TMAC Resources Inc.

HOPE BAY BELT PROJECT
2018 Nunavut Water Board Annual Report






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Prepared by
TMAC Resources Inc.
Toronto, ON

Prepared for
Nunavut Water Board

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Executive Summary – English

The Hope Bay Greenstone Belt (the Belt) is an approximately 20 km × 80 km property along the south shore of Melville Sound in Nunavut, Canada. The Belt is TMAC Resources Inc.'s (TMAC) prime holding and is its sole focus for exploration, development and mining. This report to the Nunavut Water Board (NWB) has been prepared to summarize the Project activities and monitoring conducted under TMAC Type A Water Licence 2AM-DOH1323, Type B Water Licence(s) 2BB-MAE1727, 2BB-BOS1727, and the exploration Type B Water Licence 2BE-HOP1222 for 2018.

In 2018 commercial operations continued at Doris with continued efforts to progressively ramp up production to increase ore throughput and optimize gold recovery. Infrastructure constructed included a fabric tent structure over the primary crusher of the mill and an enclosure for the detoxified tailings conveyor exiting the mill building. Two dorms were added to allow an additional 98 beds at the Doris site.

Earthworks continued to complete the Doris Airstrip south apron expansion and lined aircraft de-icing and refueling pad. Construction of the Tailings Impoundment Area South Dam and associated access road were completed in 2018. In addition to this, construction of the access road and outfall berm for the Roberts Bay ocean discharge line and fusing of the discharge pipeline began in 2018. To accommodate increased fuel storage required for future project activities, the Roberts Bay single tank farm berm was raised to allow full use of the 5 ML tank and this tank was recommissioned in 2018. In order to support continued underground development, the Doris Connector Vent Raise access road was constructed. The final section of Pad T was completed in 2018 to allow additional ore and waste rock storage within the permitted footprint.

Underground waste development continued in 2018 with further advancement of the below the dyke (BTD) decline and necessary support infrastructure. TMAC completed ore development above the dyke for long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris North, and commenced ore sill development in the DCO. TMAC also continued waste development of the DCO for future mining horizons. Long hole blasting continued throughout 2018, with all ore production trucked to surface and processed through the mill or added to the stockpile. Development of the Doris Central (DCN) decline began in Q4 of 2018. TMAC continued underground exploration diamond drilling below the dyke at Doris, focused on the BTD East limb in 2018. The DCO Vent Raise was constructed and a conventional raise to surface was also developed from the BTD to support underground ventilation requirements.

Ore development also occurred from surface in Q4 of 2018 with the completion of surface blasting and hauling of ore and waste rock from the Doris Crown Pillar Trench.

In the fall, TMAC concluded another successful sealift operation including the purchase and delivery of diesel fuel and Jet-A fuel as well as explosives and reagents to support mining and milling activities. The sealift also included additional heavy equipment and supplies to support mining and construction operations.

Waste disposal, fuel usage and chemical storage stayed consistent with previous years. Fifteen spills were reported to the Nunavut Spill Line, Water Licence Inspector and KIA Major Projects office. The remaining spills that occurred during 2018 were minor in nature, occurring on land, with quick response and clean up resulting in negligible impact to the receiving environment. Empty cargo aircraft were utilized in 2018 for waste backhaul from the Doris Camp to KBL Environmental in Yellowknife to arrange for final remediation/disposal.

Water use in 2018 was conducted in accordance with Type A Water Licence 2AM-DOH1323, the Type B Water Licences 2BB-BOS1727 for Boston, the Type B Water Licences 2BB-MAE1727 for Advanced Exploration at Madrid, and the Type B Water Licence 2BE-HOP1222 for regional exploration. The referenced water licences include provisions for sampling programs that involve recording data related to the volume of water extracted for any purpose, testing of effluents (e.g., treated sewage effluents) discharged to the environment, and monitoring water quality within specific Project areas (e.g., surface discharge downstream of construction areas, storm water from an engineered containment structure, sewage and oily water effluent, etc.). Water usage in 2018 was conducted within approved limits.

There were two cases of discharges of non-compliant effluent in 2018, both of which were authorized by the Inspector. The first occurred in June when samples collected from the Roberts Bay Bulk Fuel Storage Facility (ST-6b) exceeded the allowable discharge criteria for Total Suspended Solids (TSS) outlined in Part G Item 23(a) of licence 2AM-DOH1323. The Inspector granted permission to use this water for dust suppression on site roads at Doris Camp as TSS was the only parameter to exceed the allowable limits. A total of 1,114 m^3 of water from this facility was used for dust suppression in July 2018. All other water accumulating in this facility in 2018 was transferred to the Tailings Impoundment Area. Details of sampling at ST-6b is provided in Appendix D of this report.

The second case of non-compliant discharge of effluent occurred in 2018 when samples collected from the Boston Containment Pond (BOS-2) exceeded the discharge criteria for TSS, total copper, total arsenic and total zinc. Water quality treatment was undertaken at this facility and additional samples collected. The Inspector granted permission to discharge this water to a depression in the camp pad following receipt of results for a sample collected August 26 which exceeded the discharge criteria for TSS but was below the discharge criteria for all other parameters. Details of sampling at BOS-2 is provided in Appendix D.4 of this report.

On-going progressive reclamation of the unoccupied Windy Camp focused on reclaiming ten cabins and ensuring appropriate financial security is in place.

Community consultation in 2018 focused on engaging positively and effectively with local communities regarding TMAC operations, employment and contracting opportunities and consultation on TMAC's Boston-Madrid Project.

In 2018 the focus of TMAC's permitting efforts were on the Madrid-Boston (Phase 2) project. The scope of activities proposed included mobilization, construction, operation, closure, reclamation, and post-closure monitoring of three (3) gold mines along the Hope Bay Property, referred to as the Madrid North, Madrid South and Boston. After completing the review of the final environmental impact study, the Nunavut Impact Review Board issued a recommendation to the Ministers of Crown-Indigenous Relations and Northern Affairs Canada for approval of a new Project Certificate for the Madrid and Boston mines, which approval was granted on November 12, 2018. The final permitting for the Madrid and Boston projects was completed on January 14, 2019 with the approval of two Type A Water Licence as recommended by the NWB on December 7, 2018 and concludes the final step in the environmental permitting process that enables mine development at Madrid North, Madrid South and Boston, with connecting all-weather roads.

As demonstrated above, TMAC strives to continually achieve compliance with the various regulatory requirements and maintain community relationships. Environmental monitoring in accordance with the existing Water Licences, Framework Agreement, Project Certificate, authorizations, management plans and environmental effects monitoring plans will continue during 2019

ᐱᒻᒪᕆᐅᔪᒃᑯᑦ ᓇᐃᓈᕐᓯᒪᔪᑦ ᐅᓂᒃᑳᓕᐊᑦ – ᐃᓄᒃᑎᑐᑦ

Hᐅᑉ ᐹ ᒍᕇᓐ ᓵᑐᓐ ᐱᐅᑦ ᐃᒻᒫᕈ 20 ᑭᓚᒦᑕᓂ ᐊᒻᒪᓗ 80 ᑭᓚᒦᑕᓂᒃ ᓇᒻᒥᓂ ᕿᓯᐅᔪᖅ ᓂᒡᕕᐊᑕ ᓯᖅᓯᒥ ᒥᐅᕝᐅᓪ ᓴᐅᓪ ᓄᓇᕗᒻᒥ, ᑲᓇᑕ. ᐱᐅᑦ TMAC ᓄᓇᓂᙵᕐᑐᓕᕆᔮᒃᑯᑦ (“TMAC) ᑎᒍᒻᒥᔪᑦ ᐊᒻᒪᓗ ᑎᒥᖕᑐᑦ ᑐᕌᕐᓯᒪᔪᑦ ᕿᒥᕐᕈᐊᕐᓂᕐᒧᑦ, ᐱᓕᕆᐊᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐅᔭᕋᖕᓂᐊᕐᓂᕐᒧᑦ. ᑕᒪᓐᓇ ᐅᓂᒃᑳᓕᐊᖅ ᓄᓇᕗᒻᒥ ᐃᒪᓕᕆᔮᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ (NWB) ᐋᖅᑭᒃᑕᐅᓯᒪᔪᑦ ᓇᓗᓇᐃᔭᕆᐊᕐᓗᒋᑦ ᐱᓕᕆᐊᕐᓴᐅᑉ ᐱᓕᕆᐊᓯᒪᓂᖏᓐᓄᑦ ᐊᒻᒪᓗᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ TMAC–ᑯᓐᓂᑦ. Type A ᐃᒪᒧᑦ ᓚᐃᓴᖓ 2AM-DOH1323, Type B ᐃᒪᒧᑦ ᓚᐃᓴ 2BB-MAE1727, 2BB-BOS1727 ᐊᒻᒪᓗ ᕿᒥᕐᕈᐊᕐᓂᖅ Type B ᐃᒪᒧᑦ ᓚᐃᓴ 2BE-HOP1222

ᑕᐃᑲᓂ 2018 ᐊᐅᓚᑦᑎᓂᖅᑎᓪᓗᒋᑦ ᑲᔪᓯᓂᖃᓚᐅᖅᑯᑦ ᐊᐅᓚᑕᐅᔪᑦ ᑑᕋᔅ ᑲᔪᓯᓂᖃᐃᓐᓇᑎᓪᓗᒋᑦ ᐱᓇᓱᐊᕐᓂᕐᒥᓂᑦ ᐃᖏᕐᕋᓯᕆᐊᒃᑲᓐᓂᕐᑯᓪᓗᒍ ᐱᓕᕆᐊᓂᐅᔪᖅ ᑕᒪᒃᑯᐊ ᐅᔭᕋᒃᓴᐃᑦ ᐊᒥᓱᕈᕆᐊᖅᑕᐅᓗᑎᑦ ᐊᒻᒪᓗ ᐱᕙᐅᓕᕆᐊᓗᑎᑦ ᒎᓗᒃᓴᐅᔪᑦ. ᑕᒪᒃᑯᐊ ᓴᓇᕕᒃᑲᕕᐅᔪᑦ ᓴᓇᔭᐅᓯᒪᓂᖏᑦ ᐱᖃᓯᐅᔾᔨᕚᑦ ᑐᐱᖅᑐᑎᑦ ᓇᓭᓂᑦ ᓯᕐᑯᓗᐃᕕᐅᑉ ᐊᒻᒪᓗ ᒪᑐᐊᕐᓯᒪᓗᓂ ᐊᒥᐊᒃᑯᕐᓗᖃᕕᖓ ᐊᓂᕙᓕᐊᔪᖅ ᓯᕐᑯᓗᐃᕕᒻᒥ. ᒪᕐᕈᒃ ᐃᓂᒃᓴᖃᓐᓂᐅᔫᒃ ᐱᖃᓯᐅᔾᔭᐅᖃᓐᓂᓚᐅᖅᑯᑦ ᐃᓚᓕᐅᑎᒃᑲᓂᖅᑐᑎᑦ 98 ᐃᓕᖅ ᑕᐃᑲᓂ ᑑᕋᔅ ᐃᓂᖃᕐᕕᖓᓂᑦ.

ᓄᓇᒥ ᐃᖅᑲᓇᐃᔫᖑᔪᑦ ᑲᔪᕉᓐᓇᖅᑯᑦ ᑖᓐᓇ ᐱᔭᕇᖅᑕᐅᓚᔅᑐᓂ ᑑᕋᔅ ᒥᕝᕕᖃᕐᕕᖓ ᓂᒋᖓᓂ ᐃᓚᓕᐅᔾᔭᐅᓂᖓ ᐊᒻᒪᓗ ᐃᓂᖃᕐᕕᔅᓴᒥᑦ ᖃᖓᑕᓲᓄᑦ ᖁᐊᖏᔭᐃᕕᖏᓐᓂᑦ ᐊᒻᒪᓗ ᐅᖅᓵᑕᐅᕕᖏᑕ ᐃᓂᖃᕐᕕᖏᓐᓂᑦ. ᓴᓇᔭᐅᓂᖓ ᐊᒥᐊᒃᑯᓗᕐᓄᑦ ᓄᐊᑕᐅᔪᑦ ᓂᒋᖓᑕ ᓯᒥᒃᑕᐅᓯᒪᔫᑉ ᐊᒻᒪᓗ ᐱᔾᔪᑎᒃᑲᓂᖏᑦ ᐊᖁᑎᓕᐊᙱᔪᑦ ᐱᐊᓂᒃᑕᐅᓚᐅᖅᑯᑦ 2018. ᑕᒪᔅᓯᒎᖓ ᐱᖃᓯᐅᑎᓪᓗᒍ, ᓴᓇᕕᓕᐊᓂᖅ ᐊᖁᑎᓂᑦ ᐊᓕᕐᑲᓐᓂᖓᓄᑦ ᑯᕕᕙᐅᓚᔭᖅᑐᒥᑦ ᓱᓗᓕᓖᓗᑎ ᑕᐃᑲ ᕿᕗᑦ ᕙᐃ ᐃᒪᖓᑕ ᐊᓂᐊᖅᑎᕆᕙᓪᓕᐊᔭᖏᑦ ᐊᒻᒪᓗ ᐊᐅᑦᑎᑦᑎᕆᓂᖅ ᐊᓂᐊᕿᕙᓪᓕᐊᔪᓂᑦ ᓱᓗᓕᓖᓂᖅ ᐱᒋᐊᓚᐅᖅᑯᖅ 2018. ᑕᒪᒃᑯᐊ ᒪᓕᑦᑐᒋᑦ ᐊᑐᖅᑕᐅᔭᕆᐊᓖᑦ ᐅᖅᓱᐊᓗᕐᕕᔅᓴᐃᑦ ᓯᕗᓂᔅᓴᒥᑦ ᐱᓕᕆᐊᔅᓴᓄᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᓚᔪᖅᑐᓄᑦ, ᑖᓐᓇ ᕿᕗᑦ ᕙᐃ ᐅᖅᓱᐊᓗᕐᕕᖓ ᐊᖏᓕᕆᐊᖅᑕᐅᓚᐅᖅᑯᖅ ᑕᒪᐃᓐᓂᓕᒫᖅ ᐊᑐᖅᑕᐅᒍᓐᓇᕐᑯᓪᓗᒋᑦ 5 ML ᐅᖅᓱᐊᓗᕐᕕᒃ ᐊᒻᒪᓗ ᑖᓐᓇ ᐅᖅᓱᐊᓗᕐᕕᒃ ᐊᑐᓕᖅᑎᑦᑎᑲᓐᓂᓚᐅᖅᑯᖅ ᑕᐃᑲᓂ 2018. ᑕᒪᓐᓇ ᐃᑲᔪᖅᓱᐃᓐᓇᕋᓱᓐᓂᐊᕐᓗᒍ ᓄᓇᐅᑉ ᐊᑖᓂ ᐱᓕᕆᐊᓂᐅᔪᖅ, ᑖᓐᓇ ᑑᕋᔅ ᑲᓱᖅᑕᕈᑎᖓ ᐊᖅᑯᑎᖓᓄᑦ ᓴᓇᔭᐅᓚᐅᖅᑯᖅ. ᑭᖑᓪᓕᖅᐹᒥ ᐃᓚᖓ ᑕᐃᑲᓂ Pad T ᐱᔮᕐᖅᑕᐅᓚᐅᖅᑐᓂ 2018 ᑕᒪᒃᑯᐊ ᐱᖃᓯᐅᔾᔭᐅᓂᖅᑐᑦ ᐅᔭᕋᖕᓴᐃᑦ ᐊᒻᒪᓗ ᐅᔭᕋᕐᓂᓗᑯᒥᓂᕐᓄᑦ ᑐᖅᓱᖅᑐᐃᕕᖕᖓᓂ.

ᓄᓇᐅᑉ ᐊᑖᓂ ᐅᔭᕋᕐᓂᓗᑯᓂᑦ ᐱᓕᕆᐊᓂᖅ ᑲᔪᓯᓂᖃᓚᐅᖅᑯᖅ 2018 ᑕᒪᓐᓇ ᐱᐅᓯᕖᓕᖅᑎᑕᐅᓇᓱᑦᑐᓂ ᐊᑏᓃᑦᑐᖅ ᐳᐃᓂᑯ (ᐊᑏᓃᑦᑐᑦ ᐳᐊᐃᓂᑯ) ᒥᑭᓕᕚᓕᖅᑐᒥ ᐊᒻᒪᓗ ᐃᑲᔪᖅᓱᕈᑎᔅᓴᑦ ᓴᓇᕕᓕᕆᓂᕐᒧᑦ. TMAC ᐱᐊᓂᒃᓯᓚᐅᖅᑯᑦ ᐱᓕᕆᐊᓂᖓᓂᑦ ᖁᓖᓂ ᐳᐊᐃᓂᑯ ᑕᑭᓂᖅᓴᓄᑦ ᐳᑑᕋᔾᔪᑎᓄᑦ ᐊᒻᒪᓗ ᖃᖅᑎᑦᑎᓂᕆᓂᖅ ᑕᐃᑲᓂ ᑑᕋᔅ ᑲᓱᖅᑕᕈᑎᖓ (ᑑᕋᔅ ᑲᓱᖅᑕᕈᑎᖓ) ᐊᒻᒪᓗ ᐊᑏᓃᑦᑐᖅ ᐳᐊᐃᓂᑯ ᑑᕋᔅ ᐅᐊᓐᓇᖓᓂᑦ, ᐊᒻᒪᓗ ᐱᒋᐊᒃᑲᓂᖅᑐᑎᑦ ᐅᔭᕋᖅᓴᓕᕆᓂᕐᒥᑦ ᐱᓕᕆᐊᑎᑦᑎᓂᕐᒥᑦ ᑕᐃᑲᓂ ᑑᕋᔅ ᑲᓱᖅᑕᕈᑎᖓᓂᑦ. TMAC ᑲᔪᓯᒃᑯᑦ ᐱᓕᕆᐊᑎᑦᑎᓪᓗᑎᑦ ᐅᔭᕋᕐᓂᓗᑯᓂᑦ ᐱᓕᕆᐊᓂᖅᑐᑎᑦ ᑕᐃᑲᓂ ᑑᕋᔅ ᑲᓱᖅᑕᕈᑎᖓᓂᑦ ᓯᕗᓂᑦᑎᓐᓂᑦ ᐅᔭᕋᓐᓂᐊᕐᓂᕐᒧᑦ ᐊᑐᕋᔪᖅᑐᓂᑦ. ᑕᑭᓂᖅᓴᓂᑦ ᖃᖅᑎᑦᑎᕆᓂᖅ ᑲᔪᓯᓂᖃᓚᐅᖅᑯᖅ 2018, ᑕᒪᒃᑯᐊ ᐅᔭᕋᖅᓴᓕᒫᑦ ᐅᓯᔭᐅᓪᓗᑎᑦ ᐊᒻᒪᓗ ᑲᒪᒋᔭᐅᓕᖅᑐᑎᑦ ᓯᕐᑯᓗᐃᕕᒻᒥ ᐅᕝᕙᓘᓐᓃᑦ ᐃᓚᓕᐅᔾᔭᐅᓗᑎᑦ ᓄᐊᑕᐅᔪᓂᑦ. ᐱᓕᕆᐊᓂᖅ ᑕᐃᑲᓂ ᑑᕋᔅ ᕿᑎᖅᐸᓯᐊᓂ (ᑑᕋᔅ ᕿᑎᖅᐸᓯᐊ) ᒥᑭᓕᕚᓕᕐᓂᖓ ᐱᒋᐊᓚᐅᖅᑯᖅ ᑕᐃᑲᓂ Q4 2018. TMAC ᑲᔪᓯᒃᑯᑦ ᓄᓇᐅᑉ ᐊᑖᓂ ᖃᖅᑎᑦᑎᖃᑦᑕᖅᑐᑎᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑕᐃᒪᓐ ᐃᑯᑕᕐᓂᖅ ᐊᑏᓃᑦᑐᖅ ᐳᐊᐃᓂᑯ ᑕᐃᑲᓂ ᑑᕋᔅ, ᑕᑯᓇᕐᓇᕆᔭᖅᑐᑎᑦ ᑕᐃᑲᓂ ᐊᑏᓃᑦᑐᖅ ᐳᐊᐃᓂᑯ ᑲᓇᓐᓇᖓᓂᑦ ᑕᐃᑲᓂ 20ᖕ8. ᑖᓐᓇ ᑑᕋᔅ ᑲᓱᖅᑕᕈᑎᖓᓂ ᐊᓂᐊᖅᑭᕕᖓ ᓴᓇᔭᐅᕆᐊᓚᐅᖅᑯᖅ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᐊᑦᑐᐃᓂᖅᑐᖅ ᐱᓕᕆᐊᑎᑕᐅᓚᐅᕆᕗᖅ ᑕᐃᑲᓂ ᐊᑏᓃᑦᑐᖅ ᐳᐊᐃᓂᑯ ᐃᑲᔪᖅᓱᐃᕐᓗᒍ ᓄᓇᐅᑉ ᐊᑖᓂ ᐊᓂᐊᖅᑎᕆᓕᕆᐊᕐᓂᕐᒧᑦ ᐱᔭᐅᔭᕆᐊᓕᓐᓂᑦ.

ᐅᔭᕋᒃᓴᓕᕆᓂᕐᒧᑦ ᐱᓕᕆᐊᓂᖅ ᑕᐃᑲᓃᒃᑭᕗᖅ Q4 ᐊᕐᕌᒍᐊᓂ 2018 ᐱᔮᕐᖅᑕᐅᓚᐅᖅᑐᓂ ᑕᒪᓐᓇ ᖃᖅᑎᑦᑎᕆᓂᖅ ᐊᒻᒪᓗ ᐅᓯᑲᖅᑕᕐᓂᖅ ᐅᔭᕋᒃᓴᔭᓂᑦ ᐊᒻᒪᓗ ᐅᔭᕋᕐᓂᓗᑯᓂᑦ ᑕᐃᑲᙵ ᑑᕋᔅ ᑯᕋᐅᓐ ᐱᓗᕐ ᑐᕋᓐᑦ.

ᐅᑭᐊᔅᓵᒃᑯᑦ, TMAC ᖃᐅᔨᓂᖃᓚᐅᕆᕗᑦ ᑲᔪᓯᖃᑦᑎᐊᖅᑐᒥᑦ ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᐊᐅᓚᑦᑎᓂᕐᒥᑦ ᐱᖃᓯᐅᑎᓪᓗᒍ ᐅᖅᓱᐊᓗᒻᒥᑦ ᓂᐅᕕᕐᓂᖅ ᐊᒻᒪᓗ ᐊᐅᓛᖅᑎᑕᐅᓂᖓ ᐊᒻᒪᓗ ᖃᖓᑕᓲᓄᑦ ᐅᖅᓱᐊᓗᒃᓴ ᐊᒻᒪᓗᑦᑕᐅᖅ ᖃᖅᑎᑦᑎᕆᔾᔨᑎᓄᑦ ᐊᒻᒪᓗ

ᐃᓚᐅᖅᑐᕈᑎᓄᑦ ᑕᒪᒃᑯᓄᖓ ᐅᔾᕋᓐᓂᐊᓂᕐᒧᑦ ᐃᑲᔪᕈᑎᒃᓴᓂᑦ ᐊᒻᒪᓗ ᓯᖁᓪᓗᐃᕚᒻᒥᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᐃᑦ. ᑖᓐᓇ ᐅᒥᐊᕐᔪᐊᖅ ᓂᐅᓯᔪᖅ ᐱᖃᓯᐅᔾᔨᓚᐅᕆᕗᖅ ᐃᓚᓕᐅᔅᓴᐅᓯᒪᔪᓂᑦ ᐊᖏᔩᑕᐅᓂᖅᓴᓄᑦ ᓄᓇᓯᐅᑎᓄᑦ ᖃᓄᕋᐅᑎᓖᑦ ᐊᒻᒪᓗ ᓱᓇᒃᑯᑖᖏᑦ ᐃᑲᔪᖅᓱᐃᒋᑎᖕᓴᑦ ᐅᔾᕋᓐᓂᐊᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓴᓇᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᓂᕐᒥᑦ.

ᑕᒪᒃᑯᐊ ᐅᔾᕋᕐᓃᓪᓗᑯᐃᑦ, ᐅᖅᓱᐊᓗᒻᒥᑦ ᐊᑐᕐᓃᑦ ᐊᒻᒪᓗ ᐃᓚᐅᕈᑎᒃᓴᓄᑦ ᑐᖅᑯᖅᓯᕖᑦ ᑕᐃᒪᐃᓕᖓᓪᓗᐊᖏᓐᓇᖅᓯᒪᕗᑦ ᐊᕐᕎᒧᑦ ᖃᑦᑎᑦ ᐊᓂᒍᖅᑐᓂᑦ. 15 ᐅᖅᓱᐊᓗᒻᒥᑦ ᑯᕙᓂᑯᐃᑦ ᐅᓂᒃᑳᓯᐅᖃᑦᑕᖅᓯᒪᕗᑦ ᓄᓇᕗᒻᒥ ᐅᖅᓱᐊᓗᒻᒥᑦ ᑯᕙᔪᓄᑦ ᐅᖃᓚᐅᑎᖕᒐᓄᑦ, ᐃᒪᕐᒥᒃ ᓚᐃᓴᓂᑦ ᖃᐅᔨᓴᖅᑎᒧᑦ ᐊᒻᒪᓗ ᑭᕙᓪᓕᖅ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖃᑎᒌᑦ ᐱᓕᕆᐊᔅᓯᕆᔩᐅᑉ ᐊᓪᓚᕝᕚᖓᓄᑦ. ᑕᒪᒃᑯᐊ ᐅᖅᓱᐊᓗᐃᑦ ᑯᕚᖃᑦᑕᕐᓂᑯᑦ 2018 ᐊᖏᔫᓗᐊᓚᐅᙱᓚᑦ ᓄᓇᐅᑉ ᐊᑦᑐᖅᑕᐅᓂᖓᒍᑦ, ᓴᖅᑭᓕᖅᑭᑦᑖᓂᖏᑦ, ᑐᐊᕝᖅᑐᒃᑯᑦ ᐱᓕᕆᐊᖑᑲᐅᑎᒋᓚᐅᖅᑐᑎᑦ ᐊᒻᒪᓗ ᓴᓗᒻᒪᖅᑕᐅᑦᑕᐅᑎᒋᓂᖓ ᐊᑦᑐᐃᒍᑕᐅᓗᐊᓚᐅᙱᓚᖅ ᐊᕙᑎᑦᑎᓐᓄᑦ. ᐃᓗᓕᖃᐅᙱᑦᑐᑦ ᖃᖓᑕᓲᑦ ᐊᑐᓕᖅᑎᑕᐅᒃᑲᓐᓂᓚᐅᑲᕗᑦ 2018 ᑕᒪᒃᑯᓄᖓ ᐅᔾᕋᕐᓂᓗᑯᓄᑦ ᐅᓯᔾᔪᔪᓂᑦ ᑕᐃᑲᙱᑦ ᑑᑲᓐ ᑐᐱᖅᕚᖓᓂᑦ ᑕᐃᑲᒥ KBL ᐊᕙᑎᓕᕆᔩᒃᑯᑦ ᔫᓇᐃᕝᒥ ᑲᒪᒋᔭᐅᓂᐊᓕᕐᓗᑎᑦ ᑭᖑᓪᓕᖅᐹᒥ ᓴᓗᒻᒪᖅᑕᐅᓂᐊᕐᓗᑎᑦ/ ᐃᒋᑕᐅᓂᐊᕐᓗᑎᑦ.

ᐃᒥᕐᒥᑦ ᐊᑐᕐᓂᖅ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕆᕗᖅ ᑕᐃᒫᓪᓗᐊᕋᓗᐊᕐᒪᖔᖅ ᖃᓄᐃᑦᑑᓂᖓ Δ ᐃᒥᓕᕆᓂᕐᒧᑦ ᓚᐃᓴ 2AM-DOH1323, ᑖᓐᓇ ᖃᓄᐃᑦᑑᓂᖓ ᐱ ᐃᒥᓕᕆᓂᕐᒧᑦ ᓚᐃᓴ 2BB-BOS1727 ᑕᐃᑯᖓ ᕚᔅᑕᓐ, ᑖᓐᓇᓗ ᖃᓄᐃᑦᑑᓂᖓ ᐱ ᐃᒥᓕᕆᓂᕐᒧᑦ ᓚᐃᓴ 2BB-MAE1727 ᖃᐅᔨᔅᑲᓂᕐᓂᕐᒧᑦ ᑕᐃᑲᓂ ᒪᐃᑐᕋᑦ, ᐊᒻᒪᓗ ᑖᓐᓇ ᖃᓄᐃᑦᑑᓂᖓ ᐱ ᐃᒥᓕᕆᓂᕐᒧᑦ ᓚᐃᓴ 2BE-HOP1222 ᐊᕝᑐᖅᓯᒪᔪᒥᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ. ᑖᒃᑯᐊ ᐅᖃᐅᓯᐅᔪᑦ ᐃᒥᓕᕆᓂᕐᒧᑦ ᓚᐃᓴᐃᑦ ᐱᖃᓯᐅᔾᔨᕗᑦ ᐋᖅᑭᒋᐊᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᕈᑎᒃᓴᓄᑦ ᐱᓕᕆᐊᒃᓴᓂᑦ ᐱᔾᔪᑎᓕᓐᓂᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐅᕐᑯᒪᐃᓐᓂᖏᓐᓂᑦ ᐃᒪᐅᑉ ᐱᔭᐅᕙᓪᓕᐊᓂᖓᓄᑦ ᑭᓱᑐᐃᓐᓇᕐᒧᑦ ᐱᓕᕆᓂᕐᒧᑦ, ᖃᐅᔨᓴᕐᓂᖅ ᒥᓪᓗᐊᖅᑕᐅᕙᓪᓕᐊᔪᓂᑦ (ᓱᕐᓗ, ᒥᓪᓗᐊᖅᑕᐅᕙᓪᓕᐊᔪᑦ ᐃᓱᐊᖅᓴᖅᑕᐅᓂᖏᑦ) ᐊᓂᐊᕿᕙᓪᓕᐊᔪᑦ ᐊᕙᑎᑦᑎᓐᓂ, ᐊᒻᒪᓗ ᖃᐅᔨᓴᕐᓂᖅ ᐃᒪᐃᑉ ᖃᓄᐃᑦᑑᓂᖓᓂᑦ ᑕᐃᑲᓂ ᐱᓕᕆᕝᕕᐅᔫᑉ ᐃᓂᖅᑲᕝᖓᓂᑦ (ᓱᕐᓗ ᑯᐸᓪᓕᐊᔪᑦ ᓴᓇᕝᖃᕝᖓᓂᑦ, ᐃᒥᕐᒧᑦ ᑎᒻᒥᒃᑮᑕᐅᕙᓪᓕᐊᔪᑦ, ᒥᓪᓗᐊᖅᑕᐅᕙᓪᓕᐊᔪᑦ ᐊᒻᒪᓗ ᐅᖅᓱᐊᕿᔪᑦ ᐃᒪᐃᑦ ᒥᓪᓗᐊᖅᑕᐅᓯᒪᔪᑦ, ᐆᑦᑑᑎᒋᓗᒋᑦ). ᐃᒥᕐᒥ ᐊᑐᕐᓂᖅ ᑕᐃᑲᓂ 2018 ᖃᐅᔨᓴᖅᑕᐅᓂᖓ ᓈᒻᒪᒋᔭᐅᓯᒪᓚᐅᖅᑯᖅ ᒪᓕᒋᐊᓕᖏᑎᒍᑦ.

ᒪᕈᓕᖓᓚᖈᒃ ᐊᓂᐊᕿᕙᓪᓕᐊᔪᑦ ᒥᓪᓗᐊᖅᑕᐅᓯᒪᔪᑦ ᑕᐃᒪᐃᓪᓗᐊᙱᑦᑑᓐᓂ ᑕᐃᑲᓂ 2018, ᑕᒪᒃᑮᒃ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᓪᓗᑎ ᖃᐅᔨᓴᖅᑎᒧᑦ. ᓯᕗᓪᓕᖅᐹᖅ ᓴᖅᑭᓚᐅᖅᑐᖅ ᔩᓂᒥᑦ ᑕᒪᒃᑯᐊ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ ᓄᐊᑕᐅᕙᓪᓕᐊᔪᑦ ᑕᐃᑲᓂ ᕌᕗᑦ ᕙᐃ ᐅᖅᓱᐊᓗᖃᕝᕕᖓᓂᑦ (ST-6b) ᐅᖓᑕᐅᔾᔨᓚᐅᕐᖓᑕ ᐊᓂᐊᕿᕙᓪᓕᐊᔫᒥᑦ ᒪᓕᑦᑕᐅᔭᕆᐊᓕᓐᓂᑦ ᑕᐃᑲᓂ ᑲᑎᓕᒫᕐᓗᒋᑦ ᐊᑐᖅᑕᐅᒍᓐᓃᖅᑐᑦ ᑎᓯᔪᑦ (ᑲᑎᓕᒫᕐᓗᒋᑦ ᐊᑐᖅᑕᐅᒍᓐᓃᖅᑐᑦ ᑎᓯᔪᑦ) ᓇᓗᓇᐃᖅᑕᐅᓯᒪᔪᑦ ᑕᐃᑲᓂ ᐃᓚᖓ G 23(a) ᓚᐃᓇ 2AM-DOH1323. ᖃᐅᔨᓴᖅᑎᐅᔪᖅ ᐱᔪᓐᓇᑎᑦᑎᓚᐅᖅᑯᖅ ᑕᒪᓐᓇ ᐃᒪᖅ ᐊᑐᖅᑕᐅᒍᓐᓇᕐᓗᓂ ᓯᐅᕋᔮᓂᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᐊᖅᑯᑎᖏᓐᓂᑦ ᑑᑲᓐ ᑐᐱᖅᕚᖓᑕ ᑖᓐᓇ ᑲᑎᓕᒫᕐᓗᒋᑦ ᐊᑐᖅᑕᐅᒍᓐᓃᖅᑐᑦ ᑎᓯᔪᑦ ᑖᓐᓇᑑᓚᐅᖅᑯᖅ ᐅᖓᑕᐅᔾᔨᔪᖅ ᐱᕚᕆᔭᕆᐊᓕᒥᓂᑦ. ᑲᑎᓕᒫᖅᑐᕆᑦ 1,114 m^3 ᐃᒪᖅ ᑕᕝᕙᙱᑦ ᐱᓕᕆᕝᕕᒥ ᐊᑐᖅᑕᐅᓚᐅᖅᑯᖅ ᓯᐅᕋᔮᓂᑦ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᔪᓚᐃ 2018-ᖑᑎᓪᓗᒍ. ᐊᓯᓕᒫᖏᑦ ᐃᒥᖅ ᓄᐊᑉᐸᓪᓕᐊᔪᑦ ᑕᕝᕙᓂ ᐱᓕᕆᕝᕕᒥ 2018-ᖑᑎᓪᓗᒍ ᐊᐅᓪᓛᖅᑕᐅᓚᐅᖅᑯᑦ ᐊᒥᐊᒃᑯᕐᓗᕝᕖᑦ ᐃᓂᖅᑲᕝᖓᓄᑦ. ᓇᓗᓇᐃᔭᖅᓯᒪᔪᑦ ᖃᐅᔨᓴᕈᑕᐅᓯᒪᔪᑦ ᑕᐃᑲᓂ ST-6b ᐊᑐᐃᓐᓇᐅᕗᑦ ᐃᓚᖓᓂ D ᑕᕝᕙᓂ ᐅᓂᒃᑲᒥ.

ᐊᐃᑉᐸᖓ ᖃᓄᐃᓐᓂᐅᔪᖅ ᑕᐃᒫᓪᓗᐊᖏᑦᑐᒃᑯᑦ ᐊᓂᐊᕿᕙᓪᓕᐊᔪᑦ ᒥᓪᓗᐊᖅᑕᐅᓯᒪᔪᑦ ᓴᖅᑭᓚᐅᖅᑯᖅ 2018 ᑖᒃᑯᐊ ᖃᐅᔨᓴᕈᑎᒃᓴᐃᑦ ᓄᐊᑕᐅᕙᓪᓕᐊᔪᑦ ᑕᐃᑲᙵ ᕚᔅᑕᓐ ᐃᓂᖅᑲᕝᖓᓂ ᑕᓯᓕᐊᖑᓯᒪᔪᒥᑦ (BOS-2) ᐅᖓᑕᐅᔾᔨᓚᐅᕐᖓᑕ ᐊᓂᐊᕿᕙᓪᓕᐊᔪᒥᑦ ᒪᓕᑦᑕᐅᔭᕆᐊᓕᓐᓂᑦ ᑕᐃᑲᓂ ᑲᑎᓕᒫᕐᓗᒋᑦ ᐊᑐᖅᑕᐅᒍᓐᓃᖅᑐᑦ ᑎᓯᔪᑦ, ᑲᑎᓕᒫᖅᑐᕆᑦ ᑳᓄᕙᖅ, ᑲᑎᓕᒫᖅᑐᕆᑦ ᐋᓂᐊᑖᕈᑕᐅᒍᓇᖅᑐᑦ ᐊᒻᒪᓗ ᑲᑎᓕᒫᖅᑐᕆᑦ ᓴᕝᕋᔭᔅᓴᑦ. ᐃᒪᐅᑉ ᖃᓄᐃᓐᓂᖓᓄᑦ ᖃᐅᔨᓴᕐᓂᖅᑕᖃᓚᐅᕆᕗᖅ ᑕᕝᕙᓂ ᐱᓕᕆᕝᕕᒥ ᐊᒻᒪᓗ ᐃᓚᓕᐅᔾᔨᒃᑲᓐᓂᖅᑐᑎᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᔪᓂᑦ. ᑖᓐᓇ ᖃᐅᔨᓴᖅᑎᐅᔪᖅ ᑲᔪᓯᒍᓐᓇᖅᓯᑎᑦᑎᓚᐅᖅᑯᖅ ᐊᓂᐊᕿᑎᑦᑐᒍ ᑖᓐᓇ ᐃᒪᖅ ᑐᐱᕝᕕᐅᑉ ᓴᓂᐊᓄᑦ ᑖᒃᑯᐊ ᓴᖅᑭᑦᑕᐅᓚᐅᖅᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᓯᒪᔪᑦ ᐋᖏᓯ 26 ᐅᖓᑕᐅᔾᔨᓚᐅᖅᑐᑎᓪᓗ ᐊᓂᐊᕿᔭᕆᐊᓕᒻᒧᑦ ᒪᓕᑦᑕᐅᔭᕆᐊᓖᑦ ᑕᐃᑯᖓ ᑲᑎᓕᒫᕐᓗᒋᑦ ᐊᑐᖅᑕᐅᒍᓐᓃᖅᑐᑦ ᑎᓯᔪᑦ ᑭᓯᐊᓂᓗ ᑖᒃᑯᐊ ᐊᑦᑎᓐᓂᖅᓴᐅᓚᐅᖅᑐᑎᑦ ᐊᓯᖏᓐᓂᑦ ᐱᓕᕆᕝᕕᐅᔪᒥᑦ. ᓇᓗᓇᐃᔭᖅᓯᒪᔪᑦ ᖃᐅᔨᓴᕈᑕᐅᓯᒪᔪᑦ ᑕᐃᑲᓂ BOS-2 ᐊᑐᐃᓐᓇᐅᕗᑦ ᐃᓚᖓᓂ D.4 ᑕᕝᕙᓂ ᐅᓂᒃᑲᒥ.

ᑕᒪᓐᓇ ᑲᔪᓯᔪᒃᑯᑦ ᐃᓂᑐᖅᑲᖓᓄᑦ ᐅᑎᖅᑎᑦᑎᓂᖅ ᐃᓂᖅᑲᕝᕕᐅᒍᓐᓃᖅᑐᒥᑦ ᑕᐃᑲᓂ ᕗᐃᓐᑎ ᑐᐱᖅᕚᖓᓂᑦ ᑐᕋᖓᖅᑯᖅ ᐅᑎᖅᑎᑦᑎᓂᕐᒥᑦ ᖁᓕᓂᑦ ᐃᓪᓗᕋᕆᓂᑦ ᐊᒻᒪᓗ ᑕᒪᒃᑯᐊ ᑮᓇᐅᔭᖅᑑᑎᔅᓴᖏᑦ ᐱᑕᖃᑦᑎᐊᕋᓗᐊᕐᒪᖔᑕ.

ᑕᒪᒃᑯᐊ ᓄᓇᓕᖕᓄᑦ ᑐᓴᐅᒪᖃᑎᒌᖕᓃᑦ ᑕᐃᑲᓂ 2018 ᑐᓵᒐᖃᓚᐅᖅᑯᑦ ᐱᓕᕆᖃᑎᒌᖕᓂᕐᒥᑦ ᐱᐅᓂᖅᓴᒃᑯᑦ ᐊᒻᒪᓗ ᓈᒻᒪᓈᕐᓂᖅᓴᒃᑯᑦ ᓄᓇᓕᒥᐅᑕᓂᑦ ᐱᔾᔪᑎᓕᖕᓂᑦ TMAC ᐊᐅᓚᓂᕆᔭᖏᖕᓂᑦ, ᐃᖅᑲᓇᐃᔭᖅᑎᑦᑎᓂᕐᒧᑦ ᐊᒻᒪᓗ ᑳᖕᑐᕌᒃᑎᑦᑎᓂᕐᒧᑦ ᐊᑐᐃᖕᓇᐅᑎᑕᐅᔪᓂᑦ ᐊᒻᒪᓗ ᑲᑎᒪᑎᑦᑎᓂᖅ ᐱᔾᔪᑎᓕᖕᓂᑦ TMAC's ᐙᔅᑕᓐ ᒪᐃᑐᕋᑦ ᐱᓕᕆᐊᖑᓂᑦ.

ᑕᐃᑲᓂ 2018 ᑖᓐᓇ ᑐᓵᒐᔭᐅᔪᖅ TMAC's ᐱᔪᓐᓇᐅᑎᑎᒍᑦ ᐱᓇᓱᐊᕐᓂᖏᓐᓄᑦ ᑕᐃᑲᓃᓚᐅᖅᑯᑦ ᒪᐃᑐᕋᑦ-ᐙᔅᑕᓐ (ᓇᒦᓕᕐᓂᖓ 2) ᐱᓕᕆᐊᔅᓴᖅ. ᑖᒃᑯᐊ ᐃᖅᑲᓇᐃᔮᖑᔭᕆᐊᖃᕐᓂᖏᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᒧᑦ ᑐᒃᓯᐊᐅᑕᐅᓯᒪᔪᒧᑦ ᐱᖃᓯᐅᔾᔨᕗᑦ ᐊᑐᐃᖕᓇᕈᖅᓴᐃᓂᕐᒥᑦ, ᓴᓇᓂᕐᒥᑦ, ᐊᐅᓚᑦᑎᓂᕐᒥᑦ, ᒪᑐᓯᓂᕐᒥᑦ, ᐅᑎᖅᑎᑦᑎᓂᕐᒥᑦ, ᐊᒻᒪᓗ ᒪᑐᔭᐅᓯᒪᕙᕆᖅᑐᓂᑦ ᖃᐅᔨᓴᕐᓂᕐᒥᑦ ᐱᖓᓱᓂᑦ (3) ᒨᓗᓯᐅᕐᓂᕐᒧᑦ ᐅᔭᕋᖕᓂᐊᕐᕕᒃ ᖃᓂᒋᔮᓂ ᐊᐅᐸᓗᒃ ᐱᕐᑯᑎᖃᕐᕕᖑᓂᑦ, ᐅᖃᐅᓯᐅᓯᒪᔪᖅ ᒪᐃᑐᕋᑦ ᐅᐊᖕᓇᖓ, ᒪᐃᑐᕋᑦ ᓂᒋᖅ ᐊᒻᒪᓗ ᐙᔅᑕᓐ. ᖁᒥᕐᕈᓂᖓ ᐱᔭᕇᕐᓂᖃᓚᐅᖅᑎᓪᓗᒍ ᑖᒃᑯᓂᖓ ᑭᖑᓪᓕᖅᐹᒥ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐊᑦᑐᖅᑕᐅᓂᖏᖕᓄᑦ ᖃᐅᔨᓴᕐᓃᑦ, ᑖᒃᑯᐊ ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᑦ ᑐᓂᓯᓚᐅᖅᑯᑦ ᐊᑐᓕᕐᑯᔨᔪᒻᒥᑦ ᑖᔅᓱᒧᖓ ᒥᓂᔅᑕᖑᓄᑦ ᓄᓇᖅᑲᖅᑳᖅᓯᒪᔪᓕᕆᔨᒃᑯᑦ ᐊᒻᒪᓗ ᐅᑭᐅᖅᑕᖅᑐᒥ ᓄᓇᖅᑲᖅᑳᖅᓯᒪᔪᓄᑦ ᓈᒻᒥᓴᐅᕐᑯᓪᓗᒍ ᓄᑖᒧᑦ ᐱᓕᕆᐊᔅᓱᑦ ᐃᓕᓴᕆᔭᐅᔾᔪᑦ ᑕᐃᑯᖓ ᒪᐃᑐᕋᑦ ᐊᒻᒪᓗ ᐙᔅᑕᓐ ᐅᔭᕋᖕᓂᐊᕐᕕᖏᖕᓄᑦ, ᑖᓐᓇᓗ ᓈᒻᒥᓴᐅᓂᖓ ᑐᓂᔭᐅᓚᐅᖅᑐᓂ ᓅᕕᐱᕆ 12, 2018. ᑖᓐᓇ ᑭᖑᓪᓕᖅᐹᒥ ᐱᔪᓐᓇᐅᑎᖓ ᑕᐃᑯᖓ ᒪᐃᑐᕋᑦ ᐊᒻᒪᓗ ᐙᔅᑕᓐ ᐱᓕᕆᐊᔅᓴᓄᑦ ᐱᔭᕇᖅᑕᐅᓚᐅᖅᑯᖅ ᔮᓄᐊᕆ 14, 2019 ᓈᒻᒥᓴᐅᓪᓗᑎᒃ ᒪᒃᐲᒃ ᖃᓄᐃᑦᑑᓂᖏᑦ ᐃ ᐃᒥᕐᒧ ᓚᐃᓴ ᑖᒃᑯᐊ ᐊᑐᓕᖁᔭᐅᓯᒪᑎᓪᓗᒋᑦ ᓄᓇᕗᑦ ᐃᒪᓕᕆᔨᑦ ᑲᑎᒪᔨᑦ ᑕᐃᑲᓂ ᑎᓯᐱᕆ 7, 2018 ᐊᒻᒪᓗ ᑭᖑᓪᓕᖅᐹᒥ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐱᔪᓐᓇᐅᑎᑖᕐᓂᕐᒨᖓᔪᓂᑦ ᑲᔪᓯᑎᑦᑎᕙᓪᓕᐊᔪᓂᑦ ᐅᔭᕋᖕᓂᐊᕐᓂᕐᒥᑦ ᐱᕙᓪᓕᐊᓂᐅᔪᒥᑦ ᑕᐃᑲᓂ ᒪᐃᑐᕋᑦ ᐅᐊᖕᓇᖓᓂᑦ, ᒪᐃᑐᕋᑦ ᓂᒋᖓᓂᑦ ᐊᒻᒪᓗ ᐙᔅᑕᓐ, ᐊᖅᑯᑎᖃᖅᑐᑎᑦ ᐊᖅᑯᑎᓕᐊᖑᔪᓯᒪᔪᓂᑦ ᓯᓚ ᖃᓄᐃᑦᑑᒐᓗᐊᖅᑲᑦ.

ᓇᓗᓇᐃᔭᖅᑕᐅᓯᒪᑎᓪᓗᒍ ᖁᓖᓂ, ᑖᒃᑯᐊ TMAC ᐊᖏᖅᓯᒪᓂᖃᐃᖕᓇᖅᑯᑦ ᑲᔪᓯᔪᒃᑯᑦ ᒪᓕᒋᐊᓕᖕᓂᑦ ᒪᓕᒃᑕᑦᑕᓂᕐᒥᑦ ᐊᔾᔨᒌᙱᒋᕈᓘᔭᖅᑐᓂᑦ ᒪᓕᒐᖅᑎᒍ ᐱᖃᓯᐅᔾᔭᐅᓯᒪᔭᕆᐊᓕᖕᓂᑦ ᐊᒻᒪᓗ ᑲᒪᒋᔭᖃᕐᓂᕐᒥᑦ ᓄᓇᓕᖕᓄᑦ ᐱᓕᕆᖃᑎᒌᑦᑎᐊᓂᕐᒥᑦ. ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᓂᖅ ᒪᓕᑦᑐᒍ ᒫᓇᐅᔪᒥᑦ ᐃᒥᓕᕆᓂᕐᒧᑦ ᓚᐃᓴ, ᐃᖅᑲᓇᐃᔫᖑᔭᕆᐊᓕᖕᓄᑦ ᐊᖏᕈᑎᑦ, ᐱᓕᕆᐊᔅᓴᓄᑦ ᐃᓕᓴᕆᔭᐅᔪᑦ, ᑲᔪᓯᑎᑕᐅᒍᓐᓇᐅᑏᑦ, ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᑦ ᐊᒻᒪᓗ ᐊᕙᑎᑦᑎᖕᓄᑦ ᐊᑦᑐᐃᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᖓ ᑲᔪᕈᓐᓇᓂᐊᖅᑯᖅ ᐊᕐᕌᒍ 2019.

Executive Summary – Inuinnaqtun

Taamna Kapihiliktuumi Greenstone Belt Nunauyuq aktigiyuq 20 km-nik x 80 km-niklu nanminiriyauyuq hivuraqhianit hinaani Melville Sound-mi Nunavunmi, Kanatami. Taamna Nuna TMAC Resources Inc.-kut (TMAC) nanminirilluaqtaat ihumagilluaqhugu nalvaaqhiuqvighaq, hanavighaq uyaraghiuqvighaqlu. Hapkua naunaitkutat talvunga Nunavunmi Imaliqiyit Katimayiit (NWB) parnaiyaqtauhimayuq ilittuqhitighaq Havakvingnit hulihimayainik munaqtainiklu qauyihaqtainik ataagut TMAC Resources Inc.-kut (TMAC) Type A-mik Imaqmut Laisiutaat 2AM-DOH1323, Type B Imaqmut Laisiutainik(t) 2BB-MAE1727, 2BB-BOS1727 taamnalu nalvaaqhiuqtunut Type B Imaqmut Laisiutaat 2BE-HOP1222.

Tamna Ikaluktuk Uyaagukhiukvik Hungayaktunik Uyaagunik Nunani itkukniakhugu nayuganik nungumanginiklu 20 km x 80 km nik avaatingnut nungumanginik piutiyanik hungnikgainik hivugani hinngnanginiklu talvanitunik Melville Kangikhukmi Nuvgiyanik talvani Nunavutmi Kanatami. Talvanitunik nunani piutigyanik TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit (TMAC) Uyaagukhiuktit Atugakhaliuknikmun Havakvit ilingaaituniklu pihimayunik uvunalu iluumukgutauvaktunik ammigiyauyukhanik mikharut nalvakhiuknikmun nalvagukhanik kinikhianikmunlu, aullaktikgutikhanik uvunalu uyaagukhiukvikhaniklu. Una uniklutigiyauyunik tahapkununga Nunavut Imaktigut Katimayit (NWB) pihayunik upalungaikhimavaktunik mikharut tutkikhaiyukhanik Havakhautikhanik hulilukakgutauyukhanik uvunalu havagiyauyukhanik ataniktutauvaktunik talvunakukhimayunik TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit. (TMAC) Uyaagukhiuktit Atugakhaliuknikmun Havakvit Naunaitkutak A Imaktigut Nungudjutilingnik Ubluinik Atugakhanik Atuknianut 2AM-DOH1323, Naunaitkutak B Imaktigut Naunaitkutak Nungudjutilingnik Ubluinik Atugakhanik Atuknianut (unalu) 2BB-MAE1727, 2BB-BOS1727 tahapkunungalu nalvakhiuknikmun nalvagukhanik kinikhianikmunlu Naunaitkutak B Naunaitkutak Imaktigut Nungudjutilingnik Ubluinik Atugakhanik Atuknianut 2BE-HOP1222 uvani 2018.

Uvanilu 2018 nungmilingnik piutigiyainik havagiyauvaktunik aulladjutigiplugit talvanitunik Dorismi pidjutiplutik aulladjutigiplugit pinnahuaknikmun hivumuknikmun hivunikgiktukhaniklu. Hungnaayauyukhanik avaatikhainiklu ilauhimayunik aah tuupikhautikhanik tuupiklutik hungnaahimayunik kangarguut tamnalluak kiikhuktuidjutit aihikguktuidjutit uyaaganik havakviuyukhamik imalu aah ingulaiyaklugit talvanitunik halumaktikgutikhaniklu halumailgunik kuvikgakvinik imaluknik huppimutakhaniklu atadjutihimayunik talvanitunik havakvik kiikhuktuidjutit aihikguktuidjutit uyaaganik. Malguknik igluyakhanik ilauhimayunik hungnaayauhimayunik pidjutiyanginik inikhakakgianginik ilauyukhanik 98 nik iglikhanik talvanitunik Dorismi nunani.

Nunaap nunanik atukhugu aulladjutigiplugit iniktikgiyukhanik talvanitunik Dorismi Milvikhainik Tingmitunut hivugani tungavikhainiklu ungigliyumiktauyukhanik imalu ungiyunuut tingmitingnik uuhiyakvikhainik ukkhikhivikhainiklu tungavikhangniklu. Hungnaayauhimayuniklu talvanitunik Halumailgunik kuvikgakvinik imaluknik Huppimutakhainiklu Nunani Hivugani Imakaknit Huppimutanik atadjutivaktunik pidjutitaliktunik apkutinik pihimayunik iniktauhimayunik uvani 2018. Uvunalu ilauhimayunik, hungnaayauhimayunik pidjutitaliktunik apkutinik mikharutlu kugluakvik huppimutikhimayunik talvanitunik Roberts Kangikhuani taryumut kugluakvilikhimayuk tuukhualiukhimayunik imalu atadjutihimayunik atautimut kugluakviliukhimayunik tuukhualiukhimayuniklu havagiyauvaktunik uvani 2018. Tahapkununa havagiyauyukhanik ungigliyumiktauvaktunik ukkhukluknik tuutkuktuivikhanik havakhikariakaktut hivunikgiyakhainik havakhautikhanik hulilukakgutauvaktunik, tamna Roberts Kangikhuani ilikuaktumik ukkhukluukakvikhak huppimutalingnik pidjutauvakhimayunik ukkakgiyauvaktunik pidjutiyauyanginiklu atuktauyukhanik 5 ML Imakaknit ukkhukakvikhak, unalu ukkhukakvikhak pidjutauhimayuk havagiyaufakpaktuk uvani 2018. Uvuna havagiyauyukhanik ikayutauyukhaniklu auladjutigiplugit atani nunaap havagiyauvaktunik, talvanitunik Dorismi Atadjutauvaktunik Ungniavit Kingaliukhimayunik

Kulvaktikhikhimayunik pidjutitaliktuniklu apkutinik hungnaayauhimayunik. Tamna inikgutikgutauvaktunik uiwuanganik talvanitunik Tungvakvikhak T havagiyauvakhimayuk iniktiktauhimayuniklu uvani 2018 pidjutivaliayukhaniklu ilauhimayunik uyaagaktakvit imalu atukgungnaiktainiklu uyaagaktakhimayunik tutkuktuivikhanik pikaktuniklu naunaitkutalingnik nungudjutilingnik ubluanganik atugakhanik atuknianut avaatainik nungumanginiklu.

Atani nunaap havagiyauvaktunik ikkakungukpaktunik auladjutigiplugit uvani 2018 pilingnik ahiagut hivunikgiktunik talvanitunik atani huppimutaliukhimayunik (BTD) mikhivaliavaktunitlu imalu nakukgutauyukhanik ihuakkutikhainiklu hungnaayauhimayunik TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit inikpakhimayunik uyaaguktaktauvaktunik kanginiklu huppimutauyunik taakiyunik iguutakvikhanik imalu kargaktuktuukhaniklu talvanitunik Dorismi Atadjutihimayunik (DCO) uvanilu BTD talvanitunik Dorismi Tunngnungani imalu ukkakhikhimayutlu uyaaguktakvit havagiyauvaktunik huli talvanitunik DCO. TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit auladjutigiplugitlu ikakuktauvaktunik havagiyauvaktunik huli talvanitunik DCO mikharutlu hivunikgiyakhainik uyaagukhiuktit uyaaguktakvikhanik. Taakiyunik iguutakvikhanik kargaktuktuukhaniklu auladjutigiplugit talvanganit 2018, pidjutiplugit tamakpianginik uyaaguktakhimayainik havagiyauvaktunik akhaluutitukhutik akyaktaakhugit atanit nunaap kangungnungaktikhugit pingmigiplugitlu havakvianut kiikhuktikgivaktunik aihikguktikgivaktunik uyaaganik naliak ilaliiutiplugit tuutkuktauvaktunik uyaagukakvinut. Havagiyauvaktunik talvanitunik Dorismi Kitikmiuyumik (DCN) mikhivaliavaktunitlu havagiyauvaktunik uvani Q4 2018. TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit auladjutigiplugit nalvakhiuknikmun nalvagukhanik kinikhianikmunlu uyaaganitunik kiplakgaakpiaktunik iluinik iguutakhutiklu atanginik huppimutaliukhimayunik talvanitunik Doris, ammigiplugitlu mikharut BTD Hivuganik uyaagaktakvinik uvani 2018. Talvanitunik DCO Ungniavit Kingaliukhimayunik Kulvaktikhikhimayunik havakhikhimayunik imalu nakukgutikhaniklu kulvaktikhikhimayunik nunaap kangunuut talvanitunik BTD ihuakkutikhanik atani nunaap Ungniavikhanik Kingaliukhimayunik havakhikariakakmataalu.

Uyaagaktakviuvaktunik havagiyauvaktunik pihimayaitlu takungnakhivaktunik kangingnik talvanitunik Q4 uvani 2018 pilingnik iniktikhimayunik kanginik kargaktakpakhimayunik imalu ugyaaktakhugitlu uyaagaktakhimayunit ikakungukpaktunik uyaaguktakhimayunit talvanitunik Dorismi Uyaagakhiukvinik Kalikgiiktiktauvaktunik Iluukhaingnitlu.

Uvani ukiiakhamilu, TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit havagiblugit alauyunik iniktauvaktuniklu taryumi umiaktukhutik akyaaktakhutik havagiyauvaktunik ilauhimayuniklu niuviktauvaktunik uvunalu akyaaktauvaktunik ukkhukluknik taimaituniklu tingmitit ukkhukhainik pidjutiplugitlu kargaktautikhanik tumaayukhautikhanik atugakhanik nakukgutauyukhanik uyaagakhiukpaktunik imalu havakvit kiikhuktuivit aihikguktuivinik uyaagaktakhimayunik hulilukakgutauvaktuniklu. Tahapkunani taryumi umiaktukhutik akyaaktakhutik pidjutihimayuniklu ilauhimayunik akhaalutinik alguktautilingniklu uvunalu atugakhainik nakukgutauyukhanik uyaagakhiukpaktunik mikharutlu hungnaayauyukhanik havagiyauyukhaniklu.

Ikakunik ikakuktauvaktunik, ukkhukluknik atugakhanik uvunalu tukungnalingnik tutkuktauvaktunik auladjutivakhimayuniklu ilidjuhikgiyainik pidjutauvaktunik aipangaaninguktunik ukiungnit. 15 nik kuvihivaktunik ingaktitugit havakhikhimavaktunik unikluktauhimayut tahapkununga Nunavutmi Kuvihivaktunik Ingaktunik takulugu Hivayautaat, Imaktigut Naunaitkutak Nungudjutilingnik Ubluinik Atugakhanik Atuknianut Havaktiat Ihiviukhinikmun talvanilu KIA Hivituvaktunik Havakhautikhanik havakvit. Tahapkuninga aulahimayunit kuvihivaktunik ingaktunik takungnakhiyunik talvanitunik 2018 pihimayut mikauvakhimayunik ilidjuhikgiyainik nunaini, takungnakhivaktunik talvanitunik nunaainakmitunik, pidjutauhimayunik kilamiukgutauplutik kiudjutauyukhaingnakhimayuniklu imalu halumaktiktauhaingnakhimayunik naunaituuniktunik nungaayauhimaituniklu ihuinakgutauvaktunik mikharut havagitiakhugit nunainik. Uhiyakpaktuniklu uhiyakgangumik tingmitit atuufakhugit uhiliktuukhugit uvani 2018 ikakunik akyaaktauyukhanik talvanitunik Dorismit Ingnituklianit talvungalluak

KBL Nunalikiyinut talvanitunik Yaluniami piyukhanik upalungaiyaktauyukhanik uvunalu iniktikgutauyukhanik halumaktiktauyukhanik/ikakuktauvaktuniklu.

Imak atuktauvaktunik uvani 2018 pihimayunik ataniktutauvaktuniklu hivunikgiplugit Naunaitkutanik A Imaktigut Nungudjutilingnik Ubluinik Atugakhanik Atuknianut 2BB-BOS1727 talvanitunik Bostonmi, unalu Naunaitkutak B Imaktigut Naunaitkutak Nungudjutilingnik Ubluinik Atugakhanik Atuknianut unalu 2BB-MAE1727 mikharut Hivunikgiktunik Nalvakhiuknikmun nalvagukhanik kinikhianikmunlu talvanitunik Madridmi, Naunaitkutak B Naunaitkutak Imaktigut Nungudjutilingnik Ubluinik Atugakhanik Atuknianut 2BE-HOP1222 uvunalu nunatuttukanik nalvakhiuknikmun nalvagukhanik kinikhianikmunlu. Tamna naunaitkutaulluaktuklu naunaitkutak imaktigut nungudjutilingnik ubluinik atugakhanik atuknianut ilauyunik ilidjuhikgiyakhainik ihiviuktauyukhanik havagiyauyukhanik pihimayunik ilauhimayunik adjiliuktauyukhaniklu naunaitkutakhanik atadjutivaktunik mikharut nallautakgutauvaktunik imak ihuinaktaugumiklunin kauhimayauvaktunik, ihiviukhinikmun atuktauvaktunik imak (unalu., halumaktauvaktunik kuvikgakhimayunik imaklungukpaktunik atuktauvaktunik imak) kugluaktitauvaktunik kuvikgaktauvaktunik nunaamut, uvunalu havagiyauyukhanik imak kanukgitakhaniklu talvanitunik nalikmik Havakhautikhanik nunaini (unalu., kanginiklu kuvikgaktauvaktunik kugluaktitauvaktunik ungmuut taungnunga havakviuvaktunik nunainik, piktuumit imaakpaktunik tahapkununga havahikpaktunik huppimutaliukhimayunik havagiyauvaktunit, imakluknik kuvikgakhimayunik imalu ukkhuklukaktunik imakmi atuktauvaktunik imak, unalu). Imak atuktauvaktunit uvani 2018 pihimayut ataniktutauvaktuniklu talvanitunik angiktauvaktunik nungumaakhainiklu.

Tahapkunalu pihimayunik malguknik havagiyauvaktunik kugluaktitauvaktunik adjikingitunik atuktauvaktunik imak uvani 2018, tamungnik havagiyauvakhimayunik nakugiyauhimayunik tapfumanga Havaktiat Ihiviukhinikmun naunaitkutakhanik. Tahapkunani hivuliuhimayunik takungnakhiyunik uvani Imakguktikvia havagiyauyunik ihiviuktauyunik katitikgiyauyunik talvanitunik Roberts Kangikhuani Ungiyunik Ukkhukluknik Tutkuktuivit Havakvit (ST-6b) kangikhugit nungumangiyakhukgulluanginik pidjutauvaktunik kugluaktitauvaktunik kanukgilidjutivaktuniklu uvunalu Tamakpianginik Nuutkaktitauvaktunik Atukhimayunik (TSS) naunaitkutalingnik uvani Uiwuanganik G Atugakhanik 23 (a) naunaitkutak nungudjutilingnik ubluinik atugakhanik Aatuknianut 2AM-DOH1323. Tamna Havaktiat Ihiviukhinikmun naunaitkutakhanik angikhimayuk atuktauyukhanik atuktuukhanik imakmik imalu puuyukpaktunik hiugak ilangautiyukhanik nunani apkutiniklu talvanitunik Dorismi Ingnituklianik una TSS pihimayuk tamnaluak avaatainik pidjutiplutik kangikhugit nungumanginik pidjutiyauyukhanik nungumanginiklu. Aah tamakpianganik mikharut 1,114 m^3 imakaknit imaktukpaktunik talvanitunik havakvinit atuktauhimayunik mikharutlu puuyukpaktunik hiugak ilangautiyukhanik nunani uvani Tarhilikviani 2018. Tamakpianginiklu imak imakuktuuhivaktunik talvanitunik havakviuvaktunik uvani 2018 pihimayut havagiplugit talvungaktikhugit Halumailgunik Kuvikgakvik Huppimutalingnik Nunani. Naunaitkutakgiyainik ihiviuktauvaktunik talvanitunik ST-6b havakhikhimayunik Uiwuanganik D uvani uniklutinik.

Talvani aipanik havagiyauvaktunik adjikingitunik kuvikgaktauvaktunik atuktauvaktunik imaknik takunakhimayunik uvani 2018 havagiyauhimayunik ihiviuktauvaktunik katitikhimayunik talvanitunik Bostonmi Huppimutainiklu Taahikgakmi (BOS-2) kangikpaktunik nungumagiyakhainiklu kuvikgaktauvaktunik kanukgilidjutivaktunik uvunalu TSS, tamakpianganik kungnuuyauyaliknik, tamakpianganik tuukungnalingnik imalu huvikhulgitlu. Imak kanukgitakhanguniklu halumakhiktauvaktunik havakhiktauvaktunik talvanitunik havakviuvaktunit ilauhimayuniklu ihiviuktauvaktunik katitikhimayunik. Tamna Havaktiat Ihiviukhinikmun naunaitkutakhanik angikhimayuk atuktauyukhanik atuktuukhanik kugluaktitiyukhanik imakluknik mikharut huppimutaliukhimayunik kugluakvikhanik talvanitunik ingnituklinik tungavikhainiklu malikgakhaniklu tuniyauyukhanik naunaitkutanik mikharut ihiviuktauvaktunik katitikhimayunik uvani Nikilikiviani 26 kanukgilidjutivaktunik kangikpaktunik nungumagiyakhainiklu kuvikgaktauvaktunik kanukgilidjutivaktunik tahapkunani tamainik alauyunitlu nungumanginiklu. Naunaitkutauyunik ihiviuktauvaktunik talvanitunik BOS-2 pihimayunik upalungaikhimayuniklu uvani Uiwuanganik D.4 tahapkunani uniklutinik.

Talvunalu havagiyauyunik huli hivunikgiktunik halumakhiyunik talvanitunik naayuktauyungnaiktumit Windymi Ingnituklianik ammigiyauyuk halumaktiktauyuk havagilifakhugit kulinik aihikpani iglukpautainik uvunalu havagiyauyakhainiklu nakuyumik manikhakhuliklu pirgumiyauyunik havakhikhimayunik.

Nunalingni ayuukiktuinikmun uvani 2018 ammigiplugit mikharut atadjutivaliayukhanik pinnahuaklutik aullaktikgutikhaniklu tahapkunani nunatuttukanik nunalingni kauhimayauvaktuniklu TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit havakviuvaktuniklu, havakhautikhanik uvunalu havaktitauyunik havakhautikhanik uktutikhanik imalu ayuukiktuinikmun mikharut TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit Bostonmi-Madridmi Havakhautikhanik.

Uvani 2018 ammigiyauvaktunik pinnahuakpaktunik TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit naunaitkutakhanik nungudjutilingnik ubluinik atugakhanik atuknianut pinnahuaklugitlu mikharut Madridmi-Bostonmi (Ilidjuhikgiyainik 2) havakhautikthanik. Tahapkununa naunaikhimayunik havagiyauyukhanik aullaktikgutikhanik ilauhimayunik nuttikhimaklutik, havagiyaulutik, havakviulutik, umiktikgiyukhaniklu, halumaktikgiyukhanik, imalu hivuagut umiktikgiyauyukhanik havagiyaulutik pingahuyunik (3) manilingnik uyaaganik kuulingnik uyaagukhiukvit hungnirgainik Ikaluktumi Nunani, ilihimayaulluaktumik Madridmi Tunngnungani, Madridmi Hivugani uvanilu Bostonmi. Ahiagutlu iniktikhimayunik utiutifaakpaktunik tahapkuninga iniktikgutauyukhanik nunattigut ihuinakgutivaktunik naunaiyainikmun naunaitkutakhaniklu, tahapkuat Nunavut Ihuinaktulikiyit Utiutifaakpaktunik Katimayit tunihimayunik aah havagiyauyukhanik tapfumunga Ministaah Atanikyuamut Hivuliuktiat Atanik Nunattaknikmun Malikgak tahapkunanilu Tunngani Aviktuinikmun Nunattaknikmun Kanatami piyukhanik angiktauyukhanik uvunalu nuttakhanik Havakhautikhanik Naunaitkutakhamik Nungudjutilingnik Ubluinik Atugakhanik Atuknianut talvanitunik Madridmi uvanilu Bostonmi uyaagukhiukvit, kanukgiliuktauhimayunik havagiyauhimayunik angiktauvaktunik tuniyauhimayunik uvani Tatiaknakhivia 12, 2018. Tamna iniktikgutanik naunaitkutakhanik nungudjutilingnik ubluinik atugakhanik atuknianut talvanitunik Madridmi uvanilu Bostonmi havakhautikhanik pihimayunik iniktauhimayunik uvani Idjikgukvia 14, 2019 pilingnik angiktauvaktunik malguknik Naunaitkutanik A Imaktigut Nungudjutilingnik Ubluinik Atugakhanik Atuknianut pitkuihimayunit havagiyauyukhanik tahapkunanga Nunavut Imaktigut Katimayit NWB uvani Ubluikvia 7, 2018 imalu ilauhimayunik inikgutikhanik hivumut nunattigut naunaitkutakhanik nungudjutilingnik ubluinik atugakhanik atuknianut hivumuktukhanik pinnahuaknikmunlu uyaagukhiuknikmun havagiyauyukhanik talvanitunik Madridmi Tunngnungani, Madridmi Hivugani uvanilu Bostonmi, pilingnik atadjutiyukhanik tamakpianganut ukiunganik hila maliklugu apkutikhaniklu.

Aah ilidjihikgiyainik kulani uma, TMAC Uyaagukhiuktit Atugakhaliuknikmun Havakvit hivumuknikmunlu auladjutigiplugit ungnigutivaktukhanik inikhinikmun malikgakhaniklu pilingnik nalikmut kauhimayauvaktunik havagiyauyukhaniklu uvunalu havagilugit nunalingni havakattigiknikmunlu. Nunattigutlu havagiyauyukhanik malikgakhaniklu pilingnik aullayuitunit Imaktigut Nungudjutilingnik Ubluinik Atugakhanik Atuknianut, Havagiyauyukhanik Angiktauvaktunitlu, Havakhautikhanik Naunaitkutakhamik Nungudjutilingnik Ubluinik Atugakhanik Atuknianut, angiktauvaktukhaniklu, havagiyauyukhanik pangnattauyukhanik uvunalu nunattigut ihuinakgutivaktunitlu havagiyauyukhanik pangnattauyukhaniklu pilugit auladjutilugit uvani 2019.

HOPE BAY BELT PROJECT
2018 Nunavut Water Board Annual Report

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Acronyms and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AEMP	Aquatic Effects Monitoring Program
DNSEMC	Doris North Project Specific Committee
KitSEMC	Kitikmeot Socio-Economic Monitoring Committee
m	Metre
NEF	Nunavut Economic Forum
NWB	Nunavut Water Board
SDS	Safety Data Sheets
t	Tonnes
TDGA	*Transportation of Dangerous Goods Act*
TIA	Tailings Impoundment Area
TMAC	TMAC Resources Inc.
WRIA	Waste rock influenced area
WWTF	Wastewater treatment facility

1. Introduction

This report to the Nunavut Water Board (NWB) has been prepared to summarize the Project activities and monitoring conducted under TMAC Resources Inc. (TMAC) Type A Water Licence 2AM-DOH1323, Type B Water Licence(s) 2BB-MAE1727, 2BB-BOS1727 and the exploration Type B Water Licence 2BE-HOP1222. Concordance tables referencing where in this report the requirements of the reporting outlined in each of the referenced water licences has been met are presented in Appendix A.

The referenced water licences include provisions for sampling programs that involve recording data related to the volume of water extracted for any purpose, testing of effluents (e.g., treated sewage effluents) discharged to the environment, and monitoring water quality within specific Project areas (e.g., surface discharge downstream of construction areas, storm water from an engineered containment structure, sewage and oily water effluent, etc.). These data are summarized and referenced on the completed NWB Annual Report Forms, included as Appendix B and all monitoring data is provided in Appendix D of this report.

As an update to procedural matters related to the Boston-Madrid (Phase 2) Project, on November 9, 2018, TMAC received Project Certificate No. 009 for the Boston-Madrid (Phase 2) Project. The Boston-Madrid (Phase 2) Project includes the construction of required surface infrastructure and operation of three (3) new mines at Hope Bay: Madrid North, Madrid South and Boston. On January 14, 2019 the Minister of Intergovernmental and Northern Affairs and Internal Trade approved the amended Type A Water Licence 2AM-DOH1335 (Amendment No. 2; Doris-Madrid Project) and New Type A Water Licence No. 2AM-BOS1835 (Boston Project) as recommended by the Nunavut Water Board on December 7, 2018. As these Licences were only received in 2019 therefore no monitoring in 2018 occurred under these licences. Annual reporting for 2AM-DOH1335 and 2AM-BOS1835 will be included in the 2019 annual report to the NWB.

2. Regulatory Framework and Legal Matters

The key regulatory and legal documents that relates to this report are the Project Type A and B Water Licence(s), however this report is presented in context of other applicable regulatory authorizations and schedules. TMAC holds, or will soon hold, the permits and authorizations required to carry out the future work scope. A listing of the key regulatory instruments that allowed for work to be completed in 2018 is provided in Table 2-1.

Table 2-1. Key TMAC Permits/Licences and Approvals

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
NIRB Project Certificate	009	Authorization for Madrid-Boston to proceed, provided certain conditions and requirements are incorporated in the various regulatory permits and authorizations issued by the regulatory agencies with permitting authority for the Hope Bay Project. The Project includes the construction of all required surface Infrastructure and operation of three new mines at Hope Bay: Madrid North, Madrid South and Boston.	Life of Doris Project	None
NIRB Project Certificate	003	Authorization for Doris to proceed provided certain conditions and requirements are incorporated in the various regulatory permits and authorizations issued by the regulatory agencies with permitting authority for the Hope Bay Project.	Life of Doris Project	None
NWB Type A Water Licence Amendment No.2	2AM-DOH1335	Water Licence for Doris and Madrid project that authorizes the construction, operation and reclamation of the Doris, Madrid and the all- weather road of the Hope Bay Project. Licence scope includes Amendment No.1.	22 years	March 2035
NWB Type A Water Licence Amendment No.1	2AM-DOH1323	Water Licence for Doris with a 10-year term that authorizes the construction, operation and reclamation of the Doris Project. Licence was renewed (with certain amendments) in November 2016. – Superseded by Amendment No. 2 2AM-DOH1835.	10 years	August 2023
NWB Type A Water Licence Amendment	2AM-BOS1835	Water Licence for the Phase 2 Boston Site that authorizes the construction, operation and reclamation of the Boston Project.	17 years	March 2035
Type B Water Licence for the HBVB including a camp at Windy Lake	2BE-HOP1222	Water Licence that allows for the use of water and disposal of waste associated with regional exploration program including drilling and camp operations.	10 years	June 2022

(continued)

Table 2-1. Key TMAC Permits/Licences and Approvals (continued)

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
Type B Water Licence for bulk sample exploration at Boston	2BB-BOS1727	Water licence that allows for the use of water and the disposal of waste for the Boston Advanced Exploration Project. Licence was renewed in July 2017, was formerly 2BB-BOS1217.	10 years	July 2027
Type B Water Licence for Madrid Advanced Exploration Amendment No.2	2BB-MAE1727	Water licence that allows for the use of water and the disposal of waste for an undertaking classified as Mining and Milling as per Schedule II of the Regulations for the Madrid Advanced Exploration Project (Amended in 2018).	10 years	May 2027
Framework Agreement		Framework Agreement provides comprehensive land tenure governing the issuance of surface exploration licences, advanced exploration leases, commercial leases, and compensation associated with tenure. Framework Agreement includes a belt-wide Land Use Licence, an Inuit Impact and Benefits Agreement (IIBA) and a Water and Wildlife Agreement. Framework Agreement was signed in March 2015 for belt-wide land tenure.	20 years	March 2035
Water and Wildlife Agreement		Included as a Schedule to the Framework Agreement, this Agreement details compensation to be provided to the KIA and Inuit beneficiaries for negative effects that may occur to wildlife harvesting and water as a result of mining related activities across the Belt.	20 years	March 2035
Amended and Restated Inuit Owned Lands Commercial Lease	KTCL 313D001	Commercial Lease for use of designated lands associated with the Hope Bay Volcanic Belt (HBVB) area. Currently, lands have been designated that encompass Doris. Expansion to include other areas of the HBVB is administrative in nature. Original Commercial Lease was amended and restated in March 2015 as a means to obtain surety of belt-wide land tenure.	20 years	March 2035
Inuit Impact and Benefits Agreement		Included as a Schedule to the Framework Agreement, this Agreement details the benefits to be provided to the KIA and Inuit beneficiaries from the Hope Bay Project, including compensation, employment and contracting opportunities. The IIBA originally signed in association with Doris was revised in March 2015 and expanded in scope to encompass belt-wide activities.	20 years	March 2035

(continued)

Table 2-1. Key TMAC Permits/Licences and Approvals (completed)

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
KIA Advanced Exploration Agreements	KTAEL15C001 KTAEL15C002	Two agreements as per the terms of the Framework Agreement enabling quarry operations at designated locations in the Hope Bay Belt and advanced exploration at Boston.	5 year renewable annually thereafter for up to 20 years	March 2020
KIA Land Use Licences		Enables exploration activities across the Hope Bay Belt as per the terms of the Framework Agreement.	1 year automatic renewable for 20 years	March 2016
DFO authorization	NU-02-0117.2	Construction of the jetty in Roberts Bay.		December 2009
DFO authorization	NU-1000-0028	Changes to the Doris jetty.		July 2012
DFO authorizations	NU-02-01117.3	Construction of the Doris Tailings Impoundment Area (TIA) north dam.	Life of Mine	None
Navigable Waters Permit	8200-02-6565	Installation of the jetty in Roberts Bay.	N/A	N/A
Navigable Waters Permit	2018-600028	Approval for Jetty in Roberts Bay	N/A	N/A
Navigable Waters Permit	2018-600006	Approval for Marine Outfall Berm	N/A	N/A
Jetty Lease	77A3-1-2	Foreshore lease from the Crown for construction and operation of the Roberts Bay Jetty.	30 years	June 2047
Marine Outfall Berm	77A/3-3-2	Lease from Crown for construction and operation of Roberts Bay Marine Outfall Berm.	30 years	July 2048
Amendment to Schedule 2 of the Metal Mining Effluent Regulations (MMER)	Registration SOR/2008-216	Designation of Tail Lake as a tailings impoundment.	Life of Mine	None

3. Summary of Project Activities for 2018

3.1 CONSTRUCTION AND OPERATIONS

In 2018 commercial operations continued at Doris with continued efforts to progressively ramp up production to increase ore throughput and optimize gold recovery. In 2018 the mill processed 464,615 tonnes (t) of ore and poured 111,043 ounces of gold, and successfully treated 63,462 t of cyanide solutions. The installation of the secondary crushing line was completed in 2018 which allowed increased throughput of ore in the mill. Projects such as the installation of gravity concentrators in the mill crushing circuit contributed to improved gold recovery.

Civil construction activities included the installation of a fabric tent structure over the mill primary crusher and completion of an enclosure for the detoxified tailings conveyor exiting the mill building. Two dorms were added to allow an additional 98 bed spaces at Doris Camp. Earthworks continued in order to complete the Doris Airstrip south apron expansion and lined aircraft de-icing and refueling pad. Construction of the Tailings Impoundment Area South Dam and associated access road were completed in 2018. In addition to this, construction of the access road and marine outfall berm for the Roberts Bay ocean discharge line and fusing of the discharge pipeline began in 2018. To accommodate increased fuel storage required for future project activities, the Roberts Bay single tank farm berm was raised to allow full use of the 5 ML tank and this tank was recommissioned in 2018. In order to support continued underground development, the Doris Connector Vent Raise access road was constructed. The final section of Pad T was completed in 2018 to allow additional ore and waste rock storage within the permitted footprint.

Underground waste development continued in 2018 with further advancement of below the dyke (BTD) decline and necessary support infrastructure. TMAC completed ore development above the dyke for long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris North, and commenced ore sill development in the DCO.

TMAC also continued waste development of the DCO for future mining horizons. Long hole blasting continued throughout 2018, with all ore production trucked to surface and processed through the mill or added to the stockpile. Development of the Doris Central (DCN) decline began in Q4 of 2018. TMAC continued underground exploration diamond drilling below the dyke at Doris, focused on the BTD East limb in 2018. The DCO Vent Raise was constructed and a conventional raise to surface was also developed from the BTD to support underground ventilation requirements.

Ore development also occurred from surface in Q4 of 2018 with the completion of surface blasting and hauling of ore and waste from the Doris Crown Pillar Trench (DCPT).

In the fall of 2018, TMAC concluded another successful sealift operation including the purchase and delivery of 17,500,000 L of fuel as well as explosives and reagents to support mining and milling activities. The sealift also included additional heavy equipment and supplies to support mining and construction operations.

Site layouts and aerial photos for the Belt are provided in Appendix C of this report and provide details of the existing camps, infrastructure and equipment at site.

3.2 EXPLORATION

The planned 2018 glacial till sampling program was completed, consisting of approximately 800 samples, within the northern portion of the Belt and building on the 2016 and 2017 programs. Results of the till program are used to refine regional drill targets for 2019 exploration programs.

In late 2018 a limited regional drilling program was completed, consisting of 758 metres of diamond drilling. Two drill holes were completed to evaluate the stratigraphy within a wide valley north of the Madrid deposit. Geological compilation, target generation and prioritization continued in preparation for the 2019 regional exploration program.

In the spring of 2018 TMAC contracted Geotech Geophysics to complete a 2,645 line-kilometer helicopter-borne time-domain electromagnetic (TEM) survey covering the Elu Link claims. The results of the survey highlight several deep-seated conductors particularly in the southern portion of the survey area. These anomalies are coincident with strong, NE-trending magnetic features and will be areas of focus in future exploration initiatives of the Elu Link property.

3.2.1 Drilling

During the 2018 Exploration and Geoscience program, TMAC Resources Inc. contracted Geotech Drilling Services Ltd. to complete surface and underground diamond drilling targeting both short-term production areas through longer-term definition and expansion of resources at Doris and Madrid North.

The Doris underground diamond drilling program consisted of definition and expansion drilling on the high-grade zones in Doris BTD and infill drilling within Doris Connector to support detailed mine planning. A total of 24,245 metres of underground drilling has been completed in 2018, including 10,918 metres in Doris Connector and 13,327 metres within Doris BTD.

A total of 9,452 metres of diamond drilling was completed at Madrid. The 2018 program comprised 75 drill holes at Madrid North with 44 of those completed on Naartok West and 31 completed on Naartok East. The objective of the program was to obtain additional data to further the evaluation of the project given the advanced stage of permitting and the strategic imperative to increase potential ore feed sources as early as 2019.

4. Summary of Project Plans for 2018

4.1 CONSTUCTION AND OPERATIONAL WORK PLANS FOR FUTURE YEAR (2019)

The following activities are planned for the Doris site and associated permitted infrastructure for 2019:

- Madrid North Portal development and associated infrastructure;
- Madrid Crown Pillar development of Naartok east zone;
- Backfill and reclamation of the Doris Crown Pillar Trench;
- Construction of the effluent mixing box at the mill;
- Installation of the ocean discharge line between the mill and into Roberts Bay;
- Discharge of MDMER-complaint effluent to Roberts Bay;
- DCO vent raise fan installation;
- Expansion of glycol heat loop to mechanical shop;
- Construction of additional 5 million liter fuel tank at Roberts Bay;
- Installation of 2 x 48 person accommodation complex;
- Construction of a lined waste storage facility;
- Installation of additional contact water sumps in proximity to Doris Camp pad;
- Active quarrying and crushing at Quarry 2 and Quarry D;
- Mining, exploration and underground development at Doris;
- Regional exploration program based at the Boston camp;
- Ore stockpiling and processing;
- Waste rock stockpiling and backfill underground;
- Windy Camp and reclamation activities; and
- Continue with legacy drill site reclamation activities.

TMAC will also continue exploration on the Hope Bay Belt and will operate from the Doris site for exploration.

4.2 EXPLORATION WORK PLANS FOR FUTURE YEAR (2019)

<u>2019 Doris Drilling</u>

Exploration underground drilling resumed at Doris in late-January 2019, and will continue to follow closely behind development of the Doris BTD exploration ramp and DCO development. A total of 30,000 metres is planned for Doris in 2019.

2019 Madrid Drilling

Drilling at Madrid began in late-January with two drill rigs situated on Patch Lake focusing on a 6,000 metre resource definition program of the Suluk zone. In mid-February 2019 a single rig will complete approximately 2,000 metres of drilling on the Naartok East Crown Pillar Recovery area. An additional 2,000 metres of drilling is budgeted for exploratory, ice-based drilling of Madrid South.

2019 Boston Drilling

The 2019 exploration program at Boston is scheduled to start in late summer and is expected to transition to a winter on-ice drilling program late in the year. Initial drilling, supported out of the Boston camp, will focus on high priority regional targets proximal to Boston, including the Domani trend to the south. Approximately 10,000 metres of drilling has been budgeted for the Boston program.

2019 Regional Activities

Regional till sampling is expected to continue in 2019. Approximately 800 samples will be collected in the Northern and Middle portions of belt. An optional 200 sample program is proposed south-east of Boston to refine targeting in the Domani alteration trend.

A significant regional drilling program will be executed in 2019 in addition to exploration near the known deposits. Exploration targets near current and planned infrastructure at Doris and Madrid will be evaluated and prioritized for diamond drilling. Over 7,000 metres of diamond drilling is budgeted to test regional targets in the north portion of the Hope Bay Belt, and drilling will commence in May after the winter drilling program at Madrid North is completed.

5. Water Use and Waste Disposal

During 2018, water management at Hope Bay Project Site was in line with the authorized Doris Site, Type A Water Licence 2AM-DOH1323, the Type B Regional Exploration Licence 2BE-HOP1222, Type B Water Licences for Madrid 2BB-MAE1727, and the Type B Water Licence for Boston 2BB-BOS1727.

An overview of the sampling programs for each of the sites (Doris, Windy, Madrid and Boston) including site photographs showing the locations of monitoring sites as well as annual water sampling programs for the Hope Bay Project are provided in Appendix D of this report.

5.1 DORIS

A summary of water sampling for Doris under the Type A Water Licence 2AM-DOH1323 is presented in Appendix D.1 of this report as outlined in Schedule J.

Water for domestic use at Doris Camp is obtained from Windy Lake. Water is drawn from the lake at the freshwater intake and trucked to Doris Camp. The Doris Lake pumphouse was not supplying domestic water to Doris Camp in 2018.

Sewage and greywater produced onsite is processed in the sewage treatment plant at Doris in line with Part G Item 4 of the Type A Water Licence 2AM-DOH1323. Sludge produced by the treatment plant is disposed of within the TIA as outlined in existing Hope Bay Project Domestic Waste Water Treatment Management Plan.

All containment berm water is sampled for water quality against the discharge criteria of the licence. Water that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector; water that does not meet the licence criteria is treated onsite until it is remediated to acceptable levels for discharge to the tundra, is discharged to the TIA, and/or is managed as approved by the Inspector.

Runoff and contact seepage at site is managed in accordance with the approved Quarry Management and Monitoring Plan and Water Management Plan for the Doris Site.

During 2018, TMAC collected data from the following active or seasonally active monitoring stations: TL-1, TL-2, TL-5, TL-6, TL-7, TL-9, TL-11, TL-12, ST-1, ST-2, ST-4, ST-5, ST-6a, ST-6b, ST-7, ST-7a, ST-8, ST-9, ST-10, ST-11, and ST-12.

Monitoring at station ST-3 (Landfill Sump) and station ST-13 (Pollution Control Pond #2) did not occur, as these facilities were not constructed as of 2018.

Monitoring of the TIA was undertaken at monitoring station TL-1. Monitoring of the tailings deposited into the TIA continued at monitoring stations TL-5 and TL-6 in 2018. Monitoring of detoxified tailings backfilled underground was completed at monitoring stations TL-7 and TL-11. As described in the Hope Bay Water Management Plan, the sedimentation pond (ST-1) was used as a collection pond for the water that accumulated in the pollution control pond (ST-2) and the two underflow sumps (ST2-S1 and ST2-S2). The water collected in ST-1 was then transferred to the TIA by pipeline. Dewatering of the TIA did not occur in 2018.

All monitoring was conducted in accordance with the Hope Bay Project Quality Assurance and Quality Control Plan (2017).

TMAC uses an external certified laboratory to carry out all analyses reported in the monthly and annual reports. The QA/QC data produced by ALS Canada Ltd. and Maxxam Analytics are used to determine the accuracy and precision of results in these reports.

Analytical results for all monitoring stations can be found in Appendix D.1.

5.1.1 Water Balance and Water Quality Model

In 2018 commercial operations continued at Doris with continued efforts to progressively ramp up production. Monitoring continued at the associated SNP stations. Water quality source terms, climate data, mine water dewatering rates, processing rates and TIA storage curves were reviewed and/or updated in the water and load balance model, with 2017 and 2018 data, to compare against the predicted TIA water quality and water elevation. Results of the Water and Load Balance Assessment, including relevant supporting data, internal modelling results and adaptive management strategies, have been summarized in the Doris Mine Annual Water and Load Balance Assessment found in Appendix E.

5.1.2 Tailings Impoundment Area

The North Dam which ensures containment of reclaim water in the TIA was completed in 2012. The South Dam which ensures containment of tailings solids was completed in 2018. The total tonnage of tailings solids deposited in 2018 was 0.45 Mt. As of December 2018, 25% of the licensed 2.5 Mt TIA tailings capacity has been utilized (0.61 Mt). The water level at the end of December 2018 was 30.8 masl. The full supply level of the TIA is 33.5 masl. This equates to approximately 3.0 Mm^3 of additional water storage capacity available in the reclaim pond. Approximately 17,680 tonnes of detoxified tailings were placed underground as backfill.

5.2 WINDY – 2BE-HOP1222

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the NWB details the sampling and analysis requirements for the SNP program. Windy Camp and the Patch Lake Laydown facility were not in use in 2018; therefore, sampling stations associated with camp operations and fuel storage facility are not being used or monitored. Tables in Appendix D.2 of this report summarize the results of sampling undertaken as part of the monitoring program detailed in Part J of 2BE-HOP1222.

Water is obtained from Windy Lake (ST-7a) for use at Doris Camp under 2AM-DOH1323 and as allowed under 2BE-HOP1222. Water is taken up through a screened intake and sunken heat-traced line by a permanent pump house, which is used as needed to fill a water truck that transports the water to Doris Camp for use.

The camp water treatment and wastewater treatment facility (WWTF) permitted under this licence was not operational in 2018, therefore no sampling was conducted at monitoring stations HOP-1 (freshwater intake), HOP-2 (WWTF discharge), or HOP-3 (point of entry of WWTF discharge to Windy Lake). Water was utilized from Windy Lake for domestic consumption at Doris Camp and the monitoring station ST-7a (HOP-1) was sampled for the monitoring criteria under the Doris North Water Licence 2AM-DOH1323. For the ST-7a results see the 2AM-DOH1323 Appendix D.1 The Landfarm at Windy Camp (HOP-4) has been dismantled, so no sampling was conducted at this monitoring station.

The bulk fuel storage tanks at Windy Camp were moved to Doris Camp in winter 2009 for use there, and the bulk fuel storage berm (HOP-5) was dismantled in 2012. The bulk fuel storage berm at Patch Lake laydown (HOP-6) was also dismantled in 2012. No sampling was conducted at either of these monitoring stations.

No sampling occurred at monitoring stations HOP-7A HOP-7B, or HOP-7D (located in Quarries A, B, and D, respectively) during 2018 because there was no ponded water to sample.

On-ice exploration drilling did not occur in the licence area in 2018, therefore no samples were taken through lake ice (required by Part F Item 7 and Part J Item 7) to establish water quality prior to, and upon completion of, an on-ice drilling program.

Water used for drilling was taken from the closest lake to each drill in accordance with Part C Item 1 of the 2BE-HOP1222 Licence. For drill locations accessible by road or winter ice road, water is hauled by truck from Windy Lake or compliant berm effluent from the Doris Project is recycled through the drills to lessen freshwater lake use. Water is supplied to a water tank at the drill, and recirculation to cool equipment occurs through this tank.

No additional details on water use or waste disposal were requested by the Board in 2018 related to the Project. No artesian flow occurrences were encountered in 2018.

5.3 MADRID – 2BB-MAE1727

The Type B Water Licence No. 2BB-MAE1727 issued to TMAC by the NWB details the sampling and analysis requirements for the SNP program. There was no activity at Madrid in 2018. Water quality sampling was completed at proposed locations for monitoring stations MAE-14 (Windy Lake), MAE-15 (Patch Lake) and MAE-16 (Wolverine Lake), located downgradient of future Pollution Control Pond discharge locations. A summary of water monitoring for the Madrid Site is provide in Appendix D.3.

No additional details on water use or waste disposal were requested by the Board in 2018 related to the Project. No artesian flow occurrences were encountered in 2018.

5.4 BOSTON – 2BB-BOS1727

The Type B Water Licence No.2BB-BOS1727 details the sampling and analysis requirements for the SNP program. The Boston Camp was not operational in 2018, therefore, sampling stations associated with camp operations were not being used or monitored.

No water was used from Aimaokatalok (Spyder) Lake (BOS-1a) or Stickleback Lake (BOS-1b) and no samples were collected at these monitoring stations in 2018. The Sewage Treatment Facility (BOS-3) was not active, therefore no effluent was discharged from this facility and no effluent quality sampling was conducted at BOS-3 or at the point prior to treated effluent entering into Aimaokatalok (Spyder) Lake (BOS-4).

Water management occurred at the Containment Pond (BOS-2), the Bulk Fuel Storage Facility (BOS-5) and the Portal Decline (BOS-9) in 2018. Water quality sampling was completed at these facilities prior to discharge to the environment to confirm effluent quality. Notification of discharges from these facilities was provided to the Inspector in May 2018 and approval was granted prior to any dewatering activities. Dewatering of the Landfarm Treatment Area (BOS-6) was not required as there was not sufficient water accumulated in this facility to require dewatering; no water quality sampling was conducted at this facility in 2018. Water quality sampling of seepage/runoff from the ore stockpiles and camp pad to the tundra (BOS-8) was conducted. A summary of water quality monitoring for the Boston Site is provided in Appendix D.4.

No additional details on water use or waste disposal were requested by the Board in 2018 related to the Project. No artesian flow occurrences were encountered in 2018.

6. Solid Waste Disposal

At present Waste Management for the Hope Bay Project is currently divided into the following management areas which address:

- Non-hazardous Waste Management;
- Landfarm Management; and
- Hazardous Waste Management

6.1 NON-HAZARDOUS WASTE MANAGEMENT

TMAC has an existing Non-hazardous Waste Management Plan (2017) which covers information pertaining to management of non-hazardous waste generated at the Doris, Boston and the regional exploration leases in the Hope Bay Greenstone Belt. The Interim Non-hazardous Waste Management Plan has been developed to ensure that proper documentation, tracking and handling strategies are in place to monitor compliance and take corrective actions as necessary. In general, non-hazardous waste is generated by the camp(s), the kitchen and various on-site facilities and contracting groups. Management of non-hazardous waste includes recycling, treatment, and disposal of waste streams based on their specific characteristics. Incineration is used as a volume reduction treatment on-site for most non-hazardous domestic waste streams.

In 2018, waste produced at site was collected and consolidated at the Doris Waste Management area by the site services department (includes waste produced during activities at Boston). TMAC is authorized to dispose of all non-hazardous solid waste in a landfill on site under the existing Type A Water Licence however to date a landfill has not been built. Therefore in 2018, all non-hazardous solid waste that could not be incinerated on site was stored on site for later landfilling or back haul to an approved facility off site.

6.1.1 Camp Incinerators

TMAC's Type A Water Licence 2AM-DOH1323, Type B Water Licence 2BE-HOP1222 and Type B Water Licence No. 2BB-BOS1727 issued by the NWB allows for the incineration of approved waste streams.

Two incinerators for the Doris Project are currently located at the Roberts Bay laydown waste management facility; these provide contingency for maintenance or repair. Both incinerator units are CY-2050-A-FA models with a capacity of burning 75 kg of waste per hour. There was no incinerator operated at the Windy Camp and no domestic waste produced at Windy Camp in 2018. Boston Camp was closed for operations, therefore no incinerator was operated and no domestic waste was produced at Boston Camp in 2018.

Food waste and paper is incinerated as per Incinerator Management Plan (2019) for the Hope Bay Project. This plan outlines TMAC's approach to domestic waste stream segregation and incinerator management as it pertains to all the Hope Bay Project developments. The objective of the plan is to enable the operation of domestic waste incinerators to be undertaken in a safe, efficient and environmentally compliant manner. The Incinerator Management Plan strives to ensure that:

- Only appropriate burnable material enters the incinerator waste stream;
- Animal attractants are promptly incinerated;

- The incinerator is operated in a manner that reduces harmful emissions;
- Residual ash is handled and disposed of properly; and
- Compliance monitoring and reporting associated with incinerator operations are undertaken.

As recommended by the Nunavut Environmental Guideline for the Burning and Incinerations of Solid Waste, written records are kept of date and volume of burnt waste.

As per Schedule B, Item 12 of Type A Water Licence 2AM-DOH1323, TMAC is required to report the results of Incinerator Stack Testing when available compared to the Canada-wide Standards (CWS) for Dioxins and Furans and the CWS for Mercury.

Due to the exceedances observed in previous year's stack tests, TMAC purchased a new incinerator (Westland Model CY-100-CA-D) from the Ketek Group Inc. which arrived on the 2018 sealift. Installation, commissioning and training is planned for early 2019 with stack testing planned soon after. Stack tests were not conducted on the existing incinerators in 2018. TMAC maintained good combustion practices in parallel with improved waste sorting practices to reduce the formation of hazardous compounds during incineration.

6.1.2 Open Burning

The disposal method for untreated wood, cardboard and paper products generated on-site is open burning. This method reduces the volume of inert waste disposed of in the landfill. The landfill has yet to be constructed at the Doris Site.

A total of 624 m^3 of clean wood and 438 m^3 of cardboard was open burned in 2018.

All other waste is sorted and stored in sea cans at the Waste Management facility and is either backhauled for disposal or stored until the Landfill is constructed.

6.2 LANDFARM MANAGEMENT

TMAC operates a landfarm facility at Doris and the Boston sites to treat hydrocarbon contaminated materials. The Doris Landfarm Facility is located on previously disturbed area approximately 0.6 km north of the existing Doris Camp Area, at approximately 432,573 Easting and 7,559,542 Northing (UTM NAD 83, Zone 13). The Facility is located in a restricted area of the site and is situated between the existing all-weather road and Quarry 2. The Boston Landfarm facility or Land Treatment Area (LTA), is located at the Boston Camp Site, south west of the tank farm.

Hydrocarbon contaminated water, snow and soils (including waste rock and ore) can be treated using on-site facilities at Doris or can be relocated off site to an appropriate treatment facility. The existing LTA at Boston is currently at capacity and undergoing reclamation. In case of hydrocarbon contaminated water and snow, it is either stored on-site for shipment off-site to an approved facility or treated with the use of an oil separation (absorbent) treatment system (if required) on site and then verified through laboratory analysis to meet discharge criteria prior to discharge the environment. In case of hydrocarbon contaminated soils (including waste rock and ore), they are relocated to the Doris mine where they are treated in the Doris Landfarm or placed in the Doris underground mine for permanent storage.

Only material containing the following hydrocarbons is farmed at the Doris Landfarm facility:

- Diesel fuel;
- Jet fuels (Jet A, Jet A-1); and
- Gasoline.

All other materials are deemed inappropriate for landfarming and will ultimately be placed in the Doris Mine for permanent storage in accordance with the approved Hope Bay Project Groundwater Management Plan or placed for offsite disposal at a licensed remediation/disposal facility. A copy of the Hope Bay Project Groundwater Management Plan can be found on the NWB ftp site.

TMAC's Hydrocarbon Contaminated Material Management and Monitoring Plan (2017) describes the Doris and Boston facility design as it relates to storage and management of hydrocarbon contaminated materials, including soils and water generated at the site and associated facilities. This plan presents the management and monitoring obligations for each facility as modules A and B, respectively. TMAC's Landfarm Management and Monitoring Plan can be found on the NIRB Public Registry for reference.

In 2017, TMAC commenced reclamation of the LTA at Boston with the excavation and stockpiling of contaminated materials from the site for future treatment or shipment offsite to an approved facility. TMAC intends to backhaul the contaminated soil to Doris Camp during the 2019 resupply for Boston Camp via a winter track for treatment or disposal. Reclamation of the LTA at Boston is planned to continue into 2019 and no additional contaminated material is expected to be deposited for treatment prior to full decommissioning and reclamation.

6.3 HAZARDOUS MATERIAL MANAGEMENT

TMAC has a Hazardous Waste Management Plan aimed at ensuring that hazardous waste collection, segregation, handling, storage, transport and disposal procedures are promptly and efficiently carried out, thus minimizing the risk to the site workforce and the environment, as well as reducing the financial cost to the Project. A copy of the updated Hazardous Waste Management Plan is being provided with this Annual Report.

The Hazardous Waste Management Plan requires in general that all hazardous materials will be shipped offsite for disposal at an approved site. The Hazardous Waste Management Plan describes the purpose-designed hazardous waste management facility. Based on the principles of reduction, reuse and recycling, the plan addresses hazardous waste streams in terms of their risks, storage and labelling, transportation, and disposal, including:

- waste glycol (antifreeze);
- waste solvents;
- waste batteries;
- fluorescent tubes;
- penetrable wastes (sharps);
- waste lubricating oils;
- waste aerosols;
- medical wastes and sewage treatment plant sludge;
- applicable incinerator and wood ash;
- contaminated rags, absorbents and soil;
- residue last contained ammonium nitrate packaging; and
- explosives products and explosives residue containers.

6.3.1 Waste Back-haul

Waste materials back-hauled off site are regulated by the *Transportation of Dangerous Goods Act* (TDGA). In 2018, empty cargo aircraft were utilized for waste backhaul from the Doris Camp throughout the year. Approximately 68 m^3 of waste oil, 5 m^3 of waste glycol, and 13 m^3 of kitchen grease were transported to KBL Environmental in Yellowknife to arrange for final remediation/disposal.

6.4 LANDFILL

TMAC is authorized to dispose of all non-hazardous solid waste in a landfill on site as per Type A Water Licence of 2AM-DOH1335. To date, a landfill has not been constructed. All waste that cannot be incinerated on site is backhauled to an approved facility for disposal or is stored on site for later landfilling. Because a landfill has not been constructed, no landfill management report has been prepared. TMAC will continue to manage solid waste produced in Hope Bay according to three waste management plans:

- Non-Hazardous Waste Management Plan;
- Hazardous Waste Management Plan; and
- Incinerator Management Plan.

These plans describe how various streams of waste are managed.

7. Aquatic Effects Monitoring Program

The Doris Project (the Project) is located on the Hope Bay Belt (the Belt), an 80 by 20 km property along the south shore of Melville Sound in Nunavut. TMAC acquired the Belt from Newmont Corporation in March 2013. The acquisition included exploration and mineral rights over the Belt, including the Doris Gold Mine and its permits, licences, and authorizations for development received by previous owners. In late 2012, prior to the sale, the Hope Bay Belt Project was placed into care and maintenance, and the site was seasonally closed during the winter of 2012/2013. TMAC re-opened the Doris Camp in March of 2013 for the purposes of conducting site water management and environmental compliance programs and to support exploration activities. Following notification to the NWB and NIRB, construction was resumed during the summer of 2015. The Project transitioned from a construction phase into commercial operations in early 2017, and operations have continued through 2018.

This report presents the results of the 2018 Aquatic Effects Monitoring Program (AEMP) for the Project. The 2018 AEMP was conducted according to the Hope Bay Project: Doris Aquatic Effects Monitoring Plan (the Plan; ERM 2016). The Plan focuses on pathways of potential effects in Doris Lake, since most mine infrastructure is adjacent to Doris Lake and this waterbody has the greatest potential to be affected by the Project. Mining activities also have the potential to draw down the water level in Doris Lake due to permitted water withdrawal for Project use and water loss through the recharge of mine-intercepted groundwater (TMAC 2016).

Two lake sites were monitored as part of the 2018 AEMP in accordance with the Plan: Doris Lake North and Reference Lake B. Aquatic components evaluated in 2018 included the following: under-ice water level; under-ice dissolved oxygen concentration; water temperature; water quality; and phytoplankton biomass. Statistical and/or graphical analyses were performed in order to determine whether there were any apparent effects of Project activities on the aquatic monitoring components at the exposure site (Doris Lake North) in 2018. The analyses included comparisons of baseline data (pre-2010) to data collected during mine construction (2010 to 2016) and operations (2017 onward) phases and comparisons between the reference site (Reference Lake B) and the potentially affected site (Doris Lake North) over time.

Table 7-1 presents a summary of the overall findings of the evaluation of effects for the 2018 AEMP, as well as the corresponding section in this report in which to find the discussion of the evaluation of effects for each monitoring component.

Table 7-1. Summary of Evaluation of Effects for 2018 Aquatic Effects Monitoring Program

Evaluated Variable	Doris Lake North (exposure site)	Low Action Level Triggered?	Report Section
Under-ice water level	No effect	No	3.1
Under-ice dissolved oxygen	No effect	No	3.2
Temperature	No effect	No	3.2
Water quality	Possible effect (total molybdenum)	No	3.3
Phytoplankton biomass	No effect	No	3.4

8. Geochemical Studies

8.1 DORIS MINE

This section summarizes the operational geochemical monitoring results for Doris Mine, including waste rock from the Doris Mine, flotation tailings slurry and detoxified tailing solids from the Doris Mill, quarry rock used for infrastructure and road construction and seepage monitoring programs of waste rock, construction rock and underground mine backfill (detoxified tailings).

8.1.1 Waste Rock

In 2018, waste rock was produced from the underground mine and crown pillar recovery trench (CPRT) on surface. Waste rock brought to surface from all areas was placed on Pad T and managed as mineralized rock.

8.1.1.1 Underground Mine

In 2018, approximately 557,007 t of waste rock were produced from mining in the Doris underground. Approximately half of this waste rock (260,452 t) was placed directly as backfilled in underground stopes with the balance (299,188 t) transferred and placed in a stockpile on Pad T. As per the Waste Rock and Ore Management Plan (2017), all waste rock was designated as mineralized waste rock that will be eventually placed as backfill in the underground mine. In 2018, 1,760 t of waste rock from surface stockpiles was placed as backfill in underground stopes in the Doris underground mine.

A total of 36 underground waste rock samples were collected as part of the waste rock geochemical monitoring program in 2018, with one sample geologically identified as diabase (11c) and the others as mafic metavolcanics (1a). All samples were geochemically characterized for acid-base accounting parameters with selected samples also analyzed for trace elements. Geological inspections were conducted by TMAC 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. In August 2018, SRK completed an inspection of the waste rock placed in 2018 in the waste rock stockpile on the east side of Pad T.

According to TMAC geologists, in 2018 the majority of waste rock intersected by the Doris underground workings was geologically described as: mafic metavolcanic flow (1a); massive mafic metavolcanic flow (1i); vesicular mafic metavolcanics (1ay) and altered mafic metavolcanics (1as). Furthermore, 1 to 2% of waste rock was quartz veins (12q and 12qd) with minor amounts (<1%) of late felsic dykes (9); late gabbroic dykes (10a). All waste rock placed on Pad T was classified as mineralized.

For the mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.26% and median levels of 0.12%. TIC and Modified NP content was high (25th to 75th percentile levels) ranging from 130 to 230 kg $CaCO_3$ eq/tonne and 126 to 154 kg $CaCO_3$ eq/tonne, respectively). All samples were classified as non-PAG. The one sample of diabase (11c) was characterized by low sulphur (0.07%) and low TIC and NP (19 and 60 kg $CaCO_3$ eq/tonne, respectively), and was classified as non-PAG.

Trace element analyses on the solids indicated that concentrations of trace elements in volcanics (1a) and diabase (11c) materials were less than ten times the average crustal abundance for basalt.

8.1.1.2 CPRT

Mining of CPRT was initiated in November 2018 with completion in December 2018. During this period, 263,500 t of waste rock was produced. All waste rock from the CPRT was placed on Pad T, of which 212,500 t was placed in the existing waste rock stockpile on the east side of Pad T and 51,000 t in a separate stockpile on the western extend of Pad. Of the 212,500 t placed in the existing stockpile, 190,000 t will be placed backfill in the CPRT and 22,500 t will be placed as backfilled in the underground mine. The CPRT waste rock placed on the western extent of pad T will be placed as capping material on the CPRT. Placement of backfill in the CPRT commenced in January 2019 and tonnages will be reported in the 2019 annual report.

Three samples were collected representing CPRT waste rock from the stockpile on west end of Pad T. At each sampling location, two sieved fractions (-2 mm and -1 cm) were collected, for a total of six samples for geochemical analysis. Sulphur concentrations ranged from 0.17% to 0.44%; with higher sulphur concentrations observed in the -2 mm size fractions. TIC values ranged from 212 to 296 kg $CaCO_3$ eq/tonne and Modified NP ranged from 125 to 199 kg $CaCO_3$ eq/tonne. Both size fractions for all CPRT samples were classified as non-PAG.

Arsenic, gold and sulphur were higher than the screening criteria in one or more samples. SFE test leachates were alkaline pH with ammonia concentrations were higher than the screening criteria for the two samples. The source of ammonia is residues from explosives.

8.1.2 Tailings

8.1.2.1 Effluent from Process Plant Tailings (TL-5)

Samples of effluent from the Process Plant (TL-5) were collected from January to December 2018. These results are presented in Appendix D of this report. Figures depicting time series of constituent loads from the process plant tailing water discharge (TL-5) to the TIA are presented in Appendix F - 2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project (see Attachment D of Appendix D - 2018 Geochemical Monitoring of Flotation Tailings Slurry and Detoxified Tailings, Doris Mill). The geochemistry of the 2018 process plant tailings discharge (TL-5) is summarized as follows:

- The pH ranged from 7.7 to 8.4 s.u.
- Sulphate loadings were stable with the range equivalent to 2017.
- The increase observed in total aluminum, total iron and TSS in March indicates that the sample includes solids. During March, loadings of arsenic, bismuth, cadmium, selenium, lead, silver and zinc (all totals) exhibit an increase indicating concentrations represent the chemistry of the tailings solids. Notably, concentrations of bismuth, cadmium, lead and zinc were below detection for a number of other samples with lower TSS.
- Trends for major ions and trace elements were stable in 2018 with ranges equivalent to 2017. Exceptions included calcium, magnesium, strontium (which are likely indicative of carbonates) and molybdenum, all of which exhibited increasing trends.

8.1.2.2 Flotation Tailings (TL-6)

Flotation tailings deposition in the Doris TIA commenced on January 20, 2017. A total of 446,594 t (dry weight) of flotation tailings were deposited in the TIA in 2018. Monitoring details are provided in Appendix D.1.

For flotation tailings solids (TL-6) sulphur concentrations ranged between <0.05 and 1.4 % with a notable increase starting in April. TIC content ranged between 57 and 140 kg $CaCO_3$/t, with TIC values underestimated for all samples analyzed prior to April 2018 because of the analytical method. All flotation tailings samples are classified as non-PAG, which is consistent with 2017 operational and metallurgical tailings samples (SRK 2015).

Trace element content was compared to ten times the average crustal abundance for basalt (Price 1997) as an indicator of enrichment. Trace element content was elevated compared to screening criteria for arsenic, silver and gold one high sulphur sample. Boron and lead were also elevated in one sample each. All other parameters were below the screening criteria indicating no appreciable enrichment.

8.1.2.3 Detoxified Tailings (TL-7)

In 2018, a total of 17,680 t of detoxified tailings were placed as backfill in Doris Mine underground stopes. Details are provided in Appendix D.1 of this report.

Sulphur concentrations ranged between 3 and 23% and showed a similar trend to the flotation tailings, increasing after April 2018. TIC results for 2018 ranged between 59 and 140 kg $CaCO_3$/t, with TIC values underestimated for all samples analyzed prior to April 2018. All of the detoxified tailings samples were classified as PAG, which in consistent with 2017 operational and metallurgical tailings samples (SRK 2015).

All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, lead, selenium, silver and sulphur with more than half of samples elevated in cadmium and zinc. All other parameters were below the screening criteria indicating no appreciable enrichment. This is consistent with 2017 operational monitoring samples except for cobalt, which was enriched in 2017 but not in 2018.

WAD cyanide concentrations analyzed at ALS between January and early April were below detection (20 mg/L). WAD cyanide results for April to December samples are not currently available due to a laboratory methodological error where measurements were conducted on the leached detoxified tailings solids and not the extractant. Maxxam is currently re-analyzing these samples for WAD cyanide and a supplemental report will be submitted once the data are available. There is no regulatory limit for WAD cyanide in tailings. Thiocyanate concentrations ranged between 1.1 ppm and 5,300 ppm and cyanate concentrations ranged between 46 ppm and 1,100 ppm.

8.1.3 Quarry Rock

8.1.3.1 Quarry Monitoring

In 2018, blasting occurred in Quarry 2 from February to June and August to September. Approximately 537,110 t of quarry rock were blasted in 2018 for use as construction or road maintenance material. Infrastructure constructed between 2017 and 2018 included the southern extent of the tailings impoundment area (TIA) access road, the south dam, an expansion to the jetty road, the cyanide reagent pad, Pad T surface repairs, the marine outfall berm (MOB) access road at Roberts Bay, airstrip south apron and the east airstrip access road. All infrastructure was constructed from quarry rock from Quarry 2.

Visual inspections of active quarry faces conducted indicated that quarry rock was mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). Samples of run-of-quarry rock were collected for geochemical characterization as per the Quarry Management and Monitoring plan (TMAC 2017).

Geochemical monitoring of ROQ rock indicated that the monitoring samples were non-PAG according to NP/AP and TIC/AP ratios. Total sulphur concentrations ranged between 0.13 and 0.28%. Modified NP and TIC content ranged between 19 and 151 kg $CaCO_3$/t and 76 and 143 kg $CaCO_3$/t, respectively. Elemental analyses indicated no appreciable enrichment compared to average crustal abundance for basaltic rocks. Results from the SFE tests were below these screening criteria and the pH of the tests were alkaline, indicating the risk of ML/ARD from run-of-quarry rock is low.

8.1.3.2 Construction Monitoring

SRK inspected Doris North infrastructure areas constructed between summer 2017 and summer 2018 including the southern extent of the TIA access road, the south dam, an expansion to the jetty road, the cyanide reagent pad, Pad T surface repairs, the marine outfall berm access road at Roberts Bay, airstrip south apron, and the east airstrip access road. All construction rock was sourced from Quarry 2. A total of 12 samples, from the surface material in the areas inspected. At each sampling site -1 cm and -2 mm sieved splits were collected separately. Field contact rinse tests were conducted on the -2 mm samples. All -1 cm samples were analyzed for total sulphur with a subset analyzed for full ABA and trace element content. Five samples were also analyzed for shake flask extractions to assess the soluble component of the samples.

Geological inspection of as-built construction areas at the time of sampling confirmed that construction materials were characteristic of Quarry 2: grey-green mafic metavolcanics (basalt) containing carbonate and trace (<1%) to no visible sulphides.

Total sulphur ranged between 0.04% and 0.22%. Modified NP and TIC levels ranged from 67 to 157 kg $CaCO_3$/t and 36 to 129 kg $CaCO_3$/t, respectively. All samples were classified as non-PAG. Arsenic and boron were enriched relative to the screening criteria in a sample from the East Airstrip Access Road and South Dam, respectively. All other parameters were below the screening criteria indicating no appreciable enrichment. SFE test results indicated that all test leachates were alkaline and that all parameters were below the screening criteria, except for pH.

The results indicate that the quarry rock used in the infrastructure areas was geochemically suitable for use as construction rock.

8.2 BOSTON CAMP

This section summarizes monitoring in support of the Boston Camp closure plan.

8.2.1 Waste Rock and Ore

It is estimated that there are approximately 47,400 m^3 of ore stockpiled on site at Boston Camp based on digital models of the ore removed historically from the underground workings at Boston. There are no projected changes to waste rock and ore stockpile volumes because there is no mining activity occurring or currently planned for Boston under the current water licence.

In 2018, geochemical test work of waste rock and ore at Boston camp included a rinse test survey.

<u>Rinse Test Survey</u>

The majority of ore in stockpiles at Boston is classified as non-PAG but some sample are classified as uncertain (SRK 2009). Based on the uncertain classifications, the ore/waste rock management plan (SRK 2017a) includes monitoring the oxidation of the ore by carrying out a survey of rinse pH and conductivity every ten years. The first rinse pH and conductivity survey was conducted in 2008 (SRK 2009). Rinse pH indicates if materials are acidic or not acidic, whereas rinse conductivity is a measure of soluble oxidation products.

On August 12 and 13, 2018, SRK conducted a rinse test survey of the ore stockpiles at Boston on 31 samples. The survey included the collection of <2 mm samples of ore and waste rock for rinse tests, as well as detailed geological descriptions. Sampling locations were established based on the 2008 sampling locations to generate directly comparable results.

In 2018, rinse pH for the ore and development rock samples ranged from 7.9 to 9.1, while conductivity ranged from 99 to 4,100 µS/cm consistent with 2008, rinse EC levels were highest in samples with lowest pH. Maximum levels of EC observed in 2008 (15,000 µS/cm) were higher than in 2018 (4,000 µS/cm). Similarly, lower pH values were observed in 2008 (minimum of 7.2) as compared to 2018 (minimum of 7.9).

Findings from the 2018 rinse pH survey of development rock and ore at the Boston site, as per conditions of the Water Licence 2BB-BOS1727 (Part E, Item 2), have confirmed that ore and waste rock on the camp pad remain not acidic.

9. Geochemical Seepage Surveys

9.1 DORIS MINE

This section summarizes the seepage surveys conducted at Doris Mine as part of the geochemical operational monitoring programs.

9.1.1 Construction (Quarry) Rock and Waste Rock Seepage Survey

The seep survey was carried out between June 14 and June 18, 2018 by TMAC in the Doris North area. The construction seepage monitoring program included visual inspection and opportunistic sampling of seepage downstream of the areas constructed between summer 2017 and summer 2018 including the southern extent of the TIA access road, the south dam, an expansion to the jetty road, the cyanide reagent pad, tailings catchment basin (east of Doris Creek) and airstrip. As par to the waste rock monitoring program, the toe of the waste rock stockpile and the downstream areas of the waste rock storage area were surveyed. This area is referred to the waste rock influenced area (WRIA).

For the construction rock survey, seepage was observed along the TIA access road and airstrip. In addition, three references sites were sampled. Samples were collected from each seepage site observed and submitted to ALS Environmental for geochemical analysis.

A summary of the field measurements is presented in Table 9.1-1. At all sites the pH was neutral to slightly alkaline (median 7.7 to 8.6) with median levels of conductivity ranging from 70 to 2000 µS/cm. The samples collected within the Waste Rock Influenced Area (WRIA) had the highest levels of conductivity (1,900 to 2,600 µS/cm).

Table 9.1-1. Median Values for Field Conductivity and pH Measurements

Site Area	No. of Samples	Conductivity (µS/cm)	pH
Waste Rock Influenced Area	5	2000	8
TIA Access Road	6	96	8.6
Airstrip	2	230	8.1
Reference Points	3	70	7.7

The results of the 2018 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. Compared with seeps from infrastructure areas, and consistent with previous years, seepage from areas impacted by waste rock had elevated levels of chloride, nitrate and ammonia. Chloride levels are attributed to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock.

In terms of metal leaching from waste rock, concentrations of sulphate, copper and selenium 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 selenium may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of arsenic and iron for the 2018 waste rock seepage samples were higher than the screening criteria; however, this was attributed to the presence of colloids. When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable. Further monitoring will establish trends in these parameter concentration.

9.1.2 Underground Backfilled Stopes (TL-11) Seepage Survey

Seepage samples were collected in 2018 from the underground backfilled stopes (TL-11). Ten stopes were surveyed during each inspection; one seep was identified during each inspection (at the same location in each inspection). An additional sample was also collected from a pool of water at the base of one backfilled stope. No flowing water was identified at this location but a sample was collected to provide additional characterization of water underground near backfilled materials. Additional details of seepage monitoring can be found in Appendix D.1 of this report.

Seepage pH was circum-neutral for all samples. Major anion chemistry was dominated by chloride (40,000 to 47,000 mg/L) and to a lesser degree sulphate (860 to 1,000 mg/L), while major cation chemistry was dominated by calcium 12,000 to 15,000 mg/L), sodium (11,000 to 12,000 mg/L) and to a lesser degree magnesium (1,600 to 1,800 mg/L). Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), other sources of saline water (chloride, sulphate, calcium, sodium and magnesium), and sulphide oxidation with associated carbonate dissolution from waste rock and detoxified tailings (sulphate and calcium).Total cyanide concentrations in the seepage ranged from 0.007 to 1.1 mg/L and WAD cyanide concentrations ranged from 0.005 mg/L to 0.017 mg/L. The sources of ammonia (220 to 380 mg/L), nitrate (490 to 520 mg/L) and nitrite (1.6 to 18 mg/L) are attributable to degradation of cyanate and thiocyanate in detoxified tailings and/or blast residues from waste rock. Cadmium and copper, nickel and selenium, silver and zinc were reported at concentrations exceeding the screening criteria. With the exception of zinc all of these parameters were noted as parameters of potential concern on the basis of the humidity cell test (HCT) program for detoxified tailings (SRK 2015). The low arsenic concentrations in the seepage are consistent with observations from the HCT program for metallurgical detoxified tailings (SRK 2015); however, are notable given the elevated concentrations of solid-phase arsenic in the detoxification tailings.

9.2 BOSTON CAMP

This section summarizes the geochemical monitoring results at Boston. The seepage and ephemeral streams monitoring programs are conducted annually in the context of the waste rock and ore management and Boston closure plans. The objective of the seepage monitoring is to provide an indication of water quality from the waste rock (camp pad) and ore stockpiles. The seepage samples are collected at the toe of the camp pad. The two objectives of the ephemeral streams program are to monitor drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra.

9.2.1 Seepage Monitoring

There are two opportunistic seepage monitoring programs, seepage monitoring at station BOS8 as indicated by Boston water licence 2BB-BOS1727 and a freshet seepage survey along the north and east sides of the camp pad, and the southern end of the airstrip as specified in the Boston Water and Ore/Waste Rock Management Plan (SRK 2017). In 2018, seepage was observed, and samples collected from three sites along the east side of the camp pad, with site BOS-8A sampled twice. Four samples were submitted to ALS Environmental for water quality analyses.

The four seepage samples were pH neutral to slightly alkaline with sulphate concentrations (150 to 530 mg/L) within the range of historic seepage monitoring samples. Arsenic concentrations (0.043 to 0.71 mg/L) were elevated for selected samples compared to the screening criteria, but were within the historical range of observed concentrations, and there is no long-term increasing trend in the data. Two samples collected from the same location (BOS-8A) a week apart showed a wide range of concentrations, but the ratio between the two samples was consistent, indicating that the difference is due to dilution of the seep. In general, metal concentrations in samples collected in 2018 are within the historical range of observed concentrations

9.2.2 Ephemeral Streams Monitoring

As outlined in the Water and Ore/Waste Rock Management Plan for the Boston Site, Hope Bay Project, Nunavut (2017), five ephemeral streams (A to E) within the catchments of the Boston camp pad are monitored during spring freshet. The objectives of the program are to monitor drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra. TMAC inspected ephemeral streams A2 to E2 for flow on June 16 and June 25, 2018. Flow was observed in ephemeral streams A2 and C2 during both inspection dates and samples collected for laboratory analysis.

The pH of ephemeral streams A2 and C2 were neutral to slightly alkaline. In terms of trends, sulphate and selenium concentrations for one 2018 sample collected at A2 and arsenic and sulphate concentrations for one 2018 sample collected at C2 exceeded historical concentrations. The analysis of the water quality data for ephemeral streams A2 and C2 indicated that concentrations of the potential contaminants of concern (nitrate, sulphate, arsenic, copper, iron, nickel and selenium) as identified by the water and load balance (SRK 2009), are either decreasing or stable. The stable concentrations indicate that the tundra continues to effectively attenuate contaminants of concern and the breakthrough of the effectiveness of the attenuation process has not occurred. Sulphate and chloride levels are not attenuated by the tundra and the concentrations measured in 2018 validate the 2009 water and load balance. Overall, the water quality of the ephemeral streams is stable and results validate the findings of the water and load balance and that there are therefore no projected impacts to the receiving environment.

10. Fuel Storage

Bulk fuel storage at the Hope Bay Project site is accomplished in compliance with relevant regulations and authorizations. Bulk fuel is stored in steel tanks or manufactured fuel bladders which are housed in a “tank farm” that is lined with an impermeable membrane and surrounded with a berm with sufficient capacity to meet containment criteria (i.e., 110% of the largest tank in the farm). This minimizes the potential of fuel entering the environment from a spill. Chemical storage at the Hope Bay Project site is accomplished in compliance with handling and storage instructions detailed in the respective manufactures Material Safety Data Sheets (MSDS).

TMAC maintains a Hope Bay Project Spill Contingency Plan (most recently revised in 2019), available in Appendix H of this report, which is utilized to safeguard against accidental spills of harmful substances that may negatively affect the environment. Implementation of spill prevention systems are critical to avoid such accidents, followed by a response system that is timely and efficient if spills do occur, and contains and mitigates the negative environmental consequences. The Hope Bay Project Spill Contingency Plan was developed in accordance with the Spill Contingency Planning and Reporting Regulations developed under Section 34 the Government of Nunavut’s *Environmental Protection Act* (RSNWT Nu1988), and was developed specifically to address the requirements of the Framework Agreement; NWB Water Licences: 2AM-DOH1335, 2BE-HOP1222, 2BB-MAE1727 and 2BB-BOS1217; and NIRB Project Certificates: Number 003 and Number 009; including all amendments. The Hope Bay Project Spill Contingency Plan provides a consistent spill response framework that is available to all site personnel so they can effectively and efficiently respond to a spill of petroleum products and/or hazardous materials regardless of where on the Hope Bay site they are encountered.

The Hope Bay Project Spill Contingency Plan contains detailed inventories and measurable quantities of all on-site hazardous materials and provides layouts indicating locations of all spill response equipment at site. A list of spill containment systems used are summarized below:

- Gravel/HDPE lined containment facilities (e.g., Roberts Bay and Doris Tank Farms);
- HDPE/wood containments (e.g., Jet-A storage at Heli-pad);
- Concrete berms (day-tanks at the Powerhouse);
- Double-walled steel tanks at location of use;
- Steel spill containment (e.g., beneath tanks at incinerator);
- Insta-berms; and
- Plastic spill pallets.

Spill response resources are also described in detail in the existing management plan together with their routine maintenance and inspection. The availability and organization of the human resources deemed required to respond to spill events is described in the Hope Bay Project Spill Contingency Plan, along with the responsibilities of specified personnel and response teams clearly defined. External notification and communication in the event of spill events are addressed and there is also a specified and comprehensive system of internal reporting. The Hope Bay Project Spill Contingency Plan considers, and will address where needed, the requirements of the Environmental Emergency Regulations (SOR/2003-307). The Plan is subject to annual review and an update to this plan is being provided with this Annual Report in Appendix H.

11. Spill Reports

During 2018, fifteen spills were reported to the Nunavut Spill Line, Water Licence Inspector and KIA Major Projects. No spills were reported to Environment and Climate Change Canada. These fifteen spills met the reporting threshold as outlined in the Nunavut Spill Contingency Planning and Reporting Regulations. In addition to the required Spill Line report, a more detailed follow-up report was filed within thirty days of each reported spill that included a description of the event together with the immediate cause, corrective and preventative action. The fifteen reportable spill events are summarized in Table 11-1 below. The follow-up spill reports detail basic causes and short/long term corrective actions.

The remaining spills that occurred during 2018 were minor in nature, occurring on land, with quick response and clean up resulting in negligible impact to the receiving environment. TMAC tracks all unauthorized discharges and spills on site, regardless if they are externally reportable or not, and identifies any observable trends. Based on those results, root cause analysis and corrective actions are recorded, tracked and implemented. Inspectors have the opportunity to review the information on demand or when at site conducting inspections.

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
9-Jan-18	18-010	10-Jan-18	Propylene glycol - 15,000 L	A spill of propylene glycol was discovered emanating from the glycol heat loop system inside the Assay Lab compressor room. One of the heater coils within the compressor room cracked releasing glycol onto the surrounding floor. The crack in the heater coil is attributed to the failure of a fan located on the west wall of the compressor room. When the fan failed, a loss of air movement over the coils caused reduced flow within the coil, allowing the coil to freeze and crack. When the pressure of the glycol system overwhelmed the frozen coil, glycol was released. This fluid flowed out of the room via a door located on the north side of the room between the Assay Lab building and the Process Plant and onto the engineered camp pad constructed of crushed quarry rock. Upon discovery of the spill, the cracked heater coil was isolated to prevent further spillage. Spill pads were placed on the floor of the compressor room to absorb the remaining glycol. Contaminated snow was collected and disposed of within TIA. The saturated area froze shortly after the spill event limiting the recovery of contaminated crush. Some of the spilled material is believed to have flowed beneath the compressor room, which will also be a limiting factor in the recovery of this material. Corrective actions: • Assay lab staff will inspect this area once during each 12 hour shift; • Installation of rough neck heater which is self contained and draws air from inside the room rather than outside reducing the chance of heating coils freezing; • Propylene glycol within the heat loop system will be replaced with a product that does not degrade as readily under high temperatures; and • TMAC is investigating a system that will alarm the mill control room if a decrease in volume or pressure is observed within the heat loop system.	Initial follow-up report provided on 7-Feb-18. Final report provided on 13-Mar-18.
22-Jan-18	18-024	23-Jan-18	Ethylene glycol - 30 L	A coolant leak was discovered from the radiator core of an inactive generator in the Doris Camp Powerhouse. Coolant leaked from the radiator core onto the roof of the generator module and flowed over the edge of the module onto the concrete foundation below. The follow-up investigation identified that a weld had failed due to extreme temperatures. The core was drained of its residual coolant and a new radiator core will replace the damaged unit. Contaminated materials were removed from the area for disposal. Clean-up efforts included hand excavation of contaminated snow from the roof of the generator module and the concrete foundation. Spill pads were also used to absorb any coolant that could not be hand excavated.	09-Feb-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				Corrective actions: • The area is routinely inspected by the powerhouse operator (approximately every 2 hours) to identify any issues with the coolant and heat-exchange systems; and • This unit has been taken out of service and will be replaced with a new radiator core.	
31-Jan-18	18-028	31-Jan-18	Sewage – 300 L	A sewage leak was discovered from a 2" distribution line between a newly commissioned accommodations complex and the camp's main line to the Sewage Treatment Plant. The line was found to be cracked in several places due to expansion caused by freezing. At the time, only four individuals were occupying the accommodations and had been moved in the day prior to the spill event. It was found that the spill and the contents remaining in the lift station were primarily greywater from shower usage. The distribution line was found to be inadequately insulated and heat traced, which contributed to the line failure. Due to the extremely cold temperatures, the spilled material froze in place and did not seep through the layer of packed snow and ice to the crush material below. The line runs just beside the accommodations facility so contaminated materials were easily accessible for cleanup. Contaminated materials were scraped up with heavy equipment and removed from the area for disposal. The 2" line was replaced. A second heat trace cable was installed on the line and additional insulation was added to the box housing the distribution line. Corrective actions: • Supervisors are to ensure all water/septic lines are properly insulated and heat traced to prevent freezing; and • Supervisors are to inspect and approve all new installations or modified lines prior to commissioning. Documentation will be provided to Superintendent that show Supervision sign off.	4-Feb-18
3-Feb-18	18-031	3-Feb-18	Ethylene glycol – 25 L	A spill of ethylene glycol coolant occurred due to a damaged radiator. Water for the Doris Camp is supplied by Windy Lake via water truck. Whiteout conditions had occurred throughout the site and water restrictions were put in place due to a reduced supply. A loader was sent out ahead of the water truck to clear the 8km road in order for the water truck to access the pump house, and replenish the camp water supply. Conditions deteriorated during the return trip and the water truck struck the back of the loader puncturing the radiator of the water truck. The water truck operator failed to maintain an adequate distance for the vehicle to come to a safe stop. Poor visibility and road conditions were also contributing	27-Feb-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				factors in the collision. Contaminated snow and crush material were immediately collected and brought to the waste management area for disposal. Corrective actions: • Vehicles will no longer be sent for water in poor weather conditions; and • Crews have been reminded to leave adequate stopping distance and if weather conditions are not acceptable, to stop and wait for weather condition to improve before resuming travel.	
2-Mar-18	18-066	03-Mar-18	Greywater - 1,500 L	The Wastewater Treatment Plant operator was conducting routine checks of the kitchen lift-station and discovered pooling water inside the lift-station enclosure on the east side of the kitchen building. The spill occurred from a heat-traced, insulated PVC pipe used to drain the kitchen dishwasher into the lift-station. The PVC pipe had been in place since the original installation and it is believed that the high temperatures of the commercial dishwasher caused the pipe to deteriorate over time causing it to break and release the spill. Upon discovery of the spill, a sump was dug inside the lift-station enclosure and a small pump was used to recover the pooling greywater into plastic totes. This material was treated through the wastewater treatment plant. Corrective actions: • The PVC drain pipe has been replaced with a pipe made of appropriate heat resistant material; and • Appropriate heat resistant pipe will be selected in all future commercial dishwasher installations.	03-Apr-18
31-May-18	18-205	31-May-18	Danafloat 245 promotor – 900 L	While attempting to remove a tote of DanaFloat 245 from a sea-can using a telehandler, the operator shifted the forks to the right side of the machine and then attempted to access the openings at the base of the tote with the forks. The floor of the sea-can had a buildup of snow and ice, which caused the right fork to raise up and puncture the tote as the operator moved the telehandler forward. The DanaFloat 245 spilled from the tote into the sea-can and out the door onto the crush rock pad surrounding the sea-can. Spill pads were immediately placed on the affected area to contain the spill and the area was taped off to prevent vehicle and pedestrian traffic from entering the area. Contaminated crush was excavated from the camp pad surface; this included removing the storage sea-can of the punctured tote and adjacent sea-cans to excavate contaminated crush from product that had migrated beneath the sea-cans. All contaminated crush was removed and placed in the Tailings Impoundment Area for disposal.	25-Jun-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				Corrective actions: • Through site-wide safety presentations, department safety toolbox talks, and stop/corrects emphasize to all departments the requirements of using a spotter when loading or unloading product from storage sea-cans; • Instruct all Supervisors and Superintendents to conduct spot checks and/or stop and corrects of deficiencies on pre-op check sheets and ensure the optimal working condition of all equipment used in their scope of work; • Discuss, form and implement a plan for the efficient layout of sea-cans to reduce congestion on the process plant laydown and allows for an effective delivery system of reagents, parts and materials; • Review the possibility of raising sea-cans above grade to facilitate easier clean up of drifting snow during winter months, and allow for closing and positive seal of all doorways to prevent snow buildup within sea-cans; and • Inquire into the possibility of single product loads of reagents into sea-cans by vendors to eliminate the need to handle multiple containers to access the required ones and reduce the risk of a similar event from occurring. An alternative plan to be considered during the summer weather to rearrange sea-cans currently on-site which contain multiple products.	
15-Jun-18	18-234	16-Jun-18	Cyanide leach slurry – 50 L	A leach filter feed pump leaked slurry due to the failure of the gland seal and pump sleeve. The slurry sprayed onto the interior wall of the process plant building, which lacked an adequate seal between the concrete retaining wall and the exterior cladding to prevent the material from escaping the mill. As a result, some of the material spilled out onto the camp pad. Upon discovery of the spill, the pump was shutoff and removed from service for repair. The circuit operator informed their supervisor of the spill and relocated the contaminated material into the mill for treatment and disposal. Corrective actions: • A barrier has been placed between the pump and the exterior cladding as a temporary measure; • The gland seal and pump sleeve were replaced and the preventative maintenance schedule modified to match wear time for both parts; • Mechanical seals will be investigated as a better application for the environment the pump is located in; and • The gap between the concrete retaining wall and the exterior cladding will be sealed to prevent another spill occurrence.	05-Jul-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
3-Aug-18	18-310	4-Aug-18	Flotation Tailings - 8.4 m^3 solution, 1.6 m^3 solids	An underground employee reported to the Environmental Supervisor that they observed a small leak coming from the tailings distribution line running from the Doris North mill facility to the Tailings Impoundment Area (TIA). The mill control operator was immediately notified and mill operations were promptly suspended and the tailings pump shutdown. The underground employee remained at the spill area to secure the scene and divert traffic from the area. The Assistant Mine General Manager, Environmental Supervisor, Maintenance Manager and Safety Superintendent assembled at the spill scene to assess the severity of the spill and determine if a spill emergency existed. Once the spill was deemed to be under control, the Environmental Supervisor and Maintenance Manager remained at the scene to ensure the spill had been contained, document and investigate the incident, and to oversee and advise the spill response team on spill recovery efforts and corrective actions. Upon investigation it was determined that a small hole had worn through an elbow joint on the steel tailings line from the inside, and that it had not been punctured from the outside. A spigot change had occurred earlier that morning which may have caused a temporary increase in line pressure. This may have also contributed to the rupture. Heavy equipment operators were called to the scene in order to recover the spilled and contaminated materials. A berm was initially constructed with clean crush rock material to minimize the spread of the spill. An excavator was used to excavate the tailings and contaminated materials from the mine pad surface, and a haul truck was used to transport contaminated materials to the TIA for disposal. Corrective actions: • A ¼" thick halfpipe was welded overtop of the hole in order to prevent another spill occurrence; • Routine ultrasonic thickness testing at elbows to confirm pipe thickness; • The steel section of the tailings line is in the process of being replaced with an HDPE line that has a significantly reduced wear rate; and • A Leak Detection System (LDS) is being investigated and may be installed on the tailings line to improve leak detection capability and decrease response time in the event of a spill.	31-Aug-18
5-Aug-18	18-315	6-Aug-18	Wastewater - 500 L	A spill of wastewater was discovered while conducting a routine inspection of the unoccupied Boston advanced exploration site. A small stain was observed outside of a sea-can being utilized for storage of treated sewage sludge that was generated during the 2017 seasonal exploration program based at the	04-Sep-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				Boston camp. A single tote was found to have released the liquid contents (wastewater) of the sludge stored within its containment. The sea-can did not have a liner installed to act as a form of secondary containment unlike others at the site. Initial efforts to backhaul this material on the winter track in March 2018 were suspended due to mechanical issues with the equipment used to conduct this work which could not be resolved prior to spring thaw and freshet. Upon discovery of the spill a plan was actioned to expedite transport of all remaining totes containing treated sewage sludge back to Doris Camp for disposal in the Tailings Impoundment Area (TIA) as per the Hope Bay Project Domestic Wastewater Treatment Management Plan – Module D: Boston (November 2017). This would eliminate the risk of a future spill from these totes. Totes were transported back to Doris Camp via helicopter and disposed of in the TIA. Once the sea-can was empty, it was moved in order to access the contaminated material beneath. Contaminated material was excavated from the spill area and placed into a lined mega bag for backhaul to the Doris Project for disposal. Corrective actions: • Treated sewage sludge transported back to Doris Camp for disposal as soon as possible to reduce the risk of stored totes undergoing damage during freeze/thaw; • Sea-can liners will be used in the event that totes are to be stored in sea-cans; and • If sea-cans are utilized for storage of liquids they will be sloped to encourage drainage towards the back of the sea-can rather than the front in order to contain any spilled material.	
20-Aug-18	18-335	20-Aug-18	Tailings slurry - 150 L	A spill of flotation tailings slurry was discovered emanating from the inspection port on an elbow of the steel tailings distribution located at the north-west corner of the Pollution Control Pond. A contractor working in the area identified the spill immediately and contacted the mill control room operator. An estimated 150 L of tailings slurry was released to the crush pad within the pollution control water management system; no release occurred to the tundra or any water body. Maintenance personnel immediately attended the area to block the port and prevent further release of tailings slurry. Repairs were completed to the thread of the port and the cap replaced. Contaminated crush material was excavated from the area and disposed of in the Tailings Impoundment Area.	17-Sep-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				It was determined that a thread failure had occurred on the cap of the inspection port located on the elbow of the steel tailings line. The cap was off the inspection port and the thread was found to be worn. No pressure spikes or flow rate increases were identified by the mill control room prior to the failure. Corrective actions: • Repairs were completed to the inspection port threads and the cap replaced; • The steel section of the tailings line has been replaced with a fuse welded HDPE line which does not require the same inspection port installation; • An additional flowmeter will be installed on the tailings distribution line prior to discharge into the Tailings Impoundment Area. This flowmeter will be linked to the mill control room and monitor for potential loss of flow within the line. A loss of flow could indicate an issue or leak with the tailings line and would trigger additional inspections of the tailings line; and • A Leak Detection System (LDS) is being investigated and may be installed on the new HDPE tailings line to improve leak detection capability and decrease response time in the event of a spill.	
29-Aug-18	18-351	29-Aug-18	Sewage - Unknown	An employee conducting inspections of the various sewage lift stations at Doris Camp observed evidence of a leak emanating from a deformed sewage distribution pipeline. It is not known when the leak began and therefore, the spill volume released could not be estimated. The damaged line was replaced immediately and contaminated soils were excavated and disposed of on the overburden stockpile. The incident investigation identified that a large and heavy piece of rubber liner being used as a temporary roof cover had blown off during a storm and had landed on the pipeline below. The cribbing used to support the pipe was insufficient to support this additional weight and caused the pipeline to sag over time. This caused the pipe to deform and leak. Corrective actions: • An inspection of all service pipes was conducted to ensure all pipelines are adequately supported, insulated and protected from potential falling objects; and • Inspections of all service pipelines will be conducted on a routine basis to evaluate pipeline integrity and identify any potential issues requiring maintenance.	27-Sep-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
10-Sep-18	18-371	11-Sep-18	Flotation tailings - 30 m^3	The Mill Control Room operator observed an increase in pressure followed by a sudden decrease in pressure within the tailings distribution line. The increase was within the typical operating range for the line. The Mill Control Room operator then notified the Mill Supervisor who went to investigate. The Mill Supervisor observed a leak from a flange on the tailings distribution line running from the Doris mill facility to the Tailings Impoundment Area (TIA). The mill operation was immediately suspended and the tailings pump was shut down. A new tailings distribution line was commissioned and put into service on September 9, 2018, approximately 36 hours prior to the spill. A hydrotest was conducted prior to the introduction of tailings to the line to ensure no leaks were present. It was discovered that a flange gasket had failed on the new line resulting in the spill. An investigation was conducted to identify any contributing factors and the root cause of the gasket failure. The gasket and flange were removed from the line and found to have sustained damage due to wear from the tailings solids under high pressure. The investigation also revealed that the gaskets were not properly sized for this particular application nor were they installed as per the manufacturers recommendation. Heavy equipment operators were called to the scene to recover the spilled and contaminated materials. A berm was constructed with crushed quarry rock to contain the spill. Contaminated materials were excavated from the mine pad surface and transported to the TIA for disposal. Snow and ice on the roadway provided a barrier to the spread of the tailings material and prevented much of the tailings solution from spreading beyond the surface of the road. Tailings and contaminated materials that were not accessible by equipment were hand excavated and disposed of within the TIA. High winds during the spill event resulted in some windblown tailings being deposited on nearby tundra east of the spill area. The tundra (active layer) was not yet frozen at the time of the spill, which prohibited the use of heavy equipment to recover contaminated snow. This area is within the footprint of the permitted Waste Rock Storage Pad U that is planned for construction during the winter of 2019. Once the tundra has frozen sufficiently to support heavy equipment and prior to construction of this pad, the area will be scraped and contaminated materials will be disposed of within the TIA. In the interim, silt fence was installed downstream of the impacted area to direct any melt water to a water management sump prior to freeze-up. TMAC personnel consulted with an onsite Mechanical Engineer regarding the use of a gasket in this application along the tailings line. After reviewing the	11-Oct-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				technical specifications on both the flange and gaskets, it was determined that removing the gaskets from the flange installations was the best course of action to eliminate the likelihood of another potential gasket failure and spill event. All gaskets along the tailings line were removed and flanges were torqued as per the manufacturer's recommendation. Prior to resuming the mill operations and tailings discharge to the TIA, a hydrotest was conducted to ensure line integrity. Corrective actions: • All gaskets were removed from flange installations on the tailings distribution line; • A preventative maintenance program has been established to confirm target residual bolt torque is maintained and re-torque occurs as required; • Protective flange boxes have been installed to allow easier access during winter months and if a flange failure were to occur, may aid in containing the spill to a smaller footprint in the event of high winds; and • Various Leak Detection Systems (LDS) are being investigated and may be installed on the tailings line to improve leak detection capability and decrease response time in the event of a spill.	
19-Oct-18	18-430	19-Oct-18	Ethylene Glycol – 8 L	A spill of 8L of ethylene glycol coolant was released to the snow covered road surface. Further investigation by mechanics determined the hole in the hose line was a result of normal wear and tear on the equipment. Preventative maintenance had been conducted within the recommended schedule for this equipment at the time of the spill. Spill pads were placed beneath the leak to reduce the amount of spill contacting the ground surface. Mechanics were called to the scene of the spill and patched the coolant line to stop the leak. The reach stacker was then taken to the mechanical shop to replace the hose line. Contaminated materials were removed from the surface of the road (spill pads, snow and crush) and taken to the waste management facility to be stored for offsite disposal. Corrective actions: • Continue performing pre-operational checks on all equipment prior to use to identify potential issues prior to using the equipment; • If an issue is identified during the pre-operational check, use alternative equipment if available to conduct tasks until repairs can be completed; and • Continue performing preventative maintenance programs on all equipment at the recommended interval (every 500 operating hours for the reach stacker).	14-Nov-18

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
09-Dec-18	18-475	10-Dec-18	Flotation Tailings – 6000 L	A grader operator was clearing snow on the Tailings Impoundment Area (TIA) access road when he discovered a spill of flotation tailings onto the roadway and into the TIA from the tailings distribution pipeline. The spill was reported to his supervisor who contacted the mill control operator and the Environmental department. The mill operations were promptly suspended and the tailings pump shutdown. The grader operator used the grader to create a snow berm next to the leaking pipeline to direct the tailings material into the TIA and away from the roadway. The spill investigation determined that a small hole had worn through a steel flange located on a low point drain of the HDPE tailings distribution pipeline allowing release of tailings from the flange. The steel flange at this location had been installed in 2017 with the original pipeline installation. Snow banks on the roadway had prevented tailings from migrating off the road to the tundra east of the TIA and all spilled tailings were contained to the roadway or directed into the TIA. An excavator was used to excavate the tailings and contaminated crush from the road surface and dispose of this material into the TIA. Corrective actions: • The worn steel flange was replaced; • Routine ultrasonic thickness testing of drains/spigot points to confirm thickness integrity; and • Options to install a Leak Detection System (LDS) have been investigated and TMAC is in the process of evaluating operational effectiveness of these options in order to determine which system will be most suitable given the tailings pipeline alignment and operation in arctic conditions.	07-Jan-19
28-Dec-18	18-487	28-Dec-18	Sewage - 3-4 m^3	The sewage treatment operator noted lower than normal overnight input into the Sewage Treatment Plant. During a daily inspection of the main Doris Camp lift station, the sump was found to be overflowing and weeping on to the gravel floor of the building. The sump pump had been replaced in the same lift station the previous day. Multiple tests were completed to ensure proper function of the pump and the sump was closed up for the night. Investigation revealed that excess wire from the new pump installation had broken its mooring and fallen, trapping the floats in the down or off position. The pump did not turn on as needed and the sump over flowed. The sump pump was immediately switched to manual mode to pump the water level down and excess wire was secured to an area away form the float with	22-Jan-19

Table 11-1. Summary of Reportable Spills in 2018

Date of Occurrence	Spill Number	Date of Notification to an Inspector	Spilled Material and Volume	Details of Spill Event and Follow up Activities	Date Follow-up Report Provided to an Inspector
				additional strapping. The float connection point was also relocated to ensure free movement and no chance of obstruction. The spill area surrounding the sump was hand excavated to the extent practicable and contaminated soil was removed from the area. Lime was also placed on the impacted areas to prevent the development of odors or pathogens during the warmer months. Corrective actions: • An upgraded inspection schedule will be made after repairs on key systems to monitor the first few hours or as deemed necessary to ensure correct function.	

12. Management Plans

The Table 12-1 below provides and overview of all Management Plans for the Hope Bay Project.

Table 12-1. Hope Bay Project Management Plans

Topic	Management Plans	Revision Date
Environmental Management System	Hope Bay Project Environmental Management System	Dec-17
Management Plans		
Emergency Response	Hope Bay Project Emergency Response Plan*	Mar-19
Spill Contingency	Hope Bay Project Spill Contingency Plan*	Mar-19
Hazardous Waste Management Plan	Hope Bay Project Hazardous Waste Management Plan*	Mar-19
Incinerator Management Plan	Hope Bay Project Incinerator Management Plan*	Mar-19
De-icing Management	Hope Bay Project Aircraft De-icing Management Plan*	Mar-19
QA/QC	Hope Bay Project Quality Assurance Quality Control Plan*	Mar-19
Water Management	Hope Bay Project Doris-Madrid Water Management Plan*	Mar-19
	Hope Bay Project Boston Water Management Plan	Dec-17
	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site	Jan-17
Waste Rock Management Plan	Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan	Mar-19
	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site	Jan-17
Landfarm Management	Hope Bay Project Hydrocarbon Contaminated Material Management Plan	Dec-17
Air Quality	Air Quality Management Plan, Hope Bay Project	Dec-17
Domestic Waste Water Management	Hope Bay Project Domestic Wastewater Treatment Management Plan	Dec-17
	Boston Sewage Treatment Operations and Maintenance Management Plan	Sep-17
WWMP	Doris North Project Wildlife Mitigation and Monitoring Plan	Dec-16
	Wildlife Mitigation and Monitoring Plan	Dec-17
AMEP	Hope Bay Project Aquatic Effects Monitoring Plan	Apr-18
Ground Water Management Plan	Hope Bay Project Ground Water Management Plan	Apr-18
Tailing Management Plan	Hope Bay Project, Phase2 Doris Tailings Impoundment Area – Operations, Maintenance, and Surveillance Manual	Dec-17
	Hope Bay Project Boston Tailings Management Area - Operations, Maintenance, and Surveillance Manual	Dec-17
Non-Hazardous Waste	Hope Bay Project Non-hazardous Waste Management Plan	Dec-17
Quarry Management	Hope Bay Project Quarry Management and Monitoring Plan	Dec-17

(continued)

Table 12-1. Hope Bay Project Management Plans (completed)

Topic	Management Plans	Revision Date
Closure	Hope Bay Project Doris-Madrid Closure and Reclamation Plan	Nov-17
	Hope Bay Project Boston Conceptual Closure and Reclamation Plan	Nov-17
	Hope Bay Project Windy Camp and Patch Lake Facility Updated Closure Plan (SRK)	May-14
	Hope Bay Project: Madrid Advanced Exploration Program: Conceptual Closure and Reclamation Plan (SRK)	Oct-14
Explosives	Hope Bay Project Explosives Management Plan	Nov-17
OPEP	Oil Pollution and Emergency Preparedness Plan	Aug-18
Noise Management	Hope Bay Project Noise Abatement Plan	Dec-17
Socio-economic Management Plans		
Health and Safety	Hope Bay Health and Safety Management Plan	Dec-17
Human Resources	Hope Bay Project Human Resources Plan	Sep-16
Community Involvement	Hope Bay Project Community Involvement Plan	Dec-16
Cultural Heritage	Cultural Heritage and Natural Resources Management Plan	Dec-17

** Indicates plan has been updated and is being provided to the NWB in March 2019.*

13. Closure and Reclamation

13.1 PROGRESSIVE RECLAMATION

In 2018, progressive reclamation work was focused on Windy Camp. Environmental Affairs personnel completed reclamation activities with focus was to dismantle the Weather Haven tents and wood framed cabins at the north end of the camp (Photo 13.1-1).

Photo 13.1-1. Windy Camp pictured in 2013. Area of 2018 reclamation activities denoted by red circle.

Waste sorting was completed as the structures were taken down and segregated into mega-bags and other containers. Waste was removed from the site and disposed of at the Roberts Bay waste management facility with some waste segregated and stockpiled for future removal as containers are filled.

As the cabins were dismantled, the electrical cables and fixtures were stripped and sorted for disposal. Some of the tarps used for the roofing of the wooden framed cabins were still in good condition and were recovered and saved for future use. In addition, the windows from some of the cabins were in good condition and 10 window units were recovered and stockpiled.

The program resulted in 10 cabins and one (1) cabin foundation, as shown in Photo 13.1-1, dismantled and taken down in 2018. Approximately 460 labour hours were used to complete the work. A detailed summary of the work and results can be found in the Windy Camp 2018 Reclamation Summary, which is Appendix K of this report. Photo 13.1-2 show progressive reclamation of these structures.

Photo 13.1-3 provides an aerial view of the progressive reclamation completed as of August 26, 2018. Additional reclamation work was completed in early September and additional cabins (indicated by red circle) were dismantled.

Photo 13.1-2. Cabin and tent structures prior to reclamation (top) and post reclamation (bottom). Waste piled and segregated for transport to Doris Waste Management Facility shown in background.

Photo 13.1-3. Progressive reclamation completed as of August 26, 2018. Additional reclamation work conducted in September 2018 (indicated by red circle).

13.2 COST ESTIMATE

The reclamation work for the Hope Bay Project will be done in accordance to approved Closure and Reclamation Plans for the Project. Reclamation progress is monitored through site inspections and annual reporting to the KIA, INAC and NWB, and is documented in updates of the Project Closure and

Reclamation Plan and financial security costs estimates. As part of the Type A Water Licence approval process for Boston-Madrid (Phase 2) Project in 2018, financial security costs estimates were updated and approved by the NWB, KIA and CIRNAC which consider all existing infrastructure, proposed Phase 2 infrastructure, and any new information available since the last revision. The resulting financial security estimates and their associated Closure and Reclamation Plans, which are applicable to each site, are outlined in the subsections below.

13.2.1 Doris and Madrid

TMAC maintains Hope Bay Project Doris-Madrid Closure and Reclamation Plan (November 2017) which describes the activities, requirements, and monitoring necessary for the closure and reclamation of the Doris site.

As part of the Type A Water Licence approval process for Boston-Madrid (Phase 2) Project in 2018, TMAC provided to the NWB an updated and final Closure and Reclamation cost estimate, which constituted an agreement between TMAC, KIA and CIRNAC on the financial security parties agreed was required for Doris and Madrid sites. Details of this process can be found on the NWB public registry and resulted in a requirement in Type A Water Licence 2AM-DOH1335 for $62,058,577 to be posted for the Doris-Madrid portion of the Project; $51,659,822 to KIA, $10,398,755 to the Crown. This security is to be posted across nine (9) installments or tranches based on distinct project components.

In addition to the financial security required to be posted for Doris and Madrid under Type A Water Licence 2AM-DOH1335 described above, TMAC also has rights to conduct the Madrid Advanced Exploration Program in accordance with Water Licence No. 2BB-MAE1727 Amendment No.2. In the event TMAC proceeds the Madrid Advanced Exploration Program, and does not commence activities under Type A Water Licence 2AM-DOH1335, TMAC's Conceptual Madrid Closure and Reclamation Plan (2017) will dictate the activities, requirements, and monitoring necessary for the closure and reclamation of the Madrid site(s). In this scenario, TMAC is required to maintain reclamation security in the amount of $7,131,000 for the work at Madrid. As per the amended licence, this amount is split between activities at Madrid North ($4,042,000), Madrid South ($3,072,000) and Madrid North to South All Weather Road (AWR) ($17,000).

13.2.2 Windy

TMAC has an approved Hope Bay Project, Windy Camp and Patch Lake Facility Updated Closure Plan (SRK 2014). This document presents the closure obligations and the plan for closing both facilities, and demonstrates how the closure obligations can be met. A copy of this plan can be found on the NWB public registry.

13.2.3 Boston

For current Boston infrastructure, TMAC has an approved Boston Camp Interim Closure Plan (2014) which was submitted to the NWB May 26, 2014. The plan includes a current closure cost estimate of $5,988,000. This amount includes cost escalation, management of mineralized rock, reclaiming drill sites and other areas of permafrost degradation, remediation of hydrocarbon contaminated soils, indirect costs, and a contingency. A copy of this plan can be found on the NWB public registry.

For planned Boston infrastructure under the Boston-Madrid (Phase 2) Project, TMAC provided to the NWB an updated and final Closure and Reclamation cost estimate as part of the Type A Water Licence approval process. The updated and final Closure and Reclamation cost estimate provided constituted an agreement between TMAC, KIA and CIRNAC on the financial security parties agreed was required for the

Bostin site. Details of this process can be found on the NWB public registry and resulted in a requirement in Type A Water Licence 2AM-BOS1835 for $37,458,491 total to be posted; $9,963,564 to KIA and $27,494,927 to the Crown. This security is to be posted across nine (6) installments or tranches based on distinct project components.

14. Community Consultation

TMAC is committed to engaging positively and effectively with local communities in a manner that emphasizes respect, integrity and demonstrates a willingness to learn from experience and embrace necessary change. TMAC recognizes that maintaining engagement and community involvement is necessary throughout the mining cycle, and critical to continuous improvement. TMAC bases its approach to community involvement on the following principles:

1. Identify all Stakeholders in our operations;
2. Effectively engage Stakeholders and establish a dialogue;
3. Provide Stakeholders with means to respond to us as well as generate responses; and
4. Report to Stakeholders and regulators on our Engagements.

TMAC operates within Nunavut, and on Inuit Owned Lands. The KIA, representing the Inuit of the Kitikmeot region, advised TMAC during the IIBA negotiation process that all Kitikmeot communities are considered affected by Hope Bay. As a result, TMAC considers every Kitikmeot Inuk, and their representative organizations including the KIA to be Stakeholders in the Belt. For the purposes of local community engagement, communities involved in the Belt include Kugaaruk, Taloyoak, Gjoa Haven, Cambridge Bay, Umingmaktok, Kingaok, and Kugluktuk, comprising the Kitikmeot region of Nunavut.

In order to effectively engage, establish and maintain a dialogue with TMAC's various local communities, TMAC has implemented a number of steps and activities designed to support two-way communication. These efforts and activities are described in the subsections below.

14.1 CAMBRIDGE BAY OFFICE

TMAC maintains an office in Cambridge Bay, which is the closest, occupied, affected community to the Belt. The office is centrally located in the community, furnished with bilingual signage, and accessible by the public during regular business hours. The primary purpose of this office is to facilitate community engagement. The Cambridge Bay office supports TMAC's engagement of government, regulators, intervenors, interested members of the public, employees, those seeking employment at Hope Bay and other interested parties.

Staff of the Cambridge Bay office are available to communicate directly with local Stakeholders and participate in a number of regional and territorial events that regularly occur in Cambridge Bay, thereby informing communities of TMAC operations, and actively soliciting feedback. The Cambridge Bay office is staffed with a Vice President of Corporate Social Responsibility, a TMAC Liaison and an HR/SR Coordinator. They engage regularly with the public using two-way communications for a variety of activities including:

- Employee and public relations;
- Annual community awareness meetings;
- Regular meetings with individual Inuit job seekers;
- Recruiting and onboarding Inuit personnel;
- Regular communications with Community Liaison Officers in the Kitikmeot;

- Annual meetings between KIA and TMAC Presidents;
- Annual updating of KIA Board by TMAC Executive;
- Attendance at the KIA Annual General Meeting;
- Quarterly participation in the IIBA Implementation Committee;
- Presentation of the IIBA Annual Evaluation Report to the KIA Board;
- At a minimum, semi-annual meetings of the Inuit Environmental Advisory Committee ("IEAC") in order to review environmental management and monitoring plans, discuss project related environmental issues, and obtain advice from knowledgeable Inuit on these matters;
- Meetings between TMAC staff and Kitikmeot Qualified Businesses;
- Regular meetings with relevant KIA Lands, Employment and Training and Executive staff; and
- Annual visits of the KIA Board, IIBA Implementation Committee, IEAC, and individual harvesters at Hope Bay.

14.2 ENGAGEMENT WITH INUIT THROUGH THE IIBA

In accordance with the IIBA, TMAC regularly engages Inuit on a range of matters directly as well as through the KIA. The IIBA includes the following schedules which contain specific provisions of adaptive socio-economic effect mitigation measures aimed at Kitikmeot Inuit:

- Schedule D – Training and Education Opportunities: whereby Inuit are provided support and training for opportunities at the Hope Bay Project;
- Schedule E – Employment: whereby measures and supports are provided to maximize Inuit participation in the Hope Bay Project;
- Schedule F – Business and Contracting Opportunities: whereby Inuit are provided business and contracting opportunities; and
- Schedule I – Inuit Environmental Advisory Committee: whereby Inuit have the opportunity to receive and consider information, provide advice and attempt to resolve community concerns relative to the environment and wildlife for the Hope Bay Project.

14.3 COMMUNITY AWARENESS: KITIKMEOT COMMUNITY MEETINGS

TMAC undertakes regional consultation tours of the Kitikmeot region. The tours consist of visits to each Kitikmeot community by TMAC community relations staff and relevant subject matter experts. TMAC endeavours to schedule the tour for a time of year that promotes participation and provides at least two weeks advanced notice for each Kitikmeot community. During the public meeting, TMAC delivers a presentation that provides the public information on the socio-economic and environmental performance of the Company. TMAC supports public meeting proceedings with simultaneous translation consistent with the dialect of Inuktun used in each community. TMAC logs meeting participants for future reference. In the meetings, community members have an opportunity to make comments, ask questions, and raise any concerns they may have regarding TMAC operations. TMAC documents the proceedings of public meetings in order to track issues and follow up on any concerns.

During the regional consultation tours of the Kitikmeot region, TMAC also endeavours to schedule meetings in each community with specific Stakeholder groups such as Kitikmeot Hamlet Councils and/or senior management, local Nunavut Arctic College and High School classes as specific Stakeholders that may have an interest in employment and training at TMAC.

In 2017, TMAC hosted community meetings in Kugluktuk, Cambridge Bay, Kugaaruk, Taloyoak, and Gjoa Haven from October 18 to November 2, 2017 with the purpose of sharing a Hope Bay Project update and seeking public input on the proposed Madrid-Boston Project.

14.4 COMMUNITY AWARENESS: KITIKMEOT CAREER AWARENESS SESSIONS

TMAC host community and information and career awareness sessions in all Kitikmeot communities regularly in order to maximize Inuit employment opportunities at Hope Bay. The purpose of these sessions is to provide information on:

- expected labour needs of Hope Bay;
- the skills, behaviours and qualifications required for employment and advancement at Hope Bay;
- the training opportunities and educational support programs available to prepare for employment at Hope Bay; and
- career opportunities in related fields such as science, technology, mathematics or professional services.

14.5 SOCIAL MEDIA

TMAC maintains a company Facebook ™ page to both share operational information with communities and increase awareness of mining. TMAC uses its Facebook ™ page to augment information distributed through TMAC's website. TMAC also makes use of Kitikmeot community Facebook ™ pages to advertise job postings, meeting notices, and any other news that may be of interest to Nunavut Stakeholders (http://www.facebook.com/tmacresources/).

Comments, questions or concerns received via social media are addressed promptly in a manner consistent with public meetings.

14.6 ELECTRONIC MAIL

TMAC maintains and periodically updates a listing of electronic mail addresses of Stakeholders, including select community members. This listing includes, but is not restricted to the following:

- Public elected officials;
- Inuit elected officials;
- Relevant federal and territorial regulator employees;
- Relevant Inuit Organization employees;
- Relevant municipal officials; and
- Relevant training and employment agency employees.

When necessary, TMAC distributes electronic mail messages to this listing to inform them of TMAC related events, news and happenings. This engagement activity is conducted to ensure that Stakeholders and communities are well informed and if willing, able to plan participation in any future TMAC engagement.

14.7 NUNAVUT EVENT PARTICIPATION

TMAC ensures it is well informed of key events that occur on an annual basis in Nunavut that represent opportunities for community involvement and dialogue. TMAC makes staff available to attend these events in order to foster communication. These events included the following:

- Kitikmeot Mayor's Meeting;
- Kitikmeot Trade Show; and
- Nunavut Mining Symposium.

14.8 STAKEHOLDER REPRESENTATIVE ORGANIZATIONS

TMAC recognizes that one of the most effective means of engagement and dialogue with Stakeholders and communities is joining with them in an organization of mutual benefit. Towards this aim, TMAC is a member of established organizations involving numerous community members. TMAC's participation in these groups provides members with information on TMAC's activities and, allows them to discuss matters of mutual concern, and undertake initiatives of mutual benefit. These organizations include the following:

- NWT/Nunavut Chamber of Mines;
- Nunavut Mine Training Roundtable; and
- Kitikmeot ASETS Stakeholder Working Group.

14.9 COMMUNITY/STAKEHOLDER RELATIONS SUMMARY FOR 2018

As described in the subsections above, TMAC used a number or methods and avenues to ensure TMAC positively and effectively engages with local communities and stakeholders. A summary of community/ stakeholder related engagement activities in 2018 is provided in Table 14.9-1 below.

Table 14.9-1. Community/Stakeholder Engagement Summary for 2018

Date	Agency	Method	Topic
17-Jan-18	NWB	In Person	Meeting in Edmonton, Project Updates
23-Jan-18	CIRNAC	In Person	Land Lease and HAZOP Workshops
30-Jan-18	KIA	Teleconference	Framework Agreement and Commercial Lease
30-Jan-18	Transport Canada	Teleconference	Navigable Water Approvals
01-Feb-18	CIRNAC	In Person	Boston-Madrid (Phase 2) Project Update
01-Feb-18	Northern Lights	In Person	Nunavut Mining Industry
06-Feb-18	Federal Agencies and GN	Teleconference	Boston-Madrid (Phase 2) Project Update
23-Feb-18	NWB	Teleconference	Water Licence application review process
27-Feb-18	KIA	Teleconference	Boston-Madrid (Phase 2) Project Review
27-Feb-18	KIA	Teleconference	Boston-Madrid (phase 2) Financial Security
Mar-18	Kitikmeot Communities	In Person	Community Tour for Boston-Madrid (Phase 2) Project Awareness
28-Mar-18	KIA	In Person	IIBA Meeting
09-Apr-18	GN Department of Economic Development and Tourism	In Person	Boston-Madrid (Phase 2) Project Review
11-Apr-18	Nunavut Mining Symposium	In Person	Project Update
11-Apr-18	GN Department of Environment	In Person	Boston-Madrid (Phase 2) Project Review
11-Apr-18	CIRNAC	In Person	Boston-Madrid (Phase 2) Project Review
23-Apr-18	Transport Canada	Teleconference	Navigable Water Notice of Works
24-Apr-18	CIRNAC	Teleconference	Boston-Madrid (Phase 2) Project Review
24-Apr-18	KIA	Teleconference	Boston-Madrid (Phase 2) financial security
25-Apr-18	KIA	Teleconference	Boston-Madrid (Phase 2) Project Review
25-Apr-18	Health Canada	Teleconference	Boston-Madrid (Phase 2) Project Review
30-Apr-18	CIRNAC	In Person	Boston-Madrid (Phase 2) Project Review (in Ottawa)
01-May-18	DFO	Teleconference	Boston-Madrid (Phase 2) Project Review
07-May-18	ECC	Teleconference	Boston-Madrid (Phase 2) Project Review
08-May-18	NIRB, NWB, Community Reps, Federal Agencies, GN, Public	In Person	Boston-Madrid (Phase 2) Final Hearings
13-May-18	ECCC	In Person	Technical comments on Water Licence Application
14-May-18	NWB, Community Reps, Federal Agencies, GN, Public	In Person	Nunavut Water Board Technical Meetings
15-May-18	NWB, Community Reps, Federal Agencies, GN, Public	In Person	Nunavut Water Board Technical Meetings

(continued)

Table 14.9-1. Community/Stakeholder Engagement Summary for 2018 (continued)

Date	Agency	Method	Topic
08-Jun-18	CANNOR	Teleconference	NIRB Approval Process for Phase 2
18-Jun-18	DFO, NRCAN	In Person	Phase 2 Project Approvals
25-Jun-18	KIA	In Person	IIBA Meeting
04-Jul-18	KIA	Teleconference	Boston-Madrid (phase 2) Financial Security
04-Jul-18	KIA	In Person	Water Licence Application Review Process
11-Jul-18	CIRNAC	Teleconference	Land Lease Applications
25-Jul-18	KIA	Teleconference	Boston-Madrid (Phase 2) Project Review
26-Jul-18	CIRNAC	Teleconference	Land Lease and Financial Security
31-Jul-18	NWB, CIRNAC, DFO, KIA	Teleconference	Pre-hearing Conference
13-Aug-18	CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
16-Aug-18	ECC	Teleconference	Newly proposed Carbon Tax
28-Aug-18	KIA	Teleconference	Boston-Madrid (Phase 2) Financial Security
30-Aug-18	CIRNAC	Email	Discussion of HAZOP as per lease
31-Aug-18	KIA	Teleconference	Land Use Planning
31-Aug-18	KIA	Teleconference	Framework Agreement and Commercial Lease
13-Sep-18	ECCC	In Person	Carbon Tax
13-Sep-18	ECC	In Person	Carbon Tax
18-Sep-18	KIA, CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
18-Sep-18	KIA	Teleconference	Phase 2 WL Review
20-Sep-18	KIA, CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
20-Sep-18	CIRNAC, KIA	Teleconference	Phase 2 WL Review
21-Sep-18	NWB	Teleconference	Water Licence Hearing Prep
27-Sep-18	KIA, CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
27-Sep-18	CIRNAC, KIA	Teleconference	Phase 2 WL Review

(continued)

Table 14.9-1. Community/Stakeholder Engagement Summary for 2018 (completed)

Date	Agency	Method	Topic
Oct-18	Kitikmeot Communities	In Person	Human Resources Community Tour
02-Oct-18	CIRANC	Teleconference	Phase 2 WL Review
04-Oct-18	KIA, CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
04-Oct-18	CIRNAC, KIA	Teleconference	Phase 2 WL Review
10-Oct-18	KIA	Teleconference	Phase 2 WL Review
12-Oct-18	KIA, CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
19-Oct-18	KIA, CIRNAC	Teleconference	Boston-Madrid (Phase 2) Financial Security
19-Oct-18	KIA, CIRNAC	Teleconference	Phase 2 WL Review
23-Oct-18	CIRNAC	In Person	Phase 2 WL Review
26-Oct-18	DFO	In Person	Phase 2 Fisheries offsetting
09-Nov-18	GN Department of Economic Development and Tourism	Email	Fall 2018 New Release and Kitikmeot Career Tour
10-Nov-18	GN Department of Family Services	Email	Fall 2018 New Release and Kitikmeot Career Tour
15-Nov-18	KIA	Email	IIBA Update
15-Nov-18	Auditor General	Email	Follow Up on Education and Employment discussion
21-Nov-18	ECCC	In Person	Doris Bird Compliance Program
03-Dec-18	KIA	In Person	Project Update and Planning Session
04-Dec-18	KIA	In Person	Project Update and Planning Session

15. Annual Inspection Activities

In 2018 TMAC hosted regulatory inspections for ECCC, CIRNAC, NIRB, KIA, WSCC, and DFO. Details of when those visits occurred and a summary of the reports and follow up from those visits are detailed in Table 15-1.

Table 15-1. Summary of Annual Inspection Activities

Date	Agency	Summary	Follow up	Response
February 13-14, 2018	Indigenous and Northern Affairs Canada	Inspection to verify compliance with the Type A water license, 2AM-DOH1323. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities.	Confirm that water from Windy Lake is only to be used for domestic purposes as per the licence. All industrial water usage must originate from sources approved under 2AM-DOH1323. Metering of water usage is preferable. All hazardous materials are to be stored in secondary containment as per Part 1 Item 3 of the Licence. Storage areas should be kept free of snow to the extent possible. Sump locations in both cells of the Reagent Pad are to be confirmed and must be left unobstructed. Demonstrate how the tailings are to be diverted to the Emergency Dump Catch Basin on east side of Doris Creek.	Water extracted from Windy Lake is only used for domestic purposes at Doris Camp. Water extracted for industrial purposes in the Doris licence area will be extracted from Doris Lake as permitted under the 2AM-DOH1323. TMAC is investigating options to establish flow meters at the raw water intake for both facilities. All hazardous materials at the Hope Bay Site will be managed in accordance with TMAC's existing Hazardous Waste Management Plan. The identified sea-can containers were closed immediately after the inspection and Environmental staff discussed proper handling and storage procedures for these materials with all staff during site safety meetings. TMAC plans to construct a separate lined storage area to be used for the storage of oils, lubricants, drums of fuel and other hazardous materials. Sea-can containers currently storing those materials will be relocated to this area once constructed. Sea-can containers previously obstructing the sumps in the Reagent Pad have been removed. Delineators have been placed to identify the sumps and prevent materials from being placed in those locations. TMAC plans to replace the current steel tailings pipeline with an HDPE pipeline; the new tailings pipeline will be placed at the correct height relative to the walls of the east Emergency Dump Catch basin to allow tailings to be diverted into this basin effectively.
March 27, 2018	Worker's Safety and Compensation Commission	Inspection to verify compliance with Mines Health & Safety Regulations. The inspection focused on the mill, underground mining as well as surface infrastructure including the geotech laydown, camp facility, maintenance shops and south dam construction area. The inspector issued 10 orders for action.	Order issues.	Compliance report was submitted from TMAC within 30 days.
May 22-24, 2018	Indigenous and Northern Affairs Canada	Inspection to verify compliance with the Type A water license, 2AM DOH1323. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities.	All Hazardous Waste generated by the project must be held in secondary containment. Non-burnable material must be removed from the burn pan. Waste entering the burn pan must be segregated. The inspector identified Styrofoam and clear plastic bags containing cardboard.	Waste management procedures were reinforced with site personal and all containers were placed into secondary containment and sealed. This was communicated with site personal and the waste entering the burn pan has been appropriately segregated.
June 19-20, 2018	Kitikmeot Inuit Association	On June 19-20 the KIA inspected the Doris Commercial Lease area and infrastructure including Roberts Bay, the Jetty, Doris Site and Area, the North Dam and Tailings Impoundment Area infrastructure, and the Doris Windy All-Weather Road. Windy Camp and Boston Camp were also toured.	There is some more wear at the bridge's abutment on top (Doris Creek bridge), which needs to be monitored. There is some cracking on the North dam's water intake pad. There is some erosion by the survey marker on the north face, which will be repaired. Craters are still monitored weekly. Minor slumping at diversion berm. No water at the toe of berm. Drill stems still need to cut and capped.	All areas identified will continue to be monitored by TMAC. On going reclamation of historic drill sites will continue.
July 31-August 2, 2018	Worker's Safety and Compensation Commission	Inspection to verify compliance with Mines Health & Safety Regulations. The inspection focused on exploration activities, underground mining as well as surface infrastructure including the camp facility and warehouse. The inspector issued 20 orders for action.	Order issues.	Compliance report was submitted from TMAC within 30 days.
August 3-4, 2018	Indigenous and Northern Affairs Canada	Inspection to verify compliance with the Type A water license, 2AM DOH1323. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities. Inspection also included the 2BB-MAE1727, 2BB-BOS1727 license areas.	Inspectors noted a drum of waste water contaminated with hydrocarbons outside of secondary containment. This container must be held in secondary containment. It is suggested that TMAC install intake flow meters at all raw water intake facilities due to possible margin for error, this will ensure accurate tracking of water usage.	The drum was placed into secondary containment and appropriate waste management practices as outlined in the Hazardous Waste Management Plan were reinforced with site personnel. TMAC has repaired a flow meter that had previously been installed on the Doris Lake pump house facility but was not in service at the time of the inspection. A flow meter has been sourced for the Windy Lake pump house facility and will be installed on the intake pipeline of this facility once received on site.

(continued)

Table 15-1. Summary of Annual Inspection Activities (completed)

Date	Agency	Summary	Follow up	Response
September 25-26, 2018	Fisheries and Oceans Canada and Environment and Climate Change Canada	DFO inspection to review performance on DFO Authorizations and Letters of Advice. ECCC inspection to review water and fuel management with respect to MDMER and fuel regulations. These inspections were orientation site visits that did not require follow up or response.	Not applicable.	Not applicable.
October 10, 2018	Indigenous and Northern Affairs Canada	Inspection to verify compliance with the Type A water license, 2AM DOH1323. The inspection focus was on fuel storage, waste and water management, site infrastructure as well as drilling and mining activities. Inspection also included Lease 77A3-1-7.	Maintenance of the berm of the Single Tank Farm at Roberts Bay. Maintenance of the Diversion Ditch at Doris North Camp to ensure proper management of contact water. During inspection of the Jetty, the Inspector observed debris such as wood, ropes, boat anchors, ramps, and a floating dock. Some of the wood on the Jetty appears to have been wind blown into the ocean. Shipping ramps and floating dock were still lingering although the sea lift season had been completed. Embankments appear to be in good condition and were to the satisfaction of the Inspector.	TMAC will conduct maintenance on the berm of the Single Tank Farm at Roberts Bay in 2019. Maintenance will be conducted to re-establish the buffer between the diversion berm and the waste rock storage area in order to ensure that all waste rock and contact water is contained within the berm and water management area. This work will be completed prior to freshet in 2019. The Inspector noted that TMAC has restored the Jetty to the satisfaction of the Inspector throughout the course of this inspection. With permission from the Inspector, a shipping ramp has been left in place on the jetty to facilitate inspections of a tug boat and cargo barge that was iced in at the end of the sealift season. This shipping ramp will be removed prior to freshet in 2019 as requested by the Inspector.
October 16, 2018	Worker's Safety and Compensation Commission	Inspection to verify compliance with Mines Health & Safety Regulations. The inspection focused on a full geotechnical and electrical review of the Doris site. The inspector issued 17 orders for action.	Order issues.	Compliance report was submitted from TMAC within 30 days.

References

SRK Consulting (Canada) Inc. 2009. *Water and Ore/Waste Rock Management Plan for the Boston Site Hope Bay Project, Nunavut*. Report 1CH008.022 for Hope Bay Mining Ltd. July 2009.

SRK Consulting (Canada) Inc. 2017. *Water and Ore/Waste Rock Management Plan for the Boston Site Hope Bay Project, Nunavut*. Report 1CT022.009 for TMAC Resources Inc. January 2017.

ERM. 2016. *Doris North Project: 2015 Aquatic Effects Monitoring Program Report.* Prepared for TMAC Resources Inc. by ERM Consultants Canada Ltd.: Yellowknife, NT.

Appendix A
Concordance Table

Type A Water Licence 2AM-DOH1323	
Condition	**Section**
Summary of monthly monitoring data	Section 5.1, Appendix D.1
Information with respect to Geochemical Monitoring and Waste Rock Storage Assessment	Section 8, Appendix F
Information with respect Quarry Rock Seepage Monitoring and management Program	Section 9, Appendix F
Summary of the results of monthly water balance and water quality model assessments	Section 5.1.1, Appendix E
Update on current capacity of the Tailings Impoundment Area	Section 5.1.2
Information on flows at monitoring stations TL-2 and measurements of Doris Lake Water level	Appendix D.1
Annual review and any revisions of management plans and Emergency Response and Contingency Plan	Section 12
A list and description of all unauthorized discharges including volumes, spill report line identification number and summaries of follow-up actions taken	Section 11
Results of the Aquatic Effects Monitoring Program	Section 7
Annual adjustments to reclamation security	Section 13
Annual incineration stack testing results	Section 6.1
Annual Landfill Management Report	Section 6.4
A summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and an outline of any work anticipated for the next year	Section 3 and Section 4
A summary of any closure and reclamation work undertaken and an outline of any work anticipated for next year, including changes to implementation and scheduling	Section 13
A summary report describing consultation and participation with local organizations and residents of nearby communities, including a schedule of upcoming events/information sessions	Section 14
GPS locations of monitoring stations	Appendix B
A summary of actions taken to address concerns or deficiencies listed in the inspection reports and/or compliance reports filed by an Inspector any other details on water use and waste disposal requested by the board	Section 15

Type A Water Licence 2BE-HOP1222	
Condition	**Section**
A summary report of water use and waste disposal activities	Section 5.2, Section 6, Appendix D.2
A summary of all information requested and results of the Monitoring Program	Section 5.2, Appendix D.2
A list of unauthorized discharges and a summary of follow-up actions taken	Section 11
A brief description of follow-up actions taken to address concerns detailed in inspection and	Section 15
An update to the Spill Contingency Plan, if required, including contact information in the form of an addendum	Section 10, Section 12
A description of all progressive and/or final reclamation work undertaken, including photographic records of site conditions before, during and after completion of operations	Section 13
A summary of modification and/or major maintenance work carried out on the water supply and waste disposal facilities, including all associated structures, and an outline of any work anticipated for the next year	Section 3, Section 4
A summary of any specific studies or reports requested by the board, and a brief description of future studies planned or proposed	Section 4
Any other details on water use or waste disposal requested by the board	Section 5.2

Type A Water Licence 2BB-MAE1727	
Condition	**Section**
The monthly and annual quantities in cubic metres of all freshwater obtained at Monitoring Stations No. MAE-01, No. MAE-02 and MAE-03, including all sources of water identified for domestic and industrial use under Part D, Item 1	Section 5.3, Appendix D.3
The daily, monthly and annual quantities, in cubic metres, of mine water pumped from the underground mine	Section 5.3, Appendix D.3
The monthly and annual quantities in cubic metres of Effluent discharged from the Pollution Control Ponds onto the tundra and/or transported to Doris to be discharged into the TIA, including the analysis result	Section 5.3, Appendix D.3
The monthly and annual quantities in cubic metres of Sewage Effluent transported to the Doris	Section 5.3, Appendix D.3
Report all artesian flow occurrences as identified under Part F, Item 9	Section 5.3
An estimate of the volume of waste rock and ore currently stockpiled at site, to date	No waste rock and ore to date.
Tabular summaries of all data generated under the Monitoring Program, Part J	Section 5.3, Appendix D.3
A summary of modifications and/or major maintenance work carried out on the Water Supply Facilities, Buk Fuel Storage Facility, Pollution Control Ponds and any wastewater related	Section 3, Section 4
A list of unauthorized discharges and follow-up action taken	Section 11
Updates or revisions to the Water Management Plan, Abandonment and Restoration Plan, QA/QC, Waste Rock and Ore Storage Plan, and Spill Contingency Plan and/ or any other management plan	Section 12
An updated estimate of the current Madrid Advanced Exploration Project restoration and liability, as required under Part C, Item 5, based upon the results of the restoration research, project development monitoring, and any modifications to the site plan	Section 13
A brief description of follow-up action taken to address concerns detailed in inspection and compliance reports prepared by the Inspector	Section 15
A summary of drilling activities and reclamation of drilling sites	Section 3.2, Section 13
A public consultation/participation report describing consultation with local organizations and residents of the nearby communities, conducted during the Report period	Section 14
A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year	Section 13
A summary of any specific studies or reports requested by the Board, and a brief description of any future studies planned or proposed; and any other details on the use of Water or the deposit of Waste requested by the board Board by the 1st of November of year being reported	Section 5.3

Type A Water Licence 2BB-BOS1727	
Condition	**Section**
The monthly and annual quantities in cubic metres of all freshwater obtained from Aimaokatalok (Spyder) Lake, Monitoring Stations No. BOS-1a and from Stickleback Lake, Monitoring Station No. BOS-1b and additional sources of water identified for domestic and other uses under Part C, Item 1	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of Mine water pumped from the underground	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of Effluent discharged at Monitoring Station Number BOS-2, BOS-2, BOS-4 and BOS-5, BOS-6 and BOS-7	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of non-compliant effluent transported to	Section 5.4, Appendix D.4
The monthly and annual quantities in cubic metres of Sludge removed from the Sewage Treatment Facility	Appendix D. 4
The annual quantities in cubic metres of all soil and types of contaminants from all locations that are placed within the Landfarm facility and/or transported to Doris North Project	Section 6.2
Report all artesian flow occurrences as identified under Part F, Item 3	Section 5.4
Boston Ephemeral Stream Monitoring Report	Section 9.2, Appendix G
Tabular summaries of all data generated under the Monitoring Program	Appendix D.4
A summary of modification and/or major maintenance work carried out on the Water Supply and the Waste Disposal Facilities, including all associated structures, and an outline of any work anticipated for the next year	Section 3, Section 4
A list of unauthorized discharges and follow-up action taken	Section 11
Updates or revisions to the Closure Plan, QA/QC, Water and Ore/Waste Rock Management Plan, Spill Contingency Plan, and Landfarm Plan and/or any other plans	Section 12
A brief description of follow-up action taken to address concerns detailed in inspection and compliance reports prepared by the Inspector	Section 15
A summary of drilling activities and progressive reclamation of drill sites	Section 13.1
An estimate of the current volume of waste rock and ore stockpiled on site	Section 8.2
A public consultation/participation report describing consultation with local organizations and residents of the nearby communities, if any were conductec	Section 14
A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year	Section 13
A summary of any specific studies or reports requested by the Board, and a brief description of any future studies planned or proposed	Section 5.4
Any other details on Water use or Waste disposal requested by the Board by November 1st of the year being reported	Section 5.4

Appendix B
NWB Forms

NWB Annual Report **Year being reported:** 2018

License No:	2AM-DOH1323	**Issued Date:**	August 16, 2013
		Expiry Date:	August 15, 2023

Project Name: Doris North Project

Licensee: TMAC Resources Inc.

Mailing Address:
95 Wellington St. W.
Suite 1010, PO Box 44
Toronto, Ontario M5J 2N7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2AM-DOH0713 was assigned from Hope Bay Mining Ltd. to TMAC Resources Inc. on June 18, 2013. This licence was renewed on Aug. 16, 2013 and renamed 2AM-DOH1323. This license was subsequently amended in December, 2016.

General Background Information on the Project (*optional):

In 2018 commercial operations continued at Doris with continued efforts to progressively ramp up production to increase ore throughput and optimize gold recovery. Infrastructure constructed included a fabric tent structure over the primary crusher of the mill and an enclosure for the detoxified tailings conveyor exiting the mill building. Two dorms were added to allow an additional 98 bed spaces at Doris Camp. Earthworks continued to complete the Doris Airstrip south apron expansion and lined aircraft de-icing and refueling pad. Construction of the Tailings Impoundment Area South Dam and associated access road were completed in 2018. In addition to this, construction of the access road and outfall berm for the Roberts Bay ocean discharge line and fusing of the discharge pipeline began in 2018. To accommodate increased fuel storage required for future project activities, the Robert's Bay single tank farm berm was raised to allow full use of the 5ML tank and this tank was recommissioned in 2018. In order to support continued underground development, the Doris Connector Vent Raise access road was constructed. The final section of Pad T was completed in 2018 to allow additional ore and waste rock storage within the permitted footprint.

Underground waste development continued in 2018 with further advancement of the below the dyke (BTD) decline and necessary support infrastructure. TMAC completed ore development above the dyke for long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris North, and commenced ore sill development in the DCO. TMAC also continued waste development of the DCO for future mining horizons. Long hole blasting continued throughout 2018, with all ore production trucked to surface and processed through the mill or added to the stockpile. Development of the Doris Central (DCN) decline began in Q4 of 2018. TMAC continued underground exploration diamond drilling below the dyke at Doris, focused on the BTD East limb in 2018. The DCO Vent Raise was constructed and a conventional raise to surface was also developed from the BTD to support underground ventilation requirements.

Ore development also occurred from surface in Q4 of 2018 with the completion of surface blasting and hauling of ore and waste from the Doris Crown Pillar Trench (DCPT).

In the fall, TMAC concluded another successful sealift operation including the purchase and delivery of diesel fuel and Jet-A fuel as well as explosives and reagents to support mining and milling activities. The sealift also included additional heavy equipment and supplies to support mining and construction operations.

Licence Requirements: the licensee must provide the following information in accordance with

Part B	Item 4

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Doris Lake/Windy Lake

Water Quantity:		
	22995 cu.m/yr*	Quantity Allowable Domestic (cu.m)
	14277 cu. m/yr	Actual Quantity Used Domestic (cu.m)
	457005	Quantity Allowable Domestic, Mining, Milling, Drilling, etc.
	4653 cu. m/yr	Total Quantity Used Domestic, Mining, Milling, Drilling, etc

**Part E, Item 1 total volume from "all sources and for all purposes"*

Waste Management and/or Disposal

- ☑ Solid Waste Disposal
- ☑ Sewage
- ☑ Drill Waste
- ☑ Greywater
- ☑ Hazardous
- ☑ Other: Containment Berm and Control Pond Effluent

Additional Details:

Water for domestic use at Doris Camp was obtained from Windy Lake. Water is drawn from the lake at the freshwater intake and trucked to Doris Camp. The Doris Lake pump house is not supplying domestic water to Doris Camp at this time.

Waste produced on site is treated according to Part G of the licence, and in accordance with the relevant Management Plans *(Incinerator Management Plan, Non-Hazardous Waste Management Plan, Hazardous Waste Management Plan, Ore and Waste Rock Management Plan, Landfarm Management Plan, Waste Water Treatment Management Plan, and Water Management Plan*).

Some specifics are as follows:

-Food waste is incinerated as per Part G Item 5
-Paper products, paperboard packing, and untreated wood waste is open burned as per Part G Item 6.
-TMAC is authorized to dispose of all non-hazardous solid waste in a landfill on site as per Part G Item 8. To date, a landfill has not been built. All waste that cannot be incinerated on site is backhauled to an approved facility off site or will be held for deposit in a landfill once constructed.
-Sewage and greywater produced onsite is processed in the sewage treatment plant as per Part G Item 4. Sludge produced by the treatment plant is disposed in the TIA as outlined in the Waste Water Treatment Management Plan.
-Hazardous materials such as waste oil, glycol, and contaminated soil are shipped offsite for disposal at an approved site as per Part G Item 11.
-All containment berm water is sampled for water quality against the discharge criteria of the licence. Water that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector; water that does not meet the licence criteria is treated onsite until it is remediated to acceptable levels for discharge to the tundra, and/or it is discharged to the TIA.
-Runoff and contact seepage at site is managed in accordance with the Quarry Management and Monitoring Plan and Water Management Plan.

A list of unauthorized discharges and a summary of follow-up actions taken

Spill No.: (as reported to the Spill Hot-line)

Date of Spill:

Date of Notification to an Inspector:

Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc.)

Please see Section 11. of the attached Annual Report Supplement for a summary of all unauthorized discharges that occurred in 2018 under license 2AM-DOH1323.

Revisions to the Spill Contingency Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 12. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Details attached

Additional Details:

N/A

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Details attached

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

No additional sampling requested by an Inspector or the Board

Additional Details: (date of request, analysis of results, data attached, etc.)

N/A

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

No additional sampling requested by an Inspector or the Board

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

Inspection Report received by the Licensee (Date):

Additional Details: (Dates of Report, Follow-up by the Licensee)

See Section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2AM-DOH1323

Date Submitted:	March 31 2019	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	416.628.0216 ext. 124
	Fax:	
	email:	Oliver.Curran@tmacresources.com

GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing
ST-7 Doris Freshwater Intake	433525	7558727
ST-7a Windy Freshwater Intake	432626	7550477

GPS Locations of areas of waste disposal

Location Description	UTM Easting	UTM Northing
TL-5	435539	7556285
TL-6	435539	7556285
TL-7	435539	7556285
TL-9	435539	7556285
ST-4	432450	7559600
ST-5	432960	7559270
ST-6A	432954	7563407
ST-6B	432878	7563130
ST-8 STP Discharge	432413	7559596
ST-9 STP Tundra Discharge	430898	7559328

GPS Locations of Active Monitoring Stations not included above*

Monitoring Station	UTM Easting	UTM Northing
TL-1	434712	7558948
TL-2	434053	7559507
TL-11	various locations as required	
TL-12	435539	7556285
ST-1	433093	7558914
ST-2	433217	7558935
ST-10	various locations as required	
ST-11	434573	7559182
ST-12	various locations as required	

** Thermal monitoring locations are documented in the Annual Geotechnical Report*

NWB Annual Report **Year being reported:** 2018

License No:	2BE-HOP1222	**Issued Date:**	June 30, 2012
		Expiry Date:	June 30, 2022

Project Name: Hope Bay Regional Exploration Project

Licensee: TMAC Resources

Mailing Address:
95 Wellington St. W.
Suite 1010, PO Box 44
TD Centre
Toronto, Ontario M5J 2N7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2BE-HOP1222 was issued June 30, 2012 to Hope Bay Mining Ltd. Effective June 18, 2013, the NWB authorized the assignment of Licence 2BE-HOP1222 from Hope Bay Mining Ltd. To TMAC Resources Inc.

General Background Information on the Project (*optional):

Licence 2BE-HOP1222 allows TMAC to carry out activities in support of exploration drilling at the Hope Bay Regional Exploration Project and the Windy Camp, which supports exploration activities.

Licence Requirements: the licensee must provide the following information in accordance with

Part B Item 2

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Domestic and dust suppression water sourced from Windy Lake.

Water Quantity:		
	22995 cu.m	Quantity Allowable Domestic (cu.m)
	14277 cu. m.	Actual Quantity Used Domestic (cu.m)
	29200 cu.m	Quantity Allowable Drilling (cu.m)
	97 cu. m.	Total Quantity Used Drilling (cu.m)
	30600 cu.m	Quantity Allowable Dust Suppression (cu.m)
	2757 cu.m	Total Quantity Used Dust Suppression (cu.m)

Waste Management and/or Disposal

- [x] Solid Waste Disposal
- [ ] Sewage
- [x] Drill Waste
- [ ] Greywater
- [ ] Hazardous
- [ ] Other:

Additional Details:

The Hope Bay Project was placed into Care and Maintenance in October 2012. Occupancy of the Old Windy Camp ended October 23, 2008 and dismantling and reclamation of the area is on-going.

Water was used from Windy Lake to supply domestic water to Doris Camp in accordance with 2BE-HOP1222 Part C, Item 1. Water used for drilling is taken from the closest lake to each drill using a similar system to the domestic system, or for drill locations accessible by road or winter ice road, water is hauled by truck from Windy Lake, or compliant berm effluent from the Doris Project is recycled through the drills to lessen freshwater lake use. In the case of regional drilling, water is taken from the closest lake to the drill site in accordance with Part C Item 1. Non-saline drill cuttings produced under this licence are deposited in a depression at Quarry D along the Doris-Windy AWR. Saline cuttings are removed to the Tailings Imoundmnet Area at the Doris Project. A regional exploration and geotechnical drill program occurred in the license area in 2018.

The Landfarm at Windy Camp and Bulk Fuel Storage Facilities at Windy Camp and Patch Lake have been dismantled and are in the process of reclamation. No effluent is produced at these locations.

Water accumulated in Quarries A, B and D is managed in accordance with the approved *Quarry A, B, D Management and Monitoring Plan* and the relevant sections of Part D of the licence. No discharges of water occurred form these sites in 2018.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)

Date of Spill:

Date of Notification to an Inspector:

Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

No unauthorized discharges occurred in 2018 under licence 2BE-HOP1222.

Revisions to the Spill Contingency Plan

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 12. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Additional Details:

Details attached.

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

Additional Details: (date of request, analysis of results, data attached, etc)

No additional sampling requested.

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

Additional Details: (Attached or provided below)

No additional sampling requested.

Any responses or follow-up actions on inspection/compliance reports

Additional Details: (Dates of Report, Follow-up by the Licensee)

See Section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2BE-HOP1222.

Date Submitted:	March 31 2019	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	416.628.0216 ext. 124
	Fax:	
	email:	oliver.curran@tmacresouces.com

GPS Coordinates for water sources utilized

Source Description	Latitude	Longitude
HOP-1 - Raw water supply intake at Windy Lake	432626	7550477
Raw water supply intake at Doris Lake	433525	7558727

GPS Locations of areas of waste disposal

Source Description	Latitude	Longitude

NWB Annual Report **Year being reported:** 2018

License No:	2BB-MAE1727	**Issued Date:**	May 23, 2017
		Expiry Date:	May 22, 2027

Project Name: Madrid Advanced Exploration Program

Licensee: TMAC Resources Inc.

Mailing Address:
95 Wellington St. W.
Suite 1010, PO Box 44
Toronto, Ontario M5J 2N7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2BB-MAE1727 was assigned to TMAC Resources Inc. on May 23, 2017.

General Background Information on the Project (*optional):

No construction or mining activities occurred in the Madrid license area in 2018. A brief exploration and geotechnical drill program occurred in the license area. Baseline sampling was conducted during the open water season at proposed monitoring stations.

Licence Requirements: the licensee must provide the following information in accordance with

Part B Item 2

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Patch Lake/Windy Lake

Water Quantity:		
	108000 cu.m/yr*	Quantity Allowable Domestic (cu.m)
	0 cu. m/yr	Actual Quantity Used Domestic (cu.m)
	not specified	Quantity Allowable Drilling (cu.m)
	0 cu. m/yr	Total Quantity Used Drilling (cu.m)

**Part E, Item 1 total volume from "all sources and for all purposes"*

Waste Management and/or Disposal

- ☐ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☐ Other:

Additional Details:

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.:	N/A	(as reported to the Spill Hot-line)
Date of Spill:	N/A	
Date of Notification to an Inspector:	N/A	

Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc.)

No spills occurred in this license area during 2017.

Revisions to the Spill Contingency Plan

Other: (see additional details)

Additional Details:

See Section 12. of attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Other: (see additional details)

Additional Details:

Please see Section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see Section 12. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Details attached

Additional Details:

N/A

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Not Applicable (N/A)

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

No additional sampling requested by an Inspector or the Board

Additional Details: (date of request, analysis of results, data attached, etc.)

N/A

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

No additional sampling requested by an Inspector or the Board

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

No inspection and/or compliance report issued by INAC

Additional Details: (Dates of Report, Follow-up by the Licensee)

N/A

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2BB-MAE1727.

Date Submitted:	March 31 2019	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	416.628.0216 ext. 124
	Fax:	
	email:	oliver.curran@tmacresouces.com

GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing
MAE-01 Windy Freshwater Intake	432626	7550477

GPS Locations of areas of waste disposal

Location Description	UTM Easting	UTM Northing

GPS Locations of Active Monitoring Stations not included above*

Monitoring Station	UTM Easting	UTM Northing
MAE-14	7550317	432644
MAE-15	7550458	433578
MAE-16	7547060	434748

NWB Annual Report **Year being reported:** 2018

License No:	2BB-BOS1727	**Issued Date:**	August 1, 2017
		Expiry Date:	July 31, 2027

Project Name: Boston Advanced Exploration Project

Licensee: TMAC Resources Inc.

Mailing Address:
95 Wellington St. W.
Suite 1010, PO Box 44
Toronto, Ontario M5J 2N7

Name of Company filing Annual Report (if different from Name of Licensee please clarify relationship between the two entities, if applicable):

Licence 2BB-BOS1217 was issued Aug 2, 2012 to Hope Bay Mining Ltd. Effective June 18, 2013, the NWB authorized the assignment of Licence 2BB-BOS1217 from Hope Bay Mining Ltd. to TMAC Resources Inc. The license was renewed on August 1, 2017 and renamed 2BB-BOS1727.

General Background Information on the Project (*optional):

The Boston site supports advanced mineral exploration in the south end of the Hope Bay Greenstone Belt. The site reamined in a state of care and maintenance in 2018. Activites for 2018 were limited to a resupply of exploration equipment and back haul of waste to the Doris site in April via winter track. Routine sampling, inspections and dewatering of water management facilities occurred during the open water season as well as waste backhaul to the Doris site.

Licence Requirements: the licensee must provide the following information in accordance with

Part B	Item 9

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s): Aimaokatalok (Spyder) Lake for domestic use and drilling purposes. The total quantity of water allowable by the licence is 36,500 m^3/yr or 100 m^3/day. There is no differentiation between quantities to be used domestically or for drilling.

Water Quantity:

not specified	Quantity Allowable Domestic (cu.m)
0	Actual Quantity Used Domestic (cu.m)
not specified	Quantity Allowable Drilling (cu.m)
0	Total Quantity Used Drilling (cu.m)

Waste Management and/or Disposal

- ☑ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☑ Other: Fuel Farm Berm, Containment Pond and Mine Portal discharges

Additional Details:

Activities in 2018 at the Boston Camp were limited to water management and licence compliance as the camp was not operational.

When the camp is open, the following applies:
Water for domestic use at Boston Camp is obtained from Aimaokatalok Lake via a 2 inch diameter submerged pipe with a DFO compliant fish screen. This intake pipe is linked to a pump house located approximately 30 metres from shore. In winter, the pump house is moved onto the ice to decrease the length of heat-traced line required to reach the location where the water is open under the ice.

Waste produced on site will be treated according to Part D of the licence, and in accordance with the relevant Management Plans *(Incineration Management Plan, Non-Hazardous Waste Management Plan, and Hazardous Waste Management Plan*). Some specifics are as follows:
-Food waste, paper waste and untreated wood waste is burned in the incinerator as per Part D Item 3.
-Solid waste that cannot be burned is transferred to the Roberts Bay waste management facility for packaging and is taken offsite for disposal.
-Drill cuttings produced under this licence are disposed of in depressions as per Part F Item 2.
-Sewage and greywater produced on site is processed in the sewage treatment plant as per Part D Item 11. Sludge is transported to Doris camp for disposal via winter track.
-Waste hazardous materials such as waste oil, glycol, and contaminated soil are shipped to Doris North either to be reclaimed or shipped offsite for disposal in an approved facility as per Part D Item 6.
-Fuel berm effluent is sampled for water quality against the discharge criteria of the licence. Effluent that meets the standards for discharge is released in accordance with the licence following a notification to the Inspector. Effluent that does not meet the licence criteria is treated onsite within the BOS-2 containment until it is remediated to acceptable levels for discharges from BOS-2 and BOS-5, or it is removed offsite for treatment/disposal. Approximately 45 cu.m was discharged to the tundra from BOS-2.
-Effluent from the landfarm is sampled in accordance with the licence criteria for discharge when water is available - no discharges occurred from the facility in 2018.
- Effluent from the mine portal/decline is sampled in accordance with the criteria specified for Monitoring Station BOS-9. Approximately 19 cu.m was discharged to the tundra from BOS-9.

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)
Date of Spill:
Date of Notification to an Inspector:
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

Please see section 11. of the attached Annual Report Supplement for a summary of all unauthorized discharges that occurred in 2018 under license 2BB-BOS1727.

Revisions to the Spill Contingency Plan

Additional Details:

See section 12. of attached Annual Report Supplement for details.

Revisions to the Abandonment and Restoration Plan

Additional Details:

Please see section 12. of the attached Annual Report Supplement for details.

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Please see section 12. of the attached Annual Report Supplement for details.

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Additional Details:

Details attached.

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Additional Details:

N/A

Results of any additional sampling and/or analysis that was requested by an Inspector

Additional Details: (date of request, analysis of results, data attached, etc)

No additional sampling or analysis was requested.

Any other details on water use or waste disposal requested by the Board by November 1 of the year being reported.

Additional Details: (Attached or provided below)

N/A

Any responses or follow-up actions on inspection/compliance reports

Additional Details: (Dates of Report, Follow-up by the Licensee)

See section 15. of attached Annual Report Supplement for details on inspection action items and how these were addressed.

Any additional comments or information for the Board to consider

Please see attached Annual Report Supplement for additional information requirements set out in Licence No. 2BB-BOS1727.

Date Submitted:	March 31 2019	
Submitted/Prepared by:	Oliver Curran	
Contact Information:	**Tel:**	416.628.0216 ext. 124
	Fax:	
	email:	Oliver.curran@tmacresouces.com

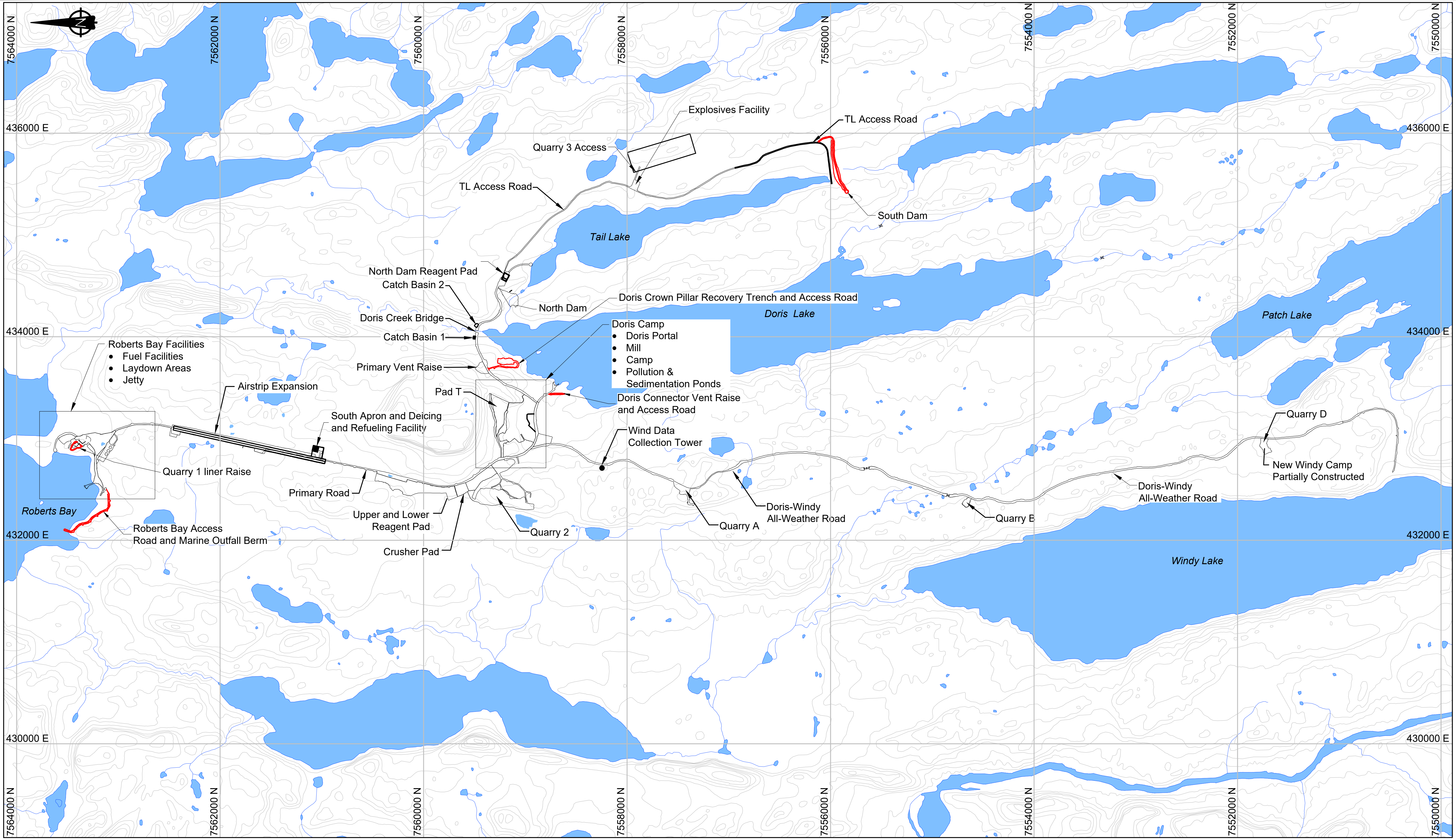
GPS Coordinates for water sources utilized

Source Description	UTM Easting	UTM Northing
BOS-1a - Raw water supply intake at Spyder Lake	440855	7505584

GPS Locations of areas of waste disposal

Location Description (type)	UTM Easting	UTM Northing
BOS-2 - Containment Pond Discharge	441332	7505378
BOS-3 - Sewage Disposal Facility Final Discharge	441191	7505560
BOS-4 - Treated sewage effluent point prior to entry into Aimaokatuk (Spyder) Lake	441211	7505776
BOS-5 - Effluent from the bulk fuel storage facility prior to release	441321	7505322
BOS-6 - Effluent from the landfarm treatment facility prior to release	441274	7505317
BOS-8 - Seepage/runoff from the ore stockpiles and camp pad, monitored on the tundra east of the ore stockpiles	441272	7505473
BOS-9 - Effluent from the portal decline	441219	7505378

Appendix C
Site Layouts



P:\01_SITES\Hope Bay\ACAD\2018 Drawings\1CT022.026 - 2018 As-Built Update.dwg

LEGEND

Asbuilt Crests / Toes

2018 Construction Items

NOTES

1. Coordinate system is UTM Zone 8, NAD83.

0m 350 700 1050 1400

srk consulting

SRK JOB NO.: 1CT022.026

FILE NAME: 1CT022.026 - 2018 As-Built Update.dwg

MAC RESOURCES

HOPE BAY PROJECT

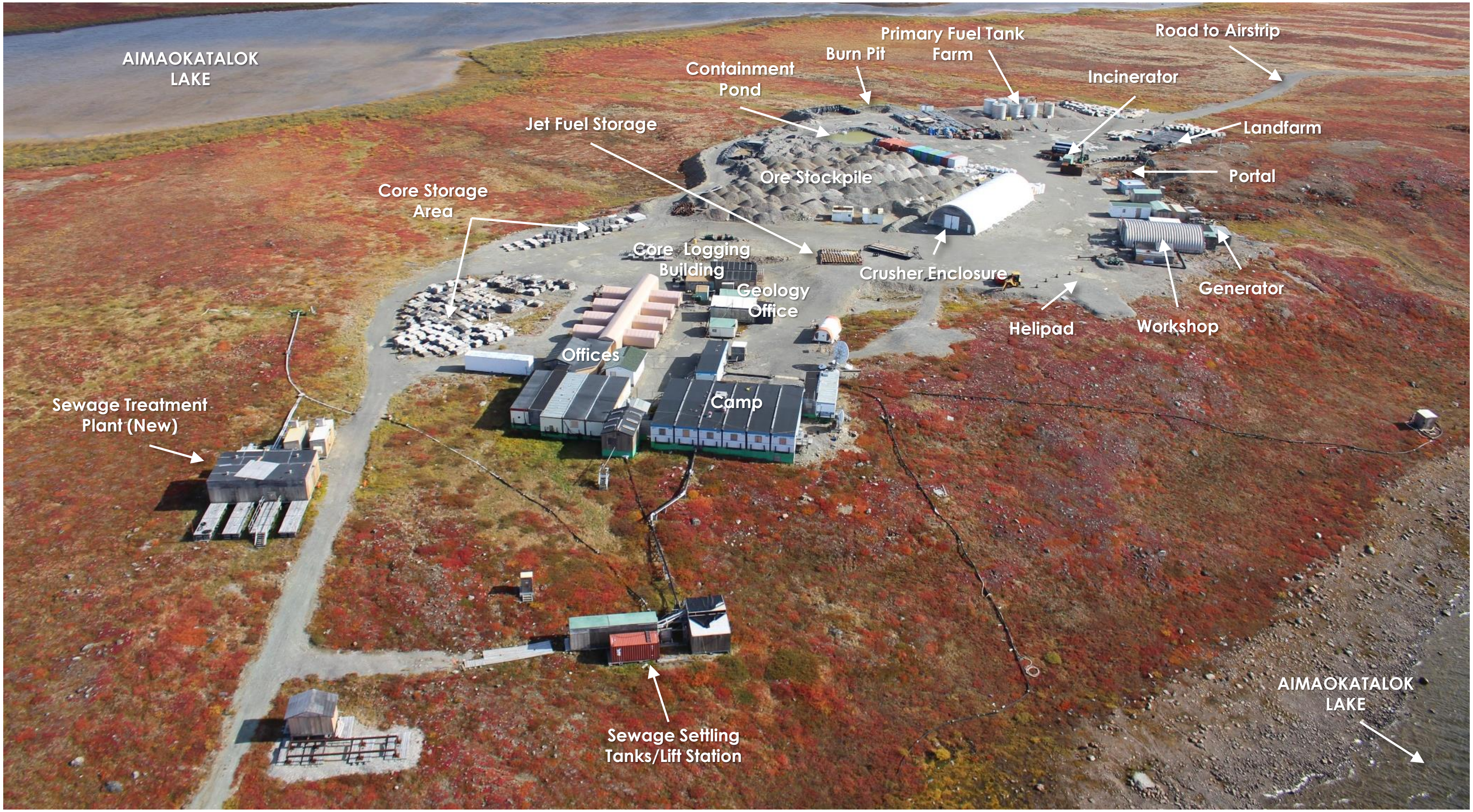
2018 KIA Annual Report

Doris Area 2018
As-Built Summary

DATE:	APPROVED:	FIGURE:
February 2019	CH	1

TMAC RESOURCES	KIA Annual Report	
	Doris Site Layout (looking North)	
HOPE BAY PROJECT	Date:	March 2019

TMAC RESOURCES	KIA Annual Report	
	Windy Camp Layout (looking East)	
HOPE BAY PROJECT	Date:	March 2019



TMAC RESOURCES	KIA Annual Report	
	Boston Site Layout (looking South)	
HOPE BAY PROJECT	Date:	March 2019

Appendix D
Water Licence(s) Monitoring Data

Appendix D.1. 2AM-DOH1323

Appendix D.2. 2BE-HOP1222

Appendix D.3. 2BB-MAE1727

Appendix D.4. 2BB-BOS1217

Appendix D.1. 2AM-DOH1323

The Type A Water Licence No. 2AM-DOH1323 details the sampling and analysis requirements for the Surveillance Network Program (SNP) program. Table D1-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2AM-DOH1323. The location of each sampling point is illustrated in Figure D1-1 below.

Table D1-1. 2AM-DOH1323 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
ST-1	Sedimentation Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-2	Pollution Control Pond	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
ST-3	Discharge from Non-hazardous Landfill pollution control sump	Construction, Care and Maintenance, Operation, Closure	G, MT and Total Ammonia-N, Total Sulphate, Total and Free CN, Total Oil and Grease	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-4	Discharge from Landfarm sump	Construction, Operation, Care and Maintenance, Closure	G, HC, total Ammonium, total Lead	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-5	Discharge from the Plant Site Fuel Storage and Containment Area Sump	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-6a and ST-6b	Discharge from the Roberts Bay Fuel Storage and Containment Area Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC, Total Pb	Annually. Once prior to every discharge onto the tundra
			D	Daily during periods of discharge
ST-7	Freshwater pumped from Doris Lake	Construction, Operation, Care and Maintenance, and Closure	G, N1, N2, MT and Free CN, Total CN, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, and Total Oil and Grease, Cl	Monthly during periods of pumping
			D	Monthly during periods of pumping
			Cl-a	Annually

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
ST-7a	Freshwater pumped from the Windy Lake freshwater intake	Construction, Operation, Care and Maintenance, Closure	G, N1, N2, MT and, T-Ag, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, T-Tl, T-Ca, and Total Oil and Grease	Monthly during periods of pumping
			B	
			D	
ST-8	Discharge from Wastewater Treatment Plant bio-membrane	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when discharge to the Tundra, Annually when discharge to the TIA
			Location of discharge	Monthly during periods of discharge
			D	Daily during periods of discharge
ST-9	Runoff from Wastewater Treatment Plant discharge - downstream of wastewater treatment plant discharge point and just prior to flow entering Doris Lake	Construction, Operation, Care and Maintenance, Closure	G, B, and Total Oil and Grease	Monthly when discharged to the tundra
ST-10	Site Runoff from Sediment Controls	Construction, Operations, Closure	TSS or Turbidity (following development and approval of a site-specific TSS-Turbidity)	Daily during periods of discharge
ST-11	Reagent and Cyanide Storage Facility Sumps	Construction, Operation, Care and Maintenance, Closure	G, HC , MT, Total Ammonia, Total and Free Cyanide, and D	Annually
ST-12	Doris Lake	Operation, Closure	Water Level	Monthly
			Ice Thickness	Annually in April
ST-13	Pollution Control Pond associated to Pad U	Construction, Operation, Care and Maintenance, Closure	G, N1, MT and Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, and Total Metals by ICP-MS	Annually
TL-1	TIA at the Reclaim Pipeline	Operation, Care and Maintenance, Closure, Post-Closure (for up to 9 years after cessation of mining)	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr,T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, HC, FC	Monthly during Operations, Closure and Post-Closure Annually during Care and Maintenance
			Dissolved Oxygen and Redox Potential	Annually
			Acute Lethality	Annually during Post-Closure
			B	Annually

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
TL-2	Doris Outflow Creek - upstream (at the flow monitoring station adjacent to the bridge)	Closure, Post-Closure (for up to 9 years after cessation of mining)	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Oil and Grease	Annually during Care and Maintenance Annually for 2 years prior to Post-Closure, and during Post-Closure, Increase to three times per year (under ice, freshet, and pre-freeze up), two years prior to breach of the North Dam.
		Operation	D	Daily upon commencement of mining in or beneath the Doris Lake Talik.
TL-3	Doris Outflow Creek (~80m downstream of the base of the waterfall)	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, Total Oil and Grease D	Inactive
TL-4	TIA Discharge End-of-Pipe	Care and Maintenance, prior to any deposit of tailings to the TIA	G, N1, N2, MT, and TDS, Cl, Free CN, Total CN, T-Ag, T-Ca, T-Cd, T-Cr, T-Hg, T-K, T-Mo, T-Mg, T-Na, T-Se, T-Tl, T-Radium 226 Acute Lethality B D	Inactive
TL-5	Effluent from Process Plant (tailings slurry/ water)	Operations	G, N1, MT, and Free CN, Total CN, WAD CN, Sulphate, T-Cd, T-Cr, T-Hg, T-Mo, T-Se, and Total Metals by ICP-MS Cyanate and Thiocyanate	Quarterly
TL-6	Tailings Discharged into TIA (Solid Component) taken from a valve in the mill at the discharge end of the mill tailings pumps	Operations	Tonnage of dry tailings solids	Monthly during periods of discharge
			MT and T-Cd, T-Cr, T-Hg, T-Mo, T-Se, Total Inorganic Carbon and Total Metals by ICP-MS (must include Sulphur)	Sampled on a weekly basis with analyses carried out monthly on a composite sample of the TL-6 weekly samples
TL-7	Detoxified tailings sent underground as backfill	Operations	Dry tonnage of detoxified tailings sent underground; WAD CN, Total Inorganic Carbon, Total Metals by ICP-MS (including Sulphur), Moisture content of backfill trucked underground	Monthly
			Cyanate and Thiocyanate	Quarterly
TL-8	Reclaim water pumped from TIA to Mill Process water tank taken from a valve at the discharge end of the reclaim water pump	Inactive		Inactive

SNP Station	Description	Phase	Monitoring Parameters	Frequency during Operations and Anytime after Initial Deposit of Tailings to the TIA
TL-9	Detox tailings reactor tank (650-TK-565)	Operations	Continuous automated monitoring. Should the automatic monitor used to carry out this measurement be out of service manual samples from the detox filter feed pumps (650-PU-567/568) will be used to verify process operations.	
TL-10	Water Column in deepest portion of Tail Lake and at a location away from the TIA Reclaim water floating pump house, sampled at surface, mid- depth and near bottom	Inactive		Inactive
TL-11	Seepage from underground backfilled stopes	Operations	Visual inspection for seepage. If seepage present parameters to be monitored include N1 and pH, EC, Trace metals by ICP-MS, Alkalinity, Acidity, Sulphate, Total and WAD CN	Survey Twice annually
TL-12	Mine Water Discharge Point	Operations during continuous pumping	Chloride, TDS and nitrate	Weekly
			Total Ammonia, Nitrate, Nitrite, pH, EC, ICPMS Metals, alkalinity, sulphate, TSS, major ions and Total and WAD Cyanide	Monthly
			D	Daily during periods of discharge

Figure D1-1. 2AM-DOH1323 Sample Stations Location

SUMMARY OF MONTHLY MONITORING REPORTING [SEE PART J ITEM 21]

In 2018 commercial operations continued at Doris with continued efforts to progressively ramp up production to increase ore throughput and optimize gold recovery. The installation of the secondary crushing line was completed in 2018 which allowed increased throughput of ore in the mill. Projects such as the installation of gravity concentrators in the mill crushing circuit contributed to improved gold recovery.

Civil construction activities included the installation of a fabric tent structure over the mill primary crusher and completion of an enclosure for the detoxified tailings conveyor exiting the mill building. Two dorms were added to allow an additional 98 bed spaces at Doris Camp. Earthworks continued in order to complete the Doris Airstrip south apron expansion with lined aircraft de-icing and refueling pad. Construction of the Tailings Impoundment Area South Dam and associated access road were completed in 2018. In addition to this, construction of the access road and marine outfall berm for the Roberts Bay ocean discharge line and fusing of the discharge pipeline began in 2018. To accommodate increased fuel storage required for future project activities, the Robert's Bay single tank farm berm was raised to allow full use of the 5ML tank and this tank was recommissioned in 2018. In order to support continued underground development, the Doris Connector Vent Raise access road was constructed.

Underground waste development continued in 2018 with further advancement of the BTD decline and necessary support infrastructure. TMAC completed ore development above the dyke for long hole drilling and blasting in the Doris Connector (DCO) and BTD in Doris North, and commenced ore sill development in the DCO. TMAC also continued waste development in the DCO for future mining horizons. Long hole blasting continued throughout 2018, with all ore production trucked to surface and processed through the mill or added to the stockpile. Development of the Doris Central (DCN) decline began in Q4 of 2018. TMAC continued underground exploration diamond drilling below the dyke ("BTD") at Doris, focused on the BTD East limb in 2018. The DCO Vent Raise was constructed and a conventional raise to surface was also developed from the BTD to support underground ventilation requirements.

Ore development also occurred from surface in Q4 of 2018 with the completion of surface blasting and hauling of ore and waste from the Doris Crown Pillar Trench (DCPT).

During 2018, TMAC collected data from the following active or seasonally active monitoring stations: TL-1, TL-2, TL-5, TL-6, TL-7, TL-9, TL-11, TL-12, ST-1, ST-2, ST-4, ST-5, ST-6a, ST-6b, ST-7, ST-7a, ST-8, ST-9, ST-10, ST-11 and ST-12.

