ACTIVE TAILINGS AND PRODUCTION ROCK SITE
2016 ANNUAL REPORT

Hecla Greens Creek Mining Company

April 15, 2017

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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 11 August 2014. This report presents the results from inspections and monitoring performed during 2016 (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 2016 are presented in Technical Report No. 17-03.

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 (TDF). 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 2016. 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 41,800 tons to the facility. An additional 7,028 tons of other material

were also placed at the facility in 2016. 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 in the facility are shown in Table 4.2.b. Tailings generated but not hauled to the TDF were disposed of in the underground mine. In 2016 212,209 tons (55%) of tailings were placed in the stage 3 phase 1 area (S3P1), 86,516 tons (22%) in the northeast, 79,987 tons (21%) in the east, and 8,162 tons (2%) in the southwest. Approximately 72,000 tons of the total 212,209 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 Asbuilt). Operations in the S3P1 area started in 2016 and estimates extend current mining operations for an additional 10-12 years.

The pile currently contains approximately 8.3 million tons of material. Based on the survey data presented in Table 4.2.a and not including the S3P1 area there is a remaining capacity of approximately 1.3 million tons of the 9.6 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 a range of 2 – 3 years has been estimated.

Table 4.2.a Tailings Placement

2016	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)
1/31/2016	20,132	4,336,681	36,473	7,856,765	530	436	35,507
2/29/2016	15,821	4,352,502	28,663	7,885,428	940	125	27,598
3/31/2016	22,553	4,375,055	40,859	7,926,287	582	156	40,121
4/30/2016	15,024	4,390,079	27,219	7,953,506	31	58	27,130
5/31/2016	19,043	4,409,122	34,500	7,988,006	3401	575	30,524
6/30/2016	18,604	4,427,726	33,705	8,021,711	7073	0	26,632
7/31/2016	30,418	4,458,144	55,108	8,076,819	18075	1792	35,241
8/31/2016	25,622	4,483,766	46,419	8,123,239	8362	2240	35,817
9/30/2016	27,000	4,510,766	48,916	8,172,155	0	1355	47,561
10/27/2016	15,307	4,526,073	27,732	8,199,886	155	291	27,286
11/30/2016	12,512	4,538,585	22,668	8,222,554	812	0	21,856
12/29/2016	18,457	4,557,042	33,439	8,255,993	1838	0	31,601
Totals	**240,493**	**4,557,042**	**435,701**	**8,255,993**	**41,799**	**7,028**	**386,874**

Tons calculated at 134.2 pounds per cubic foot for tailings

Table 4.2.b Miscellaneous 2016 Materials Disposal Estimates			
Surface Tailings	**CY**	**Underground**	**CY**
Pressed Sewage Sludge	70	Tires, Sump Sediment, Shop, Mine, Electrical & Mill Refuse	2,800
Pressed Water Treatment Plant Sludge	695		
Incinerator Ash	14		
Site E	0		

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 15 sand cone samples taken throughout the year in 2016 was 134 pcf, and the average percent proctor density was 96.6%. The mean dry density for 32 soil density gauge samples taken throughout the year in 2016 was 135 pcf, and the average percent proctor density was 94.8%. Results to date confirm proctor and moisture data received from the outside materials testing lab. All of the sand cone samples measured with the balloon method in 2016 showed greater than 90% compaction and 31 of the 32 soil density samples collected showed 90% or greater compaction. A summary of 2016 results are shown in Table 4.2.c.

Table 4.2.c Summary Statistics for 2016 Tailings Compaction Testing

Method	Compaction Variable	Mean	Max	Min	Std. Dev	n
IGES Laboratory	Std. Proctor[ASTM #D698 (pcf)	136	144	133	5	4
	Opt. Moisture (%)	13.5	14.7	11.3	1.5	4
HGCMC Lab 1-pt Proctor	Measured Dry Density (pcf)	137	147	129	7	12
	Measured Moisture (%)	13.4	15.3	11.2	1.3	12
Sand Cone Method Field Test	Measured Dry Density (pcf)	134	141	125	5	15
	Measured Moisture (%)	13.7	15.5	11.5	1.3	15
	(%) Proctor Density	96.6	101	90.7	2.8	15
Soil Density Gauge Field Test	Measured Dry Density (pcf)	135	142	129	3	32
	Measured Moisture (%)	13.7	15.6	10.9	1.1	32
	(%) Proctor Density	94.8	98.3	88.1	2.8	32

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.

ADEC representatives inspected the site once in 2016 on May 9. An ADNR representative inspected the site twice in 2016 on February 5 and June 16. ADF&G representatives inspected the site three time in 2016 on April 27, September 2, and December 1. During 2016 the USFS conducted 12 routine inspections (Site inspections #368 - #379) 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 2016 are shown in Table 4.2.d below. Samples collected at the TDF in 2016 had an average acid potential of 381 $tCaCO_3$/kt, average neutralization potential of 264 $tCaCO_3$/kt, and an average net neutralization of -117 $tCaCO_3$/kt. The lab results can be found in Attachment E Sample IDs T1 through T6.

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

2016	Acid Potential	Neutralization Potential	Net Neutralization Potential
January	350.0	278.80	-71.17
February	367.6	291.35	-76.27
March	345.3	314.33	-30.95
April	398.6	309.60	-89.01
May	408.5	292.08	-116.41
June	397.0	244.51	-152.45
July	390.3	214.50	-175.82
August	367.0	244.83	-122.17
September	324.0	204.46	-119.49
October	436.2	262.10	-174.14
November	392.5	230.82	-161.65
December	390.0	275.86	-114.10
Average	**380.58**	**263.60**	**-116.97**

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 2016. 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	-4.6	9.9	2.0	5.6
February	-3.1	8.7	2.9	3.4
March	-0.4	14.1	4.9	1.8
April	-2.3	15.8	5.1	4.8
May	0.1	21.4	11.2	0.4*
June	6.4	27.4	13.5	3.5
July	9.9	25.2	15.1	3.0
August	9.9	24.1	14.8	4.4
September	2.3	22.4	10.7	7.8
October	-1.2	13.9	5.8	3.5
November	-4.3	14.3	3.4	4.4
December	-11.8	6.1	-2.1	3.3*
2016			7.3	46.0

*The tipping bucket rain gauge malfunctioned which resulted in precipitation not being recorded for the months of May and December.

Table 4.2.f Meteorological Data at 920 Mill

Month	Min Temp (°C)	Max Temp (°C)	Avg Temp (°C)	Precipitation (in)
January	-5.9	5.6	0.9	6.8
February	-6.3	7.3	1.6	3.8
March	-2.9	14.9	3.4	1.9
April	-0.5	16.3	5.4	5.2
May	2.5	23.0	9.2	6.4
June	4.7	25.0	11.8	3.5
July	8.8	25.6	13.8	3.3
August	7.6	22.3	13.5	4.4
September	1.7	19.9	9.6	9.4
October	-1.5	12.0	4.1	2.9
November	-8.0	9.7	1.4	8.4
December	-12.8	4.6	-3.9	7.3
2016			5.9	63.4

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 2016 reporting period.

4.2.6 Water Level Data

The Tailing 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 47 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. The dust loading data for 2016 presents the sixth consecutive year of the ADP monitoring program.

This data 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 15th through March 14th (Period 1) and March 15th through November 14th (Period 2). This equates to a 140 day duration for Period 1 and a 244 day duration for Period 2 (Table 4.2.h). Out of the five ADP systems deployed since 2011, three have consistently received a higher rate of loading than the other two; they are the ADP systems in the west, southwest, and south. As shown in Table 4.2.i, the vast majority of the loading in these three systems occurs during Period 1 (winter).

Table 4.2.g Summary of 2016 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	1-Jan-16	68	224	35	23	20
	6-Jan-16	203	196	173	91	74
	20-Jan-16	421	121	83	161	94
	1-Feb-16	1,282	86	70	100	63
	16-Feb-16	1,088	269	120	148	633
	2-Mar-16	380	351	71	62	121
	14-Mar-16	18	8	10	15	18
Period 2	15-Mar-16	1,043	500	300	464	520
	26-Apr-16	849	487	105	355	256
	12-May-16	548	170	149	601	433
	25-May-16	245	191	259	423	610
	7-Jun-16	561	233	196	1,685	1,040
	21-Jun-16	741	219	80	474	539
	7-Jul-16	357	120	880	1,818	866
	20-Jul-16	249	99	173	683	412
	4-Aug-16	296	216	454	389	466
	17-Aug-16	738	148	684	602	1,255
	8-Sep-16	436	109	283	201	197
	22-Sep-16	414	172	1,011	258	244
	8-Oct-16	341	148	1,451	161	237
	21-Oct-16	180	336	1,134	146	142
	14-Nov-16	17	5	21	8	6
Period 1	15-Nov-16	594	1,442	65,166	331	1,733
	1-Dec-16	400	189	1,508	351	224
	14-Dec-16	366	277	891	229	413
	21-Dec-16	185	369	5,708	47	96
	31-Dec-16	54	74	90	54	85
	Total	**12,075**	**6,760**	**81,106**	**9,879**	**10,797**
		µg/m²/year	µg/m²/year	µg/m²/year	µg/m²/year	µg/m²/year

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 2016. 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	140	33%
2	Spring, Summer, Fall: March 15th through November 14th	244	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

For 2016, the south ADP had the highest yearly accumulative lead load of 81,106 µg/m² followed by the west system with accumulative lead load of 12,075 µg/m². The east and northeast systems were comparable at around 10,000 μg/m², followed by the southwest system at 6,760 μg/m² (Table 4.2.g). The 2016 data presents the lowest lead dust levels since the monitoring began.

Based on the predominant winds out of the north/northeast and the fact that tailings placement occurred mostly in the S3P1 (55%) area the expected area of loading would occur to the south of the TDF as supported by the data. Cumulative lead loading in 2016 was the lowest since monitoring began in 2011.

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 2016 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 Reclamation Plan includes all estimated costs (labor, materials, equipment, consumables, administration, monitoring, and long term maintenance) for task specific work associated with the final closure of the property under a default scenario.

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 Stage 3 Tailings Expansion process included a National Environmental Policy Act (NEPA) review through an Environmental Impact Statement (2013 EIS) to analyze the potential environmental effects of the project. The renewed Waste Management Permit (Permit Number 2014DB0003) included the increased disturbance from the tailings expansion. The reclamation cost detailed in GPO 14 Reclamation Plan is approximately was increased from $68,918,907 to $72,881,187 in 2016 to account for additional waste rock disposal from Site 23. The regulatory agencies accepted this bond revision amount.

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 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, are 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.

ADEC representatives inspected the site once in 2016 on May 9. An ADNR representative inspected the site twice in 2016 on February 5 and June 16. ADF&G representatives inspected the site three time in 2016 on April 27, September 2, and December 1. During 2016 the USFS conducted 12 routine inspections (Site inspections #368 - #379) 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					
2016	Surveyed (cy)		Surveyed (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
1/31/2016	6,366	915,693	10,776	1,550,076	530	298,903	8,002	0	2,927	10,929
2/29/2016	5,849	921,542	9,901	1,559,977	940	299,003	6,529	3,153	1,311	10,993
3/31/2016	4,692	926,234	7,943	1,567,920	582	299,003	3,767	2,874	2,483	9,124
4/30/2016	3,439	929,673	5,822	1,573,741	31	300,359	2,232	2,260	2,288	6,780
5/31/2016	6,214	935,887	10,519	1,584,260	3,402	309,818	3,850	530	7,528	11,908
6/30/2016	6,529	942,416	11,052	1,595,312	7,073	316,753	2,651	2,455	7,243	12,349
7/31/2016	7,250	949,666	12,273	1,607,585	18,075	318,439	4,197	1,088	3,878	9,163
8/31/2016	4,153	953,819	7,030	1,614,615	8,362	318,749	3,807	1,869	4,771	10,447
9/28/2016	5,754	959,573	9,740	1,624,356	0	318,779	1,618	56	6,919	8,593
10/28/2016	7,905	967,478	13,382	1,637,737	155	319,309	1,702	1,423	7,700	10,825
11/30/2016	4,848	972,326	8,207	1,645,944	812	319,527	3,264	1,423	7,700	12,387
12/29/2016	2,224	974,550	3,765	1,649,708	1,838	320,087	754	224	2,238	3,216
TOTAL	**65,223**	**974,550**	**110,409**	**1,649,708**	**41,800**		**42,373**	**17,355**	**56,986**	**116,714**

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 show the results from the 2016 visual inspections. Results show a correct class determination of 41.5 percent, with 53.7 percent overestimation and a 4.9 percent underestimation out of a total of 41 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 in 2016 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 in 2016 are shown in Table 5.2.b below. Laboratory results from samples collected during the 2016 report period are presented 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 – 03/30/16	67.5	319.9	252.4
Class 1 – 03/30/16	65.9	317.4	251.5
Class 1 – 06/20/16	110.6	238.1	127.5
Class 1 – 06/20/16	69.1	360.5	291.4
Class 1 – 9/13/16	102.5	397.2	294.7
Class 1 – 9/13/16	108.1	421.2	313.1
Class 1 – 11/14/16	103.1	452.7	349.6
Class 1 – 11/14/16	100.6	487.5	386.9
Class 1 Average	**90.9**	**374.3**	**283.4**
Class 2/3 – 03/30/16	124.1	109.3	-14.8
Class 2/3 – 03/30/16	130.9	147.0	16.1
Class 2/3 – 06/20/16	31.6	123.3	91.7
Class 2/3 – 06/20/16	91.9	201.5	109.6
Class 2/3 – 9/13/16	99.7	210.4	110.7
Class 2/3 – 9/13/16	103.1	218.7	115.6
Class 2/3 – 11/14/16	104.4	138.3	33.9
Class 2/3 – 11/14/16	120.0	139.7	19.7
Class 2/3 Average	**100.7**	**161.0**	**60.3**

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 2015 through October 2016, and the total movement since installation.

Table 5.2.c Site 23 Inclinometers

Inclinometer ID	Location	Movement 10/2015 – 10/2016	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	4.7 mm	32.6 mm	79.3 ft	Oct. 2006
IN-23-10-02	West of Site 23	2.2 mm	12.9 mm	114.4 ft	Nov. 2010
IN-23-10-08	Above Site 23	1.2 mm	8.8 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 in two forms, absolute position and incremental displacement. The view of absolute position (Attachment I) shows the orientation of the inclinometer casing. A positive deviation on the A axis and a negative deviation on the B axis indicate southerly (downslope) and easterly deviations, respectively. The deviation from vertical in this view likely represents deflection of the bore hole that occurred during drilling. The displacements measured since the initial readings are too small to show up in this view and the curves plot on top of each other. 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 32.6 mm (from 2006 through October 2016; less than approximately 1.1-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) (The instrument was calibrated in Oct. 2013 and readings were taken in May and Sept. 2013 which show the same movement rate as post calibration.). Approximately 4.7 mm of movement was observed from October 2015 to October 2016. 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 2.2 mm of movement was observed at approximately 114.4 ft bgs from October 2014 to October 2016 (approximately 12.9 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 1.2 mm at 131.8 ft bgs from October 2014 to October 2016, with rate remaining relatively constant (approximately 8.8 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. Comparison of historic versus modeled flow from the finger drains and the curtain drain indicated they are performing as designed and as necessary (EDE 2004). 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

2016	Tailings (DST)	% of tailings generated	Waste Rock (tons)
January	23,381	43.2%	9,388
February	29,434	55.3%	12,227
March	24,026	43.2%	4,170
April	30,314	59.4%	12,398
May	29,627	56.0%	4,260
June	33,219	61.2%	10,005
July	26,964	49.1%	9,653
August	21,544	39.4%	6,729
September	19,634	35.2%	5,395
October	30,196	55.3%	12,983
November	31,395	64.6%	16,060
December	29,242	52.5%	6,697
Total	**328,977**		**109,965**

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 wastewaters 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

2016	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	665,000	14.9	638,000	14.3	54,250,000	1,215.3
February	547,000	13.1	518,000	12.4	41,180,000	986.1
March	482,000	10.2	469,000	10.5	35,650,000	798.6
April	422,400	9.77	447,400	10.36	42,300,000	979.2
May	Totalizer not functioning		965,000	21.62	46,810,000	1048.6
June			461,000	10.67	37,800,000	875.0
July			396,000	8.9	37,200,000	833.3
August			431,000	9.7	42,780,000	958.3
September			603,000	14.0	57,300,000	1,326.4
October			766,000	17	42,780,000	958.3
November			913,500	20.5	50,400,000	1,166.7
December			580,300	13.0	48,670,000	1,090.3

8.0 REFERENCES

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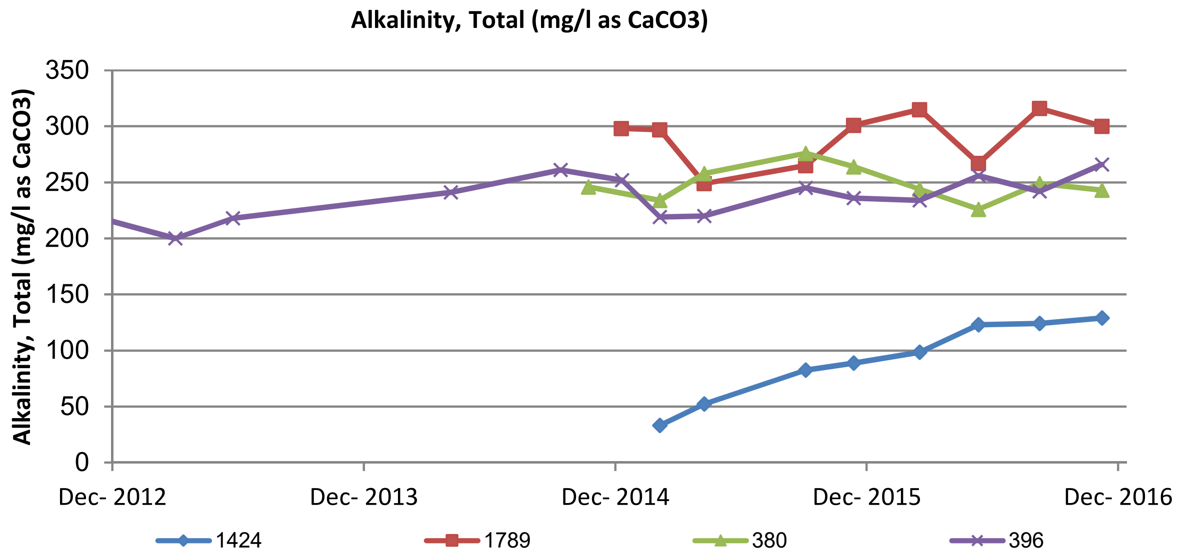
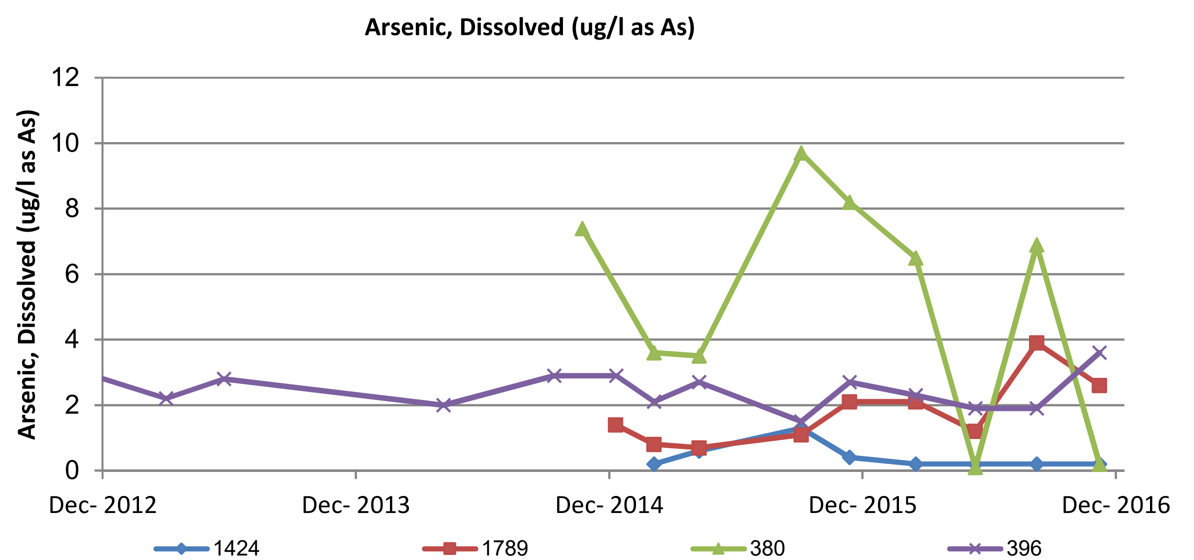
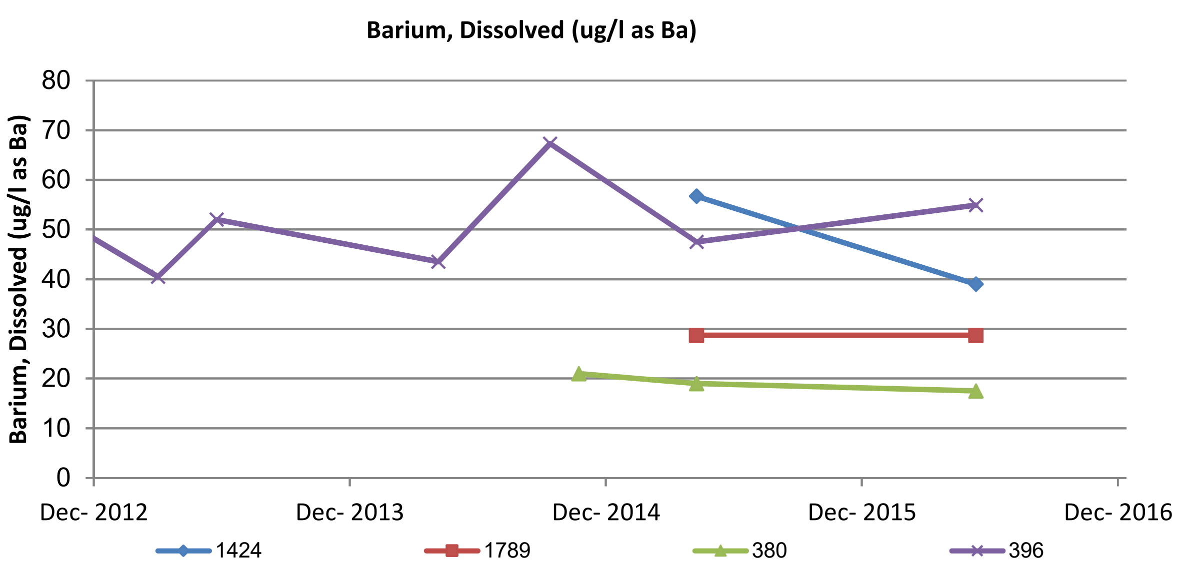
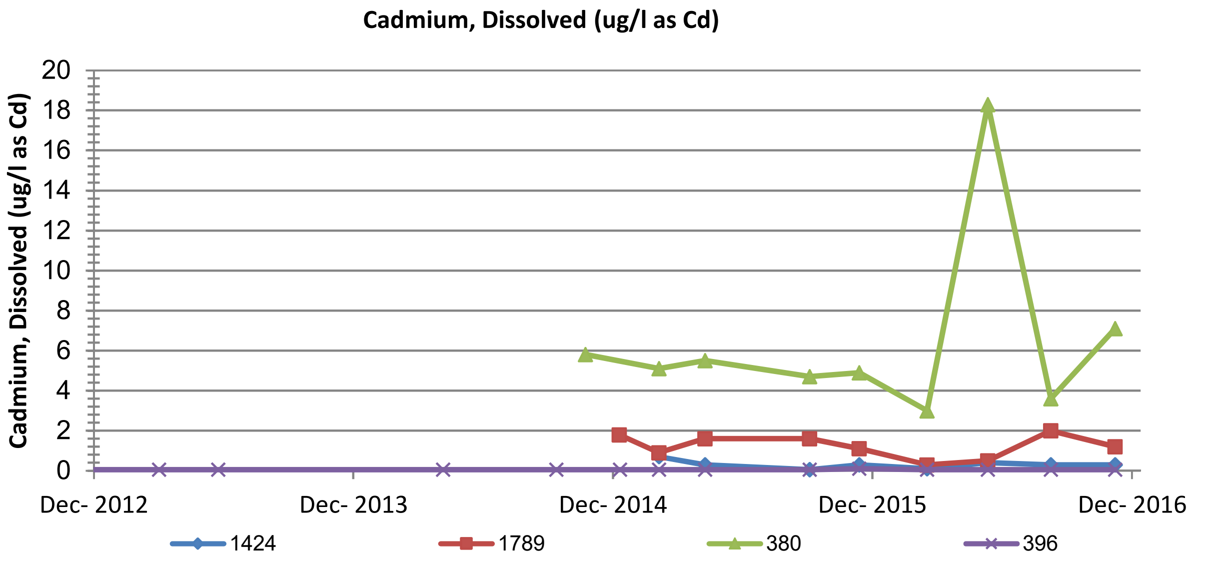
ATTACHMENT A
Tailings Area Underdrains

