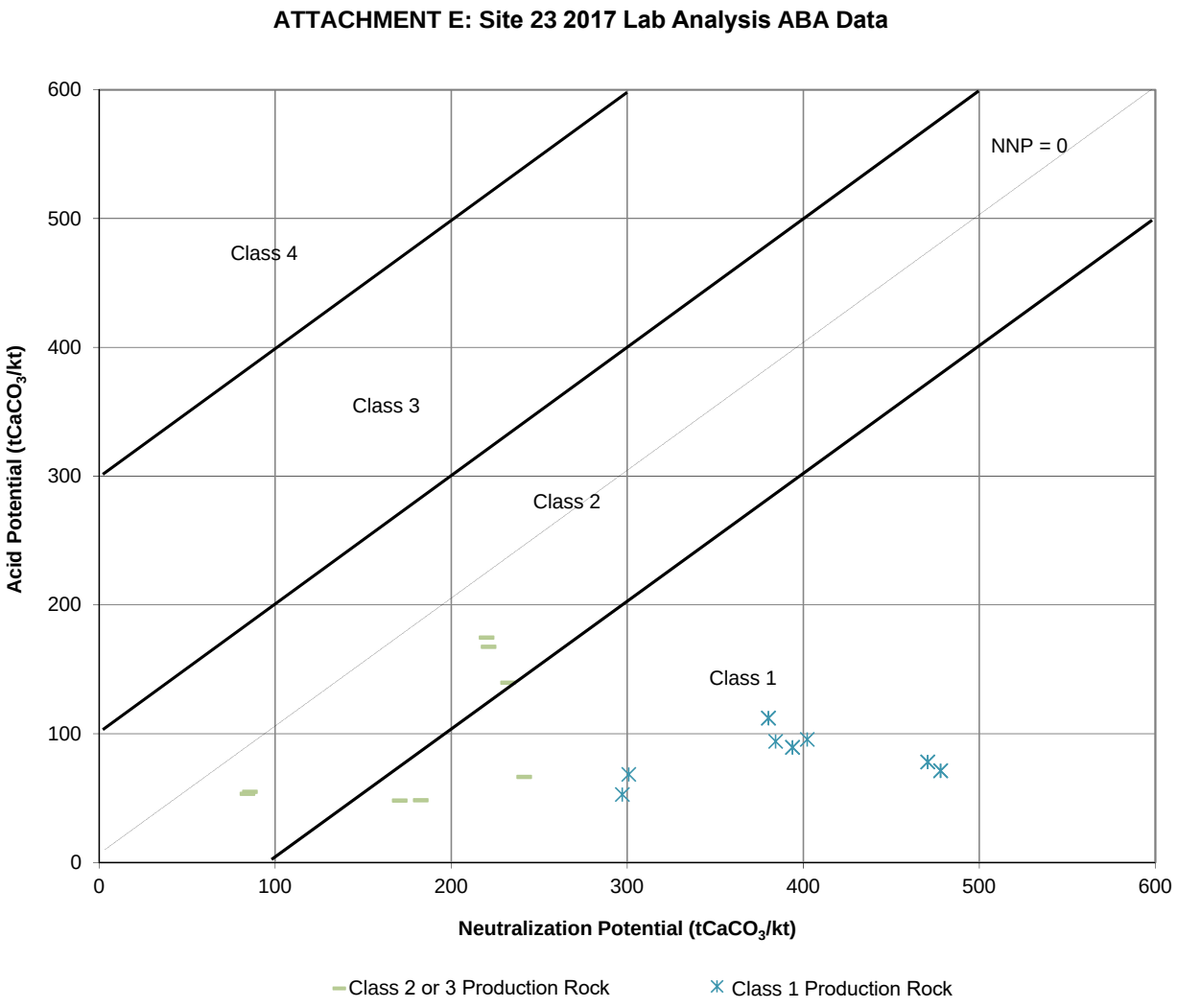
CLIENT : **Hecla Greens Creek Mining Company**
PROJECT : **HGCMC - WMP Samples**
SGS Project # : **08123**
TEST : **Modified Acid-Base Accounting with Siderite Correction**
Date : **July 28, 2017**

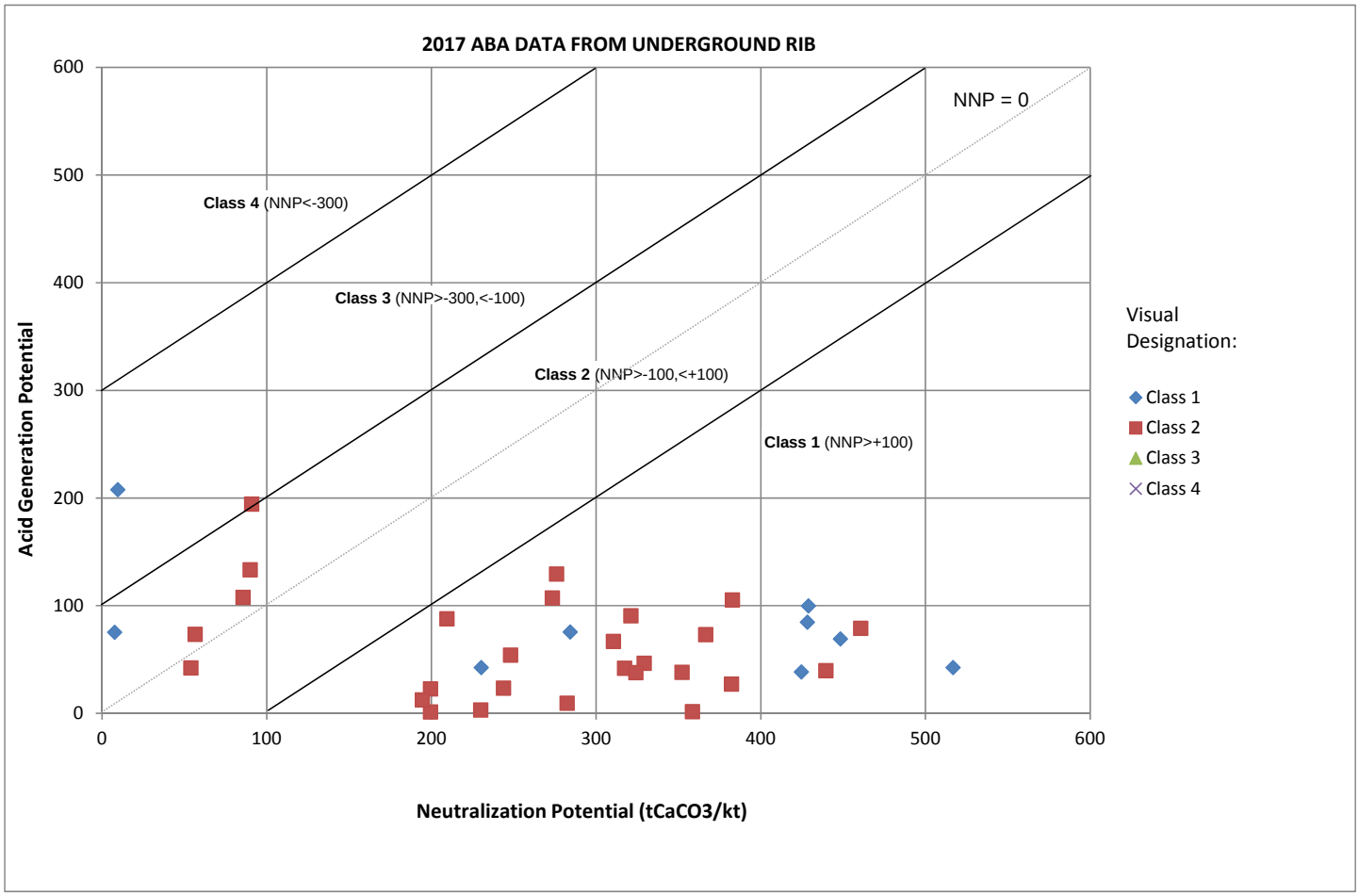
Sample ID	**Paste pH**	**S(T) %**	**S(SO4) %**	**S(S-2) %**	**AP**	**Modified NP**	**Net Modified NP**	**Fizz Test**
Method Code	Sobek	CSA06V	CSA07V	Calc.	Calc.	Siderite Corr.	Calc.	Sobek
LOD	0.20	0.005	0.01	#N/A	#N/A	0.5	#N/A	#N/A
23C1-032817-1	8.43	3.19	0.13	3.06	95.6	402.3	306.7	Moderate
23C1-032817-2	8.50	3.13	0.12	3.01	94.1	384.3	290.2	Moderate
23C3-032817-1	8.86	1.81	0.05	1.76	55.0	85.7	30.7	Slight
23C3-032817-2	8.95	1.76	0.05	1.71	53.4	84.3	30.9	Slight
23C1-062917-1	8.51	2.37	0.18	2.19	68.4	300.9	232.5	Strong
23C1-062917-2	8.44	1.83	0.14	1.69	52.8	297.2	244.4	Strong
23C3-062917-1	9.41	1.6	0.06	1.54	48.1	170.8	122.7	Moderate
23C3-062917-2	8.58	1.62	0.07	1.55	48.4	182.7	134.3	Moderate
Duplicate								
23C1-032817-1	8.46					403.5		Moderate
23C3-032817-1		1.77						
23C3-062917-2			0.07					
QC								
GTS-2A		0.342						
RTS-3A			1.32					
NBM-1						52.2		Slight
Certified Values		0.341	1.34			49.6		Slight
Tolerance +/-		0.030	0.17			4.5		

CLIENT : **Hecla Greens Creek Mining Company**
PROJECT : **HGCMC - WMP Samples**
SGS Project # : **08123**
TEST : **Modified Acid-Base Accounting with Siderite Correction**
Date : **January 10, 2018**

