Figure 4.2 Water intake at site CV128

No residual effects are anticipated on fish and fish habitat from the footprint of the pumps at the top of bank or the hose and screened intake in the wetted channel.

4.3.2 ENTRAINMENT IN PUMPS / IMPINGEMENT ON SCREENS

Water extraction can result in entrainment (when a fish is drawn into a water intake) or impingement (when an entrapped fish is held in contact with the intake screen). Baffinland has committed to following the interim code of practice for designing, installing, maintaining, and cleaning small end-of-pipe water intake fish screens (DFO, 2020). The interim code of practice applies to small-scale water intakes, where the water intake flow rate is up to 0.150 m^3/s and to fish that have a minimum fork length of 25 mm, requiring that the design opening of the screen material does not exceed 2.54 mm.

The average field capacity of the 4” Gorman-Rupp pump is 0.75 m^3/minute (0.0125 m^3/s). For the 6” pump, manufacturer published operating discharge rates vary from 0.025 m^3/s to 0.095 m^3/s, depending on total head and suction lift.

Additional mitigation measures outlined in the interim code of practice that will be followed include:

- Siting intakes with low concentrations of fish throughout the year
- Placing screens a minimum of 30 cm above the bottom of the watercourse to prevent the entrainment of sediment and benthos
- Avoid withdrawing water from the littoral zone when possible
- Avoid withdrawing water, or reducing the rate of water withdrawal, during critical timing windows to diminish the likelihood of entraining eggs and larval fish

A qualified professional will identify the exact intake locations at each site, based on suitability of fish habitat.

The critical timing windows during which instream activities should be avoided to reduce the risk of harm to fish and fish habitat in Nunavut are determined by the location of a project (one of two zones) and whether fish species present spawn in the spring or fall (DFO, 2013b). The Mary River Project is located in Fish Timing Zone 1, and the spawning period for Arctic char is in the fall. The critical timing window (when work should be avoided) in areas containing Arctic char spawning habitat is September 1 to June 30. A qualified

professional will determine if water withdrawal is allowed at each site during the critical timing window, based on suitability of spawning habitat.

No residual effects are expected from entrainment or impingement with the implementation of these measures and following the interim code of practice for fish screens.

4.3.3 USE OF INDUSTRIAL EQUIPMENT

Use of industrial equipment could result in the potential mortality of fish or eggs from physical disruption during instream works; increased erosion potential from bank instability resulting in change in substrate composition; or changes in water quality from spills or leakage of fuel, oil, grease, or other contaminants.

Baffinland uses a 4” or 6” Gorman-Rupp pump to fill the water trucks, and the pump remains at the top of the stream or lake bank; therefore, there will not be any direct mortality of fish or eggs from physical disruption or bank erosion from the pump. The intake hose and screen will not be placed on any Arctic char redds or in areas where spawning is observed.

Mitigation measures for working in an around water outlined in the Surface Water and Aquatic Ecosystems Management Plan (Baffinland, 2020) will be implemented. In addition, mitigation measures for fuel handling outlined in the Hazardous Materials and Hazardous Waste Management Plan (Baffinland, 2019) will also be implemented.

4.3.4 CHANGES IN FLOW VOLUMES OR TIMING, DURATION, AND FREQUENCY OF FLOW

Water withdrawal could result in increased water temperature and decreased dissolved oxygen concentrations; and dewatering of downstream areas, causing desiccation of incubating eggs, fish stranding, and fish passage obstruction, as well as reduction in littoral habitat and riparian vegetation. The assessment of hydrological changes (timing, duration, and frequency) from water withdrawals are discussed in Section 3. The risk to fish use and fish habitat (littoral/shore/riparian areas) at the water withdrawal locations, based on site surveys conducted by North/South Consultants Inc. (NSC) in 2019, are discussed in Section 4.4.

4.4 SITE-SPECIFIC ASSESSMENTS

4.4.1 MP-MRY-2 (PHILLIPS CREEK AT MILNE PORT)

Channel morphology is riffle and run, and the river is braided and deltaic, as it flows into Milne Inlet. Substrate is comprised of gravel, small cobble, and patches of sand. The streambed is moderately sloped, with water depth exceeding 1 m at approximately 3 m from shore. Banks are steep and high and consist primarily of sand. Riparian vegetation is absent along the immediate shoreline and comprised of grasses with some moss along the top of the bank.

The MP-MRY-2 (Phillips Creek at Milne Port) site is downstream of the impassable Phillips Creek Falls and fish use of the area is restricted primarily to open water rearing for anadromous juvenile Arctic char, although adults may also occasionally enter the river to feed. The high flows in this reach of Phillips Creek are thought to make it unsuitable for ninespine stickleback, as they have not been observed or captured to

date. The risk to fish and fish habitat as a result of water withdrawal is low. Photos of the water intake site, showing sandy, steep banks and lack of riparian vegetation, are provided in Plate 4.1.

	
Downstream view from the left (east) bank	Upstream view from the left (east) bank

Plate 4.1 MP-MRY-2 (Phillips Creek) Intake Site

4.4.2 WS9.2 (CWP1-ALTERNATE)

This site is located on Phillips Creek at KM 9.2 along the Tote Road and is an alternate location for station CWP1 identified in the previous water licence amendment application (KP, 2019). The proposed site is located on the left bank (east shore) of Phillips Creek, and downstream from the impassable falls at 15 km.

Channel morphology at the intake site is primarily run with some deeper (>1 m) pools. Substrate is primarily gravel, with some cobble and boulder. Depths throughout most of the reach downstream of the falls are shallow (<2.0 m), and the creek likely freezes to the bottom during winter. The shoreline is a steep and riparian vegetation is abundant, comprised of mosses and willows.

The creek near the intake site provides optimal open water rearing habitat for anadromous Arctic char juveniles from Milne Inlet, but minimal overwintering or spawning habitat. Substrate and shoreline conditions are favourable habitat for ninespine stickleback.

Photos of the intake site are shown in Plate 4.2. The risk to fish and fish habitat is low with implementation of the mitigation measures noted in Section 4.3.

	
View from left to right bank	View downstream from left bank

Plate 4.2 WS9.2 (CWP1-Alt)

4.4.3 WS13.3 (CWP2)

This site is located on Phillips Creek and was identified as station CWP2 in the previous water licence amendment application (KP, 2019). The proposed site is located on the left bank (east shore) of Phillips Creek, at KM 13.3 along the Tote Road. The channel width at this site is approximately 100 m.

Stream morphology is rapids, with some riffle and run sections. Substrate in the area is primarily cobble and gravel with some boulders and finer substrates in low velocity areas, and the water depth at the intake site is fairly shallow (maximum depth less than 1.5 m). Upstream of the withdrawal site, the floodplain is relatively wide and riparian vegetation is primarily grass and moss with some willows and wildflowers. The bank is relatively steep over a short distance adjacent to the road and sparsely vegetated.

Arctic char are present in this section of Phillips Creek, but ninespine stickleback have not be captured or observed. Rearing and feeding habitat for Arctic char is abundant within the creek, but overwintering habitat is not present due to the shallow depths. High water velocities prevent use by ninespine stickleback.

Photos of intake site WS13.3 are shown in Plate 4.3. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

	
Aerial view of shore at intake site	View of riparian vegetation at intake site

Plate 4.3 WS13.3 (CWP2)

4.4.4 WS17.4 (FORMERLY CV-128)

Site WS17.4 (formerly CV-128), is located beside a bridge on a tributary to Phillips Creek, near the confluence with Phillips Creek, at approximately KM 17.4 on the Tote Road. A permanent pump is installed at the site and it is routinely used as a water source for dust suppression.

