APPENDIX 6-C

Hydrology Baseline

June 2016
Report No. 1541520

AGNICO EAGLE
Golder Associates

January 2016

AGNICO EAGLE MINES: MEADOWBANK DIVISION - WHALE TAIL PIT PROJECT

2015 Hydrology Baseline Report

Submitted to:
Agnico Eagle Mines Limited
Ryan Vanengen
Environment Superintendent

REPORT

Report Number: Doc 037-1524321.1300 Ver 1

Distribution:

1 copy: Agnico Eagle Mines Limited
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Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX A
Hydrometric Stations

APPENDIX B
Shoreline Baseline Characterization

APPENDIX C
Water Balance Model

1.0 INTRODUCTION

Agnico Eagle Mines Limited: Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit, a satellite deposit on the Amaruq property, in continuation of mine operations and milling of the Meadowbank Mine. The Amaruq Exploration property is a 408 square kilometre (km^2) site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of the Meadowbank Mine in the Kivalliq region of Nunavut (Figure 1-1). The property was acquired by Agnico Eagle in April 2013 subject to a mineral exploration agreement with Nunavut Tunngavik Incorporated.

The Meadowbank Mine is an approved mining operation and Agnico Eagle is looking to extend the life of the mine by constructing and operating Whale Tail Pit and Haul Road (referred to in this document as the Project), which is located on the Amaruq Exploration property. As an amendment to the existing operations at the Meadowbank mine, it is subject to an environmental review established by Article 12, Part 5 of the *Nunavut Land Claims Agreement* (NLCA). Baseline data have been collected in support of the Environmental Review to document existing conditions and to provide the foundation for a qualitative and quantitative assessment of project operations and the extension of the mine development, to be evaluated in the Environmental Impact Statement (EIS) for the Project.

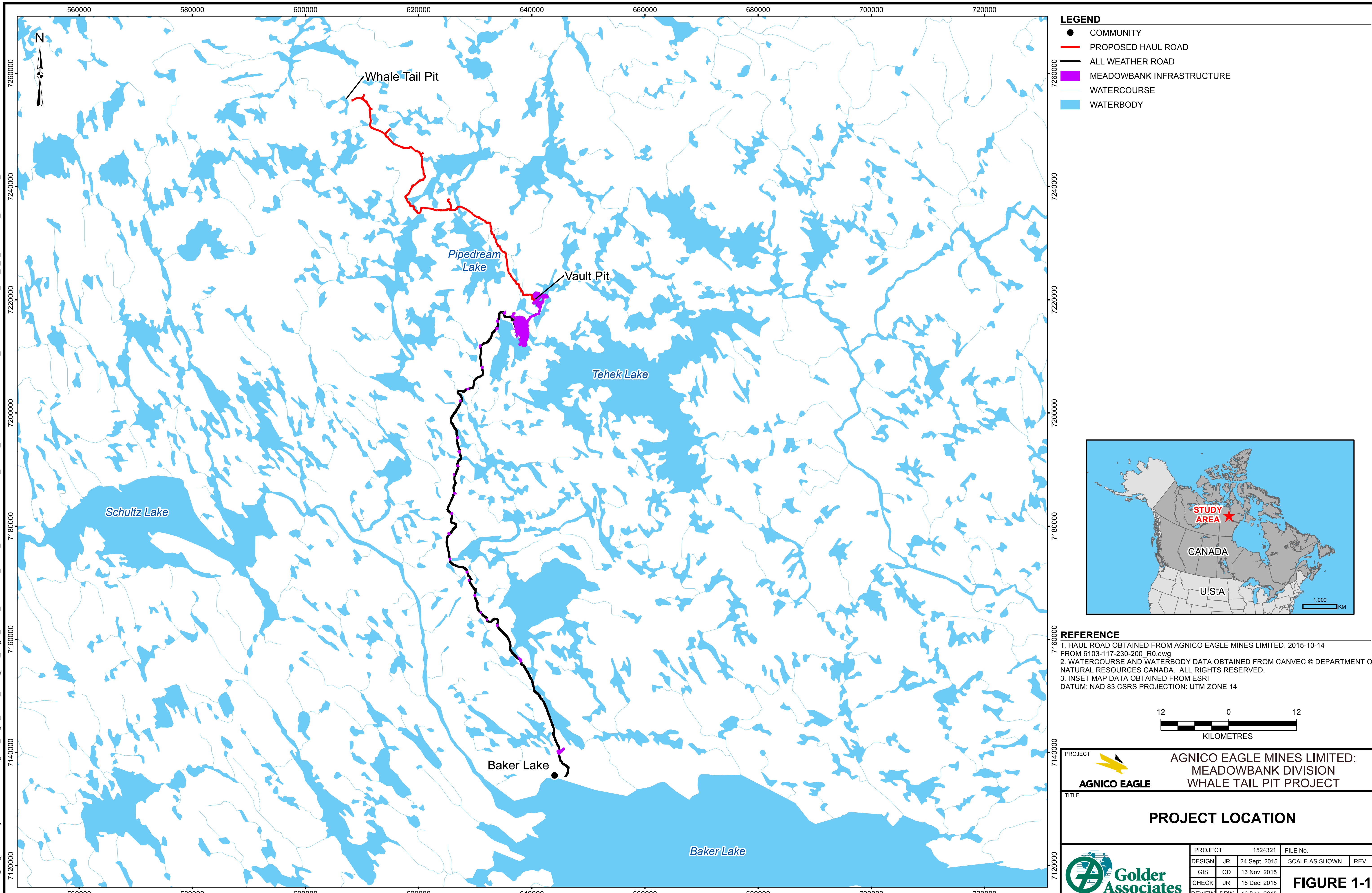
This report presents the results of a baseline hydrology study completed by Golder Associates Ltd. (Golder) for the area associated with the Project. Specifically, this report provides a review of existing hydrology conditions in watersheds potentially affected by the Project.

1.1 Physical Setting

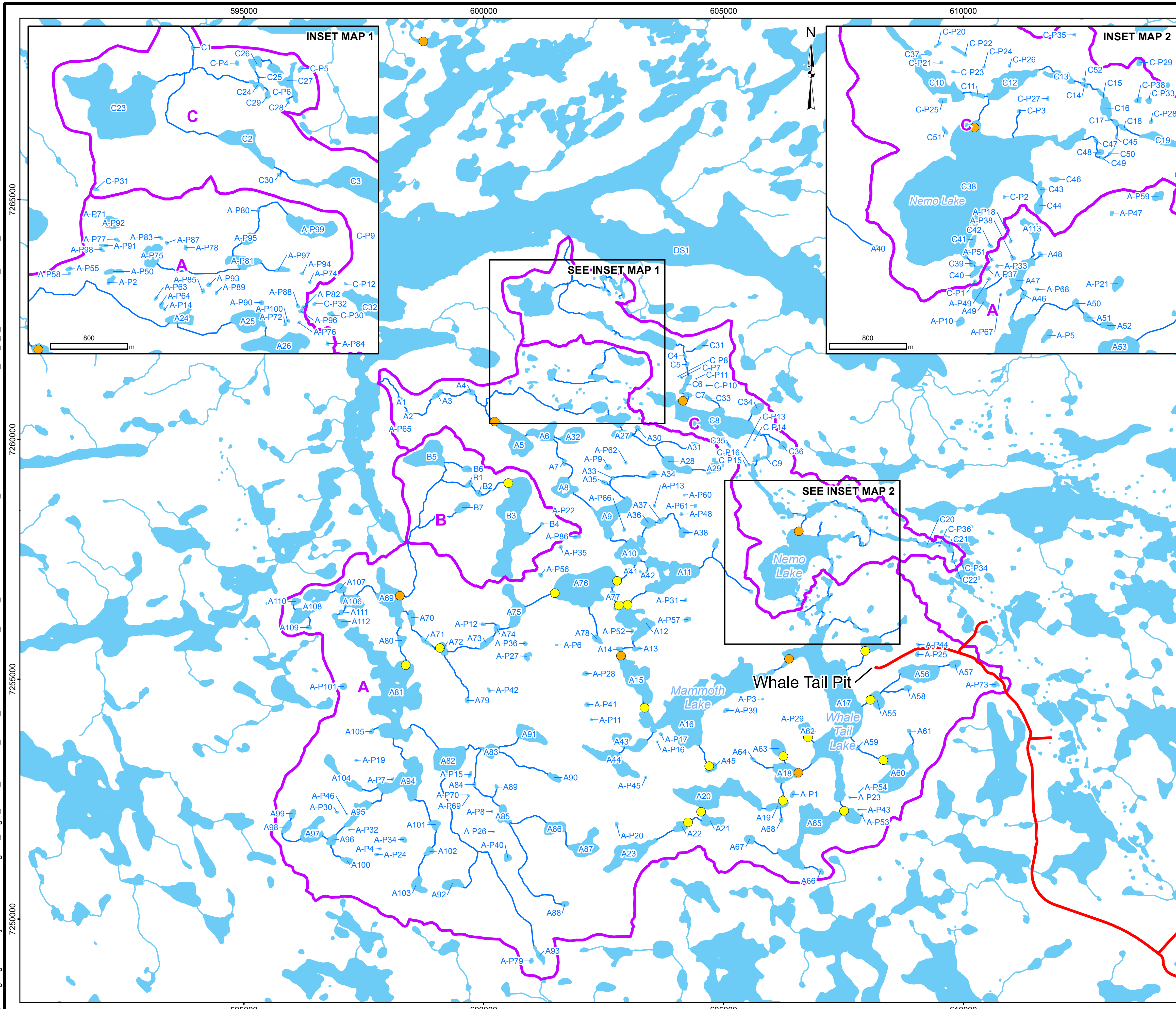
The Project is located at the southern limit of the Northern Arctic terrestrial ecozone, which is one of the coldest and driest regions of Canada, with a Low Arctic ecoclimate. This ecozone extends over most of the non-mountainous areas of the Arctic Islands, northeastern portions of the Kivalliq region of Nunavut, western Baffin Island, and a portion of northern Québec.

