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March 17, 2016

Mr. Jim Millard
Environmental Manager
Baffinland Iron Mines Corporation
Mary River Project
2275 Upper Middle Road East, Suite 300
Burlington, Ontario L6H 0C3

Dear Mr. Millard,

Re: Mary River Project CREMP Recommendations for Future Monitoring

In 2015, the Mary River Project CREMP was implemented to evaluate potential mine-related influences on chemical and biological conditions at aquatic environments located near the mine following the first full year of mine operation. The 2015 study was conducted with no deviations from the original CREMP study design (KP 2014; NSC 2014). The key findings of the CREMP suggested a mine-related influence to water and/or sediment quality at Camp Lake system water bodies, and to water quality at a tributary to Sheardown Lake, but no influence to water and sediment quality of Sheardown Lake, Mary River and Mary Lake. In addition, no adverse mine-related influences on phytoplankton, benthic invertebrates or fish (Arctic charr) populations were indicated at any of the Camp Lake, Sheardown Lake and Mary River/Mary Lake systems based on comparisons to reference conditions and to baseline information.

The CREMP was designed as an iterative system of monitoring and interpretation stages, with the results of previous studies used to inform the direction of future monitoring. Therefore, based on the results of the 2015 study, this letter outlines 19 recommendations for modifications of the CREMP design. The suggested modifications are not only intended to provide greater efficiencies to the program, but will also improve the ability of the program to meet the overall objectives (i.e., to evaluate short- and long-term effects of the project on aquatic ecosystems). Accordingly, the following recommendations applicable to stream water quality monitoring, lake water quality monitoring, stream sediment quality and benthic invertebrate community monitoring, lake sediment and benthic invertebrate community sampling and lake fish population monitoring are provided in separate sub-sections herein.

Stream Water Quality Monitoring

1) **Discontinue water quality monitoring at Station L1-09 (Camp Lake Tributary 1)**. Currently, four water quality monitoring stations are located on the main stem of Camp Lake Tributary 1 (CLT1), with Stations L1-09 and L1-05 both located on the portion of the main stem between the confluence with the north branch and the mine tote road crossing. Monitoring conducted during the 2015 CREMP indicated that water chemistry at these stations was very similar, which can be expected since no sources of dilution occur between these stations. Therefore, the monitoring of two stations within this segment of the CLT1 is redundant.

2) **Add a water quality monitoring station to the lower Tom River**. Currently, water quality monitoring stations are located in the tributary exiting Camp Lake (Station J0-01) and on the Tom River upstream of the confluence with this tributary (Station I0-01), but not on the Tom River downstream of this confluence. Therefore, the addition of a water quality monitoring station on the Tom River downstream of the Camp Lake outlet stream confluence would provide information on potential mine-related influence on water quality of the Tom River (Figure 1).

3) **Add a water quality monitoring station to each of Sheardown Lake Tributary 12 and Sheardown Lake Tributary 9**. Although benthic invertebrate community sampling is conducted at both of these Sheardown Lake tributaries, no water quality monitoring is conducted on either tributary. Therefore, the addition of a water quality monitoring station on the lower segment of each of these tributaries would provide supporting information important to the interpretation of potential mine-related effects to benthic invertebrate communities of these tributaries (Figure 1).

4) **Discontinue water quality monitoring at Station D1-05 (Sheardown Lake Tributary 1)**. Currently, two water quality monitoring stations, upstream Station D1-05 and downstream Station D1-00, are located on Sheardown Lake Tributary 1 (SDLT1). Water quality monitoring data collected at the downstream station is sufficient for evaluating mine related effects to water quality of SDLT1. Therefore, water quality monitoring at upstream station D1-05 does not provide additional information important to evaluating effects at SDLT1.

5) **Discontinue water quality monitoring at upstream Mary River Stations G0-09A and G0-09B**. The G0-09 series of stations, including G0-09A, G0-09 and G0-09B, are located on Mary River well upstream of the area of mine influence, and thus act as reference stations. Due to the close proximity of all three G0-09 series stations to one another, the water quality data provided from all three stations is redundant. The sampling of a single station at this upstream area is sufficient for interpreting potential effects of the Mary River Project on water quality of Mary River.