The wetted width in this tributary ranges from approximately 41 m to 45 m, and water velocity during early baseline sampling ranged from 0.11 m/s to 0.53 m/s. Mean water depth at the intake is estimated to be approximately 1 m to 1.5 m. Stream morphology is characterized as riffle and run with occasional deep pools, and the substrate is anthropogenic (riprap) in the immediate area of the bridge footings. Cobble, gravel, and finer materials, with the occasional boulder, are found in undisturbed areas upstream and downstream of the bridge. No macrophytes are present at the intake site, but periphyton is abundant during the summer. Riparian vegetation is absent along the immediate shoreline near the bridge footings but comprised of grasses with some moss along the top of the bank in undisturbed areas. The water intake is in a back eddy with silt/sand substrate along the shore, with increasing proportions of cobble offshore.

The stream provides rearing habitat for juvenile land-locked Arctic char and occasional summer feeding habitat for adults. Boulders provide the predominant form of cover. The site does not provide overwintering habitat or char spawning habitat due to inadequate depth. Ninespine stickleback have not been observed at this site, likely due to persistent high flows during the open water season, and lack of boulders and aquatic vegetation for cover.

The risk to fish and fish habitat as a result of water withdrawal is low. Photos of water intake site, showing the lack of instream cover and riparian vegetation, are provided in Plate 4.4.

	
Cross channel view from right to left bank	Nearshore intake site

Plate 4.4 WS17.4 (CV-128) Intake Site

4.4.5 WS20.5 (CWP3-ALTERNATE)

This site is located on Phillips Creek at KM 20.5 along the Tote Road, and is an alternate location for station CWP3 identified in the previous water licence amendment application (KP, 2019). Channel width is approximately 50 m at the intake site.

Channel morphology is primarily riffle and run, and substrate is predominantly cobble and gravel with some boulder. Aquatic vegetation is restricted to periphyton. Riparian vegetation is comprised of grasses and moss, with the occasional willow.

Open water rearing and feeding habitat for Arctic char are abundant; however, overwintering is thought to occur in the tributary lakes in the reach, as the water is relatively shallow (not exceeding 0.5 m to 0.6 m). The cobble and boulder substrate provide cover for juvenile Arctic char and ninespine stickleback in the lower velocity inshore area.

Photos of intake site WS20.5 are provided in Plate 4.5, showing the cobble and gravel substrate and low velocity near-shore habitat. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

	
View cross channel from left to right bank	View upstream from left bank

Plate 4.5 WS20.5 (CWP3-Alternate)

4.4.6 WS23.3 (CWP4)

This site is located on Phillips Creek at KM 23.3 along the Tote Road, and was identified as station CWP4 in the previous water licence amendment application (KP, 2019). Channel width is approximately 50 m at the intake site.

Channel morphology at the site is mainly run and pool, with low velocities and a gradually sloping shore (maximum depth of 1 m to 2 m within 5 m to 7 m from the shoreline). Substrate at the intake site is primarily fines. No rooted macrophytes are present, and algae is patchily distributed and sparse. Riparian vegetation is comprised of grasses, mosses, and a few willows.

The stretch of Phillips Creek provides foraging and rearing habitat for land-locked Arctic char, but water depth is insufficient to provide spawning or overwintering habitat for the species. The predominantly sand substrate does not provide ideal cover for juvenile Arctic char, though aquatic vegetation (primarily patchy benthic algae) may offer some shelter for young of year. Although ninespine stickleback have not been confirmed in this reach of Phillips Creek, the low flows and aquatic vegetation may provide suitable rearing habitat.

Photos of intake site WS23.3 are shown in Plate 4.6. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

	
View upstream from left bank	View of substrate 30 m upstream of intake site

Plate 4.6 WS23.3 (CWP4)

4.4.7 WS27.1 (KM27 LAKE)

This water station is located on a small lake on Phillips Creek at km 27.1 along the Tote Road. It was identified as station CWP5 in the previous water licence amendment application (KP, 2019). This site is proposed to supply water for dust suppression during the summer, and as a domestic/industrial water supply year-round. If used as a camp water supply, it would be as an alternative to KM32 Lake, which is currently used year-round (Section 4.4.8).

Three potential water withdrawal sites have been identified as follows: WS27.1a, WS27.1b and WS27.1c. The location selected for summer withdrawals (WS27.1a) is not suitable as a winter water source for reasons described below. As such, two alternative sites are also proposed: WS27.1b as a winter-only withdrawal site, and WS27.1c as a potential year-round withdrawal site.

WS27.1a – Summer Withdrawals

This site is located on a small off-channel lake, with an area of 4.5 ha and a shoreline length of 1,023 m. The substrate is cobble and gravel. Some aquatic vegetation (mainly algae) is present. The lake shore is gently sloping, with an average depth of 1 m up to 10 m from shore. The bank is moderately sloped with patchy grasses and mosses.

The lake provides good open water rearing habitat for Arctic char. Ninespine stickleback have not been captured in surveyed tributaries in this area, but the species could potentially use the withdrawal area for all life history stages.

Photos of the summer intake site WS27.1a are provided in Plate 4.7, and the location of the water station is shown on Figure A.7 in Appendix A. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

WS27.1b – Winter Withdrawals

This site is located on KM27 Lake itself, at an offshore location as indicated on Figure A.7 in Appendix A. There is sufficient water for winter withdrawals, based on the lake bathymetry shown as Figure 4.3 (NSC, 2012), and considering winter withdrawal best practices. Baffinland's Fresh Water Supply, Sewage and Wastewater Management Plan states that during winter under ice conditions, water must be drawn from below 2 m of non-frozen water, as the top 2 m of water provides higher oxygenation for resident fish.

	
View from east shore	View north, showing mixed substrate

Plate 4.7 WS27.1 (CWP5)

WS27.1c – Candidate Alternate Location for Summer and Winter Withdrawals

This site is also located on KM27 Lake at a location with deep water close to shore (Figures 4.3 and A.7), making it an ideal site for both summer and winter withdrawals. Though the nearshore habitat was not assessed, it is believed to be a suitable location based on deep water close to shore that makes disturbing the substrate unlikely. This location is furthest from the tote road compared with the other two options, and hence Baffinland may decide not to construct an access trail to this site.

4.4.8 WS32.8 (FORMERLY MP-MRY-3/KM32 LAKE)

Site WS32.8 (formerly referred to as MP-MRY-3) is located on an unnamed lake, colloquially referred to as KM32 Lake, on the Phillips Creek mainstem at approximately km 32.8 on the Tote Road. It is an approved water source under the water licence that is used as a year-round source of water for Milne Port.

The lake is 155 ha in size and has a shoreline length of 8.3 km. Maximum depth is estimated to be greater than 100 m. The lake at the intake site is relatively shallow (estimated as less than 1 m to approximately 7 m to 8 m from shore). The substrate is predominantly sandy at the summer intake site, transitioning to gravel along the gradually sloping bed. Riparian vegetation is sparse and comprised of patchy grasses.

During early baseline surveys, large numbers of Arctic char juveniles of all sizes were observed using nearshore habitat; and the lake is assumed to support spawning, based on the presence of young of year fish. Ninespine stickleback are likely present in the lake, given the abundance of suitable habitat.