Monitoring at station ST-3 (Landfill Sump) and station ST-13 (Pollution Control Pond #2) did not occur, as these facilities were not constructed as of 2018.

Monitoring of the TIA was undertaken at monitoring station TL-1. Monitoring of the tailings deposited into the TIA continued at monitoring stations TL-5 and TL-6 in 2018. Monitoring of detoxified tailings backfilled underground was completed at monitoring stations TL-7 and TL-11. As described in the Hope Bay Water Management Plan, the sedimentation pond (ST-1) was used as a collection pond for the water that accumulated in the pollution control pond (ST-2) and the two underflow sumps (ST2-S1 and ST2-S2). The water collected in ST-1 was then transferred to the TIA by pipeline. Dewatering of the TIA did not occur in 2018.

Dewatering of the underground (TL-12) began in February 2018. This water was transferred to the TIA through the mill tailings pipeline and through the Sedimentation Pond pipeline in August and September.

All monitoring was conducted in accordance with the Hope Bay Project Quality Assurance and Quality Control Plan (2017).

TMAC uses an external certified laboratory to carry out all analyses reported in the monthly and annual reports. The QA/QC data produced by ALS Canada Ltd. and Maxxam Analytics Inc. are used to determine the accuracy and precision of results in these reports.

Thermal monitoring was undertaken in 2018 at active ground temperature monitoring stations. Results of this monitoring are included in the annual Geotechnical Inspection report.

Conditions of the Doris North Diversion Berm's effectiveness during spring freshet, major rain events, and periods of sustained (non-frozen) precipitation were monitored and documented.

Details of all monitoring follows.

ST-1 Sedimentation Pond

This facility was constructed and first used in 2011. In 2018, during open water season, all discharges from the facility were made directly to the TIA via pipeline as per Part G Item 22. All discharges from the facility were metered. Water quality samples were collected from an outlet on the discharge pump with the intake on the pump submerged approximately 0.25m below the water surface in the Sedimentation Pond. If the pump was not running, samples were collected from the pond itself. Samples were taken monthly during periods of discharge.

Water was transferred from ST-1 to the TIA beginning in June and continued into September. The final day of discharge from the Sedimentation Pond was September 18, 2018.

Volumes transferred to the TIA from ST-1 are summarized in Table D1-2. This includes water transferred from ST-2, ST2-S1, and ST2-S2 to ST-1, as described above, and water transferred from fuel storage facility berms ST-5, ST-6a and ST-6b. Volumes presented for August and September include water transferred from the underground workings to the Sedimentation Pond for transfer to the TIA. Results of water quality samples, collected monthly from ST-1, are summarized in Table D1-3.

Table D1-2. Summary of Monthly Water Management Volumes for Monitoring Station ST-1, June to September 2018

Month	Monthly Volume (m^3)	Cumulative Volume (m^3)*
June	11,725	11,725
July	6,876	18,601
August	31,498	50,099
September	17,232	67,331
Total Volume of Water Transferred from ST-1 (includes water from ST-2, ST2-S1, ST2-S2 and TL-12) to TIA in 2018		**67,331**

** Values rounded to nearest whole cubic metre.*

ST-2 Pollution Control Pond

This facility was constructed in 2011. In 2018, it was active between June and September. Samples from ST-2 were collected from a depth of 0.25 m below the water surface. All water from the Pollution Control Pond was directed to the Sedimentation Pond.

Water quality monitoring sampling at ST-2 occurred as per Schedule J of the water licence. Results of the sampling are presented in Table D1-4.

Table D1-3. Water Quality Monitoring Program Results for ST-1, June to September 2018

	Sample ID	ST1	ST1	ST1	ST1
	ALS ID	L2111043-1	L2126698-1	L2142009-1	L2157594-1
	Date Sampled	6/10/2018 2:00:00 PM	7/8/2018 2:30:00 PM	8/5/2018 5:24:00 PM	9/2/2018 3:40:00 PM
Parameter	**Units**	**Results**			
Conductivity	µS/cm	1170	4640	34400	45200
Hardness (as $CaCO_3$)	mg/L	311 *	1150 *	6400 *	7650 *
pH	pH	7.69	7.88	7.64	7.82
Total Suspended Solids	mg/L	15.8	6.9	89.8	92.7
Alkalinity, Total (as $CaCO_3$)	mg/L	35.9	127	122	140
Ammonia, Total (as N)	mg/L	5.2	25.2	23.9	25.1
Bromide (Br)	mg/L	0.34	1.8	48.1	55.5
Chloride (Cl)	mg/L	270	1180	12900	14300
Fluoride (F)	mg/L	<0.10 *	<0.40 *	<2.0 *	<2.0 *
Nitrate (as N)	mg/L	11.1	53.7	31.5	23.7
Nitrite (as N)	mg/L	0.237	0.748	1.5	0.98
Sulfate (SO_4)	mg/L	44.3	248	1370	1470
Cyanide, Total	mg/L	0.356	2.94	0.504	0.0896
Aluminum (Al)-Total	mg/L	0.122	0.0496	0.913	2.9
Antimony (Sb)-Total	mg/L	<0.00050	0.00095	<0.0020 *	<0.0050 *
Arsenic (As)-Total	mg/L	0.00054	0.00448	<0.0020 *	<0.0050 *
Barium (Ba)-Total	mg/L	0.021	0.069	0.061	0.056
Beryllium (Be)-Total	mg/L	<0.00010	<0.00020 *	<0.0020 *	<0.0050 *
Boron (B)-Total	mg/L	<0.10	0.27	2.59	3.41
Cadmium (Cd)-Total	mg/L	0.00004	0.000125	<0.00010 *	<0.00025 *
Calcium (Ca)-Total	mg/L	103	364	1230	1330
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0020 *	<0.0050 *
Cobalt (Co)-Total	mg/L	0.00571	0.0411	0.0126	0.0068
Copper (Cu)-Total	mg/L	0.183	2.31	0.307	0.173
Iron (Fe)-Total	mg/L	0.351	1.43	2.27	7.97

	Sample ID	ST1	ST1	ST1	ST1
	ALS ID	L2111043-1	L2126698-1	L2142009-1	L2157594-1
	Date Sampled	6/10/2018 2:00:00 PM	7/8/2018 2:30:00 PM	8/5/2018 5:24:00 PM	9/2/2018 3:40:00 PM
Parameter	**Units**	**Results**			
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	0.0016	0.0037
Lithium (Li)-Total	mg/L	0.0043	0.014	0.12	0.149
Magnesium (Mg)-Total	mg/L	13.3	59.4	808	1050
Manganese (Mn)-Total	mg/L	0.23	0.566	2.14	2.64
Mercury (Hg)-Total	mg/L	<0.0000050	¥	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0013	0.0092	0.0066	0.0054
Nickel (Ni)-Total	mg/L	0.0062	0.0661	0.013	<0.025 *
Potassium (K)-Total	mg/L	5.8	33.7	179	220
Selenium (Se)-Total	mg/L	0.000471	0.00382	0.0024	<0.0025 *
Silver (Ag)-Total	mg/L	0.000856	0.0178	0.00033	<0.00050 *
Sodium (Na)-Total	mg/L	76.7	413	5950	7640
Thallium (Tl)-Total	mg/L	<0.000010	0.000027	<0.00020 *	<0.00050 *
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.0020 *	<0.0050 *
Titanium (Ti)-Total	mg/L	<0.010	<0.010	0.024	0.065
Uranium (U)-Total	mg/L	0.00026	0.00147	0.00074	<0.00050 *
Vanadium (V)-Total	mg/L	0.00089	<0.0010 *	<0.010 *	<0.025 *
Zinc (Zn)-Total	mg/L	0.0088	0.0492	0.126	<0.15 *
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No
Diethylene Glycol	mg/L	<5.0	<5.0	<5.0	<5.0
Ethylene Glycol	mg/L	<5.0	<5.0	<5.0	<5.0
1,2-Propylene Glycol	mg/L	<5.0	<5.0	7.5	<5.0
Triethylene Glycol	mg/L	<5.0	<5.0	<5	<5.0

¥ Analysis for Total Mercury was inadvertently omitted from this sample.

Table D1-4. Water Quality Monitoring Program Results for ST-2, June to September 2018

	Sample ID	ST2	ST2	ST2	ST2
	ALS ID	L2111043-2	L2126698-2	L2142009-2	L2157594-2
	Date Sampled	6/10/2018 2:30:00 PM	7/8/2018 2:50:00 PM	8/5/2018 5:02:00 PM	9/2/2018 3:20:00 PM
Parameter	**Units**	**Results**			
Conductivity	µS/cm	3320	5810	6000	10100
Hardness (as $CaCO_3$)	mg/L	710 *	1530 *	1360 *	2670 *
pH	pH	7.81	7.73	7.7	7.86
Total Suspended Solids	mg/L	8.4	10.3	25	24.7
Alkalinity, Total (as $CaCO_3$)	mg/L	168	125	134	128
Ammonia, Total (as N)	mg/L	14.6	34.1	34.9	54.7
Bromide (Br)	mg/L	<1.0 *	2.4	2.6	4.5
Chloride (Cl)	mg/L	615	1530	1530	2700
Fluoride (F)	mg/L	<0.40 *	<0.40 *	<1.0 *	<1.0 *
Nitrate (as N)	mg/L	23	69.3	64.6	115
Nitrite (as N)	mg/L	0.996	0.748	0.886	1.09
Sulfate (SO_4)	mg/L	430	281	474	335
Cyanide, Total	mg/L	19.2	9.34	3.65	2.26
Aluminum (Al)-Total	mg/L	0.209	0.0171	0.057	0.24
Antimony (Sb)-Total	mg/L	0.00155	0.00093	0.00099	<0.0010 *
Arsenic (As)-Total	mg/L	0.00894	0.00497	0.00479	0.0021
Barium (Ba)-Total	mg/L	0.043	0.089	0.079	0.137
Beryllium (Be)-Total	mg/L	<0.00020 *	<0.00020 *	<0.00050 *	<0.0010 *
Boron (B)-Total	mg/L	0.26	0.3	0.35	0.3
Cadmium (Cd)-Total	mg/L	0.000164	0.0001	0.000079	0.000125
Calcium (Ca)-Total	mg/L	225	477	421	831
Chromium (Cr)-Total	mg/L	0.0027	0.001	<0.0010	0.0015
Cobalt (Co)-Total	mg/L	0.0795	0.0471	0.0358	0.0523
Copper (Cu)-Total	mg/L	9.37	2.41	0.589	2.06
Iron (Fe)-Total	mg/L	12	2.52	1.12	1.8

	Sample ID	ST2	ST2	ST2	ST2
	ALS ID	L2111043-2	L2126698-2	L2142009-2	L2157594-2
	Date Sampled	6/10/2018 2:30:00 PM	7/8/2018 2:50:00 PM	8/5/2018 5:02:00 PM	9/2/2018 3:20:00 PM
Parameter	**Units**	**Results**			
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0097	0.0134	0.0133	0.018
Magnesium (Mg)-Total	mg/L	35.8	80.9	74.8	144
Manganese (Mn)-Total	mg/L	0.555	0.502	0.496	0.711
Mercury (Hg)-Total	mg/L	<0.00050 *	¥	0.000006	0.0000117
Molybdenum (Mo)-Total	mg/L	0.0109	0.0088	0.0072	0.0076
Nickel (Ni)-Total	mg/L	0.137	0.0683	0.0393	0.0682
Potassium (K)-Total	mg/L	27.2	44.2	36.6	51.6
Selenium (Se)-Total	mg/L	0.00587	0.0051	0.00398	0.00521
Silver (Ag)-Total	mg/L	0.0884	0.0151	0.00297	0.0103
Sodium (Na)-Total	mg/L	441	553	558	829
Thallium (Tl)-Total	mg/L	0.000024	0.000027	<0.000050 *	<0.00010 *
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.0010 *
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	0.00199	0.00184	0.00197	0.00295
Vanadium (V)-Total	mg/L	0.0039	<0.0010 *	<0.0025 *	<0.0050 *
Zinc (Zn)-Total	mg/L	0.0134	<0.0060 *	<0.015 *	<0.030 *
Oil and Grease	mg/L	6.4	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No
Diethylene Glycol	mg/L	<5.0	<5.0	<5.0	<5.0
Ethylene Glycol	mg/L	<5.0	<5.0	<5.0	<5.0
1,2-Propylene Glycol	mg/L	42.4	<5.0	15.3	<5.0

¥ Analysis for Total Mercury was inadvertently omitted from this sample.

ST-4 Landfarm

A discharge notification for this facility was provided to the Inspector on May 15, 2018. Water from the Landfarm (ST-4) was sampled on June 18, 2018; however the laboratory could not complete analysis for Benzene, Ethylbenzene and Toluene as the sample bottles used to collect this sample were incompatible for this analysis. No discharge occurred from this facility until a second sample was collected on July 6, 2018 and was compliant with criteria outlined in Part G Item 23(c) of the water licence. A total of 14 m^3 was discharged from this facility to tundra in 2018 at a location approved by the Inspector. Results of Landfarm water sampling are presented in Table D1-5.

ST-5 Doris Plant Site Fuel Storage and Containment

Water from the Doris tank farm (ST-5) was sampled on June 5, 2018 prior to discharge events and results exceeded the discharge criteria for Total Suspended Solids (TSS) outlined in Part G Item 23(e). Results of this sampling are presented in Table D1-6. The exceedance of TSS is believed to be related to vehicle traffic within the facility during maintenance of the fuel tanks at the time of sampling.

No discharge to tundra occurred from this facility in 2018. On June 20, 2018 the Inspector granted permission to use this water for dust suppression on site roads as TSS was the only parameter to exceed the allowable discharge limits. No water from this facility was used for dust suppression in 2018. A total of 923 m^3 of water was transferred to the Sedimentation Control Pond for transfer to the TIA.

ST-6a Roberts Bay Bulk Fuel Storage Facility

Water from the Roberts Bay 5ML tank farm (ST-6a) was sampled on June 5, 2018 prior to discharge and results exceeded the discharge criteria for Total Suspended Solids (TSS) outlined in Part G Item 23(e). Additional samples collected on June 13 and July 23, 2018 exceeded the discharge criteria for TSS. Results of this sampling are presented in Table D1-7. The exceedance of TSS is believed to be related to vehicle traffic within the facility during maintenance of the fuel tanks at the time of sampling.

No discharge to tundra occurred from this facility in 2018. On June 20, 2018 the Inspector granted permission to use this water for dust suppression on site roads as TSS was the only parameter to exceed the allowable discharge limits. No water from this facility was used for dust suppression in 2018. A total of 943 m^3 of water was transferred to the Sedimentation Control Pond for transfer to the TIA.

ST-6b Roberts Bay Bulk Fuel Storage Facility

Water from the Roberts Bay 3x5 ML tank farm (ST-6b) was sampled on June 6, 2018 prior to discharge and results exceeded the discharge criteria for Total Suspended Solids (TSS) outlined in Part G Item 23(e). A second sample collected on June 13, 2018 also exceeded the discharge limit for TSS. An additional sample was collected on July 23, 2018 and met the discharge criteria for TSS; however a duplicate sample collected at that time exceeded the criteria for this parameter. Results of this monitoring are presented in Table D1-8. The exceedance of TSS is believed to be related to vehicle traffic within the facility during maintenance of the fuel tanks at the time of sampling.

No discharge to tundra occurred from this facility in 2018. On June 20, 2018 the Inspector granted permission to use this water for dust suppression on site roads as TSS was the only parameter to exceed the allowable discharge limits. A total of 1,114 m^3 of water from this facility was used for dust suppression on site roads in July 2018. An additional 362 m^3 of water was transferred to the Sedimentation Control Pond for transfer to the TIA in 2018.

Table D1-5. Water Quality Monitoring Program Results for ST-4, June to July 2018

	Sample ID	ST4 *	ST4	ST4 DUP^	Part G Item 23(e.)
	ALS ID	L2114998-1	L2125252-1	L2125252-2	Maximum Allowable Concentration (mg/L)
	Date Sampled	6/18/2018 4:00:00 PM	7/6/2018 8:00:00 AM	7/6/2018 8:00:00 AM	
Parameter	**Units**		**Results**		
pH	pH	8.09	8.18	8.21	6.0-9.0
Total Suspended Solids	mg/L	3.1	<3.0	<3.0	15.0
Ammonia, Total (as N)	mg/L	<0.13	<0.0050	<0.013	2.0
Lead (Pb)-Total	mg/L	0.000204	<0.000050	<0.000050	0.01
Oil and Grease	mg/L	<5.0	<5.0	<5.0	5
Oil And Grease (Visible Sheen)		No	No	No	
Benzene	mg/L		<0.00050	<0.00050	0.37
Ethylbenzene	mg/L		<0.00050	<0.00050	0.09
Methyl t-butyl ether (MTBE)	mg/L		<0.00050	<0.00050	
Styrene	mg/L		<0.00050	<0.00050	
Toluene	mg/L		<0.00045	<0.00045	0.002
ortho-Xylene	mg/L		<0.00050	<0.00050	
meta- & para-Xylene	mg/L		<0.00050	<0.00050	
Xylenes	mg/L		<0.00075	<0.00075	
4-Bromofluorobenzene (SS)	%		92.6	92.5	
1,4-Difluorobenzene (SS)	%		104.3	99.7	

** Incorrect samples bottles were used to collect sample for Benzene, Ethylbenzene and Toluene analysis. Lab unable to complete analysis for these parameters in this sample. No discharge occurred from this facility until a second sample was collected in July to confirm discharge criteria were met for these parameters.*
^ Duplicate sample.

Table D1-6. Water Quality Monitoring Program Results for ST-5, June 2018

	Sample ID	ST5	ST5-DUP^	Part G Item 23(e.)
	ALS ID	L2108320-1	L2108320-4	Maximum Allowable Concentration (mg/L)
	Date Sampled	6/5/2018 5:45:00 PM	6/5/2018 5:45:00 PM	
Parameter	Units	Results		
pH	pH	8.02	8.02	6.0-9.0
Total Suspended Solids	mg/L	**20.5**	**29.1**	15.0
Lead (Pb)-Total	mg/L	0.00179	0.00183	0.01
Oil and Grease	mg/L	<5.0	<5.0	5
Oil And Grease (Visible Sheen)		No	No	
Benzene	mg/L	<0.00050	<0.00050	0.37
Ethylbenzene	mg/L	<0.00050	<0.00050	0.09
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	
Styrene	mg/L	<0.00050	<0.00050	
Toluene	mg/L	<0.00045	<0.00045	0.002
ortho-Xylene	mg/L	<0.00050	<0.00050	
meta- & para-Xylene	mg/L	<0.00050	<0.00050	
Xylenes	mg/L	<0.00075	<0.00075	
4-Bromofluorobenzene (SS)	%	99	95.1	
1,4-Difluorobenzene (SS)	%	100	91.8	

*Note: **Bold** indicates exceedance of Part G Item 23(e) Maximum Allowable Concentration.*
^ Duplicate sample.

Table D1-7. Water Quality Monitoring Program Results for ST-6a, June to July 2017

	Sample ID	ST6A	ST6A-DUP^	ST6A	ST6A	Part G Item 23(e.)
	ALS ID	L2108320-2	L2108320-5	L2112433-1	L2134875-1	Maximum Allowable Concentration (mg/L)
	Date Sampled	6/5/2018 6:40:00 PM	6/5/2018 6:40:00 PM	6/13/2018 1:30:00 PM	7/23/2018 3:10:00 PM	
Parameter	**Units**	**Results**				
pH	pH	7.96	8	8	8.47	6.0-9.0
Total Suspended Solids	mg/L	**24.3**	**24.7**	**28.8**	**28.4**	15.0
Lead (Pb)-Total	mg/L	0.000401	0.000394	0.000558	0.000499	0.01
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	5
Oil And Grease (Visible Sheen)		No	No	No	No	
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.37
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.09
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	
Styrene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	
Toluene	mg/L	0.00048	0.00046	<0.00045	<0.00045	0.002
ortho-Xylene	mg/L	0.00069	0.00062	<0.00050	<0.00050	
meta- & para-Xylene	mg/L	0.00106	0.00093	<0.00050	<0.00050	
Xylenes	mg/L	0.00175	0.00154	<0.00075	<0.00075	
4-Bromofluorobenzene (SS)	%	93.6	90.5	97.1	89.6	
1,4-Difluorobenzene (SS)	%	87.2	88.2	93	101.3	

*Note: **Bold** indicates exceedance of Part G Item 23(e) Maximum Allowable Concentration.*
^ Duplicate sample.

Table D1-8. Water Quality Monitoring Program Results for ST-6b, June to July 2018

Sample ID ALS ID Date Sampled		ST6B L2108320-3 6/6/2018 8:30:00 AM	ST6B-DUP^ L2108320-6 6/6/2018 8:30:00 AM	ST6B L2112433-2 6/13/2018 1:40:00 PM	ST6B L2134875-2 7/23/2018 3:30:00 PM	ST6B-DUP^ L2134875-3 7/23/2018 3:30:00 PM	Part G Item 23(e.) Maximum Allowable Concentration (mg/L)
Parameter	**Units**			**Results**			
pH	pH	8	7.99	8.09	8.36	8.35	6.0-9.0
Total Suspended Solids	mg/L	**20.5**	**19.9**	**18**	12.8	**22.2**	15.0
Lead (Pb)-Total	mg/L	0.000682	0.000688	0.000587	0.000154	0.000284	0.01
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	5
Oil And Grease (Visible Sheen)		No	No	No	No	No	
Benzene	mg/L	<0.00050	<0.00050	<0.0025 *	<0.00050	<0.00050	0.37
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.0025 *	<0.00050	<0.00050	0.09
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	<0.0025 *	<0.00050	<0.00050	
Styrene	mg/L	<0.00050	<0.00050	<0.0025 *	<0.00050	<0.00050	
Toluene	mg/L	<0.00045	<0.00045	<0.0023 *	<0.00045	<0.00045	0.002
ortho-Xylene	mg/L	<0.00050	<0.00050	<0.0025 *	<0.00050	<0.00050	
meta- & para-Xylene	mg/L	<0.00050	<0.00050	<0.0025 *	<0.00050	<0.00050	
Xylenes	mg/L	<0.00075	<0.00075	<0.0035	<0.00075	<0.00075	
4-Bromofluorobenzene (SS)	%	98.2	90.9	104	90.6	90.8	
1,4-Difluorobenzene (SS)	%	78.7	89.6	84.5	100.1	100.1	

*Note: **Bold** indicates exceedance of Part G Item 23(e) Maximum Allowable Concentration.*
^ Duplicate sample.

ST-7 and ST-7a Freshwater Usage from Doris and Windy Lakes

Table D1-9 provides the volumes of water usage at the Doris project area as required under Part E Item 1 of water licence 2AM-DOH1323. The water extraction pump for Doris operations is located off the northwest shoreline of Doris Lake and the sampling station ST-7 is located within the Doris Lake pump house. In 2018, water from Doris Lake was not used for domestic consumption; all water for domestic consumption was obtained from Windy Lake at ST-7a (equivalent to location HOP-1 of the Regional Exploration Licence 2BE-HOP1222). Water for dust suppression in 2018 was obtained from Doris Lake, as well as from containment berm effluent as approved by the Inspector. Surface drilling, underground development and construction occurred in support of the Doris mine; water was sourced from Doris Lake, for these purposes. Additionally, water was used from Doris Lake for seasonal ice track construction in January, February and December. No water from Doris Lake was used in the mill for ore processing in 2018. Table D1-9 provides only water volumes used from lake sources and does not include water recycled from berms that would otherwise have been discharged to tundra as effluent.

Results of sampling at ST-7 at Doris Lake are provided in Table D1-10 and Table D1-11. Table D1-12 and Table D1-13 provide the results of water quality sampling for monitoring station ST-7a (HOP-1) at Windy Lake in compliance with the requirements set out in Schedule J of water licence 2AM-DOH1323.

ST-8 Discharge from Sewage Treatment Plant Bio-membrane

The Sewage Treatment Plant (STP) at Doris Camp is made up of two sewage treatment plant modules. Each plant has the capacity to treat wastewater for up to 180 personnel. Both units were utilized throughout 2018 to treat all domestic wastewater generated by the site.

Treated effluent samples were collected from the combined effluent holding tank of these two modules (ST-8) in 2018 to test the quality of the effluent to be discharged to the tundra, in accordance with Part G, Item 4(b) of the Licence. In-plant sampling facilitates year-round compliance evaluation of plant performance.

All effluent quality samples collected in 2018 were in compliance with the discharge criteria. All effluent quality monitoring results for ST-8 are provided in Table D1-14 and Table D1-15.

Treated effluent volumes released from ST-8 are metered daily and summary volumes reported in the monthly monitoring reports. In 2018 all treated effluent from ST-8 was discharged to the tundra west of the facility laydown areas (13W 432933 7559057) as approved by the Inspector. The monthly volumes of effluent discharged are presented in Table D1-16.

The sludge produced at the sewage treatment plant is sent to the TIA for disposal. The volume of sludge produced in 2018 is presented in Table D1-17.

ST-9 Runoff from Sewage Treatment Plant Discharge

In consultation with the Inspector during the 2009 inspection tour, the ST-9 sampling location was established (13W 430807 7559282). This point is east of Glenn Lake and down slope from the ST-8 tundra discharge location. Monthly monitoring was conducted at ST-9 June through September in 2018 in accordance with Schedule J of 2AM-DOH1323. The station is frozen during the remainder of the year. There is no water quality criteria specified in the licence for this monitoring station. Table D1-18 provides results of the 2018 seasonal monitoring.

Table D1-9. Doris North Water Usage in 2018

	Windy Lake (ST-7A)	Doris Lake (ST-7)					Mine Inflow	
Month	Domestic Water*	Domestic Water*	Surface Exploration	Industrial Usage**	Dust Suppression	Winter Track	Industrial Usage^	Total Usage
January	1,051	0	0	0	0	119	433	1,603
February	1,277	0	0	34	0	136	0	1,447
March	1,231	0	0	29	0	0	0	1,260
April	1,208	0	0	74	0	0	0	1,282
May	1,224	0	93	46	0	0	0	1,363
June	1,115	0	4	45	669	0	0	1,833
July	1,064	0	0	78	1,863	0	0	3,005
August	1,153	0	0	67	225	0	0	1,445
September	1,144	0	0	114	0	0	0	1,258
October	1,293	0	0	42	0	8	0	1,343
November	1,265	0	0	58	0	0	0	1,323
December	1,252	0	0	52	0	464	0	1,768
Annual Total	**14,277**	**0**	**97**	**639**	**2,757**	**727**	**433**	**18,930**
Annual Allowance	**22,995**							**480,000**

**As permitted by water licences 2BE-HOP1222 and 2AM-DOH1323*
***Includes industrial uses such as underground drilling, core processing, concrete batching, etc.*
^ Dewatering of groundwater inflow from the underground workings to the Tailings Impoundment Area (TL-12) began in February. Mine water inflow was no longer being recycled into underground sumps for use in mining activities after dewatering began.
Note: All values rounded to nearest whole cubic metre.

Table D1-10. Water Sampling Monitoring Program Results for January to May 2018 Taken from ST-7

	Sample ID	ST7-08JAN18	ST7-05FEB18	ST7-05FEB18^	ST7	ST7	ST7
	ALS ID	L2043233-1	L2053244-1	L2053244-2	L2064838-1	L2075102-1	L2091797-1
	Date Sampled	1/8/2018 2:30:00 PM	2/5/2018 4:20:00 PM	2/5/2018 4:20:00 PM	3/5/2018 5:45:00 PM	4/2/2018 4:05:00 PM	5/7/2018 11:30:00 AM
Parameter	**Units**	**Results**					
Hardness (as $CaCO_3$)	mg/L	52.4 *	53.1 *	53.8 *	55.5 *	55.3 *	59.3 *
pH	pH	7.59	7.32	7.31	7.73	7.91	7.86
Total Suspended Solids	mg/L	3.6	<3.0	<3.0	<3.0	4.4	<3.0
Ammonia, Total (as N)	mg/L	0.0274	0.0377	0.0379	0.0218	<0.0050	<0.0050
Chloride (Cl)	mg/L	61.2	63.5	63.5	65.3	65.7	69.1
Nitrate (as N)	mg/L	<0.0050	0.0129	0.0134	0.0363	0.0852	0.0327
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010 *	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0196	0.0164	0.0174	0.0183	0.0189	0.0168
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aluminum (Al)-Total	mg/L	0.0104	0.0088	0.0099	0.0079	0.0221	0.0081
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	9.12	9.81	9.66	9.29	10	10.3
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total	mg/L	0.0018	0.0016	0.0016	0.0017	0.0017	0.0017
Iron (Fe)-Total	mg/L	0.092	0.073	0.055	0.061	0.655	0.089
Lead (Pb)-Total	mg/L	0.00174	0.00208	0.0021	0.00153	0.00058	0.00062
Lithium (Li)-Total	mg/L	0.0033	0.0036	0.0035	0.0038	0.0041	0.0042

Sample ID		ST7-08JAN18	ST7-05FEB18	ST7-05FEB18^	ST7	ST7	ST7
ALS ID		L2043233-1	L2053244-1	L2053244-2	L2064838-1	L2075102-1	L2091797-1
Date Sampled		1/8/2018 2:30:00 PM	2/5/2018 4:20:00 PM	2/5/2018 4:20:00 PM	3/5/2018 5:45:00 PM	4/2/2018 4:05:00 PM	5/7/2018 11:30:00 AM
Parameter	**Units**	**Results**					
Magnesium (Mg)-Total	mg/L	7.2	6.94	7.2	7.85	7.34	8.13
Manganese (Mn)-Total	mg/L	0.00561	0.00405	0.00402	0.00457	0.0217	0.00552
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium (K)-Total	mg/L	2.4	2.3	2.3	2.6	2.5	2.8
Selenium (Se)-Total	mg/L	0.000052	<0.000050	<0.000050	0.000071	<0.000050	0.000074
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	33.3	33.4	33.5	34.3	34	39.1
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No	No
Chlorophyll a	µg						

^ *Duplicate sample.*

Table D1-11. Water Sampling Monitoring Program Results for June to December 2018 Taken from ST-7

	Sample ID	ST7	ST7	ST7	ST7	ST7	ST7	ST7
	ALS ID	L2106183-1	L2122512-1	L2141996-1	L2157607-1	L2174127-1	L2192444-1	L2205987-1
	Date Sampled	6/4/2018 12:10:00 PM	7/2/2018 10:45:00 AM	8/6/2018 10:25:00 AM	9/3/2018 10:35:00 AM	10/1/2018 2:45:00 PM	11/5/2018 11:00:00 AM	12/3/2018 2:45:00 PM
Parameter	**Units**	**Results**						
Hardness (as $CaCO_3$)	mg/L	53.4 *	53.6 *	42.3 *	42.9 *	69.5 *	45.8 *	49.8 *
pH	pH	7.57	7.77	7.73	7.73	8	7.51	7.62
Total Suspended Solids	mg/L	<3.0	8.6	5	7.7	5.7	3.1	4.3
Ammonia, Total (as N)	mg/L	0.0217	0.169	<0.0050	<0.0050	<0.0050	<0.0050	0.0073
Chloride (Cl)	mg/L	70.5	62.1	52.6	53.3	94	56.3	58.1
Nitrate (as N)	mg/L	0.0778	<0.0050	<0.0050	<0.0050	0.0275	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0146	0.0552	0.0229	0.028	0.0084	0.0257	0.0246
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aluminum (Al)-Total	mg/L	0.0079	0.0208	0.0679	0.0563	0.101	0.0185	0.0103
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	<0.00050	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	<0.0000050	0.0000057	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	9.37	9.65	7.57	7.29	11.9	8.03	8.57
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	<0.00030	0.00059	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total	mg/L	0.0017	0.0017	0.0015	0.0014	0.0011	0.0014	0.0015
Iron (Fe)-Total	mg/L	0.073	9.02	0.201	0.163	0.129	0.26	0.28
Lead (Pb)-Total	mg/L	0.0008	<0.00050	0.00302	0.00107	<0.00050	0.00148	<0.00050
Lithium (Li)-Total	mg/L	0.0034	0.004	0.0031	0.0029	0.0029	0.0032	0.0034

Sample ID		ST7	ST7	ST7	ST7	ST7	ST7	ST7
ALS ID		L2106183-1	L2122512-1	L2141996-1	L2157607-1	L2174127-1	L2192444-1	L2205987-1
Date Sampled		6/4/2018 12:10:00 PM	7/2/2018 10:45:00 AM	8/6/2018 10:25:00 AM	9/3/2018 10:35:00 AM	10/1/2018 2:45:00 PM	11/5/2018 11:00:00 AM	12/3/2018 2:45:00 PM
Parameter	**Units**	**Results**						
Magnesium (Mg)-Total	mg/L	7.28	7.16	5.69	6.01	9.67	6.25	6.91
Manganese (Mn)-Total	mg/L	0.00642	0.444	0.0262	0.0198	0.00421	0.0116	0.00847
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000074	0.0000075
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium (K)-Total	mg/L	2.5	2.3	2	2.1	4	<2.0	2.4
Selenium (Se)-Total	mg/L	0.000064	<0.000050	<0.000050	<0.000050	<0.000050	0.000051	<0.000050
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	35	33.3	27.2	28.2	53.8	28.8	29.9
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00054	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	<0.0050	0.0121	0.0107	<0.0050	<0.0050	<0.0050	<0.0050
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No	No	No
Chlorophyll a	µg			5.3 **				

^ Result is average of three replicate samples collected at the same location DLN-REP1 = 4.62µg, DLN-REP2 = 5.59µg, DLN-REP3 = 5.7µg

Table D1-12. Water Sampling Monitoring Program Results for January to June 2018 Taken from ST-7a (HOP-1)

Sample ID		ST7A-02JAN18	ST7A-06FEB18	ST7A	ST7A	ST7A	ST7A-DUP^	ST7A
ALS ID		L2040444-1	L2053250-1	L2064834-1	L2075107-1	L2091807-1	L2091807-2	L2106173-1
Date Sampled		1/2/2018 8:00:00 AM	2/6/2018 7:35:00 AM	3/6/2018 7:50:00 AM	4/3/2018 7:15:00 AM	5/7/2018 4:50:00 PM	5/7/2018 4:50:00 PM	6/4/2018 8:00:00 AM
Parameter	**Units**	**Results**						
Hardness (as $CaCO_3$)	mg/L	90.4 *	90.0 *	97.1 *	89.1 *	93.6 *	94.0 *	84.8 *
pH	pH	7.91	7.87	8.03	8.02	8.2	8.19	8.03
Total Suspended Solids	mg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Ammonia, Total (as N)	mg/L	0.0051	0.0126	0.0166	0.0094	<0.0050	<0.0050	0.0076
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0065
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	0.0014	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0031	0.0043	0.0039	0.0055	0.0048	0.0046	0.0053
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aluminum (Al)-Total	mg/L	0.0157	0.012	0.0106	0.0134	0.0068	0.0063	0.0289
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	0.0000068	0.0000077	0.0000166	0.0000101	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	15.8	15.6	16.3	15.6	17.1	17.1	15
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total	mg/L	0.0011	<0.0015 *	0.0013	0.0012	0.001	<0.0010	0.0013
Iron (Fe)-Total	mg/L	0.035	<0.030	<0.030	<0.030	<0.030	<0.030	0.047
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0039	0.0035	0.0038	0.0043	0.004	0.0038	0.0033
Magnesium (Mg)-Total	mg/L	12.4	12.4	13.7	12.2	12.4	12.5	11.5

	Sample ID	ST7A-02JAN18	ST7A-06FEB18	ST7A	ST7A	ST7A	ST7A-DUP^	ST7A
	ALS ID	L2040444-1	L2053250-1	L2064834-1	L2075107-1	L2091807-1	L2091807-2	L2106173-1
	Date Sampled	1/2/2018 8:00:00 AM	2/6/2018 7:35:00 AM	3/6/2018 7:50:00 AM	4/3/2018 7:15:00 AM	5/7/2018 4:50:00 PM	5/7/2018 4:50:00 PM	6/4/2018 8:00:00 AM
Parameter	**Units**	**Results**						
Manganese (Mn)-Total	mg/L	0.00189	0.00135	0.00123	0.00132	0.00083	0.00077	0.00162
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010
Potassium (K)-Total	mg/L	5.3	5	5.3	5	4.9	4.8	4.8
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	0.000073	<0.000050	<0.000050	0.000051	0.000065
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	71.5	67.9	70.6	67.3	68.6	67.9	64.3
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	0.0377	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	0.00024	0.00022	0.00021	0.00021	0.00023	0.00022	<0.00020
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Biochemical Oxygen Demand	mg/L	3	<2.0	2	2	<2	<2	<2.0
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No	No	No
Fecal Coliform**	MPN/100mL	<1	<1	<1	<1	<1	<1	<1

^ Duplicate sample.
*** Results from a separate Lab Work Order for Potable Water Station PDC10 (same location as ST-7a)*

Table D1-13. Water Sampling Monitoring Program Results for July to December 2017 Taken from ST-7a (HOP-1)

	Sample ID	ST7A	ST7A	ST7A	ST7A	ST7A	ST7A
	ALS ID	L2122532-1	L2141990-1	L2157613-1	L2174081-1	L2192445-1	L2205979-1
	Date Sampled	7/2/2018 4:30:00 PM	8/6/2018 6:12:00 PM	9/3/2018 5:50:00 PM	10/1/2018 5:10:00 PM	11/5/2018 4:50:00 PM	12/3/2018 4:00:00 PM
Parameter	**Units**	**Results**					
Hardness (as $CaCO_3$)	mg/L	35.1 *	70.9 *	77.9 *	42.6 *	75.5 *	80.8 *
pH	pH	7.71	8.03	7.88	7.83	7.93	7.82
Total Suspended Solids	mg/L	<3.0	<3.0	16.1	7.5	<3.0	<3.0
Ammonia, Total (as N)	mg/L	<0.0050	<0.0050	<0.0050	0.0059	<0.0050	0.0063
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.0063	0.0073	0.0132	0.0348	0.0034	0.0041
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050 *	<0.0050	<0.0050	<0.0050
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050 *	<0.0050	<0.0050	<0.0050
Aluminum (Al)-Total	mg/L	0.0793	0.0643	0.0492	0.046	0.0141	0.0092
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	0.000007	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	6.15	12.4	12.8	7.61	13.1	13.7
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total	mg/L	<0.0010	<0.0010	0.001	0.0015	<0.0010	<0.0010
Iron (Fe)-Total	mg/L	0.071	0.052	0.052	0.185	<0.030	<0.030
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0016	0.003	0.003	0.0032	0.003	0.0033
Magnesium (Mg)-Total	mg/L	4.79	9.73	11.2	5.72	10.4	11.3

	Sample ID	ST7A	ST7A	ST7A	ST7A	ST7A	ST7A
	ALS ID	L2122532-1	L2141990-1	L2157613-1	L2174081-1	L2192445-1	L2205979-1
	Date Sampled	7/2/2018 4:30:00 PM	8/6/2018 6:12:00 PM	9/3/2018 5:50:00 PM	10/1/2018 5:10:00 PM	11/5/2018 4:50:00 PM	12/3/2018 4:00:00 PM
Parameter	**Units**	**Results**					
Manganese (Mn)-Total	mg/L	0.00268	0.00221	0.00381	0.0117	0.00177	0.00189
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000058	<0.0000050
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium (K)-Total	mg/L	<2.0	3.9	4.1	2.1	3.9	4.6
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	<0.000050	0.000053	<0.000050	<0.000050
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	24.7	53.1	56.2	28.9	57.4	58.2
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Biochemical Oxygen Demand	mg/L	<2.0	<2.0	<2.0	<2.0	<2	3
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No	No
Fecal Coliform**	MPN/100mL	<1	<1	<1	<1	<1	<1

*** Results from a separate Lab Work Order for Potable Water Station PDC10 (same location as ST-7a)*

Table D1-14. Water Quality Monitoring Program Results for ST-8 (Sewage Treatment Plant), January to May 2018

	Sample ID	ST8-09JAN18	ST8-13FEB18	ST8	ST8-DUP^	ST8	ST8	Part G Item 4(b)
	ALS ID	L2042950-1	L2056047-1	L2066931-1	L2066931-2	L2077755-1	L2087050-1	Maximum Allowable Concentration (mg/L)
	Date Sampled	1/9/2018 7:30:00 AM	2/13/2018 7:35:00 AM	3/13/2018 7:30:00 AM	3/13/2018 7:30:00 AM	4/10/2018 6:30:00 AM	5/1/2018 7:30:00 AM	
Parameter	**Units**	**Results**						
pH	pH units	7.8	7.84	7.65	7.69	7.85	7.94	6-9
Total Suspended Solids	mg/L	23.6	10.9	4.5	5.1	9.8	4.7	100
Fecal Coliforms	MPN/100mL	26	12	<1	<1	1	<1	10,000
Biochemical Oxygen Demand (BOD5)	mg/L	8	8	11	12	4	6	80
Oil and Grease	mg/L	<5.0	<5.0	0.639	0.617	<5.0	<5.0	5
Oil And Grease (Visible Sheen)		No	No	No	No	No	No	No Visible Sheen

^ *Duplicate sample.*

Table D1-15. Water Quality Monitoring Program Results for ST-8, June to December 2018

	Sample ID	ST8	ST8	ST8	ST8	ST8	ST8	ST8	Part G Item 4(b)
	ALS ID	L2110476-1	L2126564-1	L2141978-1	L2157616-1	L2174086-1	L2192453-1	L2208517-1	Maximum Allowable Concentration (mg/L)
	Date Sampled	6/12/2018 7:15:00 AM	7/10/2018 7:15:00 AM	8/7/2018 7:25:00 AM	9/4/2018 6:45:00 AM	10/2/2018 6:40:00 AM	11/6/2018 7:30:00 AM	12/11/2018 7:10:00 AM	
Parameter	**Units**	**Results**							
pH	pH units	7.98	8.44	8.13	7.7	7.47	7.46	7.67	6-9
Total Suspended Solids	mg/L	7.6	<3.0	3	7.8	<3.0	<3.0	<3.0	100
Fecal Coliforms	MPN/100mL	4	¥	1	<1	<1	<1	<1	10,000
Biochemical Oxygen Demand (BOD5)	mg/L	5	3	3	4	3	<2	6	80
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5
Oil And Grease (Visible Sheen)		No	No	No	No	No	No	No	No Visible Sheen

¥ Analysis for this parameter not completed in this sample due to laboratory error. Sublet laboratory provided results for Total Coliform (5MPN/100mL) but failed to complete analysis for Fecal Coliforms.

Table D1-16. Treated Effluent Released from the Doris Sewage Treatment Plant (ST-8), 2018

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	944	944
February	1,017	1,961
March	1,184	3,145
April	1,106	4,251
May	1,165	5,416
June	1,111	6,527
July	1,095	7,622
August	1,115	8,737
September	1,148	9,885
October	1,216	11,101
November	1,187	12,288
December	1,194	13,482
Total Volume of Treated Effluent Released 2018 (m^3)		**13,482**

** Values rounded to nearest whole cubic metre.*

Table D1-17. Volume of Sludge Removed from the Doris Sewage Treatment Plant, 2018

Month	Monthly Volume (m^3)*	Cumulative Volume (m^3)*
January	18.8	18.8
February	17.6	36.4
March	28.4	64.8
April	23.5	88.3
May	26.3	114.6
June	30.3	144.9
July	30.9	175.7
August*	30.0	205.7
September	29.3	235.0
October	29.6	264.6
November	25.7	290.4
December	25.0	315.4
Total Volume of Sludge Produced in 2018 (m^3)		**315.4**

** All sewage sludge reported to the TIA for disposal.*

Table D1-18. Water Quality Monitoring Program Results for ST-9, June to September 2018

	Sample ID	ST9	ST9	ST9-DUP^	ST9	ST9
	ALS ID	L2110476-2	L2126564-2	L2126564-3	L2141978-2	L2157616-2
	Date Sampled	6/11/2018 3:20:00 PM	7/9/2018 4:45:00 PM	7/9/2018 4:45:00 PM	8/6/2018 5:45:00 PM	9/3/2018 4:30:00 PM
Parameter	**Units**	**Results**				
pH	pH units	7.49	8.14	8.13	8.14	7.93
Total Suspended Solids	mg/L	<3.0	<3.0	3.9	<3.0	4.2
Fecal Coliforms	MPN/100mL	579 *	¥	¥	4	1
Biochemical Oxygen Demand (BOD5)	mg/L	3	<2	2	<2.0	<2.0
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No

^ Duplicate sample.
A Analytical hold time was exceeded.
¥ Analysis for this parameter not completed in this sample due to laboratory error. Sublet laboratory provided results for Total Coliform (5MPN/100mL) but failed to complete analysis for Fecal Coliforms.

ST-10 Site Runoff from Sediment Controls

Construction of the Doris Airstrip south apron and lined aircraft de-icing and refueling pad was completed in January 2018. No turbid runoff was observed during freshet following construction and no samples were collected under monitoring station ST-10 at this location.

In 2018, Phase 1 of the Tailings Impoundment Area (TIA) South Dam installation and associated access road was completed. Construction of this infrastructure began in January and was completed in July. Due to the topography in this area, runoff from this infrastructure flows towards the TIA and away from the surrounding environment. Pooling water observed at the toe of the South Dam in June was transferred into the TIA. No samples were collected under monitoring station ST-10 at this location.

In August, construction began on the access road and marine outfall berm for the Roberts Bay ocean discharge line. This included a culvert installation in the access road at an unnamed stream crossing. No runoff was observed during construction of the access road. Several sections of silt fence were installed downstream of the culvert during installation and were effective in eliminating turbidity caused by construction; no turbidity was evident downstream of the final fence installation located approximately 50 m upstream of Roberts Bay. During construction of the marine outfall berm, a silt curtain was installed and monitoring of the in-water works was conducted with the use of a drone. The silt curtain was effective in managing siltation and no turbidity was observed outside the silt curtain area. Construction of the berm was suspended in September with the onset of freezing conditions. Armouring of the berm occurred in December once the ocean had frozen. No samples were collected under monitoring station ST-10 at this location.

The Robert's Bay single tank farm berm was raised to increase the secondary containment capacity of the berm and allow full use of the 5ML tank. The berm is located in an old quarry and is surrounded by bedrock outcrops. Runoff from this infrastructure flows into the tank farm berm. The final section of the Pad T was completed to allow for additional ore and waste rock storage within the permitted footprint. This pad is within the footprint of the water management system and runoff from this pad is directed to the Sedimentation Pond and Pollution Control Pond. No samples were collected from either area under monitoring station ST-10.

The access road to the Doris Connector Vent Raise and culvert installation were completed in September 2018. Sections of silt fence were installed downstream of the culvert during installation and were effective in eliminating turbidity caused by construction; no turbidity was evident downstream where flowing water enters Doris Lake. Freezing temperatures occurred shortly after construction and water in this area was frozen. No samples were collected in this area.

An access road was also constructed to the Doris Crown Pillar Trench (DCPT) to allow surface blasting and hauling of ore from the DCPT. Construction of the access road and mining in the DCPT occurred after winter conditions had begun and ground conditions were frozen. No runoff was observed in this area and no samples were collected.

ST-11 Reagent and Cyanide Storage Containment Area Sump

This facility was constructed and first used in 2017. The storage area is a lined berm area divided into two cells to allow separation of different chemical products. Each cell has a water collection sump to facilitate water management (ST-11a and ST-11b). Water accumulating in this facility will be discharged directly into the Tailings Impoundment Area (TIA). No water was transferred to the TIA from this facility in 2018 as not enough water accumulated to require dewatering.

Water quality samples were collected from each sump as per Schedule J of the water licence. Results of the sampling are presented in Table D1-19.

Table D1-19. Water Quality Monitoring Program Results for ST-11, June 2018

	Sample ID	ST11A	ST11A-DUP^	ST11B
	ALS ID	L2110513-1	L2110513-3	L2110513-2
	Date Sampled	6/10/2018 3:45:00 PM	6/10/2018 3:45:00 PM	6/10/2018 3:30:00 PM
Parameter	Units	Results		
Hardness (as $CaCO_3$)	mg/L	59.5 *	38.6 *	94.9 *
pH	pH	7.7	7.63	8.18
Total Suspended Solids	mg/L	21.8	16.4	31.4
Ammonia, Total (as N)	mg/L	0.0295	0.0297	0.0374
Cyanide, Total	mg/L	<0.0050	<0.0050	<0.0050
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050
Aluminum (Al)-Total	mg/L	1.5	1.67	1.26
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.0016	0.00174	0.00103
Barium (Ba)-Total	mg/L	<0.020	<0.020	0.022
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	0.1
Cadmium (Cd)-Total	mg/L	0.0000351	0.0000305	0.0000258
Calcium (Ca)-Total	mg/L	14	9.55	22.2
Chromium (Cr)-Total	mg/L	0.0071	0.0081	0.0045
Cobalt (Co)-Total	mg/L	0.00179	0.00202	0.00162

Sample ID		ST11A	ST11A-DUP^	ST11B
ALS ID		L2110513-1	L2110513-3	L2110513-2
Date Sampled		6/10/2018 3:45:00 PM	6/10/2018 3:45:00 PM	6/10/2018 3:30:00 PM
Parameter	**Units**		**Results**	
Copper (Cu)-Total	mg/L	0.0107	0.0121	0.0112
Iron (Fe)-Total	mg/L	2.84	3.13	2.33
Lead (Pb)-Total	mg/L	0.00307	0.00341	0.00214
Lithium (Li)-Total	mg/L	0.0013	0.0012	0.0015
Magnesium (Mg)-Total	mg/L	5.93	3.59	9.58
Manganese (Mn)-Total	mg/L	0.0895	0.0971	0.0823
Mercury (Hg)-Total	mg/L	0.0000083	<0.000025 *	<0.000025 *
Molybdenum (Mo)-Total	mg/L	0.0017	<0.0010	0.0063
Nickel (Ni)-Total	mg/L	0.0039	0.012	0.0026
Potassium (K)-Total	mg/L	<2.0	<2.0	4
Selenium (Se)-Total	mg/L	0.000443	0.000166	0.0016
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	23.3	14.4	87.8
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	0.077	0.087	0.052
Uranium (U)-Total	mg/L	<0.00020	<0.00020	0.00055
Vanadium (V)-Total	mg/L	0.00693	0.00783	0.0065
Zinc (Zn)-Total	mg/L	0.0273	0.0318	0.023
Oil and Grease	mg/L	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No
Benzene	mg/L	<0.00050	<0.00050	<0.00050
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	<0.00050
Styrene	mg/L	<0.00050	<0.00050	<0.00050
Toluene	mg/L	<0.00045	<0.00045	<0.00045
ortho-Xylene	mg/L	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	<0.00075	<0.00075	<0.00075

^ *Duplicate sample.*

Hydrology Monitoring – Doris Lake Water Level and Ice Thickness (ST-12) and Doris Creek Flow (TL-2)

The 2018 compliance program consisted of two lake level monitoring stations and one stream flow monitoring stations (Table D1-20). Stations were visited throughout the open water season to perform water level surveys and manual discharge measurements. Water level surveys are performed using an engineer's level and stadia rod using a minimum of three local bench marks at each station. All bench marks are tied to geodetic elevation. Manual discharge measurements were performed using the velocity area method with a Hach FH950 electromagnetic current meter. Details regarding the standard methods used for installation of hydrometric stations, development of stage-discharge rating equations, and daily flow hydrographs can be found in the Doris North Project 2013 Hydrology Compliance Monitoring Report (ERM 2014).

Table D1-20. Station Type and Locations

Station	Station Type	Easting*	Northing*
Doris Creek TL-2	Stream Flow	434059	7559504
Windy Lake	Water Level	432636	7550371
Doris Lake	Water Level	433512	7558452
Doris Lake-2	Water Level	433547	7558601

**UTM Zone 13W. The Doris Lake monitoring location (Easting: 433512; Northing: 7558452) was moved in September 2017*

Doris Lake Station (ST-12)

Doris Lake- 2 monitoring station collected data from January 1st through to December 31st, 2018 and continues to collect data. In September of 2017, the Doris Lake monitoring location was moved to the north to facilitate the installation of two, year-round pressure transducers and to avoid potential interactions with mine construction. The new location was named Doris Lake-2 and consists of two Solinst Leveloggers installed at depths of approximately 7 metres to monitor lake level year round. The Leveloggers are coupled with a Solinst Barologger, located at Doris Camp, to compensate for changes in atmospheric pressure. The Leveloggers and Barologger record a pressure reading every 15 minutes. ERM and TMAC personnel performed a total of 5 water level surveys between June 20 and September 19, 2018 to confirm the proper functioning of the pressure transducer. Lake level was provided to TMAC monthly as mean daily water level in metres above sea level (masl).

During end of year QA/QC, two changes were made to the mean daily water level data for 2018 that had been sent to TMAC during monthly monitoring. A datum adjustment was made to the May 2018 data to account for transducer settling, based on survey data collected in June 2018. The adjustment was made retroactively to all 2018 data. An additional small compensation error in the August data resulted in water level being offset by three centimetres.

Ice thickness measurements were collected in April 2018 at monitoring station ST-12 as per Schedule J, Table 2. Ice thickness of Doris Lake was 180 cm.

Doris Creek Flow (TL-2)

The Doris Creek stream flow monitoring station TL-2 was reactivated on June 20 after being deactivated during the winter. The station uses an INW PT2X vented pressure transducer, recording water level readings every 15 minutes. The station operated during the open water season until September 23, when the station was deactivated for winter. During the 2018 open water season, ERM and TMAC personnel made a combined five visits to the station. Water level (stage) measured by the pressure transducer every 15 minutes was converted to discharge using a stage-discharge curve, also known as a rating curve. The rating curve at TL-2 is well established, with small changes from year to year due to aggradation and scour of the channel. A small adjustment for the 2018 rating curve was made to account for minor scour around the station, which was consistent with the annual variability observed at TL-2. Flow during periods that were not observed during the 2018 open water season was estimated using a linear regression between Doris Lake water level and monitored flow at TL-2 from June 5 to 20 and September 23 to November 5. It is estimated that there is no flow in Doris Creek prior to June 5 or after November 5. Discharge at the TL-2 hydrometric monitoring station is reported as mean daily discharge in cubic meters per second (m^3/s). Table D1-22 provides the results of this monitoring.

Windy Lake Station

Windy Lake water level monitoring station was reactivated on June 22 after being deactivated during the winter. The station uses an INW PT2X vented pressure transducer with water level readings recorded every 15 minutes. The station operated throughout the open water season until September 18, when the station was deactivated for winter. During the 2018 open water season, ERM and TMAC personnel made a combined five water level surveys. In addition, the station bench marks were surveyed by TMAC surveyors in June using a total station and a stable bench mark installed in bedrock several hundred meters to the north, as the bench mark elevations are known to vary due to freeze thaw effects on the tundra. Data were analysed and mean daily water level in meters above sea level developed for the period of record and are shown in Table D21 to 23.

TL-1 TIA Monitoring

This section presents the results of monitoring of the Tailings Impoundment Area (TIA) as per the applicable sections of Part G (Conditions Applying to Waste Management and Waste Management Plans) and Part J (Conditions Applying to General and Aquatic Effects Monitoring) of the water licence.

Dewatering of the TIA was not conducted in 2018. Tailings deposition into the TIA continued throughout the year. Reclaim water was also utilized to support the milling process.

Water quality samples were collected at the TIA Reclaim Pipeline monitoring station TL-1 from January to December from a sample port on the reclaim pump. Sampling results are provided in Table D1-24 and Table D1-25.

TL-5, TL6 and TL7 Tailings Monitoring

This section presents the results of monitoring of the Tailings as per the applicable sections of Part J (Conditions Applying to General and Aquatic Effects Monitoring) of the water licence.

Samples of effluent from the Process Plant (TL-5) were collected from January to December 2018. These samples were collected monthly from the tailings thickener tank inside the Process Plant prior to discharge to the Tailings Impoundment Area. A clean container was used to collect a representative sample of tailings material from the tailings thickener tank and the solid material allowed to settle. The remaining supernatant (the liquid effluent of the discharged tailings) was collected and submitted for laboratory analysis. Results of monitoring conducted at TL-5 are presented in Table D1-26 and Table D1-27.

Table D1-21. Summary of Doris Lake Mean Daily Water Levels, in Metres above Sea Level (masl), 2018

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	21.696	21.702	21.701	21.708	21.709	21.710	22.244	21.893	21.781	21.766	21.704	21.705
2	21.696	21.700	21.703	21.705	21.706	21.712	22.225	21.891	21.778	21.767	21.705	21.703
3	21.700	21.699	21.701	21.700	21.708	21.711	22.206	21.886	21.776	21.770	21.705	21.708
4	21.698	21.701	21.703	21.701	21.708	21.710	22.191	21.881	21.773	21.768	21.700	21.716
5	21.692	21.698	21.701	21.705	21.705	21.709	22.177	21.873	21.767	21.766	21.702	21.714
6	21.693	21.705	21.701	21.707	21.706	21.711	22.161	21.865	21.769	21.766	21.699	21.707
7	21.693	21.703	21.702	21.707	21.710	21.716	22.145	21.858	21.764	21.764	21.702	21.706
8	21.700	21.697	21.706	21.709	21.708	21.724	22.128	21.852	21.763	21.762	21.704	21.710
9	21.703	21.699	21.709	21.710	21.704	21.741	22.114	21.849	21.760	21.761	21.704	21.706
10	21.701	21.700	21.705	21.709	21.703	21.769	22.103	21.850	21.763	21.759	21.699	21.704
11	21.695	21.701	21.705	21.707	21.706	21.804	22.094	21.847	21.761	21.755	21.697	21.703
12	21.694	21.700	21.709	21.704	21.704	21.863	22.097	21.846	21.763	21.750	21.701	21.709
13	21.694	21.705	21.709	21.700	21.706	21.960	22.099	21.844	21.763	21.748	21.704	21.713
14	21.696	21.706	21.702	21.702	21.706	22.092	22.092	21.838	21.765	21.750	21.710	21.720
15	21.694	21.703	21.711	21.702	21.703	22.212	22.082	21.832	21.764	21.742	21.706	21.725
16	21.694	21.701	21.708	21.707	21.705	22.295	22.076	21.829	21.763	21.739	21.702	21.729
17	21.697	21.707	21.704	21.705	21.704	22.352	22.063	21.822	21.767	21.736	21.710	21.731
18	21.702	21.706	21.706	21.705	21.704	22.381	22.050	21.816	21.764	21.730	21.707	21.725
19	21.706	21.707	21.705	21.709	21.710	22.389	22.044	21.807	21.763	21.729	21.712	21.727
20	21.709	21.703	21.709	21.711	21.708	22.387	22.031	21.802	21.764	21.729	21.715	21.728
21	21.708	21.704	21.707	21.712	21.706	22.380	22.018	21.801	21.765	21.722	21.714	21.723
22	21.708	21.709	21.706	21.712	21.707	22.363	22.004	21.797	21.765	21.726	21.712	21.722
23	21.705	21.698	21.705	21.712	21.707	22.343	21.990	21.796	21.760	21.727	21.712	21.723
24	21.701	21.698	21.712	21.709	21.707	22.336	21.978	21.794	21.756	21.722	21.712	21.728
25	21.695	21.695	21.713	21.708	21.711	22.340	21.967	21.792	21.758	21.714	21.706	21.735
26	21.694	21.694	21.711	21.709	21.707	22.328	21.957	21.789	21.755	21.710	21.698	21.735
27	21.692	21.697	21.714	21.709	21.706	22.314	21.947	21.789	21.757	21.708	21.697	21.734
28	21.697	21.698	21.712	21.707	21.710	22.298	21.932	21.784	21.755	21.710	21.694	21.736
29	21.699		21.707	21.710	21.709	22.281	21.921	21.782	21.763	21.708	21.694	21.735

Date	January	February	March	April	May	June	July	August	September	October	November	December
30	21.700		21.703	21.709	21.708	22.261	21.911	21.783	21.763	21.706	21.701	21.733
31	21.700		21.704		21.711		21.902	21.783		21.704		21.735
Minimum	21.692	21.694	21.701	21.700	21.703	21.709	21.902	21.782	21.755	21.704	21.694	21.703
Maximum	21.709	21.709	21.714	21.712	21.711	22.389	22.244	21.893	21.781	21.770	21.715	21.736
Mean	21.699	21.701	21.706	21.707	21.707	22.073	22.063	21.828	21.764	21.739	21.704	21.720
Level Change	0.017	0.015	0.013	0.012	0.008	0.680	0.342	0.111	0.027	0.066	0.021	0.034
Low Action Level Trigger *	21.346	21.346	21.346	21.346	21.346	21.346	21.346	21.346	21.347	21.347	21.347	21.347

** Low action level trigger is relative to the average water level value (September 10-30, 2016-17) measured in Doris Lake. Low action level trigger (-0.42 m) outlined in Section 5.4 of the Doris Aquatic Effects Monitoring Plan, August 2016.*
Note: Two corrections were made to the Doris Lake elevation data after submission of the December 2018 Monthly SNP Monitoring report to account for settling of the transducer and to correct a small compensation error in the August data which resulted in the water level being offset by 3 cm.

Table D1-22. Summary of Doris Creek (TL-2) Daily Flow Rate, in Cubic Metres per Second (m^3/s), 2018

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	*0*	*0*	*0*	*0*	*0*	*0*	2.8807384	0.6674973	0.2611843	*0.22017285*	*0.03803345*	*0*
2	*0*	*0*	*0*	*0*	*0*	*0*	2.720508	0.6671368	0.2528566	*0.22214241*	*0.04222185*	*0*
3	*0*	*0*	*0*	*0*	*0*	*0*	2.5540301	0.6421555	0.2469522	*0.23035593*	*0.0410993*	*0*
4	*0*	*0*	*0*	*0*	*0*	*0*	2.417991	0.6151615	0.2437362	*0.22679149*	*0.02725702^*	*0*
5	*0*	*0*	*0*	*0*	*0*	*0*	2.301274	0.5825844	0.224652	*0.22073121*	*0*	*0*
6	*0*	*0*	*0*	*0*	*0*	*0.05867369**	2.1875272	0.5558037	0.2331014	*0.21952265*	*0*	*0*
7	*0*	*0*	*0*	*0*	*0*	*0.07519404*	2.059588	0.5290521	0.2194234	*0.2152701*	*0*	*0*
8	*0*	*0*	*0*	*0*	*0*	*0.09700494*	1.9486302	0.5003677	0.2066802	*0.20849693*	*0*	*0*
9	*0*	*0*	*0*	*0*	*0*	*0.14666368*	1.8419573	0.4861167	0.2033181	*0.20541066*	*0*	*0*
10	*0*	*0*	*0*	*0*	*0*	*0.22806711*	1.7595198	0.4798533	0.2168926	*0.20065078*	*0*	*0*
11	*0*	*0*	*0*	*0*	*0*	*0.32970404*	1.6783249	0.4692911	0.2115716	*0.18662043*	*0*	*0*
12	*0*	*0*	*0*	*0*	*0*	*0.59991345*	1.7243979	0.4632393	0.2150413	*0.17280876*	*0*	*0*
13	*0*	*0*	*0*	*0*	*0*	*1.01445397*	1.7277996	0.4474649	0.2138098	*0.16809699*	*0*	*0*
14	*0*	*0*	*0*	*0*	*0*	*1.57821804*	1.6836922	0.4287965	0.2231404	*0.17410188*	*0*	*0*
15	*0*	*0*	*0*	*0*	*0*	*2.62936249*	1.642072	0.4083119	0.2206292	*0.1501217*	*0*	*0*
16	*0*	*0*	*0*	*0*	*0*	*3.3090541*	1.5902678	0.4097882	0.2154988	*0.14015146*	*0*	*0*

Date	January	February	March	April	May	June	July	August	September	October	November	December
17	*0*	*0*	*0*	*0*	*0*	*3.76955033*	1.5291992	0.3829184	0.2267515	*0.13329957*	*0*	*0*
18	*0*	*0*	*0*	*0*	*0*	*4.00961562*	1.4792492	0.3503457	0.217066	*0.11500501*	*0*	*0*
19	*0*	*0*	*0*	*0*	*0*	*4.07031293*	1.4272603	0.3249103	0.2146023	*0.11205578*	*0*	*0*
20	*0*	*0*	*0*	*0*	*0*	4.0496279	1.3614769	0.3103976	0.2239542	*0.11153678*	*0*	*0*
21	*0*	*0*	*0*	*0*	*0*	3.9885032	1.2930362	0.3093438	0.2239286	*0.0913339*	*0*	*0*
22	*0*	*0*	*0*	*0*	*0*	3.8480352	1.2148216	0.2996863	0.2284638	*0.10260454*	*0*	*0*
23	*0*	*0*	*0*	*0*	*0*	3.7085769	1.1492791	0.2944699	0.2230062	*0.10627686*	*0*	*0*
24	*0*	*0*	*0*	*0*	*0*	3.6701855	1.0867328	0.2913361	*0.19104792*	*0.09314018*	*0*	*0*
25	*0*	*0*	*0*	*0*	*0*	3.7332014	1.0262438	0.2850108	*0.1974406*	*0.06921248*	*0*	*0*
26	*0*	*0*	*0*	*0*	*0*	3.6039452	0.9711017	0.2767613	*0.1892329*	*0.05780772*	*0*	*0*
27	*0*	*0*	*0*	*0*	*0*	3.4764527	0.9189126	0.2714098	*0.19374932*	*0.05039018*	*0*	*0*
28	*0*	*0*	*0*	*0*	*0*	3.3463276	0.8524621	0.2641823	*0.18666417*	*0.0558542*	*0*	*0*
29	*0*		*0*	*0*	*0*	3.1682855	0.8051555	0.2627748	*0.21020262*	*0.0510156*	*0*	*0*
30	*0*		*0*	*0*	*0*	3.0173596	0.7506694	0.2635402	*0.21023906*	*0.0449801*	*0*	*0*
31	*0*		*0*		*0*		0.7070875	0.2657581		*0.03887463*		*0*
Minimum	0	0	0	0	0	0	0.70708753	0.26277484	0.18666417	0.03887463	0	0
Maximum	0	0	0	0	0	4.07031293	2.88073837	0.66749726	0.26118434	0.23035593	0.04222185	0
Mean	0	0	0	0	0	2.0508763	1.59003246	0.41307956	0.21816125	0.14176883	0.00495372	0
Total	0	0	0	0	0	61.526289	49.2910063	12.8054664	6.54483749	4.39483378	0.14861162	0

Note: Estimated and modelled values are italicized. Estimated data were determined using three linear regressions with Doris Lake elevations, one for high flow, one for moderate flow and one for low flow conditions.
Observed data were observed using stage data collected by the TL-2 pressure transducer, converted to discharge using a rating curve that was developed using stage and discharge measurements from 2016-2018.
**Assumed start of flow.*
^Assumed end of flow.

Table D1-23. Summary of Windy Lake Mean Daily Water Levels, in Metres above Sea Level (masl), 2018

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	18.368	18.282	18.227	-	-	-
2	-	-	-	-	-	-	18.364	18.291	18.223	-	-	-
3	-	-	-	-	-	-	18.359	18.287	18.225	-	-	-
4	-	-	-	-	-	-	18.354	18.286	18.218	-	-	-
5	-	-	-	-	-	-	18.35	18.283	18.217	-	-	-
6	-	-	-	-	-	-	18.346	18.28	18.217	-	-	-
7	-	-	-	-	-	-	18.342	18.277	18.21	-	-	-
8	-	-	-	-	-	-	18.339	18.274	18.211	-	-	-
9	-	-	-	-	-	-	18.334	18.271	18.213	-	-	-
10	-	-	-	-	-	-	18.331	18.273	18.207	-	-	-
11	-	-	-	-	-	-	18.328	18.271	18.208	-	-	-
12	-	-	-	-	-	-	18.326	18.275	18.21	-	-	-
13	-	-	-	-	-	-	18.347	18.276	18.21	-	-	-
14	-	-	-	-	-	-	18.347	18.271	18.208	-	-	-
15	-	-	-	-	-	-	18.342	18.271	18.211	-	-	-
16	-	-	-	-	-	-	18.338	18.269	18.207	-	-	-
17	-	-	-	-	-	-	18.333	18.264	18.206	-	-	-
18	-	-	-	-	-	-	18.331	18.257	18.206	-	-	-
19	-	-	-	-	-	-	18.328	18.252	18.205	-	-	-
20	-	-	-	-	-	18.381	18.324	18.247	-	-	-	-
21	-	-	-	-	-	18.378	18.319	18.244	-	-	-	-
22	-	-	-	-	-	18.374	18.312	18.244	-	-	-	-
23	-	-	-	-	-	18.371	18.309	18.242	-	-	-	-
24	-	-	-	-	-	18.368	18.305	18.242	-	-	-	-
25	-	-	-	-	-	18.376	18.302	18.236	-	-	-	-
26	-	-	-	-	-	18.386	18.3	18.232	-	-	-	-
27	-	-	-	-	-	18.384	18.296	18.231	-	-	-	-
28	-	-	-	-	-	18.381	18.298	18.227	-	-	-	-
29	-	-	-	-	-	18.378	18.299	18.228	-	-	-	-

Date	January	February	March	April	May	June	July	August	September	October	November	December
30	-	-	-	-	-	18.372	18.291	18.226	-	-	-	-
31	-	-	-	-	-	-	18.286	18.225	-	-	-	-
Minimum	-	-	-	-	-	18.377	18.327	18.259	18.213	-	-	-
Maximum	-	-	-	-	-	18.386	18.368	18.291	18.227	-	-	-
Mean	-	-	-	-	-	18.368	18.286	18.225	18.205	-	-	-

Table D1-24. Water Quality in the Tailings Impoundment Area (TL-1), January to July 2018

	Sample ID	TL1-01JAN18	TL1-05FEB18	TL1	TL1	TL1	TL1	TL1
	ALS ID	L2040453-1	L2053205-1	L2064840-1	L2075109-1	L2094850-1	L2110468-1	L2126524-1
	Date Sampled	1/1/2018 6:20:00 PM	2/5/2018 3:45:00 PM	3/6/2018 5:05:00 PM	4/2/2018 9:45:00 AM	5/14/2018 5:30:00 PM	6/11/2018 4:00:00 PM	7/9/2018 5:30:00 PM
Parameter	**Units**	**Results**						
pH, Client Supplied	pH	7.3	7.5	7.8	7.7	7.9	7.6	7.7
Temperature, Client Supplied	C	2.2	1.1	1.6	2.6	1.7	1.8	11.6
Hardness (as $CaCO_3$)	mg/L	175 *	184 *	224 *	263 *	311 *	354 *	236 *
pH	pH	7.76	7.59	8.05	8.33	8.17	8.14	7.99
ORP	mV							167
Total Suspended Solids	mg/L	13.4	15.9	16.2	11.5	18.8	14.7	9.7
Total Dissolved Solids	mg/L	648	750	934	1090	1250	1470	908
Ammonia, Total (as N)	mg/L	2.17	2.67	3.34	3.74	4.56	9.8	3.78
Ammonia, Un-ionized (as N)	mg/L	0.00427	0.00759	0.0197	0.0129	0.0341	0.0372	0.0394
Chloride (Cl)	mg/L	106	117	174	250	347	415	268
Nitrate (as N)	mg/L	0.974	1.14	1.48	1.61	1.34	1.23	0.612
Nitrite (as N)	mg/L	0.103	0.12	0.118	0.1	<0.020 *	0.157	0.0406
Total Kjeldahl Nitrogen	mg/L	3.15	3.85	4.66	4.95	6.34	6.94 *	4.37
Total Nitrogen	mg/L	4.1	5.06	5.97	7.46	7.97	8.59	5.28
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010
Phosphorus (P)-Total	mg/L	0.17	0.188	0.187	0.183	0.209	0.243	0.146
Cyanide, Total	mg/L	0.0735	0.133	0.183	0.0231	0.204	0.225	0.0673
Cyanide, Free	mg/L	0.0063	0.0056	<0.0050	0.0064	<0.0050	0.0062	0.0256

Sample ID		TL1-01JAN18	TL1-05FEB18	TL1	TL1	TL1	TL1	TL1
ALS ID		L2040453-1	L2053205-1	L2064840-1	L2075109-1	L2094850-1	L2110468-1	L2126524-1
Date Sampled		1/1/2018 6:20:00 PM	2/5/2018 3:45:00 PM	3/6/2018 5:05:00 PM	4/2/2018 9:45:00 AM	5/14/2018 5:30:00 PM	6/11/2018 4:00:00 PM	7/9/2018 5:30:00 PM
Parameter	**Units**	**Results**						
MPN-Fecal Coliform	MPN/100mL	<1	<1	9 *	6 *	<1 *	10	<1
Aluminum (Al)-Total	mg/L	0.337	0.532	0.603	0.301	0.227	0.132	0.339
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.00094	0.00104	0.00107	0.00107	0.00132	0.0012	0.00088
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 *	<0.00010
Boron (B)-Total	mg/L	<0.10	<0.10	0.1	0.11	0.13	0.17	0.11
Cadmium (Cd)-Total	mg/L	0.0000069	0.0000082	0.000009	0.0000098	0.0000136	<0.000010 *	0.0000064
Calcium (Ca)-Total	mg/L	45.1	48.6	57.7	67.8	78.2	90	58
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	0.0011	<0.0010	0.0012	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.00185	0.00228	0.00227	0.0023	0.00249	0.00255	0.00186
Copper (Cu)-Total	mg/L	0.0241	0.0372	0.0262	0.0247	0.0156	0.0167	0.0316
Iron (Fe)-Total	mg/L	1.18	1.44	1.44	1.48	1.97	1.49	1.31
Lead (Pb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00196	0.00121
Lithium (Li)-Total	mg/L	0.0129	0.0156	0.0181	0.019	0.0202	0.0218	0.0141
Magnesium (Mg)-Total	mg/L	15.1	15.3	19.5	22.7	28.2	31.3	22.2
Manganese (Mn)-Total	mg/L	0.577	0.649	0.534	0.516	0.604	0.624	0.434
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0012	0.0014	0.0017	0.0018	0.0021	0.0025	0.0015
Nickel (Ni)-Total	mg/L	0.0045	0.006	0.0068	0.0068	0.007	0.0075	0.0053
Potassium (K)-Total	mg/L	10.8	13.6	18.3	20.4	23.2	25.9	15.6
Selenium (Se)-Total	mg/L	0.000182	0.000266	0.000202	0.000281	0.00051	0.00034	0.000304
Silver (Ag)-Total	mg/L	0.000022	0.000025	0.000029	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	156	190	233	278	320	367	231
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 *	<0.000010
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

	Sample ID	TL1-01JAN18	TL1-05FEB18	TL1	TL1	TL1	TL1	TL1
	ALS ID	L2040453-1	L2053205-1	L2064840-1	L2075109-1	L2094850-1	L2110468-1	L2126524-1
	Date Sampled	1/1/2018 6:20:00 PM	2/5/2018 3:45:00 PM	3/6/2018 5:05:00 PM	4/2/2018 9:45:00 AM	5/14/2018 5:30:00 PM	6/11/2018 4:00:00 PM	7/9/2018 5:30:00 PM
Parameter	**Units**	**Results**						
Titanium (Ti)-Total	mg/L	<0.010	0.011	0.01	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00021	<0.00020
Vanadium (V)-Total	mg/L	0.00125	0.00202	0.00227	0.00128	0.00114	<0.0010 *	0.00123
Zinc (Zn)-Total	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0060 *	<0.0050
Biological Oxygen Demand	mg/L							3
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No	No	No
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Styrene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene	mg/L	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045	<0.00090 *	<0.00045
ortho-Xylene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
Ra-226	Bq/L	<0.0085	<0.0049	0.0069	<0.0066	0.0046	<0.0071	<0.0066

Table D1-25. Water Quality in the Tailings Impoundment Area (TL-1), August to December 2018

	Sample ID	TL1	TL1	TL1	TL1	TL1	TL1-DUP^
	ALS ID	L2141984-1	L2157627-1	L2174093-1	L2192450-2	L2205961-1	L2205961-2
	Date Sampled	8/6/2018 9:40:00 AM	9/3/2018 4:50:00 PM	10/1/2018 5:45:00 PM	11/5/2018 3:45:00 PM	12/3/2018 5:10:00 PM	12/3/2018 5:10:00 PM
Parameter	**Units**	**Results**					
pH, Client Supplied	pH	8.4	10	9.1	8.3	8.1	8.1
Temperature, Client Supplied	C	12.5	6.6	0.6	2.3	0.2	0.2
Hardness (as $CaCO_3$)	mg/L	238	290	305	380 *	434	438
pH	pH	8.4	9.22	8.76	8.32	8.06	8.07
ORP	mV						
Total Suspended Solids	mg/L	10	26.4	29.3	27.3	27.3	23.1
Total Dissolved Solids	mg/L	1080	1180	1290	1510	1860	1710
Ammonia, Total (as N)	mg/L	2.7	1.08	1.02	1.88	2.42	2.48
Ammonia, Un-ionized (as N)	mg/L	0.145	0.631	0.101	0.0367	0.0252	0.0259
Chloride (Cl)	mg/L	330	401	450	592	662	656
Nitrate (as N)	mg/L	0.69	0.86	1.22	1.86	2.03	2.04
Nitrite (as N)	mg/L	0.16	0.279	0.298	0.257	0.237	0.253
Total Kjeldahl Nitrogen	mg/L	4.07	2.54	2.67	3.79	4	4.31
Total Nitrogen	mg/L	5.02	3.77	4.32	5.64	6.44	6.48
Orthophosphate-Dissolved (as P)	mg/L	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	0.147	0.12	0.1	0.0934	0.0868	0.084
Cyanide, Total	mg/L	0.0122	0.0148	0.0203	0.0723	0.0751	0.0809
Cyanide, Free	mg/L	<0.0050	<0.0050	<0.0050	0.0124	0.0064	0.0073
MPN-Fecal Coliform	MPN/100mL	<1	<1	<1	<1	<1	-
Aluminum (Al)-Total	mg/L	0.142	0.078	0.141	0.197	0.124	0.141
Antimony (Sb)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.00072	0.00084	0.00084	0.001	0.00105	0.00107
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium (Be)-Total	mg/L	<0.00010	<0.00020 *	<0.00010	<0.00020 *	<0.00020 *	<0.00020 *
Boron (B)-Total	mg/L	0.14	0.15	0.16	0.22	0.24	0.25

	Sample ID	TL1	TL1	TL1	TL1	TL1	TL1-DUP^
	ALS ID	L2141984-1	L2157627-1	L2174093-1	L2192450-2	L2205961-1	L2205961-2
	Date Sampled	8/6/2018 9:40:00 AM	9/3/2018 4:50:00 PM	10/1/2018 5:45:00 PM	11/5/2018 3:45:00 PM	12/3/2018 5:10:00 PM	12/3/2018 5:10:00 PM
Parameter	**Units**	**Results**					
Cadmium (Cd)-Total	mg/L	0.0000056	<0.000010 *	<0.0000050	<0.000010 *	<0.000010 *	<0.000010 *
Calcium (Ca)-Total	mg/L	64.3	70.9	71.2	83.6	92.7	96
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total	mg/L	0.00156	0.00169	0.00177	0.0025	0.00251	0.00255
Copper (Cu)-Total	mg/L	0.024	0.0237	0.0222	0.0439	0.0355	0.0356
Iron (Fe)-Total	mg/L	0.58	0.343	0.399	0.633	0.488	0.527
Lead (Pb)-Total	mg/L	0.00052	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total	mg/L	0.0143	0.0148	0.0145	0.0188	0.0183	0.0194
Magnesium (Mg)-Total	mg/L	21.8	31.5	33.6	41.5	49.7	50.5
Manganese (Mn)-Total	mg/L	0.348	0.329	0.222	0.254	0.325	0.33
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	0.0000064	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0014	0.0016	0.0017	0.0021	0.0023	0.0023
Nickel (Ni)-Total	mg/L	0.0042	0.0045	0.0053	0.0075	0.0074	0.0076
Potassium (K)-Total	mg/L	15.5	19.7	19.3	22.3	25.4	25.6
Selenium (Se)-Total	mg/L	0.000288	0.00022	0.000239	0.00034	0.00033	0.00032
Silver (Ag)-Total	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total	mg/L	226	314	355	423	457	467
Thallium (Tl)-Total	mg/L	<0.000010	<0.000020 *	<0.000010	<0.000020 *	<0.000020 *	<0.000020 *
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	0.00051	<0.0010 *	0.00053	0.0011	<0.0010 *	<0.0010 *
Zinc (Zn)-Total	mg/L	<0.0050	<0.0060 *	<0.0050	<0.0060 *	<0.0060 *	<0.0060 *
Biological Oxygen Demand	mg/L						
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Oil And Grease (Visible Sheen)		No	No	No	No	No	No

Sample ID		TL1	TL1	TL1	TL1	TL1	TL1-DUP^
ALS ID		L2141984-1	L2157627-1	L2174093-1	L2192450-2	L2205961-1	L2205961-2
Date Sampled		8/6/2018 9:40:00 AM	9/3/2018 4:50:00 PM	10/1/2018 5:45:00 PM	11/5/2018 3:45:00 PM	12/3/2018 5:10:00 PM	12/3/2018 5:10:00 PM
Parameter	**Units**	**Results**					
Benzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Ethylbenzene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Styrene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene	mg/L	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045
ortho-Xylene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
Ra-226	Bq/L	0.037	0.0081	0.021	<0.0076	<0.0054	0.0095

^ *Duplicate Sample.*

Table D1-26. Effluent from Process Plant Tailings Slurry Water (TL-5), January to June 2018

Sample ID		TL5-07JAN18 A	TL5-07JAN18 B^	TL5-11FEB18	TL5	TL5	TL5	TL5
ALS ID		L2043265-1	L2043265-2	L2056079-1	L2066947-1	L2081149-1	L2091799-1	L2110490-1
Date Sampled		1/8/2018 8:00:00 AM	1/8/2018 8:00:00 AM	2/11/2018 9:02:00 AM	3/13/2018 9:50:00 AM	4/16/2018 8:50:00 AM	5/6/2018 11:55:00 AM	6/10/2018 9:30:00 AM
Parameter	**Units**	**Results**						
Hardness (as $CaCO_3$)	mg/L	317 *	291 *	358 *	506 *	387 *	417 *	473 *
pH	pH	8.37	8.35	8.42	8.22	8.26	8.03	8.08
Total Suspended Solids	mg/L	131	161	26.2	483	32.9	52.5	16.2
Ammonia, Total (as N)	mg/L	19.5	19.4	30.7	23.4	20.6	26.1	19.9
Nitrate (as N)	mg/L	12	12.1	16.4	17.8	18.5 *	12	14.4
Nitrite (as N)	mg/L	0.358	0.359	0.438	0.428	0.308 *	0.385	0.184
Sulfate (SO_4)	mg/L	1360	1370	2040	690	738	1260	1050
Cyanide, Weak Acid Diss	mg/L	0.0123	0.0176	<1.0 *	0.016	<0.010 *	0.0099	0.121
Cyanide, Total	mg/L	0.383	0.471	2.6	1.29	0.49	1.68	1.25

	Sample ID	TL5-07JAN18 A	TL5-07JAN18 B^	TL5-11FEB18	TL5	TL5	TL5	TL5
	ALS ID	L2043265-1	L2043265-2	L2056079-1	L2066947-1	L2081149-1	L2091799-1	L2110490-1
	Date Sampled	1/8/2018 8:00:00 AM	1/8/2018 8:00:00 AM	2/11/2018 9:02:00 AM	3/13/2018 9:50:00 AM	4/16/2018 8:50:00 AM	5/6/2018 11:55:00 AM	6/10/2018 9:30:00 AM
Parameter	**Units**	**Results**						
Cyanate	mg/L	<2.0 *	16.2 *	22.5 *	72.3 *	<2.0 *	37.5 *	28.5 *
Thiocyanate (SCN)	mg/L	11.9	11.7	41.9	18.3	12.1	25.7	2.1
Cyanide, Free	mg/L	<0.0050	0.0064	0.0326	0.01	<0.010 *	0.0087	0.0754
Aluminum (Al)-Total	mg/L	4.01	3.65	0.428	5.83	0.727	5.28	0.16
Antimony (Sb)-Total	mg/L	0.00124	0.00114	0.00185	0.00113	0.00101	0.0016	0.00139
Arsenic (As)-Total	mg/L	0.0274	0.0485	0.00773	0.0396	0.0068	0.017	0.00125
Barium (Ba)-Total	mg/L	0.0319	0.0314	0.0323	0.0264	0.0253	0.0362	0.042
Beryllium (Be)-Total	mg/L	<0.00020 *	<0.00020 *	<0.00050 *	<0.00010	<0.00010	<0.00050 *	<0.00050 *
Bismuth (Bi)-Total	mg/L	0.00029	0.0007	<0.00025 *	0.000165	<0.000050	<0.00025 *	<0.00025 *
Boron (B)-Total	mg/L	0.418	0.369	0.386	0.34	0.353	0.326	0.43
Cadmium (Cd)-Total	mg/L	0.000778	0.00119	0.000034	0.000373	0.0000785	0.000139	<0.000025 *
Calcium (Ca)-Total	mg/L	68.4	58.8	85.2	137	90.6	96.5	108
Cesium (Cs)-Total	mg/L	0.000398	0.000237	0.00057	0.000531	0.000601	0.000344	0.000873
Chromium (Cr)-Total	mg/L	0.0107	0.0101	0.0008	0.0202	0.00206	0.0152	<0.00050 *
Cobalt (Co)-Total	mg/L	0.0356	0.0516	0.0119	0.0303	0.0109	0.0217	0.00553
Copper (Cu)-Total	mg/L	0.182	0.283	0.11	0.213	0.0466	0.179	0.278
Iron (Fe)-Total	mg/L	16.8	18.2	3.44	33.8	3.89	18.7	0.832
Lead (Pb)-Total	mg/L	0.0524	0.0705	0.00452	0.0341	0.0104	0.0105	<0.00025 *
Lithium (Li)-Total	mg/L	0.0794	0.0676	0.0631	0.0541	0.0545	0.0606	0.0557
Magnesium (Mg)-Total	mg/L	35.4	35.1	35.3	39.7	39	42.7	49.2
Manganese (Mn)-Total	mg/L	0.361	0.342	0.0902	0.883	0.156	0.477	0.102
Mercury (Hg)-Total	mg/L	<0.00050 *	<0.00050 *	<0.000050 *	<0.000025 *	<0.000025 *	<0.000050 *	<0.000050 *
Molybdenum (Mo)-Total	mg/L	0.00344	0.00393	0.00893	0.00636	0.00738	0.00754	0.00748
Nickel (Ni)-Total	mg/L	0.0548	0.0651	0.0655	0.07	0.0408	0.0353	0.106
Phosphorus (P)-Total	mg/L	0.73	0.64	<0.25 *	0.497	0.118	<0.25 *	0.44
Potassium (K)-Total	mg/L	108	107	96.6	98.6	74.1	58.4	85.4

Sample ID		TL5-07JAN18 A	TL5-07JAN18 B^	TL5-11FEB18	TL5	TL5	TL5	TL5
ALS ID		L2043265-1	L2043265-2	L2056079-1	L2066947-1	L2081149-1	L2091799-1	L2110490-1
Date Sampled		1/8/2018 8:00:00 AM	1/8/2018 8:00:00 AM	2/11/2018 9:02:00 AM	3/13/2018 9:50:00 AM	4/16/2018 8:50:00 AM	5/6/2018 11:55:00 AM	6/10/2018 9:30:00 AM
Parameter	**Units**	**Results**						
Rubidium (Rb)-Total	mg/L	0.0524	0.0469	0.0472	0.0465	0.0571	0.0372	0.0607
Selenium (Se)-Total	mg/L	0.00235	0.00454	0.00274	0.00265	0.00112	0.00176	0.00335
Silicon (Si)-Total	mg/L	8.31	7.38	2.26	9.88	2.74	9.28	1.86
Silver (Ag)-Total	mg/L	0.000612	0.000716	0.000091	0.000851	0.000112	0.000297	<0.000050 *
Sodium (Na)-Total	mg/L	759	702	1210	515	608	935	826
Strontium (Sr)-Total	mg/L	0.304	0.27	0.559	0.552	0.483	0.596	0.691
Sulfur (S)-Total	mg/L	567	547	850	289	310	527	396
Tellurium (Te)-Total	mg/L	<0.00040 *	<0.00040 *	<0.0010 *	0.00023	<0.00020	<0.0010 *	<0.0010 *
Thallium (Tl)-Total	mg/L	0.000091	0.000119	<0.000050 *	0.000067	0.000014	<0.000050 *	<0.000050 *
Thorium (Th)-Total	mg/L	<0.00020 *	<0.00020 *	<0.00050 *	<0.00010	<0.00010	<0.00050 *	<0.00050 *
Tin (Sn)-Total	mg/L	<0.00020 *	<0.00020 *	<0.00050 *	<0.00010	<0.00010	<0.00050 *	<0.00050 *
Titanium (Ti)-Total	mg/L	0.165	0.149	0.0097	0.18	0.0233	0.147	<0.0060 *
Tungsten (W)-Total	mg/L	0.00388	0.00334	0.00414	0.00227	0.00192	0.00356	0.00258
Uranium (U)-Total	mg/L	0.000401	0.000347	0.000624	0.000451	0.000271	0.000623	0.000525
Vanadium (V)-Total	mg/L	0.0188	0.0172	<0.0025 *	0.0207	0.00304	0.0189	<0.0025 *
Zinc (Zn)-Total	mg/L	0.425	0.714	0.026	0.164	0.0352	0.077	<0.015 *
Zirconium (Zr)-Total	mg/L	0.00078	0.00055	<0.00030 *	0.00107	0.000157	0.00099	<0.00030 *

^ *Duplicate sample.*

Table D1-27. Effluent from Process Plant Tailings Slurry Water (TL-5), July to December 2018

	Sample ID	TL5	TL5	TL5	TL5	TL5	TL5
	ALS ID	L2126431-1	L2142179-1	L2157620-1	L2177729-1	L2192448-1	L2208551-1
	Date Sampled	7/8/2018 10:00:00 AM	8/5/2018 10:00:00 AM	9/2/2018 5:50:00 PM	10/7/2018 8:45:00 AM	11/4/2018 8:05:00 AM	12/10/2018 8:20:00 AM
Parameter	**Units**	**Results**					
Hardness (as $CaCO_3$)	mg/L	585 *	517 *	518 *	484 *	1020 *	636 *
pH	pH	7.75	7.69	7.73	7.76	7.71	8
Total Suspended Solids	mg/L	8.3	24.9	17.7	51.7	33.9	28.3
Ammonia, Total (as N)	mg/L	18.9	24.8	18.7	27.9	24.2	21.4
Nitrate (as N)	mg/L	9.9	13.4	13	13.9	16.2	14
Nitrite (as N)	mg/L	0.498	0.451	0.636	0.47	0.552	0.627
Sulfate (SO_4)	mg/L	865	2770	1470	2330	1260	1900
Cyanide, Weak Acid Diss	mg/L	0.0459	0.583	0.049	0.0608	0.0511	0.279
Cyanide, Total	mg/L	0.12	3.72	0.778	0.228	0.813	1.23
Cyanate	mg/L	18.6 *	24.9 *	22.2 *	18.6 *	23.4 *	16.4 *
Thiocyanate (SCN)	mg/L	3.05	16.2	12.4	20.6	15.8	20.4
Cyanide, Free	mg/L	0.0262	0.436	0.031	0.0275	0.032	0.187
Aluminum (Al)-Total	mg/L	0.147	0.171	0.139	2.13	0.466	0.115
Antimony (Sb)-Total	mg/L	0.00055	0.00162	0.00075	0.0011	0.0012	0.00123
Arsenic (As)-Total	mg/L	0.00098	0.00276	0.0014	0.0042	0.0041	0.00129
Barium (Ba)-Total	mg/L	0.0208	0.0325	0.0247	0.042	0.0591	0.0392
Beryllium (Be)-Total	mg/L	<0.00020 *	<0.00050 *	<0.00050 *	<0.0010 *	<0.0010 *	<0.00050 *
Bismuth (Bi)-Total	mg/L	<0.00010 *	<0.00025 *	<0.00025 *	<0.00050 *	<0.00050 *	<0.00025 *
Boron (B)-Total	mg/L	0.405	2.88	0.484	0.62	0.87	0.683
Cadmium (Cd)-Total	mg/L	<0.000010 *	<0.000025 *	<0.000025 *	<0.000050 *	<0.000050 *	<0.000025 *
Calcium (Ca)-Total	mg/L	161	133	136	96.5	183	131
Cesium (Cs)-Total	mg/L	0.000951	0.000553	0.00045	0.00123	0.00101	0.000611
Chromium (Cr)-Total	mg/L	0.00072	0.00105	<0.00050 *	0.0061	0.0013	<0.00050 *
Cobalt (Co)-Total	mg/L	0.00526	0.00902	0.012	0.0138	0.0131	0.016
Copper (Cu)-Total	mg/L	0.0132	0.436	0.0594	0.102	0.122	0.274

Sample ID		TL5	TL5	TL5	TL5	TL5	TL5
ALS ID		L2126431-1	L2142179-1	L2157620-1	L2177729-1	L2192448-1	L2208551-1
Date Sampled		7/8/2018 10:00:00 AM	8/5/2018 10:00:00 AM	9/2/2018 5:50:00 PM	10/7/2018 8:45:00 AM	11/4/2018 8:05:00 AM	12/10/2018 8:20:00 AM
Parameter	**Units**	**Results**					
Iron (Fe)-Total	mg/L	0.724	1.34	0.862	5.37	2.28	0.739
Lead (Pb)-Total	mg/L	0.0002	0.00453	0.00043	0.00195	0.00107	<0.00025 *
Lithium (Li)-Total	mg/L	0.0381	0.0305	0.022	0.077	0.096	0.059
Magnesium (Mg)-Total	mg/L	44.7	44.7	43.2	58.9	136	75.2
Manganese (Mn)-Total	mg/L	0.2	0.122	0.147	0.195	0.307	0.159
Mercury (Hg)-Total	mg/L	<0.00010 *	<0.00050 *	<0.00010 *	<0.00010 *	<0.00010 *	<0.00025 *
Molybdenum (Mo)-Total	mg/L	0.00612	0.00922	0.00819	0.0124	0.0103	0.0107
Nickel (Ni)-Total	mg/L	0.0729	0.0593	0.0759	0.102	0.0509	0.101
Phosphorus (P)-Total	mg/L	0.22	<0.25 *	<0.25 *	<0.50 *	<0.50 *	<0.25 *
Potassium (K)-Total	mg/L	89.4	54.8	58.1	82.5	83.1	86.6
Rubidium (Rb)-Total	mg/L	0.0589	0.0409	0.0305	0.0722	0.0543	0.0495
Selenium (Se)-Total	mg/L	0.00095	0.00124	0.00097	0.00171	0.00264	0.00185
Silicon (Si)-Total	mg/L	1.91	1.96	1.73	4.3	3.2	1.76
Silver (Ag)-Total	mg/L	<0.000020 *	0.000063	<0.000050 *	<0.00010 *	<0.00010 *	<0.000050 *
Sodium (Na)-Total	mg/L	651	1460	887	1470	1750	1410
Strontium (Sr)-Total	mg/L	0.606	0.704	0.695	0.698	2.06	1.1
Sulfur (S)-Total	mg/L	349	987	502	859	569	791
Tellurium (Te)-Total	mg/L	<0.00040 *	<0.0010 *	<0.0010 *	<0.0020 *	<0.0020 *	<0.0010 *
Thallium (Tl)-Total	mg/L	<0.000020 *	<0.000050 *	<0.000050 *	<0.00010 *	<0.00010 *	<0.000050 *
Thorium (Th)-Total	mg/L	<0.00020 *	<0.00050 *	<0.00050 *	<0.0010 *	<0.0010 *	<0.00050 *
Tin (Sn)-Total	mg/L	<0.00020 *	<0.00050 *	0.00122	<0.0010 *	<0.0010 *	<0.00050 *
Titanium (Ti)-Total	mg/L	<0.0030 *	0.0017	<0.0018 *	<0.072 *	<0.0090 *	<0.0030 *
Tungsten (W)-Total	mg/L	0.00045	0.00236	0.00175	0.0022	0.002	0.00175
Uranium (U)-Total	mg/L	0.00014	0.00054	0.000485	0.00046	0.00055	0.000321

	Sample ID	TL5	TL5	TL5	TL5	TL5	TL5
	ALS ID	L2126431-1	L2142179-1	L2157620-1	L2177729-1	L2192448-1	L2208551-1
	Date Sampled	7/8/2018 10:00:00 AM	8/5/2018 10:00:00 AM	9/2/2018 5:50:00 PM	10/7/2018 8:45:00 AM	11/4/2018 8:05:00 AM	12/10/2018 8:20:00 AM
Parameter	**Units**	**Results**					
Vanadium (V)-Total	mg/L	<0.0010 *	<0.0025 *	<0.0025 *	0.007	<0.0050 *	<0.0025 *
Zinc (Zn)-Total	mg/L	<0.0060 *	<0.015 *	<0.015 *	<0.030 *	<0.030 *	<0.015 *
Zirconium (Zr)-Total	mg/L	<0.00012 *	<0.00030 *	<0.00030	<0.00060 *	<0.00060 *	<0.00030 *

Samples of the tailings solids (TL-6) were collected weekly from the tailings thickener tank inside the Process Plant from January to December 2018. A clean container was used to collect a representative sample of tailings material from the tailings thickener tank and the solid material allowed to settle in the container. The supernatant was then discarded and the solid materials transferred into a clean Ziploc bag and refrigerated until four weekly samples had been collected. These weekly samples were then combined to create a composite sample which was submitted for laboratory analysis. Table D1-28 and Table D1-29 provide results for monitoring conducted at TL-6.

Detoxified tailings (TL-7) were collected monthly from January to December 2018 from the discharge compartment of the detox filter press inside the Process Plant (Table D1-30 and Table D1-31).

TL-11 Underground Seepage Monitoring

Visual inspections were conducted of all safely accessible backfilled underground stopes in June and December 2018 to identify seepage from the stopes. Ten stopes were surveyed during each inspection; one seep was identified during each inspection (at the same location in each inspection). Water quality samples were collected from the seeps (TL-11) and submitted for laboratory analysis. Flow measurements could not be completed due to the flow low volume of the seeps. An additional sample was also collected from a pool of water at the base of one backfilled stope. No flowing water was identified at this location but a sample was collected to provide additional characterization of water underground near backfilled materials. Results of this sampling is provided in Table D1-32.

TL-12 Monitoring of Underground Dewatering

Dewatering of the underground workings began in February 2018. Groundwater inflow accumulating underground from mine development occurring in the Doris Connector zone was discharged to the Tailings Impoundment Area. Water quality samples were collected weekly from the discharge line and submitted for laboratory analysis as outlined in of the water licence. Results of this sampling is provided in Table D1-32 through Table D1-37.

Table D1-28. Effluent from Process Plant Tailings Slurry Solids (TL-6), January to June 2018

	Sample ID	TL6-28JAN18	TL6-27FEB18	TL6	TL6	TL6	TL6
	ALS ID	L2050784-1	L2061213-1	L2072841-1	B834215	B844457	B855956
	Date Sampled	1/28/2018 6:30:00 PM	2/26/2018 6:00:00 PM	3/26/2018 6:00:00 PM	4/29/2018 3:00: PM	5/28/2018 8:30:00 AM	6/26/2018 7:30:00AM
Parameter	**Units**	**Results**					
Moisture	%	19.3	27.4	25.3	14.5	14.7	
pH (1:2 soil:water)	pH	9.08	9.19	9.01			
Sulfate (SO_4)	mg/kg	299	671	392			
Inorganic Carbon**	wt%	0.691	0.688	0.805	4.2	3.35	3.49
Inorganic Carbon (as $CaCO_3$ Equivalent)**	kg $CaCO_3$/T	5.76	5.73	6.7	95.5	76.1	79.3
Cyanide, Weak Acid Diss	mg/kg				0.664		
Cyanide, Free	mg/kg				<0.5		
Thiocyanate	mg/kg				<1		
Cyanate	mg/kg				11.7		
Aluminum (Al)*	%	13000	10600	12900	1.06	1.08	0.78
Antimony (Sb)	mg/kg	<0.10	<0.10	<0.10	0.4	0.1	ND
Arsenic (As)	mg/kg	12.2	9.97	7.7	6.6	6.4	14.7
Barium (Ba)	mg/kg	20.1	13.7	12.9	498	12	10
Beryllium (Be)	mg/kg	0.14	0.13	0.14			
Bismuth (Bi)	mg/kg	<0.20	<0.20	<0.20	0.1	0.1	ND
Boron (B)	mg/kg	67.7	33.3	22.5	<20	<20	ND
Cadmium (Cd)	mg/kg	0.117	0.079	0.066	0.4	<0.1	ND
Calcium (Ca)*	%	26100	30300	29000	2.66	2.64	2.43
Chromium (Cr)	mg/kg	33.4	28.4	29.5	88	75	66
Cobalt (Co)	mg/kg	17.9	13.8	12.7	12.6	10.4	9.6
Copper (Cu)	mg/kg	76	70	40.1	30.1	45.5	29.7
Gallium (Ga)	mg/kg				4	4	3
Iron (Fe)*	%	40800	39300	40600	3.76	3.66	3.33
Lanthanum (La)	mg/kg				2	2	2

Sample ID		TL6-28JAN18	TL6-27FEB18	TL6	TL6	TL6	TL6
ALS ID		L2050784-1	L2061213-1	L2072841-1	B834215	B844457	B855956
Date Sampled		1/28/2018 6:30:00 PM	2/26/2018 6:00:00 PM	3/26/2018 6:00:00 PM	4/29/2018 3:00: PM	5/28/2018 8:30:00 AM	6/26/2018 7:30:00AM
Parameter	**Units**	**Results**					
Lead (Pb)	mg/kg	13	6.25	6.58	69.9	11.6	7
Lithium (Li)	mg/kg	34.2	25.4	25.5			
Magnesium (Mg)*	%	13400	14500	14600	1.28	1.24	1.07
Manganese (Mn)	mg/kg	970	1000	921	887	889	794
Mercury (Hg)	mg/kg	<0.0050	<0.0050	<0.0050	0.03	<0.01	ND
Molybdenum (Mo)	mg/kg	0.44	0.25	0.28	0.6	0.4	0.4
Nickel (Ni)	mg/kg	24.7	24.9	23.2	21.1	18.5	17.2
Phosphorus (P)*	%	305	302	320	0.032	0.029	0.026
Potassium (K)*	%	1490	1050	950	0.1	0.08	0.08
Scandium (Sc)	mg/kg				7.0	7.0	6.1
Selenium (Se)	mg/kg	0.24	<0.20	<0.20	<0.5	<0.5	ND
Silver (Ag)	mg/kg	0.56	0.33	0.25	0.4	0.2	0.2
Sodium (Na)*	%	711	931	696	0.052	0.085	0.043
Strontium (Sr)	mg/kg	13.8	18.2	17	19	18	13
Sulfur (S)	mg/kg	1900	1100	1500			
Sulfur (S)-Total*	%	500	<500	600	0.11	0.14	0.1
HCl Extractable Sulphur	wt%				0.03	0.06	0.02
Tellurium (Te)	mg/kg				<0.2	<0.2	ND
Thallium (Tl)	mg/kg	0.061	<0.050	<0.050	<0.1	<0.1	ND
Thorium (Th)	mg/kg				0.1	0.2	0.1
Tin (Sn)	mg/kg	<2.0	<2.0	<2.0			
Titanium (Ti)*	%	1100	746	659	0.057	0.053	0.038
Tungsten (W)	mg/kg	<0.50	<0.50	<0.50	0.2	0.3	0.3
Uranium (U)	mg/kg	<0.050	<0.050	0.109	<0.1	<0.1	ND
Vanadium (V)	mg/kg	66.2	49.6	49	45	43	33

	Sample ID	TL6-28JAN18	TL6-27FEB18	TL6	TL6	TL6	TL6
	ALS ID	L2050784-1	L2061213-1	L2072841-1	B834215	B844457	B855956
	Date Sampled	1/28/2018 6:30:00 PM	2/26/2018 6:00:00 PM	3/26/2018 6:00:00 PM	4/29/2018 3:00: PM	5/28/2018 8:30:00 AM	6/26/2018 7:30:00AM
Parameter	Units	Results					
Zinc (Zn)	mg/kg	79.2	50.4	47.5	75	43	34
Zirconium (Zr)	mg/kg	2.7	2.6	2.9			

Note: Result units reported for this parameter changed from mg/kg to % in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as mg/kg by ALS Environmental.

Result units reported for this parameter changed from % to wt% or kg $CaCO_3$/T in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as % by ALS Environmental.

ND - Analyte concentration below instrumentation detectable level

Table D1-29. Effluent from Process Plant Tailings Slurry Solids (TL-6), July to December 2018

	Sample ID	TL6	TL6	TL6	TL6	TL6^	TL6	TL6
	ALS ID	B865637	B872959	B887992	B896022	B896022	B8A3271	B900452
	Date Sampled	7/16/2018	8/12/2018	9/12/2018	10/14/2018	10/14/2018	11/21/2018	12/10/2018
Parameter	Units	Results						
Moisture	%							
pH (1:2 soil:water)	pH							
Sulfate (SO_4)	mg/kg							
Inorganic Carbon**	wt%	6.33	5.31	4.52	4.28	4.05	3.47	5.65
Inorganic Carbon (as $CaCO_3$ Equivalent)**	kg $CaCO_3$/T	143.9	120.7	102.7	97.3	92.1	78.9	128.4
Cyanide, Weak Acid Diss	mg/kg							
Cyanide, Free	mg/kg							
Thiocyanate	mg/kg							
Cyanate	mg/kg							
Aluminum (Al)*	%	1.07	0.67	0.74	0.73	0.77	0.49	0.70
Antimony (Sb)	mg/kg	0.3	0.1	0.1	<0.1	0.1	<0.1	<0.1
Arsenic (As)	mg/kg	67	15.4	6	9.0	9.4	6.7	8.9
Barium (Ba)	mg/kg	12	8	72	9	11	8	12

Sample ID		TL6	TL6	TL6	TL6	TL6^	TL6	TL6
ALS ID		B865637	B872959	B887992	B896022	B896022	B8A3271	B900452
Date Sampled		7/16/2018	8/12/2018	9/12/2018	10/14/2018	10/14/2018	11/21/2018	12/10/2018
Parameter	**Units**	**Results**						
Beryllium (Be)	mg/kg							
Bismuth (Bi)	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron (B)	mg/kg	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	0.4	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Calcium (Ca)*	%	3.56	3.75	2.77	2.45	2.48	2.06	3.07
Chromium (Cr)	mg/kg	65	38	71	39	51	57	66
Cobalt (Co)	mg/kg	44.4	10.9	10.2	10.5	10.1	7.6	10.7
Copper (Cu)	mg/kg	297	37.9	28.3	40.9	37.9	37.9	41.9
Gallium (Ga)	mg/kg	4	2	3	2	3	2	2
Iron (Fe)*	%	5.73	3.72	3.5	3.23	3.25	2.34	3.74
Lanthanum (La)	mg/kg	2	2	2	1	1	1	2
Lead (Pb)	mg/kg	28.5	18.3	19	6.6	10.1	3.1	6.2
Lithium (Li)	mg/kg							
Magnesium (Mg)*	%	1.36	1.26	1.13	1.10	1.14	0.89	1.10
Manganese (Mn)	mg/kg	1220	1070	892	790	780	619	951
Mercury (Hg)	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (Mo)	mg/kg	0.7	0.3	0.4	0.3	0.4	0.3	0.5
Nickel (Ni)	mg/kg	49.7	23.7	18.6	21.5	21.1	15.9	16.7
Phosphorus (P)*	%	0.031	0.027	0.034	0.023	0.027	0.016	0.032
Potassium (K)*	%	0.08	0.05	0.06	0.06	0.07	0.04	0.06
Scandium (Sc)	mg/kg	8.1	7.0	6.1	5.4	5.6	4.4	6.4
Selenium (Se)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver (Ag)	mg/kg	2.9	0.1	0.2	0.3	0.2	<0.1	0.3
Sodium (Na)*	%	0.075	0.062	0.052	0.063	0.070	0.048	0.070
Strontium (Sr)	mg/kg	22	21	18	12	14	13	18
Sulfur (S)	mg/kg							
Sulfur (S)-Total*	%	1.37	0.1	0.1	0.14	0.13	0.08	0.13

Sample ID		TL6	TL6	TL6	TL6	TL6^	TL6	TL6
ALS ID		B865637	B872959	B887992	B896022	B896022	B8A3271	B900452
Date Sampled		7/16/2018	8/12/2018	9/12/2018	10/14/2018	10/14/2018	11/21/2018	12/10/2018
Parameter	**Units**	**Results**						
HCl Extractable Sulphur	wt%	0.02	0.02	0.01	0.02	0.02	0.01	0.02
Tellurium (Te)	mg/kg	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium (Tl)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thorium (Th)	mg/kg	0.2	0.1	0.2	0.1	0.1	<0.1	0.1
Tin (Sn)	mg/kg							
Titanium (Ti)*	%	0.045	0.015	0.036	0.033	0.036	0.030	0.018
Tungsten (W)	mg/kg	0.4	0.3	0.3	0.4	0.3	0.4	0.8
Uranium (U)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	mg/kg	46	26	29	32	33	21	25
Zinc (Zn)	mg/kg	154	37	40	36	48	26	40
Zirconium (Zr)	mg/kg							

Note: Result units reported for this parameter changed from mg/kg to % in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as mg/kg by ALS Environmental.

Result units reported for this parameter changed from % to wt% or kg $CaCO_3$/T in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as % by ALS Environmental.

^ Duplicate sample.

Table D1-30. Detoxified Tailings Solids (TL-7), January to June 2018

	Sample ID	TL7-08JAN18	TL7-04FEB18	TL7	TL7	TL7	TL7	TL7
	ALS ID	L2043255-1	L2053211-1	L2064903-1	L2075124-1	B834215	B838477	B854535
	Date Sampled	1/8/2018 8:40:00 AM	2/4/2018 1:50:00 PM	3/5/2018 8:40:00 AM	4/1/2018 9:55:00 AM	4/23/2018 6:30:00 PM	5/6/2018 2:25:00 PM	6/13/2018 9:00:00 AM
Parameter	**Units**	**Results**						
Moisture	%	25.5	24.2	18.8	23.2	19.4	20.8	26
pH (1:2 soil:water)	pH	8.9	8.89	8.97	8.32			
Sulfate (SO_4)	mg/kg	2540	1170	1390	3040			
Cyanide, Weak Acid Diss	mg/kg	<13 *	<20 *	<20 *	<20 *	1144	1545	1794
Cyanide, Free	mg/kg	<13 *	<20 *	<20 *	<20 *	5.55	3.13	10.1
Thiocyanate	mg/kg					1.07	935	5338
Cyanate	mg/kg					45.6	73.7	310
Cyanide, Total	mg/kg	2020	3690	2260	2160			
Inorganic Carbon**	wt%	0.815	0.799	0.71	1.01	3.14	4.73	4.31
Inorganic Carbon (as $CaCO_3$ Equivalent)**	kg $CaCO_3$/T	6.79	6.66	5.91	8.43	71.4	107.5	98
Aluminum (Al)*	%	14300	12500	10900	11600	1.27	0.93	1.18
Antimony (Sb)	mg/kg	1.55	1.34	0.66	1.84	1.4	1.1	1.3
Arsenic (As)	mg/kg	345	262	195	556	363	466	369
Barium (Ba)	mg/kg	28.5	25	17.8	21.5	44	20	18
Beryllium (Be)	mg/kg	0.16	0.15	0.12	0.15			
Bismuth (Bi)	mg/kg	2.44	1.76	0.95	3.73	2.0	1.8	3.2
Boron (B)	mg/kg	47.3	46.8	19.8	19.6	<20	<20	ND
Cadmium (Cd)	mg/kg	6	3.21	2	6.46	4.6	2.3	7.5
Calcium (Ca)*	%	40000	32000	37200	34800	3.15	2.97	2.84
Chromium (Cr)	mg/kg	61.2	56	43.6	66	74	76	68
Cobalt (Co)	mg/kg	238	160	118	349	234	237	264
Copper (Cu)	mg/kg	5580	6830	4050	5320	5410	5670	>10000
Gallium (Ga)	mg/kg					5	3	5
Iron (Fe)*	%	133000	112000	89700	196000	14.1	15.3	14.2

	Sample ID	TL7-08JAN18	TL7-04FEB18	TL7	TL7	TL7	TL7	TL7
	ALS ID	L2043255-1	L2053211-1	L2064903-1	L2075124-1	B834215	B838477	B854535
	Date Sampled	1/8/2018 8:40:00 AM	2/4/2018 1:50:00 PM	3/5/2018 8:40:00 AM	4/1/2018 9:55:00 AM	4/23/2018 6:30:00 PM	5/6/2018 2:25:00 PM	6/13/2018 9:00:00 AM
Parameter	**Units**	**Results**						
Lanthanum (La)	mg/kg					2	1	2
Lead (Pb)	mg/kg	528	414	214	606	472	274	614
Lithium (Li)	mg/kg	30.5	30	19.9	20.5			
Magnesium (Mg)*	%	17900	14200	15800	16600	1.48	1.14	1.29
Manganese (Mn)	mg/kg	1320	1100	1220	1340	1110	1090	892
Mercury (Hg)	mg/kg	0.0759	0.0651	0.0394	0.104	0.07	0.04	0.07
Molybdenum (Mo)	mg/kg	2.5	1.99	1.34	3.2	2.4	2.5	3
Nickel (Ni)	mg/kg	185	128	106	240	181	175	214
Phosphorus (P)*	%	427	343	396	374	0.034	0.035	0.034
Potassium (K)*	%	1410	1510	910	920	0.1	0.07	0.11
Scandium (Sc)	mg/kg					8.5	7.1	7.6
Selenium (Se)	mg/kg	8.21	6.91	4.03	13	10.1	10.5	8.9
Silver (Ag)	mg/kg	13.1	17.8	16.3	7.21	16.6	15.3	22.6
Sodium (Na)*	%	2720	1710	1540	3100	0.179	0.179	0.242
Strontium (Sr)	mg/kg	25.1	17.5	22.2	21.4	19	18	17
Sulfur (S)	mg/kg	92900	82600	52900	166000			
Sulfur (S)-Total*	%	56100	60600	29600	139000	>10.0	>10.0	>10.0
HCl Extractable Sulphur	wt%					0.2	0.14	0.2
Tellurium (Te)	mg/kg					2.2	2.7	1.7
Thallium (Tl)	mg/kg	1.29	1	0.42	1.48	1.3	0.8	1.6
Thorium (Th)	mg/kg					0.2	0.1	0.2
Tin (Sn)	mg/kg	<2.0	<2.0	<2.0	<2.0			
Titanium (Ti)*	%	1070	1000	614	380	0.075	0.026	0.047
Tungsten (W)	mg/kg	1.96	1.29	0.74	2.49	1.3	1	1.7

Sample ID		TL7-08JAN18	TL7-04FEB18	TL7	TL7	TL7	TL7	TL7
ALS ID		L2043255-1	L2053211-1	L2064903-1	L2075124-1	B834215	B838477	B854535
Date Sampled		1/8/2018 8:40:00 AM	2/4/2018 1:50:00 PM	3/5/2018 8:40:00 AM	4/1/2018 9:55:00 AM	4/23/2018 6:30:00 PM	5/6/2018 2:25:00 PM	6/13/2018 9:00:00 AM
Parameter	Units	Results						
Uranium (U)	mg/kg	0.23	<0.050	0.054	0.098	<0.1	<0.1	0.1
Vanadium (V)	mg/kg	82.3	64.5	51.5	51.3	60	33	50
Zinc (Zn)	mg/kg	2980	1680	974	2830	2210	1300	3350
Zirconium (Zr)	mg/kg	4.8	3.6	3.3	3.7			

Note: Result units reported for this parameter changed from mg/kg to % in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as mg/kg by ALS Environmental.

Result units reported for this parameter changed from % to wt% or kg CaCO3/T in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as % by ALS Environmental.

Table D1-31. Detoxified Tailings Solids (TL-7), July to December 2018

Sample ID		TL7	TL7	TL7	TL7	TL7	TL7^	TL7
ALS ID		B865632	B872961	B887994	B896025	B8A3274	B8A3274	B900457
Date Sampled		7/15/2018	8/12/2018	9/12/2018	10/15/2018	11/21/2018	11/21/2018	12/10/2018
Parameter	Units	Results						
Moisture	%	19	21	21	21	20.0	22.0	23.6
pH (1:2 soil:water)	pH							
Sulfate (SO_4)	mg/kg							
Cyanide, Weak Acid Diss	mg/kg	1240	712	1924	623	482	799	669
Cyanide, Free	mg/kg	0.646	0.579	15.4	<0.5	<0.5	<0.5	<0.5
Thiocyanate	mg/kg	1148	928	2572	1807	1567	1664	910
Cyanate	mg/kg	280	318	1099	226.0	433.0	445.0	299.0
Cyanide, Total	mg/kg							
Inorganic Carbon**	wt%	6.16	5.39	4.04	3.65	5.11	5.23	6.24
Inorganic Carbon (as $CaCO_3$ Equivalent)**	kg $CaCO_3$/T	140	122.5	91.8	83.0	116.1	118.9	141.8
Aluminum (Al)*	%	1.02	0.81	0.66	0.78	0.54	0.55	0.67
Antimony (Sb)	mg/kg	1.2	1.2	1.2	1.9	1.4	1.0	0.9

Sample ID		TL7	TL7	TL7	TL7	TL7	TL7^	TL7
ALS ID		B865632	B872961	B887994	B896025	B8A3274	B8A3274	B900457
Date Sampled		7/15/2018	8/12/2018	9/12/2018	10/15/2018	11/21/2018	11/21/2018	12/10/2018
Parameter	Units	Results						
Arsenic (As)	mg/kg	486	629	823	799	855	809	708
Barium (Ba)	mg/kg	13	10	13	12	8	8	9
Beryllium (Be)	mg/kg							
Bismuth (Bi)	mg/kg	1.6	1.8	2.7	4.2	3.8	3.7	3.0
Boron (B)	mg/kg	<20	<20	<20	<20	<20	<20	<20
Cadmium (Cd)	mg/kg	2.3	1.5	3.0	5.4	3.2	3.2	2.1
Calcium (Ca)*	%	3.53	3.96	2.48	2.47	2.47	2.56	3.45
Chromium (Cr)	mg/kg	76	77	89	81	81	82	76
Cobalt (Co)	mg/kg	242	258	427	399	406	385	365
Copper (Cu)	mg/kg	5290	3970	>10000	5880	6990	6980	5880
Gallium (Ga)	mg/kg	4	3	3	3	2	2	3
Iron (Fe)*	%	14.8	16.2	25.5	20.8	22.3	20.6	22.7
Lanthanum (La)	mg/kg	2	1	1	1	<1	<1	1
Lead (Pb)	mg/kg	189	174	429	443	323	289	283
Lithium (Li)	mg/kg							
Magnesium (Mg)*	%	1.37	1.27	0.91	0.89	0.97	0.95	1.11
Manganese (Mn)	mg/kg	1290	1270	858	832	954	933	1170
Mercury (Hg)	mg/kg	0.04	0.03	0.07	0.09	0.05	0.06	0.07
Molybdenum (Mo)	mg/kg	2.6	2.7	3.1	3.1	3.5	3.4	3.3
Nickel (Ni)	mg/kg	231	267	415	337	329	299	241
Phosphorus (P)*	%	0.03	0.024	0.027	0.021	0.024	0.024	0.035
Potassium (K)*	%	0.07	0.06	0.05	0.06	0.05	0.05	0.05
Scandium (Sc)	mg/kg	7.3	7.3	5.3	5.4	5.2	5.4	6.4
Selenium (Se)	mg/kg	7.1	8.6	18.2	16.8	17.4	16.3	15.1
Silver (Ag)	mg/kg	10.1	11	64.6	26.5	22.3	21.5	18.9
Sodium (Na)*	%	0.117	0.264	0.251	0.287	0.350	0.288	0.315
Strontium (Sr)	mg/kg	23	22	16	16	17	17	22

	Sample ID	TL7	TL7	TL7	TL7	TL7	TL7^	TL7
	ALS ID	B865632	B872961	B887994	B896025	B8A3274	B8A3274	B900457
	Date Sampled	7/15/2018	8/12/2018	9/12/2018	10/15/2018	11/21/2018	11/21/2018	12/10/2018
Parameter	Units	Results						
Sulfur (S)	mg/kg							
Sulfur (S)-Total*	%	>10.0	>10.0	>10.0	>10.0	>10.0	>10.0	>10.0
HCl Extractable Sulphur	wt%	0.06	0.15	0.27	0.19	0.22	0.18	0.25
Tellurium (Te)	mg/kg	2.2	3.3	4.9	4.9	5.7	5.6	4.5
Thallium (Tl)	mg/kg	0.6	0.4	0.9	1.5	0.6	0.5	0.4
Thorium (Th)	mg/kg	0.2	0.1	0.2	0.1	0.1	0.1	0.1
Tin (Sn)	mg/kg							
Titanium (Ti)*	%	0.053	0.019	0.030	0.026	0.011	0.010	0.009
Tungsten (W)	mg/kg	1.6	1.5	2.8	2.9	2.1	2.2	1.9
Uranium (U)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	mg/kg	52	40	34	32	19	19	23
Zinc (Zn)	mg/kg	1010	613	1270	2560	1390	1370	923
Zirconium (Zr)	mg/kg							

Note: Result units reported for this parameter changed from mg/kg to % in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as mg/kg by ALS Environmental.
Result units reported for this parameter changed from % to wt% or kg $CaCO_3$/T in April 2018 due to differences in analytical methodology and reporting used by Maxxam Analytics Inc. Samples prior to April 2018 were reported as % by ALS Environmental.
^ Duplicate sample.

Table D1-32. Seepage from Underground Backfilled Stopes (TL-11), June and December 2018

	Sample ID	TL11	TL11-DUP	TL11A	TL11B	TL11-DUP
	ALS ID	L2121770-1	L2121770-2	L2211631-1	L2211631-2	L2211631-3
	Date Sampled	6/28/2018 1:50:00 PM	6/28/2018 1:50:00 PM	12/17/2018 11:25:00 AM	12/17/2018 11:55:00 AM	12/17/2018 11:55:00 AM
Parameter	**Units**	**Results**				
Conductivity	µS/cm	99200	98800	102000	91800	92200
Hardness (as $CaCO_3$)	mg/L	42800	41700	40000	36900	36100
pH	pH	6.84	6.89	6.88	6.91	6.9
Total Suspended Solids	mg/L	319	282	42000	219	282
Total Dissolved Solids	mg/L	83300	67900	79800	73400	73300
Acidity (as $CaCO_3$)	mg/L	106	103	201	123	124
Alkalinity, Total (as $CaCO_3$)	mg/L	40.3	39.4	229	59.8	62.8
Ammonia, Total (as N)	mg/L	224	226	378	228	228
Chloride (Cl)	mg/L	43300	44400	46900	40200	40800
Nitrate (as N)	mg/L	485	497	517	515	523
Nitrite (as N)	mg/L	2.84	2.89	17.6	1.59	1.64
Sulfate (SO_4)	mg/L	858	882	1010	891	919
Cyanide, Weak Acid Diss	mg/L	<0.0050 *	0.0059	0.0167	<0.0050	<0.0050
Cyanide, Total	mg/L	0.0199 *	0.0155 *	1.1	0.0067 *	0.0093 *
Cyanide, Free	mg/L	0.0067	0.0055	0.0097	<0.0050	<0.0050
Aluminum (Al)-Total	mg/L	<0.15 *	0.18	806	0.34	4.78
Antimony (Sb)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Arsenic (As)-Total	mg/L	<0.0050 *	<0.0050 *	2.54	0.0052	0.0192
Barium (Ba)-Total	mg/L	0.319	0.286	1.04	0.214	0.218
Beryllium (Be)-Total	mg/L	<0.0050 *	<0.0050 *	0.0057	<0.0050 *	<0.0050 *
Bismuth (Bi)-Total	mg/L			0.0131	<0.0025 *	<0.0025 *
Boron (B)-Total	mg/L	2.78	2.79	4.86	2.94	2.99
Cadmium (Cd)-Total	mg/L	0.0325	0.0286	0.0419	0.0405	0.041
Calcium (Ca)-Total	mg/L	14300	13200	14900	10900	10500
Cesium (Cs)-Total	mg/L			0.00833	0.00403	0.00407
Chromium (Cr)-Total	mg/L	<0.0050 *	<0.0050 *	2.4	<0.0050 *	0.0081
Cobalt (Co)-Total	mg/L	0.23	0.2	2.18	0.346	0.356
Copper (Cu)-Total	mg/L	0.574	0.537	44.5	0.854	1.48
Iron (Fe)-Total	mg/L	<0.50 *	0.83	2560	1.13	17.8
Lead (Pb)-Total	mg/L	0.164	0.16	2.85	0.145	0.392
Lithium (Li)-Total	mg/L	0.337	0.35	1.06	0.351	0.356
Magnesium (Mg)-Total	mg/L	1650	1440	2670	1640	1620
Manganese (Mn)-Total	mg/L	8.87	7.81	57.9	10.6	10.6
Molybdenum (Mo)-Total	mg/L	0.0173	0.016	0.163	0.0164	0.0164
Nickel (Ni)-Total	mg/L	0.364	0.323	2.58	0.506	0.508
Phosphorus (P)-Total	mg/L			21.5	<2.5 *	<2.5 *
Potassium (K)-Total	mg/L	572	505	657	507	497

Sample ID		TL11	TL11-DUP	TL11A	TL11B	TL11-DUP
ALS ID		L2121770-1	L2121770-2	L2211631-1	L2211631-2	L2211631-3
Date Sampled		6/28/2018 1:50:00 PM	6/28/2018 1:50:00 PM	12/17/2018 11:25:00 AM	12/17/2018 11:55:00 AM	12/17/2018 11:55:00 AM
Parameter	**Units**	**Results**				
Rubidium (Rb)-Total	mg/L			0.376	0.345	0.331
Selenium (Se)-Total	mg/L	0.0129	0.0117	0.0546	0.0155	0.0176
Silicon (Si)-Total	mg/L			454	<5.0 *	11.3
Silver (Ag)-Total	mg/L	0.0367	0.0343	0.121	0.0265	0.0275
Sodium (Na)-Total	mg/L	11300	10200	13600	10700	10600
Strontium (Sr)-Total	mg/L			38	28.6	27.6
Sulfur (S)-Total	mg/L			1370	624	649
Tellurium (Te)-Total	mg/L			0.024	<0.010 *	<0.010 *
Thallium (Tl)-Total	mg/L	0.00073	0.00075	0.00445	0.00081	0.00068
Thorium (Th)-Total	mg/L			0.006	<0.0050 *	<0.0050 *
Tin (Sn)-Total	mg/L	<0.0050 *	<0.0050 *	0.0234	<0.0050 *	<0.0050 *
Titanium (Ti)-Total	mg/L	<0.015 *	<0.015 *	15.1	0.019	0.263
Tungsten (W)-Total	mg/L			0.0155	<0.0050 *	<0.0050 *
Uranium (U)-Total	mg/L	0.00435	0.00424	0.0048	0.00437	0.0043
Vanadium (V)-Total	mg/L	<0.025 *	<0.025 *	2.75	<0.025 *	0.037
Zinc (Zn)-Total	mg/L	2.01	1.66	13.6	3.41	3.46
Zirconium (Zr)-Total	mg/L			0.0071	<0.0030 *	<0.0030 *
Antimony (Sb)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Arsenic (As)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Barium (Ba)-Dissolved	mg/L	0.311	0.303	0.596	0.245	0.258
Beryllium (Be)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Bismuth (Bi)-Dissolved	mg/L	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *
Boron (B)-Dissolved	mg/L	2.85	2.8	3.65	2.94	2.89
Cadmium (Cd)-Dissolved	mg/L	0.0321	0.0294	0.021	0.0446	0.0455
Calcium (Ca)-Dissolved	mg/L	14500	14200	13100	12100	11900
Cesium (Cs)-Dissolved	mg/L	0.00502	0.00506	<0.00050 *	0.00422	0.0045
Chromium (Cr)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Cobalt (Co)-Dissolved	mg/L	0.216	0.205	0.0452	0.344	0.345
Copper (Cu)-Dissolved	mg/L	0.54	0.522	0.34	0.838	0.836
Iron (Fe)-Dissolved	mg/L	<0.50 *	<0.50 *	<0.50 *	<0.50 *	0.75
Lead (Pb)-Dissolved	mg/L	0.168	0.16	0.0046	0.15	0.151
Lithium (Li)-Dissolved	mg/L	0.353	0.346	0.268	0.353	0.35
Magnesium (Mg)-Dissolved	mg/L	1620	1520	1780	1630	1560
Manganese (Mn)-Dissolved	mg/L	8.63	8.25	9.81	11.1	11
Molybdenum (Mo)-Dissolved	mg/L	0.0182	0.0162	0.051	0.0207	0.0187
Nickel (Ni)-Dissolved	mg/L	0.346	0.331	0.197	0.499	0.501
Phosphorus (P)-Dissolved	mg/L	<2.5 *	<2.5 *	<2.5 *	<2.5 *	<2.5 *
Potassium (K)-Dissolved	mg/L	550	524	604	524	521

Sample ID		TL11	TL11-DUP	TL11A	TL11B	TL11-DUP
ALS ID		L2121770-1	L2121770-2	L2211631-1	L2211631-2	L2211631-3
Date Sampled		6/28/2018 1:50:00 PM	6/28/2018 1:50:00 PM	12/17/2018 11:25:00 AM	12/17/2018 11:55:00 AM	12/17/2018 11:55:00 AM
Parameter	**Units**	**Results**				
Rubidium (Rb)-Dissolved	mg/L	0.39	0.379	0.31	0.379	0.374
Selenium (Se)-Dissolved	mg/L	0.0222 *	0.0161	0.0083	0.0432 *	0.0344 *
Silicon (Si)-Dissolved	mg/L	<2.5 *	<2.5 *	<2.5 *	2.7	2.6
Silver (Ag)-Dissolved	mg/L	0.0399	0.0377	0.018	0.031	0.0308
Sodium (Na)-Dissolved	mg/L	11100	10600	12300	10700	10400
Strontium (Sr)-Dissolved	mg/L	32.2	31	38.4	34.2	34.2
Sulfur (S)-Dissolved	mg/L	534	516	490	593	598
Tellurium (Te)-Dissolved	mg/L	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *
Thallium (Tl)-Dissolved	mg/L	0.00088	0.00085	0.00067	0.00084	0.00075
Thorium (Th)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Tin (Sn)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Titanium (Ti)-Dissolved	mg/L	<0.015 *	<0.015 *	<0.015 *	<0.015 *	<0.015 *
Tungsten (W)-Dissolved	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Uranium (U)-Dissolved	mg/L	0.00469	0.00446	0.00295	0.00498	0.00497
Vanadium (V)-Dissolved	mg/L	<0.025 *	<0.025 *	<0.025 *	<0.025 *	<0.025 *
Zinc (Zn)-Dissolved	mg/L	1.87	1.82	0.234	3.6	3.63
Zirconium (Zr)-Dissolved	mg/L	<0.0030 *	<0.0030 *	<0.0030 *	<0.0030 *	<0.0030 *

^ *Duplicate Sample*

Table D1-33. Water Sampling Monitoring Program Results for February to April 2018 Taken from TL-12

	Sample ID	TL12-12FEB18	TL12-26FEB18	TL12	TL12	TL12	TL12	TL12	TL12	TL12 - DUP^	TL12	TL12
	ALS ID	L2056065-1	L2061209-1	L2064836-1	L2066951-1	L2069738-1	L2072850-1	L2075121-1	L2077753-1	L2077753-2	L2081107-1	L2084112-1
	Date Sampled	2/12/2018 3:35:00 PM	2/26/2018 9:30:00 AM	3/5/2018 1:50:00 PM	3/13/2018 11:30:00 AM	3/19/2018 2:10:00 PM	3/26/2018 9:00:00 AM	4/2/2018 8:55:00 AM	4/9/2018 12:50:00 PM	4/9/2018 12:50:00 PM	4/16/2018 3:15:00 PM	4/23/2018 3:15:00 PM
Parameter	**Units**	**Results**										
Hardness (as $CaCO_3$)	mg/L				12600 *							
pH	pH	7.31			7.44			7.73	7.55	7.58	7.67	7.66
Total Suspended Solids	mg/L	829			685			89.8	2580	2640	3010	195
Total Dissolved Solids	mg/L		35600	36000	39900	38600	39500	37600	39300	39600	41700	38900
Alkalinity, Total (as $CaCO_3$)	mg/L	96.8			91.3							
Ammonia, Total (as N)	mg/L	17.3			47.4			11.7	8.75	8.77	30.9	6.81
Ammonia, Un-ionized (as N)	mg/L							0.0657	0.00711	0.00695	0.251	0.0134
Bromide (Br)	mg/L	84.2			82.3							
Chloride (Cl)	mg/L	19600	20700	21600	21100	23100	24500	21700	21600	22600	24400	20900
Fluoride (F)	mg/L	<2.0 *			<2.0 *							
Nitrate (as N)	mg/L	12.3	5.59	45.3	48.8	16.3	22.6	10.6	7.52	7.89	35.2	3.98
Nitrite (as N)	mg/L	0.66			1.83							
Sulfate (SO_4)	mg/L	1900			1920							
Cyanide, Total	mg/L	0.0271			0.133			0.0245	0.0332 *	0.0170 *	0.0563	0.0237
Aluminum (Al)-Total	mg/L	13.5			25.5			3.44	86.2	86.5	93	1.97
Antimony (Sb)-Total	mg/L	<0.010 *			<0.0050 *			<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Arsenic (As)-Total	mg/L	<0.010 *			<0.0050 *			<0.0050 *	0.0293	0.0287	0.0436	<0.0050 *
Barium (Ba)-Total	mg/L	0.0532			0.127			0.0786	0.0985	0.0957	0.203	0.0439
Beryllium (Be)-Total	mg/L	<0.010 *			<0.0050 *			<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Bismuth (Bi)-Total	mg/L	<0.0050 *			<0.0025 *			<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *
Boron (B)-Total	mg/L	3.6			3.89			4.19	3.77	3.68	3.48	4.05
Cadmium (Cd)-Total	mg/L	<0.00050 *			0.00041			<0.00025 *	0.00073	0.00064	0.00091	<0.00025 *
Calcium (Ca)-Total	mg/L	2420			3090			2710	2620	2570	4250	1860
Cesium (Cs)-Total	mg/L	0.0016			0.00161			0.00167	0.00181	0.00184	0.00231	0.00115
Chromium (Cr)-Total	mg/L	<0.010 *	-	-	0.0166	-	-	<0.0050 *	0.184	0.181	0.117	<0.0050 *
Cobalt (Co)-Total	mg/L	0.012			0.0205			<0.0050 *	0.0873	0.0886	0.122	<0.0050 *
Copper (Cu)-Total	mg/L	0.141			0.141			0.047	0.626	0.613	0.513	0.044
Iron (Fe)-Total	mg/L	35.8			60.7			10.3	208	207	313	7.42
Lead (Pb)-Total	mg/L	0.0105			0.0165			<0.0025 *	0.0475	0.0466	0.0591	<0.0025 *
Lithium (Li)-Total	mg/L	0.22			0.219			0.222	0.251	0.24	0.286	0.214
Magnesium (Mg)-Total	mg/L	1090			1180			1210	1250	1230	1280	1660
Manganese (Mn)-Total	mg/L	3.52			4.09			3.64	7.35	7.23	12.8	4.59
Mercury (Hg)-Total	mg/L										<0.00010 *	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.0119			0.0086			0.0069	0.0113	0.0114	0.0208	0.0049
Nickel (Ni)-Total	mg/L	<0.050 *			<0.025 *			<0.025 *	0.113	0.11	0.111	<0.025 *
Phosphorus (P)-Total	mg/L	<5.0 *			<2.5 *			<2.5 *	<2.5 *	<2.5 *	4.7	<2.5 *
Potassium (K)-Total	mg/L	239			263			274	265	261	293	316

Sample ID		TL12-12FEB18	TL12-26FEB18	TL12	TL12	TL12	TL12	TL12	TL12	TL12 - DUP^	TL12	TL12
ALS ID		L2056065-1	L2061209-1	L2064836-1	L2066951-1	L2069738-1	L2072850-1	L2075121-1	L2077753-1	L2077753-2	L2081107-1	L2084112-1
Date Sampled		2/12/2018 3:35:00 PM	2/26/2018 9:30:00 AM	3/5/2018 1:50:00 PM	3/13/2018 11:30:00 AM	3/19/2018 2:10:00 PM	3/26/2018 9:00:00 AM	4/2/2018 8:55:00 AM	4/9/2018 12:50:00 PM	4/9/2018 12:50:00 PM	4/16/2018 3:15:00 PM	4/23/2018 3:15:00 PM
Parameter	**Units**	**Results**										
Rubidium (Rb)-Total	mg/L	0.124			0.143			0.135	0.137	0.136	0.157	0.151
Selenium (Se)-Total	mg/L	<0.0050 *			<0.0025 *			<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *
Silicon (Si)-Total	mg/L	17			28.3			6.8	86	86.6	96.3	6.2
Silver (Ag)-Total	mg/L	<0.0010 *			<0.00050 *			0.00067	0.00268	0.00235	0.00427	<0.00050 *
Sodium (Na)-Total	mg/L	8570			9030			9110	8840	8680	9170	10700
Strontium (Sr)-Total	mg/L	28.3			26.4			26.6	27.8	27.8	24.5	23.6
Sulfur (S)-Total	mg/L	691			676			721	713	716	700	900
Tellurium (Te)-Total	mg/L	<0.020 *			<0.010 *			<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *
Thallium (Tl)-Total	mg/L	<0.0010 *			<0.00050 *			<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *
Thorium (Th)-Total	mg/L	<0.010 *			<0.0050 *			<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Tin (Sn)-Total	mg/L	<0.010 *			<0.0050 *			<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Titanium (Ti)-Total	mg/L	0.169			0.202			0.04	2.29	2.26	1.39	0.03
Tungsten (W)-Total	mg/L	<0.010 *			<0.0050 *			<0.0050 *	0.007	0.0074	0.0279	0.006
Uranium (U)-Total	mg/L	<0.0010 *			<0.00050 *			<0.00050 *	<0.00050 *	<0.00050 *	0.00066	<0.00050 *
Vanadium (V)-Total	mg/L	<0.050 *			0.054			<0.025 *	0.247	0.245	0.239	<0.025 *
Zinc (Zn)-Total	mg/L	<0.30 *			0.18			0.75	0.7	0.67	0.66	<0.15 *
Zirconium (Zr)-Total	mg/L	<0.0060 *			<0.0030 *			<0.0030 *	0.0037	0.004	0.0065	<0.0030 *

^ *Duplicate sample.*

Table D1-34. Water Sampling Monitoring Program Results for May to July 2018 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2091808-1	L2094855-1	L2098165-1	L2110495-1	L2114987-1	L2119168-1	L2124947-1	L2126705-1	L2130714-1	L2134915-1	L2139300-1
Date Sampled		5/6/2018 10:05:00 AM	5/14/2018 9:40:00 AM	5/21/2018 9:15:00 AM	6/11/2018 4:45:00 PM	6/18/2018 8:45:00 AM	6/24/2018 11:10:00 AM	7/5/2018 7:40:00 AM	7/9/2018 4:30:00 PM	7/16/2018 4:00:00 PM	7/23/2018 5:20:00 PM	7/30/2018 5:00:00 PM
Parameter	**Units**	**Results**										
Hardness (as $CaCO_3$)	mg/L			14400 *					8380 *			
pH	pH	7.64	7.59	7.59	7.65	7.7	7.8	7.59	7.71	7.6	7.67	7.74
Total Suspended Solids	mg/L	8810	5040	1900	670	986	542	426	203	1620	656	519
Total Dissolved Solids	mg/L	41200	39100	57200	36100	38800	32200	38500	39600	44000	37700	28400
Alkalinity, Total (as $CaCO_3$)	mg/L								107			
Ammonia, Total (as N)	mg/L	15.6	79.1	32.5	59.7	32.8	15	42.6	26.7	43.3	20.2	18.7
Ammonia, Un-ionized (as N)	mg/L	0.0216	0.161	0.134	0.0953	0.156	0.058	0.104		0.192	0.0807	0.158
Bromide (Br)	mg/L								68.6			
Chloride (Cl)	mg/L	19800	22900	22600	18400	18100	18700	18200	17800	18400	17500	17400
Fluoride (F)	mg/L								<2.0 *			
Nitrate (as N)	mg/L	15.5	84.2	29.9	56.3	29.5	13	37.3	15.3	44.8	19.3	6.01
Nitrite (as N)	mg/L								0.72			
Sulfate (SO_4)	mg/L								1760			

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2091808-1	L2094855-1	L2098165-1	L2110495-1	L2114987-1	L2119168-1	L2124947-1	L2126705-1	L2130714-1	L2134915-1	L2139300-1
Date Sampled		5/6/2018 10:05:00 AM	5/14/2018 9:40:00 AM	5/21/2018 9:15:00 AM	6/11/2018 4:45:00 PM	6/18/2018 8:45:00 AM	6/24/2018 11:10:00 AM	7/5/2018 7:40:00 AM	7/9/2018 4:30:00 PM	7/16/2018 4:00:00 PM	7/23/2018 5:20:00 PM	7/30/2018 5:00:00 PM
Parameter	Units	Results										
Cyanide, Total	mg/L	<0.50 *	0.18	0.0758	0.137	0.0898	0.054	0.0636	0.04	0.0701	0.0354	0.029 *
Aluminum (Al)-Total	mg/L	120	93.4	50.4	11.8	9.73	17.1	10.7	5.77	38.5	19.3	57.2
Antimony (Sb)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<2.0 *	<0.0050 *
Arsenic (As)-Total	mg/L	0.0808	0.0194	0.0155	<0.0050 *	<0.0050 *	0.0102	0.0071	0.0057	0.0267	<2.0 *	0.0154
Barium (Ba)-Total	mg/L	0.113	0.159	0.153	0.0879	0.0686	0.0637	0.076	0.0456	0.0607	<0.10 *	0.0657
Beryllium (Be)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.050 *	<0.0050 *
Bismuth (Bi)-Total	mg/L	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<2.0 *	<0.0025 *
Boron (B)-Total	mg/L	3.35	3.75	3.83	3.79	3.69	3.84	3.76	3.76	3.42	3.9	3.76
Cadmium (Cd)-Total	mg/L	0.0013	0.0003	0.00056	<0.00025 *	<0.00025 *	<0.00025 *	0.00027	<0.00025 *	0.0004	<0.10 *	0.00027
Calcium (Ca)-Total	mg/L	2300	3240	3630	1880	1730	1740	1960	1640	1570	1680	1610
Cesium (Cs)-Total	mg/L	0.00221	0.00131	0.00206	0.00103	0.00102	0.00133	0.00187	0.00124	0.00144		0.00182
Chromium (Cr)-Total	mg/L	0.161	0.0967	0.0837	0.015	0.0211	0.032	0.0195	0.014	0.0637	<0.10 *	0.072
Cobalt (Co)-Total	mg/L	0.149	0.0806	0.0548	0.0127	0.0132	0.0213	0.0141	0.0062	0.0419	<0.10 *	0.0536
Copper (Cu)-Total	mg/L	2.37	1.19	0.563	0.286	0.342	0.421	0.159	0.124	0.49	0.16	0.304
Iron (Fe)-Total	mg/L	347	229	127	30.8	24.8	42.3	31.1	15.1	109	50.1	143
Lead (Pb)-Total	mg/L	0.208	0.108	0.057	0.038	0.0169	0.0199	0.0127	0.0073	0.0602	<0.50 *	0.0343
Lithium (Li)-Total	mg/L	0.267	0.247	0.244	0.182	0.186	0.18	0.185	0.171	0.185	0.2	0.197
Magnesium (Mg)-Total	mg/L	1080	1320	1300	1130	1190	1130	1070	1040	1070	1050	1140
Manganese (Mn)-Total	mg/L	10.9	9.82	5.3	3.6	3.53	3.95	3.36	2.85	4.64	3.31	5.32
Mercury (Hg)-Total	mg/L		<0.00025 *	<0.000050 *								
Molybdenum (Mo)-Total	mg/L	0.0126	0.0076	0.0094	0.0054	0.004	0.0043	0.0066	0.0034	0.0076	<0.30 *	0.0078
Nickel (Ni)-Total	mg/L	0.147	0.076	0.069	<0.025 *	<0.025 *	0.031	0.025	<0.025 *	0.052	<0.50 *	0.06
Phosphorus (P)-Total	mg/L	3.6	<2.5 *	<2.5 *	<2.5 *	<2.5 *	<2.5 *	<2.5 *	<2.5 *	<2.5 *	<3.0 *	<2.5 *
Potassium (K)-Total	mg/L	237	261	292	238	253	248	243	217	230	232	233
Rubidium (Rb)-Total	mg/L	0.128	0.136	0.166	0.13	0.128	0.132	0.122	0.113	0.116		0.127
Selenium (Se)-Total	mg/L	0.0025	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<2.0 *	<0.0025 *
Silicon (Si)-Total	mg/L	110	89.3	58.9	16.1	14	22.2	16.3	9.8	45.2	24.2	60.9
Silver (Ag)-Total	mg/L	0.00694	0.00259	0.00155	0.00145	0.001	0.00095	<0.00050 *	<0.00050 *	0.00121	<0.10 *	0.00083
Sodium (Na)-Total	mg/L	8300	8580	9570	8110	8940	8450	7840	7540	7870	8640	7940
Strontium (Sr)-Total	mg/L	25.7	23.4	26.4	21.9	21	21.7	21.1	20.1	18.6	19.9	19.5
Sulfur (S)-Total	mg/L	651	649	747	663	681	622	615	604	615		649
Tellurium (Te)-Total	mg/L	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *		<0.010 *
Thallium (Tl)-Total	mg/L	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<2.0 *	<0.00050 *
Thorium (Th)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *		<0.0050 *
Tin (Sn)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.30 *	<0.0050 *

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2091808-1	L2094855-1	L2098165-1	L2110495-1	L2114987-1	L2119168-1	L2124947-1	L2126705-1	L2130714-1	L2134915-1	L2139300-1
Date Sampled		5/6/2018 10:05:00 AM	5/14/2018 9:40:00 AM	5/21/2018 9:15:00 AM	6/11/2018 4:45:00 PM	6/18/2018 8:45:00 AM	6/24/2018 11:10:00 AM	7/5/2018 7:40:00 AM	7/9/2018 4:30:00 PM	7/16/2018 4:00:00 PM	7/23/2018 5:20:00 PM	7/30/2018 5:00:00 PM
Parameter	Units	Results										
Titanium (Ti)-Total	mg/L	2	1.15	1.41	0.159	0.285	0.53	0.273	0.187	0.746	0.47	1.14
Tungsten (W)-Total	mg/L	0.0077	<0.0050 *	0.0056	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *		0.0059
Uranium (U)-Total	mg/L	0.00054	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *		<0.00050 *
Vanadium (V)-Total	mg/L	0.314	0.225	0.144	0.027	0.032	0.051	0.031	<0.025 *	0.116	<0.30 *	0.163
Zinc (Zn)-Total	mg/L	1.49	0.61	0.4	0.74	0.4	0.52	0.4	0.37	0.51	0.425	0.84
Zirconium (Zr)-Total	mg/L	0.0041	0.0032	<0.0030 *	<0.0030 *	<0.0030 *	<0.0030 *	<0.0030 *	<0.0030 *	<0.0030 *		0.0039

Table D1-35. Water Sampling Monitoring Program Results for August to September 2018 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12-DUP^	TL12	TL12	TL12
ALS ID		L2141981-1	L2147126-1	L2150188-1	L2154174-1	L2157647-1	L2157647-2	L2163959-1	L2166394-1	L2169727-1
Date Sampled		8/7/2018 11:00:00 AM	8/13/2018 3:30:00 PM	8/20/2018 4:30:00 PM	8/27/2018 11:00:00 AM	9/3/2018 11:10:00 AM	9/3/2018 11:10:00 AM	9/10/2018 10:55:00 AM	9/17/2018 10:15:00 AM	9/24/2018 3:45:00 PM
Parameter	Units	Results								
Hardness (as $CaCO_3$)	mg/L	8370 *				8080 *	8180 *			
pH	pH	7.82	7.68	7.8	7.78	7.59	7.59	7.54	7.54	7.72
Total Suspended Solids	mg/L	137	3080	1700	8220			5860	3520	10400
Total Dissolved Solids	mg/L	35400	38300	34900	30100	33000	31700	39100	26800	31300
Alkalinity, Total (as $CaCO_3$)	mg/L	125				164	158			
Ammonia, Total (as N)	mg/L	16.8	28	12.9	28	11.8	11.7	50.1	30	20.8
Ammonia, Un-ionized (as N)	mg/L	0.149	0.27	0.156	0.228	0.0405	0.0401	0.316	0.189	0.118
Bromide (Br)	mg/L	64.9				61.4	62.2			
Chloride (Cl)	mg/L	16800	16800	17000	17300	16200	16200	19200	15500	15100
Fluoride (F)	mg/L	<2.0				<2.0 *	<2.0 *			
Nitrate (as N)	mg/L	15.3	27.7	10.1	23.9	9.55	9.68	54.1	30.4	18.9
Nitrite (as N)	mg/L	0.77				0.73	0.85	1.73		
Sulfate (SO_4)	mg/L	1700				1700	1690			
Cyanide, Total	mg/L	0.0345	0.0862	0.0381	0.0734	0.0561	0.0469	0.0696	0.0579	0.0453
Aluminum (Al)-Total	mg/L	2.77	88.1	35.3	101	70	76.5	99.4	114	55.9
Antimony (Sb)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Arsenic (As)-Total	mg/L	<0.0050 *	0.0508	0.0227	0.109	0.0258	0.0291	0.0237	0.102	0.0612
Barium (Ba)-Total	mg/L	0.0443	0.0875	0.0591	0.102	0.078	0.0833	0.111	0.142	0.0665
Beryllium (Be)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Bismuth (Bi)-Total	mg/L	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *
Boron (B)-Total	mg/L	4.14	3.31	3.35	3.52	3.38	3.5	3.45	3.65	3.33
Cadmium (Cd)-Total	mg/L	<0.00025 *	0.00051	0.00032	0.00117	0.00035	0.00028	0.0004	0.00099	0.00065
Calcium (Ca)-Total	mg/L	1680	1380	1400	1710	1430	1490	1730	1670	1330
Cesium (Cs)-Total	mg/L	0.00119	0.0016	0.00077	0.00215	0.00172	0.00179	0.00226	0.00236	0.00116
Chromium (Cr)-Total	mg/L	<0.0050 *	0.107	0.0338	0.143	0.0709	0.0784	0.0953	0.157	0.0842

Sample ID		TL12	TL12	TL12	TL12	TL12	TL12-DUP^	TL12	TL12	TL12
ALS ID		L2141981-1	L2147126-1	L2150188-1	L2154174-1	L2157647-1	L2157647-2	L2163959-1	L2166394-1	L2169727-1
Date Sampled		8/7/2018 11:00:00 AM	8/13/2018 3:30:00 PM	8/20/2018 4:30:00 PM	8/27/2018 11:00:00 AM	9/3/2018 11:10:00 AM	9/3/2018 11:10:00 AM	9/10/2018 10:55:00 AM	9/17/2018 10:15:00 AM	9/24/2018 3:45:00 PM
Parameter	Units	Results								
Cobalt (Co)-Total	mg/L	<0.0050 *	0.0961	0.0387	0.138	0.0676	0.0738	0.0877	0.17	0.0786
Copper (Cu)-Total	mg/L	0.112	1.13	0.505	1.17	0.496	0.503	0.497	0.723	0.926
Iron (Fe)-Total	mg/L	7.96	244	105	373	192	212	274	469	168
Lead (Pb)-Total	mg/L	0.0046	0.112	0.0457	0.146	0.0481	0.0514	0.0614	0.161	0.0679
Lithium (Li)-Total	mg/L	0.178	0.204	0.171	0.237	0.192	0.2	0.231	0.24	0.174
Magnesium (Mg)-Total	mg/L	1010	1060	1040	1100	1100	1080	1080	1070	923
Manganese (Mn)-Total	mg/L	2.83	5.96	4.99	11.3	5.77	6	6.96	12.4	5.16
Mercury (Hg)-Total	mg/L									
Molybdenum (Mo)-Total	mg/L	0.0037	0.0102	0.0048	0.0171	0.0057	0.0062	0.0089	0.0133	0.0089
Nickel (Ni)-Total	mg/L	<0.025 *	0.084	0.033	0.162	0.053	0.058	0.065	0.109	0.087
Phosphorus (P)-Total	mg/L	<2.5 *	2.6	<2.5 *	3.4	<2.5 *	<2.5 *	<2.5 *	5.6	<2.5 *
Potassium (K)-Total	mg/L	240	212	221	212	224	223	221	221	189
Rubidium (Rb)-Total	mg/L	0.112	0.11	0.104	0.121	0.115	0.113	0.129	0.126	0.104
Selenium (Se)-Total	mg/L	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0025 *	0.0026	<0.0025 *
Silicon (Si)-Total	mg/L	6.7	91.5	39.2	109	74.9	84	94.7	108	62.2
Silver (Ag)-Total	mg/L	0.00062	0.00327	0.00212	0.00618	0.00348	0.00375	0.00113	0.0025	0.00343
Sodium (Na)-Total	mg/L	7650	7290	7960	7660	7560	7530	7760	7270	5970
Strontium (Sr)-Total	mg/L	19.1	16.8	17	18.3	17.3	17.7	17.7	16.2	15.7
Sulfur (S)-Total	mg/L	636	606	615	642	614	607	601	570	505
Tellurium (Te)-Total	mg/L	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010 *	<0.010	<0.010 *	<0.010 *
Thallium (Tl)-Total	mg/L	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00050 *
Thorium (Th)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Tin (Sn)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0050 *
Titanium (Ti)-Total	mg/L	0.049	1.6	0.477	1.6	1.2	1.31	1.92	1.72	1.36
Tungsten (W)-Total	mg/L	<0.0050 *	0.0052	<0.0050 *	0.0244	0.0136	0.0142	<0.0050 *	0.0155	<0.0050 *
Uranium (U)-Total	mg/L	<0.00050 *	0.00067	0.00064	0.00066	<0.00050 *	<0.00050 *	<0.00050 *	0.00057	<0.00050 *
Vanadium (V)-Total	mg/L	<0.025 *	0.225	0.084	0.292	0.178	0.189	0.269	0.304	0.162
Zinc (Zn)-Total	mg/L	0.24	0.69	0.36	0.93	0.48	0.51	0.66	1.58	0.88
Zirconium (Zr)-Total	mg/L	<0.0030 *	0.003	<0.0030 *	0.0033	<0.0030 *	0.0032	0.0037	0.0043	<0.0030 *

^ *Duplicate sample.*

Table D1-36. Water Sampling Monitoring Program Results for October to November 2018 Taken from TL-12

	Sample ID	TL12	TL-12	TL-12 DUP^	TL12	TL12	TL12	TL12	TL12	TL12	TL12
	ALS ID	L2174116-1	L2177735-1	L2177735-2	L2181243-1	L2185646-1	L2189064-1	L2192441-1	L2196214-1	L2198742-1	L2201981-1
	Date Sampled	10/1/2018 11:10:00 AM	10/8/2018 5:30:00 PM	10/8/2018 5:30:00 PM	10/15/2018 4:30:00 PM	10/22/2018 4:15:00 PM	10/29/2018 3:30:00 PM	11/5/2018 2:20:00 PM	11/12/2018 3:15:00 PM	11/19/2018 2:00:00 PM	11/26/2018 4:15:00 PM
Parameter	**Units**	**Results**									
Hardness (as $CaCO_3$)	mg/L	7740 *						6690 *			
pH	pH	7.74	7.79	7.81	7.76	7.67	7.94	7.78	7.27	7.64	7.77
Total Suspended Solids	mg/L	1650	2500	2460	1290	10600	1280	3420	1590	3430	6490
Total Dissolved Solids	mg/L	29700	31200	29100	21000	31200	20400	25700	29300	24500	29700
Alkalinity, Total (as $CaCO_3$)	mg/L	180						153			
Ammonia, Total (as N)	mg/L	13.5	36.7	36.4	49.1	24.4	10.8	29.8	54.7	31.3	51.3
Ammonia, Un-ionized (as N)	mg/L	0.0403	0.219	0.218	0.313	0.142	0.0677	0.166	0.26	0.049	0.27
Bromide (Br)	mg/L	62.3						45.4			
Chloride (Cl)	mg/L	16200	15800	16100	15200	15200	9490	12100	15500	14700	14200
Fluoride (F)	mg/L	<2.0 *						<2.0 *			
Nitrate (as N)	mg/L	12.2	37.2	37.9	57	25.2	10.2	30.2	63.1	35	54.5
Nitrite (as N)	mg/L	1.08						1.85			
Sulfate (SO_4)	mg/L	1690						1230			
Cyanide, Total	mg/L	0.0302	0.0584	0.0643	0.0397	0.0453 *	0.0216	0.0444 *	0.0625	0.0436	0.0578
Aluminum (Al)-Total	mg/L	63.7	58.1	54.4	11.7	210	24.3	70.4	75.8	45.1	91.3
Antimony (Sb)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *	<0.0050 *	0.0021	<0.0020 *	<0.010 *
Arsenic (As)-Total	mg/L	0.0362	0.032	0.0279	0.0129	0.218	0.0192	0.0495	0.0854	0.0503	0.046
Barium (Ba)-Total	mg/L	0.0683	0.0984	0.0934	0.0686	0.168	0.042	0.0859	0.124	0.0996	0.113
Beryllium (Be)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0020 *	<0.010 *
Bismuth (Bi)-Total	mg/L	<0.0025 *	<0.0025 *	<0.0025 *	<0.0010 *	<0.0025 *	<0.0025 *	<0.0025 *	<0.0010 *	<0.0010 *	<0.0050 *
Boron (B)-Total	mg/L	3.54	3.59	3.43	3.87	3.52	2.33	2.86	3.17	4.11	3.8
Cadmium (Cd)-Total	mg/L	0.00051	0.00051	0.00059	0.00025	0.00205	<0.00025 *	0.00065	0.0017	0.00065	0.00107
Calcium (Ca)-Total	mg/L	1370	1390	1330	1410	1690	791	1250	2590	1650	1470
Cesium (Cs)-Total	mg/L	0.00157	0.00193	0.00183	0.0018	0.00266	0.00107	0.00171	0.00177	0.00154	0.0024
Chromium (Cr)-Total	mg/L	0.0821	0.0609	0.0565	0.0177	0.256	0.0298	0.0819	0.0951	0.0498	0.083
Cobalt (Co)-Total	mg/L	0.0735	0.0609	0.0564	0.0158	0.313	0.0308	0.0912	0.128	0.0667	0.106
Copper (Cu)-Total	mg/L	0.467	0.349	0.331	0.179	1.6	0.17	0.484	0.949	0.459	0.522
Iron (Fe)-Total	mg/L	191	185	170	49.8	829	77.1	237	287	158	326
Lead (Pb)-Total	mg/L	0.062	0.0618	0.0564	0.0341	0.372	0.0268	0.0758	0.0986	0.0488	0.126
Lithium (Li)-Total	mg/L	0.19	0.17	0.161	0.161	0.288	0.115	0.167	0.183	0.182	0.2
Magnesium (Mg)-Total	mg/L	1050	966	954	954	1070	572	866	859	1050	999
Manganese (Mn)-Total	mg/L	5.91	5.34	5.09	3.93	21	2.79	6.55	8.78	5.58	8.07
Mercury (Hg)-Total	mg/L										
Molybdenum (Mo)-Total	mg/L	0.0071	0.0101	0.0108	0.0062	0.0264	0.004	0.0106	0.0098	0.0082	0.0141
Nickel (Ni)-Total	mg/L	0.068	0.06	0.057	0.029	0.235	0.027	0.08	0.125	0.054	0.08
Phosphorus (P)-Total	mg/L	<2.5 *	<2.5 *	<2.5 *	1.2	11.6	<2.5 *	2.7	3.7	2.1	<5.0 *
Potassium (K)-Total	mg/L	220	207	203	224	209	126	175	204	227	204

Sample ID		TL12	TL-12	TL-12 DUP^	TL12	TL12	TL12	TL12	TL12	TL12	TL12
ALS ID		L2174116-1	L2177735-1	L2177735-2	L2181243-1	L2185646-1	L2189064-1	L2192441-1	L2196214-1	L2198742-1	L2201981-1
Date Sampled		10/1/2018 11:10:00 AM	10/8/2018 5:30:00 PM	10/8/2018 5:30:00 PM	10/15/2018 4:30:00 PM	10/22/2018 4:15:00 PM	10/29/2018 3:30:00 PM	11/5/2018 2:20:00 PM	11/12/2018 3:15:00 PM	11/19/2018 2:00:00 PM	11/26/2018 4:15:00 PM
Parameter	Units	Results									
Rubidium (Rb)-Total	mg/L	0.116	0.121	0.117	0.129	0.113	0.073	0.101	0.116	0.124	0.123
Selenium (Se)-Total	mg/L	<0.0025 *	<0.0025 *	<0.0025 *	<0.0010 *	0.0044	<0.0025 *	<0.0025 *	0.003	0.0015	<0.0050 *
Silicon (Si)-Total	mg/L	67.7	61.5	59.5	16	175	28.1	71.3	83.2	49	84
Silver (Ag)-Total	mg/L	0.00128	0.00144	0.00152	0.00096	0.00667	0.0006	0.0016	0.00426	0.00237	0.0019
Sodium (Na)-Total	mg/L	7580	7610	7480	7200	6860	4210	6170	5970	7580	7210
Strontium (Sr)-Total	mg/L	16.1	15.9	16.2	16.9	15	9.41	13.4	14.4	18.1	15.1
Sulfur (S)-Total	mg/L	590	580	543	562	550	326	420	546	610	532
Tellurium (Te)-Total	mg/L	<0.010 *	<0.010 *	<0.010 *	<0.0040 *	<0.010 *	<0.010 *	<0.010 *	<0.0040 *	<0.0040 *	<0.020 *
Thallium (Tl)-Total	mg/L	<0.00050 *	<0.00050 *	<0.00050 *	<0.00020 *	<0.00050 *	<0.00050 *	<0.00050 *	<0.00020 *	<0.00020 *	<0.0010 *
Thorium (Th)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0020 *	<0.010 *
Tin (Sn)-Total	mg/L	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *	<0.0050 *	<0.0020 *	<0.0020 *	<0.010 *
Titanium (Ti)-Total	mg/L	1.44	0.982	0.94	0.156	2.84	0.5	1.34	1.74	0.861	1.04
Tungsten (W)-Total	mg/L	<0.0050 *	0.0068	0.0065	0.0038	0.0194	<0.0050 *	0.0069	0.0058	0.0048	<0.010 *
Uranium (U)-Total	mg/L	<0.00050 *	<0.00050 *	<0.00050 *	0.00041	0.00057	<0.00050 *	<0.00050 *	0.00077	0.00053	<0.0010 *
Vanadium (V)-Total	mg/L	0.176	0.155	0.149	0.035	0.583	0.064	0.193	0.215	0.118	0.232
Zinc (Zn)-Total	mg/L	0.64	0.48	0.47	0.254	1.94	0.69	0.79	1.28	0.807	0.95
Zirconium (Zr)-Total	mg/L	<0.0030 *	<0.0030 *	<0.0030 *	<0.0012 *	0.0071	<0.0030 *	0.0036	0.0036	0.0028	<0.0060 *

^ *Duplicate sample.*

Table D1-37. Water Sampling Monitoring Program Results for December 2018 Taken from TL-12

Sample ID		TL12	TL12	TL12	TL12
ALS ID		L2205955-1	L2208542-1	L2211639-1	L2215440-1
Date Sampled		12/3/2018 6:30:00 PM	12/10/2018 9:00:00 AM	12/17/2018 4:45:00 PM	12/31/2018 5:20:00 PM
Parameter	Units	Results			
Hardness (as $CaCO_3$)	mg/L	6020 *			
pH	pH	7.7	7.81	7.81	7.75
Total Suspended Solids	mg/L	880	528	659	2390
Total Dissolved Solids	mg/L	25000	28000	28100	24500 *
Alkalinity, Total (as $CaCO_3$)	mg/L	206			
Ammonia, Total (as N)	mg/L	37.3	8.12	14.1	16.2
Ammonia, Un-ionized (as N)	mg/L	0.199	0.0348	0.0703	0.0729
Bromide (Br)	mg/L	50.1			
Chloride (Cl)	mg/L	13800	15100	15200	14700
Fluoride (F)	mg/L	<2.0 *			
Nitrate (as N)	mg/L	46.5	6.37	13.8	16
Nitrite (as N)	mg/L	6.68			
Sulfate (SO_4)	mg/L	1270			

	Sample ID	TL12	TL12	TL12	TL12
	ALS ID	L2205955-1	L2208542-1	L2211639-1	L2215440-1
	Date Sampled	12/3/2018 6:30:00 PM	12/10/2018 9:00:00 AM	12/17/2018 4:45:00 PM	12/31/2018 5:20:00 PM
Parameter	Units	Results			
Cyanide, Total	mg/L	0.111 *	0.0213	0.0441	0.0278
Aluminum (Al)-Total	mg/L	16.7	12.6	173	77.1
Antimony (Sb)-Total	mg/L	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *
Arsenic (As)-Total	mg/L	0.0136	0.01	0.13	0.0232
Barium (Ba)-Total	mg/L	0.0659	0.044	0.119	0.0902
Beryllium (Be)-Total	mg/L	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *
Bismuth (Bi)-Total	mg/L	<0.0025 *	<0.0010 *	<0.0025 *	<0.0025 *
Boron (B)-Total	mg/L	3.12	3.54	3.36	3.43
Cadmium (Cd)-Total	mg/L	0.00038	0.00014	0.00149	0.00036
Calcium (Ca)-Total	mg/L	1190	1250	1540	1530
Cesium (Cs)-Total	mg/L	0.00163	0.00119	0.00206	0.00165
Chromium (Cr)-Total	mg/L	0.014	0.011	0.172	0.0458
Cobalt (Co)-Total	mg/L	0.0275	0.0181	0.235	0.0737
Copper (Cu)-Total	mg/L	0.096	0.077	1.03	0.275
Iron (Fe)-Total	mg/L	67.5	45.2	705	216
Lead (Pb)-Total	mg/L	0.0246	0.016	0.204	0.075
Lithium (Li)-Total	mg/L	0.137	0.164	0.27	0.195
Magnesium (Mg)-Total	mg/L	742	935	987	940
Manganese (Mn)-Total	mg/L	3.03	3.28	17.6	6.22
Mercury (Hg)-Total	mg/L				
Molybdenum (Mo)-Total	mg/L	0.005	0.0046	0.0186	0.007
Nickel (Ni)-Total	mg/L	0.027	0.011	0.145	0.042
Phosphorus (P)-Total	mg/L	<2.5 *	<1.0 *	9.1	3.4
Potassium (K)-Total	mg/L	173	221	197	196
Rubidium (Rb)-Total	mg/L	0.103	0.112	0.102	0.109
Selenium (Se)-Total	mg/L	<0.0025 *	<0.0010 *	<0.0025 *	<0.0025 *
Silicon (Si)-Total	mg/L	25.6	17.8	147	77.7
Silver (Ag)-Total	mg/L	<0.00050 *	0.00026	0.0028	0.00063
Sodium (Na)-Total	mg/L	5700	7180	6420	6690
Strontium (Sr)-Total	mg/L	13.4	15.5	14.2	14.6
Sulfur (S)-Total	mg/L	473	603	551	495
Tellurium (Te)-Total	mg/L	<0.010 *	<0.0040 *	<0.010 *	<0.010 *
Thallium (Tl)-Total	mg/L	<0.00050 *	<0.00020 *	<0.00050 *	<0.00050 *
Thorium (Th)-Total	mg/L	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *
Tin (Sn)-Total	mg/L	<0.0050 *	<0.0020 *	<0.0050 *	<0.0050 *

Sample ID		TL12	TL12	TL12	TL12
ALS ID		L2205955-1	L2208542-1	L2211639-1	L2215440-1
Date Sampled		12/3/2018 6:30:00 PM	12/10/2018 9:00:00 AM	12/17/2018 4:45:00 PM	12/31/2018 5:20:00 PM
Parameter	**Units**	**Results**			
Titanium (Ti)-Total	mg/L	0.274	0.241	2.12	0.762
Tungsten (W)-Total	mg/L	0.0054	0.0022	0.0103	<0.0050 *
Uranium (U)-Total	mg/L	0.00061	0.00034	<0.00050 *	<0.00050 *
Vanadium (V)-Total	mg/L	0.044	0.039	0.464	0.178
Zinc (Zn)-Total	mg/L	0.23	0.192	1.48	0.54
Zirconium (Zr)-Total	mg/L	0.0035	<0.0030 *	0.0053	0.0032

Appendix D.2. 2BE-HOP1222

Table D2-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2BE-HOP1222. The location of each sampling point is illustrated in Figure D2-1 below.

Table D2-1. 2BE-HOP1222 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
HOP-1	Raw water supply intake at Windy Lake	B, G, Oil and Grease	Monthly (when in use for Doris)
		D	Daily during periods of pumping
HOP-2*	WWTF effluent discharge at the surge tank prior to being pumped over the ridge east of the Windy Camp Facilities	G, B, MT, Oil and Grease	Monthly
		D	Daily during periods of discharge
HOP-3*	WWTF effluent at a point of entry into Windy lake	G, B, Oil and Grease	Monthly
		Acute Lethality	Annually
		D	Daily during periods of discharge
HOP-4*	Effluent from the Landfarm Treatment Facility pumped to the WWTF surge tank	B, G, Oil and Grease	Once before any discharge, daily when discharging onto the tundra
		D	Daily during periods of discharge
HOP-5*	Effluent from the Bulk Fuel Storage Facility located at the Windy Camp, prior to release	G, MT, HC, TPH, PAH, Nitrate, Nitrite, Total Phenols, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-6*	Effluent from the Bulk Fuel Storage Facility located at the Patch Lake location, prior to release to a location approved by an Inspector	G, MT, HC, Oil and Grease Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-7A, B, and D	Discharge from Quarries A, B, and D respectively	G, N1, MT, Total Sulphate, Alkalinity, Oil and Grease, Electrical Conductivity and Reduction potential (Eh)	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
HOP-8*	Effluent from the Bulk Fuel Storage Facility located at the new Windy Camp location, prior to release to a location approved by an Inspector	G, MT, HC, Total Hardness, Total Alkalinity, Calcium, Potassium, Sulphate, Sodium, Magnesium	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	G, MT, Electrical Conductivity, Oil and Grease	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

** Station not in use at this time.*

Figure D2-1. 2BE-HOP1222 Sample Stations Locations

SUMMARY OF MONITORING INFORMATION

The following tables summarize the results of sampling undertaken as part of the monitoring program detailed in Part J of 2BE-HOP1222.

The camp water treatment and wastewater treatment facility (WWTF) permitted under this licence was not operational in 2018, therefore no sampling was conducted at monitoring stations HOP-1 (freshwater intake), HOP-2 (WWTF discharge), or HOP-3 (point of entry of WWTF discharge to Windy Lake). Water was utilized from Windy Lake for domestic consumption at Doris Camp and the monitoring station ST-7a (HOP-1) was sampled for the monitoring criteria under the Doris North Water Licence 2AM-DOH1323. For the ST-7a results see Table D1-12 and Table D1-13 in Appendix D.1 of this report. The Landfarm at Windy Camp (HOP-4) was dismantled in 2008, so no sampling was conducted at this monitoring station.

The bulk fuel storage tanks at Windy Camp were moved to Doris Camp in winter 2009 for use there, and the bulk fuel storage berm (HOP-5) was dismantled in 2012. The bulk fuel storage berm at Patch Lake laydown (HOP-6) was also dismantled in 2012. No sampling was conducted at either of these monitoring stations.

No sampling occurred at monitoring stations HOP-7A HOP-7B, or HOP-7D (located in Quarries A, B, and D, respectively) during 2018 because there was no ponded water to sample.

On-ice exploration drilling did not occur in the licence area in 2018, therefore no samples were taken through lake ice (required by Part F Item 7 and Part J Item 7) to establish water quality prior to, and upon completion of, an on-ice drilling program.

Quantities of Water Utilized for Camp, Drilling and Other Purposes

During 2018, a total of 14,278 m^3 of water was used from Windy Lake for domestic purposes at Doris Camp. This included consumption for drinking water, all camp domestic water supply, and some ancillary domestic use for provisioning of portable wash cars. No water was used domestically at Windy Camp. A total of 24 m^3 of water was used from Windy Lake in 2018 for dust suppression on the Doris-Windy All-Weather Road. A total of 592 m^3 of water from Windy Lake was used to support exploration in 2018. Daily water utilization is provided in Table D2-2.

One exceedance of the daily allowable withdrawal limit for domestic use occurred from Windy Lake on February 23 (70 m^3 extracted); however, there was no exceedance of the total allowable volume used on that day. Usage limits were reviewed with operators to ensure additional exceedances did not occur. No other withdrawals exceeded the allowable limits under this licence in 2018.

No water was applied for the development of winter tracks in the licence area in 2018.

Table D2-2. Volume of Water Utilized for Camp, Drilling and Dust Suppression Purposes, 2018

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
January				
01	0	0	20	20
02	0	0	30	30
03	0	0	30	30
04	0	0	30	30
05	0	0	40	40

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
06	0	0	30	30
07	0	0	30	30
08	0	0	40	40
09	0	0	30	30
10	0	0	40	40
11	0	0	30	30
12	0	0	30	30
13	0	0	30	30
14	0	0	40	40
15	0	0	30	30
16	0	0	40	40
17	0	0	30	30
18	0	0	35	35
19	0	10	35	55
20	0	0	30	30
21	0	0	15	15
22	0	0	36	36
23	0	0	39	39
24	0	7	43	57
25	0	0	20	20
26	0	0	45	45
27	0	0	25	25
28	0	0	56	56
29	0	0	48	48
30	0	0	39	39
31	0	0	35	36
February				
01	0	0	50	50
02	0	0	30	30
03	0	0	38	38
04	0	0	45	45
05	0	0	60	60
06	0	4	52	60
07	0	1	37	39
08	0	0	56	56
09	0	0	62	62
10	0	0	42	42
11	0	0	28	28
12	0	0	28	28
13	0	0	40	40
14	0	0	42	42

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
15	0	0	35	35
16	0	0	56	56
17	0	0	63	63
18	0	0	63	63
19	0	0	40	40
20	0	0	40	40
21	0	0	28	28
22	0	0	42	42
23	0	0	70*	70
24	0	0	40	40
25	0	0	45	45
26	0	0	55	55
27	0	0	50	50
28	0	0	40	40
March				
01	0	0	50	50
02	0	0	40	40
03	0	0	40	40
04	0	0	40	40
05	0	0	45	45
06	0	0	40	40
07	0	0	45	45
08	0	0	60	60
09	0	0	40	40
10	0	0	35	35
11	0	0	40	40
12	0	0	40	40
13	0	0	35	35
14	0	0	20	20
15	0	0	38	38
16	0	0	20	20
17	0	0	20	20
18	0	0	20	20
19	0	0	20	20
20	0	0	45	45
21	0	0	55	55
22	0	0	35	35
23	0	0	40	40
24	0	0	30	30
25	0	0	45	45
26	0	0	45	45

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
27	0	0	50	50
28	0	0	50	50
29	0	0	55	55
30	0	0	53	53
31	0	0	40	40
April				
01	0	0	40	40
02	0	0	49	49
03	0	0	35	35
04	0	0	40	40
05	0	0	45	45
06	0	0	35	35
07	0	0	30	30
08	0	0	40	40
09	0	0	41	41
10	0	0	49	49
11	0	0	30	30
12	0	0	40	40
13	0	0	40	40
14	0	0	38	38
15	0	0	32	32
16	0	0	40	40
17	0	0	40	40
18	0	0	30	30
19	0	0	40	40
20	0	0	40	40
21	0	0	30	30
22	0	0	40	40
23	0	0	40	40
24	0	0	40	40
25	0	0	40	40
26	0	0	60	60
27	0	0	48	48
28	0	0	48	48
29	0	0	40	40
30	0	0	48	48
May				
01	0	0	48	48
02	0	0	38	38
03	0	0	45	45
04	0	0	43	43

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
05	0	0	35	35
06	0	0	38	38
07	0	16	32	64
08	0	0	50	50
09	0	14	40	68
10	0	0	40	40
11	0	11	38	60
12	0	2	34	38
13	0	2	32	36
14	0	0	45	45
15	0	0	30	30
16	0	0	50	50
17	0	0	40	40
18	0	0	40	40
19	0	0	40	40
20	0	0	30	30
21	0	0	50	50
22	0	12	30	54
23	0	12	46	70
24	0	10	40	60
25	0	9	38	56
26	0	14	37	65
27	0	4	36	44
28	0	0	40	40
29	0	13	40	66
30	0	24	30	78
31	0	4	50	58
June				
01	0	13	30	56
02	0	8	40	56
03	0	6	30	42
04	0	14	40	68
05	0	6	44	56
06	0	7	37	51
07	0	6	40	52
08	0	6	34	46
09	0	6	36	48
10	0	7	31	45
11	0	4	38	46
12	0	9	47	65
13	0	6	34	46

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
14	0	3	37	43
15	0	5	45	55
16	0	5	35	45
17	0	7	33	47
18	0	7	33	47
19	0	5	40	50
20	0	7	36	50
21	0	4	33	41
22	0	8	42	58
23	0	6	34	46
24	0	7	33	47
25	0	11	54	76
26	0	2	20	24
27	0	4	40	48
28	0	0	40	40
29	1	0	39	40
30	0	0	40	40
July				
01	0	0	30	30
02	0	0	40	40
03	0	7	41	55
04	0	7	29	42
05	0	1	40	41
06	0	8	30	46
07	0	3	40	47
08	0	6	30	42
09	0	5	30	40
10	0	4	40	49
11	0	17	40	74
12	0	7	30	44
13	0	0	30	30
14	0	9	40	58
15	0	7	40	54
16	0	10	30	50
17	0	9	43	61
18	0	5	30	39
19	0	0	50	50
20	0	4	20	29
21	0	3	33	39
22	0	0	37	37
23	0	9	39	56

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
24	0	7	25	38
25	0	1	36	38
26	0	0	36	36
27	0	4	29	37
28	0	0	36	36
29	0	7	24	37
30	0	5	34	44
31	0	5	32	41
August				
01	0	6	30	41
02	0	0	40	40
03	0	0	33	33
04	0	5	35	45
05	0	7	32	46
06	0	2	38	42
07	10	9	30	57
08	0	5	40	51
09	0	3	40	47
10	0	3	41	48
11	0	5	39	48
12	0	10	30	50
13	0	5	50	61
14	0	4	30	38
15	0	5	30	41
16	0	5	30	41
17	0	5	50	59
18	0	4	30	38
19	0	3	60	67
20	0	5	30	39
21	0	4	50	58
22	0	0	30	30
23	0	0	41	41
24	0	0	40	40
25	0	0	30	30
26	0	0	50	50
27	0	0	30	30
28	13	0	51	64
29	0	0	27	27
30	0	0	35	35
31	0	0	33	33

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
September				
01	0	0	34	34
02	0	0	35	35
03	0	0	31	31
04	0	0	39	39
05	0	0	39	39
06	0	0	41	41
07	0	0	33	33
08	0	0	36	36
09	0	0	40	40
10	0	0	32	32
11	0	0	40	40
12	0	0	41	41
13	0	0	32	32
14	0	0	40	40
15	0	0	35	35
16	0	0	35	35
17	0	0	40	40
18	0	0	56	56
19	0	0	35	35
20	0	0	40	40
21	0	0	40	40
22	0	0	40	40
23	0	0	40	40
24	0	0	40	40
25	0	0	40	40
26	0	0	40	40
27	0	0	30	30
28	0	0	40	40
29	0	0	40	40
30	0	0	40	40
October				
01	0	0	40	40
02	0	0	46	46
03	0	0	35	35
04	0	0	40	40
05	0	0	40	40
06	0	0	48	48
07	0	0	40	40
08	0	0	30	30
09	0	0	40	40

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
10	0	0	40	40
11	0	0	40	40
12	0	0	40	40
13	0	0	40	40
14	0	0	41	41
15	0	0	42	42
16	0	0	45	45
17	0	0	36	36
18	0	0	46	46
19	0	0	45	45
20	0	0	42	42
21	0	0	50	50
22	0	0	50	50
23	0	0	40	40
24	0	0	40	40
25	0	0	49	49
26	0	0	40	40
27	0	0	44	44
28	0	0	38	38
29	0	0	47	47
30	0	0	50	50
31	0	0	30	30
November				
01	0	0	40	40
02	0	0	40	40
03	0	0	40	40
04	0	0	30	30
05	0	0	40	40
06	0	0	48	48
07	0	0	33	33
08	0	0	40	40
09	0	0	40	40
10	0	0	40	40
11	0	0	30	30
12	0	0	40	40
13	0	0	40	40
14	0	0	40	40
15	0	0	50	50
16	0	0	40	40
17	0	0	40	40
18	0	0	40	40

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
19	0	0	40	40
20	0	0	48	48
21	0	0	51	51
22	0	0	50	50
23	0	0	40	40
24	0	0	47	47
25	0	0	40	40
26	0	0	50	50
27	0	0	55	55
28	0	0	45	45
29	0	0	40	40
30	0	0	50	50
December				
01	0	0	40	40
02	0	0	33	33
03	0	0	47	47
04	0	0	43	43
05	0	0	50	50
06	0	0	40	40
07	0	0	43	43
08	0	0	47	47
09	0	0	46	46
10	0	0	48	48
11	0	0	50	50
12	0	0	30	30
13	0	0	40	40
14	0	0	30	30
15	0	0	40	40
16	0	0	40	40
17	0	0	40	40
18	0	0	50	50
19	0	0	40	40
20	0	0	40	40
21	0	0	40	40
22	0	0	40	40
23	0	0	30	30
24	0	0	40	40
25	0	0	40	40
26	0	0	31	31
27	0	0	40	40
28	0	0	34	34

Date	Dust Suppression (m^3)	Regional Drill Water Usage Total (m^3)	Domestic Water Consumption at Doris (m^3)	Total Daily Usage (m^3)
29	0	0	38	38
30	0	0	43	43
31	0	0	40	40

Note: Values rounded to nearest whole cubic metre.

Quantity of Effluent Discharged

Windy Camp was closed throughout 2018 therefore no discharges occurred related to the waste water treatment facility (WWTF) at monitoring station HOP-2.

No discharges occurred at the Windy Camp bulk fuel storage facility (HOP-5) in 2018 as this facility was decommissioned in 2012 and the containment berm removed.

No discharges occurred at the Patch Lake bulk fuel storage facility (HOP-6) in 2018 as this facility was decommissioned and the berm removed in 2012.

Volume of Sludge Removed from Sewage Disposal Facility

No sludge was removed from the Windy Camp WWTF in 2018 because this facility was not operational and the camp was closed.

Results of Toxicity Testing

TMAC did not perform toxicity testing to demonstrate the non-acute toxicity of the effluent discharged from the WWTF at HOP-3 (at a point of entry to Windy Lake), as the camp is closed and no effluent was discharged (this facility has been removed). The testing is normally conducted in accordance with the following test procedures:

1. Acute lethality to Rainbow Trout, Oncorhynchus mykiss (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13); and
2. Acute lethality to the crustacean, Daphnia magna (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14).

Appendix D.3. 2BB-MAE1727

Table D3-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2BB-MAE1727. Sample station locations have not yet been established at this time as work has not commenced on the Madrid sites. Sample points and discharge locations for SNP stations under this licence will be established in consultation with the Inspector. The proposed sample point locations for SNP Stations MAE-14, MAE-15 and MAE-16 are illustrated in Figure D3-1 below. A Summary of Water Sampling conducted in 2018 is provided below.

Table D3-1. 2BB-MAE1727 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
MAE-01*	Madrid North, Freshwater intake at Windy Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-02*	Madrid South, Freshwater intake at Patch Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-03*	Freshwater intake at other Lakes	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
MAE-04*	Madrid North Pollution Control Pond (PCP) Water at the point of discharge	pH, TSS, Electrical Conductivity, Oil and Grease, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Chloride, Sulphate, Magnesium, Sodium, Calcium, Potassium, Total As, Cd, Cu, Cr, Fe, Pb, Hg, and Ni	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-05*	Madrid South Pollution Control Pond No.1 Water at the point of discharge	pH, TSS, Electrical Conductivity, Oil and Grease, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Chloride, Sulphate, Magnesium, Sodium, Calcium, Potassium, Total As, Cd, Cu, Cr, Fe, Pb, Hg, and Ni	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-06*	Madrid South Pollution Control Pond No.2 Water at the point of discharge	pH, TSS, Electrical Conductivity, Oil and Grease, Total Ammonia, Nitrate-Nitrite, Total Phenols, Total Alkalinity, Total Hardness, Chloride, Sulphate, Magnesium, Sodium, Calcium, Potassium, Total As, Cd, Cu, Cr, Fe, Pb, Hg, and Ni	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
MAE-07*	Madrid North Fuel Storage Area Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-08*	Madrid North Fuel Transfer Station Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-09*	Madrid South Fuel Storage Area Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-10*	Madrid South Fuel Transfer Station Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-11*	Quarry G Contact Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
MAE-12*	Quarry H Contact Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-13*	Quarry I Contact Water Sump	pH, TSS, Sulphate, Chloride, Electrical Conductivity, Oil and Grease, Total Ammonia, BTEX, Total Arsenic, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Once, prior to every discharge onto the tundra
		D	Daily during periods of discharge
MAE-14*	Windy Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids (TDS)	Once prior to each discharge; and a maximum of two weeks post discharge
MAE-15*	Patch Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids (TDS)	Once prior to each discharge; and a maximum of two weeks post discharge
MAE-16*	Wolverine Lake immediately downgradient of the Pollution Control Pond Discharge	Chloride, Electrical Conductivity, Total Dissolved Solids (TDS)	Once prior to each discharge; and a maximum of two weeks post discharge
Drill Sites	Under-ice sampling before and after drilling	pH, TSS, Electrical Conductivity, Total Trace Metals for a minimum of the following elements: As, Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Hg, Pb, Li, Mn, Mo, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of pumping
Mine Sumps*	Water from Madrid South Underground Mine Water Sumps during periods of Water inflow	Total Dissolved Solids, pH, Electrical Conductivity, Chloride, Total Ammonia and Nitrate, Alkalinity, Sulfate, Trace Metals for a minimum of the following elements: As, Al, Sb, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sn, Sr, Tl, Ti, U, V, Zn	Three times per year

** Station not in use at this time.*

Figure D3-1. 2BB-MAE1727 Sample Stations Locations

SUMMARY OF MONITORING INFORMATION

The following tables summarize the results of sampling undertaken as part of the monitoring program detailed in Part J of 2BB-MAE1727.

No activity occurred at the Madrid North or Madrid South sites in 2018. Monitoring was not undertaken at monitoring stations MAE-01 (Madrid North Windy Lake Freshwater intake), MAE-02 (Madrid South Patch Lake Freshwater intake) or MAE-03 (Freshwater intake at other lakes) as no water was obtained from these locations for use under this licence. No water was used for domestic, drilling or all other purposes and no waste was deposited under this licence in 2018. Location coordinates of all water sources and locations of waste deposit will be reported as required.

No discharge occurred and no monitoring was conducted at MAE-04 (Madrid North Pollution Control Pond), MAE-05 (Madrid South Pollution Control Pond No. 1) or MAE-06 (Madrid South Pollution Control Pond No. 2) as these facilities have not yet been constructed.

The Fuel Storage Areas and Transfer Stations at Madrid North (MAE-07 and MAE-08) and Madrid South (MAE-09 and MAE-10) have not yet been constructed. No water quality monitoring was conducted and no discharge occurred at these sampling locations.

Quarrying activities were not undertaken at Quarry G (MAE-11), Quarry H (MAE-12) or Quarry I (MAE-13) in 2018. No sampling or discharge was required for these monitoring locations.

Sampling was conducted between June and September 2018 at lakes located immediately downgradient of future Madrid North and Madrid South Pollution Control Pond discharge locations (MAE-14, Windy Lake; MAE-15, Patch Lake; MAE-16, Wolverine Lake) to collect additional information regarding baseline conditions within these lakes. Results of this monitoring is presented in Table D3-2, Table D3-3 and Table D3-4 below.

Underground mining has not yet commenced at Madrid North or Madrid South. No water was discharged from underground sumps and no water quality monitoring was conducted.

On-ice surface exploration was not conducted in the licence area in 2018, therefore under-ice water quality sampling was not required.

Table D3-2. Windy Lake Downgradient of Future Pollution Control Pond Discharge (MAE-14), June to September 2018

	Sample ID	**MAE14**	**MAE14**	**MAE14**	**DUP2 ^**	**MAE14**
	ALS ID	**L2115052-1**	**L2139116-1**	**L2150160-1**	**L2150160-5**	**L2166375-1**
	Date Sampled	**6/18/2018 4:50:00 PM**	**7/29/2018 10:55:00 AM**	**8/19/2018 2:30:00 PM**	**8/19/2018 2:30:00 PM**	**9/16/2018 2:40:00 PM**
Parameter	**Units**	**Results**				
Conductivity	µS/cm	141	423	427	424	435
Total Dissolved Solids	mg/L	93	232	244	232	238
Chloride (Cl)	mg/L	16.6	95.4	94.7	94.3	94.3
Aluminum (Al)-Total	mg/L	0.144	2.09	0.596	0.717	0.295
Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.00028	0.0009	0.00052	0.00064	0.00036
Barium (Ba)-Total	mg/L	0.00548	0.0203	0.00742	0.00825	0.00444

Sample ID		MAE14	MAE14	MAE14	DUP2 ^	MAE14
ALS ID		L2115052-1	L2139116-1	L2150160-1	L2150160-5	L2166375-1
Date Sampled		6/18/2018 4:50:00 PM	7/29/2018 10:55:00 AM	8/19/2018 2:30:00 PM	8/19/2018 2:30:00 PM	9/16/2018 2:40:00 PM
Parameter	**Units**			**Results**		
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.014	0.045	0.043	0.044	0.048
Cadmium (Cd)-Total	mg/L	<0.0000050	0.0000073	0.0000083	0.0000068	<0.0000050
Calcium (Ca)-Total	mg/L	14.7	12.6	12.3	12.7	13
Cesium (Cs)-Total	mg/L	<0.000010	0.000168	0.000038	0.000054	0.000023
Chromium (Cr)-Total	mg/L	0.00065	0.00433	0.00119	0.00147	0.00068
Cobalt (Co)-Total	mg/L	0.00011	0.00091	0.00046	0.00056	0.00016
Copper (Cu)-Total	mg/L	0.00257	0.00304	0.00265	0.00252	0.00139
Iron (Fe)-Total	mg/L	0.168	2.13	0.73	0.865	0.322
Lead (Pb)-Total	mg/L	0.000054	0.000836	0.000548	0.000542	0.000133
Lithium (Li)-Total	mg/L	0.003	0.0058	0.0038	0.004	0.0035
Magnesium (Mg)-Total	mg/L	3.59	10	10.7	10.7	10.4
Manganese (Mn)-Total	mg/L	0.00259	0.0236	0.0134	0.0173	0.00643
Molybdenum (Mo)-Total	mg/L	0.000325	0.000779	0.000495	0.000532	0.000627
Nickel (Ni)-Total	mg/L	0.00216	0.00256	0.00107	0.00132	0.00071
Phosphorus (P)-Total	mg/L	<0.050	0.058	0.111	0.163	<0.050
Potassium (K)-Total	mg/L	1.38	4.67	4.26	4.32	4.15
Rubidium (Rb)-Total	mg/L	0.00116	0.00612	0.00326	0.00352	0.00241
Selenium (Se)-Total	mg/L	<0.000050	0.000067	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total	mg/L	1.93	4.43	1.18	1.3	0.9
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	7.8	50.6	55.5	57.2	53.7
Strontium (Sr)-Total	mg/L	0.0377	0.0659	0.0608	0.0586	0.0581
Sulfur (S)-Total	mg/L	1.38	3.02	2.98	3	3.04
Tellurium (Te)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	<0.000010	0.000024	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	0.00011	0.00068	0.00021	0.00021	<0.00010
Tin (Sn)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.0051	0.106	0.0174	0.028	0.0139
Tungsten (W)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.000034	0.000354	0.000336	0.00029	0.000199
Vanadium (V)-Total	mg/L	0.00063	0.00491	0.00196	0.00205	0.00114
Zinc (Zn)-Total	mg/L	<0.0030	0.0056	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	mg/L	0.00047	0.000509	0.000183	0.000164	0.000203

^ *Duplicate sample.*

Table D3-3. Patch Lake Downgradient of Future Pollution Control Pond Discharge (MAE-15), June to September 2018

	Sample ID	MAE15	MAE15	MAE15	DUP3 ^	MAE15
	ALS ID	L2115052-2	L2139116-2	L2150160-2	L2150160-6	L2166375-2
	Date Sampled	6/18/2018 2:30:00 PM	7/29/2018 10:35:00 AM	8/19/2018 11:00:00 AM	8/19/2018 11:00:00 AM	9/16/2018 2:20:00 PM
Parameter	**Units**			**Results**		
Conductivity	μS/cm	101	293	274	289	297
Total Dissolved Solids	mg/L	78	167	170	166	160
Chloride (Cl)	mg/L	15.3	66.5	61.4	65.2	64.9
Aluminum (Al)-Total	mg/L	0.0518	0.229	0.157	0.0962	0.0864
Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.00023	0.00031	0.00025	0.00026	0.00027
Barium (Ba)-Total	mg/L	0.005	0.00421	0.00383	0.00292	0.00266
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.011	0.023	0.022	0.023	0.024
Cadmium (Cd)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	9.4	9.24	9.18	9.1	9.64
Cesium (Cs)-Total	mg/L	<0.000010	0.000016	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	0.00064	0.00052	0.00041	0.00026	0.00021
Cobalt (Co)-Total	mg/L	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.00181	0.00127	0.00128	0.00127	0.00136
Iron (Fe)-Total	mg/L	0.086	0.258	0.232	0.101	0.069
Lead (Pb)-Total	mg/L	<0.000050	0.000091	0.000062	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	0.004	0.0042	0.0045	0.0042	0.0045
Magnesium (Mg)-Total	mg/L	3.11	7.22	7.5	7.67	7.78
Manganese (Mn)-Total	mg/L	0.00057	0.0138	0.00896	0.00652	0.00471
Molybdenum (Mo)-Total	mg/L	0.000168	0.000206	0.000191	0.0002	0.000204
Nickel (Ni)-Total	mg/L	0.00232	0.00075	0.00084	0.00071	0.00056
Phosphorus (P)-Total	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	mg/L	1.35	2.8	2.55	2.71	2.64
Rubidium (Rb)-Total	mg/L	0.00119	0.00192	0.00173	0.00172	0.00153
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total	mg/L	1.87	0.74	0.84	0.46	0.45
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	4.9	33.3	34.8	35.8	34.1
Strontium (Sr)-Total	mg/L	0.0473	0.0507	0.0471	0.0481	0.048
Sulfur (S)-Total	mg/L	0.59	0.89	0.81	0.9	0.91
Tellurium (Te)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

Sample ID		MAE15	MAE15	MAE15	DUP3 ^	MAE15
ALS ID		L2115052-2	L2139116-2	L2150160-2	L2150160-6	L2166375-2
Date Sampled		6/18/2018 2:30:00 PM	7/29/2018 10:35:00 AM	8/19/2018 11:00:00 AM	8/19/2018 11:00:00 AM	9/16/2018 2:20:00 PM
Parameter	Units	Results				
Titanium (Ti)-Total	mg/L	0.00063	0.00973	0.00522	0.00313	0.00231
Tungsten (W)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.000022	0.000066	0.000063	0.000058	0.000057
Vanadium (V)-Total	mg/L	<0.00050	0.00059	<0.00050	<0.00050	0.00062
Zinc (Zn)-Total	mg/L	0.0038	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	mg/L	0.000372	0.000129	0.000123	<0.000060	<0.000060

^ *Duplicate sample.*

Table D3-4. Wolverine Lake Downgradient of Future Pollution Control Pond Discharge (MAE-16), June to September 2018

Sample ID		MAE16	MAE16	MAE16	DUP1	MAE16
ALS ID		L2115052-3	L2139116-3	L2150160-3	L2150160-4	L2166375-3
Date Sampled		6/18/2018 2:45:00 PM	7/29/2018 10:45:00 AM	8/19/2018 10:50:00 AM	8/19/2018 10:50:00 AM	9/16/2018 2:05:00 PM
Parameter	Units	Results				
Conductivity	µS/cm	119	347	352	351	363
Total Dissolved Solids	mg/L	74	200	209	204	203
Chloride (Cl)	mg/L	24.8	76.2	83.5	83.4	83.3
Aluminum (Al)-Total	mg/L	0.142	0.0783	0.217	0.166	0.0542
Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.00023	0.00037	0.00034	0.00036	0.00035
Barium (Ba)-Total	mg/L	0.00407	0.00496	0.00657	0.00604	0.00411
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L	<0.010	0.018	0.015	0.018	0.019
Cadmium (Cd)-Total	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	3.8	8.89	7.88	8.5	9.04
Cesium (Cs)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Total	mg/L	0.00038	0.00016	0.00051	0.00037	0.00014
Cobalt (Co)-Total	mg/L	0.00021	<0.00010	0.00011	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.00104	0.00055	0.00107	0.00073	0.00079
Iron (Fe)-Total	mg/L	0.25	0.176	0.264	0.236	0.093
Lead (Pb)-Total	mg/L	0.000052	<0.000050	0.00007	0.000063	0.000056
Lithium (Li)-Total	mg/L	0.0018	0.0041	0.0038	0.0043	0.0046
Magnesium (Mg)-Total	mg/L	2.94	8.9	8.71	9.71	9.81
Manganese (Mn)-Total	mg/L	0.0872	0.0164	0.013	0.0154	0.0118
Molybdenum (Mo)-Total	mg/L	0.000097	0.000099	0.000099	0.000104	0.000098
Nickel (Ni)-Total	mg/L	0.00077	0.00052	0.00093	0.00068	<0.00050
Phosphorus (P)-Total	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050

	Sample ID	MAE16	MAE16	MAE16	DUP1	MAE16
	ALS ID	L2115052-3	L2139116-3	L2150160-3	L2150160-4	L2166375-3
	Date Sampled	6/18/2018 2:45:00 PM	7/29/2018 10:45:00 AM	8/19/2018 10:50:00 AM	8/19/2018 10:50:00 AM	9/16/2018 2:05:00 PM
Parameter	**Units**			**Results**		
Potassium (K)-Total	mg/L	1.31	2.42	1.98	2.31	2.11
Rubidium (Rb)-Total	mg/L	0.00081	0.00101	0.00098	0.00112	0.00078
Selenium (Se)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total	mg/L	0.78	0.35	1.3	0.49	0.19
Silver (Ag)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	12.6	41.6	38.8	47.6	44.7
Strontium (Sr)-Total	mg/L	0.0161	0.0463	0.0389	0.0452	0.0431
Sulfur (S)-Total	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50
Tellurium (Te)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.00406	0.00256	0.00609	0.00593	0.00129
Tungsten (W)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.000026	0.000029	0.000043	0.000039	0.000031
Vanadium (V)-Total	mg/L	0.00055	<0.00050	0.00055	<0.00050	0.00063
Zinc (Zn)-Total	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	mg/L	0.000215	<0.000060	0.000162	0.000074	<0.000060

^ *Duplicate sample.*

Appendix D.4. 2BB-BOS1727

Table D4-1 summarizes the sampling stations, sampling frequency and monitoring parameters required as part of the SNP for water licence 2BB-BOS1727. The location of each sampling point is illustrated in Figure D4-1 below.

Table D4-1. 2BB-BOS1727 Sample Stations, Sample Frequency and Analytical Parameters

SNP Station	Description	Monitoring Parameters	Frequency
BOS-1a	Raw water supply intake at Aimaokatalok (Spyder) Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-1b	Raw water supply intake at Stickleback Lake	B, G, Oil and Grease	Monthly
		D	Daily during periods of pumping
BOS-2	Containment Pond discharge	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se.	Prior to discharge, weekly during periods of discharge
		D	Daily during periods of discharge
BOS-3	Sewage Disposal Facility final discharge	BOD_5, TSS, Oil and Grease, Fecal Coliforms, pH	Monthly
		D	Daily during periods of discharge
BOS-4	Treated sewage effluent point prior to entry into Aimaokatalok (Spyder) Lake	BOD5, TSS, Oil and Grease, Fecal Coliforms, pH	Once before any discharge, daily when discharging onto the tundra
		Acute Lethality	Annually
BOS-5	Effluent from the Bulk Fuel Storage Facility prior to release to a location approved by an Inspector	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se. TTPH	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge
BOS-6	Effluent from the Landfarm Treatment Facility prior to release	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se.	Once before any discharge, monthly when discharging onto the tundra
		D	Daily during periods of discharge

SNP Station	Description	Monitoring Parameters	Frequency
BOS-7*	Runoff from the temporary storage of hydrocarbon contaminated soils prior to discharge onto the tundra	TPH, PAH, BTEX, pH, Electrical Conductivity, Nitrate-Nitrite, Oil and Grease, Total Phenols, Total Alkalinity, Total Hardness, Calcium, Magnesium, Potassium, Sodium, Sulphate & Chloride, Total As, Cd, Cu, Cr, Fe, Pb, Hg, Ni and Se.	During periods of observed flow
		D	Daily during periods of discharge
BOS-8	Waste Rock and Ore Storage Pad	pH, Sulphate & Chloride, Electrical Conductivity, TSS, Total Ammonia, Total As, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Initially during spring thaw and monthly during periods of observed flow
BOS-9	Portal decline, surface water runoff discharged to onto the tundra	pH, Sulphate & Chloride, Electrical Conductivity, TSS, Total Ammonia, Total As, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Once before any discharge
		D	Daily during periods of discharge
BOS-10*	Underground Mine Water Sumps pumped from Underground	pH, Sulphate & Chloride, Electrical Conductivity, TSS, Total Ammonia, Total As, Total Trace Metals for a minimum of the following elements: Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Three times a year, during periods of water inflow
		D	Daily during periods of discharge
Drill Sites	Under-ice sampling before and after drilling	pH, TSS, Electrical Conductivity, Total Trace Metals for a minimum of the following elements: As, Al, Sb, Ba, Cd, Cr, Co, Cu, Fe, Hg, Pb, Li, Mn, Mo, Ni, Se, Sr, Tl, Ti, U, V, Zn	Before and after on-ice drilling
	Water intake from all sources	D	Daily during periods of discharge

** Station not in use at this time.*

Figure D4-1. 2BB-BOS1727 Sample Stations Locations

TABULAR SUMMARY OF MONITORING INFORMATION

The following section summarizes the results of sampling undertaken in 2018 as part of the monitoring program detailed in Part J of licence 2BB-BOS1727.

Boston Camp was not operational in 2018. No water was used from Aimaokatalok (Spyder) Lake (BOS-1a) or Stickleback Lake (BOS-1b) for domestic camp, surface drilling or any other purpose. No water quality samples were collected from these locations in 2018.

The Sewage Treatment Facility (BOS-3) was not active as the camp was not operational, therefore no effluent was discharged and no sewage sludge was produced from this facility in 2018. No effluent quality sampling was conducted at BOS-3 or at the point prior to treated effluent entering into Aimaokatalok (Spyder) Lake (BOS-4). Sewage sludge that had been produced in the Sewage Treatment Facility during surface exploration activities in 2017 was transported to Doris Camp for disposal in the Tailings Impoundment Area in 2018.

The Containment Pond (BOS-2) has been used to consolidate water from the smaller fuel containment berms and from the Bulk Fuel Storage Facility (BOS-5), to facilitate testing and treatment while allowing the fuel berms to be promptly vacated of water. As in previous years, water from the Containment Pond (BOS-2) is sampled for and screened against, both BOS-2 and BOS-5 criteria.

Pre-discharge water quality samples collected from BOS-2 on June 25 exceeded the allowable discharge limits for total suspended solids (TSS) and total copper. No dewatering of this facility occurred in June. Water quality treatment was undertaken at BOS-2 with an activated carbon oil-water separator in July. Additional water quality samples were collected July 7 and July 15 with exceedances of the Maximum Average Concentration (MAC) for total arsenic observed in both samples; these results were below the allowable Maximum Concentration in Any Grab Sample (MCGS) for this facility. No discharge occurred from this facility in July and further water quality treatment was undertaken in August.

Post-treatment water quality samples were collected from BOS-2 on August 13 with results exceeding the MAC for TSS, total arsenic and total zinc; results of this sample were below the MCGS. An additional sample was collected on August 26 after further water quality treatment. This sample exceeded the MAC and MCGS for TSS but was below discharge criteria for all other parameters. TMAC communicated with the Inspector to determine a path forward for discharging this facility prior to freeze-up and prevent overtopping of the pond during freshet in 2019. On September 5, the Inspector granted a one-time authorization to discharge from this facility to a depression in the surrounding camp pad. On September 15, 45 m^3 was discharged from this facility to the depression as approved by the Inspector (UTM 7505378 N 441332 E). TMAC is investigating alternative water quality treatment methods to be implemented in 2019 to address water quality issues within this facility. Results of all samples collected from the Containment Pond (BOS-2) are presented in Table D4-2 below.

Water quality sampling was conducted at the Bulk Fuel Storage Facility (BOS-5) on June 25 prior to water management activities. Results of this water quality sample exceeded the discharge criterial for total arsenic and total lead. Water accumulating in this facility was transferred to the Containment Pond (BOS-2) to promptly vacate the water from the berm and allow for additional treatment and analytical sampling to be conducted as discussed above. A second sample was collected from BOS-5 on September 3 to determine if additional dewatering of this facility could be conducted prior to freeze-up. This second sample also exceeded the discharge criterial for total arsenic and total lead. The onset of freezing conditions shortly after this prevent any further water management at this facility in 2018. Results of sampling conducted at the Bulk Fuel Storage Facility (BOS-5) are presented in Table D4-3 below.

Dewatering of the Landfarm Treatment Area (LTA; BOS-6) was not required in 2018 as there was not sufficient water accumulated in this facility to require dewatering and no water quality sampling was conducted. In 2017, TMAC commenced reclamation of the LTA at Boston with the excavation of contaminated soils from the LTA into mega-bags for future treatment or shipment offsite to an approved facility. Planned efforts to backhaul this material to Doris Camp on a winter track in March 2018 were suspended due to mechanical issues with the equipment used to conduct this work which could not be resolved prior to spring thaw and freshet. TMAC intends to backhaul the contaminated soil to Doris Camp for treatment or disposal during the 2019 resupply for Boston Camp via a winter track. Reclamation of the LTA at Boston is planned to continue into 2019 and no additional contaminated material is expected to be deposited for treatment prior to full decommissioning and reclamation.

No landfill exists at Boston and the status of monitoring station BOS-7 is inactive.

During 2018, TMAC opportunistically sampled at locations where seepage was observed during periods of runoff near the waste rock and ore storage pad (BOS-8). Sampling in June was conducted concurrently with the annual seepage sampling program. No seepage was identified at BOS-8 locations after June. Table D4-4 shows the results of this sampling. These monitoring results were compared with previously reported kinetic testing results from the ARD Characterization Data base for the Boston Deposit. Further discussion regarding the waste rock and ore monitoring program at Boston Camp is presented in Appendix G.

The Portal Decline (BOS-9) was sampled on June 25 prior to discharge. Results of this sample were compliant with the discharge criteria for BOS-9 and are presented in Table D4-5. Upon receiving compliant results, 19 m^3 of water was discharged directly to the tundra at UTM 7505378 N, 441219 E as approved by the Inspector.

Underground mining activities were not conducted in 2018. Mine water was not pumped from underground and no water quality monitoring was conducted of the underground mine water sumps (BOS-10).

On-ice exploration drilling did not occur in the licence area in 2018, therefore no samples were taken through lake ice (required by Part F Item 6 and Part J Item 15) to establish water quality prior to, and upon completion of, an on-ice drilling program.

Table D4-2. Results of 2018 Water Quality Sampling from Containment Pond Monitoring Station BOS-2

	Sample ID	BOS2	BOS2	BOS2	BOS2	BOS2	Part D Item 6	
	ALS ID	L2118956-1	L2126312-1	L2130808-1	L2147106-1	L2154150-1	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	6/25/2018 1:35:00 PM	7/7/2018 3:30:00 PM	7/15/2018 4:00:00 PM	8/13/2018 1:00:00 PM	8/26/2018 3:00:00 PM		
Parameter	**Units**	**Results**						
Conductivity	uS/cm	60.4	439	375	407			
Hardness (as $CaCO_3$)	mg/L	16.2 *	210 *	167 *	181 *	192 *		
pH	pH	6.81	7.05	6.63	6.87	7.03	6.0 - 9.5	
Total Suspended Solids	mg/L	**39.8**	5.5	12.1	**27.1**	**31.7**	15	30
Alkalinity, Total (as $CaCO_3$)	mg/L	6.8	71.9	14.6	16.6			
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	130	260
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010		
Sulfate (SO_4)	mg/L	8.72	140	142	159			
Aluminum (Al)-Total	mg/L	0.0875	0.0152	0.529	0.0197	0.0142		
Antimony (Sb)-Total	mg/L	<0.00050	0.00111	0.00151	0.00148	0.00145		
Arsenic (As)-Total	mg/L	0.0267	**0.0546**	**0.0635**	**0.0547**	0.0348	0.05	0.10
Barium (Ba)-Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020		
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		
Boron (B)-Total	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10		
Cadmium (Cd)-Total	mg/L	0.000017	0.0000182	0.0000241	0.0000288	0.0000192		
Calcium (Ca)-Total	mg/L	3.91	49.6	41	44.8	47.4		
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	0.0021	<0.0010	<0.0010		
Cobalt (Co)-Total	mg/L	0.00372	0.00369	0.00414	0.00653	0.00589		
Copper (Cu)-Total	mg/L	**0.0202**	0.0067	0.007	0.013	0.0142	0.020	0.040
Iron (Fe)-Total	mg/L	0.157	0.196	0.181	0.226	0.203		
Lead (Pb)-Total	mg/L	0.0007	0.00287	0.00234	0.00145	0.00131	0.010	0.020
Lithium (Li)-Total	mg/L	<0.0010	0.005	0.0035	0.0036	0.0038		
Magnesium (Mg)-Total	mg/L	1.55	21	15.8	16.9	17.9		
Manganese (Mn)-Total	mg/L	0.0127	0.047	0.0288	0.0512	0.1		
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.000006		

	Sample ID	BOS2	BOS2	BOS2	BOS2	BOS2	Part D Item 6	
	ALS ID	L2118956-1	L2126312-1	L2130808-1	L2147106-1	L2154150-1	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	6/25/2018 1:35:00 PM	7/7/2018 3:30:00 PM	7/15/2018 4:00:00 PM	8/13/2018 1:00:00 PM	8/26/2018 3:00:00 PM		
Parameter	**Units**	**Results**						
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010		
Nickel (Ni)-Total	mg/L	0.0058	0.0304	0.0277	0.0226	0.0258	0.250	0.500
Potassium (K)-Total	mg/L	<2.0	4.4	3.3	3.4	3.8		
Selenium (Se)-Total	mg/L	0.000223	0.000258	0.000243	0.000307	0.000304		
Silver (Ag)-Total	mg/L	0.000033	0.000021	0.000027	0.000039	0.000045		
Sodium (Na)-Total	mg/L	3.6	5.8	5.2	5.5	6.1		
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010		
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050		
Titanium (Ti)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010		
Uranium (U)-Total	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020		
Vanadium (V)-Total	mg/L	0.00059	<0.00050	0.00243	<0.00050	<0.00050		
Zinc (Zn)-Total	mg/L	0.172	0.101	0.119	**0.342**	0.282	0.300	0.600
Oil and Grease	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		No	No	No	No	No	No visible sheen	No visible sheen
Phenols (4AAP)	mg/L	<0.0010		<0.0010	<0.0010			
Benzene	mg/L	<0.00050		<0.00050	<0.00050			
Ethylbenzene	mg/L	<0.00050		<0.00050	<0.00050			
Methyl t-butyl ether (MTBE)	mg/L	<0.00050		<0.00050	<0.00050			
Styrene	mg/L	<0.00050		<0.00050	<0.00050			
Toluene	mg/L	<0.00045		<0.00045	<0.00045			
ortho-Xylene	mg/L	<0.00050		<0.00050	<0.00050			
meta- & para-Xylene	mg/L	<0.00050		<0.00050	<0.00050			
Xylenes	mg/L	<0.00075		<0.00075	<0.00075			
TPH10-32	mg/L	<1.0		<1.0	<1.0			
Acenaphthene	mg/L	<0.000010		<0.000010	<0.000010			
Acenaphthylene	mg/L	<0.000010		<0.000010	<0.000010			

Sample ID		BOS2	BOS2	BOS2	BOS2	BOS2	Part D Item 6	
ALS ID		L2118956-1	L2126312-1	L2130808-1	L2147106-1	L2154150-1	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
Date Sampled		6/25/2018 1:35:00 PM	7/7/2018 3:30:00 PM	7/15/2018 4:00:00 PM	8/13/2018 1:00:00 PM	8/26/2018 3:00:00 PM		
Parameter	**Units**	**Results**						
Acridine	mg/L	<0.000010		<0.000010	<0.000010			
Anthracene	mg/L	<0.000010		<0.000010	<0.000010			
Benz(a)anthracene	mg/L	<0.000010		<0.000010	<0.000010			
Benzo(a)pyrene	mg/L	<0.0000050		<0.0000050	<0.0000050			
Benzo(b&j)fluoranthene	mg/L	<0.000010		<0.000010	<0.000010			
Benzo(b+j+k)fluoranthene	mg/L	<0.000015		<0.000015	<0.000015			
Benzo(g,h,i)perylene	mg/L	<0.000010		<0.000010	<0.000010			
Benzo(k)fluoranthene	mg/L	<0.000010		<0.000010	<0.000010			
Chrysene	mg/L	<0.000010		<0.000010	<0.000010			
Dibenz(a,h)anthracene	mg/L	<0.0000050		<0.0000050	<0.0000050			
Fluoranthene	mg/L	<0.000010		<0.000010	<0.000010			
Fluorene	mg/L	<0.000010		<0.000010	<0.000010			
Indeno(1,2,3-c,d)pyrene	mg/L	<0.000010		<0.000010	<0.000010			
1-Methylnaphthalene	mg/L	<0.000050		<0.000050	<0.000050			
2-Methylnaphthalene	mg/L	<0.000050		<0.000050	<0.000050			
Naphthalene	mg/L	<0.000050		<0.000050	<0.000050			
Phenanthrene	mg/L	<0.000020		<0.000020	<0.000020			
Pyrene	mg/L	<0.000010		<0.000010	<0.000010			
Quinoline	mg/L	<0.00010 *		<0.000050	<0.000050			

Bold/shading indicates exceedance of criteria outlined in Part D Item 6.

Table D4-3. Results of 2018 Water Quality Sampling from Bulk Fuel Storage Berm Station BOS-5

	Sample ID	BOS5	BOS5	Part D Item 19
	ALS ID	L2118930-1	L2157571-1	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	6/25/2018 1:35:00 PM	9/3/2018 2:45:00 PM	
Parameter	Units	Results		
Conductivity	uS/cm	1300	1140	
Hardness (as $CaCO_3$)	mg/L	756 *	655 *	
pH	pH	8.65	7.92	6.5-9.0
Total Suspended Solids	mg/L	4.2	4.3	15
Alkalinity, Total (as $CaCO_3$)	mg/L	49.3	91.6	
Nitrate (as N)	mg/L	<0.025 *	891	
Nitrite (as N)	mg/L	<0.0050 *	<0.10 *	
Sulfate (SO_4)	mg/L	701	490	
Aluminum (Al)-Total	mg/L	0.0255	0.0073	
Antimony (Sb)-Total	mg/L	0.00784	0.0022	
Arsenic (As)-Total	mg/L	**0.339**	**0.348**	0.050
Barium (Ba)-Total	mg/L	<0.020	<0.020	
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	
Boron (B)-Total	mg/L	0.17	0.21	
Cadmium (Cd)-Total	mg/L	0.000124	0.0000638	
Calcium (Ca)-Total	mg/L	187	152	
Chromium (Cr)-Total	mg/L	<0.0010	<0.0010	
Cobalt (Co)-Total	mg/L	0.0222	0.019	
Copper (Cu)-Total	mg/L	0.0115	0.0045	0.040
Iron (Fe)-Total	mg/L	0.54	0.502	
Lead (Pb)-Total	mg/L	**0.0381**	**0.014**	0.010
Lithium (Li)-Total	mg/L	0.0092	0.0089	
Magnesium (Mg)-Total	mg/L	70.1	66.8	
Manganese (Mn)-Total	mg/L	0.0481	0.0584	
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050	
Molybdenum (Mo)-Total	mg/L	0.0034	0.0036	
Nickel (Ni)-Total	mg/L	0.132	0.187	0.500
Potassium (K)-Total	mg/L	7.2	9.2	
Selenium (Se)-Total	mg/L	0.000733	0.000272	
Silver (Ag)-Total	mg/L	0.000022	<0.000020	
Sodium (Na)-Total	mg/L	8.8	8.7	
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010	
Tin (Sn)-Total	mg/L	<0.00050	<0.00050	
Titanium (Ti)-Total	mg/L	<0.010	<0.010	
Uranium (U)-Total	mg/L	<0.00020	<0.00020	
Vanadium (V)-Total	mg/L	<0.00050	<0.00050	
Zinc (Zn)-Total	mg/L	0.0069	0.006	0.600

	Sample ID	BOS5	BOS5	Part D Item 19
	ALS ID	L2118930-1	L2157571-1	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	6/25/2018 1:35:00 PM	9/3/2018 2:45:00 PM	
Parameter	**Units**	**Results**		
Oil and Grease	mg/L	<5.0	<5.0	15
Oil And Grease (Visible Sheen)		No	No	No visible sheen
Phenols (4AAP)	mg/L	<0.0010	<0.0010	
Benzene	mg/L	<0.00050	<0.00050	0.370
Ethylbenzene	mg/L	<0.00050	<0.00050	0.910
Methyl t-butyl ether (MTBE)	mg/L	<0.00050	<0.00050	
Styrene	mg/L	<0.00050	<0.00050	
Toluene	mg/L	<0.00045	<0.00045	0.002
ortho-Xylene	mg/L	<0.00050	<0.00050	
meta- & para-Xylene	mg/L	<0.00050	<0.00050	
Xylenes	mg/L	<0.00075	<0.00075	
TPH10-32	mg/L	<1.0	<1.0	
Acenaphthene	mg/L	<0.000010	<0.000010	
Acenaphthylene	mg/L	<0.000010	<0.000010	
Acridine	mg/L	<0.000010	<0.000010	
Anthracene	mg/L	<0.000010	<0.000010	
Benz(a)anthracene	mg/L	<0.000010	<0.000010	
Benzo(a)pyrene	mg/L	<0.0000050	<0.0000050	
Benzo(b&j)fluoranthene	mg/L	<0.000010	<0.000010	
Benzo(b+j+k)fluoranthene	mg/L	<0.000015	<0.000015	
Benzo(g,h,i)perylene	mg/L	<0.000010	<0.000010	
Benzo(k)fluoranthene	mg/L	<0.000010	<0.000010	
Chrysene	mg/L	<0.000010	<0.000010	
Dibenz(a,h)anthracene	mg/L	<0.0000050	<0.0000050	
Fluoranthene	mg/L	<0.000010	<0.000010	
Fluorene	mg/L	<0.000010	<0.000010	
Indeno(1,2,3-c,d)pyrene	mg/L	<0.000010	<0.000010	
1-Methylnaphthalene	mg/L	<0.000050	<0.000050	
2-Methylnaphthalene	mg/L	<0.000050	<0.000050	
Naphthalene	mg/L	<0.000050	<0.000050	
Phenanthrene	mg/L	<0.000020	<0.000020	
Pyrene	mg/L	<0.000010	<0.000010	
Quinoline	mg/L	<0.000050	<0.000080 *	

Bold/shading *indicates exceedance of Part D Item 19 Maximum Average Concentration*

Table D4-4. Results of Opportunistic Seepage Sampling at the Boston Waste Rock and Ore Storage Pad Monitoring Station BOS-8 2018

	Sample ID	18-BOS-01	18-BOS-01	18-BOS-02	18-BOS-03	DUPLICATE ^
	ALS ID	L2115044-1	L2119509-1	L2119509-2	L2119509-3	L2119509-4
	Date Sampled	6/16/2018 4:20:00 PM	6/25/2018 10:10:00 AM	6/25/2018 10:45:00 AM	6/25/2018 11:00:00 AM	6/25/2018 10:10:00 AM
Parameter	**Units**	**Results**				
Conductivity	uS/cm	401	1200	1840	1640	1230
Hardness (as $CaCO_3$)	mg/L		666	916	826	665
pH	pH	7.31	7.81	8.04	8.05	8.18
Total Suspended Solids	mg/L	12.7	4.1	3.7	3.3	<3.0
Total Dissolved Solids	mg/L	288	967	1500	1370	1030
Acidity (as $CaCO_3$)	mg/L	4.3	4.5	2.8	4	1.6
Alkalinity, Total (as $CaCO_3$)	mg/L	22	129	90.1	88.8	129
Ammonia, Total (as N)	mg/L	0.0246	0.0239	0.349	0.0302	0.0253
Chloride (Cl)	mg/L	8.88	47.2	220	194	49.3
Fluoride (F)	mg/L	0.024	<0.10 *	<0.20 *	<0.10 *	<0.10 *
Nitrate (as N)	mg/L	0.42	1.62	3.62	3.79	1.69
Nitrite (as N)	mg/L	0.0071	<0.0050 *	0.012	0.0172	<0.0050 *
Phosphorus (P)-Total	mg/L	0.0155	0.0384	0.0507	0.0213	0.0735
Sulfate (SO_4)	mg/L	152	493	527	527	513
Aluminum (Al)-Dissolved	mg/L	0.0044	0.0054	0.002	0.0043	0.0052
Antimony (Sb)-Dissolved	mg/L	0.0025	0.00648	0.038	0.0244	0.00667
Arsenic (As)-Dissolved	mg/L	0.0427	0.0758	0.707	0.315	0.0757
Barium (Ba)-Dissolved	mg/L	0.00445	0.0191	0.0156	0.0254	0.0194
Beryllium (Be)-Dissolved	mg/L	<0.00010	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	0.025	0.078	0.176	0.178	0.081
Cadmium (Cd)-Dissolved	mg/L	<0.0000050	0.0000247	0.0000287	0.0000313	0.000026
Calcium (Ca)-Dissolved	mg/L	50.8	166	256	226	168
Cesium (Cs)-Dissolved	mg/L	0.000037				

Sample ID		18-BOS-01	18-BOS-01	18-BOS-02	18-BOS-03	DUPLICATE ^
ALS ID		L2115044-1	L2119509-1	L2119509-2	L2119509-3	L2119509-4
Date Sampled		6/16/2018 4:20:00 PM	6/25/2018 10:10:00 AM	6/25/2018 10:45:00 AM	6/25/2018 11:00:00 AM	6/25/2018 10:10:00 AM
Parameter	**Units**	**Results**				
Chromium (Cr)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00014
Cobalt (Co)-Dissolved	mg/L	0.0246	0.109	0.956	0.345	0.108
Copper (Cu)-Dissolved	mg/L	0.00198	0.00848	0.00555	0.00406	0.00834
Iron (Fe)-Dissolved	mg/L	<0.010	0.013	<0.010	<0.010	0.013
Lead (Pb)-Dissolved	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.0022	0.0069	0.0456	0.0399	0.007
Magnesium (Mg)-Dissolved	mg/L	13	61.4	67.6	63.5	59.8
Manganese (Mn)-Dissolved	mg/L	0.0241	0.111	0.25	0.133	0.108
Mercury (Hg)-Dissolved	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.00036	0.0011	0.00313	0.00401	0.00115
Nickel (Ni)-Dissolved	mg/L	0.0519	0.315	1.23	0.406	0.312
Phosphorus (P)-Dissolved	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	1.68	6.27	13.3	10.9	6.11
Rubidium (Rb)-Dissolved	mg/L	0.00102				
Selenium (Se)-Dissolved	mg/L	0.000226	0.000927	0.00305	0.00261	0.000891
Silicon (Si)-Dissolved	mg/L	0.246	2.11	1.93	1.88	2.16
Silver (Ag)-Dissolved	mg/L	<0.000010	0.000012	0.000011	0.000014	0.000016
Sodium (Na)-Dissolved	mg/L	4.11	24.8	36.3	31.3	24.3
Strontium (Sr)-Dissolved	mg/L	0.108	0.42	1.63	1.44	0.427
Sulfur (S)-Dissolved	mg/L	50.5	160	181	168	166
Tellurium (Te)-Dissolved	mg/L	<0.00020				
Thallium (Tl)-Dissolved	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Dissolved	mg/L	<0.00010				
Tin (Sn)-Dissolved	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	<0.00030	<0.00060 *	<0.00030	<0.00030	<0.00060 *
Tungsten (W)-Dissolved	mg/L	0.00013				

	Sample ID	18-BOS-01	18-BOS-01	18-BOS-02	18-BOS-03	DUPLICATE ^
	ALS ID	L2115044-1	L2119509-1	L2119509-2	L2119509-3	L2119509-4
	Date Sampled	6/16/2018 4:20:00 PM	6/25/2018 10:10:00 AM	6/25/2018 10:45:00 AM	6/25/2018 11:00:00 AM	6/25/2018 10:10:00 AM
Parameter	**Units**	**Results**				
Uranium (U)-Dissolved	mg/L	0.000035	0.000284	0.000247	0.000268	0.000292
Vanadium (V)-Dissolved	mg/L	<0.00050	<0.00050	0.0009	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.0017	0.0027	0.002	0.0292	0.0027
Zirconium (Zr)-Dissolved	mg/L	<0.000060	<0.00030	<0.00030	<0.00030	<0.00030

Note: BOS8 samples collected in June were collected as part of the annual seep survey program. Sample IDs were assigned as part of this program instead of BOS8.
18-BOS-01 is located in the vicinity of BOS8A
18-BOS-02 is located in the vicinity of BOS8B
18-BOS-03 is located in the vicinity of BOS8D/BOS7
^ Duplicate sample collected at location of 18-BOS-01

Table D4-5. Results of 2018 Water Quality Sampling from Portal Station BOS-9

	Sample ID	BOS9	BOS9-DUP^	Part D Item 6	
	ALS ID	L2118993-1	L2118993-2	Maximum Average Concentration (mg/L)	Maximum Concentration in Any Grab Sample (mg/L)
	Date Sampled	6/25/2018 1:10:00 PM	6/25/2018 1:10:00 PM		
Parameter	Units	Results			
Conductivity	uS/cm	167	170		
Hardness (as $CaCO_3$)	mg/L	58.9 *	62.7 *		
pH	pH	7.23	7.28	6.5-9.0	
Total Suspended Solids	mg/L	10	9	15	30
Ammonia, Total (as N)	mg/L	0.0077	0.0077		
Chloride (Cl)	mg/L	15.3	15.4		
Nitrate as NO_{3-}	mg/L	0.152	0.155	130	260
Sulfate (SO_4)	mg/L	38	38.3		
Aluminum (Al)-Total	mg/L	0.368	0.435		
Antimony (Sb)-Total	mg/L	0.00088	0.00094		
Arsenic (As)-Total	mg/L	0.0263	0.0287	0.050	0.10
Barium (Ba)-Total	mg/L	<0.020	<0.020		
Beryllium (Be)-Total	mg/L	<0.00010	<0.00010		
Boron (B)-Total	mg/L	<0.10	<0.10		
Cadmium (Cd)-Total	mg/L	0.0000124	0.0000142		
Calcium (Ca)-Total	mg/L	15.5	16.6		
Chromium (Cr)-Total	mg/L	0.0044	0.005		
Cobalt (Co)-Total	mg/L	0.00563	0.00634		
Copper (Cu)-Total	mg/L	0.0037	0.0041	0.02	0.04
Iron (Fe)-Total	mg/L	0.428	0.425		
Lead (Pb)-Total	mg/L	0.00087	0.00089	0.01	0.02
Lithium (Li)-Total	mg/L	0.0023	0.0024		
Magnesium (Mg)-Total	mg/L	4.88	5.17		
Manganese (Mn)-Total	mg/L	0.024	0.0265		
Mercury (Hg)-Total	mg/L	<0.0000050	<0.0000050		
Molybdenum (Mo)-Total	mg/L	<0.0010	<0.0010		
Nickel (Ni)-Total	mg/L	0.0155	0.0169	0.25	0.5
Potassium (K)-Total	mg/L	<2.0	<2.0		
Selenium (Se)-Total	mg/L	0.000154	0.000163		
Silver (Ag)-Total	mg/L	<0.000020	<0.000020		
Sodium (Na)-Total	mg/L	6.4	6.9		
Thallium (Tl)-Total	mg/L	<0.000010	<0.000010		
Tin (Sn)-Total	mg/L	<0.00050	<0.00050		
Titanium (Ti)-Total	mg/L	<0.010	<0.010		
Uranium (U)-Total	mg/L	<0.00020	<0.00020		
Vanadium (V)-Total	mg/L	0.0016	0.00174		
Zinc (Zn)-Total	mg/L	0.0079	0.0081	0.3	0.6
Oil and Grease	mg/L	<5.0	<5.0	5	10
Oil And Grease (Visible Sheen)		No	No	No visible sheen	No visible sheen

[A] Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
[B] Result from lab provided in Nitrate (as N). Value for Nitrate (as NO_3-) determined by converting NO_3-N to NO_3 (multiply NO_3-N by 4.42) as per ALS Environmental Laboratories.

