Baffinland Iron Mines Corporation
Mary River Project

2024 KP85 Lake Baseline Survey: Bathymetry and Substrate Survey

REPORT

Prepared for Baffinland Iron Mines Corporation
By North/South Consultants Inc. · 83 Scurfield Blvd. · Winnipeg, MB · R3Y 1G4

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MARY RIVER PROJECT

2024 KP85 LAKE BASELINE SURVEY:
BATHYMETRY AND SUBSTRATE

Prepared for:

Baffinland Iron Mines Corporation

Prepared by:

North/South Consultants Inc.

March 2025

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EXECUTIVE SUMMARY

ᓯᕗᓕᖅᑎᓂᖓᖅᑐᖅ ᓇᐃᓈᖅᓯᒪᔪᖅ

ᓄᓘᔮᓐᓂ ᐱᓕᕆᐊᖅ ᐊᐅᓚᓂᖅᑲᖅᑎᑦᑎᔪᖅ ᓴᕝᕝᓴᓂ ᐅᔭᕋᓐᓂᐊᖅᓱᑎᒃ ᐃᓂᖃᖅᓱᑎᒃ ᕿᑭᖅᑖᓘᑉ ᓄᓇᖁᑖᓂ ᓄᓇᕗᒻᒥ. ᐹᕗᓈᓐ ᓴᕝᕝᓴᓂᒃ ᐅᔭᕋᓐᓂᐊᖅᐱᑦ (ᐹᕗᓈᓐ; ᐱᓇᔾᔭᒃᓯᒪᔪᖅ) ᓇᒥᓂᖃᖅᑎᐅᔪᑦ ᐊᐅᓚᑦᑎᔨᐅᓪᓗᑎᒃ ᐱᓕᕆᐊᒥᒃ. ᐃᓚᒋᔭᐅᓪᓗᓂ ᒪᓕᒐᖅᑎᒎᑦ ᐊᖏᖅᑕᐅᓇᓱᓐᓂᕐᒨᑦ ᑲᔪᓯᓂᐅᕙᒃᑐᒧᑦ, ᐹᕗᓈᓐᑯᑦ ᑐᓂᓯᓯᒪᔪᑦ ᑭᖑᓪᓕᖅᐹᒥᒃ ᐊᕙᑎᒧᑦ ᐊᒃᑐᐃᓂᐅᓂᐊᖅᑐᑦ ᐅᓂᒃᑳᓂᒃ ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ, ᐅᓂᒃᑳᖅᓯᒪᔪᑦ ᓇᓗᓇᐃᑦᑎᐊᖅᓯᒪᔪᓂᒃ ᕿᒥᕐᕈᓂᕐᓂᒃ ᐊᒻᒪᓗ ᕿᒥᕐᕈᓂᕐᒥᒃ ᐊᕙᑎᒧᑦ ᐊᒻᒪ ᐃᓅᓯᕐᒧᑦ ᒪᑭᒪᔾᔪᑎᓄᓪᓗ ᐊᒃᑐᐃᔾᔪᑎᐅᑐᐃᓐᓇᕆᐊᓕᖕᓂᒃ ᐊᒃᑐᐊᔪᓄᑦ ᐱᓕᕆᐊᒧᑦ (ᐹᕗᓈᓐ 2012). 2012-ᒥ, ᐹᕗᓈᓐᑯᑦ ᐊᖏᖅᑕᓯᒪᔪᑦ ᓄᓘᔮᓐᓂ ᐱᓕᕆᐊᒧᑦ, ᐱᖃᓯᐅᑎᓯᒪᓪᓗᓂ 149 ᑮᓇᒃ ᑕᑭᓂᓕᖕᒥᒃ ᓄᓇᓯᐅᑎᑯᑖᑉ ᐊᖅᑯᑎᑯᑖᒃᓴᖓᓂᒃ ᓄᓘᔮᓐᓂᑦ ᐅᔭᕋᓐᓂᐊᕝᕕᖕᒥᑦ ᐊᕐᕋᒍᓕᒫᒧᑦ ᑐᓚᒃᑕᕝᕚᕐᓗᓂ ᐃᒃᐱᑭᑦᑐᕐᔪᐊᓄᑦ, ᑐᓂᔭᐅᓂᖓᒍᑦ ᐅᔭᕋᓐᓂᐊᕈᓐᓇᐅᑎ ᓈᓴᐅᑖ 005-ᒥ (ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᑦ 2012).

ᐱᔪᒪᓇᓲᑎ *ᐃᖃᓗᓕᕆᓂᕐᒧᑦ ᐱᕐᑯᔭᒃᑯᑦ ᐱᔨᓐᓇᕐᓂᖅᑖᖅᑎᑕᐅᓂᖅ* ᓴᓇᓂᖓᓄᑦ ᐃᒃᐱᑭᑦᑐᕐᔪᐊᓄᑦ ᓄᓇᓯᐅᑎᑯᑖᒃᓴᐅᑉ ᐊᖅᑯᑎᑯᑖᒃᓴᖓ ᐊᒻᒪᓗ ᑐᓚᒃᑕᕝᕕᒃᓴᖓ ᑐᓂᔭᐅᓯᒪᔪᖅ ᐃᒪᕐᒥᐅᑕᓕᕆᔨᒃᑯᑦ ᑲᓇᑕᒥ ᕖᕝᕗᐊᕆ 1, 2024-ᒥ (ᓇᐃᑦ ᐲᓰᑦ ᓕᒥᑎᑦ 2024). ᑐᒃᓯᕋᐅᑎ ᑭᖑᕚᕝᕕᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᓇᓗᓇᐃᔭᖅᑕᐅᓯᒪᔪᖅ ᐃᖃᓗᓕᕆᓂᕐᒧᑦ ᐱᕐᑯᔭᒃᑯᑦ ᐱᔨᓐᓇᕐᓂᖅᑖᖅᑎᑕᐅᓂᖅ ᓈᑎᑦᑎᓂᕐᒧᑦ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᐃᖃᓗᖕᓂᒃ (*Salvelinus alpinus*) ᑕᓯᕐᒧᑦ (KE85 ᑕᓯᖅ) ᐃᓂᖃᖅᑐᖅ ᖁᑦᑎᓐᓂᖅᓴᒥᒃ ᐅᐊᖕᓇᖅᐸᓯᐊᓂᒃ ᐱᓇᖕᓇᔫᒥ ᑰᒃᑐᒧᑦ ᐃᒃᐱᑭᑦᑐᕐᔪᐊᑉ ᑰᖕᒋᓐᓄᑦ. ᑕᕆᐅᕐᒥᐅᑕᑦ ᐃᖃᓗᐃᑦ ᐱᑕᖃᙱᑦᑎᑐᑦ ᑕᐸᐩᓅᓐᓂᖅᓴᓂ ᑰᒃᑐᓂ ᐊᒻᒪ ᐅᐸᒃᑕᐅᔾᔭᓇᙱᓗᓂ ᐃᓂᒥᑦ ᐃᒃᐱᑭᑦᑐᕐᔪᐊᑦ ᑕᓯᖓᓂ ᐱᔾᔪᑕᐅᓪᓗᑎᒃ ᐊᒥᓱᓛᑦ ᖁᓪᓗᖅᓅᑦ. ᑲᑭᓛᑦ ᐱᑕᖃᖅᑐᑦ ᑕᐸᐩᓅᓐᓂᖅᓴᒥ ᑰᒃᑐᒥ ᐱᖃᓯᐅᑎᓪᓗᒋ KP 85 ᑕᕐᓯᕐᒥ. ᑭᖑᕚᕝᕕᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ ᓄᑖᙳᕆᐊᖅᑕᐅᓚᐅᖅᑐᑦ ᐱᒋᐊᓕᕐᓴᖅᑎᓪᓗᒍ 2025 ᐊᒻᒪ ᐊᑐᖑᕈᓐᓇᕐᓂᖅ ᐱᑕᖃᓕᖅᑎᑕᐅᓗᑎᒃ ᑕᕆᐅᕐᒥᐅᑕᑦ ᐃᖃᓗᐃᑦ ᑕᐃᑲᓂ KP85-ᒥ ᑕᓯᕐᒥ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᔪᖅ ᐅᐸᓗᖓᐃᔭᐅᑎᓪᓗᓂ ᐊᑐᖅᑕᐅᖓᕈᓐᓇᖅᑐᖅ (ᓄᐊᑦ/ᓴᐅᑦ ᑐᓴᕋᓯᐊᖅᐲᑦ ᐃᖁᐊᐳᓃᑦ [NSC] 2025ᐃ).