Sample ID	Paste pH	S(T) %	S(SO4) %	S(S-2) %	AP	Modified NP	Net Modified NP	Fizz Test
Method Code	Sobek	CSA06V	CSA07V	Calc.	Calc.	Siderite Corr.	Calc.	Sobek
LOD	0.20	0.005	0.01	#N/A	#N/A	0.5	#N/A	#N/A
23C1-091917-1	8.04	3.87	0.28	3.59	112.2	380.2	268.0	Moderate
23C1-091917-2	8.05	3.07	0.21	2.86	89.4	393.9	304.5	Moderate
23C3-091917-1	8.65	4.59	0.12	4.47	139.7	232.3	92.6	Slight
23C3-091917-2	8.81	2.22	0.09	2.13	66.6	241.5	174.9	Slight
23C1-102517-1	8.61	2.59	0.09	2.5	78.1	470.7	392.6	Moderate
23C1-102517-2	8.60	2.38	0.1	2.28	71.3	478.0	406.8	Moderate
23C3-102517-1	8.66	5.94	0.35	5.59	174.7	220.1	45.4	Moderate
23C3-102517-2	8.74	5.72	0.36	5.36	167.5	221.3	53.8	Moderate
Duplicate								
23C1-091917-1	8.00					381.4		Moderate
23C3-091917-2		2.26						
23C3-102517-1			0.33					
QC								
GTS-2A		0.341						
RTS-3A			1.4					
NBM-1						51.2		Slight
Certified Values		0.341	1.34			49.6		Slight
Tolerance +/-		0.030	0.17			4.5		

Note:
AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material. AP is determined from the calculated sulphide sulphur content: S(T) - S(SO4).
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material. NET Modified NP = Modified NP - AP Sulphate Sulphur is determined by Sodium Carbonate Leach with S by ICP Finish

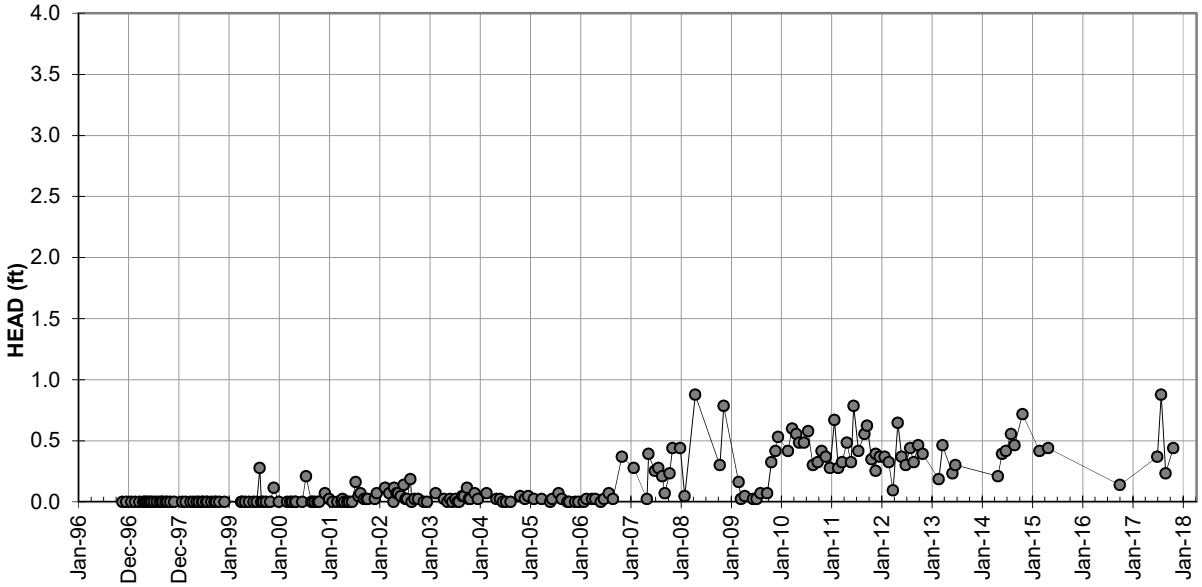

ATTACHMENT E: Site 23 2017 Lab Analysis ABA Data
Acid Potential (tCaCO3/kt)
Neutralization Potential (tCaCO3/kt)
0
100
200
300
400
500
600
Class 4
Class 3
Class 2
Class 1
NNP = 0
Class 2 or 3 Production Rock
Class 1 Production Rock


2017 ABA DATA FROM UNDERGROUND RIB
Acid Generation Potential
Neutralization Potential (tCaCO3/kt)
0
100
200
300
400
500
600
NNP = 0
Class 4 (NNP<-300)
Class 3 (NNP>-300,<-100)
Class 2 (NNP>-100,<+100)
Class 1 (NNP>+100)
Visual Designation:
Class 1
Class 2
Class 3
Class 4