6) **Discontinue water quality monitoring at Station C0-01 (Mary River)**. Because no substantial sources of dilution to Mary River occur between the current C0-05 and C0-01 water quality monitoring stations, Station C0-01 does not provide any additional, useful, information for the evaluation of potential mine influence on Mary River or Mary Lake.

Lake Water Quality Monitoring

7) **Reduce the number of water quality monitoring stations to three (3) in each of Camp, Sheardown NW and Sheardown SE lakes, and four (4) in Mary Lake**. No consistent spatial differences in water chemistry were evident in any of the mine-exposed or reference lakes in 2015, nor during any of the baseline studies. In addition, *in-situ* water quality profile data collected in 2015 indicates that all lakes are generally well mixed both laterally and vertically, and as a result, water chemistry is likely to be relatively uniform throughout these lakes during most sampling conditions. Therefore, the sampling of several water quality monitoring stations within these lakes is redundant. Accordingly, it is recommended that for each study lake, only three existing water quality monitoring stations be sampled at each lake using the locations provided in the table below and illustrated in Figure 2.

Lake	Station ID	Depth (m)	Description
Reference Lake 3	REF03-01	15.1	East end of southeast basin
	REF03-02	30.4	Centre of southeast basin
	REF03-03	37.5	Centre of northwest basin
Camp Lake	JLO-02	12.3	Littoral station near primary lake inlet (CLT1, CLT2)
	JLO-07	32.7	Deep basin, near centre of lake
	JLO-09	14.3	Near lake outlet
Sheardown Lake NW	DD-Hab9-Stn1	10.3	Near inlet from SDLT1
	DLO-01-2	17.5	Deep location, near centre of northwest basin
	DLO-01-7	11.4	Near lake outlet
Sheardown Lake SE	DLO-02-6	7.1	Near inlet from Sheardown Lake NW
	DLO-02-3	13.7	Deep location, near centre of southeast basin
	DLO-02-4	8.05	Near inlet from SDLT9
Mary Lake	BLO-1A	14.65	Deepest location at the north basin
	BLO-5	21	Near inlet from Mary River
	BLO-9	30	Deepest location at the south basin
	BLO-6	6.8	Near lake outlet

8) **Conduct water quality profiling at only a single station in each of Camp, Sheardown NW and Sheardown SE lakes, and two stations at Mary Lake**. No consistent spatial differences in *in-situ* water quality depth profiles were evident among stations at each mine-exposed and reference lake in 2015, nor would they be expected under typical mixing patterns driven by density gradients (Wetzel 2001). Therefore, it is recommended that water quality profiling be conducted only at the main (i.e., deepest) basin of each study lake, except at Mary Lake where water quality profiling is recommended at the north and south basins, to provide information on lake stratification. Stations recommended for the implementation of water quality profiling include:

    Camp Lake Station JL0-07;
    Sheardown Lake NW Station DL0-01-2;
    Sheardown Lake SE Station DL0-02-3;
    Mary Lake (north basin) Station BL0-1A;
    Mary Lake (south basin) Station BL0-9; and,
    Reference Lake 3 (northwest basin) Station REF03-3.

9) **Collect water samples only from mid-water column at each lake water quality monitoring station**. Currently, water chemistry and chlorophyll a samples are collected from approximately 1 m below the surface and 1 m above the bottom at each lake monitoring station (i.e., 2 samples per station). Water chemistry data collected during the 2015 CREMP, as well as during baseline studies, has generally shown only minor (i.e., <2-fold higher) differences in water chemistry and chlorophyll a concentrations between the surface and bottom at each station. Therefore, the collection of a single water sample from approximately mid-column will be sufficient for evaluating average water quality conditions at each lake water quality monitoring station unless it is determined that the lake is thermally (or otherwise) stratified, in which case the same sampling convention from previous studies will be applied (i.e., top-bottom). Interpretation of *in-situ* water quality profile data collected at the main basin of the lake will be used as the basis for determination of whether one or two water samples will be collected from each respective lake station during each winter, summer or fall sampling event.