ᐱᒋᐊᕈᑕᐅᔪᑦ ᖃᐅᔨᓴᕈᑏᑦ ᓄᓇᒥᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑲᒪᒋᔭᐅᓚᐅᖅᑐᖅ KP85-ᒥ ᑕᓯᕐᒥ ᔪᓚᐃ 2024-ᒥ ᐃᑲᔪᖅᑑᑕᐅᓇᓱᐊᖅᓱᑎᒃ ᑐᒃᓯᕋᖅᑕᐅᔪᒧᑦ ᑭᖑᕚᕝᕕᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᓄᑦ ᐅᓂᒃᑳᖅᑕᐅᔪᑦ ᐃᖃᓗᓕᕆᓂᕐᒧᑦ ᐱᕐᑯᔭᒃᑯᑦ ᐱᔨᓐᓇᕐᓂᖅᑖᖅᑎᑕᐅᓂᖅ ᐱᔪᒪᓇᔫᑎᒥᒃ. ᖃᐅᔨᓴᕈᑏᑦ ᐱᒋᐊᕈᑕᐅᓯᒪᔪᑦ ᓄᓇᒥᒃ ᐱᓕᕆᐊᒧᑦ ᐱᖃᓯᐅᔾᔨᔪᑦ ᐅᑯᓂᖓ:

- ᐃᑎᓂᖓᓂᒃ ᐊᒻᒪ ᓄᓇᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᑦ;
- ᐃᒪᐅᑉ ᖃᓄᐃᑦᑑᓂᖓᓂᒃ ᖃᐅᔨᓴᖃᒃᓴᓕᐅᕐᓂᖅ;
- ᐃᖅᑲᕐᒥᐅᑕᑦ ᕿᒥᕐᓗᖅᑲᖏᑦᑐᑦ ᓇᔪᕝᕕᖏᓐᓂᒃ ᖃᐅᔨᓴᖃᒃᓴᓕᐅᕐᓃᑦ; ᐊᒻᒪᓗ
- ᖃᐅᔨᓴᕐᓃᑦ ᑲᑭᓛᓂᒃ

ᑐᕌᖓᖏᑦ ᓄᓇᒥᒃ ᐱᓕᕆᐊᒧᑦ ᐃᒪᐃᑦᑑᓚᐅᖅᑐᑦ:

- ᓇᓗᓇᐃᔭᕐᓗᒋᑦ ᐃᑎᓂᖏᑦ ᐃᖅᑲᖏᓪᓗ ᖃᓄᐃᓕᖓᓂᖏᑦ ᑕᓰᑦ;
- ᓇᓗᓇᐃᔭᕐᓗᒋᑦ ᐃᒪᐅᑉ ᖃᓄᐃᑦᑑᓂᖏᑦᑕ ᖃᓄᐃᓕᖓᓂᖏᑦ ᑕᓯᕐᓂ ᓯᑯᖃᙱᑎᓪᓗᒍ (ᖃᐅᔨᓴᖃᒃᓴᓕᐅᕐᓂᖅ ᐱᓕᕆᐊᖑᓚᐳᖅᑐᑦ ᑭᖑᓂᖓᑦᑎᓐᓂ ᓯᑯᖅᑎᓪᓗᒍ ᒪᐃ/ᔫᓐ 2024-ᒥ);

- ᑲᑎᖅᓱᐃᓂᖅ ᑐᓴᐅᒪᔾᔪᑎᓂᒃ ᐊᒥᓲᓂᖏᓐᓄᑦ ᐊᒻᒪ ᖃᓄᐃᓕᖓᓂᖏᓐᓄᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᕿᒥᕐᓗᖃᖏᑦᑐᑦ ᓇᔪᐸᖏᑦ ᑕᓯᕐᓂᑦ; ᐊᒻᒪᓗ
- ᑲᑲᑎᖅᓱᐃᓂᖅ ᑐᓴᐅᒪᔾᔪᑎᓂᒃ ᑲᑭᓚᓵᑦ ᐊᒥᓲᓂᖏᓐᓄᑦ ᑕᓯᕐᓂᑦ.

ᖃᐅᔨᓴᐅᔪᑦ ᐃᒪᐅᑉ ᖃᓄᐃᑦᑑᓂᖓᓂ, ᐃᖅᑲᓐᓂ ᕿᒥᕐᓗᖕᖏᑦᑐᓂ, ᐃᖃᓗᓐᓂᓪᓗ ᖃᐅᔨᓴᕐᓂᕐᒥᑦ ᐅᓂᒃᑳᖅᑕᐅᓯᒪᔪᑦ ᓄᐊᑦ/ᓴᐅᑦ ᑐᓴᕋᓱᐊᖅᑏᑦ ᐃᖕᑯᐊᐳᓃᑎᑦᑯᓐᓂ [NSC] (2025ᐱ). ᑖᒃᑯᐊ ᐱᓕᕆᔾᔪᔩᑦ ᐊᒻᒪ ᖃᐅᔨᓴᐅᓂᖏᑦ ᐃᑎᓂᖅᓱᐅᕐᓂᕐᒧᑦ ᐊᒻᒪ ᐃᖅᑲᓐᓂ ᖃᐅᔨᓴᕐᓃᑦ ᓴᖅᑭᑕᐅᓯᒪᔪᑦ ᑕᕝᕙᓂ ᐅᓂᒃᑳᒥ.

ᐃᑎᓂᖓᑦ ᐊᒻᒪ ᐃᖅᑲᓐᓂᒃ ᖃᐅᔨᓴᕐᓃᑦ ᓇᓗᓇᐃᖅᓯᔪᑦ ᑕᓲᑦ ᐱᑕᖃᕐᕕᐅᓂᖅᓴᐅᔪᑦ ᐃᒃᑲᑦᑐᓂ ᓇᔪᒐᐅᔪᓂᒃ ᐃᖅᑲᖓᓗ ᐊᕿᑦᑑᓪᓗᓂ ᑭᓯᐊᓂᓕ ᐱᑕᖃᕐᒥᔪᖅ ᐃᑎᓂᖅᓴᓂᒃ ᐃᓚᖓ ᑐᐊᐸᔫᖑᓂᖅᓴᐅᓪᓗᓂ. ᖃᔅᓯᐅᓚᔪᓐᓂᖏᑦ ᐊᒻᒪ ᐃᑎᒫᖑᓂᕆᔭᐅᔪᑦ ᑕᓯᕐᓂ (ᐱᔭᐅᔪᑦ ᖃᐅᔨᓴᕐᕕᐅᔪᒥ) ᐃᒪᐃᑦᑑᓯᒪᔪᑦ 2.9 ᒦᑕᑦ ᐊᒻᒪ 21 ᒦᑕᑦ, ᐱᔭᓇᐊᓕᖏᓐᓂᑦ. ᒥᒃᓴᐅᓴᒃᑕᐅᓯᒪᔪᖅ 1,620 ᒦᑕᑦ ᑭᑉᐹᓇᒃᑐᑦ (m2) ᑕᓇᐅᕐᒥᐅᑕᓂ ᐃᖃᓗᖕᓂᑦ ᐃᕐᓂᐅᕐᕕᐅᓪᓗᑎᒃ ᓇᔪᕐᕕᐅᔪᑦ (ᓲᕐᓗ ᑐᐊᐸᔫᖑᓂᖅᓴᑦ ᐃᖅᑲᖓ ᐃᒪᖅ ᐃᑎᓂᖃᖅᓗᓂ 2-ᒥ 10-ᒧ ᒦᑕᑦ) ᑕᓯᕐᓃᑐᑦ.

