Appendix F

2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris and Madrid Mines, Hope Bay Project

2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris and Madrid North Mines, Hope Bay Project

Prepared for

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Prepared by

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2019 Waste Rock, Quarry and Tailings Monitoring Report, Doris and Madrid North Mines, Hope Bay Project

March 2020

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1 Introduction

Development of the Doris and Madrid North mine has resulted in the development of quarries, use of quarry rock for construction of roads, pads and other infrastructure, production of waste rock from the underground mine and processing of ore resulting in flotation tailings slurry and detoxified tailings. Monitoring plans are in place to confirm metal leaching and acid rock drainage (ML/ARD) potential for quarry rock, waste rock and tailings (flotation and detoxified), consistent with geochemical characterization studies conducted at the environmental assessment and/or water licence applications for Doris and Madrid, and to monitor the chemistry of seepage and runoff associated with these materials.

This report presents results from the 2019 waste rock, quarry, construction rock and tailings geochemical monitoring programs for Doris and Madrid North. The report is organized as follows:

- A summary of the monitoring requirements is provided in Section 2.
- Results of the geological inspections and monitoring of Doris underground and CPR waste rock are summarized in Section 3.
- Results of the geological inspections and monitoring of Madrid North waste rock are summarized in Section 4.
- Results of the geochemical inspections and monitoring of quarry and construction rock are summarized in Section 5.
- Results of the seepage surveys around infrastructure areas and downgradient of the waste rock piles are provided in Section 6.
- Results of geochemical monitoring of flotation tailings slurry and detoxified tailings solids are summarized in Section 7.
- Detailed technical memorandum on each of these subjects are provided in Appendices A, B, C, D and E.

2 Monitoring Requirements and Conformity Assessment

2.1 Waste Rock

2.1.1 Doris Mine

Monitoring plans for Doris waste rock are provided in the "*Waste Rock, Ore and Mine Backfill Management Plan, Hope Bay Project, Nunavut [WROMP]"* (TMAC 2019). The program includes inspection and geochemical monitoring of the waste rock solids from the underground mine and Doris crown pillar recovery (CPR) and routine monitoring of the pollution control pond (PCP).

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in the WROMP (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018). Geochemical monitoring of underground waste rock executed by TMAC between January and April 2019 was according to the requirements of the waste rock management plan outlined in TMAC (2016). TMAC also conducted a geochemical monitoring program of CPR waste rock placed in a separate stockpile on Pad T in 2018 (SRK 2019a) to assess if the waste rock was geochemically suitable for use as construction rock.

A summary of the requirements of TMAC (2019) is summarized in Table 2.1.

Table 2.1: Doris Waste Rock Monitoring Requirements and 2019 Monitoring Summary

Document Reference[1]	Monitoring Item	2019 Monitoring Summary
TMAC (2016)	Inspection of the working face and muck pile by a field geologist to confirm rock types, mineralogical characteristics, and to classify the rock as mineralized or non-mineralized. All waste rock will be classified and managed as "mineralized" waste rock and be used as backfill.	Not a monitoring requirement in 2019. Refer to Section 3 and Appendix A for results.
TMAC (2016)	Sampling and testing of the underground waste rock, including acid base accounting (ABA) on a minimum of one sample per 10,000 tonnes of rock.	Not a monitoring requirement in 2019. Refer to Section 3 and Appendix A for results.
TMAC (2016)	Sampling and testing of the underground waste rock, including ABA.	Completed. Nineteen samples geochemically characterized. Refer to Section 3 and Appendix A.
TMAC (2019)	Conduct waste rock geological inspections: i) underground at the blast face by TMAC geologists, with internal record keeping and ii) surface waste rock stockpile (Pad T)	Completed. Refer to Section 3 and Appendix A.
TMAC (2019)	Geochemical sampling program for CPR waste rock to confirm that it is suitable for use as construction rock: sampling frequency of one sample for every 20,000 tonnes.	Completed. Collected one sample per 1,600 t from CPR waste rock stockpile on Pad T. Refer to Section 3 and Appendix A.
TMAC (2019), NWB (2018)	Monitoring and recording the volumes of waste rock mined, waste rock management designations (mineralized and non-mineralized and placement locations, including any waste rock that is approved and used for construction (pending confirmatory test work and approval from NWB);	Completed. Refer to Section 3 and Appendix A. All waste rock managed as mineralized except for waste rock approved as construction rock (as per previous item in table).

Document Reference[1]	Monitoring Item	2019 Monitoring Summary
NWB (2018)	Annual water quality monitoring will be carried out at a surveillance monitoring station ST-2 located in the pollution control pond;	Completed. Refer to Appendix D of the Hope Bay Belt Project 2019 Nunavut Water Board Annual Report.
TMAC (2019)	Annual inspections by a qualified geochemist of the designated non-mineralized areas of the waste rock pile to confirm that there are no areas with elevated amounts of sulphide mineralization, and inspections of the designated mineralized areas of the pile to look for signs of weathering and oxidation of the sulphides; representative sample set of waste rock to be collected;	Completed. Ten samples geochemically characterized from Pad T. Refer to Section 3 and Appendix A.
TMAC (2019)	Seep surveys along the down-gradient toe of the waste rock pile and below the pollution control ponds and access road throughout operations and for at least 2 years following mining and backfilling activities. The seep survey will be completed at the same time and will follow the same procedures as used for the seep survey around other infrastructure areas. However, given the increased importance of obtaining samples from this area, all distinct seeps in the immediate vicinity of the waste rock pile (i.e. any seeps spaced more than 50 metres apart) will be tested for a full suite of laboratory parameters; and	Completed. Refer to Section 6 and Appendix D.
NWB (2018)	An annual waste rock monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March 31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).	Completed. Refer to Section 3 and Appendix A.

Note: [1]TMAC (2016) items not required in 2019 but monitoring presented for completeness. See text for details.

2.1.2 Madrid North Mine

Waste rock monitoring at Madrid North is outlined in in *Waste Rock, Ore and Mine Backfill Management Plan* (TMAC 2019), which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018) except for waste rock from the Naartok East CPR. Geochemical monitoring of waste rock from NE CPR is documented in *Classification of Waste Rock in Support of Segregating Construction Rock from Naartok East Crown Pillar Recovery, Madrid North, Hope Bay* (SRK 2019b). SRK (2019b) includes a field classification method and geochemical criteria to identify waste rock that is non-PAG and with low potential for neutral pH arsenic leaching and recommendations for operational implementation of the field-based geochemical characterization program that identifies waste rock that is suitable for use as construction rock.

A summary of the requirements for Madrid North waste rock monitoring as outlined in SRK (2019b) and TMAC (2019) is summarized in Table 2.2. Of note is that the program of geochemical sampling for Madrid North waste rock from the underground mine has been modified, with rationale outlined in Table 2.2.

Table 2.2: Madrid North Waste Rock Monitoring Requirements and 2019 Monitoring Summary

Monitoring Program	Monitoring Item	2019 Monitoring Summary
TMAC (2019)	Conduct waste rock geological inspection at underground blast face by TMAC geologists, with internal record keeping	Completed. Refer to Section 4 and Appendix B.
SRK (2019b)	Geological inspection and pXRF analysis of Naartok East Crown Pillar Recovery (NE CPR) drill cuttings for geochemical classification of waste rock to determine suitability of waste rock as construction rock.	Completed. Refer to Section 4 and Appendix B.
TMAC (2019)	In pit NE CPR waste rock construction classification and segregation according to blast rounds.	Completed. Refer to Section 4 and Appendix B.
TMAC (2019), NWB (2018)	Monitoring and recording the volumes of waste rock mined and placement locations, including waste rock that is approved for use in construction (pending confirmatory test work and approval from NWB);	Completed. Refer to Section 4 and Appendix B.
TMAC (2019)	Annual inspections by a qualified geochemist of the designated non-mineralized areas of the Madrid North WRP to confirm that there are no areas with elevated amounts of sulphide mineralization, and inspections of the designated mineralized areas of the pile to look for signs of weathering and oxidation of the sulphides; representative sample set of waste rock to be collected;	Not applicable. Waste rock not placed on the Madrid North WRP pad in summer 2019. Monitoring will be initiated in Summer 2020.
TMAC (2019)	Geochemical verification sampling program for underground waste rock approved for use as construction rock: sampling frequency of one sample for every 5,000 tonnes for underground development.	Not applicable. Underground waste rock not a source of construction rock in 2019.
TMAC (2019)	Geochemical verification sampling program for NE CPR waste rock approved for use as construction rock: sampling frequency of one sample for every 20,000 tonnes.	Completed. Refer to Section 4 and Appendix B.
TMAC (2019)	Seep surveys along the down-gradient toe of the Madrid North Waste Rock Pad and below the CWP and access road throughout operations and for at least 2 years following mining and backfilling activities. The seep survey will be completed at the same time and will follow the same procedures as used for the seep survey around other infrastructure areas. However, given the increased importance of obtaining samples from this area, all distinct seeps in the immediate vicinity of the waste rock pile (i.e. any seeps spaced more than 50 metres apart) will be tested for a full suite of laboratory parameters;	Not applicable - Waste rock not present on the WRP pad in 2019 at time of seep survey. The seep survey will be initiated in Summer 2020.
NWB (2018)	Routine water quality monitoring (sampled twice annually, weekly water levels) will be carried out at a surveillance monitoring station MMS-1, located at the Madrid North CWP; and	Completed. Refer to Appendix D of the Hope Bay Belt Project 2019 Nunavut Water Board Annual Report.
NWB (2018)	An annual waste rock monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March	Completed. Refer to Section 4 and Appendix B.

Monitoring Program	Monitoring Item	2019 Monitoring Summary
	31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).	

2.2 Quarry and Construction Rock

Details on the monitoring program for quarries and as-built construction rock for Doris and Madrid infrastructure are provided in "*Quarry Management and Monitoring Plan*" (TMAC 2017). A summary of the requirements is provided in Table 2.3.

Table 2.3: Quarry and Construction Rock Monitoring Requirements and 2019 Monitoring Summary

Monitoring Item	2019 Monitoring Summary
Visual inspections and sampling at the quarry face by site geologist when the quarries are in active use;	Completed. Refer to Section 5 and Appendix C.
Collection and testing of two samples per year from each active quarry for total sulphur analysis, and, if the sulphur content exceeds 0.1%, the samples would be subjected to full ABA tests. A subset of samples will be subjected to shake flask extraction tests. The ABA tests would be done on the whole sample and on the -2mm size fraction to determine whether there is any concentration of sulphides in the fine component of the rock;	Completed. Refer to Section 5 and Appendix C.
Quarry sumps will be monitored as described under the routine site water quality monitoring program;	Quarry sump monitoring was not required in 2019 because it was not necessary to discharge water from Quarry 2 or Quarry D.
After construction of roads and other infrastructure components that were constructed using the quarry or waste rock since the previous inspection will be inspected by a qualified geologist or geochemist to verify that the rock used in construction was suitable for that purpose. During the inspection, samples will be collected for total sulphur analysis. If the sulphur content exceeds 0.1%, the samples will be subjected to full ABA tests. A subset of samples will be subjected to shake flask extraction tests.;	Completed. Refer to Section 5 and Appendix C.
A seep survey will be conducted around all infrastructure components that have been constructed or modified within the previous year. Field pH, electrical conductivity (EC), Eh, and temperature readings will be collected. A minimum of 10% of the samples will be submitted for laboratory analyses, as detailed in Quarry Management and Monitoring Plan (TMAC 2017). Established reference stations will also be monitored to provide basis for comparing this to waters that are not influenced by the development activities; and,	Completed. Refer to Section 5 and Appendix C.
An annual quarry monitoring report, including the results and an interpretation of the geochemical data will be prepared and submitted to the NWB by March 31 of the year following sample collection (i.e. within 6 months of collecting the final quarry samples).	Completed. Refer to Section 5 and Appendix C.

2.3 Tailings

The geochemical monitoring program for flotation tailings slurry and detoxified tailings are specified in Schedule I, Tables 1 to 3 of NWB Type A Water Licence 2AM-DOH1335 Amendment

No. 2 (the "Water Licence", Nunavut Water Board 2018) and includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids[1] (TL-7A), detoxified tailings supernatant (TL-7B) and seepage from underground backfilled stopes (TL-11). Station TL-7B was added to the Water Licence (NWB 2018) and monitoring commenced in 2019. A summary of the monitoring requirements is summarized in Table 2.4.

Table 2.4: Tailings Monitoring Requirements and 2019 Monitoring Summary

Monitoring Item	2019 Monitoring Summary
Sampling of the supernatant from flotation tailings slurry discharge (TL-5) once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), and total metals. Cyanate and thiocyanate should be analysed quarterly;	Completed. Refer to Section 7 and Appendix E.
Maintain monthly records of tonnages and locations of disposal for flotation tailings (TL-6) discharged into the TIA and detoxified tailings (TL-7A) placed in the underground mine in stopes as backfill;	Completed. Refer to Section 7 and Appendix E.
Monthly geochemical monitoring of a homogenized monthly composite sample of flotation tailings solids (TL-6), from equal amounts of weekly samples, for analysis of total sulphur, sulphate sulphur, TIC and trace element content;	Completed. Refer to Section 7 and Appendix E.
Monthly sampling and analysis of detoxified tailings solids (TL-7A) for TIC, total metals (including sulphur) and moisture content;	Completed. Refer to Section 7 and Appendix E.
Monthly sampling and analysis of detoxified tailings filtrate (TL-7B) for total metals, WAD cyanide, cyanate and thiocyanate;	Completed. Refer to Section 7 and Appendix E.
Bi-annual seepage surveys of underground backfilled stopes with opportunistic sampling of seepage (TL-11) for the analysis of pH, electrical conductivity (EC), trace metals by ICP-MS, alkalinity, acidity, sulphate, total and WAD cyanide, total ammonia, nitrate and nitrite; and,	Completed. Refer to Section 7 and Appendix E.
Preparation of an annual tailings monitoring report to be submitted to the NWB by March 31 of the year following sample collection and including the results and interpretation of the geochemical data for tailings solids (TL-6, TL-7A, TL-7B), geochemical data and figures depicting time series of constituent concentration and loads for tailings supernatant (TL-5) and results and interpretation of seepage data from the bi-annual underground seepage survey of backfilled stopes (TL-11).	Completed. Refer to Section 7 and Appendix E.

3 Monitoring of Doris Waste Rock Geochemistry

Details of the 2019 waste rock monitoring program are presented in Appendix A.

[1] Detoxified tailings are referred to as cyanide leach residue in the Water License and prior to 2019 was monitored as station TL-7.

3.1 2019 Activities

In April 2015, TMAC re-initiated underground mining at Doris, with placement of waste rock on surface commencing in October 2015. Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T (Table 3-1), all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from surface waste rock stockpiles on Pad T was placed as backfill in the Doris Crown Pillar and in stopes of the Doris mine.

Table 3-1: Summary of 2019 Waste Rock Placement Locations and Volume

Doris Mine	Source Location	Placement Location	Volume (t)	Total (t)
Underground	Underground	Backfill in Stopes	265,000	430,000
		Pad T	165,000	
	Pad T	Backfill in Stopes	90,000	230,000
		Backfill in CPR	140,000	
CPR	Pad T	Backfill and cover* of CPR	38,000	51,000
		Underground waste rock stockpile	13,000	

Notes: *Deemed to be suitable for construction as per TMAC (2019)

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan* (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018). TMAC also conducted a geochemical monitoring program of CPR waste rock placed in a separate stockpile on Pad T in 2018 (Table 3-1) to assess if the waste rock was geochemically suitable for use as construction rock. CPR waste rock is considered potential construction material because the mining practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and/or ammonia (related to blasting residues).

3.2 Sampling and Testing Program

3.2.1 Underground Mine

Underground Sampling Program

TMAC geologists collected 19 underground waste rock samples as part of the waste rock geochemical monitoring program in 2019 from January to April. Of the 19 samples, all were analyzed for total sulphur and TIC and 5 samples for expanded ABA. Ore is considered to be mineralized by definition, and therefore geochemical testing was not required.

Geological inspections were conducted by site geologists when monitoring samples were collected. Where possible, both the working face and the muck pile were inspected to identify the

rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs.

Waste Rock Stockpile (Pad T) Sampling Program

SRK completed an inspection of the underground waste rock placed in the stockpile on Pad T in August 2019. Waste rock was inspected by walking over the stockpiles and around the perimeter of the upper bench, examining rock types and the presence of sulphide content. The lower benches were not inspected as they either contained waste rock deposited prior to the last inspection or were not accessible. SRK collected 10 samples with sample distribution according to the rock types visually identified by SRK during the stockpile inspection and also the proportion of rock types that were intersected by mining, as provided by TMAC geologists.

3.2.2 Doris CPR

In 2018, waste rock from the Doris CPR was placed in a separate stockpile from waste rock sourced from the underground with the objective using CPR waste rock for construction, as required. In 2019, TMAC collected an additional 24 samples from the CPR waste rock stockpile to supplement the six samples collected in 2018 (SRK 2019a) with the objective of demonstrating the suitability of using CPR waste rock as construction rock. Geochemical analysis included ABA, elemental analyses and SFE tests.

The sampling and test work program design was according to the program requirements documented in TMAC (2019) to demonstrate the suitability of waste rock as construction rock. Sample locations were randomly distributed across the area of the stockpile and an excavator used to disturb frozen areas of the stockpile to allow sample collection.

3.3 Results

3.3.1 Underground Mine

Underground Sampling Program

In 2019, waste rock intersected by the Doris underground workings was primarily (95%) mafic metavolcanic flow (1a) with lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, and rare (1%) diabase or felsic dykes. Of the 19 underground waste rock samples, they were geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high (ranging

from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- One sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

Waste Rock Stockpile (Pad T) Sampling Program

As part of the TMAC (2019) waste rock monitoring program, SRK collected ten samples (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- The one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP.

- Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

- SFE tests for the Pad T altered mafic metavolcanics (1as) waste rock had alkaline pH (8.1-8.3 s.u.). Nitrate concentrations (140 to 170 mg/L) and chloride values (180 to 490 mg/L) were high indicating the presence of explosive residue and drilling brines.

The Type A waste rock sample set represents the geochemical characteristics of all 2019 waste rock samples and rock types.

The geological and geochemical inventory of waste rock on Pad T precludes a long-term assessment of the anticipated geochemical behaviour of the waste rock on Pad T with respect to metal leaching and acid rock drainage (ML/ARD). The geochemical behaviour of the waste rock is monitored through the annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Control Pond (PCP). The results of the seepage survey are reported in Appendix D, while results of the routine monitoring program are

included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

3.3.2 Doris CPR

In 2018, CPR waste rock placed in a separate stockpile on Pad T for potential use as construction material. CPR waste rock is considered potential construction material because the drilling and blasting practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and lower loads of ammonia (related to blasting residues).

In 2019, TMAC collected 24 samples of CPR waste rock from the stockpile on the west end of Pad T to assess if this waste rock could be used for construction as per the requirements of the *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019). The results of the geochemical program for CPR waste rock are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.05 to 0.78% and median levels of 0.21%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 260 to 320 kg $CaCO_3$ eq/tonne and 170 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- Median values of arsenic for all rock types were above the screening criteria. Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver. All other parameters were below the screening criteria suggesting no appreciable enrichment.

- SFE tests had alkaline pH (9.1 to 9.4 s.u.). Nitrate and chloride values had maximum values of 1.1 mg/L and 27 mg/L, respectively, which are significantly lower than SFE results from underground waste rock samples due to differences in blasting and drilling practices for CPR waste rock.

- All samples collected from the CPR waste rock stockpile indicated that the waste rock was suitable for use as construction rock except three samples of altered and unaltered mafic metavolcanics that were above the sulphur criterion of 0.5% with a total sulphur content ranging from 0.53 to 0.72%. Confirmatory samples taken from the CPR cover were classified as suitable for use as construction rock.

The geochemical behaviour of the waste rock used as construction rock is monitored as part of the construction rock monitoring program, including the annual seep survey and geochemical monitoring of as-built infrastructure. The Type A waste rock sample set represents the geochemical characteristics of the CPR waste rock samples analyzed as part of the 2019 waste rock monitoring program.

4 Monitoring of Madrid North Waste Rock Geochemistry

Details of the 2019 quarry and construction rock monitoring program will be presented in Appendix B as an addendum to this report.

5 Monitoring of Quarry and Construction Rock Geochemistry

Details of the 2019 quarry and construction rock monitoring program are presented in Appendix C.

5.1 2019 Activities

In 2019, active blasting was conducted in Quarry 2 in May, June, October and December 2019. Active quarrying was conducted in Quarry D in May, June and September 2019. Between mid-2018 and mid-2019, TMAC constructed the following infrastructure at Doris and Madrid North:

- Doris: access road to the vent raise; access road to the Doris crown pillar recovery (CPR); cover for the Doris CPR; and access road and jetty at Roberts Bay to the effluent discharge point.
- Madrid North: access road to the Naartok East CPR; Madrid North contact water pond (CWP); access road to the Madrid North CWP; and Naartok East overburden pad berm.

Infrastructure at Doris and Madrid North were constructed using rock from Quarry 2 and Quarry D, respectively except for the Doris CPR cover, which was built using of a combination of Doris waste rock (underground and CPR) and rock from Quarry 2.

5.2 Sampling and Testing Program

5.2.1 Quarry Monitoring

In order to comply with the Quarry Management and Monitoring Plan (TMAC 2017), monitoring includes geological inspections of active quarry blast faces and collection of ROQ rock for geochemical characterization. A summary of monitoring activities at Quarry 2 and Quarry D is presented in Table 5-1. TMAC documented each blast face inspection including lithology, sulphide content and veining and presence/absence of fibrous actinolite. TMAC visually described the samples, including lithology, visible sulphide content, carbonate content and presence of veining.

TMAC collected samples of quarry rock samples from Quarry 2 in May, July and August, and from Quarry D in May, July and September 2019. Each sample set consisted of a sieved coarse fraction (screened to -1 cm) and a finer fraction (screened to -2 mm). In addition, SRK collected one composite sample of argillite from the quarry wall of Quarry 2 in August.

All -1 cm samples containing total sulphur concentrations >0.1% were submitted for analysis of acid-base accounting (ABA) and trace element content by aqua regia digestion followed by ICP-MS scan. The -2 mm samples also underwent a shake flask extraction (SFE) test on the as-received fraction using the MEND (2009) method.

Table 5-1: Summary of Quarry Inspections and Samples Collected

Inspection Month	Quarry 2		Quarry D	
	Inspections	Samples Collected	Inspections	Samples Collected
May	1	2	3	2
June	-	-	3	-
July	2	2	1	2
August	1*	1*	-	-
September	-	-	2	4

Notes: *Argillite in quarry wall.

5.2.2 Construction Monitoring

SRK inspected the Doris and Madrid infrastructure areas. The visual inspection entailed a geological inspection of infrastructure areas constructed between September 2018 and August 2019.

Twelve surface rock samples (6 samples each from Doris and Madrid North) and one field duplicate were collected from surface material in the areas inspected. Samples were collected from pre-determined locations with one sample taken from each infrastructure area inspected or at a minimum of every 500 m along roads. At each sampling site a bulk sample was screened to -1 cm and -2 mm to generate two separate samples. All 13 samples were analyzed for total sulphur, of which 12 had total sulphur content above the 0.1% criteria and were submitted for full ABA analysis and elemental content. In addition, 7 samples of as-received -2 mm fraction were submitted for SFE testing according to MEND (2009). One sample from each infrastructure area was selected for SFE. In areas where there were multiple samples, SRK selected samples on the basis of high rinse EC values and high total sulphur values. Field contact rinse tests on the -2 mm fraction were conducted on the SRK sample set.

5.3 Results

5.3.1 Quarry Monitoring

Quarry 2

In 2019, TMAC conducted geological inspections in Quarry 2 between May and August. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets except for the August inspection. In August, a 3 to 4 m thick band of argillite (5a) within mafic metavolcanics was observed in one active face in the western extent of the quarry. All inspections noted the absence of fibrous actinolite.

Geochemical monitoring of ROQ rock indicated all samples of mafic metavolcanics (1a) were non-PAG according to values of NP/AP and TIC/AP. The argillite (5a) sample was classified as having an uncertain potential for ARD owing to higher levels of total sulphur (2.3% compared to 0.14 to 0.41% for mafic metavolcanics (1a)) and lower NP and TIC (70 and 75 $CaCO_3$/t, respectively for argillite compared to an overall range of 140 to 220 kg $CaCO_3$/t for mafic metavolcanics (1a)).

Compared to the screening criteria, sulphur and arsenic were enriched for argillite (5a) and in the fine fraction (-2 mm) of mafic metavolcanics (1a). The -1 cm fraction of mafic metavolcanics were not enriched in arsenic and sulphur compared to the screening criteria. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE test results for mafic metavolcanics (1a) indicated non-acidic pH and metal concentrations below the screening criteria indicating the risk of ML/ARD from Quarry 2 metavolcanics (1a) is low.

SFE test results for argillite (5a) indicated non-acidic pH with sulphate concentrations (780 mg/L) suggestive of sulphide oxidation. Based on SFE results and the uncertain potential for argillite to generate ARD, SRK recommends that TMAC avoid argillite units for use as construction material, as much as practically possible, due to its higher risk for ML/ARD.

Quarry D

In 2019, TMAC conducted geological inspections in Quarry D in May, July and September. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets. All inspections noted the absence of fibrous actinolite.

Geochemical monitoring of ROQ rock indicated that the monitoring samples were non-PAG for all mafic metavolcanics (1a) according to values of NP/AP and TIC/AP. Total sulphur content ranged between 0.09 and 0.26% and Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively.

Elemental analyses indicated no appreciable enrichment compared to the screening criteria.

SFE test results indicated that all test leachates were non-acidic and that all parameters were below the screening criteria indicating the risk of ML/ARD from Quarry D ROQ rock is low.

5.3.2 Construction Monitoring

Doris

SRK conducted a geological inspection of as-built construction at Doris that confirmed that construction materials for the access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay were characteristic of Quarry 2: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). The geological inspection of the Doris

CPR and access road to Doris vent raise identified material that were not exclusively or typical of Quarry 2 and are described as follows:

- Doris CPR cover: TMAC constructed the cover primarily using waste rock with selected areas using ROQ rock from Quarry 2. Waste rock was geochemically characterized prior to use as construction material according to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019). The majority of construction material (both waste rock and ROQ rock) in the cover were both geologically classified as mafic metavolcanics (1) with varying textural and compositional differences.
- Access road to Doris vent raise: the geology of construction material used for the access road was characteristic of Quarry 2, except for a 120 m segment that contained a minor amount (~5-10%) of black intermixed fragments of argillite (5a) mixed with mafic metavolcanics (1a).

Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads, including two samples of waste rock from the CPR cover and one sample from the access road to the vent raise containing argillite (5a).

Total sulphur ranged between 0.18% and 0.45% with the highest sulphur value from the sample containing a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a). For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

Four samples were enriched in arsenic and/or sulphur as compared to the screening criteria. All other parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline. Results indicate that the potential for metal leaching from these samples is low. The higher chloride and nitrate levels for sample SRK19-CR11 suggest that waste rock from the underground may be present in the CPR cover material. TMAC notes that the cover design specified that underground waste rock be placed below the active layer and CPR waste rock to be placed as the cover. TMAC suspects some underground waste rock may have been mixed with the surface layer when the CPR was being backfilled in stages resulting in waste rock placement in the cover.

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, construction rock used to construct the access road to the vent raise, access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay was geochemically suitable for use as construction rock. This includes the ROQ rock from the access road to the vent raise that contained 5 to 10% argillite and also the waste rock samples collected from the cover of the CPR.

Waste rock and ROQ rock used to construct the CPR cover has a low risk of ML/ARD; however, shake flask testing indicated the potential for elevated chloride and nitrate. No seepage was observed from the CPR cover during TMAC's 2019 seepage survey. The Doris CPR cover will be included in subsequent seepage surveys to assess the potential for contaminant leaching from the Doris CPR.

Madrid North

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, the quarry rock used to construct the access road to the Naartok East CPR; Madrid North CWP; access road to the Madrid North CWP; and Naartok East overburden pad berm was geochemically suitable for use as construction rock.

SRK conducted a geological inspection of as-built construction at the Madrid North mine and confirmed that construction materials were characteristic of Quarry D: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads.

Total sulphur content ranged between 0.07% and 0.22%. Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t. Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

In terms of elemental content, concentrations of all parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline and that dissolved metals were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

6 Seepage Survey

Details of the 2019 seep survey are provided in Appendix D.

6.1 2019 Activities

In 2019, TMAC conducted a seepage survey of the waste rock influenced area (WRIA) at Doris in the following areas: toe of the waste rock stockpiles on Pad T and Pad I, including the slope of the pollution control pond (PCP) located immediately downstream of the waste rock and ore stockpile on Pad I; and toe of the access roads located down-gradient of the Doris waste rock stockpiles. At the time of the survey, there was no waste rock on the Madrid North waste rock pile (WRP) pad.

The scope of the 2019 construction rock seepage monitoring survey included infrastructure constructed since the previous seepage survey and infrastructure surveyed for seepage in 2018 but where none was observed (SRK 2019a). In the latter case, these areas were monitored again in 2019. Construction material used at Madrid North was sourced from Quarry D whereas material used at Doris was from Quarry 2 or Doris waste rock that was geochemically monitored for use as construction material according to TMAC (2019) and deemed suitable for construction by TMAC. The 2019 seepage monitoring program included the surveying of the following areas at Doris and Madrid North (with waste rock used as construction rock noted in parentheses):

- Doris
  - South Dam;
  - Access Road to the Doris Crown Pillar Recovery (CPR);
  - Access Road to Doris vent raise;
  - Cover of the Doris CPR (constructed primarily of Doris waste rock and some quarry rock); and
  - Marine Outfall Berm (MOFB) Access Road.
- Madrid North
  - Access road to the Madrid North Contact Water Pond (CWP);
  - Access road to the Naartok East CPR;
  - Naartok East overburden pad berm; and
  - Madrid North CWP construction area.

6.2 Sampling and Testing Program

TMAC conducted the seepage survey between June 19 and 24, 2019. Seepage survey locations were established where seepage was observed or suspected by examining the toes of the waste rock stockpile, infrastructure, roadways, and berms. Samples were collected and field measurements were taken at locations where water was observed flowing into and out of

construction rock material; this included seepage where precipitation runoff and snowmelt came into contact with rock along the roadways, building pads, and berms. Electrical conductivity (EC), pH, temperature, oxidation-reduction potential (ORP), and flow rates (where possible) were measured at each of these locations at the time of monitoring.

A total of thirty-three (33) seepage survey sites and three (3) reference survey sites were established where chemical and physical properties of seepage water were measured, and samples were taken for laboratory analysis. The three reference sites, located in the undisturbed tundra and not subject to mine influences, were sampled on July 3, 2019. These samples, used as baseline reference points, were collected at approximately the same locations as those of the 2010–2018 seepage surveys (in the vicinity of the Doris-Windy Road).

One duplicate sample and one field blank were collected and submitted for laboratory analysis, and one travel blank was included in sample shipments as part of SRK's recommended quality assurance/quality control (QA/QC) program.

TMAC submitted a total of 38 samples (including a duplicate and field blank) to ALS Environmental Labs in Vancouver, BC, where they were analyzed for pH, EC, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and dissolved metals (including mercury and selenium). All samples were filtered and preserved in the field, as required.

6.3 Results

A summary of the field measurements is presented in Table 6.1. The pH at all sites was neutral to slightly alkaline (7.5 to 8.1). The samples collected within the Waste Rock Influenced Area (WRIA) had the highest levels of conductivity (2,100 to 3,500 µS/cm).

Parameter concentrations for reference samples collected in 2019 were generally stable and consistent with the historical dataset, including sulphate, arsenic, cobalt, iron, selenium, ammonia, nitrate and nitrite.

For the Doris mine area, one seepage sample was collected at the South Dam, two from along the access road to the Doris CPR, and thirteen samples along the MOFB access road. There was no seepage observed downstream of the Doris CPR cover, which was constructed primarily of waste rock, and the access road to the vent raise, constructed by Quarry 2 ROQ material. Dissolved trace metals concentrations were typically within an order of magnitude of concentrations at the reference stations with the exception of manganese and molybdenum

For the Madrid North mine area, eleven seepage samples were collected along the access road to the Madrid North CWP. Seepage was not observed at the Madrid North CWP, the access road to the Naartok East CPR, or the overburden pad berms; therefore, samples were not collected from these areas. Dissolved metals concentrations were similar to the reference seeps with values differing by less than an order of magnitude with the exception of manganese and, for one sample, zinc.

Consistent with previous years, seepage from areas impacted by waste rock had increasing trends in ammonia, nitrate and chloride concentrations after the placement of ore on the stockpile due to the re-initiation of mining by TMAC in 2015, and have continuously decreased since 2016 due to the flushing of salts from drilling brines (chloride) and explosives residues (ammonia, nitrate, and nitrite) from the waste rock stockpile. Concentrations of these parameters are below the 2015 source term input values (SRK 2015a).

In terms of metal leaching, concentrations of sulphate, copper and iron were higher than screening criteria and have exhibited increasing trends since 2015 when TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, copper and iron may be attributed to the presence of ore, which has higher sulphide content than waste rock. Iron has exhibited increasing concentrations, but only for samples collected at the toe of the waste rock stockpile and within the berm of the PCP. High iron concentrations in these samples are likely due to iron particulate material less than 0.45 µm because the solubility of dissolved iron species is low in non-acidic and oxygenated conditions (Stumm and Morgan 1996). For other waste rock samples, iron concentrations are typically below the source term input values. All waste rock seepage is collected in the PCP and downstream sumps after which it is managed onsite and pumped to the TIA. In 2019, water from the PCP accounted for ~5% of total inflow volumes entering the TIA and ~2% of the total volume stored in the TIA.

Table 6.1: Median Values for Field Conductivity and pH Measurements

Mine Area	Material Source	Site Area	No. of Samples	Conductivity (µS/cm)	pH
				Median	
Reference	-	Reference (Windy Road)	3	-	-
Doris	Waste Rock	WRIA	6	2300	8.1
	Quarry 2	South Dam	1	300	7.9
		Access Road to Doris CPR	2	270	8.0
		MOFB Access Road	13	190	7.7
Madrid	Quarry D	Access Road to Madrid North CWP	11	79	7.5

Source: X:\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 115 - Doris Seepage Monitoring\3. Working File\1CT022.037_2019_Doris-MadridSeep_rev01_jce.xlsx

7 Monitoring on Tailings

7.1 2019 Activities

The geochemical monitoring program for flotation tailings slurry and detoxified tailings includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids (TL-7A), detoxified tailings supernatant (TL-7B) and seepage from underground backfilled stopes (TL-11). Detoxified tailings are referred to as cyanide leach residue in the Water Licence and prior to 2019 TL-7A was monitored as station TL-7. Station TL-7B was added to Water Licence and monitoring commenced in 2019. Details of the 2019 tailings monitoring programs are provided in 9Appendix E.

7.2 Sampling and Testing Program

7.2.1 Process Plant Flotation Tailings Slurry Discharge: Solids (TL-6) and Supernatant (TL-5)

Schedule I of the Water Licence (NWB 2018) specifies weekly sampling of flotation tailings (TL-6) and monthly sampling of the process plant tailings supernatant (TL-5). Samples of the flotation tailings solids (TL-6) and the supernatant solution (TL-5) were collected from the flotation tailings thickener tank. The filtrate from the detox filter press (where detoxified tailings are dewatered) is pumped to the flotation tailings thickener tank prior to discharge to the TIA.

TMAC collects flotation tailings slurry from the tailings thickener tank in a clean 5-gallon bucket. The sample is left in the bucket to allow gravitational settling and separation of the tailings solids from the liquid. After settling, samples of supernatant solution (TL-5) and flotation tailings solids (TL-6) are collected at the frequency outlined above.

The tailings supernatant solution (TL-5) was sampled using a sterile 60 mL syringe and submitted to ALS Laboratory in Burnaby, BC once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, dissolved and total metals. In total, the 2019 monitoring program included geochemical characterization of 12 monthly samples of tailings process supernatant collected from January to December with a duplicate sample collected in March.

After sampling is completed for the tailings supernatant solution (TL-5), the remaining supernatant is discarded and a clean stainless-steel spoon is used to transfer the solid tailings into a clean plastic Ziploc bag supplied by the laboratory. The bag is then sealed and placed in a fridge until the last weekly sample for the month has been collected. At the end of each month, TMAC combines and homogenizes equal amounts of tailings from each weekly sample to create an approximately 500 g monthly composite sample of flotation tailings solids (TL-6).

In total, the 2019 monitoring program included geochemical characterization of 12 monthly composites of flotation tailings collected from January to December with a duplicate sample collected in May. Monthly flotation tailings solids (TL-6) composite samples were submitted in glass jars to Bureau Veritas Laboratory in Burnaby, BC for analysis of:

- Total sulphur – by Leco combustion;
- Sulphate sulphur – by hydrochloric acid leach;
- TIC – carbonate carbon by CO_2 hydrochloric acid leach; and
- Trace element content – by aqua regia digest (nitric and hydrochloric acid) with ICP-MS finish.

7.2.2 Detoxified Tailings Solids (TL-7A) and Filtrate (TL-7B)

In total, the 2019 monitoring program included geochemical characterization of 12 samples of detoxified tailings solids (TL-7A) collected from January to December. One duplicate sample was collected in May. 12 samples of filtrate (TL-7B) from the detoxified tailings were collected from January to December. One duplicate sample was collected in May.

At the end of a detoxification cycle, TMAC collects one discrete sample of detoxified tailings solids (TL-7A) from the discharge compartment of the detoxification circuit filter press. A clean stainless-steel spoon is used to transfer the solid detoxified tailings solids into 125 mL glass sample jars supplied by the laboratory. Samples of the filtrate liquid component are collected from the receiving tank of the detoxification filter press using a 10 foot sampling pole with an open top 1 L poly bottle and then poured into four 500 mL settling bottles to allow gravitational settling and separation of residual tailings solids from the liquid. After settling, the filtrate (TL-7B) is transferred into laboratory supplied sample bottles either using a clean syringe or decanting the supernatant into the sample bottles.

The solids samples are submitted to Bureau Veritas Laboratory for total sulphur by total Leco, sulphate sulphur, TIC and multi-element trace element content by aqua regia digestion followed by ICP-MS finish. ABA methods at Bureau Veritas Laboratory are the same as described for flotation tailings (TL-6).

The filtrate samples (TL-7B) are submitted to ALS Laboratory for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, and total metals.

7.2.3 Seepage Survey of Underground Backfilled Stopes (TL-11)

TMAC completed underground seepage inspections of backfilled stopes in May and December 2019. Visual surveys were conducted of all backfilled stopes that could be accessed safely at the time of the survey, i.e. not all backfill could be inspected. Fifteen locations were surveyed in May and sixteen locations were surveyed in December. Inspection of the backfill materials in the stopes showed that detoxified tailings were only visible on Level 4946 and Level 5002 (TL-11B-27MAY19 and TL-11D-27MAY19); detoxified tailings were not visible in the backfill on the other levels where samples were collected.

No flowing seeps were identified in the May survey; however, TMAC collected samples from pools of water (all stagnant unless otherwise noted) at the base of stopes in the following locations:

- Base of the backfill in the East limb on Level 4932, location E433902, N7559742 (TL-11A-27MAY19). There were no obvious signs of seepage flow from the stope at this location.
- Base of the East limb of the South stope on Level 4946, location E433837, N7559620 (TL-11B-27MAY19). There were no signs of flow from the backfill tailings at this location.
- Base of the West limb on the South stope on Level 4964, location E433786, N7559507 (TL-11C-27MAY19).
- Base of the West limb, North stope on Level 5002, location E433744, N7559239 (TL-11D-27MAY19). This pool was near the Doris Central surface vent raise and there were detoxified tailings visible in the backfill at this location.
- Base of a stope in the East limb on Level 4735, location E433903, N7559726 (TL-11E-27MAY19). At the time of sampling from the pool there was water flowing down into the area from the access ramp.

- Pooled water at base of a stope in the East limb on Level 4905, location E433792, N7559314 (TL-11F-27MAY19). There were no signs of flow from the stope at this location. The area had recently been used as a drill bay.

In December, TMAC collected two seepage samples during the underground survey. One sample from the seep flowing from the bottom of the West limb, North stope at Level 120, location E433718, N7558636 (TL-11A-15DEC19). A field blank and duplicate sample were also collected at this location in the December survey. Another sample was also collected from the seep flowing from the toe of the backfill in the West limb, South stope of Level 134, location E433725, N7558381 (TL-11B-15DEC19).

Seepage samples were collected using a syringe and field measurements of pH, EC, ORP and temperature recorded. Seepage flow rates ranged from 0.022 to 0.044 L/s for TL-11A and TL-11B respectively. TMAC submitted samples to ALS in Burnaby, BC for analysis of pH, EC, TSS, TDS, alkalinity, chloride, sulphate, total and WAD cyanide, and dissolved and total metals. The sample for dissolved metals was filtered and preserved at the time of sampling.

7.3 Results

In 2019, a total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

The results of the 2019 geochemical monitoring program of flotation tailings solids (TL-6) is summarized as follows:

- Sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019.
- TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019a) and metallurgical tailings samples (SRK 2015b).
- Trace element content was compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment. The following parameters showed enrichment, all other parameters were below the screening criteria indicating no appreciable enrichment:
  - April, June, November and December samples contained elevated arsenic (9 to 170 mg/kg) and was within the range of concentrations for historical samples (except April at 170 ppm).
  - Five samples were elevated in sulphur (3,100 to 5,300 mg/kg for enriched samples).
  - All samples analyzed for gold were elevated relative to a screening criterion of 40 mg/kg (660 to 3,100 mg/kg).
  - Bismuth was elevated in the sample collected in April (9.4 mg/kg).

The results of the 2019 geochemical monitoring program of detoxified tailings solids (TL-7A) is summarized as follows:

- Sulphur concentrations ranged between 9.6 and 25% in 2019 and were highest between the months of July and December (21 to 25%).
- TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015b).
- All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration in 2018, compared to 15 mg/kg in 2019). All other parameters were below the screening criteria indicating no appreciable enrichment.

The results of the 2019 geochemical monitoring program of detoxified tailings filtrate (TL-7B) is summarized as follows:

- pH conditions ranged from 8.5 to 8.8 s.u.
- Concentrations of sulphate (a by-product of milling of sulphide rich ore) ranged from 12,000 mg/L to 28,000 mg/L.
- Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.
- Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process.
- Milling of the sulphide rich ore results in high concentrations of total metals, including: arsenic (0.022 to 0.17 mg/L), antimony (0.0059 to 0.045 mg/L), cadmium (<0.00025 to 0.00059 mg/L), cobalt (0.035 to 0.13 mg/L), copper (3.3 to 20 mg/L), iron (<0.5 to 13 mg/L), manganese (0.13 to 0.41 mg/L), molybdenum (0.024 to 0.27 mg/L), nickel (<0.025 to 0.14 mg/L), selenium (0.0053 to 0.051 mg/L), silver (0.0033 to 0.040 mg/L).
- The following parameters were consistently reported at concentrations less than analytical detection limits in all filtrate samples: chromium, phosphorous, and zinc.

Trends in process plant tailings water discharge (TL-5) are summarized as follows:

- pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u.
- Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019.
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018. Exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited

increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

The results of the opportunistic seepage sampling from underground backfilled stopes (TL-11) is summarized as follows:

- Seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. Based on field observations these seepage samples are interpreted to be contact water of waste rock and tailings backfill with the results summarized as follows:
  - pH is slightly alkaline with both seeps reporting a pH of 8.0.
  - Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium).
  - Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set.
  - Cadmium (0.00032 to 0.00056 mg/L), copper (0.039 to 0.10 mg/L), nickel (0.082 to 0.12 mg/L), selenium (<0.001 to 0.0012 mg/L) and silver (3.6 to 3.7 mg/L) were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015b). The exception to this was zinc, which reported elevated concentrations (0.026 to 0.096 mg/L) in the survey but was not noted as a parameter of potential concern in the HCT program.
- No seepage was observed in May, but samples were collected from pooled water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. The concentrations for these samples (with the exception of TL-11D-27MAY19) were notably higher than the December samples. The higher concentrations are interpreted to be a result of evaporation in the standing pools of water sampled and therefore not representative of contact water. Also, the chemistry of TL-11D-27MAY19 was notably different to the chemistry of other samples collected during the May seepage survey. The sample was collected in the vicinity of the surface vent raise and the data suggest that the seepage sample was potentially diluted by meteoric water.

8 Conclusions

8.1 Doris Waste Rock

Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T, all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from the surface waste rock stockpile was placed as backfill in the Doris Crown Pillar and stopes of the Doris mine.

TMAC collected 19 underground waste rock samples with the samples geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high, ranging from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. One sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

SRK collected ten samples (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. The one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP. Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment. SFE tests for the Pad T altered mafic metavolcanics (1as) waste rock had alkaline pH (8.1-8.3 s.u.). Nitrate concentrations (140 to 170 mg/L) and chloride values (180 to 490 mg/L) were high indicating the presence of explosive residue and drilling brines.

Mining of the CPR between November and December 2018 resulted in the production of and placement of 263,500 t of waste rock on Pad T. Of this amount, 212,500 t was placed in the existing waste rock stockpile on the east side of Pad T, of which 190,000 t will be placed as backfill in the CPR and 22,500 t will be placed as backfill in stopes of the underground mine. Another 51,000 t of material was placed in its own stockpile on the western expansion of Pad T; this material will be placed as capping material on the CPR. None of the CPR waste rock was placed as backfill in 2018.

Twenty-four CPR samples were collected representing CPR waste rock from the stockpile on west end of Pad T. For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.05 to 0.78% and median levels of 0.21%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 260 to 320 kg $CaCO_3$ eq/tonne and 170 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP. Median values of arsenic for all rock types were above the screening criteria. Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver. All other parameters were below the screening criteria suggesting no appreciable enrichment. SFE tests had alkaline pH (9.1 to 9.4 s.u.). Nitrate and chloride values had maximum values of 1.1 mg/L and 27 mg/L, respectively, which are significantly lower than SFE results from underground waste rock samples due to differences in blasting and drilling practices for CPR waste rock. All samples collected from the CPR waste rock stockpile indicated that the waste rock was suitable for use as construction rock except three samples of altered and unaltered mafic metavolcanics that were above the sulphur criterion of 0.5% with a total sulphur content ranging from 0.53 to 0.72%.

8.2 Madrid North Waste Rock

Data interpretation for the geochemical and geological monitoring of Madrid North waste rock is in progress and will be provided as a supplementary submission.

8.3 Quarry and Construction Rock

Geological inspections of active Quarry 2 and Quarry D faces indicated that quarry rock was mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). Geochemical characterization of Quarry 2 and Quarry D run-of-quarry rock indicated that all of the samples were non-PAG with low risk for ML/ARD with the exception of the argillite seam sample from Quarry 2 which was classified as having uncertain potential for ARD. Based on SFE results and the uncertain potential for argillite to generate ARD, SRK recommends that TMAC avoid argillite units for use as construction material, as much as practically possible, due to its higher risk for ML/ARD.

Geological inspection of as-built construction areas confirmed that construction materials were characteristic of Quarry 2 for the Doris mine area and Quarry D for Madrid North. All samples were classified as non-PAG on the basis of both TIC/AP and NP/AP. Four samples from Doris were enriched in arsenic and/or sulphur as compared to the screening criteria. All other parameters were below the screening criteria, suggesting no appreciable enrichment.

The results indicate that the quarry rock used in the infrastructure areas was geochemically suitable for use as construction rock and the risk for ML/ARD is low.

8.4 Infrastructure and Waste Rock Seepage Monitoring

The scope of the 2019 Hope Bay seepage monitoring survey included infrastructure constructed between fall 2018 and spring 2019 at Doris and Madrid North, three reference stations and areas downstream of the Doris waste rock stockpiles. There were no stockpiles of waste rock from Madrid North (Naartok East CPR) at the time of the survey.

Concentrations for reference area seeps were consistent and stable with the historical data record.

Infrastructure surveyed at Doris included the TIA south dam, MOFB access road at Robert's Bay, access road to the Doris Central vent raise, access road to the Doris CPR and Doris CPR cover. Construction rock at Doris was sourced from Quarry 2 except for the Doris CPR cover, which was constructed primarily of Doris waste rock and some quarry rock. Infrastructure surveyed at Madrid North included the access road to Naartok East CPR, overburden pad berm, Madrid North CWP, and access road to the Madrid North CWP. Construction rock at Madrid was sourced from Quarry D. Seepage was observed and samples collected representing construction rock from all aforementioned areas except the Doris CPR cover. The results of the 2019 seepage sampling program indicate that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay.

Seepage from areas impacted by waste rock had concentrations of sulphate, copper and cobalt that have exhibited increasing trends since TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile in 2015. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, cobalt, and copper may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of iron for the 2019 waste rock seepage samples were increasing for samples collected from the berm of the PCP; however, this was attributed to the presence of particulate material less than 0.45 µm that are not truly dissolved species. Chloride, nitrate and ammonia levels increased after ore was placed on the stockpile but have since continuously decreased in relation to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock. All waste rock seepage is intercepted, managed and pumped to the TIA.

The waste rock seepage monitoring was initiated in 2012. An assessment of the waste rock seepage monitoring record for sulphate, copper, iron, chloride, ammonia and nitrate indicated that overall, monitoring data approximates the Doris waste rock source term inputs for the 2015 water and load balance (SRK 2015a). Continued monitoring will establish trends in parameter concentrations.

SRK recommends that the 2020 seepage survey include infrastructure areas monitored in 2019, including sites where seepage was not observed at Doris (CPR cover, access road to vent raise) and Madrid North (Madrid North CWP, overburden pad berm, access road to Naartok East CPR).

8.5 Monitoring on Tailings

In 2019, a total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

For process plant tailings water discharge (TL-5), pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u. Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019. Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018; exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

For flotation tailings solids (TL-6), sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019. TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019a) and metallurgical tailings samples (SRK 2015b). Trace element content was elevated compared to screening criteria for arsenic, sulphur and gold. Bismuth was also elevated in one sample. All other parameters were below the screening criteria indicating no appreciable enrichment.

For detoxified tailings solids (TL-7A), total sulphur concentrations ranged between 9.6 and 25% in 2019 and were highest between the months of July and December (21 to 25%). TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015b). All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration) in 2018 than 2019 (15 mg/kg median concentration). All other parameters were below the screening criteria indicating no appreciable enrichment.

For detoxified tailings filtrate (TL-7B), pH ranged from 8.5 to 8.8 s.u. Concentrations of sulphate ranged from 12,000 mg/L to 28,000 mg/L. Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively. Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process. Milling of the sulphide rich ore results in high concentrations of total metals, including arsenic, antimony, cadmium, cobalt, copper, iron, manganese, molybdenum, nickel, selenium, and silver.

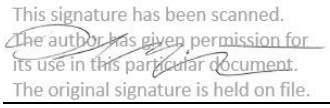
For underground backfilled stopes (TL-11), seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. Based on field observations these seepage samples are interpreted to be contact water of waste rock and tailings backfill. The pH is slightly alkaline with both seeps

reporting a pH of 8.0. Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium). Levels of ammonia, nitrate and nitrite were lower than the 5th percentile concentrations from the historical sample set.

No seepage was observed in May, but samples were collected from pooled water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. The concentrations for these samples (with the exception of TL-11D-27MAY19) were notably higher than the December samples. The higher concentrations are interpreted to be a result of evaporation in the standing pools of water sampled and therefore not representative of contact water. Also, the chemistry of TL-11D-27MAY19 was notably different to the chemistry of other samples collected during the May seepage survey. The sample was collected in the vicinity of the surface vent raise and the data suggest that the seepage sample was potentially diluted by meteoric water.

This report, 2019 Waste Rock, Quarry and Tailings Monitoring Report, was prepared by

SRK Consulting (Canada) Inc.



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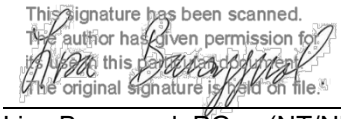

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Appendix A – 2019 Geochemical Monitoring of Waste Rock, Doris Mine

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter Lisa Barazzuol	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 17, 2020
Subject:	2019 Geochemical Monitoring of Waste Rock, Doris Mine		

1 Introduction

In April 2015, TMAC re-initiated underground mining at Doris, with placement of waste rock on surface commencing in October 2015. Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T (Table 1-1, Figure 1-1), all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from surface waste rock stockpiles on Pad T was placed as backfill in the Doris Crown Pillar and in stopes of the Doris mine.

Table 1-1: Summary of 2019 Waste Rock Placement Locations and Volume

Doris Mine	Source Location	Placement Location	Volume (t)	Total (t)
Underground	Underground	Backfill in Stopes	265,000	430,000
		Pad T	165,000	
	Pad T	Backfill in Stopes	90,000	230,000
		Backfill in CPR	140,000	
CPR	Pad T	Backfill and cover* of CPR	38,000	51,000
		Underground waste rock stockpile	13,000	

Notes:

*Deemed to be suitable for construction as per TMAC (2019)

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in Waste Rock, Ore and Mine Backfill Management Plan (TMAC 2019), the latter which is a part of Licence 2AM-DOH1335 Amendment No. 2 (NWB 2018). TMAC also conducted a geochemical monitoring program of CPR waste rock placed in a separate stockpile on Pad T in 2018 (SRK 2019) to assess if the waste rock was geochemically suitable for use as construction rock. CPR waste rock is considered potential construction material because the

mining practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and/or ammonia (related to blasting residues).

This memo documents the geochemical monitoring of waste rock in 2019, which included the following programs (parenthesis indicates the relevant report section):

- Geochemical monitoring of underground waste rock executed by TMAC between January and April 2019 according to the requirements of the waste rock management plan outlined in TMAC (2016) (Section 3.1).
- Geochemical monitoring of underground waste rock executed by SRK according to the requirements of the waste rock management plan outlined in TMAC (2019) (Section 3.2).
- Geochemical monitoring of the CPR stockpile on Pad T to confirm the geochemical suitability of the waste rock as construction rock (Section 3.3). In 2019, waste rock from the CPR stockpile was placed as the cover for backfill in the CPR.

Other monitoring activities in the Doris mine area related to waste rock included an annual seep survey along the downgradient toe of the waste rock and ore stockpile area, routine monitoring of the Pollution Collection Pond (PCP) and as-built geochemical monitoring of waste rock used as construction rock, including a seepage survey. The results of the seepage surveys and monitoring of construction rock are reported in the accompanying memos (SRK 2020a and SRK 2020b), while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the NWB.

Figure 1-1: Waste Rock Stockpile on Pad T, Doris (looking south, July 31, 2019)

2 Methods

2.1 Geological Inspections

2.1.1 Underground Mine Inspections According to TMAC (2016)

Protocols for geological inspections are documented in TMAC (2016). To summarize, geological inspections were conducted by TMAC site geologists when monitoring samples were collected between January and April 2019. Where possible, both the working face and the blasted rock (muck) pile were inspected to identify the rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs (Attachment A).

2.1.2 Waste Rock Inspections According to TMAC (2019)

Waste Rock, Ore and Mine Backfill Management Plan (TMAC 2019) defines two types of waste rock inspections: underground at the blast face by TMAC geologists, with internal record keeping and of the surface stockpile. This report documents the latter inspection, as required by TMAC (2019).

In August 2019, SRK geochemist Derrick Midwinter, PGeo completed a geological inspection of waste rock placed on Pad T between August 2018 and July 2019. The objective of the inspection was to determine the geological composition of waste rock, to examine for signs of sulphide oxidation and weathering and to collect samples for geochemical characterization of waste rock for comparison with baseline geochemical characterization (Section 3.1.3, Table 3.1; TMAC 2019). TMAC identified the inspection area as the upper lift of waste rock. SRK's inspection was limited to the interior of the upper bench of the waste rock stockpile on Pad T due to safety and accessibility.

The inspection was carried out by walking over the stockpiles and along the perimeter of the upper bench, examining rock types and the presence of sulphide and carbonate content (Attachment A).

2.1.3 Waste Rock from Crown Pillar Recovery

TMAC completed mining of the Doris CPR in 2018; therefore, there was no waste rock to inspect in 2019.

2.2 Sample Collection and Geochemical Test Work Program

2.2.1 Program According to TMAC (2016)

TMAC site geologists collected a total of 19 run-of-mine (ROM) waste rock samples (blasted rock or muck) from the underground mine between January and April for geochemical characterization (Attachment A). Samples of muck were composited over an individual blast round, typically representing 70 to 95 m^3 of rock. In all cases, samples consisted of a representative mixture of fine and coarse rock fragments from the blasted rock pile. Samples were analyzed for total sulphur (S) and total inorganic carbon (TIC) with a subset also analyzed for paste pH, Modified

NP and trace elemental content (Table 2-1). Ore is considered to be mineralized by definition, and therefore geochemical testing was not required.

Samples collected by TMAC from January to April 2019 were shipped to Bureau Veritas Laboratories (BV) in Burnaby, BC. Analytical instructions were provided by TMAC with review of the analytical parameter selection by SRK.

Table 2-1: Underground Waste Rock Monitoring Samples Collected and Associated Test Program

Rock Type[1]	Sulphur & TIC	Full ABA & Elemental Analysis
1a	16	3
1as	3	2
Total Number of Tests	19	5

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 110 Doris WR Monitoring\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev03.xlsx

Notes:

[1]1a = mafic metavolcanic, 1as = altered mafic metavolcanics

2.2.2 Waste Rock Collected from Stockpile on Pad T

In order to comply with the Waste Rock, Ore and Mine Backfill Management Plan (TMAC 2019), SRK collected samples of waste rock that was placed on the stockpile since the previous inspection (August 2018). SRK collected 10 samples (Table 2-2) with sample distribution according to the rock types visually identified by SRK during the stockpile inspection (Section 2.1.2) and also the proportion of rock types that were intersected by mining, as provided by TMAC geologists.

Each sample consisted of a sieved coarse fraction (screened to -1 cm) for ABA and total metals, and a finer fraction (screened to -2 mm) for rinse tests and shake flask extraction tests. SRK visually described the samples, including rock type, sulphide (quantity, type and habit) and carbonates (quantity, type and fizz test with 10% HCl). Rinse tests involved mixing a 1 to 1 ratio of distilled water and solids and measuring the resulting pH and electrical conductivity (EC).

SRK shipped samples to BV in Burnaby, BC for sample preparation and analysis of ABA (Section 2.3). Three samples were selected by SRK for shake flask extraction (SFE) testing based upon the high values of rinse EC. One field duplicate was collected for QAQC purposes (see Section 2.4 for more detail).

Table 2-2: Pad T Waste Rock Monitoring Samples Collected and Associated Test Program

Rock Type[1]	ABA & Elemental Analysis	SFE	Rinse Test (pH and EC)
1a	4	0	4
1as	5	3	5
12q	1	0	1
Total Number of Tests	10	3	10

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 110 Doris WR Monitoring\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev03.xlsx

Note:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12q = quartz veins

2.2.3 Waste Rock from Crown Pillar Recovery

In 2018, waste rock from the Doris CPR was placed in a separate stockpile from waste rock source from the underground with the objective of using CPR waste rock for construction, as required (Figure 2-1). In 2019, TMAC collected an additional 24 samples from the CPR waste rock stockpile to supplement the six samples collected in 2018 (SRK 2019) with the objective of demonstrating the suitability of using CPR waste rock as construction rock. Samples were collected from the stockpile in winter. Samples were selected based on spatial representation of the stockpile because snow cover on the stockpile precluded a geological inspection. Based on operational monitoring records of waste rock geology (SRK 2019) the sampling program included all waste rock types intersected during mining of the Doris CPR. Samples were sieved to -1 cm size fraction prior to being sent to the laboratory.

TMAC geologists collected and geologically described the 24 samples from the CPR waste rock stockpile representing a sampling density of one sample per 1,600 t of waste rock (Table 1-1). The sampling and test work program design was according to the program requirements documented in TMAC (2019) to demonstrate the suitability of waste rock as construction rock. Sample locations were randomly distributed across the area of the stockpile and an excavator used to disturb frozen areas of the stockpile to allow sample collection.

TMAC visually described the samples (Attachment A) including rock type, sulphide (quantity, type and habit) and carbonates (quantity, type and fizz test with 10% HCl) and sieved samples to -1 cm size fraction for ABA and trace metals and -2 mm for SFE tests and rinse tests. TMAC shipped 24 samples to BV for ABA, elemental analysis and SFE tests on a subset of samples (Table 2-3). Analytical instructions were provided by TMAC with review of sample preparation and analytical methods by SRK.

Table 2-3: Doris CPR Waste Rock Samples Collected to Demonstrate Suitability as Construction Rock

Source Area	Rock Type[1]	ABA & Elemental Analysis	SFE	Rinse
CPR Stockpile	1a	14	6	6
	1as	10	4	4
	Total Number of Tests	24	10	10

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 110 Doris WR Monitoring\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev03.xlsx

Note:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

Figure 2-1: 2018 Map of CPR Waste Rock Stockpile

2.3 Analytical Methods

The geochemical analytical methods for waste rock samples are summarized as follows:

- Total sulphur by Leco;
- Sulphate by HCl leach;
- TIC by Leco furnace to directly measure CO_2 gas evolved from HCl treatment of the sample;
- Modified Sobek NP (MEND 1991);
- Elemental analysis was determined by aqua regia digestion followed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analyses. This included determination of 9 major elements (e.g., aluminium, calcium, magnesium, sodium, potassium, iron, sulphur) and 26 trace elements (e.g., arsenic, zinc, copper, cadmium, lead).

- SFE tests, on the -2 mm size fraction, using a 3:1 solution to solid ratio and a 24 hour shaking period (MEND 2009). SFE leachates were analyzed for pH, EC, total dissolved solids (TDS), SO_4, alkalinity, acidity, chloride, ammonia, NO_3, NO_2 and element analysis by ICP-MS (including Hg).

2.4 Quality Assurance and Quality Control

All results, including BV's internal QA/QC program, were reviewed by SRK for quality assurance. Table 2-4 presents a summary of the QA/QC checks for the waste rock samples collected from the underground mine and CPR by TMAC and from Pad T by SRK, including the assessment of duplicate and blank samples and standard reference materials. SRK determined all data to be acceptable.

Table 2-4: Summary of QA/QC Results

QC Test	SRK QC Criteria	Results	
paste pH			
Field Duplicate	For any samples, +/- 0.5 difference pH unit	(n=1)	All Passed
Pulp Duplicate	For any samples, +/- 0.5 difference pH unit	(n=6)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2)	All Passed
Total C and TIC			
Method Blank	<2X detection limit (DL)	(n=3) for TIC	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=1)	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=4) for TIC	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2) for TIC	All Passed
Total S & Total Sulphate			
Method Blank	<2X detection limit (DL)	(n=3) for Total S and (n=3) for SO_4	All Passed
Sulphur balance (total S > sulphate S)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within +/-20%	(n=40)	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=1) for total S and (n=1) for SO_4	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2) for Total S and (n=6) for SO_4	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2) for Total S and (n=2) for SO_4	All Passed
Modified NP			
Method Blank (n=0)	<2X detection limit (DL)	(n=3) for NP	All Passed
NP consistent with paste pH	Negative NP has paste pH <= 5	(n=40)	All Passed
Field Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=1) for NP and (n=1) for Fizz Rating	All Passed
Pulp Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=6) for NP and (n=6) for Fizz Rating	All Passed
Fizz test rating with NP	Max NP does not exceed fizz test rating	(n=40)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=3) for NP	All Passed
Modified NP and TIC			
Comparison between Modified NP and TIC	Check for trends/co-relation	(n=40)	TIC generally higher than NP

QC Test	SRK QC Criteria	Results	
Total S-Leco and S-ICP			
Comparison between Total S-Leco and S-ICP	For samples >10X detection limit (DL), % RPD within +/-20%	(n=40)	R828409 failed. Both S-Leco and S-ICP re-run and results confirmed. Data accepted.
Trace Elements (Aqua Regia Digestion with ICP Finish)			
Method Blank	<2X Detection Limit	(n=3)	All Passed
Field Duplicate	For samples >10X detection limit (DL), % RPD within +/- 30%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	(n=1)	All Passed
Pulp Duplicate	For samples >10X detection limit (DL), % RPD within +/- 20%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	(n=3)	All Passed
Standard Reference Material	Within +/-15 % Difference	(n=6)	All Passed
MEND SFE			
Method Blank	<5x Detection Limit	(n=2)	All Passed
Pulp Duplicate	For samples >10X detection limit (DL), % RPD within +/- 20%, ok 10% of metal scan failing.	(n=4)	All Passed
Ion Balance	EC>100 uS/cm, % difference should be within +/-10%	(n=13)	SRK19-WR-01 failed due to low cations. Sample was rerun and results confirmed. Data accepted.
Standard Reference Material	Within specified tolerance ranges.	(n=2) for SO_4 and Total Alkalinity, (n=1) for the rest of the parameters	All Passed
Rinse pH			
Field Duplicate	For any samples, +/- 0.5 difference pH unit	(n=1)	All Passed
Pulp Duplicate	For any samples, +/- 0.5 difference pH unit	(n=4)	All Passed
Rinse pH vs. SFE pH	For any samples, +/- 0.5 difference pH unit	(n=3)	All Passed
Rinse EC			
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=4)	All Passed
Rinse EC vs. SFE EC	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=3)	Rinse EC higher than SFE EC due to differences in solid to solution ratios.

QC Test	SRK QC Criteria	Results	
Rinse Test for Cl and Total Ammonia			
Method Blank	<5x Detection Limit	(n=1) for Cl	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=0)	#N/A
Standard Reference Material	Within specified tolerance ranges.	(n=1) for Cl	All Passed
Chloride			
Method Blank	<5X Detection Limit	(n=3)	All Passed
Matrix Spike	Within specified tolerance ranges.	(n=3)	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2)	All Passed
Total Ammonia			
Method Blank	<5X Detection Limit	(n=3)	All Passed
Matrix Spike	Within specified tolerance ranges.	(n=3)	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2)	All Passed

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2.5 Data Interpretation Methods

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample. On the basis of sulphide (calculated as the difference between total sulphur and sulphate) and total sulphur content being at near parity, total sulphur was used to calculate AP. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when TIC/AP ratios are less than 1 and as having an uncertain potential for ARD when TIC/AP ratios are between 1 and 3. For samples with Modified NP, interpretations of ratios of NP to AP were the same as TIC to AP.

3 Results and Discussion

3.1 Waste Rock from the Underground Mine

3.1.1 Geological Inspection

A summary of the samples collected are provided in Table 3-1 and include primarily mafic volcanics (1a) with fewer altered mafic volcanics (1as). Visual sulphide content typically ranged from none to <1%, with 1 to 2% observed in altered basalt. All waste rock from the underground mine placed on Pad T was classified as mineralized.

Based on routine underground geological mapping by TMAC, waste rock intersected by the Doris underground workings between January and December 2019, waste rock was primarily (95%) mafic metavolcanic flow (1a); and lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, with rare (1%) diabase or felsic dykes.

3.1.2 ABA

ABA data are presented in Table 3-1 with complete results presented in Attachment B.

Mafic Metavolcanics (1a)

The paste pH of mafic metavolcanics (1a) ranged from 8.4 to 8.9.

Sulphur concentrations were uniformly low with a median value of 0.12% and a range of 0.02 and 0.33%, respectively. Sulphate content was below or near the limit of detection (0.01%).

TIC content ranged from 110 to 350 kg $CaCO_3$ eq/tonne with median levels of 230 kg $CaCO_3$ eq/tonne. Modified NP ranged from 140 to 170 kg $CaCO_3$ eq/tonne. For the three samples with full ABA, Modified NP was less than TIC (Figure 3-1), which results in TIC values that overestimates the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-2 and Figure 3-3).

Altered Mafic Volcanics (1as)

The paste pH of altered mafic metavolcanics (1as) ranged from 9.2 to 9.3.

Sulphur concentrations ranged from 0.12 to 1.1%. Sulphate was near the level of analytical detection (0.01%).

TIC and Modified NP content ranged from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. Modified NP was less than TIC (Figure 3-1), which results in TIC values that overestimate the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-2 and Figure 3-3).

Table 3-1: Statistical Summary of ABA Analyses for Underground Waste Rock Samples

Rock Type[1]	Statistic	Paste pH	TIC	Total S	SO_4	AP	Modified NP	TIC/AP	NP/AP
		s.u.	kg $CaCO_3$/t	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t		
1a	P000	8.4	110	0.02	0.01	0.6	140	25	24
	P025	8.4	190	0.10	0.01	3.0	150	42	26
	P050	8.4	230	0.12	0.02	3.8	160	54	28
	P075	8.7	310	0.17	0.02	5.4	160	71	30
	P100	8.9	350	0.33	0.02	10	170	500	32
	Count	3	16	16	4	16	3	16	3
1as	P000	9.2	190	0.12	0.01	3.8	140	9.2	4.2
	P025	9.2	250	0.17	0.01	5.2	140	29	8.9
	P050	9.2	310	0.21	0.01	6.6	150	49	13
	P075	9.2	310	0.64	0.01	20	150	49	18
	P100	9.3	320	1.1	0.01	33	150	50	23
	Count	2	3	3	1	3	2	3	2

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

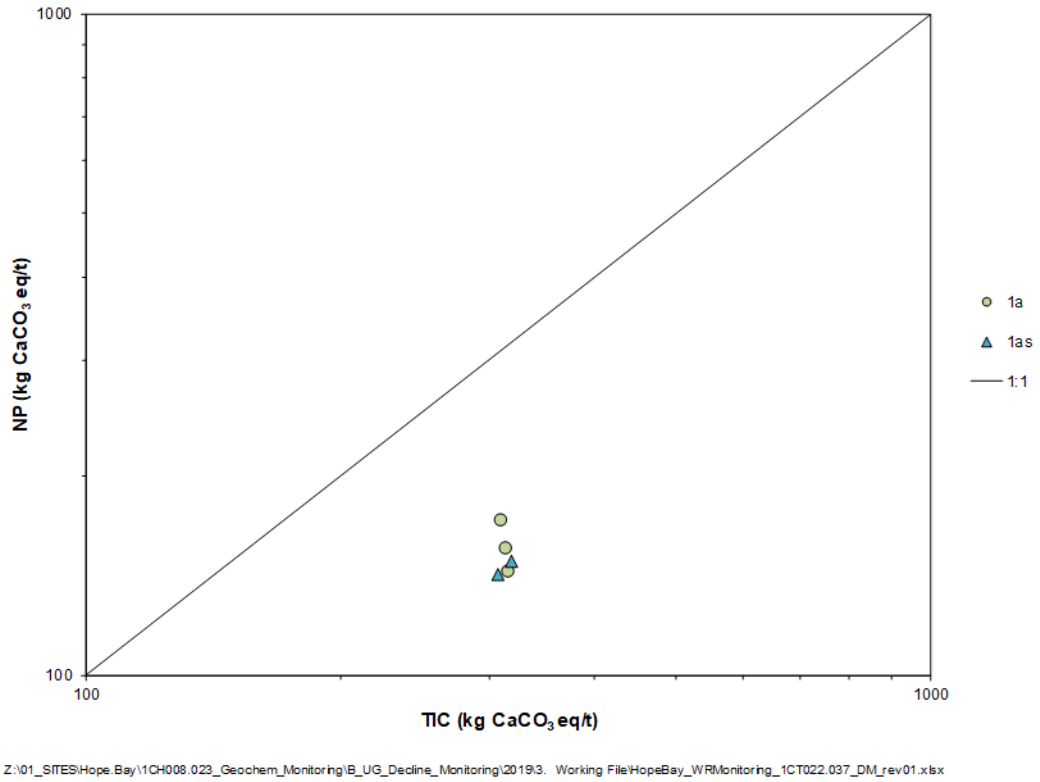

Figure 3-1: Modified NP versus TIC, Underground Waste Rock Samples

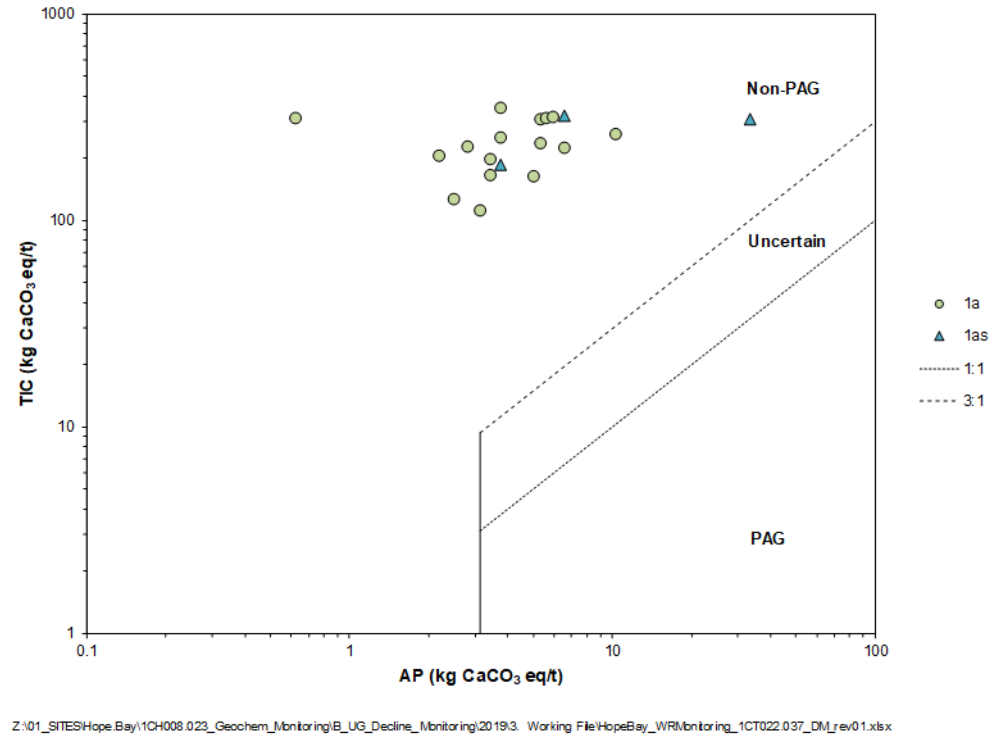

Figure 3-2: ARD Classifications based on TIC versus AP, Underground Waste Rock Samples

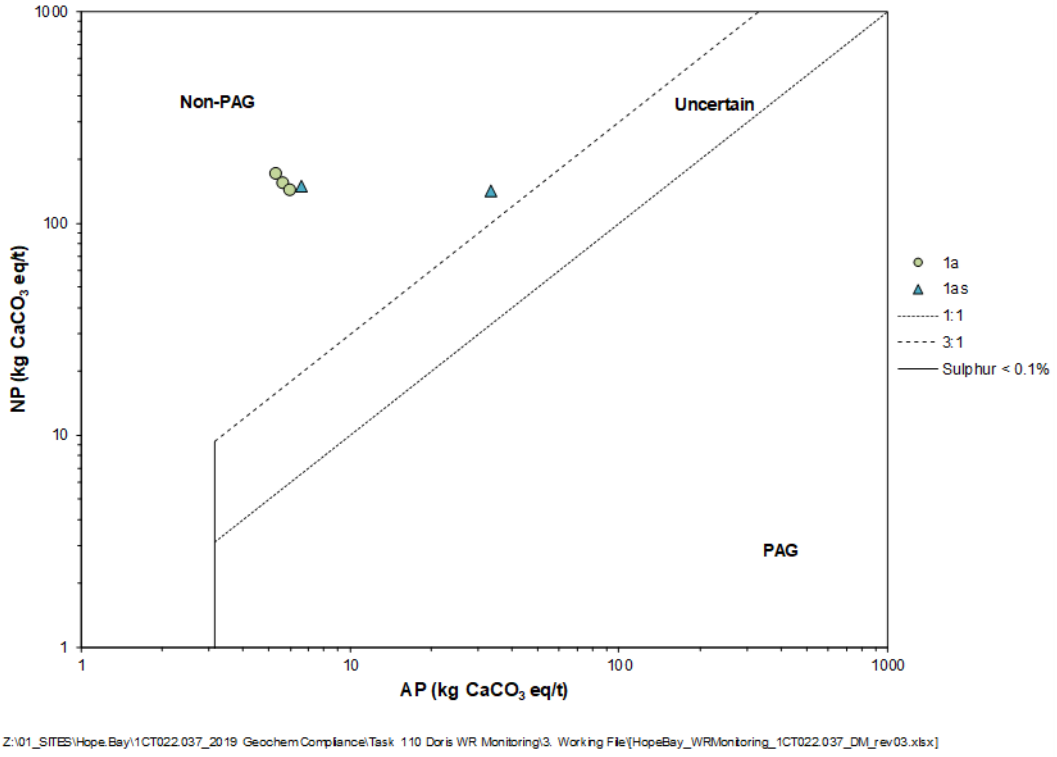

Figure 3-3: ARD Classifications based on NP versus AP, Underground Waste Rock Samples

3.1.3 Trace Elemental Analyses

Trace element data for metavolcanics (1a) and mafic metavolcanics (1as) samples are summarized in Table 3-2 with complete results presented in Attachment C. Results were compared to ten times the average crustal abundance (CA) for basalt (Price 1997) as an indicator of enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

One sample of altered mafic metavolcanics (1as; Y041493) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% visual sulphides. Concentrations for all other samples and parameters were less than ten times the average CA for basalt indicating no appreciable enrichment. This includes samples Y041497 (mafic metavolcanics) and W573598 (altered mafic metavolcanics), which were described as mineralized with 1% visual sulphides (Attachment A).

Table 3-2: Statistical Summary of Elemental Analyses for Underground Waste Rock Samples

Parameter	Detection Limit	Unit	Mafic metavolcanics (1a)			Altered Mafic metavolcanics (1as)		10x Average Crustal Abundance* for Basalt
			Y041490	W573599	Y041497	W573598	Y041493	
Ag	0.1	ppm	0.1	0.1	0.1	0.1	0.1	1.1
As	0.1	ppm	12	2.5	3.1	17	**59**	20
Ba	0.5	ppm	12	7	10	11	10	3300
Ca	0.01	%	6.0	7.6	5.3	5.8	5.9	76
Cd	0.1	ppm	0.1	0.2	0.1	0.1	0.1	2.2
Co	0.1	ppm	24	26	26	26	28	480
Cr	0.5	ppm	14	11	11	12	10	1700
Cu	0.1	ppm	24	26	37	28	24	870
Fe	0.01	%	9.9	9.4	9.8	9.7	10	87
Hg	0.01	ppm	0.01	0.01	0.01	0.01	0.01	0.09
Mg	0.01	%	1.5	1.6	1.5	1.5	1.4	46
Mn	1	ppm	2300	2300	2000	2200	2230	15000
Mo	0.01	ppm	0.1	0.2	0.4	0.2	0.1	15
Ni	0.1	ppm	1.3	1.8	1.1	2.9	1.1	1300
P	0.001	%	0.080	0.080	0.088	0.089	0.084	1
Pb	0.01	ppm	1	1.1	1.3	0.9	1.4	60
S	0.05	%	0.19	0.15	0.16	0.17	**0.97**	0.3
Sb	0.1	ppm	0.1	0.1	0.1	0.1	0.1	2
Sr	1	ppm	68	41	44	40	44	4650
U	0.1	ppm	0.1	0.1	0.1	0.1	0.1	10
V	2	ppm	18	27	12	12	10	2500
W	0.1	ppm	0.1	0.1	0.1	0.1	0.1	7
Zn	0.1	ppm	100	110	110	88	87	1050

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

* Numbers bolded and underlined exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)

3.2 Waste Rock from Pad T Stockpile

3.2.1 Geological Inspection

Based on routine underground geological mapping by TMAC, waste rock intersected by the Doris underground workings between January and June 2019 was geologically described as 97% mafic volcanics, 2% quartz veins and 1% diabase.

SRK inspected waste rock located on the upper bench of Pad T (Figure 1-1). The upper lift of the waste rock stockpile of Pad T was a mixture of approximately 40% dark green mafic metavolcanics (1a, Figure 3-4), 50% light brown foliated altered mafic metavolcanics (1as, Figure 3-5) and 10% massive blocky quartz veins (12q, Figure 3-6). Diabase was not observed. This could be because it was not visible, or diabase was placed directly as backfill in the underground and not brought to surface.

Both rock types, mafic metavolcanics (1a) and altered mafic metavolcanics (1as), had quartz and calcite veinlets (up to several cm thick) with rare occurrences of very-fine grained disseminated cubic pyrite (≤1%), and variable hematite staining. The altered mafic metavolcanics were less competent than the dark green mafic metavolcanics which occurred as boulders of variable size. Fizz test was strong for mafic metavolcanics (1a) and moderate to strong for altered mafic metavolcanics (1as). The quartz veins (12q) were associated with greater very-fine grained disseminated cubic pyrite content (5%) than the mafic metavolcanics. The fizz test was moderate for quartz (12q).

Figure 3-4: Dark Green Mafic Metavolcanics (1a) with Quartz Veining (SRK19-WR03)

Figure 3-5: Light Brown Altered Mafic Metavolcanics (1as), Note Calcite Vein on Fresh Face Near Hammer (SRK19-WR04)

Figure 3-6: Quartz Vein (12q) Waste Rock Pile (SRK19-WR06)

3.2.2 Rinse Tests

Rinse tests on the sieved -2 mm fraction indicated pH and EC values ranging from 7.9 to 8.4 s.u. and 2,700 to 7,300 µS/cm, respectively (Table 3-3).

Table 3-3: Rinse Test Results, Pad T Waste Rock

Rock Type	Sample ID	Rinse pH	Rinse EC
		s.u.	µS/cm
1a	SRK19-WR-03	8.4	2800
	SRK19-WR-05	7.9	6000
	SRK19-WR-07	8.3	5500
	SRK19-WR-10	8.4	2700
1as	SRK19-WR-01	7.8	6100
	SRK19-WR-02	8.2	5300
	SRK19-WR-04	7.9	6400
	SRK19-WR-08	8.1	3700
	SRK19-WR-09	8.0	7300
12q	SRK19-WR-06	8.3	5600

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Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12q = quartz vein

3.2.3 ABA

A summary of ABA data are presented in Table 3-4 and Figure 3-7 to Figure 3-10. Full results are presented in Attachment D.

Values of paste pH for all rock types ranged from 7.8 to 8.4.

Overall, total sulphur content for all samples was less than 1%, with highest concentration measured in the quartz (12q; 0.98%) which was higher than altered mafic metavolcanics (1as; median of 0.24%) followed by mafic metavolcanics (1a; median of 0.16%). Sulphate content was below or near the level of analytical detection (0.01%). Sulphide sulphur, calculated as the difference between total sulphur and sulphate, was at near parity with total sulphur (Figure 3-7).

Modified NP and TIC did not vary between rock types with values ranging from 150 to 190 kg $CaCO_3$ eq/tonne and 180 to 300 kg $CaCO_3$ eq/tonne, respectively. TIC content was greater than NP for all rock types (Figure 3-8), suggesting that TIC values overestimate the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-9 and Figure 3-10).

Table 3-4: Statistical Summary of ABA Analyses for Pad T Waste Rock Samples

Rock Type	Statistic	Paste pH	TIC	Total S	SO_4	AP	Modified NP	TIC/AP	NP/AP
		s.u.	kg $CaCO_3$/t	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-
1a	P000	7.9	200	0.12	0.01	3.8	150	30	20
	P025	8.1	230	0.12	0.03	3.8	160	39	26
	P050	8.2	250	0.16	0.04	5.0	160	48	34
	P075	8.3	270	0.21	0.05	6.6	170	60	41
	P100	8.4	290	0.25	0.06	7.8	170	78	43
	Count	4	4	4	4	4	4	4	4
1as	P000	7.8	180	0.19	0.01	0.01	150	10	5.7
	P025	7.9	270	0.20	0.01	0.01	150	19	12
	P050	8.1	270	0.24	0.01	0.01	170	28	24
	P075	8.1	290	0.51	0.01	0.01	180	35	25
	P100	8.3	300	0.83	0.07	0.07	190	49	27
	Count	5	5	5	5	5	5	5	5
12q (n=1)	-	8.2	220	0.98	0.04	0.01	160	7.2	5.3

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Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12 = quartz vein

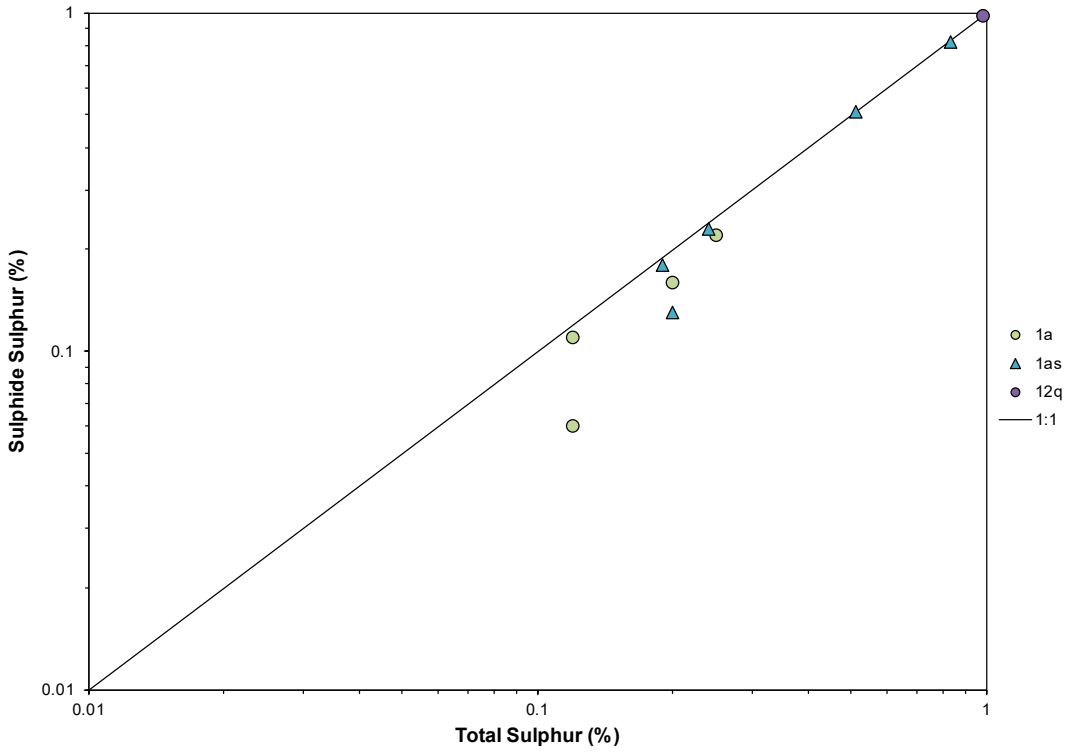

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Figure 3-7: Comparison of Total Sulphur versus Sulphide, Pad T Waste Rock

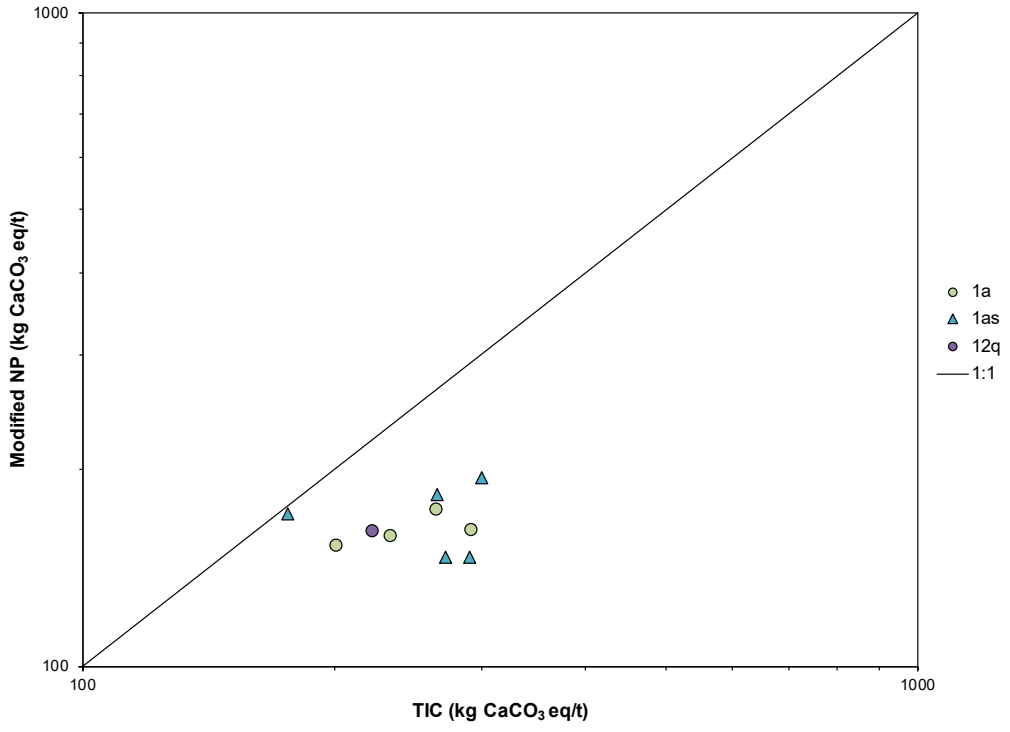

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Figure 3-8: Comparison of Modified NP versus TIC, Pad T Waste Rock

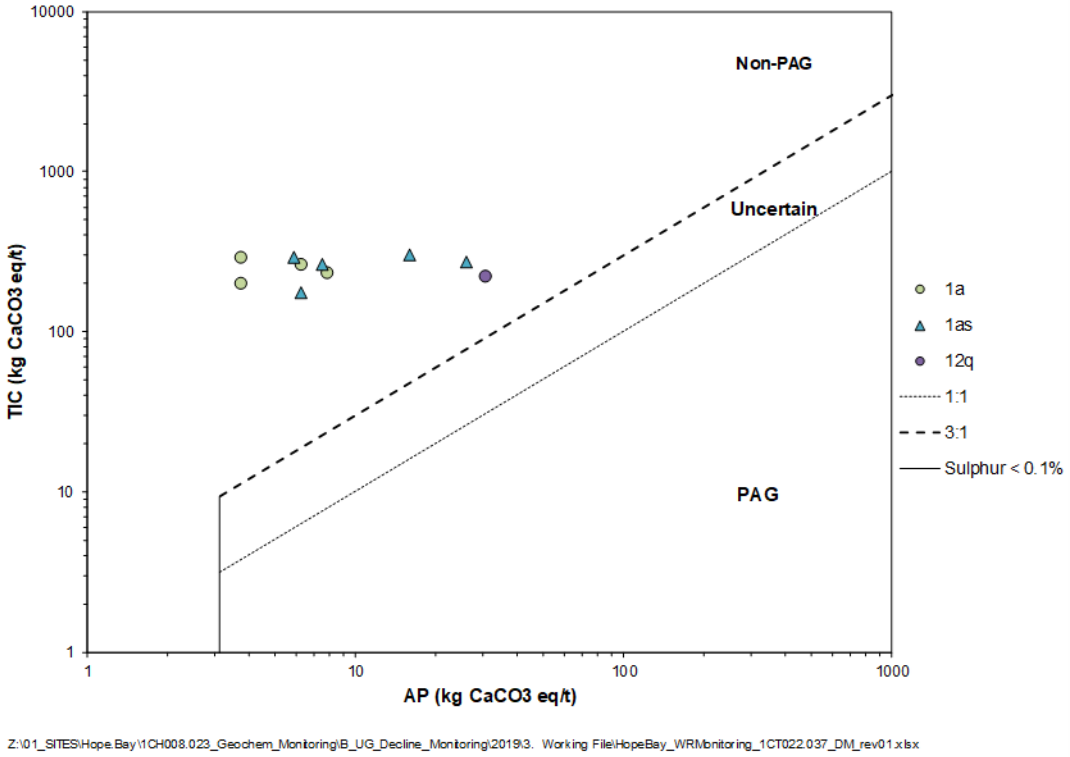

Figure 3-9: ARD Classifications by TIC/AP, Pad T Waste Rock

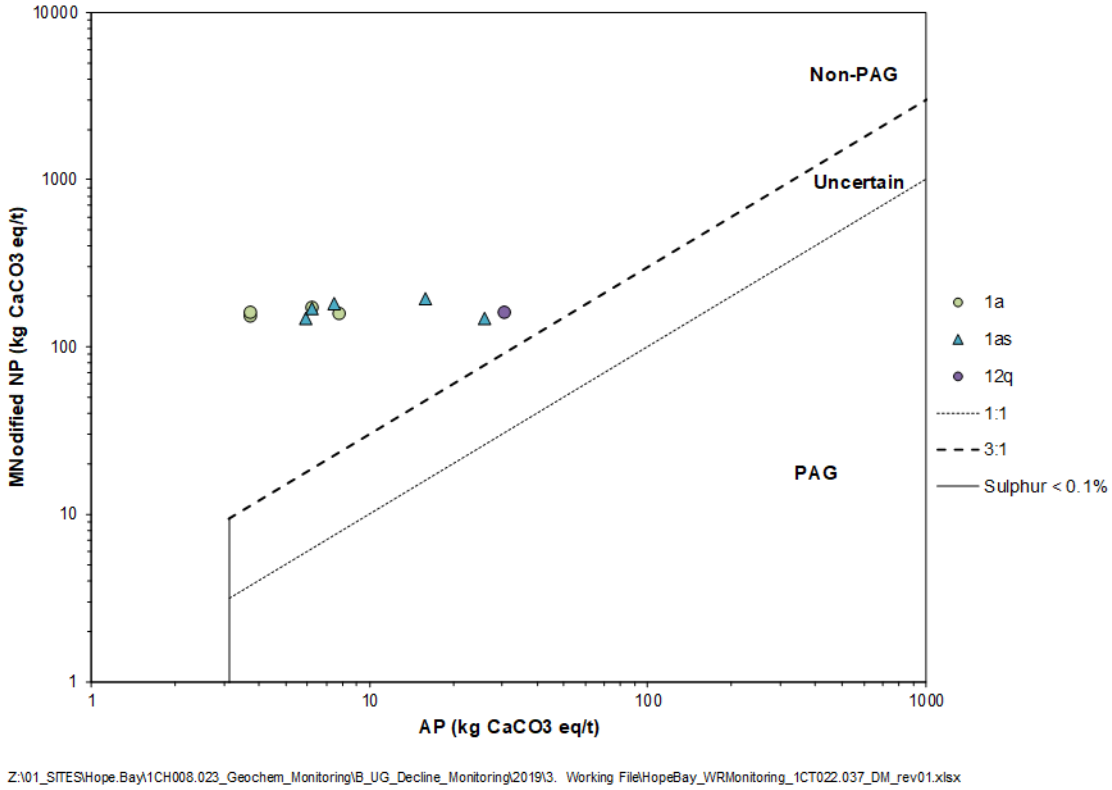

Figure 3-10: ARD Classifications by NP/AP, Pad T Waste Rock

3.2.4 Trace Elemental Analyses

A statistical summary of trace element content is presented in Table 3-5 with complete laboratory results presented in Attachment E. Table 3-5 presents the data as the median and maximum values by rock type. Results were compared to ten times average CA for basalt (Price 1997) as an indicator of enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

Arsenic and sulphur were enriched compared to the average CA of basalt. Five samples were enriched in arsenic: one sample each of mafic metavolcanics (1a) and quartz (12q) and three samples of altered mafic metavolcanics (1as). Sulphur was enriched in three samples, two of which were altered mafic metavolcanics (1as) and one of quartz (12q).

Table 3-5: Summary of Elemental Analyses for Pad T Waste Rock

Parameter	Unit	Detection Limit	1a (n=5)[1]		1as (n=4)[1]		12q (n=1)[1]	10x Average Crustal Abundance* for Basalt
			P50	P100	P50	P100	-	
Ag	ppm	0.1	0.1	0.2	0.1	0.5	0.5	1.1
As	ppm	0.1	7.4	**20**	**24**	**48**	**85**	20
Ba	ppm	0.5	9.0	11	11	13	5.0	3300
Ca	%	0.01	6.1	6.5	6.1	7.6	5.0	76
Cd	ppm	0.1	0.1	0.2	0.2	0.3	0.2	2.2
Co	ppm	0.1	28	42	31	40	23	480
Cr	ppm	0.5	19	38	22	31	49	1700
Cu	ppm	0.1	45	229	70	84	45	870
Fe	%	0.01	8.4	9.3	7.9	9.8	3.6	87
Hg	ppm	0.01	0.01	0.01	0.01	0.01	0.01	900
Mg	%	0.01	1.4	2.3	1.5	2.1	1.6	46
Mn	ppm	1	1900	2100	1800	2000	850	15000
Mo	ppm	0.01	0.4	0.5	0.4	0.7	0.3	15
Ni	ppm	0.1	7.6	40	20	45	57	1300
P	%	0.001	0.076	0.11	0.069	0.085	0.054	1
Pb	ppm	0.01	4.3	5.7	4.2	8.4	5.4	60
S	%	0.05	0.14	0.24	0.21	**0.72**	**0.98**	0.3
Sb	ppm	0.1	0.1	0.2	0.1	0.2	0.2	2
Sr	ppm	1	34	41	37	44	34	4650
U	ppm	0.1	0.1	0.1	0.1	0.1	0.1	10
V	ppm	2	39	150	39	220	10	2500
W	ppm	0.1	0.1	0.1	0.1	1.4	0.2	7
Zn	ppm	0.1	110	110	95	130	28	1050

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Note:

* Numbers bolded and underlined exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12 = quartz vein

3.2.5 SFE Tests

A summary of results for key SFE parameters is presented in Table 3-6 and complete results are included in Attachment F.

All SFE tests had alkaline pH ranging from 8.1 to 8.3. s.u. Values of EC ranged from 2,300 to 2,400 µS/cm.

Major cation chemistry was dominated by sodium (110 to 250 mg/L) and calcium (71 to 140 mg/L), while major anion chemistry was dominated by alkalinity (30 to 73 mg/L as $CaCO_3$), chloride (180 to 490 mg/L), nitrate (140 to 170 mg/L), and sulphate (40 to 48 mg/L). The source of nitrate and ammonia are explosives residues and the source of chloride is drilling brines.

The results indicate that the potential for metal leaching from these samples is low. Increased arsenic levels were not correlated to an increase in total sulphur values (Attachment D) for the 1as samples as SRK19-WR-01 had a total sulphur value of 0.83% but had the lowest dissolved arsenic.

Table 3-6: Shake Flask Extraction Results, 2019 Pad T Waste Rock Samples

Sample ID	Unit	Detection Limit	Altered Mafic Metavolcanics (1as)		
			SRK19-WR-01	SRK19-WR-04	SRK19-WR-09
pH	pH Units	5.73	8.1	8.3	8.2
EC	uS/cm	1	2300	2400	2400
Total Alkalinity	mg/L	0.5	73	33	30
SO_4	mg/L	0.5	48	40	43
Cl	mg/L	0.5	180	490	420
Ca	mg/L	0.05	71	130	140
Mg	mg/L	0.05	29	39	48
K	mg/L	0.05	22	20	36
Na	mg/L	0.05	110	250	220
Nitrate	mg/L as N	0.2	170	140	160
Nitrite	mg/L as N	0.05	1.8	1.1	1.4
Al	mg/L	0.0005	0.038	0.076	0.069
Sb	mg/L	0.00002	0.00045	0.00034	0.00038
As	mg/L	0.00002	0.00025	0.0022	0.0042
Ba	mg/L	0.000063	0.029	0.020	0.019
B	mg/L	0.05	0.12	0.10	0.086
Cs	mg/L	0.00005	0.0042	0.0053	0.0059
Cd	mg/L	0.000005	0.000012	*<0.000005*	*<0.000005*
Cr	mg/L	0.0001	0.00073	0.00015	0.0002
Co	mg/L	0.000005	0.0023	0.0018	0.0043
Cu	mg/L	0.00005	0.0035	0.00098	0.00081
Fe	mg/L	0.001	*<0.001*	0.003	*<0.001*
La	mg/L	0.00005	*<0.00005*	*<0.00005*	*<0.00005*
Pb	mg/L	0.000005	0.000018	0.000093	0.0000094
Li	mg/L	0.0005	0.0072	0.0076	0.0065
Mn	mg/L	0.00005	0.25	0.15	0.22
Hg	mg/L	0.00005	*<0.00005*	*<0.00005*	*<0.00005*
Mo	mg/L	0.00005	0.00090	0.0013	0.0022
Ni	mg/L	0.00002	0.000053	0.0012	0.0052
Se	mg/L	0.00004	0.00072	0.00064	0.0017
Sr	mg/L	0.00005	0.26	0.66	0.60
S	mg/L	10	17	16	16
Tl	mg/L	0.000002	0.000061	0.000066	0.00011
U	mg/L	0.000002	0.0000049	0.000011	0.0000051
V	mg/L	0.0002	*<0.0002*	*<0.0002*	*<0.0002*
Zn	mg/L	0.0001	0.00012	0.0018	0.00078

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes: All element concentrations are given as dissolved; SFE tests do not represent natural waters.

Values in italics represent values below the detection limit.

3.3 Assessment of CPR Waste Rock as Construction Rock

This section presents the geochemical results of the CPR waste rock stockpile samples collected in 2019 and presents the results in the context of suitability of waste rock for use as construction rock, as compared to the criteria in TMAC (2019).

3.3.1 Geological Inspection

CPR waste rock samples collected in the stockpile were described as primarily unaltered (1a) grey or green mafic metavolcanics (basalt) with minor sericitic alteration and altered mafic metavolcanics (1as) with moderate sericitic alteration. Trace disseminated to fine-grained pyrite (≤1%) was observed in the majority of samples with trace quartz and carbonate veins.

3.3.2 Rinse Tests

Rinse tests were conducted on a subset of samples. Rinse pH and EC values ranged from 8.7 to 9.2 and 320 to 480 µS/cm, respectively (Table 3-7).

Table 3-7: Rinse Test Results for 2019 CPR Samples (-2 mm Fraction)

Source	Rock Type[1]		Rinse pH	Rinse EC
			s.u.	µS/cm
Stockpile Material	1a (n=6)	Min	8.9	320
		Max	9.2	480
	1as (n=4)	Min	8.7	430
		Max	8.9	570

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12 = quartz vein

3.3.3 ABA

A summary of ABA data are presented in Table 3-8 and Figure 3-11 to Figure 3-14 with complete results presented in Attachment G.

Values of paste pH ranged from 8.5 to 9.4.

Total sulphur ranged from 0.05 to 0.78%. Sulphate values were typically at or below detection limit (0.01%). Sulphide, calculated as the difference between total sulphur and sulphate, was at near parity with sulphide sulphur (Figure 3-11).

TIC and Modified NP content ranged from 220 to 370 kg $CaCO_3$ eq/tonne and 150 to 190 kg $CaCO_3$ eq/tonne, respectively. There were no appreciable differences in TIC or NP content between rock types. TIC content was greater than NP (Figure 3-12), suggesting that TIC values overestimates the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. All samples were classified as non-PAG on the basis of NP/AP and TIC/AP (Figure 3-13 and Figure 3-14).

Table 3-8: ABA Data for CPR Samples

Rock Type[1]	Sample ID	Paste pH	TIC	Total S	SO_4	AP	Modified NP	TIC/AP	NP/AP
		s.u.	kg $CaCO_3$/t	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-
1a	R828418	8.8	260	0.21	0.03	6.6	160	40	25
	R828419	8.9	270	0.25	0.01	7.8	150	35	19
	R828420	9	250	0.78	0.01	24	180	10	7.2
	R828421	8.5	250	0.32	0.01	10	160	25	16
	R828422	9.4	370	0.14	0.01	4.4	190	84	43
	R828423	9	230	0.22	0.01	6.9	170	34	25
	R828424	8.6	320	0.1	0.01	3.1	180	100	56
	R828425	9.2	300	0.1	0.01	3.1	180	97	57
	R828426	9	300	0.17	0.01	5.3	180	56	33
	R828427	9	330	0.14	0.01	4.4	170	75	38
	R828428	8.8	310	0.32	0.01	10	180	31	18
	R828429	9	360	0.2	0.01	6.3	180	58	29
	R828430	9.1	280	0.49	0.01	15	170	18	11
	R828431	9.1	280	0.05	0.01	1.6	180	180	110
1as	R828406	9.1	290	0.23	0.01	7.2	180	40	25
	R828407	8.9	230	0.19	0.01	5.9	170	39	28
	R828408	9	270	0.28	0.01	8.8	170	31	19
	R828409	8.9	240	0.27	0.01	8.4	180	29	21
	R828410	8.8	240	0.32	0.01	10	160	24	16
	R828411	9	220	0.55	0.02	17	150	13	9
	R828412	9	300	0.59	0.01	18	190	16	11
	R828413	9.1	300	0.19	0.01	5.9	180	51	30
	R828414	8.8	260	0.36	0.01	11	160	23	14
	R828415	8.6	260	0.23	0.01	7.2	170	37	23

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

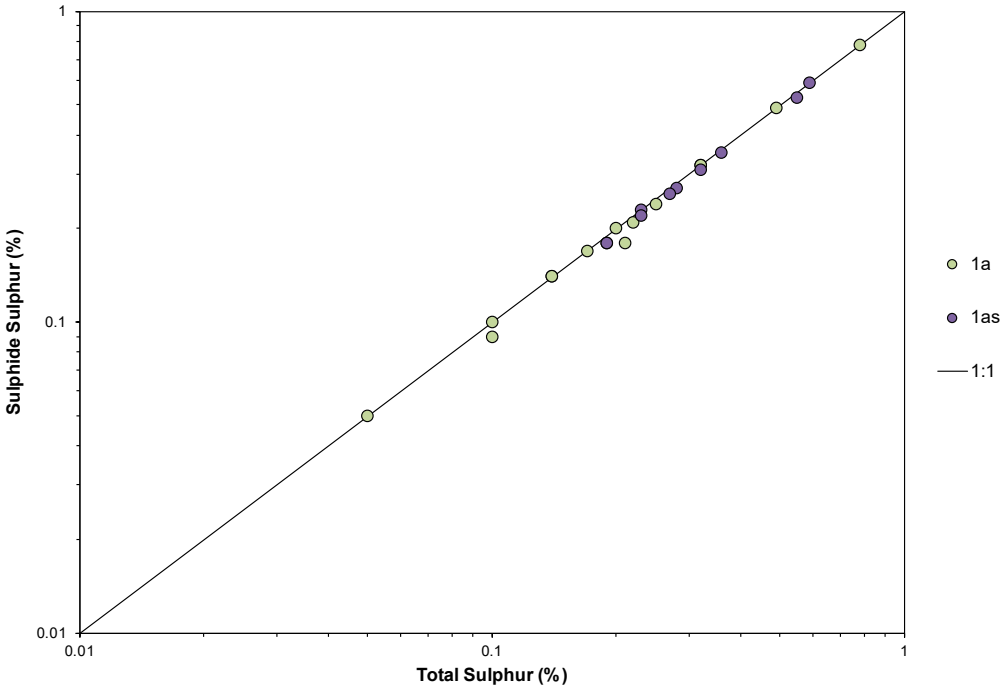

Figure 3-11: Comparison of Total Sulphur vs Sulphide in CPR Samples

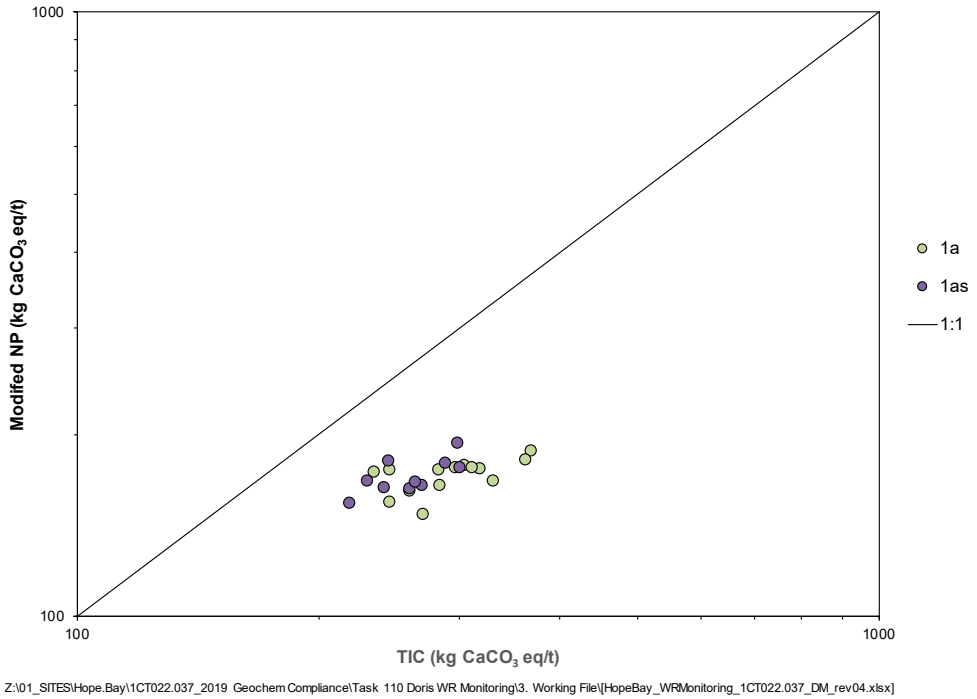

Figure 3-12: Comparison of Modified NP versus TIC, CPR Samples

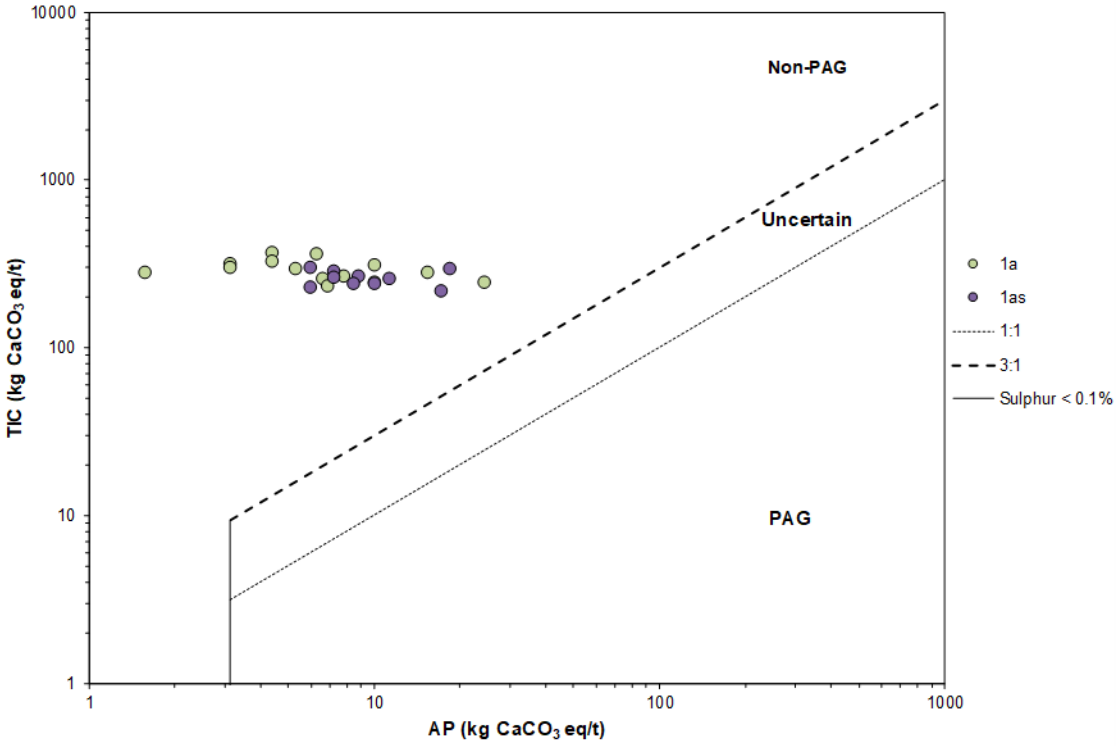

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Figure 3-13: ARD Classifications by TIC/AP, CPR Samples

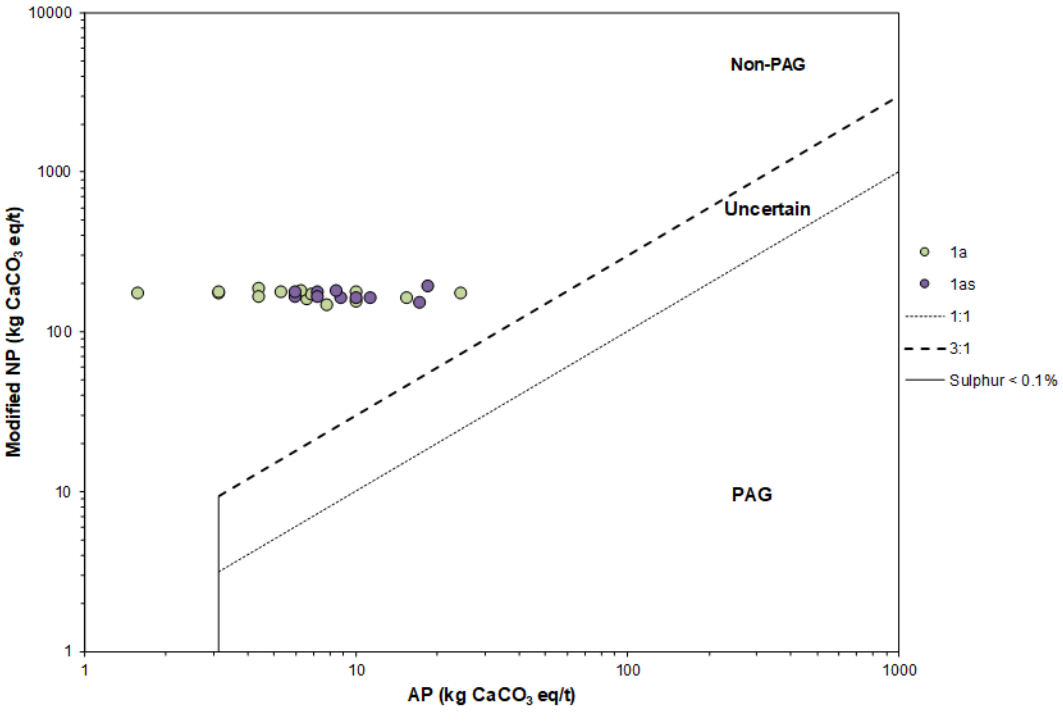

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Figure 3-14: ARD Classifications by NP/AP, CPR Samples

3.3.4 Trace Elemental Analyses

A summary of trace element content is presented in Table 3-9 with complete laboratory results presented in Attachment H. Results were compared to ten times average the crustal abundance for basalt (Price 1997) as an indicator of enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

For both rock types, median values for arsenic content were higher than the screening criterion (Table 3-9). Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver compared to the screening criterion. All other parameters were below the screening criteria suggesting no appreciable enrichment.

Table 3-9: Summary of Elemental Analyses for CPR Waste Rock

Parameter	Unit	Detection Limit	Stockpile Material				10x Average Crustal Abundance* for Basalt
			1a (n=14)[1]		1as (n=10)[1]		
			P50	P100	P50	P100	
Ag	ppm	0.1	0.1	**1.9**	0.1	0.3	1.1
As	ppm	0.1	**24**	**74**	**23**	**35**	20
Ba	ppm	0.5	5.5	14	7	14	3300
Ca	%	0.01	5.9	7.2	5.4	7.1	76
Cd	ppm	0.1	0.1	1.2	0.1	0.2	2.2
Co	ppm	0.1	36	58	34	39	480
Cr	ppm	0.5	33	43	36	56	1700
Cu	ppm	0.1	62	100	63	71	870
Fe	%	0.01	8.0	9.4	8.1	9.1	87
Hg	ppm	0.01	0.01	0.01	0.01	0.01	900
Mg	%	0.01	2.0	2.5	1.9	2.5	46
Mn	ppm	1	1700	2300	1770	2000	15000
Mo	ppm	0.01	0.25	0.5	0.4	0.5	15
Ni	ppm	0.1	54	86	32	70	1300
P	ppm	0.001	0.1	0.1	0.064	0.07	1.1
Pb	ppm	0.01	1.2	2.0	3.0	9.0	60
S	%	0.05	0.2	**0.81**	0.26	**0.56**	0.3
Sb	ppm	0.1	0.1	0.1	0.1	0.2	2
Sr	ppm	1	32	42	31	47	4650
U	ppm	0.1	0.1	0.1	0.1	0.1	10
V	ppm	2	36	50	39	54	2500
W	ppm	0.1	0.1	1.2	0.1	0.6	7
Zn	ppm	0.1	86	340	88	120	1050

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

[1] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics

* Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997

3.3.5 SFE Tests

A summary of results for key SFE parameters is presented in Table 3-10 with complete results included in Attachment I.

Median values of pH were 9.3 s.u. Values of EC ranged from 120 to 200 µS/cm.

Major cation chemistry was dominated by calcium (ranging from 6.9 to 9.2 mg/L) and sodium (12 to 23 mg/L), while major anion chemistry was dominated by alkalinity (38 to 43 mg/L), chloride (9.6 to 27 mg/L) and sulphate (1.6 to 13 mg/L). Nitrite were all below the detection limit (0.005 mg/L) and nitrate concentrations ranged from 0.2 to 1.1 mg/L. Results indicate that the potential for metal leaching from these samples is low.

Table 3-10: Shake Flask Extraction Results for 2019 CPR Samples (-2 mm Fraction)

Sample ID	Unit	Detection Limit	CPR Waste Rock Stockpile			
			1a (n=6)		1as (n=4)	
			P50	P100	P50	P100
pH	pH Units	5.87	9.3	9.4	9.3	9.4
EC	uS/cm	1.3	140	170	190	200
TDS	mg/L	10	78	92	92	110
Hardness (as $CaCO_3$)	mg/L	0.5	33	34	31	32
Total Alkalinity	mg/L	0.5	42	48	37	39
SO_4	mg/L	0.5	3.3	7.3	9.7	13
Cl	mg/L	0.5	13	24	22	27
Ca	mg/L	0.05	8.6	9.2	8.5	9.0
Mg	mg/L	0.05	2.7	2.9	2.4	2.5
K	mg/L	0.05	3.0	3.0	4.0	4.7
Na	mg/L	0.05	14	19	20	23
Nitrate	mg/L as N	0.2	0.3	0.4	0.95	1.1
Nitrite	mg/L as N	0.05	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Total Ammonia	mg/L as N	0.047	0.072	0.11	0.19	0.30
Al	mg/L	0.0005	0.50	0.66	0.53	0.70
Sb	mg/L	0.00002	0.00047	0.00080	0.00038	0.00055
As	mg/L	0.00002	0.0029	0.0098	0.0046	0.0079
Ba	mg/L	0.00002	0.00052	0.00087	0.00070	0.00084
B	mg/L	0.05	0.051	0.060	0.061	0.096
Cs	mg/L	0.00005	*< 0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Cd	mg/L	0.000005	*< 0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Cr	mg/L	0.0001	*< 0.0001*	0.00014	*<0.0001*	0.00022
Co	mg/L	0.000005	0.00016	0.00054	0.00035	0.00041
Cu	mg/L	0.00005	0.00016	0.00071	0.00041	0.00054
La	mg/L	0.00005	0.0001	*<0.00005*	*<0.00005*	*<0.00005*
Fe	mg/L	0.001	0.045	0.31	0.079	0.34
Pb	mg/L	0.000005	0.00004	0.000075	0.00015	0.00022
Li	mg/L	0.0005	0.0010	0.0011	0.001015	0.0012
Mn	mg/L	0.00005	0.0050	0.0098	0.0036	0.0081
Mo	mg/L	0.00005	0.0003	0.00056	0.0013	0.0018
Ni	mg/L	0.00002	0.0001	0.00043	0.00016	0.00038
Se	mg/L	0.00004	0.0003	0.00063	0.00044	0.00053
Sr	mg/L	0.00005	0.010	0.0134	0.0118	0.013
S	mg/L	10	*< 10*	*<10*	*<10*	*<10*
Tl	mg/L	0.000002	0.000003	0.0000042	0.0000044	0.0000057
U	mg/L	0.000002	0.00002	0.00015	0.000040	0.000041
V	mg/L	0.0002	0.00073	0.0013	0.00066	0.0012
Zn	mg/L	0.0001	0.000105	0.00062	0.00064	0.00092
Hg	mg/L	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*

Source: Z:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\B_UG_Decline_Monitoring\2019\3. Working File\HopeBay_WRMonitoring_1CT022.037_DM_rev01.xlsx

Notes:

All element concentrations are given as dissolved; SFE tests do not represent natural waters; Values in italics indicates values below the detection limit

3.3.6 Assessment of Suitability to Use as Construction Material

The *Waste Rock, Ore and Mine Backfill Management Plan* outlines the process to determine the suitability of waste rock as construction material (Section 3.2, TMAC 2019). Rock is considered suitable for construction if:

- TIC/AP and NP/AP ratios are greater than 2 with total sulphur content less than 0.1%, or
- TIC/AP and NP/AP ratios are greater than 3 with total sulphur content less than 0.5%.

