Red Dog Mine

4th Quarter Report & Annual
Waste Management Permit 2016DB0002
Reclamation Plan Approval F20169958

February 11, 2021

Teck

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Introduction

This report has been prepared to fulfill the 4th quarter and annual reporting requirements of Teck Alaska Incorporated (TAK) obligations under the State of Alaska Waste Management Permit No. 2016DB0002 and the Red Dog Mine Reclamation Plan Approval F20169958.

This report addresses Biomonitoring, Permafrost and Sub-permafrost Groundwater Monitoring, Mine Water Management, Waste Rock Management, Tailings Management, Class III Municipal Solid Waste Landfill, Mining and Milling Activities, Reclamation, Risk Management Plan, Financial Assurance and Wildlife interactions for the reporting period.

Biomonitoring Program

Annual Biomonitoring Report

The annual biomonitoring report is being prepared by ADF&G and will be submitted once received. The biomonitoring report will be incorporated as Appendix A within this report.

Annual Summary of Biomonitoring Water Quality Sampling

Analytical results of samples collected for biomonitoring water quality are included as an electronic file named *Red Dog Analytical Data 2020.xlsx*. Analytical results for the last five years are listed in this file.

Permafrost and Sub-permafrost Groundwater Monitoring

Permafrost and Subsurface Temperature Monitoring

Piezometer and thermistor measurements were completed for the 4th quarter, no issues noted. The 4th quarter and the 2020 annual Long-Term Permafrost and Groundwater Monitoring Report is expected to be completed shortly and will be listed as Appendix B. This report is expected to be completed by the end of February and will be submitted once received.

Significant activities in Permafrost and Sub-permafrost Groundwater Monitoring

A new replacement piezometer and digital thermistor well was scheduled to be completed during the fall of 2020, though due to the 2020 Covid pandemic construction was postponed until 2021. The EPA Region 10 was notified of the delay, it is anticipated the new well will be completed by this summer. No changes to the previously approved work plan are anticipated at this time.

The new well will be constructed in the same vicinity as piezometer well P-96-013 (located on the Kivalina Overburden stockpile). P-96-013 will remain active and continue to be monitored and results compared to the new well once it is completed. The new well will include both a shallow and deep piezometers along with a digital thermistor string which will be used to correlate any

temperature variations with thermistor T-96-013 (next to P96-013) which utilizes an older type analog thermistor string.

Mine Water Management

Mine water flows

Table 1 provides a summary of mine water flows for each monitoring station during the reporting period. Mine water transferred to and from the Aqqaluk pit was monitored though total flows are not included in Table 1.

Table 1 - Water Management Volumes

	Volume in Gallons			
Mine Water Monitoring Stations	Oct	Nov	Dec	Annual
Bon's Creek Total Flow	7,197,000	4,792,000	5.033,000	111,298,000
Mine Water Sump Total Flow*	197,600,000	162,800,000	53,600,000	1,270,020,000
Main Dam Seepage Pumpback	26,140,000	27,290,000	28,520,000	304,560,000
Reclaim Flow to Mill	314,900,000	276,500,000	269,000,000	2,221,160,000
WTP #1 Influent from Reclaim	2,593,000	0	0	94,342,000
WTP #1 Influent from Mine Sump	0	0	0	5,493,000
WTP #1 Clarifier Sludge To Tails	0	0	0	0
WTP #2 Influent from Reclaim	0	0	0	2,195,214,590
WTP #2 Sludge Discharge To Tails	0	0	0	37,170,000
Discharge to Red Dog Creek	0	0	0	870,607,000
WTP #3 Influent from MWD	4,540,000	6,746,000	1,773,000	62,460,000
WTP #3 Influent from Mine Sump	0	0	0	0
WTP #3 Total Effluent	4,540,000	6,746,000	1,773,000	62,460,000
East Overburden Sump	223,900	28,800	1.400	7,869,300
West Overburden Sump	770,500	253,900	149,300	10,253,000
Main Waste ARD to Main Pit	0	680,000	0	30,691,680
Treated Water to Main Pit	0	0	0	0
Tailings Water Supernatant (calc.) to TSF*	283,960,000	283,140,000	279,434,000	3,021,500,000
Mill Pad Collection	1,606,682	1,384,806	426,454	6,539,686

Notes:

* Includes Main Pit water pumped back to Tailings Storage Facility

Mine water quality

An electronic spreadsheet titled *Red Dog Analytical Data 2020.xlsx* is included with this report which includes data for the last five years. The spreadsheet includes all data used to generate the charts data for Appendixes C, D, E and F within this report.

Mine Water Quality Trend Charts

Mine water quality trend charts are provided in Appendixes C, D, E, and F of this report. Water quality Profile I and II (*"Monitoring Plan, Jan 2018")* constituents for the Mine Water, Mine Drainage, Bons Creek and APDES stations are illustrated for a five year period ending with the 4th quarter. No unusual trends were noted for the Mine Water locations areas during 4th quarter monitoring.

VISUAL MONITORING OF MINE WATER MANAGEMENT SYSTEMS

Mine water collection systems were monitored during the quarter as required per the *Integrated Waste Management Plan (IWMP) – Monitoring Plan, (January 2018).* All systems operated as designed during the 4th quarter.

Fish Weir Inspection

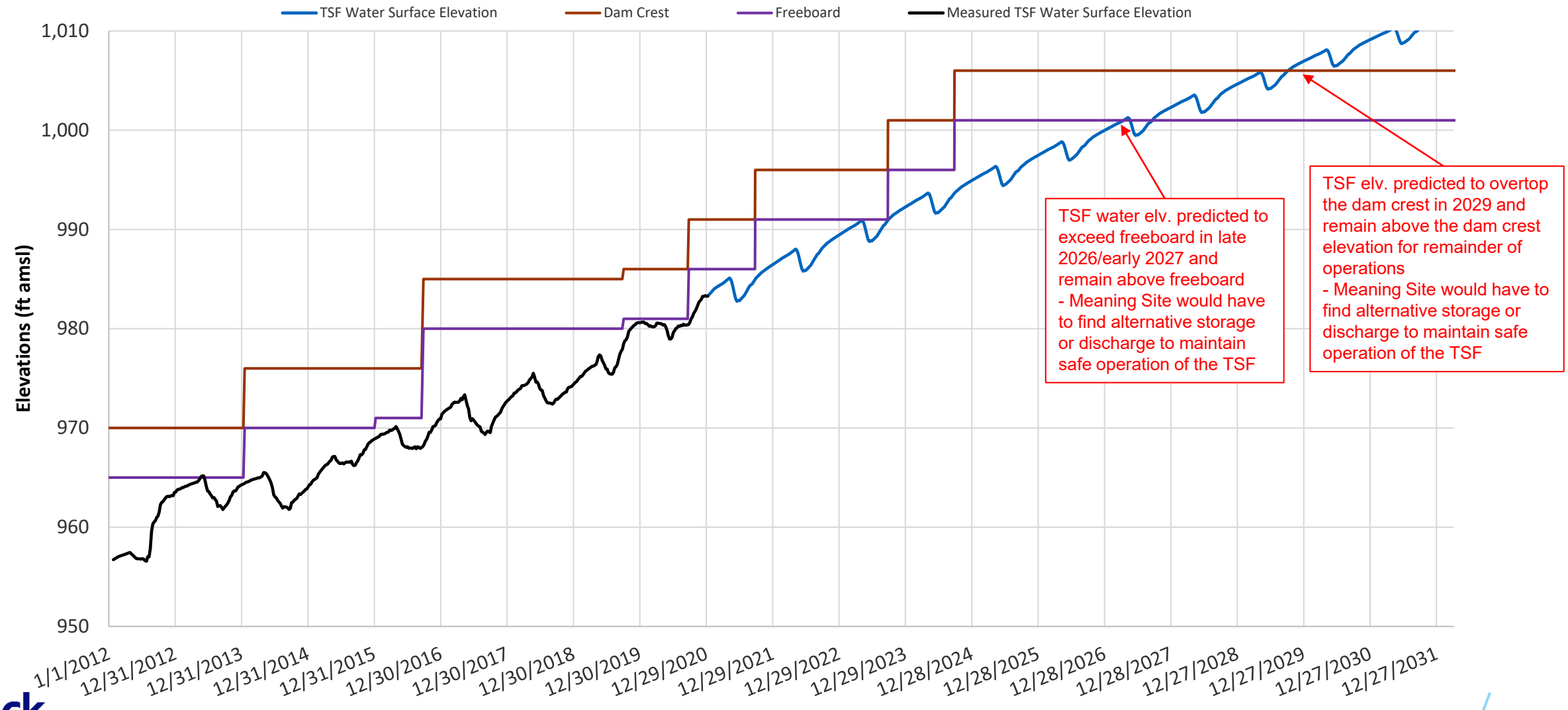
The fish weir fall inspection was completed on October 7th, 2020, no major issues were identified. The system is operating as designed. A written report was submitted to state agencies and the US EPA Region 10 on October 15th, 2020.

Water Balance

A mine water balance computer simulation program is maintained using GoldSim software. The GoldSim simulation generated a water balance projection for Life of Mine (LOM) by predicting surface water elevation in the TSF. Figure 1 depicts the simulated TSF elevation based on current operations. A free water inventory chart is provided in Figure 2 which represents historic trends through 2020 and includes water volumes for the TSF, Main Pit and Aqqaluk Pit.

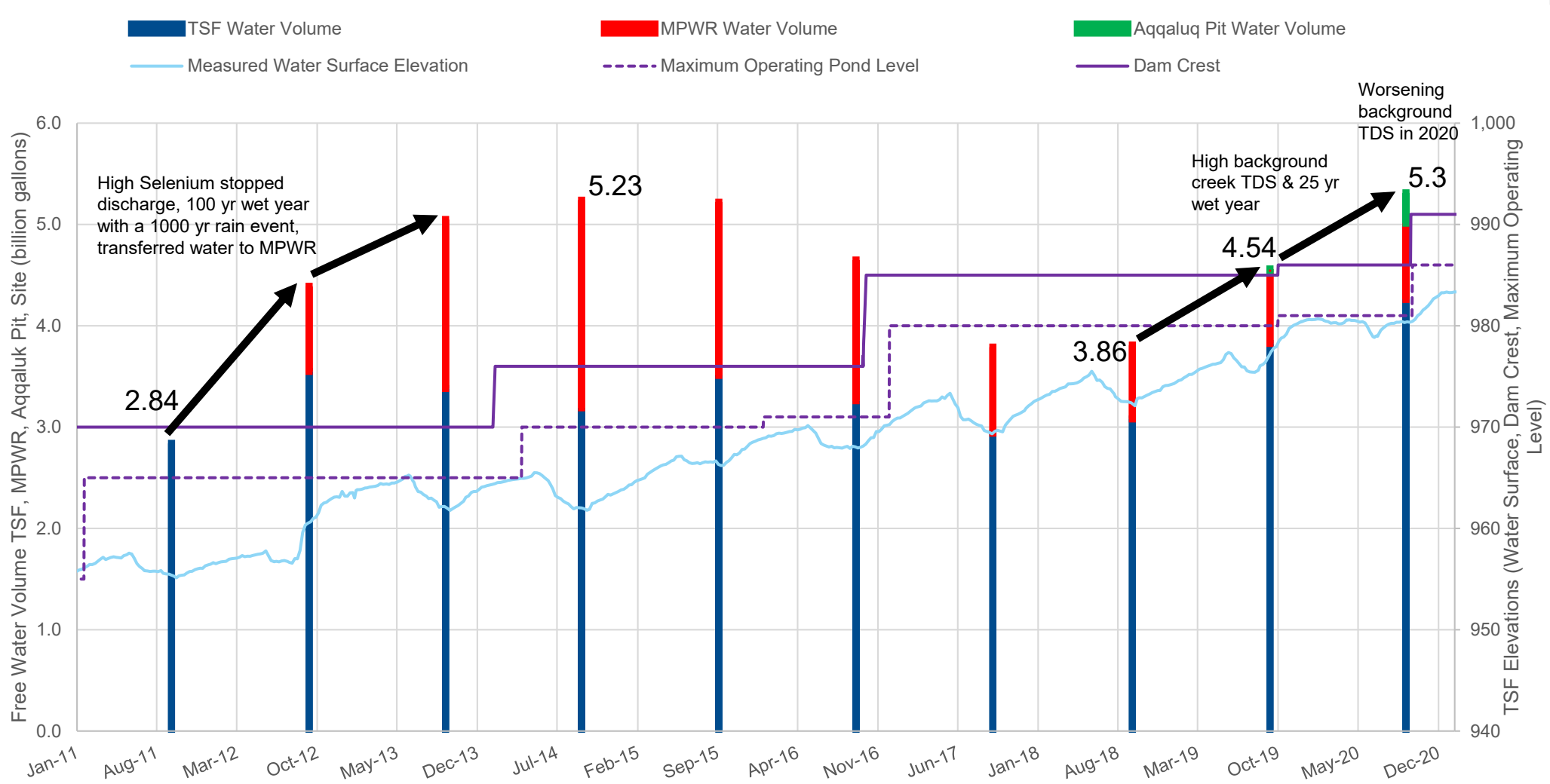
RDO Water Balance Projection & TSF Water Surface Elevation

Figure 1- *LOM RDO Water Balance Prediction for TSF without further mitigation*



RDO Water Balance & TSF Water Surface Elevation

Figure -2 *RDO Historic Free Water Inventory YE 2020*



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A Total Dissolved Solids (TDS) load balance spreadsheet was not generated for the 2020 reporting year due to the reverse pumping occurring between the Tailings Storage Facility, the Main and Aqqaluk pits to maintain freeboard limits in the Tailings Storage Facility.

Significant reagents consumed for wastewater treatment during 2020:

- Total quantity of flocculant used in Water Treatment Plant 2 (WTP2) and WTP1 was 110 metric tonnes, the majority being used in WTP2.
- Total quantity of lime used in WTP2 is not tracked individually, though the total lime used in WTP1, WTP2 and WTP3 was 8,547 metric dry tonnes.
- Total quantity of sodium sulfide used in WPT1 and WTP2 was 451 metric tonnes, utilized to precipitate cadmium.
- Total quantity of flocculants used in WTP3; - None
- Quantity of any other chemicals used in significant quantities in WTP2; - Gypsum 1,174 metric tonnes

Significant activities in mine water management

The Tailings Storage Facility contained an estimated 4.852 billion gallons of free water (end of 2020) compared to 4.215 billion gallons for the previous year. The increase in water volume was attributable to a short discharge season due to elevated background levels of Total Dissolved Solids (TDS) at stations 150 and station 160 limiting discharge from outfall 001.

A total of 870.6 million gallons of water was discharged from outfall 001 during 2020 compared to 1.39 billion gallons discharged in 2019. The reduction in discharge volume was attributable to high background TDS observed at Stations 150 and 160 which occurred earlier in the 2020 discharge season compared to the previous year and the background TDS concentrations observed during 2020 were significantly higher in concentration than in 2019.

Red Dog commenced water discharge from Outfall 001 on May 10th and ceased discharging on July 5th, 2020. Minimal discharge through outfall 001 did start-up up again on August 26 when the newly installed Reverse Osmosis (RO) water treatment facility came online. The RO facility treated and discharged approximately 33.5 million gallons until the RO facility was shut down for winterizing on September 26.

Aqqaluk Pit was used for water storage prior to the COA dam raise authorization on Sept 21, 2020. After the authorization the Aqqaluk Pit water was transferred back to the TSF to allow for continued mining of lower Aqqaluk benches.

The Acid Rock Drainage (ARD) water collection sumps directed approximately 62 million gallons of ARD water to water treatment for 2020, approximately 40% less compared to the previous year. The reduction in volume was attributable both a frozen line in late January which prevented any water collection for approximately 2.5 months the decommissioning of an ARD collection sump.

The Kaviqsaaq seep water quality monitoring ended in October due to a diminished flow and freezing conditions. The last flow measurement was taken during the month of September. Kaviqsaaq flow measurements for 2020 were notably more consistent and lower (approx. 5 gpm) when compared to flow measurements collected during 2019. It is not known if the reduction in flow is a direct result from the Phase II project which involved insulating suspected permafrost melt or the seep is naturally becoming less active.

A conceptual design plan to collect and divert Kaviqsaaq seep water to an existing mine water collection system water was submitted to ADF&G for review. ADF&G reviewed and approved the conceptual design, a final design from Red Dog Operations was expected to be completed and submitted to ADF&G by the end of December though internal delays have set back the submittal to mid March. The design will utilize a small above ground pipe to gravity transfer the seep water to the Main Pit. No surface disturbance is anticipated during construction.

Waste Rock Management

Quantities, placement locations and analysis of waste rock

Weekly waste stockpile inspections for the fourth quarter, 2020 began on October 1, 2020 and ended on December 31, 2020. Dig face inspections were carried out on waste shots to confirm waste characteristics and suitability for designated stockpile locations. All waste material was placed in suitable waste storage stockpiles. The primary waste storage sites have been the Main Pit Dump (MPD3, MPD4. MPD5), Oxide / Main Waste Dump (Cover Dump, Landfill, and East Oxide), and project construction areas (Concentrate Storage Building, PAC Switchback, Crusher Pad and road repair).

A total of 1,515,403 tonnes of waste rock were hauled from the Aqqaluk pit and a total of 111,091 tonnes of waste rock were hauled from Qanaiyaq pit.

Main Pit Dump Area

A total of 1,039,049 tonnes were haul to the Main Pit Dump Area

- 375 tonnes of Most Reactive Waste were hauled to MPD3
- 738,911 tonnes of Ikalukrok, Intrusive, Okpikruak, Siksikpuk, Mixed, Most Reactive Waste and Other Waste were hauled to MPD4
- 299,763 tonnes of Ikalukrok, Okpikruak, Siksikpuk, Kivalina, Most Reactive Waste and Other Waste were hauled to MPD5

Oxide / Main Waste Dump Area

469,974 tonnes were hauled to the Oxide / Main Waste Dump Area

- 469,497 tonnes of Kayak and Kivalina Cover Material were hauled to the Cover Dump (COV)
- 240 tonnes of Siksikpuk Construction Material were hauled to the Landfill (LAN)
- 237 tonnes of Intrusive and Other Waste were hauled to East Oxide (OXE)

Project Construction Areas and Road Construction

6,380 tonnes were hauled to Project Construction Areas and to roads for road construction

- 423 tonnes of Siksikpuk Construction Material were hauled to the CSB
- 5,640 tonnes Siksikpuk Construction Material were hauled to the PAC
- 155 tonnes of Siksikpuk Construction Material were hauled to the CPAD
- 162 tonnes of Okpikruak Construction Material were hauled to roads

Table 2 lists the amount of available cover rock material stockpiled for closure.

Table 2 - Cover Material

Tonnes Hauled per Month Cover Stockpile Location		Tonnes Collected
Ramp to Nowhere (RNC)		1,271,891
North Oxide (COV)		2,358,503
South Oxide Top Soil (SOT)		81,094
Kivalina Overburden Top Soil (KOB)		70,913
	Total	3,782,401
	Cover utilized	48,400
	Total stockpiled	3,734,001

Results of waste rock geochemical monitoring

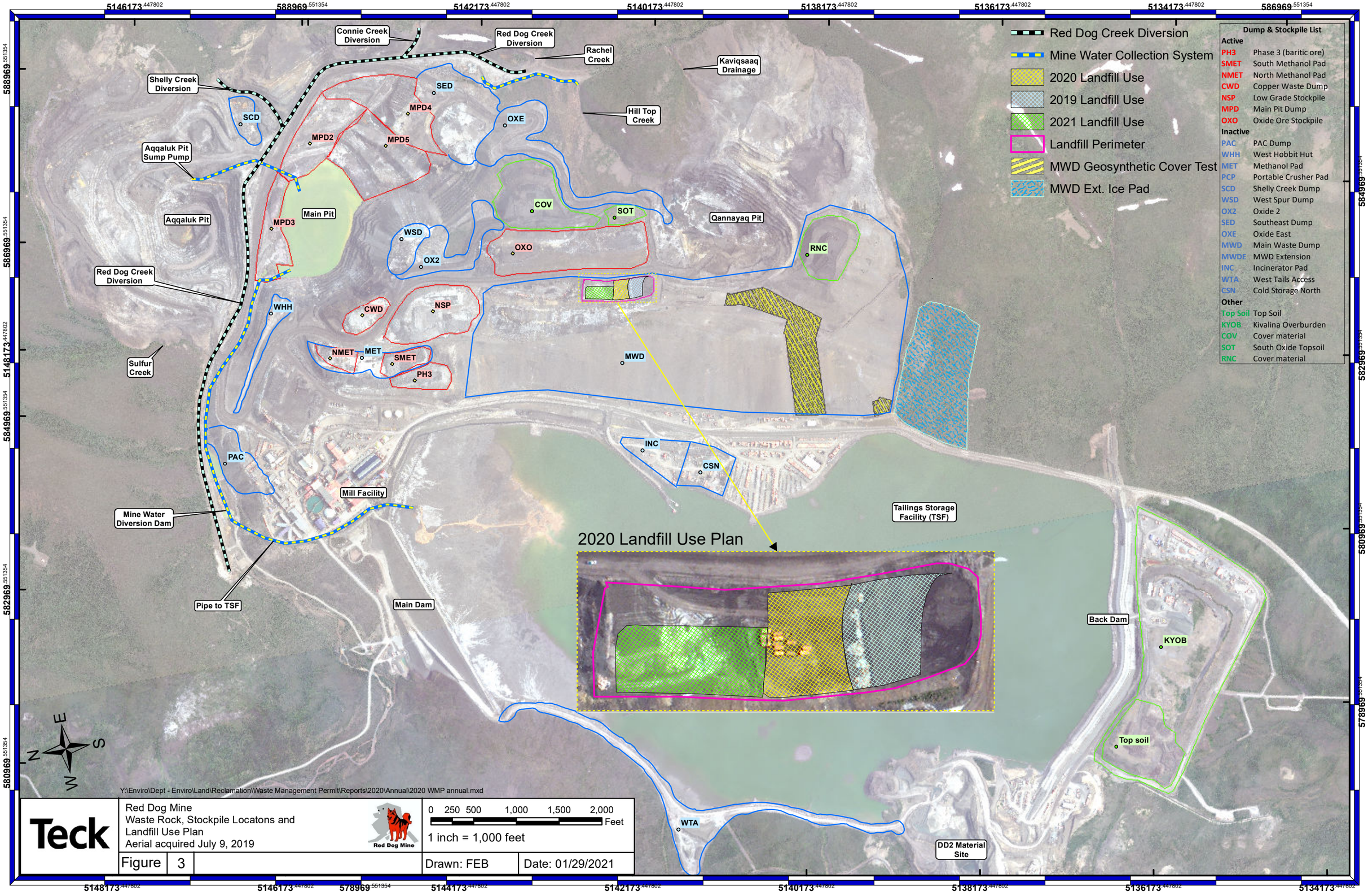
Other than blasthole analyses, no additional geochemical testing was conducted on waste rock during the reporting period. Geochemical waste rock test results are included in the *"Waste Rock Production Summary Report"* listed in Appendix G of this report. The report addresses quantity, location placement and geochemical analysis for waste rock managed during this reporting period. All waste rock was managed in accordance with the *IWMP- Waste Rock Management Plan (Sept 2018)*. A detailed Cover Rock report is included within Appendix G of this report.

Visual monitoring of waste rock dumps

Weekly visual inspections of active waste rock dumps were conducted by the Senior Geotechnical Engineer or their designee if offsite. Other than minor settling along some dump surfaces, no significant incidents were observed during the inspections.

Significant activities in waste rock management

Nothing to report this quarter



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Red Dog Mine
Waste Rock, Stockpile Locatons and
Landfill Use Plan
Aerial acquired July 9, 2019

Red Dog Mine

0 250 500 1,000 1,500 2,000 Feet

1 inch = 1,000 feet

Figure	3		Drawn: FEB	Date: 01/29/2021

Tailings Management

Quantities and analysis of tailings

Table 3 depicts the dry tonnes of tailings generated and the average lead, zinc and iron concentrations in the tailings solids discharged to the Tailing Storage Facility (TSF) for the quarter. No tails were placed into DD2 this quarter.

Table 3 - Tailings Produced

		Analysis		
Month	Dry Tonnes Tailings	% Pb	% Zn	% Fe
Oct	274,403	1.1	2.6	7.1
Nov	235,906	2.0	2.7	6.4
Dec	285,413	1.5	2.8	6.4

Tailings Storage Facility, Main Pit and Aqqaluk Pit water elevations

Table 4 lists surveyed Aqqaluk, Main Pit and the TSF water elevation levels during the reporting period. The TSF was maintained within the permitted level. The Main Pit was maintained below a water elevation of 850 feet amsl.

Table 4 - Tailings Storage Facility, Main Pit and Aqqaluk Pit Water Elevations

Survey Date	Aqqaluk Feet MSL	Main Pit Feet MSL	TSF Feet MSL	Temp (F)
2-Oct	731.35	841.07	980.74	50.0
6-Oct	729.29	840.15	980.99	32.0
9-Oct	725.59	839.92	981.09	42.0
13-Oct	720.08	839.39	981.19	21.0
17-Oct	714.97	839.51	981.38	22.0
20-Oct	712.24	839.46	981.54	28.0
23-Oct		839.37		
24-Oct	708.98		981.68	25.0
26-Oct		839.24	981.74	18.0
30-Oct	703.54			
31-Oct		838.50	981.90	
3-Nov	697.00	838.85	981.98	
7-Nov	692.27	839.65	982.23	34.1
11-Nov	686.50	839.59	982.30	
13-Nov	680.10	839.90	982.49	
18-Nov	676.58	839.50	982.66	11.0
20-Nov	672.80	839.91	982.60	12.0
24-Nov	665.99	840.25	982.81	18.0
27-Nov	661.50	839.85	982.75	16.0

1-Dec	654.00	839.38	982.98	(2.0)
4-Dec	645.88		983.07	5.0
5-Dec		838.56		
8-Dec	635.00	838.57	983.26	(13.0)
11-Dec	628.00	838.95	983.32	(18.0)
18-Dec	630.50	838.69	983.32	
25-Dec	633.00	838.58	983.33	
29-Dec		838.39	983.27	

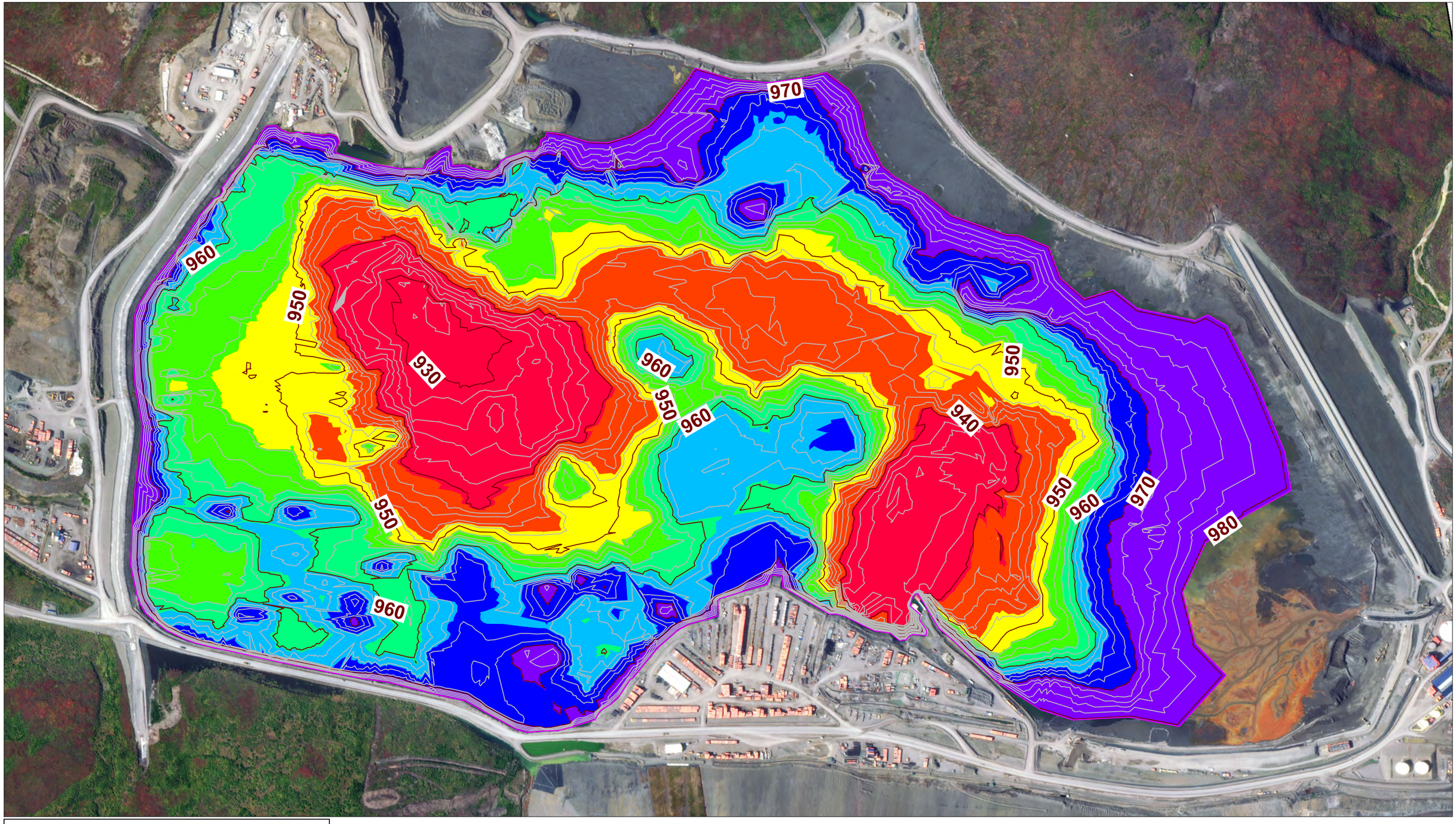
Visual monitoring of tailings facilities

Visual monitoring inspections of the TSF were completed as required. All systems operated as designed with no findings noted for the quarter. Monitoring of the dams per the requirements specified in each dams Operation and Maintenance Manuals was completed for the period, two weekly main dam inspections indicated corrective action was required to repair tears noticed on the liner.

On October 26th a weekly dam inspection noted a 10” tear in the liner, the tear was at the 991 elevation well above the surface water elevation. The second incident was noted during the December 27th weekly dam inspection which observed another tear in the liner at the same 991 elevation. Both of the incidents were reported to the EoR and ADNR-Dam Safety.

Significant activities in tailings management

ADNR-Dam Safety issued a temporary Certificate of Approval (COA) for the tailings main dam to operate at an elevation of 991, the initial expiration date of 12/31/20 was extended until March 2021. Final approval of the COA is expected once ADNR has reviewed all construction completion reports.

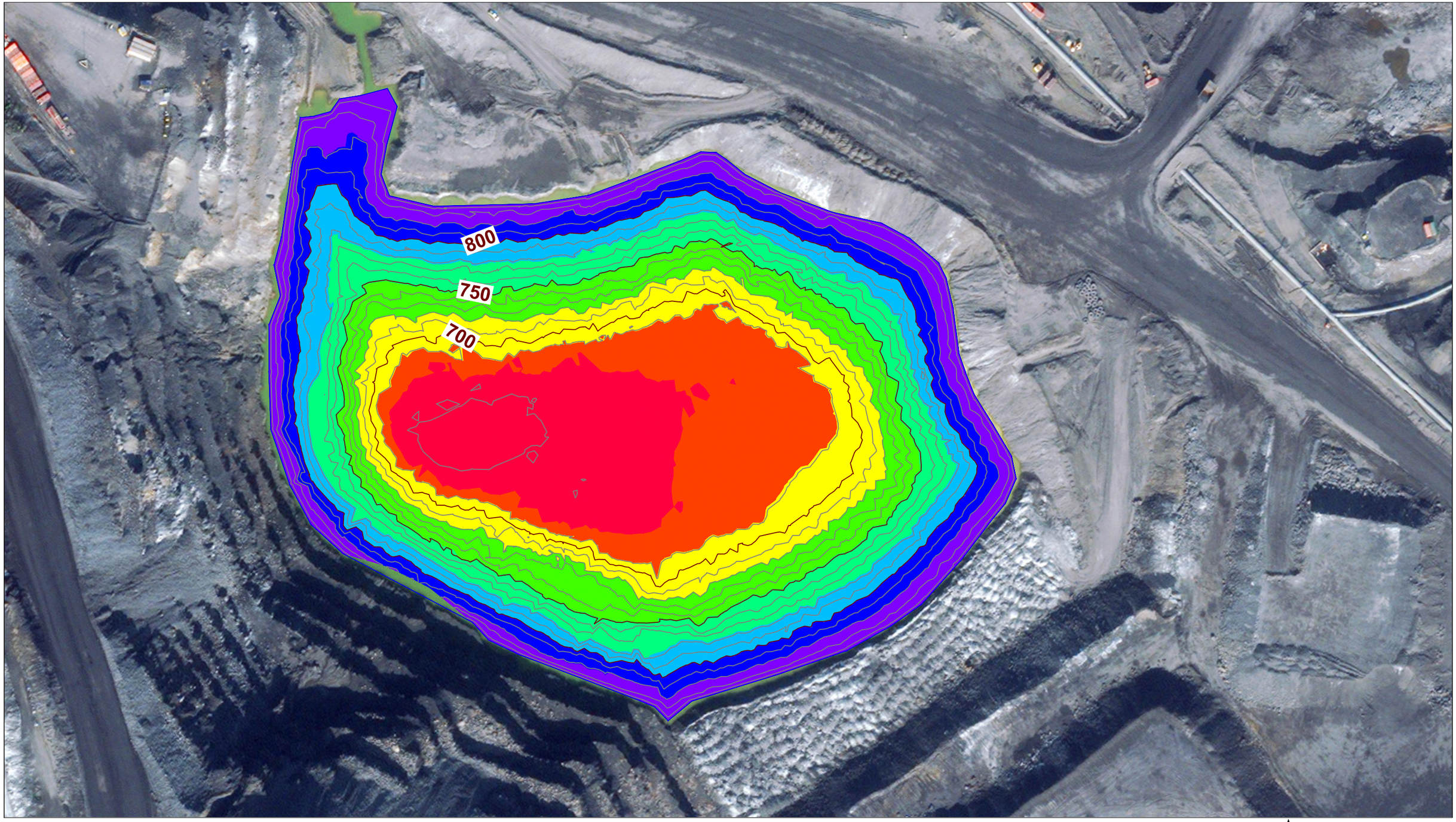


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2020 TSF Bathymetric Map

Bathymetry Date:	**9/5/2020**
Imagery Date:	**8/16/2020**
TSF Water Elevation:	**980.36 ft**
Free Water Volume:	**4,260 MGal**

0 150 300 600 1200 FEET



Red Dog / Teck

2020 MPWR Bathymetric Map

Bathymetry Date:	**9/9/2020**
Imagery Date:	**8/16/2020**
MPWR Water Elev:	**844.10 ft**
Free Water Volume:	**619 MGal**

N

0 37.5 75 150 300 FEET

Class III Municipal Solid Waste Landfill

Monthly visual inspections were completed, no significant findings were noted on any monthly inspections report.

Visual inspections were conducted at the landfill and random inspections conducted on bins of refuse waste prior to being hauled to the landfill. No incidents were reported during the 4th quarter.

The annual mine incinerator composite (3-week) ash sample was collected during September and analyzed for metals using EPA 1311 Toxicity Characteristics Leaching Procedure (TCLP) and PCB's. TCLP results indicate the ash is considered a non hazardous waste. A copy of the analytical lab report was recently submitted to Neil Lehner with ADEC.

Quantities of inert solid waste

The Red Dog survey department performed a LiDAR scan of the landfill on August 29th, 2020 and calculated a total volume 13,163 cubic yards of refuse and waste rock cover placed for the period from October 2019 through to August 2020.

Figure 6 – 2020 Landfill LiDAR image depicts the difference between the operating years 2020 and 2019. The 2020 change in surface is colored teal. The difference in volumes was taken as a volumetric calculation between surfaces utilizing MineSight.

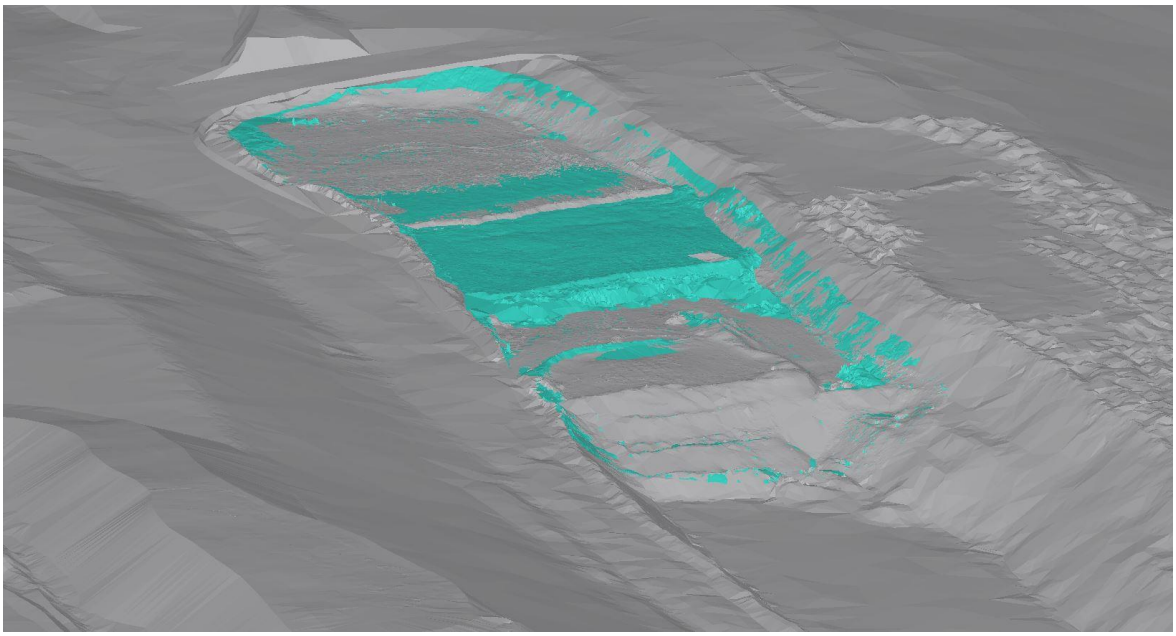


Figure 6 - Landfill LiDAR image looking south

Significant activities in solid waste landfill and waste management

Red Dog Operations continued with many improvements to the recycling program for the 2020 year. Opportunities to enhance recyclables will continue into 2021. The bullet list below represents the amount of waste which was sent off site for recycling from all of Red Dog Operations for the 2020 reporting year.

- Recycled 352,470 lbs. of cardboard,
- Recycled 7,890 lbs. of plastic
- Recycled 9,500 lbs. paper
- Recycled 735,142 lbs. of scrap steel and copper
- Recycled 486,848 lbs. of used tires
- Recycled 3,030 lbs. of electronic waste
- Recycled 746,130 lbs. of used mantles and Sag liners
- Recycled 221,605 wooden pallets

Landfill Use Plan

For the 2020 year, refuse will continue to be placed within the existing cell with refuse placement progressing to the north. Figure 1 provides a Landfill Use Plan Map which depicts the areas of use for 2019, 2020 and plans for 2021.

Significant activities in Class III municipal solid waste landfill

No significant activities occurred, waste deposition is following the 2019 landfill Use Plan submitted with the annual report.

Mining and Milling Activities

Mining quantities

Table 5 lists the total tonnes of ore hauled to the mill stockpile each month during the reporting period. The total includes both Aqqaluk and Qanaiyaq ore and does not include any marginal ore placed within the Marginal Ore Stockpile.

Table 5 - Ore Mined and Stockpiled

Month	Ore Mined, tonnes
Oct	315,902
Nov	297,112
Dec	506,265

Milling Quantities

Table 6 lists the total tonnes of ore processed through the mill facilities each month during the reporting period.

Table 6 - Ore Processed through Mill

Month	Ore Milled, tonnes
Oct	372,887
Nov	329,525
Dec	407,195

Significant activities in mining and milling

Qanaiyaq ore continued to be mixed with Aqqaluk ore at a mill feed blend of approximately 20 to 30% for the 4th quarter.

Reclamation

Significant activities associated with reclamation

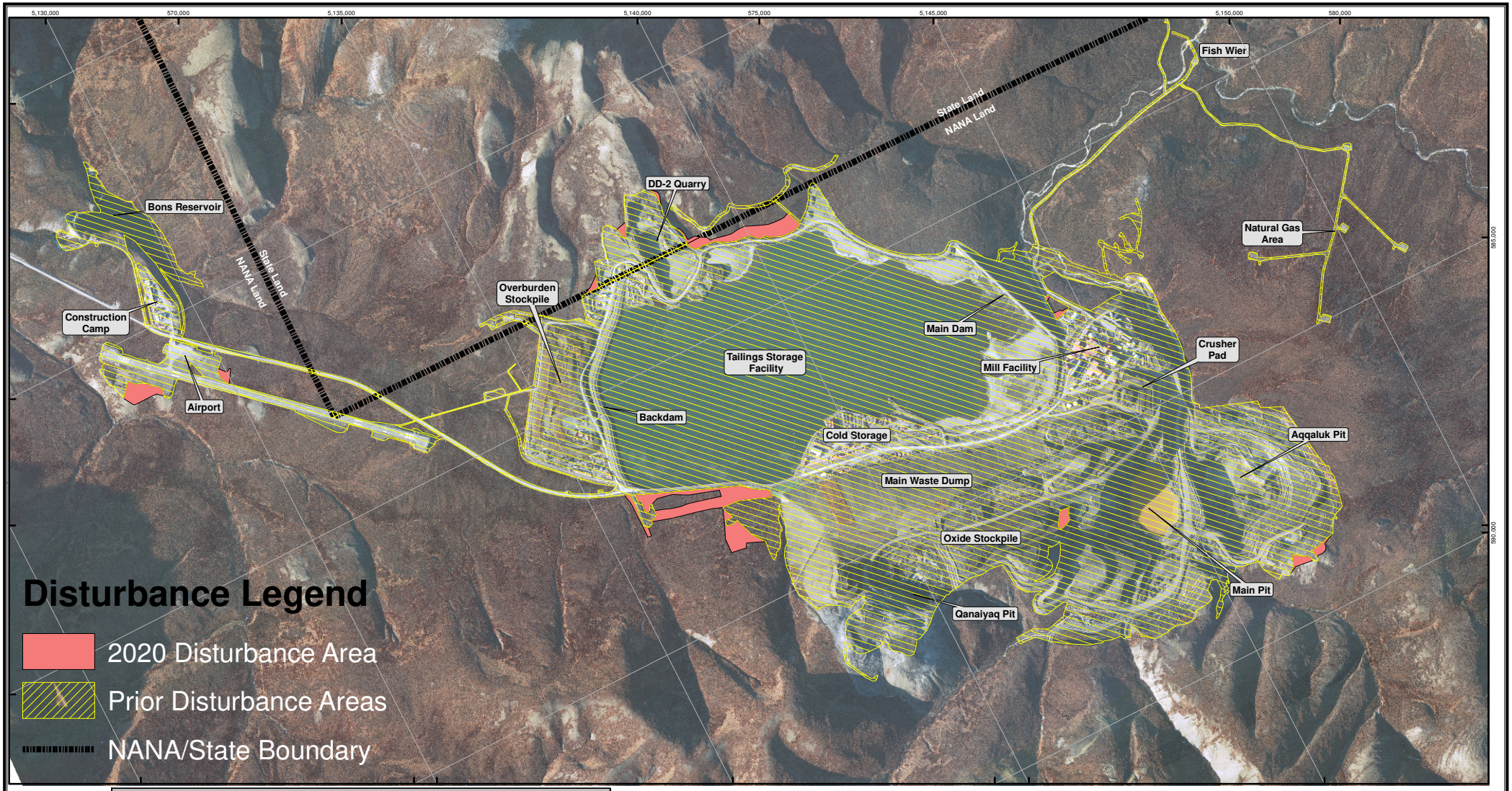
No significant reclamation activities occurred at the site during this reporting period.

Reclamation Activities

A map of the new land disturbance occurring for the mine site during the 2020 reporting year is shown in Figure 7 – Red Dog Operations 2020 Land Disturbance Map. Table 7 depicts new disturbed acreage for 2020. No areas were reclaimed during the reporting period. Top soil recovered from newly disturbed areas was stockpiled for future use.

Table 7 - Area Disturbed in 2020

2020 New Disturbance Area	Acres
Airport Stripping	5.6
West tails Road Relocation	9.6
Back Dam Clearing	1.1
Transportation Corridor – Phase 2	20.9
Cover Dump Expansion	1.4
RO Plant Clearing	0.7
Aqqaluk Pit Pushback	2.4
DD2 Development	2.2
Total 2020 Disturbance	43.9



ITEM	2020 ACRES	CHANGE	COMMENTS
2019 Total	2066.4		
Airport Stripping	5.6	5.6	For minimizing drifting snow on runway.
West Tails Road Relocation	9.6	9.6	Necessary because of rising water in TSF.
Back Dam Clearing	1.1	1.1	For back dam lift.
Transportation Corridor - Phase 2	20.9	20.9	Necessary because of rising water in TSF.
Cover Dump Expansion	1.4	1.4	No more disturbance anticipated.
RO Plant Clearing	0.7	0.7	No more disturbance anticipated.
Aqqaluk Pit Pushback	2.4	2.4	For pit expansion.
DD2 Development (State land)	2.2	2.2	More anticipated in 2021 with pushback of DD2.
TOTAL	2,110.3	43.9	

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Red Dog Operatons
Figure 1 - 2020 Land Disturbance Map
Aerial acquired October 2020

Red Dog Mine

0 425 850 1,700 2,550 3,400 Feet
1 inch = 1,700 feet

file location
Y:\Minetech\Inter\MAPS\Land_Use\Drawings\disturbance\2020 Land Disturbance\2020 Disturbance.mxd

Drawn: MRH

Date: 1/5/2020

Reclamation Research

During 2020, qualitative observations were conducted for the Main Waste Dump Test plots which were established in summer 2017. The increased density of grasses limited the ability to differentiate between previously mulched and un-mulched test plots in 2020. In 2019 aerial seeding by helicopter inadvertently placed additional grass seed over the test plots which caused grasses to dominate the plots. Individual *Artemesia arctica* and *Astragalus australis* forb seedlings (previously collected as part of the Noatak Seed Harvest Program) and planted in 2017 were observed throughout the test plot area during the 2019 evaluation, by 2020, the numbers were much lower, most likely due to the over abundance of grasses limiting their growth caused by the over seeding.

Native Seed Collection Efforts for Reclamation

Teck Alaska and NANA Regional Corporation began the Noatak Seed Harvest Program in 2015 to procure locally sourced native species to revegetate disturbed lands at Red Dog Mine. Due to COVID-19, travel to Noatak was prohibited in 2020. Seed collecting efforts were shifted to areas surrounding the DeLong Mountain Transportation System (DMTS Haul Road) to identify potential native seed harvest sites. Seven ideal seed harvesting locations were identified during the 2020 field season. Mature seeds were collected and sent to the Alaska Department of Natural Resources Plant Materials Center for seed cleaning and purity/germination tests.

Reclamation Monitoring

No monitoring was completed for the reporting year.

Significant reclamation activities

No reclamation activities took place during the 2020 reporting year.

Amendments to WMP or RPA

Two amendments were approved by ADEC and ADNR during the reporting year. The reverse Osmosis wastewater treatment facility was approved on August 7, 2020 and an amendment to delay the 5 year third-party facility audit until 2021 was approved on Sept 9, 2020.

Risk Management Plan (RMP)

The Annual 2020 RMP report is not yet completed, when completed (2nd or 3rd quarter of 2021) it will be submitted to agencies as Appendix I - 2020 WMP Annual Report.

Dust monitoring activities

Dust monitoring activities for the reporting year will be presented in the 2020 Risk Management Plan (RMP) Annual Report.

Financial Assurance

Teck Alaska decreased the reclamation bond for Reclamation Plan Approval (F20169958) by $4,410,568 to account for deflation based on the Anchorage Consumer price Index (CPI). The total bond amount is $583,665,168. The adequacy of the bond is sufficient for current operations and conditions.

Financial assurance for the 2021 renewal of the Waste Management Permit (WMP) and the Reclamation and Closure Plan (RCP) will be calculated based on the internationally recognized Standard Reclamation Cost Estimator (SRCE) Version 2. Red Dog Mine expects to submit the final renewal application by March 2021.

Wildlife

Wildlife interactions and casualties

There were no wildlife interaction noted for this reporting period.

Closing

Please accept this report as required under the State of Alaska Waste Management Permit No. 2016DB0002 and Reclamation Plan Approval F20099958. If there are any questions, please contact Frank Bendrick at (907) 754-5138 or myself at (907) 754-5127.

Based on information and belief formed after reasonable inquiry, I certify that the statements and information in and attached to this document are true, accurate and complete.

Sincerely,
Teck Alaska Incorporated



Les Yesnik .
General Manager

cc: Tim Pilon, ADEC, Fairbanks;
Emily Hart, ADNR, Juneau
Brent Martellaro, ADNR, Fairbanks
DNR.Water.Reports
Jim Vohden, ADNR
Audra Brase, ADF&G, Fairbanks
Neil Lehner, ADEC, Fairbanks
Lance Miller , NANA
Mike Gonzales, Red Dog Mine

Appendix A: Biomonitoring Report (pending)

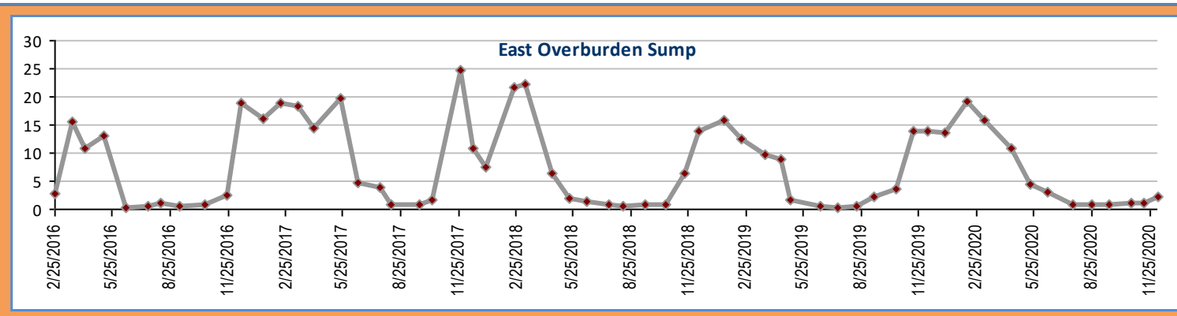
Appendix B: Long Term Permafrost and Groundwater Montoring (pending)

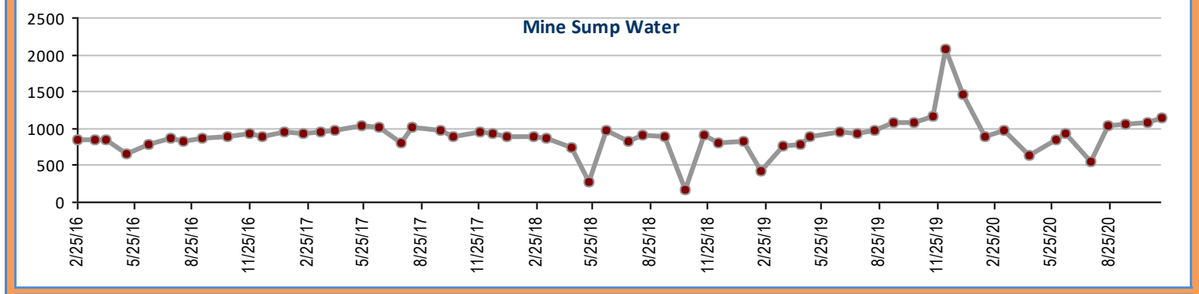
Appendix C: Water Quality Profile II Charts – Mine Water Monitoring Stations

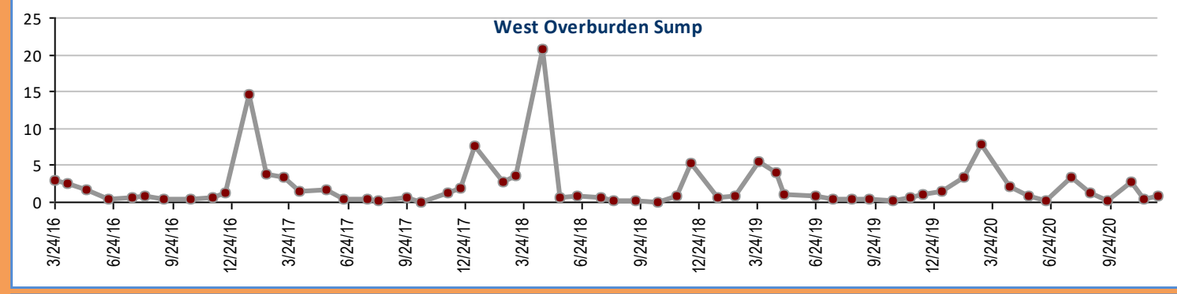
RED DOG MINE

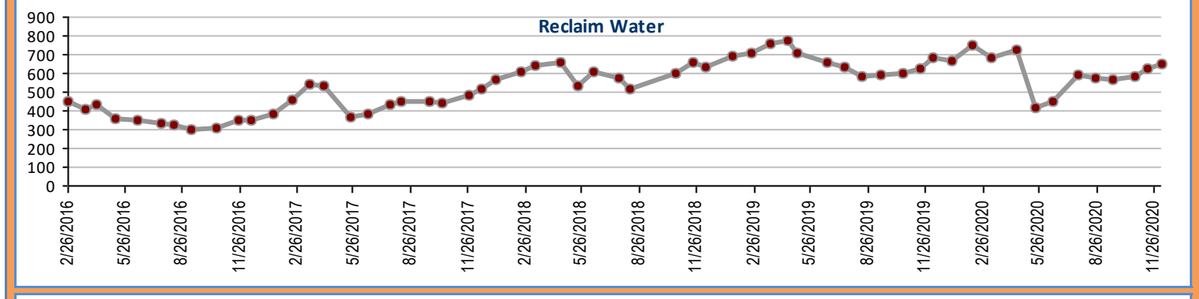
Mine Water Monitoring - Water Quality Profile II, Trend Charts

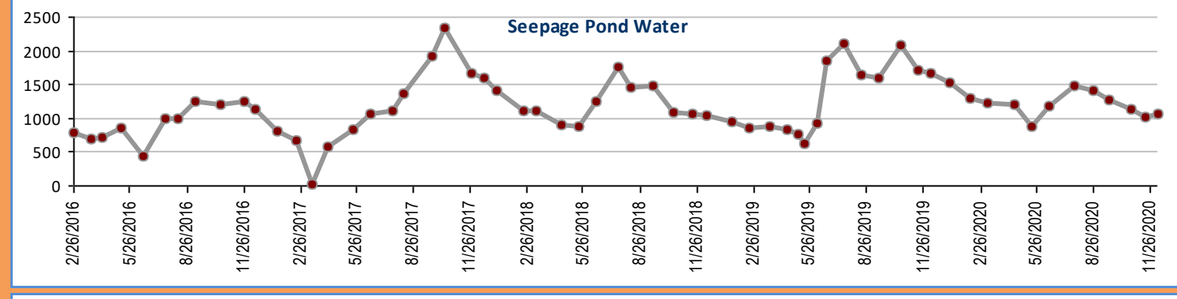
Zinc, dissolved, units, mg/L

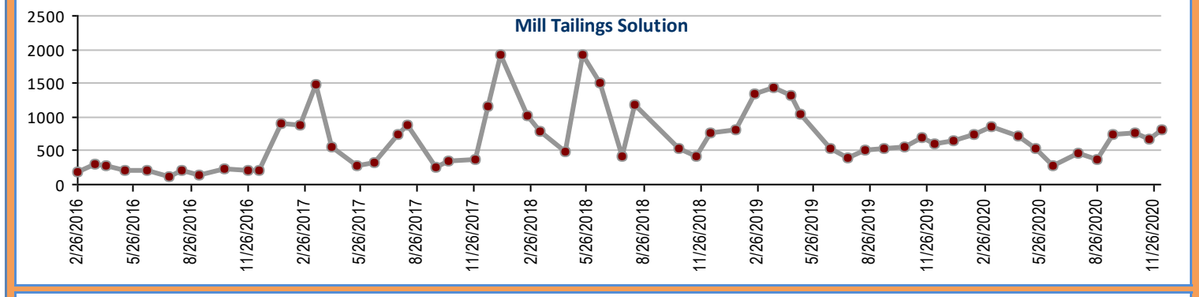


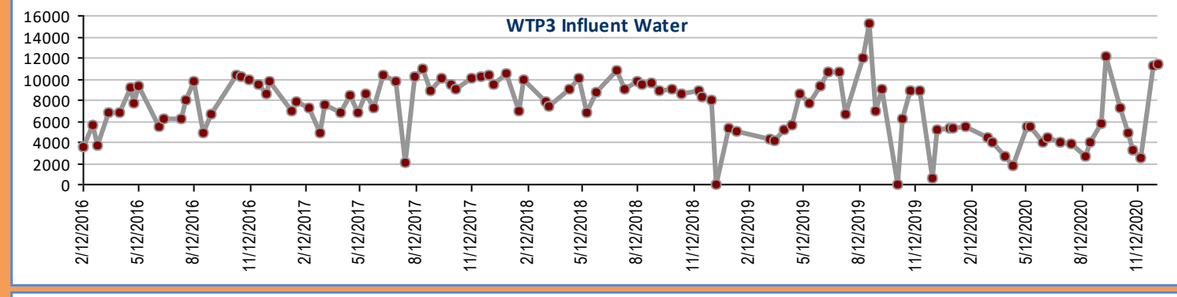


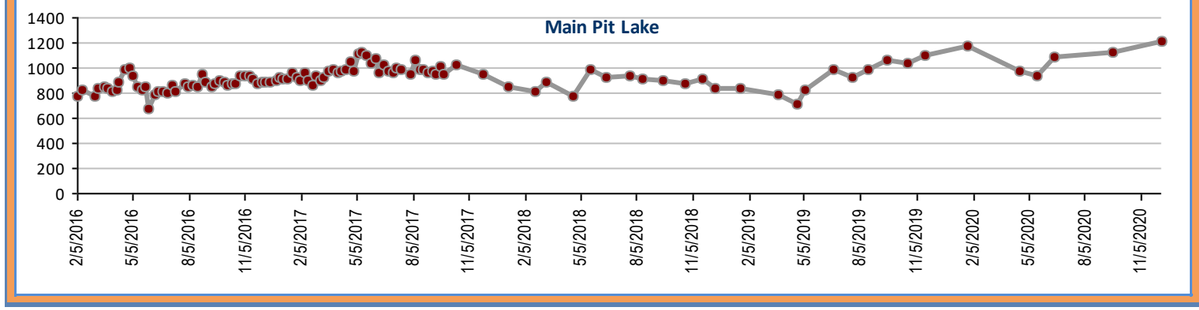


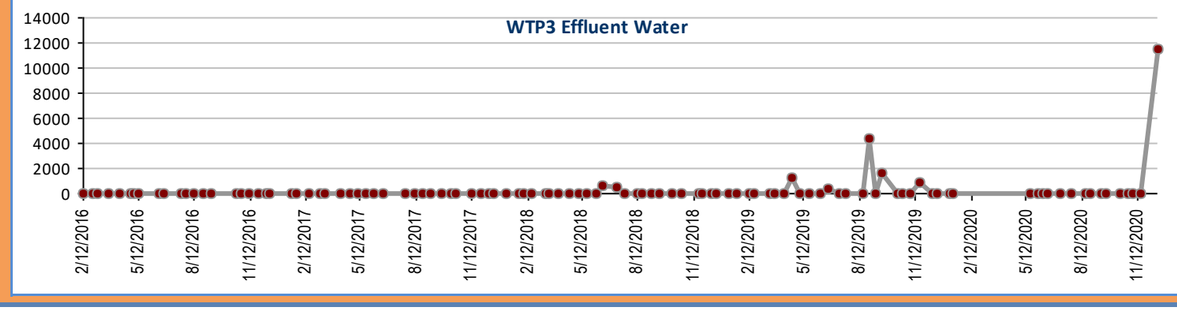








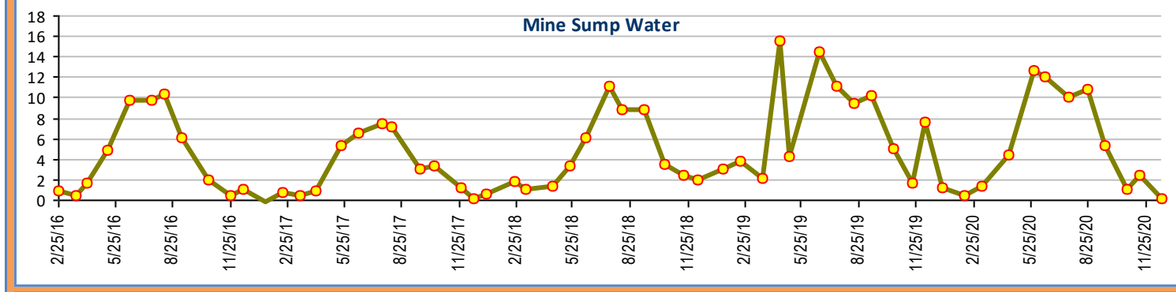


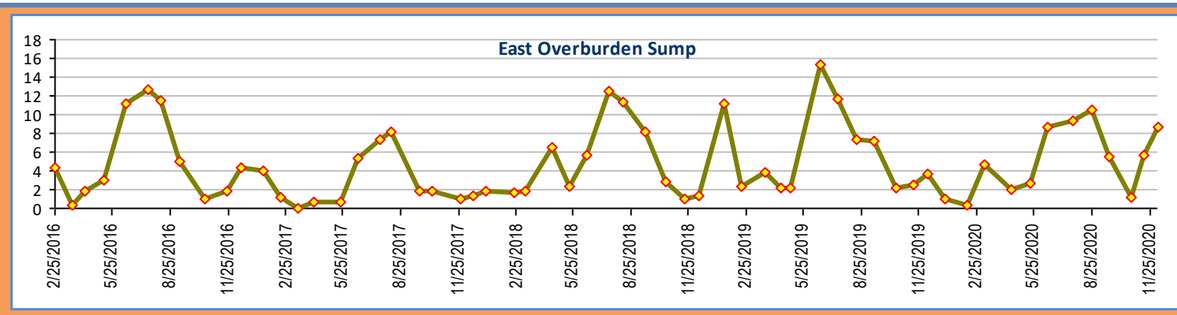


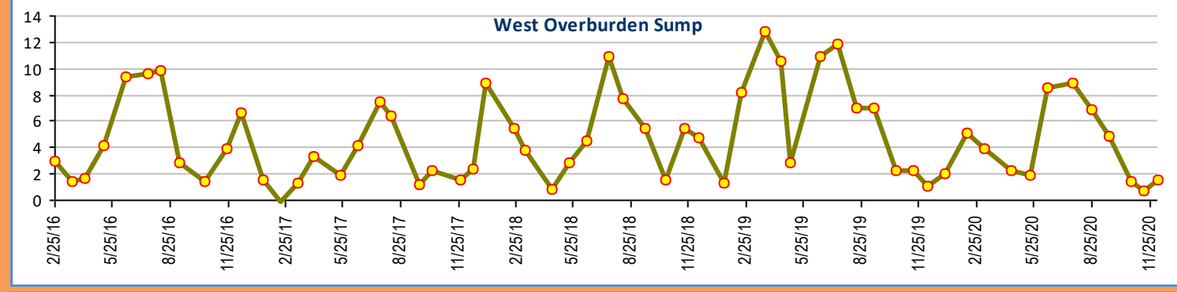
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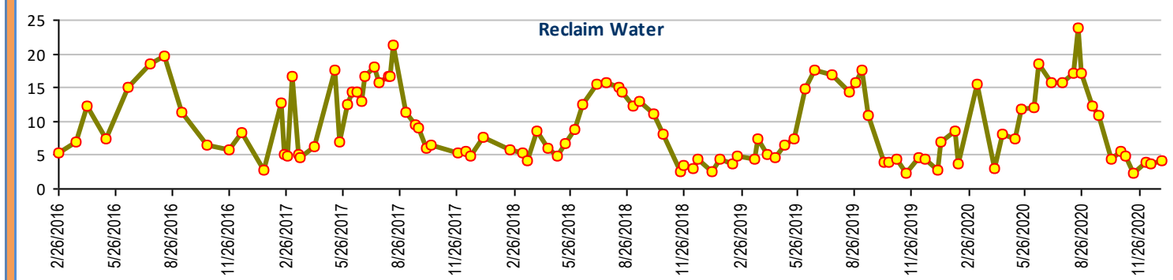
Mine Water Monitoring - Water Quality Profile II, Trend Charts

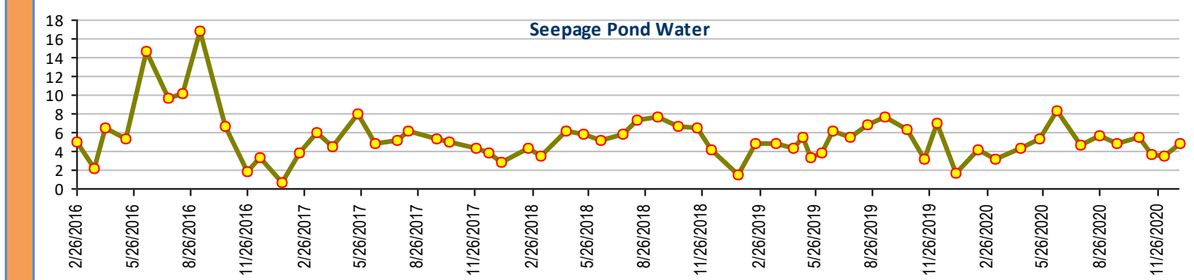
Temperature, Celsius

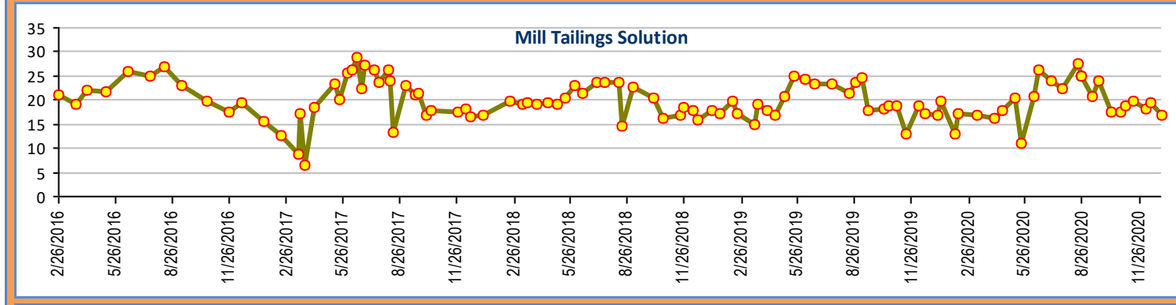


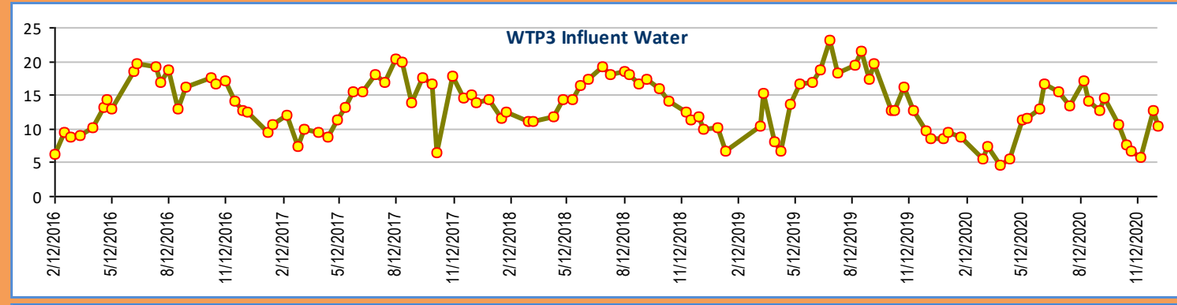


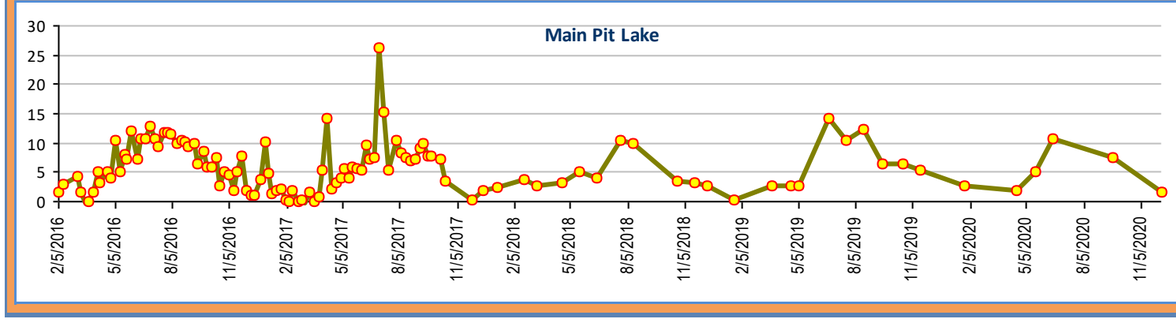


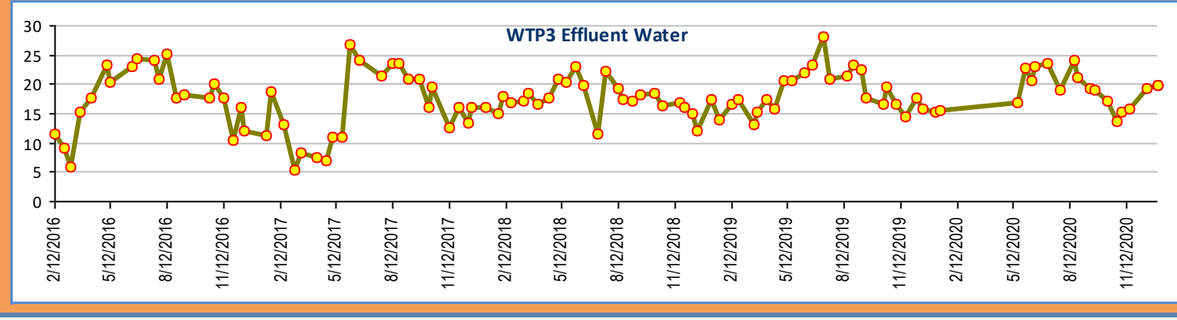








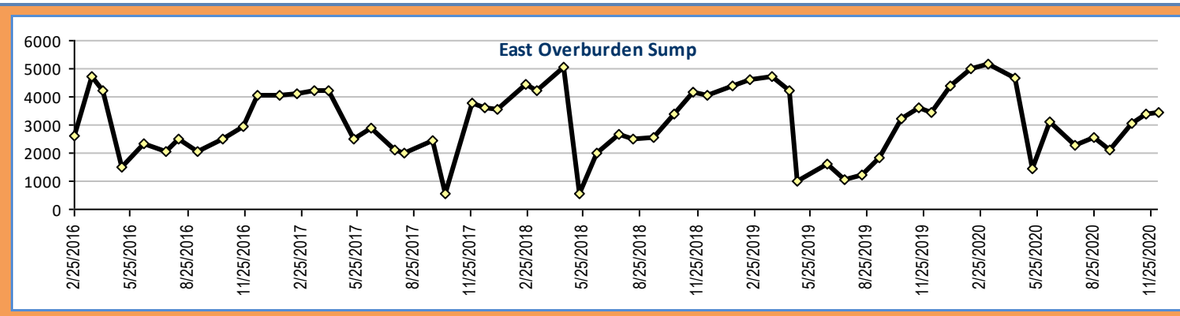


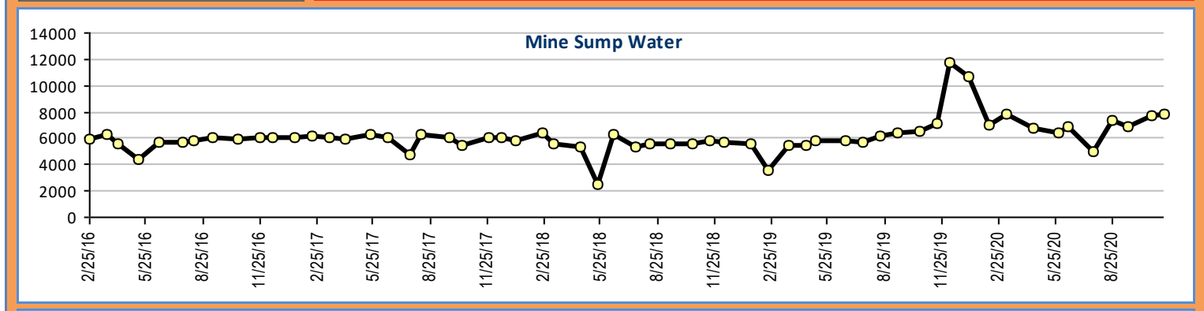


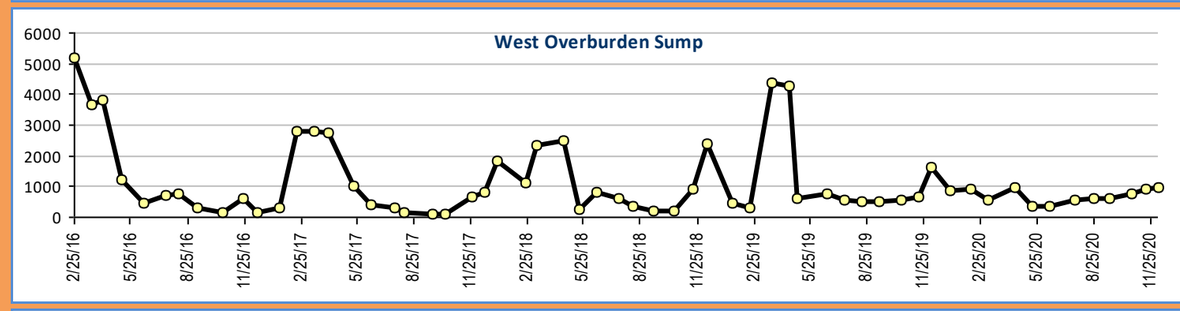
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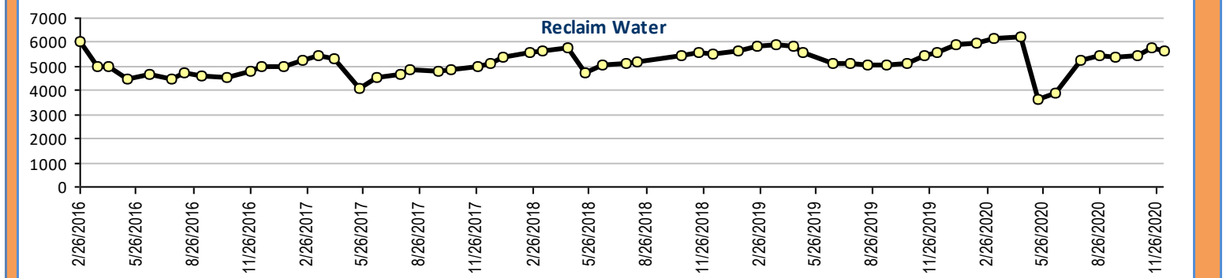
Mine Water Monitoring - Water Quality Profile II, Trend Charts

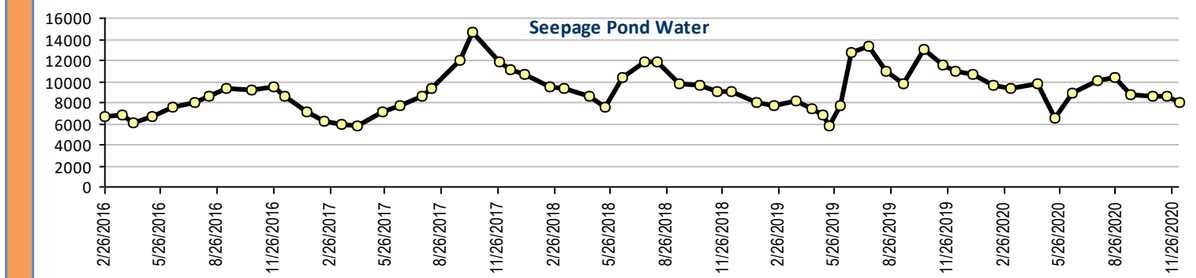
Total Dissolved Solids, units, mg/L

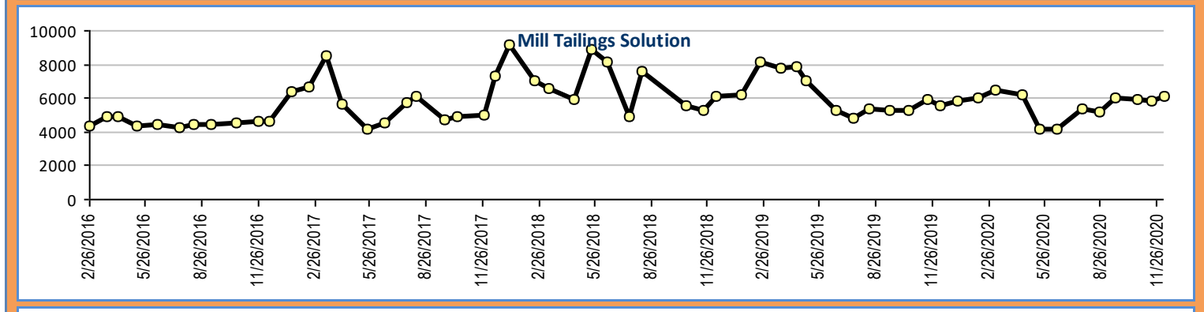


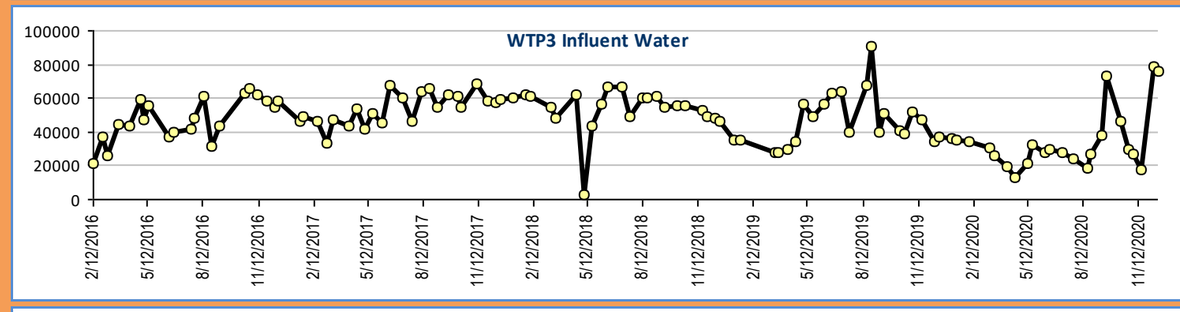


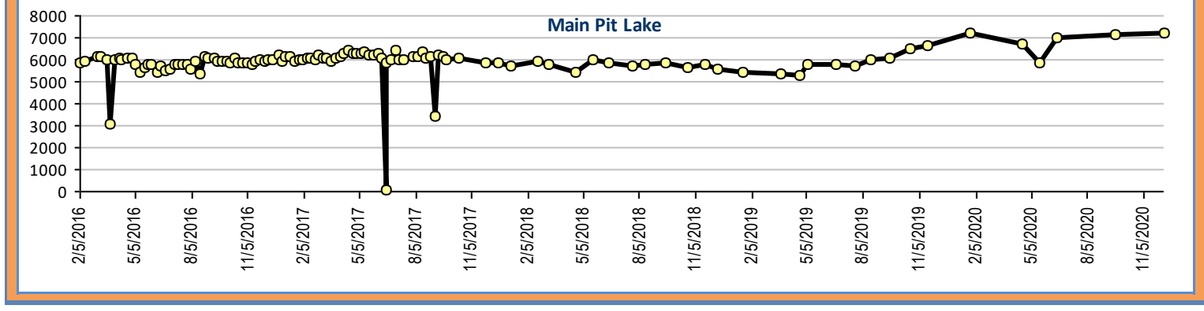


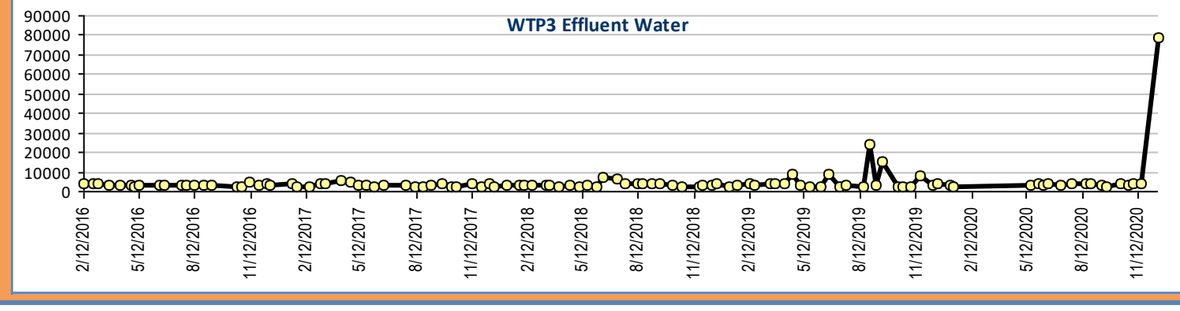








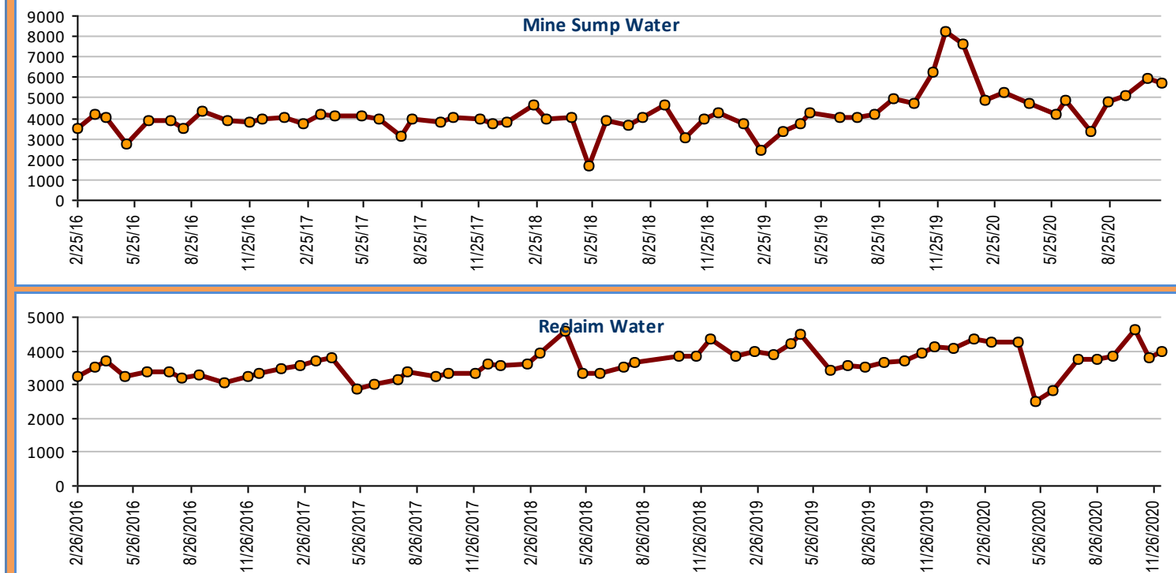


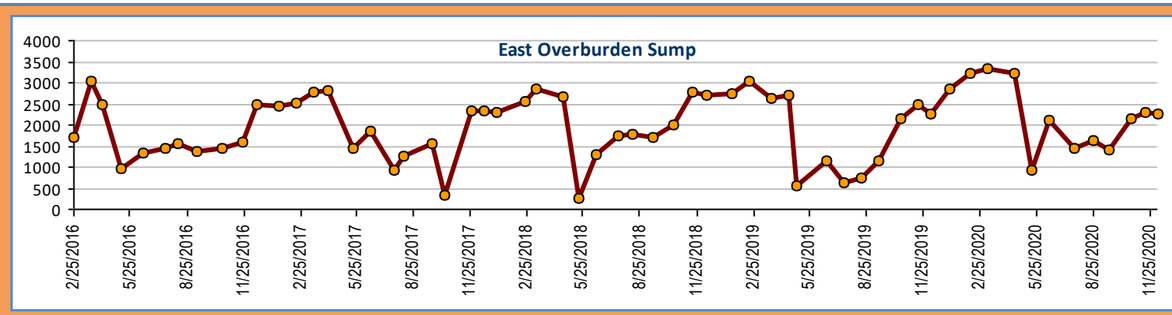


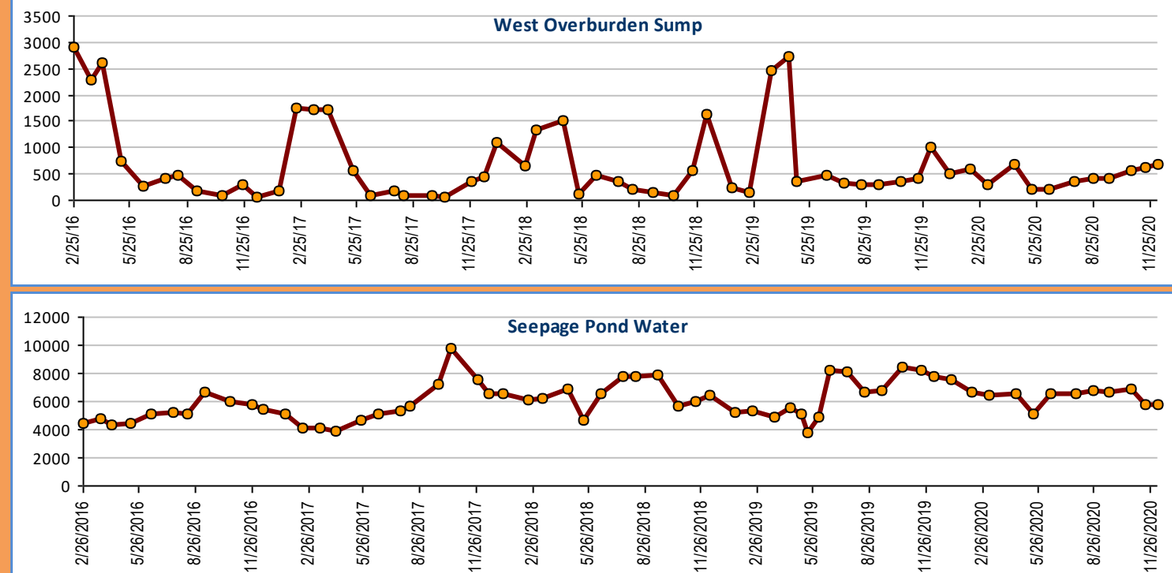
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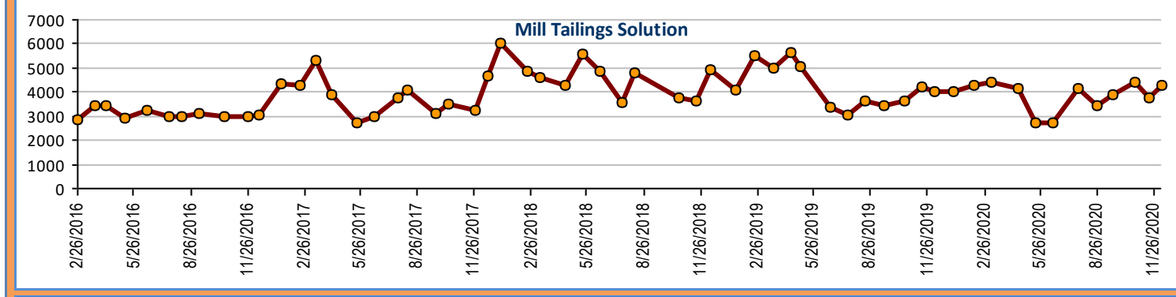
Mine Water Monitoring - Water Quality Profile II, Trend Charts

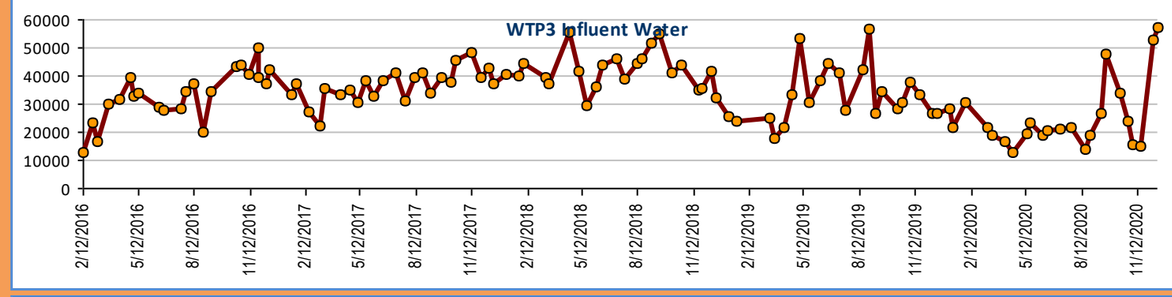
Sulfate, units mg/L

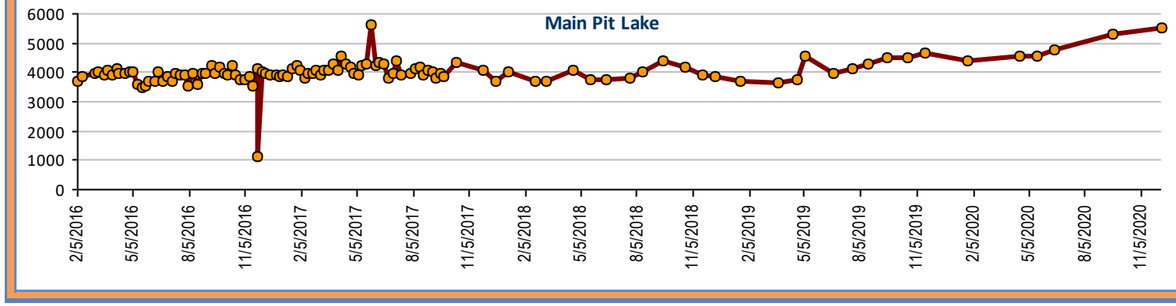


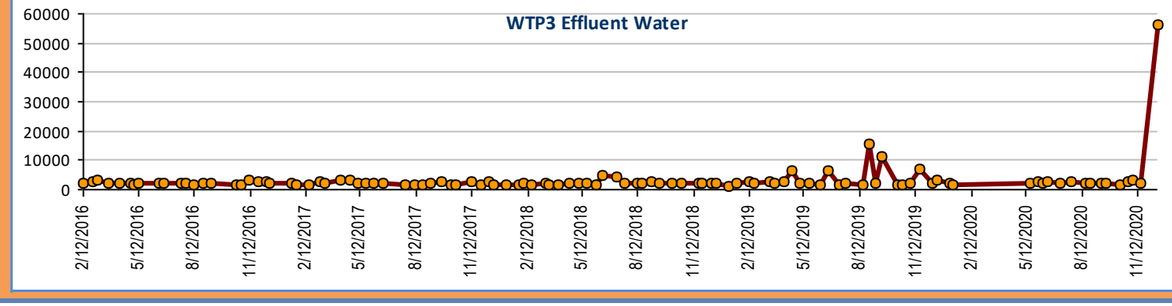








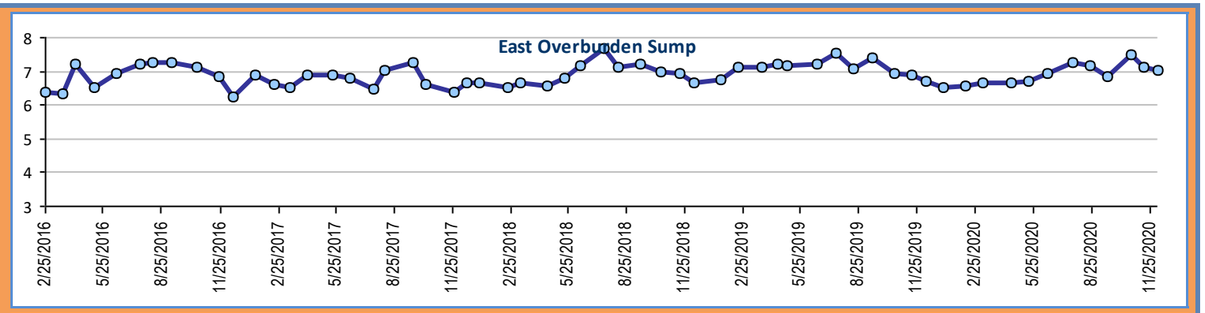


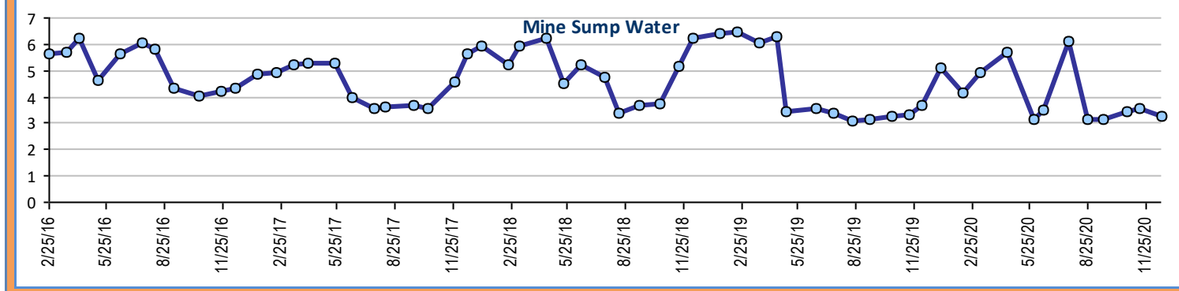


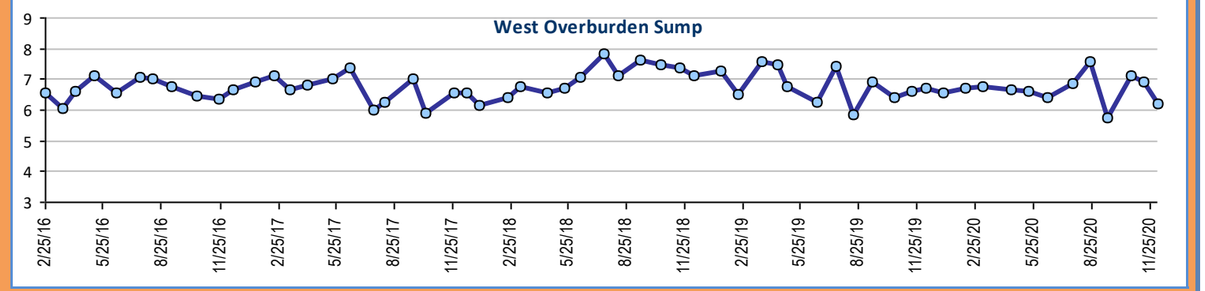
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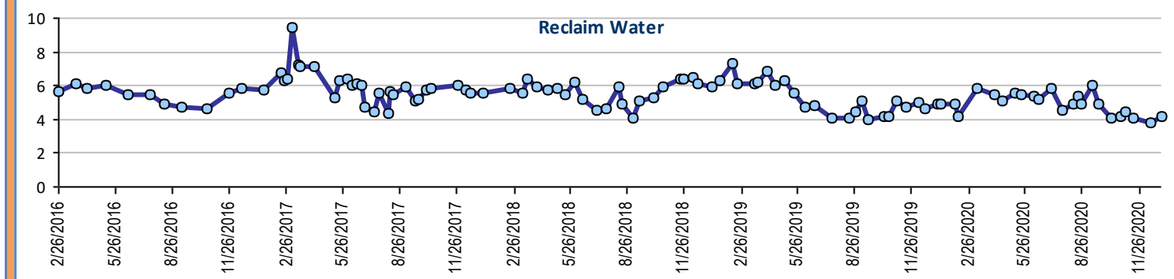
Mine Water Monitoring - Water Quality Profile II, Trend Charts