EXECUTIVE SUMMARY

The Mary River Project is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project (Baffinland 2012). In 2012, Baffinland received approval for the Mary River Project, which involves a 149-km long railway connecting the Mary River Mine to a year-round port in Steensby Inlet, through the issuance of Project Certificate No. 005 (NIRB 2012).

An application for a *Fisheries Act* Authorization (FAA) for the construction of the Steensby Rail and Port was submitted to Fisheries and Oceans Canada on February 1, 2024 (Knight Piésold Ltd. 2024). The proposed offsetting plan described in the FAA application entails the introduction of Arctic Char (*Salvelinus alpinus*) to a lake (KP85 Lake) located in the upper northwestern drainage of the Cockburn River system. Arctic Char are absent from the upper drainage and cannot access the area from Cockburn Lake due to a series of impassable falls. Ninespine Stickleback are present in the upper drainage including KP85 Lake. The offsetting plan was updated in early 2025 and the option for the introduction of Arctic Char to KP85 Lake is now identified as a contingency option (North/South Consultants Inc. [NSC] 2025a).

A baseline field survey was undertaken at KP85 Lake in July 2024 in support of the proposed Offsetting Plan presented in the FAA application. The baseline field program included the following:

- a bathymetry and substrate survey;
- water quality sampling;
- benthic invertebrate community sampling; and
- a survey of Ninespine Stickleback.

The objectives of the field program were to:

- characterize the bathymetry and substrate composition in the lake;
- describe water quality conditions in the lake during the open-water season (sampling was conducted previously in the ice-cover season in May/June 2024);
- collect information on the abundance and composition of the benthic invertebrate community in the lake; and
- collect information on the Ninespine Stickleback population in the lake.

The results of the water quality, benthic invertebrate, and fish surveys are presented in NSC (2025b). The methods and results of the bathymetry and substrate survey are presented in this report.

The bathymetry and substrate survey indicated the lake is largely composed of relatively shallow habitat with soft fine substrate but contains a deeper area with some coarse substrate. The mean and maximum depth of the lake (based on surveyed area) are 2.9 m and 21 m, respectively. An estimated 1,620 m^2 of preferred Arctic Char spawning habitat (i.e., coarse substrate at water depths of 2-10 m) is present in the lake.

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ABBREVIATIONS AND ACRONYMS

CSRS	Canadian Spatial Reference System
DFO	Fisheries and Oceans Canada
DOI	Digital Ortho Image or Digital Orthoimagery
FAA	Fisheries Act Authorization
FEIS	Final Environmental Impact Statement
GNSS	Global navigation satellite system
NIRB	Nunavut Impact Review Board
NSC	North/South Consultants Inc.
PPP	Precise Point Positioning
RTK	Real time kinematic
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

The Mary River Project is an operating iron ore mine located in the Qikiqtani Region of Nunavut. Baffinland Iron Mines Corporation (Baffinland; the Proponent) is the owner and operator of the Project. As part of the regulatory approval process, Baffinland submitted a Final Environmental Impact Statement (FEIS) to the Nunavut Impact Review Board (NIRB), which presented in-depth analyses and evaluation of potential environmental and socioeconomic effects associated with the Project (Baffinland 2012). In 2012, Baffinland received approval for the Mary River Project, which involves a 149-km long railway connecting the Mary River Mine to a year-round port in Steensby Inlet, through the issuance of Project Certificate No. 005 (NIRB 2012).

An application for a *Fisheries Act* Authorization (FAA) for the construction of the Steensby Rail and Port was submitted to Fisheries and Oceans Canada (DFO) on February 1, 2024 (Knight Piésold Ltd. 2024). The proposed Offsetting Plan described in the FAA application entails the introduction of Arctic Char (*Salvelinus alpinus*) to a lake (KP85 Lake) located in the upper northwestern drainage of the Cockburn River system (Figure 1). A notable feature of the entire sub-catchment that is drained by the northwest branch of the Cockburn River is the near total absence of lakes that could support overwintering and spawning for Arctic Char, and access from Cockburn Lake is precluded by several cataracts and high waterfalls located approximately 3.5 km north of the lake's north basin. Arctic Char are absent from, but Ninespine Stickleback (*Pungitius pungitius*) are present in, the upper drainage including an unnamed lake located at approximately KP 85 of the Steensby Rail alignment referred to as "KP85 Lake". The offsetting plan was updated in early 2025 and the option for the introduction of Arctic Char to KP85 Lake is now identified as a contingency option (North/South Consultants Inc. [NSC] 2025a).

A baseline field survey was undertaken at KP85 Lake in July 2024 in support of the proposed Offsetting Plan presented in the FAA application. The baseline field program included the following:

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Figure 1. Location of KP85 Lake.

2.0 METHODS

2.1 DATA COLLECTION

A boat-based hydroacoustic bottom typing and substrate validation (i.e., ground truthing) sampling survey was conducted on July 20 and 21, 2024, in KP85 Lake. Bottom typing and depth data were collected using a BioSonics Habitat MX single beam echo sounder manufactured by BioSonics Inc. (Seattle, Washington, USA). A Lowrance Elite FS echo sounder was used to provide sidescan imaging of the survey area. The BioSonics Habitat MX scientific-grade echo sounder was connected to a Trimble R8 real time kinematic (RTK) global navigation satellite system (GNSS) receiver to obtain highly accurate mapping with known elevations. Survey control was maintained by setting up a Trimble R8 RTK base station receiver on shore and logging the temporary benchmark position information over the course of the survey (Photograph 1). The base station receiver was set up to broadcast real-time corrections to the rover receiver on the boat via high-power VHF radio communication. Line of sight was maintained for the entire boat-based habitat survey. NSC employed a Precise Point Positioning (PPP) post-processing procedure to produce a centimetre-grade X,Y,Z, position solution for the survey.

The survey boat navigated along pre-planned survey transects oriented bank to bank along the shortest axis of the lake, spaced approximately 30–40 m on average (Figure 2). Additional ‘transects were surveyed along the longest axis of the lake and along transects parallel to shore around the perimeter of the lake in the north and south basins. Hydroacoustic data were recorded to a weather-resistant laptop computer using BioSonics Visual Acquisition software. Sidescan data, used to assist in substrate classification and mapping, were recorded to a micro-SD card in the head of the Lowrance Elite FS sonar unit.

Substrate validation (i.e., ground truthing) data were collected (n=33) coincident with the hydroacoustic survey tracking using a petite Ponar dredge sampler. Successfully retrieved benthic samples were photographed and classified in the field according to grain size (Table 1), apparent texture, composition, and compaction. Shoreline observations (i.e. photographs, substrate composition, general slope) were also recorded.