The lack of cover, small substrates, and shallow depth at the summer intake is expected to limit the use of the area by both species; therefore, the risk to fish and fish habitat as a result of water withdrawal is low. Photos of water intake site WS32.8 are provided in Plate 4.8.

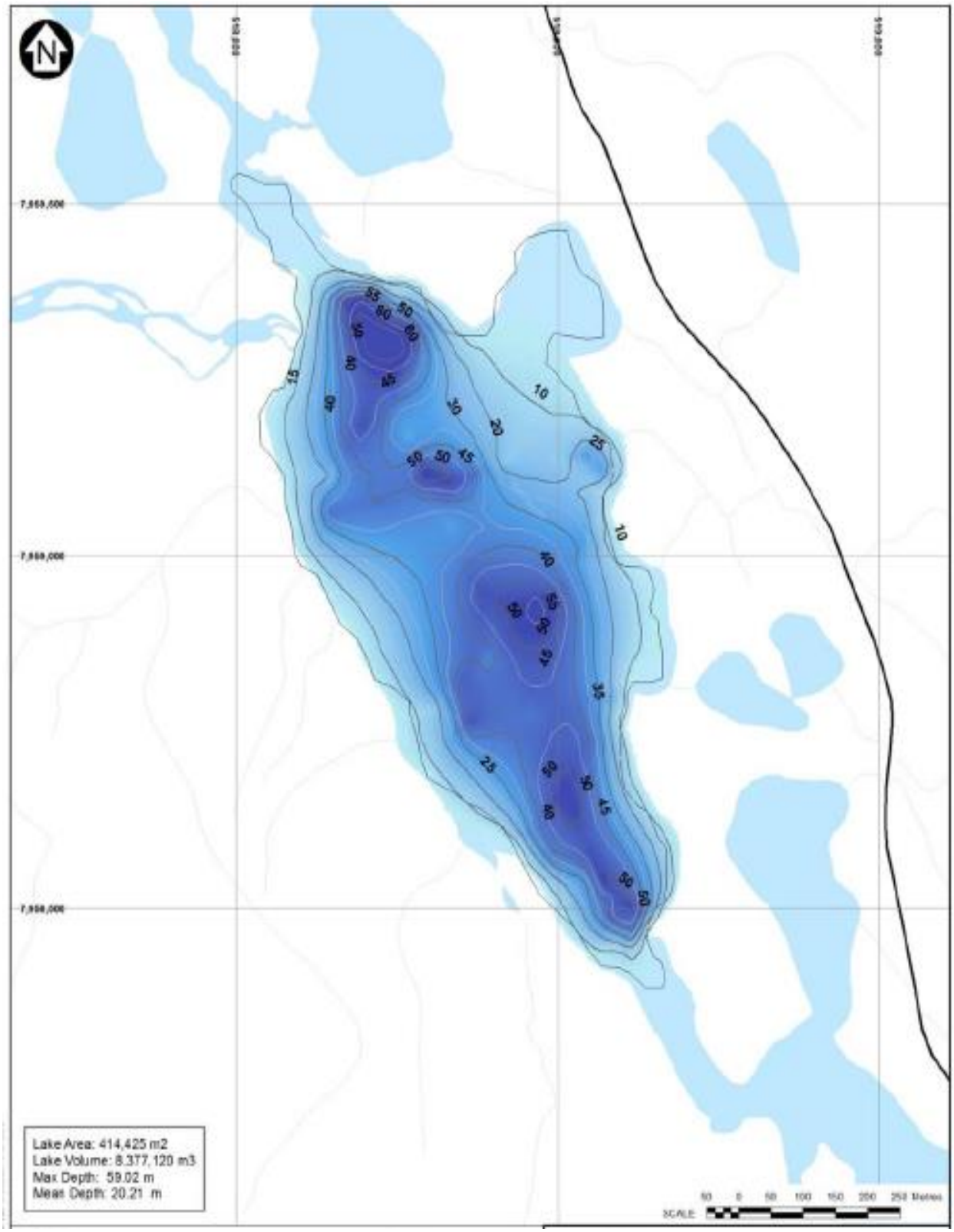


Figure 4.3 KM27 Lake Bathymetry (NSC, 2012)

	
View south along east shore of lake	View north along east shore of lake

Plate 4.8 WS32.8 (MP-MRY-3) Intake Site

The winter withdrawal site is located away from the shore in suitably deep water as per Baffinland's Fresh Water Supply, Sewage and Wastewater Management Plan, which states that during winter water must be drawn from below 2 m of non-frozen water, as the top 2 m of water provides higher oxygenation for resident fish.

4.4.9 WS37.0 (CV099-ALTERNATE)

This site is an off-channel pond on Phillips Creek at KM 37.0 along the Tote Road, and is proposed as a replacement for the previously approved CV099 station, located approximately 1 km south. The pond has a surface area of approximately 1.3 ha and a shoreline length of 434 m.

The site is located on the east shore of the off-channel pond. The substrate is gravel, and angular cobble and boulder. Water depth is less than 1 m to approximately 30 m from shore. No aquatic vegetation is present. Riparian vegetation is patchy grass, moss, and the occasional willow.

Habitat near the intake site is suitable for Arctic char rearing in the open water season. Ninespine stickleback have not yet been observed in this area, but habitat at the withdrawal site is suitable for the species.

Photos of intake site WS37.0 are provided in Plate 4.9, showing the riparian area and nearshore habitat. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

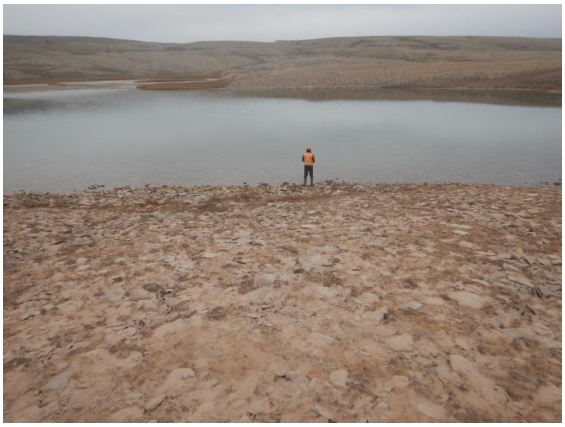
	
View from the Tote Road looking west	View north

Plate 4.9 WS37.0 (CV099-Alternate)

4.4.10 WS42.0 (CWP6 – ALTERNATE 2)

This site is located on Phillips Creek at KM 42 along the Tote Road and is an alternate location of a station identified as CWP6 in the previous water licence amendment application (KP, 2019).

Channel morphology at this site is a run with cobble and gravel substrate. Depths increase to greater than 1 m approximately 3 m from the shore. Instream vegetation is algae, and riparian vegetation is sparse moss and willows. There is abundant suitable open water rearing habitat for juvenile Arctic char and ninespine stickleback at the withdrawal site.

Photos of intake site WS42.0 are provided in Plate 4.10. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

	
View from the Tote Road	View downstream from left bank

Plate 4.10 WS42.0 (CWP6-Alternate 2)

4.4.11 WS45.0 (CWP7)

This site is located on a small unnamed lake in Phillips Creek at approximately KM 45 on the Tote Road, and was identified as station CWP7 in the previous water licence amendment application (KP, 2019). The lake has a surface area of approximately 14 ha and a shoreline length of 1,800 m.

The proposed water intake site is located on the eastern shore of the lake. The immediate nearshore area at the proposed intake site is relatively shallow (less than 1 m within 8 m of the shoreline) and the substrate is angular boulder and cobble with some gravel. No aquatic vegetation is present.