Stream Sediment and Benthic Invertebrate Community Monitoring

10) **Discontinue stream sediment quality monitoring as part of the CREMP**. Stream sediment sampling was included in the Mary River Project CREMP to provide qualitative information to support the lake sediment quality data analysis (KP 2014, 2015). Streams and rivers in the Mary River Project local study area (LSA) contain very limited depositional habitat suitable for the collection of fine sediments. The general absence of any substantial accumulation of fine sediments within these watercourses precluded any meaningful assessment of potential mine-related influences on sediment quality within, along and/or between watercourses during the 2015 CREMP, as well as during baseline studies (KP

2015). Because the current sediment sampling program provides no ecologically meaningful information considered useful for the evaluation of potential mine-related effects, it is recommended that stream sediment sampling be discontinued.

11) **Add a benthic invertebrate community study area to the CLT1 upper main stem**. Elevated concentrations of chloride, iron, nitrate and other parameters were observed at the upper main stem area of CLT1 (Station L2-03) in 2015 compared to reference conditions and the mine baseline period, with iron concentrations above water quality guidelines and AEMP benchmarks at this area. Mine-related influence on water quality of CLT1 was consistent with blasting/quarrying activity at the QRM2 pit. Therefore, the addition of a benthic invertebrate community study area to CLT1 near Station L2-03 is recommended to evaluate potential biological effects associated with mine activity in the upper portion of the CLT1 watershed. The benthic invertebrate community sampling will follow the same approach as that employed elsewhere for the stream program (Figure 3).

12) **Discontinue benthic invertebrate community sampling at the two upper reaches of Sheardown Lake Tributary 1 (SDLT1)**. Currently, three benthic invertebrate community study areas are situated on SDLT1. Similar to sampling conducted at Sheardown Lake Tributary 9 and Tributary 12, one study area is sufficient for evaluating mine related effects to the benthic invertebrate community of SDLT1. This study area should be situated at the lower creek reach (Reach 1) to provide temporal continuity with previous studies, and because water chemistry data is also collected at this location (i.e., Station D1-00).

13) **Add a stream reference benthic invertebrate community study area**. No stream reference study area has been established for the stream benthic invertebrate community component of the CREMP (NSC 2014). Therefore, in order to provide a stronger basis for evaluating mine-related effects to biota residing in the mine-exposed tributaries of Camp and Sheardown lakes, it is recommended that a reference study area be incorporated into the program. The ideal reference area should share similar habitat features with the mine-exposed tributaries (e.g., similar width, water velocity, substrate size, etc.) and be outside the area of mine influence. It is recommended that one of the watercourses used as a lotic reference for water monitoring (i.e., CLT-REF4, MRY-REF2, MRY-REF3) also serve as a reference area for the stream benthic invertebrate community assessment (Figure 3). The determination of the most suitable reference watercourse, based on similarity in habitat characteristics to the mine-exposed tributaries, can be selected during the next CREMP biological field study (i.e., August 2016).

Lake Sediment and Benthic Invertebrate Community Monitoring

14) **Consider updating the AEMP sediment quality benchmarks**. On average, arsenic, copper and iron concentrations were elevated above respective AEMP sediment quality benchmarks within Reference Lake 3 littoral and/or profundal station sediment during the 2015 CREMP. In turn, this suggested that the AEMP benchmarks for these metals may

be overly conservative. Because reference lake information had not been available at the time of AEMP benchmark development, it is recommended that reference sediment quality data be factored into the derivation of AEMP benchmarks for arsenic, copper and iron to improve the applicability of these benchmarks as a tool for evaluating potential mine effects for the Mary River Project CREMP.

15) **Focus the lake benthic invertebrate community (benthic) survey only on the littoral zone**. Benthic invertebrate density, richness and relative abundance of dominant groups, including metal-sensitive taxa, differed significantly between littoral (shallow) and profundal (deep) stations of the reference lake during the 2015 CREMP, which is consistent with general distribution patterns of benthic invertebrates with depth in lakes (Ward 1992). Thus, the sampling of benthic invertebrates at profundal depths limits the ability to evaluate the occurrence and/or magnitude, of mine-related effects on biota due to natural factors being more important drivers of community structure than mine-related contaminants of concern at these depths (e.g., naturally lower oxygen and food resources with depth). Therefore, it is recommended that benthic sampling at mine-exposed lakes focus solely on littoral sampling depth (i.e., approximately 8 – 10 m depth). Consistent with Environmental Effects Monitoring (EEM) guidance under the Metal Mining Effluent Regulations (MMER), it is recommended that five stations be sampled at each mine-exposed lake (Environment Canada 2012) at littoral sampling depths. To the extent possible, the littoral sampling stations will be established at existing benthic stations at Camp, Sheardown NW, Sheardown SE and Mary mine-exposed lakes, as well as at Reference Lake 3 (Figures 2 and 3). However, in some cases, new stations will be need to be established to ensure sufficient coverage of the lake, and to ensure that substrate properties are comparable among and within lakes. Under this recommendation, benthic sampling would be discontinued at all profundal stations, resulting in a total of 25 lake benthic stations in the CREMP rather than 50 currently (Figures 2 and 3).