2.2 DATA PROCESSING, ANALYSIS, AND MAPPING

After an initial review of the data collected on site, the acoustic data and GNSS positional data were downloaded to NSC servers upon returning to the office. The GNSS data (.T01 file) stored by the Trimble R8 base station receiver was sent to the Canadian Spatial Reference System’s (CSRS) online PPP service. The PPP method applied the HT2.0 height transformation to collected data to produce heights consistent with CGVD28 elevations. The service provides horizontal and vertical correction for the survey from stored data within the base station GNSS receiver. The resulting solution for the corrected base station location coordinates were: 605672.884 m E, 7854070.038 m N (Universal Transverse Mercator [UTM] Zone 17 NAD83); and 186.283 m CGVD28 (HTv2.0; Table 1). The reported accuracies for the temporary benchmark position solution were +/- 0.054 m horizontal and +/- 0.054 m vertical. Vertical control monuments were not located on site for additional verification. The shoreline water surface elevation at the beginning of the survey was 185.898 m (CGVD28 (HTv2.0)).

The hydroacoustic data collected with the BioSonics Habitat MX echosounder were processed with BioSonics Visual Acquisition and Visual Habitat software. Bottom depth is detected in the field based on a signal threshold decibel (dB) level. Data were reanalyzed in Visual Habitat MX software and depths were manually edited by interpreting the bottom from the echogram where the automated signal threshold detection did not capture the true lake bottom. During the manual editing process, the acoustic data were checked for signal error, invalid depths, and acoustic waveform anomalies; erroneous data were filtered out. The corrected depth acoustic data were exported to a .csv text format at a 1 Hz (1 second) ping rate resolution and imported into Microsoft® Excel. GNSS antenna elevation data recorded by the BioSonics software were also exported to Microsoft Excel. The raw survey X,Y,Z data coordinates were corrected according to the PPP solution and linked back to the acoustic depth data. Additional offset correction for the GNSS receiver head to keel transducer offset was applied to produce a bed elevation and corrected depth data set.

A shoreline boundary file of KP 85 Lake was created by manually interpreting and digitizing the shoreline from high-resolution satellite digital orthoimagery (DOI) from 2021 provided by Baffinland Iron Mines Corporation (© 2021 Digital Globe, Inc.) and supplemented with the Esri® World Imagery basemap image service where coverage did not exist using ArcGIS 10.8 (Esri, Redlands, California, USA) software.

A bathymetric surface of KP 85 Lake was interpolated from the corrected 2024 depth data, and the KP 85 Lake shoreline using the Topo to Raster interpolation tool in ArcGIS 10.8 software. A 1 metre resolution bathymetric grid was produced. Areas, volumes, and depth statistics were calculated in ArcGIS.

Visual Habitat MX uses multivariate principal component analysis and an unsupervised clustering technique to classify the acoustic data collected in the field into a specified number of bottom type classes. The user-supplied number of clusters informs the algorithm how many bottom types to sort the data into. The initial number of clusters for this study (n=6) was based on a review and spatial analysis of the validation data collected in the field.

Sidescan images collected during the field surveys using the Lowrance Elite FS with the 455 kHz StructureScan® frequency were imported into Reefmaster 2.0 (Reefmaster Software Ltd., Birdham, West Susex, United Kingdom) software. Reefmaster 2.0 uses the positional and bearing information from the recorded GPS data in the .sl3 file to georeference the sidescan images in order to display them in a seamless mosaic. The sidescan image mosaics were exported to a .mbtile image format and imported into QGIS software to assist in the verification and mapping of substrate boundaries.

Using the results of the substrate observation survey and the acoustic classification, the following substrate composition categories, named by the predominant substrate size and listed in order from coarser to finer fraction size, were selected for mapping substrate distribution in the lake:

- Boulder/Cobble (rock) – limited to shallow nearshore areas of the lake mostly along the west shore of the north basin;
- Gravel (rock) – large to small gravels;
- Gravel/Sand (rock) – small gravels combined with coarse sand;
- Sand (sand) – the dominant class in the lake; much of the nearshore shallows are dominated by sand;
- Sandy Silt/Clay (mud)– Mixed soft fines; and.
- Silt/Clay with organics (mud) – Fine depositional silt and clay substrate with traces of sand and some organic plant material.

The final substrate map which depicts the classes defined above was created in ArcGIS 10.8 using a number of input data sets: the KP 85 shoreline polygon; the classified Biosonics acoustic track data; the satellite DOI; and side scan and down scan data. After the polygons were created, the areas were attributed according to their corresponding substrate class. All classes were then symbolized and mapped for report presentation.

Table 1. Modified Udden-Wentworth (Udden 1914; Wentworth 1922) grade scale classification, in addition to the general class, basic acoustic class, and substrate size fraction groupings used in this study.

<table>
<tr><th>Size Range (metric)</th><th>Modified Udden Wentworth Class</th><th>General Class</th><th>Basic Acoustic Class</th><th>Size Fraction</th></tr>
<tr><td>>256 mm</td><td>Boulder</td><td>Boulder</td><td rowspan="7">Rock</td><td rowspan="7">Coarse</td></tr>
<tr><td>64–256 mm</td><td>Cobble</td><td>Cobble</td></tr>
<tr><td>32–64 mm</td><td>Very coarse gravel</td><td rowspan="5">Gravel</td></tr>
<tr><td>16–32 mm</td><td>Coarse gravel</td></tr>
<tr><td>8–16 mm</td><td>Medium gravel</td></tr>
<tr><td>4–8 mm</td><td>Fine gravel</td></tr>
<tr><td>2–4 mm</td><td>Very fine gravel</td></tr>
<tr><td>1–2 mm</td><td>Very coarse sand</td><td rowspan="5">Sand</td><td rowspan="5">Sand</td><td rowspan="7">Fine</td></tr>
<tr><td>0.5–1 mm</td><td>Coarse sand</td></tr>
<tr><td>0.25–0.5 mm</td><td>Medium sand</td></tr>
<tr><td>125–250 µm</td><td>Fine sand</td></tr>
<tr><td>62.5–125 µm</td><td>Very fine sand</td></tr>
<tr><td>3.9–62.5 µm</td><td>Silt</td><td>Silt</td><td rowspan="2">Mud</td></tr>
<tr><td>0.98–3.9 µm</td><td>Clay</td><td>Clay</td></tr>
</table>