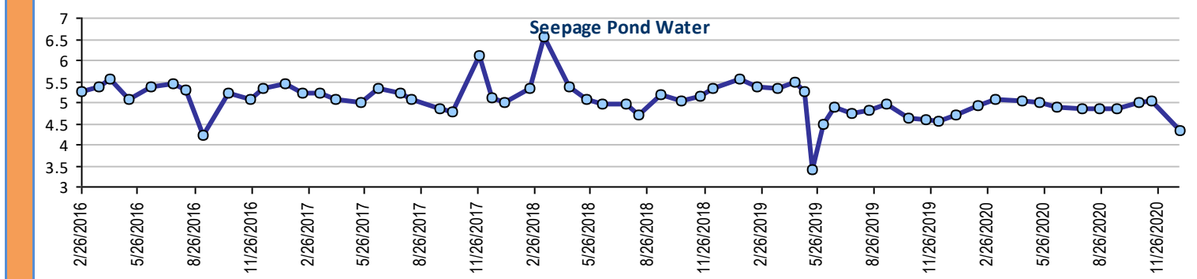
pH, units

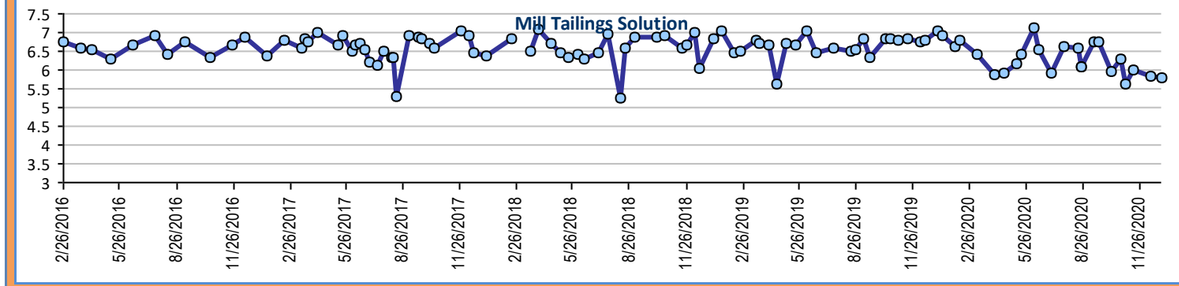


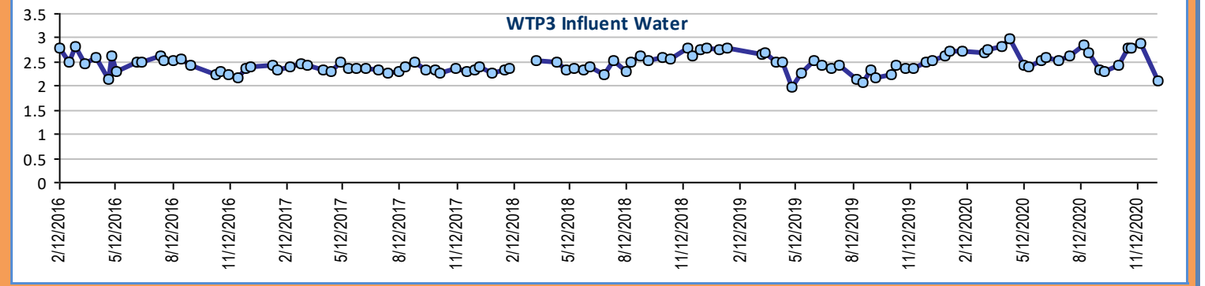


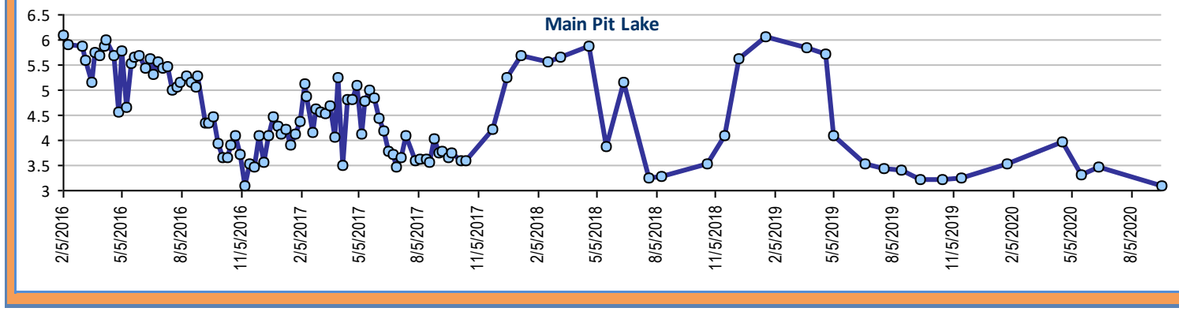


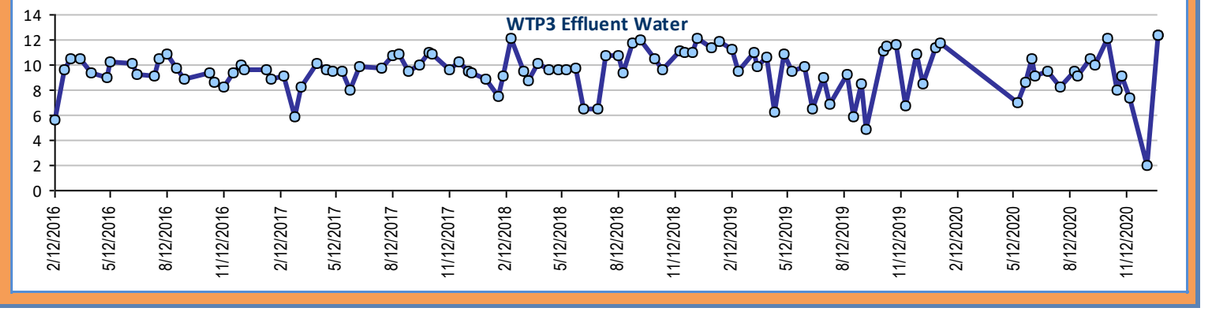








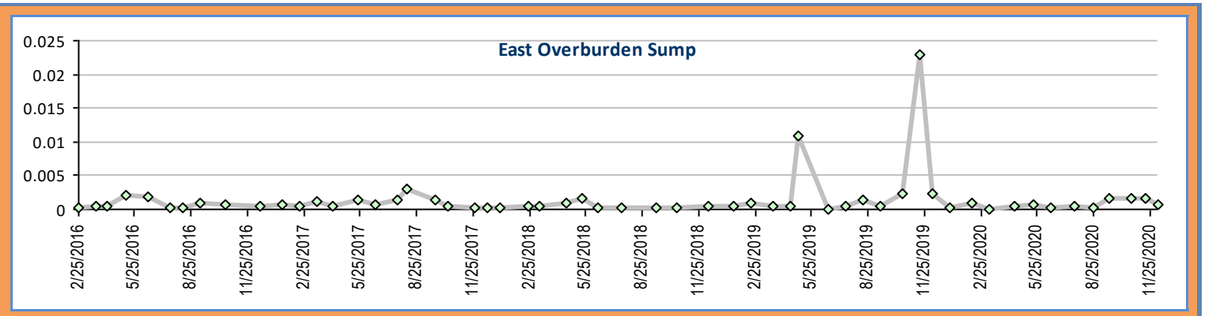


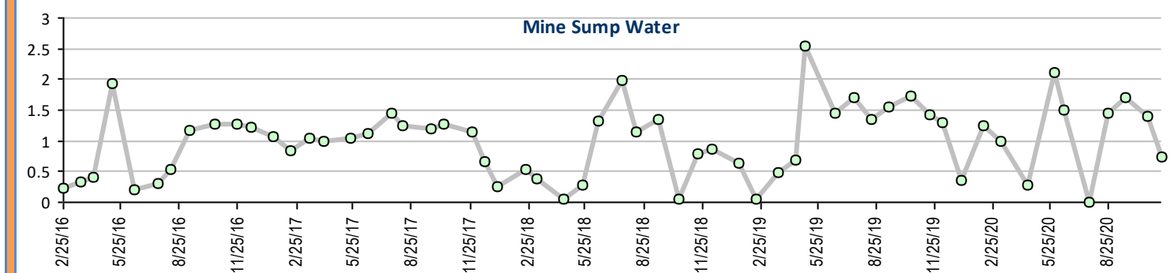


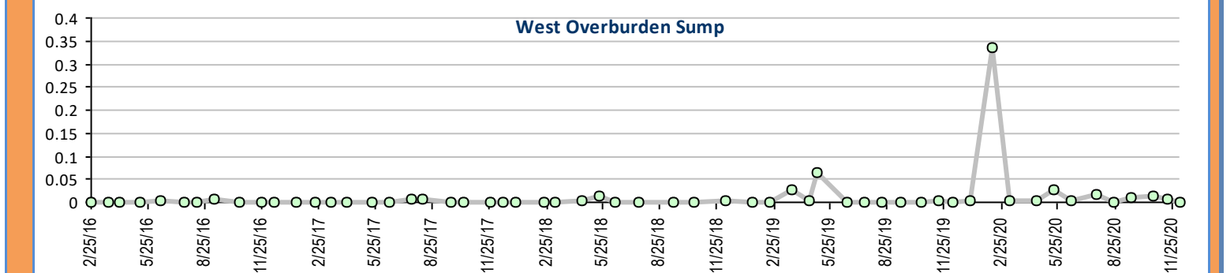
RED DOG MINE

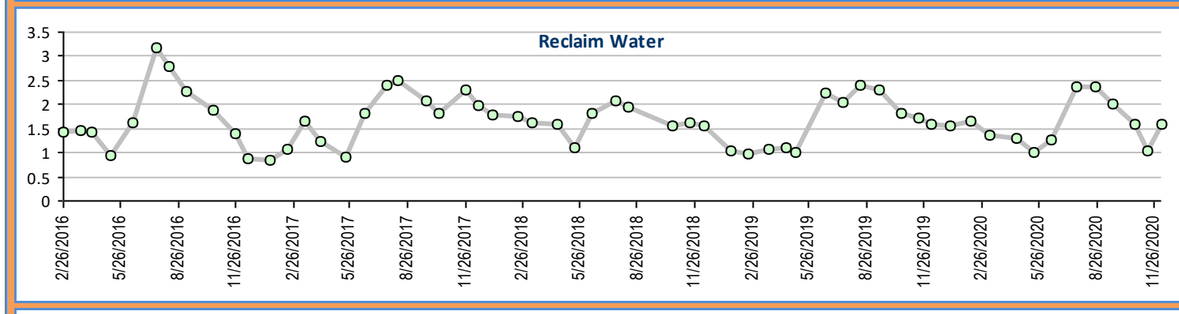
Mine Water Monitoring - Water Quality Profile II, Trend Charts

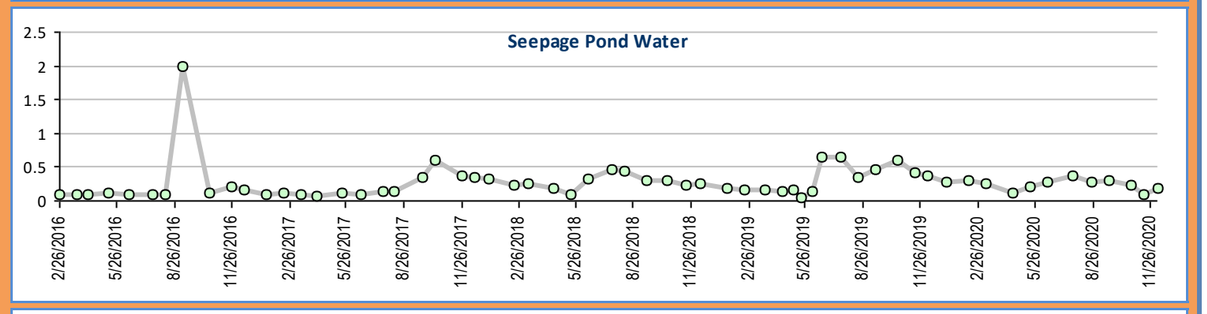
Lead, dissolved, units mg/L

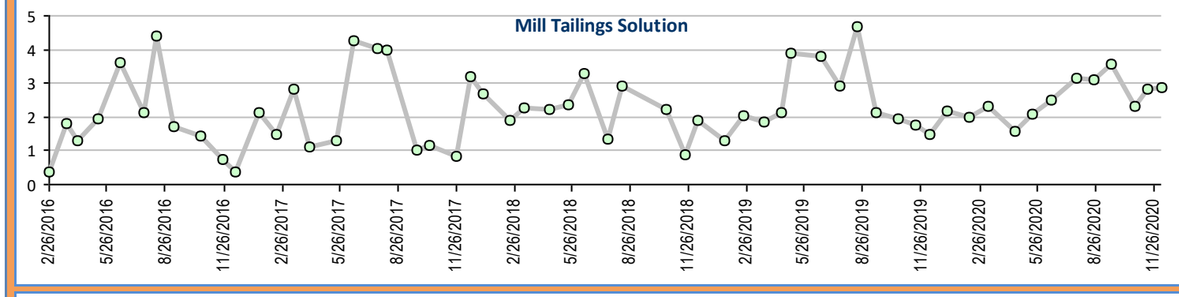


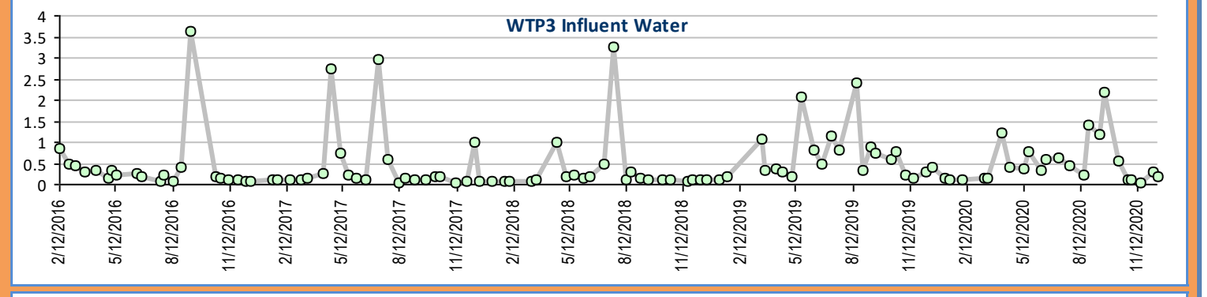


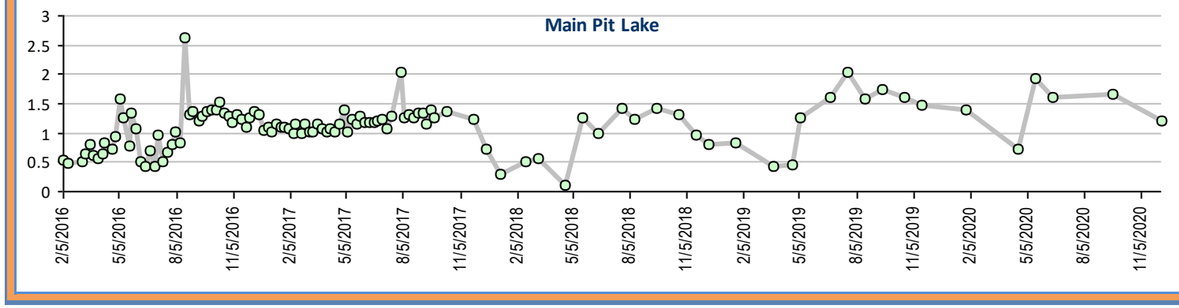


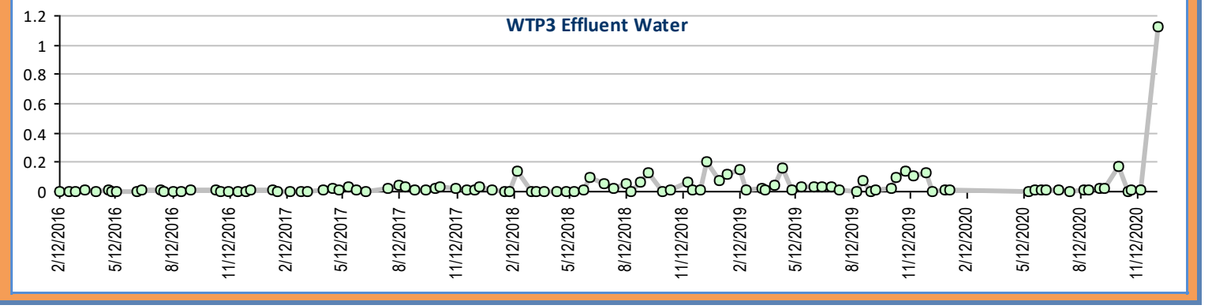








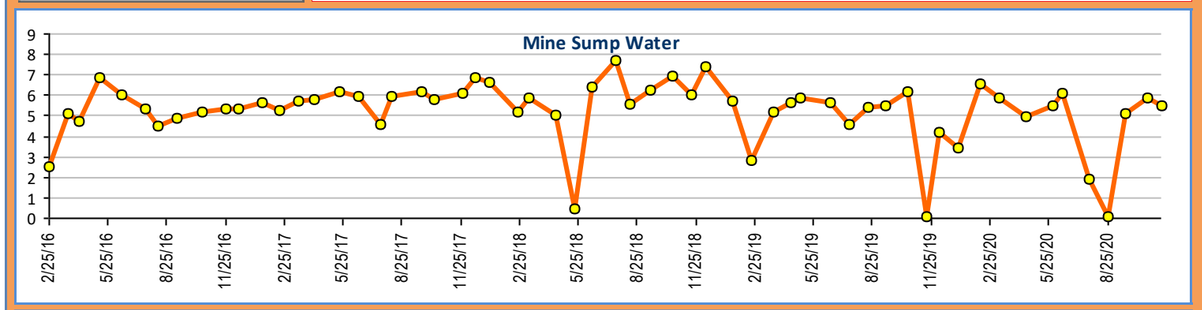


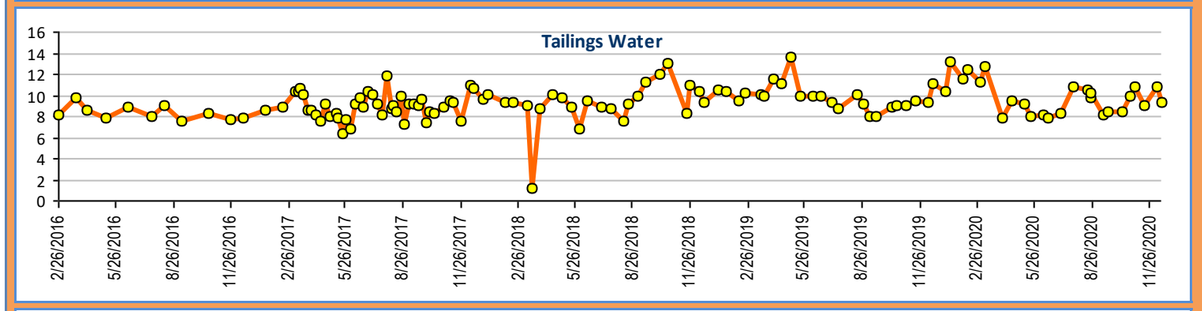


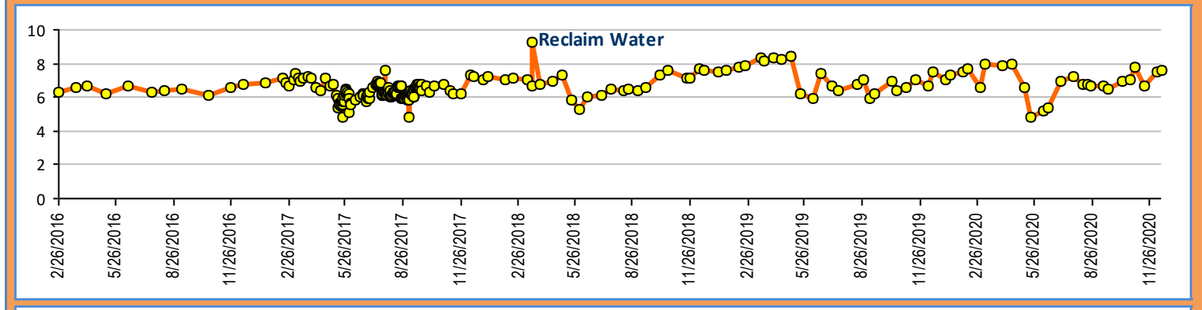
RED DOG MINE

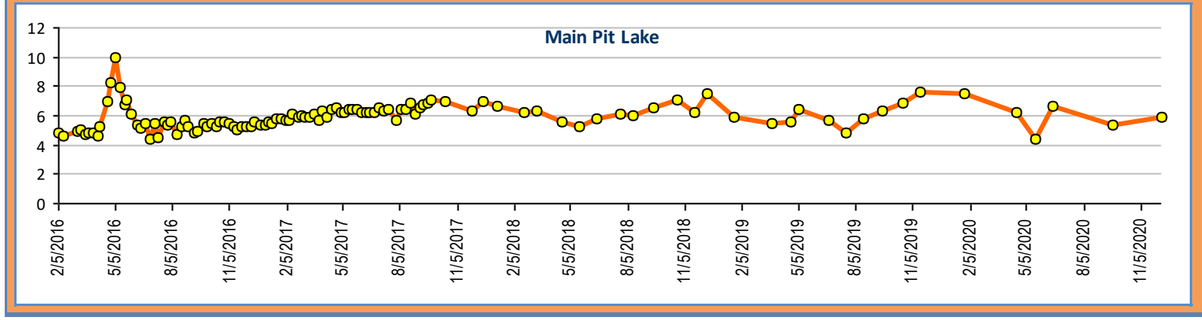
Mine Water Monitoring - Water Quality Profile II, Trend Charts

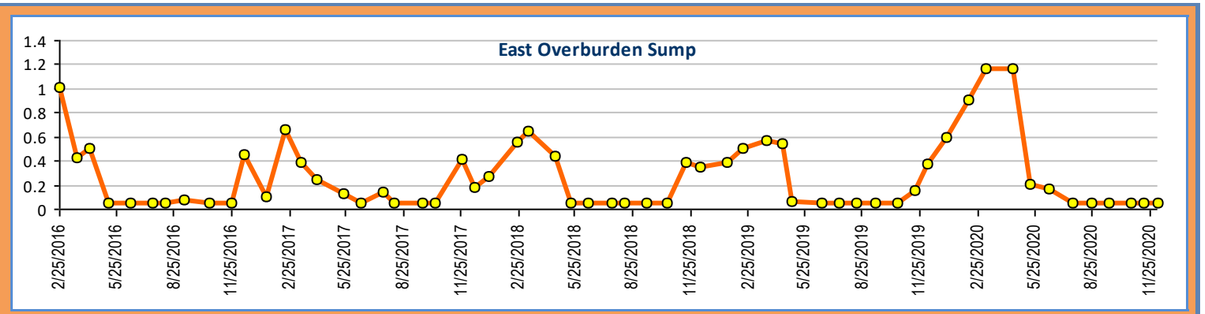
Ammonia as N, units mg/L

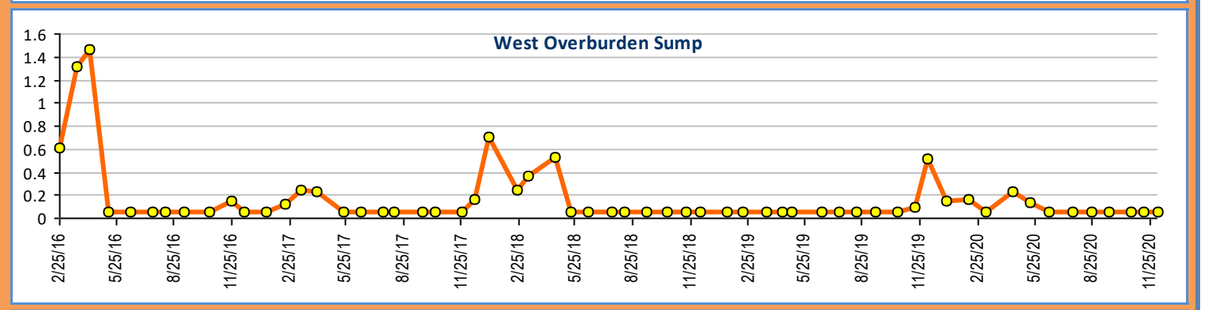


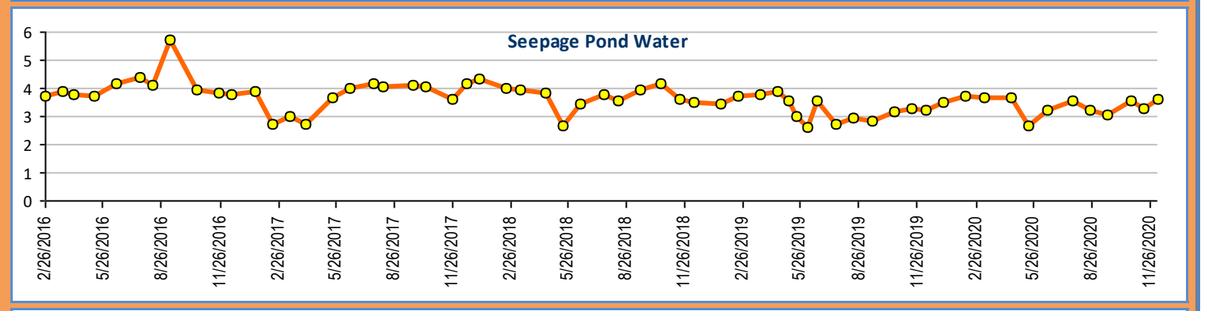


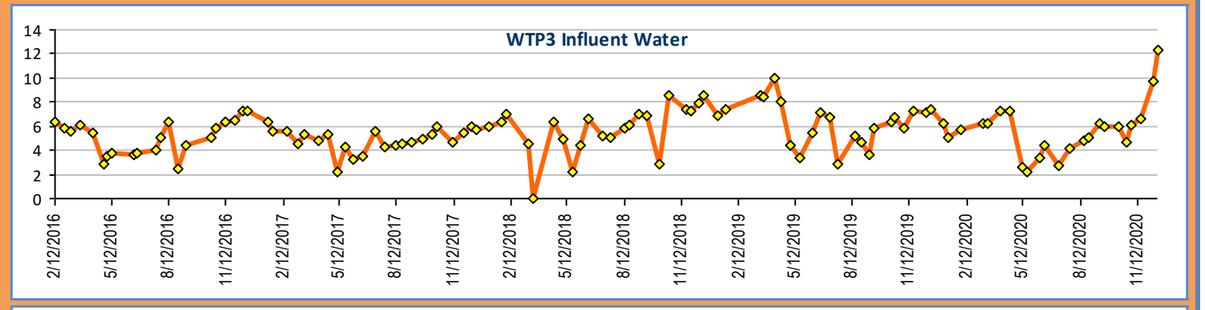


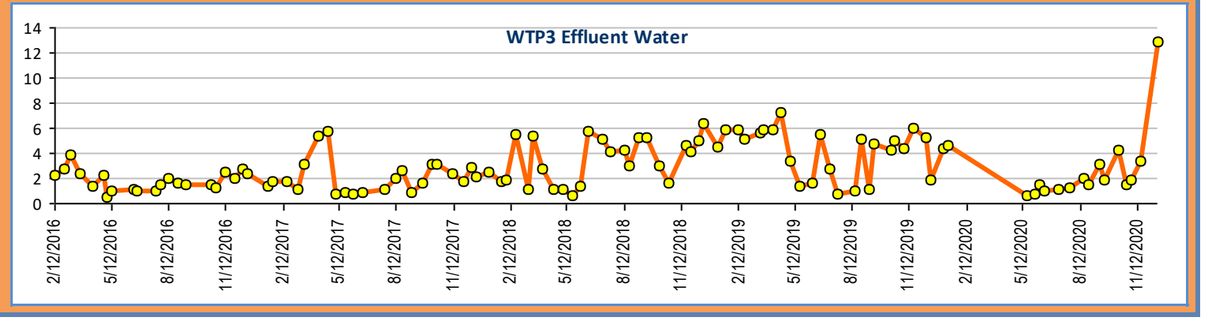








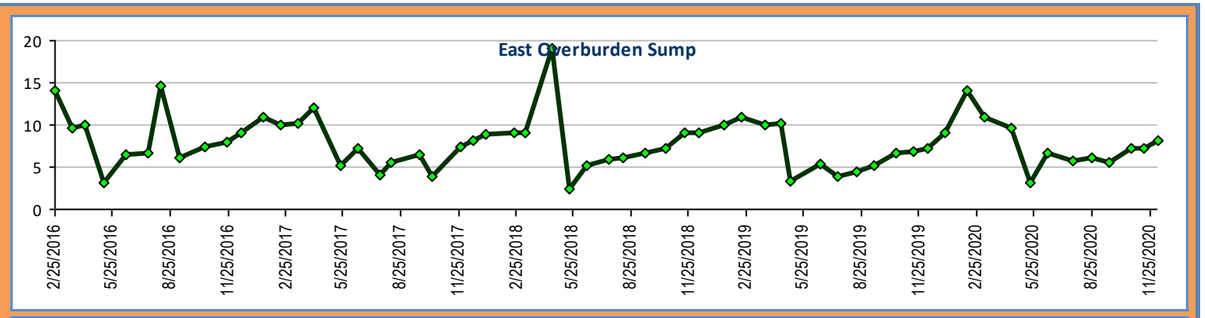


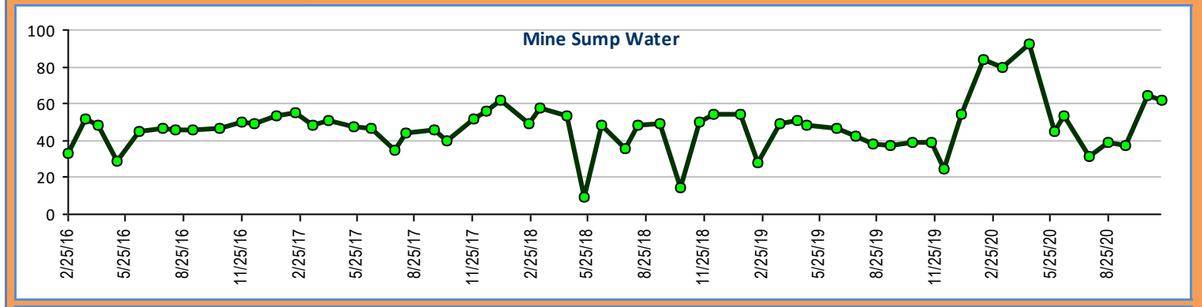


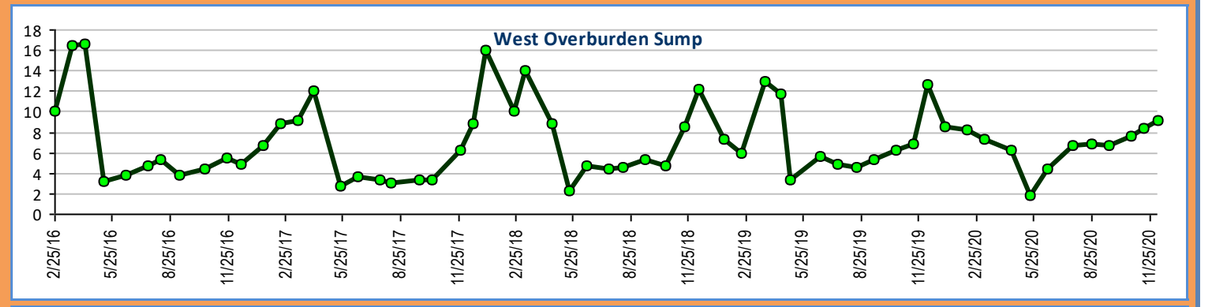
RED DOG MINE

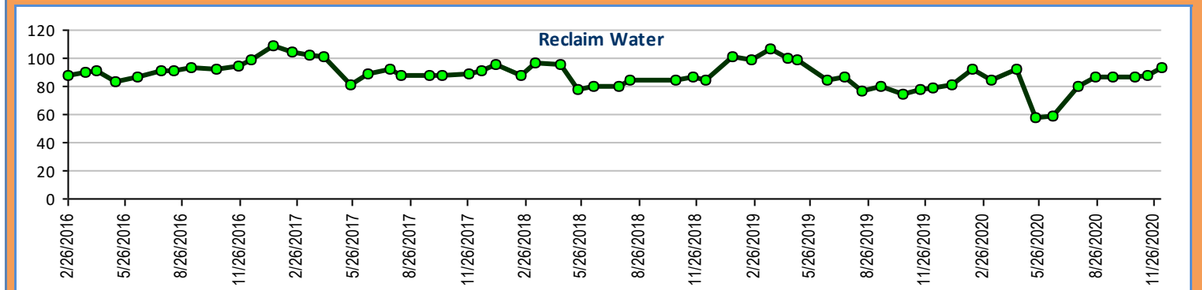
Mine Water Monitoring - Water Quality Profile II, Trend Charts

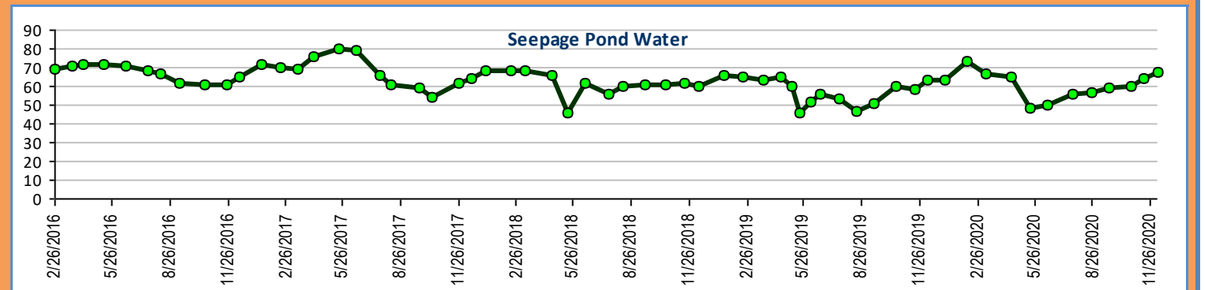
Sodium, dissolved, units mg/L

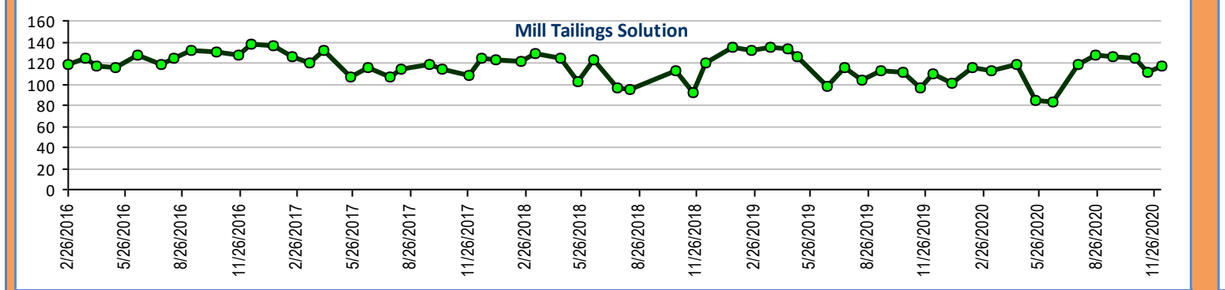


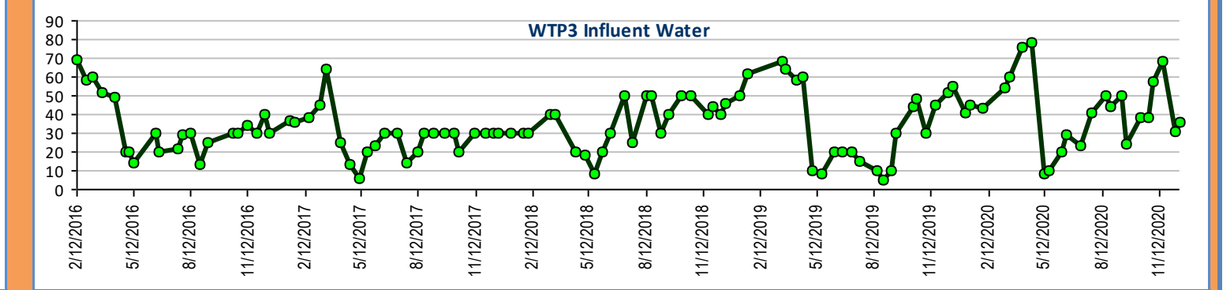


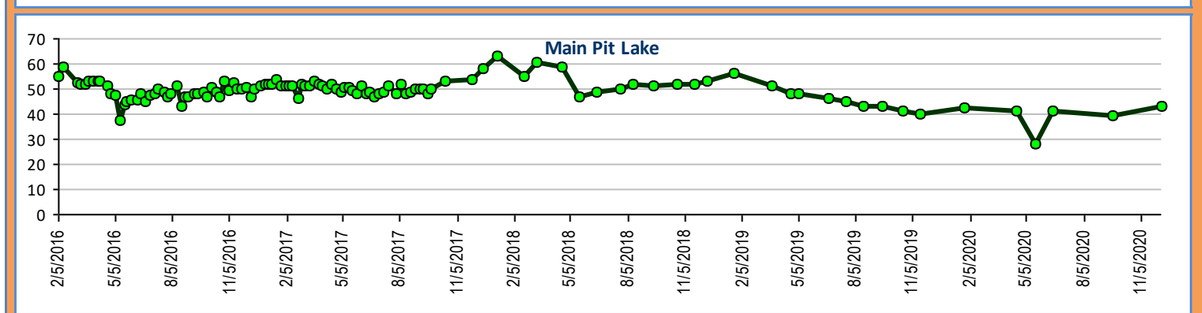


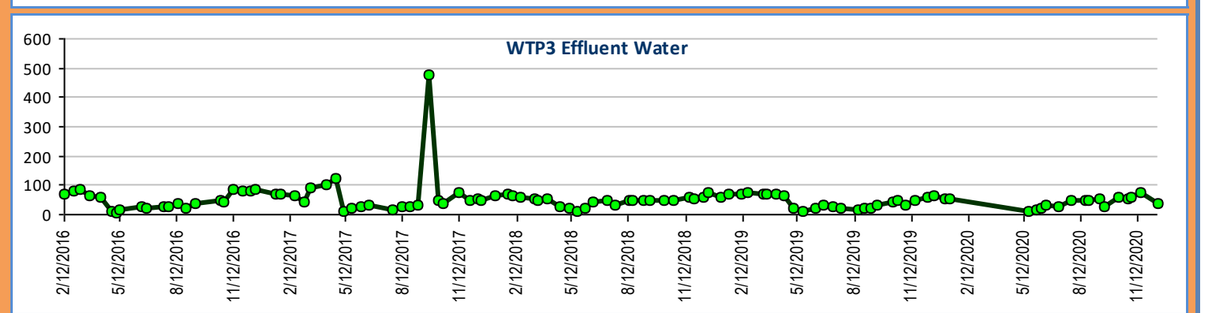








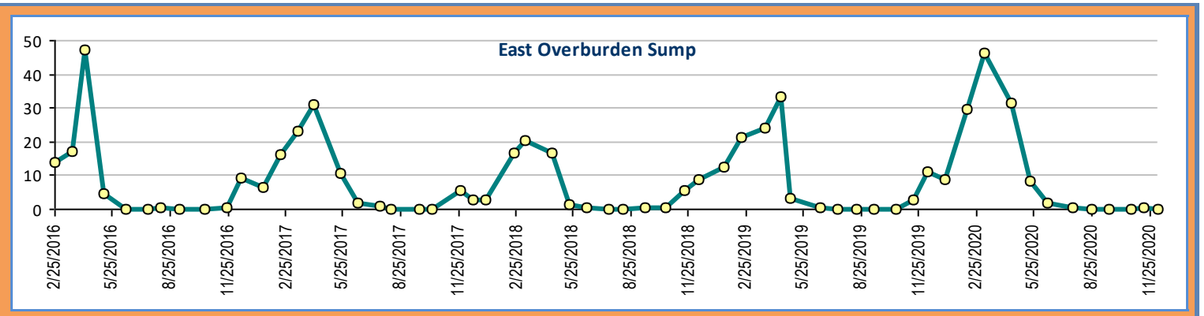


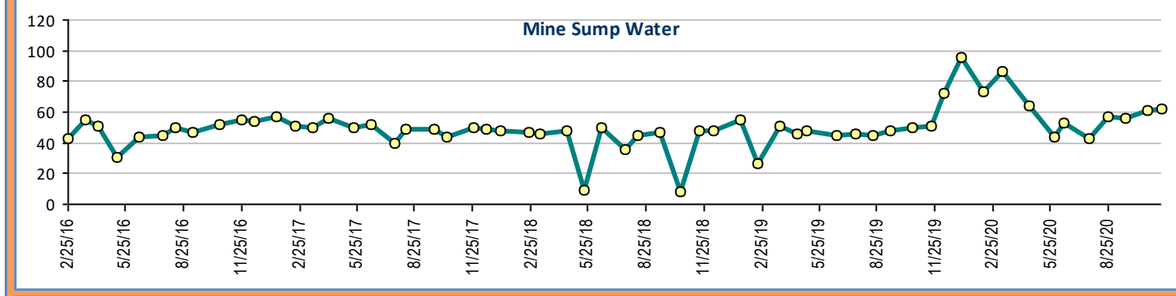


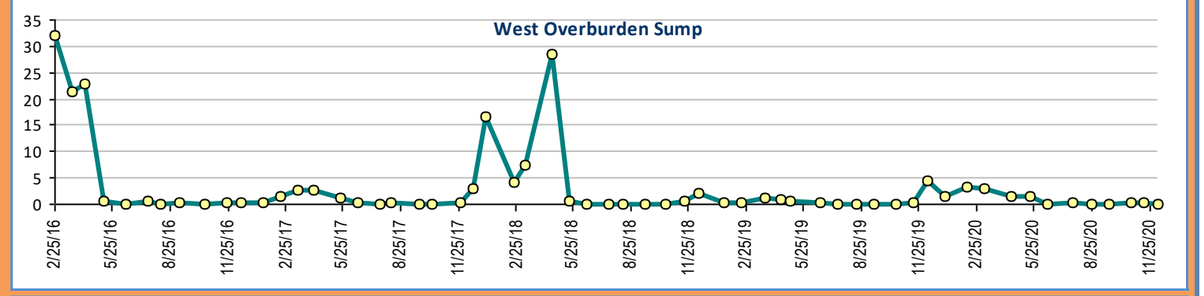
RED DOG MINE

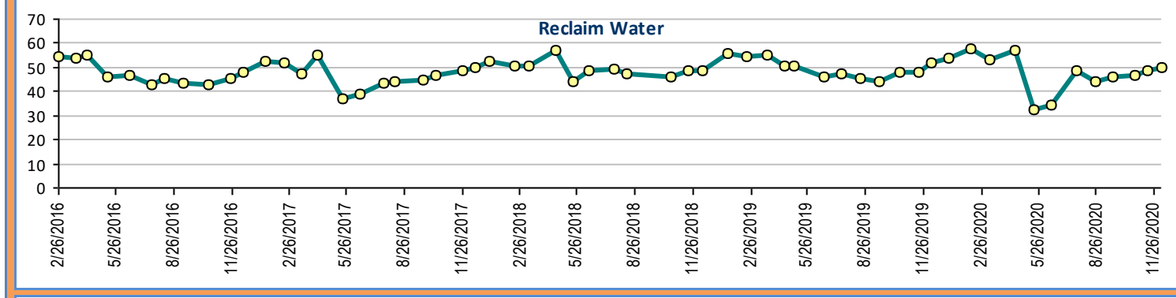
Mine Water Monitoring - Water Quality Profile II, Trend Charts

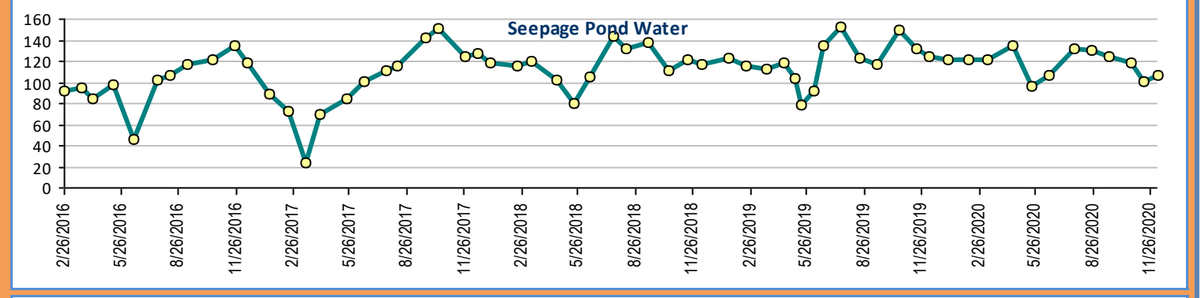
Manganese, dissolved, units mg/L

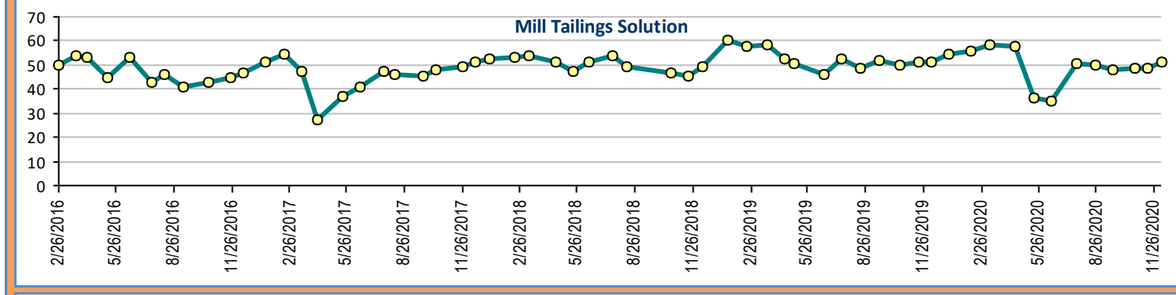


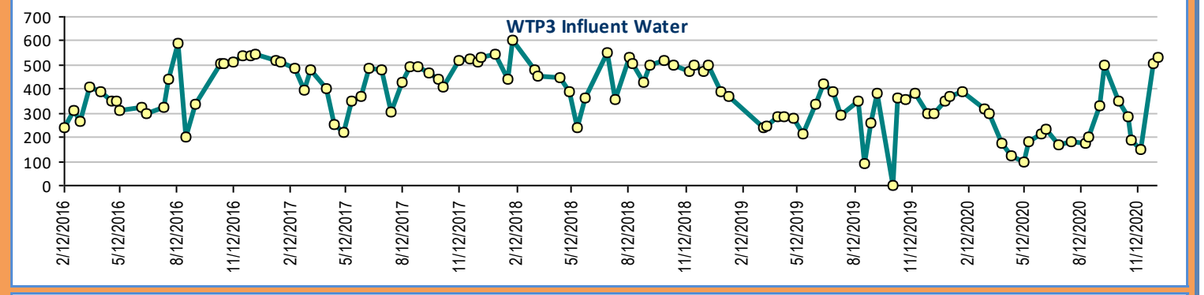


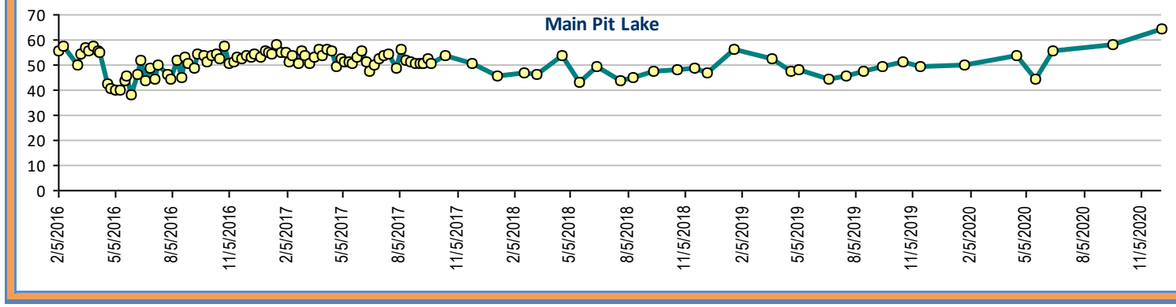


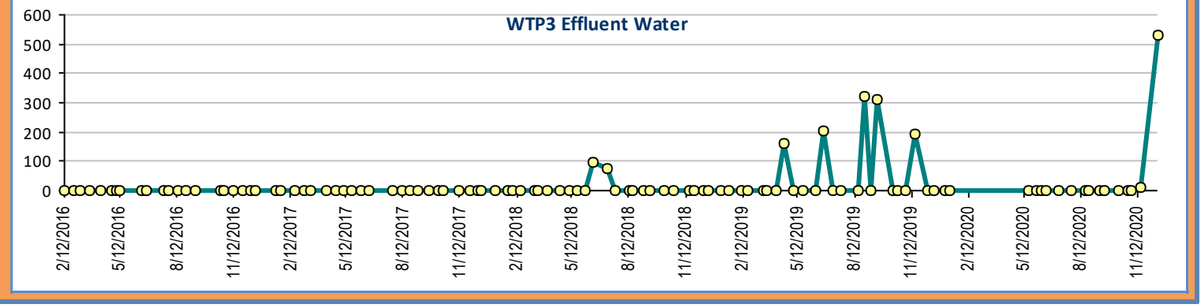








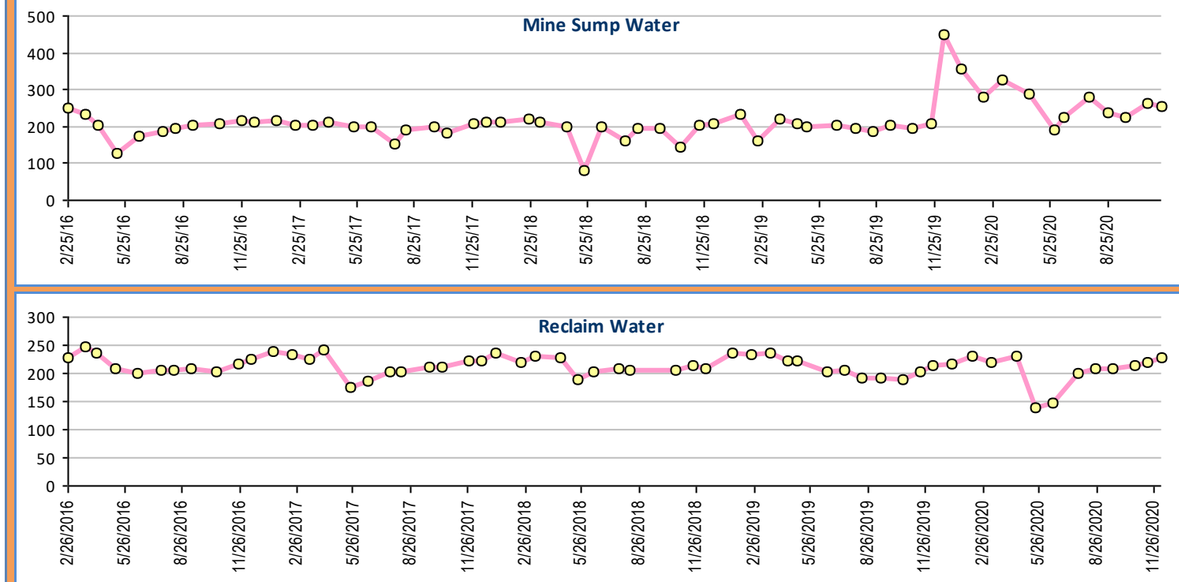


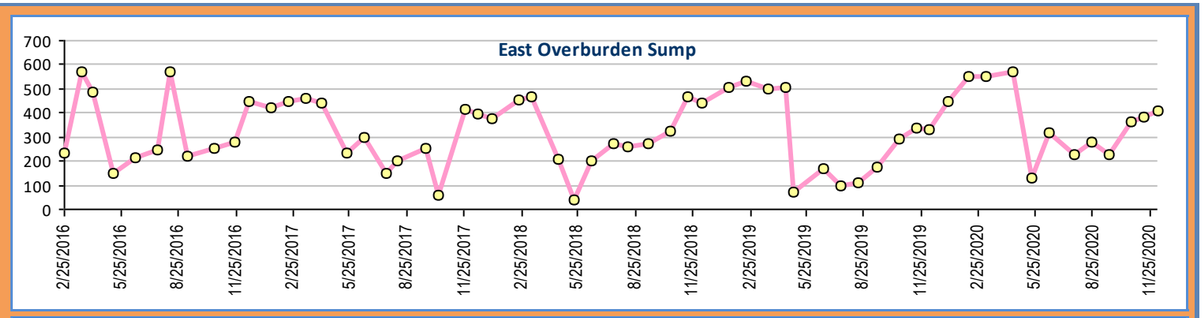


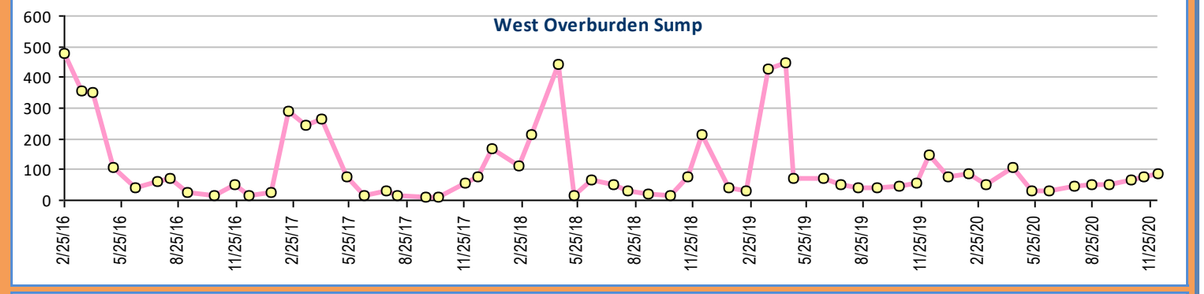
RED DOG MINE

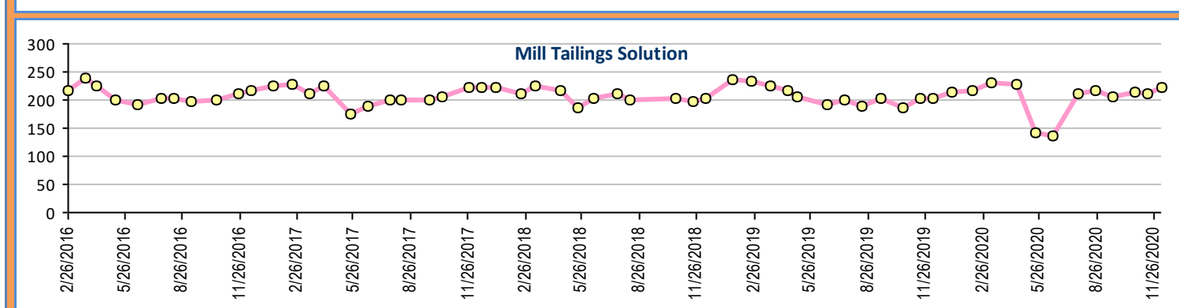
Mine Water Monitoring - Water Quality Profile II, Trend Charts

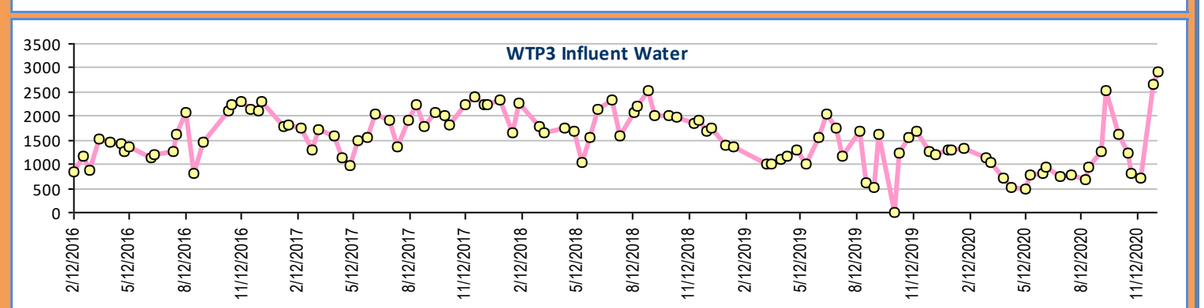
Magnesium, dissolved, units mg/L

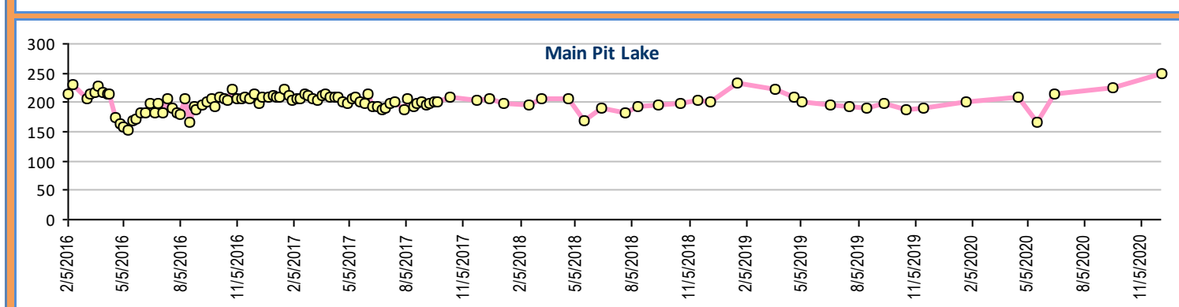


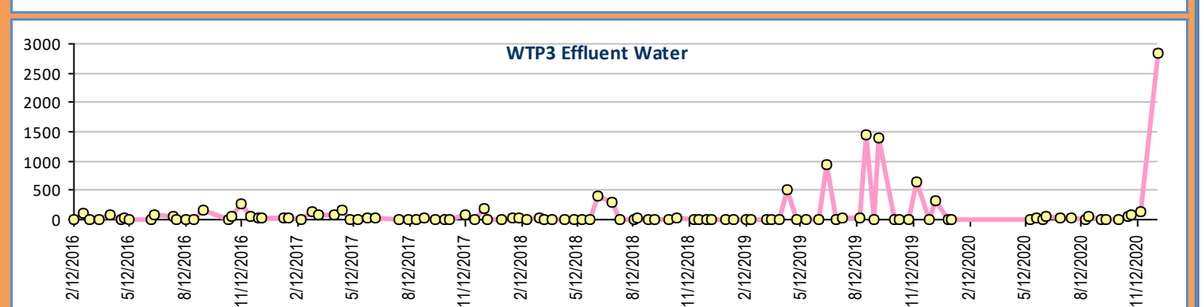








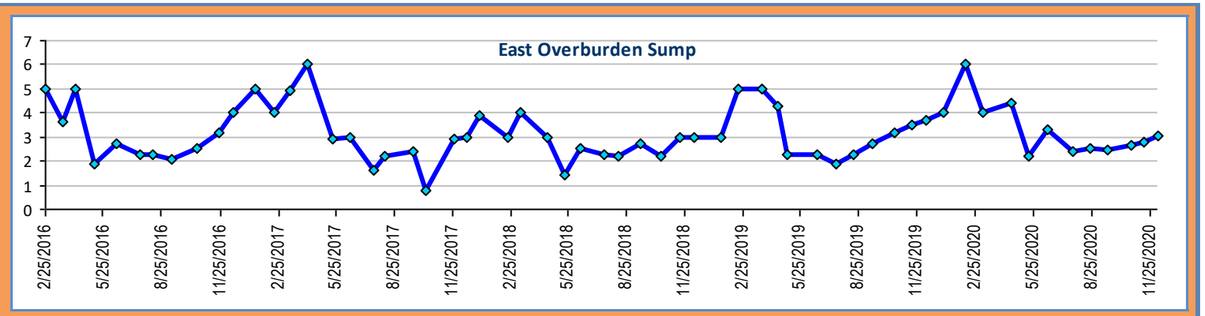


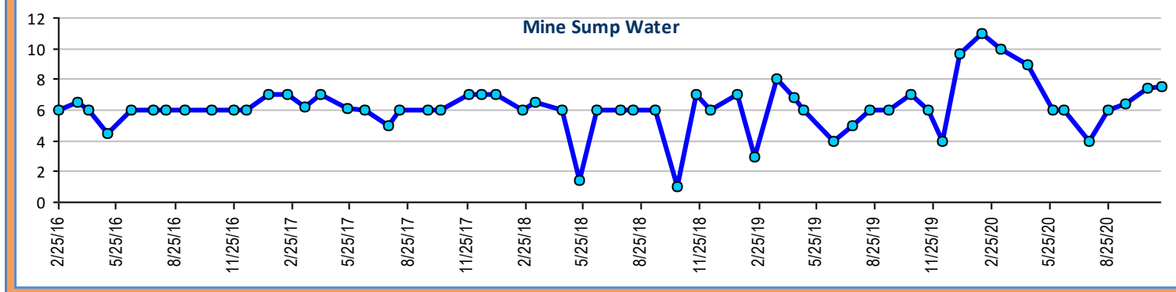


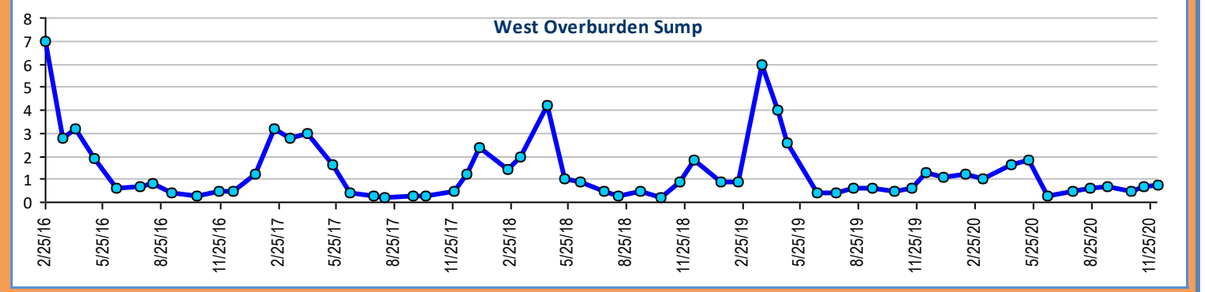
RED DOG MINE

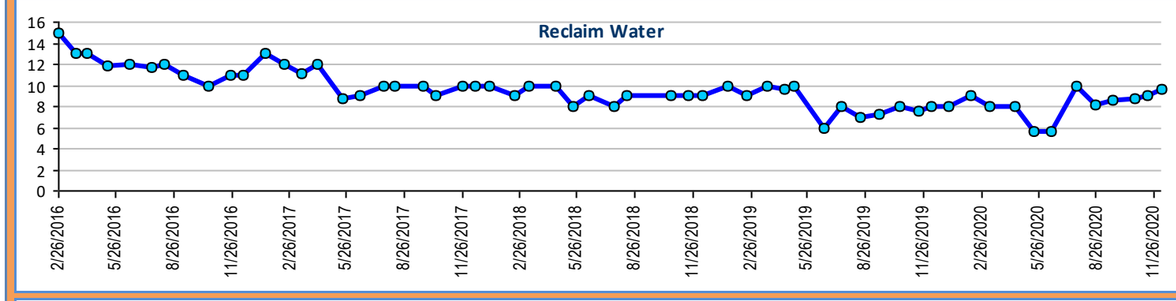
Mine Water Monitoring - Water Quality Profile II, Trend Charts

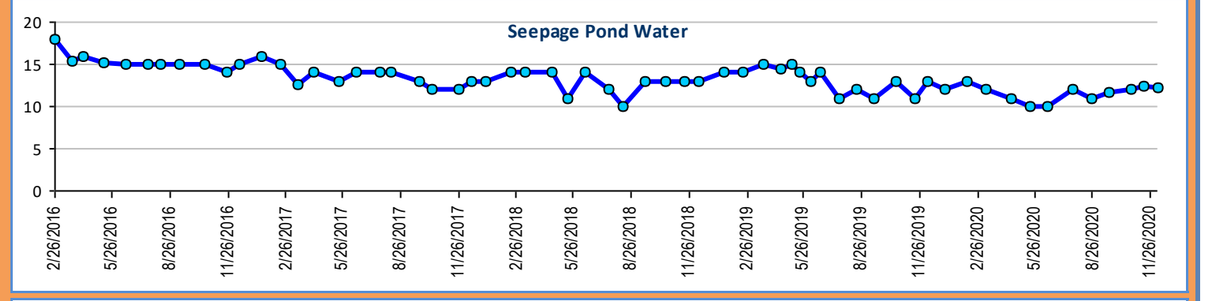
Potassium, dissolved, units mg/L

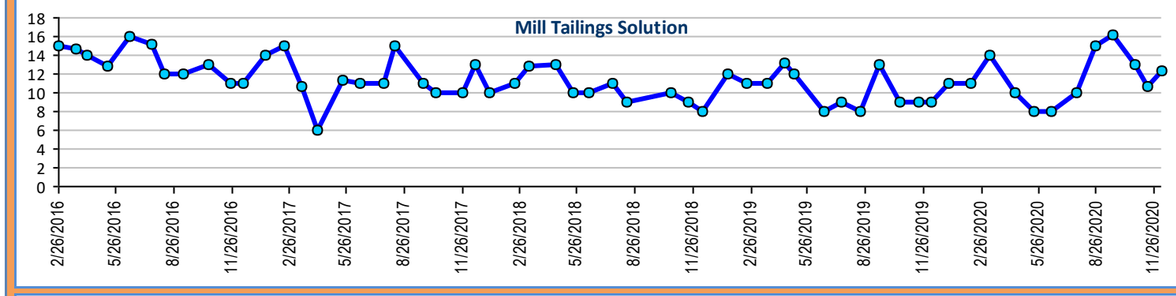


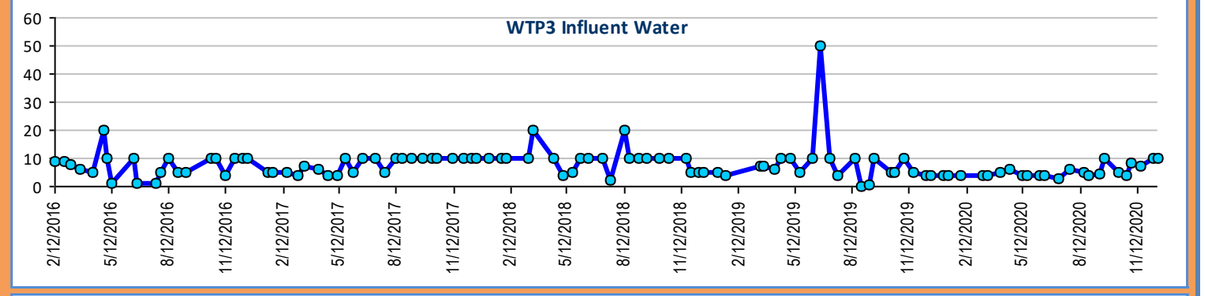


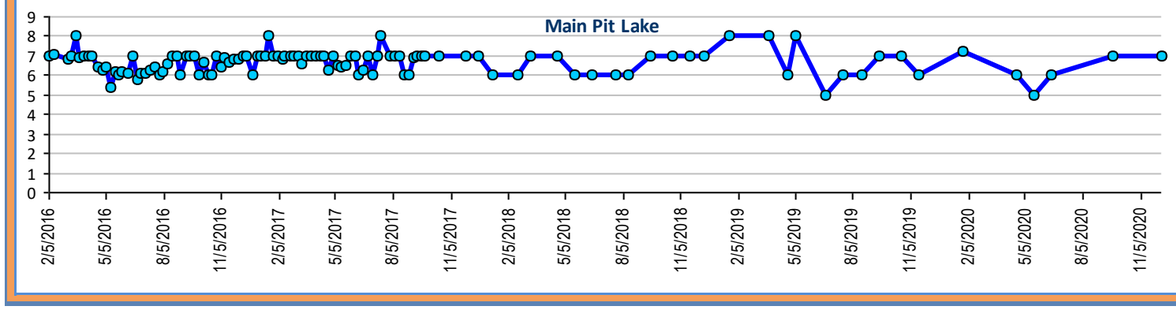


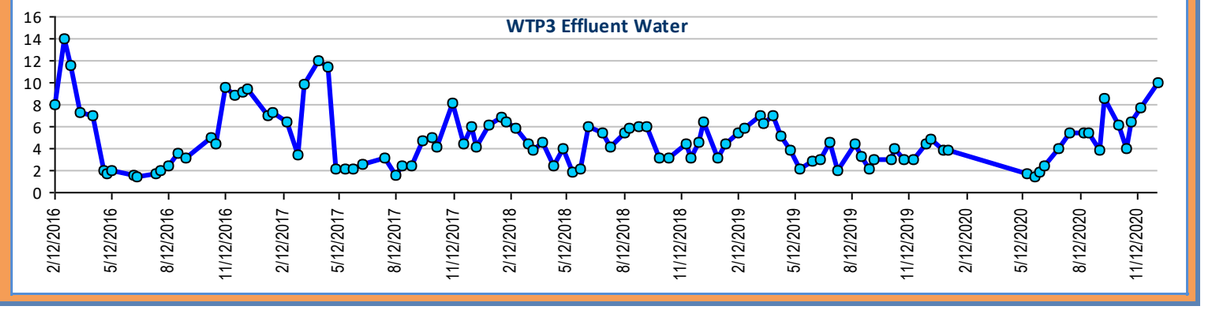








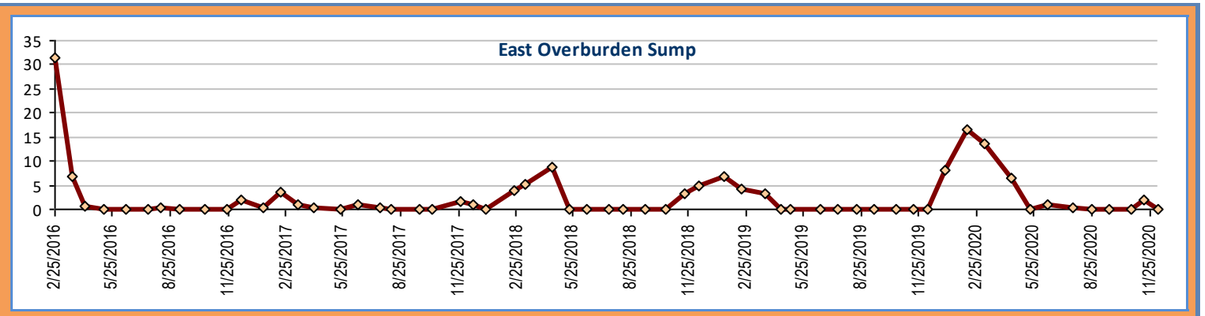


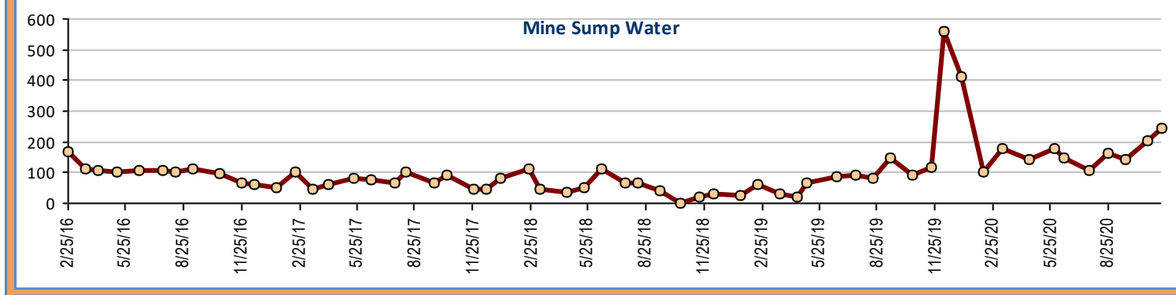


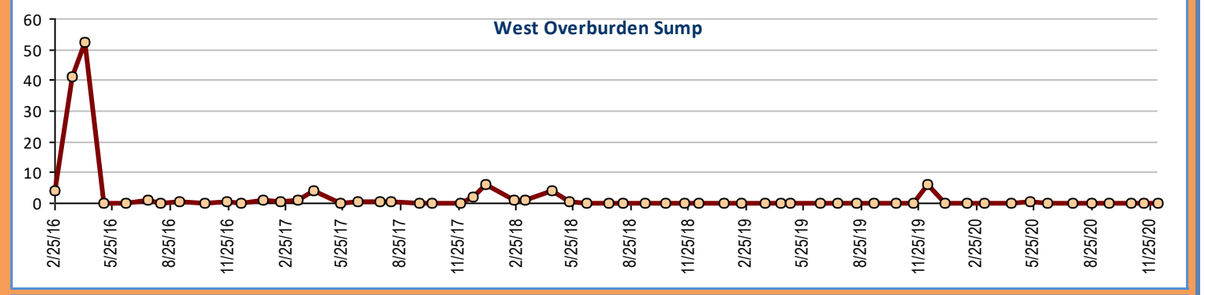
RED DOG MINE

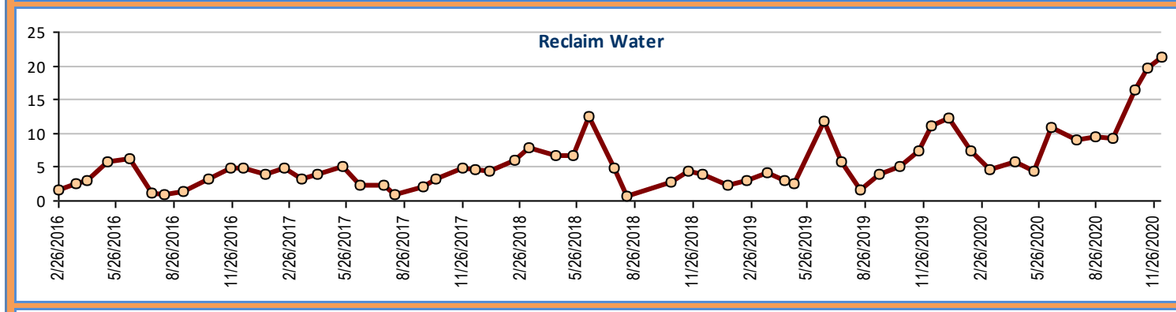
Mine Water Monitoring - Water Quality Profile II, Trend Charts

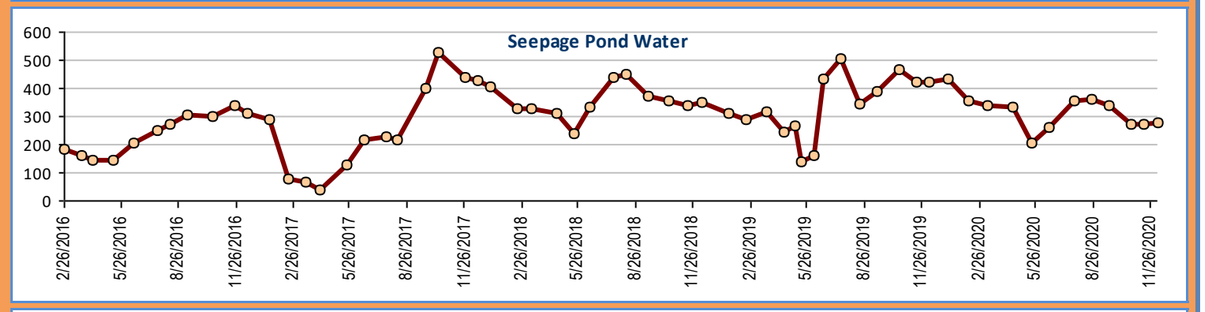
Iron, dissolved, units mg/L

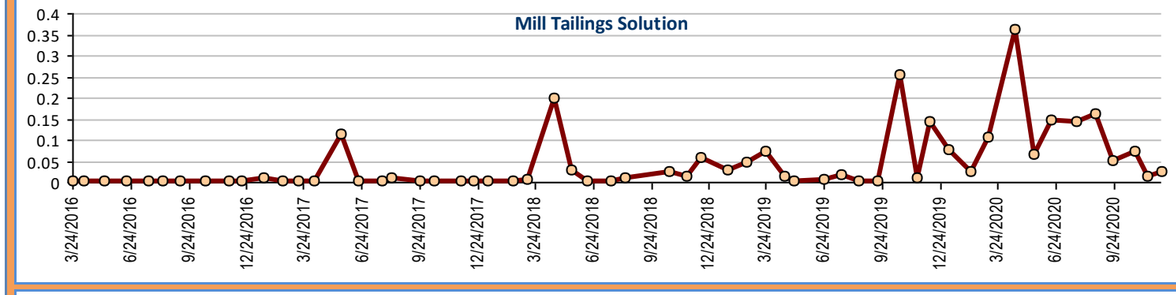


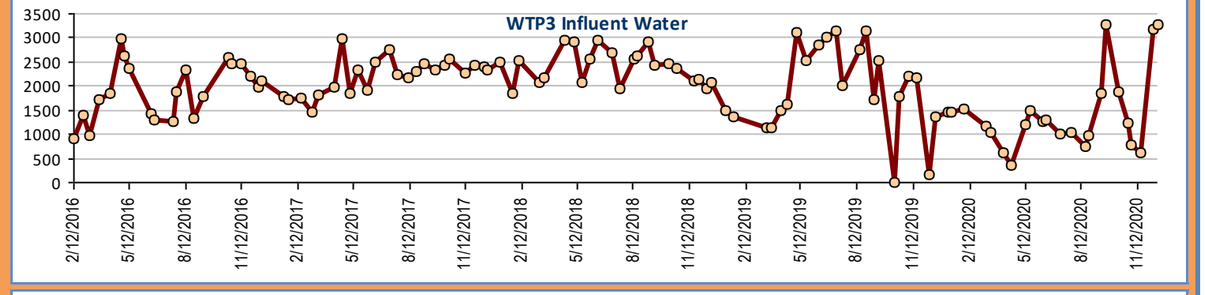


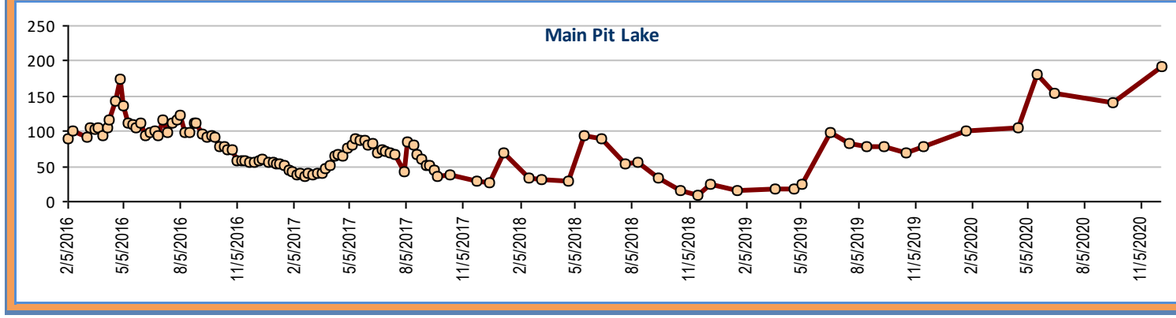


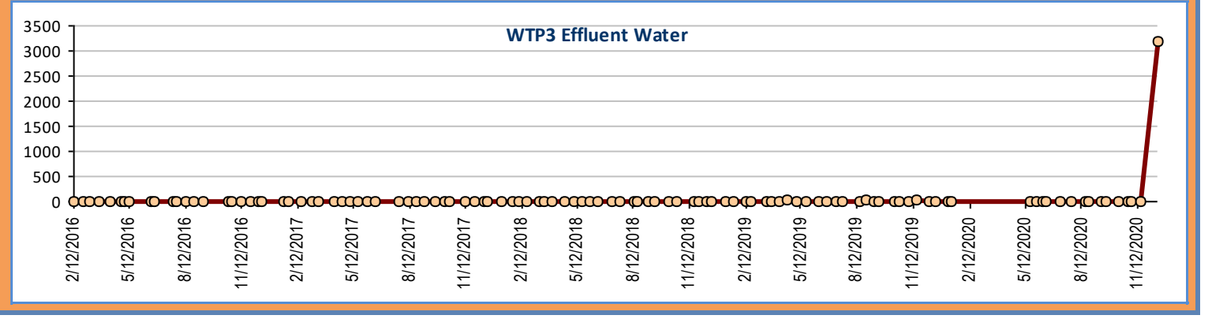








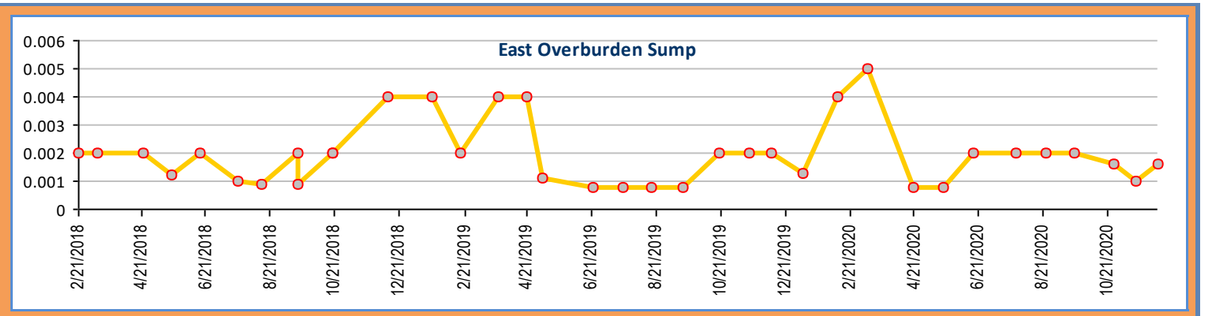


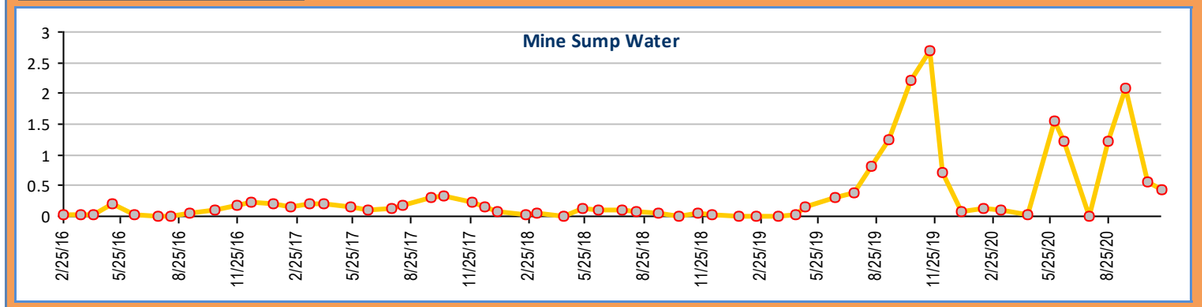


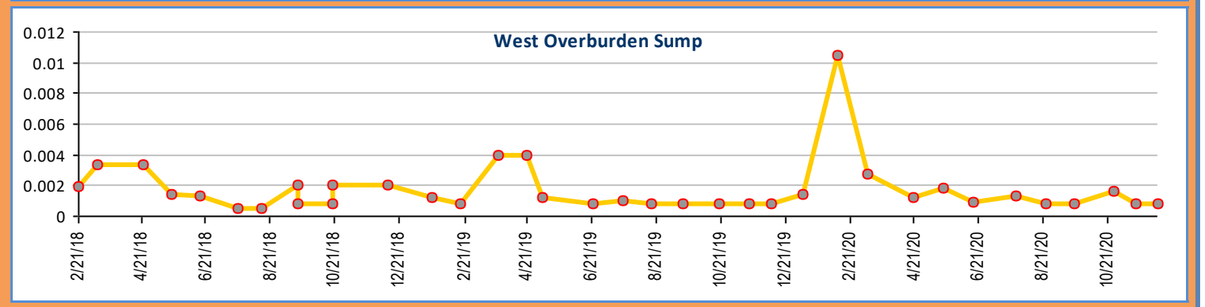
RED DOG MINE

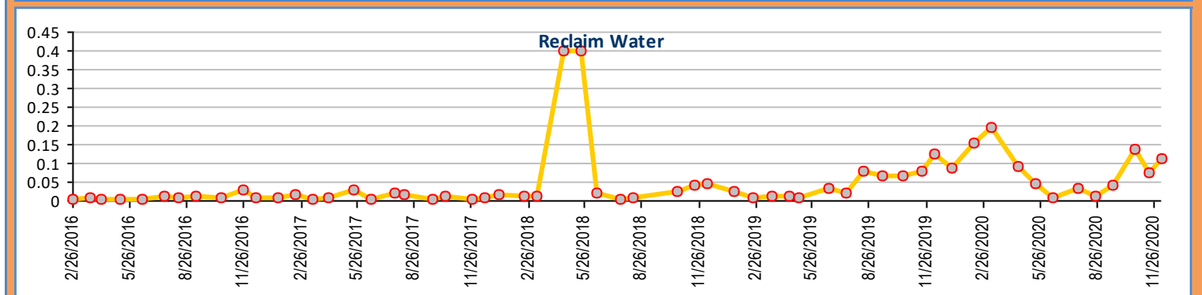
Mine Water Monitoring - Water Quality Profile II, Trend Charts

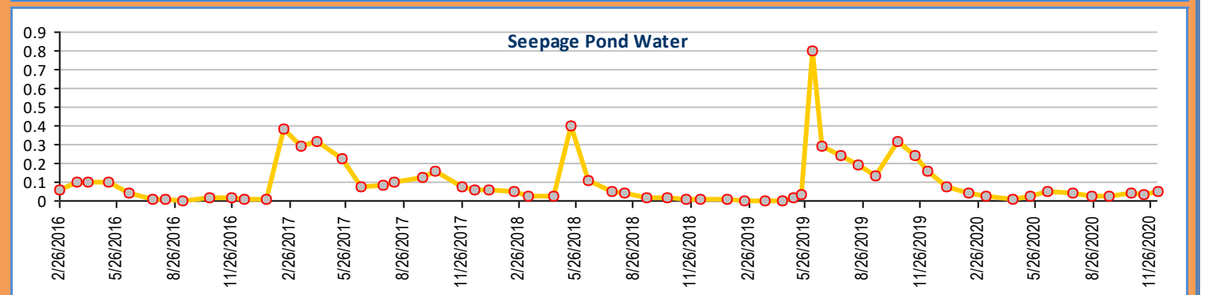
Copper, dissolved, units mg/L

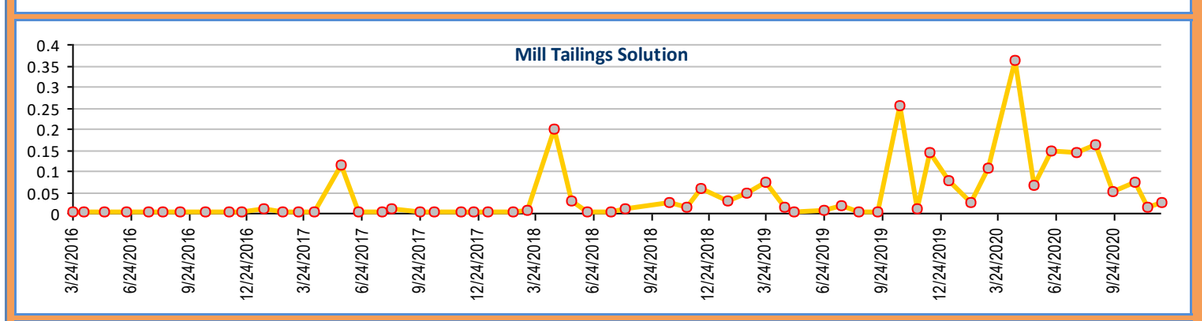


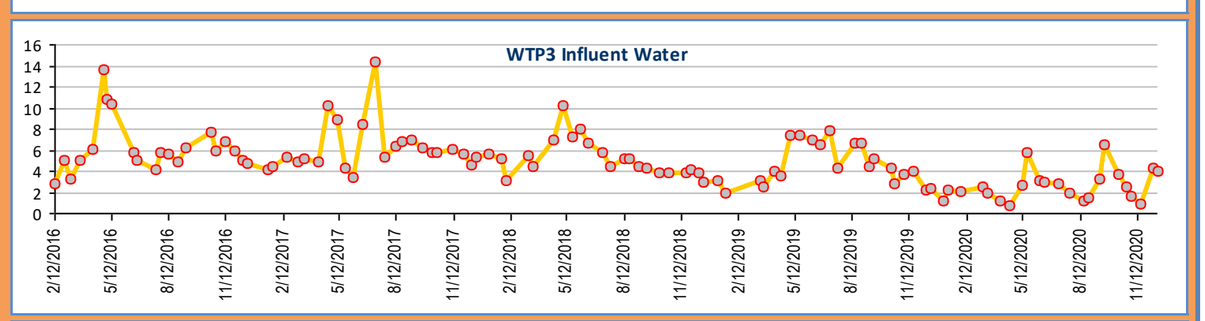


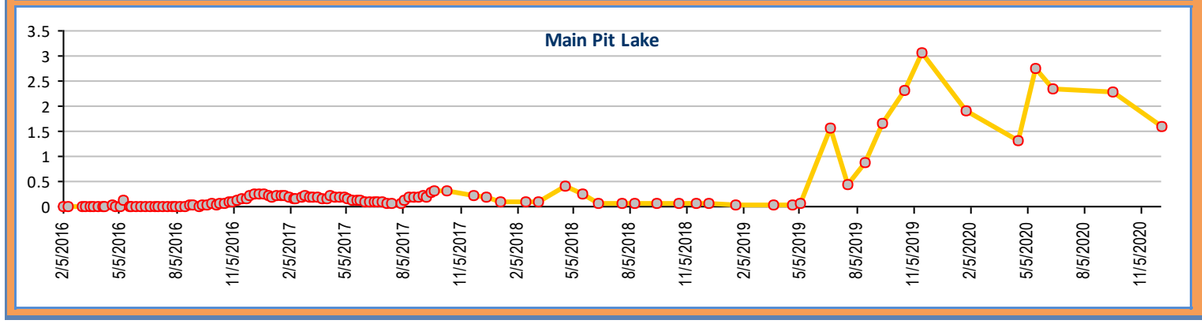


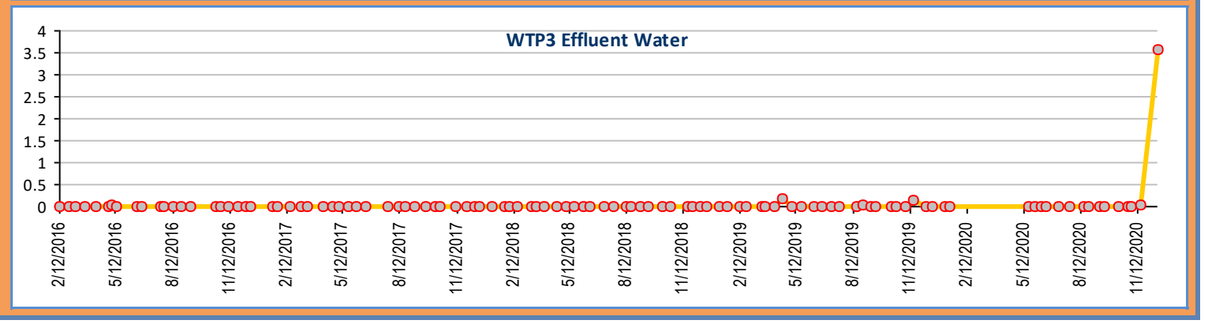








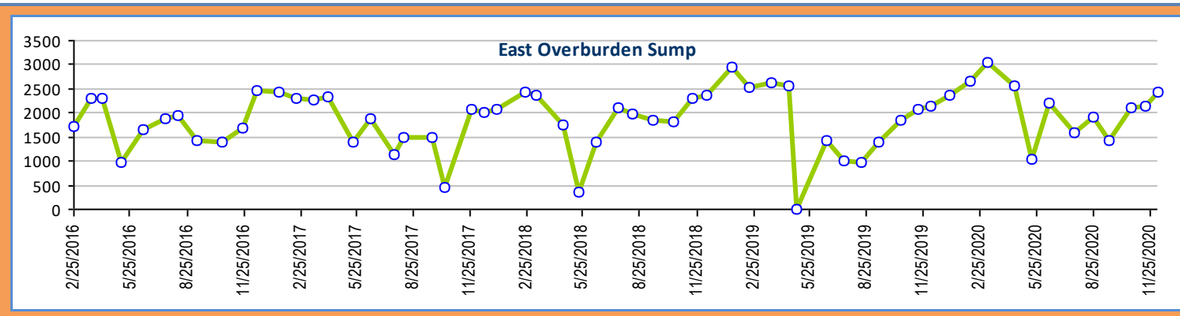


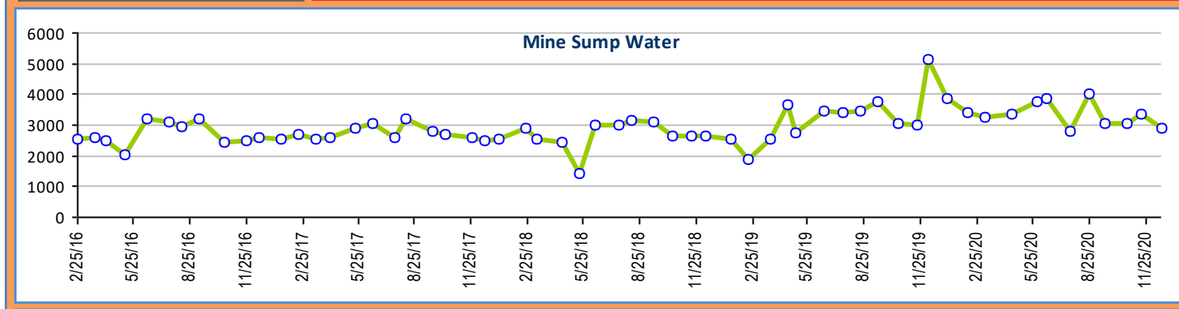


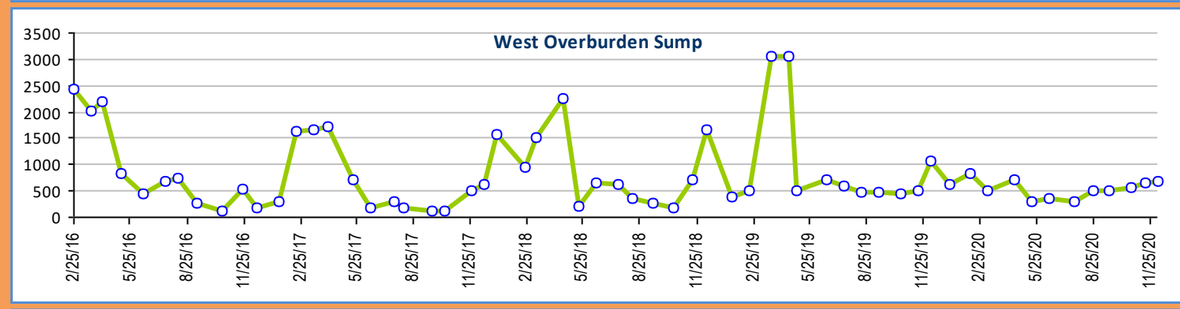
RED DOG MINE

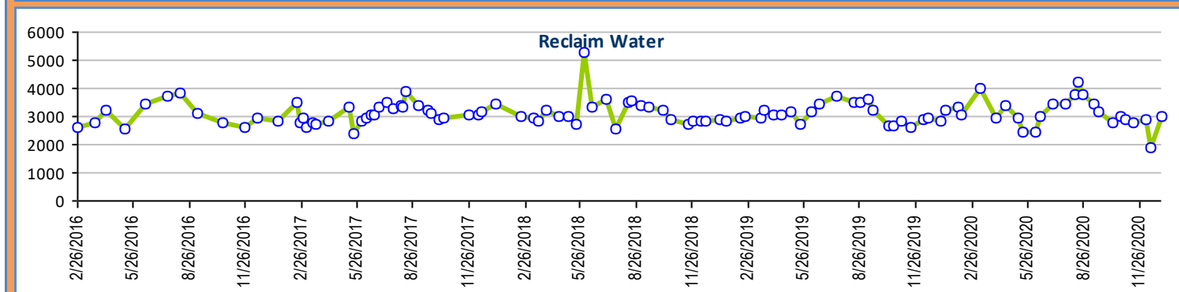
Mine Water Monitoring - Water Quality Profile II, Trend Charts