16) **Harmonize the lake sediment quality and benthic invertebrate community monitoring stations.** Currently, sediment chemistry data is not collected at all benthic invertebrate community sampling stations, limiting the ability to establish linkages between sediment metal concentrations and potential effects on benthic invertebrates. Therefore, it is recommended that sediment samples be collected at all benthic invertebrate community stations and analyzed for particle size, total organic carbon (TOC), and total metals concentrations as part of the CREMP.

17) **Restructure the lake sediment quality monitoring program to reflect changes in the benthic invertebrate community survey sampling station locations.** To accommodate the recommended changes to the lake benthic invertebrate community survey, it is recommended that sediment quality monitoring station locations be re-located to the same five littoral benthic sampling depths/stations per lake discussed above (Recommendation 15). In addition, to maintain proper coverage of each study lake and

ensure temporal continuity, it is recommended that three profundal sediment sampling stations be maintained in the program for each mine-exposed lake, resulting in a total of eight sediment quality monitoring stations at all mine-exposed lakes except Sheardown Lake SE, where the majority of the lake is less than 12 m deep (i.e., representative of littoral habitat). Under this approach, the total number of sediment quality monitoring stations sampled would be reduced from 33 currently to 29. The profundal sediment quality stations recommended for inclusion in the CREMP are provided in the table below, and are shown on Figures 2 and 3.

Lake	Station ID	Depth (m)	Sediment Profundal Station Description
Camp Lake	JLO-14	26.5	Central basin – east (inlet area)
	JLO-07	32.7	Central basin – middle
	JLO-11	28.8	Central basin – west (outlet area)
Sheardown Lake NW	DLO-01-5	23.1	Central basin – north
	DLO-01	20.8	Central basin – middle
	DLO-01-2	18.6	Central basin – south
Mary Lake	BLO-12	21.7	South basin – near Mary River inlet
	BLO-10	18.7	South basin – middle
	BLO-08	26.7	South basin – near lake outlet

Lake Fish Population Monitoring

18) **Reduce the non-lethal adult Arctic charr sample size to 50 fish per lake**. The adult Arctic charr fish population survey currently targets 100 fish from each study lake using a 'non-lethal' sampling approach (KP 2014, 2015). Based on data acquired during the 2015 CREMP, power analysis indicated that total sample sizes can be reduced by half (i.e., 50 fish) while still maintaining the ability to detect changes between lakes and/or between study periods with sufficient power. Therefore, it is recommended that sample sizes for adult Arctic charr be reduced from 100 to 50 in future CREMP studies. By doing so, the number of incidental mortalities would be reduced substantially. A total of 57 adult Arctic charr incidental mortalities were encountered during the 2015 CREMP under normal sampling conditions, and therefore, by reducing the amount of effort applied, the number of incidental mortalities may be reduced to less than 25 without affecting the ability of the program to meet study objectives.

19) **Focus the current collection gear for optimal capture rates for adult Arctic charr**. Currently, gang index gill nets with net mesh sizes ranging from 25 – 127 mm are prescribed to capture adult Arctic charr at all study lakes under the CREMP (NSC 2014, 2015). During the 2015 CREMP, the majority of Arctic charr were captured in net mesh

sizes ranging from 38 – 64 mm, which was also similar to the most efficient mesh size used to capture adult Arctic charr during the previous baseline studies. Therefore, it is recommended that the 38 – 64 mm mesh size be adopted as the 'standard' size used to collect fish samples for the CREMP. In doing so, it is anticipated that fewer incidental mortalities will be encountered (e.g., reduced handling time) and additional sampling efficiencies will be gained.