1.2 Hydrology Baseline Study Area

The Project is located in the Meadowbank River, Quoich River, and Thelon River watersheds. The hydrology baseline study area (Hydrology BSA) for the Project is the area within which Project activities could potentially have direct or cumulative effects on aquatic biological receptors. The Hydrology BSA consists of the A, B, and C watersheds, and Lake DS1 (i.e., the receiving lake of the A, B, and C watersheds), the outlet of which marks the downstream boundary of the Hydrology BSA. The Hydrology BSA only considers the Whale Tail Pit portion of the Project; the Haul Road was assessed by others. Thus, the Hydrology BSA is solely located in the upper Meadowbank River watershed, which flows north into the Back River prior to draining into the Arctic Ocean. The Hydrology BSA is shown on Figure 1-2.



Whale Tail Pit
Pipedream Lake
Vault Pit
Tehek Lake
Schultz Lake
Baker Lake
Baker Lake
N
560000
580000
600000
620000
640000
660000
680000
700000
720000
7260000
7240000
7220000
7200000
7180000
7160000
7140000
7120000
LEGEND
COMMUNITY
PROPOSED HAUL ROAD
ALL WEATHER ROAD
MEADOWBANK INFRASTRUCTURE
WATERCOURSE
WATERBODY
STUDY AREA
CANADA
U.S.A
1,000 KM
REFERENCE
1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. INSET MAP DATA OBTAINED FROM ESRI
DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14
12 0 12
KILOMETRES
PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT
TITLE
PROJECT LOCATION
PROJECT 1524321 FILE No.
DESIGN JR 24 Sept. 2015 SCALE AS SHOWN REV. A
GIS CD 13 Nov. 2015
CHECK JR 16 Dec. 2015
REVIEW DRW 16 Dec. 2015
Golder Associates
FIGURE 1-1
\\golder.gds\gal\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1524321_EIS\02_PRODUCTION\BASELINE_REPORT\1524321_FIG_1_1_GENERAL_PROJECT_LOCATION.mxd



LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- WATERSHED
- STREAM
- WATERCOURSE (CANVEC)
- WATERBODY (CANVEC)

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

1600 0 1600

METRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

HYDROLOGY BASELINE STUDY AREA

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016	FIGURE 1-2	
REVIEW	DRW	14 Jan. 2016		

\\golder.gds\gal\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1524321_EIS\02_PRODUCTION\BASELINE_REPORT\HYDROLOGY\1524321_FIG_1_2_HYDROLOGY_STUDY_AREA.mxd

2.0 METHODS

2.1 Data Sources

This report is based on the following data sources:

- potential direct Project aquatic and terrestrial disturbances provided by Agnico Eagle;
- 1 metre (m) Digital Elevation Model (DEM) and 50 centimetre (cm) precision imagery, produced from stereo satellite photos acquired on 28 August 2015 (PhotoSat 2015);
- 1:20,000 scale spatial public watercourse and waterbody datasets (CanVec 2013);
- regional climate data (Government of Canada 2015);
- previous hydrology baseline information available for the Meadowbank Gold Project (AMEC 2003);
- hydrometric data collection by other disciplines and Agnico Eagle on-site in 2015; and
- four site-specific field visits from 28 to 31 May 2015, 8 to 15 June 2015, 4 to 9 August 2015, and 16 to 21 September 2015, respectively.

Inuit Qaujimajatuqangit was collected by field crews from local assistants during their participation in the 2015 field programs, as it was provided. Inuit Qaujimajatuqangit information was only recorded by field crews if permission was granted.

2.2 Watersheds and Drainage Patterns

Watersheds potentially affected by, or relevant to, future effect assessments of the Project, were delineated based on a review of available DEM data and imagery (PhotoSat 2015), and field observations in 2015 (Figure 1-2).

Lakes (i.e., waterbodies with one or several well-defined outlet channels) and ponds (i.e., waterbodies without defined outlet channels), relevant to this report and other environmental studies, were assigned an identifier under the following criteria:

- The downstream extent of the Hydrology BSA is a large lake, and was assigned an identifier of DS1.
- Three distinct watersheds within the Hydrology BSA were defined as:
  - the A watershed (i.e., where Whale Tail and Mammoth Lake are located);
  - the B watershed (i.e., located just north of the A watershed, and west of Nemo Lake); and
  - the C watershed (i.e., where Nemo Lake is located).
- The three distinct watersheds A, B and C each drain to Lake DS1.
- Within each watershed, lakes were assigned a unique alphanumeric identifier, comprised of the name of the watershed (e.g., A), and a unique numeric value. When possible, the unique numeric value was increased in the upstream direction (e.g., Lake A3 drains to Lake A2, which drains to Lake A1).

- Within each watershed, ponds (i.e. a waterbody without defined outlet channels which freezes to the bottom in winter) were assigned a unique alphanumeric identifier, comprised of the name of the watershed (e.g., A), followed by “-P”, and a unique numeric value (e.g., A-P1).
- Lake outlets (i.e., streams) were assigned a unique alphanumeric identifier, comprised of the identifier of the upstream (i.e., source) lake, and of the identifier of the lake it is draining to, directly downstream. While this situation was not yet encountered, a prefix of “0” was proposed for cases where a stream does not originate from a lake. This convention is applied in the following examples:
  - Example: For a stream draining from Lake A2 to Lake A1, the stream is identified as Stream A2-A1.
  - Example: For a stream draining to Lake A1 without a source lake, the stream is identified as Stream 0-A1.

2.3 Hydrometry

Two types of hydrometric stations were installed in 2015, including continuous hydrometric stations (i.e., those equipped with data loggers) and manual hydrometric stations (i.e., those without data loggers, and primarily reliant on discrete discharge and water level measurements, and visual observations) (Figure 1-2). Photographs at each station are shown in Appendix A.

2.3.1 Continuous Hydrometric Stations

Six continuous hydrometric stations were installed during the second field visit, between 8 and 15 June 2015, at Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C38 (Nemo Lake), and Lake DS1. Two additional continuous hydrometric stations were installed during the third field visit between 4 and 9 August 2015 at Lake A5 and Lake C8. The locations of the continuous hydrometric stations are shown on Figure 1-2. These stations were equipped with water level loggers. Manual discharge and water level data measurements were also recorded at these stations during each field visit.