The results indicate that all 24 of the 2019 samples collected from the CPR waste rock stockpile had values of TIC/AP and NP/AP > 3 and 21 out of 24 samples fulfilled the accompanying sulphur criterion (<0.5%) (Table 3-8). The results indicate that on balance waste rock from the CPR meets the criteria. Confirmatory samples collected from the as-built cover meet the criteria TIC/AP, NP/AP and sulphur criteria (SRK 2020b).

Notably, chloride and ammonia values for the CPR stockpile material are lower than underground water rock samples because drilling brines are not used for CPR rock and blasting practices are different than underground waste rock resulting in a lower load of blast residues on the rock.

3.4 Comparison to Previous Waste Rock Geochemical Characterization Results

This section compares the 2019 waste rock monitoring samples to previous sample sets. Specifically, waste rock samples are presented according to rock type and the following samples sets:

1. Waste rock characterized as part of the Type A water licence amendment application (SRK 2015);
2. Underground mine operational waste rock monitoring samples collected prior to 2019;
3. CPR operational waste rock monitoring samples collected prior to 2019;
4. Underground mine operational waste rock monitoring samples collected in 2019; and
5. CPR operational waste rock monitoring samples collected in 2019.

Table 3-11 summarizes the differences in geological logging codes and sample types for the sample sets. The mafic metavolcanic waste rock samples that were geochemically characterized as part of the Type A Doris water licence amendment application (SRK 2015) were geologically logged as part of the exploration drilling program, at which time the lithology code 1as (altered mafic metavolcanics) was not used. Based on the geochemistry and spatial coverage of the ABA sample set, SRK assumes that altered mafic metavolcanics (1as) is represented in SRK (2015).

Figure 3-15 to Figure 3-17 compares by rock type the geochemical results from the 2019 waste rock monitoring programs to the other sample sets presented in Table 3-11. The results are discussed in subsequent sections.

Table 3-11: Overview of Waste Rock Geochemical Sample Sets

Rock Type	Sample Set and Source[1]		Geology Code[2]	Geology Codes for Samples[3]	Comment
Mafic Metavolcanics	2019 Operational Monitoring	ROM from Underground	1a,1as	1a, 1as	
		ROM from CPR	1a, 1as	1a, 1as	
	Pre-2019 Operational Monitoring	ROM from Underground	1a, 1as	1a, 1as	
		ROM from CPR	1a	1a	
	Type A	Drill core	1	1, 1a, 1ay, 1p and 1u	Logging code 1as (altered basalt) is not documented in SRK (2015) because this code was not used during the exploration logging program. Based on the geochemistry and spatial coverage of the ABA sample set, SRK assumes that rock type 1as is represented in the sample set.
Quartz Vein	2019 Operational Monitoring	Pad T	12q	12q	
	Pre-2019 Operational Monitoring	Underground ROM	12q	12q	
	Type A	Drill core	12q	12q, 12 (mixed)	

Notes:

[1]All operational monitoring samples are run-of-mine (ROM) waste rock samples; in 2019 waste rock from 2019 was sampled from the blasted pile underground and the Pad T stockpile

[2]For data interpretation and figures. For the Type A sample set, the sample set is as presented in SRK (2015).

[3] 1a = mafic metavolcanic, 1as = altered mafic metavolcanics, 12q = quartz vein

3.4.1 Mafic Metavolcanics (1a)

For mafic metavolcanics (1a), 25th to 75th percentile sulphur content was roughly equivalent for 2019 operational samples collected from the underground mine (0.11 to 0.18%, n=20), the Type A sample set (0.11 to 0.31%, n=401) and operational samples from the underground mine collected prior to 2019 (0.09 to 0.20%, n=162). The 25th to 75th percentile sulphur content was equivalent for 2019 and 2018 CPR samples (0.14 to 0.30% and 0.23 to 0.31%, respectively) with 25th percentile values for CPR samples higher than the Type A sample set.

NP and TIC values for the 2019 operational samples collected from the underground mine and also the 2019 and 2018 CPR waste rock samples were within the range of the 25th to 75th percentile levels of the Type A sample set (140 and 220 kg $CaCO_3$ eq/tonne and 170 and 340 kg $CaCO_3$ eq/tonne, respectively).

All samples of mafic metavolcanic (1a) collected from the underground mine and CPR in 2019 were classified as non-PAG on the basis of TIC/AP and NP/AP. This was consistent with the majority of the Type A and operational monitoring mafic metavolcanic (1a) samples (Figure 3-16 and Figure 3-17).

Solid-phase arsenic content can be elevated in waste rock (e.g. Section 3.2.2) and is mobile at neutral pH, though seepage monitoring of Doris waste rock does not indicate neutral pH arsenic leaching. The 25th to 75th percentile levels of arsenic (3.5 to 15 ppm) for the 2019 mafic metavolcanic (1a) underground monitoring samples were within the range of previous operational monitoring samples (25th and 75th percentile levels of 0.78 and 9.5 ppm, respectively) and also the Type A samples (25th and 75th percentile levels of 0.70 and 74 ppm, respectively). Consistent with 2018 CPR samples, the 2019 CPR samples had higher 25th to 75th percentile levels of arsenic (20 to 28 ppm) compared to the Type A and underground mine sample sets (Figure 3-15). The geochemical characteristics of the CPR samples are likely representative of the alteration envelope related to ore genesis. Arsenic content in the CPR samples was within the range of arsenic content for waste rock humidity cell test (HCT) samples for mafic metavolcanics, which indicated low rates of arsenic leaching (SRK 2015).

In summary, ABA characteristics and arsenic content for the 2019 samples of mafic metavolcanics (1a) from the underground mine and CPR were represented by the Type A waste rock sample set.

3.4.2 Altered Mafic Metavolcanics (1as)

For 2019 altered mafic metavolcanics (1as) collected from the underground mine, 25th to 75th percentile levels of sulphur content (0.20 to 0.59%, n=8) were higher than the Type A sample set (0.11 to 0.31%, n=401) and previous operational of altered mafic metavolcanic (1as) samples collected prior to 2019 (0.07 to 0.35%, n=29). Of note is that the range of sulphur content for the 2019 underground samples is captured within the overall range of the Type A sample set. For the 2019 CPR samples of altered mafic metavolcanics, (n=10) 25th to 75th percentile levels (0.23 to 0.35%) were lower than the 2019 underground samples and within the 25th to 75th percentile range of the Type A sample set.

For 2019 samples of altered mafic metavolcanic (1as) collected from the underground mine, 25th to 75th percentile levels of TIC (250 to 300 kg $CaCO_3$ eq/tonne) and NP (150 to 180 kg $CaCO_3$ eq/tonne) were similar than other of altered mafic metavolcanic (1as) monitoring samples collected from the underground mine (25th and 75th percentile values of 200 and 330 kg $CaCO_3$ eq/tonne, respectively for TIC and 150 and 230 kg $CaCO_3$ eq/tonne, respectively for NP) and were slightly lower than the Type A sample set (25th and 75th percentile values of 170 and 335 kg $CaCO_3$ eq/tonne, respectively for TIC and 140 and 220 kg $CaCO_3$ eq/tonne, respectively for NP). For the 2019 CPR of altered mafic metavolcanic (1as) samples, 25th to 75th percentile levels of TIC (240 to 290 kg $CaCO_3$ eq/tonne) and NP (170 to 180 kg $CaCO_3$ eq/tonne) were comparable to the Type A and of altered mafic metavolcanic (1as) operational monitoring sample sets.

All samples of altered mafic metavolcanic (1as) collected from the underground mine (including Pad T) and CPR in 2019 were classified as non-PAG on the basis of TIC/AP and NP/AP. This is

consistent with the majority of the Type A and operational monitoring of altered mafic metavolcanic (1as) samples (Figure 3-16 and Figure 3-17).

For 2019 of altered mafic metavolcanic (1as) underground monitoring samples, 25th to 75th percentile levels of arsenic (13 to 46 ppm) were higher than previous of altered mafic metavolcanic (1as) operational monitoring samples (25th and 75th percentile levels of 5.5 and 28 ppm, respectively) and within the Type A range (25th and 75th percentile levels of 0.70 and 74 ppm, respectively). For 2019 CPR of altered mafic metavolcanic (1as) samples had a similar relationship to other sample sets with 25th and 75th percentile levels of 19 and 29 ppm, respectively.

In summary, ABA characteristics and arsenic content for the 2019 samples of altered mafic metavolcanics (1as) from the underground mine and CPR were represented by the Type A waste rock sample set.

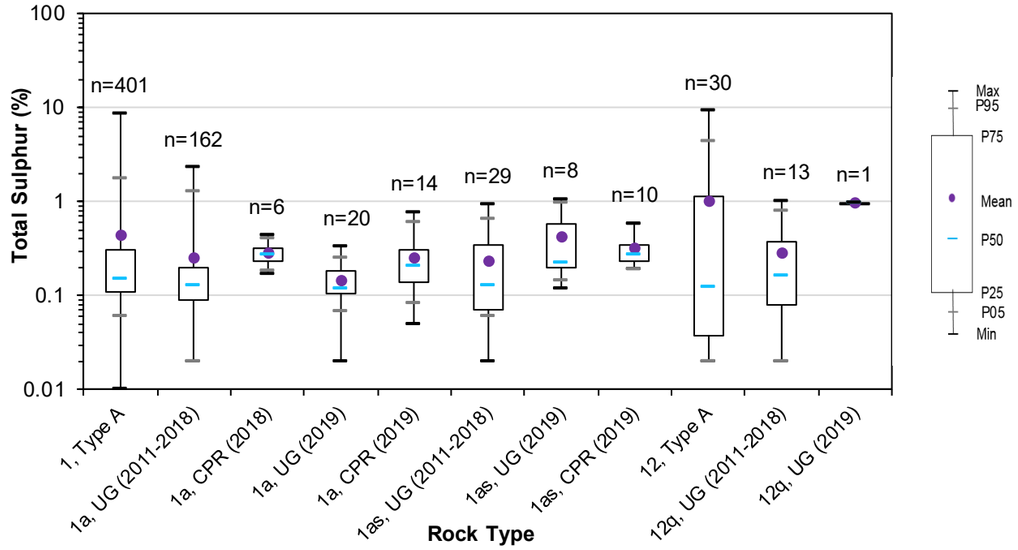
3.4.3 Quartz Veins (12q)

Total sulphur content for the 2019 quartz vein sample (0.98%) was roughly equivalent to the 75th percentile values for the Type A samples (1.2%) and maximum levels for previous operational waste rock samples (1%). TIC and NP content for the 2019 quartz vein sample (222 and 161 kg $CaCO_3$ eq/tonne, respectively) were higher than 75th percentile values for the Type A samples (44 and 36 kg $CaCO_3$ eq/tonne, respectively) and maximum value from the operational waste rock sample set (114 and 55 kg $CaCO_3$ eq/tonne, respectively, Figure 3-15).

The non-PAG classification of the quartz vein (12q) was consistent with the majority of quartz vein samples from the Type A and pre-2019 operational monitoring sample sets (Figure 3-16 and Figure 3-17).

The one 2019 quartz vein sample (12q) reported an arsenic concentration (85 ppm) that was greater than the 75th percentile levels for Type A sample set (17 to 38 ppm) but less than the maximum value (229 ppm).

The ABA characteristics and arsenic content for the 2019 quartz vein sample (12q) were represented by the Type A waste rock sample set.



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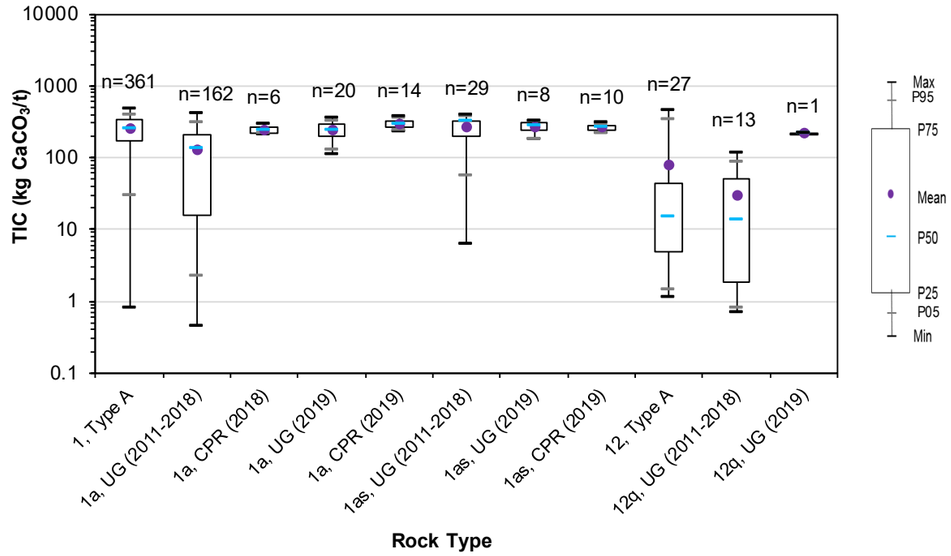

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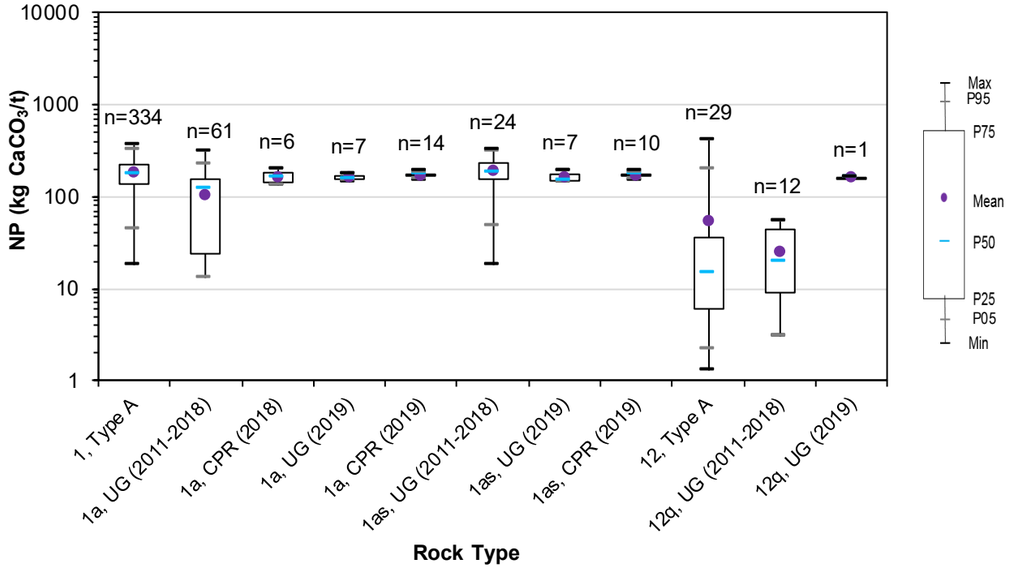

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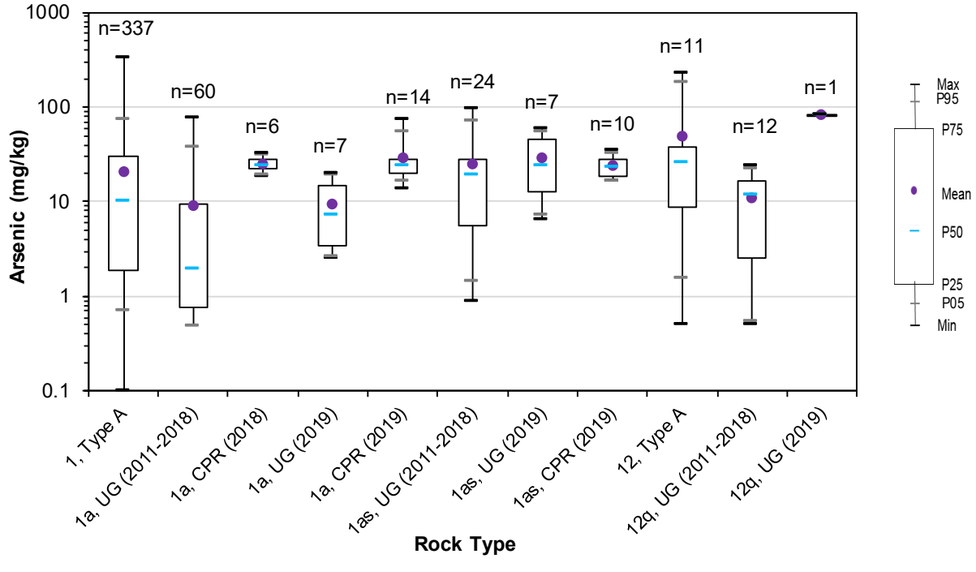

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Figure 3-15: Box and Whisker Plots of S, TIC, NP and Arsenic – Comparison of 2019 Doris Waste Rock Monitoring Samples to Other Waste Rock Sample Sets

(These plots are conventional box and whisker graphs, with the upper and lower extremes showing the minimum and maximum values, tick marks outside of the box showing the 5th and 95th percentiles, outer margins of the box showing the 25th and 75th percentiles and central division in the box showing the median value)

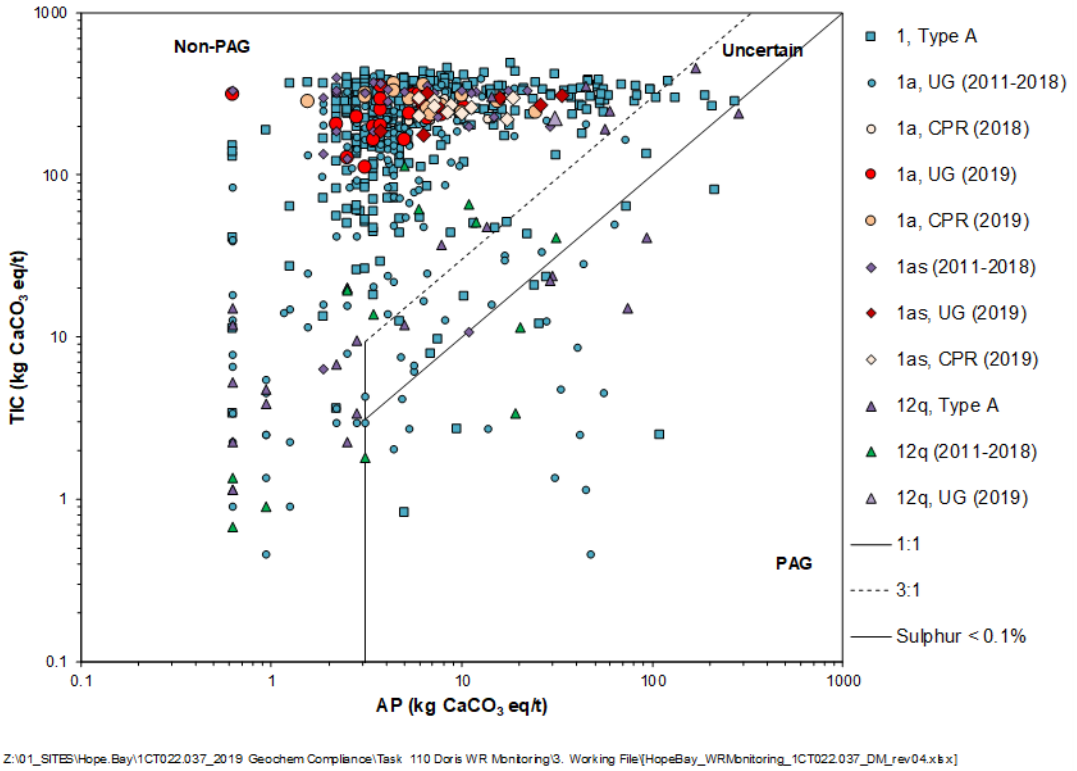

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Figure 3-16: ARD Classifications by TIC/AP, Doris Waste Rock Samples

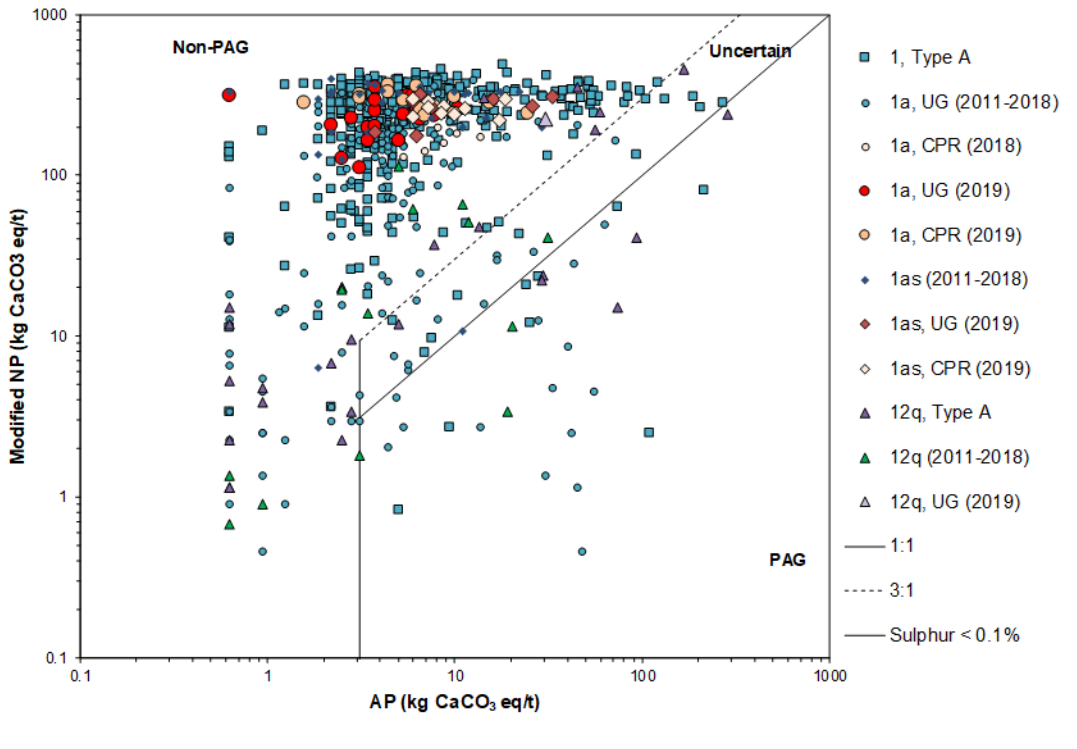

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Figure 3-17: ARD Classifications by NP/AP, Doris Waste Rock Samples

4 Summary and Conclusions

4.1 Waste Rock Monitoring Program

Mining at Doris in 2019 resulted in the placement of approximately 165,000 t of waste rock from the underground on Pad T, all of which was managed as mineralized waste rock. The balance of waste rock produced in 2019 remained underground and was placed as structural backfill in the underground stopes. In 2019, 433,000 t of waste rock from the surface waste rock stockpile was placed as backfill in the Doris Crown Pillar and stopes of the Doris mine. In 2019, waste rock intersected by the Doris underground workings was primarily (95%) mafic metavolcanic flow (1a) with lesser (2%) altered mafic metavolcanics (1as) and (2%) quartz-carbonate veins, and rare (1%) diabase or felsic dykes.

In 2019, TMAC transitioned from the waste rock monitoring program outlined in TMAC (2016) to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019), the latter which is current plan. The major difference between the two waste rock management programs is that samples are collected from the underground in TMAC (2016) whereas for the TMAC (2019) program, samples are collected from the surface waste rock stockpile on Pad T.

As part of the TMAC (2016) monitoring program conducted from January to April, TMAC collected 19 underground waste rock samples with the samples geologically identified as either altered mafic metavolcanics (1as; n=3) or mafic metavolcanics (1a; n=16). The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.33% and median level of 0.12%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 190 to 310 kg $CaCO_3$ eq/tonne and 150 to 160 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- For mafic altered metavolcanics samples (1as), total sulphur content was low (ranging from 0.12 to 1.1% and median levels of 0.21%). TIC and Modified NP content was high (ranging from 190 to 320 kg $CaCO_3$ eq/tonne and 140 to 150 kg $CaCO_3$ eq/tonne, respectively. All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- One sample of altered mafic metavolcanics (1as) contained elevated levels of arsenic and sulphur compared to the screening criteria. This sample was described as mineralized and from the alteration zone with 2% sulphides. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.

As part of the TMAC (2019) waste rock monitoring program, SRK collected ten samples (four of mafic metavolcanics (1a), five of altered mafic metavolcanics (1as), and one of quartz vein (12q)) from Pad T. The results are summarized as follows:

- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.12 to 0.25% and median levels of 0.16%. TIC and Modified NP content was high (25th to

75th percentile levels ranging from 230 to 270 kg $CaCO_3$ eq/tonne and 160 to 170 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

- For altered mafic metavolcanics samples (1as), total sulphur content was higher than the mafic metavolcanics (1a) samples, ranging from 0.19 to 0.82% and median levels of 0.23%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 270 to 290 kg $CaCO_3$ eq/tonne and 150 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- For the one sample of quartz veins (12q) had a total sulphur content of 0.98%. TIC and Modified NP content was 220 and 160 kg $CaCO_3$ eq/tonne, respectively. The sample was classified as non-PAG on the basis of TIC/AP and NP/AP.
- Trace element content was below the screening criteria for all samples with the exception of arsenic and sulphur for three samples of 1as and one sample each of 12q and 1a. Total metal concentrations for all other samples were less than ten times the average crustal abundance for basalt indicating no appreciable enrichment.
- SFE tests for the Pad T altered mafic metavolcanics (1as) waste rock had alkaline pH (8.1-8.3 s.u.). Nitrate concentrations (140 to 170 mg/L) and chloride values (180 to 490 mg/L) were high indicating the presence of explosive residue and drilling brines.

The Type A waste rock sample set represents the geochemical characteristics of all 2019 waste rock samples and rock types.

The geological and geochemical inventory of waste rock on Pad T precludes a long-term assessment of the anticipated geochemical behaviour of the waste rock on Pad T with respect to metal leaching and acid rock drainage (ML/ARD). The geochemical behaviour of the waste rock is monitored through the annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Control Pond (PCP). The results of the seepage survey are reported in the accompanying memo (SRK 2020a), while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

4.2 Geochemical Assessment of CPR Waste Rock as Construction Rock

In 2018, CPR waste rock placed in a separate stockpile on Pad T for potential use as construction material. CPR waste rock is considered potential construction material because the drilling and blasting practices differ from the underground, resulting in CPR waste rock not having issues related to leaching of chloride (from drilling brines) and lower loads of ammonia (related to blasting residues).

In 2019, TMAC collected 24 samples of CPR waste rock from the stockpile on the west end of Pad T to assess if this waste rock could be used for construction as per the requirements of the *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019). The results of the geochemical program for CPR waste rock are summarized as follows:

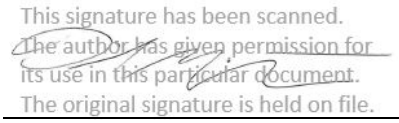
- For mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.05 to 0.78% and median levels of 0.21%. TIC and Modified NP content was high (25th to 75th percentile levels ranging from 260 to 320 kg $CaCO_3$ eq/tonne and 170 to 180 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- Median values of arsenic for all rock types were above the screening criteria. Three samples each of mafic metavolcanics (1a) and altered mafic metavolcanics (1as) were elevated in sulphur, and one sample of mafic metavolcanics (1a) was elevated in silver. All other parameters were below the screening criteria suggesting no appreciable enrichment.
- SFE tests had alkaline pH (9.1 to 9.4 s.u.). Nitrate and chloride values had maximum values of 1.1 mg/L and 27 mg/L, respectively, which are significantly lower than SFE results from underground waste rock samples due to differences in blasting and drilling practices for CPR waste rock.
- All samples collected from the CPR waste rock stockpile indicated that the waste rock was suitable for use as construction rock except three samples of altered and unaltered mafic metavolcanics that were above the sulphur criterion of 0.5% with a total sulphur content ranging from 0.53 to 0.72%. Confirmatory samples taken from the CPR cover were classified as suitable for use as construction rock (SRK 2020b).

The geochemical behaviour of the waste rock used as construction rock is monitored as part of the construction rock monitoring program, including the annual seep survey and geochemical monitoring of as-built infrastructure. The results of the seepage surveys and monitoring of construction rock are reported in the accompanying memos (SRK 2020a and SRK 2020b)

The Type A waste rock sample set represents the geochemical characteristics of the CPR waste rock samples analyzed as part of the 2019 waste rock monitoring program.

Prepared by

SRK Consulting (Canada) Ltd.



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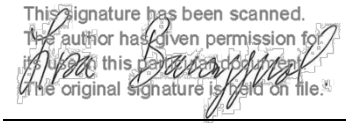

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Attachment A – Geological Description (Underground Waste Rock)

WASTE ROCK SAMPLES

			SAMPLE LOCATION								GEOLOGIC DESCRIPTION			
SAMPLE #	GEOLOGIST	DATE SAMPLED	LEVEL	STN/GP#	X	Y	Z	MINING ZONE	ANALYSIS	MINERALIZED/NOT MINERALIZED	ROCK TYPE	SULPHIDE %	CARBONATE %	DESCRIPTION
W571495	CA	02-Jan-19	4700 Decline	Face as 01-Jan-19	433788	7559982	-306	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, TR Cb Strs
W571496	AP	05-Jan-19	West vally Vent access	Muck pile of lead in slash blasted Jan 4, 2019	433690	7558216	-110	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	<1	-	-
W571497	AP	05-Jan-19	DCO Decline	Muckpile from Blast Jan 4, 2019 NS	433672	7558361	-130	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	1	~1% Carbonate Veinlets thought
W571498	AP	05-Jan-19	DCN RAMP	Left corner of face.	433649	7558111	-180	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	<1	2	~-1-2% Quartz/Carbonate Stringers throughout.
W571499	GL	23-Jan-19	4700 Ramp	Safety Bay, left side	433794	7559982	-309	Basalt and buffer zone	Full ABA+Rinse	Not Mineralized	1a	<1	2	Foliated w/ wk chloric alt'n, 1-2% qtz/Carb stringers
W571500	GL	23-Jan-19	West Valley	Left corner of access to WV Elec. Sub	433701	7558164	-110	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	-	1	Barren, <1% Carb vnlts
W573597	GL	23-Jan-19	DCN Ramp	Right corner of face	433651	7558069	-188	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	<1	2	<1% qtz/carb stringers
Y041487	C.A.	10-Jan-19	134 Acc	LW 1st ref plug in acc	433680	7558379	-132	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl
Y041488	C.A.	10-Jan-19	94 Acc	LW acc just after remuck	433711	7558376	-92	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl
Y041489	C.A.	10-Jan-19	DCN Ramp	Across from remuck	433654	7558051	-190	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl
Y041490	C.A.	10-Jan-19	South Acc Ramp	South Acc ramp RW across from 110mL	433718	7558129	-108	Basalt and buffer zone	Full ABA/Metals+Rinse	Not Mineralized	1a	<1	Trace	1a, Tr Carb/Qz Strs Tr Sulphides, Chl, Weak Ser
Y041491	GL	03-Mar-19	110 WV Access	End of access	433758	7558151	-107	Basalt and buffer zone	Total Sulphur/TIC	Not Mineralized	1a	-	1	Barren, <1% Carb vnlts
Y041492	GL	04-Mar-19	4690 Level Access	18.7m from RW Bar	433835	7559898	-314	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	2	Foliated w/ wk chloric alt'n
W573598	SAS	11-Mar-19	134 FAR drop raise	around 4 m from the stop face.	433648	7558372	-131	Alteration zone	Full ABA/Metals	Mineralized	1as	1	1	mod ser alter; wekly foliated
W573599	SAS	11-Mar-19	94 ECO LW	1 m from stop face along LW	433703	7558370	-91	Basalt and buffer zone	Total Sulphur/TIC+Metals	Not Mineralized	1a	<1	-	1a; Mod sheared; chl altered; no sulfides
Y041495	C.A	18-Mar-19	DCN Ramp	1 rnd past surveyed face march 16 2019	433669	7557981	-200	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1as	<1	Trace	1a, Tr V Tr S
Y041493	SAS	17-Mar-19	DCO Incline	6.5m up ramp from LW BAR	433648	758342	-88	Alteration zone	Full ABA/Metals	Mineralized	1as	2	Trace	1as; Str ser alt; 2% fg diss py
Y041494	SAS	17-Mar-19	4700 Decline	4m back from stop face along LW	433777	7559882	-322	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Not Mineralized	1a	<1	0.08	1a; Mod chl alt; 8% qtz carb vnlts; no sufides
Y041496	SAS	19-Mar-19	4885 remuck extention	LW 2 m back from stop face in remuck	433749	7559349	-110	Basalt and buffer zone	Total Sulphur/TIC+Rinse	Mineralized	1a	1	Trace	1a; Mod chl alt; tr qtz-car vnlts; 1% py
Y041497	AP/MS	21-Mar-19	West Valley Access	Face as of mar 21, 2019	433717	7558122	-110	Basalt and buffer zone	Full ABA/Metals	Mineralized	1a	1	Trace	1a: Weak sericitealteration. Local weack chlorite alteration. ~3% Qtz veinlets
R828404	GL	12-Apr-19	4702	8m from RW Ref	433829	7559904	-293	Basalt and buffer zone		Not Mineralized	1a	2	Trace	1a; Mod chl alt; <2% qtz carb vnlts; no sufides
R828405	GL	12-Apr-19	4700 Ramp	12m from Right Corner	433768	7559929	-327	Basalt and buffer zone		Not Mineralized	1a	<1	Trace	tr chloric alt'n, extremely rr dism pyr min'l
Y247802									Rinse					
R828406	GL	20-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828407	GL	20-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828408	GL	21-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828409	GL	21-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828410	GL	22-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828411	GL	22-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828412	SAS	24-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sercite Alt. Local trace qtz/carb. Trace fine grained PY
R828413	SAS	24-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sercite Alt. Local trace qtz/carb. Trace fine grained PY
R828414	GL	23-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828415	GL	23-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1as	<1	Trace	1as: Moderate Sericite Alt'n, trace qtz/carb., trace dism py
R828418	C.A.	25-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828419	C.A.	25-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828420	C.A.	26-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828421	C.A.	26-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828422	C.A.	27-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828423	C.A.	27-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828424	C.A.	28-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828425	C.A.	28-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828426	C.A.	29-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828427	C.A.	29-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828428	C.A.	30-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828429	C.A.	30-Apr-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828430	C.A.	01-May-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
R828431	C.A.	01-May-19	CPRT (2018 Waste Mining)	CPR Waste Stockpile				Basalt and buffer zone	ABA/Metals + SFE/Rinse	Not Mineralized	1a	>1	Trace	Barren, <1% Qz/Carb vnlts, Tr Pchy Ser Alt
SRK19-WR-06	D.M	02-Aug-19		Pad T	433354	7559297	86		ABA/Metals + SFE		12	Mostly none, few fragments with up to 5% cubic pyrite associated with 1as	Trace	12: quartz veins, barren; 1as: folited light brown mafic metavolcanics
SRK19-WR-03	D.M	02-Aug-19		Pad T	433341	75559268	84		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-03 DUP	D.M	02-Aug-19		Pad T	433341	75559268	84		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-05	D.M	02-Aug-19		Pad T	433328	7559315	84		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-07	D.M	02-Aug-19		Pad T	433369	7559286	88		ABA/Metals + SFE		1a	Mostly none, few fragments with up to 1% cubic pyrite associated with 1a	Trace	1a: dark green mafic metavolcanics; 1as: foliated light brown mafic metavolcanic, rare quartz fragments
SRK19-WR-10	D.M	02-Aug-19		Pad T	433363	7559224	87		Full ABA/Metals		1a	None visible	Trace	1a: dark green mafic metavolcanics, rare calcite and quartz veins
SRK19-WR-01	D.M	02-Aug-19		Pad T	433346	7559240	85		Full ABA/Metals		1as	None visible	Trace	1as: foliated light brown mafic metavolcanics
SRK19-WR-02	D.M	02-Aug-19		Pad T	433352	7559253	83		Full ABA/Metals		1as	None visible	Trace	1as: foliated light brown mafic metavolcanics, common hematite staining, weathered pinkish-brown
SRK19-WR-04	D.M	02-Aug-19		Pad T	433335	7559291	84		Full ABA/Metals		1as	None visible	Trace	1as: foliated light brown mafic metavolcanics, rare quartz veins
SRK19-WR-08	D.M	02-Aug-19		Pad T	433372	7559271	87		ABA/Metals + SFE		1as	Mostly none, few fragments with up to 1% cubic pyrite	Trace	1as: foliated light brown mafic metavolcanics, some quartz veins
SRK19-WR-09	D.M	02-Aug-19		Pad T	433370	7559247	88		Full ABA/Metals		1as	Mostly none, few fragments with up to 1% cubic pyrite	Trace	1as: foliated light brown mafic metavolcanics, some quartz veins

Attachment B – Underground Waste Rock Laboratory Results – Full ABA

		Paste pH	S(T)	$S(SO_4)$	S(S-2)	AP	AP from S(T)	CO_2	TIC	Mod NP	Net NP	Fizz Test	TIC/AP	NP/AP
		Std. Units	%S	%S	%S	kg $CaCO_3$/t	kg $CaCO_3$/t	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	-		-
SAMPLE #	**ROCK TYPE**	#N/A	0.02	0.01	0.02	0.6		0.08	1.8	0.1	0.1	#N/A		0.1
W571495	1a		0.17				5.3	10	238				45	
W571496	1a		0.11				3.4	8.7	199				58	
W571497	1a		0.33				10.3	12	262				25	
W571498	1a		0.16				5.0	7.2	164				33	
W571499	1a	8.4	0.17	0.02	0.15	0.15	5.3	14	310	172	167	STRONG	58	32
W571500	1a		0.12				3.8	15	352				94	
W573597	1a		0.07				2.2	9.0	205				94	
Y041487	1a		0.12				3.8	11	252				67	
Y041488	1a		0.09				2.8	10	227				81	
Y041489	1a		0.21				6.6	9.9	225				34	
Y041490	1a	8.4	0.18	0.02	0.16	0.16	5.6	14	313	156	151	STRONG	56	28
Y041491	1a		0.02				0.6	14	313				501	
Y041492	1a		0.08				2.5	5.6	128				51	
W573598	1as	9.3	0.21	0.01	0.2	0.2	6.6	14	319	149	143	STRONG	49	23
W573599	1a		0.1				3.1	4.9	112				36	
Y041495	1as		0.12				3.8	8.2	186				50	
Y041493	1as	9.2	1.07	0.01	1.06	1.06	33	14	307	142	108	STRONG	9	4
Y041494	1a		0.11				3.4	7.3	165				48	
Y041497	1a	8.9	0.19	*0.01*	0.19	0.19	5.9	14	316	144	138	STRONG	53	24

Attachment C – Underground Waste Rock Laboratory Results – Multi Element Analysis

			Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
			ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
SAMPLE #	**ROCK TYPE**	LOD	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.1	0.1	0.1	2	0.01
Y041490	1a		0.1	23.9	1	103	*0.1*	1.3	23.5	2300	9.88	12.4	*0.1*	4	0.4	68	0.1	*0.1*	*0.1*	18	5.98
W573598	1as		0.2	27.6	0.9	88	*0.1*	2.9	25.7	2210	9.65	16.9	*0.1*	15.5	0.4	40	*0.1*	*0.1*	*0.1*	12	5.76
W573599	1a		0.2	25.8	1.1	109	*0.1*	1.8	26.3	2320	9.41	2.5	*0.1*	1.9	0.6	41	0.2	*0.1*	*0.1*	27	7.55
Y041493	1as		0.1	23.5	1.4	87	*0.1*	1.1	28.4	2230	9.99	58.6	*0.1*	15.2	0.3	44	0.1	*0.1*	*0.1*	10	5.88
Y041497	1a		0.4	37.4	1.3	108	*0.1*	1.1	26.4	2040	9.81	3.1	*0.1*	1.2	0.4	44	0.1	*0.1*	*0.1*	12	5.31

			P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Hg	Sc	Tl	S	Ga	Se	Te
			%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
SAMPLE #	**ROCK TYPE**	LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.01	0.02	0.1	5	0.1	0.5	0.2
Y041490	1a		0.08	3	14	1.52	12	0.002	*20*	0.74	0.061	0.04	*0.1*	*0.01*	11.6	*0.1*	0.19	3	*0.5*	*0.2*
W573598	1as		0.089	3	12	1.52	11	0.002	*20*	0.37	0.075	0.06	*0.1*	*0.01*	11.5	*0.1*	0.17	1	*0.5*	*0.2*
W573599	1a		0.08	2	11	1.61	7	0.002	*20*	1.5	0.048	0.05	*0.1*	*0.01*	12.4	*0.1*	0.15	6	*0.5*	*0.2*
Y041493	1as		0.084	2	10	1.44	10	*0.001*	*20*	0.28	0.069	0.04	*0.1*	*0.01*	12.4	*0.1*	0.97	*1*	*0.5*	*0.2*
Y041497	1a		0.088	3	11	1.51	10	0.001	*20*	0.47	0.081	0.05	*0.1*	*0.01*	12.1	*0.1*	0.16	2	*0.5*	*0.2*

Attachment D – Pad T Laboratory Results – Full ABA

		Paste pH	S(T)	$S(SO_4)$	S(S-2)	AP	AP from S(T)	CO_2	TIC	Mod NP	Net NP	Fizz Test	TIC/AP	NP/AP
		Std. Units	%S	%S	%S	kg $CaCO_3$/t	kg $CaCO_3$/t	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-	-
SAMPLE #	ROCK TYPE	#N/A	0.02	0.01	0.02	0.6		0.08	1.8	0.1	0.1	#N/A		
SRK19-WR-06	12	8.2	0.98	0.01	0.98	31	31	10	222	161	130	MODERATE	7	5
SRK19-WR-03	1a	8.2	0.12	0.01	0.06	1.9	3.8	9	201	153	151	MODERATE	54	41
SRK19-WR-03 DUP	1a	8.2	0.15	0.06	0.10	3.1	4.7	9	205	143	140	MODERATE	44	31
SRK19-WR-07	1a	8.4	0.12	0.07	0.11	3.4	3.8	13	291	162	158	MODERATE	78	43
SRK19-WR-10	1a	8.3	0.25	0.04	0.22	6.9	7.8	10	233	159	7	MODERATE	30	20
SRK19-WR-01	1as	7.8	0.83	*0.01*	0.82	26	26	12	272	147	121	MODERATE	10	6
SRK19-WR-02	1as	8.1	0.19	0.01	0.18	5.6	5.9	13	291	147	141	MODERATE	49	25
SRK19-WR-04	1as	7.9	0.20	0.01	0.13	4.1	6.3	8	176	171	167	MODERATE	28	27
SRK19-WR-08	1as	8.3	0.24	*0.01*	0.23	7.2	7.5	12	266	183	176	MODERATE	35	24
SRK19-WR-09	1as	8.1	0.51	0.03	0.51	16	16	13	300	194	178	MODERATE	19	12

Attachment E – Pad T Laboratory Results – Multi Element Analysis

			Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
			ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
SAMPLE #	**ROCK TYPE**	LOD	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.1	0.1	0.1	2	0.01
SRK19-WR-06	12		0.6	54.2	8.4	89	0.1	7.8	26.1	1970	7.84	8.8	*0.1*	78.5	0.2	38	0.1	0.2	*0.1*	39	4.82
SRK19-WR-03	1a		0.4	66.8	4.1	113	0.5	7.2	29.1	1850	8.27	23.8	*0.1*	13000	0.3	29	0.2	0.1	*0.1*	30	5.13
SRK19-WR-03 DUP	1a		0.4	44.6	5.5	100	0.2	3.4	28.4	1630	8.05	3.8	*0.1*	10.1	0.4	29	0.1	0.1	*0.1*	39	5.68
SRK19-WR-05	1a		0.5	45.2	5.7	108	0.1	4.2	27.6	1610	8.06	3.1	*0.1*	10.2	0.4	28	*0.1*	*0.1*	*0.1*	39	5.34
SRK19-WR-07	1a		0.3	84.4	3.1	126	*0.1*	20.3	39.9	1760	9.81	6.6	*0.1*	8.8	0.2	44	*0.1*	*0.1*	*0.1*	216	6.09
SRK19-WR-10	1a		0.5	62.3	4.2	107	*0.1*	40.4	35.3	1880	8.36	20.2	*0.1*	164	0.2	34	0.1	*0.1*	*0.1*	80	6.54
SRK19-WR-01	1as		0.3	45.0	5.4	28	0.5	56.9	22.6	848	3.55	84.5	*0.1*	435	0.2	34	0.2	0.2	0.3	10	5.00
SRK19-WR-02	1as		0.3	39.8	3.0	109	*0.1*	7.6	27.0	2120	8.46	7.4	*0.1*	0.9	0.3	41	0.2	*0.1*	*0.1*	35	6.05
SRK19-WR-04	1as		0.4	72.5	4.2	95	0.1	43.5	37.1	1690	7.91	44.3	*0.1*	195	0.2	35	0.2	*0.1*	*0.1*	76	6.67
SRK19-WR-08	1as		0.7	70.0	4.4	89	0.2	45.3	30.8	1830	6.51	48.2	*0.1*	919	0.2	37	0.3	0.2	*0.1*	21	7.58
SRK19-WR-09	1as		0.3	229	4.3	113	*0.1*	37.9	41.9	2060	9.26	17.2	*0.1*	21.9	0.2	38	*0.1*	0.2	*0.1*	153	6.09

			P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Hg	Sc	Tl	S	Ga	Se	Te
			%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
SAMPLE #	**ROCK TYPE**	LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.01	0.02	0.1	5	0.1	0.5	0.2
SRK19-WR-06	12		0.076	1	22	1.46	13	0.002	*20*	1.02	0.045	0.06	1.4	*0.01*	9.5	*0.1*	0.72	4	*0.5*	*0.2*
SRK19-WR-03	1a		0.085	2	15	1.46	10	0.003	*20*	1.04	0.067	0.04	*0.1*	*0.01*	11.4	*0.1*	0.19	4	*0.5*	*0.2*
SRK19-WR-03 DUP	1a		0.107	3	16	1.19	9	0.003	*20*	2.49	0.060	0.06	*0.1*	*0.01*	13.3	*0.1*	0.10	8	*0.5*	*0.2*
SRK19-WR-05	1a		0.096	3	13	1.21	11	0.004	*20*	2.37	0.046	0.06	0.1	*0.01*	13.0	*0.1*	0.14	8	*0.5*	*0.2*
SRK19-WR-07	1a		0.069	3	17	1.91	11	0.007	*20*	3.94	0.037	0.02	*0.1*	*0.01*	28.1	*0.1*	0.18	15	*0.5*	*0.2*
SRK19-WR-10	1a		0.064	2	38	1.94	9	0.003	*20*	2.28	0.068	0.04	*0.1*	*0.01*	16.3	*0.1*	0.20	8	*0.5*	*0.2*
SRK19-WR-01	1as		0.054	1	49	1.61	5	-0.001	*20*	0.13	0.068	0.03	0.2	*0.01*	6.4	*0.1*	0.98	-1	*0.5*	0.4
SRK19-WR-02	1as		0.076	3	19	1.43	8	0.003	*20*	1.58	0.024	0.04	*0.1*	*0.01*	12.0	*0.1*	0.11	6	*0.5*	*0.2*
SRK19-WR-04	1as		0.050	2	30	2.05	7	0.006	*20*	2.22	0.025	0.04	0.5	*0.01*	14.7	*0.1*	0.21	7	*0.5*	*0.2*
SRK19-WR-08	1as		0.052	2	31	1.47	11	0.002	*20*	1.21	0.025	0.06	0.1	*0.01*	8.7	*0.1*	0.48	3	*0.5*	*0.2*
SRK19-WR-09	1as		0.059	2	35	2.27	5	0.005	*20*	3.08	0.023	0.04	*0.1*	*0.01*	21.4	*0.1*	0.24	11	*0.5*	*0.2*

Attachment F – Pad T Laboratory Results – SFE

Shake Flask Extraction Results					
		LOD	SRK19-WR-01	SRK19-WR-04	SRK19-WR-09
			-2 mm rock	-2 mm rock	-2 mm rock
pH	pH Units	N/A	8.1	8.3	8.2
EC	uS/cm	0.5	2330	2430	2440
SO4	mg/L	0.5	48	40	43
Total Alkalinity	mg/L	0.5	73	33	30
Bicarbonate	mg/L	0.5	89	40	37
Carbonate	mg/L	0.5	*0.5*	*0.5*	*0.5*
Hydroxide	mg/L	0.5	*0.5*	*0.5*	*0.5*
Dissolved Chloride	mg/L	0.5	176	491	423
Nitrate-N	mg/L	0.02	172	140	158
Nitrite-N	mg/L	0.005	1.83	1.06	1.44
Total Ammonia	mg/L	0.005	-	-	-
Total Dissolved Solids	mg/L	10	1300	1700	1900
Hardness (CaCO3)	mg/L	0.5	299	485	543
Dissolved Aluminum (Al)	mg/L	0.0005	0.038	0.076	0.069
Dissolved Antimony (Sb)	mg/L	0.00002	0.00045	0.00034	0.00038
Dissolved Arsenic (As)	mg/L	0.00002	0.00025	0.0022	0.0042
Dissolved Barium (Ba)	mg/L	0.00002	0.029	0.020	0.019
Dissolved Beryllium (Be)	mg/L	0.00001	*0.00001*	*0.00001*	*0.00001*
Dissolved Bismuth (Bi)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*
Dissolved Boron (B)	mg/L	0.05	0.12	0.098	0.086
Dissolved Cesium (Cs)	mg/L	0.00005	0.0042	0.0053	0.0059
Dissolved Cadmium (Cd)	mg/L	0.000005	0.0000120	*0.000005*	*0.000005*
Dissolved Calcium (Ca)	mg/L	0.05	71	130	139
Dissolved Chromium (Cr)	mg/L	0.0001	0.00073	0.00015	0.00020
Dissolved Cobalt (Co)	mg/L	0.000005	0.0023	0.0018	0.0043
Dissolved Copper (Cu)	mg/L	0.00005	0.0035	0.00098	0.00081
Dissolved Lanthanum (La)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*
Dissolved Iron (Fe)	mg/L	0.001	*0.001*	0.0030	*0.001*
Dissolved Lead (Pb)	mg/L	0.000005	0.000018	0.000093	0.0000094
Dissolved Lithium (Li)	mg/L	0.0005	0.0072	0.0076	0.0065
Dissolved Magnesium (Mg)	mg/L	0.05	29	39	48
Dissolved Manganese (Mn)	mg/L	0.00005	0.25	0.15	0.22
Dissolved Phosphorus (P)	mg/L	0.002	0.0086	0.015	0.0091
Dissolved Molybdenum (Mo)	mg/L	0.00005	0.00090	0.0013	0.0022
Dissolved Nickel (Ni)	mg/L	0.00002	0.000053	0.0012	0.0052
Dissolved Potassium (K)	mg/L	0.05	22	20	36
Dissolved Rubidium (Rb)	mg/L	0.00005	0.059	0.055	0.091
Dissolved Selenium (Se)	mg/L	0.00004	0.00072	0.00064	0.0017
Dissolved Silicon (Si)	mg/L	0.1	0.56	0.50	0.47
Dissolved Silver (Ag)	mg/L	0.000005	0.000010	*0.000005*	*0.000005*
Dissolved Sodium (Na)	mg/L	0.05	113	246	220
Dissolved Strontium (Sr)	mg/L	0.00005	0.26	0.66	0.60
Dissolved Sulphur (S)	mg/L	*10*	17	16	16
Dissolved Tellurium (Te)	mg/L	0.00002	*0.00002*	0.000040	0.000033
Dissolved Thallium (Tl)	mg/L	0.000002	0.000061	0.000066	0.00011
Dissolved Thorium (Th)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*
Dissolved Tin (Sn)	mg/L	0.0002	*0.0002*	*0.0002*	*0.0002*
Dissolved Titanium (Ti)	mg/L	0.0005	*0.0005*	*0.0005*	*0.0005*
Dissolved Tungsten (W)	mg/L	0.00001	0.00035	0.00034	0.00039
Dissolved Uranium (U)	mg/L	0.000002	0.0000049	0.000011	0.0000051
Dissolved Vanadium (V)	mg/L	0.0002	*0.0002*	*0.0002*	*0.0002*
Dissolved Zinc (Zn)	mg/L	0.0001	0.00012	0.0018	0.00078
Dissolved Zirconium (Zr)	mg/L	0.0001	*0.0001*	*0.0001*	*0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*

Notes:
Italicized font indicates result is below the detection limit
°All element concentrations are given as dissolved

Attachment G – CPR Laboratory Results – Full ABA

		Paste pH	S(T)	$S(SO_4)$	S(S-2)	AP	AP from S(T)	CO_2	TIC	Mod NP	Net NP	Fizz Test	TIC/AP	NP/AP
		Std. Units	%S	%S	%S	kg $CaCO_3$/t	kg $CaCO_3$/t	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	-	-	-
SAMPLE #	**ROCK TYPE**	#N/A	0.02	0.01	0.02	0.6		0.08	1.8	0.1	0.1	#N/A		
R828406	1as	9.1	0.23	*0.01*	0.23	7.2	7.2	13	288	180	173	MODERATE	40	25
R828407	1as	8.9	0.19	0.01	0.18	5.6	5.9	10	230	168	163	MODERATE	39	28
R828408	1as	9.0	0.28	0.01	0.27	8.4	8.8	12	269	165	157	MODERATE	31	19
R828409	1as	8.9	0.27	0.01	0.26	8.1	8.4	11	244	181	173	MODERATE	29	21
R828410	1as	8.8	0.32	0.01	0.31	9.7	10	11	241	164	154	MODERATE	24	16
R828411	1as	9.0	0.55	0.02	0.53	17	17	10	218	154	138	MODERATE	13	9.0
R828412	1as	9.0	0.59	*0.01*	0.59	18	18	13	298	194	176	MODERATE	16	11
R828413	1as	9.1	0.19	0.01	0.18	5.6	5.9	13	300	177	171	MODERATE	51	30
R828414	1as	8.8	0.36	0.01	0.35	11	11	11	259	163	152	MODERATE	23	14
R828415	1as	8.6	0.23	0.01	0.22	6.9	7.2	12	264	167	160	MODERATE	37	23
R828418	1a	8.8	0.21	0.03	0.18	5.6	6.6	11	260	162	156	MODERATE	40	25
R828419	1a	8.9	0.25	0.01	0.24	7.5	7.8	12	270	148	140	MODERATE	35	19
R828420	1a	9.0	0.78	*0.01*	0.78	24	24	11	245	175	151	MODERATE	10	7.2
R828421	1a	8.5	0.32	*0.01*	0.32	10	10	11	245	155	145	MODERATE	25	16
R828422	1a	9.4	0.14	*0.01*	0.14	4.4	4.4	16	368	188	184	MODERATE	84	43
R828423	1a	9.0	0.22	0.01	0.21	6.6	6.9	10	234	174	168	MODERATE	34	25
R828424	1a	8.6	0.10	0.01	0.09	2.8	3.1	14	317	176	174	MODERATE	102	56
R828425	1a	9.2	0.10	*0.01*	0.10	3.1	3.1	13	303	178	175	MODERATE	97	57
R828426	1a	9.0	0.17	*0.01*	0.17	5.3	5.3	13	296	177	171	MODERATE	56	33
R828427	1a	9.0	0.14	*0.01*	0.14	4.4	4.4	15	330	168	163	MODERATE	75	38
R828428	1a	8.8	0.32	*0.01*	0.32	10	10	14	310	177	167	MODERATE	31	18
R828429	1a	9.0	0.20	*0.01*	0.20	6.3	6.3	16	362	182	176	MODERATE	58	29
R828430	1a	9.1	0.49	*0.01*	0.49	15	15	12	283	165	150	MODERATE	18	11
R828431	1a	9.1	0.050	*0.01*	0.05	1.6	1.6	12	282	175	173	MODERATE	181	112

Attachment H – CPR Laboratory Results – Multi Element Analysis

Attachment H: CPR Laboratory Results - Multi Element Analysis

			Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
			ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
SAMPLE #	**ROCK TYPE**	LOD	0.01	0.01	0.01	0.1	0.1	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.1	0.1	0.1	2	0.01
R828406	1as		0.2	69.7	3.0	82	*0.1*	70.2	39.2	1570	6.90	16.4	*0.1*	15.3	0.2	26	*0.1*	0.1	*0.1*	54	5.85
R828407	1as		0.3	56.1	3.2	100	0.1	24.2	32.7	1990	8.81	17.1	*0.1*	102	0.6	33	0.1	0.1	*0.1*	34	5.36
R828408	1as		0.4	71.3	3.8	81	*0.1*	40.6	33.2	1740	7.68	23.6	*0.1*	497	0.3	32	0.1	*0.1*	*0.1*	40	5.54
R828409	1as		0.4	61.1	9.0	80	*0.1*	42.1	30.8	1680	7.16	17.9	*0.1*	136	0.3	27	*0.1*	0.2	*0.1*	41	5.47
R828410	1as		0.4	68.0	2.3	93	0.2	31.2	33.1	1740	8.11	22.3	*0.1*	1350	0.5	29	*0.1*	*0.1*	*0.1*	37	4.93
R828411	1as		0.5	67.3	3.3	102	0.3	29.9	34.7	1560	8.24	30.8	*0.1*	566	0.5	29	*0.1*	0.1	*0.1*	47	4.43
R828412	1as		0.4	58.9	2.1	75	*0.1*	58.4	38.7	2010	8.05	25.1	*0.1*	85.4	0.2	37	0.1	*0.1*	*0.1*	45	7.06
R828413	1as		0.3	43.3	1.2	80	*0.1*	31.6	32.3	1930	7.82	21.2	*0.1*	354	0.2	47	*0.1*	*0.1*	*0.1*	26	6.33
R828414	1as		0.3	56.8	3.0	116	0.2	22.4	35.7	1790	9.07	34.9	*0.1*	287	0.4	31	0.1	*0.1*	0.1	38	5.08
R828415	1as		0.5	65.6	1.4	116	0.1	32.9	36.5	1820	8.57	29.7	*0.1*	732	0.3	30	0.2	*0.1*	*0.1*	35	5.33
R828418	1a		0.3	64.7	1.2	114	*0.1*	36.7	36.0	1760	8.66	19.6	*0.1*	43.9	0.3	32	0.1	*0.1*	*0.1*	46	5.34
R828419	1a		0.3	44.8	1.3	83	0.1	24.0	33.4	1880	8.29	25.7	*0.1*	328	0.3	33	0.1	*0.1*	*0.1*	37	5.28
R828420	1a		0.5	73.3	1.8	76	1.9	54.6	50.9	1630	7.94	45.7	*0.1*	12800	0.2	32	*0.1*	0.1	0.3	28	5.79
R828421	1a		0.2	81.9	1.4	339	*0.1*	21.5	31.1	1800	8.98	26.1	*0.1*	98.1	0.6	42	1.2	*0.1*	*0.1*	34	5.34
R828422	1a		0.2	77.6	0.7	59	*0.1*	71.9	36.4	1650	6.87	26.9	*0.1*	169	0.1	20	*0.1*	*0.1*	*0.1*	32	7.14
R828423	1a		0.3	59.8	1.7	88	*0.1*	58.7	36.8	1580	7.65	18.3	*0.1*	5.3	0.5	27	*0.1*	*0.1*	*0.1*	49	5.73
R828424	1a		0.2	49.5	0.9	107	*0.1*	29.5	31.7	2320	9.38	18.5	*0.1*	14.6	0.3	38	0.1	*0.1*	*0.1*	50	6.80
R828425	1a		0.3	104	2.0	67	*0.1*	60.8	37.1	1630	6.93	46.0	*0.1*	43.8	0.1	26	*0.1*	0.1	*0.1*	34	6.42
R828426	1a		0.2	91.2	1.8	68	*0.1*	85.9	58.3	1550	7.11	73.6	*0.1*	85.2	0.5	25	0.1	*0.1*	*0.1*	35	6.03
R828427	1a		0.2	47.2	1.0	87	0.5	32.3	28.7	1930	8.41	19.8	*0.1*	3200	0.2	36	0.1	*0.1*	*0.1*	23	6.56
R828428	1a		0.3	82.9	1.1	85	*0.1*	70.2	42.8	1660	7.50	22.7	*0.1*	14.9	0.2	26	*0.1*	*0.1*	*0.1*	40	6.44
R828429	1a		0.2	53.1	1.0	88	*0.1*	53.4	33.8	2000	8.85	13.7	*0.1*	12.6	0.2	32	*0.1*	*0.1*	*0.1*	48	7.18
R828430	1a		0.3	58.8	1.0	89	0.2	53.9	37.5	1680	8.08	20.1	*0.1*	856	0.3	23	0.2	*0.1*	*0.1*	39	5.46
R828431	1a		0.2	56.6	1.1	72	*0.1*	48.5	33.6	1530	6.81	28.2	*0.1*	7.5	0.2	33	*0.1*	*0.1*	*0.1*	32	5.71

			P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Hg	Sc	Tl	S	Ga	Se	Te
			%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
SAMPLE #	**ROCK TYPE**	LOD	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.01	0.02	0.1	5	0.1	0.5	0.2
R828406	1as		0.040	2	56	2.25	14	0.005	*20*	1.49	0.059	0.05	0.1	*0.01*	15.3	*0.1*	0.24	5	*0.5*	*0.2*
R828407	1as		0.065	3	26	1.90	11	0.004	*20*	1.63	0.042	0.07	0.6	*0.01*	13.9	*0.1*	0.20	6	*0.5*	*0.2*
R828408	1as		0.055	2	42	1.93	7	0.004	*20*	1.46	0.041	0.05	*0.1*	*0.01*	15.5	*0.1*	0.27	6	*0.5*	*0.2*
R828409	1as		0.043	2	48	1.98	7	0.003	*20*	1.37	0.030	0.04	*0.1*	*0.01*	15.1	*0.1*	0.21	5	*0.5*	*0.2*
R828410	1as		0.065	3	30	1.76	7	0.006	*20*	1.66	0.033	0.05	0.1	*0.01*	13.7	*0.1*	0.28	6	*0.5*	*0.2*
R828411	1as		0.066	3	50	1.67	9	0.009	*20*	1.83	0.040	0.06	0.1	*0.01*	15.7	*0.1*	0.56	8	*0.5*	*0.2*
R828412	1as		0.037	1	45	2.48	4	0.010	*20*	1.50	0.031	0.03	*0.1*	*0.01*	15.3	*0.1*	0.55	5	*0.5*	*0.2*
R828413	1as		0.063	2	20	1.90	6	0.002	*20*	1.19	0.034	0.06	*0.1*	*0.01*	13.2	*0.1*	0.19	4	*0.5*	*0.2*
R828414	1as		0.072	3	29	1.79	8	0.012	*20*	1.59	0.035	0.06	0.3	*0.01*	14.1	*0.1*	0.38	6	*0.5*	*0.2*
R828415	1as		0.066	3	23	1.83	6	0.003	*20*	1.51	0.041	0.06	0.1	*0.01*	14.4	*0.1*	0.24	6	*0.5*	*0.2*
R828418	1a		0.065	3	33	1.96	5	0.006	*20*	1.84	0.028	0.04	*0.1*	*0.01*	16.7	*0.1*	0.20	7	*0.5*	*0.2*
R828419	1a		0.059	3	31	1.87	5	0.003	*20*	1.48	0.032	0.04	0.1	*0.01*	14.7	*0.1*	0.28	6	*0.5*	*0.2*
R828420	1a		0.049	1	28	1.86	7	0.003	*20*	1.11	0.034	0.05	*0.1*	*0.01*	13.2	*0.1*	0.81	5	*0.5*	1.4
R828421	1a		0.072	3	27	1.69	8	0.011	*20*	1.65	0.027	0.06	1.2	*0.01*	14.5	*0.1*	0.32	6	*0.5*	*0.2*
R828422	1a		0.029	1	38	2.36	4	-0.001	*20*	0.71	0.051	0.04	*0.1*	*0.01*	14.8	*0.1*	0.13	2	*0.5*	*0.2*
R828423	1a		0.054	3	43	2.15	14	0.013	*20*	1.63	0.061	0.07	*0.1*	*0.01*	17.0	*0.1*	0.22	6	*0.5*	*0.2*
R828424	1a		0.062	3	24	2.52	5	0.005	*20*	2.08	0.031	0.04	*0.1*	*0.01*	16.9	*0.1*	0.10	8	*0.5*	*0.2*
R828425	1a		0.033	1	32	2.02	5	0.003	*20*	1.08	0.045	0.04	*0.1*	*0.01*	15.2	*0.1*	0.14	4	*0.5*	*0.2*
R828426	1a		0.033	3	38	2.08	7	0.005	*20*	1.02	0.051	0.05	*0.1*	*0.01*	14.7	*0.1*	0.16	4	*0.5*	0.2
R828427	1a		0.056	2	26	1.93	6	0.001	*20*	1.06	0.036	0.05	*0.1*	*0.01*	13.5	*0.1*	0.10	4	*0.5*	*0.2*
R828428	1a		0.042	1	41	2.26	4	0.003	*20*	1.27	0.048	0.04	*0.1*	*0.01*	15.8	*0.1*	0.33	4	*0.5*	*0.2*
R828429	1a		0.049	2	30	2.54	5	0.004	*20*	1.47	0.042	0.03	*0.1*	*0.01*	16.4	*0.1*	0.20	5	*0.5*	*0.2*
R828430	1a		0.053	2	35	2.00	7	0.005	*20*	1.13	0.070	0.06	*0.1*	*0.01*	14.9	*0.1*	0.50	4	*0.5*	0.3
R828431	1a		0.040	2	37	1.95	7	0.002	*20*	1.06	0.043	0.05	*0.1*	*0.01*	13.1	*0.1*	0.06	4	*0.5*	0.3

Attachment I – CPR Laboratory Results – SFE

Shake Flask Extraction Results												
		LOD	R828408	R828410	R828411	R828415	R828419	R828420	R828423	R828425	R828426	R828431
			1as	1as	1as	1as	1a	1a	1a	1a	1a	1a
pH	pH Units	N/A	9.3	9.3	9.3	9.4	9.3	9.4	9.1	9.4	9.3	9.4
EC	uS/cm	0.5	152	180	194	199	146	136	142	124	134	172
SO4	mg/L	0.5	9.9	9.4	13.1	8.9	3.6	7.3	1.9	1.6	3.0	3.5
Total Alkalinity	mg/L	0.5	37	37	35	39	43	42	38	42	48	38
Bicarbonate	mg/L	0.5	45	45	42	48	52	52	47	51	59	46
Carbonate	mg/L	0.5	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
Hydroxide	mg/L	0.5	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
Dissolved Chloride	mg/L	0.5	12	22	21	27	15	11	23	11	9.6	24
Nitrate-N	mg/L	0.02	0.5	0.9	1.1	1.0	0.4	0.3	*0.2*	*0.2*	0.3	0.3
Nitrite-N	mg/L	0.005	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Total Ammonia	mg/L	0.005	0.098	0.13	0.3	0.25	0.09	0.077	0.035	0.11	0.051	0.067
Total Dissolved Solids	mg/L	10	68	90	94	110	92	78	72	62	78	82
Hardness (CaCO3)	mg/L	0.5	29	32	32	30	34	31	26	29	34	34
Dissolved Aluminum (Al)	mg/L	0.0005	0.70	0.48	0.51	0.54	0.66	0.54	0.38	0.54	0.61	0.51
Dissolved Antimony (Sb)	mg/L	0.00002	0.00055	0.00037	0.00039	0.00036	0.00033	0.00080	0.00024	0.00061	0.00070	0.00032
Dissolved Arsenic (As)	mg/L	0.00002	0.0079	0.0038	0.0054	0.0035	0.0029	0.0030	0.00056	0.0054	0.0098	0.0017
Dissolved Barium (Ba)	mg/L	0.00002	0.00084	0.00060	0.00080	0.00052	0.00080	0.00044	0.00032	0.00047	0.00087	0.00057
Dissolved Beryllium (Be)	mg/L	0.00001	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*	*0.00001*
Dissolved Bismuth (Bi)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Boron (B)	mg/L	0.05	0.061	0.055	0.096	0.061	0.058	*0.05*	*0.05*	0.052	0.060	*0.05*
Dissolved Cesium (Cs)	mg/L	0.00005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Cadmium (Cd)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Calcium (Ca)	mg/L	0.05	8.0	9.0	8.8	8.2	9.2	8.3	6.9	7.5	9.0	8.9
Dissolved Chromium (Cr)	mg/L	0.0001	0.00022	*0.0001*	*0.0001*	*0.0001*	0.00014	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Cobalt (Co)	mg/L	0.000005	0.00030	0.00025	0.00041	0.00040	0.00025	0.000087	0.000049	0.00022	0.00054	0.000078
Dissolved Copper (Cu)	mg/L	0.00005	0.00054	0.00034	0.00047	0.00028	0.00028	0.00019	*0.00005*	0.00013	0.00071	0.00006
Dissolved Lanthanum (La)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*
Dissolved Iron (Fe)	mg/L	0.001	0.34	0.014	0.13	0.030	0.31	0.018	0.023	0.025	0.12	0.064
Dissolved Lead (Pb)	mg/L	0.000005	0.00022	0.00012	0.00018	0.00013	0.000075	0.000051	0.000027	0.000046	0.000040	0.000036
Dissolved Lithium (Li)	mg/L	0.0005	0.0010	0.0010	0.0010	0.0012	0.0011	0.00098	0.0010	0.00089	0.00094	0.0011
Dissolved Magnesium (Mg)	mg/L	0.05	2.3	2.3	2.5	2.4	2.8	2.6	2.1	2.4	2.7	2.9
Dissolved Manganese (Mn)	mg/L	0.00005	0.0081	0.00237	0.00419	0.00307	0.0098	0.0037	0.0053	0.0031	0.0058	0.0046
Dissolved Phosphorus (P)	mg/L	0.002	0.0062	0.0029	0.0027	0.0026	0.0065	*0.002*	*0.002*	*0.002*	0.0056	0.0035
Dissolved Molybdenum (Mo)	mg/L	0.00005	0.00079	0.0018	0.0014	0.0012	0.00052	0.00056	0.00033	0.00030	0.00027	0.00036
Dissolved Nickel (Ni)	mg/L	0.00002	0.00038	0.00011	0.00020	0.00011	0.00021	0.00014	0.000071	0.00011	0.00043	0.00010
Dissolved Potassium (K)	mg/L	0.05	3.5	3.8	4.2	4.7	3.4	3.4	2.6	2.4	2.5	3.4
Dissolved Rubidium (Rb)	mg/L	0.00005	0.0015	0.0016	0.0019	0.0027	0.0019	0.0020	0.0014	0.0013	0.0011	0.0022
Dissolved Selenium (Se)	mg/L	0.00004	0.00042	0.00045	0.00053	0.00044	0.00042	0.00063	0.00019	0.00024	0.00038	0.00021
Dissolved Silicon (Si)	mg/L	0.1	1.3	0.82	0.99	0.84	1.05	0.71	0.52	0.76	0.93	0.77
Dissolved Silver (Ag)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Sodium (Na)	mg/L	0.05	16	19	21	23	14	14	19	12	14	18
Dissolved Strontium (Sr)	mg/L	0.00005	0.010	0.013	0.012	0.012	0.013	0.0099	0.0084	0.0099	0.0094	0.013
Dissolved Sulphur (S)	mg/L	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*
Dissolved Tellurium (Te)	mg/L	0.00002	*0.00002*	*0.00002*	*0.00002*	*0.00002*	*0.00002*	0.000047	*0.00002*	*0.00002*	*0.00002*	*0.00002*
Dissolved Thallium (Tl)	mg/L	0.000002	0.0000046	0.0000035	0.0000057	0.0000042	0.0000042	0.0000036	*0.000002*	*0.000002*	*0.000002*	0.0000041
Dissolved Thorium (Th)	mg/L	0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Tin (Sn)	mg/L	0.0002	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*
Dissolved Titanium (Ti)	mg/L	0.0005	0.00191	*0.0005*	0.00074	*0.0005*	0.00252	*0.0005*	*0.0005*	*0.0005*	0.00107	*0.0005*
Dissolved Tungsten (W)	mg/L	0.00001	0.00018	0.00012	0.00016	0.00029	0.00015	0.00017	0.000022	0.000069	0.000061	0.000049
Dissolved Uranium (U)	mg/L	0.000002	0.000041	0.000039	0.000041	0.000020	0.000022	0.000023	0.0000022	0.000010	0.00015	0.000005
Dissolved Vanadium (V)	mg/L	0.0002	0.0012	0.00055	0.00076	0.00056	0.00077	0.00069	0.00030	0.00089	0.00126	0.00063
Dissolved Zinc (Zn)	mg/L	0.0001	0.00092	0.00043	0.00085	0.00043	0.00062	*0.0001*	0.00011	*0.0001*	0.00019	*0.0001*
Dissolved Zirconium (Zr)	mg/L	0.0001	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.00040	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.00005*

Notes:
Italicized font indicates result is below the detection limit
°All element concentrations are given as dissolved

Appendix B – 2019 Geochemical Monitoring of Waste Rock, Madrid North Mine

Note: Data interpretation for the geochemical and geological monitoring of Madrid North waste rock is in progress and will be provided as a supplementary submission.

Appendix C – 2019 Hope Bay Quarry and Construction Rock Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter, SRK Lisa Barazzuol, SRK	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 25, 2020
Subject:	2019 Hope Bay Construction Rock Geochemical Monitoring		

1 Introduction

Between mid-2018 and mid-2019, TMAC Resources Inc. (TMAC) constructed the following infrastructure at Doris and Madrid North (Attachment A):

- Doris: access road to the vent raise; access road to the Doris crown pillar recovery (CPR); cover for the Doris CPR; and access road and jetty at Roberts Bay to the effluent discharge point.
- Madrid North: access road to the Naartok East CPR; Madrid North contact water pond (CWP); access road to the Madrid North CWP; and Naartok East overburden pad berm.

Infrastructure at Doris and Madrid North were constructed using rock from Quarry 2 and Quarry D, respectively (Attachment A) except for the Doris CPR cover, which was built using of a combination of Doris waste rock (underground and CPR) and rock from Quarry 2.

Prior to use as construction rock, TMAC geochemically characterized the stockpile of Doris CPR waste rock on Pad T and determined this material to be suitable as construction rock prior to using it to build the CPR cover (SRK 2020). Monitoring requirements for waste rock used as construction rock are specified in in Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018), *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019) and the Quarry Management and Monitoring Plan (TMAC 2017).

Prior to development, the rock from Quarry 2 and Quarry D was geochemically characterized and classified as not potentially acid generating with low potential for metal leaching (SRK 2008; SRK 2010). Operational quarry rock characterization and construction monitoring has assessed the ARD potential of the run-of-quarry (ROQ) rock and confirmed these conclusions (e.g. SRK 2019).

Monitoring requirements for quarries and quarry rock associated with the Doris Mine, Doris-Windy Road and Madrid North Mine are specified in Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018), Water Licence 2BE-HOP1222 (Nunavut Water Board 2012), and

the Framework Agreement signed between TMAC and the Kitikmeot Inuit Association (KIA) for belt wide land tenure. Details on how the requirements are implemented for quarries and quarry rock associated with the Doris-Windy Road are documented in the Quarry Management and Monitoring Plan (TMAC 2017).

This memo documents the results of the 2019 geochemical monitoring programs for run-of quarry (ROQ) rock from Quarry 2 and Quarry D, and construction materials (quarry rock and suitable waste rock) collected from as-built infrastructure. It was not necessary to discharge water from Quarry 2 or Quarry D during 2019 therefore no seep or sump sampling was undertaken.

2 Methods

2.1 Quarry Monitoring

In order to comply with the Quarry Management and Monitoring Plan (TMAC 2017), monitoring includes geological inspections of active quarry blast faces and collection of ROQ rock for geochemical characterization. A summary of monitoring activities at Quarry 2 and Quarry D is presented in Table 2-1. Active blasting was conducted in Quarry 2 in May, June, October and December 2019. Active blasting was conducted in Quarry D in May, June and September 2019. Attachment B includes the quarry inspection and sample descriptions.

Table 2-1: Summary of Quarry Inspections and Samples Collected

Inspection Month	Quarry 2		Quarry D	
	Inspections	Samples Collected	Inspections	Samples Collected
May	1	2	3	2
June	-	-	3	-
July	2	2	1	2
August	1*	1*	-	-
September	-	-	2	4

Notes:

*Argillite in quarry wall.

TMAC documented each blast face inspection including lithology, sulphide content and veining and presence/absence of fibrous actinolite (Attachment B). TMAC collected samples of ROQ rock as two fractions: a sieved coarse fraction (screened to -1 cm) and a finer fraction (screened to -2 mm). TMAC visually described the samples, including lithology, visible sulphide content, carbonate content and presence of veining (Attachment B). In addition, SRK collected one composite sample of argillite from the quarry wall of Quarry 2 in August.

TMAC and SRK shipped their respective samples to BV in Burnaby, BC for analysis of total sulphur by Leco. Samples containing total sulphur concentrations >0.1% were subsequently tested for acid-base accounting (ABA) and trace element content by aqua regia digestion followed by ICP-MS scan. ABA included paste pH, electrical conductivity (EC), sulphate sulphur by hydrochloric acid leach, Modified Sobek NP (MEND 1991), and total inorganic carbon (TIC).

TIC was determined by using a Leco furnace to directly measure CO_2 gas evolved from HCl treatment of the sample. The -2 mm samples also underwent a shake flask extraction (SFE) test on the as-received fraction using the MEND (2009) method with a 3:1 solution to solid ratio and a 24-hour shaking period. The SFE leachate was analyzed for pH, EC, SO_4, acidity, alkalinity, chloride, ammonia, total dissolved solids (TDS), and low-level dissolved metals including mercury and selenium. Geochemical analyses were coordinated by TMAC and SRK for their respective sample sets.

2.2 Construction Monitoring

In August 2019, SRK geochemist Derrick Midwinter, PGeo. conducted a geological inspection of infrastructure and roads constructed between August 2018 and August 2019 and collected 12 samples from the areas noted in Section 1 (Attachment A).

The geological inspection entailed walking the periphery of infrastructure with the objective of inspecting the construction materials to confirm the visual geological and geochemical composition were consistent with expected material sources.

SRK collected 12 samples and one field duplicate (SRK19-CR08-Dup) from the infrastructure areas inspected. Samples were collected from pre-determined locations with one sample taken from each infrastructure area inspected or at a minimum of every 500 m along roads. SRK visually described the samples, including lithology, visible sulphide content, carbonate content, and presence of veins (Attachment C). Photos of the inspected areas and sampling locations are included in Attachment D. Sample collection entailed sieving material to generate two size fractions (-1 cm and -2 mm). SRK conducted rinse tests using a 1 to 1 distilled water to solids ratio with a split of the -2 mm sieved portion and recorded the resulting pH and EC.

TMAC shipped samples to BV in Burnaby, BC with SRK providing test work instructions to the lab. The -1 cm fraction was initially analyzed of total sulphur by Leco, with samples containing total sulphur concentrations >0.1% subsequently analyzed for ABA and trace element content, using the same methods as outlined in Section 2.1. Seven samples were selected by SRK for SFE tests. One sample from each area was selected for SFE. In areas where there were multiple samples, SRK selected samples on the basis of high rinse EC values and high total sulphur values. SFE test methods are outlined in Section 2.1.

2.3 Quality Assurance and Control

SRK reviewed all data for QA/QC purposes, including BV's internal QC program.

Field rinse tests were carried out using deionized water and a handheld pH / EC meter that was calibrated prior to taking measurements. One field duplicate was collected by SRK (SRK19-CR-08-DUP) which passed all QA/QC criteria for rinse tests.

Table 2-2 presents the QAQC results for the ABA, trace element and SFE data. Laboratory results passed all QA/QC criteria except one sample. One sample initially failed the QC criterion for Leco and ICP sulphur but after the sample was re-run for both parameters, the data passed and the new results accepted. SRK deemed all results to be acceptable.

Table 2-2: QAQC Summary Table

QC Test	SRK QC Criteria	Quarry Monitoring		Construction Monitoring	
paste pH					
Field Duplicate	For any samples, +/- 0.5 difference pH unit	(n=0)	#N/A	(n=1)	All Passed
Pulp Duplicate	For any samples, +/- 0.5 difference pH unit	(n=5)	All Passed	(n=1)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=5)	All Passed	(n=1)	All Passed
Total C and TIC					
Method Blank	<2X detection limit (DL)	(n=4) for TIC	All Passed	(n=1) for TIC	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=0)	#N/A	(n=1) for TIC	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2) for TIC	All Passed	(n=2) for TIC	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=5) for TIC	All Passed	(n=2) for TIC	All Passed
Total S & Total Sulphate					
Method Blank	<2X detection limit (DL)	(n=5) for Total S and (n=5) for SO4	All Passed	(n=1) for Total S and (n=1) for SO4	All Passed
Sulphur balance (total S > sulphate S)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within +/-20%	(n=16)	All Passed	(n=12)	All Passed
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=0)	#N/A	(n=1) for Total S and (n=1) for SO4	All Passed
Pulp Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=2) for Total S and (n=4) for SO4	All Passed	(n=0) for Total S and (n=1) for SO4	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=12) for Total S and (n=8) for SO4	All Passed	(n=2) for Total S and (n=2) for SO4	All Passed
Modified NP					
Method Blank (n=0)	<2X detection limit (DL)	(n=5) for NP	All Passed	(n=1) for NP	All Passed
NP consistent with paste pH	Negative NP has paste pH <= 5	(n=16)	All Passed	(n=12)	All Passed
Field Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=0)	#N/A	(n=1)	All Passed
Pulp Duplicate	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	(n=5) for NP and (n=5) for Fizz Rating	All Passed	(n=1) for NP and (n=1) for Fizz Rating	All Passed
Fizz test rating with NP	Max NP does not exceed fizz test rating	(n=16)	All Passed	(n=12)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=5) for NP	All Passed	(n=1) for NP	All Passed
Modified NP and TIC					
Comparison between Modified NP and TIC	Check for trends/co-relation	(n=16)	NP generally higher than TIC	(n=12)	NP generally higher than TIC
Total S-Leco and S-ICP					
Comparison between Total S-Leco and S-ICP	For samples >10X detection limit (DL), % RPD within +/-20%	(n=11)	Y247801 -1CM – Sample initially failed QC criterion but upon re-run the sample passed. New data accepted.	(n=12)	All Passed
Trace Elements (Aqua Regia Digestion with ICP Finish)					
Method Blank	<2X Detection Limit	(n=4)	All Passed	(n=1)	All Passed
Field Duplicate	For samples >10X detection limit (DL), % RPD within +/- 30%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	(n=0)	#N/A	(n=1)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=8)	All Passed	(n=2)	All Passed
Shake Flask Extraction					
Method Blank	<5X Detection Limit	(n=5) for SO4, Total Alkalinity, Bicarbonate, Carbonate and Hydroxide and (n=4) for the rest of the parameters	All Passed	(n=1)	All Passed
Lab Blank	<5X Detection Limit	(n=2) for TIC	All Passed	(n=0)	#N/A
Ion Balance	EC>100uS/cm, % difference should be within +/-10%	(n=8)	All Passed	(n=7)	All Passed
Leachate Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=8)	All Passed	(n=0)	#N/A
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=0)	#N/A	(n=1)	All Passed
Standard Reference Material	Within specified tolerance ranges.	(n=2) for Total Alkalinity, (n=1) for the rest of the parameters	All Passed	(n=0)	#N/A

Source: \\VAN-SVR0\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\!020_Project_Data\Lab\Quarry Rock\1CT022.037_HopeBay_Summary_QAQC_Table_Quarry_Construction_2019_rev02_mlt.xlsx

2.4 Data Interpretation

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample, where total sulphur was used to calculate AP. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when TIC/AP ratios are less than 1 and as having an uncertain potential for ARD when TIC/AP ratios are between 1 and 3. For samples with Modified NP, interpretations of ratios of NP to AP were the same as TIC to AP.

3 Results

3.1 Quarry Monitoring

3.1.1 Quarry Face Inspections

Quarry 2

In 2019, TMAC conducted 3 active face inspections of Quarry 2 between May and August. See Attachment B for completed inspection forms. All inspections identified quarry faces as mafic metavolcanics (1a) except for the inspection in August that identified a band of argillite (5a).

The key observations recorded by TMAC geologists were that active quarry faces inspected between May and July were light to dark grey mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%). Quartz–carbonate veins were typically present (approximately <2%) and up to 10 mm wide. Small amounts of hematite staining were observed on the joint surfaces during all three inspections. No epidote or chlorite alteration was observed. All inspections noted the absence of fibrous actinolite.

TMAC's inspection of the quarry in August 2019 indicated the occurrence of a 3 to 4 m thick argillite band in one quarry face in the western extent of Quarry 2. TMAC mapped the occurrence of the argillite (Attachment B).

Quarry D

In 2019, TMAC conducted nine active face inspections in Quarry D between May and September. See Attachment B for completed inspection forms.

The key observations recorded by TMAC geologists were that all active quarry faces inspected were light to medium grey mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%). Quartz–carbonate veins were typically present (approximately <2%) and <1 cm. Small amounts of hematite stringers/staining were observed on joint and fracture surfaces during the majority of inspections. Weak to moderate epidote alteration was noted during one inspection (June 2019). In July, the visual inspection by the TMAC geologist described the quarry face as having 10% fine- to medium-grained gabbroic fragments with mafic metavolcanics. No chlorite alteration was reported. All inspections noted the absence of fibrous actinolite.

3.1.2 ABA

The ABA results for Quarry 2 and Quarry D are presented in Table 3-1, Figure 3-1 to Figure 3-4 and included in Attachment E.

Quarry 2

Samples collected from Quarry 2 were geologically logged as mafic metavolcanics (1a) or argillite (5a).

Paste pH for mafic metavolcanics (1a) samples ranged from 7.6 to 8.4 compared to a pH of 7.5 for the argillite (5a) sample.

Total sulphur concentrations ranged between 0.14 and 0.41% for mafic metavolcanics (1a) and were highest for the sample of argillite (2.3%). For mafic metavolcanics, sulphur content was greater in the fine fraction than the coarse fraction (Figure 3-1). Sulphate sulphur content was below the limit of detection (0.01%) or within the range of analytical error for all samples and rock types. Sulphide sulphur was at near parity with total sulphur content for the coarser fraction except for two samples of mafic metavolcanics (-2 mm) that contained a high proportion of sulphur as sulphate (Figure 3-1).

Modified NP and TIC content ranged between 150 and 220 kg $CaCO_3$/t and 140 and 200 kg $CaCO_3$/t, respectively for mafic metavolcanics (1a) samples. For the sample of argillite, Modified NP and TIC content was 70 and 75 kg $CaCO_3$/t, respectively. TIC content was generally at near parity with modified NP for all samples (Figure 3-2).

The mafic metavolcanics (1a) samples were classified as non-PAG whereas the argillite (5a) sample was classified as uncertain on the basis of TIC/AP and NP/AP (Figure 3-3 and Figure 3-4).

Quarry D

Paste pH for all mafic metavolcanics (1a) samples ranged from 7.5 to 9.0.

Total sulphur concentrations ranged between 0.09 and 0.26%. Total sulphur in the fine and coarse size fractions were roughly equivalent or greater in the fine fraction than the coarse fraction. Sulphate sulphur content below the limit of detection (0.01%) or within the range of analytical error. Sulphide and total sulphur content were near parity (Figure 3-1). Full ABA was not completed for sample Y250342 since total sulphur was less than 0.1%.

Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively. TIC content was generally at parity with modified NP (Figure 3-2).

All samples were classified as non-PAG on the basis of TIC/AP and NP/AP (Figure 3-3 and Figure 3-4).

Table 3-1: Acid Base Accounting Results for the 2019 Quarry 2 and Quarry D Rock Samples

Quarry	Rock Type	Sampling Month	Grain Size	Sample ID	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	Modified NP	TIC	NP/AP	TIC/AP
				Units	s.u.	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg CaCO3/t		
Quarry 2	1a	May	-1 cm	Y247801 <1CM	7.7	0.22	0.03	0.19	6.9	150	140	22	20
			-2 mm	Y247801 <2MM	7.7	0.34	0.05	0.29	10	220	190	21	18
			-1 cm	Y247802 <1CM	7.6	0.23	0.10	0.13	7.2	200	180	28	25
			-2 mm	Y247802 <2MM	7.6	0.34	<0.01	0.34	7.5	200	200	19	19
		July	-1 cm	WJ8404	8.4	0.14	0.10	0.04	4.4	170	190	40	42
			-2 mm	WJ8403	8.1	0.41	0.07	0.34	13	180	190	14	15
	5a	August	-1 cm*	SRK19-QR2-01	7.5	2.3	0.14	2.1	71	70	75	1.0	1.1
Quarry D	1a	May	-1 cm	Y264562 <1CM	7.5	0.14	<0.01	0.14	4.4	100	87	23	20
			-2 mm	Y264561 <2MM	7.5	0.12	<0.01	0.12	3.8	120	100	32	27
		July	-1 cm	Y250342**	--	0.09	--	--	--	--	--	-	-
			-2 mm	Y250341	8.2	0.18	0.02	0.16	5.6	160	150	29	26
		September	-1 cm	Y264152	9.0	0.15	<0.01	0.15	4.7	150	140	31	30
			-2 mm	Y264151	8.5	0.26	0.01	0.25	8.1	210	180	26	22
			-1 cm	Y264154	8.8	0.19	<0.01	0.19	5.9	130	150	23	26
			-2 mm	Y264153	8.7	0.15	<0.01	0.15	4.7	190	170	40	36

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Note: AP calculated from total sulphur content;

N/A denotes not applicable based on total sulphur content <0.1%

*Sample was collected from quarry wall and is not ROQ rock.

** ABA was not completed because total sulphur was <0.1%.

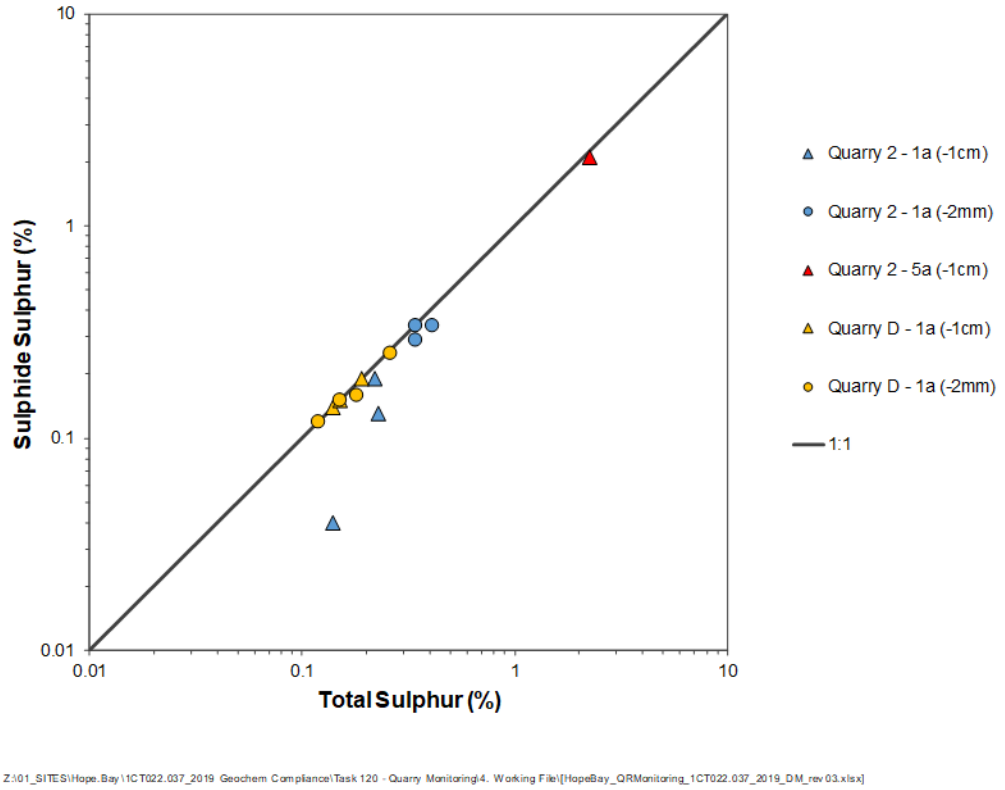

Figure 3-1: Comparison of Total Sulphur versus Sulphide, Quarry Samples

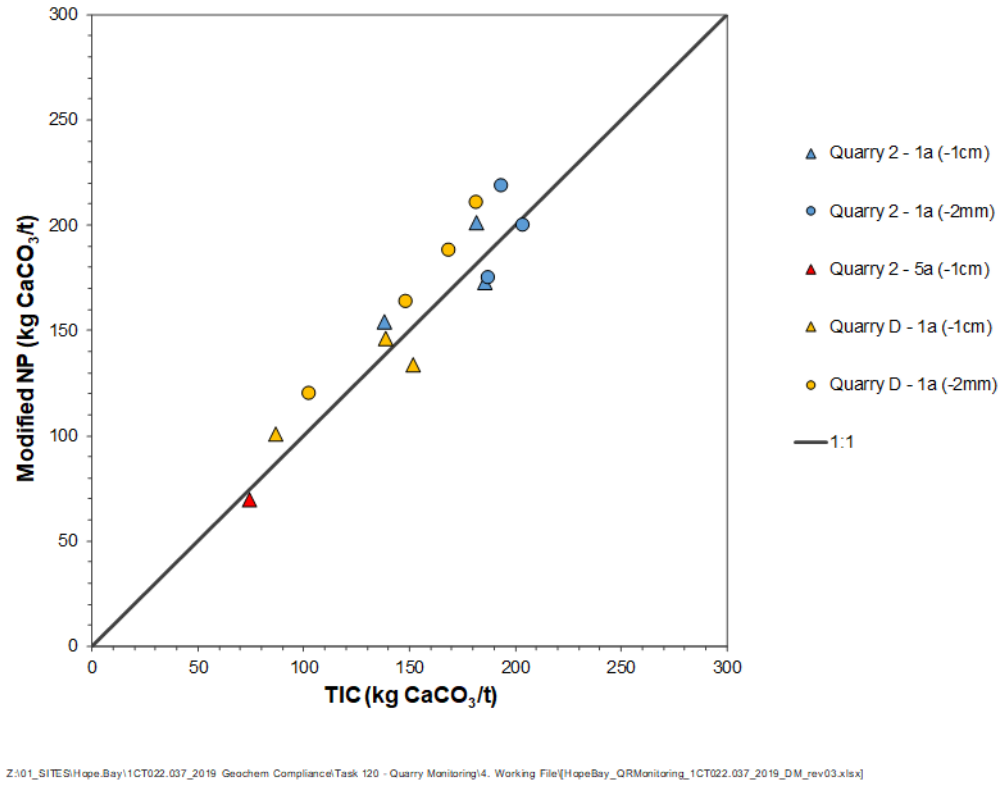

Figure 3-2: Comparison of Modified NP versus TIC, Quarry Samples

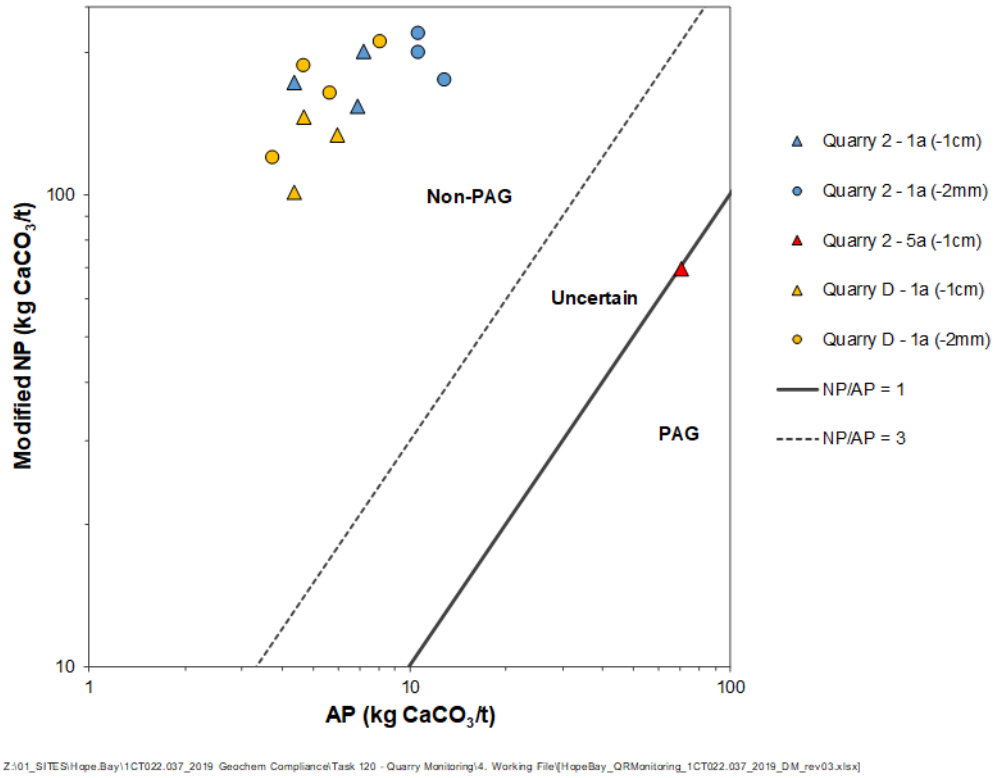

Figure 3-3: ARD Classifications by NP/AP, Quarry Samples

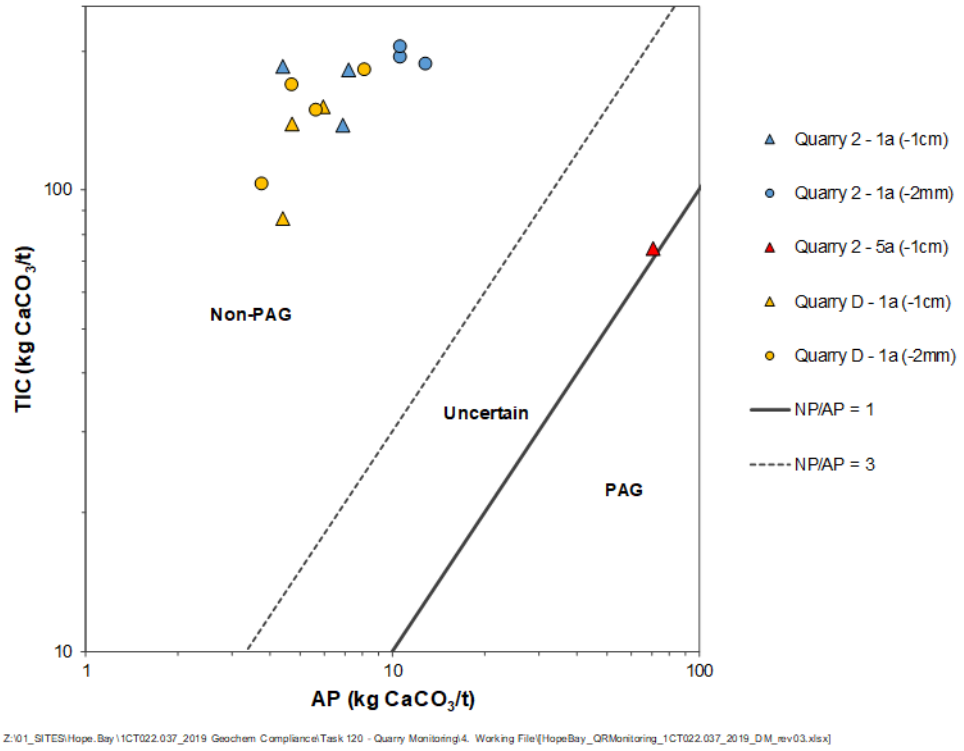

Figure 3-4: ARD Classifications by TIC/AP, Quarry Samples

3.1.3 Elemental Analyses

Selected key parameter results are presented in Table 3-2 and full laboratory results are included in Attachment E. The data were compared to ten times the average crustal abundance for basaltic rocks (Price 1997) to screen for enrichment. Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error.

Quarry 2

For mafic metavolcanics (1a) the fine fraction had higher levels of sulphur and arsenic in the fine fraction, with enrichment of sulphur in all -2 mm samples, and arsenic in two samples. All -1 cm samples of mafic metavolcanics were below the screening criteria indicating no appreciable enrichment.

Similarly, for argillite (5a) selenium, sulphur and arsenic were enriched. All other parameters for the argillite were below the screening criteria indicating no appreciable enrichment.

Quarry D

All size fractions and samples were below the screening criteria indicating no appreciable enrichment.

Table 3-2: Metals Analysis of Key Parameters for Quarry 2 and Quarry D Rock Samples

		Quarry>	Quarry 2							Quarry D						
		Rock type>	Mafic metavolcanics (1a)						Argillite (5a)	Mafic metavolcanics (1a)						
		Inspection Month>	May				July		August	May		July	September			
		Sample ID>	Y247801	Y247801	Y247802	Y247802	WJ8404	WJ8403	SRK19-QR2-01	Y264562	Y264561	Y250341	Y264152	Y264151	Y264154	Y264153
Parameter	**Units**	***Screening Criteria**	**-1 cm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**	**-1cm rock**	**-1 cm rock**	**-2 mm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**	**-1 cm rock**	**-2 mm rock**
Mo	ppm	*15*	0.30	0.40	0.40	0.50	0.30	0.50	1.2	0.90	1.50	0.80	0.50	0.30	0.20	0.20
Cu	ppm	*870*	160	150	140	150	110	130	410	100	110	110	110	110	85	89
Pb	ppm	*60*	2.7	5.6	7.3	20	1.8	2.4	9.8	1.7	4.0	3.6	1.9	3.7	1.1	2.1
Zn	ppm	*1050*	250	190	180	190	98	97	85	64	70	76	66	66	54	57
Ni	ppm	*1300*	42	41	41	41	37	37	56	200	210	110	170	200	200	230
Fe	ppm	*865000*	110000	110000	110000	110000	91000	89000	55000	53000	55000	55000	58000	55000	50000	53000
As	ppm	*20*	1.2	2.6	2.9	**24**	16	**26**	**33**	1.9	16	3.7	1.1	1.7	0.90	1.4
Au	ppm		0.023	0.032	0.018	0.012	0.0034	0.015	0.0028	0.001	0.005	0.007	0.0015	0.0031	0.0011	0.0019
Cd	ppm	*2.2*	0.70	0.50	0.40	0.50	<0.1	<0.1	0.1	<0.1	0.20	0.20	<0.1	<0.1	<0.1	<0.1
Al	ppm	*780000*	49000	49000	50000	49000	39000	38000	25000	36000	37000	35000	38000	37000	34000	38000
Hg	ppm	*0.9*	<0.01	<0.01	0.01	0.07	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S	ppm	*3000*	2300	**3300**	2400	**3100**	2800	**3300**	**24000**	800	1100	1600	1000	2100	900	1200
Se [(1)]	ppm	*0.5*	0.70	0.80	0.70	0.80	0.70	0.70	3.5	<0.50	0.60	0.60	0.50	0.70	<0.50	<0.50

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Notes:

°All element concentrations are given as dissolved

*Screening criteria is ten times average crustal abundance for basaltic rocks from Price (1997).

(1) Selenium could not be assessed because concentrations were below the detection limit or within the range of analytical error

Bold and underlined values indicate value is above the screening criteria

3.1.4 SFE Tests

A summary of SFE test results for Quarry 2 and Quarry D is presented in Table 3-3, with complete results presented in Attachment E. The results are compared to the maximum concentration in any grab sample guideline from the Quarry Effluent Quality Limits (Table 2.2, TMAC 2017); however, this is for screening purposes only as SFE results do not necessarily represent quarry water quality.

Quarry 2

For mafic metavolcanics (1a) samples, pH ranged from 9.0 to 9.2 and EC ranged from 110 to 310 µS/cm. Comparatively, the argillite (5a) sample had a pH of 7.5 and EC of 1,300 µS/cm. The conductivity value for argillite (5a) was greater than the screening criteria (500 µS/cm), and the pH of the mafic metavolcanics (1a) samples were greater than the screening criteria (pH 9.0).

For mafic metavolcanics (1a), major cation chemistry was dominated by sodium (29 to 40 mg/L) and calcium (12 to 15 mg/L), while major anion chemistry was dominated by chloride (32 to 56 mg/L), sulphate (27 to 29 mg/L) and alkalinity (23 to 24 mg/L as $CaCO_3$). Nitrate and ammonia concentrations ranged from 0.2 to 8.9 mg/L and 1.3 to 1.5 mg/L, respectively.

For the argillite sample, major cation chemistry was dominated by calcium (290 mg/L) while major anion chemistry was dominated by sulphate (780 mg/L). Magnesium, sodium and potassium were a magnitude lower than calcium. Nitrate (below detection limit, 0.2 mg/L), and chloride (4 mg/L) concentrations ranged were one to two magnitudes lower than sulphate.

All metals were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that sulphate concentrations for argillite suggest sulphide oxidation.

Quarry D

For all samples, pH ranged from 8.6 to 9.1 and EC ranged from 160 to 430 µS/cm. One sample exceeded the pH criteria.

Major cation chemistry was dominated by sodium (8.5 to 49 mg/L) and calcium (4.9 to 16 mg/L), while major anion chemistry was dominated by alkalinity (32 to 37 mg/L as $CaCO_3$), sulphate (7.9 to 25 mg/L) and chloride (6.9 to 49 mg/L). Nitrate and ammonia concentrations ranged from 2.7 to 15 mg/L and 0.011 to 6.0 mg/L, respectively. One sample exceeded the ammonia criteria.

All other parameters were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low.

Table 3-3: Shake Flask Extraction Results for Quarry 2 and Quarry D Monitoring Samples (-2 mm fraction)

Parameter	Units	Detection Limit	*Screening Criteria	Quarry 2				Quarry D			
				1a			5a	1a			
				May		July	August	May	July	September	
				Y247801	Y247802	R828433	SRK19-QR2-01	Y264561	Y250341	Y264151	Y264153
pH*	pH Units	N/A	9.0	**9.2**	**9.1**	9.0	7.7	8.6	8.9	**9.1**	8.9
EC*	uS/cm	0.5	500	320	340	290	1300	160	430	230	270
Sulphate	mg/L	0.5		27	29	28	780	21	25	7.9	14
Total Alkalinity ($CaCO_3$)	mg/L	0.5		23	23	24	15	32	35	37	35
Dissolved Chloride	mg/L	0.5		56	54	32	4	6.9	49	30	43
Nitrate-N	mg/L	0.02		3.7	4.2	8.9	< 0.2	3.0	15	2.7	6.8
Total Ammonia*	mg/L as N	0.005/ 0.25(1)	4.0	1.3 (1)	1.3 (1)	1.5	-	0.011	**6.0** (1)	1(1)	0.81 (1)
Total Dissolved Solids	mg/L	10		-	-	170	1300	90	190	130	180
Total Hardness ($CaCO_3$)	mg/L	0.5		42	51	48	820	52	48	15	18
Calcium (Ca)	mg/L	0.05		12	14	15	290	16	13	4.9	5.8
Magnesium (Mg)	mg/L	0.05		3.0	3.7	2.8	25	3.1	3.8	0.77	0.93
Potassium (K)	mg/L	0.05		4.6	5.0	6.2	8.3	1.9	4.8	2.6	3.5
Sodium (Na)	mg/L	0.05		40	40	29	5.3	8.5	49	36	46
Aluminum (Al)	mg/L	0.0005	2.0	0.33	0.33	0.21	0.029	0.17	0.18	0.25	0.20
Arsenic (As)	mg/L	0.00002	0.10	0.00040	0.00063	0.0037	0.00032	0.0064	0.00093	0.0012	0.0014
Cadmium (Cd)*	mg/L	0.000005		<0.000005	<0.000005	<0.000005	0.00018	<0.000005	<0.000005	<0.000005	<0.000005
Copper (Cu)*	mg/L	0.00005	0.04	0.00057	0.001	0.00049	0.004	0.0020	0.00085	0.00078	0.00087
Iron (Fe)*	mg/L	0.001	0.60	0.0098	0.022	0.003	0.0026	0.0021	0.0085	0.061	0.023
Lead (Pb)*	mg/L	0.000005	0.02	0.00012	0.00026	0.000022	0.00027	<0.000005	0.000073	0.000077	0.000018
Molybdenum (Mo)	mg/L	0.00005		0.0018	0.0017	0.0031	0.0035	0.0031	0.0053	0.0021	0.0028
Nickel (Ni)*	mg/L	0.00002	0.10	0.000085	0.000069	0.000049	0.00063	0.00043	0.00022	0.00022	0.0001
Selenium (Se)	mg/L	0.00004		0.0005	0.00048	0.0025	0.0027	0.00037	0.00046	0.00087	0.00081
Zinc (Zn)*	mg/L	0.0001	0.02	0.0018	0.0018	0.0028	0.0058	<0.0001	0.0027	0.0025	<0.0001
Mercury (Hg)	mg/L	0.00005		<0.00005	<0.00005	<0.00005	<0.0001	<0.00005	<0.00005	<0.00005	<0.00005

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Notes:

°All element concentrations are given as dissolved.

(1) Detection limits raised from 0.005 mg/L to 0.25 mg/L due to dilution to bring analyte within the calibrated range.

Values in bold indicates value exceeds respective water quality guideline for the parameter.

*Guideline from maximum concentration in any grab sample from the Quarry Effluent Quality Limits (Part D Item 18 of Water License 2BE-HOP-1222; TMAC, 2017).

3.2 Construction Monitoring

3.2.1 Geological Inspections

Doris

SRK understands ROQ rock was used to construct all infrastructure at Doris except for the Doris CPR cover, which was a combination of waste rock and ROQ rock.

As shown in Figure 3-5, the majority of the CPR cover material was CPR waste rock with selected area of ROQ rock. With some minor exceptions, rock used to construct the cover were mafic metavolcanics (1) but with compositional and/or textural differences. The ROQ rock in the CPR cover was mafic metavolcanics (1a) with trace (<1%) to no visible sulphides as cubic pyrite and minor carbonate and quartz veins. Waste rock was primarily foliated black-brown metavolcanics (1ay) and light brown altered metavolcanics (1as) with lesser mafic metavolcanics (1a) with <1% of waste rock present as quartz veins (12q) and lesser diabase (11). The mafic volcanics contained minor carbonate and quartz veining and also rare hematite staining and no sulphides observed except for a localized fragments of mafic metavolcanics with up to 1% cubic pyrite.

The geological inspection of all other infrastructure areas indicated that construction rock was typically dark green mafic metavolcanics (1a) except for a 120 m segment of the access road to the Doris vent raise that contained ~5-10% of argillite (5a) present as black fragments (~5-20 cm) mixed with mafic metavolcanics (1a). The argillite contained visible sulphides (3 to 5% as cubic pyrite associated with quartz veining) and no carbonate veins.

Typical ROQ mafic metavolcanics (1a) contained no to trace amounts (< 1%) of visible sulphides that were typically present as very fine grained cubic pyrite that were disseminated or associated with veining. There were few carbonate and quartz veins, typically < 1 cm wide. Also common was hematite staining (~5%). Mafic metavolcanics (1a) fragments containing greater sulphides (~5%), typically cubic and associated with quartz veins were observed in localized areas. Rare (< 1%) granitic boulders (~10-50 cm) were also encountered throughout the infrastructure. These boulders were often well-rounded and are interpreted to represent glacial erratics. One occurrence of chalcopyrite (< 1%) was observed at Roberts Bay. Rare epidote veins were also observed at Roberts Bay (Figure 3-6).¶

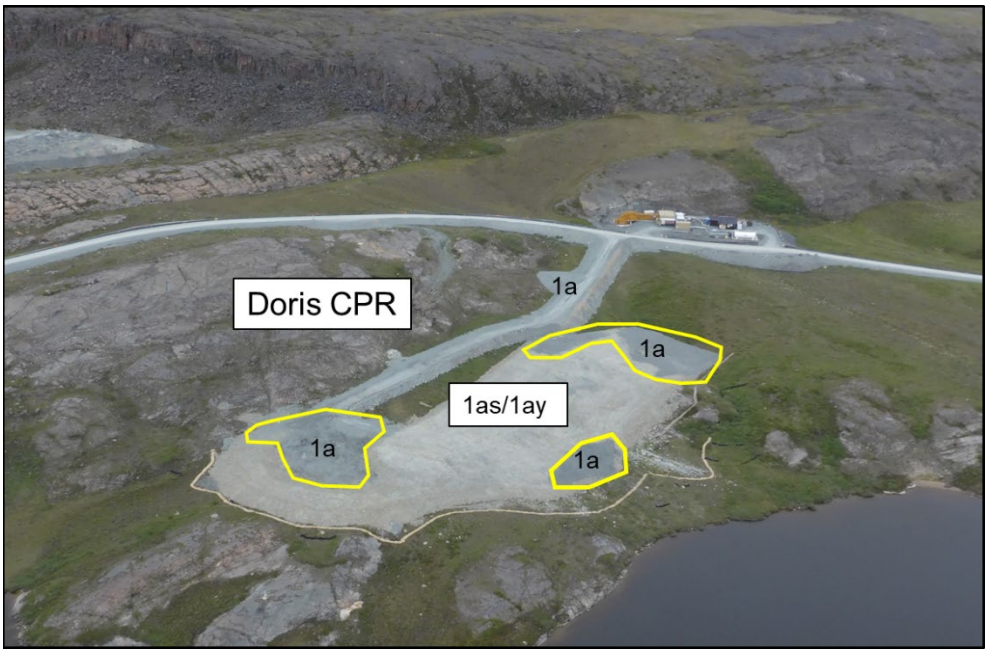

Figure 3-5: Photo of the Doris CPR Cover which was Constructed using Waste Rock (altered mafic metavolcanics and foliated metavolcanics (1as/1ay)) and ROQ Rock (mafic metavolcanics (1a)). Areas of ROQ rock are circled in in yellow (Dated July 31, 2019).

Figure 3-6: Epidote Vein within Mafic Metavolcanic (1a) (near SRK19-CR01)

Madrid North

Typical construction rock observed in infrastructure at Madrid North was dark green mafic metavolcanics (1a) with no to trace (< 1 %) visible sulphides in the form of cubic pyrite. The mafic metavolcanics contained rare to few quartz-carbonate vein that were typically < 1 cm wide. In all surveyed areas, <5% of construction material contained hematite (Figure 3-7). An estimated 5% of construction material was granitic boulders observed in all areas (Figure 3-8). These fragments were often well-rounded and are interpreted to represent glacial erratics. Rare epidote veins were observed in construction material at the overburden pad berm. A single rock (<15 cm) of graphitic argillite (5a) was observed along the access road to the Madrid North CWP, near where the SRK19-CR06 sample was collected (Attachment C).

Figure 3-7: Mafic Metavolcanic (1a) with Hematite Staining (near SRK19-CR05)

Figure 3-8: Mafic Metavolcanics with a Granitic Boulder and the Plan View of a Quartz Vein in the Top-right (near SRK19-CR03)

3.2.2 Contact Tests

Contact rinse tests results for infrastructure at Doris and Madrid North are presented in Table 3-4.

Doris

Rinse pH values for all samples ranged between 8.6 and 9.0 s.u. Rinse EC results ranged between 180 and 450 µS/cm for all samples except the waste rock material used to construct the CPR cover (4,000 and 4,900 µS/cm).

Madrid North

Rinse pH values were alkaline ranging between 8.6 and 9.0 s.u. Samples collected from the Madrid North CWP and access road to Madrid North CWP had lower EC values (ranging between 550 and 830 µS/cm) than samples collected from the access road to the Naartok East CPR and berm for the overburden pad (1600 and 2500 µS/cm, respectively).

Table 3-4: Rinse Test Results for 2019 Construction Rock Samples (-2 mm Fraction)

Mine Area	Rock Type	Area	Sample ID	Rinse pH	Rinse EC
				s.u.	uS/cm
Doris	1a	Access Road (Roberts Bay)	SRK19-CR01	8.6	450
			SRK19-CR02	9.0	180
		Access Road to Doris CPR	SRK19-CR10	8.9	370
	1a w. 5a	Access Road to Vent Raise	SRK19-CR09	8.6	320
	1as/ay	CPR Cover	SRK19-CR11	8.5	4900
			SRK19-CR12	8.6	4000
Madrid North	1a	Access Road to Madrid North CWP	SRK19-CR03	9.2	700
			SRK19-CR04	9.0	550
			SRK19-CR05	8.6	720
		Madrid North CWP	SRK19-CR06	8.8	830
		Access Road to Naartok East CPR	SRK19-CR07	8.9	1600
		Berm for Overburden Pad	SRK19-CR08	9.0	2500

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3.2.3 ABA

ABA results are presented in Table 3-5, Figure 3-9 to Figure 3-12, and Attachment F.

Doris

Samples collected represent construction rock at Doris including waste rock used as construction rock on the Doris CPR cover (SRK19-CR11 and SRK19-CR12) and for all other areas, ROQ rock that was geologically classified as mafic metavolcanics (1a). The one exception was sample SRK19-CR09 from the access road to the Doris vent raise that was a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a).

Paste pH readings for all samples ranged between 8.2 and 8.8 s.u.

For all samples, total sulphur ranged between 0.18% and 0.45%. The sample containing argillite (SRK19-CR09) contained the highest total sulphur. Sulphate content was below the limit of detection (0.01%) or within the range of analytical error for all samples. Sulphide sulphur calculated as the difference between total sulphur and sulphate, was at near parity with total sulphur, indicating that the sulphide sulphur was the predominant sulphur species (Figure 3-9).

For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity (Figure 3-10). All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP (Figure 3-11 and Figure 3-12).

Madrid North

Full ABA was completed for all samples except for sample SRK19-CR07, the latter which had total sulphur content of less than 0.1% (Section 2.2).

Paste pH readings ranged between 8.2 and 8.8 s.u.

Total sulphur ranged between 0.07% and 0.22% and sulphate sulphur values were below or near the limit of detection (0.01%). Sulphide sulphur, calculated as the difference between total sulphur and sulphate sulphur, was at near parity with total sulphur, indicating that the sulphide sulphur was the predominant sulphur species (Figure 3-9).

Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method (Figure 3-10). All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP (Figure 3-11 and Figure 3-12).