Appendix E

Doris Mine Annual Water and Load Balance Assessment – 2018 Calendar Year

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Memo

To:	Oliver Curran, Vice-President Environment	**Client:**	TMAC Resources Inc.
From:	Andrea Bowie, PEng	**Project No:**	1CT022.045
Reviewed By:	Christina James, Maritz Rykaart, PhD, PEng	**Date:**	March 19, 2019
Subject:	Doris Mine Annual Water and Load Balance Assessment – 2018 Calendar Year		

1 Introduction

Monthly monitoring of the Doris Tailings Impoundment Area (TIA) is a requirement during operations under the Hope Bay Water Licence No: 2AM-DOH1335 – Amendment No. 2 (NWB 2018). The TIA receives tailings slurry from the mine's process plant, as well as mine water from the Doris Underground mine, runoff from the camp, ore and waste rock pads, natural runoff and direct precipitation.

Under Water Licence No: 2AM-DOH1335, Schedule B Item 4, a summary of the results for the monthly TIA Water balance and Water quality model assessments and any re-calibrations that have been carried out is required. The licence was amended on December 7, 2018 and a retroactive analysis was done for the entire 2018 calendar year instead of each month individually. Measured elevation and water quality data were compared to the predictions from the Hope Bay Project Mine Water and Load Balance Model submitted as part of the Hope Bay Project Final Environmental Impact Statement (FEIS) (SRK 2017).

The previous annual review (i.e., 2017) concluded the overall mechanisms behind the water balance adequately represented the system (SRK 2018). From a water quality perspective, parameters were grouped based on the comparison of predicted and observed results. The following parameter groups were identified:

- Conservative predictions,
- Predictions trending well with measured data,
- Underpredicted, and,
- Detection limit greater than prediction.

The model was considered sufficient for the parameters where predictions were conservative, trending well with measured data and where detection limits were greater than prediction.
The 2017 review concluded that, since the process plant was still in a start-up mode and had not reached steady state, the underpredicted parameters were to be monitored and evaluated again under steady state conditions.

This memo discusses the comparison of data measured in 2018 to results predicted by the FEIS model.

2 Model Inputs and Measured Data Comparison

The model set-up and mechanisms represented are detailed in the FEIS Water and Load Balance report (SRK 2017). This section will discuss the key differences between the model setup and the measured inputs or implemented infrastructure decisions. The model was updated to reflect the measured data from 2017 and 2018 and the actual site water management configuration.

2.1 Review of Water Balance Inputs

2.1.1 Hydrology Update

At the time of this memo preparation, Doris meteorological data had not been processed for the year and measured data from three Cambridge Bay Stations (Environment and Climate Change Canada IDs: 2400600, 2400601, and, 2400602) was compiled and updated in the model through to the end of 2018. The model includes the functionality to use data measured from Cambridge Bay whenever Doris data is missing. The following parameters were included in the update: daily rainfall, daily total precipitation, daily temperature and average monthly undercatch values for snow and rain.

2.1.2 Processing Rate

The production rate applied in the model at the time of model development was 1,100 tpd in 2017 and 1,900 tpd in 2018 in accordance with the FEIS mine plan. The modelled processing rate and the measured processing rates for 2017 and 2018 are compared in Table 1 and Figure 1. The processing plant has been consistently less than the modelled production rate; processing 60% of the total modelled amount of 880,000 tonnes.

Monthly processing rates were updated in the model to reflect the measured values for 2017 and 2018. For 2019 to 2032, the forecasted processing rates in the model were left as the FEIS values.

2.1.3 Doris TIA Storage Curves

TIA storage-elevation curves applied in the model were generated every three years using the FEIS mine plan in Minebridge Muk3D. The model interpolated between curves based on elapsed model time. Since the actual processing rate was less than the modeled rate, the amount of tailings deposited over time, and therefore the date associated with each storage-elevation curve, was no longer valid.

The dates associated with each curve was modified to reflect the total amount of tailings deposited. In this way, the model was modified to reflect the actual amount of tailings deposited in 2017 and 2018. The model now effectively interpolates between storage-elevation curves based on total tonnes of tailings deposited in the Doris TIA.

2.1.4 Mine Water and Robert's Bay Discharge Line

Discharge of mine water from Doris Underground directly to Robert's Bay was originally modelled to begin in May 2017. Site operations encountered mine water in February 2018, four months later than anticipated. This was due to changes in the mine plan that delayed entering the talik zone. Since February 2018, mine water has been pumped to the Doris TIA, either via the Sediment Control Pond (SCP) or by the process plant pump box, which pumps the flotation tailings to the Doris TIA. A comparison of modelled and measured mine water flows are presented in Table 2 and Figure 2.

Measured mine water encountered to date totaled 130,000 m^3, representing about 4% of the total volume of water held in the Doris TIA (assumes: July 31 bathymetry curve (ERM 2018) and an elevation of 30 masl), and 22% of the modeled mine water flow for 2017 and 2018.

Flow rates for Doris Underground mine water were updated in the in the model to reflect measured values for 2017 and 2018. For 2019 to 2020 the originally modelled mine water rates were left as the FEIS values.

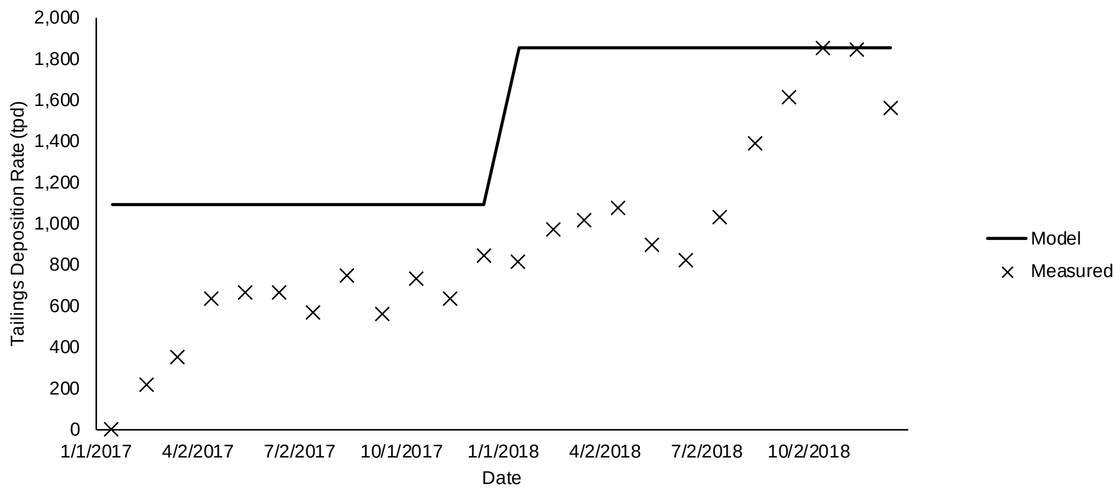
Discharge from the Doris TIA to Robert's Bay was originally modelled to begin in June 2019 and was changed to start in October 2019 to reflect the current installment date. Doris Underground mine water was directed to the Doris TIA until October 2019, after which it would be discharged to Robert's Bay directly.

No changes were made to the Madrid North or Madrid South mine water flows.

Table 1: Summary of Modelled and Measured Processing Rates

Month	Process Rate (tpd)			
	2017		2018	
	Modeled	Measured	Modeled	Measured
1	1,100	-	1,900	810
2	1,100	210	1,900	970
3	1,100	350	1,900	1,000
4	1,100	640	1,900	1,100
5	1,100	660	1,900	890
6	1,100	660	1,900	820
7	1,100	570	1,900	1,000
8	1,100	740	1,900	1,400
9	1,100	560	1,900	1,600
10	1,100	730	1,900	1,900
11	1,100	630	1,900	1,800
12	1,100	840	1,900	1,600
Total	**400,000**	**200,000**	**680,000**	**450,000**

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm



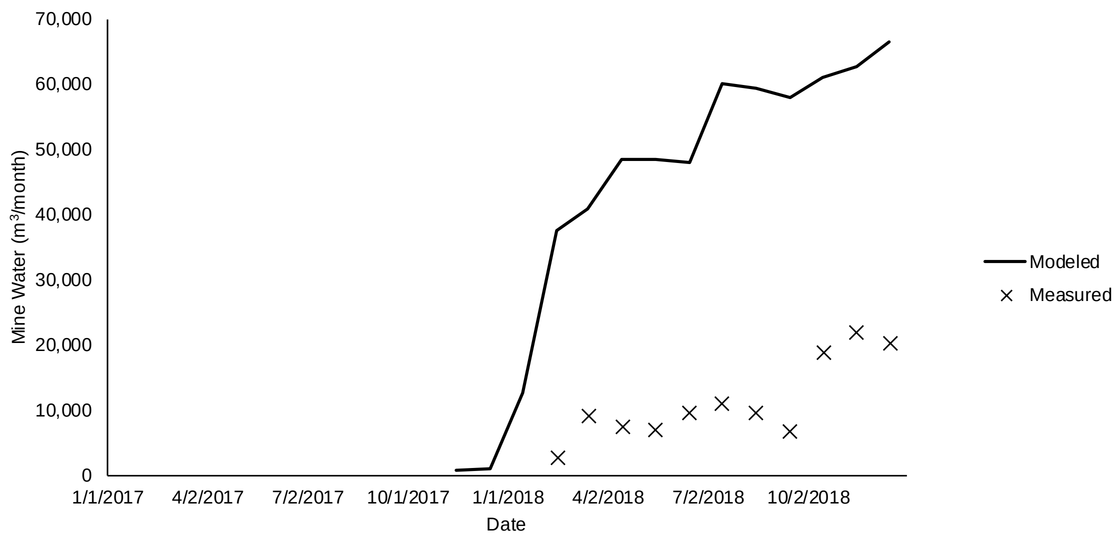
Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Figure 1: Modelled and Measured Processing Rates

Table 2: Summary of Modeled and Measured Mine Water Flows

Month	Mine Water (m^3/month)			
	2017		2018	
	Modeled	Measured	Modeled	Measured
1	-	-	13,000	-
2	-	-	38,000	2,700
3	-	-	41,000	9,300
4	-	-	48,000	7,500
5	-	-	48,000	7,100
6	-	-	48,000	9,700
7	-	-	60,000	11,000
8	-	-	59,000	9,800
9	-	-	58,000	6,800
10	-	-	61,000	19,000
11	730	-	63,000	22,000
12	1,000	-	66,000	20,000
Total	**1,700**	**-**	**600,000**	**130,000**

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm



Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Figure 2: Modeled and Measured Mine Water Flows

2.2 Review of Water Quality Inputs

TMAC provided 2018 water quality data collected in the Doris TIA at the reclaim pump station (TL-1). These data were compared to the updated model predictions (Predicted – WB), the FEIS model updated to include adjusted inputs based on measured 2017 and 2018 data (described in Section 2.1). Parameters were grouped into three categories of the categories identified through the 2017 review, presented in Table 3. For parameters that were conservative or trending well no further action was taken, however those parameters that were underpredicted are addressed in the sections below.

Table 3: Initial Screening Assessment of Water Load Balance Parameters

Classification Type	Parameters Included	Comparison to Model Prediction
Conservative	NO_3, Sb, Ba, Be, Cd, Cr, Hg, Mo, Se, Ag, Tl, Zn	Measured values are below the model prediction. The modeled values are reflective of conservative assumptions.
Trending Well	TDS, Cl, NO_2, As, B, Ca, Co, Pb, Li, Mg, U, V	Measured values are tracking well with the model predictions.
Underpredicted	TSS, NH_4, Cyanide Total, Cyanide Free, SO_4, Al, Cu, Fe, Mn, Ni, Na, P	Model predictions are lower than measured values. Corrective actions discussed in subsequent sections.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Note:

TDS = Total Dissolved Solids

TSS = Total Suspended Solids

To re-calibrate the model, model inputs were evaluated to determine how each would affect the model results. The inputs likely affecting the underpredictions were identified as:

- Doris process plant source term,
- Mine water source term, and
- Biological degradation rates in the Doris TIA.

For underpredicted parameters, loading rates were compared to identify the source of loading in 2018. Sources were identified as either Doris Underground mine water or process water from the process plant. This analysis used the mine water measured chemistry either at the inflow line to the pump box or the SCP before mixing (TL-12) and the process water chemistry measured at the flotation tailings thickener underflow (TL-5). The parameters fell into two groups:

- Parameters with most of the loading from process water, including reagents or reagent by-products originating from the process plant and ore and waste rock bearing minerals: NH_4, CN-T, CN-F, SO_4, Cu, Ni, Na.
- Parameters with most of the loading from the mine water, which were primarily metals linked to high TSS or groundwater signature: Al, Cu, Fe, Mn, P.

Copper appears in both groups as loading was roughly equal across both sources. Copper and sulphate concentrations may be linked to reagent use or to ore and waste rock bearing minerals. Nickel is included in the process water group although it is not linked to a reagent.

The model was revised with updated water quality for these two sources. The input concentration for these parameters (source terms) for the process plant and Doris Underground mine water were compared to an average of the average monthly data measured between April and December of 2018. If the average measured data was higher than the source term, the source term was changed in the model. If the source term was higher or very close, it was left as the original source term.

The biological degradation rates applied to the Doris TIA during the open water season were also evaluated. The degradation rates used for NH4, total cyanide, WAD cyanide, and cyanate were found to match the measured data well and no changes were made.

3 Stepwise Calibration Methodology

Changes were made one at a time to see the impact on the model results. A summary of the steps taken during the calibration were:

1. Water balance inputs updated.
   (a) Includes: storage curves updated, hydrology update, Doris mine water flows, and Doris Process Plant processing rate updated to include measured data for 2017 and 2018.
   (b) Results were compared back to measured data. Screening assessment results presented in Table 3.

2. Process water source term updated.

   (a) Includes changes to Doris Process Plant source term for: TDS, NH_4, Cyanide Total, Cyanide Free, SO_4, Al, Cu, Ni, Na, and, P. Updated concentrations were taken from the average of the April to December average monthly data from station TL-5 (tailings water), presented as Table 4.

   (b) The previous TDS value was increased by taking the increase in sulphate and sodium concentrations and adding this to the previously calculated TDS value. The calculation is presented in Table 5.

   (c) Parameters were compared back to measured data, all changes were accepted (discussed in Section 4.2).

   (d) For consistency in future source terms the Madrid North, Madrid South and Boston source terms for material processed at the Doris Process Plant were updated for: TDS, NH_4, Cyanide Total, Cyanide Free, SO_4, Cu, and, Na. These were the suite of parameters affected by mill reagent use specific to gold processing. Presented in Table 4 and Table 5.

3. Mine water source term updated.

   (a) Includes changes to Doris Mine Water source term for: NH_4, Al, Cu, Ni, Fe, Mn, and, P. Updated concentrations were taken from the average of the April to December average monthly data from station TL-12 (mine water), presented in Table 6.

   (b) Parameters were compared back to measured data, all changes were rejected except for NH_4 (discussed in Section 4.2).

4. Nitrogen Speciation Degradation Rates.

   (a) The degradation rates used for NH_4, cyanide Total, cyanide WAD, and cyanate were found to match the measured data well and no changes were made.

Table 4: Average Monthly Process Water (TL-5)

Month	Concentration (mg/L)								
	Total Ammonia (as N)	Total Phosphorous	Cyanide – Total	Cyanide – Free	Total Aluminum	Total Copper	Total Nickel	Total Sodium	Sulphate
January	18	0.5	0.74	0.0025	3	0.15	0.051	750	1,400
February	24	0.13	1.9	0.033	0.36	0.11	0.045	1,000	2,000
March	25	0.39	1.3	0.01	6.6	0.3	0.078	730	690
April	21	0.12	0.49	0.005	0.73	0.047	0.041	610	740
May	26	0.13	1.7	0.0087	5.3	0.18	0.035	940	1,300
June	20	0.44	1.3	0.075	0.16	0.28	0.11	830	1,100
July	19	0.22	0.12	0.026	0.15	0.013	0.073	650	870
August	25	0.13	3.7	0.44	0.17	0.44	0.059	1,500	2,800
September	19	0.13	0.78	0.031	0.14	0.059	0.076	890	1,500
October	28	0.25	0.23	0.028	2.1	0.1	0.1	1,500	2,300
November	24	0.25	0.81	0.032	0.47	0.12	0.051	1,800	1,300
December	21	0.13	1.2	0.19	0.12	0.27	0.1	1,400	1,900
Average (April to December)	**23**	**0.2**	**1.1**	**0.092**	**1.0**	**0.17**	**0.072**	**1,100**	**1,500**
FEIS Values	**0.52**	**-**	**0.52**	**-**	**0.15**	**0.027**	**0.013**	**-**	**130**

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Table 5: TDS Calculations for the Process Plant Source Terms

Location	Doris		Madrid North		Madrid South		Boston to Doris	
Parameters (mg/L)	**Sulphate**	**Total Sodium**	**Sulphate**	**Total Sodium**	**Sulphate**	**Total Sodium**	**Sulphate**	**Total Sodium**
Doris Measured	1,500	1,100	1,500	1,100	1,500	1,100	1,500	1,100
FEIS Input	130	-	490	160	670	240	670	240
Increase in TDS	2,500		2,000		1,700		1,700	
FEIS TDS	420		1,000		1,500		1,500	
TDS based on Doris Measured	2,900		3,000		3,200		3,200	

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Table 6: Average Monthly Mine Water (TL-12)

Month	Concentration (mg/L)						
	Total Ammonia (as N)	Total Phosphorous	Total Aluminum	Total Copper	Total Iron	Total Manganese	Total Nickel
January	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-
March	27	1.3	14	0.12	38	3.6	0.013
April	13	1.9	42	0.28	120	6.8	0.052
May	42	2	88	1.4	230	8.7	0.097
June	36	1.3	13	0.35	33	3.7	0.019
July	30	1.3	26	0.25	70	3.9	0.08
August	21	2.1	57	0.73	180	6.3	0.073
September	28	2.3	86	0.66	280	7.6	0.08
October	27	3.3	73	0.55	260	7.7	0.083
November	42	2.8	71	0.6	250	7.2	0.085
December	19	3.6	70	0.37	260	7.5	0.056
Average (April to December)	**29**	**2.3**	**58**	**0.57**	**190**	**6.6**	**0.069**
FEIS Values	**3.4**	**0.97**	**0.038**	**0.0011**	**4.7**	**1.7**	**0.0014**

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

4 Calibration Evaluation

4.1 Doris TIA Elevation

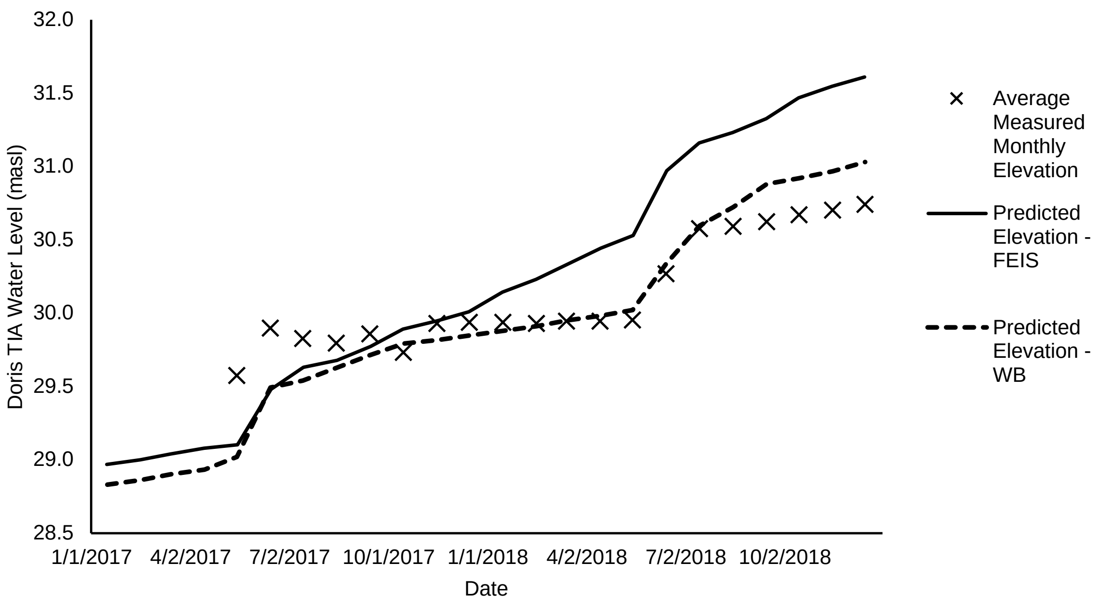
TMAC supplied measured elevations for the Doris TIA for 2018. These were compared to the originally modelled predictions (Prediction – FEIS) as well as the updated predictions (Prediction – WB). The results of the measured elevations and the two predicted elevation cases are shown in Table 7 and Figure 3.

Although some months show an elevation difference, the general trend of the measured elevation data matches the updated predictions. It appears the mechanisms affecting model calibration are trending well with measured data and no further recalibration of the model is required at this time regarding water inventory.

Table 7: Doris TIA Elevation Comparison to Model Predictions

TIA Water Level (masl)				
Month	**Year**	**Average Measured Monthly Elevation**	**Predicted Elevation - FEIS**	**Predicted Elevation - WB**
January	2017	-	29.0	28.8
February	2017	-	29.0	28.9
March	2017	-	29.0	28.9
April	2017	-	29.1	28.9
May	2017	29.6	29.1	29.0
June	2017	29.9	29.5	29.5
July	2017	29.8	29.6	29.5
August	2017	29.8	29.7	29.6
September	2017	29.9	29.8	29.7
October	2017	29.7	29.9	29.8
November	2017	29.9	30.0	29.8
December	2017	29.9	30.0	29.9
January	2018	29.9	30.1	29.9
February	2018	29.9	30.2	29.9
March	2018	29.9	30.3	30.0
April	2018	29.9	30.4	30.0
May	2018	30.0	30.5	30.0
June	2018	30.3	31.0	30.3
July	2018	30.6	31.2	30.6
August	2018	30.6	31.2	30.7
September	2018	30.6	31.3	30.9
October	2018	30.7	31.5	30.9
November	2018	30.7	31.6	31.0
December	2018	30.7	31.6	31.0

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R04_ajb.xlsm



Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Figure 3: Modeled and Predicted Elevations in the Doris TIA

4.2 Predicted TIA Water Quality

Attachment 1 presents a comparison between the measured data at TL-1 and the water quality predictions generated by the current model. The graphs show several model predictions, representing the model calibration evolution. A summary of the graphed results is presented in Table 8.

The graphs include predictions up until the Doris TIA is drained and maintained empty after the North Dam is breached. For parameters regulated under the Metal and Diamond Mining Effluent Regulations (MDMER), the maximum monthly mean concentration was included on the plots (MDMER 2018).

Table 8: Description of the Predictive Cases Graphed in Attachment 1

Graphed Prediction	Description
Predicted - FEIS	Results presented in the FEIS
Predicted - WB	Results after water balance changes (mine water, process rate, storage curves)
Predicted - LB1	Results after Process Plant source term update
Predicted - LB2	Results after Mine Water source term update (before rejection)
Predicted - LB3	Results after all accepted changes

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

After the Doris process plant and the Doris mine water source terms were adjusted, the underpredicted parameters from the screening assessment could be reclassified into three groups presented in Table 9.

Table 9: Screening Summary of Water Load Balance Parameters after Calibration

Classification Type	Parameters Included	Comparison to LB3 Model Prediction
Trending Well	TDS, CN-F, SO4, Ni, Na,	Measured values are tracking well with the model predictions.
Slightly underpredicted - process plant driven	NH_4, CN-T, Cu, P	Model predictions are tracking slightly under measured values. Variability in average monthly concentrations reflects steady state at Doris Process Plant not achieved. No increase to source terms; ongoing evaluation of parameters throughout the year for trends.
Slightly underpredicted - mine water TSS driven	TSS, Al, Cu, Fe, Mn	Model predictions are tracking slightly under measured values. Concentrations are likely reflective of high TSS water and the model does not account for settling of TSS (conservative, completely mixed reservoir). No increase to source terms; ongoing evaluation of parameters throughout the year for trends.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

The Doris process plant was still not at steady state conditions in 2018 and several changes were made to the processing circuits in the Fall of 2018. During the period between April and December of 2018, one sample was collected monthly from the location TL-5. If the process plant was not in steady state conditions, the concentrations could be biased. Even after the process water source term was adjusted, some parameters were still slightly underpredicted. These parameters will be monitored in the future to see if any trends arise once steady state conditions are reached in the processing plant.

For the process water source term, parameters can be broken into groups affected by the ore and waste rock being processed and those affected by reagent addition with some falling in both. Reagent volumes required for optimal processing may become more refined with increased operational experience and steady state conditions. However, the measured chemistry to date suggests that the source terms may underestimate the quantities of some reagents being used in the process and/or the release of some parameters from the ore being processed. Therefore, the process water source terms for the Madrid North, Madrid South and Boston ores processed at Doris were also updated to reflect the increased parameter values linked to reagents or reagent by-products. The adjusted parameters were: TDS, NH_4, CN-T, CN-F, SO_4, and, Na.

The model is set up as a conservative mass balance and is unable to accurately predict TSS in model reservoirs. For each timestep in the model, loading is added to the Doris TIA. The Doris TIA is then perfectly mixed, and load is assigned to any outflows based on the perfectly mixed concentration. The mine water contains high TSS and therefore the model can not accurately predict the total fraction of metal concentrations once the mine water is added to the Doris TIA. Since only total metals are regularly measured in the Doris TIA, the contribution of suspended solids to total concentrations is challenging to resolve.

The adjustment to the mine water source was not accepted for all parameters. The mine water source term was changed for some metals which resulted in predictions higher than the measured data. Graphs for Al, Fe, and Mn in Attachment 1 illustrate this best. As a result, the updated source term for the Doris mine water was not accepted as a change reflective of the measured data, except for NH_4 which trended fairly well with measured data. The concentrations of Al, Fe, Mn and P will continue to be monitored in the mine water as TMAC works to lower the TSS.

5 Comparison to MDMER

Updated water quality projections for the TIA were compared to the MDMER limits (MDMER 2018) in Attachment 1, as Doris TIA water will be discharged to Robert's Bay. All measured data was compared to the MDMER maximum monthly mean concentrations and maximum authorized concentrations in a grab sample, presented in Table 10 and Table 11, respectively.

The only parameter that exceeded the MDMER limits in 2018 was TSS. However, no discharge from the TIA took place in 2018. TMAC is actively taking steps to manage TSS in the TIA ahead of the proposed discharge date in 2019. All other parameters remain below the discharge limits.

Unionized ammonia concentrations increased in August and September of 2018 in the Doris TIA. This coincided with an algae bloom that increased TSS and pH concentrations in the facility. Since unionized ammonia is dependent on temperature and pH, the combination of increased temperature during the open water season with the pH increase lead to an increase in the unionized fraction of ammonia at the peak of the algae bloom. Concentrations decreased again once the bloom was over and returned to well below the MDMER limit. Algae blooms are expected to occur again in the future. TMAC is actively working towards a TSS solution that would allow for a pH adjustment, if required, for any subsequent algae blooms during planned active discharge.

The updated water quality predictions were also screened against the MDMER limits. A summary of the findings is presented in Table 12. MDMER limits were also presented along side predictions in Attachment 1.

Arsenic was identified during the FEIS as a parameter requiring treatment once the Madrid ore is processed and this remains unchanged for the updated predictions. Four parameters have been identified as parameters to monitor closely: TSS, Cu, total cyanide and unionized ammonia.

TSS and unionized ammonia have already been identified as parameters of concern and TMAC is actively working towards a solution to manage these both. Copper and total cyanide were identified as parameters to monitor closely because both originate from reagent use or the ore and waste rock in the process plant. TMAC will continue to monitor plant performance and identify the potential to reduce reagent usage.

Table 10: Comparison of Maximum Monthly Average Measured Concentrations in the Doris TIA to MDMER

Parameter	Units	MDMER Maximum Authorized Monthly Mean Concentration	Maximum of 2018 Doris TIA Average Monthly Concentrations (TL-1)	Month of Maximum Concentration	Percent of MDMER Limit
TSS	mg/L	15	30	September	200%
Total Arsenic	mg/L	0.1	0.0013	May	1.3%
Total Copper	mg/L	0.1	0.039	November	39%
Cyanide – Total	mg/L	0.5	0.23	May	46%
Total Lead	mg/L	0.08	0.0017	June	2.1%
Total Nickel	mg/L	0.25	0.0074	December	3.0%
Total Zinc	mg/L	0.4	0.003	November	0.8%
Unionized Ammonia (as N)	mg/L	0.4	0.34	August	85%

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Table 11: Comparison of Maximum Grab Sample Concentration Measured in the Doris TIA Compared to MDMER

Parameter	Units	MDMER Maximum Authorized Concentration in a Grab Sample	Maximum Concentration Measured in the Doris TIA in 2018 (TL-1)	Date of Maximum Concentration	Percent of MDMER Limit
TSS	mg/L	30	36.3	8/13/2018	121%
Total Arsenic	mg/L	0.2	0.00136	5/28/2018	0.7%
Total Copper	mg/L	0.2	0.0439	11/5/2018	22%
Cyanide – Total	mg/L	1	0.274	4/30/2018	27%
Total Lead	mg/L	0.16	0.0022	6/4/2018	1.4%
Total Nickel	mg/L	0.5	0.008	5/7/2018	1.6%
Total Zinc	mg/L	0.8	0.003	5/7/2018	0.4%
Unionized Ammonia (as N)	mg/L	1	0.63	9/3/2018	63.0%

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

Table 12: Comparison of Updated Predictions to MDMER Limits

Parameter	Discussion of Results
TSS	The model is not able to accurately predict TSS. TMAC is actively taking steps to manage TSS and these will continue to be applied in the future.
Arsenic	Updated predictions follow a very similar trend to the FEIS results indicating the need for arsenic treatment once the Madrid North ore is processed.
Copper	Updated predictions increase above the MDMER limit in 2023. TMAC will evaluate the use of copper containing reagents in the plant and speciation (dissolved versus total) to better understand if copper cyanide complexes or suspended copper is making up the majority of measured copper.
Total Cyanide	Updated predictions increase above the MDMER limit in 2030. Total cyanide concentrations in the Doris TIA originate from the cyanide leach circuit and optimization of this circuit can lead to reduction in cyanide concentrations. TMAC will monitor reagent use and attempt to manage these concentrations through processing modifications. Measured cyanide concentrations have demonstrated that cyanide readily undergoes degradation in the Doris TIA during the open water season.
Lead	Updated predictions remain below the MDMER limits and are not of concern.
Nickel	Updated predictions remain below the MDMER limits and are not of concern.
Zinc	Updated predictions remain below the MDMER limits and are not of concern.
Unionized Ammonia	Unionized Ammonia is both pH and temperature dependent and not included in the model. TMAC is aware that algae blooms may occur each year and are actively taking steps towards managing this issue.

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

6 Conclusions

Overall the mechanisms behind the FEIS water and load balance appear to be well calibrated to the measured data. A summary of the changes and conclusions of the calibration is presented in Table 13.

Four parameters have been identified as parameters of concern regarding the MDMER limits applied to mine discharges, including the future discharge of Doris TIA water to Robert’s Bay. TMAC is actively taking steps to manage TSS and unionized ammonia concentrations in the Doris TIA. TMAC will evaluate the use of copper and cyanide in the mill to identify any opportunities for reagent reduction in 2019. Also, TMAC will assess if increasing trends in concentration continue in 2019, or if they can be linked to the lack of steady state conditions in the process plant.

Table 13: Summary of the FEIS Model Calibration to the Measured 2018 Data

Evaluated Model Input	Summary of Changes Made to the Model Input	Conclusions of Calibration
Hydrology Data	updated to reflect 2017 and 2018 measured data	Predicted elevation trends well compared to measure elevations.
Doris process rate	updated to reflect 2017 and 2018 measured data	
Doris mine water flows	updated to reflect 2017 and 2018 measured data	
Doris TIA storage curves	updated to actual volume of tailings deposited, reflecting change in processing rate compared to FEIS mine plan	
Doris process water source term	source term updated based on 2018 measured data at TL-5 for TDS, NH_4, CN-T, CN-F, SO_4, Al, Cu, Fe, Mn, Ni, P, and, Na	Most parameters trend well. TMAC to evaluate Cu and CN use in the process plant to reduce reagent use in 2019. Model does not predict settling of TSS. Parameters linked to high TSS in mine water (Al, Cu, Fe, Mn, and, P) do not calibrate well. TMAC is actively working to lower TSS in the Doris TIA ahead of discharge date.
Madrid North process water source term	parameters linked to reagent use updated based on Doris data for TDS, NH_4, CN-T, CN-F, SO_4, and, Na	
Madrid North process water source term		
Boston process water source term		
Doris mine water source term	source term updated based on 2018 measured data at TL-12 for NH_4	
Biological degradation rates in the Doris TIA	no change	Degradation rates represent changes in Doris TIA well

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.026_2018 General Compliance\Annual_Review_2018\HopeBay_WLBReview_1CT022.026_R05_ajb.xlsm

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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.

7 References

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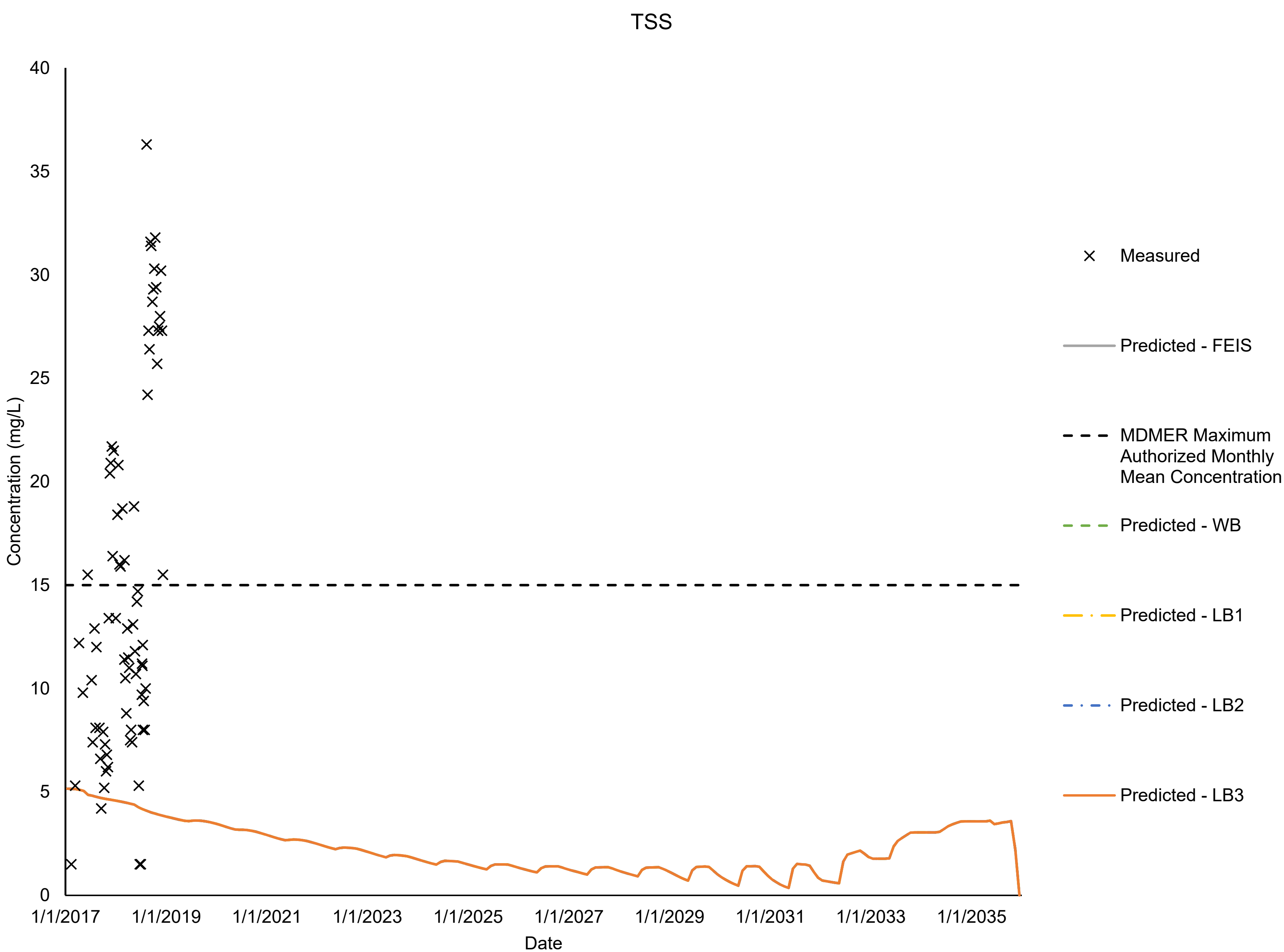
Attachment 1 - Comparison of Predicted and Measured Water Quality Data


TSS
Concentration (mg/L)
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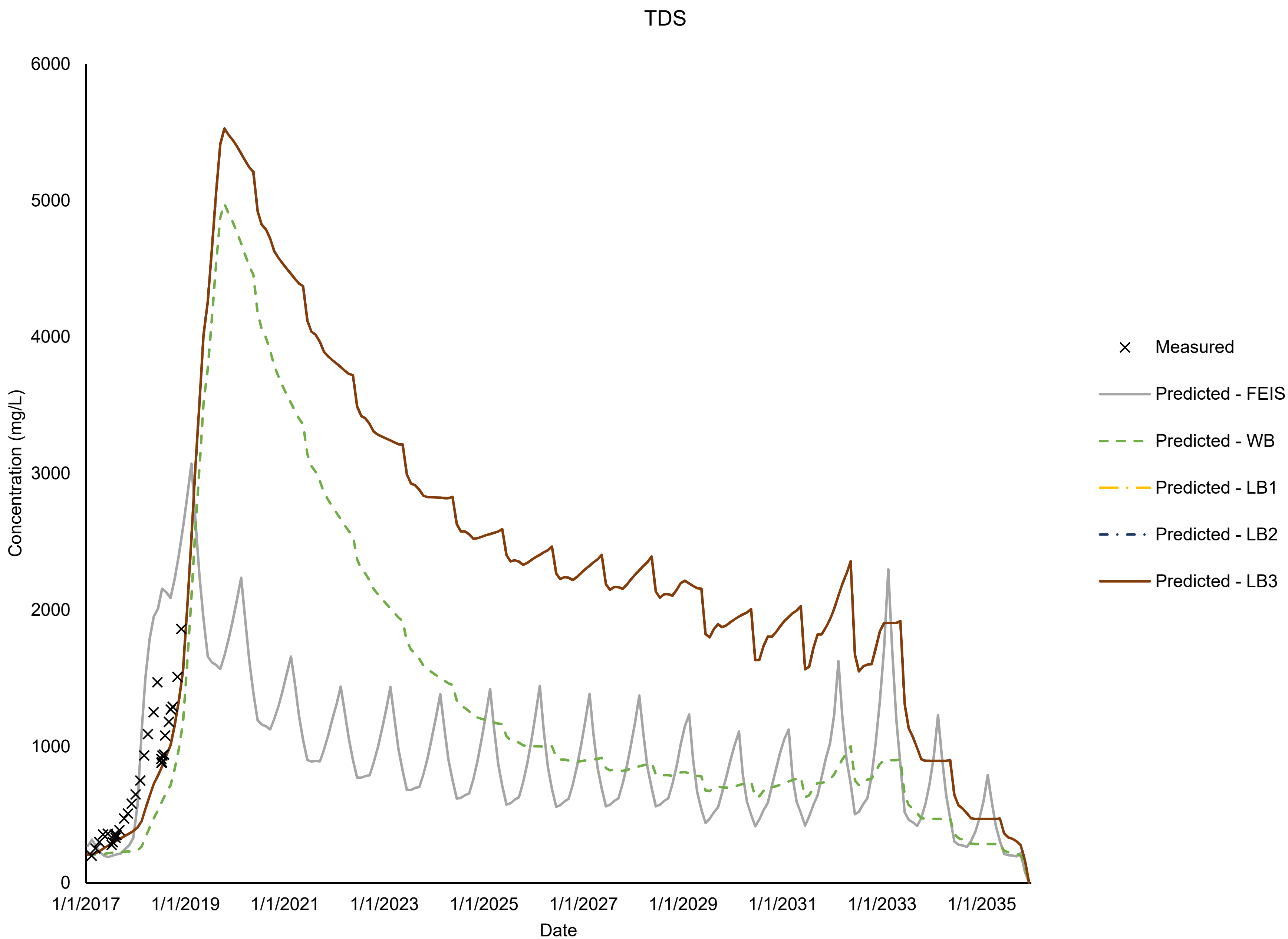
35
30
25
20
15
10
5
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


TDS
6000
5000
4000
3000
2000
1000
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
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Measured
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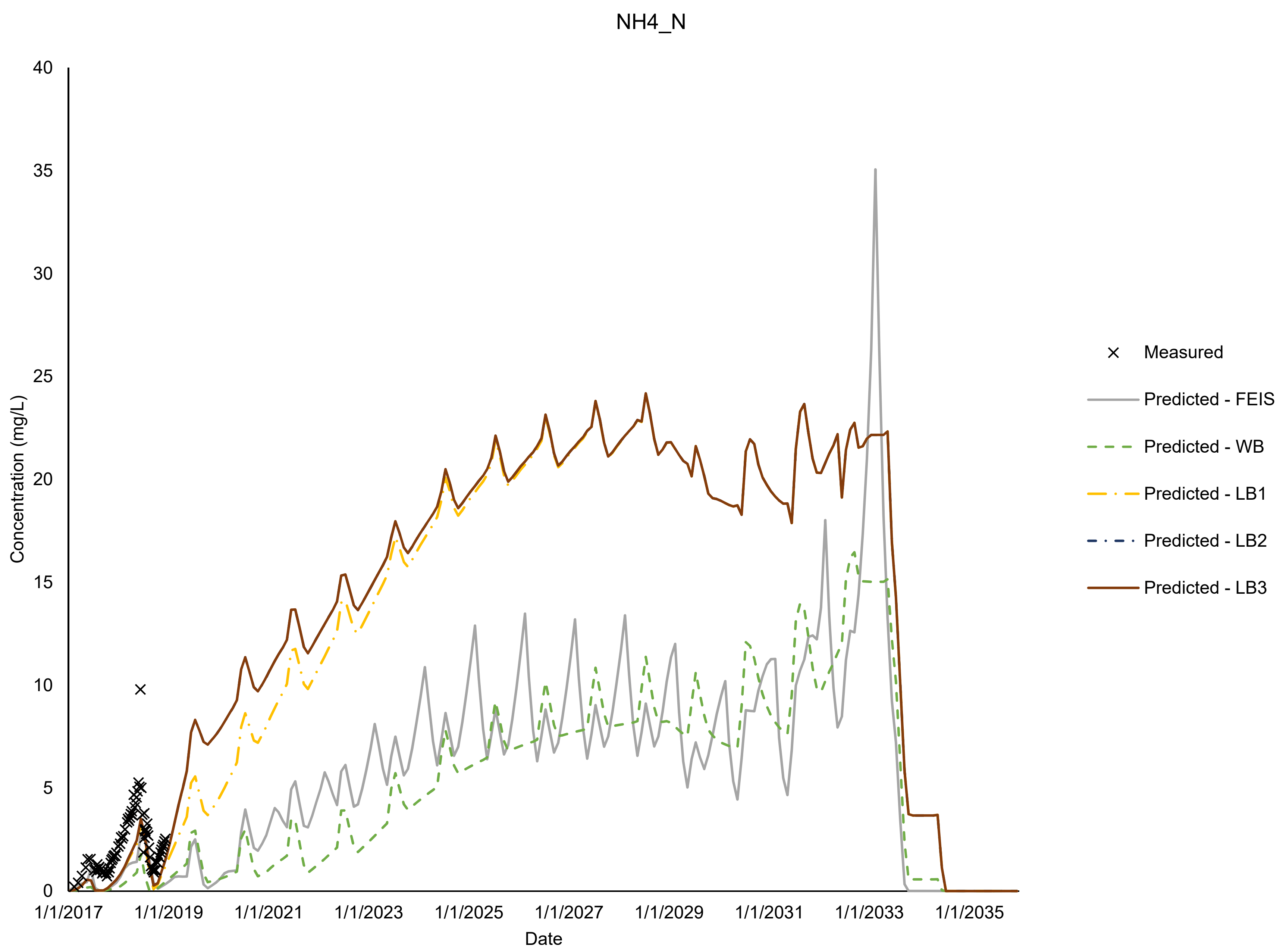
Predicted - LB1
Predicted - LB2
Predicted - LB3


NH4_N
40
35
30
25
20
15
10
5
0
Concentration (mg/L)
1/1/2017
1/1/2019
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1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
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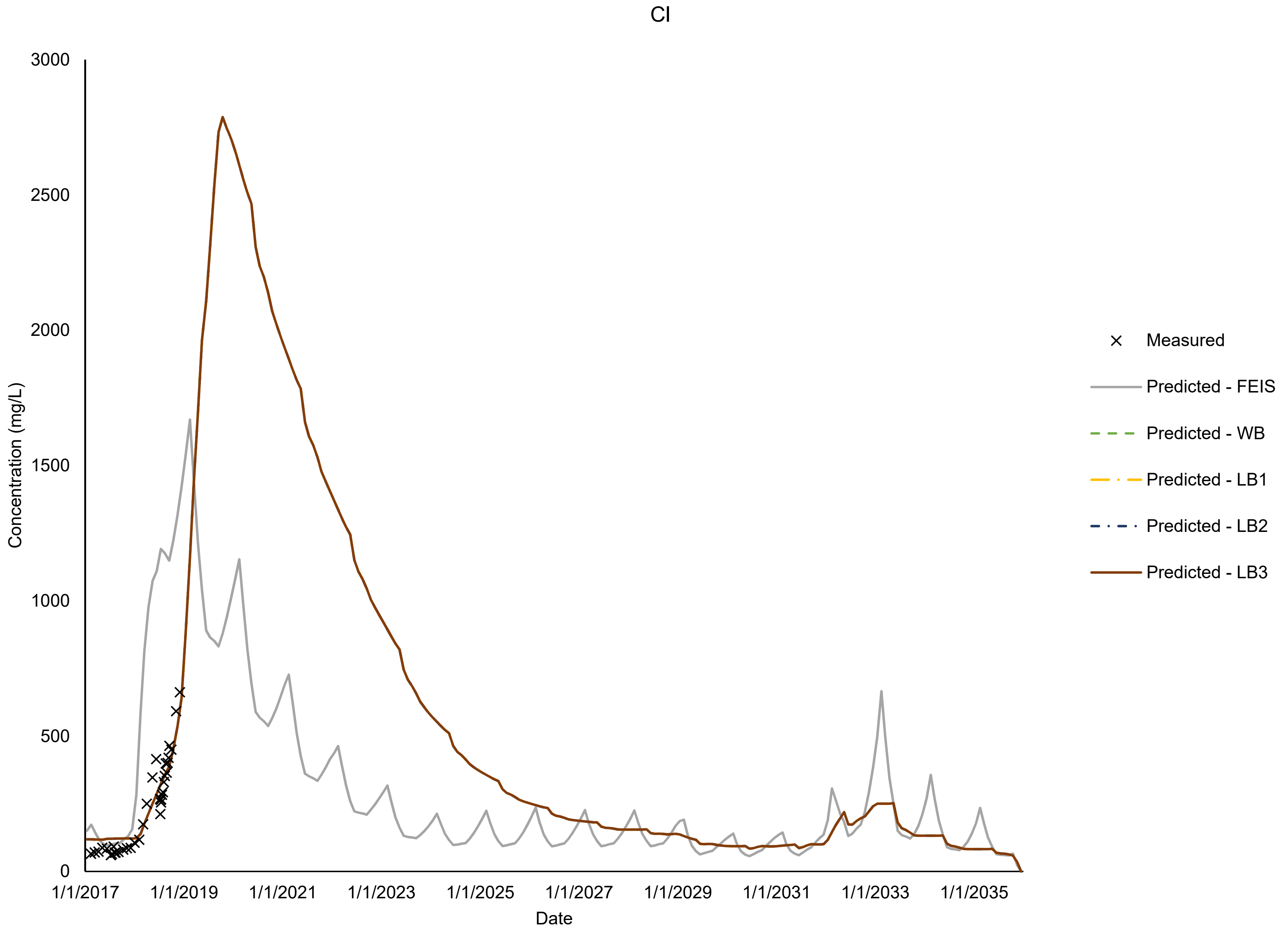
Predicted - LB2
Predicted - LB3


Cl
3000
2500
2000
1500
1000
500
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
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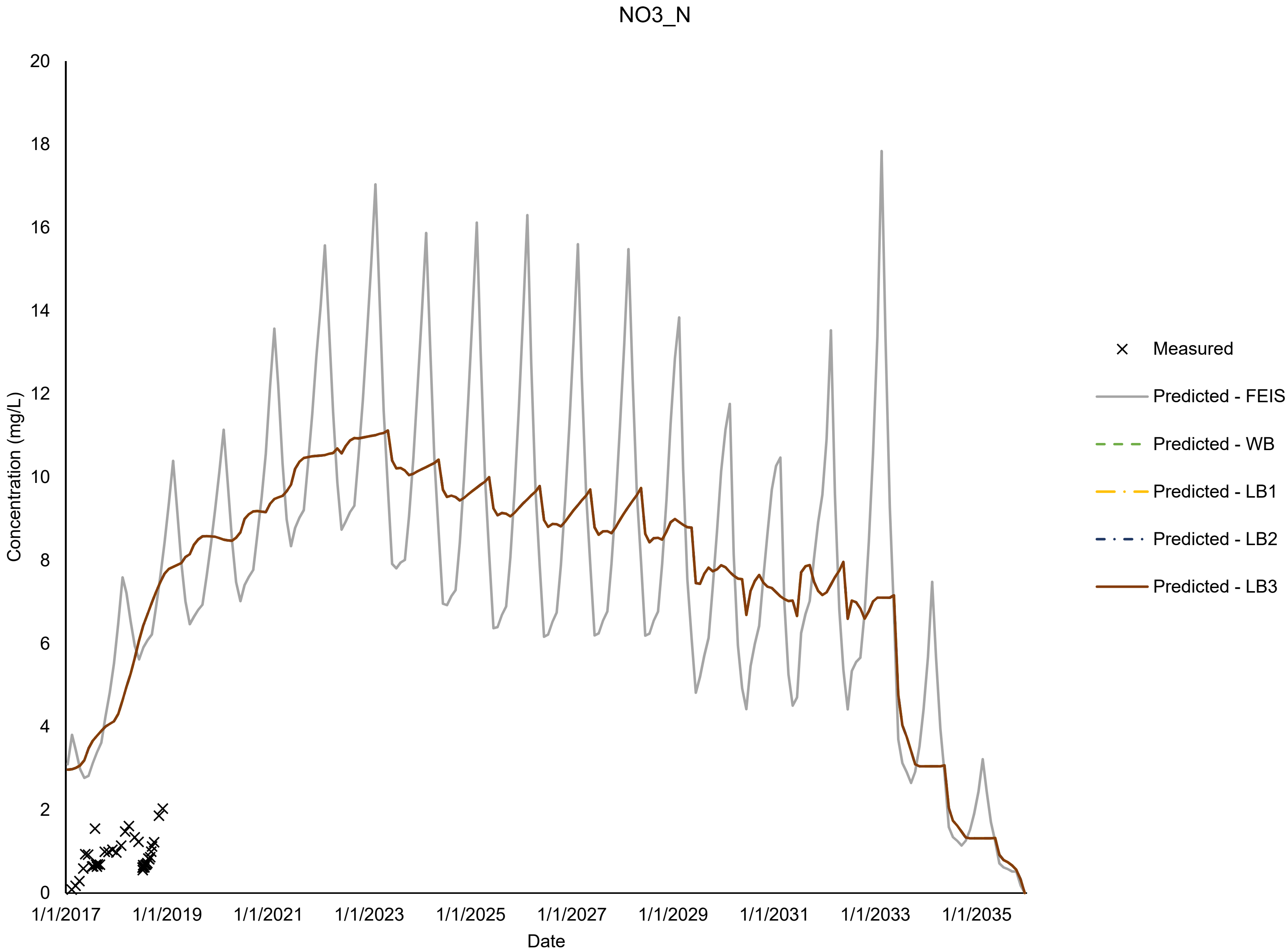
Predicted - LB2
Predicted - LB3


NO3_N
Concentration (mg/L)
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2
4
6
8
10
12
14
16
18
20
1/1/2017
1/1/2019
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1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
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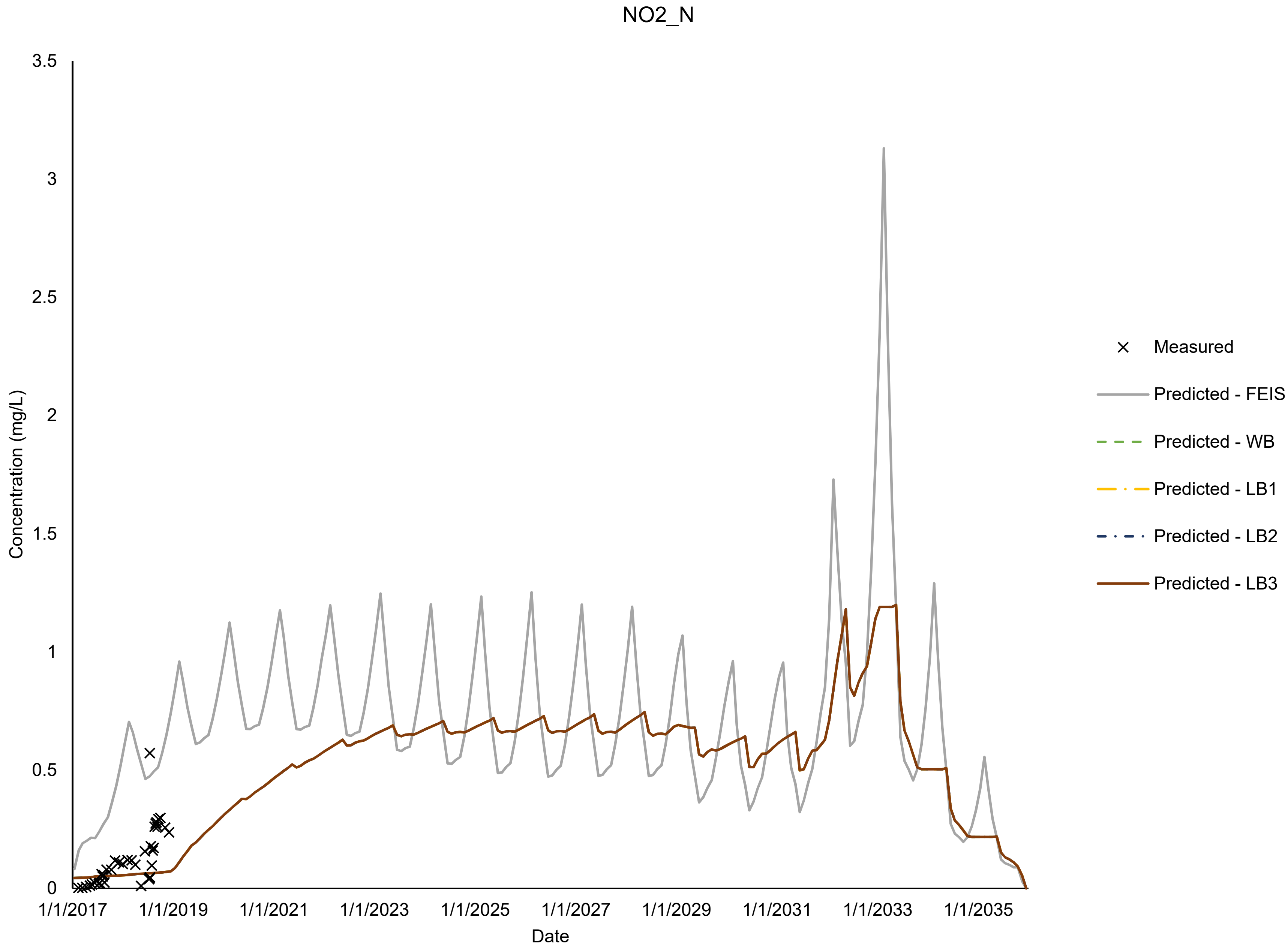
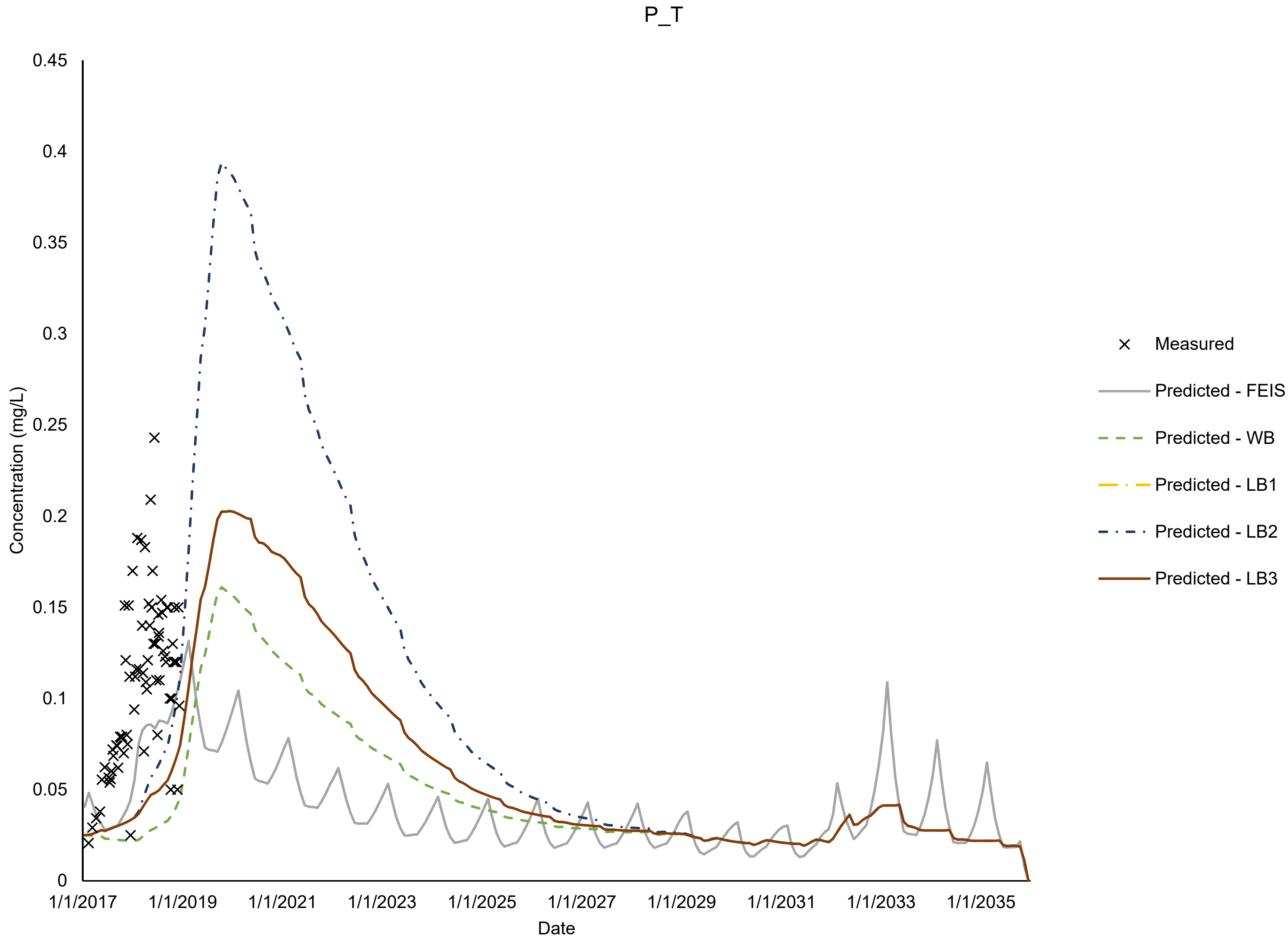
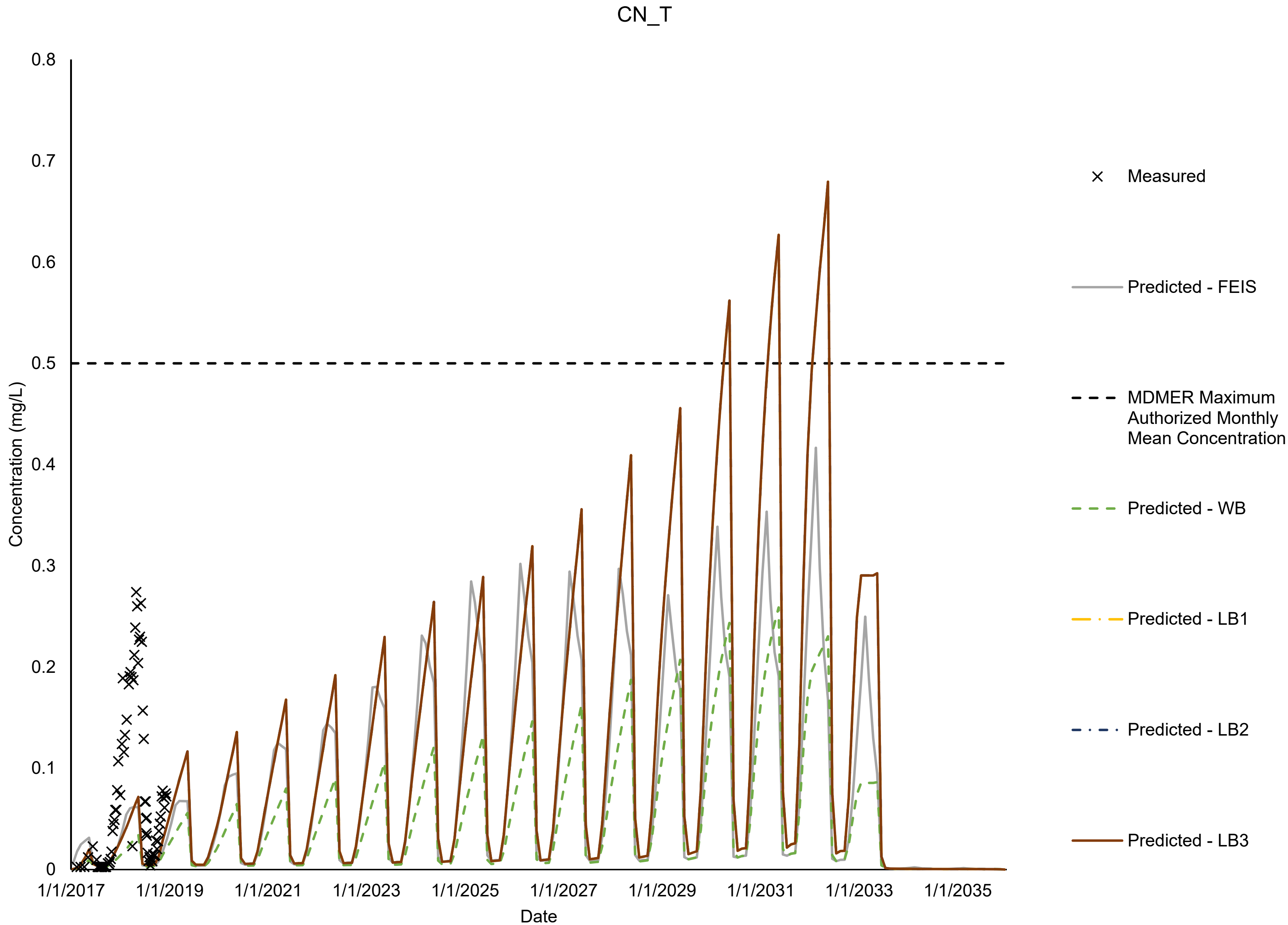
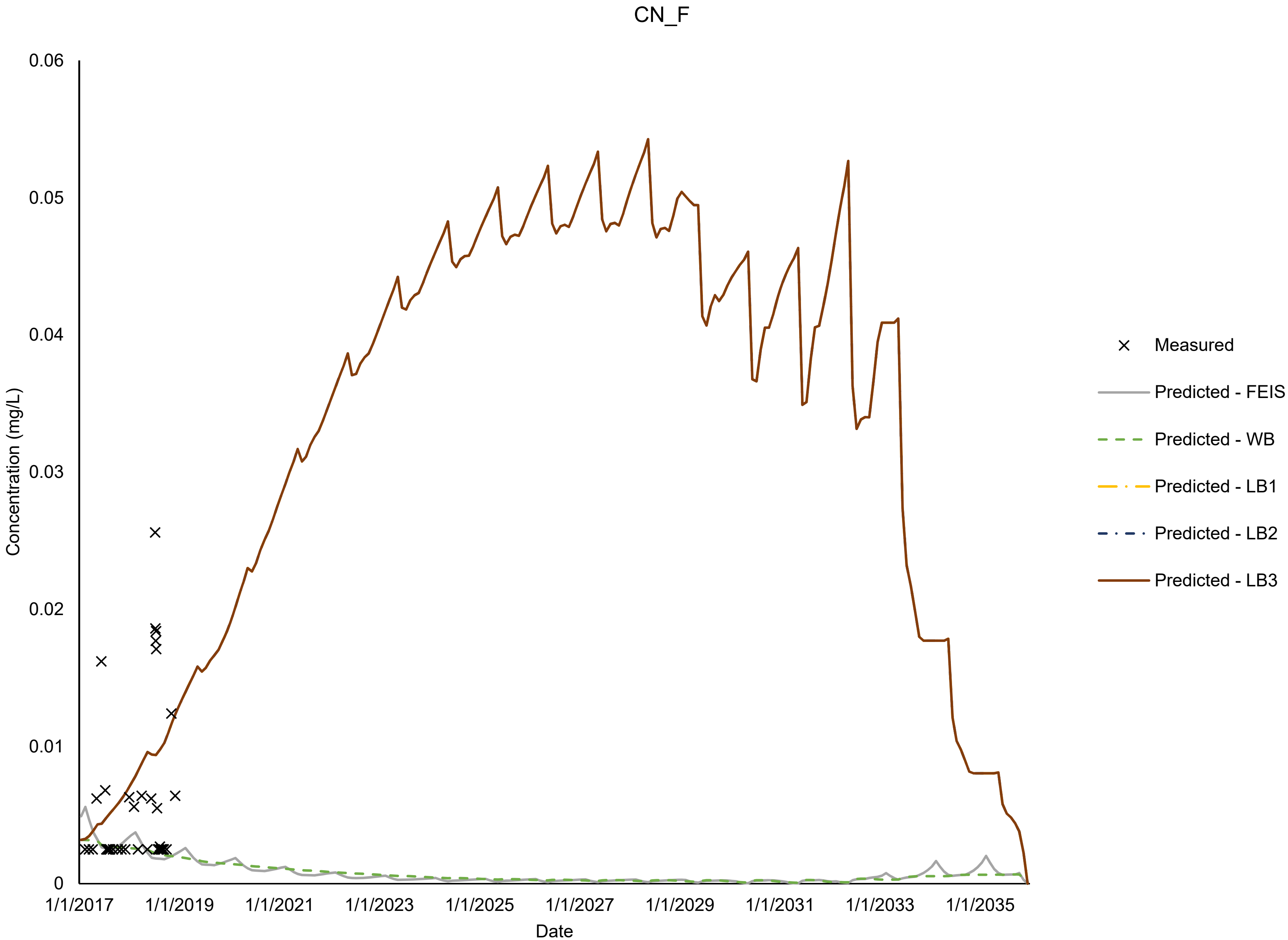
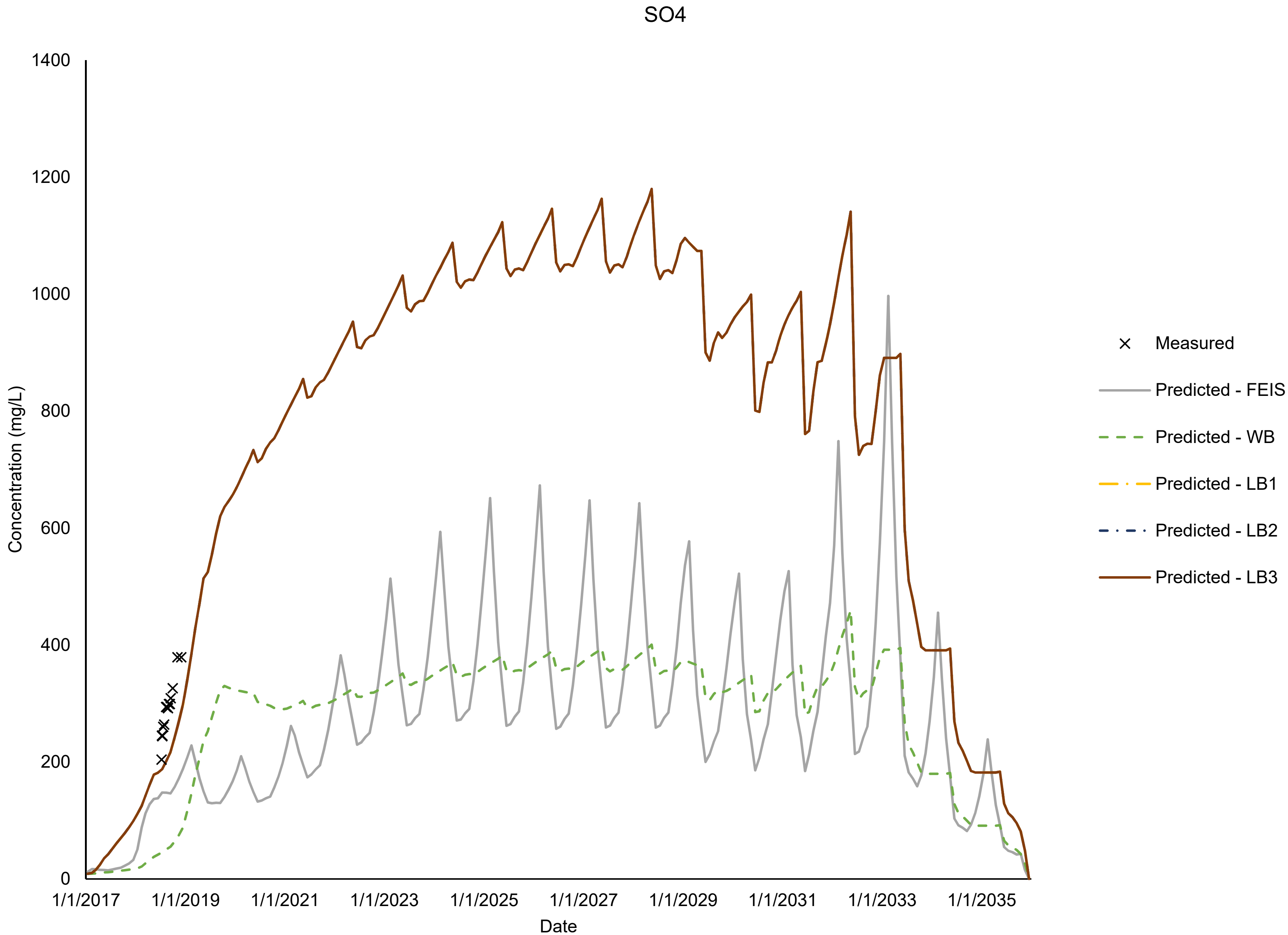
Predicted - LB2
Predicted - LB3

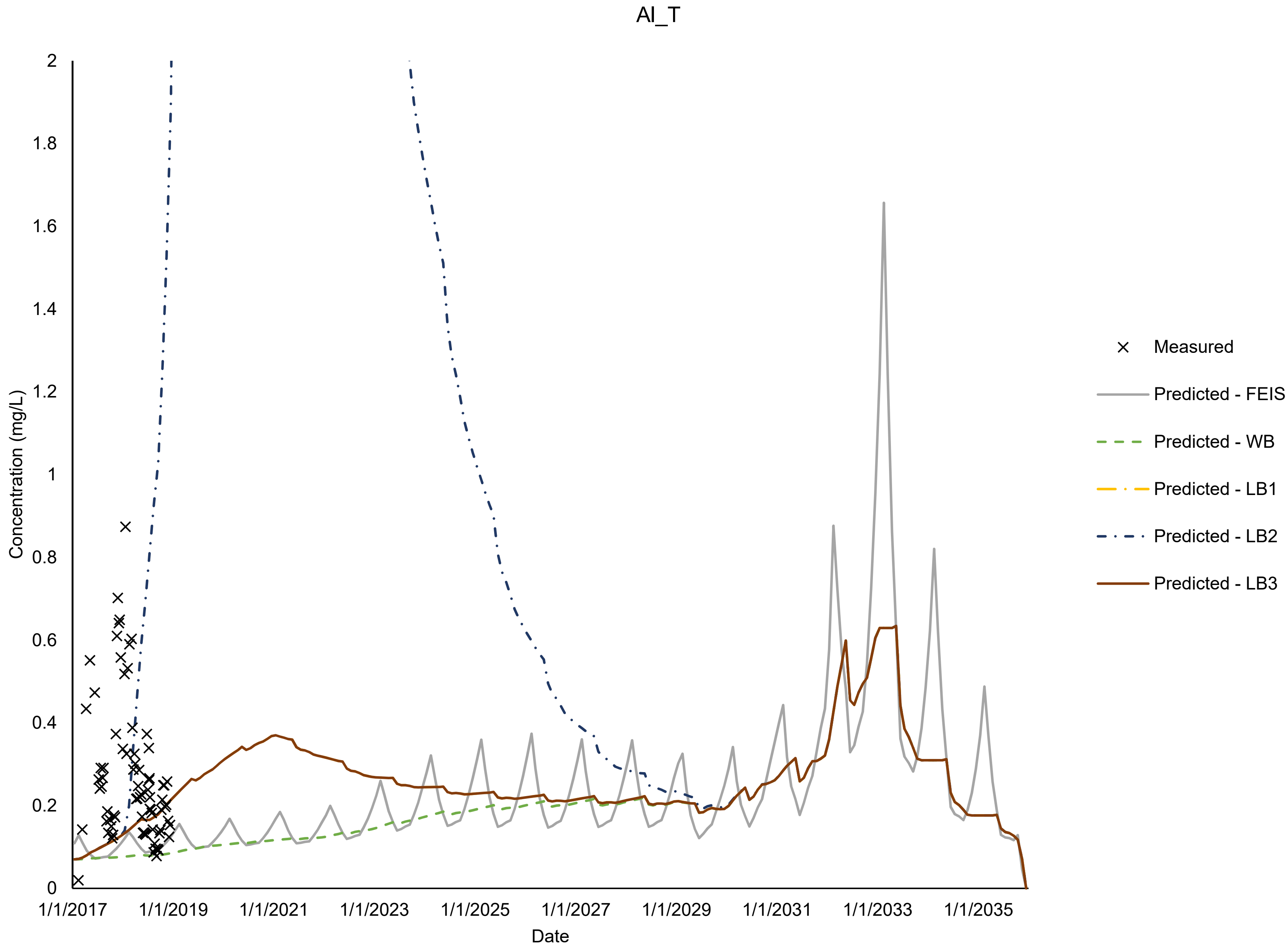

NO2_N
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

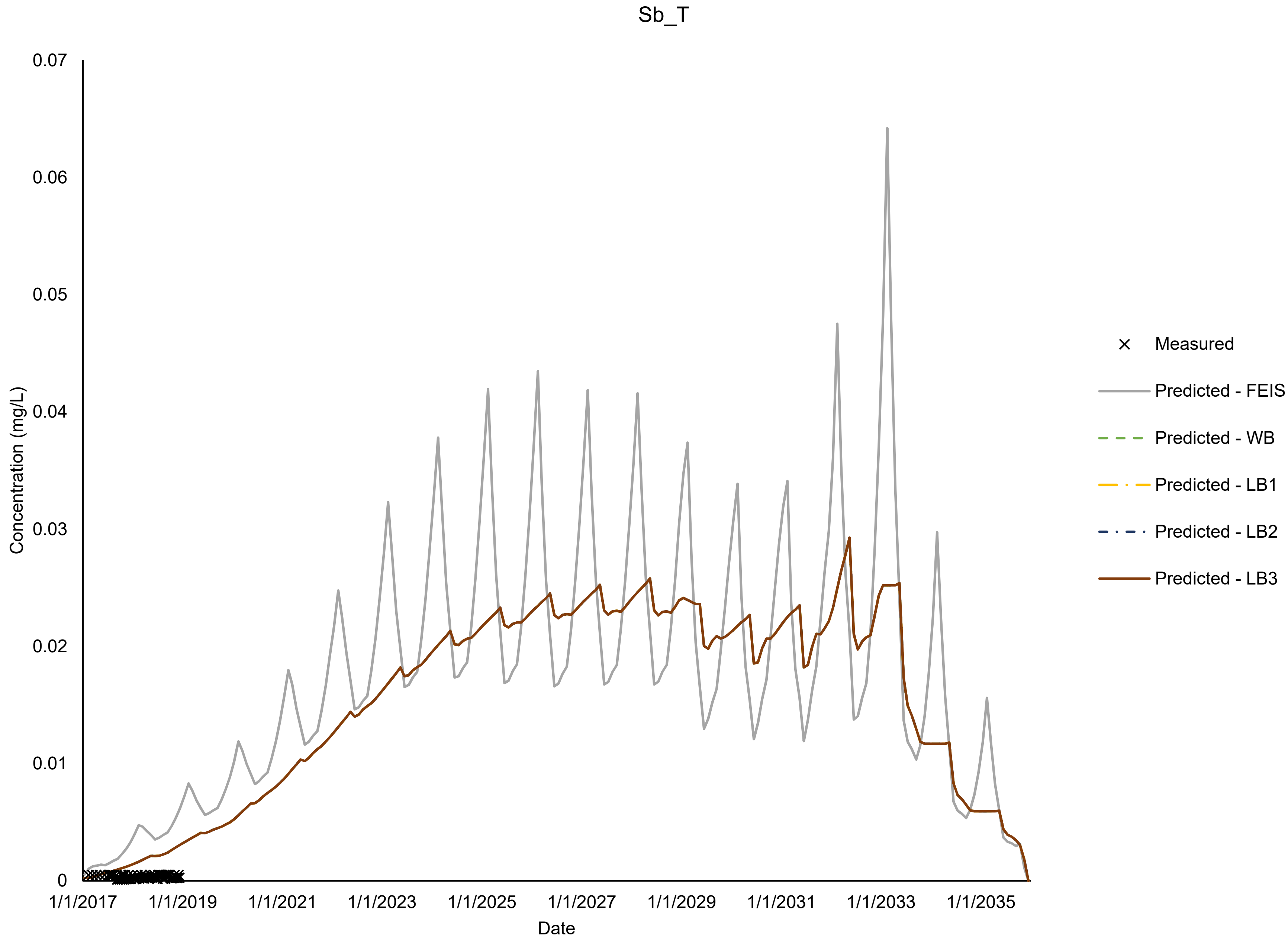

P_T
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

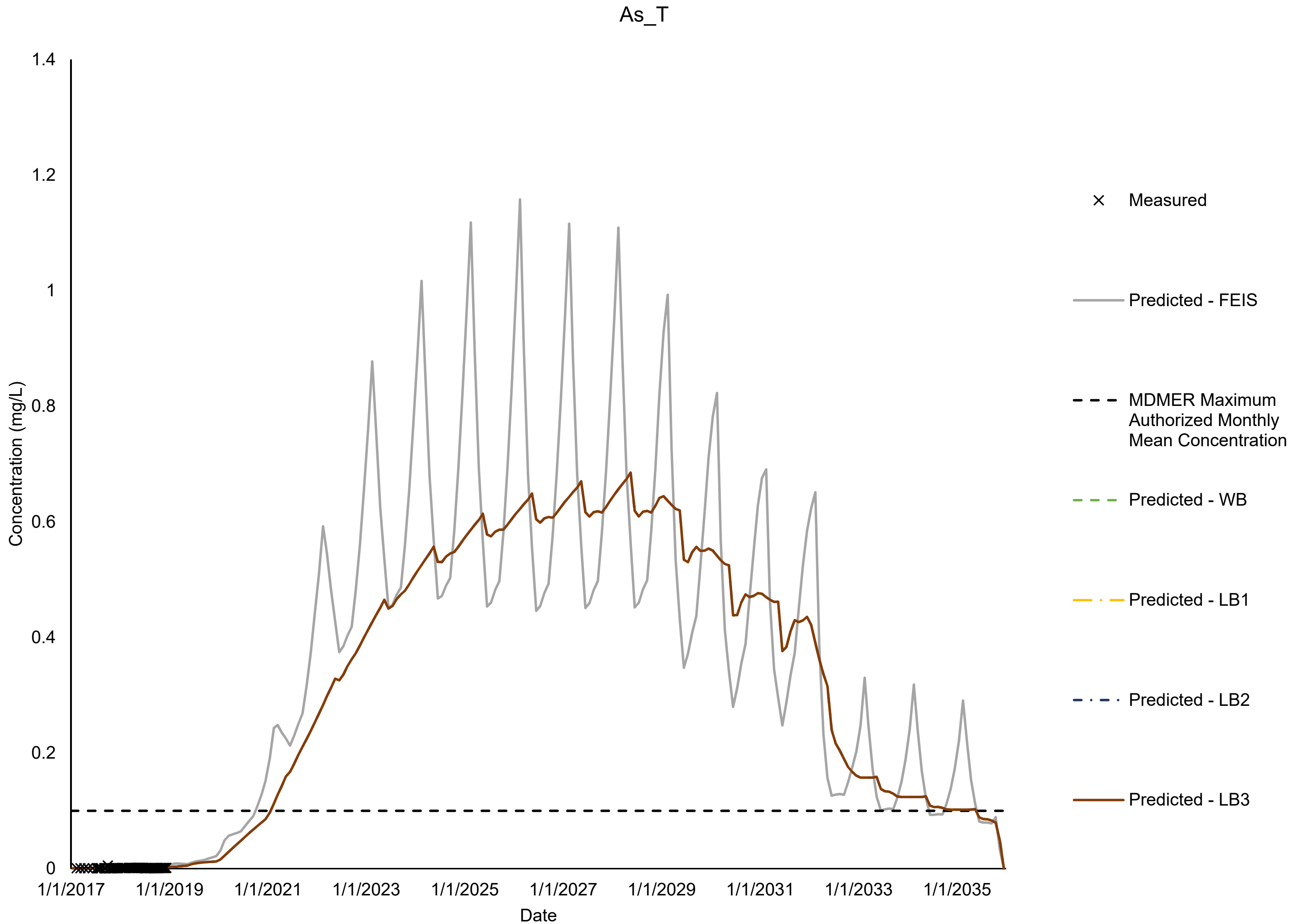

CN_T
Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


CN_F
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

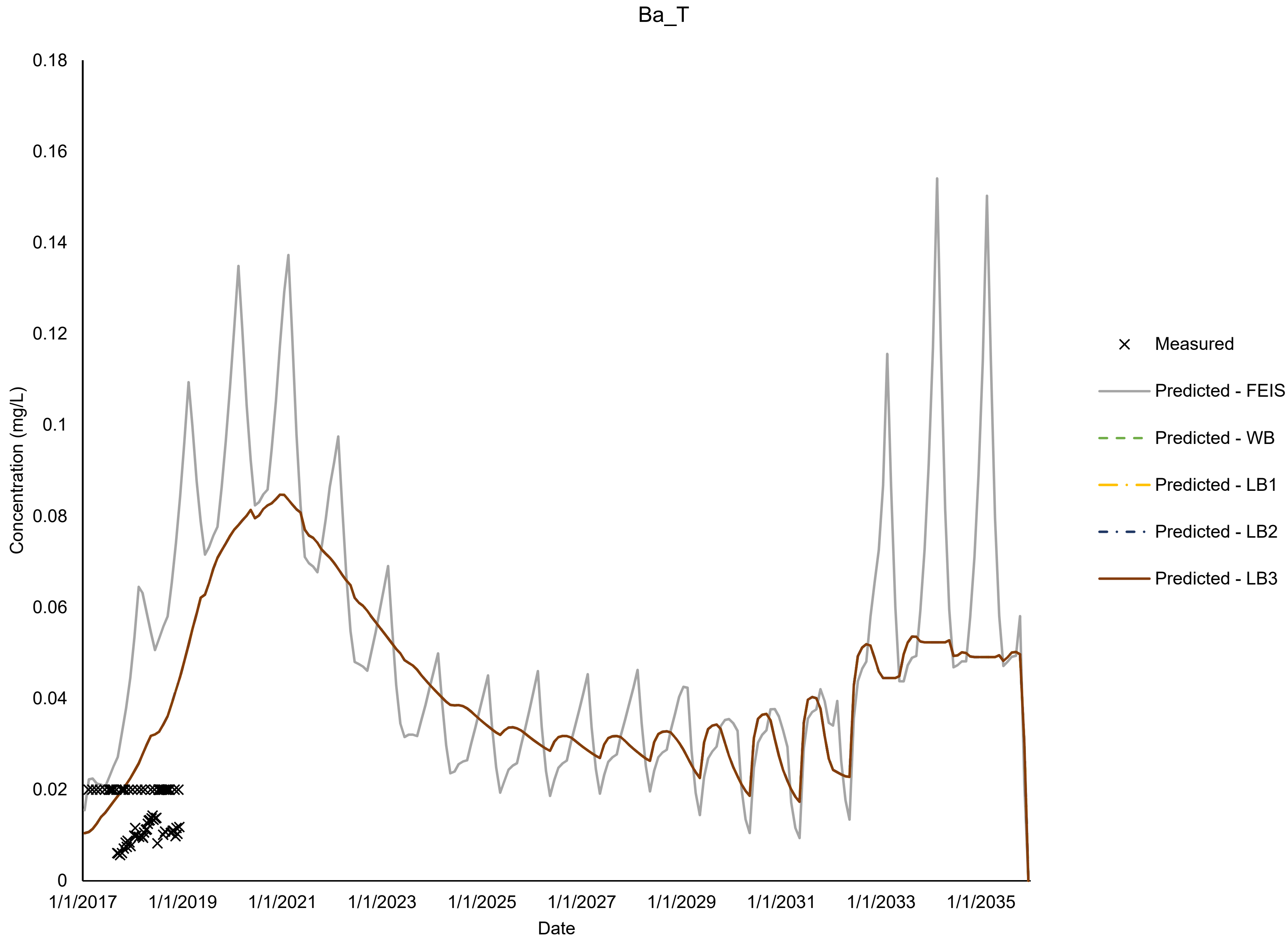

SO4
Concentration (mg/L)
1400
1200
1000
800
600
400
200
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

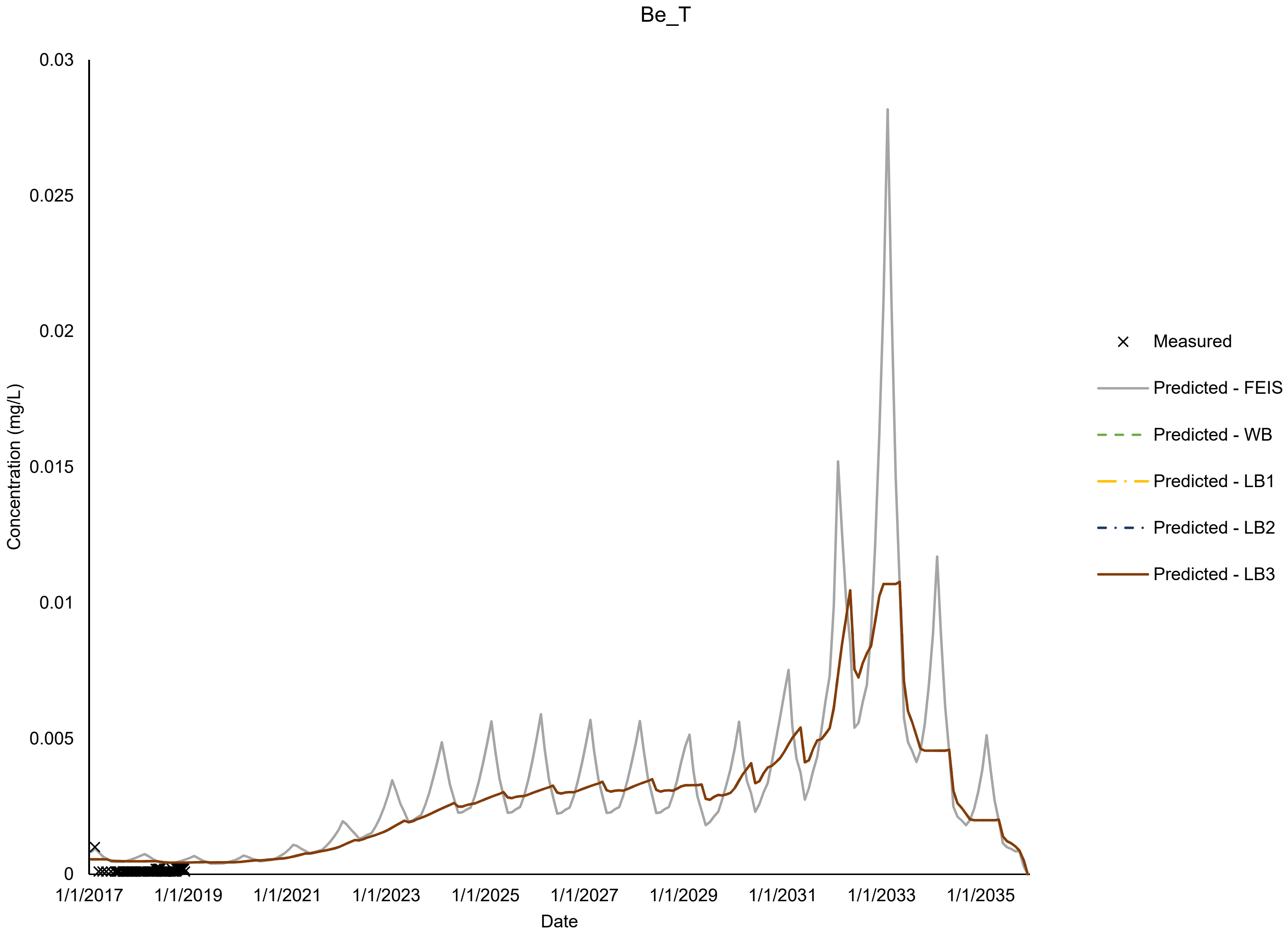

Al_T
Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

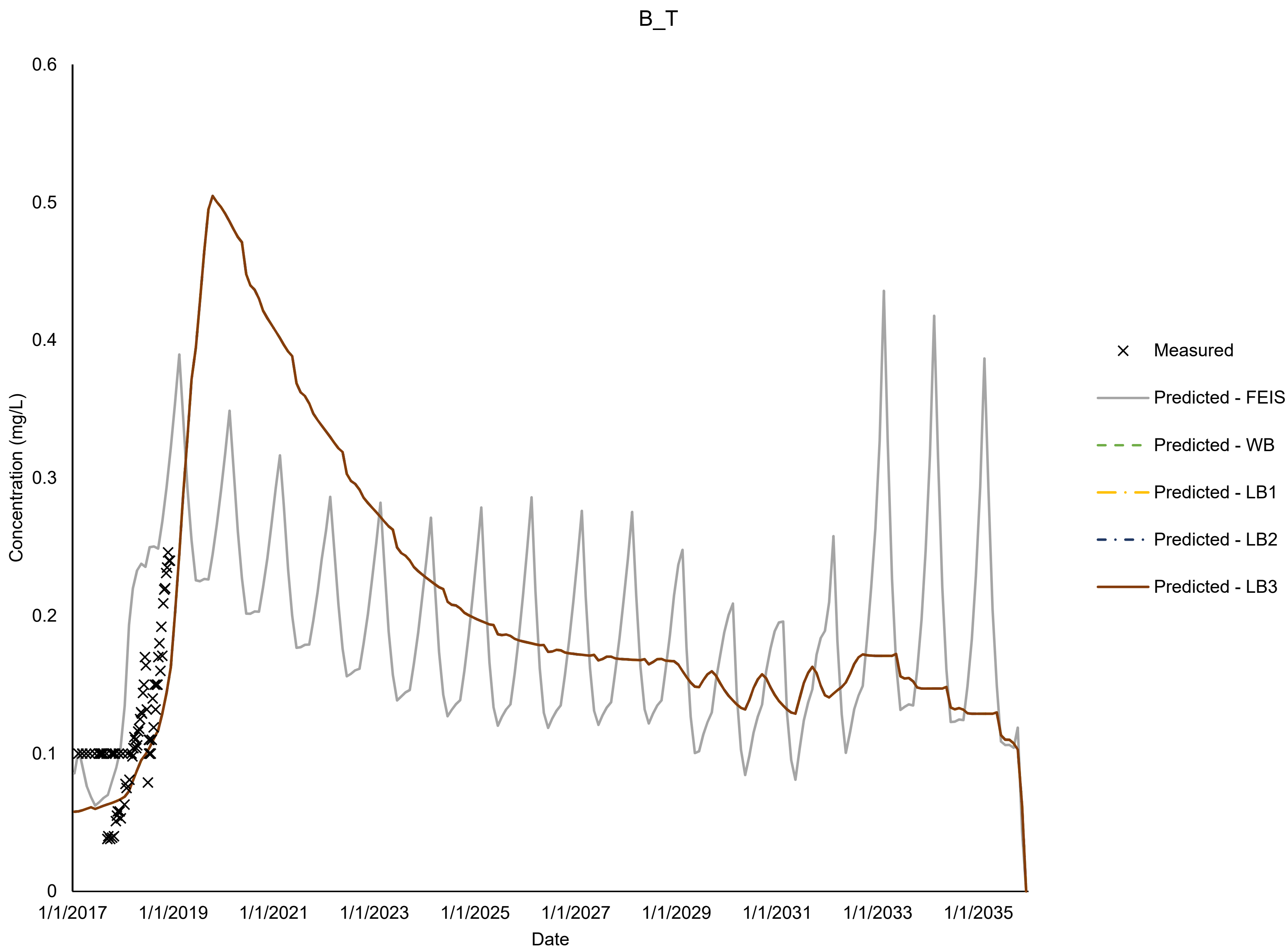

Sb_T
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

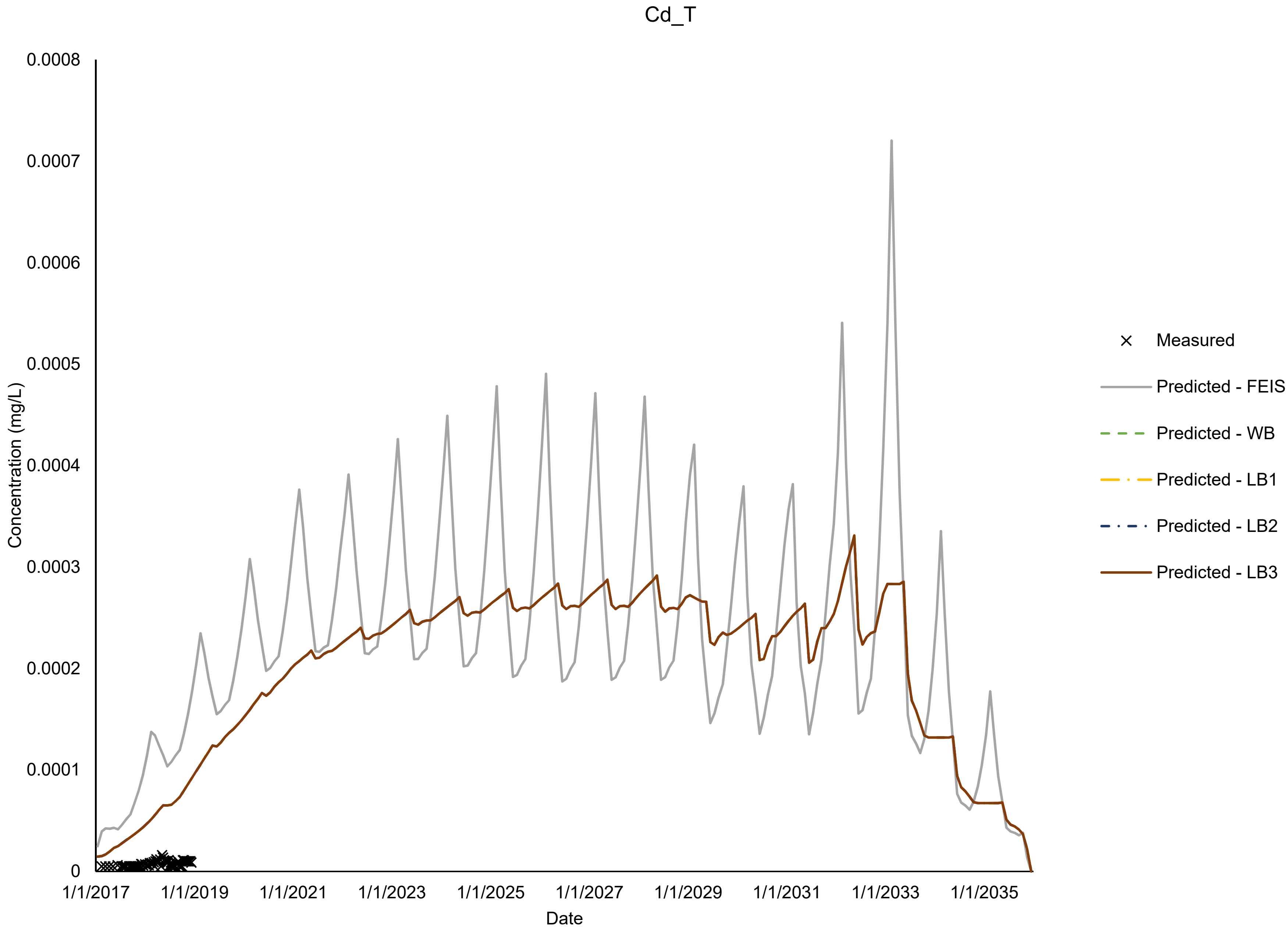


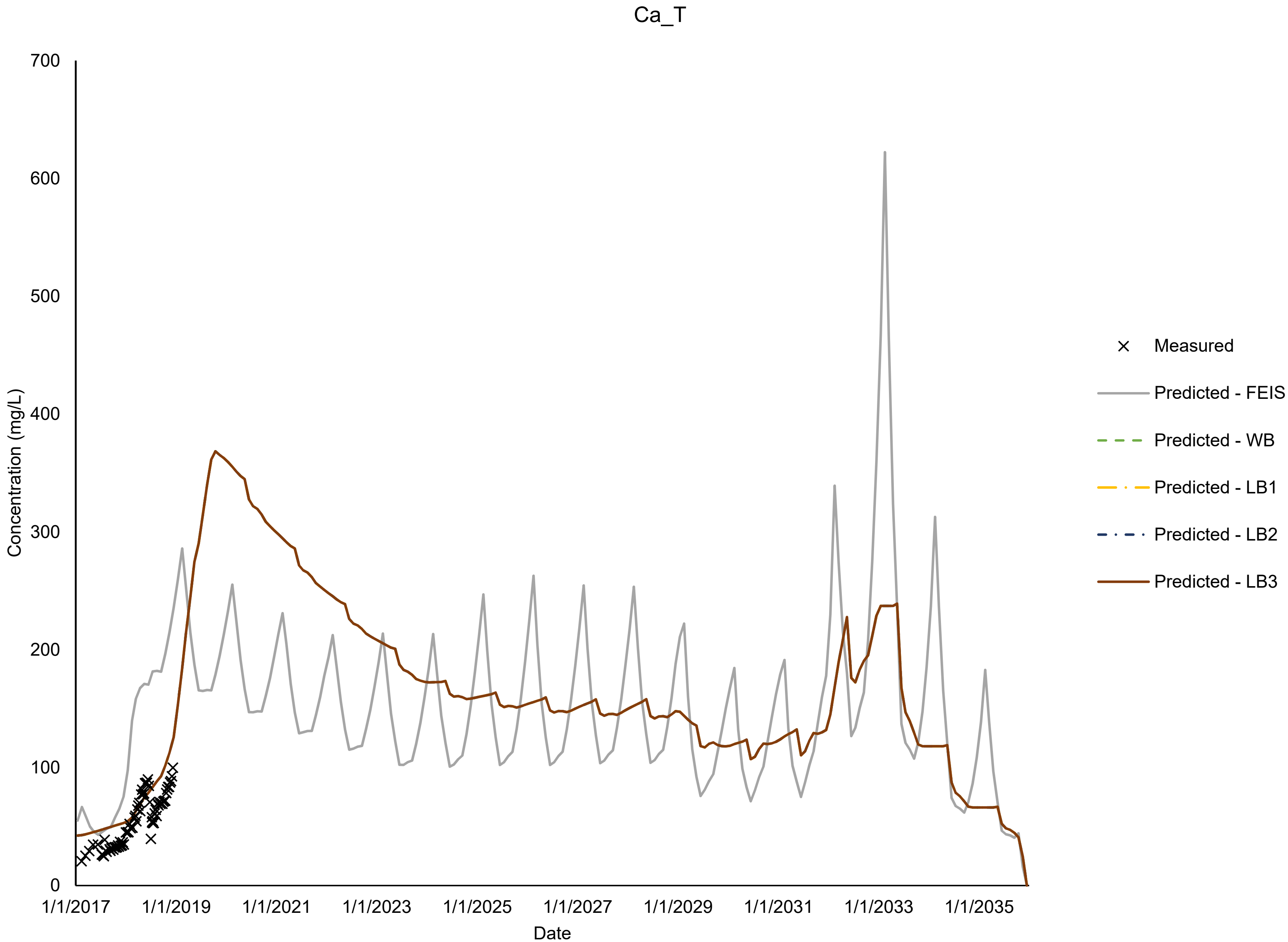
As_T
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

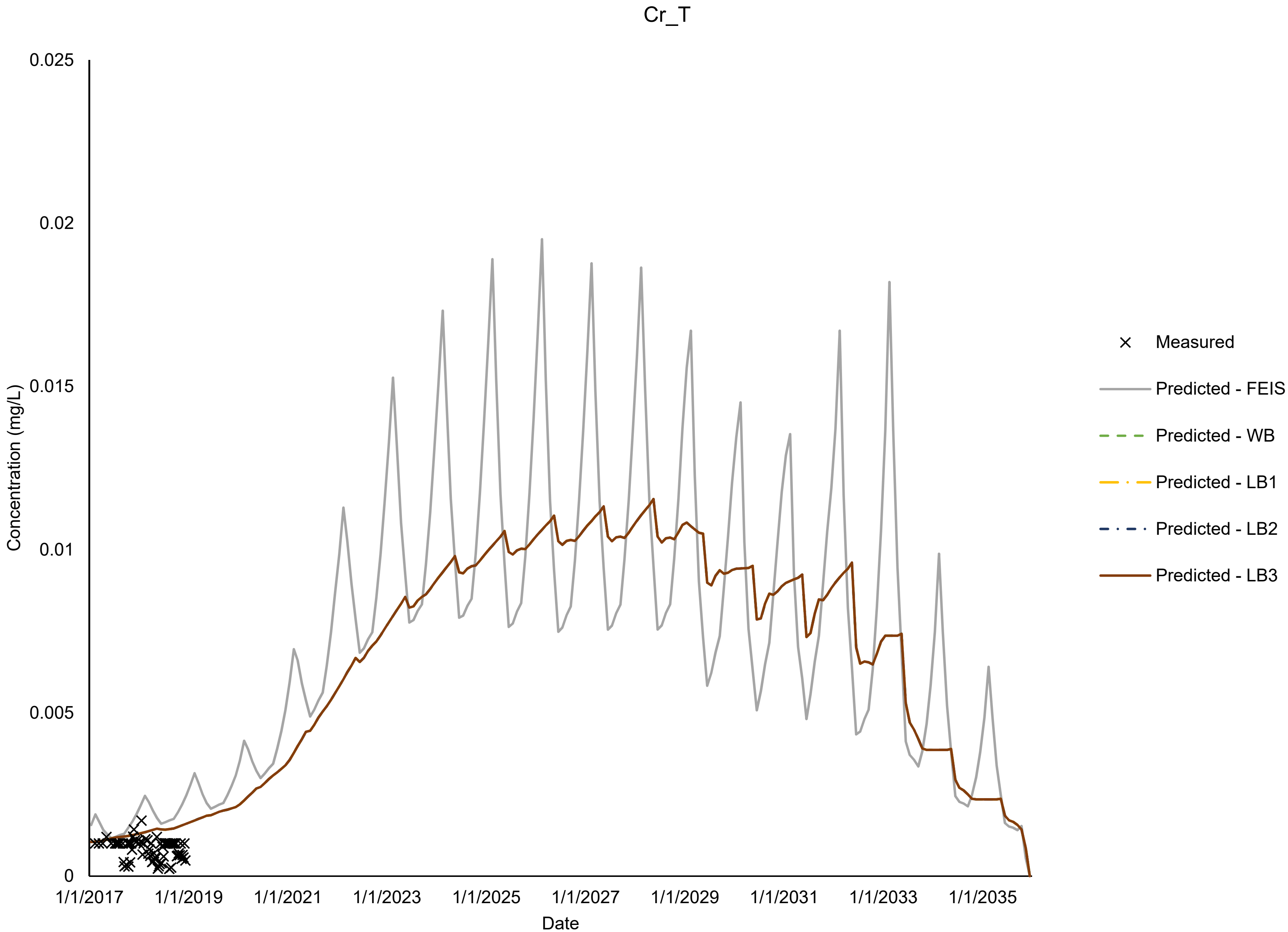

Ba_T
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


Be_T
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

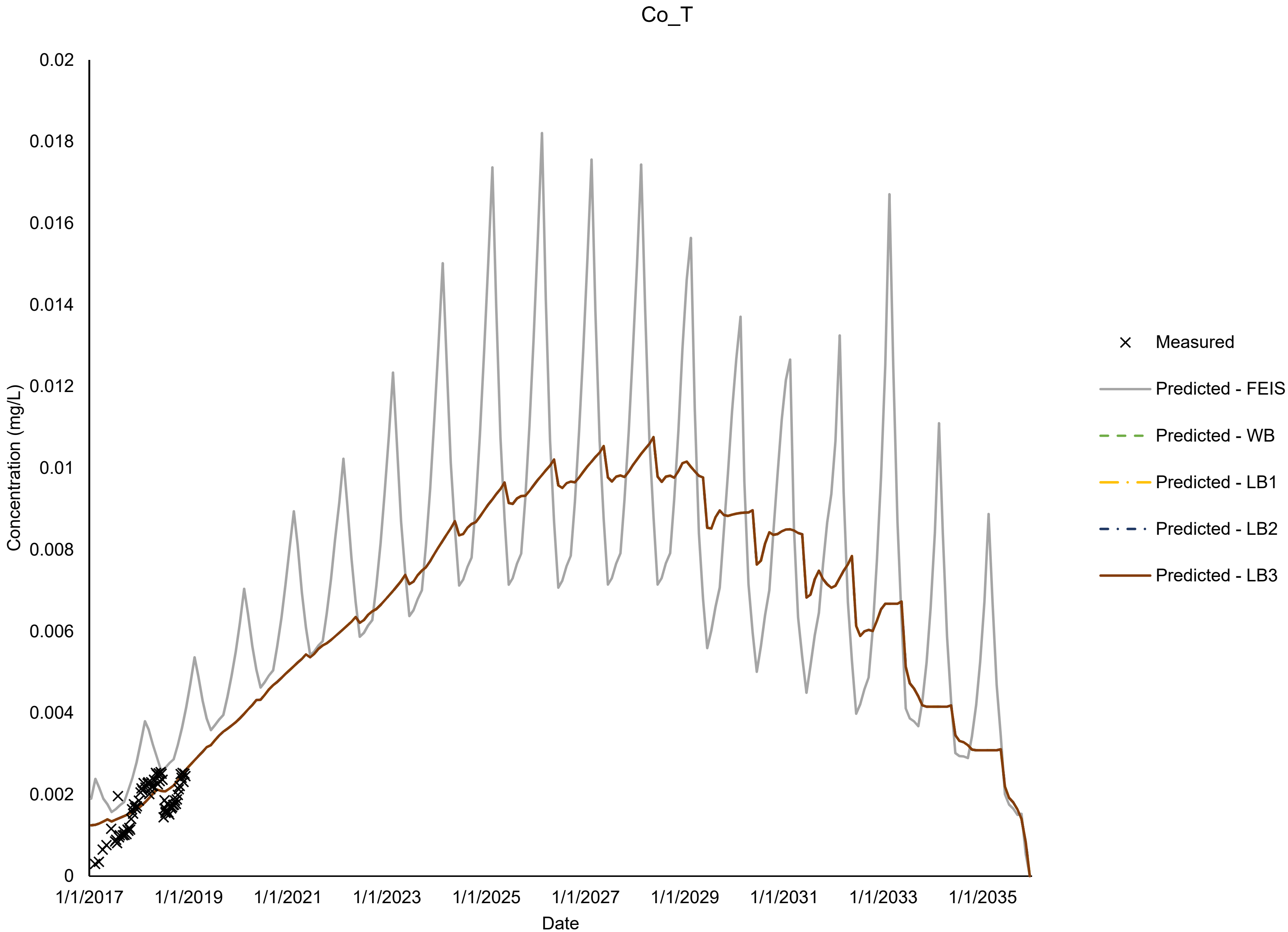

B_T
0.6
0.5
0.4
0.3
0.2
0.1
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

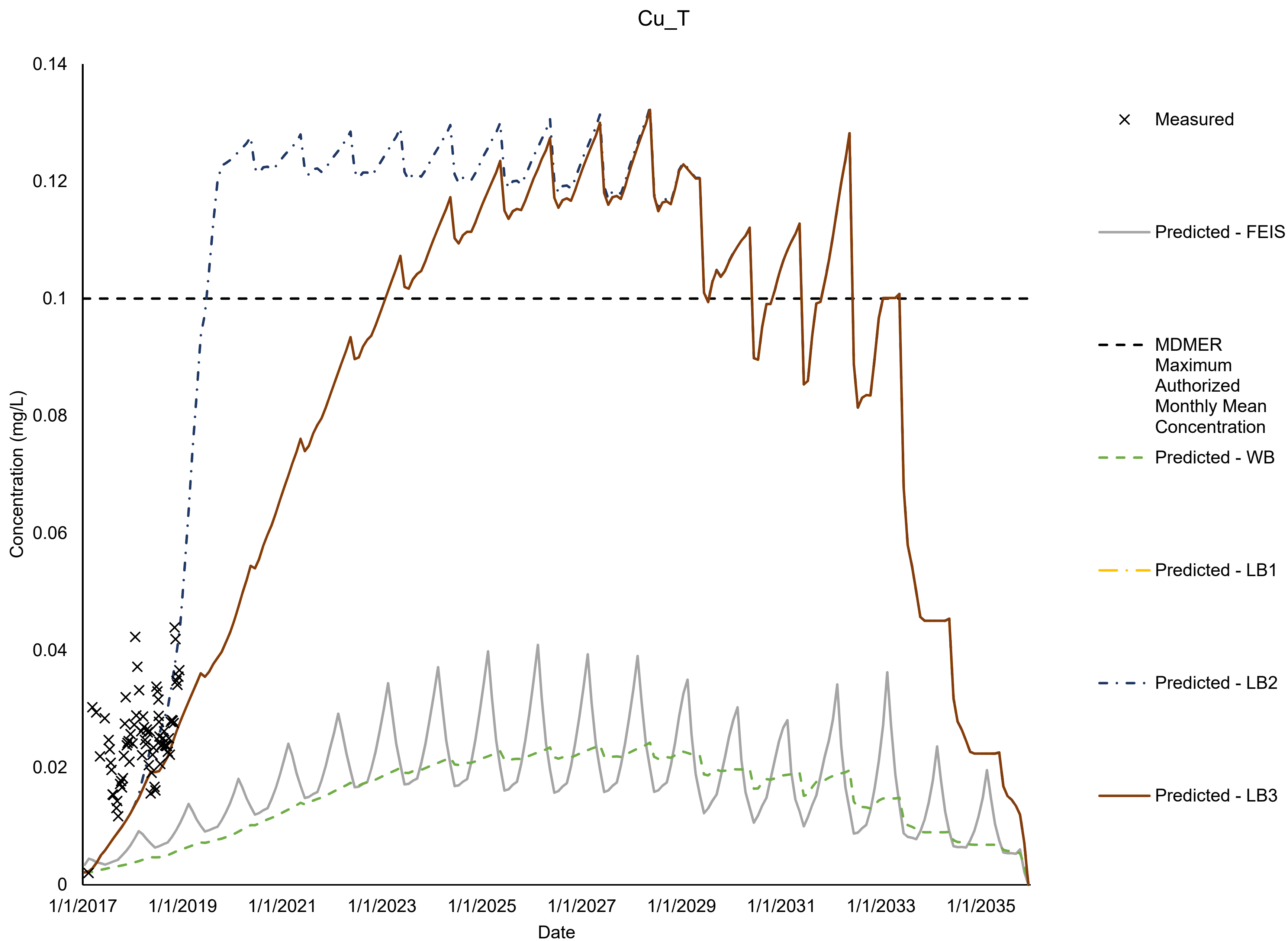

Cd_T
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

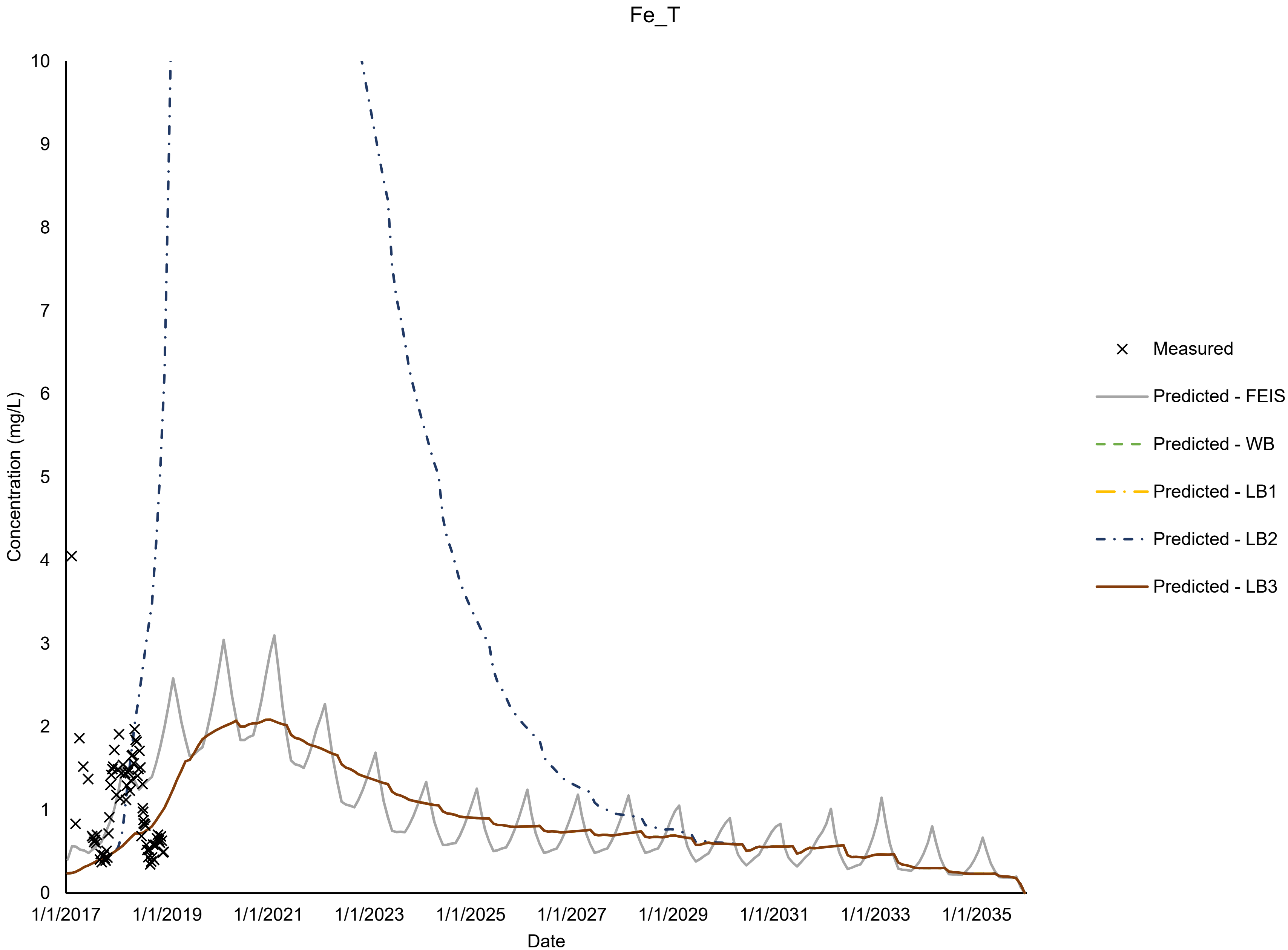

Ca_T
Concentration (mg/L)
700
600
500
400
300
200
100
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

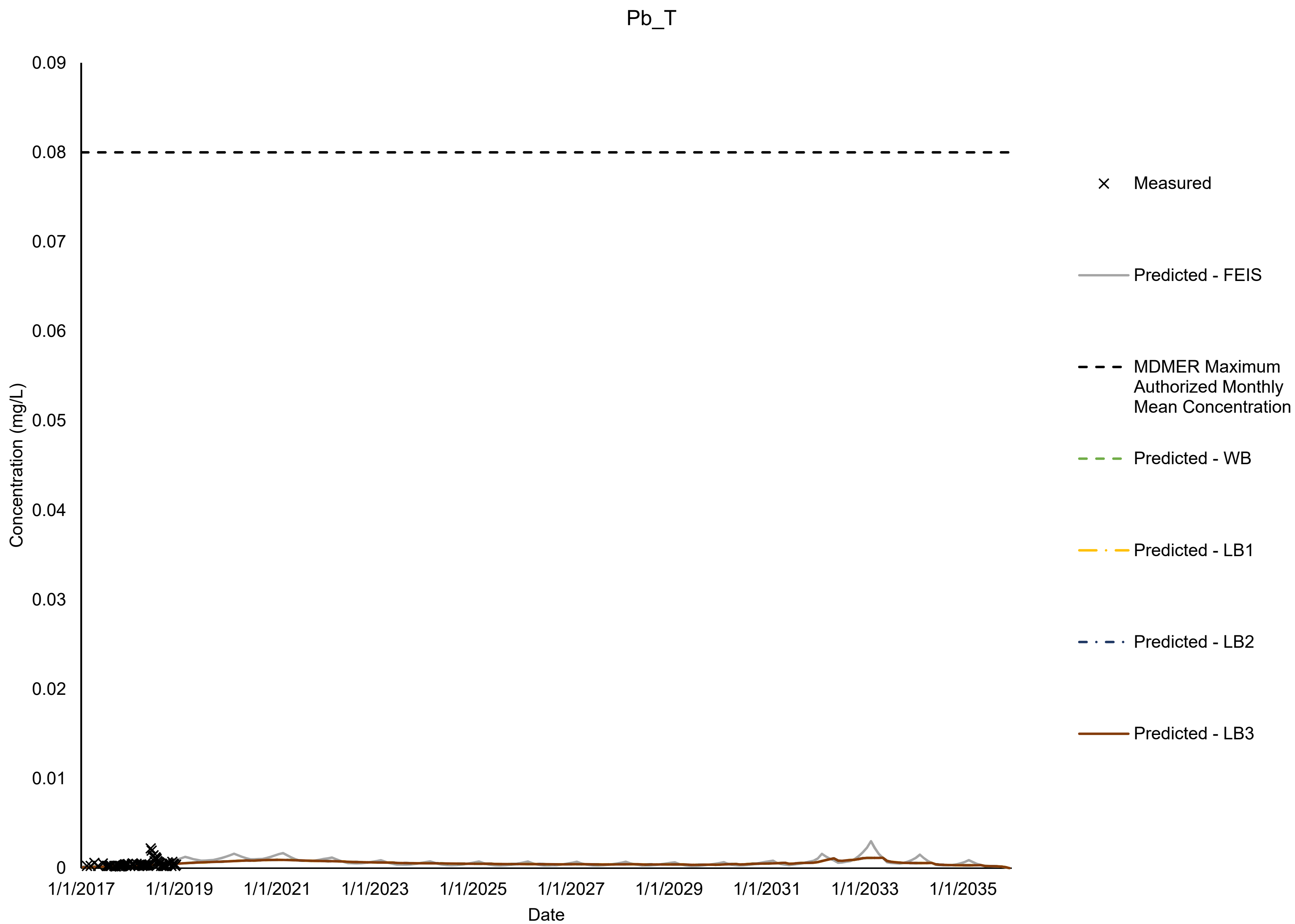


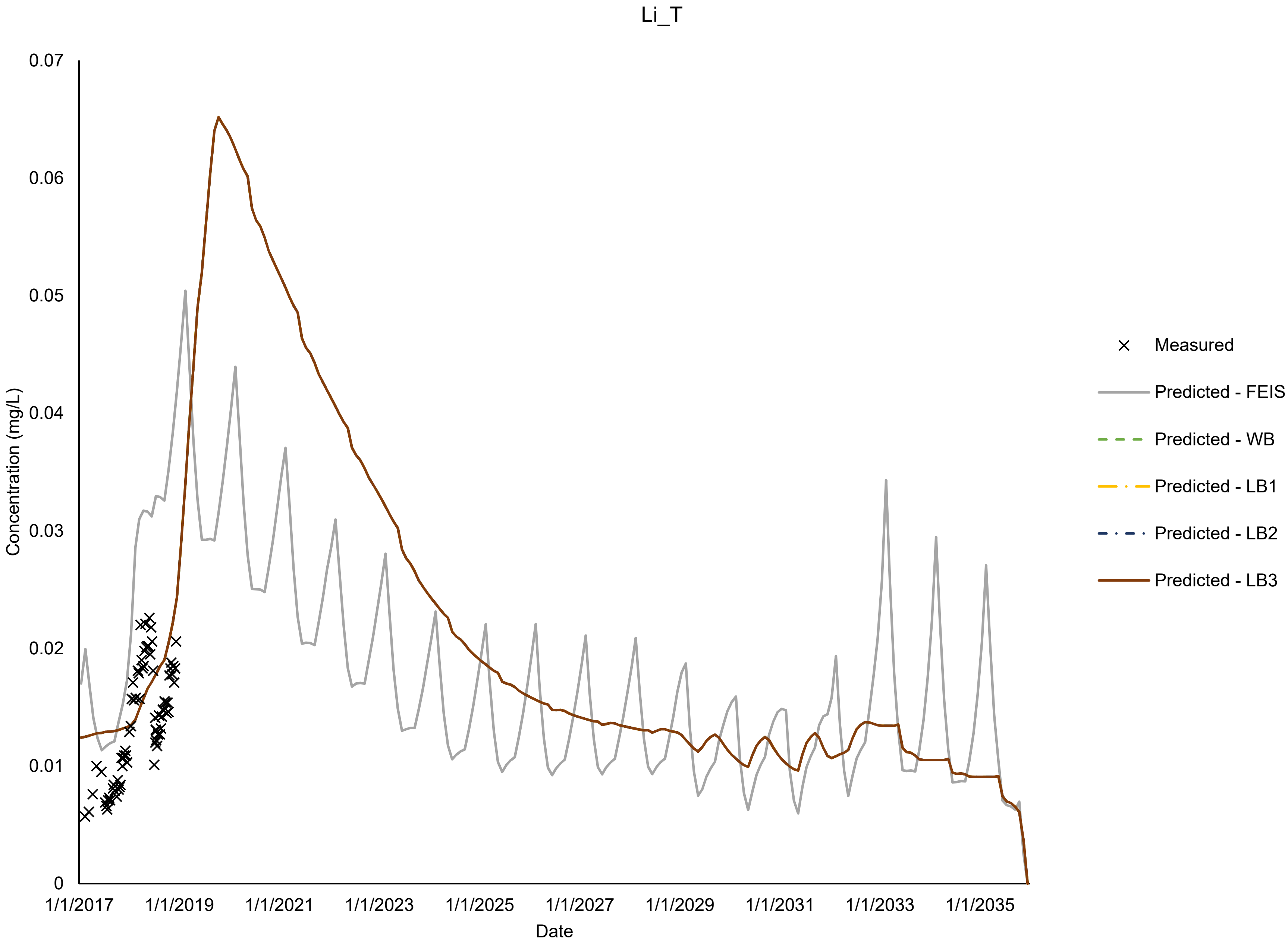
Cr_T
0.025
0.02
0.015
0.01
0.005
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


Co_T
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

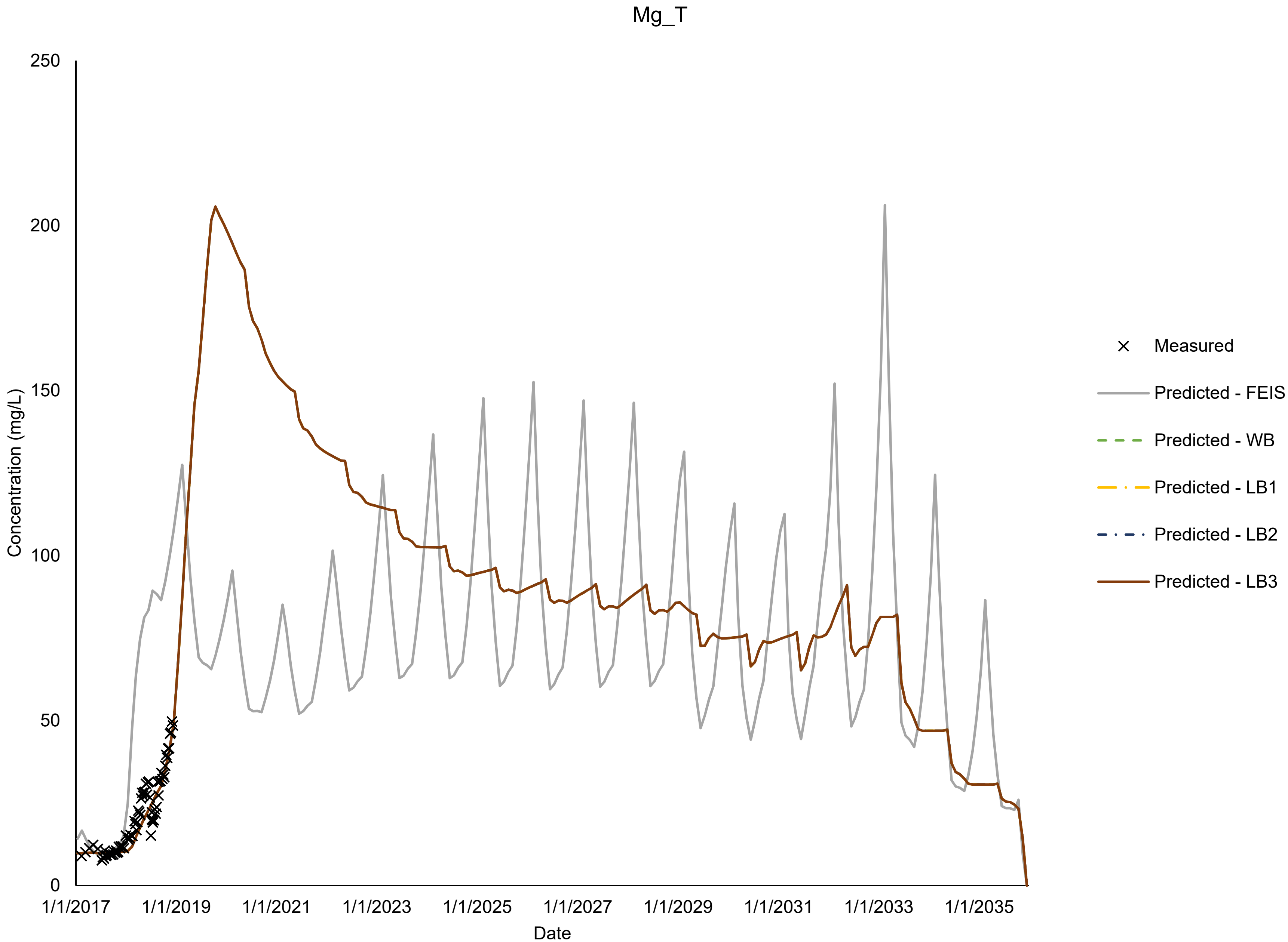

Cu_T
Concentration (mg/L)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

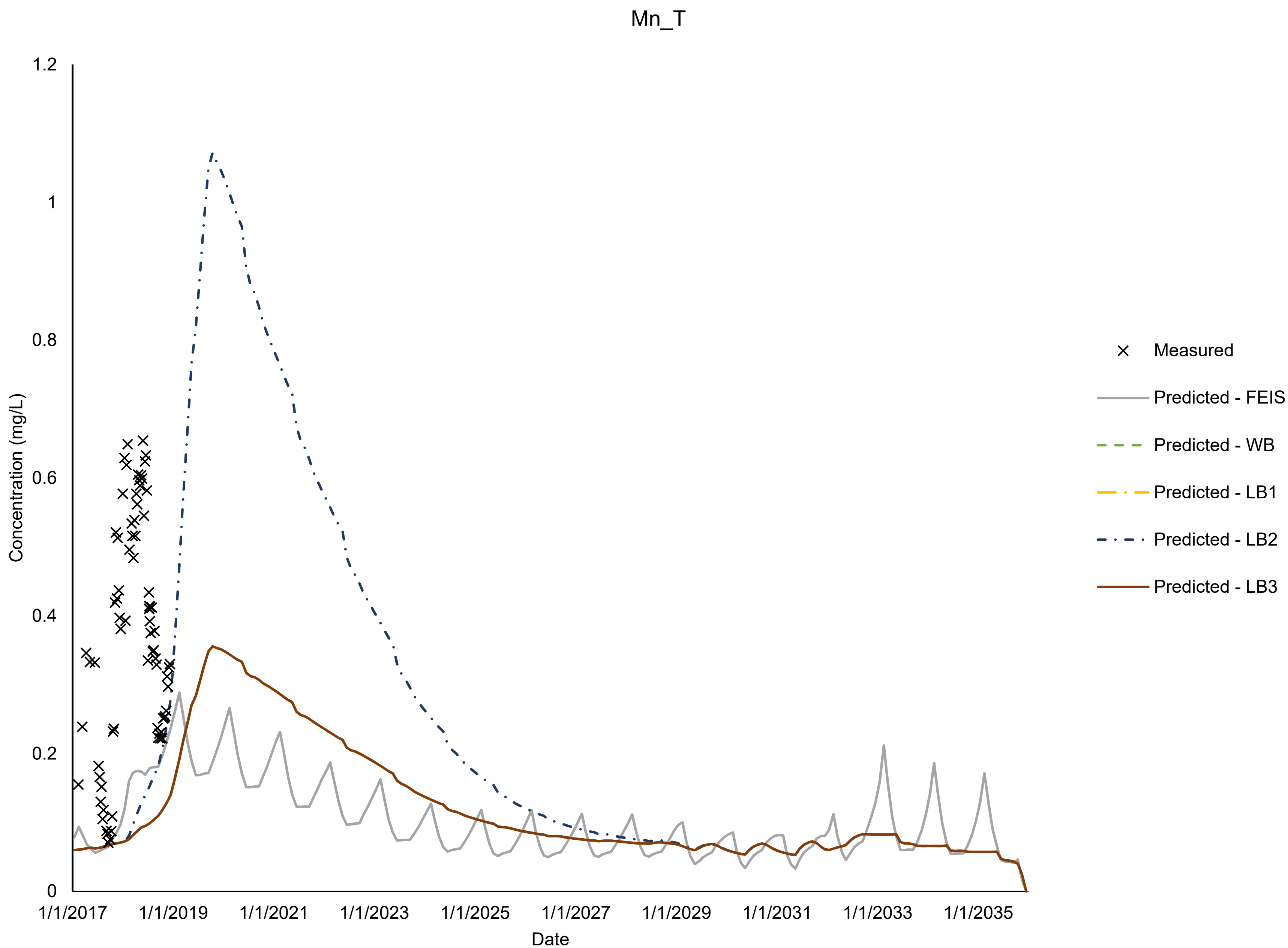

Fe_T
10
9
8
7
6
5
4
3
2
1
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

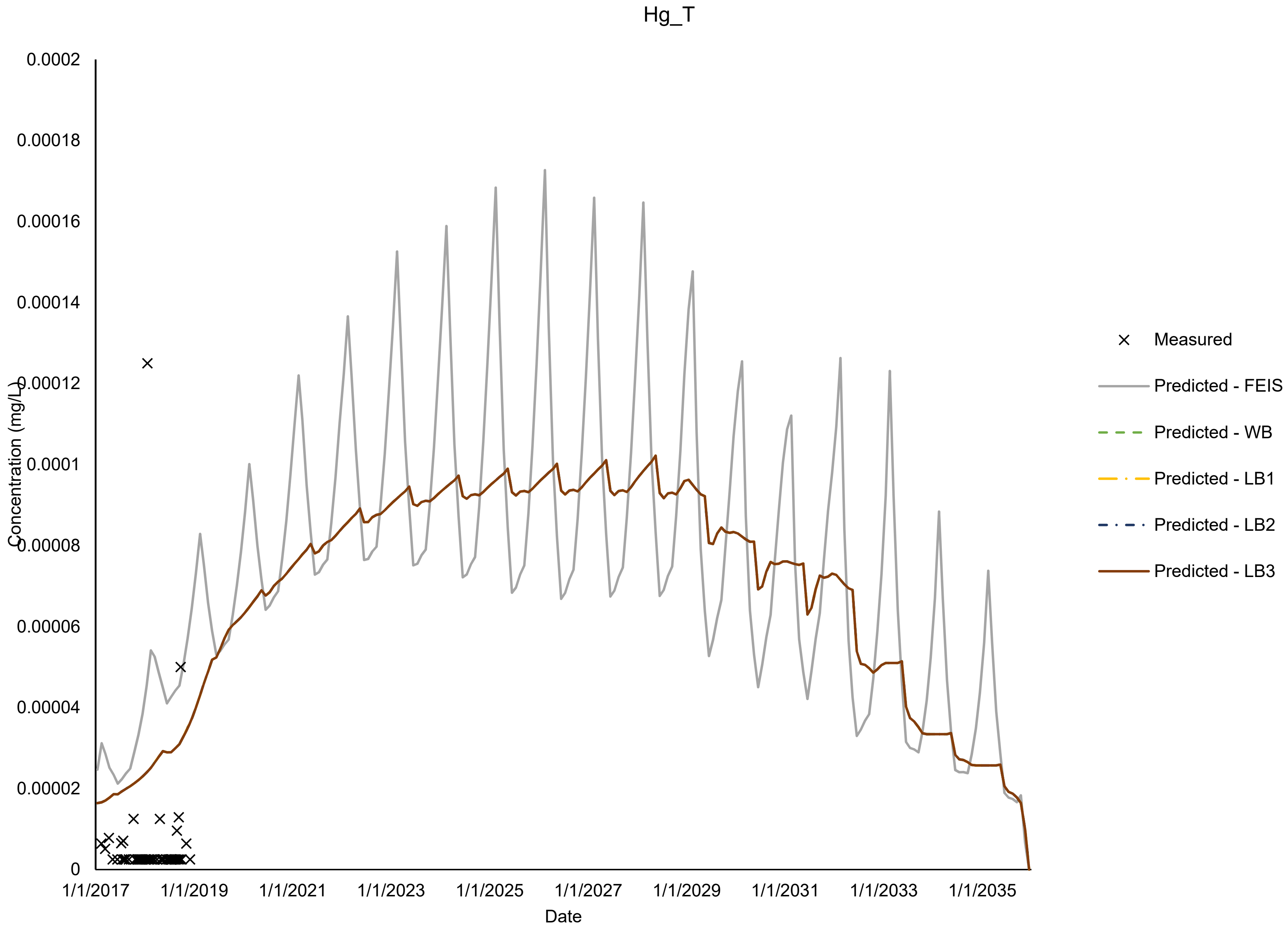

Pb_T
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

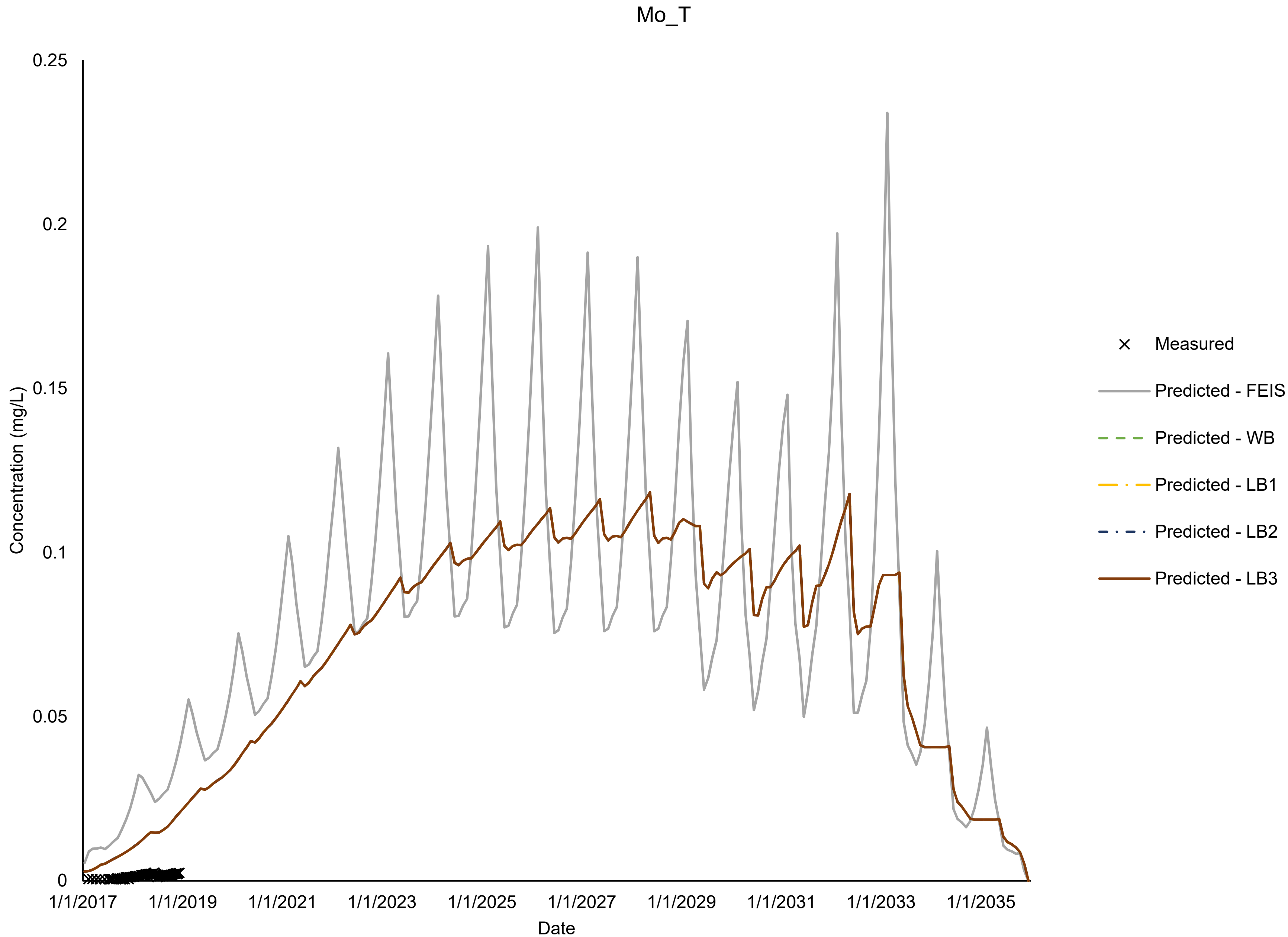


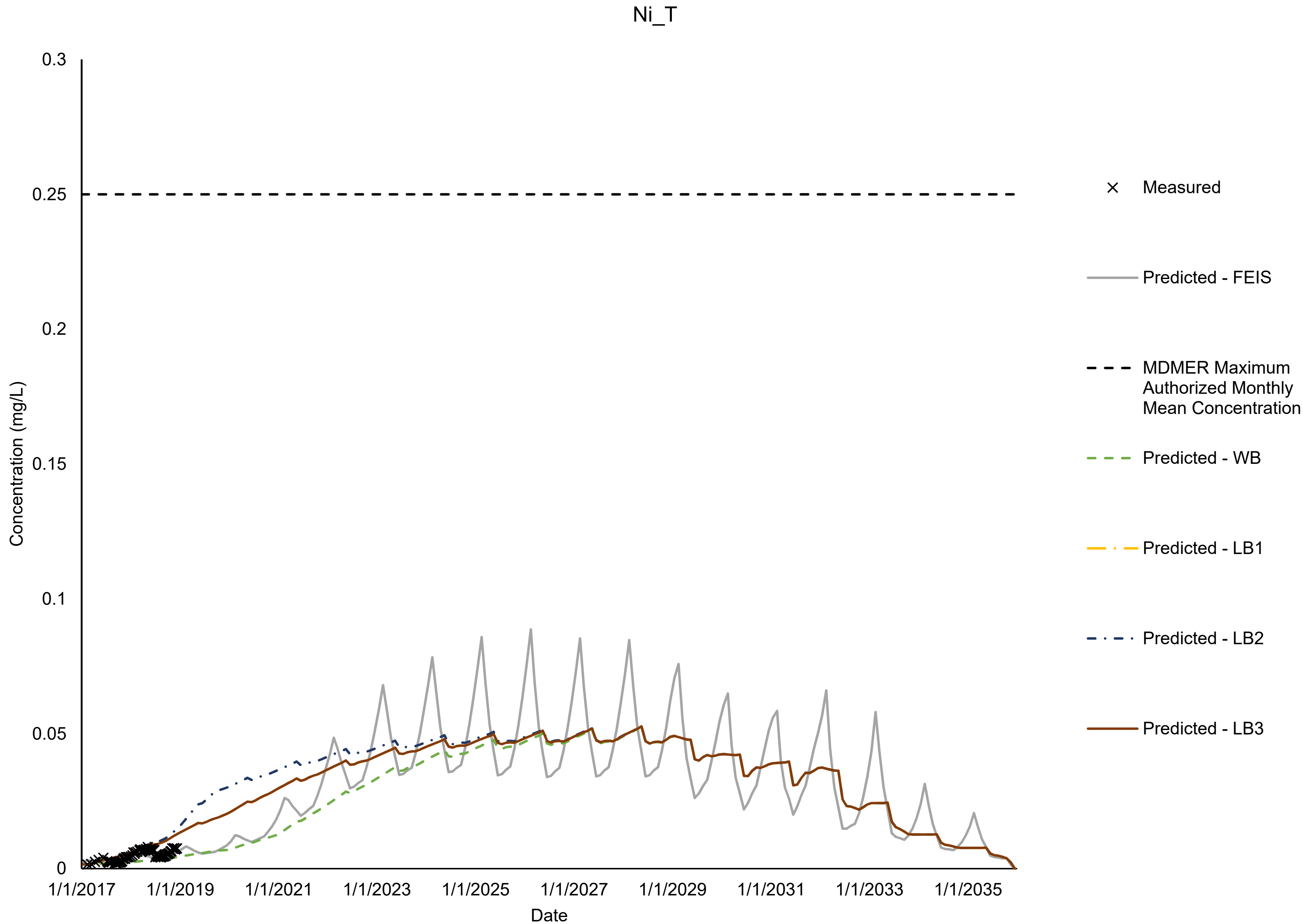
Li_T
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

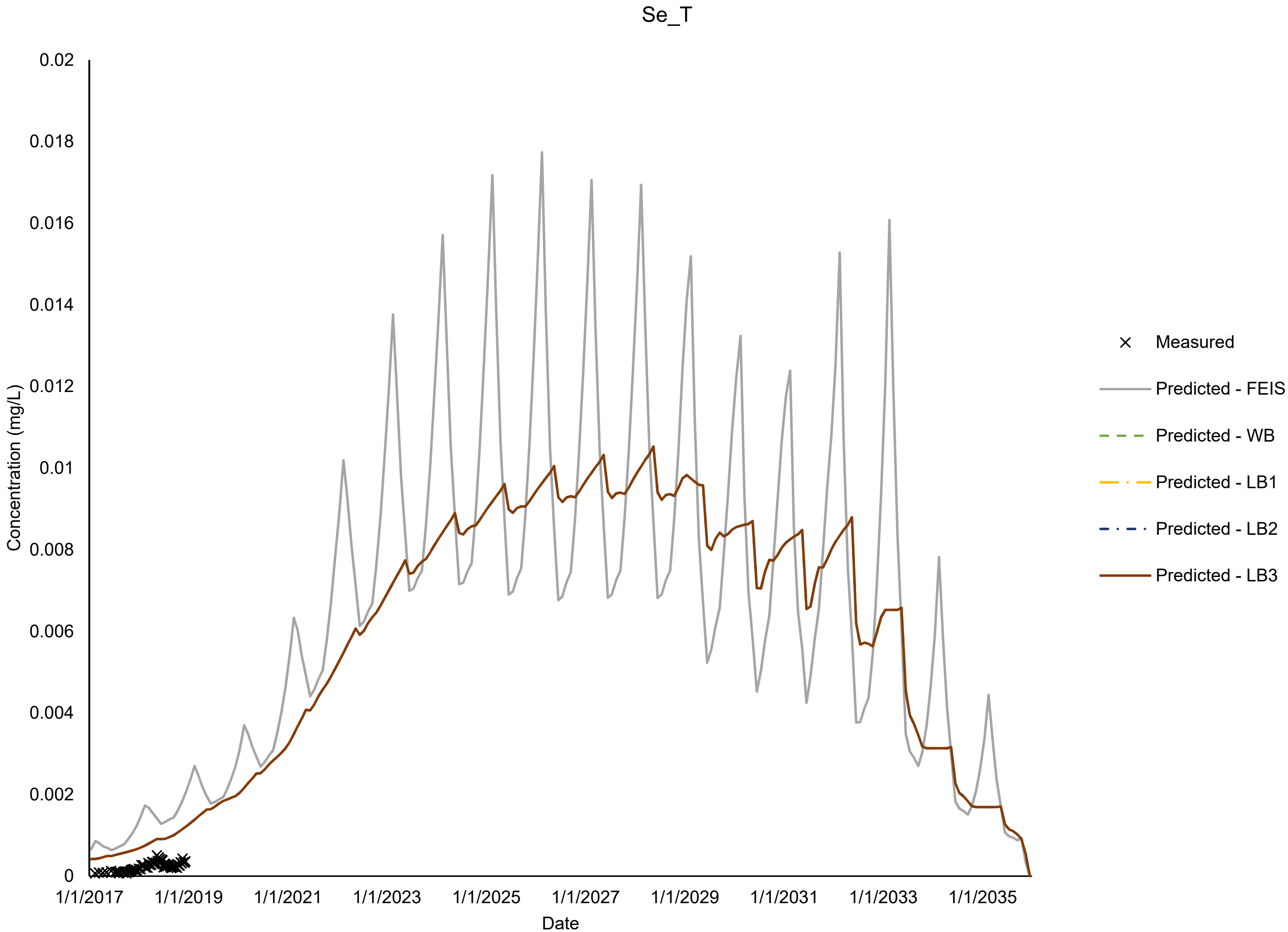

Mg_T
250
200
150
100
50
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

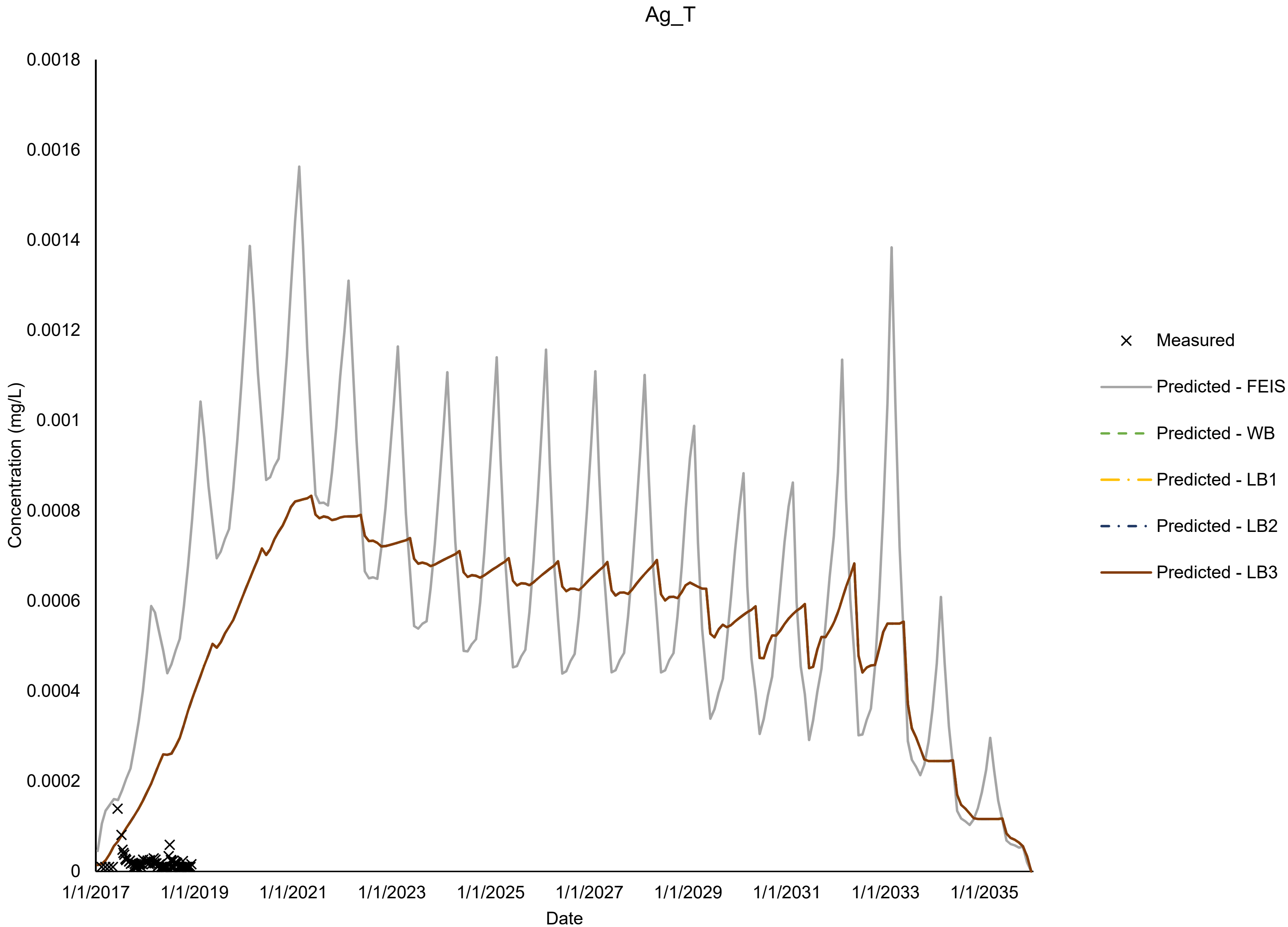

Mn_T
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

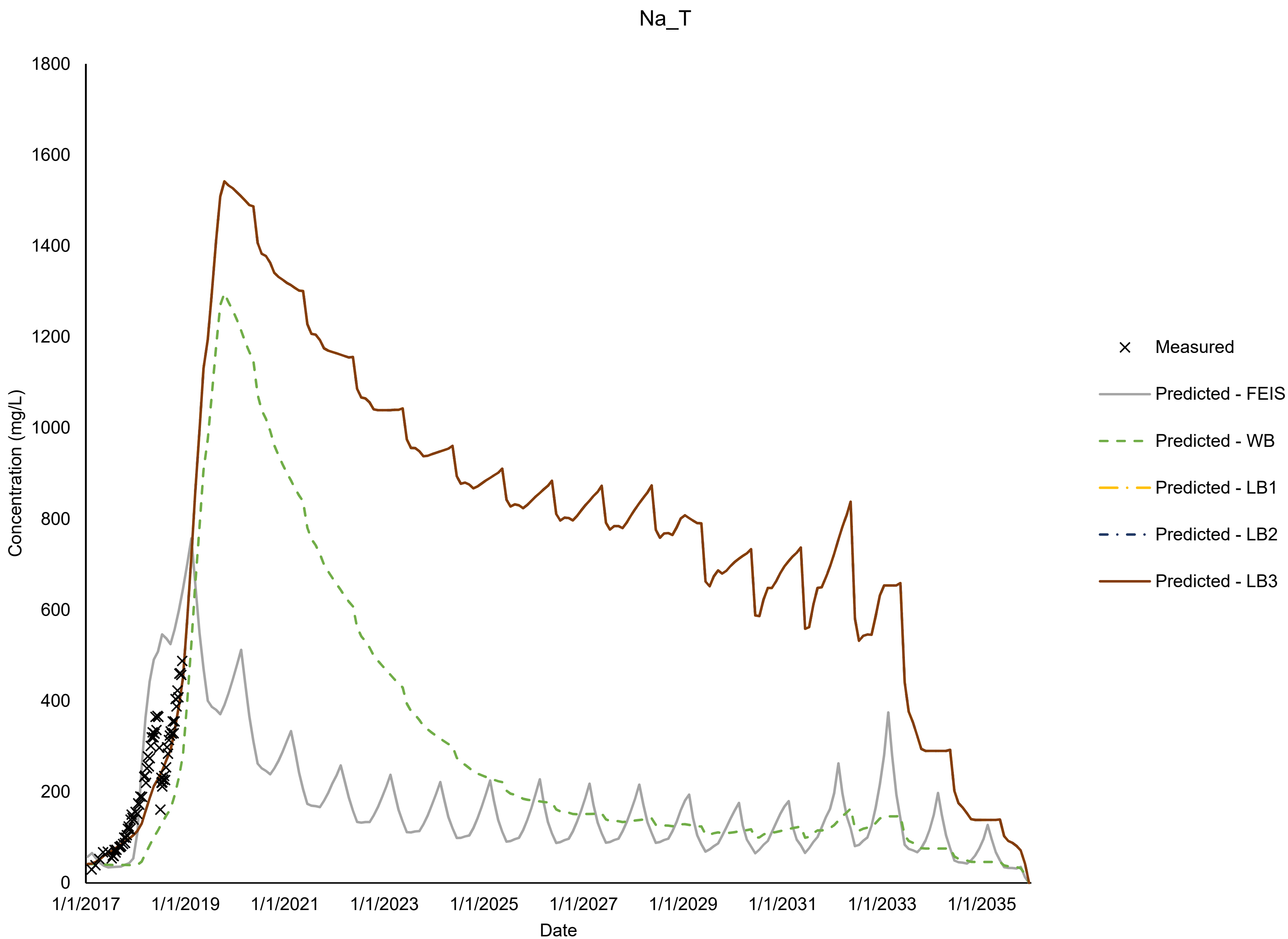

Hg_T
0.0002
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

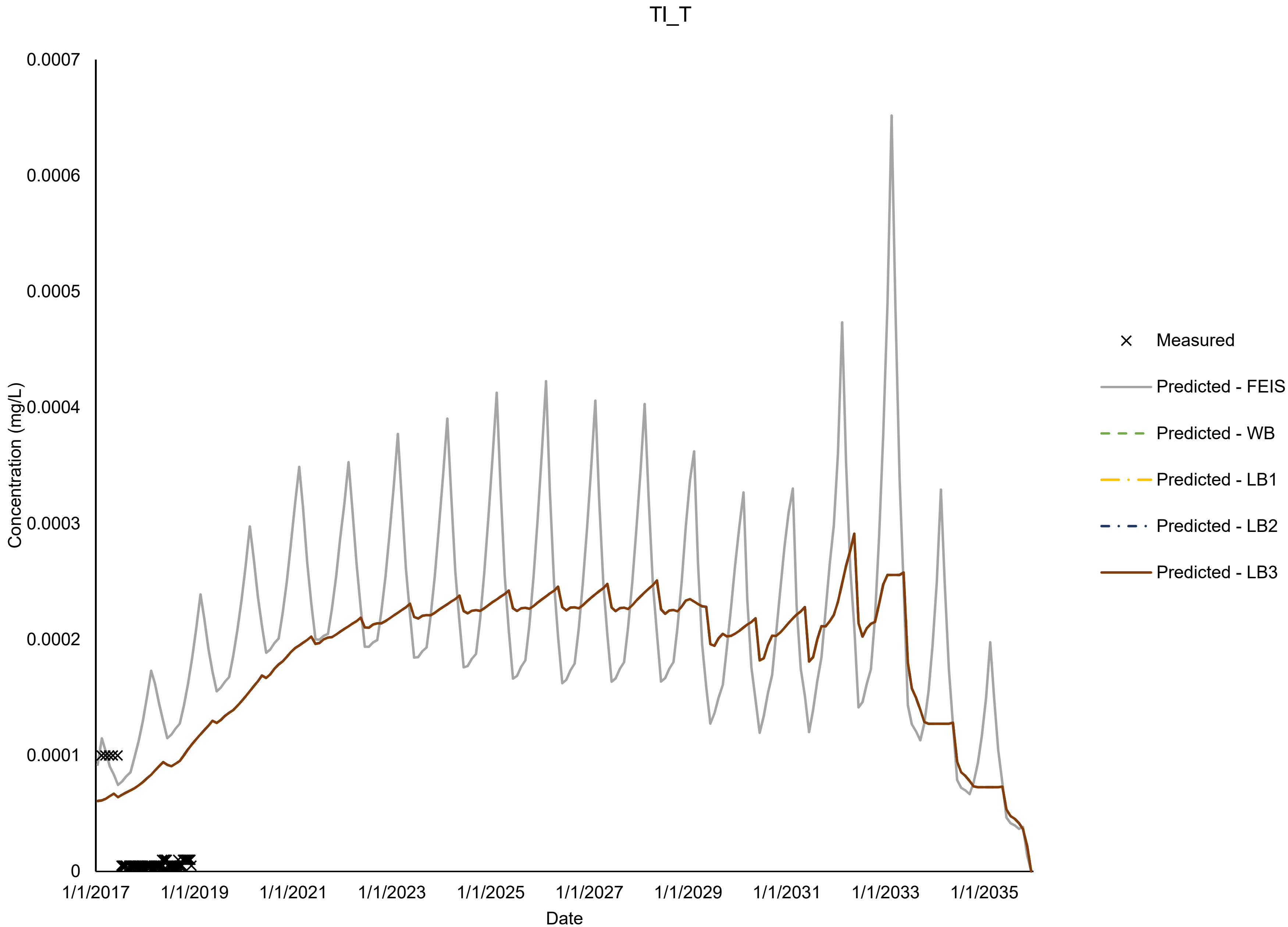

Mo_T
0.25
0.2
0.15
0.1
0.05
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

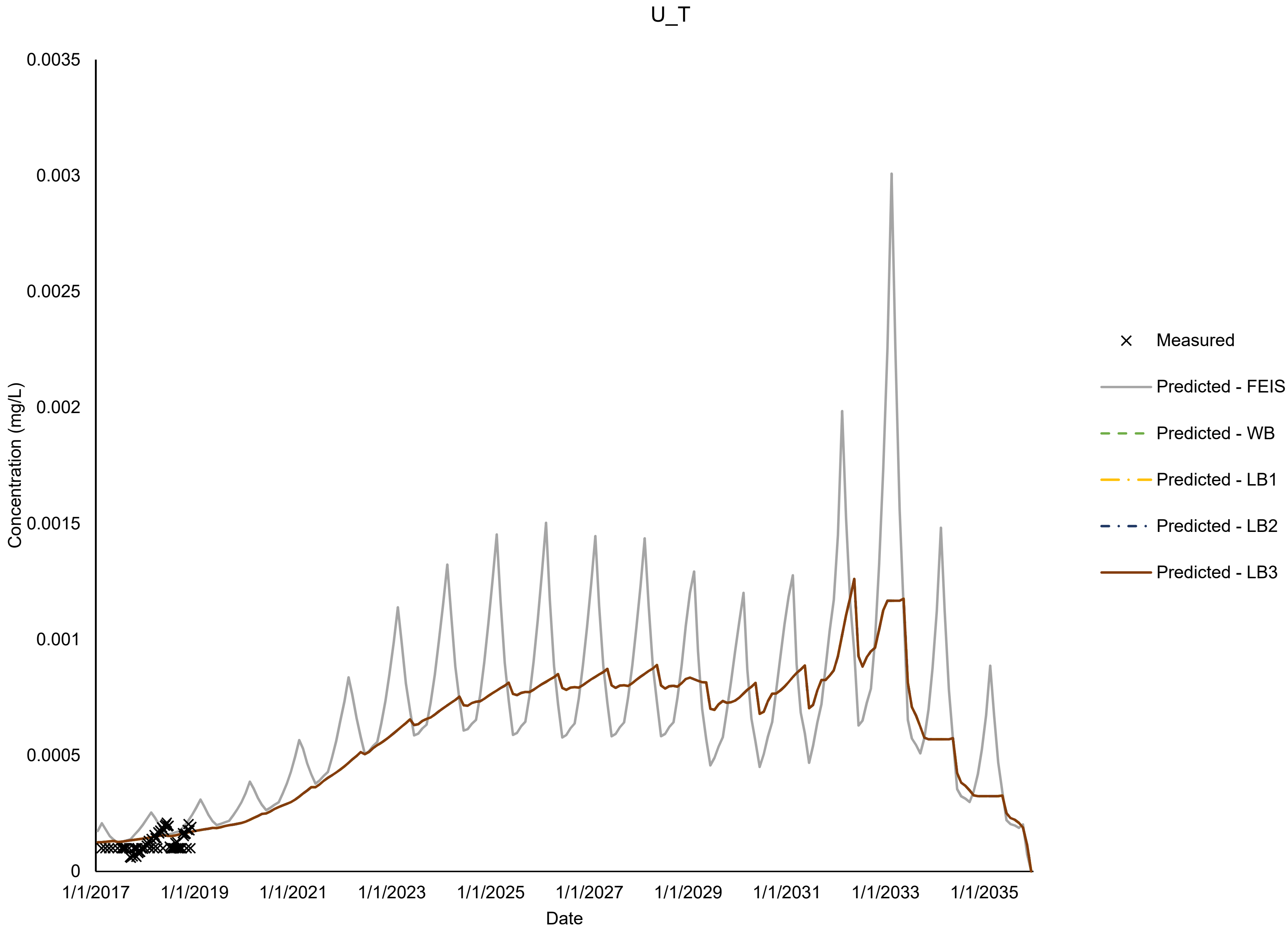

Ni_T
Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

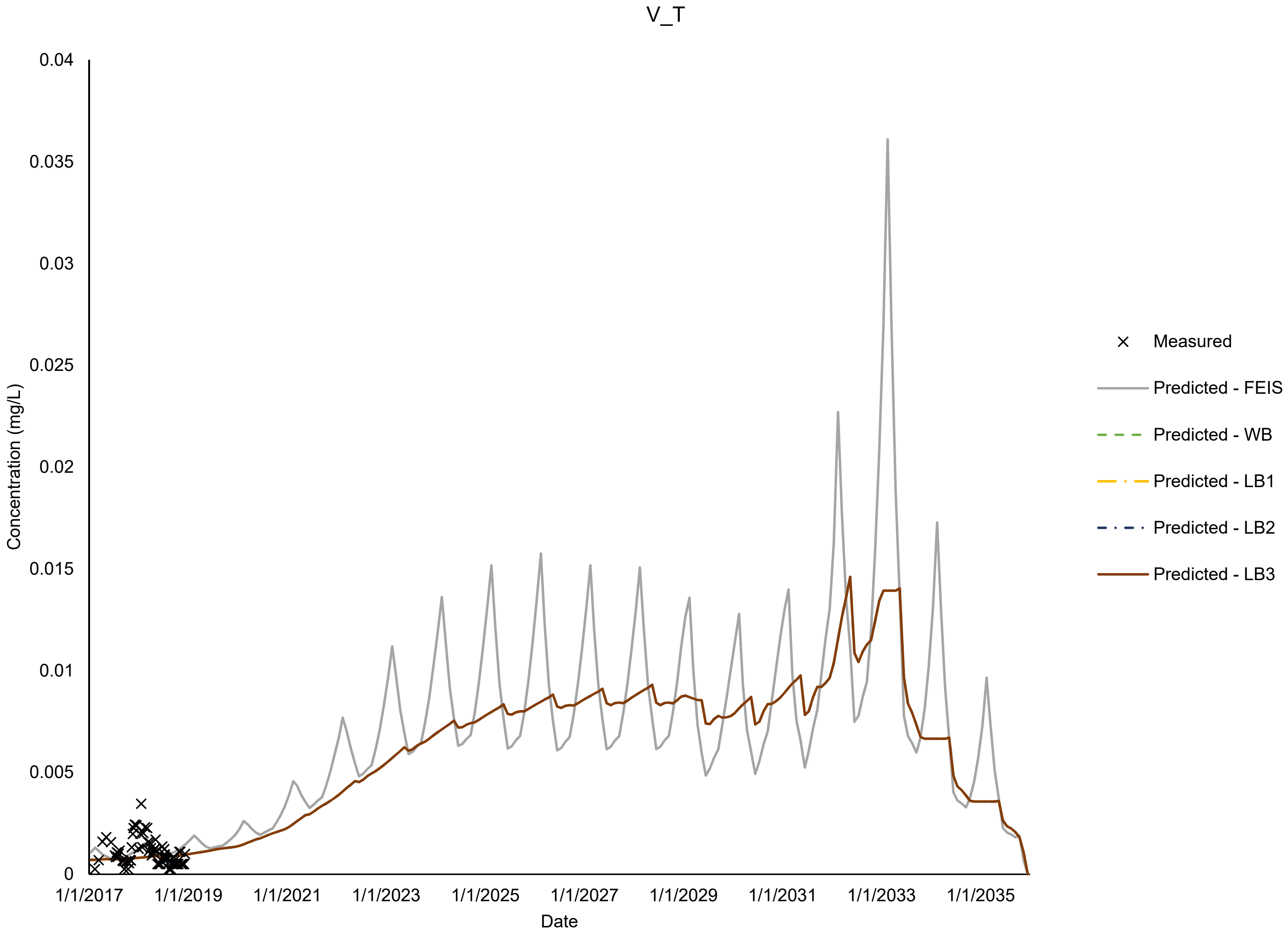

Se_T
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

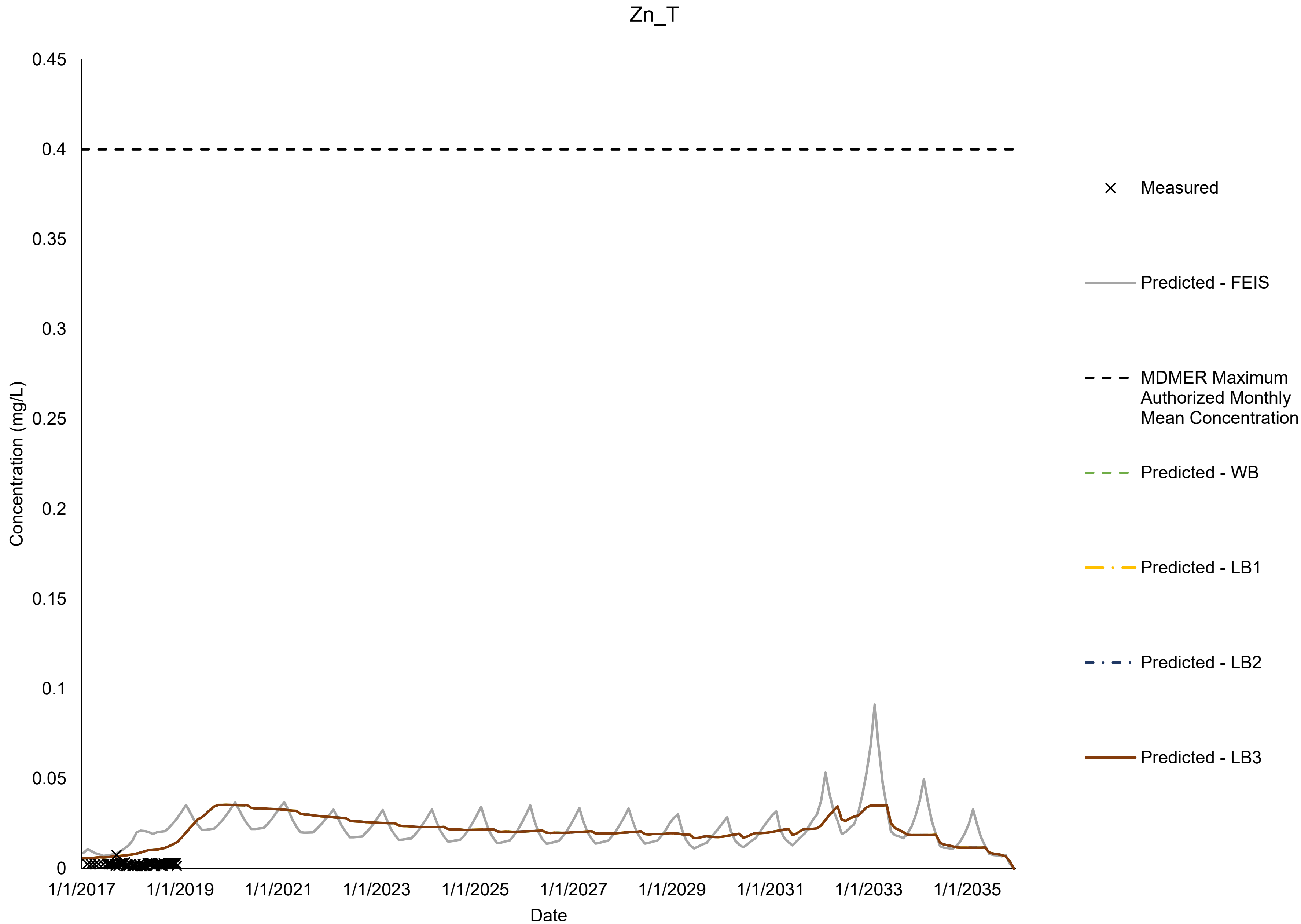

Ag_T
Concentration (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


Na_T
1800
1600
1400
1200
1000
800
600
400
200
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


TI_T
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


U_T
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


V_T
Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3


Zn_T
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Concentration (mg/L)
1/1/2017
1/1/2019
1/1/2021
1/1/2023
1/1/2025
1/1/2027
1/1/2029
1/1/2031
1/1/2033
1/1/2035
Date
Measured
Predicted - FEIS
MDMER Maximum Authorized Monthly Mean Concentration
Predicted - WB
Predicted - LB1
Predicted - LB2
Predicted - LB3

Appendix F

2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project

2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project

Prepared for

TMAC Resources Inc.

Prepared by

SRK Consulting (Canada) Inc.
1CT022.027
March 2019

2018 Waste Rock, Quarry and Tailings Monitoring Report, Doris Mine, Hope Bay Project

March 2019

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Appendices

1 Introduction

Development of the Doris 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 acid rock drainage and metal leaching (ARD/ML) potential for quarry rock, waste rock and tailings (flotation and detoxified) is consistent with geochemical characterization studies conducted at the environmental assessment and/or water licence applications for Doris, and to monitor the chemistry of seepage and runoff associated with these materials.

This report presents results from the 2018 quarry, waste rock and tailings geochemical monitoring programs. The report is organized as follows:

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

2 Monitoring Requirements and Conformity Assessment

2.1 Quarry Rock

Details on the monitoring program used for quarries and quarry rock for Doris infrastructure are provided in "*Quarry Management and Monitoring Plan*" (TMAC 2017). A summary of the requirements is provided in Table 2.1.

Table 2.1: Quarry Monitoring Requirements and 2018 Monitoring Summary

Monitoring Item	2018 Monitoring Summary
Visual inspections and sampling at the quarry face by site geologist when the quarries are in active use.	Completed. Refer to Section 3 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 acid base accounting (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 3 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 2018 because it was not necessary to discharge water from Quarry 2.
After construction any 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 3 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.	Completed. Refer to Section 5 and Appendix B.
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 Appendices B and C.

2.2 Waste Rock

Monitoring plans for the waste rock are provided in the "*Waste Rock and Ore Management Plan, Hope Bay Project, Nunavut"* (TMAC 2016a and 2016b). The program includes inspection and geochemical monitoring of the waste rock solids from the underground mine and crown pillar recovery trench (CPRT) and routine monitoring of the pollution collection pond. A summary of the requirements of TMAC (2016a) is summarized in Table 2.2.

Table 2.2: Waste Rock Monitoring Requirements and 2018 Monitoring Summary

Monitoring Item	2018 Monitoring Summary
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 of the waste rock will be classified and managed as "mineralized" waste rock and be used as backfill.	Completed. Refer to Section 4 and Appendix A.
Sampling and testing of the underground waste rock, including ABA on a minimum of one sample per 10,000 tonnes of rock;	Sampling frequency was approximately 1 sample for every 15,000 t of waste rock. Refer to Section 4 and Appendix A.
Sampling and testing of CPRT waste rock, including ABA on a minimum of one sample composite per 10,000 t of waste rock.	Three samples geochemically characterized. Refer to Section 4 and Appendix B.
Monitoring and recording the volumes of waste rock mined and placed in the mineralized and non-mineralized areas of the waste rock stockpile, and any non-mineralized waste rock that is removed for use in construction (pending confirmatory test work and approval from NWB);	Completed. Refer to Section 4 and Appendix A. No waste rock was used for construction.
Regular 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 2018 Nunavut Water Board Annual Report.
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;	Completed. Refer to Appendix A.
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 5 and Appendix B..
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 5 and Appendices A and B.

2.3 Tailings

Geochemical monitoring program for flotation and detoxified tailings as specified in Schedule J, Tables 1 and 2 of NWB Type “A” Water Licence 2AM-DOH1323 Amendment No. 1 (the “Water Licence”, Nunavut Water Board 2016) and includes the following monitoring stations: TL-5 (process plant tailings water discharge), TL-6 (flotation tailings solids), TL-7 (detoxified tailings solids[1]), and TL-11 (seepage from underground backfilled stopes). A summary of the monitoring requirements is summarized in Table 2.3.

Table 2.3: Tailings Monitoring Requirements and 2017 Monitoring Summary

Monitoring Item	2017 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), cyanate, thiocyanate, and total metals.	Completed. Refer to Appendix D.
Maintain monthly records of tonnages and locations of disposal for flotation tailings (TL-6) discharged into the TIA and detoxified tailings (TL-7) placed in the underground mine in stopes as backfill.	Completed. Refer to Section 6 and Appendix D.
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 6 and Appendix D.
Monthly geochemical monitoring of detoxified tailings (TL-7) for analysis of WAD cyanide, TIC, total metals (including sulphur) and moisture content. Quarterly analysis of cyanate and thiocyanate is also required.	Cyanate and thiocyanate were not analyzed during the first quarter as TMAC was advised by ALS during this period that there was no commercial analytical procedure for these parameters in tailings solids. Cyanate and thiocyanate were completed for Q2 to Q4. WAD cyanide data is available between January and April samples but are currently undergoing re-analysis for May to December samples due to a methodological error by the lab. A supplemental report will be submitted when the data are available. All other analyses were completed. Refer to Section 6 and Appendix D.
Bi-annual seepage surveys of underground backfilled stopes with opportunistic sampling of seepage (TL-11) for the analysis of pH, EC, trace metals by ICP-MS, alkalinity, acidity, sulphate, total and WAD cyanide, total ammonia, nitrate and nitrite.	Completed. Refer to Section 6 and Appendix D.
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 and TL-7), 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 6 and Appendix D.

[1] Detoxified tailings are referred to as cyanide leach residue in the Water Licence

3 Monitoring of Quarry Rock Geochemistry

Details of the 2018 quarry and construction rock monitoring program are presented in Appendix C.

3.1 2018 Activities

In 2018, blasting occurred in Quarry 2 from February to June and August to September. Infrastructure constructed between 2017 and 2018 included the southern extent of the tailings impoundment area (TIA) access road, the south dam, an expansion to the jetty road, the cyanide reagent pad, Pad T surface repairs, the marine outfall berm (MOB) access road at Roberts Bay, airstrip south apron and the east airstrip access road. All infrastructure was constructed from quarry rock from Quarry 2.

3.2 Sampling and Testing Program

3.2.1 Quarry Monitoring

TMAC collected two sets of quarry rock samples from Quarry 2 in June and October 2018. Each sample set consisted of a sieved coarse fraction (screened to -1 cm) and a finer fraction (screened to -2 mm).

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

3.2.2 Construction Monitoring

SRK inspected the following Doris infrastructure areas. The visual inspection entailed a geological inspection of infrastructure areas.

Twelve surface rock samples and two field duplicates were collected from the surface material in the areas inspected. t each sampling site a bulk sample was screened to -1 cm and -2 mm to generate two separate samples. All 14 samples were analyzed for total sulphur, of which 11 had sulphur contents above the 0.1% criteria and were submitted for full ABA analysis and elemental content. In addition, 5 samples of as-received -2 mm fraction were submitted for SFE testing according to MEND (2009). Field contact rinse tests on the -2 mm fraction were conducted on the SRK sample set.

3.3 Results

3.3.1 Quarry Monitoring

In 2018 TMAC conducted 28 active face inspections in Quarry 2 between February and October. Geological inspections of the active quarry faces indicated that quarry rock was mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). Quartz–carbonate veins were typically present (approximately 1 to 3%) up to 5 mm wide.

Total sulphur concentrations ranged between 0.13 and 0.28 %. Total sulphur between the samples is consistent, however total sulphur is higher in the fine fraction compared to the coarse fraction. Modified NP levels ranged between 19 and 151 kg $CaCO_3$/t and TIC ranged between 76 and 143 kg $CaCO_3$/t. ABA results indicate that the 2018 ROQ samples are non-PAG according to NP/AP and TIC/AP ratios. Elemental analyses indicates no appreciable enrichment compared to average crustal abundance for basaltic rocks

Results from the SFE tests were below these screening criteria and the pH of the tests were alkaline, indicating the risk of ML/ARD from run-of-quarry rock is low.

3.3.2 Construction Monitoring

Geological inspection of as-built construction areas confirmed that construction materials were characteristic of Quarry 2: grey-green mafic metavolcanics (basalt) containing carbonate and trace (<1%) to no visible sulphides.

Total sulphur ranged between 0.04% and 0.22%. Modified NP and TIC levels ranged from 67 to 157 kg $CaCO_3$/t and 36 to 129 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 TIC/AP and NP/AP. Arsenic and boron were enriched relative to the screening criteria in a sample from the East Airstrip Access Road and South Dam, respectively. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline and that all parameters were below the screening criteria, except for pH. SFE test results indicate that the potential for metal leaching from these samples is low.

The results indicate that the quarry rock used in the infrastructure areas was geochemically suitable for use as construction rock.

4 Monitoring of Waste Rock Geochemistry

Details of the 2018 waste rock monitoring program are presented in Appendix A.

4.1 2018 Activities

In 2018, approximately 557,007 t t of waste rock were produced from mining in the Doris underground. Approximately half of this waste rock (260,452 t) was placed directly as backfilled in underground stopes with the balance (299,188 t) transferred and placed in a stockpile on Pad T. As per the WROMP, all waste rock was designated as mineralized waste rock that will be eventually placed as backfill in the underground mine. In 2018, 1,760 t of waste rock from surface stockpiles was placed as backfill in underground stopes in the Doris underground mine.

TMAC initiated mining of the Doris Crown Pillar Recovery Trench (CPRT) in November 2018 with completion in December 2018. During this period, 263,500 t of waste rock was produced from the CPRT. All waste rock from the CPRT was placed on Pad T, of which 212,500 t was placed in the existing waste rock stockpile on the east side of Pad T and 51,000 t in its own stockpile on the western expansion of Pad T (Figure 1 1). Of the 212,500 t placed in the existing stockpile, 190,000 t will be placed backfill in the CPRT and 22,500 t will be placed as backfilled in the underground mine. The CPRT waste rock placed on the western extent of pad T will be placed as capping material on the CPRT. Placement of backfill in the CPRT commenced in January 2019 and tonnages will be reported in the 2019 annual report.

4.2 Sampling and Testing Program

4.2.1 Underground Mine

TMAC geologists collected 36 underground waste rock samples as part of the waste rock geochemical monitoring program in 2018, with one sample geologically identified as diabase (11c) and the others as mafic metavolcanics (1a). Of the 36 samples, all were analyzed for total sulphur and TIC and 12 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.

In addition, SRK completed an inspection of the underground waste rock placed in the stockpile on Pad T in August 2018. 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.

4.2.2 CPRT

TMAC geologists collected and geologically described three sets of samples of CPRT waste rock that was placed in the stockpile on the western extent of Pad T. Each sample set consisted of two sieved fractions (-2 mm and -1 cm) for geochemical analysis, for a total of six samples. Geochemical analysis included ABA, elemental analyses and SFE tests.

In addition, TMAC geologically logged 22 drillholes that intersected the CPRT for the purposes of ore grade control. The geology logs include economic classification (ore/waste), rock type, alteration and quantity of sulphide and carbonate minerals

SRK did not inspect CPRT waste rock on Pad T as mining had not commenced at the time of the inspection in August.

4.3 Results

4.3.1 Underground Mine

According to TMAC geologists, in 2018 the majority of waste rock intersected by the Doris underground workings was geologically described as: mafic metavolcanic flow (1a); massive mafic metavolcanic flow (1i); vesicular mafic metavolcanics (1ay) and altered mafic metavolcanics (1as). Furthermore, 1 to 2% of waste rock was quartz veins (12q and 12qd) with minor amounts (<1%) of late felsic dykes (9); late gabbroic dykes (10a). All waste rock placed on Pad T was classified as mineralized.

Mafic metavolcanics (1a) had uniformly low sulphur concentrations, ranging from a minimum of 0.02% to a maximum of 0.26%, with median levels of 0.12%. Median total sulphur concentrations were slightly lower than those reported in the Type A (0.15%) and pre-2018 operational monitoring sample sets (0.14%). TIC was typically (P25 to P75) between 130 kg $CaCO_3$ eq/tonne to 230 kg $CaCO_3$ eq/tonne, with median levels of 180 kg $CaCO_3$ eq/tonne. TIC levels are higher than typical concentrations observed in basalt in the Doris pre-2018 operational monitoring dataset (72 kg $CaCO_3$ eq/tonne median). Diabase (11c) contained low sulphur (0.07%) and low TIC (19 kg $CaCO_3$ eq/tonne), with both concentrations are slight higher than those reported in the historic datasets.

On the basis of TIC/AP and NP/AP, all samples collected in 2018 were classified as non-PAG; which is consistent with the overall ARD classifications for previous operational monitoring and the Type A samples sets (SRK 2015a). ARD classifications by TIC/AP are more conservative than NP/AP owing to higher levels of NP.

Trace element analyses on the solids indicated that concentrations of trace elements in mafic metavolcanics (1a) and diabase (11c) materials were less than ten times the average crustal abundance for basalt.

4.3.2 CPRT

Based on geologically logging of 22 drillholes, waste rock from the CPRT was classified as mafic metavolcanics (1a).

Sulphur concentrations for the CPRT samples ranged from 0.17% (minimum) to 0.44% (maximum); with higher sulphur concentrations observed in the -2 mm size fractions. TIC values ranged from 212 to 296 kg $CaCO_3$ eq/tonne and Modified NP ranged from 125 to 199 kg $CaCO_3$ eq/tonne. Both size fractions of the three CPRT samples were classified as non-PAG on the basis of TIC/AP and NP/AP.

Trace element analyses indicated enrichment of arsenic in both size fractions for two samples and the -2 mm size fraction for the third sample. Gold and sulphur were also above the screening criteria for the -2mm size fraction for two samples. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE tests had alkaline pH (9 s.u.). Compared to screening criteria, ammonia concentrations exceed the screening criteria for two samples. The criteria are not directly applicable as the leach does not support aquatic life. The source of ammonia is residues from explosives. All other parameters were below the screening criteria.

5 Seepage Survey

Details of the 2017 seep survey are provided in Appendix B.

5.1 Sampling and Testing Program

TMAC conducted the waste rock and construction (quarry) rock seep survey between June 14 and 15, 2018. Seep survey locations were established opportunistically by walking the toes of the waste rock stockpile, infrastructure, roadways, and berms. Infrastructure areas surveyed included the southern extent of the TIA access road, the south dam, the tailings catchment basin (east of Doris Creek) an expansion to the jetty road, the cyanide reagent pad, and airstrip. Additionally, three reference points in the tundra, not subject to mine influences, were sampled.

A total of 13 seepage sites and 3 reference sites were established. Of the thirteen seepage sites, six sites were in along the TIA Access Road, five were in the waste rock influenced area, and two were at the airstrip. Seepage was not observed in the other areas inspected. Samples were submitted to ALS Environmental Labs in Vancouver, BC where they were analyzed for pH, conductivity, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and low level dissolved metals including mercury and selenium. All samples were filtered and preserved in the field, as required.

Field measurements were taken at all locations where water was observed flowing into and out of construction rock material including seeps 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.

5.2 Results

A summary of the field measurements is presented in Table 5.1. The pH at all sites was neutral to slightly alkaline (7.1 to 8.8). The samples collected within the Waste Rock Influenced Area (WRIA) had the highest levels of conductivity (1,900 to 2,600 μS/cm).

Concentrations for reference area seeps were consistent and stable with the historical data record. Copper concentrations in all seepage samples from infrastructure areas (TIA access road and airstrip) were elevated compared to the screening criteria. A single sample collected at a seep in the TIA access road exceeded the aluminum screening criterion, however this may be due to the presence of colloids. All other parameters were below the screening criteria used by SRK. The results of the 2018 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.

Consistent with previous years, seepage from areas impacted by waste rock had elevated levels of chloride, nitrate, nitrite and ammonia compared to the screening criteria. Chloride levels are attributed to flushing of drilling brines and nitrate, nitrite, and ammonia levels to blasting residues from the waste rock. In terms of metal leaching, concentrations of sulphate, copper and selenium 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 selenium may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of arsenic and iron for the 2018 waste rock seepage samples were higher than the screening criteria, however this was attributed to the presence of colloids. When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable.

Table 5.1: Median Values for Field Conductivity and pH Measurements

Site Area	No. of Samples	Conductivity (µS/cm)	pH
		Median	
Waste Rock Influenced Area	5	2000	8
TLA Access Road	6	96	8.6
Airstrip	2	230	8.1
Reference Points	3	70	7.7

Source: file P:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\C_Seep_Surveys\June2018 Seepage Survey\3. Working File\[2018_DorisSeep_rev05_amd_lnb.xlsx]

6 Monitoring on Tailings

The geochemical monitoring program for flotation tailings slurry and detoxified tailings includes the following monitoring stations: TL-5 (process plant tailings water discharge), TL-6 (flotation tailings solids), TL-7 (detoxified tailings solids[2]), and TL-11 (seepage from underground backfilled stopes).

6.1 Sampling and Testing Program

6.1.1 Flotation Tailings (TL-6) and Process Plant Water Discharge (TL-5)

Schedule J (Table 2) of the Water Licence specifies weekly sampling of flotation tailings (TL-6) and 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.

Each week, 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.

The supernatant was sampled according to the Surveillance Network Program (SNP) monitoring requirements for tailings supernatant solution (TL-5) using a sterile 60mL syringe and submitted to Maxxam Analytics Laboratory in Burnaby, BC once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, and total metals. In total, the 2018 monitoring program included geochemical characterization of 19 samples of tailings process water collected from January to December with a duplicate sample and field blank collected in January. Four samples were collected in January (weekly), three samples were collected in February and three samples were collected in March. Monthly samples were collected from April to December.

After sampling was completed for the tailings supernatant solution (TL-5), the remaining supernatant was discarded and a clean stainless-steel spoon used to transfer the solid tailings into a plastic Ziploc bag. The bag was then sealed and placed in a fridge until the last weekly sample for the month had been collected. At the end of each month, TMAC combined and homogenized 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 2018 monitoring program included geochemical characterization of 12 monthly composites of flotation tailings collected from January to December with a duplicate sample collected in October.

Monthly flotation tailings solids (TL-6) composite samples were submitted in glass jars to ALS Environmental Laboratory in Burnaby, BC (January to March) and Maxxam Analytics Laboratory in Burnaby, BC (April to December) for analysis of total sulphur, sulphate sulphur, TIC and trace element content. The switch in laboratory was made to ensure the analytical methods were more consistent with the geochemical test work program for metallurgical tailings, as documented in the Type A water licence amendment application (SRK 2015a) and thus, allow for a direct comparison. The previous ALS methods used for sulphate sulphur and TIC were not directly comparable as discussed in Appendix D.

6.1.2 Detoxified Tailings (TL-7)

Each month and at the end of the detoxification cycle, TMAC collected one discrete sample of detoxified tailings from the discharge compartment of the detoxification circuit filter press. In total, the 2018 monitoring program included geochemical characterization of 13 samples of detoxified tailings solids (TL-7) collected from January to December. Two samples were collected in April (April 1 analyzed at ALS and April 23 analyzed at Maxxam), plus one duplicate sample was collected in November.

The rational for changes to the analytical program and laboratory in April 2018 is the same as for flotation tailings (TL-6). Samples were placed in glass sample jars using a clean stainless-steel spoon and submitted to ALS (January to April) for rinse pH, total sulphur, sulphate, TIC, trace element content and total, WAD and free cyanide and to Maxxam (April to December) for total sulphur, sulphate sulphur, TIC, multi-element trace element content by aqua regia digestion followed by ICP finish, WAD and free cyanide, cyanate and thiocyanate. ABA methods at ALS and Maxxam are the same as described for flotation tailings (TL-6). At ALS and Maxxam, WAD cyanide was determined by NaOH extraction followed by manual distillation with colorimetric finish and free cyanide was analysed by passive diffusion at pH 6. A key difference in the methods between Maxxam and ALS is that the Maxxam method included a step to confirm lixiviant pH was greater than 10 after NaOH addition (MOE), whereas the ALS method did not. A colorimetric procedure was used for the analysis of thiocyanate and cyanate was determined by converting it to ammonium carbonate by acid hydrolysis with colorimetric finish.

In March 2019, Maxxam identified that WAD cyanide data reported to TMAC were measurements erroneously conducted on the leached detoxified tailings solids, and not the extractant, as indicated by MOE (2015). Maxxam is currently in the process of re-analyzing all detoxified tailings samples for WAD cyanide. TMAC will prepare and submit a supplemental report when data are available.

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

TMAC completed underground seepage inspections of backfilled stopes in June and December 2018. Visual surveys were conducted of all backfilled stopes that could be accessed safely at the time of the survey. In December, not all backfilled levels could be safely accessed due to ice conditions. Eleven locations were surveyed in June (one with an identified seep) and eight locations were surveyed in December (two with identified seeps).

In June, TMAC collected one sample from the seep flowing from the bottom of the east limb North stope at level 4932, location E433877, N7559809. TMAC also collected a sample from this seep (east limb, North stope, level 4932) in December. An additional sample was collected from a pool of standing water at the base of the South stope on level 4946, location E433849, N7559620 in December (TL-11A); there were no obvious signs of seepage flow from the backfilled tailings at this location, therefore this sample may not be a true seep. Both stopes on level 4932 and 4946 were previously mined out in the Doris North area, and were later backfilled with a blend of unconsolidated waste rock and detoxified tailings.

TMAC submitted samples to ALS Environmental in Burnaby, BC for analysis of pH, EC, TSS, TDS, alkalinity, chloride, sulphate, total and WAD cyanide, and dissolved and total metals.

6.2 Results

TMAC initiated ore processing on January 20, 2017 with commencement of tailings monitoring in February 2017 in accordance to the water licence. In 2018, a total of 446,594 t (dry weight) of flotation tailings were deposited in the TIA and 8,333 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

In April 2018, the analytical tests work program for tailings was changed to be consistent with methods used for metallurgical tailings (SRK 2015a). The geochemical methods used for operational tailings prior to April 2018 were different except for total sulphur; differences in methods documented in SRK (2018) and Appendix D, Section 3.

The results of the 2018 geochemical monitoring program of flotation tailings solids (TL-6) is summarized as follows:

- Sulphur concentrations ranged between <0.05 and 1.4 % with a notable increase starting in April.
- TIC content ranged between 57 and 140 kg $CaCO_3$/t, with TIC values underestimated for all samples analyzed prior to April 2018.
- All flotation tailings samples are classified as non-PAG, which in consistent with 2017 operational and metallurgical tailings samples (SRK 2015a).
- Trace element content was elevated compared to screening criteria for arsenic, silver and gold one high sulphur sample. Boron and lead were also elevated in one sample each. All other parameters were below the screening criteria indicating no appreciable enrichment.

The results of the 2018 geochemical monitoring program of detoxified tailings solids (TL-7) is summarized as follows:

- Sulphur concentrations ranged between 3 and 23% and showed a similar trend to the flotation tailings, increasing after April 2018.
- TIC results for 2018 ranged between 59 and 140 kg $CaCO_3$/t, with TIC values underestimated for all samples analyzed prior to April 2018.
- All of the detoxified tailings samples were classified as PAG, which in consistent with 2017 operational and metallurgical tailings samples (SRK 2015a).
- All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, lead, selenium, silver and sulphur with more than half of samples elevated

in cadmium and zinc. All other parameters were below the screening criteria indicating no appreciable enrichment. This is consistent with 2017 operational monitoring samples except for cobalt, which was enriched in 2017 but not in 2018.

- WAD cyanide concentrations analyzed at ALS between January and April were below detection (20 mg/L). WAD cyanide data from April onwards are currently not available due to a laboratory methodology error. A supplemental report will be issued once the data becomes available. There is no regulatory limit for WAD cyanide in tailings.
- Thiocyanate concentrations ranged from 1.1 ppm to 5,300 ppm and cyanate concentrations range from 46 ppm to 1,100 ppm.

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

- Seepage from the east limb of the North stope on level 4932 containing waste rock and detoxified tailings backfill was observed and sampled in June and December. A further sample was collected during the December survey from a pool of water at the base of two backfilled stopes on level 4946.
- Seepage pH was circum-neutral for all samples.
- Major anion chemistry was dominated by chloride (40,000 to 47,000 mg/L) and to a lesser degree sulphate (860 to 1000 mg/L), while major cation chemistry was dominated by calcium 12,000 to 15,000 mg/L), sodium (11,000 to 12,000 mg/L) and to a lesser degree magnesium (1,600 to 1,800 mg/L). Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), other sources of saline water (chloride, sulphate, calcium, sodium and magnesium), and sulphide oxidation with associated carbonate dissolution from waste rock and detoxified tailings (sulphate and calcium).
- Total cyanide concentrations in the seepage ranged from 0.007 to 1.1 mg/L and WAD cyanide concentrations ranged from 0.005 mg/L to 0.017 mg/L.
- The sources of ammonia (220 to 380 mg/L), nitrate (490 to 520 mg/L) and nitrite (1.6 to 18 mg/L) are attributable to degradation of cyanate and thiocyanate in detoxified tailings and/or blast residues from waste rock.
- The following trace elements were reported at concentrations exceeding the screening criteria: cadmium and copper (approximately 45 times higher), nickel and selenium (same order of magnitude), silver (up to 20 times higher) and zinc (up to 10 times higher). Based on the humidity cell test (HCT) program for detoxified tailings, all these aforementioned parameters were noted as parameters of potential concern except for zinc (SRK 2015a).
- The low arsenic concentrations in the seepage are notable given the elevated concentrations of solid-phase arsenic in the detoxification tailings and is consistent with observations from the HCT program for metallurgical detoxified tailings (SRK 2015a).

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

- pH was near-neutral to slightly alkaline ranging between 7.7 and 8.4 s.u.
- Sulphate loadings were stable with the range equivalent to 2017
- Increased loadings for selected parameters such as arsenic, bismuth, cadmium, selenium, lead, silver and zinc (all totals) is due to the presence of tailings solids in the sample. Notably, concentrations of bismuth, cadmium, lead and zinc were below detection for a number of samples with lower TSS.
- Trends for major ions and trace elements were stable in 2018 with ranges equivalent to 2017. Exceptions included calcium, magnesium, strontium (which are likely indicative of carbonates) and molybdenum, all of which exhibited increasing trends.

7 Conclusions

7.1 Quarry and Construction Rock

Geological inspections of active Quarry 2 faces indicated that quarry rock was mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). Geochemical characterization of Quarry 2 run-of-quarry rock indicated that all of the samples were non-PAG with low risk for ML/ARD.

Geological inspection of as-built construction areas confirmed that construction materials were characteristic of Quarry 2. All samples were classified as non-PAG on the basis of both TIC/AP and NP/AP. Arsenic and boron were enriched relative to the screening criteria in a sample from the East Airstrip Access Road and South Dam, respectively. All other parameters were below the screening criteria indicating 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.

7.2 Waste Rock

The Doris underground mine produced approximately 557,007 t of waste rock (in 2018), of which almost half (260,452 t) was placed directly as backfill in the underground stopes with the balance (approximately 299,188 t) placed in a stockpile on the eastern side of Pad T. In 2018, 1,760 t of waste rock was moved from the waste rock stockpile on Pad T to the underground, where it was placed as backfill in underground stopes.

A total of 36 underground waste rock samples were collected as part of the waste rock geochemical monitoring program in 2018, with one sample geologically identified as diabase (11c) and the others as mafic metavolcanics (1a). For the mafic metavolcanics samples (1a), total sulphur content was uniformly low (0.02% to 0.26%) and TIC (130 to 230 kg $CaCO_3$ eq/t) and Modified NP content was typically (P25 to P75) high. All underground waste rock samples were classified as non-PAG. The one sample of diabase (11c) was characterized by low sulphur (0.07%) and low TIC (19 kg $CaCO_3$ eq/t) and NP (130 to 310 kg $CaCO_3$ eq/t) and was classified as non-PAG. Trace element content was below the screening criteria for all samples of 1a and 11c.

Mining of the CPRT 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 CPRT 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 CPRT. None of the CPRT waste rock was placed as backfill in 2018.

Three CPRT samples were collected representing CPRT waste rock from the stockpile on west end of Pad T. At each sampling location, two sieved fractions (-2 mm and -1 cm) were collected, for a total of six samples for geochemical analysis. All CPRT samples and size fractions were classified as non-PAG. Arsenic, gold and sulphur were higher than the screening criteria in one or more samples. SFE test leachates were alkaline pH with ammonia concentrations were higher than the screening criteria for the two samples. The source of ammonia is residues from explosives.

7.3 Infrastructure and Waste Rock Seepage Monitoring

The results of the 2018 seep survey indicated 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 waste rock influenced area had elevated levels of ammonia, chloride, nitrate, arsenic, copper and selenium concentrations in comparison to seeps from the infrastructure areas. Chloride concentrations are attributed to flushing of drilling brines and ammonia and nitrate to blasting residues from the waste rock. In terms of metal leaching, concentrations of sulphate, copper and selenium 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. Prior to this time, ore was not placed on the waste rock stockpile. Ore has higher sulphide content than waste rock. SRK's humidity cell test program (SRK 2015b) 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).Concentrations of arsenic and iron for the 2018 waste rock seepage samples were higher than the screening criteria, however this was attributed to the presence of colloids. When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable. Further monitoring will establish trends in these parameter concentrations.

7.4 Flotation Tailings Slurry and Detoxified Tailings

TMAC initiated ore processing in January of 2017 with commencement of tailings monitoring in February 2017 in accordance to the water licence. Flotation tailings deposition in the Doris TIA commenced on January 20, 2017. In 2018, a total of 446,594 t (dry weight) of flotation tailings were deposited in the TIA and 17,680 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

In April 2018, the analytical tests work program for tailings was changed to be consistent with methods used for metallurgical tailings (SRK 2015a). The geochemical methods used for operational tailings prior to April 2018 were different except for total sulphur; difference in methods documented in SRK (2018) and Appendix D, Section 3.

For flotation tailings solids (TL-6) sulphur concentrations ranged between <0.05 and 1.4 % with a notable increase starting in April. All flotation tailings samples are classified as non-PAG, which is consistent with 2017 operational and metallurgical tailings samples (SRK 2015a). Trace element content was elevated compared to screening criteria for arsenic, silver and gold. Boron, sulphur and lead were also elevated in one sample each. All other parameters were below the screening criteria indicating no appreciable enrichment.

For detoxified tailings solids (TL-7) total sulphur concentrations ranged between 3 and 23% and showed a similar trend to the flotation tailings, increasing after April 2018. All of the detoxified tailings samples were classified as PAG; consistent with 2017 operational and metallurgical tailings samples (SRK 2015a). When compared to screening criteria all detoxified tailings samples were elevated in arsenic, bismuth, copper, lead, selenium, silver and sulphur, with more than half of samples elevated in cadmium and zinc. All other parameters were below the screening criteria indicating no appreciable enrichment. With the exception of cobalt (which was previously enriched in 2017) this is consistent with 2017 operational monitoring samples.

WAD cyanide concentrations analyzed at ALS between January and early April were below detection (20 mg/L). WAD cyanide data are not available after April due to the laboratory methodological error. These samples are currently being re-analyzed and TMAC will submit a supplemental report when data are available. There is no regulatory limit for WAD cyanide in tailings. Thiocyanate concentrations for range from 1.1 to 5,300 ppm and cyanate concentrations range from 46 to 1,100 ppm.

7.5 Seepage Monitoring of Backfilled Stopes in Underground Mine

Two opportunistic seepage samples were collected from the east limb of the North stope on level 4932 (containing waste rock and detoxified tailings backfill) in June and December 2018. A further sample was collected during the December survey from a pool of water at the base of two backfilled stopes on level 4946.

Seepage pH was circum-neutral for all samples. Major anion chemistry was dominated by chloride and to a lesser degree sulphate, while major cation chemistry was dominated by calcium, sodium and to a lesser degree magnesium. Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), other sources of saline water (chloride, sulphate, calcium, sodium and magnesium), and sulphide oxidation with associated carbonate dissolution from waste rock and detoxified tailings (sulphate and calcium).

Total cyanide concentrations in the seepage ranged from 0.007 to 1.1 mg/L and WAD cyanide concentrations ranged from 0.005 mg/L to 0.017 mg/L. The sources of ammonia (220 to 380 mg/L), nitrate (490 to 520 mg/L) and nitrite (1.6 to 18 mg/L) are attributable to degradation of cyanate and thiocyanate in detoxified tailings and/or blast residues from waste rock.

Cadmium and copper, nickel and selenium, silver and zinc were reported at concentrations exceeding the screening criteria. With the exception of zinc all of these parameters were noted as parameters of potential concern on the basis of the humidity cell test (HCT) program for detoxified tailings (SRK 2015a). The low arsenic concentrations in the seepage are consistent with observations from the HCT program for metallurgical detoxified tailings (SRK 2015a); however, are notable given the elevated concentrations of solid-phase arsenic in the detoxification tailings.

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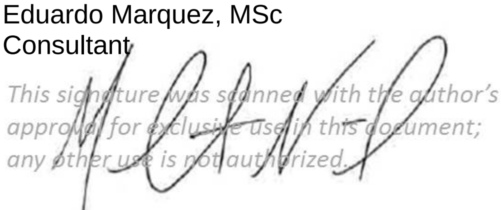

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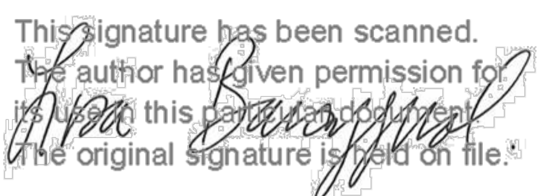

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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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 – 2018 Geochemical Monitoring of Waste Rock, Doris Mine

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Memo

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From:	Jessica Charles Lisa Barazzuol	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 21, 2019
Subject:	2018 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. Requirements for management and monitoring of waste rock and ore are specified in Water Licence 2AM DOH1323 Amendment No. 1 (Nunavut Water Board 2016) and the Waste Rock and Ore Management Plan (WROMP, TMAC 2016a and 2016b), which forms part of Licence 2AM DOH1323 Amendment No. 1.

In 2018, approximately 557,007 t of waste rock were produced from mining in the Doris underground. Approximately half of this waste rock (260,452 t) was placed directly as backfilled in underground stopes with the balance (299,188 t) transferred and placed in a stockpile on Pad T. As per the WROMP, all waste rock was designated as mineralized waste rock that will be eventually placed as backfill in the underground mine. In 2018, 1,760 t of waste rock from surface stockpiles was placed as backfill in underground stopes in the Doris underground mine.

TMAC initiated mining of the Doris Crown Pillar Recovery Trench (CPRT) in November 2018 with completion in December 2018. During this period, 263,500 t of waste rock was produced from the CPRT. All waste rock from the CPRT was placed on Pad T, of which 212,500 t was placed in the existing waste rock stockpile on the east side of Pad T and 51,000 t in its own stockpile on the western expansion of Pad T (Figure 1-1). Of the 212,500 t placed in the existing stockpile, 190,000 t will be placed as backfill in the CPRT and 22,500 t will be placed as backfill in the underground mine. The CPRT waste rock placed on the western extent of pad T will be placed as capping material on the CPRT. Placement of backfill in the CPRT commenced in January 2019 and tonnages will be reported in the 2019 annual report.

This memo documents the results of the 2018 geochemical monitoring of waste rock from the underground mine and CPRT. Other monitoring activities in the Doris mine area included an annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Collection Pond (PCP). The results of the seepage survey are reported in the accompanying memo (SRK 2019) while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

Figure 1-1: Waste Rock and Ore Stockpile Locations, Doris Mine (Photo taken August 5, 2018)

2 Methods

2.1 Geological Inspections

2.1.1 Underground Mine

Protocols for geological inspections are documented in TMAC (2016a). To summarize, geological inspections were conducted by site geologists when monitoring samples were collected and occurred at least once a month for the duration of 2018. 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 CPRT

During CPRT development, TMAC geologically logged 22 drillholes that intersected the CPRT for the purposes of ore grade control (Attachment B). The geology logs include economic classification (ore/waste), rock type, alteration and quantity of sulphide and carbonate minerals.

2.1.3 Waste Rock Stockpile

In August 2018, Eduardo Marquez of SRK completed an inspection of the waste rock from the underground mine placed on surface in the stockpile on Pad T. TMAC geologists Annette George and Scott Snider indicated that all waste rock brought to surface in 2018 from the underground mine was placed on Pad T and that waste rock deposited since the last inspection in August 2017 and that could be safely accessed would be found on the upper bench (Figure 1-1). This upper bench contained over two dozen small waste rock piles.

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 did not inspect waste rock from the CPRT because CPRT development and placement of waste rock on Pad T occurred after SRK's inspection date.

2.2 Sampling and Geochemical Test Work Program

2.2.1 Underground Mine

TMAC site geologists collected a total of 36 run of mine (ROM) waste rock samples (blasted rock or muck) from the underground mine 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. All samples tested were designated and managed as mineralized waste regardless of sulphur content or the mineralized/unmineralized designation noted in Attachment A. Samples were analyzed for total sulphur (S) and total inorganic carbon (TIC) with a subset also analyzed for paste pH, Modified NP and elemental analysis (Table 2-1).

The frequency of sample collection, as outlined by the TMAC (2016a) is one sample per 10,000 t of waste rock, which for 2018 equates to a minimum of 55 samples for the total waste rock produced from the underground mine (547,401 t). Ore is considered to be mineralized by definition, and therefore geochemical testing was not required. Samples collected by TMAC in January 2018 were shipped to SGS Canada Inc. in Burnaby, BC, for preparation and geochemical analysis whereas samples collected between February and December were shipped to Maxxam Laboratories in Burnaby, BC. Analytical instructions were provided by TMAC with input from SRK.

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

Rock Type[1]	Sulphur & TIC	ABA & Elemental Analysis
11c	1	1
1a	35	11
Total Number of Tests	36	12

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev01.xlsx

Note:

[1] 1a = mafic metavolcanic, 11c = diabase

2.2.2 CPRT

TMAC geologists collected and geologically described three sets of samples of CPRT waste rock placed in the stockpile on the western extend of Pad T. Two sets of samples were collected from the CPRT waste rock stockpile (PITWR-01 and PITWR-03) and the other was collected from within the trench (PITWR-02). Geological descriptions included rock type, sulphide (quantity, type and habit) and carbonates (quantity, type and fizz test with 10% HCl).

As per the underground waste rock, the sampling frequency for the waste rock monitoring program is one sample composite per 10,000 t of waste rock, which for 2018 equates to a minimum of 26 samples for the total waste rock produced from the CPRT (263,500 t). TMAC may potentially use the CPRT waste rock from the western stockpile as construction material, pending regulatory approval of a revised Waste Rock and Ore Management Plan. Accordingly, the sampling and test work program for CPRT waste rock was designed according to the geochemical monitoring program for construction rock outlined in the WROMP (TMAC 2016a). At each sampling location, TMAC collected two sieved fractions (-2 mm and -1 cm) for geochemical analysis, for a total of six samples.

TMAC shipped the samples to Maxxam Analytics (four November samples) and SGS (two January samples) for preparation and geochemical analysis including paste pH, sulphate, Modified NP, TIC, elemental analysis and shake flask extraction (SFE) tests. SFE tests were conducted on the as-received -2 mm fraction. Analytical instructions were provided by TMAC with input from SRK.

TMAC conducted contact tests on the -2 mm fraction in the onsite laboratory using a 1:1 deionized water to solids ratio. After shaking the samples and allowing the solids to settle, the pH and EC of the contact test leachates were measured.

2.3 Analytical Methods

The geochemical analytical methods are summarized as follows:

- Total sulphur by Leco.
- Sulphate by HCl leach.
- TIC was determined by using a 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 major elements (e.g., aluminium, calcium, magnesium, sodium, potassium, iron, sulphur) and trace elements (e.g., arsenic, zinc, copper, cadmium, lead).
- SFE tests using a 3:1 solution to solid ratio and a 24 hour shaking period (MEND 2009) method. SFE leachate was analyzed for pH, EC, total dissolved solids (TDS), SO_4, alkalinity, acidity, chloride, ammonia, NO_3, NO_2 and trace elements by ICP-MS (including Hg).

2.4 Quality Assurance and Control

2.4.1 Underground Waste Rock

All results, including SGS and Maxxam's internal QA/QC program, were reviewed by SRK for quality assurance. Table 2-2 presents a summary of the QA/QC checks for the underground waste rock samples, including the assessment of duplicate and blank samples and standard reference materials. SRK considers all data acceptable.

Table 2-2: QAQC Summary for Underground Waste Rock Samples

QC Test	SRK QC Criteria	Results
paste pH		
Lab Duplicate (n=3)	For any samples, ± 0.5 difference pH unit	All passed
Standard Reference Material (n=1)	Within specified tolerance ranges.	All passed
TIC		
Standard Reference Material (n=4)	Within specified tolerance ranges.	All passed
Total S & Total Sulphate		
Lab Blank (n=1 Total S, n=0 SO4)	<2X detection limit (DL)	All passed
Standard Reference Material (n=1 Total S, n=0 SO4)	Within specified tolerance ranges.	All passed
Modified NP		
Lab Blank (n=1)	<5x DL	All passed
NP consistent with paste pH (n=12)	Negative NP has paste pH <= 5	All passed
Lab Duplicate (n=3)	% 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.	All passed
Fizz test rating with NP (n=12)	Max NP does not exceed fizz test rating	All passed
Standard Reference Material (n=1)	Within specified tolerance ranges.	All passed
Modified NP and TIC		
Comparison between Modified NP and TIC (n=3)	Check for trends/co-relation	No clear trend
Total S-Leco and S-ICP		
Comparison between Total S-Leco and S-ICP (n=3)	For samples >10X detection limit (DL), % RPD within ±20%	All passed
Lab Blank (n=1)	<5x DL	All passed
Lab Duplicate (n=1)	For samples > 10X the detection limit (DL), % RPD within ±20%	All passed
Standard Reference Material (n=2)	Within specified tolerance ranges.	All passed
Aqua Regia Metals		
Lab Blank (n=1)	<2X Detection Limit	All passed
Standard Reference Material (n=2)	Within specified tolerance ranges.	All passed

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

2.4.2 CPRT

All results, including SGS and Maxxam's internal QA/QC program, were reviewed by SRK for quality assurance. Table 2-3 presents to results of the QAQC check completed by SRK. SRK considers all data acceptable. For the contact tests, TMAC calibrated the hand-held pH and EC meters (EC, pH) prior to taking measurements.

Table 2-3: QAQC Summary for CPRT Samples

QC Test	SRK QC Criteria	Results
Paste pH		
Lab Duplicate (n=1)	For any samples, ± 0.5 difference pH unit	Passed
TIC		
Method Blank (n=1)	<5X detection limit (DL)	Passed
Lab Duplicate (n=1)	For samples > 10X the detection limit (DL), % RPD within ±20%	Passed
Standard Reference Material (n=2)	Within specified tolerance ranges.	Passed
Total S & Total Sulphate		
Method Blank (n=1 Total S; n=1 SO_4)	<5X detection limit (DL)	All passed
Sulphur balance (n=4)	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within ±20%	All passed
Lab Duplicate (n=0 Total S; n=1 SO_4)	For samples > 10X the detection limit (DL), % RPD within ±20%	All passed
Standard Reference Material (n=2 Total S; n=1 SO_4)	Within specified tolerance ranges.	All passed
Modified NP		
NP consistent with paste pH (n=4)	Negative NP has paste pH <= 5	All passed
Lab Duplicate (n=1)	% 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.	All passed
Fizz test rating with NP (n=4)	Max NP does not exceed fizz test rating	All passed
Modified NP and TIC		
Comparison between Modified NP and TIC (n=4)	Check for trends/co-relation	TIC higher than NP
Total S-Leco and S-ICP		
Comparison between Total S-Leco and S-ICP (n=4)	For samples >10X detection limit (DL), % RPD within ±20%	All passed
Aqua Regia Metals		
Method Blank (n=3)	<5X detection limit (DL)	All passed

QC Test	SRK QC Criteria	Results
Standard Reference Material (n=6)	Within specified tolerance ranges.	All passed
Shake Flask		
SFE Blank (n=1)	<5X detection limit (DL)	All passed
Method Blank (n=7)	<5X detection limit (DL)	All passed
Ion Balance (n=2)	EC>10 uS/cm, % difference should be within ± 10%	All passed
Standard Reference Material (n=7)	Within specified tolerance ranges.	All passed

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

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. 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. 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 Geological Inspections

3.1.1 Underground Mine

A summary of the samples collected are provided in Attachment A and include mafic volcanics (1a) and diabase (11c). According to TMAC geologists, in 2018 the majority of waste rock intersected by the Doris underground workings was geologically described as: mafic metavolcanic flow (1a); massive mafic metavolcanic flow (1i); vesicular mafic metavolcanics (1ay) and altered mafic metavolcanics (1as). Furthermore, 1 to 2% of waste rock was quartz veins (12q and 12qd) with minor amounts (<1%) of late felsic dykes (9); late gabbroic dykes (10a). All waste rock placed on Pad T was classified as mineralized.

3.1.2 CPRT

CPRT geological logs are provided in Attachment B. CPRT waste rock is described as altered (1as) and unaltered (1a) grey or green mafic metavolcanics (basalt) with minor sericitic and chloritic alteration and local iron staining. Trace pyrite (≤1%) was observed in seven of the blast hole logs and no pyrite was observed in the other drillholes. Ore was logged in four blast hole logs (TR-CN9, TR-CR8, TR-C58 and TR-CT8).

3.1.3 Waste Rock Stockpiles

The majority (about 80 to 90%) of the waste rock inspected was green mafic metavolcanics (basalt or lithology code 1) with varying degrees of sericitic alteration, quartz veinlets (up to several cm thick) and trace pyrite (≤1%) occurring as disseminations or stringers (Figure 3-1). Mafic metavolcanics without or with lesser sericitic alteration were darker green and contained trace amounts of pyrite (<1%). Mafic metavolcanics with sericitic alteration tended to be lighter colored, more foliated and commonly associated with quartz veining and with slightly more pyrite (~1%) than mafic metavolcanics with lesser sericite alteration.