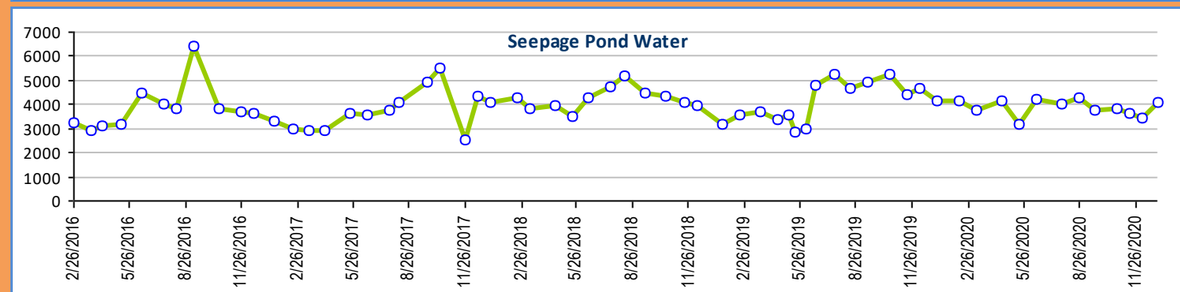
Conductivity, units uS/cm

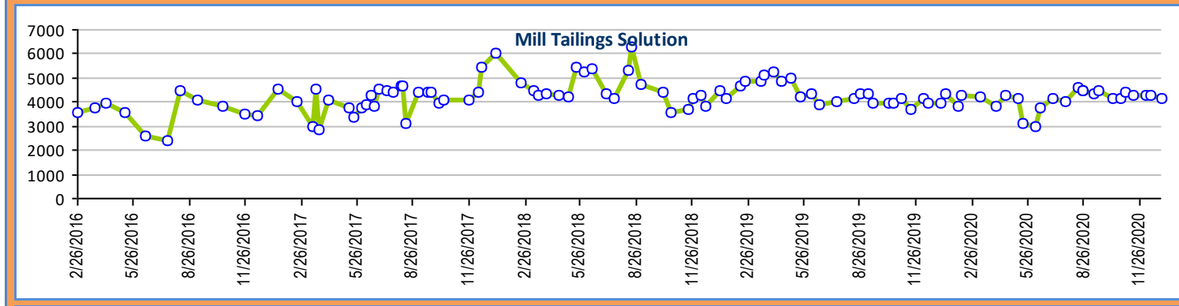


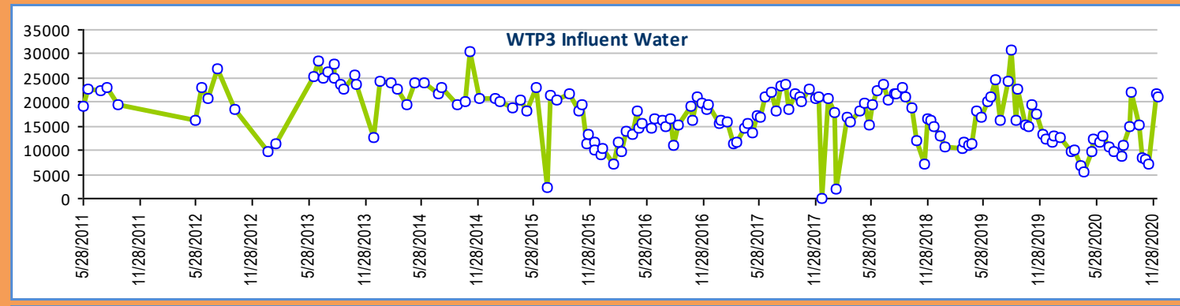


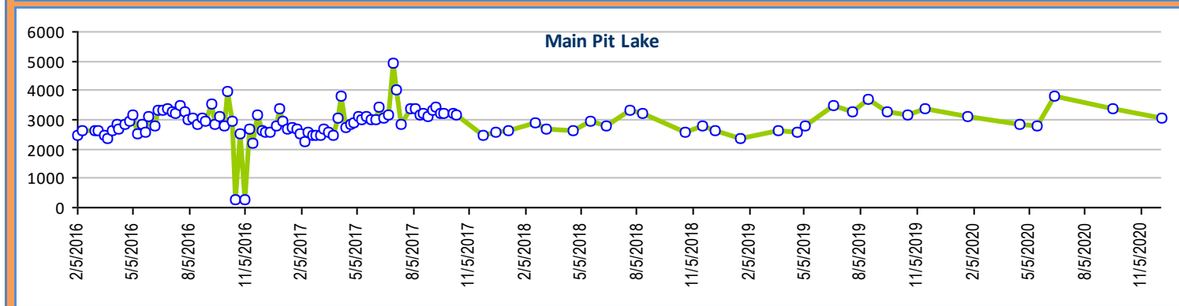


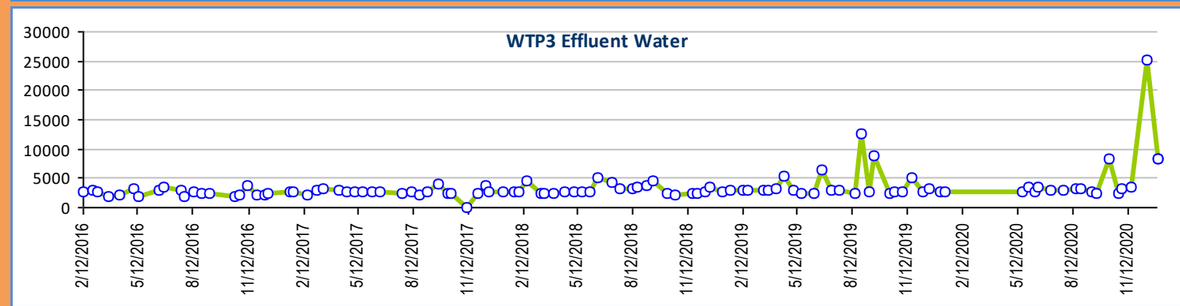








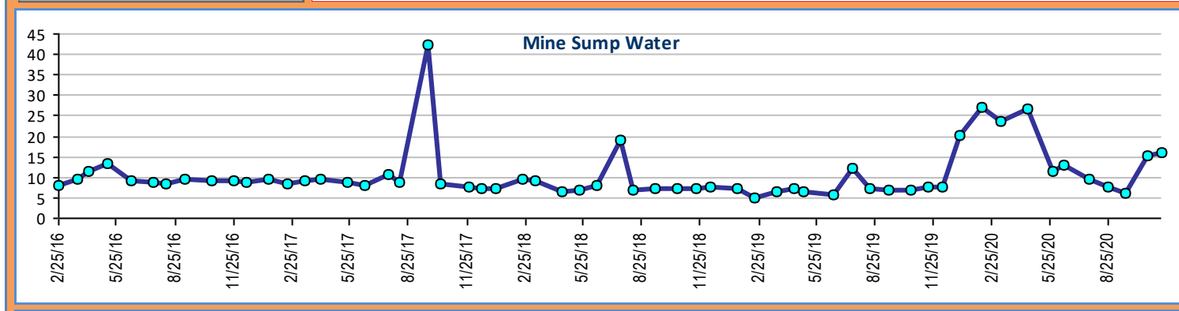


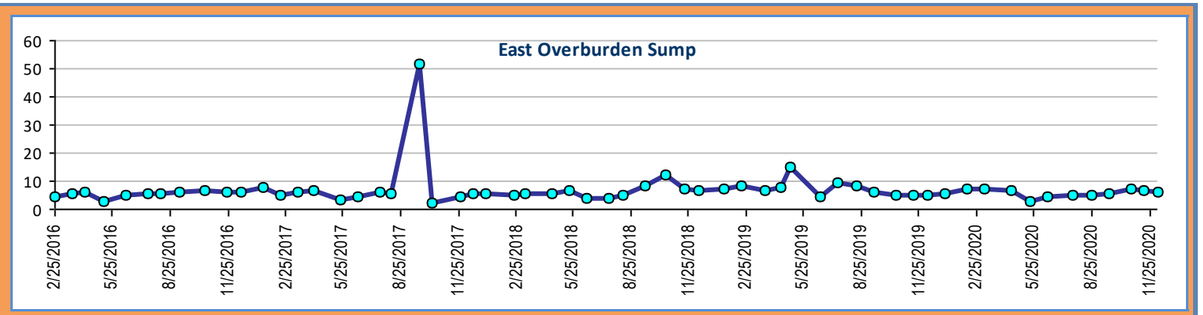


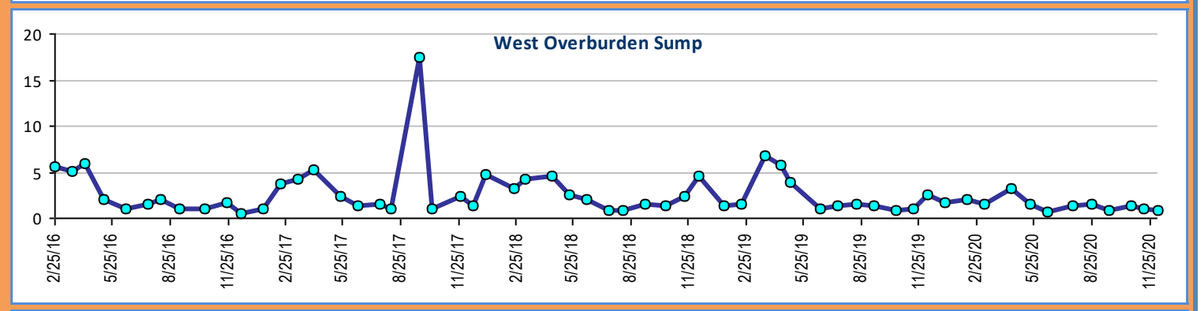
RED DOG MINE

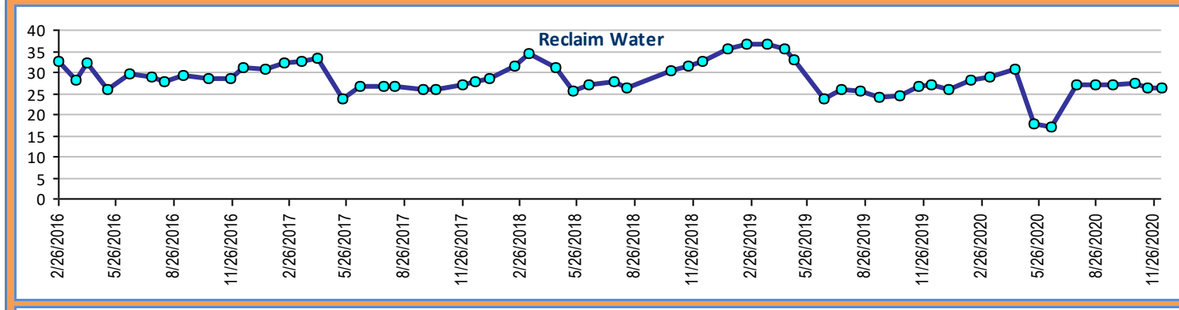
Mine Water Monitoring - Water Quality Profile II, Trend Charts

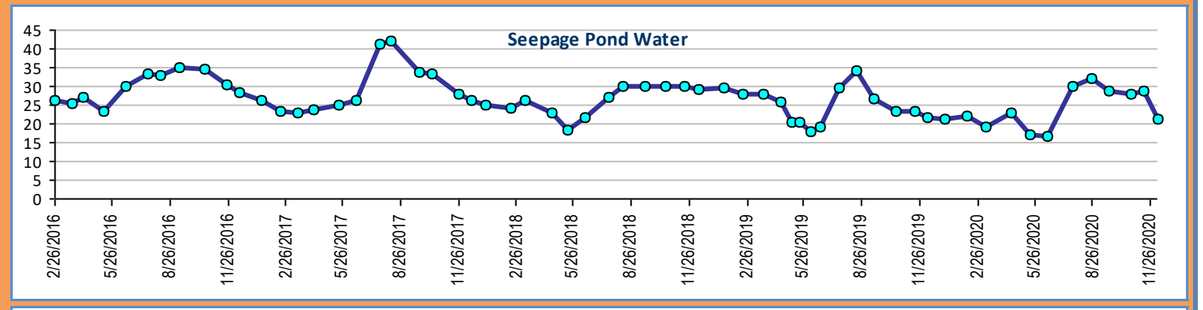
Chloride, dissolved, units mg/L

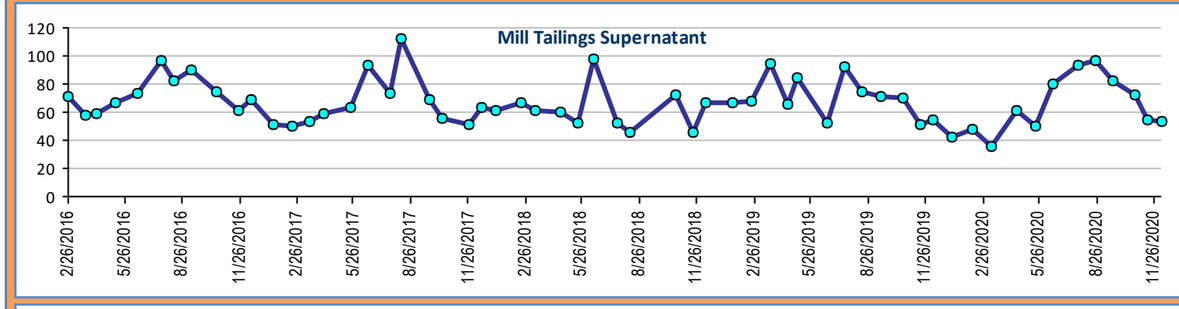


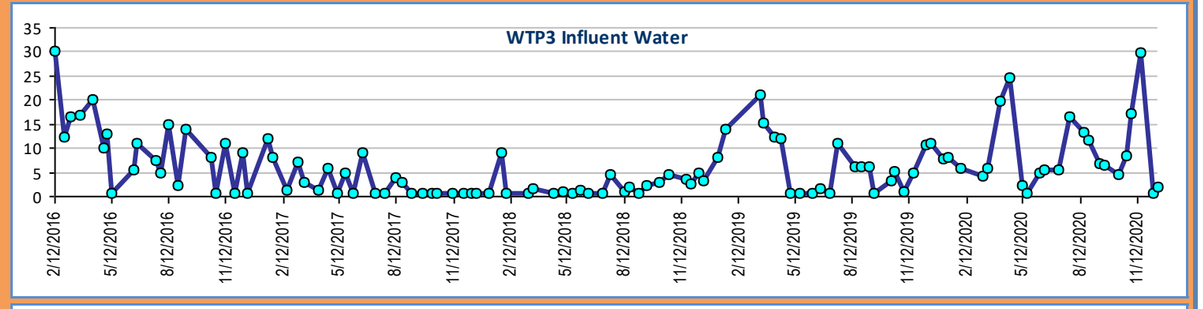


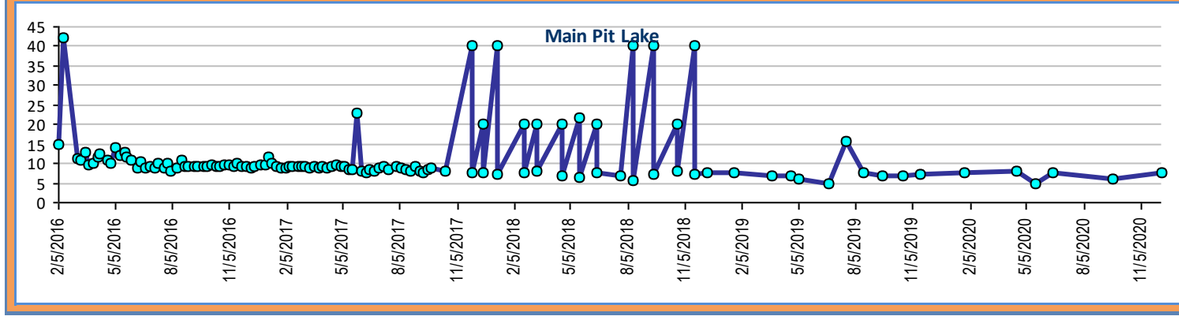


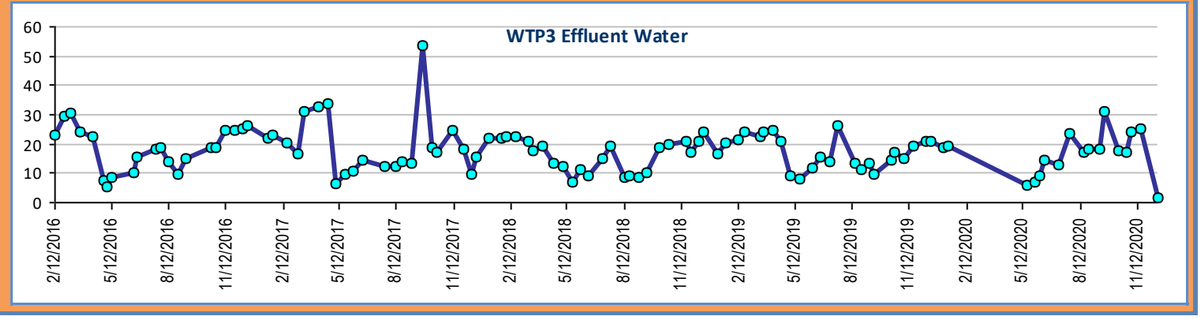








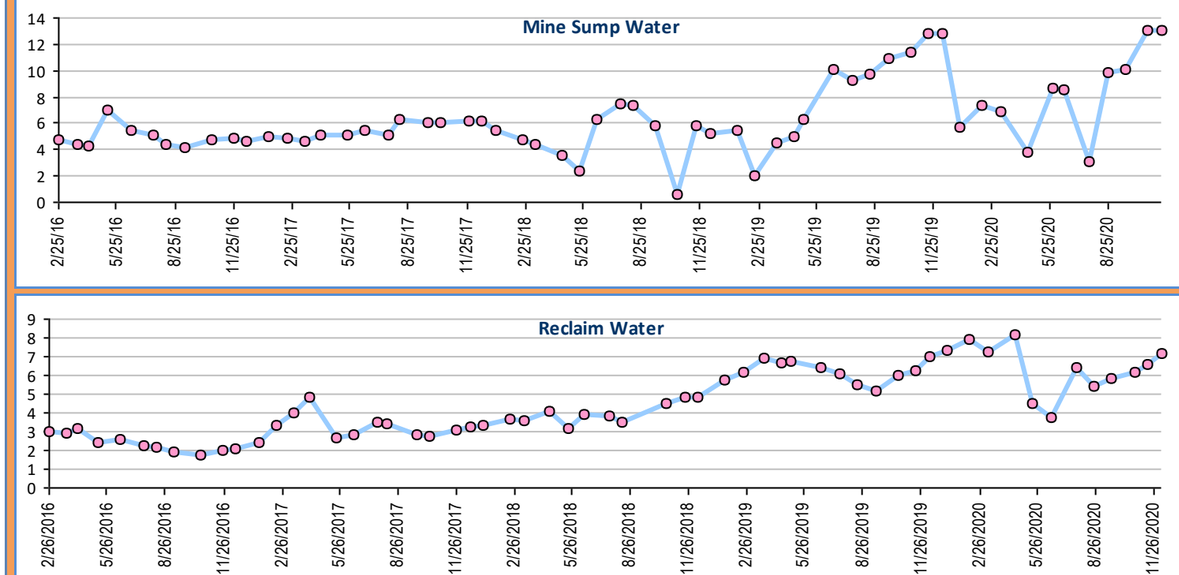


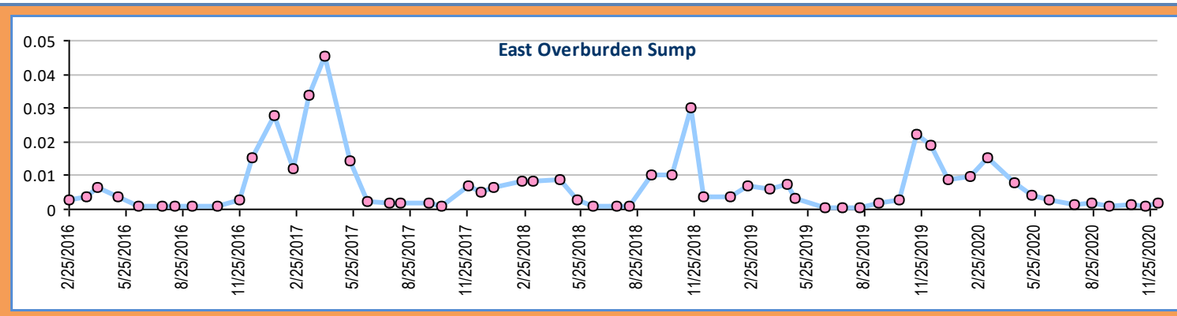


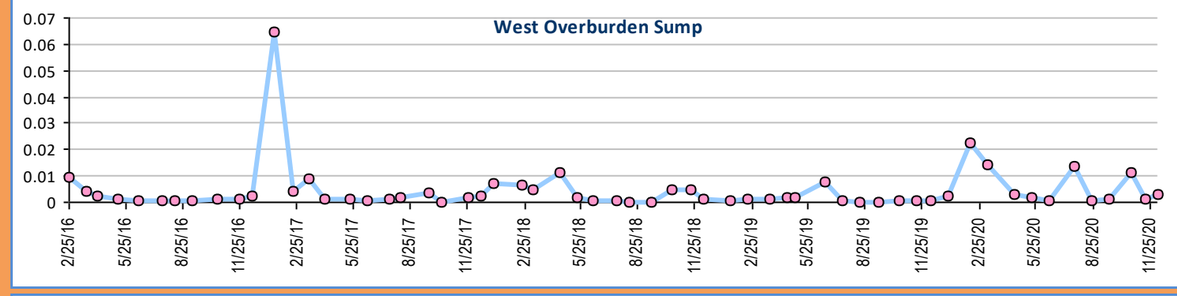
RED DOG MINE

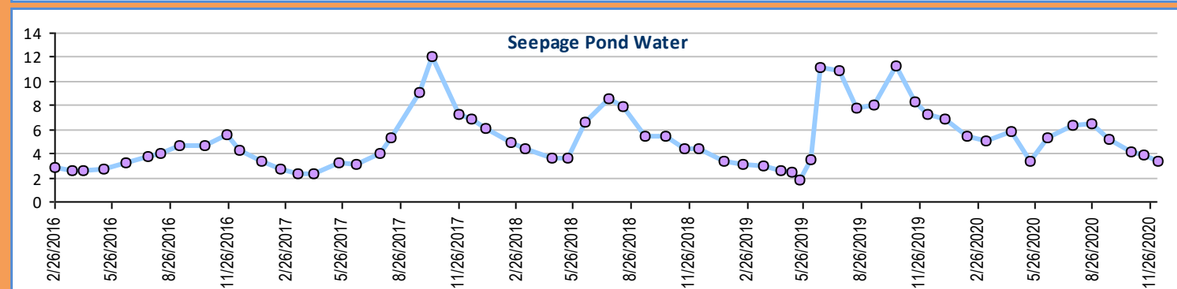
Mine Water Monitoring - Water Quality Profile II, Trend Charts

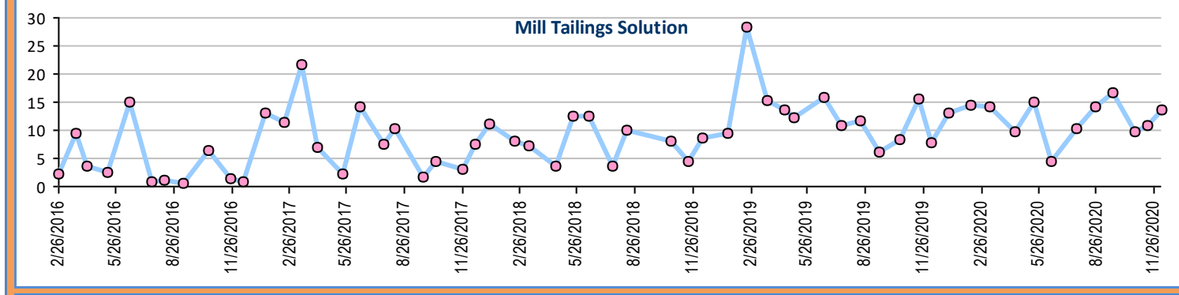
Cadmium, dissolved, units mg/L

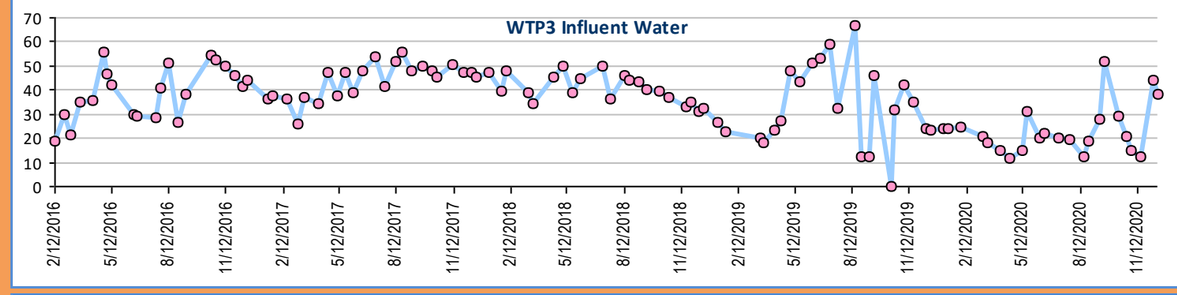


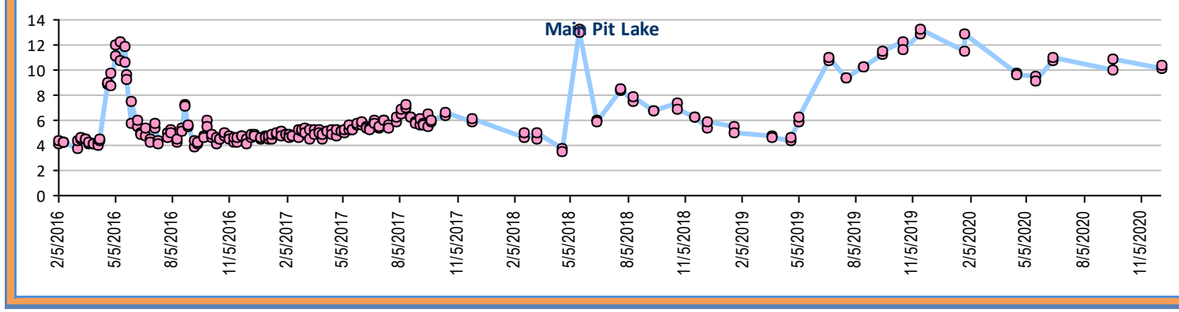


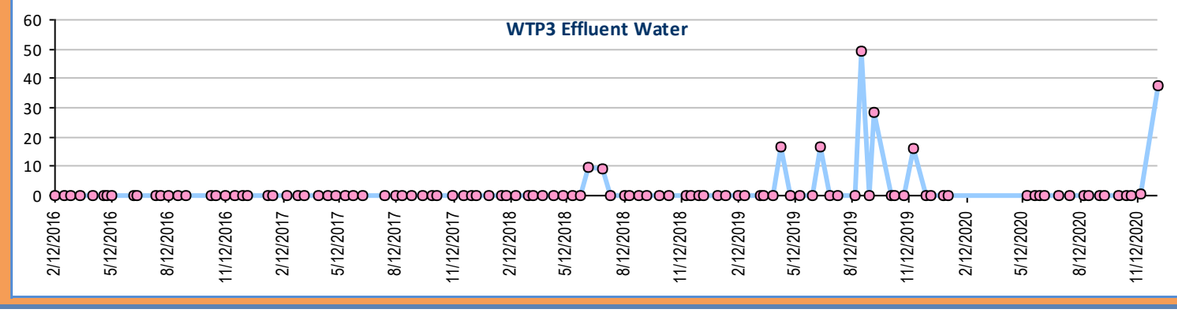








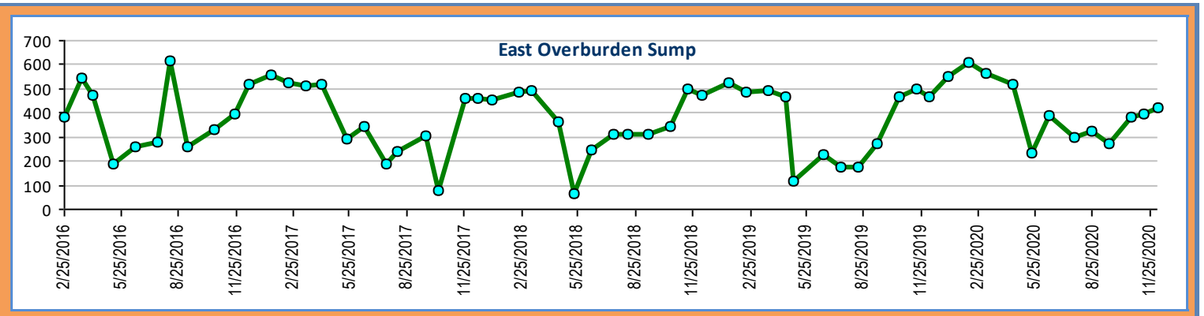


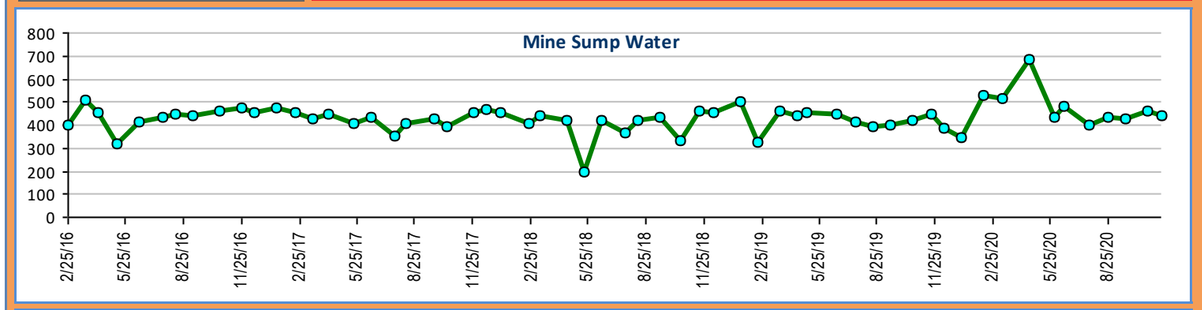


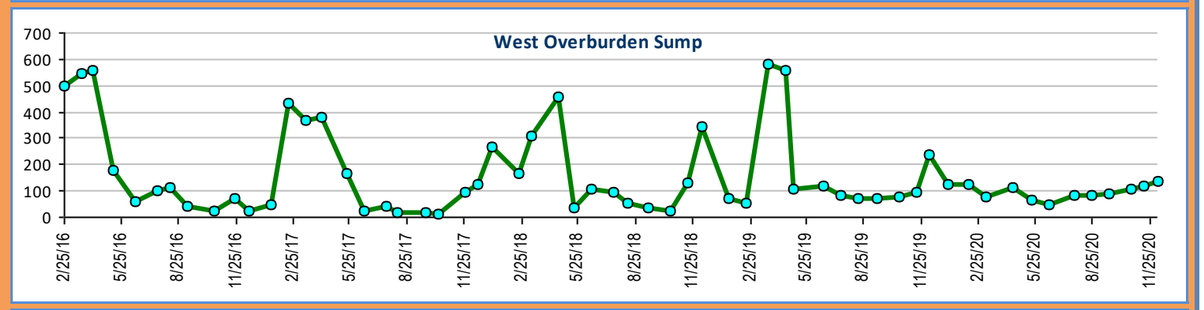
RED DOG MINE

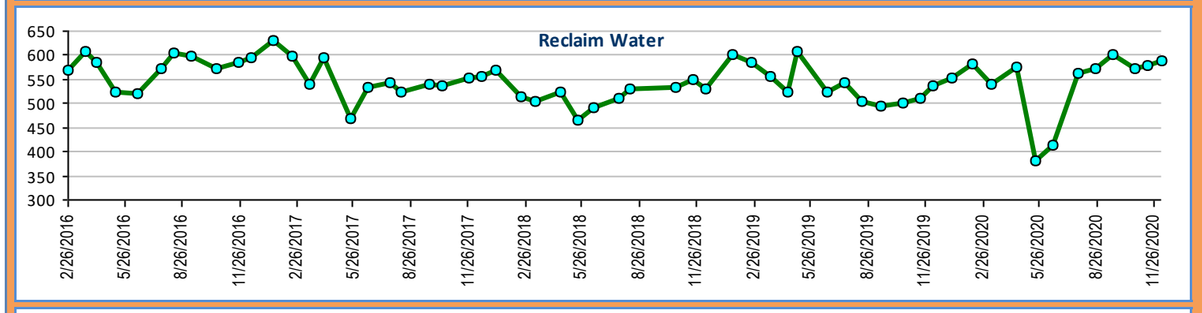
Mine Water Monitoring - Water Quality Profile II, Trend Charts

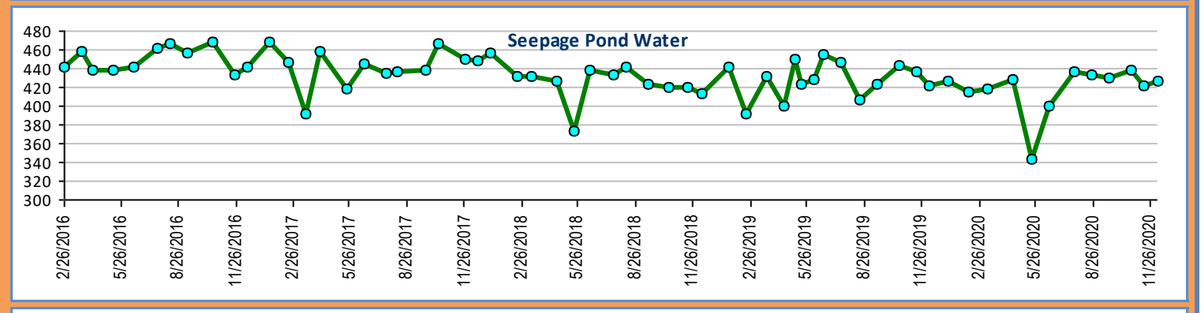
Calcium, dissolved, units mg/L

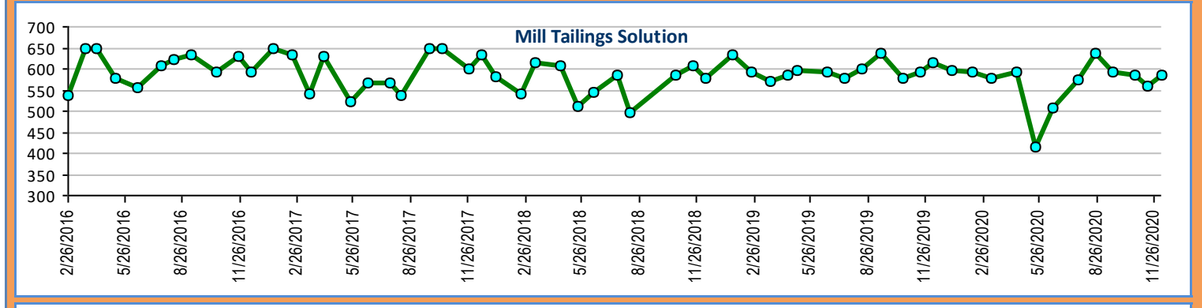


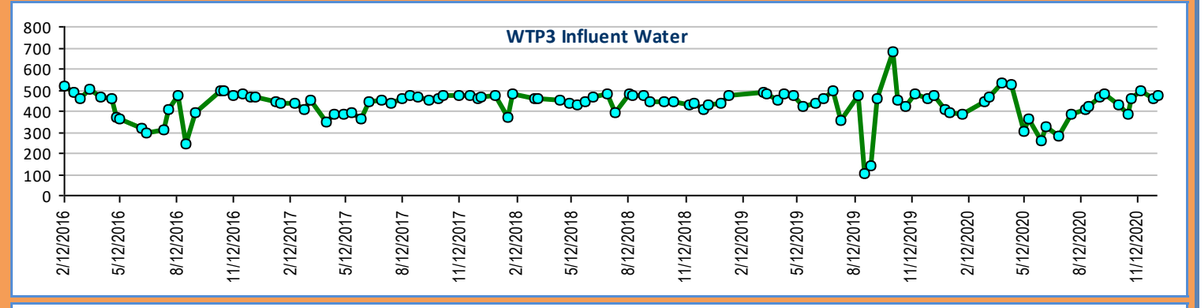


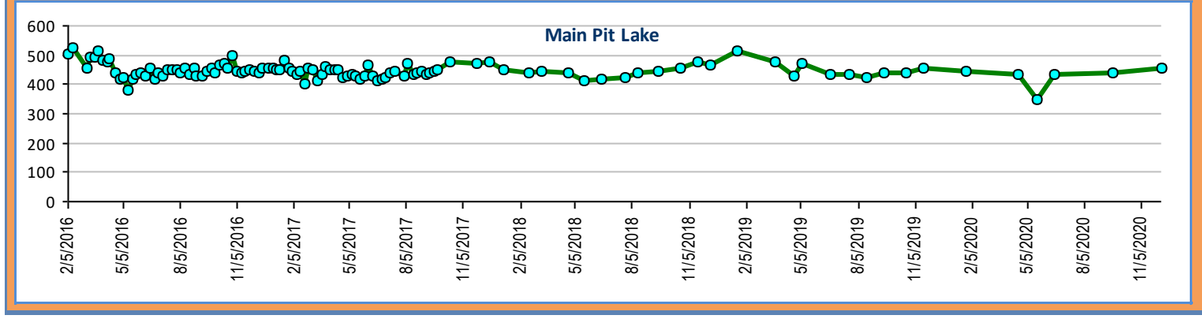


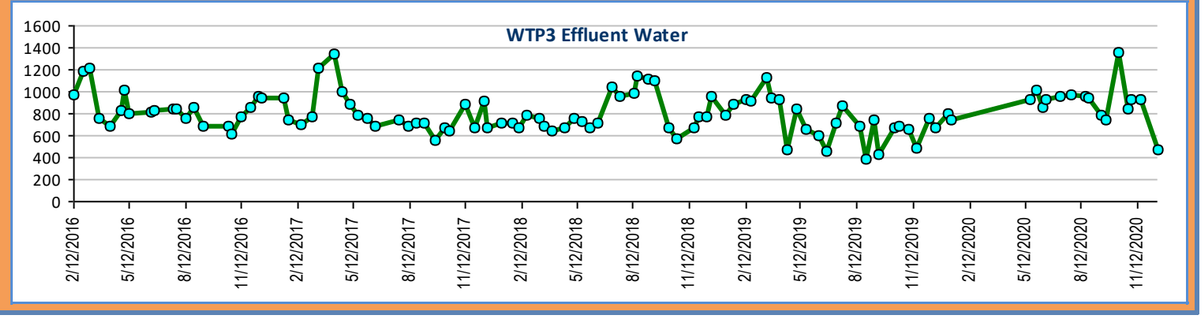








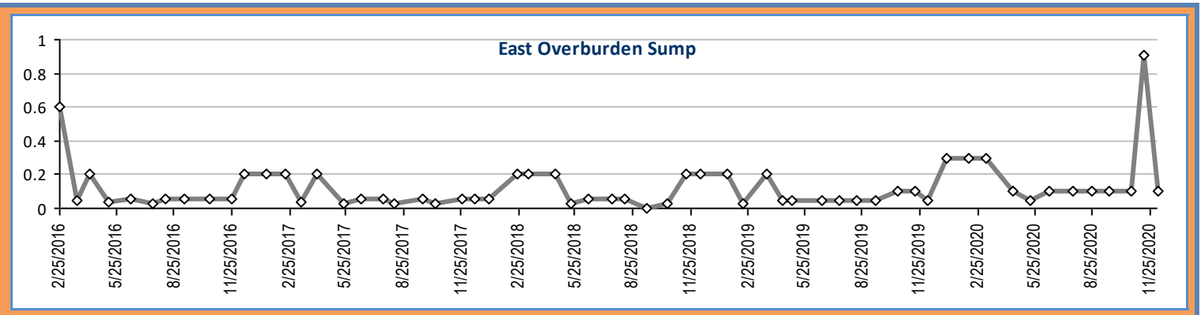


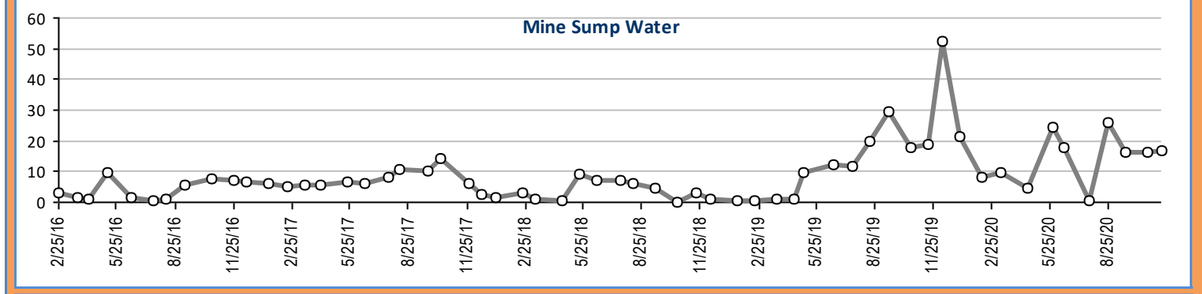


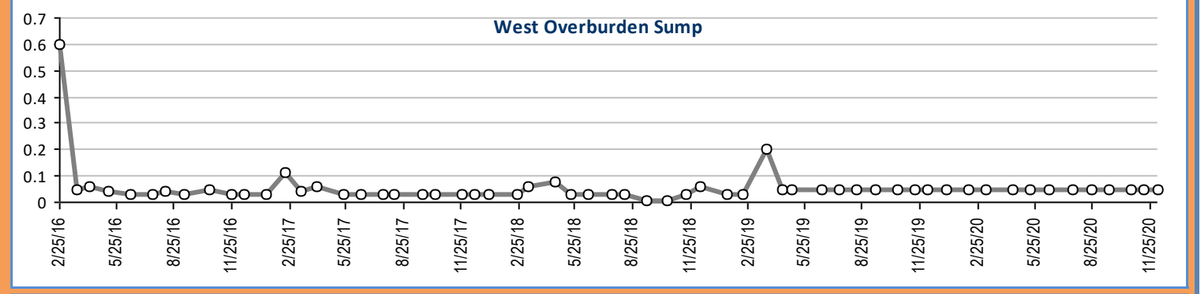
RED DOG MINE

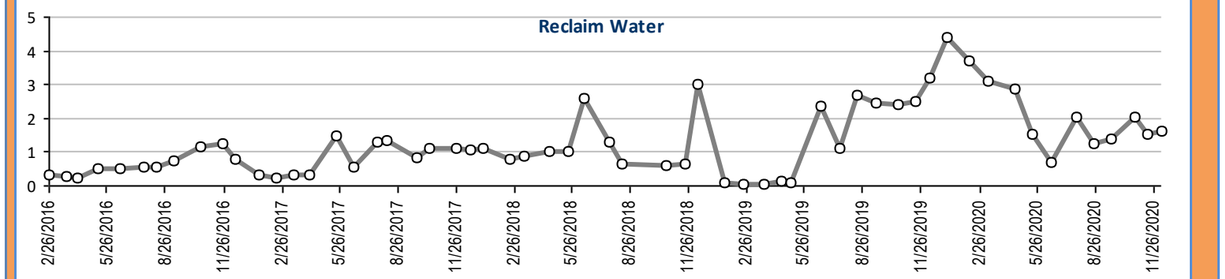
Mine Water Monitoring - Water Quality Profile II, Trend Charts

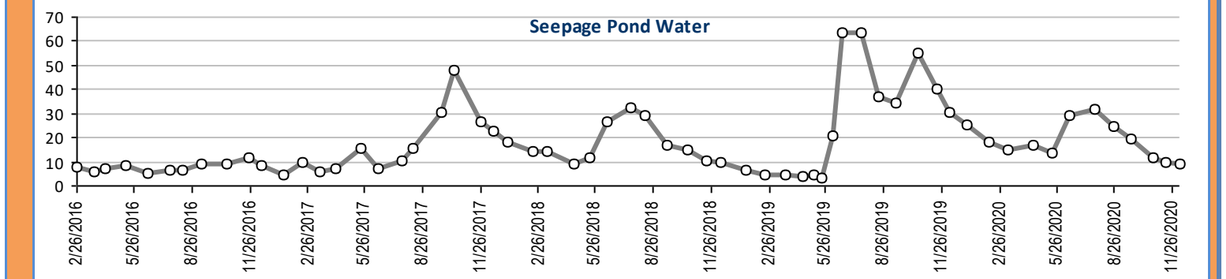
Aluminum, dissolved, units mg/L

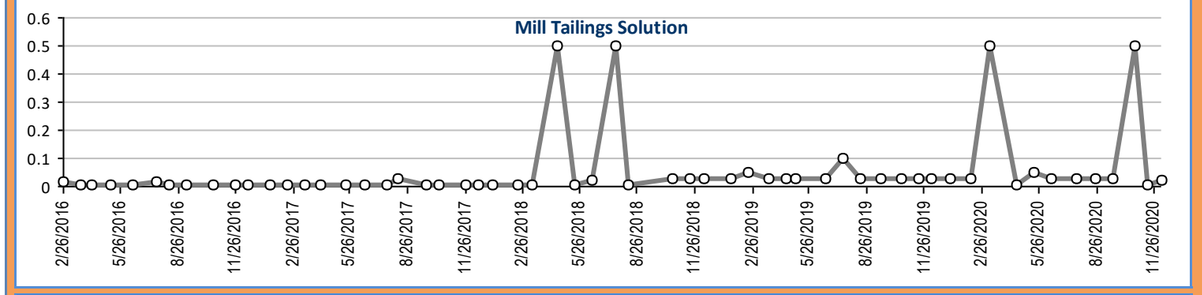


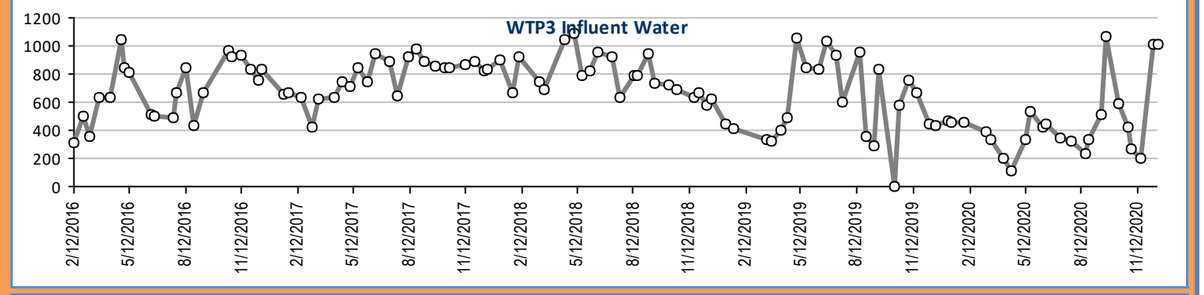


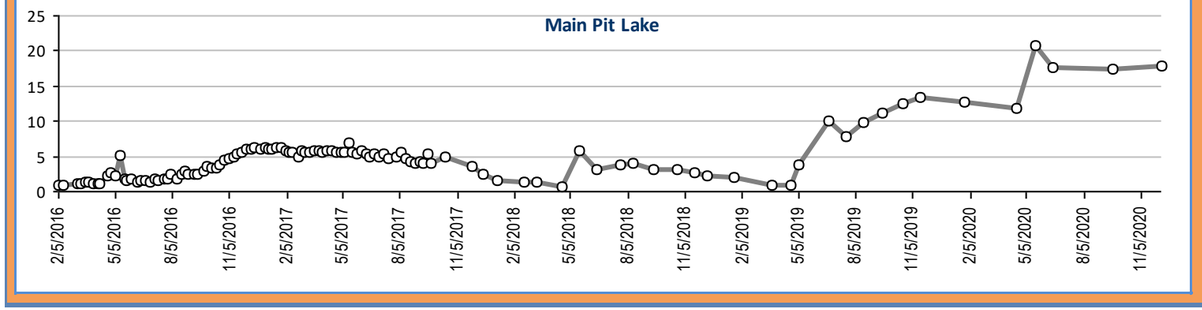


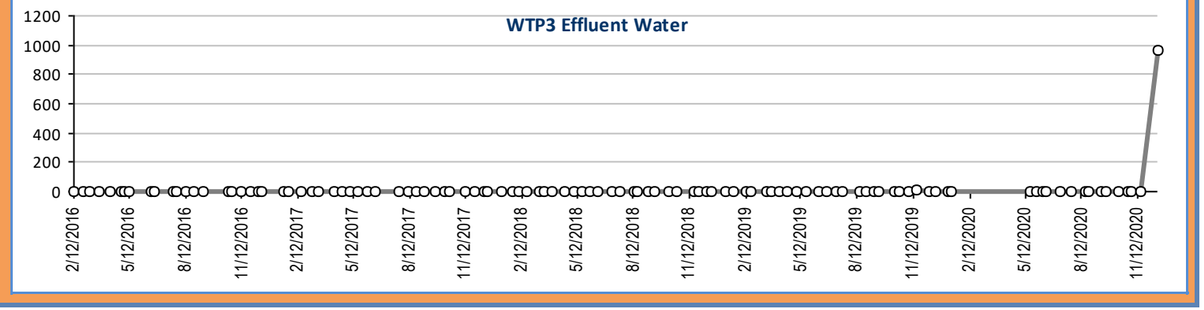








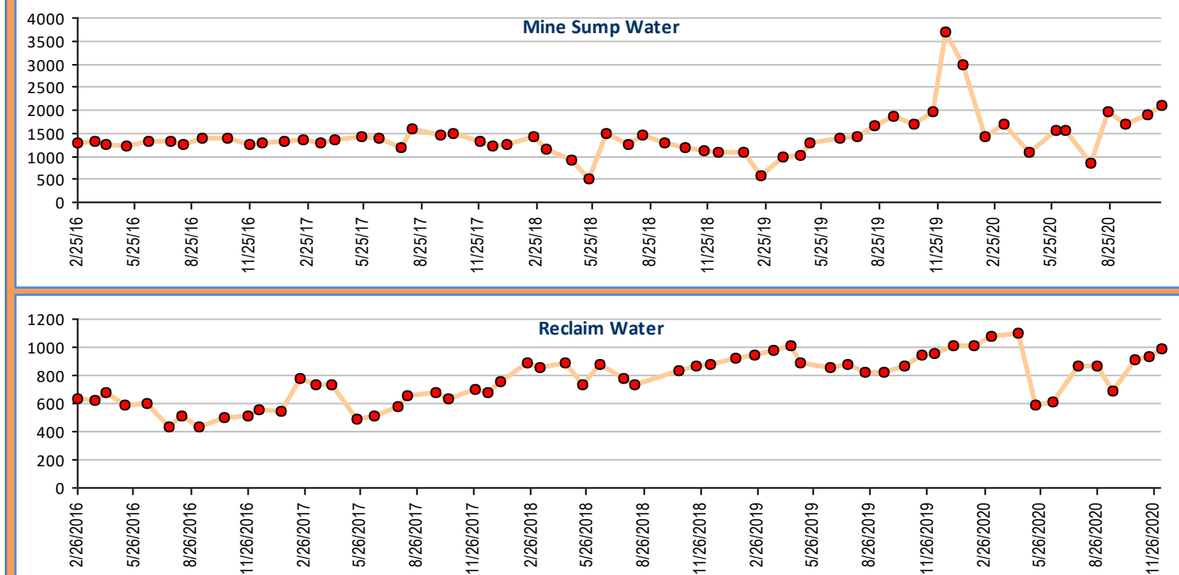


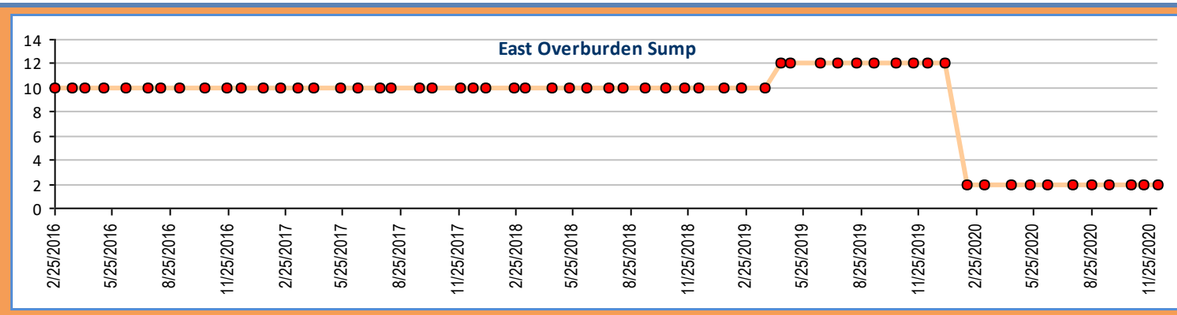


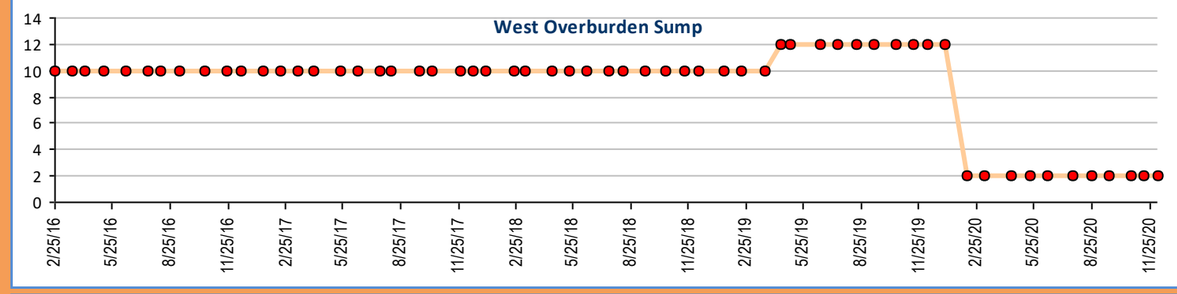
RED DOG MINE

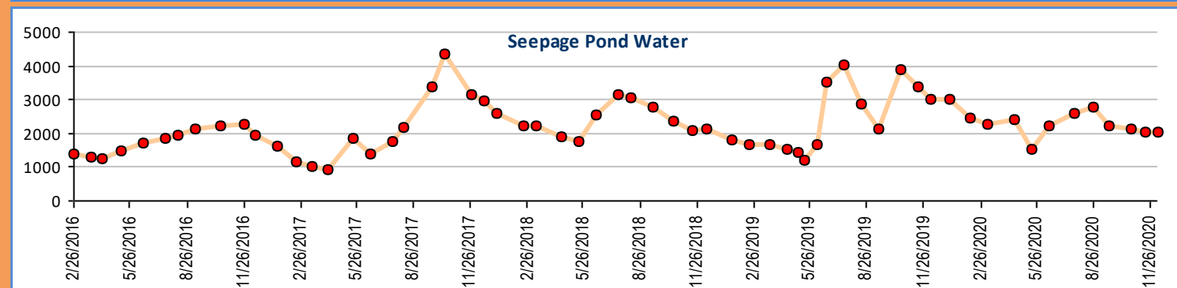
Mine Water Monitoring - Water Quality Profile II, Trend Charts

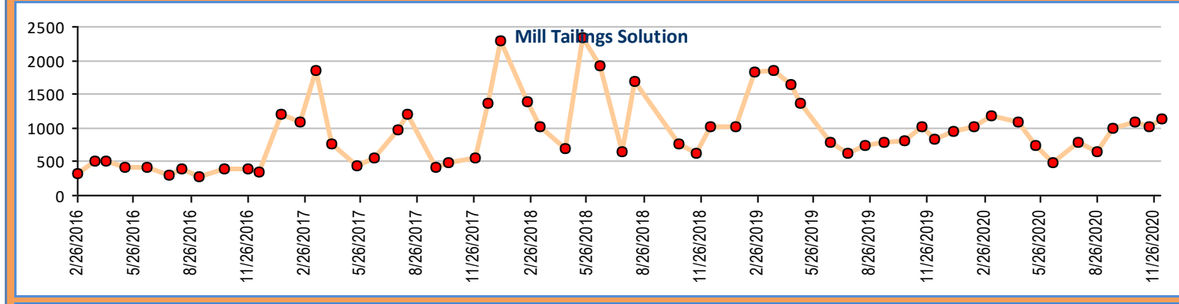
Acidity as CaCO3, units mg/L

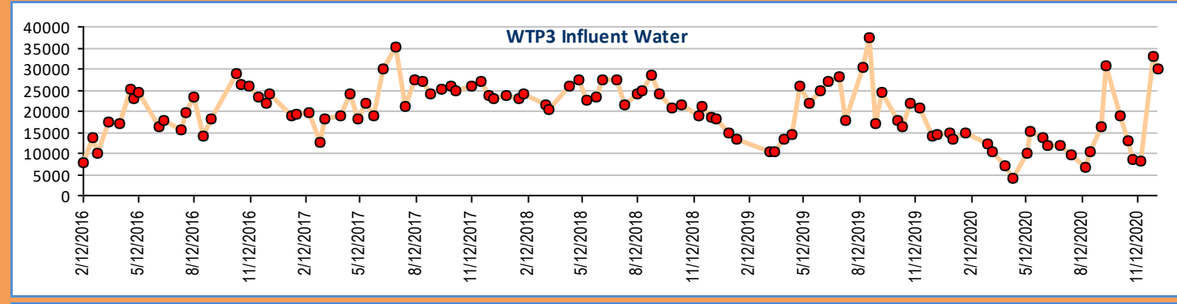


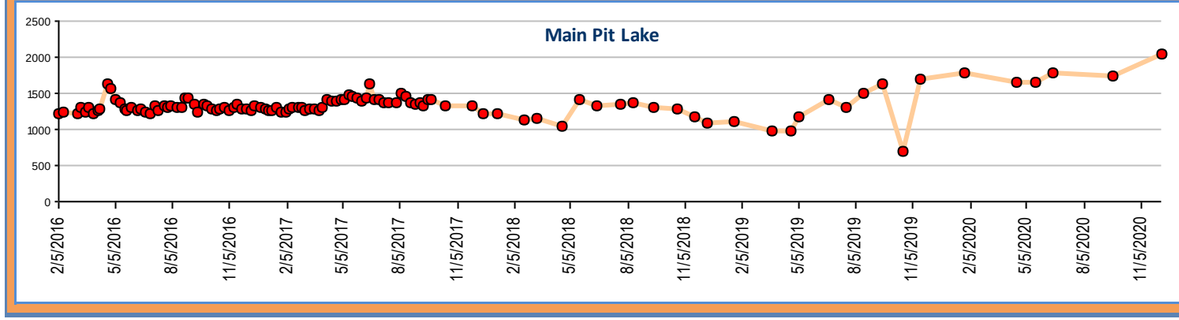


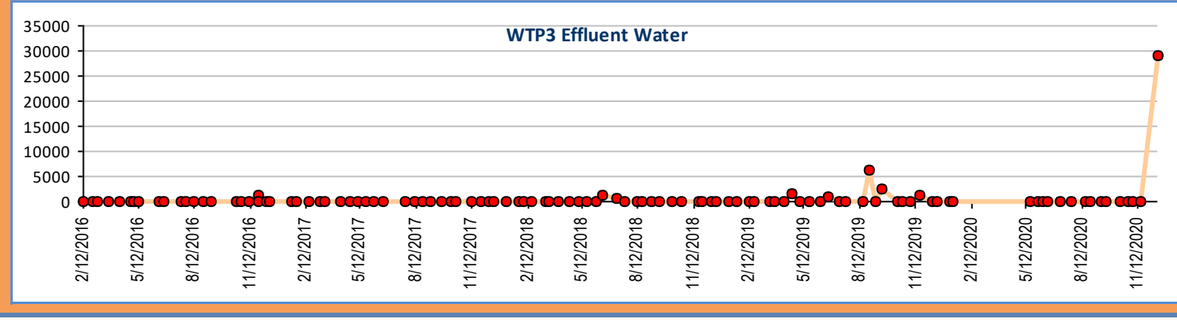






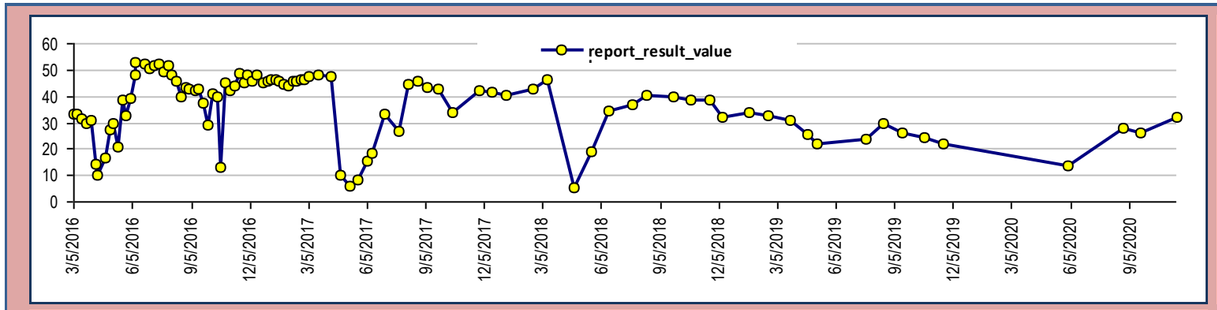


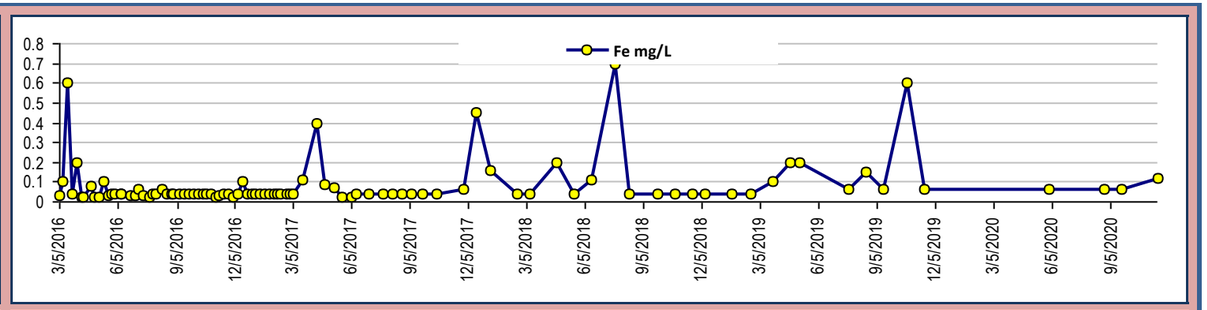


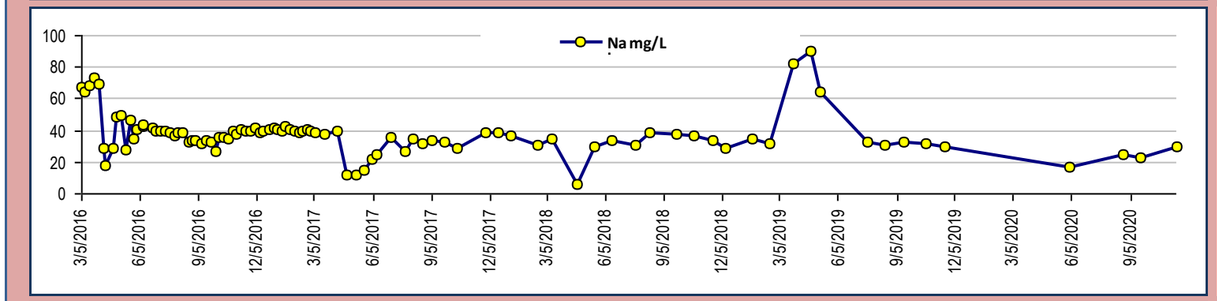


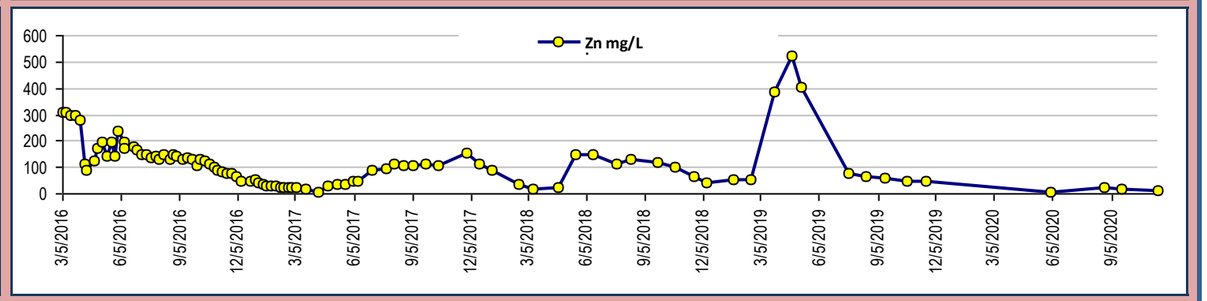
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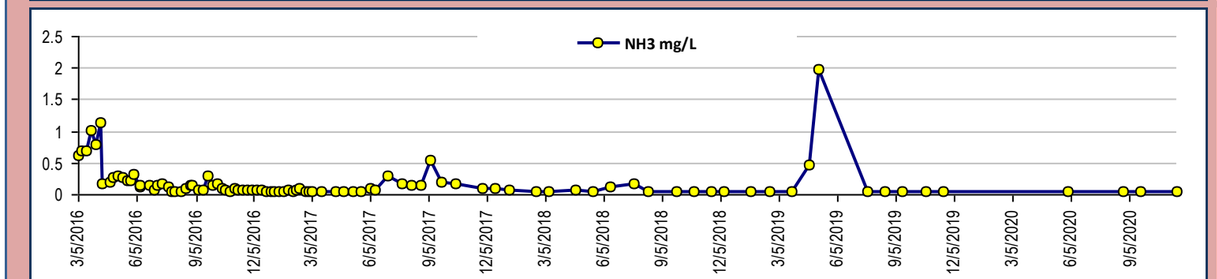
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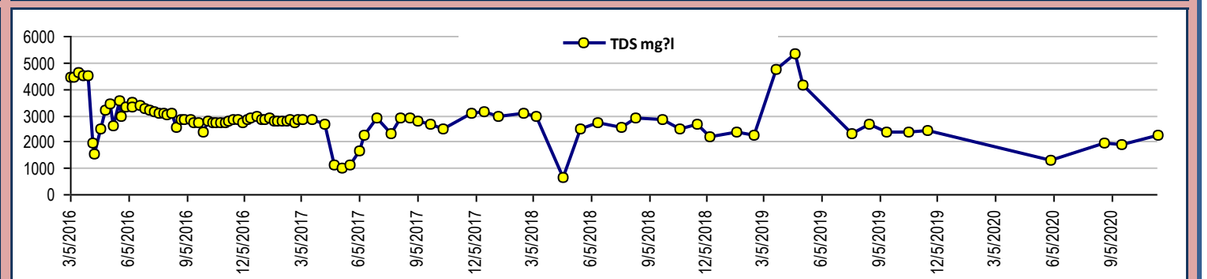


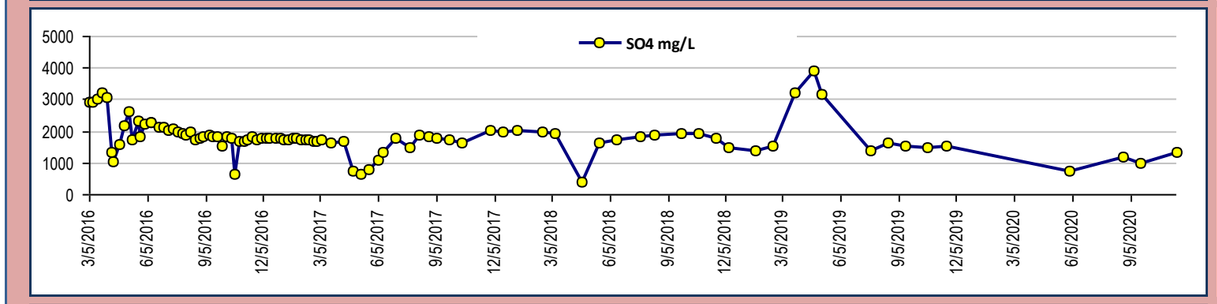


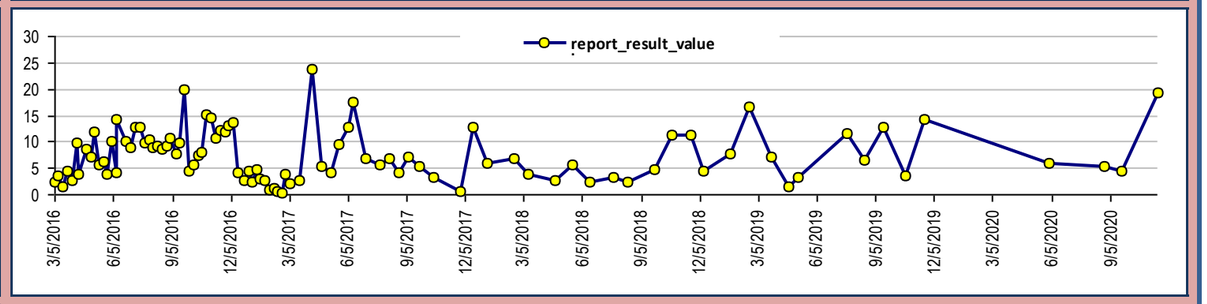


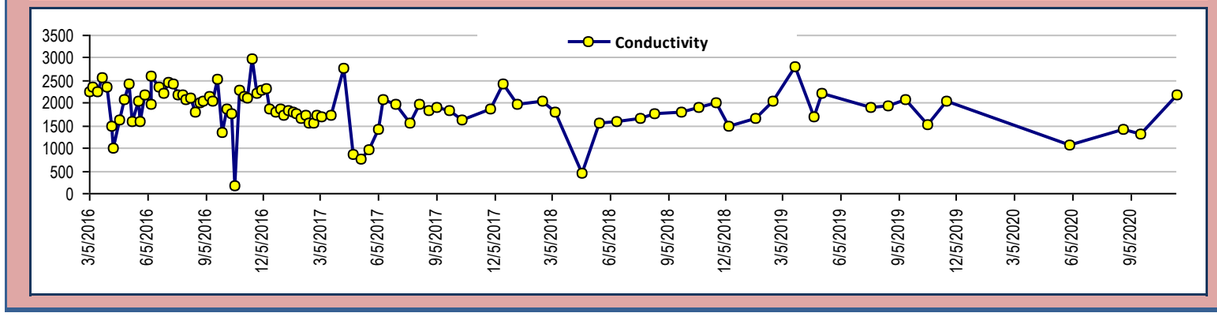






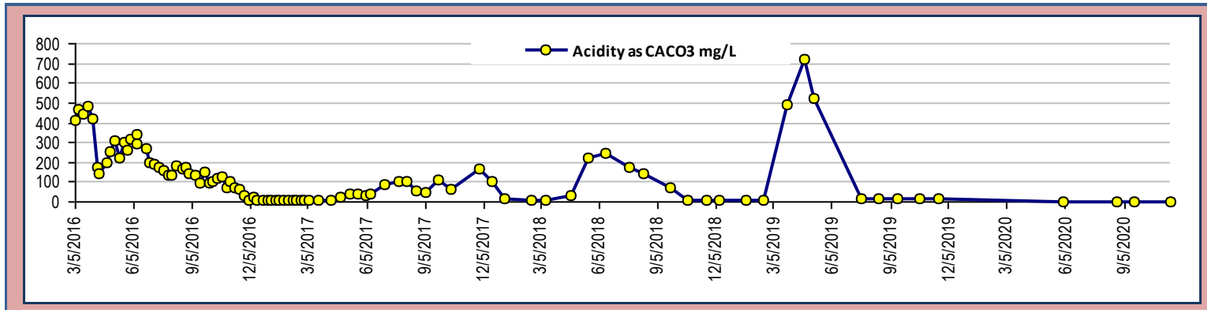


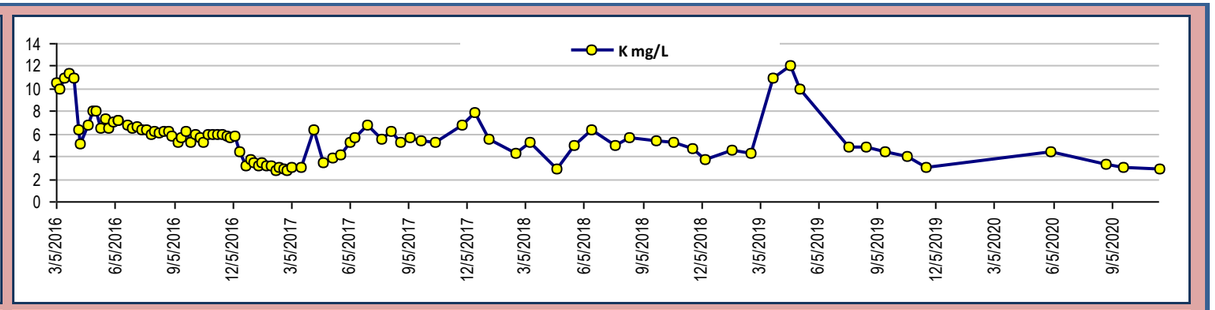


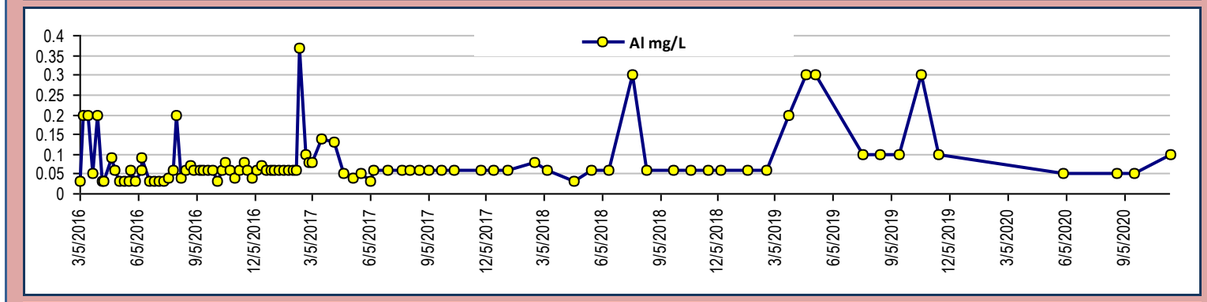


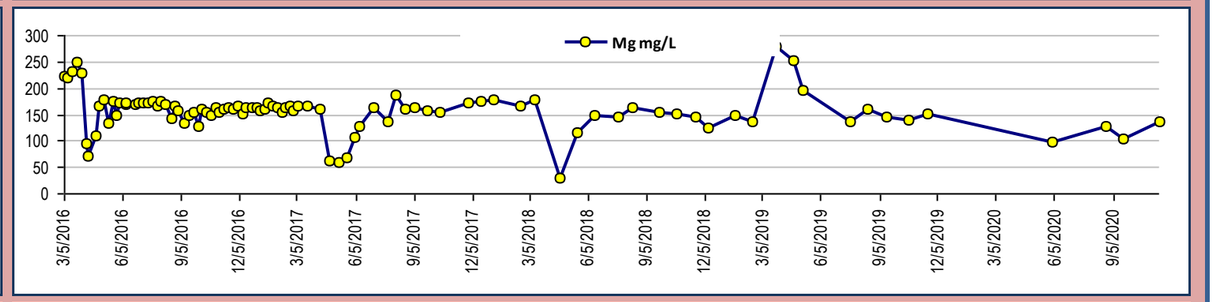
Mill Pad Runoff Dissolved Analytes

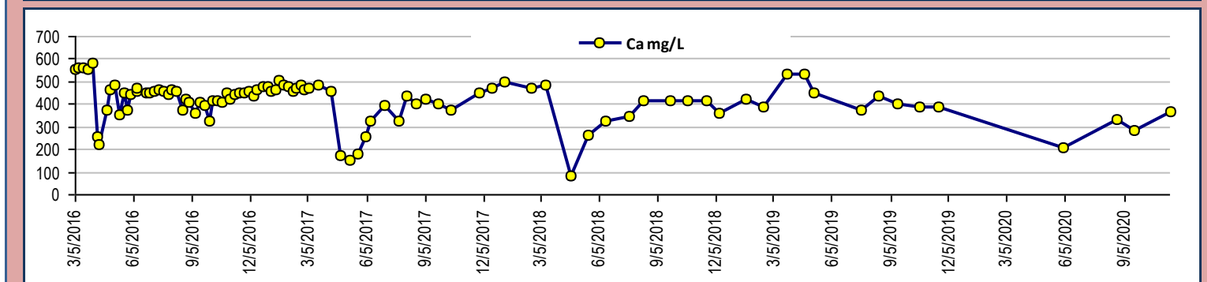
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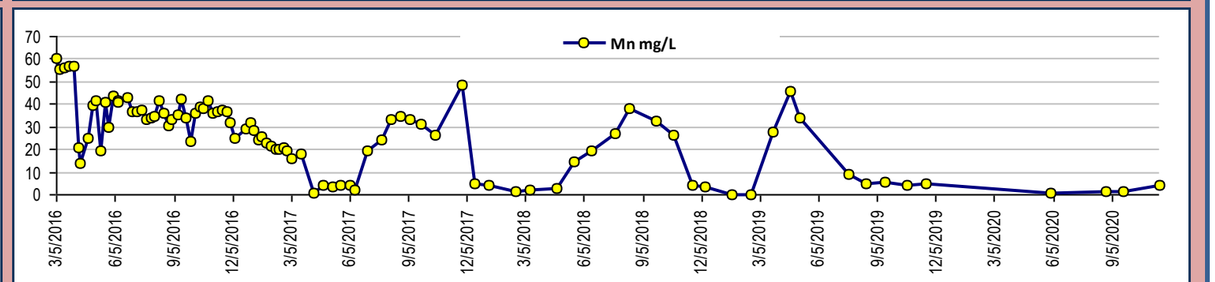


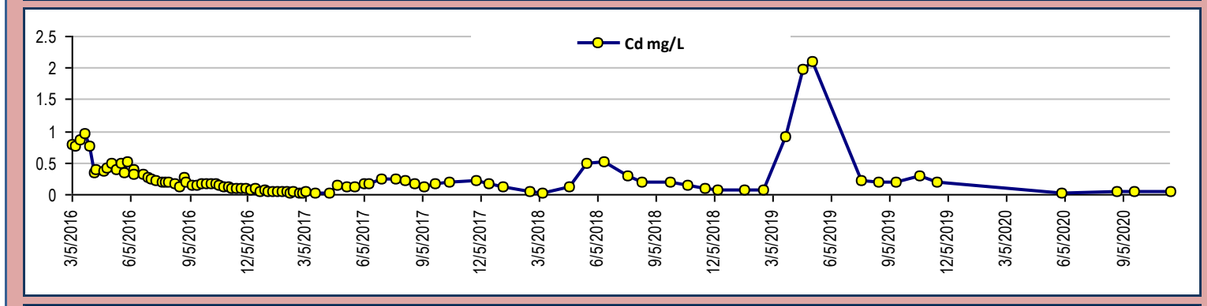


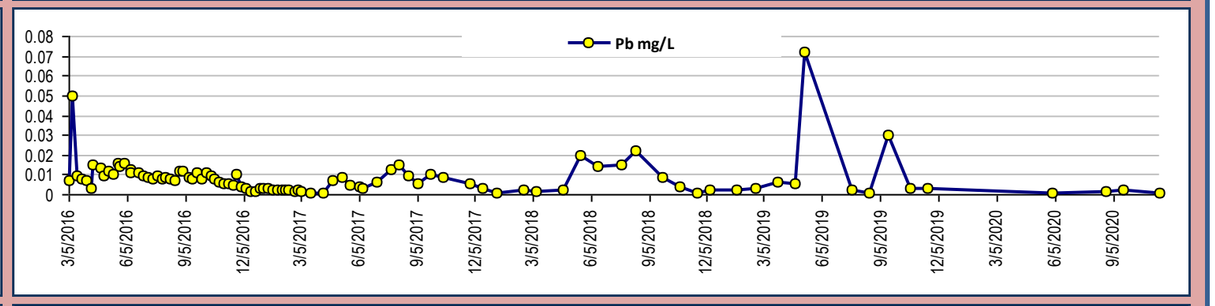


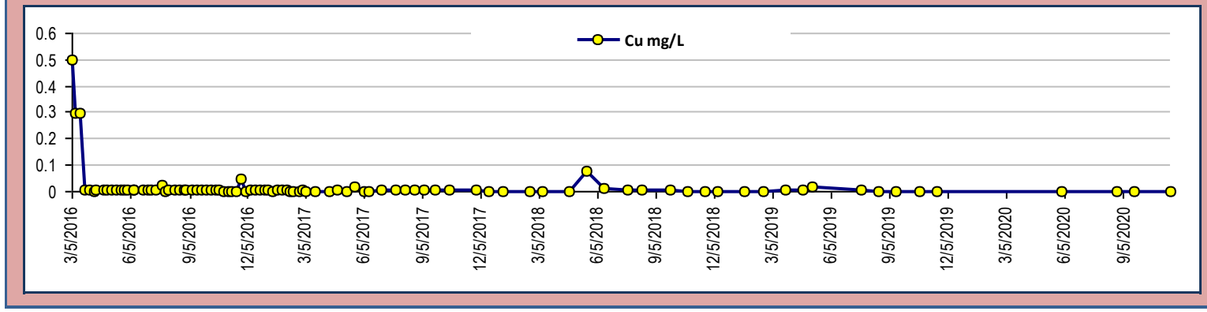


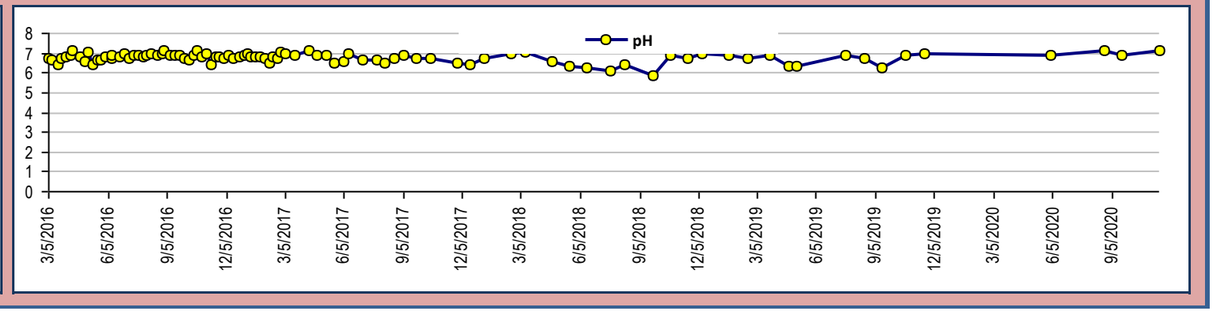






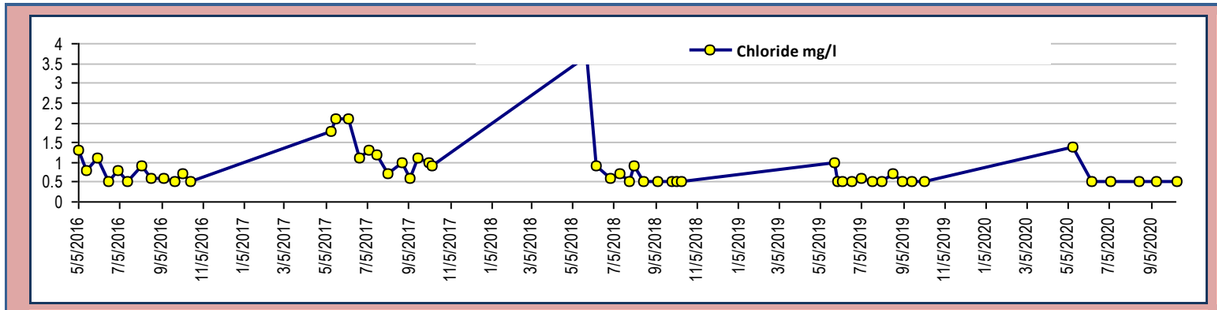


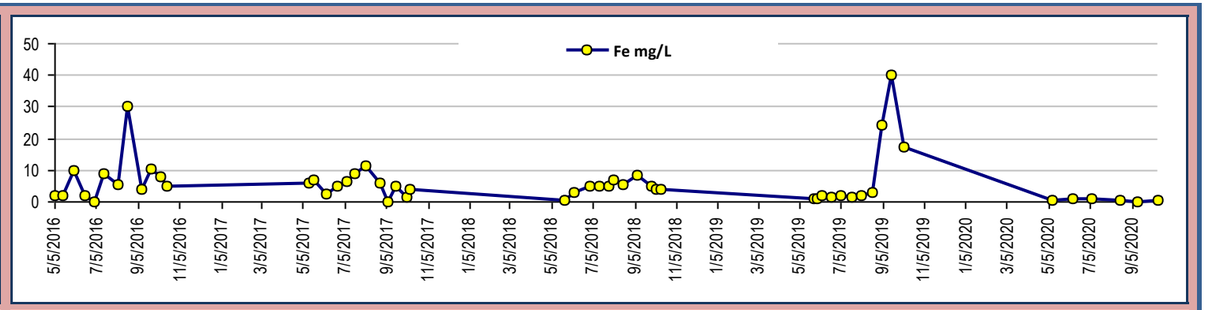


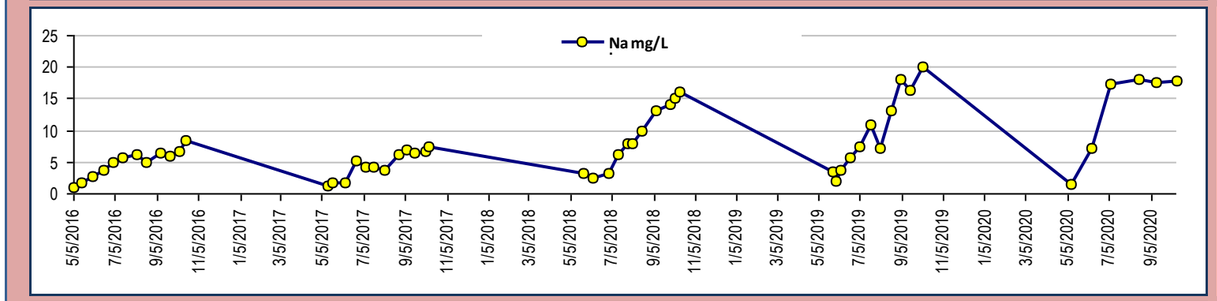


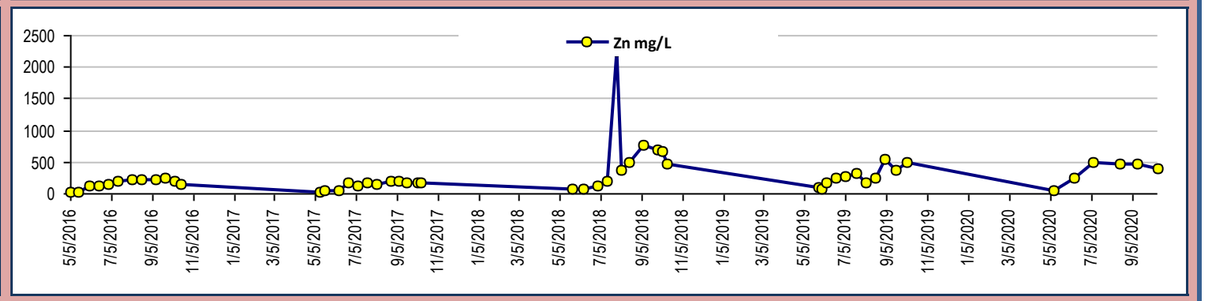
Hill Top Creek Analytes

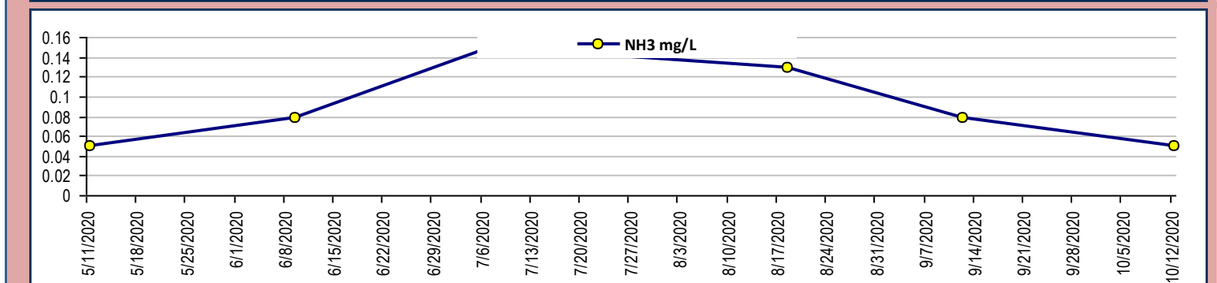
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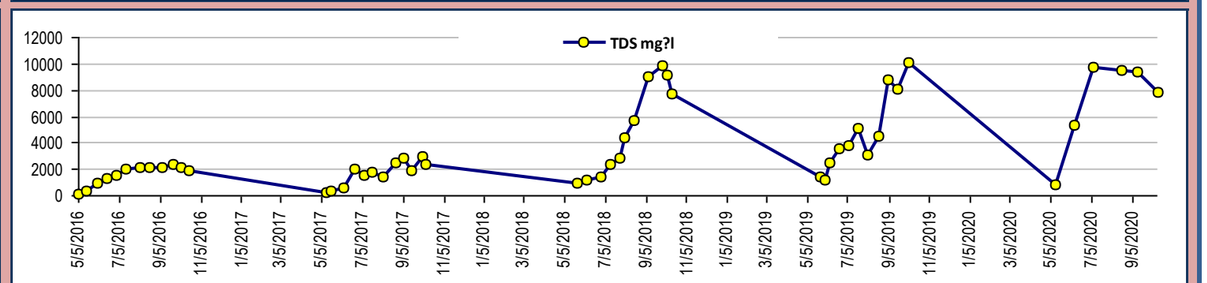