Hydrographs for all eight locations were derived using the following methods:

- Onset HOBO U20-001-04 Loggers were installed at each hydrometric station. Each data logger was programmed to record water pressure measurements at 10-minute intervals, and referenced to a local benchmark tied to the geodetic datum established by a mine surveyor.
- Two Onset HOBO U20-001-04 Loggers were installed on land at central locations to all eight sites to provide barometric pressure corrections.
- The data loggers were installed at the start of spring melt, as permitted by ice conditions and site access (excluding A5 and C8 which were installed in August).
- During each site visit, water surface elevations were surveyed using a high accuracy Real Time Kinematic (RTK) GPS Altus APS-3 system, and the pressure transducer readings were recorded during selected data logger downloads.
- Stream discharge measurements were performed during each site visit at stations with flowing water according to the Water Survey of Canada standard described by Terzi et al. (1981). Velocity and depth

measurements, which were used to calculate discharge, were collected using a Swoffer Model 2100™ or using a Marsh McBirney 2000 Flo-Mate™ velocity meter and a top-setting wading rod.

- Data loggers at each station were downloaded during each site visit and pressure transducer readings corresponding to each discharge measurement were recorded.
- Data loggers were removed during the last site visit in September prior to freeze-up.
- A stage-discharge rating curve was derived for each station based on measured water surface elevations and discharges. This rating curve was applied to the continuous record of water surface elevations, as measured and recorded by the water level logger at each station, to derive a continuous record of discharges.

2.3.2 Manual Hydrometric Stations

Following the discharge and water level data collection methods described above, additional discrete discharge and water level measurements were also collected opportunistically at the following 16 locations:

- Lake A12;
- Lake A16;
- Lake A19;
- Lake A21;
- Lake A22;
- Lake A45;
- Lake A53;
- Lake A55;
- Lake A60;
- Lake A62;
- Lake A63;
- Lake A65;
- Lake A72;
- Lake A76;
- Lake A81; and
- Lake B3.

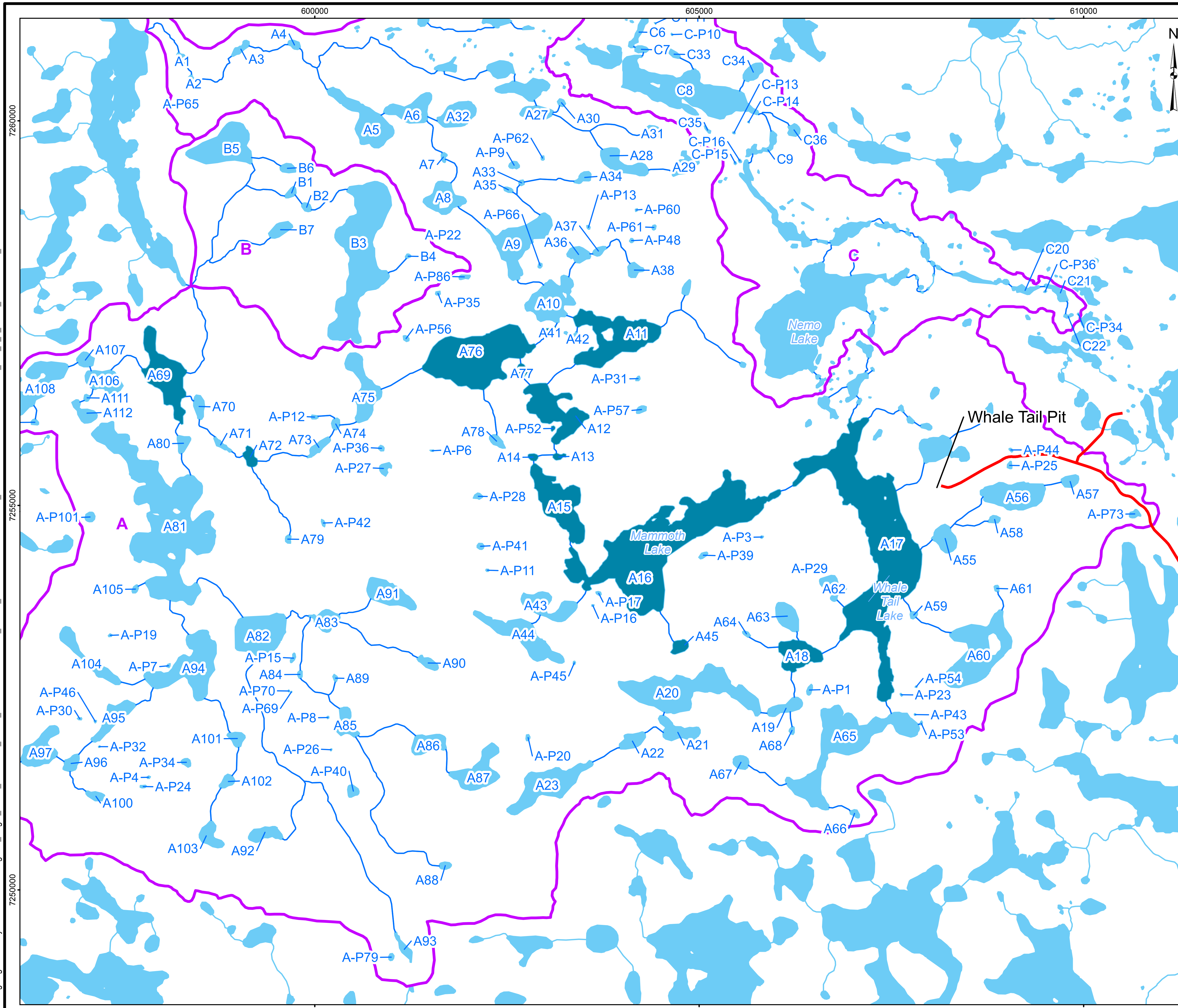
The locations of the manual hydrometric stations are shown on Figure 1-2.

2.4 Lake Shoreline Surveys

A 2015 field survey program was completed to collect geomorphological field data to characterize baseline conditions of the lake shorelines and outlet channels potentially affected by the Project (Figure 2-1). The lake shorelines were surveyed between 16 and 21 September 2015 at those lakes where baseline water levels nearest to the proposed mine operations, including: Lake A12, Lake A15, Lake A16 (Mammoth Lake), Lake A17 (Whale Tail Lake), Lake A18, Lake A45, Lake A69, Lake A72 and Lake A76.. The shorelines were accessed on foot, or by helicopter, depending on the site visit opportunity.

The methods used in the field surveys were as follows:

- For each surveyed lake, shore-normal transects were surveyed to represent typical sections of shoreline with similar slope, soil, and wave exposure.
- Lakeshore survey locations were determined based on information available from the hydrology program field trips, Project information provided by Agnico Eagle, and topographical information for the area at the time of planning (CanVec 2013).



LEGEND

- PROPOSED HAUL ROAD
- WATERSHED
- STREAM
- WATERCOURSE (CANVEC)
- SHORELINE SURVEY
- WATERBODY (CANVEC)

REFERENCE

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200_R0.dwg
2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

1600 0 1600

METRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

LAKE SHORELINE SURVEYS

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	DC	27 Oct. 2015		
CHECK	JL	14 Jan. 2016	FIGURE 2-1	
REVIEW	DRW	14 Jan. 2016		

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- At each transect, a shore-normal topographic profile was surveyed using a SOKKIA GNSS GSR 2700ISX (Global Navigation Satellite System) with RTK capabilities to provide accurate position and elevation data. The transect profiles typically extended from below the existing water level to above the high water level, estimated based on visual observation while on-site.
- Lake outlet channel cross-sections were also surveyed to provide typical channel geometry data.
- Additional data for the surveyed lakes were derived using GIS software and spatial baseline data (CanVec 2013).
- A more detailed lake shoreline description was prepared based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015).
- The digital elevation data provided by Agnico Eagle (PhotoSat 2015) was used within GIS software to derive a terrain slope dataset.
- Photographic documentation was carried out simultaneously with the field surveys for each homogeneous section of the shoreline. Representative photographs are presented in Appendix B.
- Shoreline sections were delineated in the field based on the visually observable characteristics of aspect, wave exposure (a combination of prevailing wind and fetch length), slope gradient, and terrain and sediment types (gradation and origin). Ice thrust effects (e.g., ice-push berms at the shoreline) were considered as evidence of thermal erosion at existing water level elevations.