About 5 to 10% of the waste rock observed was massive blocky quartz with trace (<1%) pyrite occurring as stringers and cubes (Figure 3-2). Few (<5%) occurrences of diabase were observed among the mafic metavolcanics, as well as traces of a pale cream-colored rock which has been described in the past as altered metavolcanics rock proximal to the contact with the diabase (i.e., low NP basalt).

Figure 3-1: Light green metavolcanics with quartz veining

Figure 3-2: Quartz vein on the upper bench of Pad T (waste rock)

3.2 Geochemical Monitoring

3.2.1 Underground Mine

Laboratory testing data for the underground waste rock samples are provided in Attachment C (ABA) and Attachment D (elemental content).

Sulphur and TIC

Sulphur and TIC results from Maxxam are available for 36 samples with a statistical summary presented in Table 3-1.

Mafic Metavolcanics (1a)

Sulphur concentrations for samples of mafic metavolcanics (1a) were uniformly low with median and maximum levels of 0.12 and 0.26%, respectively.

TIC content ranged from 14 to 320 kg $CaCO_3$ eq/tonne with median levels of 180 kg $CaCO_3$ eq/tonne. All 1a samples collected in 2018 (n=35) were classified as non-PAG on the basis of TIC/AP (Figure 3-3).

Diabase (11c)

The one sample of diabase (11c) contained low sulphur (0.07%), low TIC (19 kg $CaCO_3$ eq/tonne) and was classified as non-PAG on the basis of TIC/AP.

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

Rock Type	Statistic	Paste pH	CO_2	TIC	Total S	AP	Modified NP	TIC/AP	NP/AP
		s.u.	wt%	kg $CaCO_3$/t	%	kg $CaCO_3$/t	kg $CaCO_3$/t		-
1a	P000	7.6	0.61	14	0.02	0.63	69	3.4	17
	P025	7.9	5.7	130	0.09	2.8	130	32	33
	P050	8.4	7.9	180	0.12	3.8	140	53	40
	P075	8.5	11	230	0.14	4.4	150	76	53
	P100	9.4	14	320	0.26	8.1	310	130	190
	Count	11.0	33	35	35	35	11	35	11
11c (n=1)	-	8.5	0.82	19	0.07	2.2	60	8.5	28

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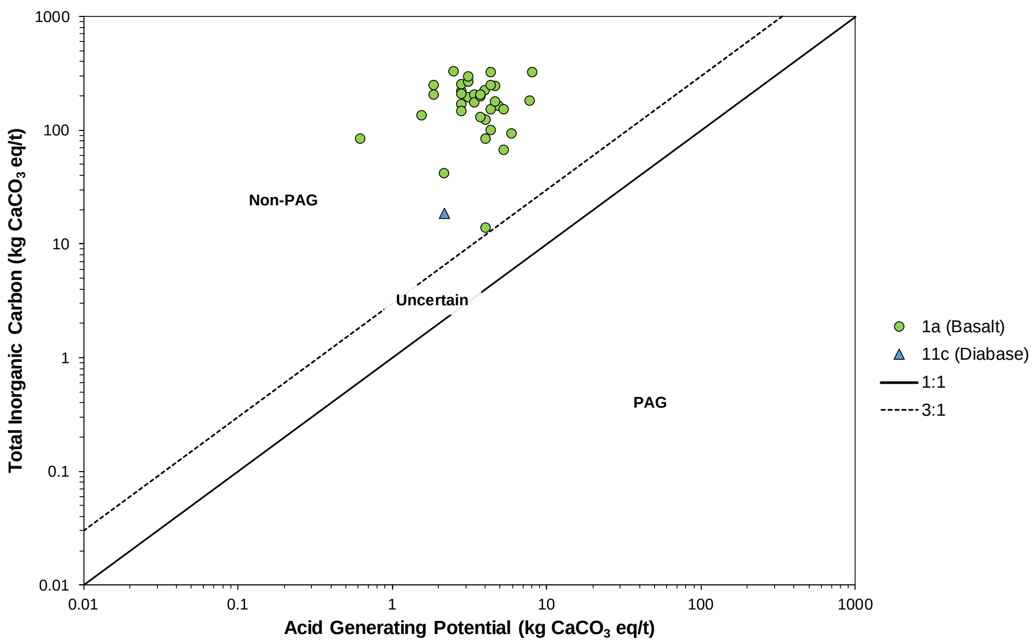

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Figure 3-3: TIC versus AP for Monitoring Samples

ABA

The expanded ABA for 11 mafic metavolcanics (1a) and one diabase (11c) samples are presented in Figure 3-4 and Figure 3-5 with a statistical summary presented in Table 3-1.

The paste pH for samples of 1a ranged from 7.6 to 9.4 whereas the pH for sample of 11c was 8.5.

For samples of 1a, 25th to 75th percentile values of Modified NP ranged from 130 to 150 kg $CaCO_3$/t. Modified NP for the diabase sample was 60 kg $CaCO_3$/t. For all samples with levels of Modified NP less than 100 kg $CaCO_3$/t, NP was greater than TIC, suggesting the occurrence of silicates measured by the NP method (Figure 3-4). For NP levels greater than 100 kg $CaCO_3$/t, TIC levels were typically greater than NP, which results in TIC values that overestimates the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. Consistent with TIC/AP, all samples were classified as non-PAG on the basis of NP/AP (Figure 3-5).

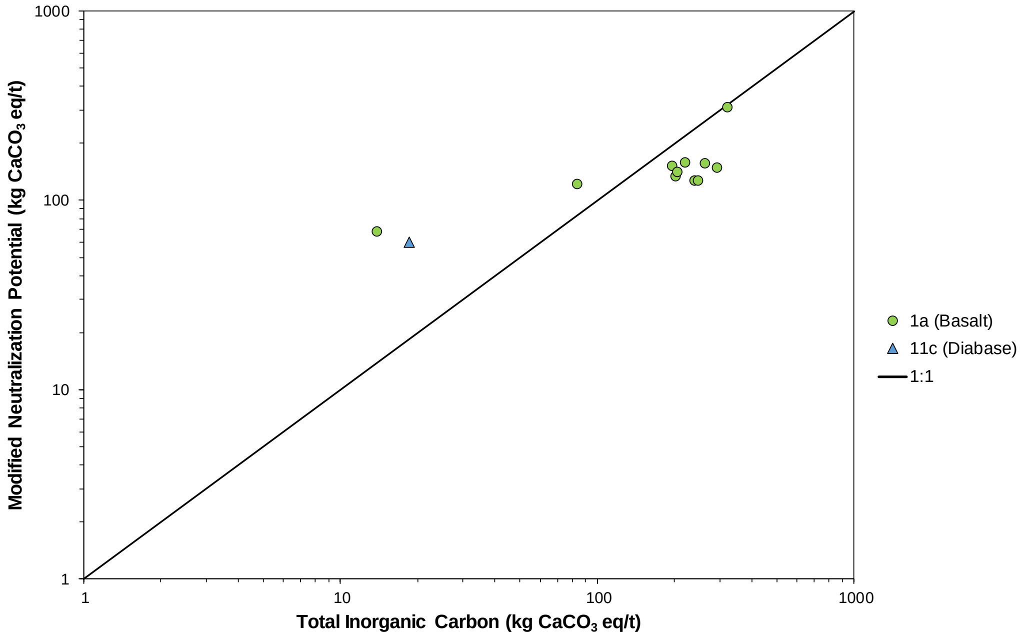

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Figure 3-4: Modified NP versus TIC for ABA Underground Waste Rock Samples

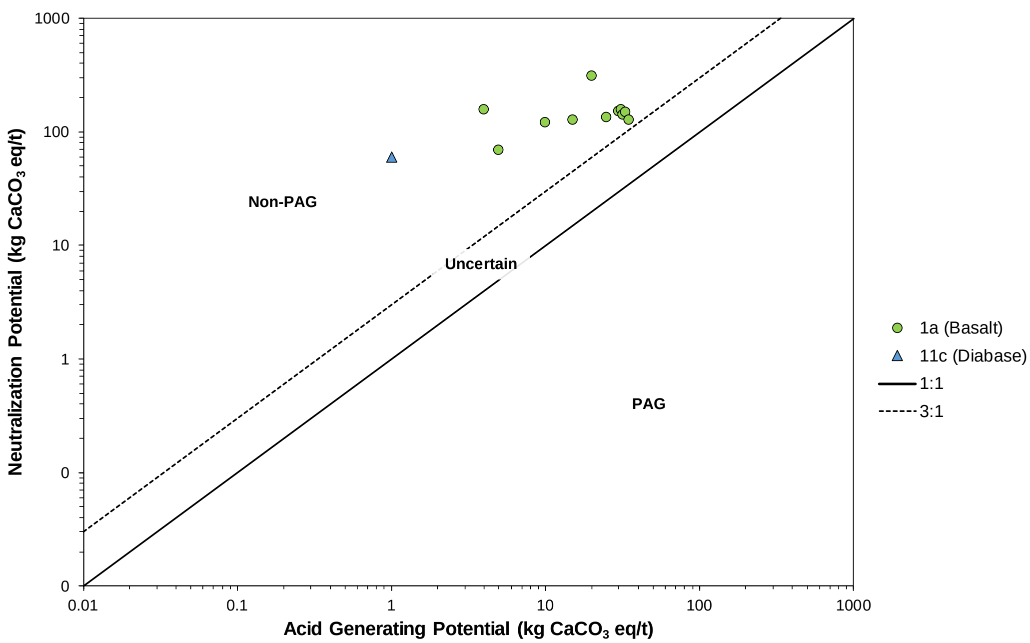

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Figure 3-5: Modified Sobek NP versus AP for ABA Underground Waste Rock Samples

Trace Elemental Analyses

Trace element data for eleven samples of metavolcanics (1a) and one sample of diabase (11c) are summarized in Table 3-2. Results were compared to ten times the average crustal abundance for basalt (Price 1997) as an indicator of enrichment.

Results indicate that concentrations of trace elements for all samples were less than ten times the average crustal abundance for basalt suggesting no appreciable enrichment.

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

Parameter	Detection Limit	Unit	Mafic metavolcanics (1a)					Diabase (11c)	10x Average Crustal Abundance* for Basalt
			P000	P025	P050	P075	P100	Result	
Ag	0.1	ppm	0.1	0.1	0.1	0.1	0.1	<0.1	1.1
As	0.5	ppm	0.5	1.2	1.8	3.6	12	1.2	20
Au	0.5	ppb	0.5	0.5	0.5	1.4	2.9	0.9	40
Ba	1	ppm	3	4	5	6.5	9	3	3300
Ca	0.01	%	3.3	4.6	5.2	5.8	7.9	2.4	76
Cd	0.1	ppm	0.1	0.1	0.1	0.1	0.1	0.1	2.2
Co	0.1	ppm	24	27	28	30	39	31	480
Cr	1	ppm	5	6	8	25	220	12	1700
Cu	0.1	ppm	15	25	28	67	340	30	870
Fe	0.01	%	5.3	7.9	9	9.7	10	11	86.5
Hg	0.01	ppb	0.01	0.01	0.01	0.03	0.12	<0.01	900
Mg	0.01	%	1.2	1.4	1.5	2	4	1.5	46
Mn	1	ppm	1100	1800	1900	2300	3300	1700	15000
Mo	0.1	ppm	0.1	0.2	0.3	0.4	0.4	0.3	15
Ni	0.1	ppm	0.8	1.3	1.7	8.1	100	1	1300
P	0.001	%	0.017	0.071	0.082	0.085	0.096	0.095	1
Pb	0.1	ppm	0.4	0.65	0.9	1.5	4.2	1.8	60
S	0.05	%	0.09	0.095	0.1	0.11	0.16	0.07	0.3
Sb	0.1	ppm	0.1	0.1	0.1	0.1	0.1	<0.1	2
Se	0.5	ppm	0.5	0.5	0.5	0.5	0.5	<0.5	0.5
Sr	1	ppm	18	28	40	50	92	22	4650
U	0.1	ppm	0.1	0.1	0.1	0.1	17	0.1	10
V	2	ppm	17	28	46	56	180	84	2500
W	0.1	ppm	0.1	0.1	0.1	0.1	0.1	<0.1	7
Zn	1	ppm	55	72	110	120	150	140	1050

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

Note:

* Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)
Statistics based on 11 samples.

3.2.2 CPRT

Laboratory testing data for the CPRT samples are provided in Attachments E (ABA), F (elemental analyses) and G (SFE tests).

Contact Tests

Contact rinse on the -2 mm fraction indicate relatively uniform values of pH (8.4 to 8.6) and EC (644 to 800 µS/cm) for all samples (Table 3-3).

Table 3-3: Rinse Test Results for 2018 CPRT Samples (-2 mm Fraction)

Sample ID	Rock Type	Size Fraction	Date	Rinse pH	Rinse EC
				s.u.	µS/cm
PITWR-01	1a	-2mm	05-Nov-18	8.4	803
PITWR-02	1a	-2mm	05-Nov-18	8.4	794
PITWR-03	1a	-2mm	02-Jan-19	8.6	644

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ABA

ABA data for the -2 mm and -1 cm size fractions are presented in Figure 3-6 to Figure 3-8 and Table 3-4.

Values of paste pH ranged from 8.4 to 9.2.

Overall, total sulphur content was low but was higher in the -2 mm fraction (0.22 to 0.33%) as compared to the -1 cm fraction (0.17 and 0.28%). Total sulphur content was at near parity with sulphide sulphur (calculated as the difference between total suphur and sulphate). Accordingly, total sulphur was used to calculate acid potential (AP).

TIC and Modified NP content ranged from 212 to 296 kg $CaCO_3$ eq/tonne and 125 to 199 kg $CaCO_3$ eq/tonne, respectively. There were no appreciable differences in TIC or NP content between size fractions. TIC content was greater than NP (Figure 3-6), suggesting that 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 3-7 and Figure 3-8).

Table 3-4: Summary of ABA Data, CPRT Samples

Sample ID	Rock Type	Size Fraction	Paste pH	TIC	Total S	SO_4	Sulphide Sulphur (by diff.)	AP	Mod. NP	TIC/AP	NP/AP
			s.u.	kg $CaCO_3$/t	%	%	%	kg $CaCO_3$/t			
PITWR-01	1a	-2mm	8.7	220	0.22	0.01	0.21	6.6	140	33	21
		-1 cm	8.9	210	0.17	0.01	0.16	5	130	42	26
PITWR-02	1a	-2mm	8.7	220	0.44	0.01	0.43	13.4	170	17	13
		-1 cm	9.2	250	0.28	<0.01	0.28	8.8	160	29	18
PITWR-03	1a	-2mm	8.4	270	0.33	<0.01	0.33	10.3	180	26	18
		-1 cm	8.5	300	0.26	<0.01	0.26	8.1	200	36	24

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

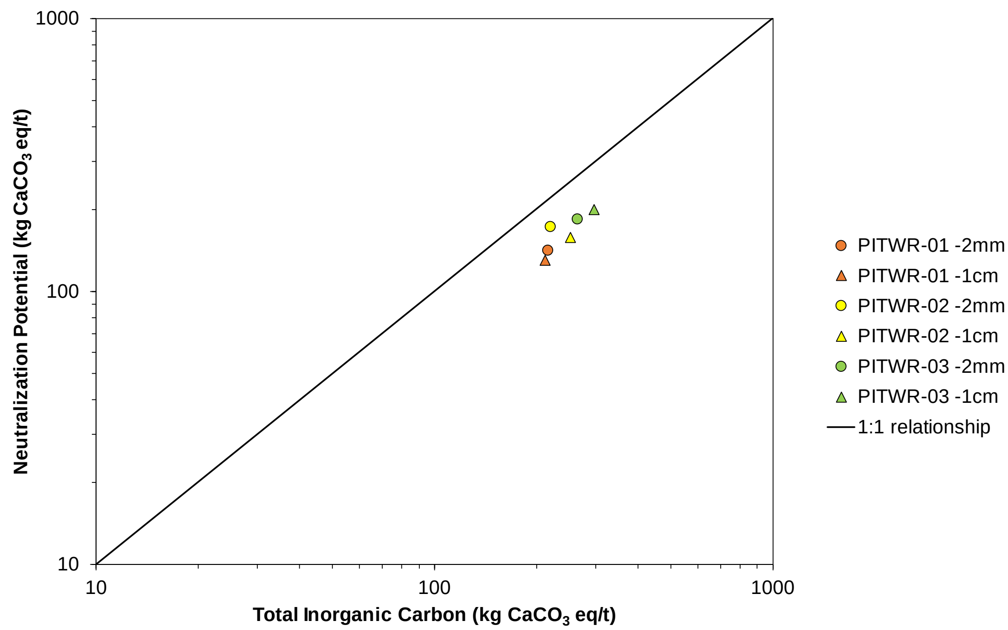

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Figure 3-6: Comparison of Modified NP versus TIC, CPRT Samples

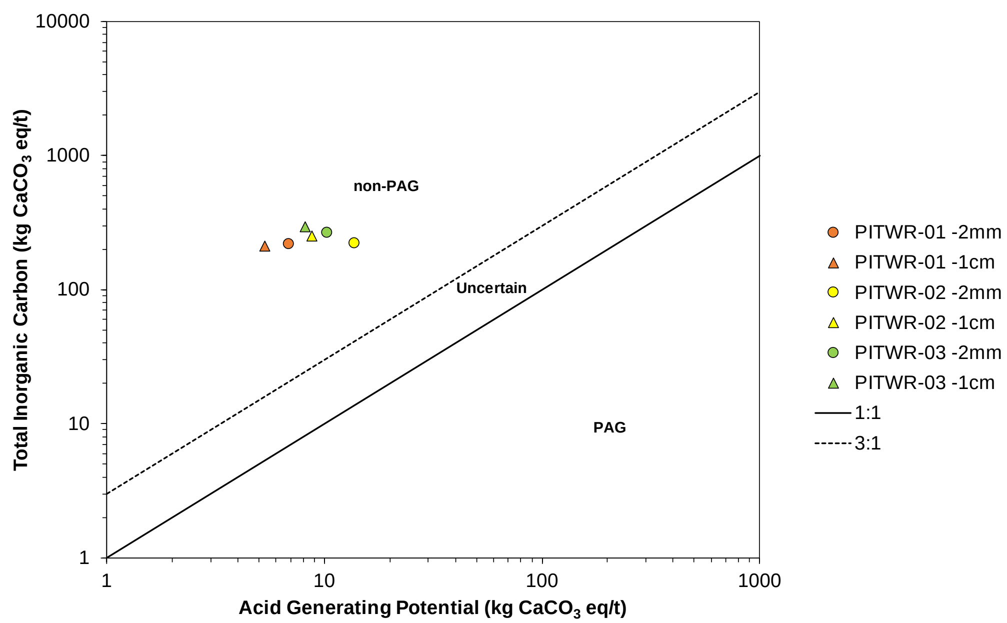

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Figure 3-7: ARD Classifications by TIC/AP, CPRT Samples

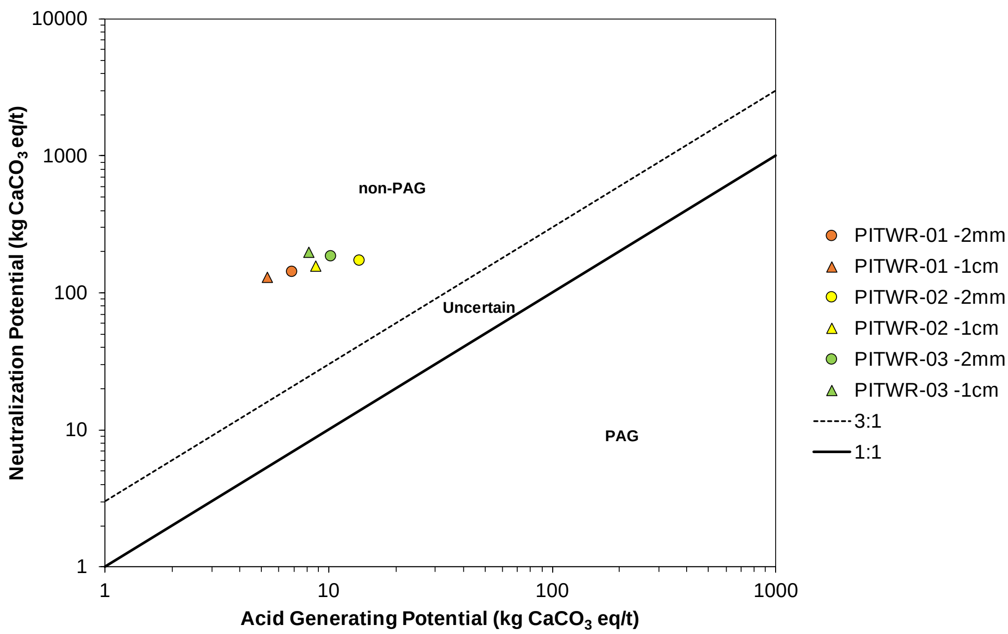

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Figure 3-8: ARD Classifications by NP/AP, CPRT Samples

Trace Elemental Analyses

A summary of trace element content is presented in Table 3-5 with complete laboratory results presented in Attachment F. Results were compared to ten times average crustal abundance for basalt (Price 1997) as an indicator of enrichment.

For two -2 mm samples, sulphur content was higher than the screening criterion to a maximum of 1.2 times. Arsenic content was 1.2 to 1.6 times higher than the screening criterion for both size fractions of PITWR-01 and PITWR-03 and the -2 mm fraction of PITWR-02. Both size fractions of PITWR-03 contained elevated gold concentrations that were 8.5 to 13 times greater than the screening criterion while the -2 mm fraction for the other samples contained gold levels 1.2 to 2.1 times higher.

Table 3-5: Summary of Elemental Analyses for CPRT Samples

Parameter	Unit	Detection Limit	Mafic Metavolcanics (1a)						10x Average Crustal Abundance* for Basalt
			PITWR-01		PITWR-02		PITWR-03		
			-2 mm	-1 cm	-2 mm	-1 cm	-2 mm	-1 cm	
Ag	ppb	100	100	100	200	100	120	75	1100
As	ppm	0.5	**22**	18	**25**	**23**	**33**	**29**	20
Au	ppb	0.5	**85**	9.5	**460**	16	**530**	**340**	40
Ba	ppm	1	14	6	13	9	12	9.4	3300
Ca	%	0.01	4	4.7	4.5	4.8	5.5	6	76
Cd	ppm	0.1	0.1	0.1	0.2	0.1	0.14	0.11	2.2
Co	ppm	0.1	34	29	31	29	40	38	480
Cr	ppm	1	37	23	37	30	63	55	1700
Cu	ppm	0.1	67	50	170	87	92	74	870
Fe	%	0.01	9	9.4	8.4	8.5	6.1	6.3	86.5
Hg	ppb	10	10	10	10	10	5	5	900
Mg	%	0.01	1.5	1.7	1.5	1.6	1.7	1.8	46
Mn	ppm	1	1800	2100	1900	2000	1400	1500	15000
Mo	ppm	0.1	0.8	0.6	1.1	0.6	1.1	1	15
Ni	ppm	0.1	9.1	5.5	17	14	75	63	1300
P	%	0.001	0.089	0.087	0.084	0.074	0.045	0.041	1
Pb	ppm	0.1	1.6	0.9	2.2	1.1	1.9	1.2	60
S	%	0.05	0.2	0.2	**0.35**	0.24	**0.31**	0.26	0.3
Sb	ppm	0.1	0.1	0.1	0.1	0.1	0.09	0.07	2
Se	ppm	0.5	0.5	0.5	0.8	0.9	0.3	0.3	0.5
Sr	ppm	1	33	33	28	28	21	23	4650
U	ppm	0.1	0.1	0.1	0.1	0.1	0.1	0.1	10
V	ppm	2	39	34	28	24	46	41	2500
W	ppm	0.1	3	0.3	0.7	0.1	0.1	0.3	7
Zn	ppm	1	130	110	120	76	66	64	1050

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

Note:

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

SFE Tests

Shake flask extraction tests were conducted on the as-received -2 mm size fraction of the CPRT samples. A summary of results for key parameters is presented in Table 3-6 and complete results are included in Attachment G.

All SFE tests had alkaline pH ranging from 8.5 to 9 s.u. Values of EC ranged from 430 to 490 µS/cm. Major cation chemistry was dominated by sodium (49 to 50 mg/L) and calcium (8.8 to 11 mg/L), while major anion chemistry is dominated by alkalinity (28 to 29 mg/L as $CaCO_3$), chloride (65 to 79 mg/L) and sulphate (25 to 43 mg/L). Nitrate concentrations ranged from 2.9 to

4.1 mg/L. The source of nitrates are ammonia-based explosives residues. No brines were used for during drilling of the CPRT.

The SFE results were compared to ten times the CCME guidelines for the protection of aquatic life (CCME 2014) to evaluate parameters that were elevated in the test leachate. Ammonia concentrations for two samples (1.5 and 1.97 mg/L) exceeded the screening criteria of 0.55 mg/L. As with nitrate, the source of ammonia is residues from explosives. The following parameters were consistently reported at concentrations less than their respective analytical limits of detection: beryllium, bismuth, cadmium, lanthanum, mercury, silver, tellurium, thorium, tin, zirconium.

Due to the high water to rock ratio, SFE tests are considered dilute and concentrations of contact water may be higher than those in the test leachates. However, results indicate that the potential for metal leaching from these samples is low.

Table 3-6: Shake Flask Extraction Results for 2018 CPRT Samples (-2 mm Fraction)

Sample ID	Unit	Detection Limit	Screening Criteria*	PITWR-01 -2 mm	PITWR-02 -2 mm	PITWR-03 -2 mm
pH	pH Units	5.87	6.5 - 9	9	9	8.5
EC	uS/cm	1.3		430	440	490
TDS	mg/L	10		200	190	
Hardness (as $CaCO_3$)	mg/L	0.5		48	43	60
Total Alkalinity	mg/L	0.5		28	29	67
SO_4	mg/L	0.5		25	43	38
Cl	mg/L	0.5	1200	79	65	67
Ca	mg/L	0.05		11	8.8	13
Mg	mg/L	0.05		5.2	5.2	6.4
K	mg/L	0.05		8.6	10	8.1
Na	mg/L	0.05		50	49	66
Nitrate	mg/L as N	0.2	30	4.1	2.9	3.4
Total Ammonia **	mg as N/L	0.047	0.55	**1.4**	**2**	0.4
Al	mg/L	0.0005	1	0.21	0.19	0.27
Sb	mg/L	0.00002		0.000093	0.000098	0.0013
As	mg/L	0.00002	0.05	0.0012	0.0017	0.0092
Ba	mg/L	0.00002		0.0021	0.0018	0.0017
B	mg/L	0.05		0.084	0.21	0.2
Cs	mg/L	0.00005		<0.00005	0.000052	
Cd ***	mg/L	0.000005	0.0008	<0.000005	<0.000005	<0.000005
Cr	mg/L			<0.0001	<0.0001	0.00013
Co	mg/L	0.000005		0.00099	0.001	0.0011
Cu ***	mg/L	0.00005	0.02	0.00068	0.00067	0.00067
La	mg/L	0.00005		<0.00005	<0.00005	
Fe	mg/L	0.001	3	0.044	0.022	0.032
Pb ***	mg/L	0.000005	0.01	0.000016	0.000013	0.000026
Li	mg/L	0.0005		0.0019	0.0024	0.0027
Mn	mg/L	0.00005		0.0084	0.0080	0.007
Mo	mg/L	0.00005	0.07	0.0026	0.0019	0.0043
Ni ***	mg/L	0.00002	0.25	0.00014	0.00011	0.00022
Se	mg/L	0.00004	0.01	0.00052	0.00095	0.0012
Sr	mg/L	0.00005		0.023	0.02	0.031
S	mg/L	10		<10	15	16
Tl	mg/L	0.000002	0.008	0.0000076	0.0000076	0.0000051
U	mg/L	0.000002		0.000054	0.000086	0.0002
V	mg/L	0.0002		0.00024	0.00024	0.00089
Zn	mg/L	0.0001	0.3	0.00038	0.0007	<0.0001
Hg ***	mg/L	0.00005	0.00005	<0.00005	<0.00005	<0.00001

Source: P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

Notes:

All element concentrations are given as dissolved

*Comparisons to ten times the CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because SFE tests do not represent natural waters.

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

**Guideline for ammonia is pH and temperature dependent. Standard room temperature (20ºC) was used given laboratory conditions and average pH of 9 for all SFE samples. This guideline value is approximate.

***Guideline calculated based on the average hardness of the SFE samples of 45 mg/L as $CaCO_3$

3.3 Comparison to Previous Waste Rock Geochemical Characterization Results

This section presents a geochemical comparison of waste rock samples according to rock type for the following samples sets: i) 2018 operational waste rock monitoring (underground and CPRT), ii) Type A water licence amendment application (SRK 2015) and iii) operational waste rock samples collected prior to 2018.

Table 3-7 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 rock type 1as is represented in SRK (2015).

Figure 3-9 to Figure 3-11 compares by rock type the geochemical results from the 2018 waste rock monitoring program to the other sample sets presented in Table 3-7. The results are discussed in subsequent sections.

Table 3-7: Overview of Waste Rock Geochemical Sample Sets

Rock Type	Sample Set and Type		Geology Code[1]	Geology Codes for Samples	Comment
Mafic Metavolcanics	2018 Operational Monitoring	Underground ROM	1a	1a	
		CPRT ROM	1a	1a	
	Pre-2018 Operational Monitoring	Underground ROM	1a	1a	
			1as	1as	
	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.
Diabase	2018 Operational Monitoring	Underground ROM	11c	11c	
	Pre-2018 Operational Monitoring	Underground ROM	11c	11c	
	Type A	Drill core	11	11c and 11cm	

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

3.3.1 Mafic Metavolcanics (1a)

For 2018 samples of 1a collected from the underground mine, median sulphur concentrations (0.12%, n=12) were roughly equivalent to median concentrations reported in the Type A sample set (0.15%, n=401) and 1a and 1as sample sets (0.14%, n=121) but 75th percentile concentrations (0.14%) were lower than all other sample sets. 2018 CPRT samples typically had higher sulphur content than the other samples sets with 25th to 75th percentile levels of total sulphur ranging from 0.23 to 0.32%. These sulphur levels were higher than equivalent values for all other metavolcanics sample sets, except altered basalt (1as), which had equivalent 75th percentile values.

For 2018 samples of 1a collected from the underground mine, 25th to 75th percentile levels of TIC (131 to 231 kg $CaCO_3$ eq/tonne) and NP (126 to 154 kg $CaCO_3$ eq/tonne) were higher than other 1a monitoring samples collected from the underground mine (25th and 75th percentile values of 7.7 and 186 kg $CaCO_3$ eq/tonne, respectively for TIC and 24 and 160 kg $CaCO_3$ eq/tonne, respectively for NP) and are 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 138 and 223 kg $CaCO_3$ eq/tonne , respectively for NP) and 1as operational samples (25th and 75th percentile values of 199 and 330 kg $CaCO_3$ eq/tonne, respectively for TIC and 154 and 231 kg $CaCO_3$ eq/tonne, respectively for NP). For the 2018 CPRT 1a samples, 25th to 75th percentile levels of TIC (219 to 262 kg $CaCO_3$ eq/tonne) and NP (145 to 195 kg $CaCO_3$ eq/tonne) were higher than the 2018 1a monitoring samples, and comparable to the Type A and 1as operational monitoring sample sets.

All samples of 1a collected from the underground mine in 2018 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 1a and 1as samples (Figure 3-10 and Figure 3-11).

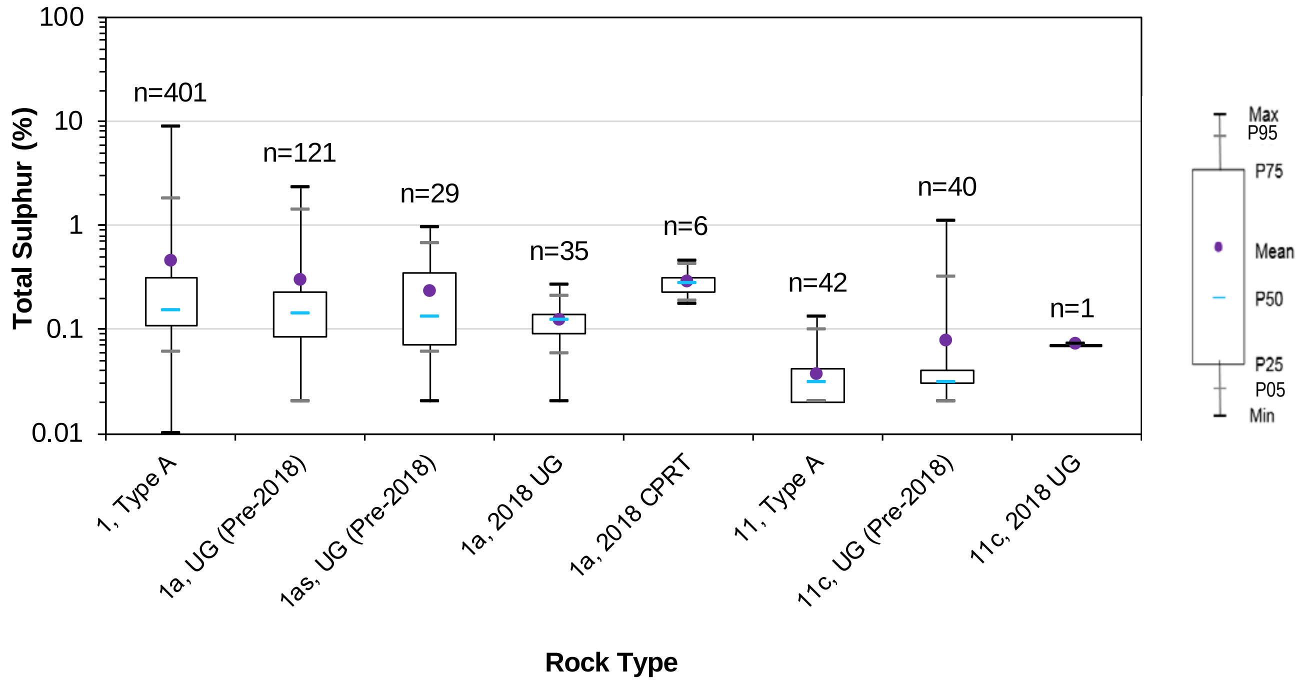
Solid-phase arsenic content can be elevated in waste rock (e.g. Section 3.2.2) and is mobile at neutral pH, though seepage monitoring of Doris waste rock does not indicate neutral pH arsenic leaching. For 2018 1a operational monitoring samples, 25th to 75th percentile levels of arsenic (1.2 to 3.6 mg/kg) were comparable to previous 1a operational monitoring samples (25th and 75th percentile levels of 0.7 and 7.1 mg/kg, respectively) and lower than the Type A (25th and 75th percentile levels of 1.9 and 30 mg/kg, respectively) and 1as operational monitoring sample sets (25th and 75th percentile levels of 5.5 and 28 mg/kg, respectively). For 2018 CPRT samples, overall arsenic was higher than the other sample sets, with 75th percentile levels of arsenic (28 mg/kg) roughly equivalent to the Type A and 1as operational monitoring sample sets, but 25th percentile levels (22 mg/kg) higher than the median levels for these aforementioned sample sets. The CPRT sample set is notably small (6 samples) compared to the other sample sets, with the geochemical characteristics of the CPRT samples are likely representative of the alteration envelope related to ore genesis. Arsenic content in the CPRT samples is 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).

3.3.2 Diabase (11c)

Reported total sulphur concentration for diabase (11c, 2018 UG) is greater than the P75 of the Type A and pre-2018 operational monitoring datasets (both 0.3%). TIC is also greater than the P95 for the historic datasets.

The non-PAG classification of the diabase (11c, 2018 UG) on the basis of TIC/AP and NP/AP, is consistent with the majority of diabase samples from the Type A and pre-2018 operational monitoring sample sets (Figure 3-10 and Figure 3-11).

The one 2018 diabase sample reported an arsenic concentration that is greater than the P75 values for the other sample sets (both 0.5 mg/kg).



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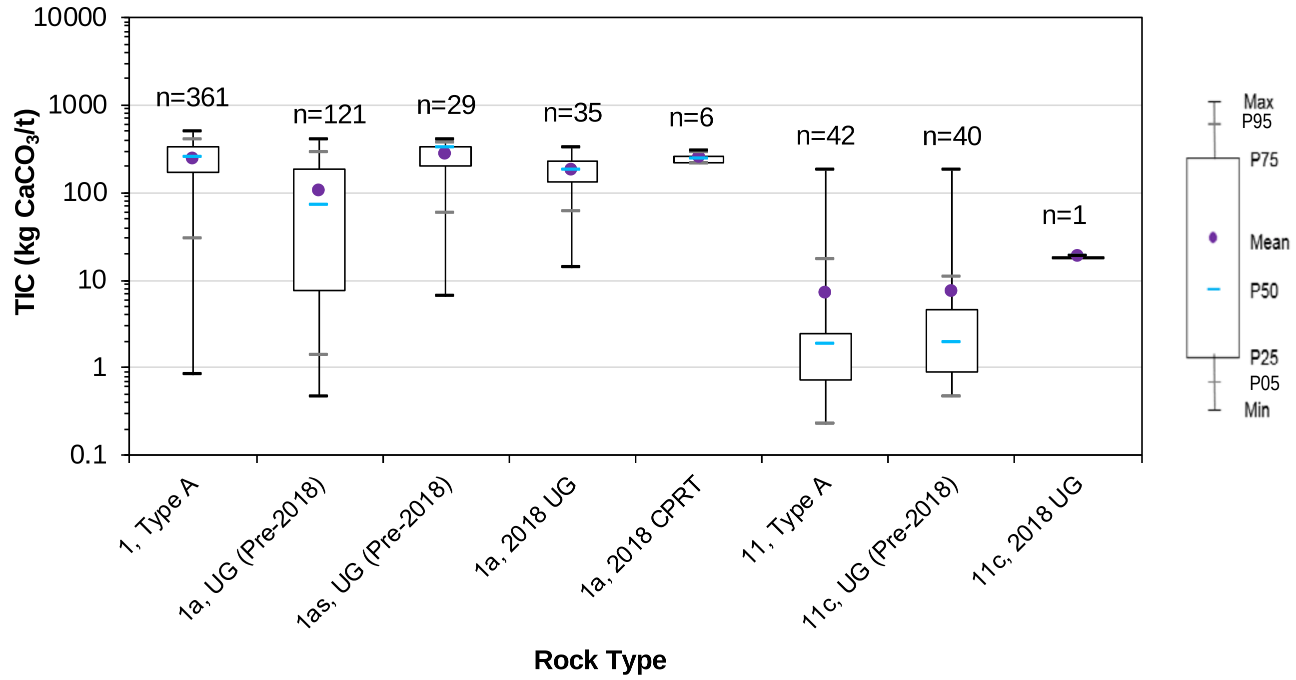

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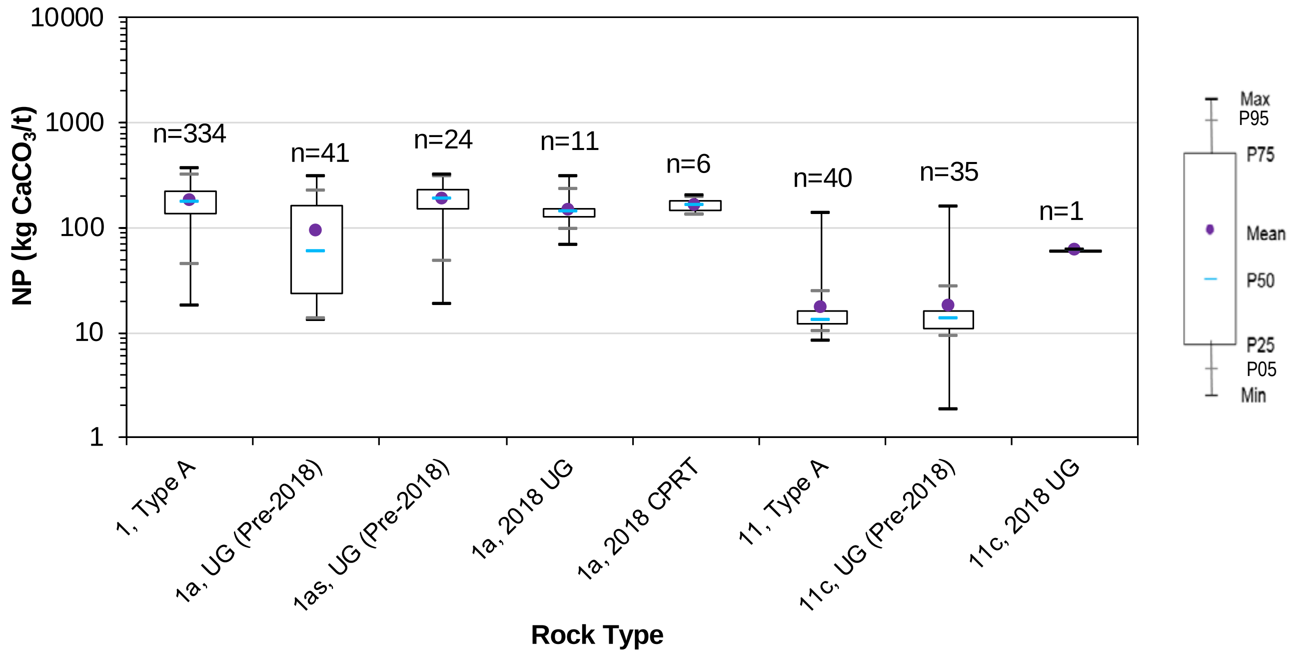

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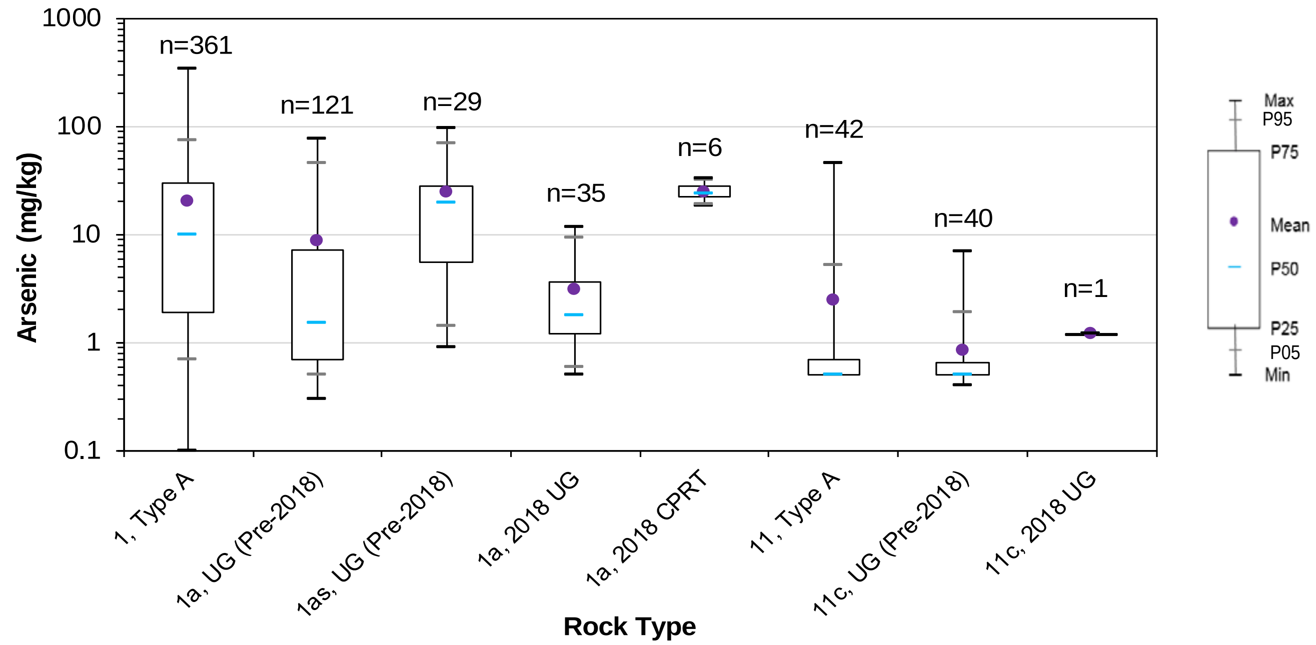

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Figure 3-9: Box and Whisker Plots of S, TIC, NP and Arsenic – Comparison of 2018 Doris Waste Rock Monitoring Samples to Other Waste Rock Sample Sets

(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)

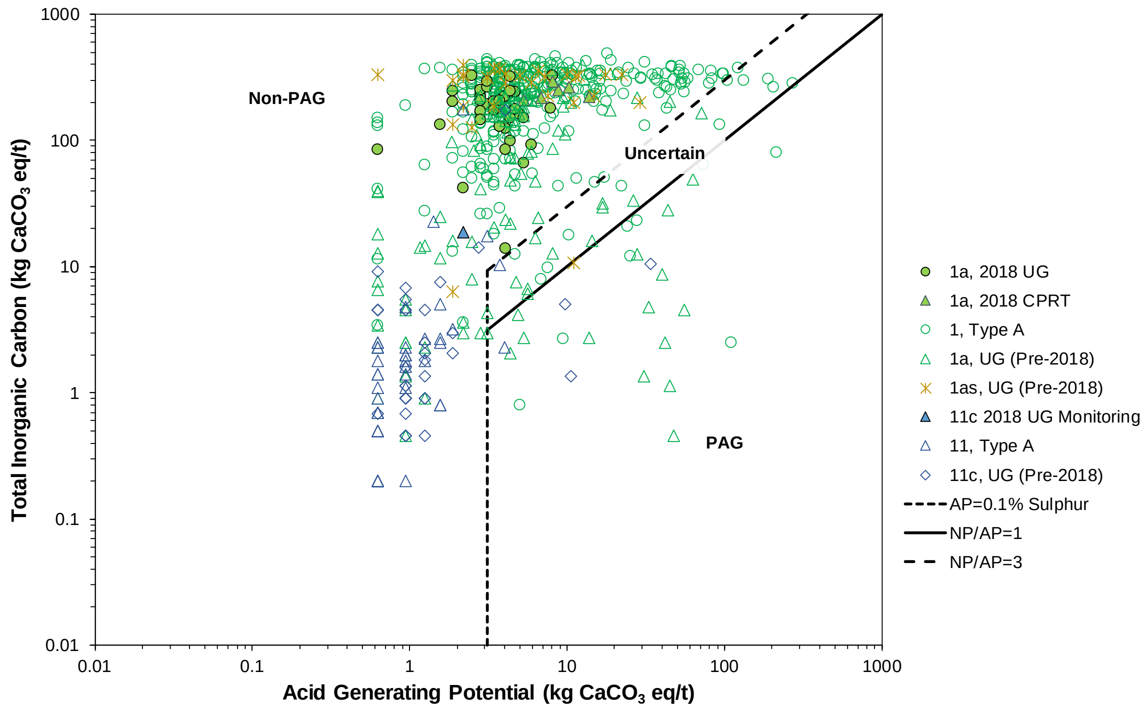

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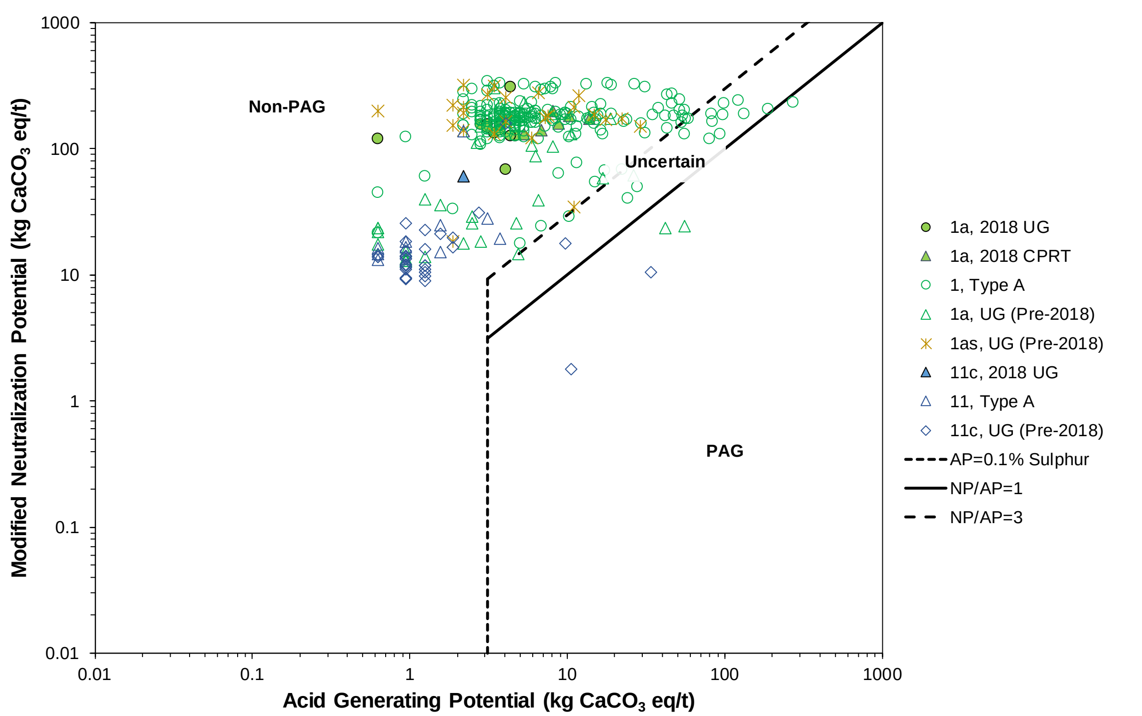
Figure 3-10: ARD Classifications by TIC/AP, Doris Waste Rock Samples



P:\30431 Hope Bay Geochemistry\Project\Waste Rock\Compilation File\HopeBay_WRMonitoring_1CT022.027_2018_JC_rev03.xlsx

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

4 Summary and Conclusions

In 2018, mine development at Doris included underground mining and development of the CPRT on surface. Waste rock brought to surface from all mining areas was placed on Pad T. All waste rock placed on Pad T was managed as mineralized rock.

In 2018, the Doris underground mine produced approximately 557,007 t of waste rock, of which almost half (260,452 t) was placed directly as backfill in the underground stopes with the balance (approximately 299,188 t) placed in a stockpile on the eastern side of Pad T. In 2018, 1,760 t of waste rock was moved from the waste rock stockpile on Pad T to the underground, where it was placed as backfill in underground stopes.

Mining of the CPRT 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 CPRT 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 CPRT. None of the CPRT waste rock was placed as backfill in 2018.

A total of 36 underground waste rock samples were collected as part of the waste rock geochemical monitoring program in 2018, with one sample geologically identified as diabase (11c) and the others as mafic metavolcanics (1a). The results of the geochemical test work program for underground waste rock monitoring samples is summarized as follows:

- For the mafic metavolcanics samples (1a), total sulphur content was uniformly low, ranging from 0.02 to 0.26% and median levels of 0.12%. TIC and Modified NP content was high (25^{th} to 75^{th} percentile levels ranging from 130 to 230 kg $CaCO_3$ eq/tonne and 126 to 154 , respectively). All samples were classified as non-PAG on the basis of TIC/AP and NP/AP.
- The one sample of diabase (11c) was characterized by low sulphur (0.07%) and low TIC and NP (19 and 60 kg $CaCO_3$ eq/tonne, respectively), and was classified as non-PAG on the basis of NP/AP and TIC/AP.
- Trace element content was below the screening criteria for all samples of 1a and 11c.
- Compared to the Type A and previous operational monitoring samples for mafic metavolcanics (1a), the geochemistry of the 2018 1a monitoring samples is described as follows:
  - Total sulphur, NP and TIC content and ARD classifications (non-PAG) were comparable.
  - Arsenic content for the 2018 1a samples was comparable to previous underground 1a monitoring samples but lower than the Type A and 1as (altered basalt) operational monitoring samples.

Mining initiated in the CPRT in November 2018. Three samples were collected representing CPRT waste rock from the stockpile on west end of Pad T and from within the trench. At each sampling location, TMAC collected two sieved fractions (-2 mm and -1 cm), for a total of six samples for geochemical analysis. The results of the geochemical test work program for CPRT waste rock are summarized as follows:

- Sulphur concentrations for the CPRT samples ranged from 0.17% to 0.44%, with slightly higher sulphur concentrations observed in the -2 mm size fraction.
- TIC and NP content ranged between 212 to 296 kg $CaCO_3$ eq/tonne and 130 to 199 kg $CaCO_3$ eq/tonne, respectively.
- All samples and size fractions were classified as non-PAG on the basis of TIC/AP and NP/AP.
- Arsenic showed enrichment compared to the screening criteria in -2 mm fraction for all samples and in the -1 cm fraction for two samples. Gold and sulphur were also higher than the screening criteria in the -2mm size fraction for two samples.
- SFE tests had alkaline pH (9 s.u.). Ammonia concentrations (1.5 mg/L and 1.97 mg/L) were higher than the screening criteria for the two samples. The source of ammonia is residues from explosives.
- CPRT samples had higher total sulphur and arsenic content compared to all other mafic metavolcanics operational monitoring and Type A sample sets. NP and TIC content were comparable to the Typa A and 1as operational monitoring samples sets, and were higher than all 1a operational samples. ARD classifications (non-PAG) were consistent with previous classifications.

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 acid rock drainage and metal leaching (ARD/ML). 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 2019) while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

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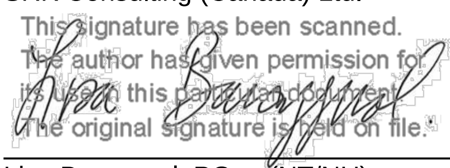

Lisa Barazzuol, PGeo (NT/NU)
Principal Consultant

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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 Inspection Logs (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
R828395	KC	18-Jan-18	DCO		433587.9	7558650.6	-110	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828396	KC	18-Jan-18	BTD		433776.6	7559770.0	-274	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828397	AP	05-Feb-18	4735 Sump	Frome face of first slash of sump	433896.0	7559730.8	-259	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Minor Hematite staining
R828398	AP	05-Feb-18	BTD	From muck pile of round blasted on Feb 3, 2017	433788.6	7559828.9	-282	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828399	KC	17-Feb-18	Quarry 2/Surface	Muck pile in quarry 2	432358.0	7559029.0	0	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		Hematite and chl staining on fractures/joints
R828400	KC	26-Feb-18	BTD	Face 26 Feb	433792.0	7559871.0	-288	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571451	GC	27-Feb-18	DCO	RMK corner 27 feb	433586.8	7558556.0	-120	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571452	AP	12-Apr-18	BTD	LW from face Blasted on April 7, 2018	433807.5	7559965.3	-297	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	1	2	
W571453	AP	12-Apr-18	BTD 4700 RMK	RW of face Blasted on April 6, 2018	433823.8	7559939.8	-295	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1	<1	
W571454	AP	12-Apr-18	BTD 4705 RMK	LW of face Blasted on March 23, 2018	433820.3	7559914.5	-293	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1	2	Mod Hematite and Chlorite Alt along joints and fractures
W571455	AP	12-Apr-18	DCO VA	Face as of April 6, 2018	433554.8	7558582.3	-116	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1	<1	
W571456	AP	12-Apr-18	DCO Ramp	Muck from April 12, 2018 blast	433587.2	7558527.6	-122	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571457	AP	12-Apr-18	DCO South Access RMK	Muck from April 8, 2018 blast	433681.4	7558564.3	-118	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571458	AP	12-Apr-18	4977 WLN	Muck from April 12, 2018 blast	433873.3	7559694.7	-19	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571466	AP	25-May-18	5002 WLN	From muck pile from May 24 blast	433778.9	7559355.9	-2	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
W571467	AP	25-May-18	4750 Access	From muck pile from May 24 blast	433844.2	7559809.6	-249	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571468	AP	25-May-18	DCO VA	Face of drill bay in DCO vent acc.	433548.6	7558563.8	-118	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	S	<1		
W571472	GL	25-Jun-18	BTD	BTD	433828.3	7560029.3	-307	Basalt and buffer zone	Total Sulphur and TIC		1a	<1		
W571475	GL	13-Aug-18	4690 Remuck	Corner of Remuck	433809.3	7559833.9	-284	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571476	AP	17-Aug-18	4982 Drill Cut out	Face as of Aug 17, 2018	433845.2	7559507.1	-15	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		Trace Hematite and Chlorite Alt along joints and fractures
W571477	AP	18-Aug-18	114 Access	Muck pile from blact taken Aug 17 NS	433706.6	7558379.0	-112	Diabase	ABA test	Not Mineralized	11c	<1		
W571478	AP	18-Aug-18	120 S. Access	Face as of Aug 18, 2018	433687.1	7558359.0	-114	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	1		Trace FE carbonate aleration.
W571479	AP	18-Aug-18	DCN Ramp	From muck pile from Aug 17 Blast	433687.6	7558345.6	-110	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571480	AP	01-Oct-18	4765 ELN	From muck pile from Sept 22 Blast	433905.0	7559802.5	-225	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Weak Sericite Alteration
W571481	AP	01-Oct-18	120 DCO Incline	From RW at ST# 9710	433641.2	7558345.3	-106	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Weak Hematite/Carbonate Alteration
W571482	AP	01-Oct-18	120 DCO South Access	From muck pile from Sept 30 Blast	433687.2	7558326.7	-111	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
W571483	AP	01-Oct-18	120 DCO Decline	From RW 9.5m from ST # 9704	433671.4	7558394.8	-113	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571484	GL	01-Nov-18	120 South Access	Srvy Stn # 94166	433689.9	7558298.5	-113	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571485	GL	01-Nov-18	120 DCO Incline	From Left Wall in Remuck	433612.7	7558371.1	-103	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571486	SS	01-Nov-18	120 Vent Drift (ELS)	8.1m from Main Sill (RW) Access (120 ELS)	433709.4	7558637.8	-113	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
W571489	AP	22-Nov-18	DCO Decline	Face as of Nov 22, 2018	433622.7	7558366.0	-120	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		<1% Carbonate Stringers
W571490	CA	23-Nov-18	96 DCO Vent	Near face as of 16-Nov-18	433691.8	7558667.0	-95	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		3% Qz/Carbonate Stringers
W571491	CA	23-Nov-18	BTD Decline	RW around face on 16-Nov-18	433846.2	7560088.0	-316	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		<1% Qz/Carbonate Stringers
W571492	GL	07-Dec-18	BTD Decline	1m from LW Bar	433839.0	7560081.0	-314	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
W571493	GL	08-Dec-18	DCN Ramp	Safety Bay	433628.1	7558245.0	-162	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	1		
W571494	SAS	08-Dec-18	96 vent access	Stop face of 96 vent access	433696.1	7558636.0	-93	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1	<1	Weak ser. Alteration; tr carb vntls

Attachment B – Geological Inspection Logs (CPRT – Blast Holes)

Nov 7/18 NS - J. Christmann

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Field	Value
Hole ID	TR-CN6
Project	CROWN PILLAR TRENCH
Location – Easting	
Location – Northing	
Azimuth	
Hole Depth	-4.5
Blast Pattern No.	
Drill Date	NOV 7/18 NS
Geologist	J. Christmann
Tech	
Comments	

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CN6 4.5
0	4.5		15%		Waste; las; TR S; drk gry/grn

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Field	Value
Hole ID	TR-CN7
Project	
Location – Easting	
Location – Northing	
Azimuth	
Depth	-4.6
Blast Pattern No.	
Drill Date	NOV 7/18 NS
Geologist	J. Christmann
Tech	
Comments	

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CN7 4.6
0	4.6		40%		las; TR S; ↑ Ser alt; (40 55)
					minor felsics

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Field	Value
Hole ID	TR-CN8
Project	
Location – Easting	
Location – Northing	
Azimuth	
Depth	-4.6
Blast Pattern No.	
Drill Date	NOV 7/18 NS
Geologist	J. Christmann
Tech	
Comments	

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CN8 4.6
0	4.6		5%		Waste; las; Tr S; med grey
					minor Chl alt

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Field	Value
Hole ID	TR-CN9
Project	
Location – Easting	
Location – Northing	
Azimuth	
Depth	-4.7
Blast Pattern No.	
Drill Date	NOV 7/18 NS
Geologist	J. Christmann
Tech	
Comments	

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CN9 4.7
0	4.7	Y034993	80%		Ore; las material; TR S (py)
					↑ Ser alt

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Field	Value
Hole ID	TR-CR8
Project	
Location – Easting	
Location – Northing	
Azimuth	
Depth	-4.7
Blast Pattern No.	
Drill Date	NOV 7/18 NS
Geologist	J. Christmann
Tech	
Comments	

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CR8 4.7
0	4.7		95%		Ore; las material; TR S; ↑ Ser alt

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR - CR4	Hole Depth	-4.4	Meters		Sample #	% Vein	BM Grade gpt	Description
Project	CROWN PILLAR TRENCH	Blast Pattern No.		From	To				CR4 4.4
Location Easting		Drill Date	NOV 7/18 NS	0	4.4		1%		Waste, la, drk grey
Location Northing	Azimuth								
Geologist	J Christmann	Comments							
Tech									

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR- CR5	Depth	-4.5	Meters		Sample #	% Vein	BM Grade gpt	Description
Project		Blast Pattern No.		From	To				CR5 4.5
Location Easting		Drill Date	Nov 7/18 NS	0	4.5		1%		Waste, la, drk grey
Location Northing	Azimuth								
Geologist	J. Christmann	Comments							
Tech									

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR - CR6	Depth	-4.5	Meters		Sample #	% Vein	BM Grade gpt	Description
Project		Blast Pattern No.		From	To				CR6 4.5
Location Easting		Drill Date	Nov 7/18 NS	0	4.5		1%		Waste; la; drk gy; TR S.(py)
Location Northing	Azimuth								
Geologist	J. Christmann	Comments							
Tech									

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR- CN4	Depth	-4.4	Meters		Sample #	% Vein	BM Grade gpt	Description
Project		Blast Pattern No.		From	To				CN 4 4.4
Location Easting		Drill Date	Nov 7/18 NS	0	4.4		1%		Waste, la, drk grey
Location Northing	Azimuth								
Geologist	J. Christmann	Comments							
Tech									

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR- CN5	Depth	4.4	Meters		Sample #	% Vein	BM Grade gpt	Description
Project		Blast Pattern No.		From	To				CN 5 4.4
Location Easting		Drill Date	Nov 7/18 NS	0	4.4		3%		Waste, la; drk grey
Location Northing	Azimuth								
Geologist	J. Christmann	Comments							
Tech									

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR- CR7	Hole Depth	-4.7
Project	CROWN PILLAR TRENCH	Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	NOV 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CR 7 4.7
0	4.7		5%		Waste; las (↑Ser) Chl alt; TR S

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR - CS 8	Depth	-4.5
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CS 8 4.5
0	4.5		95%		Ore; las material (↑Ser); White-light grey

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR- CS7	Depth	-4.5
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist		Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CS 7 -4.5
0	4.5		5-8%		Waste; las; med grey

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR- CS6	Depth	-4.4
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CS 6 4.4
0	4.4		3%		Waste; la; drk gry/grn

Send for Assay: Y/N

TMAC RESOURCES

Blast Hole Log/Drill Chip Log

Hole ID	TR - CS5	Depth	-4.5
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	NOV 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CS 5 4.5
0	4.5		1%		Waste; la; TR Py; drk gry/grn

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR- CT8	Hole Depth	-4.4
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CT 8 4.4
0	4.4		98%		Ore; minor las w̄ ↑ Ser; Tr Hm alt

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR- CT 7	Depth	-4.4
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CT 7 4.4
0	4.4		5%		Waste, la/las, TR S; med gry grn

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR- CT6	Depth	-4.5
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CT6 4.5
0	4.5		5%		Waste; la/las; med gry grn

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR- CT5	Depth	-4.4
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	Nov 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CT5 4.4
0	4.4		1%		Waste; la; drk grey grn.

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID		Depth	
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	
Geologist		Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR - CT4	Hole Depth	-4.4
Project	CROWN PILLAR TRENCH	Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	NOV 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CT4 4.4
0	4.4		1%		Waste, la, drk gry
					Dom. mg>cg

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR - CS4	Depth	-4.4
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	NOV 7/18 NS
Geologist		Comments	
Tech	J. Christmann		

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					CS4 -4.4
0	4.4		1%		Waste; la drk gry; minor Ser alt
					+ Chl alt

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID	TR - BZ4	Depth	-4.1
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	NOV 7/18 NS
Geologist	J. Christmann	Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description
					BZ4 -4.1
0	4.1		1%		Waste; la; drk grey; min Ser alt
					minor Chl alt

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID		Depth	
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	
Geologist		Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description

Blast Hole Log/Drill Chip Log

TMAC RESOURCES

Send for Assay: Y/N

Hole ID		Depth	
Project		Blast Pattern No.	
Location – Easting		Azimuth	
Location – Northing		Drill Date	
Geologist		Comments	
Tech			

Meters From	Meters To	Sample #	% Vein	BM Grade gpt	Description

Attachment C – Underground Waste Rock Laboratory Results – Full ABA

	WASTE ROCK SAMPLES		ABA											
			Sample ID	**Lab**	**Paste pH**	**CO2**	**TIC**	**Equiv. CaCO3**	**S(T)**	**AP from S**	**Modified NP**	**Fizz Test**	**TIC/AP**	**NP/AP**
			Unit		**Std. Units**	**wt%**	**%C**	**kg CaCO3/t**	**%S**		**kg CaCO3/t**	**-**		-
	GEOLOGIC DESCRIPTION		**Method Code**		Sobek	LECO	CSB02V	Calc.	CSA06V		Modified NP	Sobek	Calc.	Calc.
SAMPLE #	ROCK TYPE		**LOD**			0.08		1.8	0.02		0.1	#N/A		0.1
R828395	1a	Basalt	R828395	SGS			2.66	222	0.13	4.00			55.4	
R828396	1a	Basalt	R828396	SGS			1.95	163	0.16	4.94			32.9	
R828397	1a	Basalt	R828397	Maxxam		4.36	1.19	99.1	0.14	4.38			22.7	
R828398	1a	Basalt	R828398	Maxxam	7.61	9.69	2.64	220.2	0.09	2.81	157	STRONG	78.3	55.8
R828399	1a	Basalt	R828399	Maxxam	9.37	0.61	0.17	13.9	0.13	4.06	68.5	MODERATE	3.42	16.9
R828400	1a	Basalt	R828400	Maxxam		7.92	2.16	180	0.25	7.81			23.0	
W571451	1a	Basalt	W571451	Maxxam		5.43	1.48	123.4	0.13	4.06			30.4	
W571452	1a	Basalt	W571452	Maxxam		6.66	1.82	151.4	0.14	4.38			34.6	
W571453	1a	Basalt	W571453	Maxxam		6.62	1.81	150.5	0.17	5.31			28.3	
W571454	1a	Basalt	W571454	Maxxam	8.38	3.69	1.01	83.9	0.02	0.63	121	STRONG	134	194
W571455	1a	Basalt	W571455	Maxxam		11.02	3.01	250.5	0.09	2.81			89.1	
W571456	1a	Basalt	W571456	Maxxam		3.69	1.01	83.9	0.13	4.06			20.7	
W571457	1a	Basalt	W571457	Maxxam		2.93	0.80	66.6	0.17	5.31			12.5	
W571458	1a	Basalt	W571458	Maxxam		7.79	2.13	177.1	0.15	4.69			37.8	
W571466	1a	Basalt	W571466	Maxxam	8.57	10.61	2.90	241.1	0.15	4.69	126	MODERATE	51.4	26.9
W571467	1a	Basalt	W571467	Maxxam		4.08	1.11	92.7	0.19	5.94			15.6	
W571468	1a	Basalt	W571468	Maxxam		5.85	1.60	133	0.05	1.56			85.1	
W571472	1a	Basalt	W571472	Maxxam		1.84	0.50	41.8	0.07	2.19			19.1	
W571475	1a	Basalt	W571475	Maxxam		8.94	2.44	203.2	0.06	1.88			108	
W571476	1a	Basalt	W571476	Maxxam	8.08	14.14	3.86	321.4	0.14	4.38	309	MODERATE	73.5	70.6
W571477	11c	Diabase	W571477	Maxxam	8.52	0.82	0.22	18.6	0.07	2.19	60.3	SLIGHT	8.50	27.6
W571478	1a	Basalt	W571478	Maxxam		8.55	2.33	194.3	0.10	3.13			62.2	
W571479	1a	Basalt	W571479	Maxxam		5.69	1.55	129.3	0.12	3.75			34.5	
W571480	1a	Basalt	W571480	Maxxam		10.83	2.96	246.1	0.06	1.88			131	
W571481	1a	Basalt	W571481	Maxxam		9.17	2.50	208.4	0.09	2.81			74.1	
W571482	1a	Basalt	W571482	Maxxam	8.59	8.95	2.44	203.4	0.11	3.44	133	MODERATE	59.2	38.7
W571483	1a	Basalt	W571483	Maxxam		14.28	3.90	324.6	0.08	2.50			130	
W571484	1a	Basalt	W571484	Maxxam		7.65	2.09	173.9	0.11	3.44			50.6	
W571485	1a	Basalt	W571485	Maxxam		7.45	2.03	169.3	0.09	2.81			60.2	
W571486	1a	Basalt	W571486	Maxxam		14.22	3.88	323.2	0.26	8.13			39.8	
W571489	1a	Basalt	W571489	Maxxam	8.39	8.67	2.37	197.1	0.12	3.75	151	MODERATE	52.6	40.3
W571490	1a	Basalt	W571490	Maxxam	7.75	11.62	3.17	264.1	0.1	3.13	156	MODERATE	84.5	49.9
W571491	1a	Basalt	W571491	Maxxam	7.82	9.03	2.46	205.2	0.12	3.75	141	MODERATE	54.7	37.6
W571492	1a	Basalt	W571492	Maxxam	7.98	12.93	3.53	293.9	0.1	3.13	148	MODERATE	94.0	47.4
W571493	1a	Basalt	W571493	Maxxam		6.38	1.74	145	0.09	2.81			51.6	
W571494	1a	Basalt	W571494	Maxxam	8.39	10.88	2.97	247.3	0.14	4.38	126	MODERATE	56.5	28.8

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

TMAC RESOURCES

WASTE ROCK SAMPLES

Metals

SAMPLE #	ROCK TYPE	GEOLOGIC DESCRIPTION	Lab	Sample ID	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
				Unit >	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
				Method Code >	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250
				LOD >	0.1	0.1	0.1	1	100	0.1	0.1	1	0.01	0.5	0.1	0.5	0.1	1	0.1	0.1	0.1	2	0.01
R828398	1a	Basalt	Maxxam	R828398	0.30	24.8	1.70	116	< 0.10	3.90	28.8	2400	8.93	1.00	< 0.10	2.90	0.30	50.0	0.10	< 0.10	< 0.10	46.0	5.76
R828399	1a	Basalt	Maxxam	R828399	0.20	129	1.00	68.0	< 0.10	60.3	38.2	1110	5.34	5.10	< 0.10	1.40	0.30	27.0	< 0.10	< 0.10	< 0.10	124	3.27
W571454	1a	Basalt	Maxxam	W571454	< 0.10	99.7	0.70	55.0	< 0.10	103	39.0	1180	5.76	< 0.50	< 0.10	1.80	< 0.10	92.0	< 0.10	< 0.10	< 0.10	178	4.98
W571466	1a	Basalt	Maxxam	W571466	0.40	27.7	2.10	76.0	< 0.10	6.50	25.6	1760	7.15	6.60	< 0.10	< 0.50	0.30	18.0	< 0.10	< 0.10	< 0.10	17.0	5.24
W571476	1a	Basalt	Maxxam	W571476	0.40	336	4.20	68.0	< 0.10	9.60	27.0	3320	10.1	11.8	17.2	0.70	0.20	29.0	< 0.10	0.10	< 0.10	30.0	7.91
W571477	11c	Diabase	Maxxam	W571477	0.30	29.7	1.80	140	< 0.10	1.00	31.1	1660	10.6	1.20	0.10	0.90	0.50	22.0	0.10	< 0.10	< 0.10	84.0	2.44
W571482	1a	Basalt	Maxxam	W571482	0.20	21.6	0.60	113	< 0.10	1.00	27.3	1820	8.74	1.70	< 0.10	< 0.50	0.30	49.0	< 0.10	< 0.10	< 0.10	46.0	4.53
W571489	1a	Basalt	Maxxam	W571489	0.10	25.4	0.40	116	< 0.10	0.80	27.6	2260	9.57	0.70	< 0.10	1.30	0.30	40.0	0.10	< 0.10	< 0.10	66.0	4.58
W571490	1a	Basalt	Maxxam	W571490	0.40	25.0	1.20	118	< 0.10	1.50	26.4	2270	9.31	1.40	< 0.10	< 0.50	0.30	60.0	0.10	< 0.10	< 0.10	40.0	5.91
W571491	1a	Basalt	Maxxam	W571491	0.30	34.0	0.70	150	< 0.10	1.70	31.6	1850	9.75	1.80	< 0.10	< 0.50	0.20	23.0	0.10	< 0.10	< 0.10	46.0	5.53
W571492	1a	Basalt	Maxxam	W571492	0.20	14.7	0.90	109	< 0.10	1.50	24.2	2380	9.01	2.10	< 0.10	< 0.50	0.20	31.0	0.10	< 0.10	< 0.10	26.0	6.81
W571494	1a	Basalt	Maxxam	W571494	0.40	30.2	0.50	131	< 0.10	0.80	28.7	1900	10.2	1.80	< 0.10	< 0.50	0.30	44.0	0.10	< 0.10	< 0.10	24.0	4.28

SAMPLE #	ROCK TYPE	GEOLOGIC DESCRIPTION	Lab	Sample ID	P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga
				Unit >	%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm
				Method Code >	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250	AQ250
				LOD >	0.001	1	1	0.01	1	0.001	20	0.01	0.001	0.01	0.1	0.1	0.1	0.05	10	0.5	0.2	1
R828398	1a	Basalt	Maxxam	R828398	0.082	4.00	22.0	1.44	9.00	0.0070	< 20.0	2.15	0.034	0.040	< 0.10	< 0.010	15.9	< 0.10	0.090	< 0.50	< 0.20	11.0
R828399	1a	Basalt	Maxxam	R828399	0.033	3.00	160	2.25	5.00	0.35	< 20.0	2.88	0.018	0.020	< 0.10	< 0.010	6.20	< 0.10	0.12	< 0.50	< 0.20	7.00
W571454	1a	Basalt	Maxxam	W571454	0.017	< 1.00	218	4.03	4.00	0.013	< 20.0	3.88	0.015	0.030	< 0.10	< 0.010	28.4	< 0.10	< 0.050	< 0.50	< 0.20	10.0
W571466	1a	Basalt	Maxxam	W571466	0.067	2.00	28.0	1.51	7.00	0.0020	< 20.0	1.03	0.028	0.030	< 0.10	11.1	< 0.10	0.16	< 0.010	< 0.50	< 0.20	4.00
W571476	1a	Basalt	Maxxam	W571476	0.074	5.00	10.0	2.96	9.00	0.0030	< 20.0	2.26	0.040	0.040	< 0.10	14.3	< 0.10	0.11	< 0.010	< 0.50	< 0.20	7.00
W571477	11c	Diabase	Maxxam	W571477	0.095	6.00	12.0	1.51	3.00	0.16	< 20.0	2.66	0.020	< 0.010	< 0.10	23.5	< 0.10	0.070	< 0.010	< 0.50	< 0.20	16.0
W571482	1a	Basalt	Maxxam	W571482	0.081	3.00	8.00	1.15	4.00	0.0040	< 20.0	1.93	0.018	0.020	< 0.10	16.5	< 0.10	0.090	< 0.010	< 0.50	< 0.20	11.0
W571489	1a	Basalt	Maxxam	W571489	0.085	3.00	6.00	1.70	3.00	0.0050	< 20.0	2.59	0.017	0.010	< 0.10	23.1	< 0.10	0.11	< 0.010	< 0.50	< 0.20	15.0
W571490	1a	Basalt	Maxxam	W571490	0.085	4.00	6.00	1.56	6.00	0.0030	< 20.0	2.03	0.035	0.030	< 0.10	15.5	< 0.10	0.090	< 0.010	< 0.50	< 0.20	10.0
W571491	1a	Basalt	Maxxam	W571491	0.096	2.00	5.00	1.38	5.00	0.0020	< 20.0	2.79	0.056	0.030	< 0.10	16.3	< 0.10	0.090	< 0.010	< 0.50	< 0.20	12.0
W571492	1a	Basalt	Maxxam	W571492	0.085	1.00	5.00	1.33	4.00	0.0010	< 20.0	1.46	0.049	0.030	< 0.10	13.9	< 0.10	0.10	< 0.010	< 0.50	< 0.20	6.00
W571494	1a	Basalt	Maxxam	W571494	0.090	4.00	7.00	1.42	5.00	0.0020	< 20.0	1.24	0.033	0.040	< 0.10	13.0	< 0.10	0.10	< 0.010	< 0.50	< 0.20	6.00

Attachment E – CPRT Laboratory Results – Full ABA

Client ID	Sample ID	Size Fraction	Sample Date	Sample Location	Rock Type	Description	Fizz Test Results	Contact Test Date	Contact Test pH	Contact Test EC (uS)	Contact Test DI pH	Contact Test DI EC (uS)
Y035551	PITWR-01	-2mm	05-Nov-18	Pit WR stockpile on west end of Pad T	1a	Trace Py	Slight-Moderate	11-Nov-18	8.4	803	7.9	1
Y035551	PITWR-01	-10mm	05-Nov-18	Pit WR stockpile on west end of Pad T	1a	Trace Py						
Y035552	PITWR-02	-2mm	05-Nov-18	Pit WR stockpile within trench	1a	Trace Py	Slight-Moderate	11-Nov-18	8.4	794	7.9	1
Y035552	PITWR-02	-10mm	05-Nov-18	Pit WR stockpile within trench	1a	Trace Py						
Y035553	PITWR-03	-2mm	02-Jan-19	Top of WR stockpile on west end of P	1a	Light-medium grey-greenish Mafic volcanic. Trace fine grained Pyrite/Chalcopyrite, trace quartz-carbonate veinlets. Local weak sericite and chlorite alteration, with local iron staining.	Moderate-strong	03-Jan-19	8.6	622	8	7
Y035554	PITWR-03	-1 cm	02-Jan-19	Top of WR stockpile on west end of P	1a	Light-medium grey-greenish Mafic volcanic. Trace fine grained Pyrite/Chalcopyrite, trace quartz-carbonate veinlets. Local weak sericite and chlorite alteration, with local iron staining.	Weak					

Client ID	Sample ID	Size Fraction	Paste pH	CO2	TIC	$CaCO_3$ Equiv.	Total S	HCl Extractable Sulphur	Sulphide Sulphur (by diff.)	Acid Generation Potential	Mod. ABA Neutralization Potential	Fizz Rating	Net Neutralization Potential	TIC/AP	Neutralization Potential Ratio
			pH Units	wt%	%	kg $CaCO_3$/t	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A	kg $CaCO_3$/t		N/A
Y035551	PITWR-01	-2mm	8.74	9.58		218	0.22	0.01	0.21	6.6	141	MODERATE	135	33	21.4
Y035551	PITWR-01	-10mm	8.89	9.32		212	0.17	0.01	0.16	5.0	130	MODERATE	125	42	26.0
Y035552	PITWR-02	-2mm	8.73	9.73		221	0.44	0.01	0.43	13.4	172	MODERATE	159	17	12.8
Y035552	PITWR-02	-10mm	9.16	11.11		253	0.28	<0.01	0.28	8.8	158	MODERATE	150	29	18.0
Y035553	PITWR-03	-2mm	8.4		3.19	265.8	0.329	<0.01	0.33	10.3	183.5	Moderate	173	26	17.8
Y035554	PITWR-03	-1 cm	8.5		3.55	295.8	0.26	<0.01	0.26	8.13	198.8	Moderate	191	36	24.5

Attachment F – CPRT Laboratory Results – Multi Element Analysis

Client ID	Sample ID	Size Fraction	Mo ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	Co ppm	Mn ppm	Fe %	As ppm	U ppm
Y035551	PITWR-01	-2mm	0.8	67.3	1.6	127	<0.1	9.1	34.4	1760	8.99	22.0	0.1
Y035551	PITWR-01	-10mm	0.6	49.6	0.9	106	<0.1	5.5	29.0	2050	9.39	18.3	<0.1
Y035552	PITWR-02	-2mm	1.1	171	2.2	116	0.2	16.7	31.2	1880	8.40	25.2	0.1
Y035552	PITWR-02	-10mm	0.6	86.5	1.1	76	<0.1	13.6	29.0	2040	8.54	22.6	<0.1

Client ID	Sample ID	Size Fraction	P %	La ppm	Cr ppm	Mg %	Ba ppm	Ti %	B ppm	Al %	Na %	K %	W ppm
Y035551	PITWR-01	-2mm	0.089	5	37	1.54	14	0.007	<20	1.83	0.060	0.11	3.0
Y035551	PITWR-01	-10mm	0.087	4	23	1.65	6	0.006	<20	1.58	0.027	0.06	0.3
Y035552	PITWR-02	-2mm	0.084	4	37	1.50	13	0.009	<20	1.27	0.063	0.11	0.7
Y035552	PITWR-02	-10mm	0.074	3	30	1.59	9	0.007	<20	0.92	0.039	0.08	<0.1

Au ppb	Th ppm	Sr ppm	Cd ppm	Sb ppm	Bi ppm	V ppm	Ca %
85.0	0.7	33	0.1	<0.1	<0.1	39	4.02
9.5	0.4	33	<0.1	<0.1	<0.1	34	4.65
458	0.7	28	0.2	<0.1	<0.1	28	4.53
15.9	0.5	28	<0.1	<0.1	<0.1	24	4.79

Hg ppm	Sc ppm	Tl ppm	S %	Ga ppm	Se ppm	Te ppm
<0.01	12.1	<0.1	0.20	7	<0.5	<0.2
<0.01	12.7	<0.1	0.20	7	<0.5	<0.2
<0.01	9.0	<0.1	0.35	4	0.8	<0.2
<0.01	8.6	<0.1	0.24	3	0.9	<0.2

Attachment G – CPRT Laboratory Results – SFE

Client ID	Sample ID	Size Fraction	Sample Weight	Volume Used	pH	EC	SO_4	Acidity to pH4.5	Acidity to pH8.3	Total Alkalinity	Bicarbonate	Carbonate	Hydroxide	Cl	NO_3-N	NO_2-N	Total NH_4	TDS	Hardness $CaCO_3$	Al	Sb	As
			g	ml	pH Units	uS/cm	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
Y035551	PITWR-01	-2mm	250	750	8.96	427.0	25.1	<0.5	<0.5	28	34	<0.5	<0.5	78.6	4.1	0.11	1.35	200	47.6	0.206	0.000093	0.00124
Y035552	PITWR-02	-2mm	250	750	9.01	438.0	43.1	<0.5	<0.5	29	35	<0.5	<0.5	64.9	2.9	0.08	1.97	190	43.3	0.189	0.000098	0.00174

Client ID	Sample ID	Size Fraction	Ba	Be	Bi	B	Cs	Cd	Ca	Cr	Co	Cu	La	Fe	Pb	Li	Mg	Mn	P	Mo	Ni	K
			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
Y035551	PITWR-01	-2mm	0.00211	<0.000010	<0.0000050	0.084	<0.000050	<0.0000050	10.5	<0.00010	0.000993	0.000677	<0.000050	0.0441	0.0000155	0.00193	5.19	0.00841	0.0051	0.00263	0.000142	8.56
Y035552	PITWR-02	-2mm	0.00183	<0.000010	<0.0000050	0.212	0.000052	<0.0000050	8.84	<0.00010	0.00103	0.000673	<0.000050	0.0219	0.0000132	0.00243	5.15	0.00800	0.0058	0.00192	0.000106	9.95

Client ID	Sample ID	Size Fraction	Rb	Se	Si	Ag	Na	Sr	S	Te	Tl	Th	Sn	Ti	W	U	V	Zn	Zr	Hg
			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
Y035551	PITWR-01	-2mm	0.00380	0.000515	0.51	<0.0000050	49.8	0.0233	<10	<0.000020	0.0000076	<0.0000050	<0.00020	0.00070	0.0177	0.0000541	0.00024	0.00038	<0.00010	<0.000050
Y035552	PITWR-02	-2mm	0.00663	0.000947	0.44	<0.0000050	49.3	0.0196	15	<0.000020	0.0000076	<0.0000050	<0.00020	0.00088	0.00275	0.0000859	0.00024	0.00070	<0.00010	<0.000050

Appendix B – 2018 Doris Waste Rock, Ore and Infrastructure Seep Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Marie-Christine Noel Lisa Barazzuol	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 20, 2019
Subject:	2018 Doris Waste Rock, Ore and Infrastructure Seep Monitoring		

1 Introduction

As part of the verification, monitoring and management plans for the Hope Bay Project (the Project), TMAC monitors seepage downstream of the Doris North infrastructure, pads, roads, and waste rock. The 2018 seepage program was completed by TMAC in accordance with conditions outlined in Part D “Conditions applying to Construction and Operations” Item 20 of Water Licence 2AM-DOH1323 Amendment No. 1 (Nunavut Water Board 2016), Quarry Management and Monitoring Plan (TMAC 2017) and the Waste Rock and Ore Management Plan, Hope Bay Project, Nunavut (TMAC 2016).

This memo presents the results of the 2018 freshet seep survey and complies with Item 21 of the Water Licence cited above. It includes seepage monitoring of the Doris waste rock stockpiles and infrastructure constructed at Doris between 2017 to mid-2018 using Quarry 2 rock, including:

- South dam and southern extent of Tailings Impoundment Area (TIA) access road;
- Tailings catchment basin (east of Doris Creek)
- Jetty road (widened and regraded);
- Cyanide reagent pad (new material placed on top);
- Airstrip south apron; and
- East airstrip access road.

2 Methods

2.1 Seep Survey and Sample Collection

TMAC conducted the waste rock and construction (quarry) rock seep survey between June 14 and 15, 2018 in the areas outlined in Section 1. Seep survey locations were established opportunistically by walking the toes of the waste rock stockpile, infrastructure, roadways, and berms outlined in Section 1 (Attachment A). Additionally, three reference points in the tundra, not subject to mine influences, were sampled. The samples used as reference points were collected at approximately the same points as the 2010-2017 seep surveys (in the vicinity of the Doris-Windy Road, Attachment A)

A total of 13 seepage sites and 3 reference sites were established. Of the thirteen seepage sites, six sites were in along the TIA Access Road, five were in the waste rock influenced area, and two were at the airstrip. Seepage was not observed in the other areas inspected.

Field measurements were taken at all locations where water was observed flowing into and out of construction rock material including seeps 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.

As per the water licence, a minimum of 10% of the total sample set, including any sites with elevated conductivity, were submitted to a laboratory for an extended analytical suite. A total of 16 samples was collected and submitted to the laboratory. In addition, 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 quality assurance/quality control (QA/QC) program.

TMAC submitted 19 samples (including a duplicate and field and travel blanks) to ALS Environmental Labs in Vancouver, BC where they were analyzed for pH, conductivity, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and low level dissolved metals including mercury and selenium. All samples were filtered and preserved in the field, as required.

2.2 Quality Assurance

QA/QC review of all data was conducted by SRK and deemed overall acceptable.

Ion balances ranged from -16.2 to 9.1% for the seep samples. One sample exceeded SRK's criteria of ±10% (18-REF-01) with an ion balance of -16.2%. As the sample had very low concentrations of ions (electrical conductivity <100 µS/cm) this was deemed acceptable. All other samples complied with SRK's criteria.

Field blank parameters were below detection limits indicating that appropriate field filtration and sampling methods were employed. The field duplicate results were within ±7% relative percent difference (RPD) for all parameters with measured concentrations above ten times the detection limit.

Laboratory and field values of pH and electric conductivity (EC) were compared, as well as total dissolved solids (TDS) and lab conductivity. Conductivity values were near parity for all samples. No consistent trend between lab and field pH was found. One sample, 18-TLA-04, had a difference between field and lab pH of 1.1 pH units, greater than the SRK criteria of a maximum difference of 1 pH unit. As this was the only sample where this discrepancy was seen, and since the difference is close to the criteria, the data was deemed acceptable. For all samples, TDS demonstrated a strong positive correlation with lab conductivity.

3 Results and Discussion

Attachment A presents maps of the seepage sample locations and the as-built alignment of the airstrip, TIA access road and waste rock stockpile area. A complete set of field observations and measurements is provided in Attachment B. Attachment C contains the laboratory water chemistry results.

3.1 Field Measurements

The maps in Attachment A present electric conductivity and pH measured in the field. The field data are summarized as follows (Table 1):

- pH for all samples was slightly alkaline and ranged from 7.1 to 8.8.
- The samples collected within the Waste Rock Influenced Area (18-DC-01, 18-DC-02, 18-DC-03, 18-DC-04, 18-DC-05) had the highest levels of conductivity (range of 1930 to 2640 µS/cm).
- Median conductivity concentrations of the seepage samples collected along the TIA access road were 96 µS/cm while the median conductivity concentrations of the samples collected along the airstrip was 230 µS/cm.
- Median concentrations for the reference samples were 70 µS/cm. The reference points were measured as representative of conditions outside the influence of construction and mining operations.

Table 1: Median Values for Field Conductivity and pH Measurements

Site Area	No. of Samples	Conductivity (µS/cm)	pH
		Median	
Waste Rock Influenced Area	5	2000	8
TIA Access Road	6	96	8.6
Airstrip	2	230	8.1
Reference Points	3	70	7.7

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\C_Seep_Surveys\June2018 Seepage Survey\3. Working File\2018_DorisSeep_rev00_amd.xlsx

3.2 Laboratory Data

A summary of water quality analyses for the 2018 seep samples is presented in Table 2. All parameters were compared to the CCME water quality guidelines for the protection of aquatic life to screen for elevated parameters (dissolved). Comparisons to these criteria were used solely for screening purposes and are not directly applicable because the seep locations do not support aquatic life.

3.2.1 Windy Road Area (Reference)

Consistent with previous years, three reference samples were taken in the Windy Road area and submitted for laboratory analysis (Table 2). The lab pH values ranged from 7.3 to 7.8, while lab electric conductivity was measured between 45 and 130 µS/cm. Parameter concentrations were below the screening criteria.

3.2.2 Waste Rock Influenced Area

Five samples from the Waste Rock Influenced Area (WRIA) in the Doris Camp were submitted for laboratory analysis (Table 2). DC-01, DC-02 and DC-03 were sampled 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, DC-02 and DC-03 are considered contact water (undiluted) from this stockpile.

The lab pH values for all samples were 7.9, and lab electric conductivity ranged from 2,200 to 3,100 µS/cm.

Parameters with elevated concentrations compared to the screening criteria included ammonia, nitrate, chloride, arsenic, copper, iron and selenium.

For all stations, ammonia concentrations ranged from 1.5 to 3 times above the screening criteria and nitrate concentrations were 7 to 13 times higher. Chloride concentrations ranged from 3 to 7 times above the screening criteria. For DC-04 and DC-05, copper concentrations were 6 to 10 times higher and selenium concentrations were 1.5 times higher than the screening criteria.

For DC-01 to DC-03, iron concentrations ranged from 3.8 to 4.2 mg/L and were 13 to 14 times higher than the screening criteria. At DC-01 to DC-03, the field note document low flow and/or the presence of fine sediments, which with the high iron content suggests the presence of colloids which can pass through the sample filter. For DC-01 to DC-03, arsenic concentrations were between 1.2 and 1.4 times higher than the screening criteria. As discussed in Section 3.3.1, elevated arsenic concentrations for DC-01 to DC-03 are likely due to the presence of colloids.

3.2.3 TIA Access Road Area

Six samples from the TIA access road area (including the tailings catchment basin) were submitted for laboratory analysis (Table 2). Lab pH ranged from 7.7 to 8.1, and lab electric conductivity ranged from 80 to 240 µS/cm. All TIA samples had copper concentrations that exceeded the screening criteria ranging from 2% over the criteria to 4 times the criteria.
One sample (18-TLA-01) exceeded the aluminum screening criteria by 10%, possibly due to the presence of colloidal aluminum in the filtered sample. Other samples with elevated aluminum (18-TLA-03 and 18-TLA-06) may also have the presence of colloidal material, which may result in the elevated arsenic and nickel concentrations seen in the respective samples.

Table 2: Summary of Laboratory Results of 2018 Seep Samples.

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	Total Hardness	TDS	Total Ammonia	Cl	NO_3	SO_4	Al	As	Cd	Cu	Fe	Pb	Hg	Ni	Se	Tl	Zn
		s.u.	s.u.	µS/cm	µS/cm	mV	mg $CaCO_3$/L	mg/L	mg N/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
	CCME guideline*	*6.5-9*	*6.5-9*	-	-	-	-	-	*4***	*120 mg/L*	*3 mg N/L*	-	*0.1*	*0.005*	*0.0041****	*0.004****	*0.3*	*0.007****	*0.000026*	*0.15****	*0.001*	*0.0008*	*0.03*
Waste Rock Influenced Area	18-DC-01****	7.8	7.9	2000	2200	160	350	1300	**9.4**	**400**	**21**	250	0.015	**0.0072**	0.000054	**2.9**	**4.2**	0.000084	<0.0000050	0.051	**0.0039**	0.000028	0.0015
	18-DC-02****	8.2	7.9	2000	2200	170	360	1300	**9.1**	**410**	**21**	250	0.015	**0.0065**	0.000062	**3.1**	**4.2**	0.000079	<0.0000050	0.054	**0.0042**	0.000028	0.0013
	18-DC-03****	8.3	7.9	1900	2200	150	350	1300	**8.6**	**400**	**21**	250	0.011	**0.0058**	0.000063	**2.7**	**3.8**	0.000082	<0.0000050	0.051	**0.0039**	0.000015	0.0012
	18-DC-04	8	7.9	2500	2900	110	830	2600	**15**	**750**	**37**	76	0.0081	0.0015	0.00011	**0.038**	0.025	<0.00010	<0.0000050	0.0033	**0.0015**	0.000048	<0.0020
	18-DC-05	7.6	7.9	2600	3100	91	900	3000	**15**	**830**	**39**	73	0.0084	0.0014	0.00015	**0.024**	<0.020	<0.00010	<0.0000050	0.0033	**0.0014**	0.000051	0.002
Tail Lake Access (TLA) Road	18-TLA-01	8.2	7.9	92	100	59	40	87	0.02	2.2	0.018	0.6	**0.11**	0.00055	0.00002	**0.011**	0.13	0.000089	<0.0000050	0.00093	<0.000050	<0.000010	0.0013
	18-TLA-02	8.7	7.7	99	110	60	39	81	0.05	7.3	<0.0050	1.7	0.066	0.00044	0.00002	**0.0084**	0.073	0.000085	0.0000063	0.0011	0.000081	<0.000010	0.0022
	18-TLA-03	8.6	7.9	130	130	82	55	110	0.032	6.6	0.022	3.5	0.094	0.00083	0.000019	**0.017**	0.11	0.00014	0.0000069	0.0016	0.00011	<0.000010	0.0011
	18-TLA-04	8.8	7.7	77	80	96	27	68	0.014	4.5	0.033	3.5	0.092	0.00036	9.9E-06	**0.0055**	0.07	<0.000050	<0.0000050	0.00082	0.00013	<0.000010	0.0012
	18-TLA-05	8.5	7.6	54	55	100	18	41	0.0098	3.7	0.018	2.5	0.038	0.00018	<0.0000050	**0.0041**	0.03	<0.000050	<0.0000050	<0.00050	0.00012	<0.000010	<0.0010
	18-TLA-06	8.1	8.1	240	240	100	94	170	0.13	18	0.45	4.2	0.095	0.00025	5.4E-06	**0.0069**	0.1	0.000056	0.0000056	0.0026	<0.000050	<0.000010	0.0017
Airstrip	18-AIRSTR-01	8.1	8.1	220	210	53	86	130	0.12	14	0.052	7.5	0.025	0.0011	6.9E-06	**0.013**	0.099	<0.000050	<0.0000050	0.0013	0.00011	<0.000010	<0.0010
	18-AIRSTR-02	8	8.1	240	220	61	87	140	0.094	14	0.1	8.8	0.033	0.0012	5.5E-06	**0.017**	0.12	<0.000050	<0.0000050	0.003	0.00013	<0.000010	<0.0010
Reference (Windy Road)	18-REF-01	7.1	7.3	47	45	140	18	58	0.0092	3.4	<0.0050	0.58	0.059	0.00015	<0.0000050	0.004	0.17	<0.000050	0.0000059	0.0023	<0.000050	<0.000010	0.0047
	18-REF-02	8	7.8	130	130	120	50	92	0.0061	11	<0.0050	2.6	0.015	0.00015	<0.0000050	0.0024	0.047	<0.000050	<0.0000050	0.0019	0.000077	<0.000010	0.0017
	18-REF-03	7.7	7.5	70	65	79	23	54	0.0062	6.9	<0.0050	1.7	0.015	<0.00010	<0.0000050	0.0021	0.048	<0.000050	<0.0000050	<0.00050	<0.000050	<0.000010	<0.0010

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\C_Seep_Surveys\June2018 Seepage Survey\3. Working File\2018_DorisSeep_rev00_amd.xlsx

Note:

*Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life.

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

**Guideline for ammonia is pH and temperature dependent. Seepage waters had an average temperature of 3.6ºC at time of sampling and an average pH of 7.8. This guideline value is approximate.

***Guideline calculated based on the average hardness of the seepage samples of 195 mg CaCO3 mg/L

****Samples collected from turbid area. Iron levels indicate colloids and/or solids introduced in samples, Refer to text in Section 3.3.1.

3.2.4 Airstrip Area

Two samples from the Airstrip area were submitted for laboratory analysis (Table 2). Lab pH for both samples was 8.1 and lab electric conductivity was 210 and 220. The copper concentration for both samples exceeded the screening criteria by a factor of approximately 4. All other parameters were below the screening criteria. Sulphate concentrations for both samples were low (≤9 mg/L).

3.3 Comparison to Previous Surveys

Table 3 presents a comparison of samples collected in 2018 from the waste rock influenced and reference areas with a statistical summary of historical seepage samples collected from the same areas until 2017 (refer to maps in Attachment A). Table 3 presents the historical data as 5^{th}, 50^{th}, and 95^{th} percentile statistics, with concentrations below the detection limit assumed to be equal to the detection limit. Figure 1 to Figure 10 present all seepage monitoring data from these areas for parameters that exceeded the screening criteria and other parameters relevant to metal leaching, e.g. sulphate. The results are discussed below.

Table 3: Comparison of Water Quality Results to Range of Observed Data for Waste Rock Influenced Area and Reference Sites

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	Total Hardness	TDS	Total Ammonia	Cl	NO_3	NO2	SO_4	Al	As	Cd	Cu	Fe	Pb	Hg	Ni	Se	Tl	Zn
		s.u.	s.u.	µS/cm	µS/cm	mg $CaCO_3$/L	mg/L	mg N/L	mg/L	mg N/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*	*0.77*	*46*	*0.011*	*0.00072*	*0.000075*	*0.0095*	*0.041*	*0.00011*	*0.0001*	*0.0023*	*0.0009*	*0.00011*	*0.028*
Waste Rock Influenced Area	18-DC-01*	7.8	7.9	2000	2200	350	1300	9.4	400	21	0.56	250	0.015	0.0072	0.000054	2.9	4.2	0.000084	<0.0000050	0.051	0.0039	0.000028	0.0015
	18-DC-02*	8.2	7.9	2000	2200	360	1300	9.1	410	21	0.55	250	0.015	0.0065	0.000062	3.1	4.2	0.000079	<0.0000050	0.054	0.0042	0.000028	0.0013
	18-DC-03*	8.3	7.9	1900	2200	350	1300	8.6	400	21	0.57	250	0.011	0.0058	0.000063	2.7	3.8	0.000082	<0.0000050	0.051	0.0039	0.000015	0.0012
	18-DC-04	8	7.9	2500	2900	830	2600	15	750	37	0.42	76	0.0081	0.0015	0.00011	0.038	0.025	<0.00010	<0.0000050	0.0033	0.0015	0.000048	<0.0020
	18-DC-05	7.6	7.9	2600	3100	900	3000	15	830	39	0.3	73	0.0084	0.0014	0.00015	0.024	<0.020	<0.00010	<0.0000050	0.0033	0.0014	0.000051	0.002
	2011-2017 P05	7.8	7.6	490	390	120	240	0.33	58	1.9	0.012	11	0.0061	0.0004	0.0000069	0.0027	0.01	0.00005	0.000005	0.00059	0.00018	0.00001	0.001
	2011-2017 P50	8.1	7.9	2000	3100	720	1900	13	840	42	0.098	65	0.0097	0.0013	0.000056	0.0064	0.026	0.0001	0.00001	0.0018	0.0012	0.000029	0.002
	2011-2017 P95	8.4	8.1	4000	8500	2500	7100	67	2500	140	1.2	170	0.033	0.0076	0.00033	2.1	0.57	0.00025	0.00001	0.071	0.0039	0.00011	0.005
	2011-2017 n	13	18	13	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Reference (Windy Road)	18-REF-01	7.1	7.3	47	45	18	58	0.0092	3.4	<0.0050	<0.0010	0.58	0.059	0.00015	<0.0000050	0.004	0.17	<0.000050	0.0000059	0.0023	<0.000050	<0.000010	0.0047
	18-REF-02	8	7.8	130	130	50	92	0.0061	11	<0.0050	<0.0010	2.6	0.015	0.00015	<0.0000050	0.0024	0.047	<0.000050	<0.0000050	0.0019	0.000077	<0.000010	0.0017
	18-REF-03	7.7	7.5	70	65	23	54	0.0062	6.9	<0.0050	<0.0010	1.7	0.015	<0.00010	<0.0000050	0.0021	0.048	<0.000050	<0.0000050	<0.00050	<0.000050	<0.000010	<0.0010
	2011-2017 P05	6.6	6.9	33	53	17	33	0.005	3.7	0.005	0.001	0.3	0.0059	0.0001	0.000005	0.00084	0.028	0.00005	0.000005	0.0005	0.00005	0.00001	0.0014
	2011-2017 P50	7.2	7.5	81	70	23	57	0.0063	5.9	0.005	0.001	0.73	0.02	0.00014	0.00001	0.0012	0.097	0.00005	0.00001	0.001	0.0001	0.00001	0.0035
	2011-2017 P95	7.7	8	310	200	76	120	0.015	28	0.005	0.001	3.9	0.051	0.00021	0.00005	0.0019	0.19	0.00005	0.00001	0.0026	0.001	0.0001	0.005
	2011-2017 n	12	19	12	15	19	19	16	19	19	15	19	19	19	19	19	19	19	15	19	19	19	19

Notes:

(1) All metal concentrations are dissolved

(2) Values below the detection limit are included within statistics as being at the detection limit

*Samples collected from turbid area. Iron levels indicate colloids and/or solids introduced in samples, with arsenic, copper and possibly selenium concentrations elevated due to colloidal fraction. Refer to text in Section 3.3.1.

3.3.1 Waste Rock Influenced Area

Sulphate and Trace Elements

Figure 1 to Figure 5 present temporal trends of sulphate, copper, selenium, arsenic and iron compared to the average of the 2012 data set for SNP station ST-2 (pollution containment 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 since 2012 have ranged from 9 to 250 mg/L with an overall median concentration of 76 mg/L. Sulphate concentrations have been increasing since 2016. Prior to 2016, sulphate concentrations ranged from 9 to 140 mg/L. The majority of samples have had sulphate concentrations greater than the source term input of 46 mg/L but the overall median value of 76 mg/L is at near parity. 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 selenium 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 2.9 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. Selenium concentrations prior to 2016 ranged from 0.00016 to 0.0026 mg/L and from 0.00082 to 0.0042 mg/L since 2016. Overall, median selenium concentrations for seepage samples are 0.0015 mg/L compared to the source term input of 0.0009 mg/L.

As discussed in Section 3.2.2, review of the 2018 data suggest that three seepage samples contain colloids. Arsenic co-precipitates/adsorbs to iron (oxy)hydroxides therefore elevated arsenic is likely due to the introduction of iron colloids to the sample. Figure 6 compares concentrations of arsenic to iron, where iron concentrations greater than 0.5 mg/L suggest the presence of colloids in the seepage sample. The comparison indicates that five samples (3 from 2018 and 2 from 2017) with iron concentrations greater than 0.5 mg/L also have higher concentrations of arsenic compared to the overall data set. Field observations for all five samples note fine sediments and/or low flow. Sediments were also observed for a sample collected in 2016 that had relatively low dissolved iron (0.047 mg/L) but higher arsenic (0.0091 mg/L) compared to the overall data set. Accordingly, concentrations of arsenic and iron for these six samples are discussed separately than the rest of the data set.

Concentrations of arsenic for samples not suspected of containing colloids are relatively stable and range from 0.0014 to 0018 mg/L compared to the source term input of 0.0007 mg/L. Similarly, iron concentrations were also relatively stable and ranged from 0.01 to 0.084 mg/L compared to a source term input of 0.04 mg/L. For 2016 to 2018 samples suspected of containing colloids, arsenic and iron concentrations ranged from 0.0033 to 0.0091 mg/L and 0.047 to 4.2 mg/L, respectively.

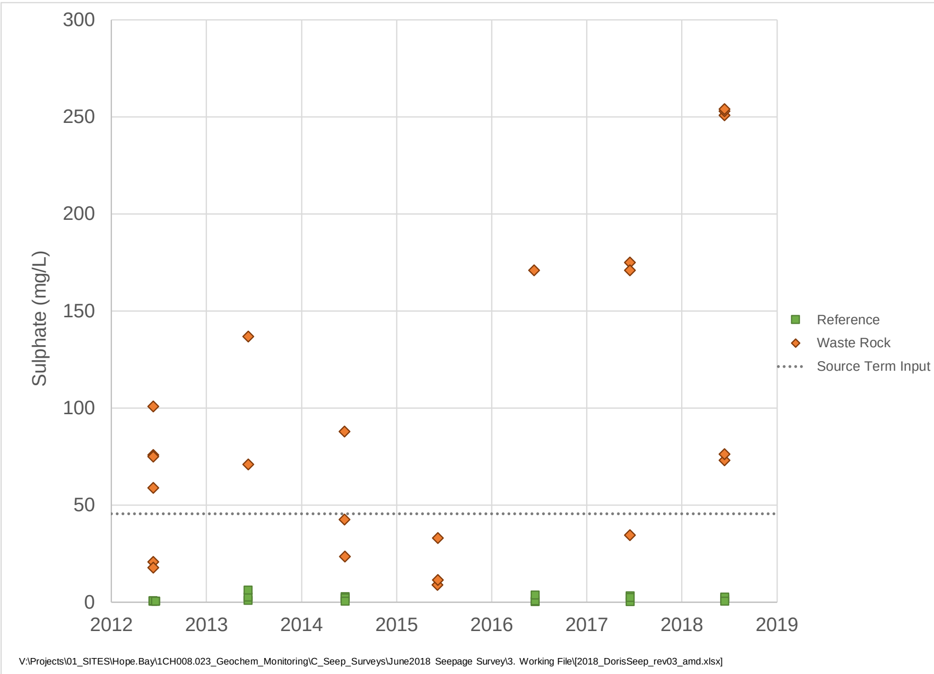


Figure 1: Sulphate seepage monitoring data, Waste-Rock Influenced and Reference Areas

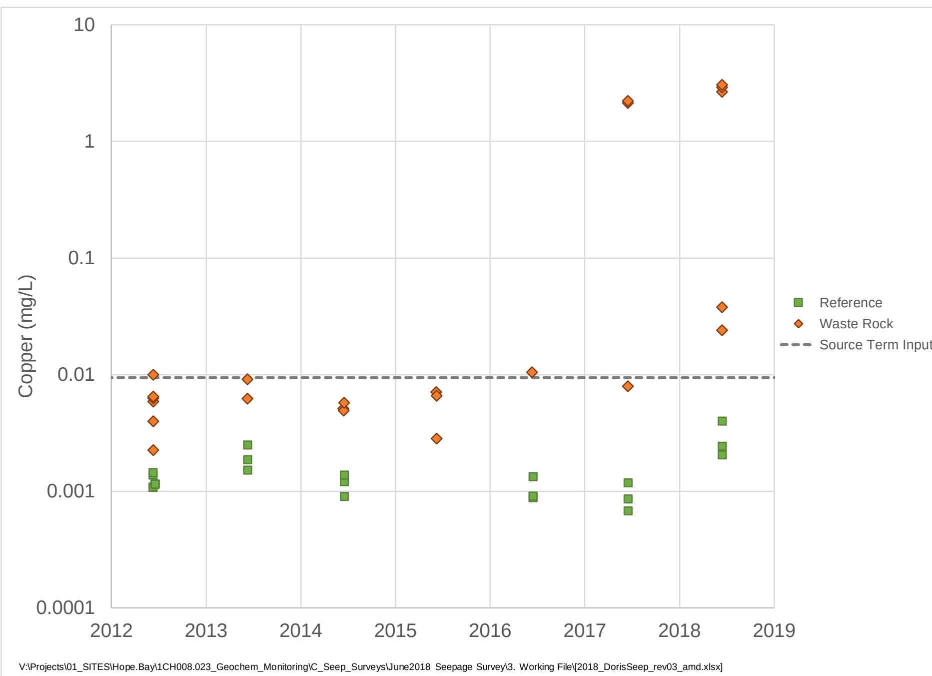


Figure 2: Copper seepage monitoring data, Waste-Rock Influenced and Reference Areas

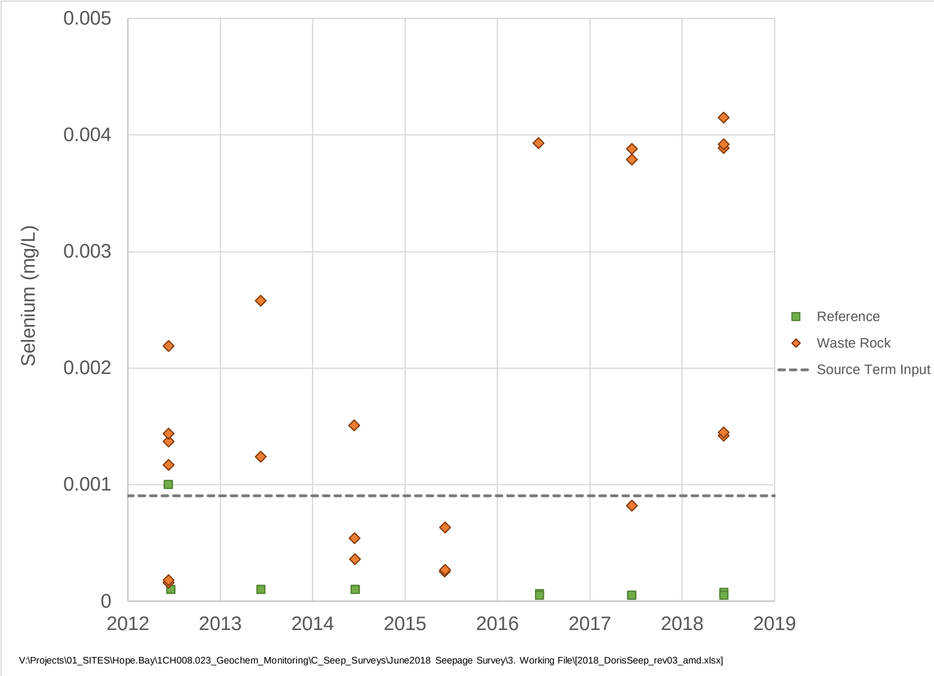


Figure 3: Selenium seepage monitoring data, Waste-Rock Influenced and Reference Areas

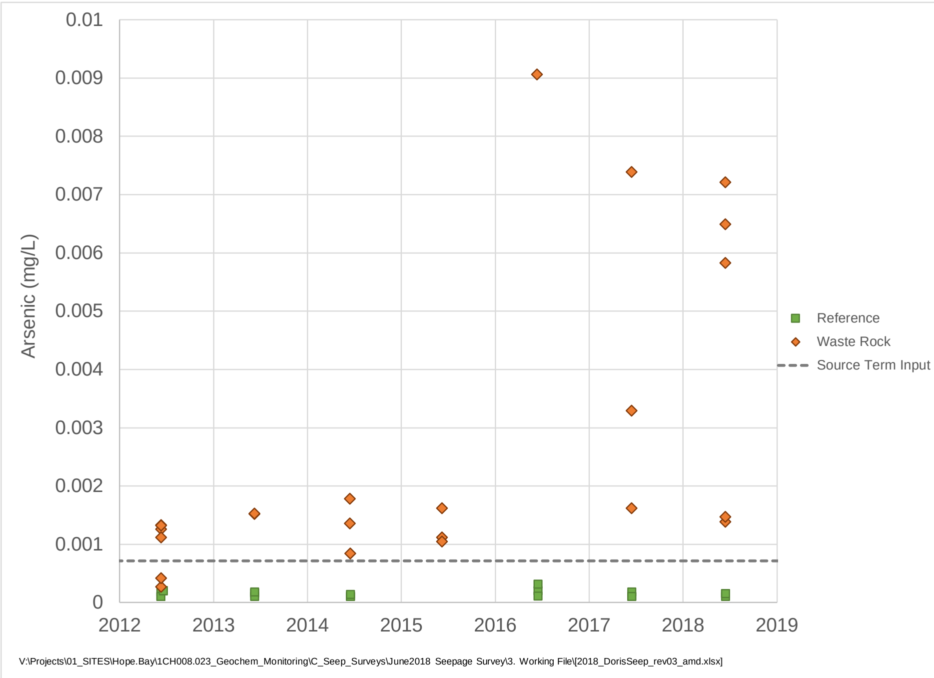


Figure 4: Arsenic seepage monitoring data, Waste-Rock Influenced and Reference Areas

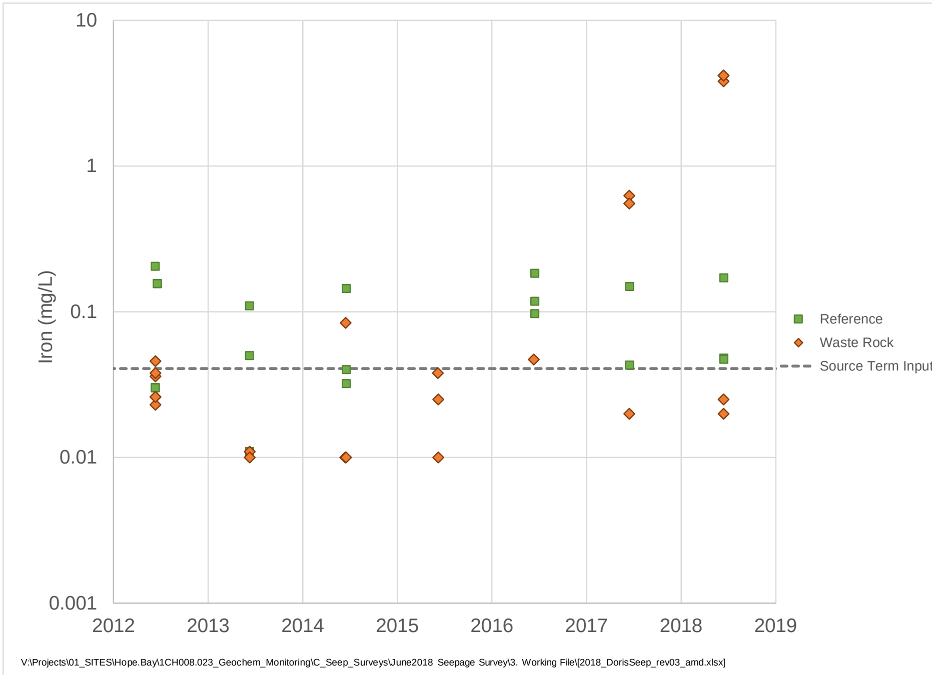


Figure 5: Iron seepage monitoring data, Waste-Rock Influenced and Reference Areas

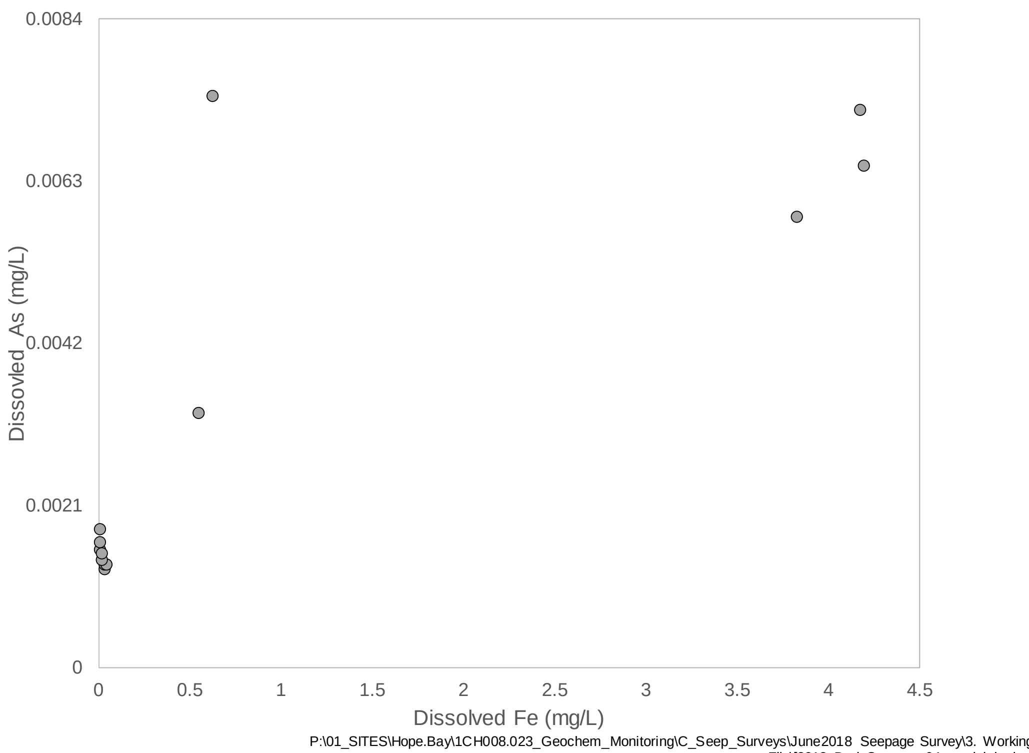


Figure 6: Comparison of Dissolved Arsenic and Iron, Waste-Rock Influenced Areas

Ammonia, Nitrate and Chloride

Trends in ammonia, nitrate, nitrite and chloride concentrations have been decreasing since 2016. The increase observed in 2016 is related to the re-initiation of mining by TMAC in 2015 (Figure 7 to Figure 10). These decreases are due to the flushing of salts from drilling brines (chloride) and explosives residues (ammonia, nitrate and nitrite) from the waste rock stockpile. Nitrite did not exceed the screening criteria but is presented here as it is a parameter associated with blast residues.

The monitoring data are comparable to the source term input for ammonia, nitrite and chloride but higher for nitrate.

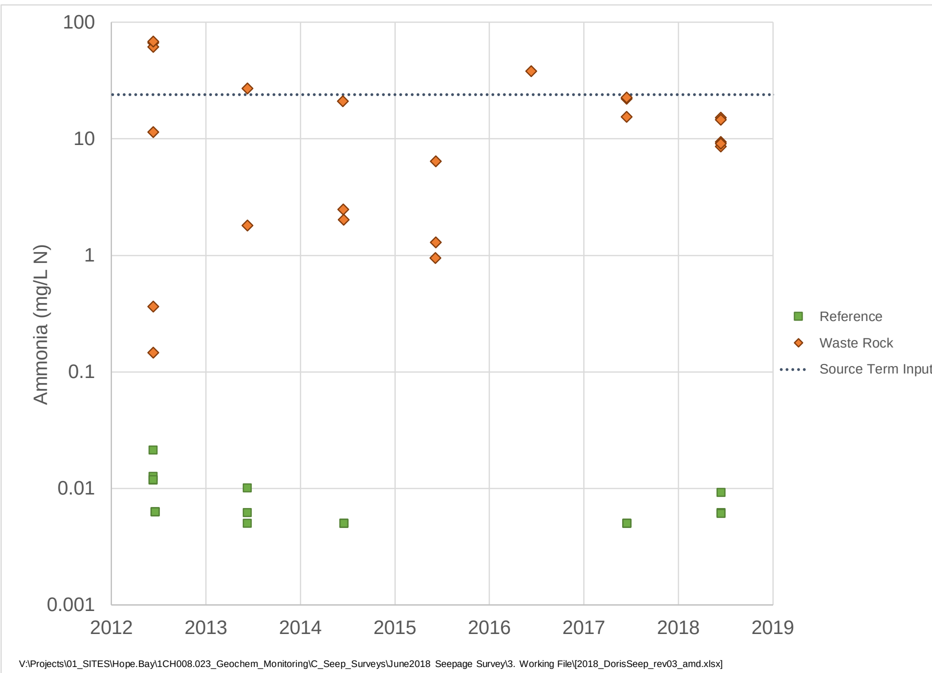


Figure 7: Ammonia seepage monitoring data, Waste-Rock Influenced and Reference Areas

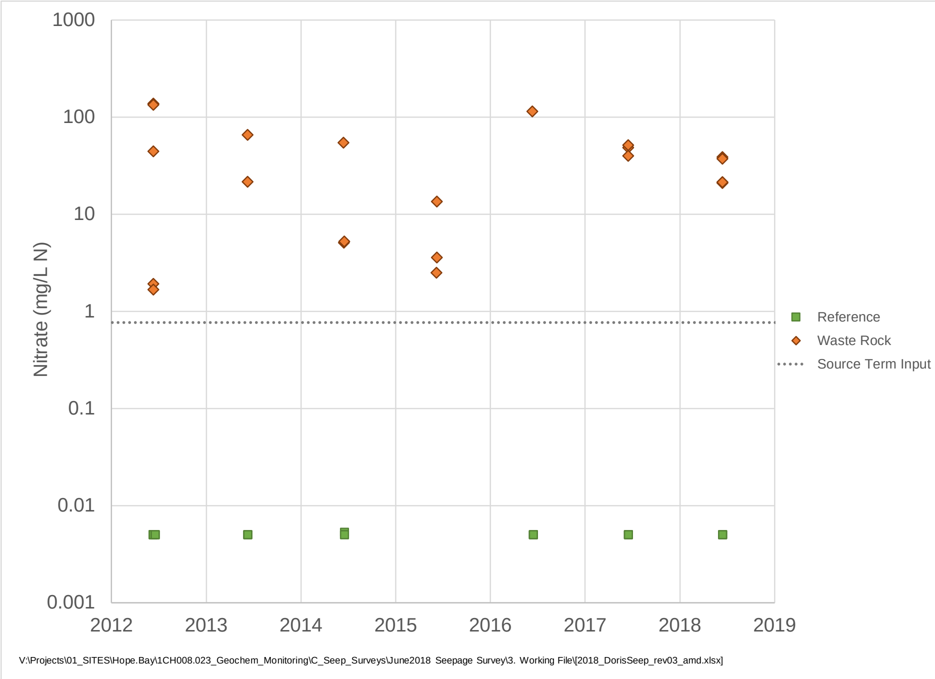


Figure 8: Nitrate seepage monitoring data, Waste-Rock Influenced and Reference Areas

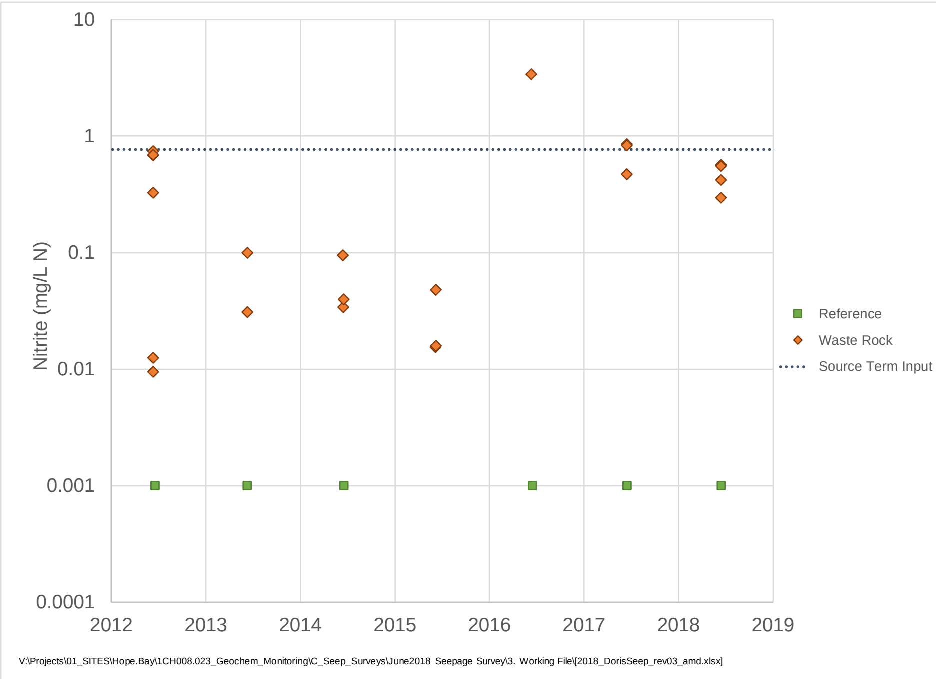


Figure 9: Nitrite seepage monitoring data, Waste-Rock Influenced and Reference Areas

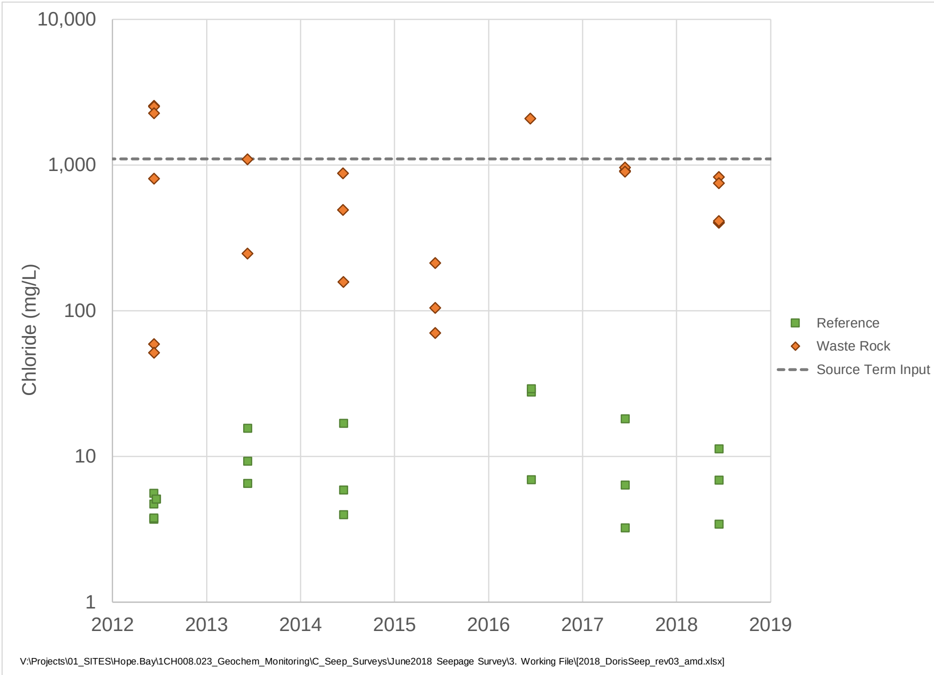


Figure 10: Chloride seepage monitoring data, Waste-Rock Influenced and Reference Areas

3.3.2 Windy Road Area (Reference)

Parameter concentrations for reference samples collected in 2018 were generally stable and consistent with the historical dataset, including sulphate, arsenic, iron, selenium, ammonia, nitrate and nitrite. The copper concentrations for all three reference samples in 2018 (range of 0.0021 to 0.004 mg/L) were the highest recorded concentrations for reference material (Figure 2) and is considered consistent with the historical data record (5th to 95th percentile concentration ranging from 0.00084 to 0.0019 mg/L).

4 Conclusions and Recommendations

The scope of the 2018 Hope Bay seep monitoring survey included infrastructure constructed from quarry rock between fall 2017 and mid-2018 (south dam, southern extent of the TIA access road, jetty road, cyanide reagent pad, airstrip south apron and East airstrip access road), three reference stations and areas downstream of waste rock stockpiles, including seepage collected from the toe of the stockpiles. All infrastructure surveyed was constructed from rock sourced from Quarry 2. Seepage samples were observed and collected from the airstrip, TIA access road and waste rock stockpiles.

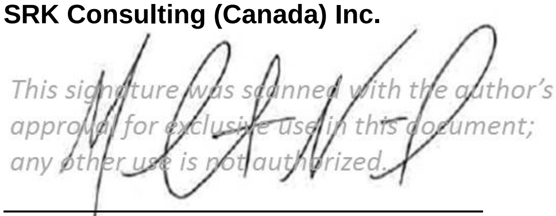
Concentrations for reference area seeps were consistent and stable with the historical data record. Copper concentrations in all seepage samples from infrastructure areas (TIA access road and airstrip) were elevated compared to the screening criteria. A single sample collected at a seep in the TIA access road exceeded the aluminum screening criterion, however this may be due to the presence of colloids. All other parameters were below the screening criteria.
The results of the 2018 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.

Consistent with previous years, seepage from areas impacted by waste rock had elevated levels of chloride, nitrate, nitrite and ammonia compared to the screening criteria. Chloride levels are attributed to flushing of drilling brines and nitrate, nitrite, and ammonia levels to blasting residues from the waste rock. In terms of metal leaching, concentrations of sulphate, copper and selenium were higher than screening criteria and have exhibited increasing trends since 2015, which is 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 selenium may be attributed to the presence of ore, which has higher sulphide content than waste rock. Concentrations of arsenic and iron for the 2018 waste rock seepage samples were higher than the screening criteria, however this was attributed to the presence of colloids. When the sample set was screened for samples suspected of containing colloids, the overall arsenic and iron concentrations since 2012 were stable.

The waste rock seepage monitoring was initiated in 2012. A comparison of the waste rock seepage monitoring record for sulphate, arsenic, copper, iron, selenium, chloride, ammonia, nitrate and nitrite to the data set used to derive the Doris waste rock source term for the 2015 water and load balance (2015a) indicated that overall, monitoring data approximates the source term inputs. Continued monitoring will establish trends in parameter concentrations.

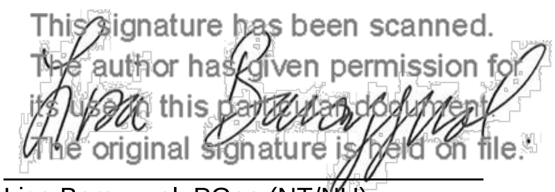
SRK recommends that the 2019 seepage survey include infrastructure areas monitored in 2018 but where seepage was not observed (south dam, jetty road, and cyanide reagent pad).

Regards,
SRK Consulting (Canada) Inc.



Marie-Christine Noel
Consultant

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.

5 References

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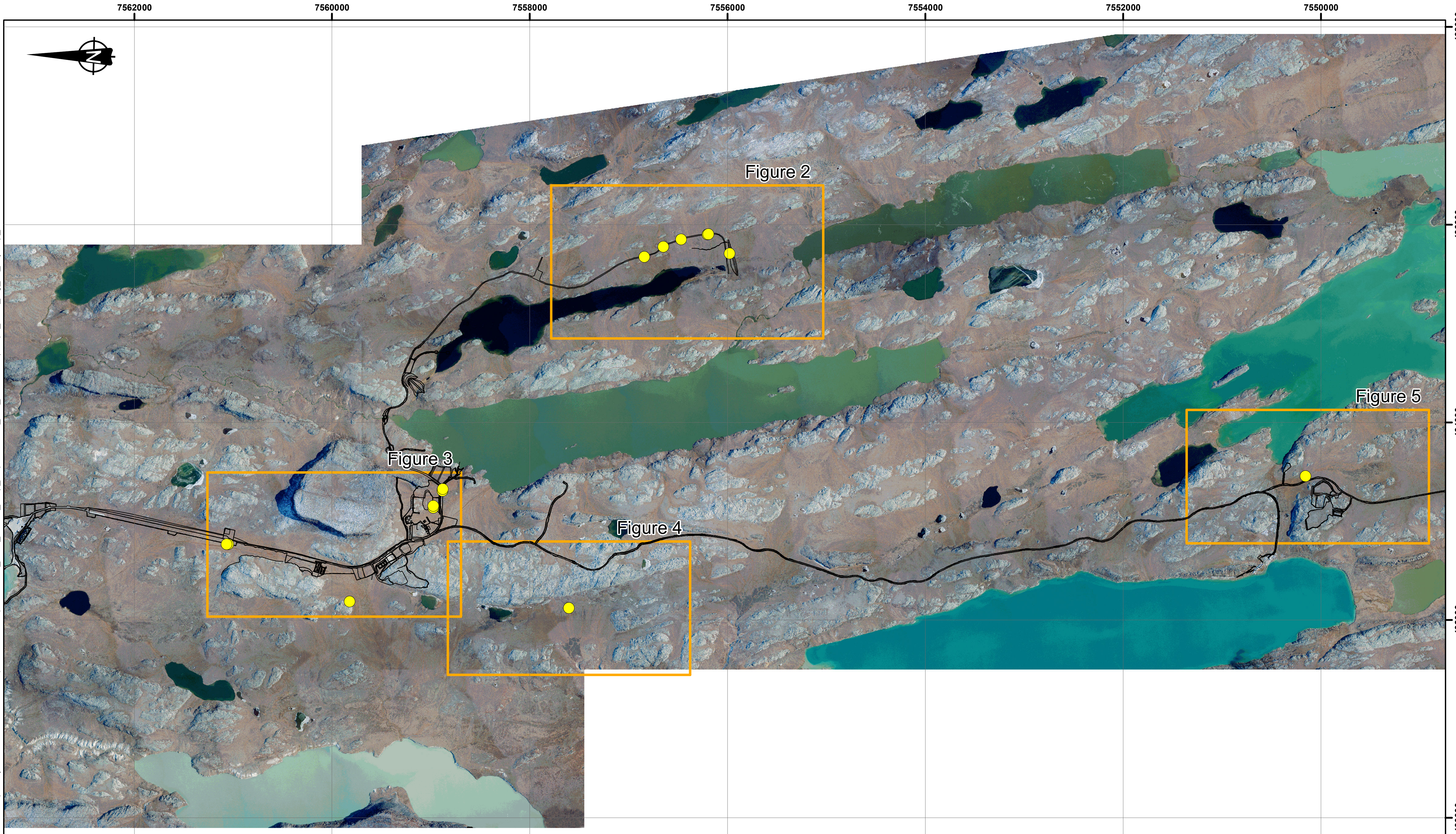
Attachment A – Maps of 2018 Sampling Locations



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Legend

- 2018 Seepage
- As-Built Infrastructure

0 1 2 Kilometers

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Job No: 1CT022.016

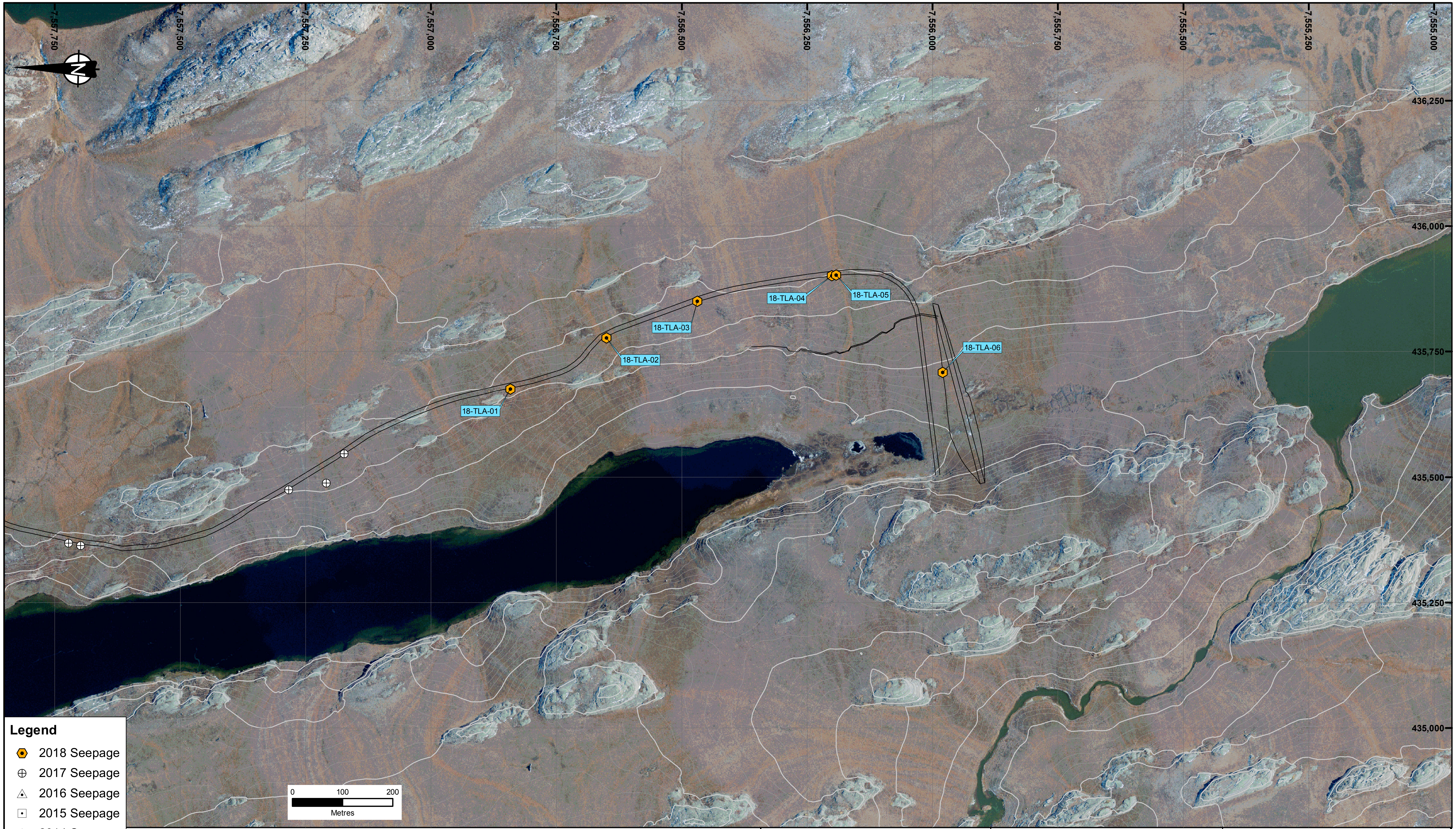
Filename: 1CT022_016_AnnualSeepMaps_2018_Fig_01_keymap_rev01

2018 Seepage Monitoring

Hope Bay Gold Project

Seepage Survey Locations
Key Map

Date:	Approved:	Figure:
Feb 2019	MCN	1



Legend

- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage

	pH 6.0 to 6.9	pH 7 to 7.9	pH 8 to 8.9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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Job No: 1CT022.016

Filename: 1CT022_016_AnnualSeepMaps_2018_Fig_02_rev01

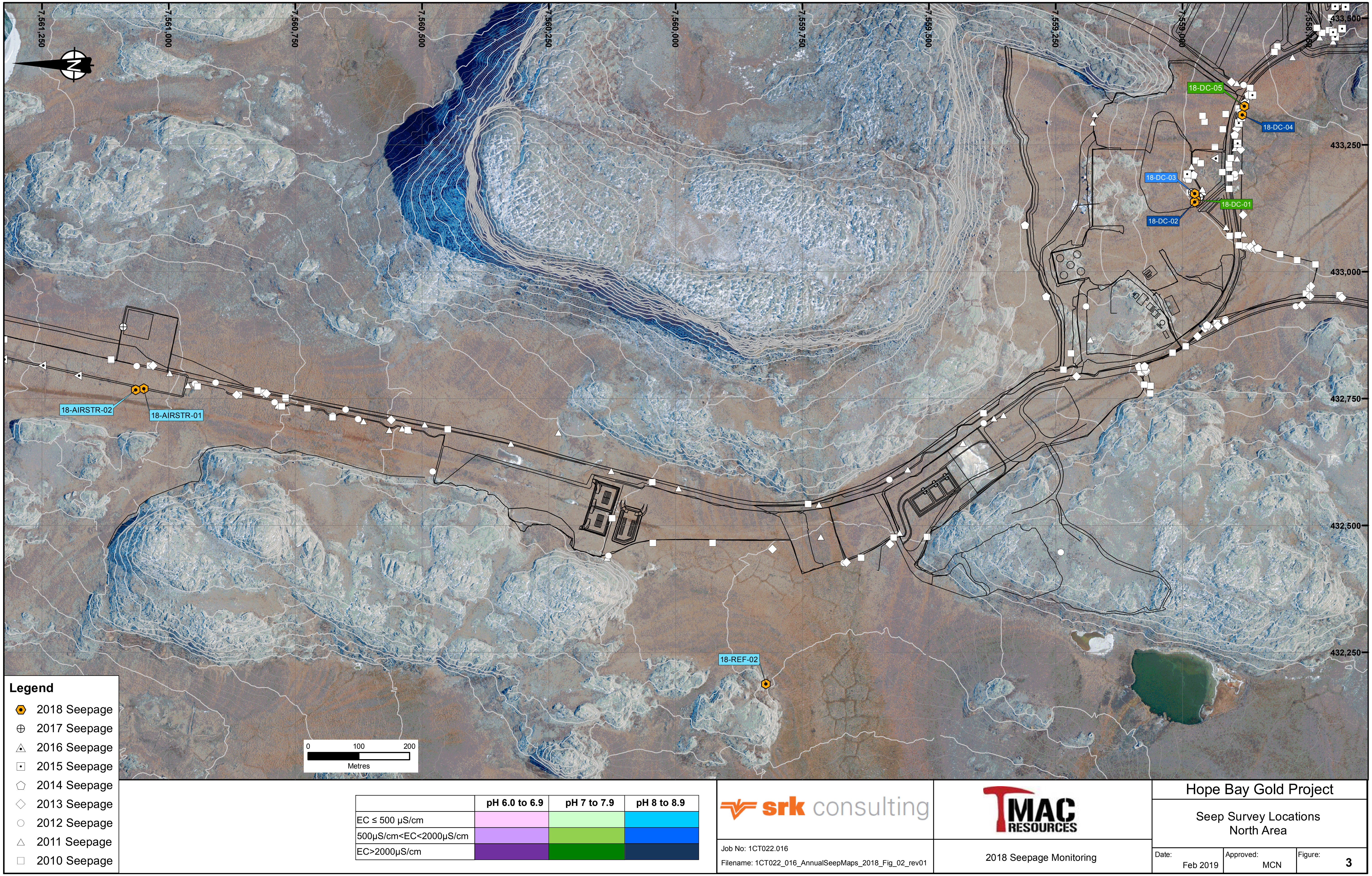
TMAC RESOURCES

2018 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations
TIA Area

Date: Feb 2019 | Approved: MCN | Figure: 2



	pH 6.0 to 6.9	pH 7 to 7.9	pH 8 to 8.9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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TMAC RESOURCES

Hope Bay Gold Project

Seep Survey Locations
North Area

Job No: 1CT022.016

Filename: 1CT022_016_AnnualSeepMaps_2018_Fig_02_rev01

2018 Seepage Monitoring

Date: Feb 2019

Approved: MCN

Figure: 3

Legend

- 2018 Seepage
- 2017 Seepage
- 2016 Seepage
- 2015 Seepage
- 2014 Seepage
- 2013 Seepage
- 2012 Seepage
- 2011 Seepage
- 2010 Seepage

	pH 6.0 to 6.9	pH 7 to 7.9	pH 8 to 8.9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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Job No: 1CT022.016

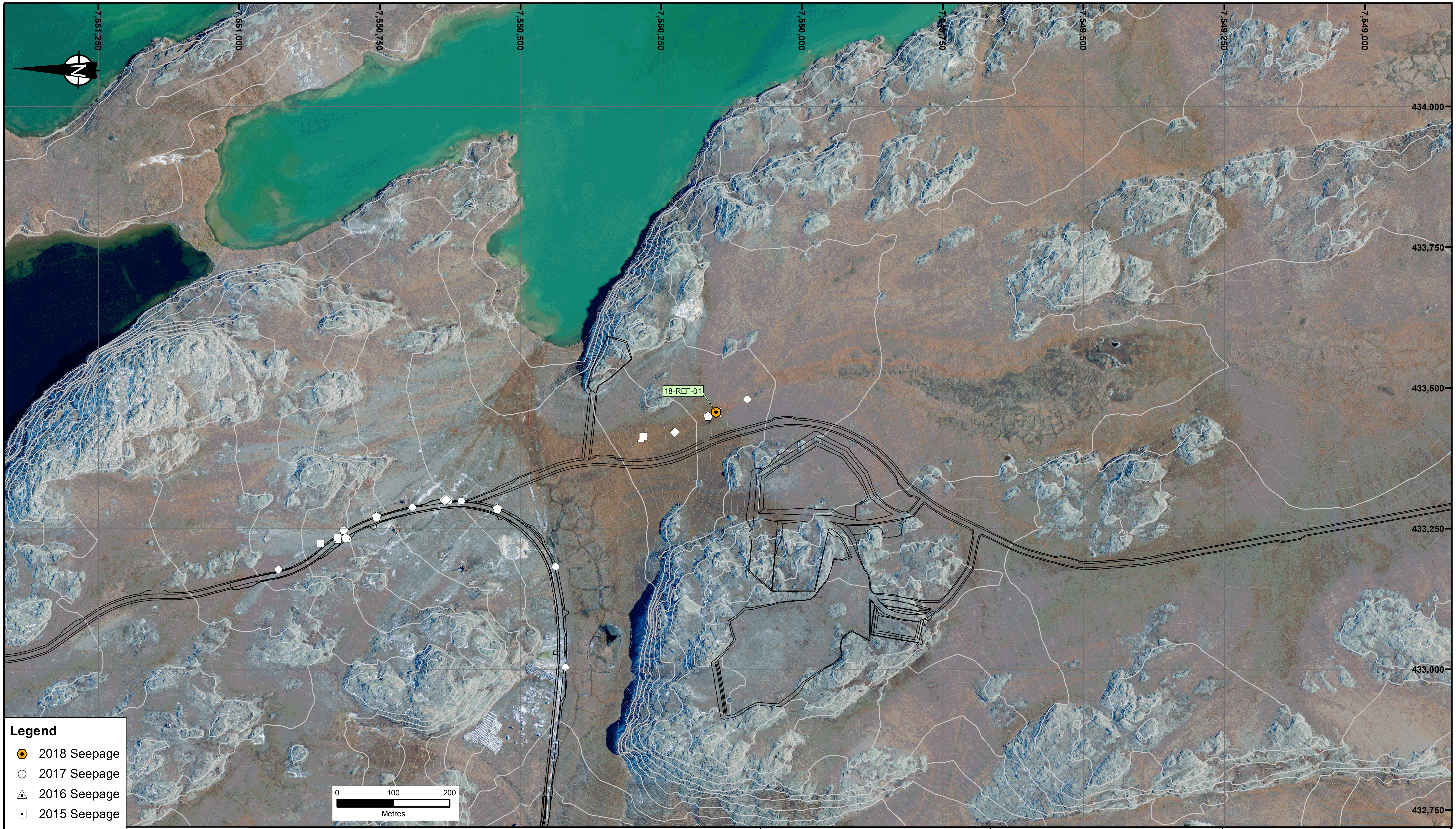
Filename: 1CT022_016_AnnualSeepMaps_2018_Fig_02_rev01

2018 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations
Reference Area

Date:	Approved:	Figure:
Feb 2019	MCN	4



	pH 6.0 to 6.9	pH 7 to 7.9	pH 8 to 8.9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

srk consulting

Job No: 1CT022.016

Filename: 1CT022_016_AnnualSeepMaps_2018_Fig_02_rev01

MAC RESOURCES

2018 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations
Doris Windy Road

Date:	Approved:	Figure:
Feb 2019	MCN	5

Attachment B – 2018 Field Observations and Measurements

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			General Observations				Field Measurements																				
Date	Sampling Point	Area	Coordaintes (UTM Zone 13)		Description of Location	pH	Conductivity	ORP	Water Temperature	Water Colour	Turbidity	Precipitates/Stains	Odours	Photos Taken	Flow Measurement Calculations	t1	t2	t3	Amount	Capture	Flow	Lab sample collected	Filtrate colour	Sediment colour	Number of filters used	Duplicate	Field Blank
			Easting	Northing		pH units	µS/cm	mV	°C							sec	sec	sec	mL	%	L/s						
14-Jun-18	18-DC-01	Waste Rock Influenced Area	433141	7558973	No vegetation, rocky ground cover - small pool with light sediment on bottom - steady flow from rock berm into PCP - multiple seepages in sample area, challenge to collect flow -syringe used to collect sample	7.8	2006	160	0.5	clear	N	None	None	Y	Y	-	-	-	Multiples seeps, cannot characterize flow	-	-	Y	Clear	Reddish, brown	1	-	-
14-Jun-18	18-DC-02	Waste Rock Influenced Area	433137	7558976	Approx 10 m east from 18-DC-01 -small seepage observed from base of berm. Flow is steady. Water is slightly cloudly. Syringe used to collect sample	8.2	2002	171	2.5	Slightly cloud	N	-	-	-	Y	3	3	3	125	90	0.1	Y	Slightly cloudly	Reddish, brown	1	-	-
14-Jun-18	18-DC-03	Waste Rock Influenced Area	433154	7558976	North west edge of PCP, steady but small flow from base of slope -syringe shallow seeps. Toe small to measure flow	8.3	1930	154	2.5	Clear	N	None	None	Y (7-9)	Y	-	-	-	-	-	-	Y	Clear	Reddish brown, some grey	1	-	-
14-Jun-18	18-DC-04	Waste Rock Influenced Area	433309	7558882	Seep at base of road along the southern edge af PCC. 30 m west of sump 1.	8	2530	110	1.0	Clear	N	None	None	Y	Y	5	6	5	1000	90	0.2	Y	Clear	Grey	1	-	-
14-Jun-18	18-DC-05	Waste Rock Influenced Area	433326	7558878	Seep at base of road draining into tussock tundra approx. 15 m from sampling. Muddy and mucky ground cover at edge of rock berm seep slow but steady	7.6	2640	91	2.0	Clear	N	None	None	Y	Y	-	-	-	Too light to measure	-		Y	Clear	Brown	1	-	-
14-Jun-18	18-TLA-01	TLA Road	435675	7556842	West side of TIA road 30 m from trailor + container, dusty ground cover. Slight flow off the of road. Removed few rocks for access. Water is slightly cloudy, flows through some willow and tundra, tussock. Flow dissappears into tundra. Smaples collected with syringes	8.2	92	59	0.3	Clearish brown	Y	None	None	Y	Y	12	9	10	1000	90	0.1	Y	Clear	Grey fines	4	-	-
14-Jun-18	18-TLA-02	TLA Road	435777	7556650	Small, shallow, seep at base of road way ~ 200 from TL. Clear some sediment. Seep drains into tundra area is quite clusty, with airborne dust and dust on plants. Syringe was used to sample.	8.7	99	60	1.8	Clear-very light brown	N	None	None	Y	Y	3	3	2	250	90	0.1	Y	Clear, slightly yellow	browny grey	2	Yes	Yes
14-Jun-18	18-TLA-03	TLA Road	435850	7556469	Right side of trails lake road up 4-500 m dump off port. Water is clear, bit yellow/white. Possibly from snow melt on other side of road. Water flow is steady. Flows into little grass area. Used syringe to sample. About 200 m from tails lake seep is shallow	8.6	132	82	4.0	Clearish yellow	N	None	None	Y	Y	2	1	2	250	80	0.2	Y	Clear	Brown to grey bottom is organic	2	-	-
14-Jun-18	18-TLA-04	TLA Road	435901	7556201	Right side of TLA road about 100 m from turn around down to south dam	8.8	77	96	2.2	Clear/yellowish brown	N	None	None	Y	Y	1	1	1	250	90	0.3	Y	Clear, very slight yellow	Not much sediment grass bottom brown	2	-	-
14-Jun-18	18-TLA-05	TLA Road	435902	7556192	Tails lake side of the road about 5 m from 18-TLA-04 grassy tundra some willows. Multiple seeps in same area, possibly from water source on other side of road. Flow is steady, deep pooling. Flowing down towards tails lake-500 to 600 m from lake	8.5	54	101	3.7	clear	N	None	None	Y	Y	2	2	2	1000	60	0.9	Y	Clear	rocky bottom , vegetated bottom, little visible sediment	1	-	-
15-Jun-18	18-TLA-06	TLA Road	435708	7555980	Southern edge of tailings lake empoundment … along northern edge of road, seep drains along road edge, shallow, but with steady flow. Roughly 300 m SE from edge of lake. Seep drains from base of roadway. Syringe need to collect sample.	8.1	240	103	4.0	Clear pale yellow	N	None	None	Y	Y	2	2	2	1000	60	0.9	Y	Clear to very pale yellow	brown + large rocks and grasses	3	-	-
15-Jun-18	18-AIRSTR-01	Airstrip	432769	7561049	Right across from sencan on the south end of airstrip. Seep flowing through big rocks, through gravel laying on toe of tundra. Little seep and pooling around. Samples taken with syringe	8.1	224	53	2.9	Clear	N	None	None	Y	Y	2	2	2	250	80	0.2	Y	Clear	grey/brown	1	-	-
15-Jun-18	18-AIRSTR-02	Airstrip	432767	7561065	West side of airstrip, south end. Seep flowing out of big rocks, pooling onto gravel covered tundra. Flow is steady. Flows and pools down north of airstrip. Poolong deep samples collected with syringe	8	236	61	0.4	grey brown	N	None	None	Y	Y	2	1	2	1000	60	1.1	Y	Clear	grey/brown	-	-	-
15-Jun-18	18-REF-01	Reference	433457	7550153	Flow is flowing through very grassy area (And willows). Flows is about a foot wide flowing quickly. Flow going down stream to the north. Samples collected with Syringe	7.1	47	144	5.5	Pale yellowish	N	None	None	Y	Y	1	1	1	t~ 1 m wide~ 7.5 cm deep,		0.1	Y	Clear	Reddish brown	2	-	-
15-Jun-18	18-REF-02	Reference	432187	7559822	Narrow stream flowing in a very grassy ground. Stream is shallow and grassy, steady down flow. Syringe used to collect sample	8	131	122	5.4	pale yellow	N	None	None	Y	Y	2	1	2	1000	95	0.7	Y	Clear	Reddish brown	1	-	-
15-Jun-18	18-REF-03	Reference	432122	7557605	Narrow flow, shallow through grass and tundra. Steady flow, pebble bottom on some parts. Samples collected with syringe	7.7	70	79	7.8	clear	N	None	None	Y	Y	1	1	1	1000	80	1.5	Y	Clear	Reddish brown	2	-	-

Attachment C – 2018 Laboratory Water Quality Data

Attachment C: Laboratory Results of the 2018 Seep Survey Samples

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	Total Hardness	TSS	TDS	Acidity	Total Alkalinity	Total 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 N/L	mg N/L	mg/L	mg/L	mg/L
	CCME guideline*	*6.5-9*	*6.5-9*	-	-	-	-	-	-	-	-	*4***	*120 mg/L*	-	*3 mg N/L*	-	-	-	*0.1*
Waste Rock Influenced Area	18-DC-01	7.8	7.9	2000	2200	160	350	17	1300	6.1	110	-	**400**	<0.20	**21**	0.56	0.09	250	0.015
	18-DC-02	8.2	7.9	2000	2200	170	360	120	1300	5.3	120	-	**410**	<0.20	**21**	0.55	0.13	250	0.015
	18-DC-03	8.3	7.9	1900	2200	150	350	28	1300	5.4	120	-	**400**	<0.20	**21**	0.57	0.1	250	0.011
	18-DC-04	8	7.9	2500	2900	110	830	9.9	2600	5.7	74	-	**750**	<0.40	**37**	0.42	0.0084	76	0.0081
	18-DC-05	7.6	7.9	2600	3100	91	900	9.7	3000	6.1	74	-	**830**	<0.40	**39**	0.3	0.0089	73	0.0084
Tail Lake Access (TLA) Road	18-TLA-01	8.2	7.9	92	100	59	40	73	87	1.4	53	-	2.2	0.027	0.018	0.0014	0.078	0.6	**0.11**
	18-TLA-02	8.7	7.7	99	110	60	39	16	81	2.6	40	-	7.3	0.024	<0.0050	<0.0010	0.071	1.7	0.066
	18-TLA-03	8.6	7.9	130	130	82	55	9.5	110	1.8	53	-	6.6	0.043	0.022	0.0024	0.045	3.5	0.094
	18-TLA-04	8.8	7.7	77	80	96	27	24	68	1.7	30	-	4.5	0.03	0.033	<0.0010	0.033	3.5	0.092
	18-TLA-05	8.5	7.6	54	55	100	18	31	41	1.6	18	-	3.7	<0.020	0.018	<0.0010	0.032	2.5	0.038
	18-TLA-06	8.1	8.1	240	240	100	94	19	170	1.8	89	-	18	0.088	0.45	0.031	0.042	4.2	0.095
Airstrip	18-AIRSTR-01	8.1	8.1	220	210	53	86	5.3	130	1.5	82	-	14	0.036	0.052	0.0029	0.016	7.5	0.025
	18-AIRSTR-02	8	8.1	240	220	61	87	3.1	140	1.5	84	-	14	0.04	0.1	0.0027	0.014	8.8	0.033
Reference (Windy Road)	18-REF-01	7.1	7.3	47	45	140	18	<3.0	58	2.2	13	-	3.4	0.046	<0.0050	<0.0010	0.02	0.58	0.059
	18-REF-02	8	7.8	130	130	120	50	<3.0	92	1.8	43	-	11	0.05	<0.0050	<0.0010	0.018	2.6	0.015
	18-REF-03	7.7	7.5	70	65	79	23	<3.0	54	1.7	19	-	6.9	<0.020	<0.0050	<0.0010	0.013	1.7	0.015

*Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life.

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

**Guideline for ammonia is pH and temperature dependent. Seepage waters had an average temperature of 5.2ºC at time of sampling and an average pH of 7.6. This guideline value is approximate.

***Guideline calculated based on the average hardness of the seepage samples of 330 mg $CaCO_3$ mg/L

Area	Sample ID	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg
		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
	CCME guideline*	*-*	*0.005*	*-*	*-*	*-*	*-*	*0.00037****	*-*	*-*	*-*	*0.004****	*0.3*	*0.007****	*-*	*-*	*-*	*0.000026*
Waste Rock Influenced Area	18-DC-01	0.0013	**0.0072**	0.028	<0.000020	<0.000050	0.36	0.000054	96	0.0024	0.038	**2.9**	**4.2**	0.000084	0.0053	27	0.078	<0.0000050
	18-DC-02	0.0013	**0.0065**	0.03	<0.000020	<0.000050	0.37	0.000062	100	0.0026	0.039	**3.1**	**4.2**	0.000079	0.006	28	0.1	<0.0000050
	18-DC-03	0.0014	**0.0058**	0.025	<0.000020	<0.000050	0.36	0.000063	96	0.0022	0.039	**2.7**	**3.8**	0.000082	0.0083	27	0.13	<0.0000050
	18-DC-04	0.00042	0.0015	0.059	<0.000040	<0.00010	0.18	0.00011	270	<0.00020	0.0014	**0.038**	0.025	<0.00010	0.0091	38	0.098	<0.0000050
	18-DC-05	0.00038	0.0014	0.07	<0.000040	<0.00010	0.18	0.00015	300	<0.00020	0.0013	**0.024**	<0.020	<0.00010	0.0088	39	0.092	<0.0000050
Tail Lake Access (TLA) Road	18-TLA-01	<0.00010	0.00055	0.0037	<0.000020	<0.000050	<0.010	0.00002	11	0.00052	0.00026	**0.011**	0.13	0.000089	0.0011	2.9	0.042	<0.0000050
	18-TLA-02	<0.00010	0.00044	0.002	<0.000020	<0.000050	<0.010	0.00002	11	0.00028	0.00023	**0.0084**	0.073	0.000085	0.001	2.8	0.059	0.0000063
	18-TLA-03	<0.00010	0.00083	0.0025	<0.000020	<0.000050	<0.010	0.000019	16	0.00049	0.00029	**0.017**	0.11	0.00014	0.0017	4	0.028	0.0000069
	18-TLA-04	<0.00010	0.00036	0.0015	<0.000020	<0.000050	<0.010	0.0000099	8.5	0.00026	0.00025	**0.0055**	0.07	<0.000050	<0.0010	1.5	0.033	<0.0000050
	18-TLA-05	<0.00010	0.00018	0.0013	<0.000020	<0.000050	<0.010	<0.0000050	5.3	<0.00010	0.00012	**0.0041**	0.03	<0.000050	<0.0010	1.1	0.015	<0.0000050
	18-TLA-06	<0.00010	0.00025	0.0076	<0.000020	<0.000050	<0.010	0.0000054	19	0.00063	0.00014	**0.0069**	0.1	0.000056	0.0061	11	0.024	0.0000056
Airstrip	18-AIRSTR-01	<0.00010	0.0011	0.0036	<0.000020	<0.000050	0.018	0.0000069	25	0.00014	0.00049	**0.013**	0.099	<0.000050	0.0015	5.5	0.1	<0.0000050
	18-AIRSTR-02	<0.00010	0.0012	0.0032	<0.000020	<0.000050	0.024	0.0000055	26	0.00042	0.00041	**0.017**	0.12	<0.000050	0.0015	5.7	0.068	<0.0000050
Reference (Windy Road)	18-REF-01	<0.00010	0.00015	0.0029	<0.000020	<0.000050	<0.010	<0.0000050	3.9	0.00038	<0.00010	0.004	0.17	<0.000050	0.0023	2	0.00074	0.0000059
	18-REF-02	<0.00010	0.00015	0.0026	<0.000020	<0.000050	<0.010	<0.0000050	13	0.00025	<0.00010	0.0024	0.047	<0.000050	0.0018	4.3	0.00032	<0.0000050
	18-REF-03	<0.00010	<0.00010	0.0026	<0.000020	<0.000050	<0.010	<0.0000050	6.5	<0.00010	<0.00010	0.0021	0.048	<0.000050	<0.0010	1.5	0.034	<0.0000050

*Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life.

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

**Guideline for ammonia is pH and temperature dependent. Seepage waters had an average temperature of 5.2ºC at time of sampling and an average pH of 7.6. This guideline value is approximate.

***Guideline calculated based on the average hardness of the seepage samples of 330 mg $CaCO_3$ mg/L

Attachment C: Laboratory Results of the 2018 Seep Survey Samples

Area	Sample ID	Mo	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	mg/L
	CCME guideline*	-	*0.15****	-	-	*0.001*	-	-	-	-	-	*0.0008*	-	-	-	-	*0.03*	-
Waste Rock Influenced Area	18-DC-01	0.01	0.051	0.38	26	**0.0039**	2.2	0.015	270	0.38	94	0.000028	<0.00010	<0.00030	0.001	0.0024	0.0015	<0.00030
	18-DC-02	0.01	0.054	0.36	26	**0.0042**	2.3	0.031	270	0.4	95	0.000028	<0.00010	0.00031	0.0012	0.0022	0.0013	<0.00030
	18-DC-03	0.01	0.051	0.34	26	**0.0039**	2.2	0.024	270	0.38	90	0.000015	<0.00010	<0.00030	0.0012	0.002	0.0012	<0.00030
	18-DC-04	0.0048	0.0033	<0.10	17	**0.0015**	1.7	0.00014	190	0.68	28	0.000048	<0.00020	<0.00060	0.00083	<0.0010	<0.0020	<0.00030
	18-DC-05	0.0044	0.0033	<0.10	17	**0.0014**	1.7	<0.000020	190	0.72	26	0.000051	<0.00020	<0.00060	0.00086	<0.0010	0.002	<0.00030
Tail Lake Access (TLA) Road	18-TLA-01	0.0003	0.00093	<0.050	1.3	<0.000050	1	<0.000010	2.6	0.013	0.53	<0.000010	<0.00010	0.0026	0.000046	0.00053	0.0013	0.00043
	18-TLA-02	0.00024	0.0011	0.062	1.6	0.000081	0.73	<0.000010	4.9	0.015	0.9	<0.000010	<0.00010	<0.0015	0.000025	<0.00050	0.0022	<0.00030
	18-TLA-03	0.00027	0.0016	<0.050	1.7	0.00011	1.4	<0.000010	5.4	0.019	1.5	<0.000010	<0.00010	0.0019	0.000071	0.00073	0.0011	0.00054
	18-TLA-04	0.00017	0.00082	<0.050	1.1	0.00013	0.58	<0.000010	4.3	0.0078	1.3	<0.000010	<0.00010	0.0013	0.000051	<0.00050	0.0012	<0.00030
	18-TLA-05	0.00009	<0.00050	<0.050	0.65	0.00012	0.3	<0.000010	3.3	0.0063	0.9	<0.000010	<0.00010	0.00048	0.00002	<0.00050	<0.0010	<0.00030
	18-TLA-06	0.00054	0.0026	<0.050	2.6	<0.000050	3.5	<0.000010	12	0.04	1.7	<0.000010	<0.00010	0.0027	0.000058	0.00055	0.0017	0.00054
Airstrip	18-AIRSTR-01	0.00032	0.0013	<0.050	1.8	0.00011	1.5	<0.000010	11	0.041	2.3	<0.000010	<0.00010	0.00056	0.00018	<0.00050	<0.0010	<0.00030
	18-AIRSTR-02	0.00058	0.003	<0.050	2	0.00013	1.6	<0.000010	12	0.042	2.8	<0.000010	<0.00010	0.00075	0.00023	0.00054	<0.0010	<0.00030
Reference (Windy Road)	18-REF-01	0.00021	0.0023	<0.050	1.6	<0.000050	1.1	<0.000010	2.7	0.0094	<0.50	<0.000010	<0.00010	<0.00060	0.000023	<0.00050	0.0047	0.00049
	18-REF-02	0.00018	0.0019	<0.050	1.3	0.000077	1.6	<0.000010	6.6	0.05	1	<0.000010	<0.00010	<0.00030	0.000014	<0.00050	0.0017	<0.00030
	18-REF-03	0.000053	<0.00050	<0.050	0.61	<0.000050	0.5	<0.000010	4.7	0.011	0.76	<0.000010	<0.00010	<0.00030	<0.000010	<0.00050	<0.0010	<0.00030

*Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life.

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

**Guideline for ammonia is pH and temperature dependent. Seepage waters had an average temperature of 5.2ºC at time of sampling and an average pH of 7.6. This guideline value is approximate.

***Guideline calculated based on the average hardness of the seepage samples of 330 mg $CaCO_3$ mg/L

Appendix C – 2018 Hope Bay Quarry and Construction Rock Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Jessica Charles, SRK Melanie Cox, SRK Lisa Barazzuol, SRK	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 21, 2019
Subject:	2018 Hope Bay Construction Rock Geochemical Monitoring		

1 Introduction

During 2018, TMAC Resources Inc. constructed the following infrastructure at Doris using was run-of-quarry (ROQ) rock from Quarry 2: southern extent of the tailings impoundment area (TIA) access road, the south dam, an expansion to the jetty road, the cyanide reagent pad, Pad T surface repairs, the Marine Outfall Berm (MOB) Access Road at Roberts Bay, airstrip south apron and the east airstrip access road. In 2018, blasting occurred in Quarry 2 from February to June and August to October.

Prior to development, the rock from Quarry 2 was geochemically characterized and classified as not potentially acid generating with low potential for metal leaching (SRK 2008). Subsequent geochemical monitoring was carried out to confirm these results and assess the ARD potential of the fine fraction produced when this material is blasted during quarrying activities and post-construction.

Monitoring requirements for quarries and quarry rock associated with the Doris Mine and Doris-Windy Road are specified in Water Licence 2AM-DOH1323 Amendment No. 1 (Nunavut Water Board 2016), Water Licence 2BE-HOP1222 (Nunavut Water Board 2012), and 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 provided in the Quarry Management and Monitoring Plan (TMAC 2017). This Plan is structured in a manner such that one document pertaining to quarrying is approved and implemented across all TMAC Hope Bay Project sites, while still addressing site and licence-specific needs.

This memo documents the results of the 2018 quarry rock and construction geochemical monitoring programs. It was not necessary to discharge water from Quarry 2 during 2018 so no seep or sump sampling was undertaken.

2 Methods

2.1 Quarry Monitoring

TMAC geologists inspected the active faces in Quarry 2 on an approximately weekly basis between February 11 and June 30 (20 inspections) then again from August 11 to September 16, 2018 (7 inspections) with a single inspection was carried out on October 21, 2018. Field notes were taken to document each inspection, including lithology, sulphide content and veining and presence/absence of fibrous actinolite (Attachment A).

In order to comply with the Quarry Management and Monitoring Plan (TMAC 2017), TMAC collected two sets of samples of run-of-quarry (ROQ) rock from Quarry 2 in June and October 2018. Each sample set consisted of 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 and veining (Attachment B).

TMAC shipped samples to Maxxam Analytics in Burnaby, BC for sample preparation where samples were analyzed by total sulphur by Leco. Samples containing total sulphur concentrations >0.1% were subsequently submitted for analysis of acid-base accounting (ABA) and trace element content by aqua regia digestion followed by ICP-MS scan. ABA included paste pH, 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. For the October sample set, both size fractions underwent the SFE test and all results are reported for completeness. 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.

2.2 Construction Monitoring

In August 2018, SRK geochemist Eduardo Marquez conducted a visual inspection and geochemical sampling program of areas where TMAC had placed construction rock materials in 2018 and early 2019, including:

- South Dam and the southern extent of the TIA access road;
- Jetty Road (widened and regraded);
- Cyanide Reagent Pad (new material placed on top);
- Pad T (surface repairs using quarry rock);
- Airstrip South Apron;
- East Airstrip Access Road; and
- MOB Access Road at Roberts Bay.

The visual inspection entailed a geological inspection of infrastructure areas. Twelve surface rock samples and two field duplicates (18-QR-08 and 18-QR-13) were collected from the surface material in the areas inspected (Attachment C). Photos of the inspected areas and sampling locations are included in Attachment D.

The samples were collected from pre-determined locations with one sample taken from each facility inspected or at a minimum of every 500 m along roads. SRK visually described the samples, including lithology, visible sulphide content and veining (Attachment E). At each sampling site a bulk sample was screened to -1 cm and -2 mm to generate two separate samples. SRK also conducted contact tests with a 1 to 1 distilled water to solids ratio and using a split of the -2 mm sieved portion of each sample. The pH and EC of the contact test leachates were recorded.

All samples were shipped to Maxxam Analytics in Burnaby, BC and the -1 cm fraction was analyzed of total sulphur by Leco. Samples of the -1 cm size fraction containing total sulphur concentrations >0.1% were also subsequently submitted for ABA and trace element content, using the same methods as outlined in Section 2.1. Of the 12 (-1 cm) samples analyzed for total sulphur by Leco analysis, 11 were subsequently submitted for ABA and trace element analysis using the methods outlined in Section 2.1.

Five samples were selected by SRK for SFE testing based upon rinse test data and / or location. Where several samples were collected at South Dam and along the East Airstrip Access Road, samples were selected based upon higher sulphur and EC values. Where only a single sample was selected at a particular location this also underwent SFE testing.

The SFEs were carried out on the -2 mm samples (on the as-received fraction) as per 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, total dissolved solids (TDS), SO_4, alkalinity, acidity, chloride, ammonia, NO_3, NO_2 and trace elements by ICP-MS (including Hg by ICP-MS). Geochemical analyses were coordinated by SRK.

2.3 Quality Assurance and Control

2.3.1 Quarry Monitoring

All laboratory results passed Maxxam's internal QA/QC criteria including the use of duplicate measurements and reference material. SRK reviewed the data for quality assurance, including assessment of laboratory duplicates, blanks and standard reference materials.

Table 2-2 presents the QAQC results for the ABA and trace element data. All results were deemed to be acceptable.

Table 2-3 presents the QAQC results for the SFE tests on the Quarry 2 samples. Results for the SFE blank were accepted with the exception of ammonia, which had concentrations greater than 5 times the detection limit. This result is currently being confirmed by the laboratory. The outcome of the recheck will not change the data interpretation. All results were deemed to be acceptable.

Table 2-1: QA/QC Summary for ABA and Aqua Regia Analysis, Quarry 2 Monitoring

QC Test	n	SRK QC Criteria	Results
Paste pH			
Lab Duplicate	2	For any samples, ± 0.5 difference pH unit	Passed
Standard Reference Material	1	Within specified tolerance ranges.	Passed
TIC			
Lab Blank	3	<5X detection limit (DL)	All passed
Standard Reference Material	3	Within specified tolerance ranges.	Passed
Total S & Total Sulphate			
Lab Blank	n=3 for Total S, and n=2 for SO4	<5X detection limit (DL)	All passed
Sulphur balance	4	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within ±20%	All passed
Lab Duplicate	n=0 for Total S, and n=2 for SO4	For samples > 10X the detection limit (DL), % RPD within ±20%	All passed
Standard Reference Material	n=6 for Total S, and n=2 for SO4	Within specified tolerance ranges.	All passed
Modified NP			
NP consistent with paste pH	4	Negative NP has paste pH ≤ 5	All passed
Lab Duplicate	n=2 for fizz test and n=2 for NP	% 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.	All passed
Fizz test rating with NP	4	Max NP does not exceed fizz test rating	All passed
Standard Reference Material	1	Within specified tolerance ranges.	All passed
Modified NP and TIC			
Comparison between Modified NP and TIC	4	Check for trends/co-relation	TIC higher than NP (Jun) NP higher than TIC (Oct)
Total S-Leco and S-ICP			
Comparison between Total S-Leco and S-ICP	4	For samples >10X detection limit (DL), % RPD within ±20%	All passed
Aqua Regia Metals			
Lab Blank	6	<5X detection limit (DL)	All passed
Standard Reference Material	8	Within specified tolerance ranges.	All passed

Sources: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\HopeBay_QRMonitoring_1CT022.027_2018_JC_MC_rev07.xlsx

Table 2-2: QA/QC Summary for SFE Analysis, Quarry 2 Monitoring

QC Test	n	SRK QC Criteria	Results
pH			
Lab Duplicate	n = 1 (Jun) n = 1 (Oct)	For any samples, ± 0.5 difference pH unit	All passed
Ion Balance			
Ion balances	n = 1 (Jun) n = 2 (Oct)	EC>10 uS/cm, % difference should be within ± 10%	All Passed
Ions, Nutrients and Trace Elements			
Lab Blank (Jun)	n=2 forAcidity to 4.5, Acidity to 8.3, SO4, Total Alkalinity, Bicarbonate, Hydroxide, Carbonate, Dissolved Cl, Nitrite-N, Total Ammonia, Total Dissolved Solids; and n=1 for other parameters,	<2X Detection Limit	All Passed
Lab Blank (Oct)	n=2 Total Alkalinity, Bicarbonate, Carbonate and Hydroxide, SO_4, Dissolved Cl, Nitrite-N, and n=1 for other parameters,	<5X detection limit (DL)	All Passed
SFE Blank	n = 1 (Oct)	<5X detection limit (DL)	Total Ammonia is above 5X DL Recheck has been requested and laboratory is reconfirming result.
Lab duplicates	n = 1 (Jun) n = 1 (Oct, selected parameters)	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Standard Reference Material (Jun)	n = 1 (Jun)	Within specified tolerance ranges.	All passed
Standard Reference Material (Oct)	Total Alkalinity, SO_4, Dissolved Cl, Nitrite-N, n=2 and for other parameters, n=1	Within specified tolerance ranges.	All passed

Sources: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\HopeBay_QRMonitoring_1CT022.027_2018_JC_MC_rev07.xlsx

2.3.2 Construction Monitoring

SRK reviewed the data for quality assurance, including assessment of laboratory duplicates, blanks and standard reference materials and two sets of field duplicates collected by SRK (18-QR-08 and 18-QR-13) and two split samples generated by the laboratory (18-QR-05 and 18-QR-10).

Table 2-3 presents a summary of QAQC checks for the ABA and trace element data. All results were deemed acceptable.

Table 2-4 presents the QAQC summary for the SFE leachates for the construction rock samples. All results were deemed acceptable except for the SFE blank sample which had zinc concentrations (0.0017 mg/L) greater than five times the detection limit. Zinc levels were confirmed by re-analysis and the laboratory attributed the contamination to their filtration methods. Zinc concentrations in the blank were greater than the samples therefore the samples appear not to be contaminated with zinc. SRK considers all SFE data acceptable.

Field rinse tests were carried out using deionized water and the handheld pH / EC meter was calibrated prior to taking measurements. The relative percent difference (RPD) for rinse test field duplicates were acceptable and ranged from <1% to 25%.

Table 2-3: QA/QC Summary for ABA and Trace Element Data on Construction Monitoring Samples

QC Test	n	SRK QC Criteria	Results
		Paste pH	
Split Duplicates	2	For any samples, ± 0.5 difference pH unit	All passed
Lab Duplicate	2	For any samples, ± 0.5 difference pH unit	All passed
Field Duplicate	2	For any samples, ± 0.5 difference pH unit	All passed
		TIC	
Lab Blank	1	<5x Detection Limit	Passed
Split Duplicates	2	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Lab Duplicate	1	For samples > 10X the detection limit (DL), % RPD within ±30%	Passed
Standard Reference Material	2	Within ±20% difference	All passed
		Total S & Total Sulphate	
Lab Blank	n=2 for total S, and n=1 for SO_4	<5x Detection Limit	All passed
Sulphur balance (total S > sulphate S)	15	For samples > 10X the detection limit (DL), Total Sulphur should be greater than Total Sulphate, if not the % difference should be within ±20%	All passed
Split Duplicates	2	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Lab Duplicate	n=1 for total S, and n=1 for SO_4	For samples > 10X the detection limit (DL), % RPD within ±20%	All passed
Field Duplicate	n=4 for total S, and n=2 for SO_4	For samples > 10X the detection limit (DL), % RPD within ±30%	All passed
Standard Reference Material	n=4 for total S, and n=1 for SO_4	Within specified tolerance ranges.	All passed
		Modified NP	
NP consistent with paste pH	15	Negative NP has paste pH ≤ 5	All passed
Split Duplicates	2	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Lab Duplicate	(n=2) for NP, (n=2) for fizz test	% 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.	All passed

QC Test	n	SRK QC Criteria	Results
Field Duplicate	n=2 for NP and n=2 for fizz test	For samples > 10X the detection limit (DL), % RPD within ±30%	All passed
Fizz test rating with NP	15	Max NP does not exceed fizz test rating	All passed
Modified NP and TIC			
Comparison between Modified NP and TIC	15	Check for trends/co-relation	NP higher than TIC
Total S-Leco and S-ICP			
Comparison between Total S-Leco and S-ICP	15	For samples >10X detection limit (DL), % RPD within ±30%	All passed
Aqua Regia Metals			
Lab Blank	3	<5x Detection Limit	All passed
Split Duplicates	2	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Lab Duplicate	1	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Field Duplicate	2	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Standard Reference Material	2	Within specified tolerance ranges.	All passed

Source: "P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\SRK - As-built monitoring\3. Lab data\QAQC\Copy of B872599 2018 Hope Bay Construction Rock Geochem_1CT022.027_QAQC_MAC_mlt.xlsx"

Table 2-4: QA/QC Summary for SFE on Construction Monitoring Samples

pH			
Split Duplicates	1	For any samples, ± 0.5 difference pH unit	All passed
Lab Duplicate	1	For any samples, ± 0.5 difference pH unit	All passed
Trace Metals			
Lab Duplicate	1	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Lab Blank	1	<5x Detection Limit	Dissolved zinc above 5x DL (0.0017 mg/L). Result confirmed by laboratory. Contamination introduced by lab filtration techniques Concentration in blank greater than samples therefore samples not contaminated.
Split Duplicates	1	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	All passed
Standard reference material	1	Within specified tolerance ranges.	All passed
Ion balance			
Ion balance	5	EC>100 us/cm, %difference should be within ± 10%	All passed
Split duplicate	1	EC>100 us/cm, %difference should be within ± 10%	All passed
Anions and Nutrients (Water)			
Split duplicate	1	For samples >10X detection limit (DL), % RPD within ± 30%, ok.	All passed
Lab Duplicate	1	For samples >10X detection limit (DL), % RPD within ± 30%, ok.	All passed
Lab Blank	3	Within specified tolerance ranges.	All passed
Standard reference material	1	Within specified tolerance ranges.	All passed

Source: "P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\SRK - As-built monitoring\3. Lab data\QAQC\Copy of B887046-SRK Hope Bay, 29 samples_1CT022.027_QAQC_MAC_mlt.xlsx"

3 Results

3.1 Quarry Monitoring

3.1.1 Quarry Face Inspections

In 2018, TMAC conducted 28 active face inspections in Quarry 2 between February and October. Figure 3-1 presents an example of a typical quarry face.

The key observations recorded by TMAC geologists were that all of the materials inspected were light to medium grey mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). Quartz–carbonate veins were typically present (approximately 1 to 3%) and up to 5 mm wide. One of the visual inspections in May reported up to 15% quartz-carbonate veins up to 15 cm wide. Small amounts of hematite staining were frequently observed on the surface. Moderate epidote alteration was recorded in August 2018 and weak chlorite alteration was reported during the September and October inspections. All inspections noted the absence of fibrous actinolite with the exception of the April 28 inspection which reported that drilling was taking place adjacent to a fibrous actinolite stake. TMAC clarified that a surface surveyor observed the suspected actinolite outside of the quarry boundary. The TMAC geologist recorded the anecdotal evidence of actinolite but was not able to confirm the occurrence of actinolite. .

Figure 3-1: Quarry 2 Active Face (Photo taken May 26, 2018)

3.1.2 ABA

The ABA results for the Quarry 2 ROQ rock samples are presented in Table 3-1 and included in Attachment B.

Paste pH for all samples was alkaline ranging from 8.4 to 8.9.

Total sulphur concentrations ranged between 0.13 and 0.28%. Total sulphur content between the samples is consistent, however total sulphur is higher in the fine fraction compared to the coarse fraction. Sulphate sulphur content was near the limit of detection (0.01%) ranging from 0.03 to 0.05%. On the basis of sulphide (calculated as the difference between total suphur and sulphate) and total sulphur content being at near parity, total sulphur was used to calculate the acid potential (AP).

Modified NP and TIC content ranged between 19 and 151 kg $CaCO_3$/t and 76 and 143 kg $CaCO_3$/t, respectively. For samples collected in June, TIC content was greater than modified NP, suggesting the presence of iron carbonate minerals, which results in TIC values that overestimates the amount of carbonate available for buffering due to the presence of NP-neutral iron carbonate. For October samples, modified NP content was greater than TIC, indicating the occurrence of silicates measured by the NP method. All of the samples are classified as non-PAG on the basis of TIC/AP and NP/AP.

3.1.3 Elemental Analyses

Selected key parameter results are presented in Table 3-2 and full laboratory results are included in Attachment B. The data were compared to ten times the average crustal abundance for basaltic rocks (Price 1997) as an indicator of enrichment. Selenium could not be assessed because the detection limit was equal to the screening criteria and selenium content was either below the limit of detection or within analytical error.

All samples were below the screening criteria suggesting no appreciable enrichment.

3.1.4 SFE Tests

A summary of the SFE test results is presented in Table 3-3, with complete results presented in Attachment B.

All of the samples reported an alkaline pH ranging from 9.1 to 9.6.

Major cation chemistry was dominated by sodium (9.6 to 36 mg/L) and calcium (5.1 to 12 mg/L), while major anion chemistry was dominated by alkalinity (17 to 26 mg/L as $CaCO_3$), sulphate (5.4 to 54 mg/L) and chloride (7.7 to 48 mg/L). Nitrate and ammonia concentrations ranged from 0.7 to 3.9 mg/L and 0.11 to 0.2 mg/L, respectively. The source nitrate and ammonia is explosives residues.

The SFE results were compared to ten times the Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (CCME 2014) as screening criteria to evaluate parameters that were elevated in the test leachate. All parameters were below the screening criteria. Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life. Due to the high water to rock ratio, these tests are considered dilute and concentrations of contact water may be higher than those in the SFE leachates. However, results indicate that the potential for metal leaching from these samples is low.

Table 3-1: Acid Base Accounting Results for the 2018 Quarry 2 Rock Samples

Sampling Month	Grain Size	Sample ID	Paste pH	TIC	Total S	Sulphate Sulphur	Sulphide Sulphur	AP	Modified NP	TIC/AP	NP/AP
		Units	pH Units	kg CaCO3/t	wt%	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A	N/A
Jun	-2 mm	W571470	8.4	143	0.23	0.05	0.18	7.2	100	20	14
	-1 cm	W571471	8.6	76	0.13	0.04	0.09	4.1	19	19	5
Oct	-2 mm	W571487	8.5	125	0.28	0.04	0.21	7.8	151	16	19
	-1 cm	W571488	8.9	105	0.19	0.03	0.16	5.9	130	18	22

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.xlsx]

Note: AP calculated from total sulphur content

Table 3-2: Metals Analysis of Key Parameters for Quarry 2 Rock Sample

Parameter	Units	*Screening Criteria	Jun		Oct	
			-2 mm	-1 cm	-2 mm	-1 cm
			W571470	W571471	W571487	W571488
Mo	ppm	*15*	0.80	0.30	0.60	0.20
Cu	ppm	*870*	140	120	140	140
Pb	ppm	*60*	22	5.3	2.8	1.6
Zn	ppm	*1050*	250	85	200	130
Ni	ppm	*1300*	61	63	45	48
Fe	ppm	*865000*	59000	57000	76000	73000
As	ppm	*20*	3.9	2.3	3.8	1.9
Au	ppm		0.0033	0.0012	0.0039	0.0026
Cd	ppm	*2.2*	0.20		0.20	<0.10
Al	ppm	*780000*	30000	29000	38000	34000
Hg	ppm	*0.9*	0.010	<0.010	<0.010	<0.010
Tl	ppm	*2.1*	<0.10	<0.10	<0.10	<0.10
Se	ppm	*0.5*	**<0.50**	**1.1**	0.50	**0.90**

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.xlsx]

Notes:

°All element concentrations are given as dissolved
*Comparisons to ten times average crustal abundance for basaltic rocks from Price (1997).

Table 3-3: Shake Flask Extraction Results for Quarry 2 Monitoring Samples

Parameter	Units	Detection Limit	*Screening Criteria	09-Jun	21-Oct	
				-2 mm	-2 mm	-1 cm
				W571470	W571487	W571488
pH	pH Units	N/A	6.5 - 9	**9.4**	**9.1**	**9.6**
EC	uS/cm	0.5		270	330	110
Sulphate	mg/L	0.5		14	54	5.4
Total Alkalinity	mg/L	0.5		26	17	18
Dissolved Chloride	mg/L	0.5	1200	48	30	7.7
Nitrate-N	mg/L	0.02	30	1.3	3.9	0.7
Total Ammonia**	mg/L	0.005	1.4	0.12	0.11	0.2
Total Dissolved Solids	mg/L	10		120	170	52
Total Hardness ($CaCO_3$)	mg/L	0.5		21	53	15
Calcium (Ca)	mg/L	0.05		6.9	12	5.1
Magnesium (Mg)	mg/L	0.05		1.0	5.6	0.50
Potassium (K)	mg/L	0.05		3.3	3.4	1.1
Sodium (Na)	mg/L	0.05		36	34	9.6
Aluminum (Al)	mg/L	0.0005	1	0.25	0.20	0.33
Arsenic (As)	mg/L	0.00002	0.05	0.00037	0.00036	0.00038
Cadmium (Cd)***	mg/L	0.000005	0.6	<0.000005	<0.000005	<0.000005
Copper (Cu)***	mg/L	0.00005	0.02	0.00024	0.00031	0.00013
Iron (Fe)	mg/L	0.001	3	0.0035	0.0051	0.043
Lead (Pb)	mg/L	0.000005	0.01	0.000028	<0.000005	0.000018
Molybdenum (Mo)	mg/L	0.00005	0.07	0.0015	0.0031	0.0008
Nickel (Ni)***	mg/L	0.00002	0.25	<0.00002	0.000086	0.0001
Selenium (Se)	mg/L	0.00004	0.01	0.00048	0.00073	0.00025
Thallium (Tl)	mg/L	0.000002	0.008	0.0000044	0.000010	0.0000052
Zinc (Zn)	mg/L	0.0001	0.3	<0.0001	0.00089	0.0012
Mercury (Hg)	mg/L	0.00005	0.00026	<0.00005	<0.00005	<0.00005

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.xlsx]

Notes:

°All element concentrations are given as dissolved

*Comparisons to ten times the CCME water quality guidelines for the protection of aquatic life (freshwater; long term) are intended for screening purposes and are not directly applicable because SFE tests do not represent natural waters.

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

**Guideline for ammonia is pH and temperature dependent. Standard room temperature (20ºC) was used given laboratory conditions and average pH of 8.8 for all SFE samples. This guideline value is approximate.

***Guideline calculated based on the average hardness of the SFE samples of 29.6 mg $CaCO_3$ mg/L

3.2 Construction Monitoring

3.2.1 Visual Inspection

Geological inspection of as-built construction areas confirmed that construction materials were characteristic of Quarry 2: grey-green mafic metavolcanics (basalt) containing carbonate and trace (<1%) to no visible sulphides . Additional observations were as follows:

- Pyrite was observed in trace amounts (from <1% to 1%) as dissemination at the majority of the sampling locations. On the east side of the TIA access road at sample location 18-QR-04, there were localized boulders with up to 5% visible pyrite as weathered stringers and disseminations. Overall, the rock inspected on the TIA access road contained typical sulphide content (<1%).
- Calcite veins were present in minor amounts (3-5%) at the Cyanide Reagent Pad, Airstrip South Apron and two out of three of the locations of the East Airstrip Access Road; in moderate amounts (5-10%) at the Jetty Road and in more abundant proportions (10-15%) at some of the South Dam, one of the locations at East Airstrip Access Road and MOB Access Road.
- At the Jetty Road, there were minor amounts of pale, cream-coloured altered metavolcanics (<1%).
- Hematite was seen in varying proportions at most of the sampling locations:
  - Ranging between 5% and 20% at the South Dam sampling sites, TIA access road and East Airstrip Access Road;
  - At approximately 3 to 5% proportions at the Airstrip South Apron and Pad T; and
  - In minor proportions (1–3%) at the MOB Access Road.
- K-feldspar was observed in minor proportions (3-5%) at the Cyanide Reagent Pad, at the Jetty Road and East Airstrip Access Road and in trace amounts (up to 1%) at Pad T, MOB Access Road and two areas at the top of South Dam.
- Minor hornblende (up to 5%) was observed at two areas at the top of South Dam.
- Trace amounts of epidote (<1%) were observed at the sampling location on the east side of the TIA access road, Pad T, East Airstrip Access Road, the Cyanide Reagent Pad and at the MOB Access Road . Up to 5% epidote was observed at the Airstrip South Apron.
- Trace to minor proportions of quartz vein (<1% to 3%) were observed at the Cyanide Reagent Pad, Airstrip South Apron and East Airstrip Access Road. Moderate proportions of vein quartz (5-10%) were also observed at the East Airstrip Access Road.

3.2.2 Contact Tests

Contact rinse tests were conducted onsite by SRK on all -2 mm samples. The results are presented in Table 3-4 and show that rinse EC results ranged between 61 and 521 µS/cm. Rinse pH values were alkaline ranging between 8.9 and 9.5 s.u.

Table 3-4: Rinse Test Results for 2018 Construction Rock Samples (-2 mm Fraction)

Area	Sample ID	Rinse pH	Rinse EC
		s.u.	uS/cm
South Dam	18-QR-01	9.3	73
	18-QR-02	9.3	88
	18-QR-03	9.2	82
TIA Access Road	18-QR-04	9.2	68
Jetty Road	18-QR-05	9.1	120
Cyanide Reagent Pad	18-QR-06	9.0	111
Pad T	18-QR-07	9.2	351
Airstrip South Apron	18-QR-09	9.3	140
East Airstrip Access Road	18-QR-10	8.9	79
	18-QR-11	9.1	63
	18-QR-12	9.1	61
MOB Access Road	18-QR-14	9.5	521

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.xlsx]

3.2.3 ABA

The ABA results for the -1 cm fraction are presented in Table 3-5 and Attachment F. All samples were analyzed for total sulphur with a subset analyzed for full ABA (Section 2.2)

Paste pH readings were moderately alkaline ranging between 8.2 and 9.1 s.u.

Total sulphur ranged between 0.04% and 0.22% and sulphate sulphur ranged from the analytical limit of detection (<0.01%) to 0.05%. Sulphide sulphur was calculated as the difference between total sulphur and sulphate sulphur with near parity between total sulphur and sulphide indicating that the sulphide sulphur was the predominant sulphur species (Figure 3-2). Accordingly, acid potential (AP) was calculated based on total sulphur.

Modified NP and TIC levels ranged from 67 to 157 kg $CaCO_3$/t and 36 to 129 kg $CaCO_3$/t, respectively. Modified NP content was consistently greater than TIC, indicating the occurrence of silicates measured by the NP method (Figure 3-3). All samples were classified as non-PAG on the basis of both TIC/AP and NP/AP (Figure 3-4 and Figure 3-5).

Table 3-5: Acid Base Accounting Results for the 2018 Construction Rock Samples (-1 cm Fraction)

Area	SRK ID	Total S	Paste pH	Sulphate Sulphur	Sulphide Sulphur	AP	TIC	Modified NP	TIC/AP	NP/AP
		wt%	pH Units	wt%	wt%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	N/A	N/A
South Dam	18-QR-01	0.13	9.0	0.02	0.11	4.1	36	67	8.7	17
	18-QR-02	0.22	8.9	0.05	0.17	6.9	82	112	12	16
	18-QR-03	0.14	8.9	0.04	0.1	4.4	127	133	29	30
TIA Access Road	18-QR-04	0.10	9.1	0.01	0.09	3.1	50	76	16	24
Jetty Road	18-QR-05	0.13	8.8	0.02	0.11	4.1	103	114	25	28
Cyanide Reagent Pad	18-QR-06	0.15	8.8	0.02	0.13	4.7	83	101	18	22
Pad T	18-QR-07	0.12	9.0	0.02	0.10	3.8	82	92	22	24
Airstrip South Apron	18-QR-09	0.09	9.1	0.01	0.08	2.8	63	73	22	26
East Airstrip Access Road	18-QR-10	0.08	8.2	<0.01	0.08	2.5	84	115	34	46
	18-QR-11	0.04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	18-QR-12	0.11	8.3	<0.01	0.04	3.4	59	85	17	25
MOB Access Road	18-QR-14	0.17	9.1	0.04	0.13	5.3	129	136	24	26

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.xlsx]

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

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

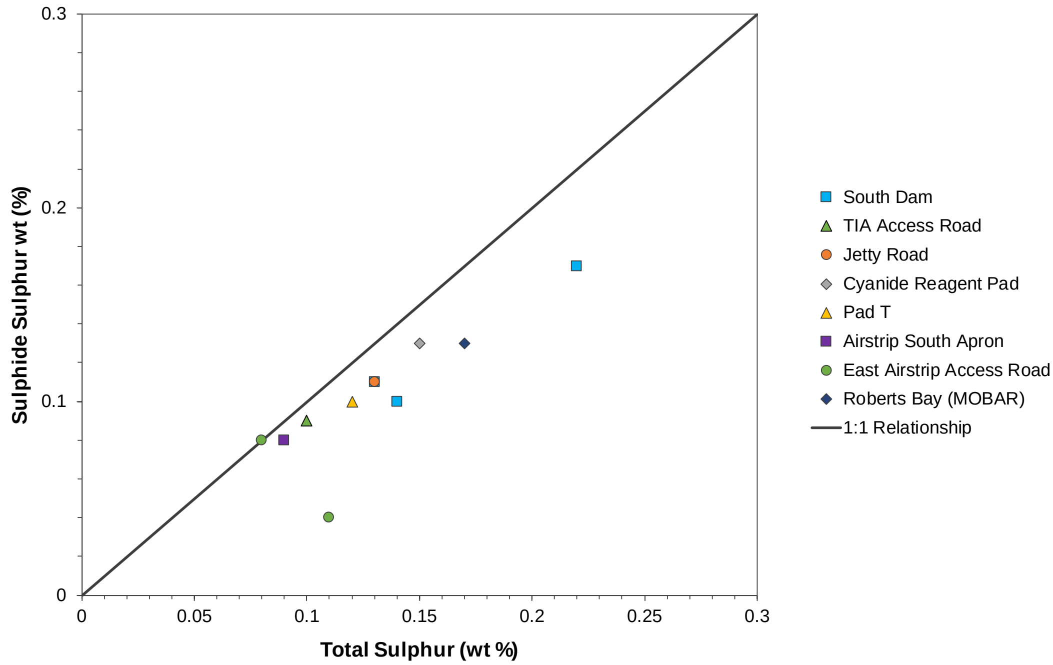

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Figure 3-2: Total Sulphur vs. Calculated Sulphide Sulphur

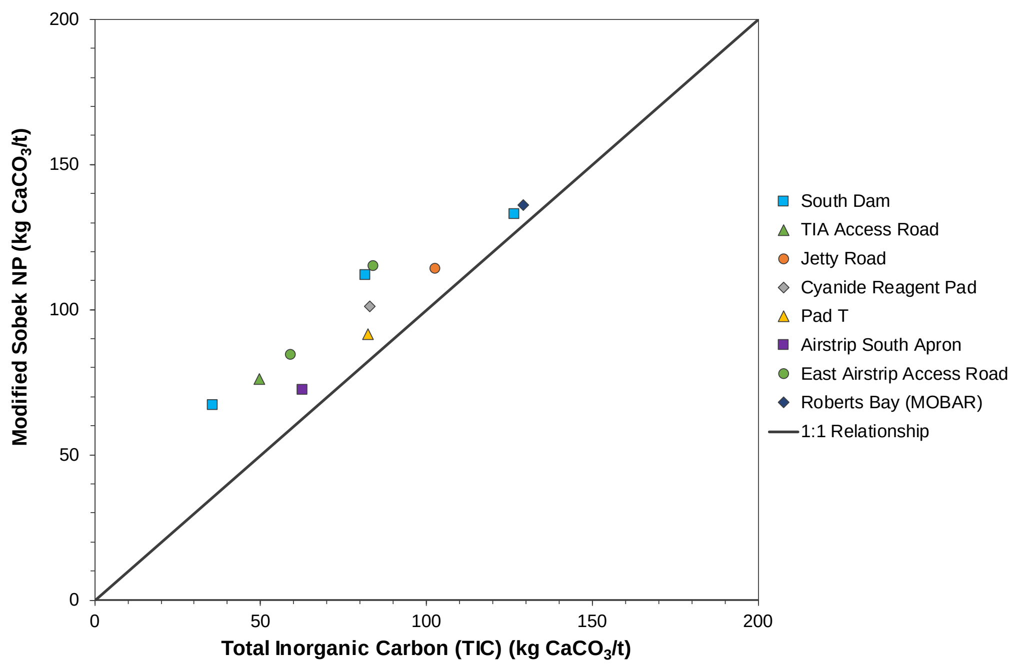

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Figure 3-3: Total Inorganic Carbon vs. Modified Sobek NP

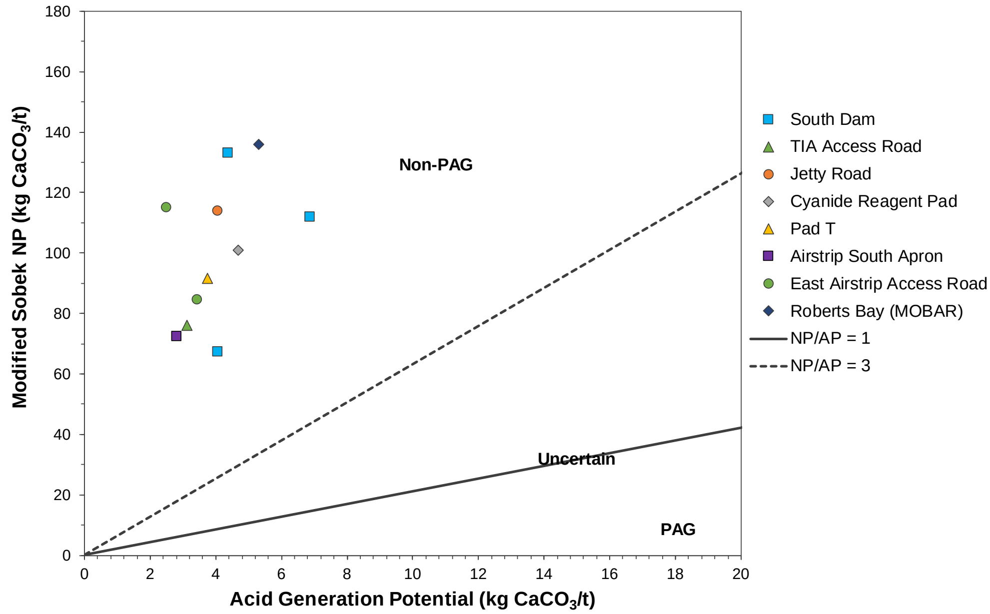

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Figure 3-4: ARD Classification by NP/AP

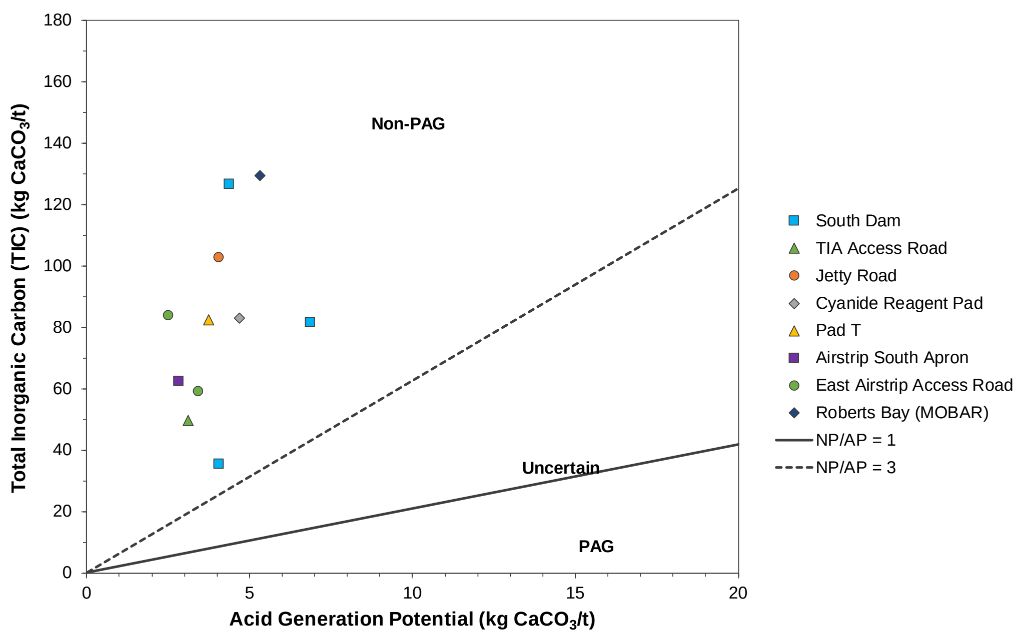

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Figure 3-5: ARD Classification by TIC/AP

3.2.4 Elemental Analyses

Eleven samples were analyzed for trace element content. Table 3-6 presents a summary of key parameters and full laboratory results are included in Attachment F.

The data were compared to ten times the average crustal abundance for basaltic rocks (Price 1997) as a method of screening samples with elevated trace element content. Bismuth and selenium could not be adequately assessed because the analytical limit of detection (<0.10 and <0.5 ppm, respectively) exceeded or was equal to ten times average crustal abundance (0.07 and 0.5 ppm, respectively). For selenium results were all below detection or within the range of analytical uncertainty.

Samples 18-QR-10 (East Airstrip Access Road) and 18-QR-01 (South Dam) were above the screening criteria for arsenic by 1.4 times and boron by 1.1 times, respectively. All other parameters were reported at concentrations below the screening criteria, suggesting no appreciable enrichment.

3.2.5 SFE Tests

A summary of results for key parameters for the five samples analyzed is presented in Table 3-7 and full results are included in Attachment F.

The pH was alkaline for all samples with values ranging between 8.7 and 9.4 s.u. EC values ranged between 83 and 220 uS/cm. The pH and EC as determined by SFE and contact tests (Section 3.2.2) were roughly equivalent.

Major cation chemistry was dominated by sodium (1.9 to 29 mg/L) and calcium (6.1 to 11 mg/L), while major anion chemistry was dominated by alkalinity (23 to 36 mg/L as $CaCO_3$) and chloride (0.6 to 25 mg/L). Nitrate concentrations were consistently reported below the analytical limit of detection (<0.2 mg/L) with the exception of the sample 18-QR-14 (3.5 mg/L) collected at MOB Access Road. Concentrations of ammonia were below detection limit (<0.005 mg/L) in all samples.

The SFE results were compared to ten times the Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (CCME 2014) as screening criteria to evaluate parameters that were elevated in the test leachate. The pH for samples 18-QR-02 (Jetty Road),18-QR-07 (Pad T) and 18-QR-14 (MOB Access Road) were higher than the screening criterion of pH 9. All other parameters were below the screening criteria.

Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life. Due to the high water to rock ratio, these tests are considered dilute and concentrations of contact water may be higher than those in the SFE leachates.

Table 3-6: Summary of Element Analysis for the 2018 Construction Rock Samples (-1 cm Size Fraction)

Parameter	Units	*Screening Criteria	South Dam			TIA Access Road	Jetty Road	Cyanide Reagent Pad	Pad T	Airstrip South Apron	East Airstrip Access Road		MOB Access Road
			18-QR-01	18-QR-02	18-QR-03	18-QR-04	18-QR-05	18-QR-06	18-QR-07	18-QR-09	18-QR-10	18-QR-12	18-QR-14
Mo	ppm	*15*	0.20	0.30	0.60	0.20	0.20	0.20	0.30	0.20	0.20	0.30	0.20
Cu	ppm	*870*	140	140	120	120	130	120	120	130	130	130	140
Pb	ppm	*60*	0.90	1.1	2.2	0.60	1.0	1.0	1.2	1.3	2.1	1.8	1.0
Zn	ppm	*1050*	66	87	89	61	71	82	81	74	72	70	90
Ni	ppm	*1300*	52	52	58	56	55	49	120	70	71	59	56
Fe	ppm	*865000*	45000	64000	59000	45000	52000	66000	59000	47000	54000	52000	66000
As	ppm	*20*	3.8	1.5	3.4	5.3	4.8	2.5	3.0	5.5	12	3.8	<0.50
Au	ppm		0.0015	0.0024	0.00050	0.00050	0.00050	0.00060	0.00050	0.0071	0.0035	0.0023	0.0011
Cd	ppm	*2.2*	0.30	<0.10	0.10	<0.10	0.10	<0.10	<0.10	0.20	0.10	<0.10	0.10
B	ppm	*50*	**53**	<20	<20	29	26	<20	27	23	24	<20	27
Al	ppm	*780000*	23000	34000	32000	24000	28000	33000	33000	25000	32000	28000	36000
Hg	ppm	*0.9*	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tl	ppm	*2.1*	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.20	<0.10	<0.10	<0.10	<0.10
Se	ppm	*0.5*	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.80**

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.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

Table 3-7: Shake Flask Extraction Results for 2018 Construction Rock Samples (-2 mm Fraction)

Parameter	Units	Detection Limit	*Screening Criteria	South Dam	Jetty Road	Pad T	East Airstrip Access Road	MOB Access Road
				18-QR-02	18-QR-05	18-QR-07	18-QR-10	18-QR-14
pH	pH Units	N/A	6.5 - 9	9	**9.1**	**9.3**	8.7	**9.4**
EC	uS/cm	0.5		93	110	180	83	220
SO_4	mg/L	0.5		9.2	18	28	4.7	18
Total Alkalinity	mg/L	0.5		29	25	23	34	28
Dissolved Chloride	mg/L	0.5	1200	0.8	1.6	18	0.6	25
Nitrate-N	mg/L	0.02	30	<0.2	<0.2	<0.2	<0.2	3.5
Total Ammonia**	mg/L	0.005	1.4	<0.005	<0.005	<0.005	<0.005	0.89
Total Dissolved Solids	mg/L	10		38	50	82	44	98
Hardness ($CaCO_3$)	mg/L	0.5		26	30	25	31	20
Aluminum (Al)	mg/L	0.0005	1	0.34	0.31	0.18	0.27	0.29
Antimony (Sb)	mg/L	0.00002		0.00019	0.00014	0.00033	0.00031	0.00015
Arsenic (As)	mg/L	0.00002	0.05	0.00066	0.0010	0.0025	0.013	0.00014
Cadmium (Cd)***	mg/L	0.000005	0.6	<0.000005	<0.000005	<0.000005	<0.0000050	<0.000005
Copper (Cu)***	mg/L	0.00005	0.02	0.00071	0.0012	0.0016	0.0022	0.00024
Iron (Fe)	mg/L	0.001	3	0.0036	0.0039	0.018	0.023	0.0041
Lead (Pb)	mg/L	0.000005	0.01	0.0000088	<0.000005	0.000011	0.000021	0.000007
Molybdenum (Mo)	mg/L	0.00005	0.07	0.0023	0.0017	0.0039	0.0033	0.0011
Nickel (Ni)***	mg/L	0.00002	0.25	0.000043	0.000065	0.00011	0.00021	0.00003
Selenium (Se)	mg/L	0.00004	0.01	0.00040	0.00044	0.00070	0.00044	0.00037
Thallium (Tl)	mg/L	0.000002	0.008	0.0000036	0.00001	0.000012	0.000018	0.00003
Zinc (Zn)	mg/L	0.0001	0.3	0.00069	0.0001	0.00016	0.00014	0.00013
Mercury (Hg)	mg/L	0.00005	0.00026	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Source: P:\30431 Hope Bay Geochemistry\Project\Quarry Rock\Compilation File\[HopeBay_QRMonitoring_1CT022.027_2018_JC_rev06.xlsx]

Notes:

°All element concentrations are given as dissolved

*Comparisons to ten times the CCME water quality guidelines for the protection of aquatic life (freshwater; long term) are intended for screening purposes and are not directly applicable because SFE tests do not represent natural waters.

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

**Guideline for ammonia is pH and temperature dependent. Standard room temperature (20ºC) was used given laboratory conditions and average pH of 8.8 for all SFE samples. This guideline value is approximate.

***Guideline calculated based on the average hardness of the SFE samples of 29.6 mg CaCO3 mg/L

4 Summary and Conclusions

4.1 Quarry Monitoring

In 2018, blasting occurred in Quarry 2 from February to June and August to October. Geological inspections of the active quarry faces indicated that quarry rock was mafic metavolcanics (basalt) containing trace amounts of disseminated pyrite (<1%). All inspections noted the absence of fibrous actinolite, with the exception of one inspection which took place in April. The TMAC geologist documented the observation by a surface surveyor of a suspected actinolite vein outside the quarry boundary, however the geologist was not able to confirm the occurrence of the actinolite.

Geochemical monitoring of ROQ rock indicated that the monitoring samples were non-PAG according to NP/AP and TIC/AP ratios. Total sulphur concentrations ranged between 0.13 and 0.28%. Modified NP and TIC content ranged between 19 and 151 kg $CaCO_3$/t and 76 and 143 kg $CaCO_3$/t, respectively. Elemental analyses indicates no appreciable enrichment compared to average crustal abundance for basaltic rocks

SFE test results indicated that all test leachates were alkaline and that all parameters were below the screening criteria. SFE test results indicated the risk of ML/ARD from ROQ rock is low.

4.2 Construction Monitoring

Based on the 2018 geological and geochemical monitoring program of quarry and as-built construction rock, the quarry rock used to construct the southern extent of the TIA access road, the south dam, an expansion to the jetty road, the cyanide reagent pad, Pad T surface repairs, the MOB Access Road, airstrip south apron and the east airstrip access road construction was geochemically suitable for use as construction rock.

Twelve surface rock samples were collected from the surface material in the areas inspected. Geological inspection of as-built construction areas at the time of sampling confirmed that construction materials were characteristic of Quarry 2: grey-green mafic metavolcanics (basalt) containing carbonate and trace (<1%) to no visible sulphides.

Total sulphur ranged between 0.04% and 0.22%. Modified NP and TIC levels ranged from 67 to 157 kg $CaCO_3$/t and 36 to 129 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 TIC/AP and NP/AP.

Arsenic and boron were enriched relative to the screening criteria in a sample from the East Airstrip Access Road and South Dam, respectively. All other parameters were below the screening criteria indicating no appreciable enrichment.

SFE test results indicated that all test leachates were alkaline and that all parameters were below the screening criteria, except for pH. SFE test results indicate that the potential for metal leaching from these samples is low.

Regards,
SRK Consulting (Canada) Inc.

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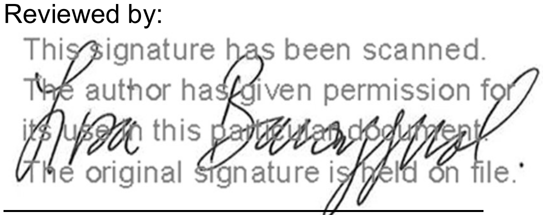

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied 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 Inspections, Quarry Monitoring Program

TMAC RESOURCES

Quarry Inspection

Blast Date: Feb 6, 2018.

Date: 11-Feb-2018

Geologist: K.CHISLETT

Quarry Location: Quarry 2.

General Visual Inspection

Rock Type	Mafics Basalt	Description: Massive mafics w/ hematite staining on jt surfaces.
Vein	Y/N (N circled)	If yes, describe (min, %, size):
Sulphides	Y/N (Y circled)	If yes: Disseminated/Vein/Stringer/Other (Disseminated circled) Percentage: Trace
Fibrous Actinolite	Y/N (N circled)	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides: N/A	TAGGED: Y/N	Description: N/A
UTM (only needed if anomalous): N/a		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
~60m blasted.	Mafics basalt. Iron staining (hematite) on jts. ? calcite ~~or~~ stringers. COVERED SNOW &ICE

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

Whole Rock Sample
Sample ID: ______________
Description: N/A
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: ______________
Description: N/A

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 minimum 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.

TMAC RESOURCES

Quarry Inspection

Blast date: Feb 6, 2018.
(same as last week)

Date: Feb 17 2018
Geologist: K, CHISLETT
Quarry Location: Quarry 2

General Visual Inspection

Rock Type	Mafic basalt.	Description: Massive mafics w/ hematite & cl staining on jt surfaces.
Vein	(Y)/N	If yes, describe (min, %, size): <1% stringers of calcite
Sulphides	(Y)/N	If yes: (Disseminated)/Vein/Stringer/Other Percentage: < 1% (trace).
Fibrous Actinolite	Y/(N).	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous): 13W 432358 7559029.		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-60	As above.

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

Whole Rock Sample
Sample ID: R828399.
Description: Mafic volcanics w/ minor hematite & chl staining. Grabbed from mucker. UTM 13W 432358 7559029.
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: R828399.
Description: As above. UTM:

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date: Feb 24, 2018 Blast Date: Feb 19, 2018.

Geologist: K. CHISLETT

Quarry Location: 2.

General Visual Inspection

Rock Type	Basalt	Description: Iron stained mafic Volcanics FG
Vein	Y/N (N circled)	If yes, describe (min, %, size): Stringers - tr
Sulphides	Y/N (Y circled)	If yes: Disseminated/Vein/Stringer/Other (Disseminated circled) Percentage: trace
Fibrous Actinolite	Y/N (N circled)	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0 - 10	above

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

Whole Rock Sample
Sample ID: ____________________
Description: N/A
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: ____________________
Description: N/A.

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date: 03/03/2018 Blast Date: MARCH 2, 2018

Geologist: GARY LOW

Quarry Location: GPS 68°08'14.6"N / 106°37'39.9"W

General Visual Inspection

Rock Type	BASALT.	Description: MAFIC VOLCANICS. TRACE FOLIATION EXTREMELY RARE PYRITE MIN'L.
Vein	Y/N (N circled)	If yes, describe (min, %, size): QUARTZ FRACTURE INFILL
Sulphides	Y/N	If yes: Disseminated/Vein/Stringer/Other (Disseminated circled) <1% Percentage:
Fibrous Actinolite	Y/N (N circled)	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-10	AS ABOVE

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

Whole Rock Sample
Sample ID: ______________
Description: N/A
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: ______________
Description: N/A

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date: MAR 10, 2018 Blast Date: MAR 2, 2018

Geologist: GARY LOW

Quarry Location: (NEAR) 68.08'.14.6"N 106.37'.39.9"W

General Visual Inspection

Rock Type	BASALT	Description: mAFIC VOLCANICS
Vein	Y/N	If yes, describe (min, %, size): QTZ/CARB TENSION FRACTURE INFILL VEINLETS.
Sulphides	Y/N	If yes: Disseminated/Vein/Stringer/Other [illegible] <1% Percentage:
Fibrous Actinolite	Y/N	If yes, describe (min, %, size): N/A
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: mafic Volcanics
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-40	mAFIC VOLCANICS.

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

Whole Rock Sample
Sample ID: ____________
Description: N/A
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: ____________
Description: N/A

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

Quarry Inspection

Inspection Date: 18-Mar-18 Blast Date: 02-Mar-18

Geologist: Annette Pardy

Quarry Location: Quarry 2

General Visual Inspection

Rock Type	Basalt	Description: Meduim grey mafic volcanics
Vein	Yes	If yes, describe (min, %, size): ~1% mm scale carbonate/quartz filling tension fractures.
Sulphides	No	If yes: Disseminated/Vein/Stringer/Other Percentage:
Fibrous Actinolite	No	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: Mafic Volcanics
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-40m	Mafic Volcanics. No Change in face from inspection done on March 10, 2018

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date: 24-Mar-18 Blast Date: 02-Mar-18

Geologist: Annette Pardy

Quarry Location: Quarry 2

General Visual Inspection

Rock Type	Basalt	Description: Light to Meduim grey mafic volcanics with ~ 2-5% local iron staining on joint surfaces
Vein	Yes	If yes, describe (min, %, size): ~1% mm scale carbonate/quartz filling tension fractures.
Sulphides	No	If yes: Disseminated/Vein/Stringer/Other Percentage: Trace
Fibrous Actinolite	No	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: Mafic Volcanics
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-100m	Mafic Volcanics. All of the blast face has now been exposed.

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

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date:	31/03/2018	Blast Date:	N/A (March 3rd?)
Geologist:	Gary Low		
Quarry Location:	Quarry #2		

General Visual Inspection

Rock Type	Basalt	Description: Light - medium grey, massive, aphinitic.
Vein	<u>Y</u>/N	If yes, describe (min, %, size):Quartz / Carbonate fracture infill, 1-5mm, (<1%)
Sulphides	<u>Y</u>/N	If yes: extremely rare disemminated pyritic flakes randomly scattered throught.
Fibrous Actinolite	Y/<u>N</u>	If yes, describe (min, %, size): None
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0 - 100m	Mafic Volcanics, as above

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

Whole Rock Sample
Sample ID: ____________________
Description: N/A
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: ____________________
Description: N/A

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.

Quarry Inspection

Inspection Date: 09/04/2018 Blast Date: 09/04/2018

Geologist: Gary Low

Quarry Location: Quarry #2

General Visual Inspection

Rock Type		Description: **Mafic Volcanics.**
Vein	**Y**/N	If yes, describe (min, %, size): **1-5mm Quartz / C**
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	Description:
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0 - 100m	Mafic Volcanics ;
	trace quartz / Carbonate fracture infill veinlets
	randomly scattered throughout.
	Extrememly rare (<1%) dismminated pyritic flecks
	creating weak oxidation on some joint surfaces.

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

Whole Rock Sample
Sample ID: No Sample(s) taken
Description: **N/A**
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: No Sample(s) taken
Description: **N/A**

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

Quarry Inspection

Inspection Date:	15-Apr-18	Blast Date:	09-Apr-18
Geologist:	Annette Pardy		
Quarry Location:	Q2		

General Visual Inspection

Rock Type	Basalt	Description: Mafic Volcanics
Vein	Yes	If yes, describe (min, %, size): 1% carbonate/quarts veinlets
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other Percentage: <1% Dissmeinated
Fibrous Actinolite	No	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0-100m	Light to medium grey mafic volcanics. Local light pink-deep red moderate to strong iron staining along joints and fractures. ~1% carbonate/quarts fracture filling veinlets. Trace Pyrite.

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

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date:	21-Apr-18	Blast Date:	18-Apr-18
Geologist:	Annette Pardy		
Quarry Location:	Q2		

General Visual Inspection

Rock Type	Basalt	Description: Mafic Volcanics
Vein	Yes	If yes, describe (min, %, size): 1% carbonate/quarts veinlets
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other Percentage: <1% Dissmeinated
Fibrous Actinolite	No	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
	Face not exposed due to blasted muck.
	Muck Pile description: Fine to boulder size broken material. Light to med grey mafic volcanics. Mod pink to local strong deep red iron staining on joint 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.

TMAC RESOURCES

Quarry Inspection

Inspection Date:	28-Apr-18	Blast Date:	18-Apr-18
Geologist:	Annette Pardy		
Quarry Location:	Quarry #2		

General Visual Inspection

Rock Type	Basalt	Description: Mafic Volcanics
Vein	Yes	If yes, describe (min, %, size): 1% carbonate/quarts veinlets
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other Percentage: <1% Dissmeinated
Fibrous Actinolite	Y/N	If yes, describe (min, %, size):**NOTE: Currently drilling adjacent to Fibrous Actinolite Stake**
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: NOTE:
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
1-300m	WALL: Light to local dark grey mafic volcanics. Mod pink to local strong deep red iron staining on joint surfaces.

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

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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.

Quarry Inspection

Inspection Date: 05-May-18 Blast Date: 02-May-18

Geologist: Gary low

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Basalt	Description: Mafic Volcanics
Vein	Yes	If yes, describe (min, %, size): 1% carbonate/quarts veinlets
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other Percentage: <1% Dissmeinated
Fibrous Actinolite	Y/**N**	If yes, describe (min, %, size):**NOTE: No Actinolite present.**
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: NOTE:
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
1-300m	Predominantly grey in colour, trace to rare secondary quartz / calcite fracture infill crystallization, very weak iron staining / oxidization on some joint surfaces.

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

Whole Rock Sample
Sample ID:
Description:

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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.

TMAC RESOURCES

Quarry Inspection

Inspection Date: 14-May-18 Blast Date: 09-May-18

Geologist: Gary low

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Basalt	Description: Mafic Volcanics, light grey, rare secondary quartz fracture infilling, extremely rare oxidation on some joint surfaces.
Vein	Yes	If yes, describe (min, %, size): < 1% carbonate/quarts veinlets
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other Percentage: < 1% Disseminated
Fibrous Actinolite	Y/N	If yes, describe (min, %, size):**NOTE: No Actinolite present.**
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: NOTE:
UTM (only needed if anomalous):		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
1-300m	Predominantly grey, trace to rare secondary quartz / calcite fracture infill crystallization, very weak iron staining / oxidization on some joint 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)
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.