Table 3-5: Acid Base Accounting Results for the 2019 Construction Rock Samples (-1 cm Fraction)

Mine Area	Rock Type	Area	SRK ID	Paste pH	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
				pH Units	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A	N/A
Doris	1a	Access Road (Roberts Bay)	SRK19-CR01	8.2	0.20	<0.01	0.19	5.9	110	140	18	23
			SRK19-CR02	8.4	0.18	<0.01	0.18	5.6	110	140	19	24
		Access Road to Doris CPR	SRK19-CR10	8.8	0.38	<0.01	0.38	12	220	200	18	16
	1a w. 5a*	Access Road to Vent Raise	SRK19-CR09	8.4	0.45	<0.01	0.44	14	130	150	9	10
	1as/ay	Doris CPR	SRK19-CR11	8.3	0.29	<0.01	0.28	9.1	220	200	25	22
			SRK19-CR12	8.8	0.21	<0.01	0.21	6.6	250	210	38	31
Madrid North	1a	Access Road to Madrid North CWP	SRK19-CR03	8.8	0.15	<0.01	0.15	4.7	120	140	26	31
			SRK19-CR04	8.6	0.17	<0.01	0.16	5.0	130	150	25	27
			SRK19-CR05	8.2	0.11	<0.01	0.11	3.4	120	130	35	39
		Madrid North CWP	SRK19-CR06	8.4	0.22	<0.01	0.22	6.9	130	150	18	22
		Access Road to Naartok East CPR	SRK19-CR07	--	0.07	--	--	--	--	--	--	--
		Berm for Overburden Pad	SRK19-CR08	8.3	0.11	<0.01	0.11	3.4	170	200	50	57

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Notes:

AP is acid generation potential, calculated from total sulphur

NP is neutralization potential

Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur

-- denotes not applicable based on total sulphur content <0.1%

*Sample was ~90 to 95% mafic metavolcanics (1a) and 5 to 10% argillite (5a)

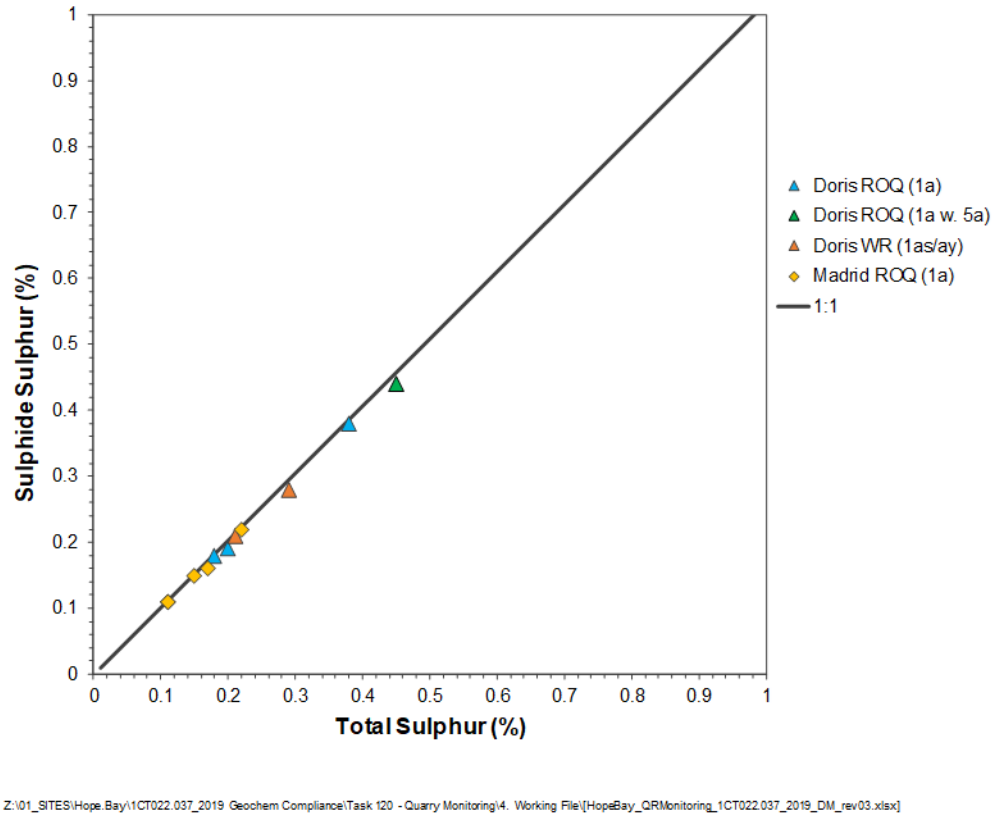

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Figure 3-9: Comparison of Total Sulphur versus Sulphide, Construction Rock Samples

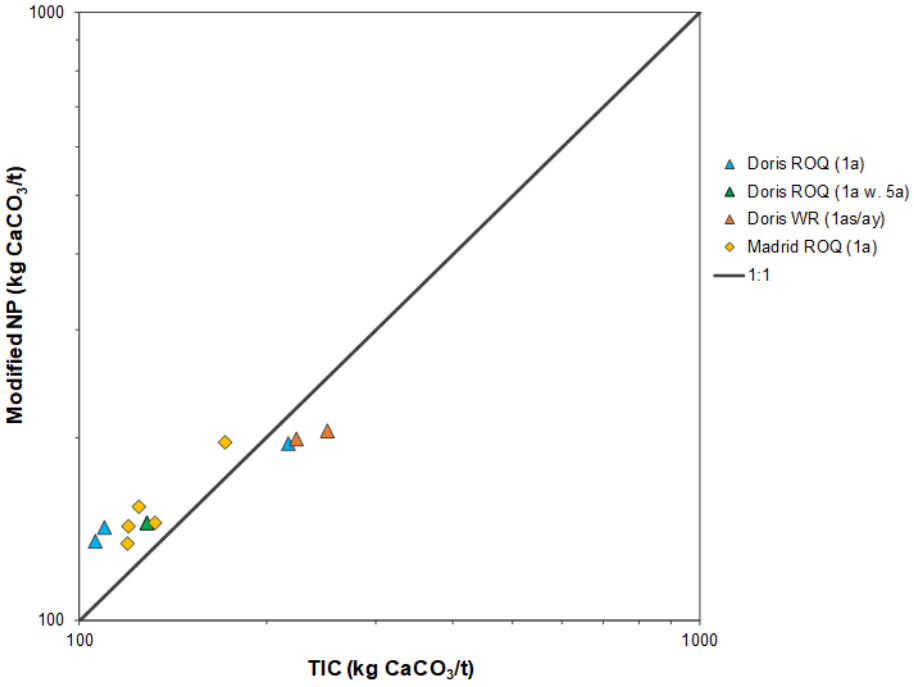

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Figure 3-10: Comparison of Modified NP versus TIC, Construction Rock Samples

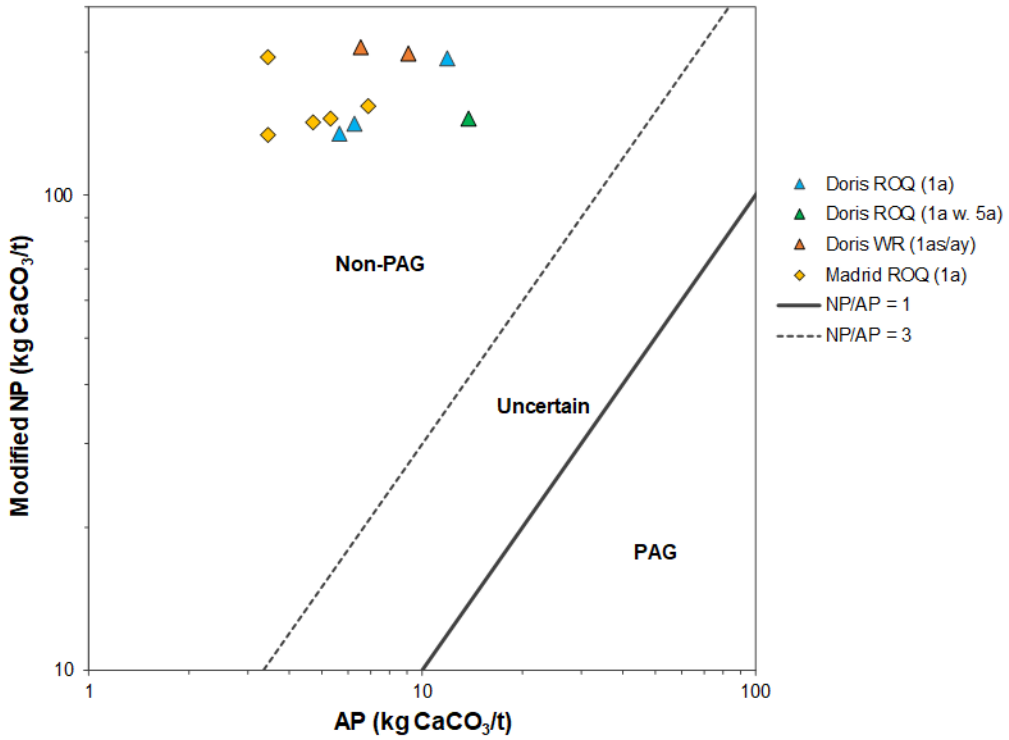

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Figure 3-11: ARD Classifications by NP/AP, Construction Rock Samples

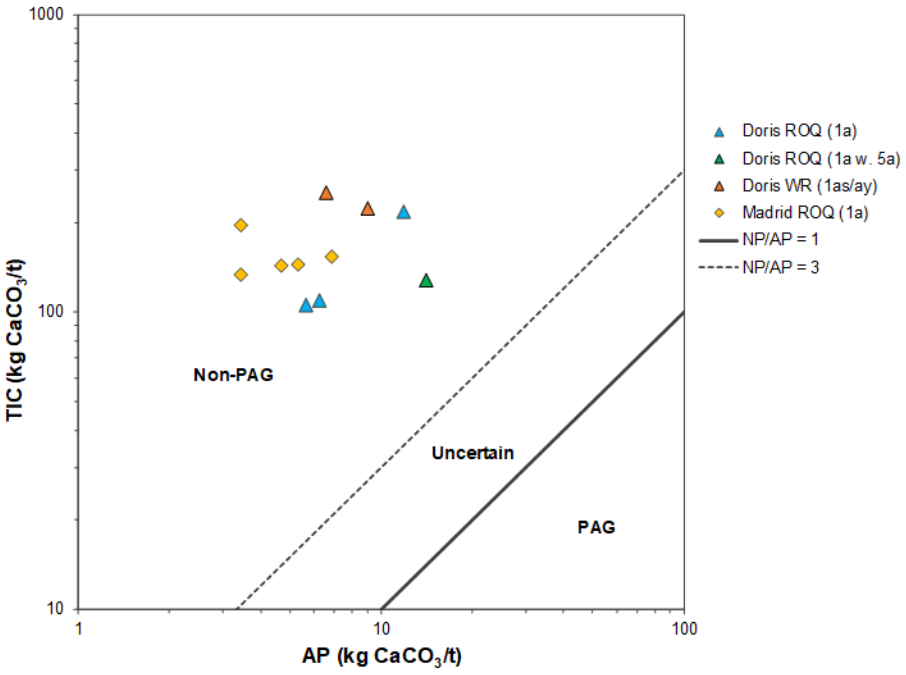

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Figure 3-12: ARD Classifications by TIC/AP, Construction Rock Samples

3.2.4 Elemental Analyses

Table 3-6 presents a summary of elemental content with full laboratory results presented in Attachment F. Elemental content was compared to ten times the average crustal abundance for basaltic rocks (Price 1997) to screen for enrichment.

Doris

Four samples were enriched in arsenic and/or sulphur as compared to the screening criteria as follows:

- Sample SRK19-CR10 of ROQ mafic metavolcanics (1a) was enriched in arsenic and sulphur.
- Sample SRK19-CR09 (ROQ sample containing a mixture of mafic metavolcanics (1a) and argillite (5a)) was enriched in sulphur only.
- The waste rock samples (SRK19-CR11 and SRK19-CR12) were both enriched in sulphur and one was enriched in arsenic.

All other parameters were below the screening criteria, suggesting no appreciable enrichment.

Madrid North

All parameters for Madrid North samples were below the screening criteria, suggesting no appreciable enrichment.

Table 3-6: Summary of Element Analysis for the 2019 Construction Rock Samples (-1 cm Size Fraction)

		Mine Area>	Doris						Madrid North				
		Rock Type>	1a			1a w. 5a	1as/ay		1a				
Parameter	Units	*Screening Criteria	Roberts Bay		Access Road to Doris CPR	Access Road to Vent Raise	Doris CPR		Access Road to Madrid North CWP			Madrid North CWP	Overburden Pad Berm
			SRK19-CR01	SRK19-CR02	SRK19-CR10	SRK19-CR09	SRK19-CR11	SRK19-CR12	SRK19-CR03	SRK19-CR04	SRK19-CR05	SRK19-CR06	SRK19-CR08
As	ppm	*20*	5.2	2.4	**45**	12	**31**	**31**	3.2	4.3	2.9	4.3	1.5
Cd	ppm	*2.2*	0.40	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.20	< 0.1	0.20	< 0.1
Co	ppm	*480*	42	41	45	37	37	39	38	41	44	41	43
Cr	ppm	*1700*	150	160	50	69	40	45	230	320	350	180	540
Cu	ppm	*870*	130	150	120	160	72	88	120	100	100	120	92
Hg	ppm	*0.9*	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Mo	ppm	*15*	0.3	0.8	1.0	0.5	0.5	0.7	1.1	0.3	0.3	0.6	0.3
Ni	ppm	*1300*	64	61	73	46	54	64	69	110	130	79	170
Pb	ppm	*60*	4.4	2.1	2.0	2.5	1.8	2.6	2.0	2.8	3.1	1.9	2.5
S	%	*0.3*	0.16	0.14	**0.35**	**0.39**	**0.31**	0.23	0.14	0.12	0.10	0.19	0.08
Se	ppm	*0.5*	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sr	ppm	*4650*	24	27	27	29	27	26	24	22	19	25	19
Zn	ppm	*1050*	120	89	61	95	69	59	79	77	80	110	58

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Notes:

* Screening criteria corresponds to 10 times the average crustal abundance for basaltic rocks as per Price (1997)

All values have been rounded to two significant figures

BOLD values indicate result exceeds screening criteria

3.2.5 SFE Tests

A summary of results for key parameters analyzed is presented in Table 3-7 and full results are included in Attachment F. The results are compared to the maximum concentration in any grab sample guideline from the Quarry Effluent Quality Limits (Table 2.2, TMAC 2017), however this screening is for screening purposes only as SFE do not necessarily represent quarry water quality.

Doris

SFE tests were conducted on two samples of Doris ROQ (including sample SRK19-CR09 containing argillite) and one sample of Doris waste rock used to construct the CPR cover (SRK19-CR11).

The pH for all samples ranged between 8.7 and 8.8 s.u. Consistent with rinse test data, EC values for Doris ROQ samples (42 and 200 µS/cm) were lower than the waste rock sample SRK19-CR11 (1500 µS/cm). The EC for sample SRK19-CR11 was above the screening criterion.

For all samples, major cation chemistry was dominated by sodium and calcium, however concentrations were lower for ROQ rock samples (4 and 22 mg/L for sodium and 10 and 16 mg/L for calcium) than the waste rock sample (230 and 30 mg/L, respectively). Major anion chemistry was different for ROQ and waste rock samples with ROQ samples dominated by alkalinity (27 and 29 mg/L as $CaCO_3$) and chloride (3.1 and 14 mg/L) and waste rock samples dominated by chloride (350 mg/L) and sulphate (120 mg/L). Notable nitrate concentrations were lower for ROQ samples (0.2 and 0.9 mg/L) that the waste rock sample (19 mg/L).

No dissolved metals were above the screening criteria. Results indicate that the potential for metal leaching from these samples is low. The higher chloride and nitrate levels for sample SRK19-CR11 suggest that waste rock from the underground may be present in the CPR cover material.

Madrid North

The pH ranged from 8.7 and 8.9 s.u. EC values ranged between 250 and 890 µS/cm. The EC values for the two samples from the access road to the Naartok East CPR and berm for the overburden pad (SRK19-CR07 and SRK19-CR08) were higher than the screening criteria.

Major ion composition was similar for all samples with a few notable differences. Major cation chemistry was dominated by sodium and calcium for all samples; however, concentrations of sodium were higher for samples SRK19-CR07 and SRK19-CR08 (88 and 150 mg/L) compared to samples SRK19-CR05 and SRK19-CR06 (23 and 41 mg/L). Notable differences in major anion chemistry included chloride for samples SRK19-CR07 and SRK19-CR08 (120 and 200 mg/L), which was at least 2 to 4 times higher than other samples.

For the two samples with the lowest values of EC (SRK19-CR05 and SRK19-CR06), major cation chemistry was dominated by sodium (23 and 41 mg/L) and calcium (15 and 16 mg/L), while the major anion chemistry was dominated by sulphate (16 and 29 mg/L), alkalinity (23 mg/L), nitrate (7.6 and 19 mg/L) and chloride (6.7 to 52 mg/L).

For samples SRK19-CR07 and SRK19-CR08 (samples with the highest EC values), major cation chemistry was dominated sodium (88 and 150 mg/L), while the major anion chemistry was dominated by chloride (120 and 200 mg/L) one to two magnitudes greater than other Madrid North construction samples. Concentrations of nitrate have a maximum value of 19 mg/L.

No dissolved metals were above the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

Table 3-7: Shake Flask Extraction Results for 2019 Construction Rock Samples (-2 mm Fraction)

			Mine Area>	Doris			Madrid North			
			Rock Type>	1a	1a w. 5a	1as/ay	1a			
Parameter	Units	Detection Limit	Screening Criteria*	Roberts Bay	Access Road to Vent Raise	Doris CPR Cover	Access Road to Madrid North CWP		Access Road to Naartok East CPR	Overburden Pad Berm
				SRK19-CR01	SRK19-CR09	SRK19-CR11	SRK19-CR05	SRK19-CR06	SRK19-CR07	SRK19-CR08
pH	pH Units	N/A	9.0	8.8	8.7	8.7	8.7	8.7	8.9	8.9
EC	uS/cm	0.5	500	200	140	**1500**	250	350	**560**	**890**
SO_4	mg/L	0.5		49	30	120	16	29	45	46
Total Alkalinity	mg/L	0.5		27	29	22	23	23	31	28
Chloride	mg/L	0.5		14	3.0	350	6.7	52	120	200
Nitrate-N	mg/L	0.02		0.2	0.9	19	19	7.6	2.4	8.2
Total Dissolved Solids	mg/L	10		130	92	920	180	210	310	490
Hardness ($CaCO_3$)	mg/L	0.5		40	56	200	62	63	51	62
Calcium (Ca)	mg/L	0.05		10	16	30	16	15	11	12
Sodium (Na)	mg/L	0.05		22	4	230	23	41	88	150
Aluminum (Al)	mg/L	0.0005	2.0	0.25	0.18	0.090	0.15	0.18	0.14	0.11
Antimony (Sb)	mg/L	0.00002		0.00016	0.00025	0.00023	0.00011	0.00011	0.00011	0.00008
Arsenic (As)	mg/L	0.00002	0.1	0.00096	0.0012	0.021	0.0015	0.0015	0.001	0.00048
Cadmium (Cd)	mg/L	0.000005		<0.0000050	<0.0000050	< 0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Copper (Cu)	mg/L	0.00005	0.04	0.00075	0.0016	0.0018	0.0008	0.0019	0.0012	0.00062
Iron (Fe)	mg/L	0.001	0.6	0.020	0.0025	0.0050	0.0091	0.001	0.013	0.0036
Lead (Pb)	mg/L	0.000005	0.02	0.000022	0.000009	0.0000065	0.000012	0.000008	0.000010	0.000009
Molybdenum (Mo)	mg/L	0.00005		0.0018	0.0021	0.0026	0.0014	0.0017	0.0029	0.0022
Nickel (Ni)	mg/L	0.00002	0.1	0.000091	0.000057	0.00049	0.00023	0.00020	0.00045	0.00028
Selenium (Se)	mg/L	0.00004		0.00033	0.00130	0.0023	0.00060	0.00130	0.00060	0.00064
Thallium (Tl)	mg/L	0.000002		0.0000099	0.000009	0.000014	0.000013	0.000010	0.000015	0.000020
Zinc (Zn)	mg/L	0.0001	0.02	0.00042	0.00020	0.00025	0.00034	0.00011	0.00038	0.00017

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 120 - Quarry Monitoring\4. Working File\HopeBay_QRMonitoring_1CT022.037_2019_DM_rev02.xlsx

Notes:

°All element concentrations are given as dissolved. Bold and underlined value indicates value greater than the screening criteria.

*Guideline from maximum concentration in any grab sample from the Quarry Effluent Quality Limits (Part D Item 18 of Water License 2BE-HOP-1222; TMAC, 2017).

4 Summary and Conclusions

4.1 Quarry Monitoring

4.1.1 Quarry 2

In 2019, TMAC conducted geological inspections in Quarry 2 between May and August. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets except for the August inspection. In August, a 3 to 4 m thick band argillite (5a) within mafic metavolcanics was observed in one active face in the western extent of the quarry. All inspections noted the absence of fibrous actinolite.

Geochemical monitoring of ROQ rock indicated all samples of mafic metavolcanics (1a) were non-PAG according to values of NP/AP and TIC/AP. The argillite (5a) sample was classified as having an uncertain potential for ARD owing to higher levels of total sulphur (2.3% compared to 0.14 and 0.41% for mafic metavolcanics (1a)) and lower NP and TIC (70 and 75 $CaCO_3$/t, respectively for argillite compared to an overall range of 140 to 220 kg $CaCO_3$/t for mafic metavolcanics (1a)).

Compared to the screening criteria, sulphur and arsenic were enriched for argillite (5a) and in the fine fraction (-2 mm) of mafic metavolcanics (1a). The -1 cm fraction of mafic metavolcanics were not enriched in arsenic and sulphur compared to the screening criteria. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE test results for mafic metavolcanics (1a) indicated non-acidic pH and metal concentrations below the screening criteria indicating the risk of ML/ARD from Quarry 2 metavolcanics (1a) is low.

SFE test results for argillite (5a) indicated non-acidic pH with sulphate concentrations (780 mg/L) suggestive of sulphide oxidation. Based on SFE results and the uncertain potential for argillite to generate ARD, SRK recommends that TMAC avoid argillite units for use as construction material, as much as practically possible, due to its higher risk for ML/ARD.

4.1.2 Quarry D

In 2019, TMAC conducted geological inspections in Quarry D in May, July and September. Geological inspections of all active quarry faces indicated that quarry rock was predominantly mafic metavolcanics (1a) containing trace amounts of disseminated pyrite (<1%) with occasional quartz and carbonate veinlets. All inspections noted the absence of fibrous actinolite

Geochemical monitoring of ROQ rock indicated that the monitoring samples were non-PAG for all mafic metavolcanics (1a) according to values of NP/AP and TIC/AP. Total sulphur content ranged between 0.09 and 0.26% and Modified NP and TIC content ranged between 100 and 210 kg $CaCO_3$/t and 87 and 180 kg $CaCO_3$/t, respectively.

Elemental analyses indicated no appreciable enrichment compared to the screening criteria.

SFE test results indicated that all test leachates were non-acidic and that all parameters were below the screening criteria indicating the risk of ML/ARD from Quarry D ROQ rock is low.

4.2 Construction Monitoring

4.2.1 Doris

SRK conducted a geological inspection of as-built construction at Doris that confirmed that construction materials for the access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay were characteristic of Quarry 2: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). The geological inspection of the Doris CPR and access road to Doris vent raise identified material that was not exclusively or typical of Quarry 2 and are described as follows:

- Doris CPR cover: TMAC constructed the cover primarily using waste rock with selected areas using ROQ rock from Quarry 2. Waste rock was geochemically characterized prior to use as construction material according to the program outlined in *Waste Rock, Ore and Mine Backfill Management Plan (*TMAC 2019), with results of this program presented in SRK (2020). The majority of construction material (both waste rock and ROQ rock) in the cover were both geologically classified as mafic metavolcanics (1) with varying textural and compositional differences.
- Access road to Doris vent raise: the geology of construction material used for the access road was characteristic of Quarry 2, except for a 120 m segment that contained a minor amount (~5-10%) of black intermixed fragments of argillite (5a) mixed with mafic metavolcanics (1a).

Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads, including two samples of waste rock from the CPR cover and one sample from the access road to the vent raise containing argillite (5a).

Total sulphur ranged between 0.18% and 0.45% with the highest sulphur value from the sample containing a mixture of mafic metavolcanics (1a) and 5 to 10% argillite (5a). For all samples, Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t, respectively. Modified NP content was greater than TIC for mafic metavolcanics (1a) indicating the occurrence of silicates measured by the NP method, whereas TIC was greater than NP for rock types argillite (5a) and altered and foliated mafic metavolcanics (1as/ay) indicating the presence of iron carbonates that do not have buffering capacity. All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

Four samples were enriched in arsenic and/or sulphur as compared to the screening criteria. All other parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline. Results indicate that the potential for metal leaching from these samples is low. The higher chloride and nitrate levels for sample SRK19-CR11 suggest that waste rock from the underground may be present in the CPR cover

material. TMAC notes that the cover design specified that underground waste rock be placed below the active layer and CPR waste rock to be placed as the cover.

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, construction rock used to construct the access road to the vent raise, access road to the Doris crown pillar recovery (CPR) and jetty at Roberts Bay was geochemically suitable for use as construction rock. This includes the ROQ rock from the access road to the vent raise that contained 5 to 10% argillite and also the waste rock samples collected from the cover of the CPR.

Waste rock and ROQ rock used to construct the CPR cover has a low risk of ML/ARD however shake flask test indicate the potential for elevated chloride and nitrate. No seepage was observed from the CPR cover during TMAC's 2019 seepage survey. The Doris CPR cover will be included in subsequent seepage surveys to assess the potential for contaminant leaching from the Doris CPR.

4.2.2 Madrid North

Based on the 2019 geological and geochemical monitoring program of quarry and as-built construction rock, the quarry rock used to construct the access road to the Naartok East CPR; Madrid North CWP; access road to the Madrid North CWP; and Naartok East overburden pad berm was geochemically suitable for use as construction rock.

SRK conducted a geological inspection of as-built construction at the Madrid North mine and confirmed that construction materials were characteristic of Quarry D: grey-green mafic metavolcanics (1a) containing few carbonate and quartz veinlets with trace (<1%) to no visible sulphides (very fine grained cubic pyrite that were disseminated or associated with veining). Six surface rock samples were collected for geochemical characterization from as-built infrastructure and roads.

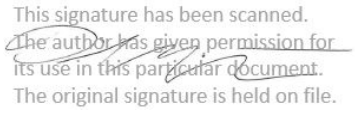
Total sulphur content ranged between 0.07% and 0.22%. Modified NP and TIC levels ranged from 140 to 210 kg $CaCO_3$/t and 110 to 250 kg $CaCO_3$/t. Modified NP and TIC levels ranged from 120 to 170 kg $CaCO_3$/t and 130 to 200 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method All samples were classified as non-PAG on the basis of both NP/AP and TIC/AP.

In terms of elemental content, concentrations of all parameters were below the screening criteria, suggesting no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline and that dissolved metals were below the screening criteria. Results indicate that the potential for metal leaching from these samples is low but that chloride levels are higher for samples SRK19-CR07 and SRK19-CR08 compared to other construction rock samples.

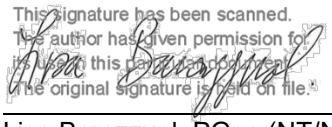
Regards,
SRK Consulting (Canada) Inc.

Prepared by:



Derrick Midwinter, PGeo (ON)
Staff Consultant (Geochemistry)

Reviewed by:



Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant (Geochemistry)

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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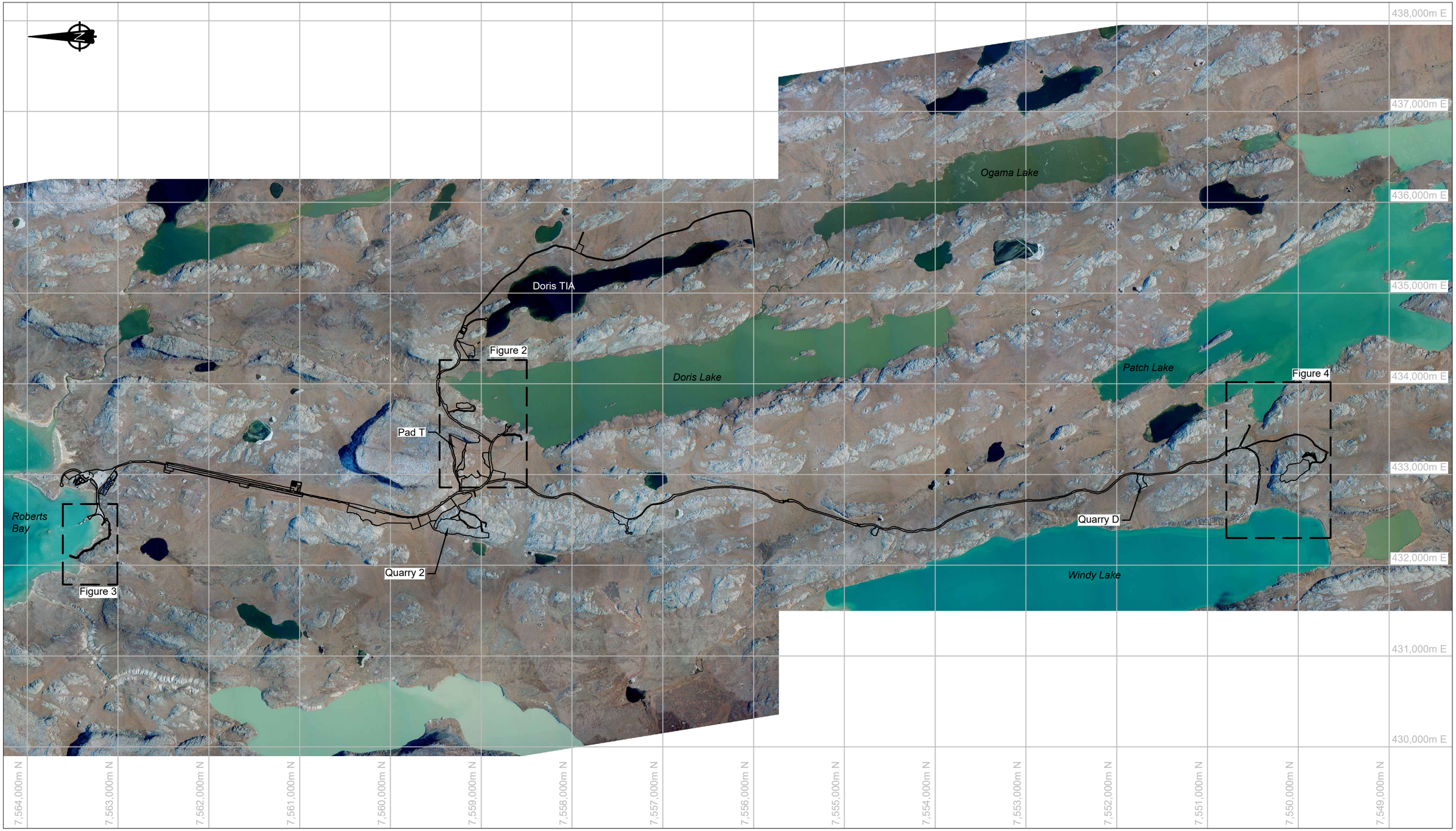
Attachment A – Map of Construction Monitoring Sample Locations



LEGEND

Existing Infrastructure

REFERENCE

NAD83 UTM Zone 13.

0m 400 800 1200 1600

srk consulting		TMAC RESOURCES	2019 Rock Samples
SRK JOB NO.: 1CT022.037			General Arrangement
FILE NAME: 1CT022.037 - GA.dwg		Hope Bay Project	DATE: July 2019 / APPROVED: / FIGURE: 1

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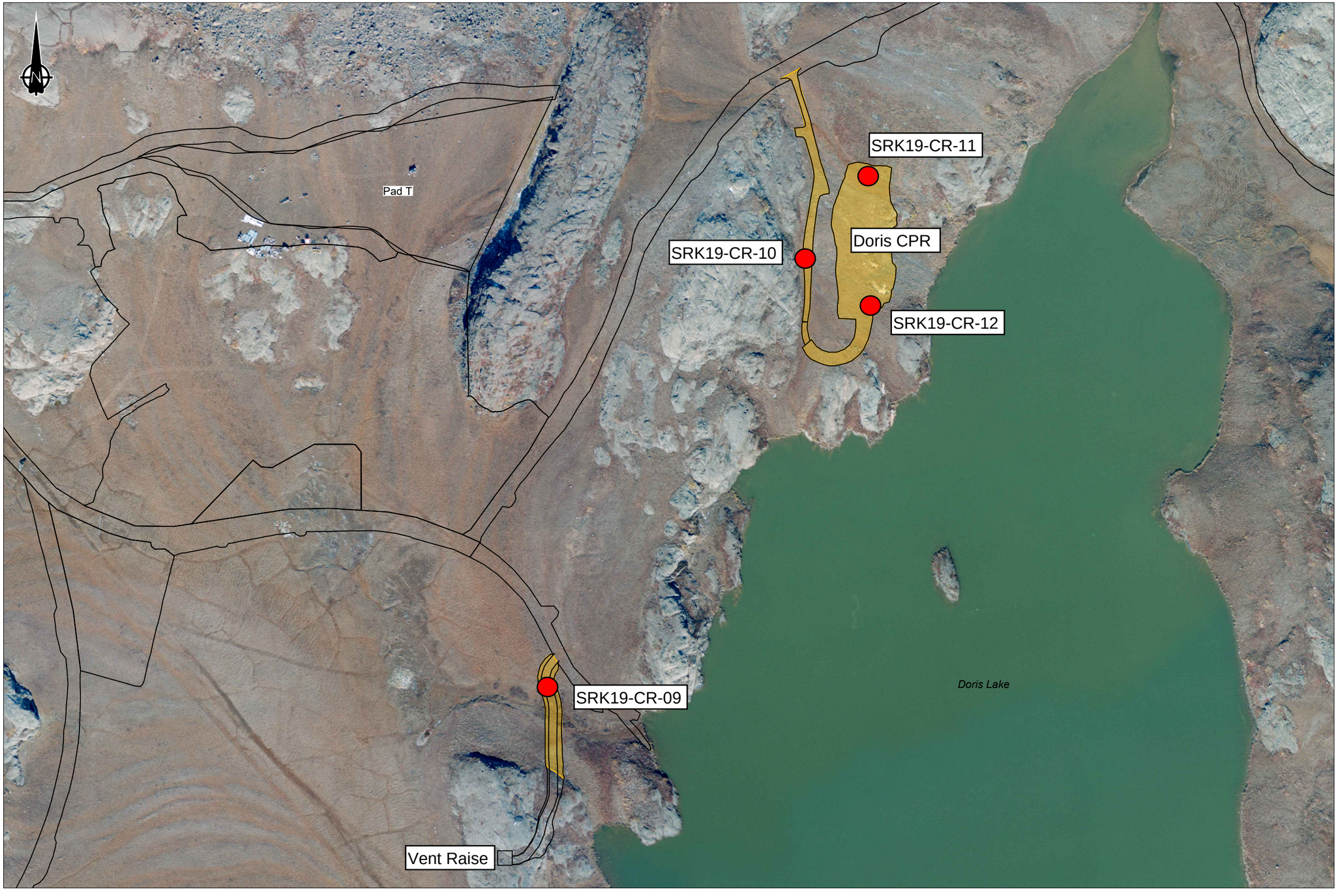

LEGEND

- Existing Infrastructure
- Construction Rock Sampling

REFERENCE

NAD83 UTM Zone 13.

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srk consulting	TMAC RESOURCES	2019 Rock Samples
SRK JOB NO.: 1CT022.037	Hope Bay Project	Doris CPRT and Vent Raise Access Construction Rock Sampling
FILE NAME: 1CT022.037 - GA.dwg		DATE: July 2019 / APPROVED: / FIGURE: 2

LEGEND

- Existing Infrastructure
- Construction Rock Sampling

REFERENCE

NAD83 UTM Zone 13.

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srk consulting

SRK JOB NO.: 1CT022.037

FILE NAME: 1CT022.037 - GA.dwg

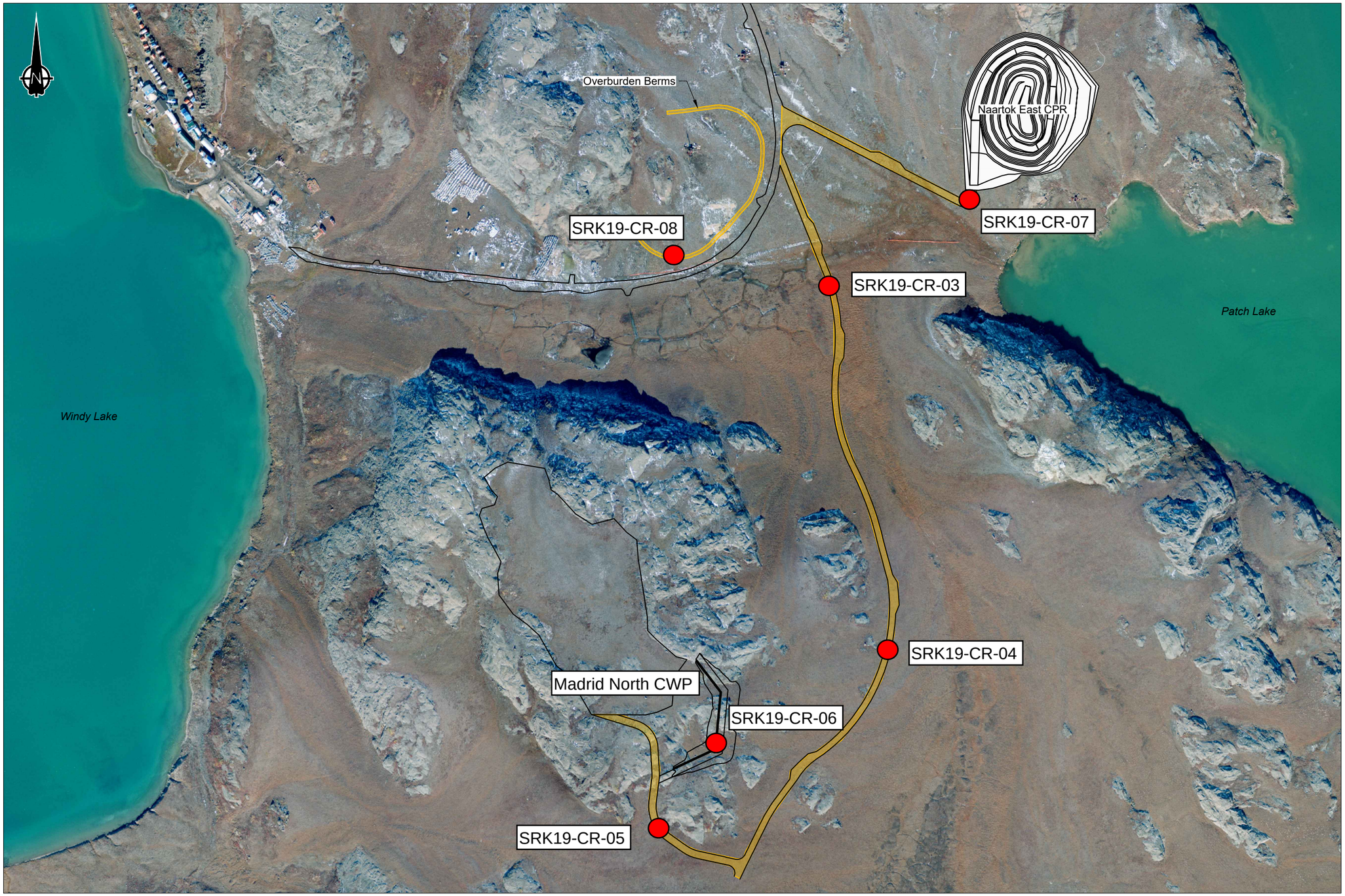
TMAC RESOURCES

Hope Bay Project

2019 Rock Samples

Roberts Bay Discharge System Access Road and Marine Outfall Berm Construction Rock Sampling

DATE:	APPROVED:	FIGURE:
July 2019		3



LEGEND

- Existing Infrastructure
- Construction Rock Sampling

REFERENCE

NAD83 UTM Zone 13.

0m 50 100 150 200

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srk consulting

SRK JOB NO.: 1CT022.037

FILE NAME: 1CT022.037 - GA.dwg

TMAC RESOURCES

Hope Bay Project

2019 Rock Samples

Madrid South All-Weather Road, Madrid North Waste Rock Pile Road, Naartok East CPRT Access Road, and Overburden Stockpile Berms Construction Rock Sampling

DATE:	APPROVED:	FIGURE:
July 2019		4

Attachment B – Geological Inspections, Quarry Monitoring Program

MAC RESOURCES

Quarry Inspection

Inspection Date:	06-May-19	Blast Date:	20-Apr-19
Geologist:	Annette Pardy/ Chris Annan		
Quarry Location:	Quarry 2		

General Visual Inspection

Rock Type	**Mafic Volcanics**	Description: **Light to Medium grey, fine to medium grained mafic volcanics. Week to moderate, light pink to red heamatite alteration locally observed**
Vein	Y	If yes, describe (min, %, size): **1-2% quartz/carbonate veinlets. Mm scale, randomly oriented and fracure filling.**
Sulphides	Y	If yes: **Trace fine to coarse grained disemminated Pyrite.** Percentage: **0.01%**
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-70m	Only partial blast face exposed due to blasted muck. Rock Type description from observed muck pile.
	Blast Face: Light to med grey in color. Weak to moderate, pink to red heamaitie alteration concentrated on the far west side of blast face. Blast face is intensly fractured and blocky.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y247801 2.15 kg

Description: **UTM: 13W0432354; 7559143; Elevation: 53m** **L**ight to Medium grey, fine to medium grained mafic volcanics. Week to moderate, light pink to red heamatite alteration locally observed. 1-2% quartz/carbonate veinlets. Mm scale, randomly oriented and fracure filling. Trace fine to coarse grained disemminated Pyrite**.**

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y247802 2.3 gk

Description:UTM: 13W0432354; 7559143; Elevation: 53m Light to Medium grey, fine to medium grained mafic volcanics. Week to moderate, light pink to red heamatite alteration locally observed. 1-2% quartz/carbonate veinlets. Mm scale, randomly oriented and fracure filling. Trace fine to coarse grained disemminated Pyrite.

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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MAC RESOURCES

Quarry Inspection

Inspection Date: 04-Jul-19 Blast Date: 30-Jun-19

Geologist: Gary Low

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	(Blasted Muck Pile) Ver fine - fine grained, medium to dark greenish grey mafics. Occasional light to pale red Oxidation along some joint surfaces.
Vein	Y	(<0.1%) 5-10mm scale Quartz / Carbonate secondary fracture infilling.
Sulphides	Y	<0.1% disseminated very fine lower grain sized pyritic flakes. Percentage: Trace
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
90 - 120m	Blasted Muck pile. No visibly exposed face looking NW. Rock is medium - dark grey in colour with trace oxidation on some joint surfaces. No visible veining, secondary qtz/carb fracture infill. Foliated in part trending NNW with rare secondary chloritic alternation along some surfaces.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID: _____
Description:

2 mm screen sample (same material as Whole Rock Sample)
Sample ID: _____
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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MAC RESOURCES

Quarry Inspection

Inspection Date:	July 17th, 2019	Blast Date:	July 15th, 2019
Geologist:	Gary Low		
Quarry Location:	Quarry 2		

General Visual Inspection

Rock Type	Mafic Volcanics	Light Grey / green, very fine to fine grained, massive, affinitic. Rare oxidation exhibited on some joint surfaces.
Vein	Y	Rare quartz / carbonate fracture infill veinlets, <1%, mm scale, random.
Sulphides	Y	Trace scattered, extremely rare disseminated pyritic flakes. <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: **N**	
UTM: 432365, 7559198		

Inspection at 100m intervals

Rock Characteristics	
Interval (m):	**Description**
140 - 170	Light Grey / green mafic volcanics with oxidized joint surfaces that trend NNE - SSW.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: **R828432**

Description: -> Light Grey / green mafic volcanics with oxidized joint surfaces that trend NNE - SSW. Rare Quartz / Carbonate fracture infill veinlets, <1%, mm scale, ramdomly orientated throughout. Trace scattered disseminated pyrite flakes (<0.01%).

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: **R828433**

Description: -> Light Grey / green, very fine to fine grained, massive, affinitic. Rare oxidation exhibited on some joint surfaces.

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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TMAC Resources Doris Mine UNDERGROUND FACE SHEET

General Information		Location/Orientation		Blast Attributes	
Heading:	Quarry 2	Easting:	432310.	Ore/Waste Call	Assig. Grade:
Faceplate Number:	ARGILLITE / GRAPHITE	Northing:	7559.144	O / W	BM Grade:
Project:		Elevation:		Width:	Survey Station:
Geologist / Tech:		Face Azi:		Height:	Distance to face:
Blast Date (DD/MM/YY):		Vein Strike:		Depth:	Location Sketch:
Shift (DS/NS):		Vein Dip:		Round / Breast / Slash / Long Hole / Bench	
Sample Date (DD/MM/YY):		% Vein:			

	Sample ID	FR.	TO	LITHO	Vn%	Vn Style	Septa %	Septa Style	Min %	Min or Alt type	Au
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

Abbreviations

Vein styles	
Quartz vein	QTZ VN
Veinlet	VNLT
Extensional	EXT
Breccia	BX
Fault filled	FLTF
Shear	SHR
Stockwork	STOCK

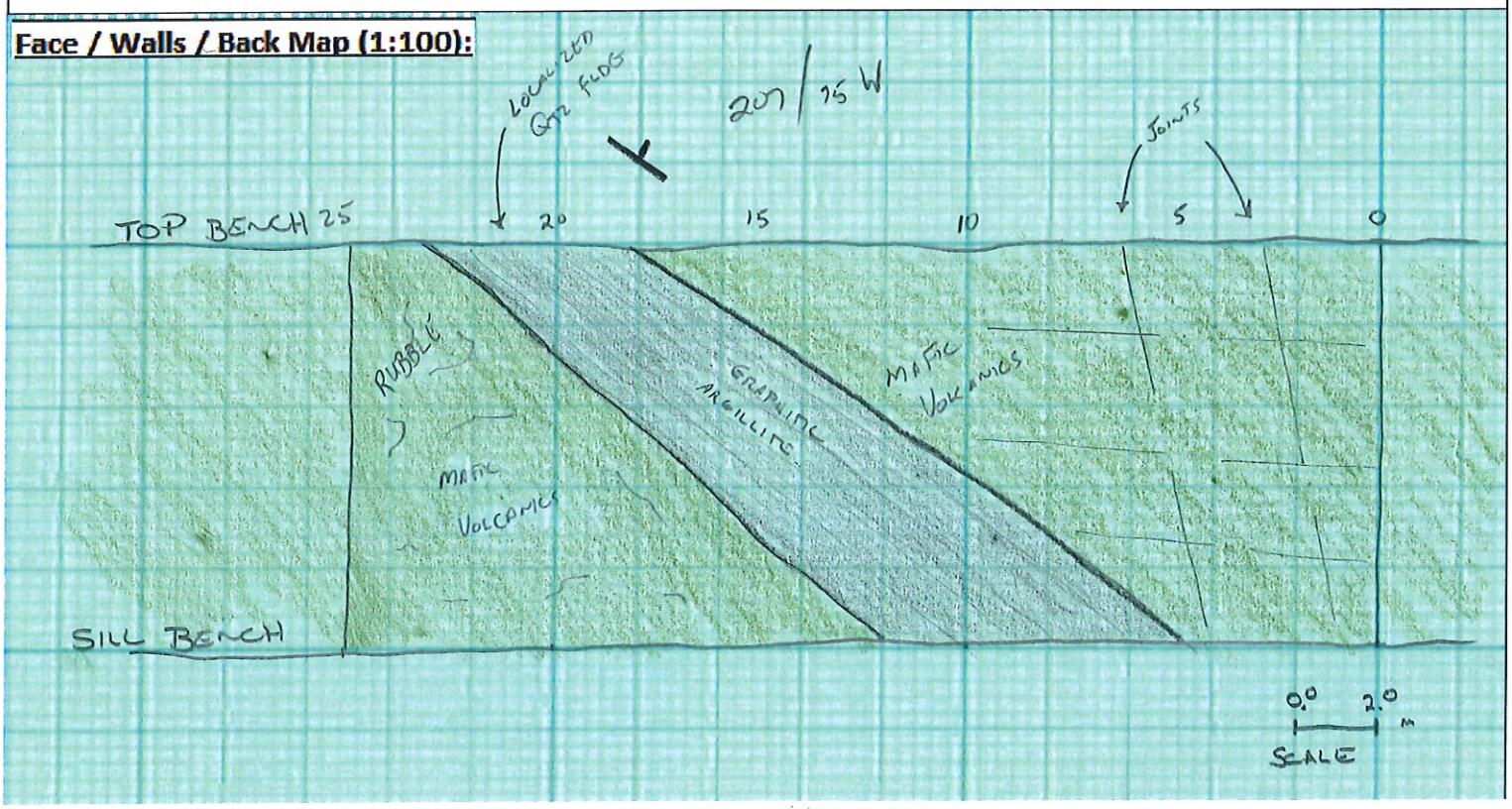
Septa Style	
Tourmaline	TUR
Light green	LTGR
Black	BLK
Dark Green	DKGR

Mineralization	
Pyrite	PY
Chalcopyrite	CPY

Alteration	
Sericite	SER
Hematite	HEM
Magnetite	MAG
Chlorite	CHL
Fuchsite	FUCH
Carbonate	CARB

Geological Observations / Mining Recommendations:

Face / Walls / Back Map (1:100):



Quarry Inspection

Inspection Date:	16-May-19	Blast Date:	11-May-19
Geologist:	Eric Alexander		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type	**Mafic Volcanics**	Description: **Light to medium grey/green, fine to medium grained mafic volcanics. Light reddish heamatite alteration locally observed along fracture surfaces.**
Vein	Y	If yes, describe (min, %, size): **1-2% quartz/carbonate veinlets randomly oriented. Mm scale, randomly oriented and fracure**
Sulphides	Y	If yes: **Trace fine grained disemminated pyrite.** Percentage: **0.01%**
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	Blast Face: Light to med grey/green in color. Local reddish hematite alteration concentrated on west side of blast face. Blast face is moderate to highly fractured and blocky.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y264562 (6.00lbs)

Description: **UTM: 432929.00E 7551736.00N**
Light to medium grey/green, fine to medium grained mafic volcanics. Light reddish heamatite alteration locally observed along fracture surfaces. Trace disseminated pyrite.

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y264561 (2.00lbs)

Description:UTM: UTM: 432929.00E 7551736.00N Light to medium grey/green, fine to medium grained mafic volcanics. Light reddish heamatite alteration locally observed along fracture surfaces. Trace disseminated pyrite.

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

MAC RESOURCES

Quarry Inspection

Inspection Date:	May 23rd, 2019	Blast Date:	May 17th, 2019
Geologist:	Scott Snider		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type	Mafic Volcanics	Light to med grey-green; fine grained basalt; 15% meter scale jointing; wk hemitite alt.
Vein	Y	Rare quartz / carbonate fracture infill veinlets, <2%, mm scale, random.
Sulphides	Y	Occasionally scattered, extremely rare disseminated pyritic flakes. <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval (m):	**Description**
30m	Light to med grey-green; fine grained basalt; 15% meter scale jointing; wk hemitite alt.
	Blast face: Partially exposed; stong fracted and blocky. See photos.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: _____

Description:

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: _____

Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

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MAC RESOURCES

Quarry Inspection

Inspection Date:	May 31st, 2019	Blast Date:	May 26th, 2019
Geologist:	Gary Low		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type	Mafic Volcanics	Medium Grey / green, very fine to fine grained, affinitic. Trace oxidation exhibited on joint surfaces.
Vein	Y	Rare quartz / carbonate fracture infill veinlets, <2%, mm scale, random.
Sulphides	Y	Occasionally scattered, extremely rare disseminated pyritic flakes. <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval (m):	**Description**
100 - 140	Medium Grey / green - dark green mafic volcanics with oxidized joint surfaces that trend NNE - SSW with an (approx) 80Deg dip to the East

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID: _____
Description:
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: _____
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

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MAC RESOURCES

Quarry Inspection

Inspection Date:	07-Jun-19	Blast Date:	2019-06-06
Geologist:	Daniel Mwagura		
Quarry Location:	Quarry D		

General Visual Inspection

Rock Type		Description: **Mafic Volcanics,light-med grey, fg-mg, massive, with trace calcite stringers, trace disseminated pyrite ~0.01%, predominant haematite staining on fracture faces**
Vein	Y	If yes, describe (min, %, size): **Quartz- Carbonate veining ~1%, with some pink alteration staining**
Sulphides	N	If yes: Disseminated/Vein/Stringer/Other: **Disseminated fg Pyrite ~0.01%** Percentage:
Fibrous Actinolite	N	If yes, describe (min, %, size): **None**
If anomalous rock types/significant sulphides:	TAGGED: N	None Observed
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
140-180m	Mafic Volcanics, light-med grey, fg-mg, massive, with trace calcite stringers, trace disseminated pyrite ~0.01%, predominant haematite staining on fracture face
	Blast Face: Strong Haematite staining, Weak-moderately sheared on the far East side of the face, Oberseved 2-predominant fracture sets, NW-SE/NE-SW

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID: _____
Description:

2 mm screen sample (same material as Whole Rock Sample)
Sample ID: _____
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Quarry Inspection

Inspection Date: 16-Jun-19 Blast Date: 12-Jun-19

Geologist: Annette Pardy

Quarry Local: Quarry D

General Visual Inspection

Rock Type	Mafic Volcanics	Description:Greenish grey, fine to medioum grained massive mafic volcanics. Week to moderiate epidote alteration. Local Fe staining along fracture surfaces.
Vein	Y	<1% mm scale qtz/carb veinlets randomly oreinted throught. Hematite alteration associated with local veinlets
Sulphides	N	No visible sulphides observed
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	Could not see blast face due to blasted muck pile. Observations were taken from broken material. Massive mafic volcanics.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID: _____
Description:

2 mm screen sample (same material as Whole Rock Sample)
Sample ID: _____
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Quarry Inspection

Inspection Date: 16-Jun-19 Blast Date: 2019-06-07

Geologist: Daniel Mwagura

Quarry Location: Quarry D

General Visual Inspection

Rock Type		Description: **Mafic Volcanic, med-dark grey green, weakly foliated, <0.01% dis pyrite, trace calcite stringers, occassional haematite staining on frac faces,**
Vein	Y	If yes, describe (min, %, size): **~1%** **Quartz+ carbonate veinlets on rubble,**
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other: **Disseminated** Percentage: <0.01%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	There is no exposed face to see, Descriptions based on blast rubble or muck.

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID:
Description:

2 mm screen sample (same material as Whole Rock Sample)
Sample ID:
Description:

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

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Quarry Inspection

Inspection Date: July 26 2019 Blast Date: July 25 2019

Geologist: Daniel Mwagura

Quarry Location: D

General Visual Inspection

Rock Type	Mafic Volcanic	Description:~80% Mafic Volcanic, 10% fine-med grained gabbroic fragments, medium green- grey, massive, blocky, occassional mm-scale quartz +carbonate veinlets/ stringers, <0.1% disseminated fg py
Vein	Y	If yes, describe (min, %, size): <1% Quartz +carbonate stringers/ veinlets.
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other Percentage: <0.1%
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-30m	Mafic Volcanic with trace mm-scale quartz+ carbonate veinlets & random calcite stringers, medium green-grey, fine grained, massive, blocky in parts, moderate haematite staining on fracture planes

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample

Sample ID: Y250342

Description:
Mafic Volcanic with fine-med grained gabbroic fragments, medium green- grey, massive, blocky, occassional mm-scale quartz +carbonate veinlets/ stringers, <0.1% disseminated fg py.
UTM: N: 7551710 E: 432959

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y250341

Description: Predominantly Mafic Volcanic fragments with traces of haematite stained fragments, traces of mm-scale Qtz+ carbonate/ Calcite stringers

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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MERC
Quarry D
July 26, 2019

Quarry D
July 26, 2019
MERC

E
SE
BLAST # 8

NE

MAC RESOURCES

Quarry Inspection

Inspection Date: 06-Sep-19 Blast Date: 04-Sep-19

Geologist: Rob Reukl

Quarry Location: Madrid - Quarry "D"

General Visual Inspection

Rock Type	1a	Description: Mafic Volcanic
Vein	Y	If yes, describe (min, %, size): <1% Quartz Carbonate veinlets & Calcite stringers
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other Dis Percentage: Trace (<0.01%)
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: N	
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
Blast	**Mafic Volcanics:** Fine grained, grey/green, <1% qtz-carb mm-cm scale veinlets & calcite stringers, ocaisional traces of vfg diss'd pyrite (<0.01%)

Quarry Rock Sampling (to be done at two different stages of quarry development per year**)**

Whole Rock Sample
Sample ID: No Sample
Mafic Volcanics: **UTM: N: 7550694 E: 433581**

2 mm screen sample (same material as Whole Rock Sample)
Sample ID: No Sample

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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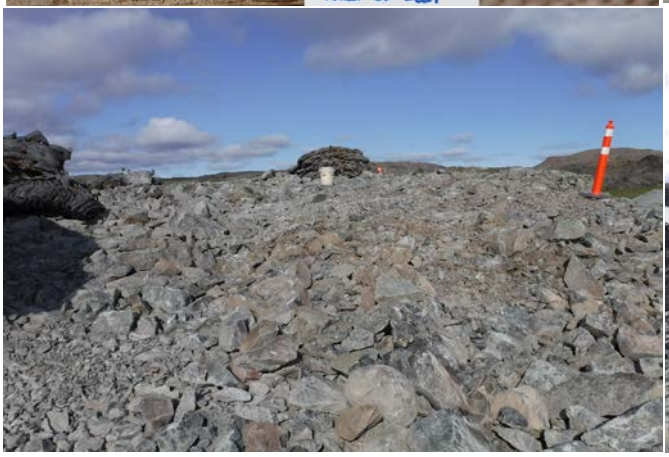
Naartok East

Naartok East P.1
July 27 2019
20,000 tonnes



TMAC RESOURCES

Quarry Inspection

Inspection Date: 23-Sep-19 Blast Date: 20-Sep-19

Geologist: Juliana Morales

Quarry Location: Quarry D

General Visual Inspection

Rock Type	1a/1as	Description: light to medium grey, fine grained, massive mafic volcanics
Vein	Y/N	If yes, describe (min, %, size): 1% quartzs carbonate veins, calcite stringers
Sulphides	Y/N	If yes: Disseminated/Vein/Stringer/Other Percentage: <1%
Fibrous Actinolite	Y/N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-50	light to medium grey, fine grained, massive mafic volcanics, hematite stringers on the wall

Quarry Rock Sampling (to be done at two different stages of quarry development per year)

Whole Rock Sample

Sample ID: Y264152

Description: Green mafic volcanics, medium grained, 2% quartz carbonate veining, <1% pyrite and some hematite staining

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y264151

Description: Green mafic volcanics, medium grained, 5% quartz carbonate veining, <1% pyrite and some hematite staining

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Quarry Rock Sampling (to be done at two different stages of quarry development per year)

Whole Rock Sample

Sample ID: Y264154

Description: Green mafic volcanics, medium grained, 2% quartz carbonate veining, <1% pyrite and some hematite staining

2 mm screen sample (same material as Whole Rock Sample)

Sample ID: Y264153

Description: Green mafic volcanics, medium grained, 5% quartz carbonate veining, <1% pyrite and some hematite staining

Contingency - Identification of Inappropriate Quarry Rock

In the unlikely event that the visual inspection identifies PAG rock, the geologist will 'tag' the material for avoidance or removal. If the material is excavated, it will be transported to a waste rock storage area for disposal underground. If this is not possible at the time, the PAG rock will be buried in an active or previously mined out quarry. If the PAG material is buried, it will be covered with a min of 2m of rock material that is approved for construction and will be clearly marked as inappropriate for use as construction material.

In the unlikely event that the visual inspection identifies fibrous actinolite, the geologist will 'tag' the material for avoidance or removal. If the materical is excavated, it will be transported to a waste storage area for disposal underground. If this is not possible at the time, the material will be buried in one of the previously mined-out quarries and covered with a 1m layer of benign rock and a record of the location maintained.

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Attachment C – Sample Descriptions, Construction Monitoring Program

Notes from Construction and Waste Rock Inspection at Hope Bay (August 1-2, 2019) - Derrick Midwinter																
			Coordinates (NAD83)		Elevation			Fines		Rinse Test (on <2mm size)				Analyses Requested			
Sample ID	Date	Area	Northing	Easting	(m)	Geological Description of Sampling Location	Sulphides	Fizz	Color	Colour	Weight	pH	EC (uS/cm)	Total Sulpur (<1 cm)	ABA (< 1 cm)	Aqua Regia Metals (<1 cm)	SFE (<2 mm)
SRK19-CR01	01-Aug-19	Roberts Bay (Terminus)	432105	7563528	17	1a: Dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins, rare epidote veins	Mostly none, few fragments with up to 3% cubic pyrite, few chalcopyrite	Strong	medium brown	cloudy grey	50g	8.95	453	X	X	X	X
SRK19-CR02	01-Aug-19	Roberts Bay Road	432300	7563126	18	1a: Dark green mafic metavolcanic, rare hematite stains, few carbonate and quartz veins, rare epidote veins	Mostly none, few fragments with up to 5% cubic pyrite	Strong	light brown	cloudy grey	50g	8.97	181.1	X	X	X	
SRK19-CR03	01-Aug-19	Road to Madrid North CWP	433364	7550427	57	1a: Dark green mafic metavolcanic, rare hematite stains, few carbonate and quartz veins, rare sericitic texture; lesser granitic boulders (glacial erratic?)	Mostly none, few fragments with up to 1% cubic pyrite	Strong	light brown	cloudy grey	50g	9.19	696	X	X	X	
SRK19-CR04	01-Aug-19	Road to Madrid North CWP	433440	7549990	72	1a: Dark green mafic metavolcanic, few hematite stains, rare carbonate and quartz veins, rare sericitic texture; lesser granitic boulders (glacial erratic?)	None visible	Strong	light brown	cloudy grey	50g	8.97	551	X	X	X	
SRK19-CR05	01-Aug-19	Road to Madrid North CWP	433146	7549725	64	1a: Dark green mafic metavolcanic, few hematite stains, rare carbonate and quartz veins; lesser granitic boulders (glacial erratic?)	None visible	Strong	light brown	cloudy grey	50g	8.60	720	X	X	X	X
SRK19-CR06	01-Aug-19	Madrid North CWP	433220	7549843	87	1a: Dark green mafic metavolcanic, few hematite stains, rare carbonate and quartz veins; lesser granitic boulders (glacial erratic?)	None visible	Strong	light brown	cloudy grey	50g	8.82	831	X	X	X	X
SRK19-CR07	01-Aug-19	Naartok Pit Road	433537	7550534	53	1a: Dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins	None visible	Strong	light brown	cloudy grey	50g	8.89	1589	X		X	X
SRK19-CR08	01-Aug-19	Overburden Berm	433199	7550551	63	1a: Dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins, rare epidote veins	None visible	Strong	light brown	cloudy grey	50g	9.00	2450	X	X	X	X
SRK19-CR08-Dup	01-Aug-19	Overburden Berm				1a: Dark green mafic metavolcanic, few hematite staining, few carbonate and quartz veins, rare epidote veins	None visible	Strong	light brown	cloudy grey	50g	9.02	2360	X	X	X	X
SRK19-CR09	01-Aug-19	Road to Vent Raise	433437	7558731	49	1a: Dark green mafic metavolcanic, few hematite staining, few carbonate and quartz veins; common granitic boulders; common graphitic argillite-stained metavolcanic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with graphitic rocks and metavolcanics	Strong	brownish grey	cloudy grey, bla	50g	8.63	316	X	X	X	X
SRK19-CR10	01-Aug-19	Doris Access Road to CPR	433716	7559253	62	1as: foliated 'banded' black-brown metavolcanics, rare amydoloids; 1as: light brown metavolcanics, some sericitic texture; 1a: lesser dark green mafic metavolcanic, rare hematite stains, rare carbonate and quartz veins; 12: boulders of quartz veins; lesser granitic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with 1a	Strong	light brown	cloudy grey	50g	8.94	372	X	X	X	
SRK19-CR11	01-Aug-19	Doris CPR (North)	433774	7559223	56	1ay: foliated 'banded' black-brown metavolcanics, rare amydoloids; 1as: light brown metavolcanics, some sericitic texture; 1a: lesser dark green mafic metavolcanic, rare hematite stains, few carbonate and quartz veins; 12: boulders of quartz veins; lesser granitic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with 1a	Strong	light brown	cloudy grey	50g	8.53	4930	X	X	X	X
SRK19-CR12	01-Aug-19	Doris CPR (South)	433736	7559111	55	1ay: foliated 'banded' black-brown metavolcanics, rare amydoloids; 1as: light brown metavolcanics, some sericitic texture; 1a: lesser dark green mafic metavolcanic, few hematite stains, few carbonate and quartz veins; 12: boulders of quartz veins; 11c: lesser diabase (one boulder); lesser granitic boulders	Mostly none, few fragments with up to 1% cubic pyrite associated with 1as	Strong	light brown	cloudy grey	50g	8.59	3960	X	X	X	

Attachment D – Photos of Sample Locations, Construction Monitoring Program

Photo: Sampling location for SRK19-CR-01

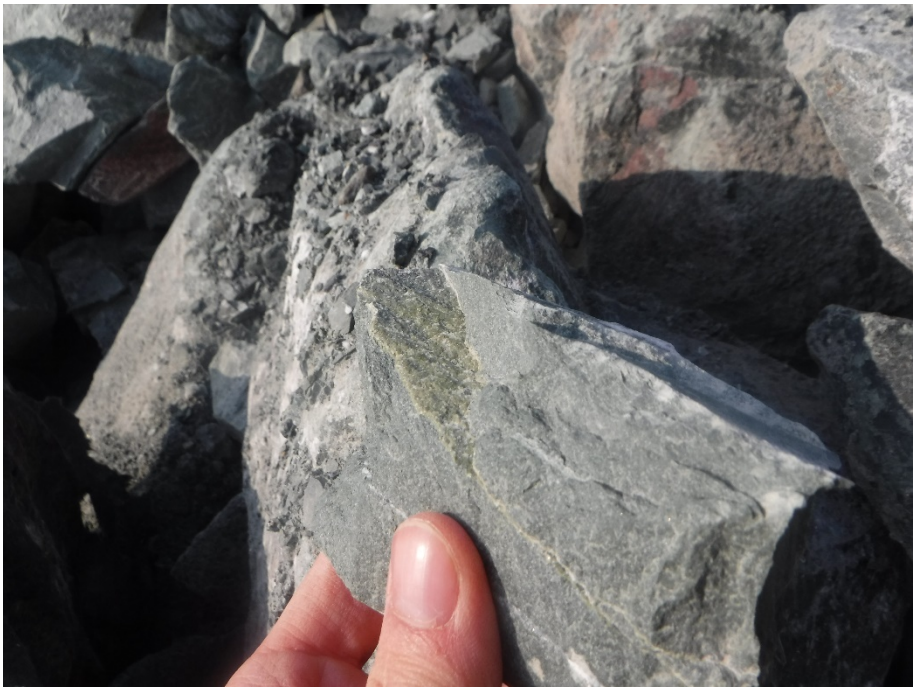

Photo: Epidote veining among rock type 1a at sampling location for SRK19-CR-01

Photo: Sampling location for SRK19-CR-02

Photo: Sulphides (pyrite) along quartz vein among rock type 1a at sampling location for SRK19-CR-02

Photo: Sampling location for SRK19-CR-03

Photo: Sulphides (pyrite) among rock type 1a at sampling location for SRK19-CR-03

Photo: Sampling location for SRK19-CR-04

Photo: Granitic boulder among rock type 1a at sampling location for SRK19-CR-04

Photo: Sampling location for SRK19-CR-05

Photo: Hematite vein among rock type 1a at sampling location for SRK19-CR-05

Photo: Sampling location for SRK19-CR-06

Photo: Graphitic rock (5a) among rock type 1a at sampling location for SRK19-CR-06

Photo: Sampling location for SRK19-CR-07

Photo: Sampling location for SRK19-CR-07

Photo: Sampling location for SRK19-CR-08

Photo: Calcite vein with hematite staining among rock type 1a at sampling location for SRK19-CR-08

Photo: Sampling location for SRK19-CR-09

Photo: Graphitic rock (5a) and granite among rock type 1a at sampling location for SRK19-CR-09

Photo: Sampling location for SRK19-CR-10

Photo: Quartz vein fragments (12q) and rock type 1as among rock type 1a at sampling location for SRK19-CR-10

Photo: Cover of Doris CPR with rock type 1as among rock type 1ay, near sampling location for SRK19-CR-11

Photo: Rock type 1as and 1ay, quartz vein fragment next to rock hammer, at sampling location for SRK19-CR-11

Photo: Rock type 1as and 1ay, with quartz vein fragments and granitic boulder, near sampling location for SRK19-CR-11

Photo: Rock type 1as and 1ay, near sampling location for SRK19-CR-12

Photo: Cubic pyrite within foliations of rock type 1ay, at sampling location for SRK19-CR-12

Photo: Diabase boulder among rock type 1as and 1ay, at sampling location for SRK19-CR-12

Attachment E – Sample Descriptions and Geochemical Data, Quarry Monitoring Program

Quarry Monitoring - ABA																	
Parameter	**Units**	**Detection Limits**	**Quarry 2**							**Quarry D**							
Sample Collected>			**May**				**July**		**August**	**May**		**July**		**September**			
Rock Type>			**1a**						**5a**	**1a**							
Sample ID>			**Y247801 <1CM**	**Y247801 <2MM**	**Y247802 <1CM**	**Y247802 <2MM**	**R828433**	**R828432**	**SRK19-QR2-01**	**Y264561 <2MM**	**Y264562 <1CM**	**Y250341**	**Y250342**	**Y264151**	**Y264152**	**Y264153**	**Y264154**
Sample Form>			**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-2 mm rock**	**-1cm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**
Dry Weight Received	kg		1.5	0.4	0.4	1.7	2.1	2.9	3.2	0.9	2.7	1.3	5.3	0.3	2.7	0.2	3.3
Paste pH	pH Units	*N/A*	7.7	7.7	7.6	7.6	8.1	8.4	7.5	7.5	7.5	8.2	-	8.5	9.0	8.7	8.8
CO_2	wt%	*0.02*	6.1	8.5	8.0	9.0	8.2	8.2	3.3	4.5	3.8	6.5	-	8.0	6.1	7.4	6.7
TIC	kg CaCO3/t	*0.50*	140	190	180	200	190	190	75.0	100	87.0	150	-	180	140	170	150
Total S	wt%	*0.02*	0.22	0.34	0.23	0.34	0.41	0.14	2.3	0.12	0.14	0.18	0.09	0.26	0.15	0.15	0.19
Sulphate Sulphur	wt%	*0.01*	0.03	0.05	0.10	<0.01	0.07	0.10	0.1	<0.01	<0.01	0.02	-	0.01	<0.01	<0.01	<0.01
Sulphide Sulphur (by difference)	wt%	*0.02*	0.19	0.29	0.13	0.3	0.34	0.04	2.1	0.1	0.1	0.16	-	0.25	0.15	0.15	0.19
AP (calculated from total S)	kg $CaCO_3$/t	*0.6*	7	11	7.2	10.6	10.6	1.3	225	3.8	4.4	5.0	-	7.8	4.7	4.7	5.9
Mod. ABA NP	kg $CaCO_3$/t	*0.1*	150	220	200	200	180	170	70	120	100	160	-	210	150	190	130
Fizz Rating	N/A	*N/A*	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	-	MODERATE	MODERATE	MODERATE	MODERATE
Net Neutralization Potential	kg $CaCO_3$/t	*0.1*	140	210	200	190	160	170	3.4	120	100	160	-	200	140	180	130
TIC/AP (calculated from Total Sulphur)	N/A		20	18	25	19	15	42	1.1	27	20	26	-	23	30	36	25
NP/AP (calculated from Total Sulphur)	N/A		22	21	28	19	14	40	1.0	32	23	29	-	27	32	40	22

Notes:
AP is acid generation potential, calculated from Total Sulphur
NP is neutralization potential
Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur

Quarry Monitoring - Elemental Analysis															
Parameter	**Units**	**Quarry 2**							**Quarry D**						
Sample Collected>		**May**				**July**		**August**	**May**		**July**	**September**			
Rock Type>		**1a**						**5a**				**1a**			
Sample ID>		**Y247801**	**Y247801**	**Y247802**	**Y247802**	**Y264562**	**Y250341**	**SRK19-QR2-01**	**WJ8403**	**WJ8404**	**Y264561**	**Y264151**	**Y264152**	**Y264153**	**Y264154**
Sample Form>		**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-2 mm rock**	**-1cm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**
Ag	mg/kg	0.20	0.70	0.20	0.40	*<0.1*	*<0.1*	0.5	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Al	mg/kg	49000	49000	50000	49000	38000	39000	25000	37000	36000	35000	37000	38000	38000	34000
As	mg/kg	1.2	2.6	2.9	24	26	16	33	16	1.9	3.7	1.70	1.10	1.40	0.90
Au	mg/kg	0.023	0.032	0.018	0.012	0.015	0.0034	0.0028	0.005	0.001	0.007	0.0031	0.0015	0.0019	0.0011
B	mg/kg	25	29	24	22	*<20*	*<20*	*<20*	77.00	63	64	41	35	*<20*	*<20*
Ba	mg/kg	7.0	13.0	28.0	20.0	7.0	6.0	11	7.0	4.0	8.0	12.00	9.00	14.00	7.00
Bi	mg/kg	*<0.1*	*<0.1*	0.10	2.40	2.30	0.30	0.7	0.20	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Ca	mg/kg	70000	91000	84000	95000	60000	58000	21000	55000	50000	66000	79000	67000	76000	65000
Cd	mg/kg	0.70	0.50	0.40	0.50	*<0.1*	*<0.1*	0.1	0.20	*<0.1*	0.20	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Co	mg/kg	49	50	49	49	46	45	60	48	46	39	47	44	47	42
Cr	mg/kg	45	51	49	46	32	32	35	550	590	330	580	540	710	650
Cu	mg/kg	160	150	140	150	130	110	410	110	100	110	110	110	89	85
Fe	mg/kg	110000	110000	110000	110000	89000	91000	72000	55000	53000	55000	55000	58000	53000	50000
Ga	mg/kg	17	17	17	17	13	14	8	8	8	7	8.00	8.00	8.00	8.00
Hg	mg/kg	*<0.01*	*<0.01*	0.01	0.07	*<0.01*	*<0.01*	0.05	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
K	mg/kg	200	300	300	300	400	400	1100	400	200	300	100	100	100	*<100*
La	mg/kg	30000	60000	50000	60000	40000	30000	5	20000	20000	20000	10000	*<10000*	10000	*<10000*
Mg	mg/kg	27000	28000	28000	28000	27000	28000	19000	37000	36000	31000	36000	35000	38000	35000
Mn	mg/kg	2100	2400	2400	2500	2000	2000	540	1200	1100	1400	1400.00	1500.00	1300.00	1200.00
Mo	mg/kg	0.30	0.40	0.40	0.50	0.50	0.30	1.2	1.50	0.90	0.80	0.30	0.50	0.20	0.20
Na	mg/kg	70	220	150	180	200	110	120	100	80	280	240	190	240	150
Ni	mg/kg	42	41	41	41	37	37	56	210	200	110	200	170	230	200
P	mg/kg	390	380	390	390	470	440	730	190	190	200	160	170	160	170
Pb	mg/kg	2.7	5.6	7.3	20	2.4	1.8	9.8	4.0	1.7	3.6	3.7	1.9	2.1	1.1
S	mg/kg	2300	3300	2400	3100	3300	2800	24000	1100	800	1600	2100	1000	1200	900
Sb	mg/kg	*<0.1*	*<0.1*	*<0.1*	0.60	*<0.1*	*<0.1*	0.6	0.20	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
Sc	mg/kg	34	33	33	33	23	23	5.4	5	5	7	6.90	6.30	6.70	5.40
Se	mg/kg	0.70	0.80	0.70	0.80	0.70	0.70	3.5	0.60	*<0.50*	0.60	0.70	0.50	*<0.50*	*<0.50*
Sr	mg/kg	38	49	47	51	35	34	10	14	13	20	20.00	15.00	18.00	16.00
Te	mg/kg	*<0.20*	*<0.20*	*<0.20*	*<0.20*	0.30	*<0.20*	0.8	*<0.20*	*<0.20*	*<0.20*	*<0.20*	*<0.20*	*<0.20*	*<0.20*
Th	mg/kg	0.10	0.20	0.20	0.20	0.60	0.20	0.0025	0.60	0.30	0.40	0.10	*<0.1*	0.10	*<0.1*
Ti	mg/kg	1600	1600	1500	1400	200	190	80	2300	2500	2500	2500	2700	2400	2300
Tl	mg/kg	*<0.10*	0.20	*<0.10*	0.10	*<0.10*	*<0.10*	<0.10	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*	*<0.10*
U	mg/kg	*<0.1*	*<0.1*	*<0.1*	*<0.1*	0.20	0.20	0.3	0.10	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
V	mg/kg	330	320	320	320	240	240	38	98	98	120	130.00	130.00	130.00	120.00
W	mg/kg	*<0.1*	*<0.1*	*<0.1*	*<0.1*	0.20	*<0.1*	*<0.1*	0.20	*<0.1*	0.20	0.10	<0.1	0.40	*<0.1*
Zn	mg/kg	250	190	180	190	97	98	85	70	64	76	66	66	57	54

Notes:

Quarry Monitoring - Shake Flask Extraction Results (-2 mm)										
Parameter	**Units**	**Detection Limit**	**Quarry 2**				**Quarry D**			
Sample Collected>			**May**		**July**	**August**	**May**	**July**	**September**	
Rock Type>			**1a**			**5a**	**1a**			
Sample ID>			**Y247801**	**Y247802**	**R828433**	**SRK19-QR2-01**	**Y264561**	**Y250341**	**Y264151**	**Y264153**
pH	pH Units	N/A	**9.2**	**9.1**	9.0	7.7	8.6	8.9	**9.1**	8.9
EC	uS/cm	0.5	320	340	290	1300	160	430	230	270
SO4	mg/L	0.5	27	29	28	780	21	25	7.9	14
Total Alkalinity	mg/L	0.5	23	23	24	15	32	35	37	35
Bicarbonate	mg/L	0.5	28	28	30	18	39	42	45	43
Carbonate	mg/L	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Hydroxide	mg/L	0.5	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.5*
Dissolved Chloride	mg/L	0.5	56	54	32	4	6.9	49	30	43
Nitrate-N	mg/L	0.02	3.7	4.2	8.9	< 0.2	3.0	15	2.7	6.8
Nitrite-N	mg/L	0.005	1.3	1.3	0.01	< 0.5	0.09	0.05	0.05	0.2
Total Ammonia **	mg/L	0.005/0.025[(1)]	1.3 [(1)]	1.3 [(1)]	1.5	-	0.011	6.0 [(1)]	1.0 [(1)]	0.81 [(1)]
Total Dissolved Solids	mg/L	10	-	-	170	1300	90	190	130	180
Hardness (CaCO3)	mg/L	0.5	42	51	48	820	52	48	15	18
Dissolved Aluminum (Al)	mg/L	0.0005	0.33	0.33	0.21	0.029	0.17	0.18	0.25	0.20
Dissolved Antimony (Sb)	mg/L	0.00002	0.00031	0.00034	0.00039	0.00016	0.00030	0.00035	0.00058	0.0004
Dissolved Arsenic (As)	mg/L	0.00002	0.00040	0.00063	0.0037	0.00032	0.0064	0.00093	0.0012	0.0014
Dissolved Barium (Ba)	mg/L	0.00002	0.00940	0.01500	0.005	0.012	0.0018	0.0081	0.0098	0.023
Dissolved Beryllium (Be)	mg/L	0.00001	*< 0.00001*	*< 0.00001*	*< 0.00001*	*< 0.00002*	*< 0.00001*	*< 0.00001*	*< 0.00001*	*< 0.00001*
Dissolved Bismuth (Bi)	mg/L	0.000005	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.00001*	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Boron (B)	mg/L	0.05	0.073	0.067	0.19	0.28	0.056	0.53	0.86	0.6
Dissolved Cesium (Cs)	mg/L	0.00005	0.000093	0.000093	0.00009	*< 0.0001*	*< 0.00005*	0.00015	0.000053	0.000055
Dissolved Cadmium (Cd)	mg/L	0.000005	*< 0.000005*	0.0000086	*< 0.000005*	0.00018	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Calcium (Ca)	mg/L	0.05	12	14	15	290	16	13	4.9	5.8
Dissolved Chromium (Cr)	mg/L	0.0001	*0.0001*	*0.0001*	*0.0001*	0.00041	0.00052	*0.0001*	0.0017	0.0042
Dissolved Cobalt (Co)	mg/L	0.000005	0.00012	0.00012	0.00027	0.00039	0.0000947	0.00048	0.00073	0.00068
Dissolved Copper (Cu)	mg/L	0.00005	0.00057	0.001	0.00049	0.004	*0.0020*	0.00085	0.00078	0.00087
Dissolved Lanthanum (La)	mg/L	0.00005	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.0001*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*
Dissolved Iron (Fe)	mg/L	0.001	0.0098	0.022	0.003	0.0026	0.0021	0.0085	0.061	0.023
Dissolved Lead (Pb)	mg/L	0.000005	0.00012	0.00026	0.000022	0.00027	*0.000005*	0.000073	0.000077	0.000018
Dissolved Lithium (Li)	mg/L	0.0005	0.00063	0.0008	0.0017	0.015	0.0018	0.0024	0.00063	*0.0005*
Dissolved Magnesium (Mg)	mg/L	0.05	3.0	3.7	2.8	25	3.1	3.8	0.77	0.93
Dissolved Manganese (Mn)	mg/L	0.00005	0.0014	0.0023	0.0036	0.02	0.0025	0.0024	0.0014	0.00045
Dissolved Phosphorus (P)	mg/L	0.002	0.0036	0.0037	0.0043	*< 0.004*	0.0065	0.002	0.011	0.015
Dissolved Molybdenum (Mo)	mg/L	0.00005	0.0018	0.0017	0.0031	0.0035	0.0031	0.0053	0.0021	0.0028
Dissolved Nickel (Ni)	mg/L	0.00002	0.000085	0.000069	0.000049	0.00063	0.00043	0.00022	0.00022	0.0001
Dissolved Potassium (K)	mg/L	0.05	4.6	5.0	6.2	8.3	1.9	4.8	2.6	3.5
Dissolved Rubidium (Rb)	mg/L	0.00005	0.0046	0.0049	0.0054	0.0039	0.00069	0.0045	0.0021	0.0026
Dissolved Selenium (Se)	mg/L	0.00004	0.0005	0.00048	0.0025	0.0027	0.00037	0.00046	0.00087	0.00081
Dissolved Silicon (Si)	mg/L	0.1	0.51	0.49	0.6	0.34	1.12	1.3	1.6	1.8
Dissolved Silver (Ag)	mg/L	0.000005	*< 0.000005*	0.0000066	0.0000055	*< 0.00001*	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Sodium (Na)	mg/L	0.05	40	40	29	5.3	8.5	49	36	46
Dissolved Strontium (Sr)	mg/L	0.00005	0.045	0.048	0.038	0.17	0.018	0.037	0.014	0.02
Dissolved Sulphur (S)	mg/L	*10*	*10*	11	*10*	*270*	*10*	*10*	*10*	*10*
Dissolved Tellurium (Te)	mg/L	0.00002	*< 0.00002*	*< 0.00002*	*< 0.00002*	*< 0.00004*	*< 0.00002*	*< 0.00002*	*< 0.00002*	*< 0.00002*
Dissolved Thallium (Tl)	mg/L	0.000002	0.000068	0.000068	0.0000081	0.000054	0.000013	0.000068	0.000018	0.0000033
Dissolved Thorium (Th)	mg/L	0.000005	*< 0.000005*	*< 0.000005*	0.0000052	< 0.00001	*< 0.000005*	*< 0.000005*	*< 0.000005*	*< 0.000005*
Dissolved Tin (Sn)	mg/L	0.0002	*< 0.0002*	*< 0.0002*	*< 0.0002*	*< 0.0004*	*< 0.0002*	*< 0.0002*	*< 0.0002*	*< 0.0002*
Dissolved Titanium (Ti)	mg/L	0.0005	*< 0.0005*	*< 0.0005*	0.0014	*< 0.001*	*< 0.0005*	*< 0.0005*	*< 0.0005*	0.00062
Dissolved Tungsten (W)	mg/L	0.00001	0.000081	0.000081	0.0006	*< 0.00002*	0.00226	0.00044	0.0014	0.0015
Dissolved Uranium (U)	mg/L	0.000002	0.0000024	0.0000024	0.000017	0.00012	0.0000291	0.0000024	0.00001	*< 0.000002*
Dissolved Vanadium (V)	mg/L	0.0002	0.00112	0.0011	0.0052	*< 0.0004*	0.00186	0.00096	0.00087	0.0068
Dissolved Zinc (Zn)	mg/L	0.0001	0.0018	0.0018	0.0028	0.0058	*< 0.0001*	0.0027	0.0025	*< 0.0001*
Dissolved Zirconium (Zr)	mg/L	0.0001	*< 0.0001*	*< 0.0001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0001*	*< 0.0001*	*< 0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.0001*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*

Notes:
Italicized font indicates result is below the detection limit
Bold font indicates result is above the guideline
°All element concentrations are given as dissolved
[(1)] Detection limits raised to 0.025 mg/L due to dilution to bring analyte within the calibrated range.
**Guideline for ammonia is maximum average concentration from the Quarry Effluent Quality Limits (Part D Item 18 of Water License 2BE-HOP-1222; TMAC, 2017).

Attachment F – Geochemical Data, Construction Monitoring Program

Construction Monitoring - ABA													
Mine Area>			Doris						Madrid North				
Rock Type>			1a			1a w. 5a	1as/ay		1a				
Parameter	Units	Detection Limits	Robert's Bay		Road to Doris CPR	Road to Vent Raise	Doris CPR Cover		Road to Madrid North CWP			Madrid North CWP	East Naartok CPR	Berm for Overburden
		Sample ID>	SRK19-CR01	SRK19-CR02	SRK19-CR10	SRK19-CR09	SRK19-CR11	SRK19-CR12	SRK19-CR03	SRK19-CR04	SRK19-CR05	SRK19-CR06	SRK19-CR07	SRK19-CR08
Paste pH	pH Units		8.2	8.4	8.6	8.8	8.2	8.4	8.8	8.6	8.2	8.4	#N/A	8.3
CO2	wt%	*0.02*	4.8	4.7	5.8	5.3	5.3	5.5	5.3	5.8	5.3	5.5	#N/A	7.6
Total S	wt%	*0.02*	0.20	0.18	0.17	0.15	0.1	0.2	0.15	0.17	0.11	0.22	0.07	0.11
Sulphate Sulphur	wt%	*0.01*	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	#N/A	0.01
Sulphide Sulphur	wt%	*0.02*	0.19	0.18	0.16	0.15	0.11	0.22	0.15	0.16	0.11	0.22	#N/A	0.11
AP	kg CaCO3/t	*0.60*	5.9	5.6	5.0	4.7	3.4	6.9	4.70	5.0	3	7	#N/A	3.4
AP (total S)			6.3	5.6	5.3	4.7	3.4	6.9	4.69	5.3	3	7	#N/A	3.4
TIC	kg CaCO3/t	*0.5*	110	110	130	120	120	125	120.2	132	119	125	#N/A	172
Mod. Sobek NP	kg CaCO3/t		140	140	150	140	130	154	143	145	134	154	#N/A	196
Fizz Rating	N/A	*N/A*	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	#N/A	MODERATE
Net Neutralization Potential	kg CaCO3/t		140	130	140	140	130	150	138	140	130	147	#N/A	193
TIC/AP	N/A		19	19	26	26	35	18	26	26	35	18	#N/A	50
TIC/AP (total S)			18	19	25	26	35	18	26	25	35	18	#N/A	50
NP/AP	N/A	*0.1*	20	21	27	43	33	25	43	27	33	25	#N/A	29
NP/AP (total S)			23	24	27	31	39	22	31	27	39	22	#N/A	57

Notes:

AP is acid generation potential, calculated from Total Sulphur

NP is neutralization potential

Sulphide Sulphur calculated from the difference of Total Sulphur and Sulphate Sulphur

Attachment F: Geochemical Data, Construction Monitoring Program

Construction Monitoring - Elemental Analysis												
Mine Area>		**Doris**						**Madrid North**				
Rock Type>		**1a**			**1a w. 5a**	**1as/ay**		**1a**				
Parameter	**Units**	**Robert's Bay**		**Road to Doris CPR**	**Road to Vent Raise**	**Doris CPR Cover**		**Access Road to North Madrid CWP**			**Madrid North CWP**	**Berm for Overburden Pad**
		SRK19-CR01	SRK19-CR02	SRK19-CR10	SRK19-CR09	SRK19-CR11	SRK19-CR12	SRK19-CR03	SRK19-CR04	SRK19-CR05	SRK19-CR06	SRK19-CR08
Ag	*ppm*	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Al	*%*	3.3	3.3	1.7	3.3	1.2	1.05	3.7	3.9	3.7	3.6	3.2
As	*ppm*	5.2	2.4	45	12	30.8	31	3.2	4.3	2.9	4.3	1.5
Au	*ppb*	7.5	5.4	259	4.5	401	163	1.8	2.6	1.5	7.6	2
B	*ppm*	20	20	20	20	20	20	20	20	20	20	20
Ba	*ppm*	8	10	7	11	12	9	4	6	5	6	13
Bi	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ca	*%*	5.5	5.0	5.5	4.5	4.9	5.4	5.4	5.4	5.3	5.3	7.6
Cd	*ppm*	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1
Co	*ppm*	42	41	45	37	37	38.8	38	41	44	41	43
Cr	*ppm*	154	157	50	69	40	45	234	324	350	181	541
Cu	*ppm*	125	149	123	157	72	88	119	104	101	118	92
Fe	*%*	5.9	6.0	6.2	7.0	5.8	5.7	6.0	6.3	5.8	6.9	4.9
Ga	*ppm*	8	8	5	10	4	3	9	9	9	11	8
Hg	*ppm*	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
K	*%*	0.02	0.02	0.05	0.06	0.05	0.05	0.02	0.02	0.02	0.02	0.05
La	*ppm*	2	3	2	5	3	3	2	2	2	2	4
Mg	*%*	2.4	2.5	2.0	2.5	1.7	1.9	3.1	3.4	3.4	2.5	2.9
Mn	*ppm*	1360	1370	1630	1540	1440	1430	1480	1520	1390	1620	1470
Mo	*ppm*	0.3	0.8	1	0.5	0.5	0.7	1.1	0.3	0.3	0.6	0.3
Na	*%*	0.008	0.009	0.024	0.007	0.053	0.032	0.011	0.01	0.009	0.009	0.057
Ni	*ppm*	64	61	73	46	54	64	69	111	134	79	174
P	*%*	0.028	0.032	0.025	0.035	0.038	0.031	0.024	0.025	0.02	0.03	0.021
Pb	*ppm*	4.4	2.1	2	2.5	1.8	2.6	2	2.8	3.1	1.9	2.5
S	*%*	0.16	0.14	0.35	0.39	0.31	0.23	0.14	0.12	0.1	0.19	0.08
Sb	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sc	*ppm*	10.4	10.1	11.4	16.3	10.5	11.3	13.1	12.6	9.3	14.5	6.7
Se	*ppm*	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sr	*ppm*	24	27	27	29	27	26	24	22	19	25	19
Te	*ppm*	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Th	*ppm*	0.3	0.3	0.4	1.1	0.8	0.8	0.2	0.2	0.3	0.2	1.6
Ti	*%*	0.25	0.28	0.064	0.10	0.016	0.017	0.22	0.21	0.22	0.17	0.24
Tl	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
U	*ppm*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
V	*ppm*	150	162	77	175	36	40	165	161	135	174	117
W	*ppm*	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Zn	*ppm*	119	89	61	95	69	59	79	77	80	112	58

Parameter	Units	Detection Limit	Screening Criteria	Mine Area>	Doris			Madrid North			
				Rock Type>	1a	1a w. 5a	1as/ay	1a			
					SRK19-CR01	SRK19-CR09	SRK19-CR11	SRK19-CR05	SRK19-CR06	SRK19-CR07	SRK19-CR08
					-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock	-2 mm rock
					Robert's Bay	Road to Vent Raise	Doris CPR Cover	Road to Madrid North CWP	Madrid North CWP	Road to Naartok East CPR	Berm for Overburden Pad
pH	pH Units	N/A	9		8.8	8.7	8.7	8.7	8.7	8.9	8.9
EC	uS/cm	0.5	500		200	142	1488	251	345	562	890
SO4	mg/L	0.5			49	30	124	16	29	45	46
Total Alkalinity	mg/L	0.5			27	29	22	23	23	31	28
Dissolved Chloride	mg/L	0.5			14	3.1	352	6.7	52	123	203
Nitrate-N	mg/L	0.02			0.20	0.9	19.3	19	7.6	2.4	8.2
Nitrite-N	mg/L	0.005			0.05	0.05	0.16	0.07	0.16	0.17	0.05
Total Dissolved Solids	mg/L	10			130	92	920	180	210	310	490
Hardness CaCO3	mg/L	0.5			40	56	195	62	63	51	62
Dissolved Aluminum (Al)	mg/L	0.0005	2		0.2	0.18	0.09	0.15	0.18	0.14	0.11
Dissolved Antimony (Sb)	mg/L	0.00002			0.0002	0.00025	0.00023	0.00011	0.00011	0.00011	0.00008
Dissolved Arsenic (As)	mg/L	0.00002	0.1		0.0010	0.0012	0.0205	0.0015	0.0015	0.0014	0.0005
Dissolved Cadmium (Cd)	mg/L	0.000005			0.000005	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*	*0.000005*
Dissolved Calcium (Ca)	mg/L	0.05			10	16	30	16	15	11	12
Dissolved Chromium (Cr)	mg/L	0.0001			0.0001	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Cobalt (Co)	mg/L	0.000005			0.00004	0.000038	0.006720	0.000048	0.00004	0.00010	0.00022
Dissolved Copper (Cu)	mg/L	0.00005	0.04		0.00075	0.0016	0.0018	0.00079	0.0019	0.0012	0.00062
Dissolved Iron (Fe)	mg/L	0.001	0.6		0.020	0.0025	0.0050	0.0091	0.0010	0.0130	0.0036
Dissolved Lead (Pb)	mg/L	0.000005	0.02		0.000022	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Dissolved Magnesium (Mg)	mg/L	0.05			3.6	3.6	29.2	5.2	6.1	6.0	7.9
Dissolved Manganese (Mn)	mg/L	0.00005			0.0034	0.0050	0.0247	0.0040	0.0042	0.0030	0.0025
Dissolved Phosphorus (P)	mg/L	0.002			0.0021	0.061	0.005	0.0030	0.0033	0.0044	0.0042
Dissolved Molybdenum (Mo)	mg/L	0.00005			0.0018	0.0021	0.0026	0.0014	0.0017	0.0029	0.0022
Dissolved Nickel (Ni)	mg/L	0.00002	0.1		0.00009	0.0001	0.0005	0.0002	0.0002	0.0004	0.0003
Dissolved Potassium (K)	mg/L	0.05			2.9	3.6	18.4	3.1	4.7	5.7	7.8
Dissolved Sodium (Na)	mg/L	0.05			22	4.0	230	23	41	88	150
Dissolved Strontium (Sr)	mg/L	0.00005			0.034	0.032	0.089	0.032	0.037	0.041	0.051
Dissolved Sulphur (S)	mg/L	10			15	10	45	10	12	17	18
Dissolved Uranium (U)	mg/L	0.000002			0.000016	0.000028	0.000156	0.000008	0.000011	0.000015	0.000012
Dissolved Vanadium (V)	mg/L	0.0002			0.0020	0.00049	0.00067	0.0023	0.0011	0.0032	0.0033
Dissolved Zinc (Zn)	mg/L	0.0001	0.02		0.0004	0.00020	0.00025	0.00034	0.00011	0.00038	0.00017
Dissolved Zirconium (Zr)	mg/L	0.0001			0.0001	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*
Dissolved Mercury (Hg)	mg/L	0.00005			0.0001	0.000050	0.000050	*0.00005*	*0.00005*	*0.00005*	*0.00005*

Notes:
°All element concentrations are given as dissolved

Appendix D – 2019 Hope Bay Waste Rock, Ore and Infrastructure Seep Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Derrick Midwinter Lisa Barazzuol	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 18, 2020
Subject:	2019 Seep Monitoring of Doris and Madrid Waste Rock, Ore, and Infrastructure		

1 Introduction

As part of the verification, monitoring and management plans for the Hope Bay Project (the Project), located in Nunavut, TMAC Resources Inc. (TMAC) monitors seepage downstream of mine infrastructure, pads, roads and waste rock. Water Licence 2AM-DOH1335 Amendment No. 2 (Nunavut Water Board 2018) is the permit that governs mining activities at the Doris and Madrid areas of the Project. The 2019 seepage monitoring program was completed by TMAC in accordance with conditions outlined in Item 8, Part D "Conditions applying to Construction and Operations" of Water Licence 2AM-DOH1335 Amendment No. 2, Quarry Management and Monitoring Plan (TMAC 2017) and Waste Rock, Ore and Backfill Management Plan, Hope Bay Project, Nunavut (TMAC 2019).

In 2019, TMAC conducted a seepage survey of the waste rock influenced area (WRIA) at Doris in the following areas (Attachment 1): toe of the waste rock stockpiles on Pad T and Pad I, including the slope of the pollution control pond (PCP) located immediately downstream of the waste rock and ore stockpile on Pad I; and toe of the access roads located down-gradient of the Doris waste rock stockpiles where contact water bypasses the PCP. At the time of the survey, there was no waste rock on surface at Madrid North.

The scope of the 2019 construction rock seepage monitoring survey included infrastructure constructed since the previous seepage survey and infrastructure surveyed for seepage in 2018 but where none was observed (SRK 2019). In the latter case, these areas were monitored again in 2019. Construction material used at Madrid North was sourced from Quarry D whereas material used at Doris was from Quarry 2 or Doris waste rock that was geochemically monitored for use as construction material according to TMAC (2019) and deemed suitable for construction by TMAC. The 2019 seepage monitoring program included the surveying of the following areas at Doris and Madrid (with waste rock used as construction rock noted in parentheses):

- Doris
  - South Dam;
  - Access Road to the Doris Crown Pillar Recovery (CPR);

  - Access Road to Doris vent raise;
  - Cover of the Doris CPR (constructed primarily of Doris waste rock and some quarry rock); and
  - Marine Outfall Berm (MOFB) Access Road.
- Madrid North
  - Access road to the Madrid North Contact Water Pond (CWP);
  - Access road to the Naartok East CPR;
  - Naartok East overburden pad berm; and
  - Madrid North CWP construction area.

2 Methods

2.1 Seepage Survey and Sample Collection

TMAC conducted the seepage survey between June 19 and 24, 2019. Seepage survey locations, outlined in Section 1, Table 2-1 and in Attachment 1, were established where seepage was observed or suspected by examining the toes of the waste rock stockpile, infrastructure, roadways, and berms. Samples were collected and field measurements were taken at locations where water was observed flowing into and out of construction rock material; this included seepage where precipitation runoff and snowmelt came into contact with rock along the roadways, building pads, and berms. Electrical conductivity (EC), pH, temperature, oxidation-reduction potential (ORP), and flow rates (where possible) were measured at each of these locations at the time of monitoring.

A total of thirty-three (33) seepage survey sites and three (3) reference survey sites were established where chemical and physical properties of seepage water were measured and samples were taken for laboratory analysis. The three reference sites, located in the undisturbed tundra and not subject to mine influences, were sampled on July 3, 2019. These samples, used as baseline reference points, were collected at approximately the same locations as the 2010 to 2018 seepage surveys (in the vicinity of the Doris-Windy Road, Attachment 1).

Table 2-1: Summary of 2019 seepage survey

Mine Area	Material Source	Surveyed Area	Surveyed Seeps
Reference	Background[1]	Reference (Doris-Windy Road)	3
Doris	Waste Rock Stockpiles	Toe of the waste rock stockpiles on Pad T and Pad I	0
		Berm of the pollution control ponds (PCP) located immediately downstream of the waste rock and ore stockpile on Pad I	3
		Toe of the access roads located down-gradient of the Doris waste rock stockpiles	3
	Quarry 2	South Dam	1
		CPR Access Road	2
		MOFB Access Road	13
		Access Road to Vent Raise	0
	Waste Rock for Construction	Cover of Doris CPR	0
Madrid North	Quarry D	Access Road to Naartok East CPR	0
		Access Road to Madrid North CWP	11
		Madrid North CWP	0
		Overburden Pad Berm	0

Notes:

See Attachment A for surveyed areas in 2019

[1] One reference station (REF-001) may be impacted by nearby infrastructure

One duplicate sample and one field blank were collected and submitted for laboratory analysis, and one travel blank was included in sample shipments as part of SRK's recommended quality assurance/quality control (QA/QC) program.

TMAC submitted a total of 38 samples (including a duplicate and field blank) to ALS Environmental Labs in Vancouver, BC, where they were analyzed for pH, EC, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and dissolved metals (including mercury and selenium). All samples were filtered and preserved in the field, as required.

2.2 Quality Assurance

SRK conducted a QA/QC review of all data and overall, results were deemed acceptable. The general findings are outlined as below:

- Ion balances ranged from -7.2 to 8.7% for the samples. No samples exceeded SRK's criteria of ±10%.
- Field blank parameter concentrations were below detection limits, indicating that field filtration and sampling methods did not introduce contamination.

- Field duplicate results were within ±10% relative percent difference (RPD) for all parameters with measured concentrations greater than ten times the detection limit.
- Laboratory and field values of pH, EC, and TDS were compared and met SRK's QA/QC criteria with the exception of one sample (19-DC-06) that had the highest level of EC and a relative percent difference (RPD) of 24%.

3 Results

Attachment 1 presents location maps of the seepage samples, surveyed areas and of the as-built alignment of the Doris and Madrid mine areas. A complete set of field observations and measurements is provided in Attachment 2. Attachment 3 contains the laboratory water chemistry results. Table 3-1 presents median values for field pH and conductivity measurements.

3.1 Windy Road Area (Reference Stations)

3.1.1 Field Data

Field data were not collected at the three reference stations.

3.1.2 Laboratory Data

Consistent with previous years, three reference samples were taken in the Windy Road area and submitted for laboratory analysis (Table 3-1). The laboratory pH values ranged from 7.1 to 7.8 and laboratory EC measured between 50 and 160 µS/cm, both within the historical range (see Section 4.1.1).

Major cation chemistry was dominated by sodium (3.4 to 9.9 mg/L) and calcium (4.3 to 15 mg/L), while major anion chemistry was dominated by alkalinity (18 to 47 mg/L as $CaCO_3$), sulphate (0.3 to 5.3 mg/L) and chloride (3.7 to 19 mg/L).

Nitrite and nitrate values were below the limit of detection (0.005 mg/L).

3.2 Doris

3.2.1 Waste Rock Influenced Area

Six samples from the WRIA were submitted for laboratory analysis (Table 3-2). 19-DC-01, 19-DC-02 and 19-DC-03 were sampled along the northwest edge of the pollution containment pond (PCP). These three seeps are immediately downstream of the toe of the stockpile on Pad I that is composed of TMAC ore placed on top of waste rock placed in a stockpile in 2011. Accordingly, seepage from DC-01 to DC-03 were considered contact water (undiluted) from this stockpile. 19-DC-04, 19-DC-05 and 19-DC-06 were sampled along the access road located down-gradient of the Doris waste rock stockpiles.

Field Data

The samples collected within the WRIA (19-DC-01 to 19-DC-06) had the highest levels of field EC (ranging from 2000 to 3500 µS/cm) compared to other site areas. Field pH ranged from 7.6 to 8.1.

Table 3-1: Median values for field pH and conductivity measurements

Mine Area	Material Source	Site Area	No. of Samples	Conductivity (µS/cm)	pH
				Median	
Reference	-	Reference (Windy Road)	3	-	-
Doris	Waste Rock	WRIA	6	2300	8.1
	Quarry 2	South Dam	1	300	7.9
		Access Road to Doris CPR	2	270	8.0
		MOFB Access Road	13	190	7.7
Madrid	Quarry D	Access Road to Madrid North CWP	11	79	7.5

Source: X:\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 115 - Doris Seepage Monitoring\3. Working File\1CT022.037_2019_Doris-MadridSeep_rev01_jce.xlsx

Laboratory Data

The laboratory pH values ranged from 7.9 to 8.1 and laboratory EC measured between 2100 and 2700 µS/cm.

The major ion chemistry for WRIA samples located immediately downstream of the toe of the waste rock pile (19-DC-01 to 19-DC-03) varied from the samples located at the toe of the road (19-DC-04 to 19-DC-06) both in concentrations of chloride and sulphate and major cation composition.

For samples 19-DC-01 to 19-DC-03 major cation chemistry was dominated by sodium (290 to 350 mg/L) with lesser calcium (82 to 90 mg/L), while major anion chemistry was dominated by chloride (350 to 400 mg/L), sulphate (310 to 350 mg/L), alkalinity (130 mg/L as $CaCO_3$) and nitrate (18 to 21 mg/L).

For samples 19-DC-04 to 19-DC-06 the cation chemistry was dominated by calcium (160 to 260 mg/L) and sodium (170 to 190 mg/L) , while major anion chemistry was dominated by chloride (470 to 640 mg/L), sulphate (95 to 200 mg/L), alkalinity (74 to 88 mg/L as $CaCO_3$) and nitrate (25 to 28 mg/L).

Nitrite ranged from 0.13 to 0.44 mg/L, greater than the concentrations that were below detection (0.001 mg/L) at the reference stations. Ammonia (ranging from 5.6 to 9.7 mg/L) and chloride levels (350 to 470 mg/L) were one to three orders of magnitude greater than the reference stations. The source of ammonia, nitrate and nitrite are explosives residues and the source of chloride is drilling brines used in underground mining.

Iron concentrations at 19-DC-01 to 19-DC-03 ranged from 6.5 to 7.7 mg/L. High iron concentrations are likely due to presence of iron particulate material less than 0.45 µm because the solubility of dissolved iron species is low in non-acidic and oxygenated conditions (Stumm and Morgan 1996).

Metals which were an order of magnitude greater at 19-DC-01 to 19-DC-03 than 19-DC-04 to 19-DC-06 were cobalt (ranging from 0.041 to 0.51 mg/L), copper (ranging from 3.5 to 3.9 mg/L),

molybdenum (ranging from 0.014 to 0.016 mg/L), nickel (0.073 to 0.085 mg/L), silver (0.032 to 0.033 mg/L), and sulphur (120 to 140 mg/L). Calcium was the only parameter that 19-DC-04 to 19-DC-06 (ranging from 160 to 260 mg/L) compared to 19-DC-01 to 19-DC-03. All seepage from waste rock and at toe of the road is intercepted by water management collection systems and pumped to the Tailings Impoundment Area.

3.2.2 Infrastructure and Roads

One seepage sample was collected at the South Dam, two from along the access road to the Doris CPR, and thirteen samples along the MOFB access road. There was no seepage observed downstream of the Doris CPR cover, which was constructed primarily of waste rock, and the access road to the vent raise, constructed by Quarry 2 ROQ material.

Field Data

For all samples, the pH ranged from 7.6 to 8.3, and the EC ranged from 100 and 410 µS/cm.

Laboratory Data

For all samples, laboratory pH range from 7.7 to 8.1, and laboratory EC ranged 110 to 430 µS/cm.

The major cation chemistry for all seepage samples collected from infrastructure areas was dominated by sodium (9.1 to 48 mg/L) and calcium (7.6 to 19 mg/L) while major anion chemistry was dominated by alkalinity (26 to 77 mg/L as $CaCO_3$), sulphate (4.0 to 26 mg/L) and chloride. Chloride concentrations ranged from 5.9 to 51 mg/L except for two samples located in Roberts Bay (19-MOFB-01 and 19-MOFB-09) that had concentrations of 71 and 86 mg/L.

Nitrite and nitrate values were similar for the sixteen samples (ranging from 0.001 to 0.11 mg/L and 0.005 to 5.4 mg/L, respectively). Ammonia (ranging from 0.0056 to 3.5 mg/L) and chloride levels were one to two orders of magnitude greater than the reference stations, and one to two orders of magnitude lower than the waste rock influenced seepage. Sulphate was also more than one magnitude greater than the reference stations.

Dissolved trace metals concentrations were typically within an order of magnitude of concentrations at the reference stations with the exception of manganese and molybdenum.

3.3 Madrid North

3.3.1 Infrastructure and Roads

Eleven seepage samples were collected along the access road to the Madrid North CWP. Seepage was not observed at the Madrid North CWP, the access road to the Naartok East CPR, or the overburden pad berms; therefore, samples were not collected from these areas.

Field Data

For all samples, the pH ranged from 7.0 to 7.8 and the EC ranged from 54 and 200 µS/cm.

Laboratory Data

For all samples, laboratory pH ranged from 7.4 to 8.1, and laboratory EC ranged from 54 to 220 µS/cm.

The major cation chemistry was dominated by calcium (4.8 to 29 mg/L) and sodium (2.7 to 7.1 mg/L), while major anion chemistry was dominated by alkalinity (21 and 69 mg/L as $CaCO_3$), and chloride (3.3 and 22 mg/L). Sulphate values ranged from 0.4 to 4.9 mg/L.

Nitrite and nitrate values ranged from 0.001 and 0.032 mg/L and 0.0084 and 0.42 mg/L, respectively. Compared to the reference seeps, ammonia (ranging from 0.0074 and 0.094 mg/L) was one to two orders of magnitude greater.

Dissolved metals concentrations were similar to the reference seeps with values differing by less than an order of magnitude with the exception of manganese and for one sample zinc.

3.3.2 Waste Rock

There was no waste rock placed on surface, either as construction rock or in a stockpile at the time of the seepage survey; therefore, there are no seepage samples of waste rock.

Table 3-2: Summary of select laboratory results of 2019 seepage samples

Mine Area	Infrastructure	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	TDS	Total Ammonia	Cl	NO_3	NO_2	SO_4	Ca	Mg	K	Na	Al	As	Cd	Cu	Fe	Pb	Ni	Se	Zn
			s.u.	s.u.	µS/cm	µS/cm	mV	mg/L	mg N/L	mg/L	mg/L	mg/L	mg/L	Mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reference	Reference (Windy Road)	19-REF-01	-	7.1	-	50	-	60	0.015	3.7	*<0.005*	*<0.001*	0.3	4.3	2.5	0.56	3.4	0.063	0.00018	*<0.000005*	0.0013	0.13	*<0.00005*	0.002	*<0.00005*	0.0042
		19-REF-02	-	7.7	-	160	-	130	0.022	19	*<0.005*	*<0.001*	2.3	15	5	0.61	9.5	0.023	0.00025	*<0.000005*	0.0014	0.064	*<0.00005*	0.002	*<0.00005*	0.0017
		19-REF-03	-	7.8	-	130	-	98	*<0.005*	11	*<0.005*	*<0.001*	5.3	12	2.9	0.35	9.9	0.015	0.0001	*<0.000005*	0.0011	0.045	*<0.00005*	0.0005	0.000054	*<0.001*
Doris	Waste Rock Influenced Area	19-DC-01	8.1	8.1	2500	2500	160	1500	7.9	400	21	0.44	350	87	34	30	350	0.0096	0.0054	0.000064	3.8	7.7	*<0.0001*	0.082	0.0049	*<0.002*
		19-DC-02	8.1	8.1	2400	2500	150	1600	8.2	400	21	0.4	350	90	33	30	340	0.0086	0.005	0.000097	3.9	7.7	*<0.0001*	0.085	0.0048	*<0.002*
		19-DC-03	8.1	7.9	2200	2200	160	1400	6.8	350	18	0.36	310	82	31	26	290	0.0089	0.0053	0.000065	3.5	6.5	0.000068	0.073	0.0045	*<0.001*
		19-DC-04	7.7	7.9	2000	2100	140	1600	9.5	470	25	0.13	95	160	32	17	170	0.0092	0.0031	0.000058	0.012	0.013	*<0.00005*	0.0018	0.0011	0.0018
		19-DC-05	8.0	7.9	2100	2100	130	1600	9.7	480	25	0.15	95	170	32	16	160	0.0082	0.003	0.000048	0.011	0.012	*<0.00005*	0.0016	0.0013	*<0.001*
		19-DC-06	7.6	8.0	3500	2700	130	2100	5.6	640	28	0.37	200	260	56	16	190	0.0055	0.0027	0.000049	0.0041	0.01	*<0.00005*	0.004	0.0021	*<0.001*
	South Dam	19-TLA-01	7.9	8.0	300	260	120	180	0.31	19	0.61	0.016	26	32	5.2	1.5	15	0.034	0.00071	*<0.000005*	0.0072	0.063	0.000061	0.0011	0.00017	*<0.001*
	Access Road to Doris CPR	19-DCPRT-01	8.0	8.1	180	190	89	140	0.26	15	0.87	0.028	8.9	31	5.1	1.4	14	0.038	0.00022	*<0.000005*	0.0088	0.056	*<0.00005*	0.00081	0.00008	*<0.001*
		19-DCPRT-02	7.9	8.0	360	350	100	220	0.90	51	4.2	0.11	18	15	8.3	3	26	0.048	0.00032	0.00001	0.016	0.062	*<0.00005*	0.0013	0.00036	0.0014
	MOFB Access Road	19-MOFB-01	7.7	7.8	410	430	35	250	0.013	86	*<0.005*	*<0.001*	7.6	17	3.9	1.6	13	0.029	0.00018	*<0.000005*	0.0019	0.13	*<0.00005*	0.0011	*<0.00005*	*<0.001*
		19-MOFB-02	7.7	7.8	200	220	64	140	0.006	35	*<0.005*	*<0.001*	4.6	16	5.4	3.4	41	0.014	0.00016	*<0.000005*	0.0012	0.062	*<0.00005*	0.00075	*<0.00005*	*<0.001*
		19-MOFB-03	7.7	7.8	190	210	81	130	0.0074	32	*<0.005*	*<0.001*	4.4	19	9.5	2.2	48	0.018	0.00014	*<0.000005*	0.0012	0.06	*<0.00005*	0.00073	*<0.00005*	*<0.001*
		19-MOFB-04	7.6	7.8	190	200	88	130	0.008	31	*<0.005*	*<0.001*	4.3	14	5.4	1.4	21	0.014	0.00014	*<0.000005*	0.0011	0.059	*<0.00005*	0.00074	*<0.00005*	*<0.001*
		19-MOFB-05	7.6	7.9	180	210	100	130	0.007	30	*<0.005*	*<0.001*	4.2	14	5.4	1.3	20	0.013	0.00016	*<0.000005*	0.0011	0.058	*<0.00005*	0.00064	*<0.00005*	*<0.001*
		19-MOFB-06	7.7	7.9	180	200	96	120	0.0056	28	*<0.005*	*<0.001*	4.1	14	5.3	1.3	19	0.02	0.00015	*<0.000005*	0.0012	0.073	*<0.00005*	0.0007	*<0.00005*	*<0.001*
		19-MOFB-07	7.7	7.9	180	200	89	120	0.0084	27	*<0.005*	*<0.001*	4	13	5.4	1.3	19	0.02	0.00014	*<0.000005*	0.00099	0.088	*<0.00005*	0.00066	*<0.00005*	*<0.001*
		19-MOFB-08	7.8	7.9	200	210	57	130	0.039	30	0.078	*<0.001*	4.3	14	5.2	1.3	18	0.013	0.00013	*<0.000005*	0.001	0.071	*<0.00005*	0.00075	*<0.00005*	*<0.001*
		19-MOFB-09	7.8	7.7	340	340	95	180	0.03	71	*<0.005*	*<0.001*	13	14	5.2	1.3	18	0.044	*<0.0001*	*<0.000005*	0.0014	0.065	*<0.00005*	0.0005	*<0.00005*	*<0.001*
		19-MOFB-10	7.9	7.9	230	260	88	140	0.15	36	0.23	0.0051	7.6	14	5.6	1.4	20	0.03	0.00015	0.000012	0.0021	0.049	*<0.00005*	0.0005	*<0.00005*	*<0.001*
		19-MOFB-11	8.0	8.0	170	180	90	130	0.23	11	0.95	0.021	5.2	9.9	9.2	1.4	45	0.096	0.00019	0.0000064	0.004	0.033	*<0.00005*	0.00057	0.000084	*<0.001*
		19-MOFB-12	8.3	7.8	100	110	100	72	0.26	5.9	2.2	0.02	6.7	13	7.1	1.7	29	0.032	0.00017	0.0000065	0.0035	0.023	*<0.00005*	0.0005	0.0001	*<0.001*
		19-MOFB-13	8.1	7.7	170	150	110	90	3.5	8.6	5.4	0.11	6.6	13	6.2	1.8	15	0.037	0.00014	*<0.000005*	0.0035	0.022	*<0.00005*	0.0005	0.00011	*<0.001*
Madrid North	Access Road to Madrid North CWP	19-MAD-01	7.5	7.8	120	110	120	77	0.019	3.4	0.12	0.0033	1.3	17	2.3	0.76	3.3	0.016	0.00016	*<0.000005*	0.0011	0.017	*<0.00005*	0.00072	*<0.00005*	0.0018
		19-MAD-02	7.6	7.5	76	74	60	69	0.012	5.1	0.053	0.0035	0.92	7.7	2.4	1.1	4.2	0.054	0.00016	*<0.000005*	0.0017	0.071	*<0.00005*	0.0021	*<0.00005*	0.0036
		19-MAD-03	7.4	7.4	55	55	100	62	0.0077	3.4	0.011	*<0.001*	0.48	4.8	2	1	2.7	0.052	0.00015	*<0.000005*	0.0015	0.086	*<0.00005*	0.0021	*<0.00005*	0.0044
		19-MAD-04	7.1	7.4	54	54	99	60	0.0074	3.3	0.015	*<0.001*	0.42	4.9	1.9	1.1	2.7	0.051	0.00013	*<0.000005*	0.0015	0.088	*<0.00005*	0.002	*<0.00005*	0.0044
		19-MAD-05	7.5	7.6	83	81	70	72	0.0084	3.9	0.091	0.0029	0.48	9.5	2.6	1.2	3.1	0.046	0.00022	*<0.000005*	0.0018	0.078	*<0.00005*	0.0022	*<0.00005*	0.0039
		19-MAD-06	7.7	7.6	69	68	78	65	0.0099	3.4	0.019	0.0011	0.4	7.6	2.4	1.1	2.7	0.055	0.00021	*<0.000005*	0.0019	0.095	*<0.00005*	0.0022	*<0.00005*	0.0034
		19-MAD-07	7.7	7.6	71	70	99	64	0.02	3.6	0.074	0.0014	0.45	7.9	2.4	1.1	2.9	0.055	0.00018	*<0.000005*	0.0019	0.097	*<0.00005*	0.0023	*<0.00005*	0.0034
		19-MAD-08	7.4	7.9	180	150	100	110	0.094	8.8	0.42	0.032	1.7	17	4.6	1.8	7.1	0.054	0.00025	0.0000087	0.0025	0.097	*<0.00005*	0.0027	*<0.00005*	0.022
		19-MAD-09	7.0	7.7	79	85	92	75	0.011	4.1	0.0084	0.0014	0.49	9.5	3.2	1.1	3.4	0.076	0.00023	*<0.000005*	0.0021	0.12	*<0.00005*	0.0024	*<0.00005*	0.0032
		19-MAD-10	7.6	8.0	190	220	80	120	0.038	22	0.19	0.0094	4.9	29	5.2	1.4	7.1	0.016	0.00046	*<0.000005*	0.0025	0.035	*<0.00005*	0.0017	*<0.00005*	0.0025
		19-MAD-11	7.8	8.1	200	220	59	140	0.02	22	0.11	0.0072	4.7	29	5.5	1.4	7.1	0.018	0.00044	*<0.000005*	0.0025	0.034	*<0.00005*	0.0016	*<0.00005*	0.0049

Source: Z:\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 115 - Doris Seepage Monitoring\3. Working File\1CT022.037_2019_Doris-MadridSeep_rev02_jce_dwm.xlsx

Notes:

Italics indicate values below the method detection limit.