The shoreline parameters measured for the lakeshore characterization at each transect were: bank features (elevations, bank height, bank slope), bank materials, and exposure characteristics such as shore orientation and fetch length. A more detailed description of the parameters used in shoreline transect characterization is presented in Table 2-1.

Table 2-1: Shoreline Transect Parameters Description

Parameter	Description
Length	The total length of the surveyed transect
Elevations	Maximum and minimum surveyed elevations
Bank materials	The following materials classes have been used for characterization: - Fines and organics; - Sand; - Gravel; - Cobbles; - Boulders; and - Bedrock. A combination of 2 or more materials may be found at a particular transect location.
Bank height	The average bank height at the transect location
Bank slope	The average bank slope at the transect location, classified for the purposes of this study in the following 3 classes: - <10% as flat to shallow; - 10% to 30% as moderate; and - >30% as steep.
Shoreline geometry	The general shape of the shoreline at the survey location, classified as: - Coves or bays; - Irregular or straight; and - Headland or islands.
Shoreline orientation	The general exposure of the shoreline, in geographic degrees similar to wind direction.
Fetch length	The length of open water perpendicular to the shoreline over which the wind blows generating waves.

2.5 Water Balance Model

A water balance model was developed for the BSA to assess mean characteristics and natural variability of discharge and water levels of lake outlets in the baseline area.

The water balance model was developed using the GoldSim software with a 1-hour time step and input data for the period of 1950 to 2015. Model output results were obtained for all years, with the exception of years with meteorological input data gaps, including years 1951, 1979, 1993, and 2010, which were not modeled. The basic water balance elements for each modeled lake reservoir considered rainfall and snowmelt runoff, lake evaporation, changes in lake storage, and outflow to downstream basins.

The model was calibrated using runoff coefficients for land surfaces, lake outlet stage-discharge rating curves, and degree-day models for snowmelt and formation of ice in outlet channels. Runoff coefficients for land surfaces account for water losses to ground infiltration and summer evapotranspiration. The runoff coefficients were calibrated to the calculated annual water yield of hydrometric stations with available data for most of the 2015 open water season (i.e., stations with a period of record of 97 days or greater). Lake outlet stage-discharge rating curves and degree-day models were calibrated to site-specific data.

The calibrated model was used to generate daily time series datasets of lake stages and lake outlet discharges for the BSA. Frequency analyses were completed for key sites to provide a historical baseline of lake stage and lake outlet discharge regimes.

Further details on the water balance model, including input data, model structure, calibration, and preliminary validation, are presented in Appendix C.

3.0 RESULTS

3.1 Watersheds and Drainage Patterns

Watersheds within the Hydrology BSA comprise an extensive network of lakes, ponds, and interconnecting streams (Figure 1-2).

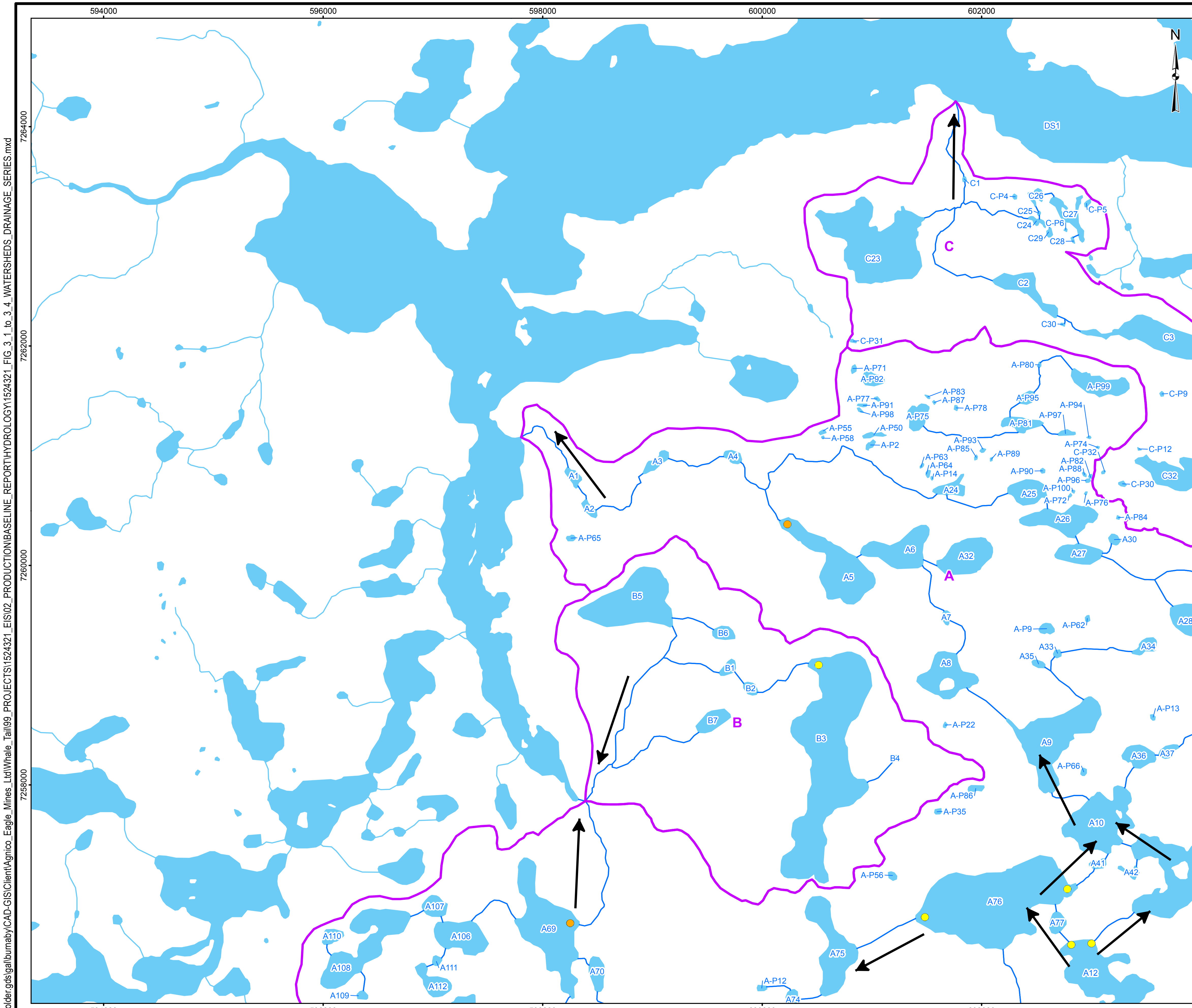
Characteristics of the A, B, and C watersheds are summarized in Table 3-1. As an example the A watershed has a drainage area of 110 km^2, and lake water surface fraction (i.e., the ratio of lake area to land area) of 16%. Watersheds and general drainage patterns are shown in Figure 3-1 to Figure 3-4.

It should be noted that the boundary separating the A watershed from the C watershed just north of Lake A113 is associated with a degree of uncertainty due to the local flat topography. Field observations noted discharge from Lake A113 both to the north (i.e., within the C watershed) and to the south (i.e., within the A watershed). Based on visual observations, Lake A113 is thought to drain primarily to the south (i.e., within the A watershed) and Lake A113 was included in the A watershed.