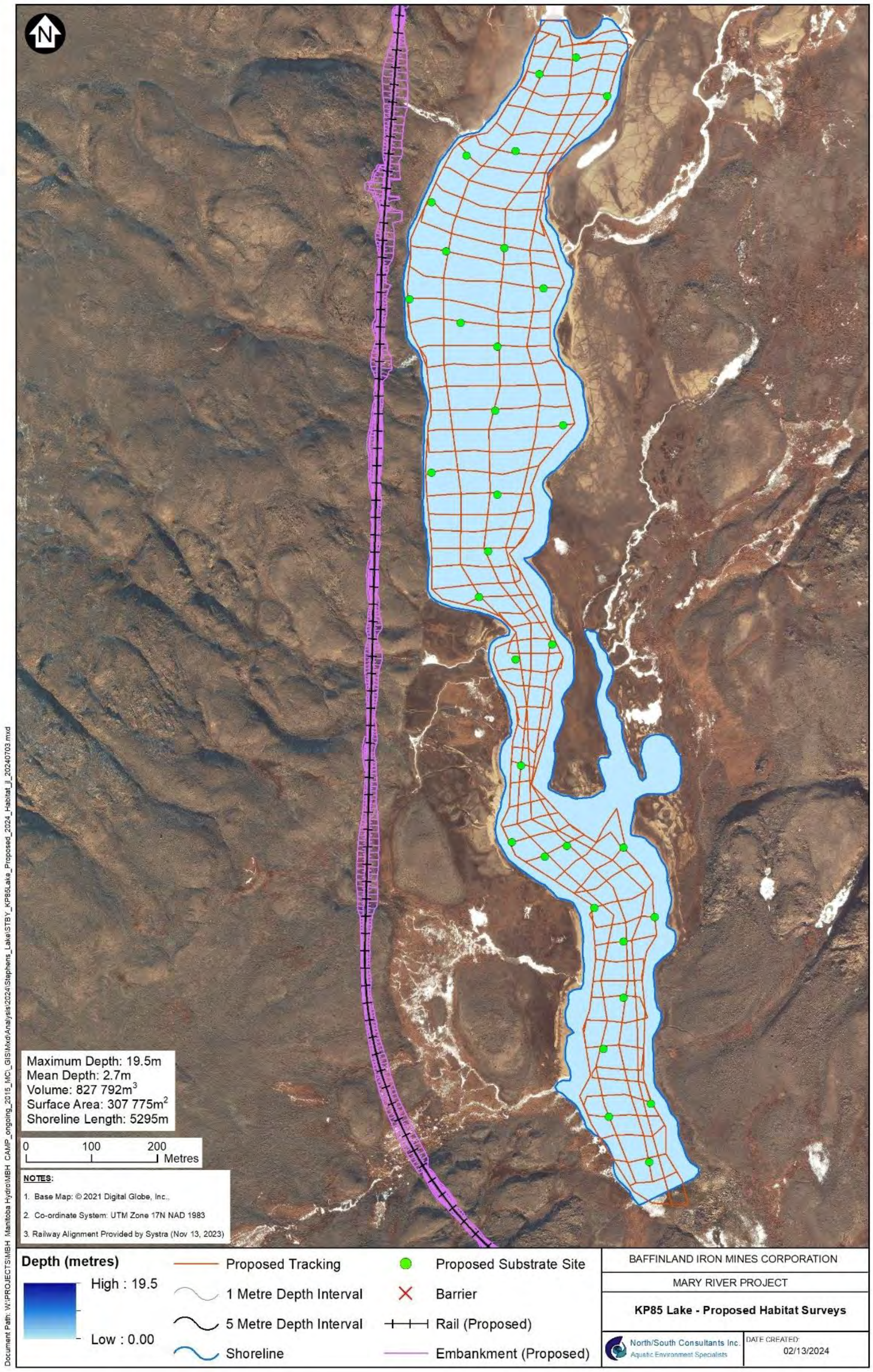

Figure 2. Survey design showing proposed acoustic sampling transects and physical substrate sampling sites for KP85 Lake.

Photograph 1. RTK GNSS base station receiver setup along the sandy shores at the midpoint between the north and south basins of KP85 Lake.

3.0 RESULTS

3.1 SUBSTRATE VERIFICATION

A total of 33 substrate observations were completed in the study area (Table 2; Figure 3). Only two sites were classified as predominantly rocky boulder/cobble substrates, they were observed along the western shore of the north basin, north of the transition to lower sloped sand shores of the south basin (Photographs 2-3). Sidescan image data were also used to confirm the presence of coarse rocky substrate along the shallow nearshore of the western shores of the north basin (Figure 4). Sandy gravel substrate was also confirmed at four sampling locations (Sites 1, 5, 21 and 23); Photograph 4). The most frequently observed substrate was sand which was found to be the predominant substrate at 14 of the 33 validation sites throughout the study area (Photograph 5). Predominantly clay and silt (mud) substrates were found at 11 sites (Photograph 6), while organic substrates (plant material) were located at two sites (Photograph 7).

3.2 HABITAT MAPPING

3.2.1 Depth

KP85 Lake has a total area of 309,345 m^2 and a total volume of 894,707 m^3 (Table 3; Figure 5). In general, the lake is low-sloped and shallow having a mean depth of 2.9 metres. Over 71% of the lake's area is less than 2 metres deep. The area of the lake greater than 2 metres is 88,282 m^2 (29%). The volume the lake area greater than 2 metres is 715,429 m^3. There is a large steeply sloped deep bowl towards the southern end of the north basin of the lake. The maximum water depth (21 metres) occurs in this deep feature.

3.2.2 Substrate

Fine substrates comprise the large majority of the lake bottom. The predominant substrate class mapped in the lake was sand (51%) followed by sandy silt/clay substrate (27%); Table 4; Figure 6). Coarser substrates including gravel and sand substrate made up 7% of the total lake area. Cobble and boulder substrate comprised 3% of the total lake area. This substrate class was largely limited to water depths of less than 2 m.

3.2.3 Potentially Suitable Arctic Char Spawning Habitat

Areas that were between 2 and 10 m of water depth and of predominantly coarse substrate were mapped to show potentially suitable preferred Arctic Char spawning habitat (Figure 7). The total area of this habitat class was 1,620 m^2 and accounted for 3% of the area of the lake in that depth range.

Table 2. Results of substrate validation sampling for KP85 Lake.