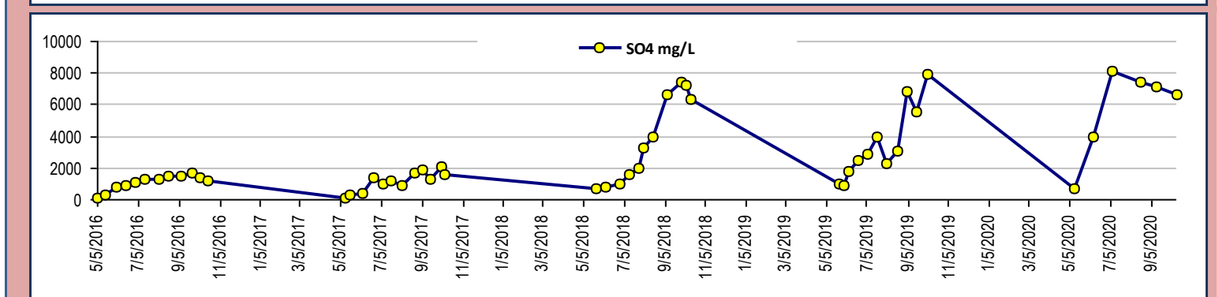


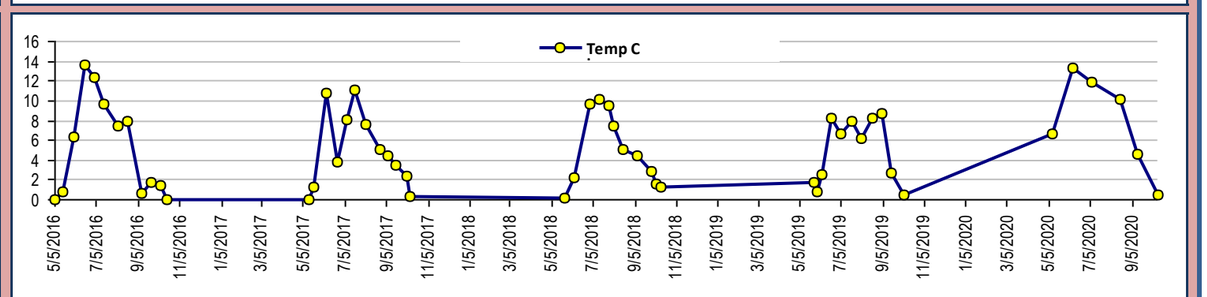


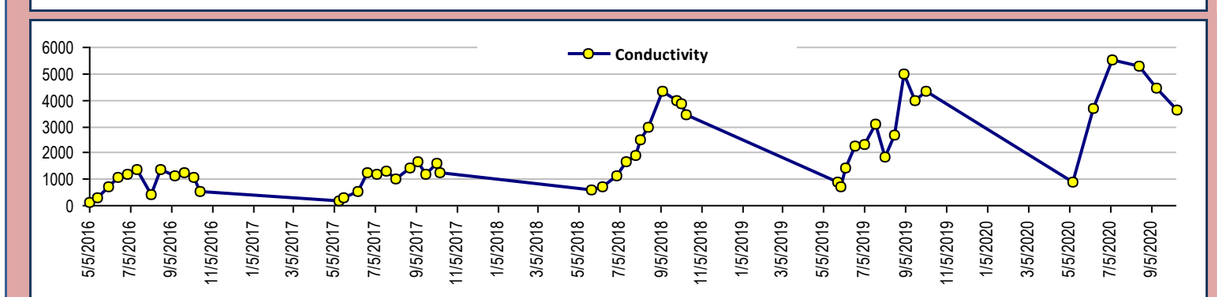






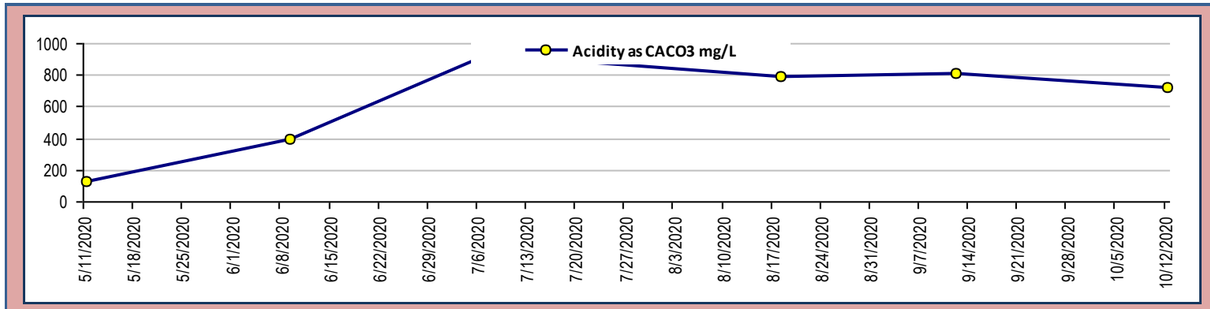


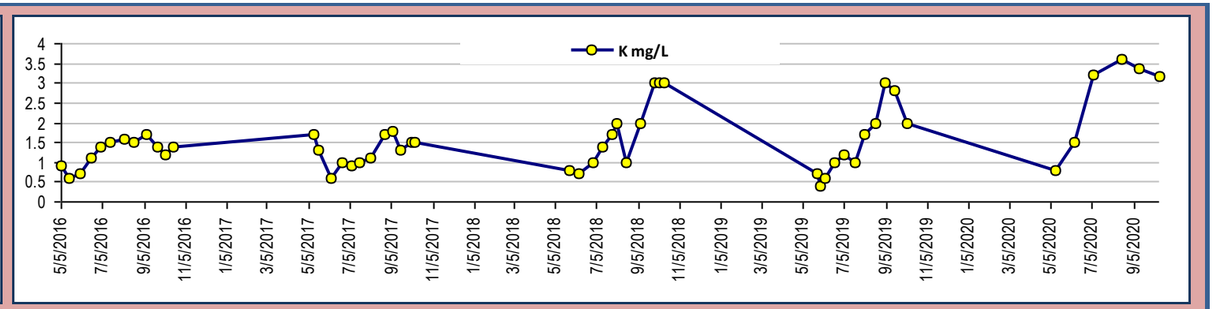


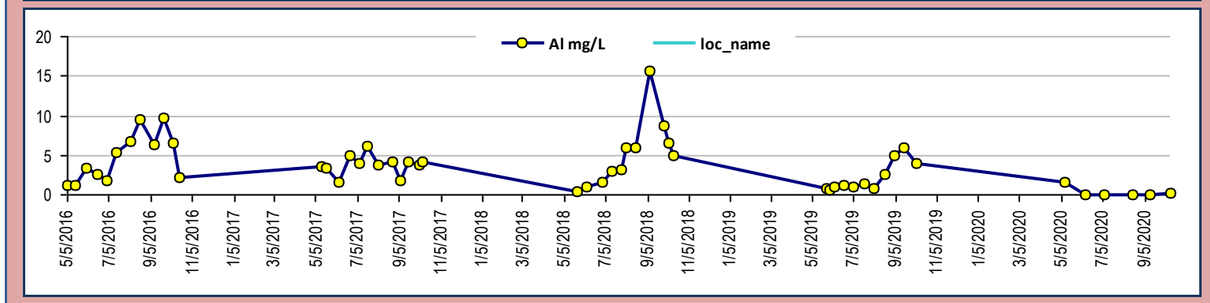


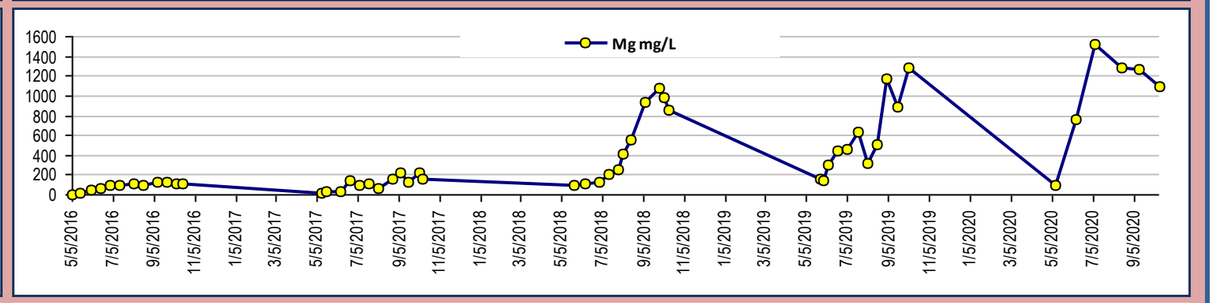
Hill Top Creek Analytes

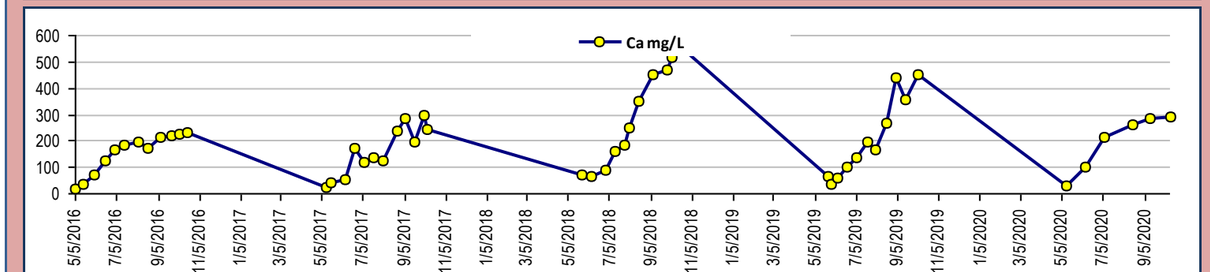
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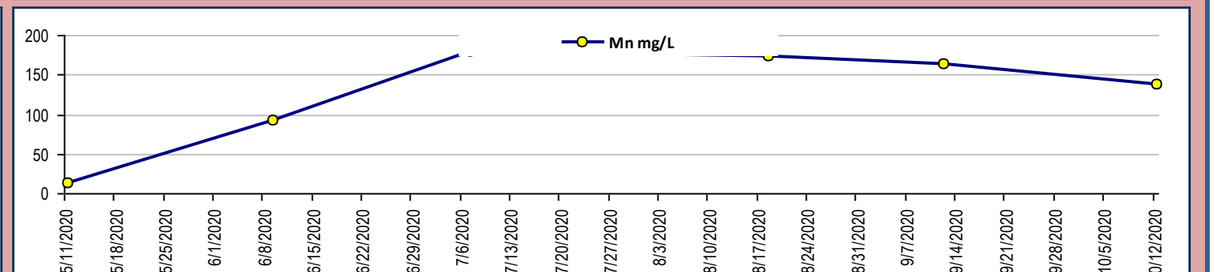


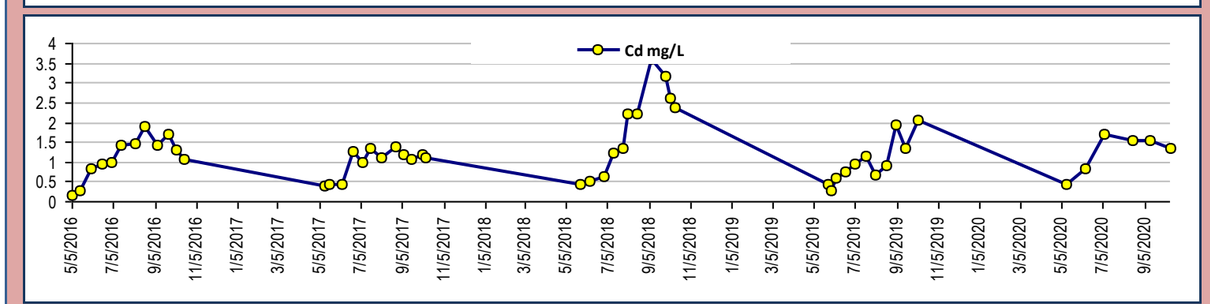


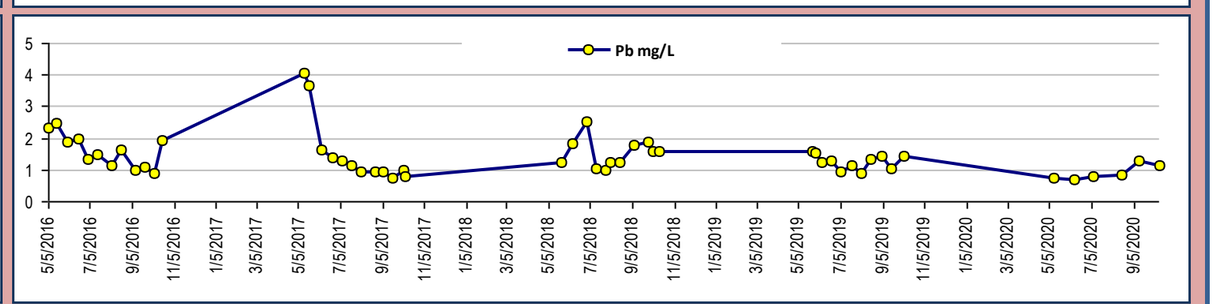


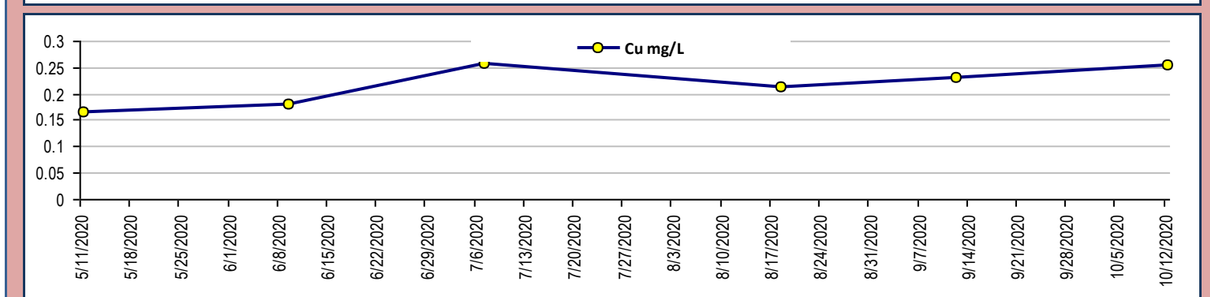


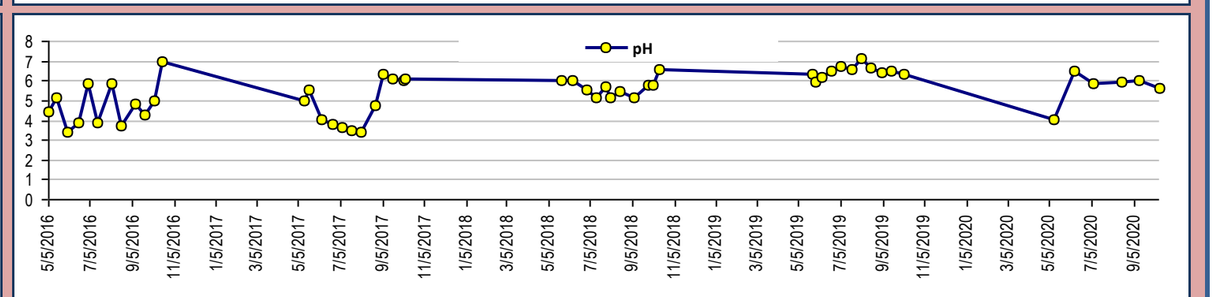












Appendix D: Water Quality Profile I Charts – Mine Drainage Monitoring Stations

RED DOG MINE

Water Monitoring Drainage
Water Quality Profile I , 5-Year Trend Charts

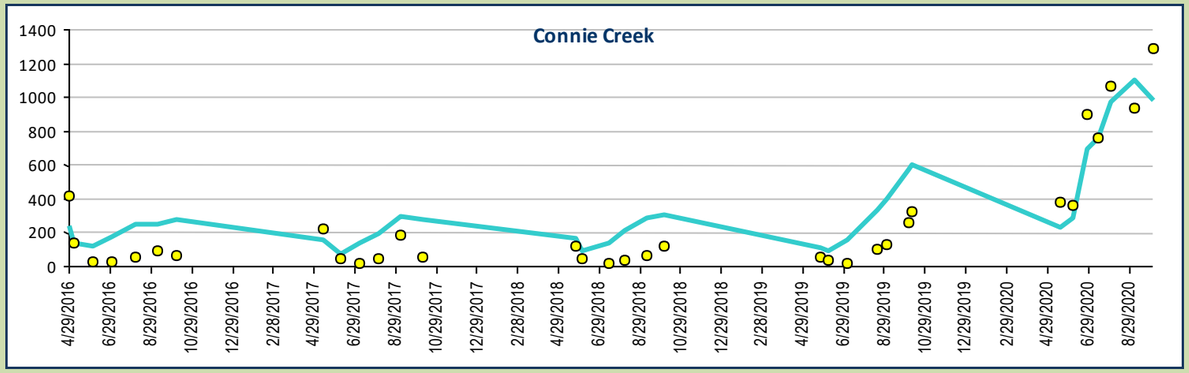
Zinc, Total Recoverable, units ug/L

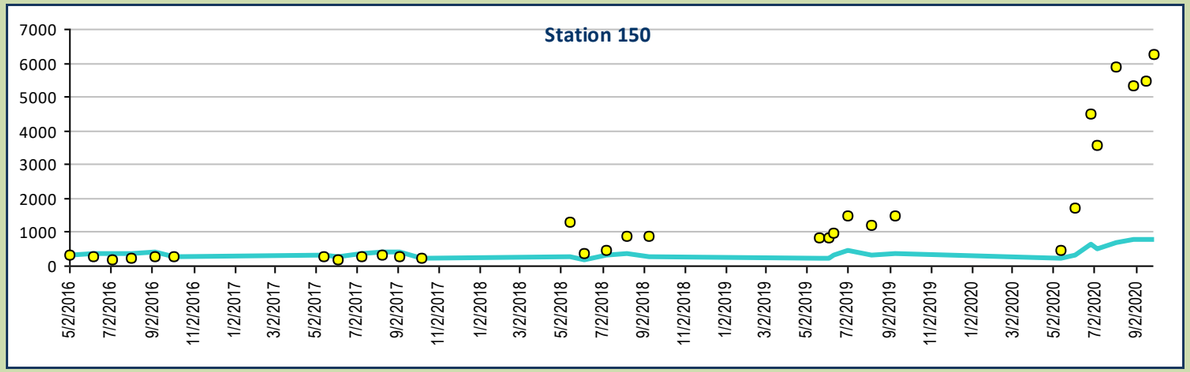
Aquatic Life - Fresh Water Acute WQS ug/L

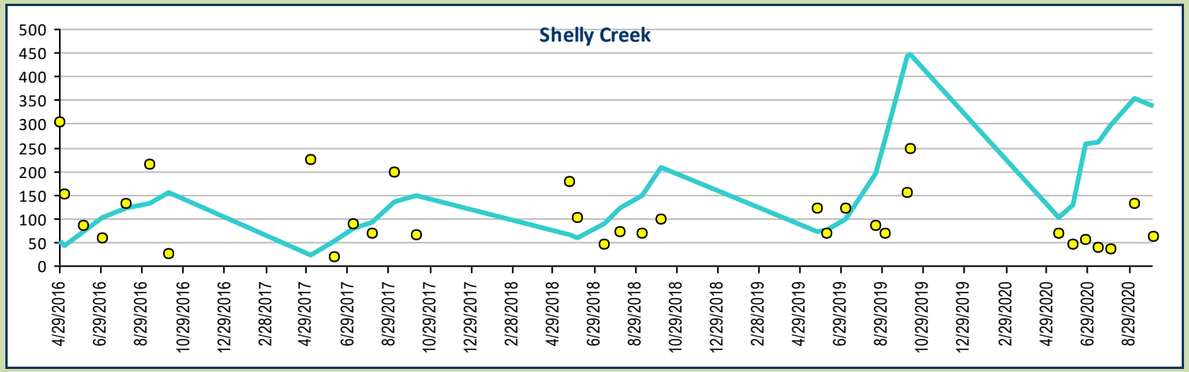
Hardness Dependent Calculation

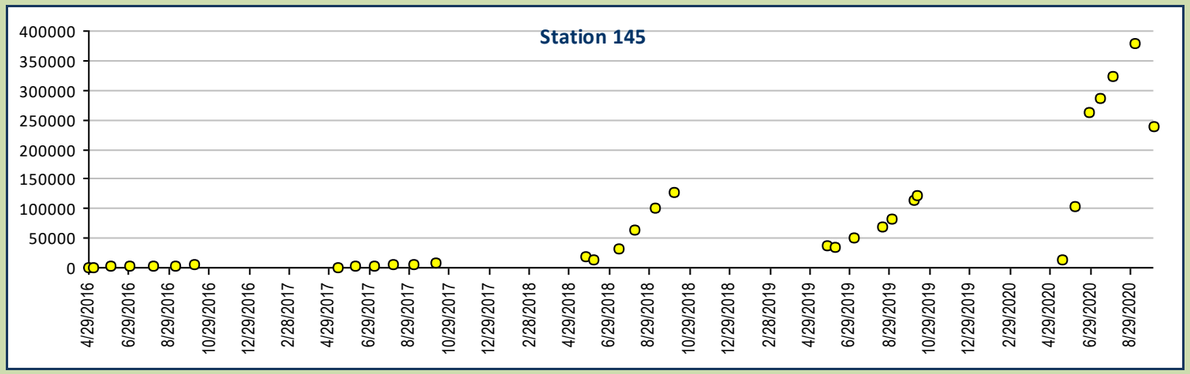
=EXP(0.8473*(LN(*hardness))+0.884)

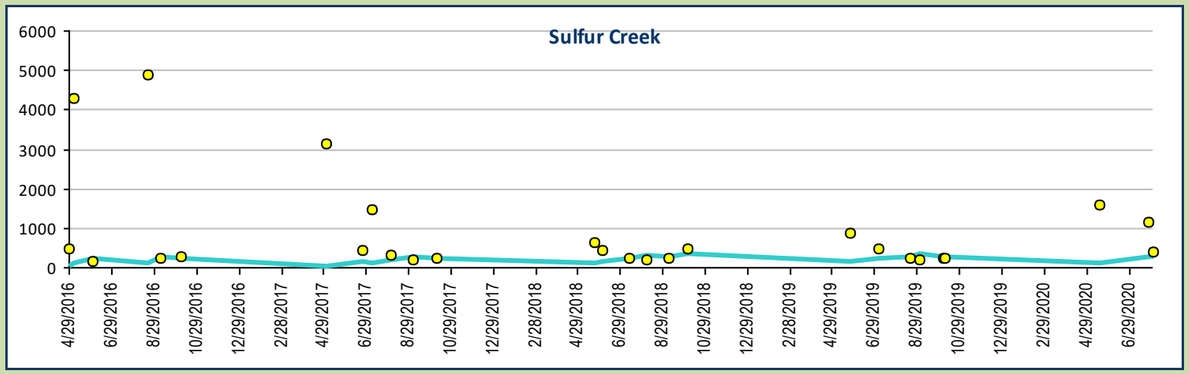
* Calculated using Standard Methods 2340B

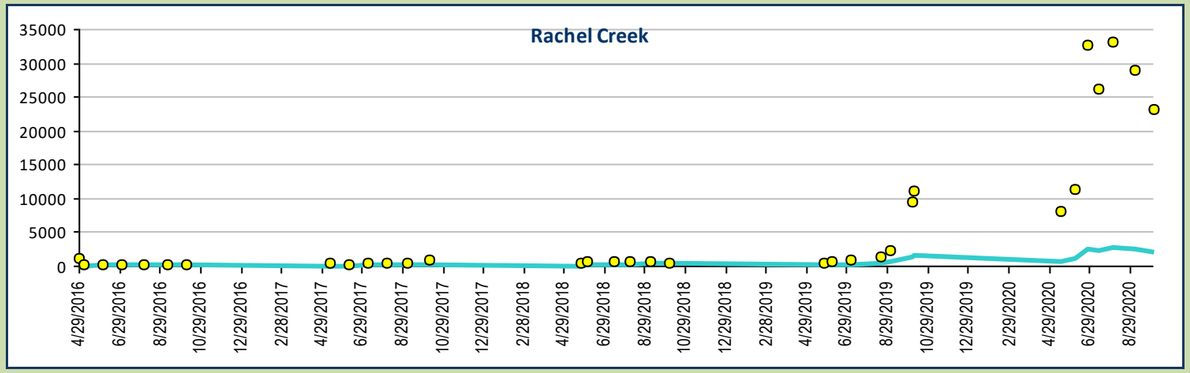


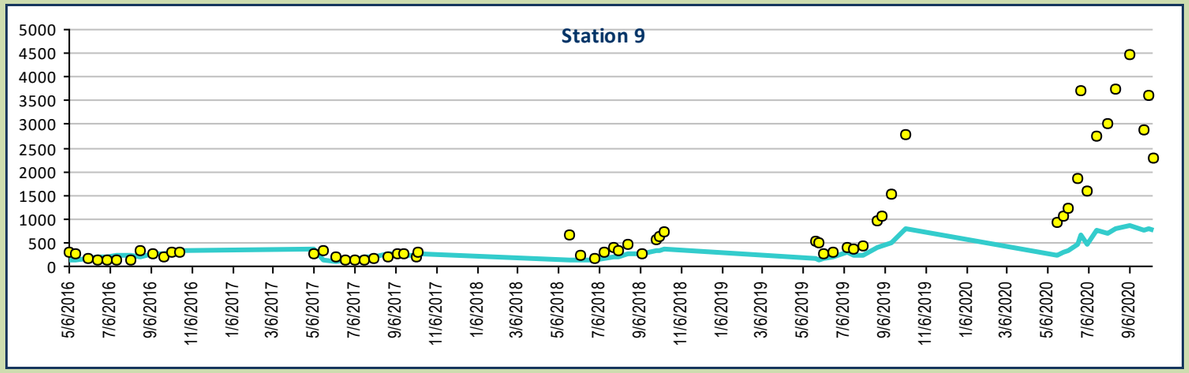








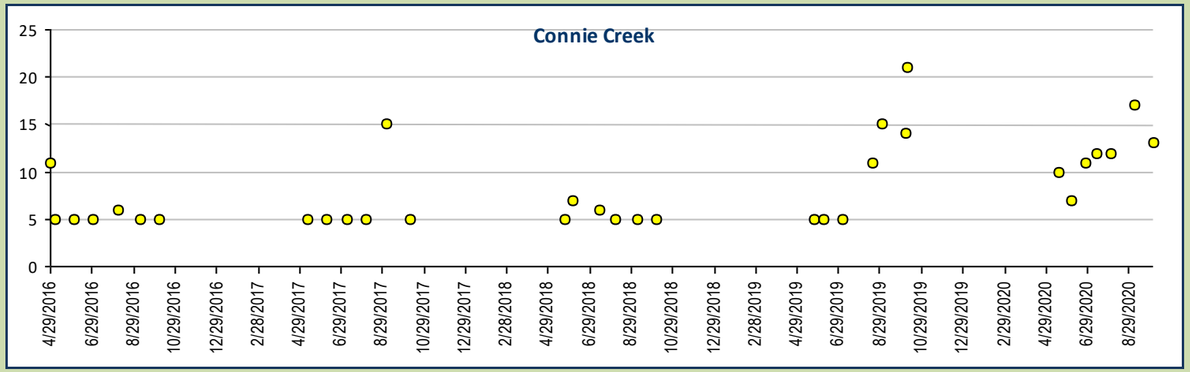


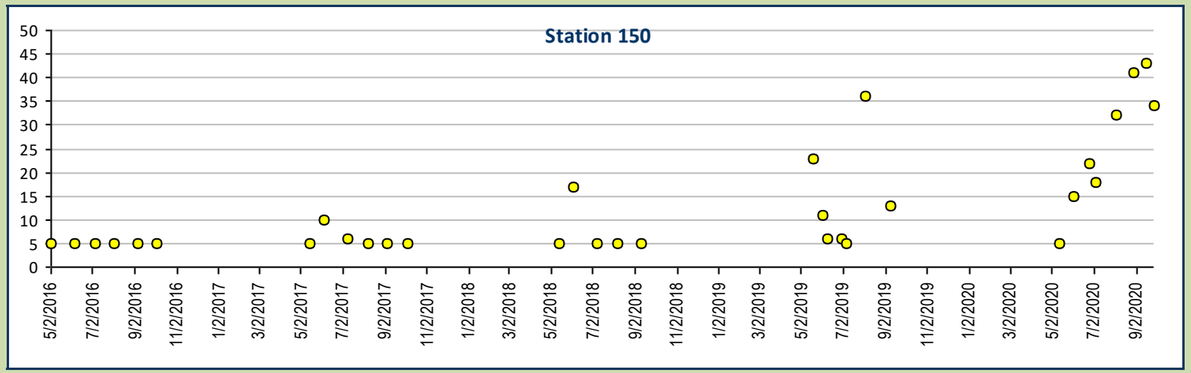


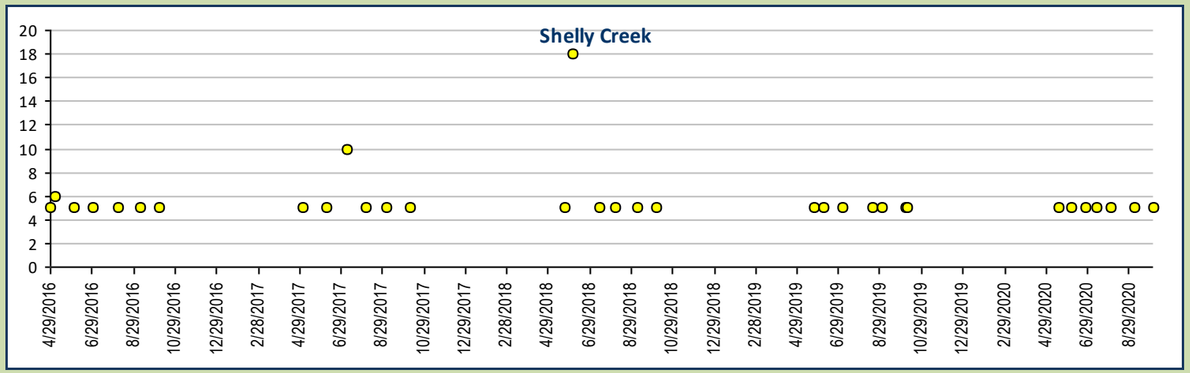
RED DOG MINE

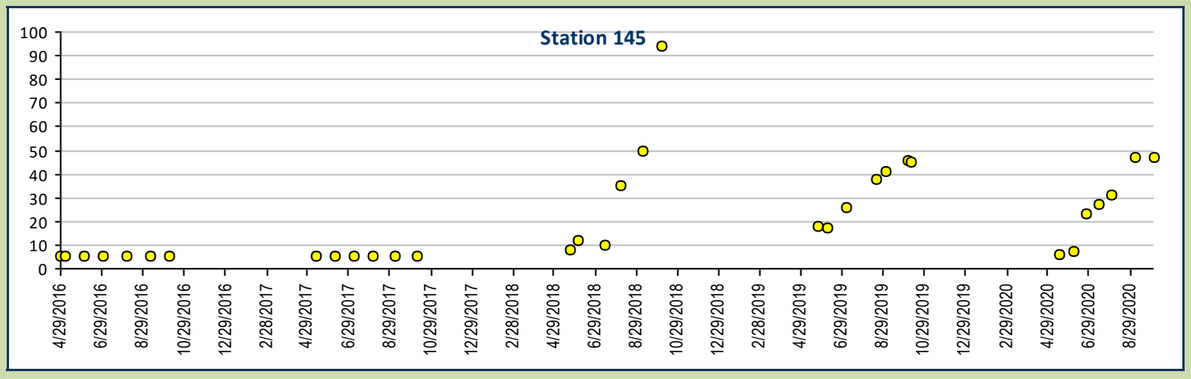
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

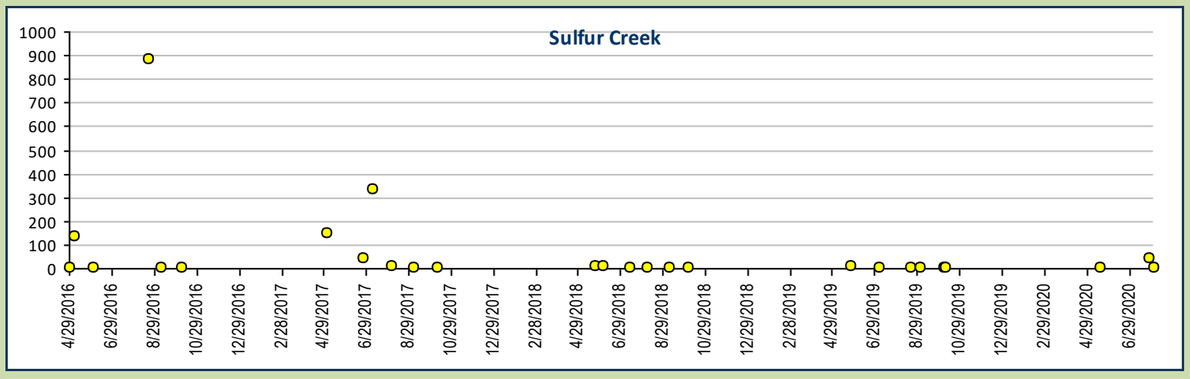
Total Suspended Solids, units mg/L

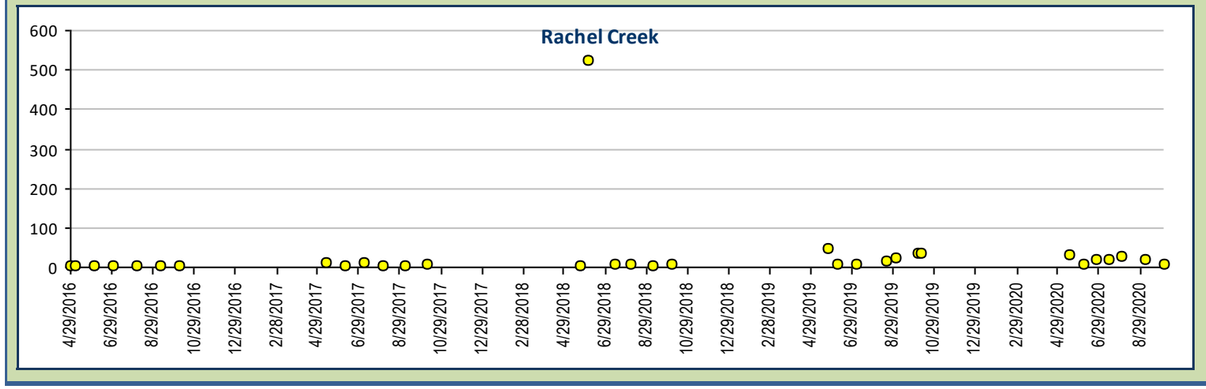


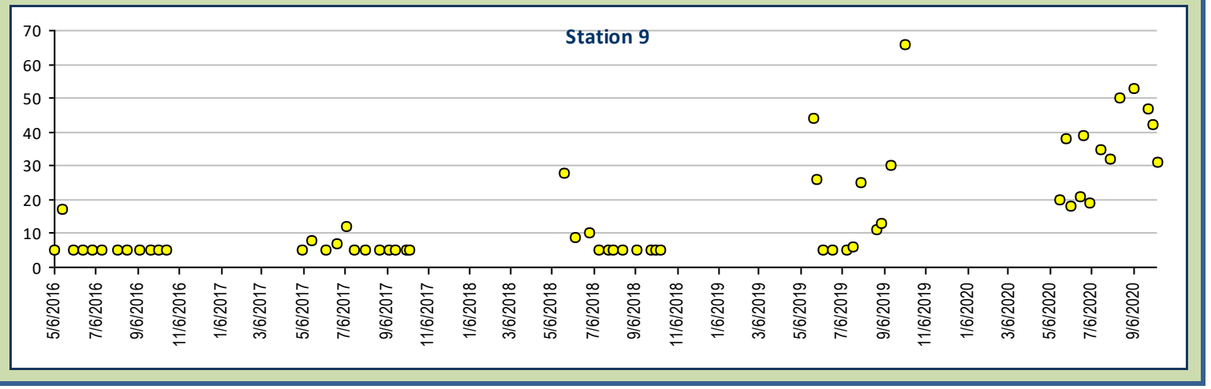












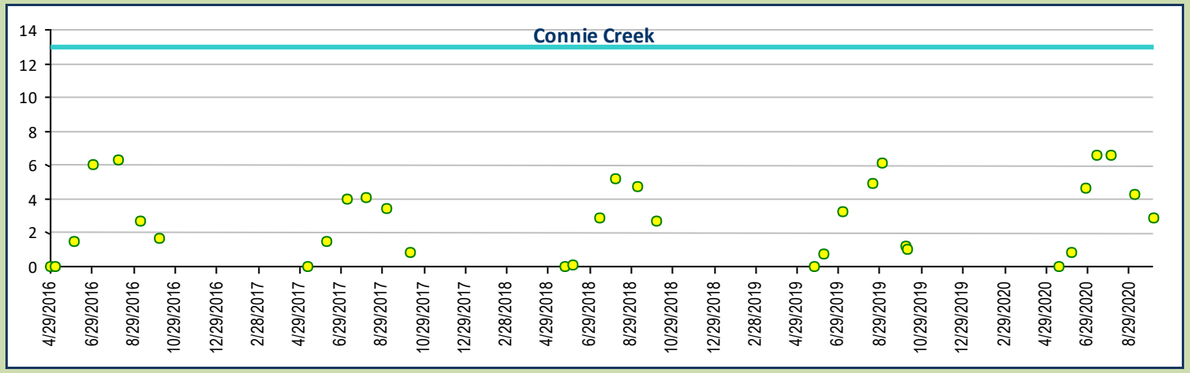
RED DOG MINE

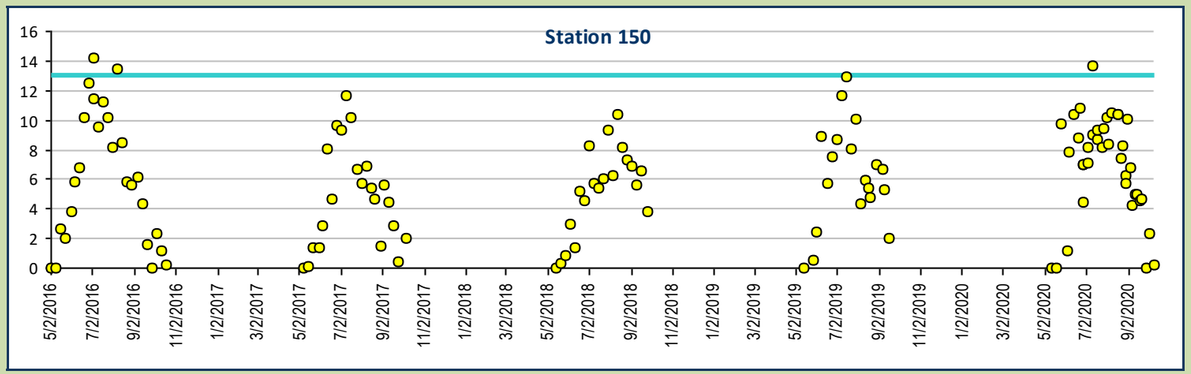
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

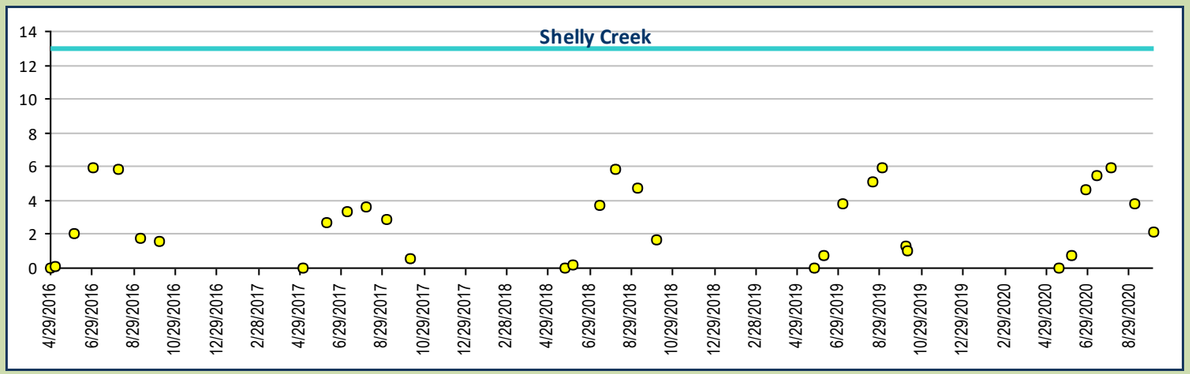
Temperature Field, Celsius

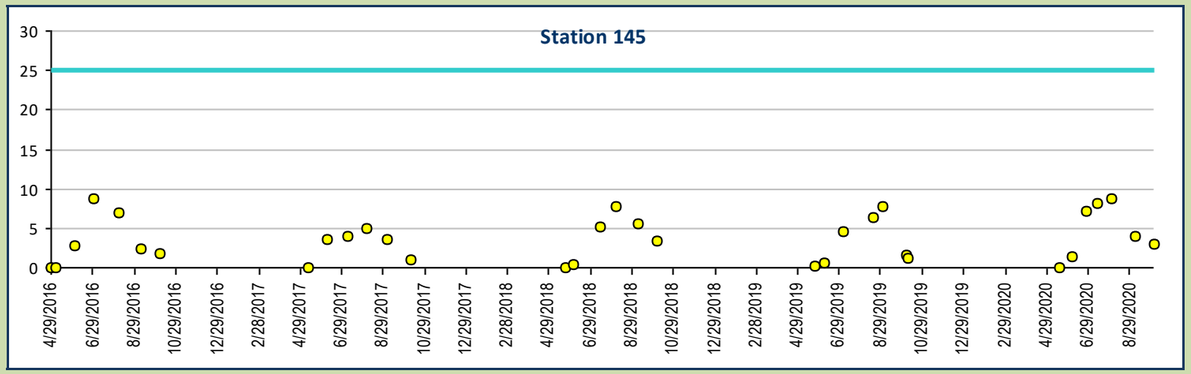
Site Specific WQS mg/L

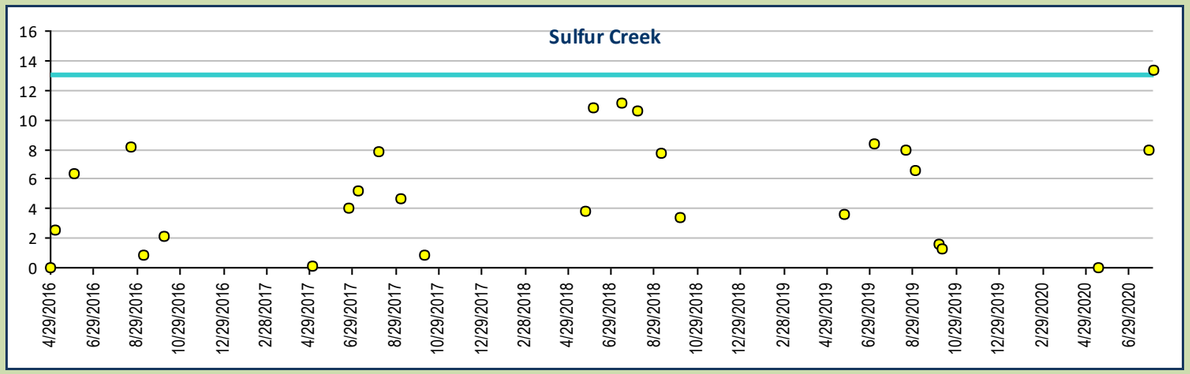
13 Celsius

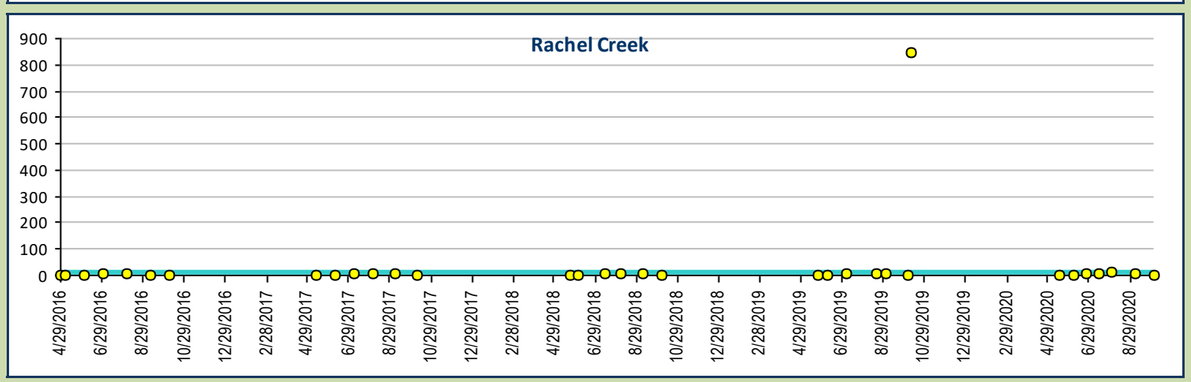


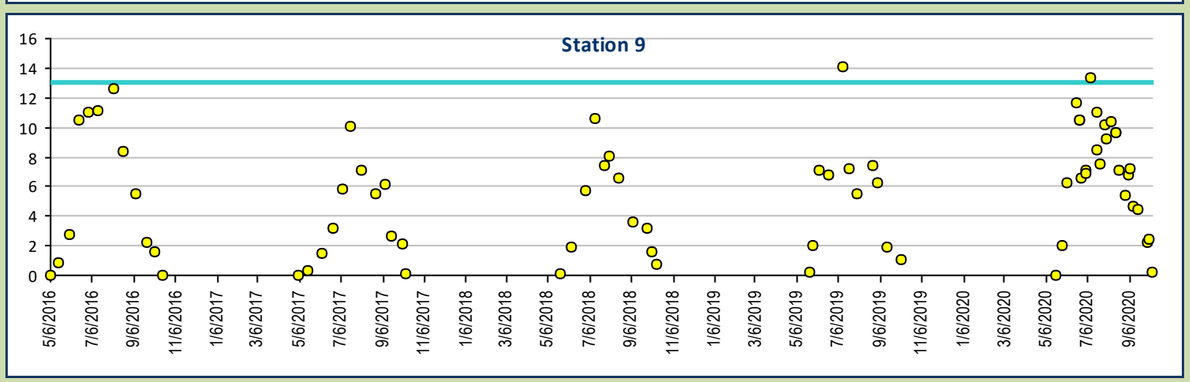












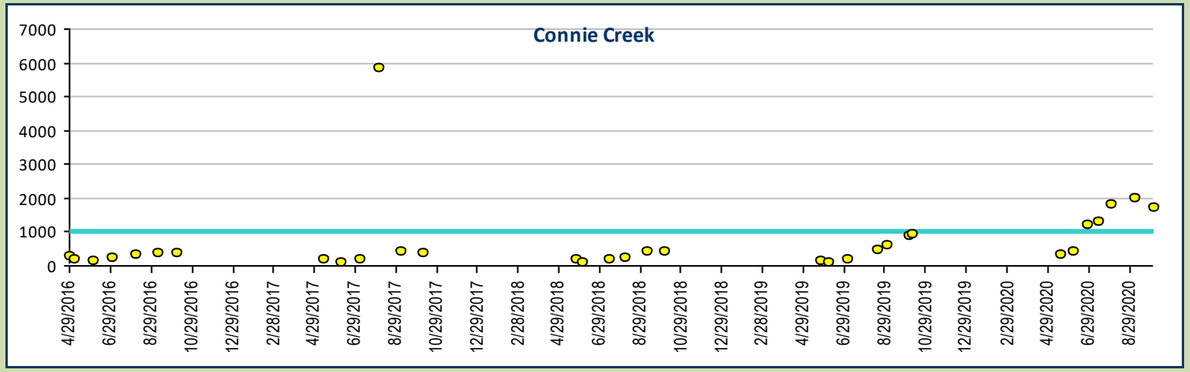
RED DOG MINE

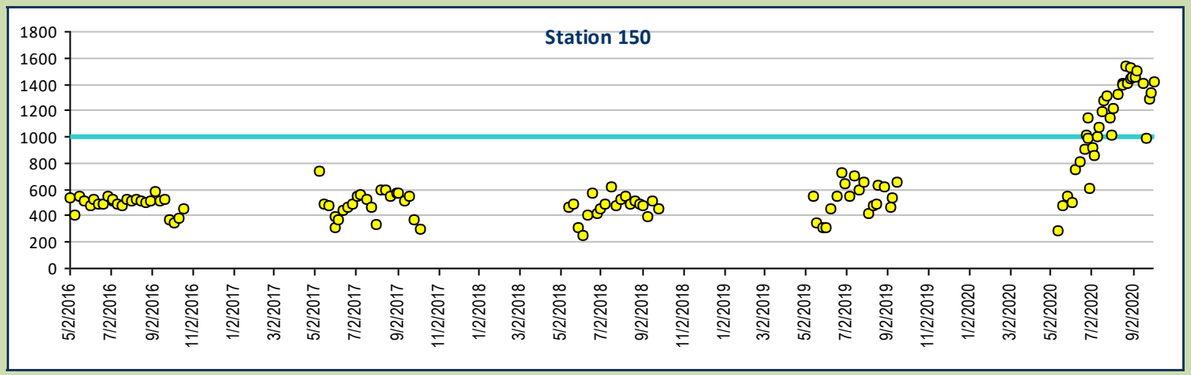
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

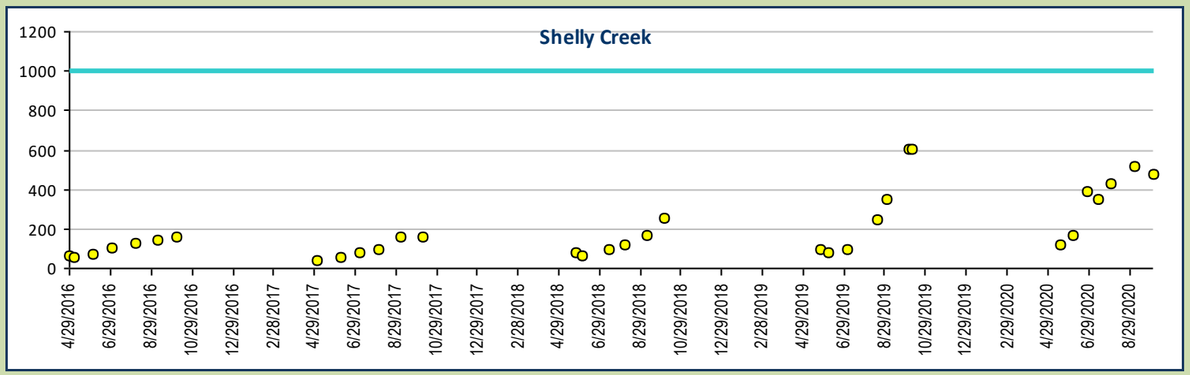
Total Dissolved Solids, units mg/L

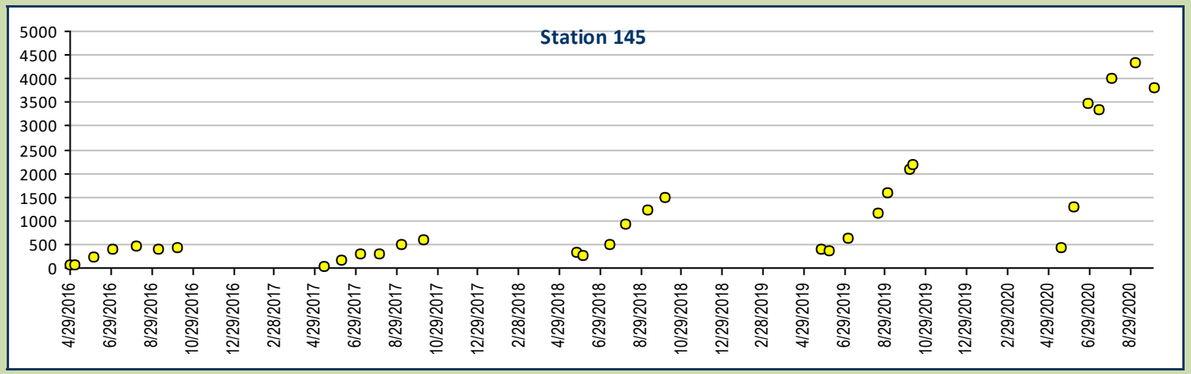
Site Specific WQS mg/L

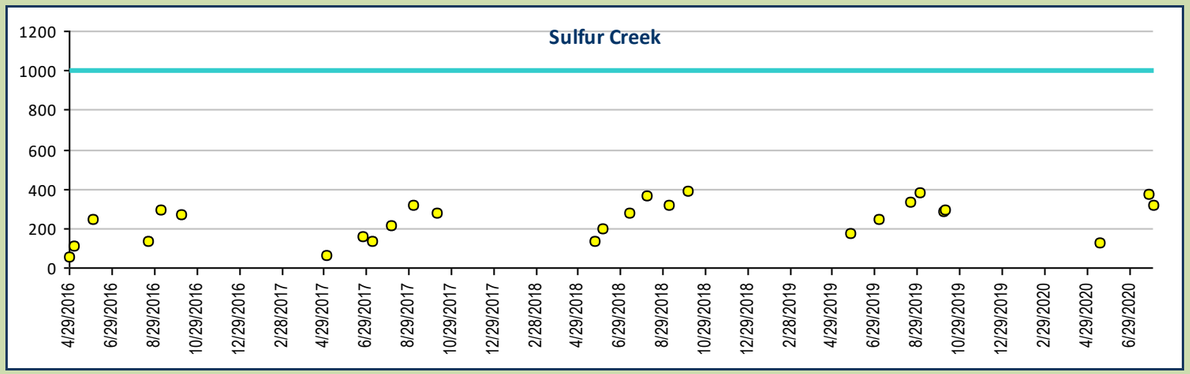
1000 mg/L

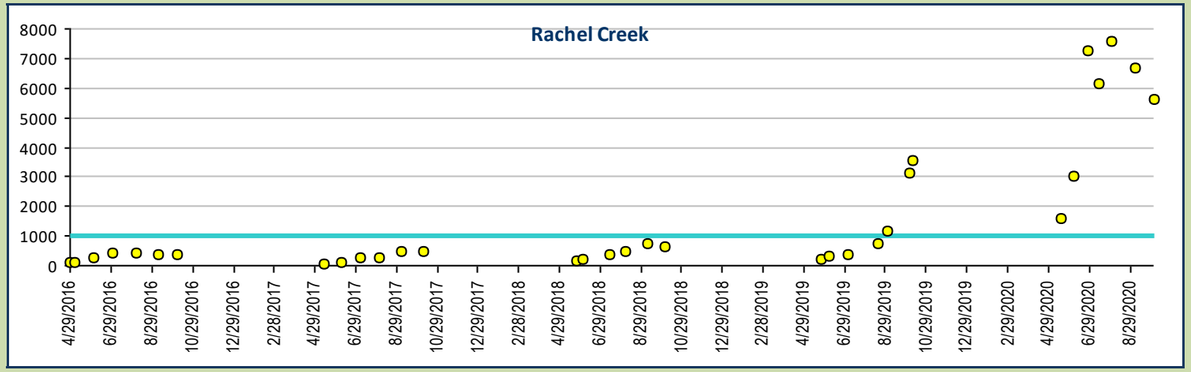


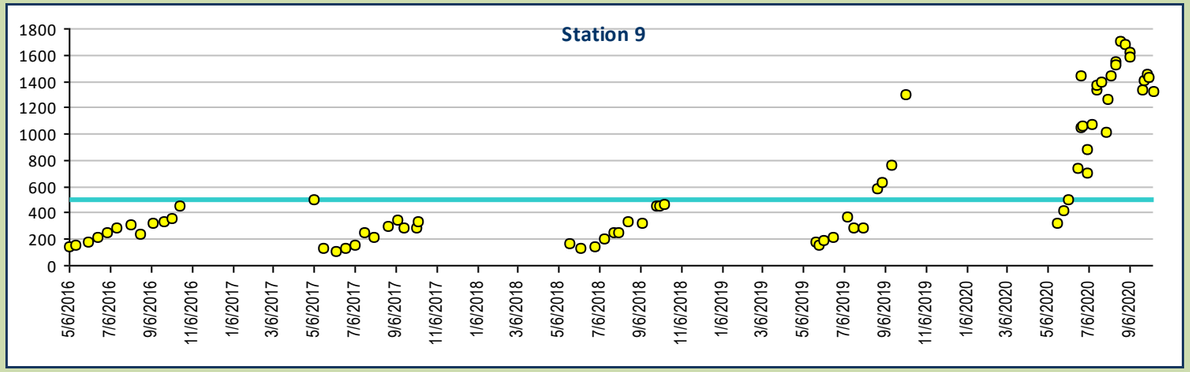








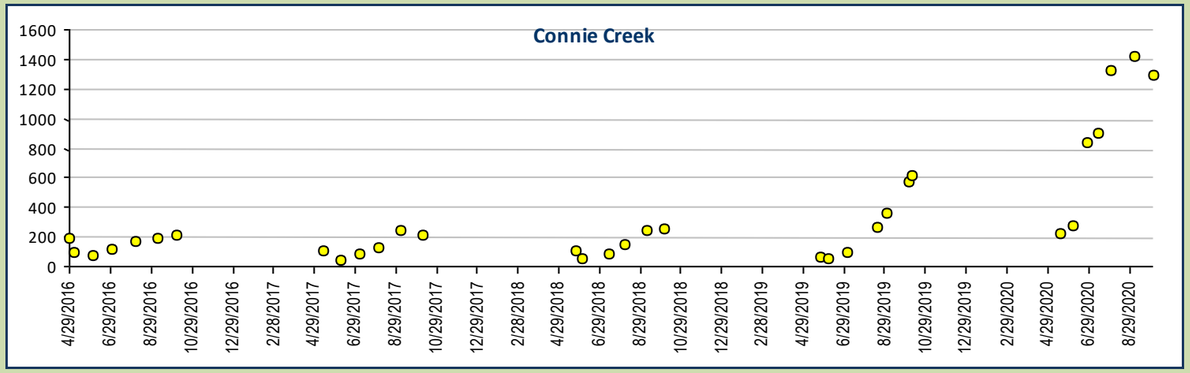


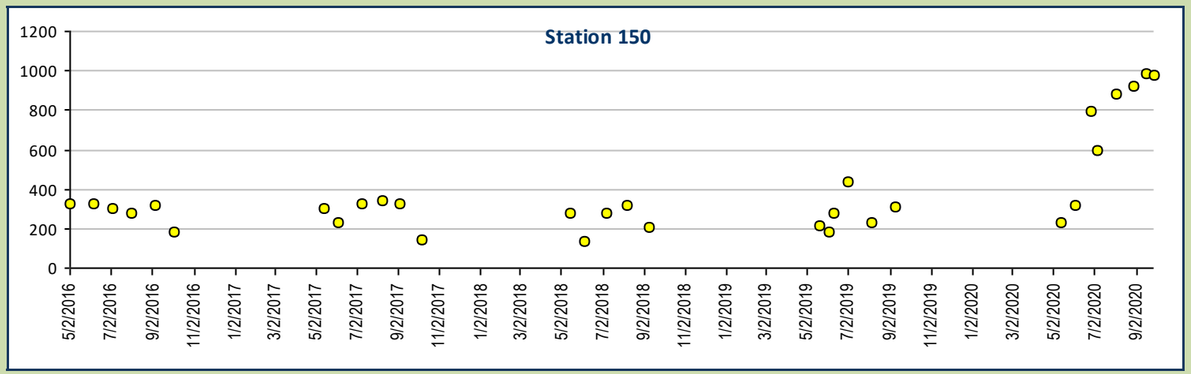


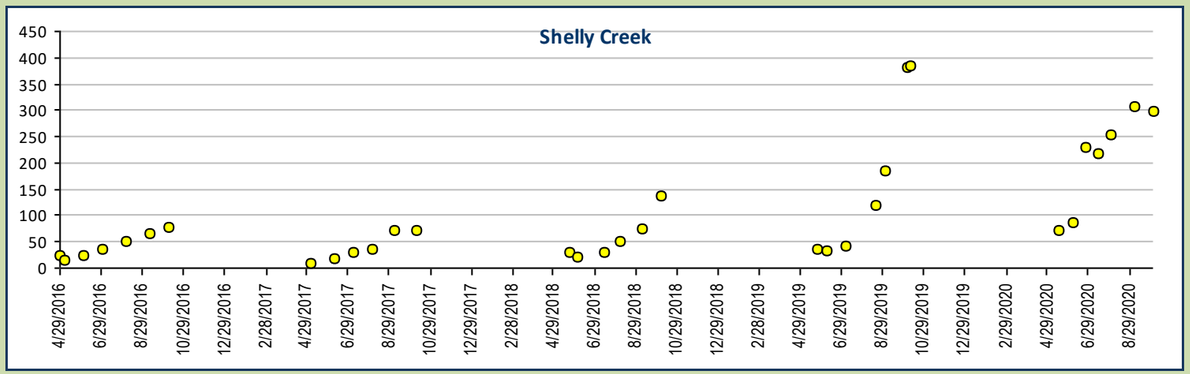
RED DOG MINE

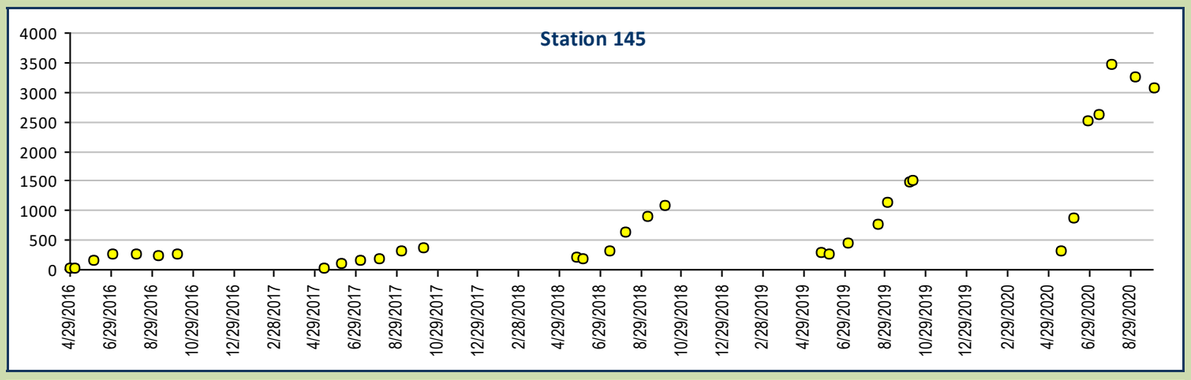
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

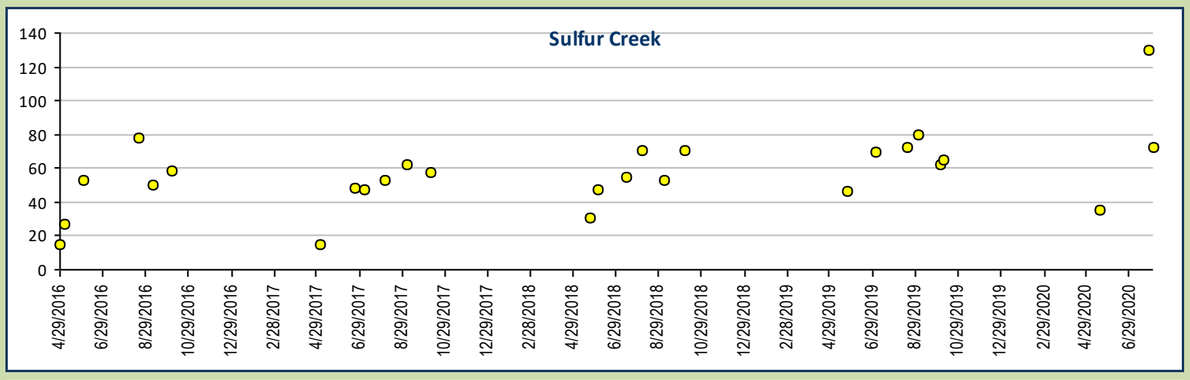
Sulfate, units mg/L

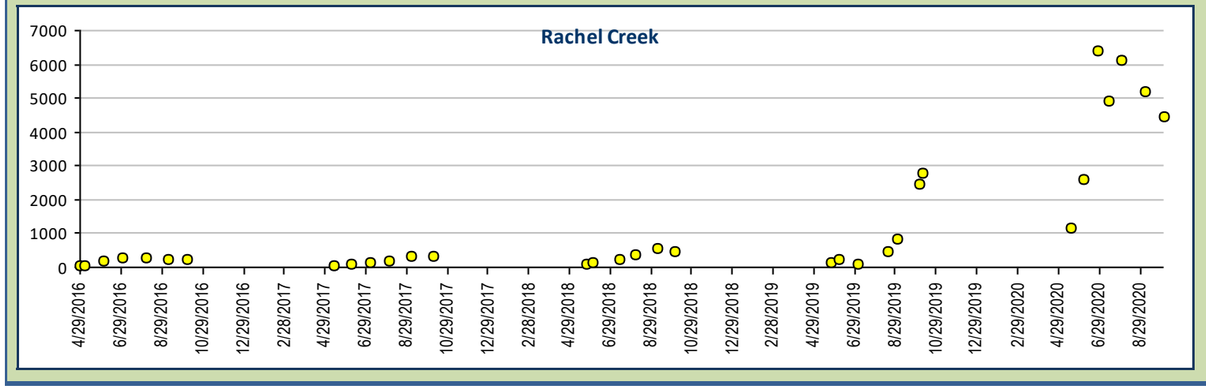


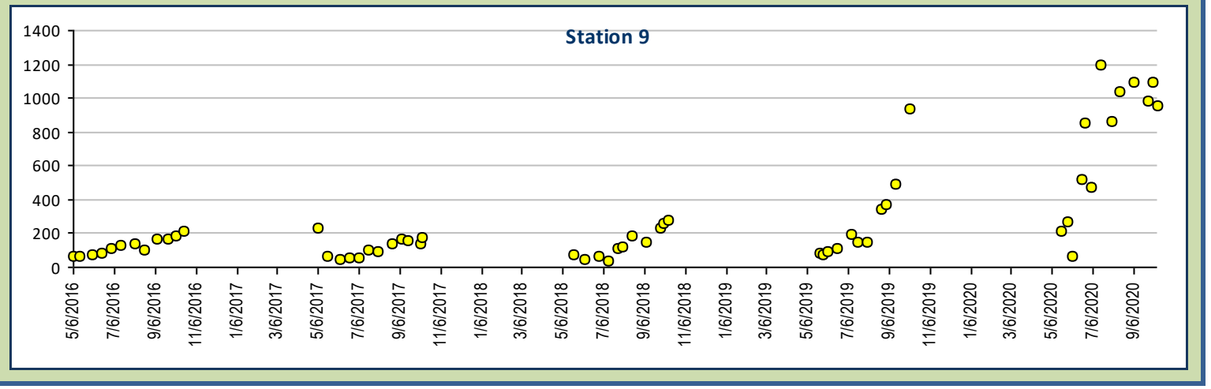












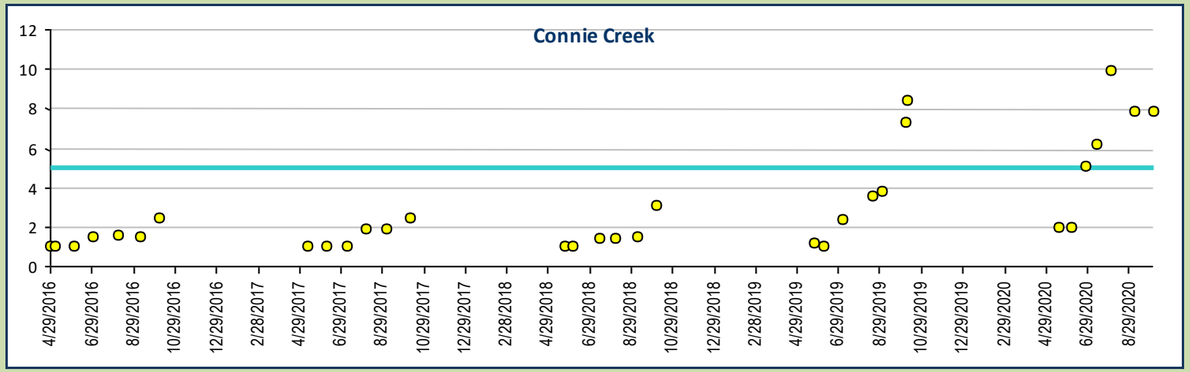
RED DOG MINE

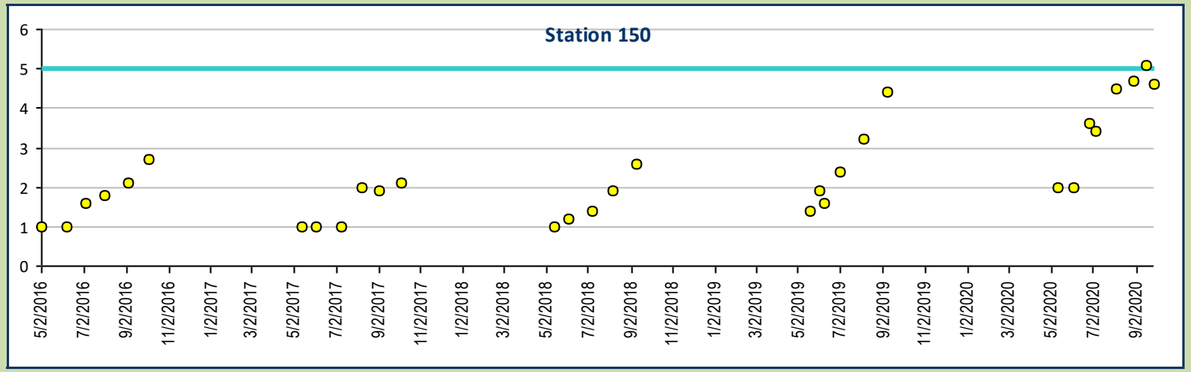
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

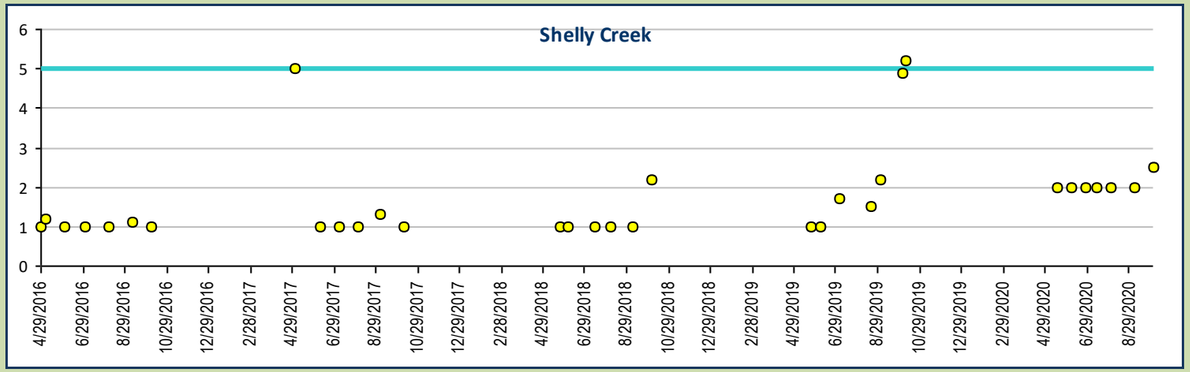
Selenium, Total Recoverable, units ug/L

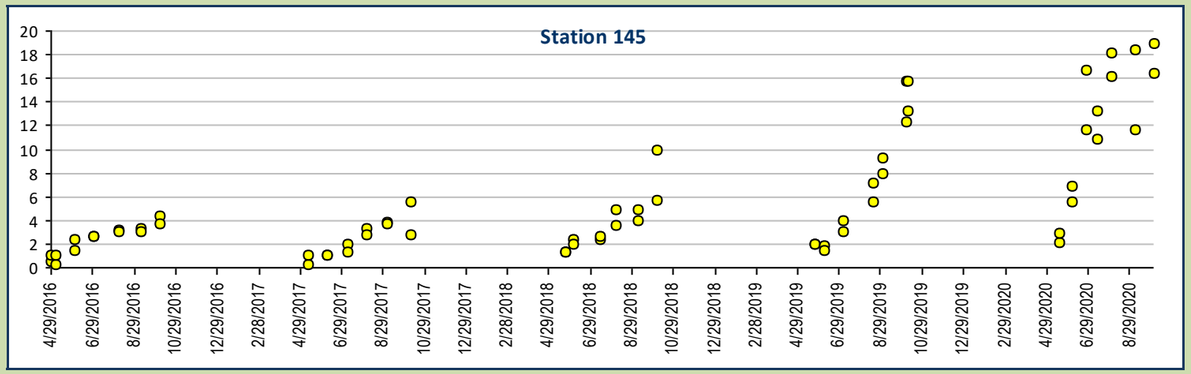
Aquatic Life - Fresh Water Chronic WQS ug/L

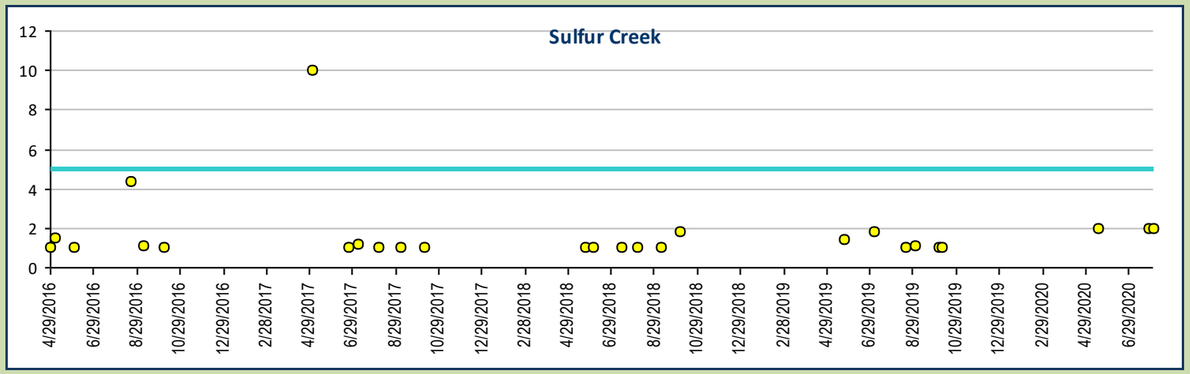
5 ug/L

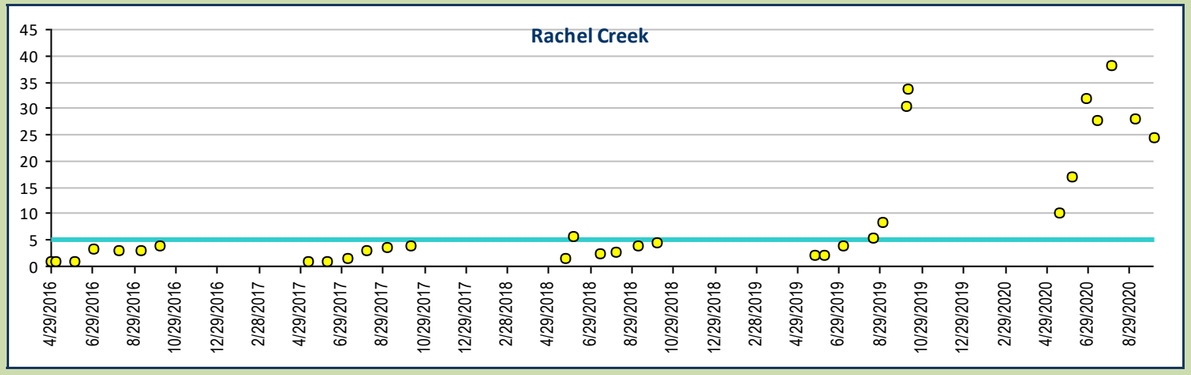


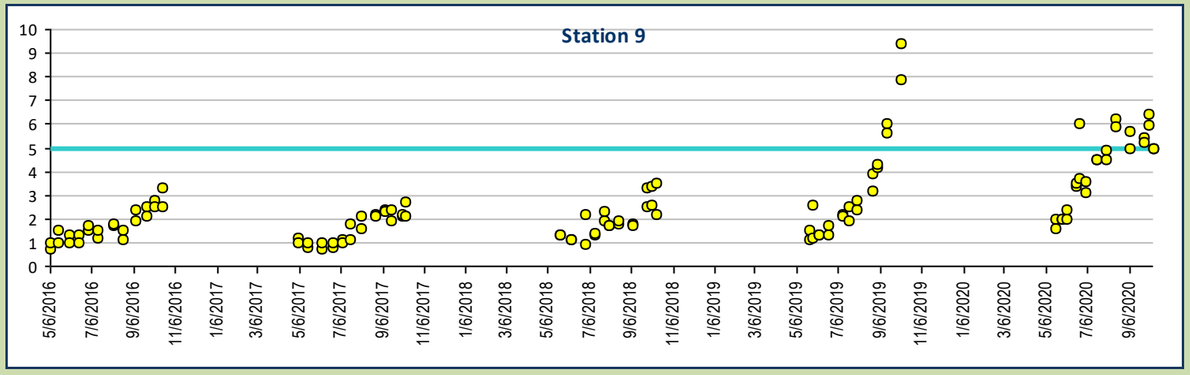










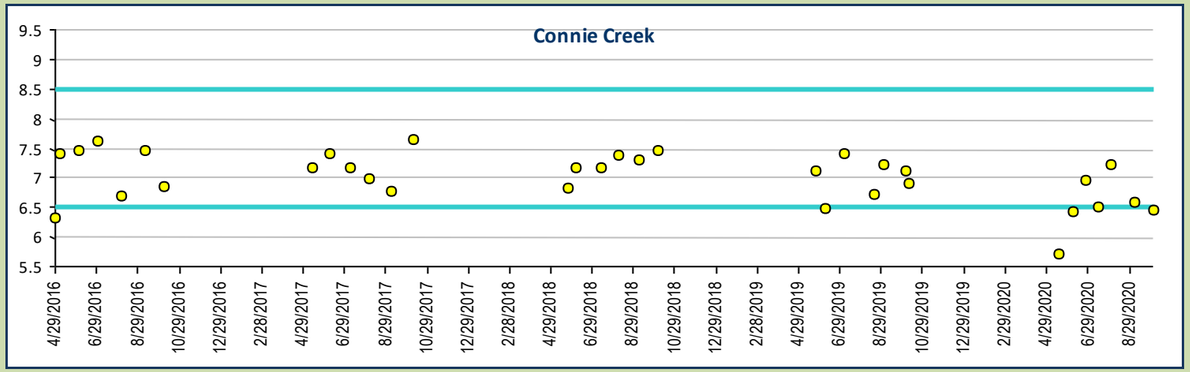


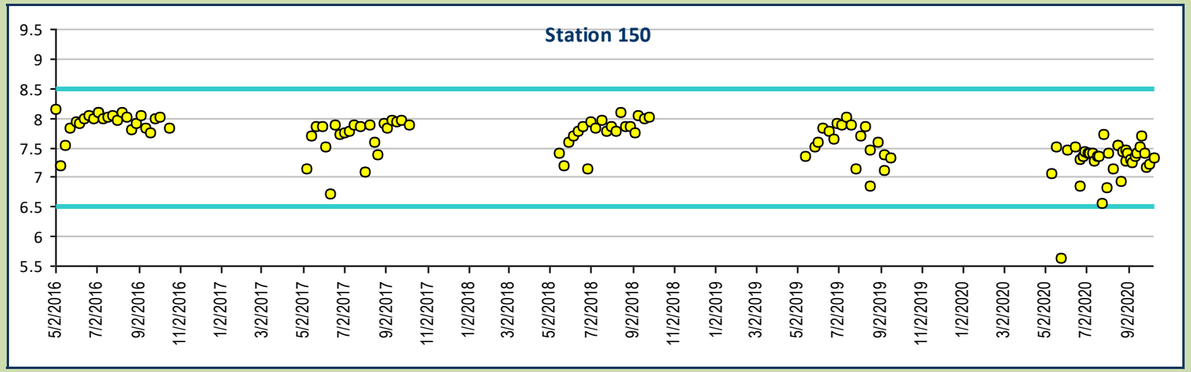
RED DOG MINE

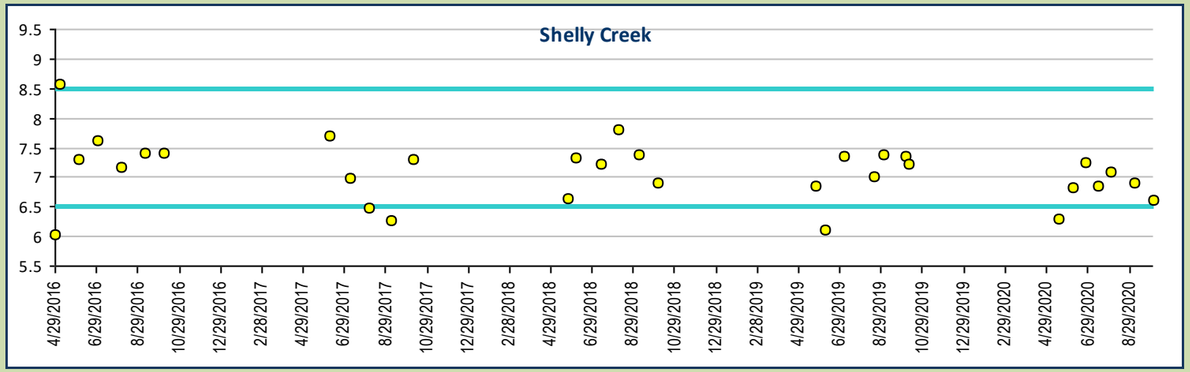
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

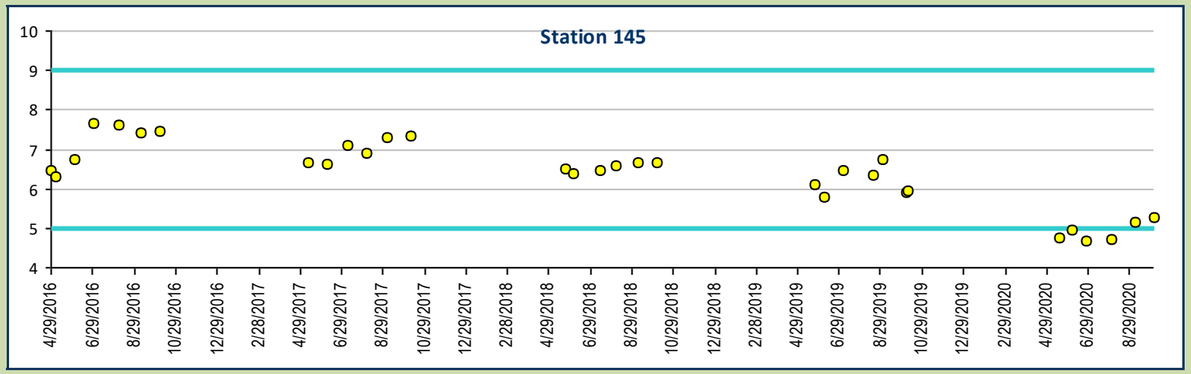
pH

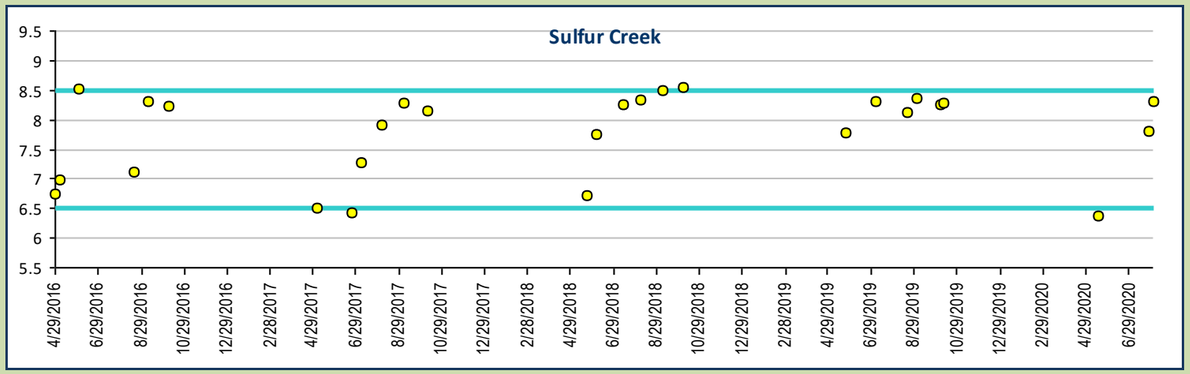
Site Specific WQS pH units

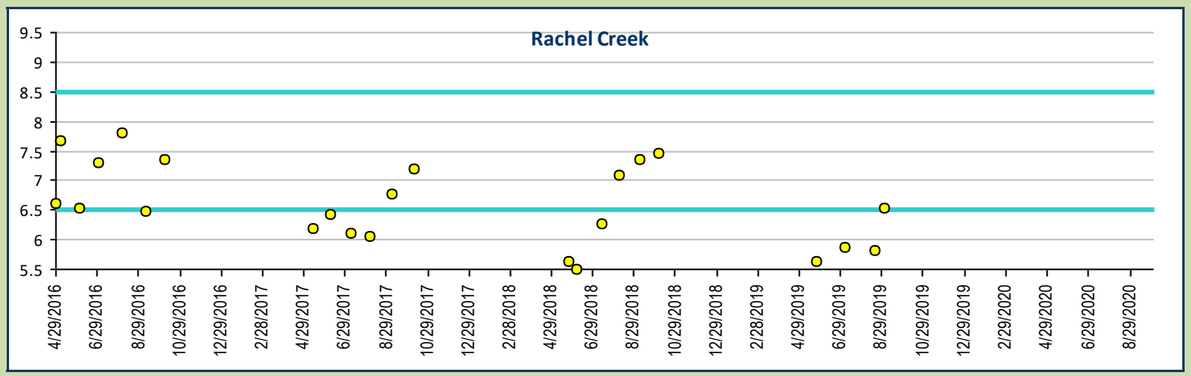


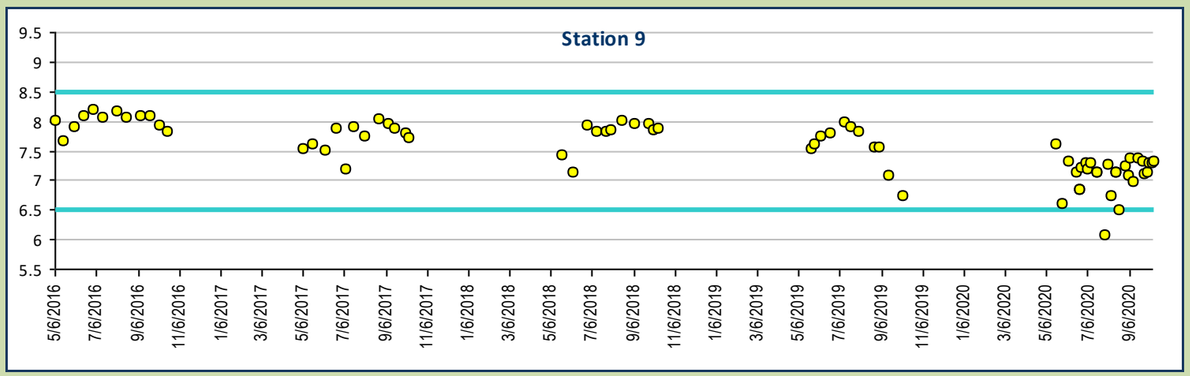












RED DOG MINE

Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

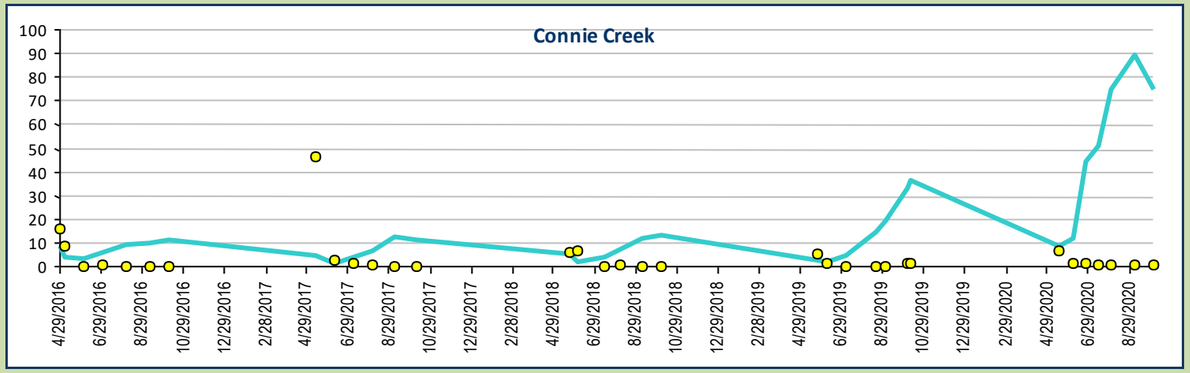
Lead, Total Recoverable, units ug/L

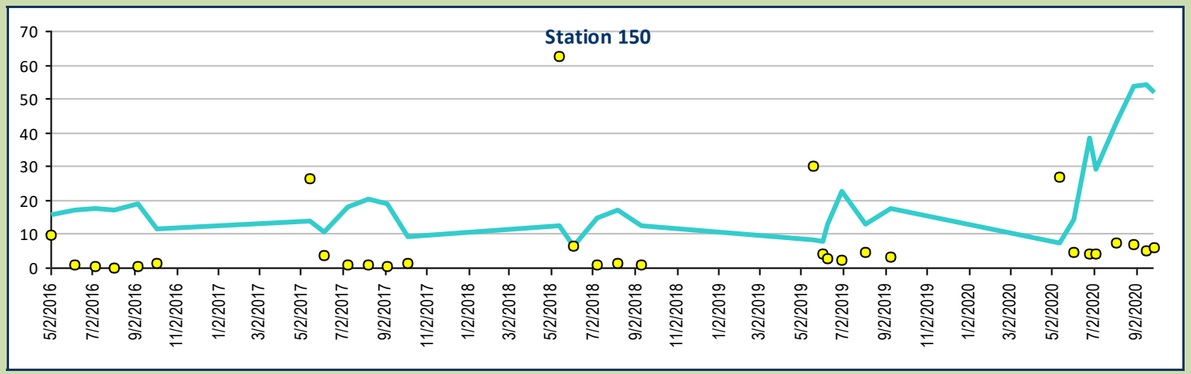
Aquatic Life - Fresh Water Chronic WQS ug/L

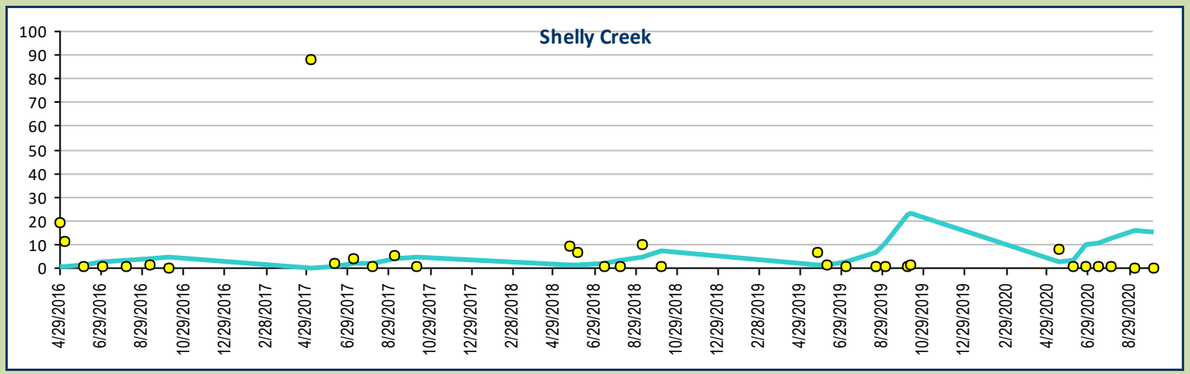
Hardness Dependent Calculation

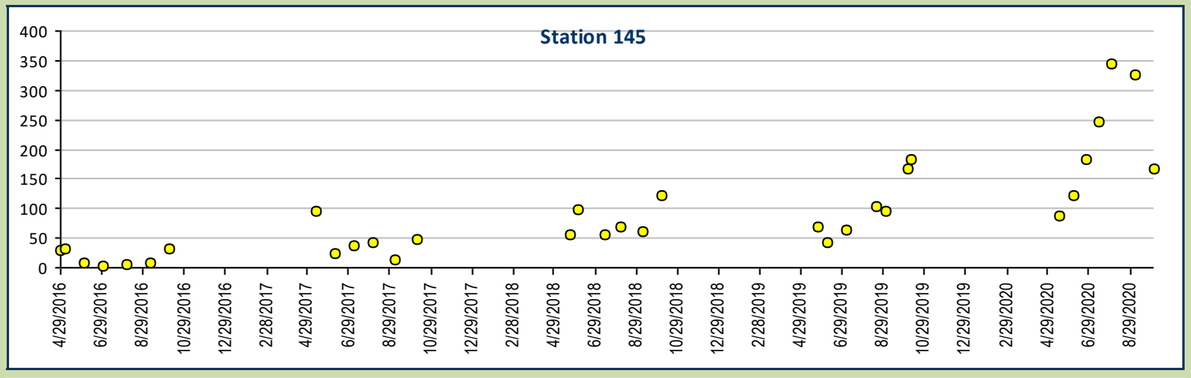
=EXP(1.273*(LN(calc *hardness))-4.705)