Table 3-1: Characteristics of Watersheds in the Hydrology Baseline Study Area

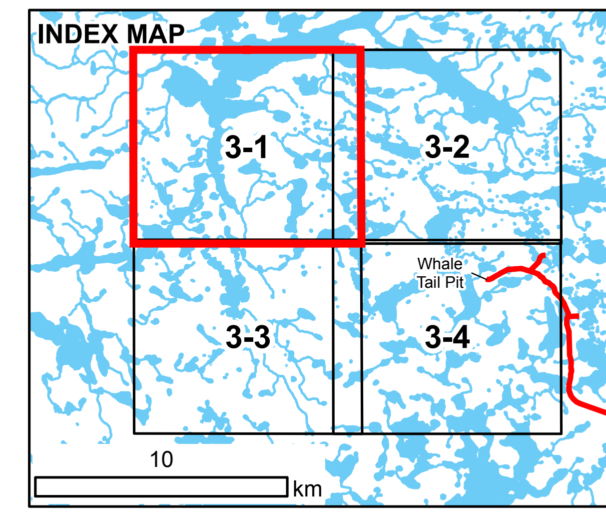
Watershed	Land Surface Area (km^2)	Lake Surface Area (km^2)	Total Area (km^2)	Lake Water Surface Fraction
A	95.6	14.8	110	0.155
B	5.95	1.19	7.14	0.200
C	14.4	3.24	17.6	0.226

km^2 = square kilometre



LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY



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2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATERSHEDS AND DRAINAGE PATTERNS (NORTH WEST)

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016	FIGURE 3-1	
REVIEW	DRW	14 Jan. 2016		

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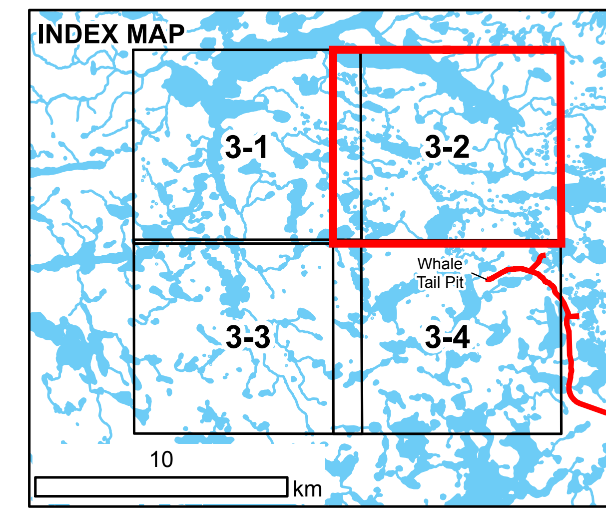
LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY



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2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE
WATERSHEDS AND DRAINAGE PATTERNS (NORTH EAST)

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
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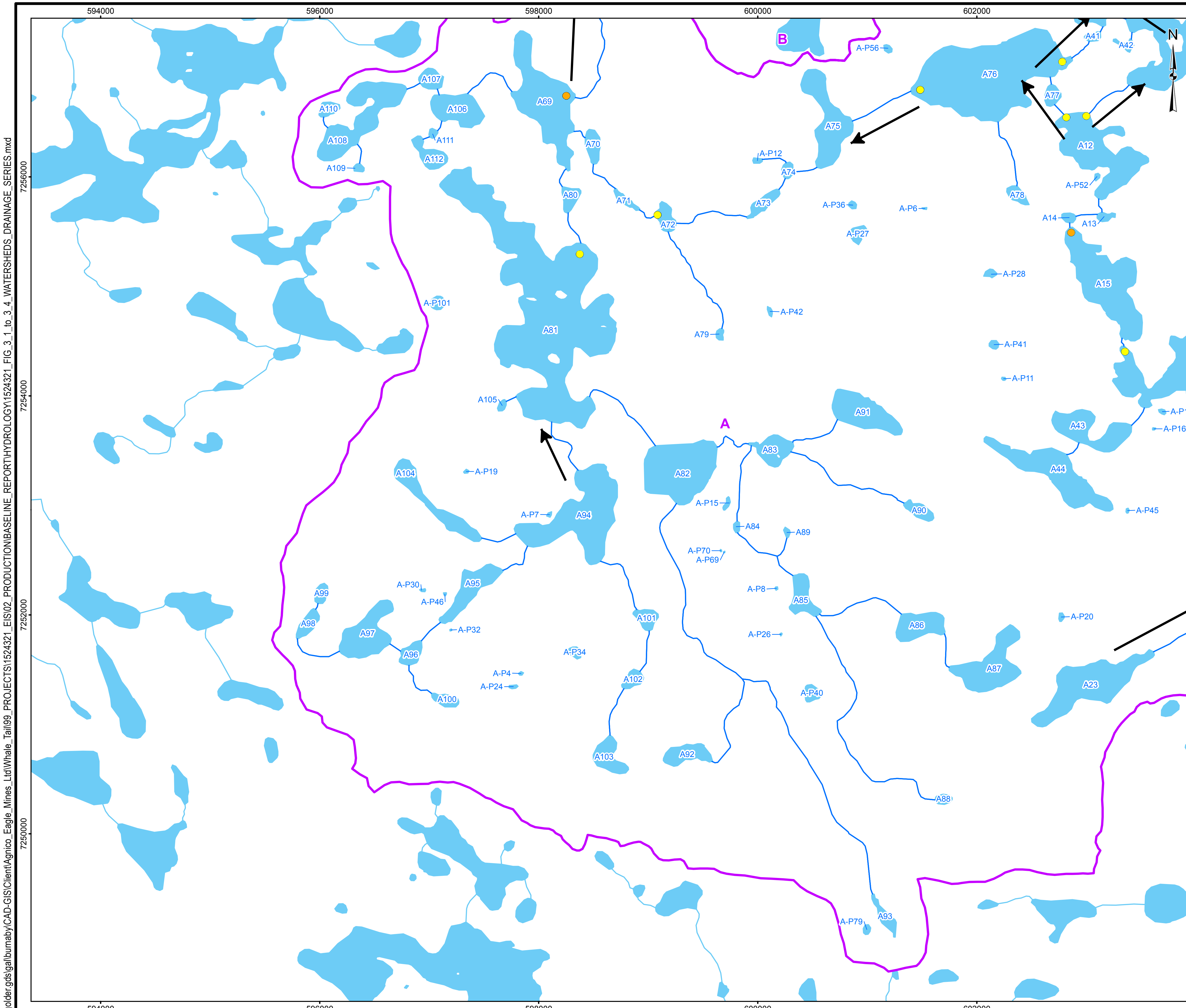
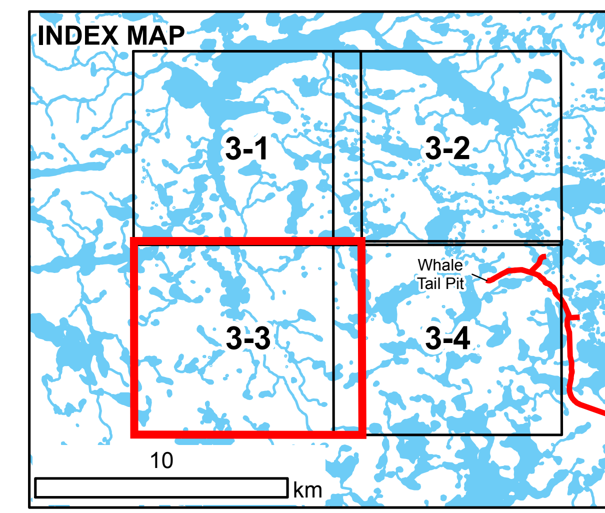
CHECK	JL	14 Jan. 2016	**FIGURE 3-2**	
REVIEW	DRW	14 Jan. 2016		



LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY



REFERENCE

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2. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