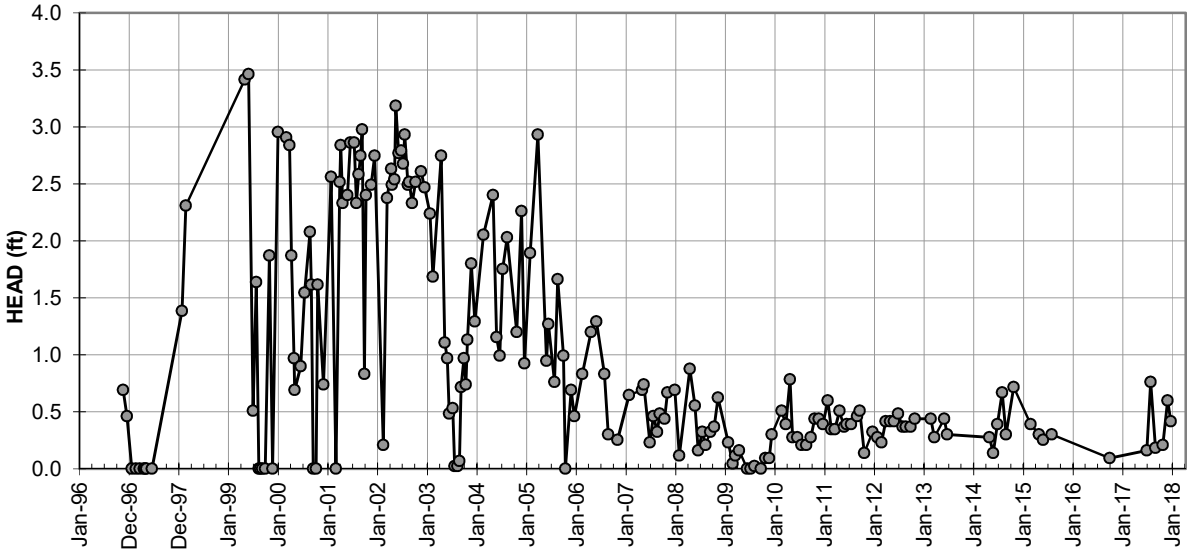
ATTACHMENT F

Water Level Data at Site 23 / D

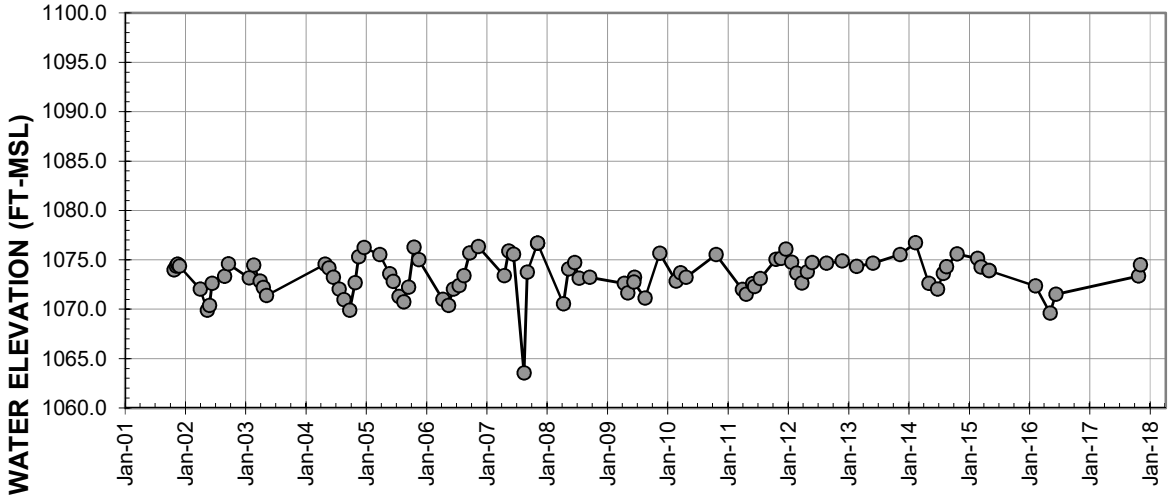
Pressure Data for Piezometer 52



Pressure Data for Piezometer 53

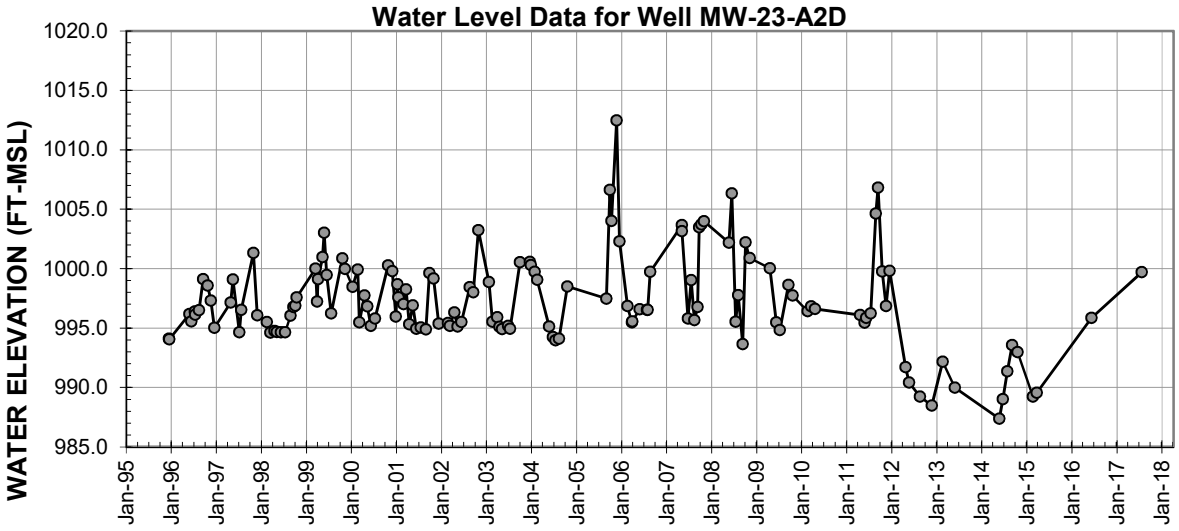


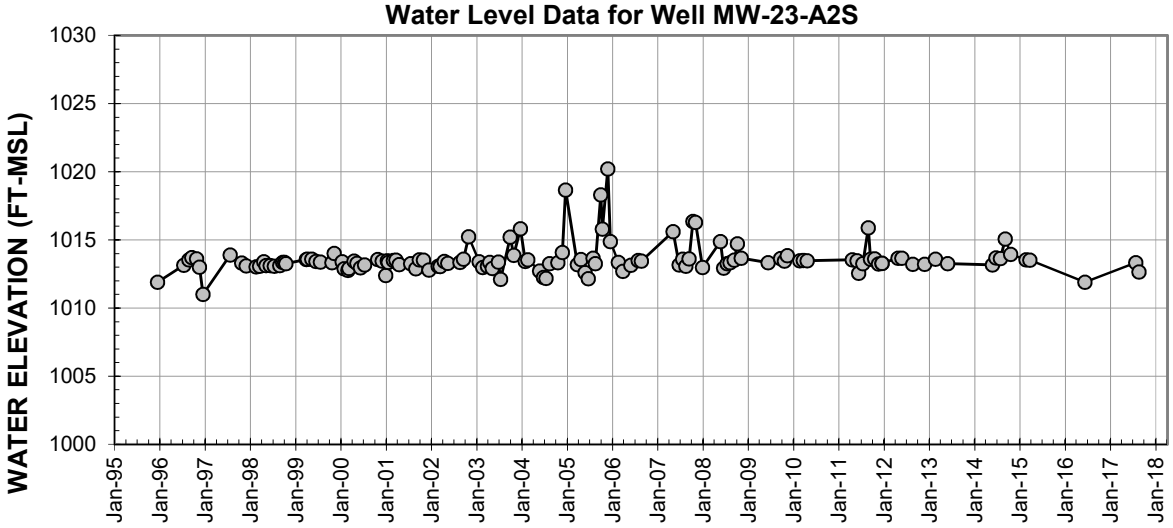
Water Level Data for Well MW-23/D-00-03

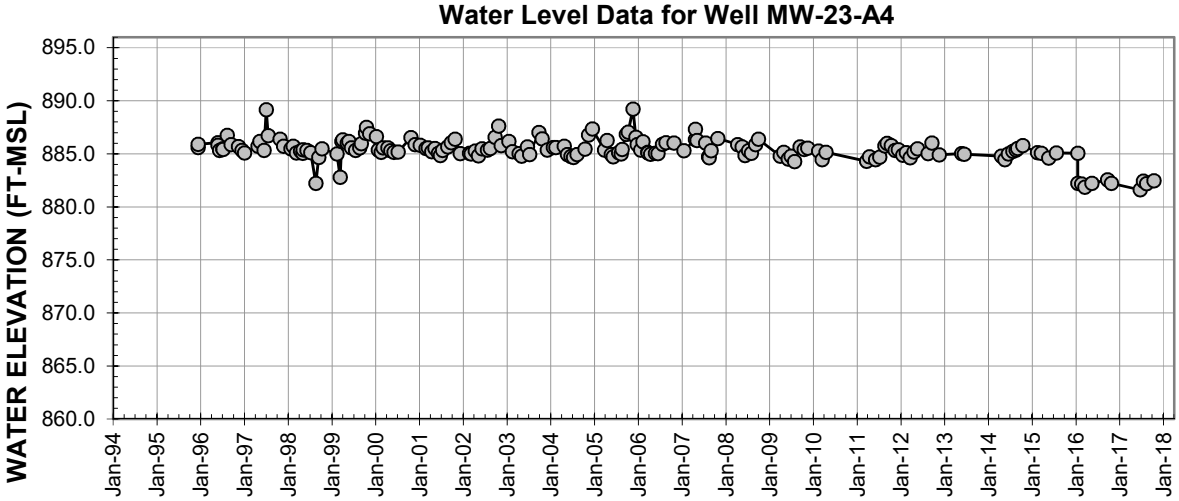


ATTACHMENT F

Water Level Data at Site 23 / D

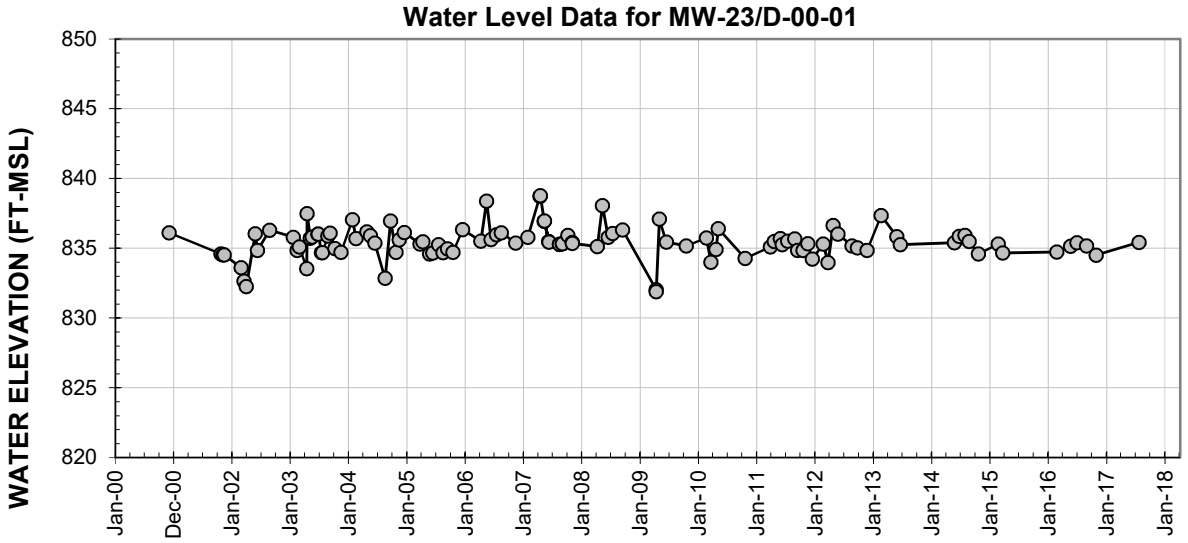


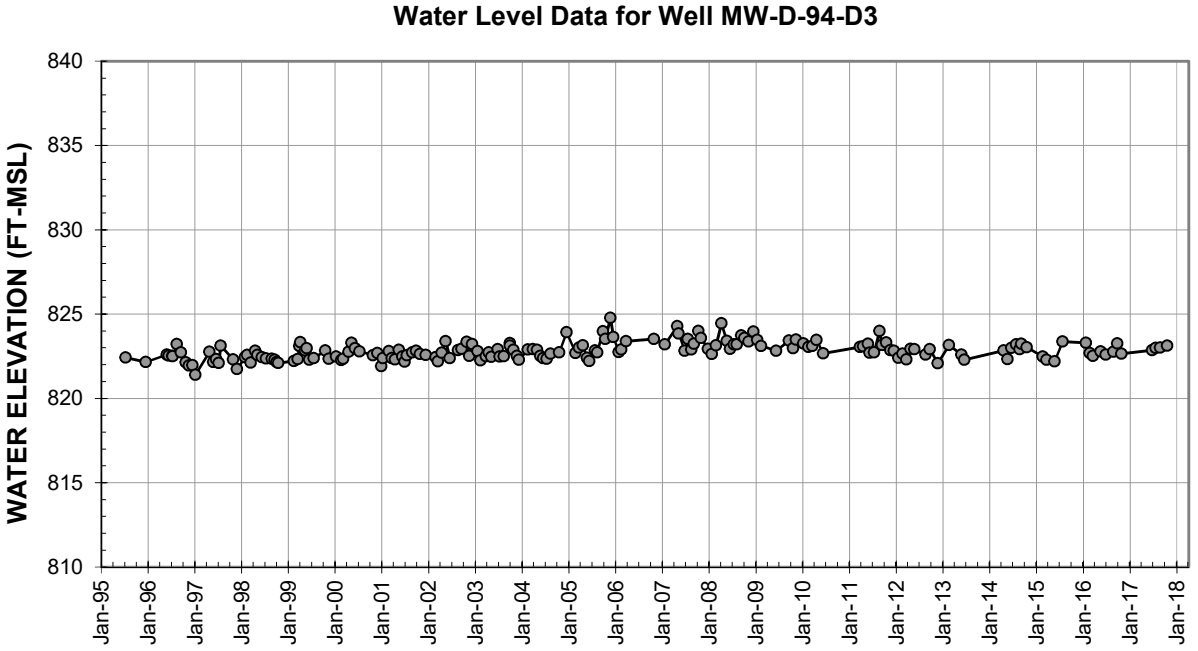


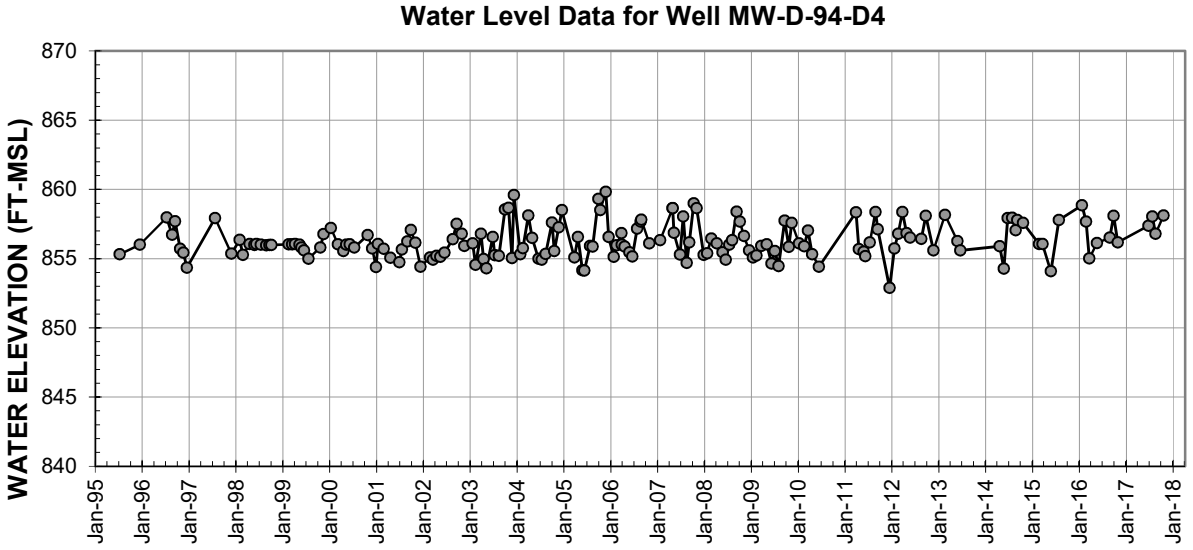


ATTACHMENT F

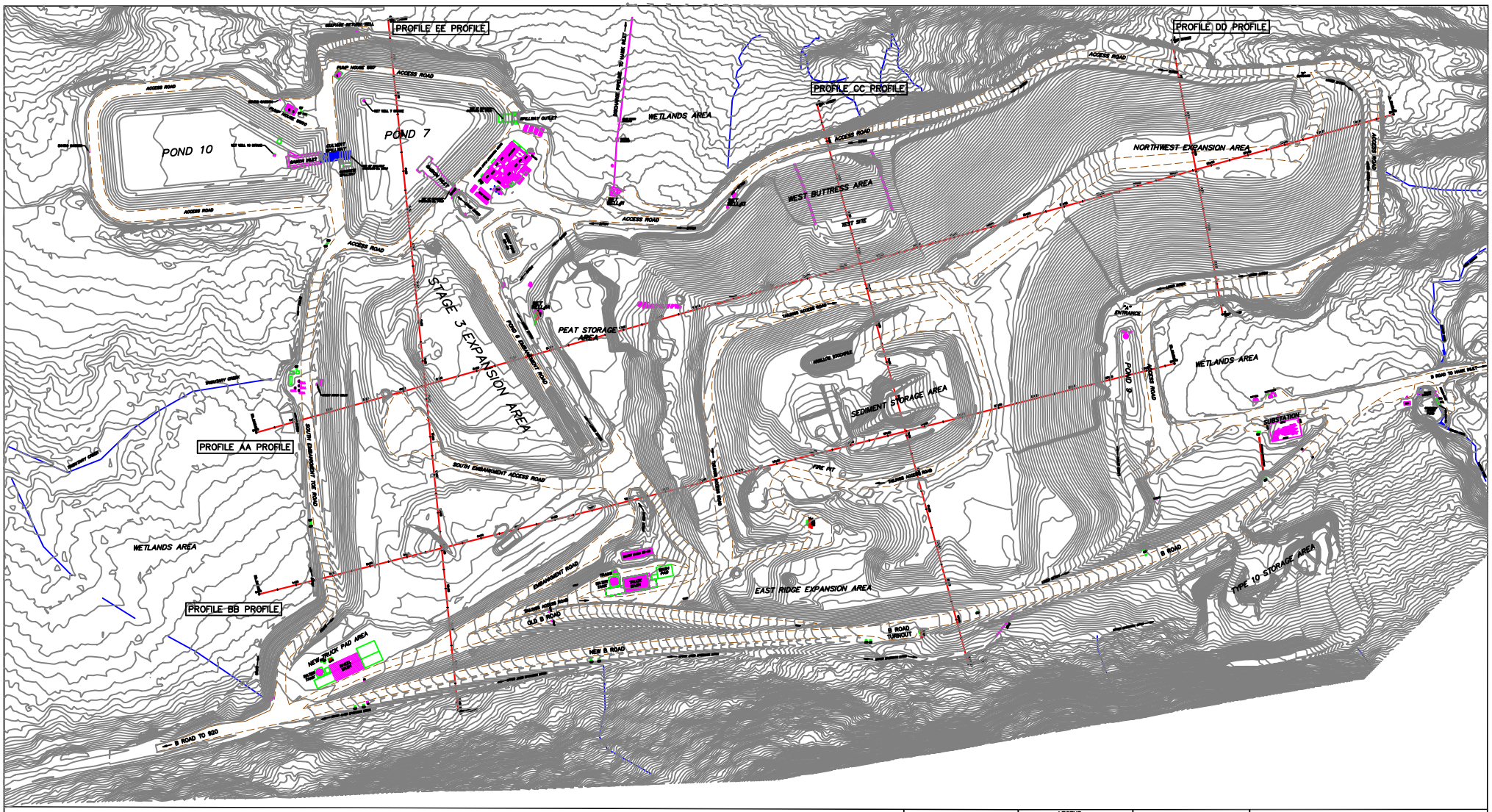
Water Level Data at Site 23 / D







Attachment G:
TDF Layout



HECLA GREENS CREEK MINING CO.

P.O. BOX 32199 JUNEAU, ALASKA 99803

PHONE: (907)790-8441 FAX: (907)790-8448

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LEGEND:

BUILDINGS
WATER UTILS
ROADS
ELECT UTILS
FUEL UTILS
LINED DITCHES

SYMBOLS:

FIRE HYDRANT
BOLLARDS
WATER VALVE
MONITORING POINT
POWER POLES
CATCH BASIN

GRAPHIC SCALE:

0 50 100 200

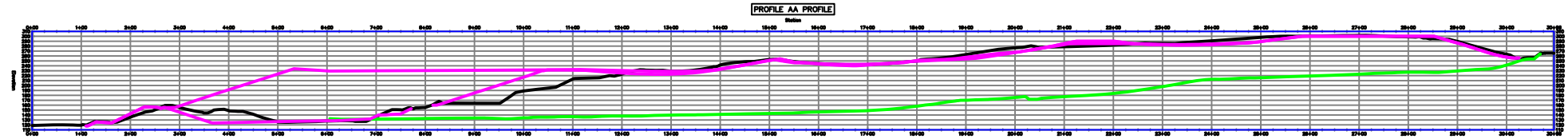
TRUE

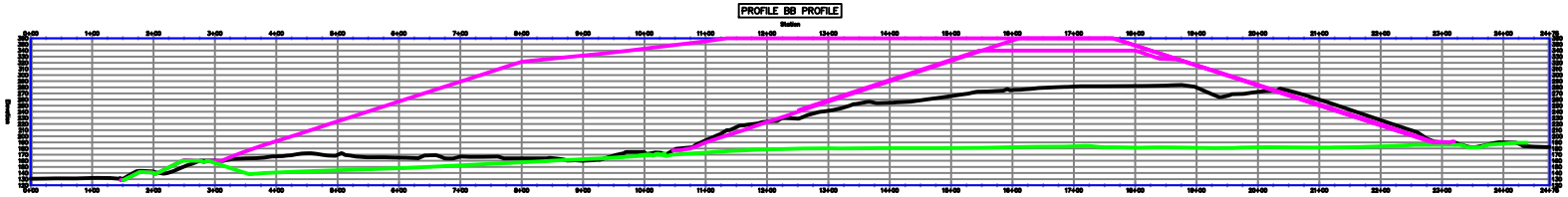
DRAWING BY: Shelby Edwards
DESIGN BY: ------
REVIEWED BY: ------
PROJ OR REF. ------

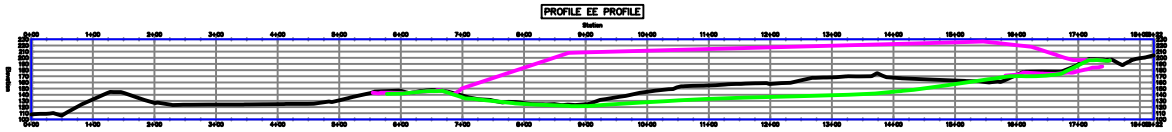
TITLE: Tailings Asbuilt

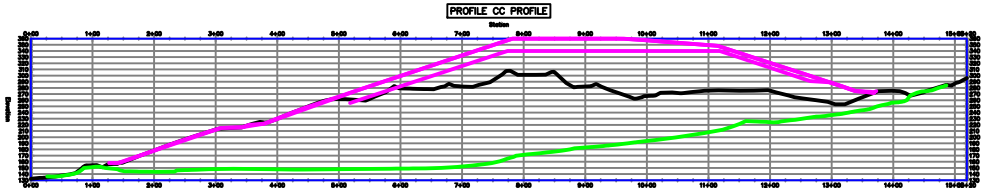
SHEET: 12/31/17

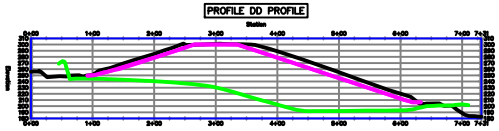
SHEET: 1 OF 1











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P.O. BOX 32199 JUNEAU, ALASKA 99803

PHONE: (907)790-8441 FAX: (907)790-8448

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LEGEND:

ORIGINAL GROUND

EXISTING GROUND

STAGE 2&3 DESIGN

SYMBOLS:

FIRE HYDRANT, BOLLARDS, WATER VALVE, MONITORING POINT, POWER POLES, CATCH BASIN

GRAPHIC SCALE: 0 40 80 160

DRAWING BY: Shelby Edwards

DESIGN BY: ----

REVIEWED BY: ----

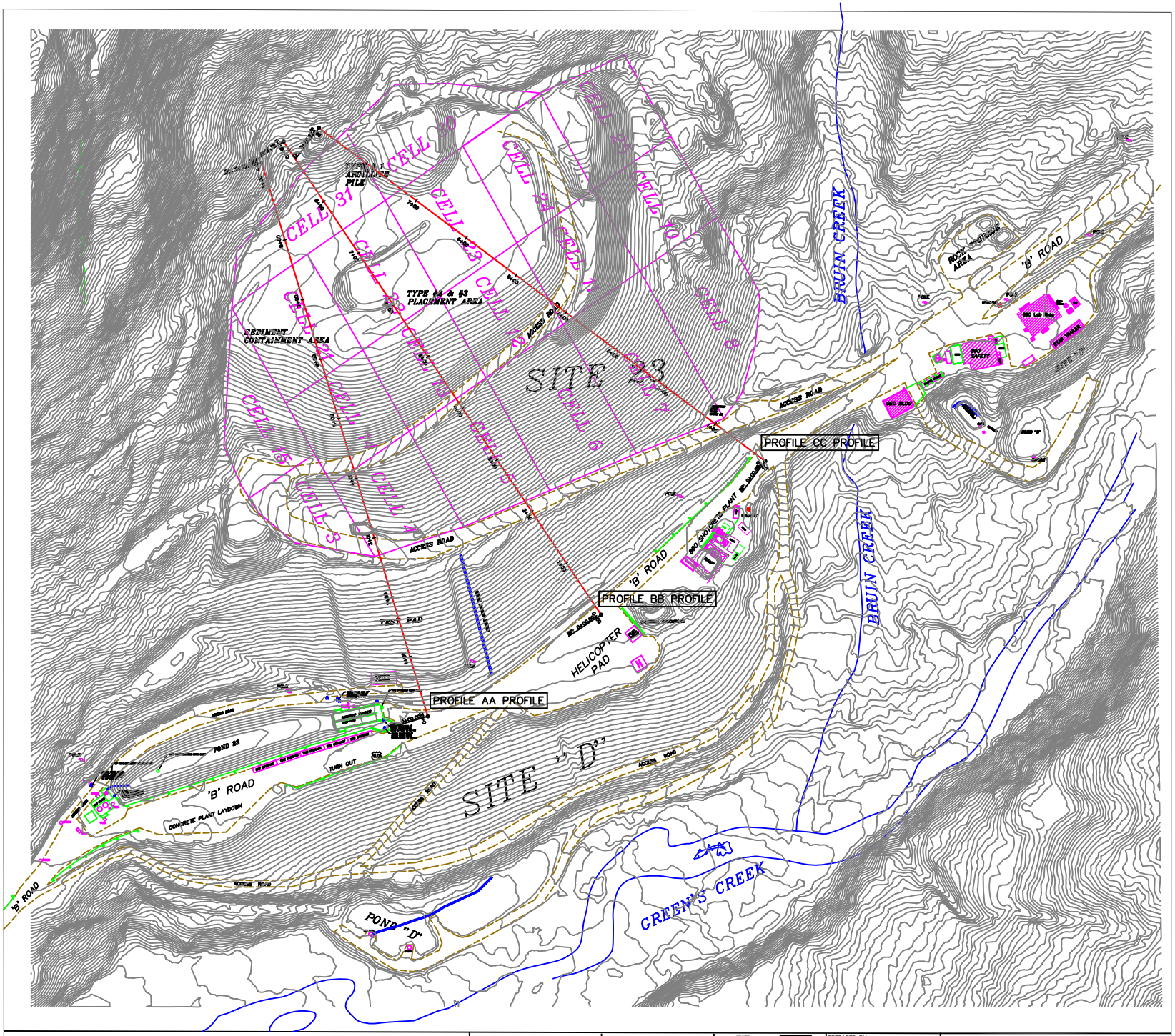
PROJ OR REF. ----

TITLE: 2017 TAILINGS YEAR END PROFILE VIEWS

SHEET: 12/31/17

SHEET: 1 OF 1

Attachment H:
Site 23 Layout



Hecla MINING COMPANY

HECLA GREENS CREEK MINE

ADMIRALTY ISLAND, ALASKA

LEGEND

- (A) CHEMICAL TANK
- (24) PETROLEUM TANK
- TO- TRANSFORMER
- (SC) SPILL RESPONSE

LEGEND:
ROADS/DITCHES
SEWER
WATER UTILS
ELECT UTILS
BUILDINGS
CONCRETE CURBS

SYMBOLS:
FIRE HYDRANT
BOLLARD
WATER VALVE
MONITORING POINT
POWER POLES
CATCH BASIN

PREPARED BY:
HECLA GREENS CREEK MINE
P.O. BOX 32199
JUNEAU, ALASKA 99801
PHONE: (907)790-8441 FAX: (907)790-8446

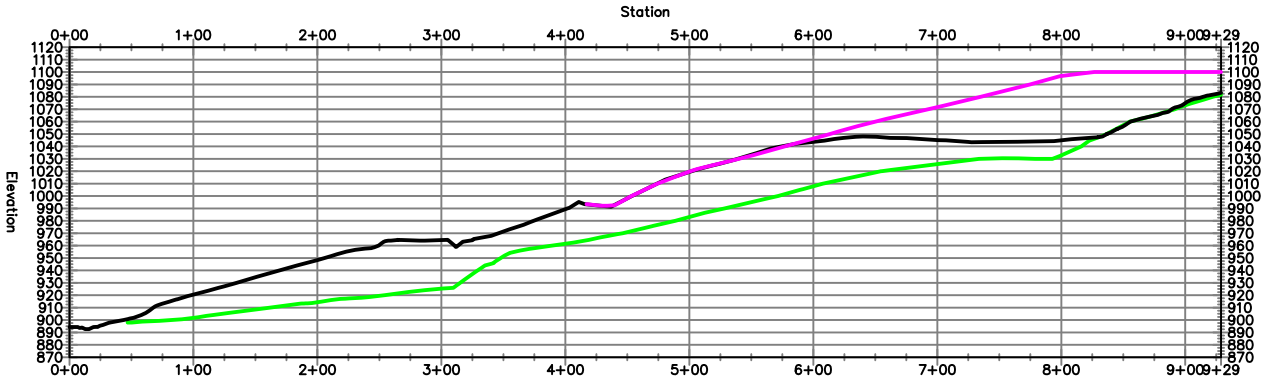
DRAWING BY: Shelby Edwards
DESIGN BY: ——
REVIEWED BY: ——
PROJ OR REF.: ——

SITE 23 Asbuilt

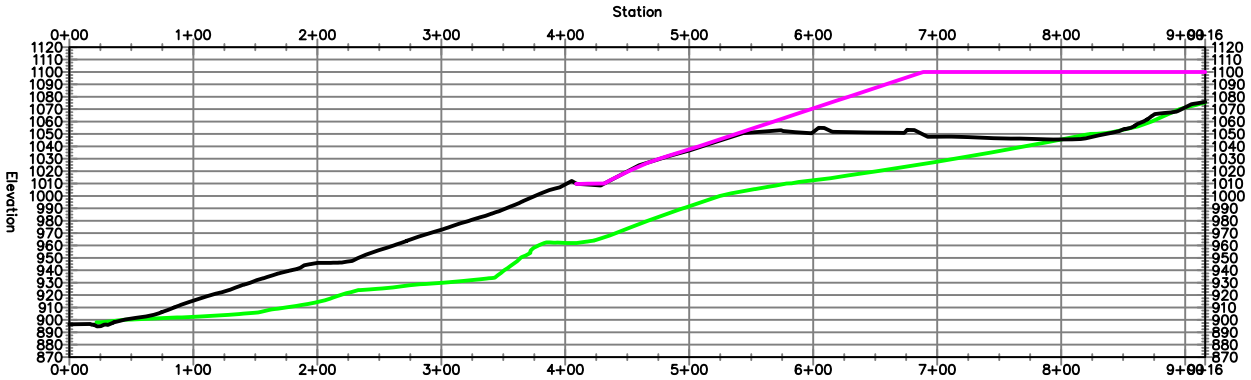
12/31/17

SHEET: 1 OF 1

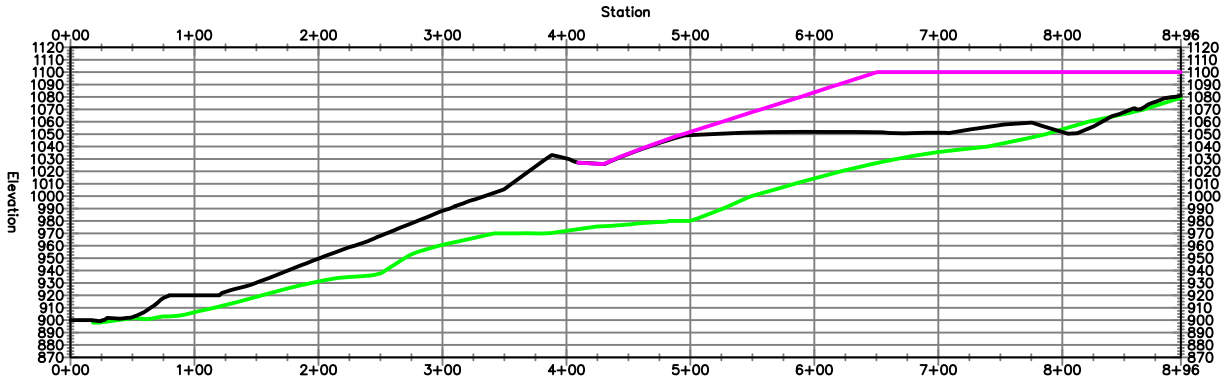
Alignment – AA PROFILE



Alignment – BB PROFILE



Alignment – CC PROFILE



Site 23 existing 3:1 design volume as of 12-31-17

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
vol fg123117-3to1 existing	1.000	1.000	273210.06 Sq. Ft.	627.17 Cu. Yd.	180682.01 Cu. Yd.	180054.85 Cu. Yd.<Fill>
Totals			273210.06 Sq. Ft.	627.17 Cu. Yd.	180682.01 Cu. Yd.	180054.85 Cu. Yd.<Fill>