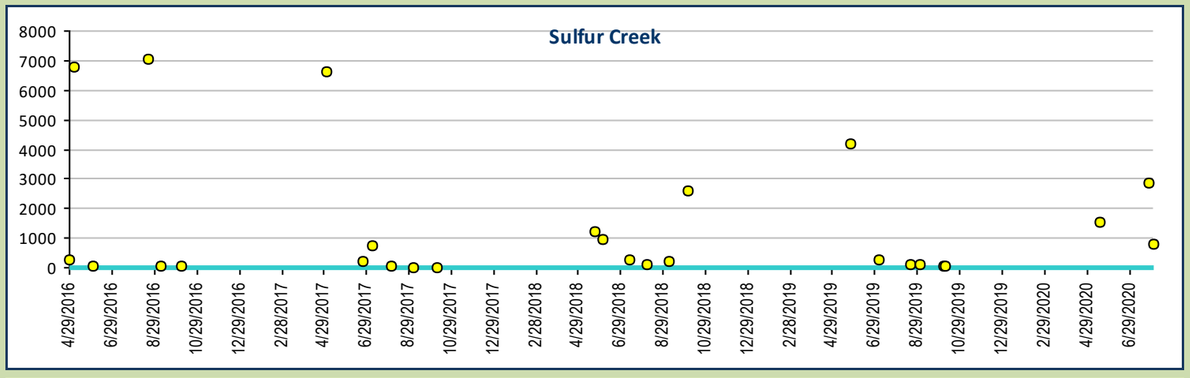
* Calculated using Standard Methods 2340B

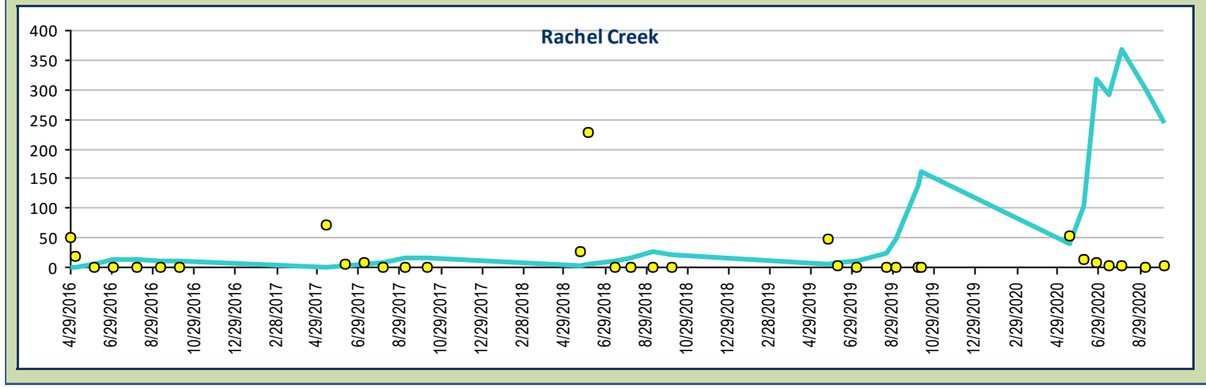


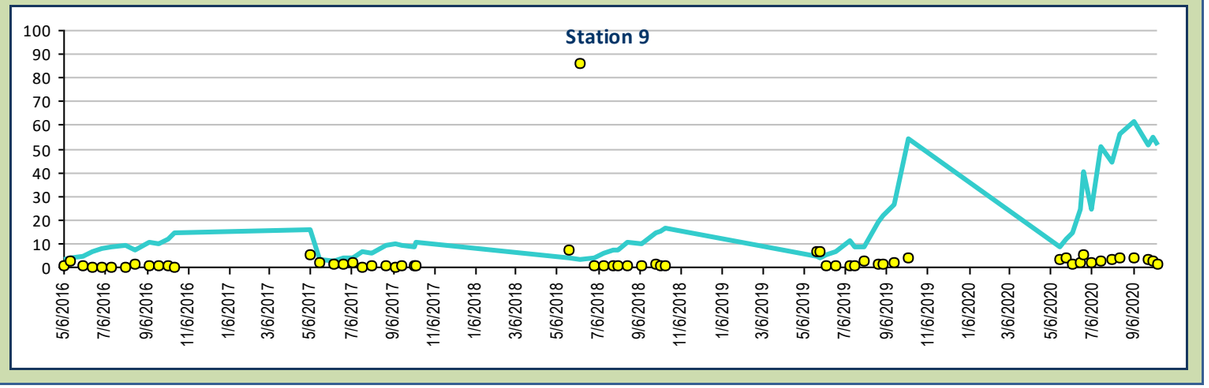








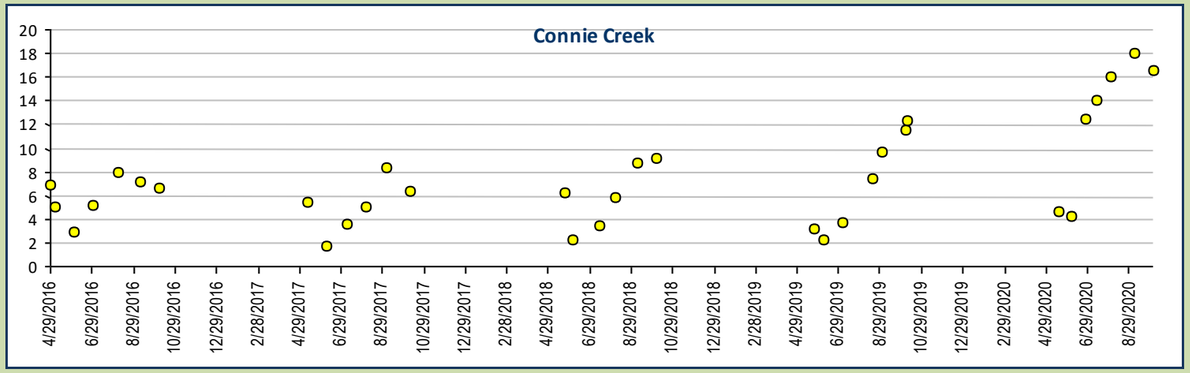


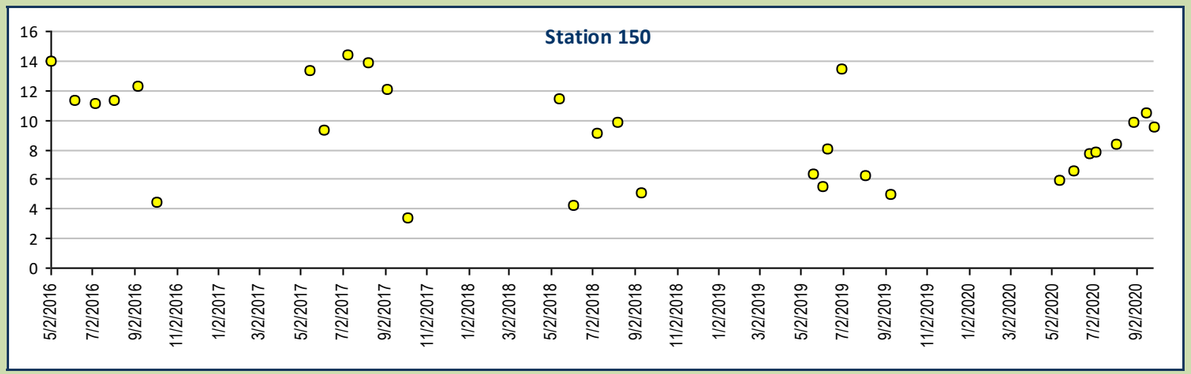


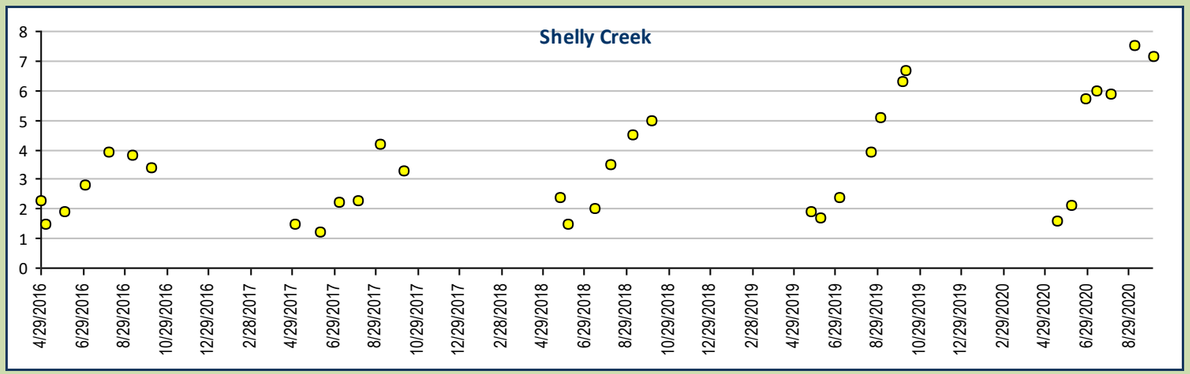
RED DOG MINE

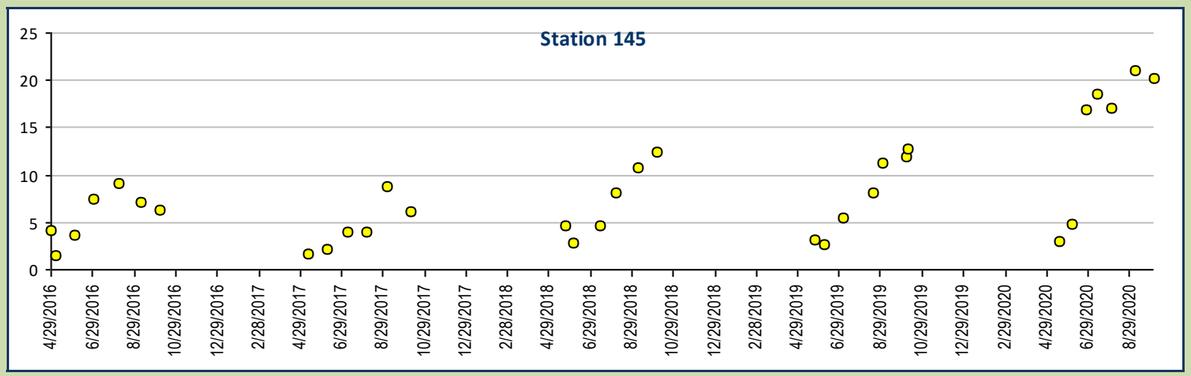
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

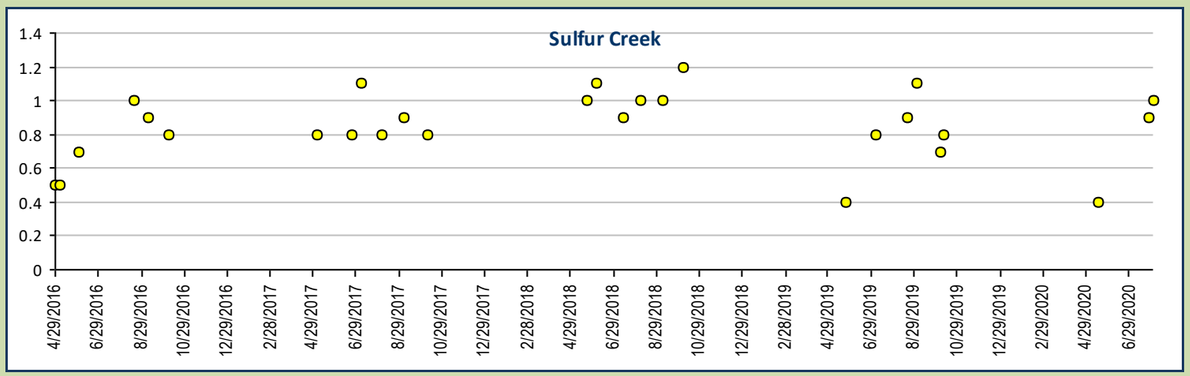
Sodium, Total Recoverable, units mg/L

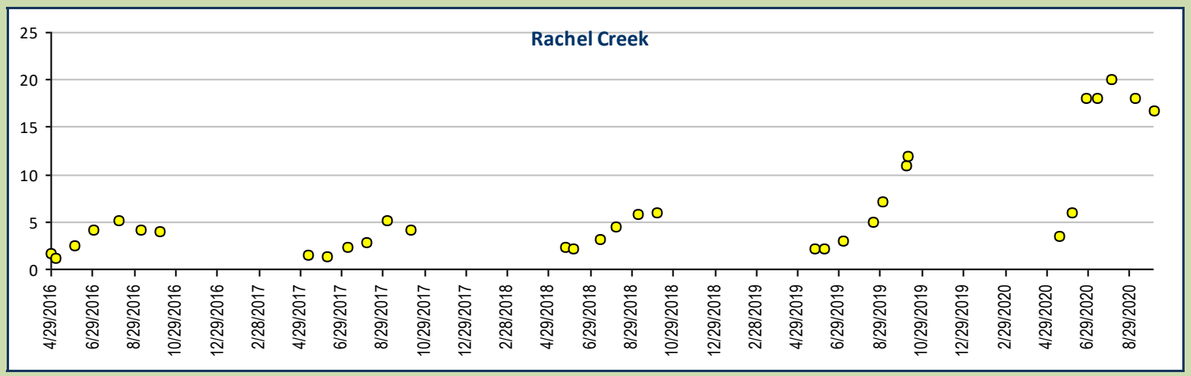


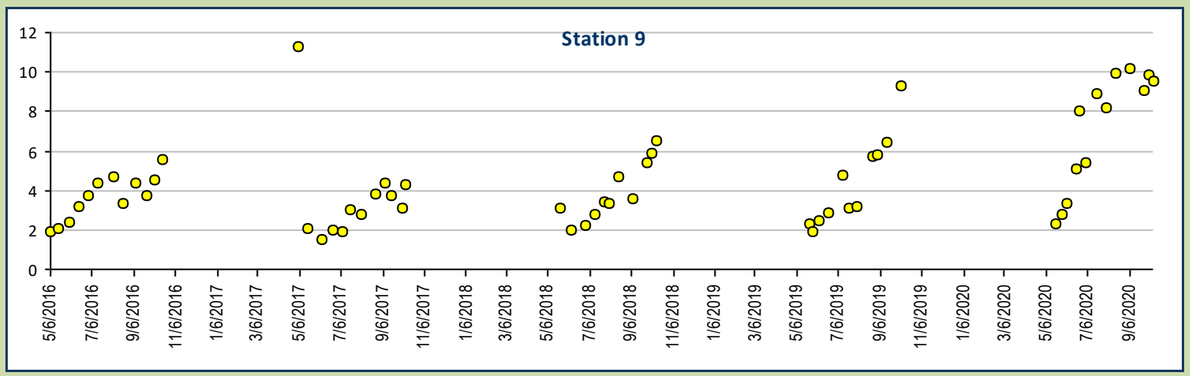








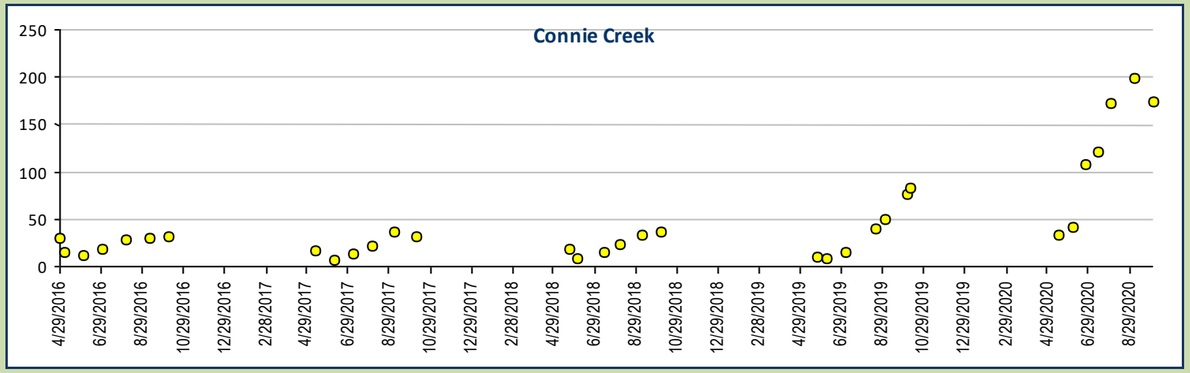


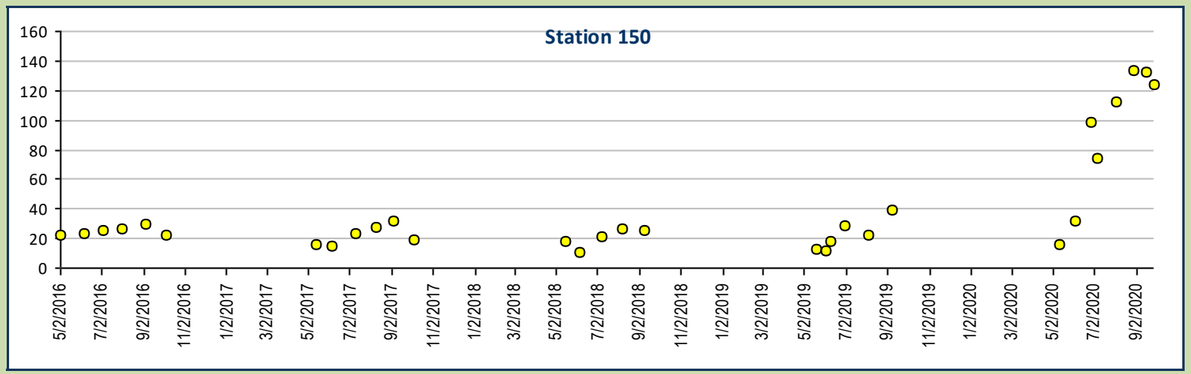


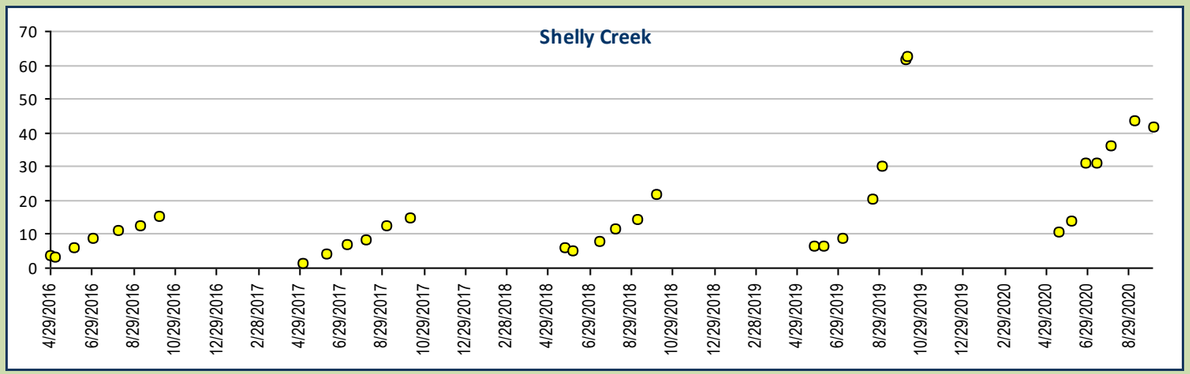
RED DOG MINE

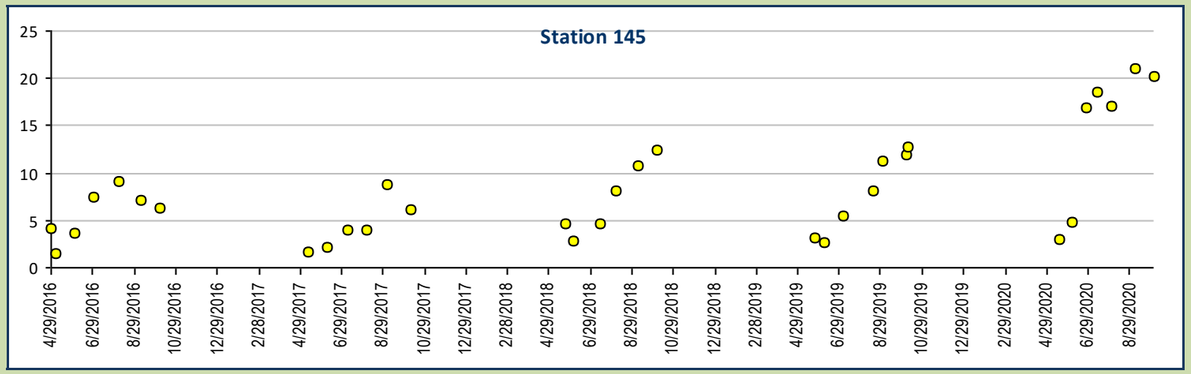
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

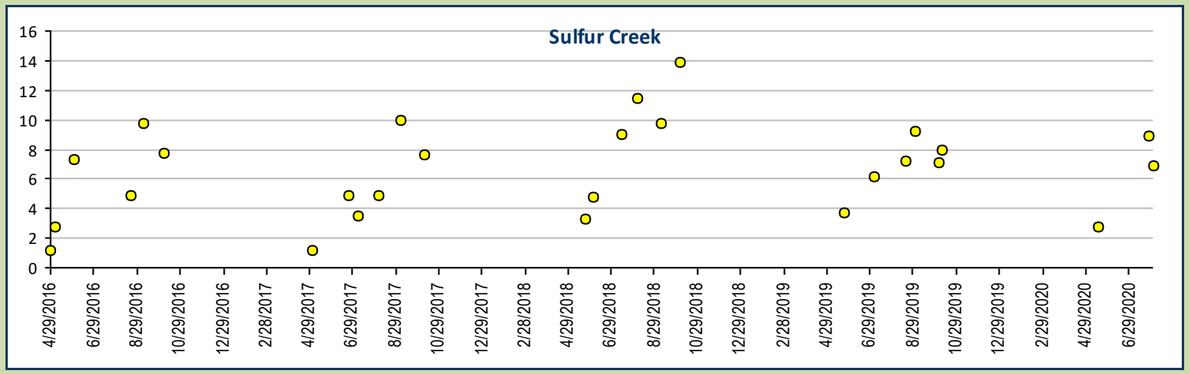
Magnesium, Total Recoverable, units mg/L

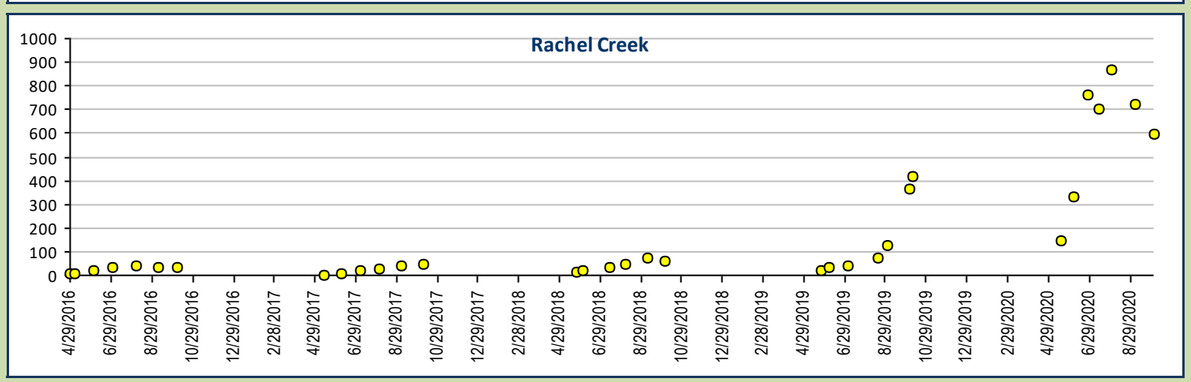


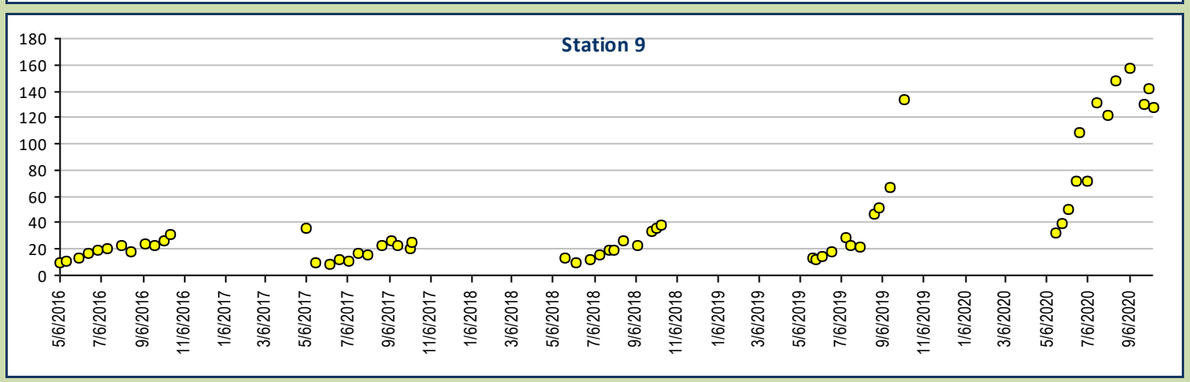








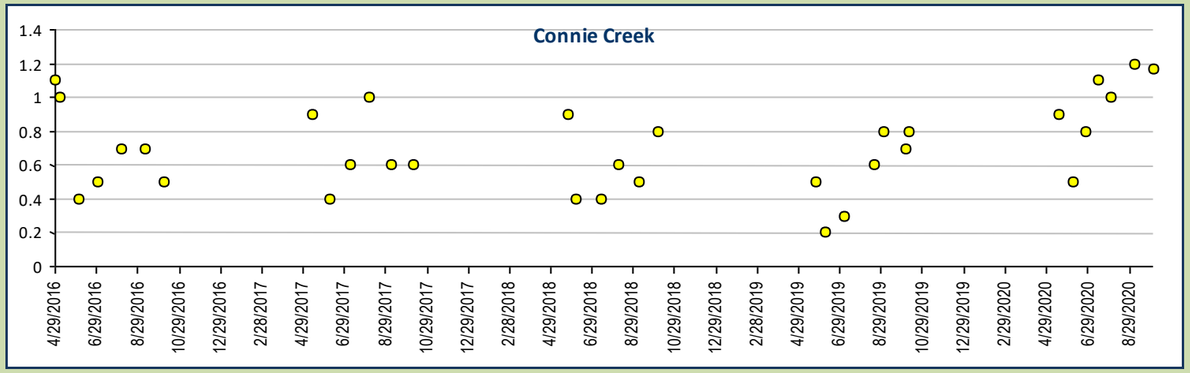


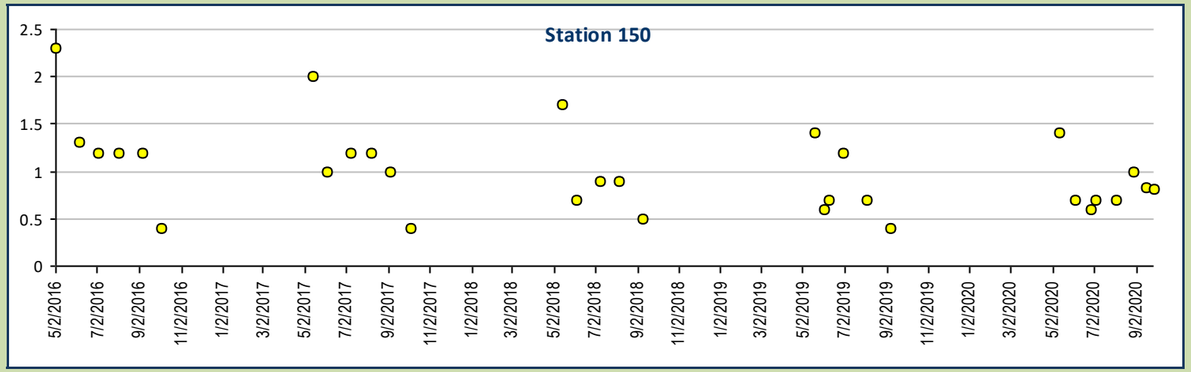


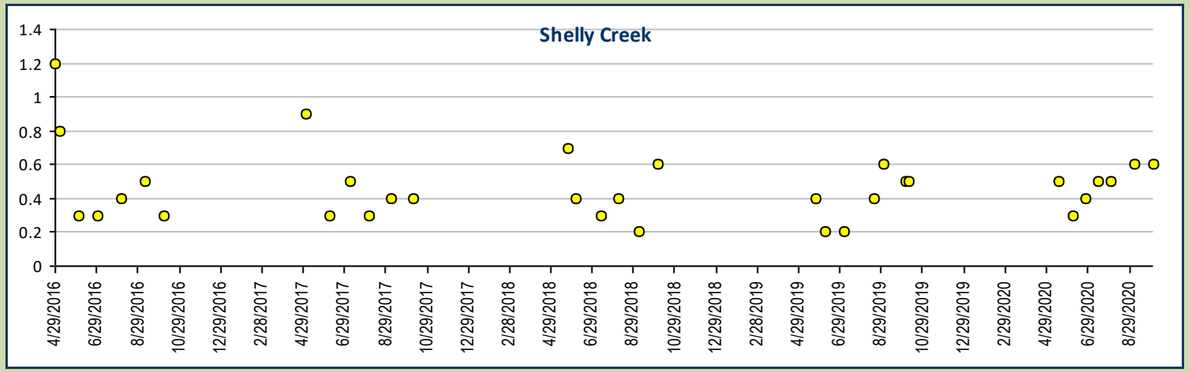
RED DOG MINE

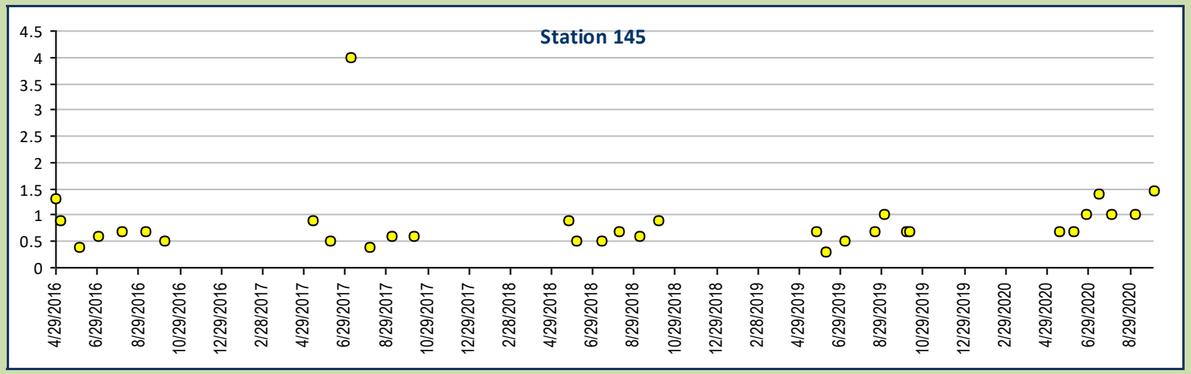
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

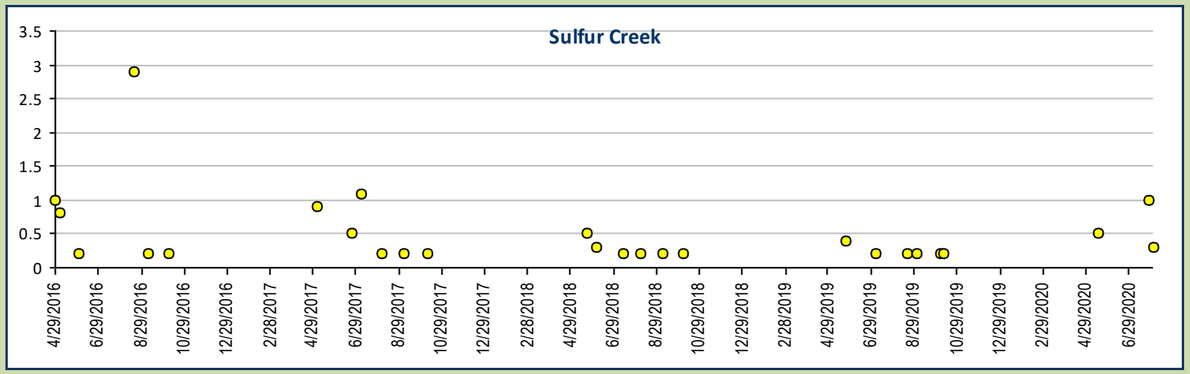
Potassium, Total Recoverable, units mg/L

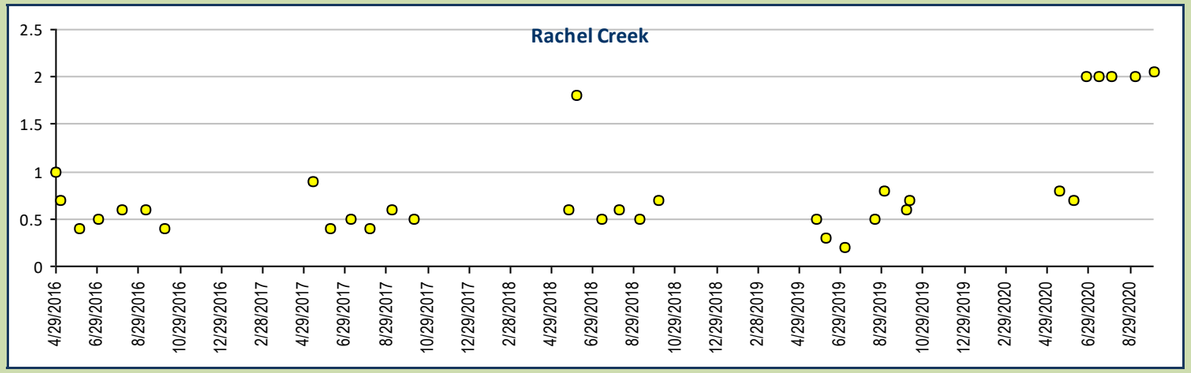


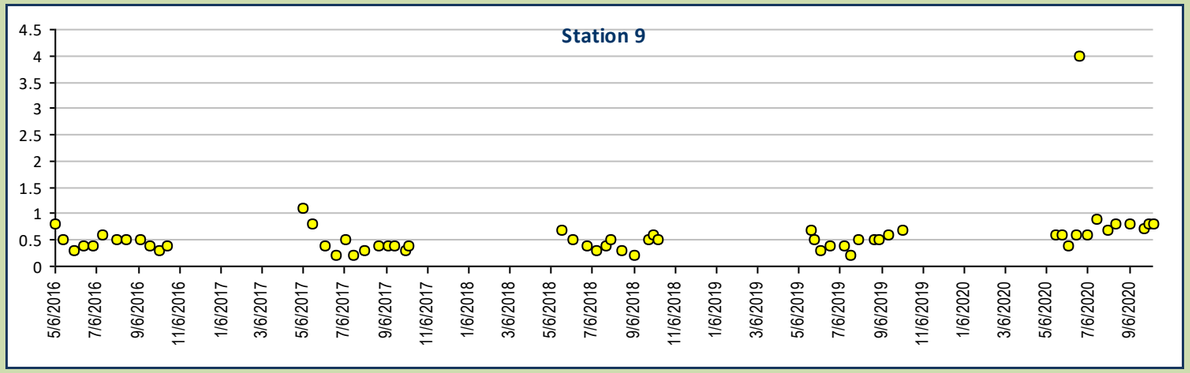












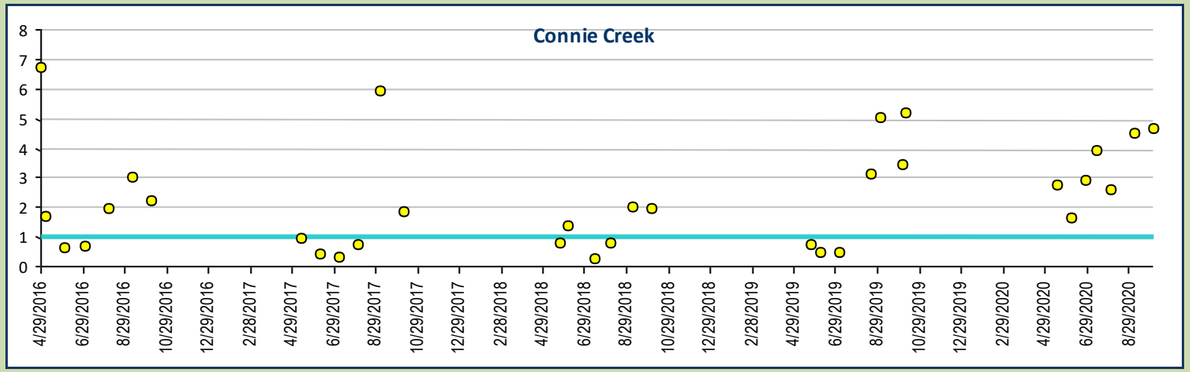
RED DOG MINE

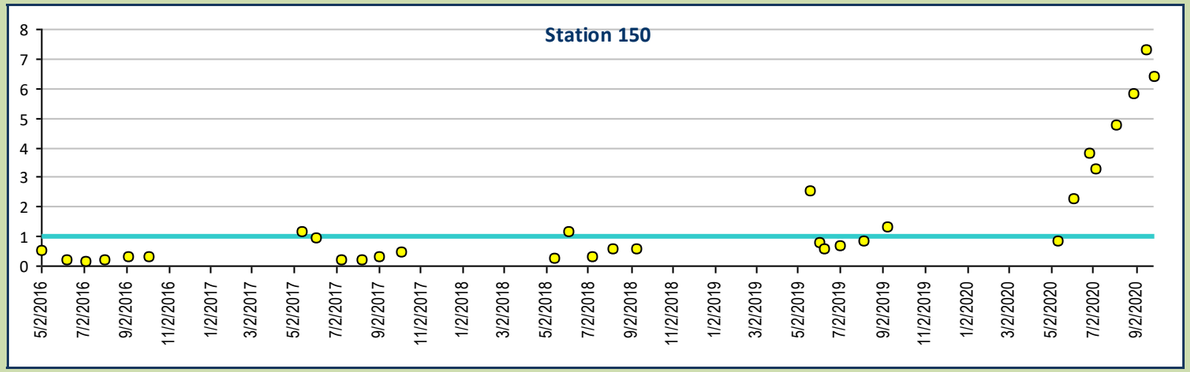
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

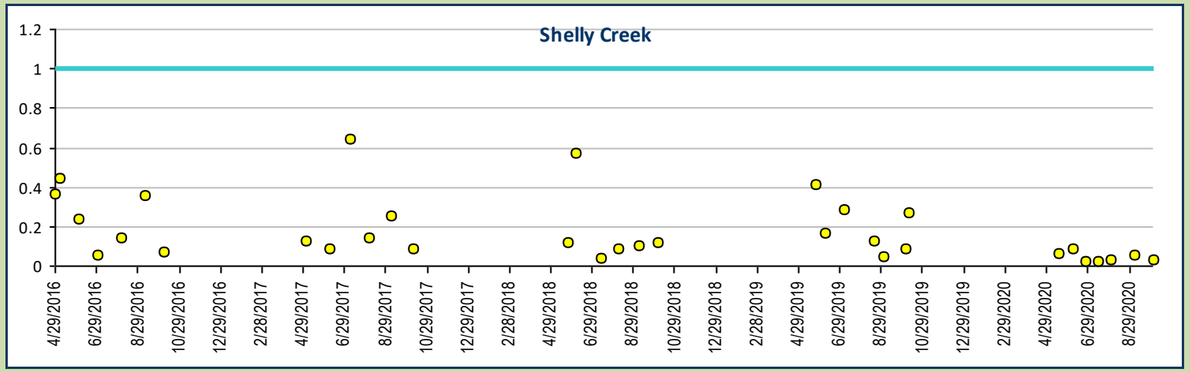
Iron, Total Recoverable, units mg/L

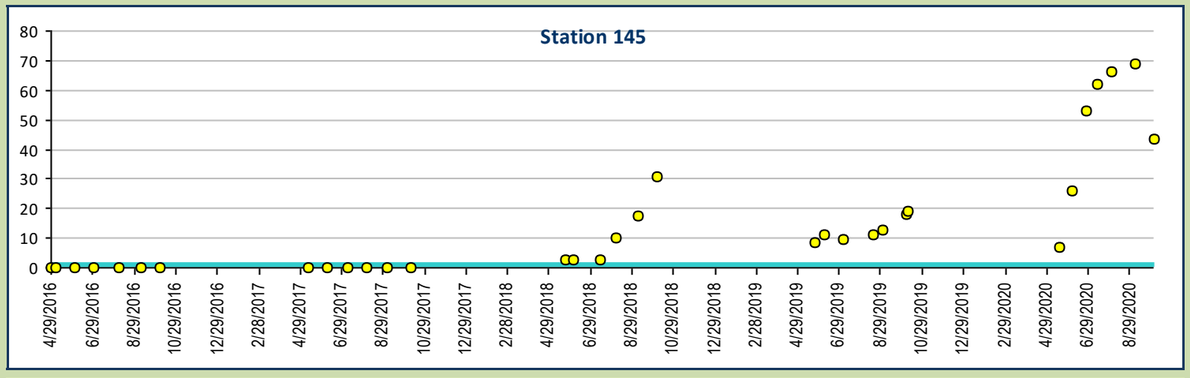
Aquatic Life - Fresh Water Chronic WQS mg/L

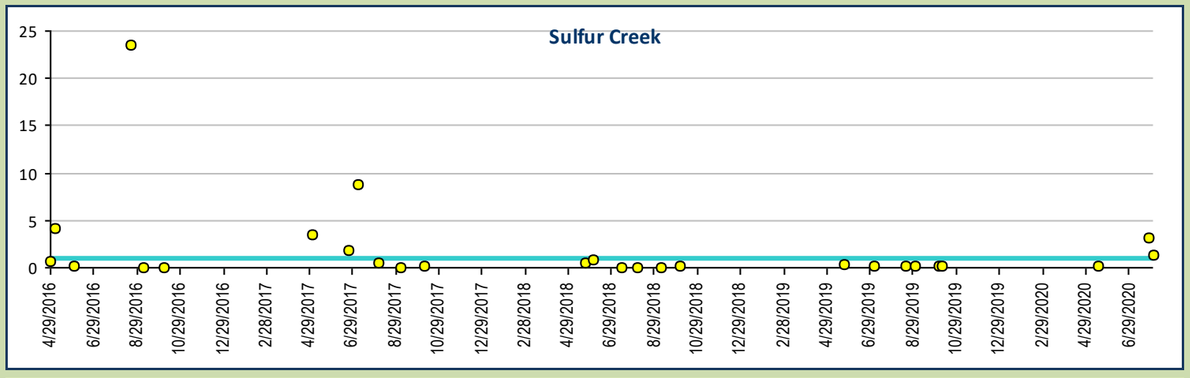
1.0 mg/L

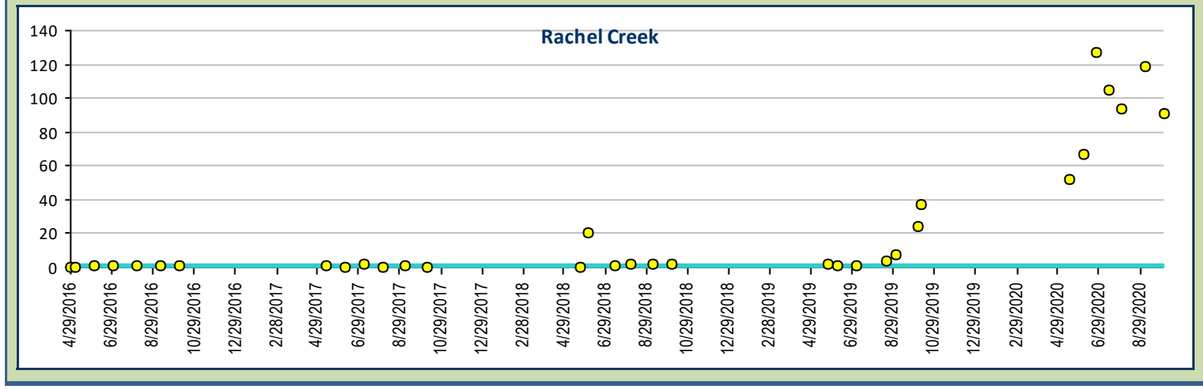


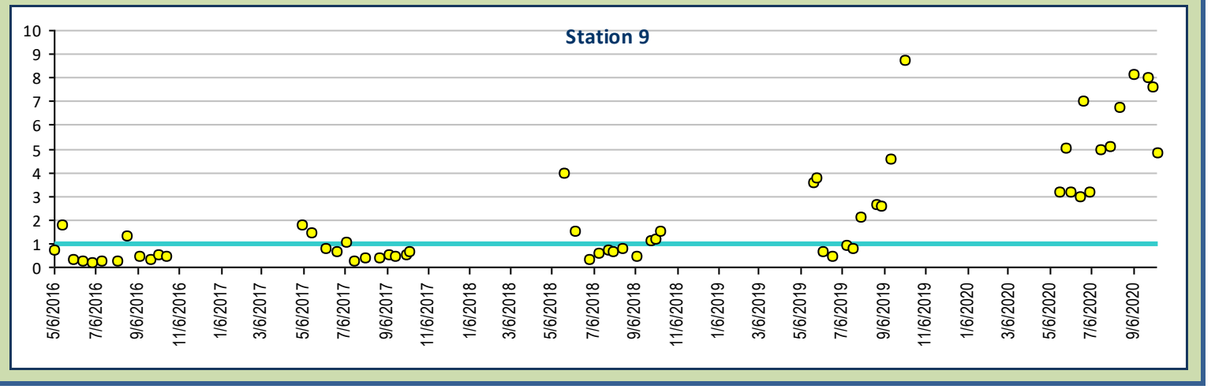








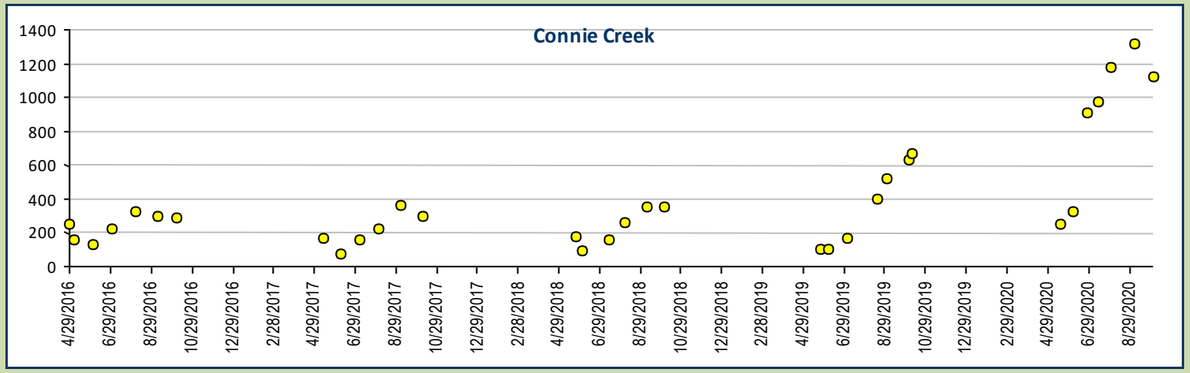


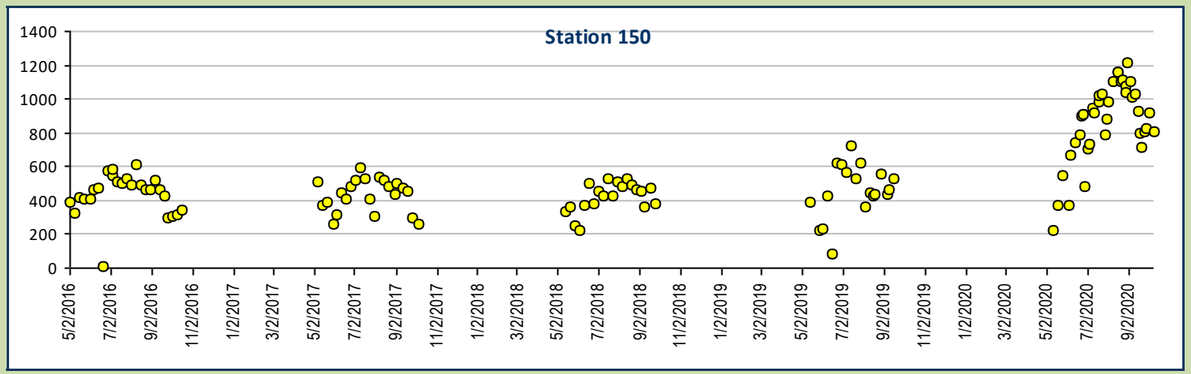


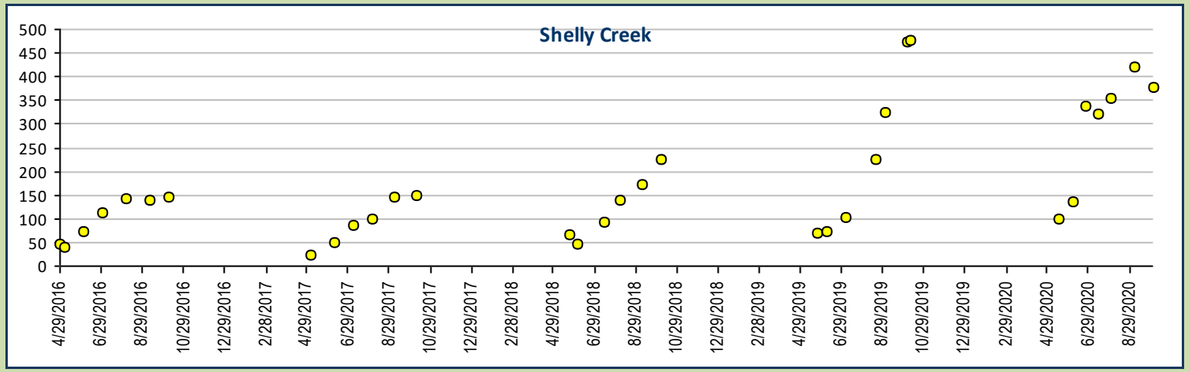
RED DOG MINE

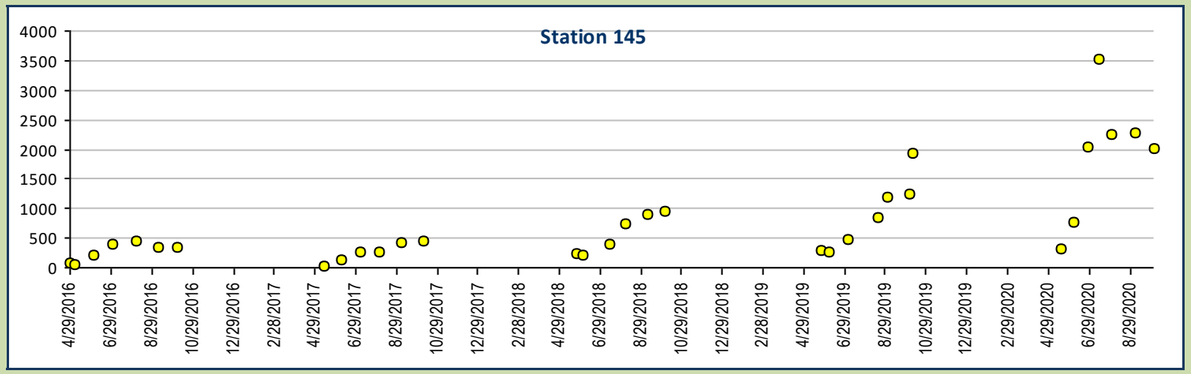
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

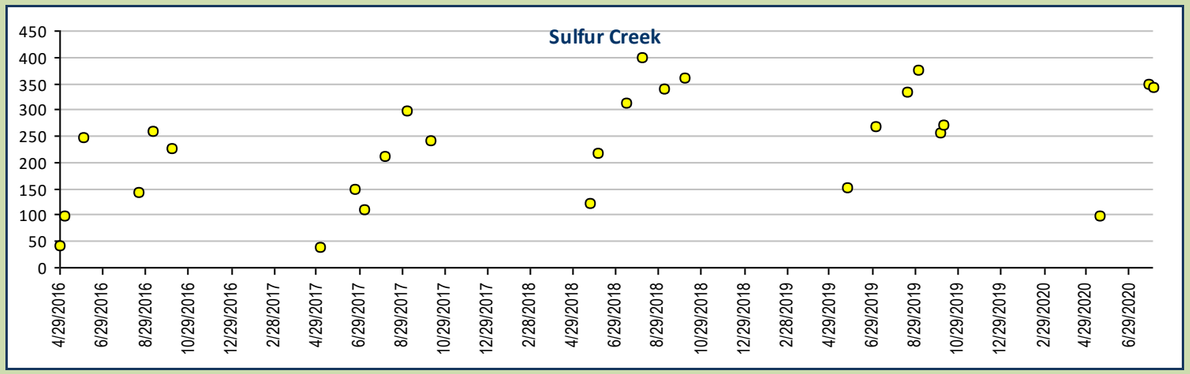
Conductivity, units uS/cm

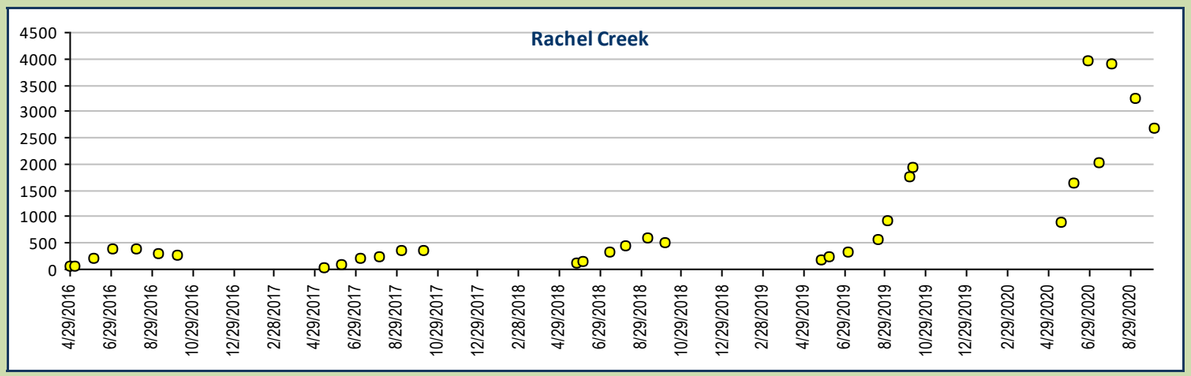


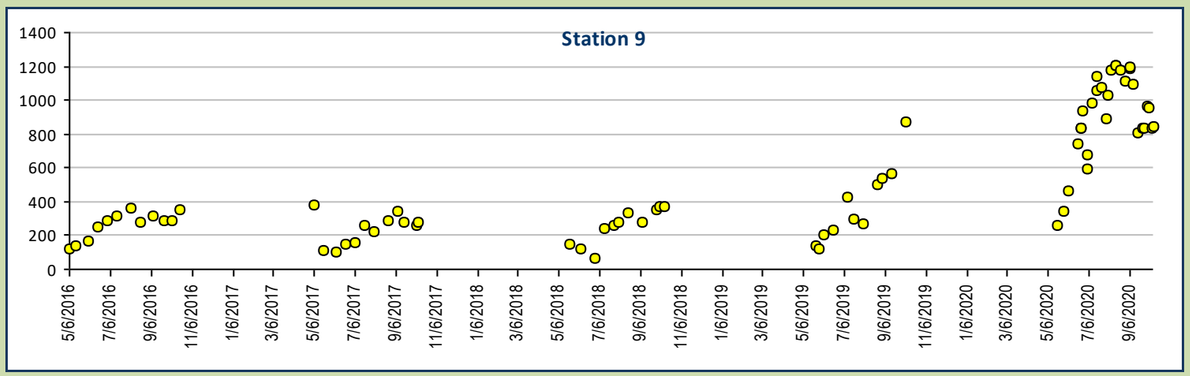












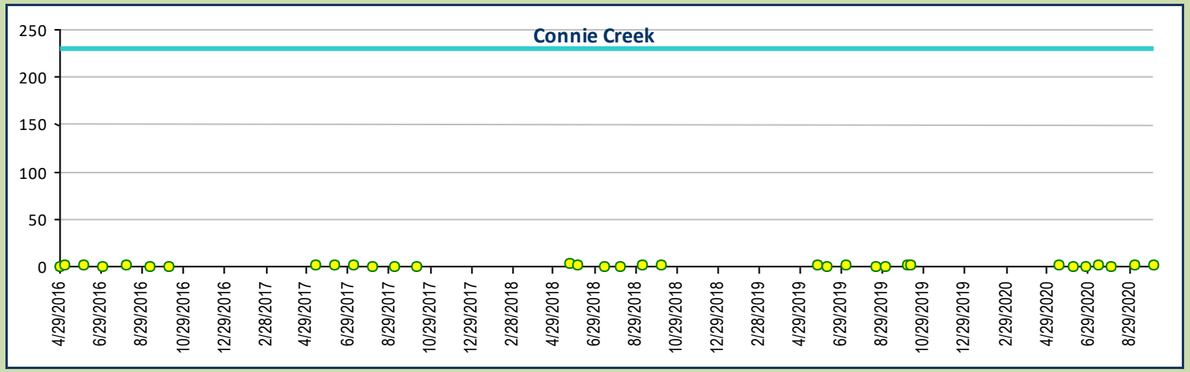
RED DOG MINE

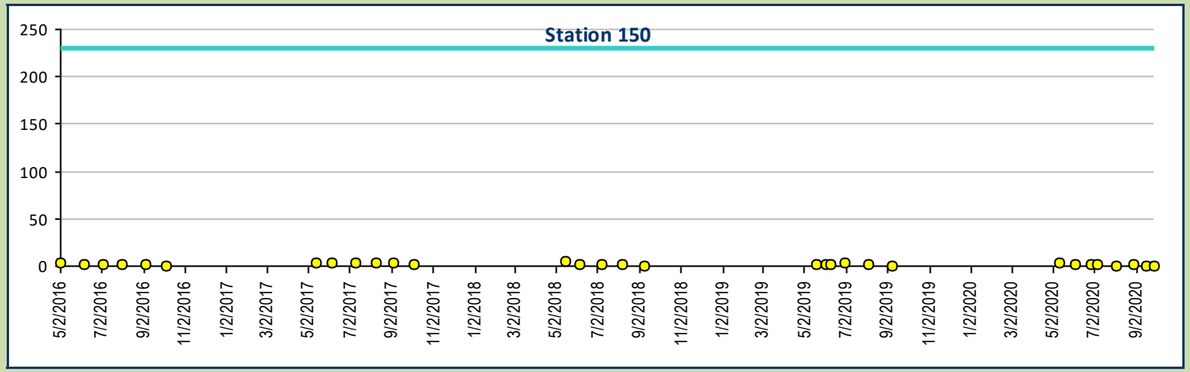
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

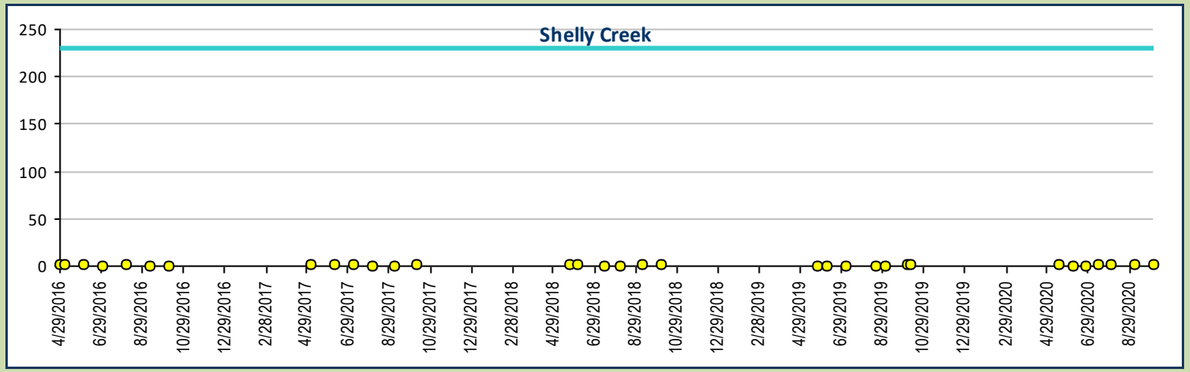
Chloride, Total Recoverable, units mg/L

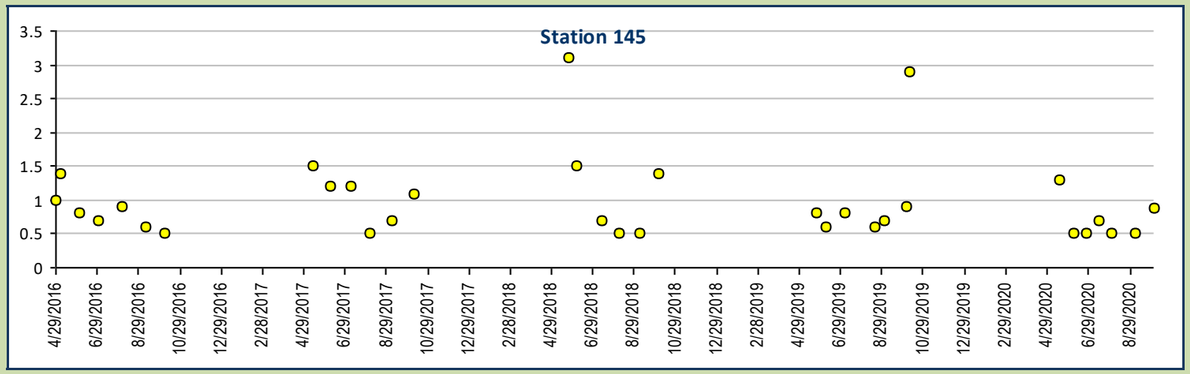
Aquatic Life - Fresh Water Chronic WQS mg/L

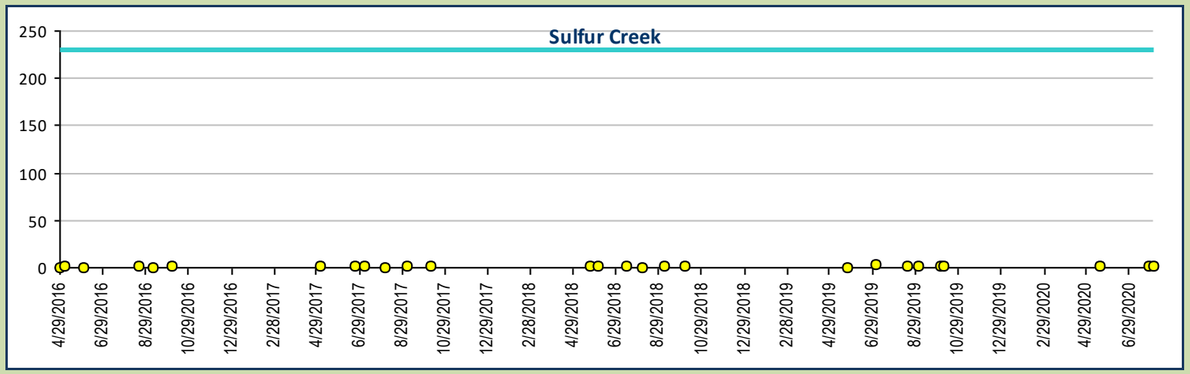
230 mg/L

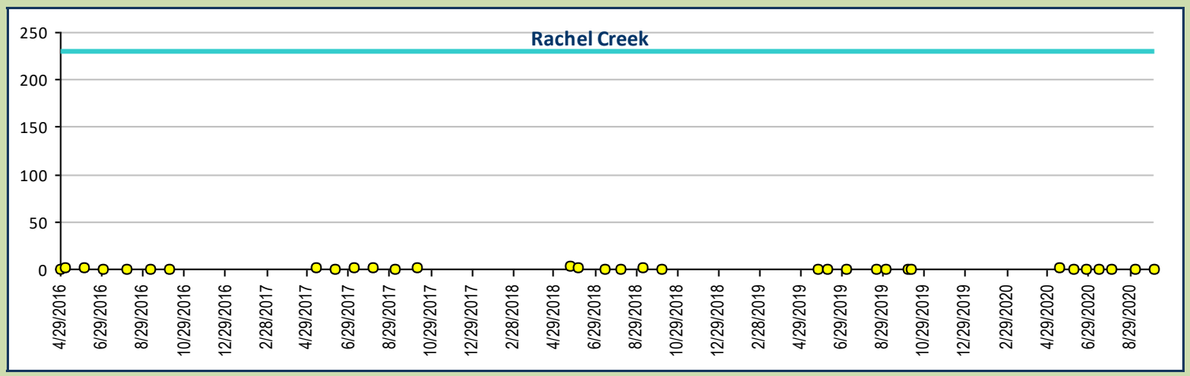


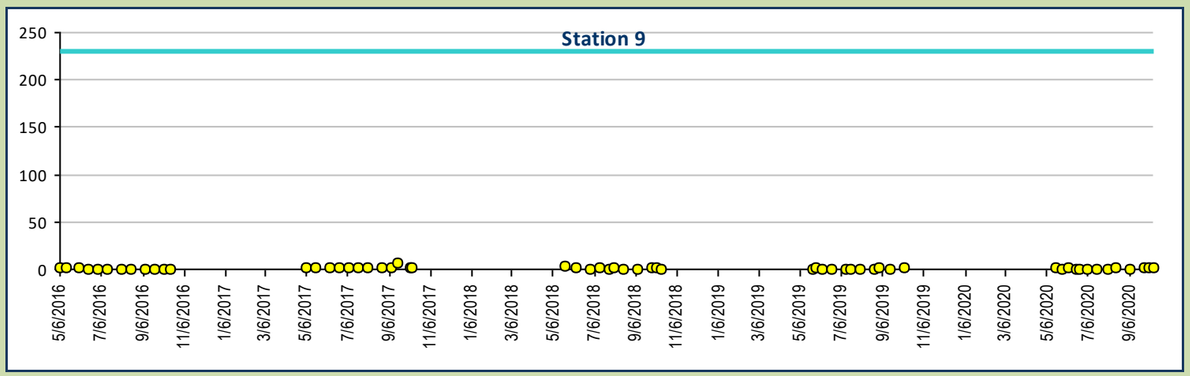












RED DOG MINE

Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

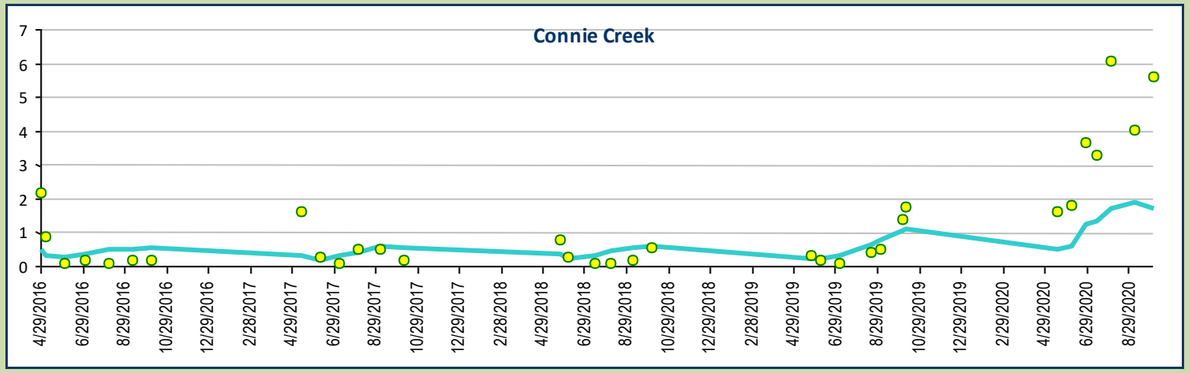
Cadmium, Total Recoverable, units ug/L

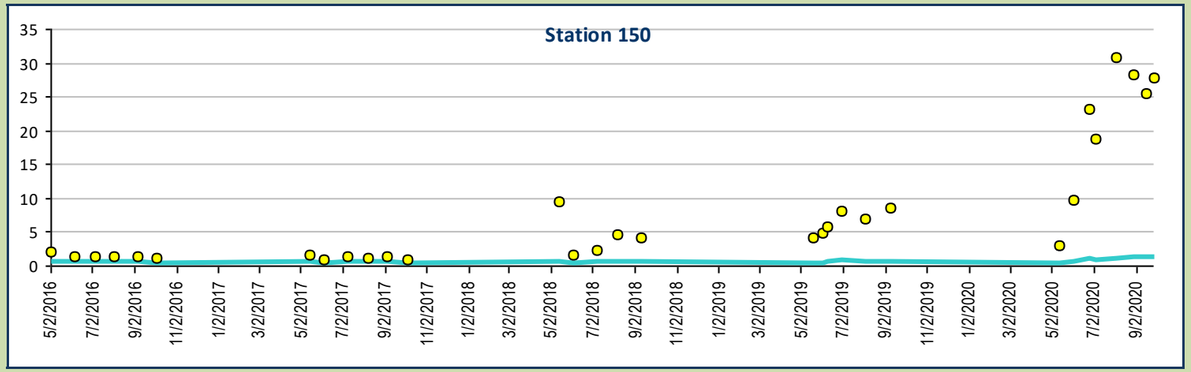
Aquatic Life - Fresh Water Chronic WQS ug/L

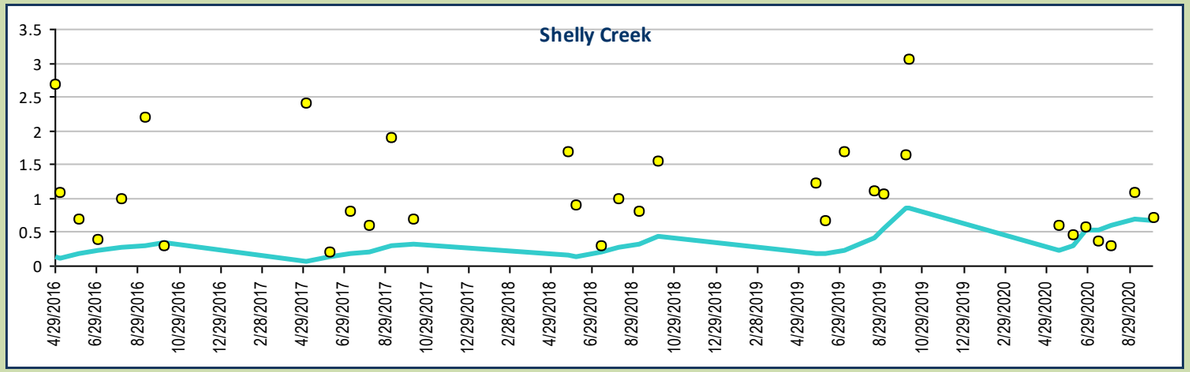
Hardness Dependent Calculation

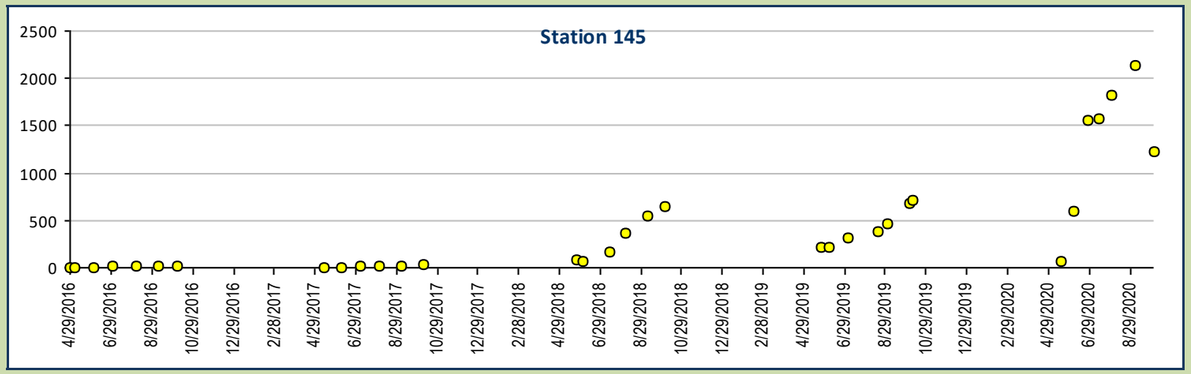
=EXP(0.7409*(LN(calc *hardness))-4.719)

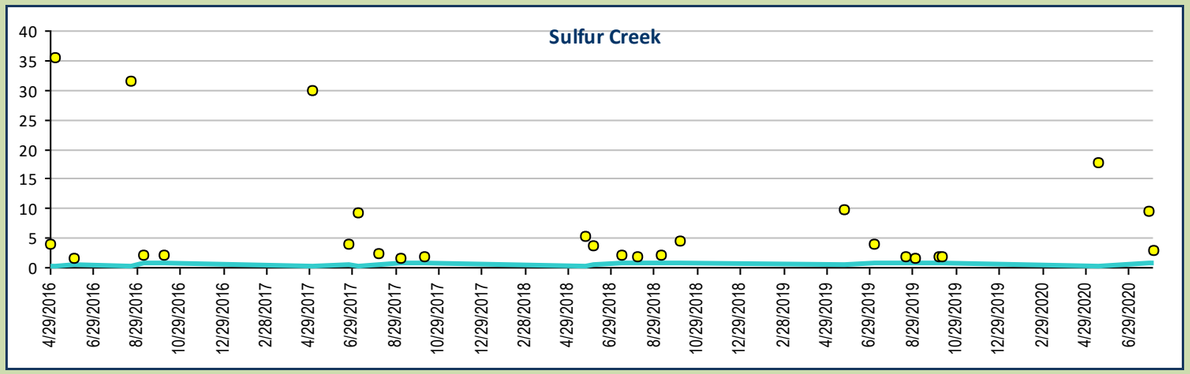
* Calculated using Standard Methods 2340B

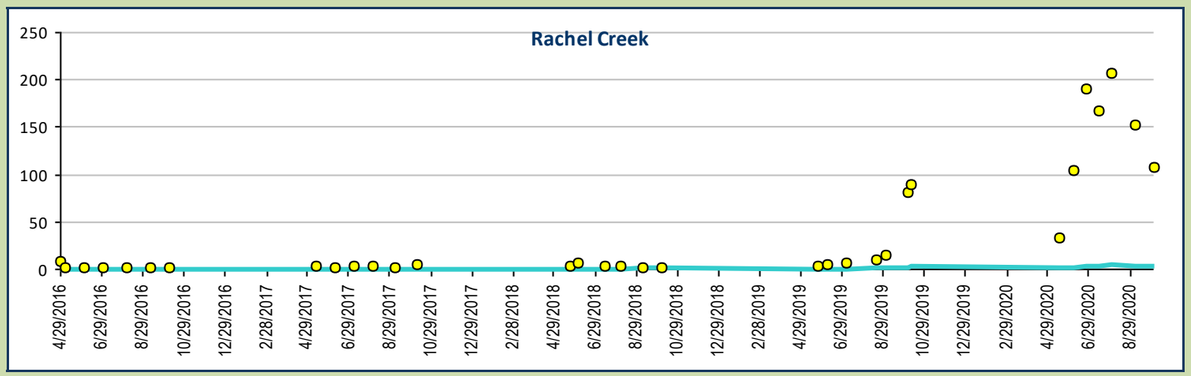


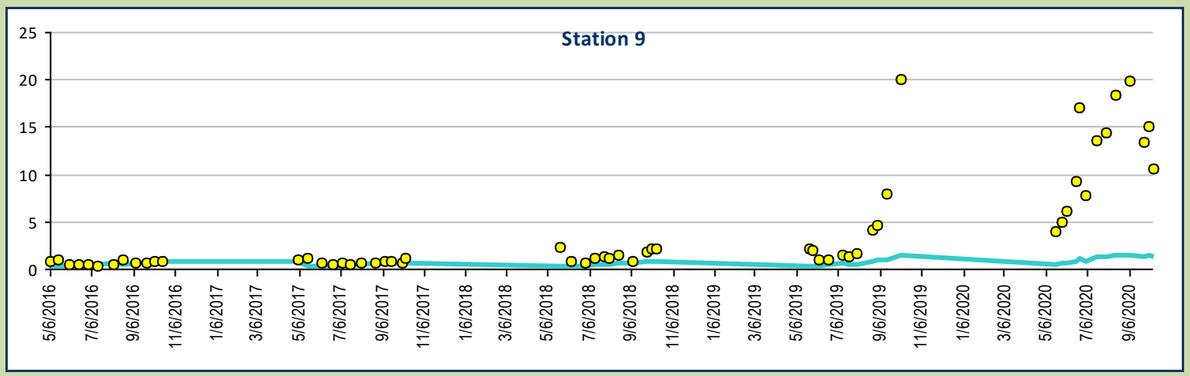








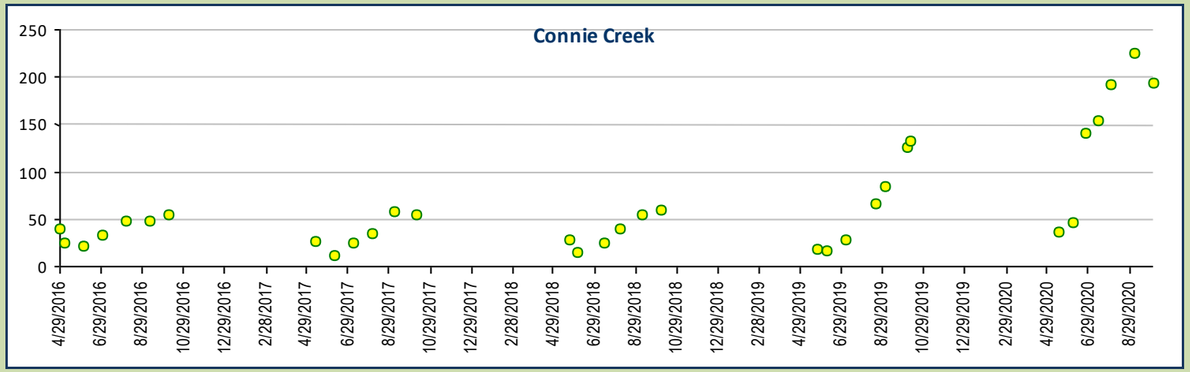


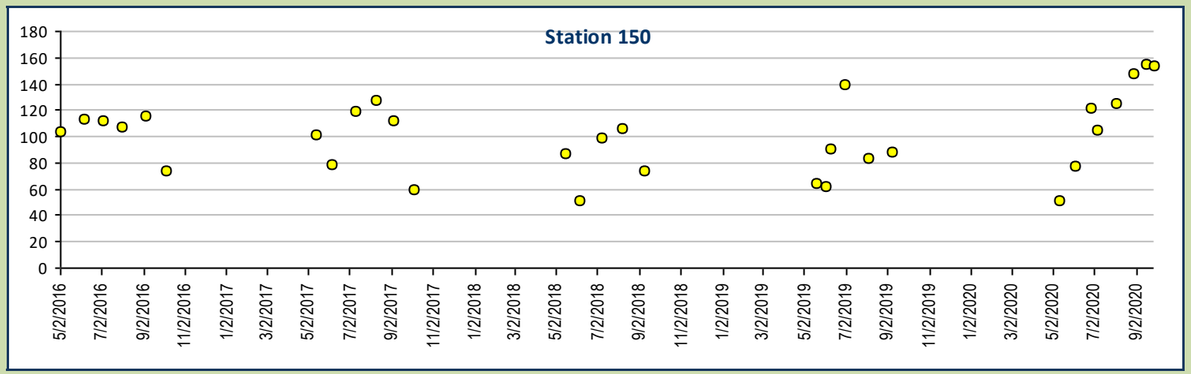


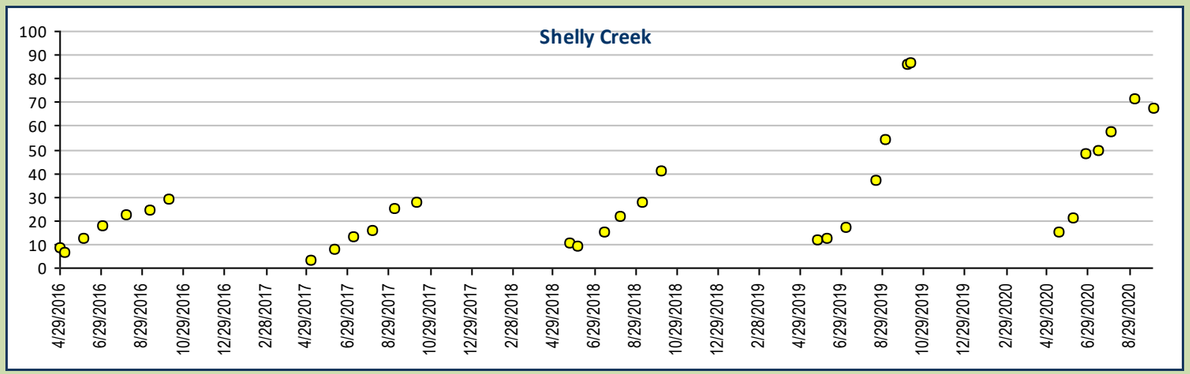
RED DOG MINE

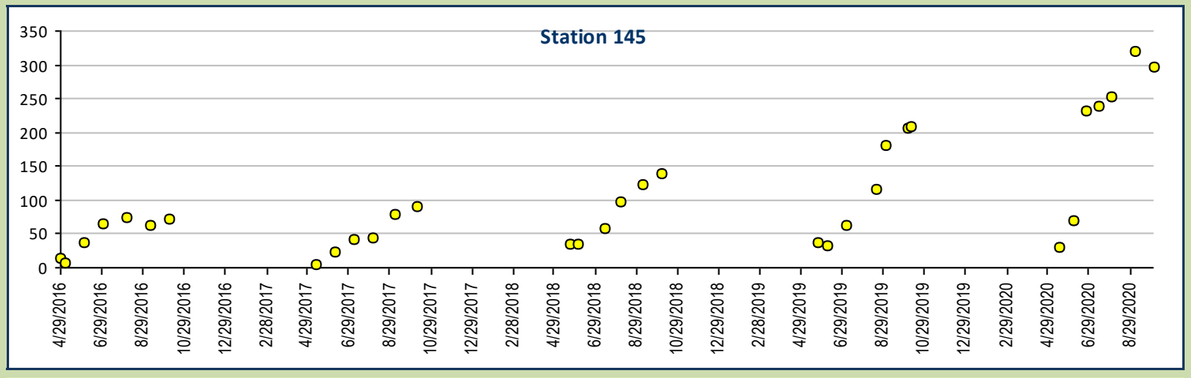
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

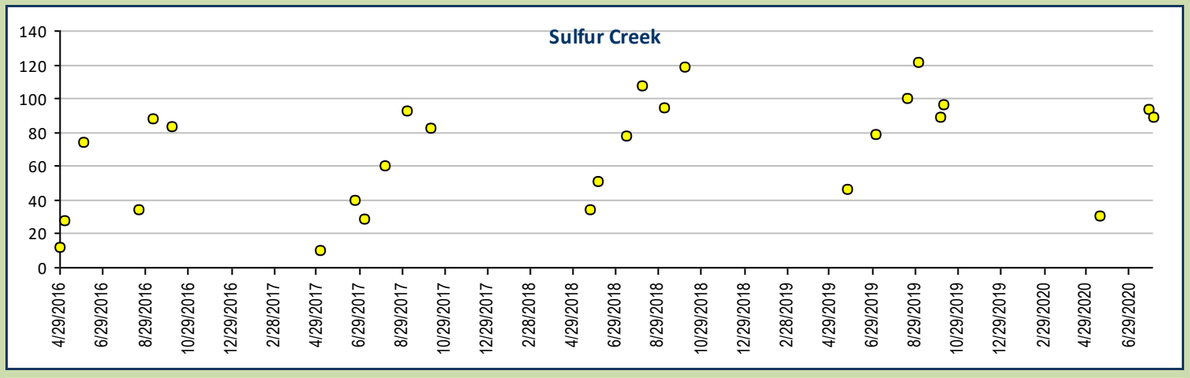
Calcium, Total recoverable, units mg/L

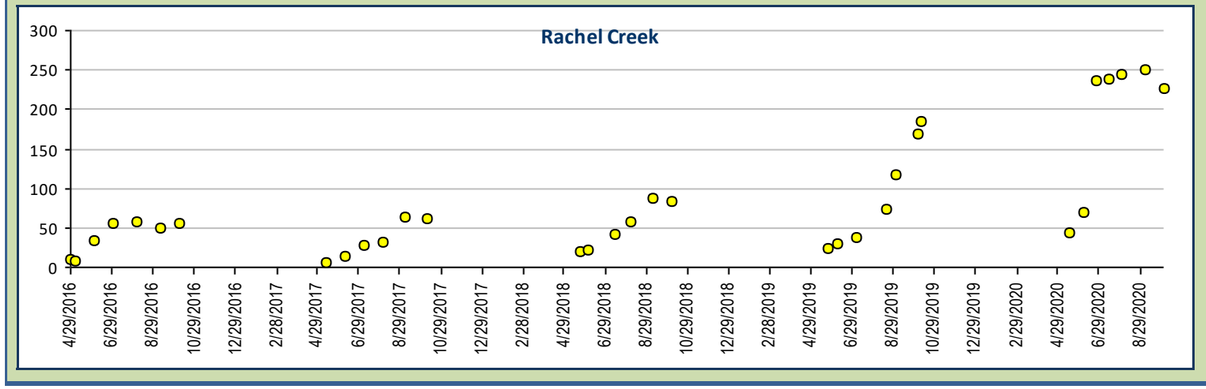


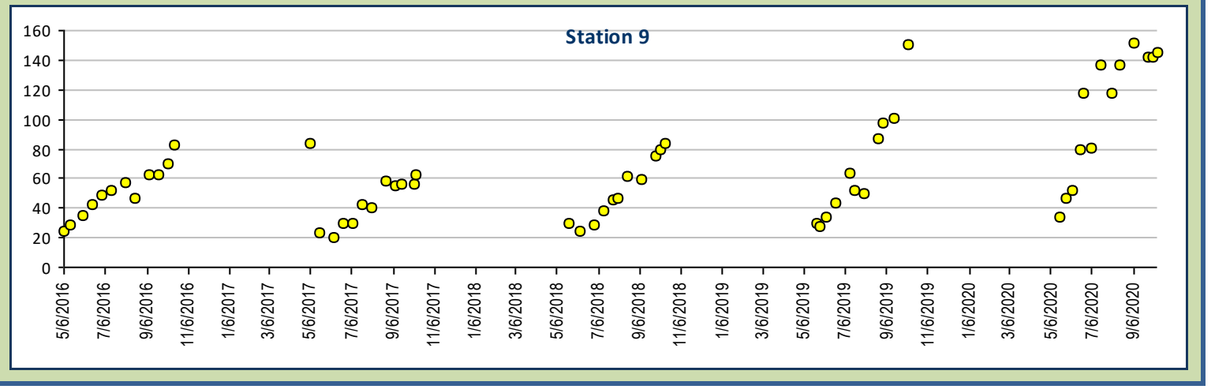












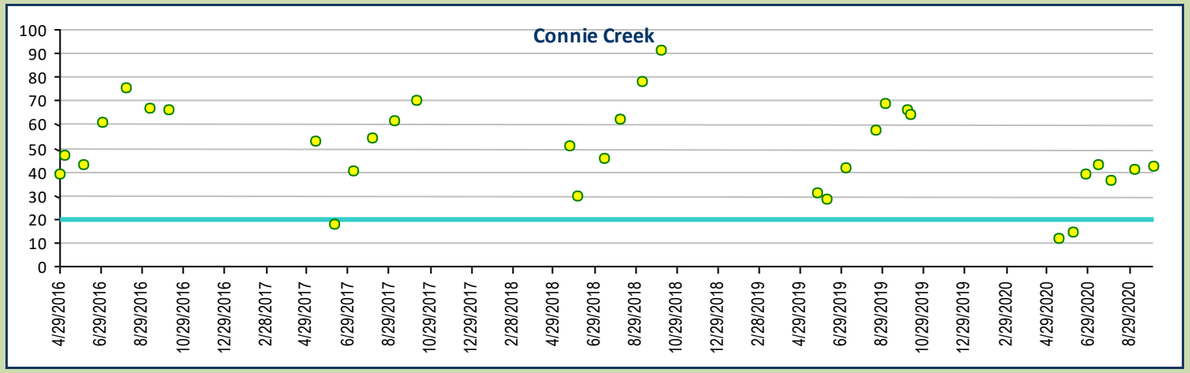
RED DOG MINE

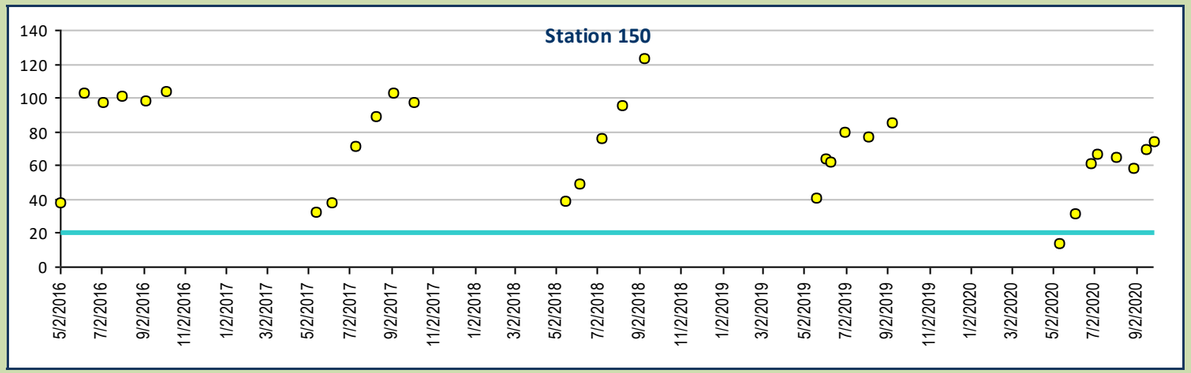
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

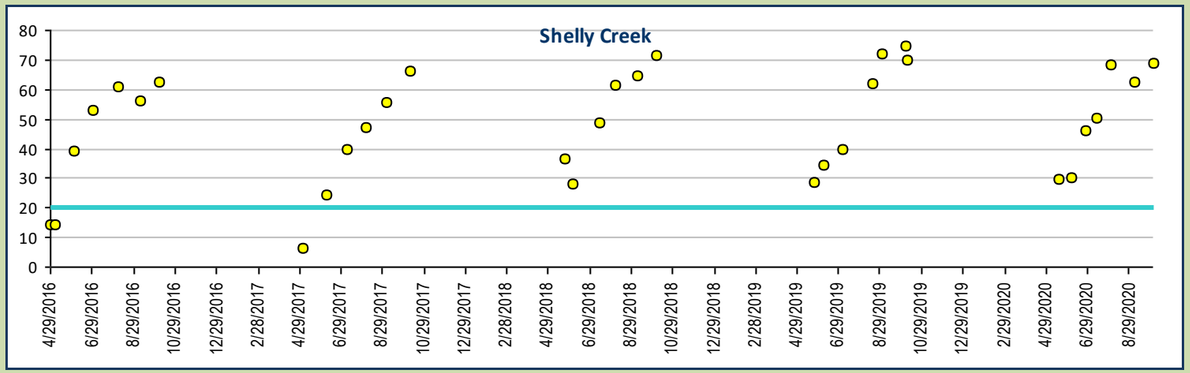
Alkalinity as CaCO3, units mg/L

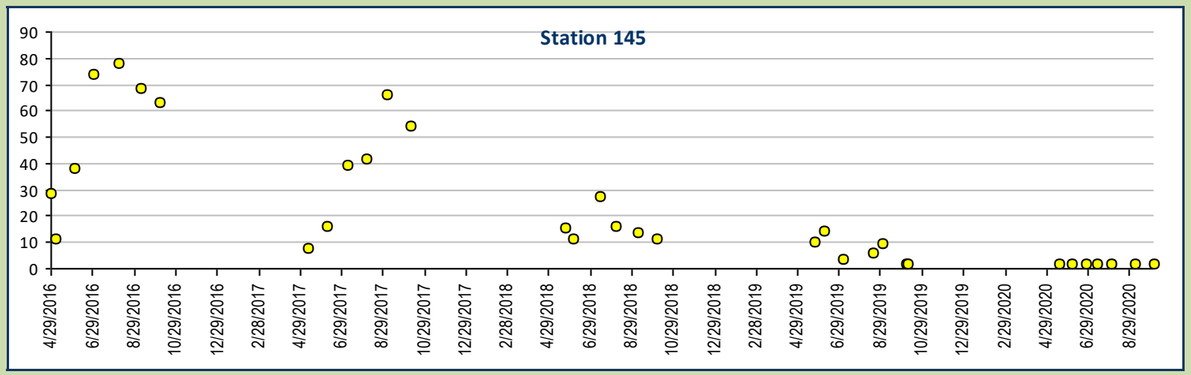
Aquatic Life - Fresh Water Chronic WQS mg/L