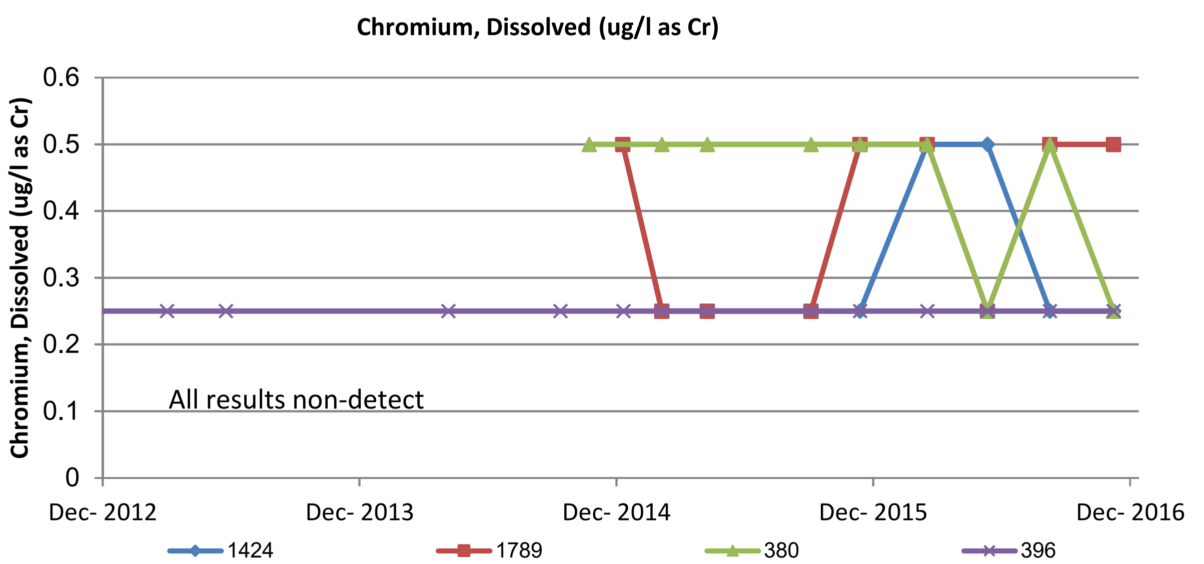


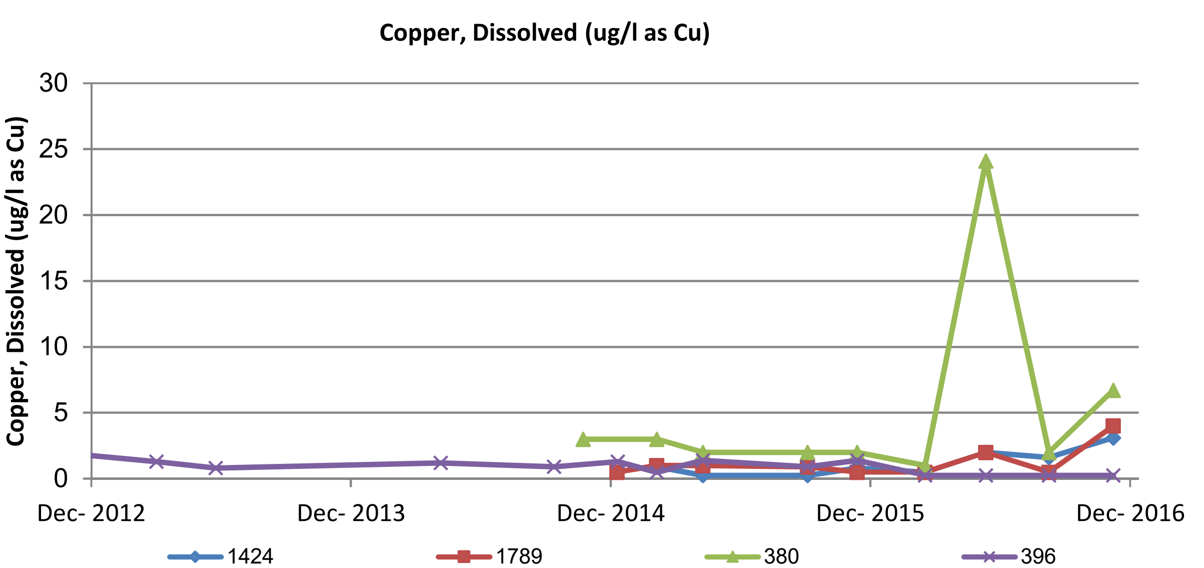




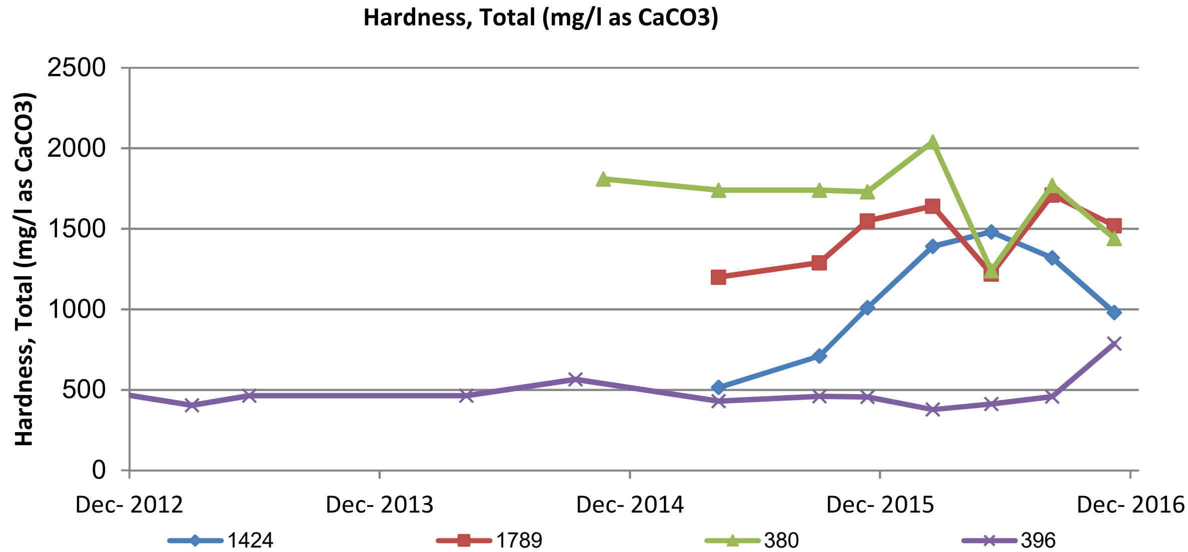
ATTACHMENT A
Tailings Area Underdrains

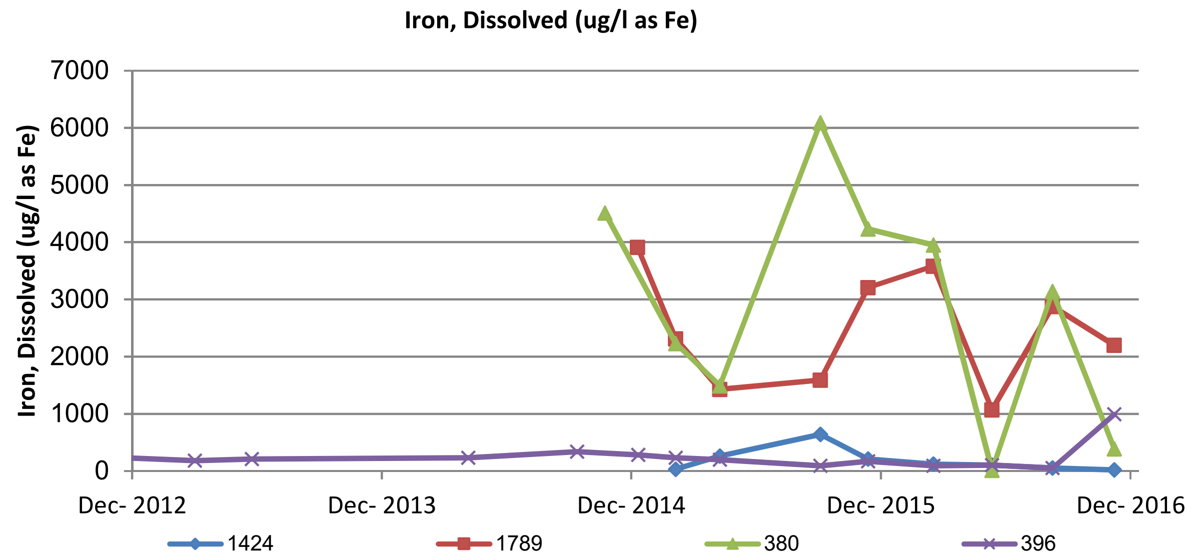


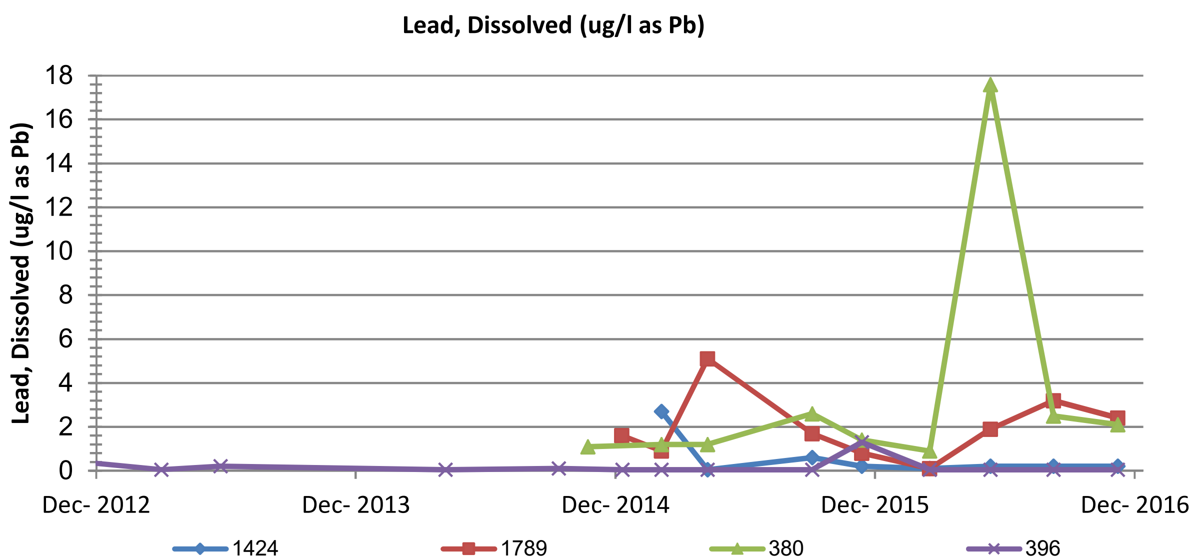




ATTACHMENT A
Tailings Area Underdrains

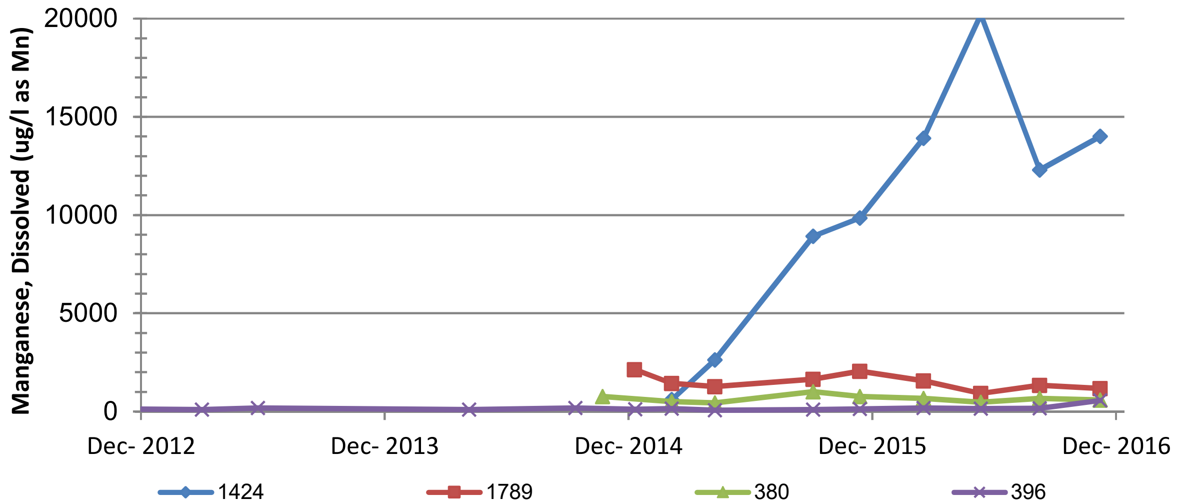






ATTACHMENT A
Tailings Area Underdrains

Manganese, Dissolved (ug/l as Mn)



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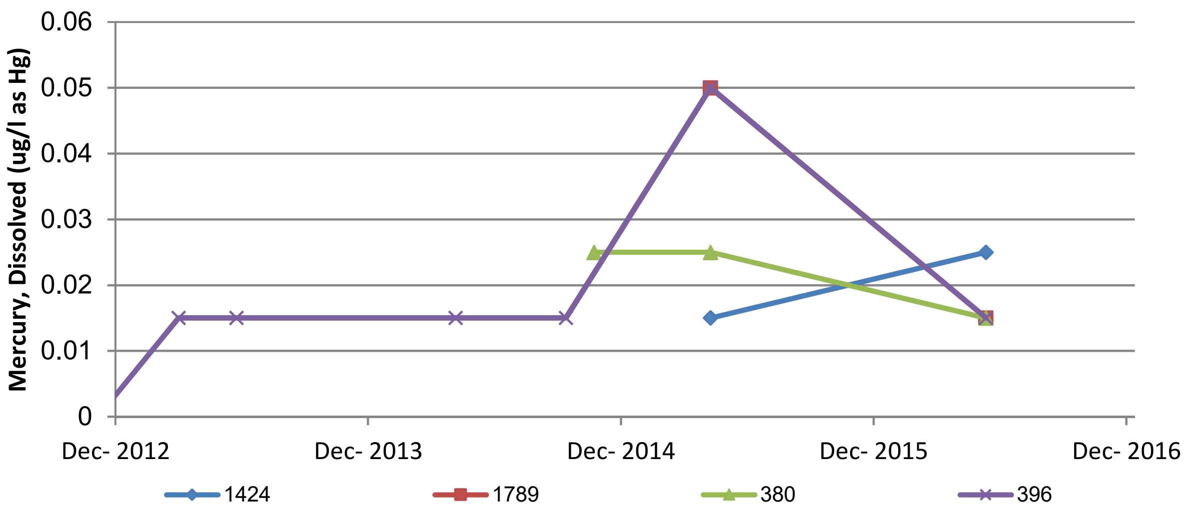
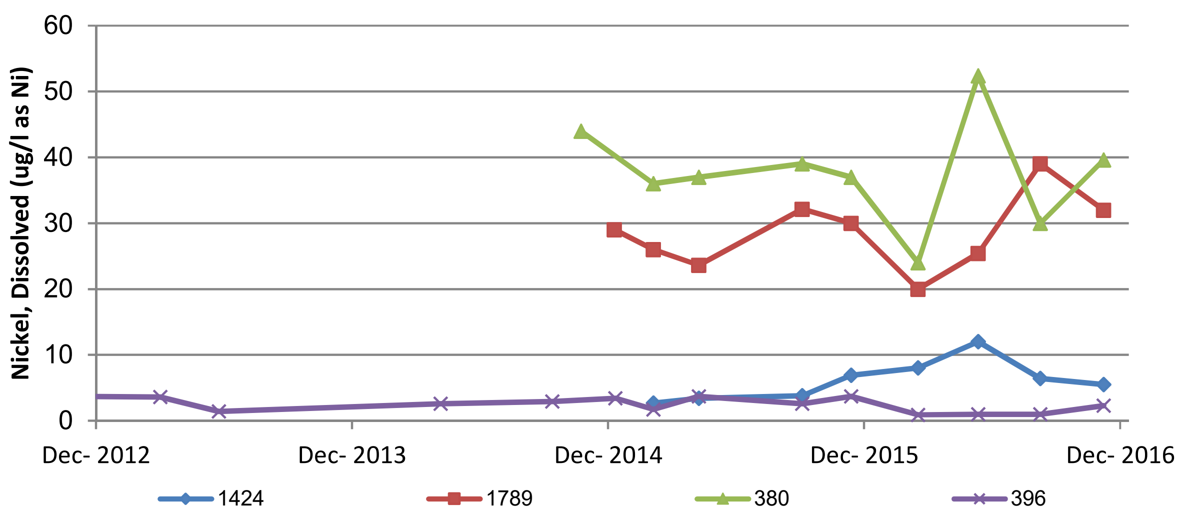
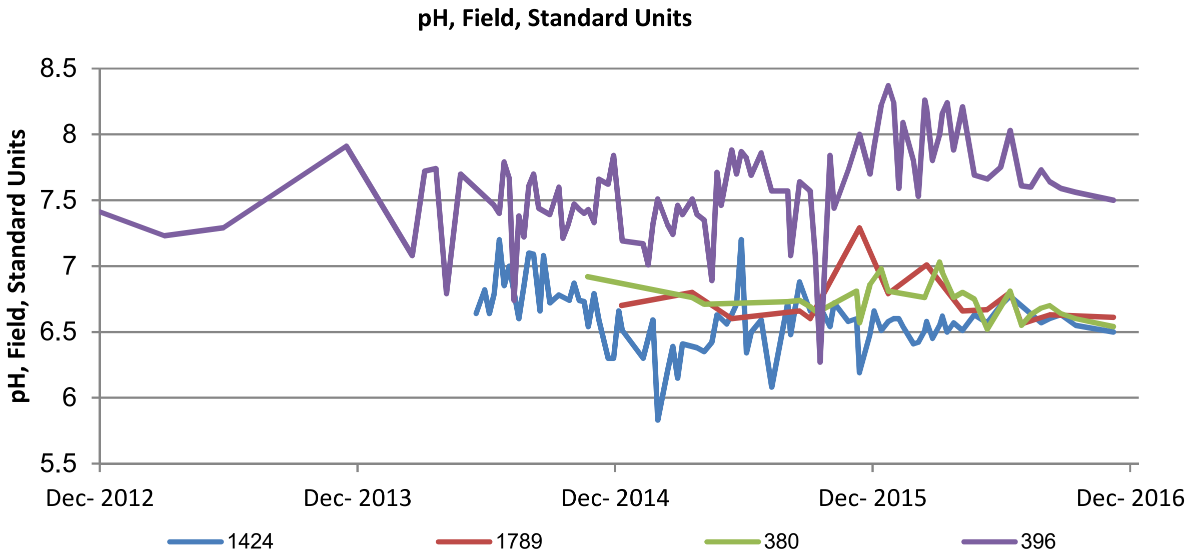
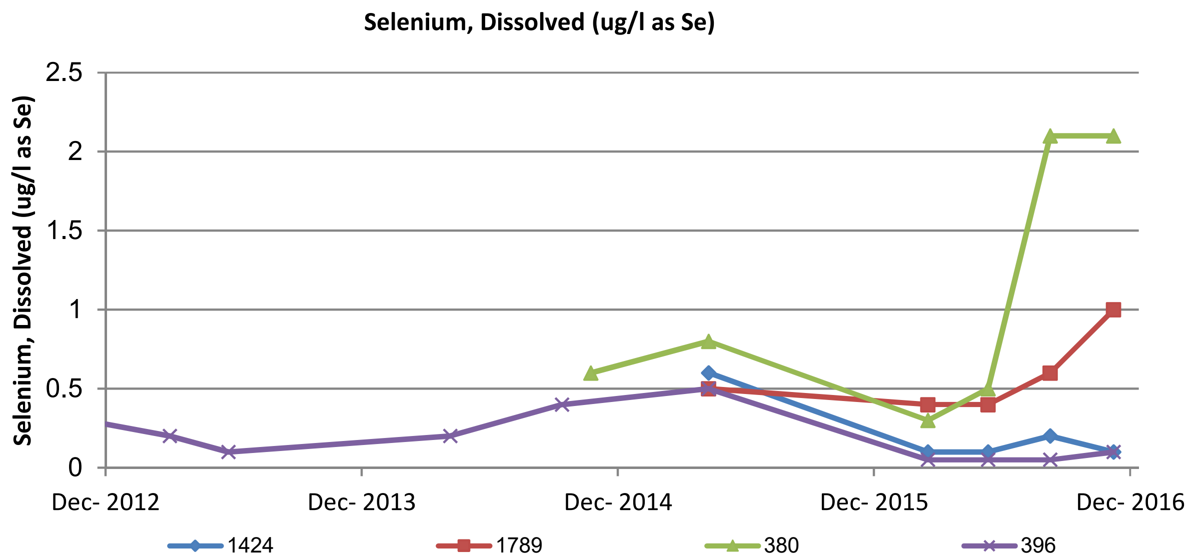


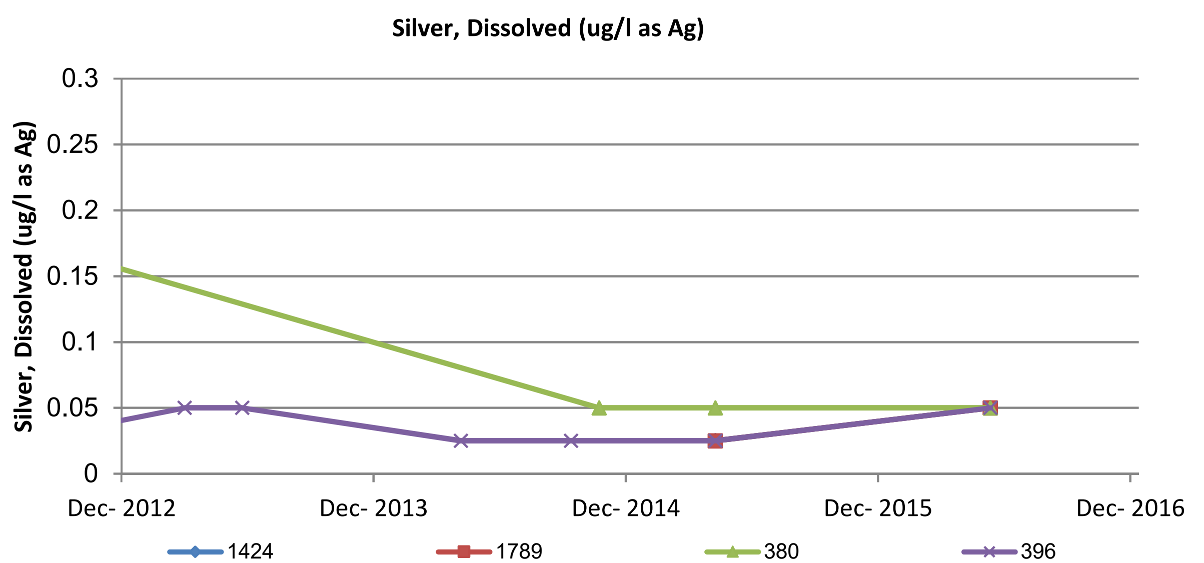
Nickel, Dissolved (ug/l as Ni)



ATTACHMENT A
Tailings Area Underdrains

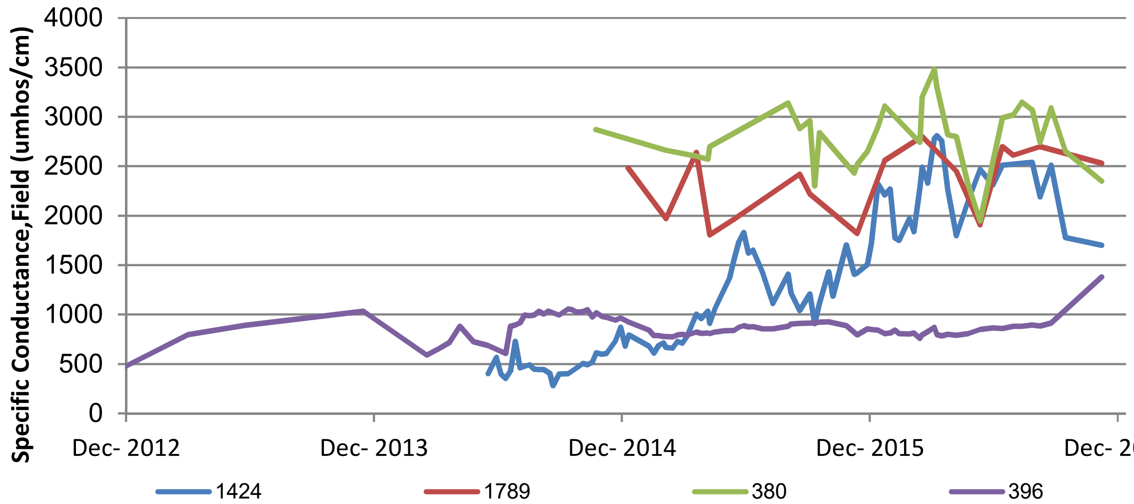




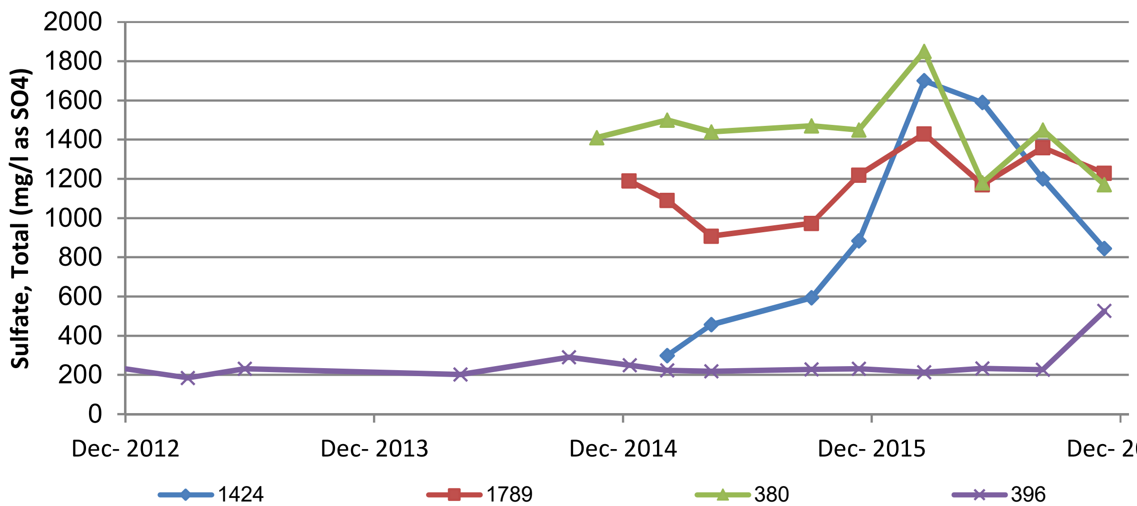


ATTACHMENT A
Tailings Area Underdrains

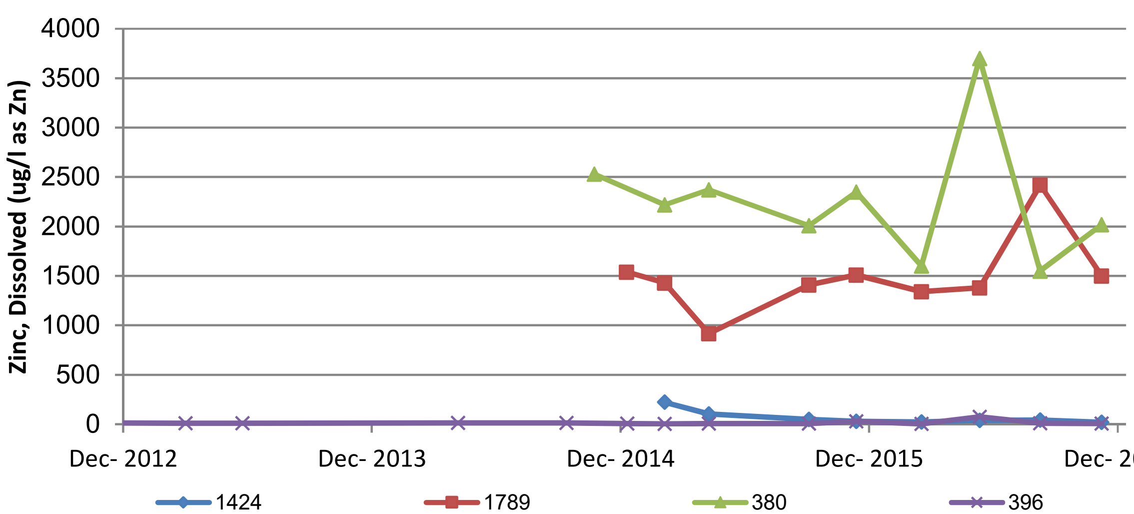
Specific Conductance,Field (umhos/cm @ 25C)



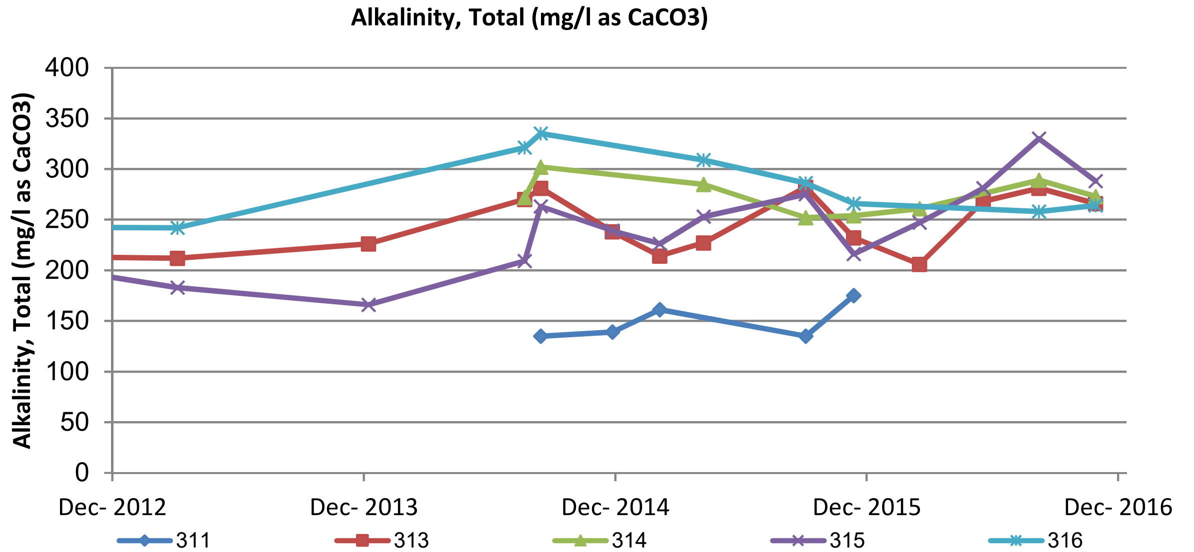
Sulfate, Total (mg/l as SO4)