[1] Seepage samples collected at these stations were outside the scope of the 2019 monitoring program. Results are included for completeness

4 Comparison to Previous Surveys

Table 4-1 compares the results of samples collected in 2019 from the waste rock influenced area at Doris and reference stations (Windy Road area) with a statistical summary of historical seepage samples collected from those same areas between 2011 and 2018 (Attachment 1). Table 4-1 presents the historical data as 5th, 50th, and 95th percentile statistics, with concentrations below the detection limit assumed to be equal to the detection limit.

Figure 1 to Figure 3 present all seepage monitoring data from these areas for parameters that are relevant to metal leaching. This includes sulphate and contaminants of potential concern with 2019 median values at least ten times greater than the historic median (copper, and iron). Figure 4 to Figure 6 present all seepage monitoring data from these areas for parameters that are related to leaching of blasting residues (ammonia and nitrate) and drilling brines (chloride).

There are no historical seepage samples for the South Dam, access road to the Doris CPR, MOFB Access Road in the Doris mine area and for the access road to Naartok East CPR, Madrid North CWP and overburden pad berm in the Madrid North mine area.

Table 4-1: Comparison of analytical results between 2019 survey data and 5th, 50th, and 90th percentile of 2011 to 2018 survey data

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	Total Hardness	TDS	Total Ammonia	Cl	NO_3	SO_4	Al	As	Cd	Cu	Fe	Pb	Ni	Se	Zn
		s.u.	s.u.	µS/cm	µS/cm	mg $CaCO_3$/L	mg/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2015 Source Term	-	*7.7*	-	-	*1200*	-	*24*	*1100*	*45*	*46*	*0.011*	*0.00072*	*0.000075*	*0.0095*	*0.041*	*0.00011*	*0.0023*	*0.0009*	*0.028*
Waste-Rock Influenced Area	19-DC-01	8.1	8.1	2500	2500	360	1500	7.9	400	21	**350**	0.0096	0.0054	0.000064	**3.8**	**7.7**	0.0001	0.082	0.0049	0.002
	19-DC-02	8.1	8.1	2400	2500	360	1600	8.2	400	21	**350**	0.0086	0.005	0.000097	**3.9**	**7.7**	0.0001	0.085	0.0048	0.002
	19-DC-03	8.1	7.9	2200	2200	330	1400	6.8	350	18	**310**	0.0089	0.0053	0.000065	**3.5**	**6.5**	0.000068	0.073	0.0045	0.001
	19-DC-04	7.7	7.9	2000	2100	540	1600	9.5	470	25	**95**	0.0092	0.0031	0.000058	**0.012**	0.013	0.00005	0.0018	0.0011	0.0018
	19-DC-05	8	7.9	2100	2100	540	1600	9.7	480	25	**95**	0.0082	0.003	0.000048	**0.011**	0.012	0.00005	0.0016	0.0013	0.001
	19-DC-06	7.6	8	3500	2700	880	2100	5.6	640	28	**200**	0.0055	0.0027	0.000049	0.0041	0.01	0.00005	0.004	0.0021	0.001
	P05	7.6	7.6	300	320	100	200	0.083	33	0.99	13	0.006	0.00059	8.3E-06	0.0034	0.01	0.00005	0.00061	0.00021	0.001
	P50	8.0	7.9	2100	2200	360	1600	9.1	470	22	76	0.0092	0.0016	0.000063	0.01	0.036	0.000084	0.0033	0.0014	0.0018
	P95	8.3	8.1	3800	8100	2400	6300	64	2400	140	330	0.027	0.0073	0.00031	3.7	7.1	0.00025	0.081	0.0047	0.005
	n	13	18	13	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Reference (Windy Road)	19-REF-01	-	7.1	-	50	21	60	0.015	3.7	0.005	0.3	0.063	0.00018	0.000005	0.0013	0.13	0.00005	0.002	0.00005	0.0042
	19-REF-02	-	7.7	-	160	58	130	0.022	19	0.005	2.3	0.023	0.00025	0.000005	0.0014	0.064	0.00005	0.002	0.00005	0.0017
	19-REF-03	-	7.8	-	130	41	98	0.005	11	0.005	5.3	0.015	0.0001	0.000005	0.0011	0.045	0.00005	0.0005	0.000054	0.001
	P05	6.6	6.9	36	50	17	34	0.005	3.5	0.005	0.3	0.006	0.0001	0.000005	0.00086	0.03	0.00005	0.0005	0.00005	0.001
	P50	7.3	7.5	79	70	23	58	0.0063	6.3	0.005	0.74	0.02	0.00015	0.00001	0.0012	0.064	0.00005	0.0019	0.0001	0.0033
	P95	7.8	8.0	290	190	71	120	0.021	26	0.005	5	0.058	0.00024	0.00005	0.0025	0.18	0.00005	0.0026	0.001	0.005
	n	12	19	12	15	19	19	16	19	19	19	19	19	19	19	19	19	19	19	19

Notes:

(1) All metal concentrations are dissolved.

(2) Values below the detection limit are included in statistics as being equal to the detection limit.

(3) Bolded values are greater than those from the 2015 Waste Rock Source Term (SRK 2015a).

(4) Percentiles 5th (P05), 50th (P50), and 95th (P95)

4.1.1 Doris Waste Rock Influenced Area

Sulphate and Trace Elements

Figure 1 to Figure 3 present temporal trends of sulphate, copper and iron compared to the average of the 2012 data set for SNP station ST-2 (pollution control pond), which was used as an input for derivation of the Doris waste rock source term for the 2015 water and load balance (SRK 2015a). Sulphate is presented in the context of sulphide oxidation in relation to metal leaching.

Sulphate concentrations have increased since 2015 with seepage concentrations typically higher than the source term input (Figure 1). The increasing sulphate concentrations in seepage may be due to the increased source of sulphide in the stockpiled ore. From 2014 to 2015 TMAC initiated the practice of placing ore in stockpiles on the waste rock dump immediately upstream of the toe seepage samples. Prior to this, ore and waste rock were placed in separate stockpiles. Ore has higher sulphide content than waste rock, with average concentrations typically greater than 1% and <0.5%, respectively (SRK 2015b). Increasing sulphate concentrations in seepage may be due to sulphide oxidation from ore. SRK's humidity cell test program (SRK 2015c) demonstrated that sulphate leaching rates were higher for samples of ore (average stable rate of 3.2 mg/kg/week, n=4) compared to waste rock (average stable rate of 1.1 mg/kg/week, n=12).

Copper and cobalt have also exhibited increasing trends since ore was placed on the waste rock stockpile in 2015. Copper concentrations prior to 2016 ranged from 0.0023 to 0.01 mg/L and from 0.0080 to 3.9 mg/L since 2016. All copper concentrations prior to 2018 have been at near parity or below the source term input of 0.0095 mg/L.

Iron has also exhibited increasing concentrations, but only for samples collected at the toe of the waste rock stockpile and within the berm of the PCP. High iron concentrations in these samples are likely due to iron particulate material less than 0.45 µm because the solubility of dissolved iron species is low in non-acidic and oxygenated conditions (Stumm and Morgan 1996). For other waste rock samples, iron concentrations are typically below the source term input values. All waste rock seepage is collected in the PCP and downstream sumps after which it is pumped to the TIA. In 2019, water from the PCP accounted for ~5% of total inflow volumes entering the TIA and ~2% of the total volume stored in the TIA.

Ammonia, Nitrate and Chloride

Trends in ammonia, nitrate and chloride concentrations increased after the placement of ore on the stockpile due to the re-initiation of mining by TMAC in 2015, and have continuously decreased since 2016 due to the flushing of salts from drilling brines (chloride) and explosives residues (ammonia, nitrate, and nitrite) from the waste rock stockpile (Figure 4 to Figure 6). Concentrations of these parameters are below the 2015 source term input values.

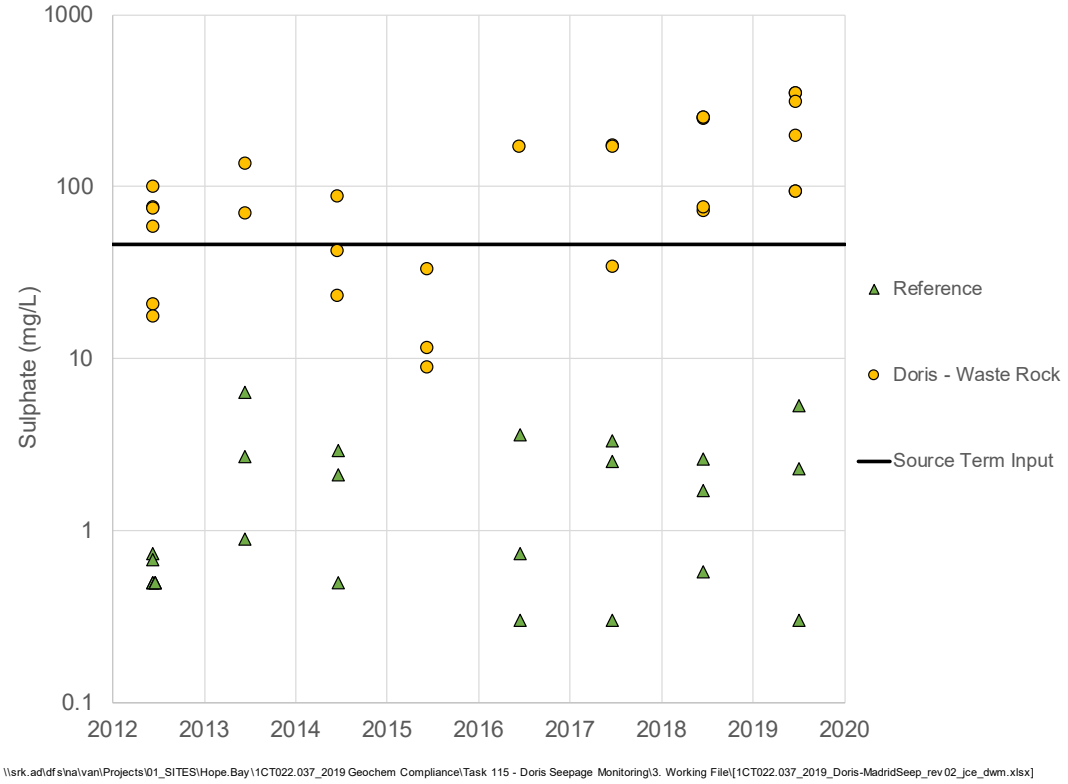


Figure 1: Sulphate seepage monitoring data, waste rock influenced area and reference areas

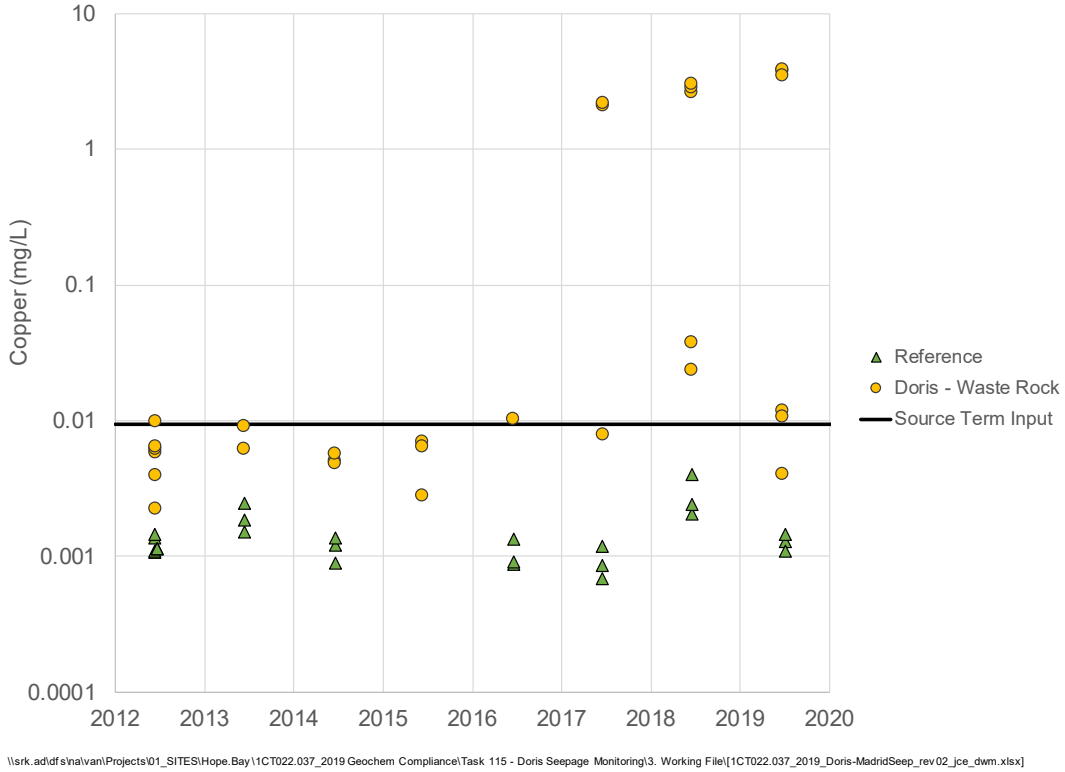


Figure 2: Copper seepage monitoring data, waste rock influenced area and reference areas

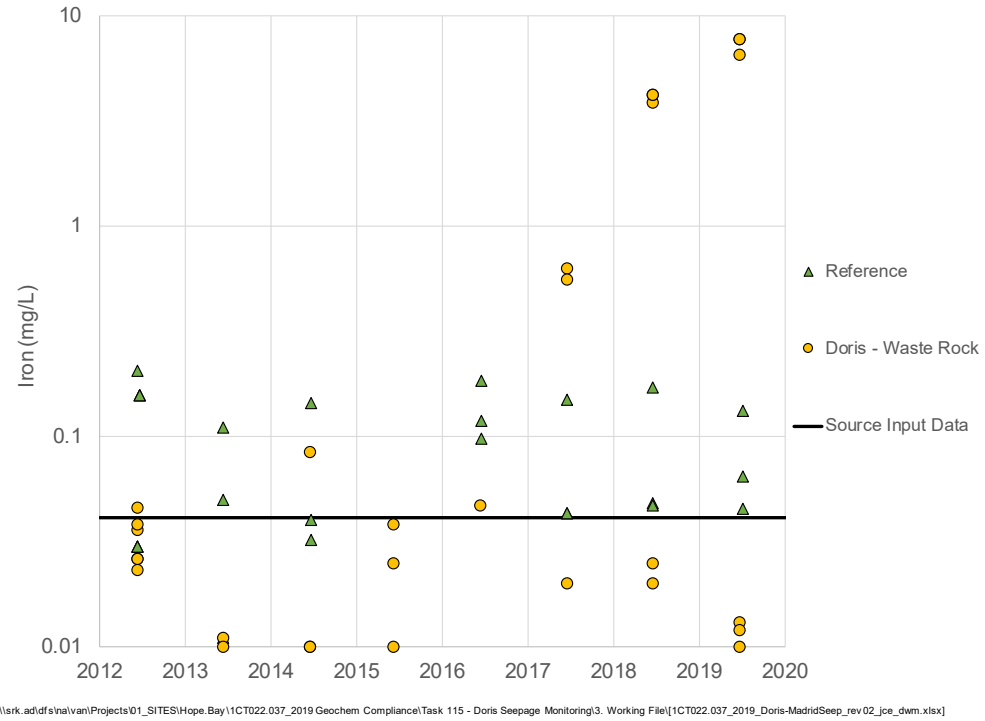


Figure 3: Iron seepage monitoring data, waste rock influenced area and reference areas

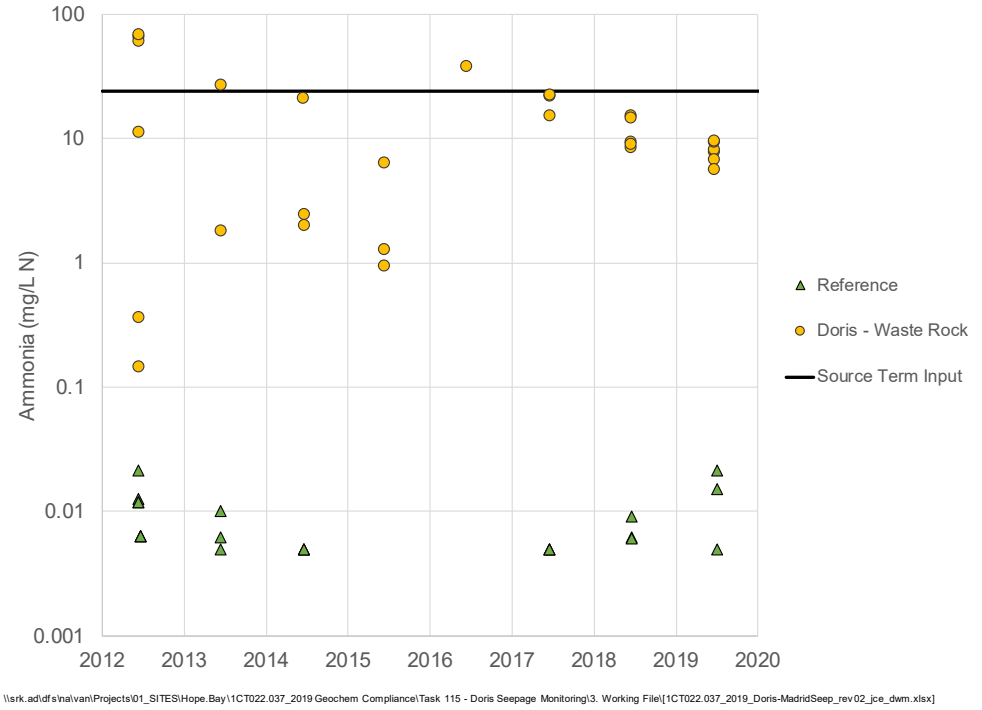


Figure 4: Ammonia seepage monitoring data, waste rock influenced area and reference areas

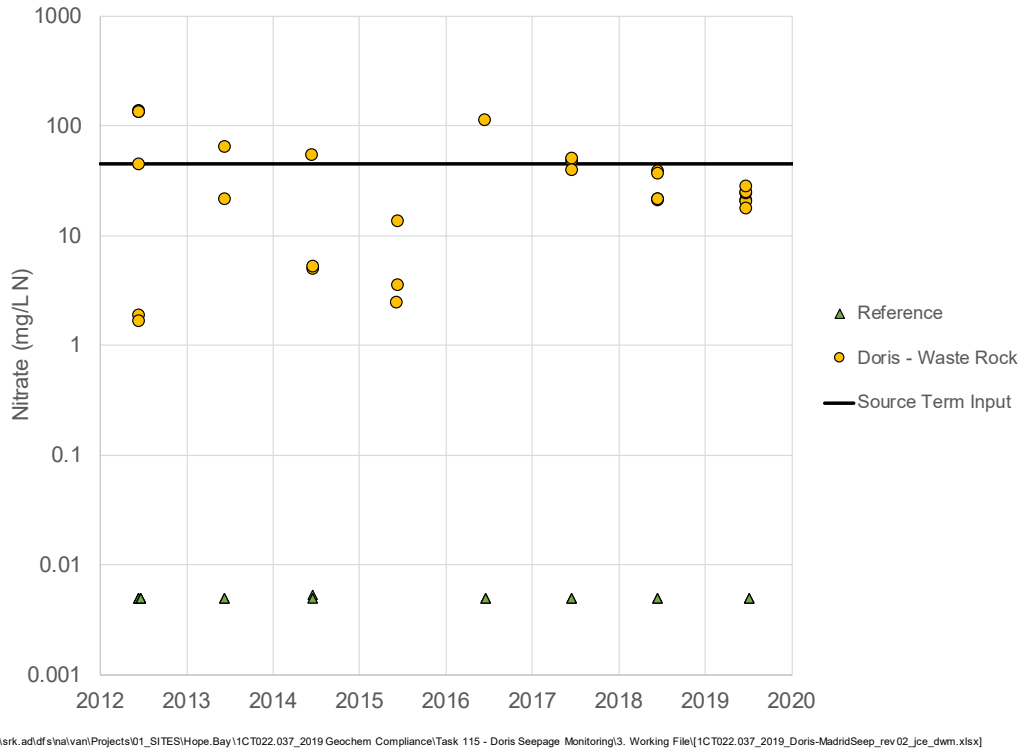


Figure 5: Nitrate seepage monitoring data, waste rock influenced area and reference areas

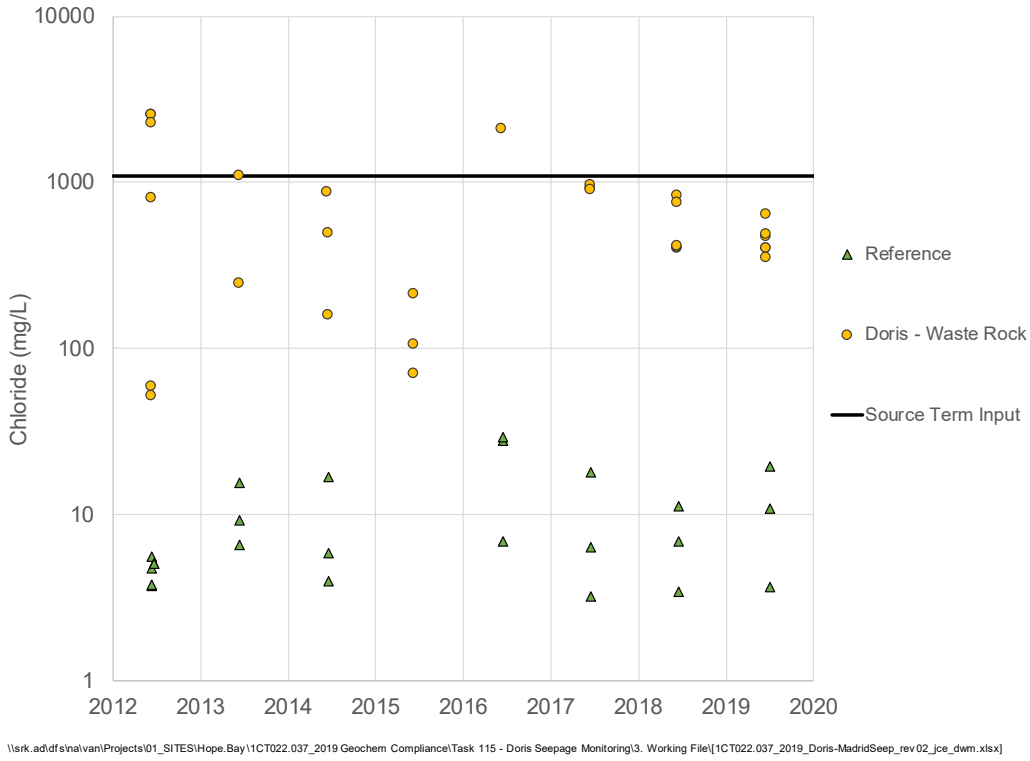


Figure 6: Chloride seepage monitoring data, waste rock influenced area and reference areas

4.1.2 Windy Road Area (Reference Stations)

Parameters concentrations for reference samples collected in 2019 were generally stable and consistent with the historical dataset, including sulphate, arsenic, cobalt, iron, selenium, ammonia, nitrate and nitrite.

5 Conclusions and Recommendations

The scope of the 2019 Hope Bay seepage monitoring survey included infrastructure constructed between fall 2018 and spring 2019 at Doris and Madrid North, three reference stations and areas downstream of the Doris waste rock stockpiles. There were no stockpiles of waste rock from Madrid North (Naartok East CPR) at the time of the survey.

Concentrations for reference area seeps were consistent and stable with the historical data record.

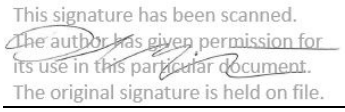
Infrastructure surveyed at Doris included the TIA south dam, MOFB access road at Robert's Bay, access road to the Doris Central vent raise, access road to the Doris CPR and Doris CPR cover. Construction rock at Doris was sourced from Quarry 2 except for the Doris CPR cover, which was constructed primarily of Doris waste rock and some quarry rock. Infrastructure surveyed at Madrid North included the access road to Naartok East CPR, overburden pad berm, Madrid North CWP, and access road to the Madrid North CWP. Construction rock at Madrid was sourced from Quarry D. Seepage was observed and samples collected representing construction rock from all aforementioned areas except the Doris CPR cover. The results of the 2019 seepage sampling program indicate that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay.

Seepage from areas impacted by waste rock had concentrations of sulphate, copper and cobalt that have exhibited increasing trends since TMAC initiated ore placement in stockpile on top of Newmont's waste rock stockpile in 2015. This stockpile is immediately upstream of the waste rock seepage sample sites. Increased concentrations of sulphate, cobalt, and copper may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of iron for the 2019 waste rock seepage samples were increasing for samples collected from the berm of the PCP; however, this was attributed to the presence of particulate material less than 0.45 µm that are not truly dissolved species. Chloride, nitrate and ammonia levels increased after ore was placed on the stockpile but have since continuously decreased in relation to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock. All waste rock seepage is intercepted, managed and pumped to the TIA.

The waste rock seepage monitoring was initiated in 2012. An assessment of the waste rock seepage monitoring record for sulphate, copper, iron, chloride, ammonia and nitrate indicated that overall, monitoring data approximates the Doris waste rock source term inputs for the 2015 water and load balance (SRK 2015a). Continued monitoring will establish trends in parameter concentrations.

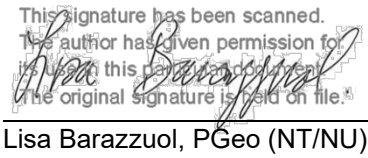
SRK recommends that the 2020 seepage survey include infrastructure areas monitored in 2019, including sites where seepage was not observed at Doris (CPR cover, access road to vent raise) and Madrid North (Madrid North CWP, overburden pad berm, access road to Naartok East CPR).

Regards,
SRK Consulting (Canada) Inc.



Derrick Midwinter, PGeo (ON)
Staff Consultant (Geochemistry)

Reviewed by



Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant (Geochemistry)

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

6 References

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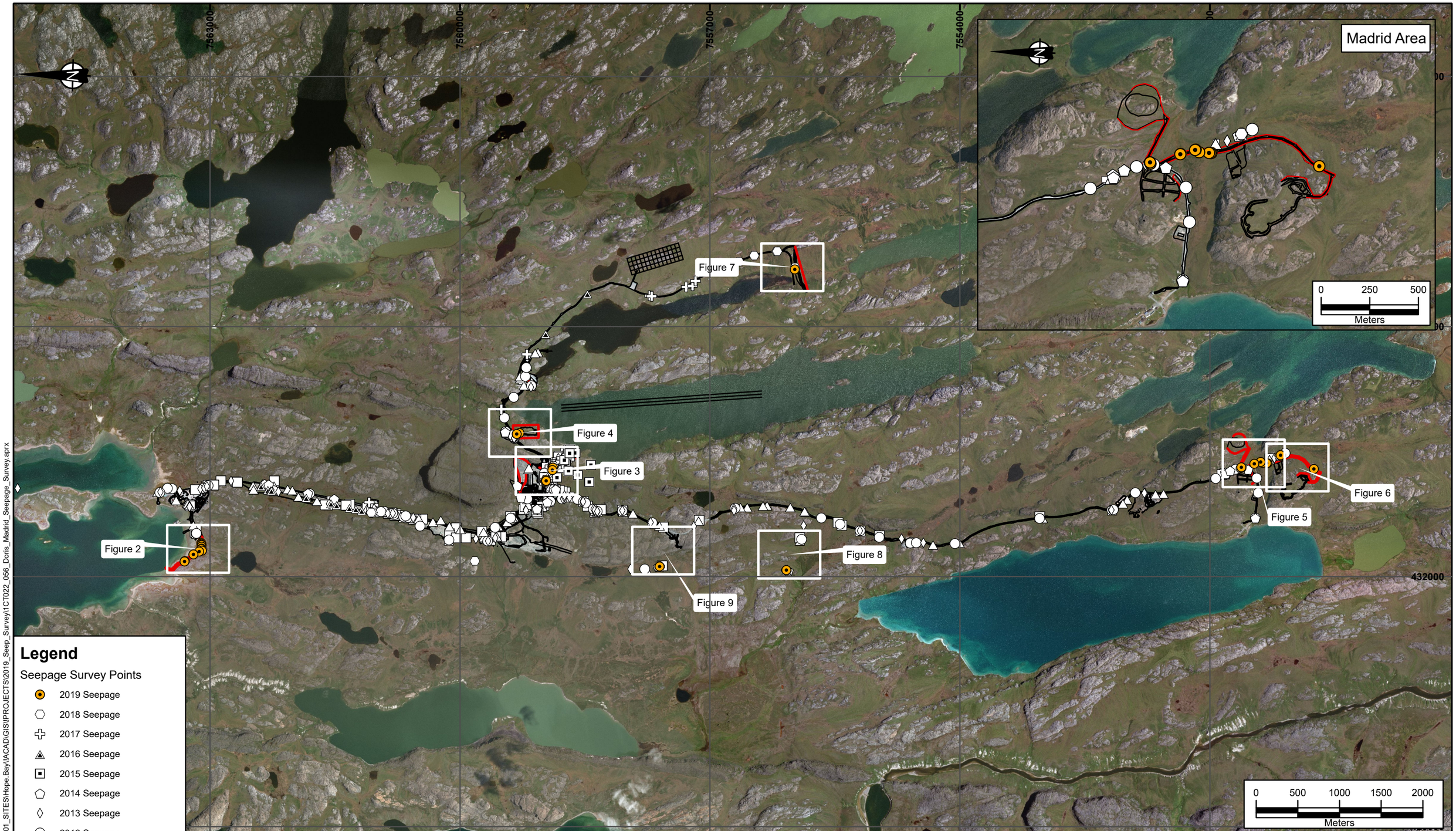
Attachment 1 – Maps of 2019 Seepage Survey Locations



Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

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FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

TMAC RESOURCES

2019 Seepage Monitoring

Hope Bay Gold Project

Seepage Survey General Arrangement

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7563450
7563300
7563150
7563000
7562850
432450
432300
432150

19-MOFB-01
19-MOFB-02
19-MOFB-03
19-MOFB-04
19-MOFB-05
19-MOFB-06
19-MOFB-07
19-MOFB-08
19-MOFB-09
19-MOFB-10
19-MOFB-11
19-MOFB-12
19-MOFB-13

N

0 25 50 75 100
Meters

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

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Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
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	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

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Hope Bay Gold Project

Seep Survey Locations

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7559550
7559400
7559250
7559100
7558950
433950
433800
433650

Doris
CPR

19-DCPRT-01
19-DCPRT-02

0 25 50 75 100
Meters

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
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	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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Seep Survey Locations

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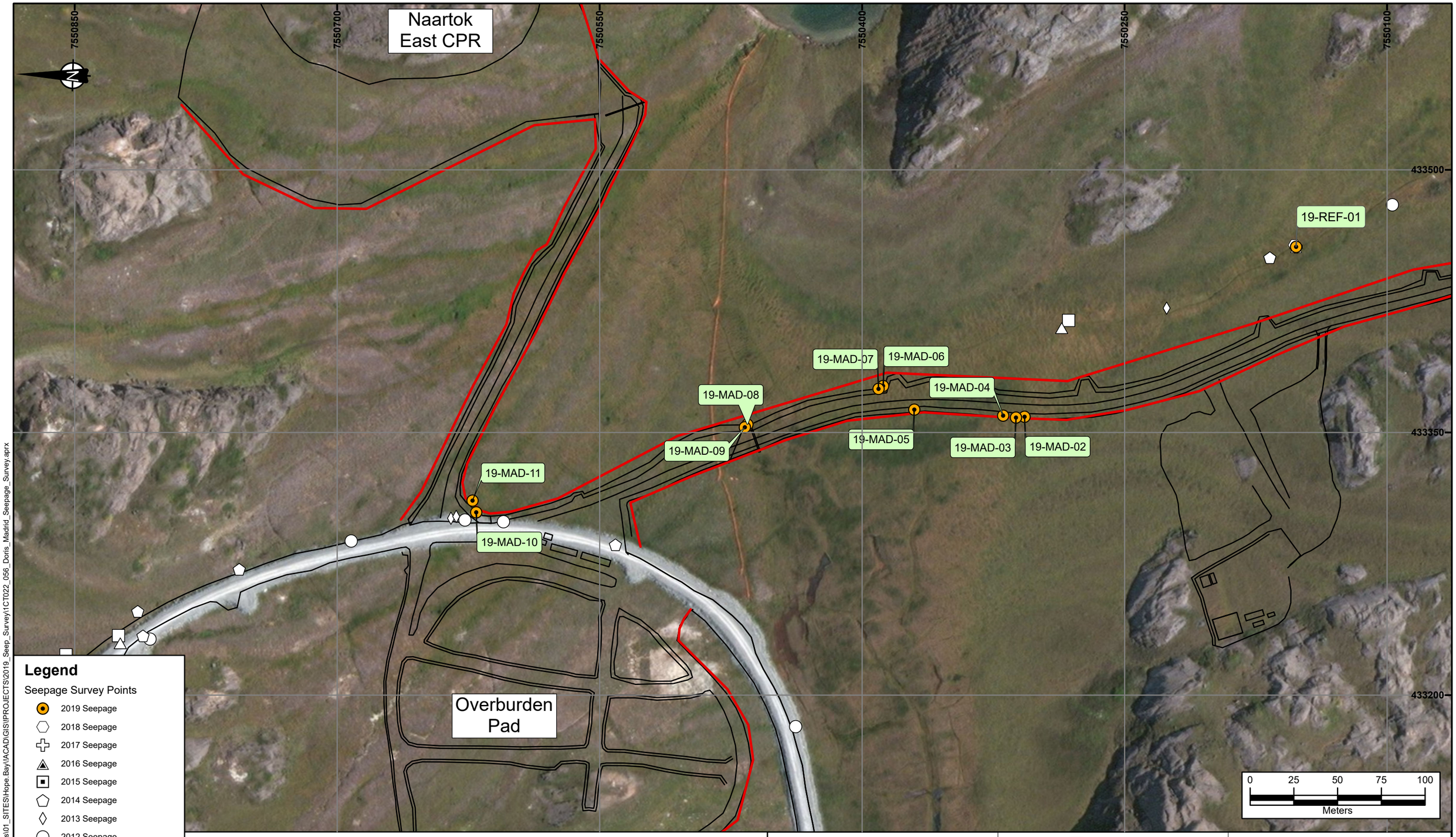

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
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	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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Seep Survey Locations

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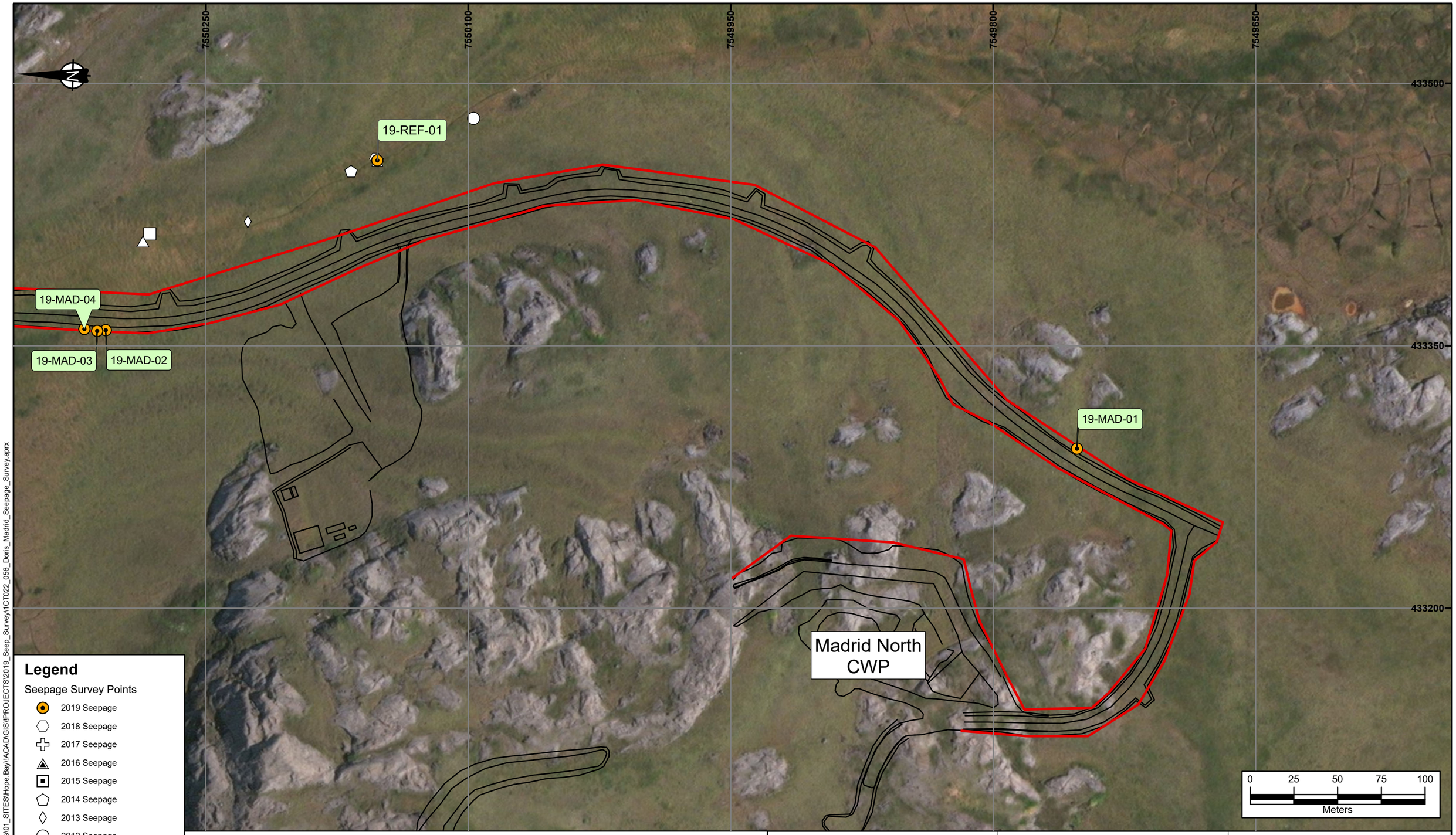

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
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- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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Hope Bay Gold Project

Seep Survey Locations

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7556400
7556250
7556100
7555950
7555800
7555650
435900
435750
435600

South Dam

19-TLA-01

0 25 50 75 100
Meters

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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Hope Bay Gold Project

Seep Survey Locations

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7556400 7556250 7556100 7555950 7555800 7555650

432450

432300

432150

19-REF-02

0 25 50 75 100
Meters

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

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2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

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7557900
7557750
7557600
7557450
7557300
432450
432300
432150
19-REF-03
0 25 50 75 100
Meters

Legend

Seepage Survey Points

- 2019 Seepage
- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage
- 2019 Surveyed Areas
- Camp Layout Infrastructure

	pH 6 to 7	pH 7 to 8	pH 8 to 9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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SRK JOB NO.: 1CT022.056

FILE NAME: 1CT022_056_Doris_Madrid_Seepage_Survey

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2019 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations

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Attachment 2 – 2019 Field Observations and Measurements

Region	Material Source	Area	Sample ID	Date	Description of Location	Field Measurements												Duplicate	Field Blank
						pH	Conductivity	ORP	Water Temperature	Water Colour	Turbidity	t1	t2	t3	Amount	Capture	Flow		
						pH units	µS/cm	mV	ºC			sec	sec	sec	mL	%	L/s		
Reference	-	Reference (Windy Road)	19-REF-01	03-Jul-19	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N
			19-REF-02	03-Jul-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N
			19-REF-03	03-Jul-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N
Doris	Waste Rock	Waste Rock Influenced Area	19-DC-01	19-Jun-19	In NW corner of PCP. Multiple seeps in area. Shallow flow with some pools, large seep. Fans out over large area.	8.1	2490	159	0.4	--	N	0.98	0.89	0.86	100	40	0.0027	N	N
			19-DC-02	19-Jun-19	Multiple seeps in area. Very shallow surface trickle our of NW edge of PC pond. Largest of small shallow surface seeps in area.	8.1	2430	152	3.5	--	--	5.2	4.94	5.82	100	80	0.0006	N	N
			19-DC-03	19-Jun-19	Multiple seeps in area. Strong flow from NW edge of PCP.	8.1	2210	160	0.1	--	--	0.76	0.83	0.78	100	75	0.0016	N	N
			19-DC-04	20-Jun-19	On southern edge of roadway and the U/G laydown. Flow is through larger rocks and into tundra toward sump locations.	7.7	2030	137	0.2	--	N	2.0	2.3	2.3	100	75	0.00086	N	N
			19-DC-05	20-Jun-19	Approximately 10m from 19-DC-04. Shallow flow out of rocks towards sumps.	8.0	2130	125	1.4	--	--	2.4	2.5	2.5	100	80	0.00075	N	N
			19-DC-06	20-Jun-19	Approximately 20m from 19-DC-05. Very shallow, upwelling from rocks. Slower flow.	7.6	3450	134	0.9	--	N	2.7	3.4	3.3	50	--	--	N	N
	Quarry 2	South Dam (Tail Lake Area)	19-TLA-01	19-Jun-19	Located upstream of S.dam into pond. Strong flows with some channeling through sediment.	7.9	303	115	2.1	--	N	1.5	1.7	1.7	250	70	0.0023	N	N
		Access Road to Doris CPR	19-DCPRT-01	19-Jun-19	Located at road leading to CPRT. Strong flow. Seeps meet in a pool.Flow measured just downstream.	8.0	178.6	89	0.6	--	N	0.91	0.91	0.92	250	65	0.0033	Y	Y
			DUP	19-Jun-19	Duplicate of 19-DCPRT-01	--	--	--	--	--	--	--	--	--	--	--	--	Y	N
			FB	19-Jun-19	Field blank collected at 19-DCPRT-01	--	--	--	--	--	--	--	--	--	--	--	--	N	Y
			19-DCPRT-02	19-Jun-19	Shallow seep leading out of road to CPRT. Low flow with small pools.	7.9	355	102	5.1	--	--	2.32	2.59	2.29	100	95	0.00066	N	N
		Marine Outfall Berm Access Road	19-MOFB-01	20-Jun-19	Multiple seeps in area. Flowing strongly through large aggregate. Little turbidity. Located approx. 75m E of large pad. Approx. 100-125m from culvert. Large creek on upstream side.	7.7	407	35	8.1	--	Y	2.46	2.41	2.4	100	25	0.0024	N	N
			19-MOFB-02	20-Jun-19	Located approx. 20m from 19-MOFB-01. Multiple seeps in area. Steady flow through large aggregate at base of road. Large creek flowing on upstream side.	7.7	204	64	8.2	--	--	1	1.16	1.1	100	45	0.0022	N	N
			19-MOFB-03	20-Jun-19	Multiple seeps in area. Located approx. 15m E of MOFB-02. Strong flow through large agg. @ base of road. Clear, no visible turbidity.	7.7	193.2	81	7.8	Clear	N	0.93	1.06	0.965	100	25	0.0041	N	N
			19-MOFB-04	20-Jun-19	Approx. 10m from MOFB-03. Strong flow through smaller medium sized rocks. Multiple seeps in area.	7.6	188.5	88	7.3	--	--	1.8	1.9	1.7	100	25	0.0029	N	N
			19-MOFB-05	20-Jun-19	Steady flow through large agg. @ base of road. Approx. 15m from MOFB-04 (E). Multiple seeps in area. Snow approx. 15m from seep.	7.6	183.9	104	6.9	--	--	1.2	1.3	1.2	250	40	0.0045	N	N
			19-MOFB-06	20-Jun-19	Multiple seeps in area flowing through medium/large sized aggregate. Strong and steady flow.	7.7	183.3	96	6.4	--	--	2.6	2.9	2.8	250	10	0.013	N	N
			19-MOFB-07	20-Jun-19	Multiple steady flowing seeps in area, through the base of large agg. No visible turbidity.	7.7	176.9	89	6.5	--	N	1.2	1.2	1.1	250	10	0.018	N	N
			19-MOFB-08	20-Jun-19	Multiple seeps in area. Steady flow at base of large agg. No visible turbidity.	7.8	203	57	6.2	--	N	1.2	1.3	1.2	250	30	0.0060	N	N
			19-MOFB-09	22-Jun-19	Flow through base of road and large aggreagte at road bend. Approx. 30m from culvert. Low, but steady flow.	7.8	342	95	4.2	--	--	1.4	1.4	1.5	250	60	0.0028	N	N
			19-MOFB-10	22-Jun-19	Very small, shallow flow through agg. No visible turbidity.	7.9	232	88	4.2	--	N	4.5	4.7	4.7	100	50	0.0010	N	N
			19-MOFB-11	22-Jun-19	Very small shallow flow through agg. Rock. No visible turbidity.	8.0	166.3	90	0.5	--	N	2.3	2.4	2.2	100	70	0.00090	N	N
			19-MOFB-12	22-Jun-19	Multiple seeps in area, at base of hill. Shallow flow with some pooling downstream. Flowing through large and medium sized agg.	8.3	104.1	104	0.2	--	--	2.1	2.1	2.1	100	80	0.00081	N	N
			19-MOFB-13	22-Jun-19	Multiple seeps in area. 10m from MOFB-12, slightly up hill. Flowing through medium and large sized agg. at base of road.	8.1	174.4	109	-0.1	--	--	1.5	1.7	1.6	250	90	0.0018	N	N
Madrid	Quarry D	Access Road to Madrid North CWP	19-MAD-01	23-Jun-19	Approx. 100m N of Madrid-Boston intersection. Small, shallow flow from road at base of large aggregate material. Grass around location dusty.	7.5	117	124	2.7	--	--	2.3	2.3	2.4	100	60	0.0010	N	N
			19-MAD-02	23-Jun-19	Multiple seeps in area, steady flow. Seeping from road base through medium/large aggregate toward Windy	7.6	76	60	7.8	Tea colour (?)	--	1.6	1.6	1.7	100	60	0.0012	N	N
			19-MAD-03	23-Jun-19	Multiple seeps in area. Strong flow from base of road, medium to large aggregate. ~10m from MAD-02. Sample collected tea colour.	7.4	55	104	9.1	Tea colour (?)	--	1.6	1.7	1.8	100	10	0.0073	N	N
			19-MAD-04	23-Jun-19	Multiple seeps in area. Strong flow from base of road, medium to large aggregate. ~10m from MAD-02. Light tea coloured sample.	7.1	54	99	9.5	Light tea colour (?)	--	1.6	1.6	1.7	100	95	0.00078	N	N
			19-MAD-05	23-Jun-19	Multiple seeps in area. Strong flow from base of roadway. Approx. 300m from culvert. Unable to capture flow.	7.5	83	70	6.4	--	--	--	--	--	--	--	--	N	N
			19-MAD-06	23-Jun-19	Flow through road turnout, stead. Multiple seeps in area. Through medium sized agg. Light tea coloured sample.	7.7	69	78	9	Light tea colour (?)	--	3.3	3.3	3.3	100	80	0.0007	N	N
			19-MAD-07	23-Jun-19	Multiple seeps in area. At base of road, coming from elbow where turnout meets roadway. Steady flow through large agg. Light tea colour sample.	7.7	71	99	8	Light tea colour (?)	--	1.2	1.3	1.3	100	75	0.0012	N	N
			19-MAD-08	24-Jun-19	Seep located next to culvert, with flow towards Patch Lake. Multiple in area, through medium sized aggregate. Stready flow.	7.4	184.9	100	2.9	--	--	1.5	1.5	1.5	100	80	0.0010	N	N

Region	Material Source	Area	Sample ID	Date	Description of Location	Field Measurements												Duplicate	Field Blank
						pH	Conductivity	ORP	Water Temperature	Water Colour	Turbidity	t1	t2	t3	Amount	Capture	Flow		
						pH units	µS/cm	mV	ºC			sec	sec	sec	mL	%	L/s		
			19-MAD-09	24-Jun-19	Multiple seeps in area. Flowing from base of roadway, medium sized agg. Light tea coloured sample. Flowing b/w 2 culverts.	7.0	78.8	92	7.1	Light tea colour (?)	--	0.95	0.9	1	100	70	0.0015	N	N
			19-MAD-10	24-Jun-19	Shallow flow through base of road, through medium sized agg. Located near Madrid offices, through Windy Road. Flows into organics. Multiple seeps in area. Some organics present in sample.	7.6	189.8	80	7.1	--	--	1.5	1.6	1.6	100	80	0.0010	N	N
			19-MAD-11	24-Jun-19	Multiple seeps in area. Flows through medium-large agg. At corner leading to Naartok E from Windy Rd. Flows into organics.	7.8	197.9	59	7.5	--	--	0.83	0.83	0.8	100	60	0.0019	N	N

Attachment 3 – 2019 Laboratory Water Quality Data

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	Total Hardness	TSS	TDS	Acidity	Total Alkalinity	Ammonia	Cl	F	NO_3	NO2	Total P	SO_4	Al
		s.u.	s.u.	µS/cm	µS/cm	mV	mg $CaCO_3$/L	mg/L	mg/L	mg $CaCO_3$/L	mg CaCO3/L	mg N/L	mg/L	mg/L	mg /L	mg/L	mg/L	mg/L	mg/L
Reference (Windy Road)	19-REF-01	--	7.1	--	50	--	21	*3*	60	3.7	18	0.015	3.7	0.061	*0.005*	*0.001*	0.0056	*0.3*	0.063
	19-REF-02	--	7.7	--	160	--	58	*3*	130	2.8	47	0.022	19	0.065	*0.005*	*0.001*	0.0052	2.3	0.023
	19-REF-03	--	7.8	--	130	--	41	*3*	98	2.3	44	*0.005*	11	0.02	*0.005*	*0.001*	0.003	5.3	0.015
Waste Rock Influenced Area	19-DC-01	8.1	8.1	2500	2500	160	360	140	1500	6.6	130	7.9	400	*0.4*	21	0.44	0.25	350	0.0096
	19-DC-02	8.1	8.1	2400	2500	150	360	6.4	1600	6.8	130	8.2	400	*0.4*	21	0.4	0.23	350	0.0086
	19-DC-03	8.1	7.9	2200	2200	160	330	6.6	1400	7.6	130	6.8	350	*0.4*	18	0.36	0.22	310	0.0089
	19-DC-04	7.7	7.9	2000	2100	140	540	59	1600	3.7	77	9.5	470	*0.2*	25	0.13	0.023	95	0.0092
	19-DC-05	8.0	7.9	2100	2100	130	540	24	1600	3.9	74	9.7	480	*0.2*	25	0.15	0.0089	95	0.0082
	19-DC-06	7.6	8	3500	2700	130	880	3.9	2100	3.5	88	5.6	640	*0.4*	28	0.37	0.0078	200	0.0055
TLA	19-TLA-01	7.9	8	300	260	120	72	7	180	2	77	0.31	19	0.065	0.61	0.016	0.033	26	0.034
CPR Access Road	19-DC-02	8	8.1	180	190	89	58	11	140	1	59	0.26	15	0.031	0.87	0.028	0.023	8.9	0.038
	19-DC-03	7.9	8	360	350	100	62	23	220	1.3	50	0.9	51	0.037	4.2	0.11	0.049	18	0.048
Marine Outfall Berm Access Road	19-MOFB-01	7.7	7.8	410	430	35	85	*3*	250	1.3	46	0.013	86	0.051	*0.005*	*0.001*	0.0086	7.6	0.029
	19-MOFB-02	7.7	7.8	200	220	64	57	*3*	140	1.2	49	0.006	35	0.043	*0.005*	*0.001*	0.0072	4.6	0.014
	19-MOFB-03	7.7	7.8	190	210	81	56	*3*	130	1.3	49	0.0074	32	0.043	*0.005*	*0.001*	0.0084	4.4	0.018
	19-MOFB-04	7.6	7.8	190	200	88	55	*3*	130	1.9	50	0.008	31	0.045	*0.005*	*0.001*	0.0081	4.3	0.014
	19-MOFB-05	7.6	7.9	180	210	100	54	*3*	130	1.8	50	0.007	30	0.038	*0.005*	*0.001*	0.0081	4.2	0.013
	19-MOFB-06	7.7	7.9	180	200	96	57	*3*	120	1.7	51	0.0056	28	0.041	*0.005*	*0.001*	0.0079	4.1	0.02
	19-MOFB-07	7.7	7.9	180	200	89	56	*3*	120	1.9	49	0.0084	27	0.041	*0.005*	*0.001*	0.0075	4	0.02
	19-MOFB-08	7.8	7.9	200	210	57	57	*3*	130	1.8	52	0.039	30	0.044	0.078	*0.001*	0.0095	4.3	0.013
	19-MOFB-09	7.8	7.7	340	340	95	63	3.4	180	2	38	0.03	71	0.027	*0.005*	*0.001*	0.0097	13	0.044
	19-MOFB-10	7.9	7.9	230	260	88	62	*3*	140	1.7	62	0.15	36	0.037	0.23	0.0051	0.016	7.6	0.03
	19-MOFB-11	8	8	170	180	90	59	*3*	130	1.7	62	0.23	11	0.046	0.95	0.021	0.029	5.2	0.096
	19-MOFB-12	8.3	7.8	100	110	100	31	17	72	1.7	29	0.26	5.9	*0.02*	2.2	0.02	0.02	6.7	0.032
	19-MOFB-13	8.1	7.7	170	150	110	30	8.2	90	2.3	26	3.5	8.6	0.020	5.4	0.11	0.011	6.6	0.037
Access Road to Madrid North CWP	19-MAD-01	7.5	7.8	120	110	120	51	*3*	77	1.4	51	0.019	3.4	*0.02*	0.12	0.0033	0.015	1.3	0.016
	19-MAD-02	7.6	7.5	76	74	60	29	*3*	69	1.6	28	0.012	5.1	0.057	0.053	0.0035	0.0091	0.92	0.054
	19-MAD-03	7.4	7.4	55	55	100	20	5.8	62	1.7	22	0.0077	3.4	0.057	0.011	*0.001*	0.0094	0.48	0.052
	19-MAD-04	7.1	7.4	54	54	99	20	*3*	60	1.7	21	0.0074	3.3	0.057	0.015	*0.001*	0.0098	0.42	0.051
	19-MAD-05	7.5	7.6	83	81	70	35	*3*	72	1.6	34	0.0084	3.9	0.057	0.091	0.0029	0.014	0.48	0.046
	19-MAD-06	7.7	7.6	69	68	78	29	*3*	65	1.6	28	0.0099	3.4	0.058	0.019	0.0011	0.0098	0.4	0.055
	19-MAD-07	7.7	7.6	71	70	99	29	*3*	64	1.6	28	0.02	3.6	0.059	0.074	0.0014	0.01	0.45	0.055
	19-MAD-08	7.4	7.9	180	150	100	60	*3*	110	1.9	59	0.094	8.8	0.067	0.42	0.032	0.016	1.7	0.054
	19-MAD-09	7	7.7	79	85	92	37	*3*	75	3.1	35	0.011	4.1	0.065	0.0084	0.0014	0.0094	0.49	0.076
	19-MAD-10	7.6	8	190	220	80	94	4.2	120	2.2	66	0.038	22	0.048	0.19	0.0094	0.019	4.9	0.016
	19-MAD-11	7.8	8.1	200	220	59	95	*3*	140	1.7	69	0.02	22	0.044	0.11	0.0072	0.013	4.7	0.018

Italicized text indicates value below the method detection limit.

Area	Sample ID	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reference (Windy Road)	19-REF-01	*0.0001*	0.00018	0.0031	*0.00002*	*0.00005*	0.01	*0.000005*	4.3	0.00072	*0.0001*	0.0013	0.13	*0.00005*	0.003	2.5	0.0013	0.0000051	0.00019
	19-REF-02	*0.0001*	0.00025	0.0032	*0.00002*	*0.00005*	0.01	*0.000005*	15	0.00049	*0.0001*	0.0014	0.064	*0.00005*	0.0022	5	0.00088	0.0000059	0.000096
	19-REF-03	*0.0001*	0.0001	0.0025	*0.00002*	*0.00005*	0.01	*0.000005*	12	0.00013	*0.0001*	0.0011	0.045	*0.00005*	*0.001*	2.9	0.0028	0.0000086	0.00005
Waste Rock Influenced Area	19-DC-01	0.0013	0.0054	0.025	*0.00004*	*0.0001*	0.5	0.000064	87	0.0044	0.051	3.8	7.7	*0.0001*	0.0058	34	0.12	0.0000067	0.014
	19-DC-02	0.0013	0.005	0.026	*0.00004*	*0.0001*	0.5	0.000097	90	0.0045	0.051	3.9	7.7	*0.0001*	0.0067	33	0.15	0.0000073	0.014
	19-DC-03	0.0012	0.0053	0.025	*0.00002*	*0.00005*	0.43	0.000065	82	0.0039	0.041	3.5	6.5	0.000068	0.0048	31	0.1	0.0000065	0.016
	19-DC-04	0.00045	0.0031	0.034	*0.00002*	*0.00005*	0.16	0.000058	160	0.00094	0.001	0.012	0.013	*0.00005*	0.0059	32	0.076	*0.000005*	0.0048
	19-DC-05	0.00046	0.003	0.038	*0.00002*	*0.00005*	0.16	0.000048	170	0.001	0.00093	0.011	0.012	*0.00005*	0.0058	32	0.068	*0.000005*	0.0049
	19-DC-06	0.00046	0.0027	0.043	*0.00002*	*0.00005*	0.26	0.000049	260	0.0011	0.0015	0.0041	0.01	*0.00005*	0.0074	56	0.11	*0.000005*	0.011
TLA	19-TLA-01	0.00011	0.00071	0.0043	*0.00002*	*0.00005*	0.041	*0.000005*	15	0.00023	0.00032	0.0072	0.063	0.000061	0.0023	8.3	0.058	*0.000005*	0.0012
CPR Access Road	19-DC-02	*0.0001*	0.00022	0.0043	*0.00002*	*0.00005*	0.022	*0.000005*	17	0.00022	0.00015	0.0088	0.056	*0.00005*	*0.001*	3.9	0.044	*0.000005*	0.00049
	19-DC-03	*0.0001*	0.00032	0.0054	*0.00002*	*0.00005*	0.05	0.00001	16	0.00019	0.00023	0.016	0.062	*0.00005*	*0.001*	5.4	0.0023	*0.000005*	0.0011
Marine Outfall Berm Access Road	19-MOFB-01	*0.0001*	0.00018	0.0048	*0.00002*	*0.00005*	0.022	*0.000005*	19	0.00018	0.00014	0.0019	0.13	*0.00005*	0.0031	9.5	0.052	*0.000005*	0.00017
	19-MOFB-02	*0.0001*	0.00016	0.003	*0.00002*	*0.00005*	0.015	*0.000005*	14	0.00011	*0.0001*	0.0012	0.062	*0.00005*	0.002	5.4	0.0088	*0.000005*	0.0002
	19-MOFB-03	*0.0001*	0.00014	0.0029	*0.00002*	*0.00005*	0.015	*0.000005*	14	0.00011	*0.0001*	0.0012	0.06	*0.00005*	0.002	5.4	0.0042	*0.000005*	0.00021
	19-MOFB-04	*0.0001*	0.00014	0.0029	*0.00002*	*0.00005*	0.015	*0.000005*	14	0.0001	*0.0001*	0.0011	0.059	*0.00005*	0.002	5.3	0.0038	*0.000005*	0.00023
	19-MOFB-05	*0.0001*	0.00016	0.0028	*0.00002*	*0.00005*	0.013	*0.000005*	13	0.00011	*0.0001*	0.0011	0.058	*0.00005*	0.0019	5.4	0.0043	*0.000005*	0.0002
	19-MOFB-06	*0.0001*	0.00015	0.0032	*0.00002*	*0.00005*	0.014	*0.000005*	14	0.00013	*0.0001*	0.0012	0.073	*0.00005*	0.002	5.2	0.0073	*0.000005*	0.00021
	19-MOFB-07	*0.0001*	0.00014	0.003	*0.00002*	*0.00005*	0.014	*0.000005*	14	0.00014	*0.0001*	0.00099	0.088	*0.00005*	0.002	5.2	0.0091	*0.000005*	0.00021
	19-MOFB-08	*0.0001*	0.00013	0.0032	*0.00002*	*0.00005*	0.017	*0.000005*	14	0.00013	0.00014	0.001	0.071	*0.00005*	0.0021	5.6	0.034	*0.000005*	0.00024
	19-MOFB-09	*0.0001*	0.0001	0.0053	*0.00002*	*0.00005*	0.016	*0.000005*	9.9	0.0001	0.00013	0.0014	0.065	*0.00005*	0.0016	9.2	0.045	*0.000005*	0.00041
	19-MOFB-10	*0.0001*	0.00015	0.0037	*0.00002*	*0.00005*	0.036	0.000012	13	0.0001	0.00014	0.0021	0.049	*0.00005*	0.0014	7.1	0.078	*0.000005*	0.0045
	19-MOFB-11	*0.0001*	0.00019	0.0033	*0.00002*	*0.00005*	0.025	0.0000064	13	0.00012	0.00011	0.004	0.033	*0.00005*	0.0012	6.2	0.019	*0.000005*	0.00066
	19-MOFB-12	*0.0001*	0.00017	0.00083	*0.00002*	*0.00005*	0.028	0.0000065	8.2	0.0001	*0.0001*	0.0035	0.023	*0.00005*	*0.001*	2.6	0.013	*0.000005*	0.00063
	19-MOFB-13	*0.0001*	0.00014	0.0018	*0.00002*	*0.00005*	0.015	*0.000005*	7.6	0.0001	*0.0001*	0.0035	0.022	*0.00005*	*0.001*	2.6	0.015	*0.000005*	0.0004
Access Road to Madrid North CWP	19-MAD-01	*0.0001*	0.00016	0.0054	*0.00002*	*0.00005*	0.01	*0.000005*	17	0.00013	*0.0001*	0.0011	0.017	*0.00005*	*0.001*	2.3	0.0017	*0.000005*	0.000063
	19-MAD-02	*0.0001*	0.00016	0.0029	*0.00002*	*0.00005*	0.01	*0.000005*	7.7	0.00048	*0.0001*	0.0017	0.071	*0.00005*	0.0022	2.4	0.0047	*0.000005*	0.00021
	19-MAD-03	*0.0001*	0.00015	0.0027	*0.00002*	*0.00005*	0.01	*0.000005*	4.8	0.00037	*0.0001*	0.0015	0.086	*0.00005*	0.0022	2	0.0053	*0.000005*	0.00019
	19-MAD-04	*0.0001*	0.00013	0.0027	*0.00002*	*0.00005*	0.01	*0.000005*	4.9	0.00036	*0.0001*	0.0015	0.088	*0.00005*	0.0021	1.9	0.0055	*0.000005*	0.00021
	19-MAD-05	*0.0001*	0.00022	0.003	*0.00002*	*0.00005*	0.01	*0.000005*	9.5	0.0004	*0.0001*	0.0018	0.078	*0.00005*	0.0022	2.6	0.004	*0.000005*	0.00028
	19-MAD-06	*0.0001*	0.00021	0.0028	*0.00002*	*0.00005*	0.01	*0.000005*	7.6	0.00039	*0.0001*	0.0019	0.095	*0.00005*	0.0022	2.4	0.0062	*0.000005*	0.00023
	19-MAD-07	*0.0001*	0.00018	0.0028	*0.00002*	*0.00005*	0.01	*0.000005*	7.9	0.00043	*0.0001*	0.0019	0.097	*0.00005*	0.0022	2.4	0.0062	0.0000051	0.00025
	19-MAD-08	*0.0001*	0.00025	0.0047	*0.00002*	*0.00005*	0.011	0.0000087	17	0.0005	0.00029	0.0025	0.097	*0.00005*	0.0022	4.6	0.065	*0.000005*	0.00044
	19-MAD-09	*0.0001*	0.00023	0.0042	*0.00002*	*0.00005*	0.01	*0.000005*	9.5	0.00054	0.00012	0.0021	0.12	*0.00005*	0.0021	3.2	0.0086	*0.000005*	0.00029
	19-MAD-10	*0.0001*	0.00046	0.0075	*0.00002*	*0.00005*	0.018	*0.000005*	29	0.00031	0.00012	0.0025	0.035	*0.00005*	0.0038	5.2	0.0087	*0.000005*	0.00038
	19-MAD-11	*0.0001*	0.00044	0.0081	*0.00002*	*0.00005*	0.019	*0.000005*	29	0.00028	*0.0001*	0.0025	0.034	*0.00005*	0.0037	5.5	0.0087	*0.000005*	0.00037

Italicized text indicates value below the method detection lim

Area	Sample ID	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reference (Windy Road)	19-REF-01	0.002	*0.05*	0.56	0.00005	1.7	*0.00001*	3.4	0.01	*0.5*	*0.00001*	*0.0001*	0.00059	0.000021	*0.0005*	0.0042	0.00049
	19-REF-02	0.002	*0.05*	0.61	0.00005	3.5	*0.00001*	9.5	0.063	0.96	*0.00001*	*0.0001*	0.00057	0.000014	*0.0005*	0.0017	*0.0003*
	19-REF-03	*0.0005*	*0.05*	0.35	0.000054	1.8	*0.00001*	9.9	0.023	1.8	*0.00001*	*0.0001*	*0.0003*	*0.00001*	*0.0005*	*0.001*	*0.0003*
Waste Rock Influenced Area	19-DC-01	0.082	0.18	30	0.0049	2.6	0.032	350	0.35	140	*0.00002*	*0.0002*	*0.0006*	0.0014	0.0022	*0.002*	*0.0004*
	19-DC-02	0.085	0.16	30	0.0048	2.6	0.033	340	0.35	140	*0.00002*	*0.0002*	*0.0006*	0.0015	0.0021	*0.002*	*0.0004*
	19-DC-03	0.073	0.16	26	0.0045	2.5	0.033	290	0.32	120	0.000017	*0.0001*	*0.0003*	0.0014	0.0021	*0.001*	*0.0003*
	19-DC-04	0.0018	*0.05*	17	0.0011	2	*0.00001*	170	0.44	34	0.000034	*0.0001*	*0.0003*	0.00086	0.00074	0.0018	*0.0003*
	19-DC-05	0.0016	*0.05*	16	0.0013	1.9	*0.00001*	160	0.44	33	0.000037	*0.0001*	*0.0003*	0.00087	0.00072	*0.001*	*0.0003*
	19-DC-06	0.004	*0.05*	16	0.0021	2.4	*0.00001*	190	0.63	70	0.000042	*0.0001*	*0.0003*	0.0021	0.00079	*0.001*	*0.0003*
TLA	19-TLA-01	0.0011	*0.05*	3	0.00017	1.6	*0.00001*	26	0.035	9	0.00001	0.0001	0.00088	*0.00005*	*0.0005*	*0.001*	*0.0003*
CPR Access Road	19-DC-02	0.00081	*0.05*	1.6	0.00008	1.8	*0.00001*	13	0.036	3.2	*0.00001*	*0.0001*	0.00062	0.000036	*0.0005*	*0.001*	*0.0003*
	19-DC-03	0.0013	*0.05*	3.4	0.00036	1.9	0.000017	41	0.041	6.6	*0.00001*	*0.0001*	0.00081	0.000027	*0.0005*	0.0014	*0.0003*
Marine Outfall Berm Access Road	19-MOFB-01	0.0011	*0.05*	2.2	0.00005	2.1	*0.00001*	48	0.047	2.8	*0.00001*	*0.0001*	*0.0003*	0.000033	*0.0005*	*0.001*	*0.0003*
	19-MOFB-02	0.00075	*0.05*	1.4	0.00005	1.5	*0.00001*	21	0.03	1.7	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-03	0.00073	*0.05*	1.3	0.00005	1.5	*0.00001*	20	0.029	1.5	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-04	0.00074	*0.05*	1.3	0.00005	1.5	*0.00001*	19	0.03	1.5	*0.00001*	*0.0001*	*0.0003*	0.000016	*0.0005*	*0.001*	*0.0003*
	19-MOFB-05	0.00064	*0.05*	1.3	0.00005	1.5	*0.00001*	19	0.03	1.4	*0.00001*	*0.0001*	*0.0003*	0.000015	*0.0005*	*0.001*	*0.0003*
	19-MOFB-06	0.0007	*0.05*	1.3	0.00005	1.6	*0.00001*	18	0.029	1.5	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-07	0.00066	*0.05*	1.3	0.00005	1.5	*0.00001*	18	0.029	1.3	*0.00001*	*0.0001*	*0.0003*	0.00002	*0.0005*	*0.001*	*0.0003*
	19-MOFB-08	0.00075	*0.05*	1.4	0.00005	1.6	*0.00001*	20	0.032	1.5	*0.00001*	*0.0001*	*0.0003*	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-09	*0.0005*	*0.05*	1.4	0.00005	0.93	*0.00001*	45	0.041	4.3	*0.00001*	*0.0001*	*0.0003*	0.000023	*0.0005*	*0.001*	*0.0003*
	19-MOFB-10	*0.0005*	*0.05*	1.7	0.00005	1.1	*0.00001*	29	0.031	2.5	*0.00001*	*0.0001*	0.0004	0.00008	*0.0005*	*0.001*	*0.0003*
	19-MOFB-11	0.00057	*0.05*	1.8	0.000084	1.5	*0.00001*	15	0.022	1.7	*0.00001*	*0.0001*	0.00088	0.000063	*0.0005*	*0.001*	*0.0003*
	19-MOFB-12	*0.0005*	*0.05*	0.83	0.0001	0.35	*0.00001*	9.1	0.012	2.2	*0.00001*	*0.0001*	0.00039	0.000017	*0.0005*	*0.001*	*0.0003*
	19-MOFB-13	*0.0005*	*0.05*	1.5	0.00011	0.38	*0.00001*	10	0.015	2.1	*0.00001*	*0.0001*	0.00043	0.000024	*0.0005*	*0.001*	*0.0003*
Access Road to Madrid North CWP	19-MAD-01	0.00072	*0.05*	0.76	0.00005	1	*0.00001*	3.3	0.015	*0.5*	*0.00001*	*0.0001*	*0.0003*	*0.00001*	*0.0005*	0.0018	*0.0003*
	19-MAD-02	0.0021	*0.05*	1.1	0.00005	1.6	*0.00001*	4.2	0.012	*0.5*	*0.00001*	*0.0001*	0.00056	0.000021	*0.0005*	0.0036	0.0004
	19-MAD-03	0.0021	*0.05*	1	0.00005	1.4	*0.00001*	2.7	0.0092	*0.5*	*0.00001*	*0.0001*	0.00049	0.000019	*0.0005*	0.0044	0.00037
	19-MAD-04	0.002	*0.05*	1.1	0.00005	1.4	*0.00001*	2.7	0.0088	*0.5*	*0.00001*	*0.0001*	0.00043	0.000019	*0.0005*	0.0044	0.00036
	19-MAD-05	0.0022	*0.05*	1.2	0.00005	1.5	*0.00001*	3.1	0.012	*0.5*	*0.00001*	*0.0001*	0.00043	0.000019	*0.0005*	0.0039	0.00039
	19-MAD-06	0.0022	*0.05*	1.1	0.00005	1.5	*0.00001*	2.7	0.01	*0.5*	*0.00001*	*0.0001*	0.00059	0.000021	*0.0005*	0.0034	0.00045
	19-MAD-07	0.0023	*0.05*	1.1	0.00005	1.5	*0.00001*	2.9	0.011	*0.5*	*0.00001*	*0.0001*	*0.0006*	0.000021	*0.0005*	0.0034	0.00038
	19-MAD-08	0.0027	*0.05*	1.8	0.00005	1.8	*0.00001*	7.1	0.023	*0.5*	*0.00001*	*0.0001*	0.00051	0.00002	*0.0005*	0.022	0.00044
	19-MAD-09	0.0024	*0.05*	1.1	0.00005	1.8	*0.00001*	3.4	0.016	*0.5*	*0.00001*	*0.0001*	0.0009	0.000023	*0.0005*	0.0032	0.00048
	19-MAD-10	0.0017	*0.05*	1.4	0.00005	2.7	*0.00001*	7.1	0.11	1.6	*0.00001*	*0.0001*	0.00033	0.00003	*0.0005*	0.0025	*0.0003*
	19-MAD-11	0.0016	*0.05*	1.4	0.00005	2.8	*0.00001*	7.1	0.11	1.6	*0.00001*	*0.0001*	0.00038	0.000035	*0.0005*	0.0049	*0.0003*

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Appendix E – 2019 Geochemical Monitoring of Flotation and Detoxified Tailings, Doris Mill

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Jessica Evans; Lisa Barazzuol, SRK	**Project No:**	1CT022.037
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 23, 2020
Subject:	2019 Geochemical Monitoring of Flotation and Detoxified Tailings, Doris Mill		

1 Introduction

TMAC initiated ore processing at the Doris mill and deposition of flotation tailings in the Doris tailings impoundment area (TIA) in January 2017. In October 2019, TMAC started processing ore from Madrid North (Naartok East Crown Pillar Recovery) at the Doris mill. Ore from the Naartok East Crown Pillar Recovery is blended with Doris ore for processing at a ratio of a maximum 25% Naartok East ore to 75% Doris ore. Placement of detoxified tailings as backfill in stopes of the Doris Mine and geochemical monitoring of tailings commenced in February 2017. In 2019, a total of 573,868 t (dry weight equivalent) of flotation tailings were deposited in the Doris TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine.

The geochemical monitoring program for flotation tailings slurry and detoxified tailings are specified in Schedule I, Tables 1 to 3 of NWB Type “A” Water Licence 2AM-DOH1335 Amendment No. 2 (the “Water Licence”, Nunavut Water Board 2018) and includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids[1] (TL-7A), detoxified tailings supernatant (TL7-B) and seepage from underground backfilled stopes (TL-11). Station TL7-B was added to Water Licence and monitoring commenced in 2019. This memo documents the results of the 2019 geochemical monitoring of flotation and detoxified tailings at TL-5, TL-6, TL-7A, TL-7B and TL-11 and fulfills the reporting requirements outlined in Schedule B, Items 2a i, ii, iii and iv of Water Licence 2AM-DOH1335.

2 Background

In the processing plant, there are two sections: the concentrate lines (CL1 and CL2) and the Concentrate Treatment Plant (CTP). Cyanide is a reagent used exclusively in the CTP to dissolve gold from the solid concentrate to be captured by resin. The concentrate lines (CL) react poorly to the presence of cyanide and so this side must be kept free of cyanide in order for the process to perform well. The final stage of the CTP is cyanide destruction. Cyanide is destroyed using the

[1] Detoxified tailings are referred to as cyanide leach residue in the Water Licence and prior to 2019 was monitored as station TL-7.

INCO SO_2 process. The detoxified slurry is filtered with the solids (TL-7A) placed in a stockpile for co-disposal with backfill underground for permanent storage (TL-11 seepage survey). The solution (TL-7B) is pumped to the tailings thickener where it is combined with the flotation tailings slurry. Samples of TL-5 and TL-6 represent the tailings slurry supernatant and solids, respectively, that is discharged to the TIA. The detoxification circuit is run to produce a total cyanide level of less than one part per million (1 ppm). The solution from the detoxification circuit and final detoxified tailings are routinely analyzed for weak acid dissociable (WAD) and total cyanide species by mill personnel to monitor the performance of the cyanide detoxification circuit. Concentrations of free, WAD and total cyanide in the process plant tailings water discharge (TL-5) are reported monthly to the Nunavut Water Board and cyanate and thiocyanate are reported quarterly. Concentrations of cyanate, thiocyanate and WAD cyanide in the detoxified tailings filtrate (TL-7B) are analyzed monthly.

3 Methods

3.1 Sample Collection and Analysis

3.1.1 Tailings and Process Water

Process Plant Flotation Tailings Slurry Discharge: Solids (TL-6) and Supernatant (TL-5)

Schedule I (Table 3) of the Water Licence specifies weekly sampling of flotation tailings (TL-6) and monthly sampling of the process plant tailings supernatant (TL-5). Samples of the flotation tailings solids (TL-6) and the supernatant solution (TL-5) were collected from the flotation tailings thickener tank. The filtrate from the detox filter press (where detoxified tailings are dewatered) is pumped to the flotation tailings thickener tank prior to discharge to the TIA.

TMAC collects flotation tailings slurry from the tailings thickener tank in a clean 5-gallon bucket. The sample is left in the bucket to allow gravitational settling and separation of the tailings solids from the liquid. After settling, samples of supernatant solution (TL-5) and flotation tailings solids (TL-6) are collected at the frequency outlined above.

The tailings supernatant solution (TL-5) was sampled using a sterile 60 mL syringe and submitted to ALS Laboratory in Burnaby, BC once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, dissolved and total metals. In total, the 2019 monitoring program included geochemical characterization of 12 monthly samples of tailings process supernatant collected from January to December with a duplicate sample collected in March.

After sampling is completed for the tailings supernatant solution (TL-5), the remaining supernatant is discarded and a clean stainless-steel spoon is used to transfer the solid tailings into a clean plastic Ziploc bag supplied by the laboratory. The bag is then sealed and placed in a fridge until the last weekly sample for the month has been collected. At the end of each month, TMAC combines and homogenizes equal amounts of tailings from each weekly sample to create an approximately 500 g monthly composite sample of flotation tailings solids (TL-6).

In total, the 2019 monitoring program included geochemical characterization of 12 monthly composites of flotation tailings collected from January to December with a duplicate sample

collected in May. Monthly flotation tailings solids (TL-6) composite samples were submitted in glass jars to Bureau Veritas Laboratory in Burnaby, BC for analysis of:

- Total sulphur – by Leco combustion;
- Sulphate sulphur – by hydrochloric acid leach;
- TIC – carbonate carbon by CO_2 hydrochloric acid leach; and
- Trace element content – by aqua regia digest (nitric and hydrochloric acid) with ICPMS finish.

Detoxified Tailings Solids (TL-7A) and Filtrate (TL-7B)

As a requirement of Water License 2AM-DOH1335 samples of the detoxified tailings produced in the process plant must be submitted for laboratory analysis. Schedule I of the Water Licence identifies the detoxified tailings solids component (TL-7A) and the filtrate liquid component (TL-7B) as compliance monitoring stations.

Schedule I (Table 3) of the Water Licence specifies monthly sampling and analysis of detoxified tailings solids (TL-7A) for TIC, total metals (including sulphur) and moisture content, and for the filtrate (TL-7B) monthly analysis of total metals, WAD cyanide, cyanate and thiocyanate.

In total, the 2019 monitoring program included geochemical characterization of 12 samples of detoxified tailings solids (TL-7A) collected from January to December. One duplicate sample was collected in May. 12 samples of filtrate (TL-7B) from the detoxified tailings were collected from January to December. One duplicate sample was collected in May.

At the end of a detoxification cycle, TMAC collects one discrete sample of detoxified tailings solids (TL-7A) from the discharge compartment of the detoxification circuit filter press. A clean stainless-steel spoon is used to transfer the solid detoxified tailings solids into 125 mL glass sample jars supplied by the laboratory. Samples of the filtrate liquid component are collected from the receiving tank of the detoxification filter press using a 10 foot sampling pole with an open top 1 L poly bottle and then poured into four 500 mL settling bottles to allow gravitational settling and separation of residual tailings solids from the liquid. After settling, the filtrate (TL-7B) is transferred into laboratory supplied sample bottles either using a clean syringe or decanting the supernatant into the sample bottles.

The solids samples are submitted to Bureau Veritas Laboratory for total sulphur by total Leco, sulphate sulphur, TIC and multi-element trace element content by aqua regia digestion followed by ICP finish. ABA methods at Bureau Veritas Laboratory are the same as described for flotation tailings (TL-6). Laboratory data are provided in Attachment B.

The filtrate samples (TL-7B) are submitted to ALS Laboratory for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, and total metals. Laboratory data are provided in Attachment B.

3.1.2 Seepage Survey of Underground Backfilled Stopes (TL-11)

Schedule I (Table 3) of the Water Licence specifies bi-annual seepage surveys of underground backfilled stopes with opportunistic sampling of seepage for the analysis of pH, electrical

conductivity (EC), trace metals by ICP-MS, alkalinity, acidity, sulphate, total and WAD cyanide, total ammonia, nitrate and nitrite.

TMAC completed underground seepage inspections of backfilled stopes in May and December 2019. Visual surveys were conducted of all backfilled stopes that could be accessed safely at the time of the survey, i.e. not all backfill could be inspected. Fifteen locations were surveyed in May and sixteen locations were surveyed in December. Inspection of the backfill materials in the stopes showed that detoxified tailings were only visible on Level 4946 and Level 5002 (TL-11B-27MAY19 and TL-11D-27MAY19); detoxified tailings were not visible in the backfill on the other levels where samples were collected.

No flowing seeps were identified in the May survey; however, TMAC collected samples from pools of water (all stagnant unless otherwise noted) at the base of stopes in the following locations:

- Base of the backfill in the East limb on Level 4932, location E433902, N7559742 (TL-11A-27MAY19). There were no obvious signs of seepage flow from the stope at this location.
- Base of the East limb of the South stope on Level 4946, location E433837, N7559620 (TL-11B-27MAY19). There were no signs of flow from the backfill tailings at this location.
- Base of the West limb on the South stope on Level 4964, location E433786, N7559507 (TL-11C-27MAY19).
- Base of the West limb, North stope on Level 5002, location E433744, N7559239 (TL-11D-27MAY19). This pool was near the Doris Central surface vent raise and there were detoxified tailings visible in the backfill at this location.
- Base of a stope in the East limb on Level 4735, location E433903, N7559726 (TL-11E-27MAY19). At the time of sampling from the pool there was water flowing down into the area from the access ramp.
- Pooled water at base of a stope in the East limb on Level 4905, location E433792, N7559314 (TL-11F-27MAY19). There were no signs of flow from the stope at this location. The area had recently been used as a drill bay.

In December, TMAC collected two seepage samples during the underground survey. One sample from the seep flowing from the bottom of the West limb, North stope at Level 120, location E433718, N7558636 (TL-11A-15DEC19). A field blank and duplicate sample were also collected at this location in the December survey. Another sample was also collected from the seep flowing from the toe of the backfill in the West limb, South stope of Level 134, location E433725, N7558381 (TL-11B-15DEC19).

Seepage samples were collected using a syringe and field measurements of pH, EC, ORP and temperature recorded. Seepage flow rates ranged from 0.022 to 0.044 L/s for TL-11A and TL-11B respectively. TMAC submitted samples to ALS in Burnaby, BC for analysis of pH, EC, TSS, TDS, alkalinity, chloride, sulphate, total and WAD cyanide, and dissolved and total metals. The sample for dissolved metals was filtered and preserved at the time of sampling. Laboratory data are provided in Attachment C.

3.2 Data Interpretation

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when ratios are less than 1 and as having an uncertain potential for ARD when ratios are between 1 and 3 (DIAND 1993).

4 Results and Discussion

4.1 Data QA/QC

4.1.1 Tailings Solids Samples (TL-6 and TL-7A)

All solids data for the flotation (TL-6) and detoxified (TL-7A) tailings were reviewed by SRK for QA/QC. Table 4-1 presents the results of the QA/QC checks including comparison of duplicate sample pairs for the flotation (TL-6) and detoxified (TL-7A) (TL6-6MAY19DUP and TL7-5MAY19DUP). Relative percentage differences (RPD) were calculated to assess reproducibility of results. SRK considers all data acceptable.

4.1.2 Detoxified Tailings Filtrate (TL-7B)

All filtrate water quality data from the detoxified tailings (TL-7B) were reviewed by SRK for QA/QC. Table 4-2 presents the results of the QA/QC checks including a comparison of the duplicate sample collected in May (TL-7B_DUP). SRK considers all data acceptable.

4.1.3 Process Plant Tailings Supernatant (TL-5)

All supernatant water quality data from the flotation tailings (TL-5) were reviewed by SRK for QA/QC. Table 4-2 presents the results of the QA/QC checks including a comparison of the duplicate sample collected in March.

One selenium result reported dissolved concentrations that exceeded the total concentrations by greater than +/-20%. This may be attributed to the introduction of metallic contaminant to the dissolved sample during field filtration. SRK considers all data acceptable.

4.1.4 Seepage Survey Samples (TL-11)

All seepage water quality data from the underground stopes (TL-11) were reviewed by SRK for QA/QC. Table 4-2 presents the results of the QA/QC checks including a comparison of the duplicate samples and analysis of the field blank samples collected in May and December (TL11-C-DUP, TL11-A-DUP and TL11_FB).

RPD values for the field duplicates exceed the QA/QC criterion for the following total metals: aluminium, arsenic, chromium, copper, iron, lead, titanium, vanadium and zinc. This may be attributed to disturbed sediments during sampling. All the dissolved metals for the duplicate samples passed the RPD check. All other data passed the QA/QC tests. SRK considers all data acceptable.

Table 4-1: QA/QC Summary for Solid Analysis of Flotation (TL-6) and Detoxified (TL-7A) Tailings

QC Test	SRK QC Criteria	TL-6 Results	TL-7A Results
Rinse pH			
Lab Duplicate	For any samples, +/- 0.5 difference pH unit	N/A	N/A
Field Duplicate	For any samples, +/- 0.5 difference pH unit	N/A	N/A
Standard/Controls	Within tolerance ranges	N/A	N/A
TIC			
Lab Method Blank	<5X detection limit (DL)	(n=13) All passed.	(n=11) All passed.
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=4) All passed.	(n=19) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	N/A	(n=1) All passed.
Standard reference materials	Within +/-20% difference	(n=21) All passed.	(n=21) All passed.
Total S & Sulphate			
Lab Method Blank	<5X detection limit (DL)	(n=12 for Total S, and n=10 for SO_4) All passed.	(n=9 for Total S, n=10 for SO_4) All passed.
Sulphur balance (total S > sulphate S)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not then (sulphate-total S)/Total S> 20%	(n=11) All passed.	(n= 11) All passed.
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-20%	(n=0 for Total S, and n=10 for SO_4) All passed.	(n=8 for Total SO_4, n=4 for Total S) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within +/-30%	(n=1 for Total SO_4 and n=1 for Total S) All passed.	(n=1 for Total SO_4, n=1 for Total S) All passed.
Standard reference materials	Within +/-20% Difference	(n=24 for Total S and n=21 for Total SO_4) All passed.	(n=22 for Total S, n=20 for SO_4) All passed.
Total S-Leco and S-ICP			
Comparison between Total S-Leco and S-ICP	For samples >10X detection limit (DL), % RPD within +/-20%	(n= 13) All passed.	(n=10) The S-ICP is higher than the maximum detection limit (samples May to Nov 2019). Sulphur quantified by Leco S method.
Trace Element Content			
Lab Method Blank	<5X Detection Limit	(n=13) All passed.	(n=11) All passed.
Lab Duplicate	For samples >10X detection limit (DL), % RPD within +/- 20%, ok 10% of metal scan failing.	(n=2) All passed.	(n=2) All passed.
Field Duplicate	For samples >10X detection limit (DL), % RPD within +/- 30%, ok 10% of metal scan failing.	(n=1) All passed.	(n=1) All passed.
Standard reference materials	Within specified tolerance ranges.	(n=24) All passed.	(n=23) All passed.

Table 4-2: QA/QC Summary for Process Plant Tailings Supernatant from Flotation Tailings (TL-5) and Backfilled Stope Seepage Samples (TL-11)

QC Test	SRK QC Criteria	TL-5 Results	TL-7B	TL-11 Results
Physical Test[1]				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for EC, (n=2) for Hardness, (n=2) for pH, (n=2) for TSS and (n=2) for TDS (All passed.)
Method Blank	<2X DL	(n=12) for TSS and (n=9) for EC (All passed.)	(n=0)	(n=4) for TSS and (n=4) for EC and (n=2) for TDS (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Hardness, (n=1) for pH and (n=1) for TSS (All passed.)	(n=1) for pH. (All passed.)	(n=2) for EC, (n=2) for Hardness, (n=2) for pH, (n=2) for TSS and (n=2) for TDS (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=1) for TSS (All passed.)	(n=0)	(n=1) for EC, (n=1) for TDS and (n=1) for pH (All passed.)
Field pH vs. Lab pH	Difference should not be greater than 1 pH unit	(n=11) (All passed.)	(n=0)	(n=8) (All passed.)
Field EC vs Lab EC	For samples > 10X the detection limit (DL), % RPD should be within +/-30%	(n=9) (All passed.)	(n=0)	(n=10) (TL11-A, TL11-B, TL11-C, TL11-E and TL11-F have OR field EC value)
Standard Reference Materials	Within specified tolerance ranges.	(n=9) for EC and (n=10) for pH and (n=11) for TSS (All passed.)	(n=12) for pH. (All passed.)	(n=4) for EC, (n=4) for TSS, (n=2) for TDS and (n=4) for pH (All passed.)
Anions and Nutrients[2]				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for Alkalinity, Total, (n=2) for Ammonia, Total, (n=2) for Cl, (n=2) for Nitrate (as N), (n=2) for Nitrite (as N), (n=2) for Sulphate (SO_4), (n=2) for Acidity (as $CaCO_3$) (All passed.)
Method Blank	<2X DL	(n=9) for Total Alkalinity, (n=12) for Ammonia, Total, (n=10) for Cl, (n=12) for Nitrate (as N), (n=12) for Nitrite (as N), (n=12) for Sulphate (SO_4) (All passed.)	(n=12) for Total Ammonia (as N). (All passed.)	(n=4) for Alkalinity, Total, (n=4) for Ammonia, Total, (n=3) for Cl, (n=3) for Nitrate (as N), (n=3) for Nitrite (as N), (n=3) for Sulphate (SO_4), (n=7) for Acidity (as $CaCO_3$) (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Ammonia, Total, (n=1) for Nitrate (as N), (n=1) for Nitrite (as N), (n=1) for Sulphate (SO_4) (All passed.)	(n=1) for Total Ammonia (as N). (All passed.)	(n=2) for Alkalinity, Total, (n=2) for Ammonia, Total, (n=2) for Cl, (n=2) for Nitrate (as N), (n=2) for Nitrite (as N), (n=2) for Sulphate (SO_4), (n=2) for Acidity (as $CaCO_3$) (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=0)	(n=0)	(n=2) for Alkalinity, Total (as $CaCO_3$) (All passed.)
Ion Balance	EC>100 uS/cm, % difference should be within +/-10%	(n=9) (All passed.)	Not possible to calculate with available data (no major ions).	(n=8) (All passed.)
Standard Reference Materials	Within specified tolerance ranges.	(n=9) for Total Alkalinity, (n=11) for Ammonia, Total, (n=9) for Cl, (n=11) for Nitrate (as N), (n=11) for Nitrite (as N), (n=11) for Sulphate (SO_4) (All passed.)	(n=12) for Total Ammonia (as N). (All passed.)	(n=3) for Ammonia, Total, (n=2) for Cl, (n=2) for Nitrate (as N), (n=2) for Nitrite (as N), (n=2) for Sulphate (SO_4), (n=2) for Acidity (as $CaCO_3$) and (n=2) for Alkalinity, Total (All passed.)
Cyanides and Cyanide Degradation Products[3]				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for WAD CN, (n=2) for Total CN, and (n=2) for Cyanide, Free (All passed.)
Method Blank	<2X DL	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free (All passed.)	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free. (All passed.)	(n=3) for WAD CN, (n=3) for Total CN, and (n=5) for Cyanide, Free (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for WAD CN, (n=1) for Total CN, (n=1) for Cyanate, (n=1) for Thiocyanate (SCN) and (n=1) for Cyanide, Free (All passed.)	(n=1) for Cyanate, (n=1) for Thiocyanate, (n=1) for Cyanide, Total, (n=1) for Cyanide, Free and (n=1) for Cyanide, Weak Acid Diss. (All passed.)	(n=2) for WAD CN, (n=2) for Total CN, and (n=2) for Cyanide, Free (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=3) for Thiocyanate (SCN) (All passed.)	(n=5) for Cyanate and (n=2) for Thiocyanate. (All passed.)	(n=0)
Standard Reference Materials	Within specified tolerance ranges.	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free (All passed.)	(n=12) for WAD CN, (n=12) for Total CN, (n=12) for Cyanate, (n=12) for Thiocyanate (SCN) and (n=12) for Cyanide, Free. (All passed.)	(n=3) for WAD CN, (n=3) for Total CN, and (n=4) for Cyanide, Free (All passed.)
Trace Metals by ICP-MS				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for Total and (n=2) for Dissolved (All passed.)
Method Blank	<2X DL	(n=8) for Dissolved and (n=10) for Total (All passed.)	(n=12) for Total. (All passed.)	(n=4) for Dissolved and (n=4) for Total (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Total (All passed.)	(n=2) for Total. (All passed.)	(n=2) for Total and (n=2) for Dissolved (TL11-C Dup failed for Total Al, As, Cr, Cu, Fe, Pb, Ti, V and Zn - >30% RPD and >10x DL. The parent sample, TL-11, are <10x DL (L2280421))
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=0)	(n=1) for Total. (All passed.)	(n=1) for Total (All passed.)
Total vs Dissolved Metals	Total Metals>Dissolved metals. Total Metals should be greater than Dissolved Metals, if not the % difference should be within +/-20%. ALS would use 10X DL, Maxxam would use 5X DL	(n=9) (Se failed the criteria - both Total and Dissolved Se are >10x DL (L2361827)	(n=0)	(n=8) (All passed.)
Standard Reference Materials	Within specified tolerance ranges.	(n=7) for Dissolved and (n=9) for Total (All passed.)	(n=12) for Total. (All passed.)	(n=4) for Dissolved and (n=4) for Total (All passed.)
Hg-CVAAS				
Field Blank	Minimum criteria is <2X DL, will accept <5X DL	(n=0)	(n=0)	(n=2) for Total and (n=2) for Dissolved (All passed.)
Method Blank	<2X DL	(n=12) for Total and (n=8) for Dissolved (All passed.)	(n=0)	(n=5) for Total and (n=3) for Dissolved (All passed.)
Field Duplicate	For samples >10X DL should be within +/-30% RPD	(n=1) for Total (All passed.)	(n=0)	(n=2) for Total and (n=2) for Dissolved (All passed.)
Lab Duplicate	For samples >10X DL should be within +/-20% RPD	(n=4) for Dissolved (All passed.)	(n=0)	(n=1) for Dissolved (All passed.)
Standard Reference Materials	Within specified tolerance ranges.	(n=12) for Total and (n=8) for Dissolved (All passed.)	(n=0)	(n=4) for Total and (n=3) for Dissolved (All passed.)

Notes:

1) Conductivity, pH, Hardness (as $CaCO_3$), Total Suspended Solids

2) Total Alkalinity, Total Ammonia, Unionized Ammonia, Cl, NO_3, NO_2, Total N, SO_4

3) WAD CN, Total CN, Cyanate, SCN, Free CN

4.2 Tailings Solids (TL-6 and TL-7A)

4.2.1 Acid Base Accounting

A summary of ABA results for the flotation tailings (TL-6) and detoxified tailings (TL-7A) solids are presented in Table 4-3 and Table 4-4, respectively. Full results are presented in Attachment A and Attachment B.

Historically, tailings samples were analyzed at a different lab (ALS) using different analytical test work methods that resulted in results that were in some cases lower, e.g. TIC or higher, e.g. sulphate. Accordingly, parameters in Table 4-3 and Table 4-4 are presented according to laboratory to account for differences in analytical differences when data sets are not equivalent methods (SRK 2019). The methods used by BV are equivalent to the geochemical test work conducted on metallurgical tailings (SRK 2015).

Table 4-3: Summary of ABA Results for Flotation Tailings (TL-6)

Year	Sampling Date	Total Sulphur	Sulphate		TIC		AP	TIC/AP	
			ALS	BV	ALS	BV		ALS	BV
		%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	Ratio
2019	Jan-19	0.09	--	0.01	--	160	2.2	--	72
	Feb-19	0.21	--	0.01	--	110	6.3	--	18
	Mar-19	0.17	--	0.02	--	130	4.4	--	29
	Apr-19	0.35	--	0.04	--	160	10	--	16
	May-19	0.23	--	0.02	--	110	6.6	--	17
	Jun-19	0.33	--	0.01	--	160	11	--	14
	Jul-19	0.2	--	0.02	--	170	8	--	22
	Aug-19	0.3	--	0.02	--	97	9.4	--	10
	Sep-19	0.19	--	0.02	--	110	5.9	--	18
	Oct-19	0.24	--	0.02	--	130	7.5	--	17
	Nov-19	0.53	--	0.02	--	200	17	--	12
	Dec-19	0.38	--	0.03	--	220.00	12	--	19
Statistical Summary									
2019	P005	0.13	--	0.01	--	100	3.4	--	11
	P050	0.24	--	0.02	--	140	7.7	--	17
	P095	0.45	--	0.04	--	210	14	--	48
	P100	0.5	--	0.04	--	220	17	--	72
	n	12	--	12	--	12	12	--	12
2018	P005	0.05	0.031	0.01	57	77	1.6	36	8.1
	P050	0.1	0.039	0.02	58	97	3.1	37	28
	P095	0.71	0.064	0.048	66	140	22	37	41
	P100	1.4	0.067	0.06	67	140	43	37	42
	n	12	3	9	3	9	12	3	9
2017 (n = 11)	P005	0.05	0.036	--	43	--	1.6	1.7	--
	P050	0.07	0.049	--	63	--	2.2	25	--
	P095	0.86	0.065	--	92	--	27	48	--
	P100	1.0	0.066	--	110	--	33	48	--

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Notes:

AP calculation is based upon total sulphur

Results from ALS and Bureau Veritas presented separately when methods were not comparable.

"-" denotes sample not analyzed.

Table 4-4: Summary of ABA Results for Detoxified Tailings (TL-7A)

Year	Sampling Date	Total Sulphur	Sulphate		TIC		AP	TIC/AP	
			ALS	BV	ALS	BV		ALS	BV
		%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	Ratio
2019	Jan-19	12	--	0.16	--	160	360	--	0.44
	Feb-19	9.6	--	0.18	--	170	300	--	0.57
	Mar-19	15	--	0.20	--	140	480	--	0.29
	Apr-19	14	--	0.26	--	130	450	--	0.28
	May-19	12	--	0.13	--	120	360	--	0.34
	Jun-19	13	--	0.29	--	140	410	--	0.35
	Jul-19	22	--	0.28	--	98	680	--	0.14
	Aug-19	21	--	0.27	--	64	660	--	0.10
	Sep-19	22	--	0.16	--	110	690	--	0.16
	Oct-19	25	--	0.22	--	120	770	--	0.15
	Nov-19	22	--	0.10	--	140	680	--	0.20
	Dec-19	21	--	0.25	--	130	670	--	0.20
Statistical Summary									
2019	P005	11	--	0.12	--	83	330	--	0.12
	P050	17	--	0.21	--	130	540	--	0.27
	P095	23	--	0.28	--	160	730	--	0.50
	P100	25	--	0.29	--	170	770	--	0.57
	n	12	--	12	--	12	12	--	12
2018	P005	4.6	0.12	0.09	60	76	140	0.22	0.12
	P050	13	0.2	0.2	67	110	420	0.37	0.24
	P095	23	0.3	0.26	82	140	700	0.6	0.34
	P100	23	0.3	0.27	84	140	720	0.64	0.37
	n	13	4	9	4	9	13	4	9
2017 (n = 11)	P005	2.9	0.16	--	51	--	92	0.1	--
	P050	7.9	0.28	--	75	--	250	0.3	--
	P095	17	0.39	--	81	--	530	0.8	--
	P100	19	0.43	--	82	--	610	1.0	--

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.037_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2019_rev12.xlsx

Notes:

AP calculation is based upon total Sulphur

Results from ALS and Bureau Veritas presented separately when methods were not comparable.

"-" denotes sample not analyzed.

Flotation Tailings (TL-6)

Total sulphur in flotation tailings (TL-6) were variable throughout 2019 ranging from a minimum concentration of 0.09% in January to a maximum of 0.53% in November (Table 4-2). The annual median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019 (Figure 4-1).

Sulphate sulphur was uniformly low resulting in levels of total sulphur and sulphide (calculated as the difference between total sulphur and sulphate) at near parity, suggesting that the majority of sulphur is present as sulphide sulphur (Figure 4-2). On this basis, total sulphur was used to calculate acid potential (AP).

TIC content ranged from 97 to 220 kg $CaCO_3$/t (Figure 4-3) and oscillated throughout 2019. Typically, TIC content of the flotation tailings (TL-6) was greater than the detoxified tailings (TL-7A) with the exception of August to October where the TIC content of the two streams was equivalent. All flotation tailings samples were classified as non-PAG (Figure 4-4). The non-PAG classifications are consistent with the ARD classifications of the metallurgical flotation tailings characterized as part of the Type A water licence amendment (SRK 2015).

Detoxified Tailings (TL-7A)

Sulphur trends in detoxified tailings (TL-7A) showed lower sulphur content earlier in the year compared to July onward. Between January and June, sulphur concentrations in detoxified tailings ranged from 9.6 to 15% whereas from July onwards, sulphur ranged from 21 to 25% (Table 4-2). In 2019, sulphur content of operational detoxified tailings is higher than metallurgical detoxified tailings characterized as part of the Type A water licence amendment (SRK 2015).

Sulphate sulphur ranged from 0.1 to 0.29% and possibly represents sulphate that is a by-product of the cyanide detoxification process and is present in the residual moisture in tailings. Total sulphur and sulphide content were at near parity for detoxified tailings as sulphate content was relatively low compared to sulphide (Figure 4-2). Accordingly, total sulphur was used to calculate AP.

TIC content ranged from 64 to 170 kg $CaCO_3$/t (Figure 4-3) and oscillated throughout 2019, with the lowest concentrations reported in July and August. Consistent with the ARD classifications of the metallurgical tailings characterized as part of the Type A water licence amendment (SRK 2015), all detoxified tailings were classified as PAG (Figure 4-4).

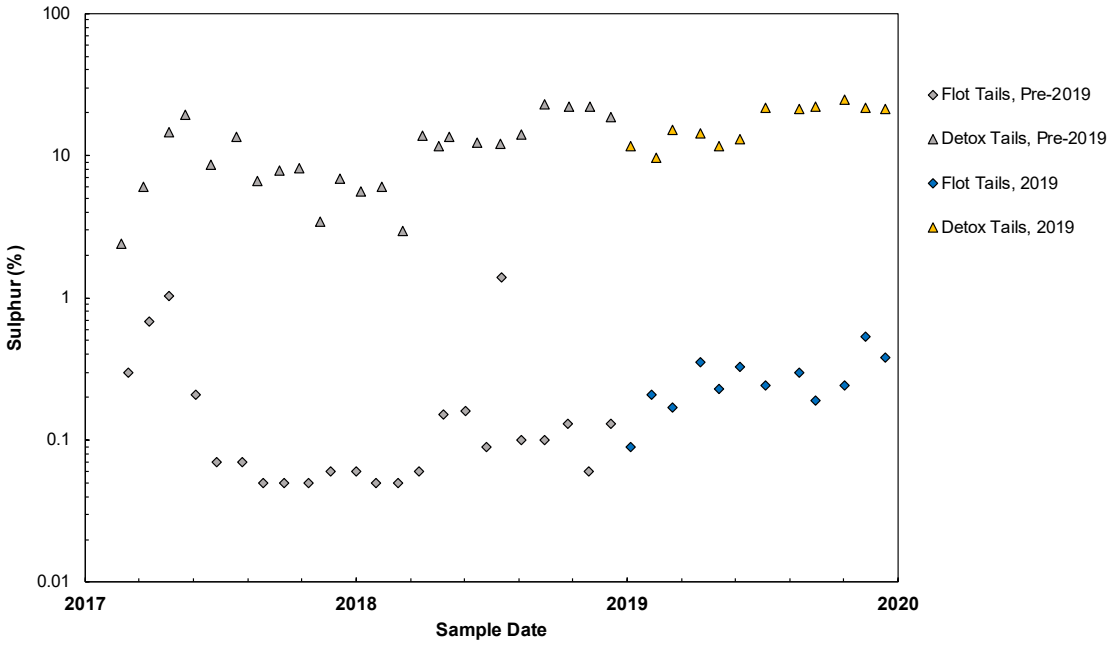

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Figure 4-1: Sulphur Concentrations for Tailings Samples Over Time

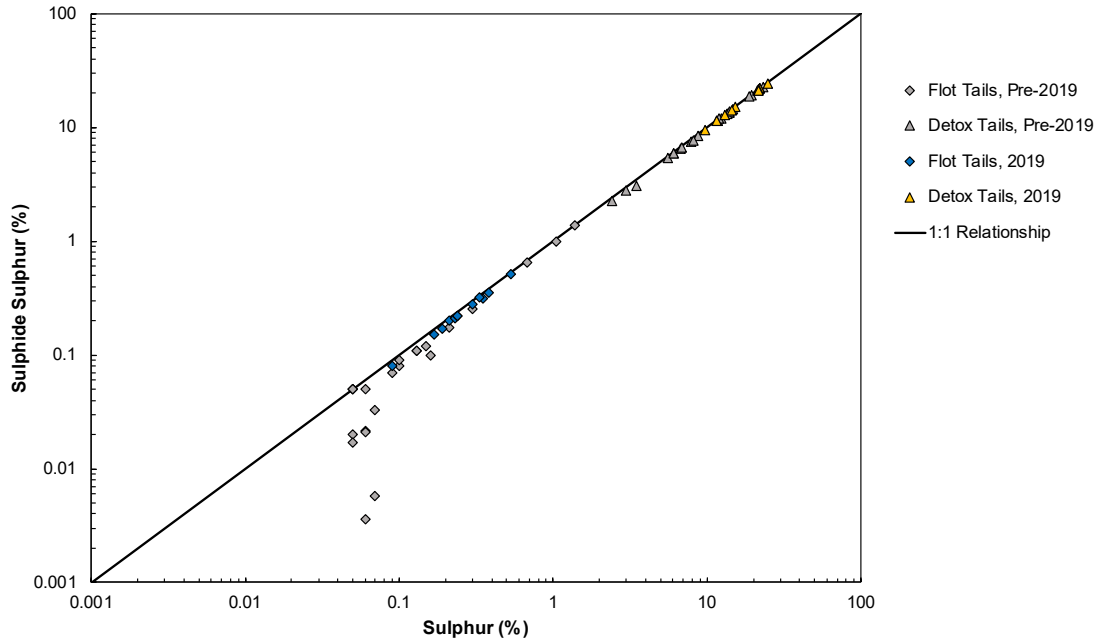

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Figure 4-2: Total Sulphur versus Calculated Sulphide Sulphur

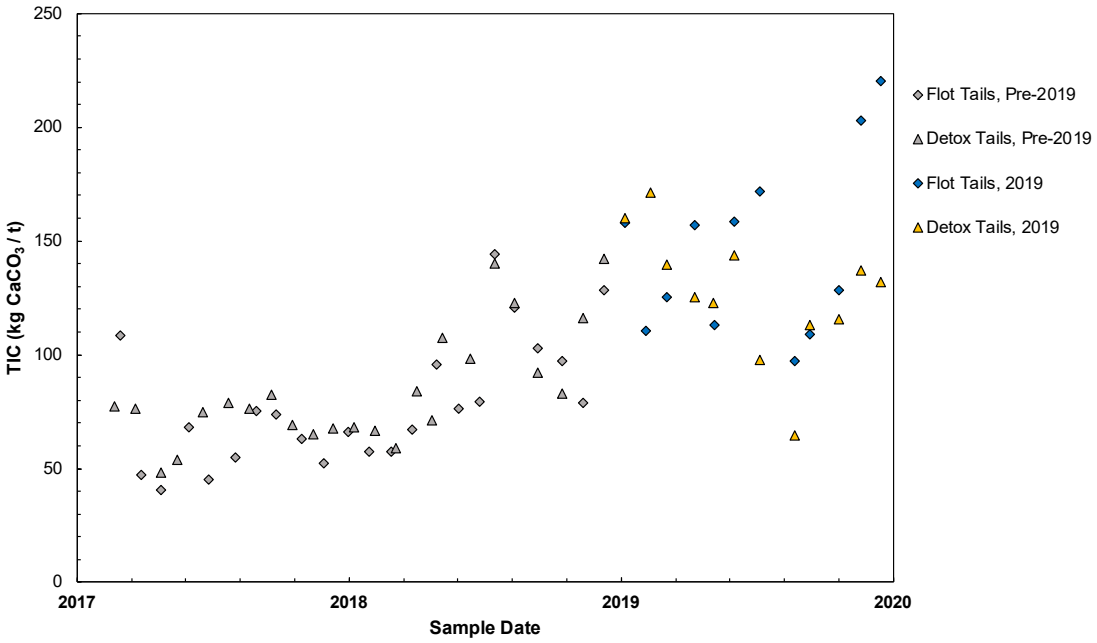

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Figure 4-3: Total Inorganic Carbon (TIC) Concentrations for Tailings Samples Over Time

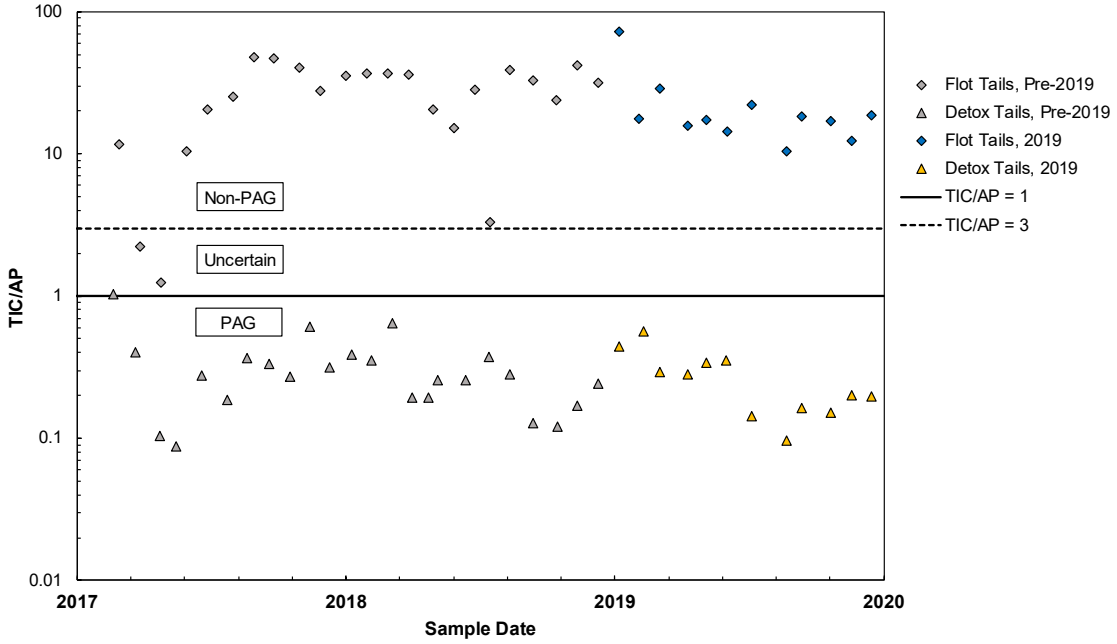

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Figure 4-4: ARD Classifications for Tailings Samples Over Time

4.2.2 Elemental Analysis

Trace element content for flotation (TL-6) and detoxified (TL-7A) tailings are summarized in Table 4-5 and Table 4-6, respectively. Full results are presented in Attachment A and Attachment B.

Results were compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment. Selenium and bismuth could not be assessed because the detection limit is equivalent or higher than the screening criteria of 0.5 mg/kg and 0.07 mg/kg, respectively. Only samples with selenium and bismuth concentrations above the level of analytical uncertainty were assessed and are discussed.

Flotation Tailings (TL-6)

The flotation tailings samples (TL-6) reported concentrations below the screening criteria levels for the majority of parameters. Exceptions included:

- April, June, November and December samples contained elevated arsenic. The arsenic content in 2019 ranged from 9 to 170 mg/kg and was within the range of concentrations for historical samples except for April (170 ppm) (Figure 4-5).
- Five samples were elevated in sulphur, with content for enriched samples of 3,100 to 5,300 mg/kg.
- All samples analyzed for gold were elevated relative to a screening criterion of 40 mg/kg. Gold concentrations ranged from 660 to 3,100 mg/kg.
- Bismuth was elevated in the sample collected in April (9.4 mg/kg).

All other parameters were below the screening criteria indicating no appreciable enrichment.

Detoxified Tailings (TL-7A)

The 2019 detoxified tailings (TL-7A) were elevated for the following parameters relative to the screening criteria:

- All samples were elevated in arsenic (between 23 and 50 times the screening criterion), bismuth (between 17 and 89 times), copper (between 3 and 11 times), selenium (between 12 and 38 times), sulphur (between 27 and 33 times), gold (between 103 and 1,400 times), and silver (between 12 and 46 times).
- More than half of samples were elevated in cadmium (between 1.2 to 3 times higher than the screening criterion), lead (up to 14 times higher) and zinc (between 1.2 and 4 times).
- The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples (Figure 4-6 to Figure 4-11). Arsenic concentrations where slightly higher in 2019 with a median concentration of 15 mg/kg in 2019, compared with 9.2 mg/kg in 2018 (Figure 4-5).

All other parameters, including cobalt (Figure 4-12) were below the screening criteria indicating no appreciable enrichment.

Table 4-5: Summary of Elemental Concentrations for Flotation (TL-6) Tailings

Year	Sampling Date	Ag	As	Au	B	Bi	Cd	Co	Cu	Ni	Pb	S	Se	Zn
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2019	Jan-19	0.2	6.4	***940***	<20	<0.1	<0.1	8.7	26	18	1.5	700	<0.5	31
	Feb-19	0.3	17	***810***	<20	<0.1	0.1	11	93	22	4.0	2000	*<0.5*	43
	Mar-19	0.5	13	***3100***	<20	<0.1	<0.1	12	37	23	3.8	1400	*0.6*	42
	Apr-19	1.0	***170***	***1500***	<20	***9.4***	0.1	12	82	22	44	***3200***	*<0.5*	52
	May-19	0.3	13	***1200***	<20	0.1	0.1	12	70	20	9.8	2100	*<0.5*	55
	Jun-19	0.6	***23***	***2500***	<20	0.1	0.2	17	99	28	11	***3500***	*<0.5*	71
	Jul-19	0.3	16	***1400***	<20	<0.1	0.2	14	99	22	7.3	2500	*0.6*	71
	Aug-19	0.3	12	***1900***	<20	0.1	0.3	12	640	18	14	***3100***	*<0.5*	74
	Sep-19	0.3	9	***920***	<20	<0.1	0.1	13	70	20	12	2200	*<0.5*	67
	Oct-19	0.2	11	***660***	<20	0.1	0.1	13	91	22	9.4	2400	*<0.5*	65
	Nov-19	0.9	***55***	***760***	47	0.1	0.7	21	140	53	43	***5300***	*<0.5*	140
	Dec-19	0.4	***53***	***1000***	<20	0.3	0.2	17	90	58	12	***3800***	*<0.5*	60
Summary Statistics														
2019 (n=12)	P005	0.2	7.8	***720***	20	0.1	0.1	10	32	18	2.8	1100	*0.5*	37
	P050	0.3	15	***1100***	20	0.1	0.1	13	90	22	10	2500	*0.5*	63
	P095	0.95	***110***	***2800***	32	***4.4***	0.48	19	360	55	43	***4500***	*0.6*	100
	P100	1	***170***	***3100***	47	***9.4***	0.7	21	640	58	44	***5300***	*0.6*	140
2018	P005	0.1	6.2	***280***	20	0.1	0.073	8.7	25	16	4.8	910	0.2	30
	P050	0.23	9.2	***530***	20	0.1	0.1	11	39	21	11	1200	0.5	45
	P095	***1.6***	***39***	***7600***	49	0.2	0.4	30	180	36	47	***7200***	0.5	110
	P100	***2.9***	***67***	***12000***	***68***	0.2	0.4	44	300	50	***70***	***14000***	0.5	150
	n	12	12	9	12	12	12	12	12	12	12	12	12	12
2017 (n = 11)	P005	0.18	6.6	--	7.3	0.2	0.063	10	22	18	4.2	1000	0.2	47
	P050	0.28	8.3	--	14	0.2	0.11	13	27	22	6.3	1100	0.2	61
	P095	***1.4***	***47***	--	34	0.2	0.24	32	140	42	15	1400	0.51	130
	P100	***2.1***	***83***	--	41	0.2	0.26	48	200	55	22	1500	0.82	130
10 X Basalt Average		***1.1***	***20***	***40***	***50***	***0.07***	***2.2***	***480***	***870***	***1300***	***60***	***3000***	***0.5***	***1050***

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.037_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2019_rev12.xlsx

Notes:

Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997).

Bismuth was not assessed because the detection limit was greater than the screening criteria.

Table 4-6: Summary of Elemental Concentrations for Detoxified Tailings (TL-7A)

Year	Sampling Date	Ag	As	Au	B	Bi	Cd	Co	Cu	Ni	Pb	S	Se	Zn
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2019	Jan-19	***13***	***490***	***13000***	20	***1.3***	0.6	230	***4600***	180	49	***100000***	***7.3***	240
	Feb-19	***14***	***460***	***6800***	20	***1.2***	1.0	230	***4500***	210	***270***	***82000***	***6.0***	520
	Mar-19	***20***	***670***	***7300***	20	***2.2***	1.2	290	***5100***	260	***130***	***100000***	***9.9***	520
	Apr-19	***51***	***810***	***56000***	20	***4.6***	***3.5***	280	***9400***	240	***500***	***100000***	***10***	***1700***
	May-19	***18***	***500***	***16000***	20	***2.7***	***4.0***	200	***4000***	160	***370***	***100000***	***9***	***1600***
	Jun-19	***25***	***600***	***17000***	20	***2.6***	***3.4***	220	***5500***	200	***360***	***100000***	***9.7***	***1700***
	Jul-19	***15***	***660***	***17000***	20	***5.1***	***7.1***	300	***5800***	200	***850***	***100000***	***16***	***3900***
	Aug-19	***16***	***450***	***20000***	20	***5.3***	***6.1***	280	***8800***	190	***780***	***100000***	***19***	***2900***
	Sep-19	***18***	***580***	***11000***	20	***4.8***	***5.3***	350	***6300***	220	***450***	***100000***	***15***	***2100***
	Oct-19	***17***	***570***	***17000***	20	***3.9***	***3.5***	310	***9200***	220	***390***	***100000***	***16***	***1700***
	Nov-19	***15***	***1000***	***6600***	24	***3.2***	***2.7***	290	***4600***	320	***260***	***100000***	***14***	***1300***
	Dec-19	***17***	***1000***	***4100***	20	***6.2***	***3.5***	210	***2900***	350	***180***	***100000***	***13***	***1100***
Summary Statistics														
2019 (n=12)	P005	***14***	***450***	***5500***	20	***1.3***	0.8	200	***3500***	170	***96***	***92000***	***6.7***	400
	P050	***17***	***590***	***14000***	20	***3.6***	***3.5***	280	***5300***	210	***370***	***100000***	***12***	***1700***
	P095	***37***	***1000***	***36000***	22	***5.7***	***6.6***	330	***9300***	330	***810***	***100000***	***17***	***3400***
	P100	***51***	***1000***	***56000***	24	***6.2***	***7.1***	350	***9400***	350	***850***	***100000***	***19***	***3900***
2018	P005	***8.9***	***240***	***7100***	<20	***1.8***	1.8	140	***4000***	120	***180***	***71000***	***5.8***	800
	P050	***17***	***490***	***15000***	<20	***3.2***	***3.2***	260	***5700***	230	***410***	***>100000***	***10***	***1400***
	P095	***42***	***840***	***25000***	47	***6.9***	***6.9***	410	***10000***	370	***610***	***130000***	***18***	***3100***
	P100	***65***	***860***	***26000***	47	***7.5***	***7.5***	430	***10000***	420	***610***	***170000***	***18***	***3400***
	n	13	13	9	13	13	13	13	13	13	13	13	13	13
2017 (n = 11)	P005	***6.5***	***260***		8.3	***1.9***	1.9	150	***2900***	130	***180***	***82000***	***4.7***	850
	P050	***21***	***410***		13	***5.7***	***5.7***	280	***5400***	220	***380***	***>100000***	***8.2***	***2800***
	P095	***50***	***710***		24	***12***	***12***	460	***16000***	320	***1100***	***210000***	***17***	***5100***
	P100	***51***	***730***		24	***13***	***13***	***510***	***20000***	350	***1500***	***230000***	***18***	***6100***
10 X Basalt Average		***1.1***	***20***	***40***	***50***	***0.07***	***2.2***	***480***	***870***	***1300***	***60***	***3000***	***0.5***	***1050***

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Notes:

Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997).