The lake substrate provides optimal cover for juvenile Arctic char and for ninespine stickleback. The depth of the lake is unknown but is suspected to be sufficient to support spawning and overwintering for both species.

Photos of intake site WS47.0 are shown in Plate 4.11. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

	
View west	View south

Plate 4.11 WS45.0 (CWP7)

4.4.12 WS47.1 (CV087 – ALTERNATE 2)

This site is on Phillips Creek where the channel widens to form a large pond, approximately 14 ha in area and with a shoreline length of approximately 2.3 km. The station is south of the previously approved CV087 water station, located on a small tributary to Phillips Creek, just downstream of the Tote Road culvert at CV-087. Baffinland proposes to remove CV087 from the water licence, as it has insufficient depths for withdrawal throughout most of the open water period, and hence is rarely if ever used.

Nearshore substrate is largely small and large cobble and gravel overlying fines. Depth increases gradually, reaching 1 m approximately 10 m from shore. The bank is gradually sloping from the Tote Road, with patchy grasses among cobble. Riparian vegetation is patchy, sparse grass.

The pond substrate provides optimal cover for juvenile Arctic char and for ninespine stickleback. The depth of the lake is unknown but is suspected to be sufficient to support spawning and overwintering for both species.

Photos of intake site WS47.1 are shown in Plate 4.12. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

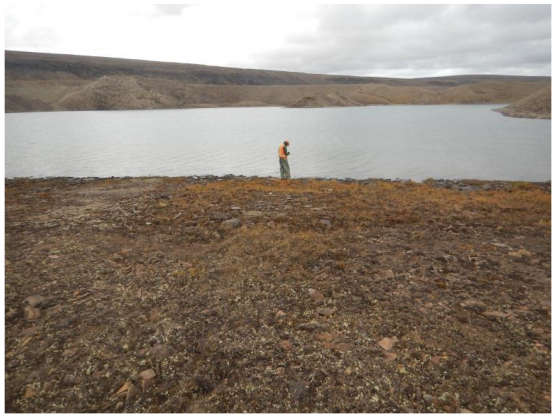
	
View from the left to the right bank (to the west)	View south from the left bank

Plate 4.12 WS47.1 (CV087 – Alternate 2)

4.4.13 WS52.9 (KATIKTOK LAKE)

This water station is located on Katiktok Lake. Site CV078 Alternate 2, is on the east shore at the north end of Katiktok Lake, near the headwaters of the Phillips Creek mainstem at approximately KM 52.9 on the Tote Road. The lake has a surface area of approximately 450 ha and a shoreline length of 21 km.

Substrate at the intake site is largely gravel with some cobble, and the bed is moderately sloping, increasing to greater than 1 m at approximately 4 m from the shore. The bank shore texture is cobble and gravel and gradually sloping. No aquatic vegetation is present near the site, and riparian vegetation is patchy and comprised of sparse grass and moss.

Fish sampling has not been conducted in the lake, but Arctic char have been captured in tributary streams flowing into the north end of the lake, so their presence is assumed. Katiktok Lake is likely deep enough to provide spawning and overwintering habitat for Arctic char. Ninespine stickleback have not been captured in the tributaries, but the species is assumed to be present based on suitable habitat elsewhere in the lake.

Photos of water intake site WS52.9 are provided in Plate 4.13, showing the predominantly gravel substrate and lack of riparian vegetation. The risk to fish and fish habitat as a result of water withdrawal is low, due to the shallow water in the littoral zone and lack of cover.

	
View of intake site	View south along east shore of lake Katiktok Lake

Plate 4.13 WS52.9 (Katiktok Lake) Intake Site

4.4.14 WS52.9 (CV078 – ALTERNATE 2)

This site is located at the north end of Katiktok Lake and replaces the previously approved CV078 water station. CV078 is on a small tributary to Phillips Creek and Baffinland proposes to remove the site from the water licence application due to insufficient depths for withdrawal throughout most of the open water period. Katiktok Lake has a surface area of approximately 450 ha and a shoreline length of 21 km; the intake site is on the east shore at the north end of the lake.

Arctic char have been captured in tributary streams that flow into the north end of Katiktok Lake, and the lake is assumed to provide spawning and overwintering habitat for Arctic char. Ninespine stickleback have never been captured in the streams that flow into Katiktok Lake, but the lake does provide suitable habitat for the species.

Substrate at the intake site is largely cobble and gravel. The shoreline depth is moderately sloping, increasing to greater than 1 m at a distance of 4 m to 5 m from shore. The bank is gradually sloping from the Tote Road and composed mainly of cobble and gravel, and riparian vegetation is sparse grass and moss.

Photos of intake site WS52.9 are shown in Plate 4.14. The risk to fish and fish habitat from water withdrawal is low with implementation of the mitigation measures noted in Section 4.3.

	
View north	View south

Plate 4.14 WS52.9 (CV078 – Alternate 2)

4.4.15 WS63.5 (FORMERLY BG50)

This station, formerly referred to as BG50, is near a bridge on an unnamed tributary flowing into the Ravn River from the northeast at KM 63.5 along the Tote Road.

The channel morphology at this site is riffle at high flows, and riffle (80%) and pool (20%) during lower flows. Wetted widths range from approximately 45 m to 60 m, and bankfull width is 77 m. Substrate at the intake site is largely gravel and cobble, overlain with fines, and the bed is moderately sloping. Water depths in the riffles are estimated to be 0.20 m, and pools have a maximum depth of 0.5 m. No aquatic macrophytes are present, and periphyton is patchily distributed. The bank shore texture is cobble and gravel and gradually sloping. Riparian vegetation is sparse grass.

Large numbers of juvenile Arctic char have been observed at the road crossing during the open water rearing period, but the site does not provide overwintering habitat for Arctic char due to inadequate depths. Arctic char potentially spawn in this section of the creek but water depths at the intake site do not provide suitable spawning habitat. Ninespine stickleback have not been captured, and the high flows at the site are assumed to preclude their presence.

Photos of water intake site WS63.5, showing the shallow nearshore habitat and gravel-cobble substrate overlain by fines, are provided in Plate 4.15. The risk to fish and fish habitat as a result of water withdrawal is low, due to the shallow water and lack of cover in the littoral zone.

	
View downstream at the intake site	View of substrate at the intake site

Plate 4.15 WS63.5 (BG50) Intake Site

4.4.16 WS79.9 (FORMERLY CV217)

Site WS79.9 (formerly referred to as CV217) is at the outlet of Muriel Lake, in the Ravn River watershed. A permanent pump is installed on the south side of the outlet downstream of a bridge crossing the Tote Road.

The channel morphology at this site is run and pool, and wetted widths range from approximately 70 m to 137 m. Substrate at the intake site sand and cobble, and the bed is moderately sloping. Average water depth is 0.3 to 0.5 m, and pools have a maximum depth of 2 m. Water velocity is variable, ranging from 0 m/s up to 0.76 m/s. No aquatic macrophytes are present, and algae is sparse and patchy. The bank material is anthropogenic, comprised of the bridge abutment and road aggregate. Riparian vegetation upstream and downstream of the intake site and bridge abutments is small intermittent patches of small plants, willows, and grasses.

Juvenile and adult Arctic char have been observed/captured in the vicinity of the intake site, and ninespine stickleback have been captured in nearshore habitat in Muriel Lake upstream of the bridge. No instream cover is present. The area around the intake site provides open water rearing habitat for both species but does not support Arctic char overwintering or spawning. Muriel Lake upstream of this site provides important rearing, overwintering, and spawning habitat for both species further offshore.