Site ID	Method	Easting	Northing	Depth (m)	Date	Compaction	Estimated Composition								Basic Class	Substrate Class
							Substrate[1]	%	Substrate[2]	%	Substrate[3]	%	Substrate[4]	%		
1	ponar	605810	7854964	2.17	21-Jul-24	hard	Gravel	70	Sand	30	-	-	-	-	Rock	Sandy Gravel
2	ponar	605718	7854822	1.13	21-Jul-24	moderate	Organic	40	Sand	40	Clay	20	-	-	Sand	Clayey Sand
3	visual	605589	7854743	1.58	21-Jul-24	hard	Cobble	70	Boulder	30	-	-	-	-	Rock	Cobble/Boulder
4	ponar	605701	7854674	0.99	21-Jul-24	moderate	Sand	70	Clay	20	Organic	9	Gravel	1	Sand	Sand
5	visual	605857	7854905	0.55	21-Jul-24	hard	Sand	60	Gravel	40	-	-	-	-	Rock	Sandy Gravel
6	visual	605556	7854595	1.14	21-Jul-24	hard	Cobble	70	Boulder	30	-	-	-	-	Rock	Cobble/Boulder
7	ponar	605687	7854425	15.41	21-Jul-24	moderate	Clay	70	Organic	30	-	-	-	-	Mud	Silty Organics
8	ponar	605589	7854330	2.31	21-Jul-24	moderate	Clay	90	Sand	10	-	-	-	-	Mud	Sandy Clay
9	ponar	605676	7854210	13.25	21-Jul-24	moderate	Clay	97	Organic	3	-	-	-	-	Mud	Silt/Clay
10	ponar	605690	7854297	20.29	21-Jul-24	soft	Organic	70	Clay	20	Silt	10	-	-	Organic	Silty Organics
11	ponar	605662	7854140	4.24	21-Jul-24	moderate	Clay	99	Sand	1	-	-	-	-	Mud	Sandy Silt/Clay
12	ponar	605790	7854403	1.71	21-Jul-24	soft	Sand	100	-	-	-	-	-	-	Sand	Sand
13	ponar	605774	7854068	1.02	20-Jul-24	moderate	Sand	40	Silt	30	Sand	20	Clay	10	Sand	Silty Sand
14	ponar	605726	7853884	0.96	20-Jul-24	soft	Clay	30	Gravel	30	Sand	20	Silt	20	Sand	Silty Sand
15	ponar	605712	7853766	1.06	20-Jul-24	soft	Silt	50	Clay	40	Sand	10	-	-	Mud	Sandy Silt/Clay
16	ponar	605796	7853761	1.20	20-Jul-24	soft	Clay	89	Sand	10	Gravel	1	-	-	Mud	Sandy Clay
17	ponar	605930	7853652	0.31	20-Jul-24	soft	Silt	50	Sand	40	Gravel	10	-	-	Sand	Sand
18	ponar	605883	7853529	1.24	20-Jul-24	moderate	Silt	70	Sand	10	Gravel	10	Organic	10	Mud	Sandy Silt
19	ponar	605924	7853367	0.91	20-Jul-24	moderate	Sand	80	Gravel	20	-	-	-	-	Sand	Sand
20	ponar	605852	7853451	0.69	20-Jul-24	moderate	Sand	70	Silt	20	Gravel	10	-	-	Sand	Sand
21	ponar	605922	7853278	0.88	20-Jul-24	moderate	Gravel	70	Sand	30	-	-	-	-	Rock	Sandy Gravel
22	ponar	605838	7853666	1.22	20-Jul-24	soft	Sand	90	Gravel	10	-	-	-	-	Sand	Gravely Sand
23	ponar	605860	7853348	0.67	20-Jul-24	moderate	Gravel	70	Sand	20	Silt	10	-	-	Rock	Sandy Gravel
24	ponar	605763	7853744	2.00	20-Jul-24	soft	Clay	50	Silt	40	Sand	10	-	-	Mud	Clay/Silt
25	ponar	605754	7854939	2.15	21-Jul-24	moderate	Sand	100	-	-	-	-	-	-	Sand	Sand
26	ponar	605634	7854559	1.41	21-Jul-24	soft	Clay	97	Sand	1	Gravel	1	Organic	1	Mud	Silt/Clay
27	ponar	605883	7853758	0.45	20-Jul-24	moderate	Sand	60	Silt	30	Gravel	10	-	-	Sand	Silty Sand
28	ponar	605690	7854523	8.87	21-Jul-24	soft	Clay	59	Organic	40	Sand	1	-	-	Mud	Silty Organics
29	ponar	605612	7854668	1.50	21-Jul-24	moderate	Sand	50	Clay	30	Gravel	20	-	-	Sand	Clayey Sand
30	ponar	605718	7854045	0.91	20-Jul-24	moderate	Sand	40	Clay	30	Silt	30	-	-	Sand	Silty Sand
31	ponar	605883	7853615	1.35	20-Jul-24	moderate	Sand	90	Gravel	10	-	-	-	-	Sand	Sand
32	ponar	605643	7854814	2.09	21-Jul-24	moderate	Clay	100	-	-	-	-	-	-	Mud	Clay/Silt
33	ponar	605761	7854612	1.32	21-Jul-24	soft	Organic	99	Clay	1	-	-	-	-	Organic	Organics

Notes:
1. Primary substrate composition
2. Secondary substrate composition
3. Tertiary substrate composition
4. Quaternary substrate composition

Table 3. Summary of depth and slope statistics for KP85 Lake.

Max. Depth (m)	Mean Depth (m)	Max Slope (%)	Mean Slope (%)	Area (m^2)	Volume (m^3)
21.0	2.9	58.3	7.6	309,345	894,707

Table 4. Summary of mapped substrate class by depth categories for KP85 Lake.

Substrate Class	Size Fraction	Depth 0 – 2 m		Depth 2 – 10 m		Depth 10 - 21 m		Lake Total	
		Area (m^2)	Area (%)	Area (m^2)	Area (%)	Area (m^2)	Area (%)	Area (m^2)	Area (%)
Cobble/Boulder	Coarse	7,905	4	342	1	0	0	8,247	3
Gravel		3,657	2	0	0	0	0	3,657	1
Gravel/Sand		18,896	9	1,278	2	76	0	20,250	7
Sand	Fine	133,692	60	20,804	37	2,209	7	156,705	51
Sandy Silt/Clay		41,771	19	20,927	37	24,146	75	84,635	27
Silt/Clay with organics		7,187	3	12,584	22	8,113	25	27,884	9
Not Classified	Not Classified	7,967	4	0	0	0	0	7,967	3
Total		**221,075**	**100**	**55,935**	**100**	**32,335**	**100**	**309,345**	**100**

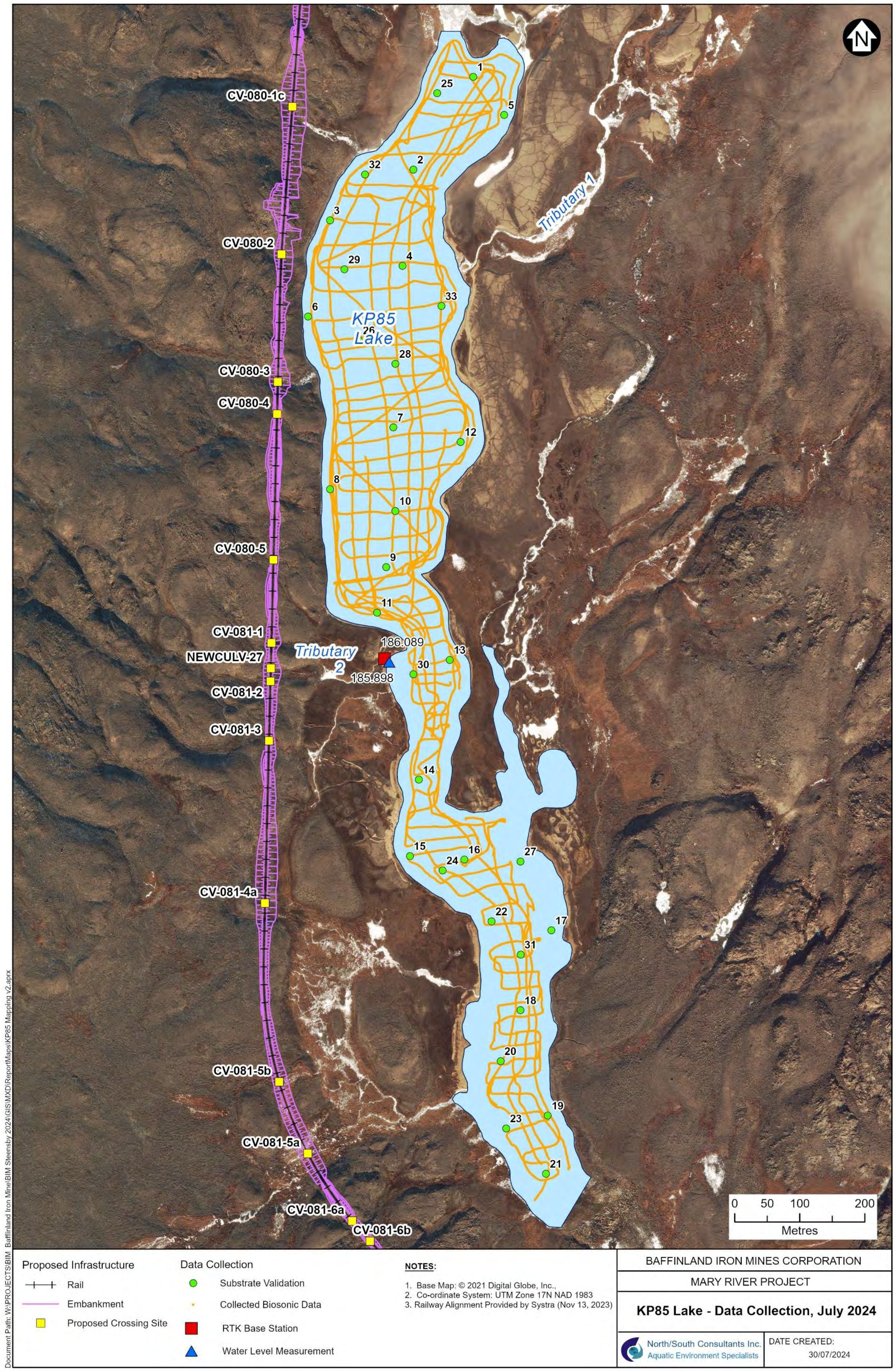

Figure 3. Map of substrate validation sampling locations and acoustic data tracking locations for the habitat mapping survey conducted at KP85 Lake in July 2024.