Summary statistics assume values which are reported as below minimum or above maximum detection limits are equal to that limit.

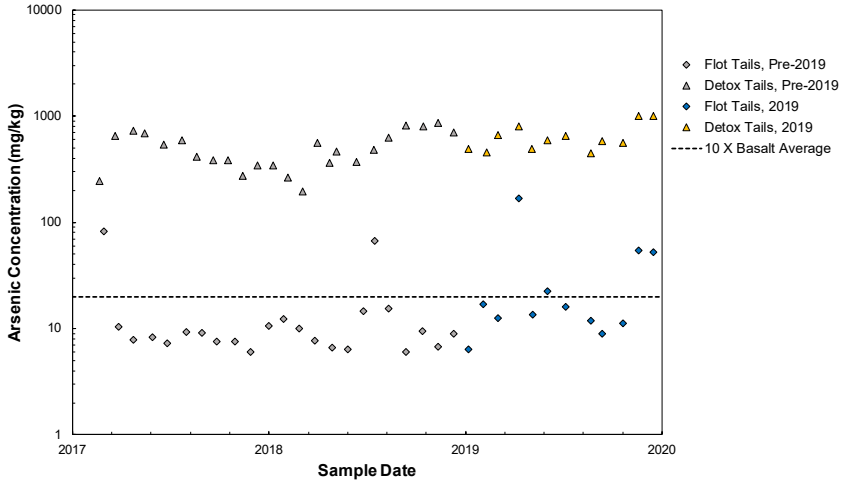

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Figure 4-5: Arsenic Concentrations in Tailings Samples

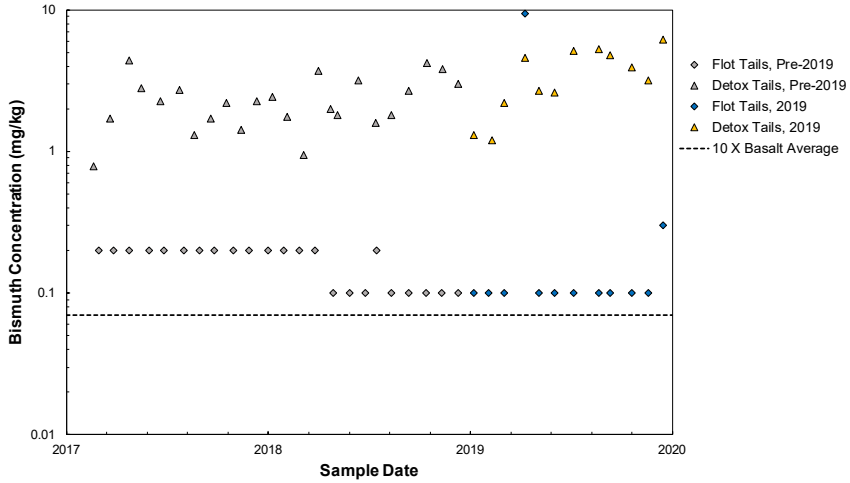

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Figure 4-6: Bismuth Concentrations in Tailings Samples

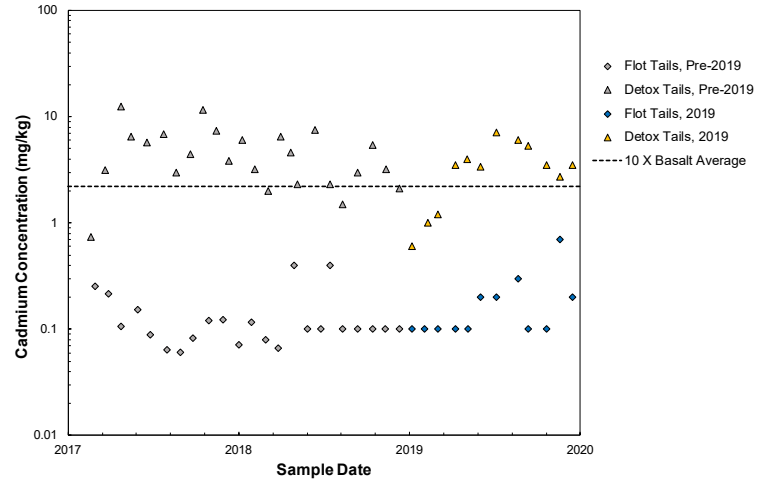

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Figure 4-7: Cadmium Concentrations in Tailings Samples

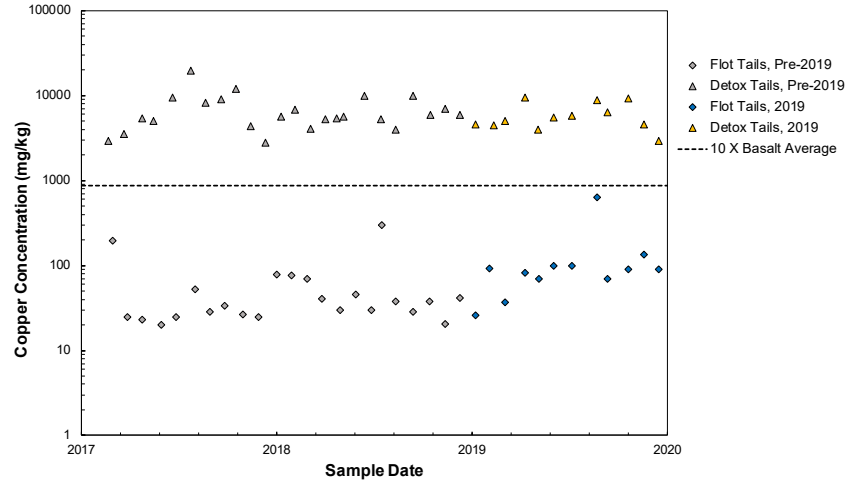

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Figure 4-8: Copper Concentrations in Tailings Samples

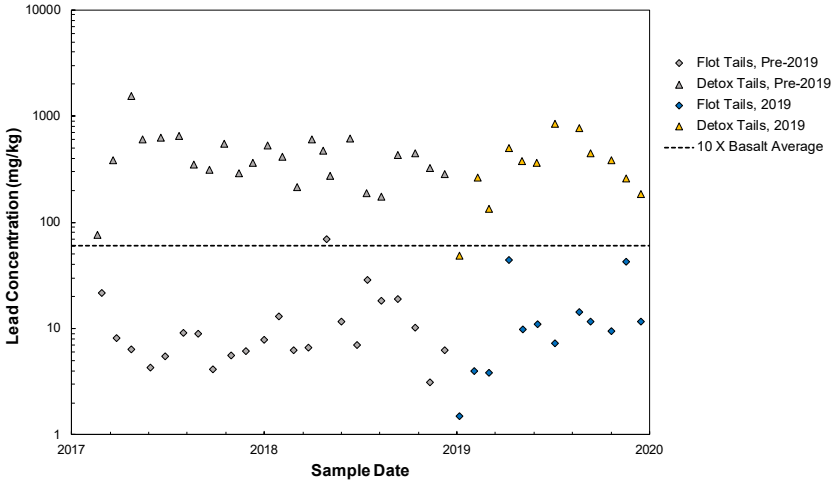

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Figure 4-9: Lead Concentrations in Tailings Samples

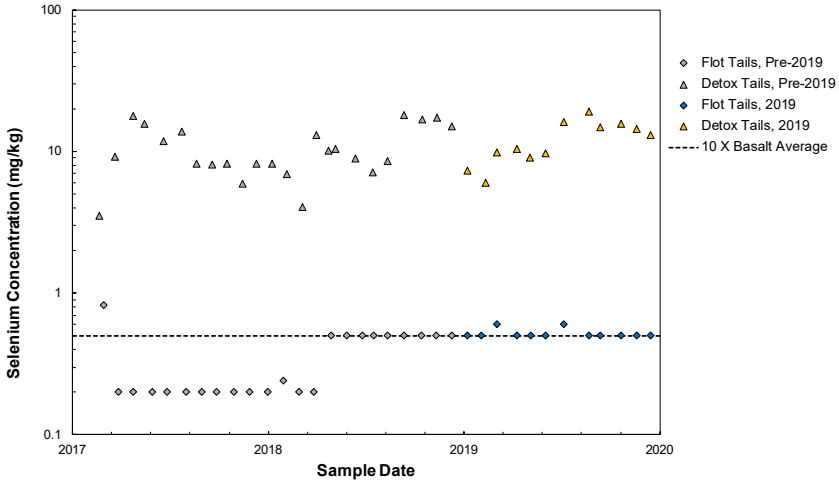

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Figure 4-10: Selenium Concentrations in Tailings Samples

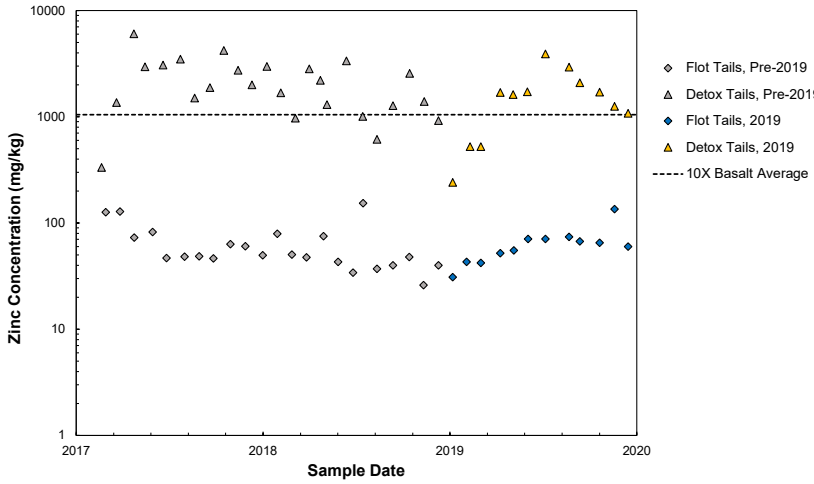

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Figure 4-11: Zinc Concentrations in Tailings Samples

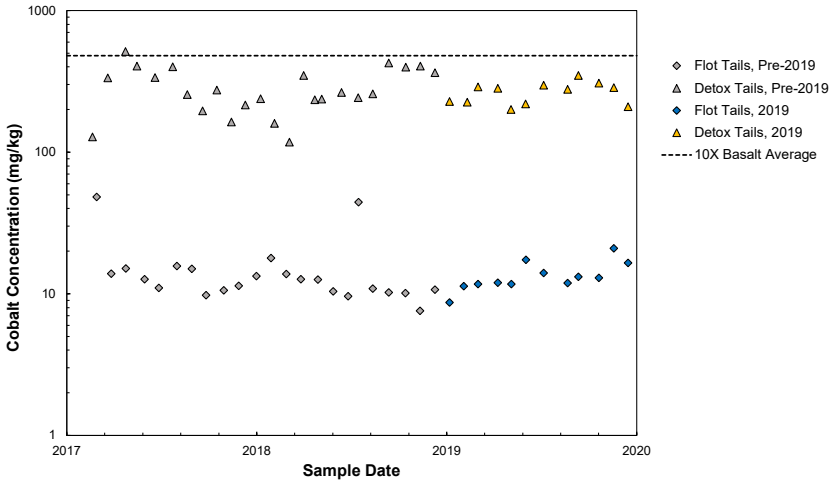

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Figure 4-12: Cobalt Concentrations in Tailings Samples

4.3 Detoxified Tailings Filtrate (TL-7B)

A summary of the detoxified tailings filtrate (TL-7B) analysis is presented in Table 4-7 and Figure 4-13 to Figure 4-22 below. Full results are presented in Attachment C. Cyanide detoxified tailings slurry are squeezed in a filter press to separate the detoxified tailings supernatant from solids (TL-7A). The detoxified tailings supernatant is combined with the flotation tailings slurry in the thickener tank (TL-5). The detoxified tailings supernatant is approximately 7% of the volume of TL-5 and is managed within the TIA. TL-7B represents the chemistry of the residual moisture within the detoxified tailings, which ranges from 18 to 24%. Total metals were analyzed for TL-7B as per the Water Licence. The detoxified tailings filtrate (TL-7B) monitoring data are summarized as follows:

- pH conditions were slightly alkaline with values of between 8.5 to 8.8.
- Sulphate was a significant anion with concentrations ranging between 12,000 mg/L to 28,000 mg/L. The most significant cation was sodium (5,700 to 13,000 mg/L), which is a milling reagent.
- Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.
- Thiocyanate, cyanate and ammonia are produced as by-products of the cyanide detoxification process. Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L.
- Milling of the sulphide rich ore results in high concentrations of total metals, including arsenic (0.022 to 0.17 mg/L), antimony (0.0059 to 0.045 mg/L), cobalt (0.035 to 0.13 mg/L), copper (3.3 to 20 mg/L), iron (<0.5 to 13 mg/L), manganese (0.13 to 0.41 mg/L), molybdenum (0.024 to 0.27 mg/L), nickel (<0.025 to 0.14 mg/L), selenium (0.0053 to 0.051 mg/L) and silver (0.0033 to 0.040 mg/L).
- The following parameters were consistently reported at concentrations less than analytical detection limits in all filtrate samples: chromium, phosphorous, and zinc.

Table 4-7: Summary of 2019 Detoxified Tailings Filtrate (TL-7B) Analyses

Parameters	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Moisture content*	%	18	21	22	23	21	26	19	19	20	23	54	21
pH	s.u.	8.6	8.6	8.5	8.5	8.5	8.7	8.7	8.7	8.7	8.7	8.8	8.8
NH_3	mg/L as N	220	190	220	200	180	220	220	230	240	260	270	290
Cyanate	mg/L	310	420	520	510	310	570	620	520	420	670	620	10
Thiocyanate	mg/L	320	150	20	18	12	310	19	200	370	200	180	490
Total CN	mg/L	2.1	0.8	1.5	1	1.8	0.51	0.55	0.38	1.8	1.2	1.2	0.95
WAD CN	mg/L	0.26	0.063	0.11	0.18	0.11	0.48	0.31	0.15	0.34	0.11	0.24	0.42
Free CN	mg/L	*0.005*	*0.005*	*0.005*	*0.01*	0.0051	0.0055	0.008	*0.005*	0.015	*0.01*	*0.005*	*0.019*
Al_T	mg/L	0.84	*0.15*	0.44	0.65	0.44	0.29	0.36	0.18	0.61	0.4	0.32	0.53
Sb_T	mg/L	0.013	0.0059	0.019	0.0088	0.012	0.018	0.022	0.045	0.019	0.026	0.035	0.028
As_T	mg/L	0.17	0.022	0.12	0.061	0.059	0.11	0.04	0.045	0.06	0.057	0.14	0.1
Ba_T	mg/L	0.035	0.054	0.058	0.048	0.071	0.053	0.072	0.056	0.086	0.058	0.053	0.049
Be_T	mg/L	*0.005*	*0.005*	*0.002*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Bi_T	mg/L	--	*0.0025*	*0.001*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*
B_T	mg/L	1	1.1	1.2	1	0.89	1.2	1.1	0.91	1.4	1.3	0.95	1.7
Cd_T	mg/L	*0.00025*	*0.00025*	*0.0001*	*0.00025*	*0.00025*	*0.00025*	0.00029	*0.00025*	*0.00025*	0.00059	0.00025	0.00025
Ca_T	mg/L	36	56	48	74	72	41	42	40	43	45	39	32
Cs_T	mg/L	--	*0.0005*	*0.0002*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*
Cr_T	mg/L	*0.0064*	*0.005*	0.0051	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.01*	*0.018*
Co_T	mg/L	0.15	0.049	0.075	0.048	0.035	0.13	0.045	0.096	0.066	0.051	0.028	0.23
Cu_T	mg/L	10	5.2	8.5	7.2	6	9.4	6.5	8.5	11	20	9.4	3.3
Fe_T	mg/L	*13*	*0.5*	3.1	5.7	2.3	1.7	2.8	0.67	4.1	4.4	5	4.9
Pb_T	mg/L	0.0067	0.0063	0.0031	0.015	0.0085	0.0033	0.0079	0.0053	0.0067	0.024	0.0071	0.012
Li_T	mg/L	*0.05*	*0.05*	0.039	*0.05*	0.059	0.055	0.072	0.055	0.075	0.059	0.06	0.086
Mg_T	mg/L	45	41	47	50	56	50	44	34	45	46	43	76
Mn_T	mg/L	0.25	0.2	0.21	0.35	0.41	0.13	0.24	0.26	0.24	0.33	0.21	0.21
Mo_T	mg/L	0.065	0.024	0.037	0.04	0.053	0.066	0.13	0.12	0.23	0.27	0.11	0.12
Ni_T	mg/L	*0.052*	*0.025*	0.028	0.031	*0.025*	*0.025*	*0.025*	0.14	*0.025*	0.041	0.031	0.025
P_T	mg/L	--	*2.5*	*1*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*
K_T	mg/L	67	47	64	48	68	69	66	30	79	57	55	81
Rb_T	mg/L	--	*0.01*	*0.004*	*0.01*	*0.01*	*0.01*	*0.01*	0.011	*0.01*	0.013	0.01	0.01
Se_T	mg/L	0.007	0.0053	0.0099	0.015	0.007	0.0083	0.013	0.027	0.012	0.051	0.032	0.0094
Si_T	mg/L	--	*5*	3.8	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
Ag_T	mg/L	0.04	0.0033	0.0084	0.0079	0.0039	0.0078	0.0052	0.0051	0.0099	0.017	0.0092	0.018
Na_T	mg/L	10000	5700	9700	7300	8900	11000	9800	10000	13000	11000	8700	11000
Sr_T	mg/L	--	0.46	0.49	0.68	0.72	0.47	0.54	0.56	0.69	0.45	0.53	0.51
S_T	mg/L	--	3900	6900	4700	5900	7300	6500	8100	9200	8000	5600	7500
Te_T	mg/L	--	*0.01*	*0.004*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Tl_T	mg/L	*0.0005*	*0.0005*	*0.0002*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.0005*
Th_T	mg/L	--	*0.005*	*0.002*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Sn_T	mg/L	*0.005*	*0.005*	*0.002*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Ti_T	mg/L	*0.015*	*0.015*	*0.006*	*0.017*	*0.03*	*0.015*	*0.015*	*0.015*	0.02	*0.015*	*0.015*	*0.015*
W_T	mg/L	--	0.017	0.048	0.028	0.035	0.062	0.053	0.12	0.096	0.22	0.11	0.089
U_T	mg/L	*0.0013*	*0.0005*	0.00041	0.00066	*0.0005*	0.0011	*0.0005*	0.00064	0.00053	0.00072	0.0005	0.00062
V_T	mg/L	*0.025*	*0.025*	*0.01*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*
Zn_T	mg/L	*0.15*	*0.15*	*0.06*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*
Zr_T	mg/L	--	*0.003*	0.0044	*0.003*	*0.003*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*

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Notes:

Blue italics = Value less than laboratory detection limit. Detection limit shown.

-- = Data not available.

Metal(loid) concentrations are reported as 'Totals'

* Moisture content of TL-7A

4.4 Process Plant Tailings Water Discharge (TL-5)

Between January and December 2019, 12 samples of process plant tailings water discharge (TL-5) were collected. Figures depicting time series of constituent concentrations and loads from the process plant tailings water discharge (TL-5) to the TIA are presented in Attachment D. Prior to 2019, total metals were determined at TL-5 as per the Water Licence; in 2019 dissolved metals were also analyzed. Both totals and dissolved metals are presented in subsequent figures. The geochemistry of the 2019 process plant tailings discharge (TL-5) is summarized as follows:

- The pH of TL-5 ranged from 8.0 to 8.4 s.u for all months except August which had an anomalous low of 6.2 s.u. compared to other months (Figure 4-13). Field pH measurements of 6.1 s.u. confirmed the anomalously value of pH.
- Sulphate loadings increased slightly in 2019 (Figure 4-14).
- Notably, trends in aluminum and zinc loadings decreased in 2019, this difference may be due to change from total to dissolved metals (where total metals analysis also includes measurements due to TSS).
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2017 and 2018, including arsenic. Exceptions included antimony, magnesium and molybdenum, all of which exhibited increasing trends in 2019 (Figure 4-18, Figure 4-21 and Figure 4-22). Selenium showed elevated loadings between August and November, relative to other months in 2019 (Figure 4-23). TSS, antimony, copper, cadmium, nickel, manganese, lead, molybdenum, selenium zinc and phosphorous loadings spiked in August 2019. The spike is also reflected in the solids data for flotation tailings for copper (Section 4.2.2).

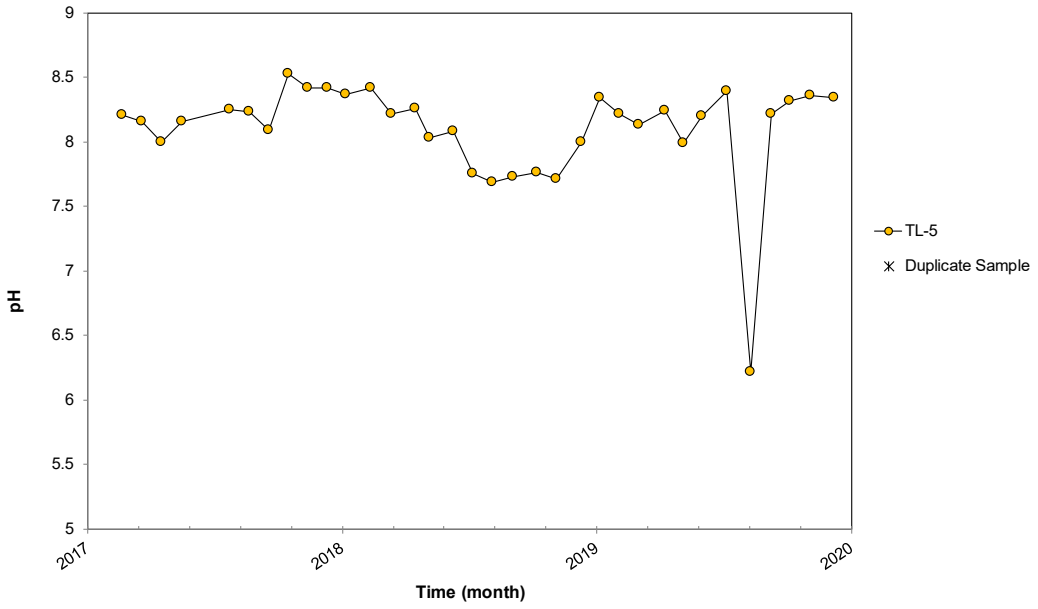

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Figure 4-13: Trends in pH for Process Plant Supernatant Discharge (TL-5)

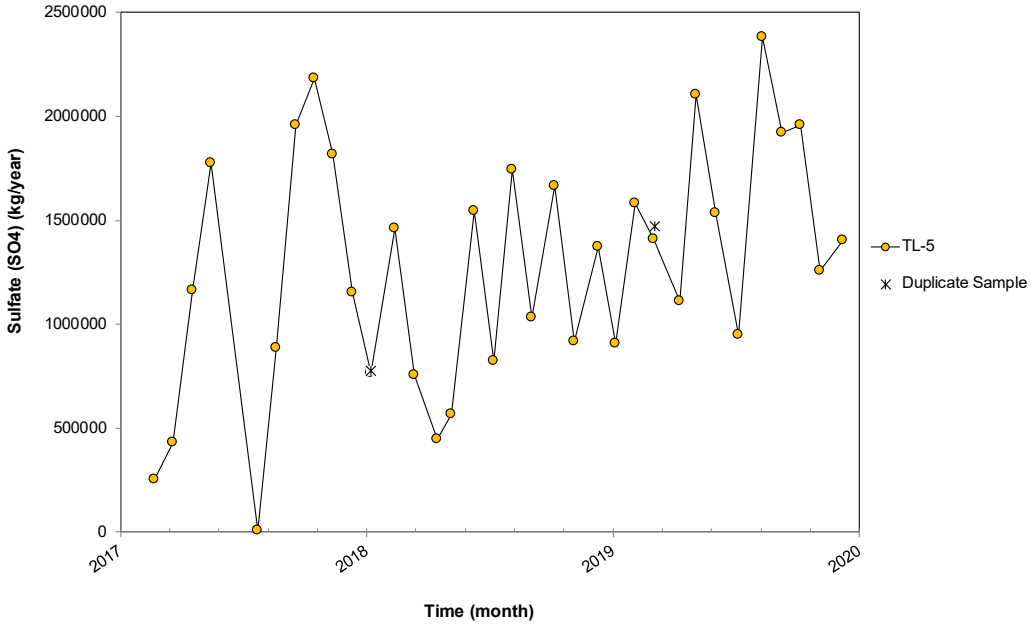

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Figure 4-14: Trends in Sulphate for Process Plant Supernatant Discharge (TL-5)

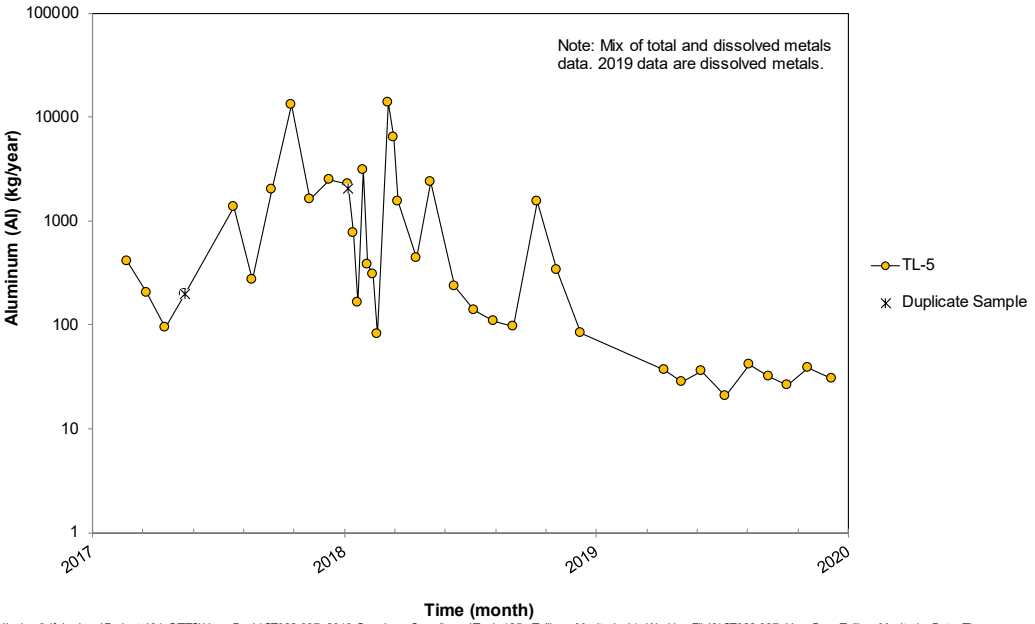

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Figure 4-15: Trends in Aluminum for Process Plant Supernatant Discharge (TL-5)

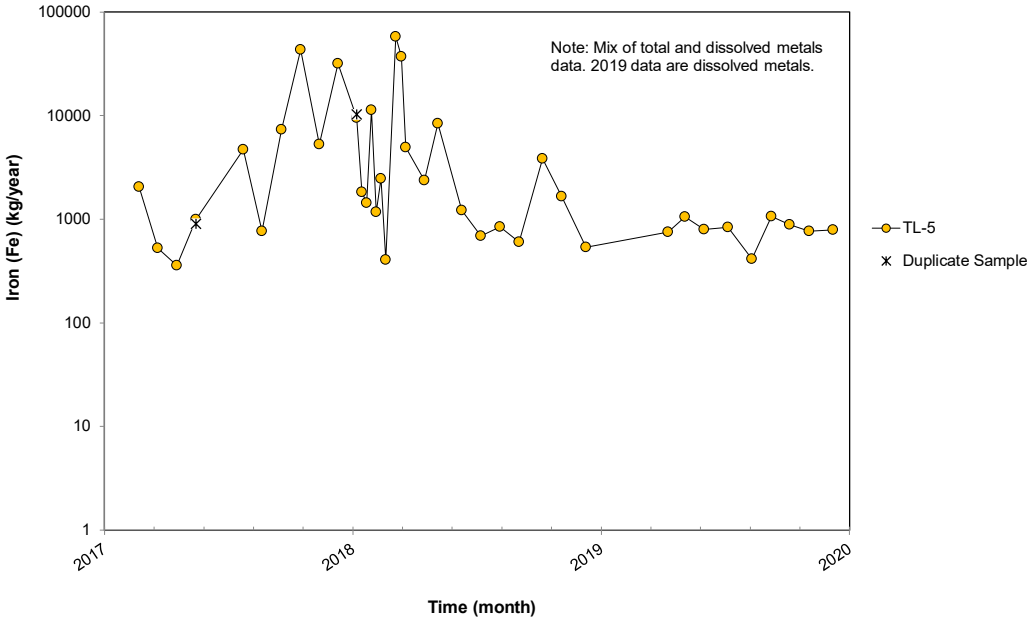

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Figure 4-16: Trends in Iron for Process Plant Supernatant Discharge (TL-5)

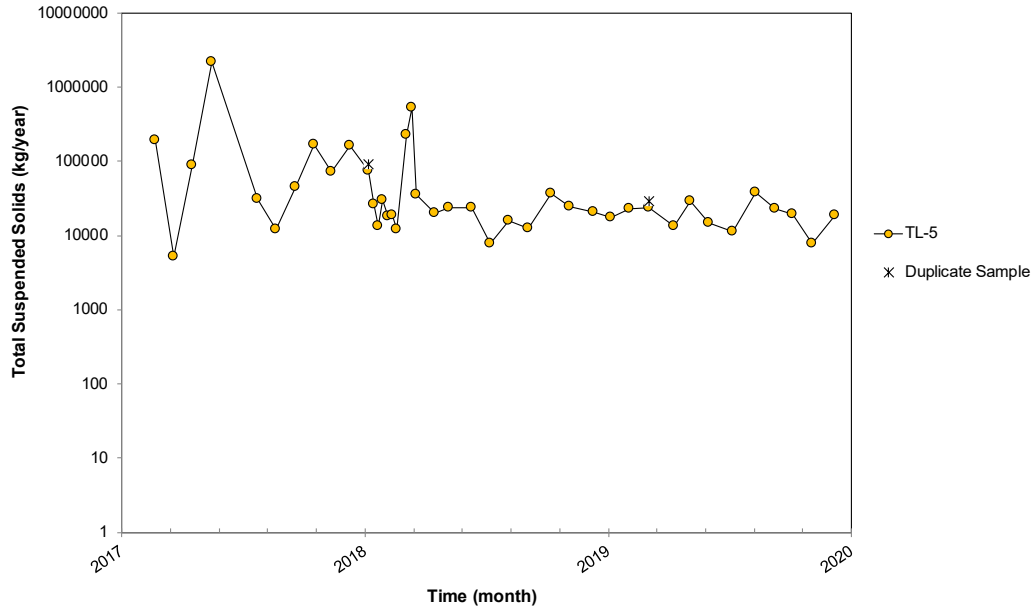

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Figure 4-17: Trends in TSS for Process Plant Supernatant Discharge (TL-5)

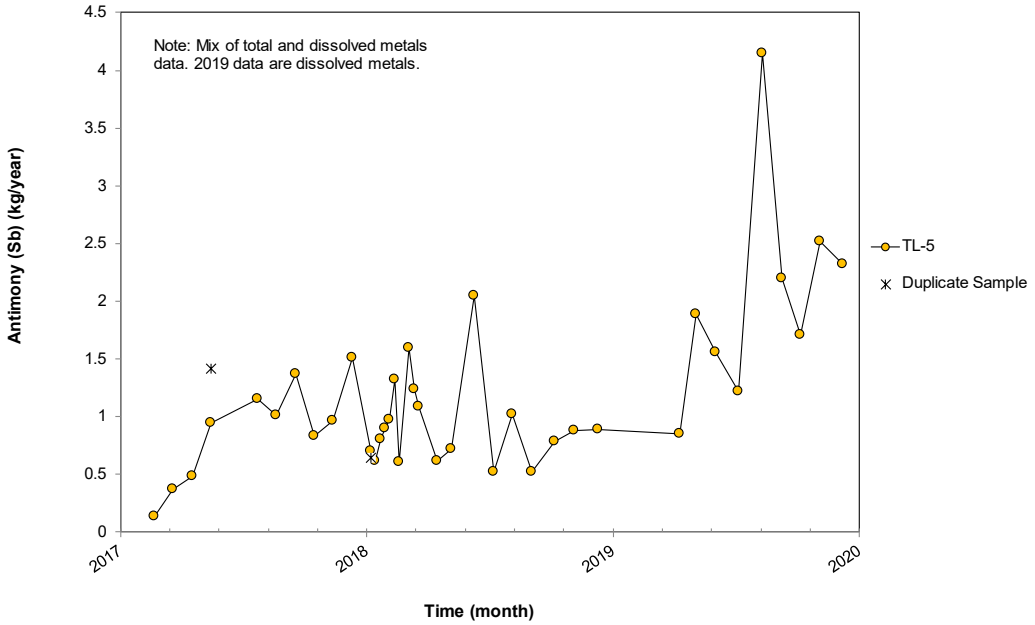

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Figure 4-18: Trends in Antimony for Process Plant Supernatant Discharge (TL-5)

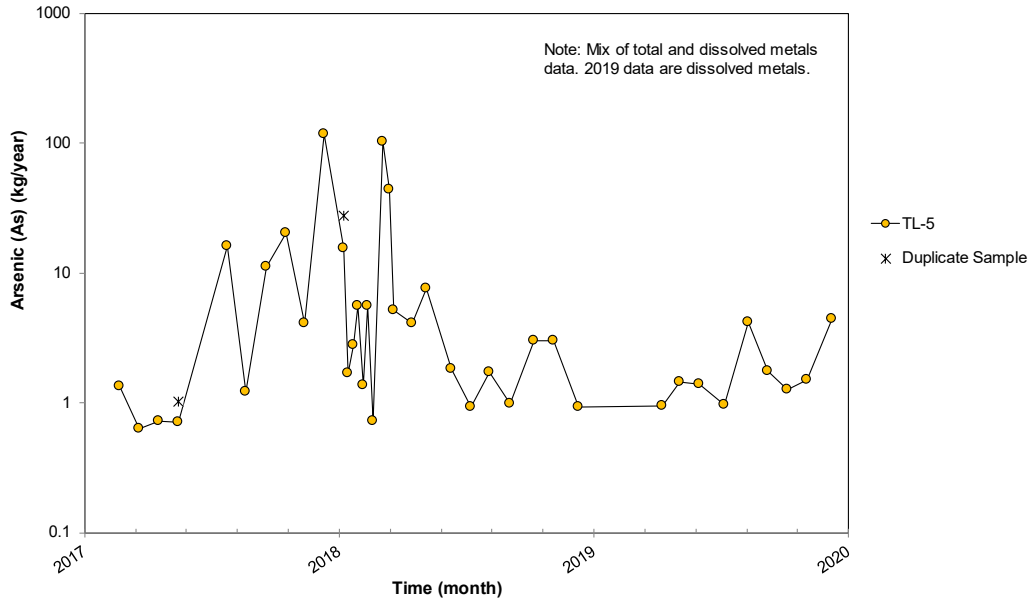

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Figure 4-19: Trends in Arsenic for Process Plant Supernatant Discharge (TL-5)

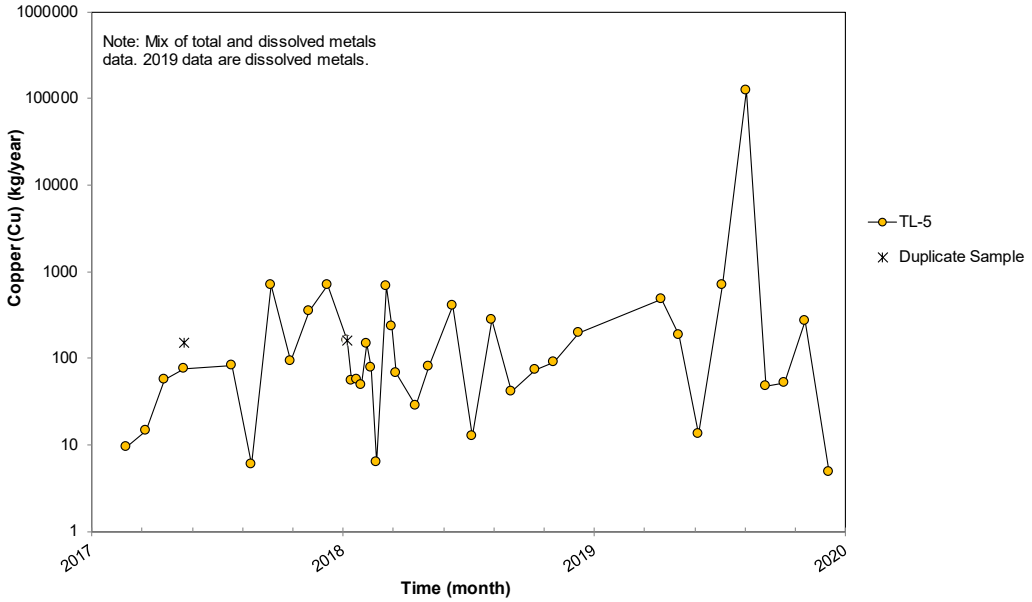

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Figure 4-20: Trends in Copper for Process Plant Supernatant Discharge (TL-5)

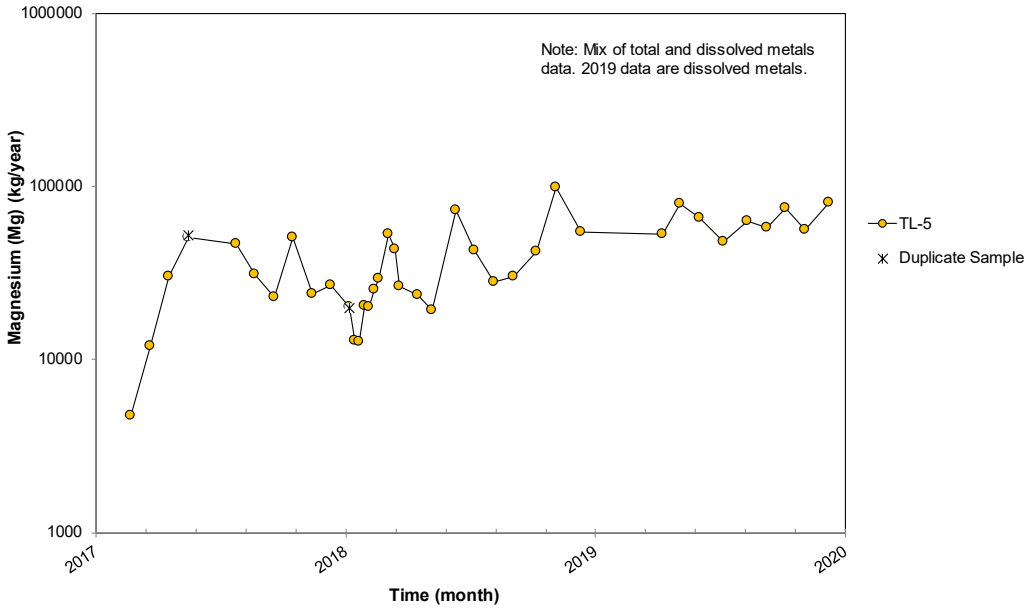

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Figure 4-21: Trends in Magnesium for Process Plant Supernatant Discharge (TL-5)

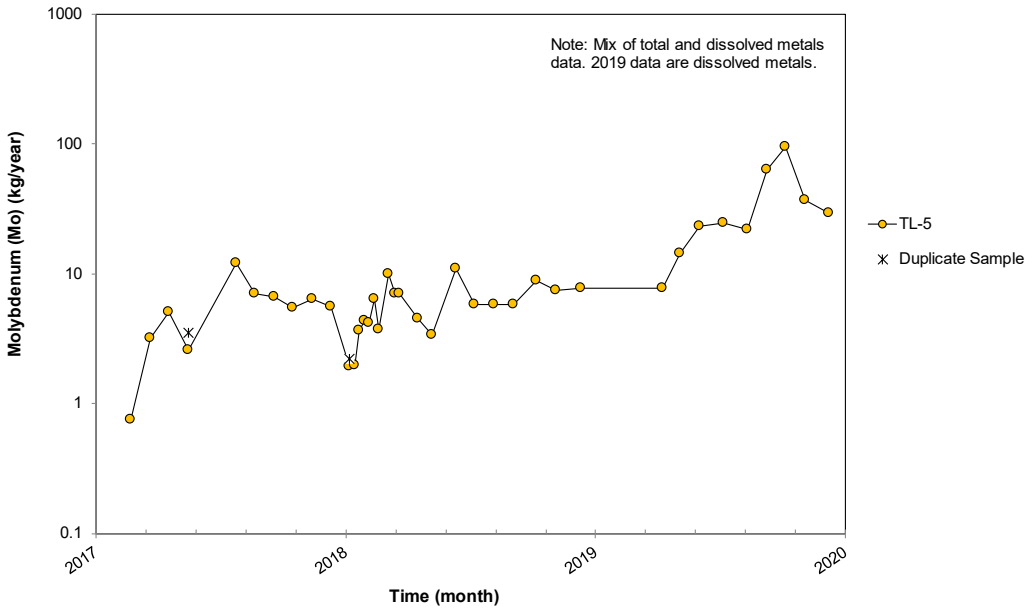

Figure 4-22: Trends in Molybdenum for Process Plant Supernatant Discharge (TL-5)

4.5 Seepage Monitoring of Backfilled Stopes (TL-11)

Selected water quality analyses of the seepage monitoring samples collected from base of underground stopes are provided in Table 4-8. The results are compared to median and 5th and 95th percentile concentrations reported in the previous TL-11 monitoring surveys (2017 and 2018).

Seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. The stopes contained both waste rock and detoxified tailings backfill and is interpreted to be contact water of these material types. In the May survey samples were collected from pools of standing water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. There was no flow observed and accordingly, these samples may not represent contact water chemistry of backfill, particularly for sample TL-11D-27MAY19 which was collected in the vicinity of the surface vent raise.

The chemistry of the two samples collected from seeps on Level 120 and Level 134 in the December survey are interpreted to be contact water of waste rock and tailings backfill based on field observations and is summarized as follows:

- pH is slightly alkaline with both seeps reporting a pH of 8.0.
- The major ion chemistry is presented in Figure 4-23. Major anion chemistry was dominated by chloride (9,000 to 9,300 mg/L) and to a lesser degree sulphate (1,200 to 1,300 mg/L). The major cation chemistry was dominated by sodium (4,500 to 4,300 mg/L) with lesser magnesium (600 to 630 mg/L) followed by calcium (460 to 520 mg/L). Potential sources of

the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium).

- Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set.
- Cadmium (0.00032 to 0.00056 mg/L), copper (0.039 to 0.10 mg/L), nickel (0.082 to 0.12 mg/L), selenium (<0.001 to 0.0012 mg/L) and silver (3.6 to 3.7 mg/L) were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015). The exception to this was zinc which was not noted as a parameter of potential concern in the HCT program but report elevated concentrations (0.026 to 0.096 mg/L) in the TL-11 survey.
- The following dissolved parameters were consistently reported at concentrations less than analytical detection limits in all seepage samples from the December survey: aluminium, beryllium, bismuth, chromium, iron, lead, phosphorous, tin, thallium, titanium, vanadium and zirconium.

The chemistry of the underground seepage monitoring samples collected from pooled water at the base of backfilled stopes in May (with the exception of TL-11D-27MAY19) was notably different than the December samples and is summarized as follows:

- pH conditions ranged from 5.8 to 8.0.
- Major ion chemistry is comparable to the samples collected in December (Figure 4-23); however, concentrations were higher, which could be a result of evaporation in the standing pools of water sampled. Major anion chemistry were dominated by chloride (15,000 to 35,000 mg/L) and to a lesser degree sulphate (1,100 to 1,300 mg/L), while major cation chemistry was dominated by sodium (6,700 to 12,000 mg/L), calcium (3,700 to 9,600 mg/L), and to a lesser degree magnesium (860 to 1,800 mg/L).
- Total cyanide concentrations ranged from 0.05 to 0.17 mg/L and free cyanide concentrations were <0.005 to 0.012 mg/L. WAD cyanide concentrations (<0.005 to 0.026 mg/L) were at near parity with free cyanide.
- Levels of ammonia (180 to 350 mg/L) and nitrate (210 to 470 mg/L) were between the 50th to 95th percentile historical concentrations. Levels of nitrite (6.5 to 21 mg/L) were also generally within the range of 50th to 95th percentile concentrations of historical samples, with the exception of sample TL-11B-27MAY19. Sources of these nutrients are degradation of cyanate and thiocyanate in detoxified tailings with a minor contribution from blast residues on waste rock.
- As with the major ions, metals concentrations were higher for May samples as compared to December samples, including cadmium (0.0033 to 0.034 mg/L), copper (0.069 to 0.37 mg/L), nickel (0.11 to 0.35 mg/L), selenium (0.0048 to 0.013 mg/L) and silver (0.0026 to 0.014 mg/L).

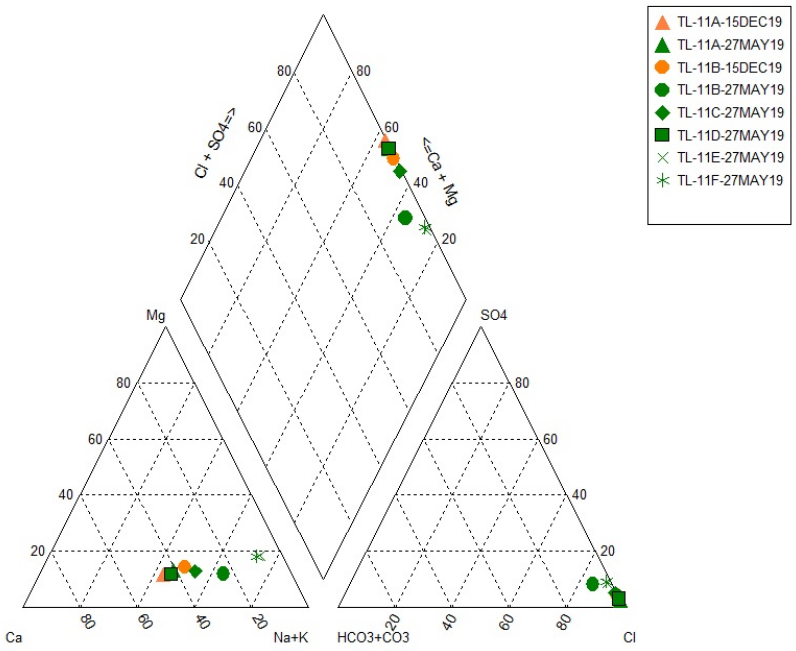

Figure 4-23: Major Ion Chemistry for TL-11 Seepage Water Quality Analysis

The chemistry of TL-11D-27MAY19 was notably different to the chemistry of the other samples collected during the May seepage survey. Field notes recorded for TL-11D-27MAY19 state that the sample was collected in the vicinity of the surface vent raise. This suggests that the seepage sample was potentially diluted by meteoric water, with supporting evidence as follows.:

- TDS was notably lower at 2,600 mg/L compared to between 33,000 to 71,000 mg/L.
- Major anion (chloride and sulphate) and cation (calcium, sodium and magnesium) concentrations were also notably lower than the other May samples by one to two orders of magnitude. However, the major ion signature as shown in Figure 4-23 is consistent with the other samples suggesting dilution from surface meteoric water.
- For cyanide species, concentrations of total (0.052 mg/L), free (0.0061 mg/L) and WAD (0.0069 mg/L) cyanide concentrations were within the range measured in the other seeps.
- Ammonia (29 mg/L) and nitrate (35 mg/L) concentrations were an order of magnitude lower than the other May samples and were also lower than the 5th percentile historical concentrations. In comparison the nitrite concentration (16 mg/L) in the TL-11D-27MAY19 sample was higher than the other May samples and the 95th percentile historical concentrations.
- Generally, concentrations of trace metal in TL-11D-27MAY19 were lower than other May samples. The exception to this is chromium which was elevated (0.015 mg/L) compared to 95th percentile historical concentrations.

Table 4-8: Summary of TL-11 (Backfilled Stopes) Seepage Water Quality Analysis

Parameter	Units	Detection Limit	Historical Statistics (2017-2018)			TL11-A-27MAY19	TL11-B-27MAY19	TL11-C-27MAY19	TL11-D-27MAY19	TL11-E-27MAY19	TL11-F-27MAY19	TL11-A-15DEC19	TL11-B-15DEC19
						Level 4932	Level 4946	Level 4964	Level 5002	Level 4735	Level 4905	Level 120	Level 134
			P05	P50	P95	27-May-2019 10:35	27-May-2019 10:55	27-May-2019 11:20	27-May-2019 11:45	29-May-2019 10:20	29-May-2019 11:00	15-Dec-2019 10:50	15-Dec-2019 11:15
EC	uS/cm	2	93000	100000	100000	80000	84000	58000	3600	50000	68000	25000	27000
pH	pH	0.1	6.7	6.8	6.9	5.8	7.2	7.2	8	7.5	7.2	8	8
TSS	mg/L	3	230	470	32000	13	41	20	15	18	3.5	670	37
TDS	mg/L	10	56000	77000	110000	68000	71000	48000	2600	33000	50000	17000	18000
Total Alkalinity	mg/L as $CaCO_3$	1	41	49	200	2.6	75	73	98	88	62	230	260
NH_3	mg/L	0.005	230	280	390	280	350	220	29	180	310	10	17
Cl	mg/L	0.5	41000	45000	48000	34000	35000	22000	880	15000	27000	9000	9300
NO_3	as N mg/L	0.005	490	520	590	470	430	280	35	210	390	14	16
NO_2	as N mg/L	0.001	1.8	6.7	15	7.2	21	8.5	16	6.5	8.2	0.72	0.6
SO_4	mg/L	0.3	860	890	990	1200	1100	1300	110	1100	1100	1200	1300
Total CN	mg/L	0.005	0.01	0.069	0.85	0.073	0.17	0.074	0.052	0.15	0.051	0.25	0.031
WAD CN	mg/L	0.005	0.005	0.017	0.027	0.011	0.018	*0.005*	0.0069	0.026	0.011	0.01	0.0098
Free CN	mg/L	0.005	0.0054	0.016	0.025	0.0087	0.0051	*0.005*	0.0061	0.012	0.0095	0.01	0.0088
Al_D	mg/L	0.001	0.05	0.1	0.12	*0.05*	*0.05*	*0.05*	0.012	*0.05*	*0.05*	*0.02*	*0.02*
Sb_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	0.00039	*0.005*	*0.005*	*0.002*	0.0032
As_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	0.0014	*0.005*	*0.005*	0.0052	*0.002*
Ba_D	mg/L	0.0001	0.26	0.51	0.62	0.26	0.46	0.2	0.022	0.14	0.22	0.031	0.054
B_D	mg/L	0.01	2	2.8	3.5	3.1	3.8	3.1	0.15	3.5	2.7	2.4	2.4
Cd_D	mg/L	0.000005	0.022	0.029	0.041	0.034	0.012	0.0086	*0.00001*	0.0033	0.01	0.00032	0.00056
Ca_D	mg/L	0.05	12000	15000	18000	9600	9300	5000	140	3700	6700	460	520
Cr_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	0.015	*0.005*	*0.005*	*0.002*	*0.002*
Co_D	mg/L	0.0001	0.072	0.2	0.31	0.21	0.033	0.089	0.0025	0.026	0.12	0.031	0.057
Cu_D	mg/L	0.0002	0.23	0.55	0.79	0.25	0.25	0.25	0.015	0.069	0.37	0.039	0.1
Fe_D	mg/L	0.01	0.5	0.75	1	*0.5*	*0.5*	*0.5*	0.025	*0.5*	*0.5*	*0.2*	*0.2*
Pb_D	mg/L	0.00005	0.0052	0.13	0.16	0.0068	*0.0025*	*0.0025*	*0.0001*	*0.0025*	*0.0025*	*0.001*	*0.001*
Li_D	mg/L	0.001	0.29	0.37	0.45	0.32	0.21	0.2	0.029	0.13	0.18	0.097	0.092
Mg_D	mg/L	0.1	1100	1400	1700	1500	1800	1200	43	860	1100	630	600
Mn_D	mg/L	0.0001	6.7	8.2	11	10	8.2	7.6	0.06	3.6	7	1.5	1.5
Mo_D	mg/L	0.00005	0.019	0.027	0.046	0.022	0.065	0.029	0.0043	0.021	0.016	0.0062	0.0063
Ni_D	mg/L	0.0005	0.23	0.38	0.48	0.35	0.15	0.18	0.0016	0.11	0.29	0.082	0.12
Se_D	mg/L	0.00005	0.0095	0.014	0.038	0.013	0.0048	0.0097	0.0019	0.005	0.0058	0.0012	0.001
Si_D	mg/L	0.05	2.5	3.9	5	2.9	*2.5*	4.5	4.2	3.2	2.6	3.7	3.6
Na_D	mg/L	0.05	7400	9800	12000	10000	12000	7700	420	6700	8200	4700	4500
S_D	mg/L	0.5	410	510	590	590	560	600	52	500	510	420	450
Tl_D	mg/L	0.00001	0.00071	0.0011	0.0015	0.0009	*0.0005*	*0.0005*	*0.00002*	*0.0005*	*0.0005*	*0.0002*	*0.0002*
Sn_D	mg/L	0.0001	0.005	0.0075	0.01	*0.005*	*0.005*	*0.005*	*0.0002*	*0.005*	*0.005*	*0.002*	*0.002*
U_D	mg/L	0.00001	0.0025	0.0031	0.0049	0.0031	0.0013	0.0019	0.00023	0.0019	0.0026	0.00028	0.00059
Zn_D	mg/L	0.001	0.32	1.7	3.2	1.3	0.11	0.21	0.0082	1.2	0.42	0.026	0.094

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.037_2019 Geochem Compliance\Task 125 - Tailings Monitoring\1. Working File\1CT022.027_HopeBay_TailingsMonitoringData_TL-11_2019_rev04.xlsx

Notes:

Blue italics = Value less than laboratory detection limit. Detection limit shown.

-- = Data not available.

Metal(loid) concentrations are reported as 'Dissolved'

5 Summary and Conclusions

In 2019, a total of 573,868 t (dry weight) of flotation tailings were deposited in the TIA and 18,831 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

The results of the 2019 geochemical monitoring program of flotation tailings solids (TL-6) is summarized as follows:

- Sulphur concentrations ranged between 0.09 and 0.53%. Median total sulphur content has increased from 0.1% in 2018 to 0.24% in 2019.
- TIC content ranged between 97 and 220 kg $CaCO_3$/t. All flotation tailings samples were classified as non-PAG, which in consistent with 2017 and 2018 operational tailings monitoring (SRK 2019) and metallurgical tailings samples (SRK 2015).
- Trace element content was compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment. The following parameters showed enrichment, all other parameters were below the screening criteria indicating no appreciable enrichment:
  - April, June, November and December samples contained elevated arsenic (9 to 170 mg/kg) and was within the range of concentrations for historical samples (except April at 170 ppm).
  - Five samples were elevated in sulphur (3,100 to 5,300 mg/kg for enriched samples).
  - All samples analyzed for gold were elevated relative to a screening criterion of 40 mg/kg (660 to 3,100 mg/kg).
  - Bismuth was elevated in the sample collected in April (9.4 mg/kg).

The results of the 2019 geochemical monitoring program of detoxified tailings solids (TL-7A) is summarized as follows:

- Sulphur concentrations ranged between 9.6 and 25 % in 2019 and were highest between the months of July and December (21 to 25%).
- TIC results for 2019 ranged between 64 and 170 kg $CaCO_3$/t. All of the detoxified tailings samples were classified as PAG, which is consistent with 2017 and 2018 operational tailings monitoring and metallurgical tailings samples (SRK 2015).
- All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, selenium, gold, silver and sulphur. More than half of samples elevated in cadmium, lead and zinc. The range of concentrations for bismuth, cadmium, copper, selenium, silver and zinc in 2019 was within the range of 2017 and 2018 samples. Arsenic concentrations where slightly higher (9.2 mg/kg median concentration in 2018, compared to 15 mg/kg in 2019). All other parameters were below the screening criteria indicating no appreciable enrichment.

The results of the 2019 geochemical monitoring program of detoxified tailings filtrate (TL-7B) is summarized as follows:

- pH conditions ranged from 8.5 to 8.8 s.u.
- Concentrations of sulphate (a by-product of milling of sulphide rich ore) ranged from 12,000 mg/L to 28,000 mg/L.
- Total cyanide concentrations ranged from 0.38 to 2.1 mg/L. Concentrations of free and WAD cyanide ranged from <0.005 to 0.015 mg/L and 0.063 to 0.48 mg/L, respectively.
- Thiocyanate and cyanate concentrations ranged from 12 mg/L to 490 mg/L and 10 mg/L to 670 mg/L, respectively. Ammonia concentrations ranged from 180 to 290 mg/L. These parameters are produced as by-products of the cyanide detoxification process.
- Milling of the sulphide rich ore results in high concentrations of total metals, including: arsenic (0.022 to 0.17 mg/L), antimony (0.0059 to 0.045 mg/L), cadmium (<0.00025 to 0.00059 mg/L), cobalt (0.035 to 0.13 mg/L), copper (3.3 to 20 mg/L), iron (<0.5 to 13 mg/L), manganese (0.13 to 0.41 mg/L), molybdenum (0.024 to 0.27 mg/L), nickel (<0.025 to 0.14 mg/L), selenium (0.0053 to 0.051 mg/L), silver (0.0033 to 0.040 mg/L).
- The following parameters were consistently reported at concentrations less than analytical detection limits in all filtrate samples: chromium, phosphorous, and zinc.

Trends in process plant tailings water discharge (TL-5) are summarized as follows:

- pH was slightly alkaline ranging from 8.0 to 8.4 s.u for all months except August which reported a pH of 6.2 s.u.
- Sulphate loadings were initially stable with the range equivalent to 2018 but showed an increasing trend during the second half of 2019.
- Trends for major ions and trace elements were stable in 2019 with ranges equivalent to 2018. Exceptions included magnesium, molybdenum, antimony and selenium all of which exhibited increasing trends in 2019. Arsenic loadings have been stable since mid-2018. Selenium showed elevated loadings between August and November, relative to other months in 2019.

The results of the opportunistic seepage sampling from underground backfilled stopes (TL-11) is summarized as follows:

- Seepage was sampled from the West limb of the North stope and the West limb of the South stope on Level 120 and Level 134 respectively during the December survey. Based on field observations these seepage samples are interpreted to be contact water of waste rock and tailings backfill with the results summarized as follows:
  - pH is slightly alkaline with both seeps reporting a pH of 8.0.
  - Major anion chemistry was dominated by chloride and to a lesser degree sulphate. The major cation chemistry was dominated by sodium with lesser magnesium followed by calcium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), and sulphide oxidation with resulting carbonate dissolution from waste rock and detoxified tailings (sulphate, calcium and magnesium).

  - Levels of ammonia (10 to 17 mg/L), nitrate (14 to 16 mg/L) and nitrite (0.6 to 0.72 mg/L) were lower than the 5th percentile concentrations from the historical sample set.
  - Cadmium (0.00032 to 0.00056 mg/L), copper (0.039 to 0.10 mg/L), nickel (0.082 to 0.12 mg/L), selenium (<0.001 to 0.0012 mg/L) and silver (3.6 to 3.7 mg/L) were noted as parameters of potential concern based on the humidity cell test (HCT) program for Doris detoxified tailings (SRK 2015). The exception to this was zinc, which reported elevated concentrations (0.026 to 0.096 mg/L) in the survey but was not noted as a parameter of potential concern in the HCT program.

- No seepage was observed in May, but samples were collected from pooled water at the base of backfilled stopes on Levels 4932, 4946, 4964, 5002, 4735 and 4905. The concentrations for these samples (with the exception of TL-11D-27MAY19) were notably higher than the December samples. The higher concentrations are interpreted to be a result of evaporation in the standing pools of water sampled and therefore not representative of contact water. Also, the chemistry of TL-11D-27MAY19 was notably different to the chemistry of other samples collected during the May seepage survey. The sample was collected in the vicinity of the surface vent raise and the data suggest that the seepage sample was potentially diluted by meteoric water.

Regards
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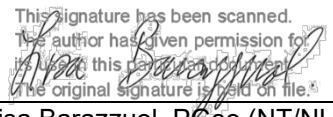
Reviewed by



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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Attachment A – TL-6 Geochemical Data

TMAC RESOURCES Flotation Tailings (TL-6)				ABA									Metals														
Sample ID	Station ID	Lab ID	Date Sampled	Moisture	Total Sulfur	HCl Extracted Sulfate	Sulfide Sulfur (by diff.)	CO_2	Inorganic Carbon	$CaCO_3$ Equiv.	AP	NP_{TIC}/AP	Al	Sb	As	Ba	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	La	Pb	Ga	Au
			Units>	%	%	mg/L	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb
TL6-7JAN19	TL-6	B910233	1/7/2019	-	0.09	0.01	0.08	7.0	1.9	158	2.2	72	5400	<0.1	6.4	5.0	<0.1	<20	<0.1	3.6	54	8.7	26	3.7	2	1.5	2	939
TL6-3FEB19	TL-6	B914932	2/3/2019	-	0.21	0.01	0.20	4.9	1.3	110	6.3	18	460	0.1	17	5.0	<0.1	<20	0.1	3.1	37	11	93	3.4	1	4.0	2	809
TL6-3MAR19	TL-6	B925906	3/3/2019	-	0.17	0.02	0.15	5.5	1.5	125	4.4	29	5200	<0.1	13	7.0	<0.1	<20	<0.1	3.3	51	12	37	3.4	1	3.8	2	3110
TL6-10APR19	TL-6	B929338	4/10/2019	-	0.35	0.04	0.31	6.9	1.9	157	10	16	5300	5	169	13	9.4	<20	0.1	3.5	60	12	82	4.1	1	44	2	1460
TL6-6MAY19	TL-6	B936614	5/6/2019	-	0.23	0.02	0.21	5.0	1.4	113	6.6	17	7300	<0.1	13	52	0.1	<20	0.1	2.6	63	12	70	3.6	2	9.8	3	1200
TL6-3JUN19	TL-6	B945612	6/3/2019	-	0.33	0.01	0.32	7.0	1.9	158	11	14	7300	0.1	23	17	0.1	<20	0.2	3.9	53	17	99	4.5	2	11	3	2480
TL6-7JUL19	TL-6	B959350	7/7/2019	-	0.24	0.02	0.22	7.6	2.1	172	7.8	22	6500	<0.1	16	8.0	<0.1	<20	0.2	3.9	41	14	99	4.5	1	7.3	2	1430
TL6-22AUG19	TL-6	B969604	8/22/2019	-	0.30	0.02	0.28	4.3	1.2	97	9.4	10	7400	0.3	12	10	0.1	<20	0.3	2.5	48	12	639	3.6	2	14	4	1850
TL6-12SEP19	TL-6	B980380	9/12/2019	-	0.19	0.02	0.17	4.8	1.3	109	5.9	18	10800	0.2	9.0	14	<0.1	<20	0.1	3.1	62	13	70	4.4	2	12	4	919
TL6-21OCT19	TL-6	B990946	10/21/2019	-	0.24	0.02	0.22	5.6	1.5	128	7.5	17	9200	0.1	11	14	0.1	<20	0.1	3.1	65	13	91	4.0	1	9.4	3	659
TL6-19NOV19	TL-6	B999581	11/19/2019	-	0.53	0.02	0.51	8.9	2.4	203	16.6	12	10500	0.4	55	12	0.1	47	0.7	4.9	73	21	135	5.5	2	43	4	763
TL6-16DEC19	TL-6	B9A8364	12/16/2019	-	0.38	0.03	0.35	9.7	2.6	220	11.9	19	9200	0.4	53	13	0.3	<20	0.2	4.7	114	17	90	5.0	2	12	3	1020

TMAC RESOURCES Flotation Tailings (TL-6)				Metals																			
Sample ID	Station ID	Lab ID	Date Sampled	Mg	Mn	Hg	Mo	Ni	P	K	Sc	Se	Ag	Na	Sr	S	Te	Tl	Th	Ti	W	U	V	Zn
			Units>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
TL6-7JAN19	TL-6	B910233	1/7/2019	10800	1050	<0.01	0.30	18	290	400	6.3	<0.5	0.2	0.061	18	700	<0.2	<0.1	0.1	30	0.7	<0.1	17	31
TL6-3FEB19	TL-6	B914932	2/3/2019	10000	973	0.02	0.40	22	230	400	6.1	<0.5	0.3	0.057	16	2000	<0.2	<0.1	0.7	80	0.2	<0.1	17	43
TL6-3MAR19	TL-6	B925906	3/3/2019	10700	934	<0.01	0.30	23	270	400	5.8	0.6	0.5	0.069	17	1400	<0.2	<0.1	0.2	80	0.3	<0.1	18	42
TL6-10APR19	TL-6	B929338	4/10/2019	11800	1020	0.23	0.50	22	320	500	6.5	<0.5	1	0.063	18	3200	0.4	<0.1	1.1	80	0.6	<0.1	19	52
TL6-6MAY19	TL-6	B936614	5/6/2019	13000	830	<0.01	0.50	20	310	500	6.1	<0.5	0.3	0.11	18	2100	<0.2	<0.1	0.4	360	0.4	<0.1	26	55
TL6-3JUN19	TL-6	B945612	6/3/2019	13800	1130	<0.01	0.40	28	310	900	7.9	<0.5	0.6	0.082	51	3500	<0.2	<0.1	0.5	220	0.4	<0.1	25	71
TL6-7JUL19	TL-6	B959350	7/7/2019	13000	1230	<0.01	0.40	22	360	400	7.2	0.6	0.3	0.085	20	2500	<0.2	<0.1	0.2	110	0.4	<0.1	20	71
TL6-22AUG19	TL-6	B969604	8/22/2019	12400	791	0.01	0.30	18	390	500	6.3	<0.5	0.3	0.088	15	3100	<0.2	<0.1	0.5	370	0.8	<0.1	26	74
TL6-12SEP19	TL-6	B980380	9/12/2019	15700	950	<0.01	0.80	20	450	800	7.6	<0.5	0.3	0.13	19	2200	<0.2	<0.1	0.6	500	0.8	<0.1	39	67
TL6-21OCT19	TL-6	B990946	10/21/2019	14800	896	<0.01	1.0	22	300	600	6.9	<0.5	0.2	0.11	18	2400	<0.2	<0.1	0.20	400	0.8	<0.1	39	65
TL6-19NOV19	TL-6	B999581	11/19/2019	21200	1370	<0.01	1.1	53	400	900	10	<0.5	0.9	0.15	40	5300	<0.2	<0.1	0.20	300	0.9	<0.1	38	135
TL6-16DEC19	TL-6	B9A8364	12/16/2019	17700	1400	<0.01	0.90	58	450	700	9	<0.5	0.4	0.11	43	3800	<0.2	<0.1	0.2	80	0.7	<0.1	29	60

Attachment B – TL-7A Geochemical Data

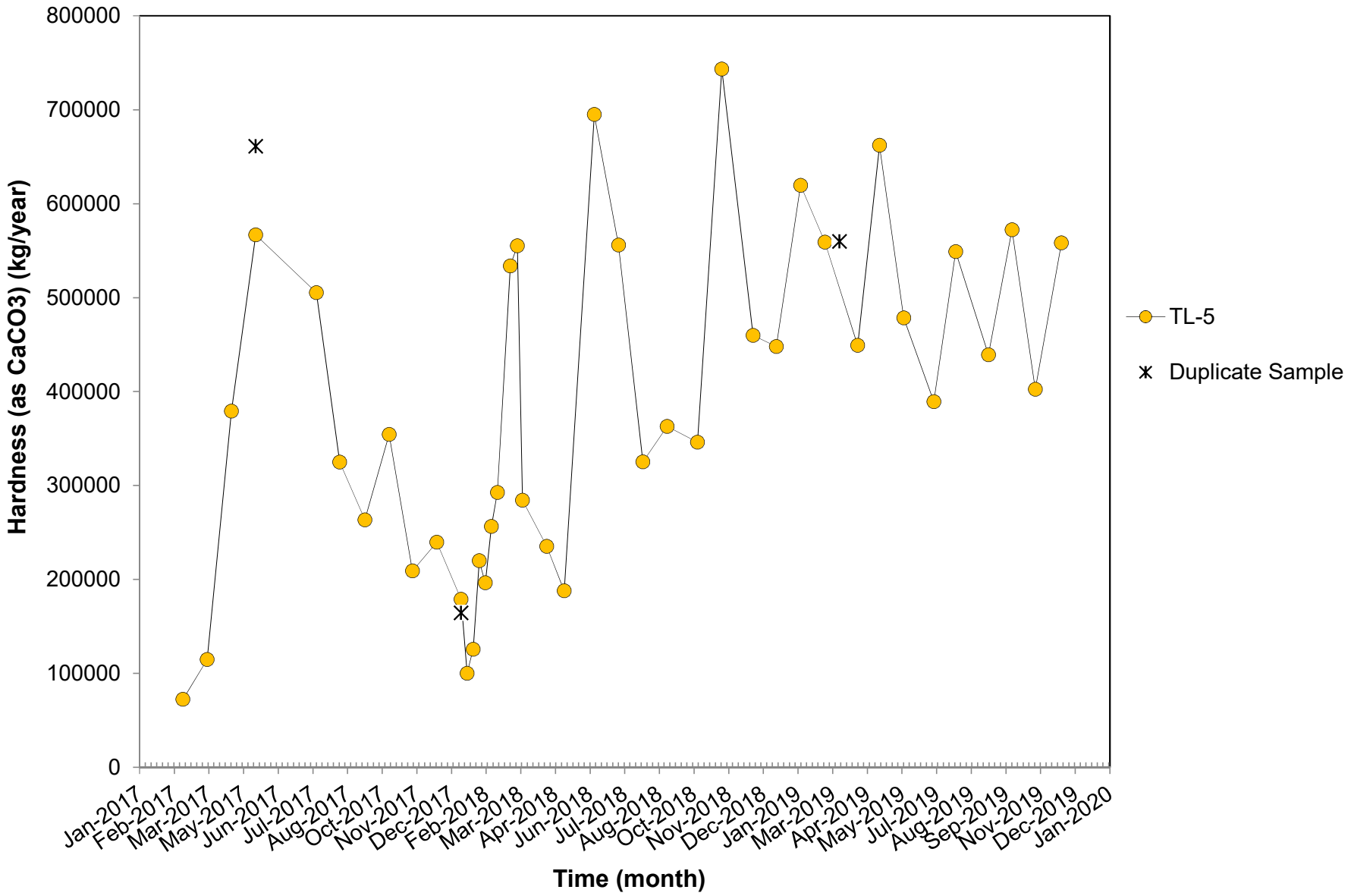
TMAC RESOURCES	Detoxified Tailings (TL-7A)			ABA									Metals														
Sample ID	Station ID	Lab ID	Date Sampled	Moisture	Total Sulfur	HCl Extracted Sulfate	Sulfide Sulfur (by diff.)	CO_2	Inorganic Carbon	$CaCO_3$ Equiv.	AP	NP_{TIC}/AP	Al	Sb	As	Ba	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	La	Pb	Ga	Au
			Units>	%	%	mg/L	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb
TL7-7JAN19	TL-7	B910230	1/7/2019	18	12	0.16	11	7.0	1.9	160	364	0.44	5800	0.5	490	7	1.3	<20	0.6	3.4	80	228	4610	15	1	49	2	12800
TL7-10FEB19	TL-7	B914934	2/10/2019	21	10	0.18	9.5	7.5	2.1	171	301	0.57	6200	0.5	458	8	1.2	<20	1	3.7	61	226	4470	12	1	266	2	6780
TL7-3MAR19	TL-7A	B925908	3/3/2019	22	15	0.2	15	6.1	1.7	140	477	0.29	6500	1.2	665	9	2.2	<20	1.2	3.6	85	289	5060	16	1	134	2	7310
TL7-10APR19	TL-7A	B929340	4/10/2019	23	14	0.26	14	5.5	1.5	125	449	0.28	6800	4.6	808	11	4.6	<20	3.5	3.2	88	283	9440	17	1	504	2	56300
TL7-5MAY19	TL-7A	B936612	5/5/2019	21	12	0.13	11	5.4	1.5	123	362	0.34	7400	1.2	495	20	2.7	<20	4	2.8	69	200	3980	14	2	374	3	16100
TL7-2JUNE19	TL-7A	B945617	6/2/2019	26	13	0.29	13	6.3	1.7	143	409	0.35	8800	0.9	598	10	2.6	<20	3.4	3.7	70	219	5480	16	1	362	3	16500
TL7-7JULY19	TL-7A	B959353	7/7/2019	19	22	0.28	21	4.3	1.2	98	679	0.14	7600	1.5	656	11	5.1	<20	7.1	2.5	67	297	5760	21	1	851	3	17100
TL7-22AUG19	TL-7A	B969606	8/22/2019	19	21	0.27	21	2.8	0.77	64	664	0.10	5200	1.4	451	7	5.3	<20	6.1	1.7	64	278	8780	20	1	776	3	19700
TL7-12SEP19	TL-7A	B980383	9/12/2019	20	22	0.16	22	5.0	1.4	113	690	0.16	6800	1.2	579	10	4.8	<20	5.3	2.5	72	348	6340	23	1	448	3	10500
TL7-21OCT19	TL-7A	B990943	10/21/2019	23	25	0.22	24	5.1	1.4	116	772	0.15	5100	1.1	565	9	3.9	<20	3.5	2.5	66	307	9170	21	1	385	2	16600
TL7-19NOV19	TL-7A	B999582	11/19/2019	54	22	0.1	22	6.0	1.6	137	680	0.20	6100	1	1010	8	3.2	24	2.7	3.5	334	286	4590	21	1	259	2	6620
TL7-16DEC19	TL-7A	B9A8370	12/16/2019	21	21	0.25	21	5.8	1.6	126	671	0.20	8100	1.2	1000	12	6.2	<20	3.5	2.8	359	209	2920	19	1	183	3	4100

TMAC RESOURCES	Detoxified Tailings (TL-7A)			Metals																			
Sample ID	Station ID	Lab ID	Date Sampled	Mg	Mn	Hg	Mo	Ni	P	K	Sc	Se	Ag	Na	Sr	S	Te	Tl	Th	Ti	W	U	V	Zn
			Units>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
TL7-7JAN19	TL-7	B910230	1/7/2019	11200	1090	0.03	2.2	180	260	500	6.5	7.3	13	0.23	19	>100000	2.5	0.2	0.2	50	2.6	<0.1	19	241
TL7-10FEB19	TL-7	B914934	2/10/2019	11700	1180	0.04	2.4	206	250	500	7.4	6.0	14	0.28	20	82400	2.3	0.3	0.4	60	1	<0.1	21	524
TL7-3MAR19	TL-7A	B925908	3/3/2019	11000	1140	0.04	2.7	257	280	600	6.8	10	20	0.23	23	>100000	3.9	0.4	0.5	80	1.5	<0.1	23	522
TL7-10APR19	TL-7A	B929340	4/10/2019	11400	1030	0.14	2.7	244	240	600	6.3	10	51	0.26	22	>100000	3.7	0.6	0.3	160	2.1	<0.1	26	1700
TL7-5MAY19	TL-7A	B936612	5/5/2019	12100	999	0.08	2.6	164	350	700	6.2	9.0	18	0.25	21	>100000	2.2	0.6	3.2	330	2.8	<0.1	23	1620
TL7-2JUNE19	TL-7A	B945617	6/2/2019	14500	1260	0.07	2.7	199	320	600	8.2	10	25	0.49	26	>100000	4.1	0.4	0.2	150	1.3	<0.1	29	1720
TL7-7JULY19	TL-7A	B959353	7/7/2019	10600	953	0.16	3.4	199	320	600	5.8	16	15	0.29	18	>100000	4.3	0.6	0.6	180	1.7	<0.1	26	3920
TL7-22AUG19	TL-7A	B969606	8/22/2019	8200	541	0.08	3.4	188	250	400	4.1	19	16	0.41	12	>100000	4.5	0.9	0.4	250	3.6	<0.1	19	2940
TL7-12SEP19	TL-7A	B980383	9/12/2019	10800	878	0.08	4.3	215	280	600	5.7	15	18	0.21	19	>100000	5.6	1	0.7	270	3.8	<0.1	27	2090
TL7-21OCT19	TL-7A	B990943	10/21/2019	9200	846	0.06	5.1	219	240	500	4.8	16	17	0.30	20	>100000	4.5	0.6	0.3	160	5.5	<0.1	23	1710
TL7-19NOV19	TL-7A	B999582	11/19/2019	12700	979	0.06	4.3	318	260	600	6.4	14	15	0.25	30	>100000	3.5	0.5	0.1	180	4	<0.1	23	1250
TL7-16DEC19	TL-7A	B9A8370	12/16/2019	14200	1040	0.06	4.6	346	260	700	7.0	13	17	0.29	35	>100000	5.3	0.2	0.2	150	4.2	<0.1	28	1080

Attachment C – TL-7B Geochemical Data

TMAC RESOURCES			Aluminum (Al)-Total	Ammonia, Total (as N)	Antimony (Sb)-Total	Arsenic (As)-Total	Barium (Ba)-Total	Beryllium (Be)-Total	Bismuth (Bi)-Total	Boron (B)-Total	Cadmium (Cd)-Total	Calcium (Ca)-Total	Cesium (Cs)-Total	Chromium (Cr)-Total	Cobalt (Co)-Total	Copper (Cu)-Total	Cyanate	Cyanide, Total	Cyanide, Weak Acid Diss	Iron (Fe)-Total	Lead (Pb)-Total	Lithium (Li)-Total	Magnesium (Mg)-Total	Manganese (Mn)-Total	Molybdenum (Mo)-Total	Nickel (Ni)-Total	pH
Sample ID	**Lab ID**	**Sample Date**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**pH**
TL7B	L2231509-1	10-Feb-2019 15:45	<0.15	186	0.006	0.022	0.054	<0.005	<0.0025	1.1	<0.00025	56	<0.0005	<0.005	0.049	5.2	416	0.80	0.063	<0.5	0.0063	<0.05	40.9	0.20	0.024	<0.025	8.6
TL7B	L2239798-1	03-Mar-2019 13:30	0.44	216	0.019	0.12	0.058	<0.002	<0.001	1.2	<0.0001	48	<0.0002	0.0051	0.075	8.5	516	1.5	0.11	3.09	0.0031	0.039	47.1	0.21	0.037	0.028	8.5
TL7B	L2256606-1	10-Apr-2019 14:30	0.65	202	0.0088	0.061	0.048	<0.005	<0.0025	1.0	<0.00025	74	<0.0005	<0.005	0.048	7.2	510	1.0	0.18	5.74	0.015	<0.05	50.3	0.35	0.040	0.031	8.5
TL7B	L2268411-1	05-May-2019 17:45	0.44	175	0.012	0.059	0.071	<0.005	<0.0025	0.89	<0.00025	72	<0.0005	<0.005	0.035	6.0	305	1.8	0.11	2.32	0.0085	0.059	56	0.41	0.053	<0.025	8.5
TL7B	L2285448-1	02-Jun-2019 10:55	0.29	224	0.018	0.11	0.053	<0.005	<0.0025	1.2	<0.00025	41	<0.0005	<0.005	0.13	9.4	570	0.51	0.48	1.68	0.0033	0.055	49.7	0.13	0.066	<0.025	8.7
TL7B	L2307036-1	07-Jul-2019 10:40	0.36	219	0.022	0.040	0.072	<0.005	<0.0025	1.1	0.00029	42	<0.0005	<0.005	0.045	6.5	620	0.55	0.31	2.83	0.0079	0.072	43.9	0.24	0.13	<0.025	8.7
TL7B	L2328804-1	11-Aug-2019 18:50	0.18	229	0.045	0.045	0.056	<0.005	<0.0025	0.91	<0.00025	40	<0.0005	<0.005	0.096	8.5	519	0.38	0.15	0.67	0.0053	0.055	34.4	0.26	0.12	0.139	8.7
TL7B	L2344190-1	08-Sep-2019 16:45	0.61	242	0.019	0.060	0.086	<0.005	<0.0025	1.4	<0.00025	43	<0.0005	<0.005	0.066	11	416	1.8	0.34	4.05	0.0067	0.075	44.9	0.24	0.23	<0.025	8.7
TL7B	L2361805-1	05-Oct-2019 17:05	0.40	259	0.026	0.057	0.058	<0.005	<0.0025	1.3	0.00059	45	<0.0005	<0.005	0.051	19.9	665	1.2	0.11	4.36	0.024	0.059	46.1	0.33	0.27	0.041	8.7
TL7B	L2377266-1	03-Nov-2019 15:30	0.32	270	0.035	0.14	0.053	<0.005	<0.0025	1.0	<0.00025	39	<0.0005	0.0103	0.028	9.4	615	1.2	0.24	5.01	0.0071	0.06	42.9	0.21	0.11	0.031	8.8
TL7B	L2394097-1	08-Dec-2019 15:30	0.53	291	0.028	0.10	0.049	<0.005	<0.0025	1.7	<0.00025	32	<0.0005	0.0181	0.23	3.3	<10	1.0	0.42	4.9	0.012	0.086	75.7	0.21	0.12	<0.025	8.8
TL7B	L2223176-1	21-Jan-2019 10:00	0.84	216	0.013	0.17	0.035	<0.005	-	1.0	<0.00025	36	-	0.0064	0.15	10	311	2.1	0.26	13.2	0.0067	<0.05	45.2	0.25	0.065	0.052	8.6

			Phosphorus (P)-Total	Potassium (K)-Total	Rubidium (Rb)-Total	Selenium (Se)-Total	Silicon (Si)-Total	Silver (Ag)-Total	Sodium (Na)-Total	Strontium (Sr)-Total	Sulfur (S)-Total	Tellurium (Te)-Total	Thallium (Tl)-Total	Thiocyanate (SCN)	Thorium (Th)-Total	Tin (Sn)-Total	Titanium (Ti)-Total	Tungsten (W)-Total	Uranium (U)-Total	Vanadium (V)-Total	Zinc (Zn)-Total	Zirconium (Zr)-Total	Cyanide, Free
Sample ID	Lab ID	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
TL7B	L2231509-1	10-Feb-2019 15:45	<2.5	47	<0.01	0.0053	<5	0.0033	5660	0.46	3890	<0.01	<0.0005	146	<0.005	<0.005	<0.015	0.017	<0.0005	<0.025	<0.15	<0.003	<0.005
TL7B	L2239798-1	03-Mar-2019 13:30	<1	64	<0.004	0.0099	3.8	0.0084	9650	0.49	6860	<0.004	<0.0002	20	<0.002	<0.002	<0.006	0.048	0.00041	<0.01	<0.06	0.0044	<0.005
TL7B	L2256606-1	10-Apr-2019 14:30	<2.5	48	<0.01	0.0151	<5	0.0079	7310	0.68	4710	<0.01	<0.0005	18	<0.005	<0.005	<0.017	0.028	0.00066	<0.025	<0.15	<0.003	<0.01
TL7B	L2268411-1	05-May-2019 17:45	<2.5	68	<0.01	0.007	<5	0.0039	8900	0.72	5920	<0.01	<0.0005	12	<0.005	<0.005	<0.03	0.035	<0.0005	<0.025	<0.15	<0.003	0.0051
TL7B	L2285448-1	02-Jun-2019 10:55	<2.5	69	<0.01	0.0083	<5	0.0078	10600	0.47	7270	<0.01	<0.0005	313	<0.005	<0.005	<0.015	0.062	0.00113	<0.025	<0.15	<0.01	0.0055
TL7B	L2307036-1	07-Jul-2019 10:40	<2.5	66	<0.01	0.0133	<5	0.0052	9840	0.54	6510	<0.01	<0.0005	19	<0.005	<0.005	<0.015	0.053	<0.0005	<0.025	<0.15	<0.01	0.008
TL7B	L2328804-1	11-Aug-2019 18:50	<2.5	30	0.011	0.0274	<5	0.0051	10300	0.56	8130	<0.01	<0.0005	203	<0.005	<0.005	<0.015	0.12	0.00064	<0.025	<0.15	<0.01	<0.005
TL7B	L2344190-1	08-Sep-2019 16:45	<2.5	79	<0.01	0.0121	<5	0.0099	13400	0.69	9200	<0.01	<0.0005	368	<0.005	<0.005	0.02	0.096	0.00053	<0.025	<0.15	<0.01	0.015
TL7B	L2361805-1	05-Oct-2019 17:05	<2.5	57	0.013	0.0508	<5	0.017	11400	0.45	8040	<0.01	<0.0005	196	<0.005	<0.005	<0.015	0.22	0.00072	<0.025	<0.15	<0.01	<0.01
TL7B	L2377266-1	03-Nov-2019 15:30	<2.5	55	<0.01	0.0319	<5	0.0092	8700	0.53	5630	<0.01	<0.0005	184	<0.005	<0.005	<0.015	0.11	<0.0005	<0.025	<0.15	<0.01	<0.005
TL7B	L2394097-1	08-Dec-2019 15:30	<2.5	81	<0.01	0.0094	<5	0.018	10800	0.51	7510	<0.01	<0.0005	493	<0.005	<0.005	<0.015	0.089	0.00062	<0.025	<0.15	<0.01	0.019
TL7B	L2223176-1	21-Jan-2019 10:00	-	67	-	0.007	-	0.040	10200	-	-	-	<0.0005	319	-	<0.005	<0.015	-	0.0013	<0.025	<0.15	-	<0.005



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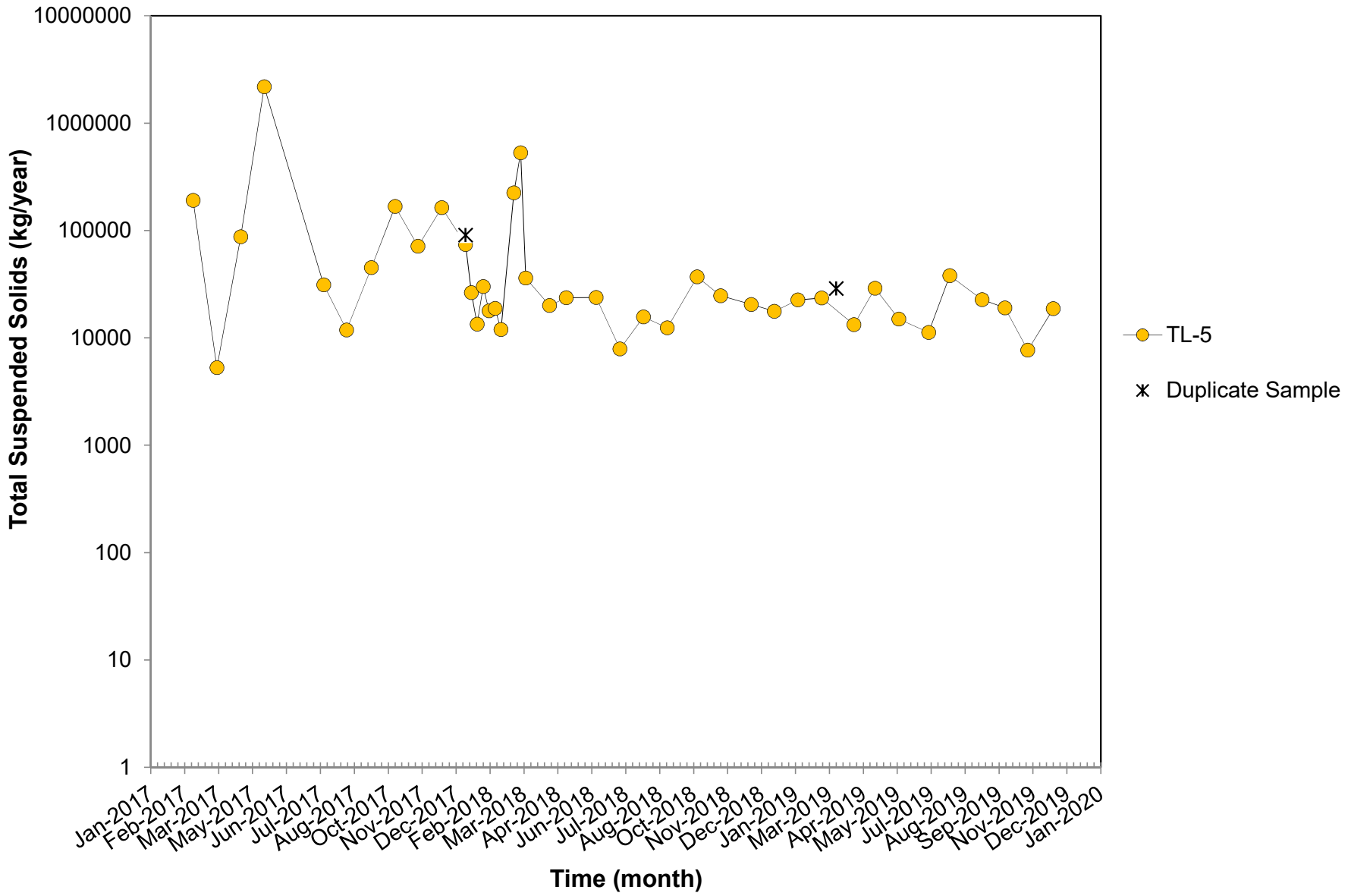

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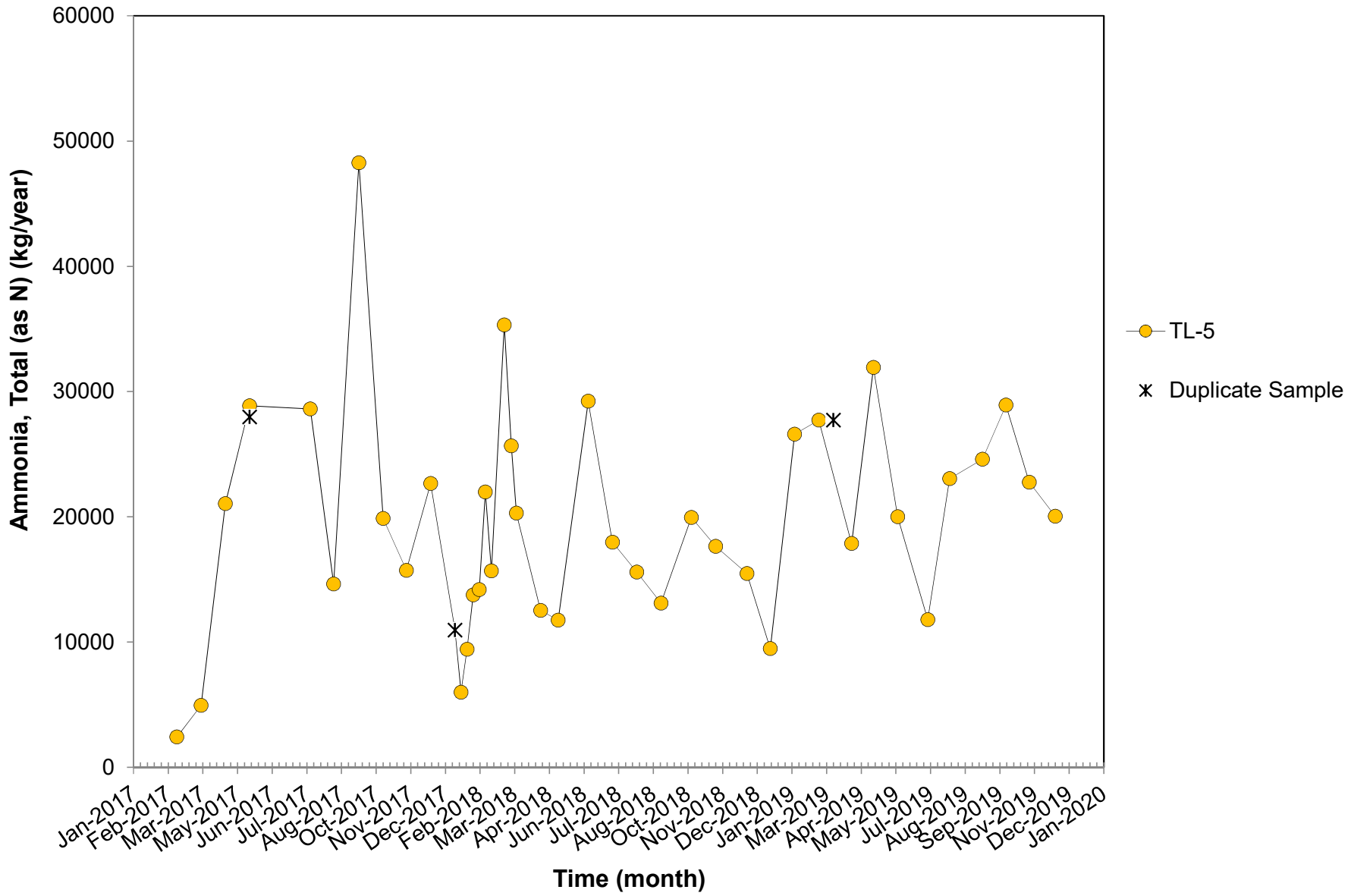

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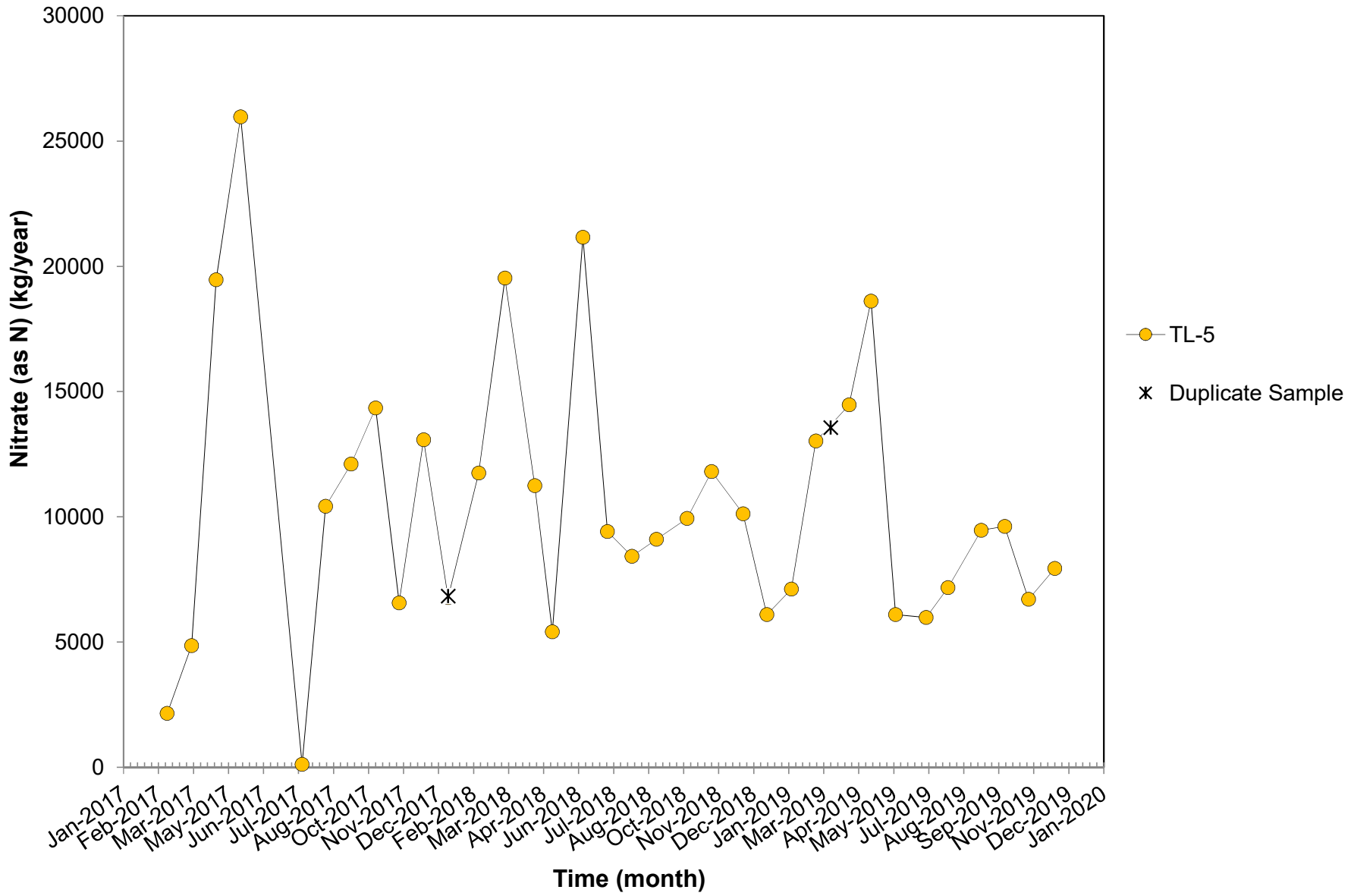

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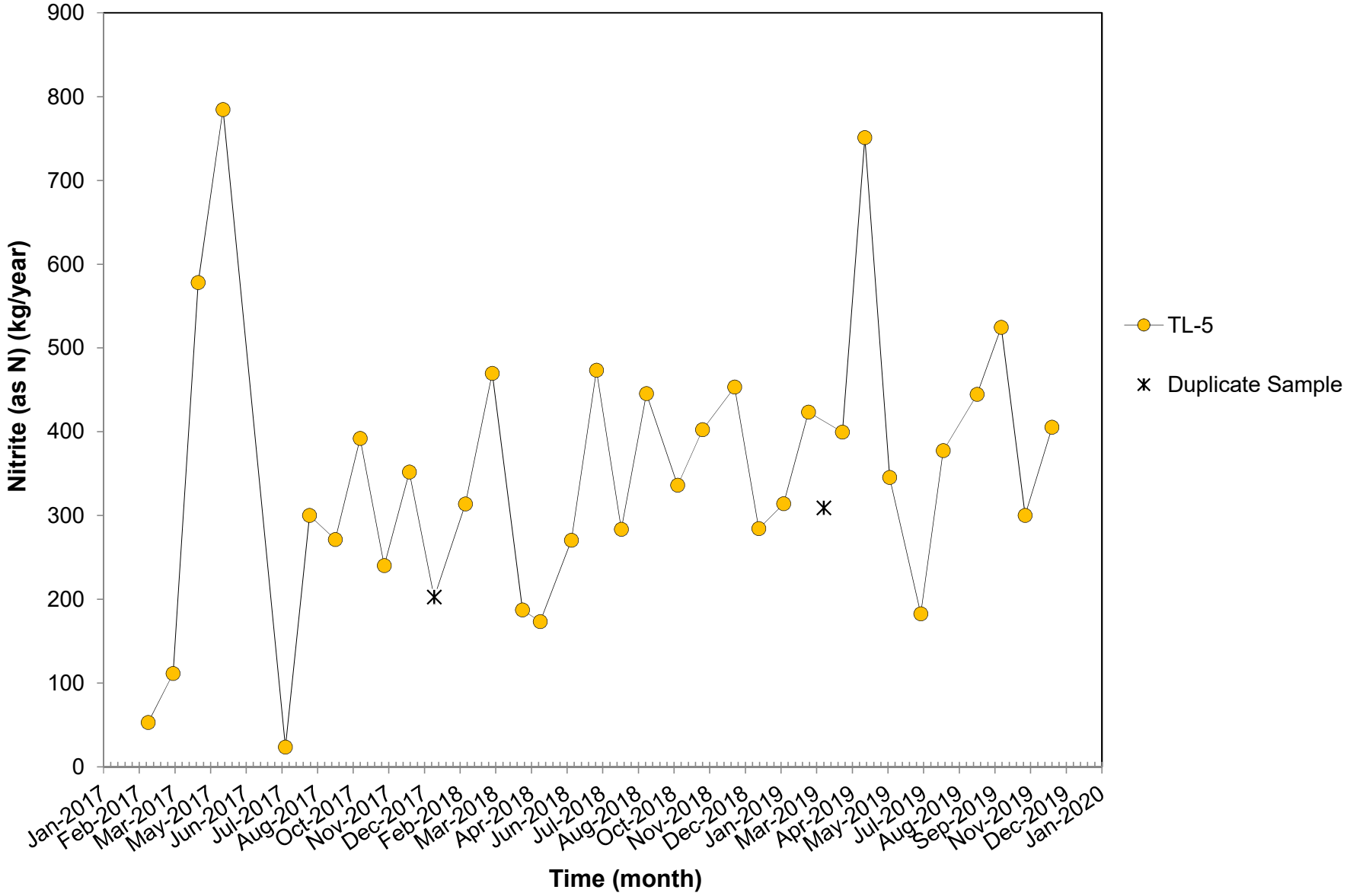

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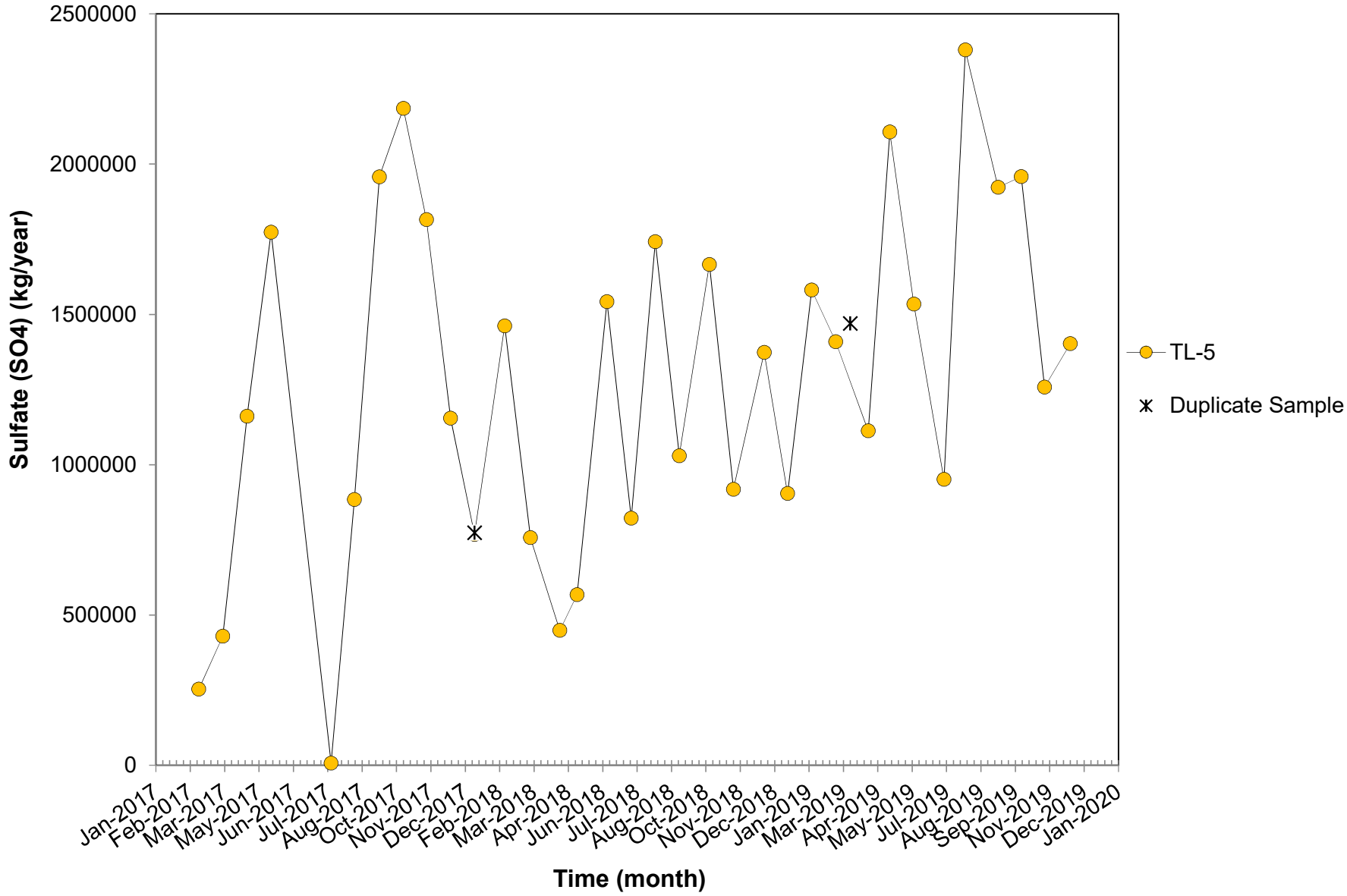

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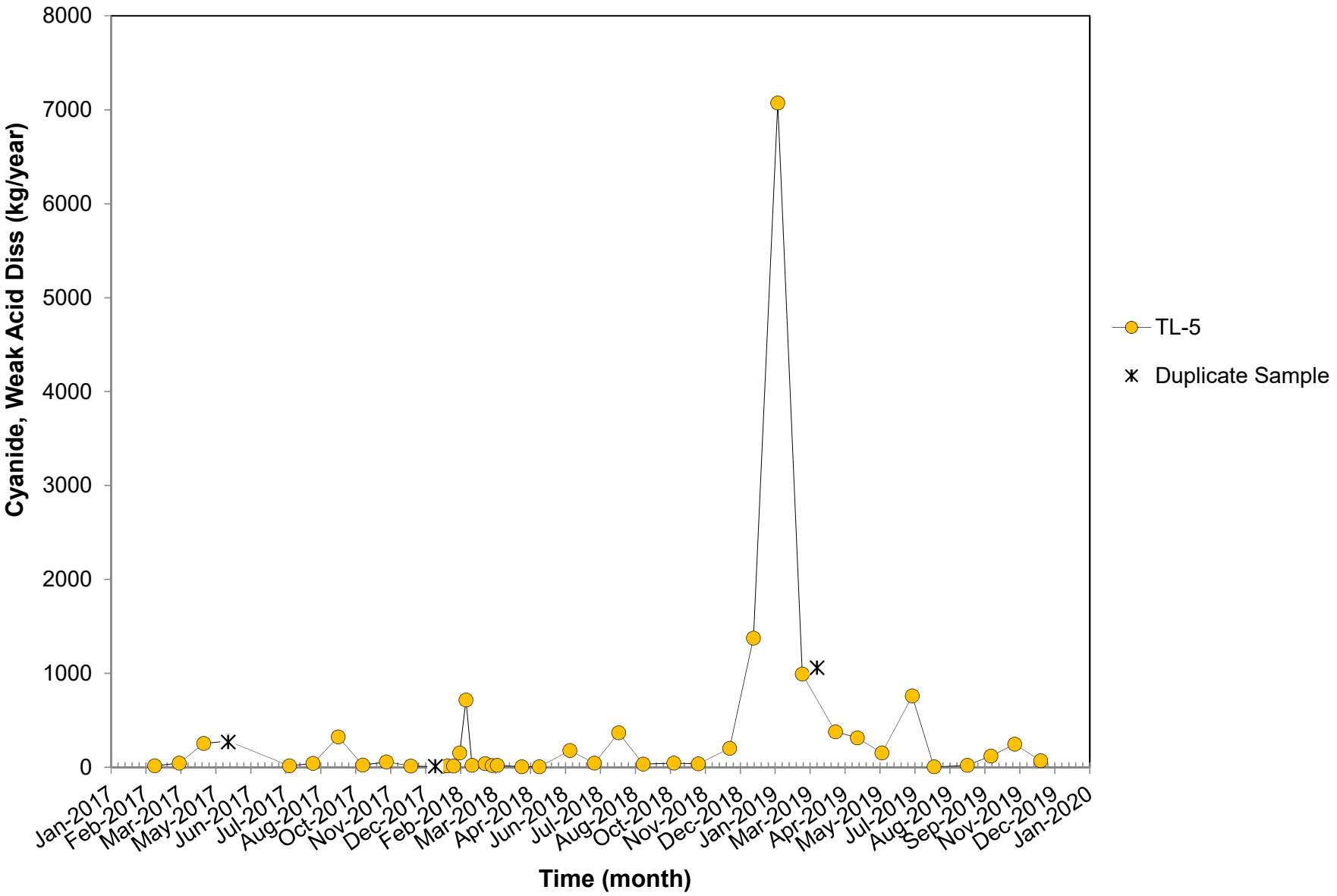

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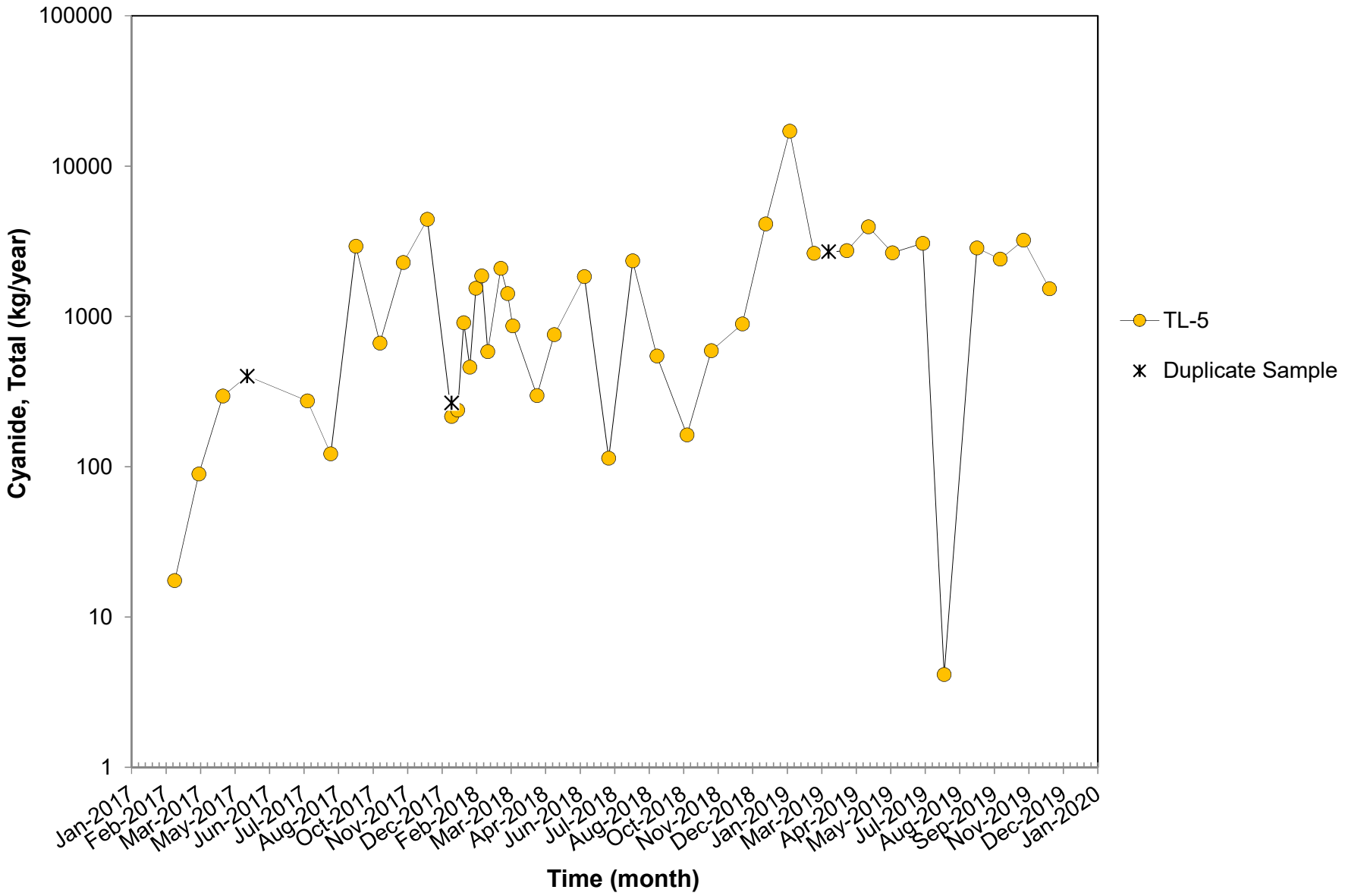

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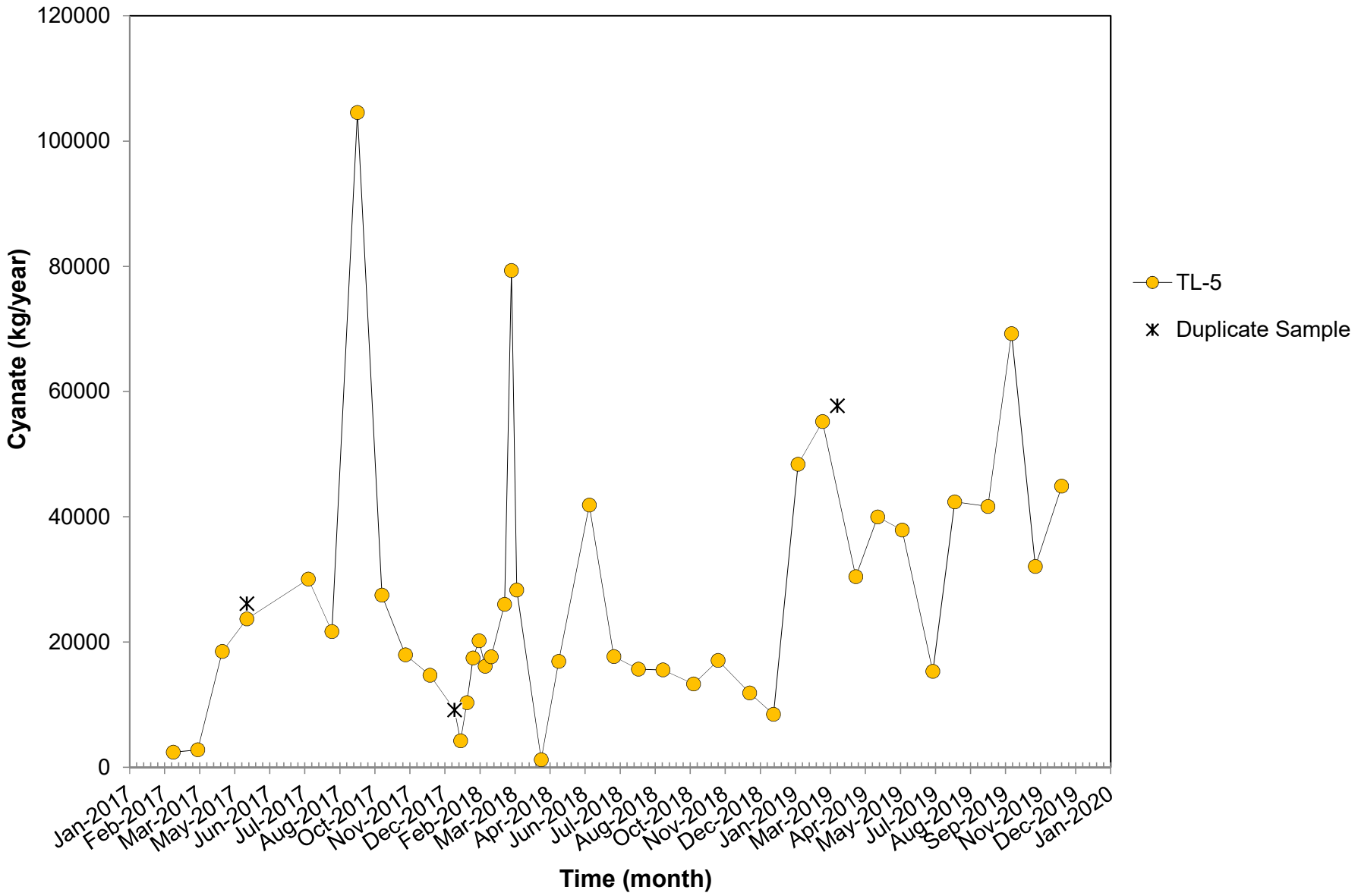

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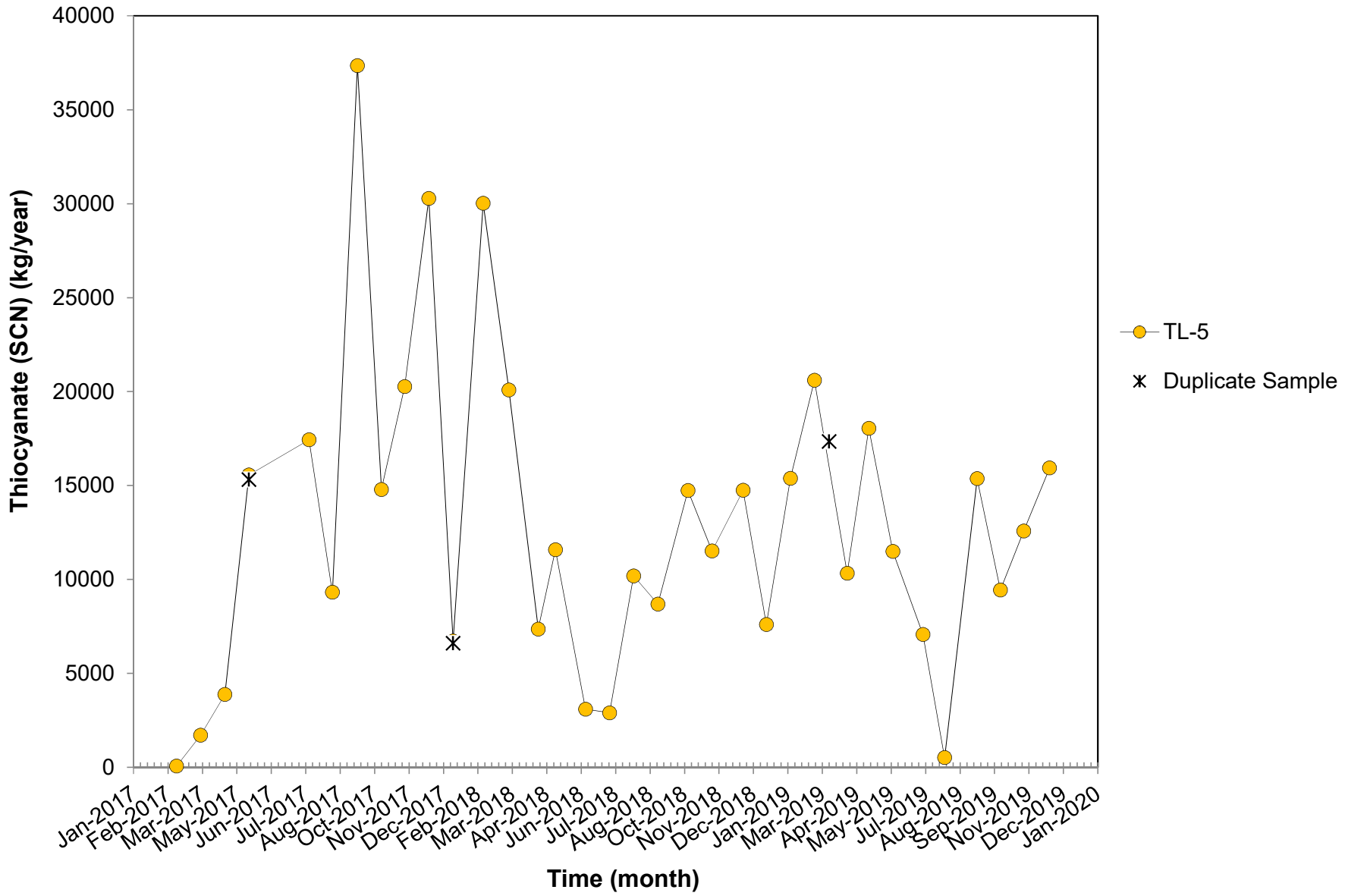