Photos of water intake site WS79.9 are provided in Plate 4.16, showing the primarily sand substrate, shallow depth, and lack of instream and overbank cover. The risk to fish and fish habitat because of water withdrawal is low, given the lack of optimal rearing habitat.

	
View upstream from right bank	View downstream from right bank

Plate 4.16 WS79.9 (CV217) Intake Site

4.4.17 WS80.3 (MURIEL LAKE)

Site WS80.3 (formerly referred to as Muriel Lake) is on the south shore of Muriel Lake, in the Ravn River watershed. The area of Muriel Lake is approximately 488 ha and the shoreline length is 14 km. The approved water withdrawal site on Muriel Lake is on the shoreline approximately 250 m southeast of the Tote Road bridge crossing CV-217 at the outflow of the lake.

Ninespine stickleback and juvenile Arctic char have been captured in nearshore habitat in the lake and adult char have been observed at the lake outflow and farther offshore. The lake provides rearing, overwintering, and spawning habitat for both species offshore.

The substrate near the shore is sand, and the shoreline is gently sloping, remaining relatively shallow (<0.5 m) until approximately 10 m from shore. No instream cover or aquatic vegetation are present. Riparian vegetation, primarily grasses, are present at the top of bank. Photos of water intake site WS79.9 are shown in Plate 4.17. The risk to fish and fish habitat from water withdrawal is low.

	
Cross channel from left bank, September 2020	View downstream from right bank, September 2020

Plate 4.17 WS780.3 (Muriel Lake Intake Site

4.4.18 WS87.7 (FORMERLY DAVID LAKE)

Site WS87.7 (formerly referred to as David Lake) is on the southwest shore of David Lake at KM 87.7 along the Tote Road. David Lake has an estimated area of 280 ha and a shoreline length of approximately 15 km.

Substrate at the intake site is mainly fines with some small cobble and gravel close to shore. The lake bed is gently sloping, reaching a depth of 1 m approximately 5 m from shore, and the bank texture is cobble gravel. Riparian vegetation is grasses and mosses.

Juvenile Arctic char have been observed along the shoreline of the lake and in nearby tributary streams, and adult Arctic char have been observed offshore. The lake provides suitable Arctic char habitat for rearing, overwintering, and spawning. Ninespine stickleback have not been captured or observed in the lake but have been captured in a tributary stream that flows into the southeast end of the lake, so their presence is assumed in the lake, as it provides overwintering habitat, and possibly rearing and spawning habitat.

Photos of water intake site WS87.7 are shown in Plate 4.18. The risk to fish and fish habitat as a result of water withdrawal is low, due to the lack of fish cover.

	
View of David Lake from the south	View northwest of David Lake shoreline

Plate 4.18 WS87.7 (David Lake) Intake Site

4.4.19 WS94.0 (CWP12 – ALTERNATE 2)

This site is located on the east shore of a small, unnamed lake in the Ravn River watershed, south of the previously proposed CWP12. The lake has an area of 35 ha and a shoreline length of 3 km.

Although the lake has not been assessed for fish presence, offshore surface feeding, presumably by adult char, on emerging insects has been observed. In addition, Arctic char and ninespine stickleback have been captured or observed in the main inflow stream from the south. The lake has sufficient depth for overwintering and likely also provides suitable spawning habitat.

Aquatic habitat at the intake site is cobble within 0.5 m of the shore, transitioning to soft fines offshore. The lake bed is moderately sloped, with depths increasing to greater than 1 m within 2 m to 3 m of shore. The

banks are vegetated and moderately sloped. Riparian vegetation is primarily grass with some moss and wildflowers.

Photos of intake site WS94.0 are shown in Plate 4.19. The risk to fish and fish habitat from water withdrawal is low.

	
View west from the Tote Road	View northwest from east shore of lake

Plate 4.19 WS94.0(CWP12 – Alternate 2)

4.4.20 WS97.0 (FORMERLY CV223)

Site WS97.0 (formerly referred to as CV223) is on the Tom River at KM 97 along the Tote Road. Tom River is the largest inflow to the north basin of Mary Lake.

The lower 1,500 m of the river is 90% run and 10% riffle during spring and 85% riffle and 15% run during summer and fall. Water depths in the spring are greater than 1 m and decline to 0.5 m in the summer and fall. Wetted widths range from approximately 40 m to 117 m. Water velocity ranges from 0.01 m/s to 1.26 m/s. This reach consists of several braided channels, with a bankfull width of 195 m, at the Tote Road crossing. Cobble is the dominant substrate type, followed by boulders. At the intake site near the Tote Road, channel morphology is riffle and pool and substrate is predominantly cobble and gravel. The only aquatic vegetation is periphyton. The bank is moderately sloped and rocky, and riparian vegetation is absent around the bridge abutments.

Juvenile Arctic char have been consistently captured or observed in the Tom River during the open water season. Depth is insufficient for Arctic char spawning, and the river freezes to the bottom during winter. Ninespine stickleback have never been captured in the Tom River, and it is expected that the typically high velocities in this river render it unsuitable for the species. Large cobbles and boulders provide the only instream cover.

Photos of water intake site WS97.0 are provided in Plate 4.20. The risk to fish and fish habitat is low with implementation of the mitigation measures noted in Section 4.3.

	
View of Tom River in September 2020	View of Tom River in June 2020

Plate 4.20 WS97.0 (CV223) Intake Site

4.4.21 CAMP LAKE

Water is withdrawn from an existing water jetty in Camp Lake. As such, a habitat assessment is not required.

5.0 DISCUSSION AND CONCLUSION

Fish use and fish habitat features as well as site access constraints were assessed at 44 existing and proposed water withdrawal locations between August 29 and September 1, 2019. Refined information was received from Baffinland regarding pumping rates and updated water requirements from each site. Based on the results of these surveys and additional information, Baffinland now expects to withdraw water from a total of 21 sites along the road and rail alignment (10 approved and 11 proposed). These are presented in Table 5.1.

Table 5.1 Proposed Water Stations

Site ID	Former Site ID	Waterbody Name	Proposed Withdrawals		Maximum Pumping Rate
			Open Water	Ice Cover	
			(m^3/day)	(m^3/day)	(m^3/min)
MP-MRY-2	MP-MRY-2	Phillips Creek mainstem	1,630		5.7
WS9.2	CWP1	Phillips Creek mainstem	880		5.7
WS13.3	CWP2	Phillips Creek mainstem	880		5.7
WS17.4	CV-128	Phillips Creek northern tributary	1,870		5.7
WS20.5	CWP3	Phillips Creek mainstem	880		5.7
WS23.3	CWP4	Phillips Creek	880		5.7
WS27.1	CWP5	km27 Lake, Phillips Creek mainstem	2,290	750	None
WS32.8	MP-MRY-3	km32 Lake, Phillips Creek mainstem	2,750	750[1]	None
WS37.0	CV099	Pond on Phillips Creek mainstem	880		5.7
WS42.0	CWP6	Phillips Creek mainstem	880		2.6
WS45.0	CWP7	Phillips Creek mainstem	880		2.5
WS47.1		Phillips Creek mainstem	880		2.3
WS52.9	Katiktok Lake	Katiktok Lake	1,500	Note 1	None
WS63.5A	BG50	Ravn River	880		2.5
WS63.5B		Ravn River	1,000		2.5
WS79.9	CV217	Muriel Lake	1,870		None
WS80.3	Muriel Lake	Muriel Lake	880	Note 1	None
WS87.7	David Lake	David Lake	1,540		None
WS94.0	CWP12	Unnamed Lake	400		None
WS97.0	CV223	Tom River	2,200		3.4
Camp Lake	Camp Lake	Camp Lake	1,657.5	657.5[1]	None

NOTES:

1. ONE-TIME WINTER WATER WITHDRAWALS OF 2,000 M3 FOR WINTER ROAD CONSTRUCTION ASSOCIATED WITH BRIDGE CONSTRUCTION. THESE VOLUMES HAVE NOT BEEN INCORPORATED INTO THE ASSESSMENT.
2. STREAMS ARE SHADED BLUE AND LAKES ARE SHADED GREEN.