TMAC RESOURCES

Quarry Inspection

Inspection Date:	19-May-18	Blast Date:	09/05/2018
Geologist:	Gary Low		
Quarry Location:	Quarry #2		

General Visual Inspection

Rock Type	Mafic Volcanics	Light grey, massive in appearance, blocky, occassional oxidation on some joint surfaces, rare secondary quartz/calcite fracture infill, extremely rare disseminated pyrite flakes scattered throughout.
Vein	Y/N	If yes, describe (min, %, size): rare (<1%) quartz fracture infill veinlets, 0.5 - 1.0cm in thickness.
Sulphides	**Y**/N	If yes: Disseminated Percentage: <1%
Fibrous Actinolite	Y/N	If yes, describe (min, %, size): None.
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description: NOTE:
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0 - 100m	Mafic Volcanics, Grey, Massive, trace oxidation on some joint surfaces, rare secondary quartz veinlets as fracture infilling, extremely rare dissmenated pyritic flakes..

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

Whole Rock Sample
Sample ID:
Description:

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

Quarry Inspection

Inspection Date: 26-May-18 Blast Date: 16-May-18
Geologist: Scott Snider
Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	Description: Dark grey to green; fine grained-granular; trace py min; 3-8% irregular qtz-carb veining/veinletts.
Vein	Yes	If yes, describe (min, %, size): Up to 15%: 1-15cm wide irregular qtz-carb veinletts
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other: py; fine graind to med grained; disseminated; Percentage: Trace
Fibrous Actinolite	No	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**
0-40m	Partial face exposure due to muckpile. Broken up rubble (fine grained to boulder size blast rocks): see above rock discription.

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

Whole Rock Sample
Sample ID: W571469
Description: Dark grey to green; fine grained-granular; trace py min; 3-8% irregular qtz-carb veining/veinletts. Hemitite alteration noted along joint plains; Weak to moderate carbonate alteration observed by applying HCL. **SAMPLE UTM: 13W432361; 7559035; ELV : 59M**
2 mm screen sample (same material as Whole Rock Sample)
Sample ID:
Description:

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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.

***Photo**: Quarry Monitoring Inspection 26th May 2018*

TMAC RESOURCES

Quarry Inspection

Inspection Date: 09-Jun-18 Blast Date: 04-Jun-18

Geologist: Annette Pardy and Jonathan Warner

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	Description: Dark grey to green; fine-medium grained massive basalt. Local weak to moderate hematite altertion along joints and fractures.
Vein	Yes	If yes, describe (min, %, size): 1-3% mm-cm scale carbonate/quartz veinlets.
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other: Trace fine to coarse grained disseminated PY
Fibrous Actinolite	No	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**
	Description based on broken material. Face not exposed due to blasted muck.

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

Whole Rock Sample
Sample ID: W571471
Description: Dark grey to green; fine-medium grained massive basalt. Local weak to moderate hematite altertion along joints and fractures. 1-3% mm-cm scale carbonate/quartz veinlets. Trace fine to coarse grained disseminated PY. 8.10kg Bag sample
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: W571470
Description: Same as above 3.40 kg Bag 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.

TMAC RESOURCES

Quarry Inspection

Inspection Date: 17-Jun-18 Blast Date: 04-Jun-18

Geologist: Gary Low

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	Description: Predominently grey, light grey in part. Very fine grained to affanitic. Massive.
Vein	Yes	If yes, describe (min, %, size): No veins seen. Trace Qtz / Carb Veinlets (1-3mm, 1-2%)/
Sulphides	Yes	If yes: Extremely rare disseminated pyritic flakes scattered thoughtout. Very weak oxidation staining on some joint surfaces.
Fibrous Actinolite	No	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 - 300	Description based on broken material. Face not exposed due to blasted muck.

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

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

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.

Quarry Inspection

Inspection Date:	23-Jun-18	Blast Date:	04-Jun-18
Geologist:	Gary Low		
Quarry Location:	Quarry #2		

General Visual Inspection

Rock Type	Mafic Volcanics	Description: Light grey to grey, massive, affinitic, occasional secondary quartz / carbonate infill on fractures, trace oxidation on some joint surfaces, extremely rare disemminated pyrite flakes.
Vein	Yes	If yes, describe (min, %, size): No veins seen. Trace Qtz / Carb Veinlets (1-3mm, 1-2%).
Sulphides	Yes	If yes: Extremely rare disseminated pyritic flakes scattered thoughtout. Very weak oxidation staining on some joint surfaces.
Fibrous Actinolite	No	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 - 300	Description based on broken material. Face not exposed due to blasted muck.

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

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

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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

TMAC RESOURCES

Quarry Inspection

Inspection Date: 30-Jun-18 Blast Date: 04-Jun-18

Geologist: Scott Snider

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcs	Med green to grey: fine grained (granular); wk to mod. Hem alt. along jt plains. Up to 3% irr qtz-carb <1cm wide.
Vein	YES	Up to 3% irregular qtz carb veining. Veins are typically 1-5mm wide with local cm scaled veins.
Sulphides	YES	Trace diss med grained pyrite. Subhedral. Percentage: Trace
Fibrous Actinolite	NO	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**
0-100	Med green to grey: fine grained (granular); wk to mod. Hem alt. along jt plains. Up to 5% irr qtz-carb <1cm wide. ~1% subheral py.
100-200	Med green to grey: fine grained (granular); wk to mod. Hem alt. along jt plains. Up to 3% irr qtz-carb <1cm wide. Tr py % subheral py.
200-250	Med green to grey: Blocky; fine grained (granular); wk to mod. Hem alt. along jt plains. Up to 3% irr qtz-carb <1cm wide. Tr py % subheral py.

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

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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 material 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.

TMAC RESOURCES

Quarry Inspection

Inspection Date:	Aug. 11, 207	Blast Date:	Aug. 8, 2018
Geologist: S.Snider			
Quarry Location:	Quarry #2		

General Visual Inspection

Rock Type	Mafic Volc.	Dark grey to green; f.g ganular mafic volcanics; moderate Hem alteration noted along joint surfaces; 1-3% irregular qtz- crb veinlets.
Vein	YES	1-3% mm-cm scale carbonate/quartz veinlets.
Sulphides	YES	Trace fine to coarse grained disseminated PY
Fibrous Actinolite	NO	N/A
If anomalous rock types/significant sulphides:	TAGGED: Y/N	N/A
UTM (only needed if anomalous)**: NAD83; 432336.0 ; 7559092.0; +42**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
1 -50 m	Dark grey to green; f.g ganular mafic volcanics; moderate Hem alteration noted along joint surfaces; 1-3% irregular qtz- crb veinlets.

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

Whole Rock Sample
Sample ID: W 571474
Dark grey to green; f.g ganular mafic volcanics; moderate Hem alteration noted along joint surfaces; 1-3% irregular qtz- crb veinlets.
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: W571473
Dark grey to green; f.g ganular mafic volcanics; moderate Hem alteration noted along joint surfaces; 1-3% irregular qtz- crb veinlets.

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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

***Photo**: Quarry Monitoring Inspection 11th August 2018*

***Photo**: Quarry Monitoring Inspection 11th August 2018*

TMAC RESOURCES

Quarry Inspection

Inspection Date: 19-Aug-18 Blast Date: Aug 8 2018

Geologist: Annette Pardy

Quarry Location: Quarry 2

General Visual Inspection

Rock Type	Mafic Volcanics	Description: Fine to med grained, light to med greenish grey. Local FE staining alteration along joints faces and fractures. 1-2% carb filling fractures. Mod epidote alteration.
Vein	Y	If yes, describe (min, %, size):~1-2% mm-cm carbonate/quartz veining, randomly oriented throughout with local heamatite alteration associated
Sulphides	Y	If yes: Disseminated/Vein/Stringer/Other Percentage: Trace fine to coarse grained disseminated Pyrite.
Fibrous Actinolite	N	If yes, describe (min, %, size):
If anomalous rock types/significant sulphides:	TAGGED: Y/N	Description:
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
1-100m	Looking North East: Mafic volcanic. Cm scale fauly visible abould half way alon the face interval. Steeply dipping towards the west. Appears brecciated.

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

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

TMAC RESOURCES

Quarry Inspection

Inspection Date: 25-Aug-18 Blast Date: 20-Aug-18

Geologist: Annette Pardy

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	Description:(Muck Pile) Fine to coarse grained, medium to dark greenish grey mafics. Local week to strong, light to dark red hemaitite alteration along joint faces.
Vein	Y	If yes, describe (min, %, size): ~1-2% mm scale carbonate/quartz filling fractures.
Sulphides	Y	Trace local fine to coarse grained disseminated Pyrite 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**
1-50m	Rock description based mostly from Muck pile. Could only see partial face looking NW. Face is light grey in color. No major veining was visible. Face is highly fractured (Blocky)with sub-parrallel, cross-cutting and randomely oriented fractues throughout.

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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TMAC RESOURCES

Quarry Inspection

Inspection Date: Sept. 1, 18 Blast Date: 25-Aug-18

Geologist: C.A. / A.P. / E.A.

Quarry Location: Quarry # 2

General Visual Inspection

Rock Type	Mafic Volcanics	**Description:** Grey to Green, Fg to Mg, 1% Qz/Cb Strs, Weak Pervasive Chlorite, Weak Pchy Hematite on weathered faces, Tr Sul.
Vein	***Y*** /N	**If yes, describe (min, %, size)**: 1% Qz/Cb Strs <1cm
Sulphides	***Y*** /N	**Percentage:** Tr Dis Sulphides
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**
30-40m Face	Grey to green, Fg to Mg, Tr strs, Weak hematite alteration on weathered faces, Weak pervasive Chlorite alteration, Top 2-3m of face is blocky, 1-2m Joint sets

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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TMAC RESOURCES

Quarry Inspection

Inspection Date:	09-Sep-18	Blast Date:	05/09/2018
Geologist:	Gary Low		
Quarry Location:	Quarry #2		

General Visual Inspection

Rock Type		Description: Mafic Volcanics.
Vein	Y/**N**	If yes, describe (min, %, size):
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**
0-50m	Massive Mafic Volcanics, affinitic, grey - pale green, trace to rare ox'n on some joint surfaces, no noticable qtz veinlets.

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

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

<u>Contingency - Identification of Inappropriate Quarry Rock</u>

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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TMAC RESOURCES

Quarry Inspection

Inspection Date: Sept 16, 2018 Blast Date: No blast this week
Last Blast was Sept 5, 2018
Geologist: Scott Snider
Quarry Location: Quarry #2

General Visual Inspection

Rock Type		Description: No Blast
Vein	Y/N	If yes, describe (min, %, size): N/A
Sulphides	Y/N	If yes: Disseminated/Vein/Stringer/Other Percentage: N/A
Fibrous Actinolite	Y/N	If yes, describe (min, %, size): N/A
If anomalous rock types/significant sulphides:	TAGGED: Y/N	N/A
UTM (only needed if anomalous)**:**		

Inspection at 100m intervals

Rock Characteristics	
Interval:	**Description**
0	No Blast

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

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

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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***Photo**: Quarry Monitoring Inspection 16th September 2018*

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

TMAC RESOURCES

Quarry Inspection

Inspection Date: 09-Jun-18 Blast Date: 04-Jun-18

Geologist: Annette Pardy and Jonathan Warner

Quarry Location: Quarry #2

General Visual Inspection

Rock Type	Mafic Volcanics	Description: Dark grey to green; fine-medium grained massive basalt. Local weak to moderate hematite altertion along joints and fractures.
Vein	Yes	If yes, describe (min, %, size): 1-3% mm-cm scale carbonate/quartz veinlets.
Sulphides	Yes	If yes: Disseminated/Vein/Stringer/Other: Trace fine to coarse grained disseminated PY
Fibrous Actinolite	No	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**
	Description based on broken material. Face not exposed due to blasted muck.

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

Whole Rock Sample
Sample ID: W571471
Description: Dark grey to green; fine-medium grained massive basalt. Local weak to moderate hematite altertion along joints and fractures. 1-3% mm-cm scale carbonate/quartz veinlets. Trace fine to coarse grained disseminated PY. 8.10kg Bag sample
2 mm screen sample (same material as Whole Rock Sample)
Sample ID: W571470
Description: Same as above 3.40 kg Bag 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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

TMAC RESOURCES

Quarry Inspection

Inspection Date: ______________________ Blast Date: ______________________

Geologist: Gary Low and Annette Pardy

Quarry Location: Quarry #2

General Visual Inspection

Rock Type		Description:
Vein	Y/N	If yes, describe (min, %, size):
Sulphides	Y/N	If yes: Disseminated/Vein/Stringer/Other Percentage:
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**
	No Qaurry inspection was done on Oct 21, 2018 when the samples were taken

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

Whole Rock Sample
Sample ID: W571488
Description: Medium gre, fine to med grain mafic volcanics. Trace fine to medium grained Pyite associated. Trace fine carbonate altertion, trace dark green chlorite alteration and trace heamatite alteration associated. UTM: 13W0432408:7559342 Sample taken on Octoner 21, 2018 at 3:30 pm.

2 mm screen sample (same material as Whole Rock Sample)
Sample ID: W571487
Description: Medium gre, fine to med grain mafic volcanics. Trace fine to medium grained Pyite associated. Trace fine carbonate altertion, trace dark green chlorite alteration and trace heamatite alteration associated. UTM: 13W0432408:7559342 Sample taken on Octoner 21, 2018 at 3:30 pm.

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. *Pg 16: Quarry Management and Monitoring Plan - Revision 02 SRK Consulting*

Quarry Monitoring - ABA						
Parameter	**Units**	**Detection Limits**	**09-Jun**		**21-Oct**	
		TMAC ID>	**W571470**	**W571471**	**W571487**	**W571488**
		Maxxam Sample No>	**TU3808**	**TU3809**	**UX9386 / VE5791**	**UX9387 / VE5792**
		Sample Form>	**-2 mm rock**	**-1cm rock**	**-2 mm rock**	**-1cm rock**
Dry Weight Received	kg		3.4	8.0	2.6	3.9
Paste pH	pH Units	*N/A*	8.4	8.6	8.5	8.9
CO_2	wt%	*0.08*	6.3	3.3	5.5	4.6
TIC	kg CaCO3/t		143	76	125	105
Total S	wt%	*0.02*	0.23	0.13	0.25	0.19
Sulphate Sulphur	wt%	*0.01*	0.05	0.04	0.04	0.03
Sulphide Sulphur (by difference)	wt%	*0.02*	0.18	0.09	0.21	0.16
AP (calculated from total S)	kg $CaCO_3$/t		7.2	4.1	7.8	5.9
Mod. ABA NP	kg $CaCO_3$/t	*0.1*	100	19	151	130
Fizz Rating	N/A	*N/A*	STRONG	MODERATE	MODERATE	MODERATE
Net Neutralization Potential	kg $CaCO_3$/t	*0.1*	94	16	144	125
TIC/AP (calculated from Total Sulphur)	N/A		20	19	16	18
NP/AP (calculated from Total Sulphur)	N/A		14	4.7	19	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	09 Jun		24 Oct	
		-2 mm rock	-1cm rock	-2 mm rock	-1cm rock
		W571470	W571471	W571487	W571488
Ag	mg/kg	<0.10	<0.10	0.10	<0.10
Al	mg/kg	30000	29000	38000	34000
As	mg/kg	3.9	2.3	3.8	1.9
Au	mg/kg	0.0033	0.0012	0.0039	0.0026
B	mg/kg	<20	<20	<20	20
Ba	mg/kg	36	15	10	3.0
Bi	mg/kg	<0.10	<0.10	<0.10	<0.10
Ca	mg/kg	58000	36000	60000	51000
Cd	mg/kg	0.20		0.20	<0.10
Co	mg/kg	38	37	42	41
Cr	mg/kg	150	180	110	110
Cu	mg/kg	140	120	140	140
Fe	mg/kg	59000	57000	76000	73000
Ga	mg/kg	8.0	7.0	10	10
Hg	mg/kg	0.010	<0.010	<0.010	<0.010
K	mg/kg	400	400	300	200
La	mg/kg	3.0	2.0	2.0	2.0
Mg	mg/kg	24000	23000	24000	24000
Mn	mg/kg	1300	1200	1700	1600
Mo	mg/kg	0.80	0.30	0.60	0.20
Na	mg/kg	330	210	200	140
Ni	mg/kg	61	63	45	48
P	mg/kg	330	330	340	330
Pb	mg/kg	22	5.3	2.8	1.6
S	mg/kg	1800	1000	2100	1900
Sb	mg/kg	0.80	0.10	0.10	<0.10
Sc	mg/kg	11	9.4	17	16
Se	mg/kg	<0.50	1.1	0.50	0.90
Sr	mg/kg	31	27	31	25
Te	mg/kg	<0.20	<0.20	<0.20	<0.20
Th	mg/kg	0.30	0.20	0.50	0.20
Ti	mg/kg	2200	2700	2300	2200
Tl	mg/kg	<0.10	<0.10	<0.10	<0.10
U	mg/kg	<0.10	<0.10		
V	mg/kg	150	150	210	210
W	mg/kg	<0.10	<0.10	<0.10	<0.10
Zn	mg/kg	250	85	200	130

Notes:

°All element concentrations are given as dissolved

Attachment B: Sample Descriptions and Geochemical Data, Quarry Monitoring Program

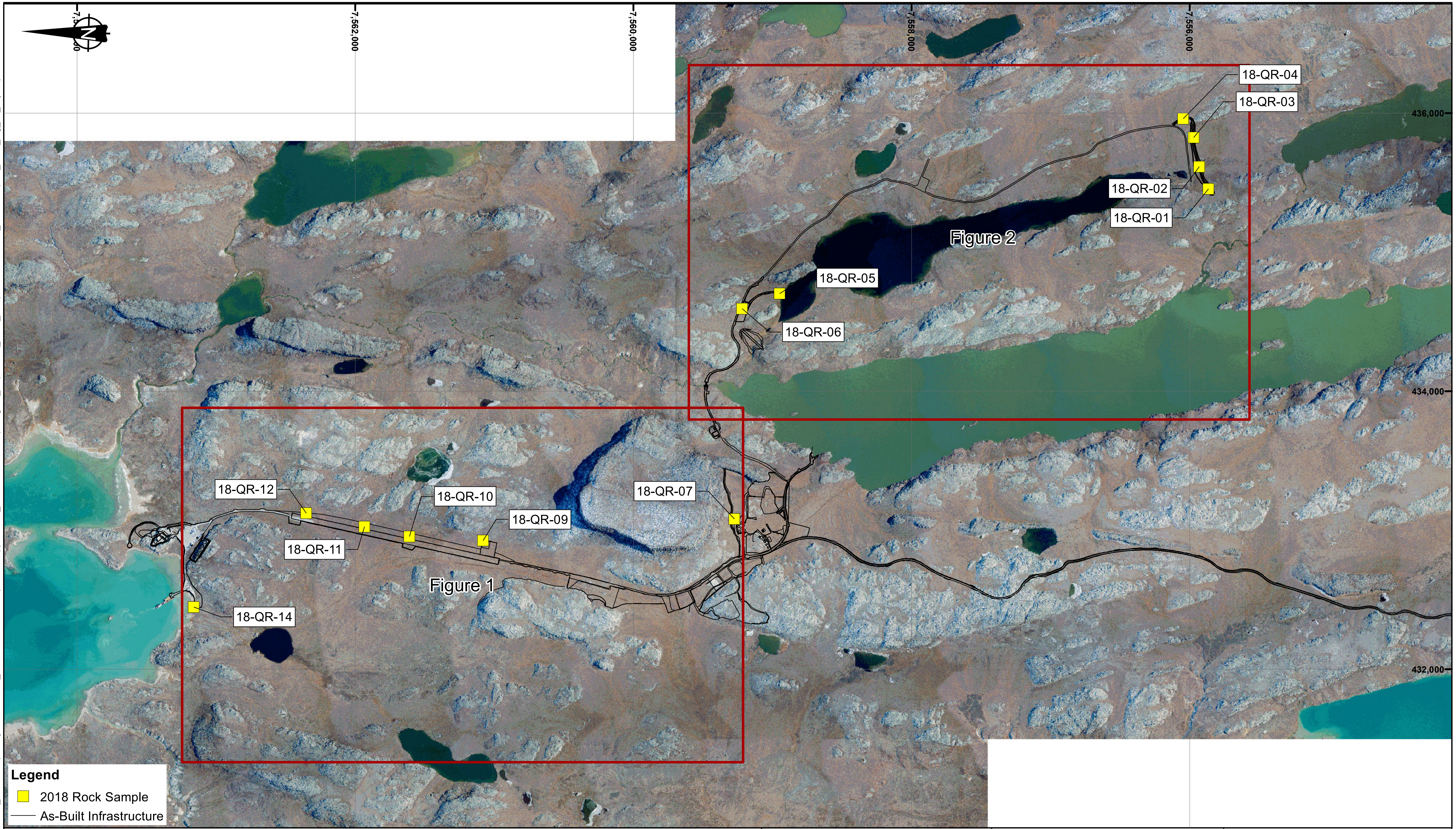
Quarry Monitoring - Shake Flask Extraction Results

Parameter	Units	Detection Limit	09-Jun	21-Oct	
			W571470	W571487	W571488
			-2 mm rock	-2 mm rock	-1cm rock
pH	pH Units	N/A	9.4	9.1	9.6
EC	uS/cm	0.5	270	330	110
Sulphate	mg/L	0.5	14	54	5.4
Acidity to pH4.5	mg/L	0.5	<0.50	<0.50	<0.50
Acidity to pH8.3	mg/L	0.5	<0.50	<0.50	<0.50
Total Alkalinity	mg/L	0.5	26	17	18
Bicarbonate	mg/L	0.5	32	20	21
Carbonate	mg/L	0.5	<0.50	<0.50	<0.50
Hydroxide	mg/L	0.5	<0.50	<0.50	<0.50
Dissolved Chloride	mg/L	0.5	48	30	7.7
Nitrate-N	mg/L	0.02	1.3	3.9	0.70
Nitrite-N	mg/L	0.005	<0.0050	<0.050	<0.050
Total Ammonia	mg/L	0.005	0.12	0.11	0.20
Total Dissolved Solids	mg/L	10	120	170	52
Total Hardness ($CaCO_3$)	mg/L	0.5	21	53	15
Aluminum (Al)	mg/L	0.0005	0.25	0.20	0.33
Antimony (Sb)	mg/L	0.00002	0.00020	0.00016	0.00015
Arsenic (As)	mg/L	0.00002	0.00037	0.00036	0.00038
Barium (Ba)	mg/L	0.00002	0.014	0.0025	0.00092
Beryllium (Be)	mg/L	0.00001	<0.000010	<0.000010	<0.000010
Bismuth (Bi)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050
Boron (B)	mg/L	0.05	0.073	0.079	<0.050
Cadmium (Cd)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L	0.05	6.9	12	5.1
Cesium (Cs)	mg/L	0.00005	<0.000050	<0.000050	<0.000050
Chromium (Cr)	mg/L	0.0001	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	0.000005	0.000025	0.000045	0.000030
Copper (Cu)	mg/L	0.00005	0.00024	0.00031	0.00013
Iron (Fe)	mg/L	0.001	0.0035	0.0051	0.043
Lanthanum (La)	mg/L	0.00005	<0.000050	<0.000050	<0.000050
Lead (Pb)	mg/L	0.000005	0.000028	<0.000005	0.000018
Lithium (Li)	mg/L	0.0005	0.0011	0.00075	<0.00050
Magnesium (Mg)	mg/L	0.05	1.0	5.6	0.50
Manganese (Mn)	mg/L	0.00005	0.00054	0.0023	0.0012
Mercury (Hg)	mg/L	0.00005	<0.000050	<0.000050	<0.000050
Molybdenum (Mo)	mg/L	0.00005	0.0015	0.0031	0.00080
Nickel (Ni)	mg/L	0.00002	<0.000020	0.000086	0.00010
Phosphorus (P)	mg/L	0.002	0.0032	0.0025	0.0038
Potassium (K)	mg/L	0.05	3.3	3.4	1.1
Rubidium (Rb)	mg/L	0.00005	0.0023	0.0025	0.00087
Selenium (Se)	mg/L	0.00004	0.00048	0.00073	0.00025
Silicon (Si)	mg/L	0.1	0.84	0.49	0.48
Silver (Ag)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L	0.05	36	34	9.6
Strontium (Sr)	mg/L	0.00005	0.023	0.030	0.0082
Sulphur (S)	mg/L	10	<10	18	<10
Tellurium (Te)	mg/L	0.00002	<0.000020	<0.000020	<0.000020
Thallium (Tl)	mg/L	0.000002	0.0000044	0.000010	0.0000052
Thorium (Th)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050
Tin (Sn)	mg/L	0.0002	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L	0.0005	<0.00050	<0.00050	<0.00050
Tungsten (W)	mg/L	0.00001	0.00012	0.000030	<0.000010
Uranium (U)	mg/L	0.000002	<0.0000020	0.0000026	<0.0000020
Vanadium (V)	mg/L	0.0002	0.0024	0.0012	0.0018
Zinc (Zn)	mg/L	0.0001	<0.00010	0.00089	0.0012
Zirconium (Zr)	mg/L	0.0001	<0.00010	<0.00010	<0.00010

Notes:

°All element concentrations are given as dissolved

Attachment C – Map of Construction Monitoring Sample Locations



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NOTES:
- Coordinate system: UTM NAD83 Zone 13

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MAC RESOURCES

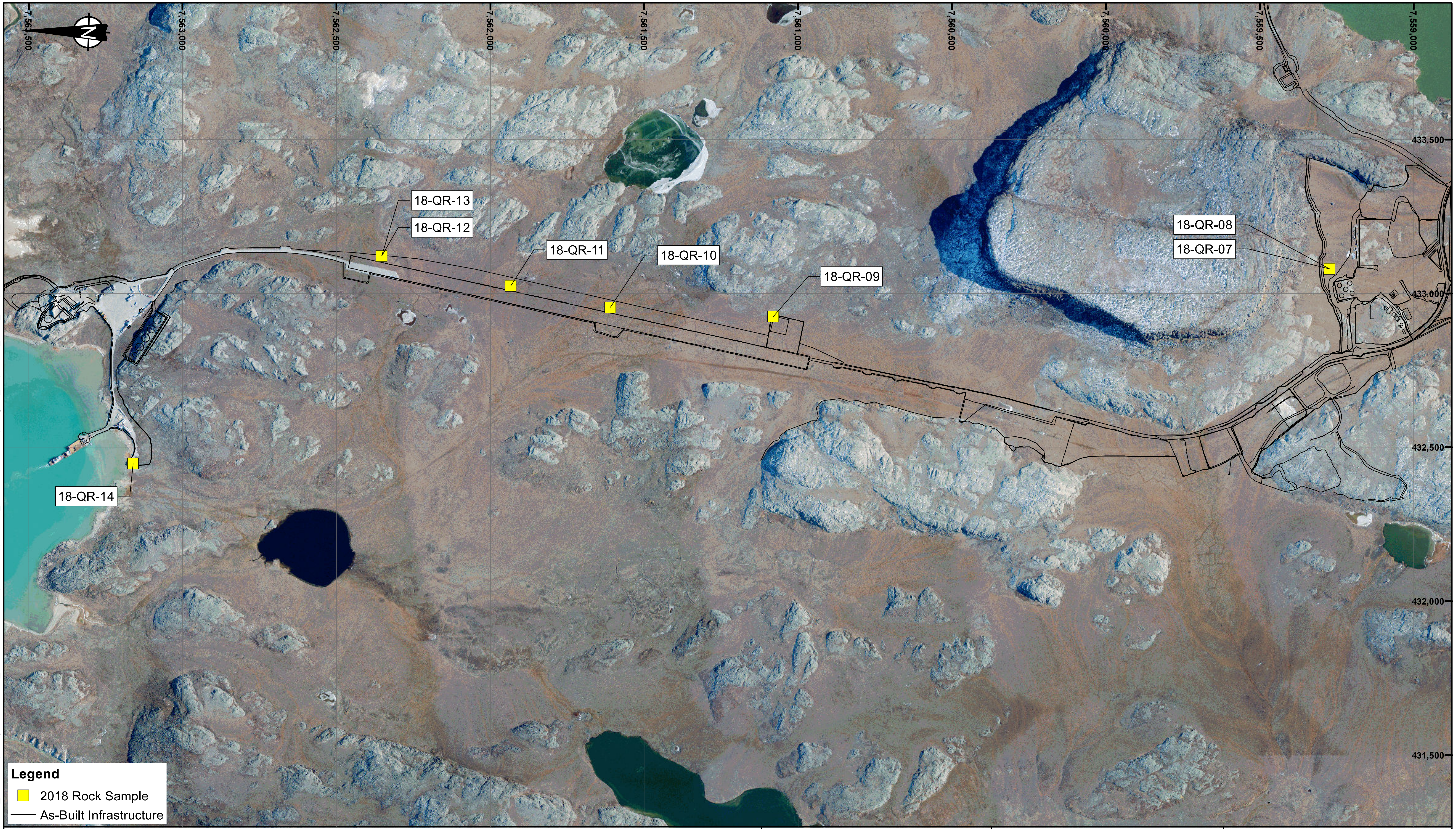
Hope Bay Gold Project

Rock Sample Locations
Key Map

Job No: 1CT022.027.120
Filename: 1CT022.027_RockSamples_2018_Fig_01_keymap

2018 Rock Samples

Date:	Approved:	Figure:
Feb 2019	EM	1



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NOTES:
- Coordinate system: UTM NAD83 Zone 13

0 500 1,000 Meters

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Job No: 1CT022.027.120

Filename: 1CT022.027_RockSamples_2018_Fig_index_map

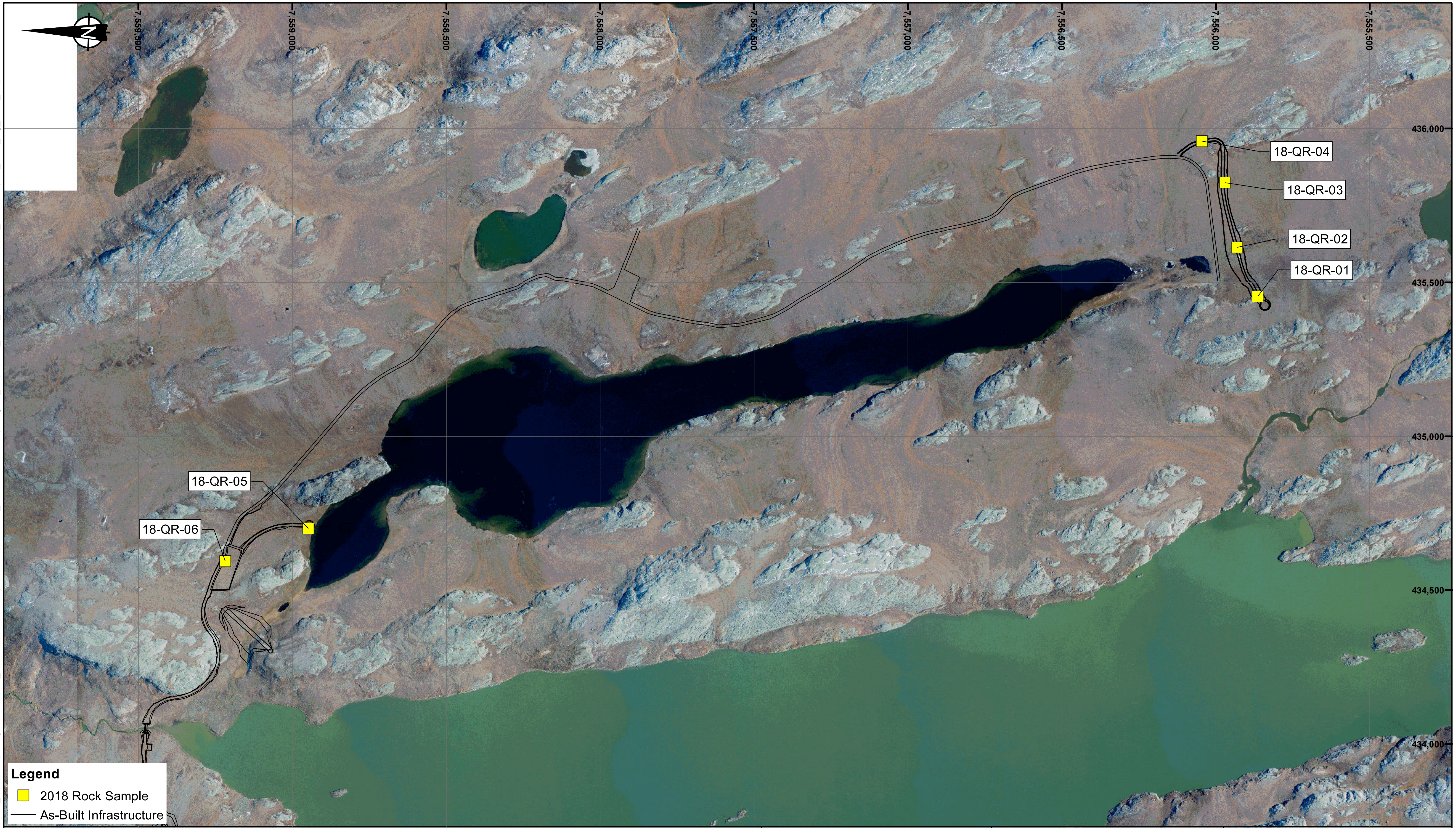
MAC RESOURCES

2018 Rock Samples

Hope Bay Gold Project

2018 Construction Rock Sample Locations Northwest

Date:	Approved:	Figure:
Feb 2019	EM	2



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NOTES:
- Coordinate system: UTM NAD83 Zone 13

0 500 1,000
Meters

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MAC RESOURCES

Hope Bay Gold Project

2018 Construction Rock Sample Locations Southeast

Job No: 1CT022.027.120

Filename: 1CT022.027_RockSamples_2018_Fig_index_map

2018 Rock Samples

Date:	Approved:	Figure:
Feb 2019	EM	3

Attachment D – Photos of Sample Locations, Construction Monitoring Program

***Photo**: Sampling location for 18-QR-01*

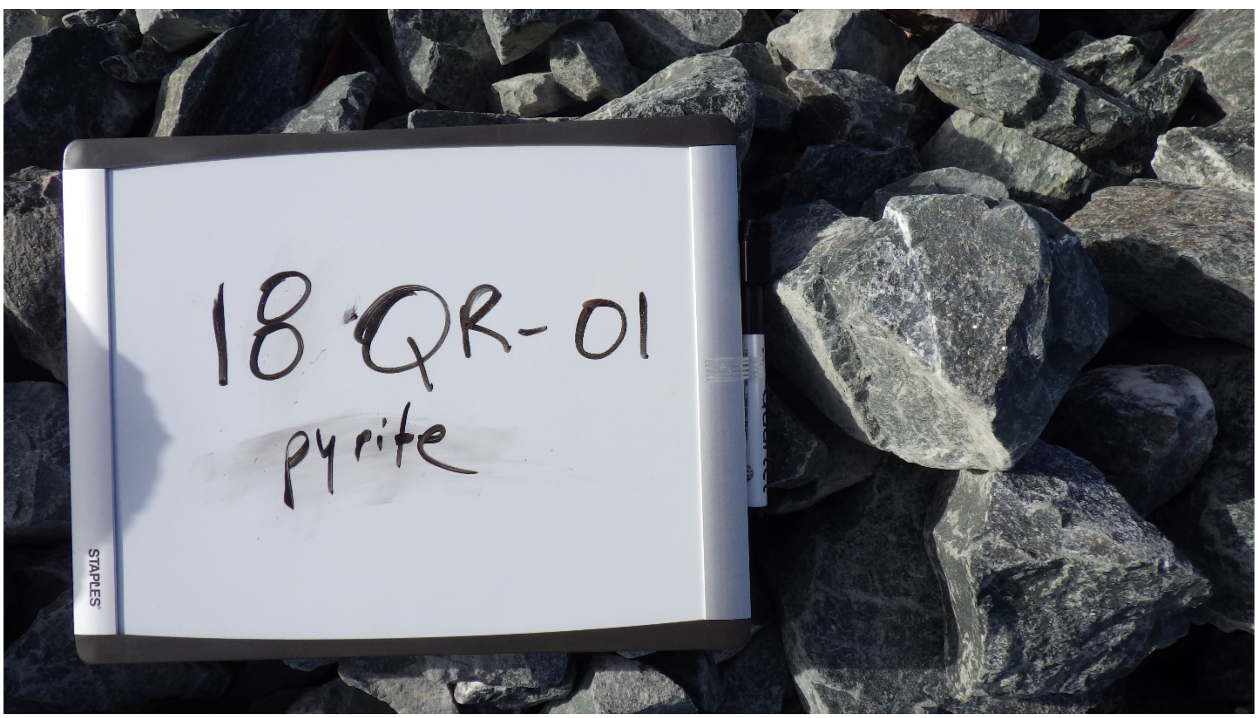

***Photo**: Pyrite at sampling location for 18-QR-01*

***Photo**: Sampling location for 18-QR-02*

***Photo**: Sampling location for 18-QR-02*

***Photo**: Sampling location for 18-QR-03*

***Photo**: Sampling location for 18-QR-03*

***Photo**: Sampling location for 18-QR-04*

***Photo**: Sampling location for 18-QR-04*

***Photo**: Sampling location for 18-QR-05*

***Photo**: Sampling location for 18-QR-05*

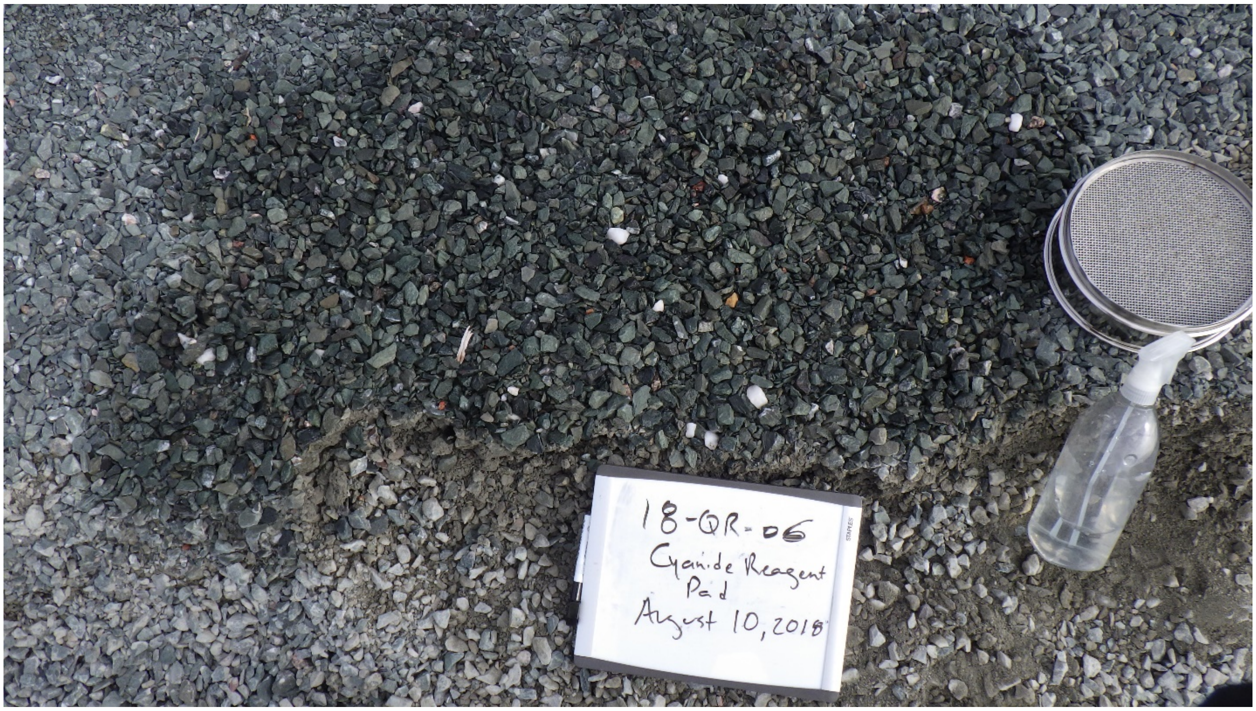

***Photo**: Sampling location for 18-QR-06*

***Photo**: Sampling location for 18-QR-06*

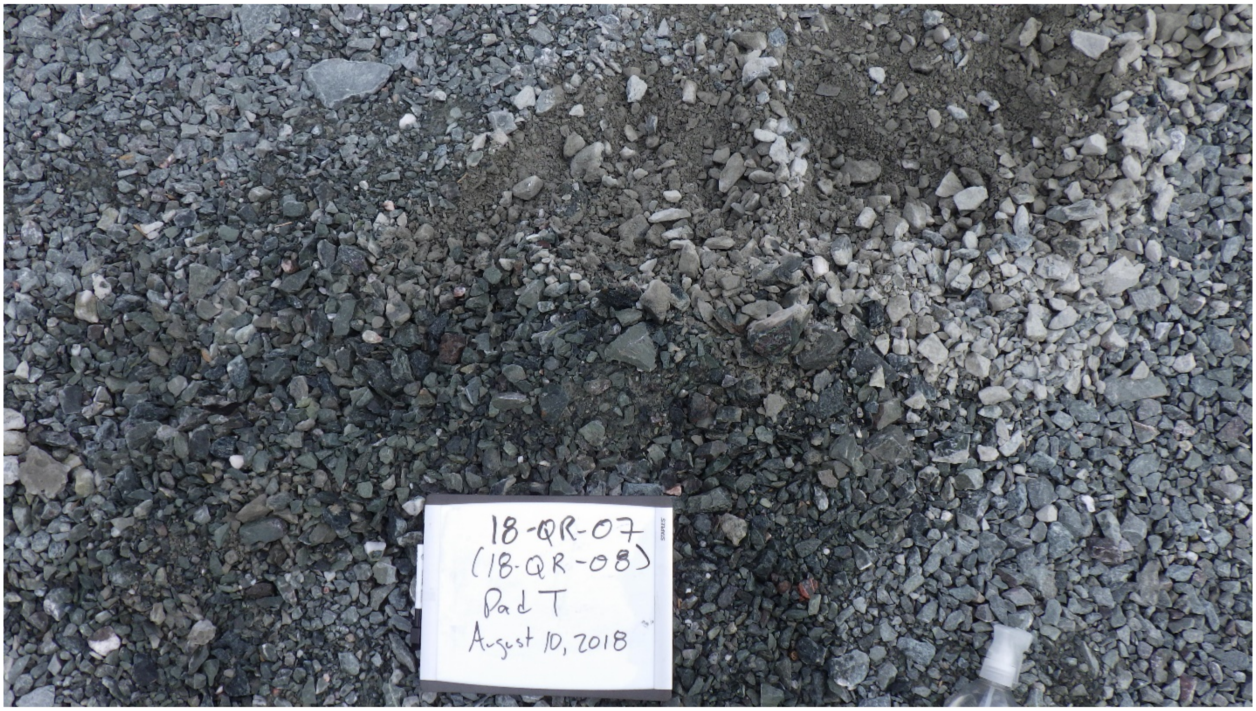

***Photo**: Sampling location for 18-QR-07*

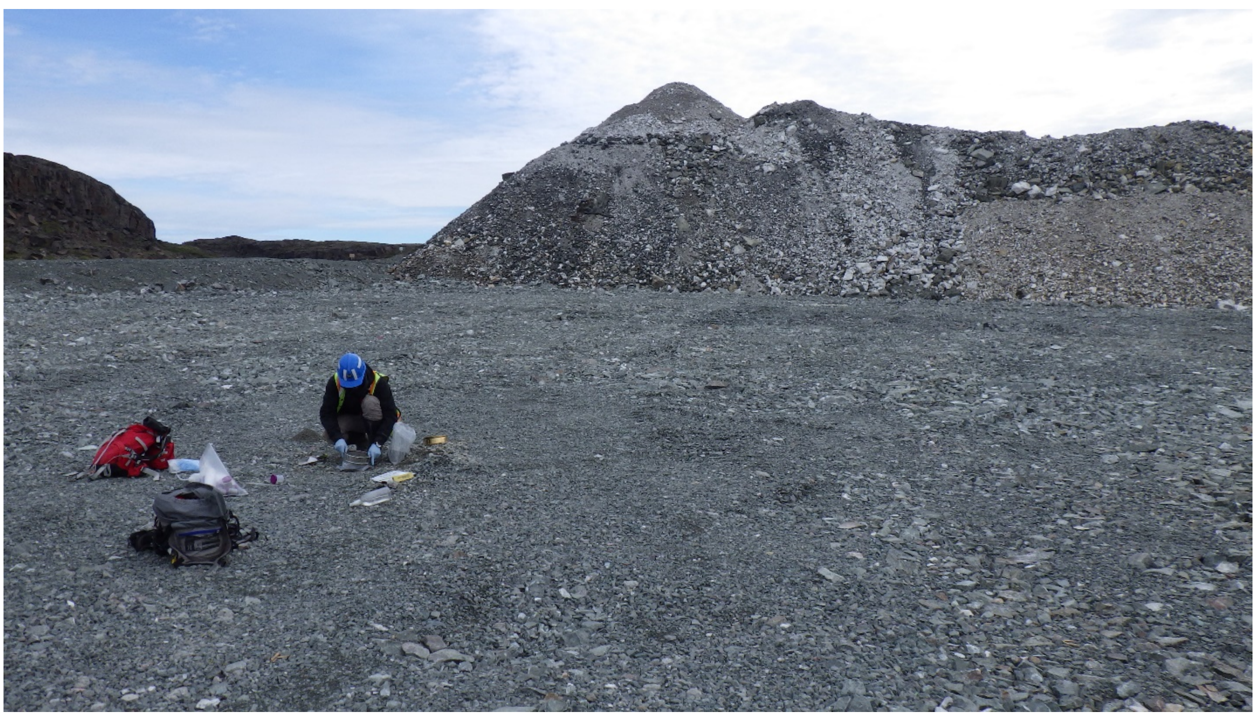

***Photo**: Sampling location for 18-QR-07*

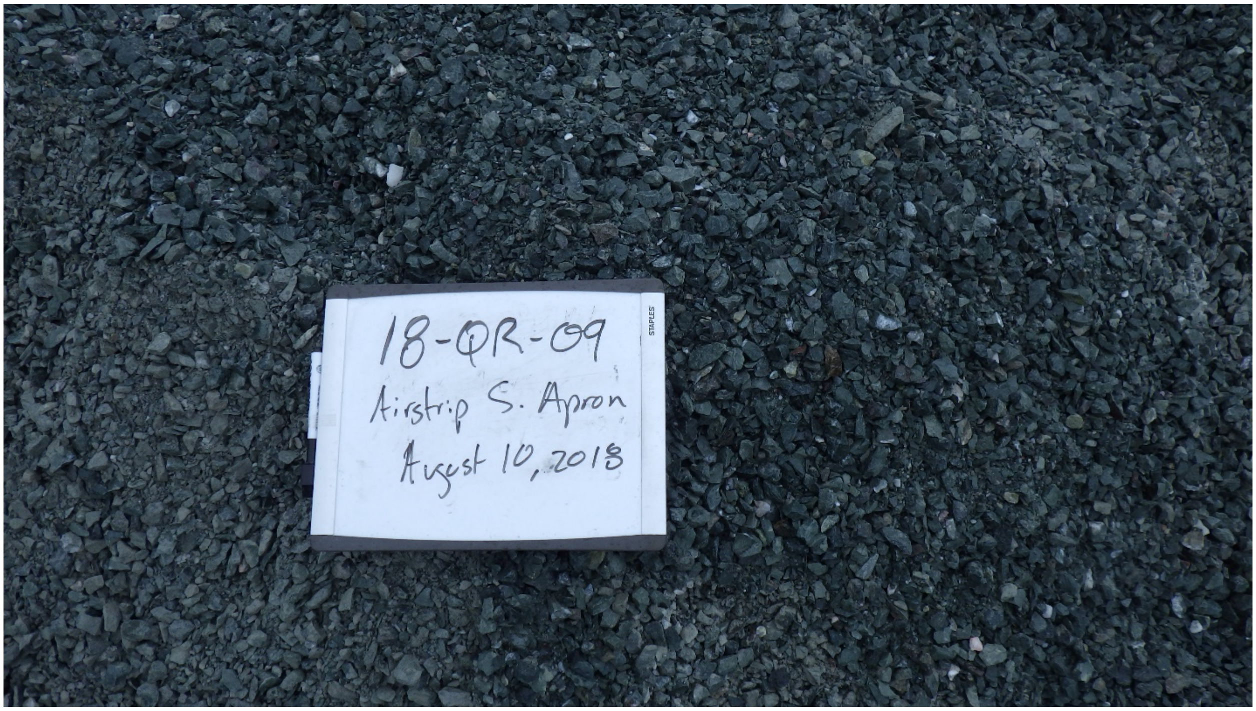

Photo*: Sampling location for 18-QR-09*

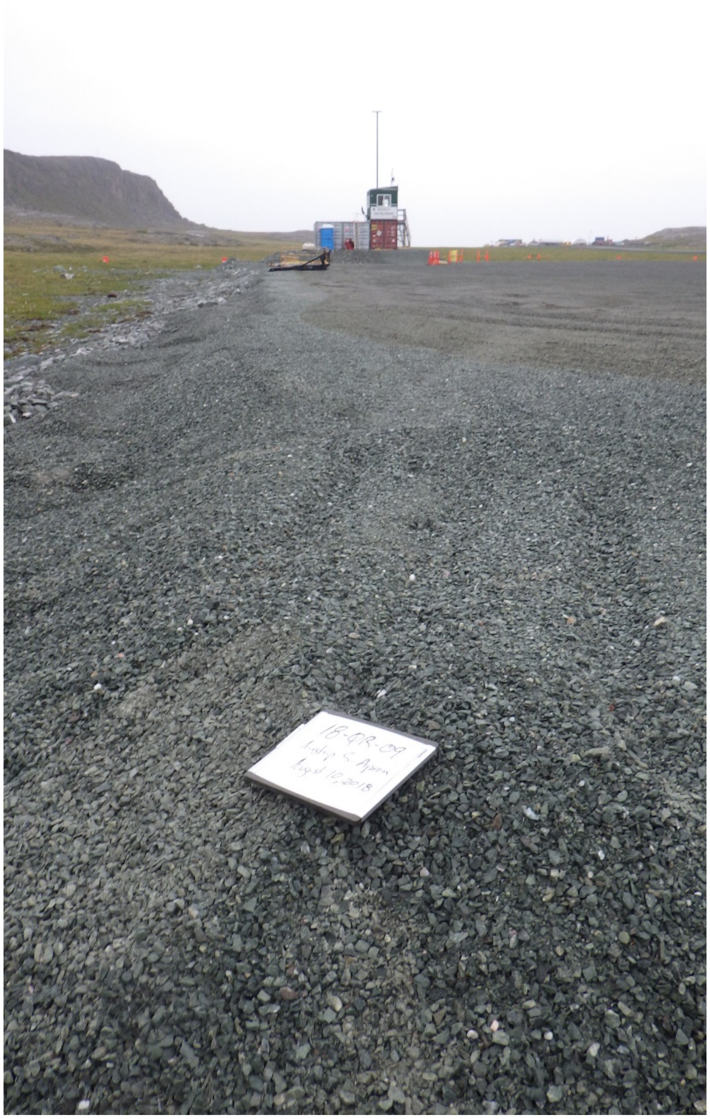

***Photo**: Sampling location for 18-QR-09*

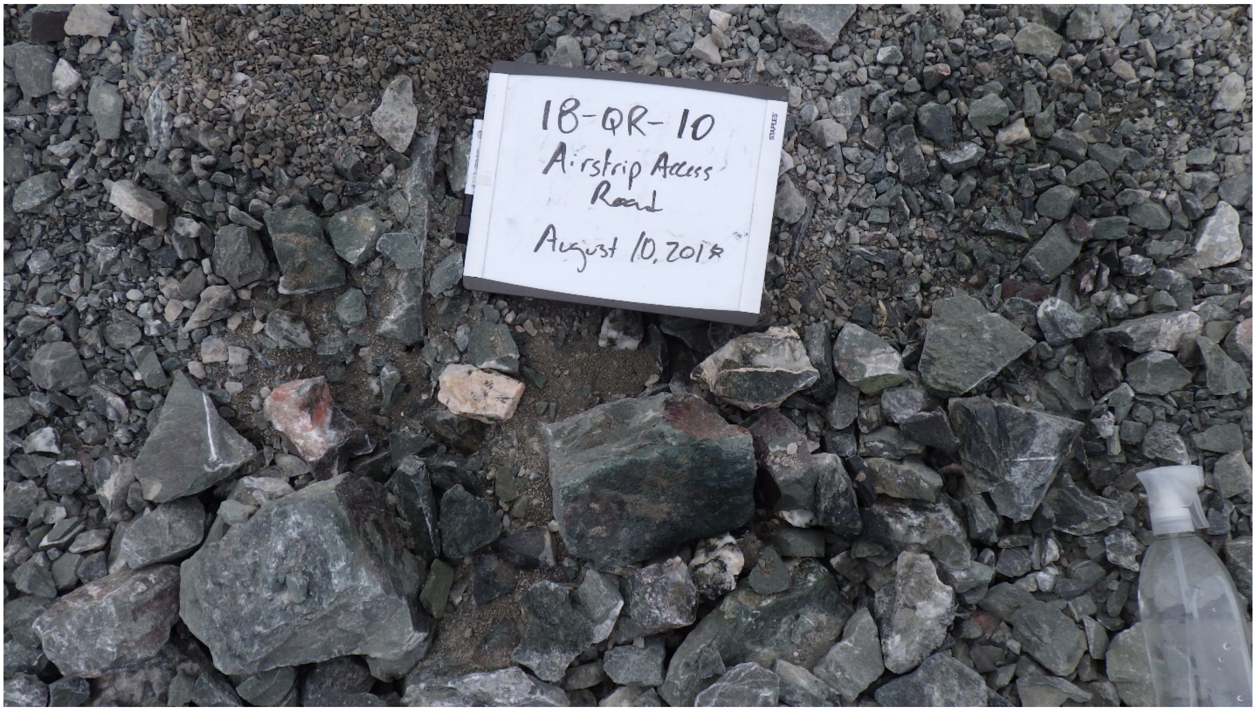

***Photo**: Sampling location for 18-QR-10*

***Photo**: Sampling location for 18-QR-10*

***Photo**: Sampling location for 18-QR-11*

***Photo**: Sampling location for 18-QR-11*

***Photo**: Sampling location for 18-QR-12*

***Photo**: Sampling location for 18-QR-12*

***Photo**: Sampling location for 18-QR-14*

***Photo**: Sampling location for 18-QR-14*

***Photo**: South Dam*

***Photo**: South Dam*

***Photo**: Sulphides observed at South Dam*

Attachment E – Sample Descriptions, Construction Monitoring Program

Attachment E: Notes from Construction Rock Inspection at Hope Bay (August 9-10, 2018) - Eduardo Marquez

Sample ID	Date	Time	Area	Duplicate	-1 cm Sample Tag	-2 mm Sample Tag	Coordinates		Description of Sampling Location	Geological Description of Sampling Location
							Northing	Easting		
18-QR-01	09-Aug-18	17:30	South Dam		29351	29352	435455	7555863	Sampled from top of South Dam on the NW side on ramp coming up from upstream face	Basalt with hematite veins (~20%), calcite veins (<5%), hornblende (~5%), trace K-feldspar (<1%), trace vein quartz (<1%)
18-QR-02	09-Aug-18	18:10	South Dam		29353	29354	435614	7555931	Sampled from top of South Dam on West side, closer to downstream face	Basalt with abundant calcite veins (>10%), minor hematite (~5%), trace K-feldspar veins (~1%), rare quartz vein (<0.5%), minor hornblende (<5%)
18-QR-03	10-Aug-18	08:25	South Dam		29355	29356	435824	7555970	Sampled from downstream face on East side, close to the top	Basalt with minor carbonate veins (5-10%) and hematite (~5%). Some veins show pinkish brown staining so could be iron carbonates.
18-QR-04	10-Aug-18	09:05	South Dam		29357	29358	435960	7556045	Sampled on east side of road to South Dam	Basalt with abundant calcite veins (10-15%), hematite (>15%), trace quartz vein with hematite (~1%), trace epidote (<1%)
18-QR-05	10-Aug-18	09:51	Jetty Road		29359	29361	434701	7558948	Sampled at the end of Jetty road, next to the pump house	Basalt with some calcite veins (5-10%), minor K-feldspar associated with quartz-calcite veins (~3-5%), rare altered metavolcanics (<1%)
18-QR-06	10-Aug-18	10:30	Cyanide Reagent Pad		29362	29363	434594	7559218	Sampled on NE side of the reagent pad from crushed rock placed on top of liner	Basalt with minor calcite (~3%), minor K-feldspar (3-5%), trace epidote (<1%), trace vein quartz (<1%)
18-QR-07	10-Aug-18	11:35	Pad T		29364	29365	433080	7559273	Sampled from middle of Pad T fill, north of waste rock pile	Basalt with minor hematite (~5%), trace K-feldspar (~1%), minor vein quartz (~3%), trace epidote (~1%). Some trace occurrence of light grey breccia/tuff.
18-QR-08	10-Aug-18			Duplicate of 18-QR-07	29366	29367				
18-QR-09	10-Aug-18	12:30	Airstrip South Apron		29368	29369	432925	7561081	Sampled at NE corner of South Apron from crushed material	Basalt with minor epidote (<5%), minor calcite (~3%), minor hematite (3-5%), trace vein quartz (<1%)
18-QR-10	10-Aug-18	14:35	East Airstrip Access Road		29370	29371	432955	7561610	Sampled on East side of access road, ~500 m from beginning of road from camp)	Basalt with abundant vein quartz (~10%), minor calcite veins (<5%), minor K-feldspar (~3%, associated with vein quartz), abundant hematite (~15%), rare epidote (<0.5%). Trace gabbro (one 25 cm boulder and few smaller fragments) with K-feldspar found between 18-QR-10 and 18-QR-11.
18-QR-11	10-Aug-18	15:15	East Airstrip Access Road		29372	29373	433025	7561934	Sampled on East side of access road, ~1km from beginning	Basalt with moderate vein quartz (5-10%, minor calcite (<5%), minor hematite (~5%), trace epidote (<1%)
18-QR-12	10-Aug-18	16:00	East Airstrip Access Road		29374	29375	433122	7562353	Sampled on Easte side of access road, ~1.3 km from beginning	Basalt wit abundant calcite veins (~10%), moderate hematite (5-10%), trace epidote (~1%), minor vein quartz (1-3%), rare K-feldspar (<1%)
18-QR-13	10-Aug-18			Duplicate of 18-QR-12	29376	29377				
18-QR-14	10-Aug-18	17:00	Roberts Bay (Marine Outfall Berm Access Road)		29378	29379	432447	7563161	Sampled on NW corner of MOB pad, close to shoreline	Basalt with abundant calcite (~10%), minor hematite (1-3%), trace epidote (~1%), trace K-feldspar (~1%)

Sample ID	Date	Time	Area	Sulphides	Fines		Rinse Test		Total Sulphur (%)		Analyses Requested			
					Fizz	Color	pH	EC (uS/cm)	-1 cm	-2 mm	ABA	Aqua Regia Metals	SFE	Notes on Selection
18-QR-01	09-Aug-18	17:30	South Dam	<1% pyrite (cyrstals/stringers)	Strong	greenish grey	9.29	73.2	0.13	0.17	Y	Y		
18-QR-02	09-Aug-18	18:10	South Dam	<1% pyrite (disseminated/oxidized crystals)	Strong	grey	9.28	87.9	0.22	0.19	Y	Y	Y	Highest %S and EC, South Dam sample for spatial representation
18-QR-03	10-Aug-18	08:25	South Dam	<0.5% pyrite	Strong	greenish grey	9.24	81.6	0.14	0.17	Y	Y		
18-QR-04	10-Aug-18	09:05	South Dam	Up to 5% visible pyrite (weathered stringers and specks; some pyrite associated with calcite veining)	Strong	greenish grey	9.21	67.7	0.1	0.16	Y	Y		
18-QR-05	10-Aug-18	09:51	Jetty Road	<1% pyrite (crystals/specks in calcite veins)	Strong	brownish grey	9.13	119.6	0.13	0.17	Y	Y	Y	Jetty road sample
18-QR-06	10-Aug-18	10:30	Cyanide Reagent Pad	~1% pyrite as stringers and crystals	Strong	brownish grey	9.03	111.1	0.15	0.13	Y	Y		
18-QR-07	10-Aug-18	11:35	Pad T	<0.5% pyrite	Strong	brownish grey	9.22	351	0.12	0.19	Y	Y	Y	Pad T fill, I understand that they filled in patches of the pad with quarry material but not sure if this is outside of the scope of construction monitoring
18-QR-08	10-Aug-18						9.25	276	0.1	0.18	Y	Y		Would SFE testing of field duplicate be useful?
18-QR-09	10-Aug-18	12:30	Airstrip South Apron	<1% pyrite (stringers and crystals)	Strong	olive grey	9.34	140.4	0.09	0.14	Y	Y		-1cm fraction <0.1%S but -2mm is >0.1%S
18-QR-10	10-Aug-18	14:35	East Airstrip Access Road	~1% pyrite (disseminated/ specks)	Strong	brownish grey	8.93	78.8	0.08	0.14	Y	Y	Y	Airstrip access road sample, higher %S and EC, lower pH
18-QR-11	10-Aug-18	15:15	East Airstrip Access Road	~1% pyrite (disseminated/ specks)	Strong	olive grey	9.12	62.5	0.04	0.08				
18-QR-12	10-Aug-18	16:00	East Airstrip Access Road	No visible pyrite	Strong	brownish grey	9.13	61	0.11	0.15	Y	Y		
18-QR-13	10-Aug-18						9.15	63	0.13	0.11	Y	Y		
18-QR-14	10-Aug-18	17:00	Roberts Bay (Marine Outfall Berm Access Road)	Almost no visible pyrite (<0.1%)	Strong	pale greenish grey	9.45	521	0.17	0.23	Y	Y	Y	High EC, Roberts Bay sample

Attachment F – Geochemical Data, Construction Monitoring Program

Construction Monitoring - ABA															
Parameter	**Units**	**Detection Limits**	**South Dam**			**East side of TIA Access Road (Southern Extent)**	**Jetty Road**	**Cyanide Reagent Pad**	**Pad T**	**Airstrip South Apron**	**East Airstrip Access Road**				**Roberts Bay (Marine Outfall Berm Access Road)**
		TMAC ID>	**18-QR-01**	**18-QR-02**	**18-QR-03**	**18-QR-04**	**18-QR-05**	**18-QR-06**	**18-QR-07**	**18-QR-09**	**18-QR-10**	**18-QR-11**	**18-QR-12**	**18-QR-12**	**18-QR-14**
		Maxxam Sample No>	**UM3111**	**UM3112**	**UM3113**	**UM3114**	**UM3115**	**UM3117**	**UM3118**	**UM3120**	**UM3121**	**UE1160**	**UM3122**	**UE1161**	**UM3124**
		Sample Form>	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**	**-1cm Rock**
Dry Weight Received (kg)			1.15	1.39	1.70	1.94	1.74	1.84	1.52	1.47	1.22	1.51	1.18	1.18	1.59
Paste pH	pH Units	*N/A*	9.0	8.9	8.9	9.1	8.8	8.8	9.0	9.1	8.2		8.3		9.1
CO2	wt%	*0.08*	1.56	3.59	5.57	2.18	4.52	3.65	3.62	2.75	3.69	-	2.60	-	5.69
TIC	kg $CaCO_3$/t	*1.8*	36	82	127	50	103	83	82	63	84		59		129
Total S	wt%	*0.02*	0.13	0.22	0.14	0.10	0.13	0.15	0.12	0.090	0.080	0.040	0.040	0.11	0.17
Sulphate Sulphur	wt%	*0.01*	0.020	0.050	0.040	0.010	0.020	0.020	0.020	0.010	<0.010		<0.010		0.040
Sulphide Sulphur (by difference)	wt%	*0.02*	0.11	0.17	0.10	0.090	0.11	0.13	0.10	0.080	0.080		0.040		0.13
AP (calculated from total S)			4.1	6.9	4.4	3.1	4.1	4.7	3.8	2.8	2.5	1.3	1.3	3.4	5.3
Mod. ABA NP	kg $CaCO_3$/t	*0.1*	67	112	133	76	114	101	92	73	115		85		136
Fizz Rating	N/A	*N/A*	MODERATE	STRONG	STRONG	MODERATE	STRONG	STRONG	MODERATE	MODERATE	STRONG	-	MODERATE		STRONG
Net Neutralization Potential	kg $CaCO_3$/t	*0.1*	64	106	129	73	110	97	88	70	113		83		132
TIC/AP (calculated from total S)			8.7	12	29	16	25	18	22	22	34		47		24
NP/AP (calculated from total S)			17	16	30	24	28	22	24	26	46		68		26

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												
		South Dam			TIA Access Road	Jetty Road	Cyanide Reagent Pad	Pad T	Airstrip South Apron	East Airstrip Access Road		Roberts Bay (MOB Road)
Parameter	**Units**	18-QR-01	18-QR-02	18-QR-03	18-QR-04	18-QR-05	18-QR-06	18-QR-07	18-QR-09	18-QR-10	18-QR-12	18-QR-14
Ag	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.10	< 0.10	< 0.10
Al	mg/kg	23000	34000	32000	24000	28000	33000	33000	25000	32000	28000	36000
As	mg/kg	3.8	1.5	3.4	5.3	4.8	2.5	3.0	5.5	12	3.8	< 0.50
Au	mg/kg	0.0015	0.0024	0.00050	0.00050	0.00050	0.00060	0.00050	0.0071	0.0035	0.0023	0.0011
B	mg/kg	53	< 20	< 20	29	26	< 20	27	23	24	< 20	27
Ba	mg/kg	3.0	4.0	6.0	3.0	3.0	6.0	6.0	3.0	4.0	3.0	4.0
Bi	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Ca	mg/kg	31000	45000	53000	34000	49000	39000	37000	33000	45000	37000	57000
Cd	mg/kg	0.30	< 0.10	0.10	< 0.10	0.10	< 0.10	< 0.10	0.20	0.10	< 0.10	0.10
Co	mg/kg	32	40	40	35	36	37	45	37	40	36	37
Cr	mg/kg	160	120	140	150	140	100	240	170	200	150	140
Cu	mg/kg	140	140	120	120	130	120	120	130	130	130	140
Fe	mg/kg	45000	64000	59000	45000	52000	66000	59000	47000	54000	52000	66000
Ga	mg/kg	5.0	8.0	7.0	6.0	6.0	9.0	8.0	6.0	7.0	7.0	8.0
Hg	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
K	mg/kg	100	200	200	200	200	300	200	100	300	200	100
La	mg/kg	1.0	2.0	2.0	3.0	2.0	3.0	3.0	2.0	3.0	2.0	< 1.0
Mg	mg/kg	17000	25000	25000	19000	21000	26000	30000	19000	30000	22000	26000
Mn	mg/kg	870	1300	1300	860	1100	1300	1100	940	1100	1000	1400
Mo	mg/kg	0.20	0.30	0.60	0.20	0.20	0.20	0.30	0.20	0.20	0.30	0.20
Na	mg/kg	160	80	80	140	130	90	120	160	80	120	160
Ni	mg/kg	52	52	58	56	55	49	120	70	71	59	56
P	mg/kg	280	320	310	340	310	370	400	350	280	260	270
Pb	mg/kg	0.90	1.1	2.2	0.60	1.0	1.0	1.2	1.3	2.1	1.8	1.0
S	mg/kg	1300	1800	1500	1100	1400	1500	1200	1000	1000	1200	1800
Sb	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Sc	mg/kg	5.0	13	11	5.6	8.0	14	9.3	5.5	9.0	7.7	9.2
Se	mg/kg	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.80
Sr	mg/kg	17	23	26	21	25	24	25	19	22	19	16
Te	mg/kg	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Th	mg/kg	0.10	0.20	0.10	0.30	0.20	0.30	0.30	0.10	0.20	0.10	< 0.10
Ti	mg/kg	2700	2600	2300	2700	2600	2100	2400	3000	2200	2800	3200
Tl	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.20	< 0.10	< 0.10	< 0.10	< 0.10
U	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
V	mg/kg	100	180	160	110	130	190	150	110	130	130	170
W	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Zn	mg/kg	66	87	89	61	71	82	81	74	72	70	90

Comstruction Monitoring - Shake Flask Extraction Results							
Parameter	Units	Detection Limit	29354 (18-QR-02) -2 mm rock South Dam	29361 (18-QR-05) -2 mm rock Jetty Road	29365 (18-QR-07) -2 mm rock Pad T	29371 (18-QR-10) -2 mm rock East Airstrip Access Road	29379 (18-QR-14) -2 mm rock Roberts Bay (Marine Outfall Berm Access Road)
pH	pH Units	N/A	9.0	9.1	9.3	8.7	9.4
EC	uS/cm	0.5	93	110	180	83	220
SO4	mg/L	0.5	9.2	18	28	4.7	18
Acidity to pH4.5	mg/L	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Acidity to pH8.3	mg/L	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Alkalinity	mg/L	0.5	29.0	25.0	23.0	34.0	28.0
Bicarbonate	mg/L	0.5	36.0	31.0	29.0	42.0	35.0
Carbonate	mg/L	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Hydroxide	mg/L	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Dissolved Chloride	mg/L	0.5	0.80	1.6	18	0.6	25
Nitrate-N	mg/L	0.02	< 0.20	< 0.20	< 0.20	< 0.20	3.5
Nitrite-N	mg/L	0.005	< 0.050	< 0.050	< 0.050	< 0.050	0.10
Total Ammonia	mg/L	0.005	< 0.0050	< 0.0050	< 0.0050	< 0.0050	0.89
Total Dissolved Solids	mg/L	10	38	50	82	44	98
Hardness (CaCO3)	mg/L	0.5	26	30	25	31	20
Aluminum (Al)	mg/L	0.0005	0.34	0.31	0.18	0.27	0.29
Antimony (Sb)	mg/L	0.00002	0.00019	0.00014	0.00033	0.00031	0.00015
Arsenic (As)	mg/L	0.00002	0.00066	0.0010	0.0025	0.013	0.00014
Barium (Ba)	mg/L	0.00002	0.0025	0.00067	0.0022	0.00078	0.0015
Beryllium (Be)	mg/L	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Bismuth (Bi)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Boron (B)	mg/L	0.05	0.063	0.061	< 0.050	< 0.050	0.11
Cadmium (Cd)	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L	0.05	7.9	9.3	8.8	11	6.1
Cesium (Cs)	mg/L	0.00005	<0.000050	<0.000050	0.000076	<0.000050	0.00014
Chromium (Cr)	mg/L	0.0001	< 0.00010	< 0.00010	0.00029	0.00029	0.00013
Cobalt (Co)	mg/L	0.000005	0.000015	0.000033	0.00011	0.000065	0.00024
Copper (Cu)	mg/L	0.00005	0.00071	0.0012	0.0016	0.0022	0.00024
Iron (Fe)	mg/L	0.001	0.0036	0.0039	0.018	0.023	0.0041
Lanthanum (La)	mg/L	0.00005	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
Lead (Pb)	mg/L	0.000005	0.0000088	< 0.0000050	0.000011	0.000021	0.000007
Lithium (Li)	mg/L	0.0005	< 0.00050	0.00078	0.0012	0.0012	0.00056
Magnesium (Mg)	mg/L	0.05	1.4	1.7	0.77	1.1	1.2
Manganese (Mn)	mg/L	0.00005	0.0013	0.0015	0.00076	0.0016	0.00050
Mercury (Hg)	mg/L	0.00005	< 0.000050	< 0.000050	< 0.000050	< 0.000050	< 0.000050
Molybdenum (Mo)	mg/L	0.00005	0.0023	0.0017	0.0039	0.0033	0.0011
Nickel (Ni)	mg/L	0.00002	0.000043	0.000065	0.00011	0.00021	0.000030
Phosphorus (P)	mg/L	0.002	0.010	0.0068	0.011	0.010	0.0077
Potassium (K)	mg/L	0.05	1.2	1.1	8.3	1.0	2.0
Rubidium (Rb)	mg/L	0.00005	0.00084	0.00064	0.0086	0.00078	0.0020
Selenium (Se)	mg/L	0.00004	0.00040	0.00044	0.00070	0.00044	0.00037
Silicon (Si)	mg/L	0.1	1.1	0.83	1.6	1.0	0.75
Silver (Ag)	mg/L	0.000005	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
Sodium (Na)	mg/L	0.05	4.80	5.20	15.0	1.90	29.0
Strontium (Sr)	mg/L	0.00005	0.016	0.012	0.037	0.010	0.013
Sulphur (S)	mg/L	10	< 10	< 10	< 10	< 10	< 10
Tellurium (Te)	mg/L	0.00002	0.000020	< 0.000020	0.000030	< 0.000020	0.000023
Thallium (Tl)	mg/L	0.000002	0.0000036	0.000010	0.000012	0.000018	0.000030
Thorium (Th)	mg/L	0.000005	0.0000050	< 0.0000050	< 0.0000050	< 0.0000050	< 0.0000050
Tin (Sn)	mg/L	0.0002	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020
Titanium (Ti)	mg/L	0.0005	< 0.00050	< 0.00050	0.00056	< 0.00050	< 0.00050
Tungsten (W)	mg/L	0.00001	0.000026	0.000037	0.00028	0.00017	0.000018
Uranium (U)	mg/L	0.000002	0.0000040	0.0000041	0.0000079	0.00013	< 0.0000020
Vanadium (V)	mg/L	0.0002	0.0028	0.0017	0.0037	0.0033	0.0036
Zinc (Zn)	mg/L	0.0001	0.00069	0.00010	0.00016	0.00014	0.00013
Zirconium (Zr)	mg/L	0.0001	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010

Notes:
°All element concentrations are given as dissolved

Appendix D – 2018 Geochemical Monitoring of Flotation Tailings Slurry and Detoxified Tailings, Doris Mill

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Jessica Charles; Melanie Cox; Lisa Barazzuol, SRK	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 21, 2019
Subject:	2018 Geochemical Monitoring of Flotation Tailings Slurry 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. Placement of detoxified tailings as backfill in stopes of the Doris Mine and geochemical monitoring of tailings commenced in February 2017. In 2018, a total of 446,594 t (dry weight equivalent) of flotation tailings were deposited in the Doris TIA and 17,680 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 J, Tables 1 and 2 of NWB Type “A” Water Licence 2AM-DOH1323 Amendment No. 1 (the “Water Licence”, Nunavut Water Board 2016) and includes the following monitoring stations: process plant tailings water discharge (TL-5), flotation tailings solids (TL-6), detoxified tailings solids[1] (TL-7), and seepage from underground backfilled stopes (TL-11). This memo documents the results of the 2018 geochemical monitoring of flotation and detoxified tailings at TL-5, TL-6, TL-7 and TL-11 and fulfills the reporting requirements outlined in Schedule B, Items 2a, 2b and 2d of Water Licence 2AM-DOH1323.

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 INCO SO_2 process. The detoxified slurry is filtered with the solids placed in a stockpile for co-disposal with backfill underground as backfill for permanent storage (TL-11 seepage survey) and the solution is pumped to the tailings thickener (TL-5) where it is combined with the flotation tailings (TL-6) where they are discharged as slurry to the TIA. The detoxification circuit is run to produce a total cyanide level of less than one part per million (1 ppm). The solutions from the

[1] Detoxified tailings are referred to as cyanide leach residue in the Water Licence

detoxification circuit and final detoxified tailings discharge (TL-7) are routinely analyzed for WAD and total cyanide species by mill personnel to monitor the performance of the cyanide detoxification circuit. Concentrations of WAD and total cyanide in the process plant tailings water discharge (TL-5) are reported monthly to the Nunavut Water Board.

3 Methods

3.1 Sample Collection and Analysis

3.1.1 Tailings and Process Water

Flotation Tailings (TL-6) and Process Plant Water Discharge (TL-5)

Schedule J (Table 2) of the Water Licence specifies weekly sampling of flotation tailings (TL-6) and 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.

Each week, 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.

The supernatant was sampled according to the Surveillance Network Program (SNP) monitoring requirements for tailings supernatant solution (TL-5) using a sterile 60mL syringe and submitted to Maxxam Analytics Laboratory in Burnaby, BC once per month for the analysis of pH, TSS, ammonia, nitrate, nitrite, sulphate, cyanide (WAD, free and total), cyanate, thiocyanate, and total metals. In total, the 2018 monitoring program included geochemical characterization of 19 samples of tailings process water collected from January to December with a duplicate sample and field blank collected in January. Four samples were collected in January (weekly), three samples were collected in February and three samples were collected in March. Monthly samples were collected from April to December.

After sampling was completed for the tailings supernatant solution (TL-5), the remaining supernatant was discarded and a clean stainless-steel spoon used to transfer the solid tailings into a plastic Ziploc bag. The bag was then sealed and placed in a fridge until the last weekly sample for the month had been collected. At the end of each month, TMAC combined and homogenized 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 2018 monitoring program included geochemical characterization of 12 monthly composites of flotation tailings collected from January to December with a duplicate sample collected in October.

Monthly flotation tailings solids (TL-6) composite samples were submitted in glass jars to ALS Environmental Laboratory in Burnaby, BC (January to March) and Maxxam Analytics Laboratory in Burnaby, BC (April to December) for analysis of total sulphur, sulphate sulphur, TIC and trace element content. The switch in laboratory was made to ensure the analytical methods were more consistent with the geochemical test work program for metallurgical tailings, as documented in the Type A water licence amendment application (SRK 2015) and thus, allow for a direct comparison. The previous ALS methods used for sulphate sulphur, TIC and solid-phase elemental analysis were not directly comparable (Table 3-1), with is discussed in more detail in SRK (2018). The analytical program was managed by TMAC. Laboratory data for flotation tailings solids (TL-6) are provided in Attachment A.

Table 3-1: Analytical Methods for Flotation Tailings Solids (TL-6) and Detoxified Tailings Solids (TL-7)

Parameter	Method Synopsis	
	ALS	**Maxxam**
Rinse pH	Sieved 2 mm fraction mixed with deionized water at a solid to water ratio of 1 to 2.	Not analysed (not a requirement of the Water Licence)
Total Sulphur	Combustion by Leco	Combustion by Leco
Sulphate Sulphur	As-received sample leached using deionized water at a solid to liquid ratio of 1 to 10. The leachate is analyzed for sulphate using ion chromatography.	Sulphate by hydrochloric acid leach. HCl extractable sulphur is based on a modified version of ASTM Method D 2492-02
Total Inorganic Carbon (TIC)	Pulverized sample treated with acetic acid. Carbonate content determined by titration.	Carbonate carbon (CO_2 HCl method). Pulverized sample treated with hydrochloric acid. CO_2 content determined by Leco.
Trace element content	Digestion of sieved 2 mm fraction with ICP-MS finish. The digestion uses a 1 to 1 mixture of nitric and hydrochloric acid and a solid to solution ratio of 1 to 1.	Aqua regia digest (nitric and hydrochloric acid) with ICP-MS finish.

Detoxified Tailings (TL-7)

Schedule J (Table 2) of the Water Licence specifies monthly sampling of detoxified tailings (TL-7) and analysis of WAD cyanide, TIC, total metals (including sulphur) and moisture content, and quarterly analysis of cyanate and thiocyanate. Historically ALS have been unable to analyse for cyanate and thiocyanate but these parameters have been included from April 2018 onwards as part of the Maxxam analyses.

Each month and at the end of the detoxification cycle, TMAC collected one discrete sample of detoxified tailings from the discharge compartment of the detoxification circuit filter press. In total, the 2018 monitoring program included geochemical characterization of 13 samples of detoxified tailings solids (TL-7) collected from January to December. Two samples were collected in April (April 1st analyzed at ALS and April 23rd analyzed at Maxxam), plus one duplicate sample was collected in November.

The rational for changes to the analytical program and laboratory in April 2018 is the same as for flotation tailings (TL-6). Samples were placed in glass sample jars using a clean stainless-steel spoon and submitted to ALS (January to April) for rinse pH, total sulphur, sulphate, TIC, trace element content and total, WAD and free cyanide and to Maxxam (April to December) for total sulphur, sulphate sulphur, TIC, multi-element trace element content by aqua regia digestion followed by ICP finish, WAD and free cyanide, cyanate and thiocyanate. ABA methods at ALS and Maxxam are the same as described for flotation tailings (TL-6). At ALS and Maxxam, WAD cyanide was determined by NaOH extraction followed by manual distillation with colorimetric finish and free cyanide was analysed by passive diffusion at pH 6. A key difference in the methods between Maxxam and ALS is that the Maxxam method included a step to confirm lixiviant pH was greater than 10 after NaOH addition (MOE 2015), whereas the ALS method did not. A colorimetric procedure was used for the analysis of thiocyanate and cyanate was determined by converting it to ammonium carbonate by acid hydrolysis with colorimetric finish. Total cyanide was analysed at ALS by rotary NaOH extraction followed by in-line UV digestion along with sample distillation and colorimetric finish. Laboratory data are provided in Attachment B.

In March 2019, Maxxam identified that WAD cyanide data reported to TMAC were measurements erroneously conducted on the leached detoxified tailings solids, and not the extractant, as indicated by MOE (2015). Maxxam is currently in the process of re-analyzing all detoxified tailings samples for WAD cyanide.

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

Schedule J (Table 2) 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 June and December 2018. Visual surveys were conducted of all backfilled stopes that could be accessed safely at the time of the survey. In December, not all backfilled levels could be safely accessed due to ice conditions. Eleven locations were surveyed in June (one with an identified seep) and eight locations were surveyed in December (two with identified seeps).

In June, TMAC collected one sample from the seep flowing from the bottom of the east limb North stope at level 4932, location E433877, N7559809 (TL-11). TMAC also collected a sample from this seep (east limb, North stope, level 4932) in December (TL-11B). A field blank and duplicate sample were also collected at this location in the December survey. An additional sample was collected from a pool of standing water at the base of the South stope on level 4946, location E433849, N7559620 in December (TL-11A); there were no obvious signs of seepage flow from the backfilled tailings at this location, therefore this sample may not be a true seep. Both stopes on level 4932 and 4946 were previously mined out in the Doris North area, and were later backfilled with a blend of unconsolidated waste rock and detoxified tailings.

Seepage samples were collected using a syringe and field measurements of pH, EC, ORP and temperature recorded. Seepage flow rates could not be measured due to the low volume of the seepage. 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 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). For samples with Modified NP, interpretations of ratios of NP to AP were the same as TIC to AP.

4 Results and Discussion

4.1 Data QA/QC

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

All solids data for the flotation (TL-6) and detoxified (TL-7) 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-7) (TL6-1NOV18B^ and TL7-23NOV18B^). Relative percentage differences (RPD) were calculated to assess reproducibility of results. SRK considers all data acceptable. Changes in detection limits within the data sets reflect the change in laboratory.

4.1.2 Seepage Survey Samples (TL-11)

All seepage water quality data from the underground stopes (TL-11) were reviewed by SRK for QA/QC. Table 4-1 presents the results of the QA/QC checks including a comparison of the duplicate sample and analysis of the blank sample collected in December (TL11-DUP and BLANKF). RPD values for the field duplicates exceed the QA/QC criterion for the following total metals: aluminium, arsenic, chromium, copper, iron, lead, silicon, titanium and vanadium. This may be attributed to disturbed sediments during sampling. All the dissolved metals for the duplicate samples passed the RPD check. Two selenium results reported dissolved concentrations that exceeded the total concentrations by 53 and 94%. Metallic contaminant may have been introduced to the dissolved sample during field filtration. 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 January. For the field duplicate, RPD values for cyanate and the following total metals exceeded the QA/QC criterion: arsenic, cadmium, cesium, cobalt, copper, selenium and zinc. This may be attributed to introduction of suspended solids during sampling and/or sample heterogeneity. Sulphate and the following total metals were also reported at concentrations greater than ten times the analytical limit of detection in the field blank: calcium, magnesium, potassium, rubidium, sodium, strontium and sulphur. This is attributed to introduction of contamination during sampling. The ion balance could not be evaluated as dissolved metals analysis were not analyzed.

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

QC Test	SRK QC Criteria	Flotation Tailings (TL-6) Results	Detoxified Tailings (TL-7) 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=3) All passed.	(n=4) All passed.
TIC			
Lab Method Blank	<5X detection limit (DL)	(n=8) All passed.	(n=12) All passed.
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within ±20%	(n=3) All passed.	(n=2) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within ±30%	N/A	N/A
Standard reference materials	Within ±20% Difference	(n=16) All passed.	(n=19) All passed.
Total S & Sulphate			
Lab Method Blank	<5X detection limit (DL)	(n=3 for Total S,n=7 for Total SO_4) All passed.	(n=3) 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=3) All passed.	N/A
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within ±20%	(n=1 for Total S,n=9 for Total SO_4) All passed.	(n=2 for Total S, n=12 for Total SO_4) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within ±30%	N/A	N/A
Standard reference materials	Within ±20% Difference	(n=2 for Total S,n=12 for Total SO_4) All passed.	(n=5 for Total S, n=14 for Total SO_4) All passed.
Cyanide Species-CN Free, CN Total, CN WAD			
Lab Method Blank	<5X detection limit (DL)	N/A	(n=4 for CN Free, n=2 for CN WAD) All passed.
Lab Duplicate	For samples > 10X the detection limit (DL), % RPD within ±20%	N/A	(n=8 for CN Free, n=3 for CN WAD) All passed.
Field Duplicate	For samples > 10X the detection limit (DL), % RPD within ±30%	N/A	N/A
Standard reference materials	Within ±20% Difference	(n=2 for CN Free) All passed.	(n=4 for CN Free, n=2 for CN WAD) All passed.
Trace Element Content			
Lab Method Blank	<5X Detection Limit	(n=3 for Hg, n=10 for the rest) All passed.	(n=3 for Hg, n=12 for the rest) All passed.
Lab Duplicate	For samples >10X detection limit (DL), % RPD within ± 20%, ok 10% of metal scan failing.	(n=1) All passed.	(n=1 for Hg) All passed.
Field Duplicate	For samples >10X detection limit (DL), % RPD within ± 30%, ok 10% of metal scan failing.	(n=1) All passed.	N/A
Standard reference materials	Within specified tolerance ranges.	(n=8 for Hg, n=49 for the rest) All passed.	(n=8 for Hg, n=56 for the rest) All passed.

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

QC Test	SRK QC Criteria	Process Plant Tailings Supernatant (TL-5) Results	Backfilled Stope Seepage Samples (TL-11) Results
Field vs. Lab pH	For any samples, ± 1 difference unit	N/A	(n=2) All passed.
Lab method Blank	<5X DL	(Physical test: n=19 for TSS; Anions: n=18 for SO_4; Nutrients: n=21 for NH_3,n=18 for NO_2, n=19 for NO_3, CN Species: n=21 for Cyanate, n=12 for CN Free, n=12 for Thiocyanate, n=22 for CN Total, n=21 for CN WAD; Metals: n=18 for T-Hg, n=22 for T-Metals) All passed.	(Physical test: n=2 for TSS, n=2 for TDS, n=2 for Conductivity; Anions: n=4 for SO_4, n=3 for Acidity, n=2 for Alkalinity, n=5 for Chloride; Nutrients: n=4 for NH_3,n=4 for NO_2, n=4 for NO_3, CN Species: n=4 for CN Free, n=3 for CN Total, n=3 for CN WAD; Metals: n=5 for T-Metals) All passed.
Lab Duplicate	For samples >10X detection limit (DL), % RPD within ± 20%, ok 10% of metal scan failing.	(Physical test: n=1 for TSS; Nutrients: n=1 for NH_3; CN Species: n=11 for Cyanate, n=2 for Thiocyanate; Metals: n=1 for T-Hg, n=7 for T-Metals) All passed.	(Physical test: n=1 for Conductivity; Anions: n=1 for Acidity, n=1 for Alkalinity; Metals: n=1 for T-Metals) All passed.
Field Blank	<5X DL	(n=1) Failed for Anions: SO_4, Metals: T-Ca, T-Mg, T-K, T-Rb, T-Na, T-Sr, T-S with results >10X DL. Attributed to contamination during sampling.	(n=1) All passed.
Field Duplicates	>10X DL, RPD better than ±20%	(n=1) Failed for cyanate, Metals: T-As, T-Cd, T-Cs, T-Co, T-Cu, T-Se, T-Zn may be attributed to disturbed sediments during sampling and/or sample heterogeneity.	(n=1) Failed for Metals: T-Al, T-As, T-Cr,T-Cu, T-Fe, T-Pb, T-Si, T-Ti, T-V. This may be attributed to disturbed sediments during sampling. The dissolved metals passed.
Standards/Controls	Within tolerance ranges	(Physical test: n=19 for TSS, n=11 for pH; Anions: n=18 for SO_4; Nutrients: n=20 for NH_3,n=19 for NO_2, n=18 for NO_3, CN Species: n=20 for Cyanate, n=12 for CN Free, n=12 for Thiocyanate, n=22 for CN Total, n=21 for CN WAD; Metals: n=18 for T-Hg, n=23 for T-Metals) All passed.	(Physical test: n=2 for TSS, n=2 for TDS, n=2 for Conductivity, n=3 for pH; Anions: n=4 for SO_4, n=3 for Acidity, n=2 for Alkalinity, n=5 for Chloride; Nutrients: n=4 for NH3,n=4 for NO_2, n=4 for NO_3, CN Species: n=4 for CN Free, n=3 for CN Total, n=3 for CN WAD; Metals: n=5 for T-Metals) All passed.
Ion Balance	EC>100 uS/cm, imbalance not greater than 10%	N/A	(n=3) All passed.
Total vs. Dissolved metals	Total metals >Dissolved metals, (Total metals-Dissolved metals)/(average(total metals,dissolved metals)=±30%	N/A	(n=3) 2 failed for Se with "DTMF*" lab qualifier

* DTMF- Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.

4.2 Flotation and Detoxified Tailings (TL-6 and TL-7)

4.2.1 Acid Base Accounting

A summary of ABA results for the flotation tailings (TL-6) and detoxified (TL-7) tailings is presented in Table 4-3 and Table 4-4, respectively. When different analytical methods were used, results are presented according to the laboratory. As discussed in Section 3.1.1, the methods used by Maxxam are comparable to the geochemical test work conducted on metallurgical tailings (SRK 2015). Compared to methods used at ALS, the data suggest that the methods used at Maxxam result in higher levels of TIC and lower levels of sulphate.

Table 4-3: Summary of ABA Results for Flotation Tailings (TL-6)

Year	Sampling Mont	Moisture	Rinse pH	Total Sulphur	Sulphate		TIC		AP	TIC/AP	
					ALS	Maxxam	ALS	Maxxam		ALS	Maxxam
		%	pH	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	Ratio
2018	Jan	19	9.1	<0.05	0.03	--	58	--	1.6	37	--
	Feb	27	9.2	<0.05	0.067	--	57	--	1.6	37	--
	Mar	25	9.0	0.06	0.039	--	67	--	1.9	36	--
	Apr	15	--	0.15	--	0.03	--	96	4.7	--	20
	May	15	--	0.16	--	0.06	--	76	5.0	--	15
	Jun	--	--	0.090	--	0.02	--	79	2.8	--	28
	Jul	--	--	1.4	--	0.02	--	140	43	--	3.3
	Aug	--	--	0.1	--	0.02	--	120	3.1	--	39
	Sep	--	--	0.1	--	0.01	--	100	3.1	--	33
	Oct	--	--	0.13	--	0.02	--	97	4.1	--	24
	Nov	--	--	0.06	--	0.01	--	79	1.9	--	42
	Dec	--	--	0.13	--	0.02	--	130	4.1	--	32
Statistical Summary											
2018	P005	15	9.0	<0.050	0.031	0.01	57	77	1.6	36	8.1
	P050	19	9.1	<0.10	0.039	0.02	58	97	3.1	37	28
	P095	27	9.2	0.71	0.064	0.048	66	140	22	37	41
	P100	27	9.2	1.4	0.067	0.06	67	140	43	37	42
	n	5	3	12	3	9	3	9	12	3	9
2017 (n = 11)	P005	21	8.8	0.050	0.036	--	43	--	1.6	1.7	--
	P050	24	9.0	0.070	0.049	--	63	--	2.2	25	--
	P095	26	9.3	0.86	0.065	--	92	--	27	48	--
	P100	27	9.3	1.0	0.066	--	110	--	33	48	--

Source: P:\30431 Hope Bay Geochemistry\Project\Tailings\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2018_rev09.xlsx]

Notes:

AP calculation is based upon total sulphur

Results from ALS and Maxxam presented separately when methods were not comparable.

"-" denotes sample not analyzed.

Table 4-4: Summary of ABA Results for Detoxified Tailings (TL-7)

Year	Sampling Date	Moisture	Rinse pH	Total Sulphur	Sulphate		TIC		AP	TIC/AP	
				ALS	ALS	Maxxam	ALS	Maxxam		ALS	Maxxam
		%	pH	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	Ratio	Ratio
2018	Jan	26	8.9	5.6	0.25	--	68	--	180	0.39	--
	Feb	24	8.9	6.1	0.12	--	67	--	190	0.35	--
	Mar	19	9.0	3.0	0.14	--	59	--	93	0.64	--
	1-Apr	23	8.3	14	0.30	--	84	--	430	0.19	--
	23-Apr	19	--	12	--	0.20	--	71	370	--	0.19
	May	21	--	13	--	0.14	--	110	420	--	0.26
	Jun	26	--	12	--	0.20	--	98	380	--	0.26
	Jul	19	--	12	--	0.06	--	140	380	--	0.37
	Aug	21	--	14	--	0.15	--	120	440	--	0.28
	Sep	21	--	23	--	0.27	--	92	720	--	0.13
	Oct	21	--	22	--	0.19	--	83	690	--	0.12
	Nov	20	--	22	--	0.22	--	120	690	--	0.17
	Dec	24	--	19	--	0.25	--	140	590	--	0.24
Statistical Summary											
2018	P005	19	8.4	4.6	0.12	0.09	60	76	140	0.22	0.12
	P050	21	8.9	13.0	0.20	0.20	67	110	420	0.37	0.24
	P095	26	9.0	23	0.30	0.26	82	140	700	0.60	0.34
	P100	26	9.0	23	0.30	0.27	84	140	720	0.64	0.37
	n	13	4	13	4	9	4	9	13	4	9
2017 (n = 11)	P005	20	8.1	2.9	0.16	--	51	--	92	0.10	--
	P050	24	8.4	7.9	0.28	--	75	--	250	0.32	--
	P095	26	9.2	17	0.39	--	81	--	530	0.81	--
	P100	27	9.3	19	0.43	--	82	--	610	1.00	--

Source: P:\30431 Hope Bay Geochemistry\Project\Tailings\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2018_rev09.xlsx]

Notes:

AP calculation is based upon total Sulphur

Results from ALS and Maxxam presented separately when methods were not comparable.

"-" denotes sample not analyzed.

Flotation Tailings (TL-6)

Rinse pH results ranged from 9 to 9.2 s.u. indicating the tailings were non-acidic. and 8.3 to 9 s.u. in the detoxified tailings), indicating that the samples were not acidic at the time of sampling.

Total sulphur in flotation tailings were lower between January and March compared to the April onward. Between January and March, maximum total sulphur concentrations in flotation tailings were below or near the level of analytical detection (0.05%). From April onwards, sulphur concentrations were typically higher, ranging from 0.06 to 0.15%, except for July which had a higher sulphur content of 1.4% (Table 4-2).

Sulphate sulphur 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 4-1). On this basis, total sulphur was used to calculate acid potential (AP).

TIC content ranged from 57 to 67 kg $CaCO_3$/t between January and March (ALS) and 76 to 144 kg $CaCO_3$/t between April and December (Maxxam, Figure 4-3). The Maxxam data are comparable to the geochemical test work conducted for metallurgical tailings (SRK 2015).

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 samples (SRK, 2015).

Detoxified Tailings (TL-7)

Rinse pH results ranged from 8.3 to 9 s.u. indicating the tailings were non-acidic.

Sulphur trends in detoxified tailings were the same as flotation tailings with lower sulphur content earlier in the year compared to April onward. Between January and March, sulphur concentrations in detoxified tailings ranged from 3 to 6.1% whereas from April onwards, sulphur ranged from 12 to 23% (Table 4-2). In 2018, sulphur content of operational tailings is higher than metallurgical tailings characterized as part of the Type A water licence amendment (SRK 2015).

Sulphate sulphur ranged from 0.06 to 0.3% and is a by-product of the cyanide detoxification process. Total sulphur and sulphide content were at near parity for detoxified tailings as sulphate content was relatively low compared to sulphide (Figure 4-1). According, total sulphur was used to calculate AP.

TIC content ranged from 59 to 84 kg $CaCO_3$/t between January and March (ALS) and 71 to 140 kg $CaCO_3$/t between April and December (Maxxam, Figure 4-3). Consistent with the ARD classifications of the metallurgical tailings (SRK 2015), all detoxified tailings were classified as PAG (Figure 4-4).

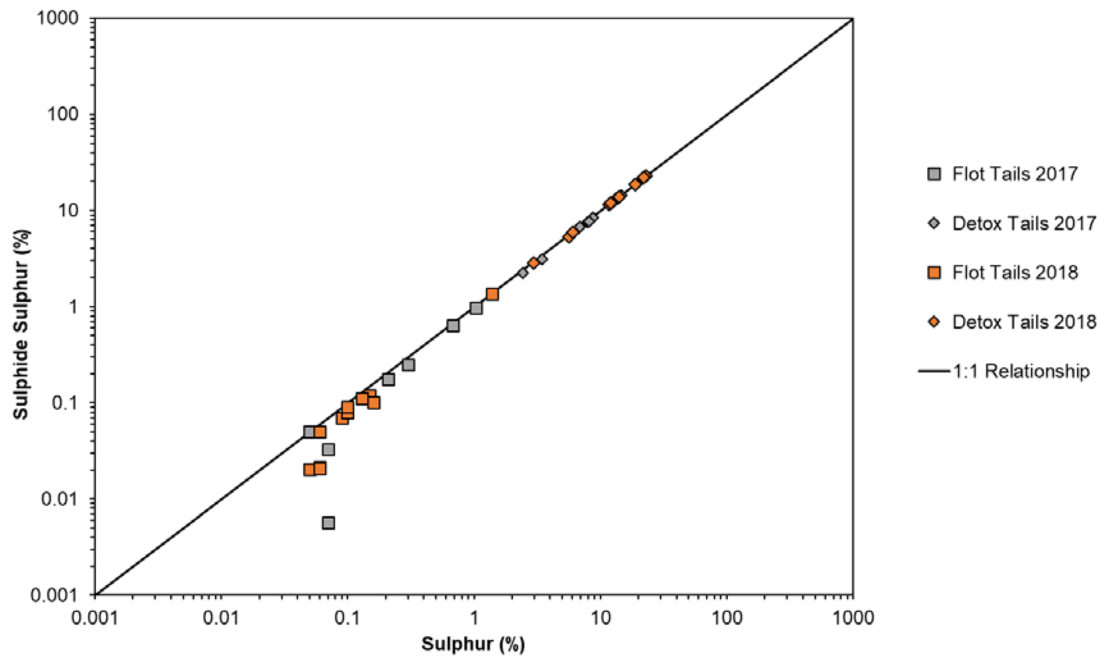

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Figure 4-1: Total Sulphur versus Calculated Sulphide Sulphur

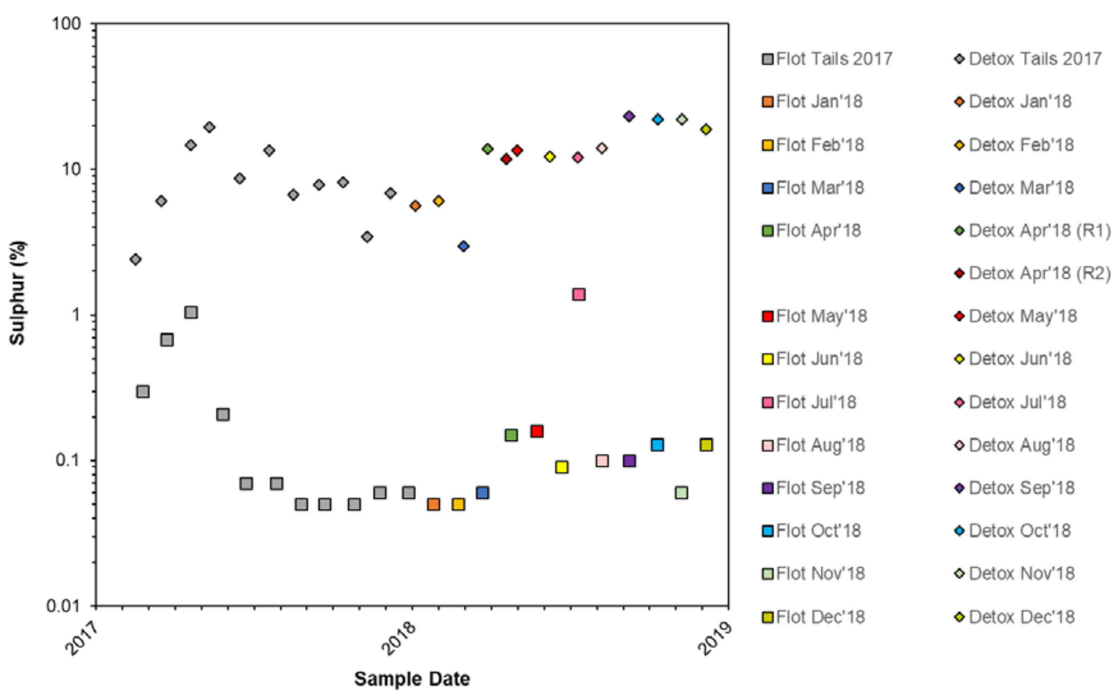

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Figure 4-2: Sulphur concentrations for Tailings Samples Over Time

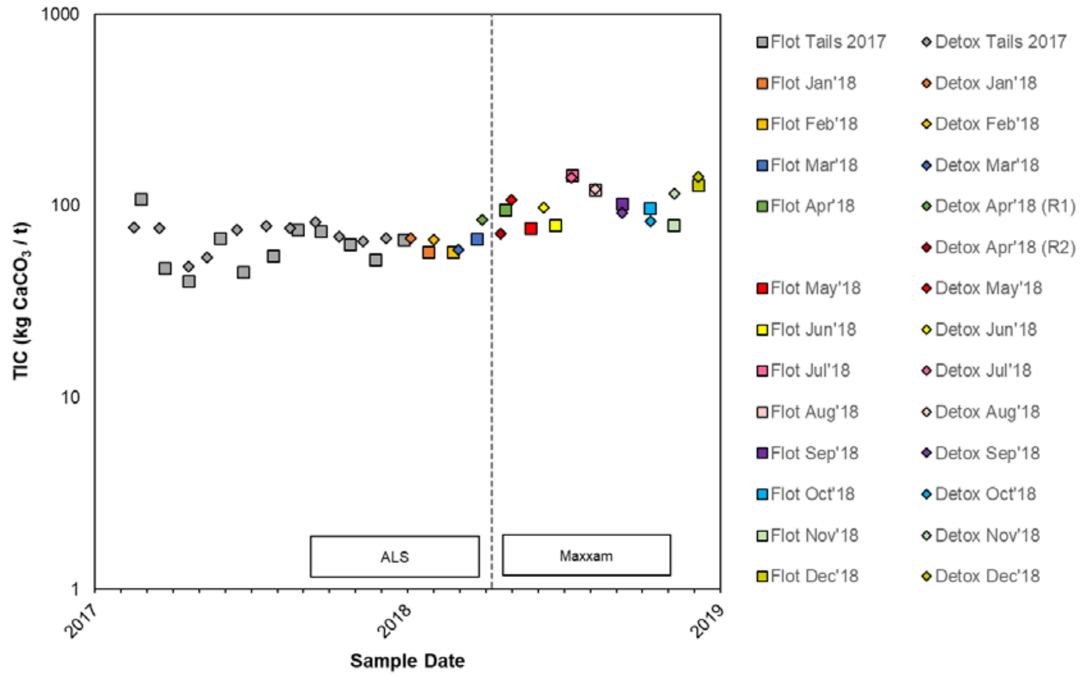

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Figure 4-3: Total Inorganic Carbon (TIC) Concentrations for Tailings Samples Over Time

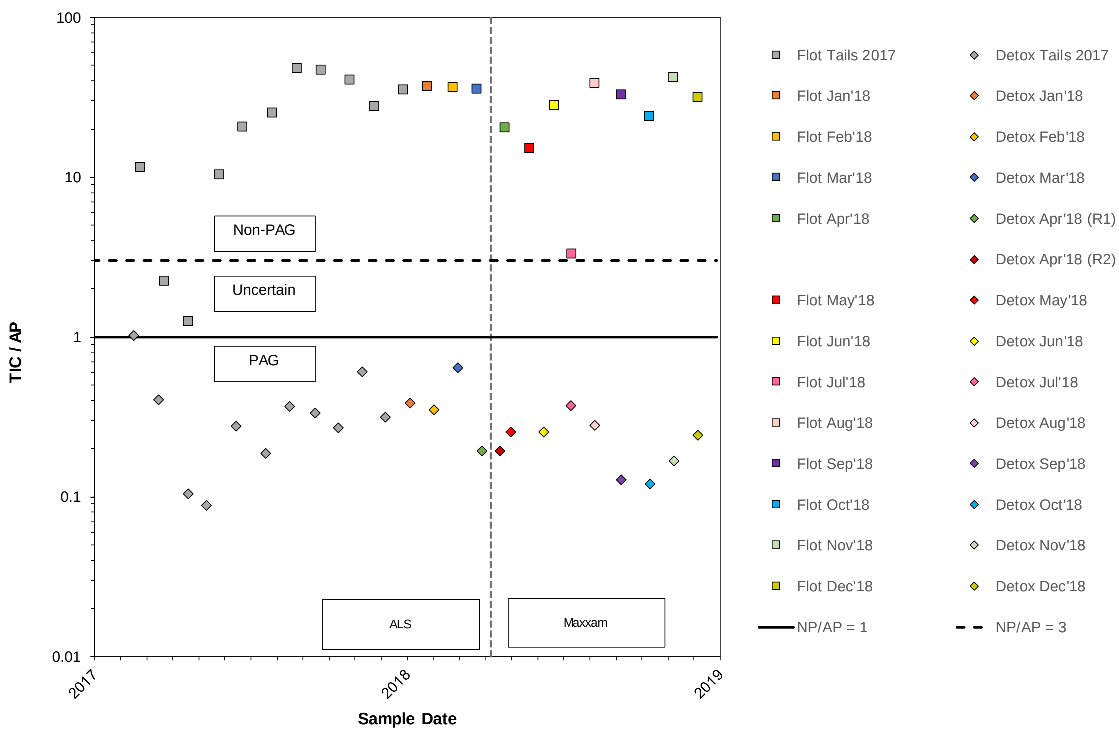

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Figure 4-4: ARD classifications for tailings samples over time

4.2.2 Elemental Analysis

Trace element content for flotation (TL-6) and detoxified (TL-7) tailings are summarized in Table 4-5 and Table 4-6, respectively. Results were compared to ten times the average crustal abundance data for basalt (Price 1997) as an indicator of enrichment.

A comparison of sulphur data determined by extraction and total sulphur by Leco indicated that the method used at ALS overestimates sulphur. Sulphur results determined by aqua regia digestion at Maxxam are comparable to total sulphur Leco and also the geochemical test work program for the Type A metallurgical tailings (SRK 2015). Selenium could only be assessed for January to March samples because with the change in labs, the detection limit increased to a level equivalent to the screening criteria of 0.5 mg/kg.

Flotation Tailings (TL-6)

The flotation tailings samples (TL-6) reported concentrations below the screening criteria levels for the majority of parameters. Exceptions included:

- July sample contained elevated sulphur, arsenic, silver and gold. The range of arsenic content in 2018 was equivalent to levels in 2017 (Figure 4-5).
- All samples analyzed for gold were elevated.
- Boron and lead were elevated in one sample each.

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

Detoxified Tailings (TL-7)

The 2018 detoxified tailings (TL-7) were elevated for the following parameters relative to the screening criteria:

- All samples were elevated in arsenic (between 10 and 43 times the criteria), bismuth (between 13 and 60 times), copper (between 4 and 11 times), lead (between 3 and 10 times), selenium (between 8 and 36 times), sulphur (between 17 and 56 times), gold (between 170 and 650 times), and silver (between 6 and 59 times).
- More than half of samples were elevated in cadmium (from values slightly above but at near parity with the screening criteria to 3 times higher) and zinc (between 1.2 and 3 times).
- The range of concentrations for arsenic, bismuth, cadmium, copper, selenium, silver and zinc in 2018 was equivalent to levels in 2017 (Figure 4-5 to Figure 4-11).

All other parameters were below the screening criteria in 2018 (including cobalt, presented in Figure 4-12, which was elevated for one sample in 2017), 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
2018	Jan	0.56	12	--	***68***	<0.20	0.12	18	76	25	13	1900	0.24	79
	Feb	0.33	10	--	33	<0.20	0.079	14	70	25	6.3	1100	<0.20	50
	Mar	0.25	7.7	--	23	<0.20	0.066	13	40	23	6.6	1500	<0.20	48
	Apr	0.40	6.6	***1700***	<20	*0.10*	0.40	13	30	21	***70***	1100	<0.50	75
	May	0.20	6.4	***790***	<20	*0.10*	<0.10	10	46	19	12	1400	<0.50	43
	Jun	0.20	15	***270***	<20	<0.10	<0.10	9.6	30	17	7.0	1000	<0.50	34
	Jul	***2.9***	***67***	***12000***	<20	*0.20*	0.40	44	300	50	29	***14000***	<0.50	150
	Aug	0.10	15	***450***	<20	<0.10	<0.10	11	38	24	18	1000	<0.50	37
	Sep	0.20	6.0	***530***	<20	<0.10	<0.10	10	28	19	19	1000	<0.50	40
	Oct	0.20	9.4	***510***	<20	<0.10	0.10	10	38	21	10	1300	<0.50	48
	Nov	<0.10	6.7	***300***	<20	<0.10	<0.10	7.6	21	16	3.1	800	<0.50	26
	Dec	0.30	8.9	***1100***	<20	<0.10	<0.10	11	42	17	6.2	1300	<0.50	40
Summary Statistics														
2018	P005	0.10	6.2	***280***	20	0.10	0.073	8.7	25	16	4.8	910	0.20	30
	P050	0.23	9.2	***530***	20	0.10	0.10	11	39	21	11	1200	0.50	45
	P095	***1.6***	***39***	***7600***	49	0.20	0.40	30	180	36	47	***7200***	0.50	110
	P100	***2.9***	***67***	***12000***	***68***	0.20	0.40	44	300	50	***70***	***14000***	0.50	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	<0.20	0.063	10	22	18	4.2	1000	<0.20	47
	P050	0.28	8.3	--	14	<0.20	0.11	13	27	22	6.3	1100	<0.20	61
	P095	***1.4***	***47***	--	34	<0.20	0.24	32	140	42	15	1400	***0.51***	130
	P100	***2.1***	***83***	--	41	<0.20	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: P:\30431 Hope Bay Geochemistry\Project\Tailings\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2018_rev09.xlsx]

Note:

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-7)

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
2018	Jan	***13***	***350***		47	***2.4***	***6.0***	240	***5600***	190	***530***	***93000***	***8.2***	***3000***
	Feb	***18***	***260***		47	***1.8***	***3.2***	160	***6800***	130	***410***	***83000***	***6.9***	***1700***
	Mar	***16***	***200***		20	***1.0***	2.0	120	***4100***	110	***210***	***53000***	***4.0***	970
	Apr 1 (R1)	***7.2***	***560***		20	***3.7***	***6.5***	350	***5300***	240	***610***	***170000***	***13***	***2800***
	Apr 23 (R2)	***17***	***360***	***26000***	<20	***2.0***	***4.6***	230	***5400***	180	***470***	***>100000***	***10***	***2200***
	May	***15***	***470***	***7900***	<20	***1.8***	***2.3***	240	***5700***	180	***270***	***>100000***	***11***	***1300***
	Jun	***23***	***370***	***17000***	<20	***3.2***	***7.5***	260	***10000***	210	***610***	***>100000***	***8.9***	***3400***
	Jul	***10***	***490***	***11000***	<20	***1.6***	***2.3***	240	***5300***	230	***190***	***>100000***	***7.1***	1000
	Aug	***11***	***630***	***7800***	<20	***1.8***	1.5	260	***4000***	270	***170***	***>100000***	***8.6***	610
	Sep	***65***	***820***	***22000***	<20	***2.7***	***3.0***	430	***10000***	420	***430***	***>100000***	***18***	***1300***
	Oct	***27***	***800***	***6700***	<20	***4.2***	***5.4***	400	***5900***	340	***440***	***>100000***	***17***	***2600***
	Nov	***22***	***860***	***23000***	<20	***3.8***	***3.2***	410	***7000***	330	***320***	***>100000***	***17***	***1400***
	Dec	***19***	***710***	***15000***	<20	***3.0***	2.1	370	***5900***	240	***280***	***>100000***	***15***	920
Summary Statistics														
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	13	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***

Source: P:\30431 Hope Bay Geochemistry\Project\Tailings\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2018_rev08.xlsx]

Note:

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.

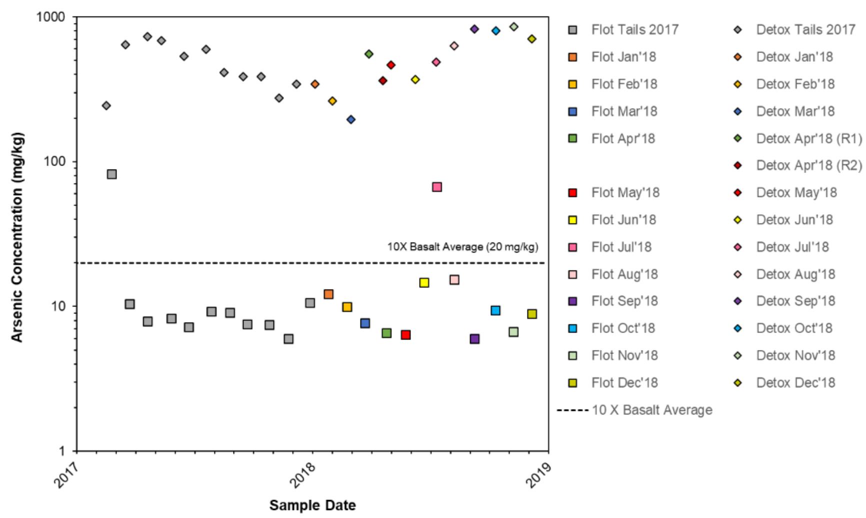

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Figure 4-5: Arsenic concentrations in tailings samples

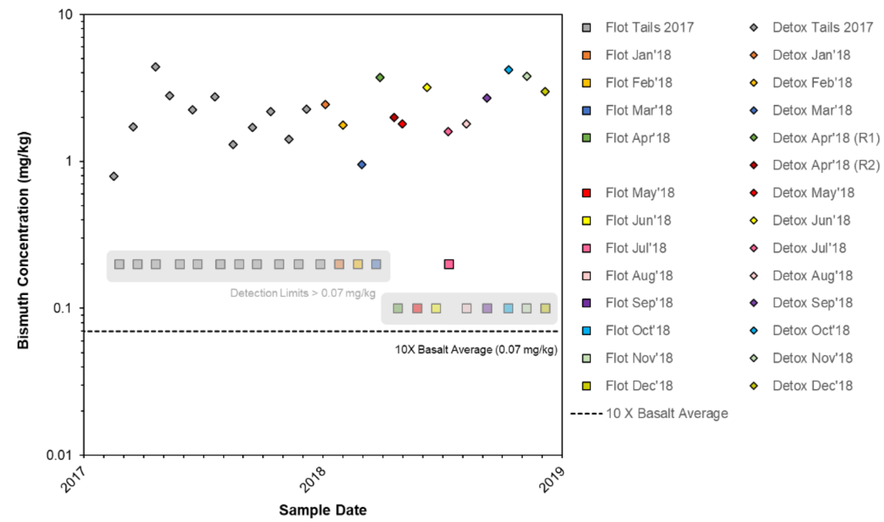

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Figure 4-6: Bismuth concentrations in tailings samples

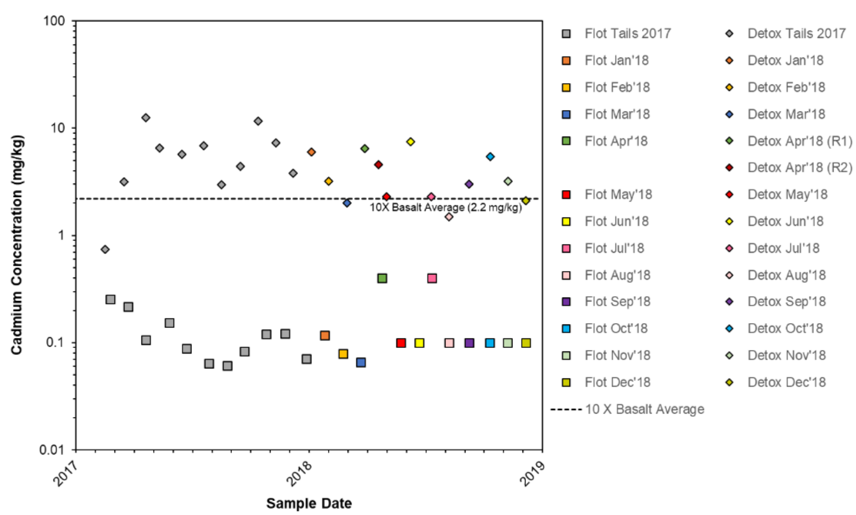

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Figure 4-7: Cadmium concentrations in tailings samples

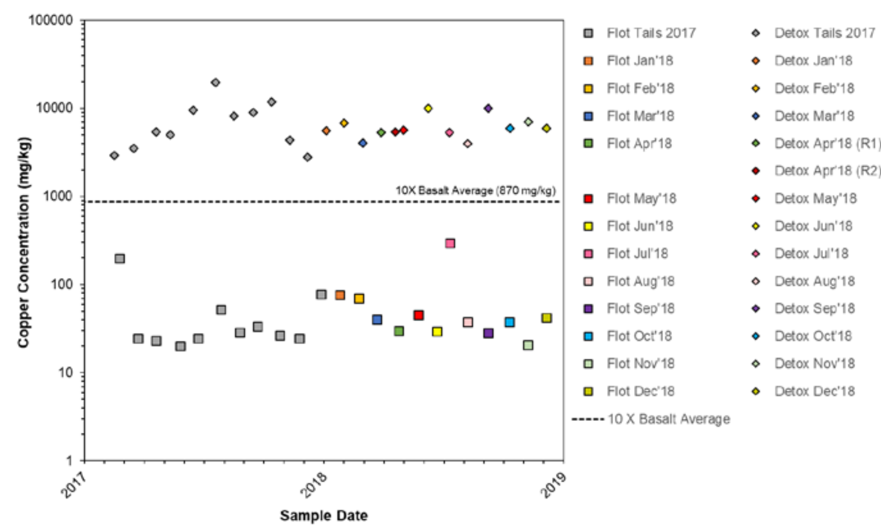

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Figure 4-8: Copper concentrations in tailings samples

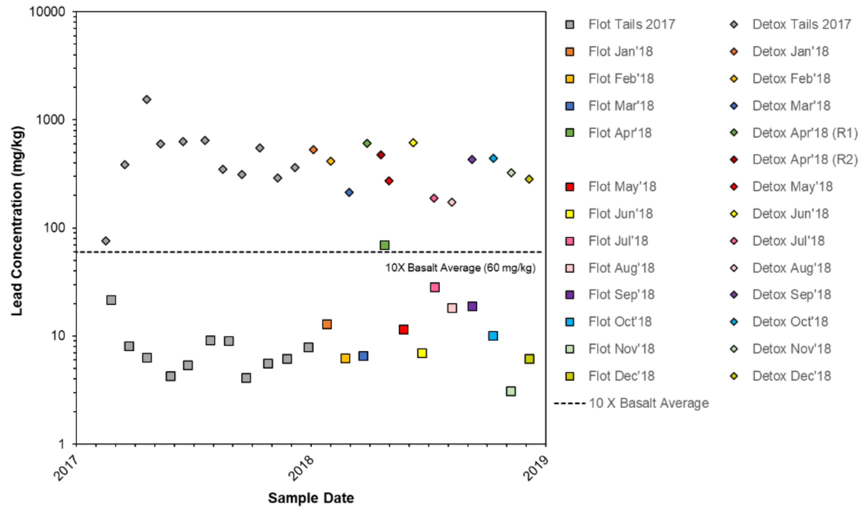

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Figure 4-9: Lead concentrations in tailings samples

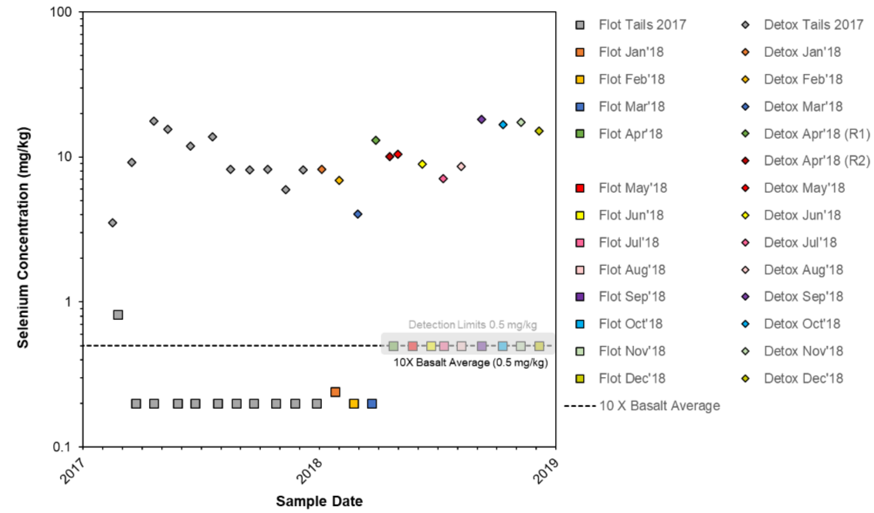

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Figure 4-10: Selenium concentrations in tailings samples

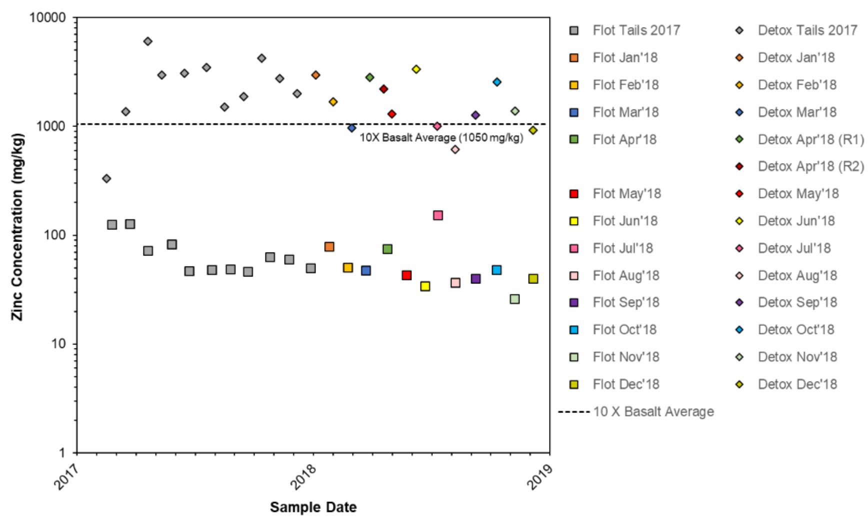

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Figure 4-11: Zinc concentrations in tailings samples

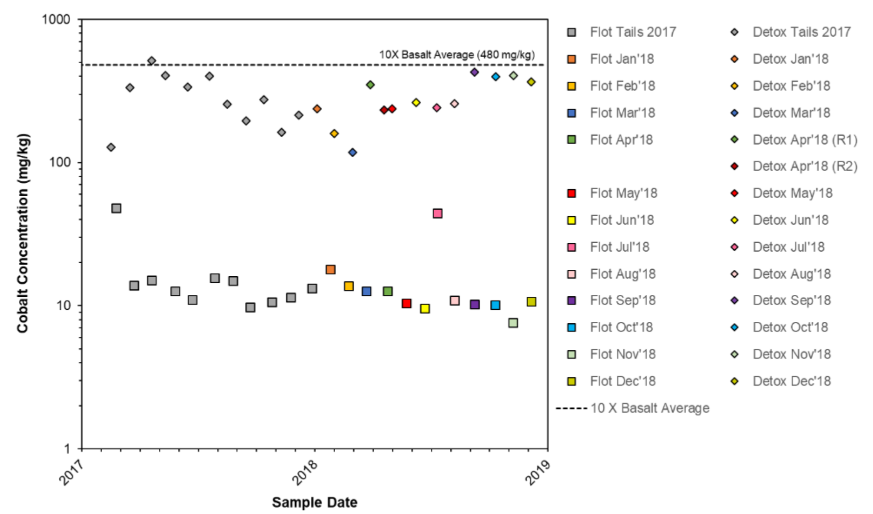

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Figure 4-12: Cobalt concentrations in tailings samples

4.2.3 Cyanide from Detoxified Tailings Solids (TL-7)

Schedule J (Table 2) of the Water Licence specifies that the monthly composite samples of the detoxified tailings solids (TL-7) should be analysed for WAD cyanide. In addition, the composite samples should be analysed for cyanate and thiocyanate on a quarterly basis. There are no regulatory limits for WAD cyanide within tailings solids. Cyanide and cyanide detoxification products extracted from the detoxified tailings solids is summarized in Table 4-7. WAD cyanide data is currently only available from ALS to April 2018 as Maxxam incorrectly executed the procedure and is currently in the process of re-analyzing the samples (Section 3.1.1). When data are available, TMAC will submit a supplemental report to TMAC to report the WAD cyanide data.

Between January and early April, concentrations of WAD and free cyanide extracted from the detoxified tailings were less than the ALS analytical limits of detection (13 to 20 ppm). The January to March samples contained lower sulphide content (maximum 6%) compared to the April sample (14%).

Thiocyanate and cyanate are produced as by-products of the cyanide detoxification circuit. Thiocyanate concentrations in the detoxified tailings ranged from 1.1 ppm to 5,300 ppm and cyanate concentrations range from 46 ppm to 1,100 ppm, with minimum concentrations observed in April. Data are not available for samples submitted to ALS as TMAC was advised that these analyses were not commercially available.

Table 4-7: Cyanide from Detoxified Tailings Solids (TL-7)

Sampling Date	Laboratory	WAD Cyanide	Free Cyanide	Thiocyanate	Cyanate
		ppm	ppm	ppm	ppm
Jan	ALS	<13	<13	Note 1	Note 1
Feb		<20	<20		
Mar		<20	<20		
Apr 1 (R1)		<20	<20		
Apr 23 (R2)	Maxxam	Note 2	6	1.1	46
May			3	940	74
Jun			10	5,300	310
Jul			0.65	1,100	280
Aug			0.58	930	320
Sep			15	2,600	1,100
Oct			<0.5	1,800	230
Nov			<0.5	1,600	430
Dec			<0.5	910	300

Source: P:\30431 Hope Bay Geochemistry\Project\Tailings\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2018_rev09.xlsx]

Note 1: Thiocyanate and cyanate data not available from ALS because ALS advised TMAC that these analyses were not commercially available.

Note 2: WAD cyanide data currently not available from Maxxam due to a methodological error. Analysis is being re-run and a supplemental report will be issued when data are available.

4.3 Seepage Monitoring of Backfilled Stopes (TL-11)

Water quality analysis of the seeps is provided in Table 4-8 for selected parameters. The results are compared to ten times the Canadian Environmental Quality Guidelines for the Protection of Aquatic Life for screening purposes only and are not directly applicable because the seepage sites do not support aquatic life.

Seepage was sampled from the East limb, North stope, Level 4932 during both the June and December surveys. The stope contained both waste rock and detoxified tailings backfill and is interpreted to be contact water of these material types. In the December survey a sample was also collected from a pool of standing water at the base of two backfilled stopes on level 4946. There was no flow observed and accordingly, this sample may not be a true seep. The underground seepage monitoring data are summarized as follows:

- pH conditions were circum-neutral with values of between 6.8 to 6.9.
- Major anion chemistry was dominated by chloride (40,000 to 47,000 mg/L) and to a lesser degree sulphate (860 to 1,000 mg/L), while major cation chemistry was dominated by calcium (12,000 to 15,000 mg/L), sodium (11,000 to 12,000 mg/L) and to a lesser degree magnesium (1,600 to 1,800 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 associated carbonate dissolution from waste rock and detoxified tailings (sulphate and calcium).
- Total cyanide concentrations ranged from 0.007 to 1.1 mg/L and free cyanide concentrations were 0.005 and 0.01 mg/L. WAD cyanide concentrations were at near parity with free cyanide.
- Levels of ammonia (220 to 380 mg/L), nitrate (490 to 520 mg/L) and nitrite (1.6 to 18 mg/L) exceed screening criteria values. Sources of these nutrients are degradation of cyanate and thiocyanate in detoxified tailings and/or blast residues on waste rock.
- Compared to the screening criteria, seepage samples exhibited elevated levels of cadmium (0.021 to 0.045 mg/L), copper (0.34 to 0.84 mg/L), nickel (0.2 to 0.5 mg/L), selenium (0.008 to 0.043 mg/L), silver (0.018 to 0.04 mg/L) and zinc (0.23 to 3.6 mg/L). Based on the humidity cell test (HCT) program for detoxified tailings, all these aforementioned parameters were noted as parameters of potential concern except for zinc (SRK 2015).
- The following dissolved parameters were consistently reported at concentrations less than analytical detection limits in all seepage samples: aluminium, antimony, arsenic, beryllium, bismuth, chromium, iron, phosphorous, silicon, tellurium, thorium, tin, titanium, tungsten, vanadium and zirconium. The low arsenic concentrations in the seepage is notable given the elevated concentrations of solid-phase arsenic in the detoxification tailings and is consistent with observations from the HCT program for metallurgical detoxified tailings (SRK 2015).

Table 4-8: Summary of TL-11 (Backfilled Stopes) Seepage Water Quality Analysis

Parameter	Units	East limb, North stope, Level 4932		South stope, Level 4946	10x CEQG
		June	Dec	Dec	
EC	uS/cm	99,000	92,000	100,000	
pH	pH	6.8	6.9	6.9	6.5 – 9
TSS	mg/L	320	220	42,000	
TDS	mg/L	83,000	73,000	80,000	
Total Alkalinity	mg/L as $CaCO_3$	40	60	230	
NH_3	mg/L	**220**	**230**	**380**	2.6
Cl	mg/L	43,000	40,000	47,000	
NO_3	as N mg/L	**490**	**520**	**520**	29
NO_2	as N mg/L	**2.8**	**1.6**	**18**	0.6
SO_4	mg/L	860	890	1000	
Total CN	mg/L	0.02	0.007	1.1	
WAD CN	mg/L	<0.005	<0.005	0.017	
Free CN	mg/L	0.007	0.005	0.010	0.05
Al	mg/L	<0.1	<0.1	<0.1	4
Sb	mg/L	<0.01	<0.01	<0.01	
As	mg/L	<0.01	<0.01	<0.01	0.05
Ba	mg/L	0.31	0.25	0.60	
B	mg/L	2.9	2.9	3.7	15
Cd	mg/L	**0.032**	**0.045**	**0.021**	0.0009
Ca	mg/L	15,000	12,000	13,000	
Cr	mg/L	<0.01	<0.01	<0.01	0.01
Co	mg/L	0.22	0.34	0.05	
Cu	mg/L	**0.54**	**0.84**	**0.34**	0.02
Fe	mg/L	<0.05	<0.05	<0.05	3
Pb	mg/L	**0.17**	**0.15**	0.0046	0.01
Li	mg/L	0.35	0.35	0.27	
Mg	mg/L	1,600	1,600	1,800	
Mn	mg/L	8.6	11.0	9.8	
Mo	mg/L	0.018	0.021	0.051	0.73
Ni	mg/L	**0.35**	**0.50**	0.20	0.25
K	mg/L	550	520	600	
Se(1)	mg/L	**0.022**	**0.043**	**0.008**	0.01
Ag	mg/L	**0.040**	**0.031**	**0.018**	0.0025
Na	mg/L	11,000	11,000	12,000	
S	mg/L	530	590	490	
Tl	mg/L	0.0009	0.0008	0.0007	0.008
U	mg/L	0.0047	0.005	0.003	0.15
Zn	mg/L	**1.9**	**3.60**	0.23	0.3

Source: P:\30431 Hope Bay Geochemistry\Project\Tailings\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-6 & TL-7_2018_rev08.xlsx]

Notes:

Screen Criteria – 10x CEQG = Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment) – used for screening purposed only

Blue italics = Value less than laboratory detection limit. Detection limit shown.

Bold values = Values exceeds screening criteria (ten times CCME Guidelines for Freshwater Aquatic Life – Long-term Concentration).

-- = Data not available.

Se(1) QAQC check for totals versus dissolved failed for selenium, potential contaminants added during field filtration process.

4.4 Process Plant Tailings Water Discharge (TL-5)

Between January and December 19 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. Data for TL-5 are reported as part of TMAC's SNP monitoring and are not reproduced in this report. The geochemistry of the 2018 process plant tailings discharge (TL-5) is summarized as follows:

- The pH of the solution was neutral to slightly alkaline ranging from 7.7 to 8.4 s.u (Figure 4-13).
- Sulphate loadings were stable with the range equivalent to 2017 (Figure 4-14).
- The increase observed in total aluminum, total iron and TSS in March indicates that the sample includes solids (Figure 4-15 to Figure 4-17). During March, loadings of arsenic, bismuth, cadmium, selenium, lead, silver and zinc (all totals) exhibit an increase indicating concentrations represent the chemistry of the tailings solids (e.g. Figure 4-18). Notably, concentrations of bismuth, cadmium, lead and zinc were below detection for a number of other samples with lower TSS.
- Trends for major ions and trace elements were stable in 2018 with ranges equivalent to 2017. Exceptions included calcium, magnesium, strontium (which are likely indicative of carbonates) and molybdenum, all of which exhibited increasing trends.

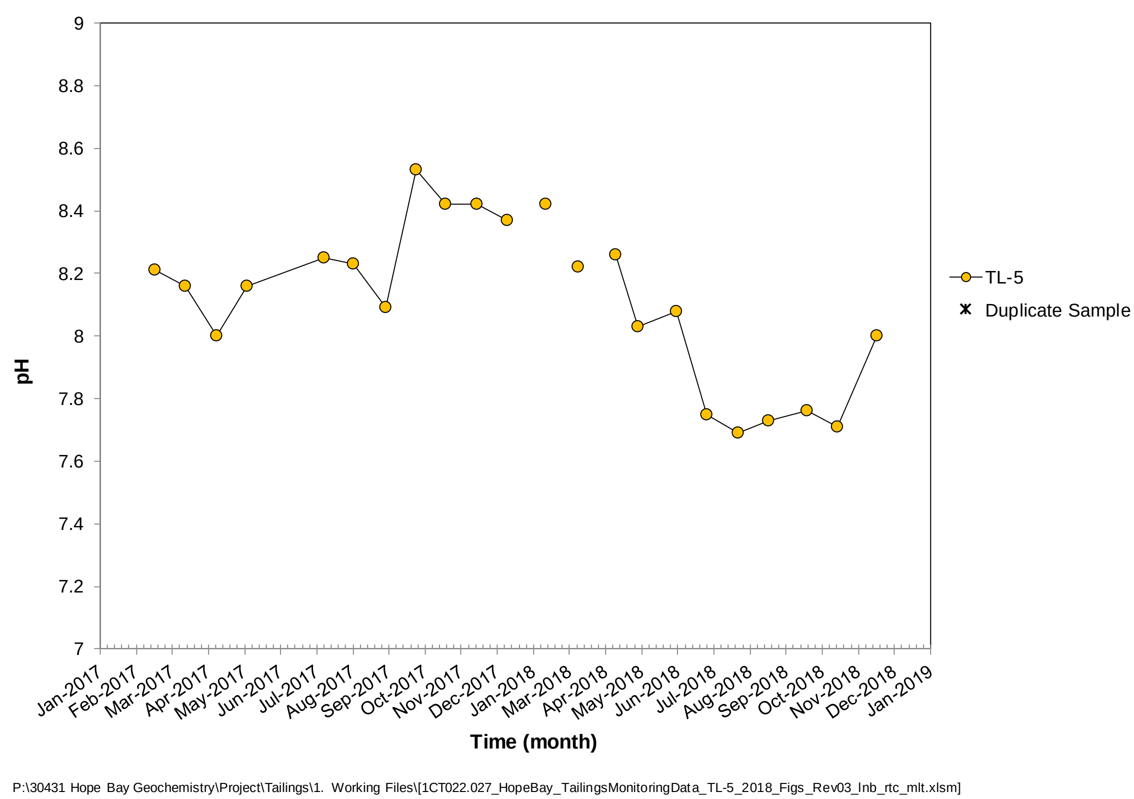

Figure 4-13: Trends in pH for process plant supernatant discharge (TL-5)

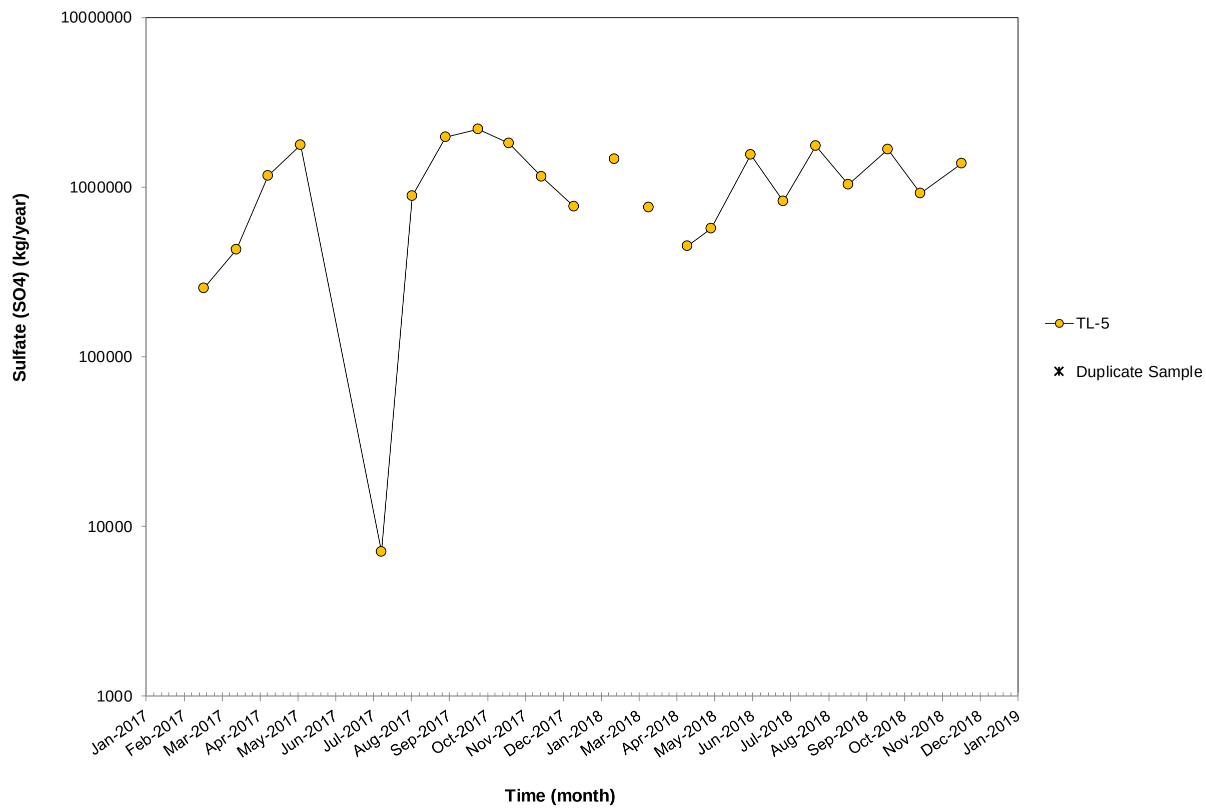

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Figure 4-14: Trends in sulphate for process plant supernatant discharge (TL-5)

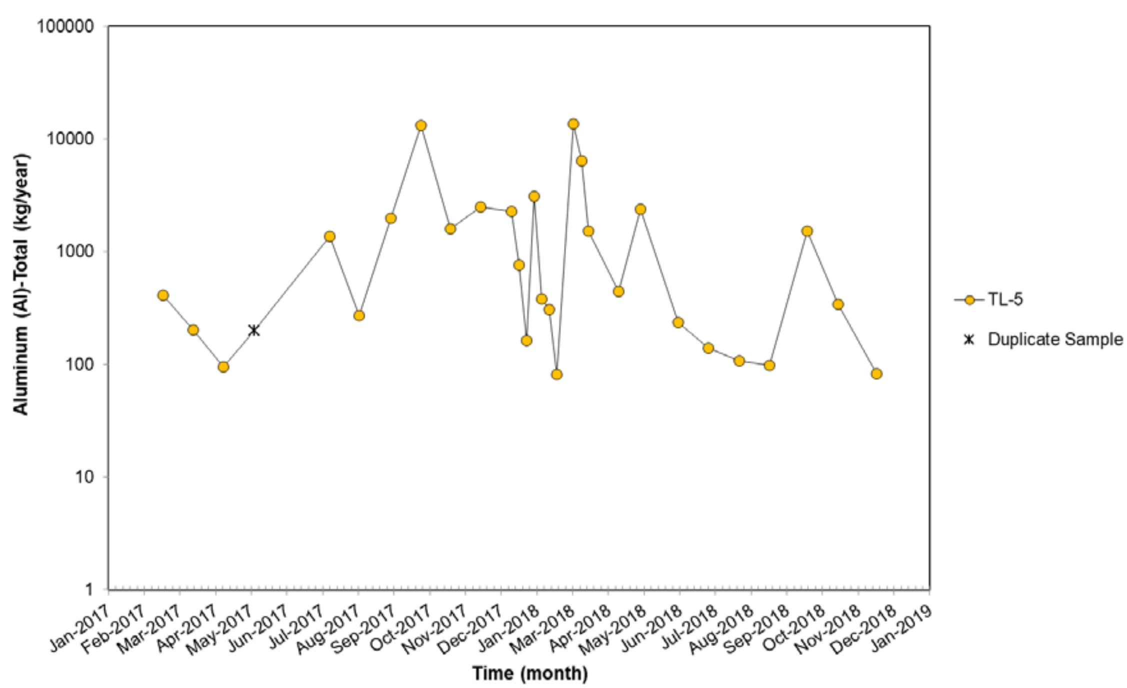

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Figure 4-15: Trends in total aluminum for process plant supernatant discharge (TL-5)

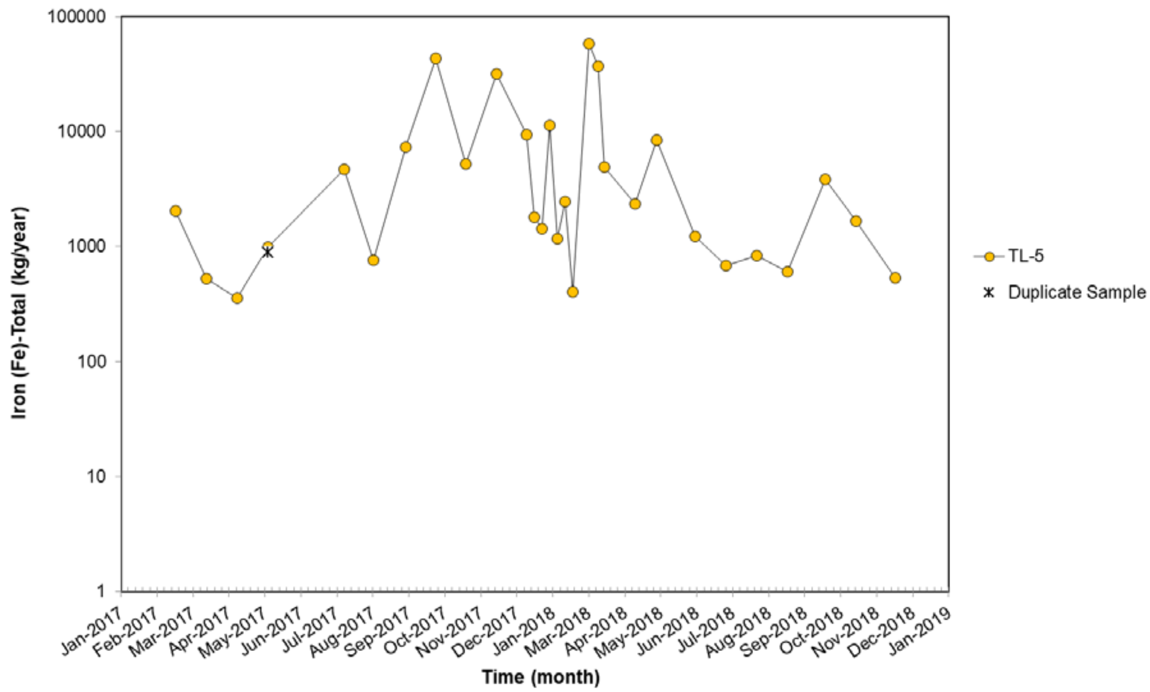

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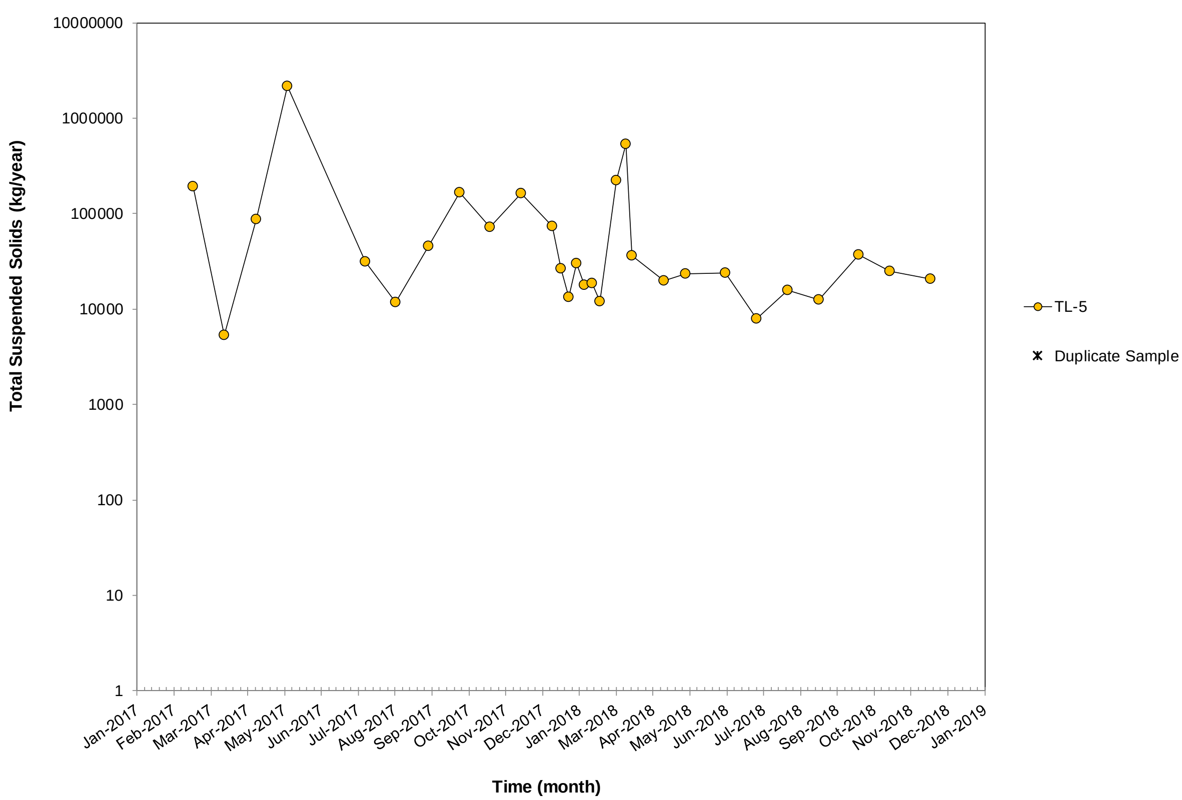
Figure 4-16: Trends in total iron for process plant supernatant discharge (TL-5)



P:\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\G_Tailings Monitoring\2018\1. Working Files\[1CT022.027_HopeBay_TailingsMonitoringData_TL-5_2018_Figs_Rev03_lnb_rtc_mlt.xlsm]

Figure 4-17: Trends in TSS for process plant supernatant discharge (TL-5)

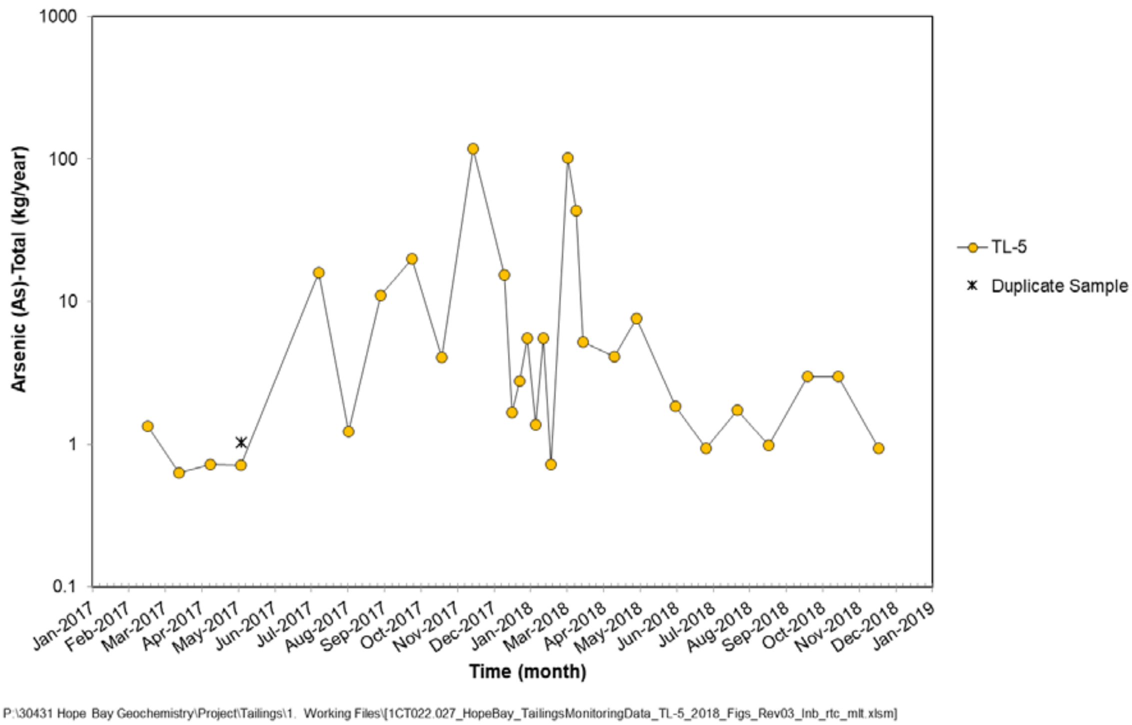


Figure 4-18: Trends in total arsenic for process plant supernatant discharge (TL-5)

5 Summary and Conclusions

TMAC initiated ore processing on January 20, 2017 with commencement of tailings monitoring in February 2017 in accordance to the water licence. In 2018, a total of 446,594 t (dry weight) of flotation tailings were deposited in the TIA and 17,680 t of detoxified tailings were placed as backfill in Doris Mine underground stopes.

In April 2018, the analytical tests work program for tailings was changed to be consistent with methods used for metallurgical tailings (SRK 2015). The geochemical methods used for operational tailings prior to April 2018 were different except for total sulphur, with the difference in methods documented in SRK (2018) and Section 3.

The results of the 2018 geochemical monitoring program of flotation tailings solids (TL-6) is summarized as follows:

- Sulphur concentrations ranged between <0.05 and 1.4 % with a notable increase starting in April.
- TIC content ranged between 57 and 140 kg $CaCO_3$/t, with TIC values underestimated for all samples analyzed prior to April 2018.
- All flotation tailings samples are classified as non-PAG, which in consistent with 2017 operational and metallurgical tailings samples (SRK 2015).
- Trace element content was elevated compared to screening criteria for arsenic, silver, gold and one high sulphur sample. Boron and lead were also elevated in one sample each. All other parameters were below the screening criteria indicating no appreciable enrichment.

The results of the 2018 geochemical monitoring program of detoxified tailings solids (TL-7) is summarized as follows:

- Sulphur concentrations ranged between 3 and 23% and showed a similar trend to the flotation tailings, increasing after April 2018.
- TIC results for 2018 ranged between 59 and 140 kg $CaCO_3$/t, with TIC values underestimated for all samples analyzed prior to April 2018.
- All of the detoxified tailings samples were classified as PAG, which in consistent with 2017 operational and metallurgical tailings samples (SRK 2015).
- All detoxified tailings samples were elevated compared to the screening criteria for arsenic, bismuth, copper, lead, selenium, silver and sulphur with more than half of samples elevated in cadmium and zinc. All other parameters were below the screening criteria indicating no appreciable enrichment. This is consistent with 2017 operational monitoring samples except for cobalt, which was enriched in 2017 but not in 2018.
- WAD cyanide concentrations analyzed at ALS between January and early April were below detection (20 mg/L). There is no regulatory limit for WAD cyanide in tailings. WAD cyanide data from April onwards is currently not available due to a laboratory methodological error. TMAC will submit a supplemental report when data are available.

- Thiocyanate concentrations ranged from 1.1 ppm to 5,300 ppm and cyanate concentrations range from 46 ppm to 1,100 ppm.

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

- Seepage from the east limb of the North stope on level 4932 containing waste rock and detoxified tailings backfill was observed and sampled in June and December. A further sample was collected during the December survey from a pool of water at the base of two backfilled stopes on level 4946.
- Seepage pH was circum-neutral for all samples.
- Major anion chemistry was dominated by chloride (40,000 to 47,000 mg/L) and to a lesser degree sulphate (860 to 1000 mg/L), while major cation chemistry was dominated by calcium 12,000 to 15,000 mg/L), sodium (11,000 to 12,000 mg/L) and to a lesser degree magnesium (1,600 to 1,800 mg/L). Potential sources of the major ions include residues on waste rock from drilling brines (calcium and chloride), process reagents (sodium), other sources of saline water (chloride, sulphate, calcium, sodium and magnesium), and sulphide oxidation with associated carbonate dissolution from waste rock and detoxified tailings (sulphate and calcium).
- Total cyanide concentrations in the seepage ranged from 0.007 to 1.1 mg/L and WAD cyanide concentrations ranged from 0.005 mg/L to 0.017 mg/L.
- The sources of ammonia (220 to 380 mg/L), nitrate (490 to 520 mg/L) and nitrite (1.6 to 18 mg/L) are attributable to degradation of cyanate and thiocyanate in detoxified tailings and/or blast residues from waste rock.
- The following trace elements were reported at concentrations exceeding the screening criteria: cadmium and copper (approximately 45 times higher), nickel and selenium (same order of magnitude), silver (up to 20 times higher) and zinc (up to 10 times higher). Based on the humidity cell test (HCT) program for detoxified tailings, all these aforementioned parameters were noted as parameters of potential concern except for zinc (SRK 2015).
- The low arsenic concentrations in the seepage are notable given the elevated concentrations of solid-phase arsenic in the detoxification tailings and is consistent with observations from the HCT program for metallurgical detoxified tailings (SRK 2015).

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

- pH was near-neutral to slightly alkaline ranging between 7.7 and 8.4 s.u..
- Sulphate loadings were stable with the range equivalent to 2017
- Increased loadings for selected parameters such as arsenic, bismuth, cadmium, selenium, lead, silver and zinc (all totals) is due to the presence of tailings solids in the sample. Notably, concentrations of bismuth, cadmium, lead and zinc were below detection for a number of samples with lower TSS.

- Trends for major ions and trace elements were stable in 2018 with ranges equivalent to 2017. Exceptions included calcium, magnesium, strontium (which are likely indicative of carbonates) and molybdenum, all of which exhibited increasing trends.

Regards
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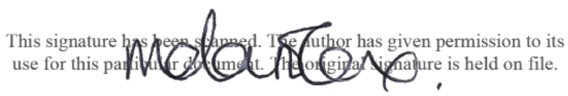

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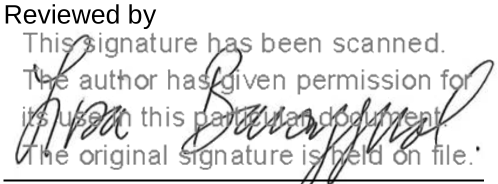

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied 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– TL-6 Geochemical Data

Flotation Tailings (TL-6)					ABA																
					ALS							Maxxam						Calculations			
Sample ID	Station ID	Laboratory ID	Date Sampled	Laboratory	Moisture	pH (1:2 soil:water)	Sulfate (SO4)	Total Sulfur	Inorganic Carbon	Inorganic Carbon (as $CaCO_3$ Eq)	(ALS) NP	Total Sulfur	HCl Extractable S (calc.)	CO2	Inorganic Carbon	CaCO3 Equiv.	(Maxxam) NP	AP	NNP	(ALS) NP/AP	(Maxxam) NP/AP
				Unit>	%	pH	%	%	%C	%	kg $CaCO_3$/t	%	%	wt%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg CaCO3/t	kg CaCO3/t	Ratio	Ratio
				LOD>	<0.25	<0.1	<0.001	<0.05	<0.05	<0.4	calc	<0.01	<0.01	<0.08	calc	<1.8	calc	calc	calc	calc	calc
TL6-28JAN18	TL-6	L2050784-1	28/01/2018	ALS	19	9.1	0.030	0.05	0.69	5.8	58							1.6	56	37	
TL6-26FEB18	TL-6	L2061213-1	26/02/2018	ALS	27	9.2	0.067	*<0.05*	0.69	5.7	57							1.6	56	37	
TL6-26MAR18	TL-6	L2072841-1	26/03/2018	ALS	25	9.0	0.039	0.06	0.81	6.7	67							1.9	65	36	
TL6-10MAY18	TL-6	TJ5954	29/04/2018	Maxxam	15			0.15				0.15	0.030	4.2	1.1	96	96	4.7	91		20
TL6-6JUN18	TL-6	TO9002	28/05/2018	Maxxam	15			0.16				0.16	0.060	3.4	0.91	76	76	5.0	71		15
TL6-9JUL18	TL-6	TV0702	26/06/2018	Maxxam				0.09				0.09	0.020	3.5	0.95	79	79	2.8	76		28
TL6-7AUG18	TL-6	UA2547	16/07/2018	Maxxam				1.4				1.4	0.020	6.3	1.7	144	144	43	100		3.3
TL6-20AUG18	TL-6	UE2969	12/08/2018	Maxxam				0.10				0.10	0.020	5.3	1.4	121	121	3.1	118		39
TL6-12SEP18	TL-6	UM9257	12/09/2018	Maxxam				0.10				0.10	0.010	4.5	1.2	103	103	3.1	100		33
TL6-1NOV18	TL-6	UR5476	14/10/2018	Maxxam				0.13				0.13	0.020	4.3	1.2	97	97	4.1	93		24
TL6-23NOV18	TL-6	UV5357	11/11/2018	Maxxam				0.06				0.06	0.010	3.5	0.95	79	79	1.9	77		42
TL6-20DEC18	TL-6	VA6198	10/12/2018	Maxxam				0.13				0.13	0.020	5.7	1.5	128	128	4.1	124		32

Flotation Tailings (TL-6)					Metals															
Sample ID	Station ID	Laboratory ID	Date Sampled	Laboratory	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg
				Unit>	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
				LOD>	<0.1	<50	<0.1	<0.5	<5	<0.5	<0.1	<0.2	<50	<0.02	<0.1	<0.5	<0.5	<50	<1	<0.005
TL6-28JAN18	TL-6	L2050784-1	28/01/2018	ALS	0.56	13000	12		68	20	0.14	<0.20	26100	0.12	18	33	76	40800		<0.005
TL6-26FEB18	TL-6	L2061213-1	26/02/2018	ALS	0.33	10600	10		33	14	0.13	<0.20	30300	0.079	14	28	70	39300		<0.005
TL6-26MAR18	TL-6	L2072841-1	26/03/2018	ALS	0.25	12900	7.7		23	13	0.14	<0.20	29000	0.066	13	30	40	40600		<0.005
TL6-10MAY18	TL-6	TJ5954	29/04/2018	Maxxam	0.40	10600	6.6	1650	<20	498		0.10	26600	0.40	13	88	30	37600	4.0	0.03
TL6-6JUN18	TL-6	TO9002	28/05/2018	Maxxam	0.20	10800	6.4	790	<20	12		0.10	26400	<0.10	10	75	46	36600	4.0	<0.01
TL6-9JUL18	TL-6	TV0702	26/06/2018	Maxxam	0.20	7800	15	271	<20	10		<0.10	24300	<0.10	9.6	66	30	33300	3.0	<0.01
TL6-7AUG18	TL-6	UA2547	16/07/2018	Maxxam	2.9	10700	67	11500	<20	12		0.20	35600	0.40	44	65	297	57300	4.0	<0.01
TL6-20AUG18	TL-6	UE2969	12/08/2018	Maxxam	0.10	6700	15	448	<20	8		<0.10	37500	<0.10	11	38	38	37200	2.0	<0.01
TL6-12SEP18	TL-6	UM9257	12/09/2018	Maxxam	0.20	7400	6	533	<20	72		<0.10	27700	<0.10	10	71	28	35000	3.0	<0.01
TL6-1NOV18	TL-6	UR5476	14/10/2018	Maxxam	0.20	7700	9.4	506	<20	11		<0.10	24800	0.10	10	51	38	32500	3.0	<0.01
TL6-23NOV18	TL-6	UV5357	11/11/2018	Maxxam	<0.10	4900	6.7	303	<20	8		<0.10	20600	<0.10	7.6	57	21	23400	2.0	<0.01
TL6-20DEC18	TL-6	VA6198	10/12/2018	Maxxam	0.30	7000	8.9	1100	<20	12		<0.10	30700	<0.10	11	66	42	37400	2.0	<0.01

Flotation Tailings (TL-6)					Metals															
Sample ID	Station ID	Laboratory ID	Date Sampled	Laboratory	K	La	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Se	Sn	Sr
				Unit>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
				LOD>	<100	<1	<2	<20	<1	<0.1	<50	<0.5	<50	<0.5	<1000	<0.1	<0.1	<0.2	<2	<0.5
TL6-28JAN18	TL-6	L2050784-1	28/01/2018	ALS	1490		34	13400	970	0.44	711	25	305	13	1900	<0.10		0.24	<2.0	14
TL6-26FEB18	TL-6	L2061213-1	26/02/2018	ALS	1050		25	14500	1000	0.25	931	25	302	6.3	1100	<0.10		<0.20	<2.0	18
TL6-26MAR18	TL-6	L2072841-1	26/03/2018	ALS	950		26	14600	921	0.28	696	23	320	6.6	1500	<0.10		<0.20	<2.0	17
TL6-10MAY18	TL-6	TJ5954	29/04/2018	Maxxam	1000	2.0		12800	887	0.60	520	21	320	70	1100	<0.10	7.0	<0.50		19
TL6-6JUN18	TL-6	TO9002	28/05/2018	Maxxam	800	2.0		12400	889	0.40	850	19	290	12	1400	<0.10	7.0	<0.50		18
TL6-9JUL18	TL-6	TV0702	26/06/2018	Maxxam	800	2.0		10700	794	0.40	430	17	260	7.0	1000	<0.10	6.1	<0.50		13
TL6-7AUG18	TL-6	UA2547	16/07/2018	Maxxam	800	2.0		13600	1220	0.70	750	50	310	29	13700	<0.10	8.1	<0.50		22
TL6-20AUG18	TL-6	UE2969	12/08/2018	Maxxam	500	2.0		12600	1070	0.30	620	24	270	18	1000	<0.10	7.0	<0.50		21
TL6-12SEP18	TL-6	UM9257	12/09/2018	Maxxam	600	2.0		11300	892	0.40	520	19	340	19	1000	<0.10	6.1	<0.50		18
TL6-1NOV18	TL-6	UR5476	14/10/2018	Maxxam	700	1.0		11400	780	0.40	700	21	270	10	1300	<0.10	5.6	<0.50		14
TL6-23NOV18	TL-6	UV5357	11/11/2018	Maxxam	400	1.0		8900	619	0.30	480	16	160	3.1	800	<0.10	4.4	<0.50		13
TL6-20DEC18	TL-6	VA6198	10/12/2018	Maxxam	600	2.0		11000	951	0.50	700	17	320	6.2	1300	<0.10	6.4	<0.50		18

Flotation Tailings (TL-6)					Metals									Cyanides				
Sample ID	**Station ID**	**Laboratory ID**	**Date Sampled**	**Laboratory**	**Te**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Zn**	**Zr**	**CN_WAD**	**CN_Total**	**CN_Free**	**Thiocyanate**	**Cyanate**
				Unit>	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
				LOD>	**<0.2**	**<0.1**	**<1**	**<0.05**	**<0.05**	**<0.2**	**<0.5**	**<2**	**<1**	**<0.05 - 20**	**<4**	**<0.05 - 20**	**<1**	**<1**
TL6-28JAN18	TL-6	L2050784-1	28/01/2018	ALS			1100	0.061	<0.05	66	<0.50	79	2.7					
TL6-26FEB18	TL-6	L2061213-1	26/02/2018	ALS			746	<0.05	<0.05	50	<0.50	50	2.6					
TL6-26MAR18	TL-6	L2072841-1	26/03/2018	ALS			659	<0.05	0.11	49	<0.50	48	2.9					
TL6-10MAY18	TL-6	TJ5954	29/04/2018	Maxxam	<0.20	0.10	570	<0.10	<0.10	45	0.20	75		0.66		<0.50	<1.0	12
TL6-6JUN18	TL-6	TO9002	28/05/2018	Maxxam	<0.20	0.20	530	<0.10	<0.10	43	0.30	43						
TL6-9JUL18	TL-6	TV0702	26/06/2018	Maxxam	<0.20	0.10	380	<0.10	<0.10	33	0.30	34						
TL6-7AUG18	TL-6	UA2547	16/07/2018	Maxxam	0.30	0.20	450	<0.10	<0.10	46	0.40	154						
TL6-20AUG18	TL-6	UE2969	12/08/2018	Maxxam	<0.20	0.10	150	<0.10	<0.10	26	0.30	37						
TL6-12SEP18	TL-6	UM9257	12/09/2018	Maxxam	<0.20	0.20	360	<0.10	<0.10	29	0.30	40						
TL6-1NOV18	TL-6	UR5476	14/10/2018	Maxxam	<0.20	0.10	360	<0.10	<0.10	33	0.30	48						
TL6-23NOV18	TL-6	UV5357	11/11/2018	Maxxam	<0.20	<0.10	300	<0.10	<0.10	21	0.40	26						
TL6-20DEC18	TL-6	VA6198	10/12/2018	Maxxam	<0.20	0.10	180	0.10	<0.10	25	0.80	40						

Attachment B – TL-7 Geochemical Data

				Detoxified Tailings (TL-7)	ABA																
					ALS							Maxxam						Calculations			
Sample ID	Station ID	Laboratory ID	Date Sampled	Laboratory	Moisture	pH (1:2 soil:water)	Sulfate (SO4)	Total Sulfur	Inorganic Carbon	Inorganic Carbon (as $CaCO_3$ Eq)	(ALS) NP	Total Sulfur	HCl Extractable S (calc.)	CO2	Inorganic Carbon	$CaCO_3$ Equiv.	(Maxxam) NP	AP	NNP	(ALS) N/AP	(Maxxam) NP/AP
				Unit>	%	pH	%	%	%C	%	kg $CaCO_3$/t	%	%	wt%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg CaCO3/t	kg CaCO3/t	Ratio	Ratio
				LOD>	<0.25	<0.1	<0.001	<0.05	<0.05	<0.4	calc	<0.01	<0.01	<0.08	calc	<1.8	calc	calc	calc	calc	calc
TL7-8JAN18	TL-7	L2043255-1	08/01/2018	ALS	26	8.9	0.25	5.6	0.82	6.8	68							175	-107	0.39	
TL7-4FEB18	TL-7	L2053211-1	04/02/2018	ALS	24	8.9	0.12	6.1	0.80	6.7	67							189	-123	0.35	
TL7-5MAR18	TL-7	L2064903-1	05/03/2018	ALS	19	9.0	0.14	3.0	0.71	5.9	59							92.5	-33	0.64	
TL7-1APR18	TL-7	L2075124-1	01/04/2018	ALS	23	8.3	0.30	14	1.0	8.4	84							434	-350	0.19	
TL7-10MAY18	TL-7	TJ5955	23/04/2018	Maxxam	19							12	0.20	3.1	0.86	71	71	367	-296		0.19
TL7-18MAY18	TL-7	TL6515	06/05/2018	Maxxam	21							13	0.14	4.7	1.3	108	108	420	-313		0.26
TL7-5JULY18	TL-7	TU3759	13/06/2018	Maxxam	26							12	0.20	4.3	1.2	98	98	384	-286		0.26
TL7-7AUG18	TL-7	UA2531	15/07/2018	Maxxam	19							12	0.06	6.2	1.7	140	140	376	-236		0.37
TL7- 28AUG18	TL-7	UE2977	12/08/2018	Maxxam	21							14	0.15	5.4	1.5	123	123	438	-315		0.28
TL7-9SEP18	TL-7	UM9259	12/09/2018	Maxxam	21							23	0.27	4.0	1.1	92	92	723	-631		0.13
TL7-1NOV18	TL-7	UR5531	15/10/2018	Maxxam	21							22	0.19	3.7	1.0	83	83	691	-608		0.12
TL7-23NOV18	TL-7	UV5365	12/11/2018	Maxxam	20							22	0.22	5.1	1.4	116	116	689	-573		0.17
TL7-20DEC18	TL-7	VA6221	10/12/2018	Maxxam	24							19	0.25	6.2	1.7	142	142	586	-444		0.24

Detoxified Tailings (TL-7)					Metals															
Sample ID	**Station ID**	**Laboratory ID**	**Date Sampled**	**Laboratory**	**Ag**	**Al**	**As**	**Au**	**B**	**Ba**	**Be**	**Bi**	**Ca**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Ga**	**Hg**
				Unit>	**ppm**	**ppm**	**ppm**	**ppb**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
				LOD>	**<0.1**	**<50**	**<0.1**	**<0.5**	**<5**	**<0.5**	**<0.1**	**<0.2**	**<50**	**<0.02**	**<0.1**	**<0.5**	**<0.5**	**<50**	**<1**	**<0.005**
TL7-8JAN18	TL-7	L2043255-1	08/01/2018	ALS	13	14300	345		47	29	0.16	2.4	40000	6.0	238	61	5580	133000		0.076
TL7-4FEB18	TL-7	L2053211-1	04/02/2018	ALS	18	12500	262		47	25	0.15	1.8	32000	3.2	160	56	6830	112000		0.065
TL7-5MAR18	TL-7	L2064903-1	05/03/2018	ALS	16	10900	195		20	18	0.12	1.0	37200	2.0	118	44	4050	89700		0.039
TL7-1APR18	TL-7	L2075124-1	01/04/2018	ALS	7.2	11600	556		20	22	0.15	3.7	34800	6.5	349	66	5320	196000		0.10
TL7-10MAY18	TL-7	TJ5955	23/04/2018	Maxxam	17	12700	363	25500	<20	44		2.0	31500	4.6	234	74	5410	141000	5.0	0.070
TL7-18MAY18	TL-7	TL6515	06/05/2018	Maxxam	15	9300	466	7890	<20	20		1.8	29700	2.3	237	76	5670	153000	3.0	0.040
TL7-5JULY18	TL-7	TU3759	13/06/2018	Maxxam	23	11800	369	16600	<20	18		3.2	28400	7.5	264	68	>10000	142000	5.0	0.070
TL7-7AUG18	TL-7	UA2531	15/07/2018	Maxxam	10	10200	486	11100	<20	13		1.6	35300	2.3	242	76	5290	148000	4.0	0.040
TL7- 28AUG18	TL-7	UE2977	12/08/2018	Maxxam	11	8100	629	7840	<20	10		1.8	39600	1.5	258	77	3970	162000	3.0	0.030
TL7-9SEP18	TL-7	UM9259	12/09/2018	Maxxam	65	6600	823	21800	<20	13		2.7	24800	3.0	427	89	>10000	255000	3.0	0.070
TL7-1NOV18	TL-7	UR5531	15/10/2018	Maxxam	27	7800	799	6660	<20	12		4.2	24700	5.4	399	81	5880	208000	3.0	0.090
TL7-23NOV18	TL-7	UV5365	12/11/2018	Maxxam	22	5400	855	23400	<20	8.0		3.8	24700	3.2	406	81	6990	223000	2.0	0.050
TL7-20DEC18	TL-7	VA6221	10/12/2018	Maxxam	19	6700	708	14700	<20	9.0		3.0	34500	2.1	365	76	5880	227000	3.0	0.070

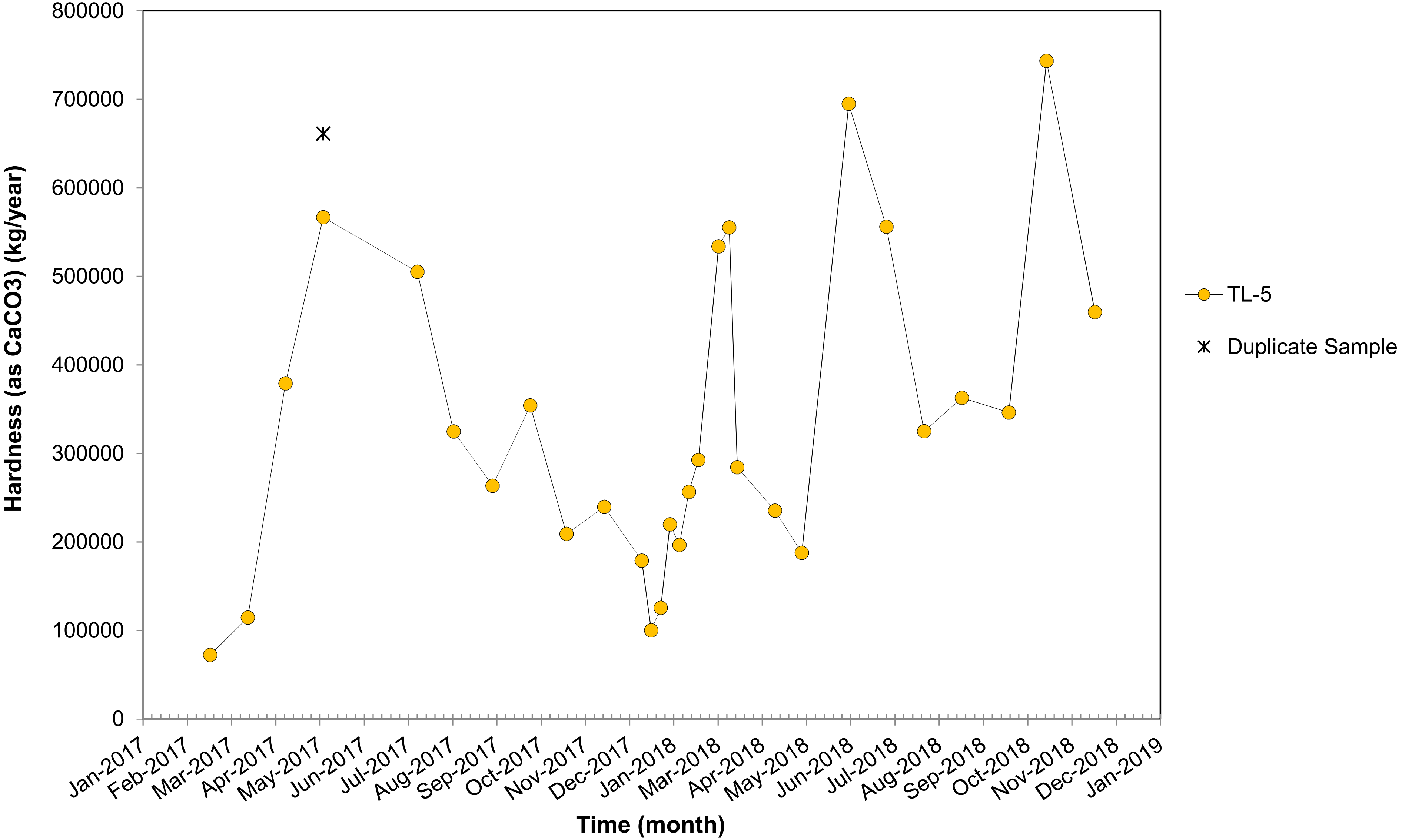
Detoxified Tailings (TL-7)					Metals															
Sample ID	**Station ID**	**Laboratory ID**	**Date Sampled**	**Laboratory**	**K**	**La**	**Li**	**Mg**	**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**	**S**	**Sb**	**Sc**	**Se**	**Sn**	**Sr**
				Unit>	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
				LOD>	**<100**	**<1**	**<2**	**<20**	**<1**	**<0.1**	**<50**	**<0.5**	**<50**	**<0.5**	**<1000**	**<0.1**	**<0.1**	**<0.2**	**<2**	**<0.5**
TL7-8JAN18	TL-7	L2043255-1	08/01/2018	ALS	1410		31	17900	1320	2.5	2720	185	427	528	92900	1.6		8.2	<2.0	25
TL7-4FEB18	TL-7	L2053211-1	04/02/2018	ALS	1510		30	14200	1100	2.0	1710	128	343	414	82600	1.3		6.9	<2.0	18
TL7-5MAR18	TL-7	L2064903-1	05/03/2018	ALS	910		20	15800	1220	1.3	1540	106	396	214	52900	0.66		4.0	<2.0	22
TL7-1APR18	TL-7	L2075124-1	01/04/2018	ALS	920		21	16600	1340	3.2	3100	240	374	606	166000	1.8		13	<2.0	21
TL7-10MAY18	TL-7	TJ5955	23/04/2018	Maxxam	1000	2.0		14800	1110	2.4	1790	181	340	472	>100000	1.4	8.5	10		19
TL7-18MAY18	TL-7	TL6515	06/05/2018	Maxxam	700	1.0		11400	1090	2.5	1790	175	350	274	>100000	1.1	7.1	11		18
TL7-5JULY18	TL-7	TU3759	13/06/2018	Maxxam	1100	2.0		12900	892	3.0	2420	214	340	614	>100000	1.3	7.6	8.9		17
TL7-7AUG18	TL-7	UA2531	15/07/2018	Maxxam	700	2.0		13700	1290	2.6	1170	231	300	189	>100000	1.2	7.3	7.1		23
TL7- 28AUG18	TL-7	UE2977	12/08/2018	Maxxam	600	1.0		12700	1270	2.7	2640	267	240	174	>100000	1.2	7.3	8.6		22
TL7-9SEP18	TL-7	UM9259	12/09/2018	Maxxam	500	1.0		9100	858	3.1	2510	415	270	429	>100000	1.7	5.3	18		16
TL7-1NOV18	TL-7	UR5531	15/10/2018	Maxxam	600	1.0		8900	832	3.1	2870	337	210	443	>100000	1.9	5.4	17		16
TL7-23NOV18	TL-7	UV5365	12/11/2018	Maxxam	500	1.0		9700	954	3.5	3500	329	240	323	>100000	1.4	5.2	17		17
TL7-20DEC18	TL-7	VA6221	10/12/2018	Maxxam	500	1.0		11100	1170	3.3	3150	241	350	283	>100000	0.9	6.4	15		22

Detoxified Tailings (TL-7)					Metals									Cyanides				
Sample ID	Station ID	Laboratory ID	Date Sampled	Laboratory	Te	Th	Ti	Tl	U	V	W	Zn	Zr	CN_WAD	CN_Total	CN_Free	Thiocyanate	Cyanate
				Unit>	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
				LOD>	<0.2	<0.1	<1	<0.05	<0.05	<0.2	<0.5	<2	<1	<0.05 - 20	<4	<0.05 - 20	<1	<1
TL7-8JAN18	TL-7	L2043255-1	08/01/2018	ALS			1070	1.3		82	2.0	2980	4.8	<13	2020	<13		
TL7-4FEB18	TL-7	L2053211-1	04/02/2018	ALS			1000	1.0	<0.050	65	1.3	1680	3.6	<20	3690	<20		
TL7-5MAR18	TL-7	L2064903-1	05/03/2018	ALS			614	0.42	0.054	52	0.74	974	3.3	<20	2260	<20		
TL7-1APR18	TL-7	L2075124-1	01/04/2018	ALS			380	1.5	0.098	51	2.5	2830	3.7	<20	2160	<20		
TL7-10MAY18	TL-7	TJ5955	23/04/2018	Maxxam	2.2	0.20	750	1.3	<0.10	60	1.3	2210		1144		5.6	1.1	46
TL7-18MAY18	TL-7	TL6515	06/05/2018	Maxxam	2.7	0.10	260	0.80	<0.10	33	1.0	1300		1545		3.1	935	73.7
TL7-5JULY18	TL-7	TU3759	13/06/2018	Maxxam	1.7	0.20	470	1.6	0.10	50	1.7	3350		1794		10	5338	310
TL7-7AUG18	TL-7	UA2531	15/07/2018	Maxxam	2.2	0.20	530	0.60	<0.10	52	1.6	1010		1240		0.65	1148	280
TL7- 28AUG18	TL-7	UE2977	12/08/2018	Maxxam	3.3	0.10	190	0.40	<0.10	40	1.5	613		712		0.58	928	318
TL7-9SEP18	TL-7	UM9259	12/09/2018	Maxxam	4.9	0.20	300	0.90	<0.10	34	2.8	1270		1924		15	2572	1099
TL7-1NOV18	TL-7	UR5531	15/10/2018	Maxxam	4.9	0.10	260	1.5	<0.10	32	2.9	2560		623		<0.50	1807	226
TL7-23NOV18	TL-7	UV5365	12/11/2018	Maxxam	5.7	0.10	110	0.60	<0.10	19	2.1	1390		482		<0.50	1567	433
TL7-20DEC18	TL-7	VA6221	10/12/2018	Maxxam	4.5	0.10	90	0.40	<0.10	23	1.9	923		669		<0.50	910	299

Attachment C – TL-11 Geochemical Data

Parameter	Units	Sample ID	TL11-28JUN18	TL11A-17DEC18	TL11B-17DEC18	TL11B-DUP	BLANKF
		ALS ID	L2121770-1	L2211631-1	L2211631-2	L2211631-3	L2211631-4
		Date Sampled	28/06/2018 13:50	17/12/2018 11:25	17/12/2018 11:55	17/12/2018 11:55	17/12/2018 12:10
		Detection Limit	Water	Water	Water	Water	Water
Conductivity	uS/cm	2	99200	102000	91800	92200	<2
Hardness (as $CaCO_3$)	mg/L	0.5	42800	40000	36900	36100	<0.5
pH	pH	0.1	7	6.88	6.91	6.90	5.41
Total Suspended Solids	mg/L	3	319	42000	219	282	<3
Total Dissolved Solids	mg/L	10	83300	79800	73400	73300	<10
Acidity (as $CaCO_3$)	mg/L	1	106	201	123	124	2.10
Alkalinity, Total (as $CaCO_3$)	mg/L	1	40	229	59.8	62.8	<1
Ammonia, Total (as N)	mg/L	0.005	224	378	228	228	<0.005
Chloride (Cl)	mg/L	0.5	43300	46900	40200	40800	<0.5
Nitrate (as N)	mg/L	0.005	485	517	515	523	<0.005
Nitrite (as N)	mg/L	0.001	3	17.6	1.59	1.64	<0.001
Sulfate (SO_4)	mg/L	0.3	858	1010	891	919	<0.3
Cyanide, Total	mg/L	0.005	0.0199	1.1	0.0067	0.0093	<0.005
Cyanide, Weak Acid Diss	mg/L	0.005	<0.005	0.0167	<0.005	<0.005	<0.005
Cyanide, Free	mg/L	0.005	0.007	0.0097	<0.005	<0.005	<0.005
Aluminum (Al)-Total	mg/L	0.003	<0.15	806	0.34	4.78	<0.003
Antimony (Sb)-Total	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Arsenic (As)-Total	mg/L	0.0001	<0.005	2.54	0.0052	0.019	<0.0001
Barium (Ba)-Total	mg/L	0.0001	0.319	1.04	0.214	0.22	<0.0001
Beryllium (Be)-Total	mg/L	0.0001	<0.005	0.0057	<0.005	<0.005	<0.0001
Bismuth (Bi)-Total	mg/L	0.00005	#N/A	0.0131	<0.0025	<0.0025	<0.00005
Boron (B)-Total	mg/L	0.01	3	4.86	2.94	2.99	<0.01
Cadmium (Cd)-Total	mg/L	0.000005	0.033	0.0419	0.0405	0.041	<0.000005
Calcium (Ca)-Total	mg/L	0.05	14300	14900	10900	10500	<0.05
Cesium (Cs)-Total	mg/L	0.00001	#N/A	0.00833	0.00403	0.0041	<0.00001
Chromium (Cr)-Total	mg/L	0.0001	<0.005	2.4	<0.005	0.0081	<0.0001
Cobalt (Co)-Total	mg/L	0.0001	0.230	2.18	0.346	0.36	<0.0001
Copper (Cu)-Total	mg/L	0.0005	1	44.5	0.854	1.48	<0.0005
Iron (Fe)-Total	mg/L	0.01	<0.5	2560	1.13	17.8	<0.01
Lead (Pb)-Total	mg/L	0.00005	0.164	2.85	0.145	0.39	<0.00005
Lithium (Li)-Total	mg/L	0.001	0.337	1.06	0.351	0.36	<0.001
Magnesium (Mg)-Total	mg/L	0.005	1650	2670	1640	1620	<0.005
Manganese (Mn)-Total	mg/L	0.0001	9	57.9	10.6	10.6	<0.0001
Molybdenum (Mo)-Total	mg/L	0.00005	0.017	0.163	0.0164	0.016	<0.00005
Nickel (Ni)-Total	mg/L	0.0005	0.364	2.58	0.506	0.51	<0.0005
Phosphorus (P)-Total	mg/L	0.05	#N/A	21.5	<2.5	<2.5	<0.05
Potassium (K)-Total	mg/L	0.05	572	657	507	497	<0.05
Rubidium (Rb)-Total	mg/L	0.0002	#N/A	0.376	0.345	0.33	<0.0002
Selenium (Se)-Total	mg/L	0.00005	0.013	0.0546	0.0155	0.018	<0.00005
Silicon (Si)-Total	mg/L	0.1	#N/A	454	<5	11.3	<0.1
Silver (Ag)-Total	mg/L	0.00001	0.037	0.121	0.0265	0.028	<0.00001
Sodium (Na)-Total	mg/L	0.05	11300	13600	10700	10600	<0.05
Strontium (Sr)-Total	mg/L	0.0002	#N/A	38	28.6	27.6	<0.0002
Sulfur (S)-Total	mg/L	0.5	#N/A	1370	624	649	<0.5
Tellurium (Te)-Total	mg/L	0.0002	#N/A	0.024	<0.01	<0.010	<0.0002
Thallium (Tl)-Total	mg/L	0.00001	0.00073	0.00445	0.00081	0.00068	<0.00001
Thorium (Th)-Total	mg/L	0.0001	#N/A	0.006	<0.005	<0.0050	<0.0001
Tin (Sn)-Total	mg/L	0.0001	<0.005	0.0234	<0.005	<0.0050	<0.0001
Titanium (Ti)-Total	mg/L	0.0003	<0.015	15.1	0.019	0.26	<0.0003
Tungsten (W)-Total	mg/L	0.0001	#N/A	0.0155	<0.005	<0.005	<0.0001
Uranium (U)-Total	mg/L	0.00001	0.004	0.0048	0.00437	0.0043	<0.00001
Vanadium (V)-Total	mg/L	0.0005	<0.025	2.75	<0.025	0.037	<0.0005
Zinc (Zn)-Total	mg/L	0.003	2	13.6	3.41	3.46	<0.003
Zirconium (Zr)-Total	mg/L	0.00006	#N/A	0.0071	<0.003	<0.003	<0.00006
Aluminum (Al)-Dissolved	mg/L	0.001	<0.05	0.125	0.05	<0.05	<0.001
Antimony (Sb)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Arsenic (As)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Barium (Ba)-Dissolved	mg/L	0.0001	0.31	0.596	0.245	0.26	<0.0001
Beryllium (Be)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Bismuth (Bi)-Dissolved	mg/L	0.00005	<0.0025	<0.0025	<0.0025	<0.0025	<0.00005
Boron (B)-Dissolved	mg/L	0.01	2.85	3.65	2.94	2.89	<0.01
Cadmium (Cd)-Dissolved	mg/L	0.000005	0.03	0.021	0.0446	0.0455	<0.000005
Calcium (Ca)-Dissolved	mg/L	0.05	14500	13100	12100	11900	<0.05
Cesium (Cs)-Dissolved	mg/L	0.00001	0.005	<0.0005	0.00422	0.0045	<0.00001
Chromium (Cr)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Cobalt (Co)-Dissolved	mg/L	0.0001	0.216	0.0452	0.344	0.35	<0.0001
Copper (Cu)-Dissolved	mg/L	0.0002	0.540	0.34	0.838	0.84	<0.0002
Iron (Fe)-Dissolved	mg/L	0.01	<0.5	<0.5	<0.5	0.75	<0.01
Lead (Pb)-Dissolved	mg/L	0.00005	0.168	0.0046	0.15	0.15	<0.00005
Lithium (Li)-Dissolved	mg/L	0.001	0.353	0.268	0.353	0.35	<0.001
Magnesium (Mg)-Dissolved	mg/L	0.005	1620	1780	1630	1560	<0.005
Manganese (Mn)-Dissolved	mg/L	0.0001	9	9.81	11.1	11	<0.0001
Molybdenum (Mo)-Dissolved	mg/L	0.00005	0.018	0.051	0.0207	0.019	<0.00005
Nickel (Ni)-Dissolved	mg/L	0.0005	0.346	0.197	0.499	0.50	<0.0005
Phosphorus (P)-Dissolved	mg/L	0.05	<2.5	<2.5	<2.5	<2.5	<0.05
Potassium (K)-Dissolved	mg/L	0.05	550	604	524	521	<0.05
Rubidium (Rb)-Dissolved	mg/L	0.0002	0.390	0.31	0.379	0.374	<0.0002
Selenium (Se)-Dissolved	mg/L	0.00005	0.022	0.0083	0.0432	0.034	<0.00005
Silicon (Si)-Dissolved	mg/L	0.05	<2.5	<2.5	2.7	2.6	<0.05
Silver (Ag)-Dissolved	mg/L	0.00001	0.040	0.018	0.031	0.031	<0.00001
Sodium (Na)-Dissolved	mg/L	0.05	11100	12300	10700	10400	<0.05
Strontium (Sr)-Dissolved	mg/L	0.0002	32	38.4	34.2	34.2	<0.0002
Sulfur (S)-Dissolved	mg/L	0.5	534	490	593	598	<0.5
Tellurium (Te)-Dissolved	mg/L	0.0002	<0.01	<0.01	<0.01	<0.01	<0.0002
Thallium (Tl)-Dissolved	mg/L	0.00001	0.0009	0.00067	0.00084	< 0.001	<0.00001
Thorium (Th)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Tin (Sn)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Titanium (Ti)-Dissolved	mg/L	0.0003	<0.015	<0.015	<0.015	<0.015	<0.0003
Tungsten (W)-Dissolved	mg/L	0.0001	<0.005	<0.005	<0.005	<0.005	<0.0001
Uranium (U)-Dissolved	mg/L	0.00001	0.0047	0.00295	0.00498	0.00497	<0.00001
Vanadium (V)-Dissolved	mg/L	0.0005	<0.025	<0.025	<0.025	<0.025	<0.0005
Zinc (Zn)-Dissolved	mg/L	0.001	1.870	0.234	3.6	3.63	<0.001
Zirconium (Zr)-Dissolved	mg/L	0.00006	<0.003	<0.003	<0.003	<0.003	<0.00006

Attachment D – TL-5 Loading Charts



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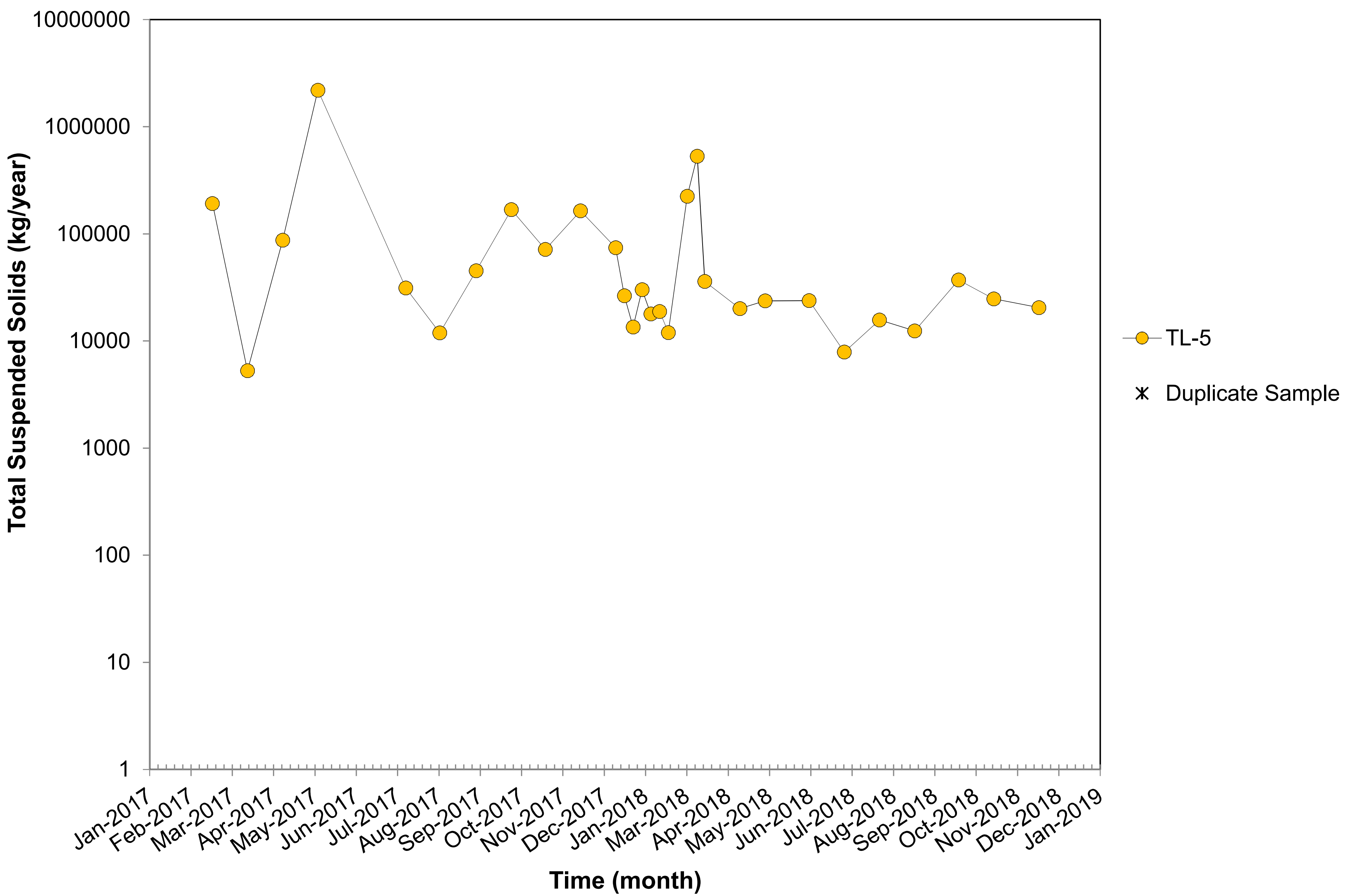

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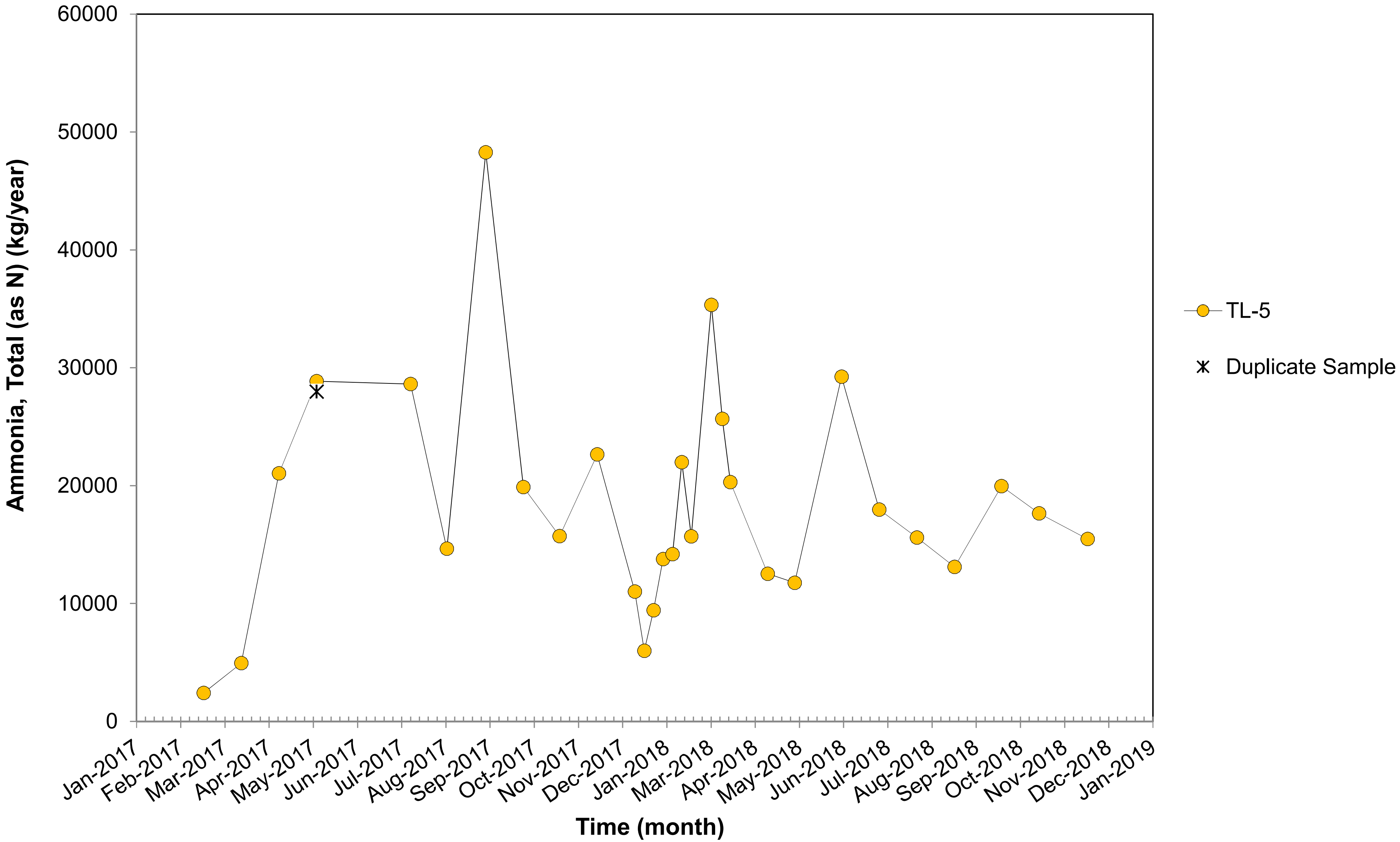

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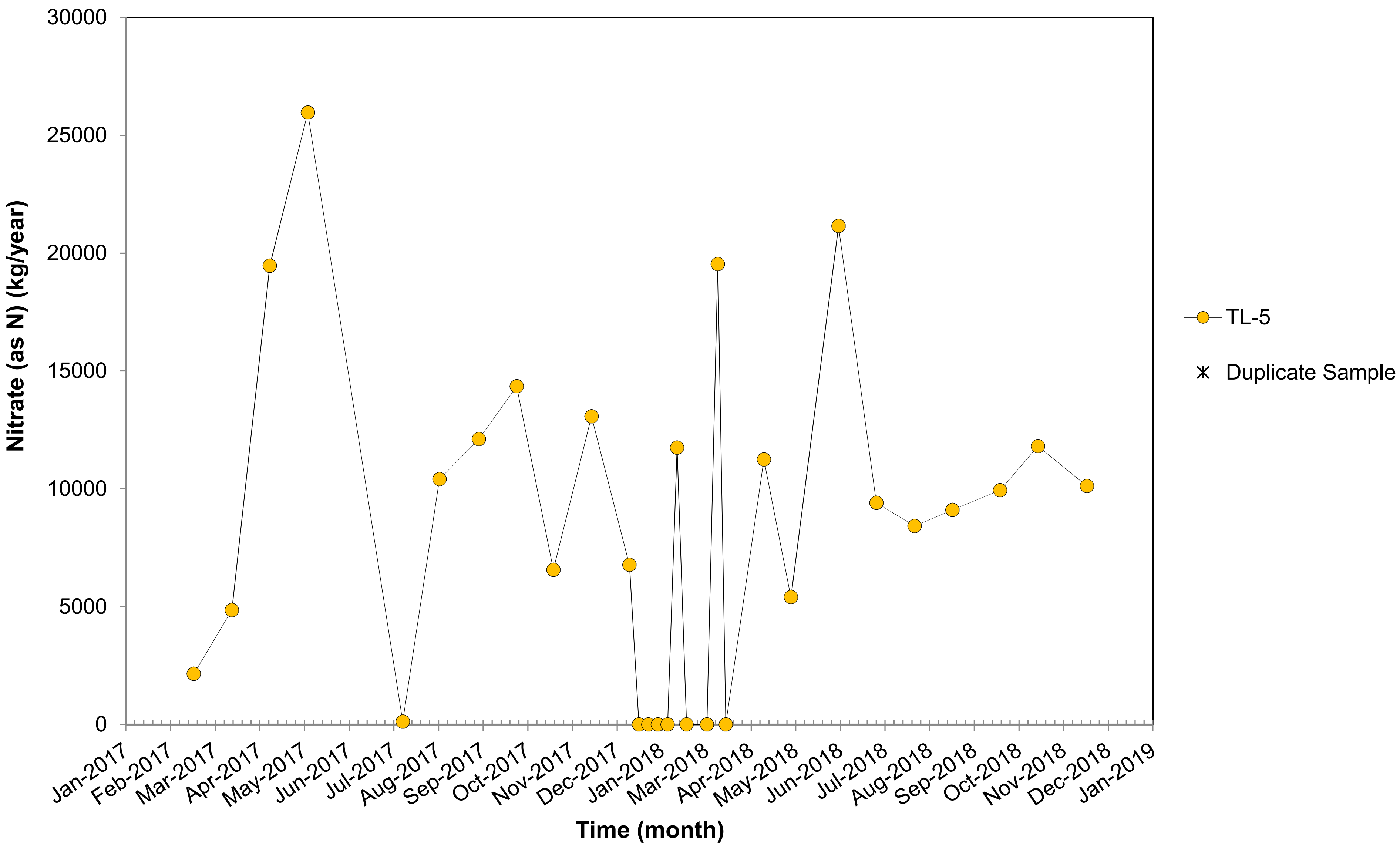

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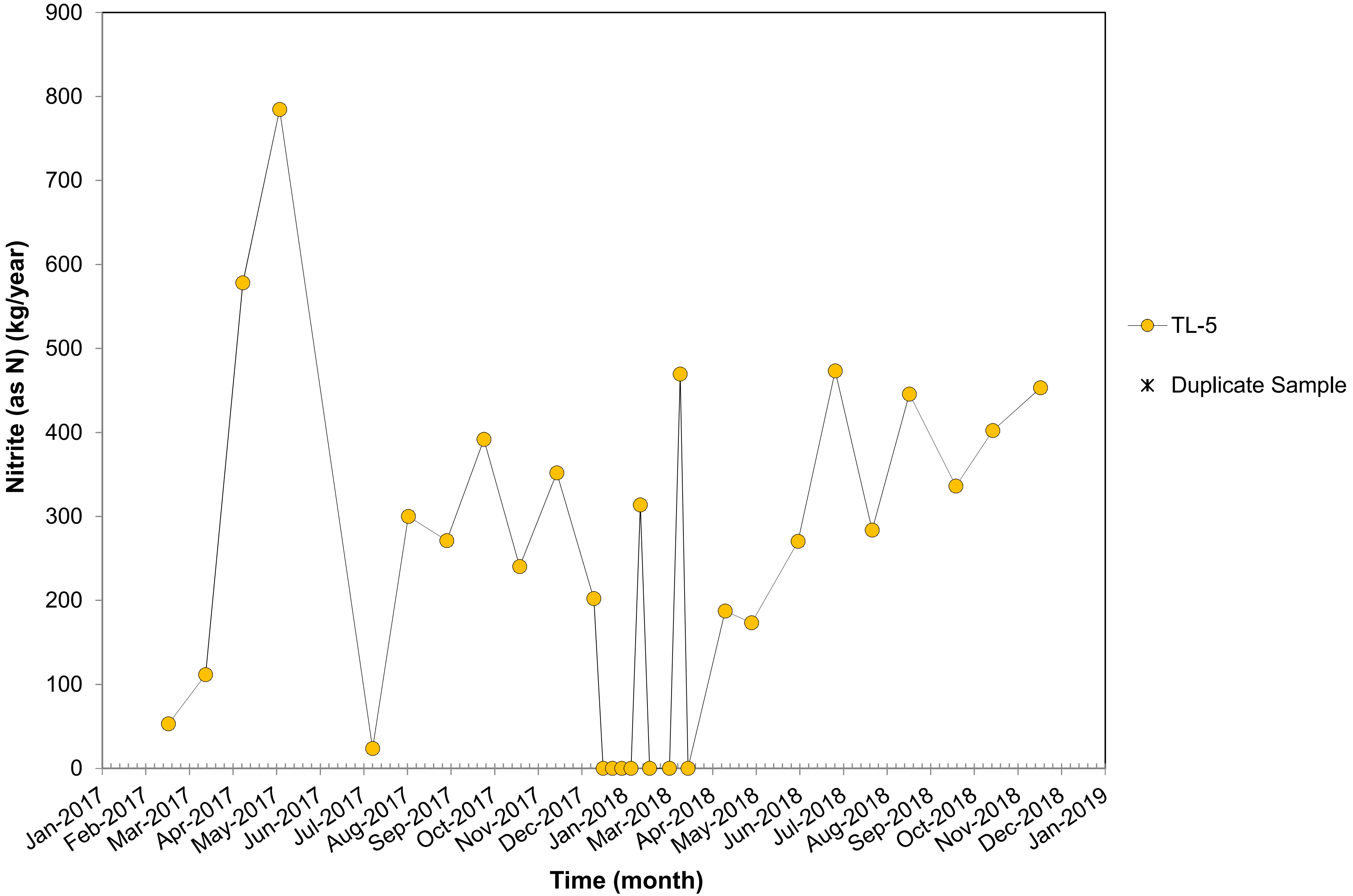

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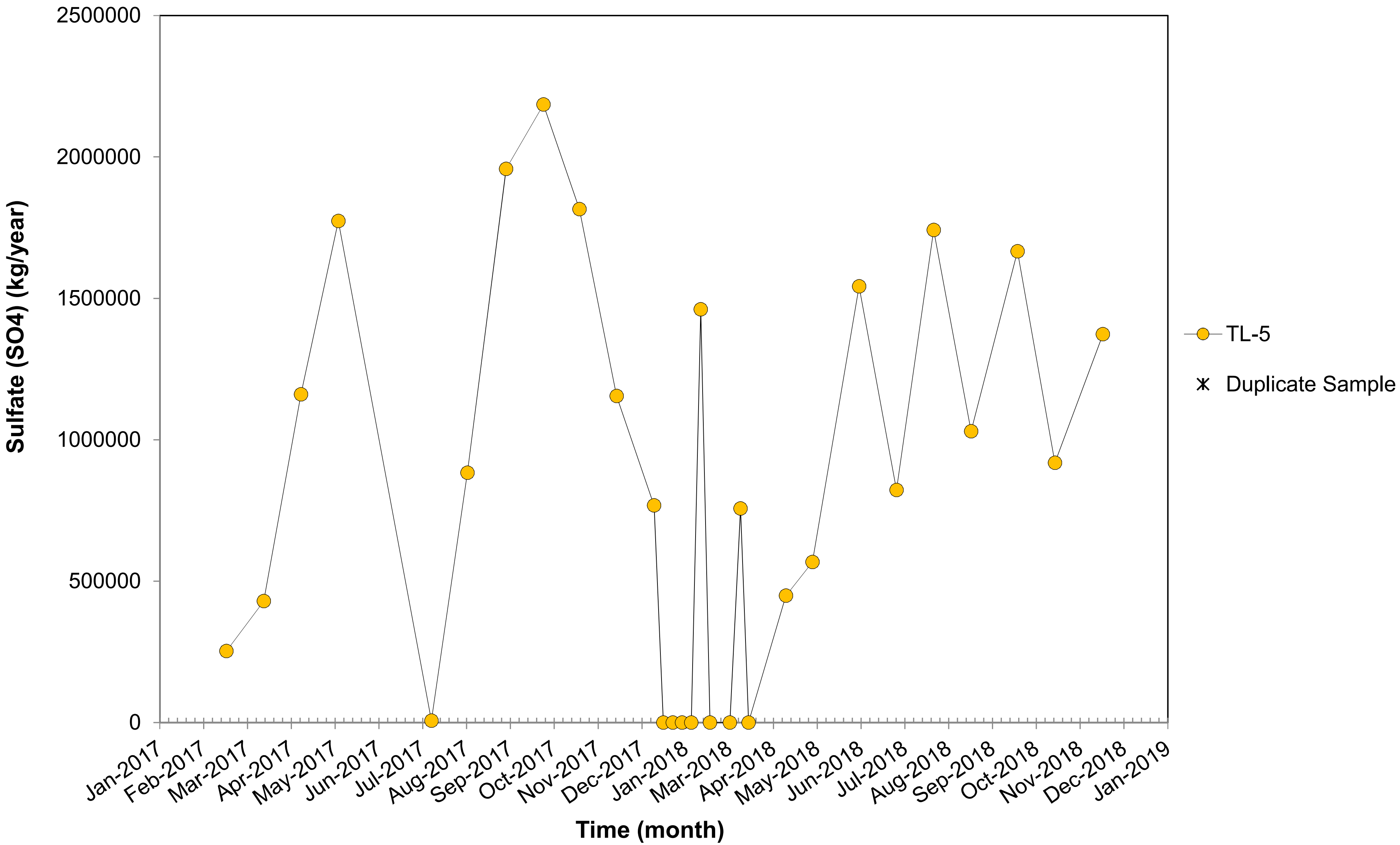

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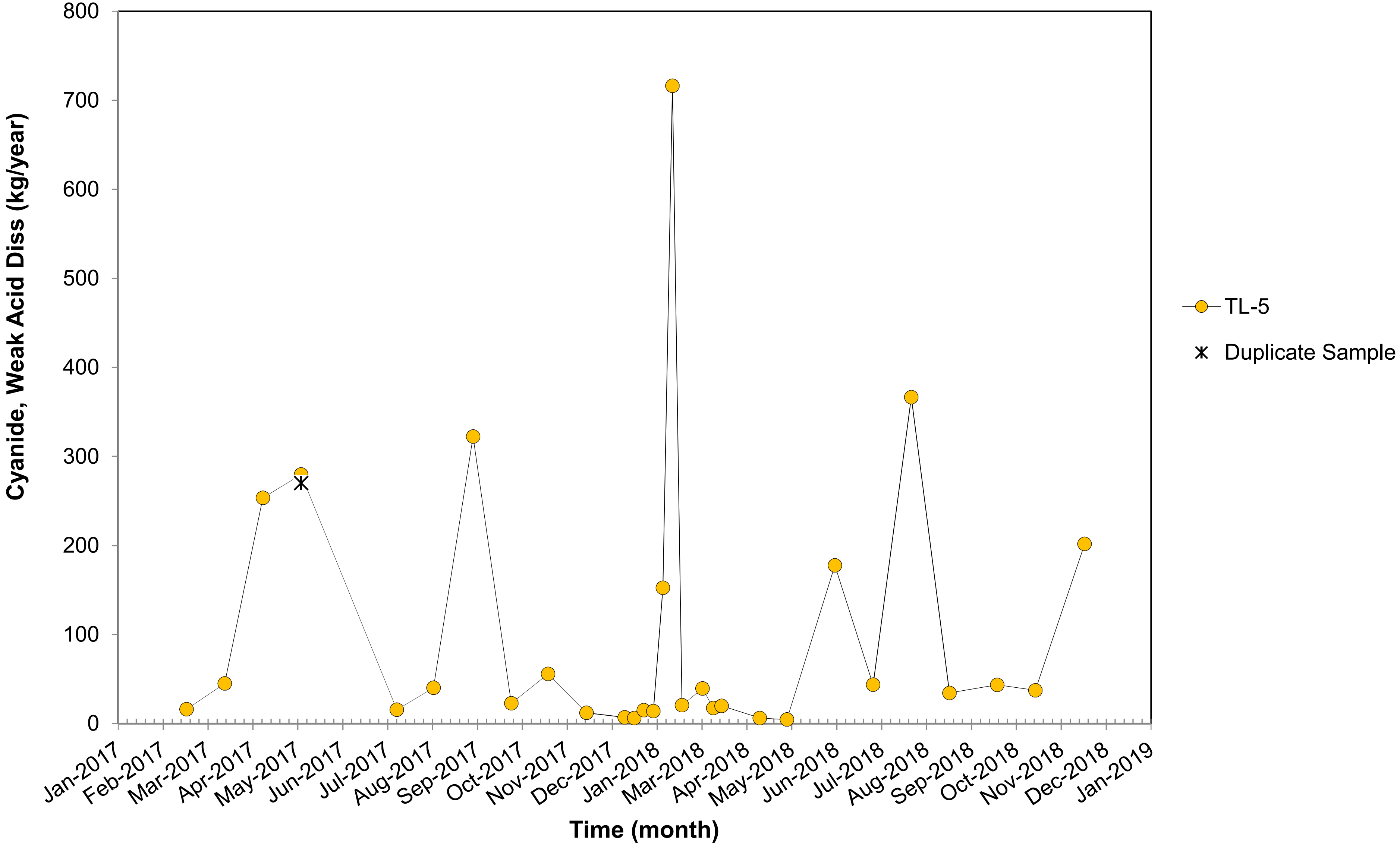

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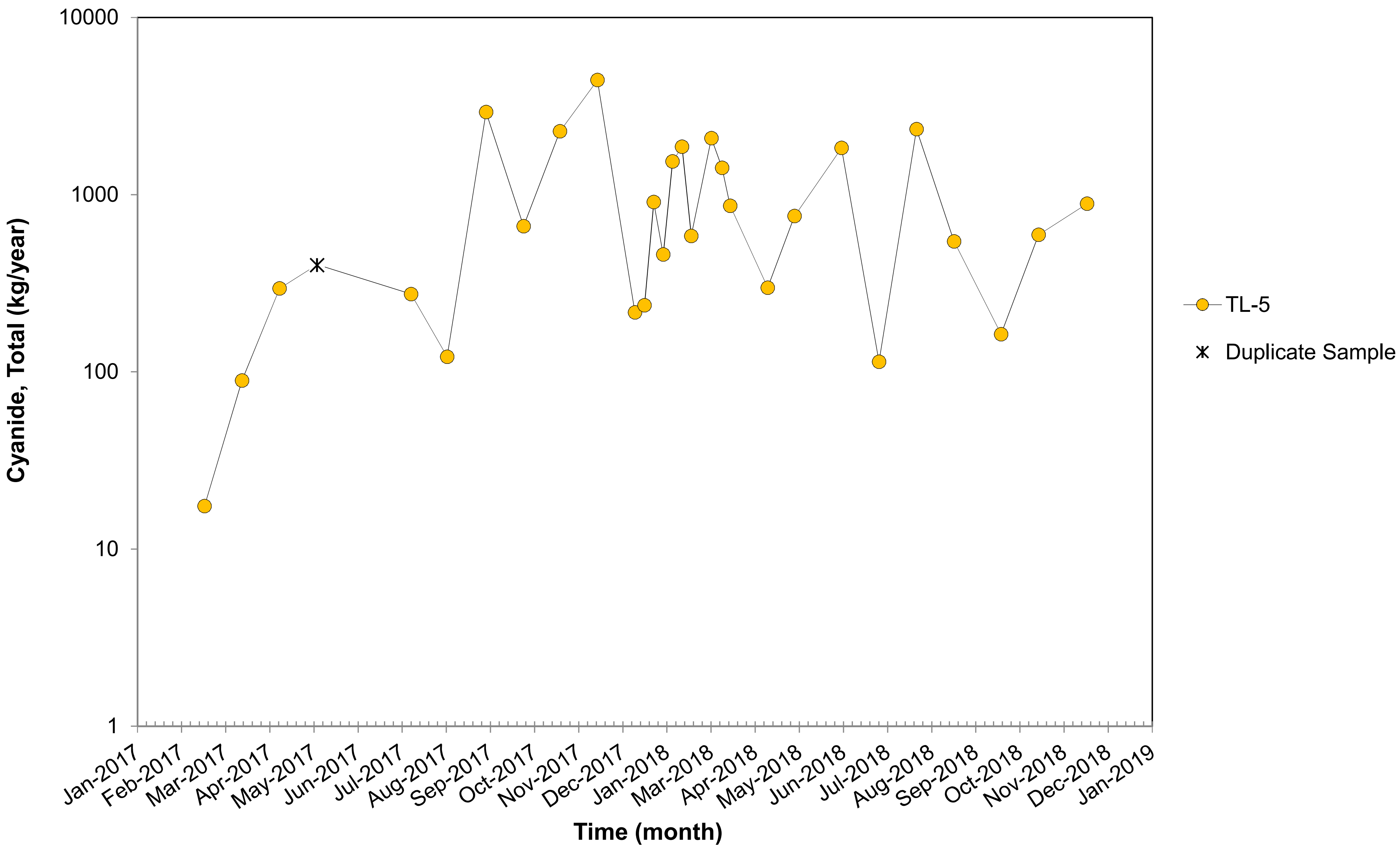

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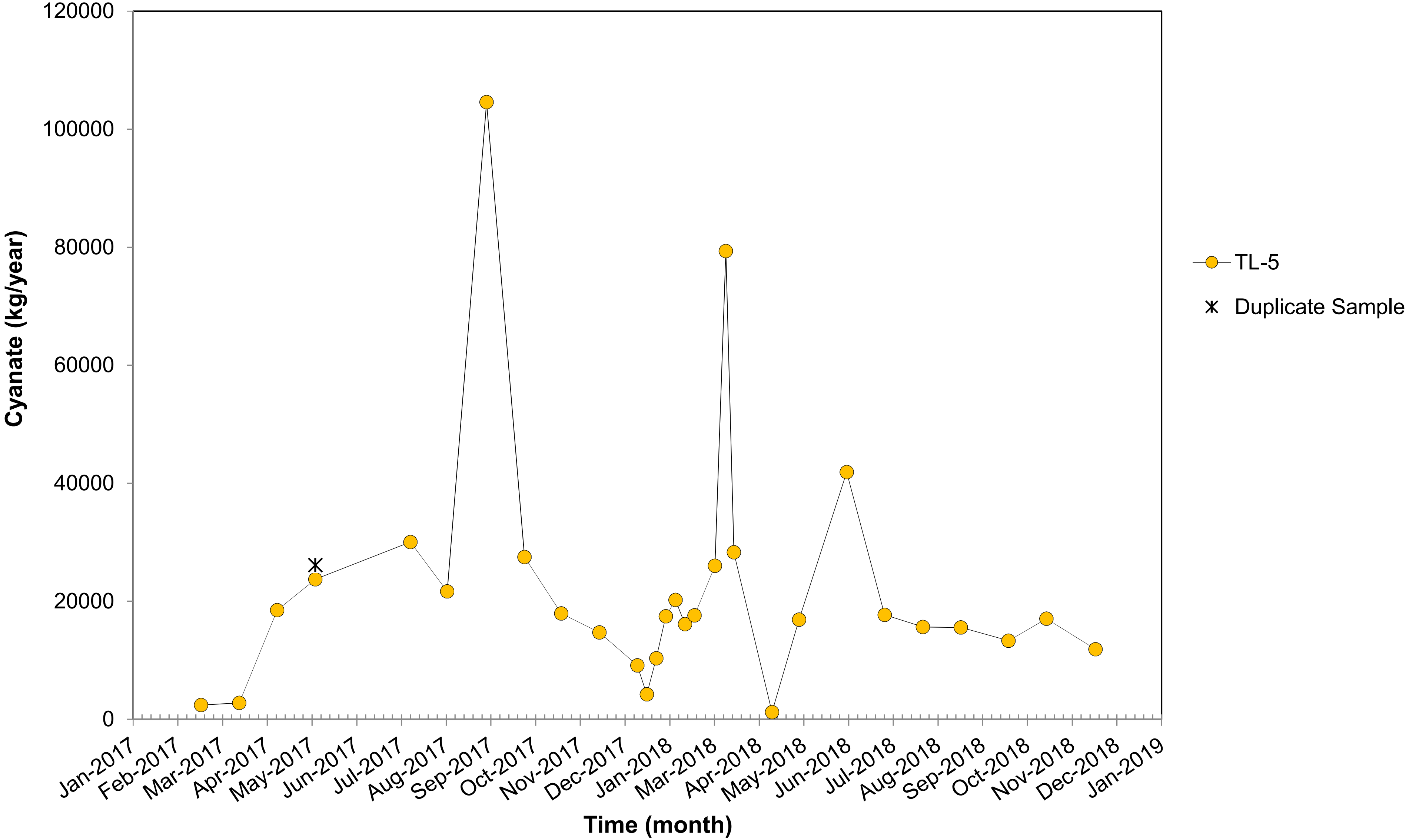