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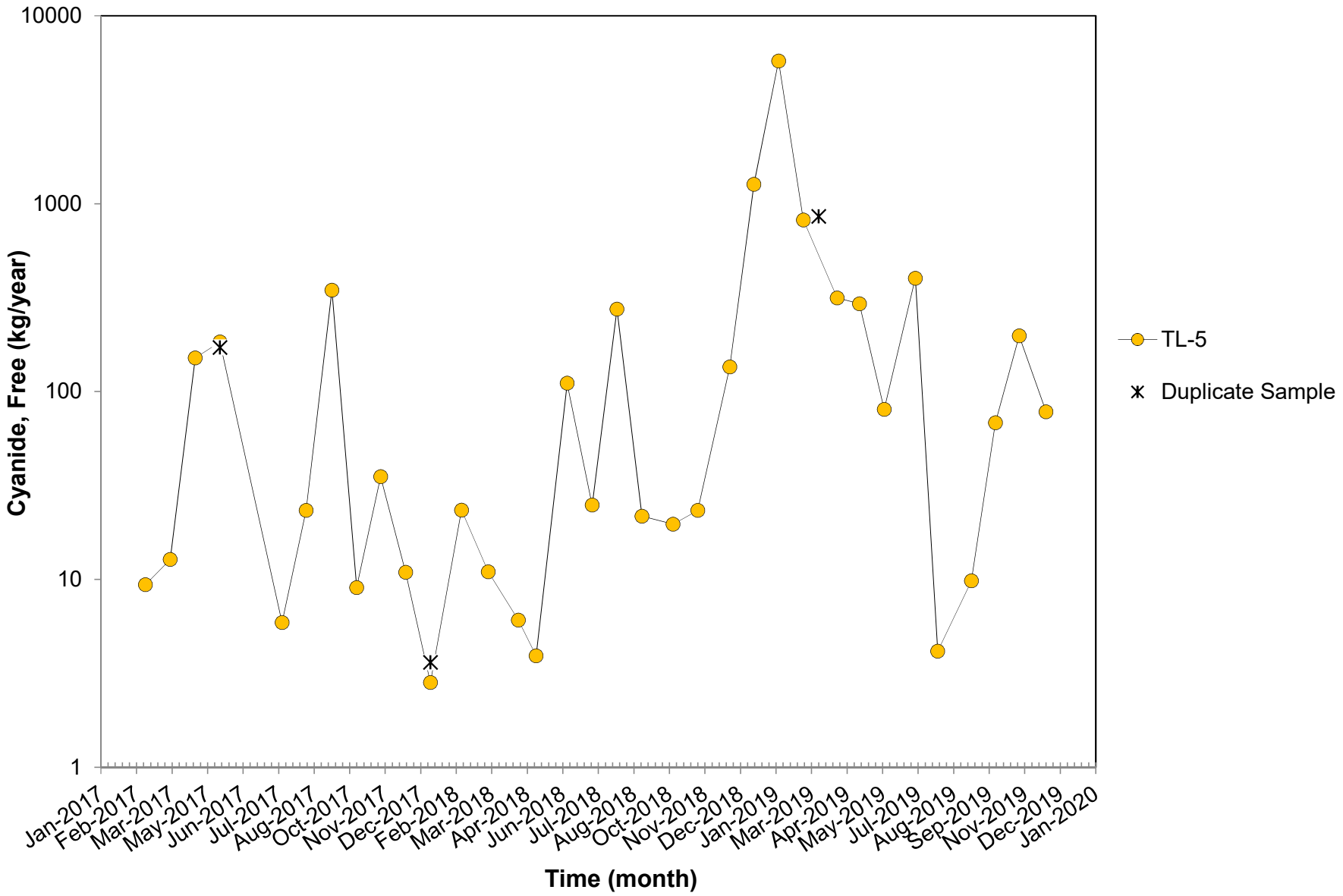

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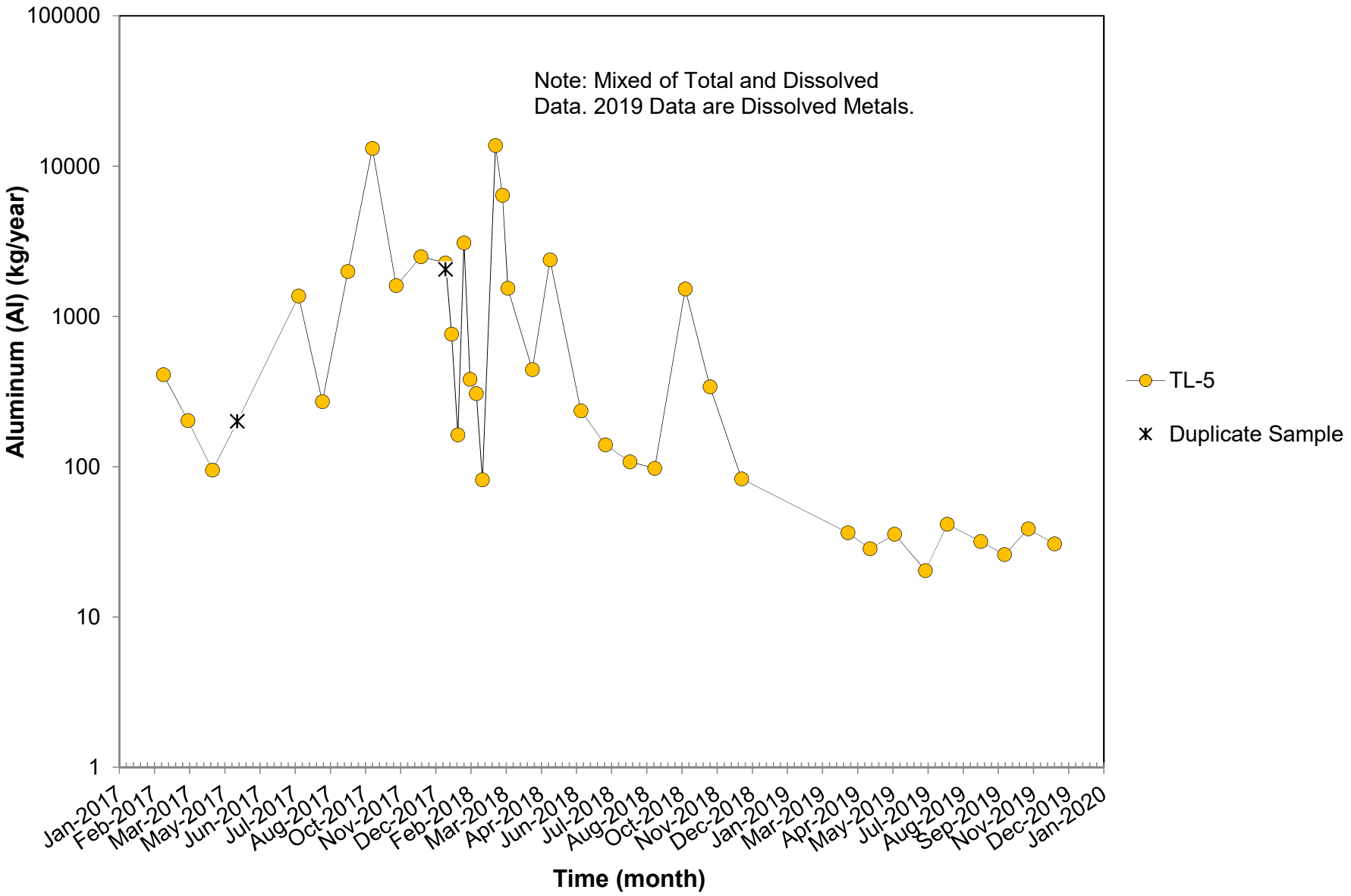

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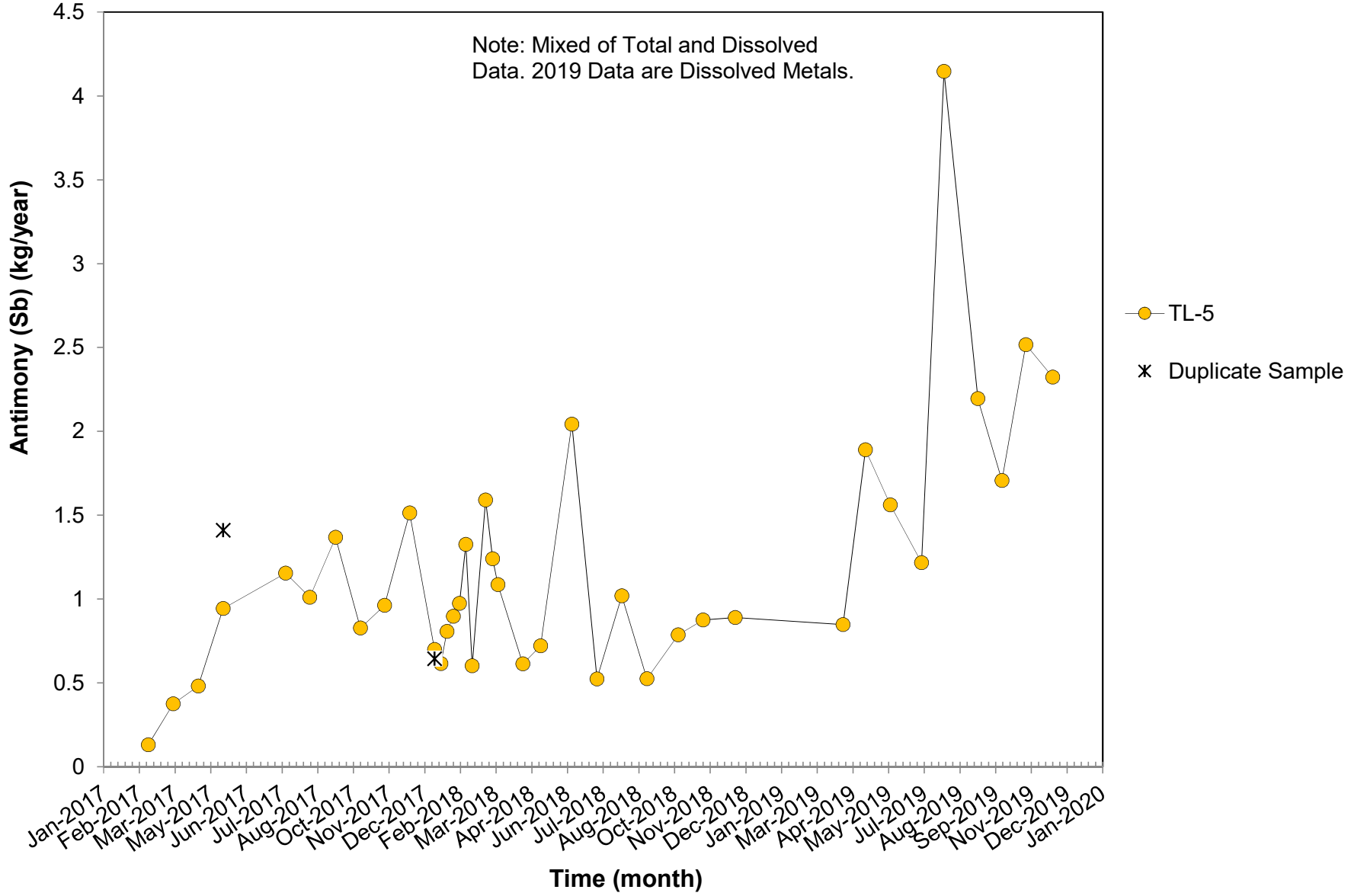

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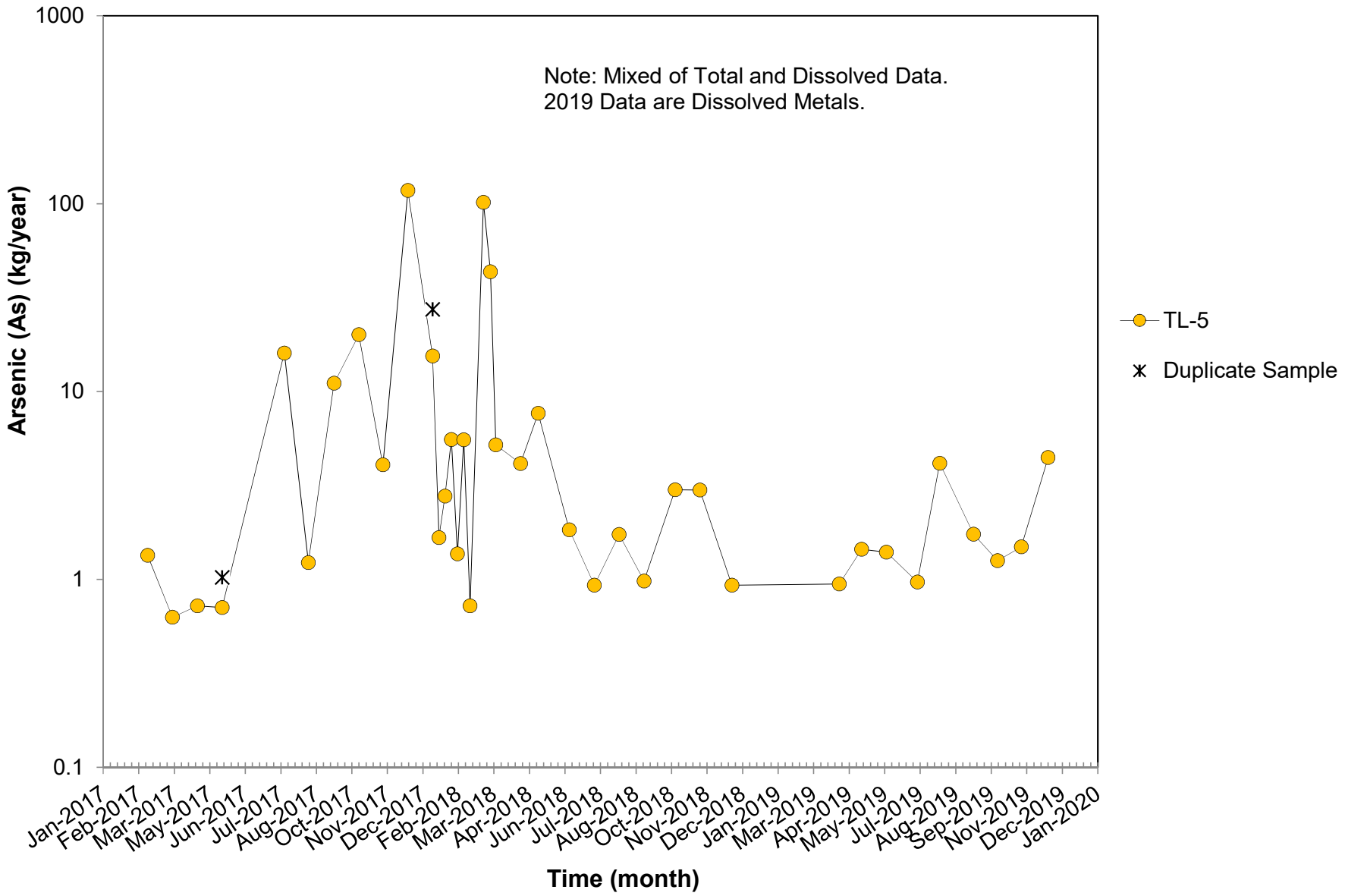

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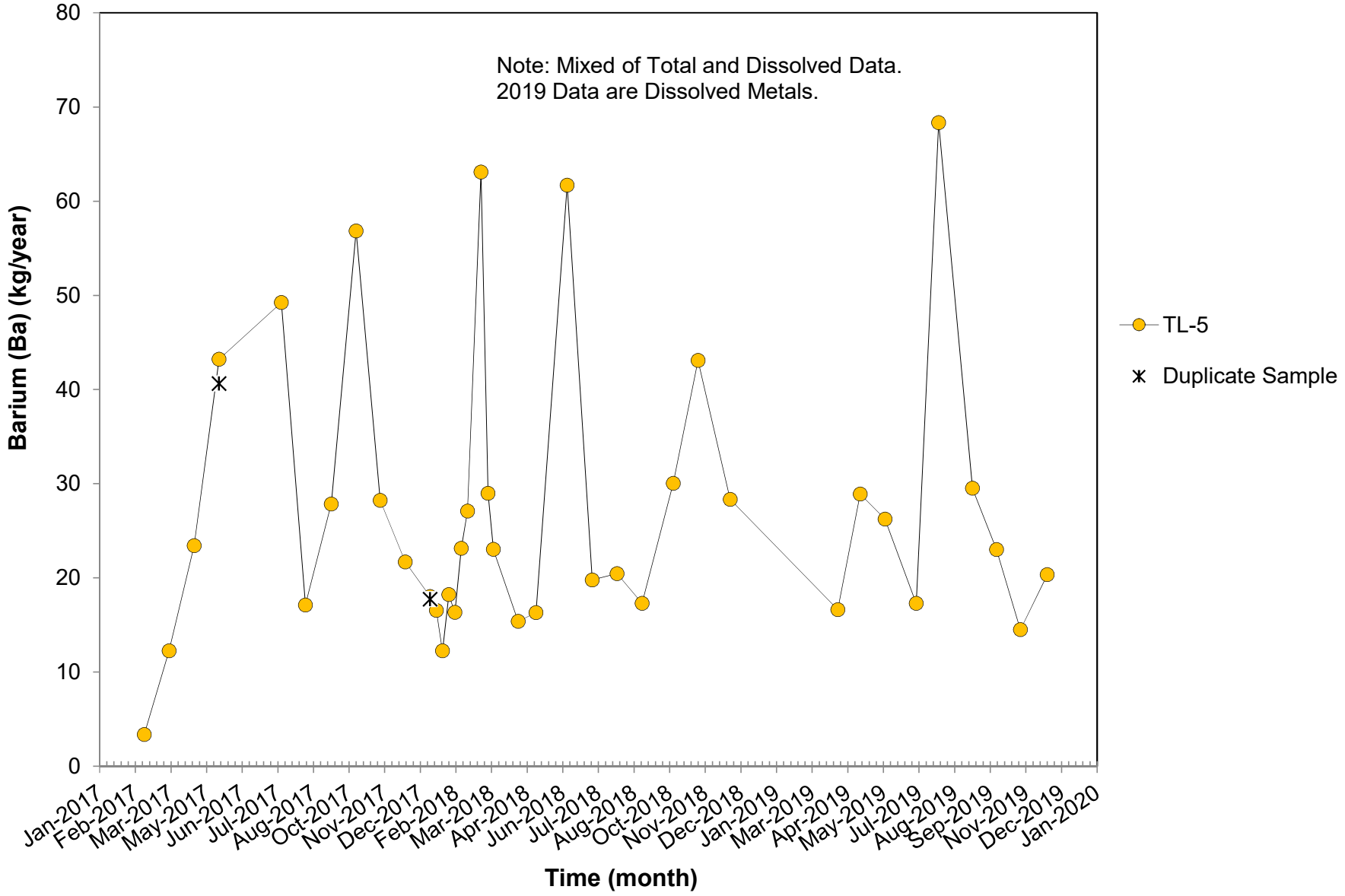

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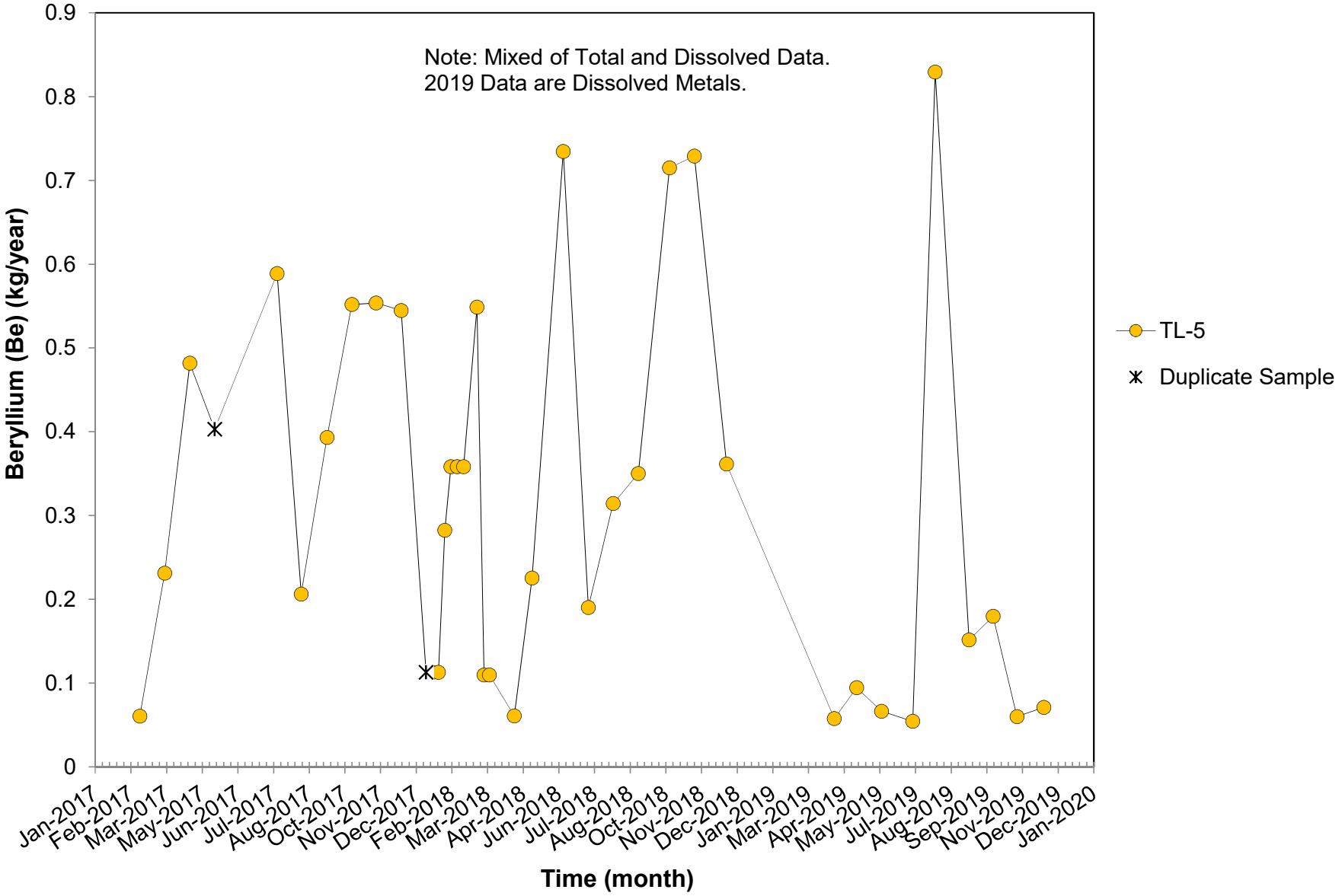

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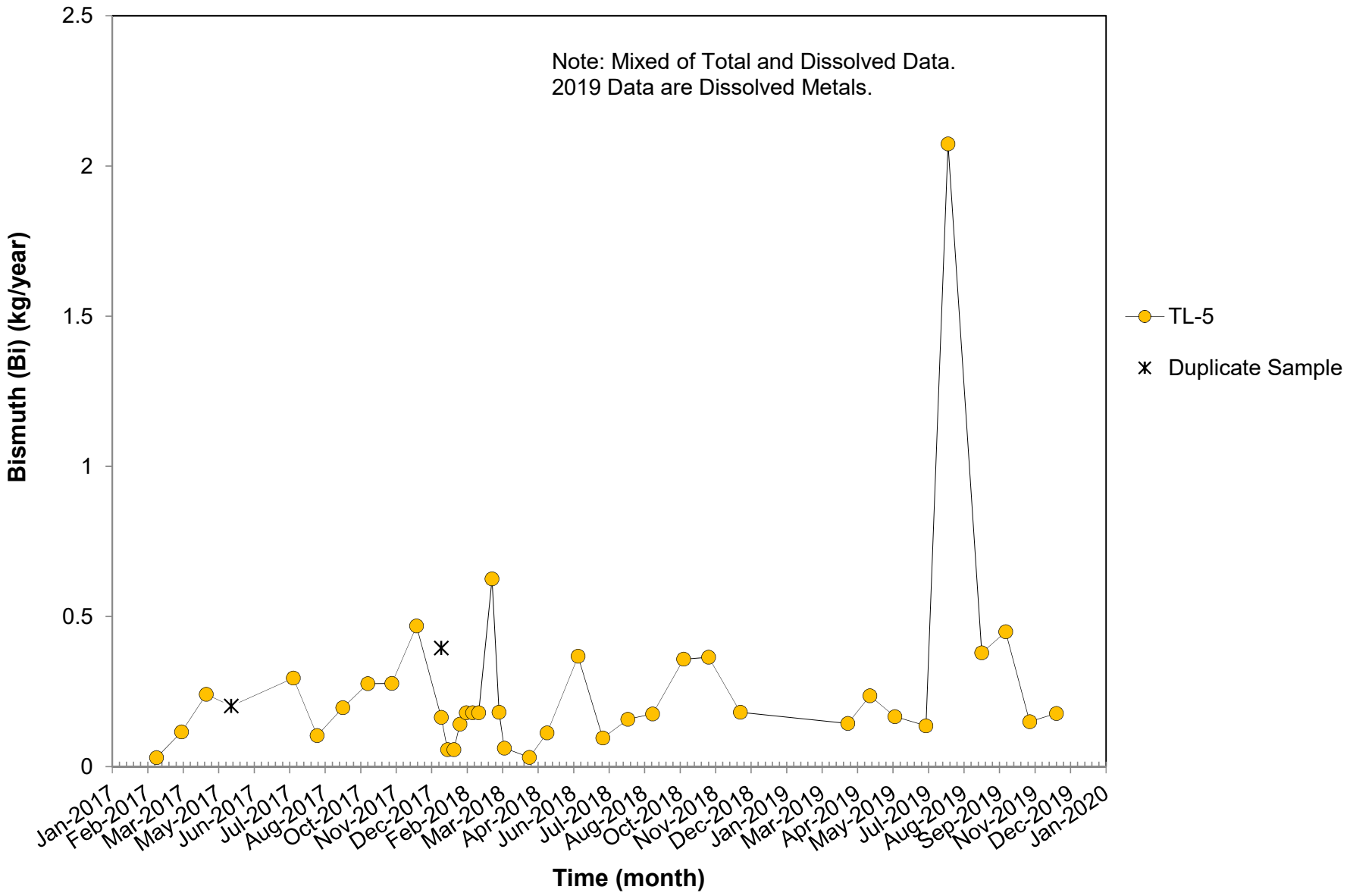

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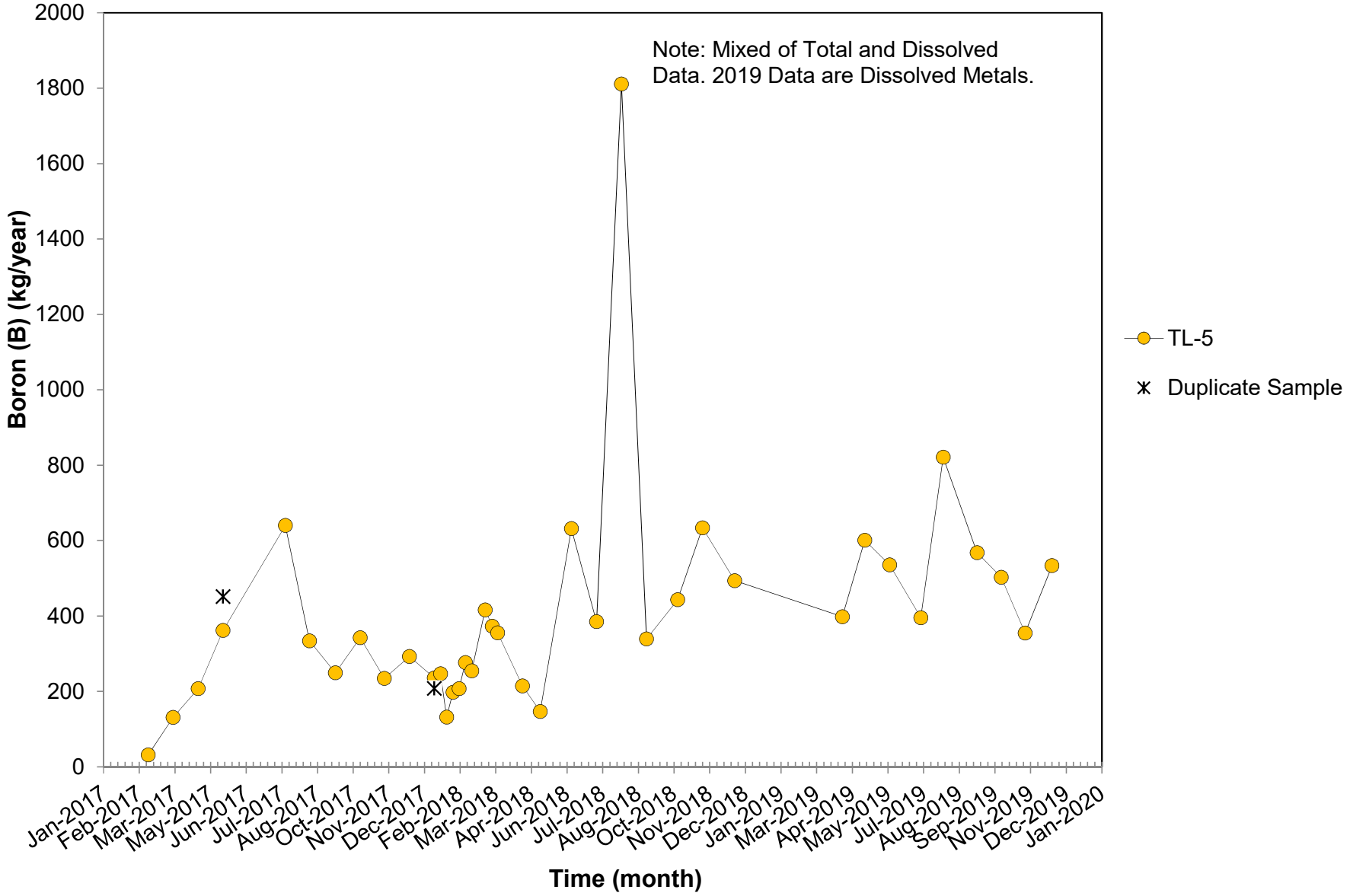

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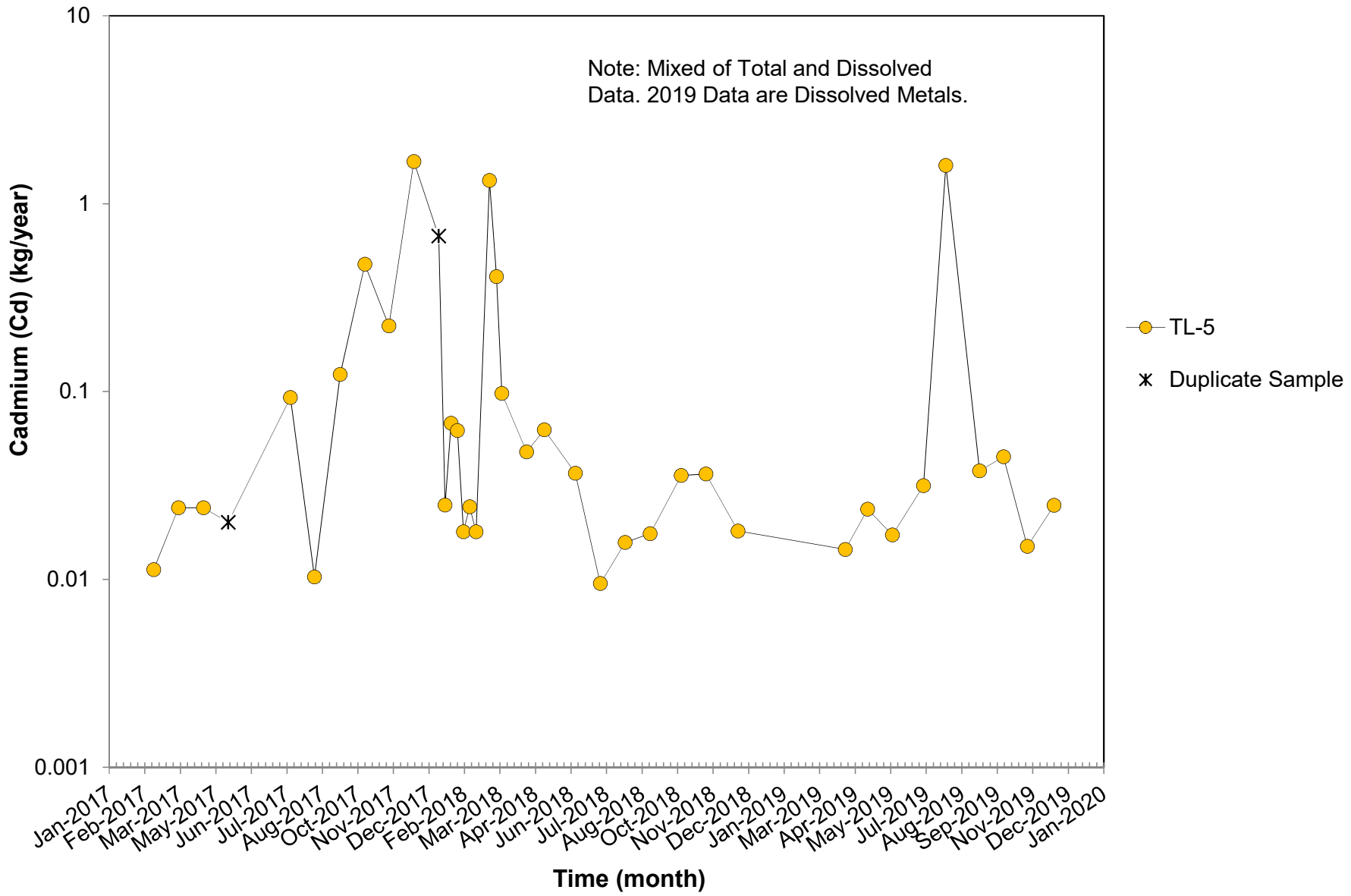

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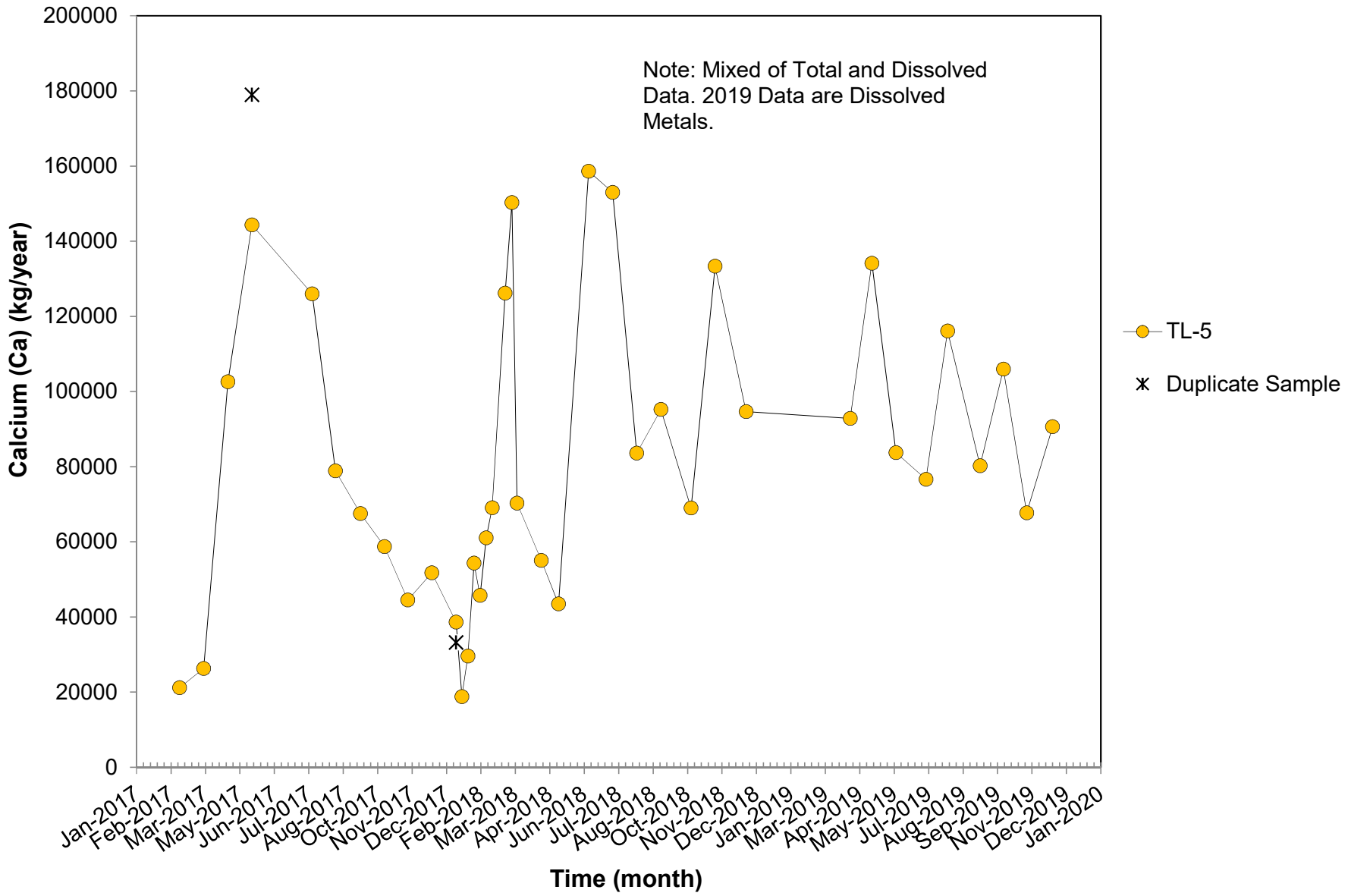

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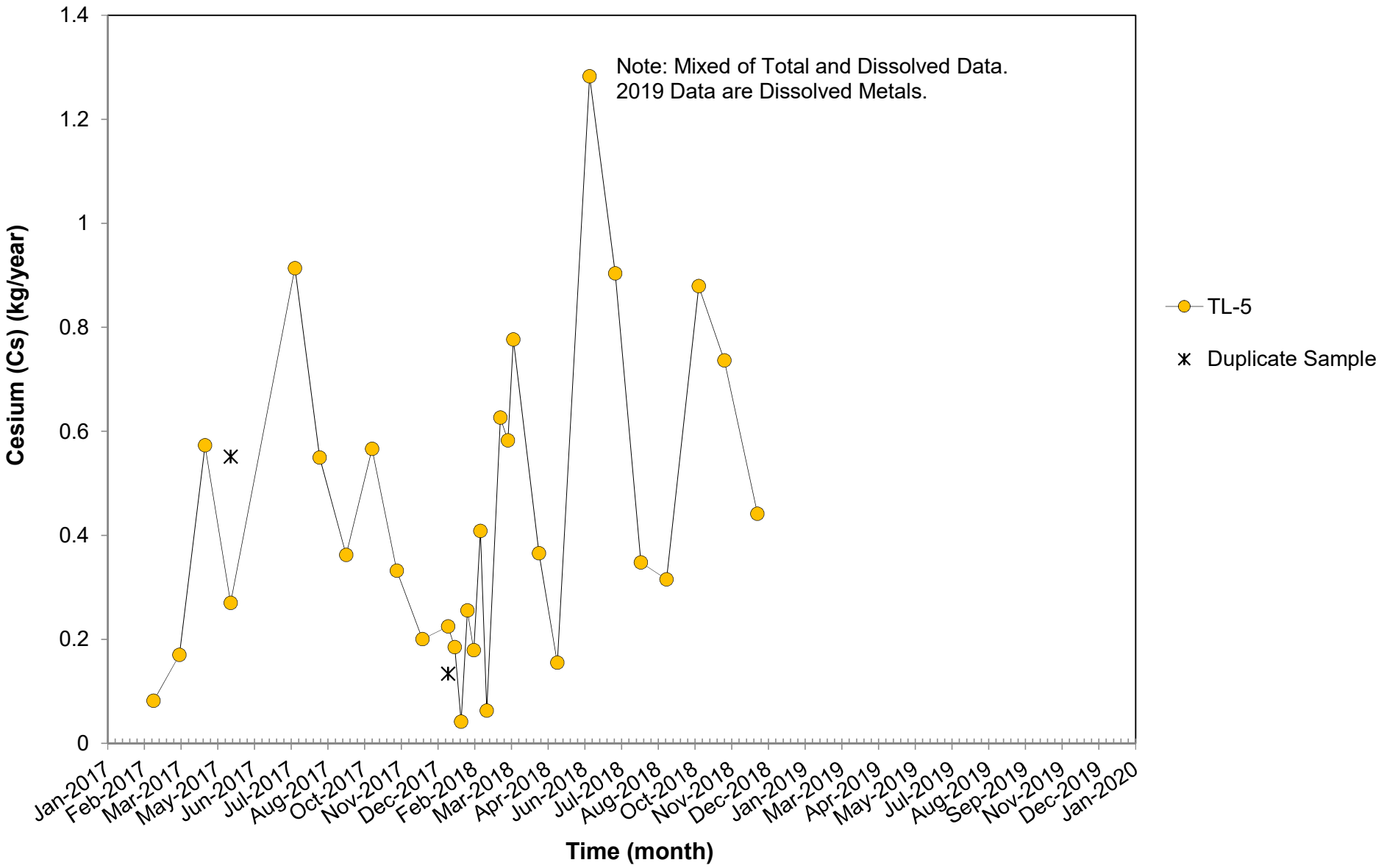

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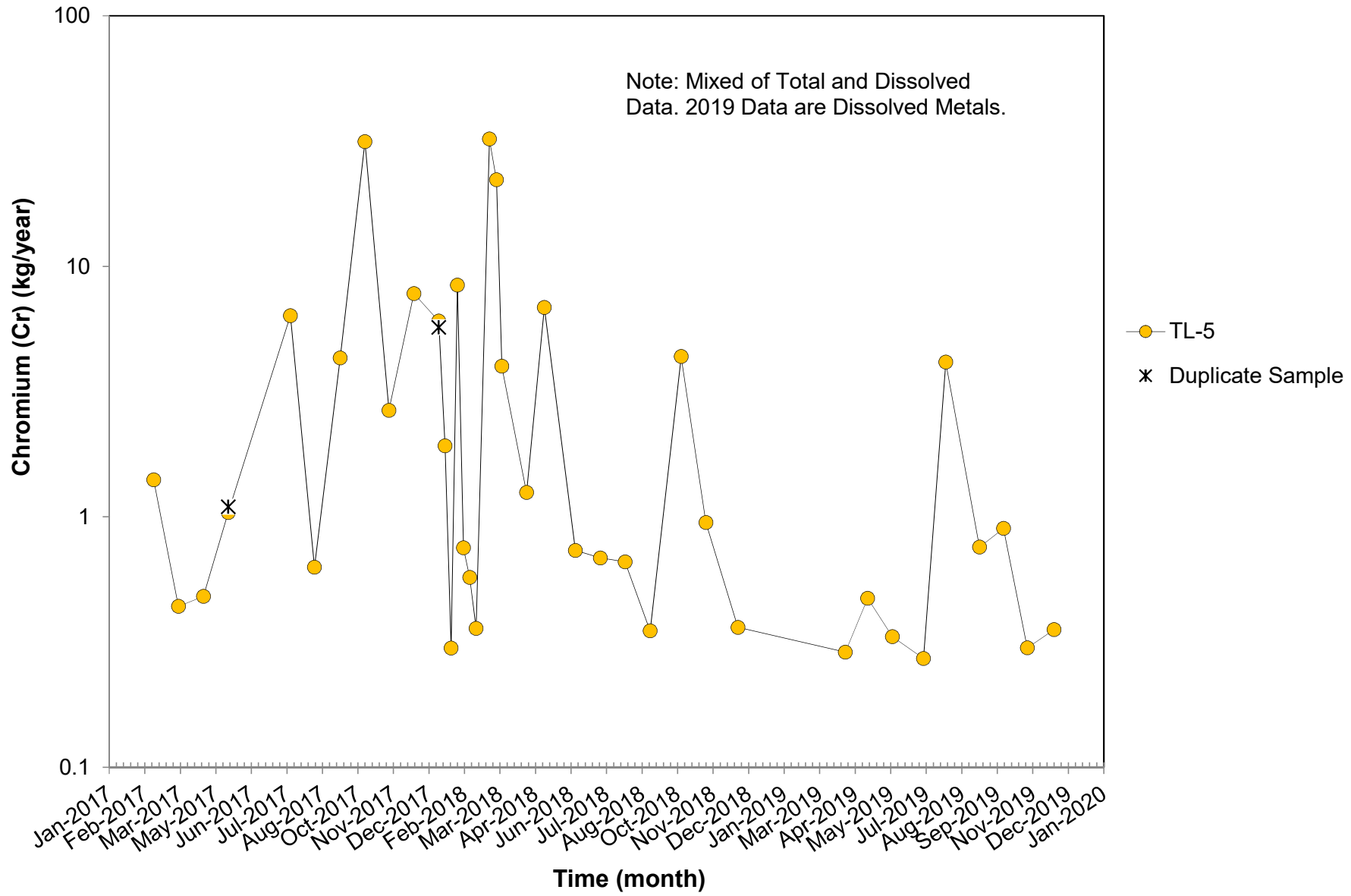

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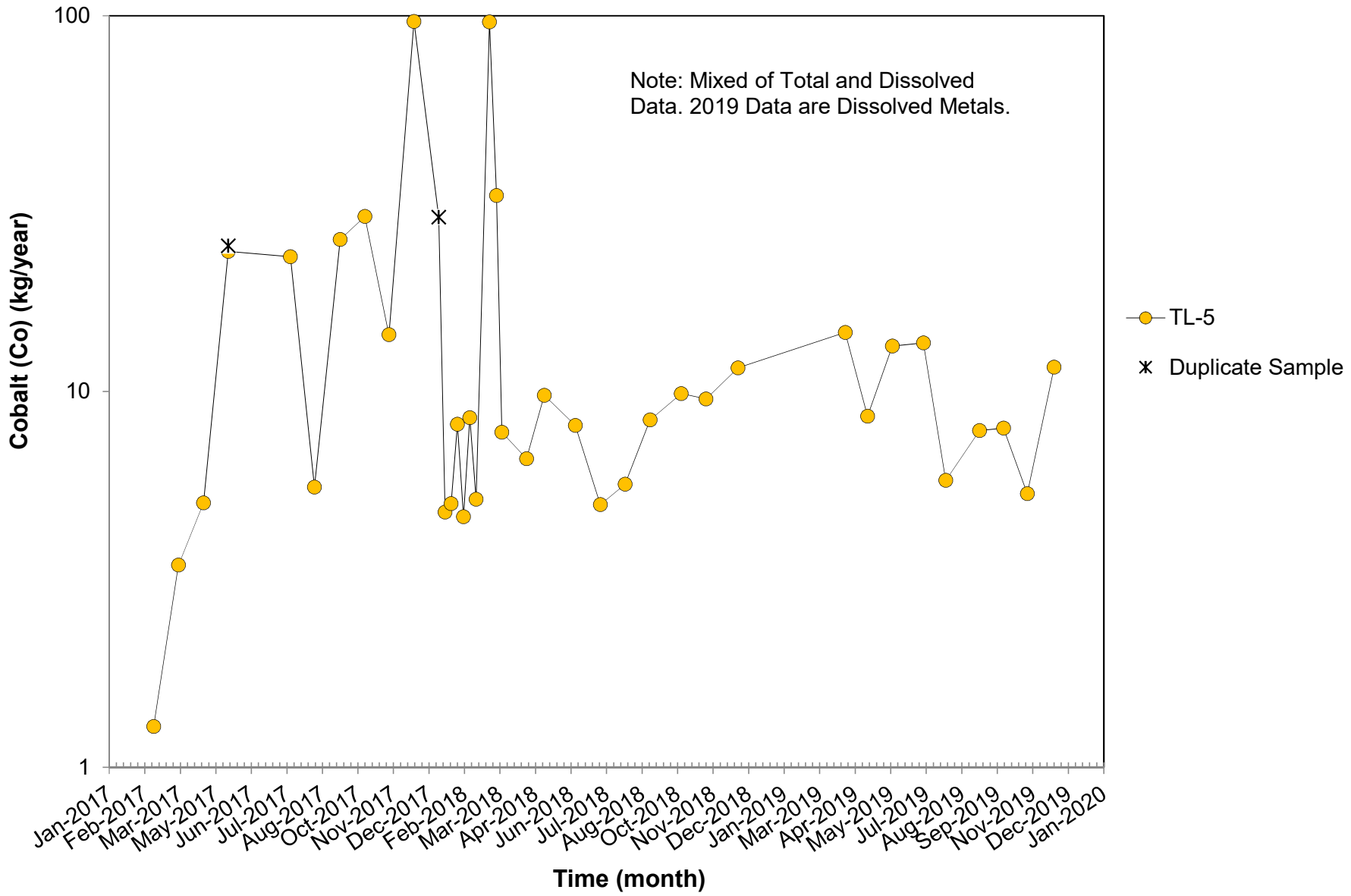

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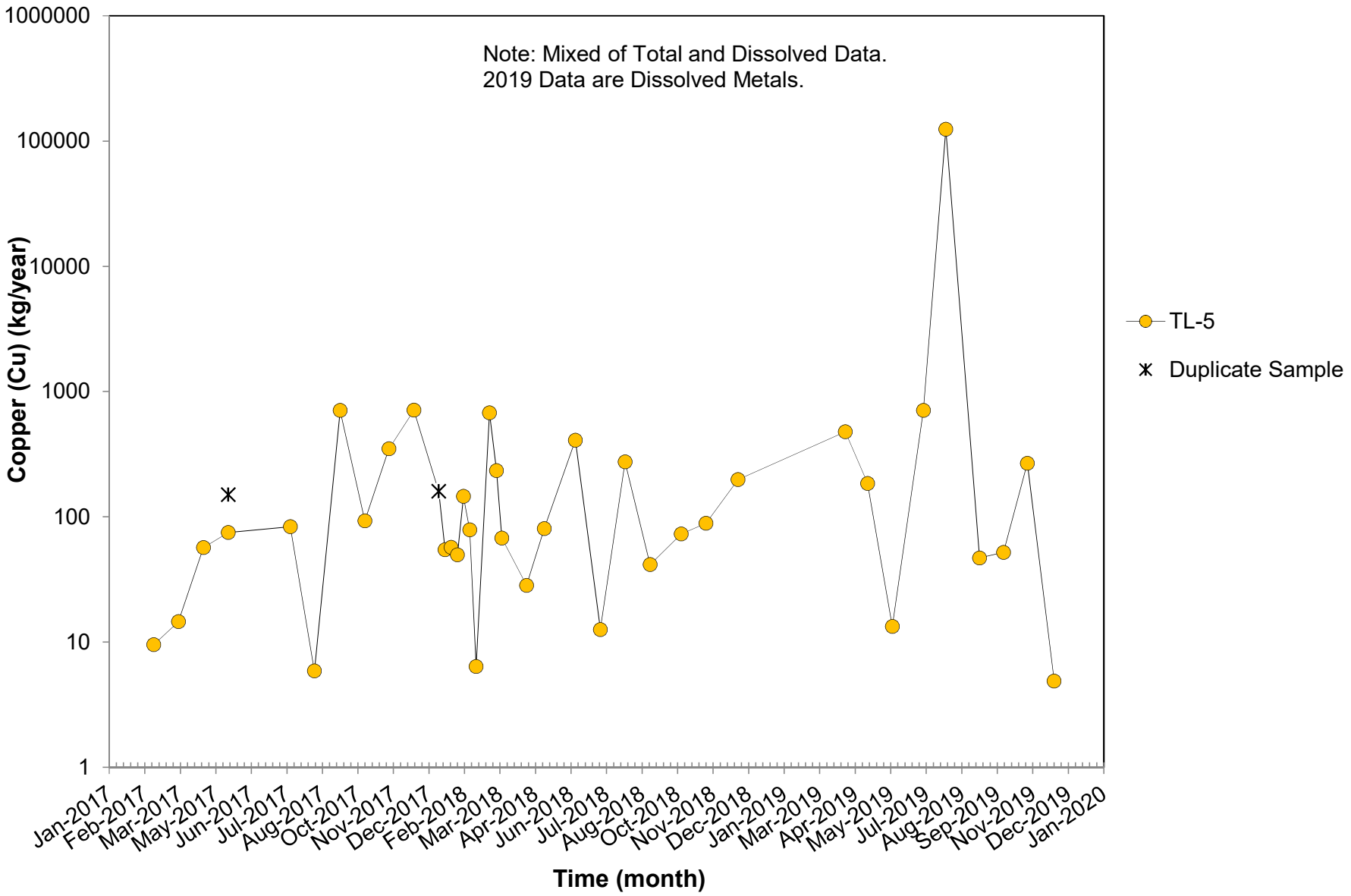

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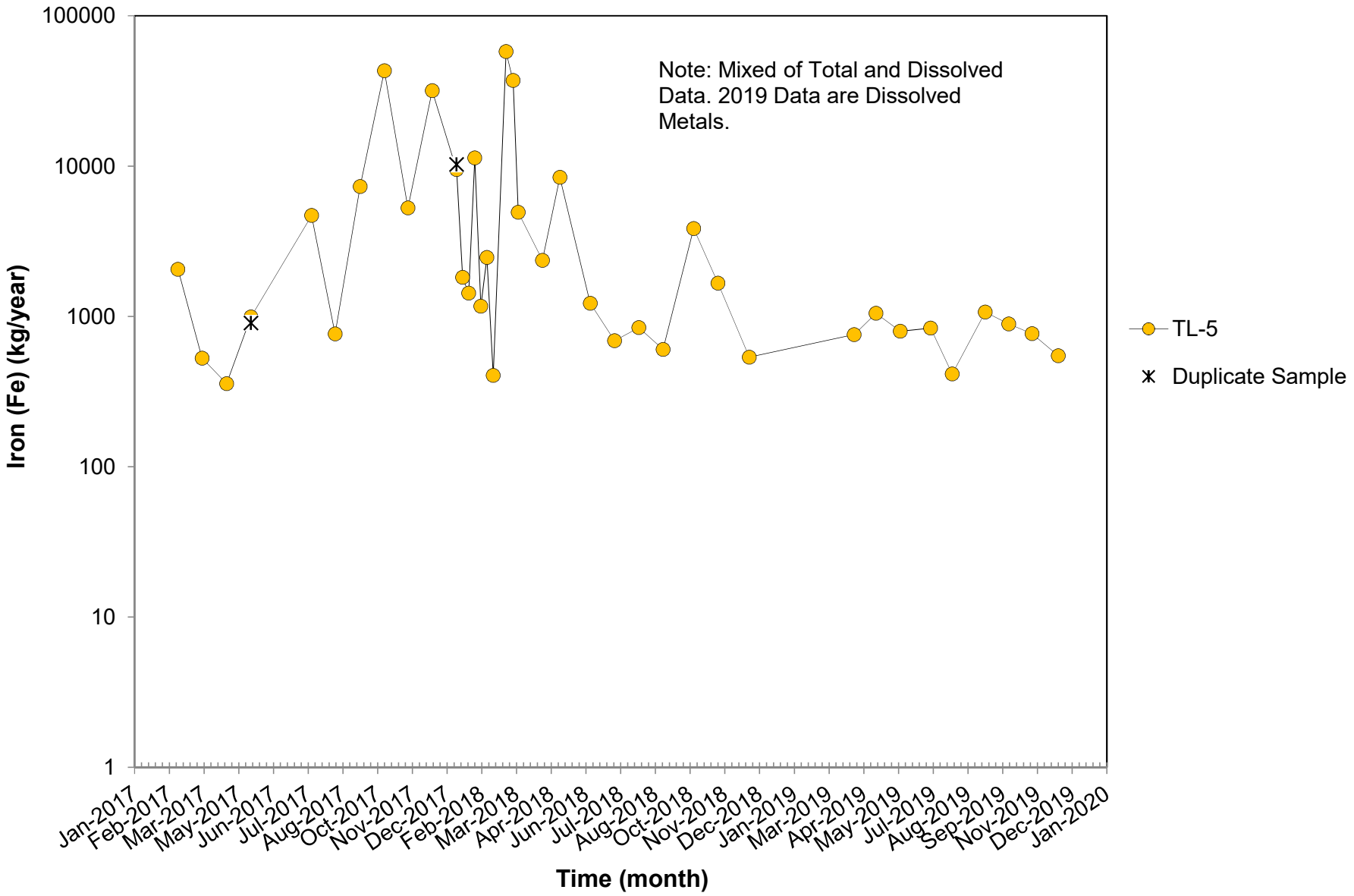

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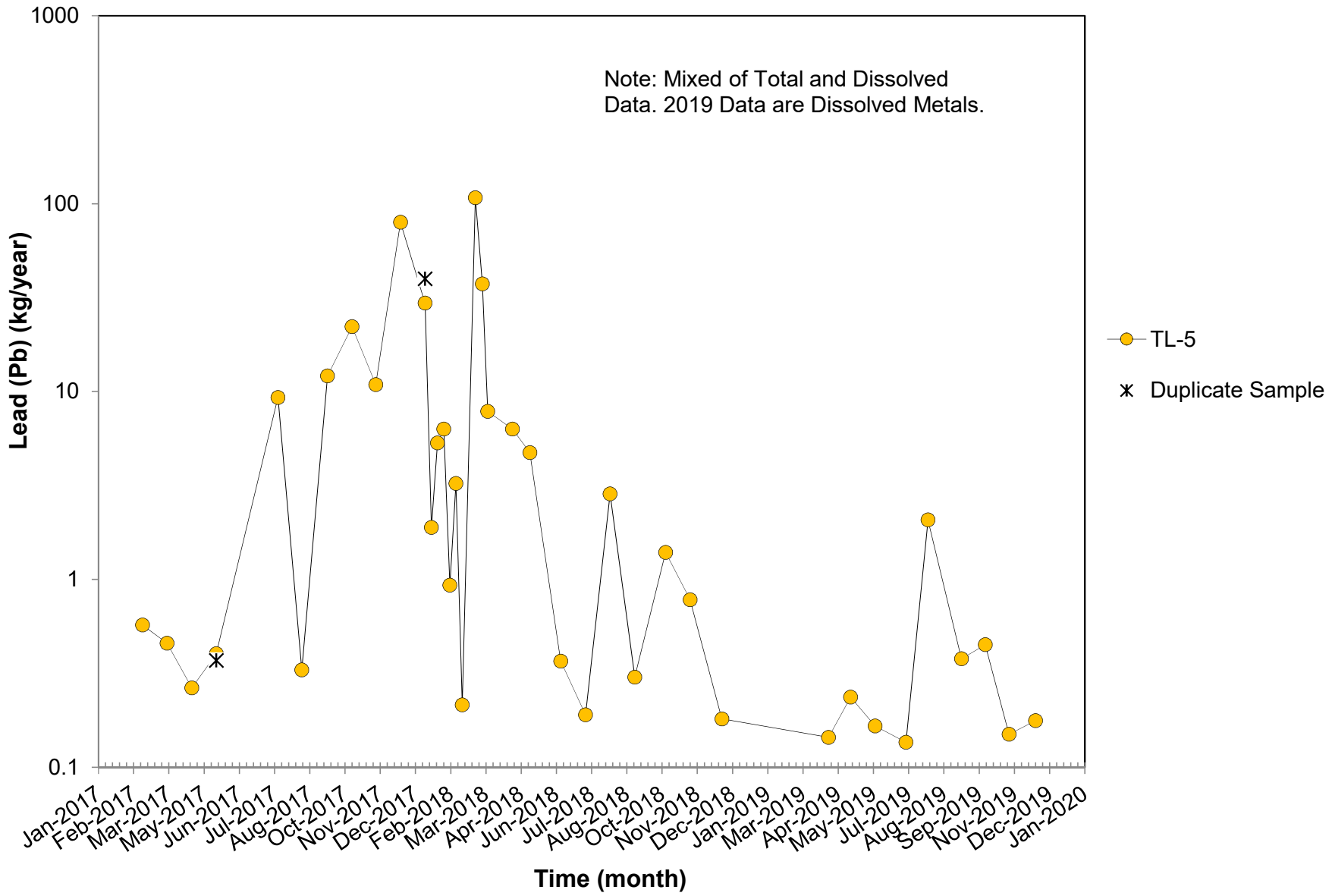

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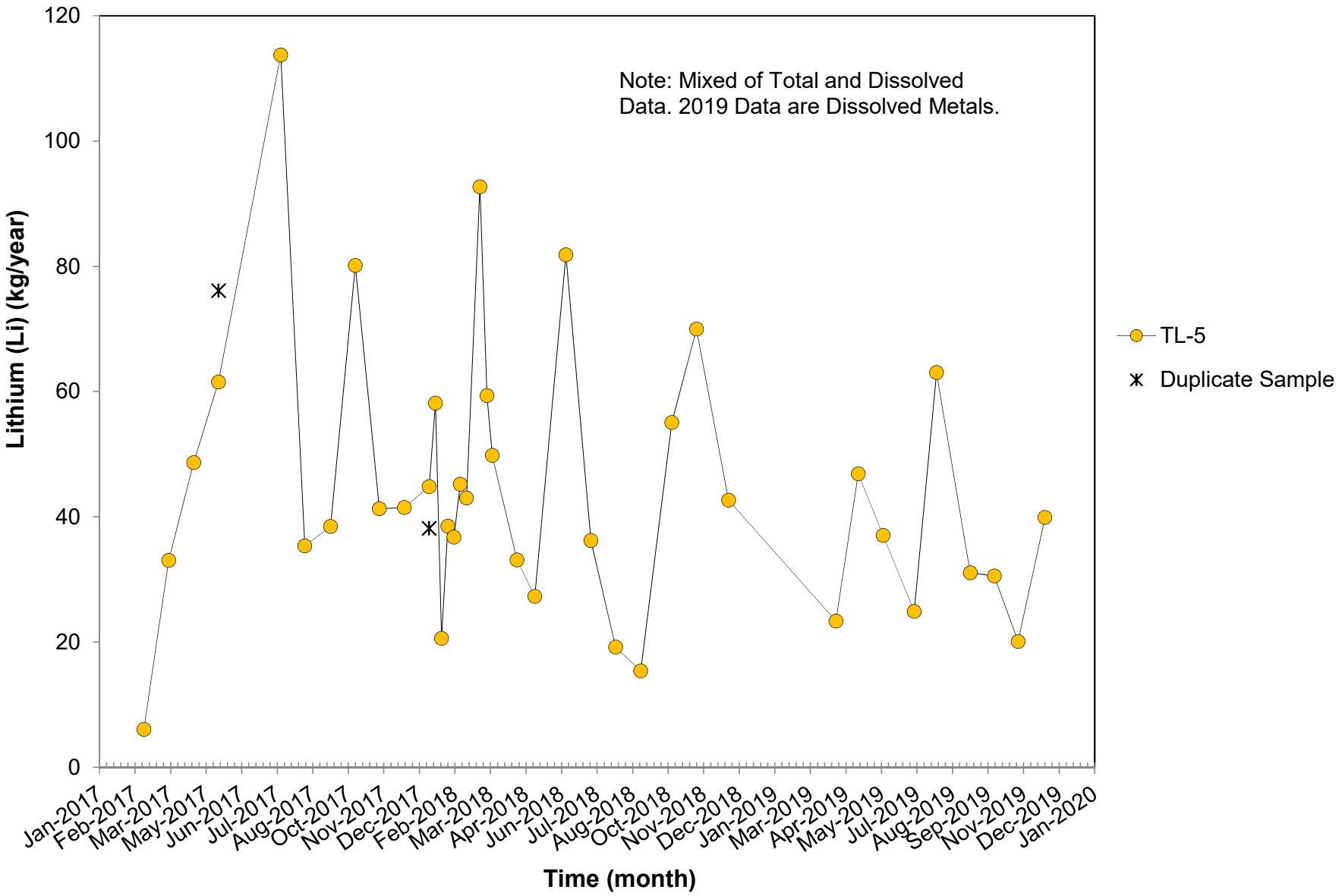

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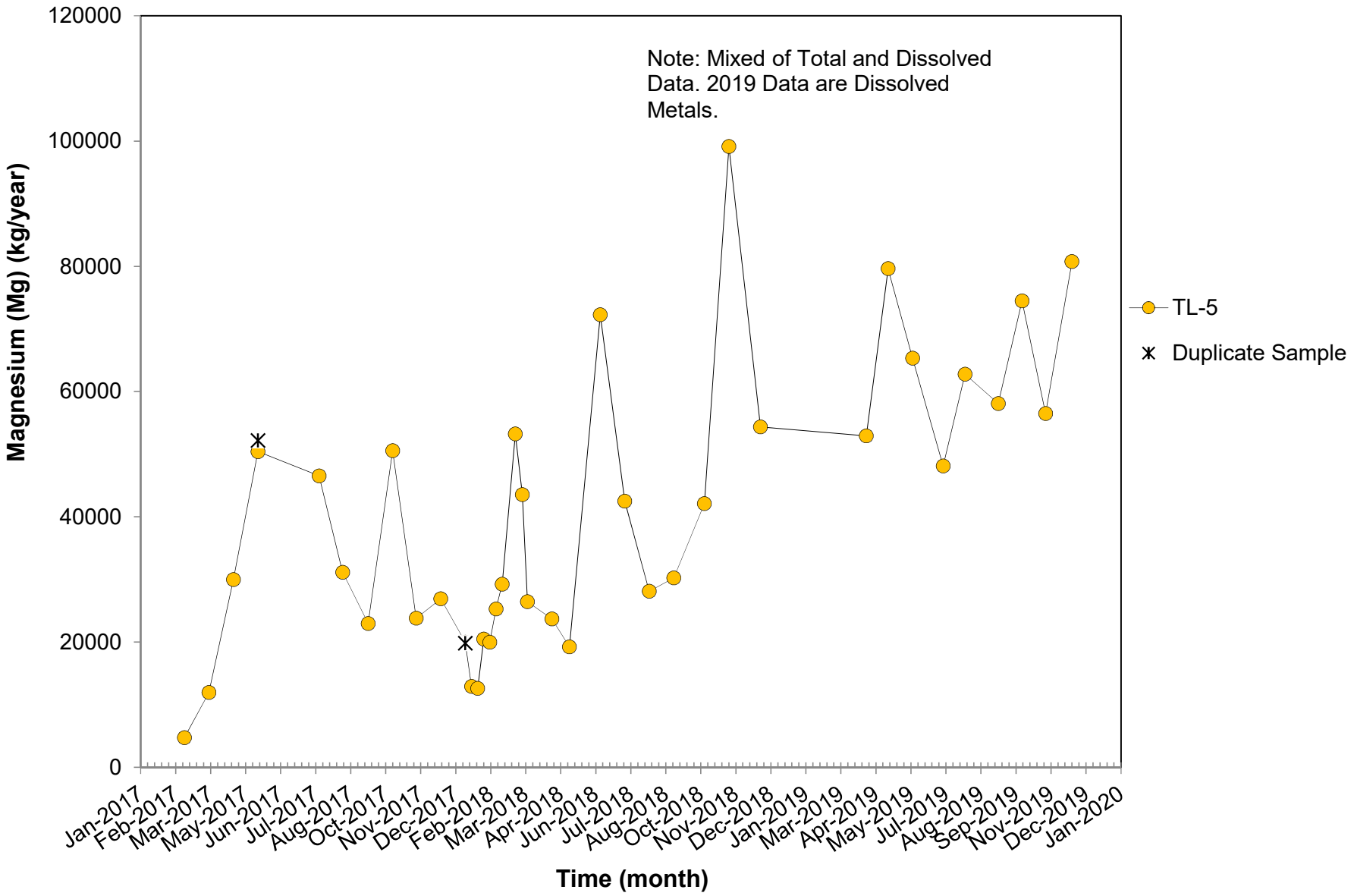

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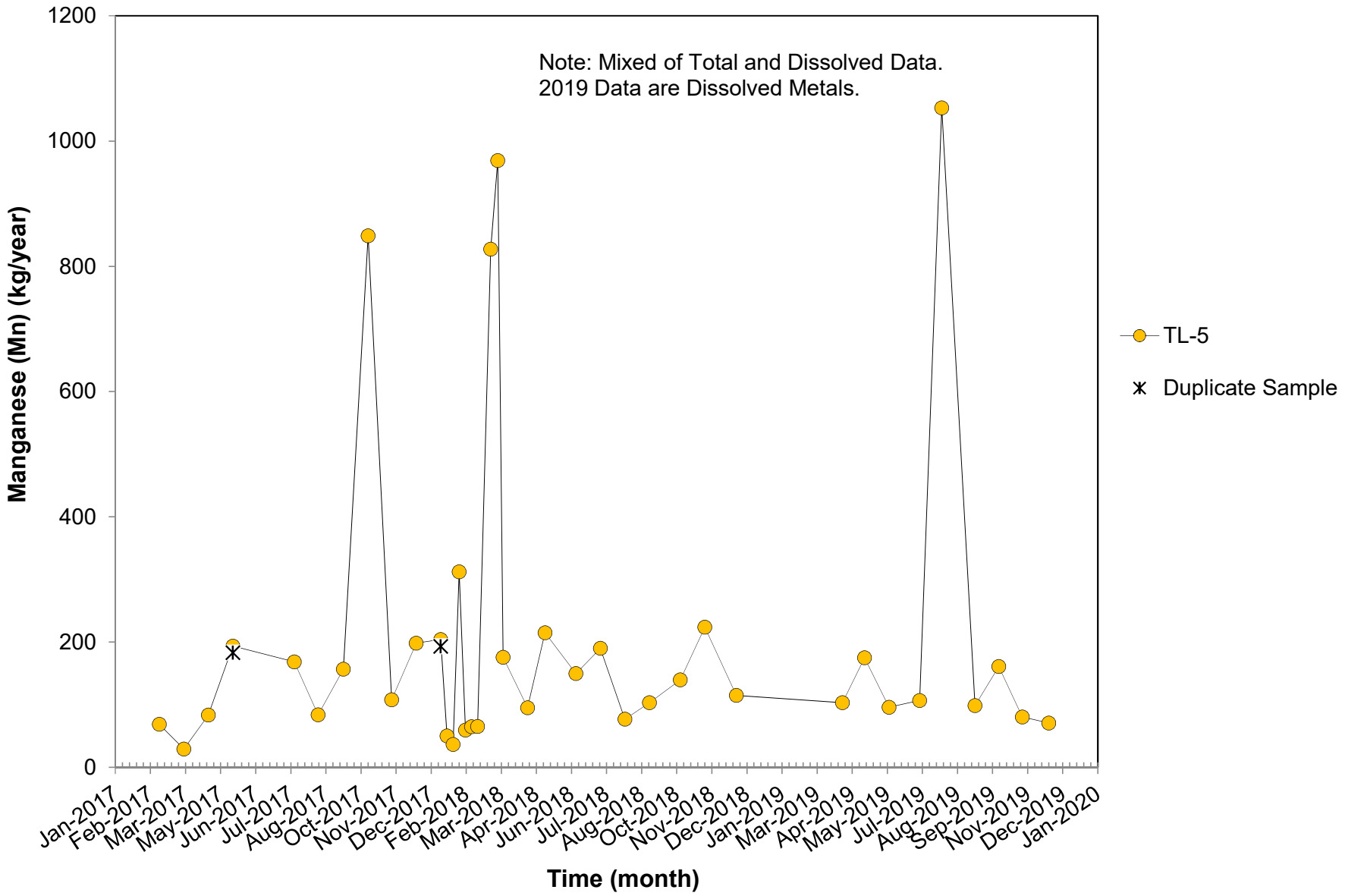

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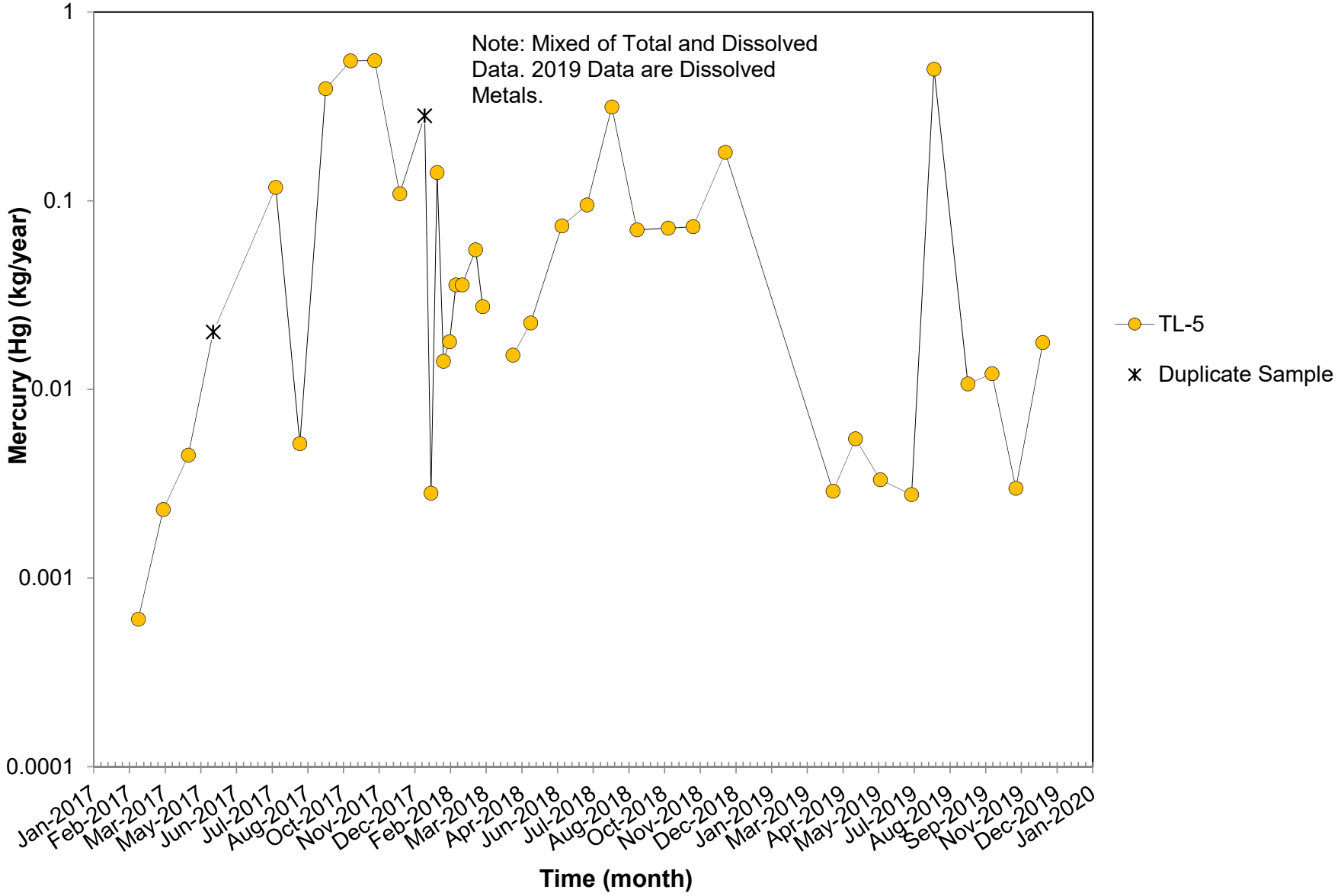

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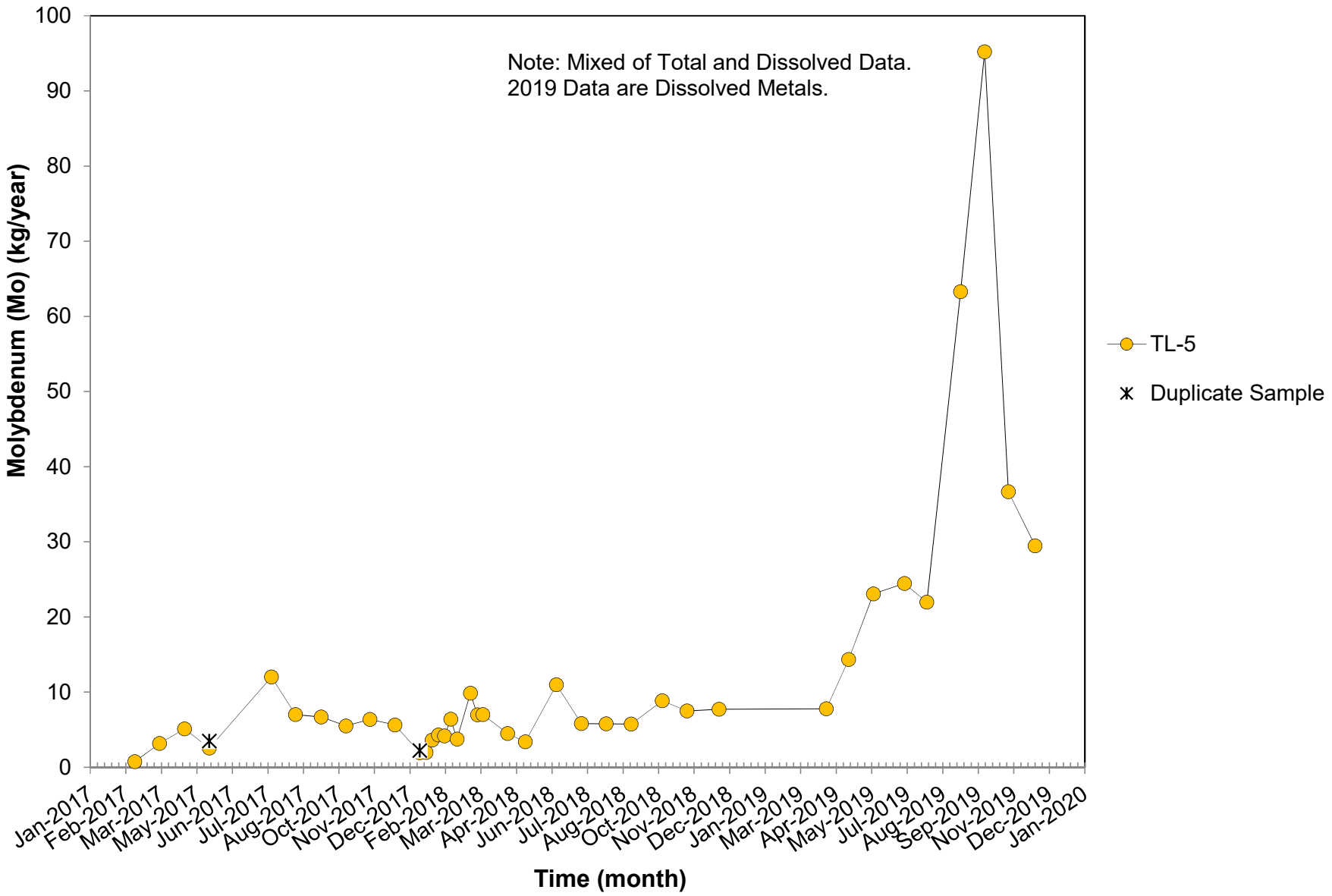

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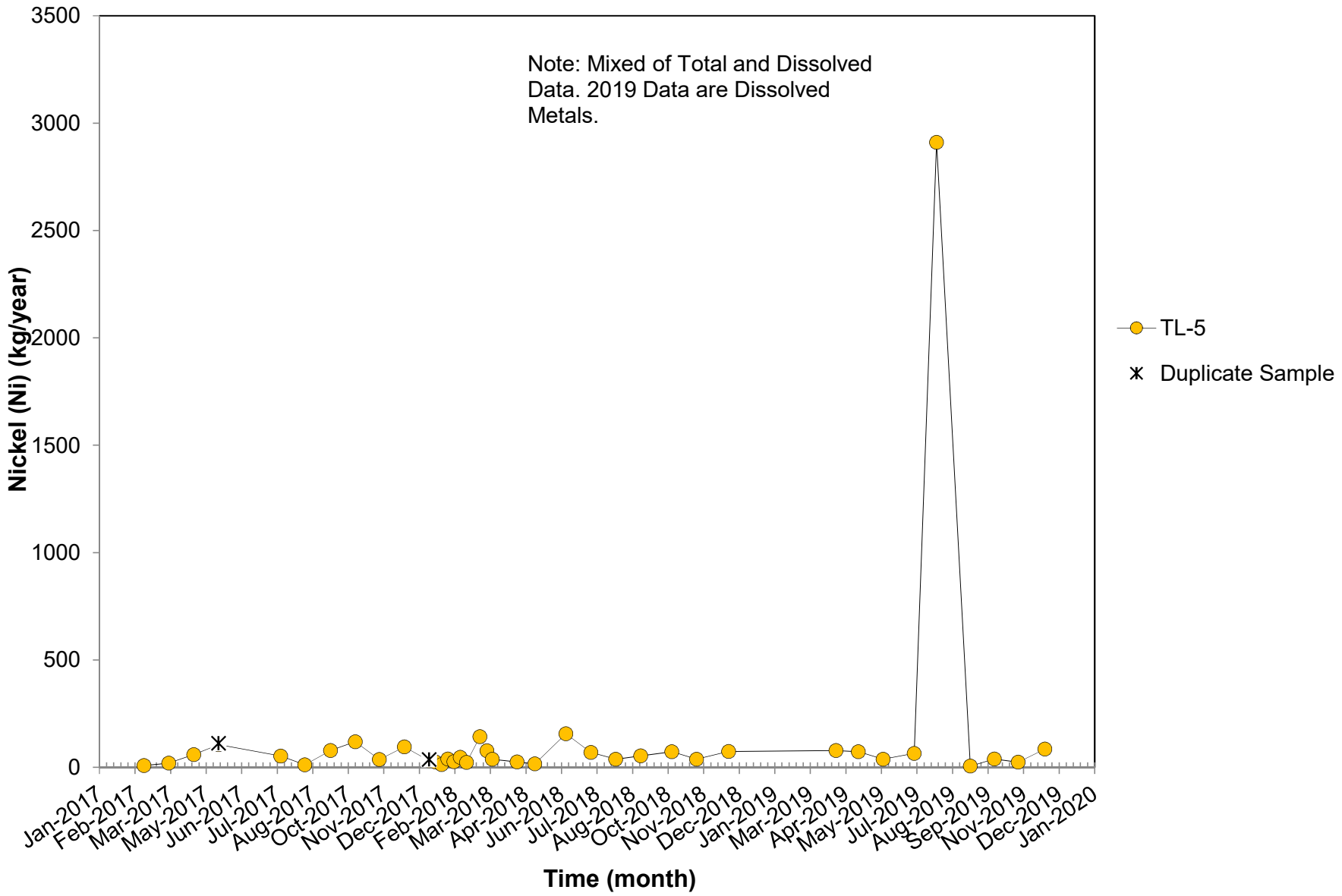

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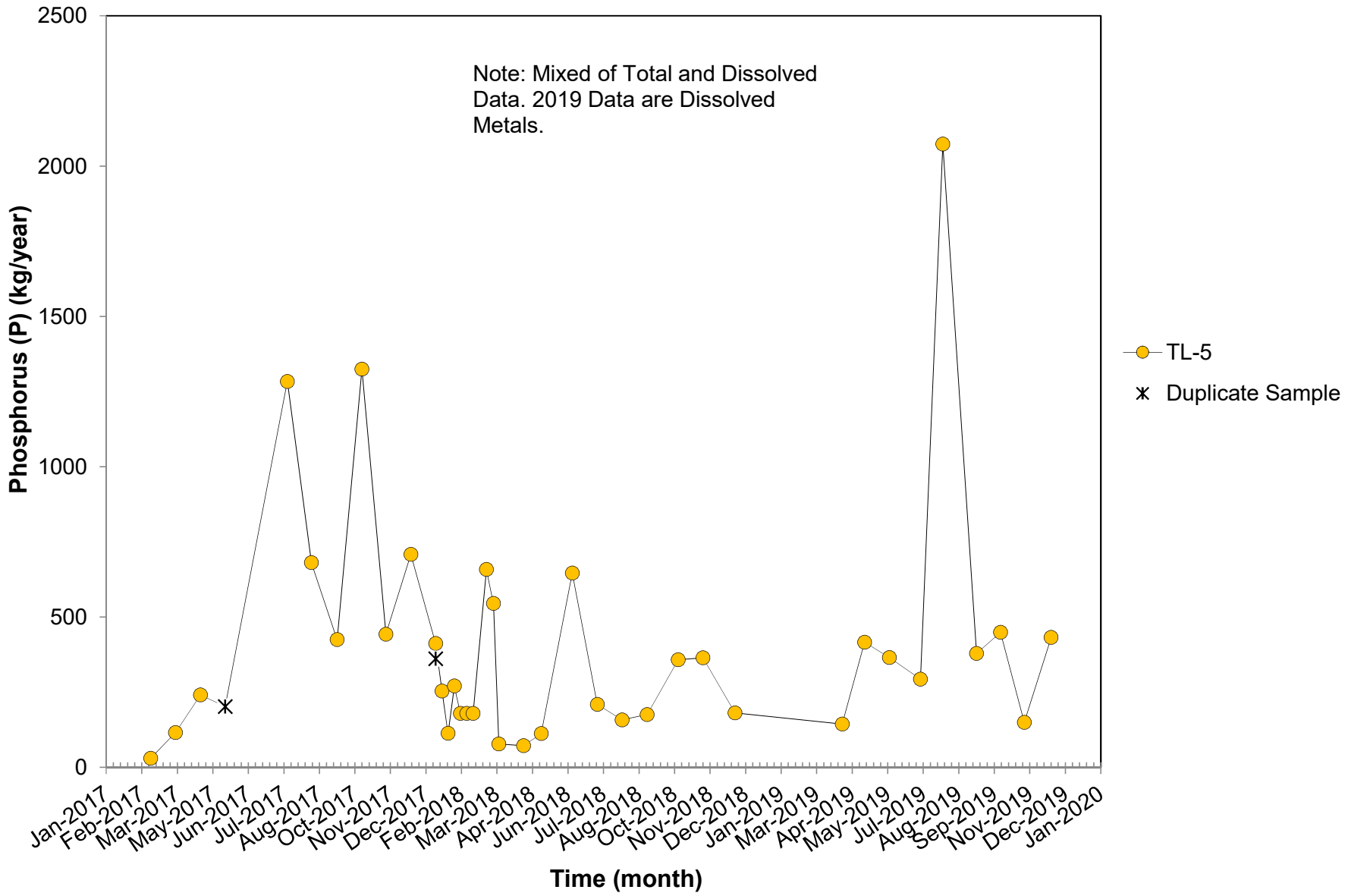

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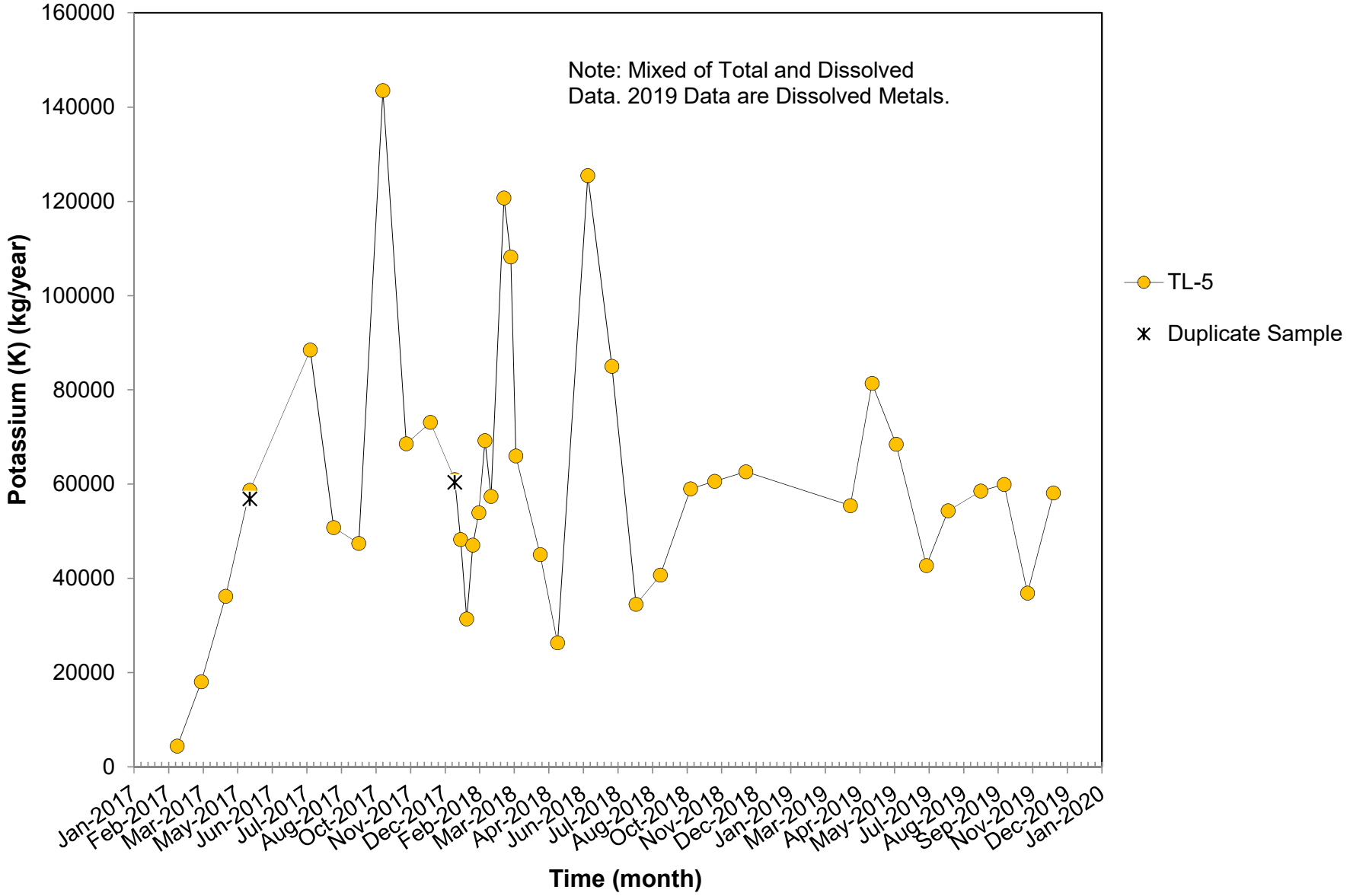

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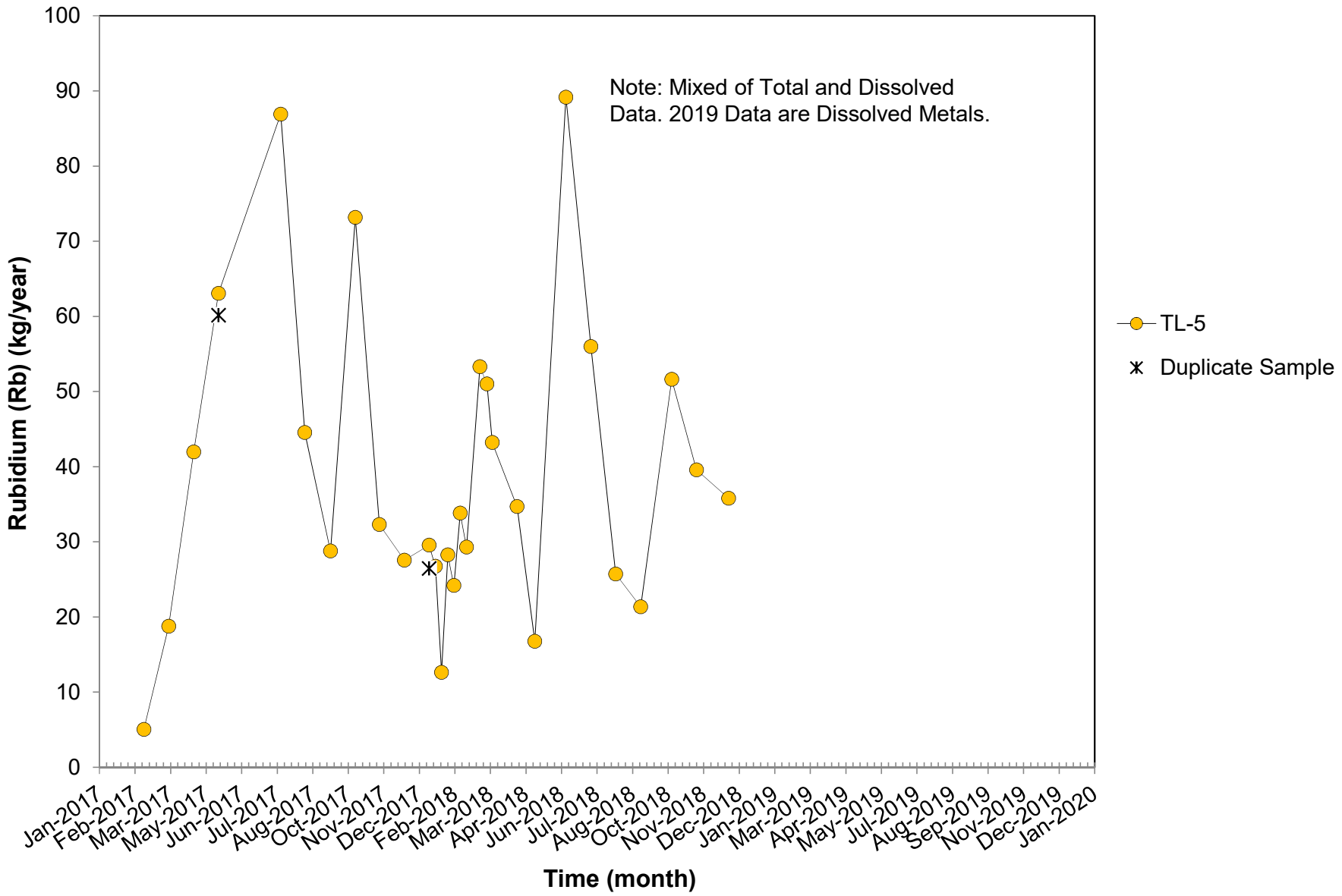

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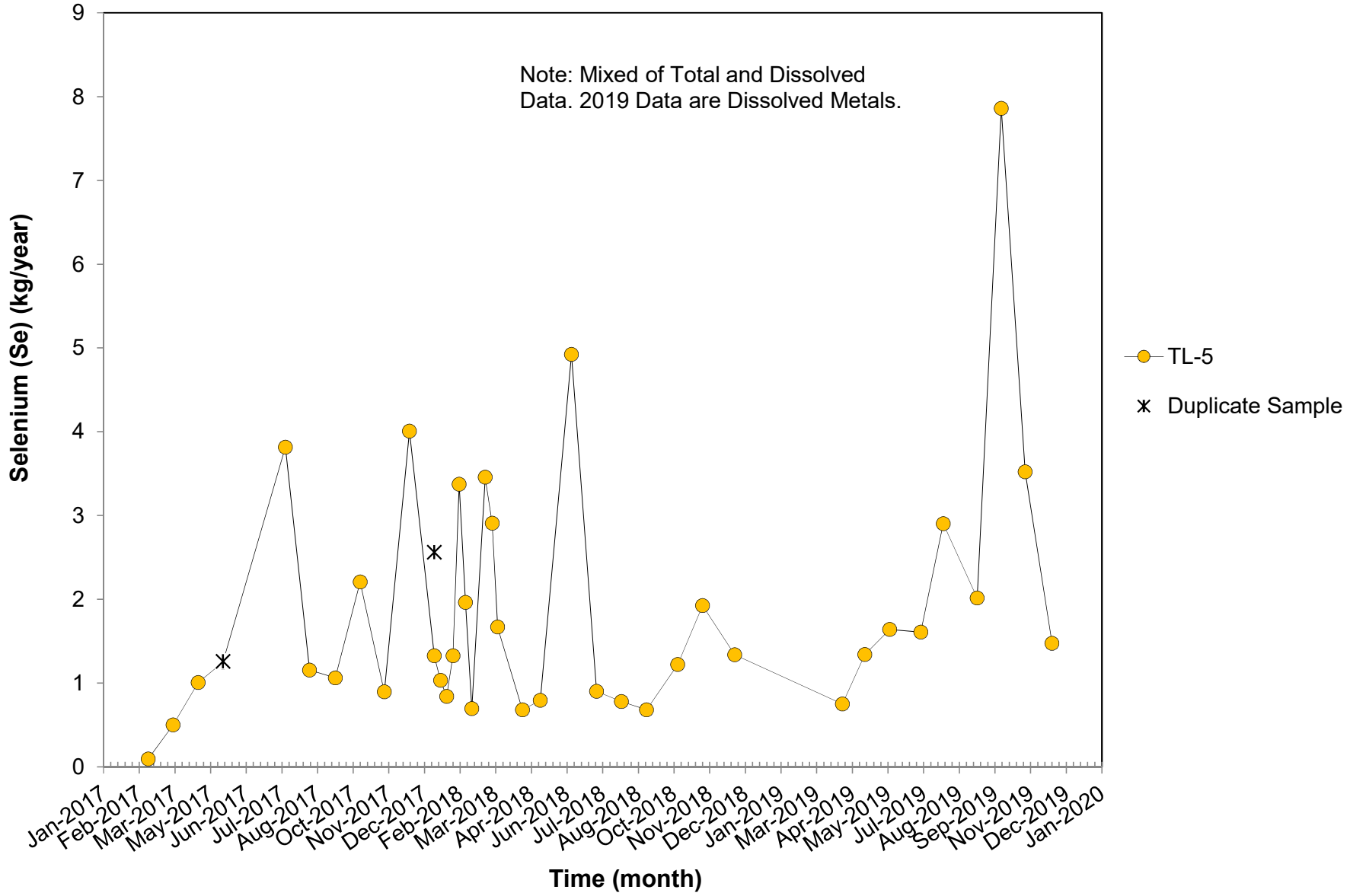

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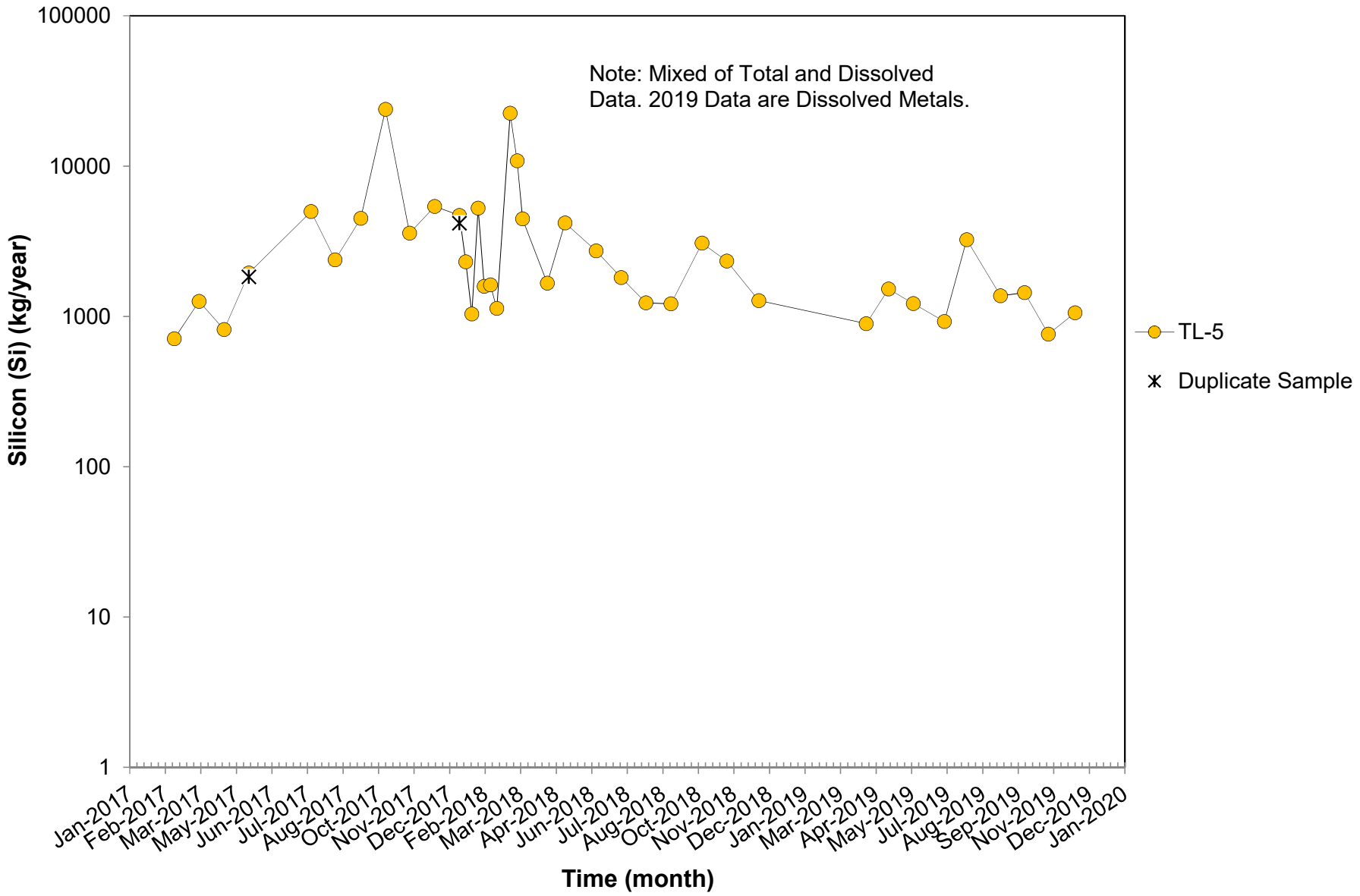

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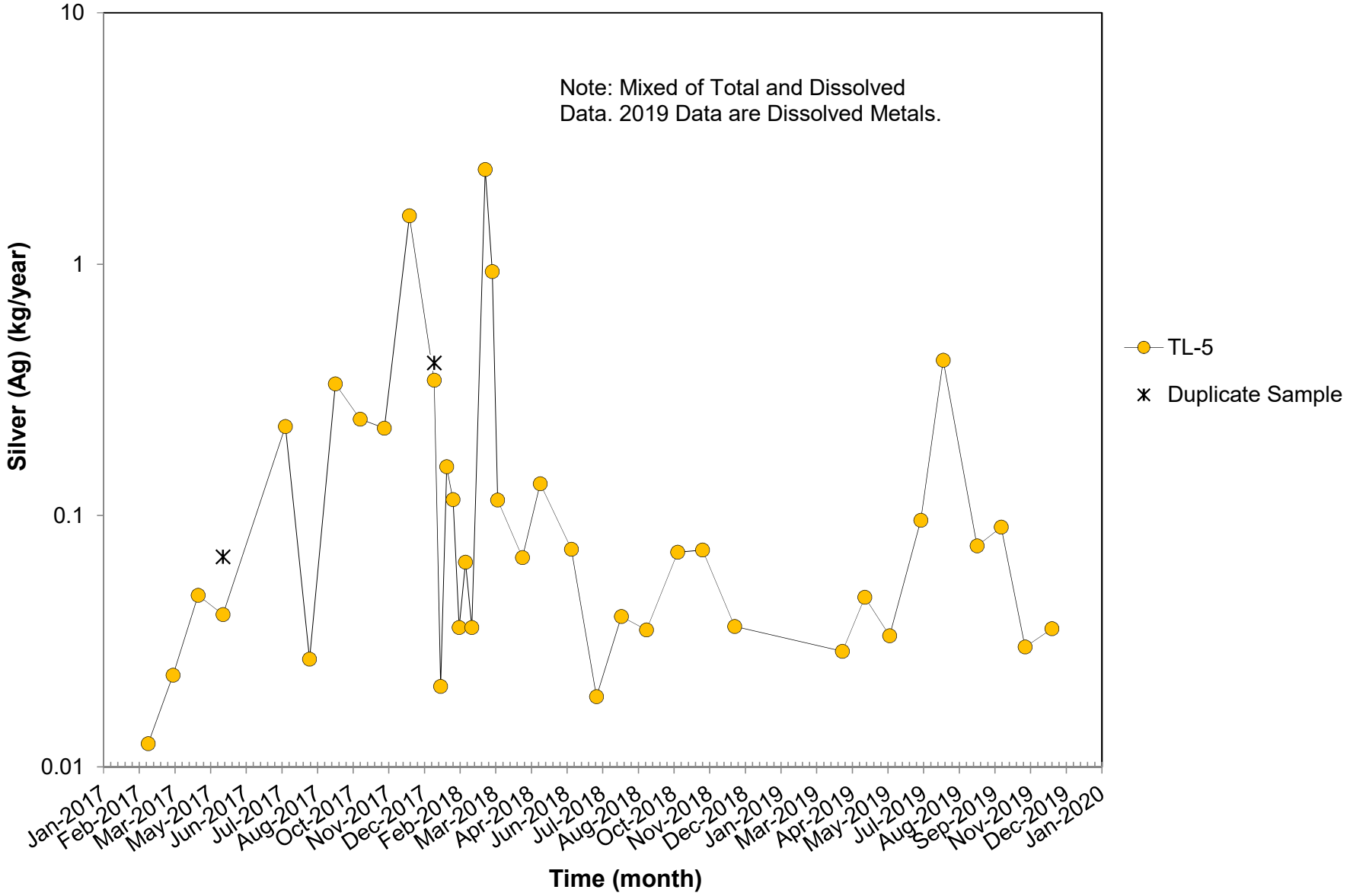

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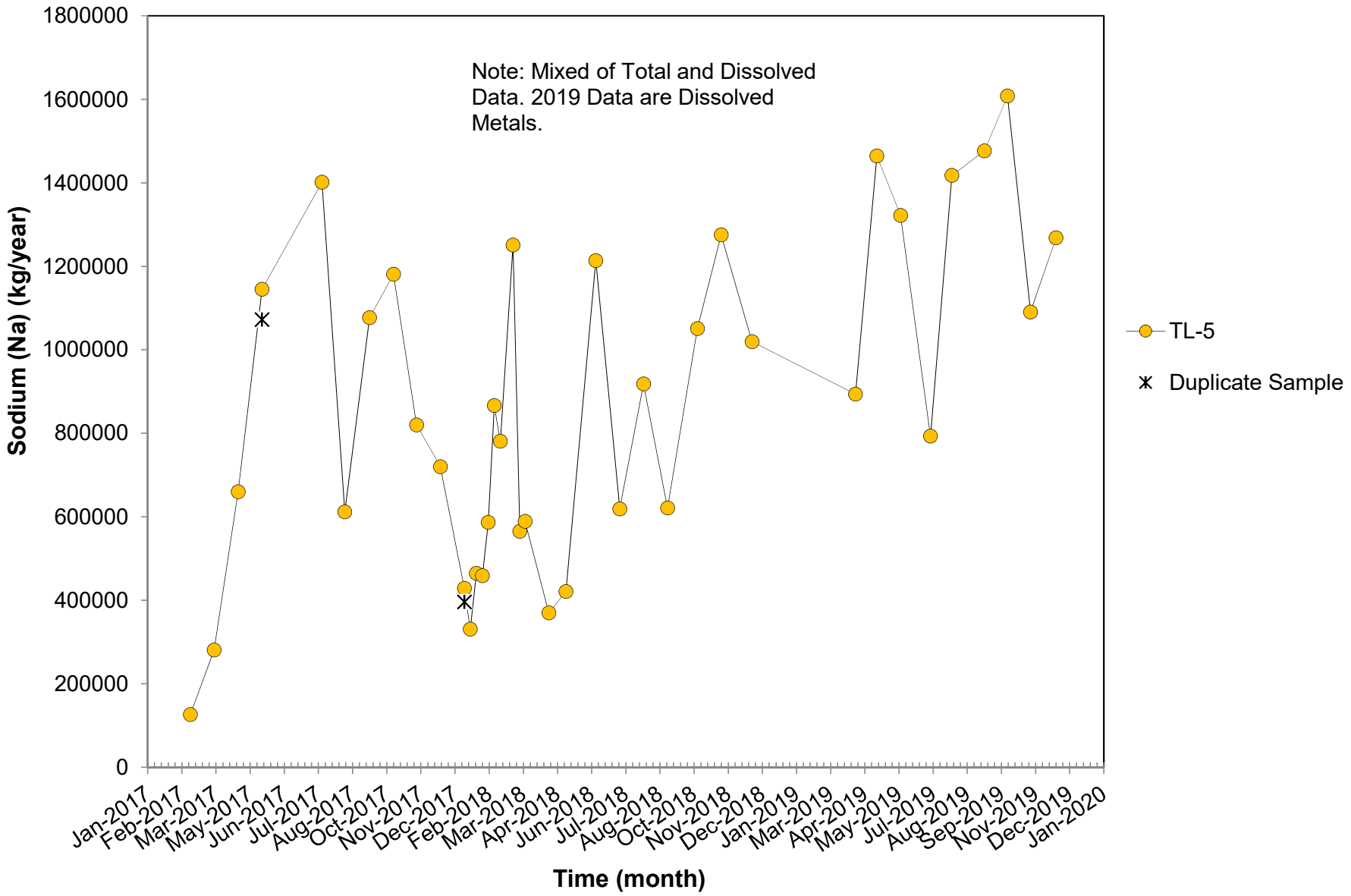

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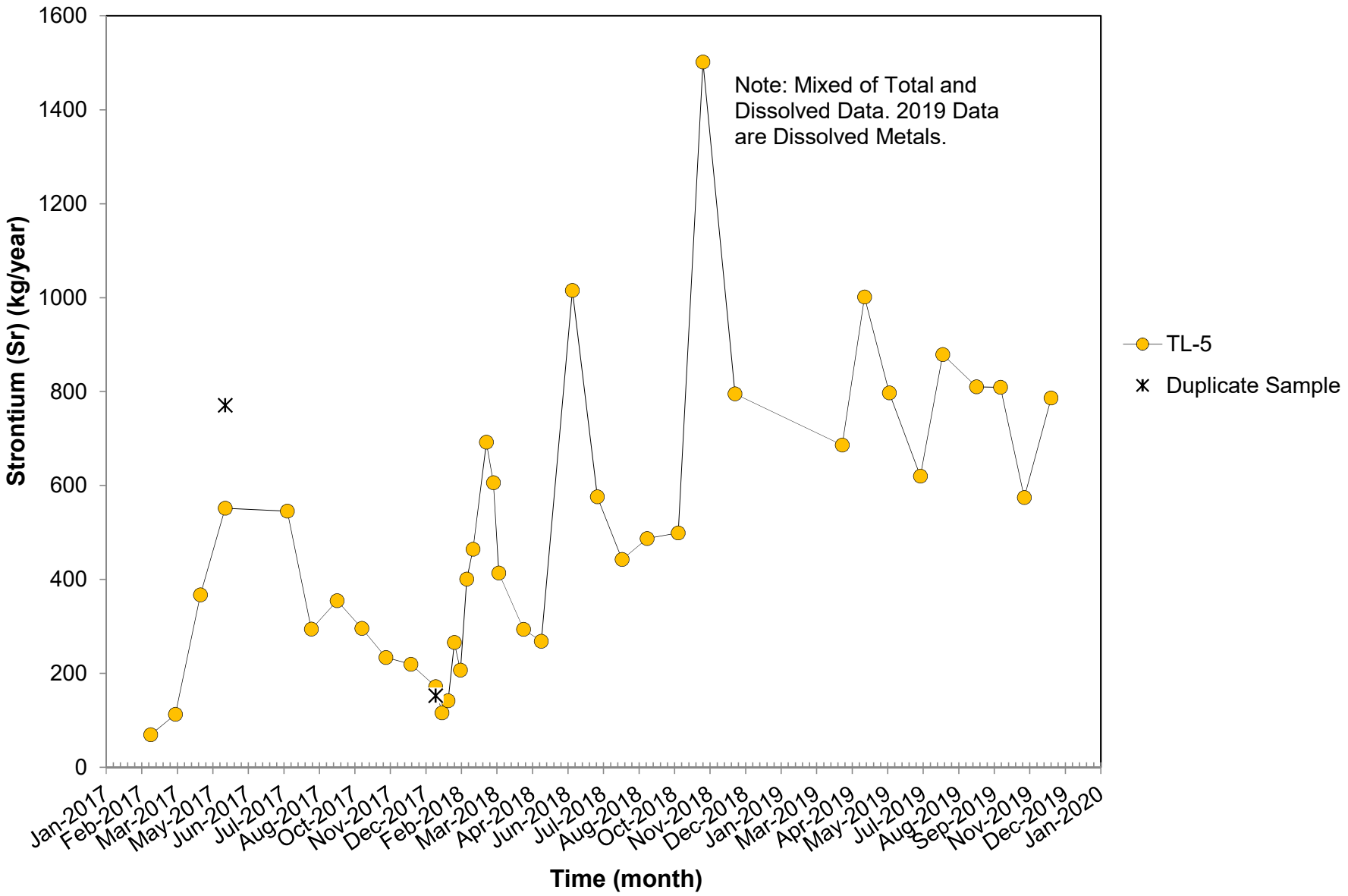

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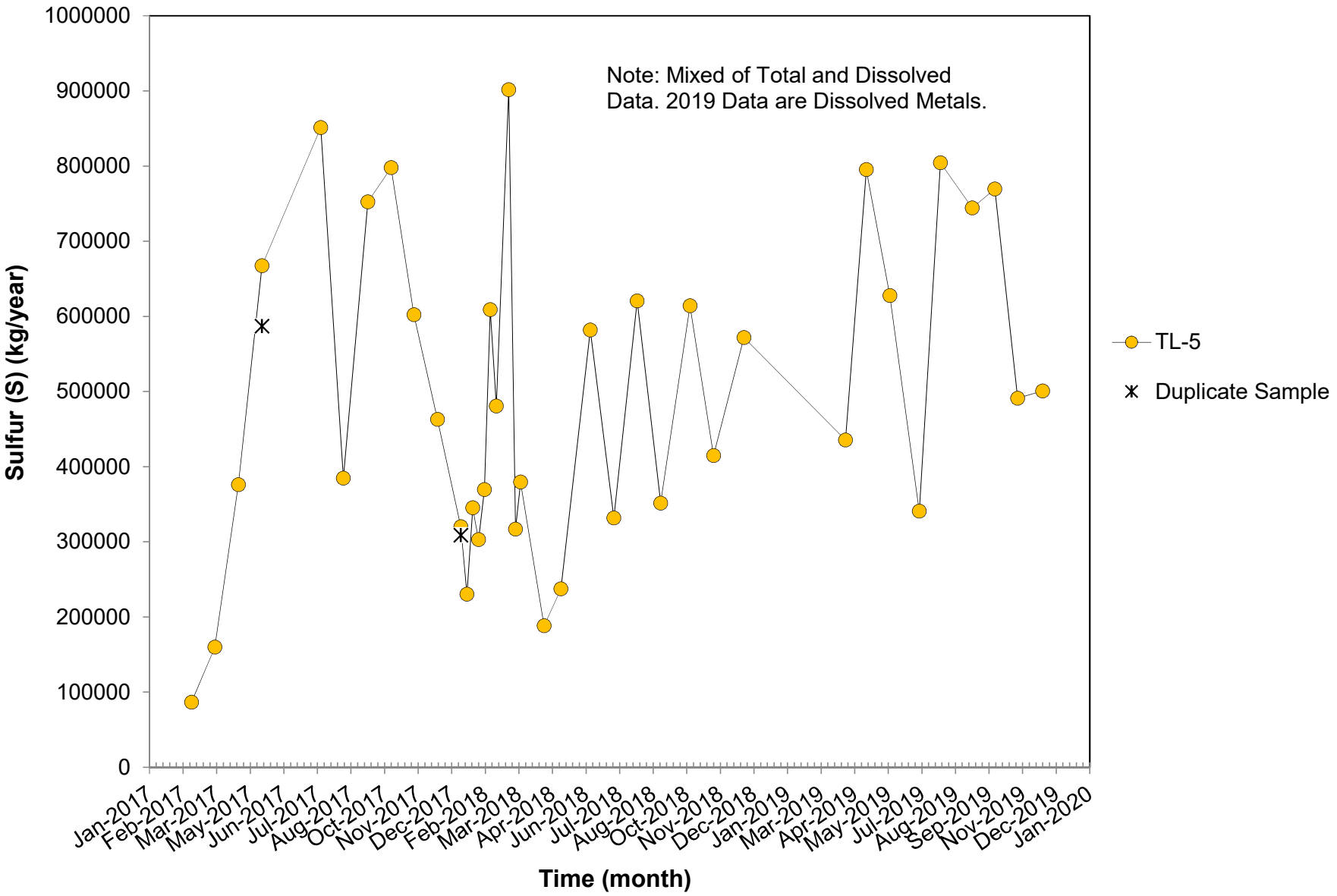