Water withdrawals have the potential to impact fish and fish habitat through the following mechanisms (DFO, 2010a):

- Placement of structures in water
- Entrainment in pumps / impingement on screens
- Use of industrial equipment
- Oxygen depletion, loss of over-wintering habitat, and/or reductions in littoral habitat during winter water withdrawal from ice-covered waterbodies
- Changes in flow volumes or timing, duration, and frequency of flow

This assessment consisted of hydrological assessments and site-specific assessments of fish habitat.

The hydrological assessment concluded the following:

- Water can be extracted at the maximum pumping rate of 5.7 m^3/min at any time between mid-June and mid-September without exceeding 10% of the instantaneous flow at seven stations within the lower Phillips Creek catchment:
  - MP-MRY-2
  - WS9.2
  - WS13.3
  - WS17.4
  - WS20.5
  - WS23.3
  - WS37.0
- Water can be extracted at lower pumping rates specified in Table 5.1 at any time between mid-June and mid-September and at the maximum pumping rate (5.7 m^3/min) 90% to 95% of the time without exceeding 10% of the flow 99% of the time between mid-June and mid-September at the following six stations:
  - WS42.0, WS45.0 and WS47.1 within the upper portion of the Phillips Creek catchment
  - WS63.5A and WS63.5B on the Ravn River
  - WS97.0 on the Tom River
- The cumulative water withdrawal from thirteen (13) water stations located on Phillips Creek was assessed, based on the maximum quantity of water that could be withdrawn by 11 water trucks (7,700 m^3.day) during construction of the North Railway. This daily extraction volume represents 3% of the flow that is exceeded 99% of the time between mid-June to mid-September in lower Phillips Creek.
- Proposed water withdrawals can occur at eight (8) water stations on seven lakes:
  - WS27.1 (KM27 Lake)
  - WS32.8 (KM32 Lake)
  - WS52.9 (Katiktok Lake)
  - WS79.9 and WS80.2 (Muriel Lake)
  - WS87.7 (David Lake)
  - WS94.0 (unnamed lake)

  The proposed water withdrawals from these lake water stations during open water will not exceed 10% of the mean monthly lake outflow or the 10-year annual low flow values, and winter water withdrawals from KM27 Lake, KM32 Lake and Camp Lake will not exceed DFO's under ice water withdrawal threshold of 10% of the under-ice volume. For the lakes that are subject to winter water withdrawals,

the winter drawdown was included in the quantity of water considered extracted during the month of June, as this volume of water could potentially delay lake outflows in the spring.

The site-specific fish habitat assessments concluded the following:

- Water withdrawal activity will not result in changes in channel morphology or shoreline morphometry. Riparian vegetation is sparse and comprised of grasses and mosses; there is typically no vegetation along the immediate shoreline of the waterbodies. Riparian vegetation clearing is not required to access the water withdrawal sites, and there is no disturbance to the stream banks.
- The hose and screened intake will not result in a constriction of flow or interfere with fish passage. The hose and screened intake are submerged near the stream bottom and have a minimal footprint. The stream channels at the intake sites will have sufficient wetted width and depth to allow placement of the hose and pump with full submergence, allowing water to flow over the hose rather than around it. No residual effects are anticipated on fish and fish habitat from the footprint of the pumps at the top of bank or the hose and screened intake in the wetted channel.
- Water extraction can result in entrainment (when a fish is drawn into a water intake) or impingement (when an entrapped fish is held in contact with the intake screen). Baffinland has committed to following the interim code of practice for designing, installing, maintaining, and cleaning small end-of-pipe water intake fish screens (DFO, 2020). The interim code of practice applies to small-scale water intakes, where the water intake flow rate is up to 0.150 m^3/s and to fish that have a minimum fork length of 25 mm, requiring that the design opening of the screen material does not exceed 2.54 mm. No residual effects are expected from entrainment or impingement with the implementation of mitigation measures and following the interim code of practice for fish screens.

The risks to fish and fish habitat from water withdrawal were determined to be low at all sites with the implementation of mitigation measures.

6.0 REFERENCES

Baffinland Iron Mines Corporation (Baffinland), 2012. *Final Environmental Impact Statement*. February.

Baffinland Iron Mines Corporation (Baffinland), 2018. *Addendum to the FEIS for the Phase 2 Proposal*. October.

Baffinland Iron Mines Corporation (Baffinland), 2019. *Draft Hazardous Materials and Hazardous Waste Management Plan*. Rev A. BAF-PH1-930-P16-0011.

Baffinland Iron Mines Corporation (Baffinland). 2020. *Surface Water and Aquatic Ecosystems Management Plan*. Rev E. BAF-PH1-830-P16-0026.

Fisheries and Oceans Canada (DFO), 2010a. *Pathways of Effects - Water Extraction*. Retrieved from: https://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/extraction-eng.html. (accessed March 2021).

Fisheries and Oceans Canada (DFO), 2010b. *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut*. June 21.

Fisheries and Oceans Canada (DFO), 2013a. *Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada*. Canadian Science Advisory Secretariat. Science Advisory Report 2013/017.

Fisheries and Oceans Canada (DFO), 2013b. *Nunavut Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat*. Retrieved from: https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/nu-eng.html. (accessed March 2021).

Fisheries and Oceans Canada (DFO), 2020. *Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater*. Retrieved from: https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html) (accessed March 2021).

Knight Piésold Ltd. (KP), 2012. *Mary River Project, Baseline Hydrology Report*. January 4. North Bay, Ontario. Ref. No. NB102-181/30-7, Rev. 1.

Knight Piésold Ltd. (KP), 2017. Letter to: Mr. Adam Grzegorczyk, Baffinland Iron Mines Corporation. Re: *Hydrologic Assessment for Water Crossings - Proposed North Railway - Phase 2 Proposal - Mary River Project*. September 1. Vancouver, British Columbia. Ref. No. VA17-01009 (NB102-00181/39).

Knight Piésold Ltd. (KP), 2018. Letter to: Mr. Lou Kamermans, Baffinland Iron Mines Corporation. Re: *Hydrology Assessment of Water Sources for Dust Suppression Along the Tote Road and North Railway - Mary River Project - Phase 2 Proposal*. October 3. North Bay, Ontario. Ref. No. NB18-00672 (NB102-00181/45).

Knight Piésold Ltd. (KP), 2019. Mary River Project - Phase 2 Proposal. *Updated Application for Amendment No. 2 of Type A Water Licence 2AM MRY1325*. May.

North/South Consultants Inc. (NSC) and Knight Piésold Ltd. (KP), 2008. *Mary River Project Railway/Access Road Watercourse Crossing Assessment Protocol.*

North/South Consultants Inc. (NSC), 2012a. *Freshwater Aquatic Biota and Habitat Baseline Synthesis Report 2005-2011*. Report Prepared for Baffinland Iron Mines Corporation. Appendix 7C Mary River Project Final Environmental Impact Statement.