As mentioned previously, we believe the 19 suggested modifications outlined above will not only provide greater efficiencies to the CREMP, but are also scientifically defensible and will maintain and, in some cases, improve the ability of the program to meet the overall objectives set out under the AEMP. Should you have any questions, or require additional supporting information regarding these recommendations, please to not hesitate to contact me.

Sincere regards,

Minnow Environmental Inc.

Paul LePage, M.Sc.
Senior Project Manager

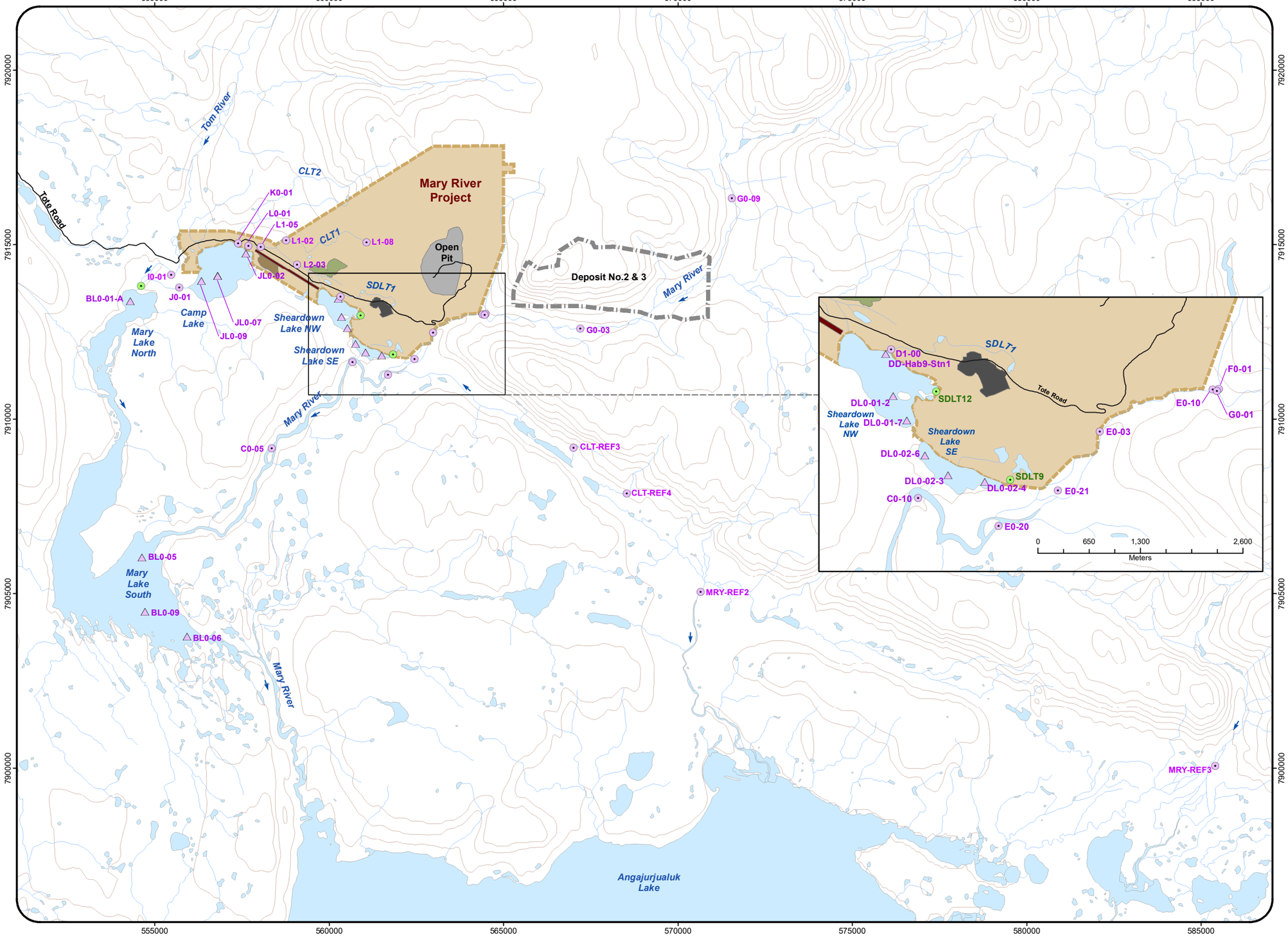

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Figure 1: Recommended CREMP Water Quality and Phytoplankton Monitoring Stations following the 2015 Program.