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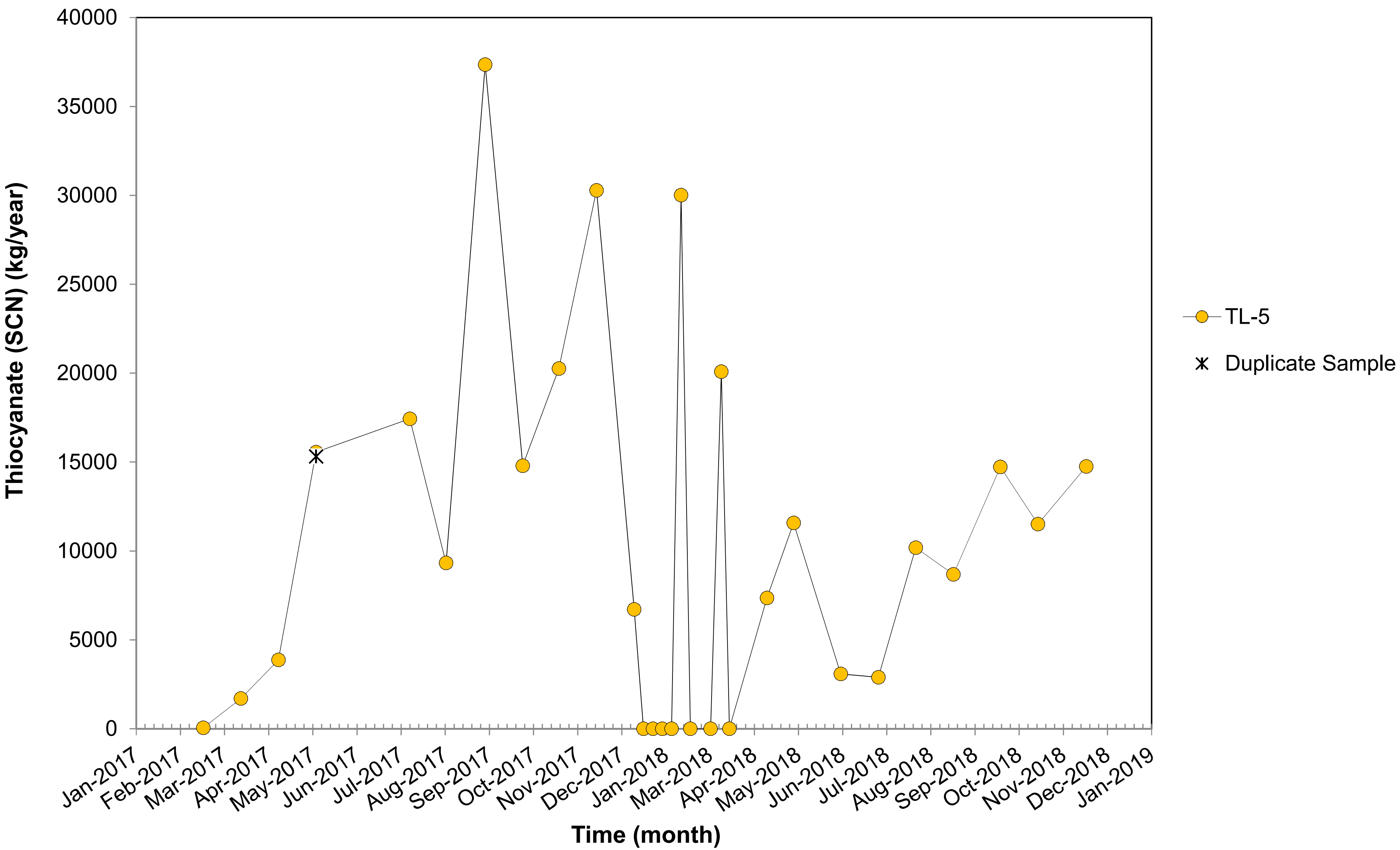

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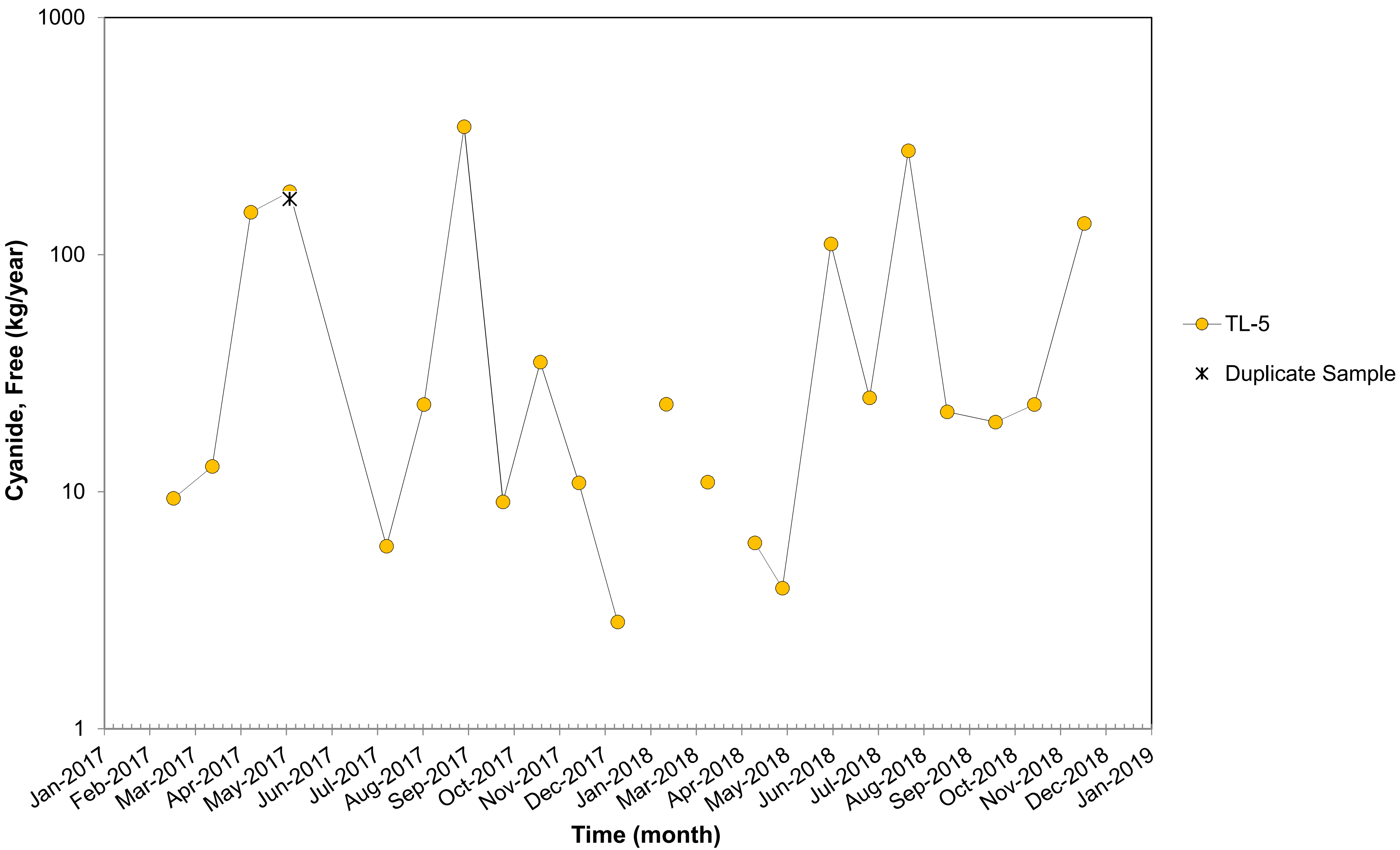

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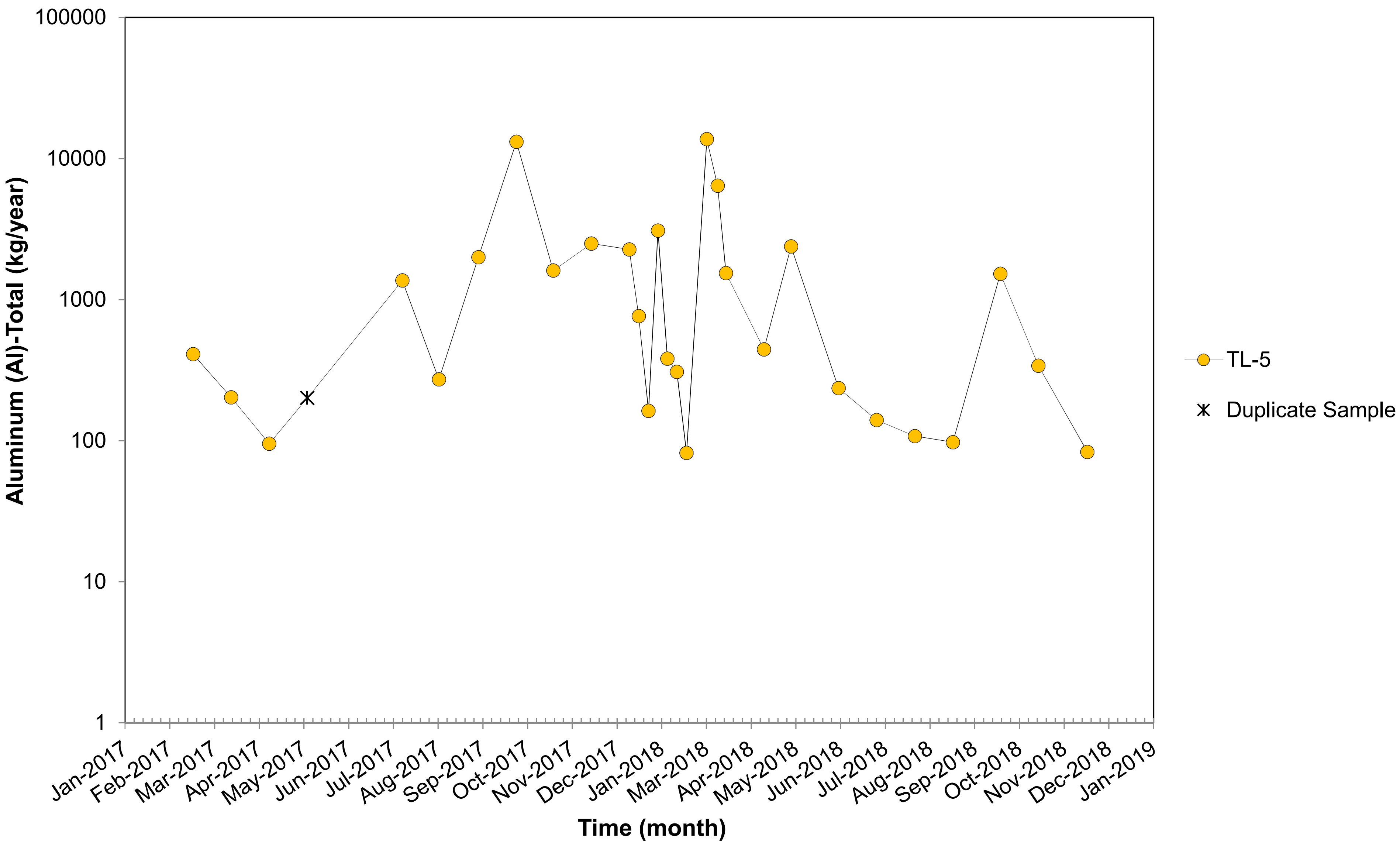

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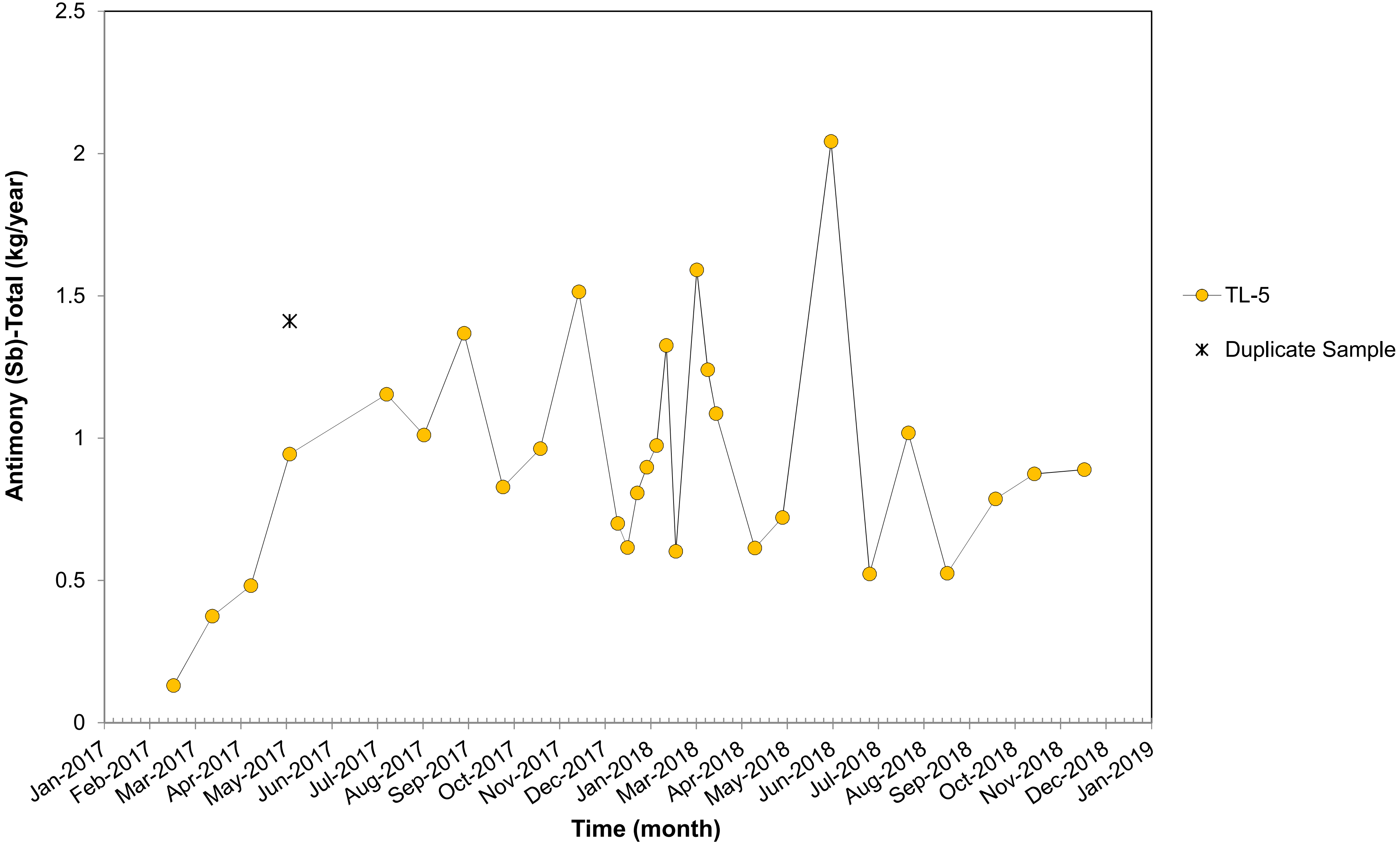

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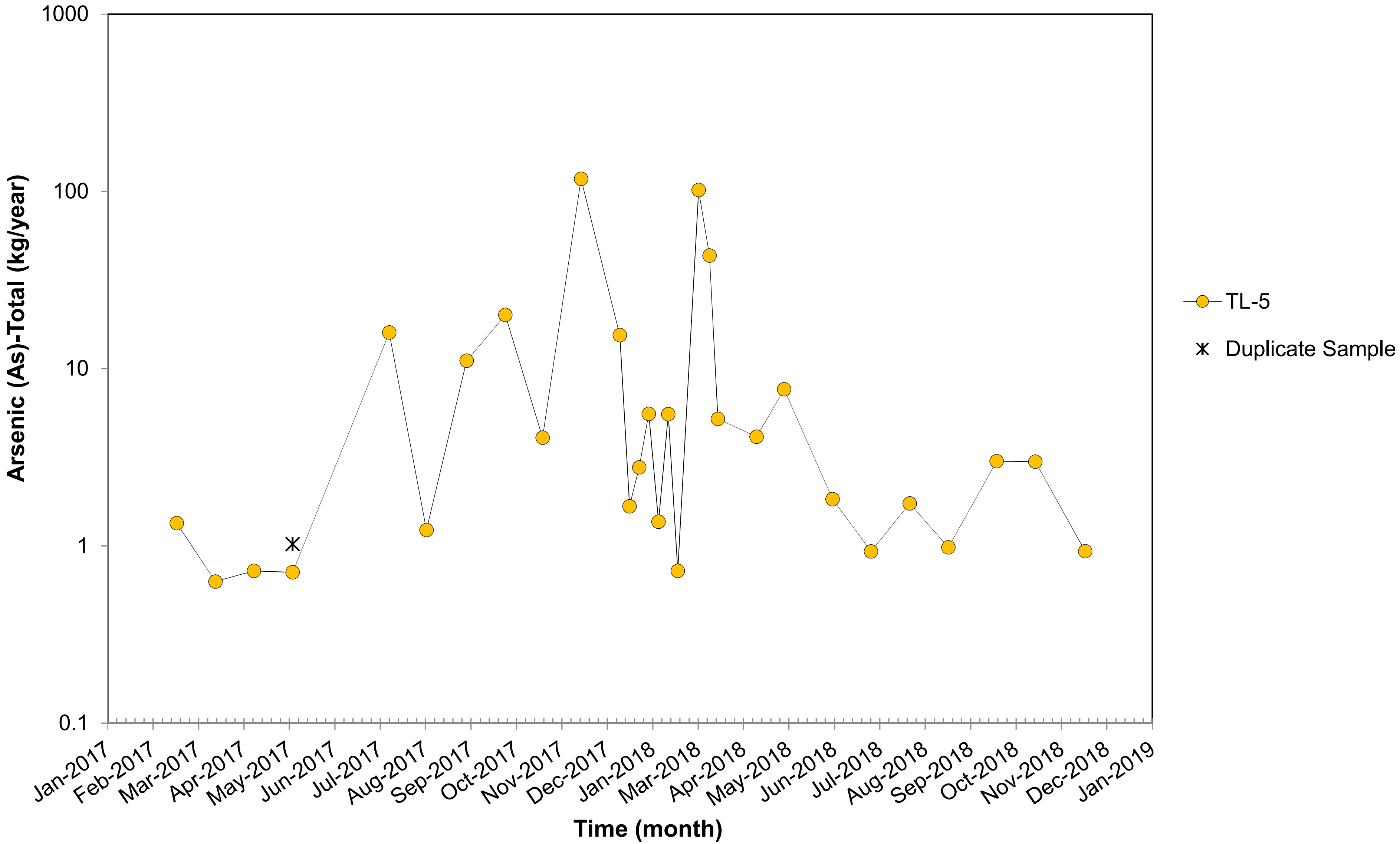

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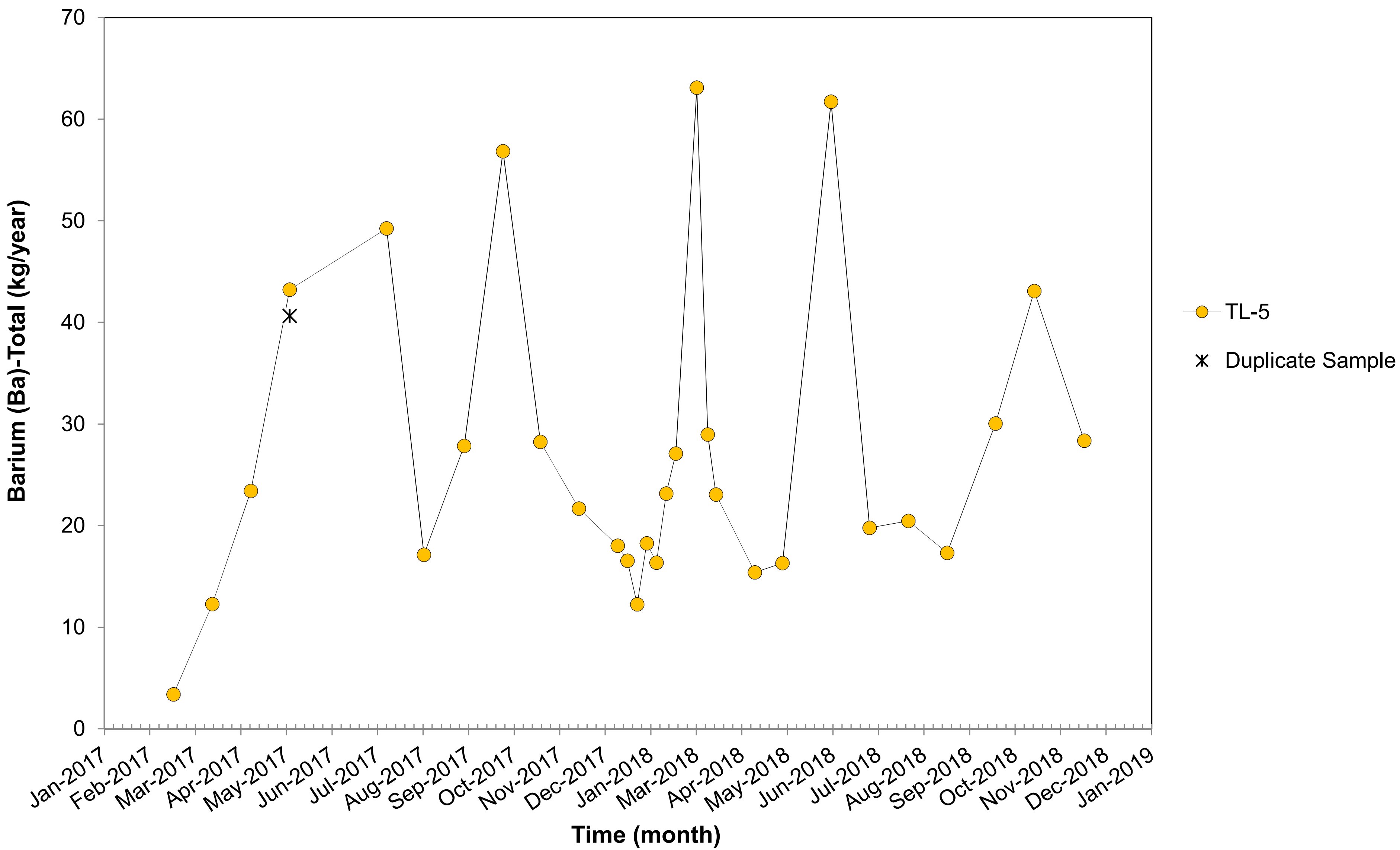

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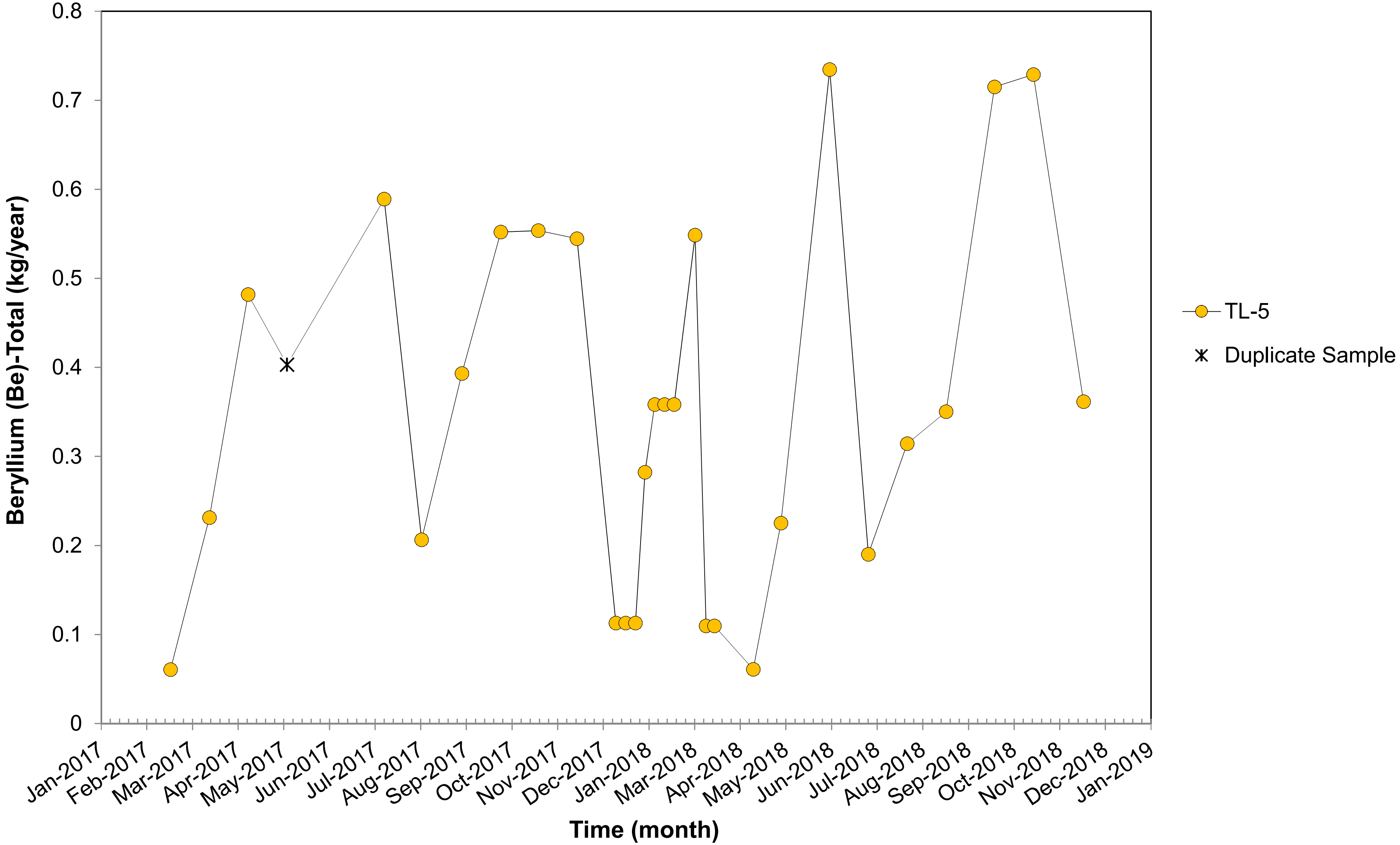

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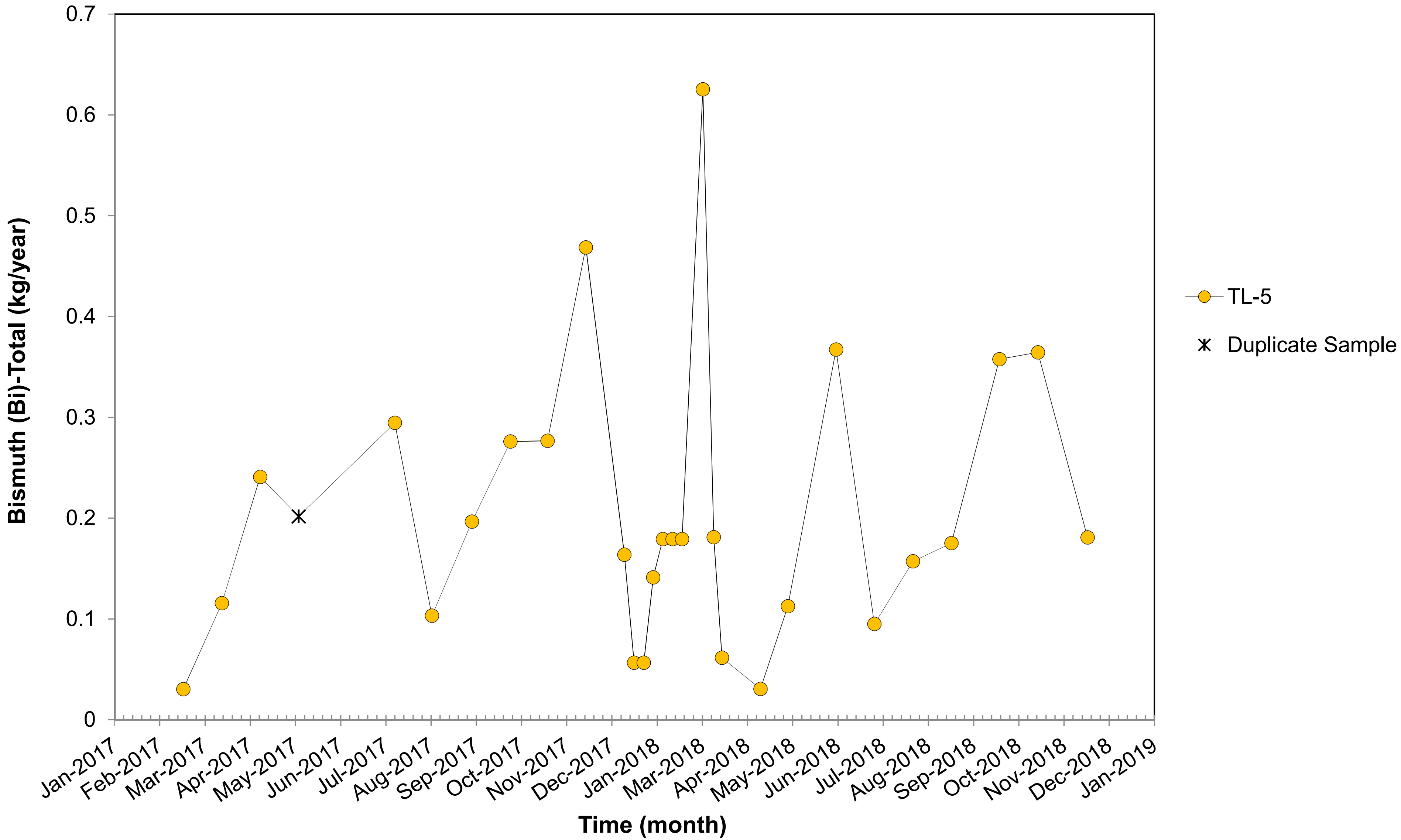

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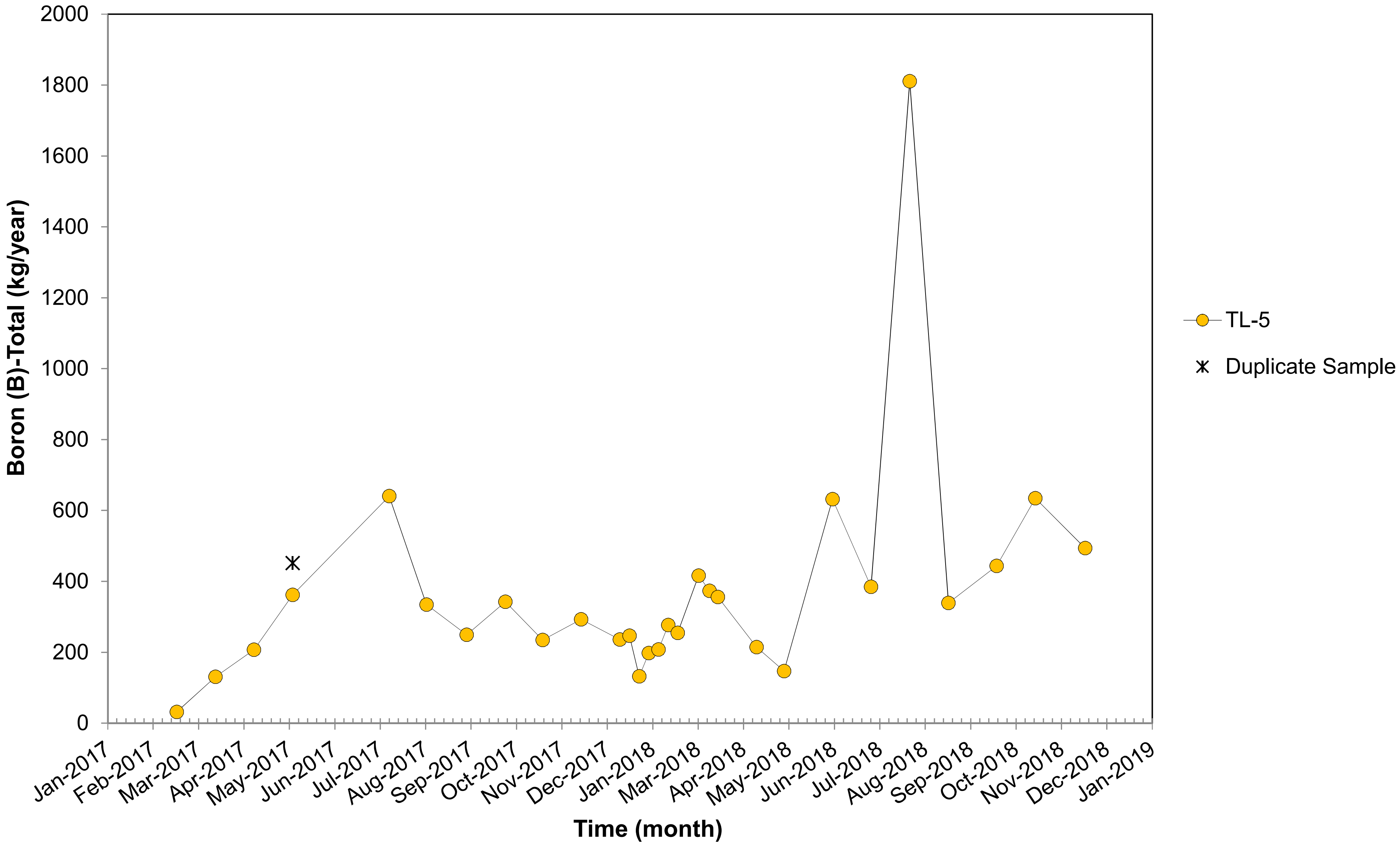

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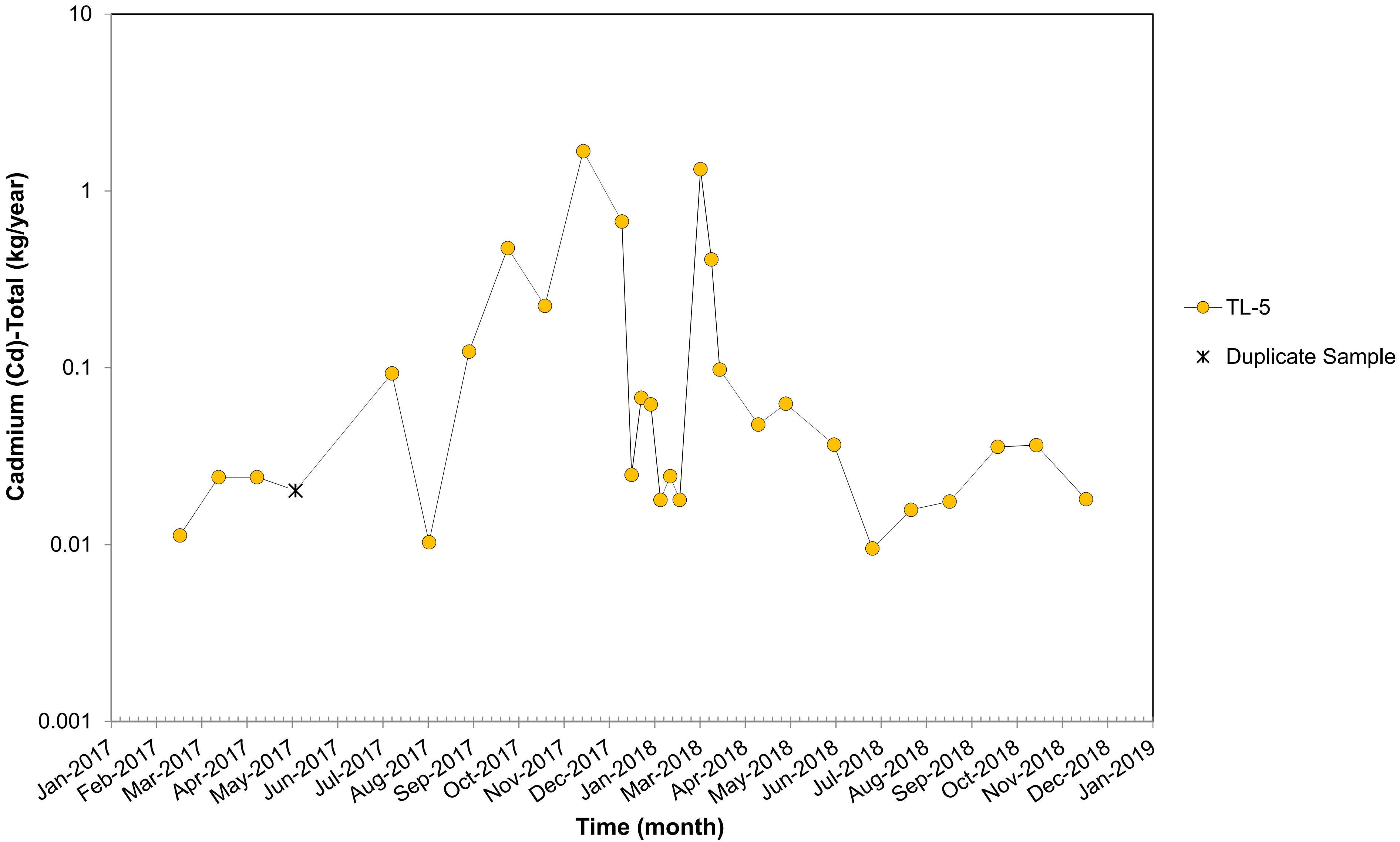

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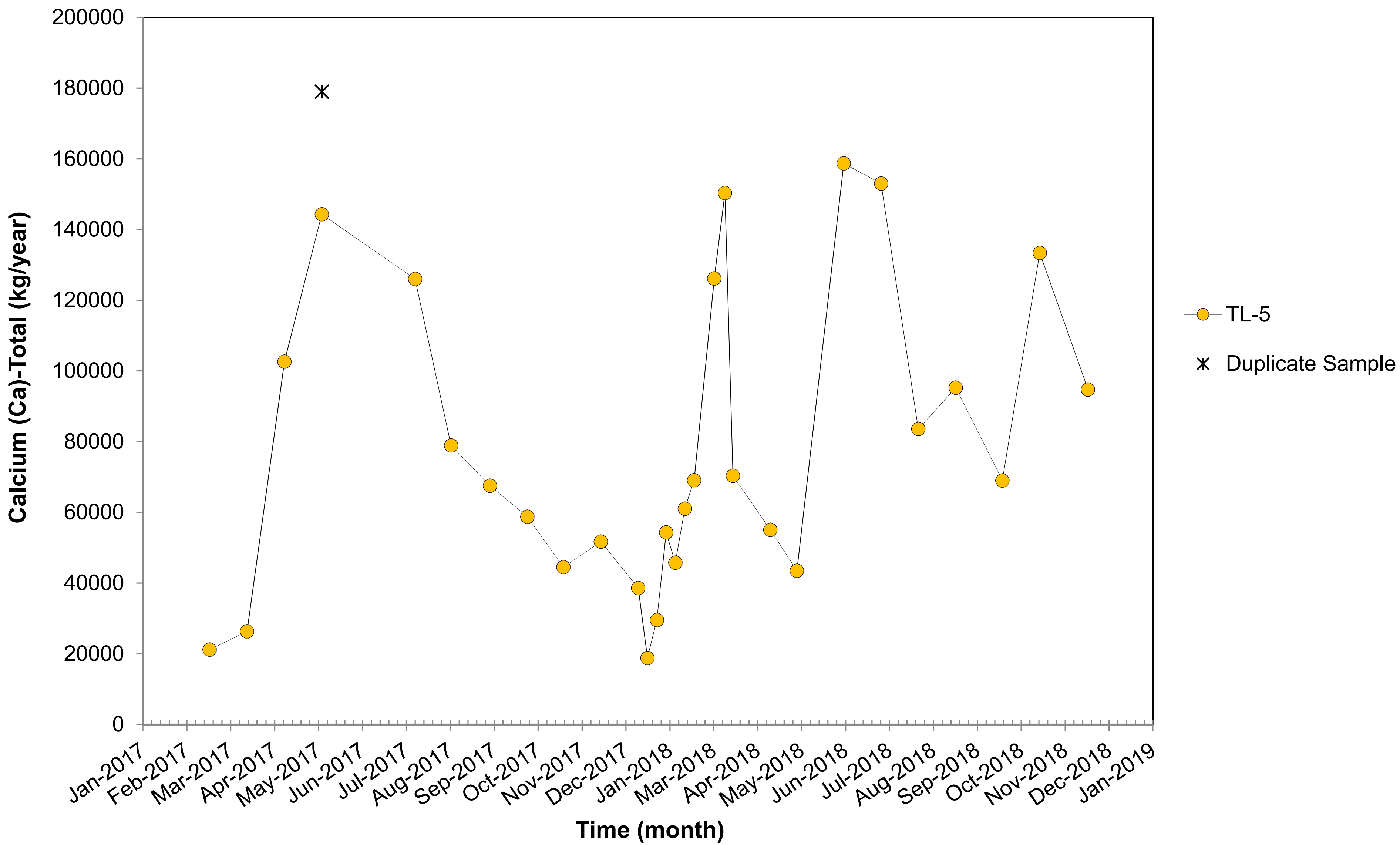

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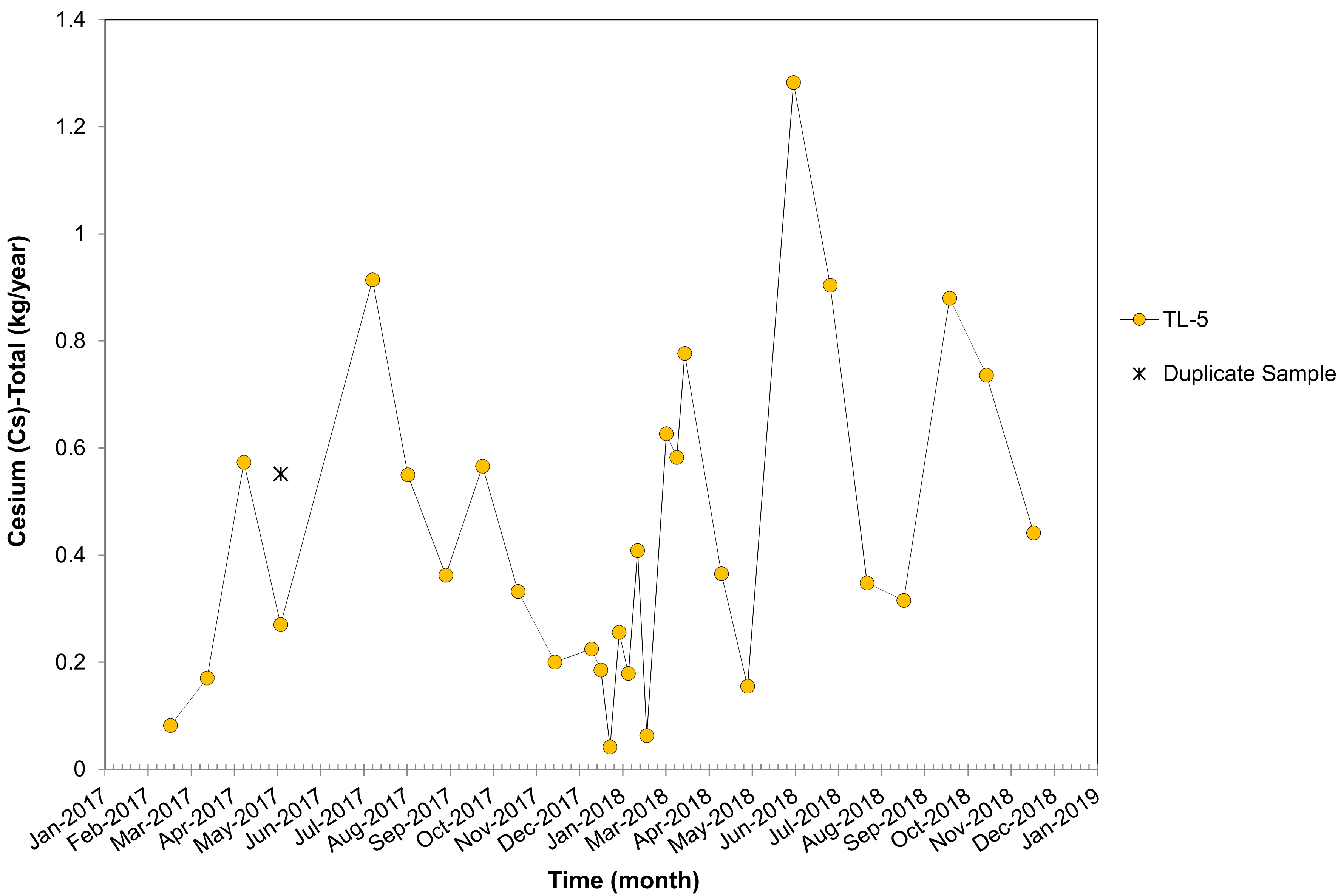

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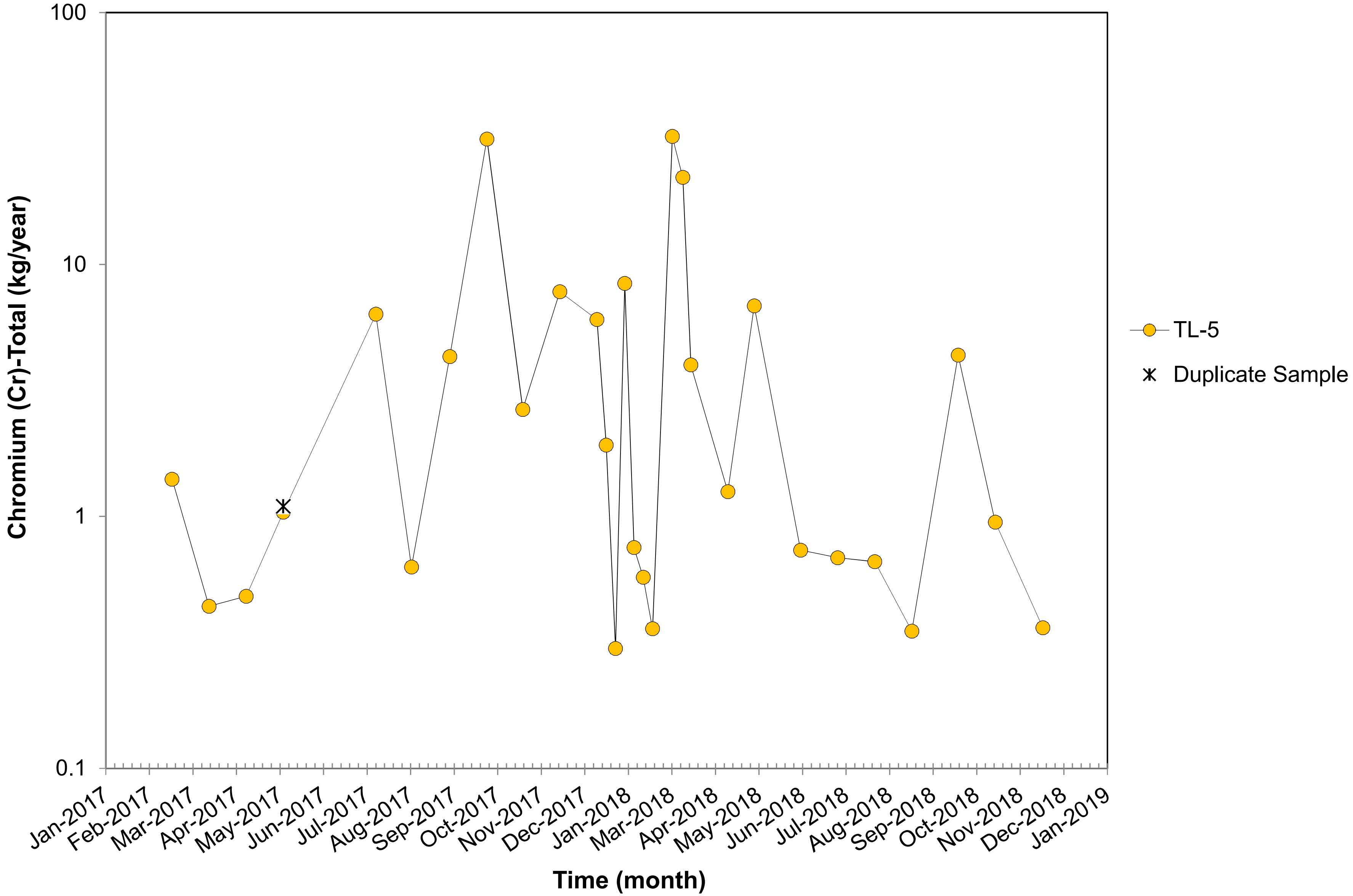

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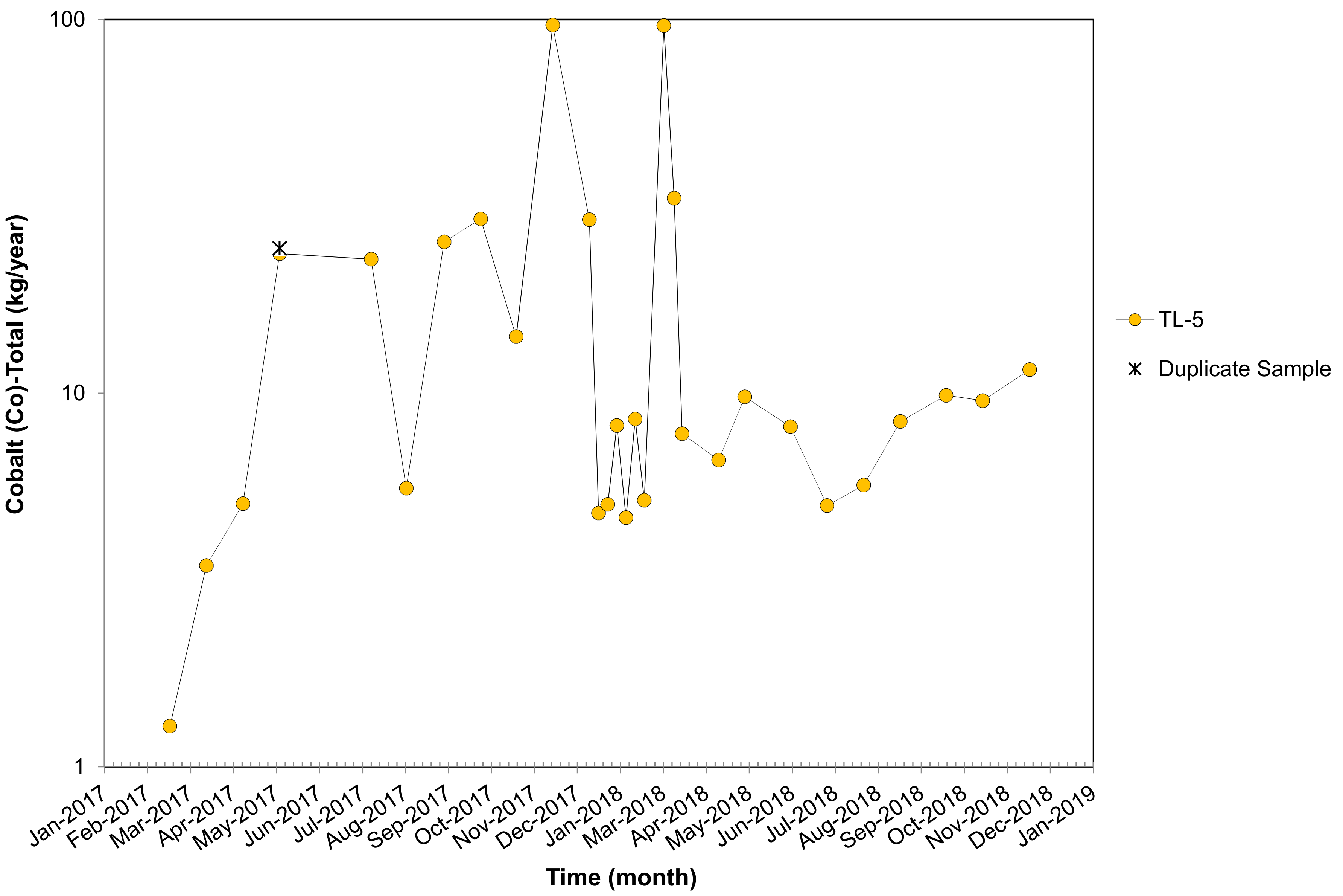

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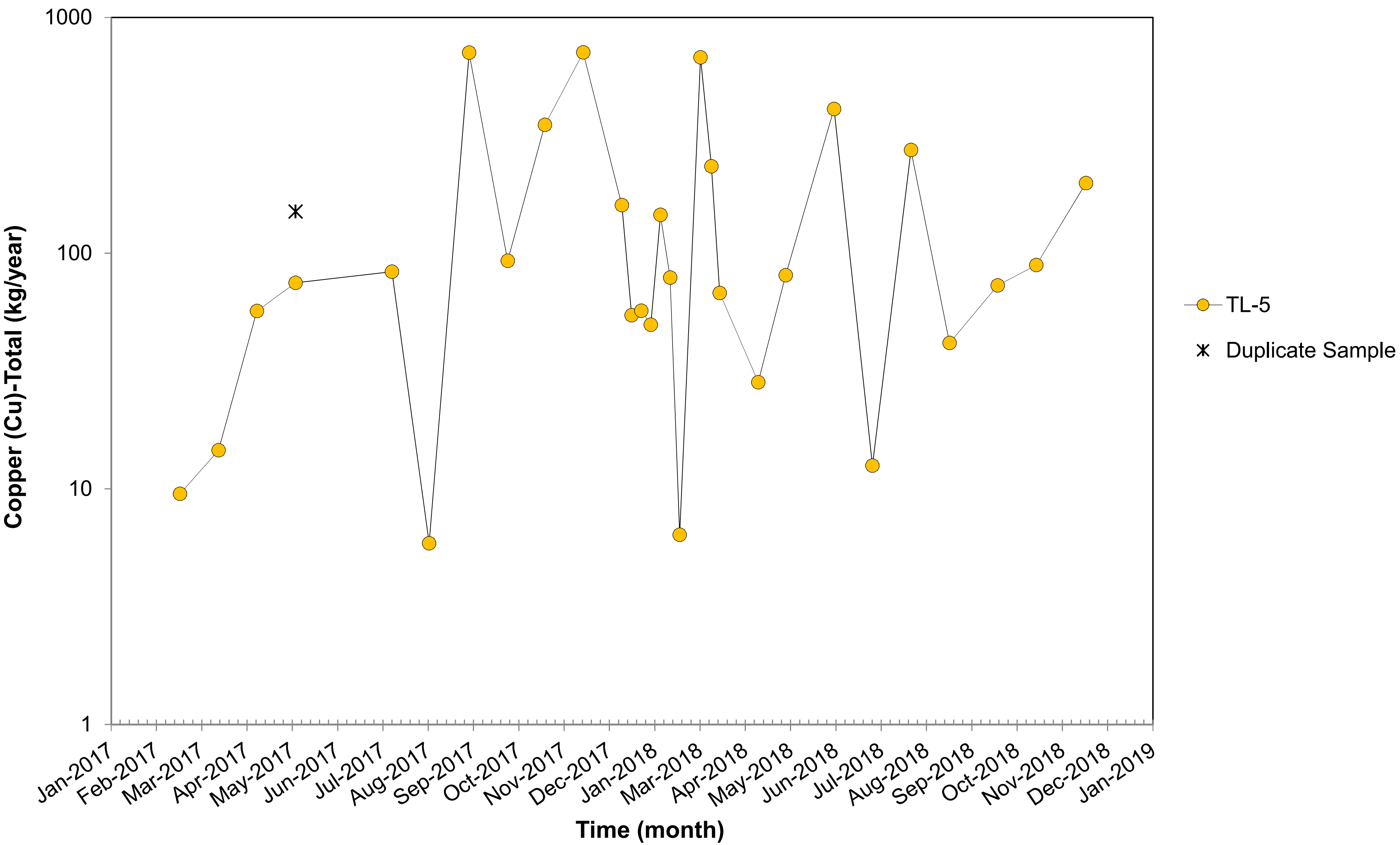

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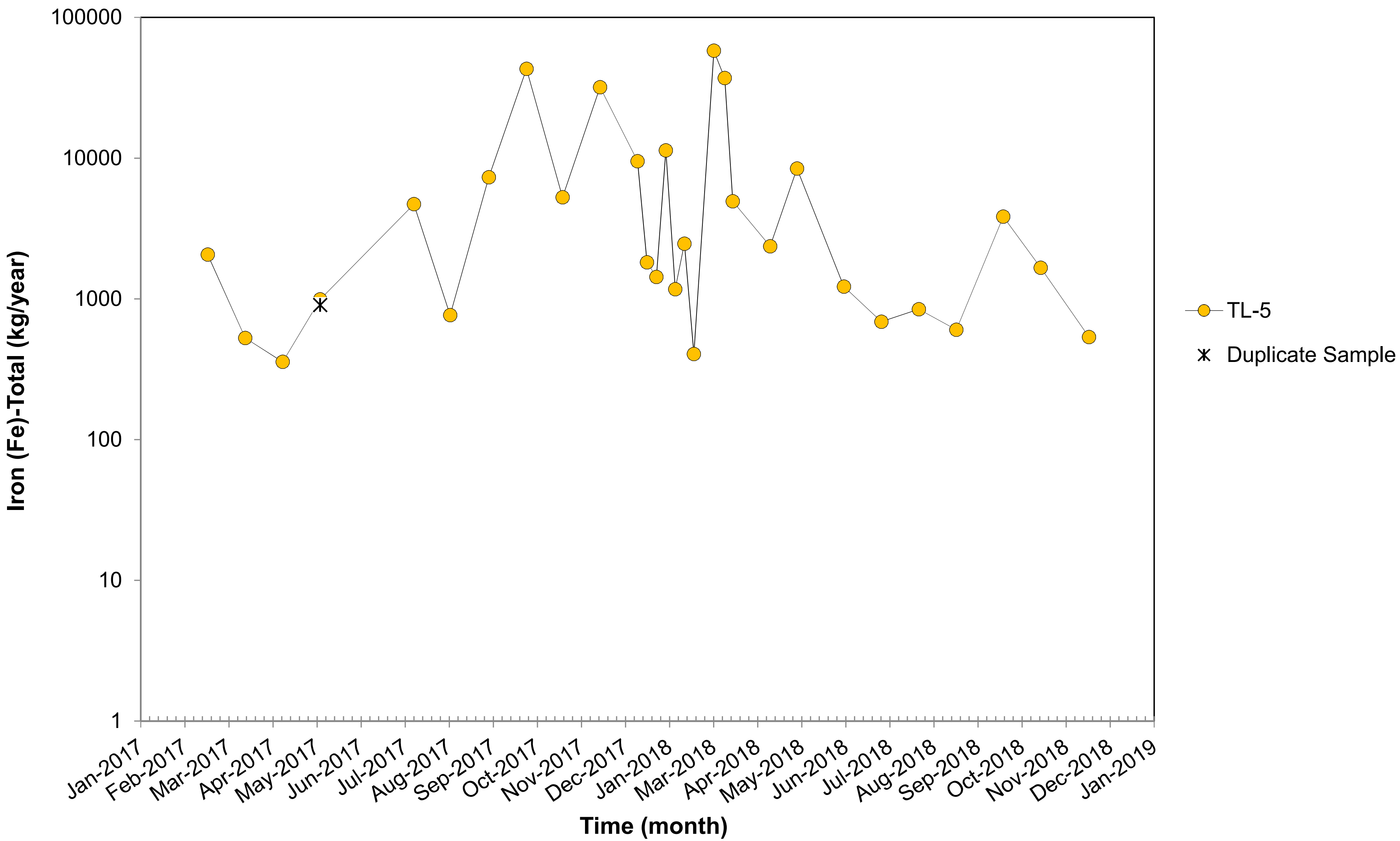

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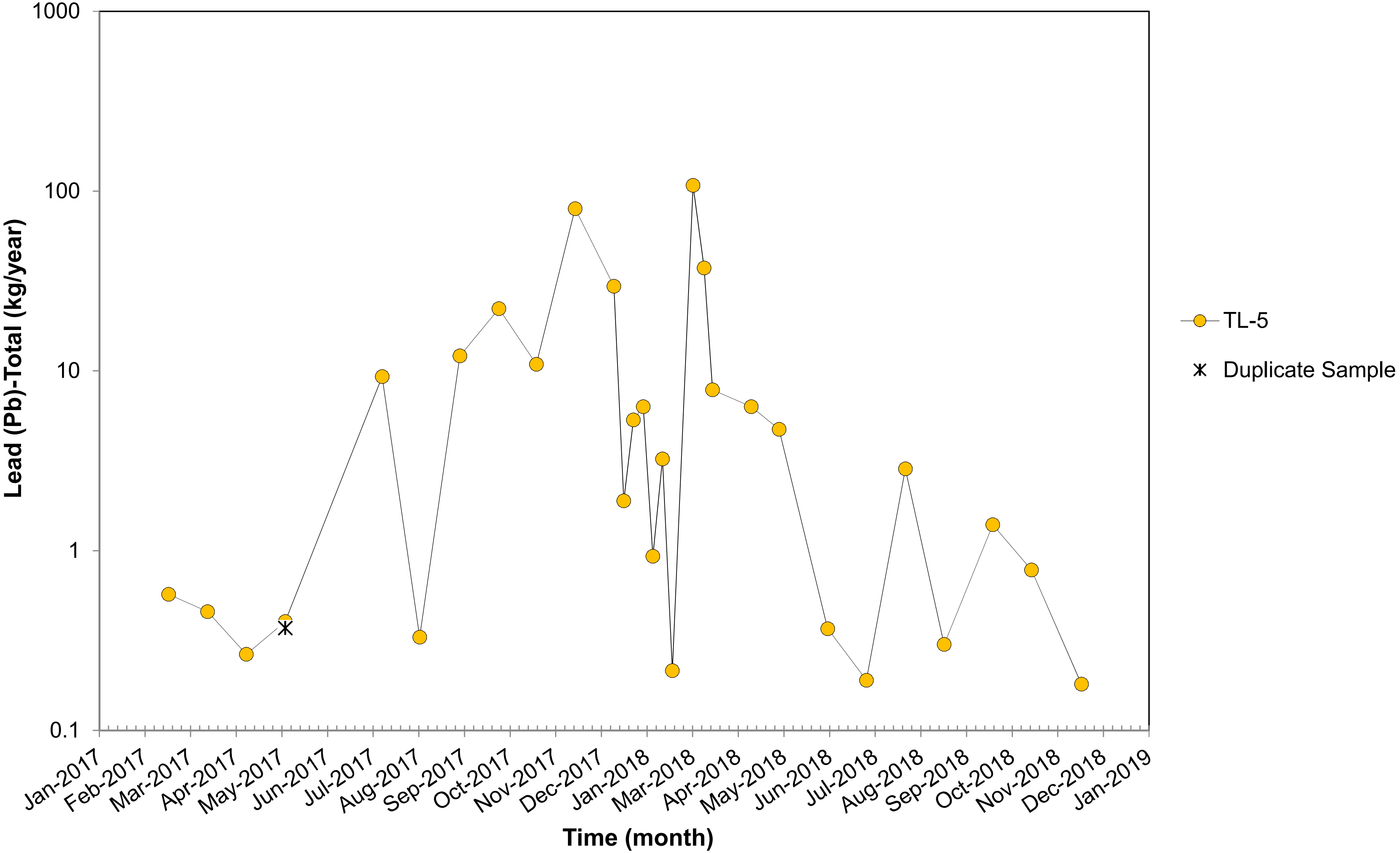

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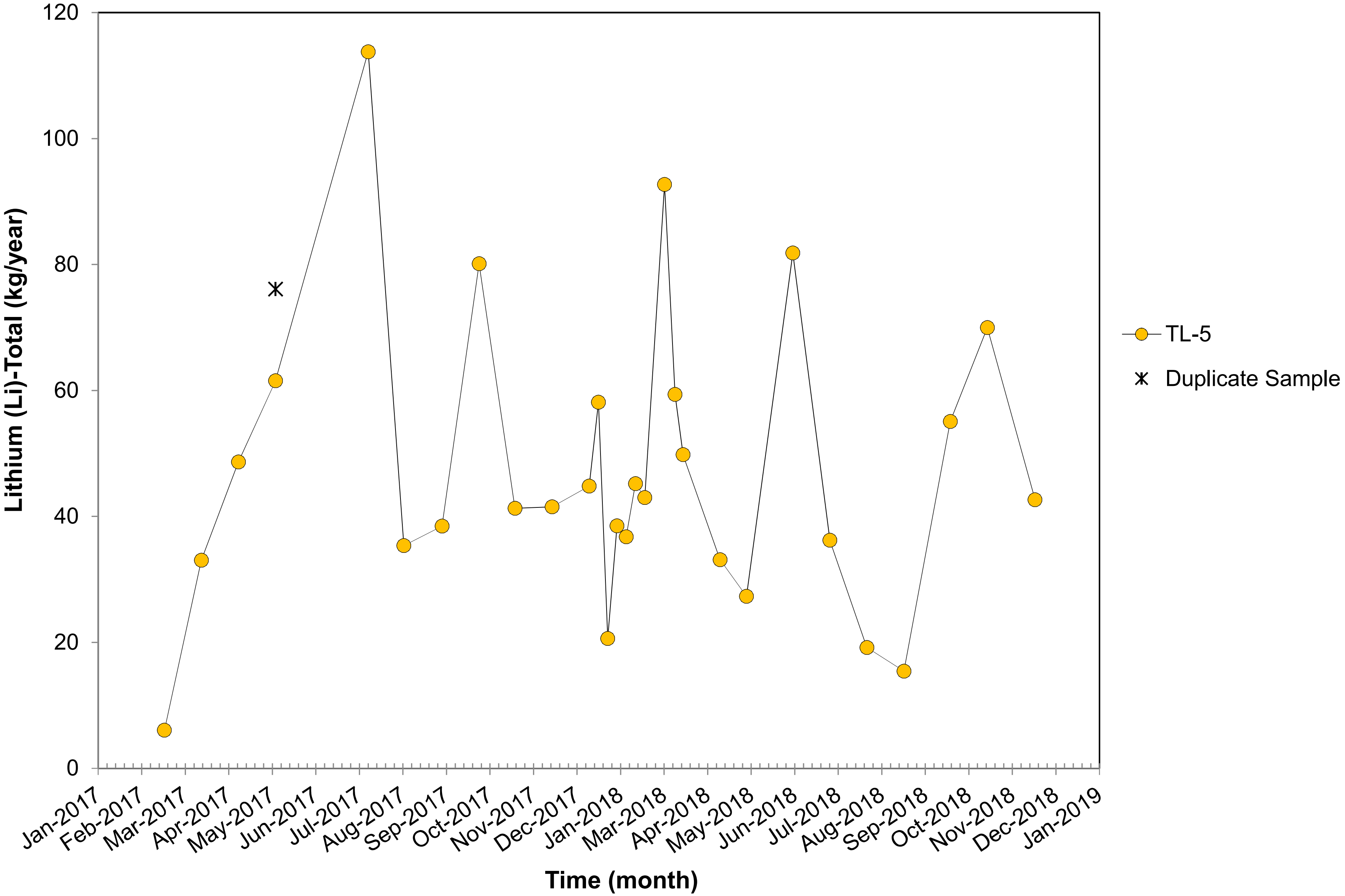

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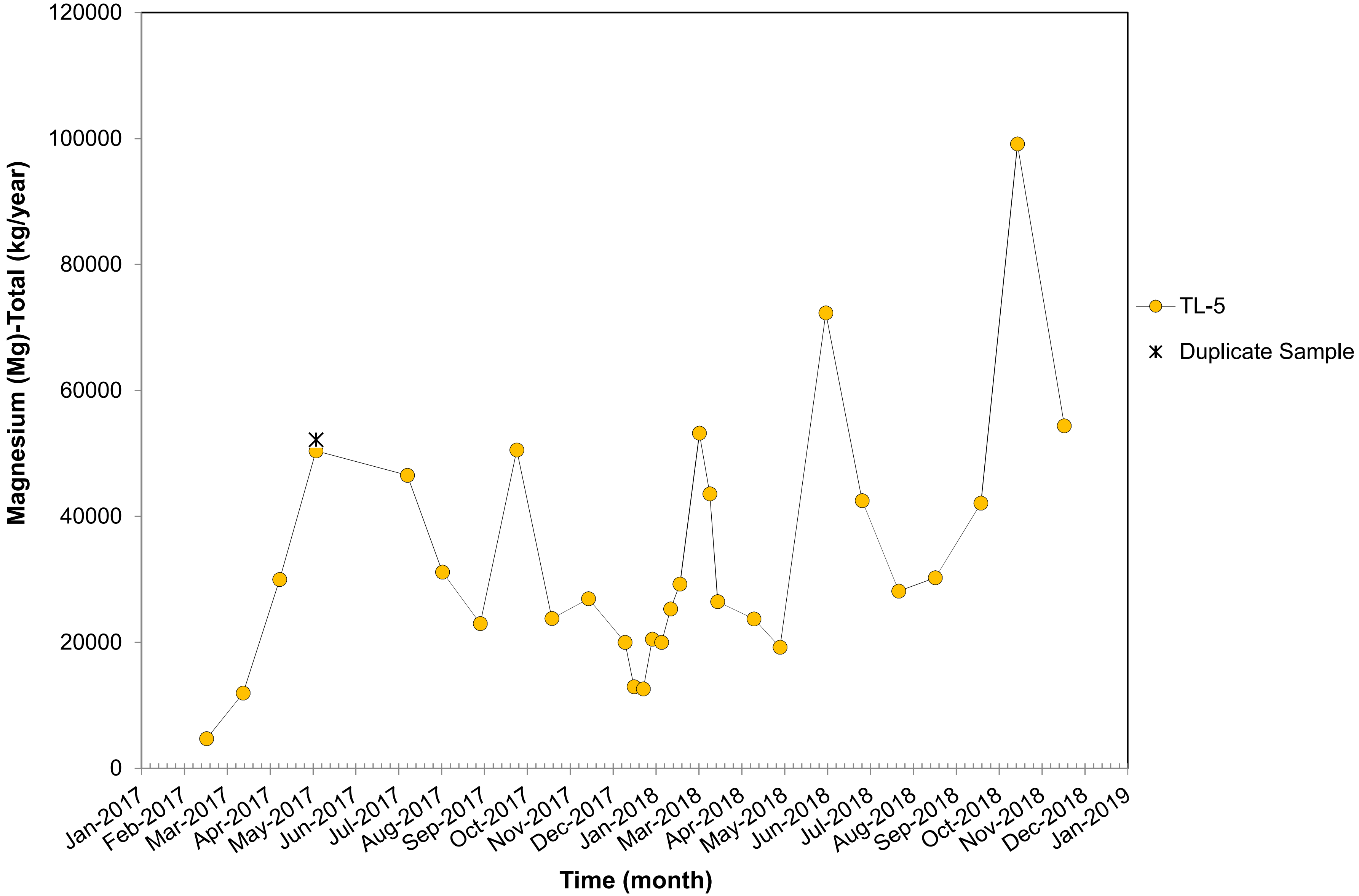

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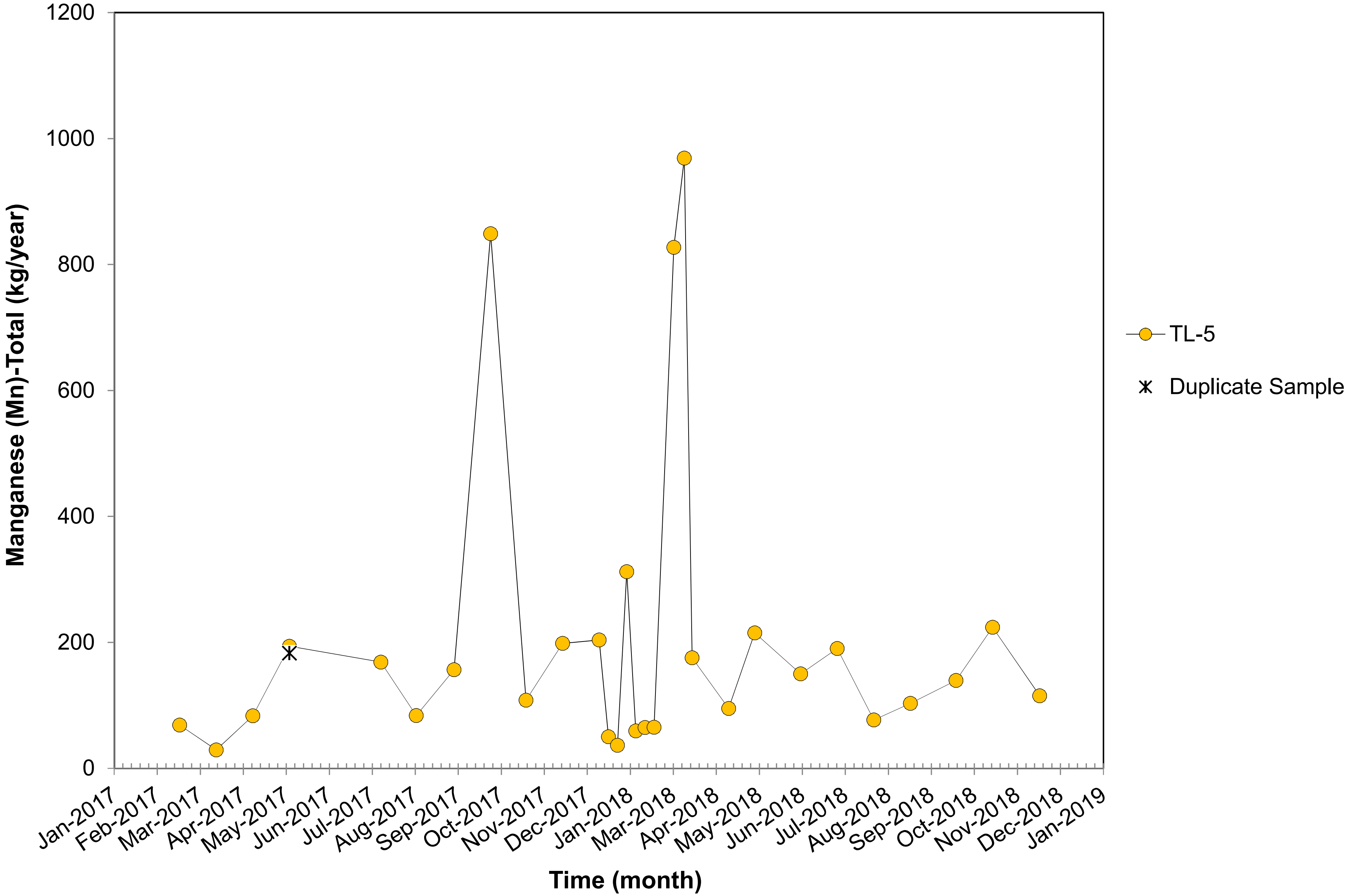

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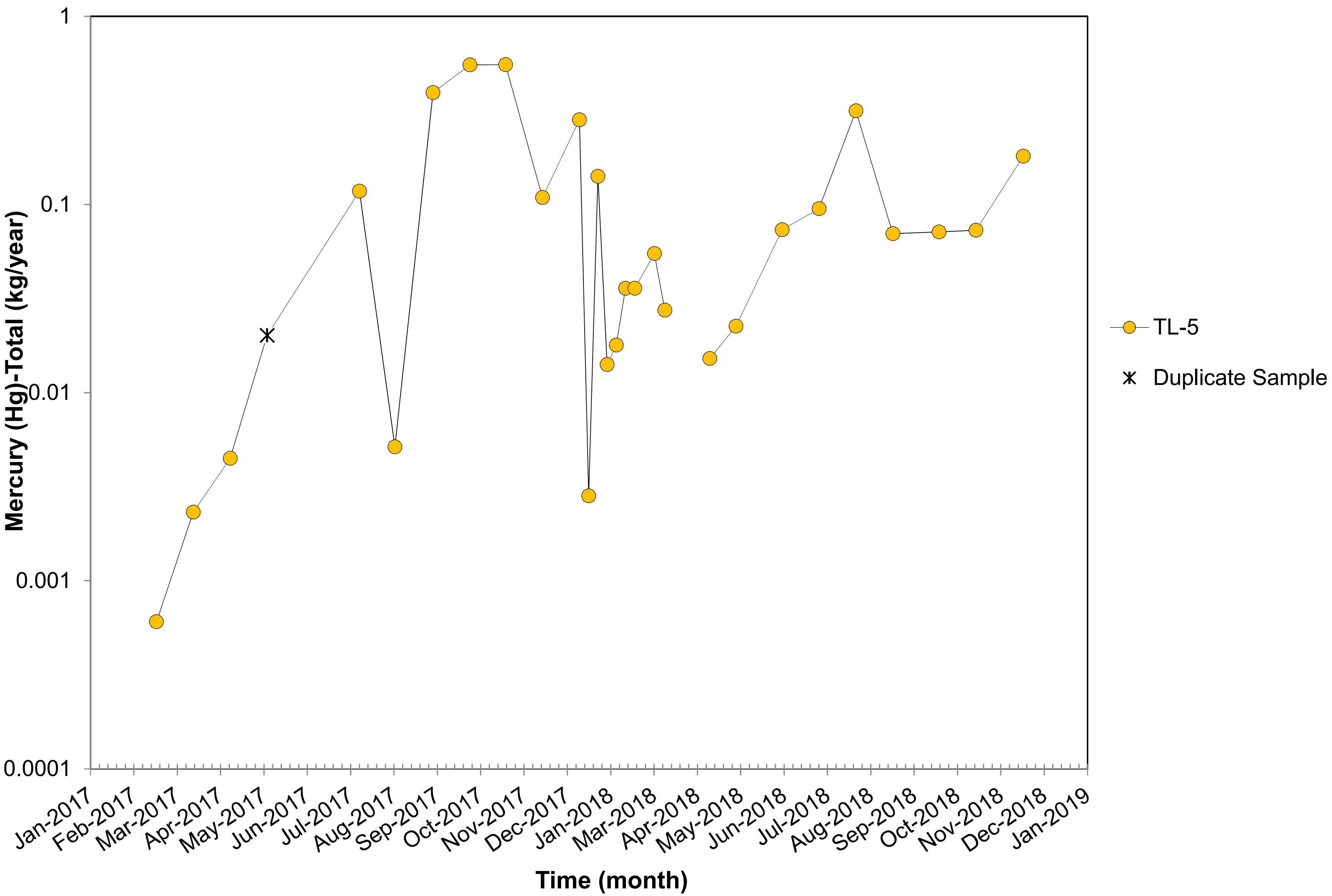

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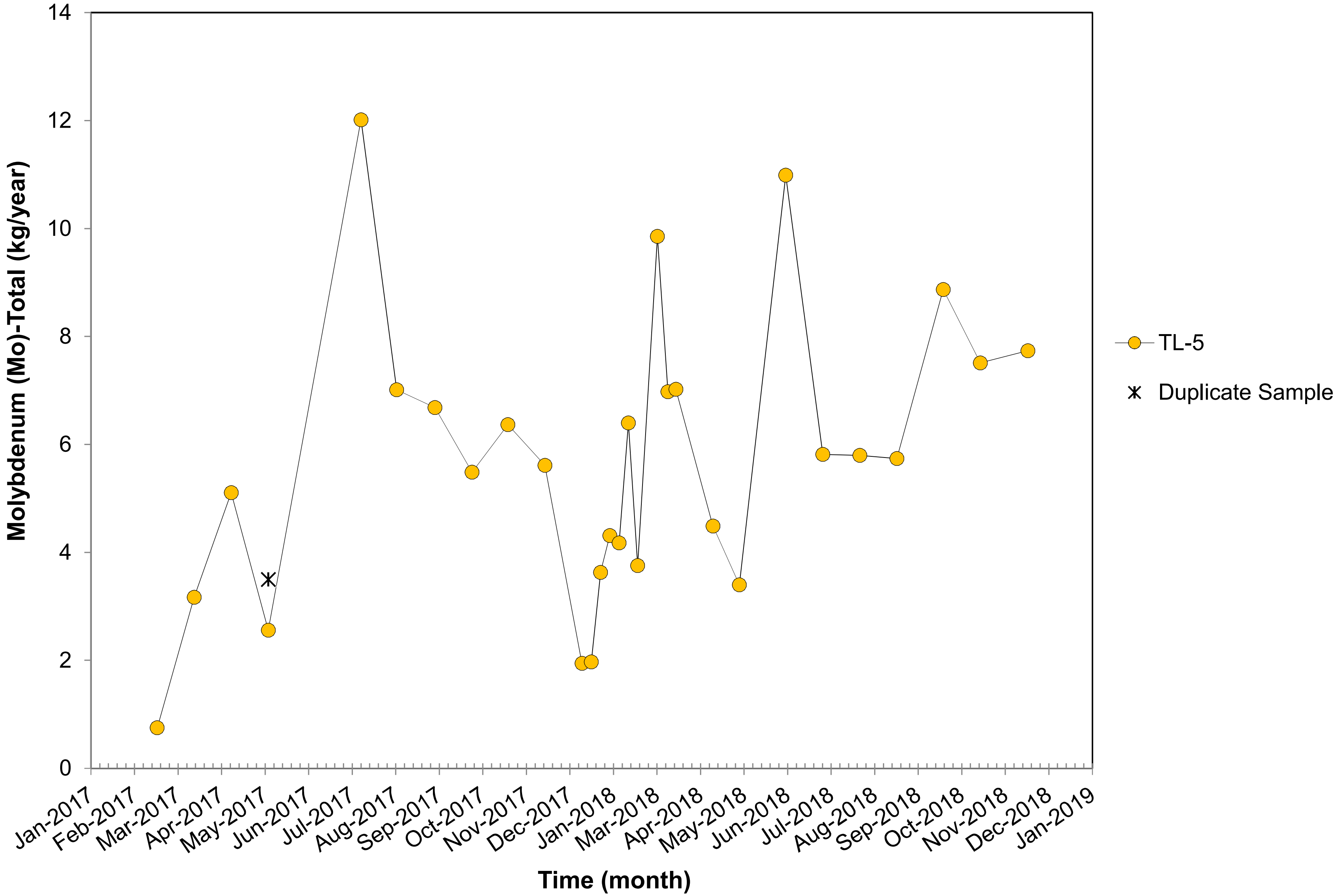

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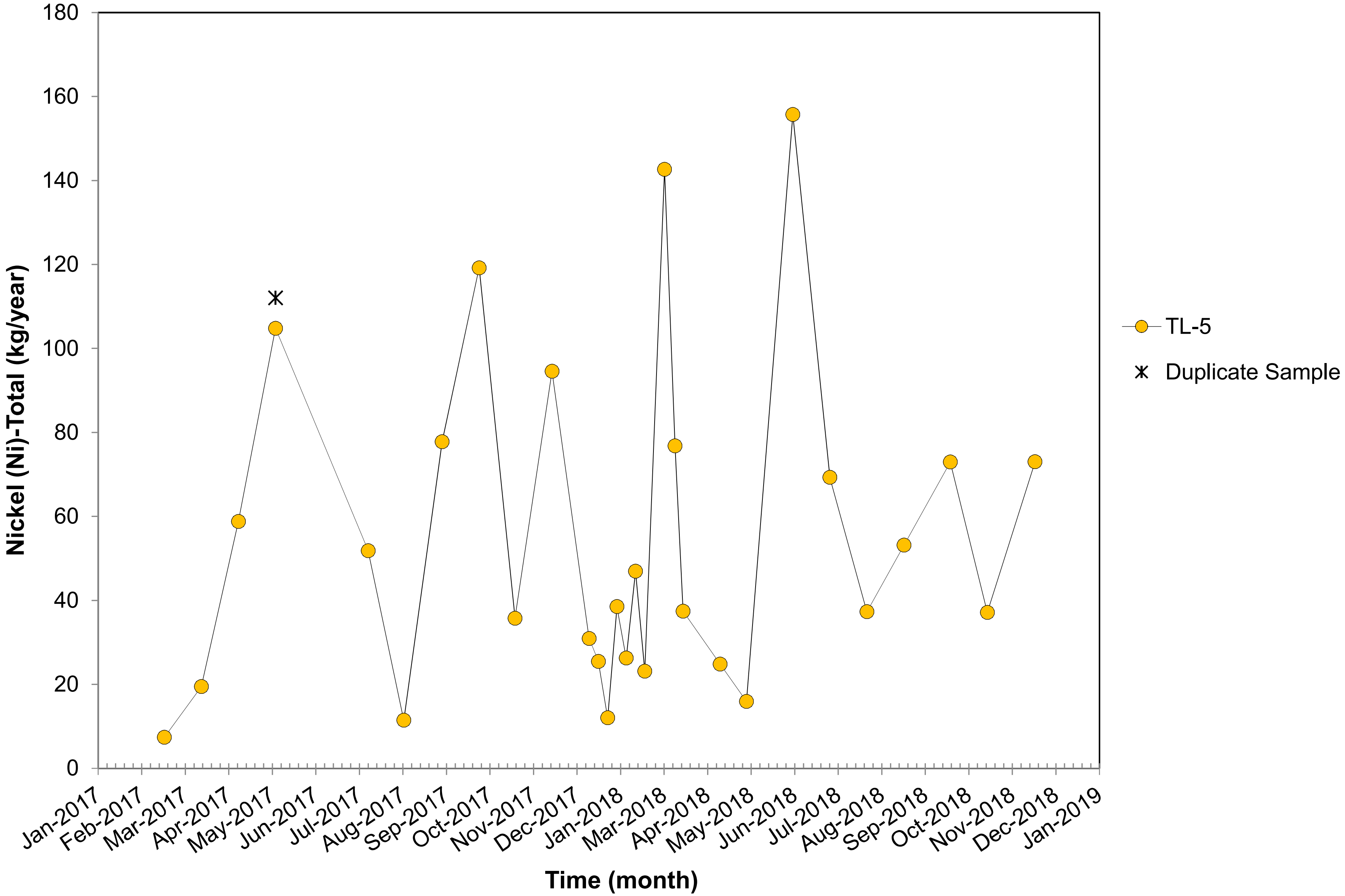

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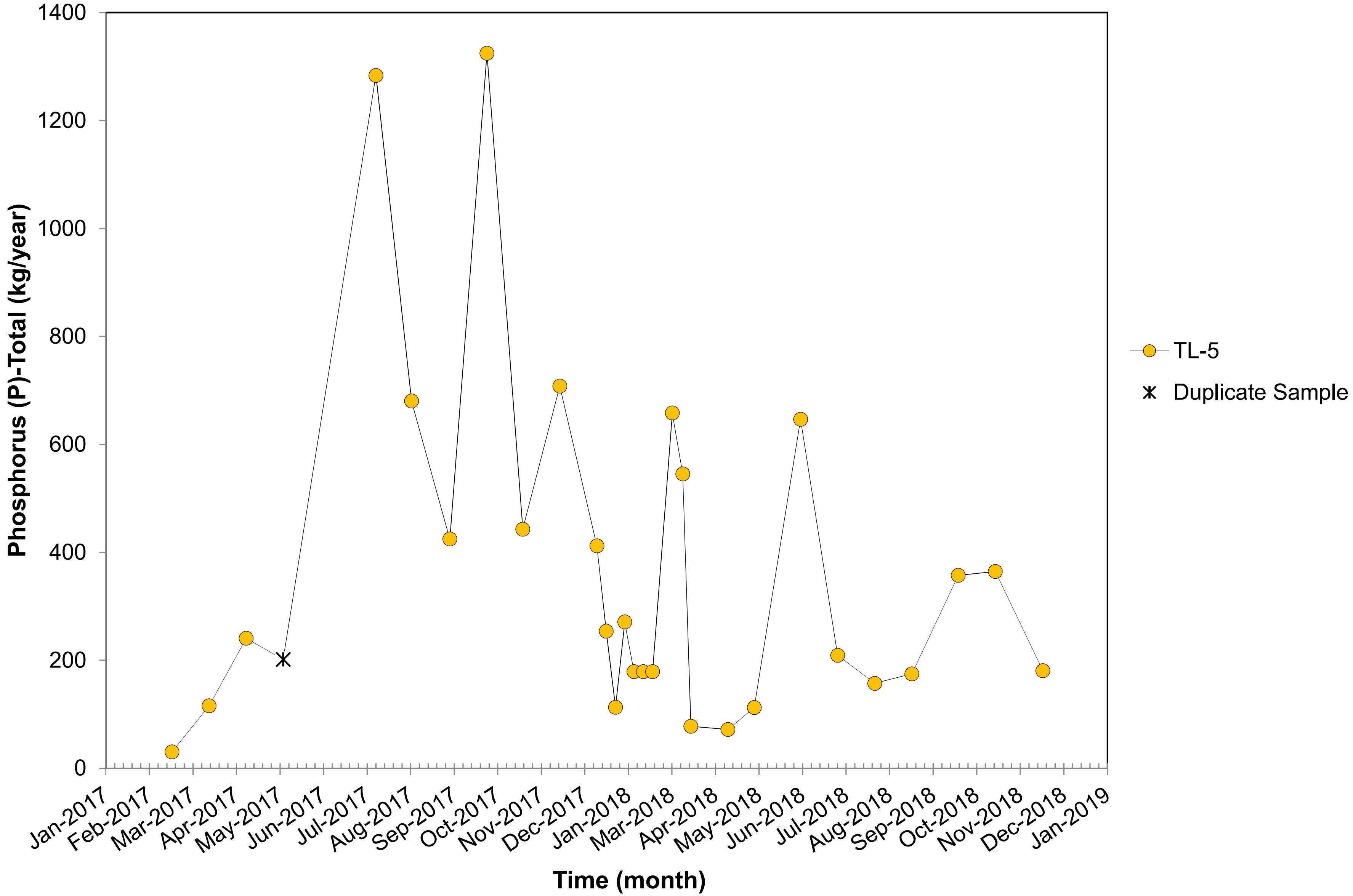

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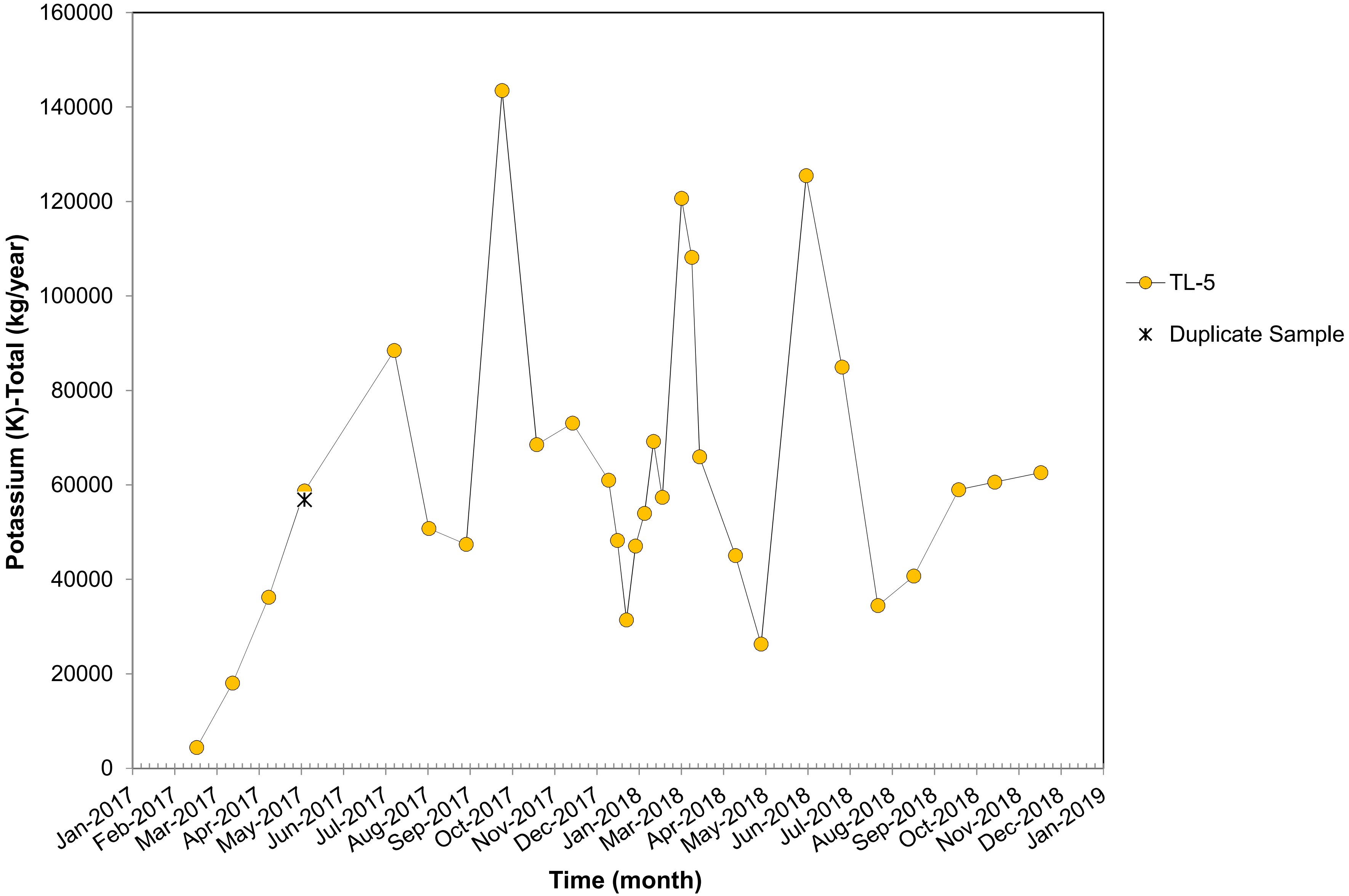

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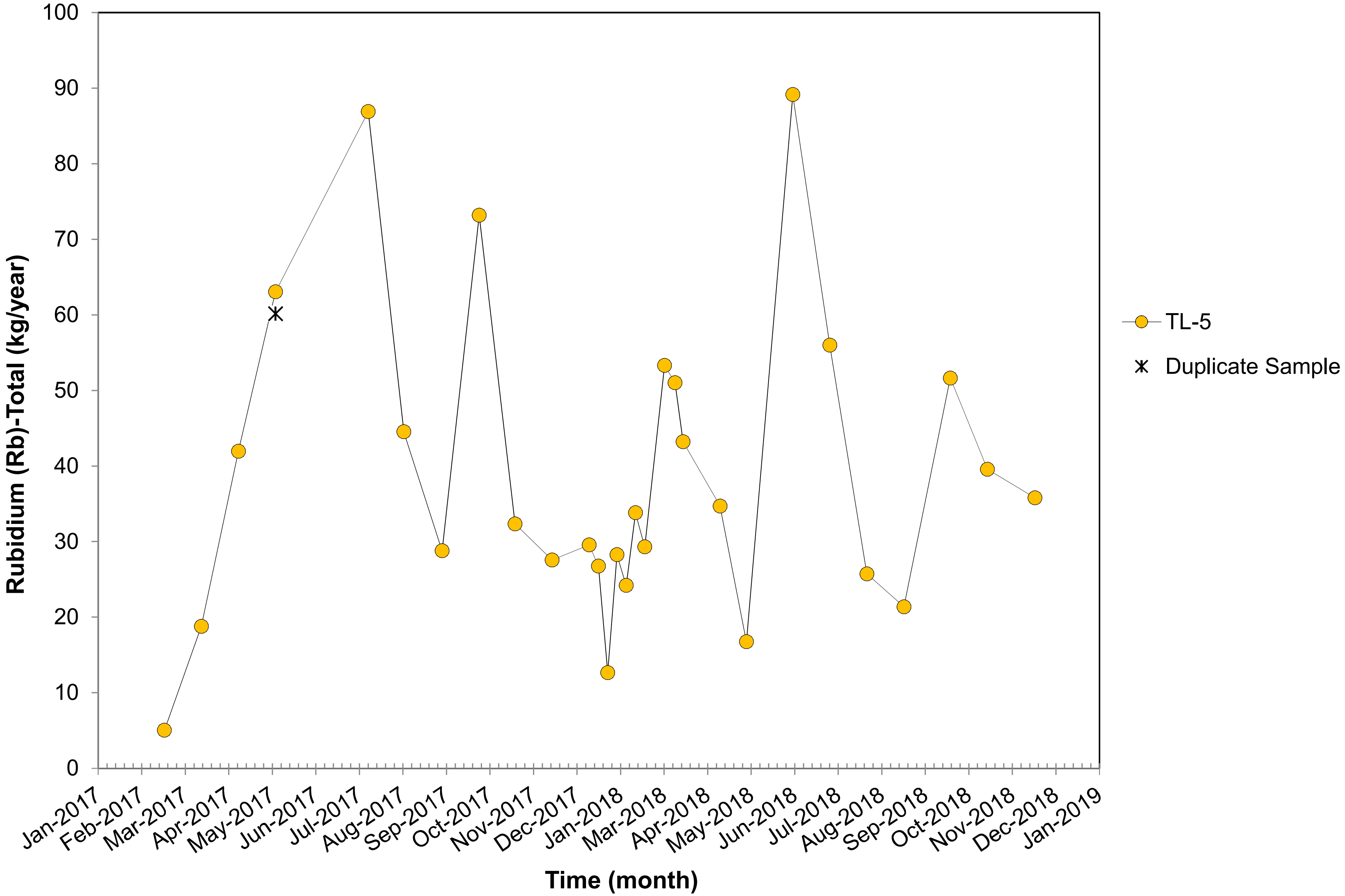

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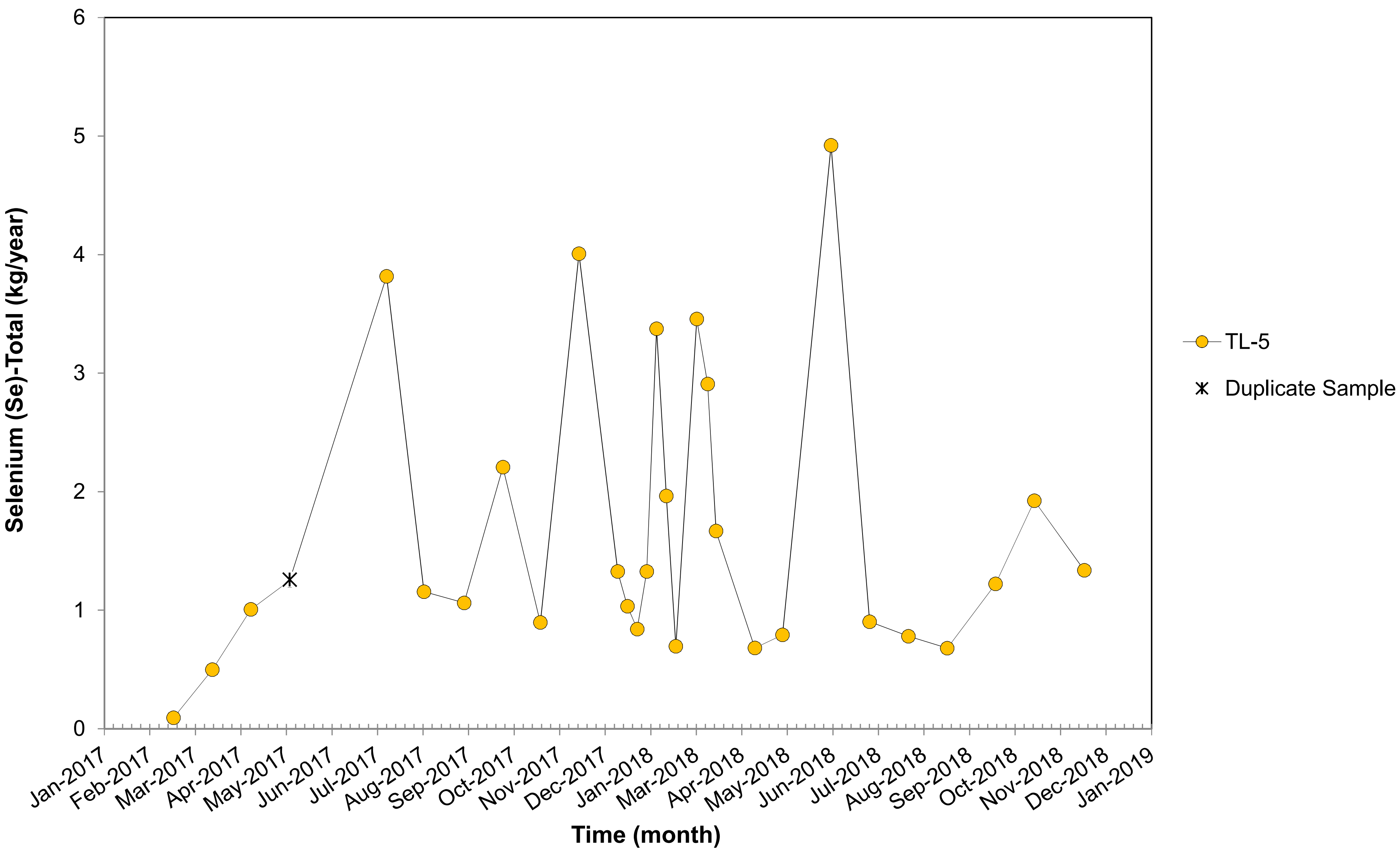

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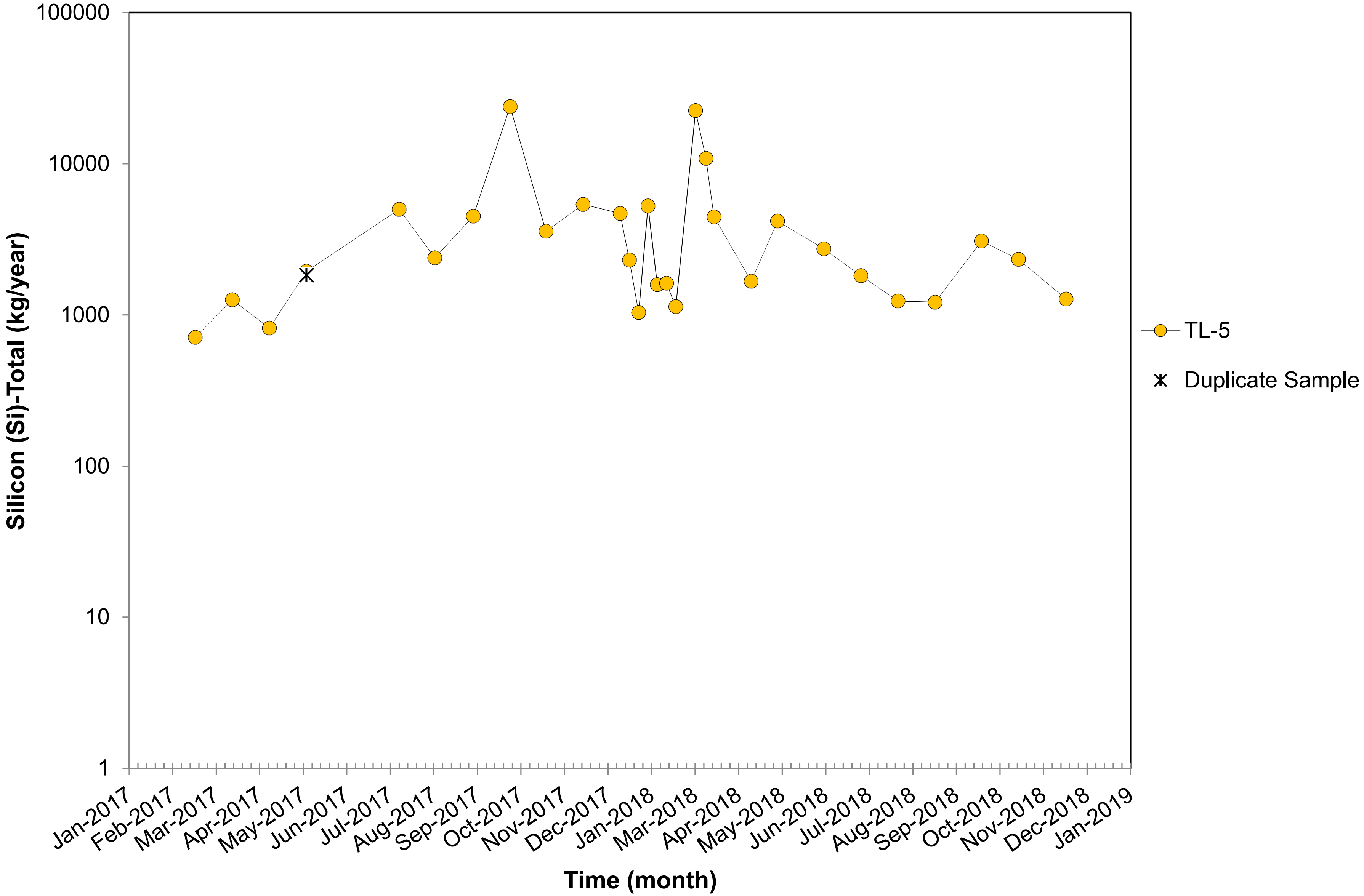

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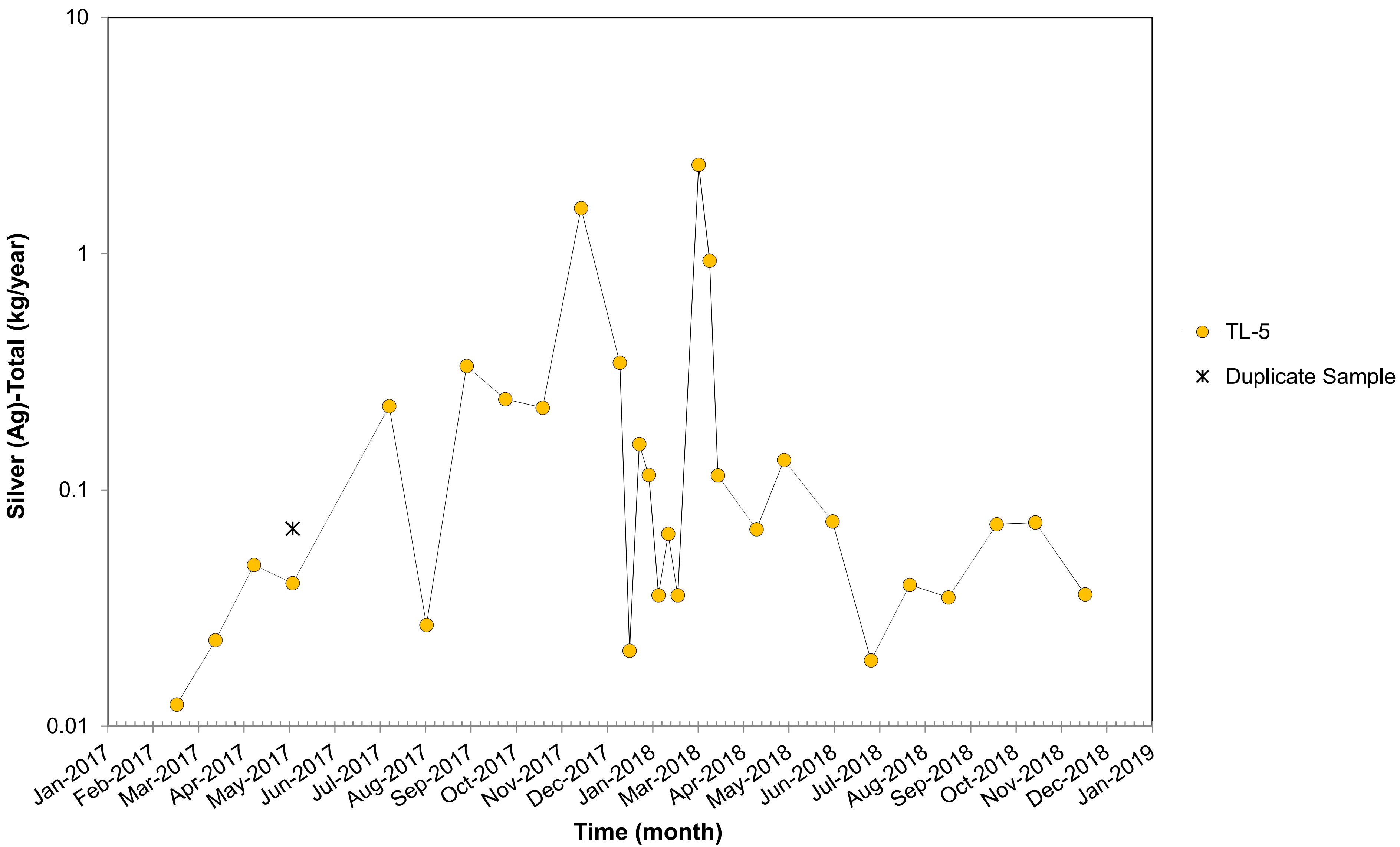

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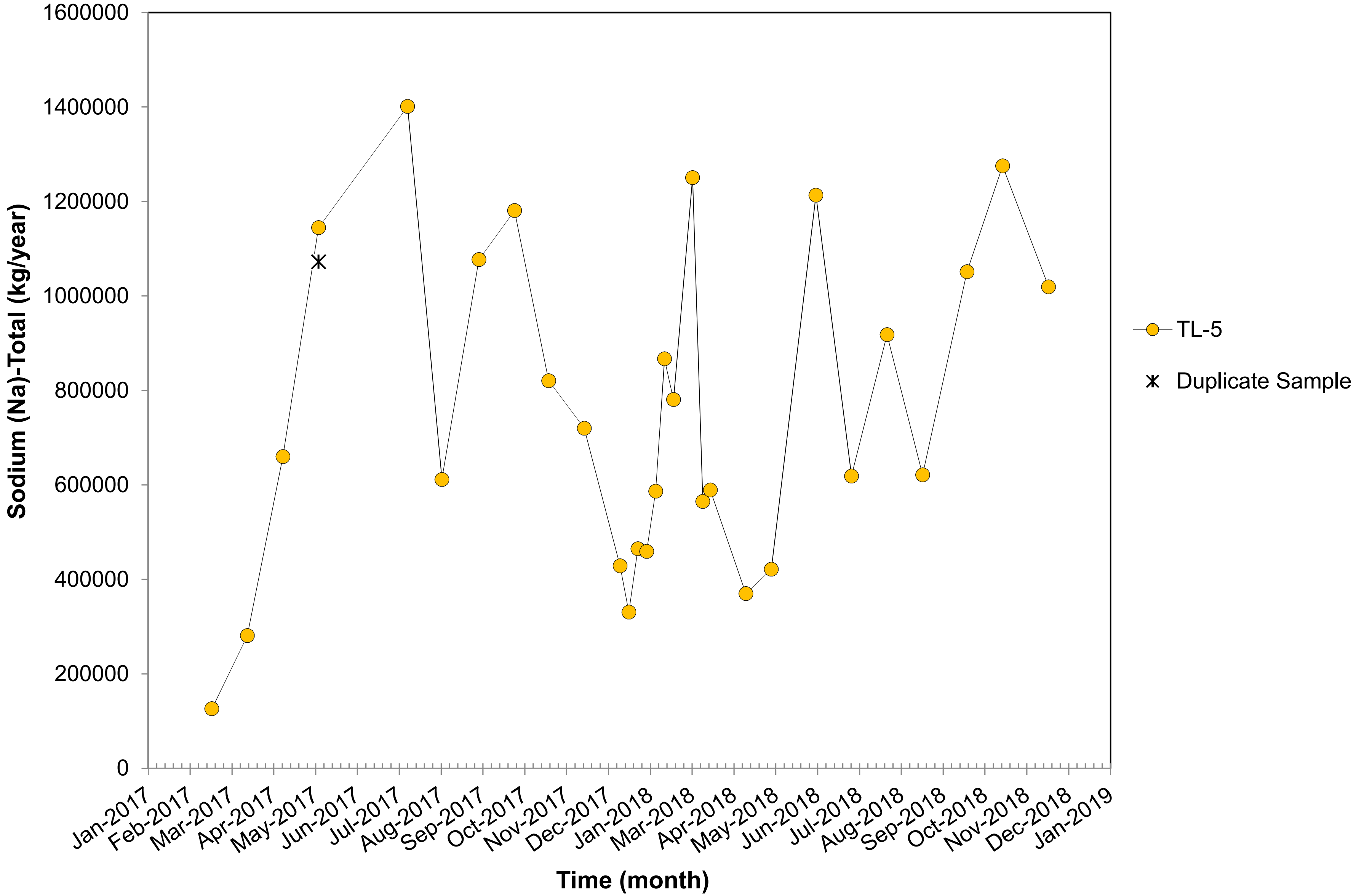

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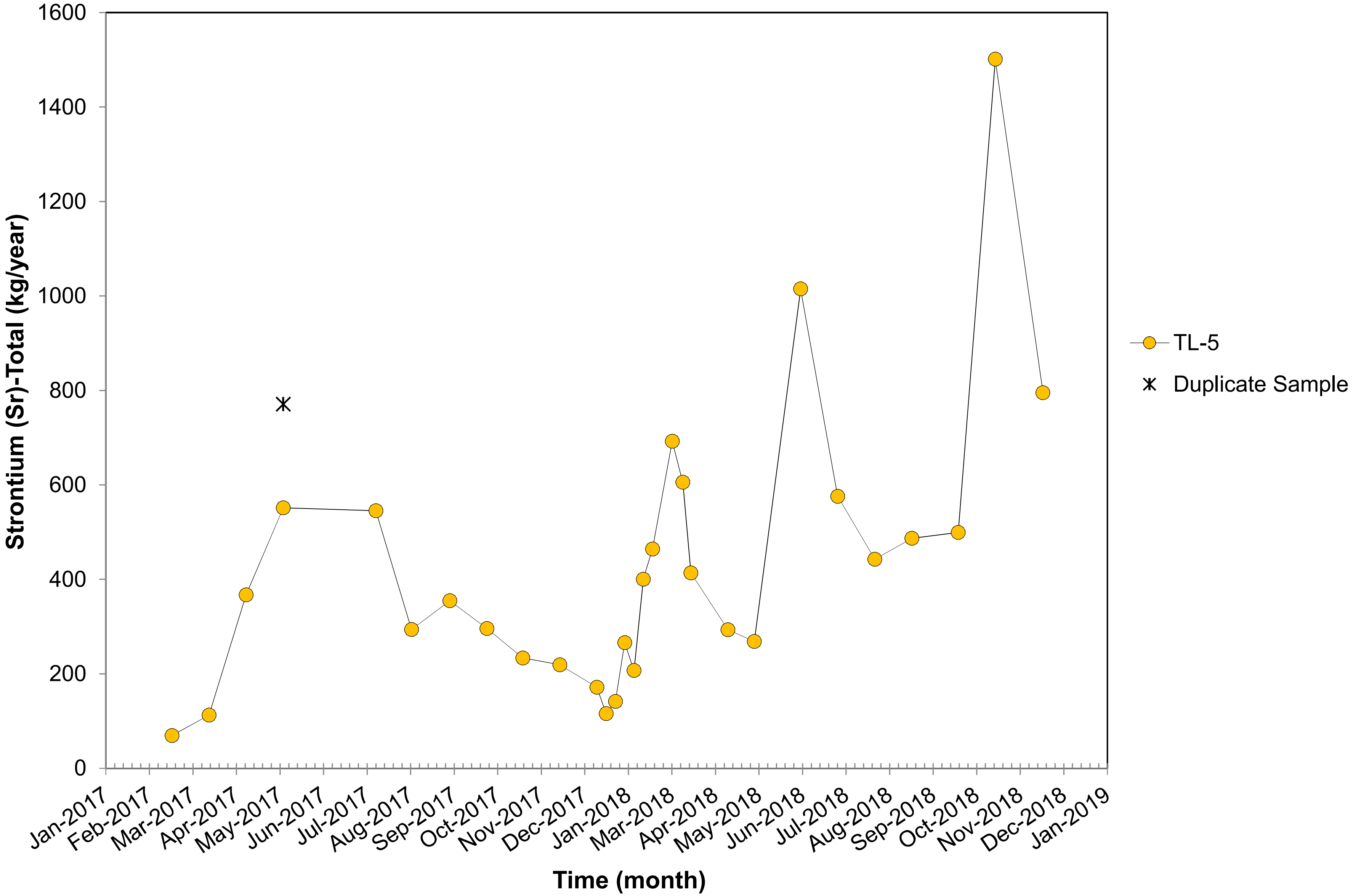

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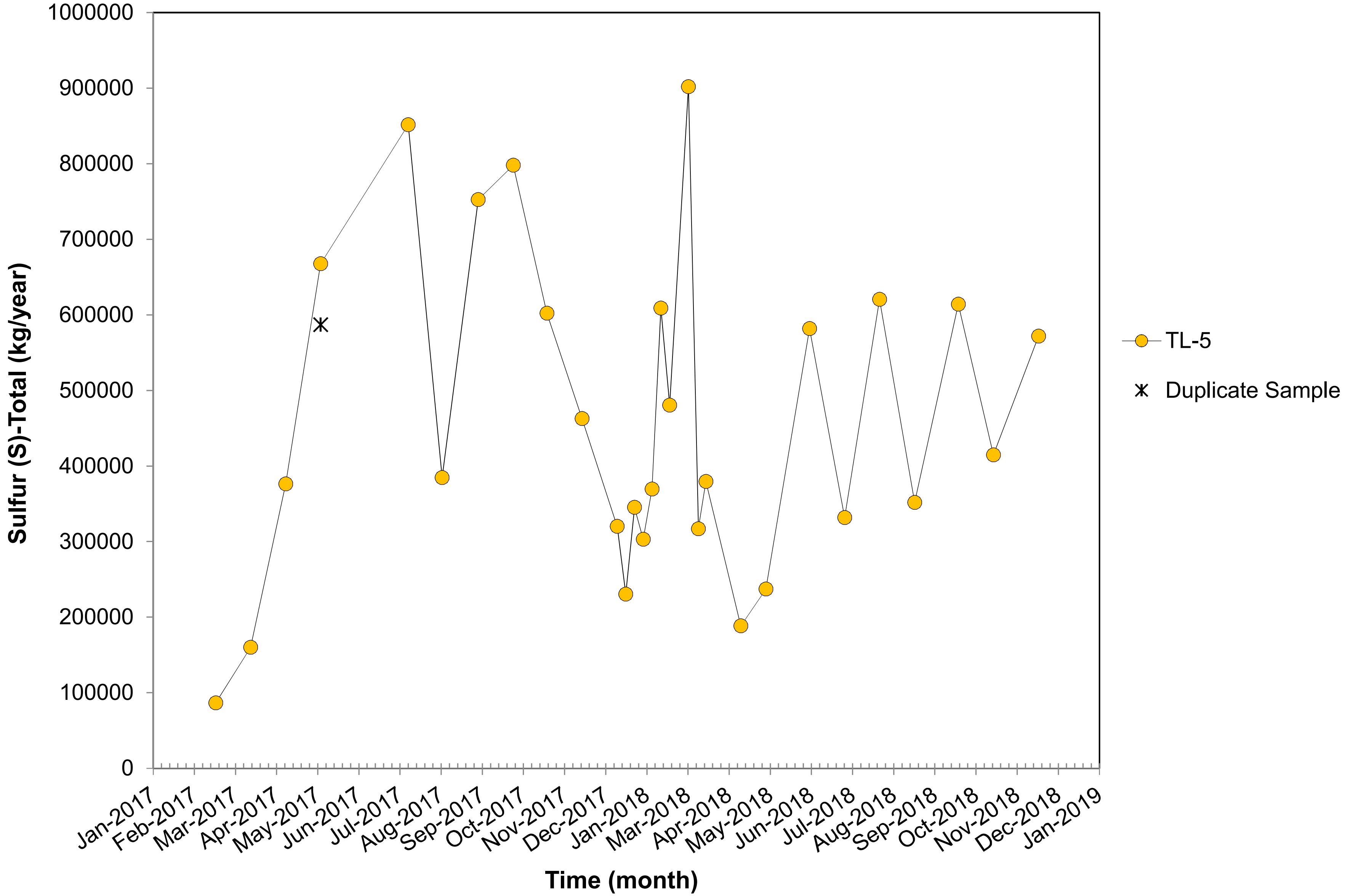

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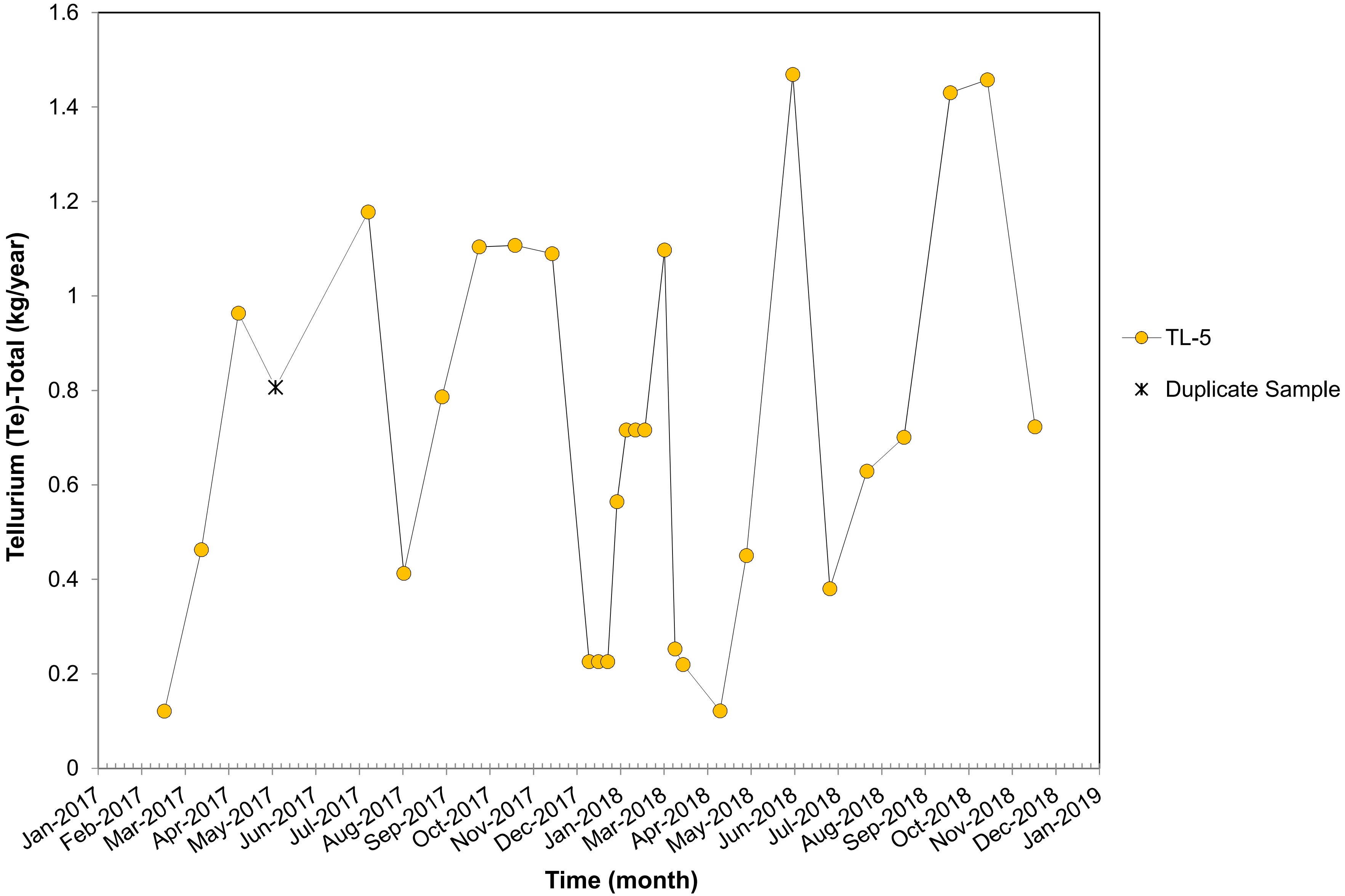

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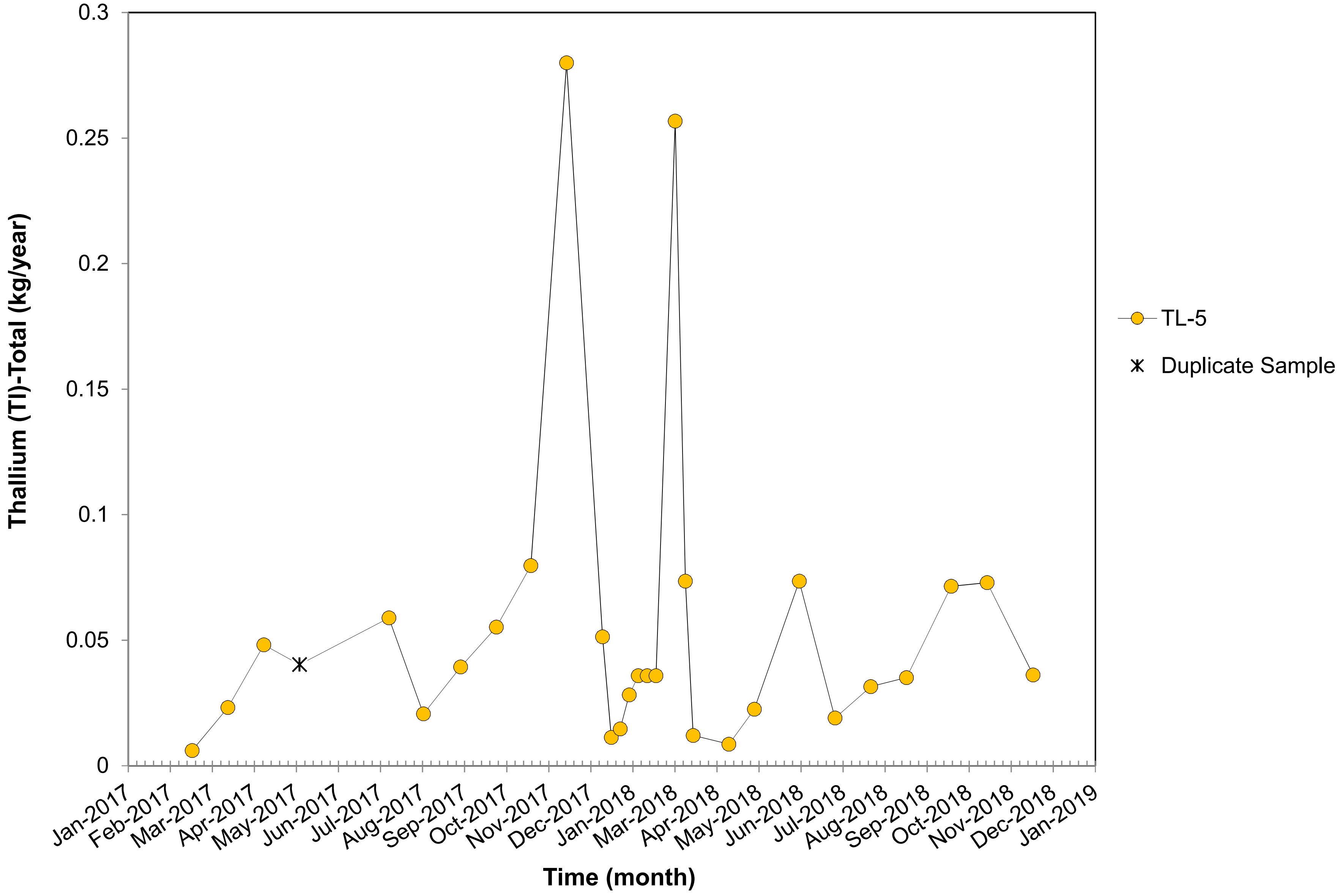

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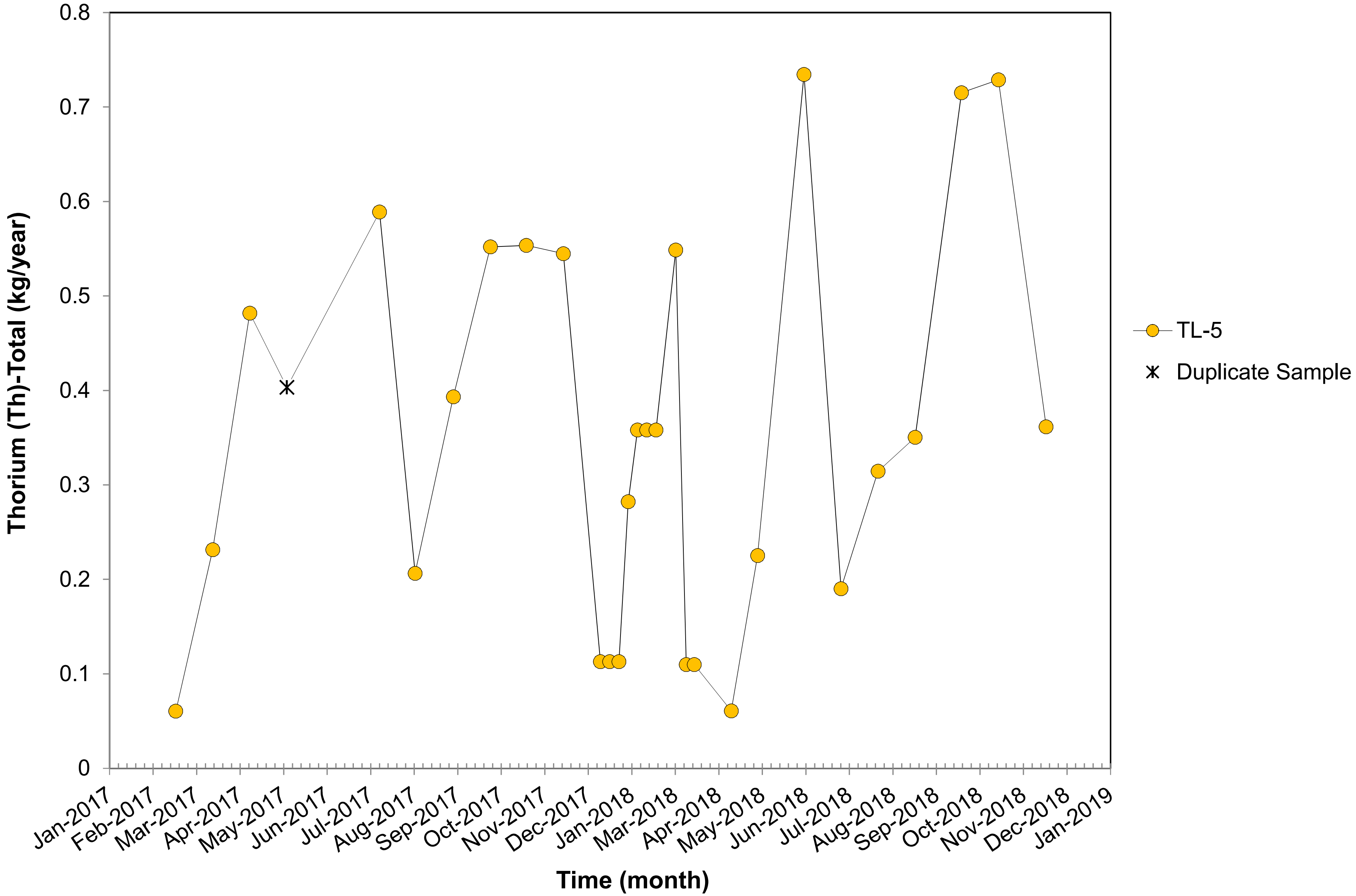

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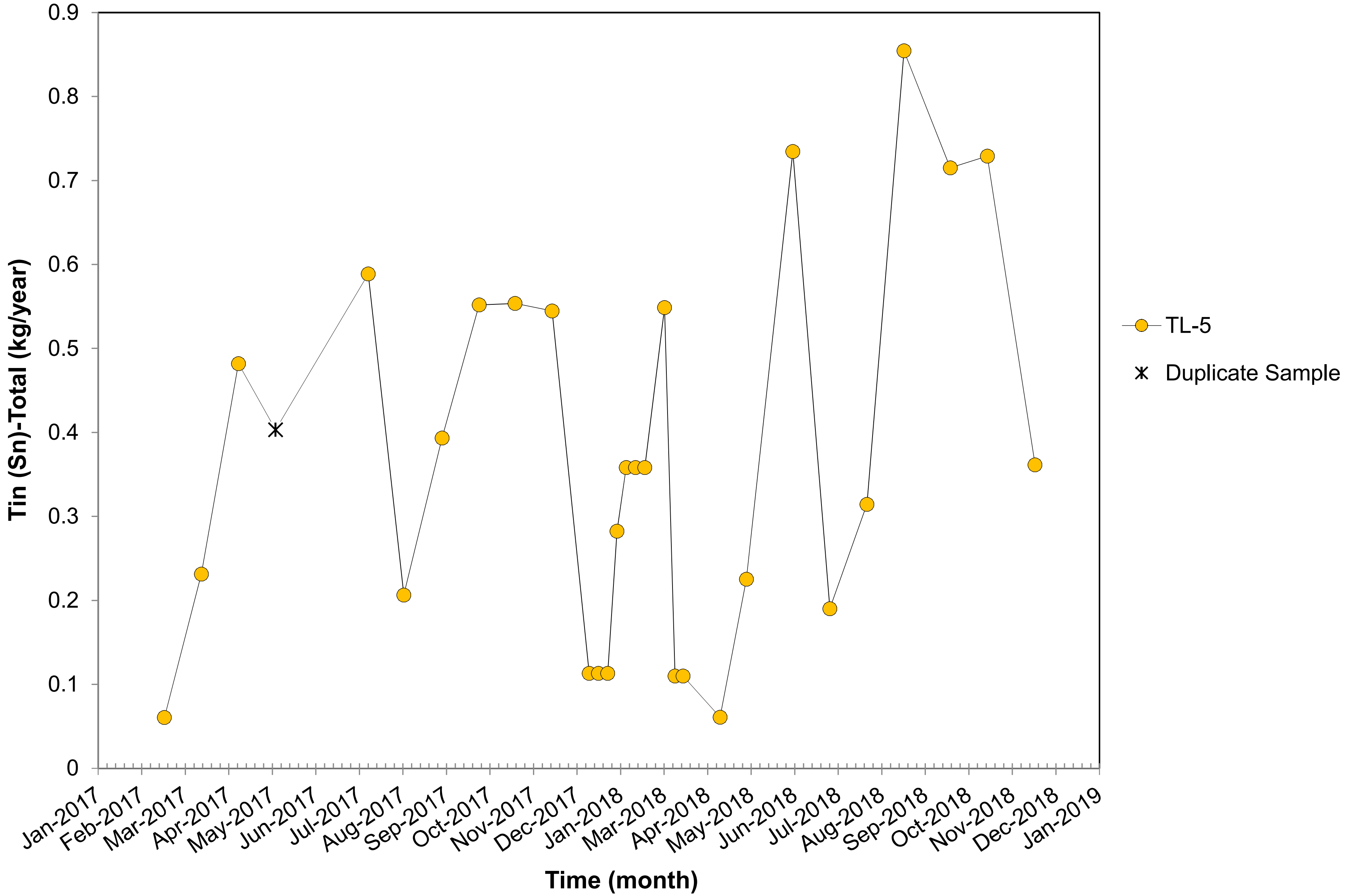

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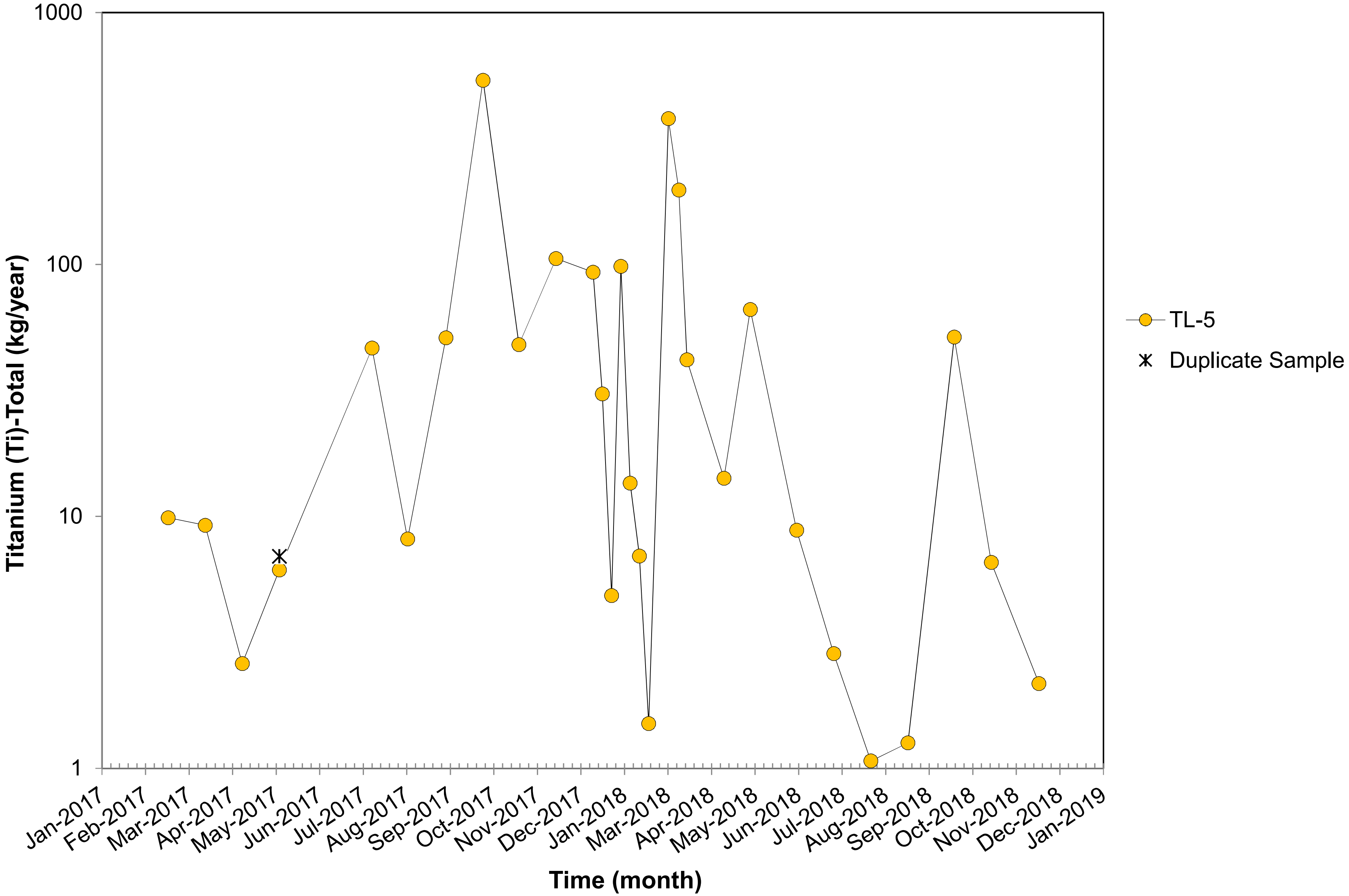

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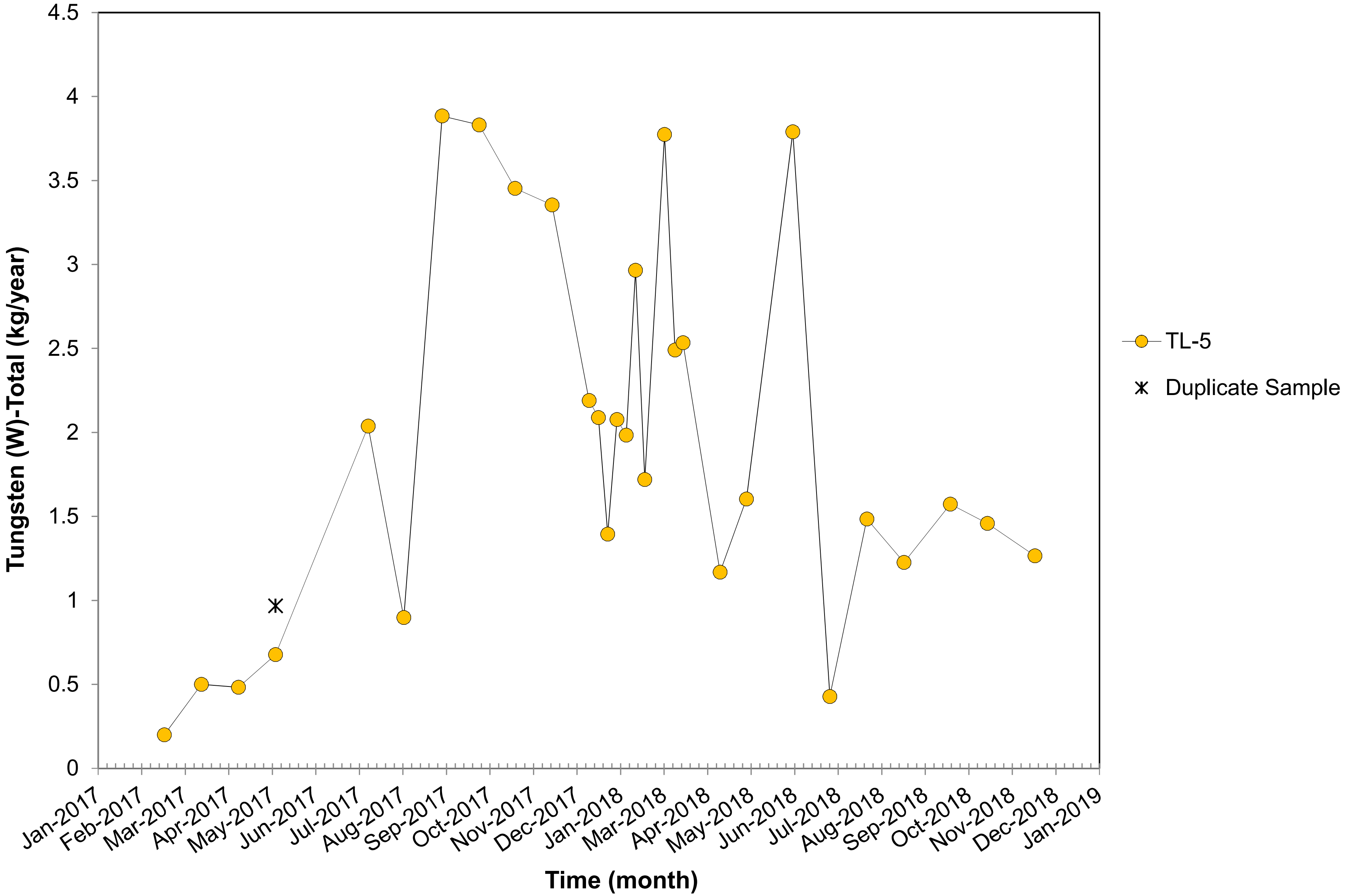

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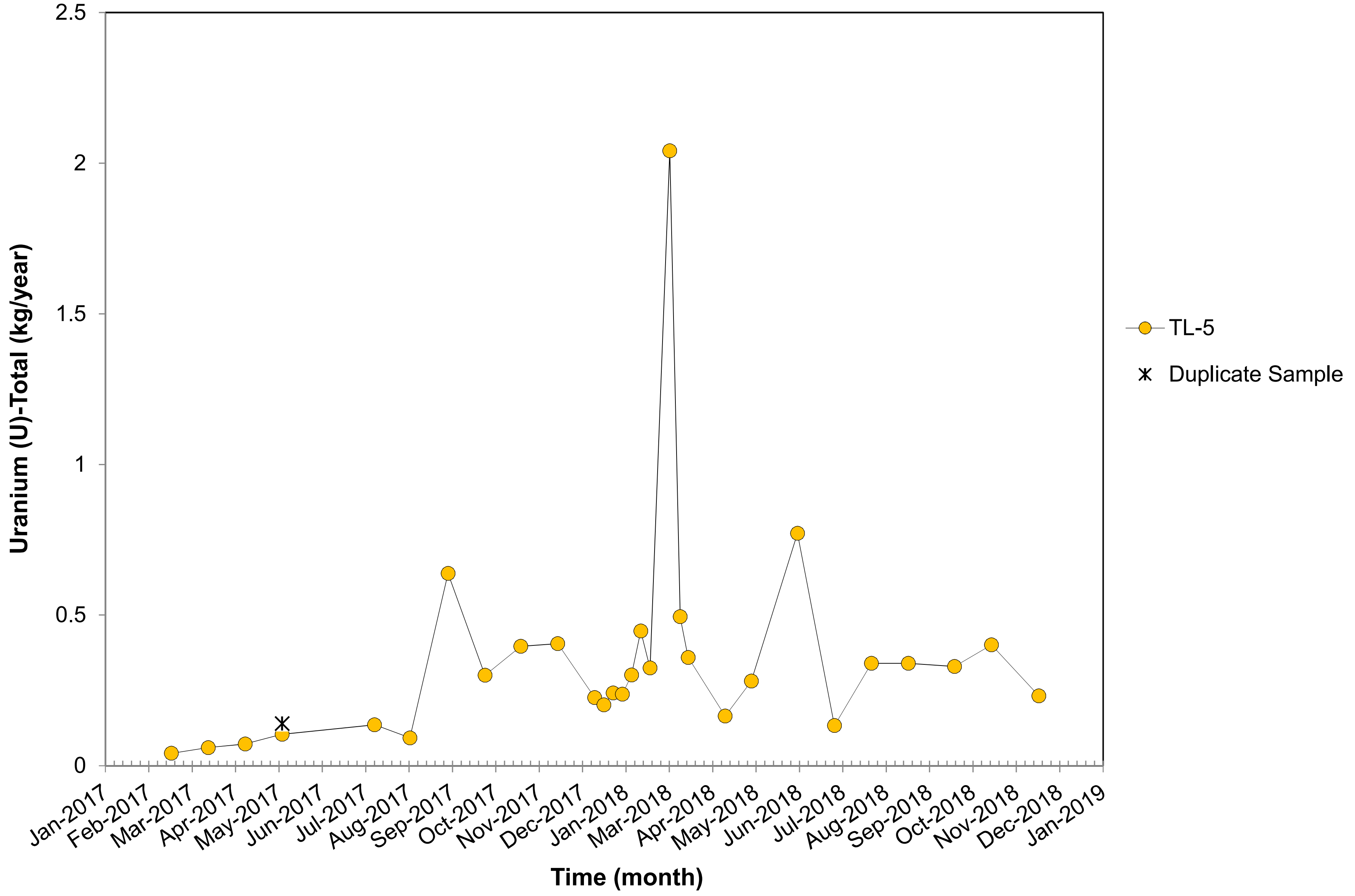

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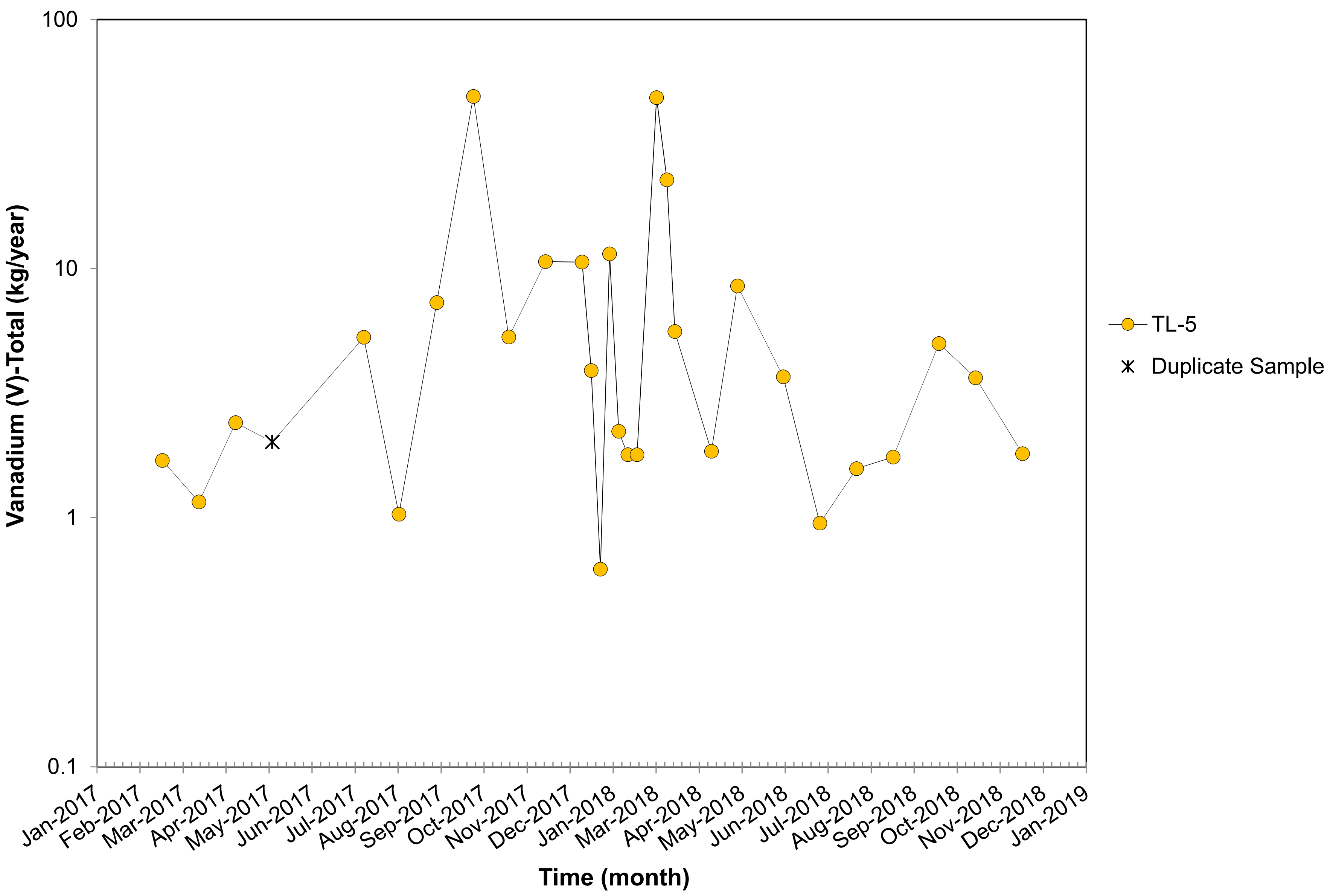

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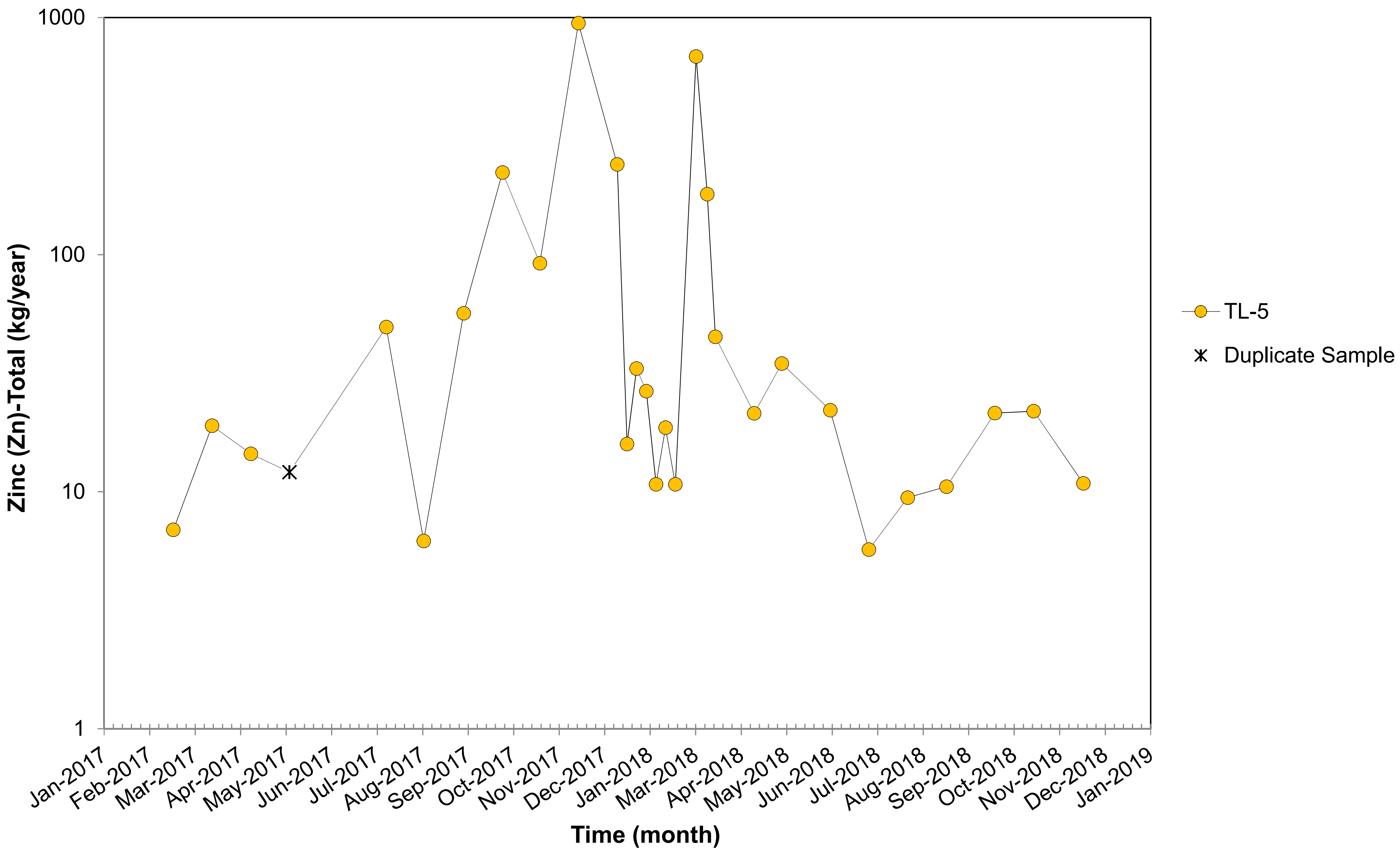

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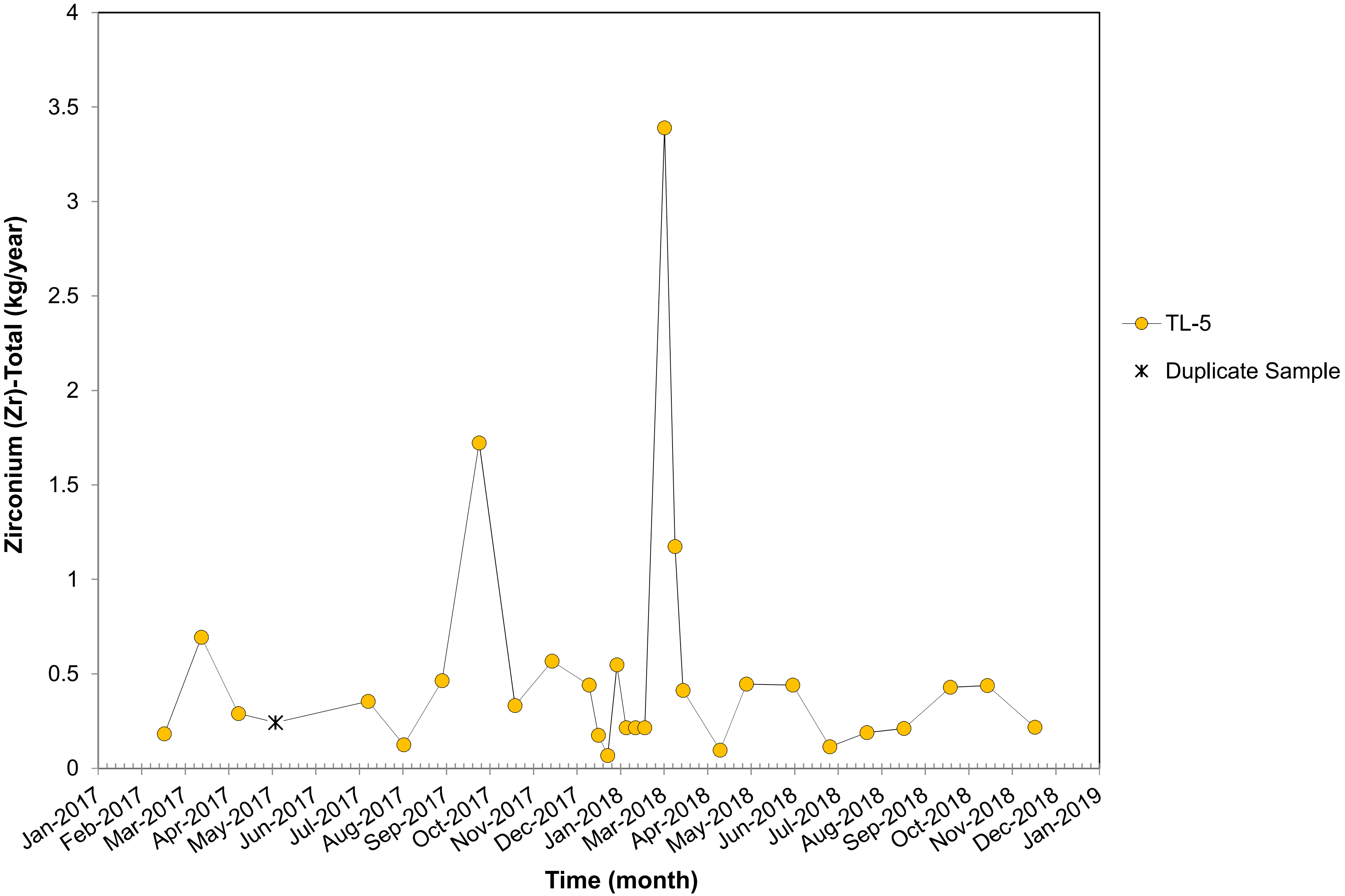

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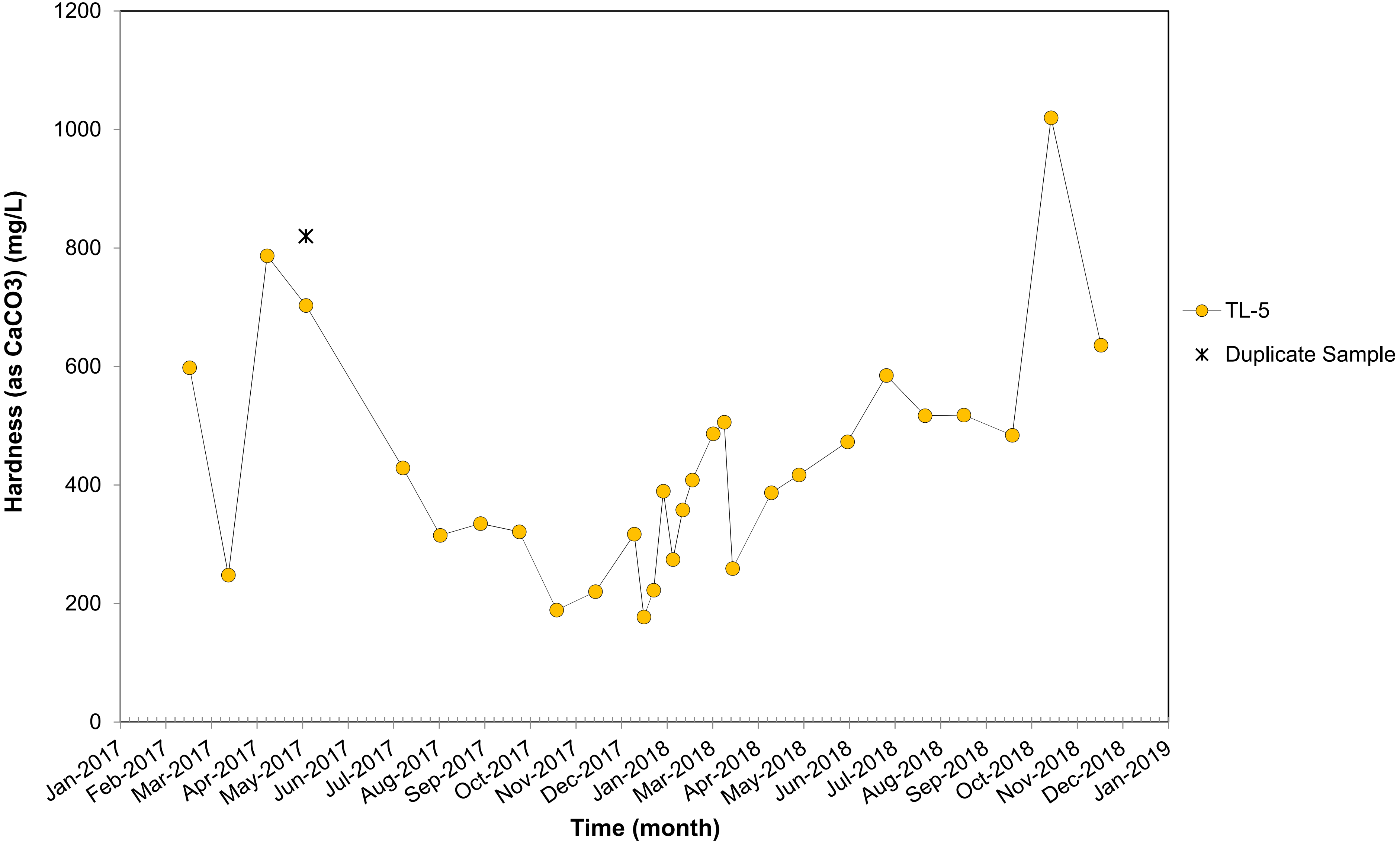

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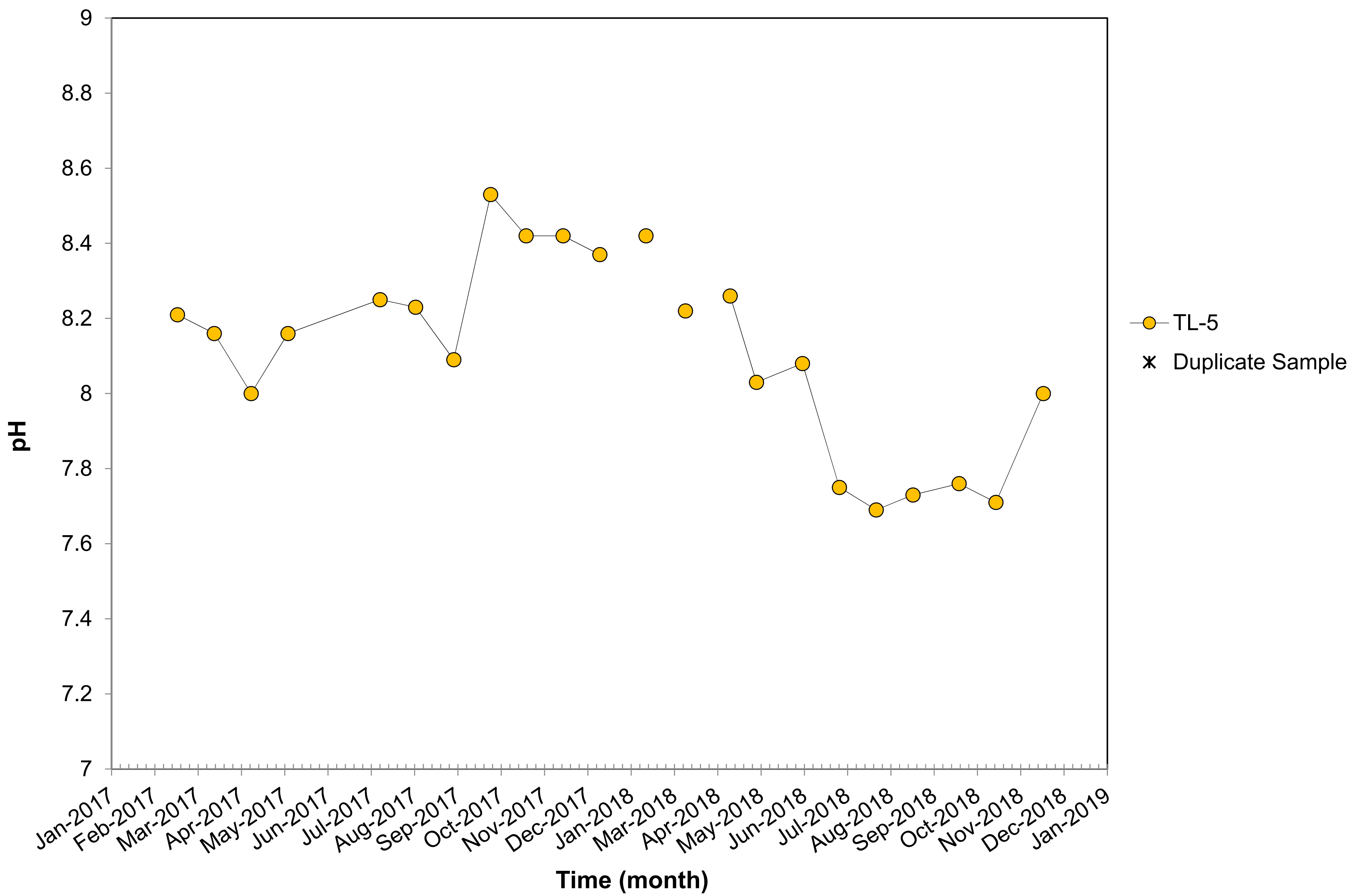

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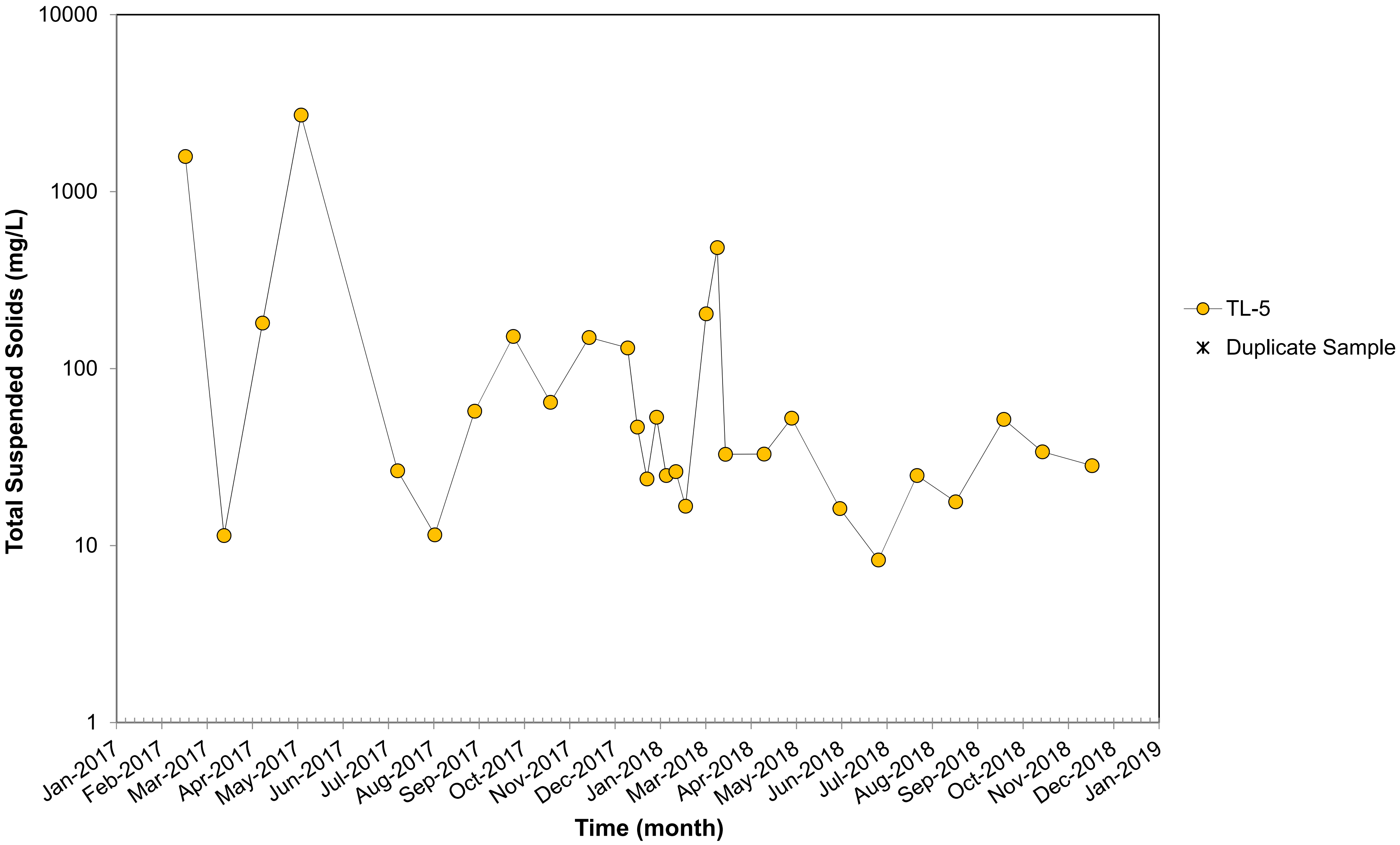

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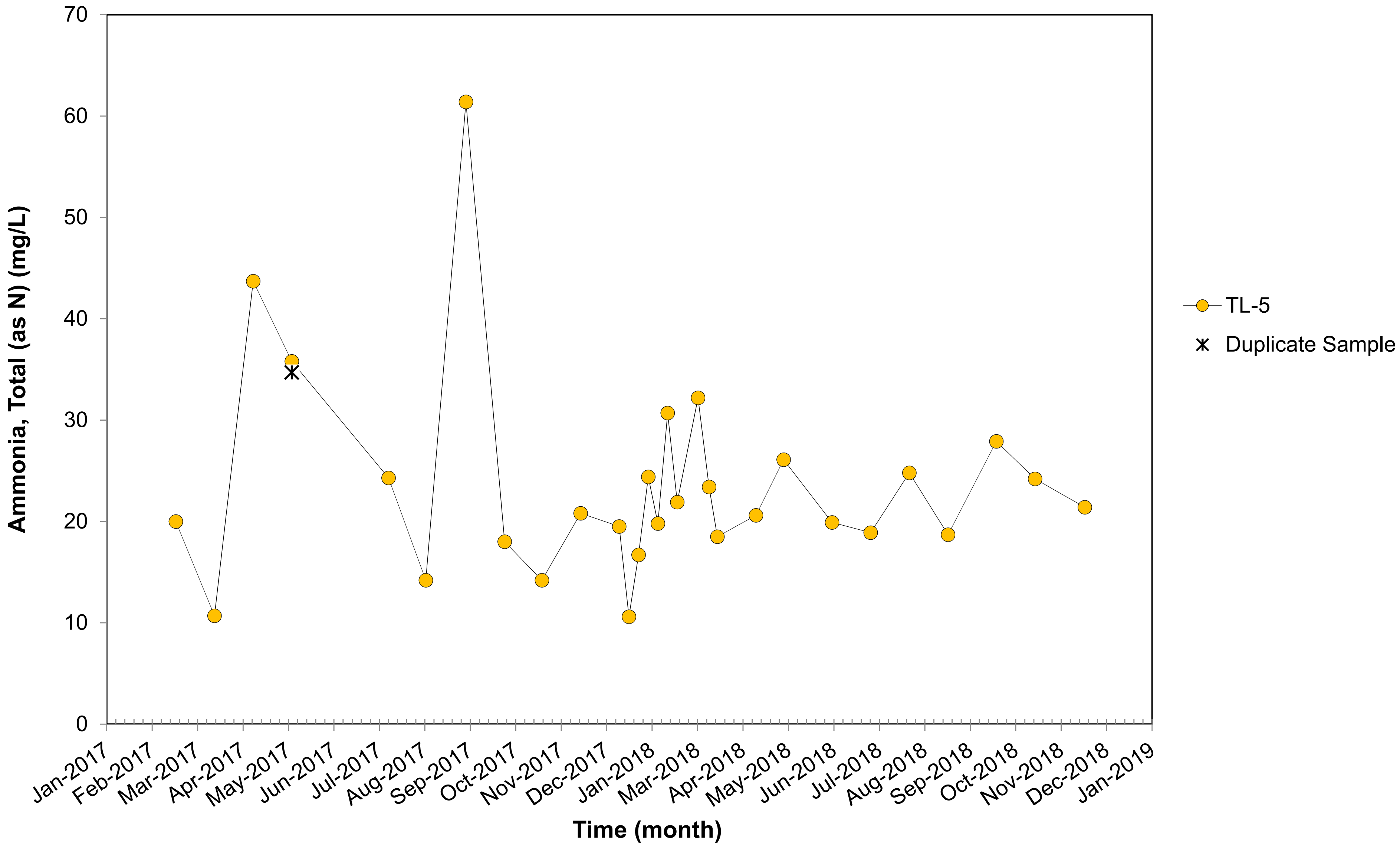

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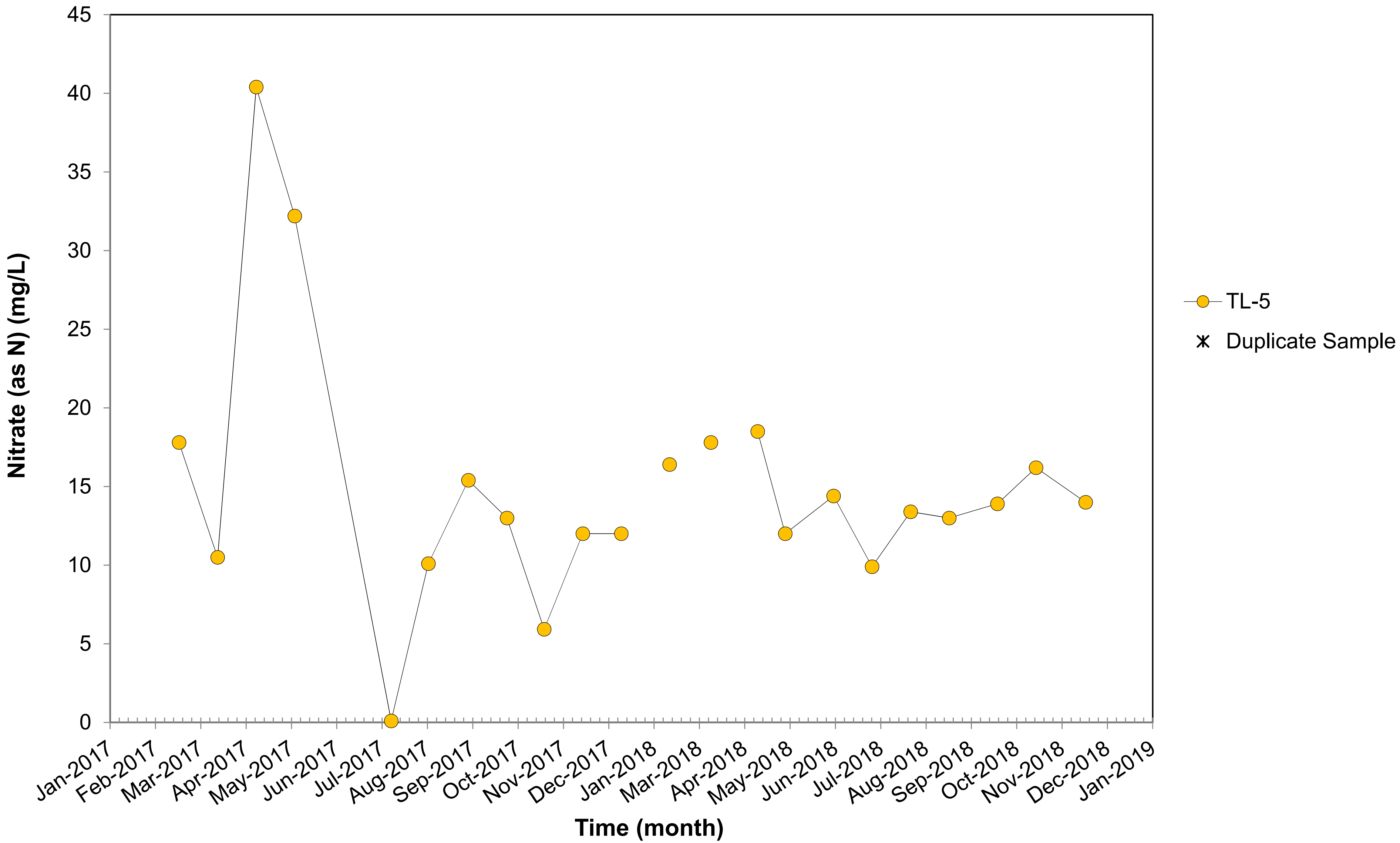

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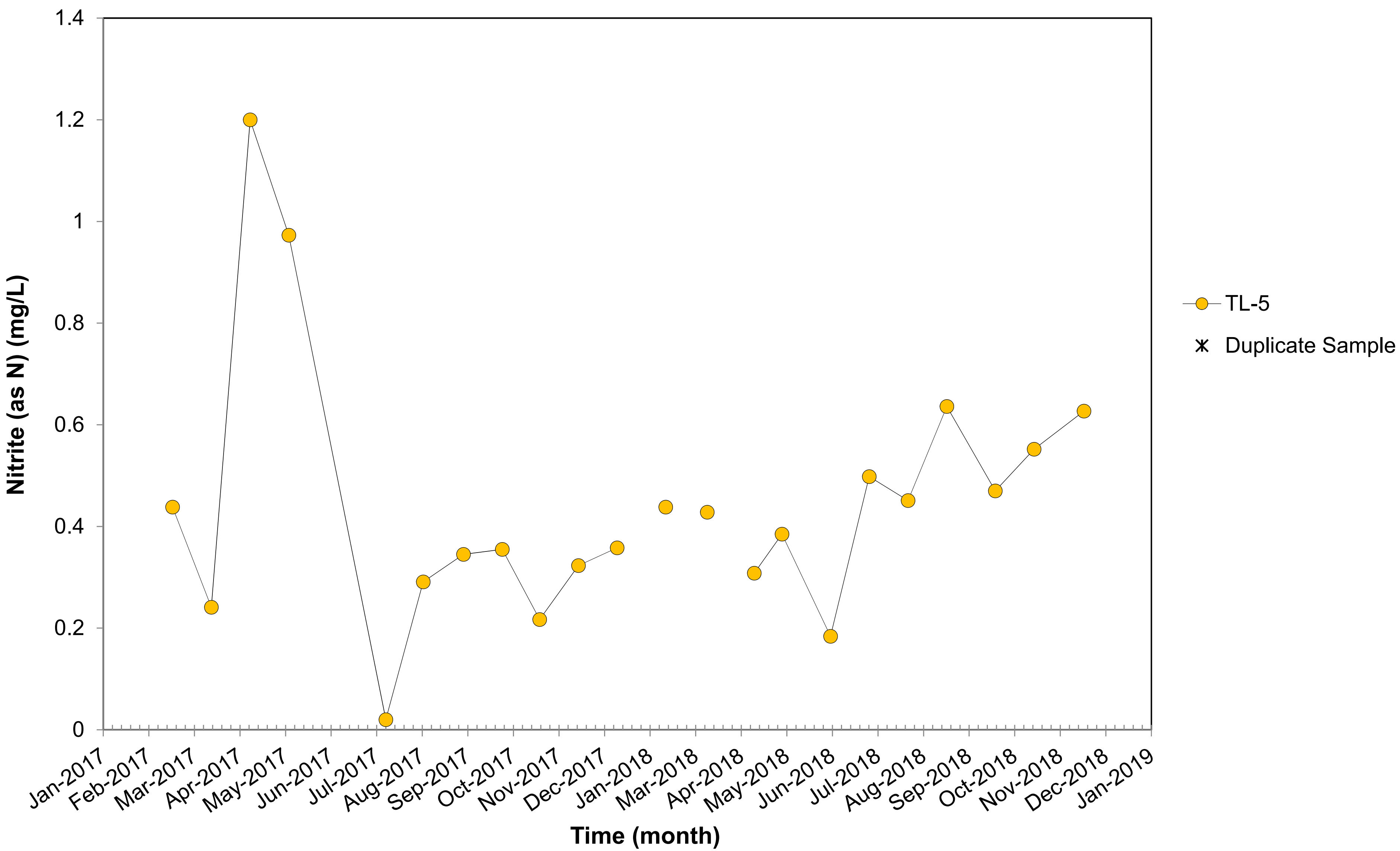

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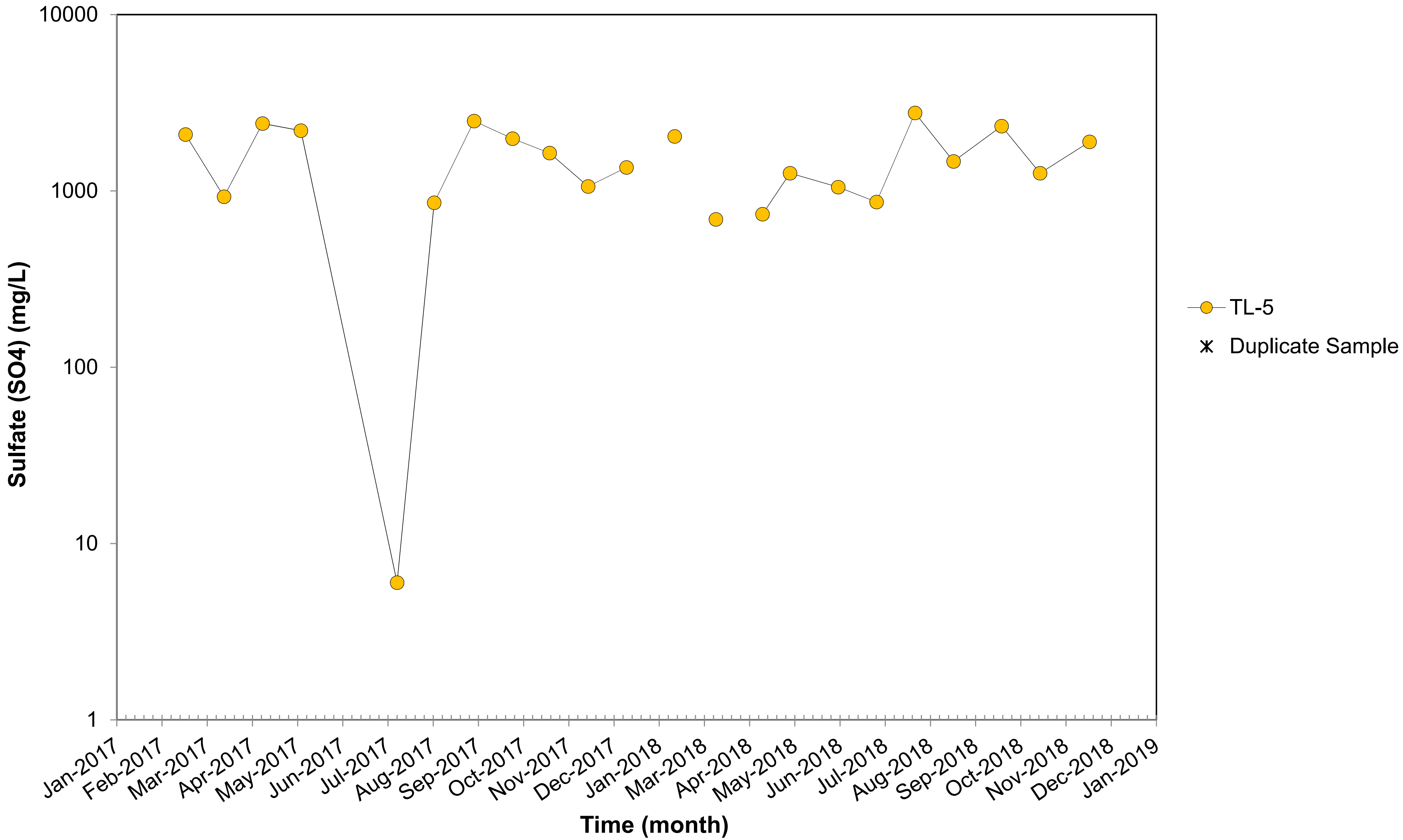

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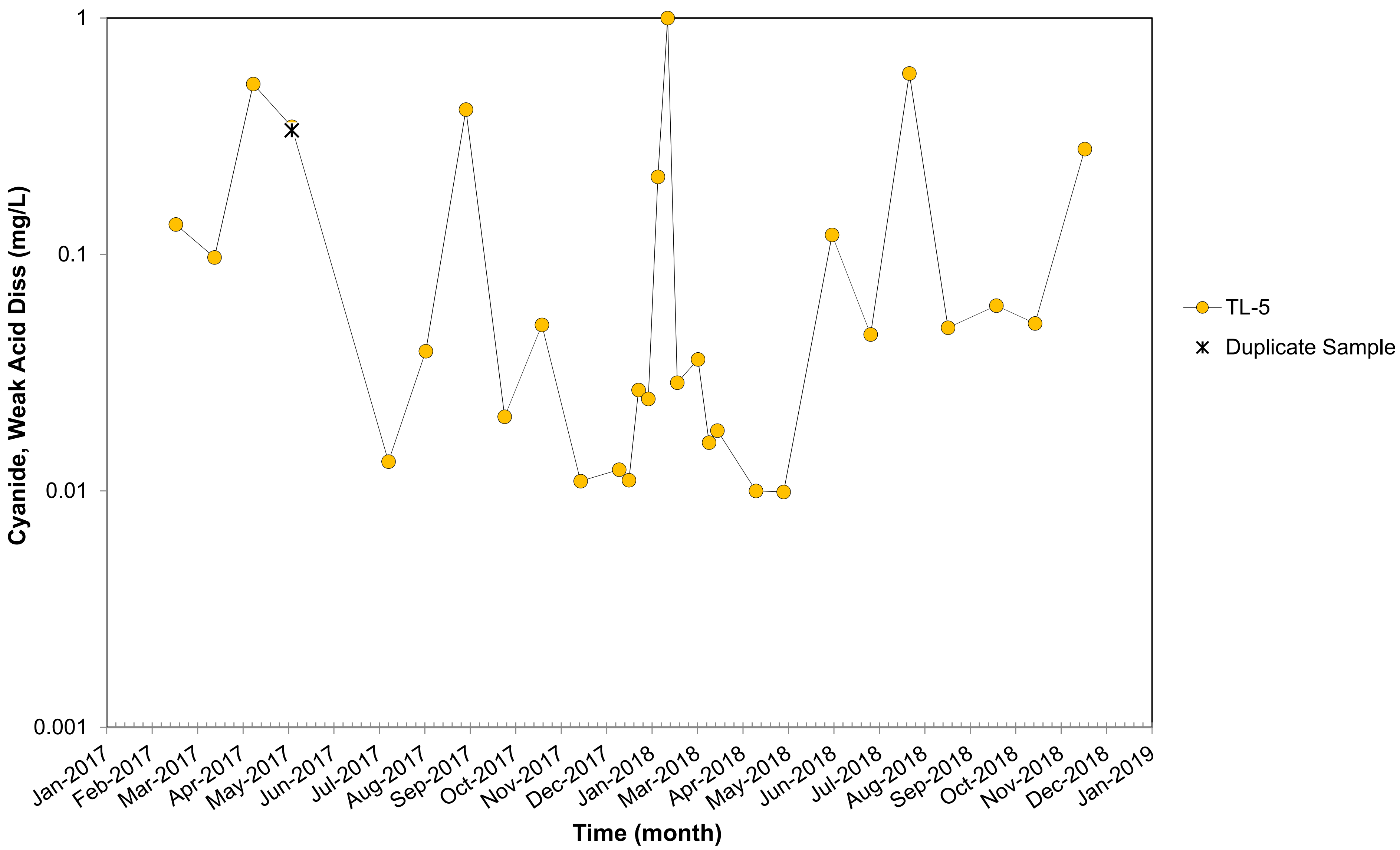

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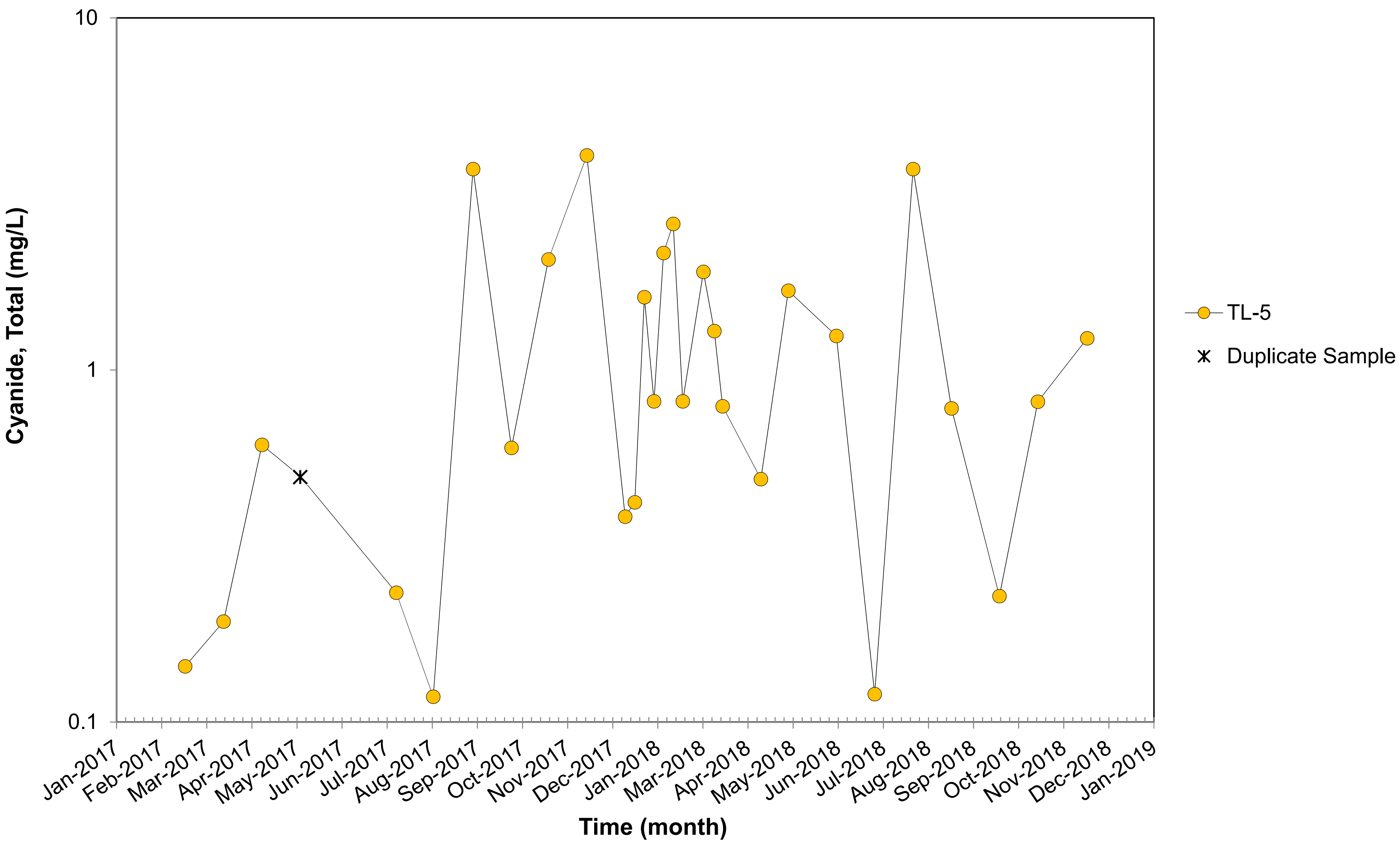

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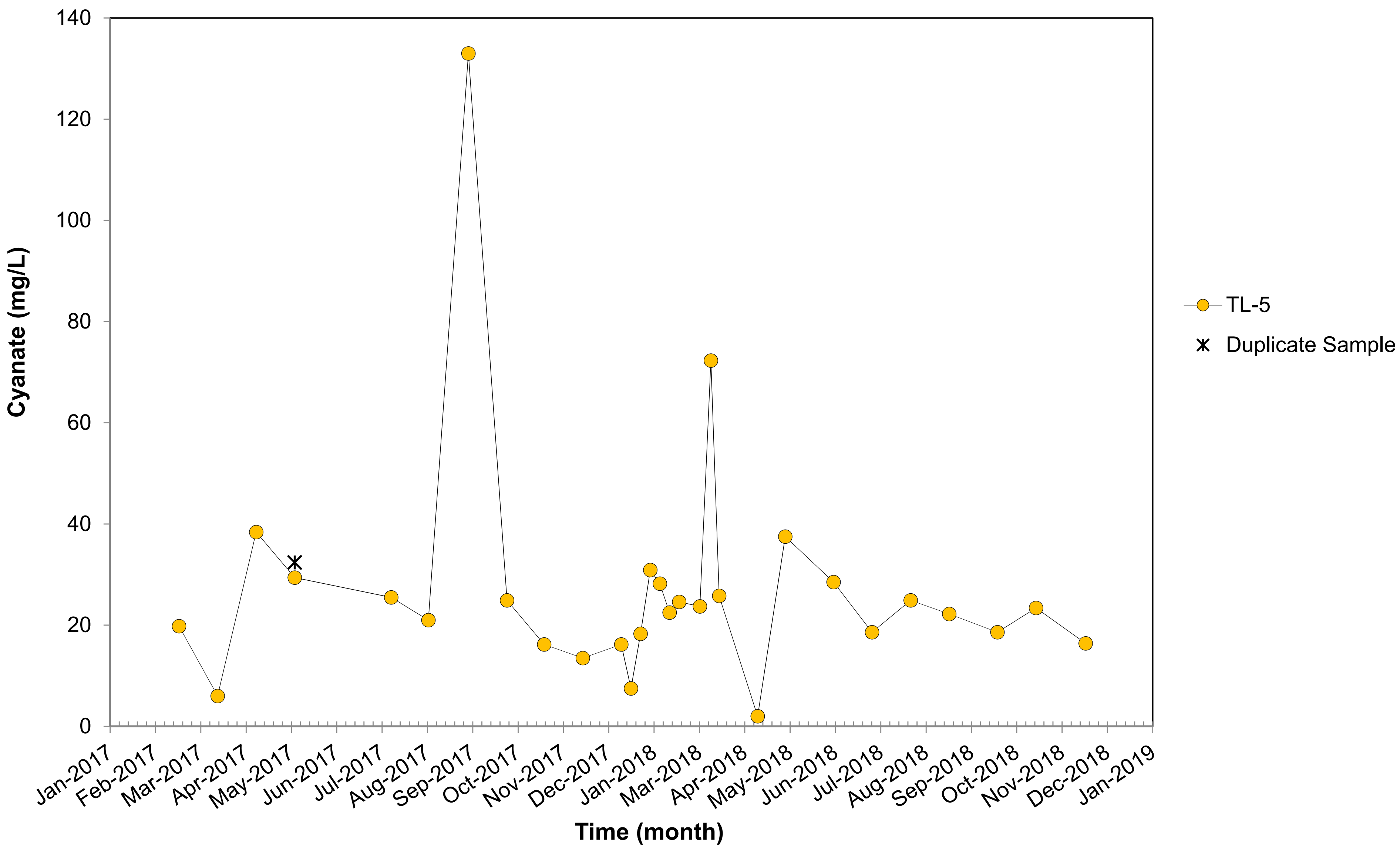

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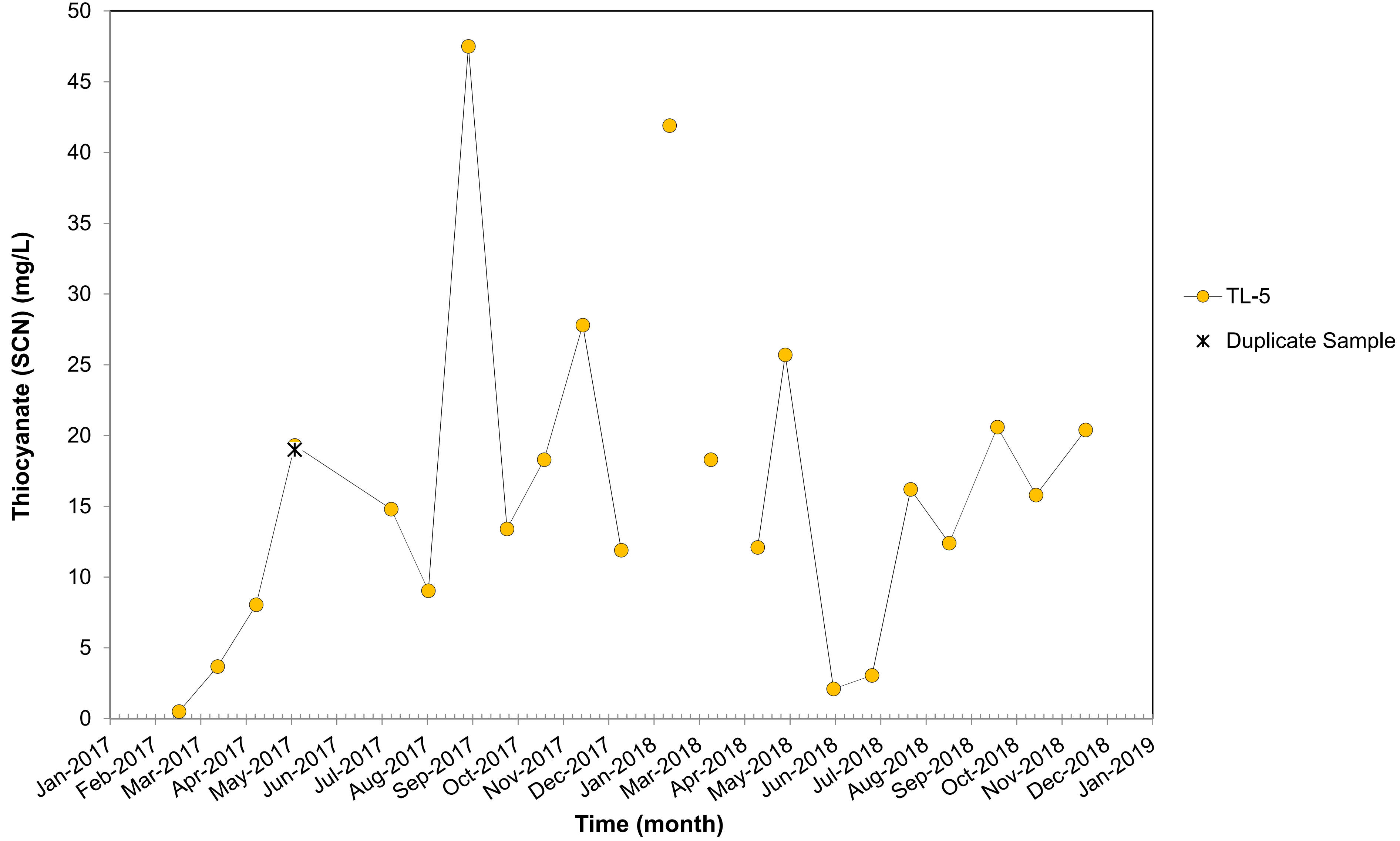

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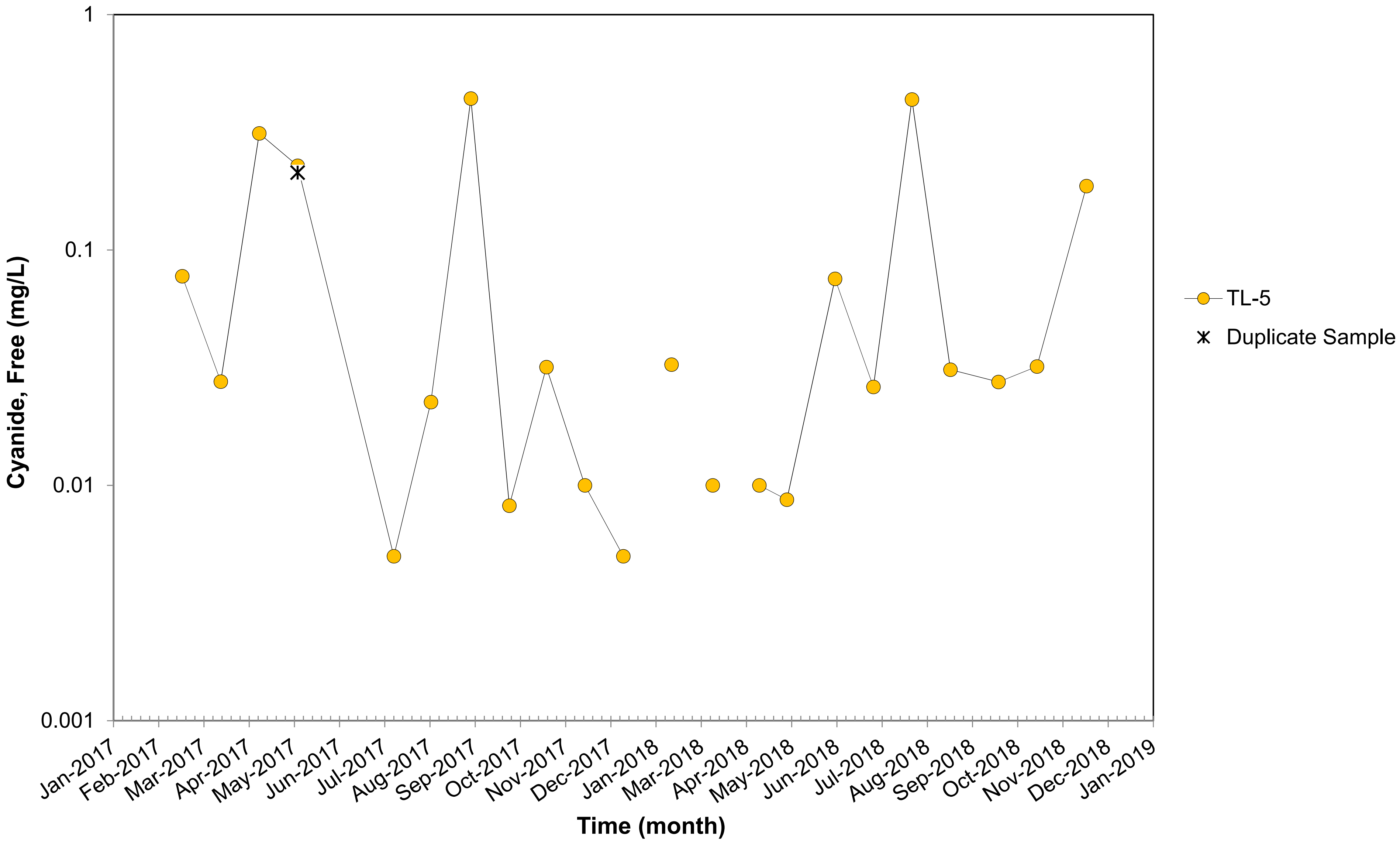

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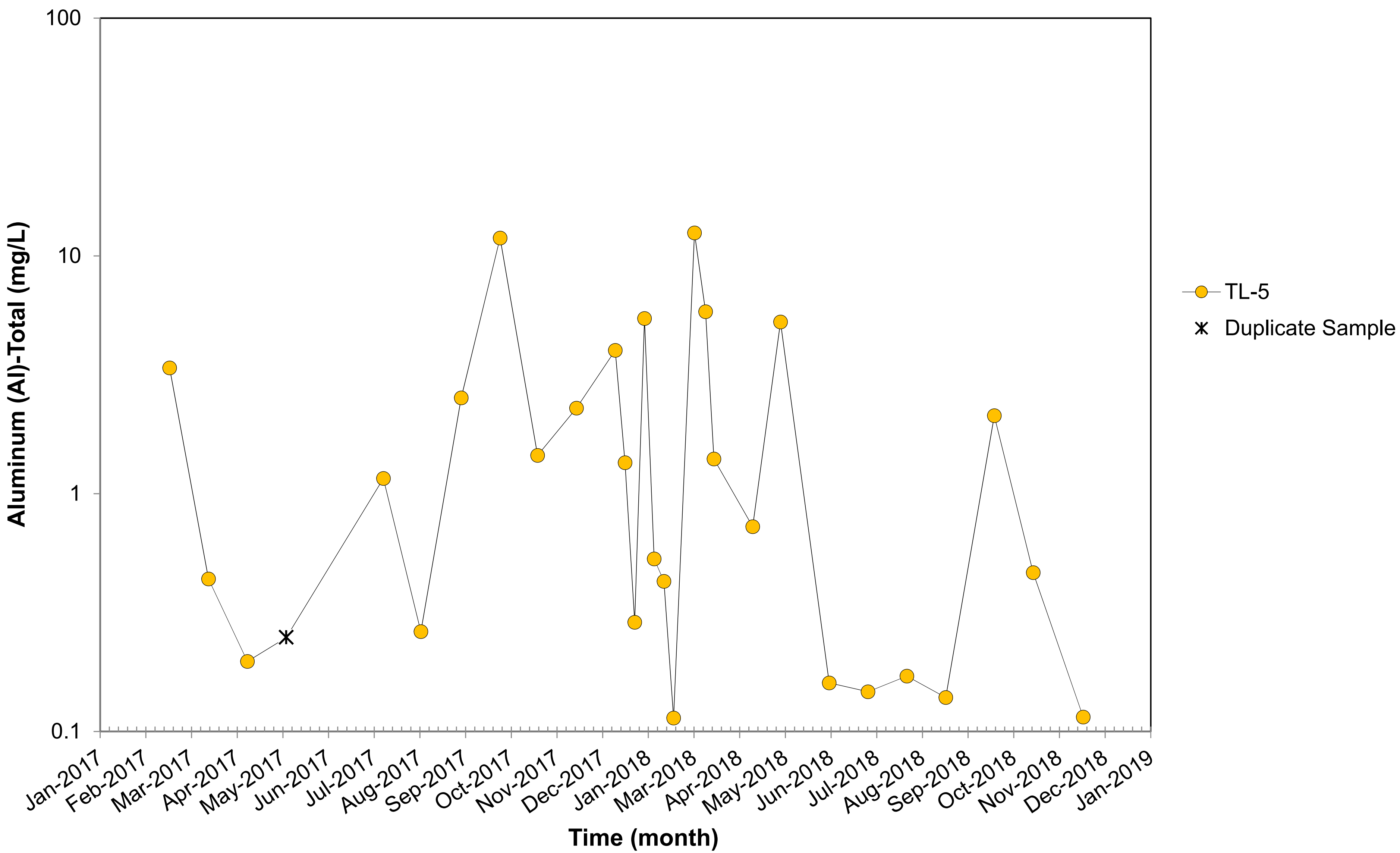

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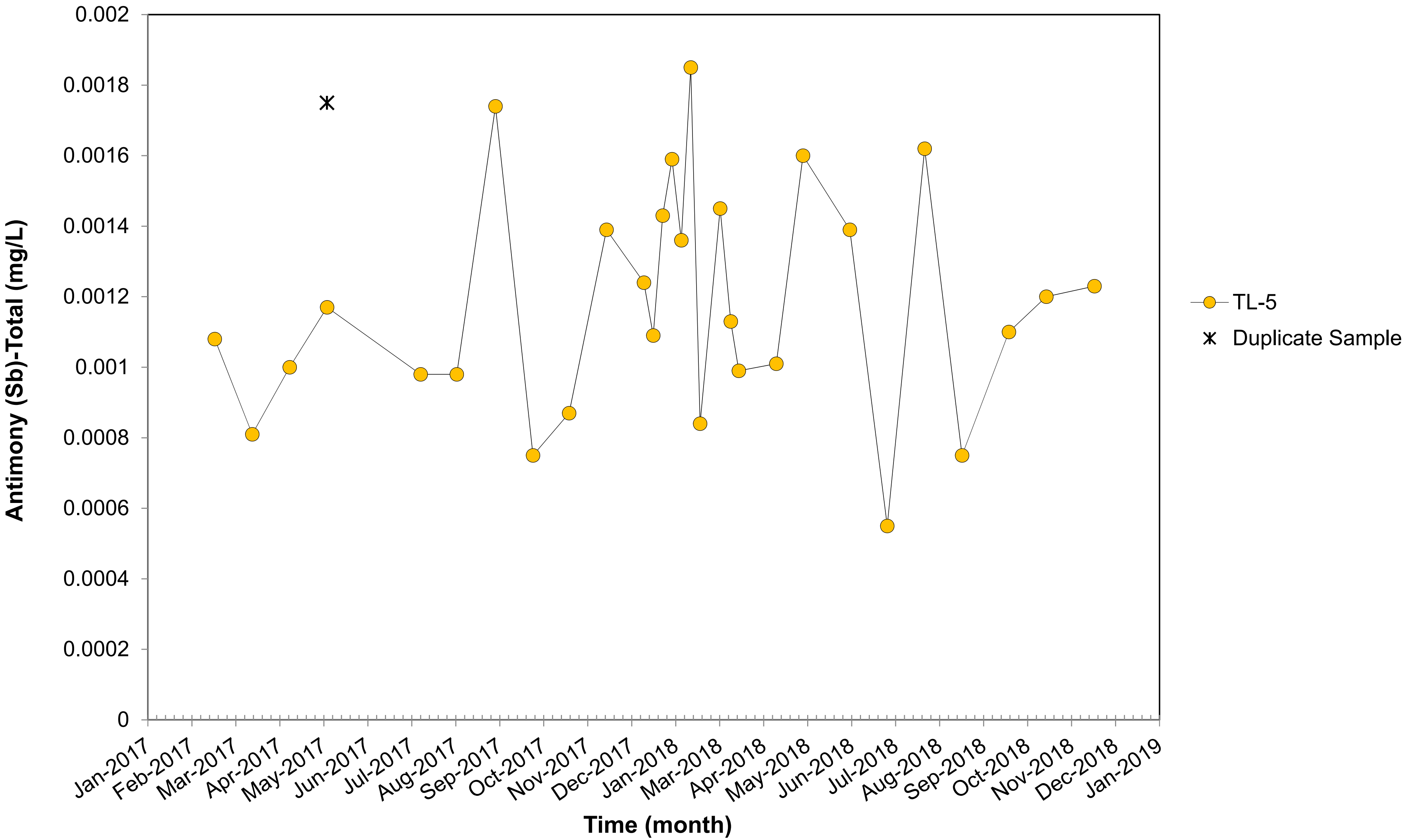

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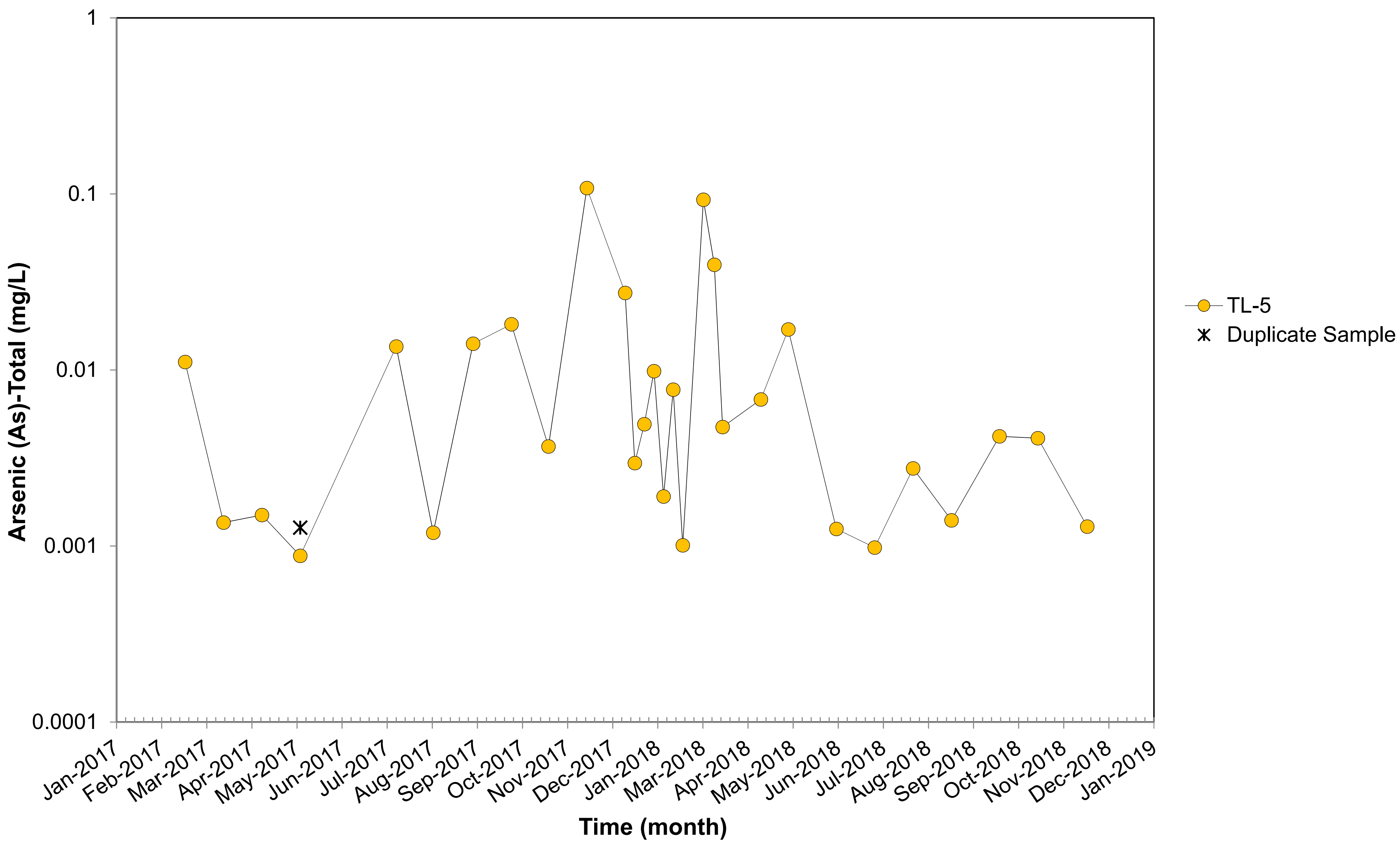

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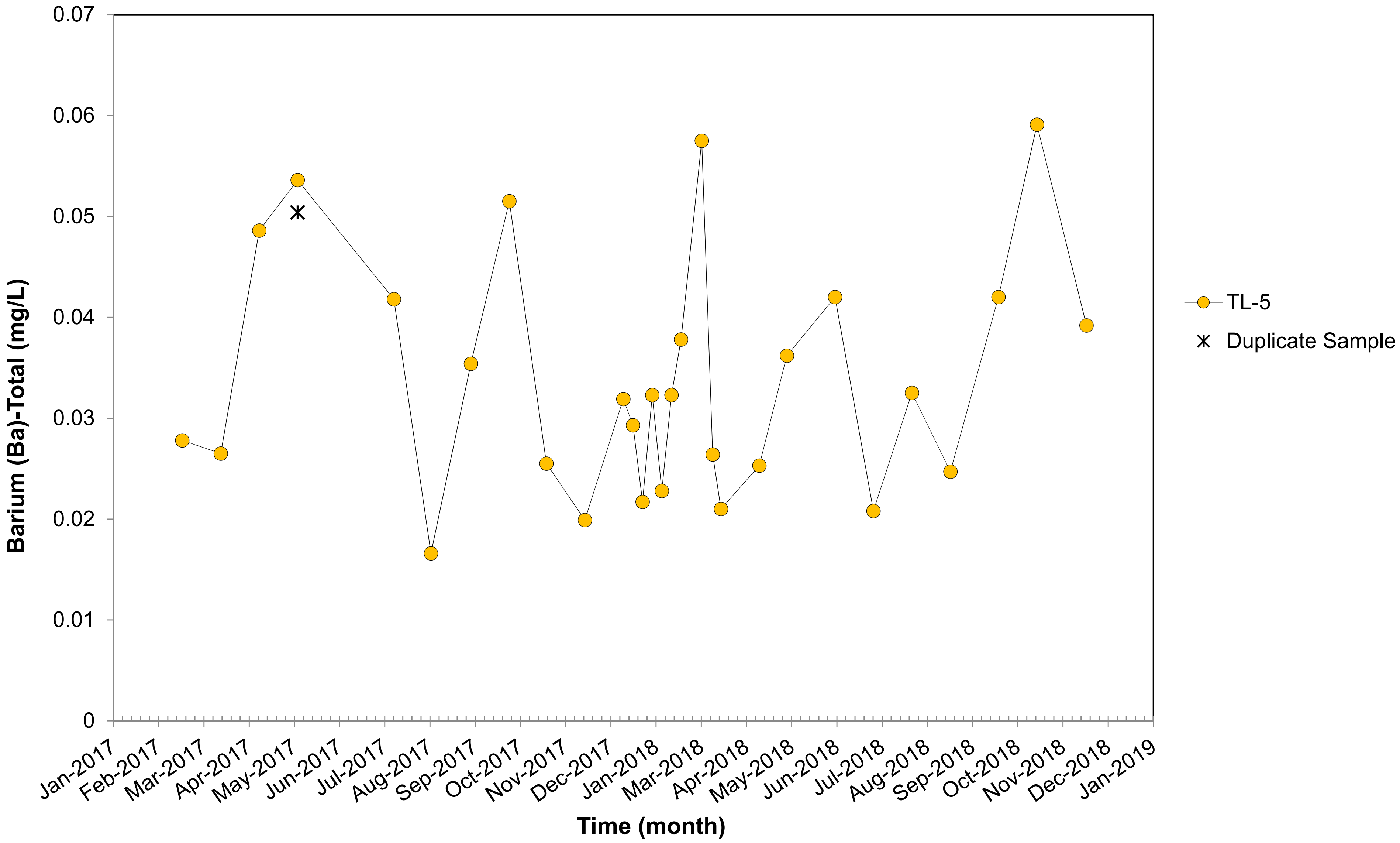

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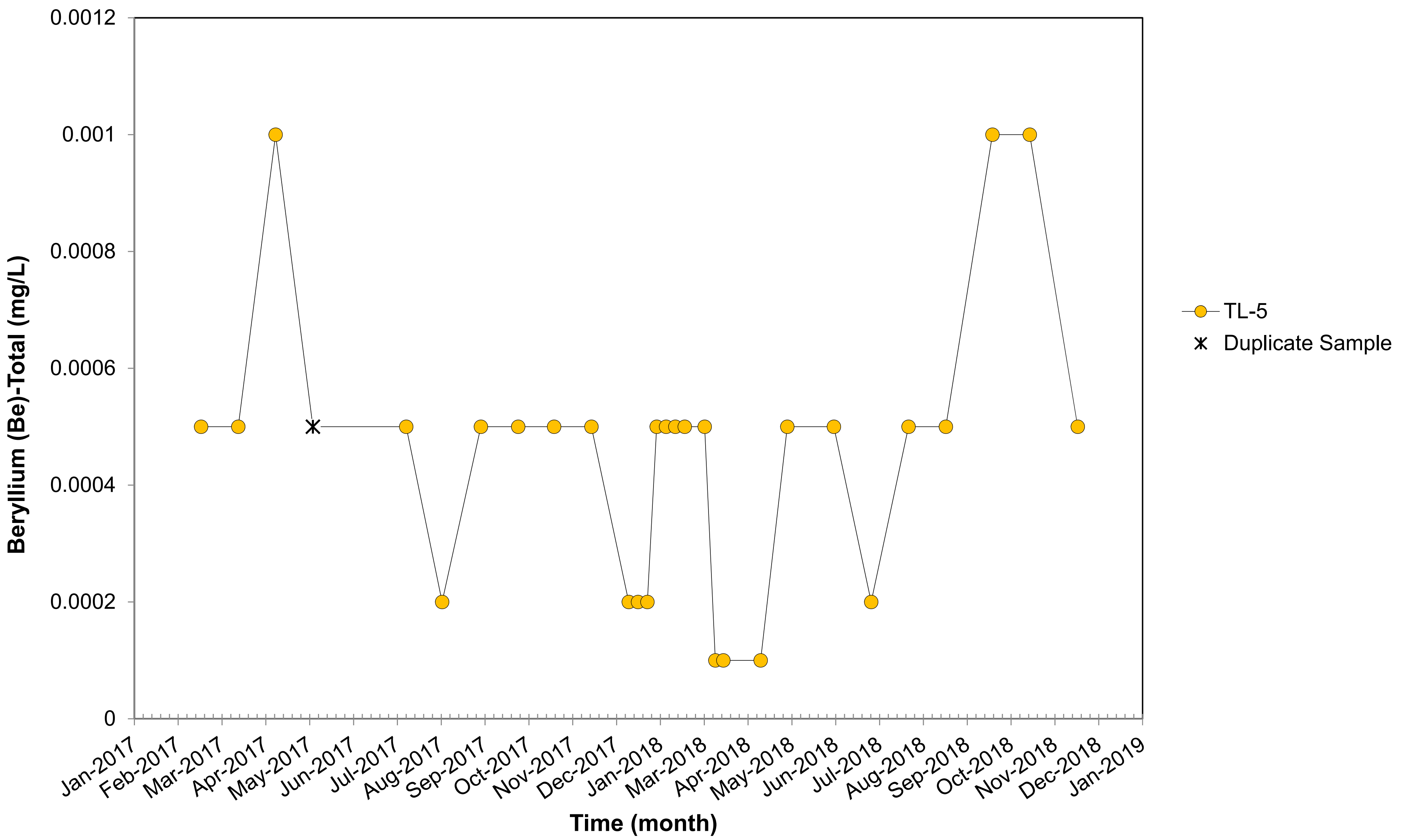

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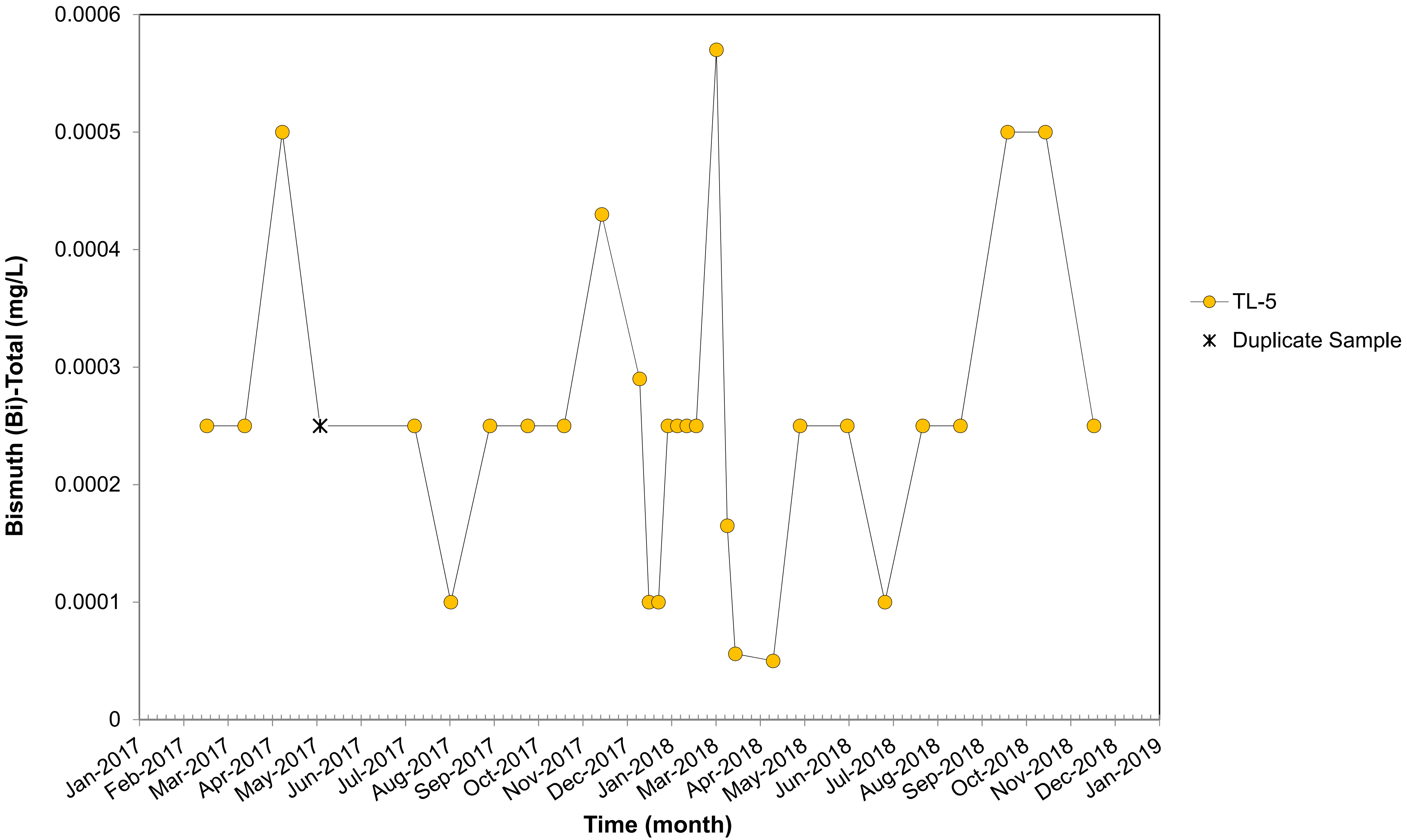