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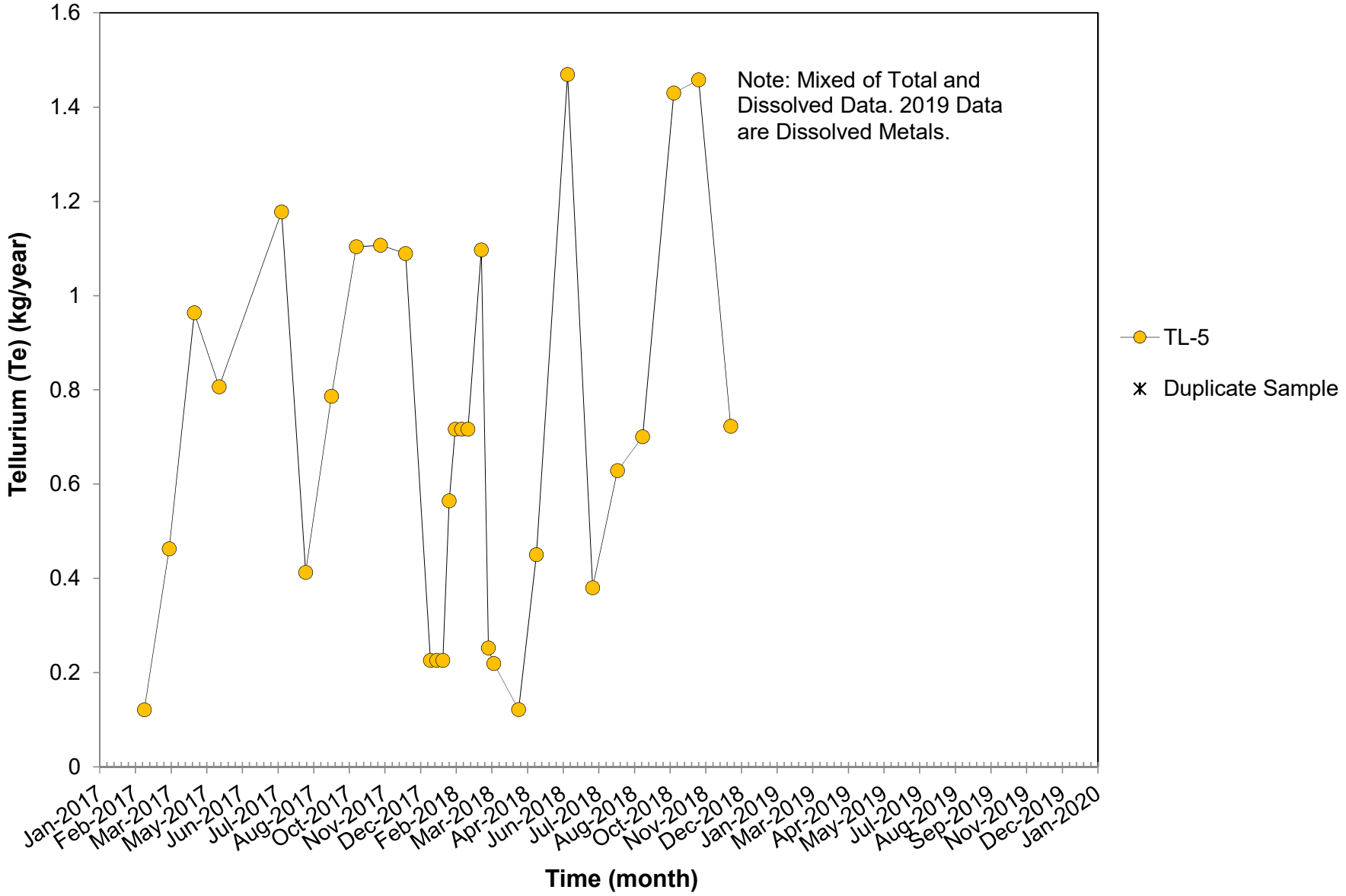

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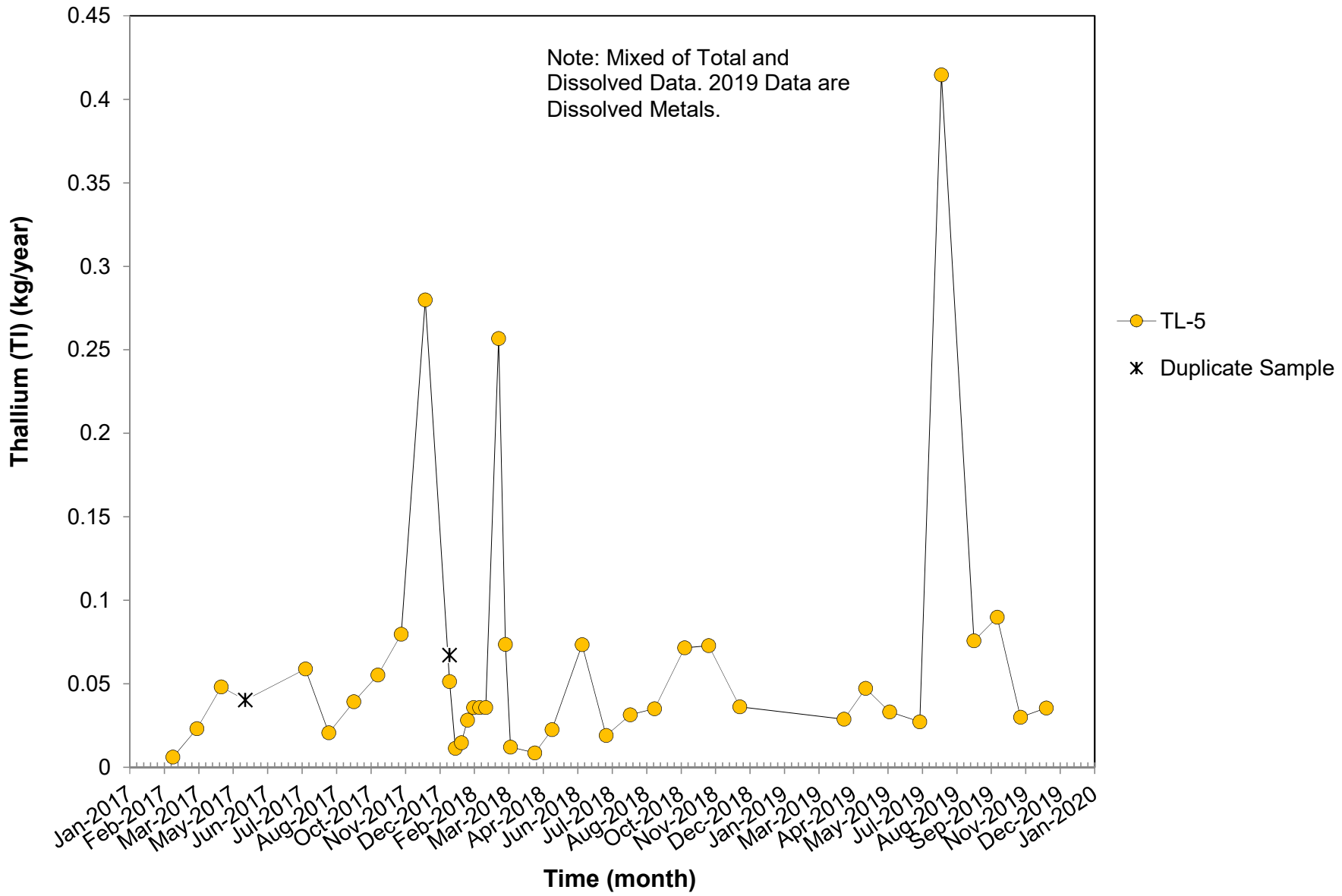

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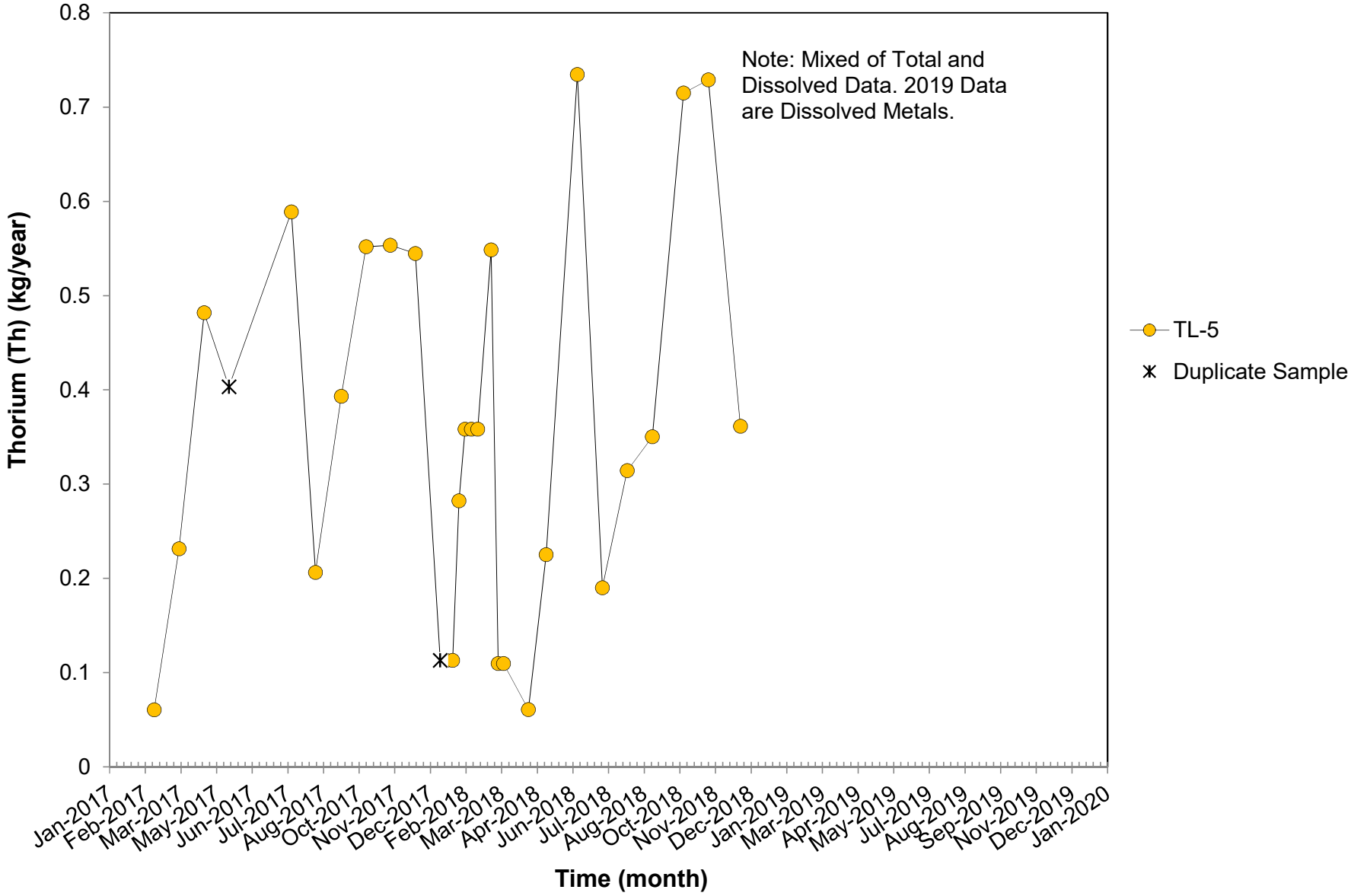

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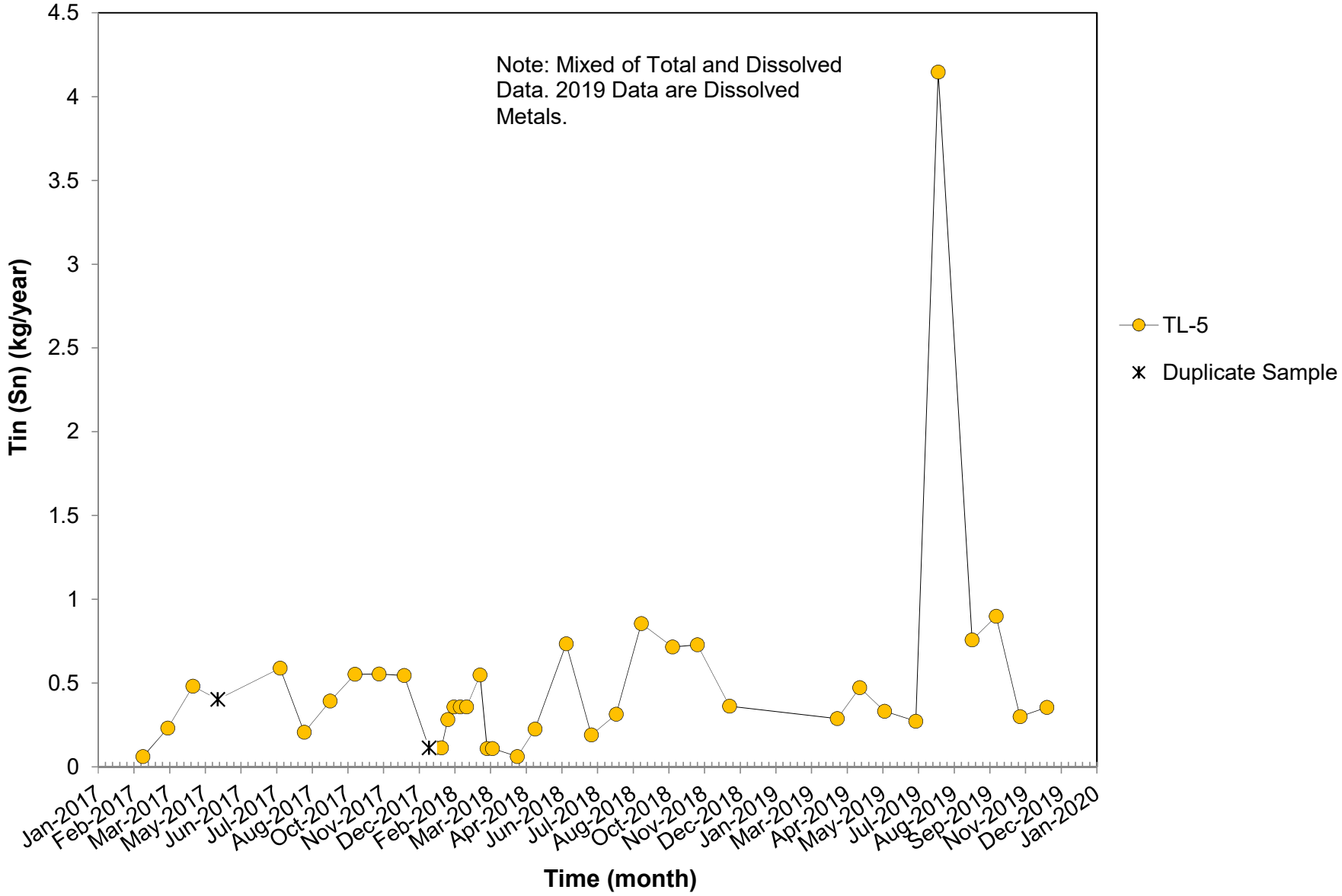

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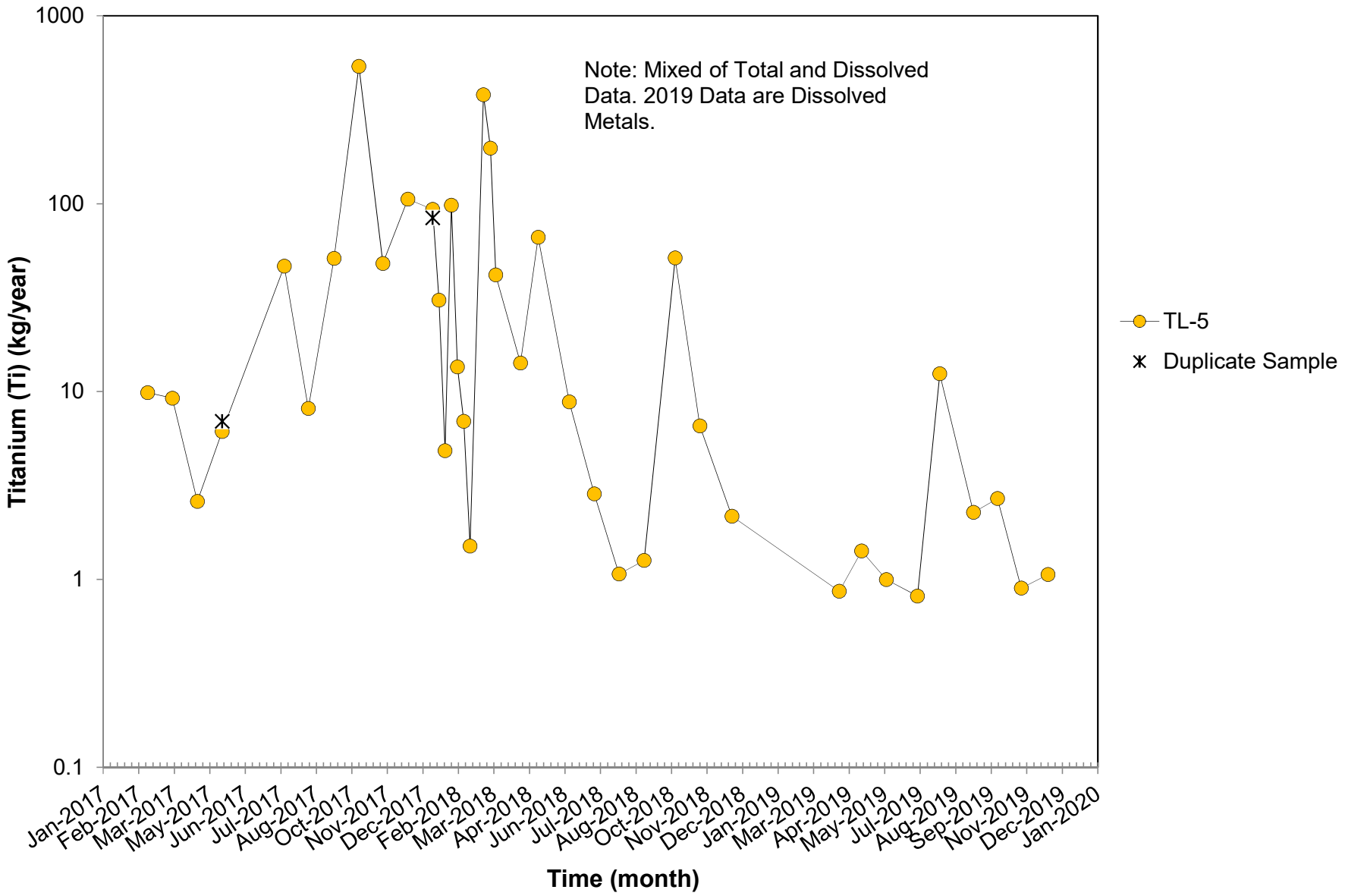

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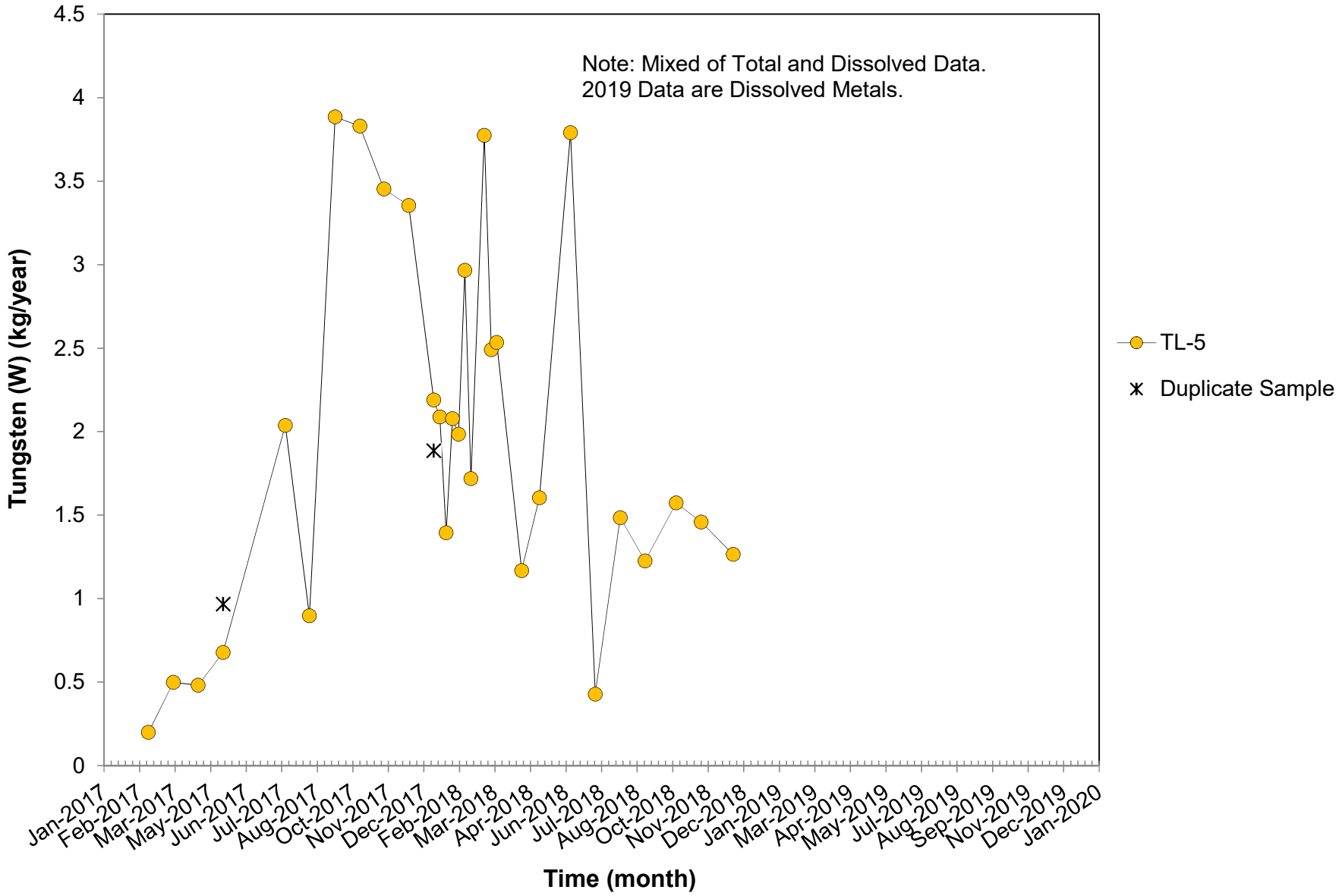

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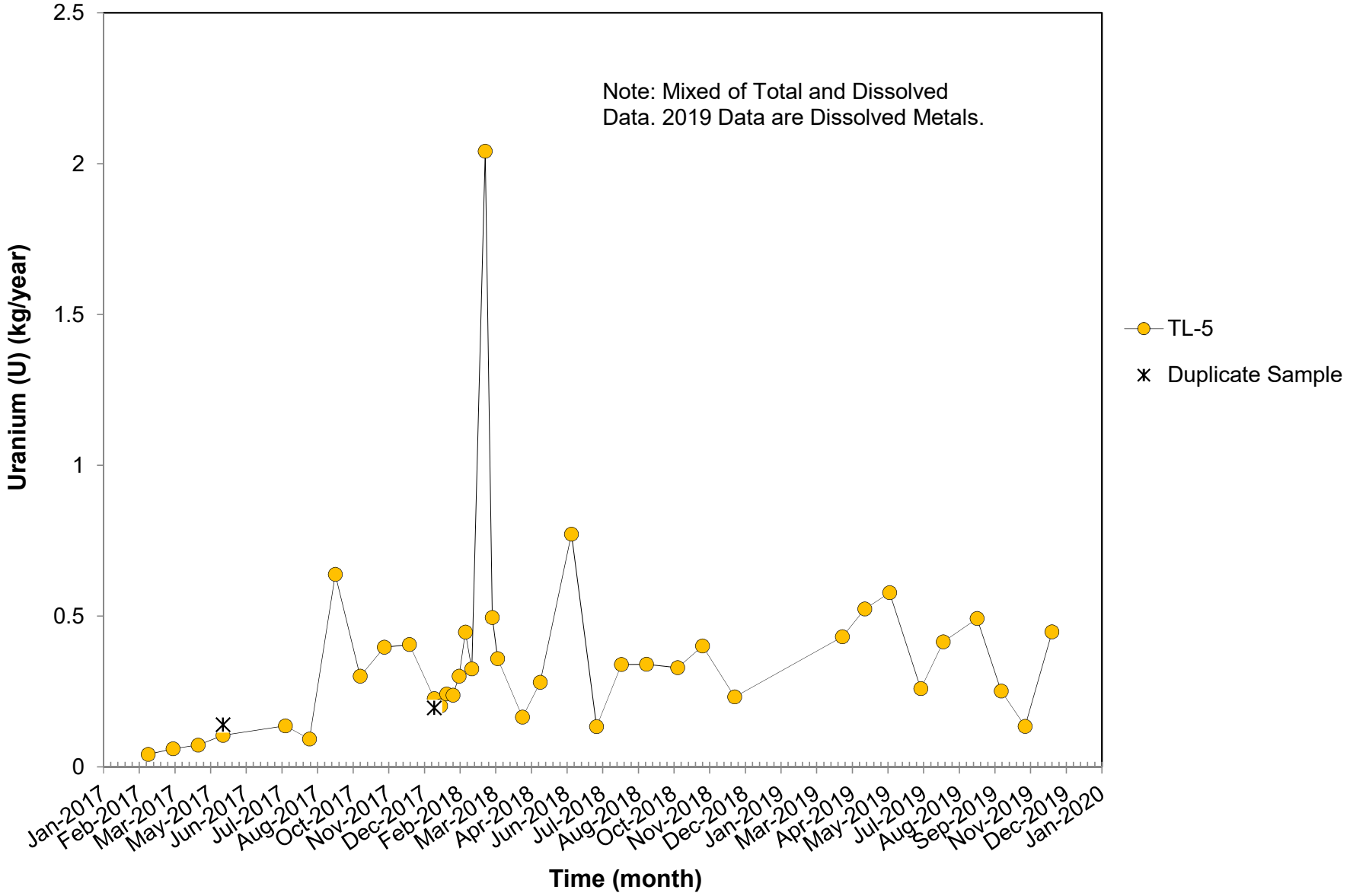

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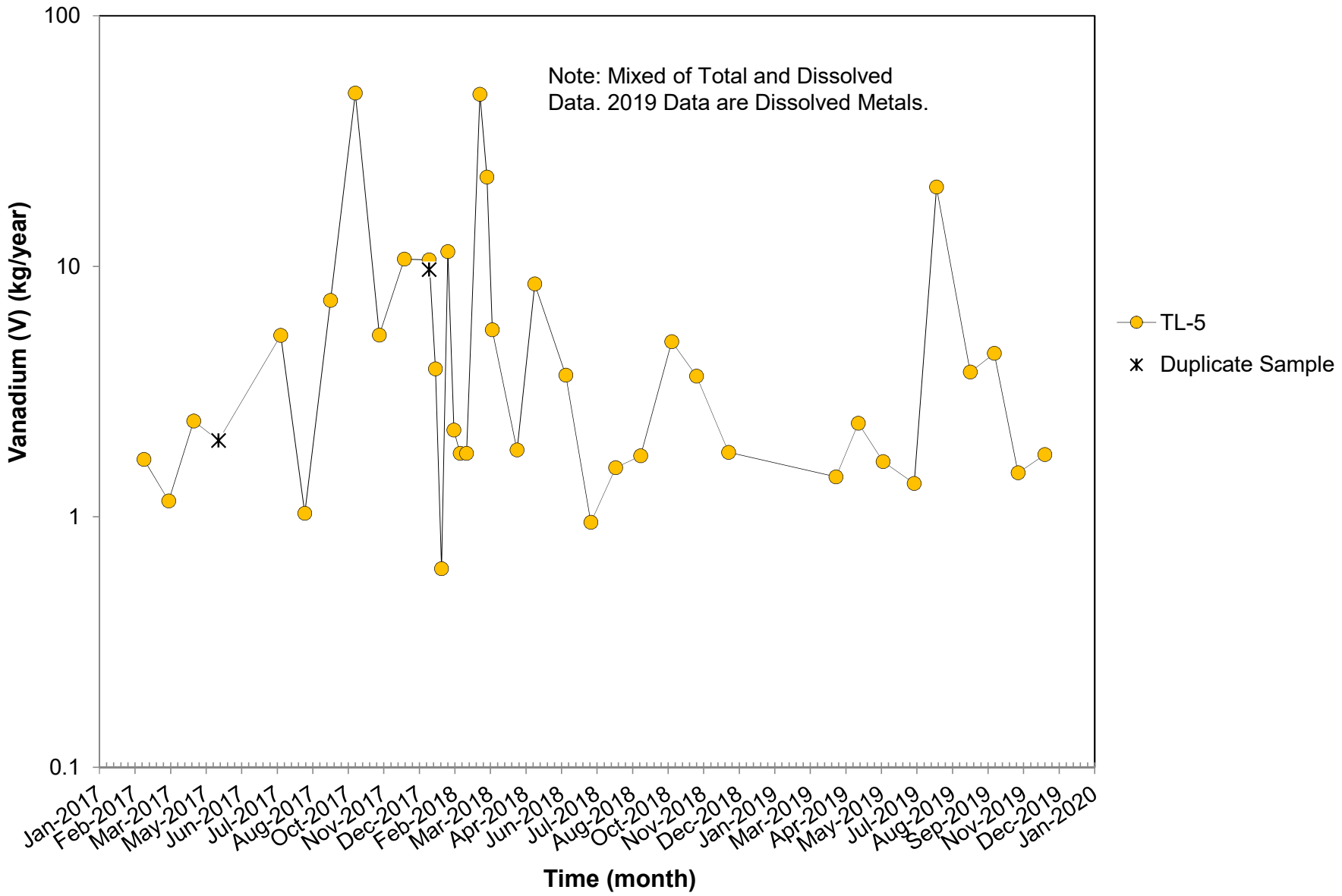

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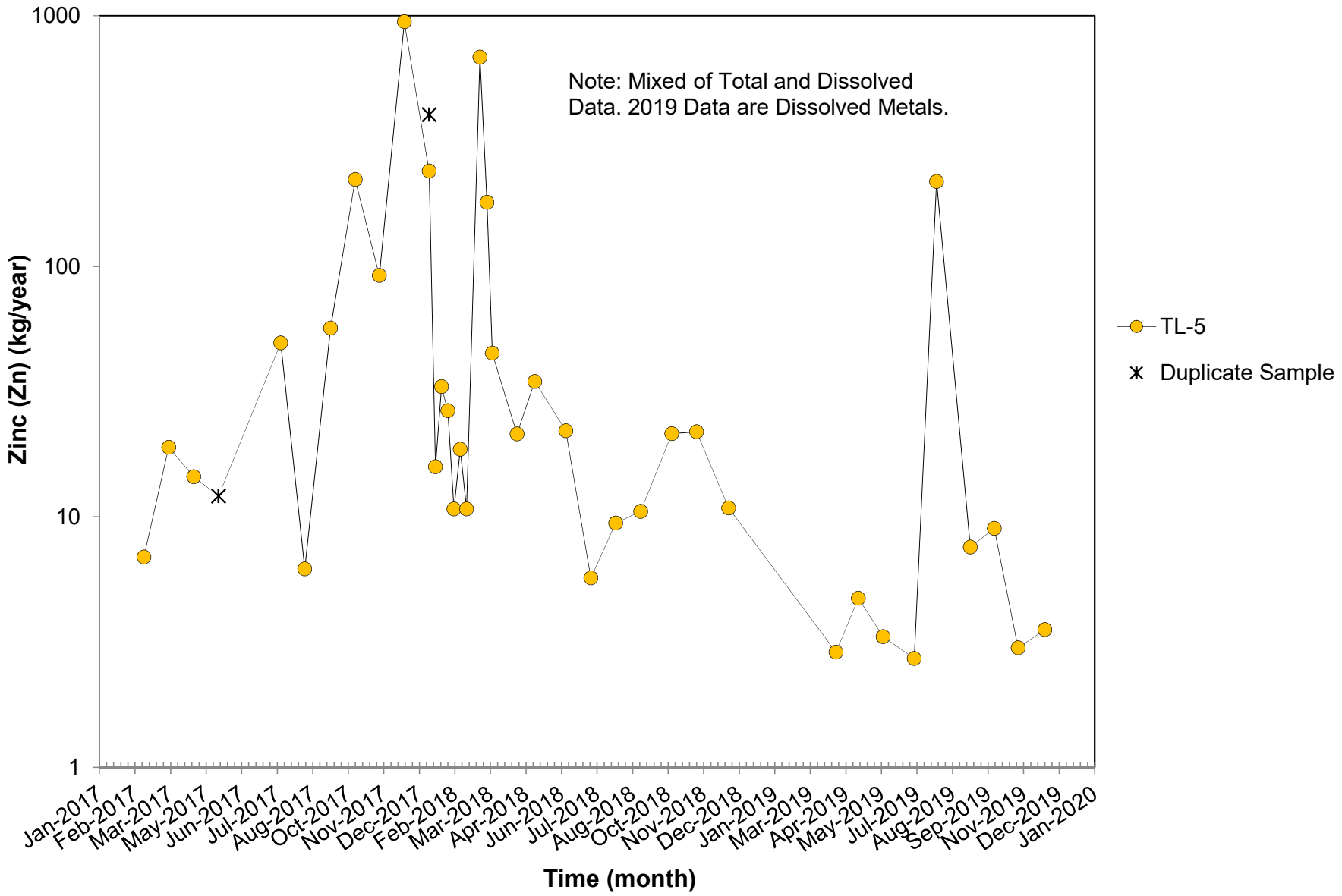

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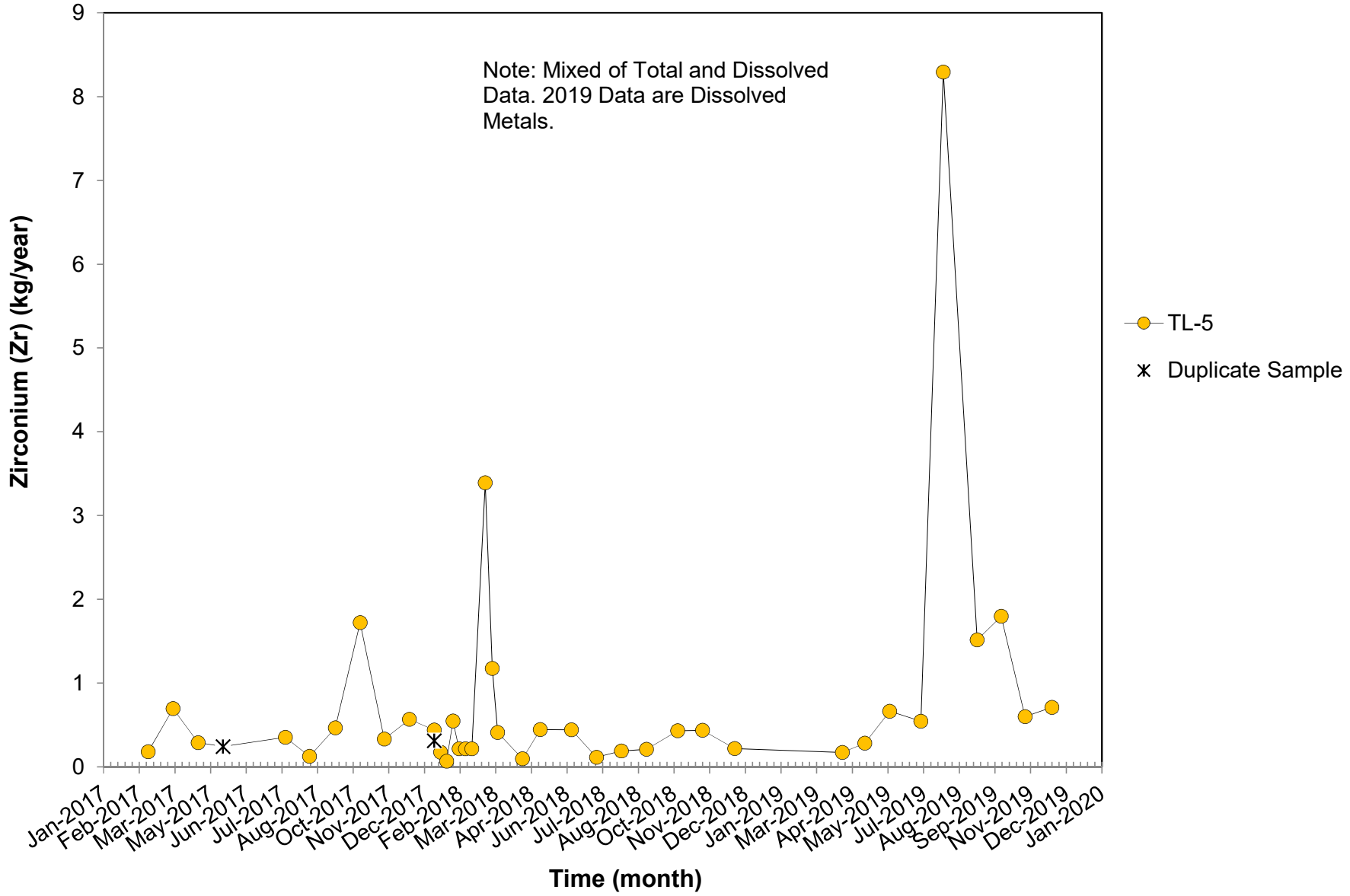

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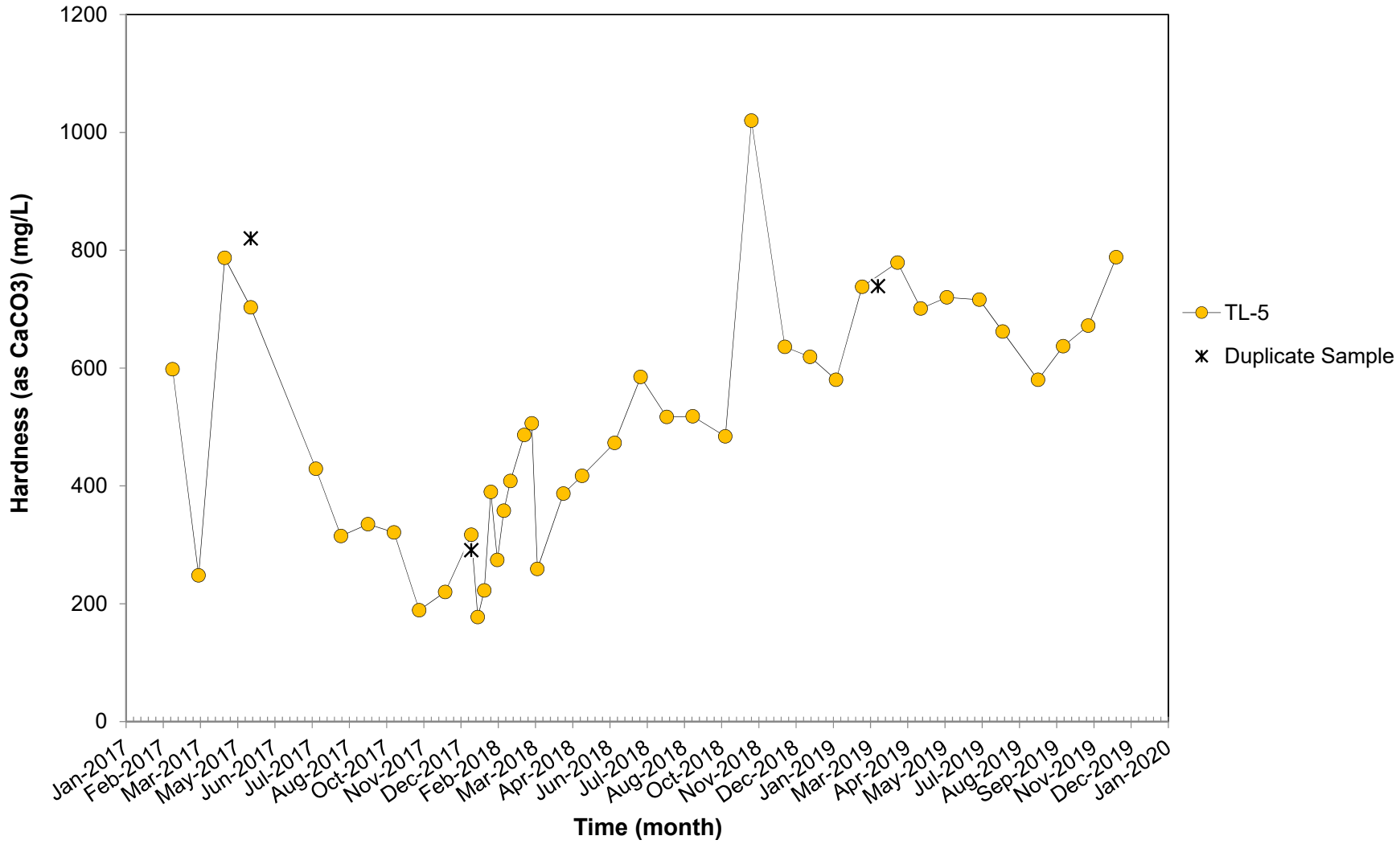

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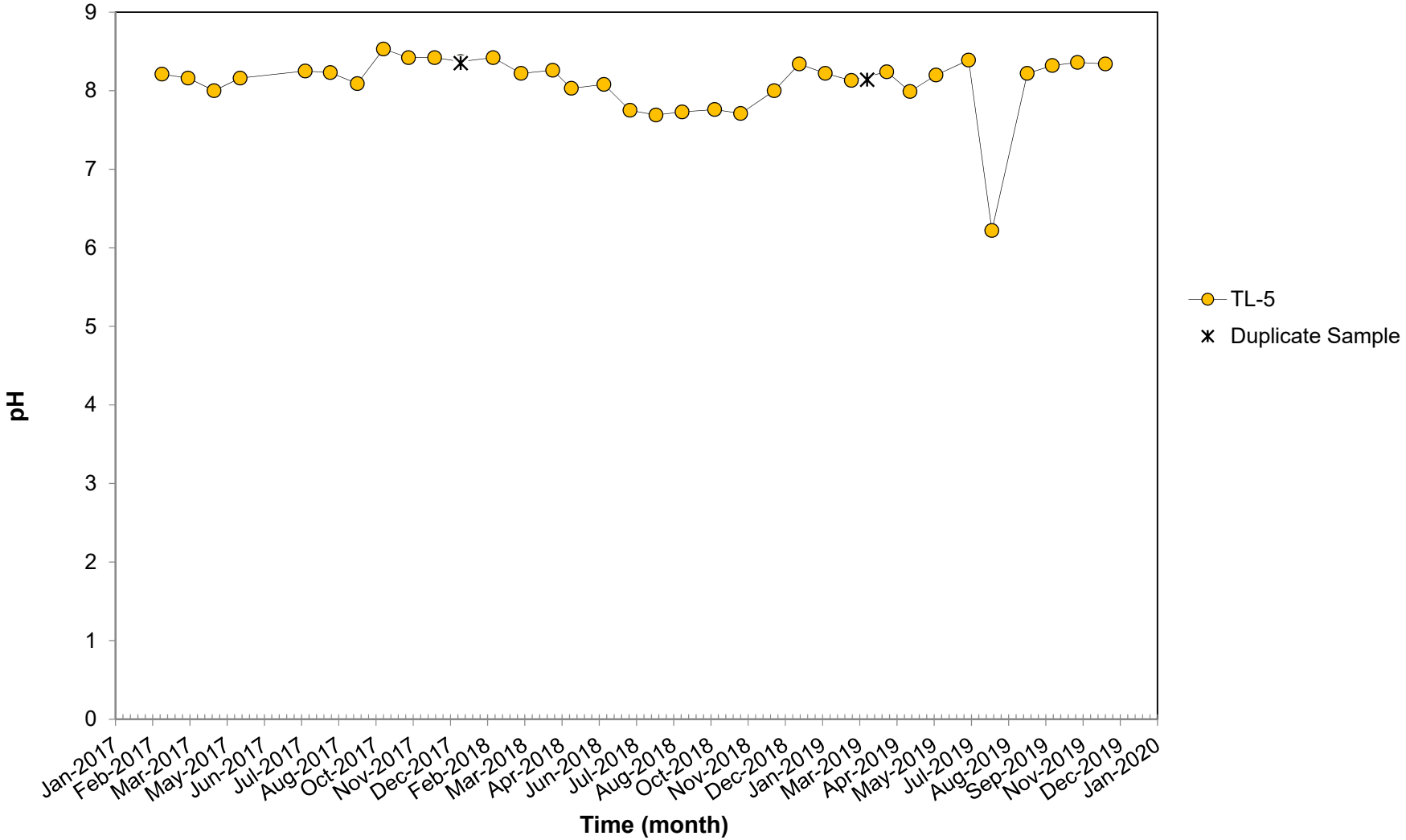

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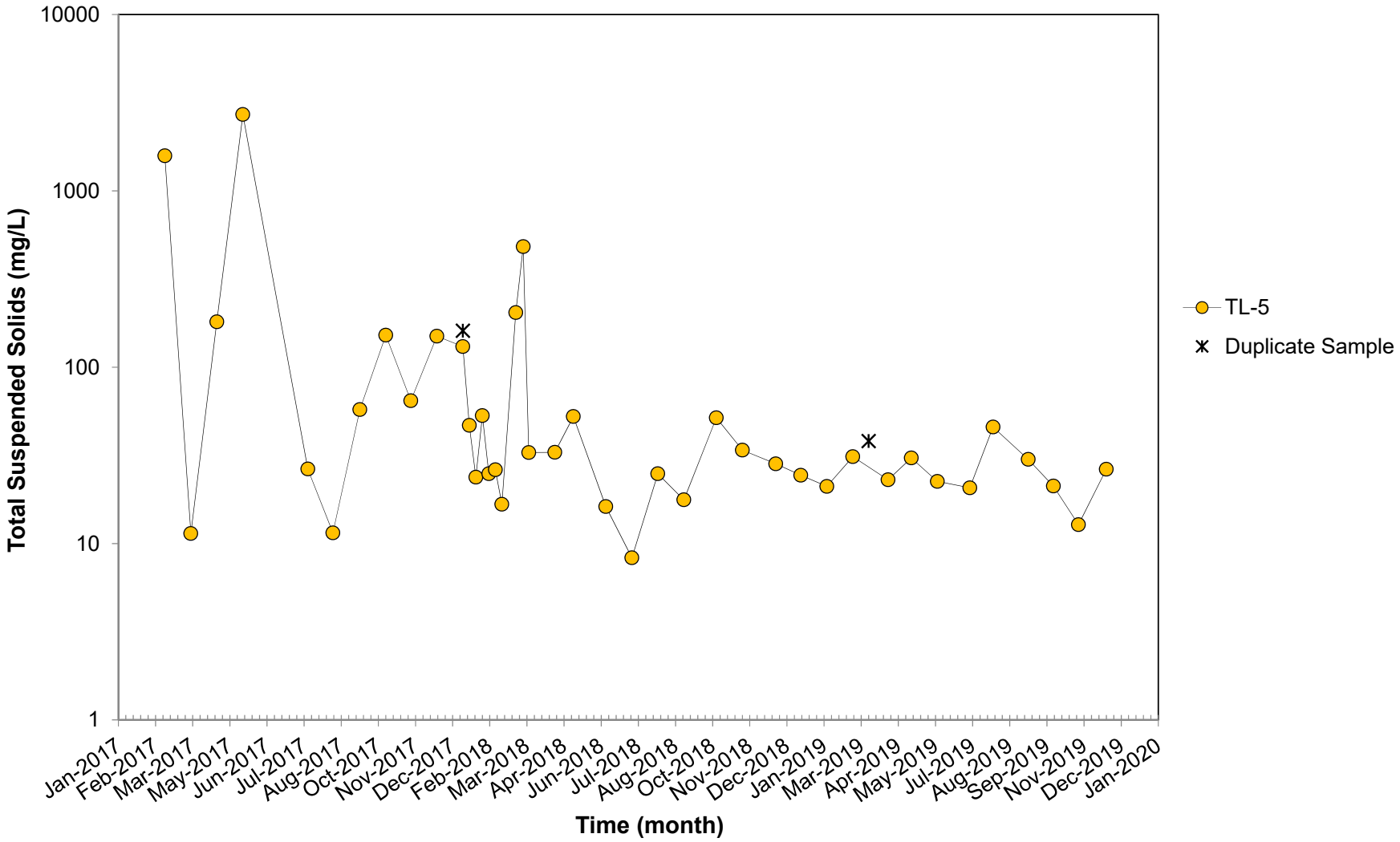

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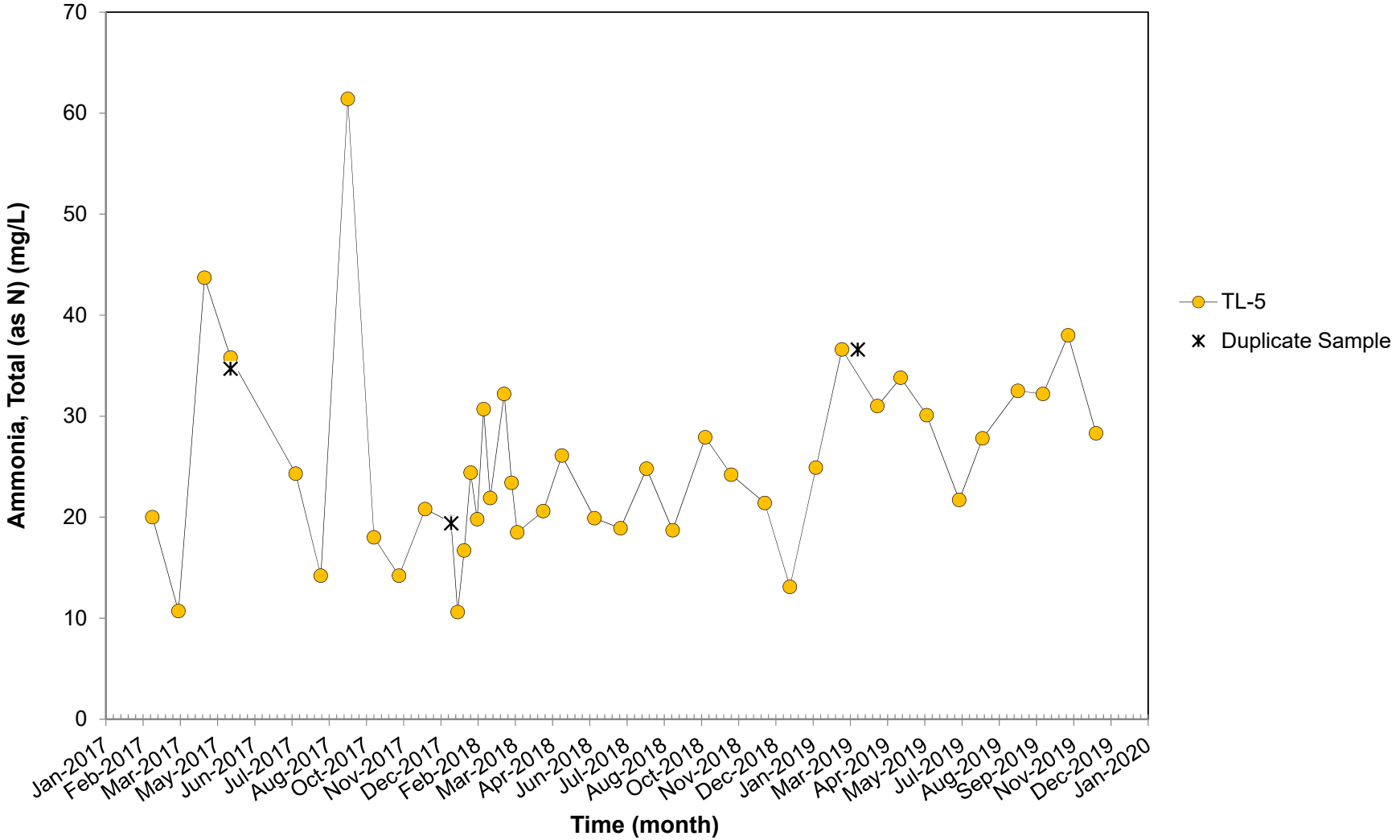

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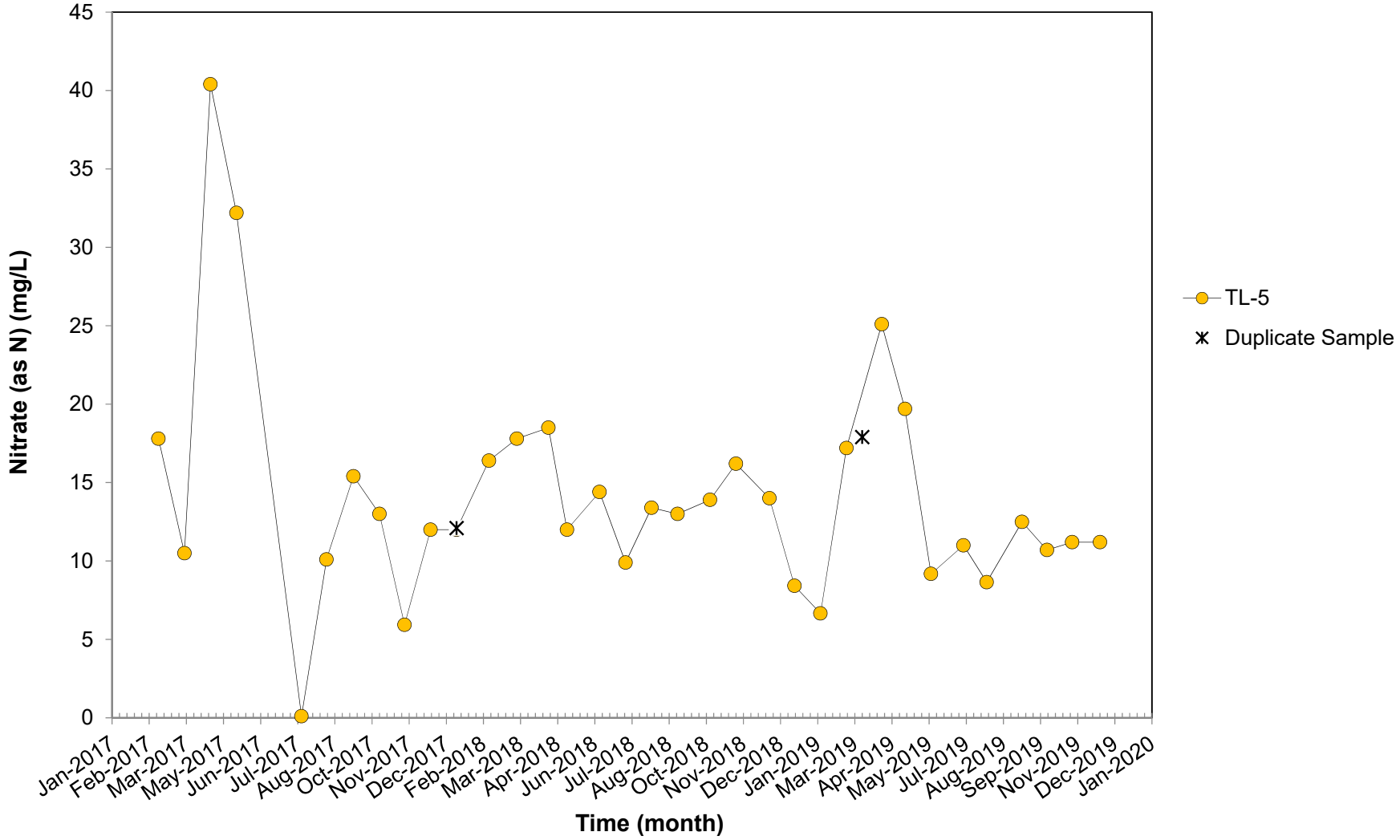

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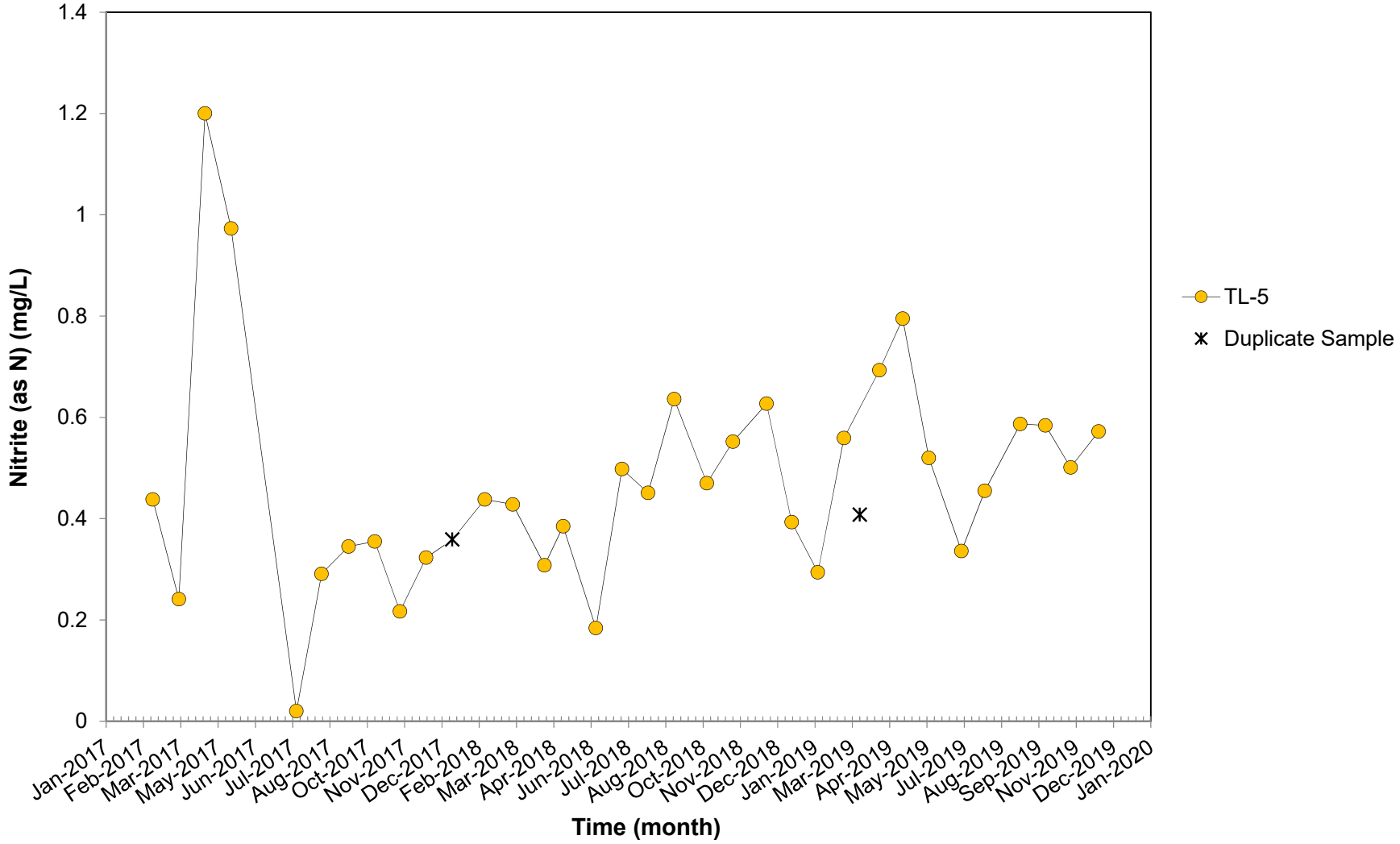

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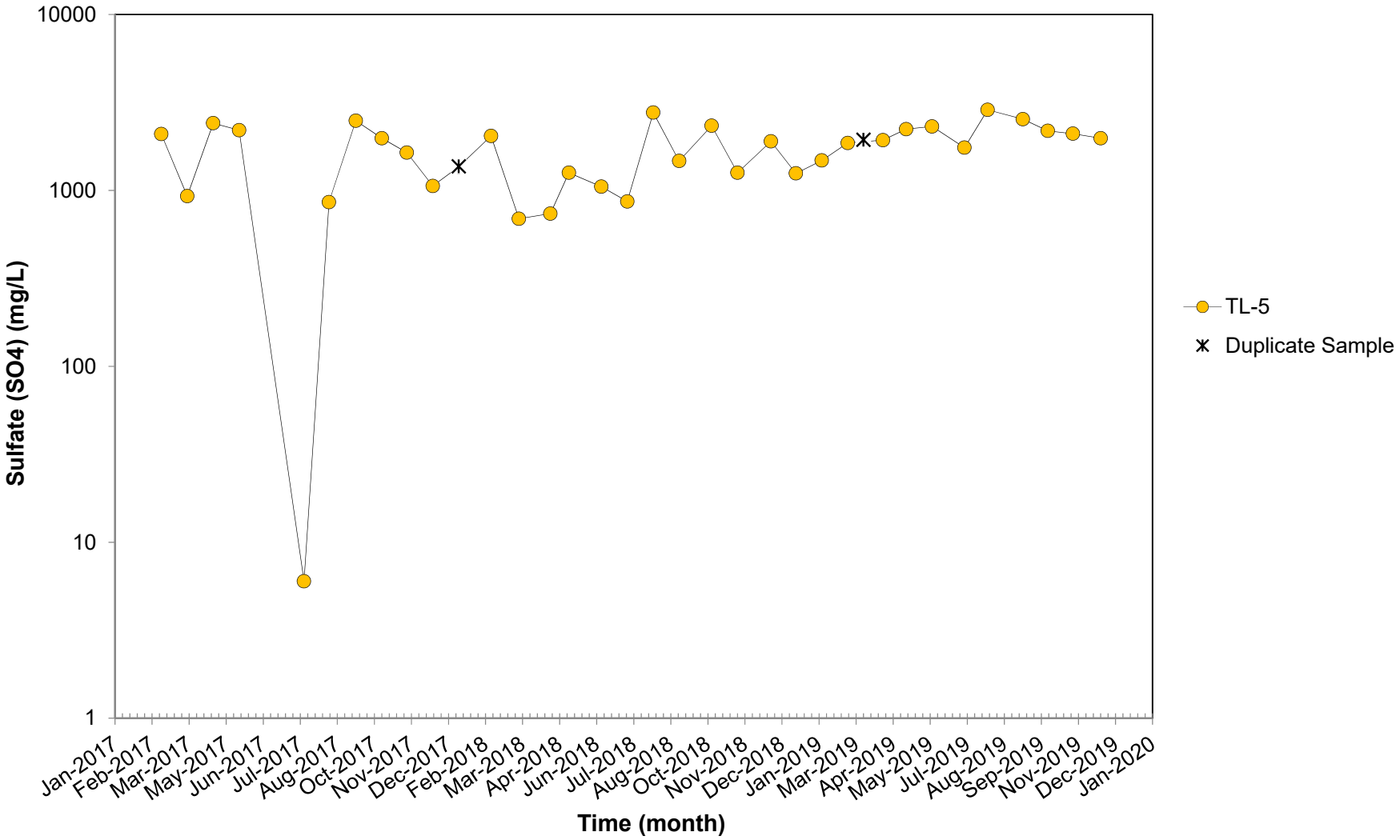

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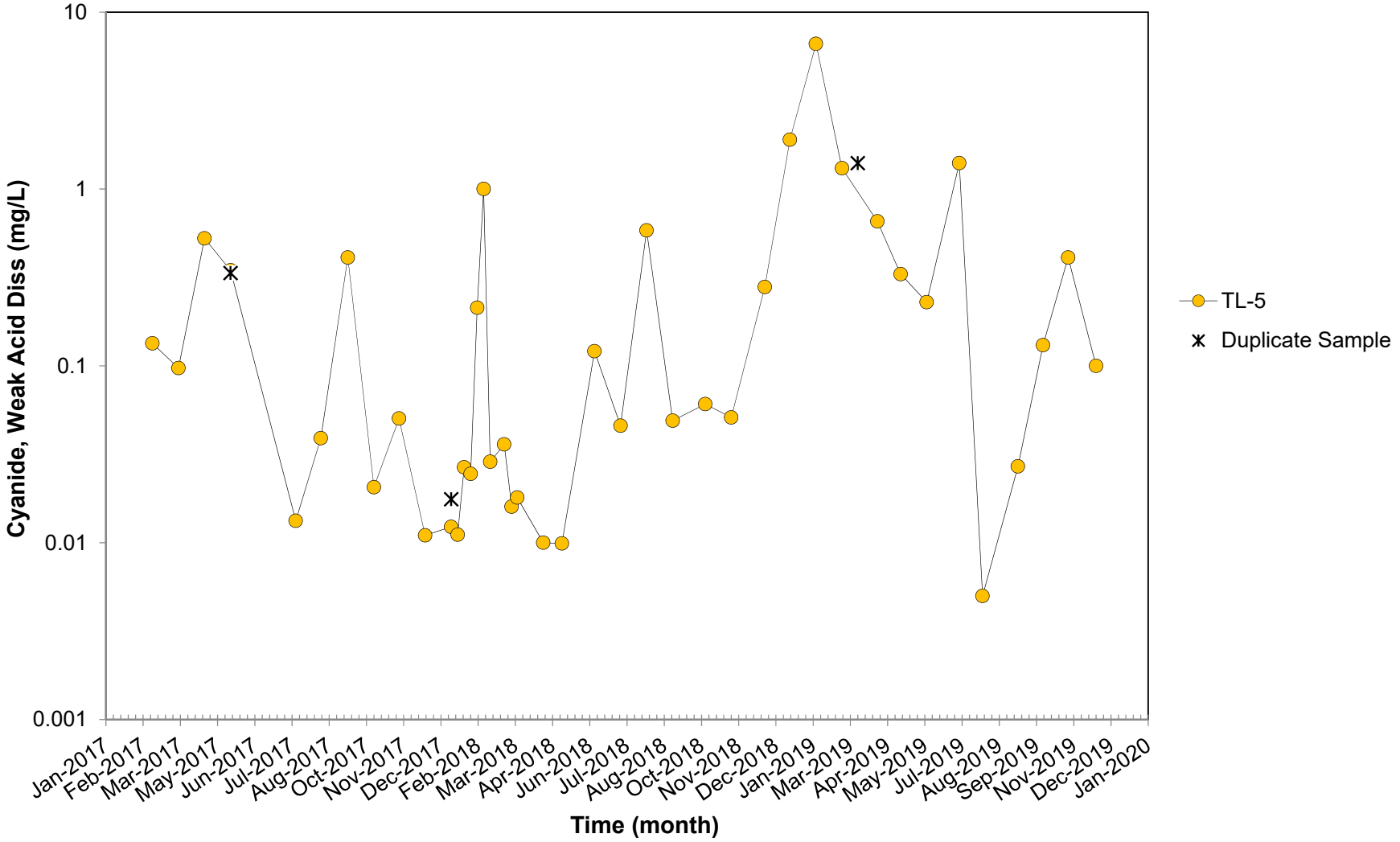

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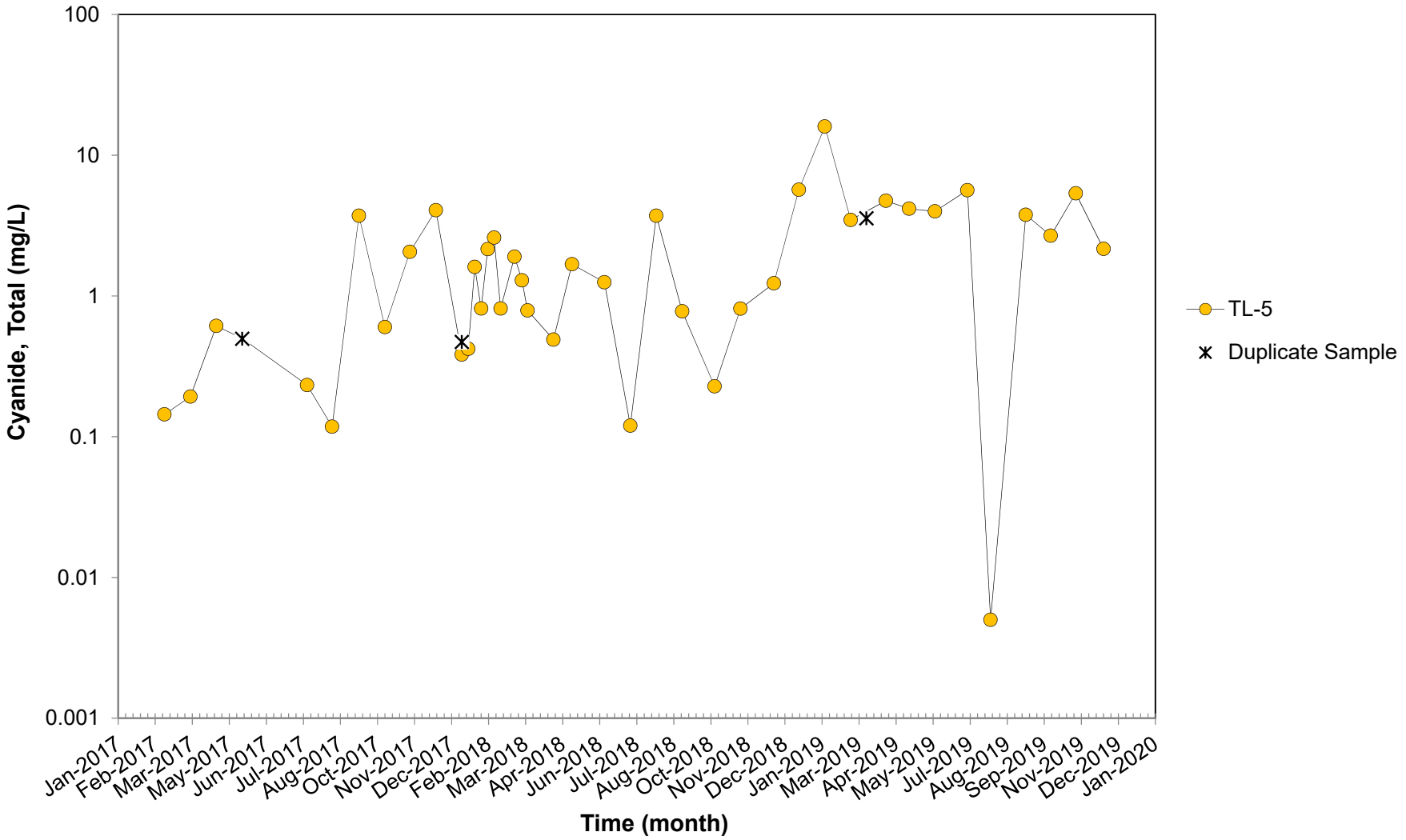

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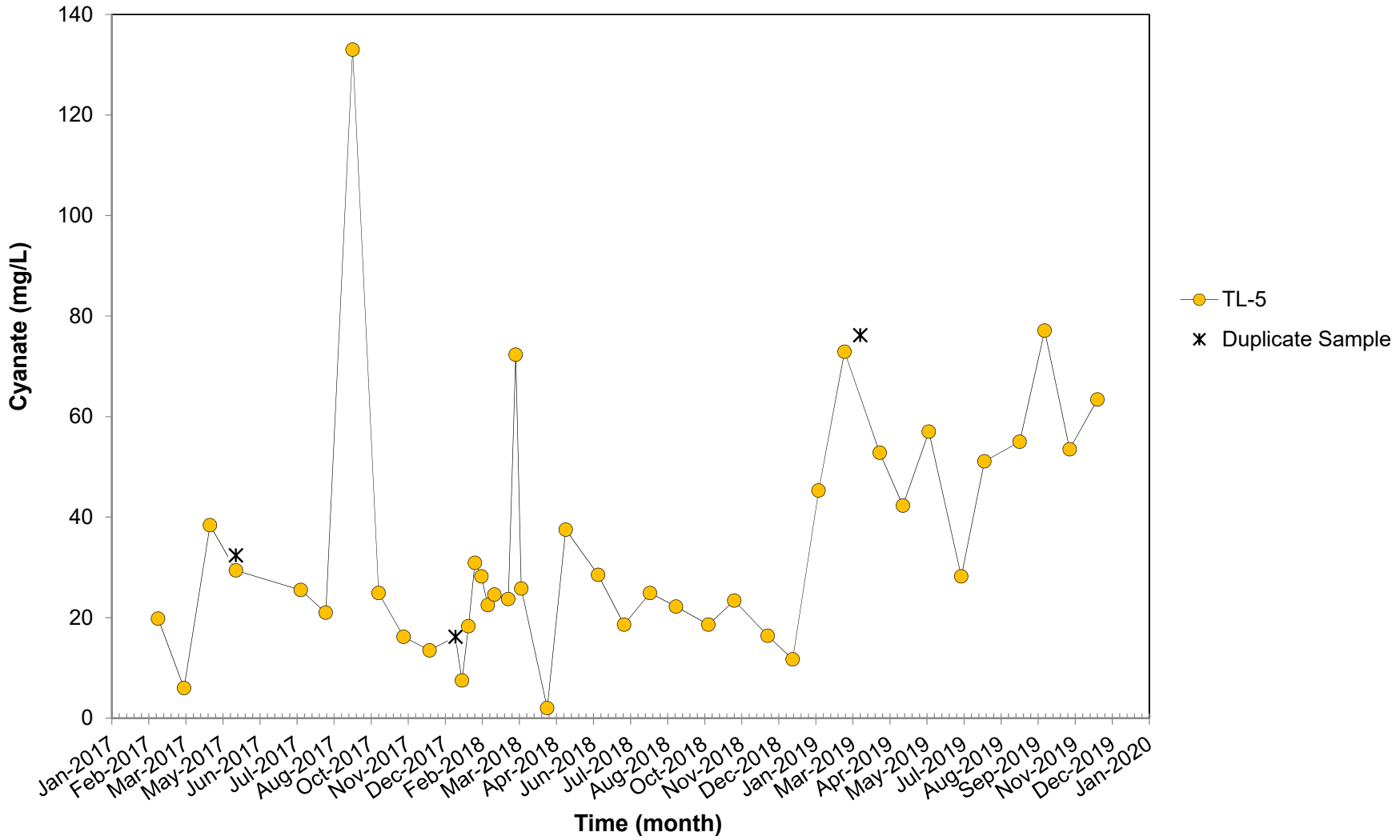

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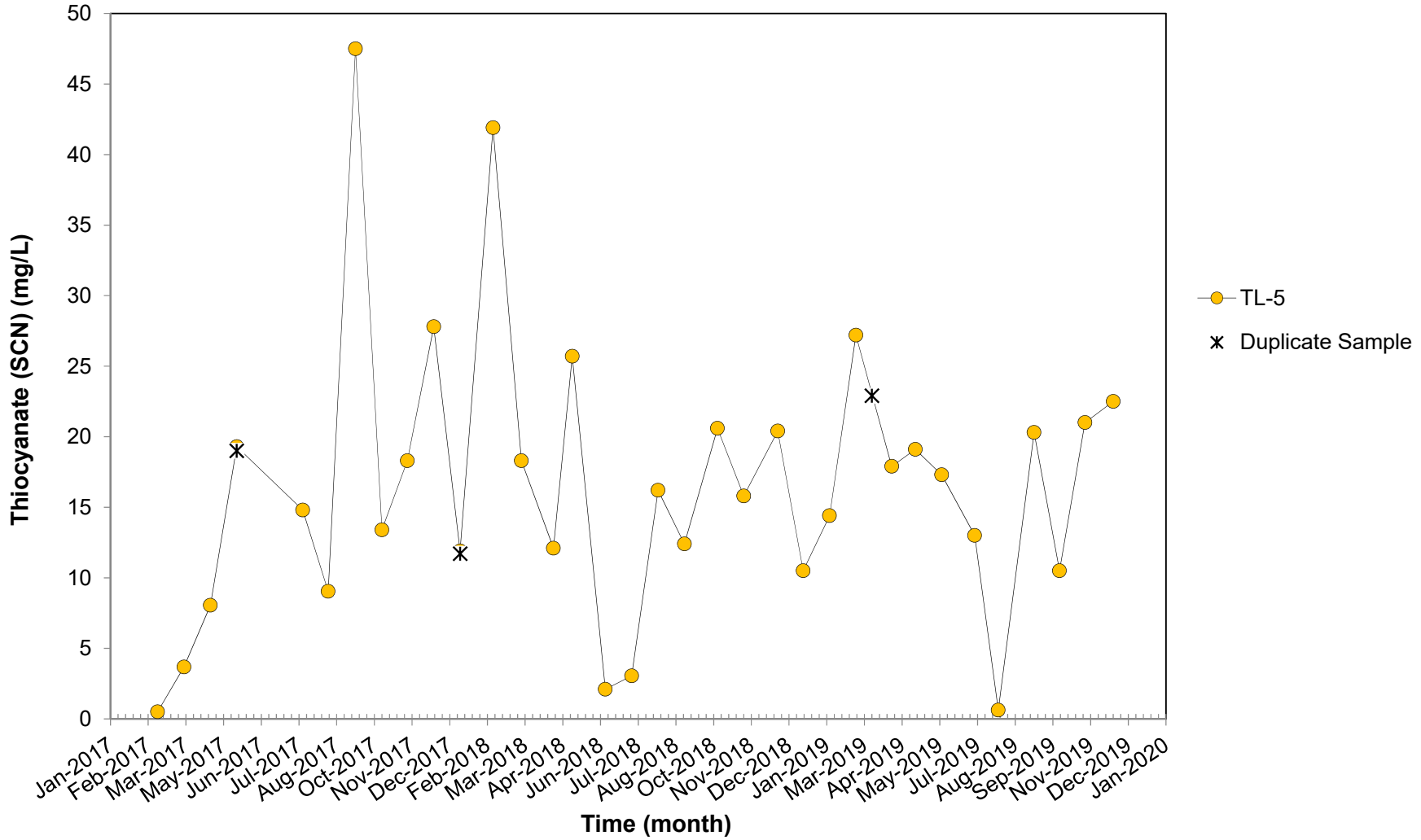

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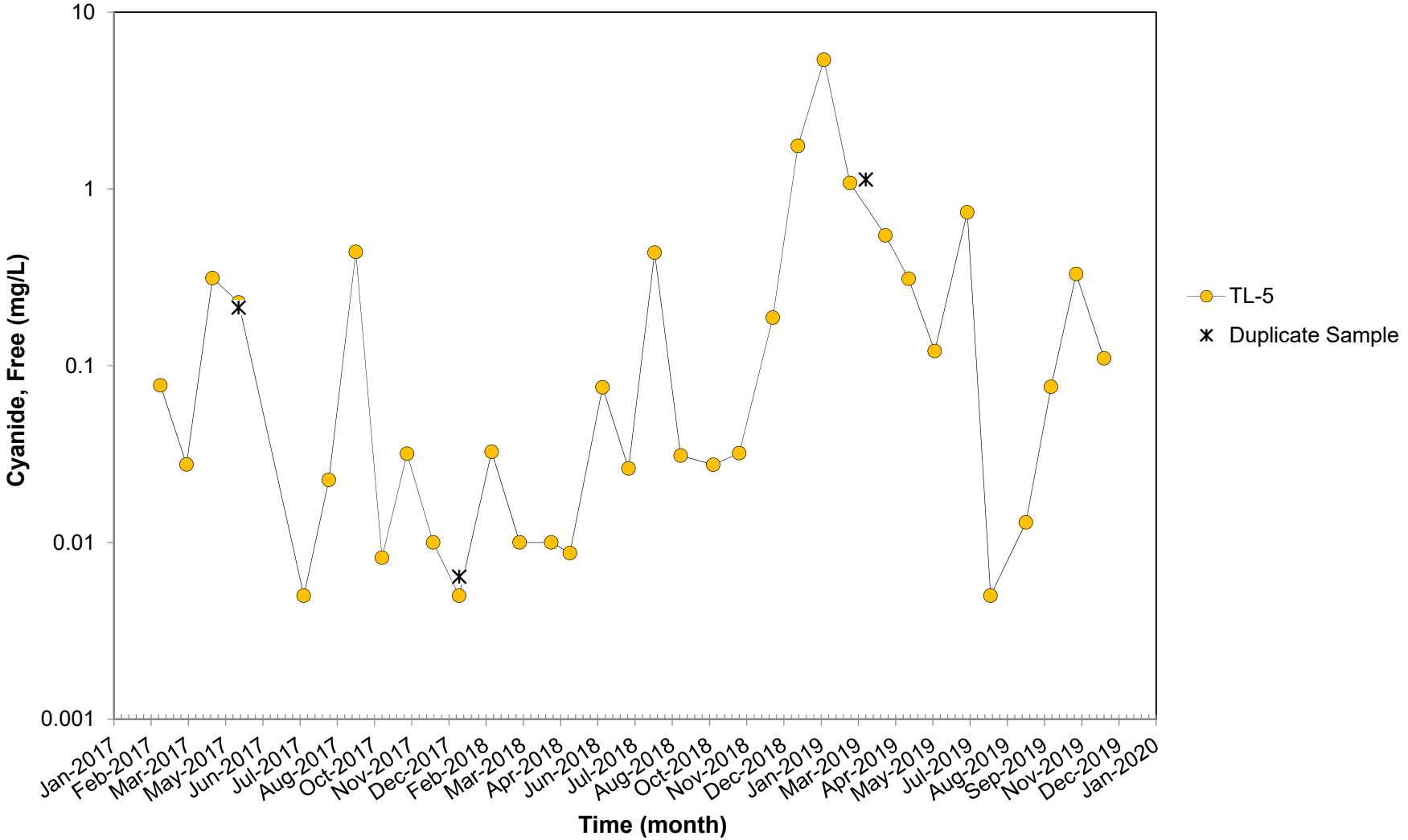

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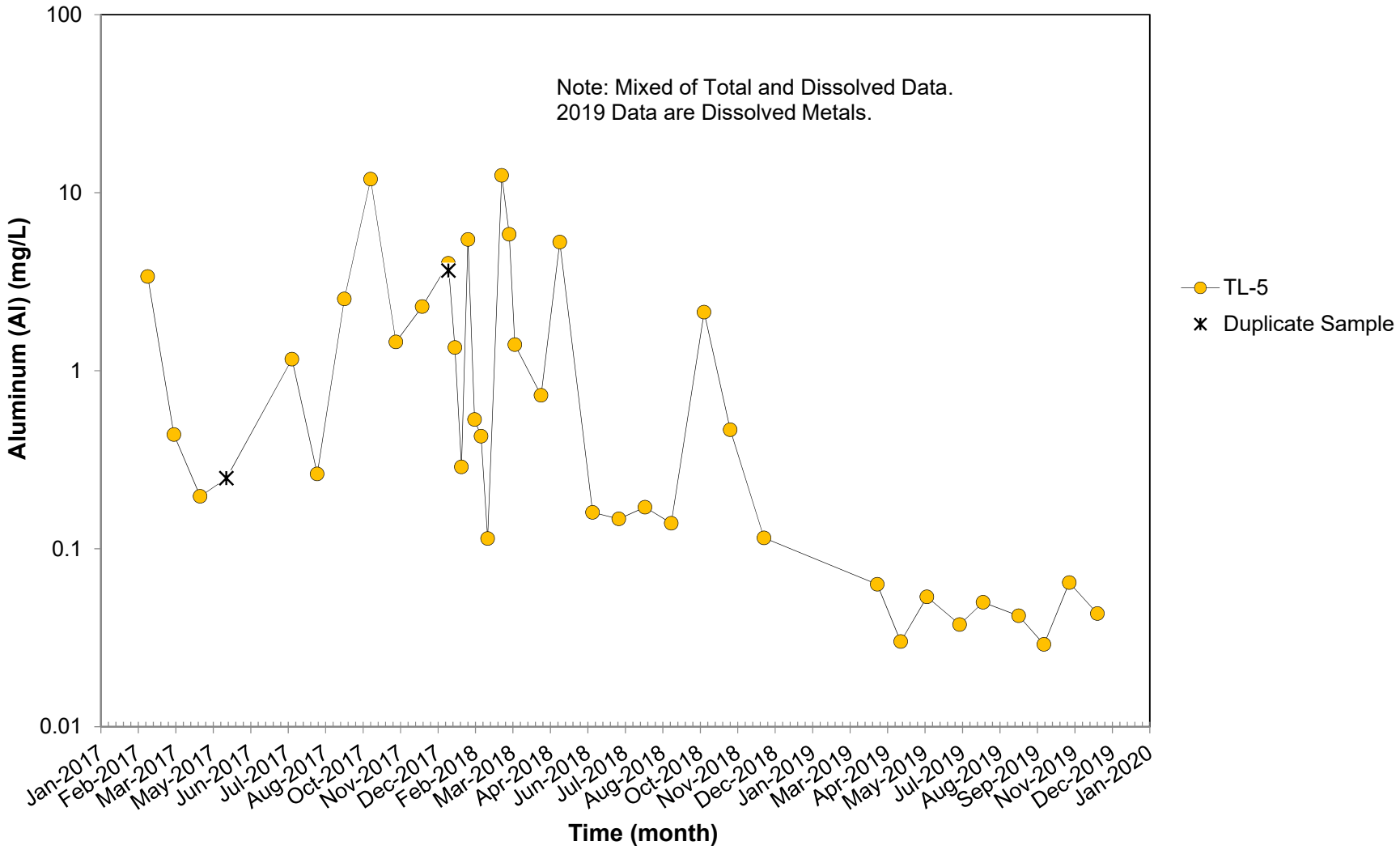

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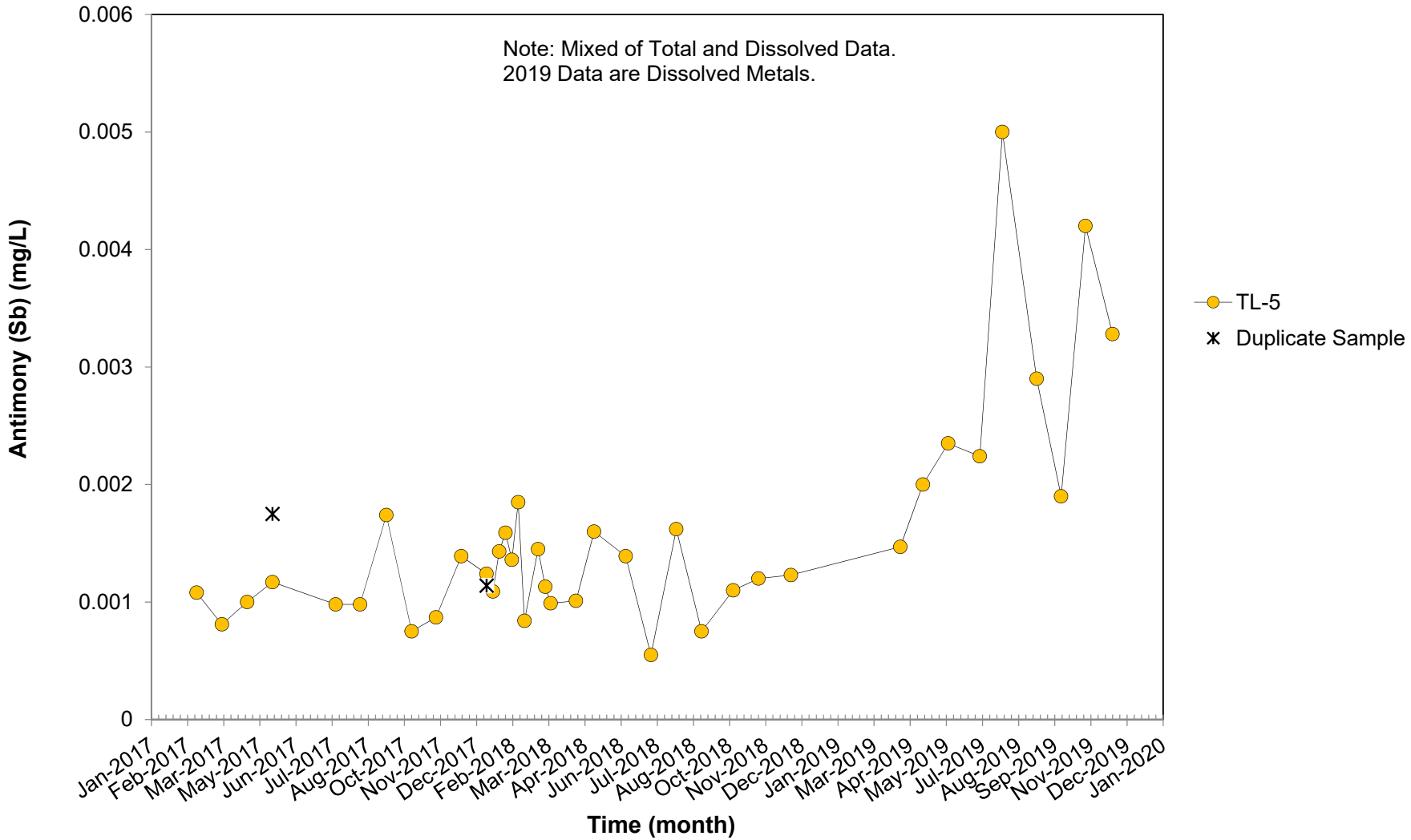

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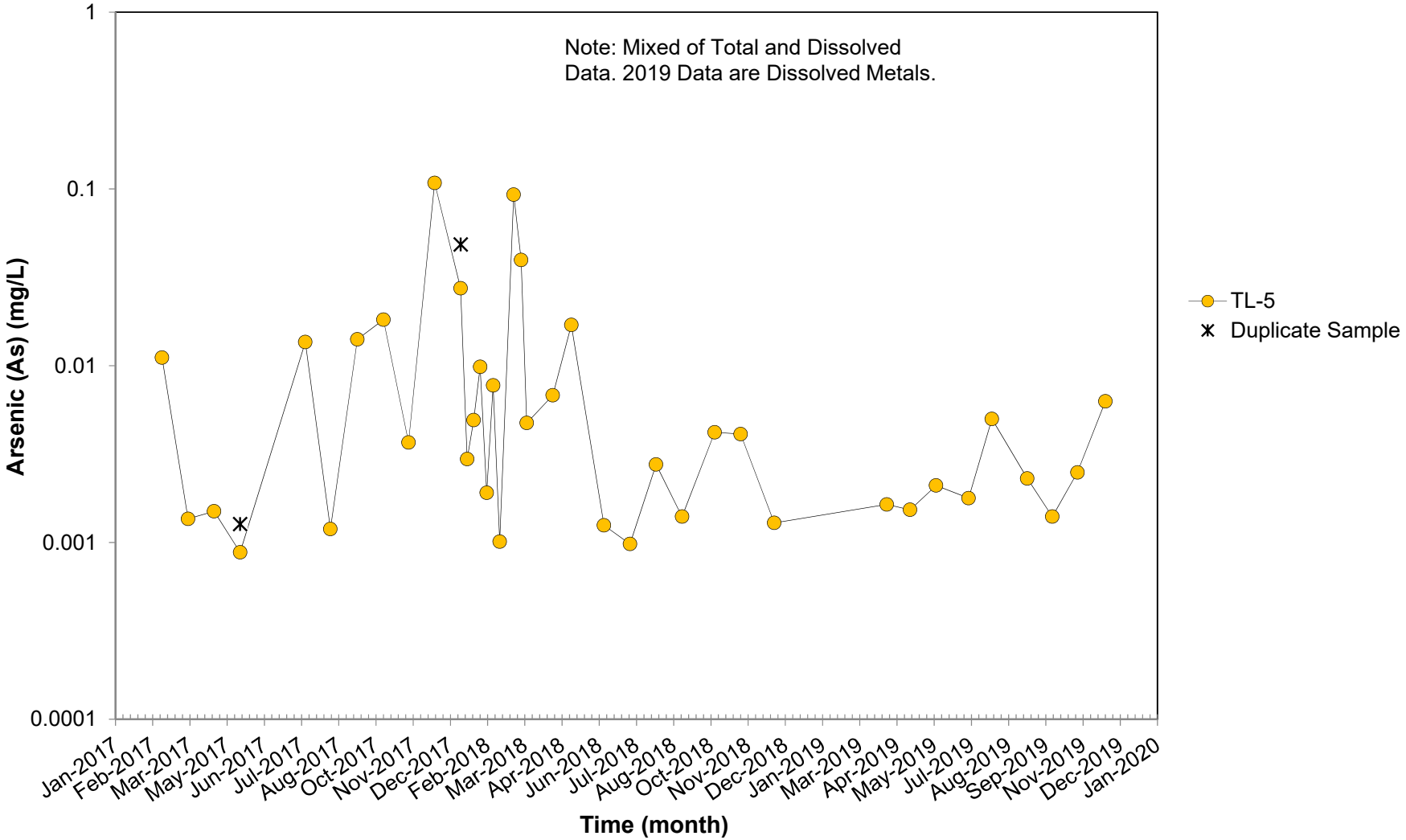

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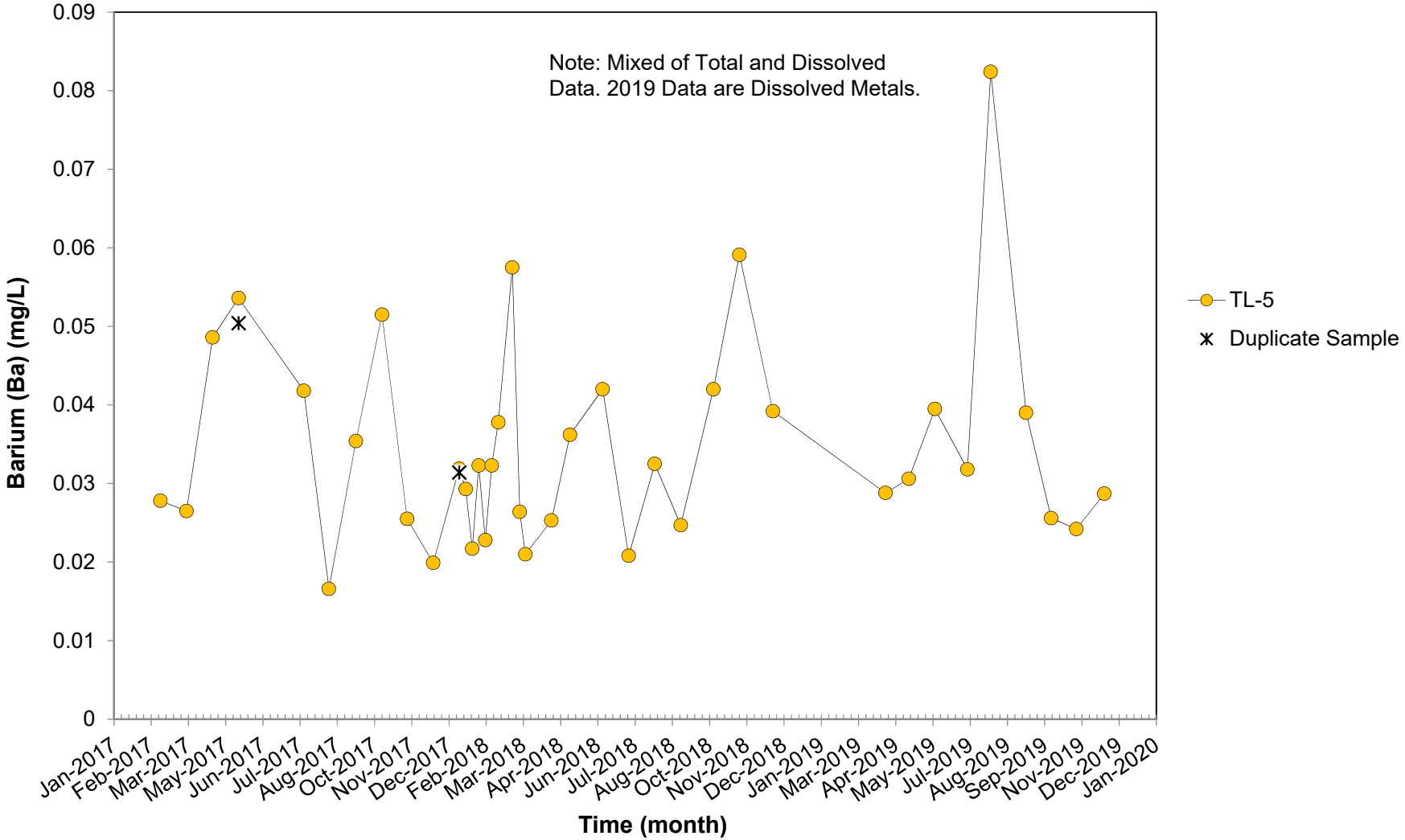

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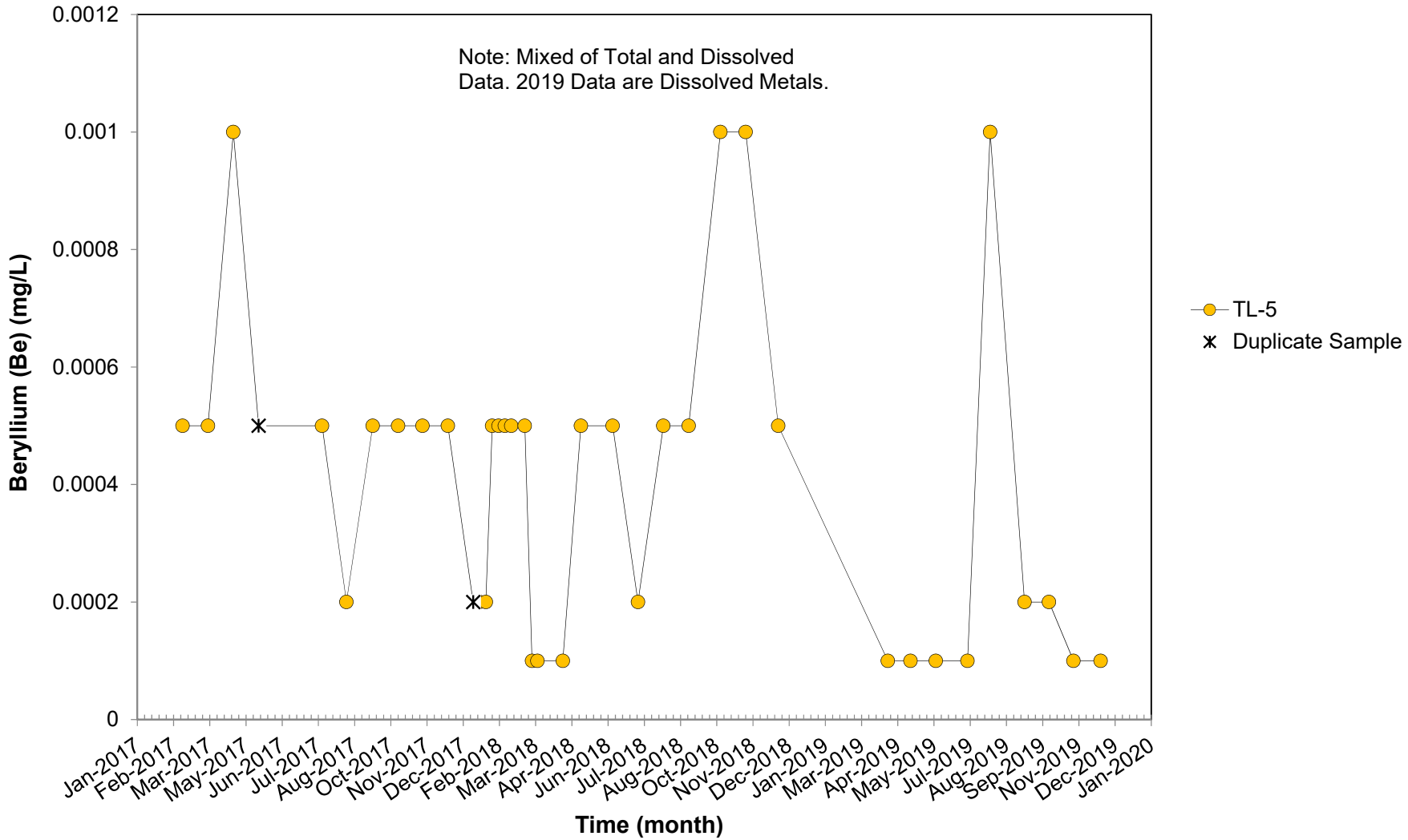

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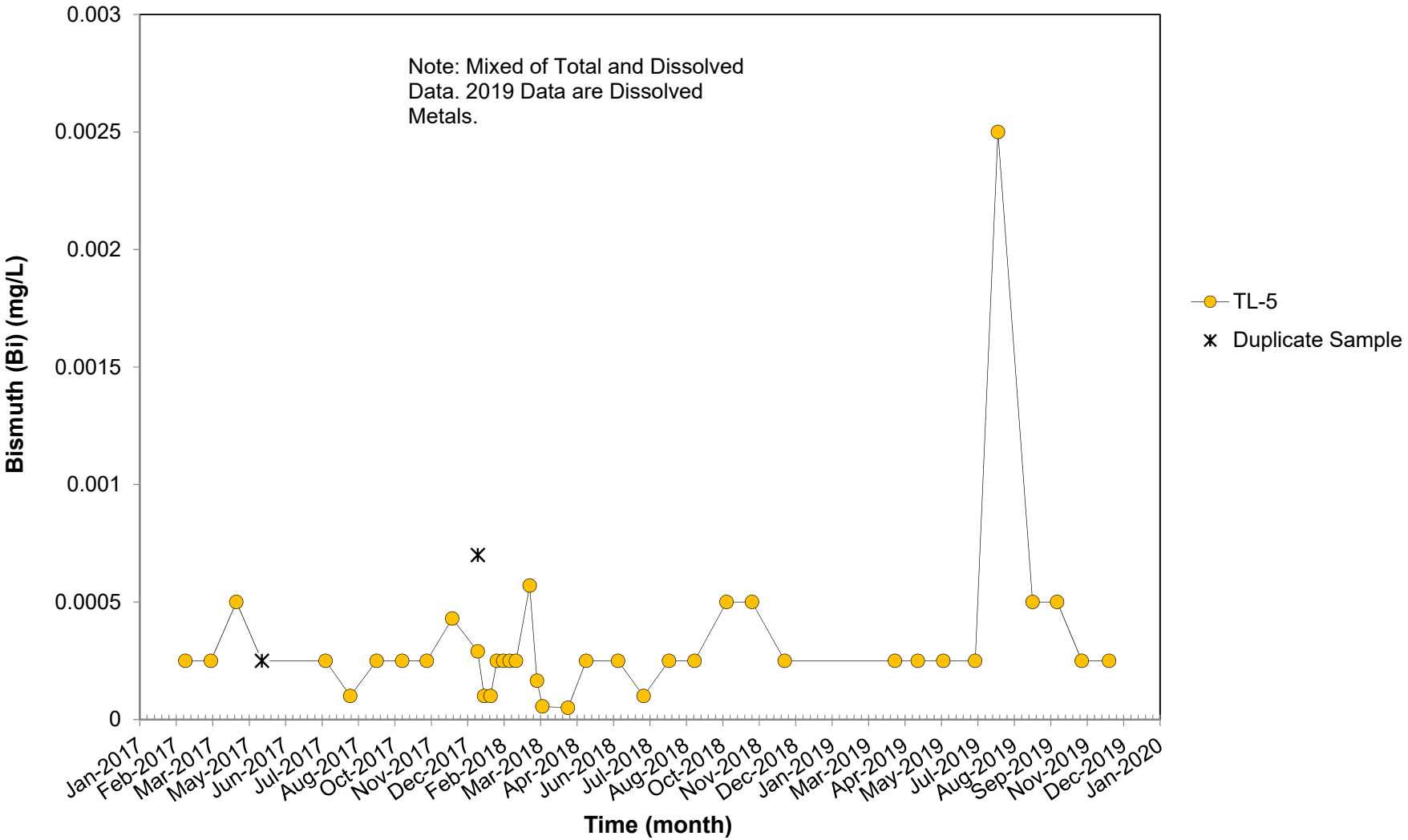

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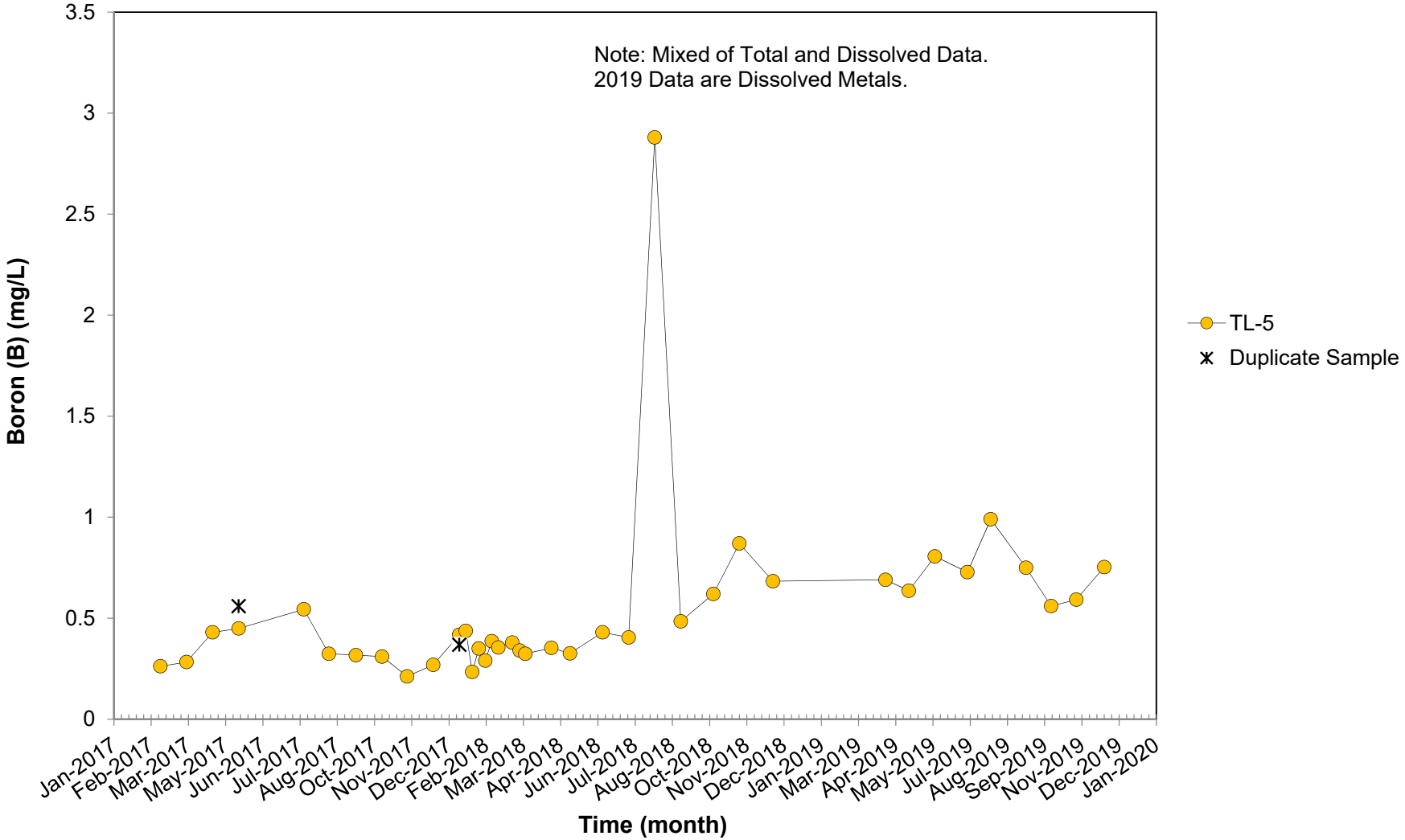

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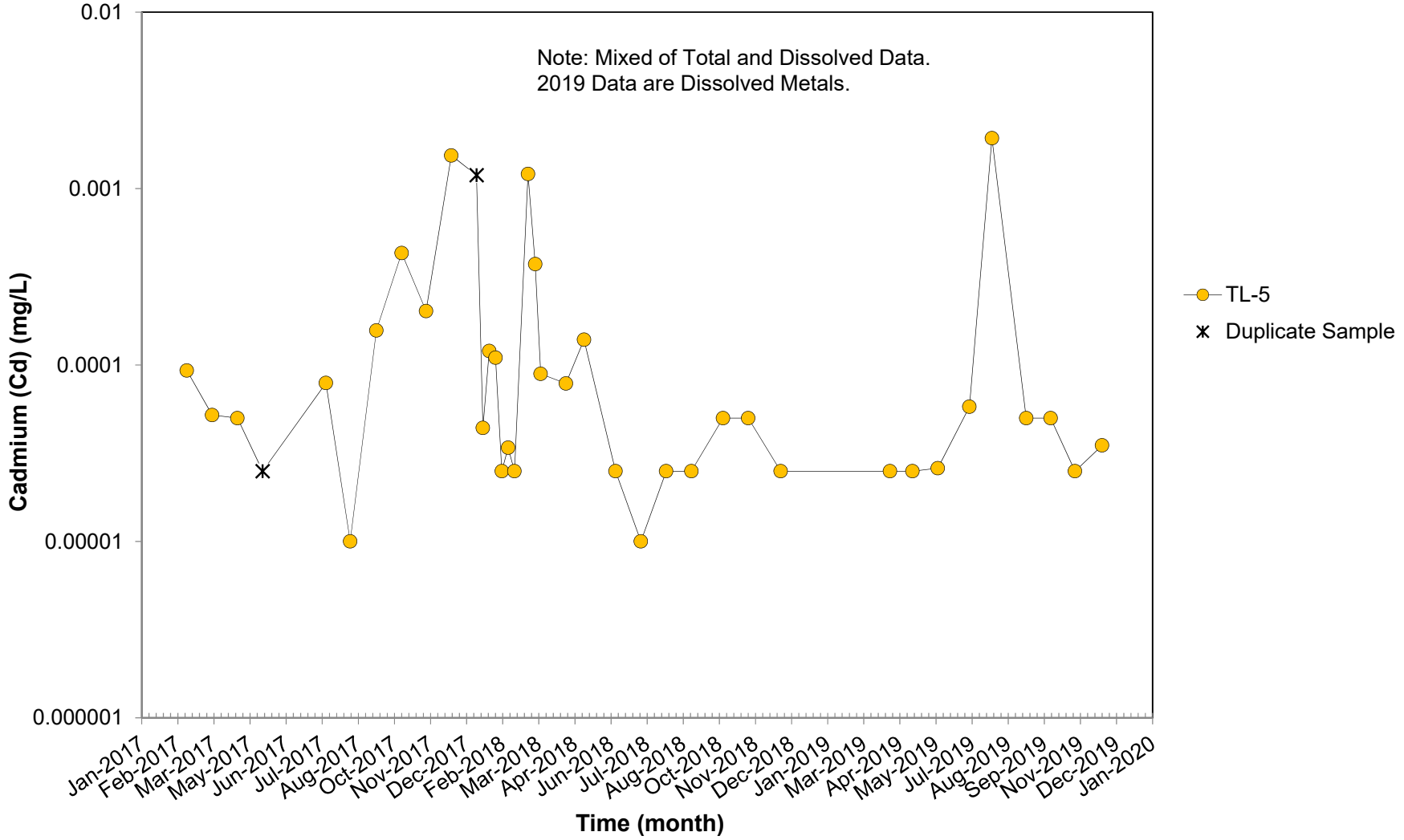

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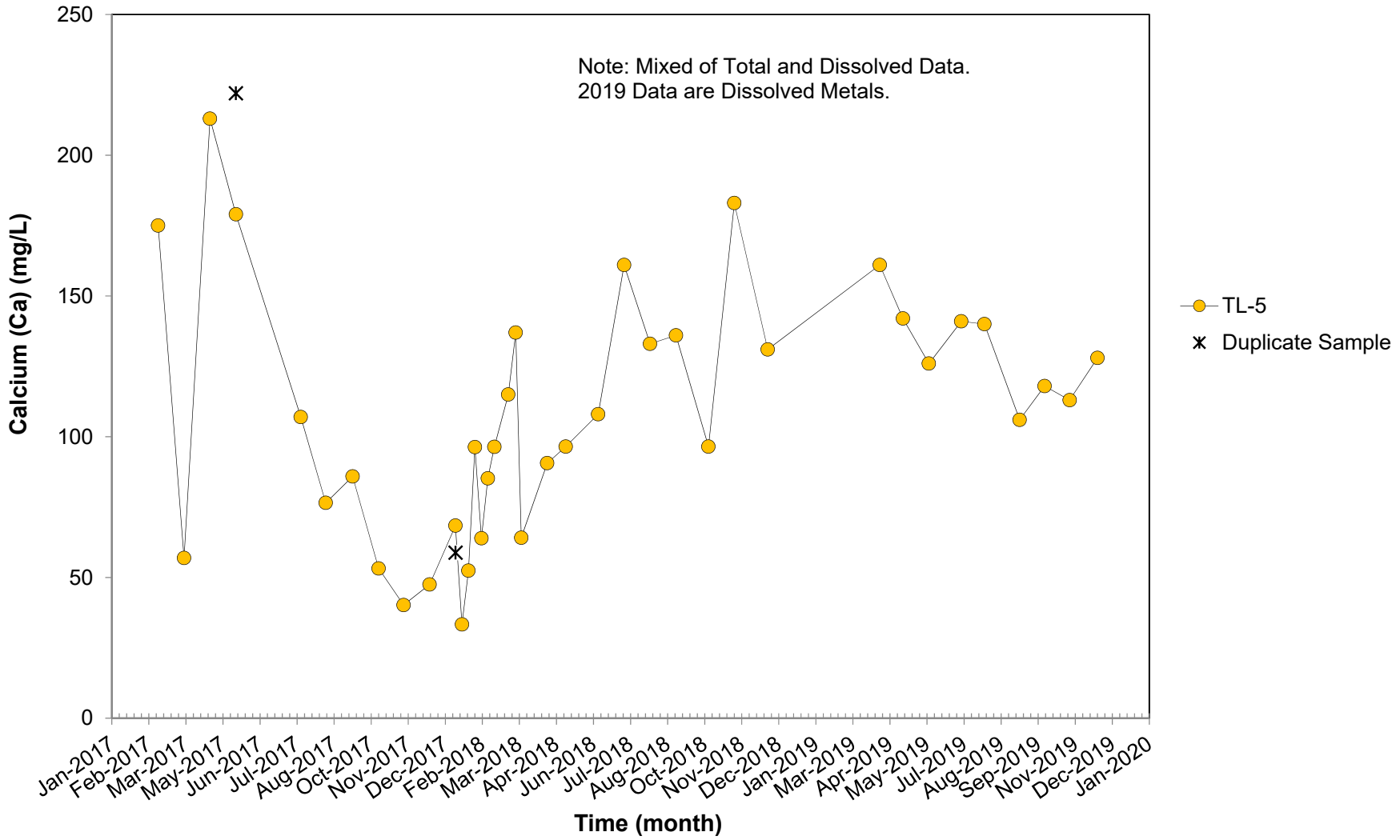

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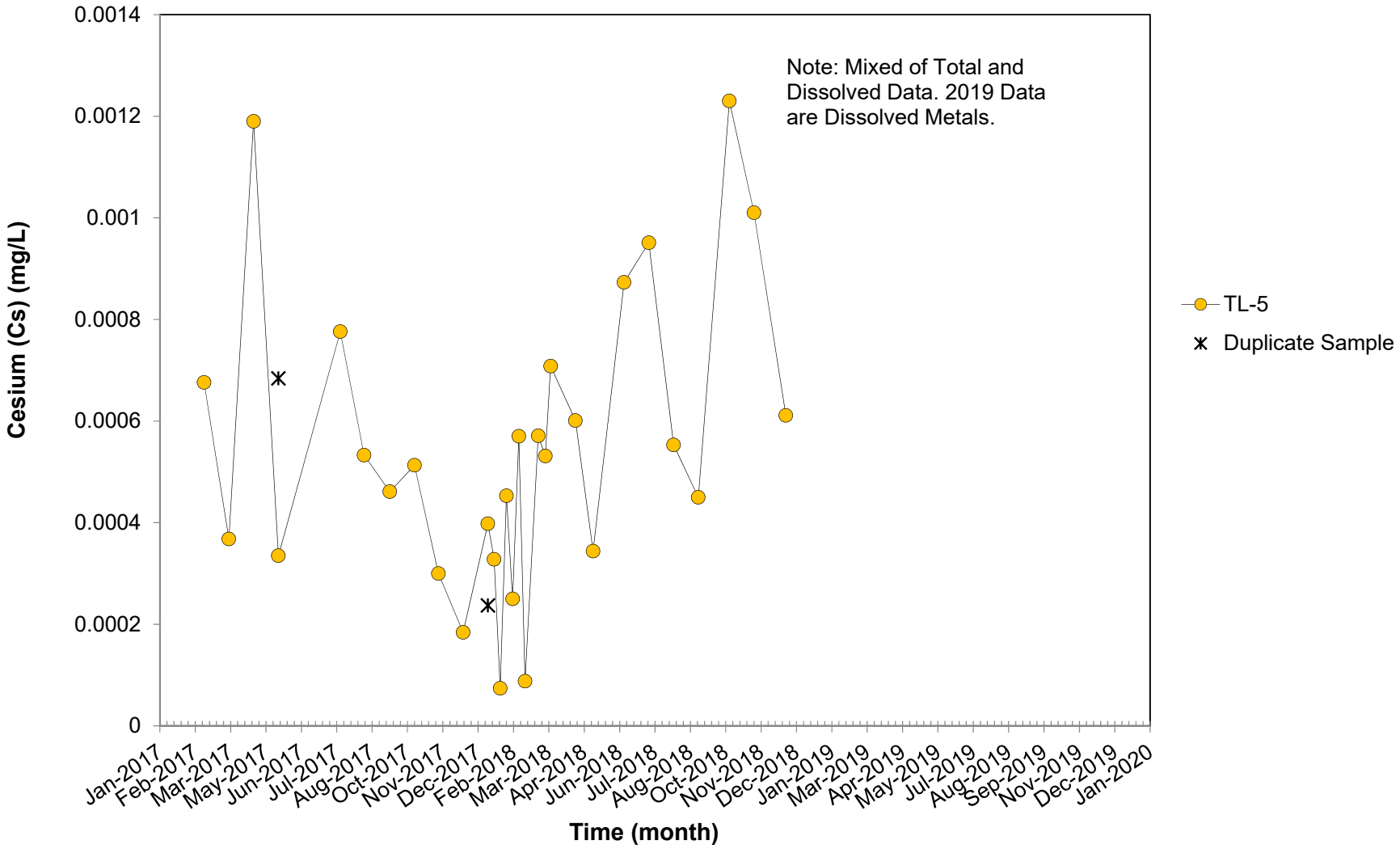

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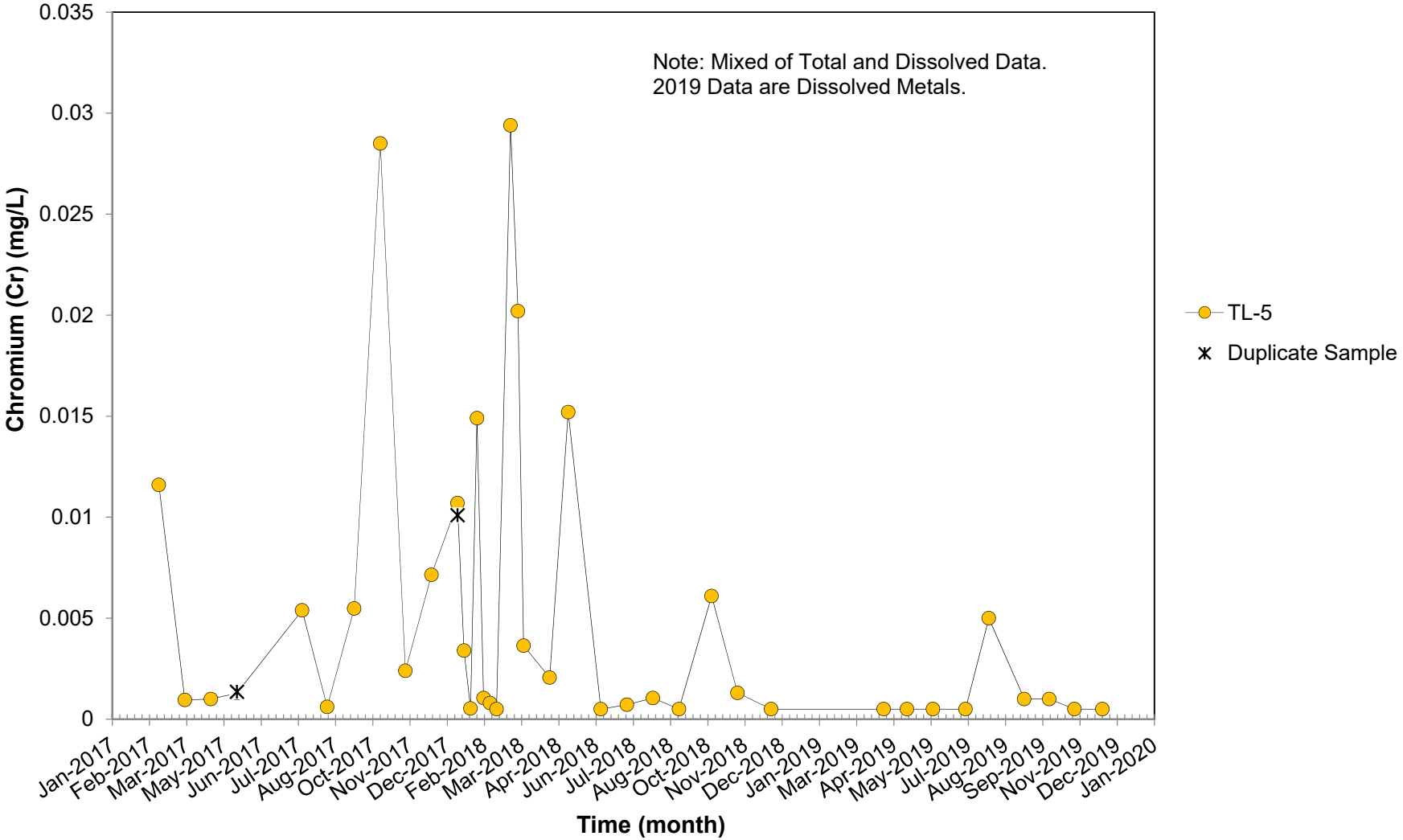