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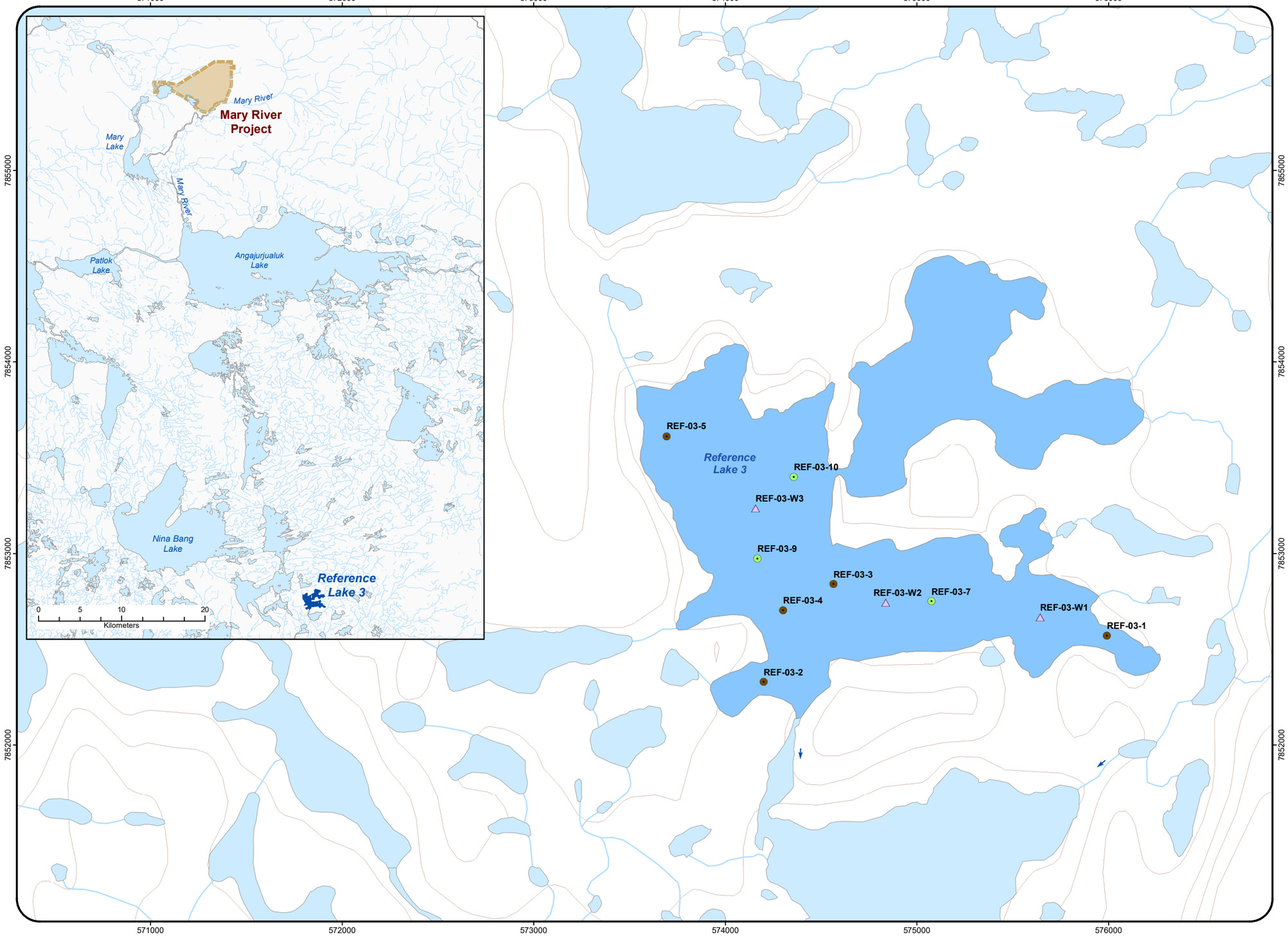

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Figure 2: Recommended CREMP Reference Lake 3 Monitoring Stations following the 2015 Program.