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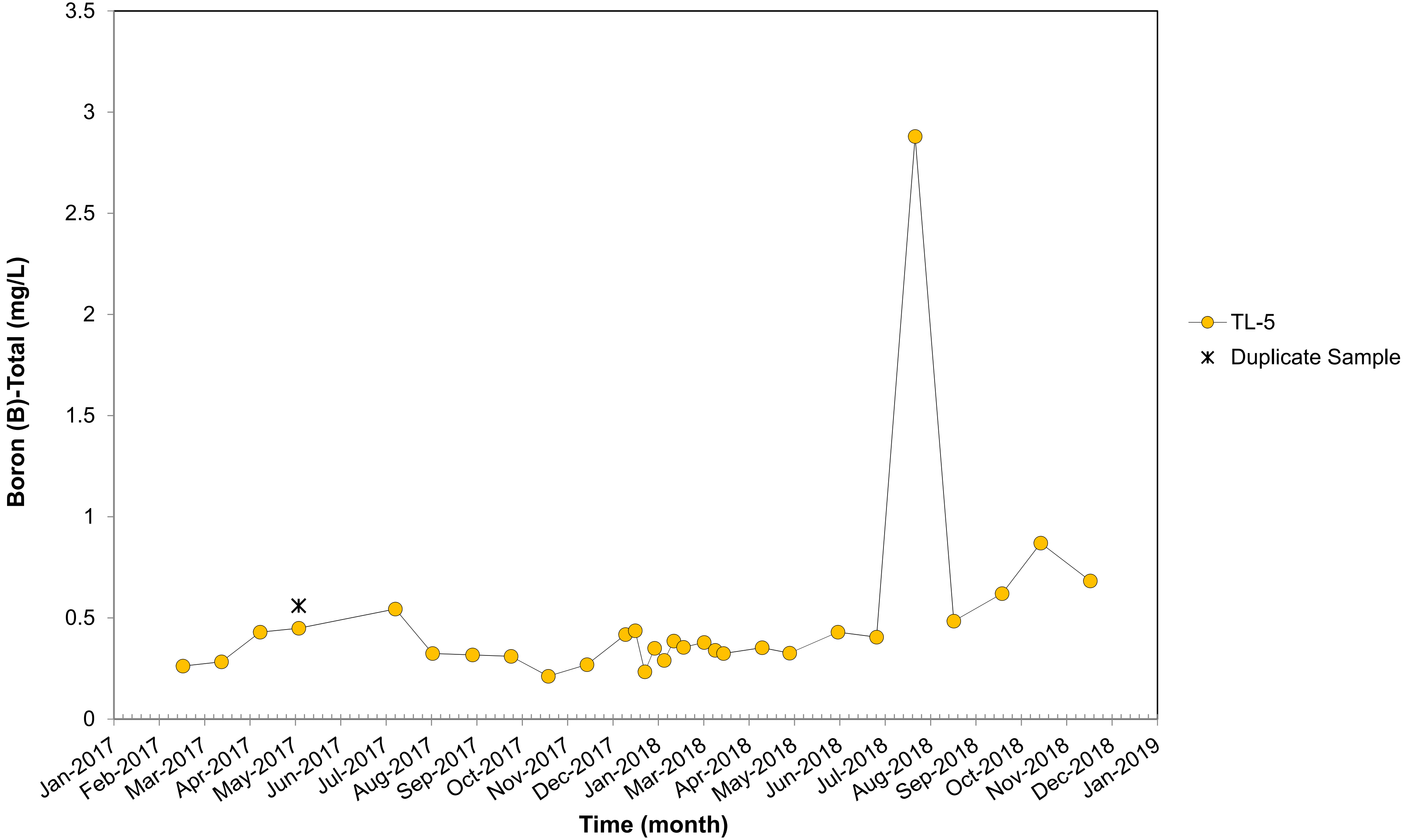

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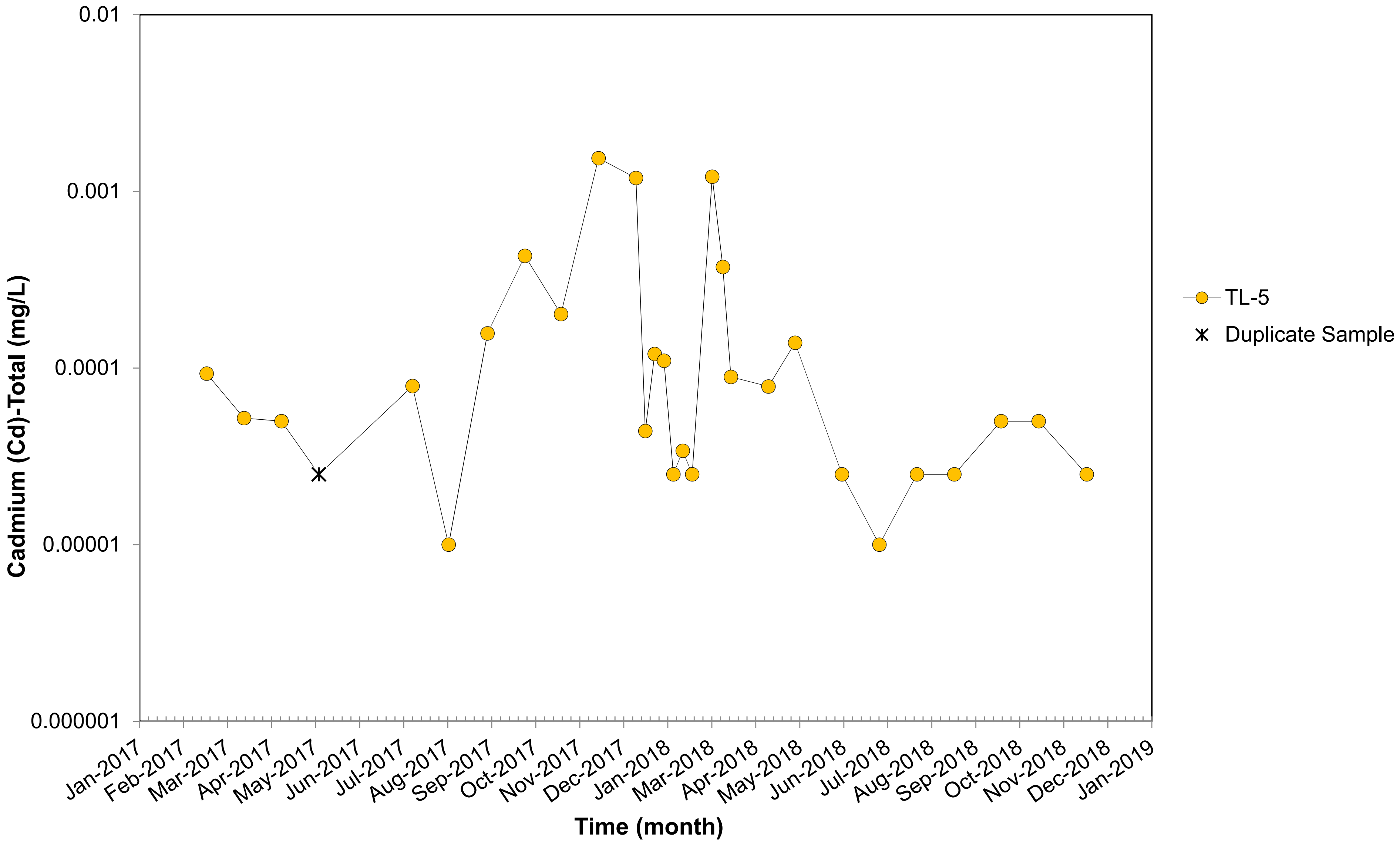

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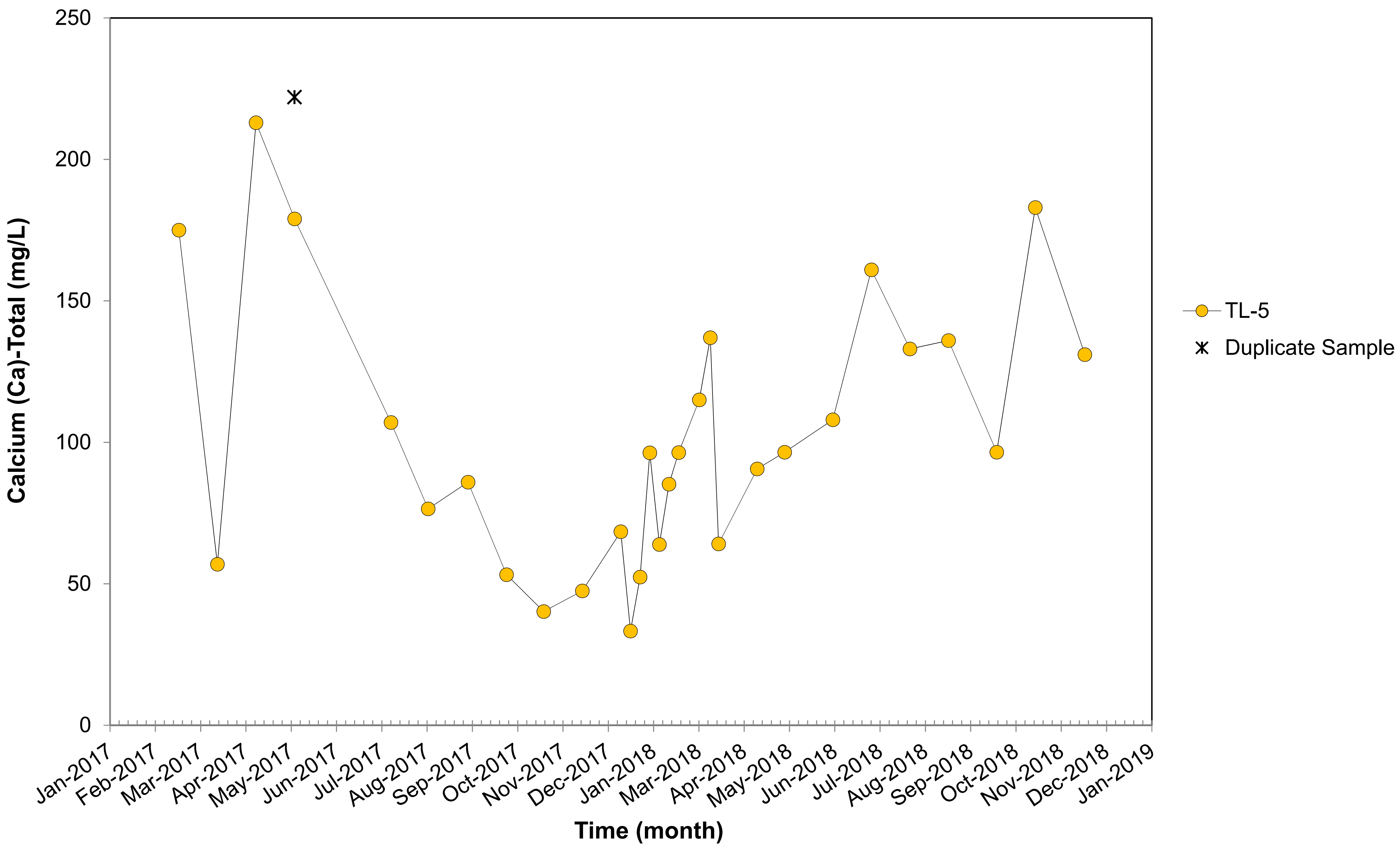

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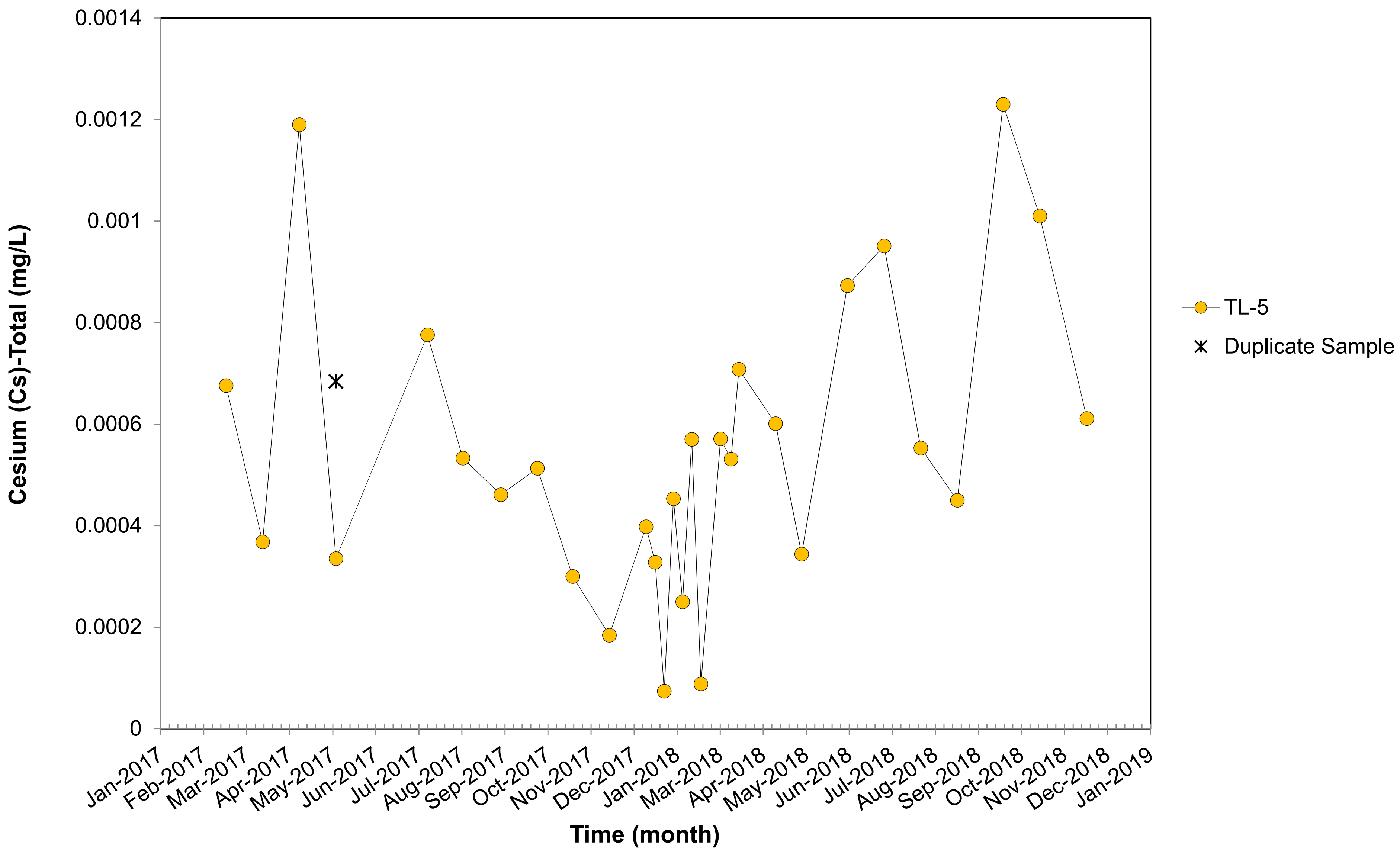

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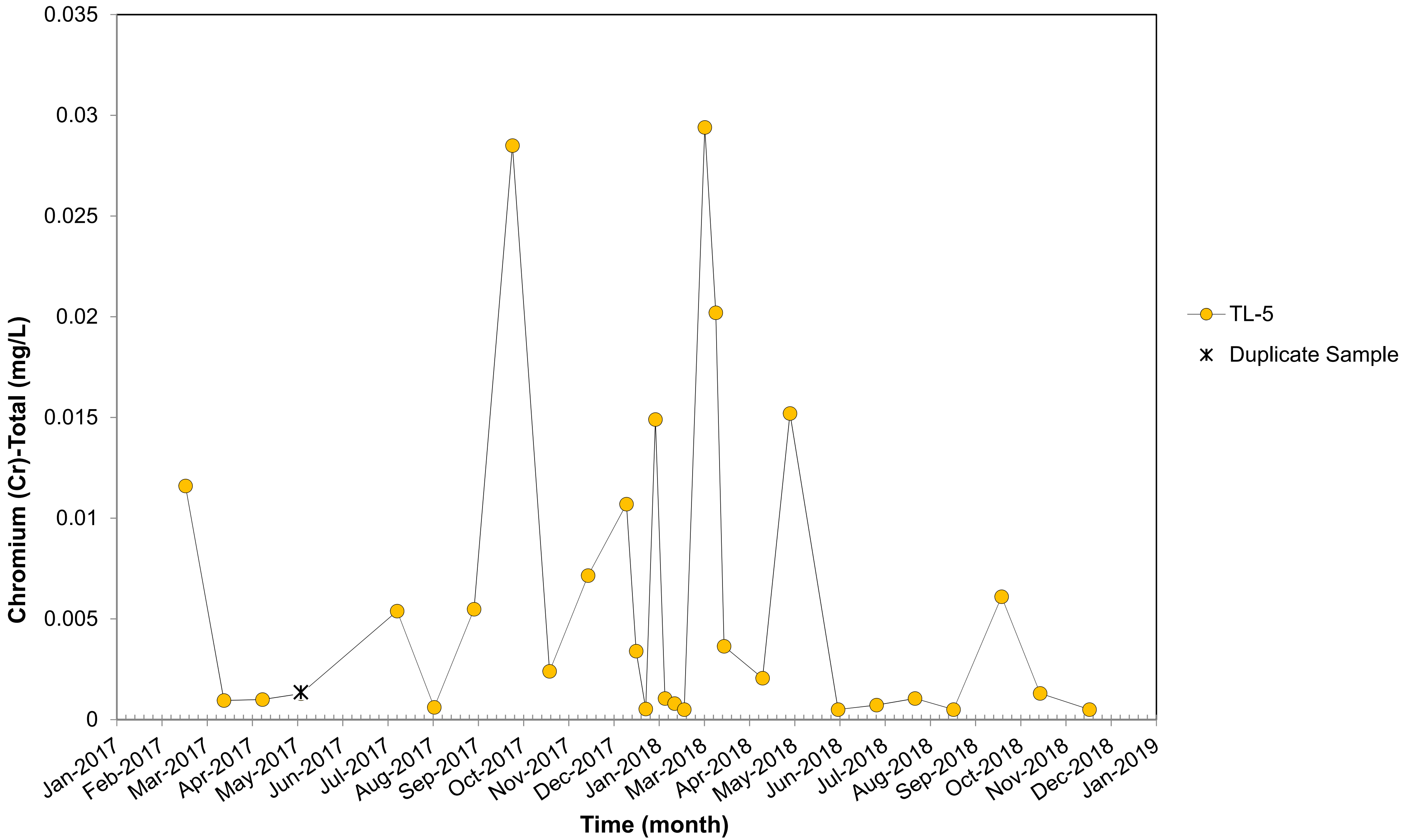

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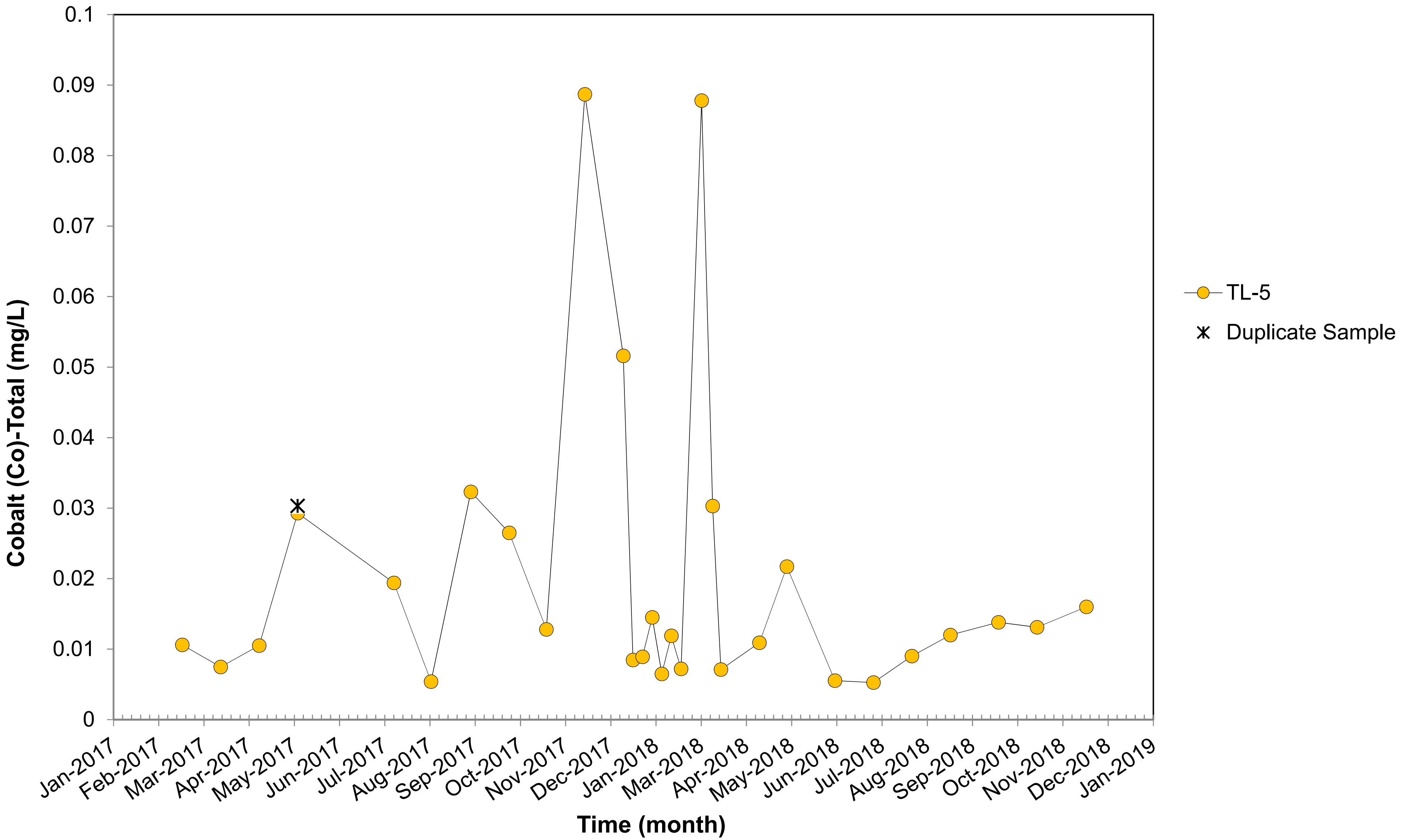

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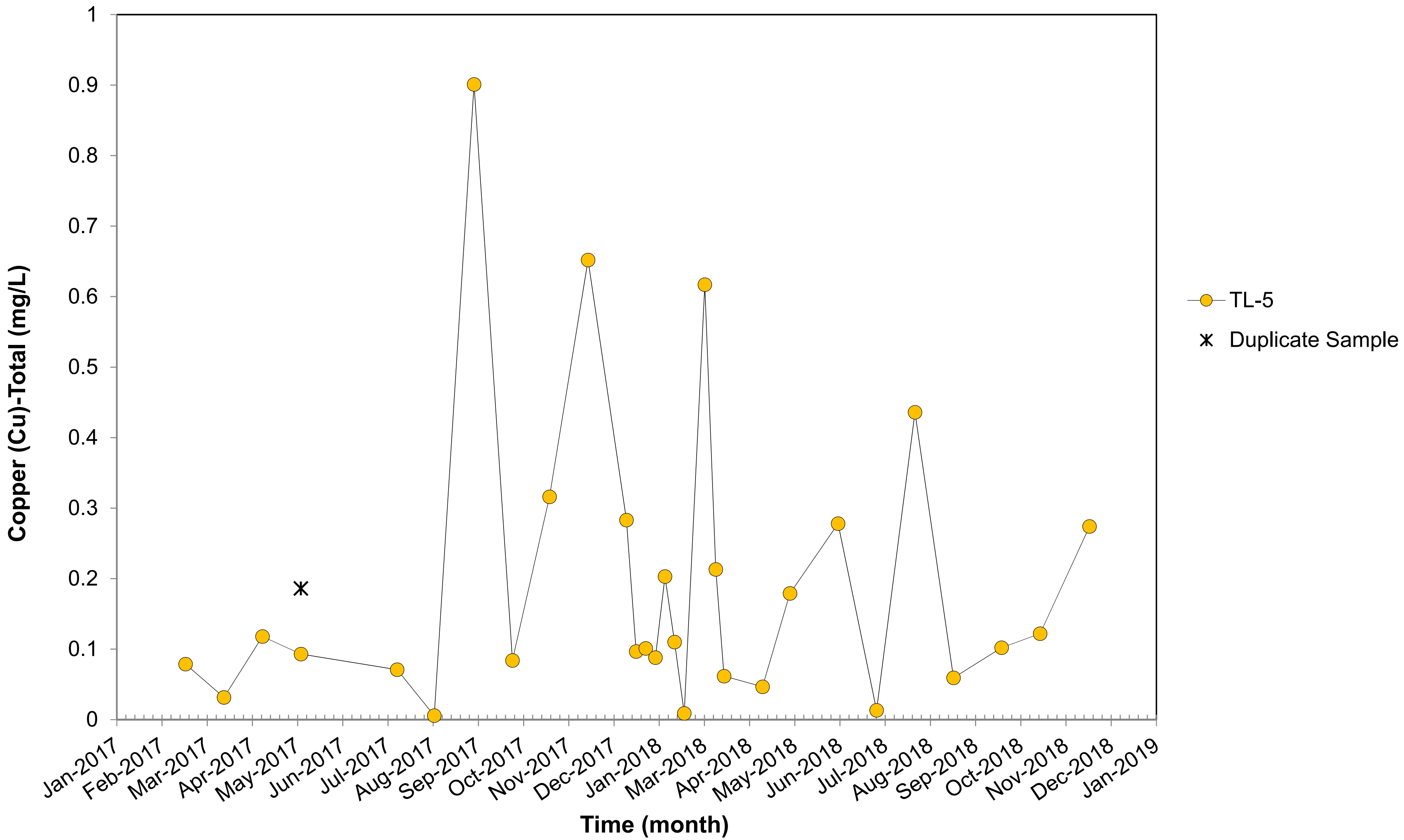

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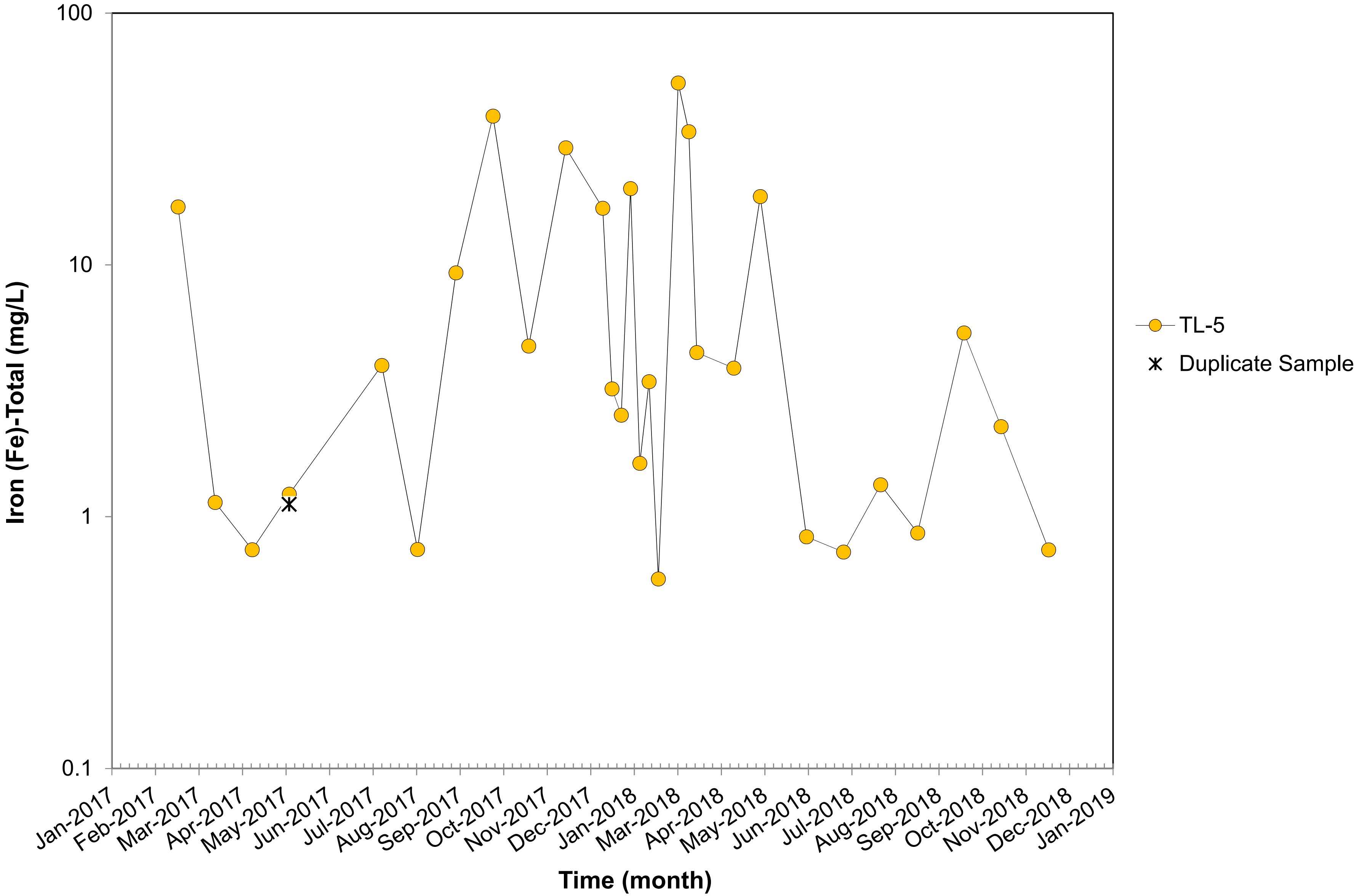

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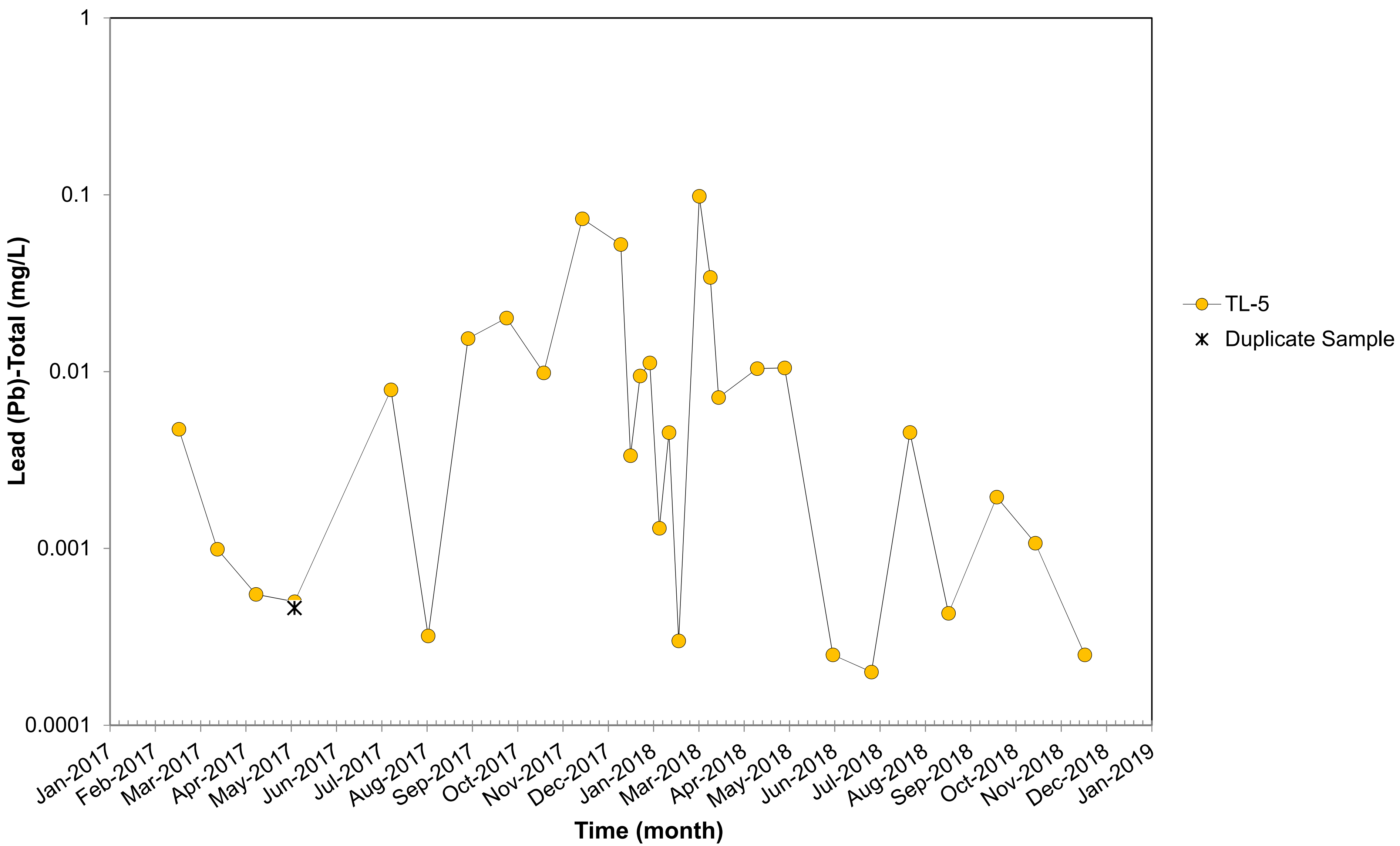

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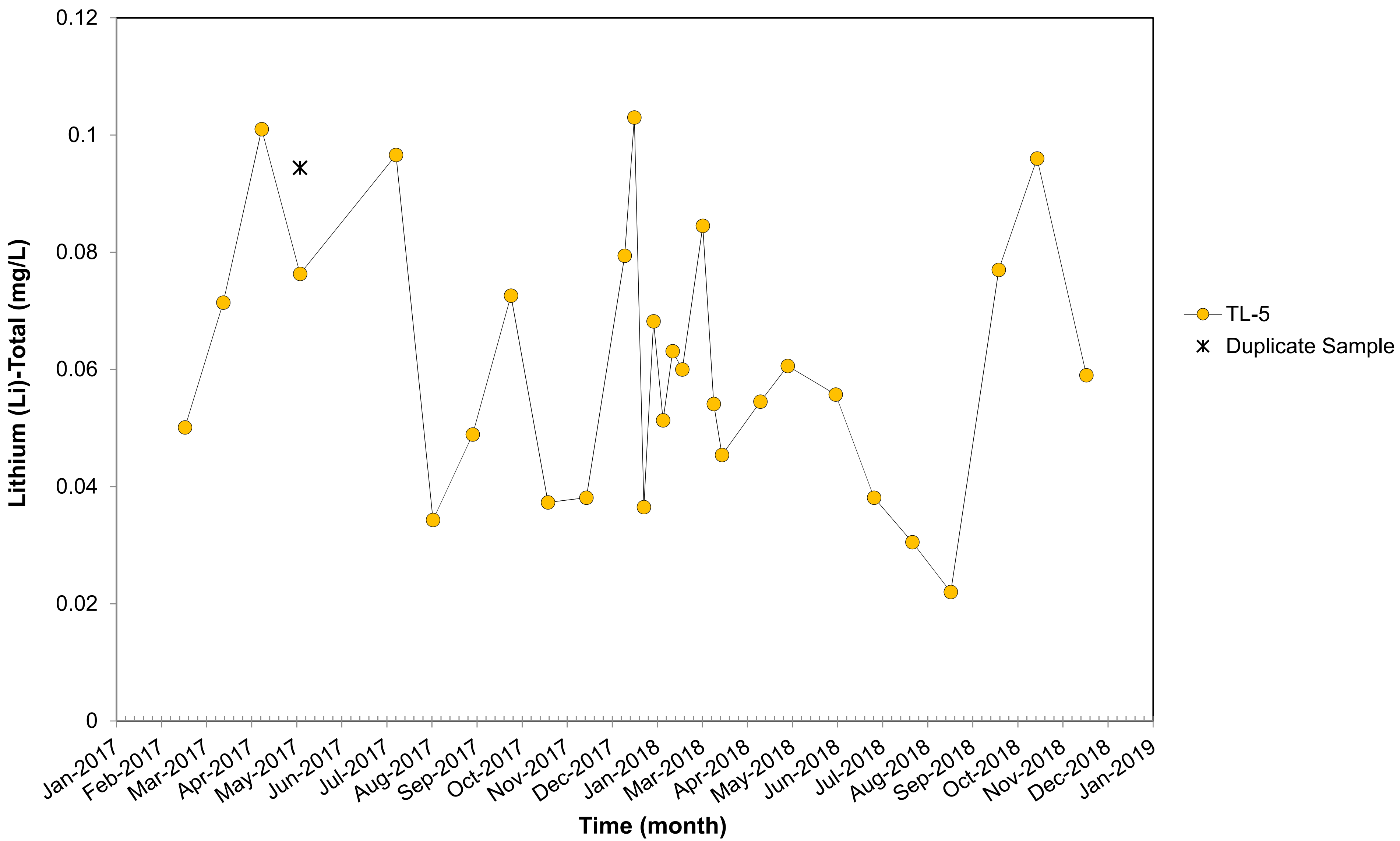

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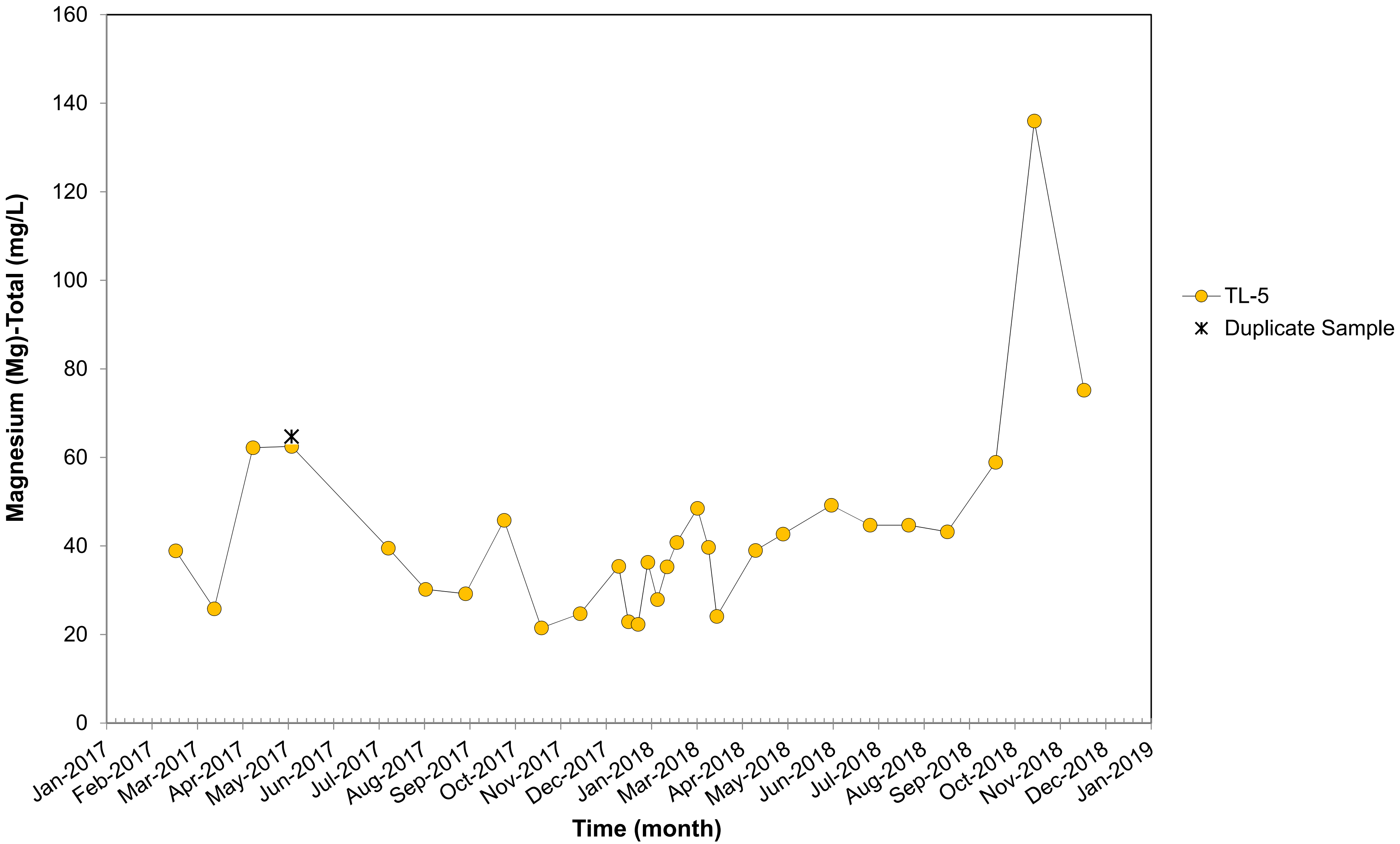

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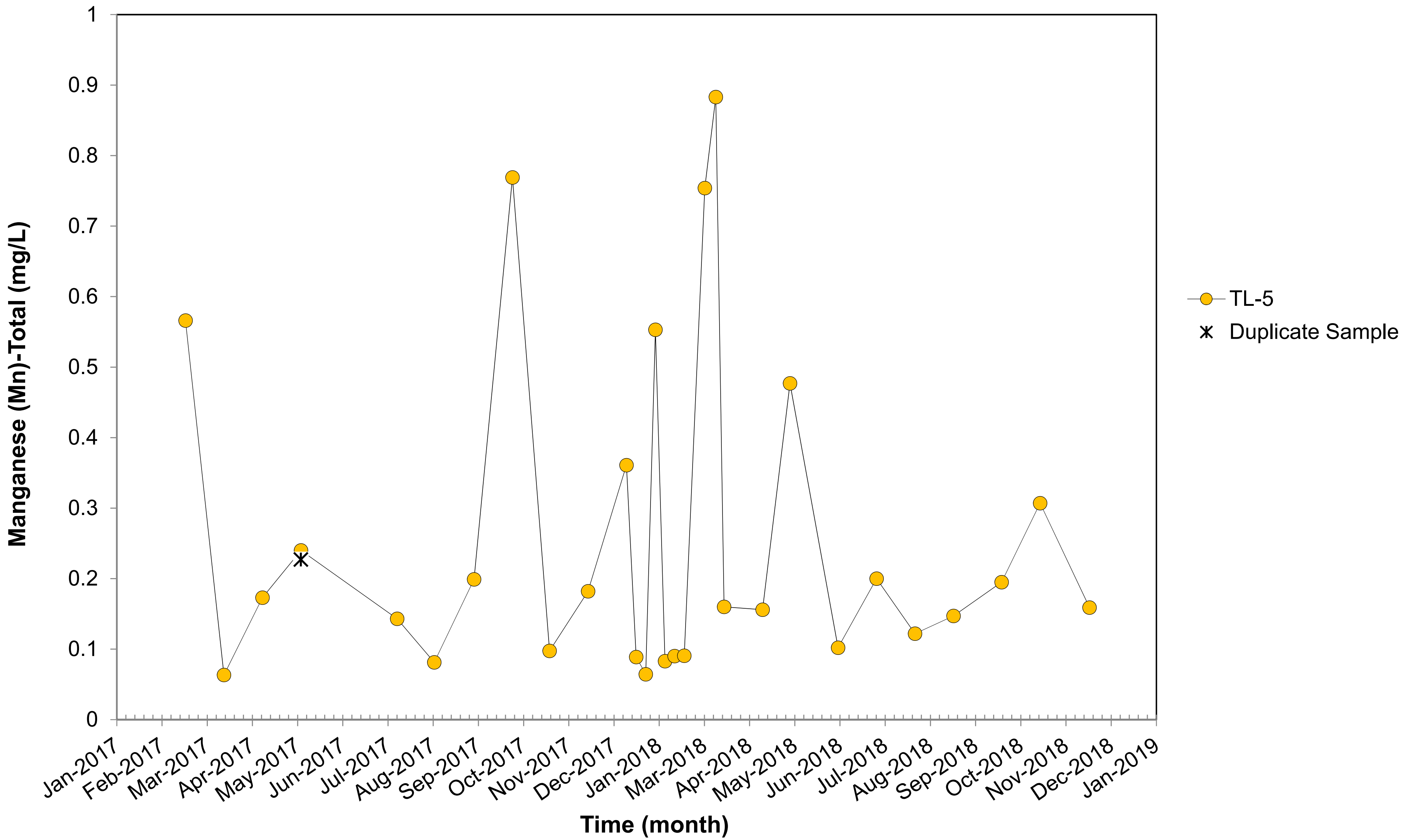

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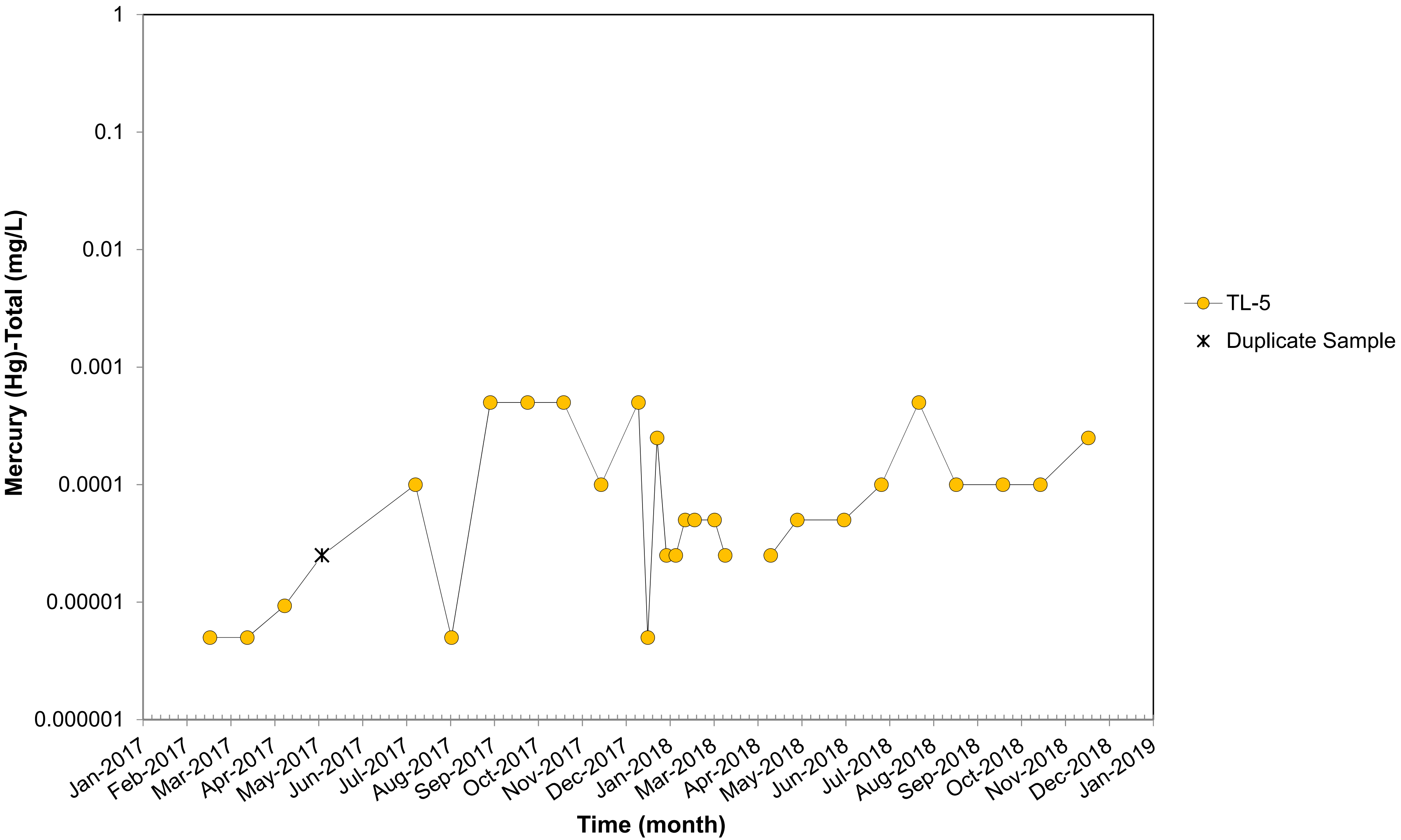

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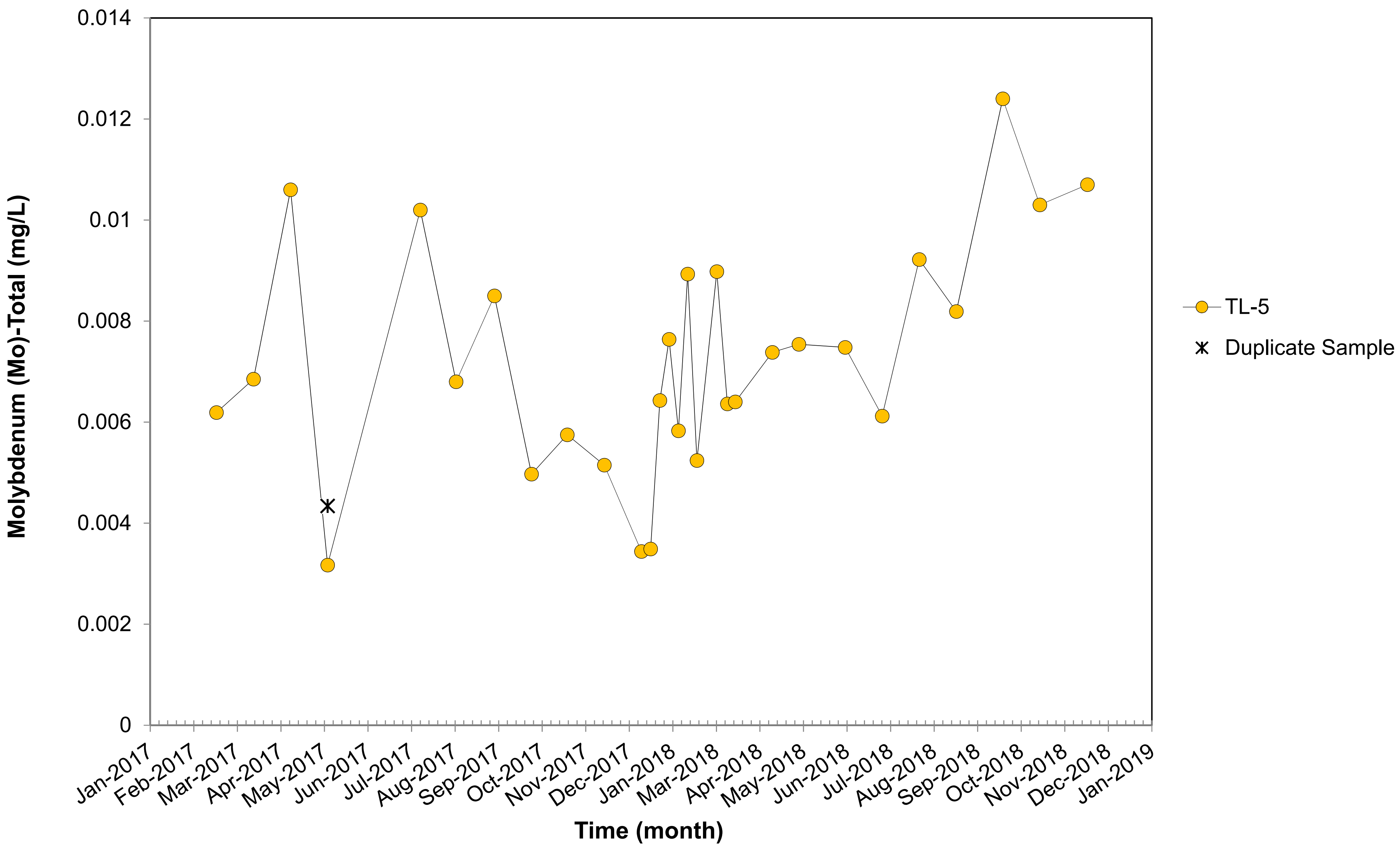

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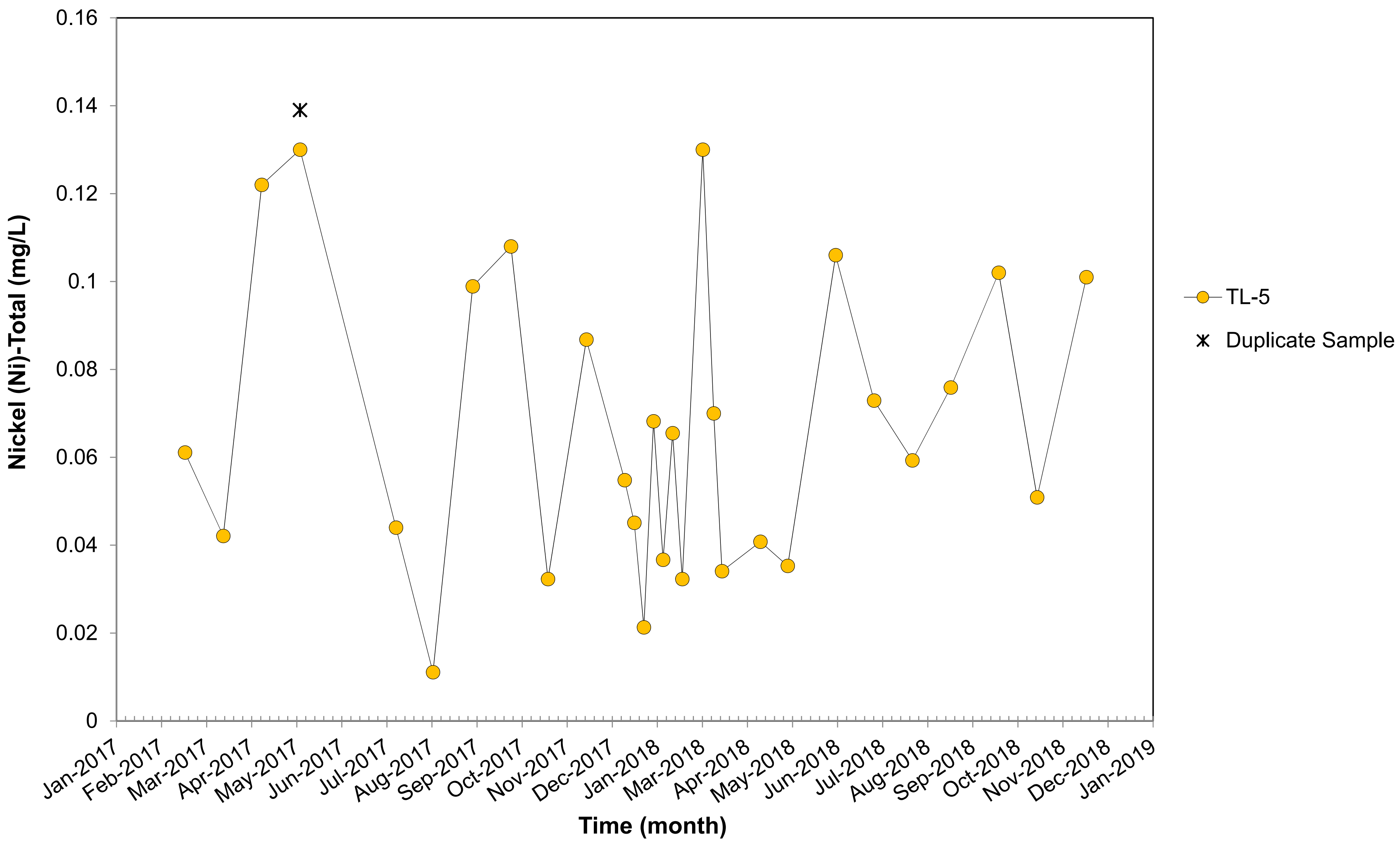

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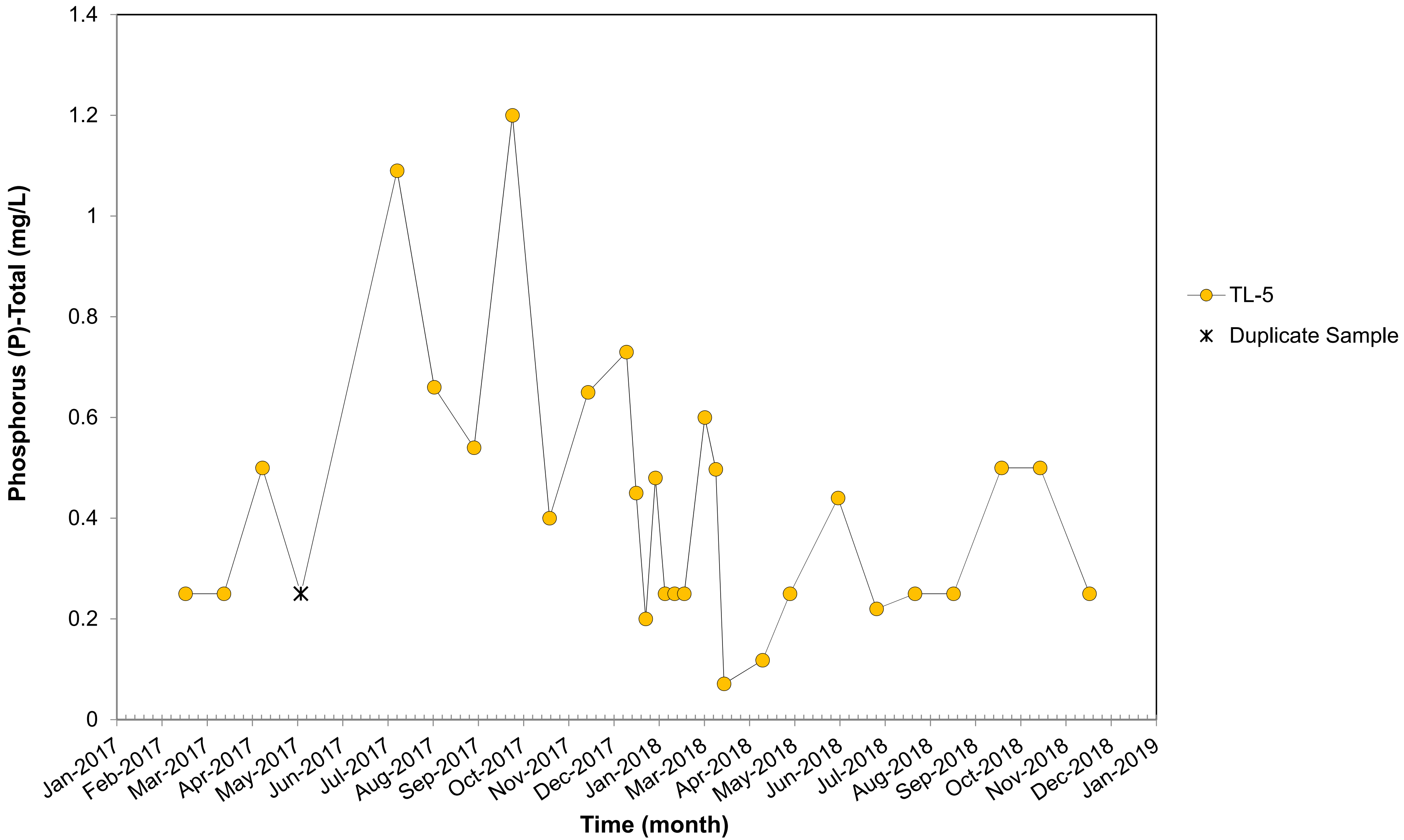

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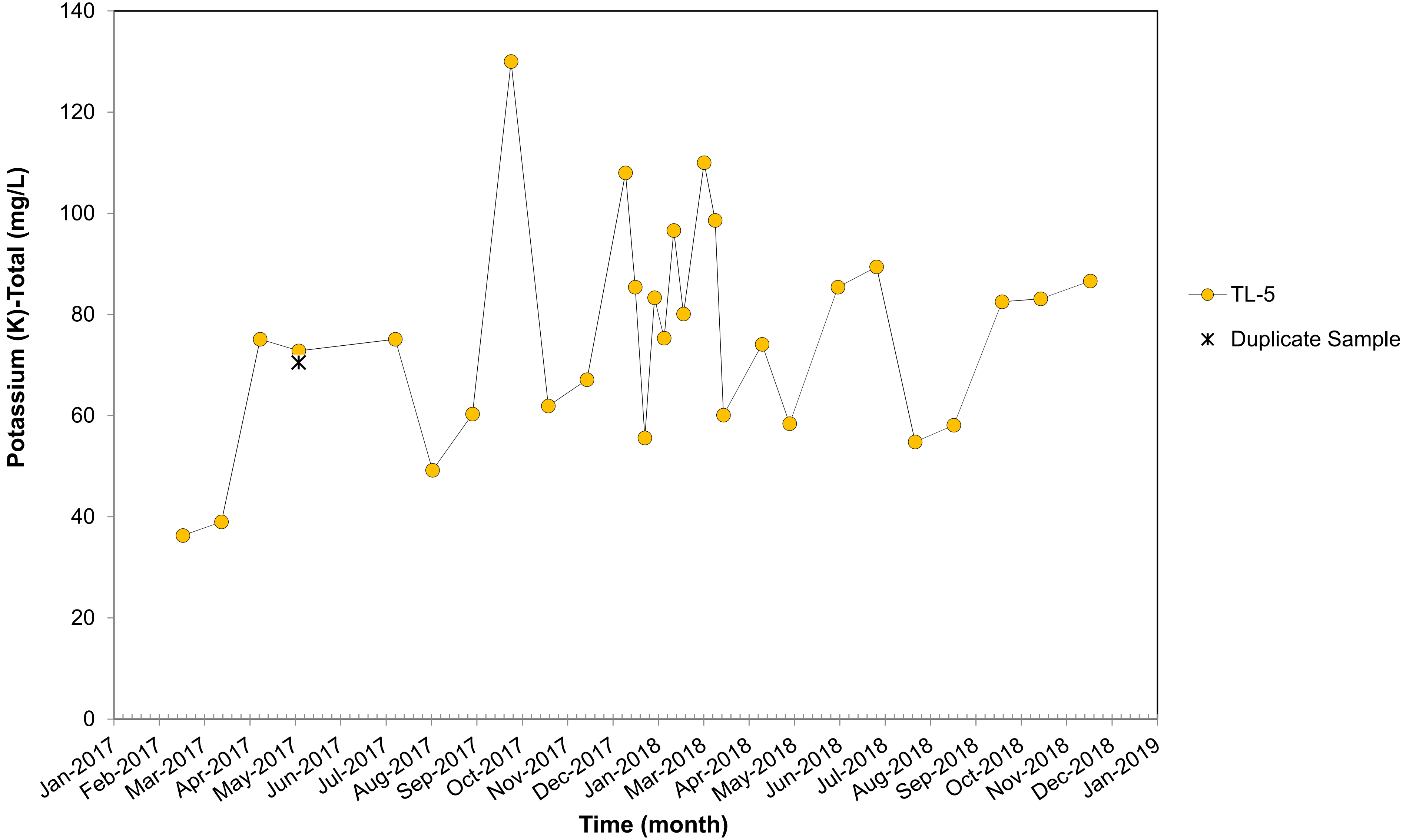

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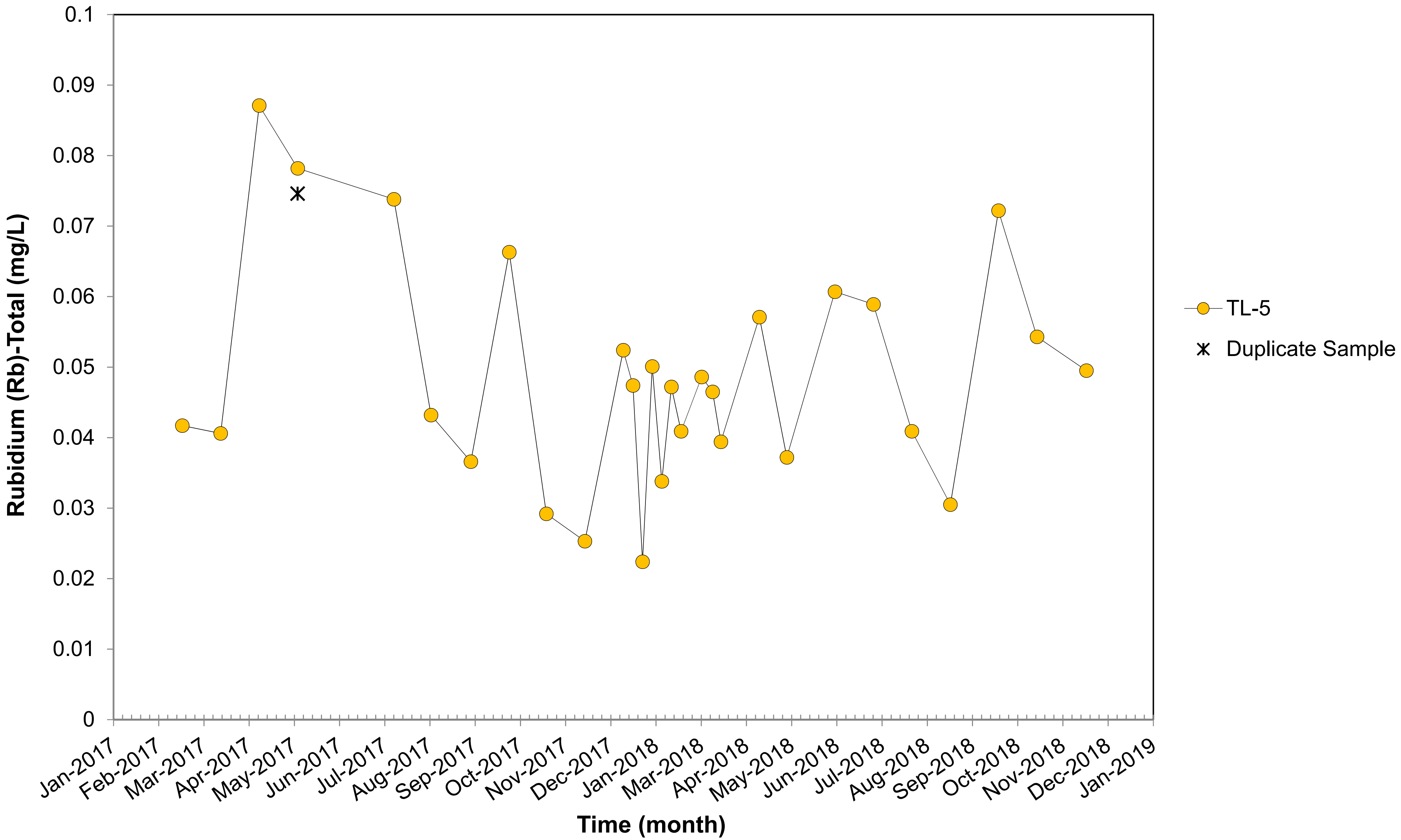

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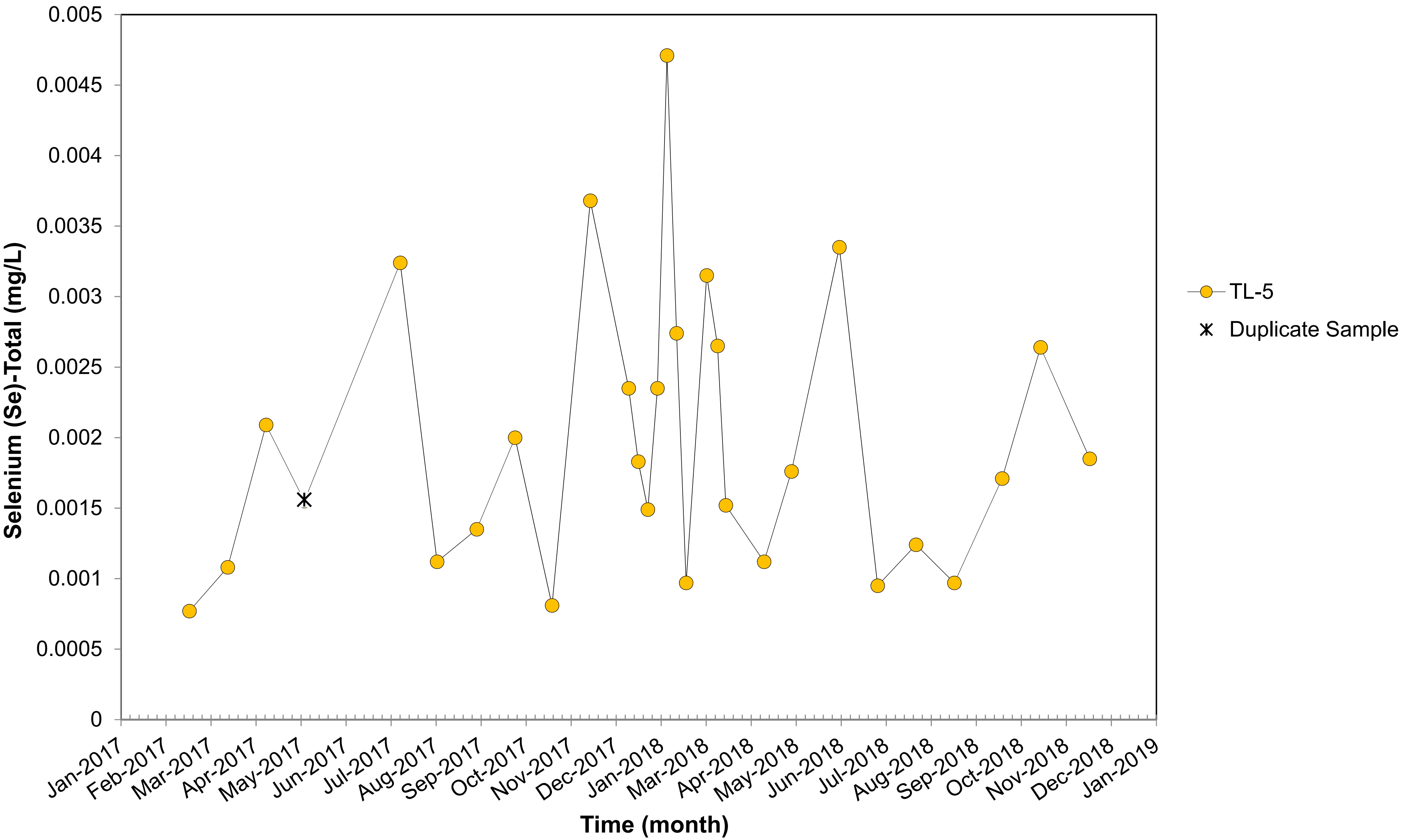

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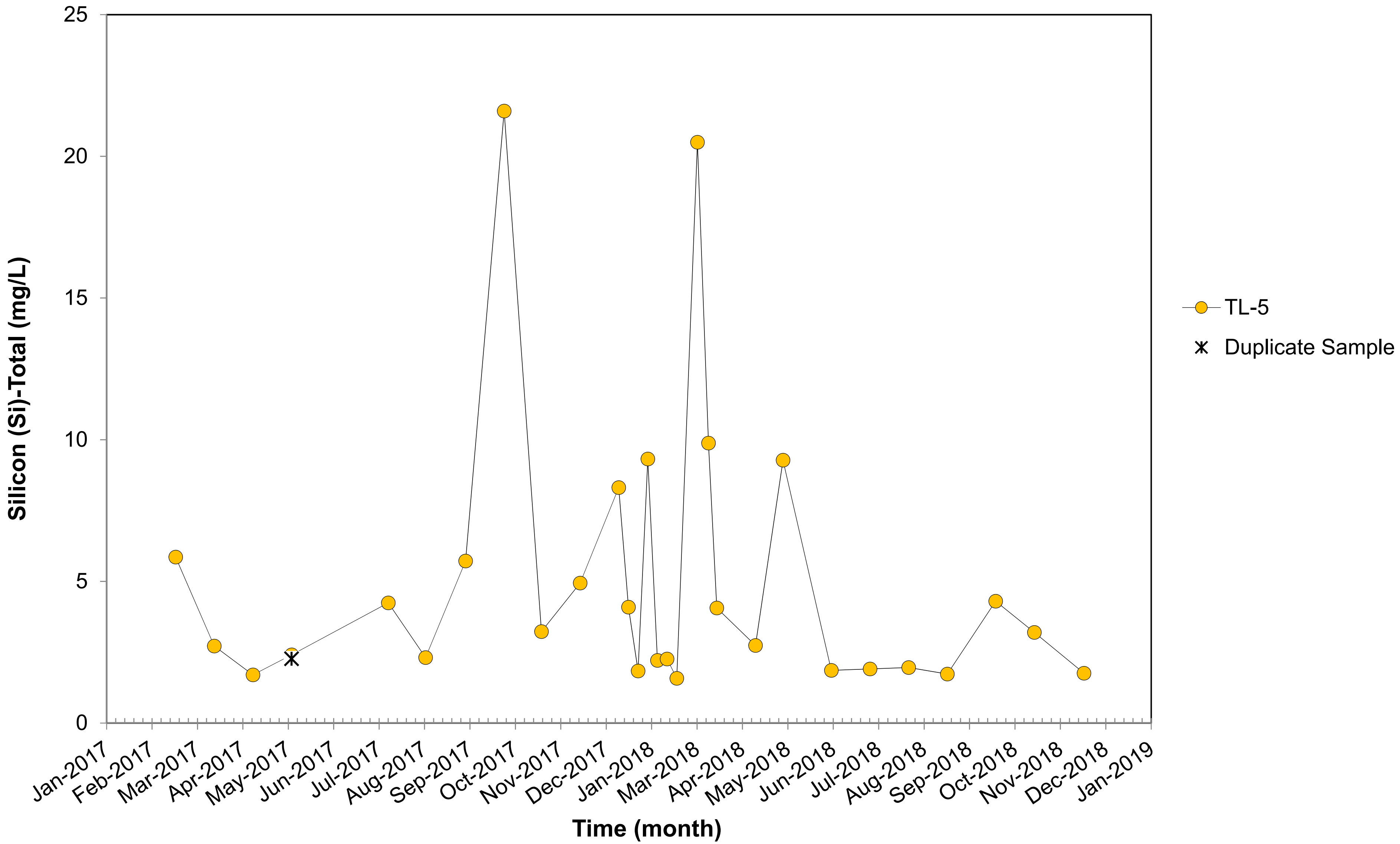

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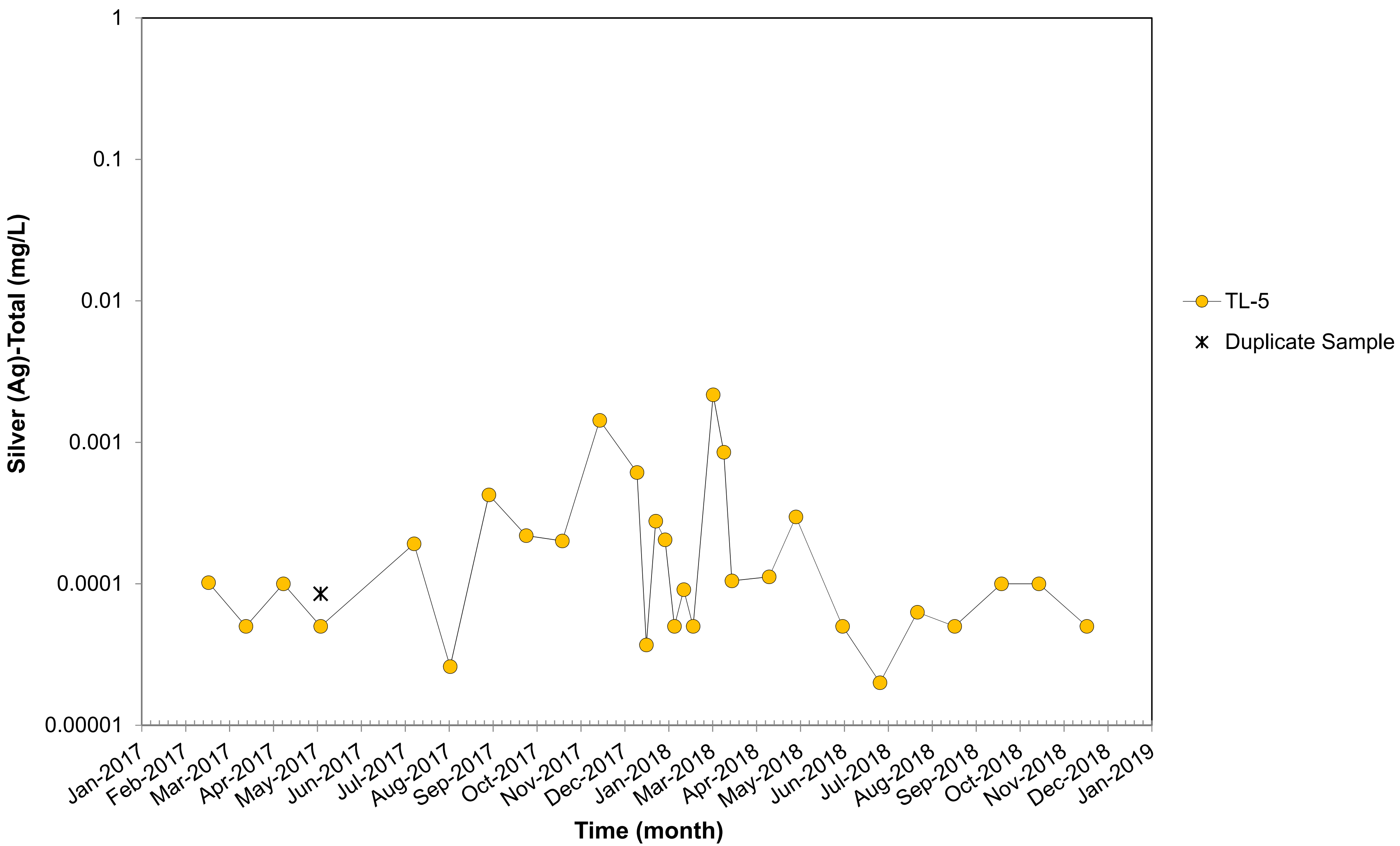

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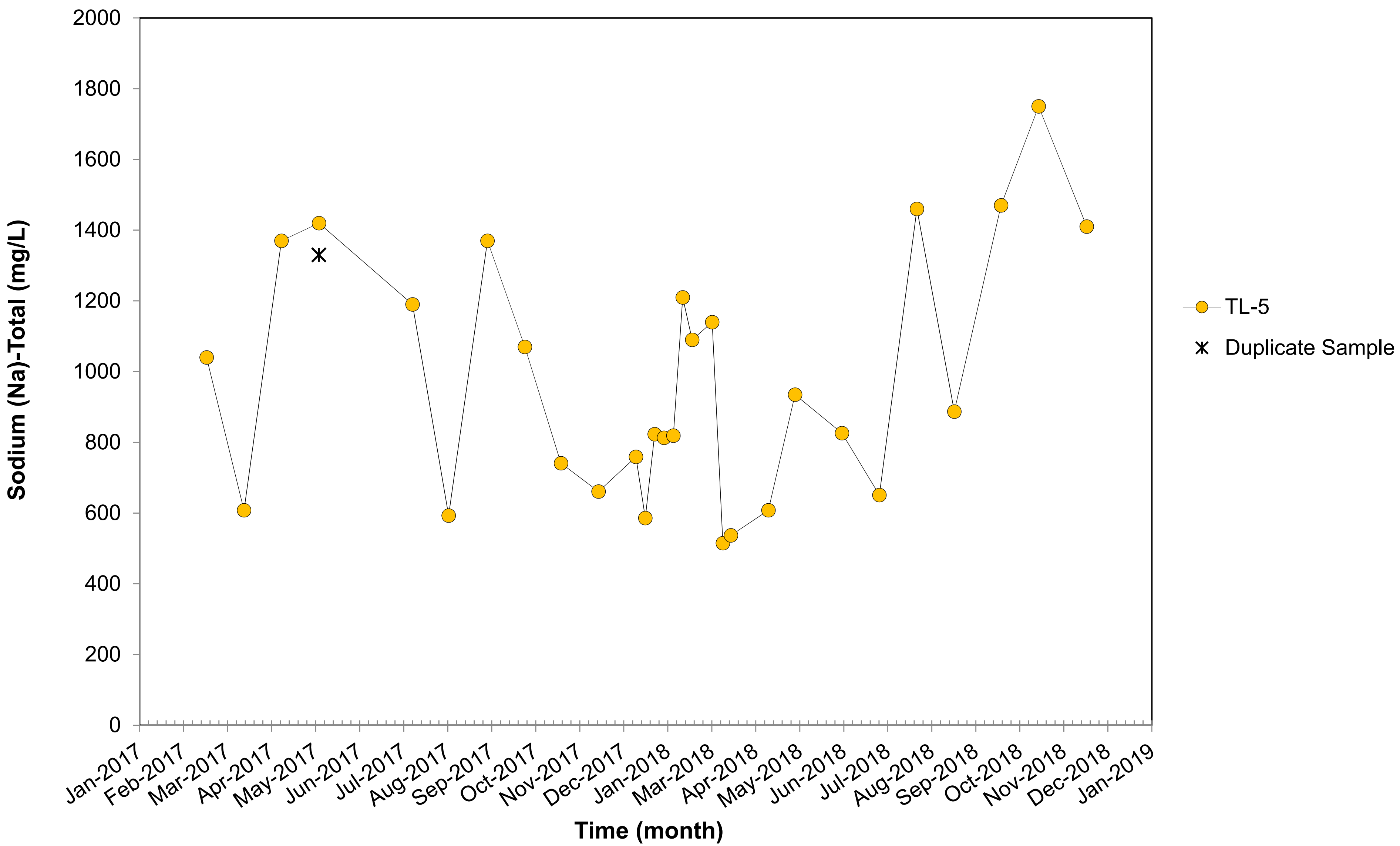

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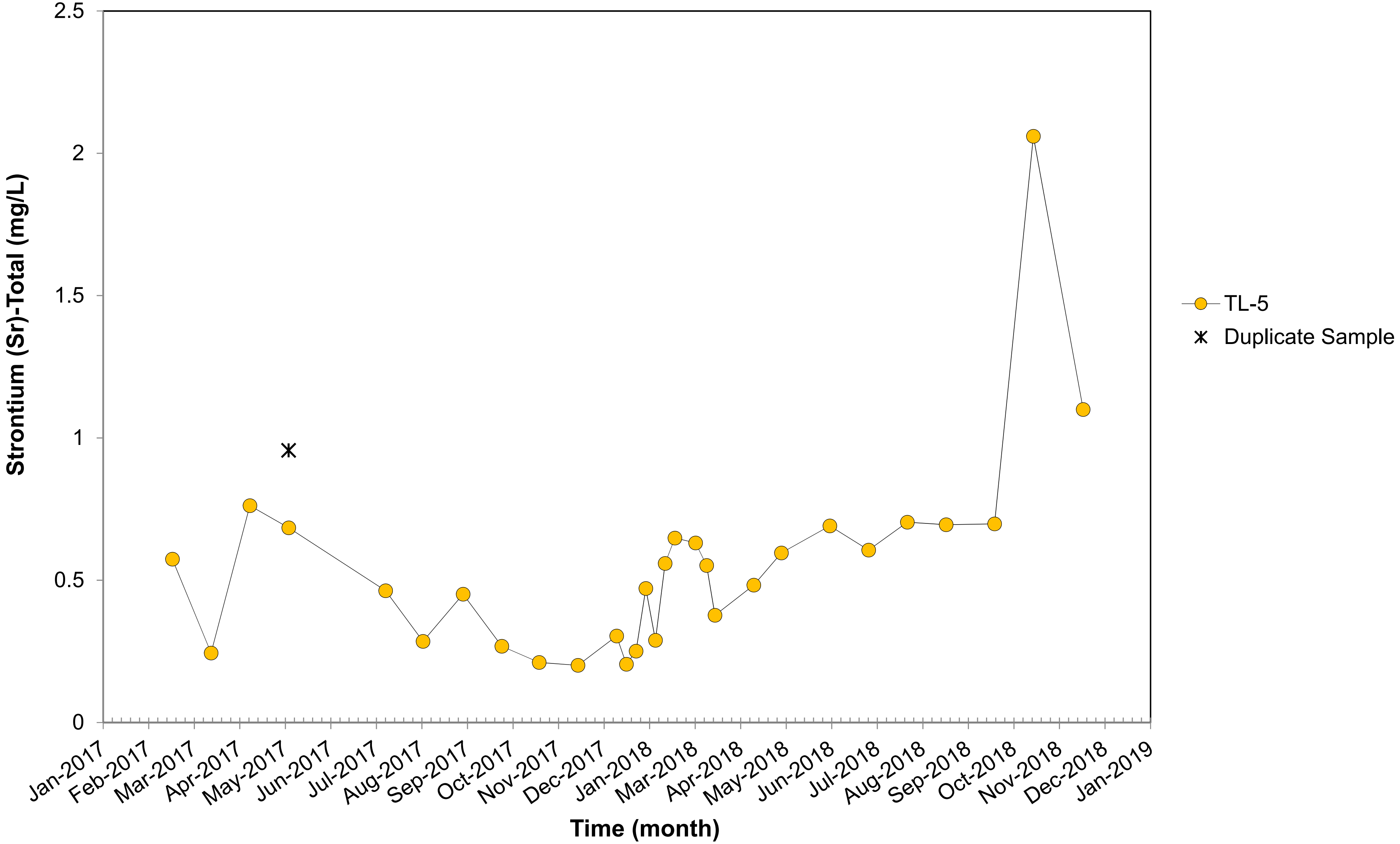

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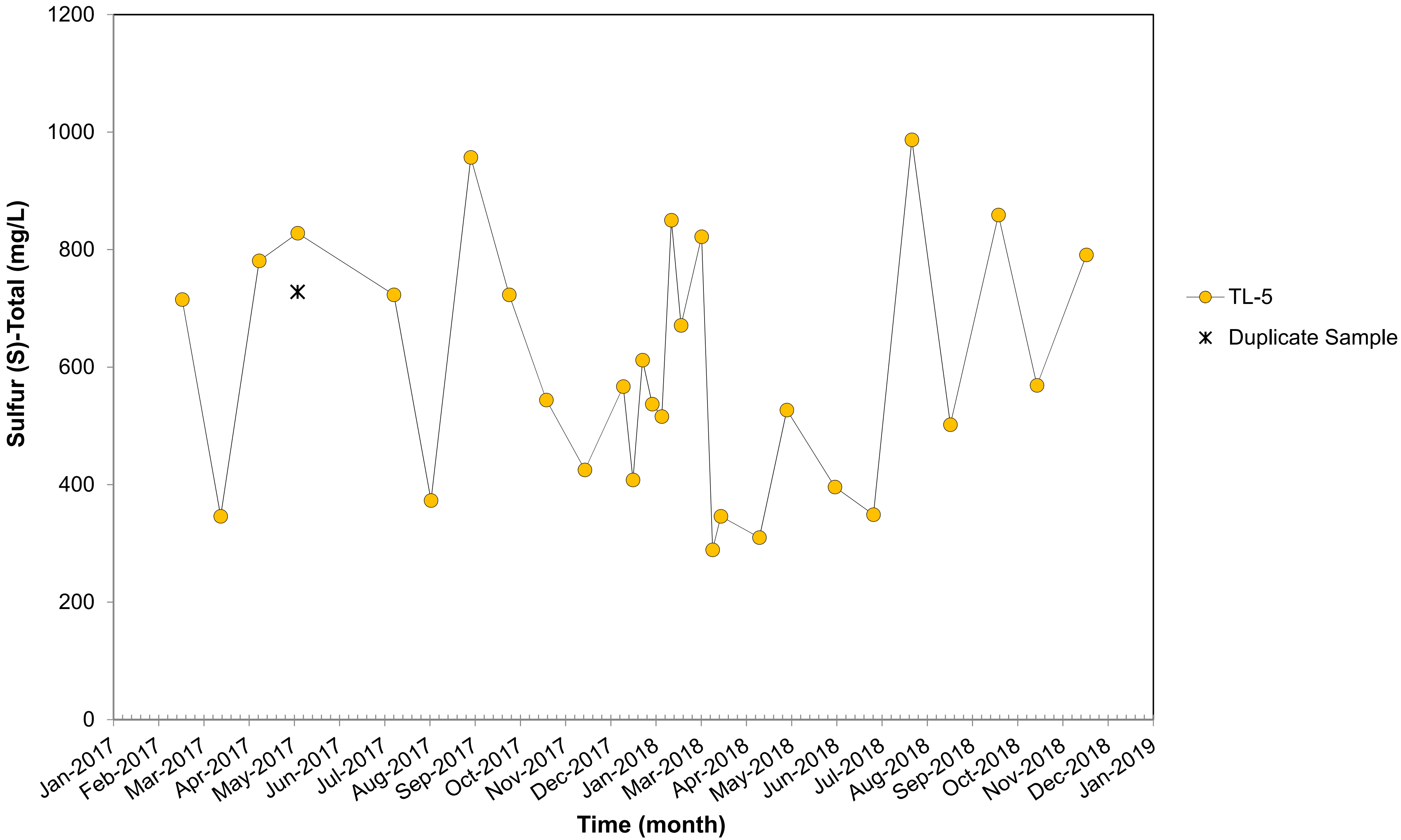

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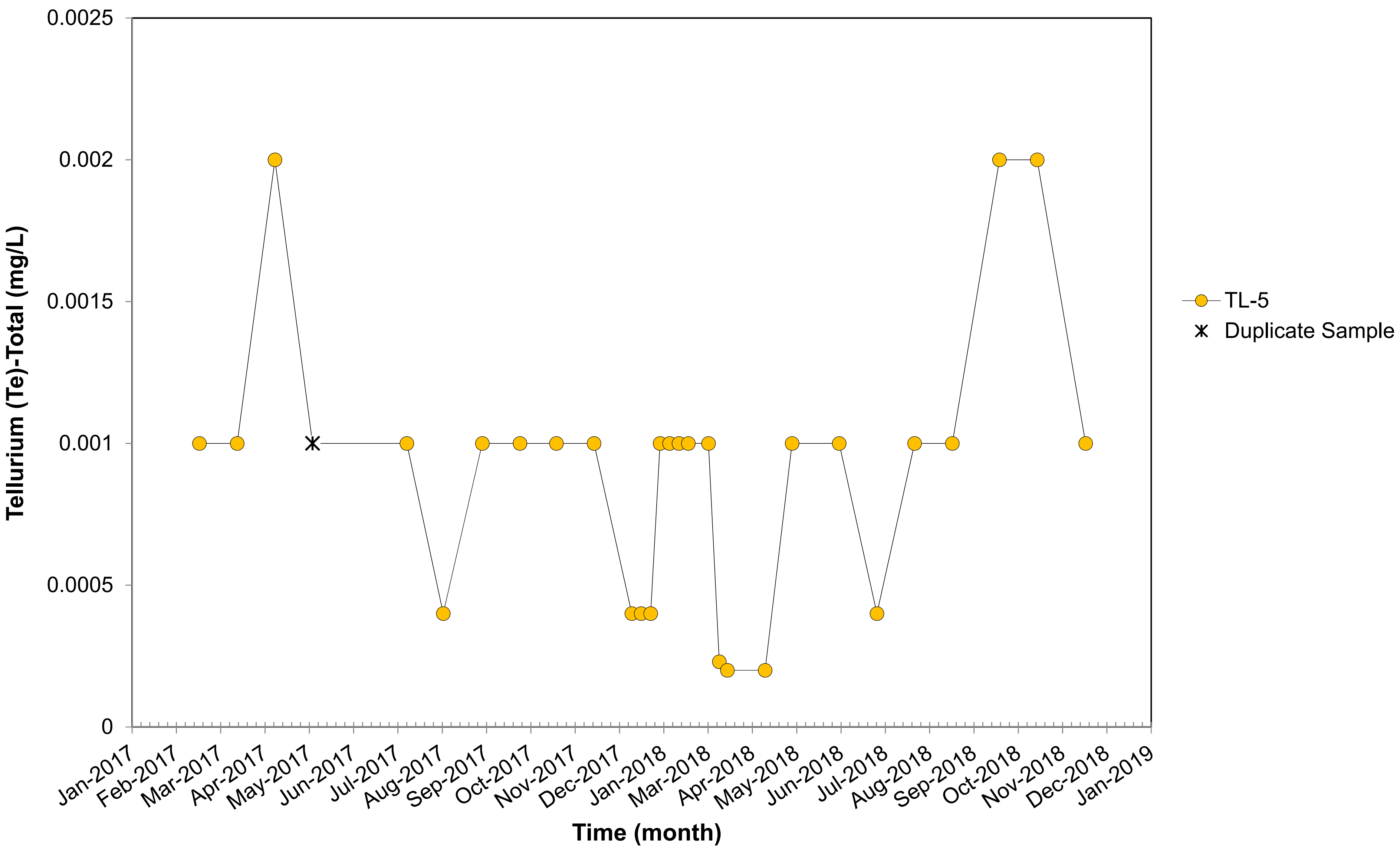

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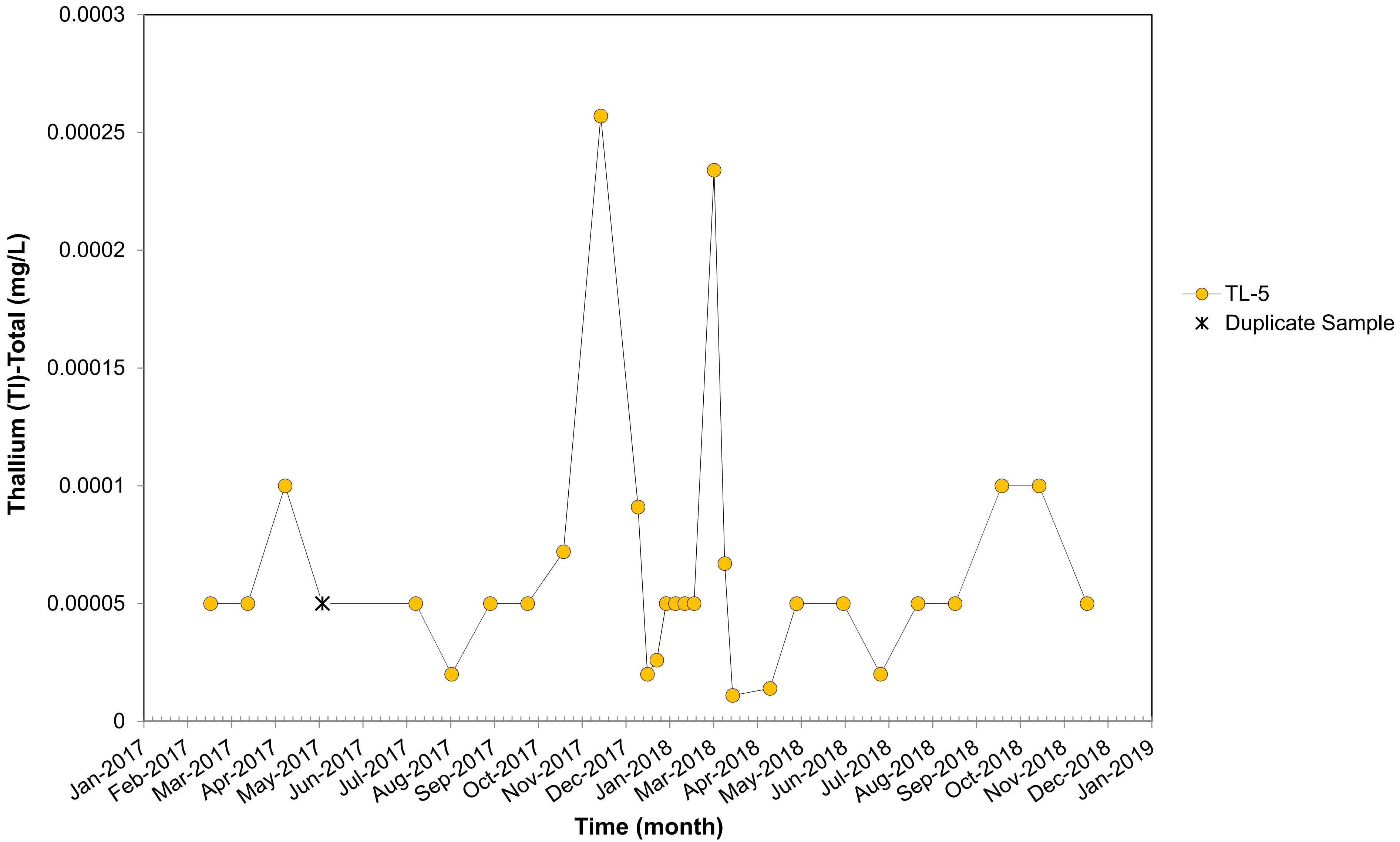

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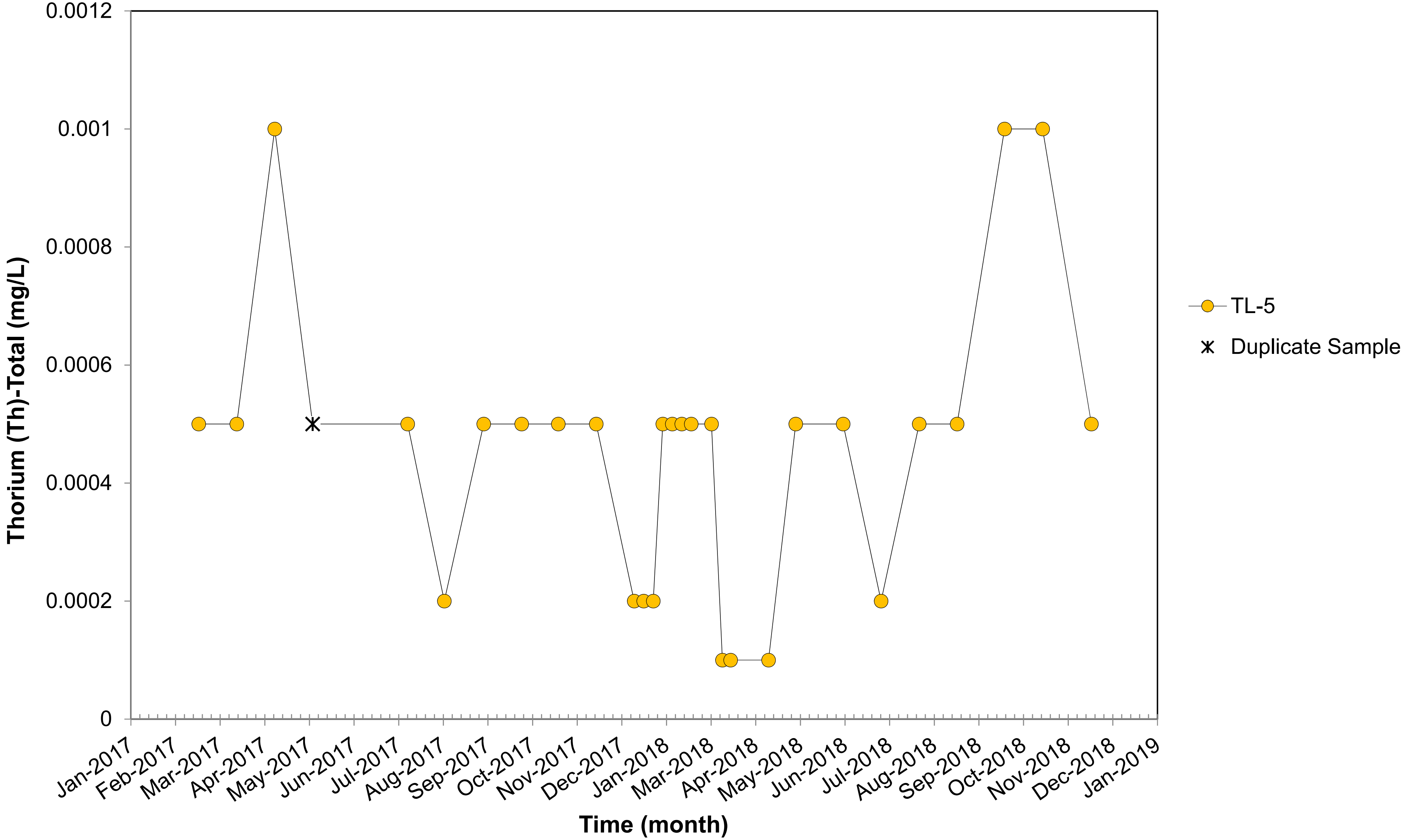

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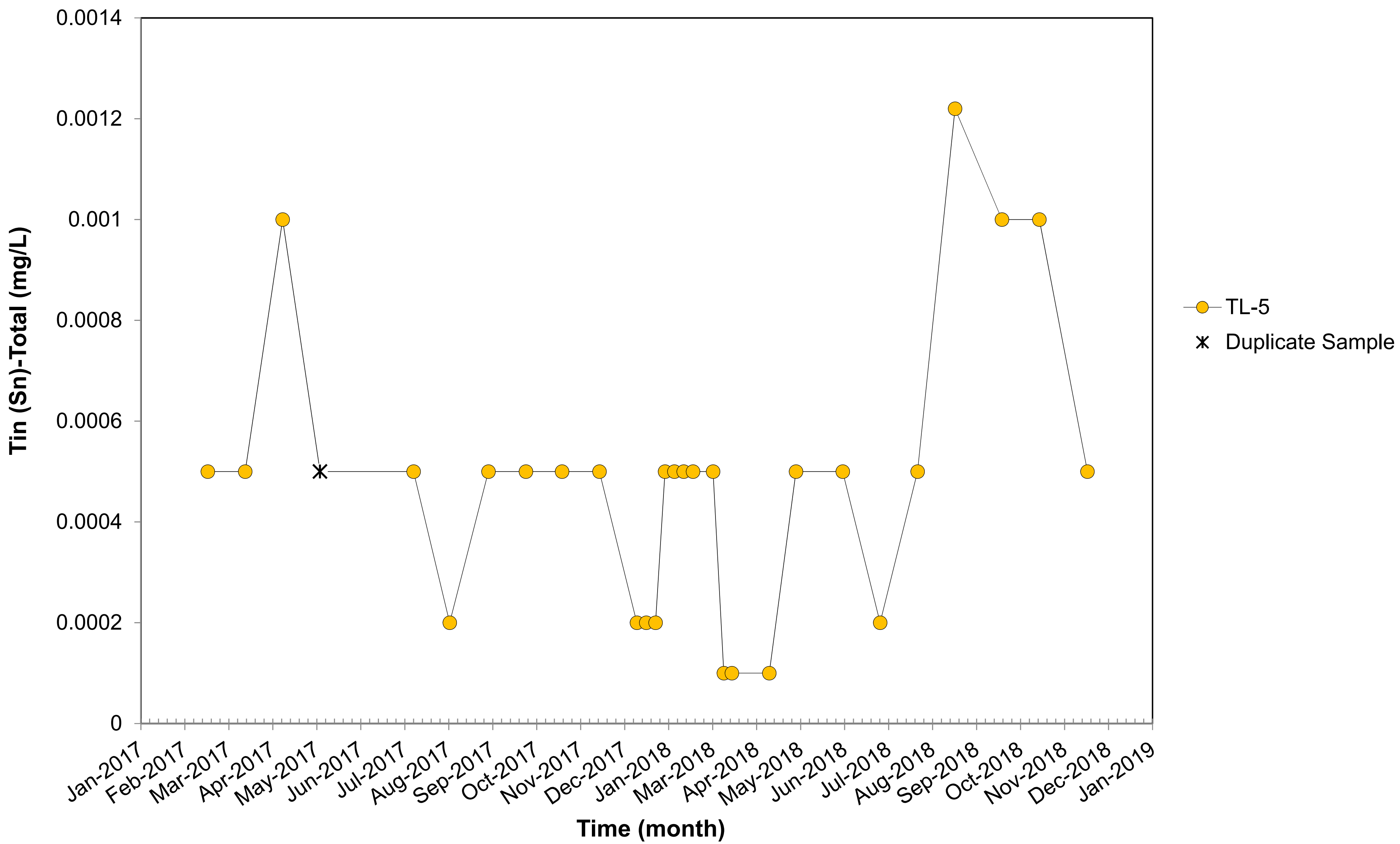

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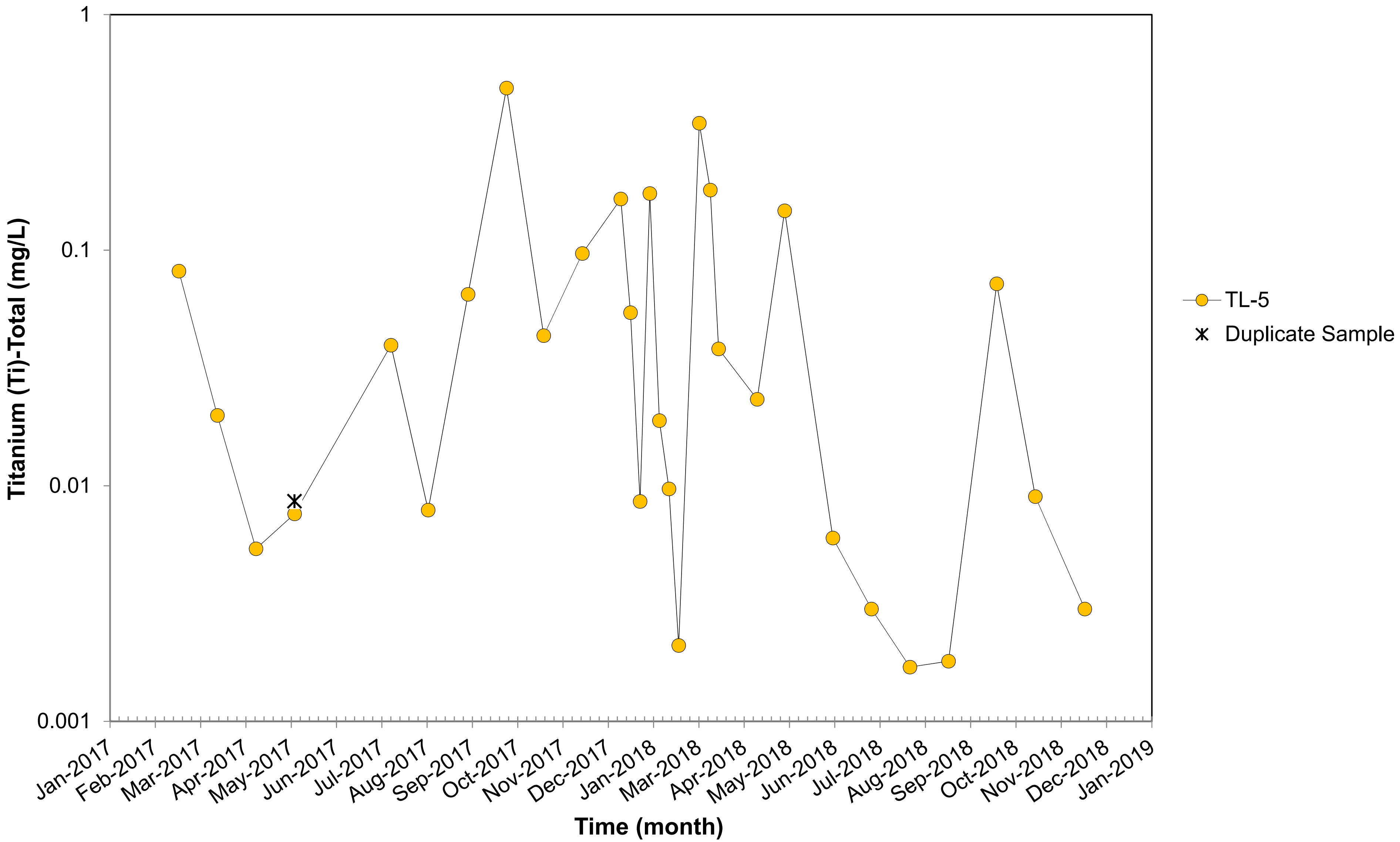

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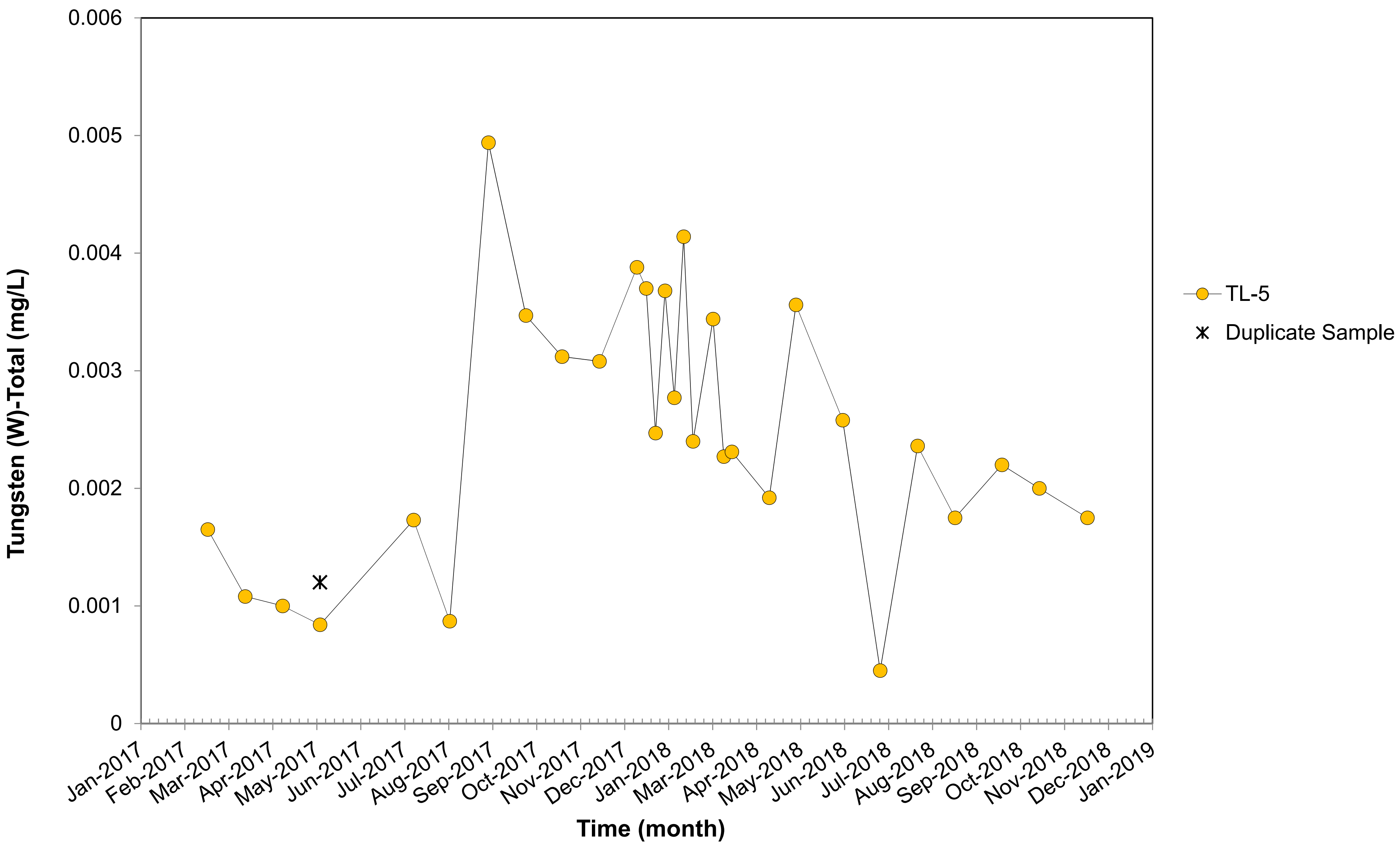

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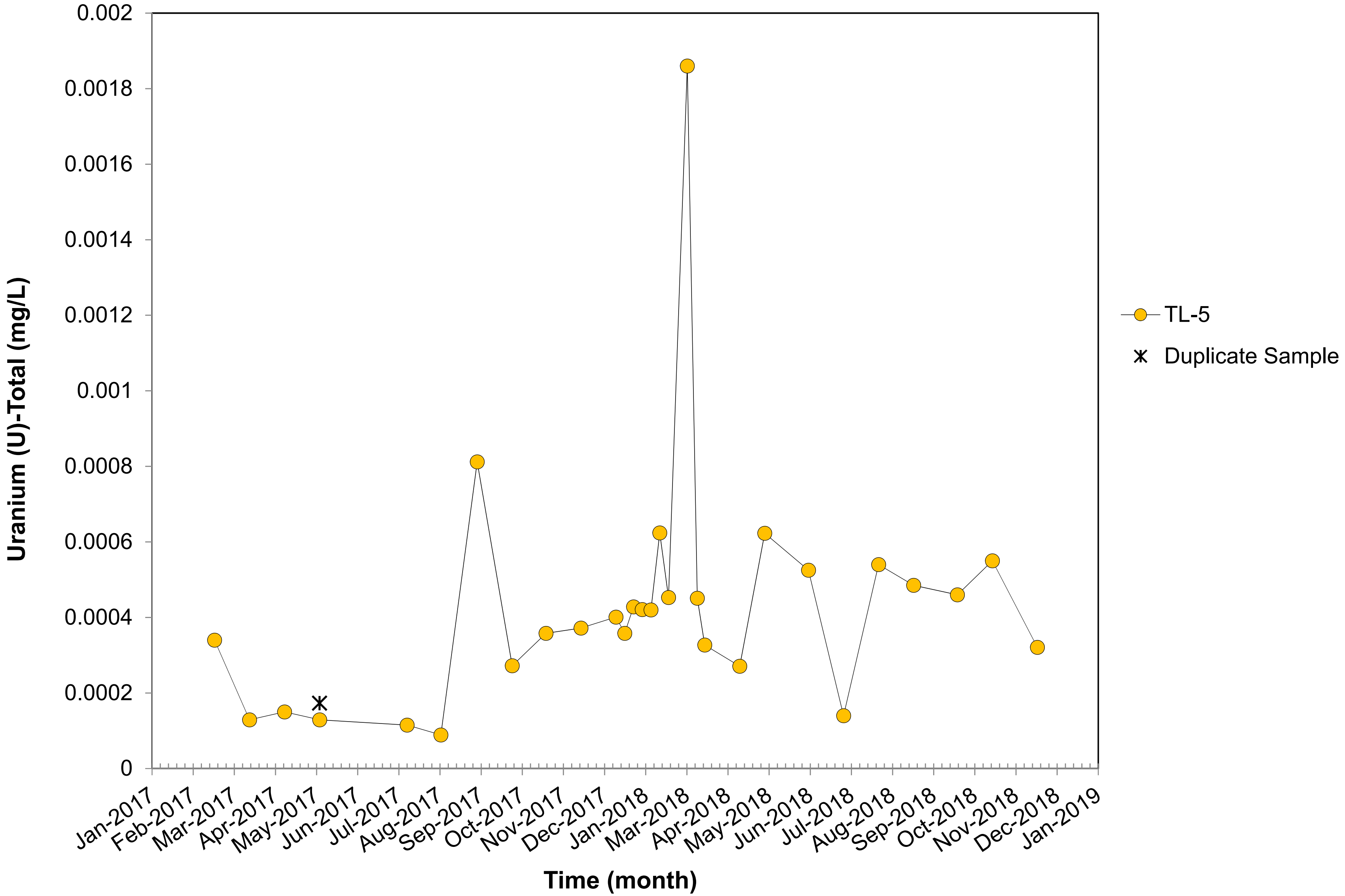

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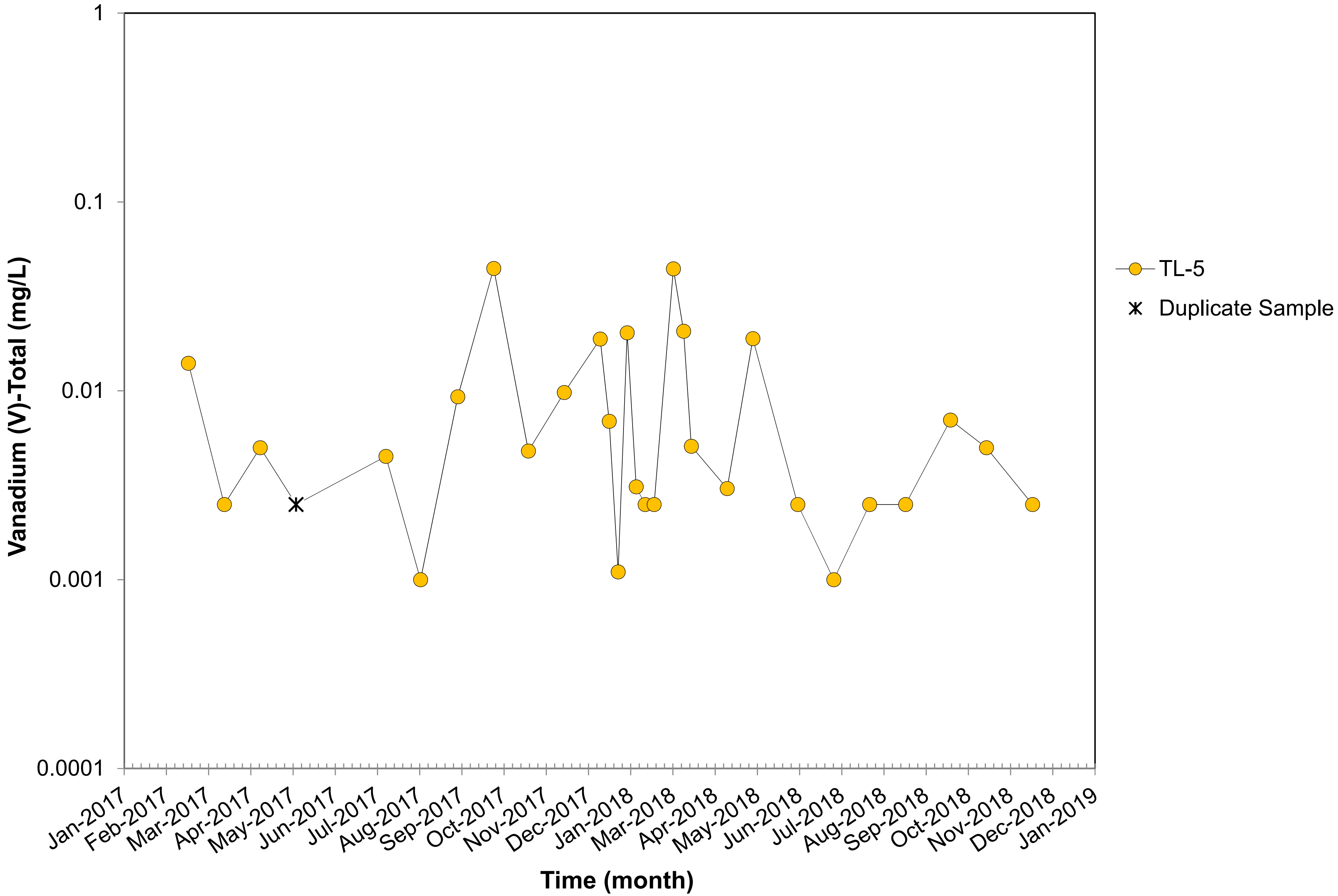

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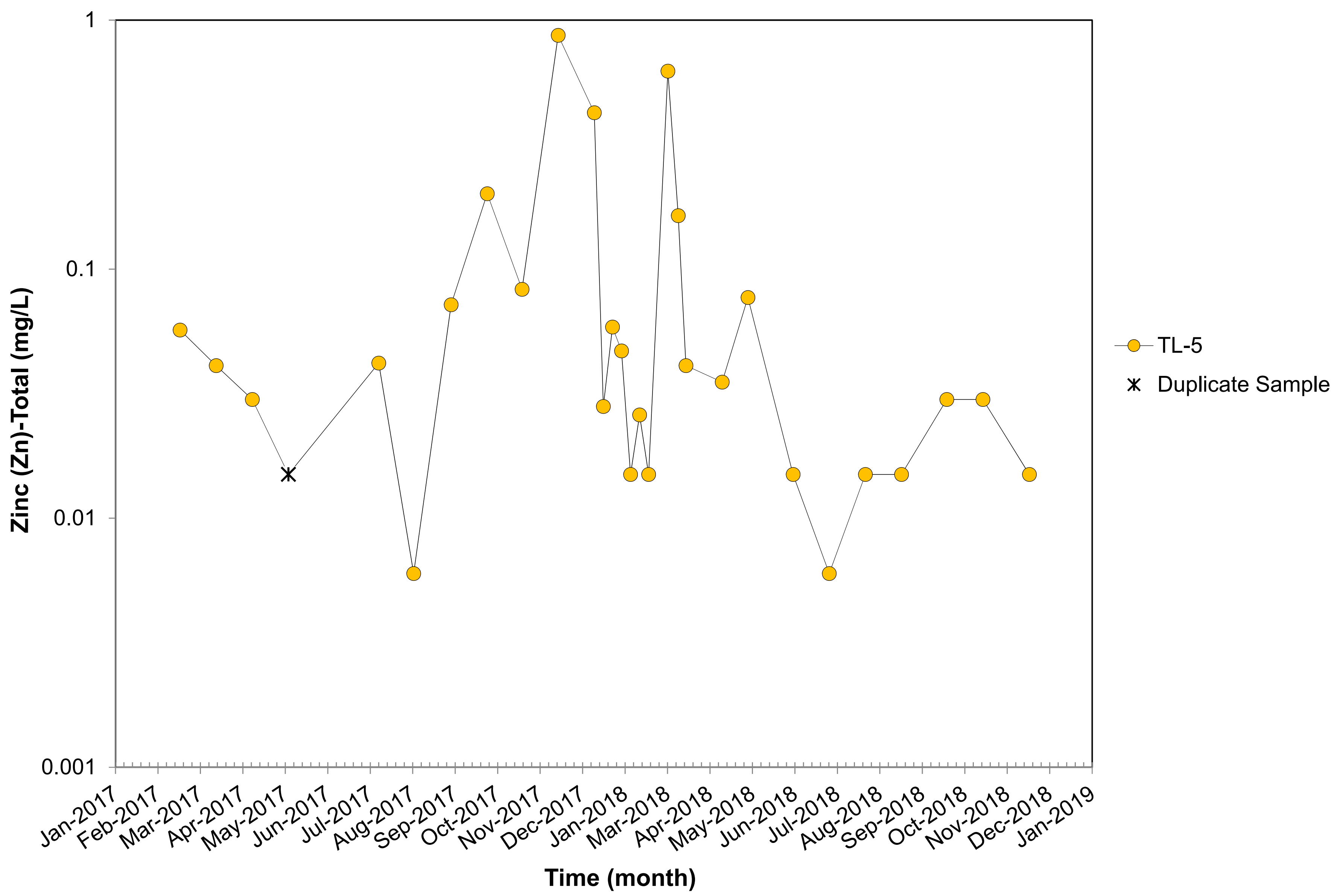

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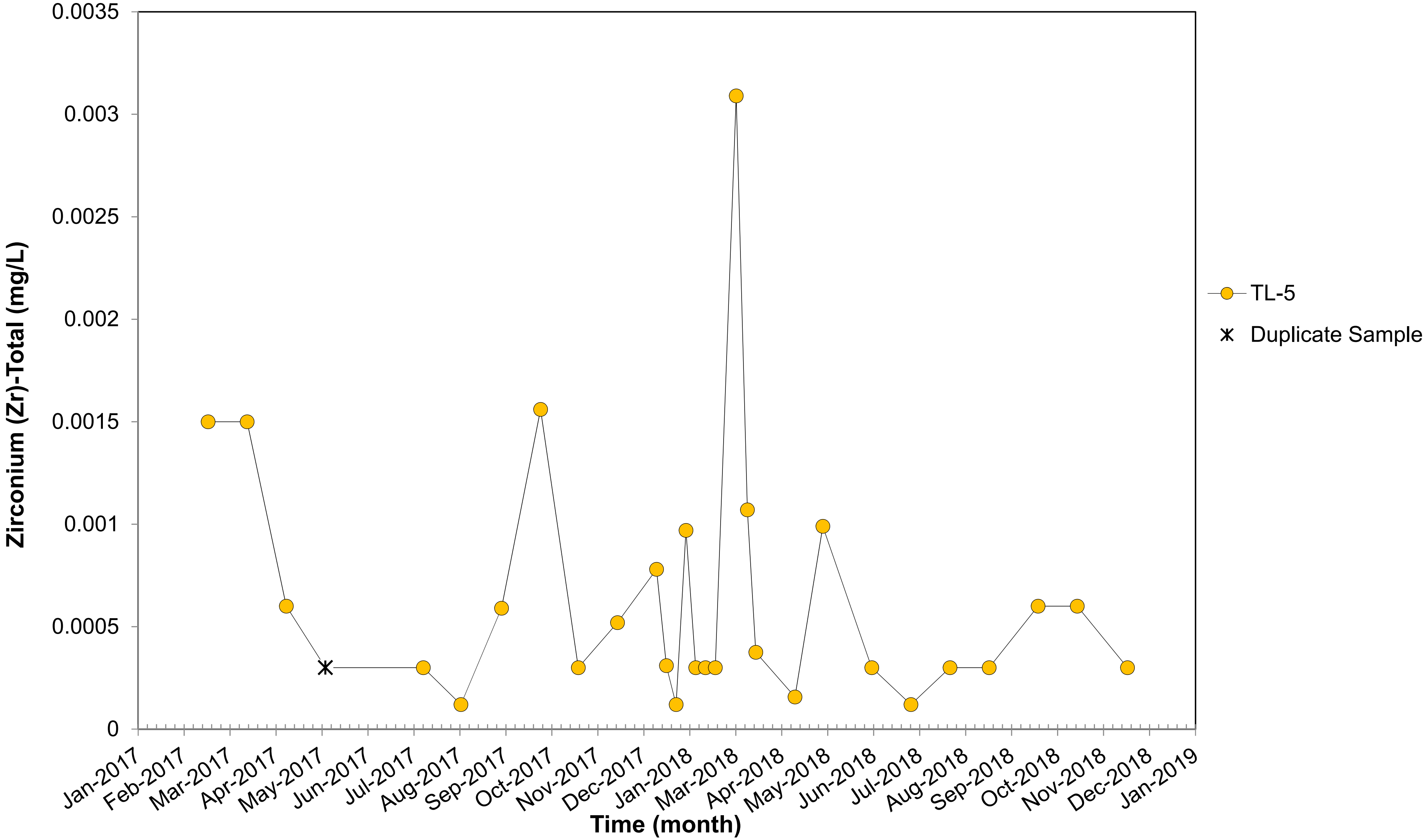

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Appendix G

2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project

2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project

Prepared for

TMAC Resources Inc.

Prepared by

SRK Consulting (Canada) Inc.
1CT022.027
March 2019

2018 Waste Rock and Ore Monitoring Report, Boston Camp, Hope Bay Project

March 2019

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Project No: 1CT022.027

File Name: 2018_Summary_Report_BostonMonitoring_1CT022.027_20190311.docx

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Table of Contents

Appendices

1 Introduction

At the Boston site, ore and waste rock were generated as part of a 1996-1997 BHP Billiton underground exploration program. The ore was placed in a number of stockpiles on the camp pad and the waste rock was used to construct a camp pad, roads, and an airstrip at Boston. Prior to TMAC Resources Inc.'s ownership, ore was subsequently used to resurface areas of the camp pad and airstrip. This practice does not continue under TMAC's ownership.

The seepage and ephemeral streams sampling programs are conducted annually in the context of the Boston waste rock and ore management and closure plans. A survey of rinse pH and conductivity of the ore is carried out every ten years as part of these plans. This report presents results from the 2018 seepage and ephemeral streams monitoring at the Boston site, and of the 2018 rinse test survey, and complies with Part J "Conditions applying to the Monitoring Program" Item 22 of Water Licence 2BB-BOS1727 (Nunavut Water Board 2018).

The report is organized as follows:

- A summary of the monitoring requirements is provided in Section 2.
- Results of the ore stockpiles rinse survey are summarized in Section 3.
- Results of the monitoring of seepage at the Boston site are summarized in Section 4.
- Results of the monitoring of ephemeral streams are summarized in Section 5.
- Detailed technical memorandum on each of these subjects are provided in Appendices A, B, and C.

2 Monitoring Requirements

2.1 Ore Stockpile

As a condition of Water Licence 2BB-BOS1727 (Part E, Item 2), TMAC is required to implement a water and ore/waste rock management plan that addresses the acid rock drainage (ARD) and metal leaching (ML) potential of the materials at the site (NWB 2017). TMAC acquired the Hope Bay project including the Boston site in 2013 and has maintained the Boston site in care and maintenance since. Geochemical characterization of waste rock and ore materials has indicated that all waste rock and most of the ore is non-acid generating with some of the ore classified as having an uncertain potential for ARD (SRK 2009a). Based on the uncertain classifications, the ore/waste rock management plan (SRK 2017) includes a commitment to monitor the oxidation of the ore by carrying out a survey of rinse pH and conductivity every ten years.

2.2 Seepage Monitoring

The objective of the seepage monitoring is to provide an indication of water quality from the waste rock (camp pad) and ore stockpiles. There are two seepage monitoring programs, SNP seepage monitoring at station BOS-8 and a freshet seepage survey along the north and east sides of the camp pad, and the southern end of the airstrip.

SNP seepage monitoring at station BOS-8 is conducted in accordance with the conditions outlined in Part J "Conditions applying to the Monitoring Program" Item 11 of Water Licence 2BB-BOS1727 (Nunavut Water Board 2017). In summary, sampling of water quality station BOS-8 and any opportunistic seeps, is required initially during spring thaw and at a minimum frequency of monthly whenever flow is observed. Samples collected at BOS-8 are to be analysed for pH, electrical conductivity (EC), total suspended solids (TSS), major anions (sulphate, chloride, ammonia), and total trace metals through an ICP scan.

A freshet seepage survey along the north and east sides of the camp pad and the southern end of the airstrip is to be completed in accordance with Section 5.2.1 of the Boston Water and Ore/Waste Rock Management Plan (SRK 2017). In summary, these areas of the pad are to be surveyed for seepage during freshet and samples collected opportunistically.

2.3 Ephemeral Streams

As outlined in the Hope Bay Project Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017), five ephemeral streams (A to E) within the catchments of the Boston camp pad are monitored during spring freshet. The objectives of the program are to monitor drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra.

3 Ore Stockpiles Rinse Survey

Details of the 2018 ore rinse survey are presented in Appendix A.

3.1 Sampling and Testing Program

The survey included the collection of <2 mm samples of ore and waste rock for rinse testing, as well as detailed geological description. Sampling locations were established based on the 2008 sampling locations to generate directly comparable results.

Rock samples were collected from test pits of approximately 25 cm depth. The <2 mm fraction from the test pit was obtained for rinse pH and electrical conductivity (EC), while the oversize fraction was discarded. A total of 30 samples were taken and transported back to the TMAC field lab at the Doris Camp.

SRK conducted the rinse testing according to the MEND (2009) protocol. Measurements of pH and EC were then taken of the supernatant using an OAKTON PCTSTestr™ 50 portable meter.

3.2 Results

The material inspected mostly consisted of crushed fragments of foliated metasediments and quartz-carbonate veins. Sulphide levels were consistent with observations from 2008 (SRK 2009b); however, tarnishing of the sulphide crystals was common in 2018, whereas these minerals were described as untarnished in 2008. Break down of the ore and development rock into finer material (clay and silt sized) due to weathering was evident for most stockpiles.

Rinse pH ranged from 7.9 to 9.1, with rinse EC levels highest in samples with the lowest pH. pH was uniformly higher at all locations in 2018 compared to 2008, with EC being overall lower. These observations indicate that while oxidation is occurring, there is sufficient carbonate to neutralize acidity produced from these reactions. Soluble oxidation products have increased in some areas and decreased in others, indicating that no significant change in soluble products has occurred overall at the site relative to the 2008 survey.

The findings of the survey have confirmed that ore and waste rock on the camp pad remain not acidic.

4 Monitoring of Boston Seepage

Details of the 2018 seepage monitoring programs are presented in Appendix B.

4.1 Sampling and Testing Program

A total of four opportunistic seepage samples were collected as part of the two seepage monitoring programs.

4.1.1 Airstrip and Camp Pad Seepage Survey

The freshet seep survey at Boston was conducted by TMAC between June 16 and June 25, 2018. The survey included walking the north and east sides of the camp pad and the full extent of the airstrip, as outlined in the Water and Ore/Waste Rock Management Plan (SRK 2017).

One seep was identified on the east side of the camp pad and sampled. No seepage was observed along the northern extent of the pad or along the airstrip. Field measurements of EC, pH, oxidation-reduction potential (ORP), temperature and flow rates (where possible) were measured at this location.

The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, hardness, conductivity, total dissolved solids, alkalinity, anions (sulphate, chloride, fluoride, and bromide), nutrients (nitrate, ammonia, nitrite and phosphorus) and dissolved metals.

4.1.2 SNP Seepage Monitoring

Three samples were sampled from two seepage stations as part of the SNP seepage monitoring at BOS-8. Two samples were collected from SNP monitoring station BOS-8A (on June 16 and June 25, 2018) and SNP monitoring station BOS-8B was sampled once (on June 25 2018). No additional samples were collected in 2018 as no seepage was observed at SNP seepage monitoring stations after June 25. Field measurements of EC, pH, ORP, temperature and flow rates (where possible) were measured at each of these locations.

The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, hardness, conductivity, total dissolved solids, alkalinity, anions (sulphate, chloride, fluoride, and bromide), nutrients (nitrate, ammonia, nitrite and phosphorus) and dissolved metals.

4.2 Results

The results for samples taken as part of both the Airstrip and Camp Pad Seepage Survey (Section 4.1.1) and the SNP seepage monitoring (Section 4.1.2) are presented in this section.

The four seepage samples were pH neutral to slightly alkaline with sulphate concentrations (150 to 530 mg/L) within the range of historic seepage monitoring samples. Arsenic concentrations (0.043 to 0.71 mg/L) were elevated for selected samples compared to the screening criteria, but were within the historical range of observed concentrations, and there is no long-term increasing trend in the data. Two samples from the same location a week apart showed a wide range of concentrations, but the ratio between the two samples was consistent, indicating that the difference is due to dilution of the seep. In general, metal concentrations in samples collected in 2018 are within the historical range of observed concentrations.

5 Monitoring of Ephemeral Streams

Details of the 2018 Boston ephemeral streams monitoring program are presented in Appendix C.

5.1 Sampling and Testing Program

TMAC inspected ephemeral streams A to E for flow on June 16 and June 25, 2018. In 2018 flow was observed and samples collected on June 16 and June 25 from A2 and C2 for a total of 4 samples. Field measurements included pH, EC, ORP, and temperature. The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, hardness, conductivity, total dissolved solids, total alkalinity, anions (bromide, chloride, fluoride, and sulphate), nutrients (nitrate, nitrite, ammonia and phosphorus) and dissolved metals (field filtered).

5.2 Results

Contaminants of concern as identified by the 2009 water and load balance (Supporting Document B of SRK 2009a) include nitrate, sulphate, arsenic, copper, iron, nickel and selenium.

The pH of ephemeral streams A2 and C2 were neutral to slightly alkaline. In terms of trends, sulphate and selenium concentrations for one 2018 sample collected at A2 and arsenic and sulphate concentrations for one 2018 sample collected at C2 exceeded historical concentrations. For these parameters, concentrations for the other 2018 sample were comparable to previous trends and concentrations. The analysis of the water quality data for ephemeral streams A2 and C2 indicated that concentrations for all other potential contaminants of concern were either decreasing or consistent with historical data.

Compared to SRK (Supporting Document B of 2009a) model predictions, the 2018 monitoring data were below maximum predicted values for chloride, nitrate, arsenic, copper, iron nickel and selenium at streams A2 and C2. At A2 and C2, maximum sulphate concentrations observed in 2018 exceeded the maximum modeled values, however the minimum observed concentrations in 2018 were within the modeled range (Supporting Document B of SRK 2009a). Future monitoring will establish sulphate trends.

Sulphate and chloride levels are not attenuated by the tundra and the concentrations measured in 2018 validate the 2009 water and load balance (Supporting Document B of SRK 2009a).
The 2009 water and load balance was developed specifically for the Boston camp pad to provide a conservative indication of the potential concentrations in drainage from the ore and waste rock before entering Aimaokatalok Lake and the natural attenuation of the tundra. The concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern and the breakthrough of the effectiveness of the attenuation process has not occurred. SRK recommends continued monitoring of the ephemeral stream sampling sites as outlined in SRK (2017).

6 Conclusions

The 2018 rinse survey found that while oxidation is occurring within the ore and waste rock stockpiles, there is sufficient carbonate to neutralize acidity produced from these reactions. The findings of the survey have confirmed that ore and waste rock on the camp pad remain not acidic.

The seepage program monitors contact water from the camp pad and ore stockpiles while the ephemeral stream program monitors drainage from the Boston ore stockpiles and camp pad before entering Aimaokatalok Lake and the natural attenuation of the tundra.

In 2018, TMAC surveyed i) the northern and eastern edges of the camp pad and the full extent of the airstrip for opportunistic seepage samples and ii) the five ephemerals streams (A to E) within the catchment of the Boston camp pad. In total, TMAC collected four seepage samples along the eastern edge of the camp pad and four ephemeral streams samples from streams A2 and C2.

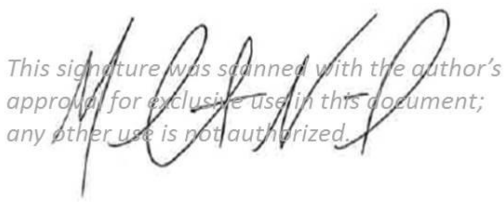
All seepage and ephemeral stream samples were pH neutral to slightly alkaline, indicating that the waste rock on the camp pad is not acidic.

Monitoring of the seepage from the camp pad and the ore stockpiles indicates that water quality for the contaminants of concern are within the range of the historical data.

The analysis of the water quality data for ephemeral streams A2 and C2 indicated that concentrations were either decreasing or consistent with historical data except for sulphate and selenium at A2 and arsenic and sulphate at C2. For these aforementioned parameters, maximum concentrations were observed in one of the 2018 samples at A2 whereas concentrations for the other 2018 sample were comparable to previous trends and concentrations. Future monitoring will establish any trends.

SRK recommends continued annual monitoring according to the Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017).

This report, 2018 Waste Rock and Ore Monitoring Report, was prepared by



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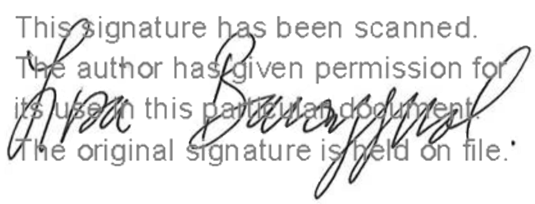

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Principal Consultant

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 – 2018 Boston Rinse Test Survey

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Memo

To:	Shelley Potter	**Client:**	TMAC Resources Inc.
From:	Eduardo Marquez, Lisa Barazzuol, SRK	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 11, 2019
Subject:	Rinse Test Survey of Ore Stockpiles at Boston Site, Hope Bay Project, Nunavut		

1 Introduction

Ore and waste rock were generated as part of a 1996/1997 BHP Billiton underground exploration program. During this program, a total of 105,400 tonnes of development (waste) rock and 26,760 tonnes of ore material were mined and brought to surface. The waste rock was used to construct a camp pad, roads and an airstrip at the Boston site. Ore was placed in stockpiles on the camp pad.

As a condition of Water Licence 2BB BOS1727 (Part E, Item 2, NWB 2017), TMAC Resources Inc. is required to implement a water and ore/waste rock management plan that addresses the acid rock drainage (ARD) and metal leaching (ML) potential of the materials at the site (SRK 2017a). TMAC acquired the Hope Bay project including the Boston site in 2013 and has maintained the Boston site in care and maintenance since.

Geochemical characterization of waste rock and ore materials has indicated that all waste rock and most of the ore is non-acid generating with some of the ore classified as having an uncertain potential for ARD (SRK 2009). Based on the uncertain classifications, the ore/waste rock management plan (SRK 2017a) includes a commitment to monitor the oxidation of the ore by carrying out a survey of rinse pH and conductivity every ten years. The first rinse pH and conductivity survey was conducted in 2008 (SRK 2009). This memo documents the results of the 2018 rinse test survey and satisfies the conditions of the ore/waste rock management plan for the Boston site, in compliance with Part J, Item 22 of the Water Licence.

2 Background

SRK (2009) documents the geochemical assessment of development rock and ore at the Boston camp in support of development of the waste management plan for the Boston site. The methods and results have been previously documented by SRK (2009) and are summarized below.

A detailed inventory of the ore stockpile area in 2009 indicated that several ore stockpiles, particularly ore material from the 1997 campaign and stockpiles on the eastern side, had been removed from the stockpile area. Inspections of the airstrip and camp pad indicated that this material had been used for airstrip resurfacing, for other repairs to the road, camp pad, and other construction projects.

Lithologically, the stockpiles were composed of varying proportions of foliated sediments (with sericite ± ferroan carbonate ± chlorite with lesser fuchsite alteration), argillite, quartz/carbonate and lesser basalt. Gabbro was observed at one B3 stockpiles.

The weathering of the rock in the ore stockpiles was variable with a number of piles exhibiting iron staining due to the oxidation of iron carbonates. The iron oxidation was typically associated with the carbonate veinlets hosted in the quartz and foliated sediments. Pyrite with minor chalcopyrite was the dominant sulphide minerals and was typically hosted as disseminated or clusters crystals within sediment foliations. Visual sulphide levels were variable, ranging locally from <1% to upwards of 10%. The exposed sulphide mineral faces were overall fresh and untarnished suggesting limited sulphide oxidation and weathering.

In 2009, a total of 28 ore and waste rock samples were obtained from the ore stockpiles, edges of the camp pad and airstrip (Figure 1). Rock samples were collected from test pits of approximately 25 cm depth. The < 1 cm fraction was obtained for geochemical analysis. Additionally, the < 2 mm fraction from the test pit was obtained for rinse pH and conductivity. Where a colour variation was observed with depth, the < 2 mm fraction was also obtained from the surface material for rinse pH and conductivity. The samples were submitted to the lab for water quality analyses, ABA tests, elemental analyses, and shake flask extraction tests.

Sulphate as sulphur was low for all samples (between <0.01% and 0.02%) indicating that sulphide was the main form of sulphur. For development rock samples, sulphide content ranged from 0.15 to 0.61% (as S), with a median of 0.46% (equivalent to 14 kg $CaCO_3$ eq./t). Modified Sobek NP ranged from 260 to 310 kg $CaCO_3$ eq./t, with a median of 270 kg $CaCO_3$ eq./t. Total inorganic carbon (TIC) ranged from 290 to 380 kg $CaCO_3$ eq./t, with a median of 340 kg $CaCO_3$ eq./t.

For ore samples, sulphide content ranged from 0.13 to 4.0%, with a median of 2.0% (equivalent to 63 kg $CaCO_3$ eq./t). Modified Sobek NP ranged from 140 to 310 kg $CaCO_3$ eq./t, with a median of 240 kg $CaCO_3$ eq./t. TIC ranged from 190 to 420 kg $CaCO_3$ eq./, with a median 360 kg $CaCO_3$ eq./t.

According to the ARD classifications described by DIAND (1992), waste rock samples were consistently classified as non-PAG. Approximately two thirds of the ore samples were classified as non-PAG and the remainder as uncertain. There was relatively little difference in the ABA results for fine (< 2mm) versus coarser (2 mm to 1 cm) size fractions. Elevated concentrations of sulphate were present in the shake flask extraction test leachates and in seepage samples. However, the concentrations were still quite low given the relatively advanced age of these stockpiles.

The humidity cell test (HCT) program for Boston ore and waste rock includes nine samples of waste rock, one sample of mixed waste rock and ore, and one sample of ore (SRK 2017b).

According to rock type, the HCT sample set included samples of mafic volcanics, mafic volcanics with sediments, metasediments and quartz vein.

Mineralogical analysis by QXRD indicated that 10 out of the 11 samples contained carbonate contents above 20%, consisting mainly of ferroan dolomite ($Ca(Fe,Mg)CO_3$). Lesser amounts of calcite and siderite were indicated. Carbonate occurrence was described as fine to very fine-grained by petrography. Scanning electron microscope (SEM) analysis of the HCT samples indicated that the stoichiometric proportion of iron in each sample varied, with the lowest calcium-plus-magnesium content for HC-38 (ore sample of quartz vein), with the following stoichiometry: $Ca(Mg_{0.55}Fe_{0.45})CO_3$.

pH results of the Boston HCTs ranged from 7.3 to 9.7 for the duration of the testing, where pH values were typically highest during the initial weeks of the tests. Samples of mafic volcanics showed the highest pH values towards the end of the testing (around pH 8.5). These samples (HC-10, HC-31, HC-12 and HC-33) also contained higher ratios of carbonate to sulphides, as well as higher contents of siderite, relative to the other samples.

Calculations of depletion of sulphides and carbonates based on stable release rates of calcium, magnesium and sulphate suggest that all of the humidity cell tests will remain neutral with the exception of HC-38 (quartz vein ore sample) which could theoretically become acidic in approximately 100 years under laboratory conditions. However, given the differences in the relative rates of depletion in the field versus the lab, it is not considered appropriate to conclude that acidic conditions would develop in this material under field conditions.

Even if localized ARD develops in ore material, the presence of the non-PAG development rock pad beneath the ore stockpiles would be expected to mitigate the seepage quality, particularly in areas where the ore only forms a thin veneer.

3 Methods

On August 12 and 13, 2018, Eduardo Marquez, an SRK geochemist, and Patrick Joliffe of TMAC Resources carried out a rinse test survey of the ore stockpiles at Boston. The survey included the collection of <2 mm samples of ore and waste rock for rinse tests, as well as detailed geological descriptions. Sampling locations were established based on the 2008 sampling locations to generate directly comparable results. A GPS unit was used to locate the 2008 sampling locations.

Based on SRK's geochemical sampling of ore stockpiles in 2008 and 2018, some material movement had occurred since the 2008 survey. SRK understands from TMAC that prior to TMAC's ownership, some of the stockpiles had been repurposed since the 2008 survey to construct new structures such as a fuel tank berm, refuelling station berm, and infill for pad and airstrip repairs. Under TMAC's ownership, some stockpiles were reshaped within the ore stockpile footprint to construct one contact water containment pond and one lined pond for brine cuttings storage.

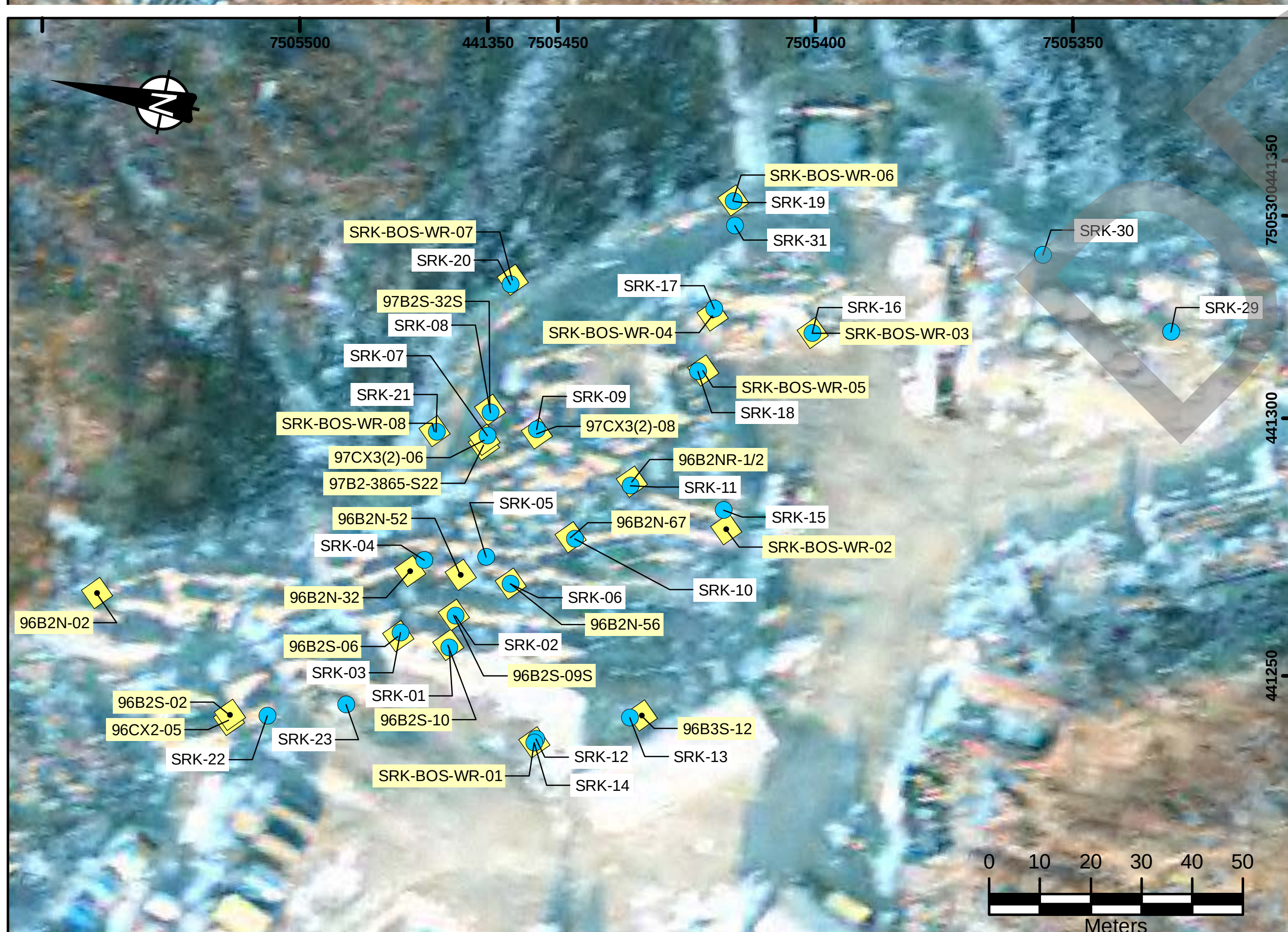
Based on field observations and satellite imagery, SRK attempted to reconstruct some of the material movement for comparison with 2018 results. If a stockpile previously sampled in 2008 could not be located, a sample was taken from a nearby stockpile or from one of the new structures (see Figure 1 for reference between 2008 and 2018 sampling locations).

Table 1 includes a list of the 2018 sampling locations relative to the 2008 locations. Most of the samples were taken at a sampling location established in 2008 with exceptions documented in Table 1.

Additionally, stockpile 96B2N-02 sampled in 2008, along with other stockpiles in the vicinity, were no longer in their original location. It is assumed that they were used for pad construction and repairs prior to TMAC taking ownership of the project.

Sampling was carried out following the methods previously established by SRK (2009). A detailed geological description was done by SRK at each of the sampling locations (see Attachment 1). Rock samples were collected from test pits of approximately 25 cm depth. The <2 mm fraction from the test pit was obtained for rinse pH and electrical conductivity (EC), while the oversize fraction was discarded. No surface samples were collected for rinse tests. A total of 30 samples were taken and transported back to the TMAC field lab at the Doris Camp in high-density polyethylene plastic cups for rinse testing.

At the field lab, SRK conducted the rinse testing according to the MEND (2009) protocol. The protocol calls for a 1:1 ratio of water to solids, therefore 50 g of volume and 50 ml of deionized (DI) water was used for the rinse tests. The samples were shaken for 5 seconds and allowed to stand for 10 minutes. Measurements of pH and EC were then taken of the supernatant using an OAKTON PCTSTestr™ 50 portable meter.



LEGEND

- 2018 Survey
- 2008 Survey

NOTES

1. Coordinate System: NAD 1983 UTM Zone 13N
2. Satellite imagery available up to 2006. This does not reflect current conditions.

REFERENCES

1. Sampling locations of the 2008 survey from SRK (2009).

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Meters

srk consulting	TMAC RESOURCES	Boston Project
		2018 Ore and Development Rock Rinse Test Survey
Job No: 1CT022.027 Filename: 1CT022.027_2008-2018_samples_ver04	HOPE BAY PROJECT	Date: Jan. 2019 / Approved: EM / Figure: 1

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Table 1: Summary of 2018 Sampling Locations and Comparison to 2008 Locations

2018 Sample ID	2008 Sample ID	Comments[1]	Material Type	Location
SRK-01	96-B2S-10	-	Ore	Stockpile
SRK-02	96-B2S-09	-	Ore	Stockpile
SRK-03	96-B2S-06	-	Ore	Stockpile
SRK-04	96-B2N-32	-	Ore	Stockpile
SRK-05	96-B2N-52	Coordinates pointed to pile further north but sample was taken from pile with the correct tag	Ore	Stockpile
SRK-06	96-B2N-56	-	Ore	Stockpile
SRK-07	97-CX3(2)-06 / 97-B2-3865-S22	Piles reshaped in 2017 within the ore stockpile footprint to construct lined storage area for brine drill cuttings disposal. Composite of both piles; hard to differentiate due to material movement.	Ore	Stockpile
SRK-08	97-B2S-32S	Piles reshaped in 2017 within the ore stockpile footprint to construct lined storage area for brine drill cuttings disposal. Sample taken from berm.	Ore	Berm
SRK-09	97-CX3(2)-08	-	Ore	Stockpile
SRK-10	96-B2N-67	-	Ore	Stockpile
SRK-11	96-B2-NR-1/2	-	Ore	Stockpile
SRK-12	SRK-BOS-WR-01	Sample taken from camp pad in front of drill shack (~10 cm deep) according to coordinates. An additional sample was taken from stockpile closest to GPS point (see SRK-14)	Ore	Camp Pad
SRK-13	96-B3S-12	-	Ore	Stockpile
SRK-14	SRK-BOS-WR-01	Sampled stockpile closest to GPS point (about 1 m away).	Ore	Stockpile
SRK-15	SRK-BOS-WR-02	Tag found next to pile on the ground; coordinates not conclusive but location was assumed based on relative position in map.	Ore	Stockpile
SRK-16	SRK-BOS-WR-03	Sampled from berm of containment pond where stockpile used to be. Containment pond by constructed by TMAC.	Ore	Berm
SRK-17	SRK-BOS-WR-04	Sampled from berm of containment pond where stockpile used to be. Containment pond by constructed by TMAC.	Ore	Berm
SRK-18	SRK-BOS-WR-05	Sampled from berm of containment pond (as close to original location as possible). Containment pond by constructed by TMAC.	Ore	Berm
SRK-19	SRK-BOS-WR-06	-	Development Rock	Camp Pad
SRK-20	SRK-BOS-WR-07	-	Ore	Camp Pad
SRK-21	SRK-BOS-WR-08	-	Ore	Camp Pad
SRK-22	96-B2S-02 / 96-CX2-05	NEW - Stockpiles no longer there; likely relocated to make pad for refueling station. Material relocated prior to TMAC's ownership. Sampled from berm of this pad as close as possible to original locations (10 m away).	Ore	Fuel Pad
SRK-23	96-B2S-02 / 96-CX2-05	NEW - sampled additional point of refueling station pad constructed from ore stockpiles. Construction conducted after 2008 and prior to TMAC's ownership.	Ore	Fuel Pad
SRK-24	SRK-BOS-WR-10	Sampled from edge of airstrip (about 2 m away from coordinate location)	Ore	Airstrip
SRK-25	SRK-BOS-WR-09	-	Development Rock	Airstrip
SRK-26	SRK-BOS-WR-11	Sampled from edge of airstrip (about 1 m away from coordinate location)	Development Rock	Airstrip
SRK-27	SRK-BOS-WR-12	Sampled from edge of airstrip (about 1 m away from coordinate location)	Ore	Airstrip
SRK-29	-	NEW - sampled crushed rock from south berm of tank farm. Construction of tank farm berm conducted after 2008 and prior to TMAC's ownership.	Ore	Tank Farm Berm
SRK-30	-	NEW - sampled crushed rock from northeast corner of berm of tank farm. Taken for spatial representation. Construction of tank farm berm conducted after 2008 and prior to TMAC's ownership. Material appears very similar throughout.	Ore	Tank Farm Berm
SRK-31	-	NEW - ore stock pile (96-B2N-01B) behind new containment pond not sampled in 2008. Construction of containment pond conducted after 2008 and prior to TMAC's ownership.	Ore	Stockpile

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Notes:

1. Includes comments regarding 2018 sampling locations and material movement relative to the 2008 survey. "-" indicates sample was taken at the exact location according to GPS coordinates.

4 Results and Interpretation

4.1 Quality Control and Assurance

As part of SRK's QA/QC protocol, the pH and conductivity meter was calibrated prior to starting with the rinse testing, three splits were generated for parallel rinse testing (representing 10% of the samples), and a blank reading on the deionized (DI) water used was carried out. Results are included in Table 2 and discussed below.

The DI water results were consistent with the expected quality of laboratory-grade deionized water.

Most of the split duplicate readings were within a relative percent difference (RPD) of 7%. The exception was sample SRK-11 which had a difference of 60% between its rinse conductivity readings. These values were confirmed with replicate conductivity measurements of the supernatants. The high RPD is potentially related to heterogeneous splitting of the <2 mm fraction. Finer fractions have a higher surface area and therefore greater storage of oxidation products resulting in higher rinse conductivity results.

Table 2: Results of Rinse Testing on QA/QC Split Samples

Sample ID	Rinse pH (s.u.)			Rinse conductivity (µS/cm)		
	Original	Split	RPD (%)	Original	Split	RPD (%)
Blank (DI water)	5.3	-	-	1.3	-	-
SRK-07	8.1	8.1	0%	3200	3000	7%
SRK-11	7.9	8	1%	2800	1500	60%
SRK-23	8.4	8.5	1%	500	520	3%

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Notes:

RPD: relative percent difference = abs(x1 - x2) / mean(x1, x2)

4.2 Field Observations

In line with observations from the 2008 survey, the material inspected mostly consisted of crushed fragments of foliated metasediments (with sericite ±ferroan carbonate ± chlorite alteration, lesser fuchsite as well as quartz veinlets) and quartz-carbonate veins. Minor graphitic argillite was also visible in some stockpiles as small (<10 cm in diameter) and larger fragments (>10 cm in diameter). Rare basalt was also encountered.

Sulphide levels were consistent with observations from 2008, with a typical range from <1% to 5%. However, in 2018 sulphide were typically observed to be tarnished indicating progressive weathering of sulphides. Pyrite was described as untarnished in 2008. Observed pervasive orange-brown staining, likely due to weathering of iron carbonates as well as sulphide oxidation, was most commonly associated with the metasediments, particularly when the fragments showed an association with the quartz-carbonate and the presence of sulphides. Iron staining due to weathering of iron carbonates was also observed in the 2008 survey.

Break down of the ore and development rock into finer material (clay and silt sized) due to weathering was evident for most stockpiles. The quartz-carbonates fragments were generally coarser than those of the metasediments, which is expected as quartz minerals have a higher hardness and are less prone to weathering than the sediments. Rare liberated pyrite crystals (typically around 1 cm in diameter) were observed in three stockpiles where argillite was abundant. In comparison, in 2008, only one occurrence of liberated pyrite was documented.

4.3 Rinse Tests

Rinse pH indicates if materials are acidic or not acidic, whereas rinse conductivity is a measure of soluble oxidation products.

In 2018, rinse pH for the ore and development rock samples ranged from 7.9 to 9.1, while conductivity ranged from 99 to 4,100 µS/cm (Figure 2). Consistent with 2008, rinse EC levels were highest in samples with lowest pH. Maximum levels of EC observed in 2008 (15,000 µS/cm) were higher than in 2018 (4,000 µS/cm). Similarly, lower pH values were observed in 2008 (minimum of 7.2) as compared to 2018 (minimum of 7.9).

Moreover, as indicated in Section 3, in 2008 several samples of surface material were taken when color variation was noted at depth. These samples have been marked in Figure 2 and showed the highest EC values and lowest pH values of the 2008 survey.

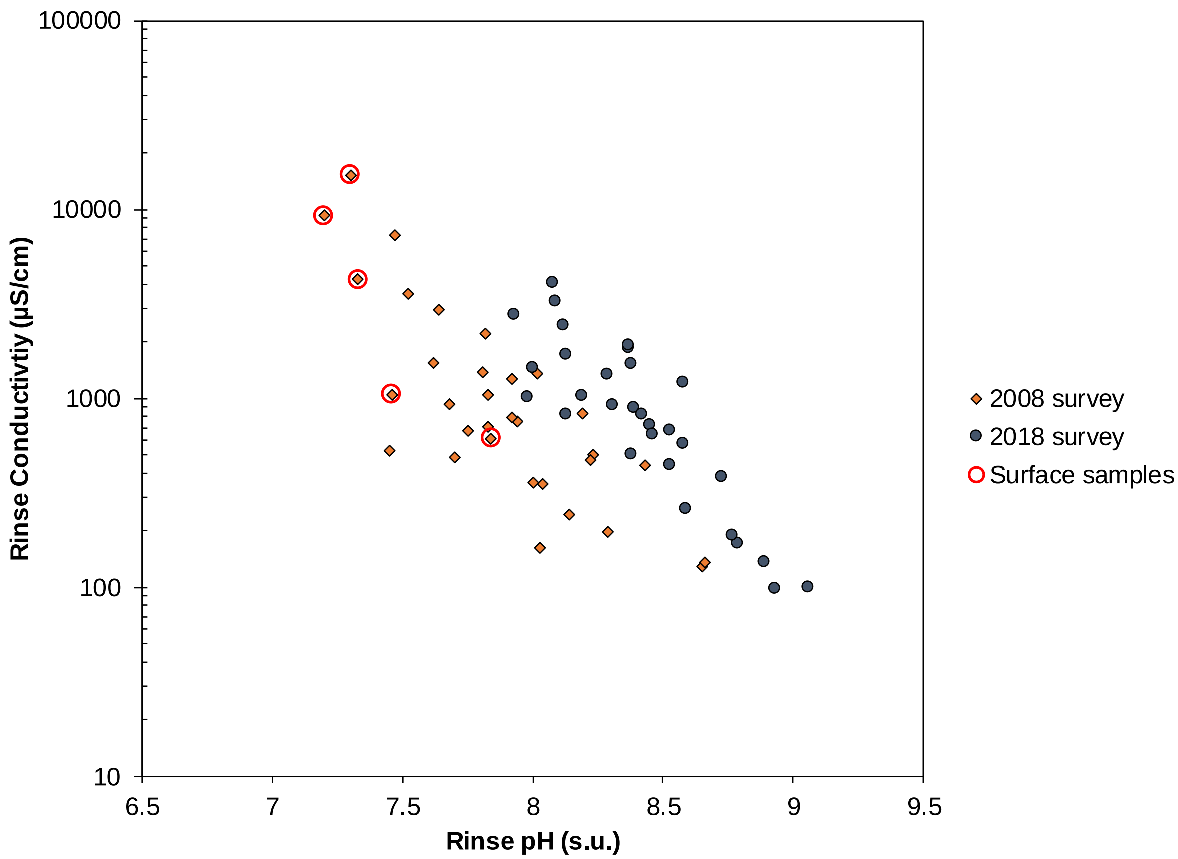

Figure 2: Rinse Test Results from the 2008 and 2018 Surveys

Figure 3, Figure 4 and Table 3 present a direct comparison of 2008 and 2018 rinse pH and EC results by sample location. The comparison indicates that pH values are uniformly higher at all locations in 2018 compared to 2008. This indicates that while sulphide oxidation is occurring, there is sufficient carbonate to maintain non-acidic conditions.

While EC was overall lower in the 2018 samples, there were instances of both higher and lower values recorded at several locations relative to the 2008 survey. The 5th percentile to 90th percentile range of EC, which omits the high EC surface samples from 2018, for both the 2008 and 2018 surveys is constrained between 110 to 4,200 µS/cm. Moreover, soluble oxidation products have increased in some areas and decreased in others. This indicates that no significant change in soluble products has occurred overall at the site relative to the 2008 survey.

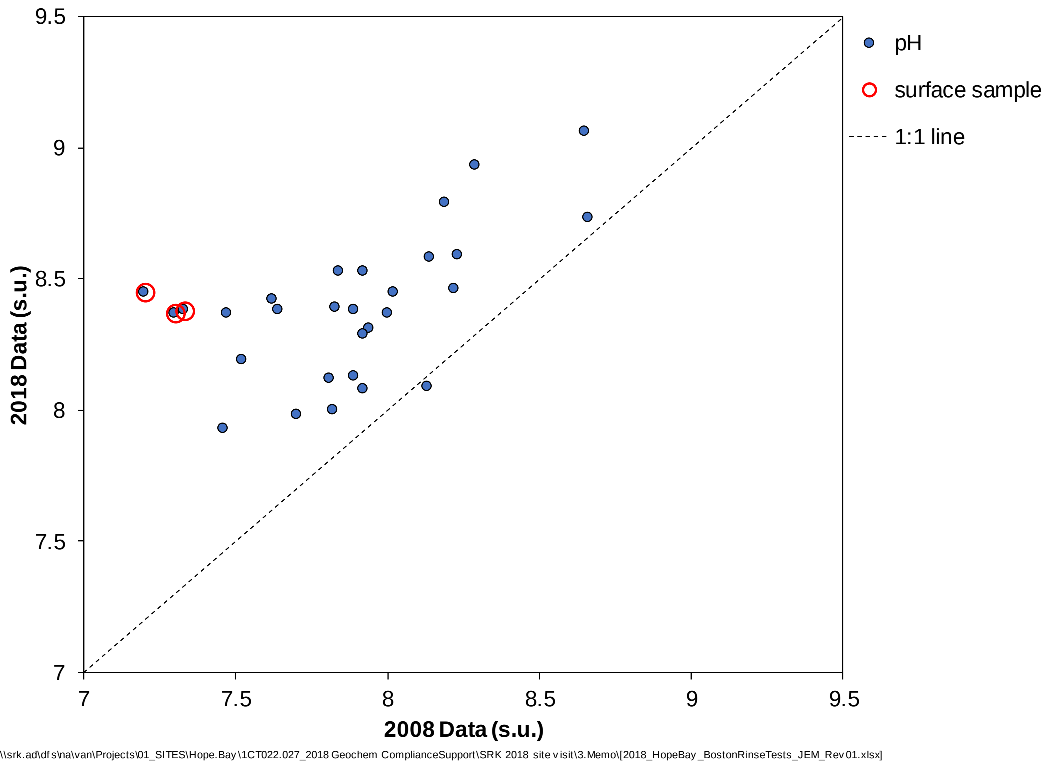

Figure 3: Rinse pH Comparison by Sample Location

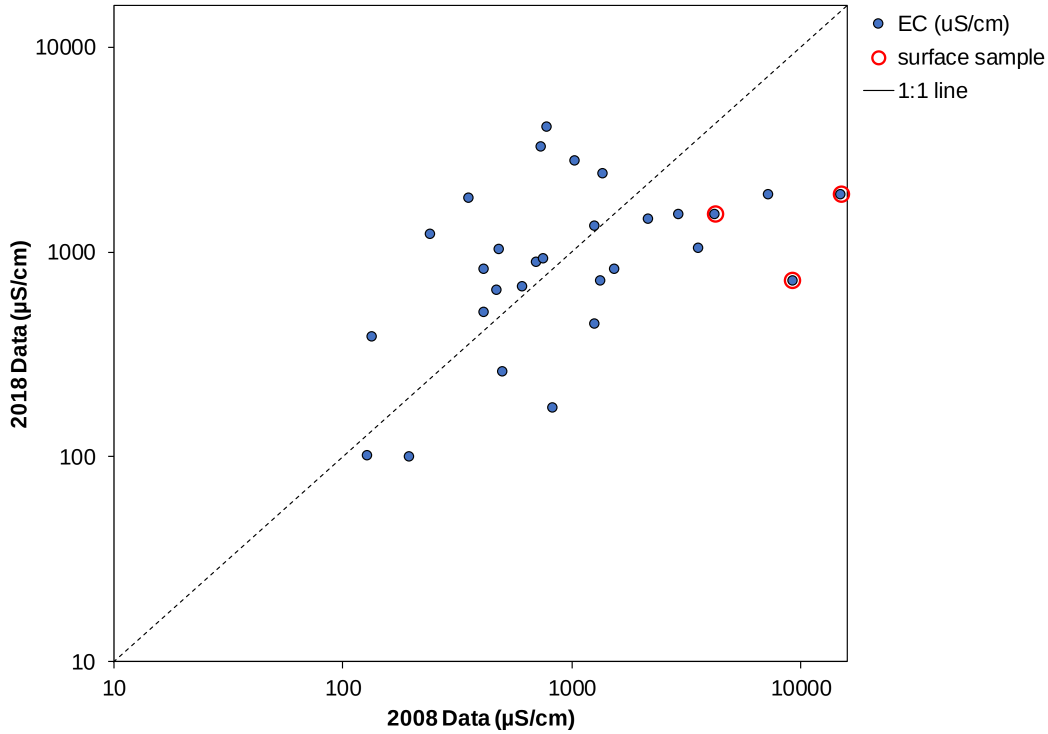

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Figure 4: Rinse EC Comparison by Sample Location

Table 3: Comparison of 2018 and 2008 Rinse Test Survey Results

2018 Sample ID	Material Type	Location	Rinse pH (s.u.)		Rinse Conductivity (µS/cm)	
			2008	2018	2008	2018
SRK-01	Ore	Stockpile	8	8.4	360	1800
SRK-02	Ore	Stockpile	8.1	8.6	240	1200
SRK-03	Ore	Stockpile	7.5	8.4	7300	1900
			7.3		15000	
SRK-04	Ore	Stockpile	7.6	8.4	3000	1500
			7.3		4300	
SRK-05	Ore	Stockpile	8	8.5	1400	720
			7.2		9300	
SRK-06	Ore	Stockpile	7.8	8.4	710	880
SRK-07	Ore	Stockpile	8.1	8.1	740	3200
SRK-08	Ore	Berm	7.9	8.3	760	920
SRK-09	Ore	Stockpile	7.8	8	2200	1400
SRK-10	Ore	Stockpile	7.8	8.5	610	680
SRK-11	Ore	Stockpile	7.5	7.9	1000	2800
SRK-12	Ore	Camp Pad	7.9	8.5	1300	440
SRK-13	Ore	Stockpile	7.7	8	490	1000
SRK-14	Ore	Stockpile	7.9	8.3	1300	1300
SRK-15	Ore	Stockpile	7.9	8.1	790	4100
SRK-16	Ore	Berm	8.2	8.5	480	640
SRK-17	Ore	Berm	7.6	8.4	1600	820
SRK-18	Ore	Berm	7.5	8.2	3600	1000
SRK-19	Development Rock	Camp Pad	8.7	8.7	140	380
SRK-20	Ore	Camp Pad	8.2	8.8	840	170
SRK-21	Ore	Camp Pad	7.8	8.1	1400	2400
SRK-22	Ore	Fuel Pad	7.9	8.1	420	820
SRK-23	Ore	Fuel Pad	7.9	8.4	420	500
SRK-24	Ore	Airstrip	-	8.9	-	140
SRK-25	Development Rock	Airstrip	8.3	8.9	200	99
SRK-26	Development Rock	Airstrip	8.7	9.1	130	100
SRK-27	Ore	Airstrip	8.2	8.6	500	260
SRK-29	Ore	Tank Farm Berm	-	8.8	-	190
SRK-30	Ore	Tank Farm Berm	-	8.6	-	580
SRK-31	Ore	Stockpile	-	8.1	-	1700

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Notes:

*If the original sample location was not located, the data was compared to the closest sampling location if available and within 10 m. In case multiple locations are available for comparison, the average of the 2008 rinse test was used for comparison.

5 Closing Summary

Findings from the 2018 rinse pH survey of development rock and ore at the Boston site, as per conditions of the Water Licence 2BB-BOS1727 (Part E, Item 2), have confirmed that ore and waste rock on the camp pad remain not acidic. While EC was overall lower in the 2018 samples, there were instances of both higher and lower values recorded at several locations relative to the 2008 survey. The geological observations of the samples were consistent with 2008 except that pyrite was tarnished in 2018 indicating progressive weathering.

These observations indicate that while oxidation is occurring, there is sufficient carbonate to maintain non-acidic conditions. Moreover, there is no overall significant change in soluble oxidation products at the site relative to the 2008 survey.

SRK recommends continuing to monitor seepage from around the Boston site and carrying out these rinse surveys every 10 years to monitor the oxidation of the ore. SRK understands from TMAC, that construction using ore stockpile material outside of the current ore stockpile footprint pre-dates TMAC's ownership of Hope Bay. SRK recommends maintaining records of material movement, which is a practice that TMAC maintains.

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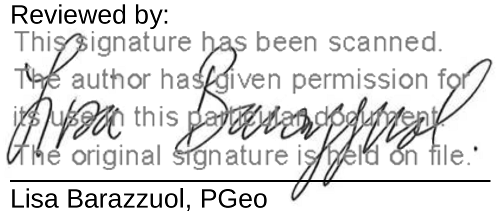

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied 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.

6 References

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Attachment 1: Rinse Test Sample Descriptions

Date	Sample ID	2008 Sample ID	Sampling Comments	Material Type	Location	Description (lithologies listed in order of abundance)	Color Fines	Fizz Fines	Rinse pH	Rinse EC (uS/cm, unless specified)	Duplicate split pH	Duplicate rinse EC (uS/cm, unless specified)
2018-08-12	SRK-01	96-B2S-10	-	Ore	Stockpile	Greenish grey foliated sediments with chlorite alteration and around 3% of small, cubic pyrite and disseminated pyrite.Quartz-carbonate with weathered carbonate veinlets and darker (sediment?) veinlets. Quartz contains around 2-3% cubic (up to 1 cm) pyrite and minor chalcopyrite mostly associated with dark veinlets. Orange brown staining mostly on foliated sediments and veinlets in quartz; not only associated with sulphides.	grey	weak	8.37	1827	-	-
2018-08-12	SRK-02	96-B2S-09	-	Ore	Stockpile	Grey-brown foliated sediments (graphitic) with chlorite and some sericite alteration, minor fuchsite, and 1-2% tarnished, cubic pyrite. Less quartz-carbonate with weathered veinlets and ~3% tarnished, blocky pyrite within veinlets. Minor argillite with no visible sulphides. Pervasive orange-brown staining (rust) of sediments and veinlets in quartz.	light grey to grey	very weak	8.58	1211	-	-
2018-08-12	SRK-03	96-B2S-06	-	Ore	Stockpile	Grey-brown foliated sediments (graphitic) with chlorite and minor sericite alteration, and up to 5% of cubic and euhedral (tarnished and fresh) pyrite. Quartz carbonate with 1-3% of euhedral pyrite. Pervasive rusting on sediments and to a lesser degree on quartz-carbonate.	brownish grey	none	8.37	1898	-	-
2018-08-12	SRK-04	96-B2N-32	-	Ore	Stockpile	Green (some graphitic) foliated sediments with sericite-chlorite alteration, minor fuchsite and 1-2% clusters of tarnished pyrite, particularly on chloritic/graphitic sediments between foliation. Dark grey argillite with ~3% tarnished pyrite clusters. Pervasive rusting on all rock types, not only associated with pyrite.	grey	none	8.38	1517	-	-
2018-08-12	SRK-05	96-B2N-52	Coordinates pointed to pile further north but sample was taken from pile with the correct tag	Ore	Stockpile	Serciite (less chlorite) altered foliated sediments with fuchsite and <1% small, tarnished pyrite crystals between foliation. Less finer quartz-carbonate with <1% small, mostly tarnished pyrite crystals in contact. Trace argillite. Around 50% of sediments are rusted and most of quartz within and around veinlets (not only associated with pyrite)	pale grey	none	8.45	720	-	-
2018-08-12	SRK-06	96-B2N-56	-	Ore	Stockpile	Particle size very fine grained. Green sericite-altered sediments with minor fuchsite (some grey chlorite altered sediments) and ~2% tarnished cubic pyrite, clusters and minor disseminated pyrite. Quartz-carbonate with 3-5% heavily weathered clusters of Py and Cpy. Trace argillite. Pervasive rusting on coarse sediments and on quartz Py clusters (less rusting on small fragments)	greenish grey	none	8.39	882	-	-
2018-08-12	SRK-07	97-CX3(2)-06 / 97-B2-38	Piles partially removed to construct containment pond (out of operation). Composite of both piles; hard to differentiate due to material movement.	Ore	Stockpile	Dark grey, graphitic argillite with minor fuchsite and up to 5% clusters of tarnished, cubic Py (1-4mm). Quartz-carbonate in contact with sediments, 1-2% pyrite associated with contact. Minor sericite altered foliated seds. Almost no rusted on argillite, some in veinlets in quartz.	grey	very weak	8.09	3.24 mS/cm	8.13	3.03 mS/cm
2018-08-12	SRK-08	97-B2S-32S	Pile now part of the berm of the containment pond that is not in operation.	Ore	Berm	Dark graphitic, foliated sediments with chlorite alteration; mostly no visible pyrite, some cubic up to 4mm and clusetrs of Py between foliation (~1%). Quartz-carbonate with almost no visible pyrite, some weathered Cpy (?) clusters, <1%. Minor dark fine-grained argillite with ~1% small Py crystal disseminations. Trace intermediate intrusive with ~2-3% small Py crystal disseminations. Rust mostly on quartz intrusive.	grey	none	8.31	915	-	-
2018-08-12	SRK-09	97-CX3(2)-08	-	Ore	Stockpile	Dark grey argillite with minor foliation and grey foliated sediments with chlorite alteration; up to 10% highly weathered (some red tarnished) Py crystals (~2mm). Quartz carbonate with sedimentary component and ~3% tarnished/rusted Py crystals (~2mm) and clusters in sed. component. Foliated sediments with sericite-chlorite alteration and minor fuchsite; no visible sulphides. Weathering observed in all rock types associated with pyrite.	brownish grey	none	8	1445	-	-
2018-08-12	SRK-10	96-B2N-67	-	Ore	Stockpile	Quartz-carbonate with dark veinlets andup to 3% of weathered/tarnished cubic (some euhedral) Py crystals and clusters and minor Cpy (one occurrence of blue Cu precipitate). Dark grey argillite sediments (graphitic) with some foliation; up to 10% of tarnished, cubic Py clusters. Grey-green foliated sediments with chlorite-sericite alteration and fuchsite; ~1% of clusters of tarnished, cubic Py (up to 2mm). Rusting mostly linked to Py clusters.Rusting mostly linked to Py clusters.	grey	very weak	8.53	676	-	-
2018-08-12	SRK-11	96-B2-NR-1/2	-	Ore	Stockpile	Argillite (dark, dark green and light) with sericite-chlorite alteration (some foliation), fuchsite and ~5% clusters of tarnished, cubic Py crystals (up to 5mm). Sericite-chlorite altered foliated sediments (yellow-green), abundant fuchsite and 1-2% small cubic Py along foliation. Quartz-carbonate with -2% weathered, cubic Py in sed. contacts. Rusting pervasive on foliated sediments with fuchsite and contact with quartz. Sediments visibly breaking down into clays.	brownish grey	none	7.93	2.77 mS/cm	7.99	1491
2018-08-12	SRK-12	SRK-BOS-WR-01	Sample taken from camp pad in front of drill shack (~10 cm deep) according to coordinates. An additional sample was taken from stockpile closest to GPS point (see SRK-14)	Ore	Camp Pad	Dark, graphitic argillite with ~2-3% tarnished, cubic Py (up to 5 mm). Sericite-chlorite altered foliated sediments with minor fuchsite and no visible Py. Quartz-carbonate in contact with intrusive, 3-5% clusters of cubic Py particularly at contact. Trace of basalt with cross-cutting quartz veinlets and gabbro with no visible sulphides. Orange-red staining mostly on quartz and slight rusting on foliated sediments.	greenish grey	moderate	8.53	444	-	-
2018-08-12	SRK-13	96-B3S-12	-	Ore	Stockpile	Sericite altered foliated sediments with minor fuchsite and ~1% cubic Py between foliation. Quartz-carbonate (contact with sediments) with ~3-5% clusters of tarnished Py. Dark grey argillite with small, cubic disseminated Py. Trace gabbro with ~2-3% cubic Py (up to 5mm). Heavy weathering of quartz contact with foliated sediments.	greenish grey	very weak	7.98	1017	-	-
2018-08-12	SRK-14	SRK-BOS-WR-01	Sampled stockpile closest to GPS point (about a meter away).	Ore	Stockpile	Sericite altered foliated sediments with abundant fuchsite and noisible sulphides. Quartz carbonate (contact with sediments) with up to 3% tarnished, cubic Py (up to 1 cm) along contacts. Green basalt with quartz veinlets and no visible Py. Chlorite altered argillite with no visible Py.	pale grey	weak	8.29	1330	-	-
2018-08-12	SRK-15	SRK-BOS-WR-02	Tag found next to pile on the ground; coordinates not conclusive but location was assumed based on relative position in map.	Ore	Stockpile	Sericite-chlorite foliated sediments with fuchsite and 1-2% cubic pyrite (small crystals) along foliation. Quartz-carbonate cross-cutting sediments with ~2-3% clusters of small cubic Py. Heavy rusting of both rock types, particularly at contact. Sediments visibly breaking down into clays.	greenish grey	none	8.08	4.07 mS/cm	-	-
2018-08-12	SRK-16	SRK-BOS-WR-03	Sampled from berm of new containment pond.	Ore	Stockpile/berm	Grey (graphitic) and dark green argillite with signs of foliation, sericite alteration and silicification; ~2-3% cubic Py (up to 3 mm) and clusters of small tarnished Py crystals (some red tarnishing). Quartz carbonate in contact with sediments with ~3% tarnished, cubic Py (up to 5 mm), mainly associated with contact. Rusting primarily associated with Py.	grey	very weak	8.46	642	-	-
2018-08-12	SRK-17	SRK-BOS-WR-04	Sampled from berm of new containment pond (as close to original location as possible)	Ore	Berm	Lithologies same as SRK-BOS-WR-03 but finer particle size, quartz-carbonate contains less sediment fragments and argillite mostly graphitic. Quartz carbonate contains higher sulphide content up to 10% (localized).	grey	very weak	8.42	815	-	-

2018-08-12	SRK-18	SRK-BOS-WR-05	Sampled from berm of new containment pond (as close to original location as possible)	Ore	Berm	Lithologies same as SRK-BOS-WR-04 but vein quartz is more pure (less sediment contact). Irradescent weathering on cubic Py (up to 1 cm) in argillite. Rare liberated Py crystals up to 2 cm with irradescent weathering observed.	grey	none	8.19	1029	-	-
2018-08-12	SRK-19	SRK-BOS-WR-06	Sampled on edge/berm of camp pad.	Development Rock	Camp Pad	Chlorite altered sediments and dark grey argillite; 3-5% tarnished Py crystals (up to 1 cm cubes) and disseminated Py. Intrusive with quartz veins cross-cutting and ~2% of smeared and cubic Py (up to few mm). Quartz-carbonate with ~1% of small, tarnished Py crystals. Sericite altered sediments with no visible pyrite. Fines are greener than in other locations. Heavy, pervasive rusting of sediments, intrusives and quartz veins.	pale greenish grey	moderate	8.73	381	-	-
2018-08-13	SRK-20	SRK-BOS-WR-07	Sampled on edge/berm of camp pad.	Ore	Camp Pad	Quartz-carbonate and gabbro with hornblende; locally up to 5% cubic and clusters of tarnished Py. Argillite (graphitic) with chlorite alteration and up to 10% sulphides (weathered/tarnished cubic Py up to 2 cm, clustered Py and Cpy and small Py crystal disseminations; some irradescent weathering visible). Trace basalt with chlorite alteration and no visible pyrite. Pervasive rusting over argillite and linked to sulphides in all rock types.	grey	none	8.79	171	-	-
2018-08-13	SRK-21	SRK-BOS-WR-08	Sampled on edge/berm of camp pad.	Ore	Camp Pad	Green bassalt with cross cutting quartz vein and trace altered basalt; smeared weathered/tarnish Py and stringers associated with quartz veins, locally up to 5%. Graphitic argillite with sericite-chlorite alteration and foliated sediments; tarnished, cubic Py with higher percent in contact with quartz (1-2%). Trace vein quartz with smeared, weathered Py (<1%). Pervasive rusting of sediments and Py clusters and stringers.	light greenish grey	strong	8.12	2.41 mS/cm	-	-
2018-08-13	SRK-22	96-B2S-02 / 96-CX2-05	Stockpiles no longer there; likely relocated to make pad for refuelling station. Sampled from berm of this pad as close as possible to original locations (10 meters away)	Ore	Fuel Pad	Green, fine-grained basalt with quartz veining, chlorite alteration and no visible sulphides. Aphanitic felsic intrusive (or silicified sediments?) with 5-10% pervasive fine-grained disseminated Py. Foliated sediments with chlorite-sericite alteration, minor fuchsite and <1% fine-grained disseminated Py. Quartz carbonate contact with smeared Py, rusted cubic Py and Py clusters (locally up to 15%). Pervasive rusting on intrusive and foliated sediments.	brownish grey	weak to mod	8.13	815	-	-
2018-08-13	SRK-23	96-B2S-02 / 96-CX2-05	Sampled additional point of refuelling station pad constructed from ore stockpiles.	Ore	Fuel Pad	Dark grey argillite (graphitic) with ~5%tarnished (often red) small, cubic Py and diss. Py. Quartz-carbonate with ~5% cubic Py (up to 3 cm) at contact. Sericite-altered foliated sediments, with abundant fuchsite and ~1% small, cubic Py (tarnished red). Trace green basalt with no visible Py. Pervasive rusting of argillite as well as Py in quartz-carbonate; moderate rusting on sediments.	brownish grey	very weak	8.38	504	8.47	520
2018-08-13	SRK-24	SRK-BOS-WR-10	Sampled furthest point of airstrip.	Ore	Airstrip	Grey -green and dark gery argillite with quartz veinlets (chlorite alteration) and ~3-5% rusted, fine-grained/disseminated cubic Py (locally up to 20-30%). Quartz-carbonate (contact with sediments and basalt) with ~5% cubic, tarnished Py and smeared rusted Py. Sericite-altered sediments with fuchsite and ~1% rusted, fine-grained Py. Green basalt with quartz veins with no visible Py. Pervasive rusting on argillite sediments and Py clusters in quartz.	pale greenish grey	very weak	8.89	135.9	-	-
2018-08-13	SRK-25	SRK-BOS-WR-09	-	Development Rock	Airstrip	Sericite-chlorite altered foliated sediments with minor fuchsite, quartz veinlets and no visible Py. Dark green basalt with quartz veining and ~1% fine-graind disseminated Py. Traces of vein quartz with <0.5% tarnished specks of Py. Pervasive rusting of sediments and quartz veinlets.	pale greenish grey	moderate	8.93	98.5	-	-
2018-08-13	SRK-26	SRK-BOS-WR-11	-	Development Rock	Airstrip	Olive green foliated sediments with sericite/chlorite alteration, fuchsite and ~1% fresh and tarnsihed cubic Py. Quartz vein with ~3-5%chunky Py (up to 1 cm width) and tarnished/rusted Cpy. Dark green basalt with <0.5% tarnished/rusted cubic Py. Trace graphitic argillite with ~1% fresh and tarnished cubic Py (up to 5 mm). Rusting pervasive in sediments, particularly samples with fuchsite and Py; preferential rusting of Py and Fe minerals in quartz and basalt.	pale greenish grey	very weak	9.06	100	-	-
2018-08-13	SRK-27	SRK-BOS-WR-12	-	Ore	Airstrip	Graphitic argillite and foliated sediments with chlorite alteration, <0.5% tarnished Py crystals/clusters. Quartz vein (contact with sediments) with up to 3% (locally) of rusted/tarnished cubic Py. Olive green sericite-altered foliated sediments with no visible pyrite. Rare liberatedy Py (up to 2 cm). Heavy rusting of quartz along contact and veinlets. Moderate rusting on sediments while other fragments are visibly breaking down to clays. Pocket of rusting found at 25 cm within test pit.	orange-greenish grey	moderate	8.59	257	-	-
2018-08-13	SRK-29	-	Sampled crushed rock from south berm of tank farm.	Ore	Tank Farm Berm	Vein quartz with up to 5% (locally) of tarnished or heavily rusted smeared Py, as well as clusters and stringers of Py. Graphitic argillite and foliated sediments and minor olive-green foliated sediments with up to 10% (locally) of tarnished, cubic Py and dense Py clusters, mostly in small rock fragments. Pervasive rusting of sediments and heavy rusting associated with Py; signs of iron oxidation at depth.	greenish grey	none	8.77	188.7	-	-
2018-08-13	SRK-30	-	Sampled crushed rock from northeast corner of berm of tank farm. Taken for spatial representation. Material appears very similar throughout.	Ore	Tank Farm Berm	Same as SRK-29	pale grey	weak	8.58	575	-	-
2018-08-13	SRK-31	-	Ore stock pile (96-B2N-01B) behind new containment pond not sampled in 2008.	Ore	Stockpile	Vein quartz with ~2-3% of tarnished red/stained clusters of cubic Py at contacts (locally up to 10%). Dark grey (graphitic) argillite with ~5% tarnishehd red cubic Py and Py clusters. Minor foliated sediments with sericite alteration and no visible Py. Common liberated Py crystals up to 2 mm. Preferntial staining of quartz veinlets, Py clusters and foliated sediments.	pale brownish grey	none	8.13	1695	-	-

Appendix B – 2018 Boston Seepage Monitoring

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Marie-Christine Noel Lisa Barazzuol, PGeo	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 11, 2019
Subject:	Boston Seepage Monitoring Program 2018 - DRAFT		

1 Introduction

At the Boston site, ore and waste rock were generated as part of a 1996-1997 BHP Billiton underground exploration program. The ore was placed in a number of stockpiles on the camp pad and the waste rock was used to construct a camp pad, roads, and an airstrip at Boston. Since that time, the site has been primarily in care and maintenance, with periodic use of the camp and airstrip in support of exploration activities.

2018 seepage monitoring activities include:

- A freshet seepage survey along the north and east sides of the camp pad, and the southern end of the airstrip, as outlined in the Water and Ore/Waste Rock Management Plan (SRK 2017), and
- Surveillance Network Program (SNP) seepage monitoring at station BOS8.

This memo presents the results of all Boston seepage samples collected in 2018 and complies with Part J "Conditions applying to the Monitoring Program" Item 22 of Water Licence 2BB-BOS1727 (Nunavut Water Board 2017).

2 Methods

2.1 Sample Collection

2.1.1 Airstrip and Camp Pad Seepage Survey

The freshet seep survey at Boston was conducted between June 16 and June 25, 2018 by TMAC Resources (TMAC) with guidance from SRK. The survey included walking the north and east sides of the camp pad and the full extent of the airstrip. Seep locations were established opportunistically by walking the toe of the camp pad and in areas where water was observed flowing out of the toe of the camp pad. One seep was identified and sampled on the east side of the camp pad (18-BOS-3, Figure 1). No seeps were observed along the airstrip or the northern extent of the camp pad. Field measurements of electrical conductivity (EC), pH, oxidation-reduction potential (ORP), temperature and flow rates (where possible) were measured at each of these locations.

The sample was collected by TMAC from all stations for laboratory analysis. The water quality sample was submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, EC, total dissolved solids (TDS), alkalinity, anions (bromide, chloride, fluoride, and sulfate), nutrients (ammonia, nitrate, nitrite, and phosphorus) and dissolved metals. All samples were filtered and preserved in the field. In addition, one duplicate sample and one field blank were collected and submitted for laboratory analysis.

2.1.2 SNP Seepage Monitoring (BOS-8)

As stipulated in Water License 2BB-BOS1727 (Nunavut Water Board 2017), TMAC monitors the seepage station BOS-8A, BOS-8B, BOS-8C, and BOS-8D. At minimum, monthly samples are to be collected if flowing seepage is observed. In 2018, TMAC collected two samples were collected at BOS-8A (referred to as location 18-BOS-01 in Figure 1) on June 16 and 25, and one sample at BOS-8B on June 25 (referred to as location 18-BOS-02 in Figure 1). Field measurements of EC, pH, ORP, temperature and flow rates (where possible) were measured. No additional samples were collected in 2018 as no seepage was observed at these monitoring stations after June 25.

Samples were collected from all stations for laboratory analysis. The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia. Both samples were analyzed for pH, hardness, conductivity, total dissolved solids, alkalinity, anions (bromide, chloride, fluoride, and sulfate), nutrients (ammonia, nitrate, nitrite, and phosphorus) and dissolved metals.

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Legend

- 2018 Seepage
- 2017 Seepage

	pH 6.0 to 6.9	pH 7 to 7.9	pH 8 to 8.9
EC ≤ 500 µS/cm			
500µS/cm<EC<2000µS/cm			
EC>2000µS/cm			

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MAC RESOURCES

Job No: 1CT022.016

Filename: 1CT022_016_AnnualSeepMaps_2018_Boston_rev01

2018 Seepage Monitoring

Hope Bay Gold Project

Seep Survey Locations
Boston Area

Date:	Approved:	Figure:
Feb. 2019	MCN	1

3 Quality Assurance and Control

3.1 2018 Data

SRK conducted a QA/QC review of all June seepage samples including the duplicate and field blank.

Laboratory and field values of pH and electrical conductivity (EC) were compared, as well as total dissolved solids (TDS) and lab conductivity. Conductivity values were near parity for all samples. Values of pH were similar between field and lab readings. For all samples, TDS demonstrated a strong positive correlation with lab conductivity.

Ion balances ranged from -2.5 to 1.2% for the seep samples. All samples complied with SRK's criteria of ±10%. All parameters in the field blank sample passed the QA/QC criteria of being below two times the detection limit.

Phosphate concentrations in the field duplicate failed the SRK criteria and exceeded a ±30% relative percent difference (RPD) with measured concentrations above ten times the detection limit, however this was not germane to data interpretation. SRK considered all data acceptable.

3.2 Historic Data

The historic seepage data set is comprised of 49 samples collected between 2008 and 2017, with the majority of samples analyzed for total metals rather than dissolved metals (Attachment 1). SRK collected three seepage samples in 2008 and based on QA/QC screening concluded that the data were acceptable (SRK 2009). All other historic samples were collected by Hope Bay Mining Ltd (HBML) or TMAC as part of the SNP water licence monitoring program or the seepage monitoring program (Attachment 2). SRK did not conduct QA/QC of the historic seepage data collected by HBML or TMAC prior to 2017 because the limited analytical suite precluded the calculation of ion balances and other QA/QC checks. SRK accepted all SNP monitoring data as-is.

4 Results

4.1 Field Observations

Field parameters for the three seeps sampled in 2018 are presented in Table 1. Field electrical conductivity varied from 390 to 1702 µS/cm, with the minimum value observed on June 16 at 18-BOS-01, and the maximum value observed over a week later on June 25 at the same location. The pH ranged from 7.5 to 7.9.

Table 1: 2018 Field Observations

Sample ID	Field pH *s.u.*	Field EC *µS/cm*	ORP *mV*	Temperature *ºC*	Flow *L/s*	Comments
B0S-8A (18-B0S-01) 2018-06-16	7.5	390	96	6.7	N/A	NE tip of Boston Camp. Seep drains from snow melt on road into grasses. Seep drains through core storage boxes along roadside. Approximately 200 m from closest camp building. Approximately 800 m from lake edge. Collected with syringe. 3 small seeps converge into the pool. Unable to collect flow - seeps too shallow.
B0S-8A (18-B0S-01) 2018-06-25	7.6	1300	27	6.5	N/A	NE camp pad. Flows slowly to BOS-08 and onto Tundra grasses. Very low flow. Flows from mixture of gravels and larges rocks. Syringe used to collect samples
BOS-8B (18-BOS-02)	7.8	1700	49	0.9	0.13	Downslope of ore stockpile at toe of containment pond base. Some ice at bottom of seep pool. Syringe used to collect sample. Potential for some flow to not be caught as some may go under and around a rock in seep path.
18-BOS-03	7.9	1600	57	8.7	N/A	Toe of camp pad on eastern-section of pad at toe of old burn pit (B0S-7). Seep flows into mucky rocky area. Free of grasses. Syringe used to collect sample. Seep too shallow for accurate flow measurement.

Source: \\van-svr0\projects\01_SITES\Hope.Bay\1CH008.022 Boston WR Management Plan\Boston seep survey\2018\3. Working file\[2018BostonSeepage_Working_1CH008-022_Rev00_MCN.xlsx]

4.2 Laboratory Results

Table 2 and Table 3 presents the 2018 Boston seepage data and compares the data to a statistical summary of historical Boston seepage samples (2008 to 2017). Table 2 presents general parameters, anions and nutrients, while Table 3 presents selected trace element data. When available, dissolved metals data are presented in Table 3, however total metals are also presented as they are analyzed as part of the seepage monitoring conducted as part of the Boston water licence.

The 2018 Boston seepage samples were compared to screening criteria based on ten times the CCME guideline (CCME 1999) for the preservation of aquatic life in fresh water (chronic concentrations) as a screening criteria. CCME guidelines are not directly applicable because the seep locations do not support aquatic life.

All samples were pH neutral to slightly alkaline (7.3 to 8.1). Sulphate concentrations were within the range of historical concentrations and ranged from 150 to 530 mg/L (Figure 2). Chloride concentrations ranged from 8.9 to 220 mg/L. The sample collected at 18-BOS-01 on June 16 (8.9 mg/L) is the lowest observed concentration of chloride in the seepage dataset.

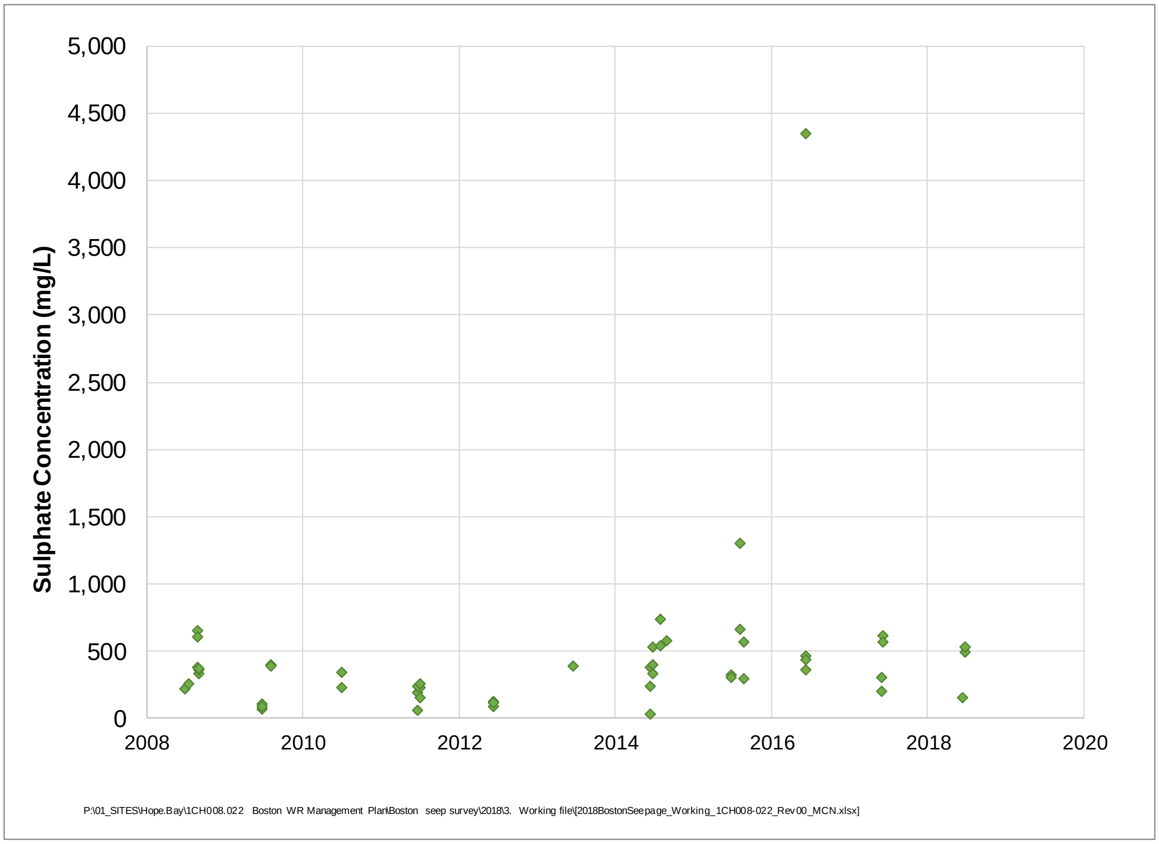

Figure 2: Sulphate concentrations observed in seeps at the Boston Camp since 2008

Table 2: Summary of General Parameters, Anions and Nutrients, 2017 and Historical Seepage Samples

Sample ID	Sample Date	Anions and Nutrients						
		Conductivity	pH	Alkalinity, Total (as $CaCO_3$)	Ammonia	Nitrate	Chloride	Sulphate
		µS/cm	s.u.	mg/L as $CaCO_3$	mg/L as N	mg/L as N	mg/L	mg/L
10x CCME					**15.4**	**130**		
18-BOS-01	2018-06-16	401	7.3	22	0.025	0.42	8.9	152
18-BOS-01	2018-06-25	1200	7.8	129	0.024	1.6	47	493
18-BOS-02	2018-06-25	1840	8.0	90	0.35	3.6	220	527
18-BOS-03	2018-06-25	1640	8.1	89	0.030	3.8	194	527
Historic Seepage data								
P5th percentile		420	6.9	31	0.0096	0.06	27	77
P50th percentile		1300	7.7	74	0.05	3.3	150	330
P95th percentile		2700	8.1	180	9.2	46	1300	700
Number of samples		49	49	26	47	25	25	49

Source: \\van-svr0\projects\01_SITES\Hope.Bay\1CH008.022 Boston WR Management Plan\Boston seep survey\2018\3. Working file\[2018BostonSeepage_Working_1CH008-022_Rev00_MCN.xlsx]

Table 3: Summary of Trace Elements, 2017 and Historical Seepage Samples

Sample ID	Dissolved Metals										
	Aluminum	**Arsenic**	**Cadmium**	**Cobalt**	**Copper**	**Iron**	**Lead**	**Manganese**	**Nickel**	**Selenium**	**Zinc**
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
10x CCME	**1**	**0.05**	**0.0037**	**-**	**0.04**	**3**	**0.07**	**-**	**1.5**	**0.01**	**0.3**
18-BOS-01 (June 16)	0.0044	0.043	<0.000005	0.025	0.002	<0.01	<0.00005	0.024	0.052	0.00023	0.0017
18-BOS-01 (June 25)	0.0054	**<u>0.076</u>**	0.000025	0.11	0.0085	0.013	<0.00005	0.11	0.32	0.00093	0.0027
18-BOS-02	0.002	**<u>0.71</u>**	0.000029	0.96	0.0056	<0.01	<0.00005	0.25	1.2	0.0031	0.002
18-BOS-03	0.0043	**<u>0.32</u>**	0.000031	0.35	0.0041	<0.01	<0.00005	0.13	0.41	0.0026	0.029
Historic Seepage data											
Dissolved Metals											
P5	0.0029	0.033	0.000016	0.029	0.0022	0.073	-	0.12	0.094	0.00073	0.0032
P50	0.0097	**<u>0.11</u>**	0.000033	0.25	0.0041	0.12	-	0.29	0.61	0.0028	0.0062
P95	0.031	**<u>0.87</u>**	0.000036	1.1	0.0068	0.24	-	1.1	**<u>1.7</u>**	**<u>0.011</u>**	0.036
Maximum	0.034	**<u>0.99</u>**	0.000037	1.1	0.0076	0.25	-	1.4	**<u>1.8</u>**	**<u>0.014</u>**	0.041
n	6	7	4	7	7	3	-	7	7	6	6
Total Metals											
P5	0.015	0.0027	0.000015	0.002	0.0014	0.034	0.0001	0.015	0.01	0.00039	0.0038
P50	0.099	**<u>0.12</u>**	0.00005	0.05	0.0049	0.3	0.0005	0.2	0.13	0.002	0.0057
P95	0.9	**<u>0.74</u>**	0.001	0.79	0.011	**<u>4.2</u>**	0.005	0.7	1.4	0.008	0.096
Maximum	**<u>6.9</u>**	**<u>5.6</u>**	0.002	1.4	**<u>0.045</u>**	**<u>16</u>**	0.022	2	**<u>4</u>**	**<u>0.017</u>**	0.1
n	43	41	45	43	45	45	45	43	45	41	43

Source: \\van-svr0\projects\01_SITES\Hope.Bay\1CH008.022 Boston WR Management Plan\Boston seep survey\2018\3. Working file\[2018BostonSeepage_Working_1CH008-022_Rev01_MCN.xlsx]

Note:

Values underlined and bolded exceed 10xCCME guidelines
1 CCME Guidelines assume an average pH of 8, a (conservative) estimate of temperature at 20°C, average hardness of 600 mg/L $CaCO_3$

Concentrations of arsenic exceeded the screening criteria. Dissolved arsenic concentrations (0.043 to 0.71 mg/L) were within the range of historical values, both total and dissolved. Figure 3 presents the dissolved and total arsenic concentrations observed since 2008. Although the concentrations exceed the screening criteria, no long-term trend can be identified in the arsenic data. All other parameters were below the screening criteria and within the range of historical observed concentrations. Previously, dissolved nickel and selenium concentrations were periodically above the screening criteria, but this was not observed for 2018 seepage samples.

Two samples were taken at 18-BOS-01 within a nine-day period. Concentrations were higher on June 25 compared to June 16 by a factor of 3.3 for the following parameters: TDS (970 and 290 mg/L, respectively), sulphate (490 and 150 mg/L, respectively) and calcium (170 and 51 mg/L, respectively). Chloride concentrations were also higher on June 25 compared to June 16 (47 and 8.9 mg/L mg/L, respectively). The lower concentrations on June 16 may be a result of greater dilution from precipitation or snowmelt. Seepage flowrates could not be measured on either day due to the seeps being too shallow, which precludes loading calculations.
The difference between the two sampling events demonstrates the range of concentrations possible at a sampling location due to dilution and the impact of freshet flow rates on water quality.

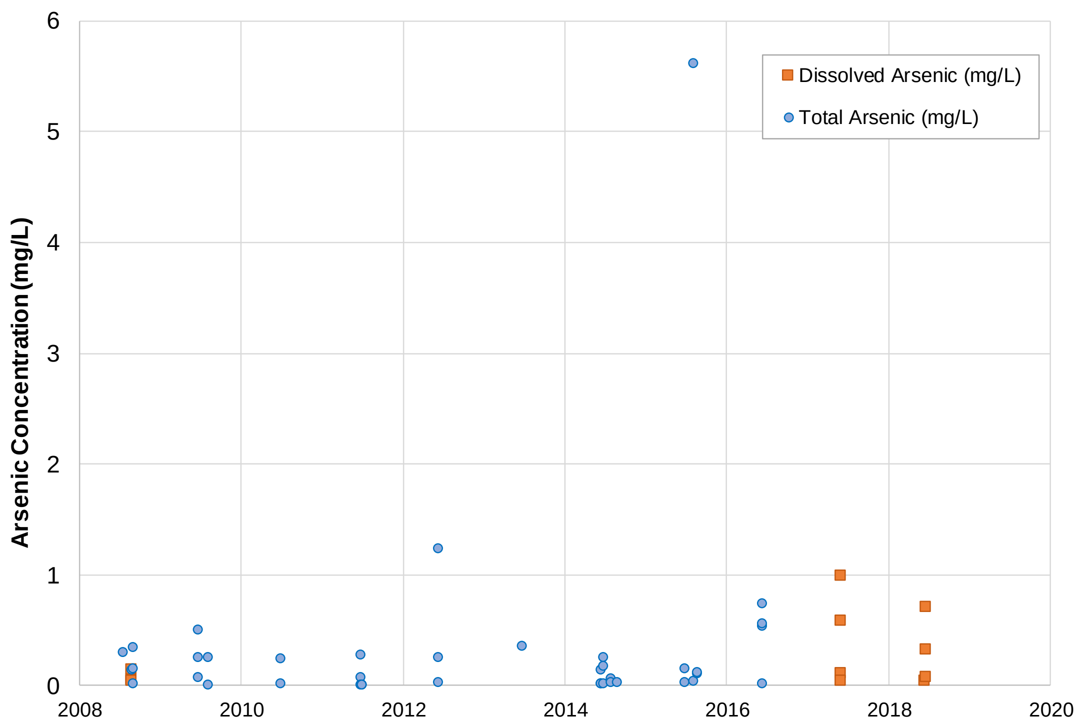

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Figure 3: Arsenic concentrations observed in seeps at the Boston Camp since 2008

5 Conclusions and Recommendations

Seepage surveys in 2018 at Boston included i) the freshet survey of the north and east sides of the camp pad and the southern end of the airstrip and ii) monthly surveys of SNP station BOS-8. This memo presents the results from both seepage surveys. In 2018, a total of four opportunistic seepage samples were collected: all four from the east side of the camp pad. No seepage was observed along the northern extent of the pad or along the airstrip.

All seepage samples were pH neutral to slightly alkaline with sulphate concentrations (150 to 530 mg/L) within the range of historic seepage monitoring samples. Arsenic concentrations (0.043 to 0.71 mg/L) were elevated for selected samples compared to the screening criteria, but were within the historical range of observed concentrations, and no long-term trend was identified. Two samples collected from 18-BOS-01 within a nine-day period suggested that the differences in concentrations are likely due to varying freshet flow rates and associated dilution of seepage samples. Continued monitoring will allow for further trends in the seepage to be established.

Regards,

SRK Consulting (Canada) Inc.

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Marie-Christine Noël
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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.