North/South Consultants Inc. (NSC), 2012b. *A Generalized Life History Description for Arctic Char and Ninespine Stickleback with Emphasis on Baffin Island Populations*. Appendix 4.4-3 of the Mary River Project Freshwater Aquatic Baseline Synthesis Report: 2005-2011.

North/South Consultants Inc. (NSC), 2019. *Mary River Phase 2 Proposal: Water Intake Aquatic Habitat Surveys*. Technical Memo prepared for Baffinland Iron Mines Corporation. Draft. November 2.

Nunavut Water Board (NWB), 2015. *Type A Water Licence No. 2AM-MRY1325 – Amendment 1.* July 30.

7.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Richard Cook, P.Geo. Ltd.
Specialist Environmental Scientist | Associate

Prepared:

Stephanie Eagen, R.P.Bio.
Senior Environmental Scientist

Reviewed:

Toby Perkins, M.A.Sc., P.Eng.
Senior Engineer

Reviewed:

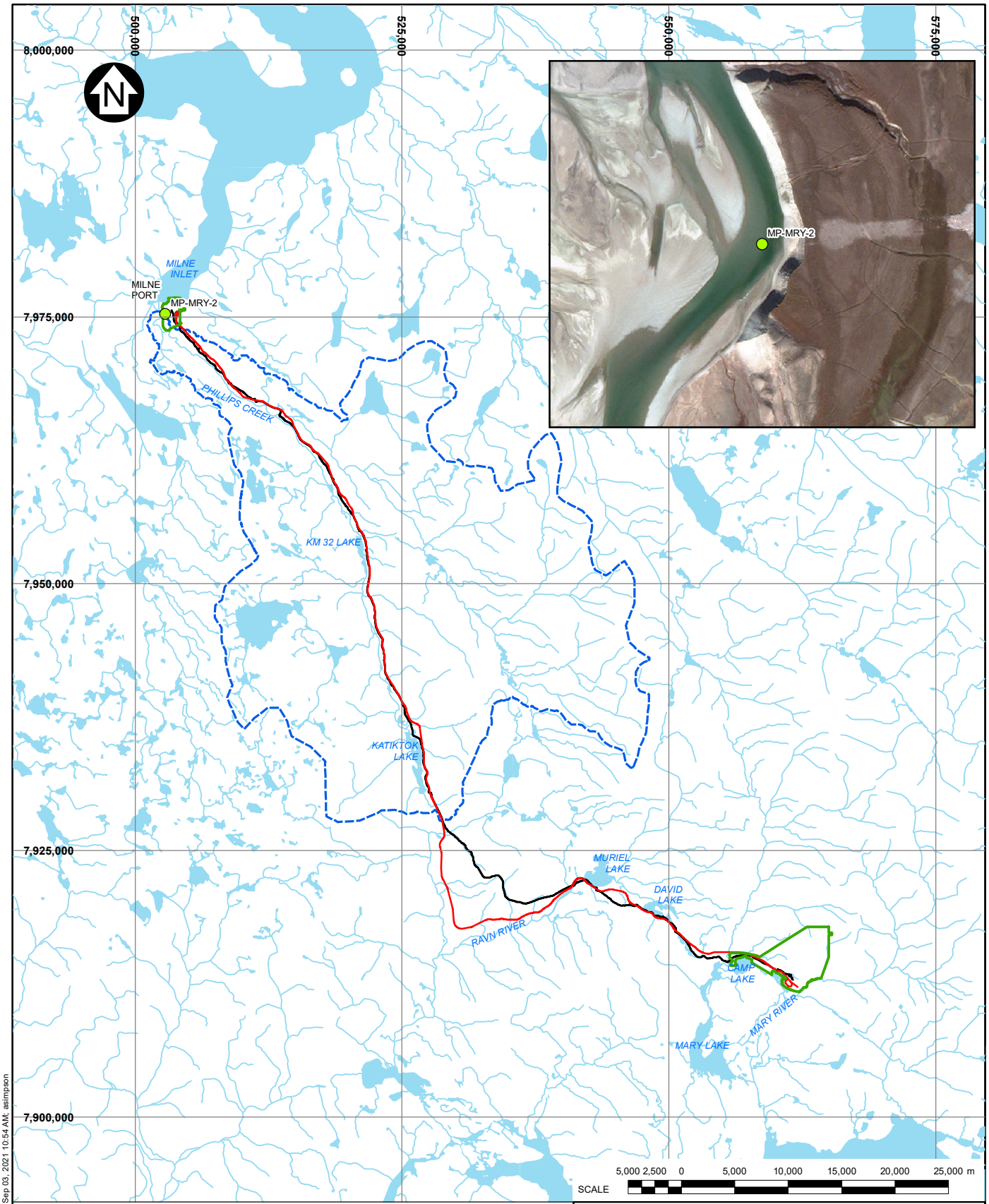
Oscar Gustafson, R.P.Bio.
Specialist Environmental Scientist | Associate

Approval that this document adheres to the Knight Piésold Quality System:

APPENDIX A

Catchment Boundaries

(Pages A-1 to A-19)



LEGEND:

- APPROVED WATER STATION
- PROPOSED WATER STATION
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- POTENTIAL DEVELOPMENT AREA
- CATCHMENT BOUNDARY

NOTES:

1. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP IMAGERY: c 2020 DIGITAL GLOBE, INC.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	03SEP'21	ISSUED WITH REPORT	RAC	AS	RAC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