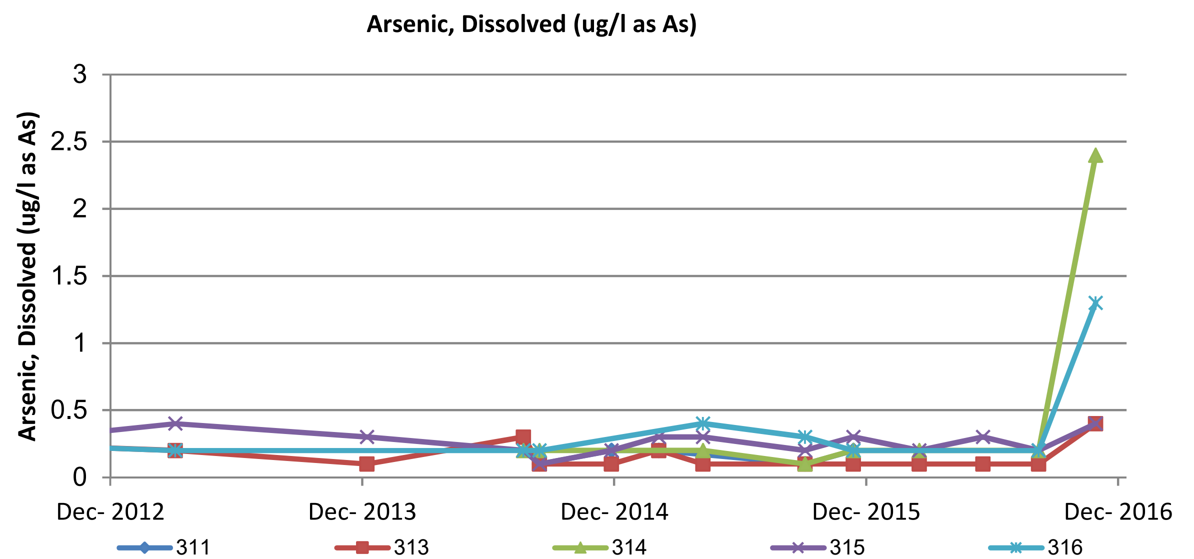


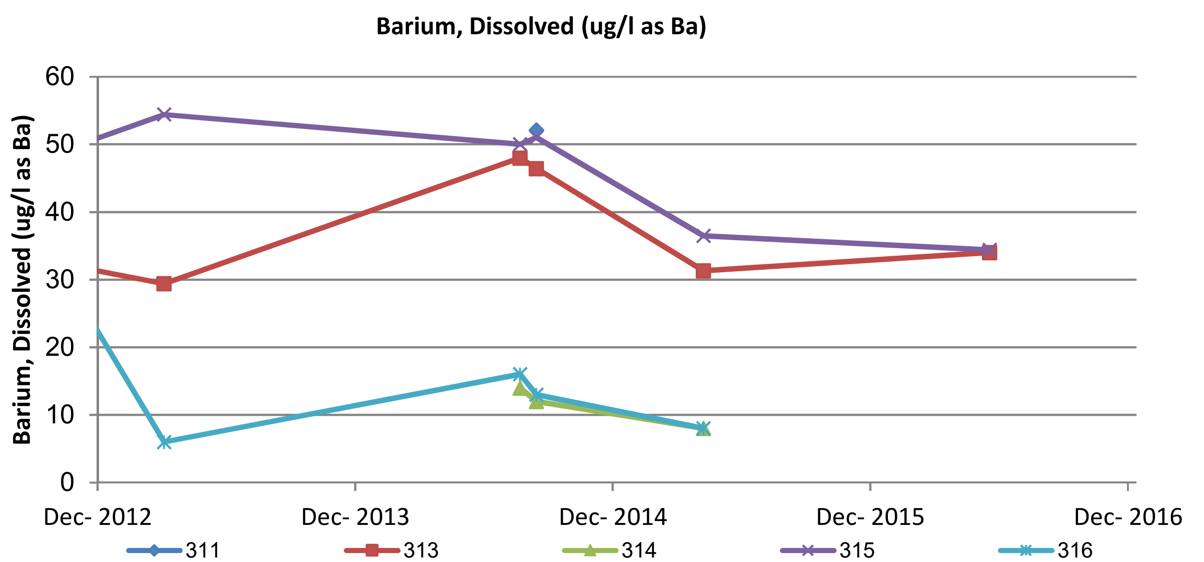
Zinc, Dissolved (ug/l as Zn)



ATTACHMENT B
Site 23 Finger Drains







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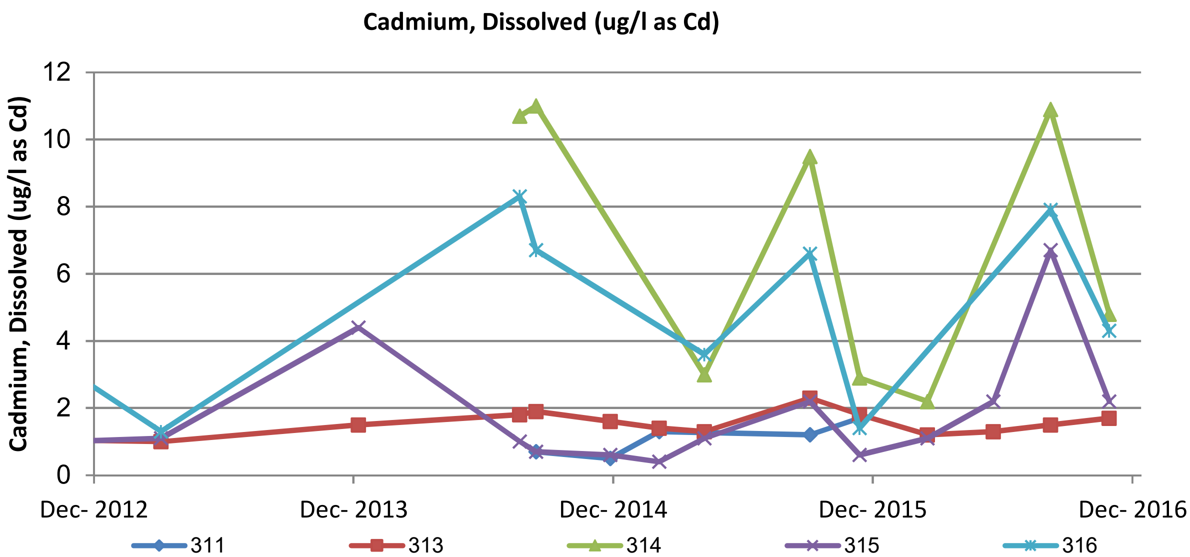
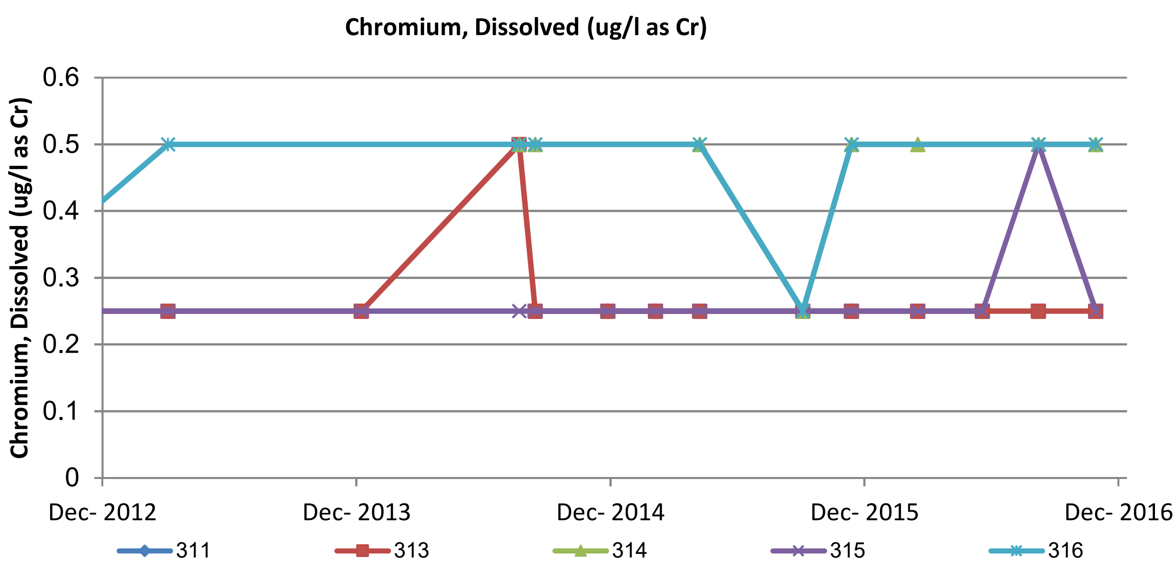
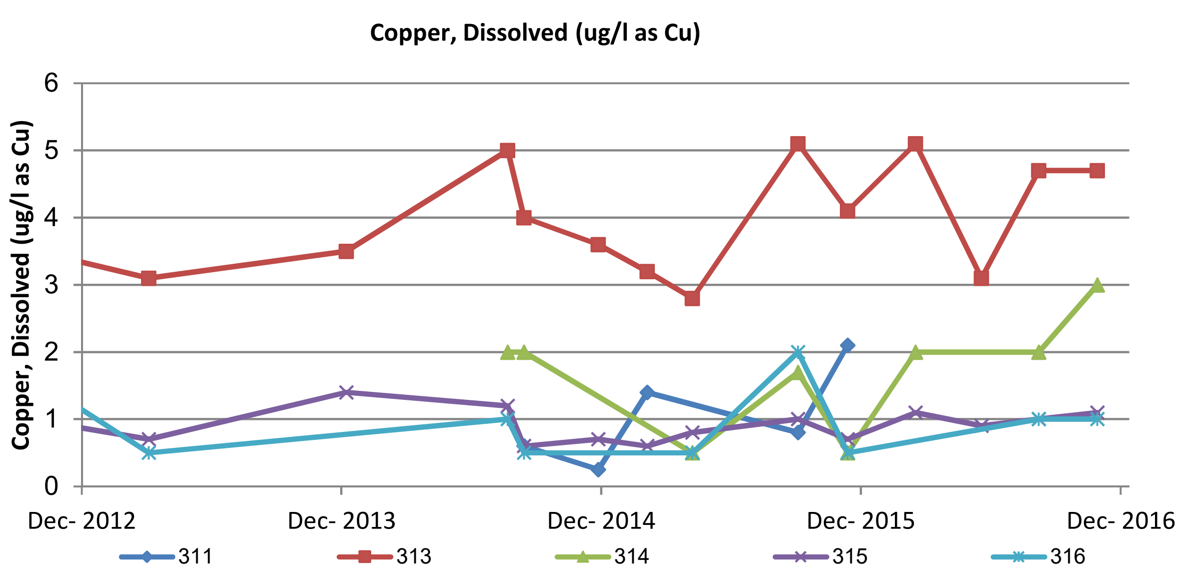
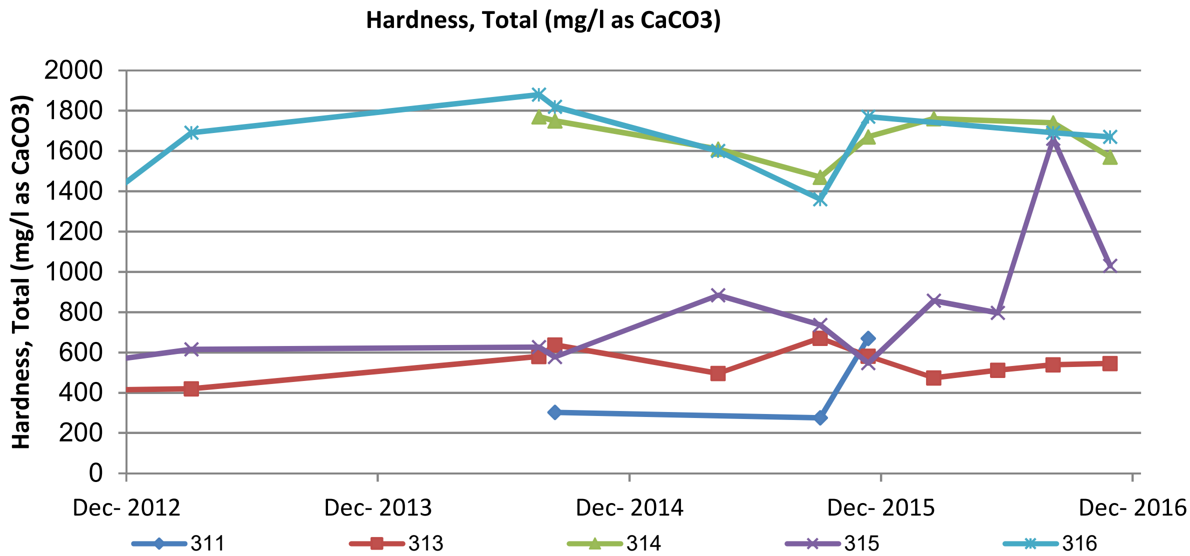
Site 23 Finger Drains