PROJECT

AGNICO EAGLE

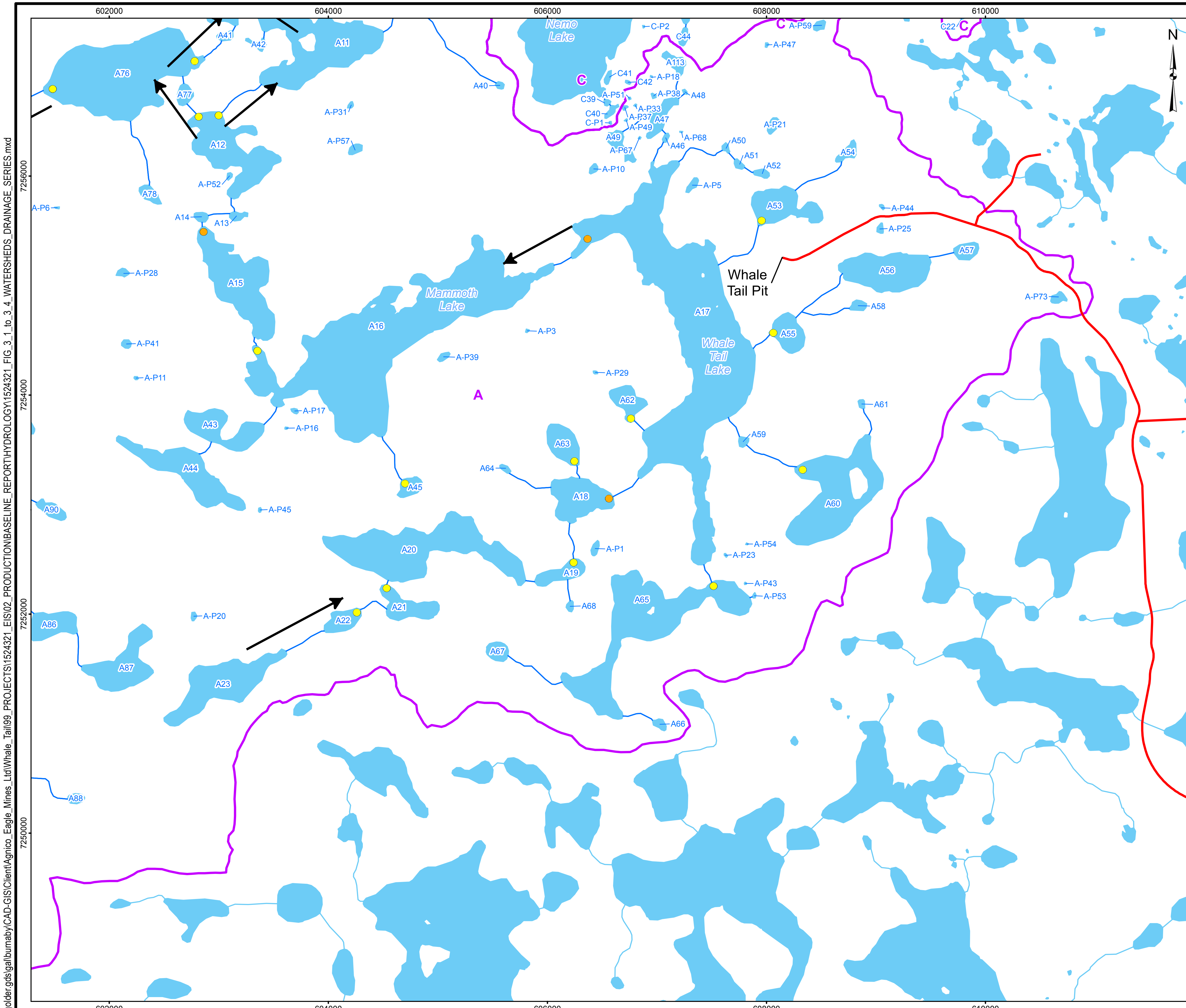
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

WATERSHEDS AND DRAINAGE PATTERNS (SOUTH WEST)

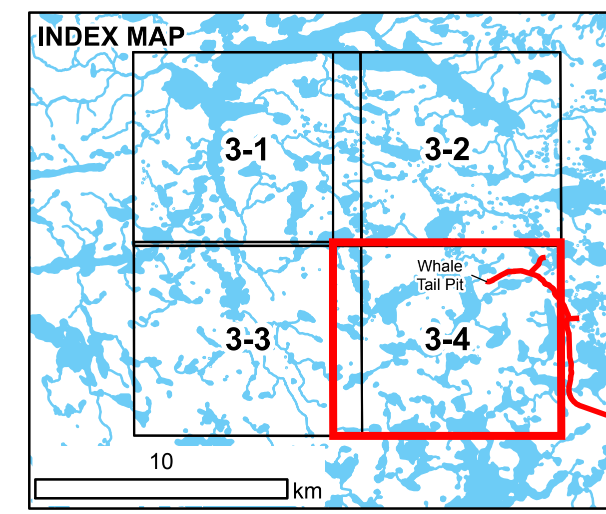
Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016	FIGURE 3-3	
REVIEW	DRW	14 Jan. 2016		



LEGEND

- CONTINUOUS STATION
- MANUAL STATION
- PROPOSED HAUL ROAD
- DRAINAGE PATTERN
- WATERSHED
- STREAM
- WATERCOURSE
- WATERBODY



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DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

700 0 700
METRES

PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE
WATERSHEDS AND DRAINAGE PATTERNS (SOUTH EAST)

Golder Associates

PROJECT		1524321	FILE No.	
DESIGN	JL	21 Oct. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 Oct. 2015		
CHECK	JL	14 Jan. 2016	FIGURE 3-4	
REVIEW	DRW	14 Jan. 2016		

3.2 Hydrometry

3.2.1 Continuous Hydrometric Stations

As stated in Section 2.3.1, continuous hydrometric stations were installed at Lake A5, Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C8, Lake C38 (Nemo Lake), and Lake DS1. Hydrographs for all eight locations and field survey results are summarized below. In addition, Appendix A includes factsheets describing the location of each hydrometric station and the equipment installed (when applicable); photographs; measured stage-discharge data; derived stage-discharge rating curve based on data collected in 2015; tabulated mean daily discharge and water level data; manual discharge measurement data; and related calculation sheets for each station.

3.2.1.1 Lake A5

The Lake A5 hydrometric station was visited twice in 2015, and a continuous hydrograph was derived for the period of 6 August to 17 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-2. The hydrographs for Lake A5 are presented in Figure 3-5. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

It should be noted that the DEM elevation (PhotoSat 2015) is approximately 25 cm higher than the derived water surface elevation. This difference in elevation falls within the accuracy of the DEM data of ± 30 cm (PhotoSat 2015).

Table 3-2: Surveys at Lake A5 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
6 Aug	Measured discharge and water surface elevation, and installed data logger.	✓	132.30	✓	0.434
28 Aug	From DEM (PhotoSat 2015)	✓	132.50	-	-
17 Sep	Measured discharge and water surface elevation. Removed and downloaded data logger.	✓	132.16	✓	0.112

masl = metres above sea level, m^3/s = cubic metres per second.