WATER STATION
MP-MRY-2 CATCHMENT

Knight Piésold CONSULTING

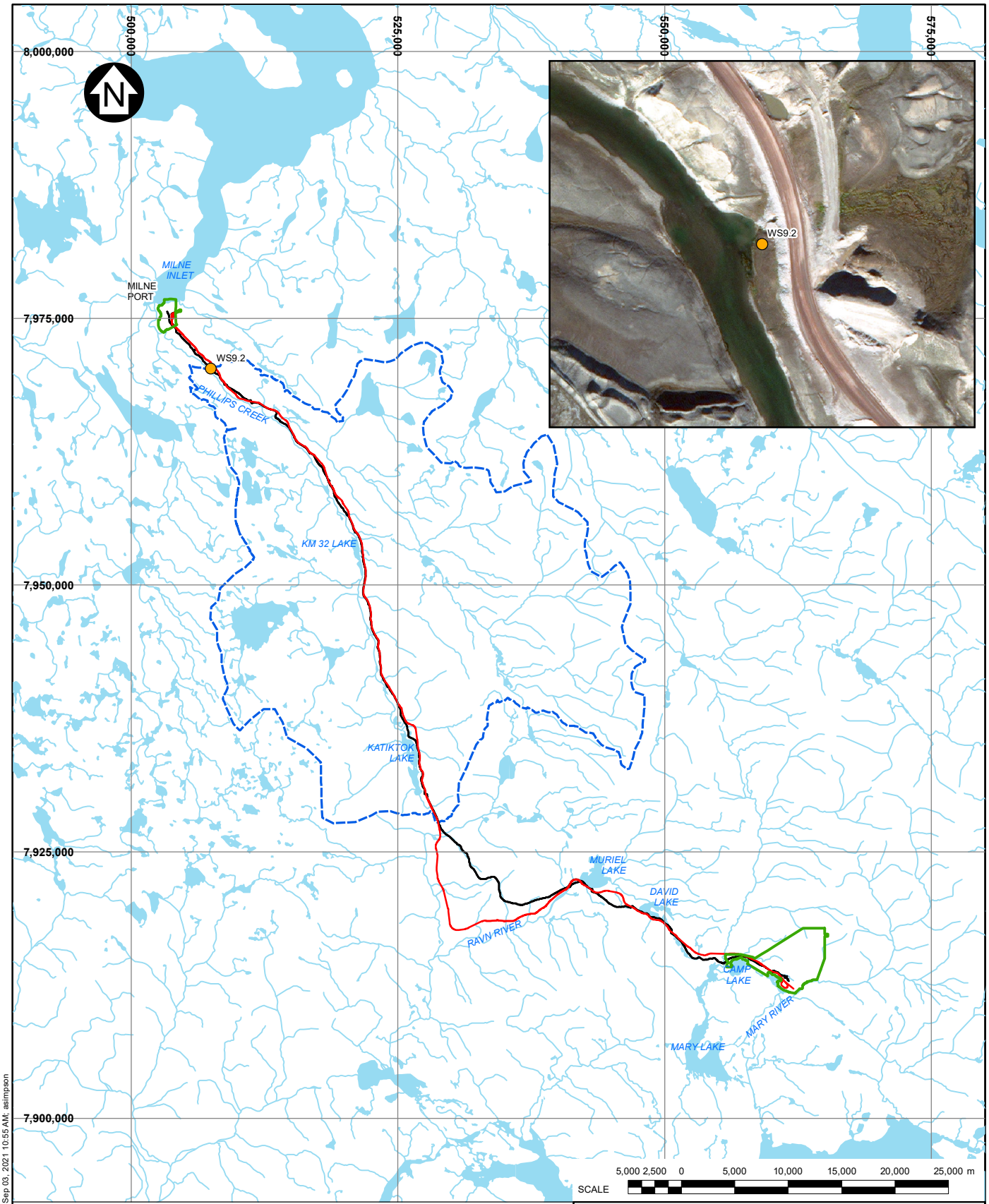
P/A NO. NB102-181/65

REF NO. 1

FIGURE A.1

REV 0

SAVED: I:\1\02\00181\65\A\GIS\Figs\A02 R0.mxd: Sep 03, 2021 10:54 AM: asimpson



LEGEND:

- APPROVED WATER STATION
- PROPOSED WATER STATION
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- POTENTIAL DEVELOPMENT AREA
- CATCHMENT BOUNDARY

NOTES:

1. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP IMAGERY: c 2020 DIGITAL GLOBE, INC.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	03SEP'21	ISSUED WITH REPORT	RAC	AS	RAC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

WATER STATION WS9.2 CATCHMENT

Knight Piésold CONSULTING

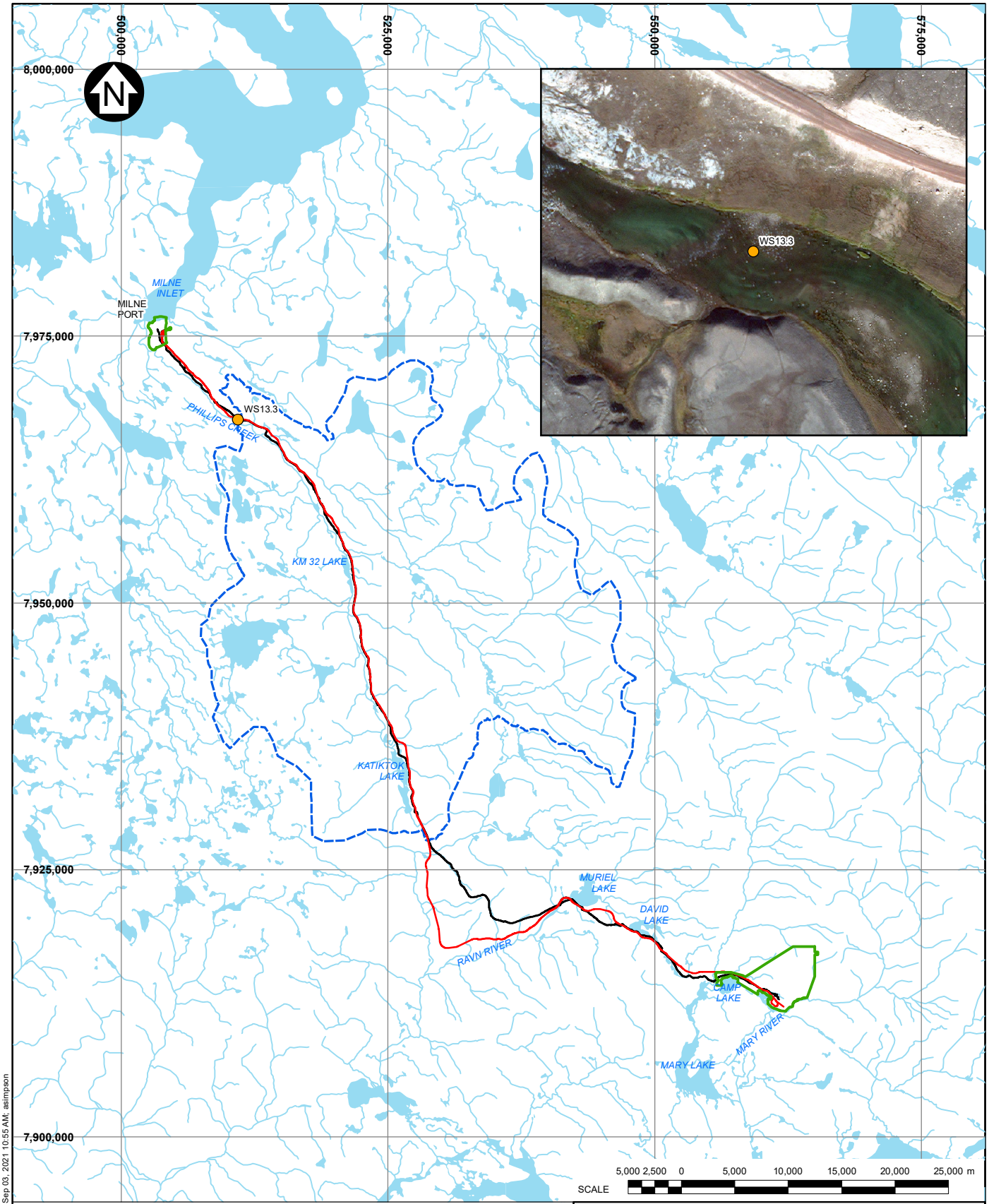
P/A NO. NB102-181/65

REF NO. 1

FIGURE A.2

REV 0

SAVED: I:\1\02\00181\65\A\GIS\Figs\A03 R0.mxd: Sep 03, 2021 10:55 AM: asimpson



LEGEND:

- APPROVED WATER STATION
- PROPOSED WATER STATION
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- POTENTIAL DEVELOPMENT AREA
- CATCHMENT BOUNDARY

NOTES:

1. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP IMAGERY: c 2020 DIGITAL GLOBE, INC.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	03SEP'21	ISSUED WITH REPORT	RAC	AS	RAC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

WATER STATION WS13.3 CATCHMENT

Knight Piésold CONSULTING

P/A NO. NB102-181/65

REF NO. 1

FIGURE A.3

REV 0

SAVED: I:\1\02\00181\65\A\GIS\Figs\A04 R0.mxd: Sep 03, 2021 10:55 AM: asimpson