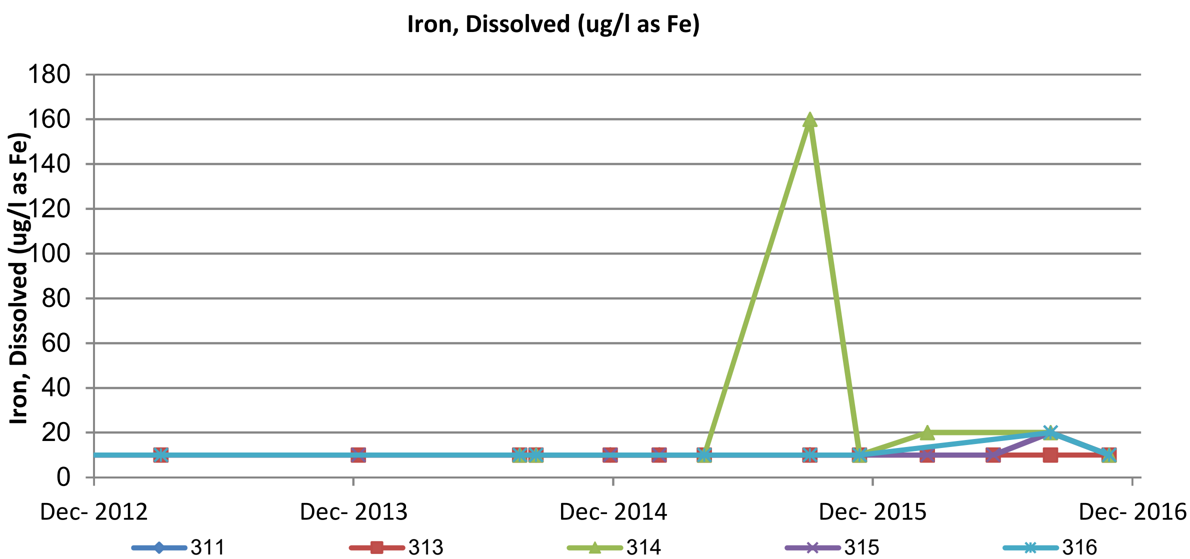


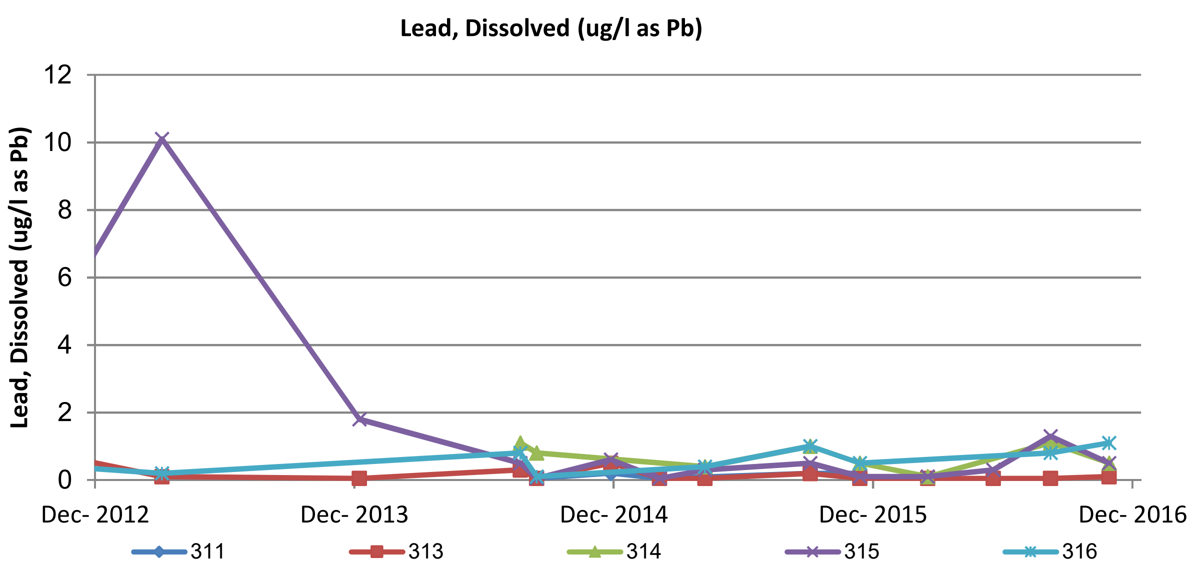




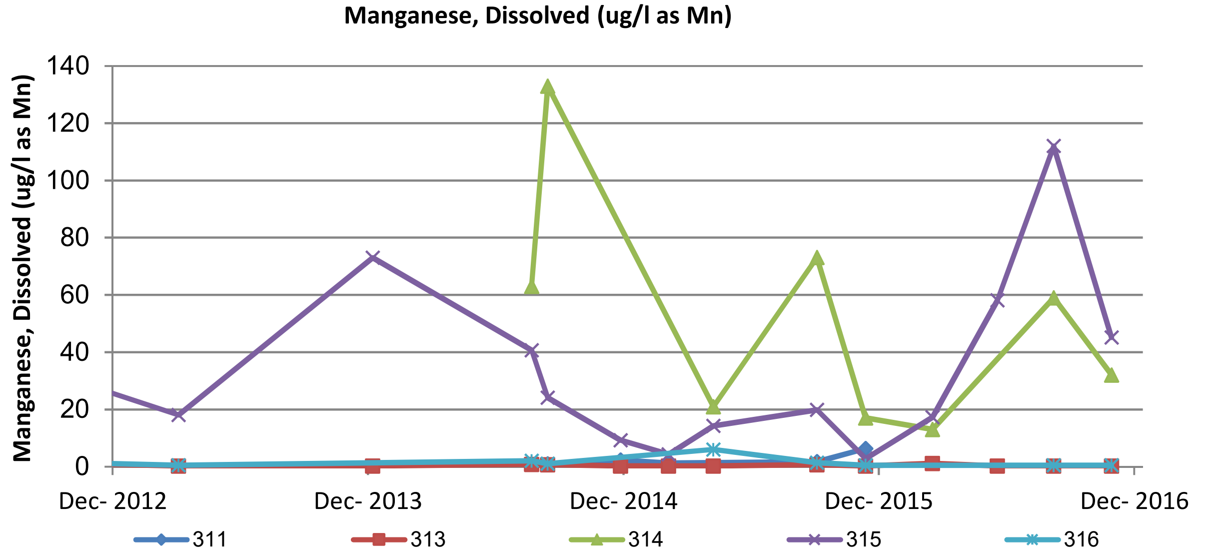
ATTACHMENT B
Site 23 Finger Drains

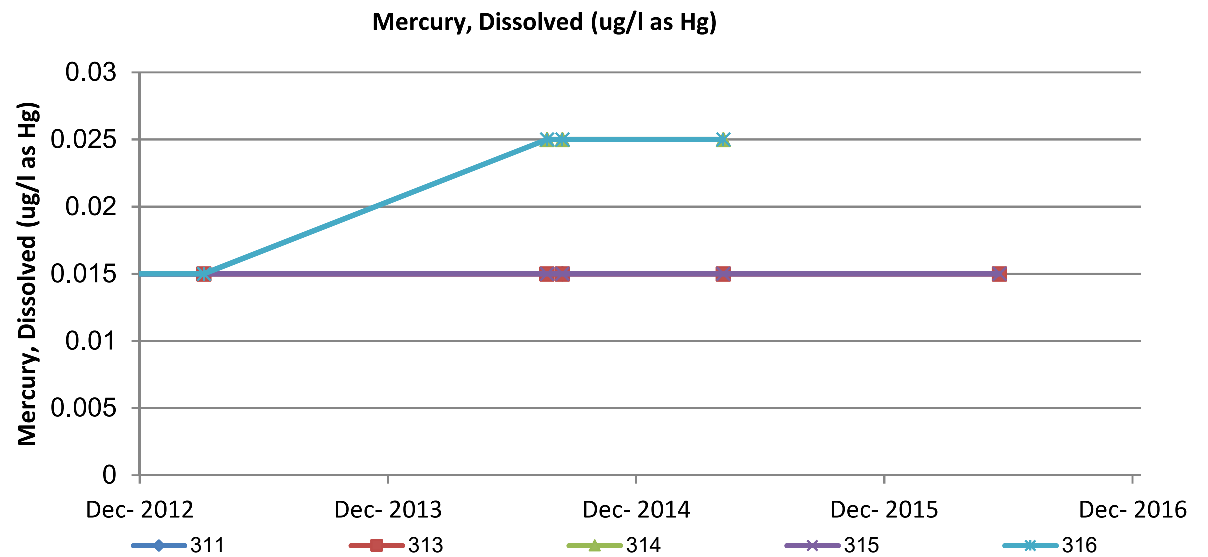


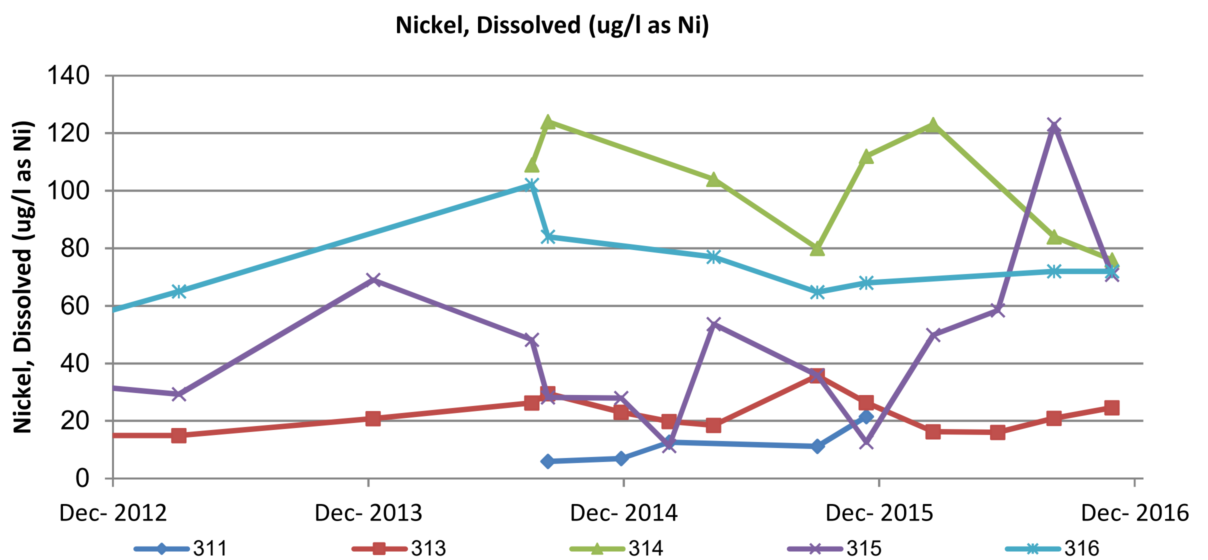




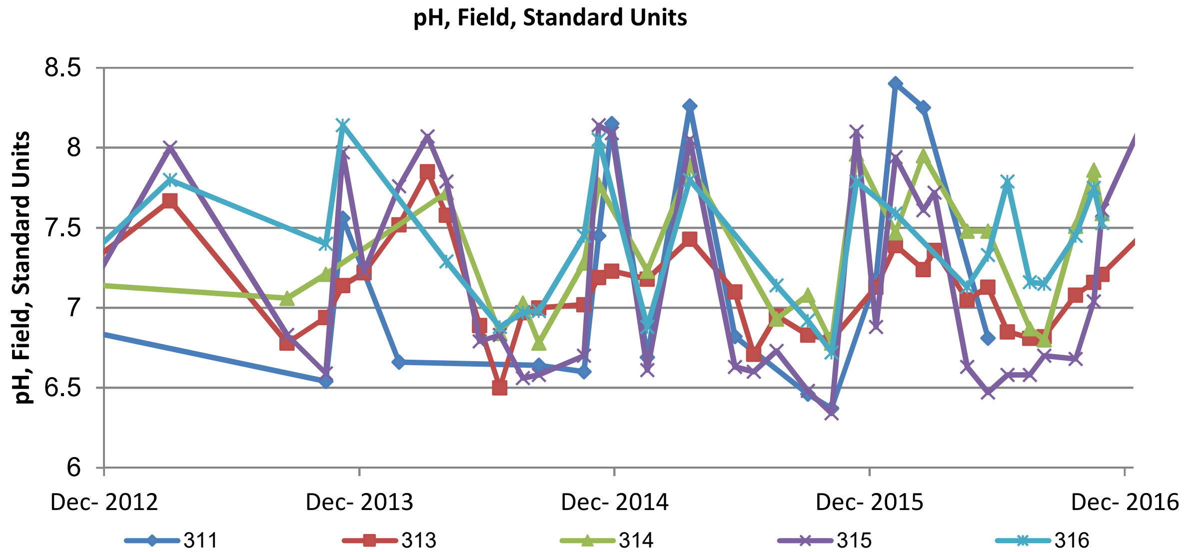
ATTACHMENT B
Site 23 Finger Drains

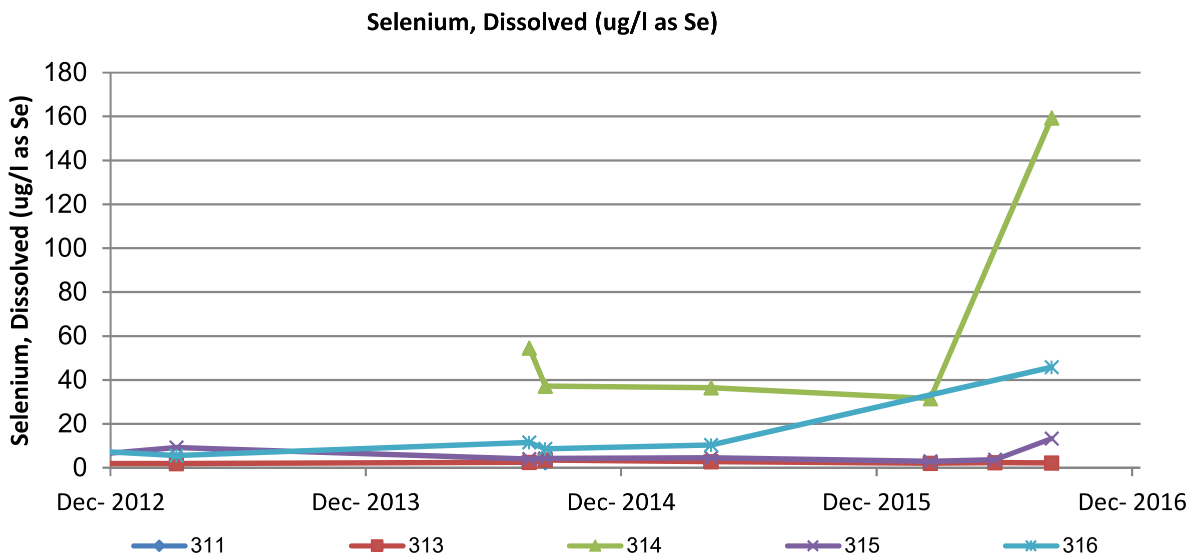


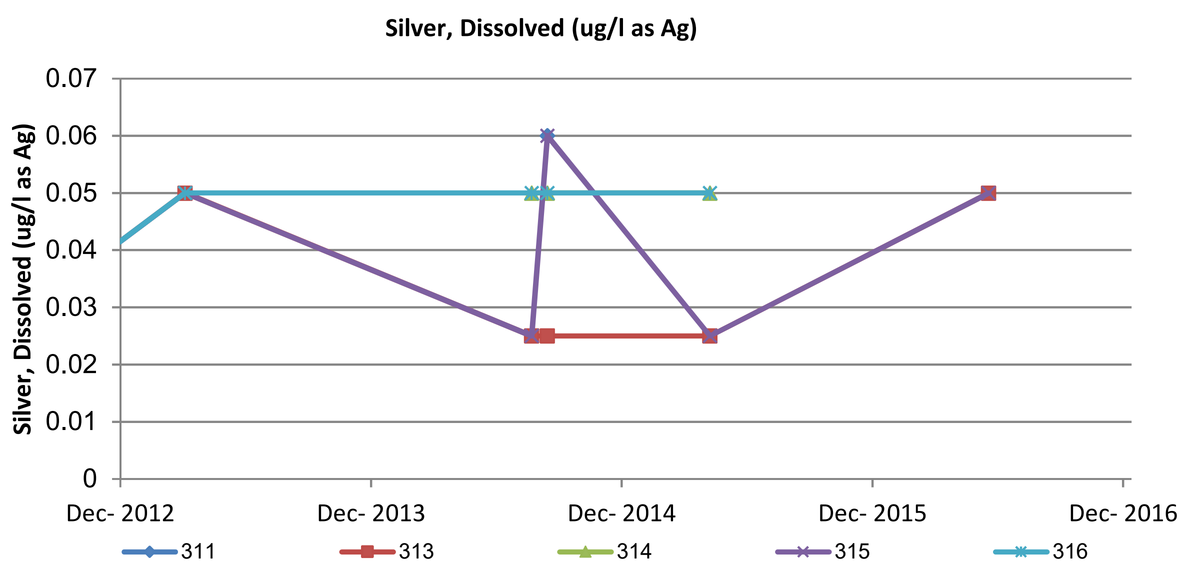




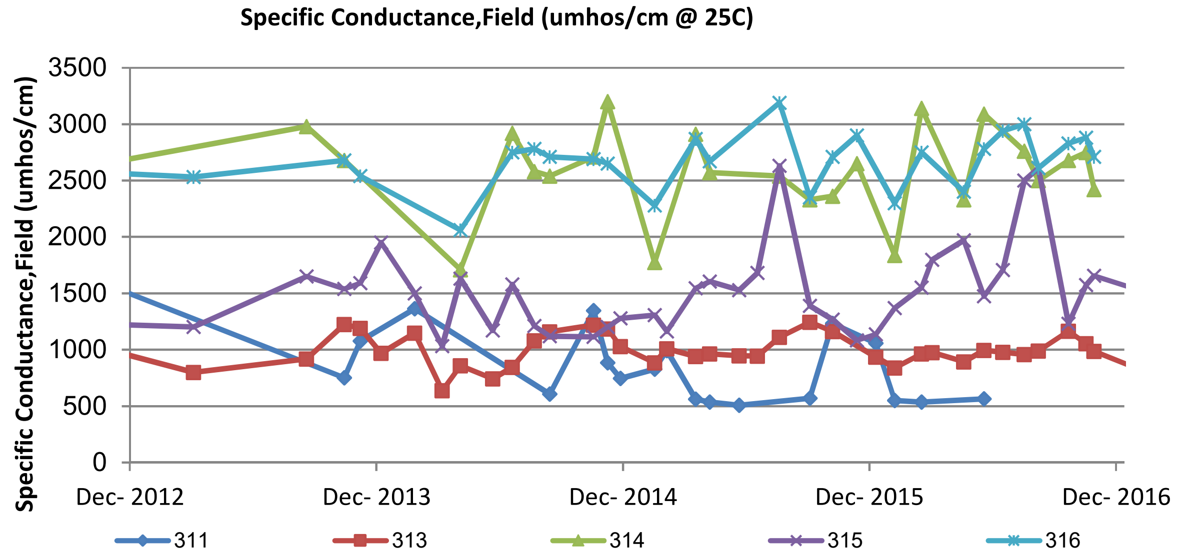
ATTACHMENT B
Site 23 Finger Drains

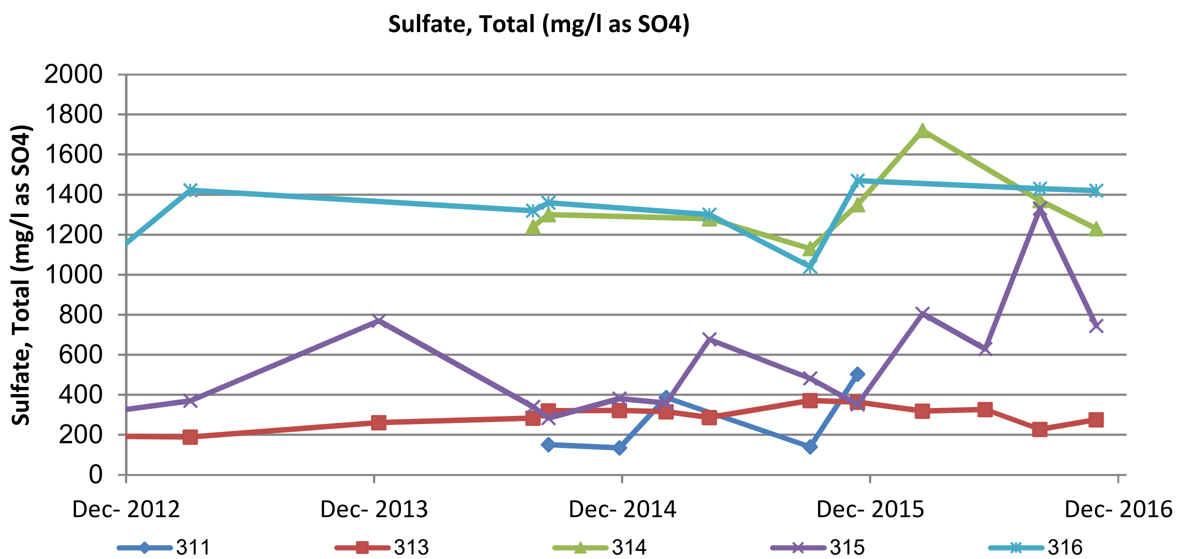


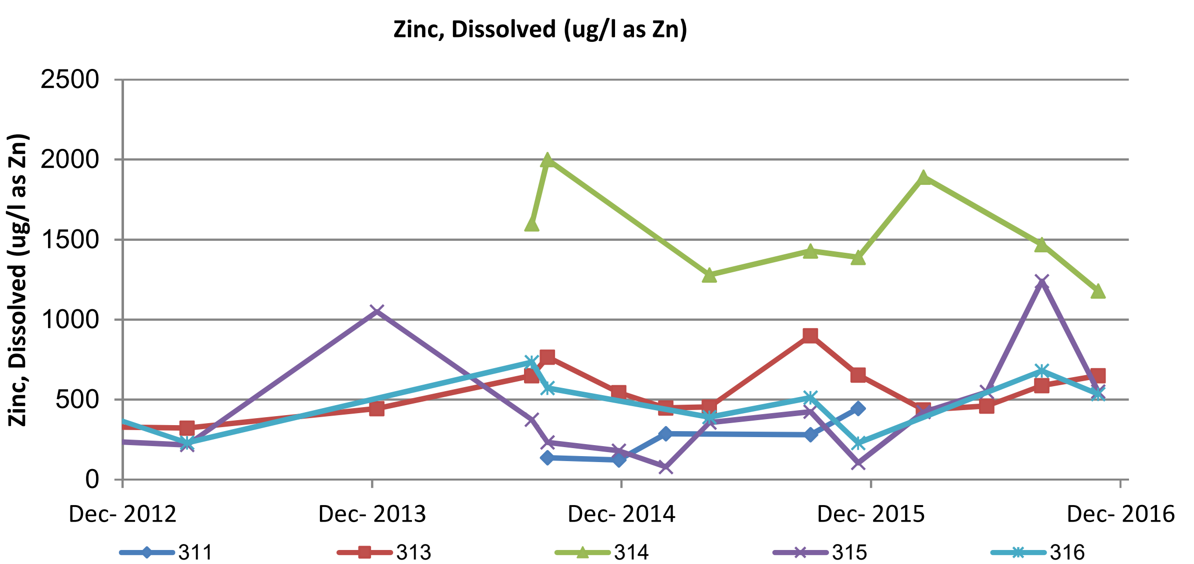




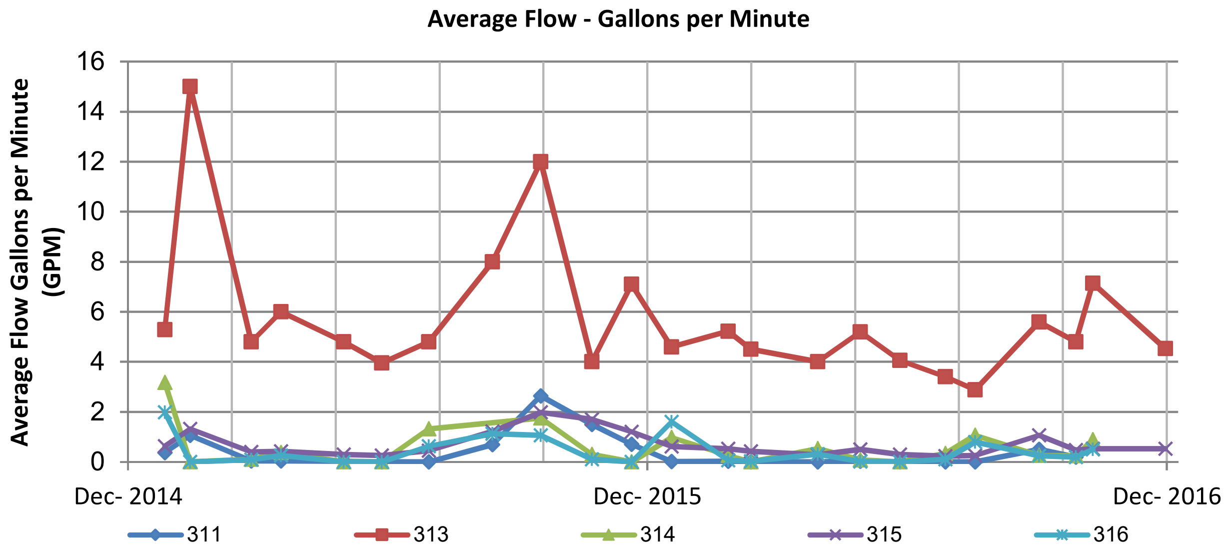
ATTACHMENT B
Site 23 Finger Drains





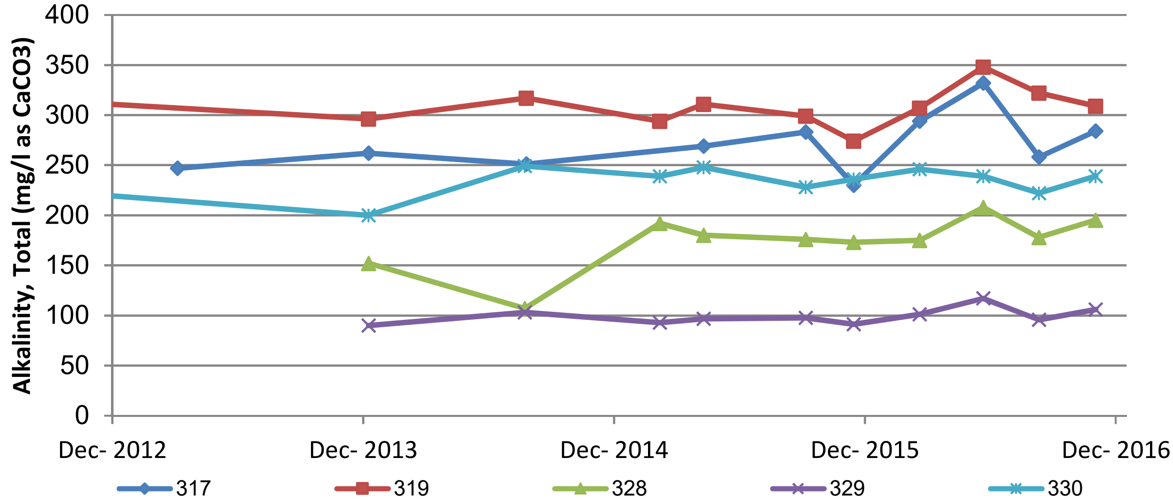


ATTACHMENT B
Site 23 Finger Drains

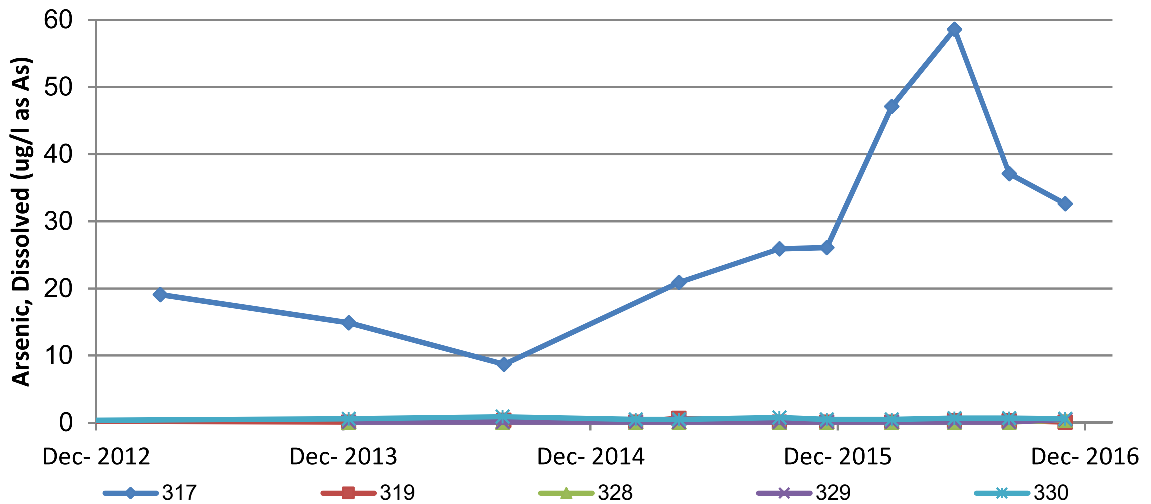


ATTACHMENT C
Site 23/D Curtain Drains

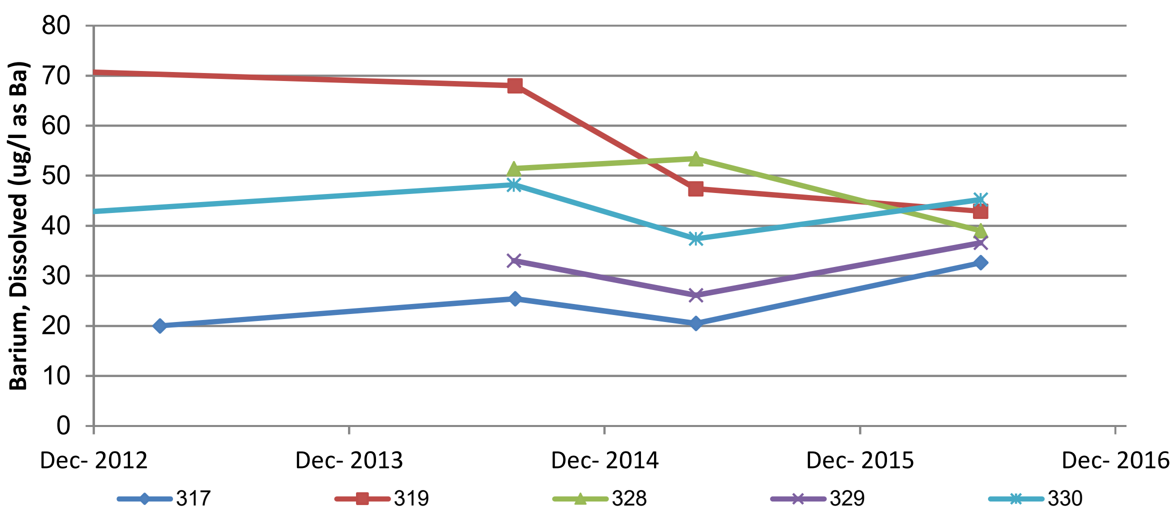
Alkalinity, Total (mg/l as CaCO3)



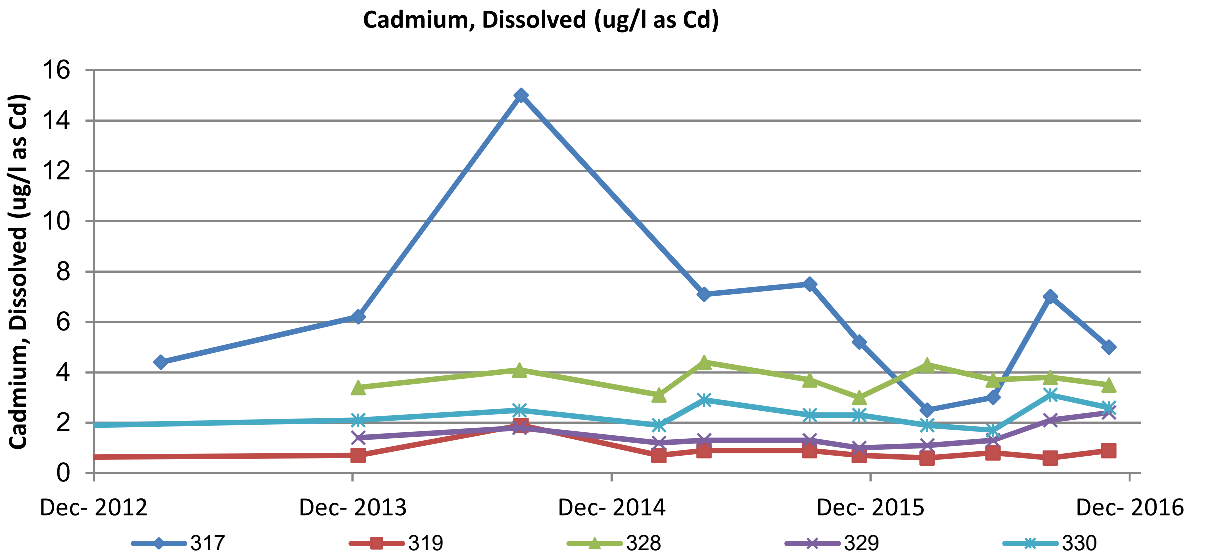
Arsenic, Dissolved (ug/l as As)

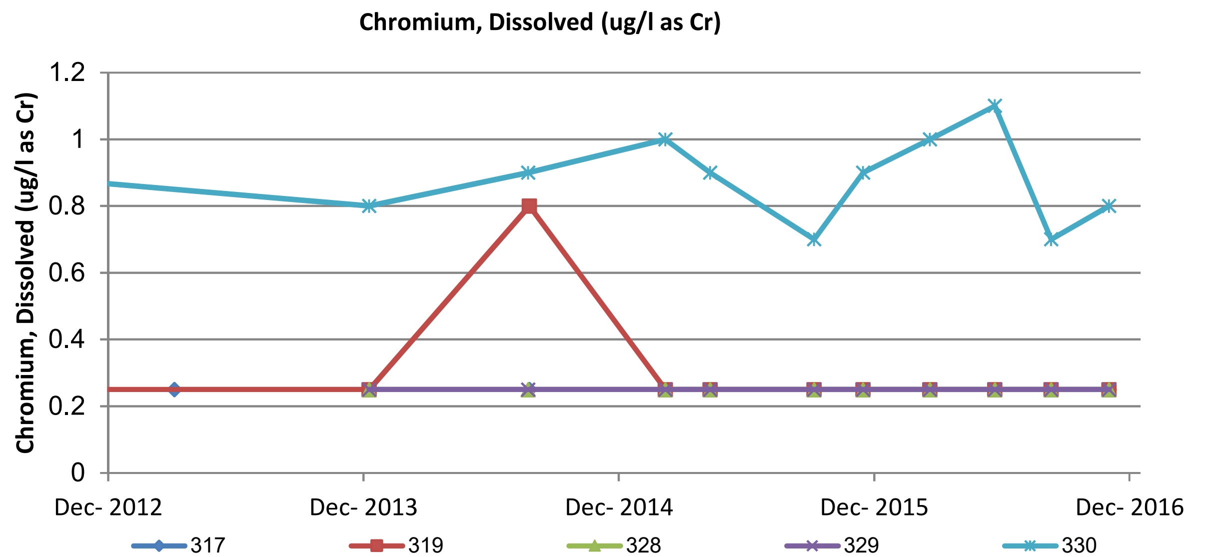


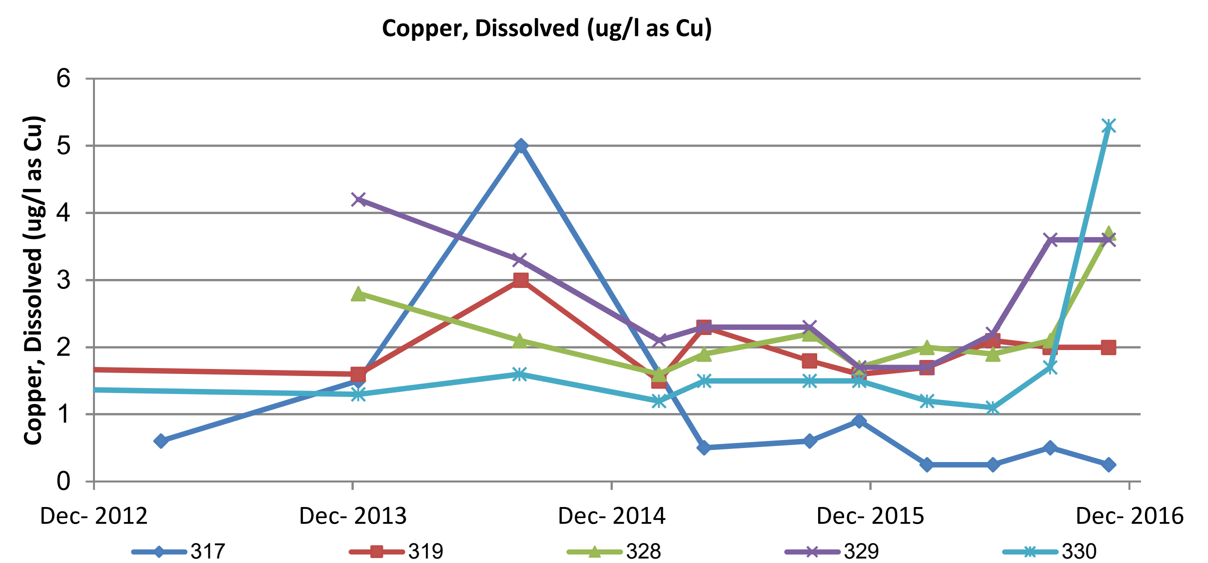
Barium, Dissolved (ug/l as Ba)