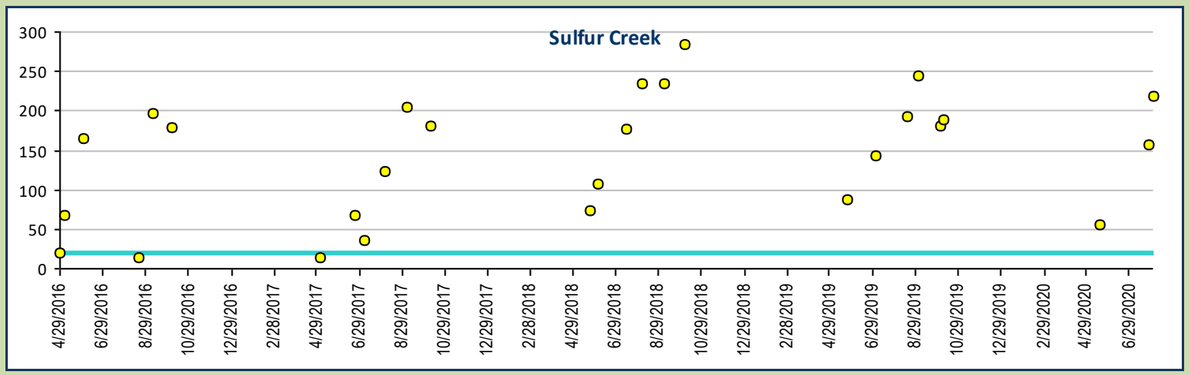
20 mg/L minimum

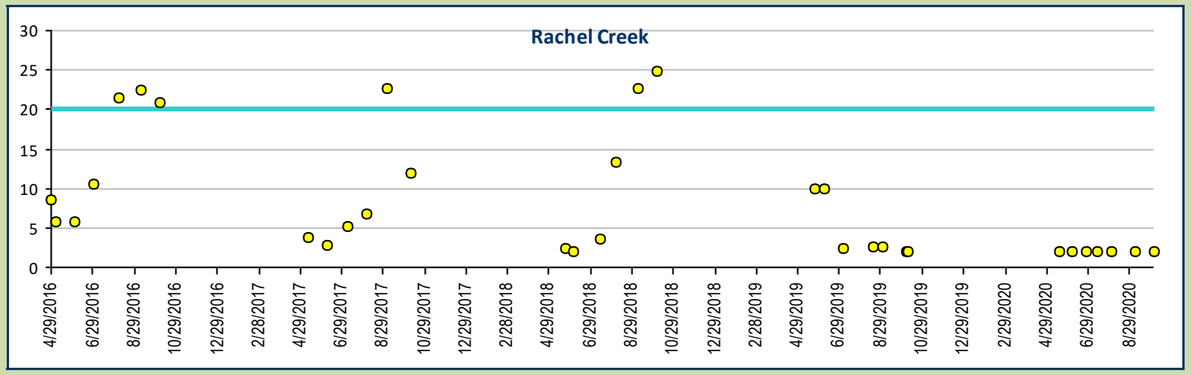


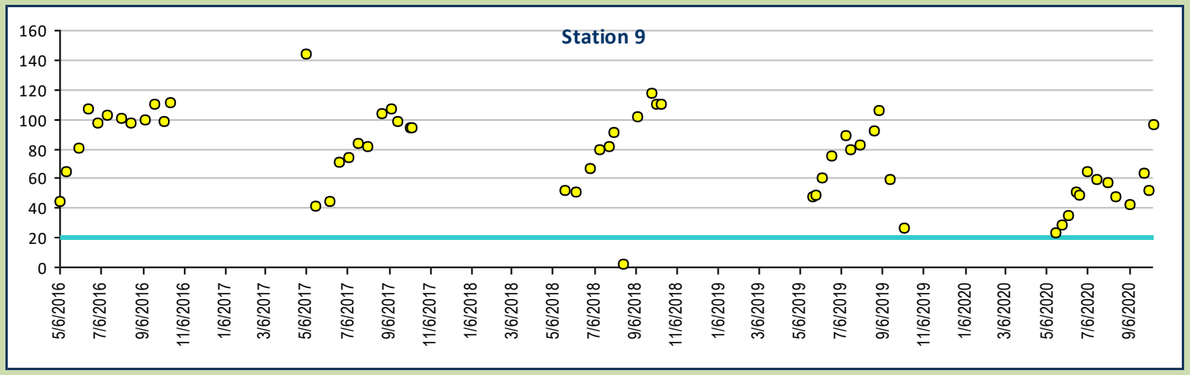












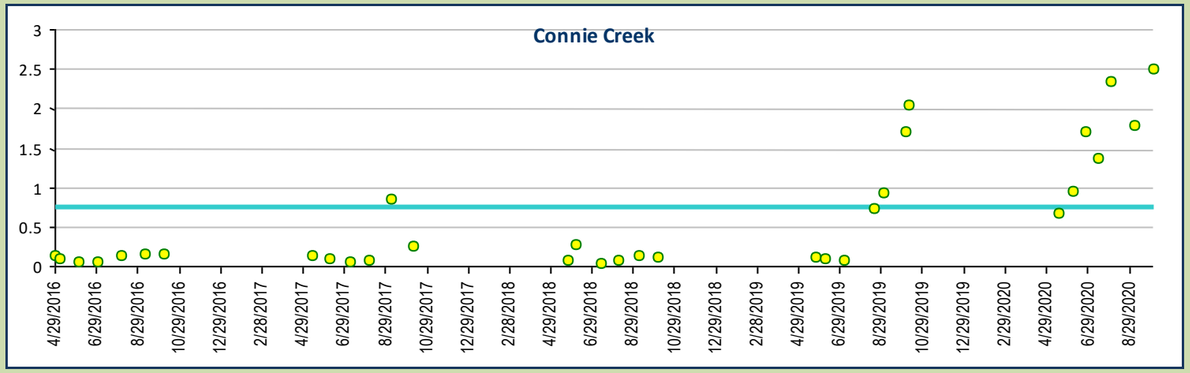
RED DOG MINE

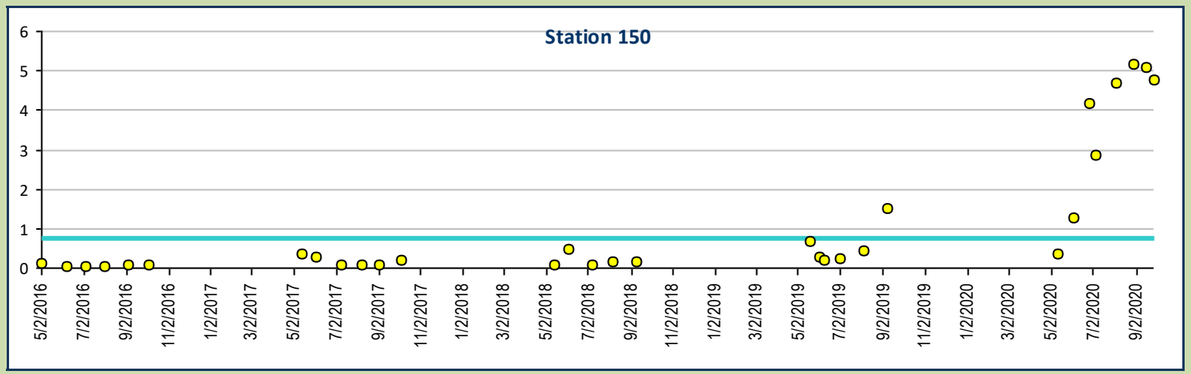
Water Monitoring Mine Drainage
Water Quality Profile I , 5-Year Trend Charts

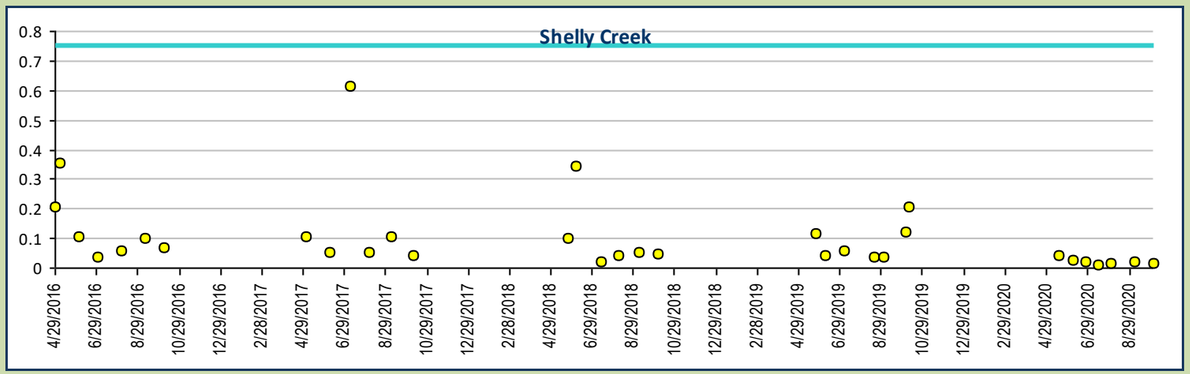
Aluminum, Total recoverable, units mg/L

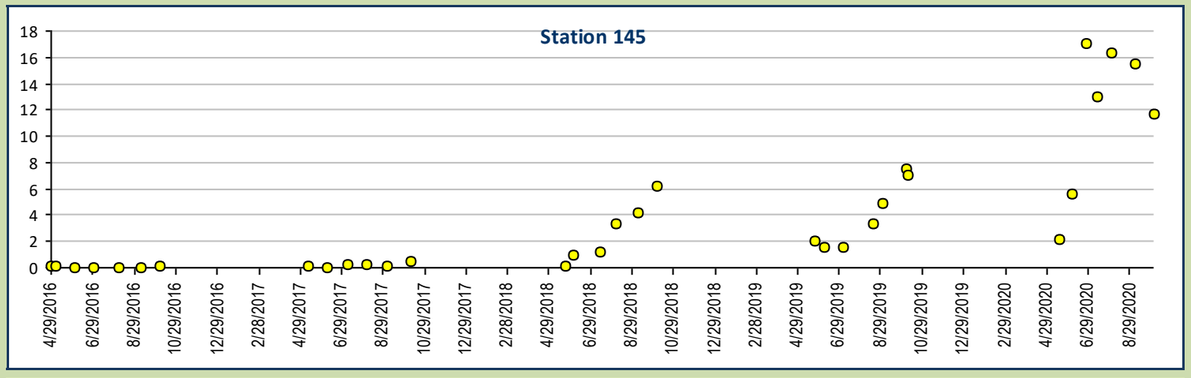
Aquatic Life - Fresh Water Chronic WQS mg/L

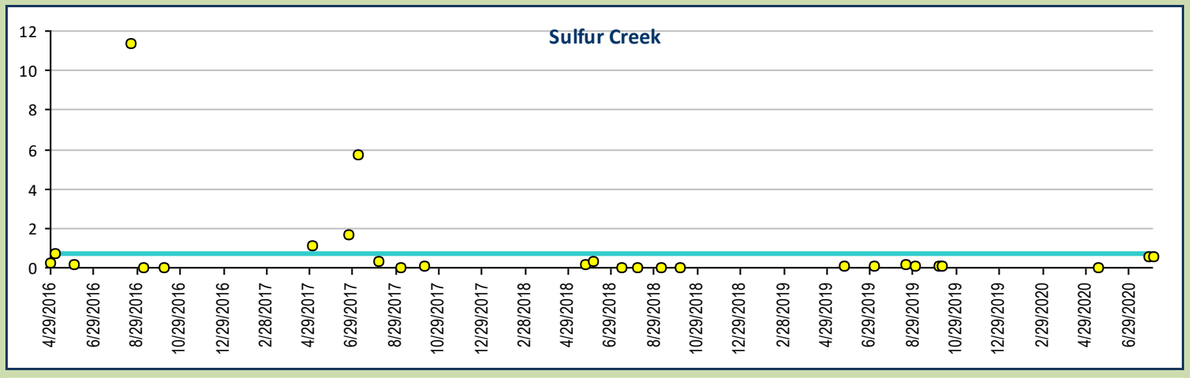
If pH > 7 and hardness > 50. then WQS = 0.75mg/l

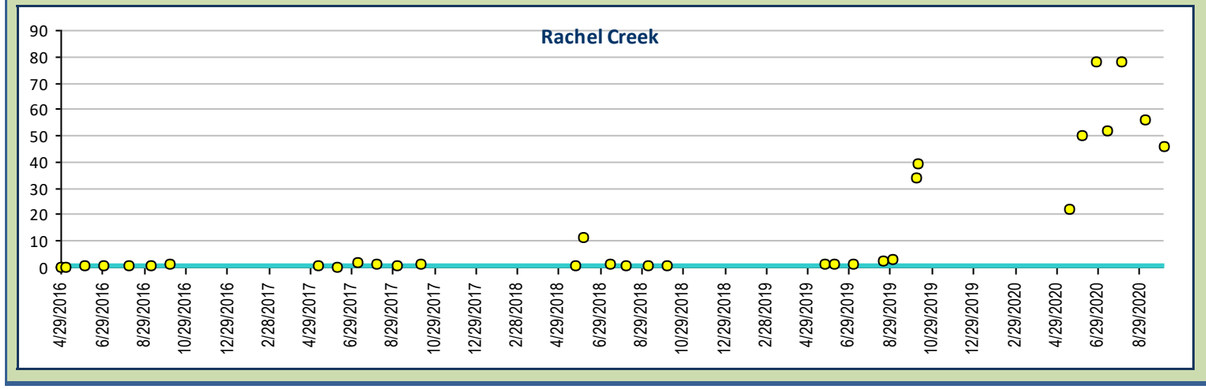


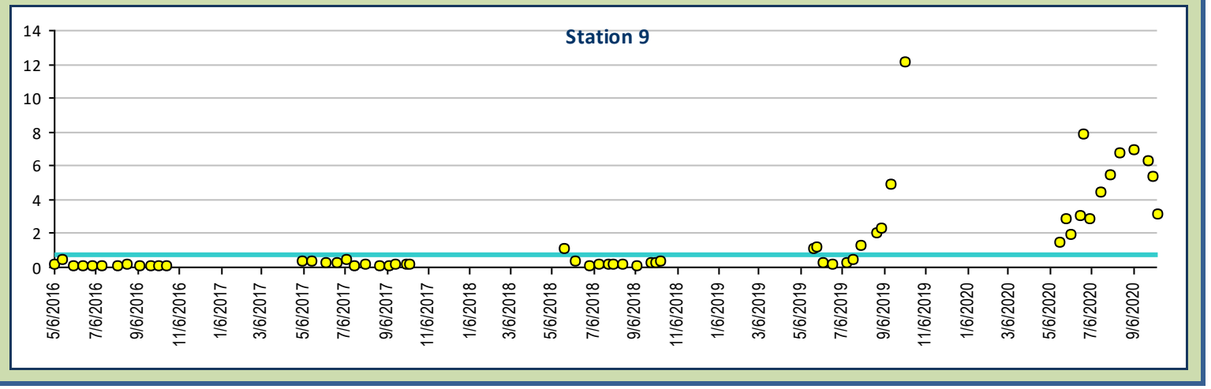












Appendix E: Water Quality Profile I Charts – Bons Creek Monitoring Stations

RED DOG MINE

Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

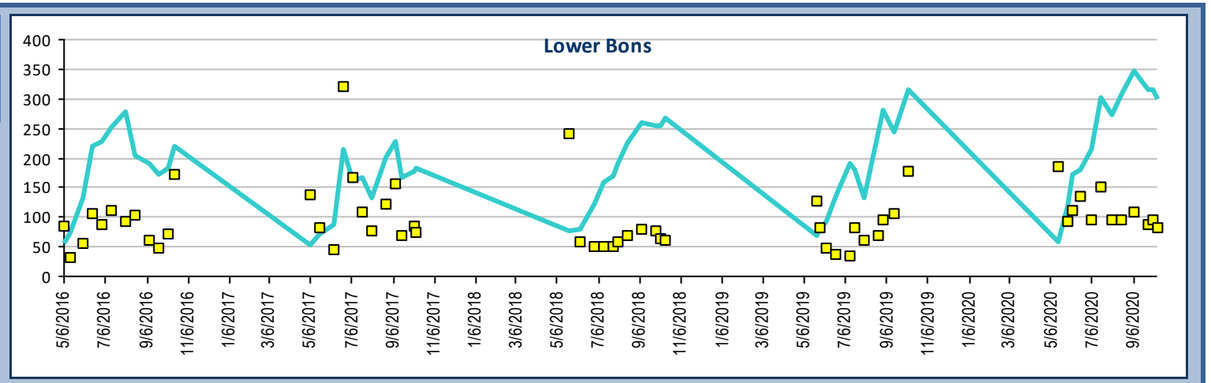
Zinc, Total Recoverable, units ug/L

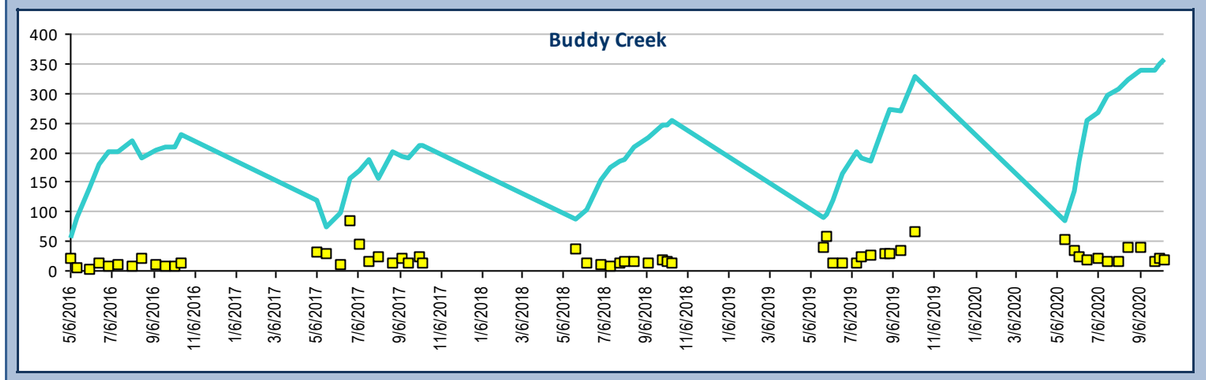
Aquatic Life - Fresh Water Acute WQS ug/L

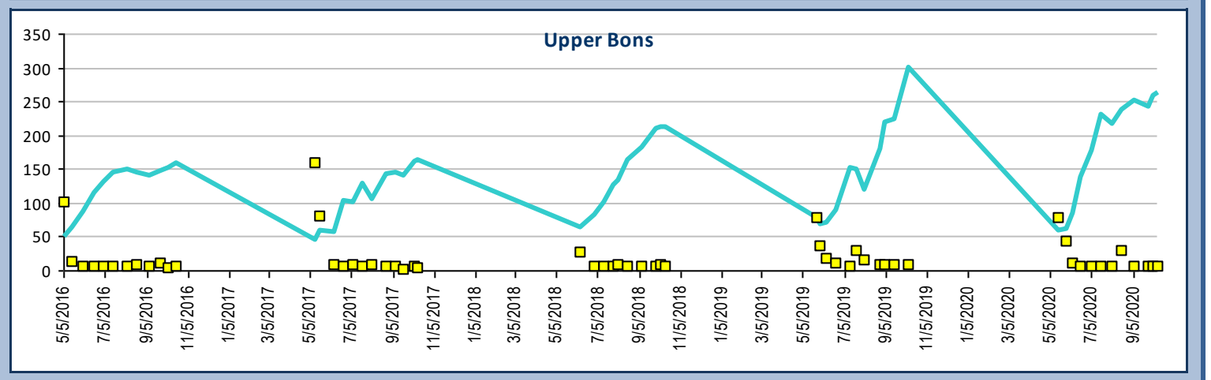
Hardness Dependent Calculation

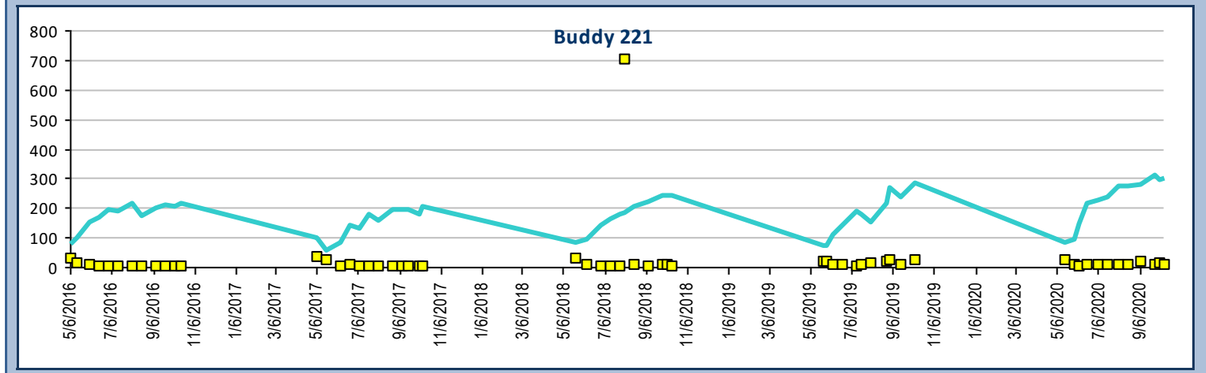
=EXP(0.8473*(LN(*hardness))+0.884)

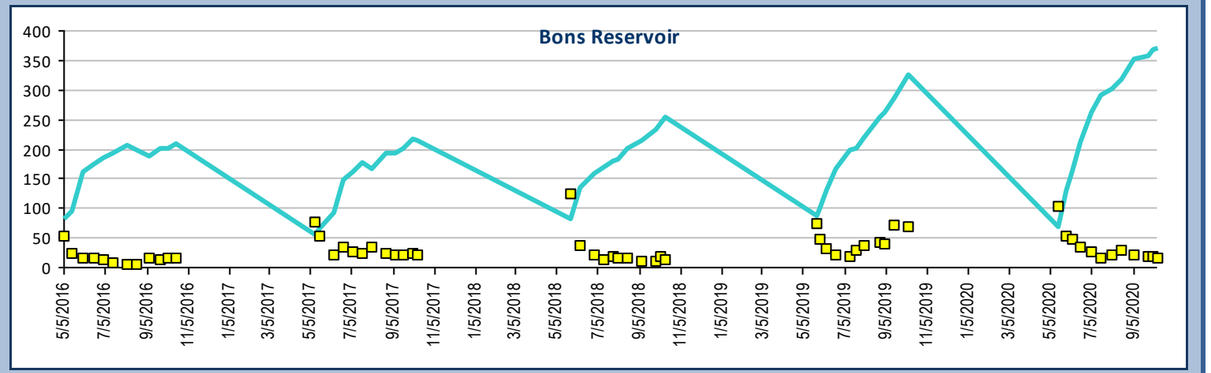
* Calculated using Standard Methods 2340B

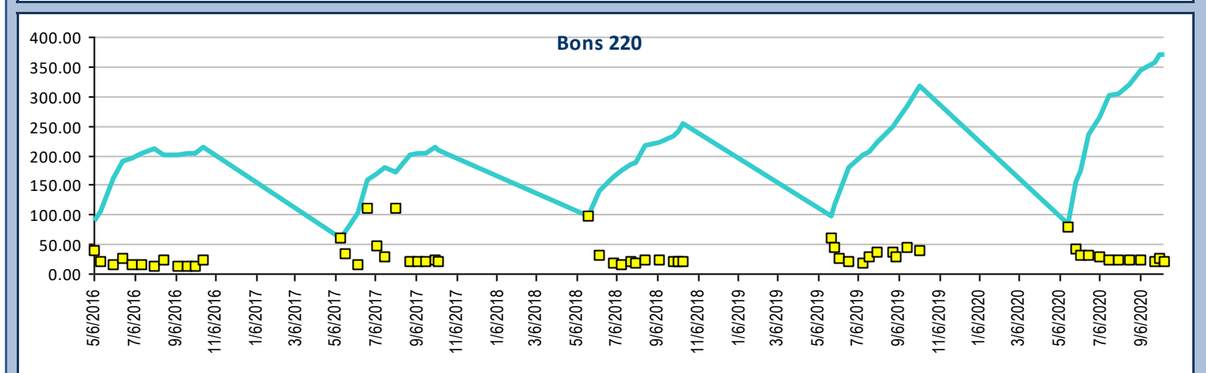


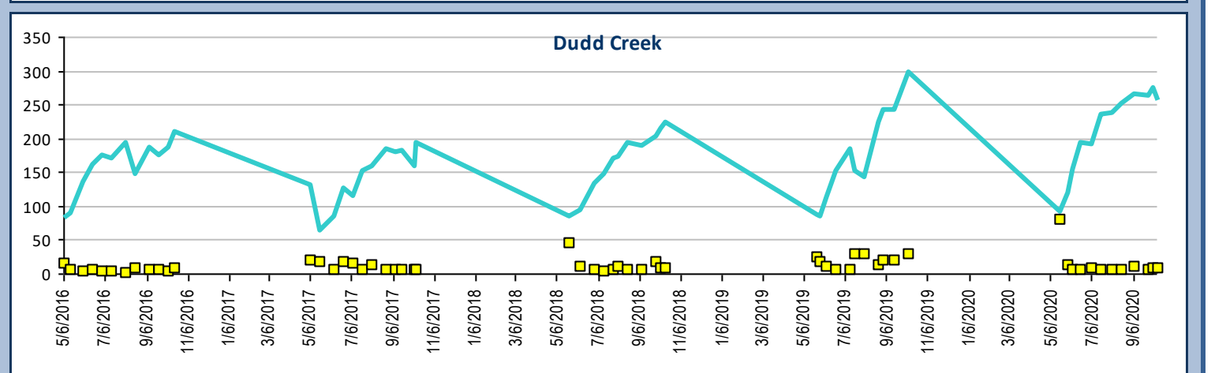








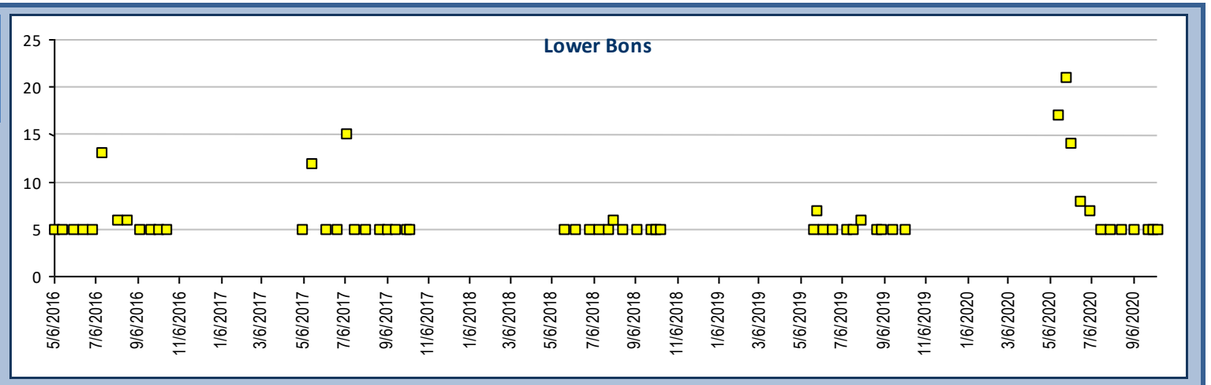


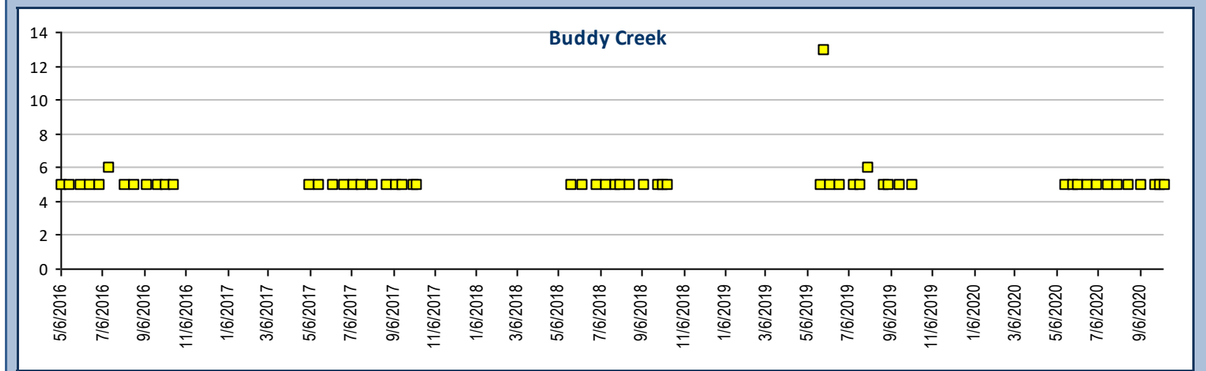


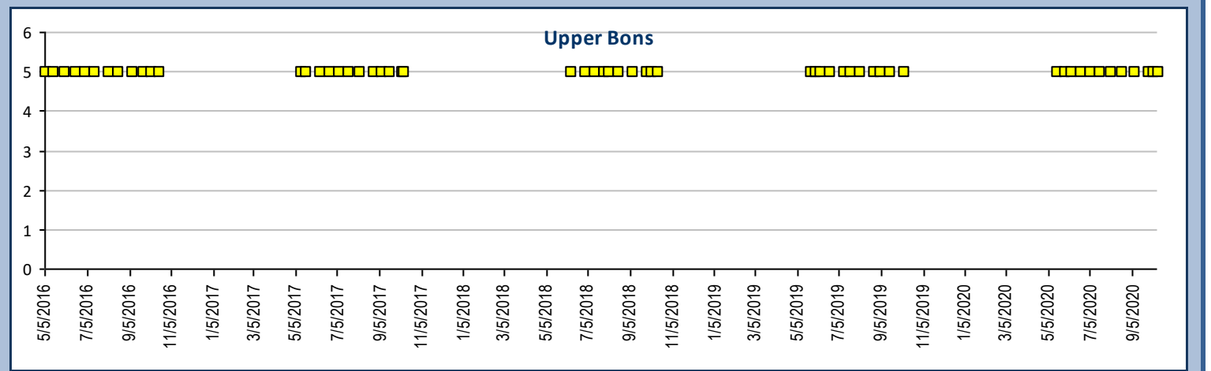
RED DOG MINE

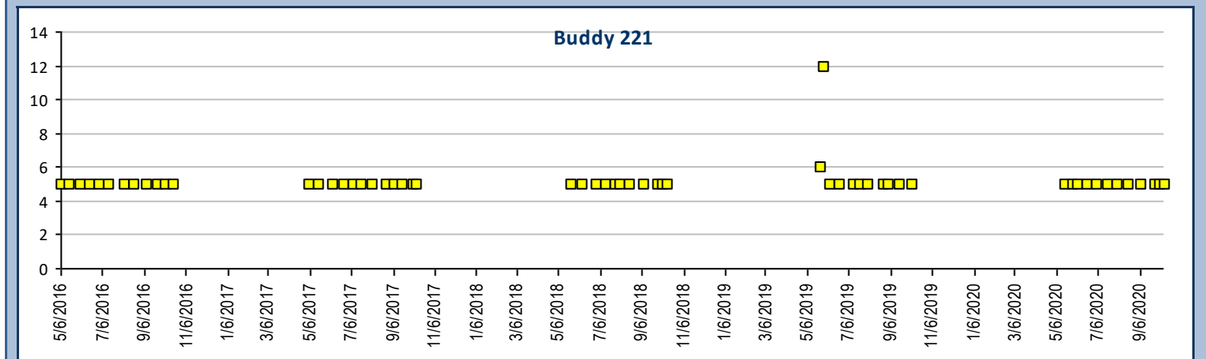
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

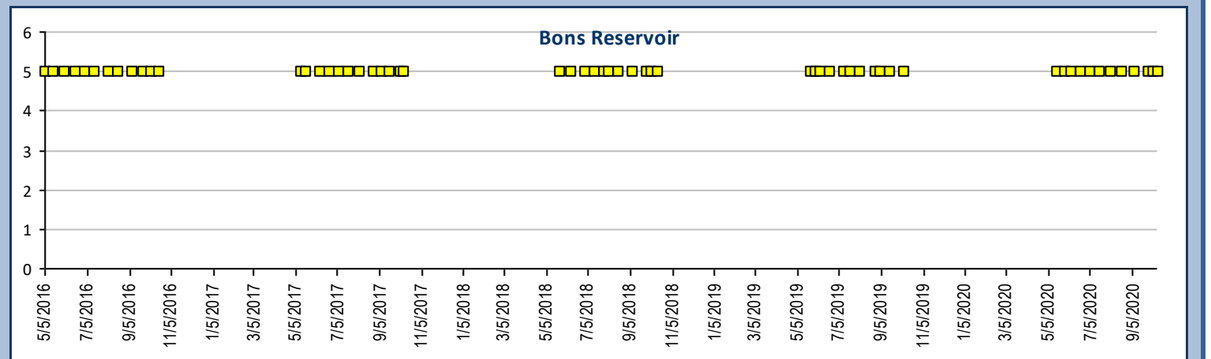
Total Suspended Solids, units mg/L

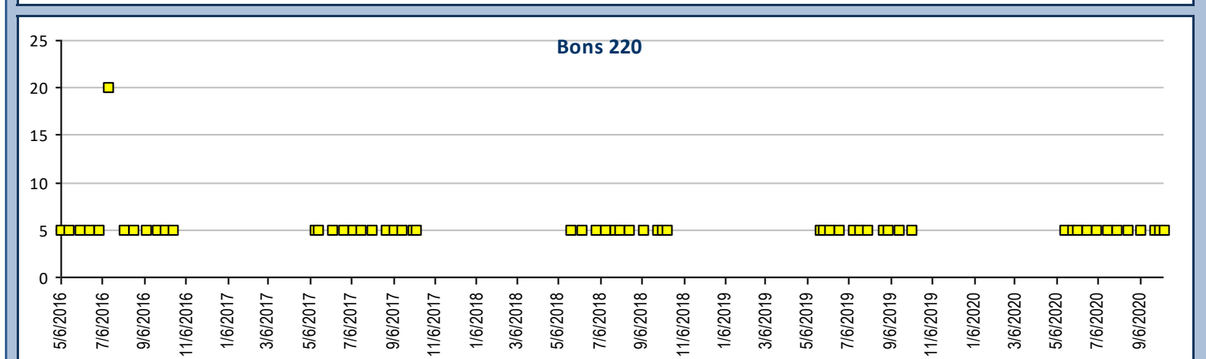


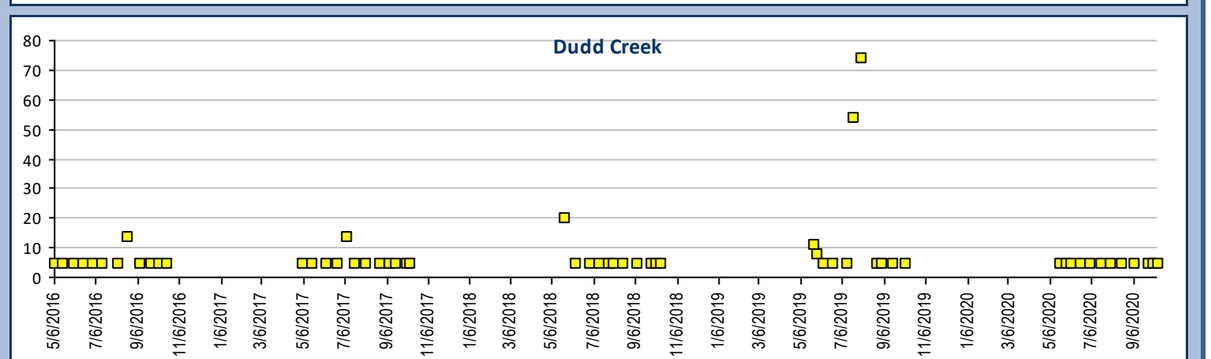












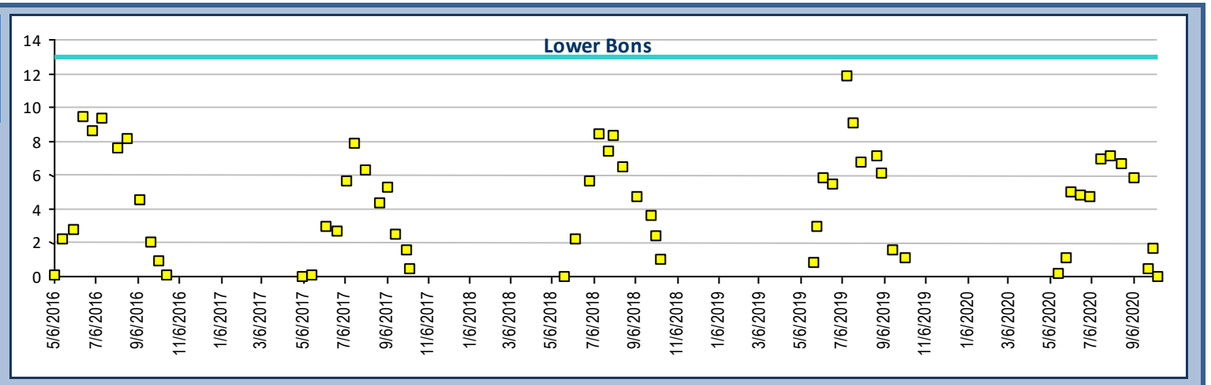
RED DOG MINE

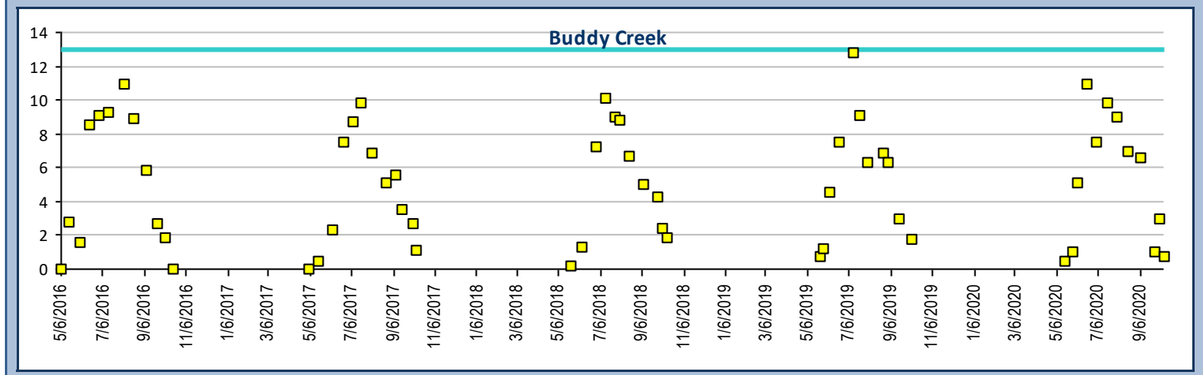
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

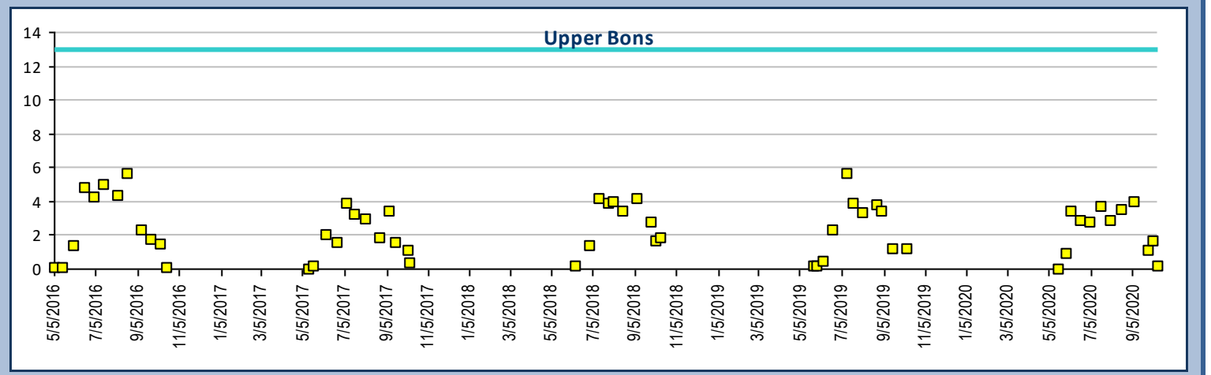
Temperature Field, units Celsius

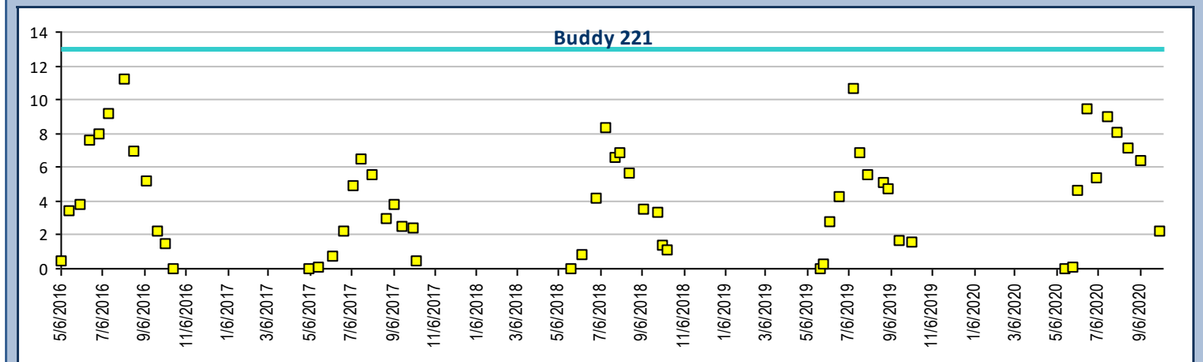
Site Specific WQS mg/L

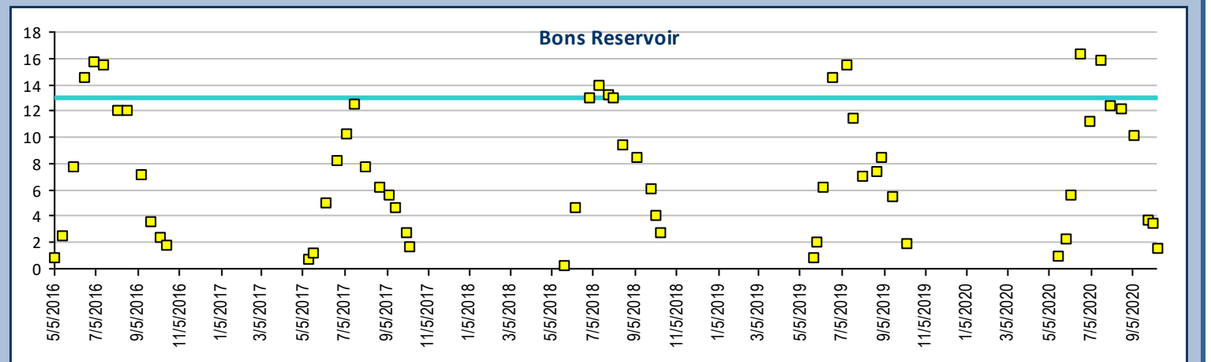
13 Celsius

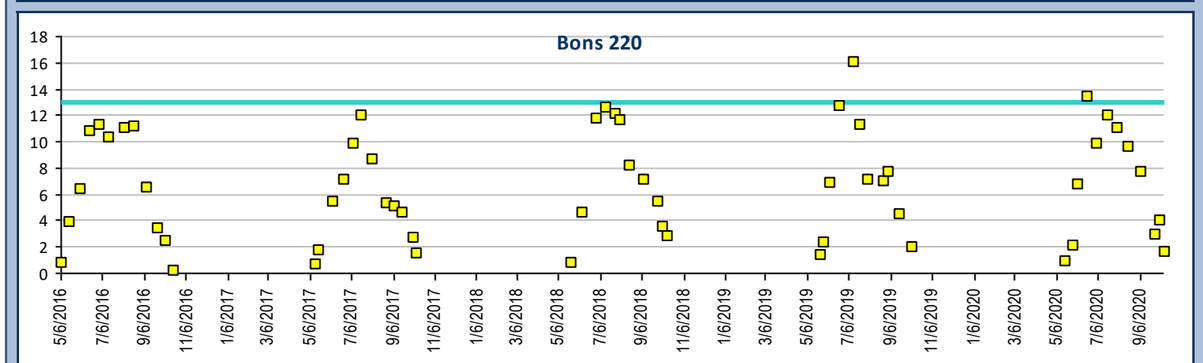


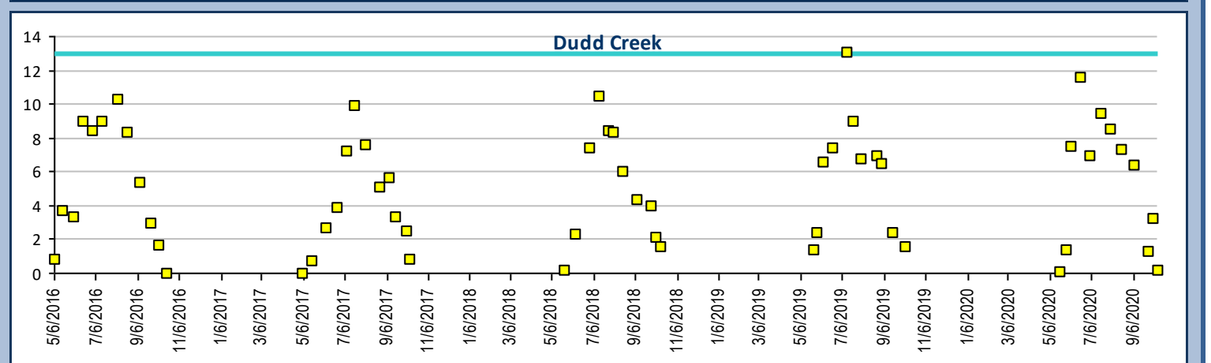












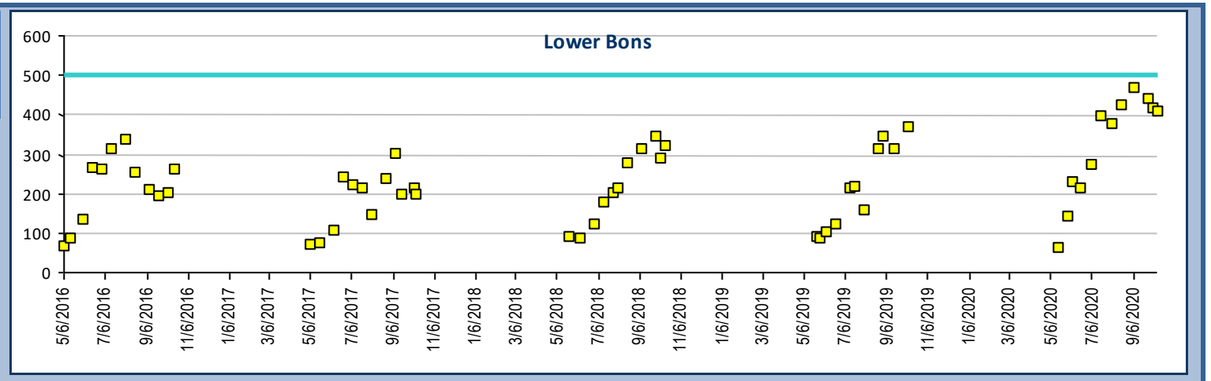
RED DOG MINE

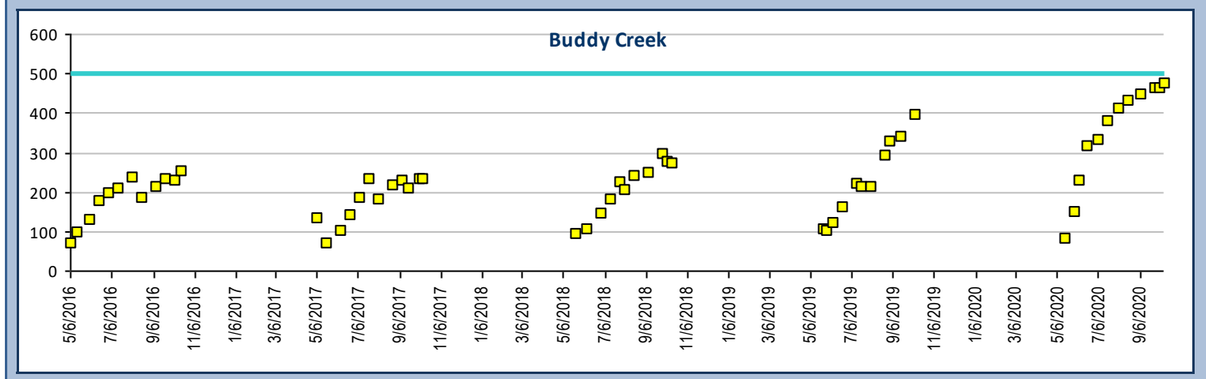
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

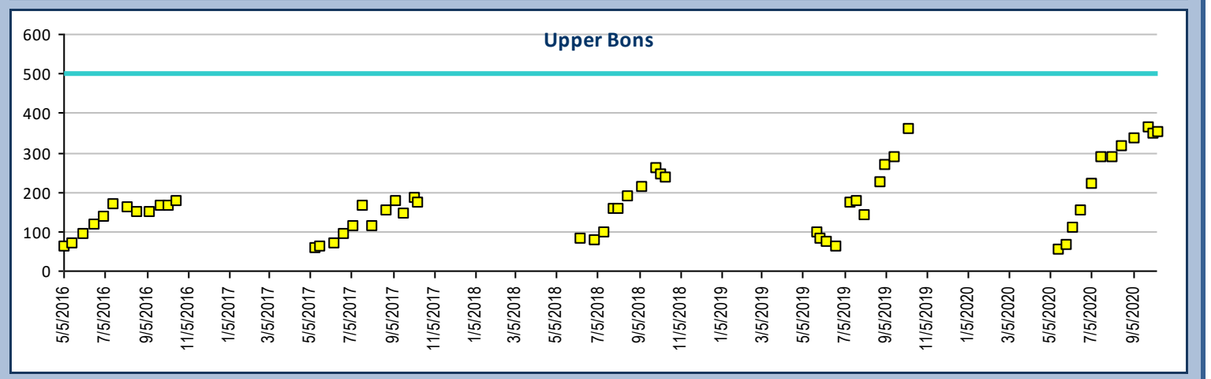
Total Dissolved Solids, units mg/L

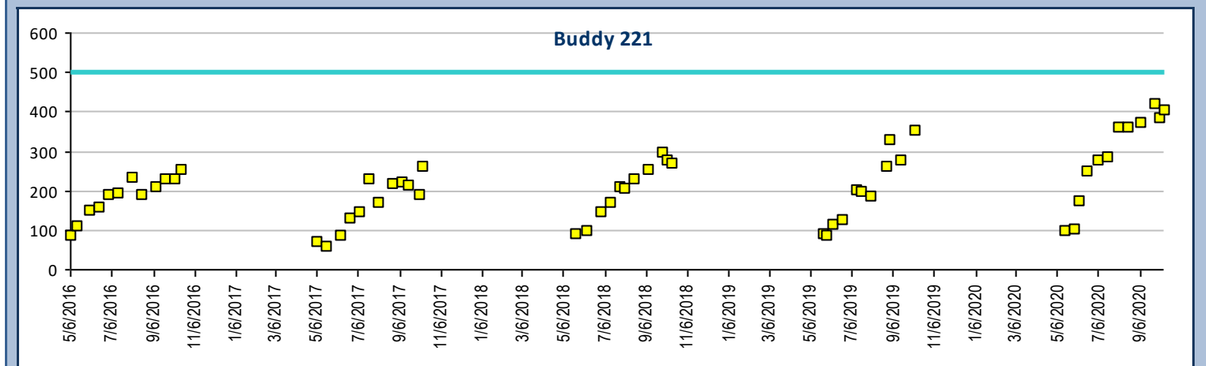
Site Specific WQS mg/L

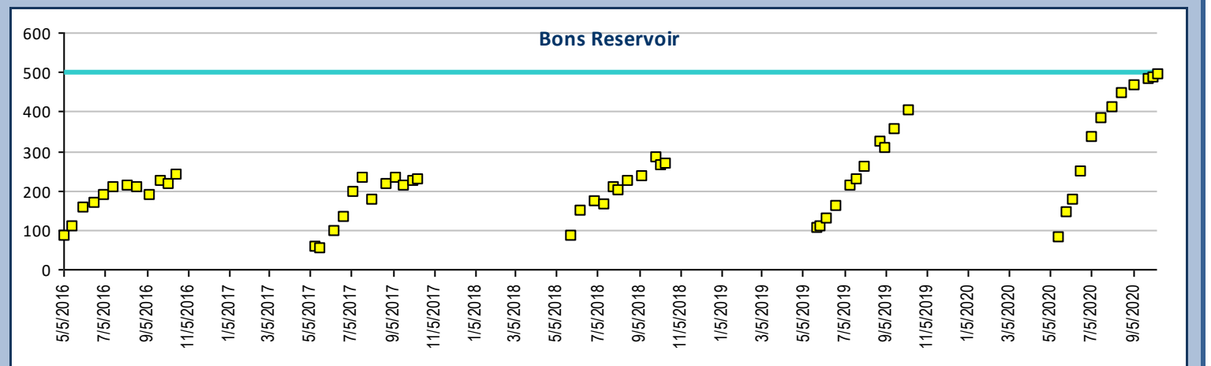
500 mg/L

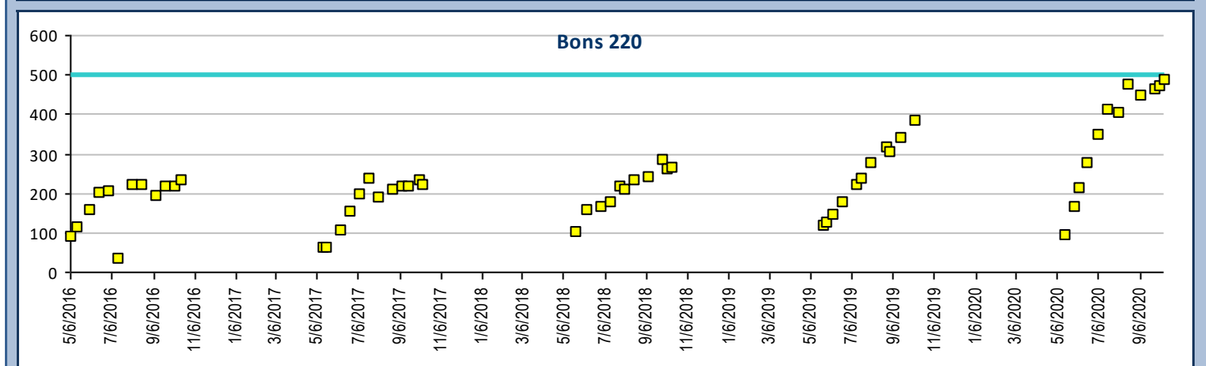


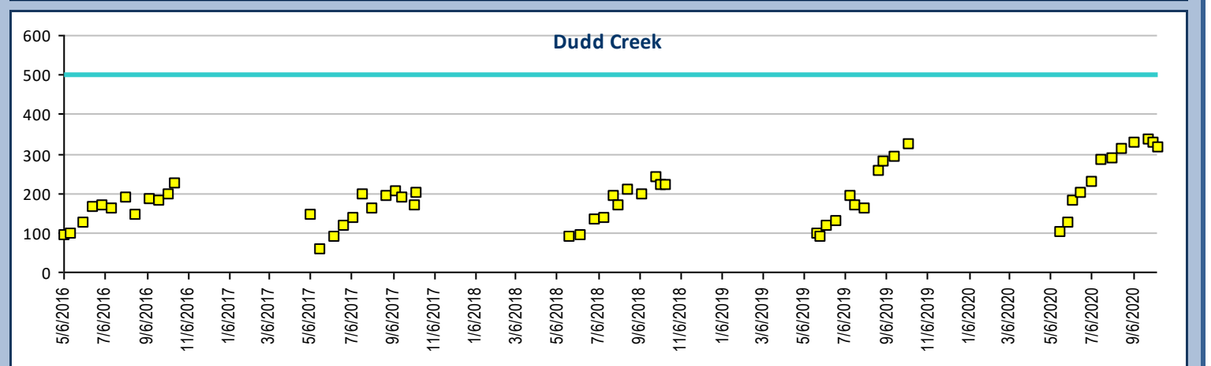








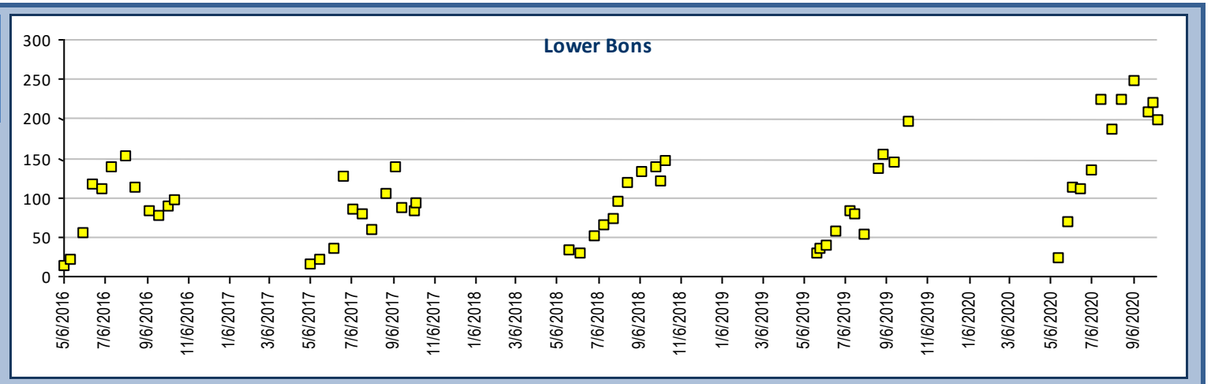


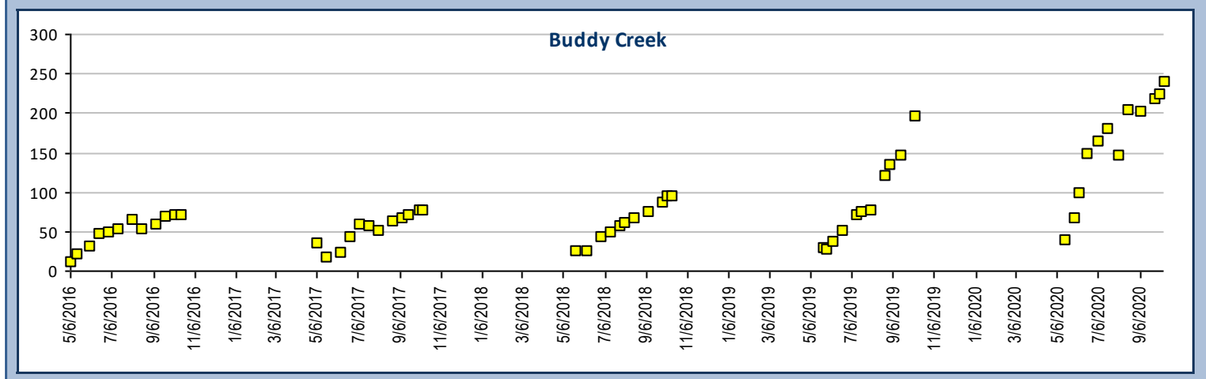


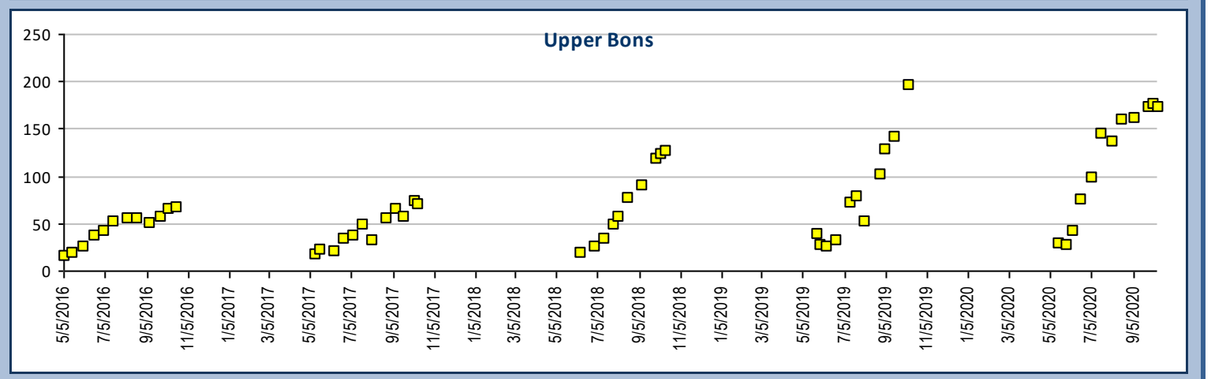
RED DOG MINE

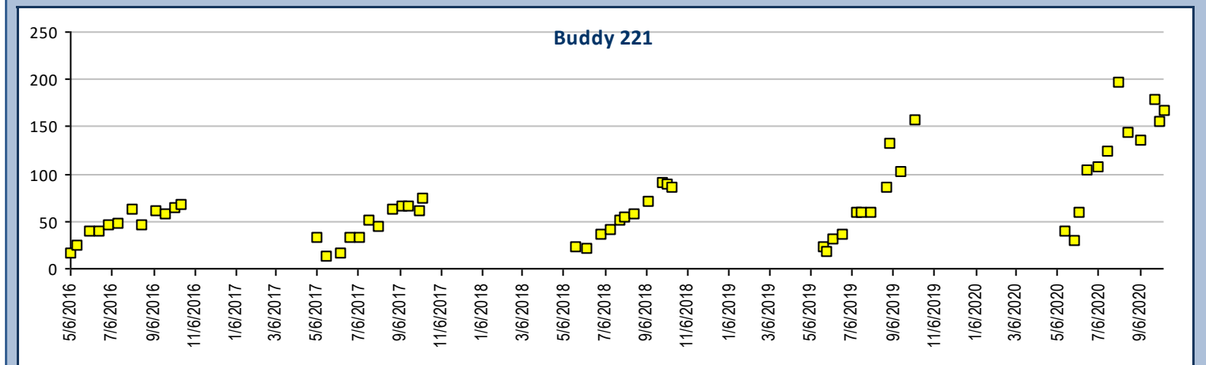
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

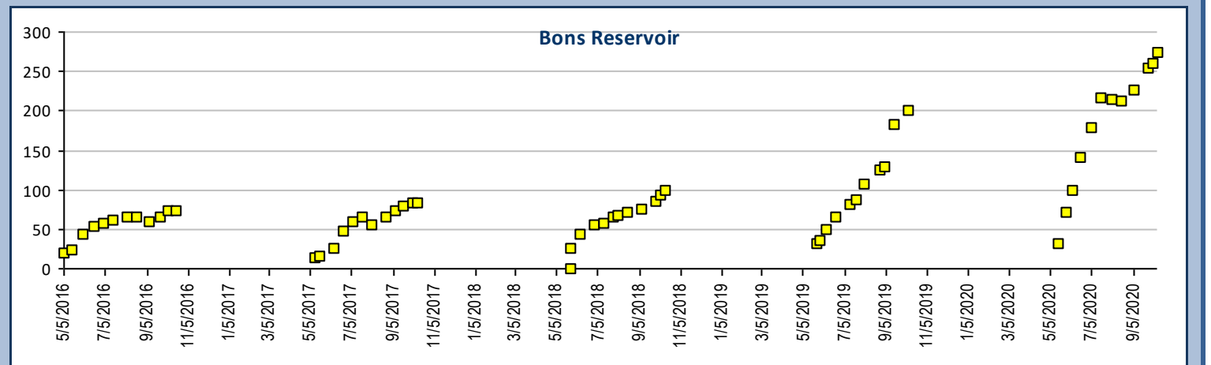
Sulfate, Total recoverable, units mg/L

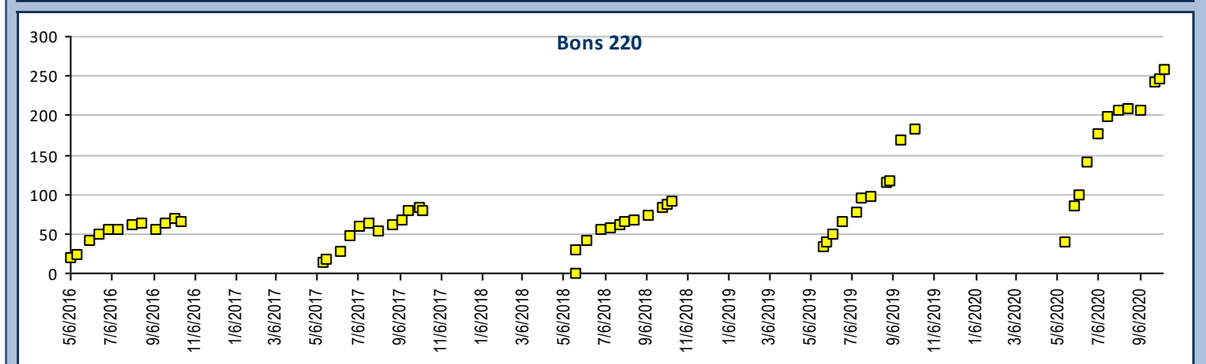


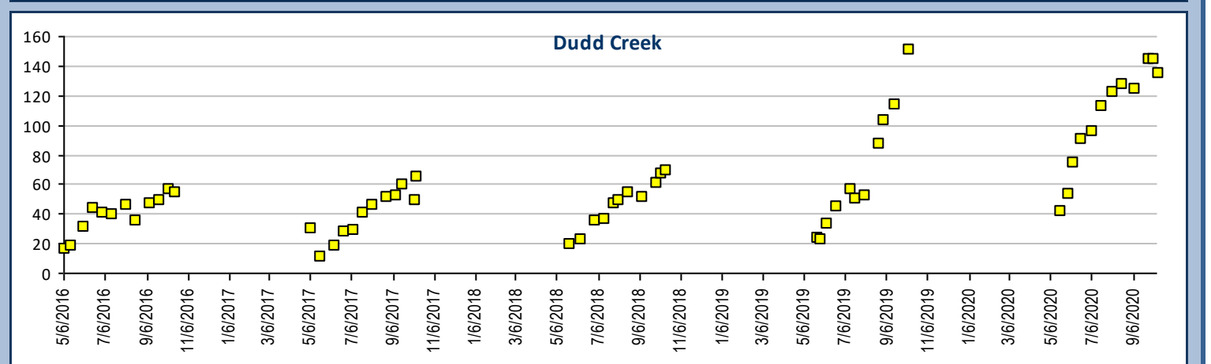












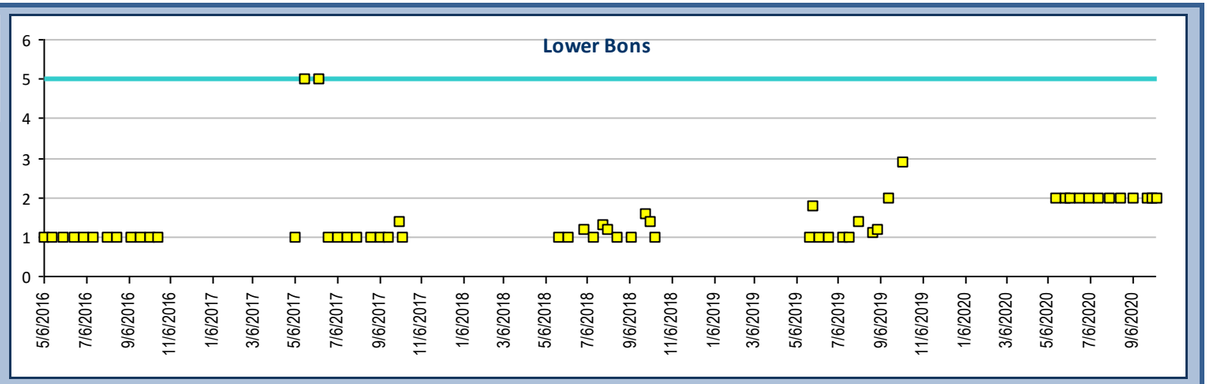
RED DOG MINE

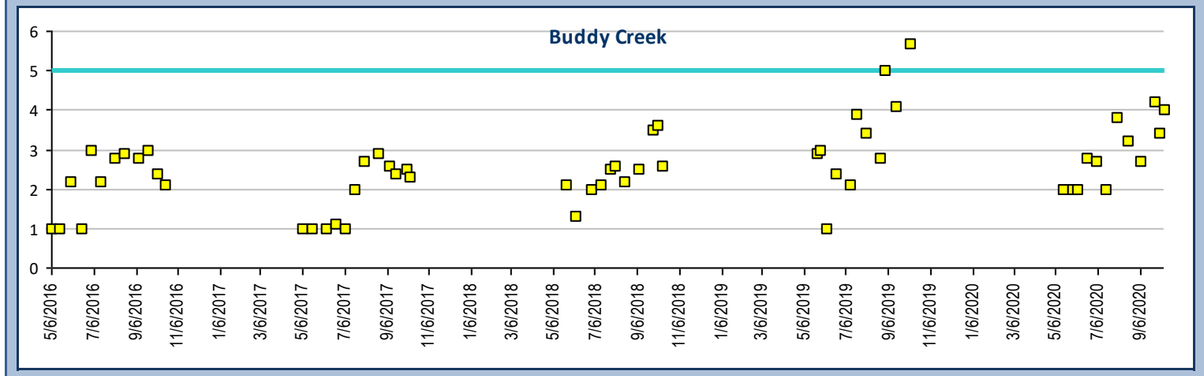
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

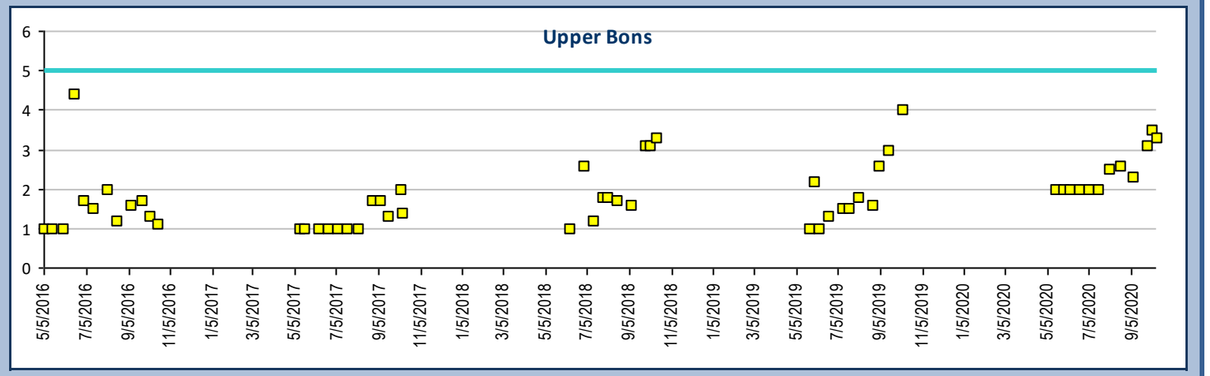
Selenium, Total Recoverable, units ug/L

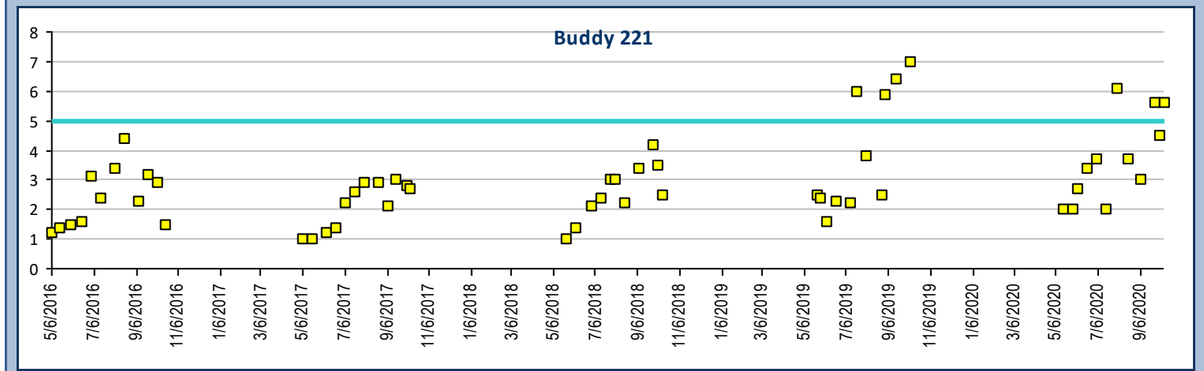
Aquatic Life - Fresh Water Chronic WQS ug/L

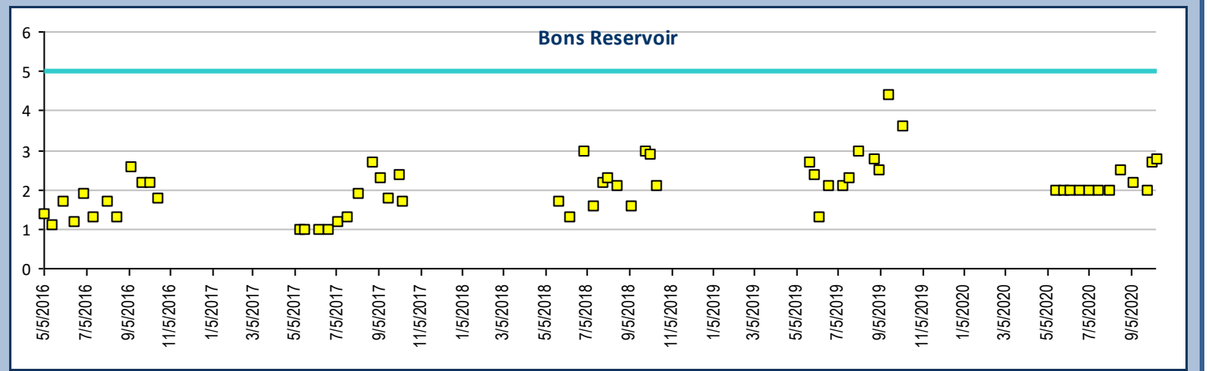
5 ug/L

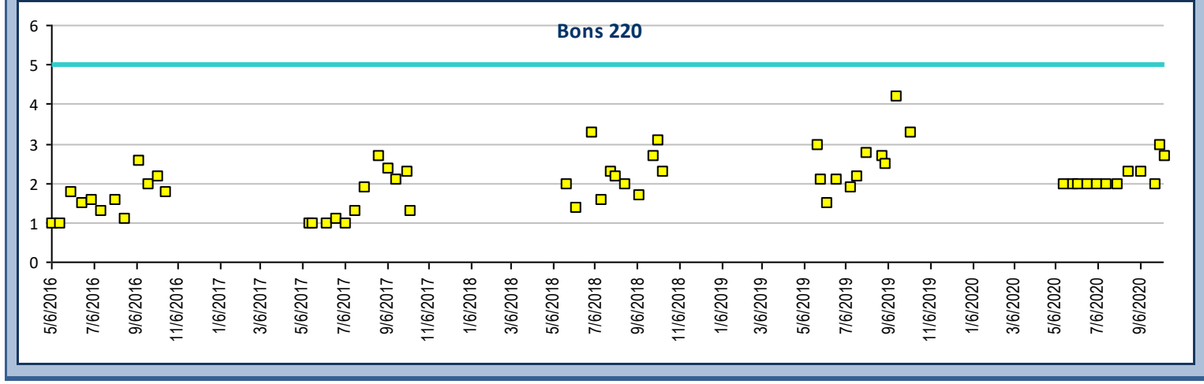


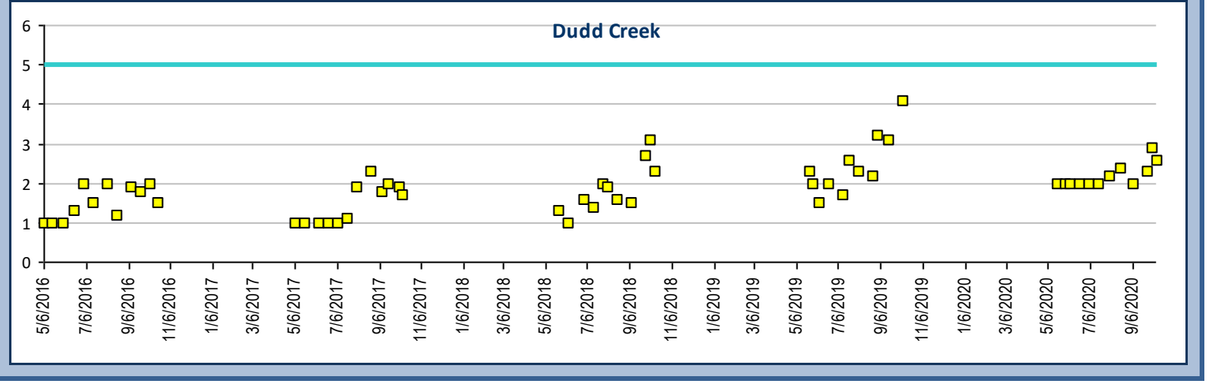










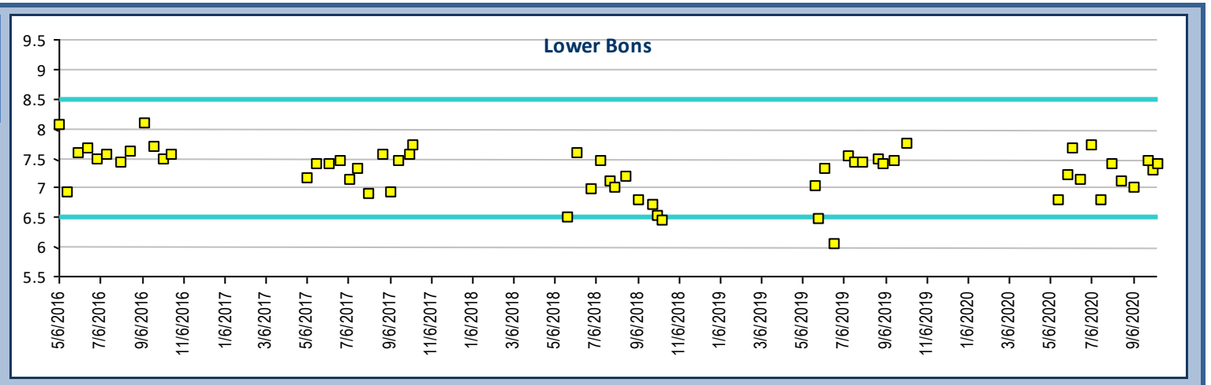


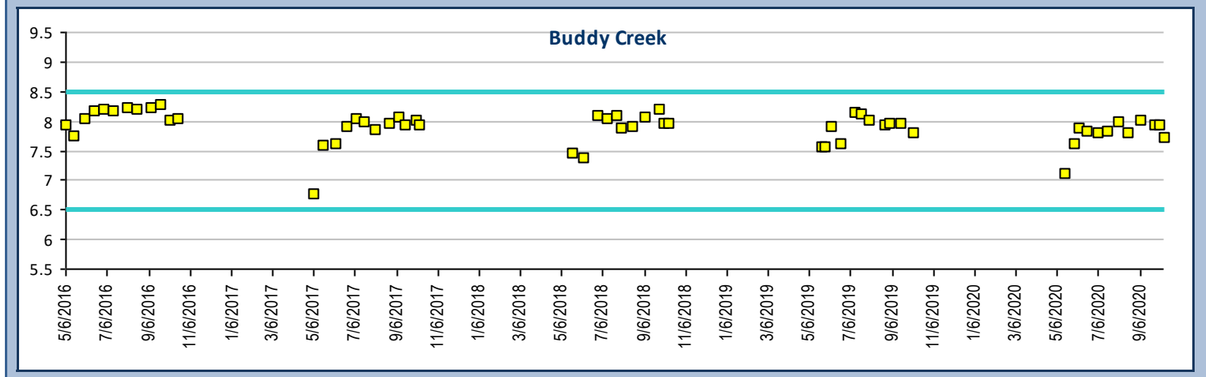
RED DOG MINE

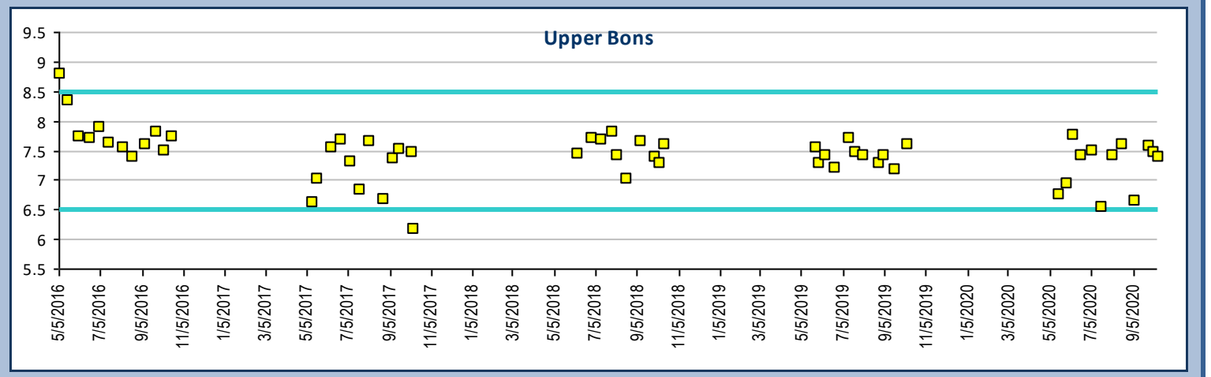
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

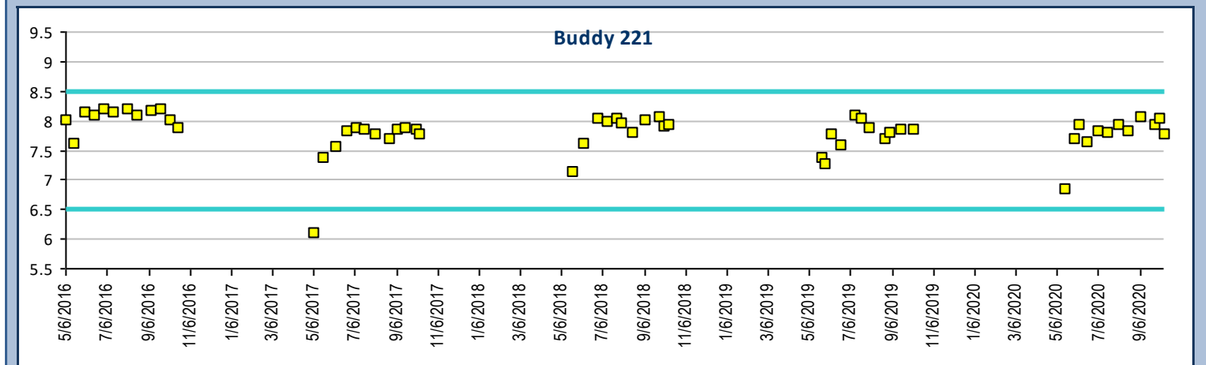
pH

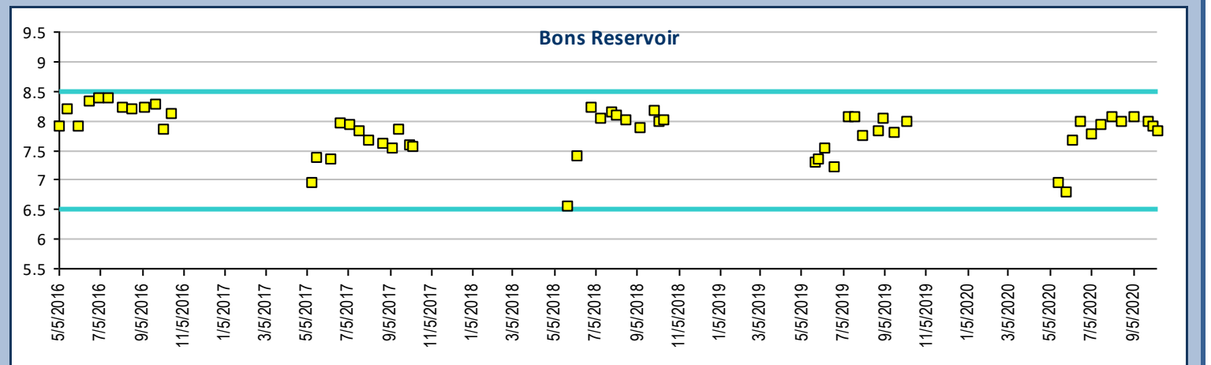
Site Specific WQS between 6.5 and 8.5

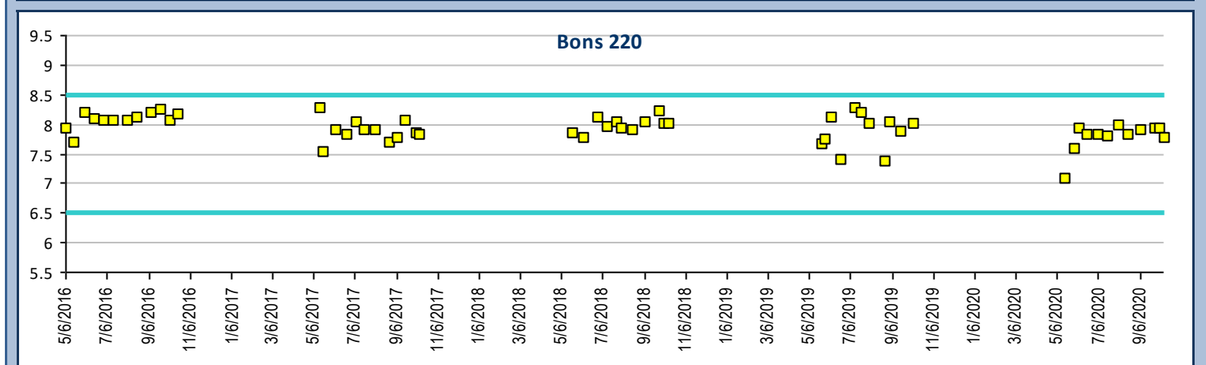


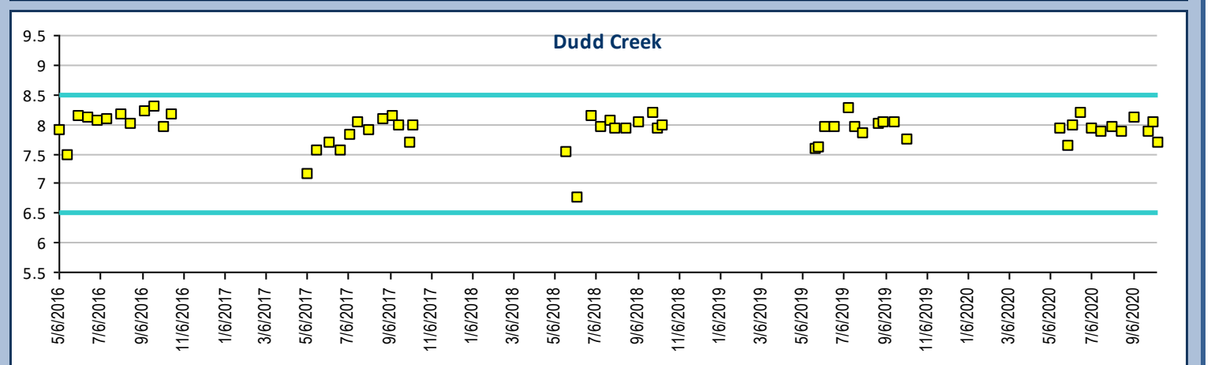












RED DOG MINE

Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

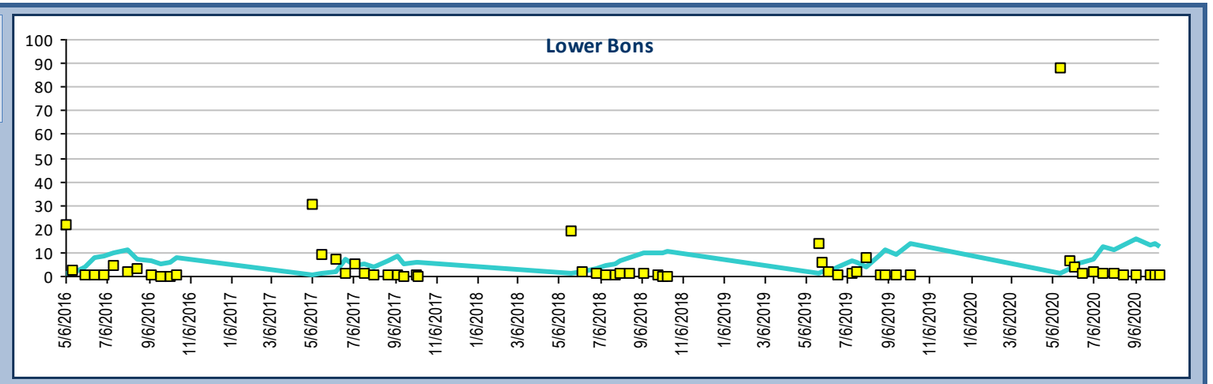
Lead, Total recoverable, units ug/L

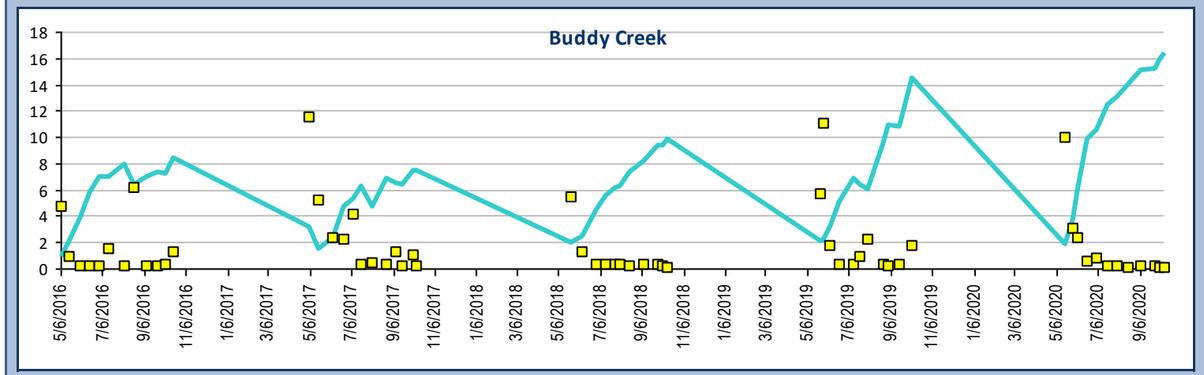
Aquatic Life - Fresh Water Chronic WQS ug/L

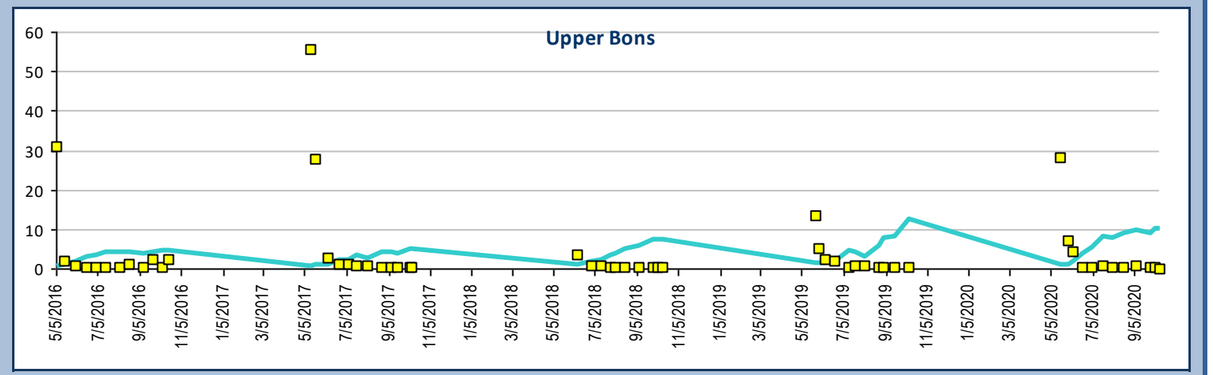
Hardness Dependent Calculation

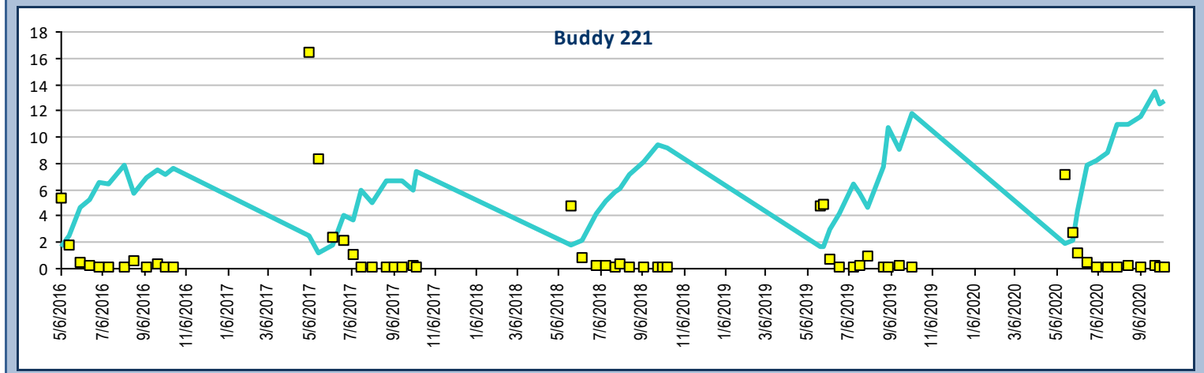
=EXP(1.273*(LN(calc *hardness))-4.705)