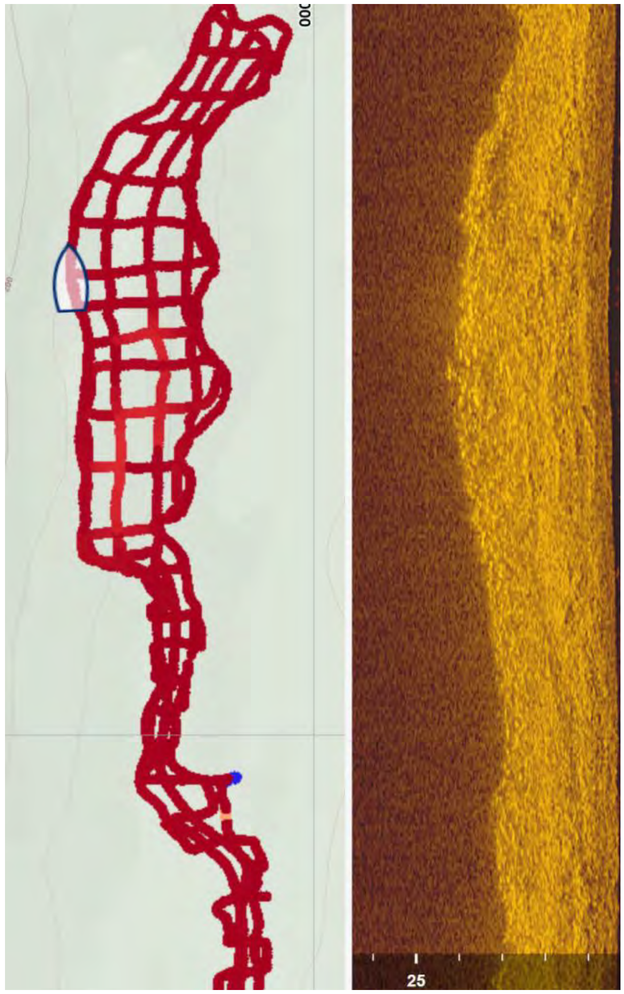

Figure 4. **Sidescan image data showing cobble and boulder substrate within 12-15 metres of the shallow western shore of the north basin of KP85 Lake.**

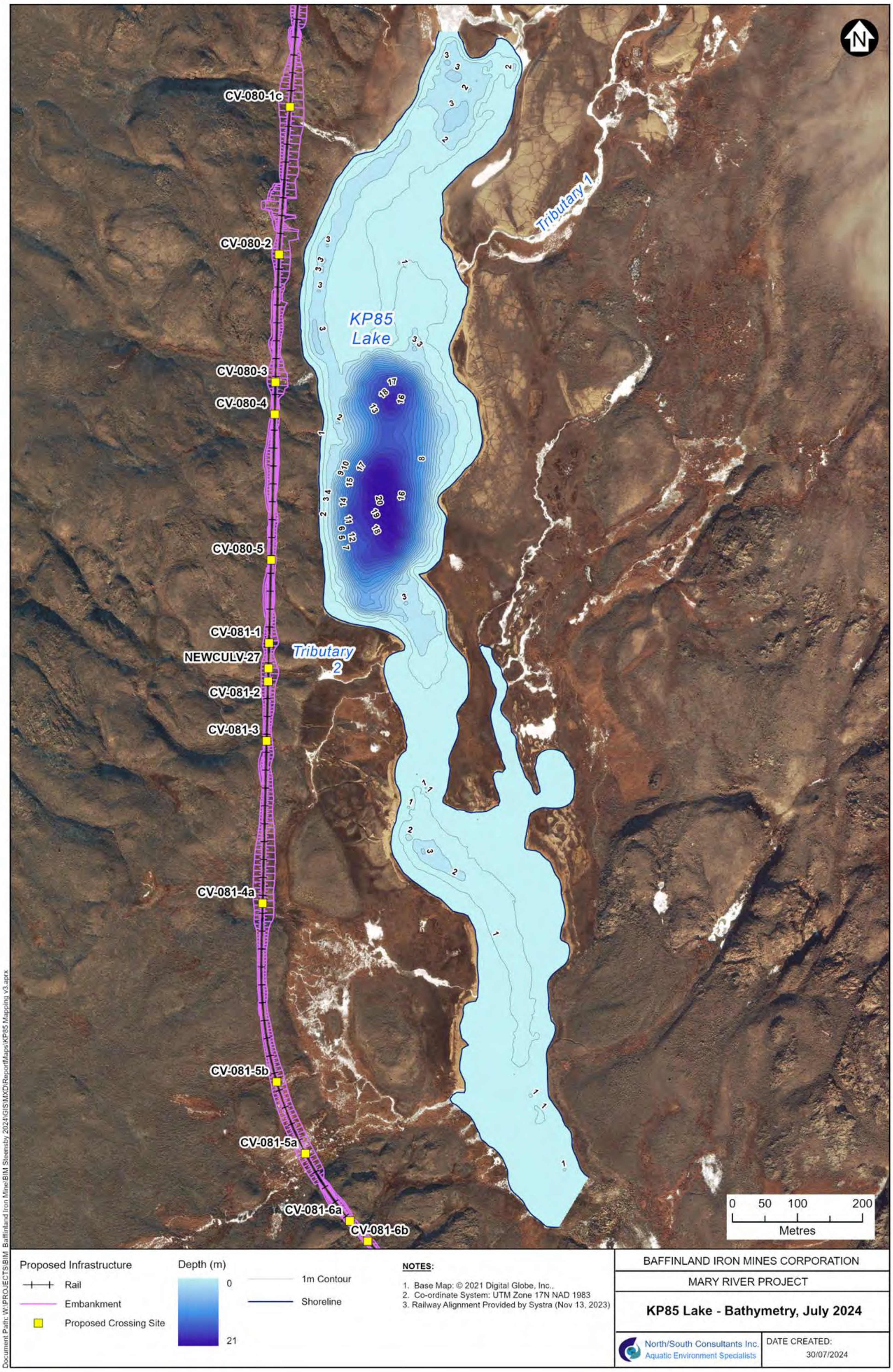

Figure 5. Bathymetric map of KP85 Lake.