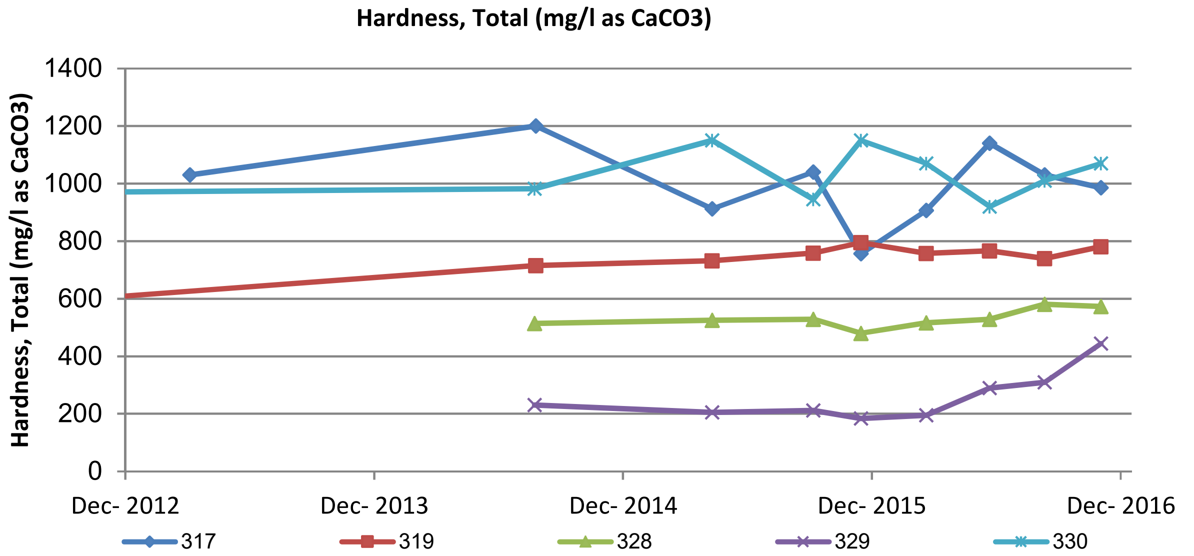
ATTACHMENT C
Site 23/D Curtain Drains

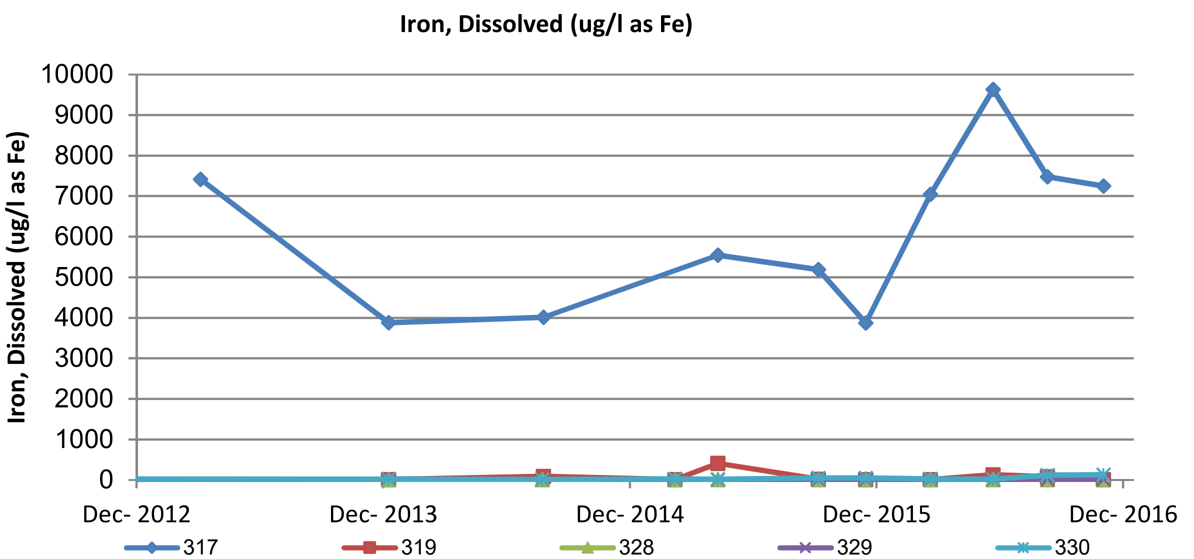


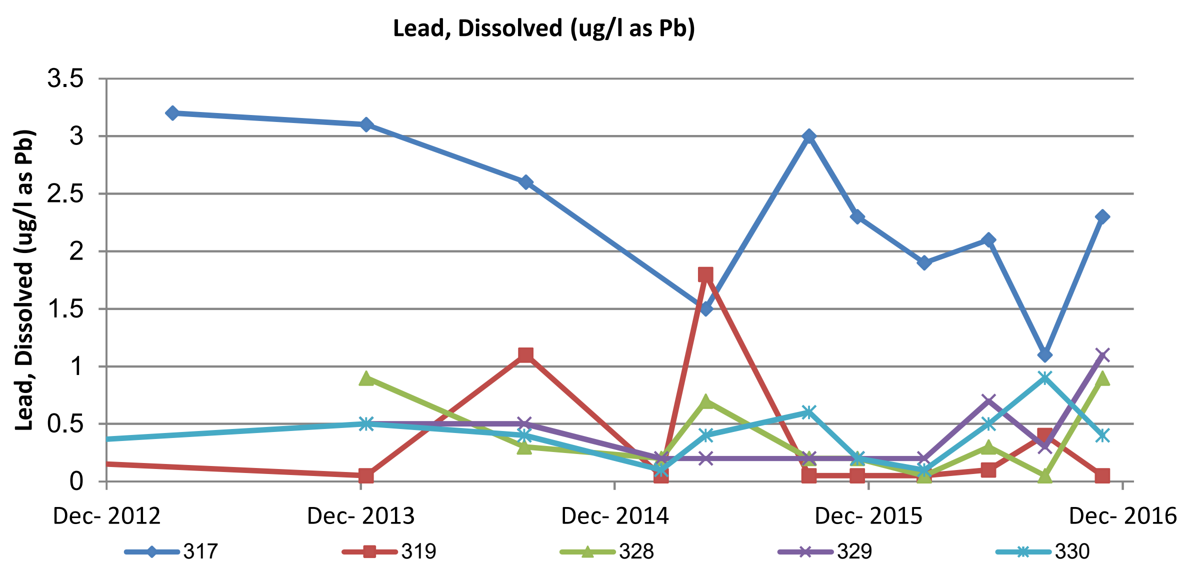




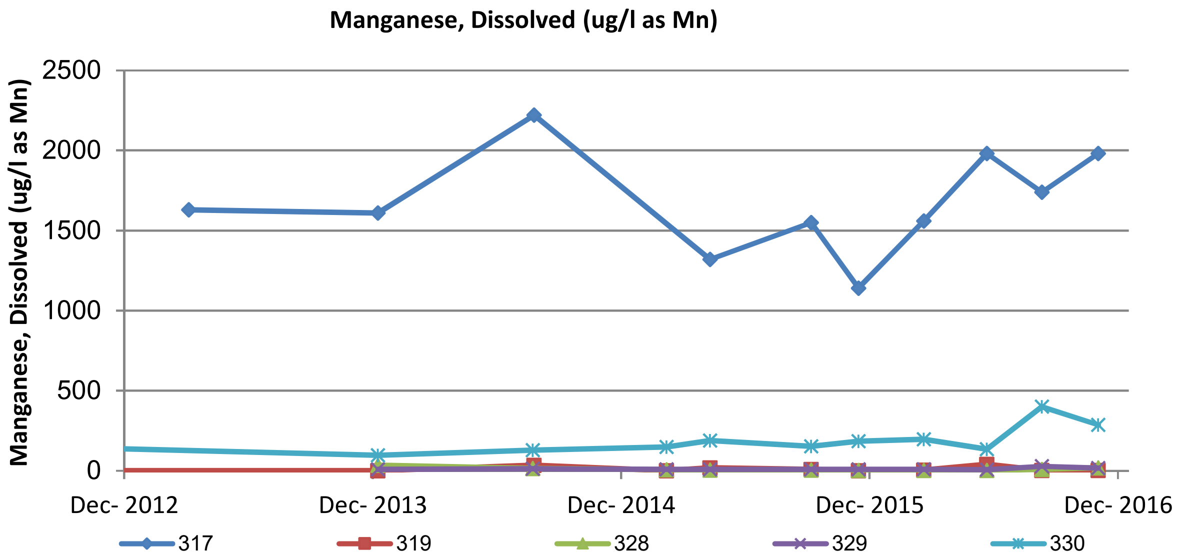
ATTACHMENT C
Site 23/D Curtain Drains

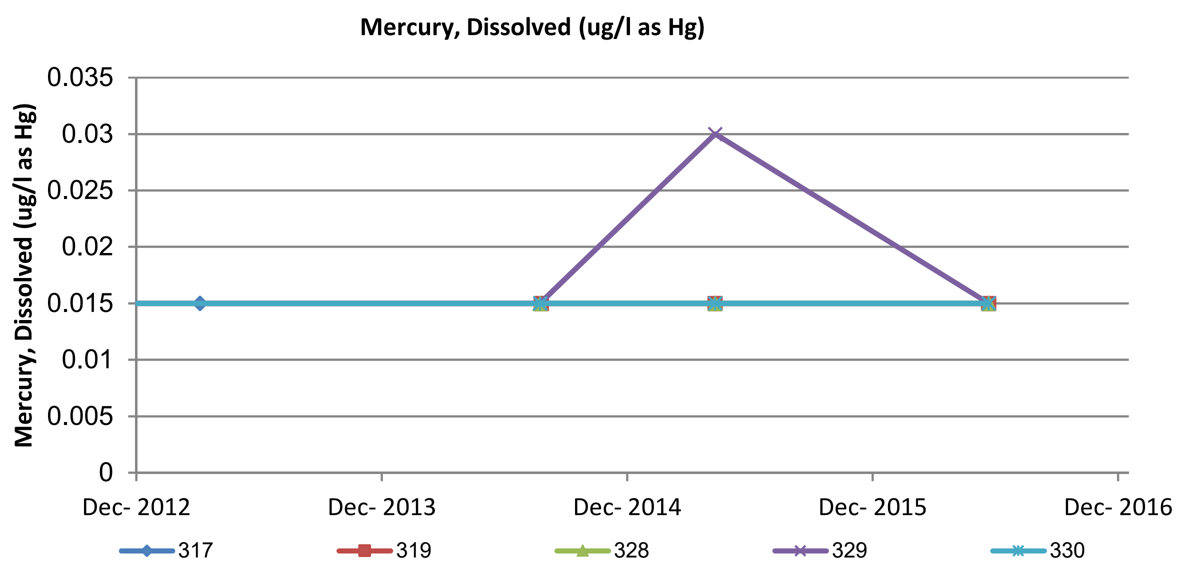


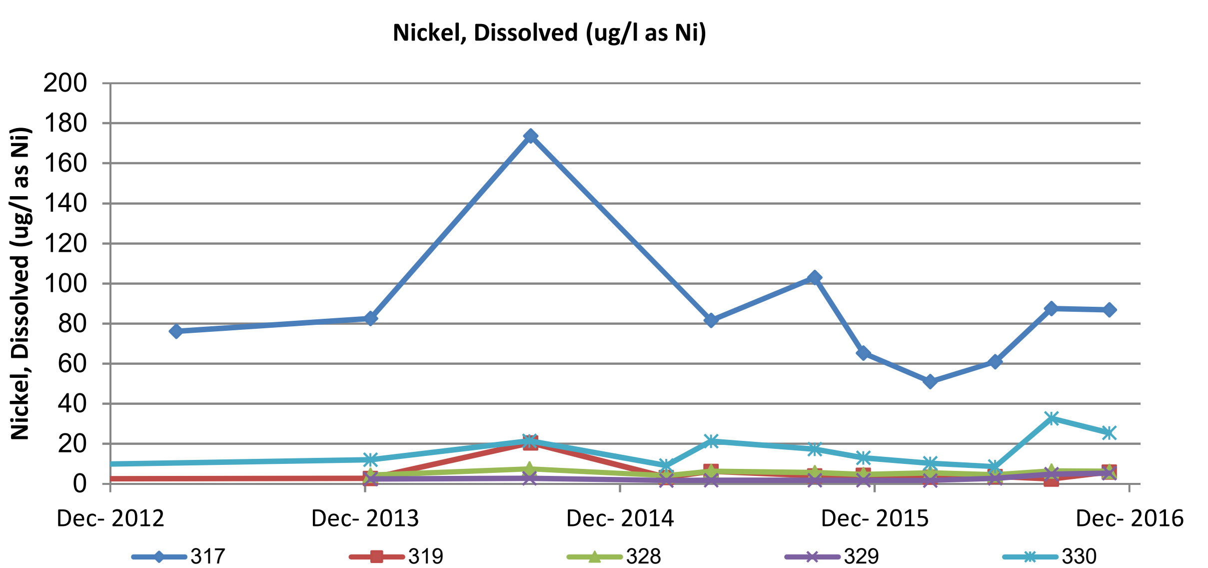




ATTACHMENT C
Site 23/D Curtain Drains

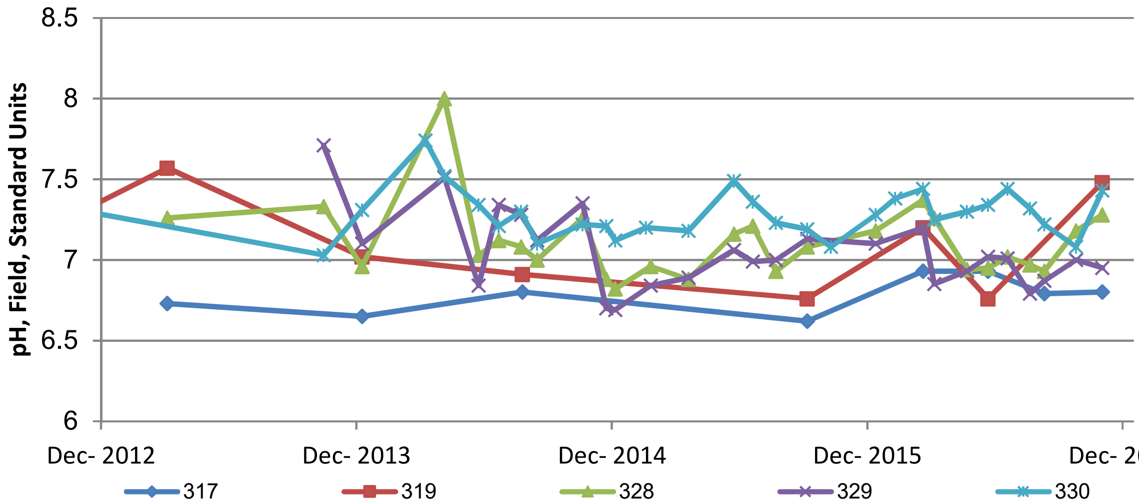




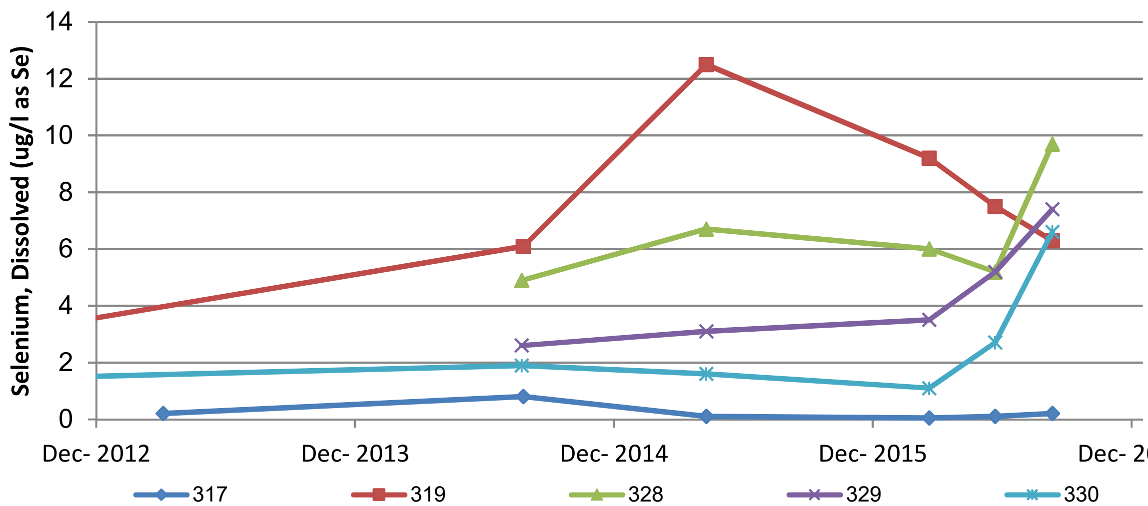


ATTACHMENT C
Site 23/D Curtain Drains

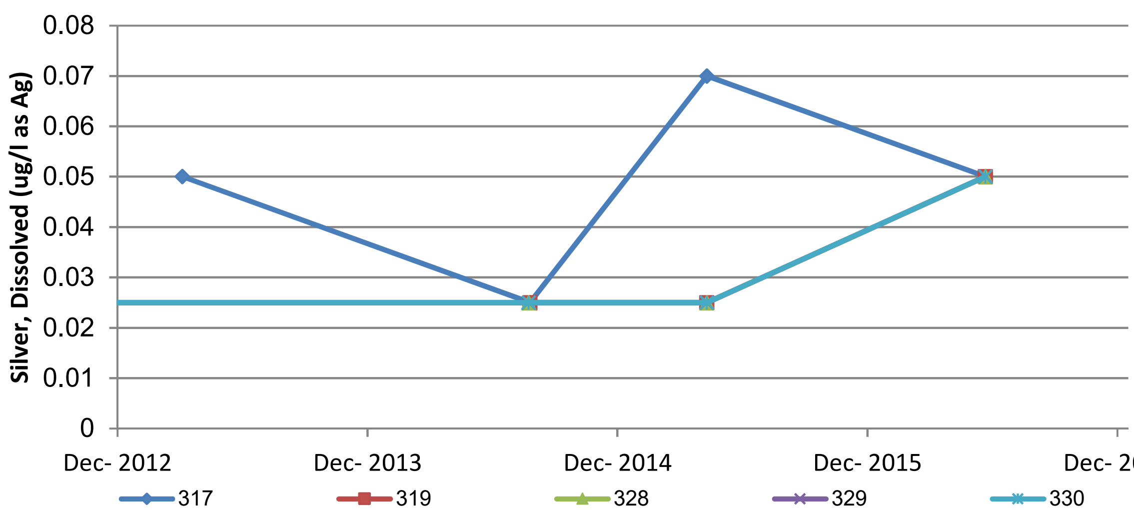
pH, Field, Standard Units



Selenium, Dissolved (ug/l as Se)

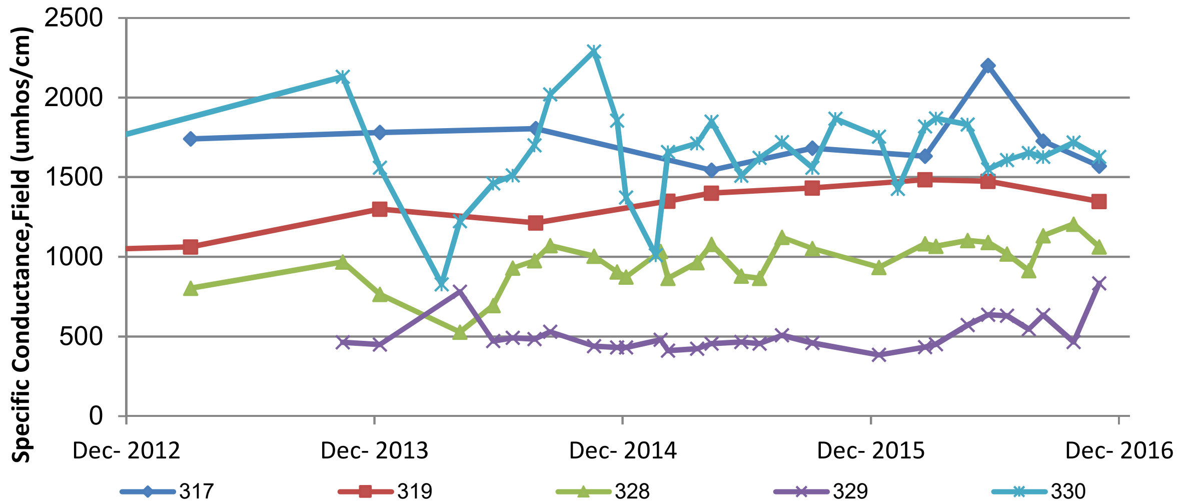


Silver, Dissolved (ug/l as Ag)

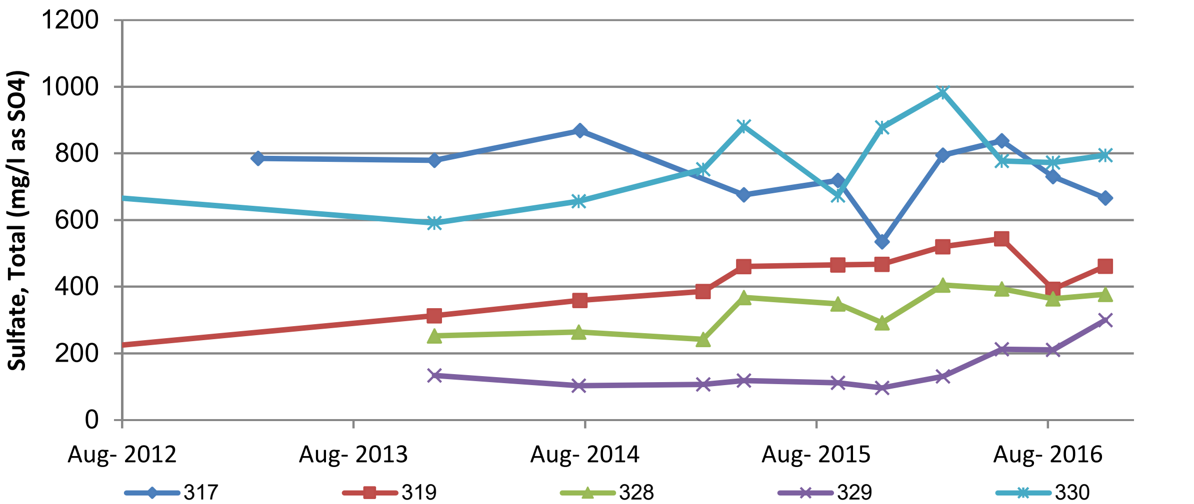


ATTACHMENT C
Site 23/D Curtain Drains

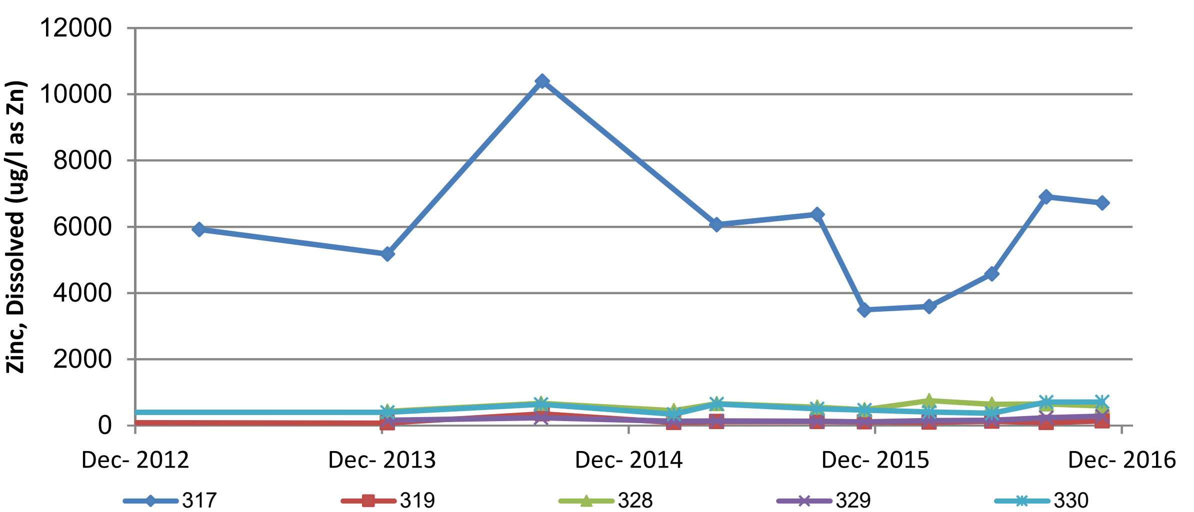
Specific Conductance,Field (umhos/cm @ 25C)



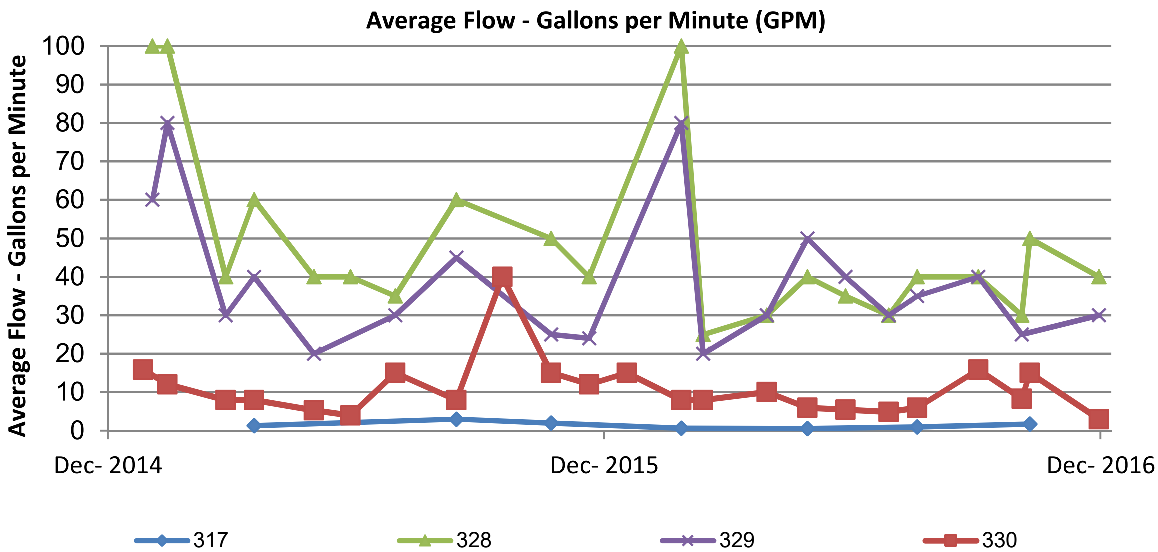
Sulfate, Total (mg/l as SO4)



Zinc, Dissolved (ug/l as Zn)

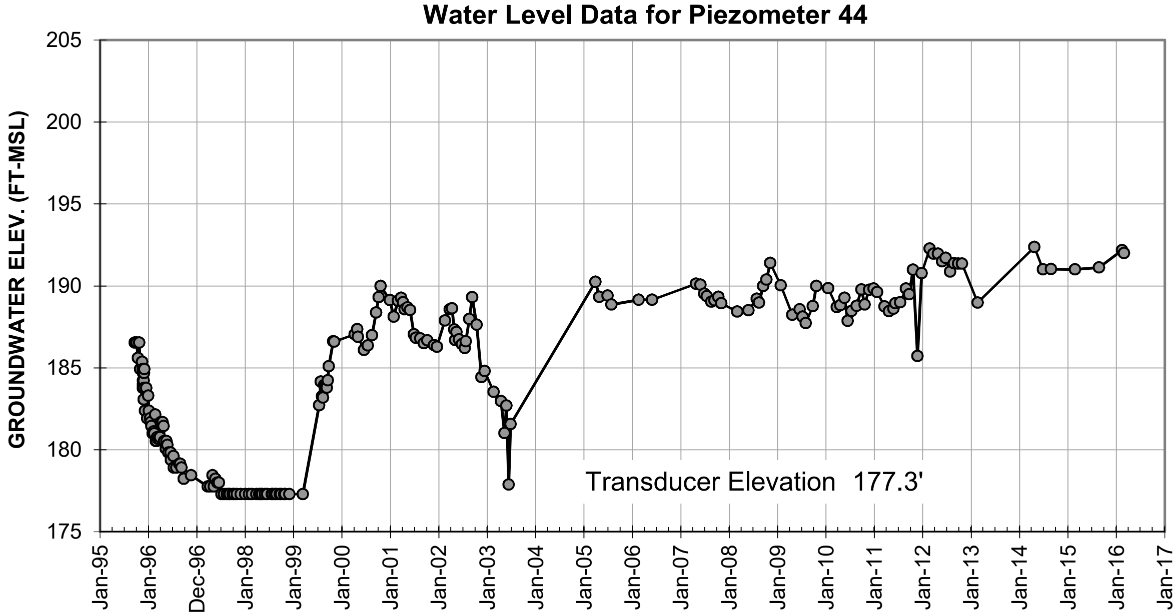


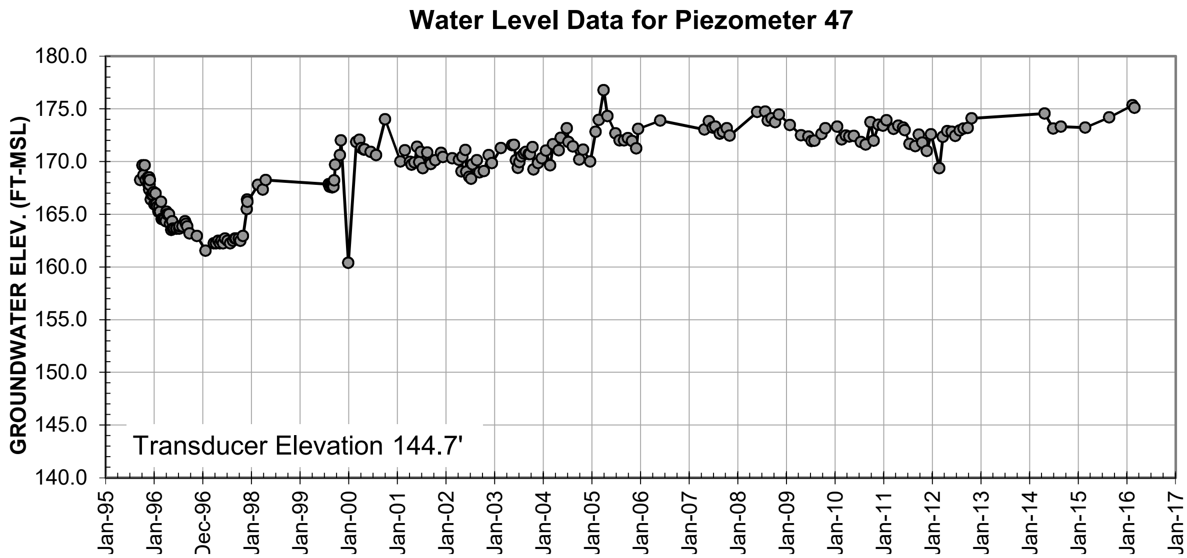
ATTACHMENT C
Site 23/D Curtain Drains

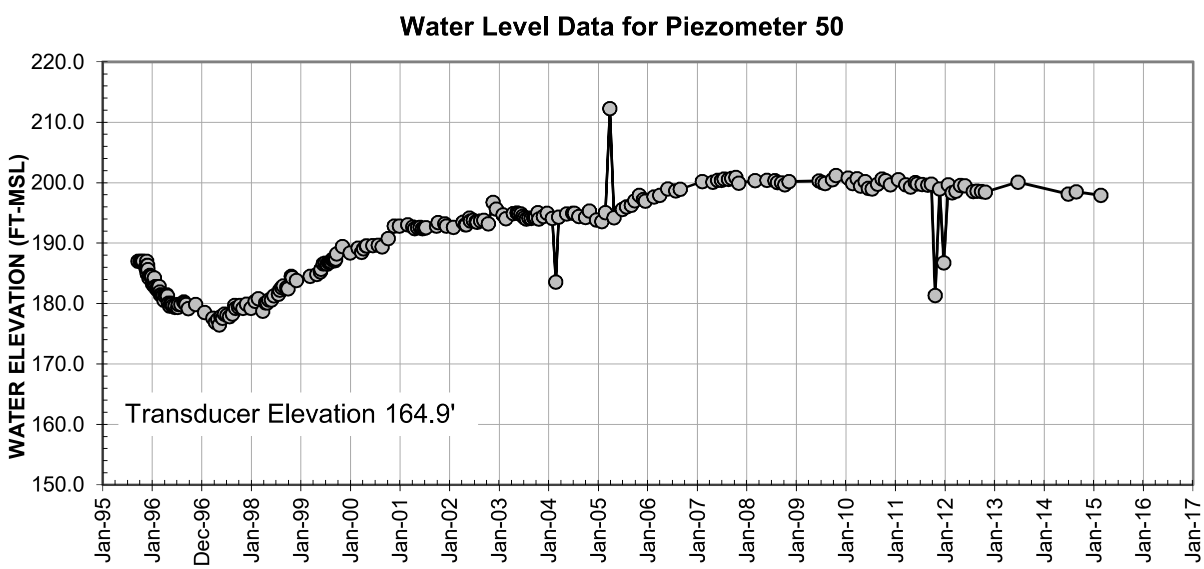


ATTACHMENT D

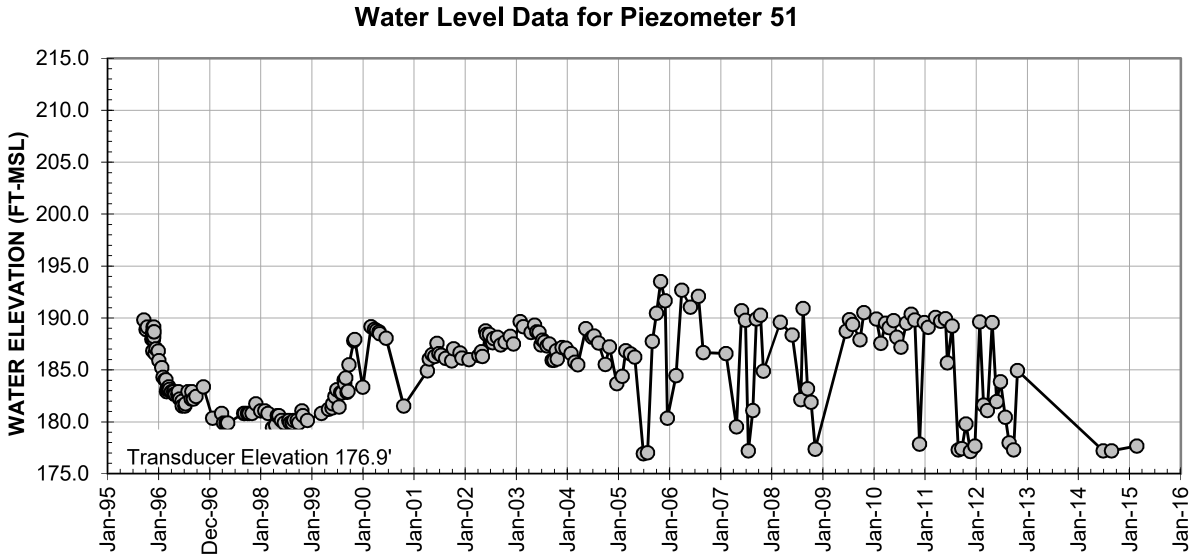
Piezometer Data at the TDF

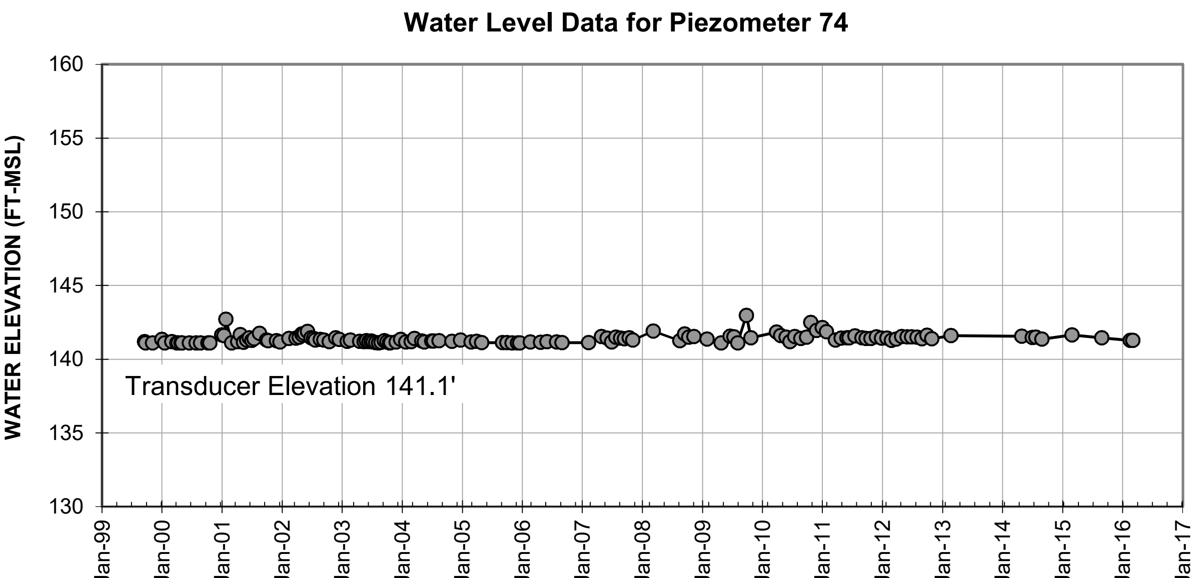


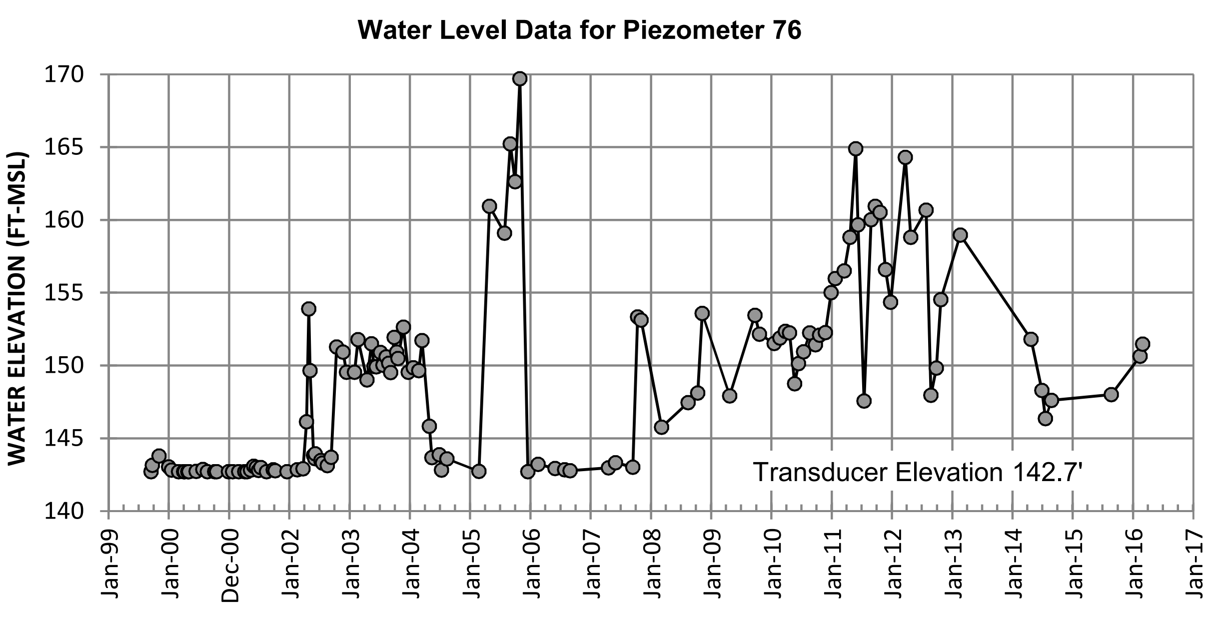




ATTACHMENT D
Piezometer Data at the TDF







CLIENT : **Hecla Greens Creek Mining Company**
PROJECT : **HGCMC - WMP Samples**
SGS Project # : **08123**
TEST : **Modified Acid-Base Accounting with Siderite Correction**
Date : **August 29, 2016**