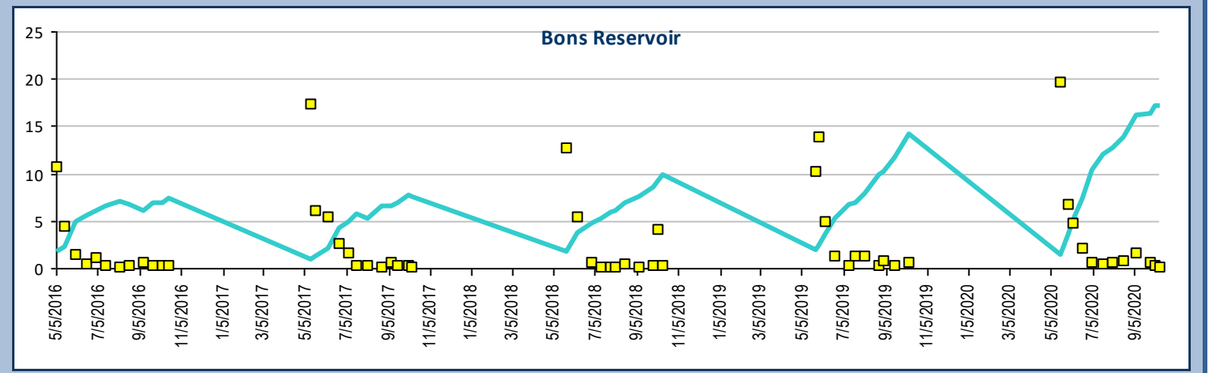
* Calculated using Standard Methods 2340B

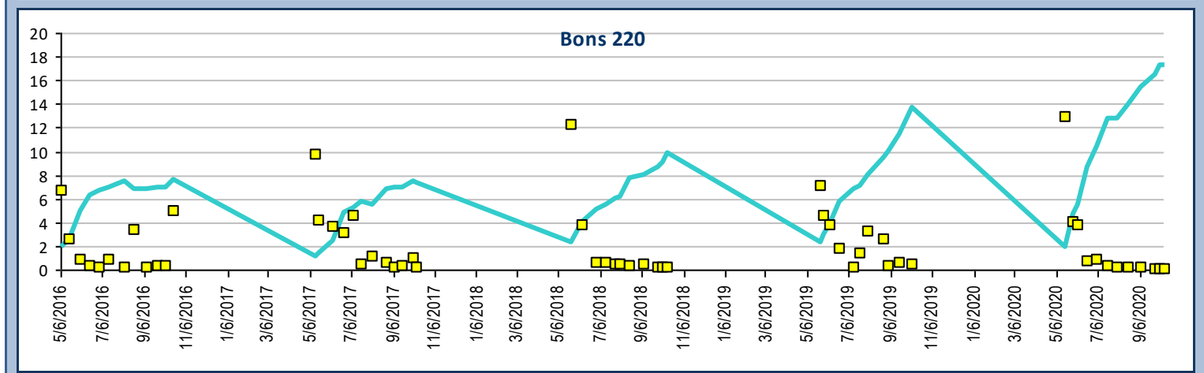


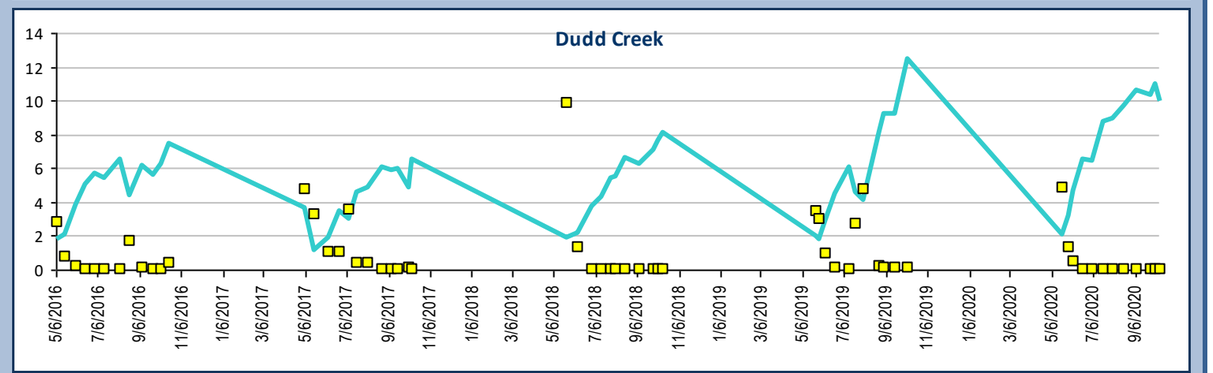








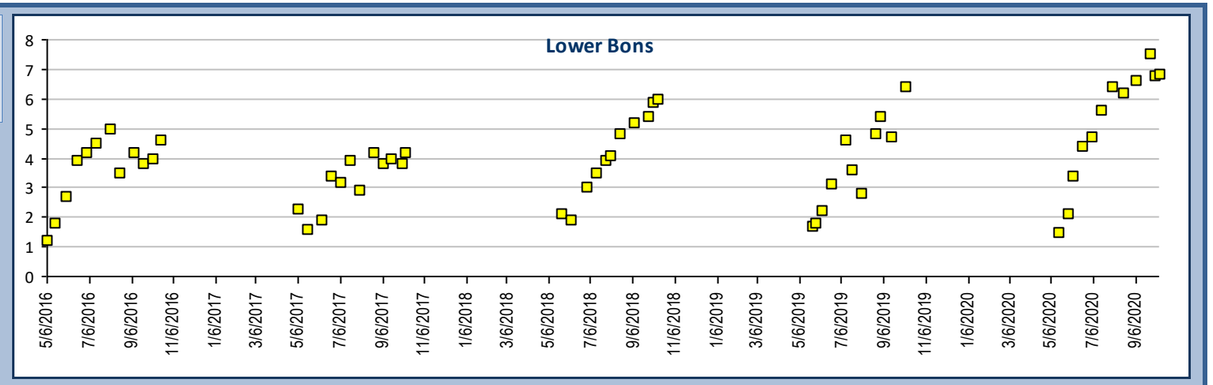


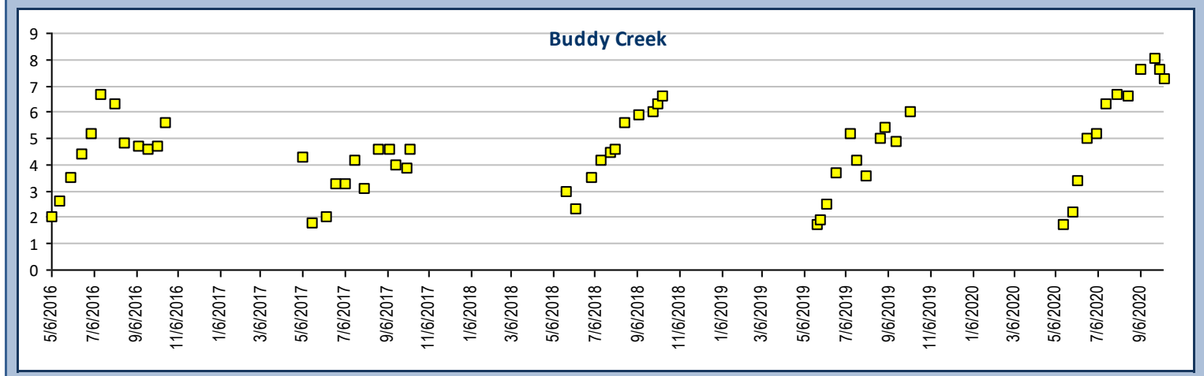


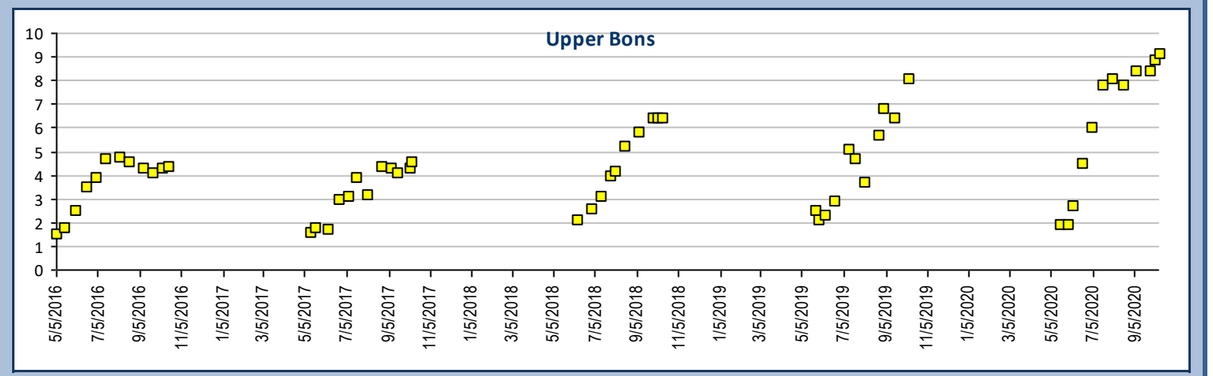
RED DOG MINE

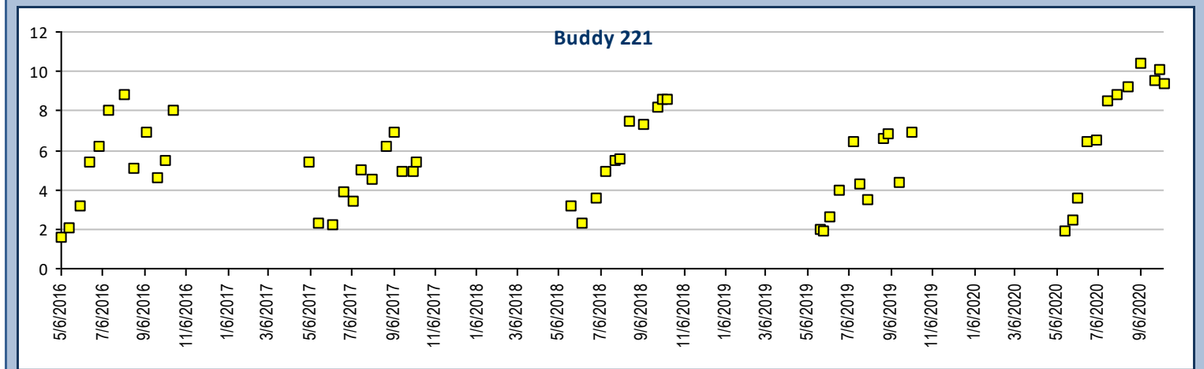
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

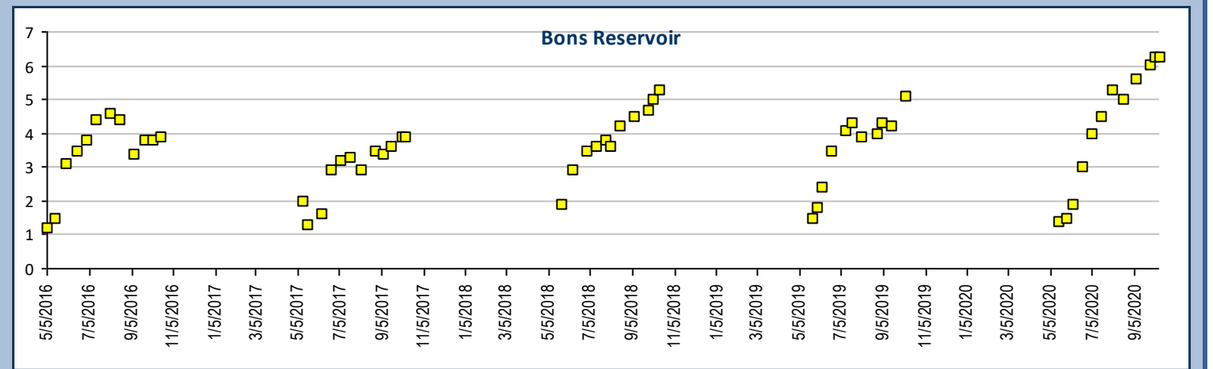
Sodium, Total Recoverable, units mg/L

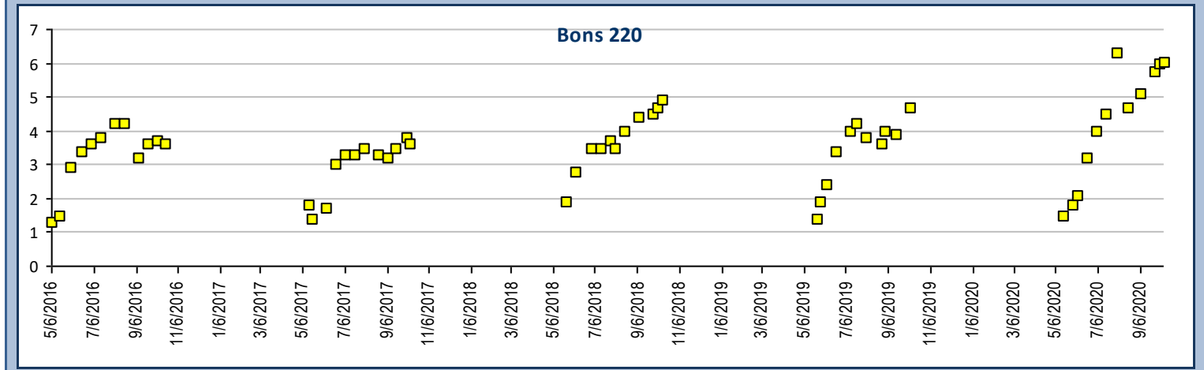


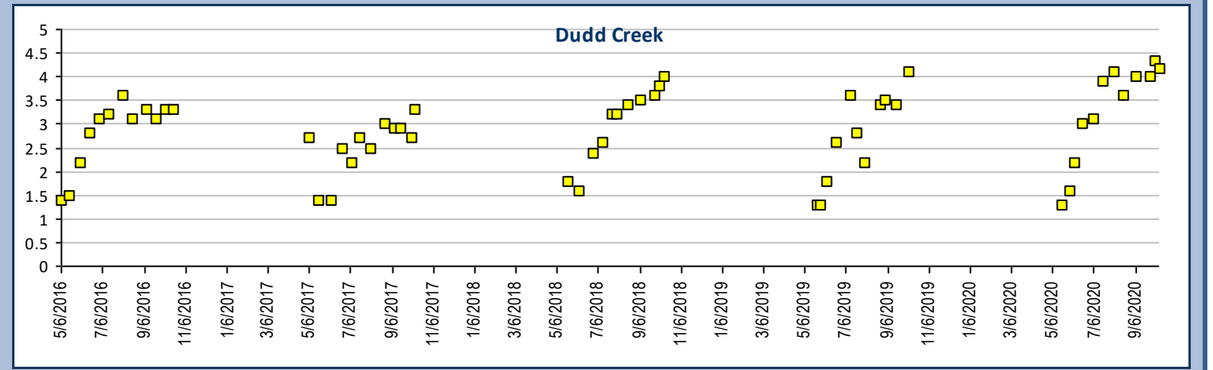








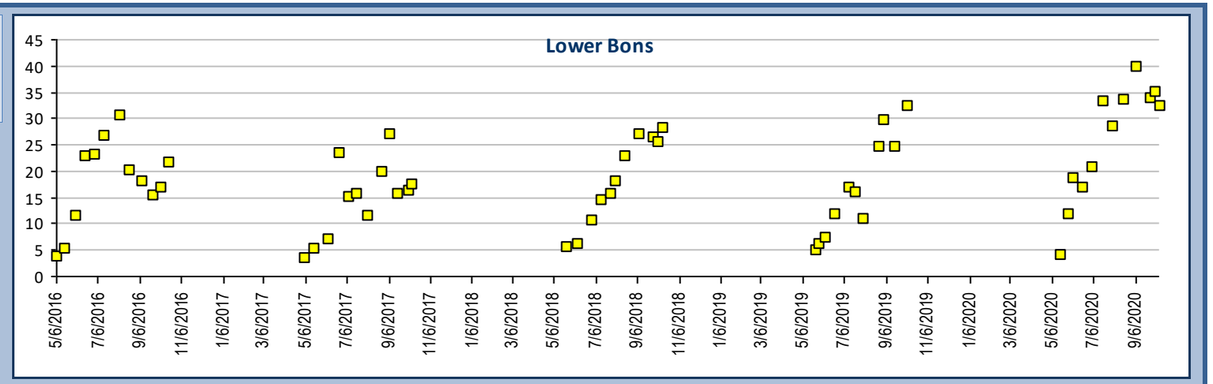


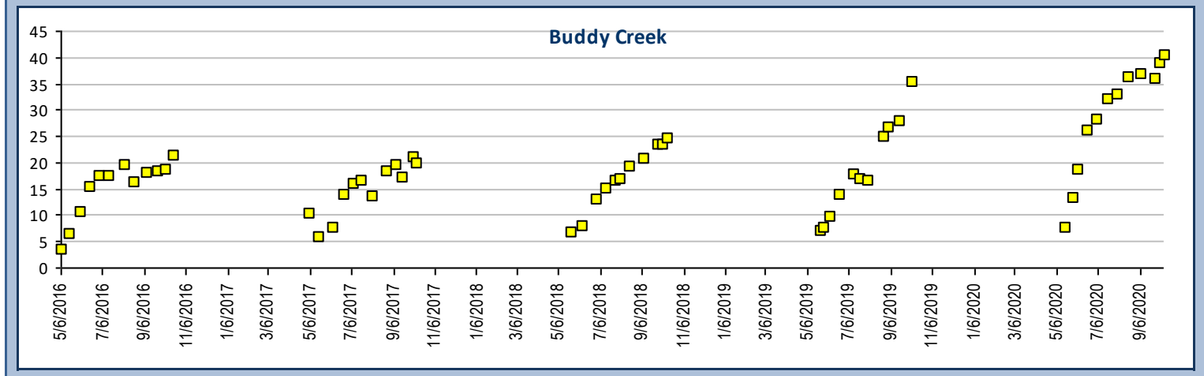


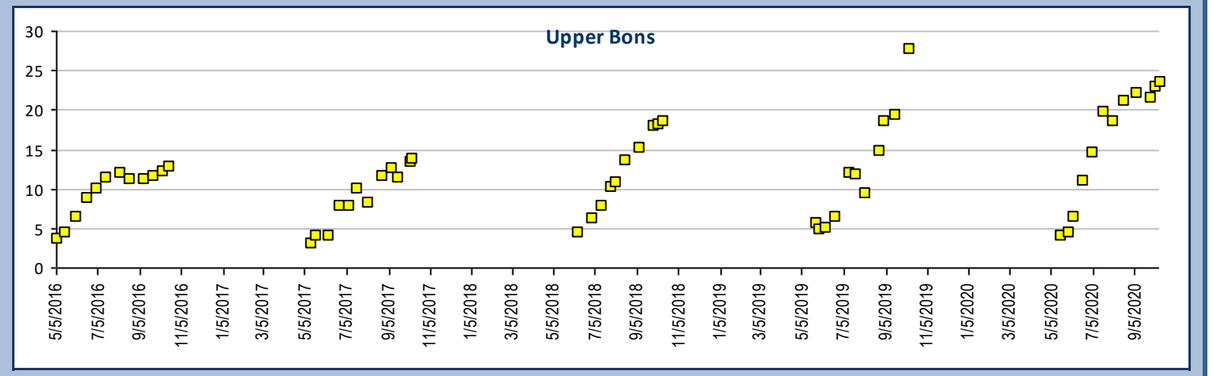
RED DOG MINE

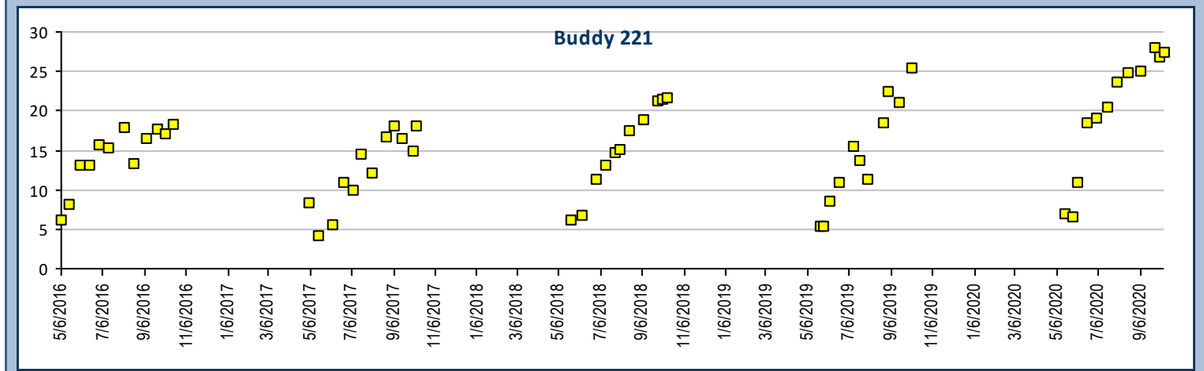
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

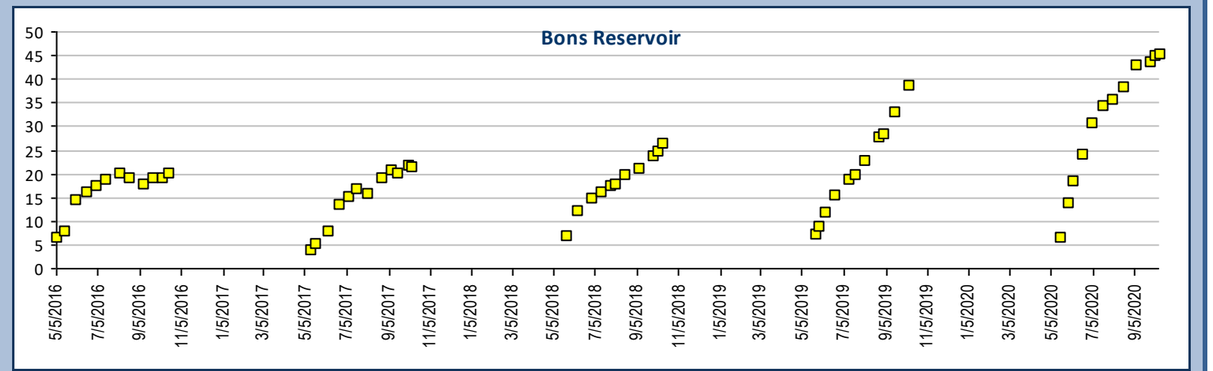
Magnesium, Total Recoverable, units mg/L

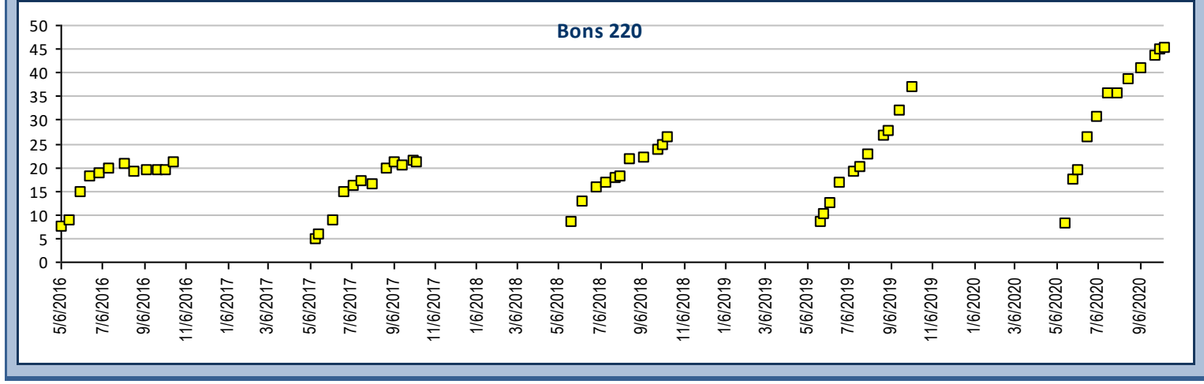


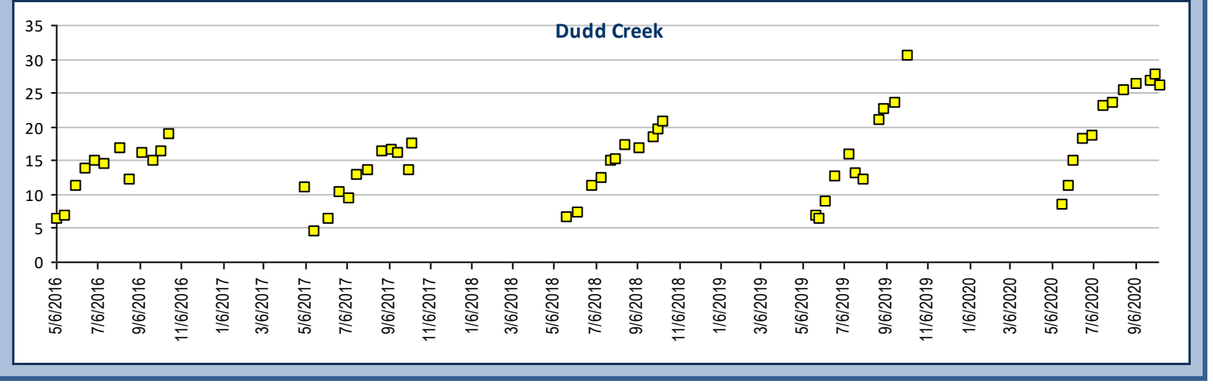








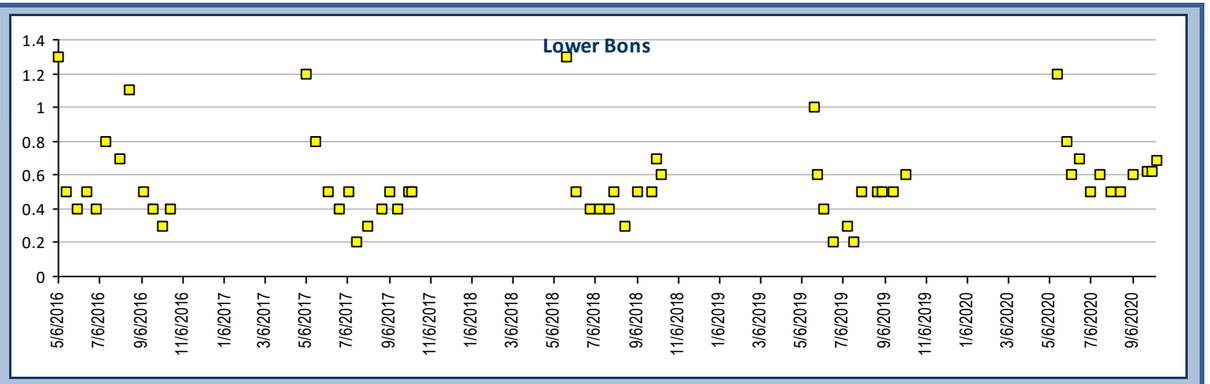


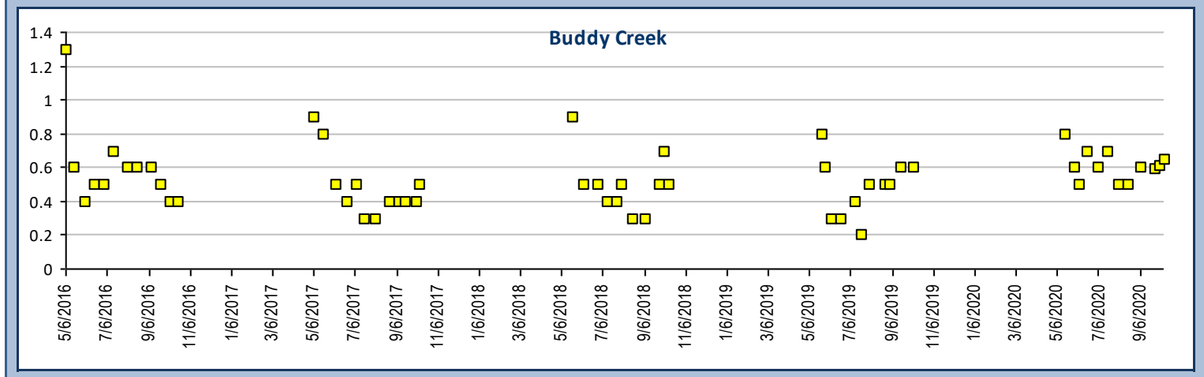


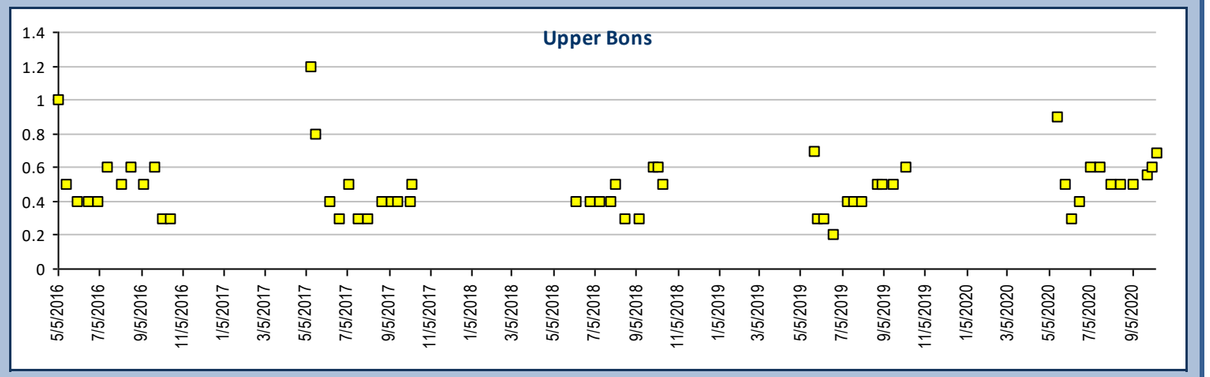
RED DOG MINE

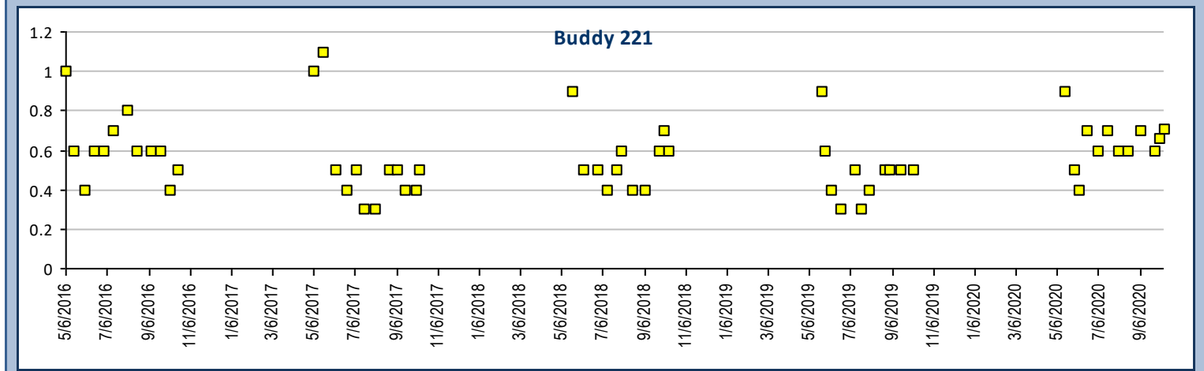
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

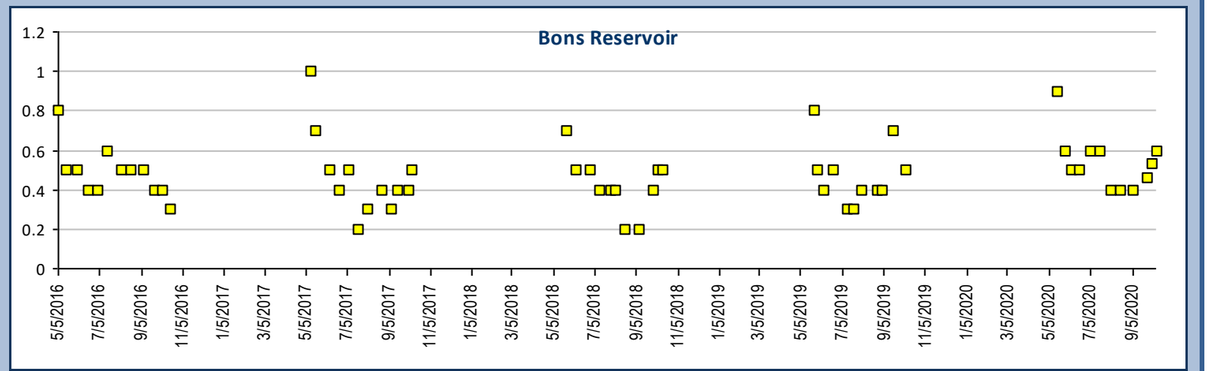
Potassium, Total Recoverable, units mg/L

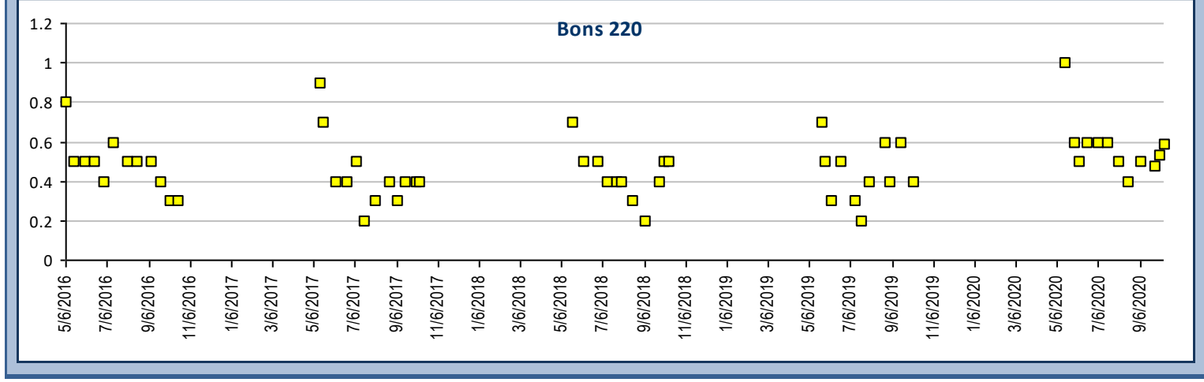


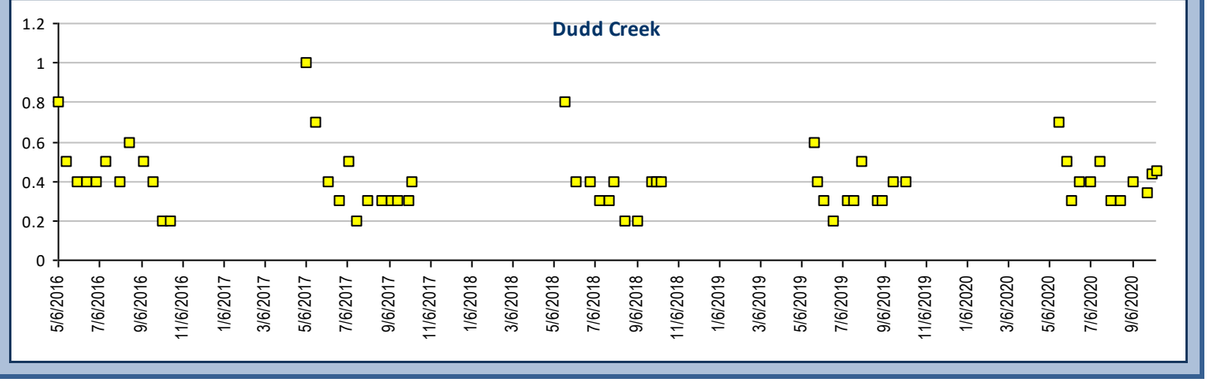








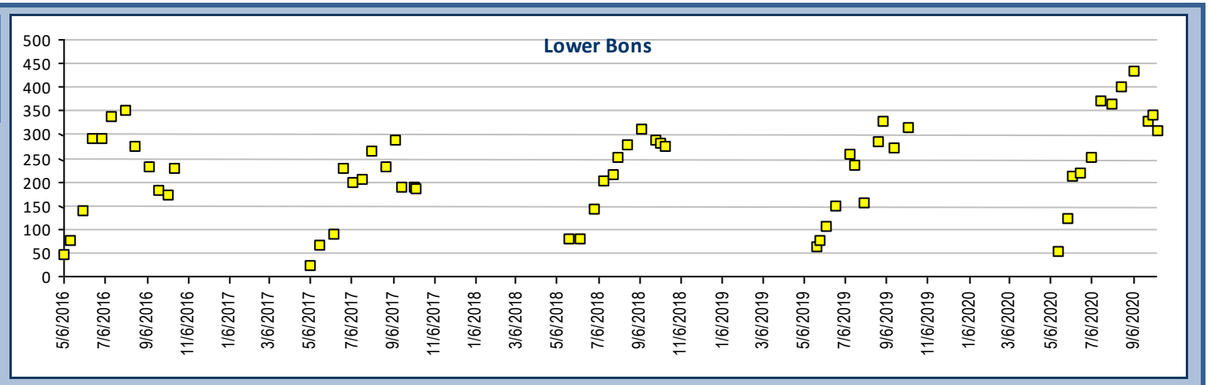


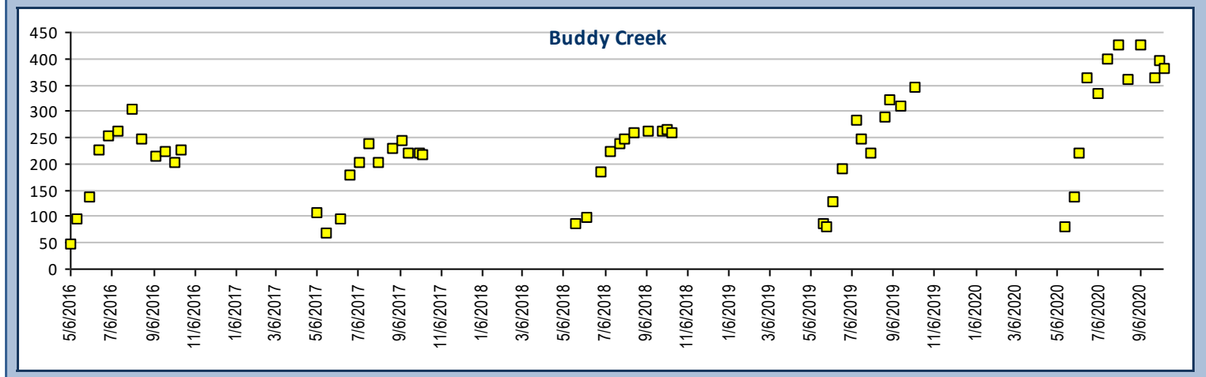


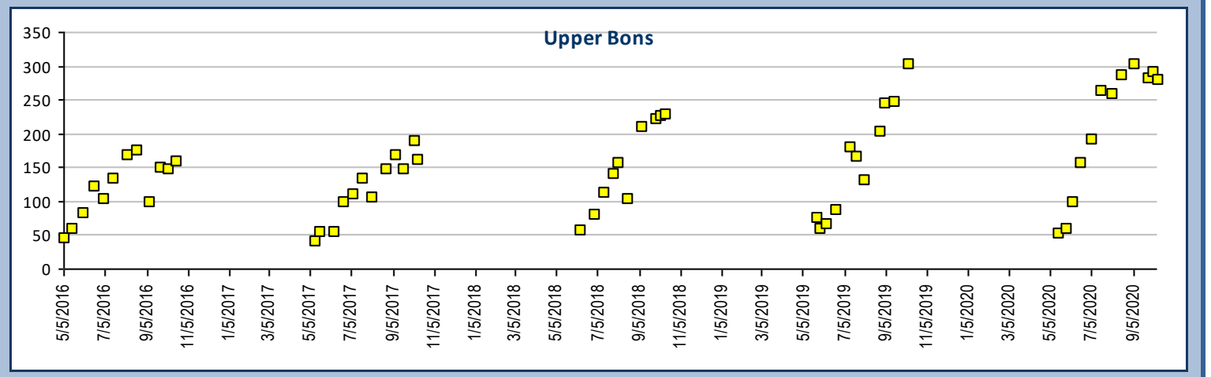
RED DOG MINE

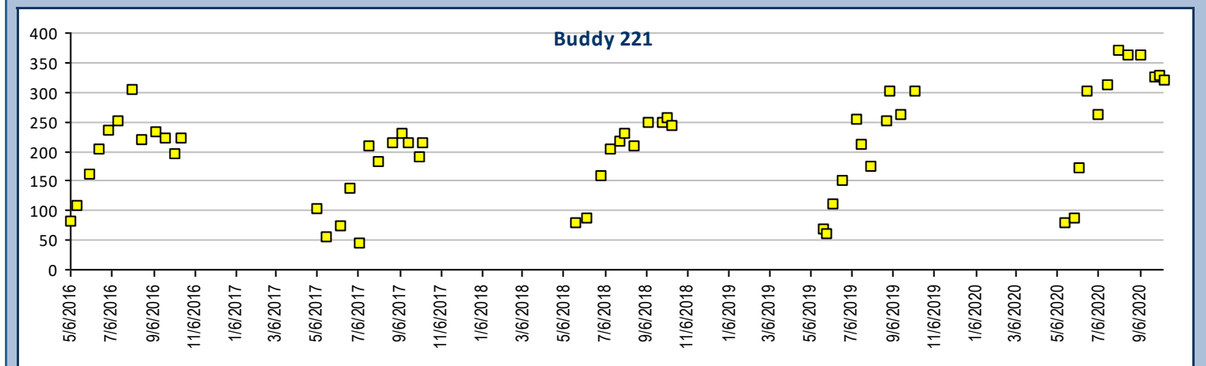
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

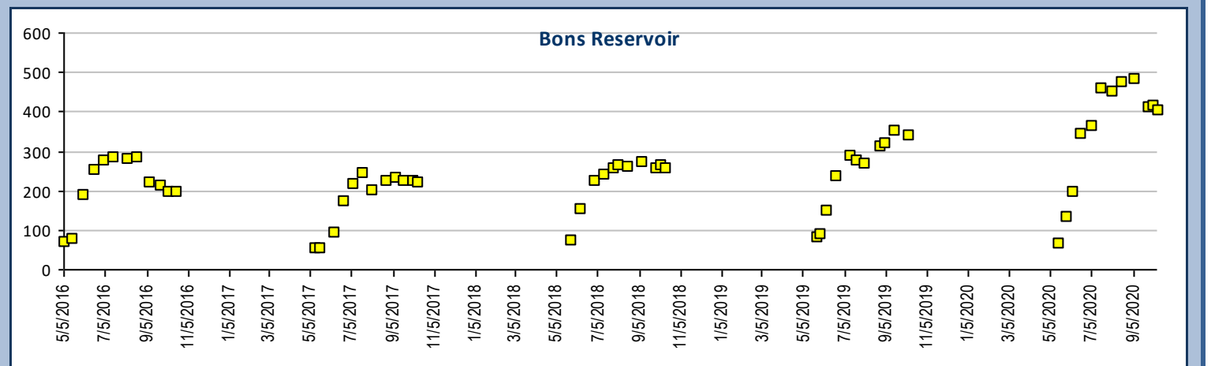
Conductivity, units uS/cm

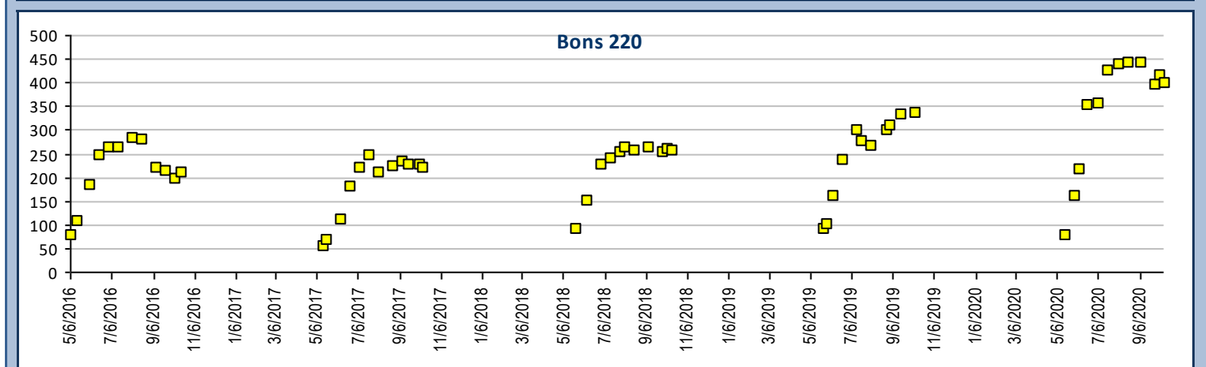


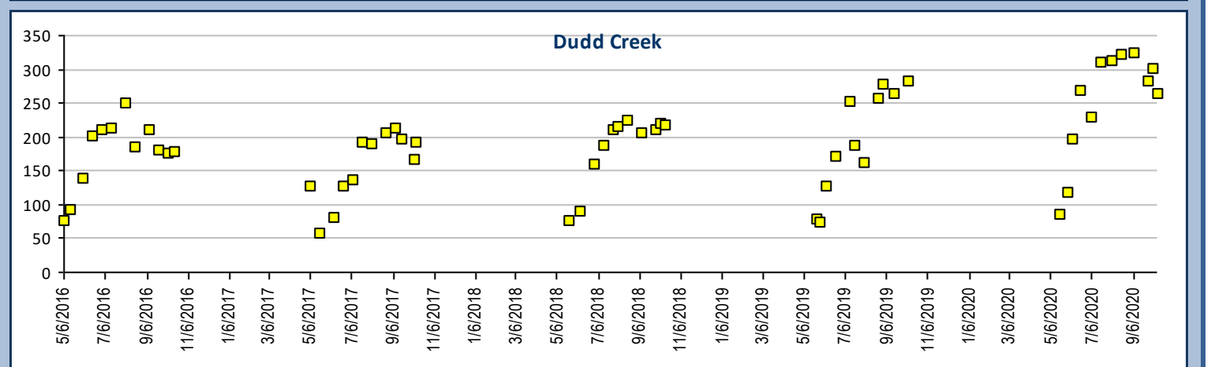












RED DOG MINE

Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

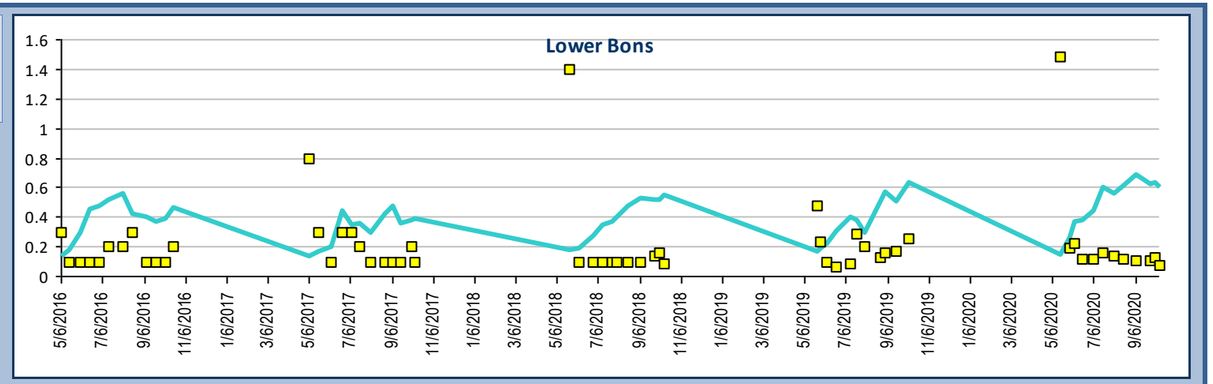
Cadmium, Total Recoverable, units ug/L

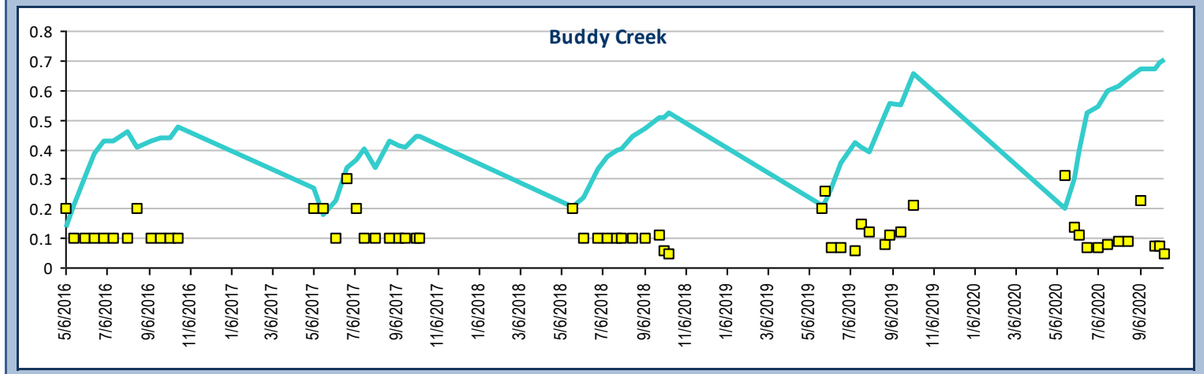
Aquatic Life - Fresh Water Chronic WQS ug/L

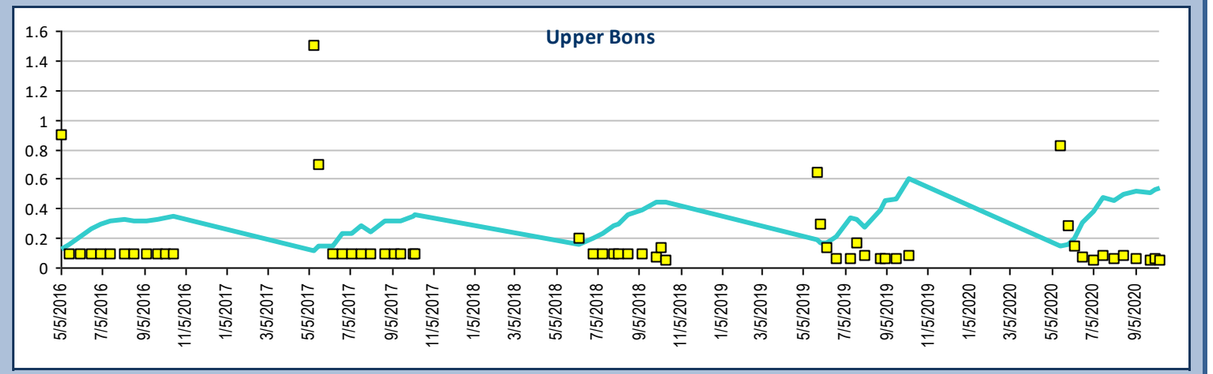
Hardness Dependent Calculation

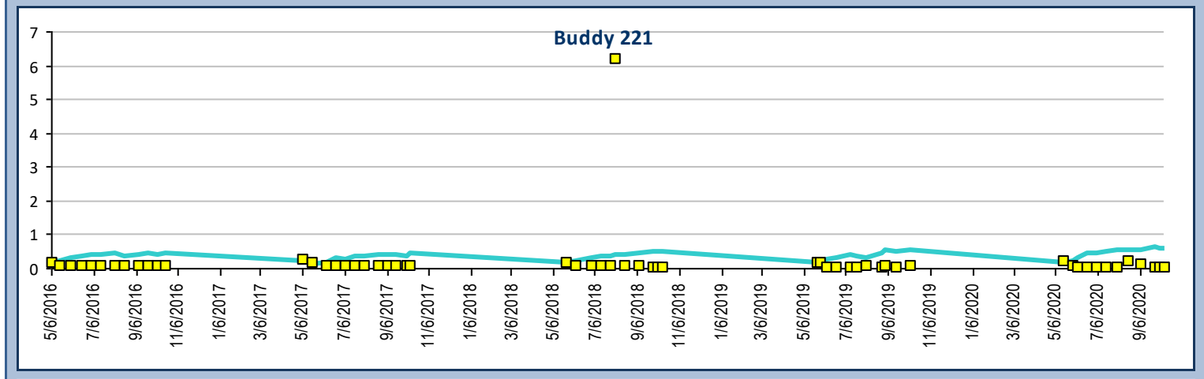
=EXP(0.7409*(LN(calc *hardness))-4.719)

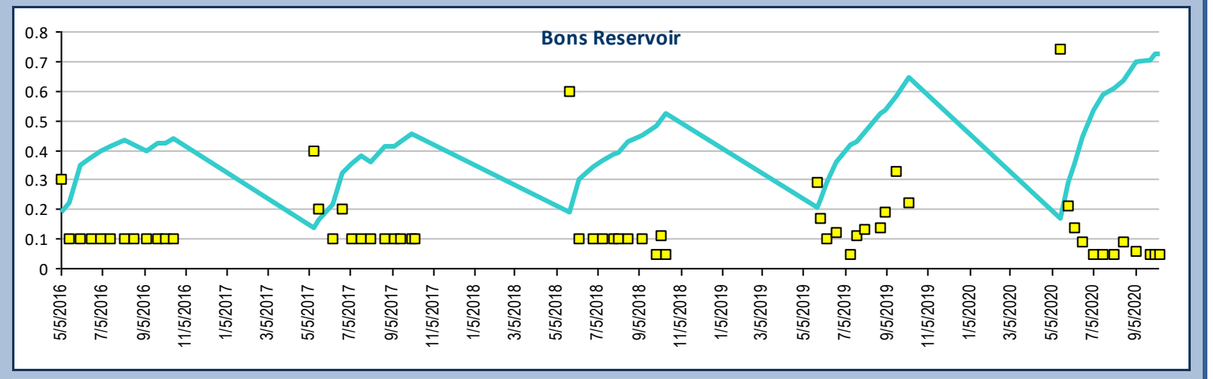
* Calculated using Standard Methods 2340B

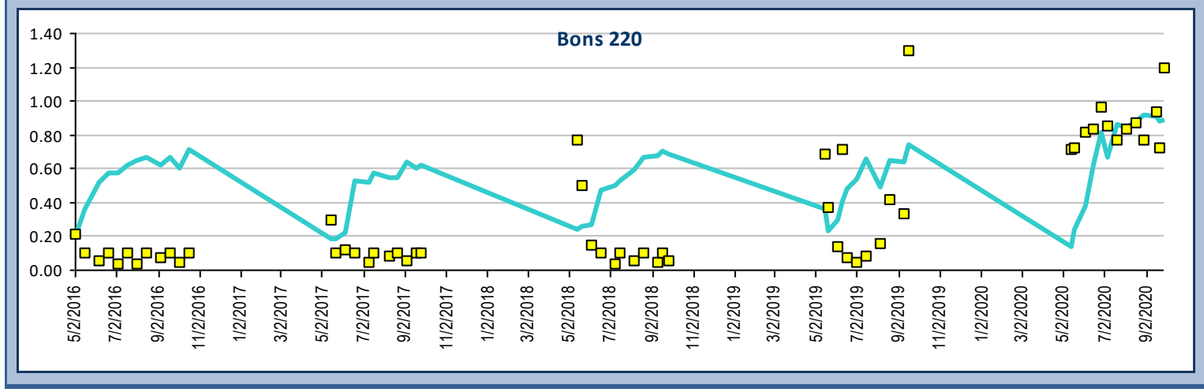


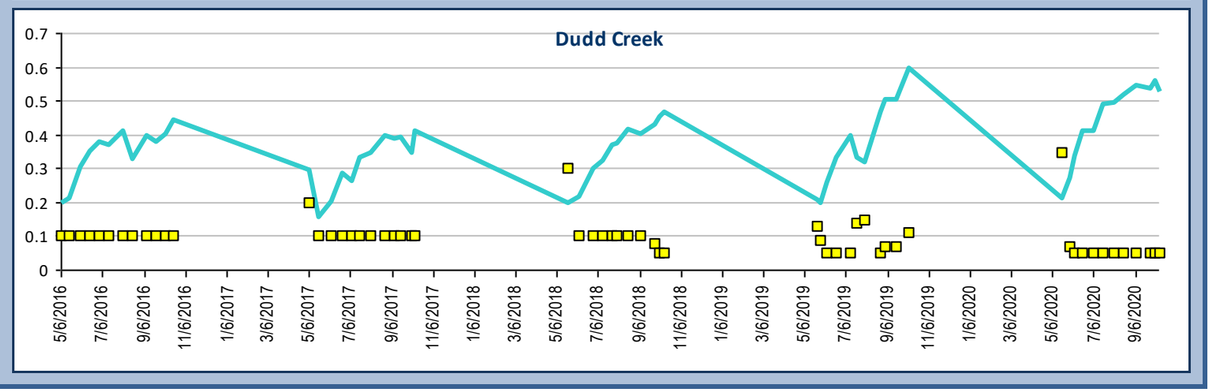








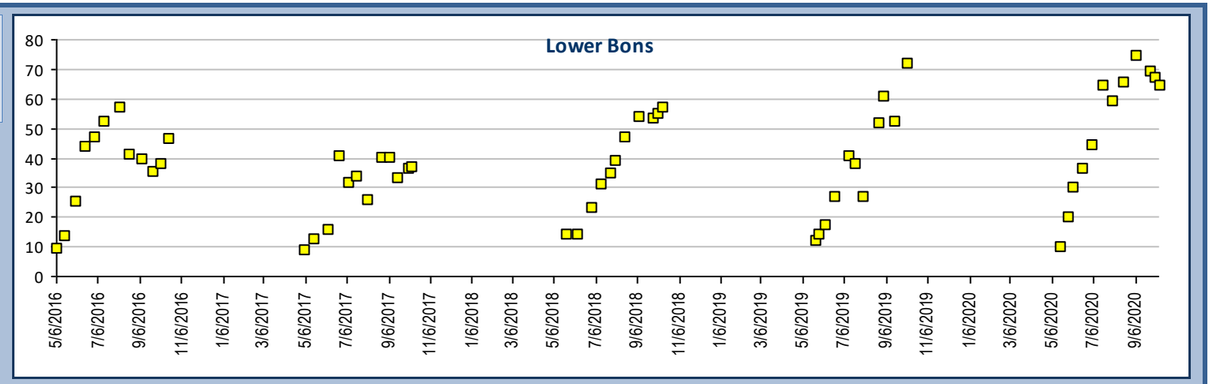


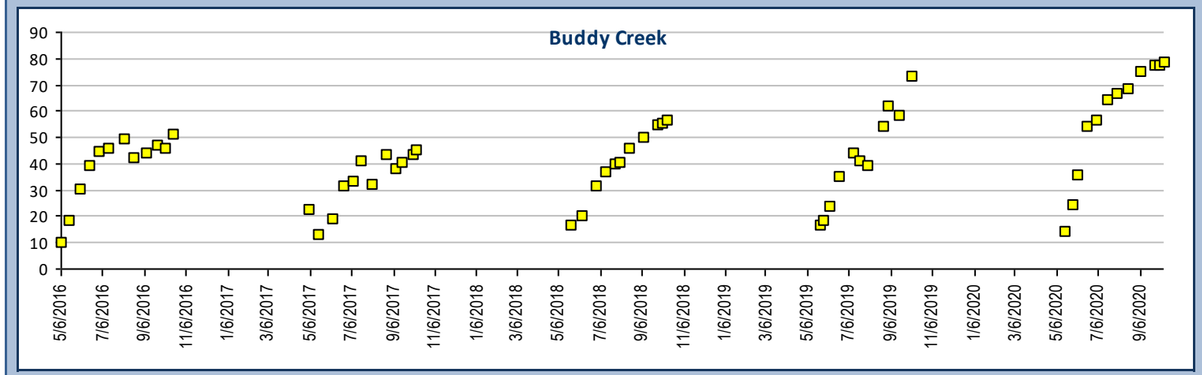


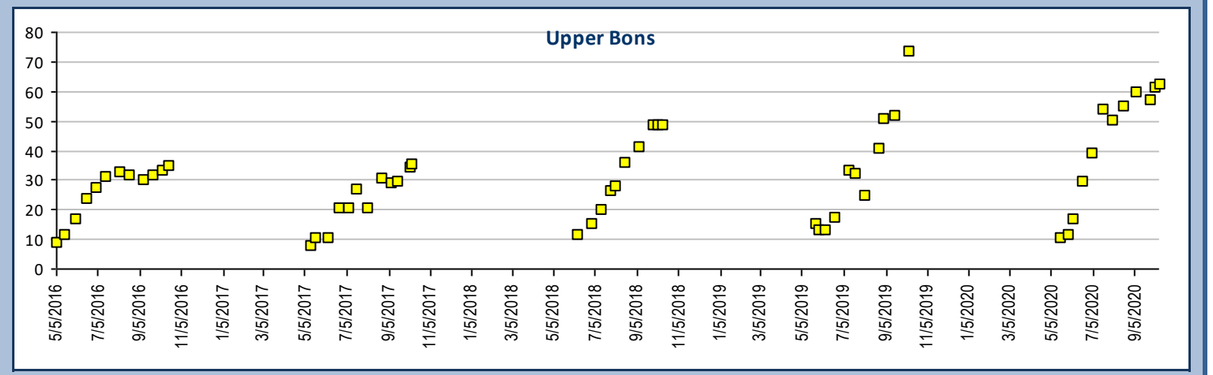
RED DOG MINE

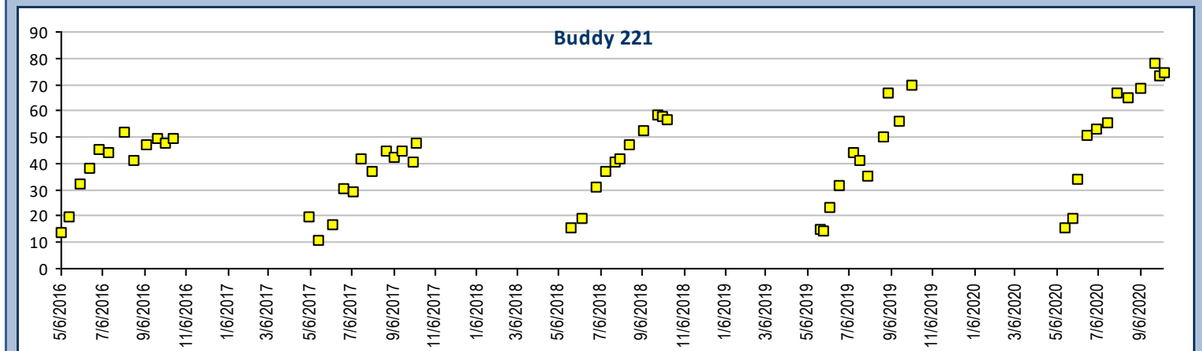
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

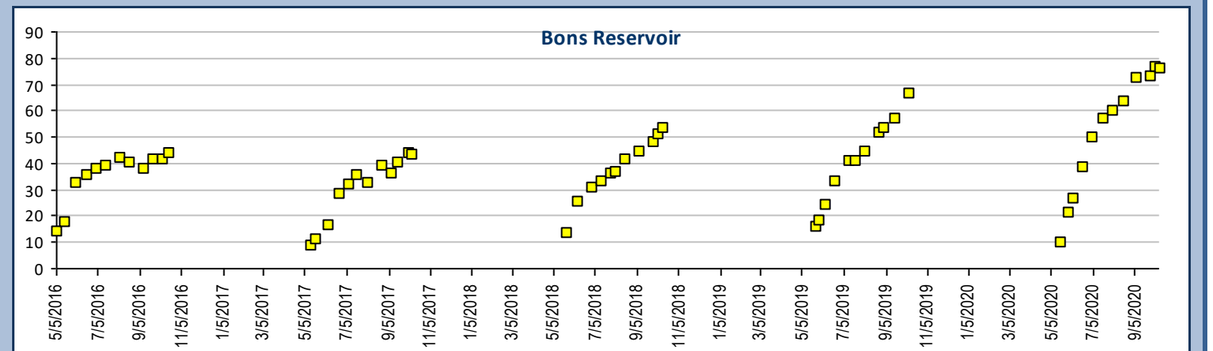
Calcium, Total Recoverable, units mg/L

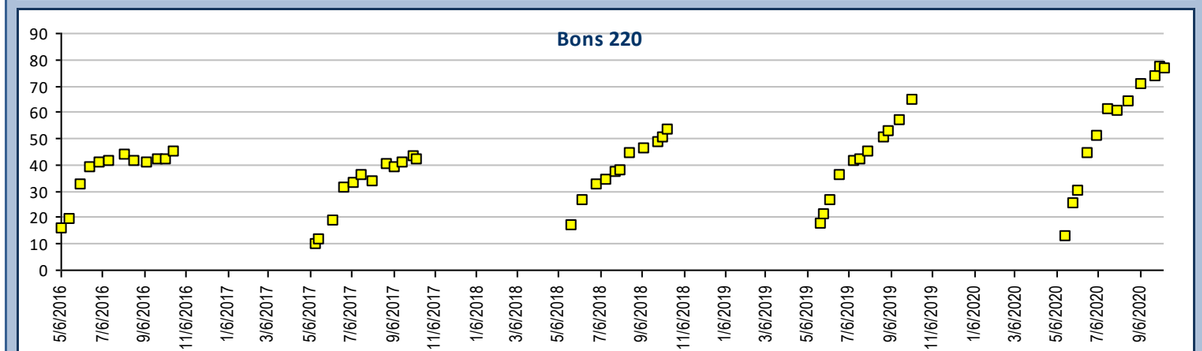


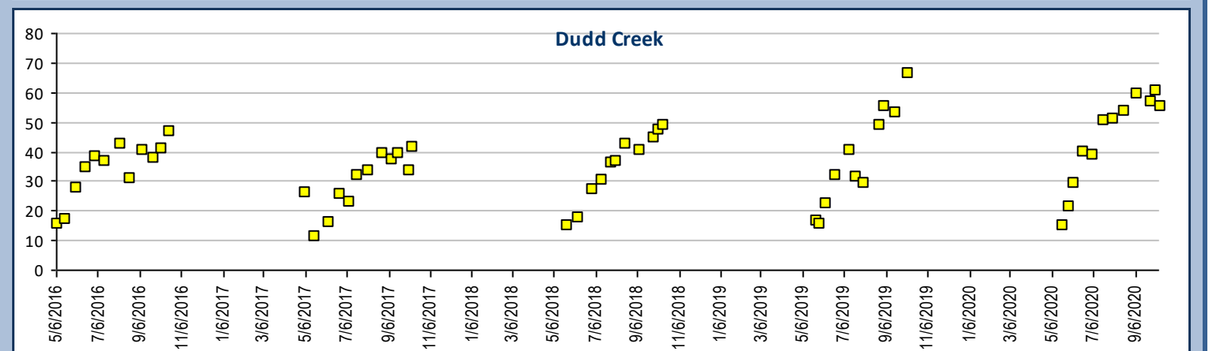












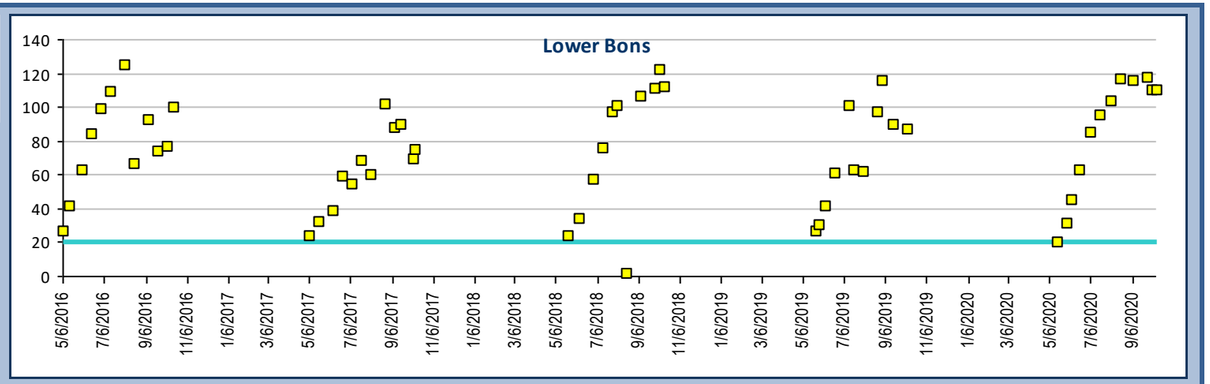
RED DOG MINE

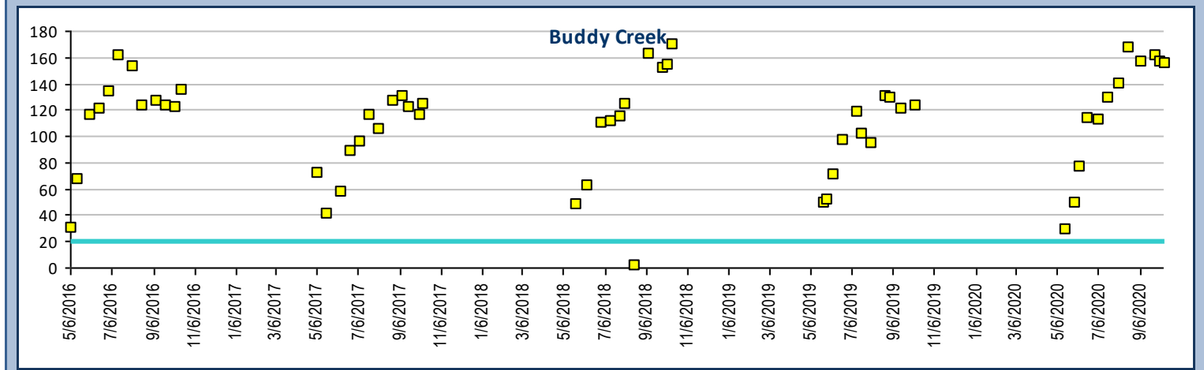
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

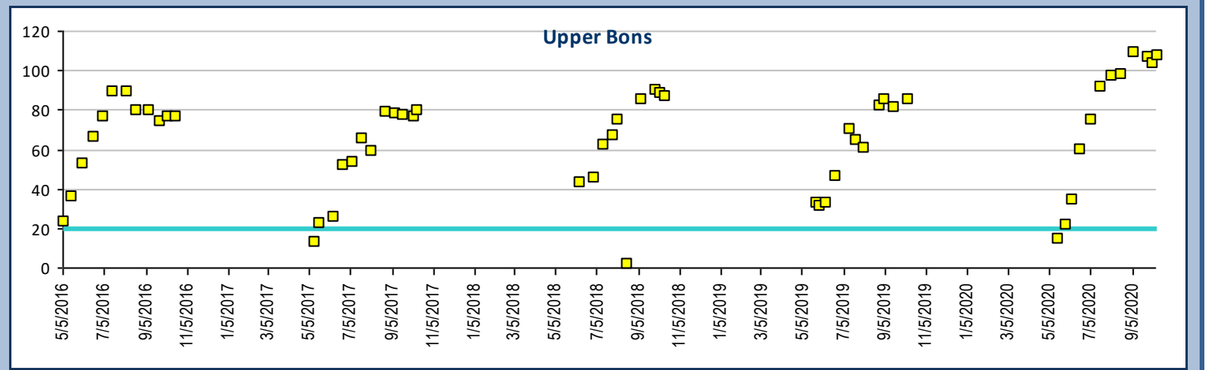
Alkalinity (as CaCO3), units mg/L

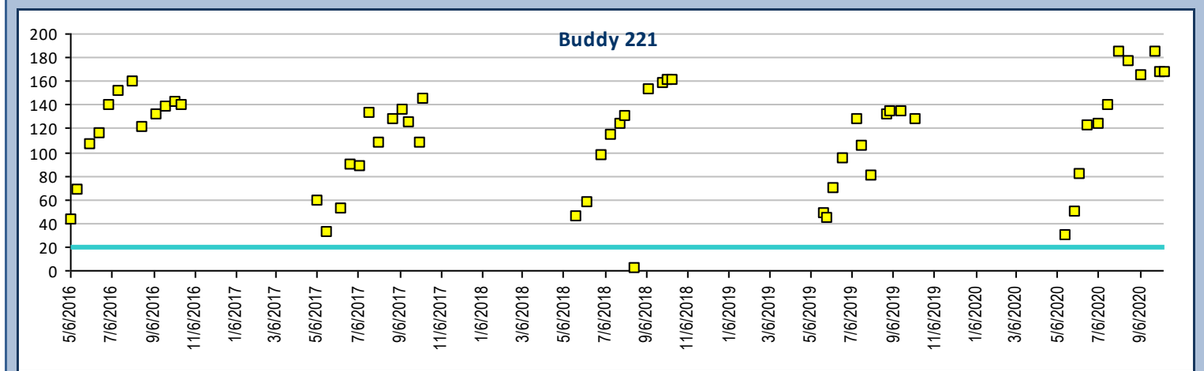
Aquatic Life - Fresh Water Chronic WQS mg/L

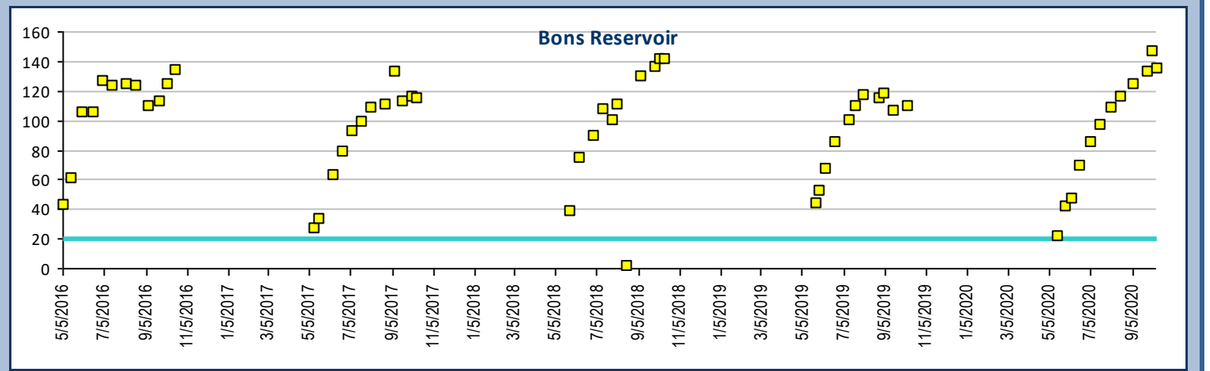
20 mg/L minimum

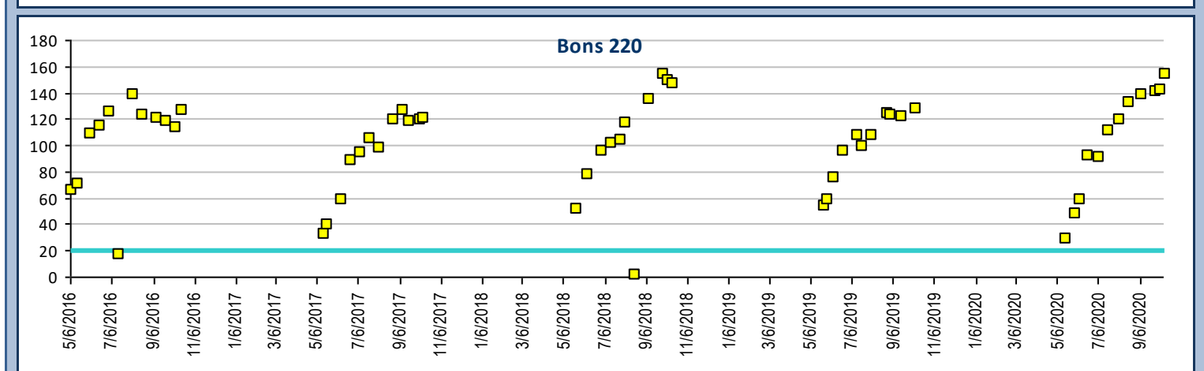


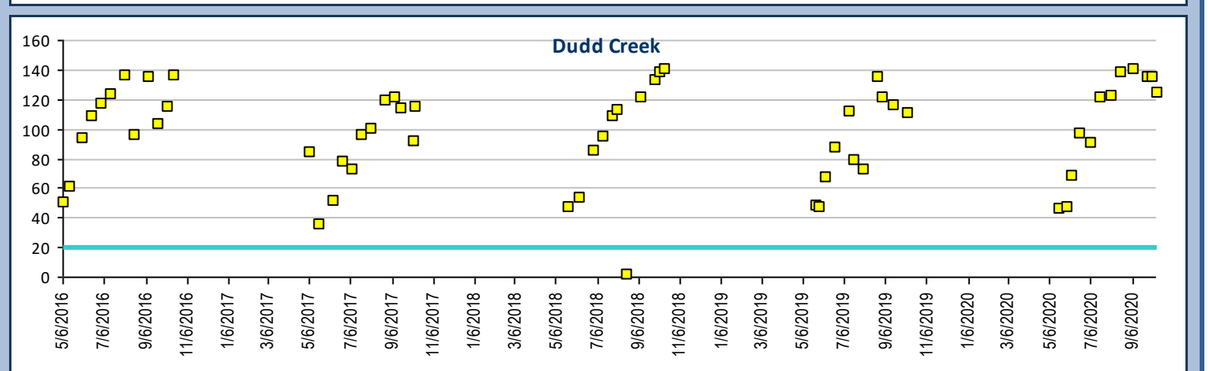












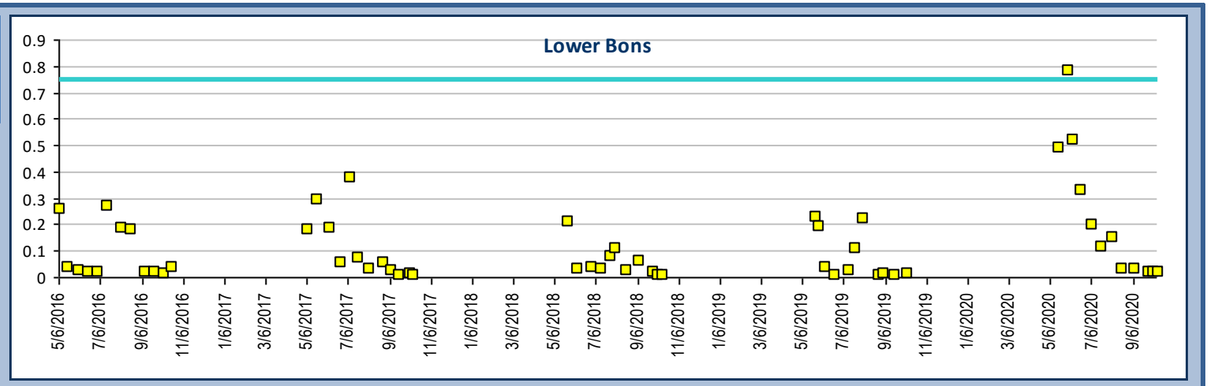
RED DOG MINE

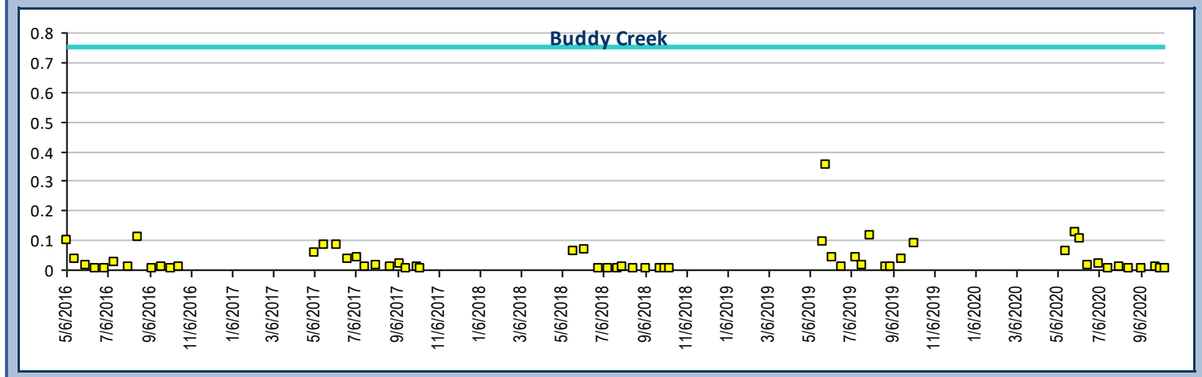
Water Monitoring Bons Creek Drainage
Water Quality Profile I , 5-Year Trend Charts

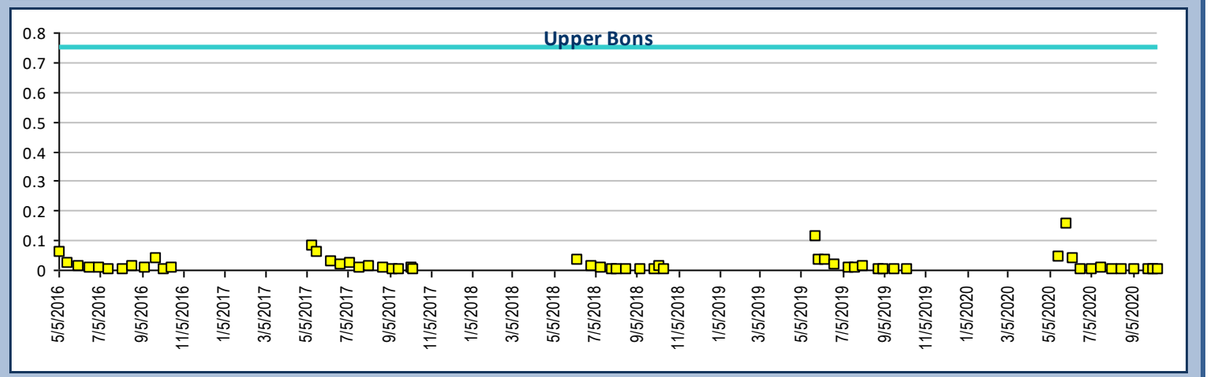
Aluminum, Total Recoverable, units mg/L

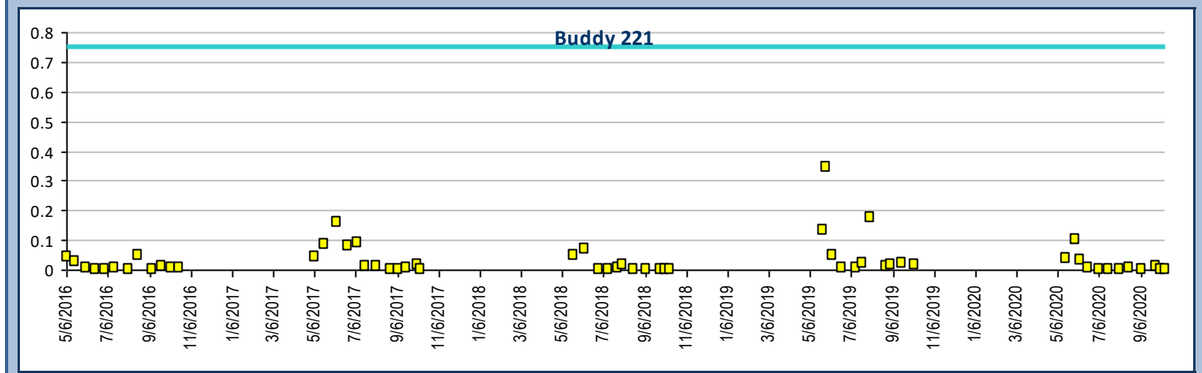
Aquatic Life - Fresh Water Chronic WQS mg/L

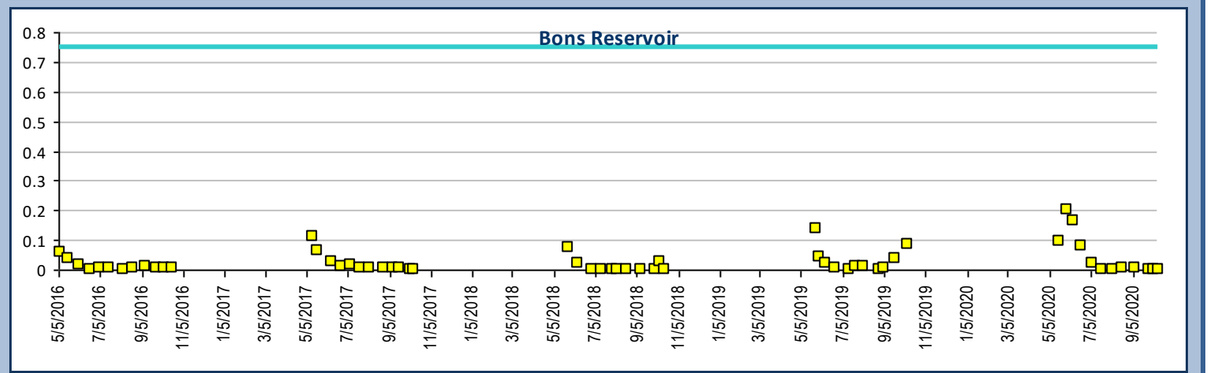
If pH > 7 and hardness > 50. then WQS = 0.75mg/l

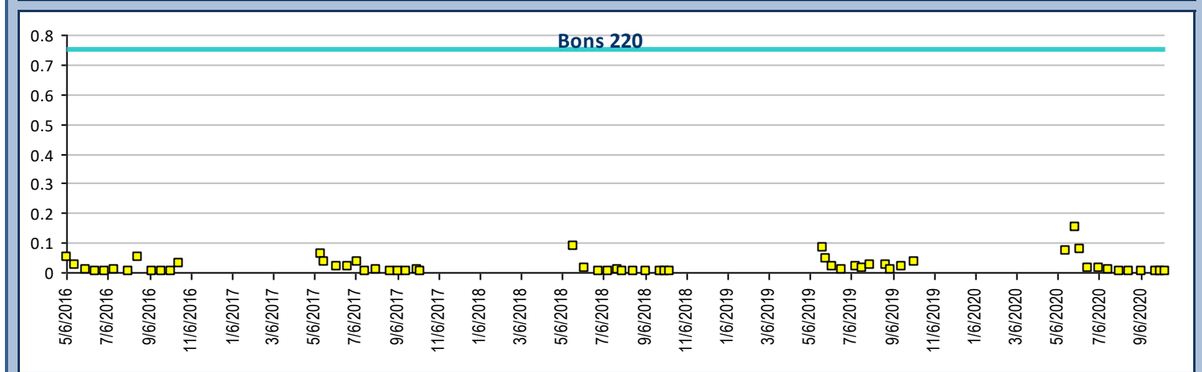


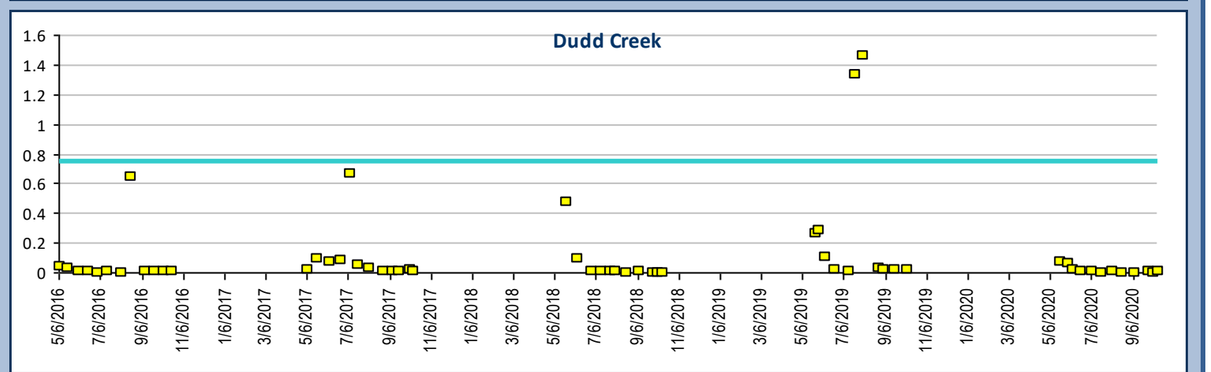






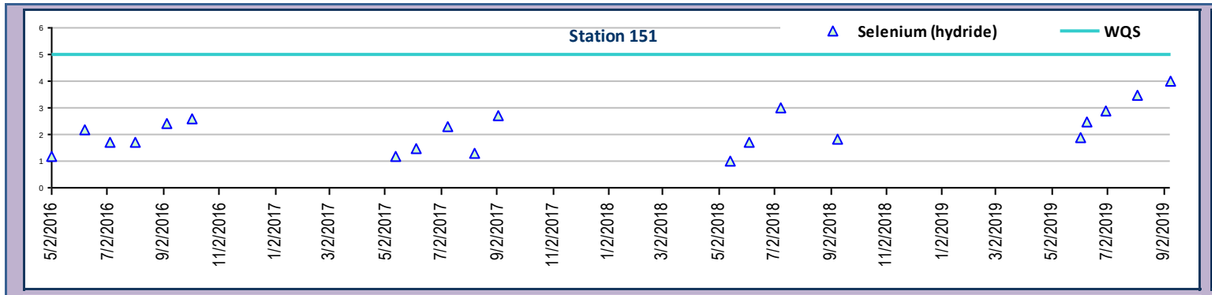


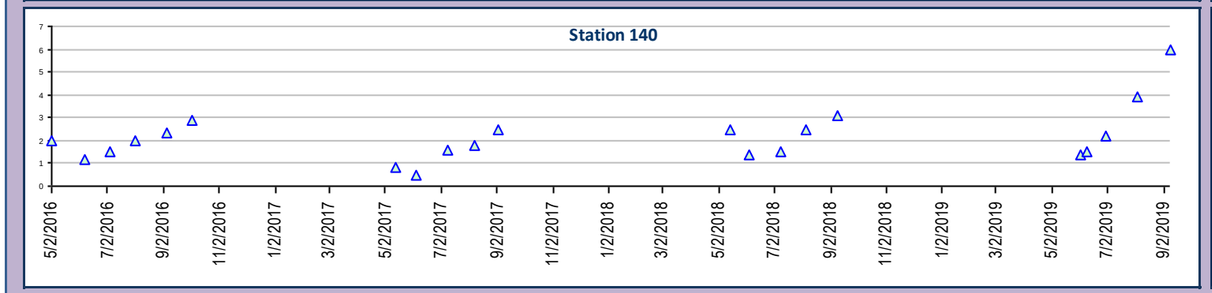


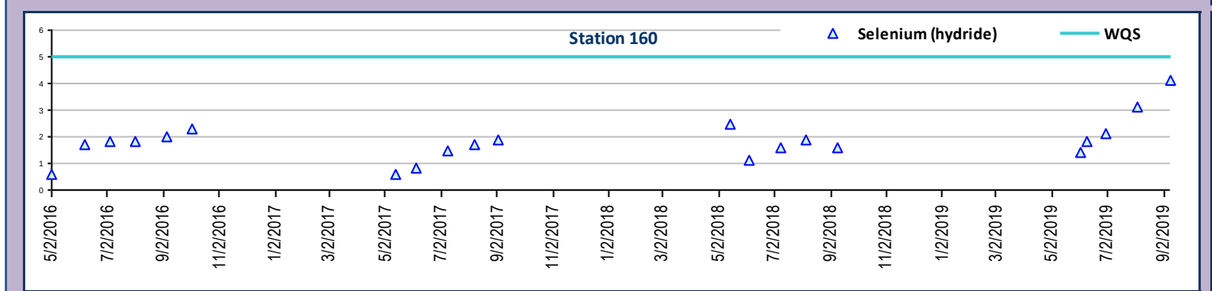


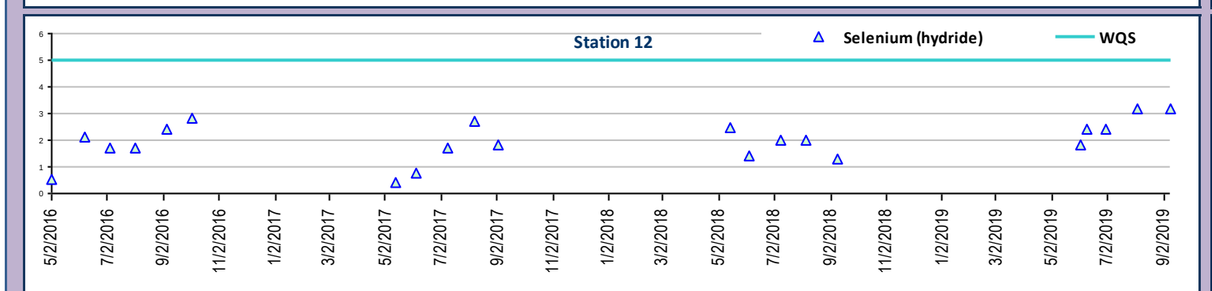
Appendix F: APDES Monitoring Station Trend Charts