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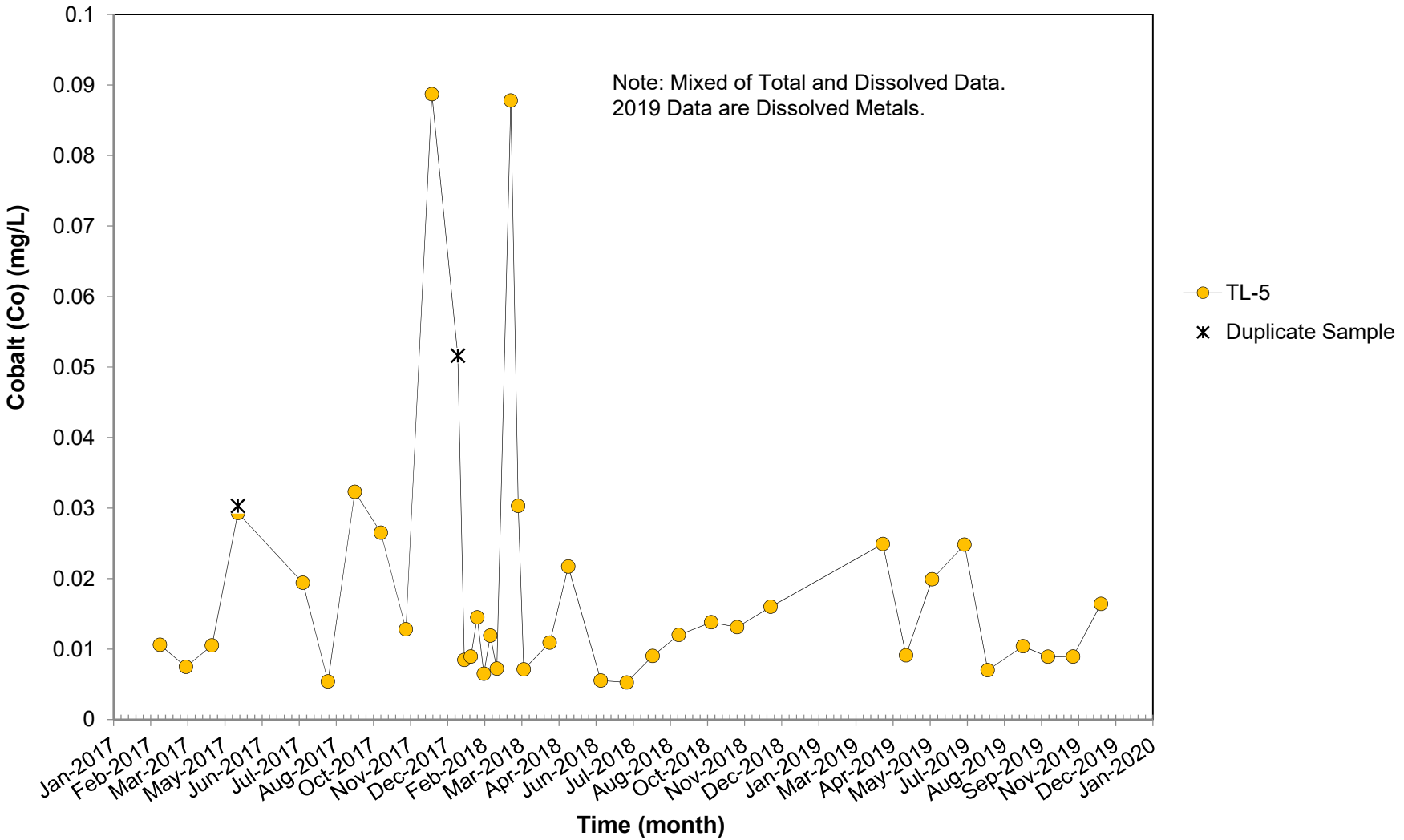

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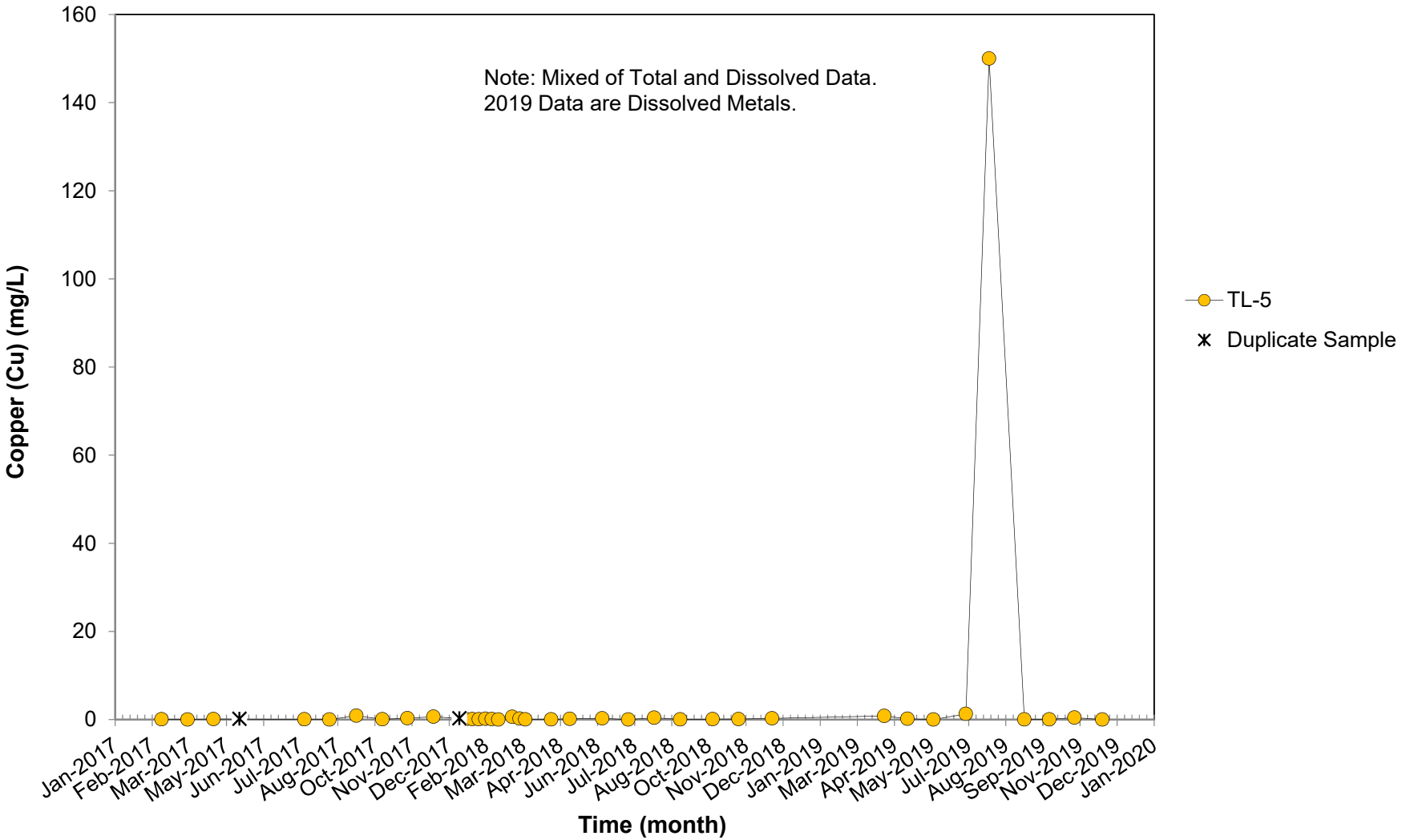

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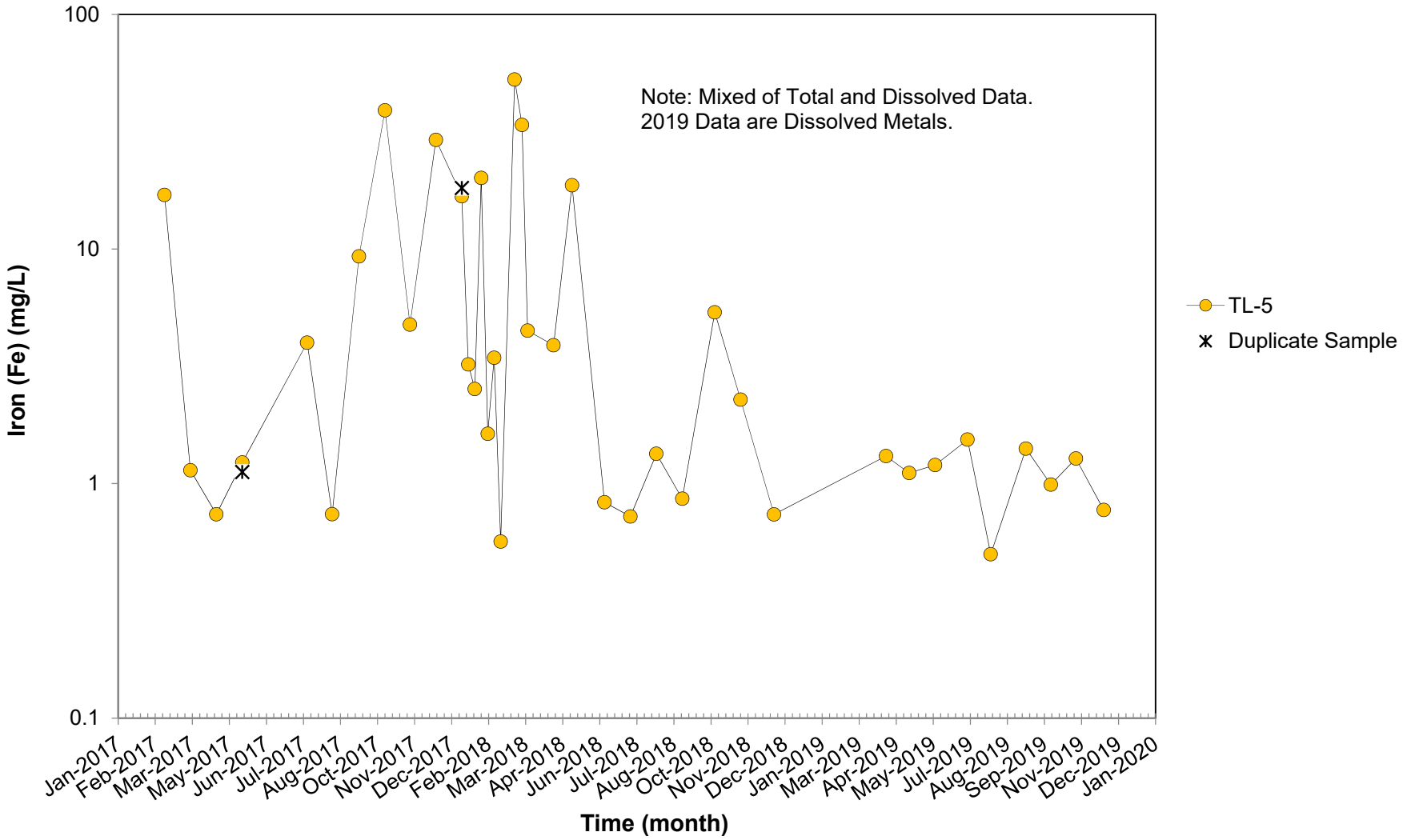

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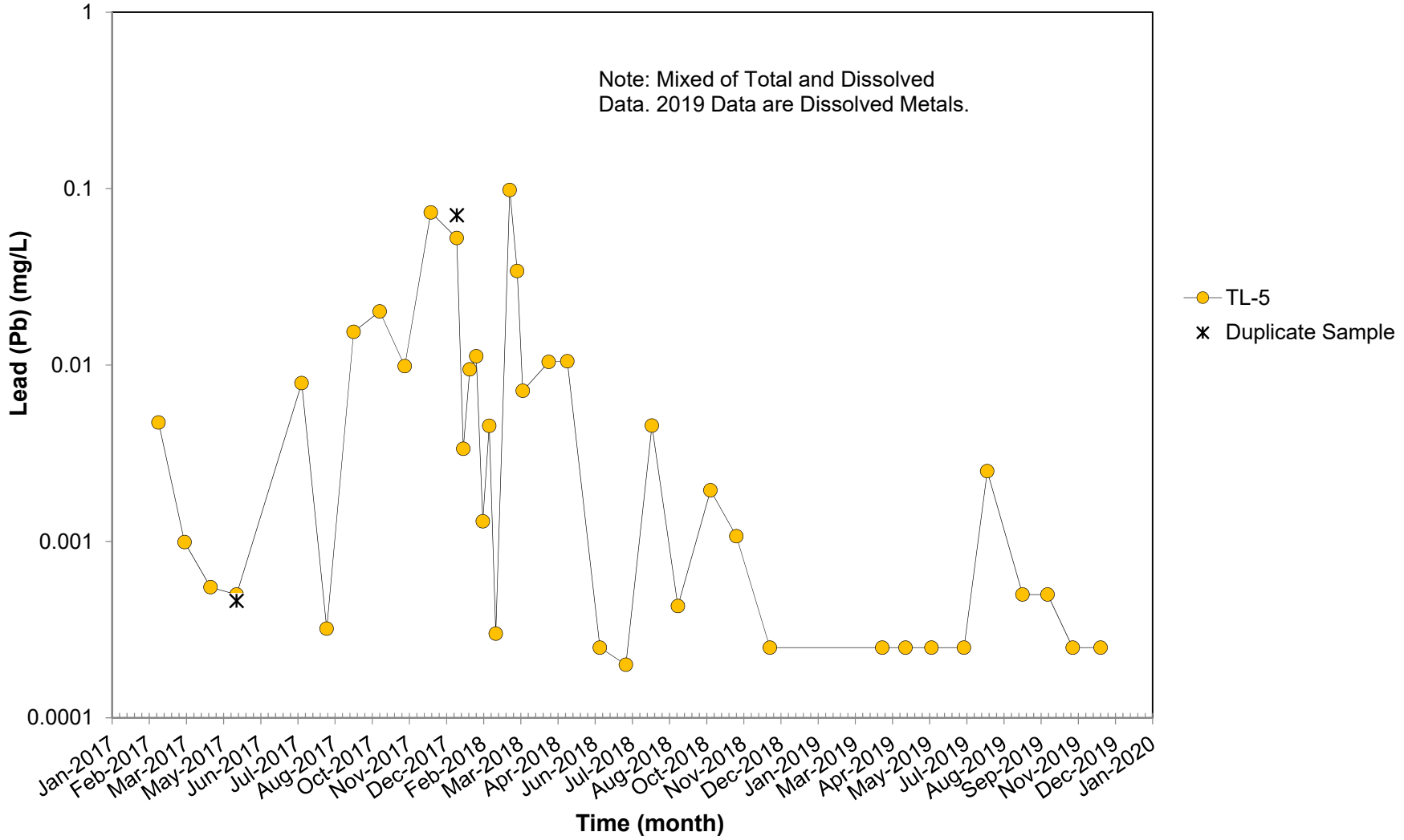

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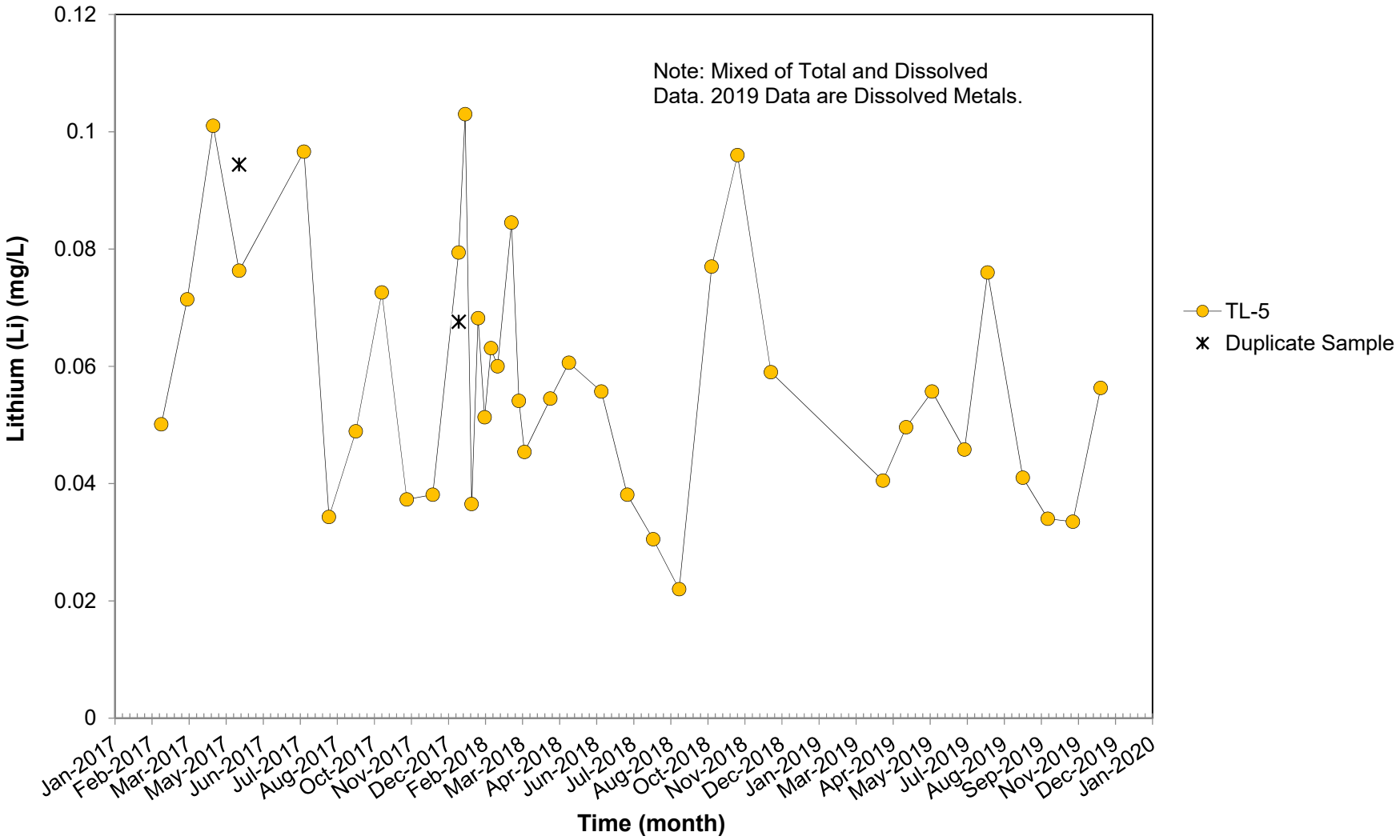

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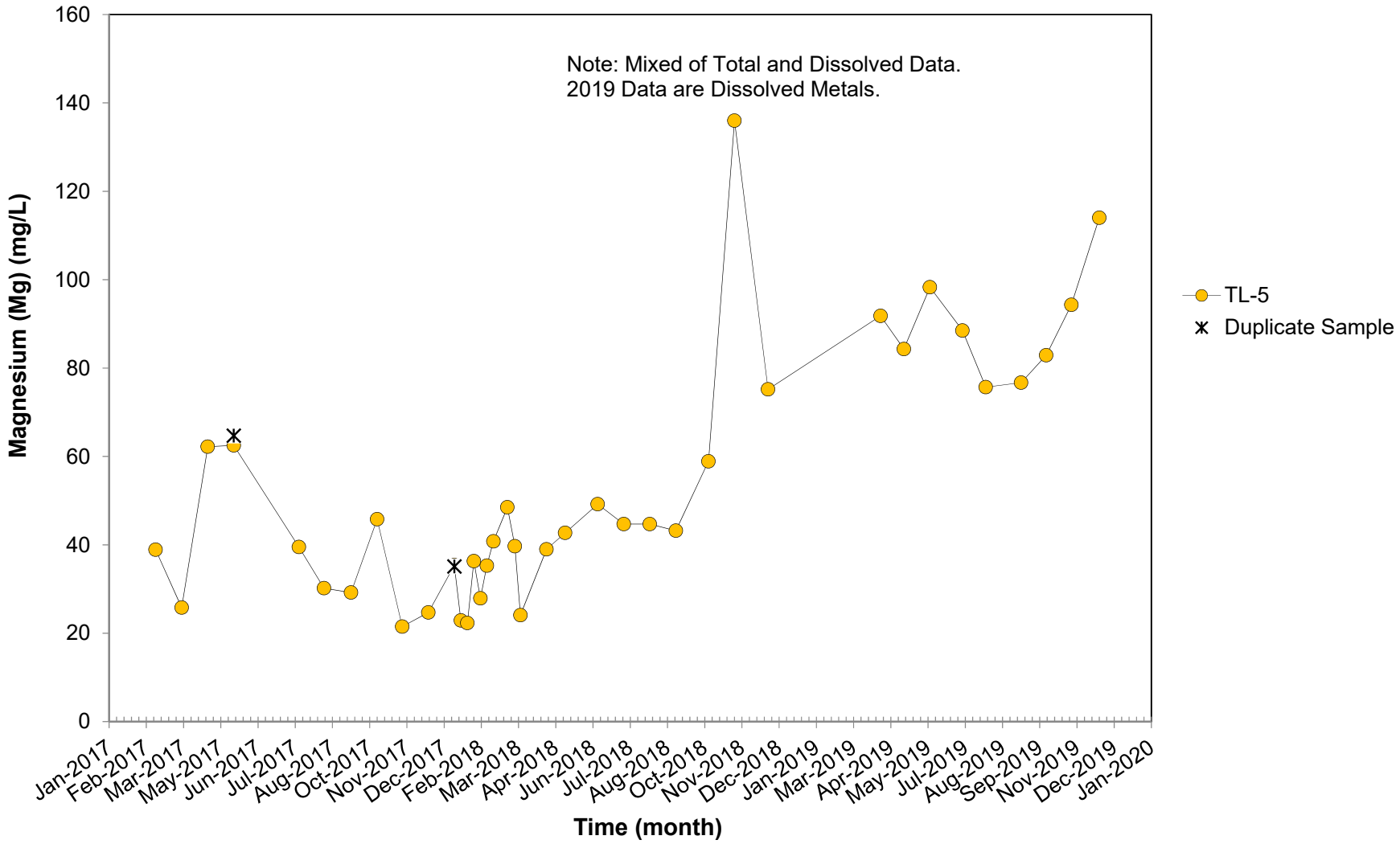

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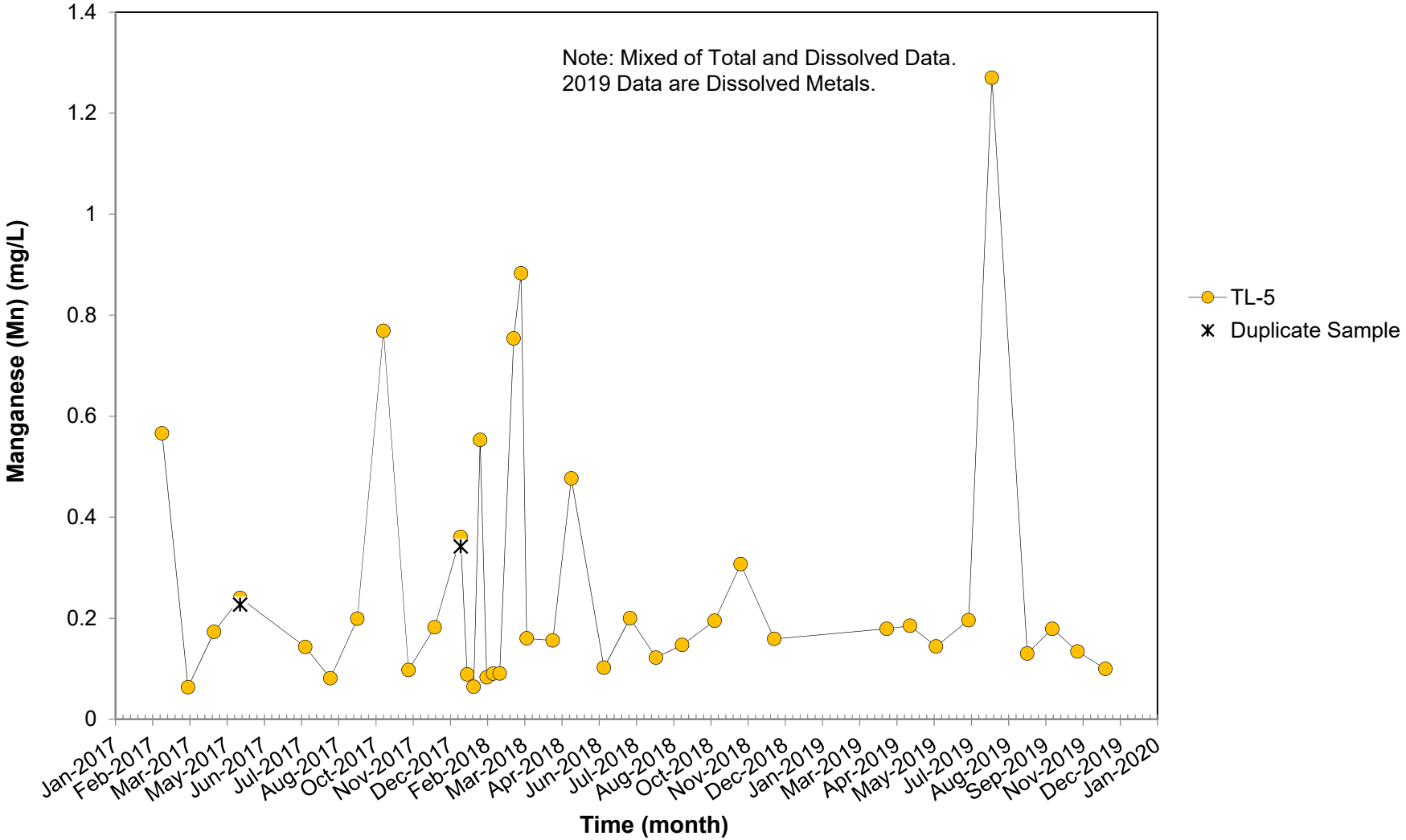

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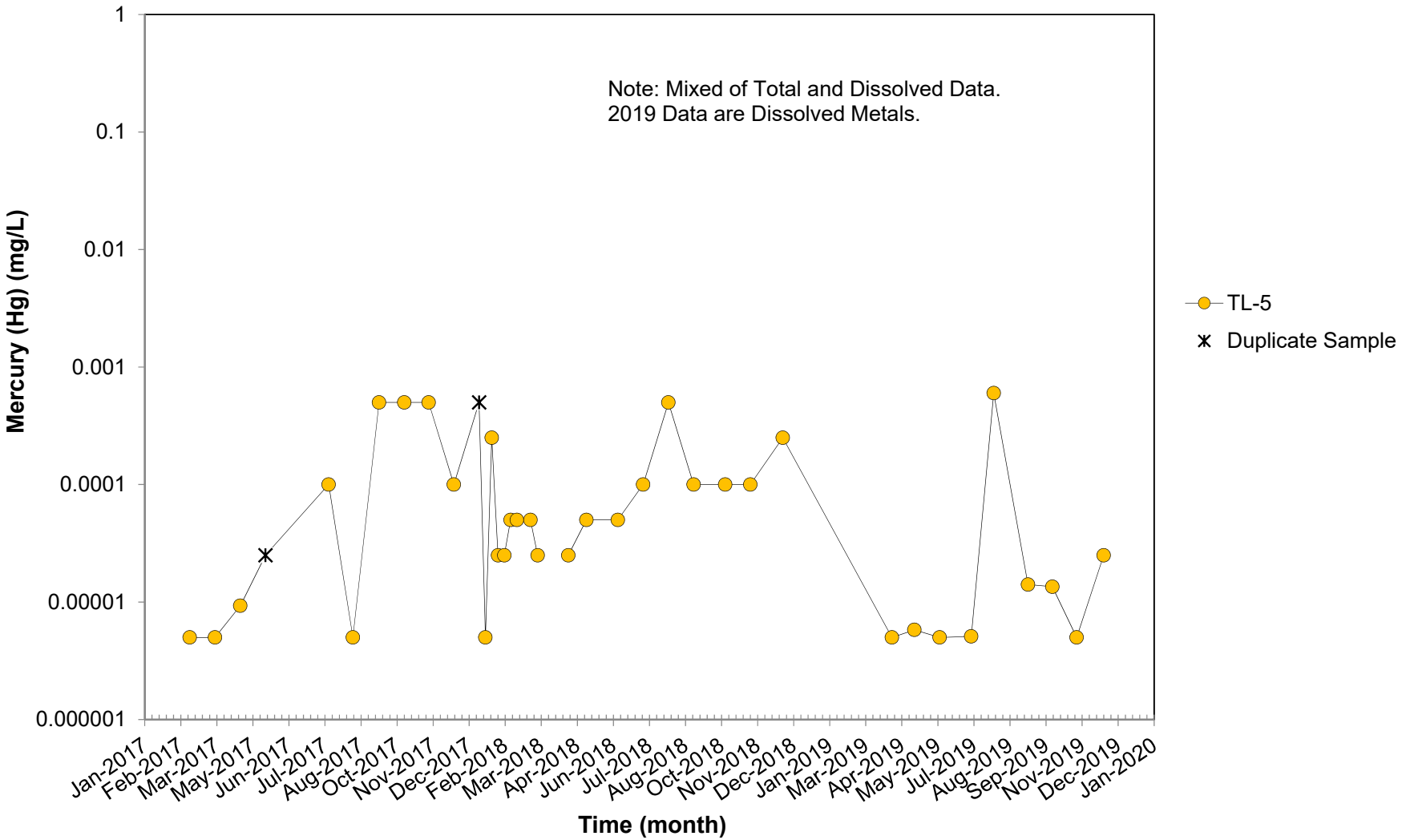

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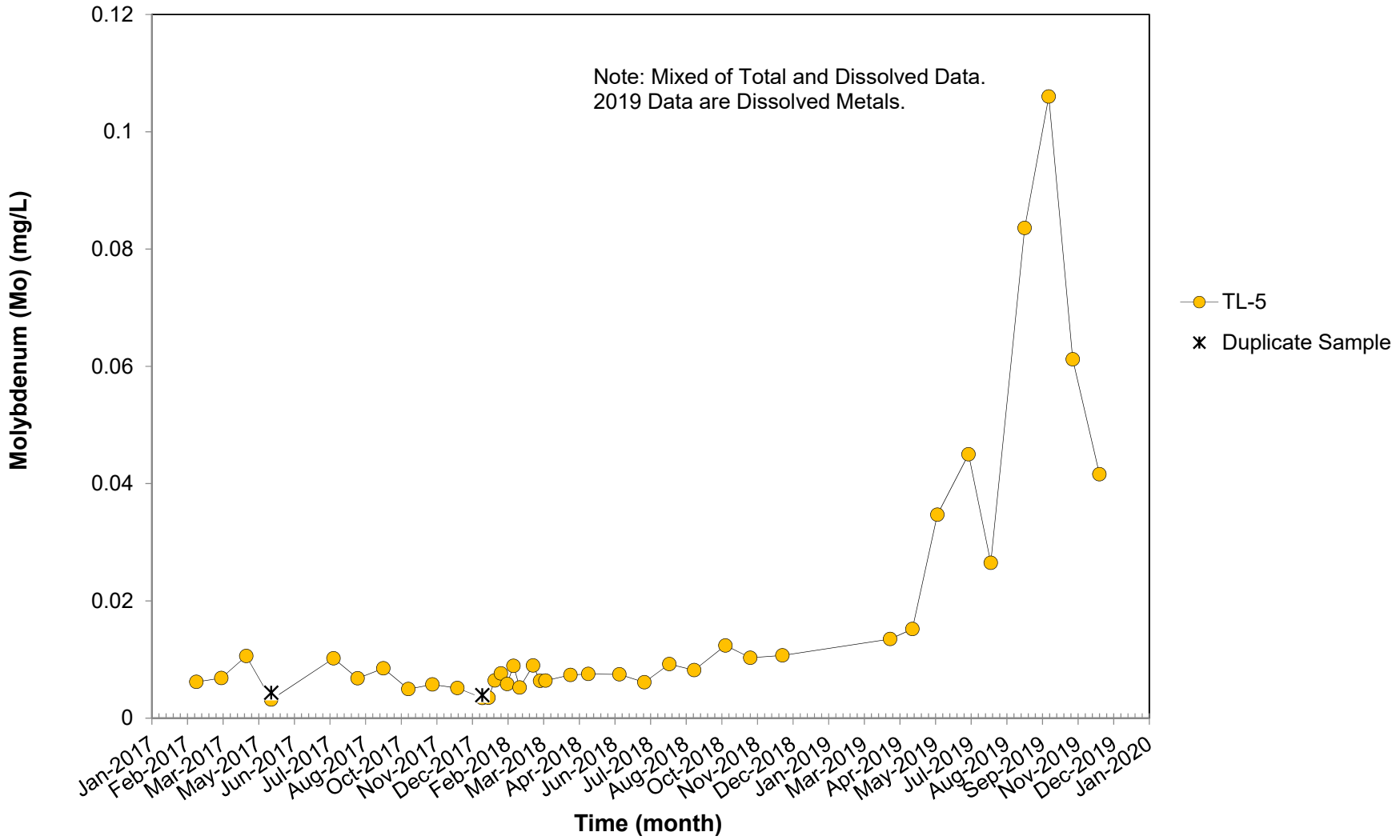

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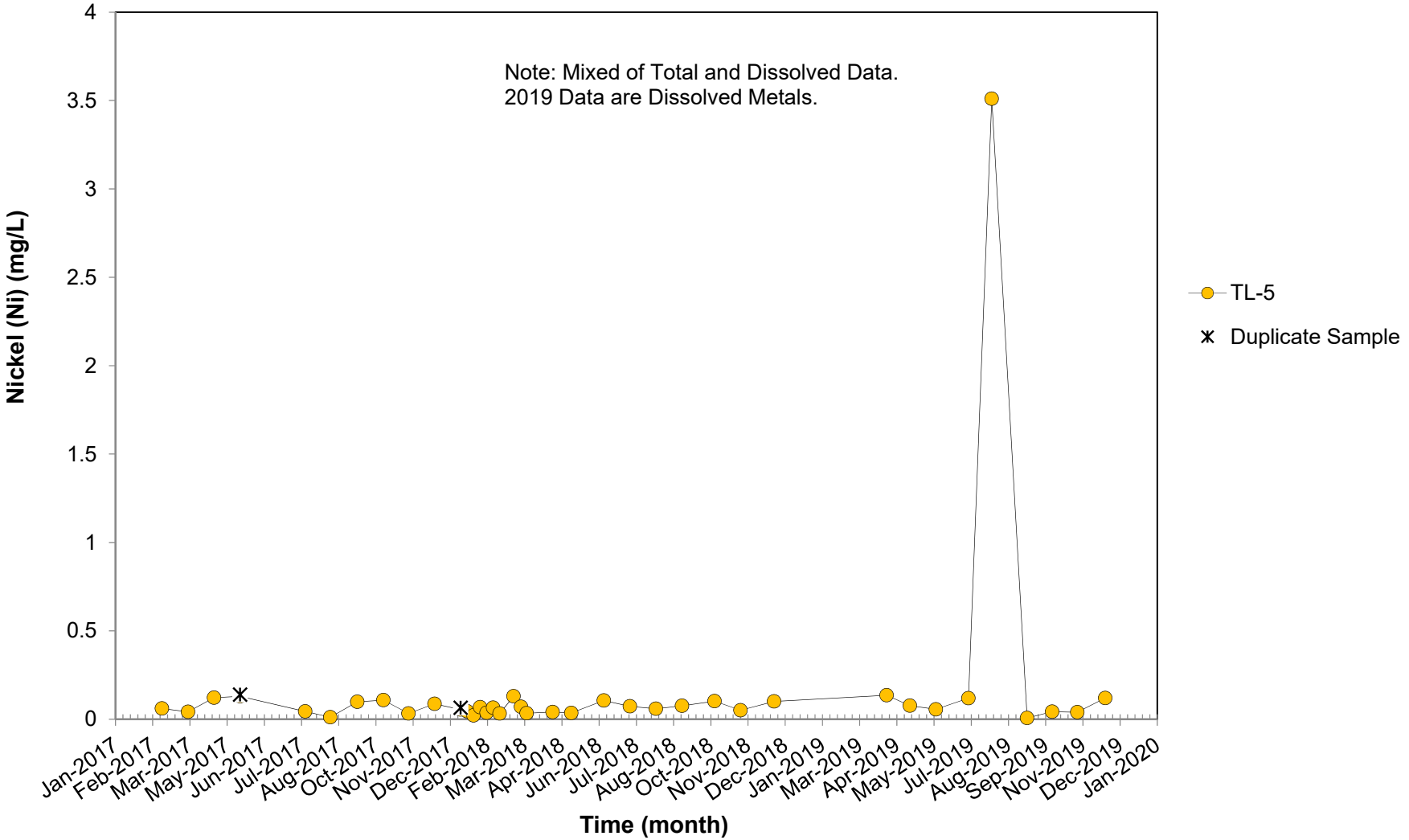

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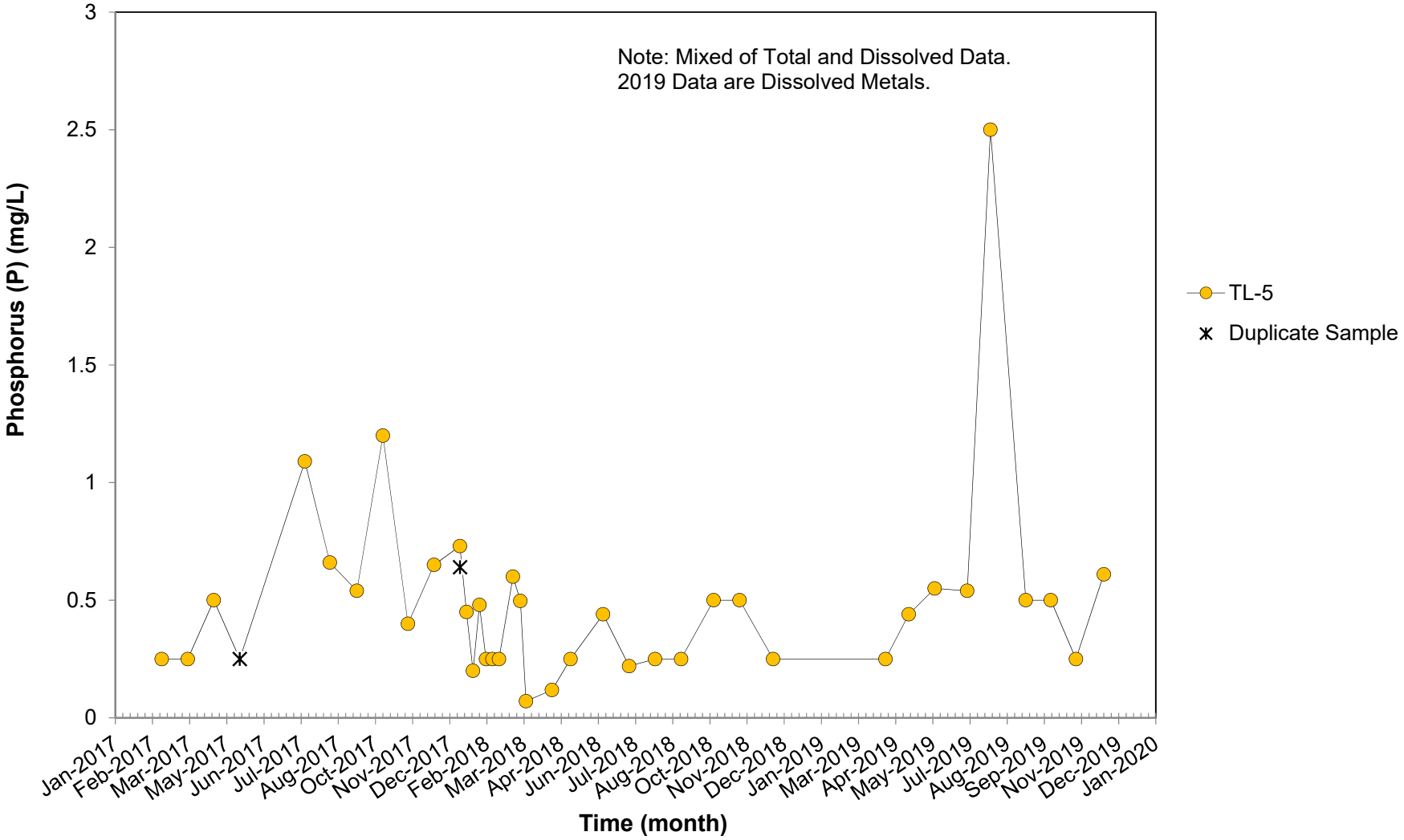

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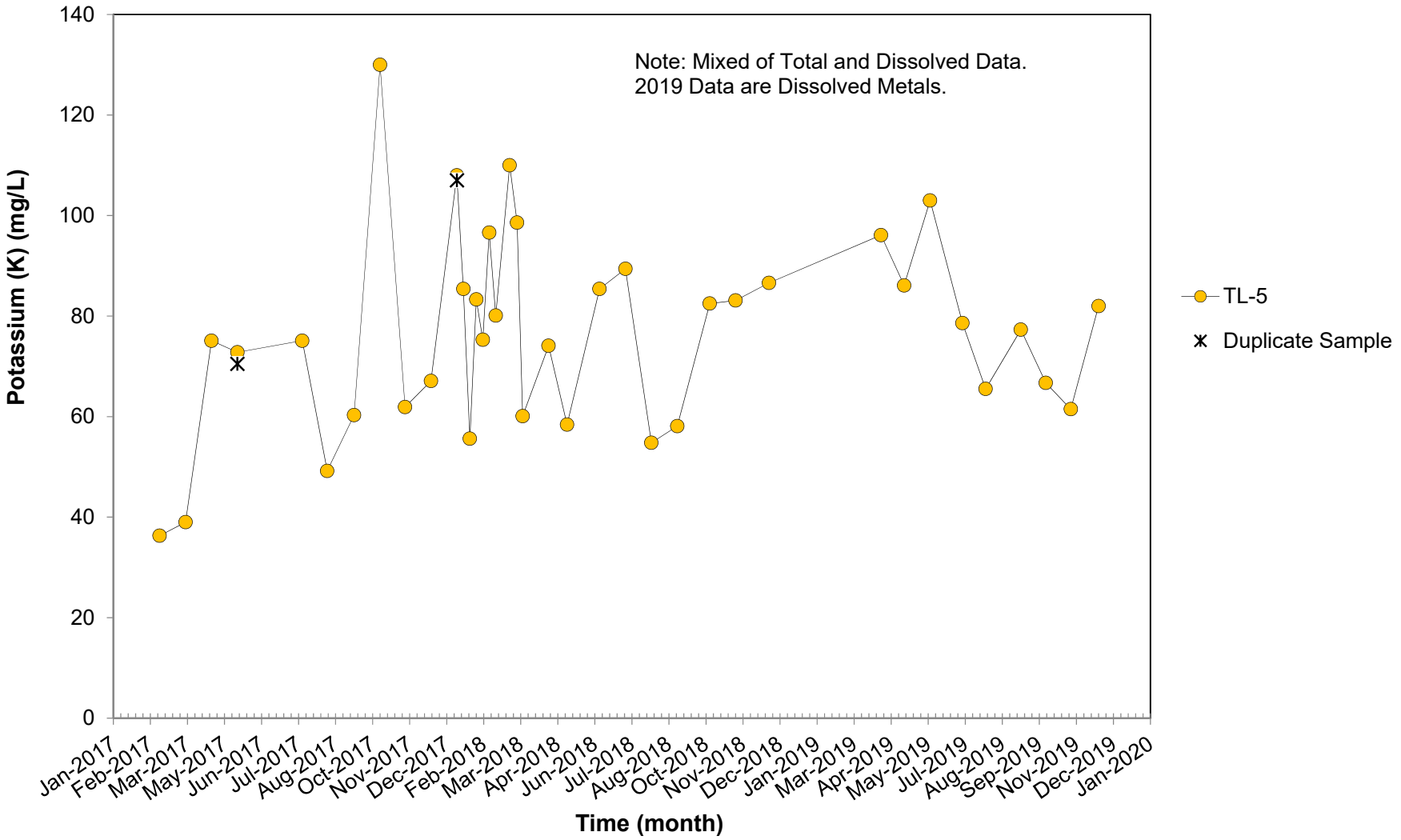

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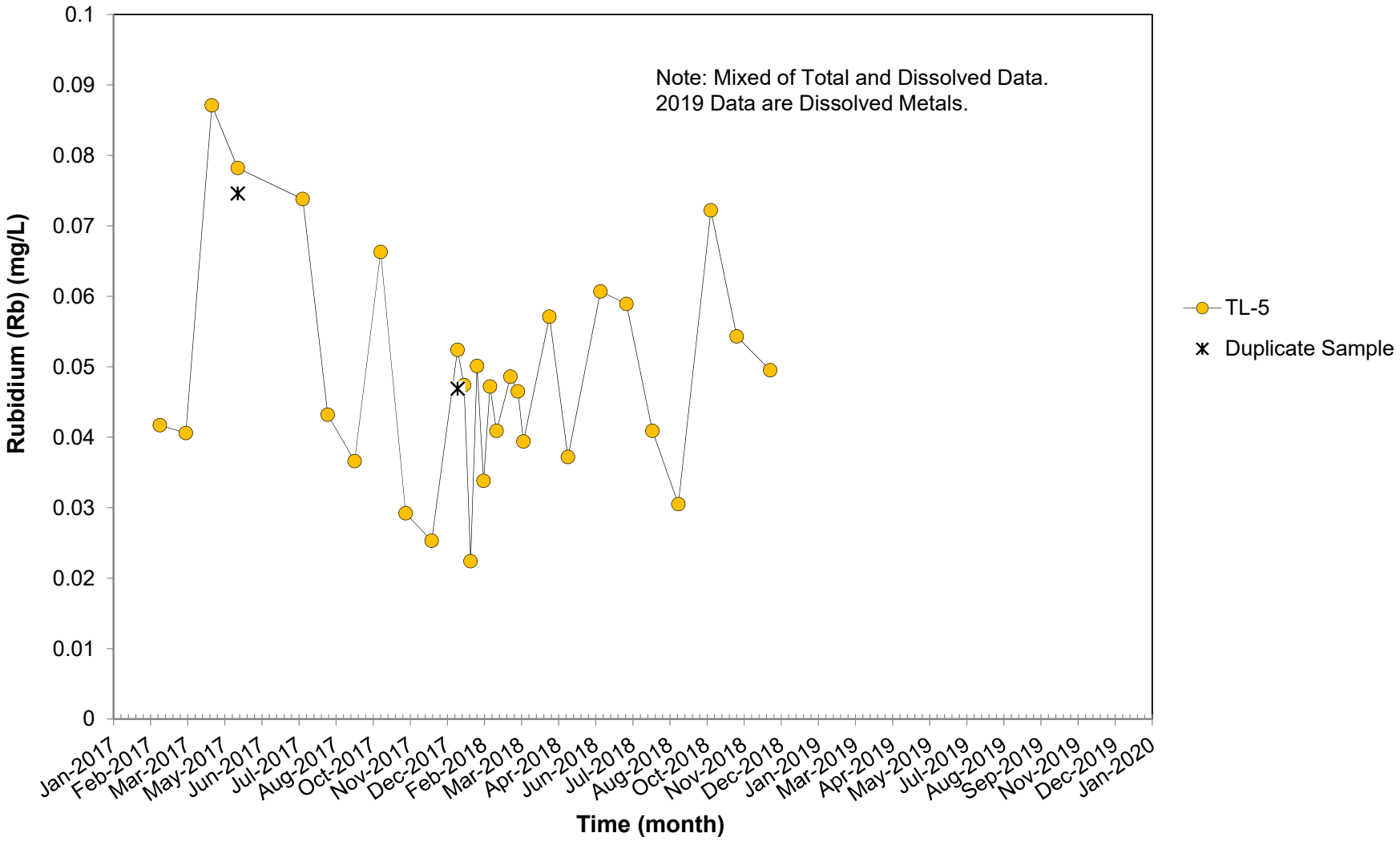

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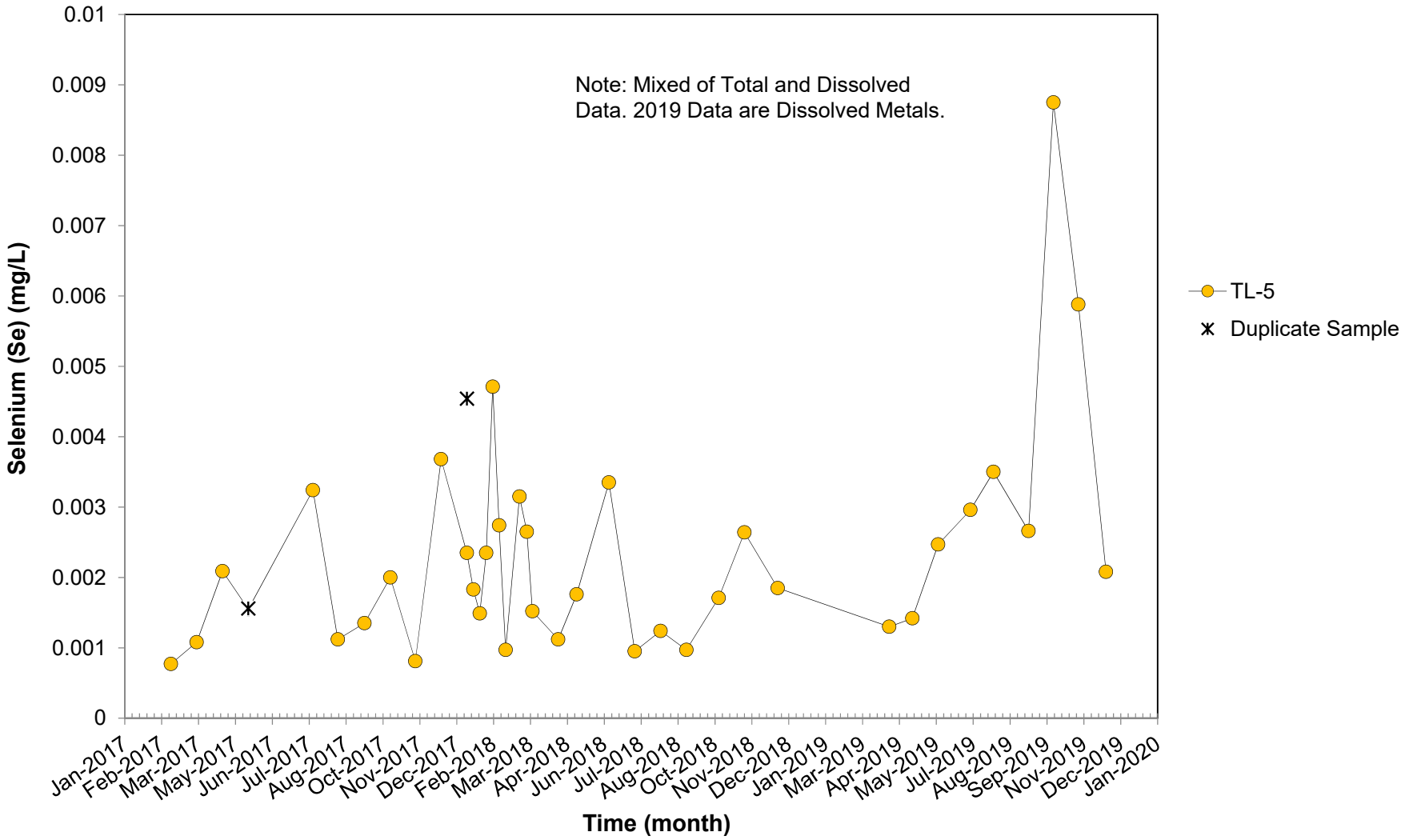

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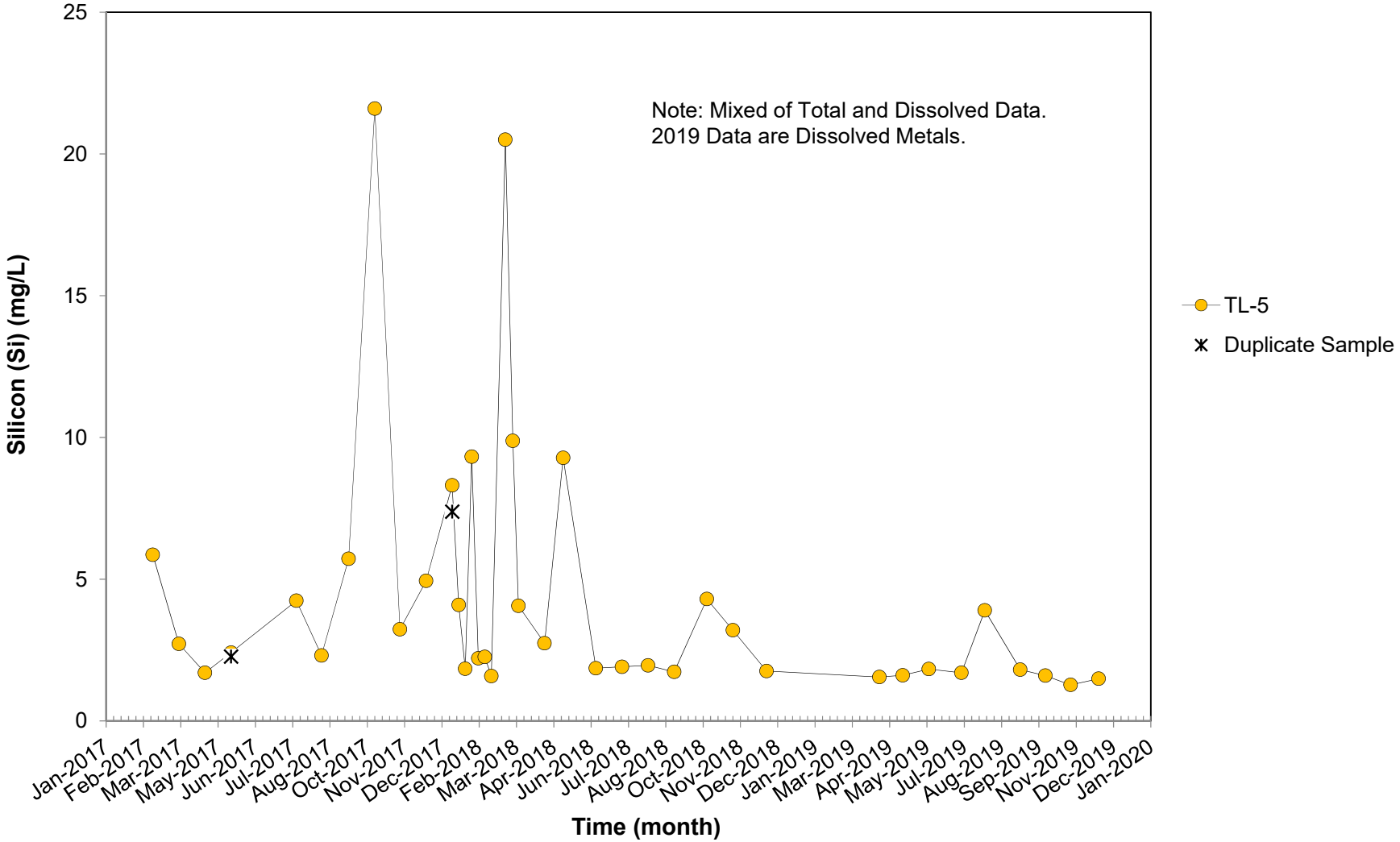

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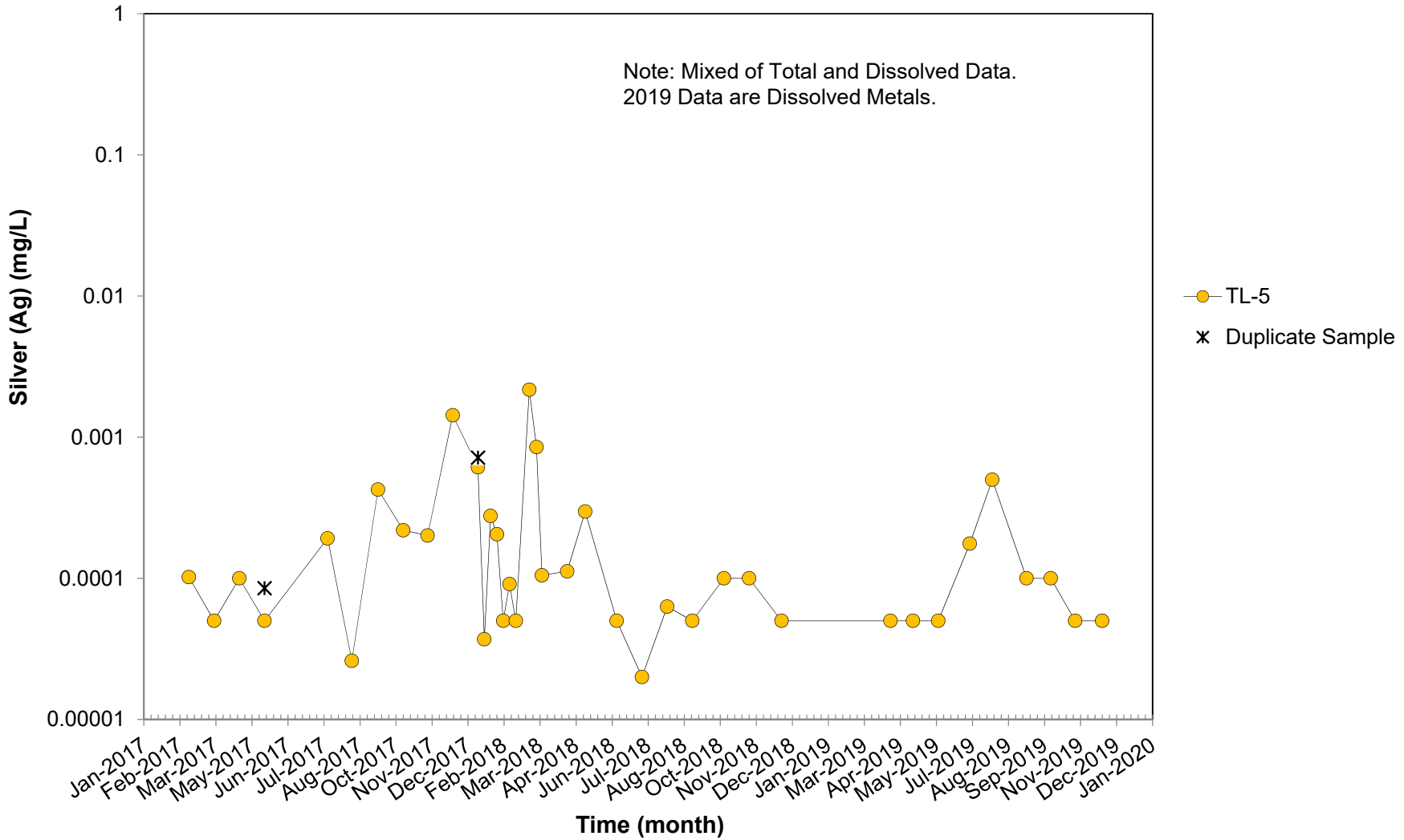

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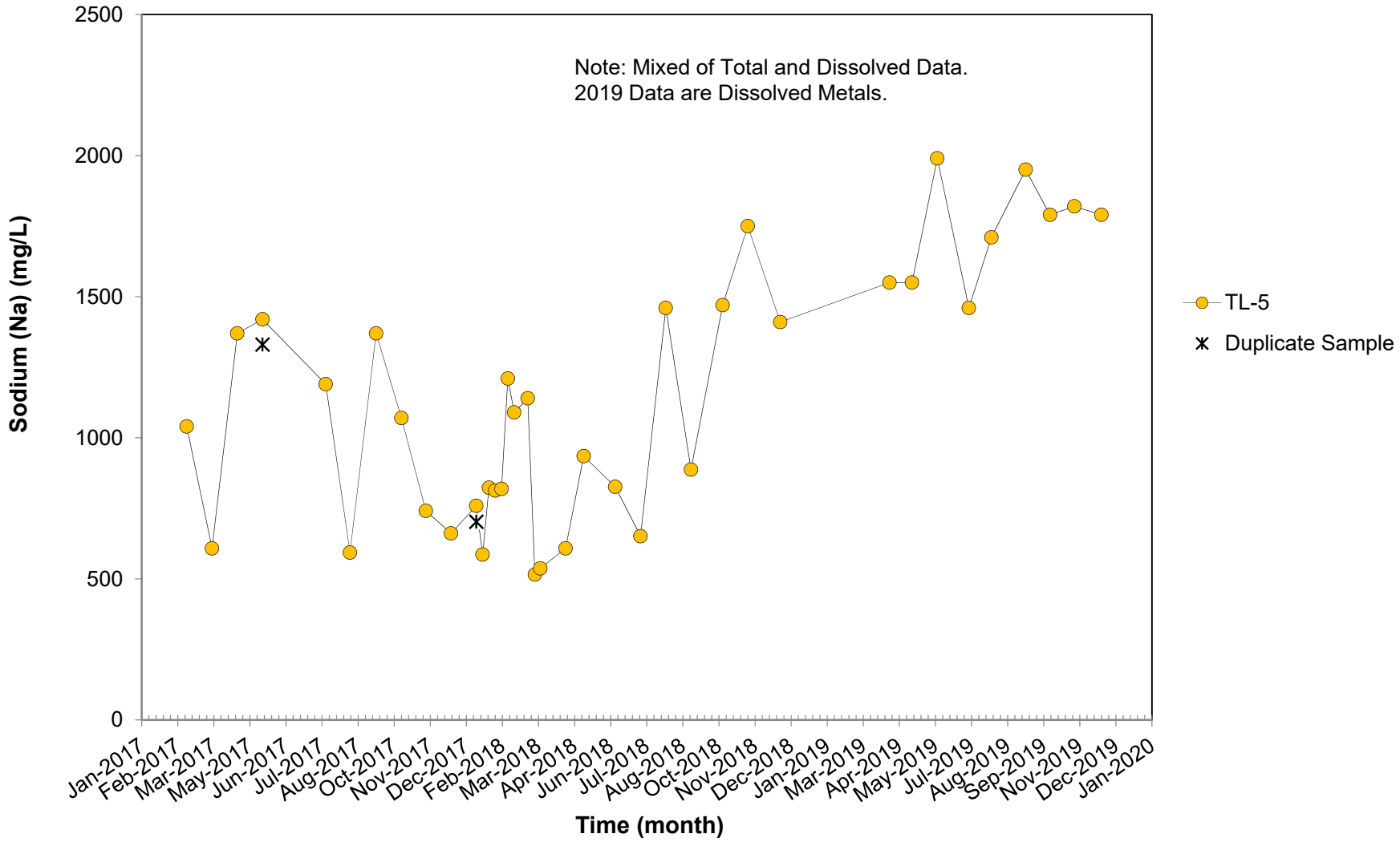

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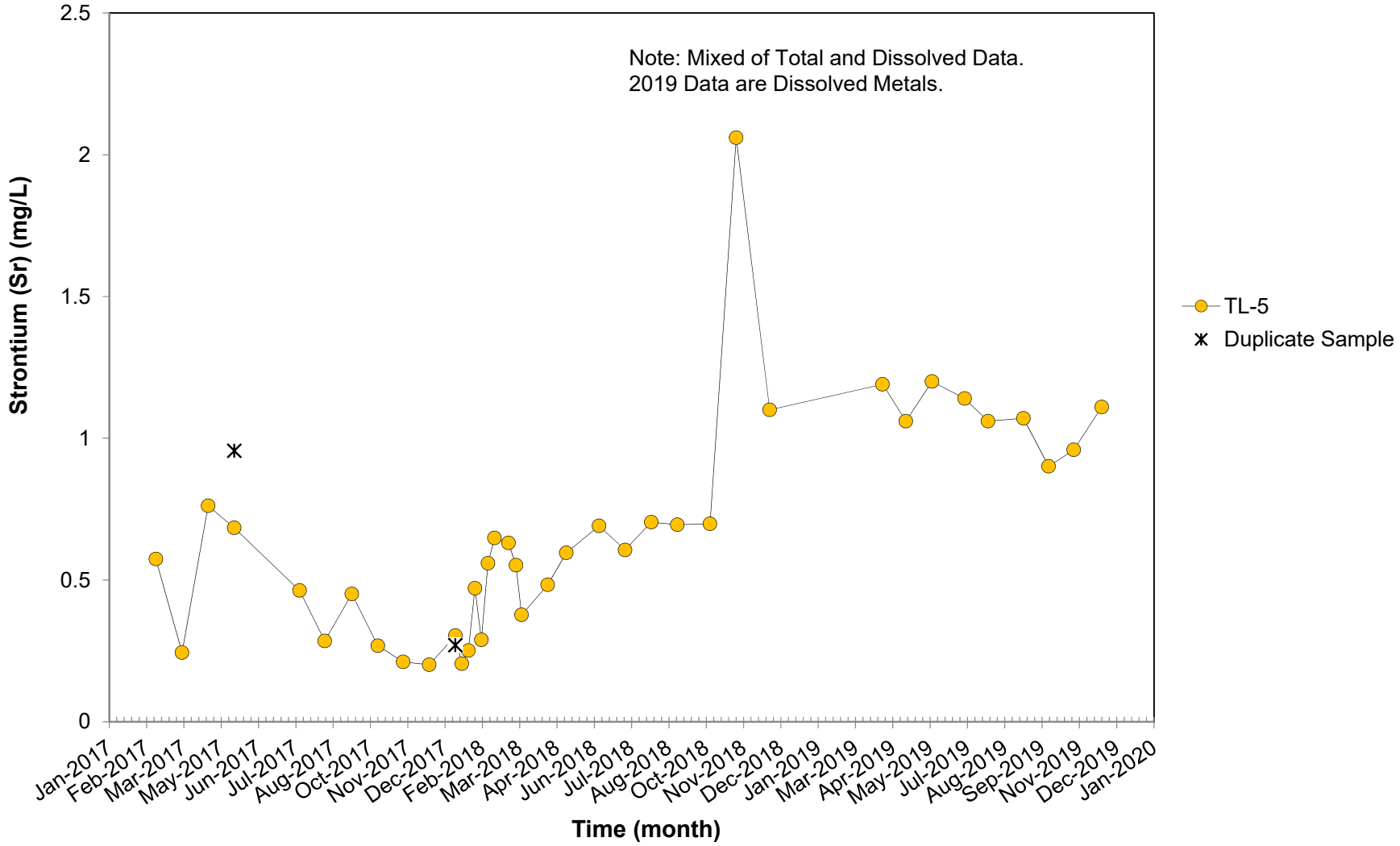

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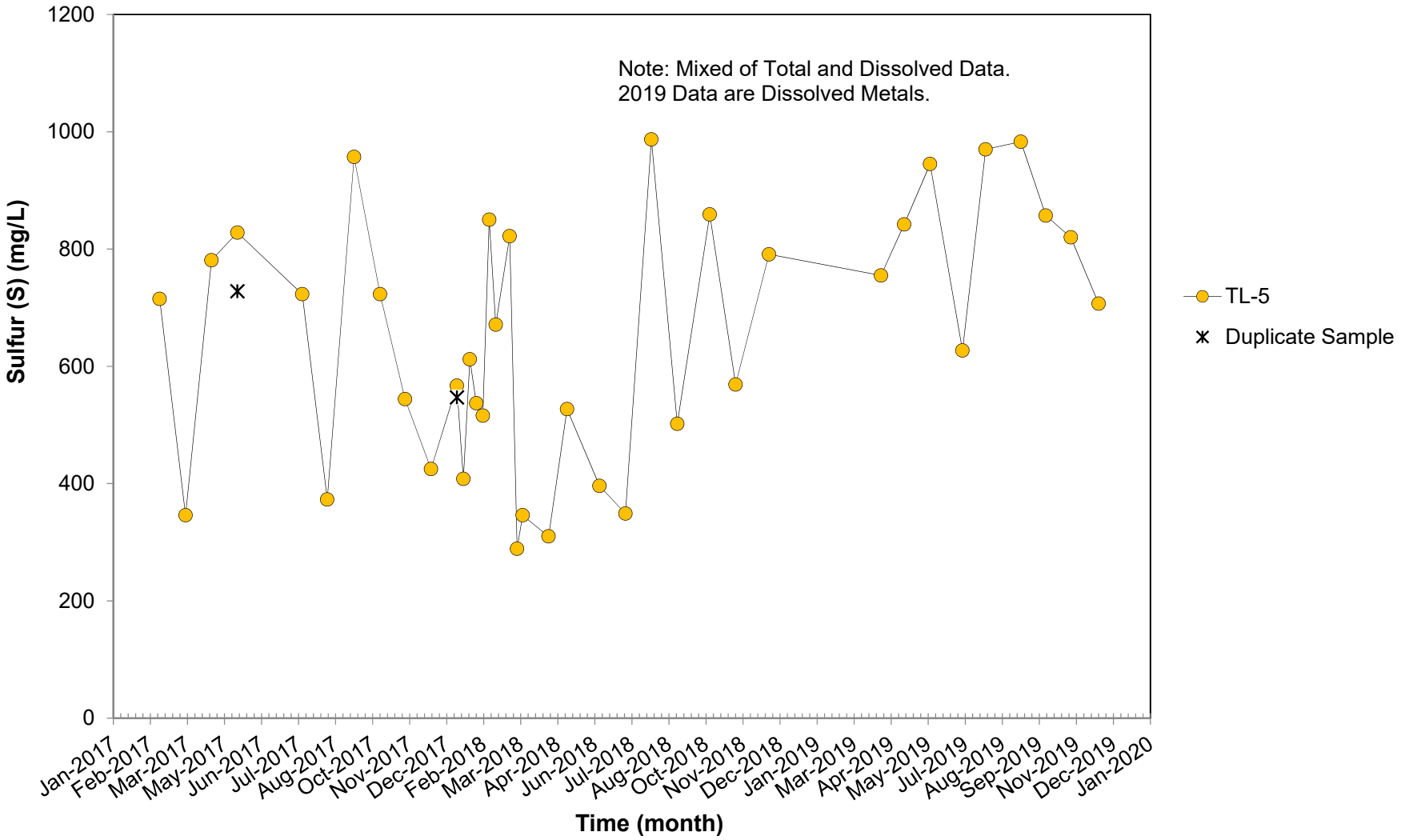

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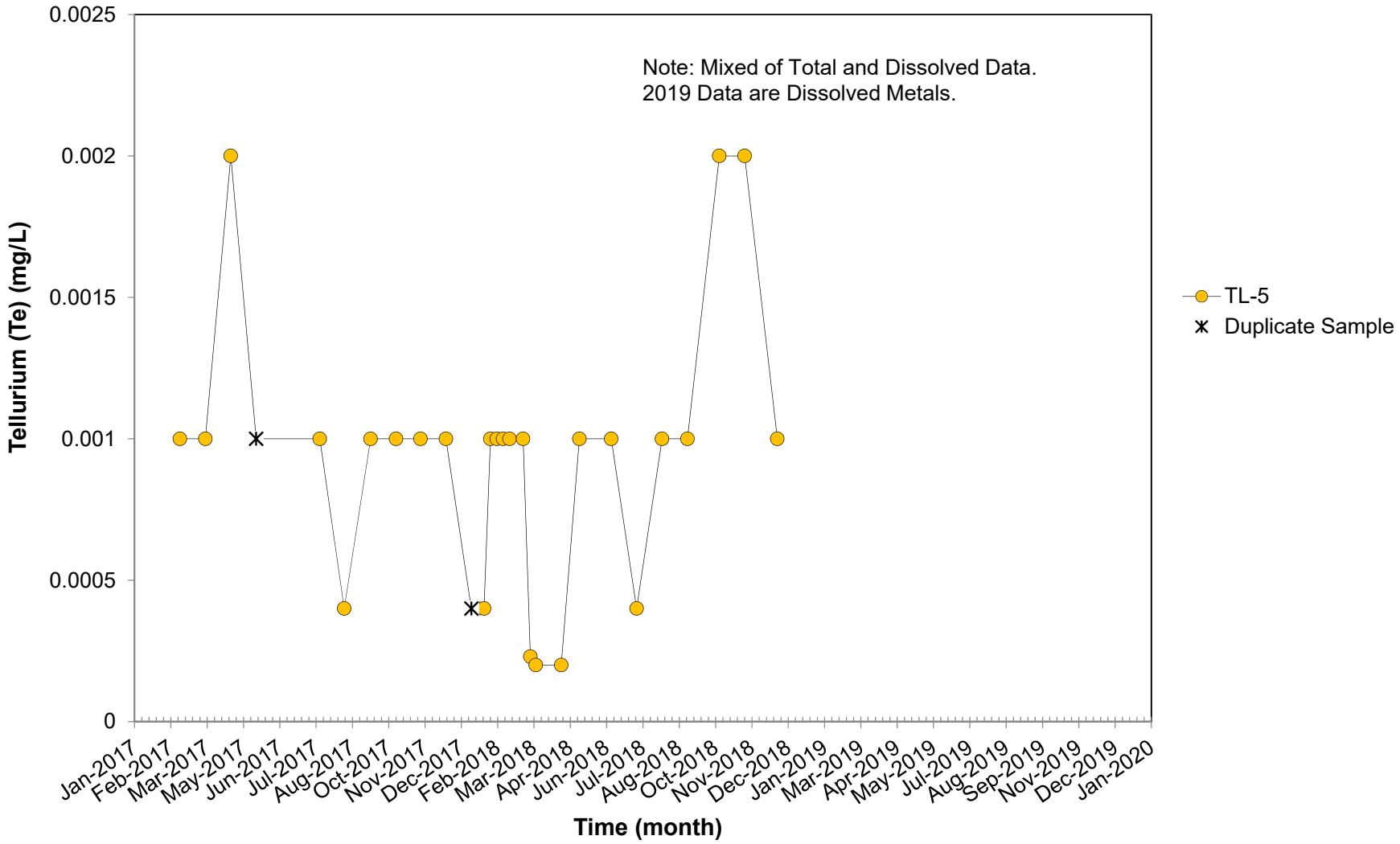

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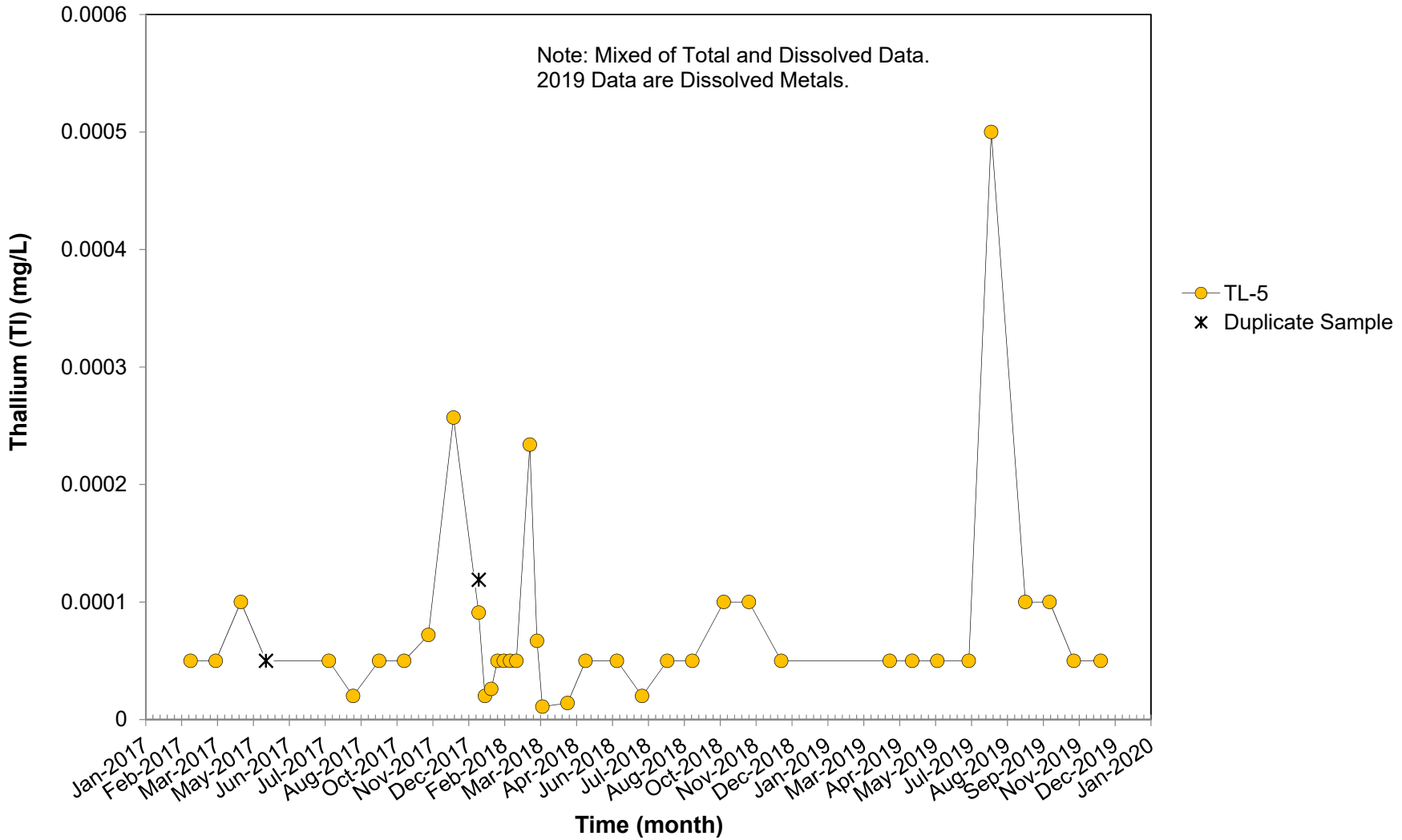

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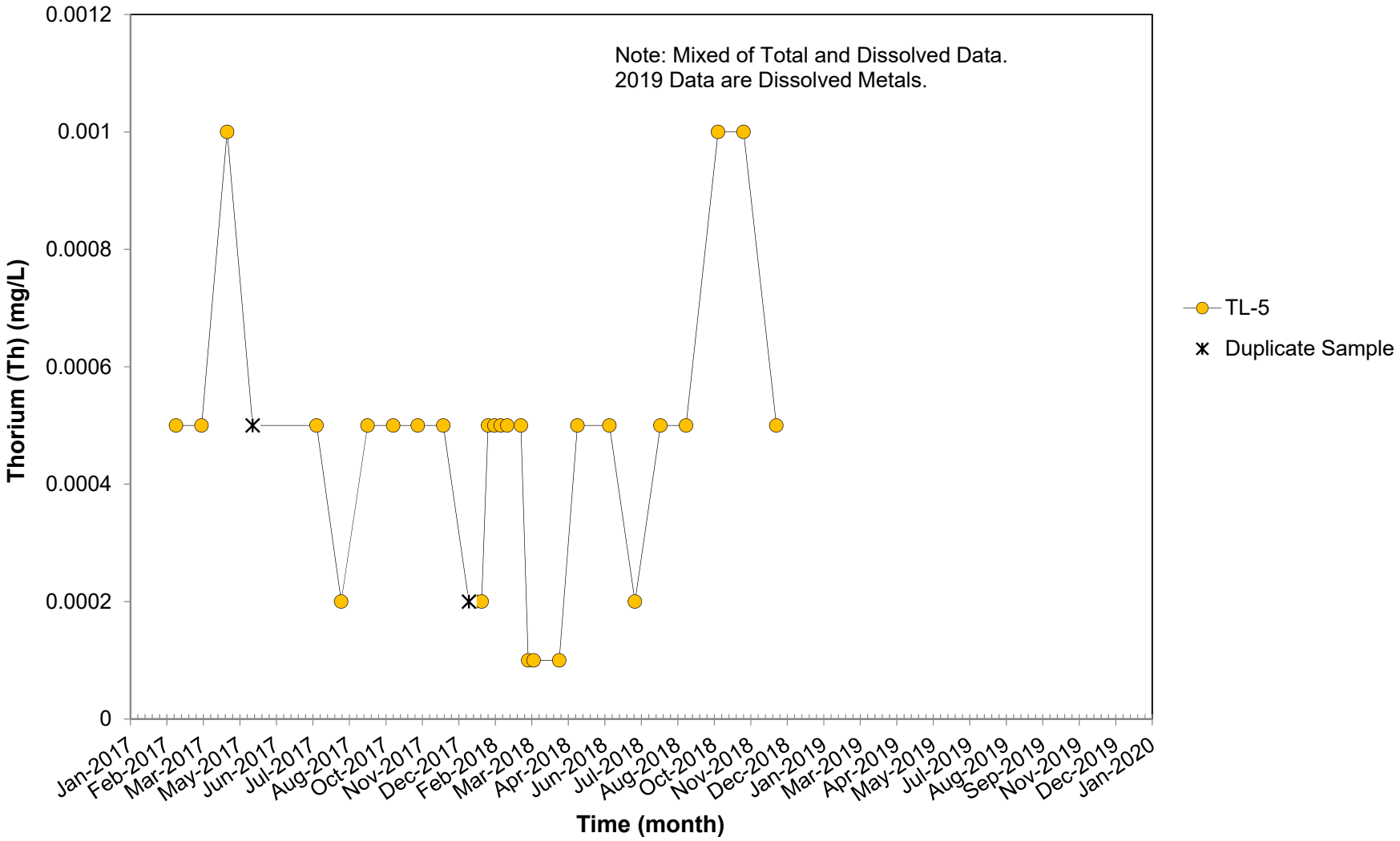

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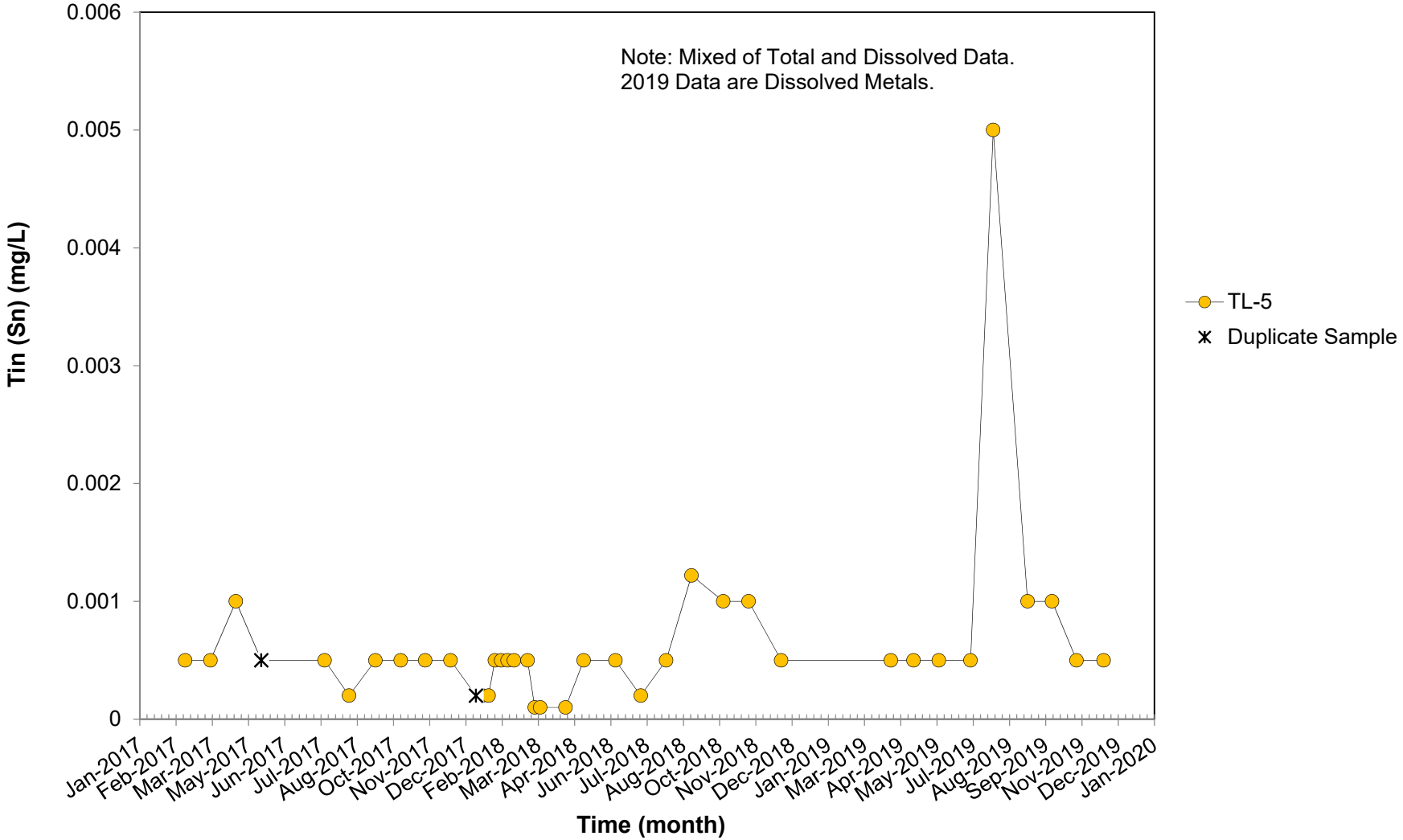

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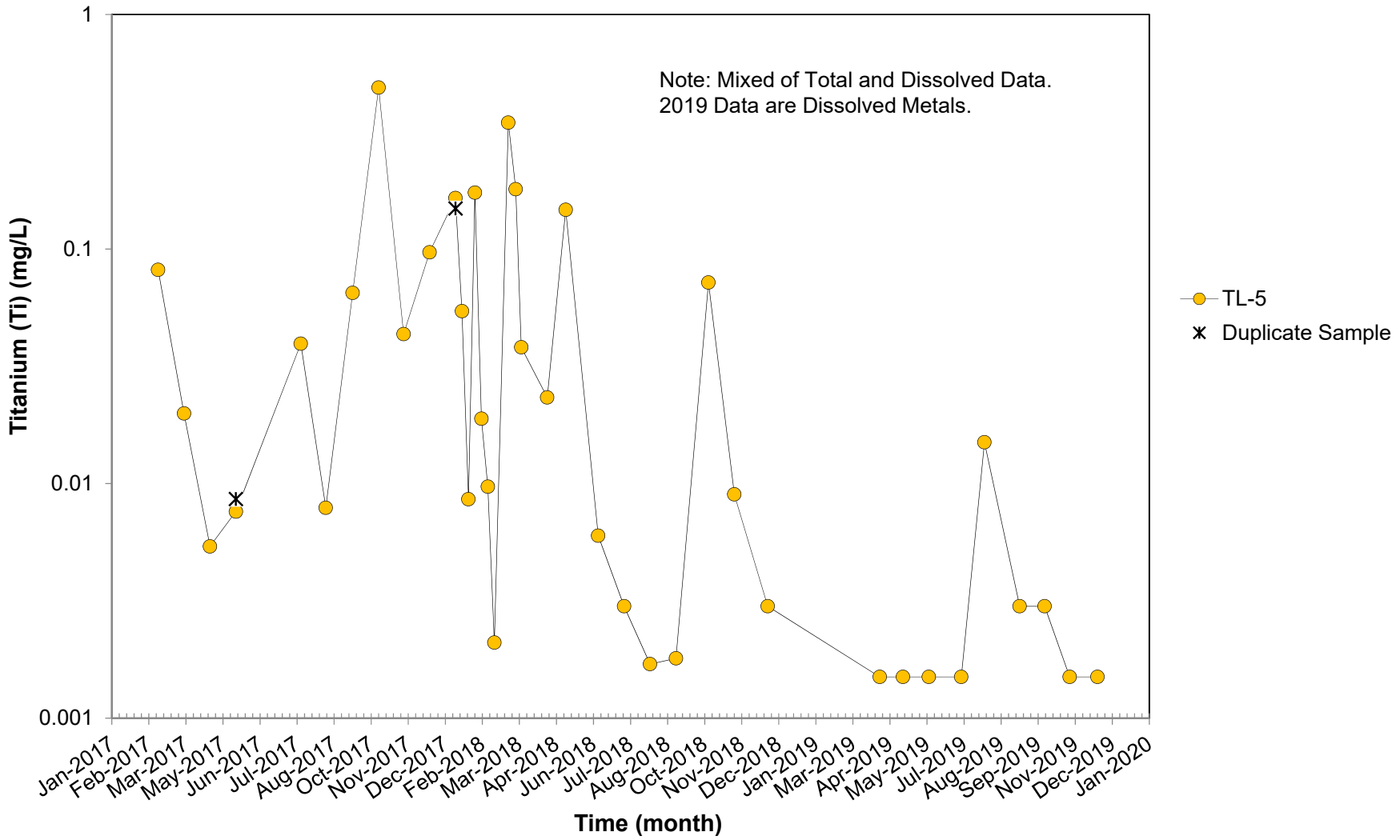

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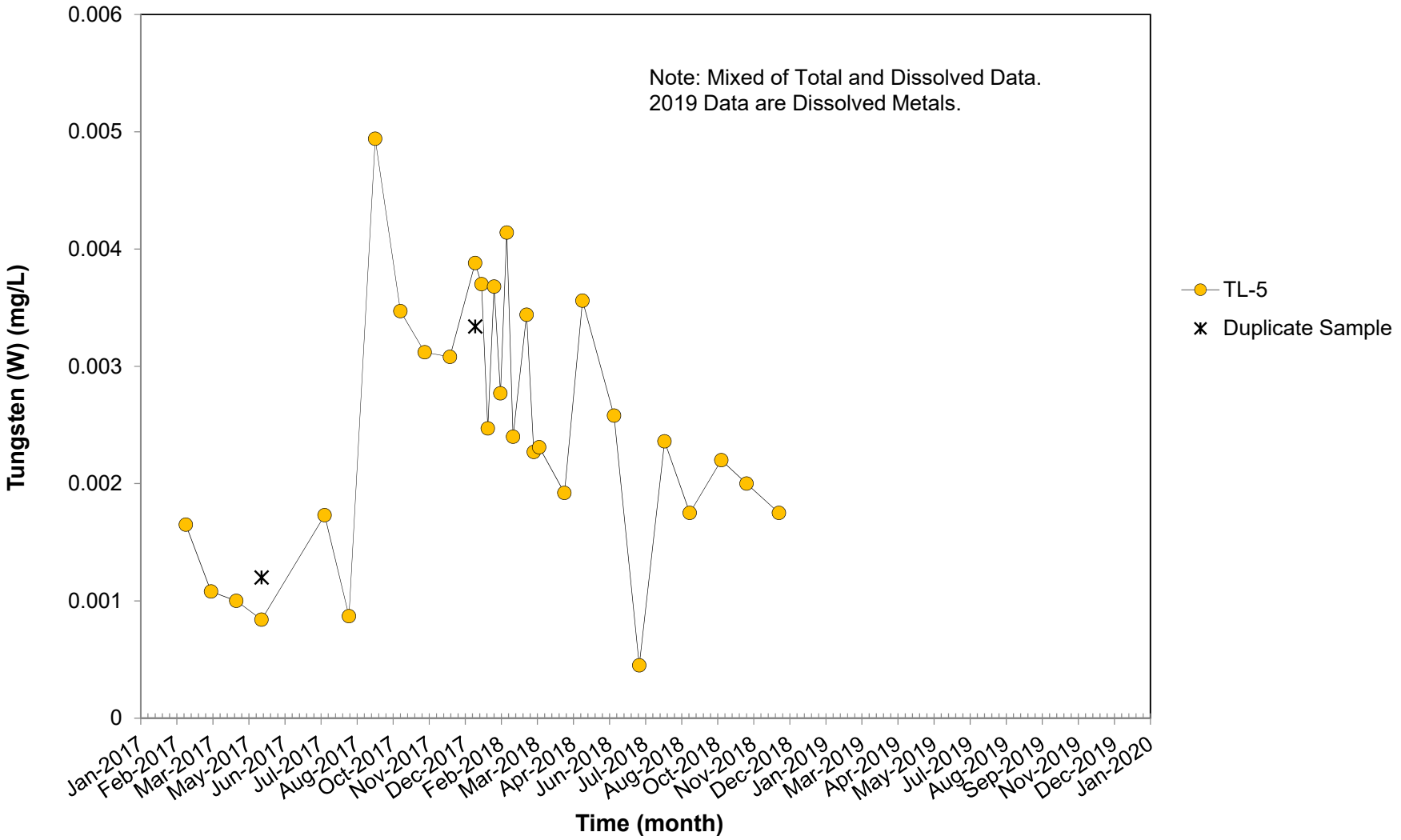

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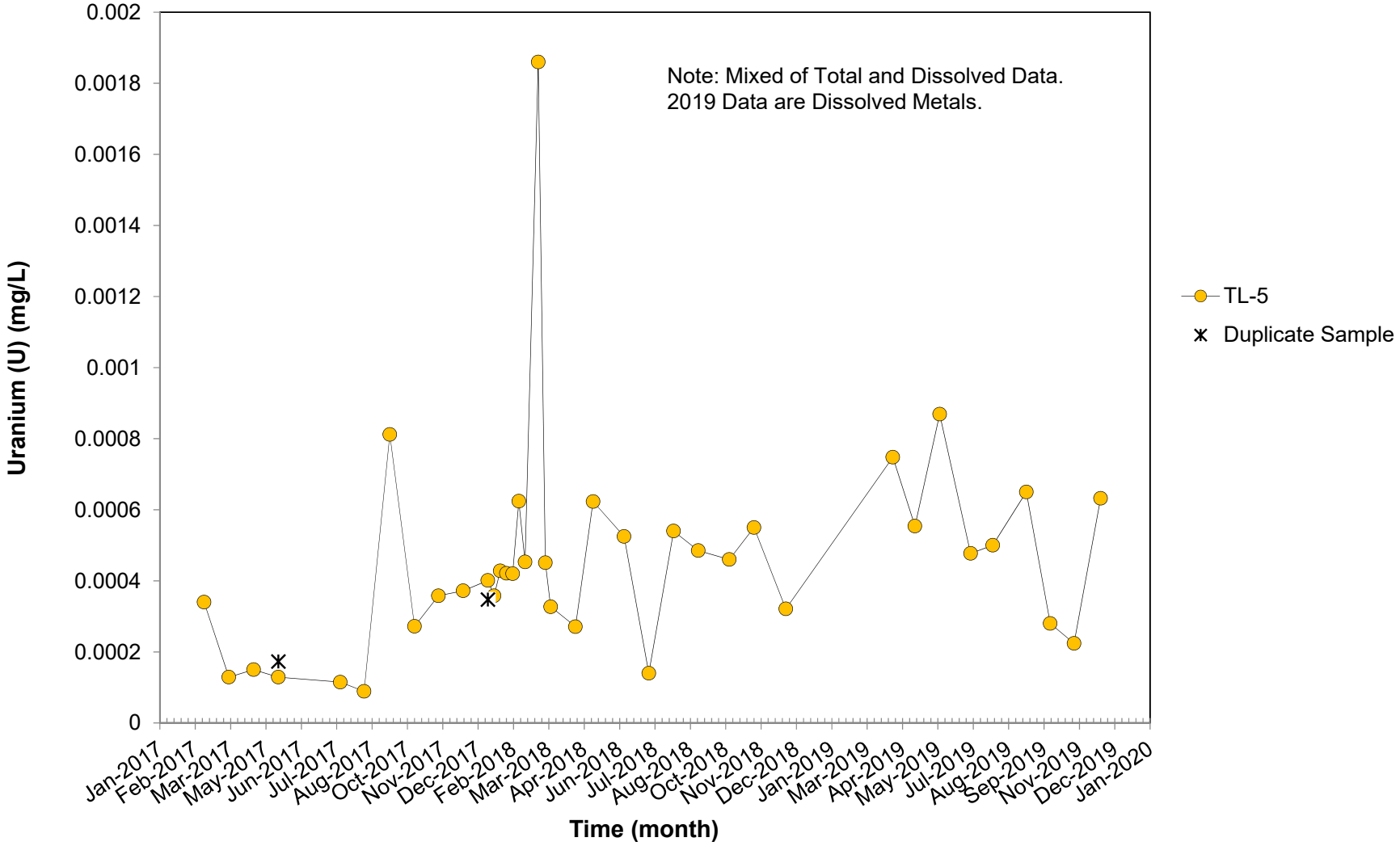

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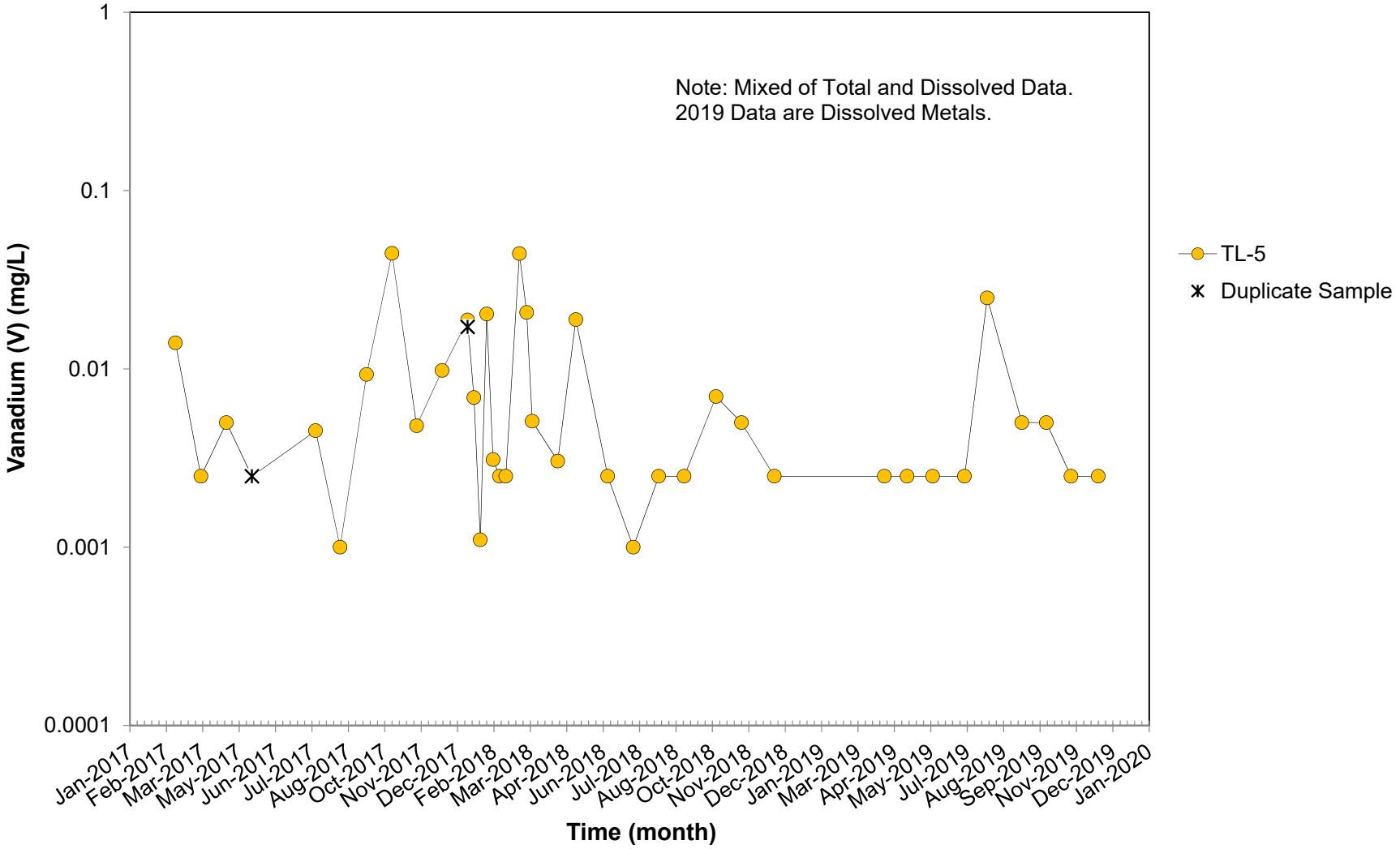

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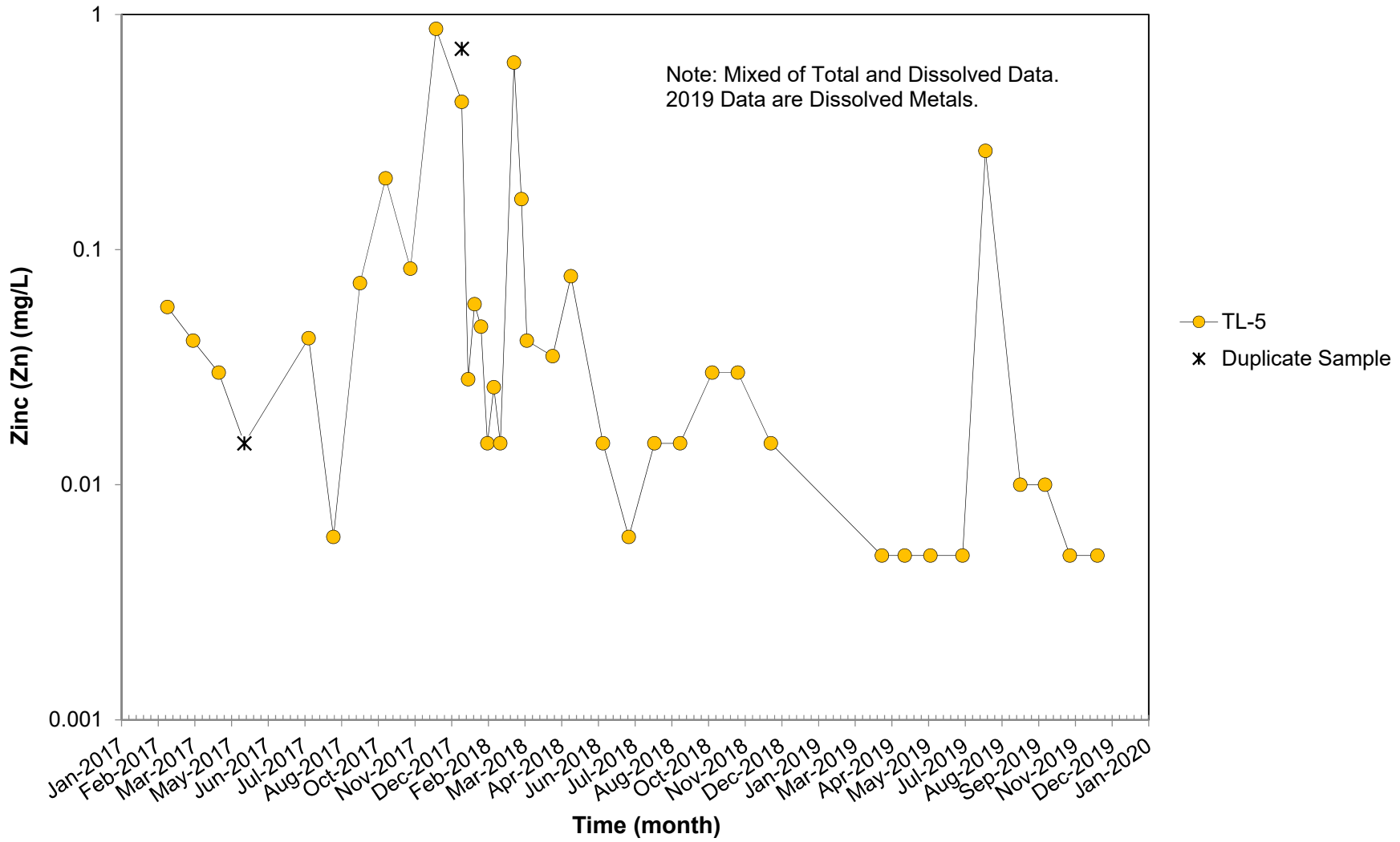

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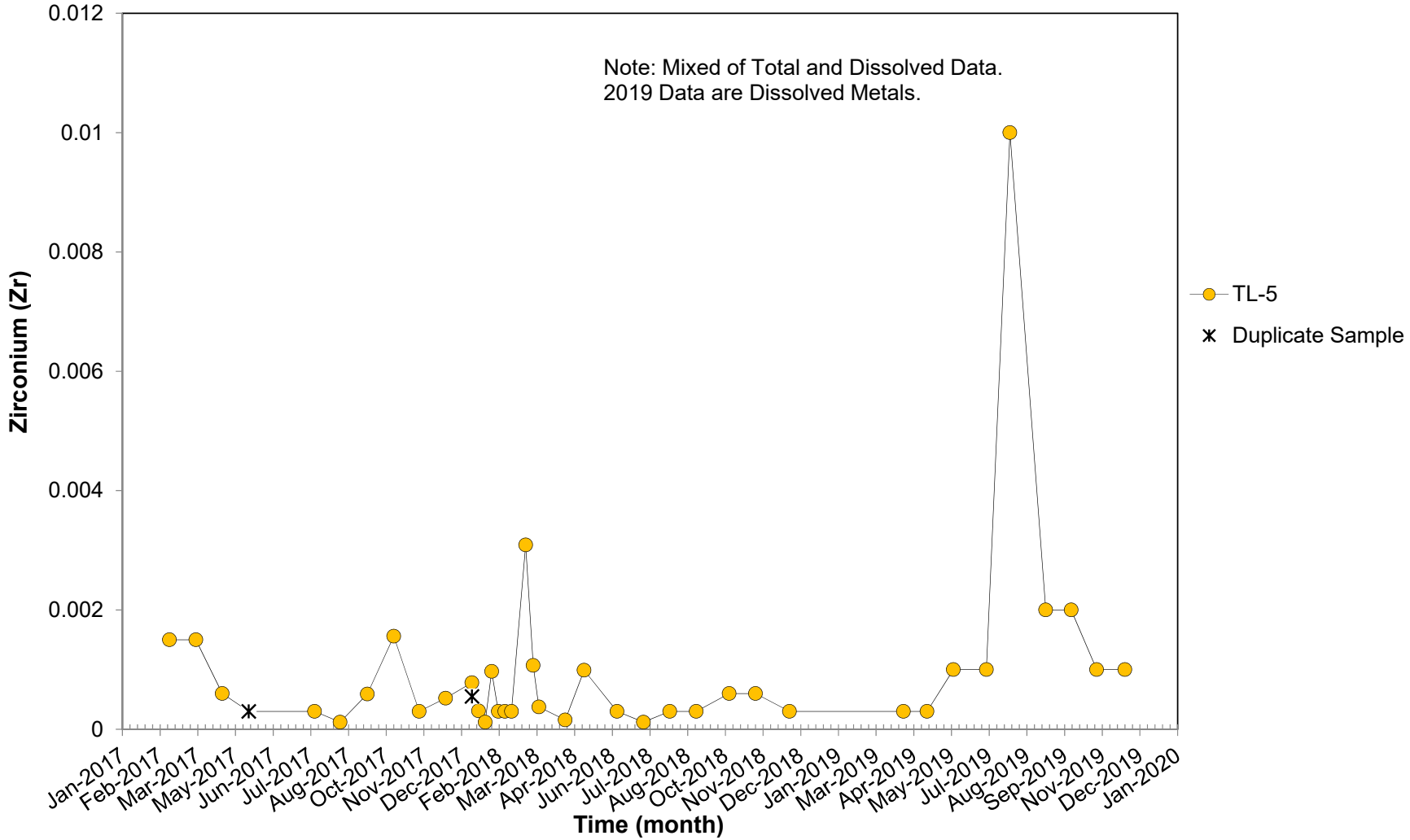

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Attachment E – TL-11 Geochemical Data

TMAC RESOURCES	Sample ID	TL11-A-27MAY19	TL11-B-27MAY19	TL11-C-27MAY19	TL11-D-27MAY19	TL11-E-27MAY19	TL11-F-27MAY19	TL11-A-15DEC19	TL11-B-15DEC19
	ALS ID	L2280421-1	L2280421-2	L2280421-3	L2280421-4	L2282417-1	L2282417-2	L2397363-1	L2397363-3
	Date Sampled	27-May-2019 10:35	27-May-2019 10:55	27-May-2019 11:20	27-May-2019 11:45	29-May-2019 10:20	29-May-2019 11:00	15-Dec-2019 10:50	15-Dec-2019 11:15
Parameter	**Units**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**	**Water**
Conductivity	uS/cm	79500	84200	58400	3610	50000	67900	25400	27400
Hardness (as $CaCO_3$)	mg/L	30200	30700	17400	537	12800	21400	3720	3740
pH	pH	5.8	7.2	7.2	8.0	7.5	7.2	8.0	8.0
Total Suspended Solids	mg/L	13	41	20	15	18	3.5	666	37
Total Dissolved Solids	mg/L	68200	70800	47900	2580	33100	49700	17100	18300
Acidity (as $CaCO_3$)	mg/L	99	134	91	6.8	65	104	14	20
Alkalinity, Total (as $CaCO_3$)	mg/L	2.6	75	73	98	88	62	227	259
Ammonia, Total (as N)	mg/L	284	352	219	29	180	308	10	17
Chloride (Cl)	mg/L	33700	35000	22400	877	15300	26600	9030	9270
Nitrate (as N)	mg/L	474	429	278	35.4	206	391	13.7	16.3
Nitrite (as N)	mg/L	7.2	21	8.5	16	6.5	8.2	0.72	0.60
Sulfate (SO_4)	mg/L	1210	1070	1340	112	1090	1070	1160	1270
Cyanide, Total	mg/L	0.073	0.17	0.074	0.052	0.15	0.051	0.25	0.031
Cyanide, Weak Acid Diss	mg/L	0.011	0.018	<0.005	0.0069	0.026	0.011	0.01	0.0098
Cyanide, Free	mg/L	0.0087	0.0051	<0.005	0.0061	0.012	0.0095	0.01	0.0088
Aluminum (Al)-Total	mg/L	0.74	0.82	<0.15	0.54	<0.15	<0.15	18	0.22
Antimony (Sb)-Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	0.003
Arsenic (As)-Total	mg/L	<0.005	0.0051	0.005	0.0019	<0.005	<0.005	0.093	0.0076
Barium (Ba)-Total	mg/L	0.26	0.39	0.19	0.022	0.13	0.21	0.040	0.047
Beryllium (Be)-Total	mg/L	<0.005	<0.005	<0.005	0.0002	<0.005	<0.005	<0.002	<0.002
Bismuth (Bi)-Total	mg/L	-	-	-	-	<0.0025	<0.0025	<0.001	<0.001
Boron (B)-Total	mg/L	3.1	3.3	2.9	0.15	3.1	2.5	2.4	2.7
Cadmium (Cd)-Total	mg/L	0.032	0.011	0.0077	0.000019	0.0026	0.0090	0.00068	0.00047
Calcium (Ca)-Total	mg/L	9470	8640	5030	144	3380	6350	530	593
Cesium (Cs)-Total	mg/L	-	-	-	-	0.0035	0.0019	0.00089	0.00023
Chromium (Cr)-Total	mg/L	<0.005	<0.005	<0.005	0.016	0.005	0.005	0.024	<0.002
Cobalt (Co)-Total	mg/L	0.22	0.034	0.083	0.0032	0.025	0.11	0.082	0.054
Copper (Cu)-Total	mg/L	0.26	0.34	0.26	0.026	0.082	0.35	0.69	0.17
Iron (Fe)-Total	mg/L	1.57	2.3	<0.5	1.86	<0.5	<0.5	97	2.2
Lead (Pb)-Total	mg/L	0.012	0.0039	<0.0025	0.0014	0.0028	<0.0025	0.034	0.0019
Lithium (Li)-Total	mg/L	0.32	0.19	0.19	0.029	0.12	0.17	0.11	0.10
Magnesium (Mg)-Total	mg/L	1570	1740	1170	41.7	862	1170	687	742
Manganese (Mn)-Total	mg/L	9.7	7.5	7.2	0.11	3.5	6.9	3.2	1.8
Molybdenum (Mo)-Total	mg/L	0.020	0.063	0.029	0.0041	0.022	0.016	0.0074	0.0062
Nickel (Ni)-Total	mg/L	0.35	0.15	0.18	0.002	0.1	0.28	0.12	0.12
Phosphorus (P)-Total	mg/L	-	-	-	-	<2.5	<2.5	1.2	<1
Potassium (K)-Total	mg/L	508	561	360	38.9	235	393	147	160
Rubidium (Rb)-Total	mg/L	-	-	-	-	0.19	0.22	0.077	0.057
Selenium (Se)-Total	mg/L	0.012	0.0039	0.0069	0.0020	0.0036	0.0074	0.0025	0.0013
Silicon (Si)-Total	mg/L	-	-	-	-	<5	<5	23	3.5
Silver (Ag)-Total	mg/L	0.0099	0.013	0.0066	0.00013	0.0040	0.015	0.0020	0.00044
Sodium (Na)-Total	mg/L	11500	12300	8370	433	6520	8290	5090	5550
Strontium (Sr)-Total	mg/L	-	-	-	-	17.9	22.2	6.3	7.5
Sulfur (S)-Total	mg/L	-	-	-	-	511	507	440	494
Tellurium (Te)-Total	mg/L	-	-	-	-	<0.01	<0.01	<0.004	<0.004
Thallium (Tl)-Total	mg/L	0.00065	<0.0005	<0.0005	<0.00002	<0.0005	<0.0005	<0.0002	<0.0002
Thorium (Th)-Total	mg/L	-	-	-	-	<0.005	<0.005	<0.002	<0.002
Tin (Sn)-Total	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002
Titanium (Ti)-Total	mg/L	<0.03	0.024	<0.015	<0.015	<0.015	<0.015	0.37	<0.006
Tungsten (W)-Total	mg/L	-	-	-	-	<0.005	0.018	0.0027	<0.002
Uranium (U)-Total	mg/L	0.0029	0.0013	0.0019	0.00024	0.0015	0.0024	0.00034	0.00049
Vanadium (V)-Total	mg/L	<0.025	<0.025	<0.025	0.0054	<0.025	<0.025	0.064	<0.01
Zinc (Zn)-Total	mg/L	1.4	<0.15	0.19	0.0138	1.2	0.43	0.28	0.1
Zirconium (Zr)-Total	mg/L	-	-	-	-	<0.003	<0.003	<0.004	<0.004
Aluminum (Al)-Dissolved	mg/L	<0.05	<0.05	<0.05	0.012	<0.05	<0.05	<0.02	<0.02
Antimony (Sb)-Dissolved	mg/L	<0.005	<0.005	<0.005	0.00039	<0.005	<0.005	<0.002	0.0032
Arsenic (As)-Dissolved	mg/L	<0.005	<0.005	<0.005	0.0014	<0.005	<0.005	0.0052	<0.002
Barium (Ba)-Dissolved	mg/L	0.26	0.46	0.20	0.022	0.14	0.22	0.031	0.054
Beryllium (Be)-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.00004	<0.001	<0.001	<0.0004	<0.0004
Bismuth (Bi)-Dissolved	mg/L	<0.0025	<0.0025	<0.0025	<0.0001	<0.0025	<0.0025	<0.001	<0.001
Boron (B)-Dissolved	mg/L	3.1	3.8	3.1	0.15	3.5	2.7	2.4	2.4
Cadmium (Cd)-Dissolved	mg/L	0.034	0.012	0.0086	<0.00001	0.0033	0.010	0.00032	0.00056
Calcium (Ca)-Dissolved	mg/L	9620	9280	4990	144	3700	6690	457	517
Chromium (Cr)-Dissolved	mg/L	<0.005	<0.005	<0.005	0.0154	<0.005	<0.005	<0.002	<0.002
Cobalt (Co)-Dissolved	mg/L	0.21	0.033	0.089	0.0025	0.026	0.12	0.031	0.057
Copper (Cu)-Dissolved	mg/L	0.25	0.25	0.25	0.015	0.069	0.37	0.039	0.10
Iron (Fe)-Dissolved	mg/L	<0.5	<0.5	<0.5	0.025	<0.5	<0.5	<0.2	<0.2
Lead (Pb)-Dissolved	mg/L	0.0068	<0.0025	<0.0025	<0.0001	<0.0025	<0.0025	<0.001	<0.001
Lithium (Li)-Dissolved	mg/L	0.32	0.21	0.20	0.029	0.13	0.18	0.097	0.092
Magnesium (Mg)-Dissolved	mg/L	1500	1820	1200	43.1	858	1130	628	595
Manganese (Mn)-Dissolved	mg/L	10.0	8.2	7.6	0.060	3.6	7.0	1.5	1.5
Molybdenum (Mo)-Dissolved	mg/L	0.022	0.065	0.029	0.0043	0.021	0.016	0.0062	0.0063
Nickel (Ni)-Dissolved	mg/L	0.35	0.15	0.18	0.0016	0.11	0.29	0.082	0.12
Phosphorus (P)-Dissolved	mg/L	<2.5	<2.5	<2.5	<0.1	<2.5	<2.5	<1	<1
Potassium (K)-Dissolved	mg/L	495	576	342	39	237	379	149	137
Selenium (Se)-Dissolved	mg/L	0.013	0.0048	0.0097	0.0019	0.005	0.0058	0.0012	<0.001
Silicon (Si)-Dissolved	mg/L	2.9	2.5	4.5	4.16	3.2	2.6	3.7	3.6
Silver (Ag)-Dissolved	mg/L	0.013	0.0095	0.0056	0.000088	0.0026	0.014	<0.0002	0.00022
Sodium (Na)-Dissolved	mg/L	10300	11700	7670	421	6710	8180	4690	4480
Strontium (Sr)-Dissolved	mg/L	28	32	19	1.06	17	22	6.0	6.2
Sulfur (S)-Dissolved	mg/L	593	563	601	52	499	509	420	450
Thallium (Tl)-Dissolved	mg/L	0.0009	<0.0005	<0.0005	<0.00002	<0.0005	<0.0005	<0.0002	<0.0002
Tin (Sn)-Dissolved	mg/L	<0.005	<0.005	<0.005	<0.0002	<0.005	<0.005	<0.002	<0.002
Titanium (Ti)-Dissolved	mg/L	<0.015	<0.015	<0.015	<0.0006	<0.015	<0.015	<0.006	<0.006
Uranium (U)-Dissolved	mg/L	0.0031	0.0013	0.0019	0.00023	0.0019	0.0026	0.00028	0.00059
Vanadium (V)-Dissolved	mg/L	<0.025	<0.025	<0.025	0.0042	<0.025	<0.025	<0.01	<0.01
Zinc (Zn)-Dissolved	mg/L	1.3	0.11	0.21	0.0082	1.2	0.42	0.026	0.094
Zirconium (Zr)-Dissolved	mg/L	<0.003	<0.003	<0.003	<0.0003	<0.003	<0.003	<0.004	<0.004