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LEDGEND:
- ORIGINAL GROUND
- EXISTING GROUND
- 3:1 DESIGN

SYMBOLS:
- FIRE HYDRANT
- BOLLARDS
- WATER VALVE
- MONITORING POINT
- POWER POLES
- CATCH BASIN

DATE: 12-31-17
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF. ----

HECLA GREENS CREEK MINING CO.
P.O. BOX 32199 JUNEAU, ALASKA 99803
PHONE: (907)790-8441 FAX: (907)790-8448

TITLE: 2017 SITE 23 YEAR END PROFILE VIEWS

0 50 100 200

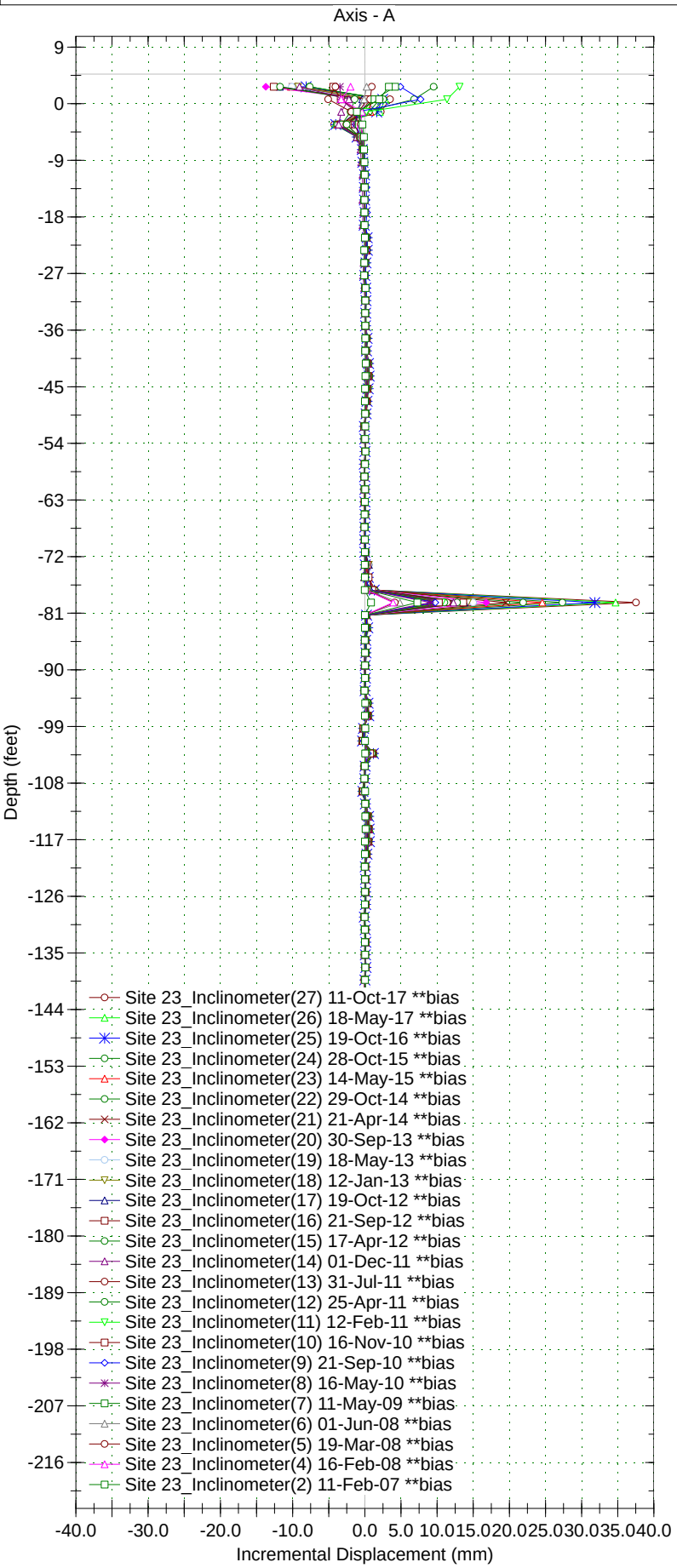
SHEET: 1 OF 1

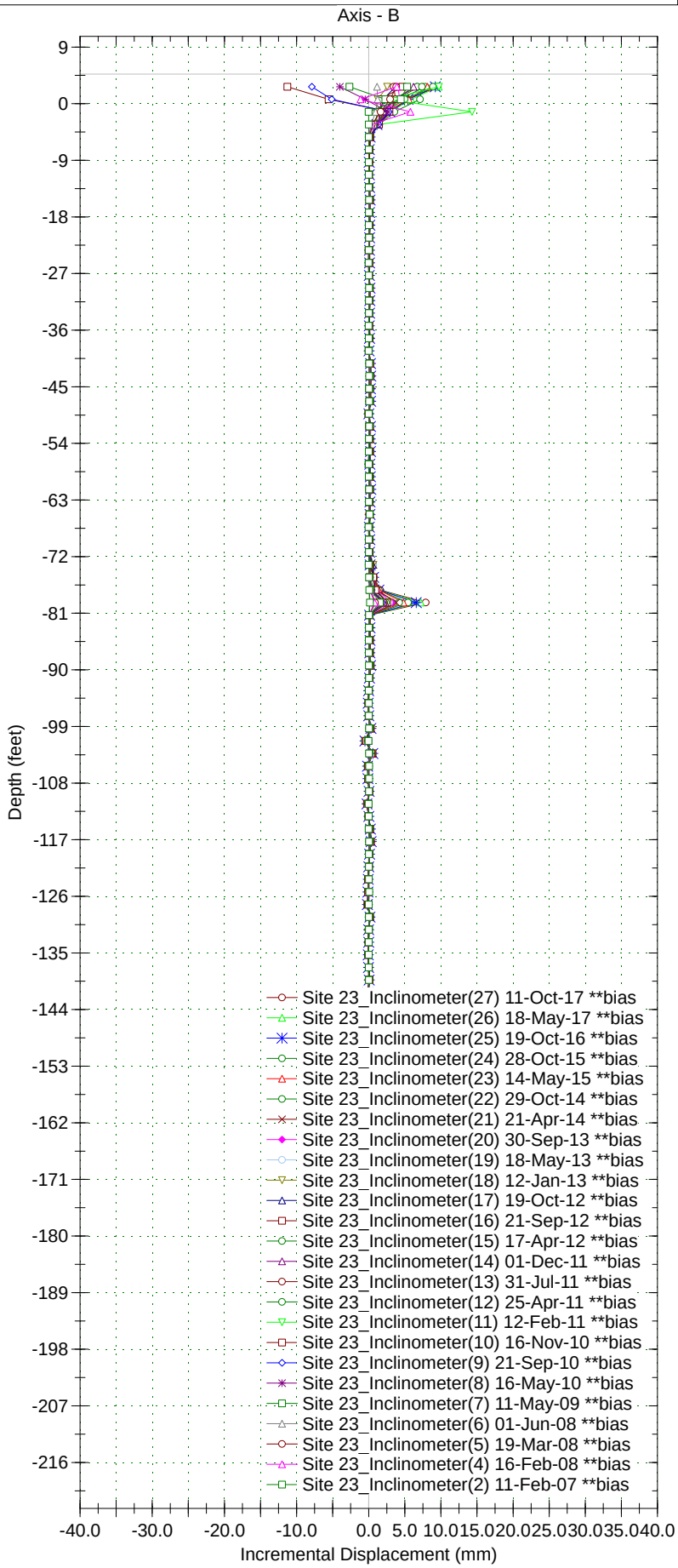
Attachment I:
Site 23
Inclinometer
Displacement

RST Instruments Ltd. INCREMENTAL DISPLACEMENT Inclinalysis v. 2.47.5

Borehole : Inclinometer
Project : Site 23
Location : IN-23-05-01
Northing : 20671.45 ft
Easting : 17186.42 ft
Collar : 948.84 ft

Spiral Correction : N/A
Collar Elevation : 4.7 feet
Borehole Total Depth : 222.0 feet
A+ Groove Azimuth :
Base Reading : 2006 Oct 07 10:28
Applied Azimuth : 0.0 degrees





RST Instruments Ltd.

TIME PLOT

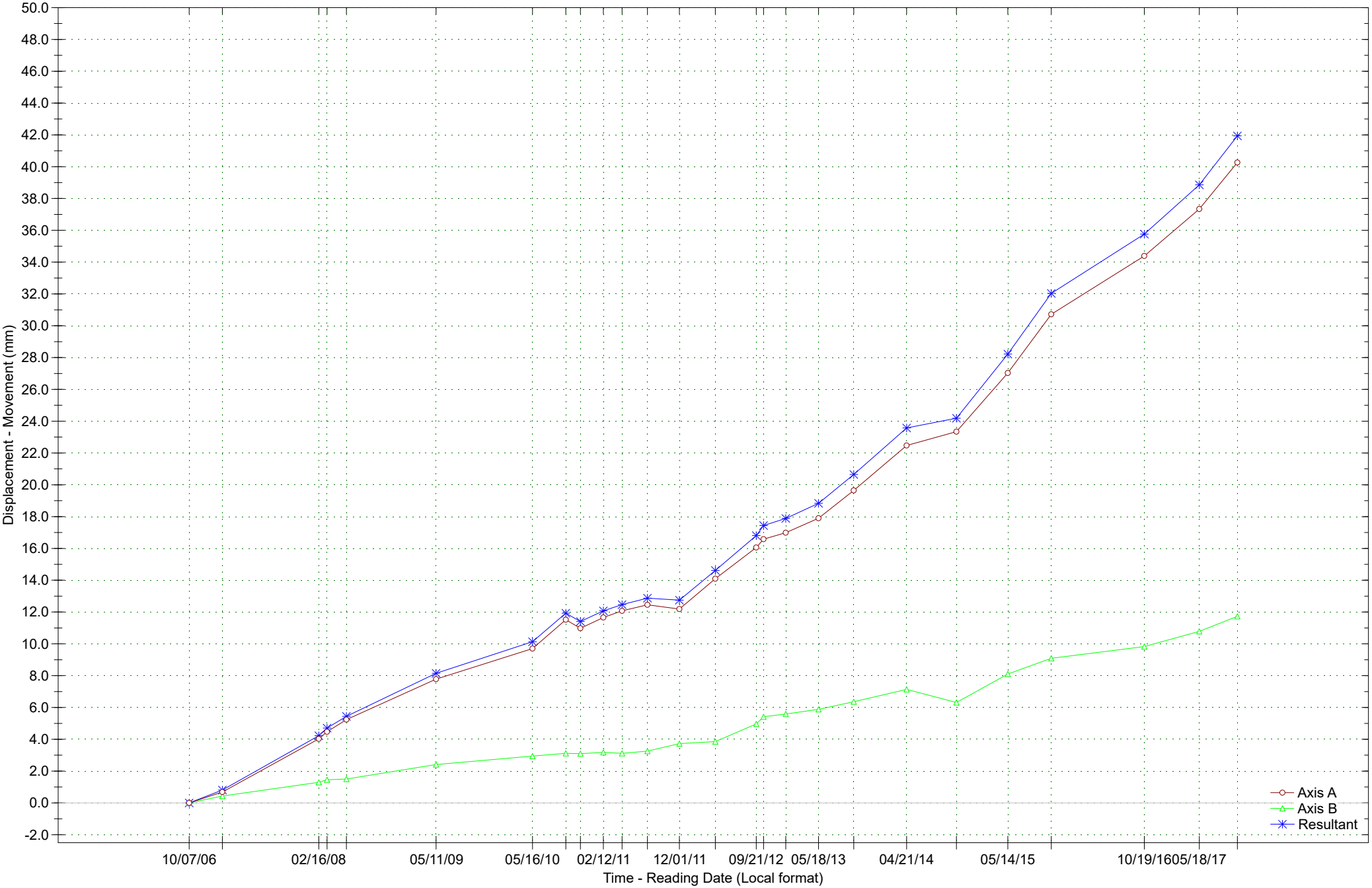
Displacement vs. Time

Inclinalysis v. 2.48.4

Borehole : Inclinometer
Project : Site 23
Location : IN-23-05-01
Northing : 20671.45 ft
Easting : 17186.42 ft
Collar : 948.84 ft
Collar Elev : 4.7 feet