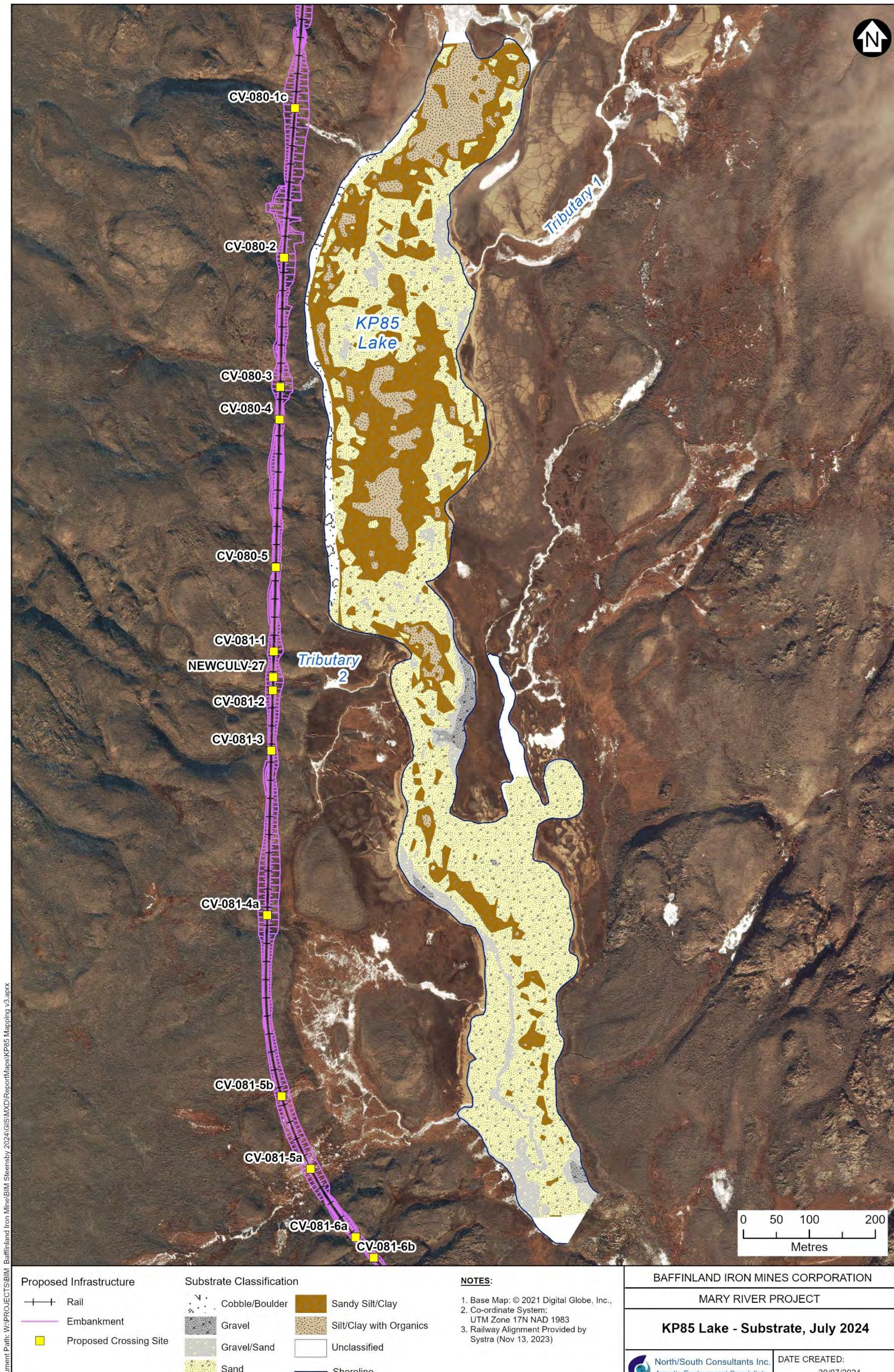

Figure 6. Substrate distribution map of KP85 Lake.

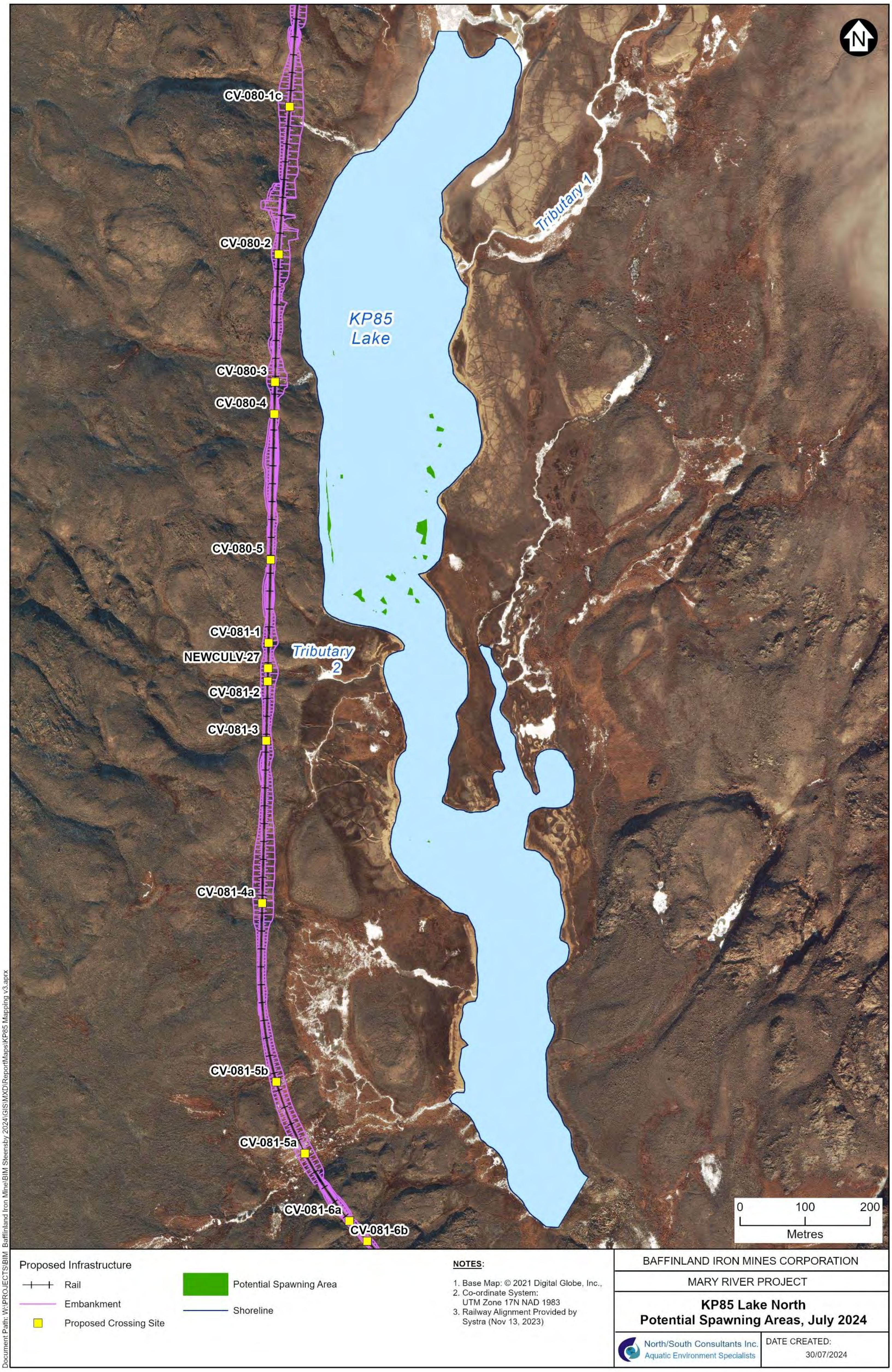

Figure 7. Potential fish spawning habitat distribution map of KP85 Lake.

Photograph 2. Transition from high gradient rocky shoreline to low gradient sand shoreline in the southwest end of the north basin of KP85 Lake

Photograph 3. Shallow nearshore cobble and boulder substrate along the western shore of the north basin (Site 3).

Photograph 4. Sandy gravel substrate sampled with a petite Ponar dredge sampler (Site 23).

Photograph 5. Sand substrate sampled with a petite Ponar dredge sampler (Site 19).

Photograph 6. Moderately compacted clay and silt substrate sampled with a petite Ponar dredge sampler (Site 32).

Photograph 7. Silt/clay substrate with organics sampled with a petite Ponar dredge sampler (Site 10).

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