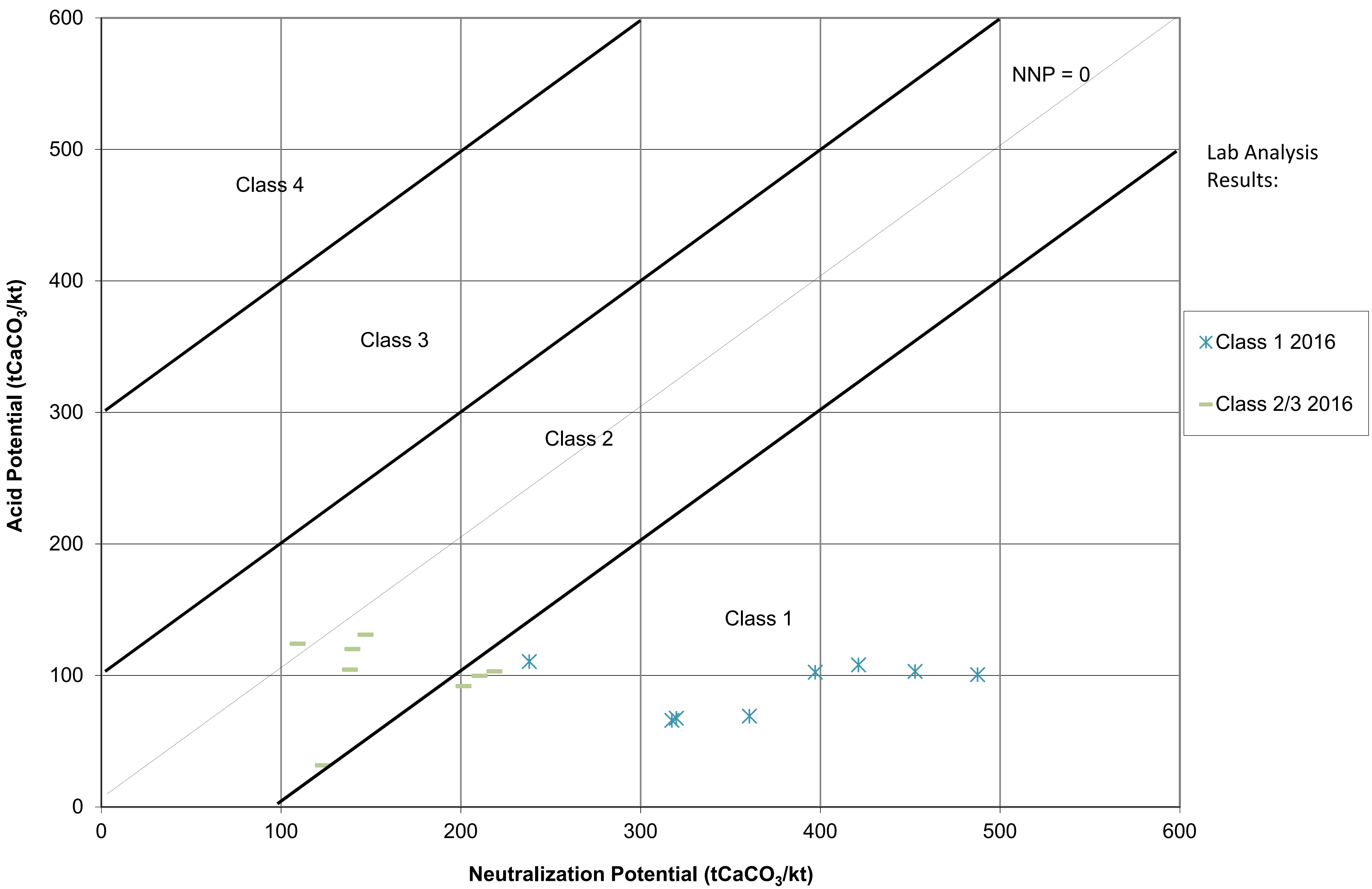
Sample ID	**Paste pH**	**S(T) %**	**S(SO4) %**	**S(S-2) %**	**AP**	**Modified NP**	**Net Modified NP**	**Fizz Test**
Method Code	Sobek	CSA06V	CSA07V	Calc.	Calc.	Siderite Corr.	Calc.	Sobek
LOD	0.20	0.005	0.01	#N/A	#N/A	0.5	#N/A	#N/A
23C1-033016-1	7.98	2.27	0.11	2.16	67.5	319.9	252.4	Moderate
23C1-033016-2	7.89	2.22	0.11	2.11	65.9	317.4	251.5	Moderate
23C3-033016-1	8.28	4.12	0.15	3.97	124.1	109.3	-14.8	Moderate
23C3-033016-2	8.30	4.38	0.19	4.19	130.9	147.0	16.1	Moderate
23C1-062016-1	7.93	5.07	1.53	3.54	110.6	238.1	127.5	Moderate
23C1-062016-2	7.92	2.47	0.26	2.21	69.1	360.5	291.4	Moderate
23C3-062016-1	7.94	1.17	0.16	1.01	31.6	123.3	91.7	Moderate
23C3-062016-2	7.98	3.37	0.43	2.94	91.9	201.5	109.6	Moderate
Duplicate								
23C1-033016-1	7.90					320.5		Moderate
23C3-033016-1			0.16					
23C3-033016-2		4.37						
QC								
GTS-2A		0.335						
RTS-3A			1.45					
NBM-1						51.7		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 4, 2017**

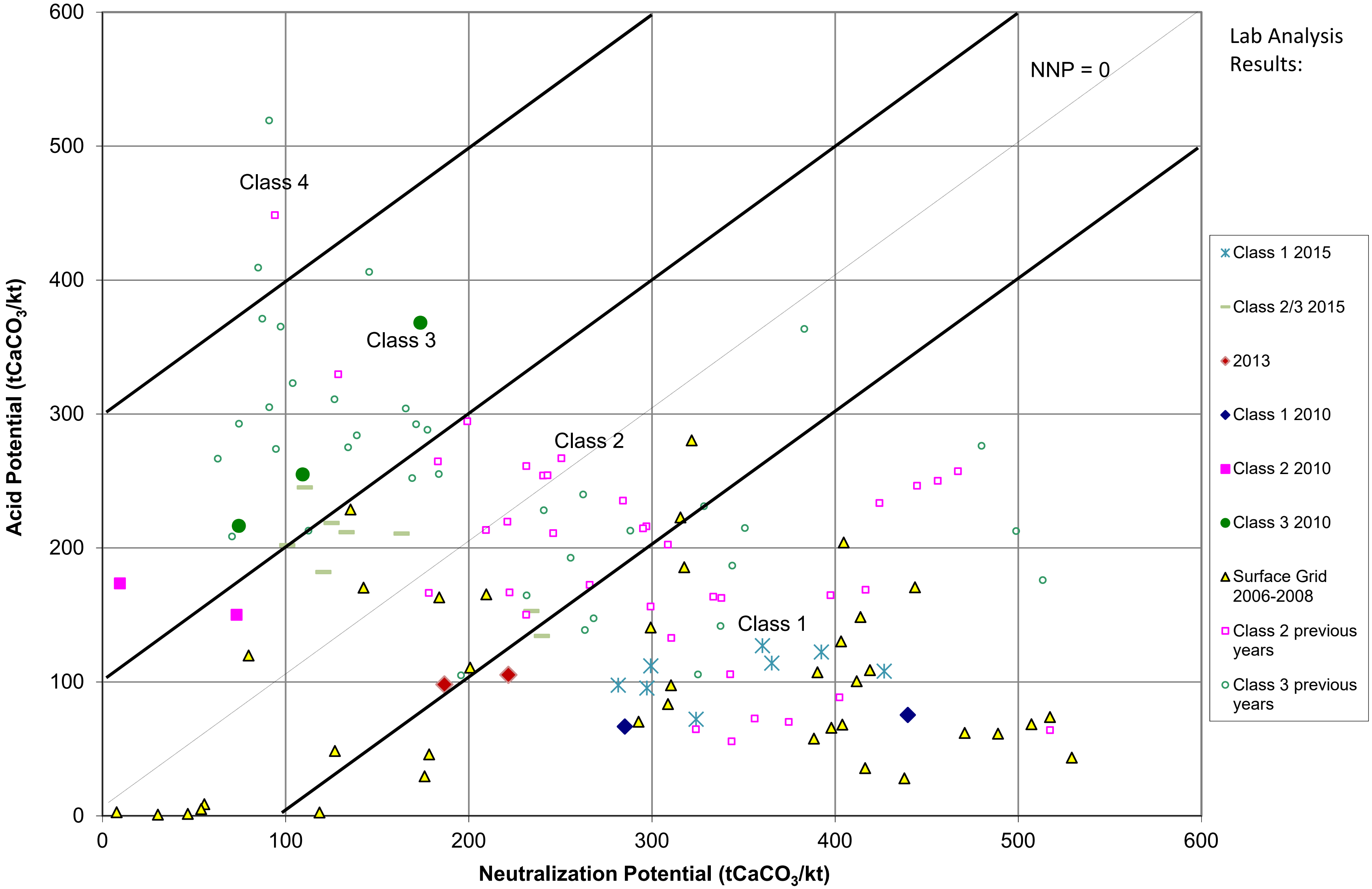
Sample ID	Paste pH	S(T) %	S(SO4) %	S(S-2) %	AP	Modified NP	Net Modified NP	Fizz Test
Method Code	Sobek	CSA06V	CSA07V	Calc.	Calc.	Siderite Corr.	Calc.	Sobek
LOD	0.20	0.005	0.01	#N/A	#N/A	0.5	#N/A	#N/A
23C1-091316-1	8.03	3.48	0.2	3.28	102.5	397.2	294.7	Moderate
23C1-091316-2	8.23	3.61	0.15	3.46	108.1	421.2	313.1	Moderate
23C3-091316-1	9.66	3.39	0.2	3.19	99.7	210.4	110.7	Moderate
23C3-091316-2	8.54	3.51	0.21	3.3	103.1	218.7	115.6	Moderate
23C1-111416-1	8.57	3.42	0.12	3.3	103.1	452.7	349.6	Moderate
23C1-111416-2	8.73	3.32	0.1	3.22	100.6	487.5	386.9	Moderate
23C3-111416-1	9.15	3.68	0.34	3.34	104.4	138.3	33.9	Moderate
23C3-111416-2	8.40	3.96	0.12	3.84	120.0	139.7	19.7	Moderate
T1-091316	7.39	14.9	1.58	13.32	416.3	237.0	-179.3	Moderate
T2-091316	6.61	13.3	1.58	11.72	366.3	248.1	-118.2	Moderate
T3-111616	7.77	15.8	1.36	14.44	451.3	261.3	-190.0	Moderate
T4-111616	8.22	15.9	1.47	14.43	450.9	252.5	-198.4	Moderate
T5-111616	7.93	14.6	1.24	13.36	417.5	300.7	-116.8	Moderate
T6-111616	7.84	14.6	0.97	13.63	425.9	320.2	-105.7	Moderate
Duplicate								
23C1-091316-1	8.09					399.0		Moderate
23C3-111416-1		3.63						
T5-111616			1.2					
QC								
GTS-2A		0.33						
RTS-3A			1.32					
NBM-1						51.7		Slight
Certified Values		0.341	1.34			49.6		Slight
Tolerance +/-		0.030	0.17			4.5		

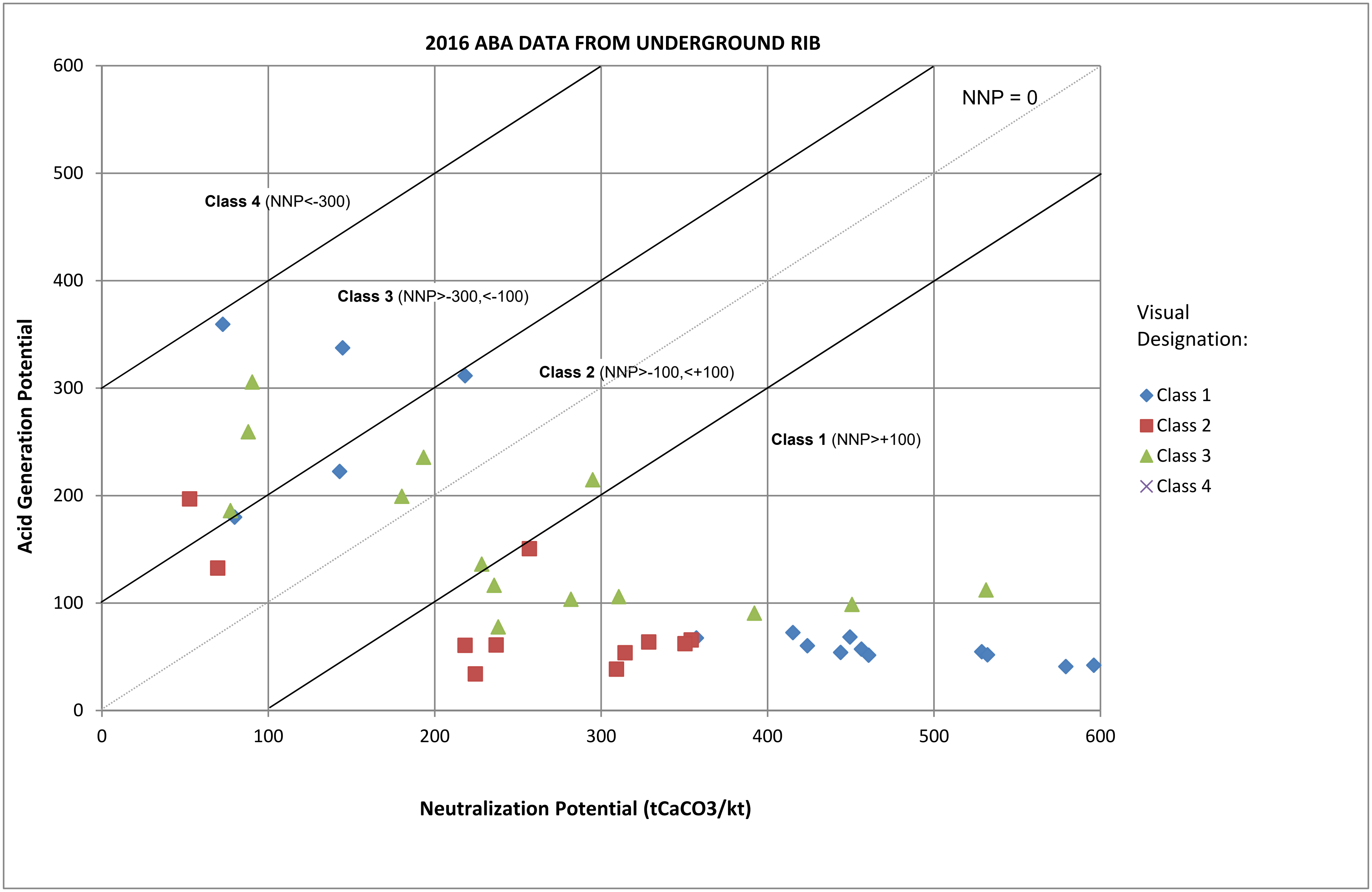
Note:
AP = Acid potential in tonnes CaCO3 equivalent per 1000 tonnes of material. AP is determined from the calculated sulphide sulphur content: S(T) - S(SO4).
NP = Neutralization potential in tonnes CaCO3 equivalent per 1000 tonnes of material. NET Modified NP = Modified NP - AP Sulphate Sulphur is determined by Sodium Carbonate Leach with S by ICP Finish

ATTACHMENT E: SITE 23 ABA CURRENT YEAR DATA

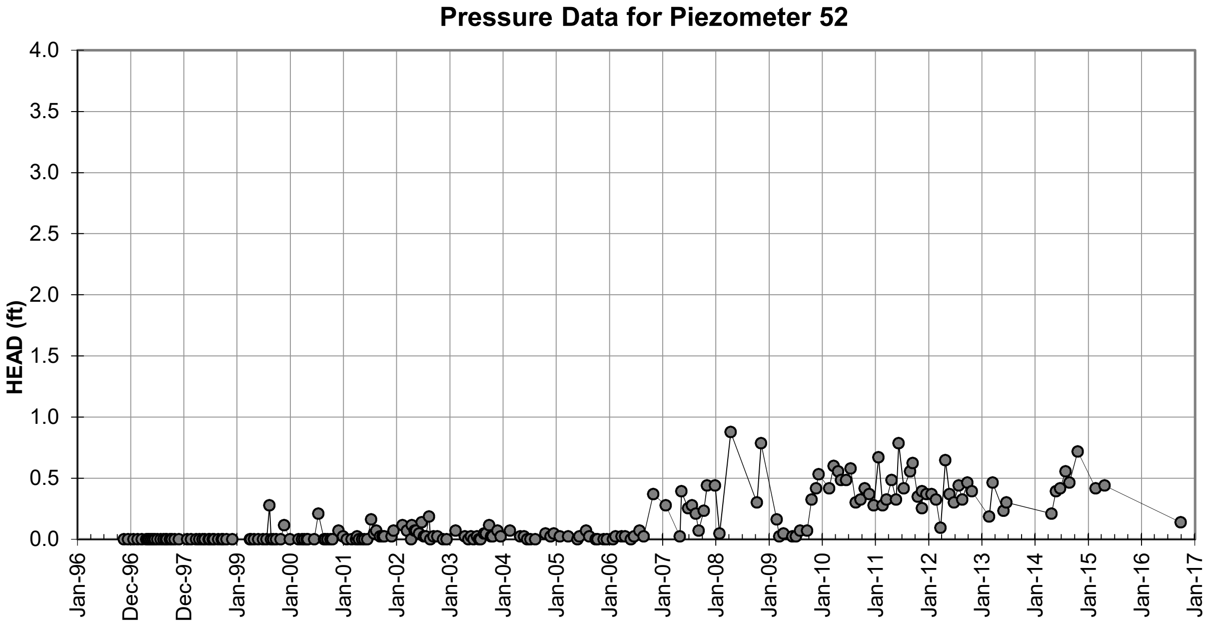


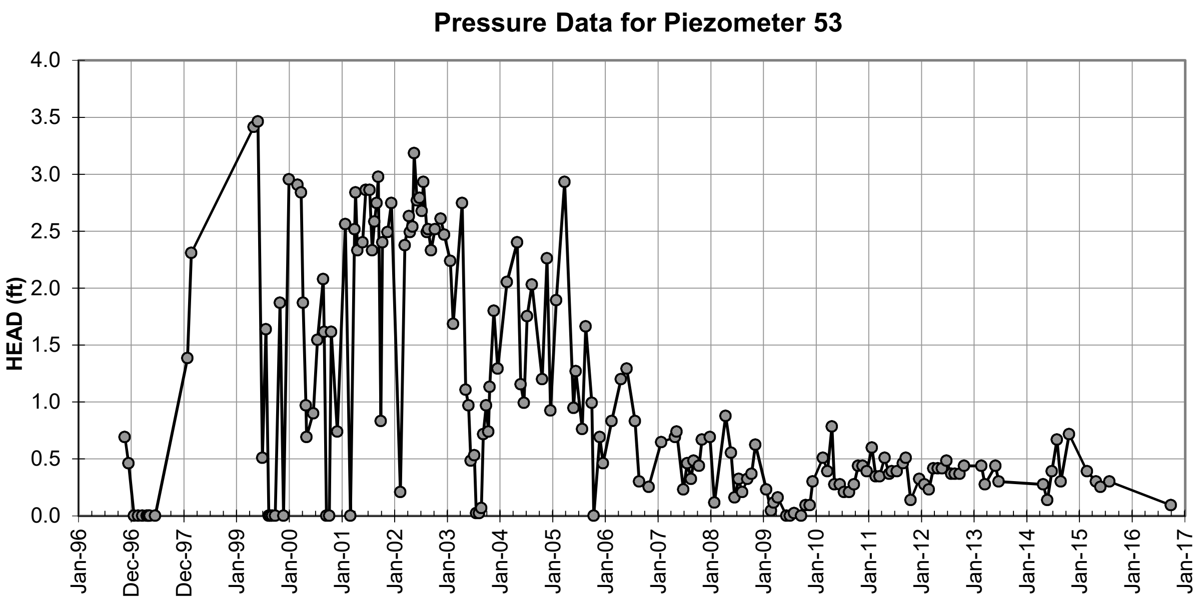
ATTACHMENT E: SITE 23 ABA HISTORICAL DATA

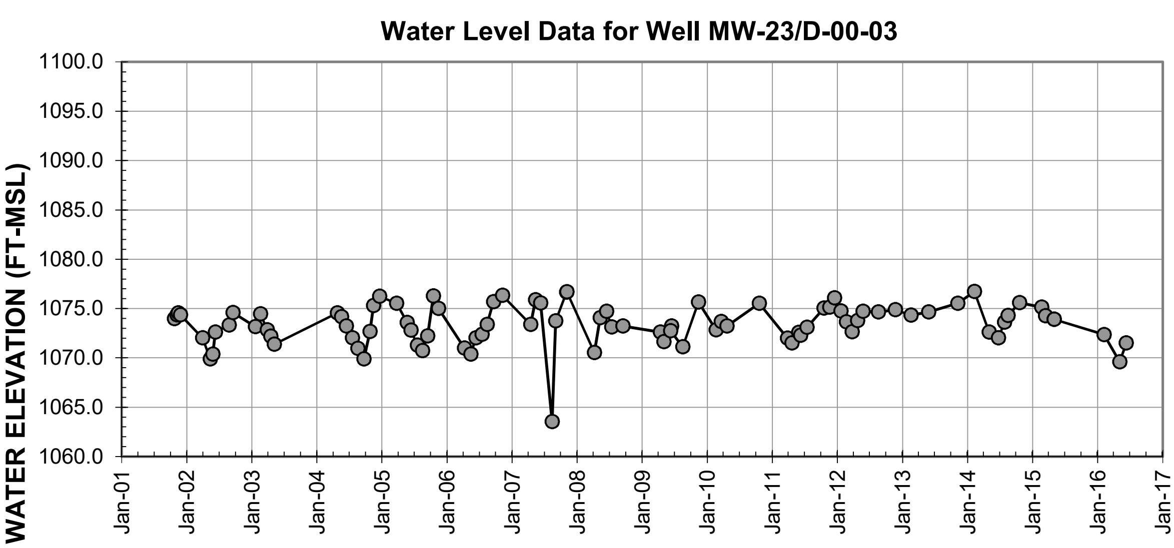



2016 ABA DATA FROM UNDERGROUND RIB
NNP = 0
Class 4 (NNP<-300)
Class 3 (NNP>-300,<-100)
Class 2 (NNP>-100,<+100)
Class 1 (NNP>+100)
Acid Generation Potential
Neutralization Potential (tCaCO3/kt)
0
100
200
300
400
500
600
Visual Designation:
Class 1
Class 2
Class 3
Class 4