Spiral Correction : N/A
Movement Depth : 70.0 - 90.0 feet
Borehole Total Depth : 222.0 feet
A+ Groove Azimuth :
Latest Reading : 2017 Oct 11 10:53
Initial Reading : 2006 Oct 07 10:28
Applied Azimuth : 0.0 degrees

Time Plot : 70.0 - 90.0 feet



Attachment J:

Monitoring Site Location

Maps

TDF

Site 23

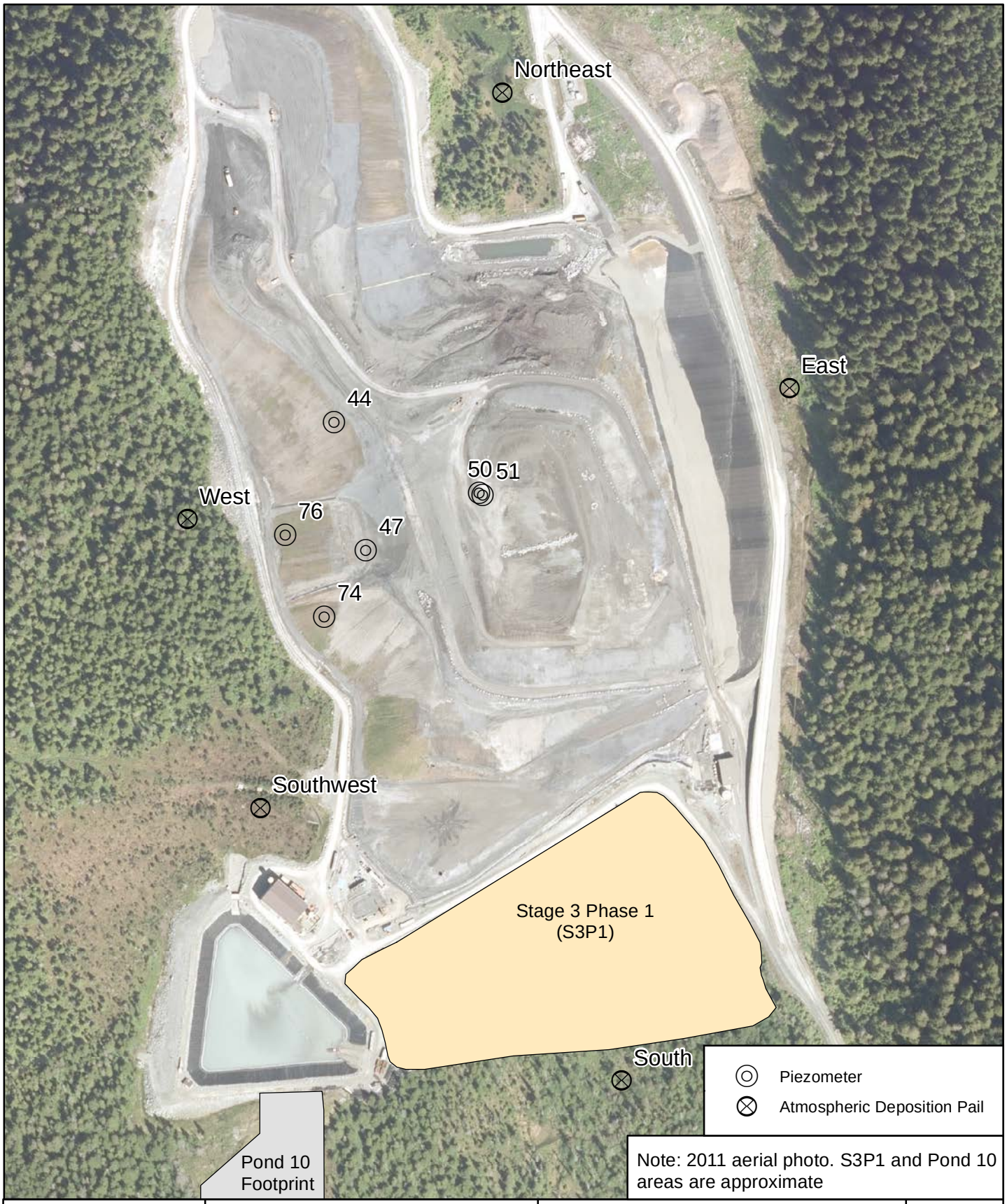
Note: 2011 aerial photo. S3P1 and Pond 10 areas are approximate

Hecla GREENS CREEK

0 200 400 600
Feet

Tailings Disposal Facility
Location Map

N



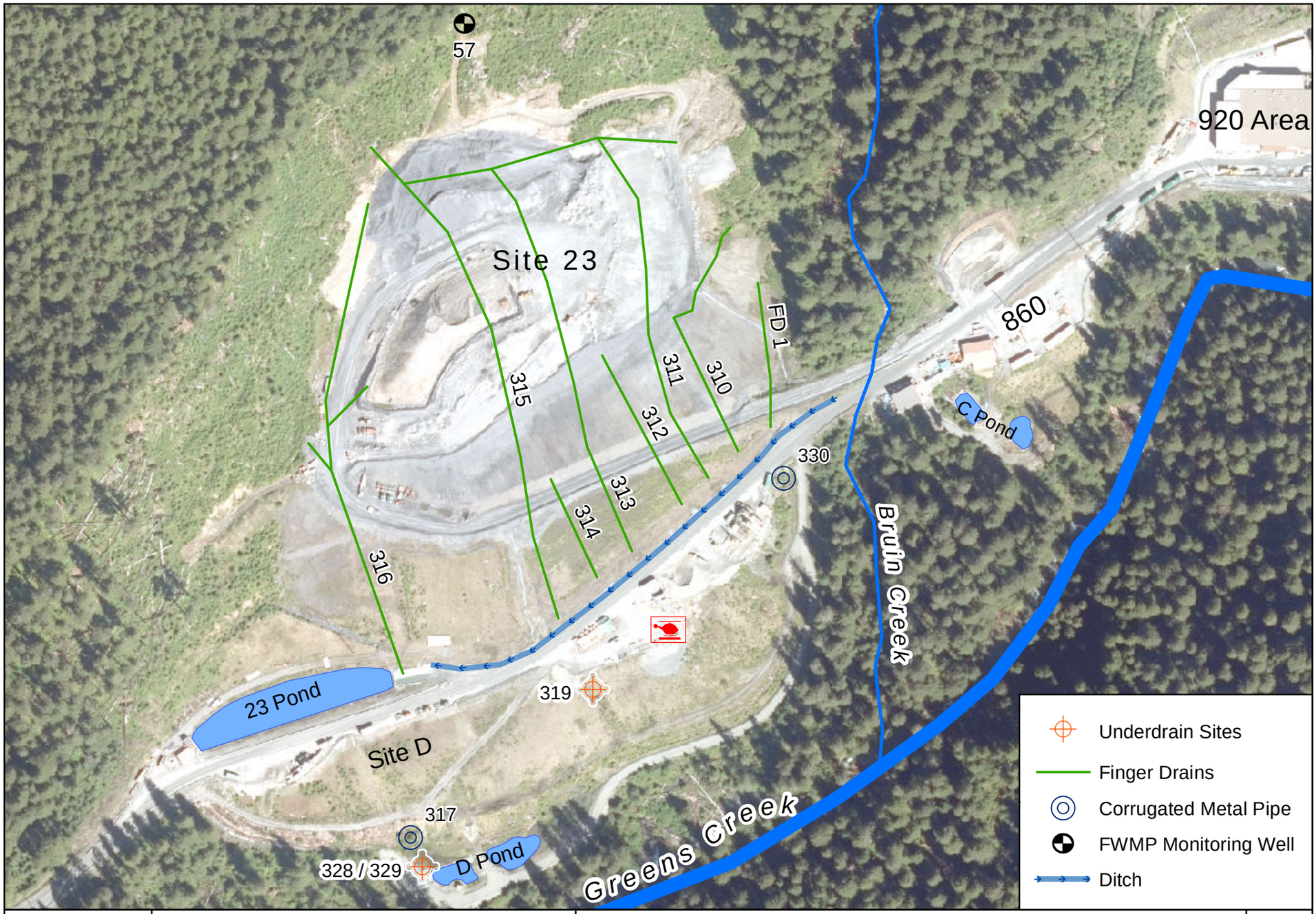
Note: 2011 aerial photo. S3P1 and Pond 10 areas are approximate