6 References

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Attachment 1: 2018 Field Observations and Water Quality Results

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Date	Time	Sampled	Station	Easting	Northing	Description	pH	Temperature	Conductivity	ORP	Flow	ALS Sample ID	Conductivity	Hardness (as CaCO3)	pH	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Bicarbonate (as CaCO3)	Alkalinity, Carbonate (as CaCO3)	Alkalinity, Hydroxide (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)
Unit				UTM 13			pH units	ºC	µS/cm	mV	L/s		uS/cm	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lowest Detection Limit													*2*	*0.5*	*0.1*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*0.005*
2018-06-16	16:20	Yes	18-BOS-01	67.39.32.9	106.23.07.7	NE tip of boston Camp	7.5	6.7	390	96	N/A	L2115044-1	400	-	7.3	13	290	4.3	-	-	-	22	0.025
2018-06-25	10:10	Yes	18-BOS-01	67.39.33.0	106.23.07.7	NE camp pad	7.6	6.5	1332	27	N/A	L2119509-1	1200	670	7.8	4.1	970	4.5	130	<1	<1	130	0.024
2018-06-25	10:10	Yes	DUPLICATE - 18-BOS-01	67.39.33.0	106.23.07.7	NE camp pad	7.6	6.5	1332	27	N/A	L2119509-4	1200	670	8.2	<3	1000	1.6	130	<1	<1	130	0.025
2018-06-25	10:45	Yes	18-BOS-02	67.39.29.4	106.22.59.1	Downslope of ore stockpile at toe of containment pad base.	7.8	0.9	1702	49	0.13	L2119509-2	1800	920	8	3.7	1500	2.8	90	<1	<1	90	0.35
2018-06-25	11:00	Yes	18-BOS-03	67.39.28.5	106.22.57.2	Toe of camp pad on eastern-section of pad.	7.9	8.7	1560	57	N/A	L2119509-3	1600	830	8.1	3.3	1400	4	89	<1	<1	89	0.03
2018-06-25	11:00	Yes	BLANK									L2119509-5	<2	<0.5	5.6	<3	<10	1.6	<1	<1	<1	<1	<0.005

Date	Time	Sampled	Station	Bromide (Br)	Fluoride (F)	Nitrate (as N)	Nitrite (as N)	Phosphorus (P)-Total	Sulfate (SO4)	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved	Calcium (Ca)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved
Unit				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
Lowest Detection Limit				*0.05*	*0.02*	*0.005*	*0.001*	*0.002*	*0.3*	*0.001*	*0.0001*	*0.0001*	*0.00005*	*0.00002*	*0.00005*	*0.01*	*0.000005*	*0.05*	*0.0001*	*0.0001*	*0.0002*	*0.01*	*0.00005*	*0.001*	*0.1*	*0.0001*
2018-06-16	16:20	Yes	18-BOS-01	-	0.024	0.42	0.0071	0.016	150	0.0044	0.0025	0.043	0.0045	<0.0001	<0.00005	0.025	<0.000005	51	<0.0001	0.025	0.002	<0.01	<0.00005	0.0022	13	0.024
2018-06-25	10:10	Yes	18-BOS-01	-	<0.1	1.6	<0.005	0.038	490	0.0054	0.0065	0.076	0.019	<0.00002	<0.00005	0.078	0.000025	170	<0.0001	0.11	0.0085	0.013	<0.00005	0.0069	61	0.11
2018-06-25	10:10	Yes	DUPLICATE - 18-BOS-01	-	<0.1	1.7	<0.005	0.074	510	0.0052	0.0067	0.076	0.019	<0.00002	<0.00005	0.081	0.000026	170	0.00014	0.11	0.0083	0.013	<0.00005	0.007	60	0.11
2018-06-25	10:45	Yes	18-BOS-02	-	<0.2	3.6	0.012	0.051	530	0.002	0.038	0.71	0.016	<0.00002	<0.00005	0.18	0.000029	260	<0.0001	0.96	0.0056	<0.01	<0.00005	0.046	68	0.25
2018-06-25	11:00	Yes	18-BOS-03	-	<0.1	3.8	0.017	0.021	530	0.0043	0.024	0.32	0.025	<0.00002	<0.00005	0.18	0.000031	230	<0.0001	0.35	0.0041	<0.01	<0.00005	0.04	64	0.13
2018-06-25	11:00	Yes	BLANK	-	<0.02	<0.005	<0.001	<0.002	<0.3	<0.001	<0.0001	<0.0001	<0.0001	<0.00002	<0.00005	<0.01	<0.000005	<0.05	<0.0001	<0.0001	<0.0002	<0.01	<0.00005	<0.001	<0.1	<0.0001

Date	Time	Sampled	Station	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Potassium (K)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved	Strontium (Sr)-Dissolved	Sulfur (S)-Dissolved	Thallium (Tl)-Dissolved	Tin (Sn)-Dissolved	Titanium (Ti)-Dissolved	Uranium (U)-Dissolved	Vanadium (V)-Dissolved	Zinc (Zn)-Dissolved	Zirconium (Zr)-Dissolved
Unit				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
Lowest Detection Limit				*0.000005*	*0.00005*	*0.0005*	*0.05*	*0.1*	*0.00005*	*0.05*	*0.00001*	*0.05*	*0.0002*	*0.5*	*0.00001*	*0.0001*	*0.0003*	*0.00001*	*0.0005*	*0.001*	*0.0003*
2018-06-16	16:20	Yes	18-BOS-01	<0.000005	0.00036	0.052	<0.05	1.7	0.00023	0.25	<0.00001	4.1	0.11	51	<0.00001	<0.0001	<0.0003	0.000035	<0.0005	0.0017	<0.00006
2018-06-25	10:10	Yes	18-BOS-01	<0.000005	0.0011	0.32	<0.05	6.3	0.00093	2.1	0.000012	25	0.42	160	<0.00001	<0.0001	<0.0006	0.00028	<0.0005	0.0027	<0.0003
2018-06-25	10:10	Yes	DUPLICATE - 18-BOS-01	<0.000005	0.0012	0.31	<0.05	6.1	0.00089	2.2	0.000016	24	0.43	170	<0.00001	<0.0001	<0.0006	0.00029	<0.0005	0.0027	<0.0003
2018-06-25	10:45	Yes	18-BOS-02	<0.000005	0.0031	1.2	<0.05	13	0.0031	1.9	0.000011	36	1.6	180	<0.00001	<0.0001	<0.0003	0.00025	0.0009	0.002	<0.0003
2018-06-25	11:00	Yes	18-BOS-03	<0.000005	0.004	0.41	<0.05	11	0.0026	1.9	0.000014	31	1.4	170	<0.00001	<0.0001	<0.0003	0.00027	<0.0005	0.029	<0.0003
2018-06-25	11:00	Yes	BLANK	<0.000005	<0.00005	<0.0005	<0.05	<0.1	<0.00005	<0.05	<0.00001	<0.05	<0.0002	<0.5	<0.00001	<0.0001	<0.0003	<0.00001	<0.0005	<0.001	<0.0003

Attachment 2: Boston Seepage Data 2008-2018

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Year	Sample Code	Station Code	Date	Conductivity	Hardness (as CaCO3)	pH	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)	Bromide (Br)	Chloride (Cl)	Fluoride (F)	Nitrate (as N)	Nitrite (as N)
			Units	uS/cm	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	2	0.5	0.1	3	10	1	1	0.005	0.05	0.5	0.02	0.005	0.001
2017	BOS8A-04JUN	BOS-8A	2017-06-04	811	0	7.61	<3.0	611	5.5	91.2	0.0145	<0.25	26.1	<0.10	1.48	<0.0050
2017	2017-BOS-001	2017-BOS-001	2017-06-04	577	0	7.09	32.8	428	8.1	61	0.0267	<0.050	15.6	0.032	0.983	0.0028
2017	17-BOS-02	17-BOS-02	2017-06-06	1830	968	8.03	6.7	1440	4.8	109	0.198	0	228	<0.20	3.81	<0.010
2017	17-BOS-03	17-BOS-03	2017-06-06	1690	903	8.04	11.7	1250	4.6	108	0.122	0	192	<0.20	3.23	0.026
2008	2008-BOS-001	2008-BOS-001	2008-08-23	1470	596	7.9	18.7	1110	12.2	162	0.155	<0.05	152	0.065	<0.005	0.0019
2008	2008-BOS-003	2008-BOS-003	2008-08-25	1890	901	7.71	<5	1490	6.4	76.7	6.04	<0.05	73	0.106	47.6	0.542
2008	BOS-8	BOS-8A	2008-08-25	6720	2740	6.9	19	8200	19.1	42.8	14.2	3.4	1890	1.3	49.7	0.261
2008	BOS-8A	BOS-8A	2008-06-30	1190	464	8	11	-	-	149	-	-	136	-	3.5	0.05
2008	BOS-8A	BOS-8A	2008-06-30	1190	464	8	11	-	-	149	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	1280	490	8.1	40	-	-	172	0.1	-	129	0.09	0.1	0.05
2008	BOS-8A	BOS-8A	2008-08-29	1330	548	8	-	-	-	130	0.05	-	124	-	22.1	0.05
2009	BOS-8A	BOS-8A	2009-06-21	483	161	8.04	19	260	-	111	1.41	-	30.9	0.073	2.07	0.05
2009	BOS-8A	BOS-8A	2009-08-04	1820	660	8.2	34	1110	-	188	0.138	-	231	0.061	1.91	0.05
2010	BOS-8A	BOS-8A	2010-07-01	1210	481	7.85	-	-	-	198	0.05	-	130	0.083	0.05	0.05
2011	BOS-8A	BOS-8A	2011-06-23	763	274	7.71	-	-	-	68.4	0.381	-	68.6	-	1.5	0.05
2011	BOS-8A	BOS-8A	2011-07-03	1050	362	7.99	-	-	-	72	0.05	-	127	-	1.96	0.05
2012	BOS-8A	BOS-8A	2012-06-10	394	149	7.78	3	-	-	-	0.127	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	1320	687	8.28	15	-	-	-	0.05	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	1560	571	7.9	-	-	-	128	0.05	-	160	-	14.3	0.05
2009	BOS-8B	BOS-8B	2009-06-21	724	209	7.71	4	387	-	63.8	2.12	-	96.8	0.054	6.26	0.071
2009	BOS-8B	BOS-8B	2009-08-04	2800	956	7.73	3	1640	-	38.6	0.05	-	548	0.05	41	0.05
2010	BOS-8B	BOS-8B	2010-07-01	1520	583	7.48	-	-	-	58.2	0.05	-	224	0.05	5.95	0.05
2011	BOS-8B	BOS-8B	2011-06-23	1690	635	6.87	-	-	-	10.1	0.0246	-	355	-	7.87	0.05
2011	BOS-8B	BOS-8B	2011-07-03	1850	708	7.6	-	-	-	38.4	0.05	-	383	-	6.52	0.05
2012	BOS-8B	BOS-8B	2012-06-10	462	168	7.73	3	-	-	-	0.142	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	4860	1890	7.4	-	-	-	47	10.6	-	1440	-	26.3	0.16
2009	BOS-8C	BOS-8C	2009-06-21	520	176	7.55	656	275	-	37.2	1.4	-	65.5	0.05	3.33	0.055
2011	BOS-8C	BOS-8C	2011-06-23	786	281	7.58	-	-	-	33.8	0.0139	-	171	-	0.549	0.05
2011	BOS-8C	BOS-8C	2011-07-03	1450	502	7.51	-	-	-	29.8	0.05	-	320	-	1.98	0.05
2012	BOS-8C	BOS-8C	2012-06-10	358	124	6.4	3	-	-	-	0.05	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	683	346	7.93	<3	-	-	-	0.0149	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	1040	461	7.86	3.2	-	-	-	0.013	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	347	106	7.95	8.8	-	-	-	0.0421	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	974	537	8.03	<3	-	-	-	0.0164	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	1110	506	7.96	<3	-	-	-	0.0068	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	2160	1040	7.75	9.5	-	-	-	0.194	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	1610	885	7.72	4.3	-	-	-	0.195	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	1460	742	7.02	<3	-	-	-	0.0081	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	951	416	7.72	<3	-	-	-	0.0308	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	1490	721	7.16	12.1	-	-	-	0.0074	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	944	426	8.03	<3	-	-	-	0.0134	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	1320	669	7.18	<3	-	-	-	0.0305	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	2620	1370	7.6	<3	-	-	-	16	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	1610	739	7.9	28	-	-	-	0.0678	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	1370	601	7.14	<3	-	-	-	0.33	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	1500	762	7.6	<3	-	-	-	0.0146	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	1220	529	7.49	<3	-	-	-	0.153	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	1470	668	7.91	9.8	-	-	-	0.0383	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	1470	669	7.94	10.1	-	-	-	0.017	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	401	-	7.31	12.7	288	4.3	22	0.0246	-	8.88	0.024	0.42	0.0071
2018	18-BOS-01	BOS8	2018-06-25	1200	666	7.81	4.1	967	4.5	129	0.0239	-	47.2	<0.1	1.62	<0.005
2018	18-BOS-02	18-BOS-02	2018-06-25	1840	916	8.04	3.7	1500	2.8	90.1	0.349	-	220	<0.2	3.62	0.012
2018	18-BOS-03	18-BOS-03	2018-06-25	1640	826	8.05	3.3	1370	4	88.8	0.0302	-	194	<0.1	3.79	0.0172

Year	Sample Code	Station Code	Date	Phosphorus (P)-Total	Ortho Phosphate as P	Sulfate (SO4)	Dissolved Mercury Filtration Location	Dissolved Metals Filtration Location	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved
			Units	mg/L	mg/L	mg/L			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.002	0.001	0.3	n/a	n/a	0.001	0.0001	0.0001	0.00005	0.00002	0.00005	0.01	0.000005
2017	BOS8A-04JUN	BOS-8A	2017-06-04	0.0275	-	305	FIELD	-	0.0047	0.00691	0.105	0.0127	<0.00010	<0.000050	0.065	0.0000138
2017	2017-BOS-001	2017-BOS-001	2017-06-04	0.0356	-	205	FIELD	-	0.0335	0.00407	0.0323	0.0106	<0.00010	<0.000050	0.087	0.0000367
2017	17-BOS-02	17-BOS-02	2017-06-06	0.0314	-	619	FIELD	-	0.0025	0.0363	0.989	0.0188	<0.000020	<0.000050	0.203	0.0000353
2017	17-BOS-03	17-BOS-03	2017-06-06	0.03	-	566	FIELD	-	0.0042	0.027	0.578	0.0256	<0.000020	<0.000050	0.205	0.0000299
2008	2008-BOS-001	2008-BOS-001	2008-08-23	-	-	380	-	-	0.0146	0.00437	0.0521	0.0314	<0.001	<0.001	0.147	<0.0001
2008	2008-BOS-003	2008-BOS-003	2008-08-25	-	-	650	-	-	<0.005	0.0142	0.0353	0.011	<0.0025	<0.0025	0.295	<0.00025
2008	BOS-8	BOS-8A	2008-08-25	-	-	603	-	-	0.023	0.0206	0.134	0.126	<0.005	<0.005	0.43	<0.0005
2008	BOS-8A	BOS-8A	2008-06-30	-	-	217	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	217	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	0.27	-	253	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-08-29	0.08	-	333	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-06-21	0.186	0.186	69	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-08-04	0.161	0.161	402	-	-	-	-	-	-	-	-	-	-
2010	BOS-8A	BOS-8A	2010-07-01	-	0.216	232	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-06-23	-	0.0593	188	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-07-03	-	0.02	233	-	-	-	-	-	-	-	-	-	-
2012	BOS-8A	BOS-8A	2012-06-10	-	-	90.1	-	-	-	-	-	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	-	-	387	-	-	-	-	-	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	0.02	-	358	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-06-21	0.102	0.102	103	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-08-04	0.02	0.02	384	-	-	-	-	-	-	-	-	-	-
2010	BOS-8B	BOS-8B	2010-07-01	-	0.103	343	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-06-23	-	0.0393	236	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-07-03	-	0.02	254	-	-	-	-	-	-	-	-	-	-
2012	BOS-8B	BOS-8B	2012-06-10	-	-	128	-	-	-	-	-	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	0.17	-	374	-	-	-	-	-	-	-	-	-	-
2009	BOS-8C	BOS-8C	2009-06-21	0.282	0.282	89.5	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-06-23	-	0.0156	61.6	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-07-03	-	0.02	150	-	-	-	-	-	-	-	-	-	-
2012	BOS-8C	BOS-8C	2012-06-10	-	-	116	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	242	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	383	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	28.7	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	333	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	398	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	526	-	-	-	-	-	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	733	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	662	-	-	-	-	-	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	359	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	569	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	325	-	-	-	-	-	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	535	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	1300	-	-	-	-	-	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	468	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	292	-	-	-	-	-	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	575	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	301	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	4350	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	434	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	0.0155	-	152	-	-	0.0044	0.0025	0.0427	0.00445	<0.0001	<0.00005	0.025	<0.000005
2018	18-BOS-01	BOS8	2018-06-25	0.0384	-	493	-	-	0.0054	0.00648	0.0758	0.0191	<0.00002	<0.00005	0.078	0.0000247
2018	18-BOS-02	18-BOS-02	2018-06-25	0.0507	-	527	-	-	0.002	0.038	0.707	0.0156	<0.00002	<0.00005	0.176	0.0000287
2018	18-BOS-03	18-BOS-03	2018-06-25	0.0213	-	527	-	-	0.0043	0.0244	0.315	0.0254	<0.00002	<0.00005	0.178	0.0000313

Year	Sample Code	Station Code	Date	Calcium (Ca)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved
			Units	**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**
			LOR	**0.05**	**0.0001**	**0.0001**	**0.0002**	**0.01**	**0.00005**	**0.001**	**0.1**	**0.0001**	**0.000005**	**0.00005**	**0.0005**	**0.05**
2017	BOS8A-04JUN	BOS-8A	2017-06-04	94.2	0.00014	0.141	0.00505	<0.010	<0.000050	0.005	40.3	0.112	<0.0000050	0.000868	0.326	<0.050
2017	2017-BOS-001	2017-BOS-001	2017-06-04	62.2	0.00015	0.0716	0.00424	0.068	<0.000050	0.0012	28.4	0.285	<0.0000050	0.00074	0.0971	<0.050
2017	17-BOS-02	17-BOS-02	2017-06-06	264	<0.00010	1.1	0.0035	<0.010	<0.000050	0.0524	75.2	0.3	<0.0000050	0.0024	1.51	<0.050
2017	17-BOS-03	17-BOS-03	2017-06-06	239	<0.00010	0.754	0.00411	<0.010	<0.000050	0.0483	74.5	0.208	<0.0000050	0.00288	0.99	<0.050
2008	2008-BOS-001	2008-BOS-001	2008-08-23	137	0.0011	0.0113	0.00756	0.253	<0.0001	0.014	62.1	0.135	<0.00005	0.00278	0.0928	<0.3
2008	2008-BOS-003	2008-BOS-003	2008-08-25	202	<0.0025	0.253	0.00183	<0.03	<0.00025	<0.025	96.6	0.374	<0.00005	0.00656	0.613	<0.3
2008	BOS-8	BOS-8A	2008-08-25	888	<0.005	1.02	0.0031	0.115	<0.0005	0.195	128	1.44	<0.00005	0.00385	1.75	<0.3
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-08-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-08-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8A	BOS-8A	2010-07-01	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-07-03	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8A	BOS-8A	2012-06-10	-	-	-	-	-	-	-	-	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-08-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8B	BOS-8B	2010-07-01	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-07-03	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8B	BOS-8B	2012-06-10	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8C	BOS-8C	2009-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-07-03	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8C	BOS-8C	2012-06-10	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	50.8	<0.0001	0.0246	0.00198	<0.01	<0.00005	0.0022	13	0.0241	<0.000005	0.00036	0.0519	<0.05
2018	18-BOS-01	BOS8	2018-06-25	166	<0.0001	0.109	0.00848	0.013	<0.00005	0.0069	61.4	0.111	<0.000005	0.0011	0.315	<0.05
2018	18-BOS-02	18-BOS-02	2018-06-25	256	<0.0001	0.956	0.00555	<0.01	<0.00005	0.0456	67.6	0.25	<0.000005	0.00313	1.23	<0.05
2018	18-BOS-03	18-BOS-03	2018-06-25	226	<0.0001	0.345	0.00406	<0.01	<0.00005	0.0399	63.5	0.133	<0.000005	0.00401	0.406	<0.05

Year	Sample Code	Station Code	Date	Potassium (K)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved	Strontium (Sr)-Dissolved	Sulfur (S)-Dissolved	Thallium (Tl)-Dissolved	Tin (Sn)-Dissolved	Titanium (Ti)-Dissolved	Uranium (U)-Dissolved	Vanadium (V)-Dissolved	Zinc (Zn)-Dissolved
			Units	**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**
			LOR	**0.1**	**0.00005**	**0.05**	**0.00001**	**0.05**	**0.0002**	**0.5**	**0.00001**	**0.0001**	**0.0003**	**0.00001**	**0.0005**	**0.001**
2017	BOS8A-04JUN	BOS-8A	2017-06-04	4.5	0.000781	1.36	<0.000010	14	0.25	111	<0.000010	<0.00010	<0.00030	0.000145	<0.00050	0.0044
2017	2017-BOS-001	2017-BOS-001	2017-06-04	5.53	0.000713	1.56	<0.000010	11.3	0.215	75.4	<0.000010	<0.00010	0.00079	0.000033	<0.00050	0.0056
2017	17-BOS-02	17-BOS-02	2017-06-06	14.1	0.00367	2.33	0.000014	38.9	1.56	215	<0.000010	<0.00010	<0.00030	0.000284	0.00142	0.0028
2017	17-BOS-03	17-BOS-03	2017-06-06	13.7	0.00314	2.35	0.000019	37.1	1.43	207	<0.000010	<0.00010	<0.00030	0.000295	0.00076	0.0407
2008	2008-BOS-001	2008-BOS-001	2008-08-23	14.8	0.0024	0.588	<0.00002	85.9	0.767	-	<0.0002	<0.0002	0.012	0.000186	<0.002	<0.002
2008	2008-BOS-003	2008-BOS-003	2008-08-25	17.9	0.014	1.21	<0.00005	50.5	0.553	-	<0.0005	<0.0005	0.012	0.000419	<0.005	0.0068
2008	BOS-8	BOS-8A	2008-08-25	51	<0.04	3.88	<0.0001	182	7.26	-	<0.001	<0.001	<0.01	0.00019	<0.01	0.022
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-08-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8A	BOS-8A	2009-08-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8A	BOS-8A	2010-07-01	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8A	BOS-8A	2011-07-03	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8A	BOS-8A	2012-06-10	-	-	-	-	-	-	-	-	-	-	-	-	-
2013	BOS-8A	BOS-8A	2013-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8B	BOS-8B	2008-08-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8B	BOS-8B	2009-08-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	BOS-8B	BOS-8B	2010-07-01	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8B	BOS-8B	2011-07-03	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8B	BOS-8B	2012-06-10	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	BOS-8C	BOS-8C	2008-08-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	BOS-8C	BOS-8C	2009-06-21	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	BOS-8C	BOS-8C	2011-07-03	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	BOS-8C	BOS-8C	2012-06-10	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-16	1.68	0.000226	0.246	<0.00001	4.11	0.108	50.5	<0.00001	<0.0001	<0.0003	0.000035	<0.0005	0.0017
2018	18-BOS-01	BOS8	2018-06-25	6.27	0.000927	2.11	0.000012	24.8	0.42	160	<0.00001	<0.0001	<0.0006	0.000284	<0.0005	0.0027
2018	18-BOS-02	18-BOS-02	2018-06-25	13.3	0.00305	1.93	0.000011	36.3	1.63	181	<0.00001	<0.0001	<0.0003	0.000247	0.0009	0.002
2018	18-BOS-03	18-BOS-03	2018-06-25	10.9	0.00261	1.88	0.000014	31.3	1.44	168	<0.00001	<0.0001	<0.0003	0.000268	<0.0005	0.0292

Year	Sample Code	Station Code	Date	Zirconium (Zr)-Dissolved	Aluminum (Al)-Total	Antimony (Sb)-Total	Arsenic (As)-Total	Barium (Ba)-Total	Beryllium (Be)-Total	Bismuth (Bi)-Total	Boron (B)-Total	Cadmium (Cd)-Total	Calcium (Ca)-Total	Chromium (Cr)-Total	Cobalt (Co)-Total	Copper (Cu)-Total
			Units	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
			LOR	0.0003	0.001	0.0001	0.0001	0.00005	0.00002	0.00005	0.01	0.000005	0.05	0.0001	0.0001	0.0002
2017	BOS8A-04JUN	BOS-8A	2017-06-04	<0.000060	-	-	-	-	-	-	-	-	-	-	-	-
2017	2017-BOS-001	2017-BOS-001	2017-06-04	0.00016	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-02	17-BOS-02	2017-06-06	<0.00030	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-03	17-BOS-03	2017-06-06	<0.00030	-	-	-	-	-	-	-	-	-	-	-	-
2008	2008-BOS-001	2008-BOS-001	2008-08-23	-	0.377	0.00448	0.134	0.0342	<0.001	<0.001	0.158	<0.0001	136	0.0052	0.0147	0.01
2008	2008-BOS-003	2008-BOS-003	2008-08-25	-	0.11	-	-	0.032	0.002	-	0.17	0.001	112	0.005	0.052	0.009
2008	BOS-8	BOS-8A	2008-08-25	-	-	-	-	-	-	-	-	0.001	-	0.005	-	0.009
2008	BOS-8A	BOS-8A	2008-06-30	-	0.11	-	-	0.032	0.002	-	0.17	0.001	112	0.005	0.052	0.009
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-	0.001	-	0.005	-	0.009
2008	BOS-8A	BOS-8A	2008-07-14	-	0.94	0.003	0.301	0.0304	0.001	0.0001	0.12	0.0002	81.9	0.0192	0.0248	0.011
2008	BOS-8A	BOS-8A	2008-08-29	-	0.15	0.0114	0.148	0.0281	0.001	0.0001	0.16	0.0002	132	0.0029	0.0503	0.009
2009	BOS-8A	BOS-8A	2009-06-21	-	0.268	0.00874	0.247	0.0127	0.001	-	0.096	0.0002	42.8	0.005	0.0603	0.0083
2009	BOS-8A	BOS-8A	2009-08-04	-	0.426	0.00532	0.248	0.0598	0.001	-	0.214	0.00005	133	0.0062	0.0312	0.0147
2010	BOS-8A	BOS-8A	2010-07-01	-	0.08	0.00496	0.235	0.0341	0.001	-	-	0.00005	109	0.005	0.0223	0.0083
2011	BOS-8A	BOS-8A	2011-06-23	-	0.167	0.0033	0.0664	0.0239	0.001	-	0.113	0.00005	60	0.005	0.0967	0.0043
2011	BOS-8A	BOS-8A	2011-07-03	-	0.0461	0.00124	0.00274	0.0386	0.0005	-	0.0497	0.000015	79.1	0.00045	0.00064	0.00278
2012	BOS-8A	BOS-8A	2012-06-10	-	0.132	0.00884	0.253	0.0075	0.001	-	0.067	0.000015	42.3	0.0014	0.0618	0.0044
2013	BOS-8A	BOS-8A	2013-06-21	-	0.292	0.00322	0.359	0.0355	0.001	-	0.118	0.000052	157	0.0041	0.114	0.0085
2008	BOS-8B	BOS-8B	2008-08-29	-	0.04	0.0116	0.0155	0.0428	0.001	0.0001	0.15	0.0002	120	0.0019	0.0025	0.003
2009	BOS-8B	BOS-8B	2009-06-21	-	0.155	0.00833	0.0749	0.0289	0.001	-	0.078	0.0002	43.5	0.005	0.0093	0.0027
2009	BOS-8B	BOS-8B	2009-08-04	-	0.042	0.00318	0.00801	0.113	0.001	-	0.201	0.00008	210	0.005	0.0057	0.0034
2010	BOS-8B	BOS-8B	2010-07-01	-	0.051	0.0045	0.0128	0.0442	0.004	-	-	0.0002	107	0.005	0.0044	0.004
2011	BOS-8B	BOS-8B	2011-06-23	-	0.099	0.0218	0.271	0.107	0.001	-	0.193	0.00005	171	0.005	0.245	0.0015
2011	BOS-8B	BOS-8B	2011-07-03	-	0.0145	0.00614	0.00164	0.0803	0.0005	-	0.128	0.000039	226	0.00018	0.00893	0.00165
2012	BOS-8B	BOS-8B	2012-06-10	-	0.122	0.00287	0.03	0.0119	0.001	-	0.079	0.000026	43.9	0.001	0.0138	0.0028
2008	BOS-8C	BOS-8C	2008-08-29	-	0.2	0.029	0.341	0.088	0.01	0.001	0.5	0.002	661	0.019	0.813	0.01
2009	BOS-8C	BOS-8C	2009-06-21	-	6.91	0.00672	0.495	0.0496	0.001	-	0.095	0.0002	57.5	0.141	0.129	0.0452
2011	BOS-8C	BOS-8C	2011-06-23	-	0.136	0.00073	0.00767	0.0382	0.001	-	0.078	0.00005	89.6	0.005	0.0028	0.0023
2011	BOS-8C	BOS-8C	2011-07-03	-	0.0087	0.00214	0.00151	0.0612	0.0005	-	0.108	0.000014	161	0.00013	0.0013	0.00094
2012	BOS-8C	BOS-8C	2012-06-10	-	0.181	0.00179	1.23	0.0077	0.001	-	0.128	0.000054	34	0.001	0.123	0.0014
2014	BOS8-16JUN14a	BOS8	2014-06-16	-	0.0311	0.00947	0.138	<0.02	<0.001	-	<0.1	0.00002	89.3	<0.001	0.132	0.005
2014	BOS8-16JUN14b	BOS8	2014-06-16	-	0.036	0.00252	0.0148	0.027	<0.001	-	0.11	0.00003	100	<0.001	0.0143	0.0032
2014	BOS8-16JUN14c	BOS8	2014-06-16	-	0.0988	0.00105	0.02	0.034	<0.001	-	<0.1	0.000025	26.9	<0.001	0.00618	0.0083
2014	BOS8-23JUN14a	BOS8	2014-06-23	-	0.0233	0.00918	0.175	0.025	<0.001	-	0.12	0.000037	136	<0.001	0.154	0.0071
2014	BOS8-23JUN14b	BOS8	2014-06-23	-	0.0231	0.00201	0.01	0.032	<0.001	-	0.14	0.000017	111	<0.001	0.0019	0.0024
2014	BOS8-23JUN14c	BOS8	2014-06-23	-	0.105	0.0294	0.247	0.041	<0.001	-	0.25	0.000086	299	0.0026	0.576	0.0023
2014	BOS8-31JUL14	BOS8	2014-07-31	-	0.0579	0.0121	0.0615	0.032	<0.001	-	0.2	0.000039	227	0.0011	0.0588	0.0082
2015	BOS8A-09AUG15	BOS8	2015-08-09	-	0.0246	0.00498	0.0362	0.039	<0.001	-	0.27	0.000129	192	<0.001	0.0599	<0.001
2016	BOS8A-12JUN16	BOS8	2016-06-12	-	0.0401	0.00139	0.0146	<0.02	<0.001	-	<0.1	0.0000295	91.5	<0.001	0.00817	0.0049
2015	BOS8A-24AUG15	BOS8	2015-08-24	-	0.074	0.00548	0.105	0.025	<0.001	-	0.17	0.0000322	168	<0.001	0.0349	0.0089
2015	BOS8A-29JUN15	BOS8	2015-06-29	-	0.0148	0.00208	0.0281	<0.02	<0.001	-	0.11	0.0000133	89.2	<0.001	0.0198	0.0027
2014	BOS8A-31JUL14	BOS8	2014-07-31	-	0.0663	0.0032	0.0251	0.021	<0.001	-	0.16	0.000073	142	<0.001	0.0171	0.006
2015	BOS8C-09AUG15	BOS8	2015-08-09	-	0.0167	0.118	5.62	<0.02	<0.001	-	0.6	0.000061	346	<0.001	1.35	0.0021
2016	BOS8C-12JUN16	BOS8	2016-06-12	-	0.541	0.0353	0.739	<0.02	<0.001	-	0.17	0.0000366	210	0.0136	0.82	0.0058
2015	BOS8C-24AUG15	BOS8	2015-08-24	-	0.021	0.0102	0.116	0.033	<0.001	-	0.22	0.0000753	185	<0.001	0.167	0.0021
2014	BOS8C-28AUG14	BOS8	2014-08-28	-	0.0216	0.00317	0.0272	0.021	<0.001	-	0.14	0.000018	155	<0.001	0.0105	0.0041
2015	BOS8C-29JUN15	BOS8	2015-06-29	-	0.0285	0.0113	0.154	0.027	<0.001	-	0.26	0.0000601	157	<0.001	0.178	0.0021
2016	BOS8D-12JUN16a	BOS8	2016-06-12	-	0.116	0.03	0.534	<0.02	<0.001	-	0.18	0.0000159	188	0.0026	0.431	0.005
2016	BOS8D-12JUN16b	BOS8	2016-06-12	-	1.24	0.0291	0.56	0.021	<0.001	-	0.18	0.0000261	186	0.0284	0.436	0.0091
2018	18-BOS-01	BOS8	2018-06-16	<0.00006	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-25	<0.0003	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-02	18-BOS-02	2018-06-25	<0.0003	-	-	-	-	-	-	-	-	-	-	-	-
2018	18-BOS-03	18-BOS-03	2018-06-25	<0.0003	-	-	-	-	-	-	-	-	-	-	-	-

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Year	Sample Code	Station Code	Date	Iron (Fe)-Total	Lead (Pb)-Total	Lithium (Li)-Total	Magnesium (Mg)-Total	Manganese (Mn)-Total	Mercury (Hg)-Total	Molybdenum (Mo)-Total	Nickel (Ni)-Total	Phosphorus (P)-Total	Potassium (K)-Total	Selenium (Se)-Total	Silicon (Si)-Total	Silver (Ag)-Total
			Units	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
			LOR	0.01	0.00005	0.001	0.1	0.0001	0.000005	0.00005	0.0005	0.05	0.1	0.00005	0.05	0.00001
2017	BOS8A-04JUN	BOS-8A	2017-06-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	2017-BOS-001	2017-BOS-001	2017-06-04	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-02	17-BOS-02	2017-06-06	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	17-BOS-03	17-BOS-03	2017-06-06	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	2008-BOS-001	2008-BOS-001	2008-08-23	1.32	0.00062	0.014	62	0.153	<0.00005	0.00226	0.104	<0.3	15.3	0.0028	1.42	0.000042
2008	2008-BOS-003	2008-BOS-003	2008-08-25	1.38	0.005	-	40.5	0.224	-	0.005	0.183	-	12	-	-	0.005
2008	BOS-8	BOS-8A	2008-08-25	1.38	0.005	-	-	-	-	-	1.38	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	1.38	0.005	-	40.5	0.224	-	0.005	0.183	-	12	-	-	0.005
2008	BOS-8A	BOS-8A	2008-06-30	1.38	0.005	-	-	-	-	-	1.38	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	3.23	0.002	-	42.6	0.277	-	0.004	0.0805	-	13.7	0.002	-	0.0004
2008	BOS-8A	BOS-8A	2008-08-29	0.398	0.0005	-	48.1	0.072	-	0.0059	0.215	-	12.3	0.002	-	0.0004
2009	BOS-8A	BOS-8A	2009-06-21	0.665	0.00085	0.01	16.3	0.146	0.0001	0.005	0.123	-	6.64	0.0023	-	0.0001
2009	BOS-8A	BOS-8A	2009-08-04	2.46	0.00294	0.013	60.8	0.311	0.0001	0.005	0.097	-	17.3	0.0034	-	0.0001
2010	BOS-8A	BOS-8A	2010-07-01	1.82	0.00038	0.011	50.5	0.219	-	0.005	0.0843	-	12.6	0.002	-	0.0001
2011	BOS-8A	BOS-8A	2011-06-23	0.469	0.00032	0.01	36.3	1.97	0.0001	0.005	0.104	-	8.93	0.00113	-	0.0001
2011	BOS-8A	BOS-8A	2011-07-03	0.173	0.000114	0.005	38.1	0.0136	-	0.000604	0.00804	-	7.3	0.00041	-	0.000093
2012	BOS-8A	BOS-8A	2012-06-10	0.199	0.00032	0.01	12.8	0.0573	0.00002	0.005	0.129	-	3.73	0.00072	-	0.00002
2013	BOS-8A	BOS-8A	2013-06-21	7.04	0.00137	0.01	57.6	0.695	0.00002	0.005	0.239	-	10.4	0.00062	-	0.000066
2008	BOS-8B	BOS-8B	2008-08-29	0.044	0.0001	-	58.6	0.002	-	0.0042	0.0127	-	18.7	0.0021	-	0.0004
2009	BOS-8B	BOS-8B	2009-06-21	0.246	0.00036	0.01	22	0.198	0.0001	0.005	0.0135	-	9.53	0.0038	-	0.0001
2009	BOS-8B	BOS-8B	2009-08-04	0.103	0.00014	0.011	110	0.04	0.0001	0.005	0.0233	-	23.2	0.0072	-	0.0001
2010	BOS-8B	BOS-8B	2010-07-01	0.088	0.0004	0.024	63.3	0.0359	-	0.005	0.0287	-	14.6	0.008	-	0.0004
2011	BOS-8B	BOS-8B	2011-06-23	0.082	0.0001	0.051	35.8	0.188	0.0001	0.0081	0.43	-	12	0.00285	-	0.0001
2011	BOS-8B	BOS-8B	2011-07-03	0.478	0.00005	0.0387	48.7	0.0432	-	0.000609	0.0454	-	13.2	0.00238	-	0.000032
2012	BOS-8B	BOS-8B	2012-06-10	0.214	0.00027	0.01	19.3	0.146	0.00002	0.005	0.0305	-	5.38	0.00054	-	0.000038
2008	BOS-8C	BOS-8C	2008-08-29	0.054	0.001	-	87	0.912	-	0.079	1.35	-	42.8	0.017	-	0.004
2009	BOS-8C	BOS-8C	2009-06-21	16	0.0223	0.016	16.4	0.398	0.0001	0.005	0.254	-	4.94	0.0022	-	0.0001
2011	BOS-8C	BOS-8C	2011-06-23	0.439	0.00045	0.011	19.6	0.0259	0.0001	0.005	0.0098	-	5.46	0.0004	-	0.0001
2011	BOS-8C	BOS-8C	2011-07-03	0.025	0.00005	0.0227	32.5	0.0109	-	0.000818	0.00885	-	9.15	0.00137	-	0.00001
2012	BOS-8C	BOS-8C	2012-06-10	0.097	0.0001	0.01	8.26	0.063	0.00002	0.005	0.592	-	5.95	0.00074	-	0.00002
2014	BOS8-16JUN14a	BOS8	2014-06-16	0.062	<0.0005	0.0068	30	0.127	-	0.0012	0.272	-	4.7	0.00078	-	0.000021
2014	BOS8-16JUN14b	BOS8	2014-06-16	0.212	<0.0005	<0.005	51.4	0.171	-	<0.001	0.0361	-	10.5	0.00088	-	0.00005
2014	BOS8-16JUN14c	BOS8	2014-06-16	0.398	<0.0005	<0.005	9.48	0.0413	-	<0.001	0.0216	-	3.1	0.00012	-	0.000842
2014	BOS8-23JUN14a	BOS8	2014-06-23	0.667	<0.0005	0.0076	47.7	0.267	-	0.0017	0.384	-	7.7	0.00065	-	0.00003
2014	BOS8-23JUN14b	BOS8	2014-06-23	0.058	<0.0005	<0.005	55.7	0.0253	-	<0.001	0.0199	-	10.6	0.00038	-	<0.00002
2014	BOS8-23JUN14c	BOS8	2014-06-23	0.274	<0.0005	0.0492	71.2	0.277	-	0.003	0.744	-	16.9	0.00271	-	0.000114
2014	BOS8-31JUL14	BOS8	2014-07-31	0.117	<0.0005	0.0134	77	0.0547	-	0.0019	0.272	-	5.3	0.001	-	<0.00002
2015	BOS8A-09AUG15	BOS8	2015-08-09	<0.03	<0.0005	0.0348	64	0.0974	-	<0.001	0.0601	-	13.5	0.00357	-	<0.00002
2016	BOS8A-12JUN16	BOS8	2016-06-12	0.107	<0.0005	0.002	45.6	0.325	-	<0.001	0.0279	-	7.4	0.000389	-	0.000025
2015	BOS8A-24AUG15	BOS8	2015-08-24	0.431	<0.0005	0.0056	73.3	0.677	-	<0.001	0.245	-	12.9	0.00209	-	0.000032
2015	BOS8A-29JUN15	BOS8	2015-06-29	0.313	<0.0005	0.0025	49.2	0.624	-	<0.001	0.0952	-	8.9	0.000472	-	<0.00002
2014	BOS8A-31JUL14	BOS8	2014-07-31	0.056	<0.0005	<0.005	75.9	0.701	-	<0.001	0.0793	-	13.2	0.00166	-	0.000026
2015	BOS8C-09AUG15	BOS8	2015-08-09	0.031	<0.0005	0.0758	122	0.465	-	0.0056	3.98	-	31.8	0.00884	-	0.000031
2016	BOS8C-12JUN16	BOS8	2016-06-12	1.62	0.00061	0.0425	51.9	0.312	-	0.0025	1.03	-	11.8	0.00216	-	0.000163
2015	BOS8C-24AUG15	BOS8	2015-08-24	0.059	<0.0005	0.0299	34	0.24	-	0.0016	0.344	-	15.1	0.00464	-	0.000028
2014	BOS8C-28AUG14	BOS8	2014-08-28	0.054	<0.0005	<0.005	91	0.299	-	<0.001	0.132	-	12.7	0.00084	-	<0.00002
2015	BOS8C-29JUN15	BOS8	2015-06-29	0.521	<0.0005	0.0248	33.4	0.256	-	0.0032	0.302	-	12.8	0.00218	-	0.000065
2016	BOS8D-12JUN16a	BOS8	2016-06-12	0.298	<0.0005	0.0417	48.3	0.131	-	0.003	0.523	-	11	0.00167	-	0.000073
2016	BOS8D-12JUN16b	BOS8	2016-06-12	4.49	0.00174	0.042	49.3	0.257	-	0.003	0.536	-	10.9	0.00159	-	0.000221
2018	18-BOS-01	BOS8	2018-06-16	-	-	-	-	-	-	-	-	0.0155	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-25	-	-	-	-	-	-	-	-	0.0384	-	-	-	-
2018	18-BOS-02	18-BOS-02	2018-06-25	-	-	-	-	-	-	-	-	0.0507	-	-	-	-
2018	18-BOS-03	18-BOS-03	2018-06-25	-	-	-	-	-	-	-	-	0.0213	-	-	-	-

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Year	Sample Code	Station Code	Date	Sodium (Na)-Total	Strontium (Sr)-Total	Thallium (Tl)-Total	Tin (Sn)-Total	Titanium (Ti)-Total	Uranium (U)-Total	Vanadium (V)-Total	Zinc (Zn)-Total
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
			LOR	0.05	0.0002	0.00001	0.0001	0.0003	0.00001	0.0005	0.001
2017	BOS8A-04JUN	BOS-8A	2017-06-04	-	-	-	-	-	-	-	-
2017	2017-BOS-001	2017-BOS-001	2017-06-04	-	-	-	-	-	-	-	-
2017	17-BOS-02	17-BOS-02	2017-06-06	-	-	-	-	-	-	-	-
2017	17-BOS-03	17-BOS-03	2017-06-06	-	-	-	-	-	-	-	-
2008	2008-BOS-001	2008-BOS-001	2008-08-23	86.5	0.782	<0.0002	<0.0002	0.024	0.000173	0.0032	0.0037
2008	2008-BOS-003	2008-BOS-003	2008-08-25	59	0.619	0.05	0.05	0.002	-	0.002	0.103
2008	BOS-8	BOS-8A	2008-08-25	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-06-30	59	0.619	0.05	0.05	0.002	-	0.002	0.103
2008	BOS-8A	BOS-8A	2008-06-30	-	-	-	-	-	-	-	-
2008	BOS-8A	BOS-8A	2008-07-14	69	0.694	0.0001	0.0004	0.013	0.0002	0.0075	0.099
2008	BOS-8A	BOS-8A	2008-08-29	65	0.64	0.0001	0.0004	0.005	0.0003	0.002	0.008
2009	BOS-8A	BOS-8A	2009-06-21	18.5	-	0.0001	0.05	0.0018	0.00028	0.0017	0.0071
2009	BOS-8A	BOS-8A	2009-08-04	102	-	0.0001	0.05	0.0052	0.00015	0.0045	0.0318
2010	BOS-8A	BOS-8A	2010-07-01	-	-	0.0001	0.05	0.0029	0.00018	0.0017	0.0049
2011	BOS-8A	BOS-8A	2011-06-23	37	-	0.0001	0.05	0.001	0.00011	0.001	0.0068
2011	BOS-8A	BOS-8A	2011-07-03	51.4	-	0.00005	0.0001	0.00066	0.000047	0.00021	0.0038
2012	BOS-8A	BOS-8A	2012-06-10	11.9	-	0.0001	0.05	0.0029	0.00011	0.001	0.0042
2013	BOS-8A	BOS-8A	2013-06-21	40.5	-	0.0001	0.05	0.0036	0.00058	0.0021	0.0079
2008	BOS-8B	BOS-8B	2008-08-29	96	0.53	0.0001	0.0004	0.005	0.0002	0.0015	0.009
2009	BOS-8B	BOS-8B	2009-06-21	36.5	-	0.0001	0.05	0.001	0.0001	0.001	0.0063
2009	BOS-8B	BOS-8B	2009-08-04	180	-	0.0001	0.05	0.001	0.0001	0.0011	0.0091
2010	BOS-8B	BOS-8B	2010-07-01	-	-	0.0004	0.05	0.0024	0.0004	0.002	0.016
2011	BOS-8B	BOS-8B	2011-06-23	40	-	0.0001	0.05	0.0032	0.0001	0.001	0.0055
2011	BOS-8B	BOS-8B	2011-07-03	54.7	-	0.00005	0.0001	0.00044	0.00002	0.00016	0.0055
2012	BOS-8B	BOS-8B	2012-06-10	16	-	0.0001	0.05	0.001	0.0001	0.001	0.0057
2008	BOS-8C	BOS-8C	2008-08-29	174	5.83	0.001	0.004	0.05	0.001	0.006	0.04
2009	BOS-8C	BOS-8C	2009-06-21	11.1	-	0.0001	0.05	0.108	0.00011	0.0373	0.0717
2011	BOS-8C	BOS-8C	2011-06-23	22.9	-	0.0001	0.05	0.0012	0.0001	0.001	0.004
2011	BOS-8C	BOS-8C	2011-07-03	48.9	-	0.00005	0.0001	0.0003	0.00001	0.00011	0.003
2012	BOS-8C	BOS-8C	2012-06-10	9.1	-	0.0001	0.05	0.0011	0.0001	0.001	0.0099
2014	BOS8-16JUN14a	BOS8	2014-06-16	14.2	-	<0.0002	<0.0005	0.011	<0.0002	<0.001	<0.005
2014	BOS8-16JUN14b	BOS8	2014-06-16	42	-	<0.0002	<0.0005	0.011	<0.0002	<0.001	<0.005
2014	BOS8-16JUN14c	BOS8	2014-06-16	4.6	-	<0.0002	<0.0005	<0.01	<0.0002	<0.001	<0.005
2014	BOS8-23JUN14a	BOS8	2014-06-23	26.5	-	<0.0002	<0.0005	0.014	0.00035	<0.001	0.0064
2014	BOS8-23JUN14b	BOS8	2014-06-23	48.3	-	<0.0002	<0.0005	0.013	<0.0002	<0.001	<0.005
2014	BOS8-23JUN14c	BOS8	2014-06-23	50.9	-	<0.0002	<0.0005	0.018	<0.0002	<0.001	0.0071
2014	BOS8-31JUL14	BOS8	2014-07-31	44.4	-	<0.0002	<0.0005	0.019	0.00042	<0.001	0.0053
2015	BOS8A-09AUG15	BOS8	2015-08-09	23.5	-	<0.0002	<0.0005	<0.01	<0.0002	<0.0005	0.0077
2016	BOS8A-12JUN16	BOS8	2016-06-12	30	-	<0.0002	<0.0005	<0.01	0.00034	<0.0005	<0.005
2015	BOS8A-24AUG15	BOS8	2015-08-24	53.7	-	<0.0002	<0.0005	<0.01	0.00062	0.00052	<0.005
2015	BOS8A-29JUN15	BOS8	2015-06-29	32.6	-	<0.0002	<0.0005	<0.01	0.00024	<0.0005	<0.005
2014	BOS8A-31JUL14	BOS8	2014-07-31	55.9	-	<0.0002	<0.0005	0.016	0.00067	<0.001	0.0053
2015	BOS8C-09AUG15	BOS8	2015-08-09	46.6	-	<0.0002	<0.0005	<0.01	0.0003	0.0037	<0.005
2016	BOS8C-12JUN16	BOS8	2016-06-12	28.2	-	<0.0002	<0.0005	0.011	0.00025	0.00394	<0.005
2015	BOS8C-24AUG15	BOS8	2015-08-24	43.3	-	<0.0002	<0.0005	<0.01	<0.0002	<0.0005	0.0068
2014	BOS8C-28AUG14	BOS8	2014-08-28	67.9	-	<0.0002	<0.0005	0.017	0.00042	<0.001	<0.005
2015	BOS8C-29JUN15	BOS8	2015-06-29	28.7	-	<0.0002	<0.0005	<0.01	<0.0002	<0.0005	0.0051
2016	BOS8D-12JUN16a	BOS8	2016-06-12	26.1	-	<0.0002	<0.0005	<0.01	0.00027	0.00138	0.0213
2016	BOS8D-12JUN16b	BOS8	2016-06-12	25.8	-	<0.0002	<0.0005	0.02	0.00027	0.00691	0.0322
2018	18-BOS-01	BOS8	2018-06-16	-	-	-	-	-	-	-	-
2018	18-BOS-01	BOS8	2018-06-25	-	-	-	-	-	-	-	-
2018	18-BOS-02	18-BOS-02	2018-06-25	-	-	-	-	-	-	-	-
2018	18-BOS-03	18-BOS-03	2018-06-25	-	-	-	-	-	-	-	-

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Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Marie-Christine Noel Lisa Barazzuol	**Project No:**	1CT022.027
Cc:	Oliver Curran, TMAC Ashley Mathai, TMAC	**Date:**	March 11, 2019
Subject:	Boston Ephemeral Stream Monitoring 2018		

1 Introduction

At the Boston site, ore and waste rock were generated as part of a 1996-1997 BHP Billiton underground exploration program. The ore was placed in a number of stockpiles on the camp pad and the waste rock was used to construct a camp pad, roads, and an airstrip at Boston. The ore/waste rock and associated runoff are managed as part of Water License 2BB-BOS1727 (Nunavut Water Board (NWB) 2017), and the Hope Bay Project Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017).

As recommended in the Hope Bay Project Water and Ore/Waste Rock Management Plan for the Boston Site (SRK 2017), ephemeral streams downgradient of the waste rock pile have been monitored during spring freshet since 2009 to monitor the attenuation capacity of the tundra and to provide an indication of whether contaminants from the ore and waste rock piles are reaching the shoreline of Aimaokatalok Lake. This memo presents the results of the 2018 ephemeral streams monitoring program.

2 Methods

2.1 Sample Collection

Five ephemeral stream sites have been identified in previous surveys of the area, as shown in Figure 1. TMAC Resources (TMAC) surveyed each of these sites for flow on June 16 and June 25, 2018. Flow was observed at stations A2 and C2 only. Field measurements included pH, electrical conductivity (EC), oxidation-reduction potential (ORP) and temperature. Samples were collected from station A2 and C2 during both sampling events for laboratory analysis. The water quality samples were submitted by TMAC for laboratory testing at ALS Environmental (ALS) in Burnaby, British Columbia for pH, electrical conductivity (EC), total dissolved solids, total alkalinity, anions (bromide, chloride, fluoride, and sulphate), nutrients (nitrate, nitrite, ammonia and phosphorus) and dissolved metals (field filtered). The QA/QC sampling program included one field duplicate and one field blank.

2.2 Quality Assurance and Control

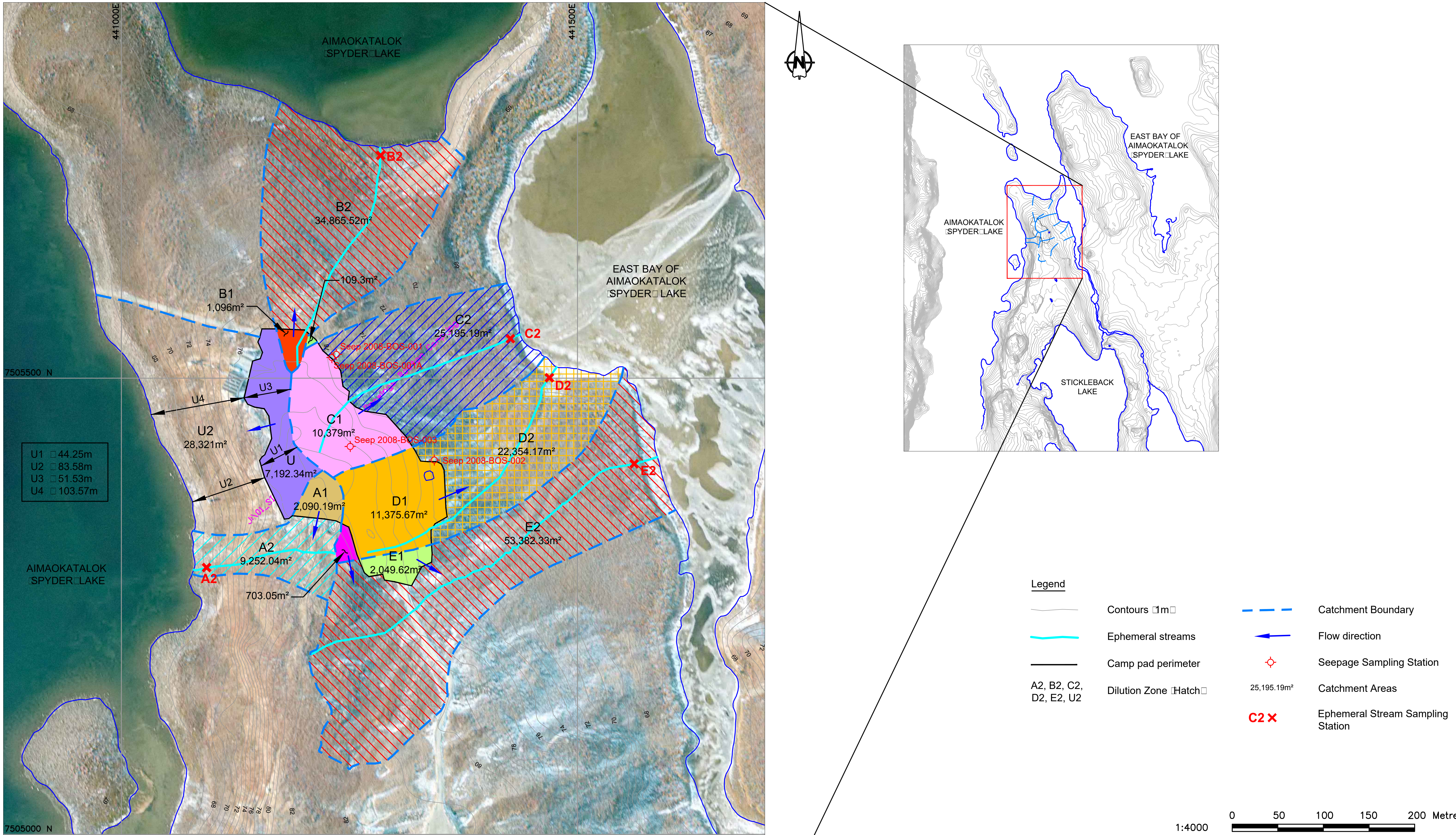
One field duplicate and one field blank were collected as part of the quality assurance and control (QA/QC) program. The QA/QC review of all data was conducted by SRK. In addition, ALS carried out its own QA/QC checks which were deemed acceptable.

Ion charge balances ranged from -4.5 to -0.8% for the four samples taken at A2 and C2 and the field duplicate. These were deemed acceptable as they comply with SRK's criteria of ±10%.

The field conductivity and lab conductivity for 18-EPH-A2 collected on June 16, 2018 exceeded the SRK criteria of an RPD ±30%. This difference may be due to miscalibration or other field errors. The June 25 sample at 18-EPH-C2 had a difference between field pH and lab pH greater than 1 pH unit, failing SRK's QA/QC criteria. This may be due to miscalibration, or a sample bottle with excessive headspace. Laboratory checks for pH confirmed the lab value. All other QA/QC tests passed for the ephemeral stream samples, and the dataset was considered acceptable.

The field duplicate (EPH-DUP) was taken at the sampling site C2 on June 25, 2018 and compared to sample 18-EPH-C2 collected on the same day. As per SRK's criteria, less than 10% of the parameters (with concentrations above 10 times the detection limit) had relative percent difference (RPD) values of over 30%, indicating a high reproducibility of sampling and low heterogeneity in the stream.

Field blanks typically indicate field contamination either due to sampling or environmental influences such as dust and ambient water. Dissolved arsenic, aluminum, and manganese were measurable in the field blank, and were at low levels, and the field blank passed SRK's criteria. SRK considered all data acceptable.



srk consulting	TMAC Resources	Boston Ephemeral Stream Monitoring
SRK JOB NO.: 1CT022.016	Hope Bay Project	Ephemeral Stream Monitoring Locations
FILE NAME: Boston_Catchments_20160324.dwg		DATE: March 2018 / APPROVED: MCN / FIGURE: 1

3 Results

3.1 Field Observations

Field parameters for the ephemeral streams A2 and C2 are presented and compared to the historical ranges of parameters from 2009 to 2017 (Table 1). Consistent with previous years, field pH values were slightly alkaline or neutral. EC levels in stream C2 (654 and 1,027 µS/cm) were higher than A2 (230 and 524 µS/cm). The flowrate measured at A2 on June 16 was more than 5 times higher than the flow measured on June 25 and an order of magnitude higher than historical flowrates. All other field parameters are within historical ranges.

Table 1: Comparison of 2017 Field Observations to Historic Monitoring Data

Ephemeral Stream	Sample Date	Field pH	Field EC	ORP	Temperature	Flow	Comments
		s.u.	*µS/cm*	*mV*	*°C*	*L/s*	
A2	2018-06-16	7.5	230	130	13.3	0.44	Streams flow directly into lake, with sediment for at base of hill. Streams flows through broken ground from top of camp pad. Located on SE section of camp pad. Water has a very light brown color.
	2018-06-25	7.8	524	90	6.7	0.08	Sampled ~10 m from lake edge. Through grassy tundra. Wide channel, deep in areas syringe used to collect sample
	P5	7.6	110	61	4.2	0.051	
	P50	7.8	270	150	5.7	0.06	
	P95	8	550	270	16	0.05	
	n	5	5	5	5	2	
C2	2018-06-16	7.5	654	140	12.6	-	Approx. 500-800 m from camp pond and 100 m from bank of lake. Water is clear, running through grasses and willows. No clear main channel, water runs through the grassy surface
	2018-06-25	6.7	1027	76	8.1	-	Fragmented channel through grassy tundra syringe used to collect sample. Sample taken ~15 m from lake shore
	P5	6.9	95	70	2.3	0.26	
	P50	7.3	620	190	9.8	1.5	
	P95	7.4	1100	350	20	2.9	
	n	8	8	9	8	4	

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3.2 Laboratory Results

A summary of water quality results for 2018 is provided in Table 2. Full results of the 2018 water quality data are presented in Attachment 1. Parameters identified by SRK (2009) as potential parameters of concern are presented in Figure 2 to Figure 9. Values below the detection limit are graphed as being at the detection limit. Lines are included in the figure for ease of trend identification, however samples from each ephemeral stream are not necessarily collected from the same location each year. A summary of the 2018 water quality data is as follows:

- Sulphate concentrations greater than the historical range were observed at both A2 and C2 in 2018 (Figure 2).
  - A2: sulphate concentrations on June 16 (240 mg/L) and June 25 (77 mg/L) four to ten times and 1.3 to 3 times greater than the historical range of concentrations, which have remained below 60 mg/L since sampling began at this station in 2012. Prior to 2018, sulphate trends were stable.
  - C2: the sulphate concentration measured on June 25 (400 mg/L) was the maximum observed to date but is within the same order of magnitude as other sulphate concentrations observed at this station and is considered consistent with previous trends (Figure 2), which have oscillated since 2011. Sulphate concentrations measured at C2 on June 16 (48 mg/L) is close to the minimum sulphate concentration observed from 2009 to 2017. The difference in sulphate concentrations between the June 16 and June 25 sampling events may be due to differences in flowrates during the freshet period and dilution.
- Alkalinity levels at both A2 and C2 were the same order of magnitude as previously observed values.
- Chloride concentrations were uniformly lower at A2 and C2 on June 25 compared to June 16, and concentrations at A2 (31 and 80 mg/L) and C2 (17 and 69 mg/L) were within the historical range of data. Both ephemeral streams sampled in 2018 had decreasing trends for chloride (Figure 3).
- Copper concentrations were uniformly lower at A2 and C2 on June 25 compared to June 16. At C2, copper concentrations (0.0012 and 0.0025 mg/L) were within the range of historical data and consistent with previous trends (Figure 4). At A2, copper concentrations (0.0017 and 0.0022 mg/L) were the maximum observed at this station and roughly equivalent to concentrations observed in 2013 and 2015.
- Nitrate concentrations were uniformly lower at A2 and C2 on June 25 compared to June 16. At A2, nitrate concentrations measured on June 16 (0.47 mg/L as N) were greater than the historical maximum concentration observed in 2012 (0.31 mg/L as N) whereas concentrations measured on June 25 (0.088 mg/L) were within the historical range of data (Figure 5). Nitrate at C2 (0.013 mg/L on June 16 and <0.005 mg/L on June 25) was within the historical range of nitrate concentrations.

- Arsenic concentrations (Figure 6) observed in ephemeral stream A2 (0.0038 and 0.019 mg/L) in 2018 were within the range of historical data. At C2, arsenic concentrations on June 16 (0.055 mg/L) was more than 20 times higher than the concentration observed on June 25 (0.0023 mg/L) and more than an order of magnitude higherthan the historical data set. Notably, the sample collected on June 16 had low sulphate (48 mg/L). Arsenic concentrations measured on June 25 at C2 are consistent with previous trends.
- Iron concentrations (Figure 7) for A2 (0.015 and 0.011 mg/L) and C2 (0.016 and 0.019 mg/L) were within the range of the historical data and consistent with previous trends.
- Nickel concentrations (Figure 8) at A2 (0.0088 and 0.010 mg/L) and C2 (0.0079 and 0.010 mg/L) were within the range of historic data and consistent with previous trends.
- Selenium concentrations (Figure 9) for ephemeral stream C2 (0.00015 and 0.00012 mg/L) were within the range of historical data with selenium exhibiting an overall decreasing trend. At A2, selenium concentrations were higher on June 16 (0.00046 mg/L) than June 25 (0.000065 mg/L), with the latter concentration close to analytical detection (0.00005 mg/L). Selenium concentrations at A2 have consistently been below are near the level of analytical detection except for the June 16, 2018 sample.
- Concentrations of the remaining dissolved metals presented in Table 2 were within the range of historical data.

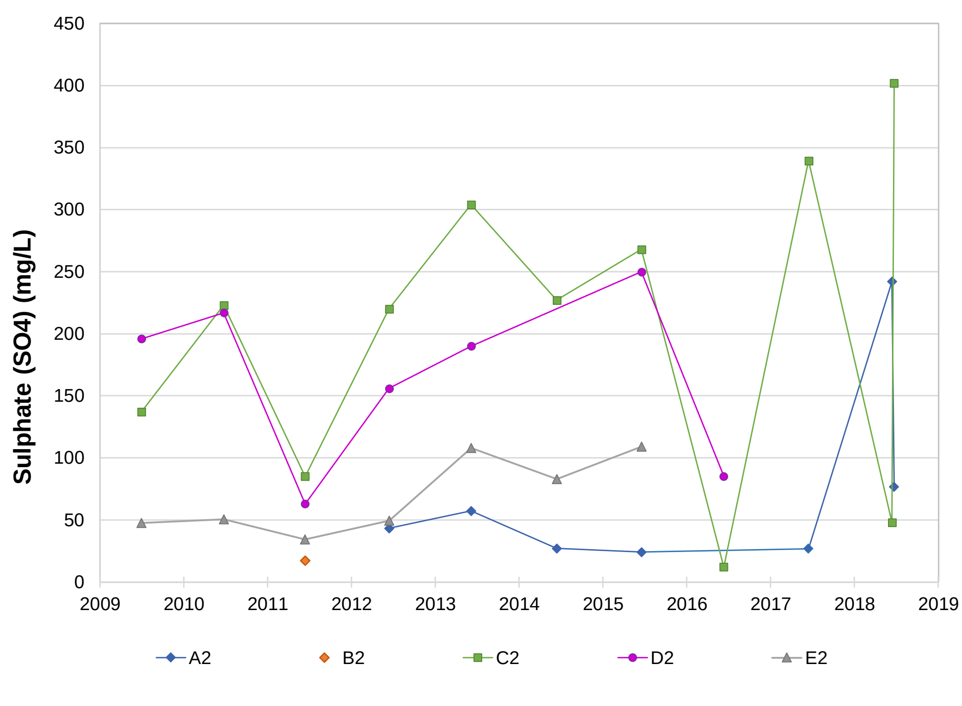

Figure 2: Ephemeral stream sulphate concentrations

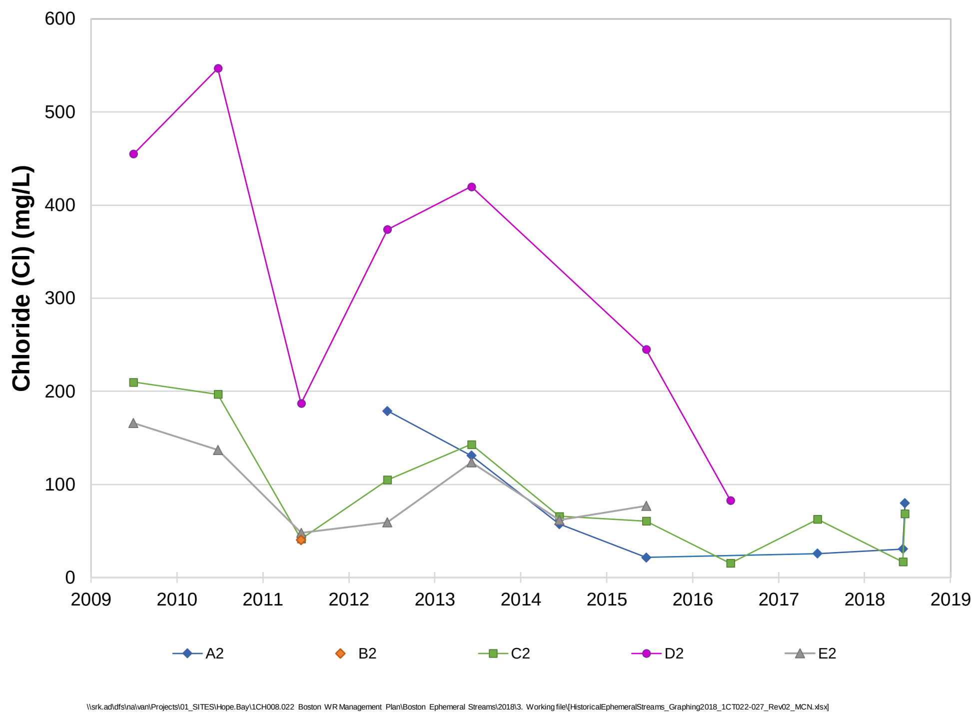

Figure 3: Ephemeral stream chloride concentrations

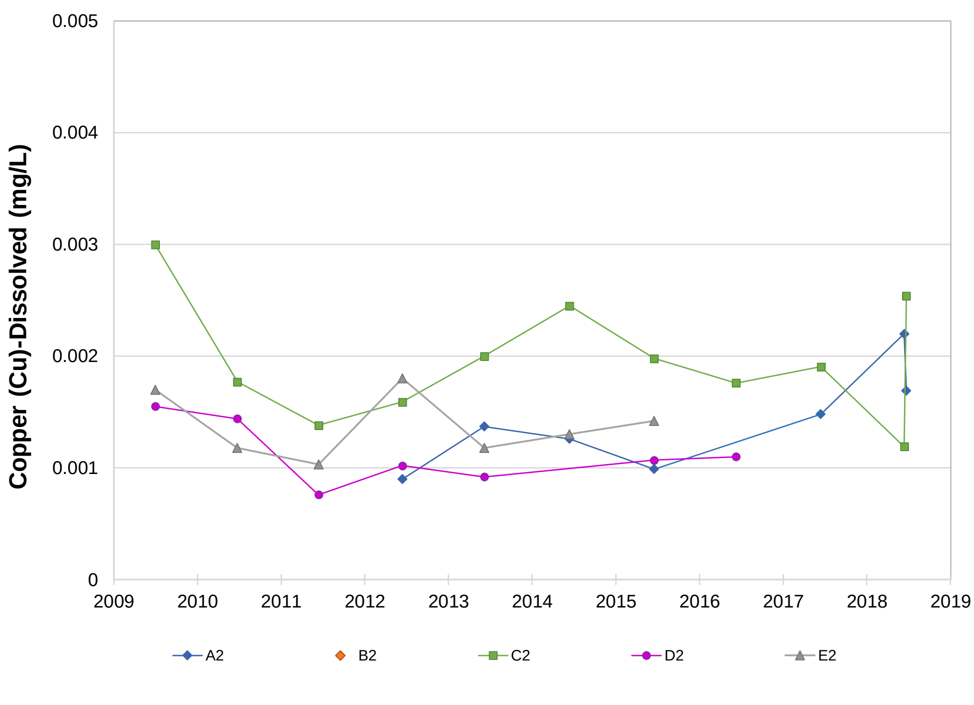

Figure 4: Ephemeral streams copper concentrations

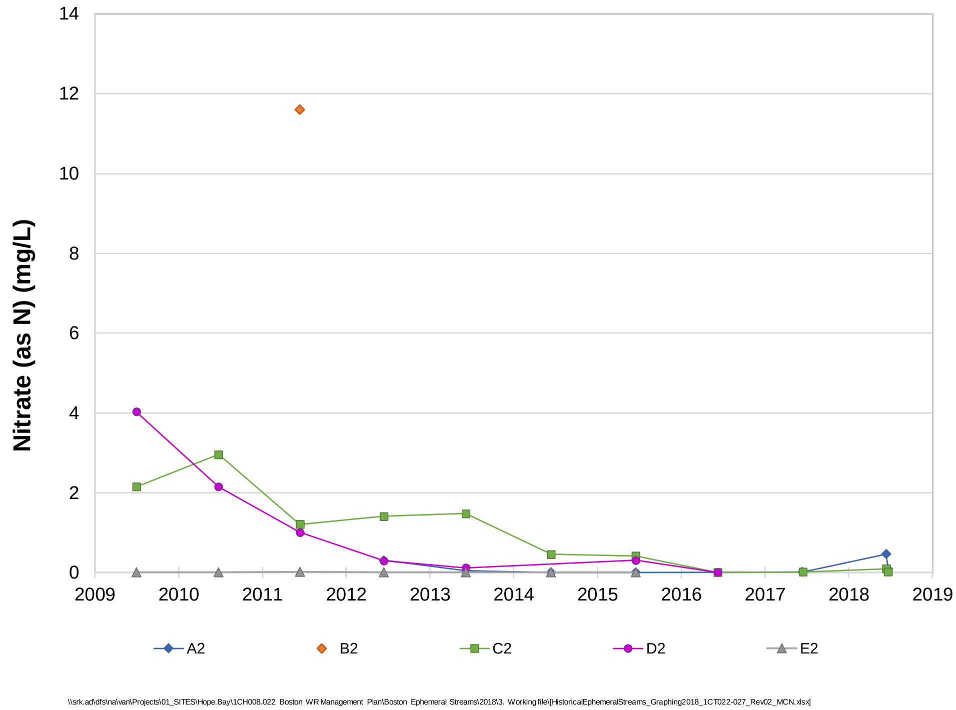

Figure 5: Ephemeral streams nitrate concentrations

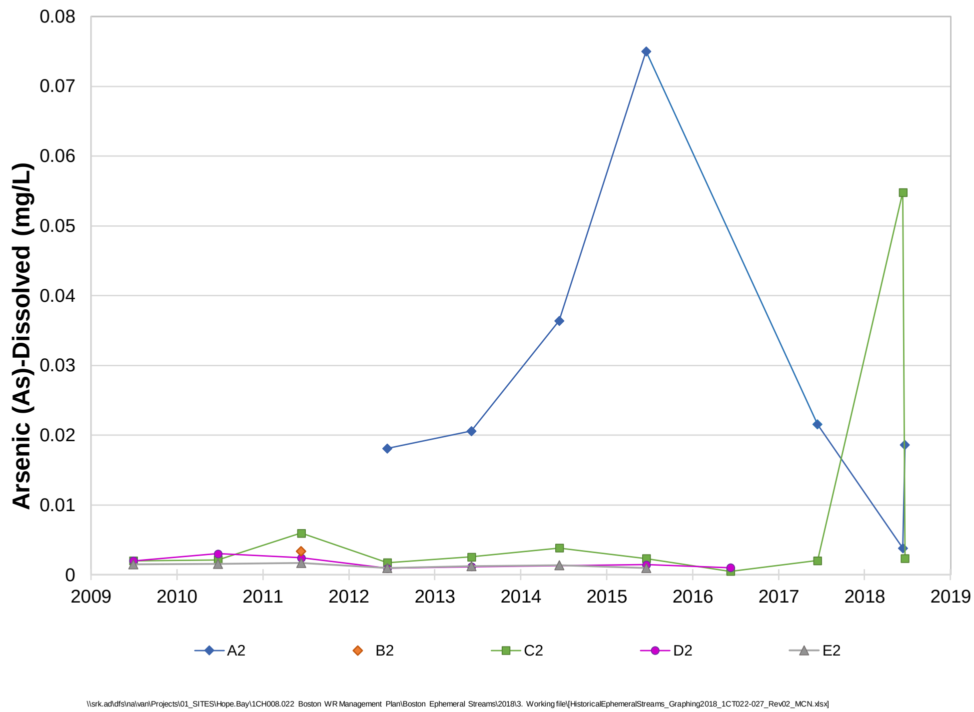

Figure 6: Ephemeral streams arsenic concentrations

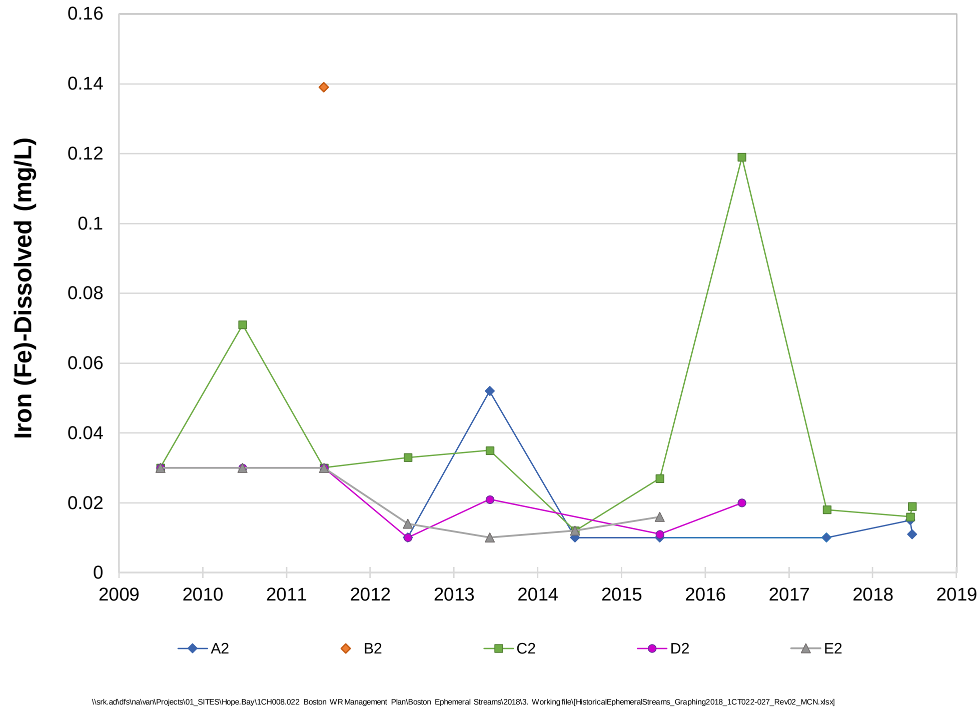

Figure 7: Ephemeral streams iron concentrations

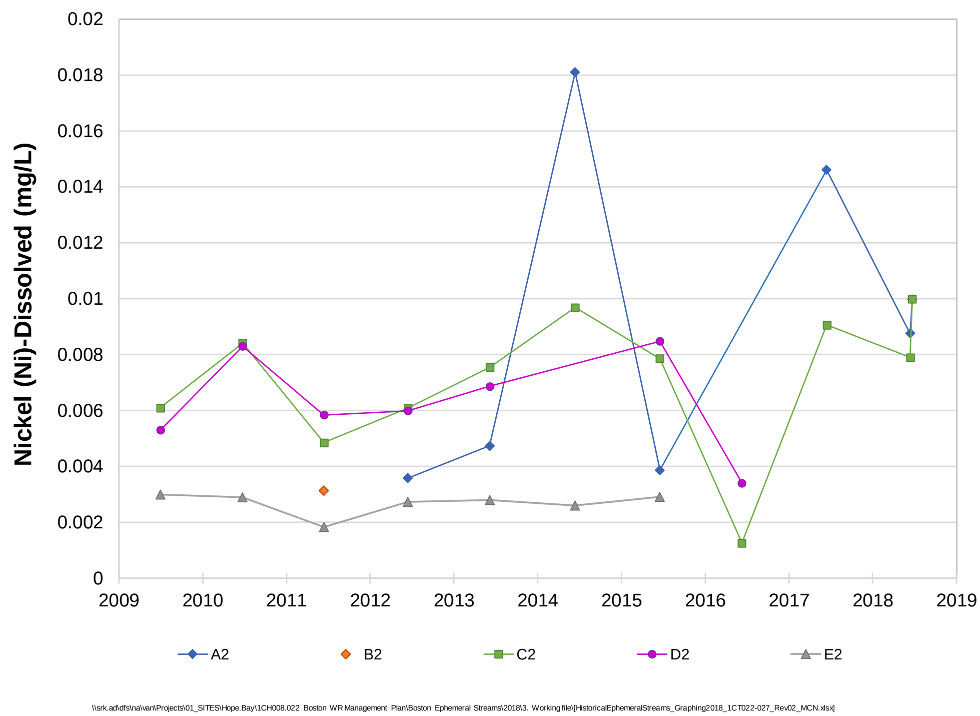

Figure 8: Ephemeral streams nickel concentrations

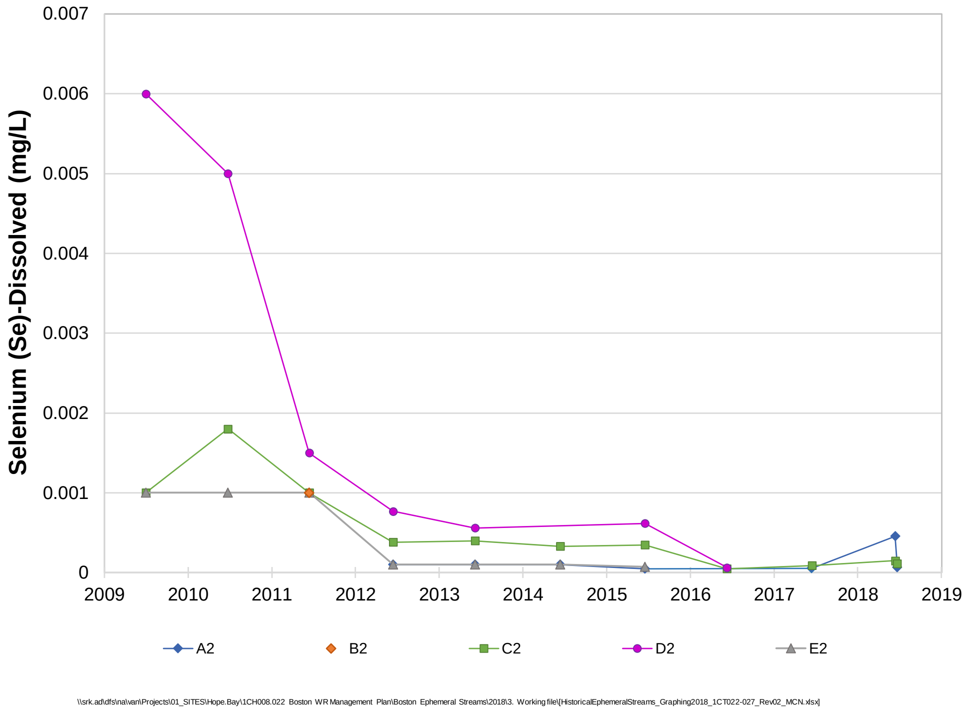

Figure 9: Ephemeral streams selenium concentrations

Table 2: Summary of Water Quality Results for Stations A2 and C2, 2009 to 2017

Sample ID	Year	General Parameters		Anions and Nutrients					Dissolved Metals								
		pH	EC	Alkalinity, Total	Ammonia	Nitrate	Sulphate	Chloride	Aluminum	Arsenic	Cadmium	Copper	Iron	Lead	Nickel	Selenium	Zinc
		s.u.	µS/cm	mg/L as $CaCO_3$	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
A2	2012	7.9	740	44	0.0077	0.31	43	180	0.0045	0.018	<0.00001	0.0009	<0.01	0.0001	0.004	<0.0001	0.0029
	2013	7.8	590	33	0.013	0.052	57	130	0.02	0.021	<0.00001	0.0014	0.052	0.000068	0.0047	<0.0001	0.0018
	2014	7.8	310	38	<0.005	<0.005	27	58	0.0027	0.036	<0.00001	0.0013	<0.01	<0.00005	0.018	<0.0001	0.0022
	2015	7.9	210	44	0.011	0.0083	24	22	0.0071	0.075	<0.000005	0.00099	<0.01	<0.00005	0.0039	<0.00005	0.0023
	2016	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	2017	8.0	270	67	<0.0050	0.017	27	26	0.01	0.022	<0.0000050	0.0015	<0.010	<0.000050	0.015	0.000053	0.0017
	2018-06-16	7.8	670	51	0.0065	0.47	240	31	0.014	0.0038	0.000013	0.0022	0.015	<0.00005	0.0088	0.00046	0.0016
	2018-06-25	8	530	63	0.0078	0.088	77	80	0.0081	0.019	0.0000055	0.0017	0.011	<0.00005	0.01	0.000065	0.001
C2	2009	7.1	--	42	<0.02	<0.005	48	170	0.014	<0.0015	<0.000017	0.0017	<0.03	<0.00005	0.003	<0.001	0.0014
	2010	--	--	44	0.083	3	220	200	0.011	0.0021	<0.00005	0.002	0.071	0.0002	0.0084	0.0018	0.0071
	2011	7.6	--	29	0.05	1.2	85	42	0.02	0.006	<0.00005	0.001	<0.03	<0.00005	0.0049	<0.001	<0.003
	2012	7.9	830	44	0.01	1.4	220	110	0.012	0.0017	0.000012	0.0016	0.033	<0.00005	0.006	0.00038	0.0021
	2013	7.7	1000	64	0.0093	1.5	300	140	0.014	0.0026	0.00002	0.002	0.035	<0.00005	0.0076	0.0004	0.0028
	2014	7.5	730	61	0.0078	0.46	230	66	0.016	0.0038	0.000013	0.0025	0.012	<0.00005	0.0097	0.00033	0.0025
	2015	7.8	810	53	0.014	0.42	270	61	0.014	0.0023	0.0000056	0.002	0.027	<0.00005	0.0079	0.00035	0.0022
	2016	7.6	160	40	0.0097	<0.005	12	16	0.021	0.00048	<0.000005	0.0018	0.12	<0.00005	0.0013	<0.00005	0.0023
	2017	7.8	940	66	<0.0050	<0.0050	340	62	0.014	0.002	0.00001	0.0018	0.017	<0.000050	0.0088	0.000079	0.0017
	2018-06-16	7.8	220	34	0.013	0.1	48	17	0.012	0.055	<0.000005	0.0012	0.016	<0.00005	0.0079	0.00015	<0.001
	2018-06-25	8	1100	65	<0.005	<0.025	400	69	0.015	0.0023	0.000013	0.0025	0.019	<0.00005	0.01	0.00012	0.0015

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4 Discussion

Seepage chemistry predictions were made as part of the Water and Ore/Waste Rock Management Plan (Supporting Document B of SRK 2009). The report calculated average and maximum predicted concentrations of sulphate, chloride, nitrate, arsenic, copper, iron, nickel and selenium that may be expected to discharge from the ore stockpile. Table 3 presents these model predictions for the ephemeral streams compared to the 2018 minimum and maximum concentrations of these parameters.

At A2 and C2, maximum sulphate concentrations observed in 2018 exceeded the maximum modeled values, however the minimum observed concentrations in 2018 were within the modeled range. As discussed in Section 3, sulphate concentrations at C2 were consistent with historical trends but concentrations at A2 were higher. According to TMAC, there are no ore stockpiles on the camp pad within ephemeral streams catchment A2, and there are no operational explanations for the higher sulphate concentrations observed at A2. Further monitoring will establish sulphate trends at A2. All other 2018 monitoring data were below maximum predicted values at streams A2 and C2.

Table 3: Comparison of 2018 Water Quality Results to Model Predictions (SRK 2009)

Parameters	Units	Predicted Value		Max Predicted Value		2018 – Min		2018 – Max	
		A2	C2	A2	C2	A2	C2	A2	C2
Chloride	mg/L	95	144	357	559	31	17	80	69
Nitrate (as N)	mg/L	3.4	5.4	9.2	15	0.088	<0.025	0.47	0.1
Sulphate	mg/L	70	110	120	190	77	48	240	400
Arsenic	mg/L	0.03	0.048	0.063	0.1	0.0038	0.0023	0.019	0.055
Copper	mg/L	0.0026	0.0026	0.0033	0.004	0.0017	0.0012	0.0022	0.0025
Iron	mg/L	0.41	0.43	0.89	1.2	0.011	0.016	0.015	0.019
Nickel	mg/L	0.095	0.15	0.32	0.51	0.0088	0.0079	0.01	0.01
Selenium	mg/L	0.0015	0.0021	0.0035	0.0053	0.000065	0.00012	0.00046	0.00015

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5 Conclusions and Recommendations

Nitrate, sulphate, arsenic, copper, iron, nickel and selenium were identified by the water and load balance as potential contaminants of concern (SRK 2009). Monitoring of the ephemeral streams A2, B2, C2, D2 and E2 (Attachment A) was initiated in 2009. In 2018 flow was observed and samples collected on June 16 and June 25 from A2 and C2.

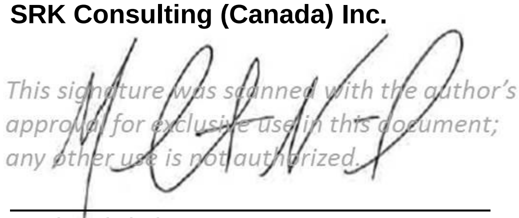
In terms of trends, sulphate and selenium concentrations for one 2018 sample collected at A2 and arsenic and sulphate concentrations for one 2018 sample collected at C2 exceeded historical concentrations. For these parameters, concentrations for the other 2018 sample were comparable to previous trends and concentrations. The analysis of the water quality data for ephemeral streams A2 and C2 indicated that concentrations for all other potential contaminants of concern were either decreasing or consistent with historical data.

Compared to SRK (2009) model predictions, the 2018 monitoring data were below maximum predicted values for chloride, nitrate, arsenic, copper, iron nickel and selenium at streams A2 and C2. At A2 and C2, maximum sulphate concentrations observed in 2018 exceeded the maximum modeled values, however the minimum observed concentrations in 2018 were within the modeled range. Sulphate concentrations at C2 were consistent with historical trends but concentrations at A2 were higher. According to TMAC, there are no ore stockpiles on the camp pad within ephemeral streams catchment A2 (Figure 1), and there was no water discharged to catchment A2 during the monitoring period. Further monitoring will establish sulphate trends.

Sulphate and chloride are not attenuated by the tundra and the concentrations measured in 2018 validate the 2009 water and load balance. The concentrations observed in the ephemeral streams indicate that the tundra continues to effectively attenuate contaminants of concern such as arsenic and selenium and the breakthrough of the effectiveness of the attenuation process has not occurred. SRK recommends continued monitoring of the ephemeral stream sampling sites as outlined in SRK (2017).

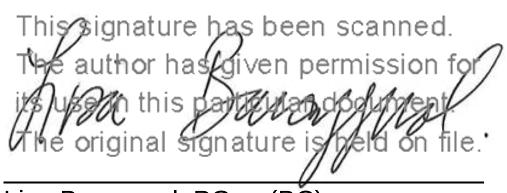
Regards,

SRK Consulting (Canada) Inc.



Marie-Christine Noël
Consultant

Reviewed by



Lisa Barazzuol, PGeo (BC)
Principal Consultant

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6 References

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SRK Consulting (Canada) Inc., 2009. Water and Ore/Waste Rock Management Plan for the Boston Site Hope Bay Project, Nunavut. Report 1CH008.022 for Hope Bay Mining Ltd. July 2009.

SRK Consulting (Canada) Inc., 2017. Water and Ore/Waste Rock Management Plan for the Boston Site, Hope Bay Project, Nunavut. Report 1CT022.009 for TMAC Resources Inc. January 2017.

SRK Consulting (Canada) Inc., 2018. Boston Seepage Monitoring Program 2018 – DRAFT. Report 1CT022.027 for TMAC Resources Inc. February 2019.

Attachment 1: 2018 Water Quality Results

Sample	Date	Start time	Coordinates (N)	Coordinates (W)	Description of location	Field measurements	Conductivity	ORP	Temperature	ALS Sample ID	Conductivity	Hardness (as CaCO3)	pH	Total Suspended Solids	Total Dissolved Solids	Acidity (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia, Total (as N)	Bromide (Br)	Chloride (Cl)
						pH				unit	µS/cm	mg/L	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
						s.u.	µS/cm	mV	ºC	detection limit	2	0.5	0.1	3	1	1	1	0.005	0.05	0.5
18-EPH-A2	2018-06-16	16:50	67.39.26.0	106.23.16.0	Streams flow directly into lake, with sediment for at base of hill. Streams flows through broken ground from top of camp pad. Located on SE section of cam pad. Water has a very light brown color.	7.5	230	130	13.3	L2115049-1	666	325	7.84	<3	497	1.9	50.6	0.0065	<0.05	30.7
18-EPH-A2	2018-06-25	11:45	-	-	sampled ~ 10m from lake edge. Through grassy tundra. Wide channel, deep in areas syringe used to collect sample	7.8	524	90	6.7	L2119203-1	531	216	7.99	5.9	424	1.6	63	0.0078	<0.05	80
18-EPH-C2	2018-06-16	17:15	67.39.33.2	106.22.56.0	Approx 500-800 m from camp pond and 100 m from bank of lake. Water is clear, running through grasses and willows. No clear main channel, water runs throught the grassy surface	7.5	654	140	12.6	L2115049-2	217	96.2	7.77	145	157	1.3	33.5	0.0127	<0.05	17
18-EPH-C2	2018-06-25	12:25	67.39.33.1	106.22.56.7	Fragmentes channel through grassy tundra syringe used to collect sample. Sample taken ~ 15 m from lake shore	6.7	1027	76	8.1	L2119203-2	1070	535	7.98	<3	806	2.1	64.8	<0.005	<0.25	68.9
EPH-DUP	2018-06-25	12:25	67.39.33.1	106.22.56.7	Collected at 18-EPH-C2					L2119203-4	1080	511	7.99	<3	865	2.1	67.3	0.0329	<0.25	70.3
FB	2018-06-25	12:25			Field Blank					L2119203-3	<2	<0.5	5.87	<3	<10	2	<1	<0.005	<0.05	<0.5

Sample	Date	Fluoride (F)	Nitrate (as N)	Nitrite (as N)	Phosphorus (P)-Total	Sulfate (SO4)	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Beryllium (Be)-Dissolved	Bismuth (Bi)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved	Calcium (Ca)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Iron (Fe)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Magnesium (Mg)-Dissolved
		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
		0.02	0.005	0.001	0.002	0.3	0.001	0.0001	0.0001	0.00005	0.00002	0.00005	0.01	0.000005	0.05	0.0001	0.0001	0.0002	0.01	0.00005	0.001	0.1
18-EPH-A2	2018-06-16	0.037	0.466	0.0038	0.029	242	0.0138	0.00142	0.00381	0.0265	<0.00002	<0.00005	0.077	0.0000127	74.2	<0.0001	0.00043	0.0022	0.015	<0.00005	0.0026	33.9
18-EPH-A2	2018-06-25	0.025	0.088	<0.001	0.021	76.5	0.0081	0.00083	0.0186	0.0139	<0.00002	<0.00005	0.026	0.0000055	57.3	<0.0001	0.00027	0.00169	0.011	<0.00005	0.0078	17.6
18-EPH-C2	2018-06-16	0.025	0.0997	0.002	0.403	48	0.0119	0.00216	0.0548	0.00671	<0.00002	<0.00005	0.029	<0.000005	25.6	<0.0001	0.00041	0.00119	0.016	<0.00005	0.005	7.84
18-EPH-C2	2018-06-25	<0.1	<0.025	<0.005	0.0064	402	0.0145	0.00078	0.00231	0.0353	<0.00002	<0.00005	0.049	0.0000133	113	<0.0001	0.00035	0.00254	0.019	<0.00005	0.0014	61.3
EPH-DUP	2018-06-25	<0.1	<0.025	<0.005	0.0073	413	0.0134	0.00078	0.00225	0.0343	<0.00002	<0.00005	0.049	0.0000106	110	<0.0001	0.00034	0.00238	0.017	<0.00005	0.0013	57.3
FB	2018-06-25	<0.02	<0.005	<0.001	<0.002	<0.3	0.0033	<0.0001	0.00012	<0.0001	<0.00002	<0.00005	<0.01	<0.000005	<0.05	<0.0001	<0.0001	<0.0002	<0.01	<0.00005	<0.001	<0.1

Sample	Date	Manganese (Mn)-Dissolved	Mercury (Hg)-Dissolved	Molybdenum (Mo)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Potassium (K)-Dissolved	Selenium (Se)-Dissolved	Silicon (Si)-Dissolved	Silver (Ag)-Dissolved	Sodium (Na)-Dissolved	Strontium (Sr)-Dissolved	Sulfur (S)-Dissolved	Thallium (Tl)-Dissolved	Tin (Sn)-Dissolved	Titanium (Ti)-Dissolved	Uranium (U)-Dissolved	Vanadium (V)-Dissolved	Zinc (Zn)-Dissolved	Zirconium (Zr)-Dissolved
		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
		0.0001	0.000005	0.00005	0.0005	0.05	0.1	0.00005	0.05	0.00001	0.05	0.0002	0.5	0.00001	0.0001	0.0003	0.00001	0.0005	0.001	0.0003
18-EPH-A2	2018-06-16	0.0117	<0.000005	0.000414	0.00876	<0.05	5.69	0.000456	1.29	0.000034	19.6	0.306	83.1	0.000011	<0.0001	<0.0003	0.00003	<0.0005	0.0016	<0.0003
18-EPH-A2	2018-06-25	0.00257	<0.000005	0.000239	0.00997	<0.05	2.49	0.000065	0.83	<0.00001	21.8	0.394	23.2	<0.00001	<0.0001	<0.0003	0.000042	<0.0005	0.001	<0.0003
18-EPH-C2	2018-06-16	0.00362	<0.000005	0.000388	0.0079	<0.05	1.62	0.000149	0.376	<0.00001	6.5	0.164	14.4	<0.00001	<0.0001	<0.0003	<0.00001	<0.0005	<0.001	<0.0003
18-EPH-C2	2018-06-25	0.00613	<0.000005	0.000298	0.01	<0.05	7.04	0.000115	1.55	0.00001	43.5	0.427	131	<0.00001	<0.0001	<0.0006	0.00005	<0.0005	0.0015	<0.0003
EPH-DUP	2018-06-25	0.00576	<0.000005	0.000324	0.00956	<0.05	6.58	0.000142	1.5	0.00001	40.9	0.412	131	<0.00001	<0.0001	<0.0003	0.00005	<0.0005	0.0014	<0.0003
FB	2018-06-25	0.00027	<0.000005	<0.00005	<0.0005	<0.05	<0.1	<0.00005	<0.05	<0.00001	<0.05	<0.0002	<0.5	<0.00001	<0.0001	<0.0003	<0.00001	<0.0005	<0.001	<0.0003

Appendix C – 2018 Boston Ephemeral Streams Monitoring

Appendix H

Hope Bay Project Spill Contingency Plan
(TMAC, March 2019)

HOPE BAY PROJECT
SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

MARCH 2019

Hope Bay Project Spill Contingency Plan

Plain Language Overview:

This Plan describes the spill response procedures to be used at the TMAC Resources Inc. Hope Bay Project. This Plan ensures that 1) human life is protected and the potential for injury during spill response activities is minimized to the extent possible, 2) all potentially harmful environmental impacts are kept to a minimum, 3) resources are used effectively and efficiently, and 4) all required internal and regulatory reporting is completed on time and as required.

Hope Bay, Nunavut

Publication Date: March 2019

Hope Bay Project
c/o #18 Yellowknife Airport
100 McMillan Drive
Yellowknife, NT X1A 3T2
Phone: 867-873-4767
Fax: 867-766-8667

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Hope Bay Emergency Phone Numbers

Onsite Contacts	Day (7 am to 7 pm)	Night (7 pm to 7 am)
24 hour Emergency Line Mill Control Room Operator	1-867-988-6882 ext. 150	1-867-988-6882 ext. 150
Mine General Manager Dan Gagnon Assistant General Manager Jerome Girard	1-867-988-6882 ext. 104	Offsite Cell: 1-705-288-4565
Maintenance Manager Ron Bertrand	1-867-988-6882 ext. 101	Offsite Cell: 1-250-488-1217
Mill (Process) Manager Chad Parent	1-867-988-6882 ext. 141	Offsite Cell: 1-907-223-7512
Manager of Mining Jason Nickel	1-867-988-6882 ext. 125	
Health and Safety Manager Doug Brown Health and Safety Superintendent Ken Cook	1-867-988-6882 ext.138	
Environmental Supervisor Sarah Warnock Kyle Conway	1-867-988-6882 ext. 102	
Surface Superintendent Brad Dahl	1-867-988-6882 ext. 131	
Medics Gabriel Bernard Tracy Wanyama	1-867-988-6882 ext. 105	1-867-988-6882 ext. 115
Security Officer Brent Cecchini Bob Fogarty	1-867-988-6882 ext. 165	
Offsite Contacts	**Day (7 am to 7 pm)**	**Night (7 pm to 7 am)**
V.P. Environmental Affairs Oliver Curran	1-416-628-0216	1-416-577-5829
Chief Operating Officer Gil Lawson	1-416-628-0216	1-416-561-0363
President & Chief Executive Officer Jason Neal	1-416-628-0216	
V.P. Corporate Social Responsibility, Cambridge Bay Alex Buchan	1-867-983-2385	1-867-445-6675

Site Radio Channels

Channel 1	Emergency
Channel 2	Security
Channel 3	Aviation
Channel 4	Roads
Channel 5	Site Services
Channel 6	Medic
Channel 7	Environment Department

Key Government Contacts

Organization	Contact	Location	Telephone	Fax
NT-NU Spill Centre	24 hour Spill Report Line	Yellowknife	867-920-8130	867-873-6924
Canadian Coast Guard – Central and Arctic Region (Any discharge to the marine environment)	24 hour Spill Report Line	Yellowknife	800-265-0237	
GN Department of Environment	Director Environmental Protection Division	Iqaluit	867-975-7729	
Nunavut Water Board	Executive Director	Gjoa Haven	867-360-6338	867-360-6369
Kitikmeot Inuit Association (KIA)	Sr. Lands Officer	Kugluktuk	867-982-3310	867-982-3311
CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada)	Field Operations Manager	Iqaluit	867-975-4553	
CIRNAC (Crown-Indigenous Relations and Northern Affairs Canada)	Inspector	Cambridge Bay	867-983-5115	
ECCC (Environment and Climate Change Canada)	Manager of Enforcement	Yellowknife	867-669-4730	867-669-6831
ECCC (Environment and Climate Change Canada)	Environmental Assessment Officer	Yellowknife	867-669-4794	
DFO (Fisheries & Oceans Canada)	Habitat Team Leader	Ottawa	705-522-9909	

Offsite Resource Contacts

Organization	Contact	Location	Telephone
Mackenzie Delta Spill Response Corporation	Tim Taylor	Inuvik	403-370-7887
Riverspill	Ian Lambton	Burnaby	604-434-0994
Points West Archaeology	Gabriella Prager	Langley	780-980-2079
Focus Wildlife	Chris Bataglia	North Vancouver	1-800-578-3048 310-371-7777/310-386-5964

Immediately Reportable Spills

Per Schedule B of the NU Spill Contingency Planning and Reporting Regulations.

Description of Contaminant	Amount Spilled	TDG Class
Explosives	Any amount	1.0
Compressed gas (toxic/corrosive)		2.3 / 2.4
Infectious substances		6.2
Sewage and Wastewater (Unless otherwise authorized)		6.2
Radioactive materials		7.0
Unknown substance		None
Compressed gas (Flammable) Compressed gas (Non-corrosive, non-flammable)	Any amount of gas from containers with a capacity greater than 100 L	2.1 2.2
Flammable Liquid	≥ 100L	3.1 / 3.2 / 3.3
Flammable Solid Substances liable to spontaneous combustion Water reactant substances	≥ 25kg	4.1 4.2 4.3
Oxidizing substances	≥ 50 L or 50 kg	5.1
Organic peroxides Environmentally hazardous substances intended for disposal	≥ 1 L or 1 kg	5.2 9.2
Toxic/Poisonous substances Dangerous wastes	≥ 5 L or 5 kg	6.1
Corrosive substances	≥ 5 L or 5 kg	8.0
Miscellaneous products, substances or organisms, excluding PCB Mixtures	>50 L or 50 kg	9.1
PCB mixtures of 5 or more ppm	≥ 0.5 L or 0.5 kg	9.1
Dangerous wastes	≥ 5 L or 5 kg	9.3
Other contaminants – for example, crude oil, drilling fluid, produced water, waste or spent chemicals, used or waste oil, vehicle fluids, wastewater	≥ 100 L or 100 kg	None
Sour natural gas (i.e., contains H_2S) Sweet natural gas	Uncontrolled release or sustained flow of 10 minutes or more	None
Flammable liquid Vehicle fluid	≥ 20 L when released on a frozen water body that is being used as a working surface	3.1 / 3.2 / 3.3 None
Reported releases or potential releases of any substance that: 1. are near or in an open water body (freshwater or marine); 2. are near or in a designated sensitive environment or habitat; 3. Pose an imminent threat to human health or safety; or 4. Pose an imminent threat to a listed species at risk or its critical habitat	Any amount	None

In the event that a particular material spill meets or exceeds the amount specified or conditions outlined in the above table the Environmental Supervisor will immediately report the spill by telephone to the NT-NU 24 Hour Spill Report Line, Yellowknife, Tel: 867-920-8130 (Email: spills@gov.nt.ca; Fax: 867-873-6924) using the NT-NU Spill Report. Any spill or discharge that occurs to the marine environment must immediately be reported to the regional Canadian Coast Guard station at Tel: 800-265-0237.

First Responder

When someone on site sees an unanticipated discharge or spill, he or she is immediately designated as the First Responder and, as such, shall complete the following actions

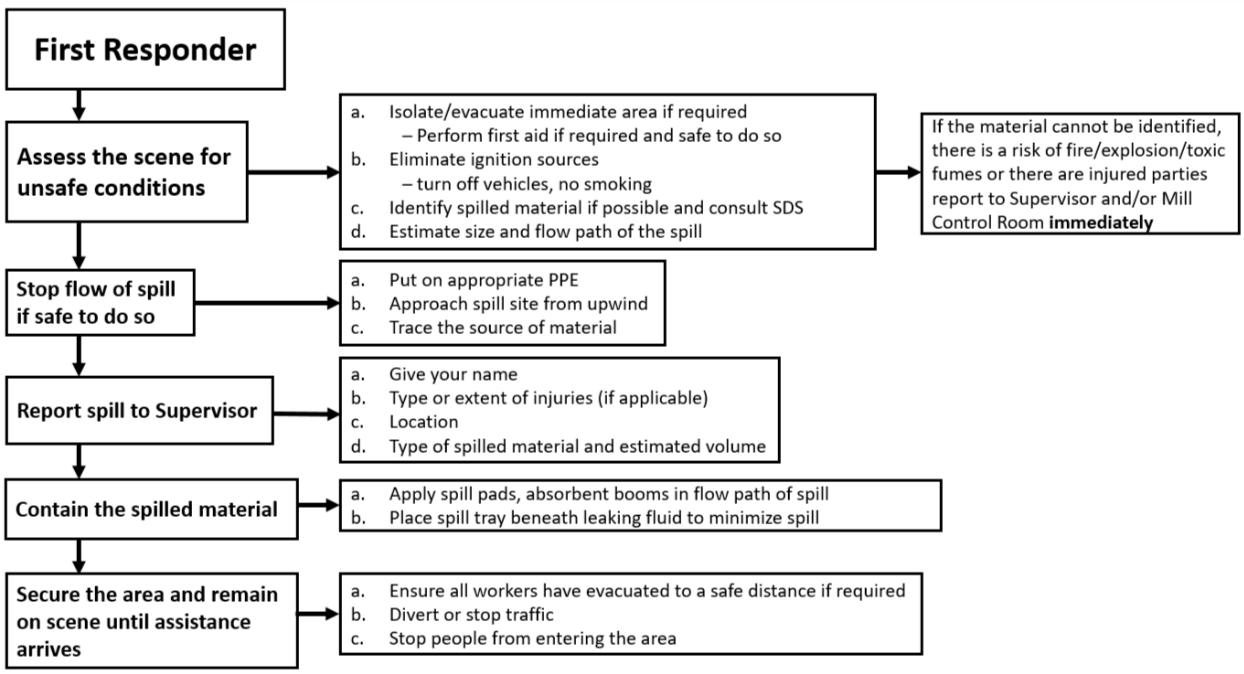

Figure 1. First Responder Spill Response Actions

Spill Response Organization Structure

When a Supervisor receives a report of an unanticipated discharge or spill, he or she shall immediately complete the following actions:

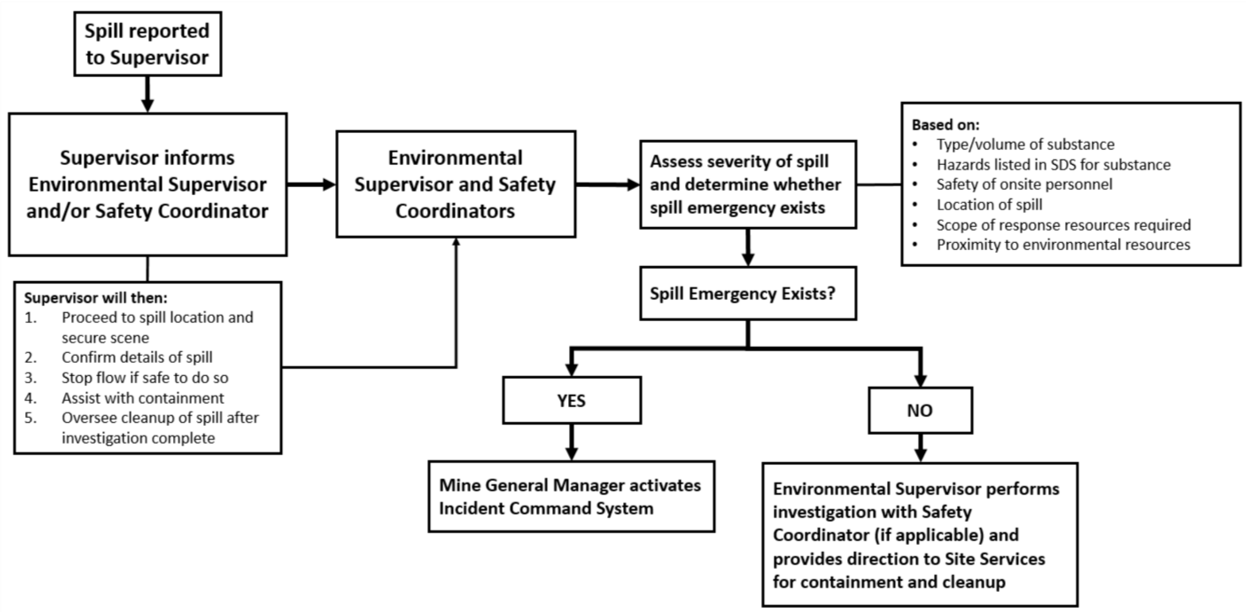

Figure 2. Spill Response Organizational Structure

Spill Emergency Incident Command System

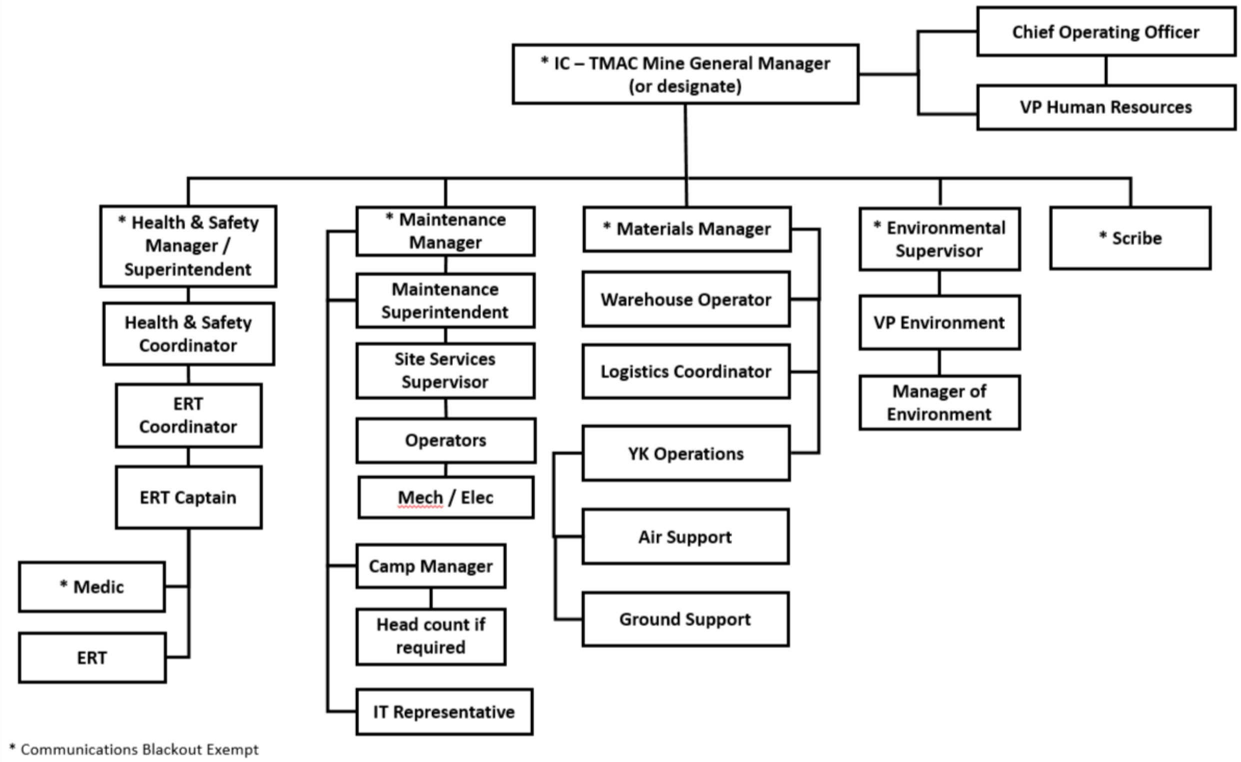

Figure 3. Incident Command System organizational structure in the event of a spill emergency

Revisions

Revision #	Date	Section	Changes Summary	Author	Approver
1	2009		Hope Bay Project Spill Contingency Plan, August 2009		
2	Feb 2010		Update phone numbers		
3	Jul 2010		Update phone numbers		
4	2011	Throughout	Update channels, figures, included OPPP info, updated phone numbers, revised fuel storage locations		
5	2012	Throughout	Overall revision for change to Care and Maintenance. Updated roles and responsibilities, phone numbers, fuel storage, added non-hydrocarbon chemicals, updated spill response procedures		
6	2014	Throughout	Overall revision to include Care and Maintenance under ownership of TMAC Resources Inc. Updated roles and responsibilities, contact information, fuel storage, updated spill response procedures		
7	Apr 2016	Throughout	Updated to reflect comments on 2014 Plan and other stakeholder inputs. Changes to document structure and addition of licence specific modules and Incident Command System response structure. Revisions to reflect Construction and Operations phases for Doris and anticipated chemical storage quantities. Inclusion of Product-specific response plans, updated contacts.		
8	Jan 2017	Throughout	Revisions in consideration of comments on 2016 Plan, and in consideration of planned resumption of exploration activity at Boston		
9	Nov 2017	Throughout	Revisions to emergency contact information, spill response organizational and ICS structure. Updates to fuel/chemical storage quantities/locations and spill kit location maps in all modules. Addition of Module C: Madrid as per licence 2BB-MAE1727. Revisions to Module D: Boston as per licence 2BB-BOS1727. Addition of Aviation fuel Product Specific Spill Response Plan to Module A.		
10	Mar 2019	Throughout	Revisions to emergency contact information, spill response organizational and ICS structure. Updates to fuel/chemical storage quantities/locations and spill kit location maps in all modules.		

Contents

Tables

Figures

Glossary

Term	Definition
CWS	Canadian Wildlife Services
COO	Chief Operating Officer
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada (formerly INAC)
DoE	Department of Environment
ECCC	Environment and Climate Change Canada
ERT	Emergency Response Team
ERP	Emergency Response Plan
GN	Government of Nunavut
IC	Incident Commander
ICS	Incident Command System
KIA	Kitikmeot Inuit Association
MGM	Mine General Manager
NWB	Nunavut Water Board
PSSR	Product Specific Spill Response
PPE	Personal Protection Equipment
SDS	Safety Data Sheet

1 Introduction

This Hope Bay Spill Contingency Plan (the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with various water licences held by TMAC associated with developments throughout the Hope Bay region.

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices for response are implemented in the event of a spill or unintentional release, and that the conditions of water licences and project permits are met.

This Plan is structured in a manner such that one document pertaining to spill response is approved and implemented across all TMAC Hope Bay project sites, while still addressing site- and licence-specific needs: the main document outlines TMAC's approach to spill response planning and management as it pertains to all TMAC Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, only the specific modules pertaining to that licence and site may need to be revised. This is intended for consistency and efficiency across operations and for compliance management.

This Plan has been developed to be applicable for all phases of the various Hope Bay Belt projects. This Plan is reviewed annually and updated as necessary.

1.1 Objectives

TMAC's vision and values which strive for zero harm are protective of people and the environment. Safe work procedures and training provided to all employees promote best practices and sound environmental management; however, the potential exists for unanticipated discharges or spills to occur during the course of operations. TMAC recognizes that prompt, effective and organized responses to an unanticipated discharge or spill will enhance the health and safety of all employees, minimize the potential adverse environmental impacts resulting from such an event, and ensure effective communication with the appropriate regulatory agencies and the public. Consistent with TMAC's intent to be a responsible operator, these objectives are described as follows:

- Provide procedures for every employee should he/she identify an unanticipated discharge or spill;
- Define roles, responsibilities and procedures for spill response actions, documentation, reporting, incident investigation and review following an event;
- Outline a process to be followed when conducting spill clean-up activities to promote safe and effective recovery of spilled materials and minimize impacts to the environment;
- Provide information on available resources and potential operational hazards/risks that may be encountered during spill response activities;
- Define methods to provide spill response training for all employees; and
- Implement a process to evaluate and continuously improve site spill response procedures.

1.2 Relevant Legislation and Guidance

Table 1.1 provides a summary of federal and territorial regulations governing this Plan and associated guidelines.

Table 1.1. List of federal and territorial regulations governing the Hope Bay Incinerator Management Plan

Regulation/Guideline	Year	Governing Body	Relevance
Guidelines for Spill Contingency Planning	2007	Indian and Northern Affairs Canada, Water Resources Division	Provides guidelines and requirements for the development of spill contingency plans
Environmental Protection Act	1999	Environment Canada	Spill contingency planning and reporting regulations (Section 34)
Environmental Emergency (E2) Regulations	2011	Environment Canada	Outlines requirements for hazardous materials emergency planning

1.3 Related TMAC Documents

The documents listed in Table 1.2 are expected to be referenced and utilized in conjunction with the Spill Contingency Plan.

Table 1.2. List of TMAC documents related to the Hope Bay Spill Contingency Plan

Document Title	Year	Relevance
Hazardous Waste Management Plan	2019	Describes proper handling, storage and disposal procedures for hazardous wastes.
Non-Hazardous Waste Management Plan	2017	Describes proper handling, storage and disposal procedures for non-hazardous wastes.
Hope Bay Project Hydrocarbon Contaminated Material Management Plan	2017	Describes process for remediating hydrocarbon contaminated soil, water and gravel and criteria for determining level of remediation.
Emergency Response Plan	2019	Describes Incident Command System and actions relating to all surface emergencies.
Doris North Tailings Operations, Management and Surveillance (OMS) Plan	2017	Describes the tailings management procedures and the aspects of the pipelines designed to reduce spills of tailings and effluent.
Oil Pollution Prevention and Oil Emergency Preparedness Plan	2018	Describes spill response actions associated with fuel transfer activities during annual sea-lift fuel offload.

1.4 Plan Management

The Chief Operating Officer (COO) has the overall responsibility for implementing this management plan and will provide the on-site resources to respond to unanticipated discharges and spills that occur in the Hope Bay Belt in accordance with this plan.

The Mine General Manager (MGM) is responsible for implementing this plan at the Hope Bay site, and providing on-site support and resources for spill response management. The MGM will act as Incident Commander (IC) in the event that a spill occurs that requires activation of the Emergency Response Plan (ERP). As Incident Commander, the MGM will coordinate the spill response efforts that protect the health and safety of all responders, and minimizes impacts to the environment.

The Environmental Supervisor is responsible for revising this plan and will assist departmental supervisors with investigation of spill incidents, development of corrective actions for those incidents as necessary, maintain records of all spill events, and complete appropriate reporting as required by TMAC policies and relevant regulations as identified in this plan. The Environmental Supervisor will also conduct and record regular inspections of spill response resources. In the event that a spill requires activation of the Emergency Response Plan, the Environmental Supervisor will provide guidance to the MGM regarding implementing response actions according to this plan and evaluating priorities for protection of sensitive habitats/species and archeological features at risk.

1.5 Plan Implementation

In accordance with the requirements of the General Conditions (Part B) of the applicable water licences, this plan will be immediately implemented following its submission, subject to any modifications proposed by the NWB as a result of the review and approval process.

This plan will be reviewed annually and updated as necessary to capture changes to site operational structure/contacts, response technologies or applicable legislation and regulations.

1.6 Project Description

The Hope Bay Project (the Project) is a gold mining project located in the West Kitikmeot region of Nunavut approximately 125 km southwest from Cambridge Bay and 75 km northeast from Umingmaktok. The various elements of the Hope Bay Project are centered at approximately N 68° 09' and W 106° 40' and extend from the head of Roberts Bay (an extension of Melville Sound) at the north end of the Project to south of the Boston site located approximately 60 km to the south. Two jetties extend into Roberts Bay and are located on foreshore Crown Land. The Hope Bay mineral exploration rights property comprises an area of 1078 km2 and forms a contiguous block that is approximately 80 km long by up to 20 km wide. Descriptions of project infrastructure pertinent to each licence area are provided in the appended modules.

The Hope Bay Project area has a low arctic eco-climate and consists of coastal lowland habitats with numerous fresh water lakes and ponds. The drainage basins are generally long and narrow and predominately oriented along the north-south axis and are separated by bedrock ridges. Continuous permafrost covers the project area with a surficial active layer of approximately 1 m. Groundwater movement only occurs in the shallow active layer during the seasonal thaw period and within the talik zones (unfrozen ground underlying larger water bodies). Permafrost underlying the area is generally impervious to groundwater movements.

2 Spill Response and Management

2.1 Spill Incident Alerts

Any person on the Hope Bay Project site who comes across or sees an unanticipated discharge or spill is designated as the First Responder and will complete the following actions (Figure 1):

1. Assess the Site:
   (a) Isolate/evacuate immediate area if required;
   (b) Perform first aid if required and safe to do so;
   (c) Eliminate ignition sources – turn off vehicles, no smoking;
   (d) Identify spilled material if possible and consult product SDS; and
   (e) Estimate size and flow path of the spill.

   NOTE: If the material cannot be identified, there is a risk of fire/explosion/toxic fumes produced or there are injured parties report to Supervisor **immediately** or call **Mill Control** if applicable (Step 3)**.**

2. Stop flow of spill if safe to do so:
   (a) Put on appropriate PPE;
   (b) Approach spill site from upwind; and
   (c) Trace the source of material.

3. Report spill to Supervisor:
   (a) Give your name;
   (b) Type or extent of injuries (if applicable);
   (c) Location; and
   (d) Type of spilled material and estimated volume.

   NOTE: Mill Control can be contacted on Radio **Channel 1**, Phone Extension **911** or **150**.

4. Contain the spilled material:
   (a) Apply spill pads, absorbent booms in flow path of spill; and
   (b) Place spill tray beneath leaking fluid to minimize spill.

5. Secure the area and remain on scene until assistance arrives:
   (a) Ensure all workers have evacuated to a safe distance if required;
   (b) Divert or stop traffic; and
   (c) Stop people from entering the area.

All personnel receive appropriate training during their initial site orientation of what to do when he/she sees an unanticipated discharge or spill anywhere at the Hope Bay site. A flow-chart summarizing the First Responder spill actions is provided in Figure 1 as a quick reference at the beginning of this plan and is available in all spill kits on site.

2.2 Spill Response Organizational Structure

Once a spill has been identified by the First Responder the following spill response organizational structure will be implemented. The responsibilities of the individuals involved in spill response actions are summarized in the sections below. A flow-chart summarizing this structure is provided in Figure 2 as a quick reference at the beginning of this plan.

2.2.1 Supervisors

In the event that a Supervisor is informed of a spill by an employee, he/she will immediately inform the Environmental Supervisor and/or Safety Coordinator that a spill has occurred and provide details of the spill as outlined in Section 2.1 above. The Supervisor will proceed to the spill location, secure the scene, confirm the type of material/size of the spill and assist with containment actions. Depending on the severity of the spill incident, either the Mine General Manager (MGM) or Environmental Supervisor will provide direction to the Supervisor regarding the removal, storage and disposal of the spilled material. The incident scene is not to be disturbed until an incident investigation can be completed.

Removal and disposal of spill materials is only to be conducted after this investigation is complete and the scene is released by the MGM and/or Environmental Supervisor.

2.2.2 Mine General Manager

Once notified of the spill, the MGM will consult with the Environmental Supervisor and Health & Safety Manager/Superintendent to assess the severity of the spill incident and determine whether a spill emergency exists that requires activation of the Incident Command System (ICS) emergency procedures. This assessment will take into account the type and volume of the substance that has spilled, the location of the spill, safety of site personnel, scope of resources required to respond and the proximity of the spill to environmental resources at risk, including water bodies, sensitive habitat, archeological sites or sensitive species in the area.

The ICS is a command structure used in the Emergency Response Plan (ERP) at the Hope Bay site. This structure is designed to have a documented sequence of decisions that has been reviewed in advance of an emergency situation and establishes a chain of command to minimize confusion, so that employees will have no doubt who has the authority for making decisions.

If the ICS is activated in response to a spill emergency, the MGM (or designate) becomes the Incident Commander and implements the ICS command system outlined in Figure 3 at the beginning of this plan. The Incident Commander will communicate with onsite managers and direct all efforts in the spill response including evacuating personnel, identifying resources required to respond to the incident and activating the Emergency Response Team (ERT). The Incident Commander will direct the Surface

Manager to coordinate containment and clean-up actions based on safety of the responders and environmental protection priorities as identified by the Health & Safety Manager/Superintendent and the Environmental Supervisor. In the event of a large spill, the Incident Commander may direct the Materials Manager to secure off-site resources and facilitate shipment to the Hope Bay site. The Incident Commander will establish communications with the Chief Operating Officer and offsite Communications Delegate and regularly brief these individuals on the status of the spill emergency. A scribe will be assigned to the Incident Commander to document all communications and response actions of the spill incident.

After the spill emergency has been contained, the Incident Commander will conduct an incident investigation with the assistance of the Environmental Supervisor, Health & Safety Manager/ Superintendent and other site managers as required.

If the spill is not deemed an emergency by the MGM, the ICS will not be activated and the Environmental Supervisor will provide direction to Site Services for containment and clean-up of the spill after an incident investigation has been completed.

2.2.3 Environmental Supervisor

The Environmental Supervisor will assist the MGM in evaluating the severity of a spill situation to determine whether a spill emergency exists. The Environmental Supervisor will identify environmental resources at risk, including water bodies, sensitive habitat and species, or archeological sites in proximity to the spill based on the size/location of the spill, anticipated path of flow and weather conditions at the time. If a spill emergency exists that triggers the ICS, the Environmental Supervisor will advise the Incident Commander on the prioritization of containment and clean-up efforts. If the ICS is not triggered, the Environmental Supervisor will provide direction to Site Services for containment and clean-up of the spill after an incident investigation has been completed.

The Environmental Supervisor will assist departmental Supervisors to document and investigate the cause of all spills, and work with onsite managers to develop corrective actions as required to prevent a repeat occurrence of the incident.

The Environmental Supervisor is also responsible for reporting of incidents as outlined in Section 3 of this plan and implementing follow-up monitoring actions deemed necessary to evaluate the extent of the spill and effectiveness of clean-up/remediation efforts. The Environmental Supervisor will communicate with the Vice President of Environmental Affairs at any time as required to determine effective clean-up measures, discuss reporting submissions and implement environmental monitoring as necessary.

2.2.4 Health & Safety Manager/Superintendent

The Health & Safety Manager/Superintendent will assist the MGM in evaluating the severity of a spill situation in instances where hazardous conditions may exist for site personnel as a result of a spill. This includes events involving injured personnel or damage to property resulting from the event, and/or situations where risk of fire, explosion or toxic fumes may be created as a result of the spill. The

Health & Safety Manager/Superintendent will identify risks to site personnel and emergency responders and advise the Incident Commander on the response in conjunction with the Emergency Response Plan (ERP).

2.2.5 Communications Delegate

In the event of a spill emergency, a Communications Delegate will be identified by TMAC Executive, and will communicate regularly with the Incident Commander to monitor the spill response and maintain a log of internal and external communications. The Communications Delegate will inform all appropriate agencies, which may include the Kitikmeot Inuit Association, the Nunavut Water Board, the Nunavut Impact Review Board, Environment and Climate Change Canada, Crown-Indigenous Relations and Northern Affairs Canada, the Department of Fisheries and Oceans Canada and will advise the public in the immediate vicinity of the spill if warranted. The Communications Delegate may designate alternative personnel to perform these communications. This individual will also update the TMAC Executive as required.

2.2.5.1 Spill Response Communications

During a spill emergency, on-site staff WILL NOT communicate directly with regulatory agencies, the press or other parties off of the mine site. All external communication is to be through the Communications Delegate. Communication systems will be shut down at the direction of the Incident Commander and only emergency radio and phone lines identified in the Incident Command organizational structure will remain operational.

All on-site communication with the Communications Designate will occur through or at the direction of the Incident Commander. On-site communications will use portable radios on designated radio channels. Independent satellite phones are available for crews for emergency communications in the unlikely event that the radio and phone systems fail.

2.2.6 Spill Response Actions

Most chemicals stored onsite are kept in small quantities and not expected to result in a major spill incident. Any chemical product which is listed under the Environmental Emergency Regulations (E2) and which will be stored in quantities on site equal to or greater than that listed in the E2 Schedule 1 will have an additional Product Specific Spill Response (PSSR) Plan detailed for that product. These PSSR plans can be found in Appendix 1 of this document.

Chemical containers are appropriately labelled to identify their contents in the event of a spill. The product label will be used to identify the substance and hazards, the Safety Data Sheets (SDS) will be consulted to determine the proper PPE requirements and appropriate spill response procedures. The following sections outline general spill response actions to be taken in the event of a spill in each associated environment. The basic spill response steps to be taken in the event of the spill are illustrated in Figure 2.1 below.

Note that some substances can be highly reactive in contact with water, air, or other substances and should not be addressed unless safe to do so.

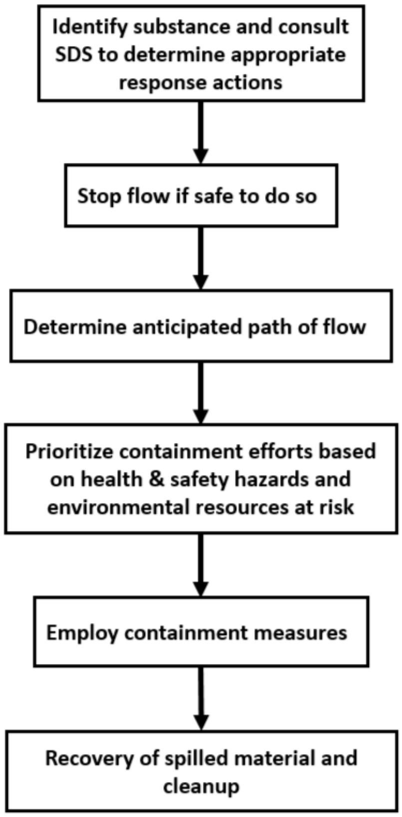

Figure 2.1. General spill response actions

2.2.7 Spills on Land and Water

In the event of a liquid spill on gravel, rock, soil or vegetation, it is very important to prevent the liquid from entering any body of water where it will spread and likely have greater environmental impact. Liquid spills on land will be contained and cleaned up by:

- Covering the spill with appropriate absorbent pads and placing absorbent booms in the path of flow of the spill;
- Constructing temporary berms from soil or snow at the leading edge of the spill to minimize flow:
  - Plastic tarps can be placed over and at the foot of the berm to capture pooling liquid and facilitate recovery; and
  - Temporary berms are an interim measure and will be removed as soon as possible after the spill is contained and remedial actions complete.
- Pumping spilled material to empty drums or tanks;
- Using a vacuum truck to recover spilled material;
- Excavators and other heavy equipment may be used to excavate contaminated materials; and
- If safe to do so, blow torches (Tiger Torches) may be used to clean small hydrocarbon spills that occur on unlined areas of the camp pad to reduce waste generation and handling.

In the event of a spill on water, the spread of the spilled material will be limited to the extent possible. The following steps will be taken to contain and clean-up a spill on water:

- Identify the direction and speed of the flow path of the product based on weather conditions and drainage patterns:
  - Monitor the spread of the material using a drone or from a helicopter if possible to identify the area of spread.
- Use appropriate absorbent pads, socks and similar materials to recover spilled product:
  - Granular sorbent materials are NOT to be used for spill response on water.
- Hydrophobic absorbent booms will be deployed to contain large spills and to facilitate recovery:
  - Absorbent booms will be drawn slowly in to encircle the spilled product and absorb it; and
  - High winds, waves and other factors may limit the effectiveness of these materials.
- Skimmers will be deployed in open-water areas to remove product from the water surface and boards or plywood may be used in streams or culverts to reduce the flow of spilled product on the surface and limit the area of the spill on the water;
- Use of sub-surface barriers to contain spilled product that may sink;
- Pump contaminated water into tanks or storage bladders if possible:
  - A vacuum truck may be used to recover spilled product.
- Contaminated substrate and vegetation will be removed either manually or with the use of heavy equipment if feasible; and
- Chemical dispersants should not be used as a spill response technique at the Hope Bay project, seek direction from VP Environment al Affairs.

Also see Section 2.3.10 of this document for guidance related to additional spill protection, clean-up, and reporting measures for environmentally sensitive species and archaeological sites.

2.2.8 Spills in a Marine Environment

The most effective way to minimize environmental damage is to focus on source control and to prevent product from spreading. The following steps will be taken in the event of a spill in the marine environment:

- Identify the direction, speed and flow path of the product based on weather conditions and drainage patterns:
  - Monitor the spread of the material using a drone or from a helicopter if possible to identify the area of spread.
- Use of appropriate absorbent pads, socks and similar materials to recover small volumes of spilled product:
  - Floating spill response booms will be used to encircle a barge prior to off-loading chemicals and fuel from the barge as a precautionary measure.

   - Granular sorbent materials are NOT to be used for spill response on water.
- Hydrophobic absorbent booms will be deployed to contain large spills and to facilitate recovery:
   - Absorbent booms will be drawn slowly in to encircle the spilled fuel and absorb it.
   - High winds, waves and other factors may limit the effectiveness of these materials.
   - Granular sorbent materials are NOT to be used for spill response on water.
- Skimmers will be deployed in open-water areas to remove product from the water surface;
- Use of sub-surface barriers to contain spilled product that may sink;
- Pump contaminated water into tanks or storage bladders if possible; and
- Chemical dispersants should not be used as a spill response technique at the Hope Bay project, seek direction from VP Environmental Affairs.

Also see Section 2.3.10 of this document for guidance related to additional spill protection, clean-up, and reporting measures for environmentally sensitive species and archaeological sites.

Spill response measures specific to bulk fuel offloads completed at Roberts Bay are detailed in the Hope Bay Ocean Pollution Prevention Plan/Oil Pollution Emergency Plan (OPPP/OPEP). The OPPP/OPEP is the main document of reference for spill control actions during a fuel offload at the Hope Bay project and is revised annually.

2.2.9 Spills on Snow

Spills on snow will be contained and recovered by:

- Use of appropriate absorbent pads, socks and similar materials to recover spilled product;
- Compacting the snow into snow-berms and placing a liner of plastic sheeting at the toe and over the berm to collect spilled material and facilitate recovery;
- Using the snow as a natural absorbent to collect spilled product; and
- An excavator, grader or other heavy equipment may be used to scrape up contaminated snow to be stored in a lined containment area or placed in steel drums.

2.2.10 Spills on Ice

Spills on ice will be contained and cleaned up by:

- Use of appropriate absorbent pads, socks and similar materials to recover spilled product;
- Creating snow-berms by compacting snow around the edge of the spill and placing a liner of plastic sheeting at the toe and over the berm to collect spilled material and facilitate recovery;
- Scraping contaminated snow/ice from the ice surface and placing in lined containment:
   - Snow may act as a natural absorbent to collect spilled product.

- In broken-ice conditions a skimmer may be used to collect product on the surface of open-water areas:
  - Caution must be used when conducting spill response efforts in broken-ice situations. An appropriate Task Hazard Analysis safety plan and PPE must be determined before initiating these actions.
- An excavator, grader or other heavy equipment may be used to scrape up contaminated ice to be stored in a lined containment area or placed in steel drums:
  - A vacuum truck may be employed to recover large volumes of spilled material.

2.2.11 Spills under Ice of Substances that Float

Hydrocarbon spills under ice will be addressed by:

- An appropriate Task Hazard Analysis safety plan and PPE must be determined before initiating these actions;
- Testing of the ice to ensure thickness is safe for personnel to work on the surface;
- Once ice has been deemed safe, slots will be cut in the ice surface in the area surrounding the spill and downstream of the anticipated direction of flow/spread:
  - Contaminant will rise to the surface within the slots.
  - Determine the direction of any currents (if expected; this would not be the case in an ice-covered lake) to identify the direction of flow and conduct ice profiling beyond the extent of the spill to identify any spread of the contaminant.
- Contaminant will be skimmed/scooped out from within the slots and placed into empty pails/drums as it is recovered;
- Pockets within the ice where contaminants can pool will be identified (this applies to ice which may have buckled areas where spills may pool; largely an ocean occurrence);
- Appropriate absorbent pads and booms will be used to contain spill if there is water moving past the ice edge (if any) where the spill took place:
  - Set booms ahead of the spill based on the direction of anticipated flow.
- A vacuum truck may be employed to recover larger volumes of spilled material or utilizing an Auger and pump system to pump spilled material into containers (e.g., drums).

2.2.12 Spills under Ice of Substances that Sink

- Response to spills below ice of substances which sink will be evaluated on a quantity, substance-specific, and risk basis. In many circumstances, particularly for small releases of non-toxic substances, the appropriate response may solely be to limit discharge as soon as possible and safe to do so. TMAC will assess each individual situation and may consult a remediation specialist for advice in addition to discussions with the KIA, CIRNAC, DFO, and ECCC, where appropriate;

- Allowing substance to settle with minimal disturbance to limit spread (for waterbodies without current);
- A vacuum truck may be employed to recover larger volumes of spilled material or utilizing an Auger and pump system to pump spilled material into containers (e.g., drums);
- Use of sub-surface barriers to contain spilled product if there is water moving past the ice edge (if any) where the spill took place; and
- Appropriate subsurface containment will be used to contain spilled material if there is water moving past the ice edge (if any) where the spill took place.

2.2.13 Spills under Ice of Substances that Dissolve

- Response to spills below ice of substances which dissolve will be evaluated on a quantity, substance-specific, and risk basis. In many circumstances, particularly for small releases of non-toxic substances, the appropriate response may solely be to limit discharge as soon as possible and safe to do so. TMAC will assess each individual situation and may consult a remediation specialist for advice in addition to discussions with the KIA, CIRNAC, DFO, and ECCC, where appropriate;
- A vacuum truck or an Auger and pump system may be used to pump contaminated water into containers (e.g., drums) if rate of dissolution is slow enough/contaminated water volume is small enough to make this feasible; and
- For Sodium Cyanide spills see substance-specific spill response plan in Appendix 1.

2.2.14 Spills of Compressed Gas

If an accidental release of compressed gas occurs:

- Stop the source if safe to do so;
- Ventilate the area well to dilute the gas;
- Cordon off the area to prevent accidental ignition, explosion or inhalation by personnel; and
- Only employees with proper training and PPE will attempt to mitigate the release.

2.2.15 Burning Spills

Small spills of hydrocarbons (< 100 L) may be removed from unlined camp pad areas by using a propane torch (Tiger torch). This response method would reduce the waste production and handling/storage of contaminated materials associated with the spill, and would reduce the risk of spreading or contaminating other areas during transport of these materials. No water would be used and no waste would be deposited to water as a result of this response method.

Extra safety precautions must be taken prior to the use of a propane torch in the event of a spill. A Task Hazard Analysis will be completed prior to undertaking this activity. The SDS for the product will be reviewed to check for the reaction of the substance to heat. PPE such as Fire Resistant clothing and the proper gloves and respirator will also be worn and a spotter with a fire extinguisher rated for the type of spill and fire must be present during the clean-up.

Burning of larger spills may be considered on a case by case basis and only once TMAC has consulted with and received approval from ECCC, the KIA, the CIRNAC Inspector and any other associated regulatory agencies. This method of response is only useful if quick action is possible, and prior to natural spill dispersal and loss of the more ignitable hydrocarbon fraction.

2.2.16 Spills Affecting Environmentally Sensitive Species or Archeological Sites

The Hope Bay Project contains a number of habitats, species and sites of archeological and historical importance. The possibility exists for a spill to impact these environmental and cultural resources.

TMAC and previous companies operating on the Hope Bay site have conducted numerous ecological surveys to identify these areas at risk, with the focus of identifying those areas immediately surrounding Project infrastructure which are at greatest risk of impact from a spill.

In the event that a spill enters the natural environment, the Environmental Supervisor may use maps identifying these sensitive areas to prioritize the protection of these resources. Prioritization of environmental sensitivities will not be at the expense of safety or of reaching or maintaining control of the release. Sensitivity maps are provided in Appendix 3.

Should decisions be required which protect some sensitive areas at the expense of others, the hierarchy of protection will attempt to favour (except as directed otherwise by regulatory agencies):

1. waterbodies;
2. sensitive habitat types;
3. archaeological sites;
4. rare plants; and
5. active raptor nest or wildlife den.

For spills in water, prioritization will attempt to avoid vegetated and finer substrate shoreline areas (sand, gravel and cobble) from which recovery is most difficult and which may be of high value to fish.

All of the communications outlined in this section would occur in addition to any appropriate spill reporting outlined in Section 3.

2.2.16.1 Mitigation of Impacts to Wildlife

All reasonable measures will be taken to deter wildlife from coming into contact with any spilled material. In the event that wildlife does come in contact with a spilled material, TMAC will contact the KIA and either ECCC (in the case of migratory birds (does not include raptors)) or GN Wildlife Officers (in the case of other animals) to inform them of the impact and determine an appropriate course of action.

In cases where wildlife can be rescued, wildlife spill response experts will be contacted for assistance and guidance.

2.2.16.2 Mitigation of Impacts to Birds

In the event that a contaminant is released to a body of water, initial wildlife response measures will be exercised in alignment with the Birds and Oil-CWS Response Plan Guidance document if migratory birds are or may be impacted. Environment and Climate Change Canada's Canadian Wildlife Service (ECCC-CWS) will be consulted to determine response strategies including the most appropriate humane treatment of oiled wildlife. TMAC may also engage contract response agencies specialized in wildlife response actions during a spill event. Initial wildlife response measures should include:

- Hazing to deter wildlife from using spill area:
  - Watercraft;
  - Sound makers such as whistles or horns; and
  - Helicopter* (if available and safe to do so).
- Wildlife monitoring:
  - Assessment surveys for oiled and unoiled wildlife; and
  - Wildlife observers will be on vessels and aircraft if possible.
- Bird Collection*:
  - To collect dead and live birds within the spill area and adjacent. All response vessels should be equipped with dip nets, large plastic collecting bags to hold dead birds, and cloth bags or cardboard boxes to hold live oiled birds.

** The use of aircraft to deter migratory birds and the collection of live and dead birds require an authorization from ECCC-CWS.*

2.2.16.3 Mitigation of Impacts to Archeological Features and Sensitive Habitats

If a spill is determined to have impacted any archeological or historic resources, prior to removing soil or vegetation, TMAC will immediately contact the Project Archaeologist. The Project Archaeologist will provide advice on next steps, and may travel to site to mitigate the archeological site. The Archeologist will also coordinate permits and communications with the Government of Nunavut Territorial Archaeologist.

In the event that shoreline substrates or aquatic vegetation have been impacted, TMAC will contact Environment and Climate Change Canada and the Department of Fisheries and Ocean for advice prior to initiating removal.

2.3 Disposal of Contaminated Materials

All contaminated materials generated during a spill event will be contained and disposed of as appropriate per the product specific SDS and as outlined in the Hazardous Waste Management Plan and Non-Hazardous Waste Management Plan. Empty drums, barrels, mega-bags and storage tanks are available to store contaminated materials for disposal.

Hydrocarbon contaminated soil, snow and water may be remediated in Landfarm facilities if these materials meet the requirements for remediation as per the Landfarm Management Plan or may be placed within the underground mine.

2.4 Spill Response Resources

2.4.1 On-Site Resources

Spill Response Kits will be available near (within 200 m) any areas where chemicals are stored and used on site, including near all bulk fuel berms and smaller fuel tanks. Spill response kits will be easily accessible for personnel responding to a spill. As project activities evolve and new locations of chemical storage and use are identified new spill kits will be added as needed, and all active construction areas where equipment is operating will also have a spill kit located within 200 m.

Additional spill response equipment is maintained for response in an aquatic environment. This equipment is stored in ten moveable containers that can be relocated for rapid response to a spill in a stream, lake or marine environment.

TMAC maintains an on-site supply of appropriate Personal Protective Equipment compatible with the chemical products used on site, including chemical resistant suits, gloves and boots, face shields/goggles and respirators. In the event of a spill, this equipment is used by spill responders as outlined in the product SDS. Specialty equipment, such as Self-Contained Breathing Apparatus, air quality monitors and fire retardant clothing are available and used as needed to ensure a safe response to a spill incident.

All fuel transfer vehicles are also equipped with a spill kit designed to address smaller spills of hazardous fluids (< 40 L). Personnel are trained in proper fueling procedures and spill trays are used during all fueling activities to minimize the potential of an unintentional release.

A list of supplies contained in each spill kit type, supplies in the aquatic spill response containers, and PPE/specialized equipment for spill response is provided in Appendix 2.

TMAC also maintains an on-site supply of roll, pad and mat absorbents, plug and dyke kits, mini booms, absorbent socks, peat moss, crushed corn cobs, coconut mats, hand tools, empty storage tanks and various pieces of heavy equipment including a vacuum truck, grader, dozers, loaders, excavators and haul trucks that would be used in the event of a large spill.

Spill kits are replenished as needed after use and inspected at least once per quarter. The purpose of the inspection is to evaluate the location of spill kit proximity to associated work activities, inspect the condition of the spill kit, and check that all required contents are available and in good condition.

The aquatic response supplies and equipment are inspected annually prior to fuel offloading events and after use in the event of a spill to the aquatic environment.

2.4.2 Off-Site Resources

The Hope Bay Project is a remote location that is only accessible by plane for the majority of the year, with a short open-water ship access season. The Hope Bay Project Spill Contingency Plan does not rely on off-site resources to successfully respond to anticipated upset conditions. The Plan has been developed such that the resources required to respond to spills have been positioned on site. It is anticipated that the Hope Bay Project will have sufficient resources and trained personnel to respond to all types/sizes of spills that could potentially occur on site.

Additional off-site resources are available to the Hope Bay Project from the Mackenzie Delta Spill Response Corporation, which focuses on the protection of the Arctic Marine environment. TMAC may secure additional equipment or assistance from the Mackenzie Delta Spill Response Corporation in the event of a significant spill to an aquatic environment.

3 Spill Investigation, Documentation and Reporting

3.1 Spill Investigation

A spill investigation will be completed for all spill events that occur at the Hope Bay site. This investigation will be aimed at determining the root cause of a spill and identifying corrective actions that may reduce the risk of a repeated incident.

For spills that exceed the volume thresholds outlined in the Immediately Reportable Spills table at the beginning of this plan, a 'Systematic Cause Analysis Technique' (SCAT) Investigation will be completed. SCAT is an in-depth root cause analysis used to investigate significant incidents and identify corrective actions. The SCAT investigation form will be completed by the departmental Supervisor with support from the Environmental Supervisor within 3 days of the spill occurrence. The Safety Manager/Superintendent and MGM may participate in the investigation and assist in developing corrective actions.

For spills that do not exceed the volume thresholds outlined in the Immediately Reportable Spills table, a '5 Why' Investigation will be completed. The '5 Why' method is a simple question-asking technique used to determine the cause/effect relationships underlying a spill. The objective is to identify the root cause by repeatedly asking 'Why?' the event occurred. The '5 Why' investigation form will be completed by the departmental Supervisor within 48 hours of the event and forwarded to the Environmental Supervisor.

Records of incident investigations will be maintained by the Environmental Supervisor. Any corrective actions that are identified will be entered into the Environmental Incident Register and implemented immediately by the departmental Supervisor and/or Manager.

3.2 TMAC Internal Reporting

An Incident Event notification will be sent by the departmental Supervisor to the Environmental Supervisor prior to the end of the shift in which the spill event occurred. This notification will provide a brief description of the spill, consequences of the spill, root cause of the event if identified and a brief description of the response including containment and cleanup actions.

Results of the SCAT Investigation and the '5 Whys' Investigation will be communicated to all site Supervisors, Superintendents and Managers, as well as offsite Environmental personnel. Corrective actions generated by these investigations will be discussed with all personnel at the Hope Bay site through email communications and/or discussions at departmental safety meetings.

All details of the spill investigation and implementation of corrective/preventative actions will be documented in the Environmental Incident Register by the Environmental Supervisor.

3.3 External Reporting Requirements

In the event that a particular material spill meets or exceeds the amount specified in the Immediately Reportable Spills Table (located at http://www.enr.gov.nt.ca/programs/hazardous-materials-spills/reporting-spills, and at the beginning of this plan), the Environmental Supervisor or representative will complete the NT-NU Spill Report form (available through the preceding link) and report the spill to the NT-NU 24 Hour Spill Report Line by phone (867-920-8130) and/or e-mail (spills@gov.nt.ca) as soon as possible within 24 hours of the event. The CIRNAC Inspector and the KIA will be copied on these submissions. The submission of the report will not be delayed even if not all information is available at the time of submission.

In the event that a spill has occurred to the marine environment, the MGM and/or Environmental Supervisor will also notify the Canadian Coast Guard station immediately and provide details on the time and location of the discharge, type and quantity of pollutant, description of assistance and salvage measures employed and any other relevant information. A written report will also be submitted within 24 hours to the Canadian Coast Guard. A copy of this report will be submitted to a Transport Canada Marine Safety Inspector if required.

The Environmental Supervisor will communicate with the VP Environmental Affairs during the incident to determine additional notifications to be submitted to regulatory agencies during the event.

Within 30 days of the event, the Environmental Supervisor will submit a detailed written spill report to the appropriate regulatory agencies. This report will include a description of the spill location, type and quantity of spilled material, associated causes that led to the incident, details of actions taken to remediate affected areas and potential effects of the spill, measures undertaken to reduce the potential for a reoccurrence of a similar incident, results of monitoring activities undertaken and details of any further actions required. Other applicable details such as the names of agencies on the scene, persons or agencies advised concerning the spill, a chronological sequence of events including internal/external notifications, and lessons learned from events leading up to the spill and the response actions taken may be included in this report. Additional follow-up engagement may occur as deemed appropriate by the VP Environmental Affairs and based on the specific spill and stakeholder input.

A list of spills reported to the NT-NU Spill Report Line will also be provided in the annual report for each of the licence areas.

3.4 Monitoring and Restoration

Monitoring activities may be conducted to assess the impacts of the spill and the effectiveness of associated cleanup/remediation efforts in the event spilled material cannot be removed. This may include a number of monitoring techniques and collection of samples for laboratory analysis. The monitoring program will be developed by the Environmental Supervisor in consultation with the Environmental Affairs Department and associated regulatory agencies.

Monitoring may be triggered in the event of spills to water of substances that dissolve or sink or where substance recovery is unlikely. Samples will be collected to characterize 1) the material discharged (if not of known characteristics), 2) the water at the location of entry into the waterbody as soon after the discharge as possible, and 3) water at a 'reference' location, preferably within the same waterbody but outside of the area of potential impact and collected at approximately the same time as the sample collected at the point of entry.

Monitoring may also be triggered in the event of externally reportable spills to land for which recovery of spilled material is unlikely or may be incomplete. Samples will be collected from locations of suspected highest remaining contamination, or as a composite sample from the remediated area. Samples will be compared to soil remediation criteria and background soil concentration data to verify appropriate clean-up has occurred.

The Environmental Supervisor will be responsible for overseeing the implementation of these monitoring activities. No person will be permitted to sample spilled materials unless that person has received adequate training in the identification of the hazards associated with the spilled material, the selection and use of appropriate personal protective equipment, and safe sampling procedures.

The final required clean-up, restoration (or mitigation) and on-going monitoring will be conducted as needed, and where appropriate in consultation with, and satisfaction of, the CIRNAC Inspector and the KIA. Site specific studies may be required to determine the appropriate final clean-up criteria.

If required, continuing and progressive sample collection/analysis will be conducted and reported upon until the completion of all prescribed remedial activities.

4 Spill Management and Mitigation

Site supervisors and managers are responsible for ensuring work area inspections and risk assessments are conducted of their respective work areas. Risk assessments include evaluation of hazardous materials available and in use in the work area, and likelihood and potential consequences of various spills. Where appropriate based on likelihood and potential severity, mitigation, management and/or substance-specific spill response plans will be developed.

The following section outlines currently identified potential spill risks with potential for high severity and/or probability of occurrence (worst case scenarios) and the management and mitigation measures employed to reduce the likelihood of these occurrences and/or the potential severity. Additional scenarios, as well as appropriate management and mitigation actions, will be added to this section through time as they are identified.

4.1 Issue: Spill from a Chemical Storage Tank or Other Containment

A fuel storage tank, containment area, sump, emergency dump catch basin or other product container may release their contents for a number of reasons, such as damage due to puncture, openings developed over time due to degradation (such as rusting), or overfilling.

Equipment malfunction or facility failure may cause a spill event to occur, particularly during extreme winter temperature conditions experienced at the Hope Bay site.

4.1.1 Management Response

This risk is minimized through the use of secondary containment and spill containment. All bulk fuel facilities are located in secondary containment (i.e., containment designed to contain volumes equivalent or greater than 110% of the aggregate or total volume of the largest container in the containment – whichever is greater). Smaller chemical storage tanks are either double walled (have built-in secondary containment), and are located in spill trays such that any leakage from hoses or lines are further contained or are located in secondary containment berms. Spill trays are used under fuel drums and other smaller chemical containers.

Inspections of all containment structures will be conducted weekly to ensure concerns are noted and are addressed promptly.

In the event that a spill exceeded the capacity of a containment berm (for example, if more than one container in a berm was breached) or a containment berm became compromised, the spill response actions outlined in Section 2 would be implemented. Containment measures would be deployed to prevent the spread of the chemical into the natural environment. This would include deploying absorbent materials or booms and constructing diversion trenches or sumps to intercept the spilled product. The vacuum truck and all available pumps would be deployed to transfer spilled product into empty storage tanks or alternative containment berms if necessary.

4.2 Issue: Spill during Transport

Spills may occur during the transport of chemicals from one site location to another.

4.2.1 Management Response

As new chemicals, fuels and hazardous materials are brought to site, standard operating procedures are developed that outline the process for safely transporting or transferring these products between locations at site. Experienced operators transport these materials and are familiar with site road conditions. Traffic right-of-way procedures are established that reduce the risk of an accident between two vehicles and all vehicles are equipped with radio communication to ensure operators can remain in contact at all times. A spotter is used to direct operators loading and off-loading these materials from transport vehicles to reduce the risk of damage to chemical storage containers during transport and loading. Spill trays are used when chemicals are transferred to equipment or secondary containers for use.

4.3 Issue: Spill during Transfer

Spills have an increased likelihood of occurring during transfer of chemicals. This may be the case during equipment refuelling, transfer of chemicals between containers, or transfer of wastewater or tailings in pipelines. Such spills may result from human error (overfilling, inaccurate filling) or equipment malfunction (such as a break in the transfer line/pipe due to wear or freeze/thaw cycles).

4.3.1 Management Response

As new chemicals, fuels and hazardous materials are brought to site, standard operating procedures are developed that outline the process for safely using these chemicals during operations. Workers who use chemicals or fuels during daily operational activities receive training in the proper handling, storage and disposal of these materials prior to commencement of work. Any applicable SDS sheets are reviewed by all workers using these chemicals to identify potential hazards. Workers are encouraged to plan work activities before beginning a task to reduce the potential for inadvertent errors.

Fueling of mobile equipment generally takes place at designated fueling stations, which are located inside of secondary containment berms, minimizing risk to the environment. Remote fueling, such as occurs for stationary equipment and helicopters, requires a spill kit be easily accessible and spill trays are used.

Fuel tanks are not filled to full capacity, to reduce the possibility of overflow during fueling or due to expansion.

Workers are provided with on-site training in spill response techniques and are familiar with the response resources available in the event of a spill.

Wastewater transfer pipelines, for sewage as well as other wastewaters, are constructed to reduce breakage due to freeze/thaw cycles and are routinely inspected to ensure they are functioning.

Delineators are used to mark pipelines to ensure vehicle and equipment operators are aware of pipeline locations when travelling on site roads.

Additional design features of the tailings lines which reduce the risk of spills are outlined in the Hope Bay Project Doris Tailings Impoundment Area Operations, Maintenance and Surveillance (OMS) Manual.

Should any of the above measures fail, spill response would be undertaken as outlined in this document.

4.4 Issue: Spills from Equipment

Spills may occur from mobile and stationary equipment during routine maintenance or due to equipment malfunction or wear combined with extreme weather conditions.

4.4.1 Management Response

All equipment at site undergoes routine preventative maintenance, and mobile equipment is subject to daily pre-operational inspections to identify specific issues for mechanical resolution. Where possible, all equipment maintenance is performed in designated maintenance areas. During equipment maintenance, spill trays are used as needed. Spill trays are also used for stationary equipment, or those parked for extended periods of time.

4.5 Issue: Health and Safety of Spill Responders

Some products and chemicals used at the Hope Bay site may pose a risk to the health and safety of personnel responding to a spill. Spilled materials may create toxic, explosive or flammable hazards that must be considered during response efforts.

4.5.1 Management Response

Personnel working at the Hope Bay site are provided on-site training in the proper handling, storage and disposal of chemicals related to their tasks. The product SDS is reviewed by personnel prior to using these chemicals to identify potential hazards related to handling these materials.

The SDS for each chemical outlines the specific personal protective equipment (PPE) required when handling each product and provides information on methods for clean-up in the event of an accidental release to the environment. SDS sheets are maintained at site for all chemicals stored and used at the Hope Bay Project.

In the event that a spill poses toxic, explosive, flammable or other hazards that endanger personnel or the environment, the Emergency Response Team (ERT) will be activated through the Incident Command System. Members of the ERT are equipped with additional PPE that allows them to safely respond to hazardous situations and receive additional training in response techniques for these scenarios.

Site chemicals are reviewed annually and compared to the Environmental Emergency Regulations. If any chemicals are anticipated to be stored in quantities exceeding the volume thresholds outlined in these regulations a Product Specific Spill Response Plan will be developed and submitted as an addendum to this Plan. Product Specific Spill Response Plans identified as necessary for products stored at the Hope Bay site are located in Appendix 1 of this Plan.

4.6 Issue: Spills to Water

Spills to water are of particular concern due to the sensitivity of water environments and potential of rapid spread of spills into water.

4.6.1 Management Response

No chemicals are stored within 31 m of water. All chemicals are kept in containment, and spill kits are located nearby which contain small booms and absorbent pads. In the event of a large spill to water, additional itemized and audited Aquatic Spill Response Equipment is located at Roberts Bay in movable seacans. Response actions protective of wildlife are outlined in environmentally Sensitive Species section above.

4.7 Issue: Operational Considerations for Spill Response

Hope Bay is a remote project site that experiences extreme weather conditions and seasonal daylight variations which may impact the effectiveness of spill response actions. The Hope Bay Project is only accessible by plane for the majority of the year, with a short open-water ship access season.

4.7.1 Management Response

This Plan has been developed such that the resources required to respond to spills have been positioned on site. It is anticipated that the Hope Bay Project will have sufficient resources and trained personnel to respond to all types/sizes of spills that could potentially occur on site.

The majority of activities conducted at the site occur on the project infrastructure roads and camp pads. In the event that a spill occurs off the site infrastructure, helicopters and off-road tundra (low impact) vehicles, such as the Rim-pull, will be used to mobilize spill response resources. The impact from these vehicles will be monitored and damage to the surrounding tundra minimized to the extent possible.

Extreme weather conditions, such as sub-zero temperatures, that may impact the response capabilities of personnel will be mitigated by rotating personnel from response activities to break areas as needed. This may include using heated vehicles, portable shelters or heated buildings.

Portable light plants are available on-site and will be used in seasonal darkness to aid in spill response containment, clean-up and remedial actions.

5 Training

All personnel working at the Hope Bay site receive onsite training during the initial site orientation. At that time, every employee is informed that he/she is potentially a First Responder to any spill or unanticipated discharge event and is provided a brief explanation of the actions expected of every First Responder and where to find the First Responder SOP (flow chart) which is included in the site spill kits. Spill response plans are also located in accessible public locations on site.

Supervisors provide task-specific training to workers using chemicals onsite which includes appropriate handling, storage, disposal, and where to find guidance on spill response for these chemicals. Workers are provided with information on spill response requirements and the locations of spill kits in their immediate work area. Spill response techniques are reviewed in departmental safety meetings by the Environmental Supervisor on a regular basis and lessons learned from spill investigations are communicated to all workers as corrective actions are developed.

Additionally, more detailed training is provided to workers involved in fuel offloading activities, through consultants such as Riverspill Response Canada Ltd. The instructional sessions include site safety, materials properties and strategies as well as tactics for containment and recovery in-facility, on land (brief) and on water spills. This training also includes the performance of mock spill response practical exercises in years of fuel offload, including deployment of spill response equipment under typical operating conditions.

Members of the Emergency Response Team receive frequent training regarding a variety of incident scenarios and response techniques applicable at the Hope Bay site. This training includes response to fire, explosive or toxic incidents, including spill of materials that could result in these conditions.

These training programs ensure that Hope Bay Project personnel understand the procedures in the *Hope Bay Project Spill Contingency Plan,* the hazards of the materials stored on-site, who is responsible for what activities, how to initiate a response, where to find and use response equipment, and how to obtain off-site resources.

6 References

2010. *Consolidation of Environmental Protection Act* (R.S.N.W.T 1988, c.E-7). Current to August 29, 2010, Government of Nunavut.

2011. *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (S.C.2002, c.10) Current to May 5, 2011, Aboriginal Affairs and Northern Development Canada.

Consolidation of Environmental Emergency Regulations (S.O.R. 2003-307). Current to March 16, 2016, Environment and Climate Change Canada.

Consolidation of Regulation R-068-93 Spill Contingency Planning and Reporting Regulations as provided by the Government of Nunavut website.

Contingency Planning and Spill Reporting in Nunavut, A Guide to the New Regulations. Environmental Protection Service, Department of Sustainable Development, Government of Nunavut.

Implementation Guidelines for Environmental Emergency Regulations. 2011. Environment and Climate Change Canada.

Canadian Wildlife Services. 2012. *Birds and oil-CWS Response Plan*.

INAC. 2007. *Guidelines for Spill Contingency Planning*. Water resource Division, Indian and Northern Affairs Canada, April 2007.

International Council on Metals and the Environment. 1999. *The Management of Cyanide in Gold Extraction.*

Mudder, T.I. *Cyanide Spills Prevention and Response.*

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module A: Doris

Conformity Table

Licence	Part	Item	Topic	Report Section
2AM-DOH1335	H	1.	The Licensee shall implement the following plans as approved by the Board: *Surface Emergency Response Plan*, *Underground Emergency Responses Plan*, and *Hope Bay Project Spill Contingency Plan*. The Licensee shall comply with the Plan(s) and any changes deemed significant shall require the submission and subsequent approval of the Board in writing.	This Plan
		2.	All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.6
		3.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering Water.	Section 2 Section 4.6
		4.	The Licensee shall provide secondary containment for fuel and chemical storage as required by applicable standards and acceptable industry practice.	Section 4.1
		5.	The Licensee shall perform weekly inspections of petroleum products storage and containment facilities, fuel tanks and connectors, for leaks and settlement and shall keep a written log of inspections to be made available to an Inspector upon request. More frequent inspections may be requested by an Inspector.	Section 4.1
		8.	The Licensee shall conduct emergency maintenance and servicing on equipment, in designated areas, and shall implement measures to collect motor fluids and other Waste to prevent and contain spills.	Section 4.4
		9.	The Licensee shall, subject to Section 16 of the Regulations, report any unauthorized deposits or foreseeable unauthorized deposits of waste and/or discharges of Effluent, and:	See below
		9a.	• employ the Spill Contingency Plan;	Section 2
		9b.	• report the incident immediately via the 24-Hour Spill Reporting Line (867) 920-8130, to the Inspector at (867) 975-4295 and to the Kitikmeot Inuit Association at (867) 982-3310; and	Section 3.3
		9c.	• for each spill occurrence, submit a detailed report to the Inspector, no later than thirty (30) days after initially reporting the event, which includes the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		10.	The Licensee shall, in addition to Part H, Item 9, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3

Licence	Part	Item	Topic	Report Section
		11.	The Licensee shall submit to the Board for review, at least sixty (60) days prior to operation of the Roberts Bay Discharge System, an addendum to the Spill Contingency Plan detailing spill prevention measures along the pipeline.	To be provided 60 days prior to operation of Roberts Bay Discharge System
	Schedule B		The Annual Report referred to in Part B, Item 2 shall include the following:	See below
		8.	A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken	Section 3.3

Contents: Module A

A1 Introduction

The Type A Water Licence No. 2AM-DOH1335 issued to TMAC by the Nunavut Water Board (NWB) requires the development of a Spill Contingency Plan in accordance with Part I. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

The 2AM-DOH1335 Licence area includes the Doris North Camp and the necessary infrastructure to support surface exploration, underground mining and development activities, and ore processing.

A2 Chemical Storage at Doris

A list of fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within each facility for the Doris North Licence area is provided in the table below. Chemical storage locations are also depicted on the photographs provided below, in addition to the default spill kit locations.

Table A.1. Doris Fuel and Chemical Storage Locations

Storage Location	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Maximum Expected Quantity Stored
Roberts Bay Bulk * Fuel Storage Facility (Quarry 1 / ST-6a)	1 @ 5,000,000 L Tank	Field-erected	Gravel/HDPE, 6,270,000 L	Diesel Fuel	5,000,000 L
Roberts Bay Bulk Fuel Storage Facility (ST-6b)	3 @ 5,000,000 L 1@ 400,000 L Tanks 4 @ 125,000 L Fuel Bladders	Field-erected Manufactured	Gravel/HDPE, 9,190,000 L	Diesel Fuel Jet-A Jet-A	15,000,000 L 400,000 L 500,000 L
Batch Plant/ equipment storage	2 @ 1240 L	Pre-fabricated, double-walled, portable	Spill containment	Diesel Fuel	2 @1116 L
Doris Camp Site Fuel Storage Facility (ST-5)	5 @ 1,500,000 L Tanks Dispensing Module (Active)	Field-erected	Gravel/HDPE, 2,976,000 L	Diesel Fuel	7,500,000 L
Doris Helipad (office, washcar)	1 @ 1240 L	Pre-fabricated, double-walled, portable	Insta-berm, spill containment	Diesel Fuel	1116 L
Doris Helipad (Jet-A Storage)	Drums in Seacan (maximum 64 drums) 2 @ 3000 L Tanks	Drums Pre-fabricated, double-walled, portable	HDPE spill containment Spill containment	Jet A Fuel Jet-A Fuel	13,120 L 5400 L

Storage Location	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Maximum Expected Quantity Stored
Doris Helipad (landing pads)	Drum fuel (8) placed at each active helicopter landing pad	Drums	Plastic spill pallets, 220 L	Jet A Fuel	1640 L
Doris Muster Station	1 @ 1240 L	Pre-fabricated, double-walled, portable	HDPE/Wood spill containment	Diesel Fuel	1116 L
Doris Powerhouse (old)	1 @ 15,000 L	Pre-fabricated, double-walled, portable	HDPE/Wood spill containment	Diesel Fuel	15,000 L
Doris Powerhouse (new)	3 @ 5000 L	Pre-fabricated, double-walled, portable	3 @ 5500 L each, Concrete	Diesel Fuel	15,000 L
Roberts Bay Waste Management Facility Generator	Internal tank @ 2250 L	Pre-fabricated, double-walled,	Internal steel spill containment	Diesel Fuel	2025 L
Roberts Bay Incinerator	1 @ 1500 L (Inactive) 2 @ 1000 L	Pre-fabricated, double-walled Pre-fabricated, double-walled	Steel Spill containment	Diesel Fuel Diesel Fuel	1350 L 2 @ 1000 L
Waste Management Facility Waste Oil Burner	2 @ 850 L	Plastic Cube	Spill containment	Waste Oil	1700 L
Rob Bay Muster Station	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel Spill containment	Diesel Fuel	1116 L
Doris Vent Raise	1 @ 70,000 L	Pre-fabricated, double-walled, portable	Gravel/HDPE, 77,000 L	Diesel Fuel	70,000 L
Doris Airport Tower Generator	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment; in seacan	Diesel Fuel	1116 L
Doris Pump House	1 @ 1240 L	Pre-fabricated, double-walled, portable	HDPE/Wood spill containment	Diesel Fuel	1116 L
Geotech Shop	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment	Diesel Fuel	1116 L
Main Shop	2 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment	Diesel Fuel	2 @ 1116 L
Explosive Berm (TIA Access Road)	Seacan	NA	NA	Amex (Ammonium nitrate)	900,000 kg

Storage Location	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Maximum Expected Quantity Stored
Mill Building	1 @ 1240 L	Pre-fabricated, double-walled, portable	Steel spill containment	Diesel Fuel	1116 L
Upper Laydown TIA Reagent Berm	Locked Seacan	NA	Seacans	Collector	90,000 kg
	Locked Seacan	NA	Seacans	Promoter	30, 100kg
	Locked Seacan	NA	Seacans	Frother	16,000 kg
	Locked Seacan	NA	Seacans	Flocculant Low pH	16, 000 kg
	Locked Seacan	NA	Seacans	Sodium Cyanide	240,000 kg
	Locked Seacan	NA	Seacan	Caustic Soda	450,000 kg
	Locked Seacan	NA	Seacans	Flocculant High pH	2,000 kg
	Locked Seacan	NA	Seacan	Sodium Metabisulpha te	240,000 kg
	Locked Seacan	NA	Seacans	Copper Sulphate	125,000 kg
	Locked Seacan	NA	Seacans	Hydrochloric Acid	4000 kg
	Locked Seacan	NA	Seacans	Sodium Benzoate	20,000 kg
	Locked Seacan	NA	Seacans	Silica Sand	5000 kg
	Locked Seacan	NA	Seacans	Borax	12,500 kg
	Locked Seacan	NA	Seacans	Soda Ash	8750 kg
	Locked Seacan	NA	Seacans	Potassium Nitrate	5000 kg
Lower Laydown	Seacans with 1000 kg mega bags	NA	NA	Calcium Chloride	11,030 tonnes
	Seacan	NA	NA	Acetylene	10 - WTL bottles (~3600 cu. ft. of product)
	Seacan	NA	NA	Propane	30 – 100 lb bottles (3000 lbs)
	Seacan ERT building ERT building	NA	NA	Oxygen	10 - K bottles (6900 L ea) 3 - M bottles (3000 L ea) 4 - D bottles (350 L ea) (~79,400 L. of product)

** Fuel tank in this facility was recommissioned in 2018. The containment capacity of this facility was increased from 3,200,000 L to 6,270,000 L in 2018 prior to filling the tank during the annual sea-lift fuel offload. Waste oil, drummed Jet-A and totes of oils and glycols that had previously been stored in this facility have been removed.*

Plate A.1. Roberts Bay Laydown (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars [or a yellow circle in the case of the aquatic mobile response spill equipment] indicate default spill kit locations.)

Plate A.2. Doris Camp (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

Plate A.3. Doris Lake Freshwater Pumphouse (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

Plate A.4. Reagent Berm and Explosive Berm (Note: Red circles are fuel or chemical storage locations, smaller containment locations may vary. Yellow stars indicate default spill kit locations.)

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module B: Windy

Conformity Table

Licence	Part	Item	Topic	Report Section
2BE-HOP1222	B	2.	The Licensee shall file an Annual Report on the appurtenant undertaking with the Board no later than March 31st of the year following the calendar year being reported which shall contain the following information:	See below
		2.e	• an update to the Spill Contingency Plan, if required, including contact information in the form of an addendum.	This report
	H	1.	The Licensee has submitted, September 23, 2011, a Spill Contingency Plan entitled Hope Bay Project Spill Contingency Plan, for the Hope Bay Project, which encompasses the Hope Bay Belt projects including Roberts Bay, the Doris, Boston and Windy camps. This Plan covers the Windy Camp with respect to care and maintenance of the site. The Licensee shall submit to the Board for approval in writing, within ninety (90) days of issuance of this Licence, a revised Plan that takes into consideration the status of the entire Hope Bay Belt project as it influences the activities, environmental and safety issues of the Windy Camp and the Hope Bay Regional Exploration Project.	This report
		2.	Licensee shall submit to the Board for approval in writing, sixty (60) days prior to the resumption of exploration activity at the Hope Bay Regional Exploration Project, a revised Spill Contingency Plan that is specific to the scope of this Licence and prepared in accordance with the *Spill Contingency Planning and Reporting Regulations* developed under Section 34 of the *Environmental Protection Act*.	Plan filed in March 2014, updated here. Sections 2 and B2
		3.	The Licensee shall, if not approved by the Board, revise the Plan referred to in Part H, Item 1, and resubmit to the Board for approval within thirty (30) days of receiving notification of the Board's decision.	Section 1.5
		4.	The Licensee shall implement the Plan specified in Part H, Item 1 as and when approved by the Board.	Section 1.5
		5.	The Licensee shall review the Plan referred to in this Part as required by changes in operation and/or technology and modify the Plan accordingly. Revisions to the Plan are to be submitted in the form of an Addendum, to be included with the Annual Report unless directed otherwise by an Inspector.	Section 1.4
		6.	The Licensee shall ensure that any chemicals, petroleum products or wastes associated with the project do not enter water. All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary high water mark of any adjacent water body and inspected on a regular basis.	Section 2 Section 4.6
		7.	The Licensee shall ensure that any equipment maintenance and servicing be conducted only in designated areas and shall implement special procedures (such as the use of drip pans) to manage motor fluids and other waste and contain potential spills.	Section 4.4
		8.	If during the term of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:	See below
		8a.	• employ the Spill Contingency Plan;	Section 2
		8b.	• report the spill immediately to the 24-Hour Spill Line at (867) 920-8130 and to the Inspector at (867) 975-4295; and	Section 3.3
		8c.	• for each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3

Contents: Module B

B1 Introduction

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the Nunavut Water Board (NWB) requires the development of a Spill Contingency Plan in accordance with Part H. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

B2 Chemical Storage at Windy

Windy Camp is located 10km south of Doris Camp at N 68° 03.715' W 106° 37.109' and is in the process of being decommissioned. Fuel storage at Windy Camp is limited to one tank (double-walled Tidy Tank) containing a maximum of 1240L of diesel fuel. This tank is located more than 31 m from any waterbody and fuels a generator used to heat a pump house structure located at the potable freshwater intake south of Windy Camp. Water is used to supply Doris Camp with potable water, and regular inspection of this facility occurs as per the requirements of the Doris Water Licence. In case of a potential spill involving the Tidy Tank, there is a spill kit located at the pump house (at the shoreline).

No other hydrocarbons or chemicals are stored at Windy Camp. Any hydrocarbons or chemicals needed for decommissioning the camp structures will be brought to Windy Camp and consumed on an as-needed basis. Spill kits will be available within 200 m of working equipment during these activities.

The Bulk Fuel Storage Facility at Patch Lake was fully dismantled in 2012 and the area is in the process of being reclaimed. There are no hydrocarbons or chemicals stored at the Patch Lake Facility. Fuel or lubes required to complete reclamation work will be brought in for immediate equipment use, and a spill kit will be available on site to support operating machinery. Chemical storage locations at Windy Camp and the Bulk Fuel Storage Facility at Patch Lake are shown in photos below.

In case of exploration drilling on land and on ice, chemicals will be brought in to assist with the drilling process. Each drill will have its own fully stocked spill kit and chemicals stored will be kept to an amount needed for each shift. Excess chemicals will not be stored within Windy Camp.

One permitted facility for explosives materials is located at Quarry A on the west side of the Doris-Windy all-weather road. This facility can store a maximum of 40,800 kg of explosive materials containing ammonium nitrate. In the event of a spill of this material, the spill response actions would be completed as outlined in the Produce Specific Spill Response plan in Appendix 1 of this document.

B3 Windy Fuel and Chemical Storage Locations

Plate B.1. Windy Camp (Note: Red circle is fuel storage location, smaller storages locations may vary. Yellow star indicates spill kit location.)

Plate B.2. Patch Laydown Facility (Note: Red circle is fuel storage location, smaller storages locations may vary. Yellow star indicates spill kit location.)

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module C: Madrid (Exploration and Operations)

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-MAE1727	B	2.	The Licensee shall file an Annual Report on the Appurtenant Undertaking with the Board no later than 31st of March, of the year following the calendar year being reported, containing the following information:	See below
		2j.	• Updates or revisions to the Water Management Plan, Abandonment and Restoration Plan, QA/QC, Waste Rock and Ore Storage Plan, and Spill Contingency Plan and/or any other management plan.	This Plan
	H	1.	The Licensee shall submit for Board approval in writing, within ninety (90) days following issuance of the Licence, a spill contingency Plan that is specific to the scope of this Licence, addresses comments received by the parties, and is prepared in the format set out by the Consolidation of Spill Contingency Planning and Reporting Regulations, R-068-93.	This Plan
		2.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering water. All Sumps and fuel caches shall be located at a distance of at least thirty-one (31) metres from the ordinary High Water Mark of any adjacent water body and inspected on a regular basis.	Section 2 Section 4.1
		3.	The Licensee shall conduct any equipment maintenance and servicing in designated areas and shall implement special procedures (such as the use of drip pans) to manage motor fluids and other waste and contain potential spills.	Section 4.4
		4.	If during the term of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:	See below
		4a.	• employ the Spill Contingency Plan;	This plan
		4b.	• report the spill immediately to the 24-Hour Spill Line at (867) 920-8130 and to the Inspector at (867) 975-4295; and	Section 3.3
		4c.	• for each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		5.	The Licensee shall, in addition to Part H, Item 4, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3

Contents: Module C

C1 Introduction

The Type B Water Licence No. 2BB-MAE1727 issued to TMAC by the Nunavut Water Board (NWB) requires the development of a Spill Contingency Plan in accordance with Part H. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

The 2BB-MAE1727 Licence Area includes the Madrid North and Madrid South sites. Work at the Madrid North site is anticipated to commence in 2019.

C2 Chemical Storage at Madrid North and Madrid South

Photos of chemical storage locations at the proposed Madrid North and Madrid South sites will be provided when these facilities are constructed in the next annual update of this plan. A list of anticipated fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within the facility for the Madrid Licence area is provided below. All storage facilities will be located at a distance greater than 31 m from any water body.

Table C.1. Madrid North Fuel and Chemical Storage Locations

Location*	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Expected Quantity Stored
Madrid North Fuel Storage Area (MAE-07)	3 @ 1,500,000 Tanks	Field erected	Gravel/HDPE	Diesel Fuel	4,500,000 L
Quarry A Explosives Magazine (Location to be confirmed)	Explosives magazines	Pre-fabricated	Gravel Berm within quarry boundary	Amex (Ammonium nitrate)	225,000 kg

**Additional portable storage facilities may be used depending on Project activity.*

Table C.2. Madrid South Fuel and Chemical Storage Locations

Location*	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Expected Quantity Stored
Madrid South Fuel Storage Area (MAE-07)	1 @ 750,000 Tank	Field erected	Gravel/HDPE	Diesel Fuel	4,500,000 L

**Additional portable storage facilities may be used depending on Project activity.*

Madrid North and Madrid South

Photos identifying the locations of fuel and chemical storage locations, and spill kit locations will be provided once these facilities are constructed. Any hydrocarbons or chemicals needed for construction of these facilities will be brought to the site and consumed on an as-needed basis. Spill kits will be available within 200 m of working equipment during these activities.

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Module D: Boston (Exploration and Operations)

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-BOS1727	B	9.	The Licensee shall file an Annual Report on the appurtenant undertaking with the Board no later than March 31st of the year following the calendar year being reported which shall contain the following information:	See below
		9l.	• updates or revisions to the Abandonment and Restoration Plan, QA/QC, Waste Rock and Ore Storage Plan, Spill Contingency Plan, and Landfarm Plan.	This Plan
	H	2.	The Licensee shall prevent any chemicals, petroleum products or wastes associated with the project from entering Water. All Sumps and fuel caches shall be located at a distance of at least thirty-one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.1
		3.	The Licensee shall conduct any equipment maintenance and servicing in designated areas and shall implement special procedures (such as the use of drip pans) to manage motor fluids and other waste and contain potential spills.	Section 4.4
		4.	If during the term of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:	See below
		4a.	• employ the Spill Contingency Plan;	This plan
		4b.	• report the spill immediately to the 24-Hour Spill Line at (867) 920-8130 and to the Inspector at (867) 975-4295; and	Section 3.3
		4c.	• for each spill occurrence, submit to the Inspector, no later than thirty (30) days after initially reporting the event, a detailed report that will include the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3
		5.	The Licensee shall, in addition to Part H, Item 4, regardless of the quantity of releases of harmful substances, report to the NWT/NU Spill Line if the release is near or into a Water body.	Section 3.3
2AM-BOS1835	H	1.	The Licensee shall implement the following plans as approved by the Board: *Surface Emergency Response Plan*, *Underground Emergency Responses Plan*, and *Hope Bay Project Spill Contingency Plan*. The Licensee shall comply with the Plan(s) and any changes deemed significant shall require the submission and subsequent approval of the Board in writing.	This Plan
		2.	All sumps and fuel caches shall be located at a distance of at least thirty one (31) metres from the ordinary High Water Mark of any adjacent Water body and inspected on a regular basis.	Section 2 Section 4.6
		3.	The Licensee shall prevent any chemicals, petroleum products or unauthorized Wastes associated with the project from entering Water.	Section 2 Section 4.6

		4.	The Licensee shall provide secondary containment for fuel and chemical storage as required by applicable standards and acceptable industry practice.	Section 4.1
		5.	The Licensee shall perform regular inspections of Fuel Storage and Containment Facilities, Sumps, Emergency Dump Catch Basins, other fuel tanks and connectors for leaks and movement and shall keep a written log of inspections to be made available to an Inspector upon request. More frequent inspections may be required at the request of an Inspector	Section 4.1
		8.	The Licensee shall conduct emergency maintenance and servicing on equipment, in designated areas, and shall implement measures to collect motor fluids and other Waste to prevent and contain spills.	Section 4.4
		9.	The Licensee shall, subject to Section 16 of the Regulations, report any unauthorized deposits or foreseeable unauthorized deposits of waste and/or discharges of Effluent, and:	See below
		9a.	• employ the Spill Contingency Plan;	Section 2
		9b.	• report the incident immediately via the NT-NU 24-Hour Spill Reporting Line (867) 920-8130 and to the Inspector at (867) 975-4295; and	Section 3.3
		9c.	• for each spill occurrence, submit a detailed report to the Inspector, no later than thirty (30) days after initiallyreporting the event, which includes the amount and type of spilled product, the GPS location of the spill, and the measures taken to contain and clean up the spill site.	Section 3.3 Section D3.2
		10.	The Licensee shall, in addition to Part H, Item 9, regardless of the quantity of release of harmful substance, report to the NT-NU 24-Hour Spill Report Line if the release is near or into a Water body.	Section 3.3
		11.	The Licensee shall submit to the Board for review, at least sixty (60) days prior to operation of the Aimaokatalok Lake Discharge System, an addendum to the Spill Contingency Plan detailing spill prevention measures along the pipeline.	To be provided 60 days prior to operation of Aimaokatalok Lake Discharge System
	Schedule B		The Annual Report referred to in Part B, Item 2 shall include the following:	See below
		8.	A list and description of all reportable unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken.	Section 3.3

Contents: Module D

D1 Introduction

The Type A Water Licence No. 2AM-BOS1835 and Type B Water Licence No. 2BB-BOS1727 issued to TMAC by the Nunavut Water Board (NWB) require the development of a Spill Contingency Plan in accordance with Part H. The Spill Contingency Plan has been prepared and is being submitted by TMAC to address this requirement, and also includes the plan for spill response throughout the Hope Bay belt.

The 2BB-BOS1727 Licence Area includes the current Boston Camp site, which is opened seasonally to support exploration activities.

Facilities outlined in the 2AM-BOS1835 Licence have not yet been constructed and there is no activity occurring at Boston Camp under this at this time.

D2 Chemical Storage at Boston

Photos of current chemical storage locations and a list of current fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within the facility for the Boston Licence area is provided below. All storage facilities are located at a distance greater than 31m from any water body.

Photos of anticipated fuel and chemical storage locations associated with facilities identified in the licence 2AM-BOS1835 for the Boston Project will be provided when these facilities are constructed. The anticipated fuel and chemical storage facilities, containment capacity, products stored and maximum expected quantity to be stored within each facility associated with development of Boston under this licence are provided in the table below. All storage facilities will be located at a distance greater than 31m from any water body.

D3 Additional Spill Contingency Management at Boston

D3.1 Issue: Bulk Fuel Tank Farm

Eight fuel tanks are currently located in a lined fuel berm covered with crush material at the Boston Site. The berm was constructed on permafrost and the crush pad is thin in some areas which may lead to permafrost degradation beneath the berm over time. Foundation settlement of the tanks due to permafrost degradation could potentially occur over time and could cause the fuel tank to destabilize creating risk of one or more of the fuel tanks to destabilize and tip.

D3.2 Management Response

Fuel tanks are visually monitored for differential settlement during seasonal visits when the Boston site is accessible and during annual geotechnical inspections. Measurements of tank movement may also be collected if visual monitoring indicates a potential issue with one or more of the tanks. This may involve measuring the vertical angle of the fuel tank sidewall. A comparison of these values over time will indicate if differential settlement is occurring.

Table D.1. Boston Fuel and Chemical Storage Locations

Location*	Facility Description/ Storage Capacity	Tank Description	Containment Capacity	Products Stored	Expected Quantity Stored
Boston Camp Bulk Fuel Storage Facility (BOS-5)	6 @ 77,000L Tanks 2 @ 33,500L Tanks	Pre-fabricated	Gravel/HDPE, 84,700 L	Diesel Fuel	377,127 L
Boston Fuelling Stations (tidy tank beside bulk storage)	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Fuelling Stations (fly tank beside bulk storage)	1 @ 785 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Gasoline	628 L
Boston Helipad	Drum storage (8 drums)	Drums	Plastic spill pallets, 220 L each	Jet A Fuel	1640 L (empty when Project closed)
Boston Jet A fuel storage	Drum storage (Portable Insta-Berm)	Drums	2 x 25,500 L	Jet A	51,250 L
Boston Generator Daytanks	2 @ 1240 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment (2)	Diesel Fuel	2232 L
Boston Fuelling Station (North, by camp facilities)	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Tent Heaters Daytank	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Daytank (inside)	1 @ 350 L	Pre-fabricated, Single walled	Steel floor and kickplate	Diesel Fuel	315 L
Boston Camp Daytank (NE side of camp between main camp and tents	1 @ 1374 L	Pre-fabricated, double-walled, portable	Gravel/HDPE spill containment	Diesel Fuel	1236 L
Boston Incinerator	1 @ 400 L	Pre-fabricated, double-walled	Steel spill containment	Diesel Fuel	360 L
Boston Bulk Fuel Storage Facility**	5 @ 1,500,000	Field erected	Gravel/HDPE spill containment	Diesel Fuel	7,500,000

** Additional portable storage facilities may be used depending on Project activity.*

*** Anticipated fuel storage as part of proposed Phase 2 Boston development outlined in Type A Water Licence 2AM-BOS1835.*

Plate D.1. Boston Camp (Note: Red circles are fuel or chemical storage locations, smaller storage locations may vary. Yellow star indicates spill kit locations.)

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 1: Hazardous Materials and Product Specific Spill Response Plans

Poisonous and Toxic Substances

Sodium Cyanide Specific Spill Response Plan

Note: Sodium cyanide is not currently listed in Schedule 1 of the E2 regulations. However, a Product Specific Spill Response Plan has been developed for this product based on the environmental and health and safety impacts of a potential spill. Hydrogen cyanide is produced when sodium cyanide reacts with water, acids or oxidizing agents. Hydrogen cyanide is listed in Schedule 1 of the E2 regulations.

CAS No: 143-33-9 (Sodium cyanide)

Potential Acute Health Effects: Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, and of inhalation. Corrosive to eyes and skin. Cyanide is classified as extremely toxic.

Storage: Sodium cyanide briquettes will be packaged in 1,000 kg bags. These bags must be kept dry, away from heat and sources of ignition. Keep away from oxidizing agents, acids and moisture. Bags will be stored on pallets in lined seacans or located in a lined containment berm or inside the Mill building as used. Do not store above 24°C. Avoid exposure to acid, water or weak alkalines which can react to form a toxic hydrogen cyanide (HCN) gas.

Personal Protective Equipment for Spill Response

- Self-contained breathing apparatus (SCBA) while conducting air quality monitoring to confirm HCN levels prior to initiating response and clean-up;
- SCBA required for response activities if HCN levels >2.5ppm;
- Full face respirator with vapor or dust cartridges, half face respirator with vapor or dust cartridges and splash goggles or safety glasses with face shield may be worn if HCN levels <2.5ppm;
- Full body chemical resistant suit (rubber);
- Rubber boots (chemical resistant); and
- Rubber gloves (chemical resistant).

Emergency response for a Sodium Cyanide Spill

- Isolate and evacuate the spill area if HCN has potentially been released.
  - Evacuation of other site locations may be required (large spills in water may require protection of personnel up to 5 km downwind).
- Report spill to Supervisor immediately. Provide location, estimated quantity, physical nature of the spilled material (e.g., solid or solution) and other substances/conditions that may create hazardous conditions during response (e.g., exposure of substance to water, acids, oxidizing agents).
- Supervisor will report the spill immediately to the Environmental Supervisor or Safety Coordinator.

- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response:
  - Based on size, location of spill and potential hazardous conditions/environmental impacts; and
  - SDS will be consulted to confirm appropriate response measures and associated hazards.
- Ventilate the area of the spill or leak and eliminate all ignition sources.
  - Air quality monitoring will be conducted in enclosed spaces to determine concentration of hazardous vapours prior to initiating spill response efforts.
- Stop the flow of spill.
- Contain the spill by placing spill booms or constructing interception dikes ahead of the flow (prioritizing prevention of release to waterways or onto ice).
- Protect the spill area from water runoff by constructing dike/berm. If raining, use tarps to cover the area to minimize water contact and spread of contamination.
- For spill to land:
  - Recover spilled solid material by shoveling into drums or containers free from impurities, seal container with lid and clearly label per WHMIS guidelines.
  - Minimize dust generated to the extent possible. Use water spray to reduce vapours; avoid contact of water spray with spilled material. Use tarps to cover spill area if water spray is used to reduce vapours.
  - Recovered solids, if free from impurities, may be suitable for its intended use. In this case, material is to be placed into containers with lid, and clearly labeled as per WHMIS guidelines.
  - Recovered material which cannot be used will be packaged into drums for offsite disposal at an approved waste management facility.
  - Neutralize residual spill material with appropriate agent as recommended by the SDS (sodium or calcium hypochlorite solution) or continue to excavate area until no visible spilled solid remains. Use suitable spill absorbent or soil to absorb the neutralized residue.
- For spill to water:
  - NaCN dissolves in water producing highly toxic hydrogen cyanide gas – use extreme caution.
  - Pump contaminated water to drums, tanks or lined containment berms if possible. Isolate/confine the spill by damming or diversion if feasible.
  - Water treatment is only effective if it can be accomplished in conjunction with the spill.
  - Treatment chemicals (sodium or calcium hypochlorite) must not be added to surface waters (e.g., streams, lakes) as these are not generally effective and could result in additional environmental impacts.

- Hydrogen peroxide for treatment of solution spills or a sulfur dioxide/air process for treatment of slurry spills may be considered. This measure may only be used as a last resort if containment is not achievable and the spill can be treated directly at the point of release.

- For indoor spills:
  - Recover spilled solid material by shoveling into drums or containers free from impurities, seal container with lid and clearly label per WHMIS guidelines.
  - Minimize dust generated to the extent possible. Use water spray to reduce vapours; avoid contact of water spray with spilled material. Use tarps to cover spill area if water spray is used to reduce vapours.
  - Recovered solids, if free from impurities, may be suitable for its intended use. In this case, material is to be placed into containers with lid, and clearly labeled as per WHMIS guidelines.
  - Recovered material which cannot be used will be packaged into drums for offsite disposal at an approved waste management facility.
  - Neutralize residual spill material with appropriate agent as recommended by the SDS (sodium or calcium hypochlorite solution) or continue to excavate area until no visible spilled solid remains. Use suitable spill absorbent or soil to absorb the neutralized residue and package into drums for offsite disposal at an approved waste management facility.
  - Mop the affected area using detergent and water.
  - Place this water in labeled waste drums for offsite disposal at an approved waste management facility
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Ammonium Nitrate Specific Spill Response Plan

Notes: Ammonium Nitrate is a substance listed on Schedule 1 of the E2 Regulations, with a threshold of 20 tonnes. Ammonium nitrate is part of the Amex explosives (UN No 0082) mixture used at site.

CAS No: 6484-52-2 (Ammonium Nitrate)

UN No: 0082 (Amex)

Potential Acute Health Effects: Highly Explosive. Hazardous in case of contact with skin, eyes, ingested and if inhaled. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation.

Usage: Amex is used for surface and subsurface blasting associated with quarrying and subsurface blasting related to mine development and mining.

Storage: Ammonium Nitrate is found in mixture form on site, in the form of Amex. Amex is stored in locked seacans located within the explosives berms or storage magazines, as well as temporary use locations during blasting preparation both underground and in the quarry sites. The magazines and explosives berm locations are established and permitted through NRCan or the Ministry of Mines as appropriate.

The explosives storage areas are constructed and located so as to minimize risk to personnel and as permitted by the Ministry of Mines. The expected quantity to be stored on site is 1125 tonnes of Amex. The maximum allowed capacity of the largest container in which the substance is stored is 40,800 kgs.

Spill Response

Personal Protective Equipment for Spill Response:

- Chemically resistant gloves;
- Protective glasses or chemical safety goggles;
- Chemically resistant coveralls or tyvek coveralls; and
- Dust mask if spill is in confined space.

Emergency response for an Ammonium Nitrate Spill

- Isolate and evacuate the spill area if potential for explosion.
- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.
- Supervisor will report the spill immediately to the Environmental Supervisor or Safety Coordinator.
- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
    - Based on size, location of spill and potential hazardous conditions/environmental impacts.

- Remove all sources of heat and ignition (there is to be no smoking or use of any flames within the area). Remove all uncontaminated combustible materials or organic compounds from spill area.
- Stop flow if safe to do so.
  - Ventilate space prior to entering, if indoors.
- For spills to land, snow or ice:
  - Protect spill area from storm water runoff and prevent entry into surface waters by constructing a ditch or dike using suitable absorbent materials, soil or other appropriate barriers.
  - Vacuum or sweep the spilled residue using non-metal, non-sparking tools.
  - Avoid shock, friction and contact with grit. Wet spillage with water to prevent dust generation.
  - Place the residue in a plastic container, label as per WHMIS Guidelines and transport to waste management for offsite disposal.
  - Recovered solids, if free from impurities, may be suitable for its intended use. In this case, material is to be placed into suitable containers with lid, and clearly labelled as per WHMIS Guidelines.
- For spills to water:
  - Ammonium nitrate sinks and mixes with water.
  - Isolate/confine the spill from spreading by damming or diversion if feasible.
  - Pump contaminated water to drums, tanks or lined containment berms if possible.
  - Label drums for offsite disposal at an approved waste management facility.
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Explosive Materials

Aviation Fuel (Jet-A) Specific Spill Response Plan

Notes: Aviation fuel is not currently listed in Schedule 1 of the E2 regulations. However, a Product Specific Spill Response Plan has been developed for this product based on the environmental and health and safety impacts of a potential spill. If spilled, aviation fuel could be immediately harmful to humans and/or the environment and has the potential to cause pool fires and vapour cloud explosion (dependent on manufacturer specific additives).

CAS No: 8008-20-06 (Kerosene)

UN No: 1223 (Kerosene)

Potential Acute Health Effects: Highly Explosive when vapour meets the air. Causes combustion and explosion. Hazardous if ingested or inhaled. May cause irritation to the eyes and respiratory tract. Reacts with oxidizing agents. Hazardous decomposition product: Carbon monoxide.

Usage: Jet-A is used to fuel aircraft operating at the Hope Bay site (helicopters, airplanes).

Storage: Jet-A is stored in steel fuel tanks or manufactured fuel bladders within the secondary containment berm. Smaller quantities are stored in steel drums within ventilated seacans or within lined containment facilities at the location of use.

The expected quantity to be stored on site is 320 tonnes of Jet-A fuel. The maximum allowed capacity of the largest container in which the substance is stored is 400,000 L.

Spill Response

Personal Protective Equipment for Spill Response:

- Chemical-resistant gloves (e.g., nitrile);
- Protective glasses or chemical safety goggles;
- Chemically resistant coveralls or Tyvek coveralls;
- Half face respirator with organic vapour cartridges or self-contained breathing apparatus; and
- Anti-static clothing.

Emergency response for a Jet-A Spill

- Isolate and evacuate the spill area if potential for explosion or combustion.
- Report spill to Supervisor immediately. Provide location and estimate of spill quantity.
- Supervisor will report the spill immediately to the Environmental Supervisor or Safety Coordinator.

- Mine General Manager will activate Incident Command System and Emergency Response Team if required for response.
  - Based on size, location of spill and potential hazardous conditions/environmental impacts.
- Remove all sources of heat and ignition (there is to be no smoking or use of any flames within the area).
- Stop flow if safe to do so.
  - Low-lying areas can trap explosive vapours.
  - Low-lying areas can trap explosive vapours.
  - Air quality monitoring will be conducted in enclosed spaces to determine concentration of hazardous vapours prior to initiating spill response efforts.
  - Ventilate space prior to entering, if indoors.
  - Restrict access to area and approach upwind of spill.
- For spills to land, snow or ice:
  - Protect spill area from storm water runoff and prevent entry into surface waters by constructing a ditch or berm using suitable non-combustible absorbent materials (e.g., sand, diatomaceous earth).
  - Do not contain spill if there is any chance of igniting vapours.
  - Cover small spills with non-combustible absorbent materials.
  - Use non-metal, non-sparking tools to collect absorption materials.
  - Place the residue in a steel container, clearly labeled as per WHMIS guidelines. Close tightly.
  - Ground tools and containers when collecting absorption material.
  - Transport to waste management for offsite disposal. Store in ventilated areas away from incompatible materials.
- For spills to water:
  - Jet-A fuel floats on surface of water.
  - Do not attempt to contain or remove spills (high explosion potential).
  - Use booms to prevent spread of spill.
- Remove, bag and label personal protective equipment for offsite disposal.
- Thoroughly wash skin with soap.

Additional E2 Regulations Schedule 2 Materials to be Stored Onsite

The hazardous materials to be stored onsite and listed in the Environmental Emergency Regulations may include the following substances throughout the duration of the project:

- Formalin;
- Unleaded Gasoline;
- Hydrochloric acid; and
- Nitric acid.

The quantities of these products are not anticipated to meet the thresholds under the Environmental Emergency Regulations for the development of a product specific spill response plan. However, if at any time the quantities of these materials stored onsite reach the threshold volume identified in these regulations a product specific spill plan will be developed and submitted as an addendum to this Plan.

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 2: Spill Response Resources

Mobile Equipment

Any mobile equipment present on site may be used as a resource for spill response or spill clean-up. This includes pick-ups, skid steers, excavators, loaders, dozers, vacuum trucks, haul trucks, and flatbed trucks.

Spill Kit Contents

Each Spill Kit contains:

- 1 roll absorbent or bundle of spill pads;
- 2 plug and dyke kits;
- 1 – 3 m x 4 m tarpaulin;
- 2 pairs of disposable coveralls;
- 4 mini booms;
- 1 bag of corncob and/or peat moss absorbent;
- 1 bag of gravel type fire retardant granular for aviation stations (helipad and airstrip);
- 2 pair of neoprene gloves (i.e., POL [petroleum/oil/lubricants] resistant);
- 2 sets of splash proof POL resistant goggles;
- 1 shovel;
- 10 disposable waste bags and ties; and
- A copy of the First Responder diagram (Figure 1 at the beginning of this plan).

Aquatic Environment Response Equipment

Response equipment available in the event of a spill to the aquatic environment is stored in ten moveable seacans, with the exception of the boats. This equipment includes:

- 450 feet of 24" solid floatation boom;
- 70 lb, 43 lb, 25 lb, and 17 lb Danforth anchors;
- 8 lb Grapnel Anchors;
- 36" sea anchors;
- Anchor pins;
- Anchor Buoys;
- Anchor lines;
- 150 feet Towline;

- Boom towing bridles;
- 1250 feet of skirted booms (preassembled with tow lines, bridles and floats);
- 200 feet of inflatable Shore Saver booms (with inflation kit);
- 1TDS-118 Drum Skimmer;
- 1 P10E Power Pack;
- 2 Pump;
- 175 L Drum Response Kits c/w lids;
- Disposable coveralls (i.e., Tyvek suits);
- POL (petroleum/oil/lubricants) resistant gloves;
- POL resistant goggles;
- Toolbox c/w assorted tools;
- 45 Gallon containers c/w lids;
- Pails and Rubbermaid tubs;
- 300 foot Nylon rope (3/8);
- Bags of Oclansorb™ Peat Moss or crushed corn cobs;
- Bundles of oil sorbent pads;
- Bundles of universal sorbent pads;
- Oil Sorbent booms;
- Oil snares;
- Universal sorbent booms;
- Bag of Sorbent scraps (spaghetti);
- Containment tanks and berms;
- Plug and dyke kits;
- HAZMAT Disposal Bags and Garbage bags;
- Portable fuel bladders;
- Ice scrapers;
- A net for capturing seabirds/oiled wildlife;
- An 18-foot landing craft boat (with boat safety kit); and
- An 18-foot Zodiac (with boat safety kit and repair kit).

The above aquatic response equipment is considered more than necessary for the potential spills covered under this Plan. Spills to the aquatic environment are limited in potential scale as all fuel storage tanks are located in secondary containment and most are located away from water. The Roberts Bay multiple tank fuel farm berm also has significant excess capacity to contain failure of more than one tank.

As a consequence, spills that may reach water are expected to be limited in size, manageable and recoverable using the aquatic response equipment available on site. If for any reason additional resources are needed, they are available through Mackenzie Delta Spill Response.

Large spills to the marine environment resulting from bulk fuel offloads are addressed through the OPPP/OPEP. As outlined therein, shipping contractors provide all necessary equipment needed to appropriately respond to a fuel-offload spill, with TMAC supplies serving as additional resources available.

Specialized Response Equipment

A stock of specialized spill response equipment is maintained on site and available for use in the event that a product spill as outlined in a Product Specific Spill Response plan occurs. This equipment includes:

- Full body chemical resistant suits (Tyvek);
- Rubber chemical resistant jackets, pants;
- Chemical resistant boots and gloves;
- Splash goggles and full face shields;
- Full and half face respirators with appropriate filters (e.g. organic vapour cartridges);
- Drager Self-contained breathing apparatus;
- Fire retardant coveralls and firefighting bunker gear;
- Drager BG-4 breathing apparatus (not to be used if product has explosive potential);
- Air quality monitors equipped with HCN, CO and O_2 sensors;
- Non sparking tools, such as plastic shovels; and
- Sodium hypochlorite solution.

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 3:
Environmental Resource Maps

Environmental Resource Maps

Shown in the following resource maps are areas of particular vegetation meaningful to the local wildlife and ecosystems which surround the project as well as raptor nests, rare plants and fish habitat. Additional detailed information may be found in baseline and monitoring reports available from the Environmental Supervisor and publically available on the Nunavut Impact Review Board and Nunavut Water Board websites. Information regarding archeological sites that have been identified on the Hope Bay belt is available to the Environmental Supervisor in the event of a spill. At the requirement of the Territorial Archaeologist, the locations of these sites are strictly confidential and information on these locations is only shared on an as needed basis. Spill containment will attempt to minimize impacts to sensitive habitats and archaeological sites.

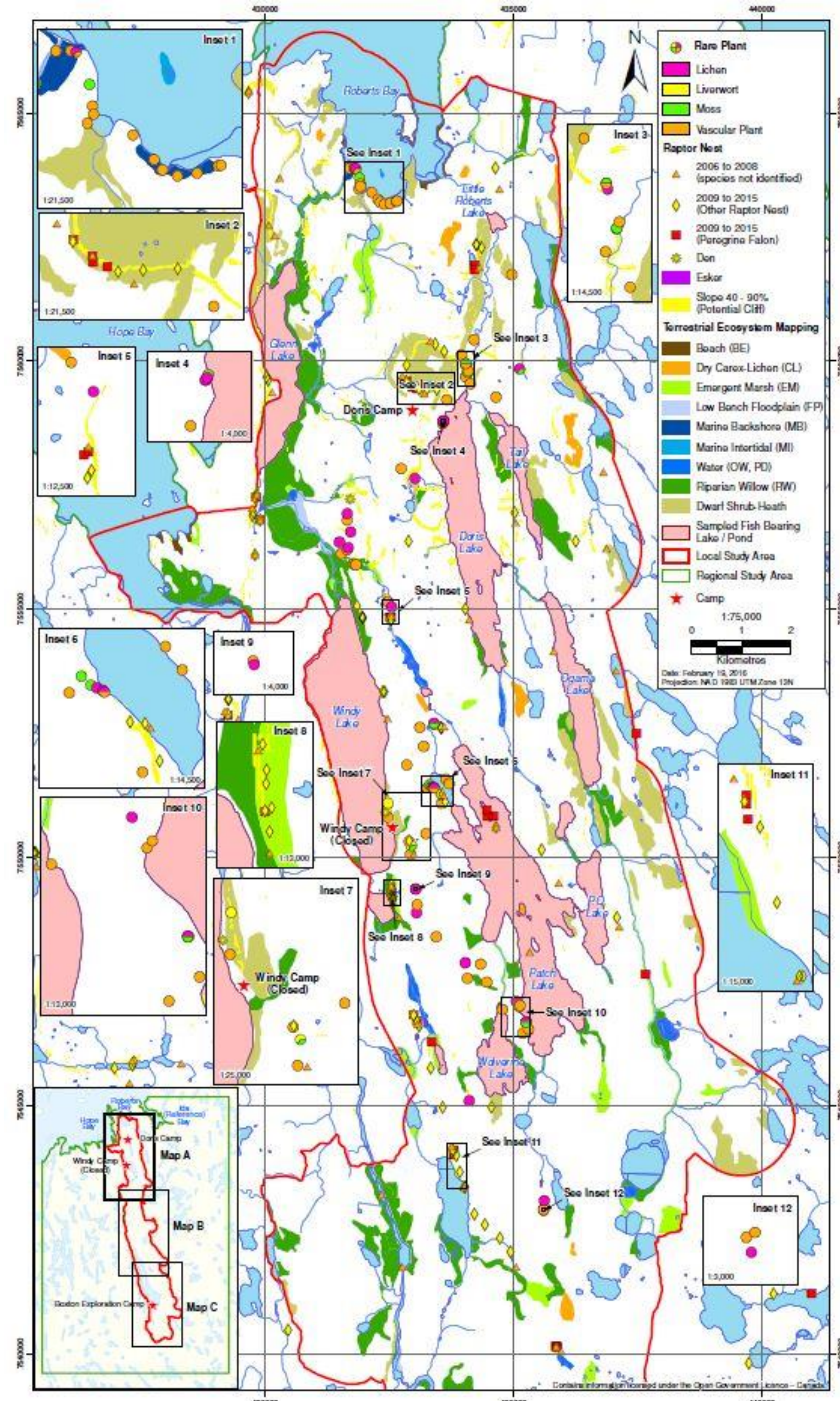

Figure 3.1. Environmental Sensitivity Mapping-Map A

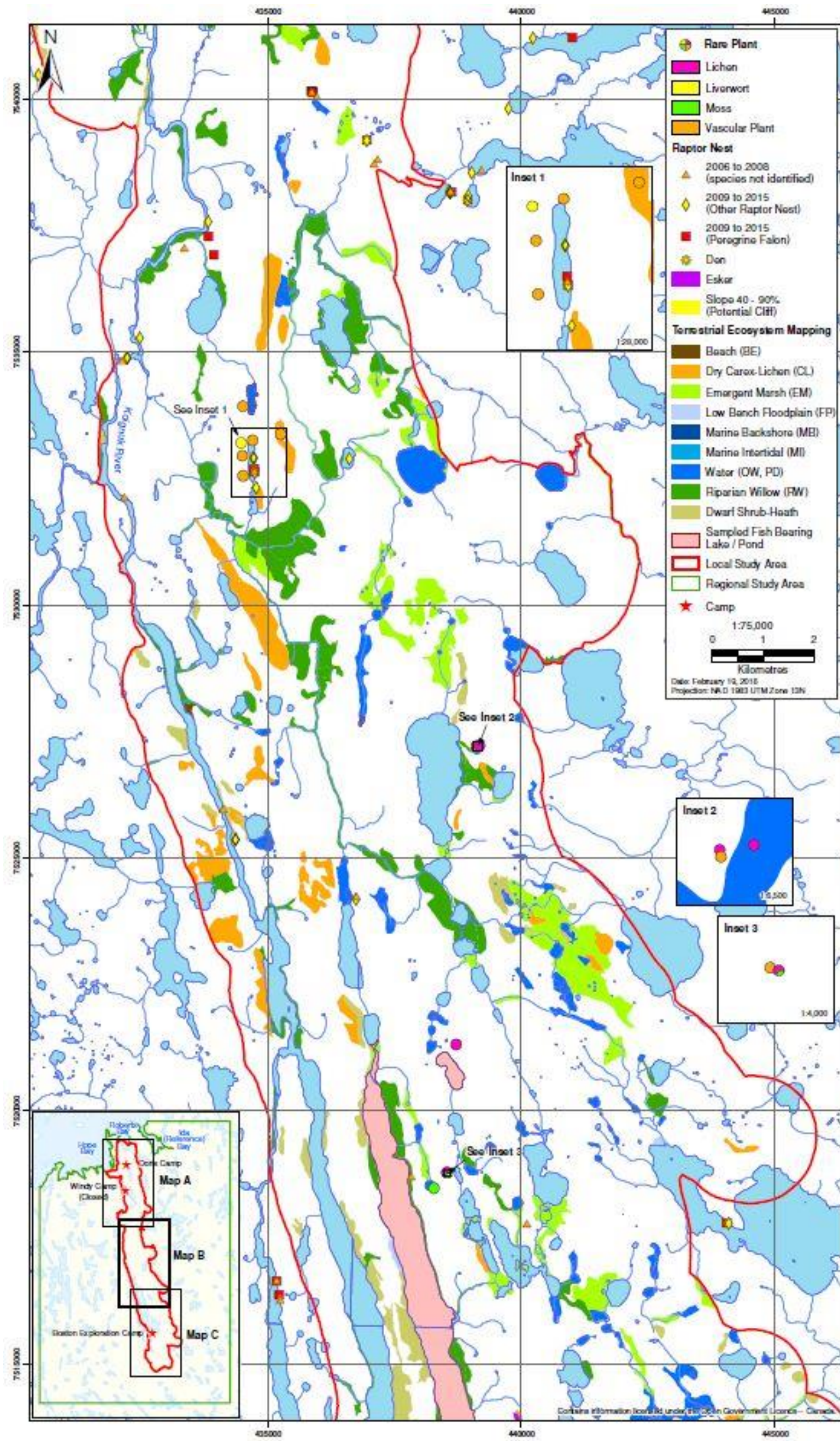

Figure 3.2. Environmental Sensitivity Mapping-Map B

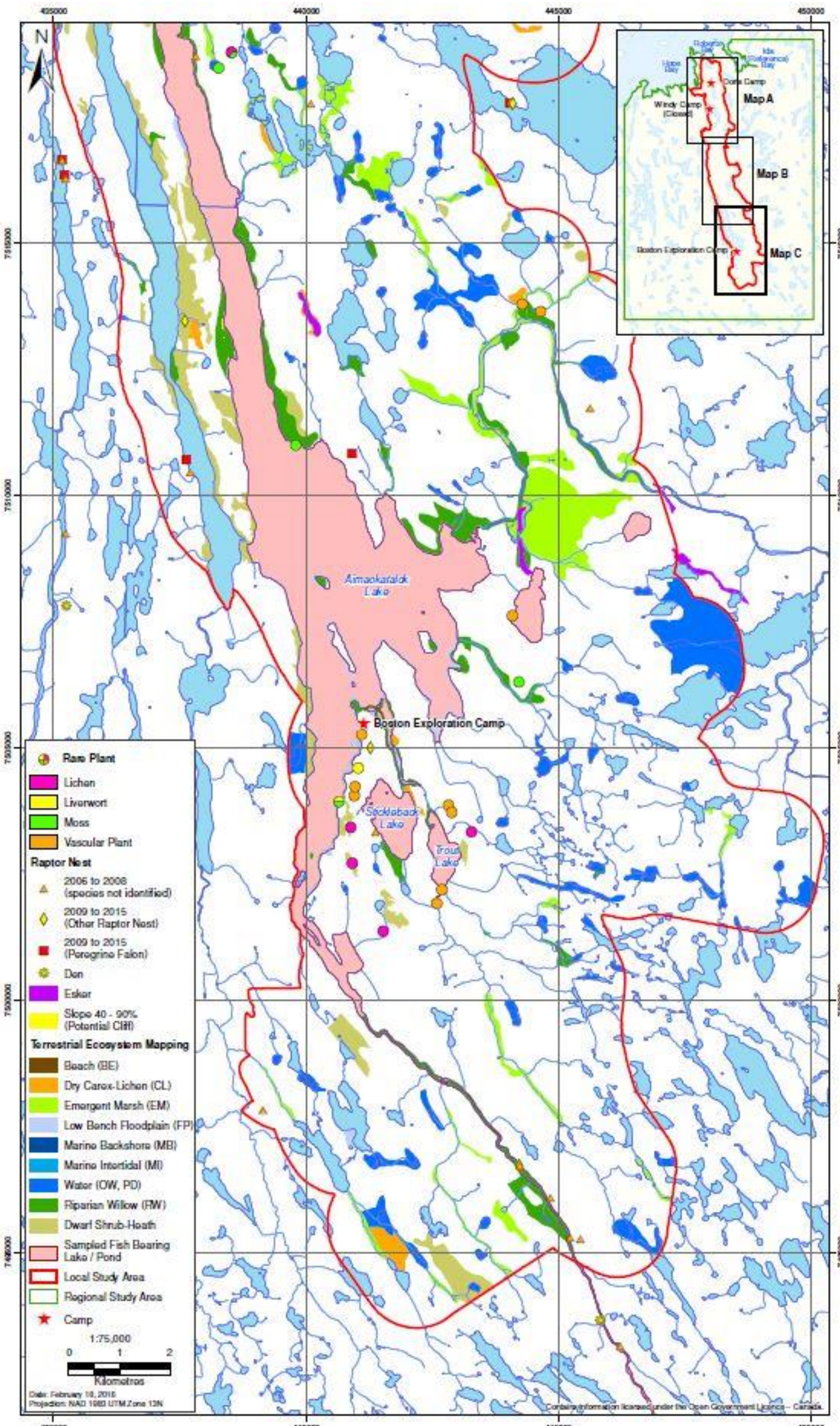

Figure 3.3. Environmental Sensitivity Mapping-Map C

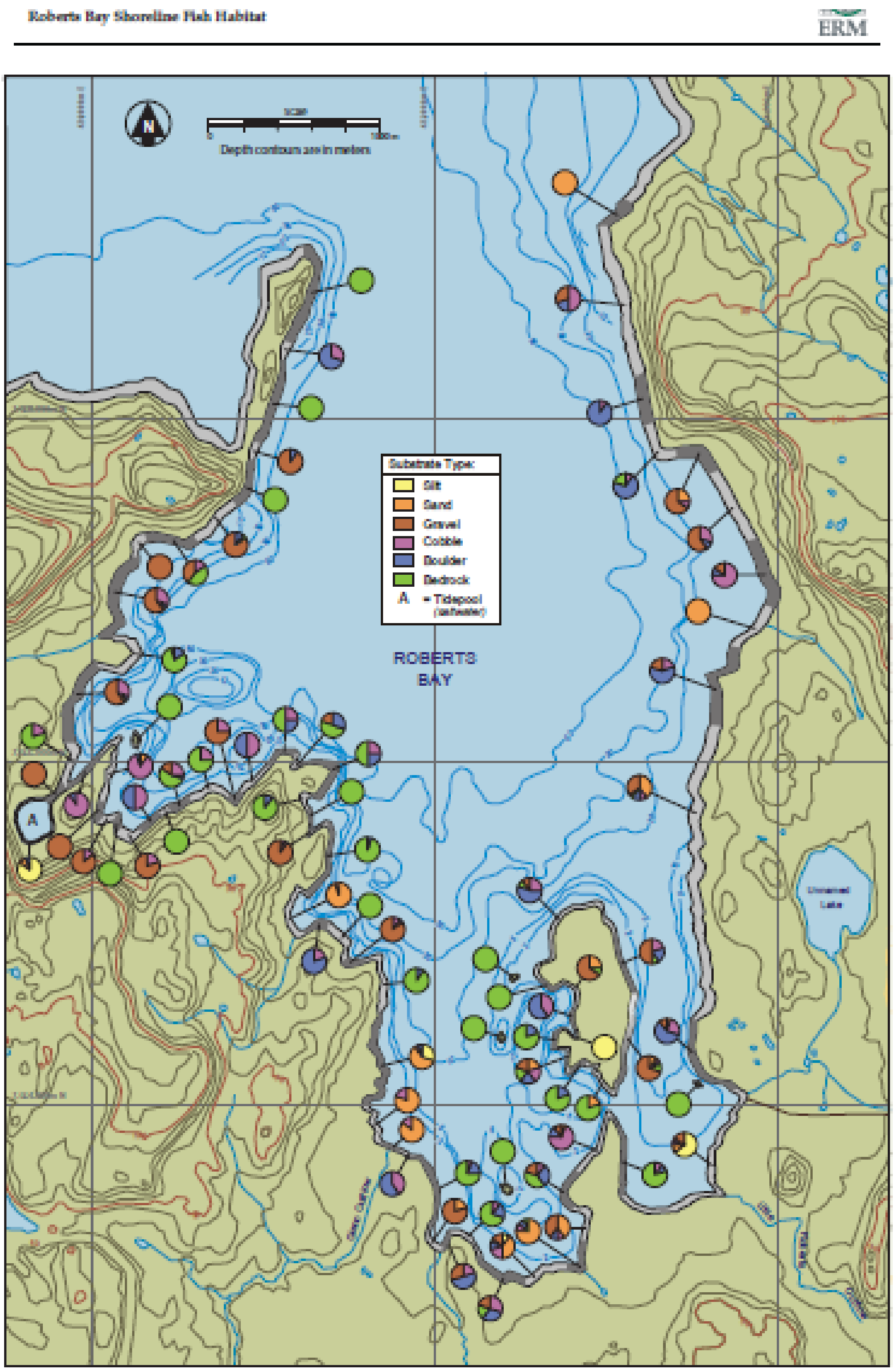

Figure 3.4. Environmental Sensitivity Mapping-Map D

HOPE BAY PROJECT SPILL CONTINGENCY PLAN

HOPE BAY, NUNAVUT

Appendix 4: Responses to Comments on Previous Plan Versions

Comment Responses and Revision References

This Plan replaces the December 2017 Spill Contingency Plan for the Hope Bay Project. The table below outlines the comments received on previous versions of this Plan and TMAC's responses.

Table 4.1. Comments received on previous versions of this Plan and TMAC's responses

Reviewer	Comment #	Comment	Recommendation	Response
INAC	1	Module A of the Spill Contingency Plan provides details on spill kit contents and aquatic environment response equipment, but the information on mobile equipment (machinery) to be used for spill response is not available.	INAC recommends that the licensee include the list of mobile equipment to be used for spill management, as well as the spill containment equipment on each piece of equipment.	Any mobile equipment present on site may be used as a resource for spill response or spill clean-up. This includes pick-ups, skid steers, excavators, loaders, vacuum trucks, haul trucks, and flatbed trucks. This has been made clear in revised text in Module A.
INAC	2	Section 2.5.1 of the spill contingency plan states that spill response kits will be available within 200 m of any areas where chemicals are stored and used. Aquatic spill response kits are available in moveable containers. The spill response kit locations are described as being easily accessible, but it is not clear if there will be adequate signage to identify them. As well, the modules at the end of the plan include pictures on which chemical storage locations are circled, but there is no indication where to find the spill kits beside them. The Guidelines for Spill Contingency Planning recommend including a plan with many features including storage locations of hazardous materials and locations of spill response kits.	INAC recommends that spill kit locations be identified on the ground and, on a site map or indicated in the pictures included in the plan. Default storage locations for the mobile aquatic response spill kits should be included so that a person consulting the plan would quickly know where to look for them.	Default spill kit locations, including the mobile aquatic response spill kits, have been now indicated on the site photographs provided in the site-specific modules.

Reviewer	Comment #	Comment	Recommendation	Response
INAC	3	The section on spill response actions (2.3) outlines actions to be taken in event of different spill scenarios. Two of the scenarios for spills in water outline actions to be taken in event of a hydrocarbon spill, but do not speak to what should be done if other materials are spilled. These are sub-sections 2.3.5, spills under ice, and mitigation of impacts to birds. Some of the materials listed as on site including sodium cyanide would not disperse in the same way as petroleum products and would require different action responses.	INAC recommends that the licensee include action responses for materials that might sink or dissolve in water for spills under ice and mitigation of impacts to birds.	Information addressing spill sunder ice of substances that sink and dissolve is now presented in Sections 2.3.6 and 2.3.7, respectively. Mitigation of impacts to birds is addressed under 2.3.10.1.
INAC	4	Table 1 of Section 1.2 includes regulations and guidelines governing the spill contingency plan. Other regulations are referenced in the text and included in Section 7 of the plan.	INAC suggests that other material to be considered might include: - Federal Transportation of Dangerous Goods Act and regulations; and - NWT Used Oil and Waste Fuel Management Regulations	Waste material generated during spill response is managed as per the Hazardous Waste Management, Non-Hazardous Waste Management Plan, and/or the Landfarm Management Plan as indicated in Section 2.4 of the Plan. TMAC's Hazardous Waste Management Plan includes consideration of/reference to the Federal Transportation of Dangerous Goods Act and regulations and NWT Used Oil and Waste Fuel Management Regulations, as well as many other materials which may apply to management and disposal of spill response wastes, such as GN's Environmental Guideline for Used Oil and Waste Fuel.
ECCC	1	Reference: Page 18 of the revised Spill Contingency Plan, EC #2 Comment: As noted in the table ECCC requested that TMAC undertake and incorporate hazardous substance identification and risk assessment into the Spill Contingency Plan in order to provide the required basis for accident scenario characterization and response planning.	It is expected that the risk assessment process will incorporate consideration of the likelihood of various spills and their potential consequences, which will determine appropriate mitigation/response strategies according to the resulting matrix rankings.	TMAC has provided further clarification of the risk assessment process to be undertaken for all work areas in the revised Plan, in Section 4.

Reviewer	Comment #	Comment	Recommendation	Response
ECCC	2	Reference: Pages 18-19 of the revised Spill Contingency Plan, EC #4 Comment: ECCC reiterates recommendation EC #4 which requests that TMAC document and provide information on worst case accident scenarios for each hazardous product stored and handled onsite.	While the TMAC has indicated that the appropriate sections of the SCP "will continue to be refined in future revisions to capture additional scenarios as operational activities evolve and corrective actions/lessons learned are developed through incident investigations" ECCC is of the opinion that by identifying worst case accident scenarios now, TMAC will be better placed to determine actual required response capacities and develop adequate preparedness and response plans.	During the 2016 revision of the Plan, and based on ECCC's recommendation # 4 cited in the 2016 Plan, TMAC identified worse case scenarios and appropriate responses and included this information in the 2016 SCP as Section 4 "Spill Response Management Issues and Contingencies". TMAC's text indicating that worst case scenarios and responses 'will continue to be refined in future' was an acknowledgement of the continual improvement process loop employed at the Hope Bay Project including the risk assessment process, and recognition that additional scenarios may be identified and added to this Plan in future as a result.
KIA	1 (KIA-6)	The Spill Contingency Plan provides a solid outline of reporting and mitigation measures in the event of a spill. Although specific mitigation of impacts to wildlife, including birds, and sensitive habitats is outlined, there is no specific detail associated with a spill into fish habitat. It is noted that no chemicals are stored with 31 m of water, but there are no specific response actions protective of fish, as is outlined for other wildlife in the 'environmentally Sensitive Species' section. Environmental Resource Maps are provided in Module C, but the focus is on vegetation and terrestrial features.	TMAC should include additional maps and detail be provided for freshwater and marine fish habitat, so that sensitive features can be avoided, and if a spill were to occur near or in water, that the sensitivity of the habitat would be easily found and appropriate mitigation measures taken.	Fish are addressed and protected under the Plan by the management actions addressing spills to water. Fish habitat (sites which have been sampled for fish and within which fish have been found) are also indicated on the Environmental Resource Maps presented in Module C. TMAC has also included a fish habitat map of Roberts Bay in the revised Plan to allow identification of sensitive intertidal and shallow subtidal habitat for avoidance where possible.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	2 (KIA-7)	The Spill Contingency Plan states in section 1.4, "In the event that a spill requires activation of the Emergency Response Plan, the Environmental Coordinator will provide guidance to the Surface Manager regarding implementing response actions according to this plan and evaluating priorities for protection of sensitive habitats/species and archeological features at risk." A decision tree for use by the Surface Manager/Incident Commander or Environmental Coordinator has not been provided for the reviewer to evaluate how sensitive habitats/species and archeological features are prioritized in the event of potential impact to multiple priority areas.	TMAC should include a decision tree outlining how various sensitive or high value locations are prioritized. This will ensure of these locations are prioritized in the event of a spill or unplanned discharge in a manner satisfactory to KIA.	A prioritization hierarchy has been proposed for the environmental sensitivities and is now included in Section 2.3.10.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	3 (KIA-8)	In Section 2.3.8, the Plan states, "TMAC and previous companies operating on the Hope Bay site have conducted numerous ecological surveys to identify [environmentally sensitive habitats or archeological sites] at risk, with the focus of identifying those areas immediately surrounding Project infrastructure which are at greatest risk of impact from a spill. In the event that a spill enters the natural environment, the Environmental Coordinator will use maps identifying these sensitive areas to prioritize the protection of these resources." In the event of an unplanned spill or discharge, these sites will only become a mitigation priority after the Environmental Coordinator has had a chance to review the pertinent maps and provide guidance to the response team. A delay in First Responders becoming aware of these priority locations may limit the effectiveness of mitigation measures, permit more significant adverse impacts than necessary, or even damage those locations through the application of mitigation measures. We understand that, Environmental Resource Maps outlining archeological sites are kept confidential by TMAC. However, the need to keep the locations of these sites confidential must be weighed against the risk of potential spills and unplanned discharges.	TMAC should ensure that the Environmental Coordinator has a-priori knowledge of high priority environmentally sensitive habitats and archeological sites and how to respond in these areas and provide all first responders with instruction on the locations of high priority environmentally sensitive habitats and archeological sites so that First Responders are immediately aware of them in the event of a spill or unplanned discharge. This would allow these locations to be prioritized and/or avoided when applying mitigation measures.	TMAC wishes to clarify that environmentally sensitive habitat maps are included in the Plan, which is available to all staff including the Environmental Coordinator. These maps identify locations of sensitive habitat, raptor nests, den sites, and fish habitat. Only archaeological site locations are kept confidential, at the requirement of the GN's Territorial Archaeologist. However, the Environmental Coordinator has ready access to archaeological site maps. of all locations which may be designated high priority.

Reviewer	Comment #	Comment	Recommendation	Response
KIA	4 (KIA-9)	In Section 3.4 the Plan states, "Monitoring activities may be conducted to assess the impacts of the spill and the effectiveness of associated cleanup/remediation efforts in the event a spill cannot be completely removed." The KIA notes that spills reaching watercourses or waterbodies will eventually disperse as a result of natural hydrology such that they are "completely removed" from the environment even if impacts have occurred. The language included in the Plan does not require monitoring in the event of a spill or unplanned discharge to water nor other habitat types. The KIA's right to compensation for damages to their lands and waters makes prompt and effective monitoring important to both TMAC and the KIA in the event of a spill or unplanned discharge.	TMAC should include triggers which require monitoring activities, and provide details of the type of monitoring that will be undertaken as part of adaptive management to spills and unplanned discharges in the Plan. This discussion should be specific to the type of spill, volume, mobility of the spilled material and proximity to various habitat features. Triggered monitoring should be implemented as quickly as possible such that it would characterize the impact of a spill to the receiving environment as well as the effectiveness of mitigation.	TMAC has provided more detail on spill related monitoring in Section 3.4.
KIA	5 (KIA-10)	TMAC specifies in Module B that the Windy Camp is "no longer occupied". TMAC further specifies that "Fuel storage at Windy Camp is limited to one tank (double-walled Tidy Tank) containing a maximum of 1240L of diesel fuel." This tank is located more than 31 m from any waterbody and has been placed in "a secondary portable berm capable of containing the full volume of this tank in the event that the double-walled system failed". However, no schedule for regular inspections of the tank or secondary containment has been included. A breach in the double-walled Tidy Tank may persist within the secondary containment for an unknown period of time placing the receiving environment and wildlife at potential risk.	TMAC should include the frequency fuel storage structures will be inspected at the Windy Camp, and increase the capacity of the secondary portable berm to 110% the total volume of the 1240L Tidy Tank.	TMAC has clarified in the revised Plan that the tank at Windy is a double-walled enviro tank (i.e. it possesses 110% secondary containment in its design and construction), and is also located inside of tertiary containment, with a capacity > 110 % of the volume of the tank. Although this tank is located at Windy camp, it is there to support Doris activities (it is the fuel supply tank for the potable water pump used to collect all potable water for Doris Camp), as such it is inspected on a regular basis as required under the Doris Water Licence (Part I Items 2 and 4).

Table 4.2. Comments received on previous versions of this Plan and TMAC's responses

Reviewer	Comment #	Comment	Recommendation	Response
CIRNAC	8		Section 2.4.1 of the Hope Bay Spill Contingency Plan indicates that spill response kits will be available near (within 200 m) areas where chemicals are stored and used on site, on fuel transfer vehicles, in moveable containesr, and that additional kits will be added as project activities evolve and new locations of chemical storage and use are identified. Reference is made to Module B for al ist of supplies in each spill kit and aquatic spill response container. This reference is incorrect – contents of spill kits and the aquatic spill response container are provided in Appendix 2: Spill Response Resources. CIRNAC recommends this error be corrected to eliminate confusion.	Corrected in this version of the Plan.
CIRNAC	9		Sections 2.3.12 and 2.2.13 of the Hope Bay Spill Continency Plan make reference to substances that will sink or dissolve if spilled under ice, indicating that response to these substances will be decided on a case-by-case basis, with consultation with regulatory agencies and remediation specialists as necessary. CIRNAC recommends that the plan should include an indication of whether these categories of materials are present on site, what they are, as well as where and how they are stored and/or utilized.	TMAC keeps on file Safety Data Sheets (SDS) for all chemicals and materials on-site. The information provided in the SDS and by the manufacturer define what they are, as well as where and how they are stored and/or utilized. SDS are made available to all employees on site and help define spill response activities for any material, including any substances that will sink or dissolve if spilled under ice.

Reviewer	Comment #	Comment	Recommendation	Response
CIRNAC	10		Appendix 2 of the Hope Bay Project Spill Contingency Plan provides information on spill response resources including mobile equipment, spill kit contents, and aquatic environment response equipment, however no mention is made of specialized equipment and material to cleanup/handle spills, for example, the respirators/self-contained breathing apparatus, fire retardant clothing, sodium or calcium hypochlorite solution, etc. identified in Appendix 1 as required to clean up/neutralize spilled sodium cyanide. CIRNAC recommends Appendix 2 should be enhanced to include all equipment and material referenced in the plan for spill response and the Proponent ensures the equipment is available on site.	Appendix 2 in this version of the Plan has been revised to include specialized equipment required for spill response.
CIRNAC	15	Multiple references (e.g. in Section 2.2.6, 2.2.24 and 4.5.1) incorrectly state that Product Specific Spill Response Plans are provided in Module A	Ensure the proper reference (Appendix 1: Hazardous Materials and Product Specific Spill Response Plans) is used to eliminate confusion	References to appendices corrected in this version of the Plan.

Appendix I

Windy Camp 2018 Reclamation Summary Memo (TMAC)

MEMORANDUM

DATE: February 2019

TO: Kyle Conway and Sarah Warnock, Environmental Supervisor(s), TMAC

FROM: Daniel Skinner, Environmental Projects Technician, TMAC

SUBJECT: **2018 Windy Camp Reclamation Summary**

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1. PURPOSE

The purpose of the memo is to document and summarize the activities, level of effort, and progress achieved in the 2018 field season in relation to reclamation of historic infrastructure at Windy Camp on the Hope Bay Belt.

2. ACTIVITIES

In the summer of 2018, TMAC Resource Inc's (TMAC) Environmental Affairs personnel completed reclamation activities at the Windy Camp property. The focus was to dismantle the Weather Haven tents and wood framed cabins at the north end of the camp (see Figure 2-1).

Figure 2-1: 2013 Aerial Photo with 2018 Reclamation Area Circled in Red

Waste sorting was completed as the structures were taken down and segregated into mega-bags and other containers. Waste was removed from the site and disposed of at the Roberts Bay waste management facility with some waste segregated and stockpiled for future removal as containers are filled.

As the cabins were dismantled, the electrical cables and fixtures were stripped and sorted for disposal. Some of the tarps used for the roofing of the wooden framed cabins were still in good condition and were recovered and saved for future use. In addition, the windows from some of the cabins were in good condition and 10 window units were recovered and stockpiled.

3. RESULTS

The 10 cabins and one (1) cabin foundation shown in Figure 2-1 were taken down in 2018.

Approximately 460 labour hours were used to complete the work.

The quantities of waste removed from Windy Camp while dismantling the 10 cabins is presented in Table 3-1.

Table 3-1: Quantities of Waste Removed from Windy Camp

Truckloads of Burnable Wood	Mega-bags of Construction Debris	Mega-bags of Plastic	Mega-bags of Painted Wood
5	42	6	1

Items that were stockpiled in containers or stacked in piles for future removal is summarized in Table 3-2.

Table 3-2 - Quantities of Waste Segregated & Stockpiled at Windy Camp

Piles of Plywood	Piles of Painted Wood	Barrels of Elect. Cable	Barrels of Elect. Fixtures	Totes of Metal
5	2	2	2	1

Figure 3-1 shows an aerial view of the reclamation in progress on August 26, 2018. Additional reclamation work was completed in early September and the cabins circled in red in Figure 3-1 were also dismantled in 2018.

Figure 3-1: Aerial Photo August 26, 2018. Windy Reclamation in Progress, Cabins Circled in Red Removed in September 2018.