ATTACHMENT F
Water Level Data at Site 23 / D

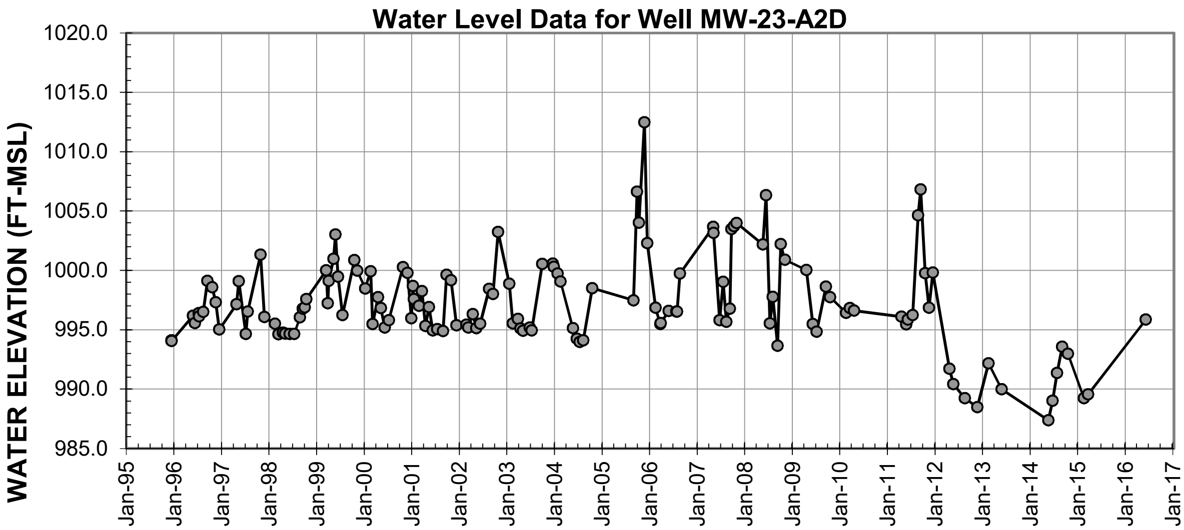


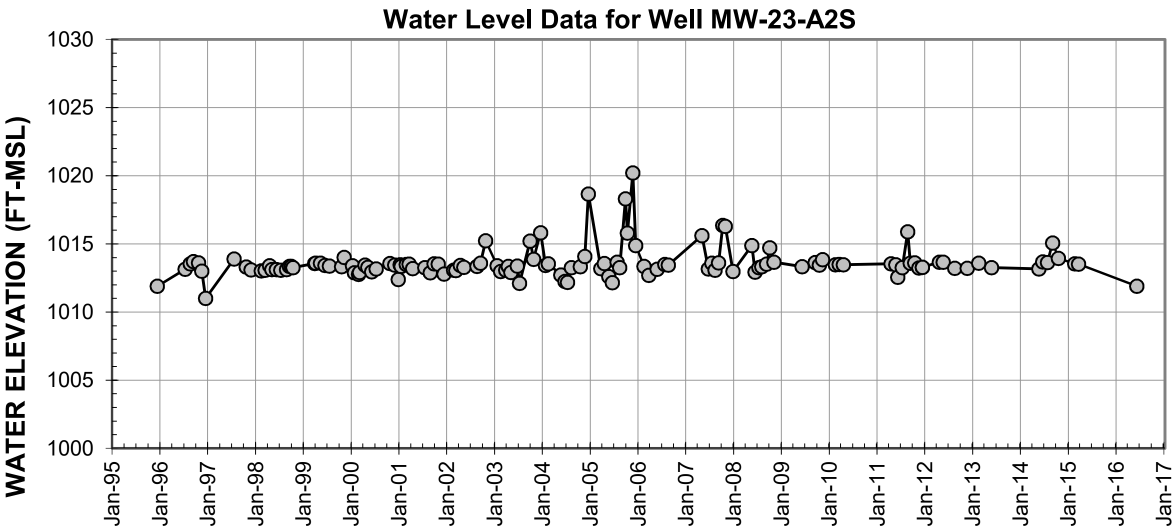


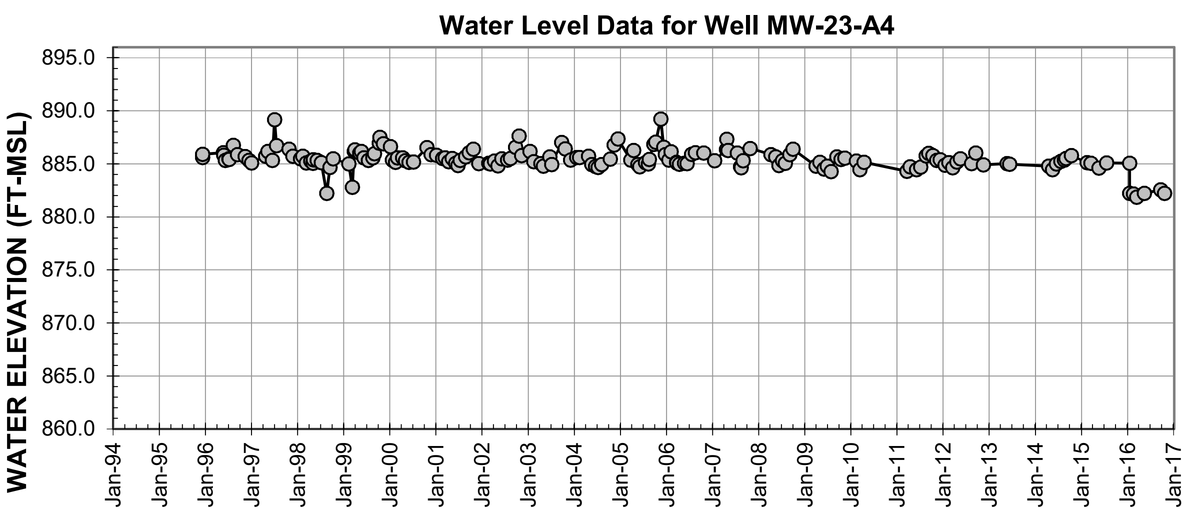


ATTACHMENT F

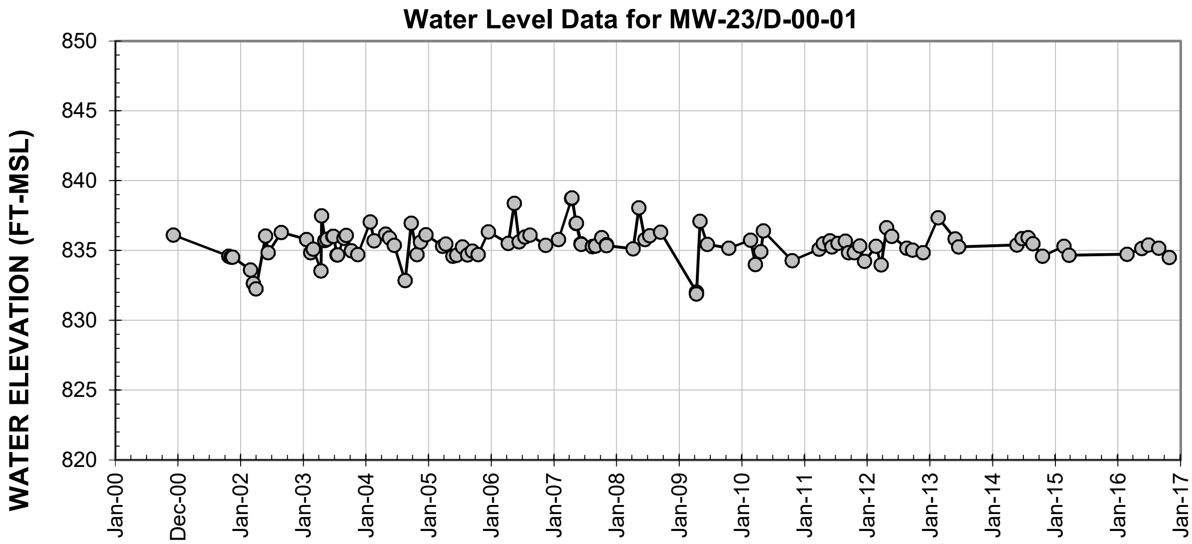
Water Level Data at Site 23 / D

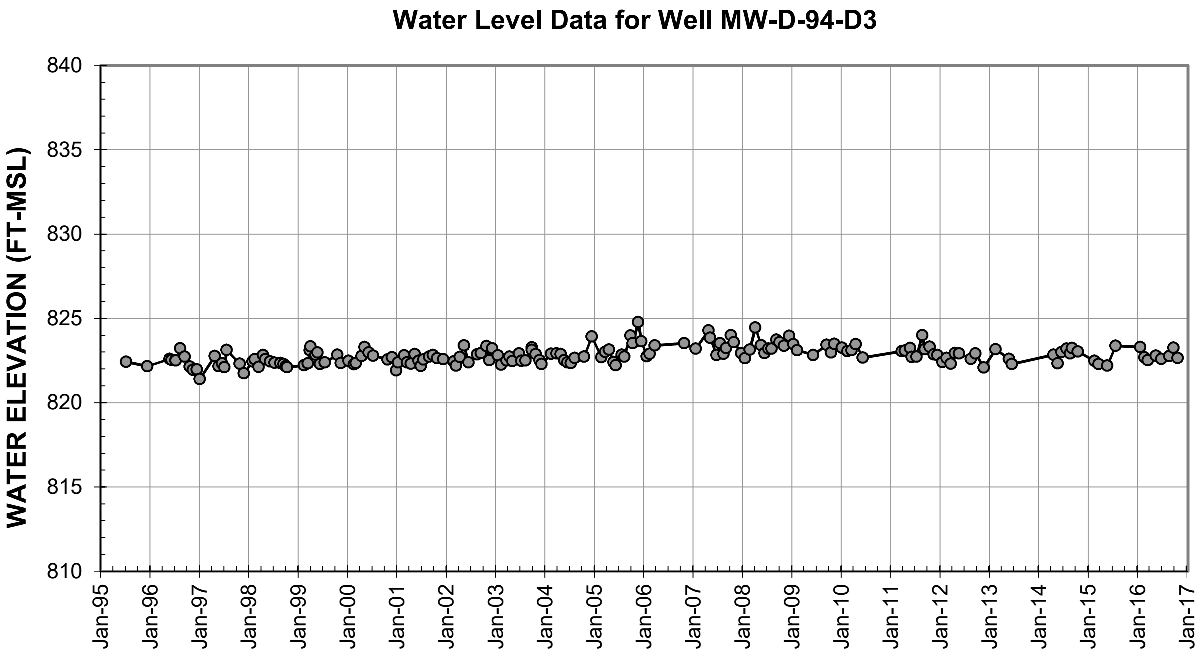


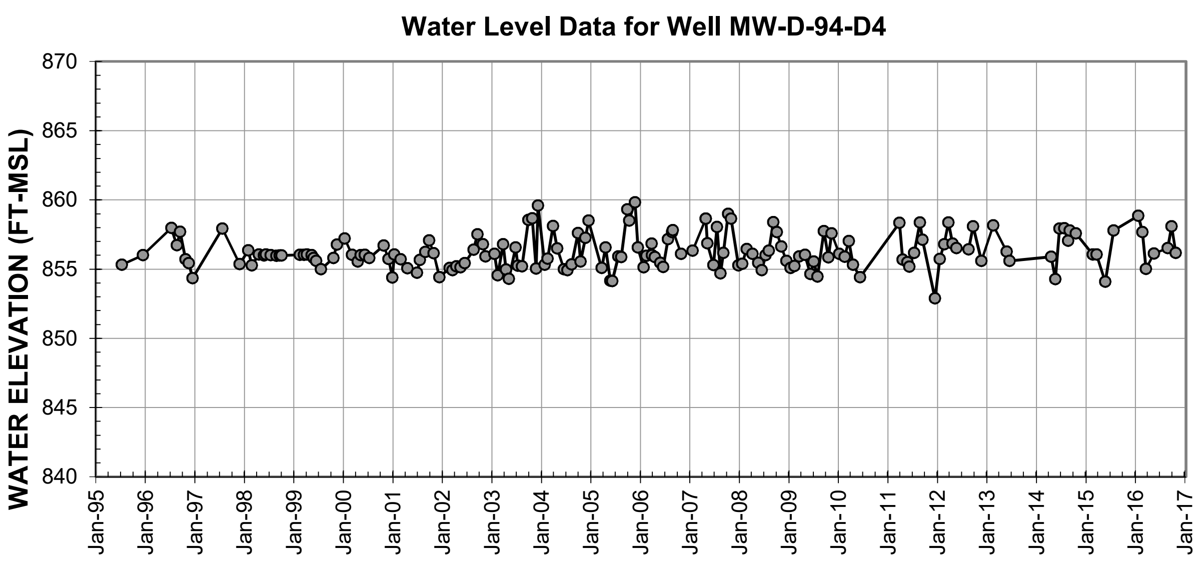




ATTACHMENT F
Water Level Data at Site 23 / D

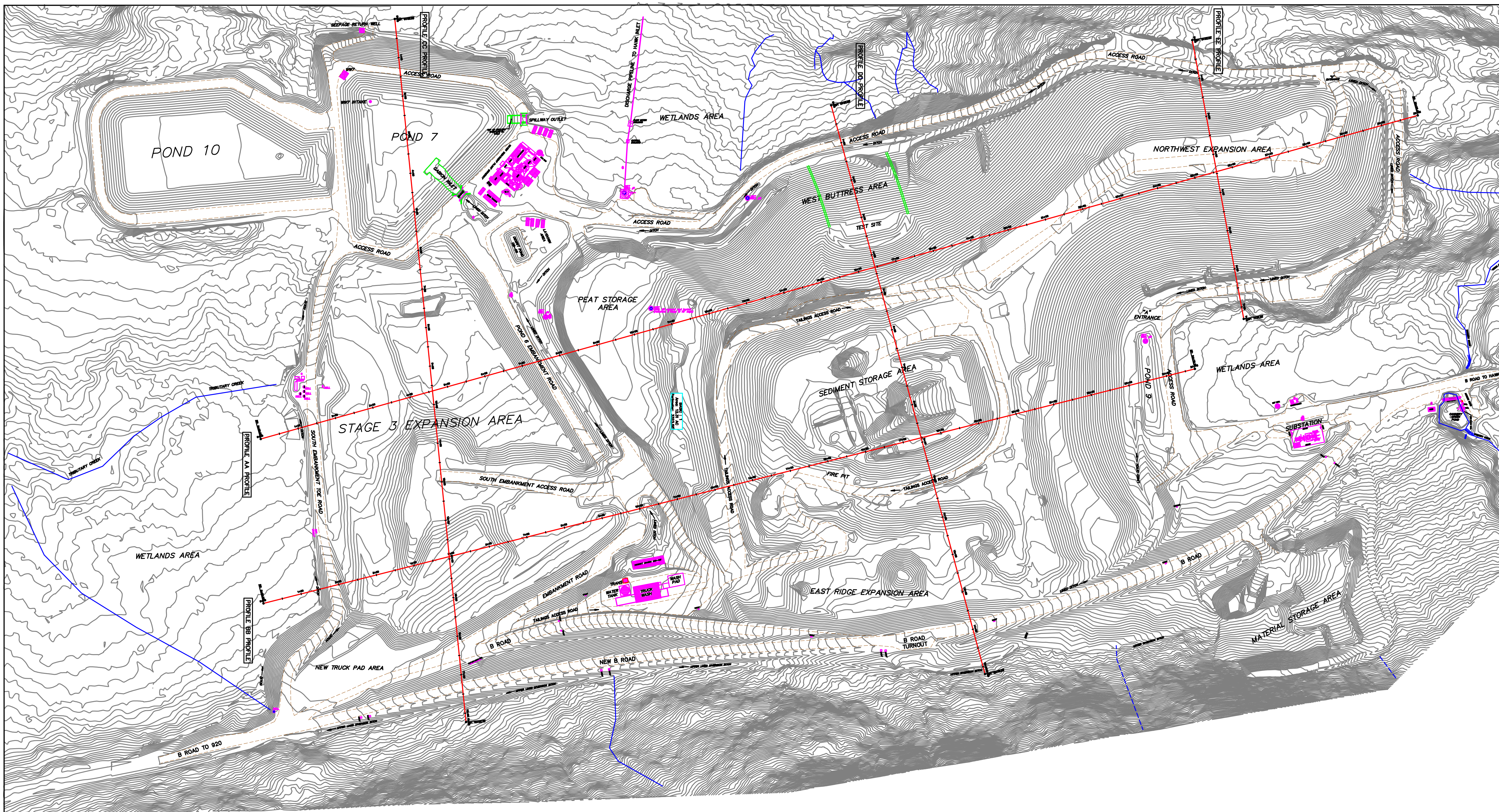






Attachment G:

TDF Layout



HECLA GREENS CREEK MINING CO.

P.O. BOX 32199 JUNEAU, ALASKA 99803

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

LEGEND:

BUILDINGS	magenta line
WATER UTILS	blue line
ROADS	brown line
ELECT UTILS	red line
FUEL UTILS	yellow line
LINED DITCHES	green line

SYMBOLS:

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

FIRE WATER	WF-767-
POTABLE WATER	WP-768-
POTABLE WATER (HOT)	WPH-768-
PROCESS WATER	WPR-170-
FRESH WATER	WFR-170-
HOT WATER SUPPLY	WHS-768-
HOT WATER RETURN	WHR-768-
TAILINGS	TA-160-
SEWAGE FORCE MAIN	DSW-012-
SANITARY SEWER	DSW-011-
PLANT AIR	AP-170-
HIGH PRESSURE SPRAY WATER	WR-170-

MH MANHOLE; C.O. CLEANOUT; GATE VALVE; GATE VALVE C/W POST INDICATOR; FIRE HYDRANT

GRAPHIC SCALE: 1" = 100'

0 20 100

TRUE

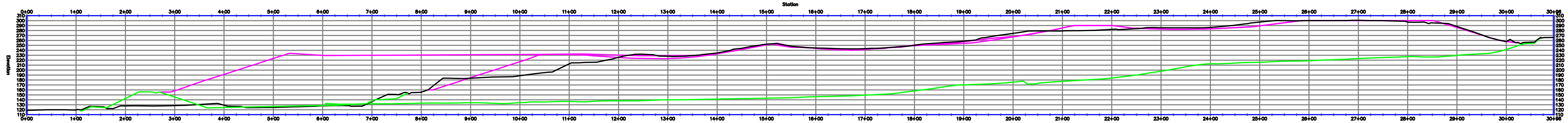
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF. ----

TITLE: Tailings Asbuilt

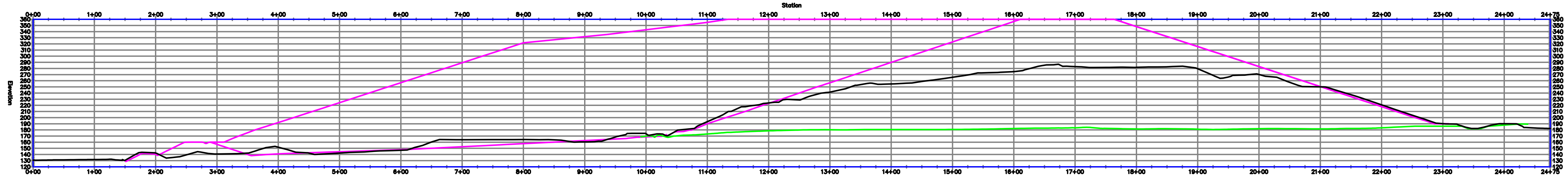
SHEET: 12/31/16

SHEET: 1 OF 1

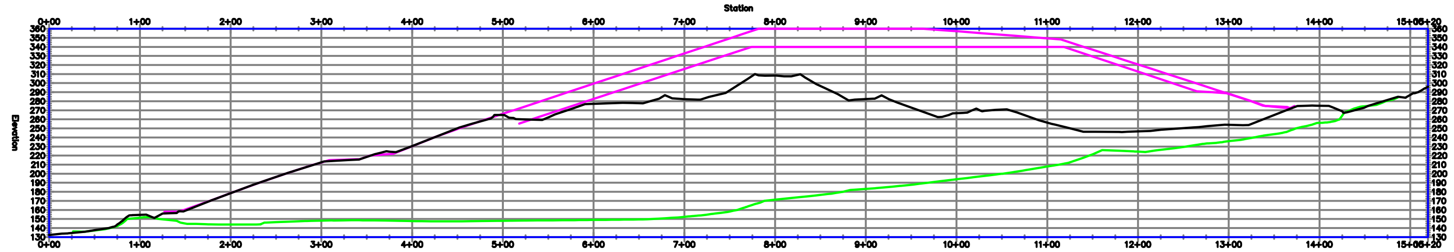
PROFILE AA PROFILE



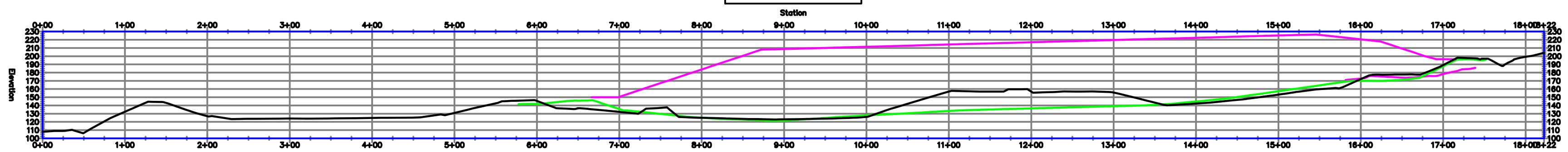
PROFILE BB PROFILE



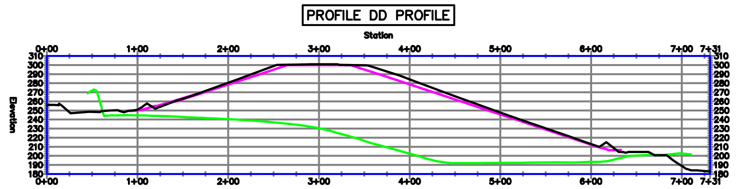
PROFILE CC PROFILE



PROFILE EE PROFILE



PROFILE DD PROFILE



LEDGEND:
ORIGINAL GROUND
EXISTING GROUND
STAGE 2&3 DESIGN

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

DATE: 12-31-16
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

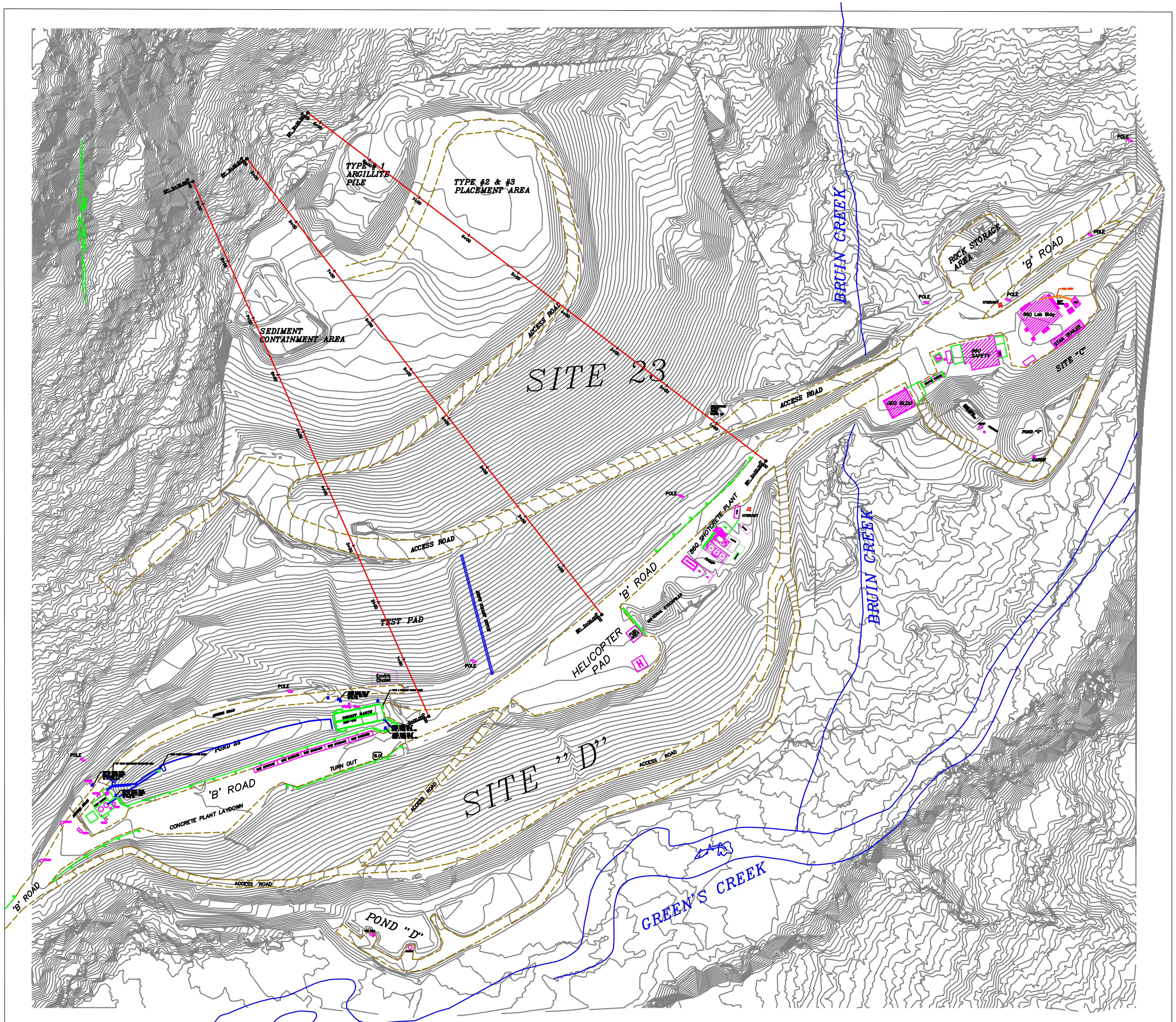
TITLE:
2016 TAILINGS YEAR END PROFILE VIEWS

0 20 50 100

SHEET: 1 OF 1

Attachment H:

Site 23 Layout



HECLA GREENS CREEK MINE

ADMIRALTY ISLAND, ALASKA

LEGEND

Ⓐ CHEMICAL TANK
㉔ PETROLEUM TANK
TO– TRANSFORMER
ⓈⒸ SPILL RESPONSE

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

SYMBOLS:
FIRE HYDRANT
BOLLARDS
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

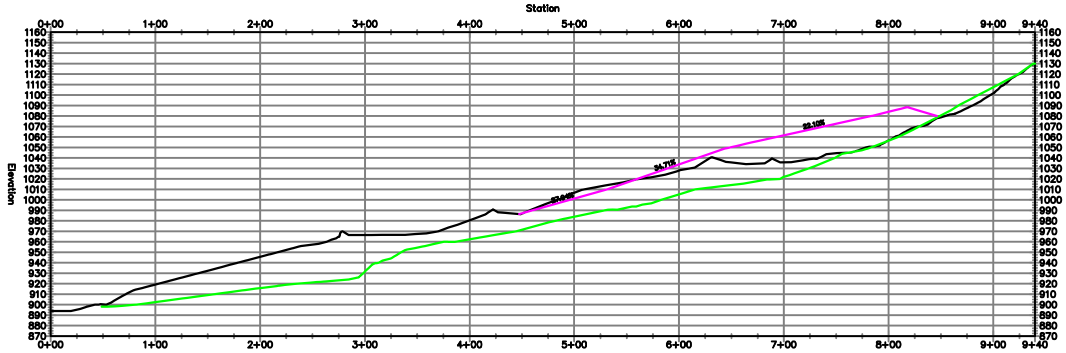
DRAWING BY: Shelby Edwards
DESIGN BY: ----
REVIEWED BY: ----
PROJ OR REF. ----

SITE 23 Asbuilt

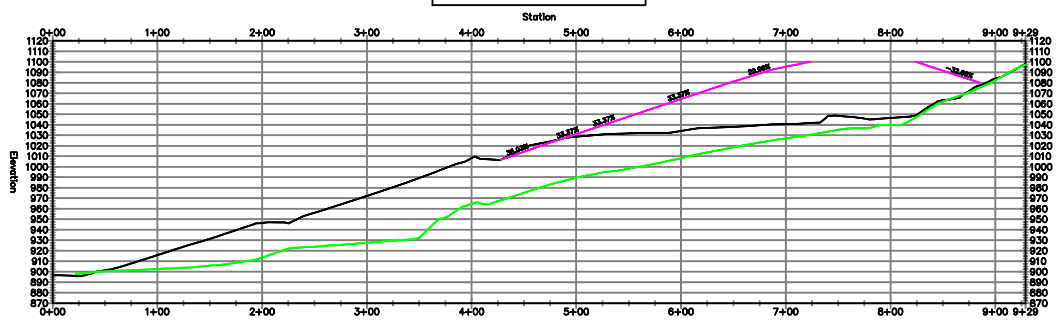
12/31/16

SHEET: 1 OF 1

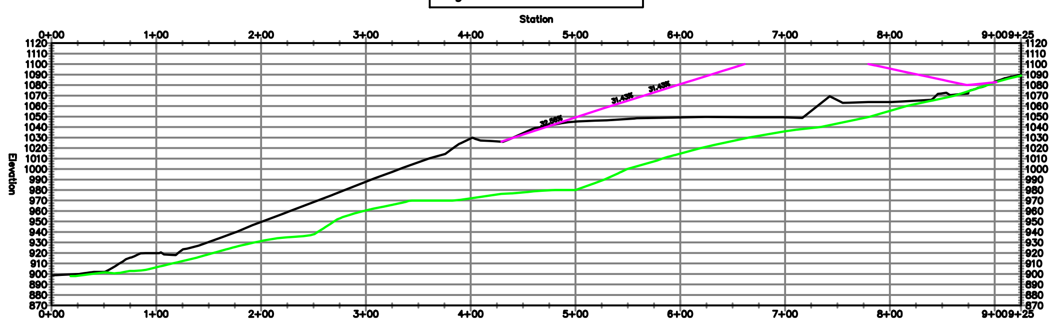
Alignment – AA PROFILE



Alignment – BB PROFILE



Alignment – CC PROFILE



VOLUME(CUBIC YARDS) REMAINING IN SITE 23 AS OF 12/31/16

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
vol fg122916 - 3to1 design	1.000	1.000	221697.05 Sq. Ft.	4536.57 Cu. Yd.	140962.16 Cu. Yd.	136425.59 Cu. Yd.<Fill>
Totals			221697.05 Sq. Ft.	4536.57 Cu. Yd.	140962.16 Cu. Yd.	136425.59 Cu. Yd.<Fill>

LEDGEND:
ORIGINAL GROUND
EXISTING GROUND
STAGE 2&3 DESIGN

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

Hecla MINING COMPANY

DATE: 12–31–16
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:
2016 SITE 23 YEAR END PROFILE VIEWS

SHEET: 1 OF 1

RST Instruments Ltd.