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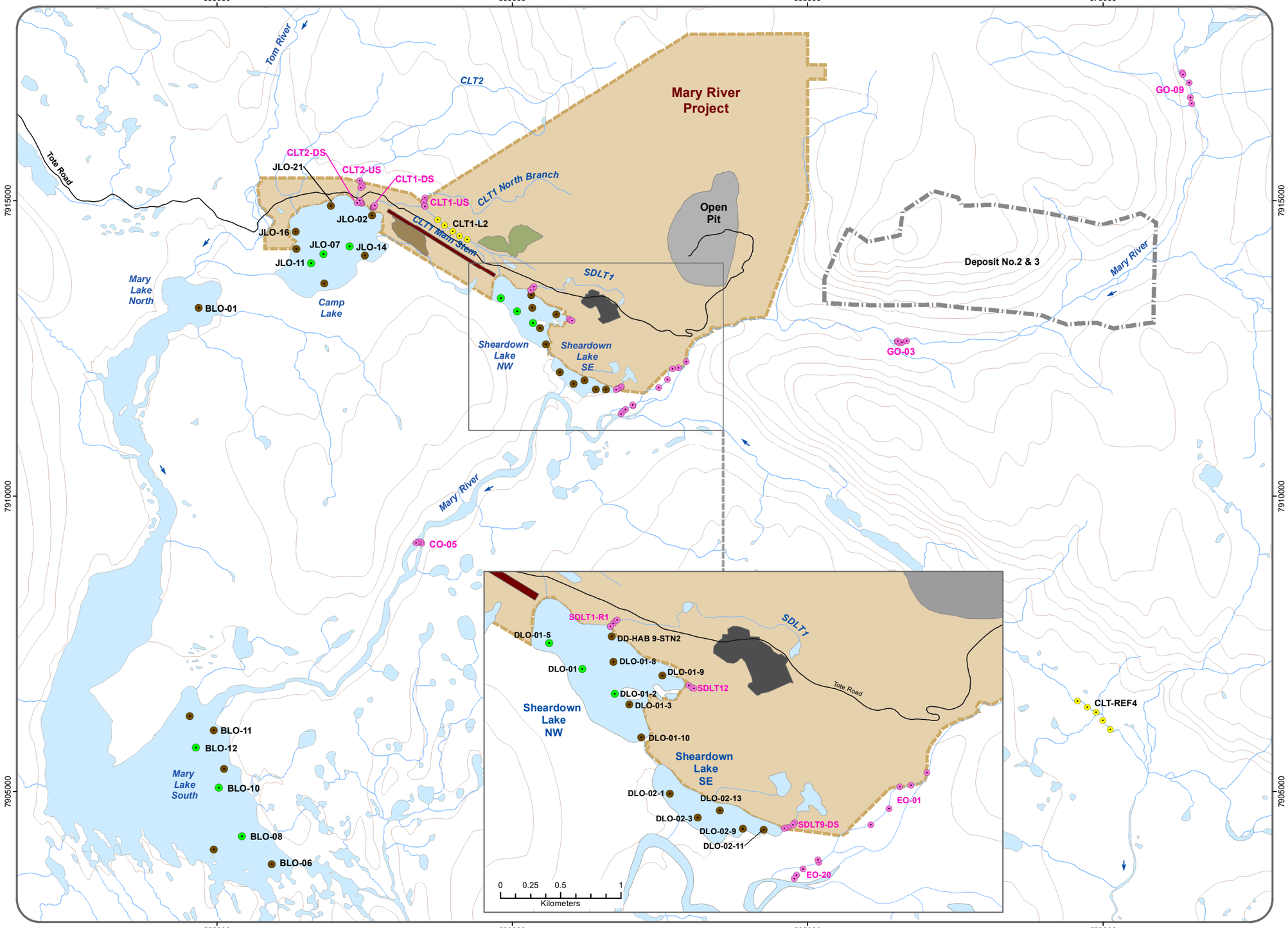

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Figure 3: Recommended CREMP Sediment and Benthic Monitoring Stations following the 2015 Program.

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