APDES Stations : Selenium, units, ug/l - 5 Year Trend

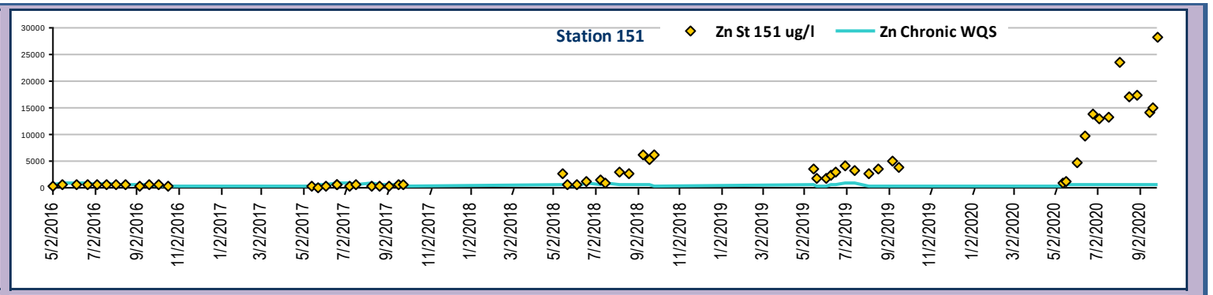


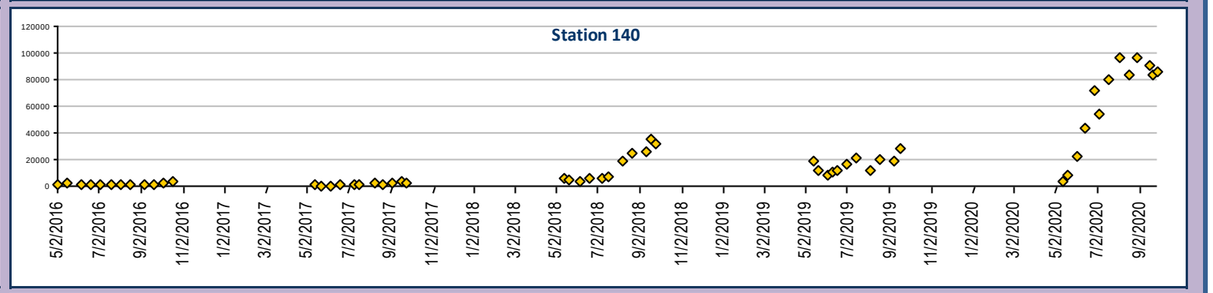


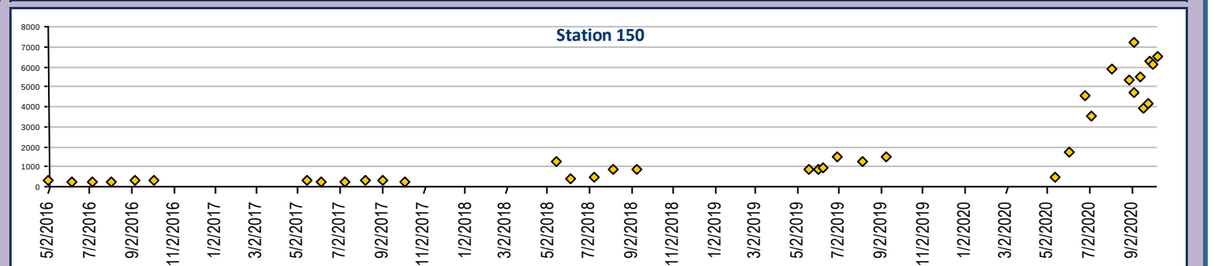


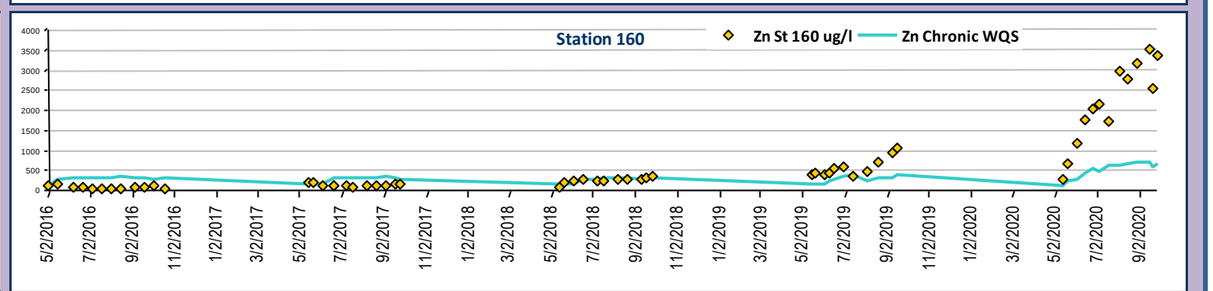


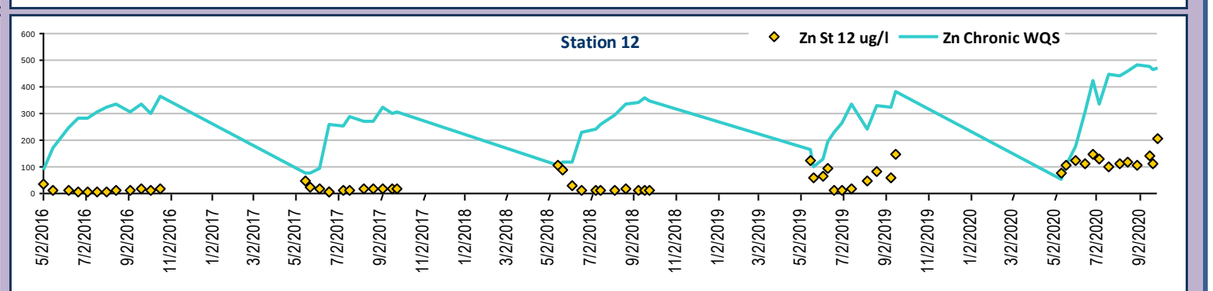
APDES Stations : Zinc, Total, units ug/l - 5 Year Trend



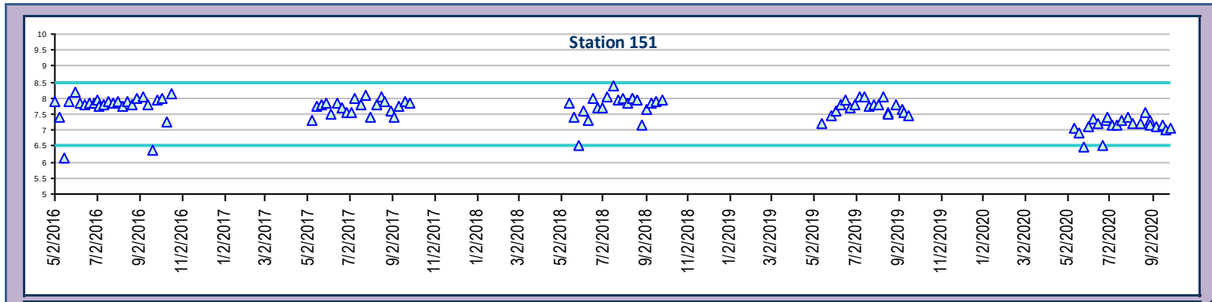


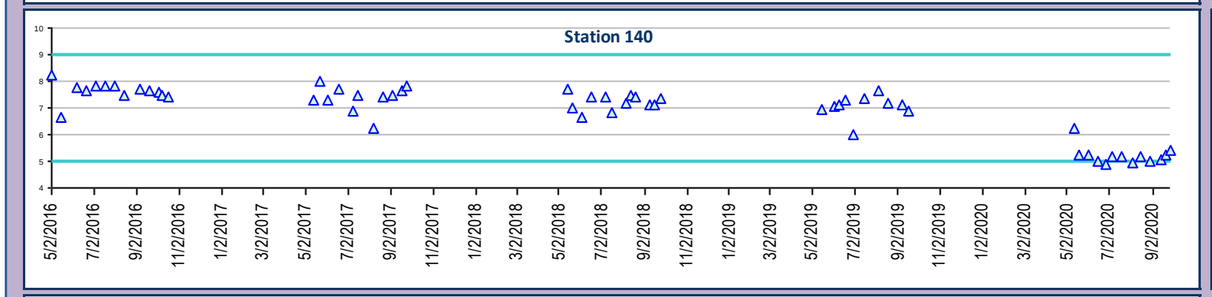


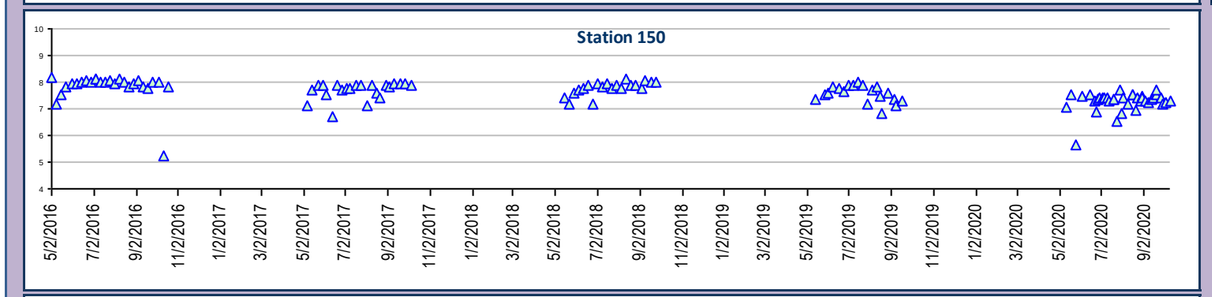


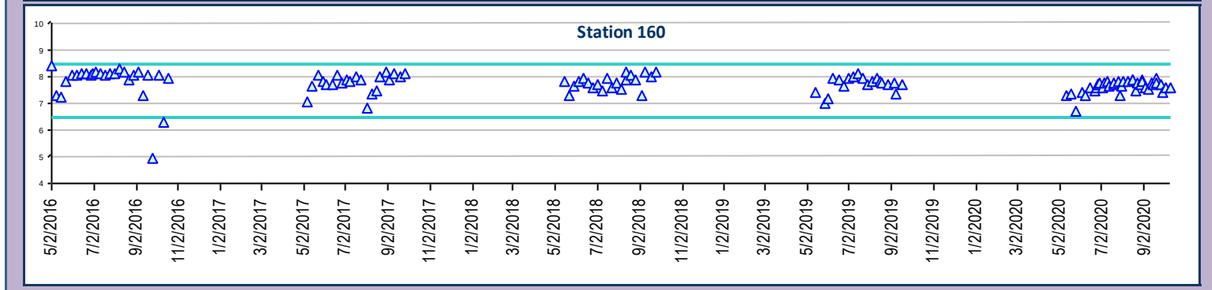


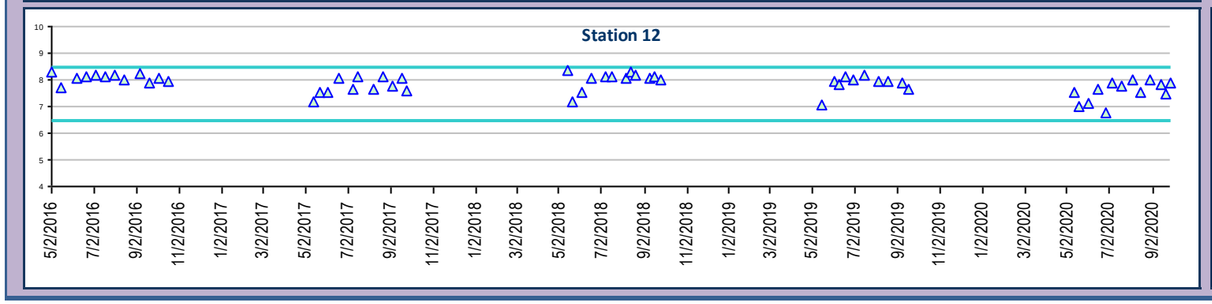
APDES Stations : pH, units - 5 Year Trend



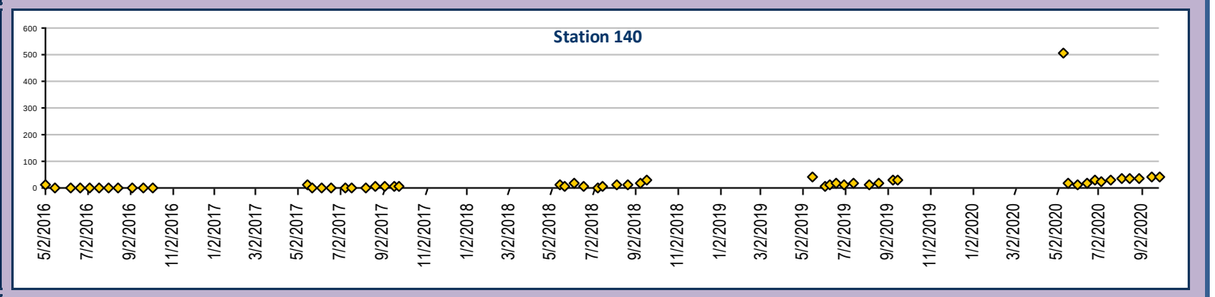


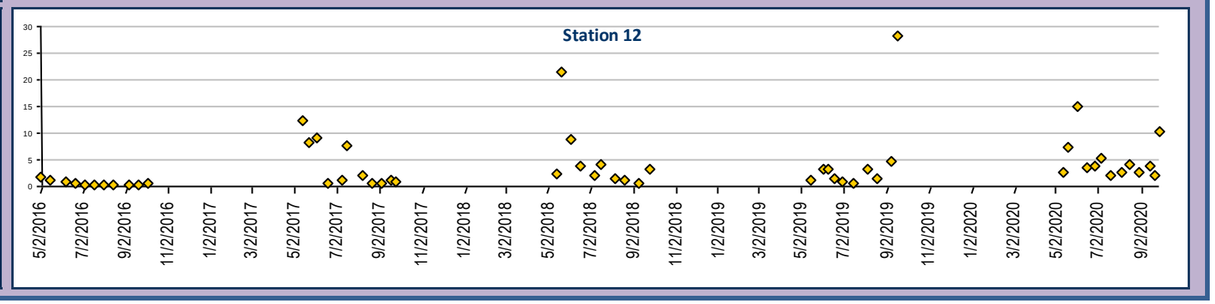




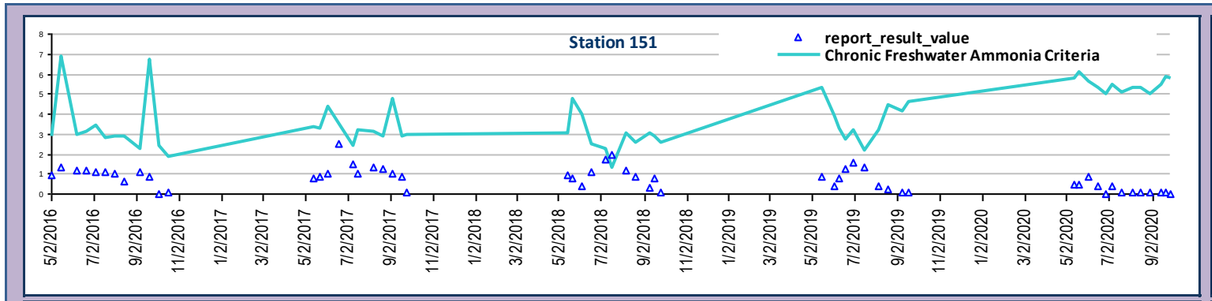


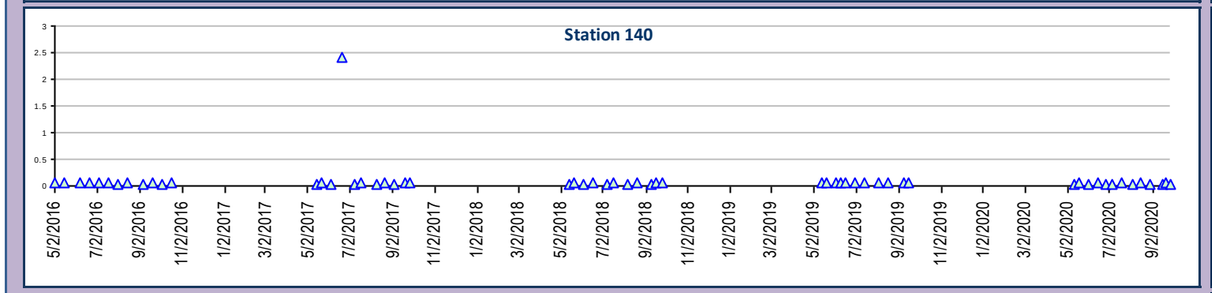
APDES Stations : Turbidity, Total, units NTU - 5 Year Trend

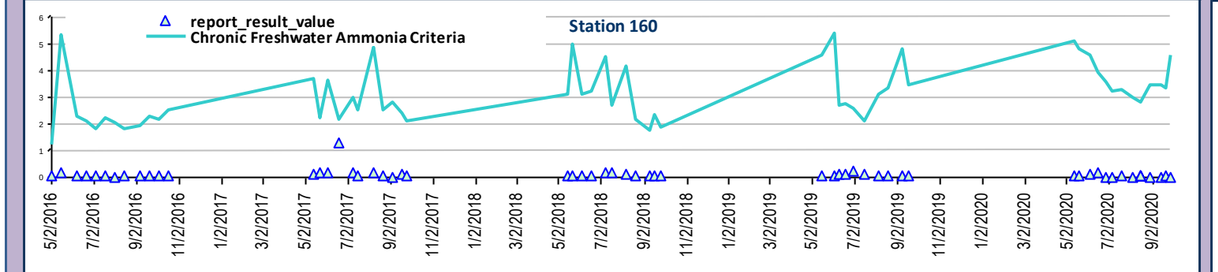


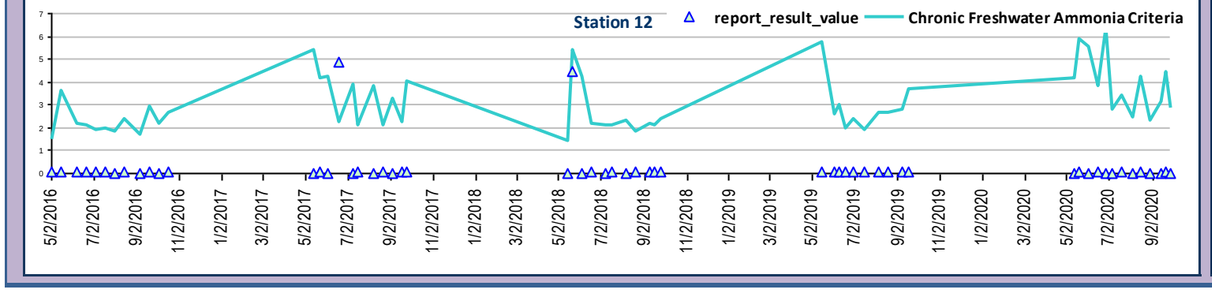


APDES Stations : NH3-N, Total, units mg/l - 5 Year Trend

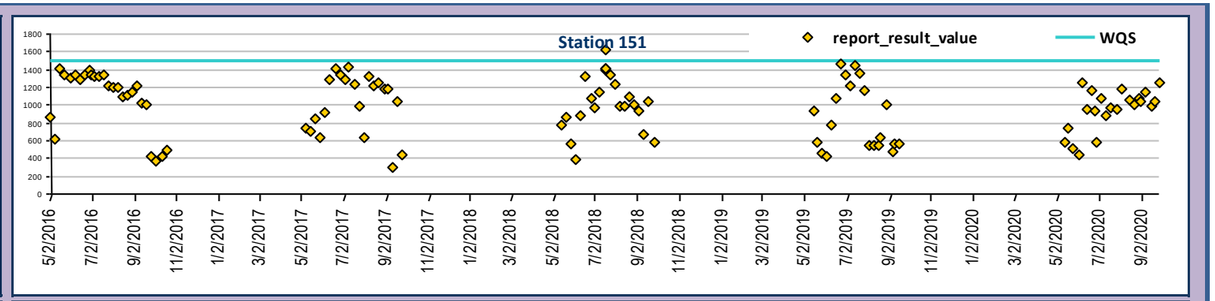


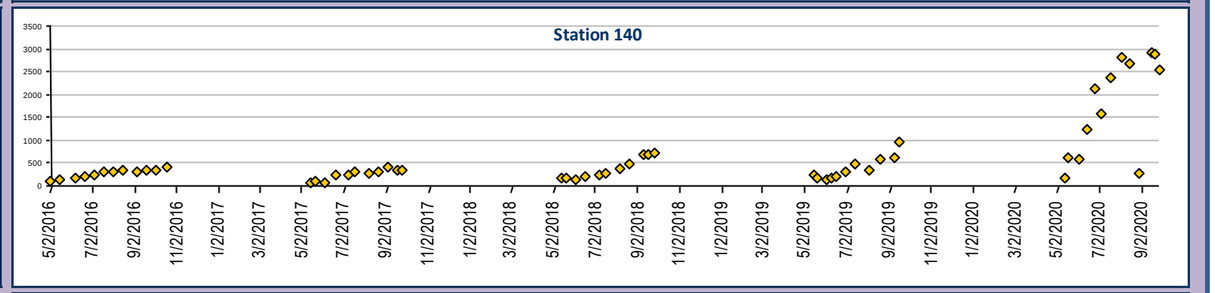


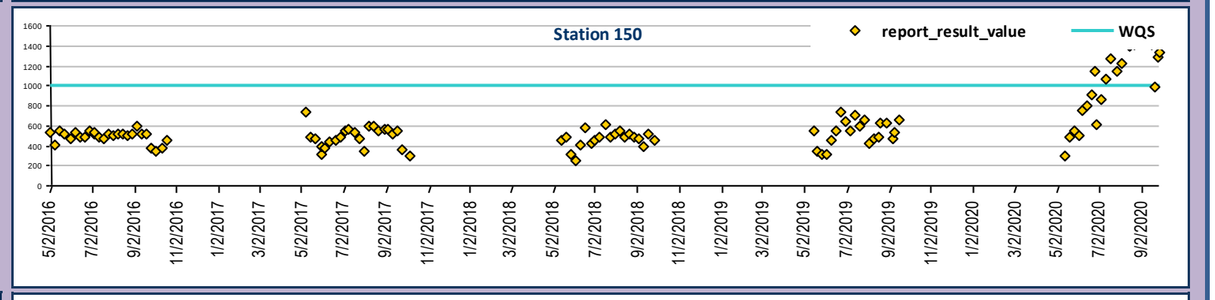


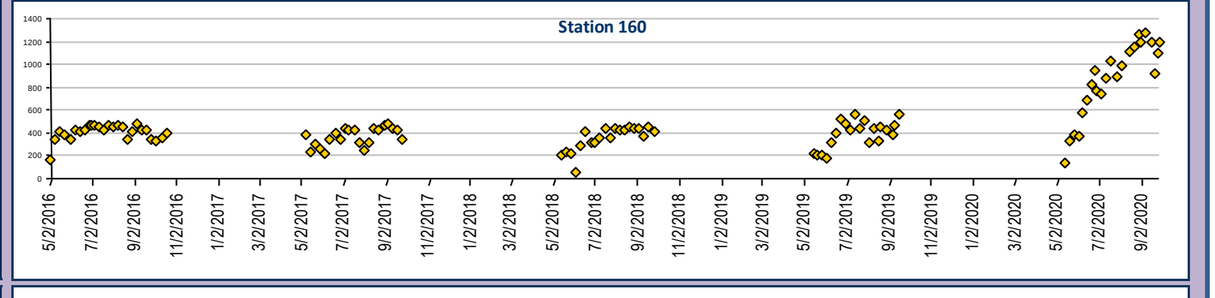


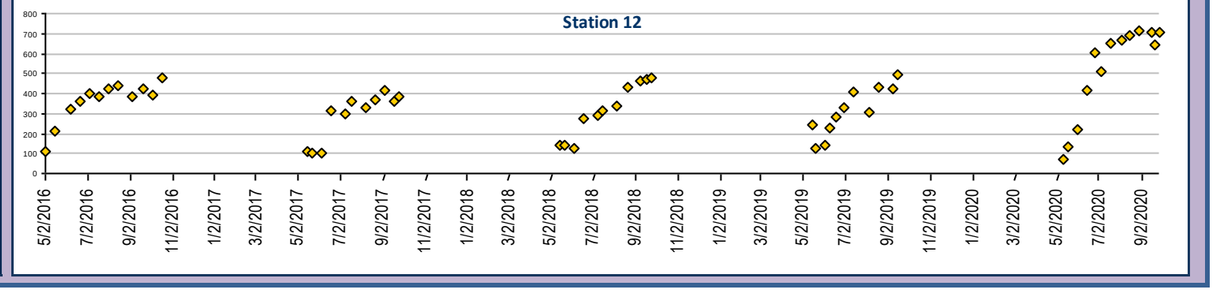
APDES Stations : TDS, units mg/l - 5 Year Trend



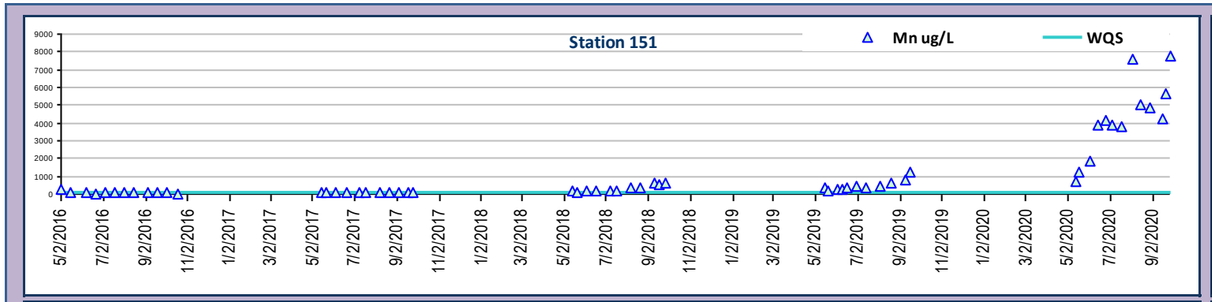


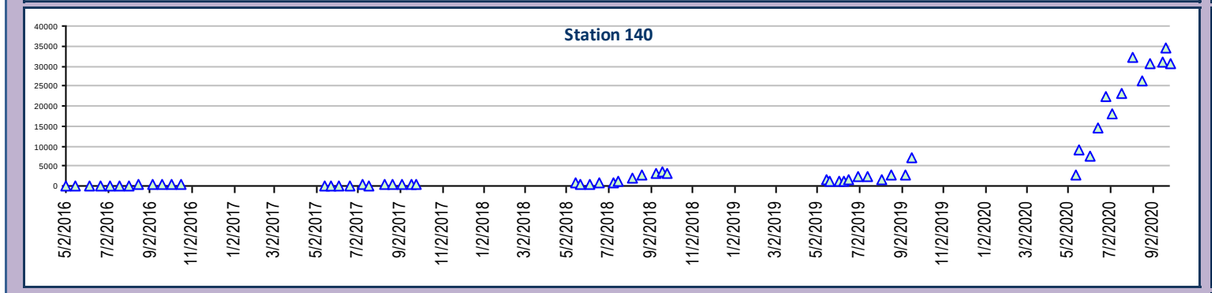


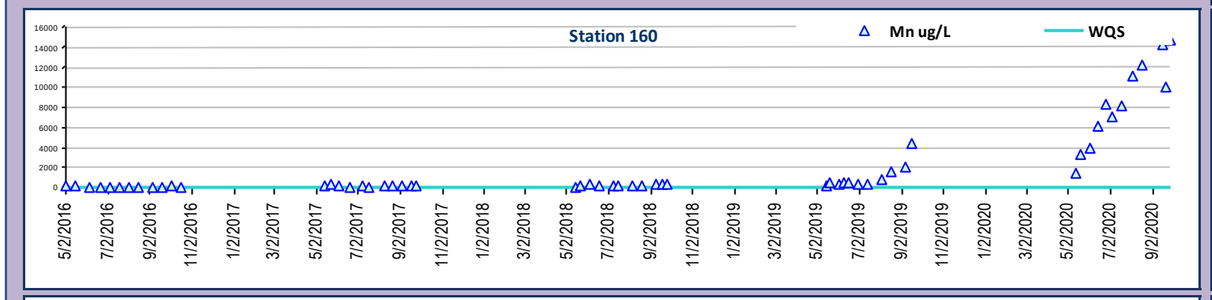


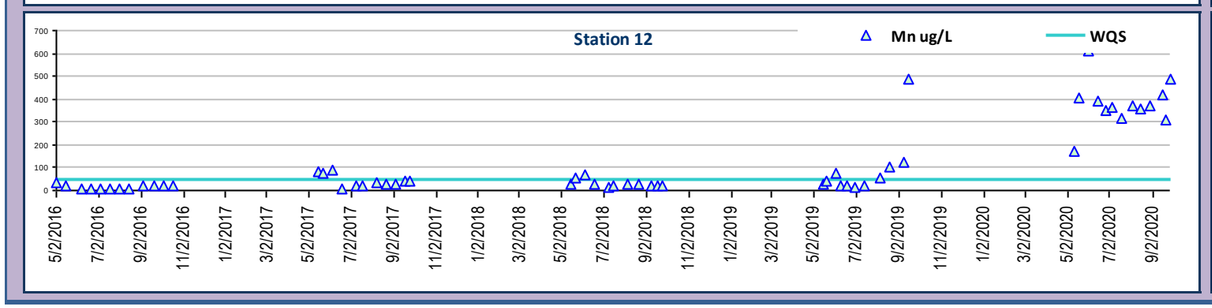


APDES Stations : Manganese, Total, units ug/L - 5 Year Trend



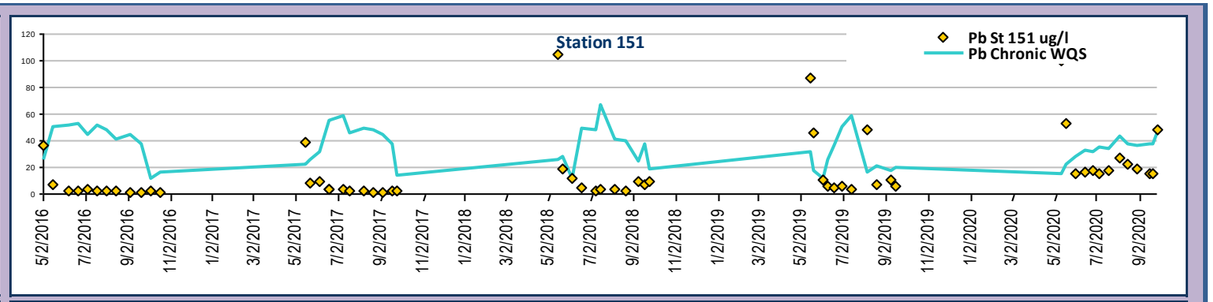


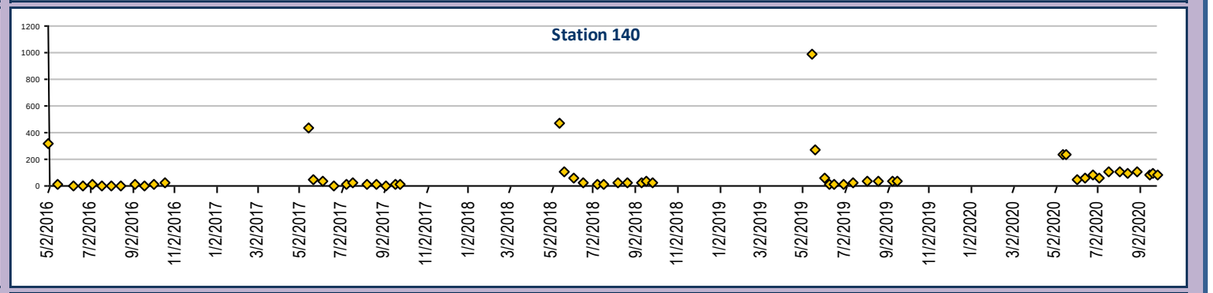


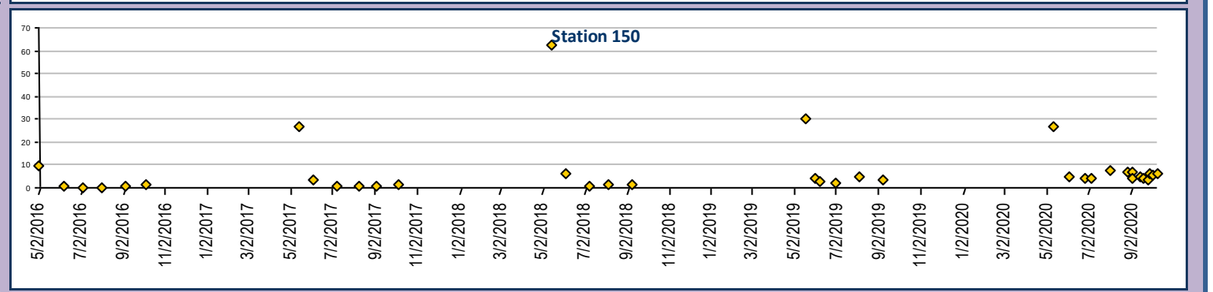


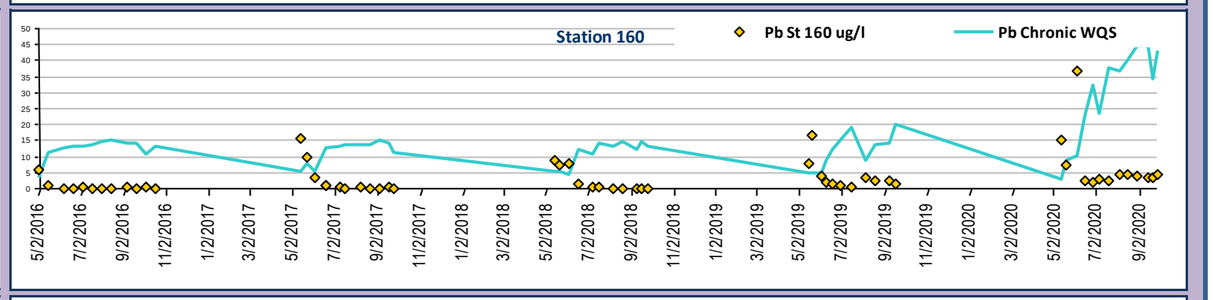
APDES Stations : Lead, Total, units, ug/L - 5 Year Trend

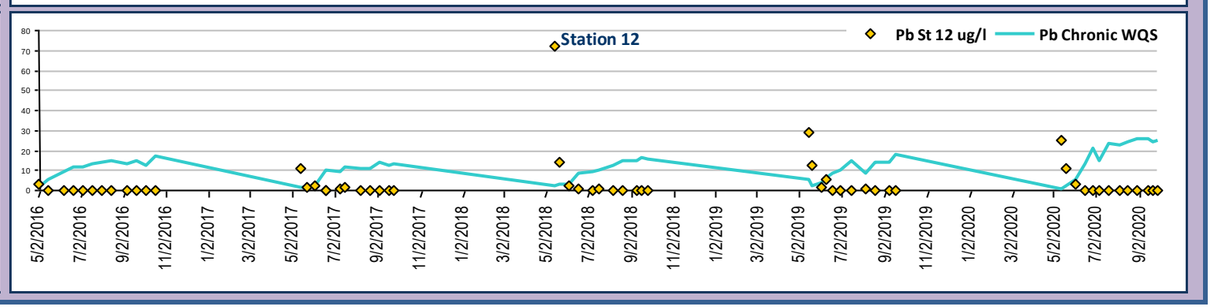
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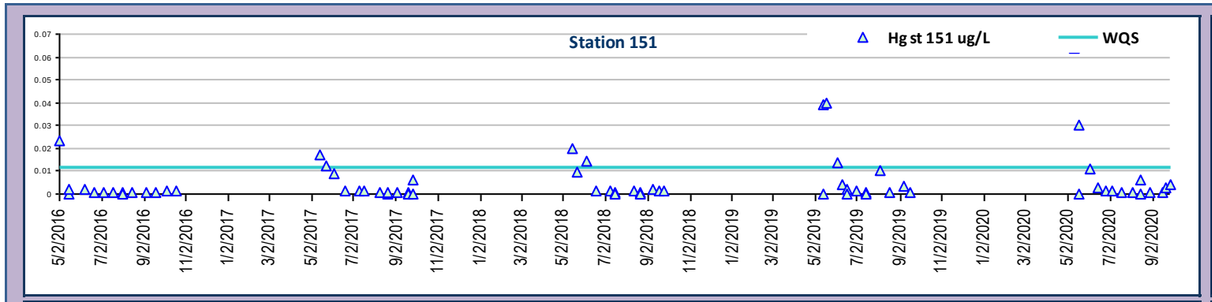


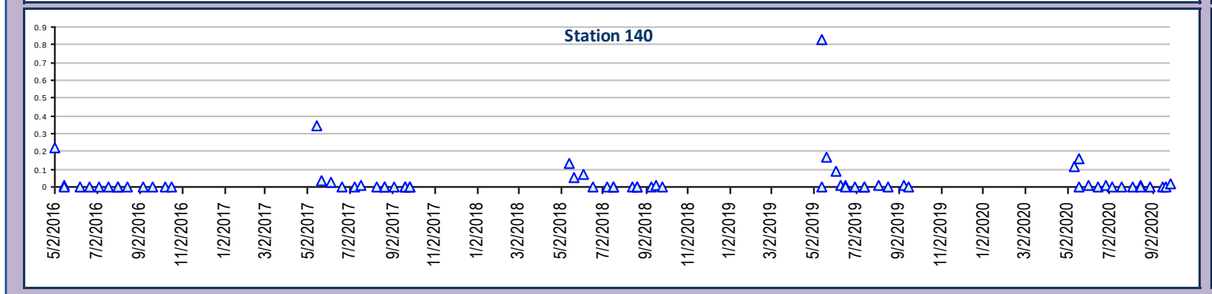






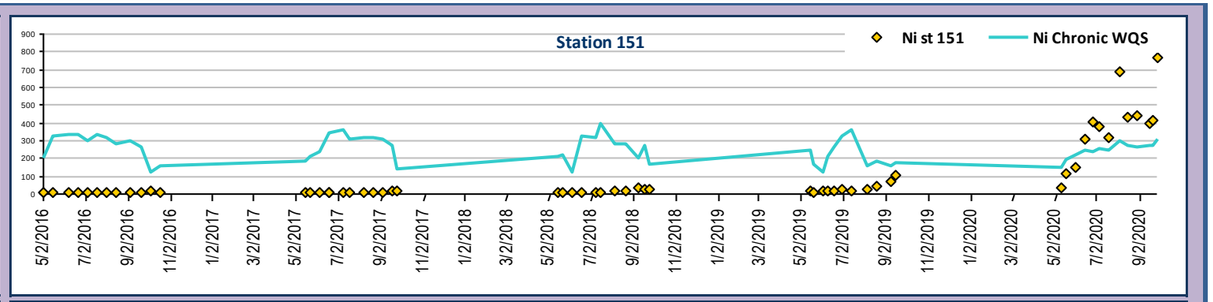
APDES Stations : Mercury, Total, units ug/L - 5 Year Trend

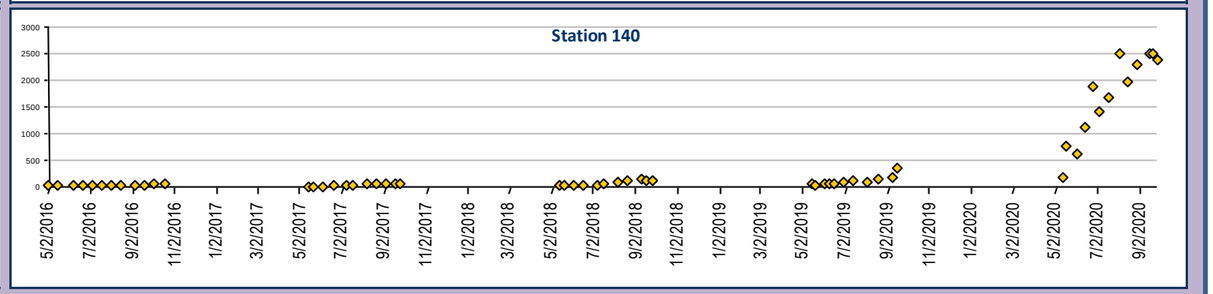


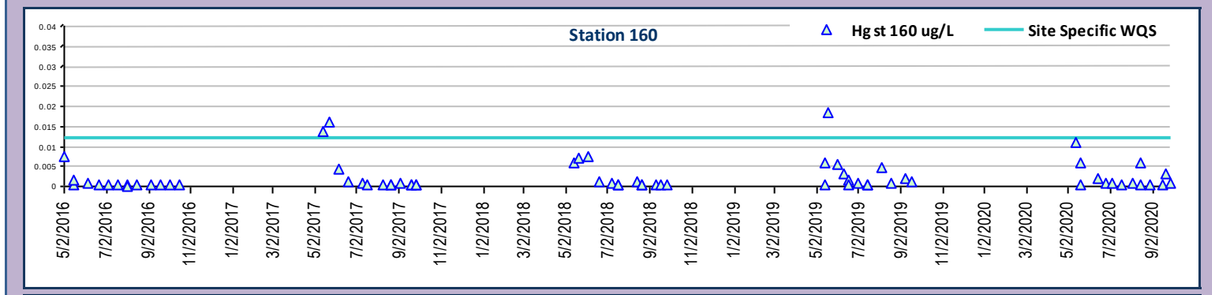


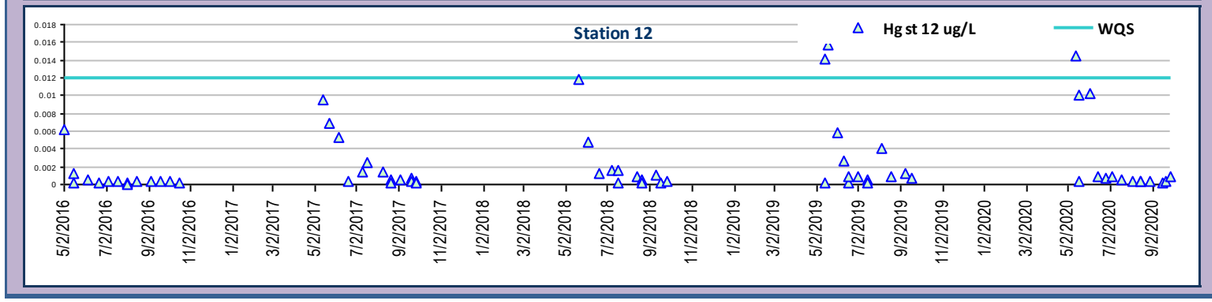
APDES Stations : Nickel, Total, units, ug/L - 5 Year Trend

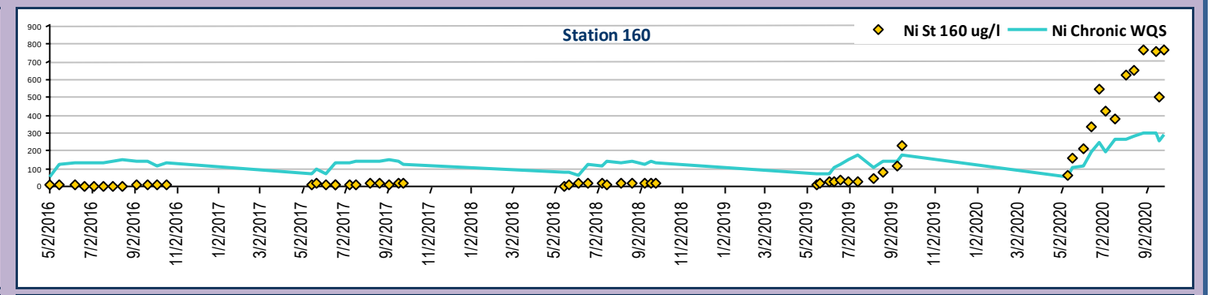
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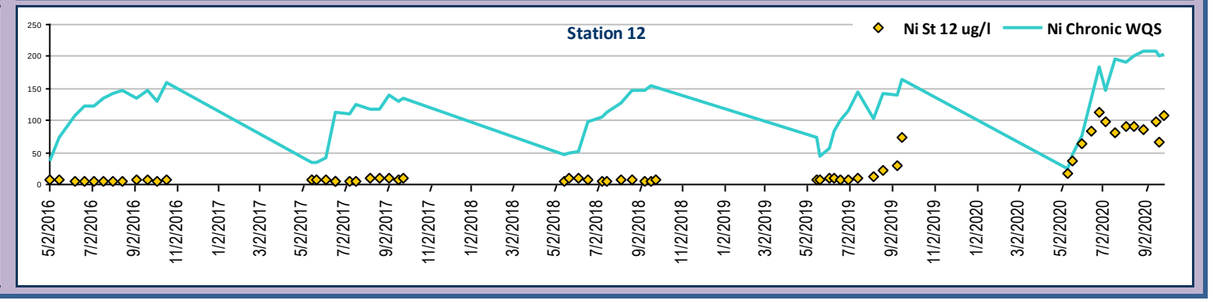




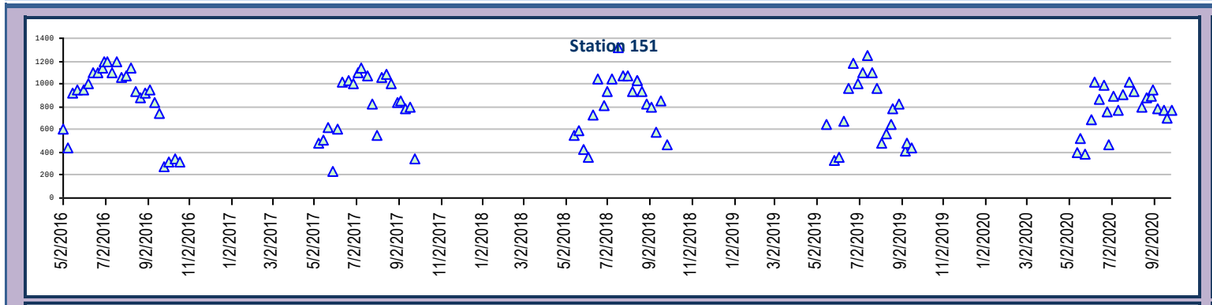


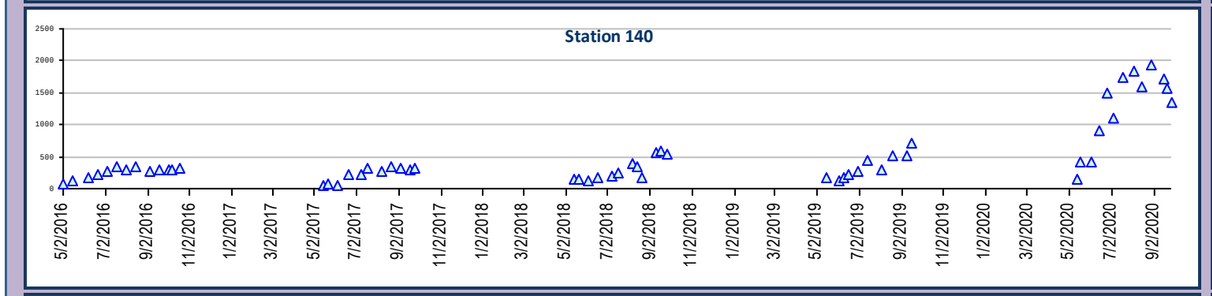


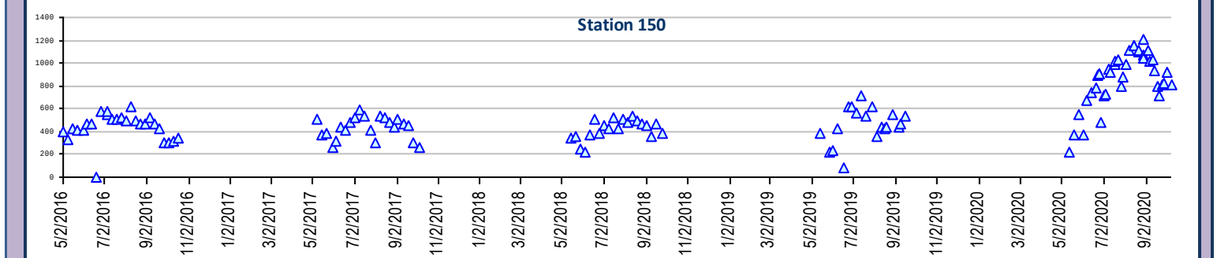


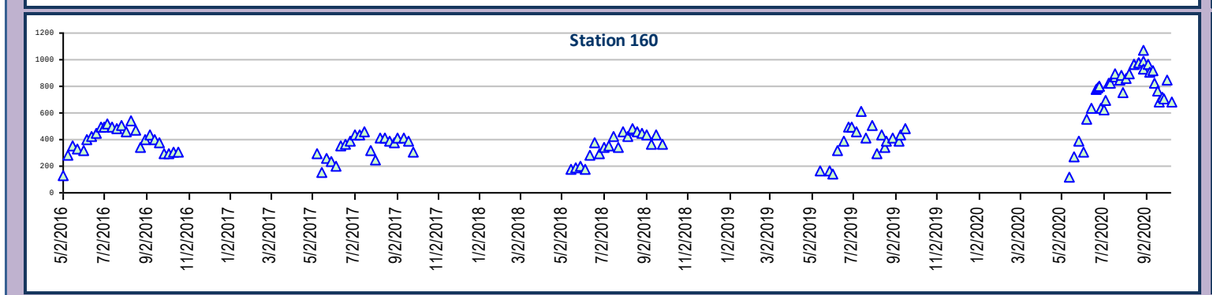


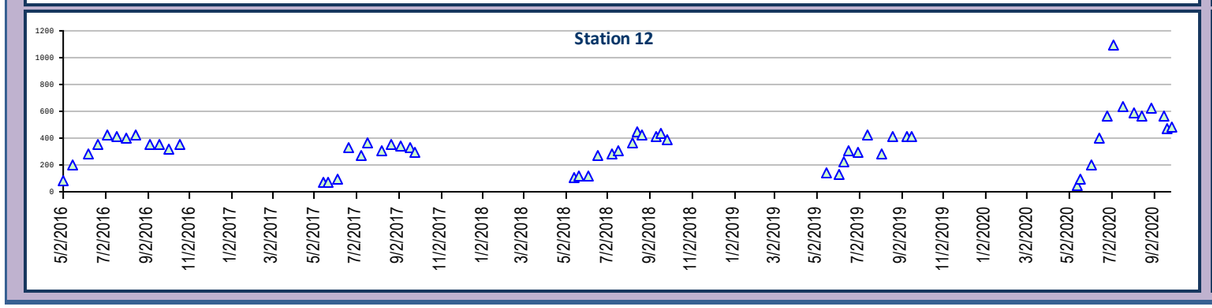
APDES Stations : Conductivity, Total, units uS/cm - 5 Year Trend



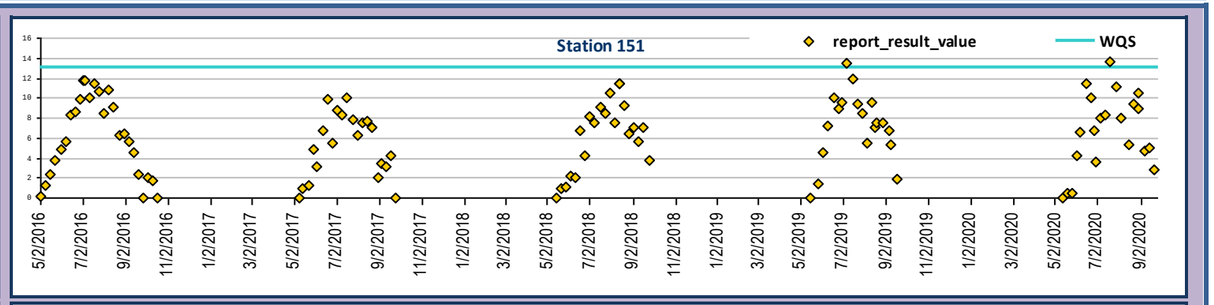


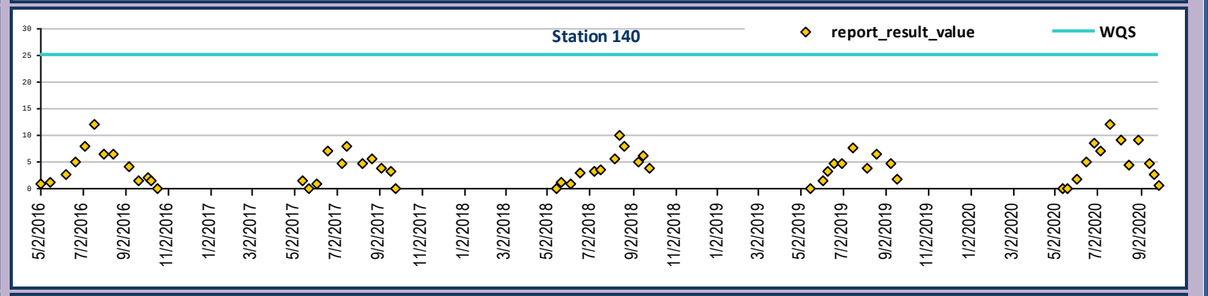


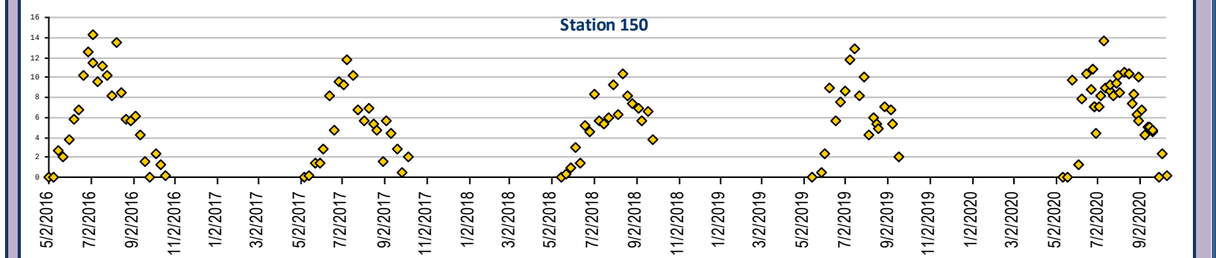


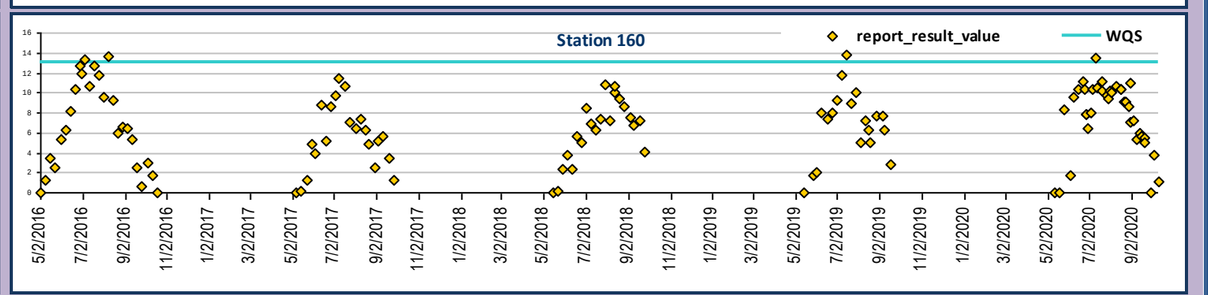


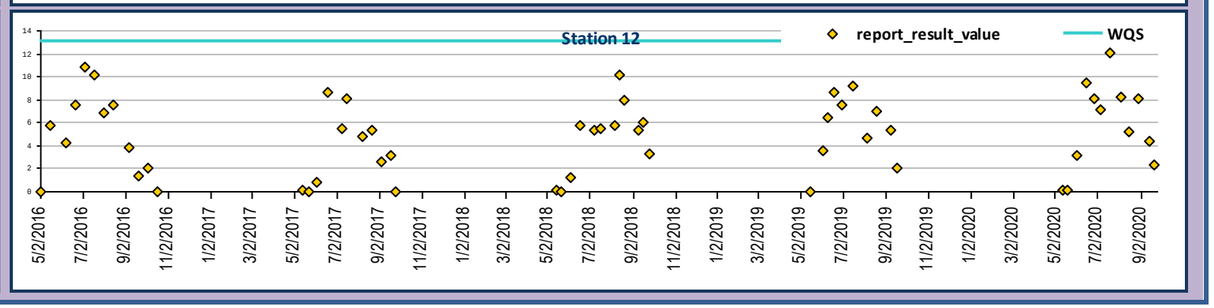
APDES Stations : Temperature, units Celsius - 5 Year Trend



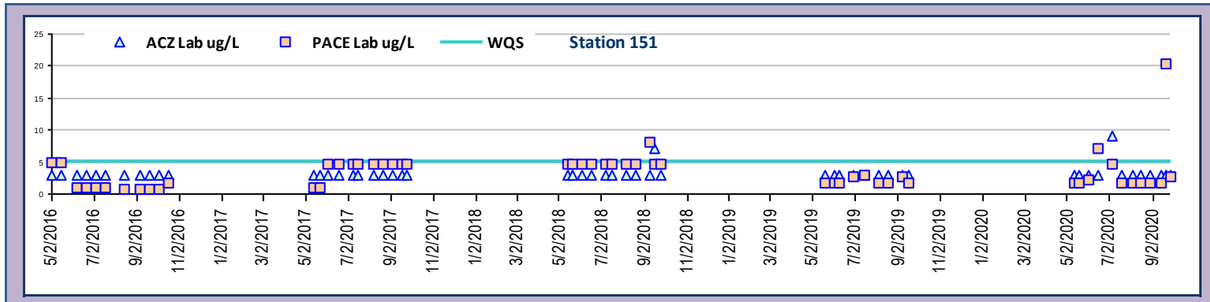




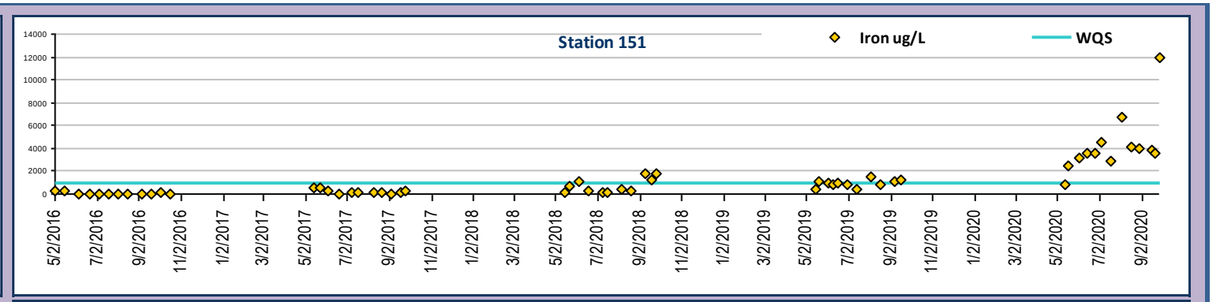


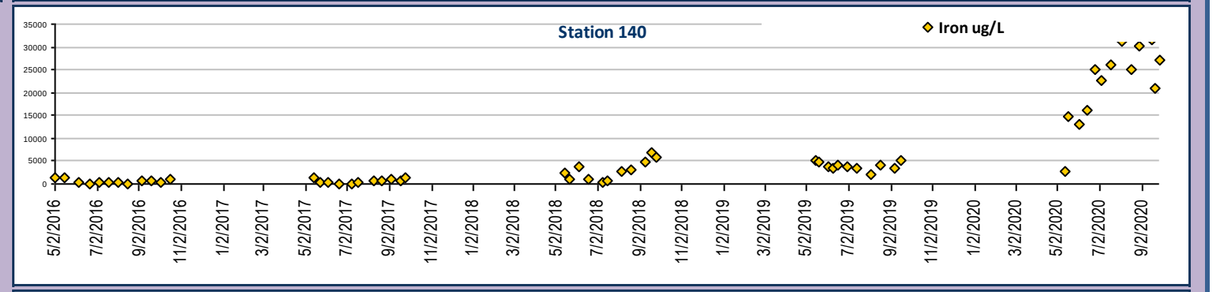


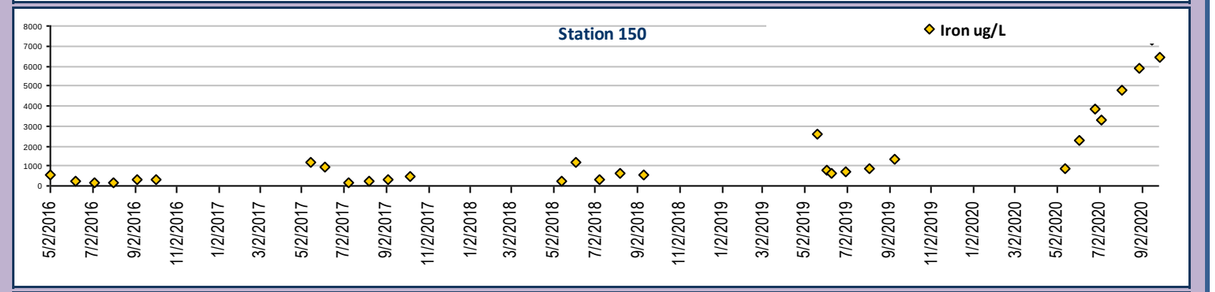
APDES Stations : Cyanide, WAD, units ug/L - 5 Year Trend

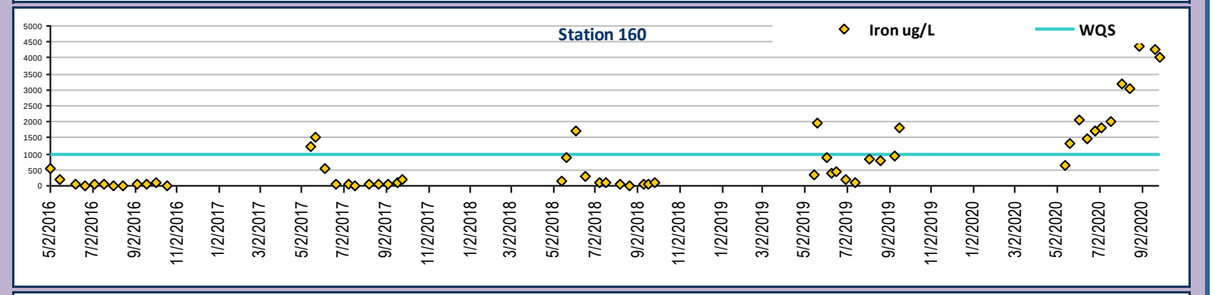


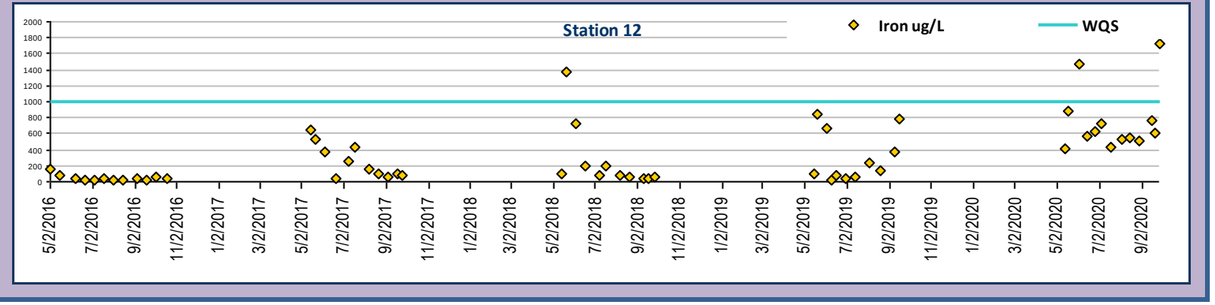
APDES Stations : Iron, Total, units, ug/L - 5 Year Trend



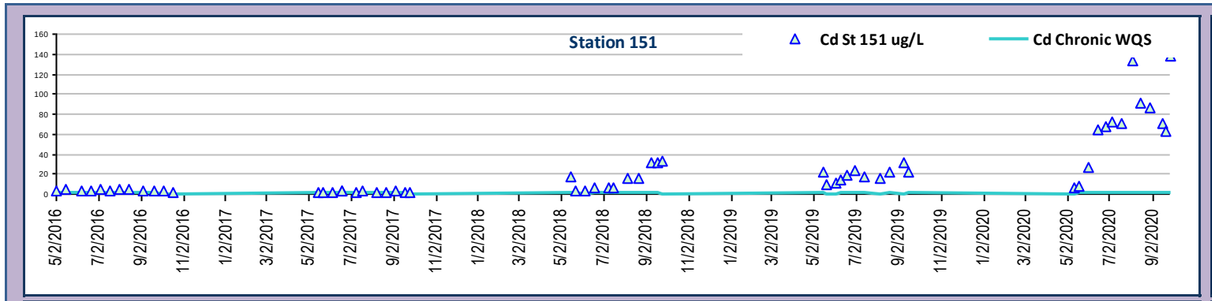


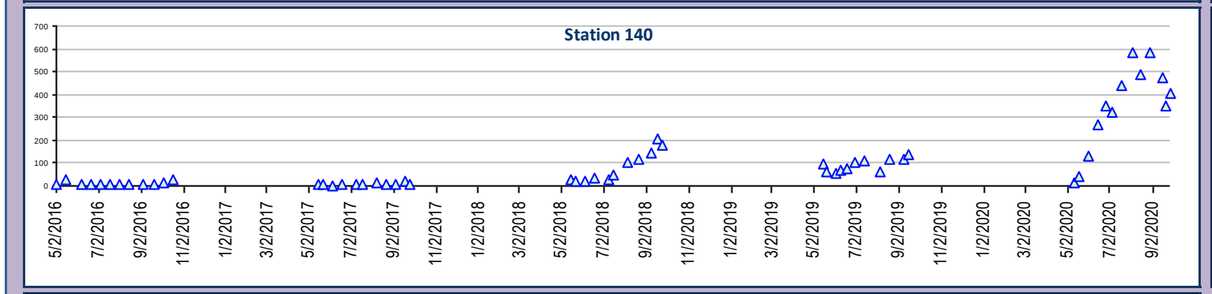


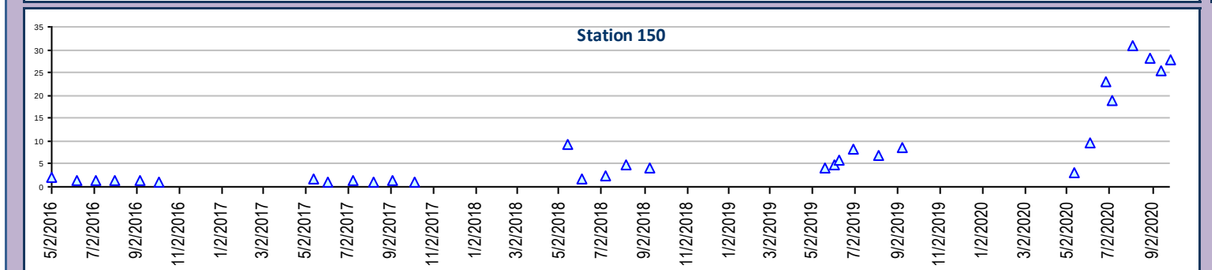


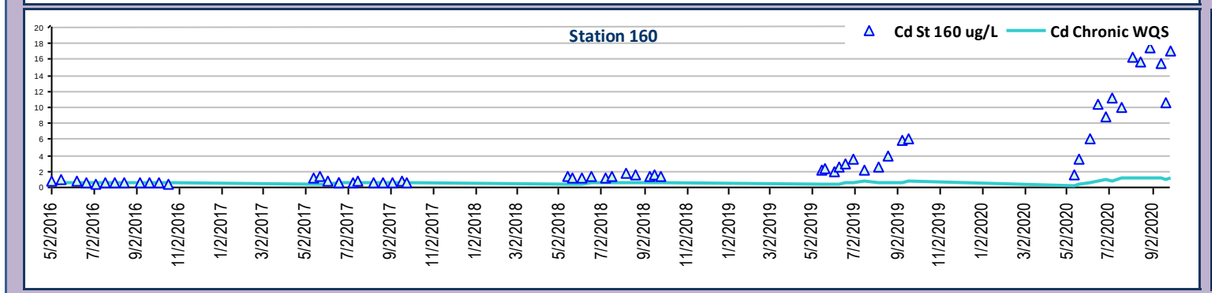


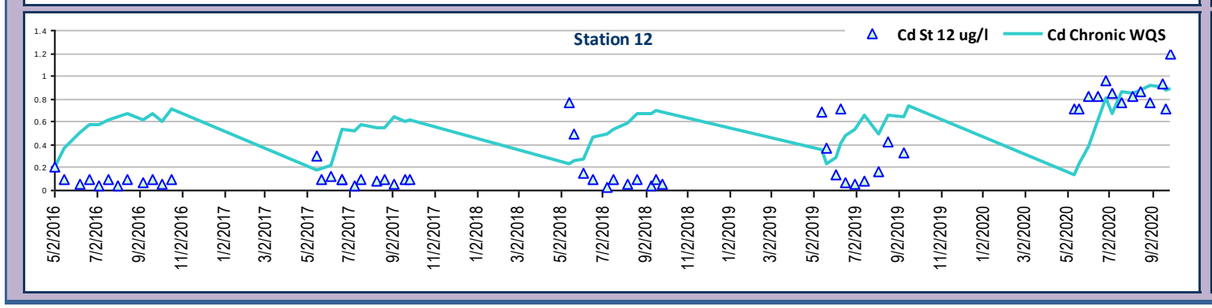
APDES Stations : Cadmium, Total, units ug/L - 5 Year Trend



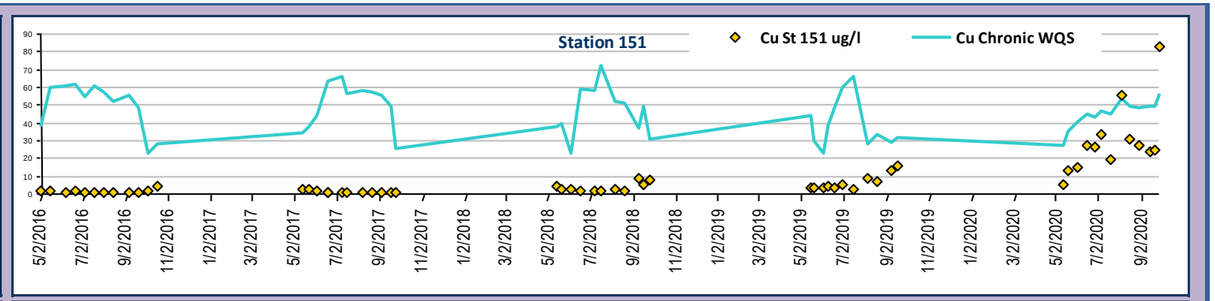


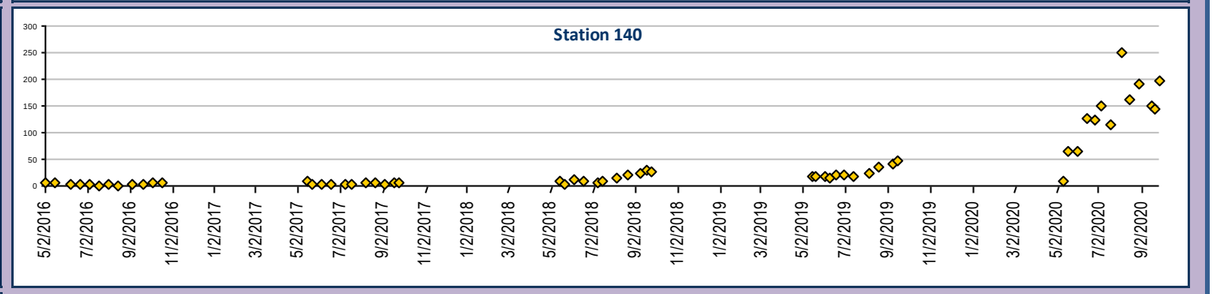


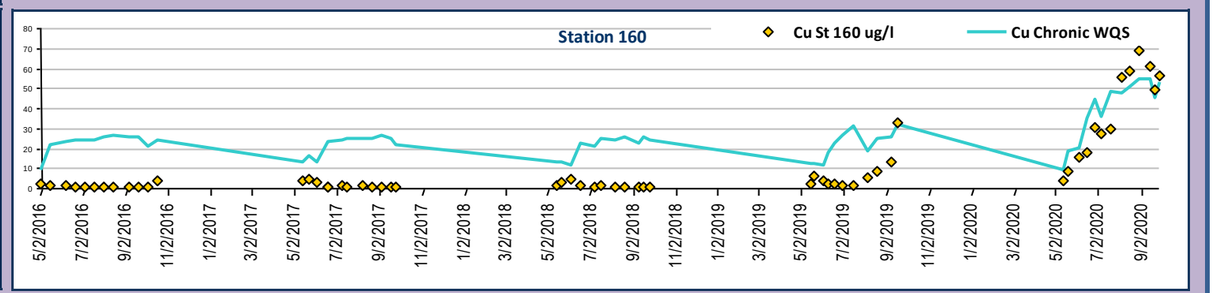


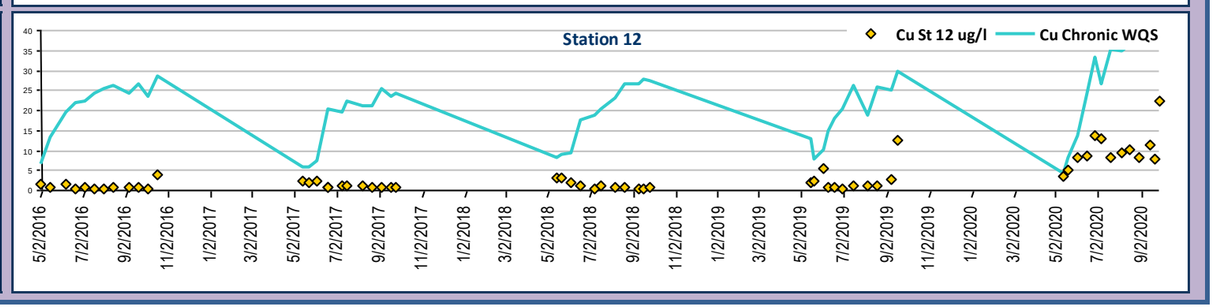


APDES Stations : Copper, Total, units, ug/L - 5 Year Trend

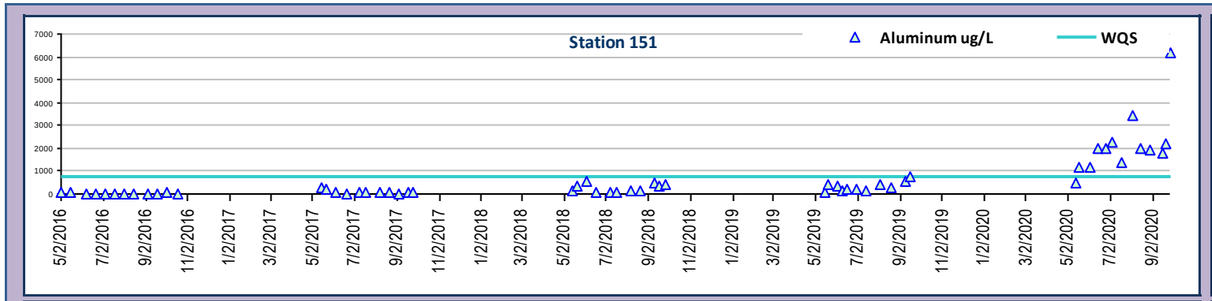


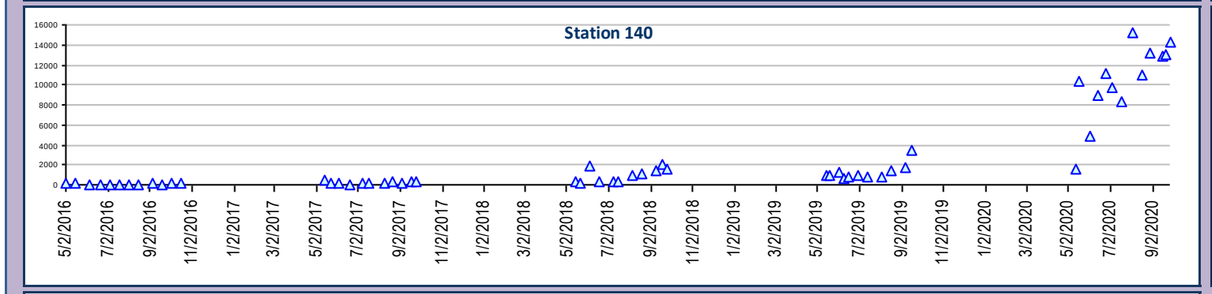


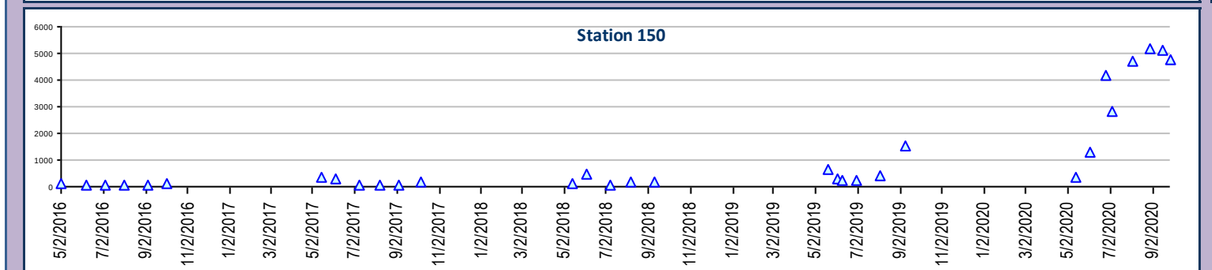


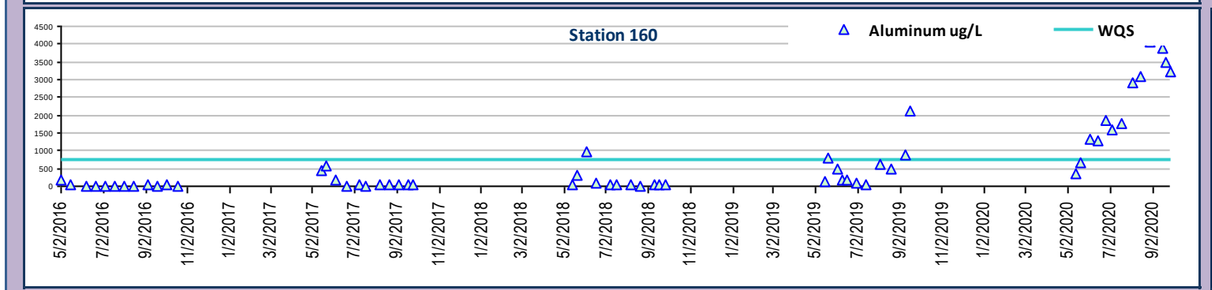


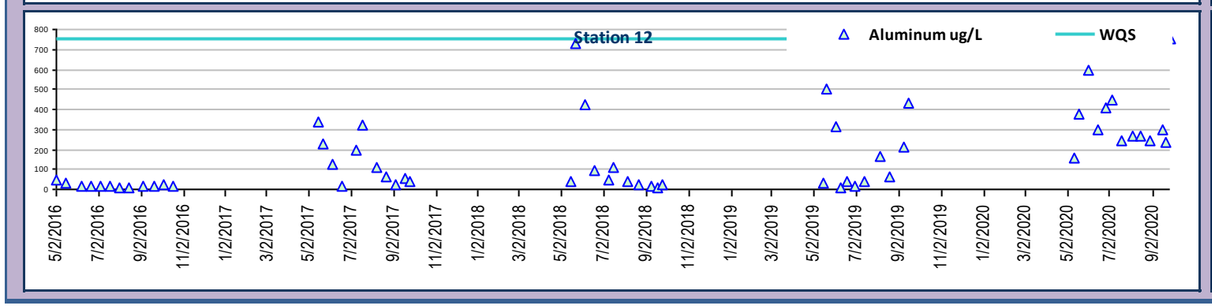
APDES Stations : Aluminum, Total, units ug/L - 5 Year Trend



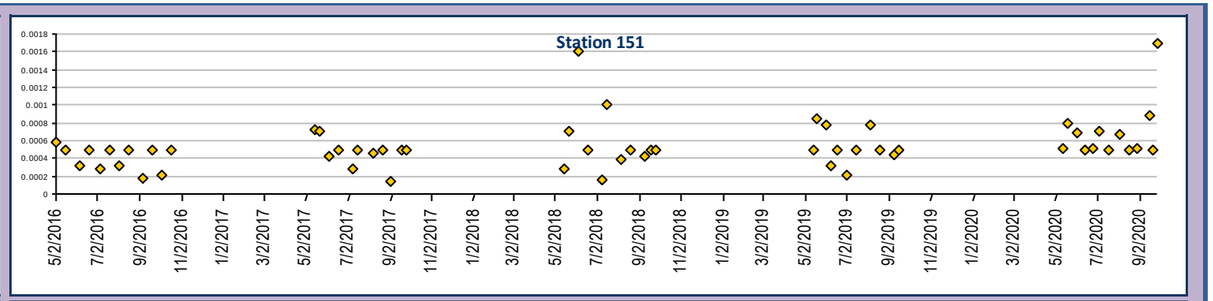


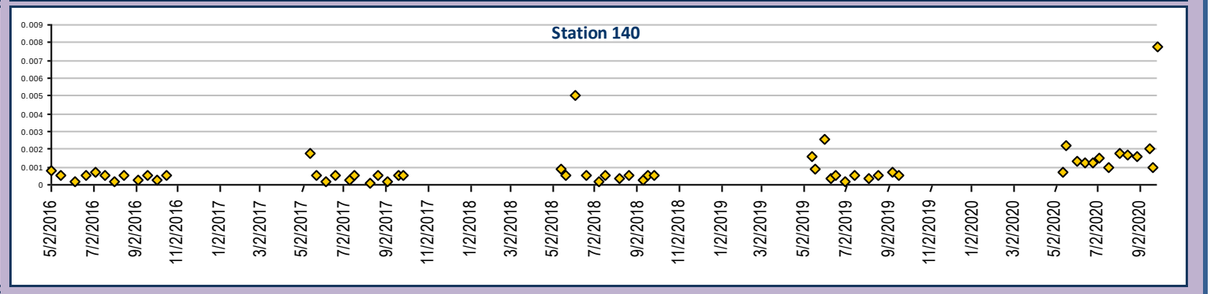


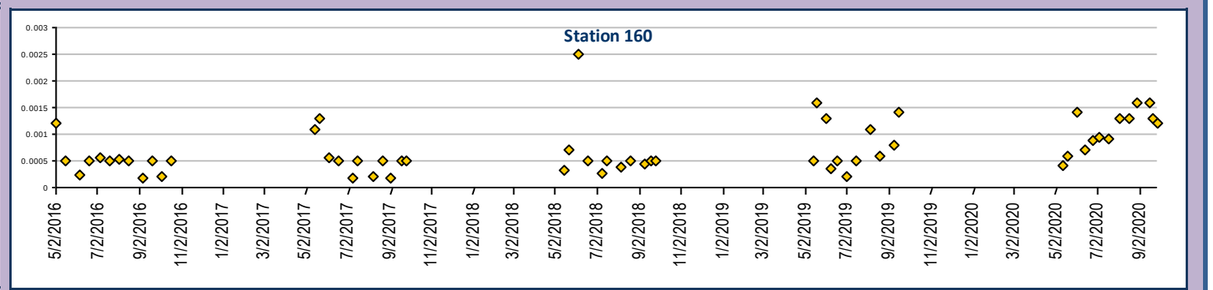


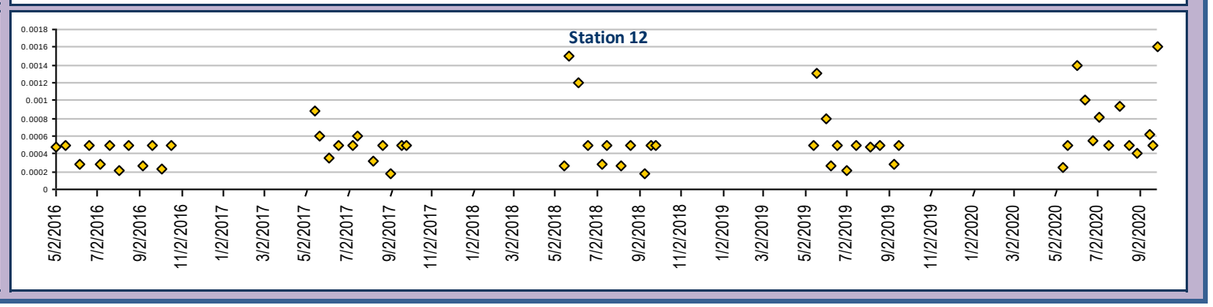


APDES Stations : Chromium, Total, units mg/L - 5 Year Trend









Appendix G: Waste Rock Management Summary Reports

Quarterly Waste Rock Production Report

Teck

Production Month **October 2020**

Waste Type: Construction Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Okpikruak				
Placed Location				
Haul Road Maintenance	162	0.08%	4.59%	0.08%
Formation: Siksikpuk				
Placed Location				
Concentrate storage	423	0.08%	4.59%	0.08%
Placed Location				
Crusher Pad	155	0.08%	4.59%	0.08%
Placed Location				
Landfill @MWD	240	0.55%	4.51%	0.11%
Placed Location				
PAC Dump	4,674	0.08%	4.59%	0.08%
Waste Type Subtotal	**5,654**			

Waste Type: Cover Material	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Kayak				
Placed Location				
Sponge	86,755	0.09%	2.33%	0.06%
Formation: Kivalina				
Placed Location				
Sponge	90,269	0.09%	2.37%	0.06%
Waste Type Subtotal	**177,024**			

Waste Type: Most Reactive Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Ikalukrok				
Placed Location				
Main pit dump 4	76,304	3.81%	12.95%	3.05%
Formation: Okpikruak				
Placed Location				
Main pit dump 4	485	0.06%	5.20%	0.06%
Waste Type Subtotal	**76,789**			

Waste Type: Other Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Ikalukrok				
Placed Location				
Main pit dump 4	18,168	3.64%	2.08%	2.63%
Formation: Intrusive				
Placed Location				
Main pit dump 4	6,120	0.06%	3.78%	0.06%
Placed Location				
Oxide East	237	0.07%	2.39%	0.06%
Formation: Kayak				
Placed Location				
Main pit dump 4	953	0.07%	2.39%	0.06%
Formation: Kivalina				
Placed Location				
Main pit dump 4	3,492	0.05%	3.60%	0.06%
Formation: Okpikruak				
Placed Location				
Main pit dump 4	77,945	0.08%	4.59%	0.08%

Formation: Siksikpuk					
Placed Location					
Main pit dump 4	67,059	0.79%	4.23%	0.41%	
Waste Type Subtotal	**173,974**				
Total tonnes for month	**433,441**				

Production Month **November 2020**

Waste Type: Construction Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Siksikpuk				
Placed Location				
PAC Dump	966	0.08%	4.59%	0.08%
Waste Type Subtotal	**966**			
Waste Type: Cover Material	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Kayak				
Placed Location				
Sponge	76,126	0.06%	2.14%	0.06%
Waste Type Subtotal	**76,126**			
Waste Type: Most Reactive Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Ikalukrok				
Placed Location				
Main pit dump 4	11,410	5.95%	15.61%	2.72%
Placed Location				
Main Pit Dump 5	11,555	5.77%	11.90%	1.46%
Formation: Kivalina				
Placed Location				
Main Pit Dump 5	24,619	2.17%	8.56%	2.03%
Placed Location				
Main pit dump 4	74,836	2.09%	7.30%	1.48%
Formation: Okpikruak				
Placed Location				
Main Pit Dump 3	375	0.06%	5.20%	0.06%
Placed Location				
Main pit dump 4	110,178	0.06%	5.20%	0.06%
Placed Location				
Main Pit Dump 5	106,242	0.06%	5.20%	0.06%
Formation: Siksikpuk				
Placed Location				
Main pit dump 4	30,332	1.77%	5.72%	0.44%
Placed Location				
Main Pit Dump 5	2,851	1.77%	5.72%	0.44%
Waste Type Subtotal	**372,398**			
Waste Type: Other Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Intrusive				
Placed Location				
Main pit dump 4	737	0.07%	3.36%	0.06%
Formation: Okpikruak				
Placed Location				
Main pit dump 4	12,081	0.24%	1.99%	0.24%
Placed Location				
Main Pit Dump 5	18,958	0.16%	3.15%	0.15%
Formation: Siksikpuk				
Placed Location				
Main Pit Dump 5	32,165	0.08%	4.59%	0.08%
Placed Location				
Main pit dump 4	5,665	0.54%	3.90%	0.14%
Waste Type Subtotal	**69,606**			
Total tonnes for month	**519,096**			

Production Month **December 2020**

Waste Type: Cover Material	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Kayak				
Placed Location				
Sponge	90,209	0.06%	2.14%	0.06%
Formation: Kivalina				
Placed Location				
Sponge	126,138	0.08%	1.86%	0.06%
Waste Type Subtotal	**216,347**			
Waste Type: Most Reactive Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Ikalukrok				
Placed Location				
Main pit dump 4	46,109	3.48%	7.61%	1.15%
Placed Location				
Main Pit Dump 5	977	8.41%	11.68%	1.38%
Formation: Kivalina				
Placed Location				
Main pit dump 4	4,850	4.35%	8.43%	3.98%
Formation: Okpikruak				
Placed Location				
Main pit dump 4	55,765	0.06%	5.52%	0.06%
Formation: Siksikpuk				
Placed Location				
Main pit dump 4	54,803	1.86%	5.61%	0.45%
Waste Type Subtotal	**162,504**			
Waste Type: Other Waste	**Tonnes**	**Avg Zn%**	**Avg Fe%**	**Avg Pb%**
Formation: Intrusive				
Placed Location				
Main pit dump 4	25,175	0.03%	0.99%	0.02%
Formation: Okpikruak				
Placed Location				
Main pit dump 4	28,201	0.08%	3.47%	0.10%
Placed Location				
Main Pit Dump 5	102,396	0.09%	3.53%	0.13%
Formation: Siksikpuk				
Placed Location				
Main pit dump 4	28,243	3.47%	1.78%	2.40%
Waste Type Subtotal	**184,015**			
Total tonnes for month	**562,866**			

Total Waste Rock tonnes for period **1,515,403**

Appendix G: Waste Rock Management Summary Reports

Waste Rock Cover Material Monitoring Report

Teck

	Date Stockpiled	Waste Rock Type	Tonnes	Formation	Zinc_%	Stockpile Code
October 2020						
	10/4/2020	Cover Material	394	Kivalina	0.09	COV
	10/5/2020	Cover Material	12,647	Kivalina	0.09	COV
	10/6/2020	Cover Material	1,729	Kivalina	0.09	COV
	10/6/2020	Cover Material	3,046	Kayak	0.07	COV
	10/7/2020	Cover Material	1,748	Kayak	0.07	COV
	10/7/2020	Cover Material	2,277	Kivalina	0.06	COV
	10/8/2020	Cover Material	5,560	Kayak	0.07	COV
	10/9/2020	Cover Material	12,717	Kayak	0.07	COV
	10/10/2020	Cover Material	10,868	Kayak	0.07	COV
	10/11/2020	Cover Material	15,562	Kayak	0.07	COV
	10/12/2020	Cover Material	9,490	Kayak	0.07	COV
	10/12/2020	Cover Material	331	Kivalina	0.07	COV
	10/13/2020	Cover Material	16,138	Kayak	0.13	COV
	10/14/2020	Cover Material	11,626	Kayak	0.13	COV
	10/17/2020	Cover Material	1,713	Kivalina	0.13	COV
	10/18/2020	Cover Material	3,221	Kivalina	0.07	COV
	10/18/2020	Cover Material	8,757	Kivalina	0.13	COV
	10/19/2020	Cover Material	3,278	Kivalina	0.07	COV
	10/19/2020	Cover Material	7,548	Kivalina	0.13	COV
	10/20/2020	Cover Material	10,034	Kivalina	0.07	COV
	10/24/2020	Cover Material	276	Kivalina	0.07	COV
	10/28/2020	Cover Material	3,332	Kivalina	0.07	COV
	10/29/2020	Cover Material	19,998	Kivalina	0.07	COV
	10/29/2020	Cover Material	80	Kivalina	0.13	COV
	10/30/2020	Cover Material	14,654	Kivalina	0.07	COV
November 2020						
	11/26/2020	Cover Material	11,687	Kayak	0.06	COV
	11/27/2020	Cover Material	12,013	Kayak	0.06	COV
	11/28/2020	Cover Material	15,873	Kayak	0.06	COV
	11/29/2020	Cover Material	21,305	Kayak	0.06	COV
	11/30/2020	Cover Material	15,248	Kayak	0.06	COV
December 2020						
	12/1/2020	Cover Material	11,399	Kayak	0.06	COV
	12/2/2020	Cover Material	9,941	Kayak	0.06	COV
	12/3/2020	Cover Material	11,689	Kayak	0.06	COV

Date Stockpiled	Waste Rock Type	Tonnes	Formation	Zinc_%	Stockpile Code
12/4/2020	Cover Material	76	Kayak	0.06	COV
12/5/2020	Cover Material	6,770	Kayak	0.06	COV
12/6/2020	Cover Material	9,312	Kayak	0.06	COV
12/7/2020	Cover Material	2,180	Kayak	0.06	COV
12/9/2020	Cover Material	6,342	Kayak	0.06	COV
12/10/2020	Cover Material	12,143	Kayak	0.06	COV
12/11/2020	Cover Material	1,379	Kivalina	0.11	COV
12/11/2020	Cover Material	8,642	Kayak	0.06	COV
12/12/2020	Cover Material	7,193	Kivalina	0.11	COV
12/14/2020	Cover Material	2,553	Kivalina	0.11	COV
12/15/2020	Cover Material	9,681	Kivalina	0.11	COV
12/15/2020	Cover Material	1,781	Kayak	0.06	COV
12/16/2020	Cover Material	3,074	Kivalina	0.11	COV
12/16/2020	Cover Material	9,104	Kivalina	0.00	COV
12/17/2020	Cover Material	3,693	Kivalina	0.11	COV
12/17/2020	Cover Material	9,934	Kayak	0.06	COV
12/18/2020	Cover Material	15,412	Kivalina	0.11	COV
12/19/2020	Cover Material	10,502	Kivalina	0.11	COV
12/21/2020	Cover Material	3,843	Kivalina	0.11	COV
12/21/2020	Cover Material	7,107	Kivalina	0.00	COV
12/22/2020	Cover Material	6,156	Kivalina	0.00	COV
12/24/2020	Cover Material	334	Kivalina	0.11	COV
12/25/2020	Cover Material	11,143	Kivalina	0.11	COV
12/26/2020	Cover Material	16,617	Kivalina	0.11	COV
12/27/2020	Cover Material	10,582	Kivalina	0.11	COV
12/28/2020	Cover Material	990	Kivalina	0.11	COV
12/30/2020	Cover Material	5,859	Kivalina	0.00	COV
12/31/2020	Cover Material	916	Kivalina	0.00	COV
	Total	**469,497**			

Appendix H: Risk Management Plan (pending)