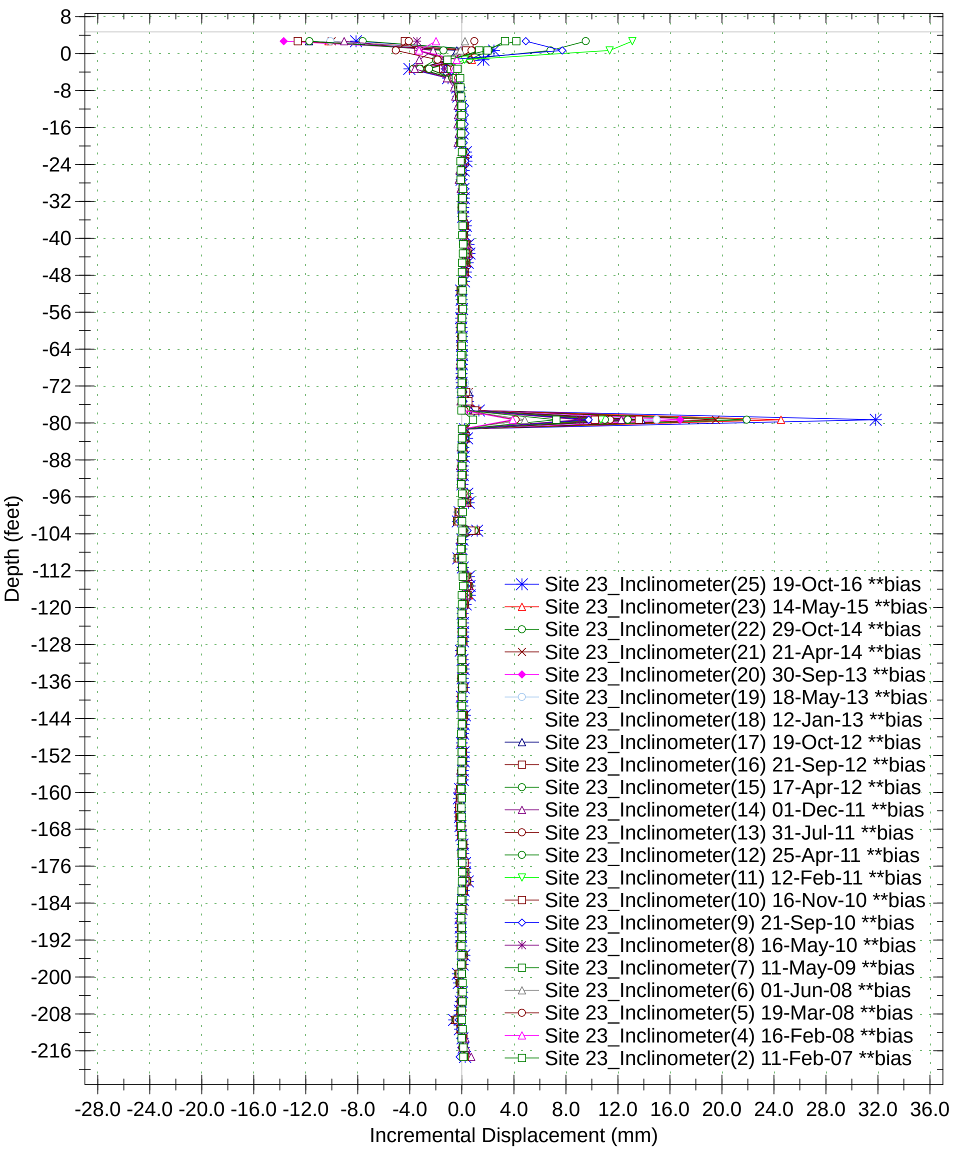
ATTACHMENT I: SITE 23 INCLINOMETER INCREMENTAL DISPLACEMENT

Inclinalysis v. 2.47.5

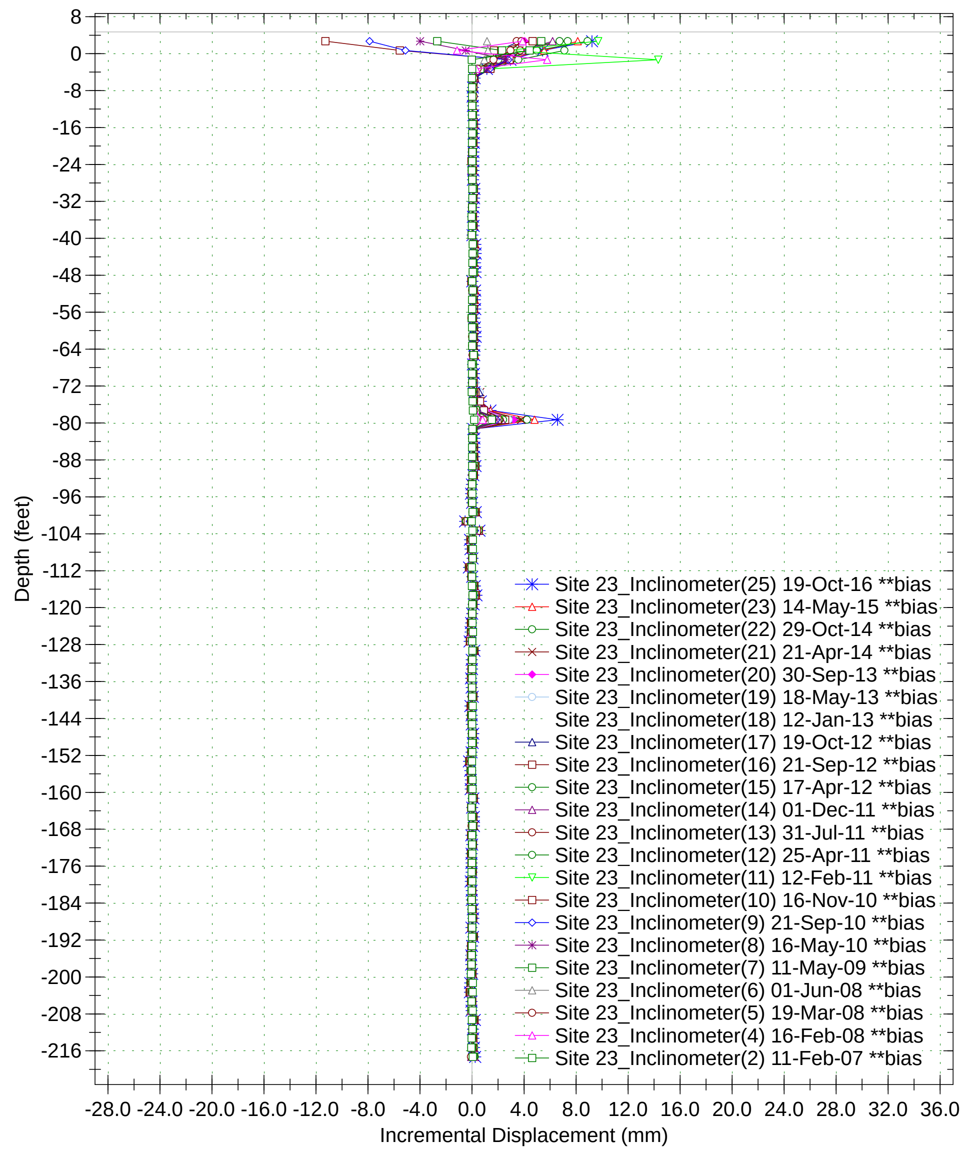
Borehole : Inclinometer
Project : Site 23
Location : IN-23-05-01
Northing : 20671.45 ft
Easting : 17186.42 ft
Collar : 948.84 ft

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

Axis - A



Axis - B



Note: Collar elevation is top of casing, at ~4.7 ft above ground surface.
Top section of casing replaced at joint in July 2011 due to damage. Bias-shift correction by pin of data sets at 150-ft depth (A-B axis).

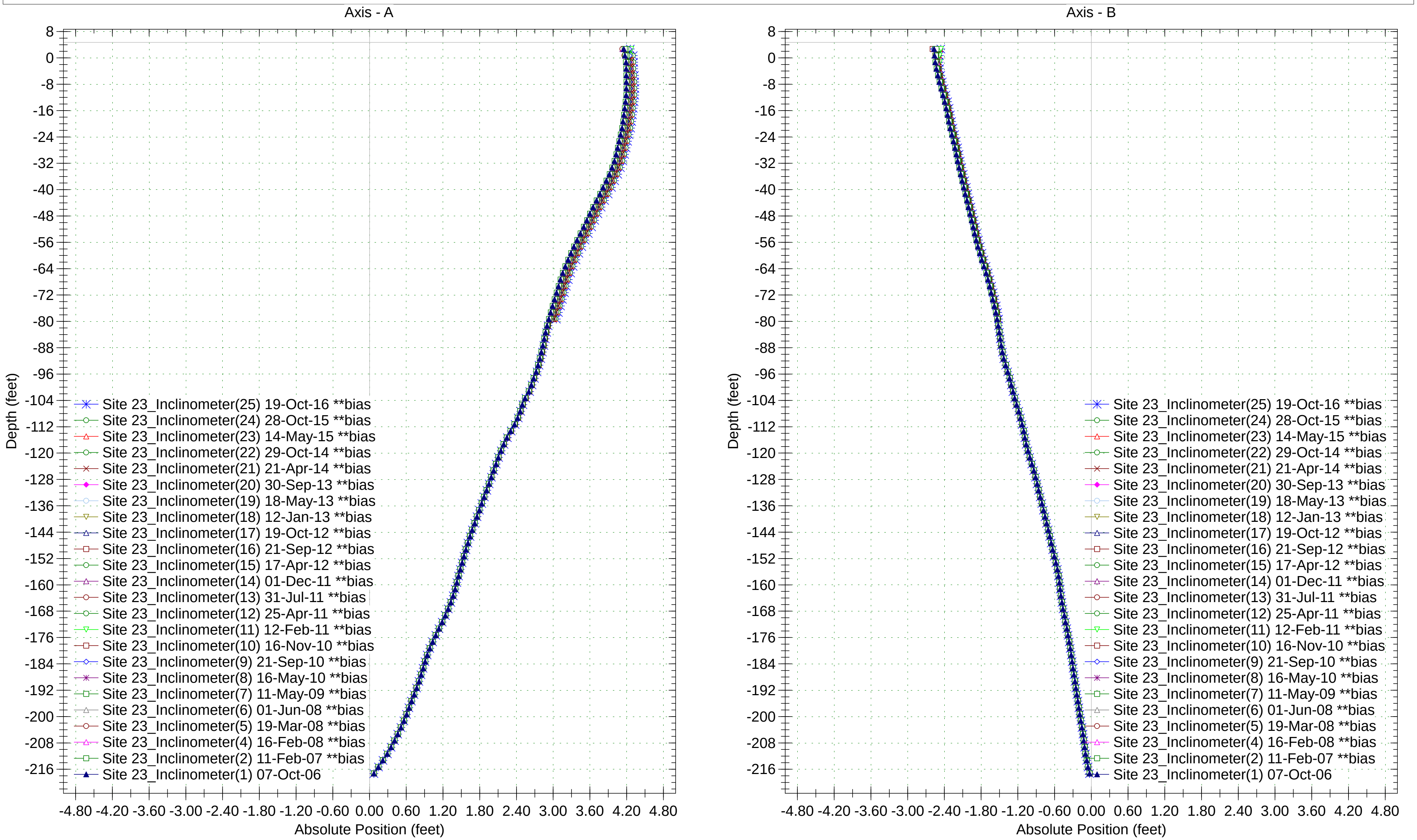
RST Instruments Ltd.

ATTACHMENT I: SITE 23 INCLINOMETER ABSOLUTE 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



Note: Collar elevation is top of casing, at ~4.7 ft above ground surface.
Top section of casing replaced at joint in July 2011 due to damage. Bias-shift correction pinned at 150-ft depth (A-B axis).

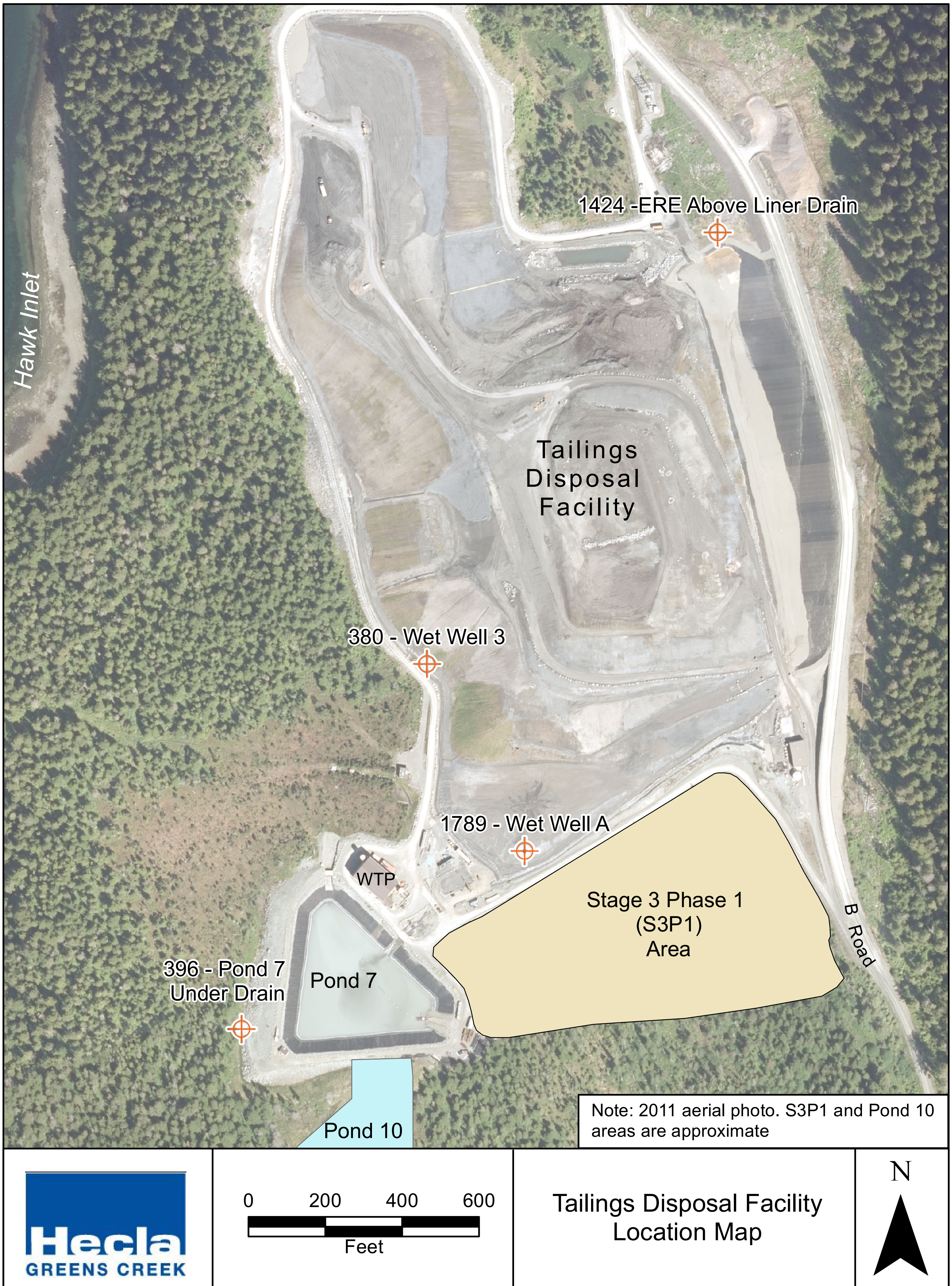
Attachment J:

Monitoring Site Location

Maps

TDF

Site 23



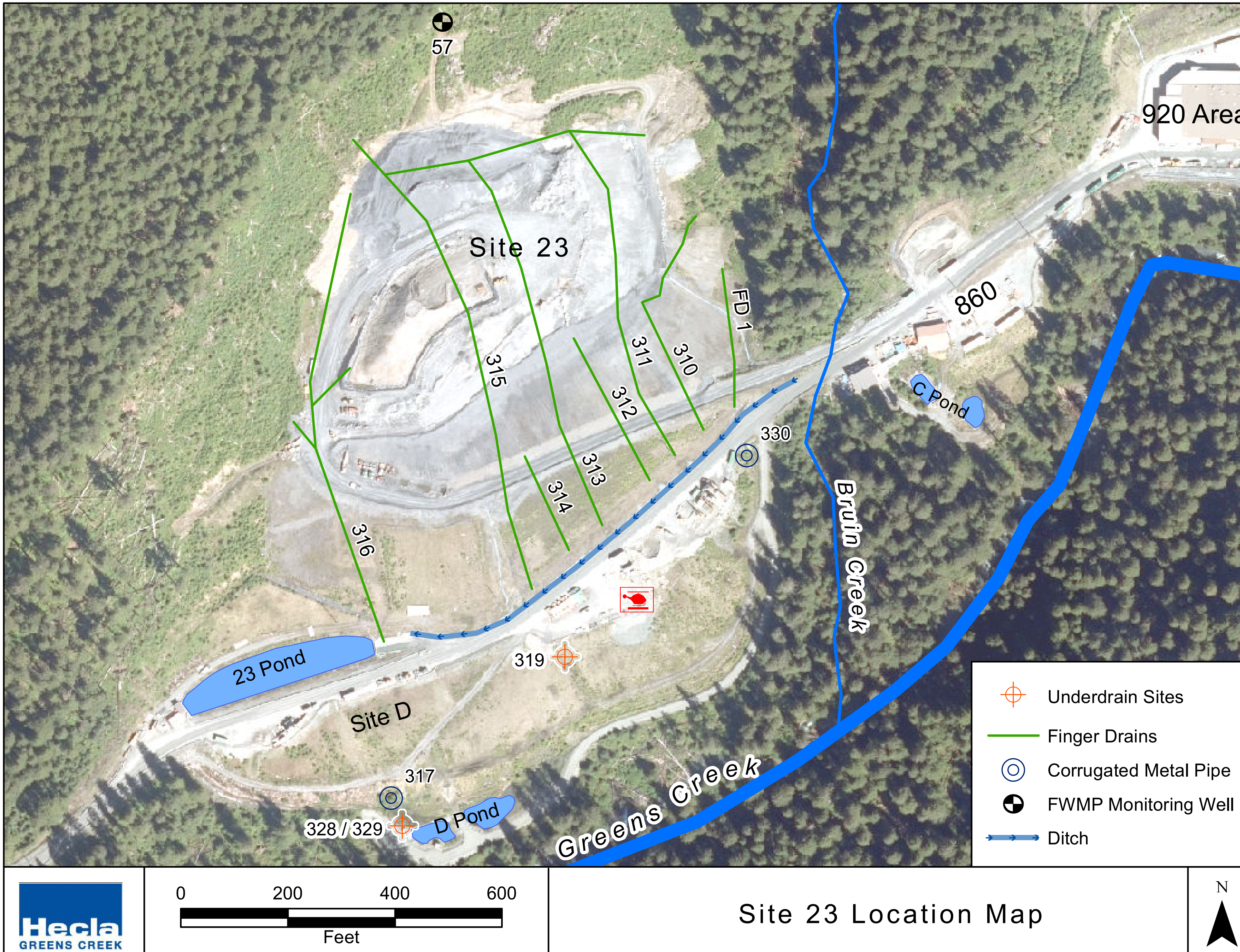
Tailings Disposal Facility Location Map

Hecla
GREENS CREEK

0 225 450 675
Feet

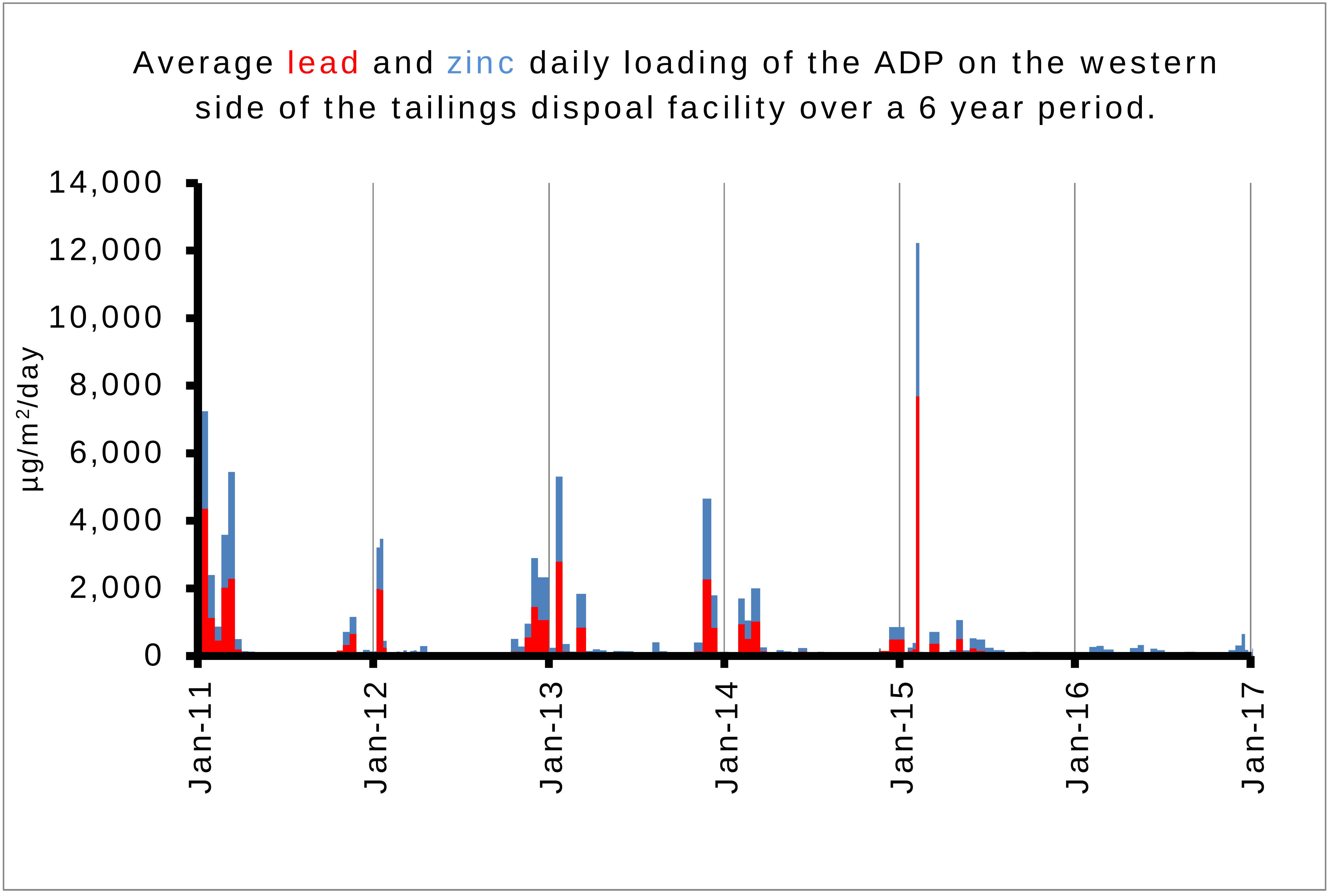
Tailings Disposal Facility Piezometer and ADP Location Map

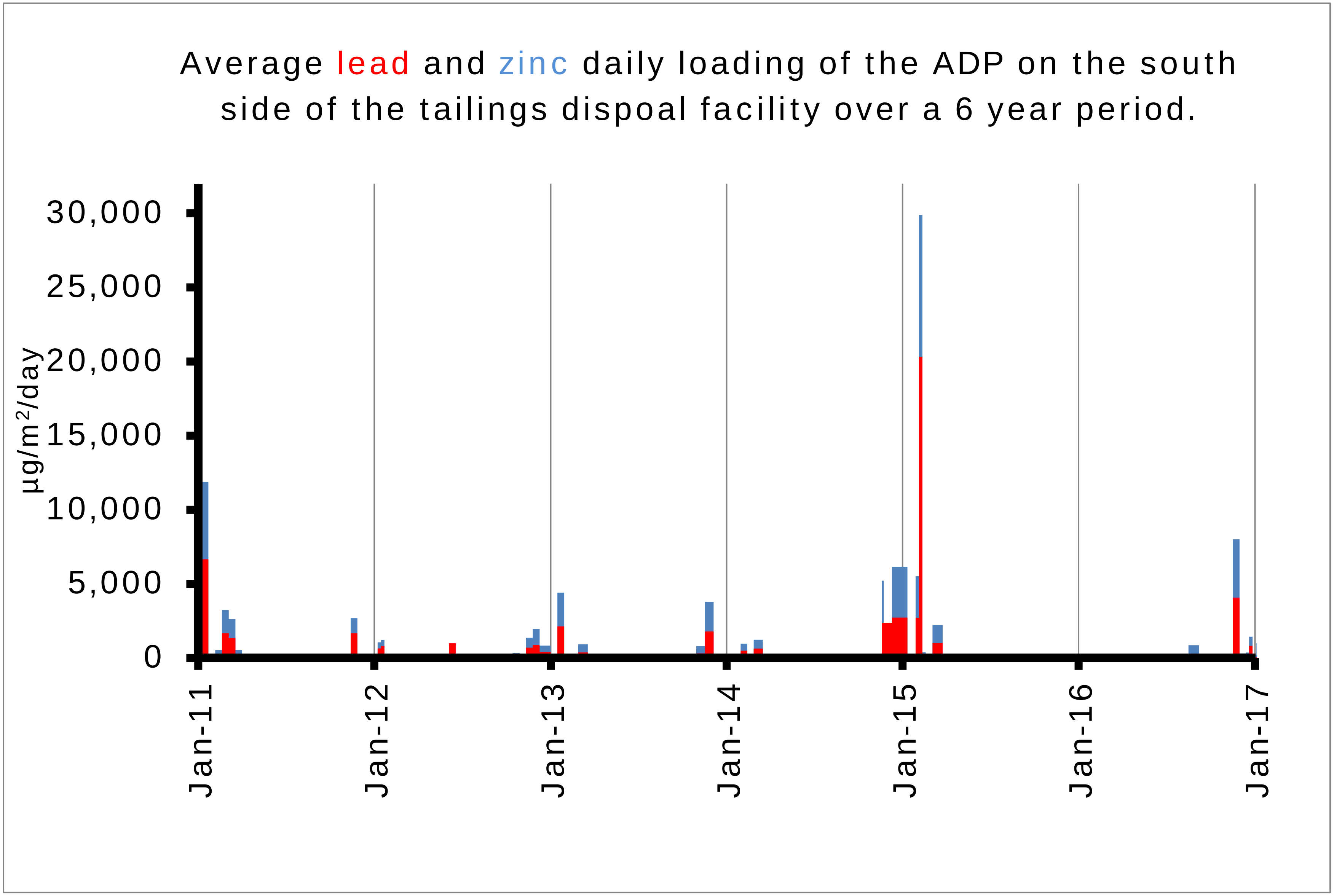
N



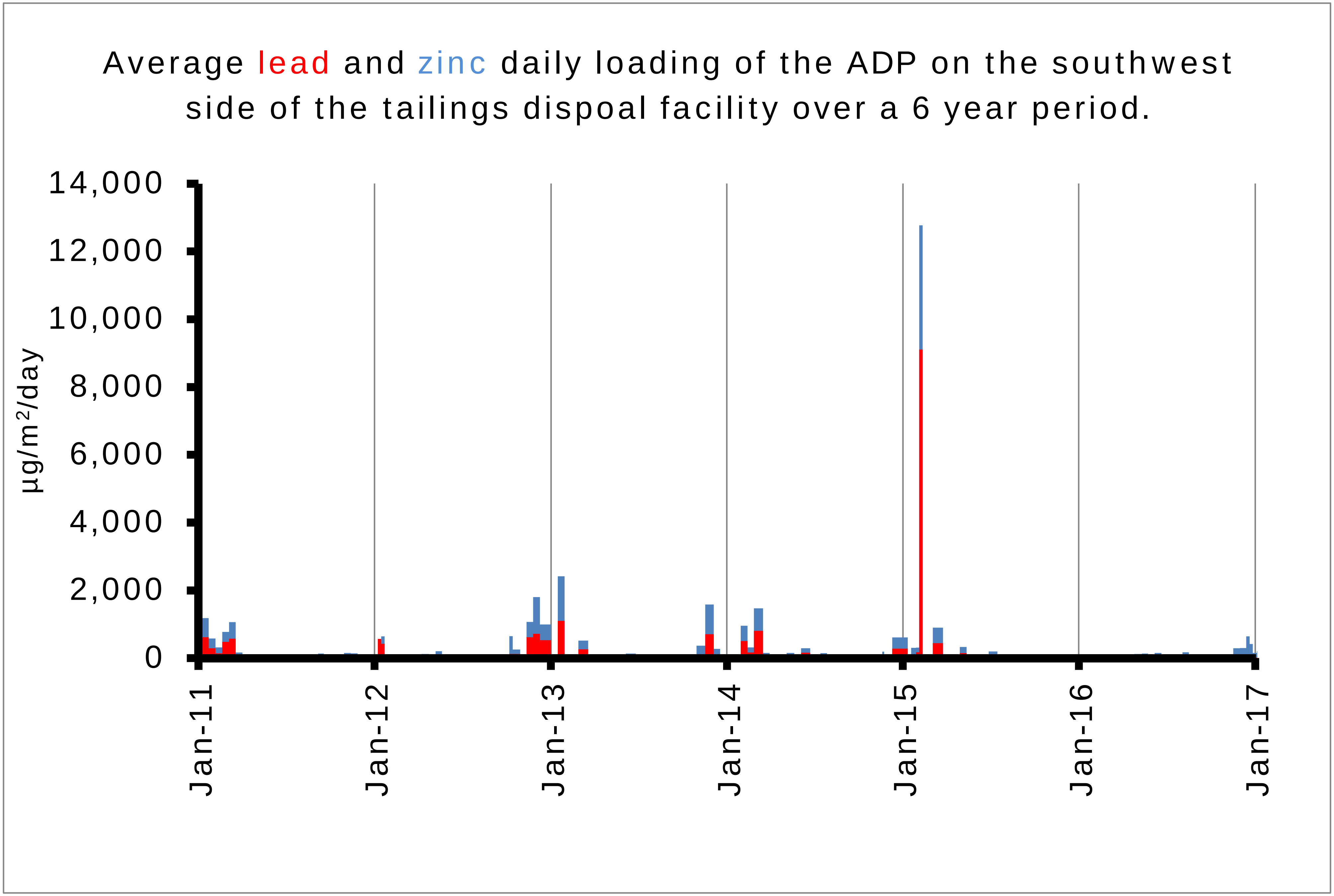
Site 23 Location Map

Note: 2011 aerial photo


Average lead and zinc daily loading of the ADP on the western side of the tailings dispoal facility over a 6 year period.
µg/m²/day
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17



Average lead and zinc daily loading of the ADP on the south side of the tailings dispoal facility over a 6 year period.
µg/m2/day
30,000
25,000
20,000
15,000
10,000
5,000
0
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17


Average lead and zinc daily loading of the ADP on the southwest side of the tailings dispoal facility over a 6 year period.
µg/m2/day
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17