Hecla GREENS CREEK

0 225 450 675
Feet

Tailings Disposal Facility Piezometer and ADP Location Map

N



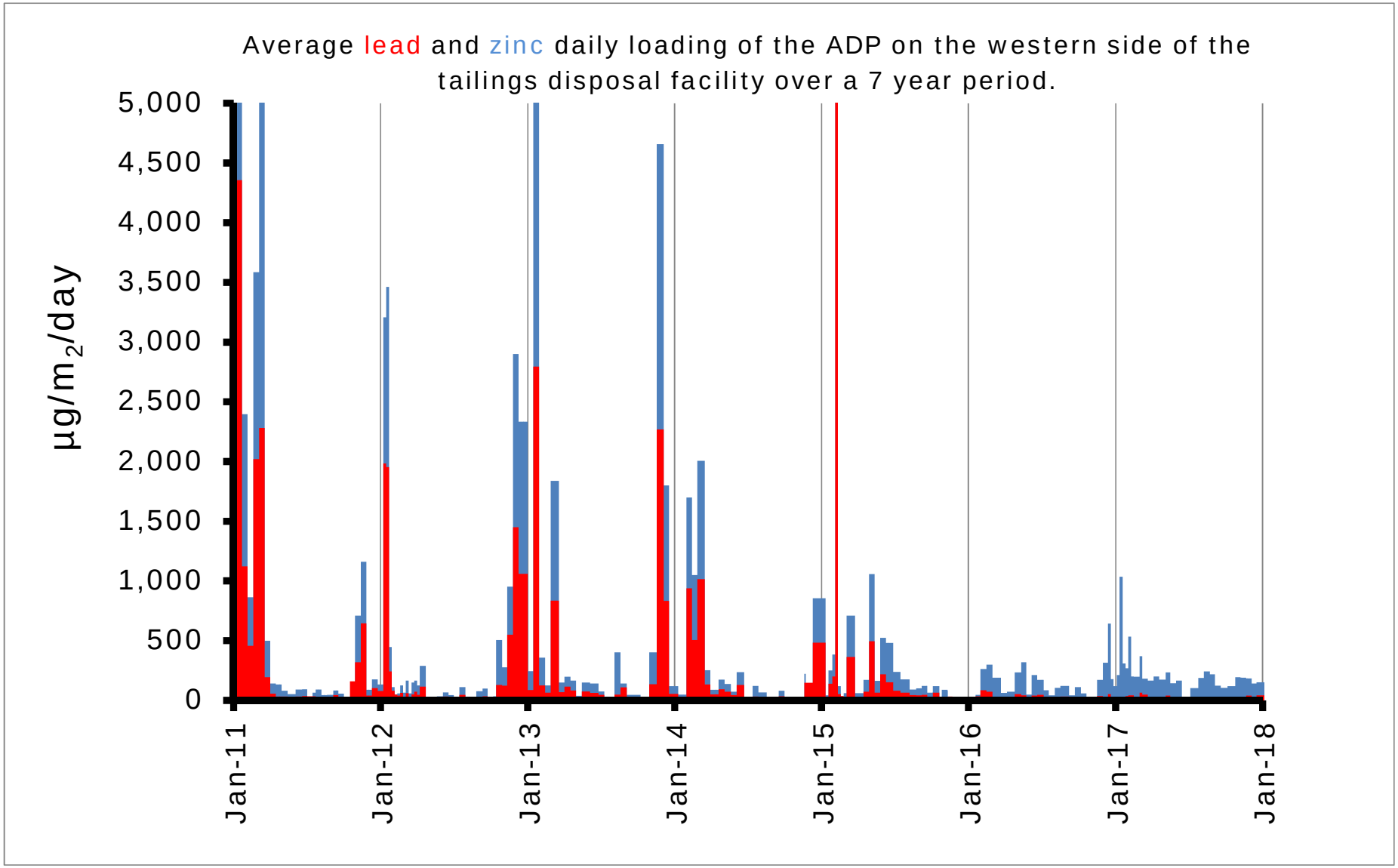
Hecla GREENS CREEK

0 200 400 600
Feet

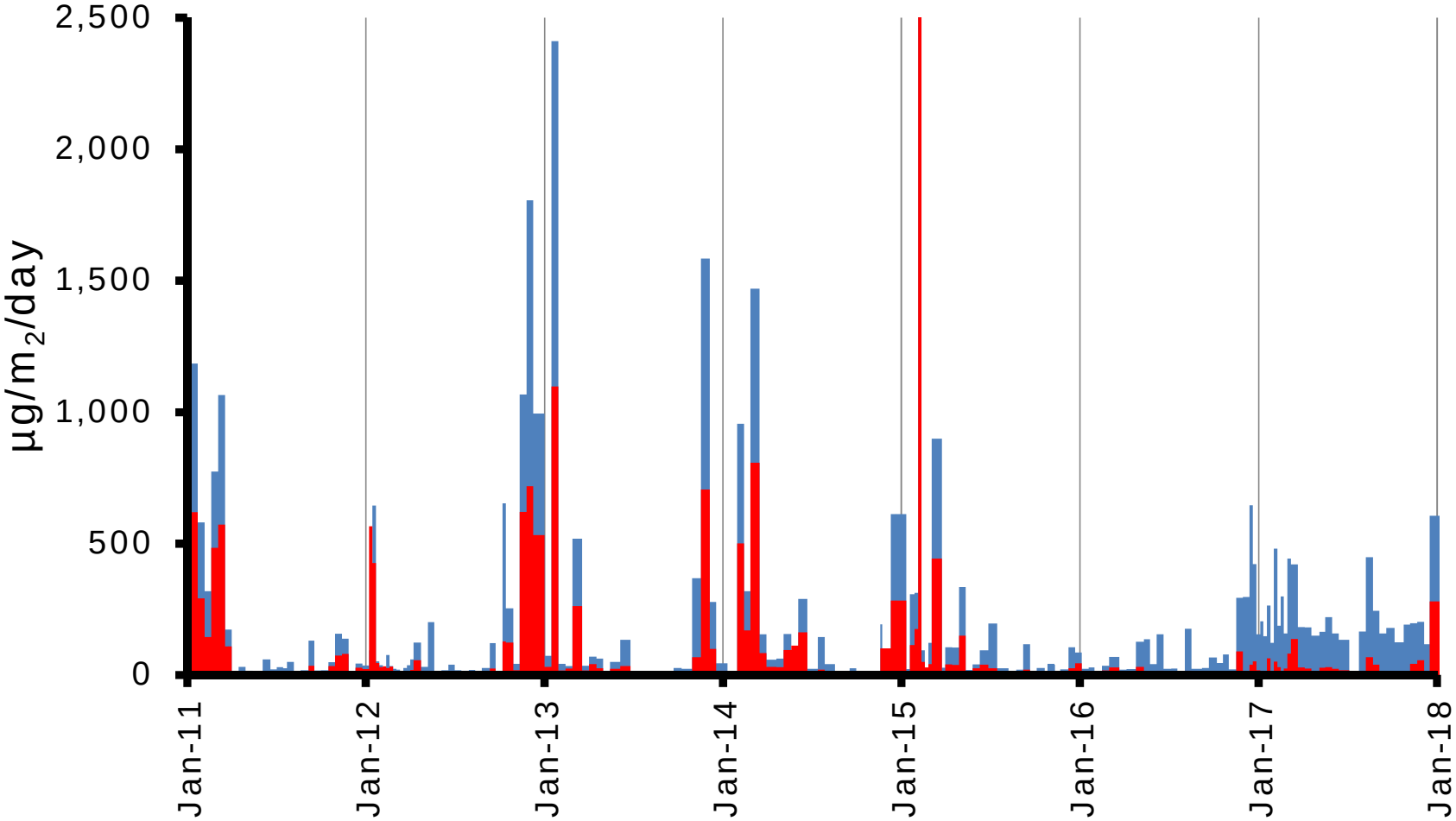
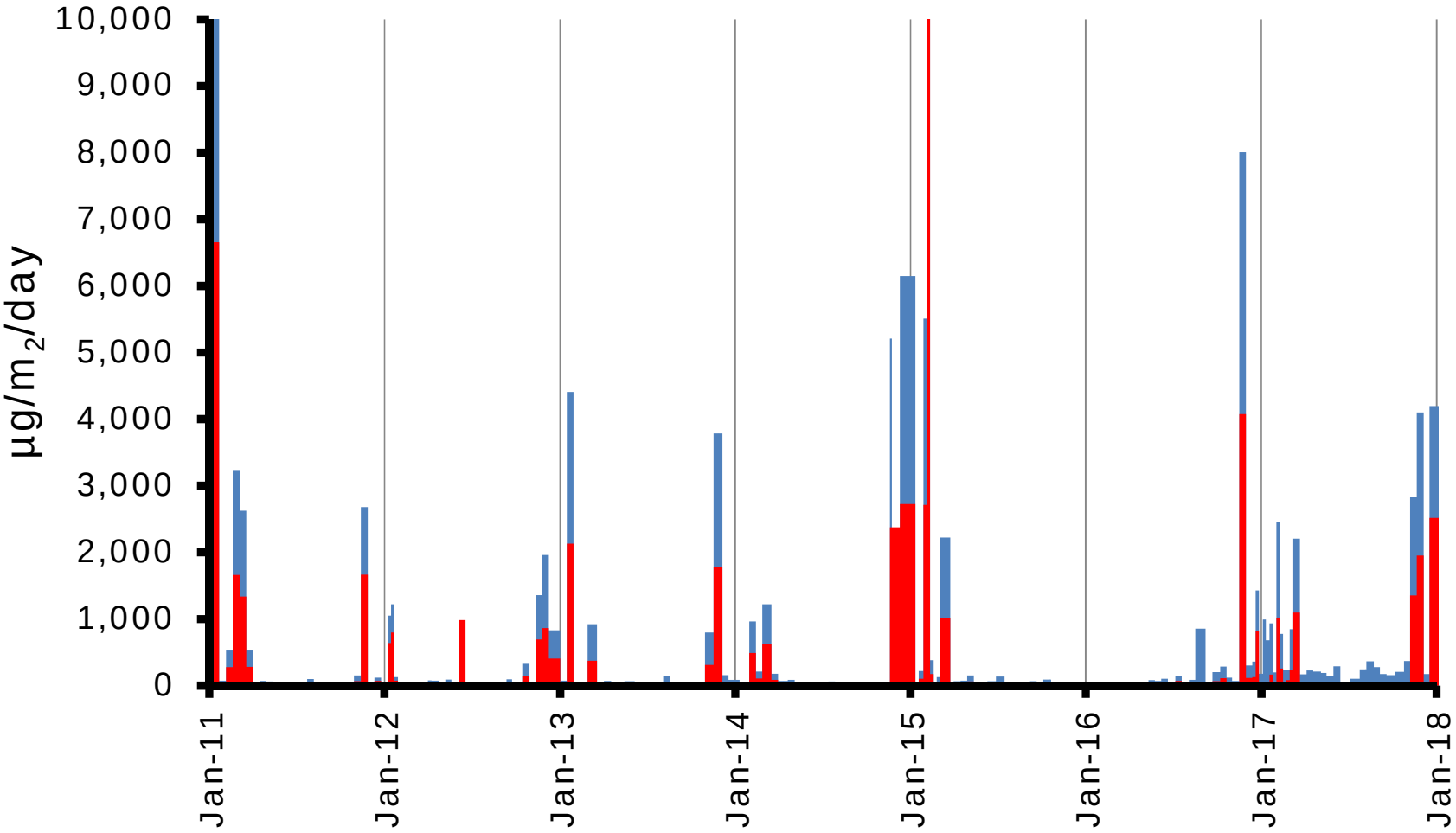
Site 23 Location Map

N

Note: 2011 aerial photo


Average lead and zinc daily loading of the ADP on the western side of the tailings disposal facility over a 7 year period.
µg/m2/day
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18

Average lead and zinc daily loading of the ADP on the southwest side of the tailings disposal facility over a 7 year period.



Average lead and zinc daily loading of the ADP on the south side of the tailings disposal facility over a 7 year period.