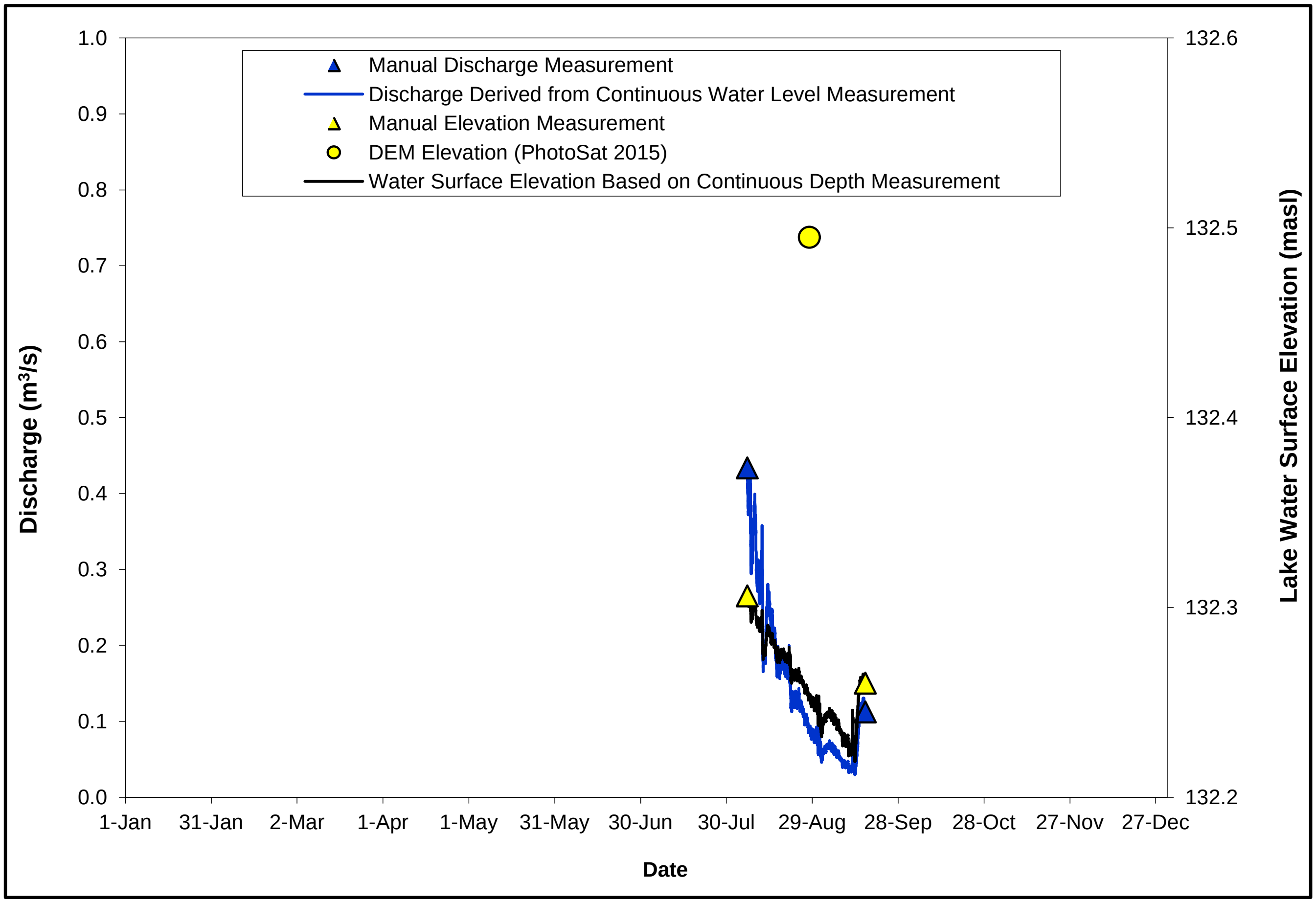

Figure 3-5: Hydrograph for Lake A5 in 2015

3.2.1.2 Lake A15

The Lake A15 hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 13 June to 18 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-3. The hydrographs for Lake A15 are presented in Figure 3-6. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-3: Surveys at Lake A15 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake A15 and outlet frozen.	-	-	-	Frozen
8 Jun	None - Lake A15 and outlet frozen.	-	-	-	Frozen
13 Jun	Installed data logger. Measured water surface elevation.	✓	152.06	-	Trickle (Ice Present)
15 Jun	Measured discharge and water surface elevation.	✓	152.09	✓	5.68
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	151.65	✓	0.233
28 Aug	From DEM (PhotoSat 2015)	✓	151.46	-	-
18 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	151.43	-	Not measurable

masl = metres above sea level, m^3/s = cubic metres per second

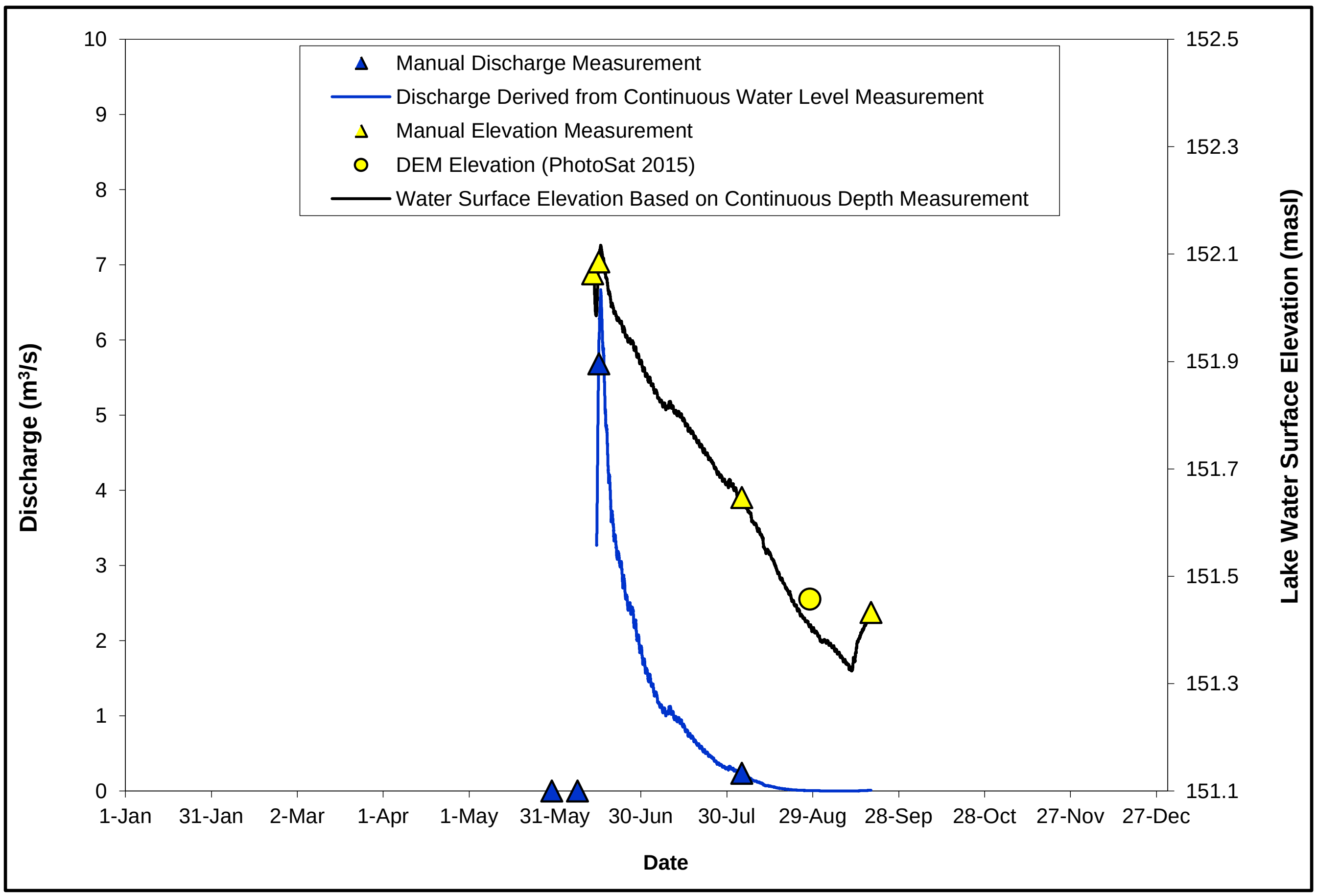

Figure 3-6: Hydrograph for Lake A15 in 2015

3.2.1.3 *Lake A17 (Whale Tail Lake)*

The Lake A17 (Whale Tail Lake) hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 12 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-4. The hydrographs for Lake A17 and Outlet are presented in Figure 3-7. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-4: Surveys at Lake A17 (Whale Tail Lake) Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake A17 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake A17 and outlet are frozen.	-	-	-	Frozen
12 Jun	Installed data logger. Measured water surface elevation.	✓	153.11	-	Frozen
14 Jun	Measured discharge and water surface elevation.	✓	153.38	✓	4.23
7 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	152.65	✓	0.190
28 Aug	From DEM (PhotoSat 2015)	✓	152.50	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	152.46	✓	0.012

masl = metres above sea level, m^3/s = cubic metres per second

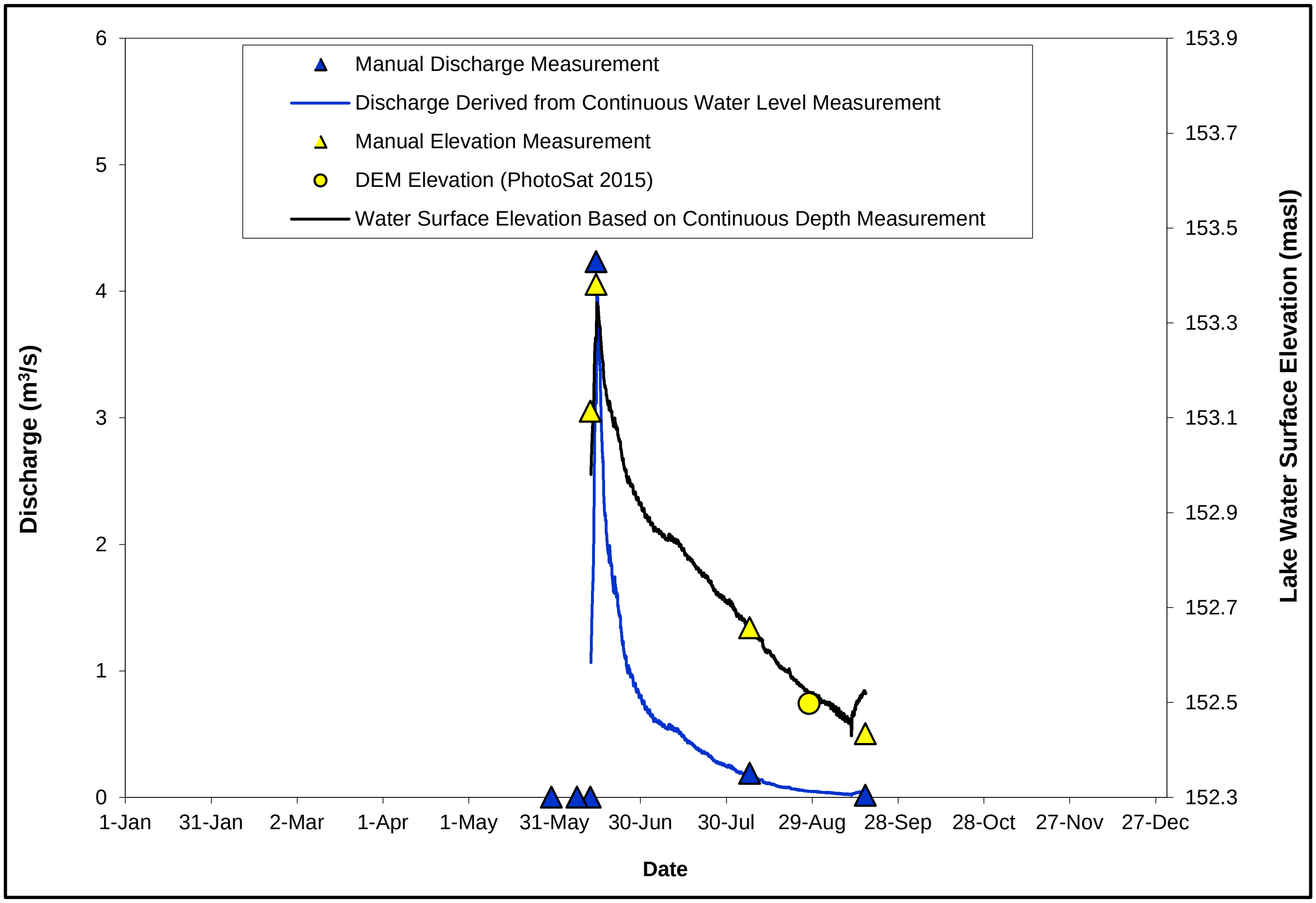

Figure 3-7: Hydrograph for Lake A17 (Whale Tail Lake) in 2015

3.2.1.4 Lake A18

The Lake A18 hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 11 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-5. The hydrographs for Lake A18 and Outlet are presented in Figure 3-8. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

It should be noted that the DEM elevation (PhotoSat 2015) is approximately 8 cm higher than the derived water surface elevation. This difference in elevation falls within the accuracy of the DEM data of ± 30 cm (PhotoSat 2015).

Table 3-5: Surveys at Lake A18 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake A18 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake A18 and outlet are frozen.	-	-	-	Frozen
11 Jun	Installed data logger. Measured water surface elevation.	✓	154.16	-	Frozen
14 Jun	Measured discharge and water surface elevation.	✓	154.22	✓	2.48
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	153.89	✓	0.129
28 Aug	From DEM (PhotoSat 2015)	✓	153.86	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	153.81	✓	0.004

masl = metres above sea level, m^3/s = cubic metres per second

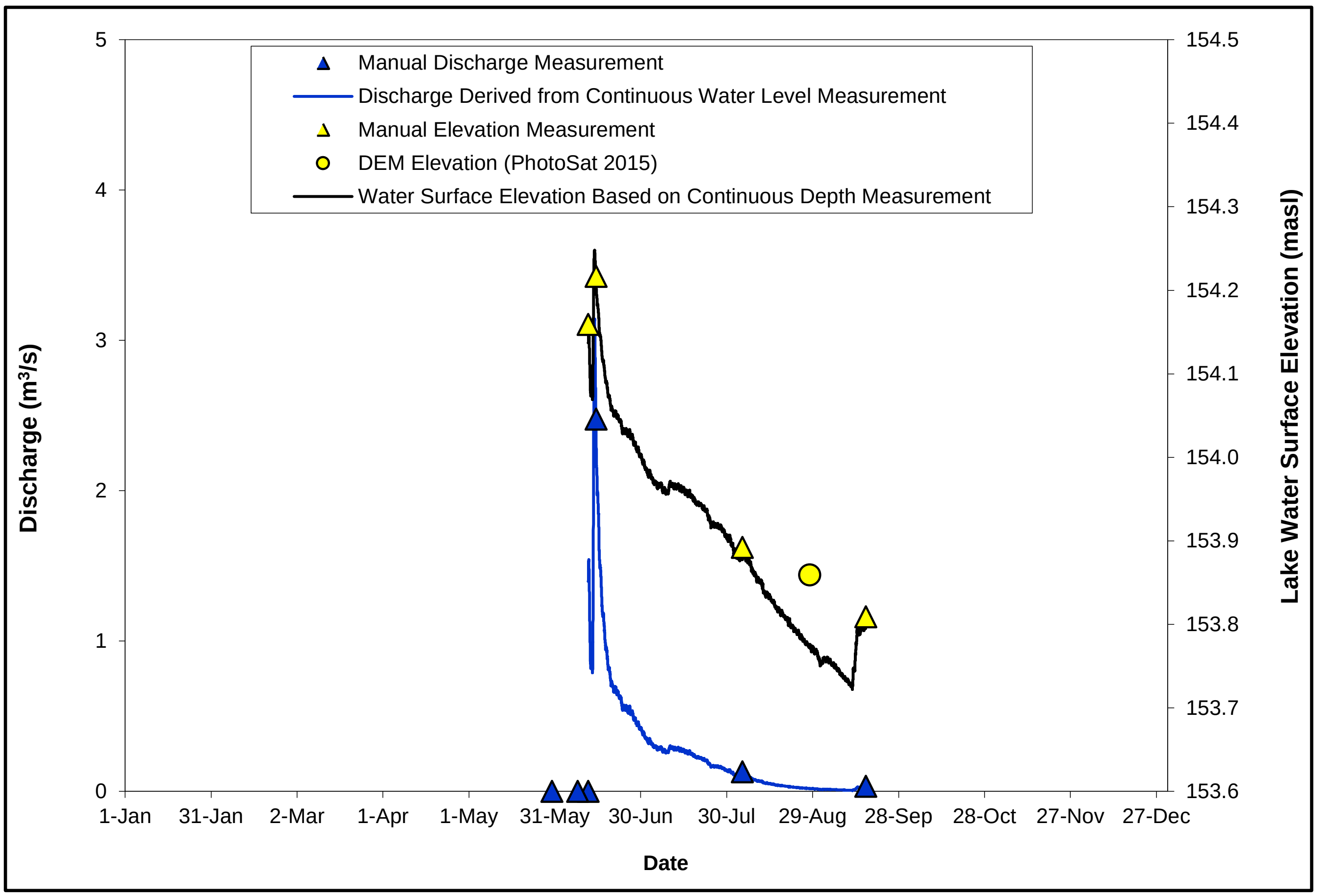

Figure 3-8: Hydrograph for Lake A18 in 2015

3.2.1.5 Lake A69

The Lake A69 hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 11 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-6. The hydrographs for Lake A69 are presented in Figure 3-9. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-6: Surveys at Lake A69 and Outlet Hydrometric Station, 2015

Date	Activities / Data Source	Lake	Lake Water Surface Elevation (masl)	Outflow	Discharge (m^3/s)
30 May	None - Lake A69 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake A69 and outlet are frozen.	-	-	-	Frozen
11 Jun	Installed data logger. Measured discharge and water surface elevation.	✓	112.47	✓	3.00
15 Jun	Measured discharge and water surface elevation.	✓	112.60	✓	6.73
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	112.21	✓	0.398
28 Aug	From DEM (PhotoSat 2015)	✓	112.21	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	112.17	✓	0.206

masl = metres above sea level, m^3/s = cubic metres per second

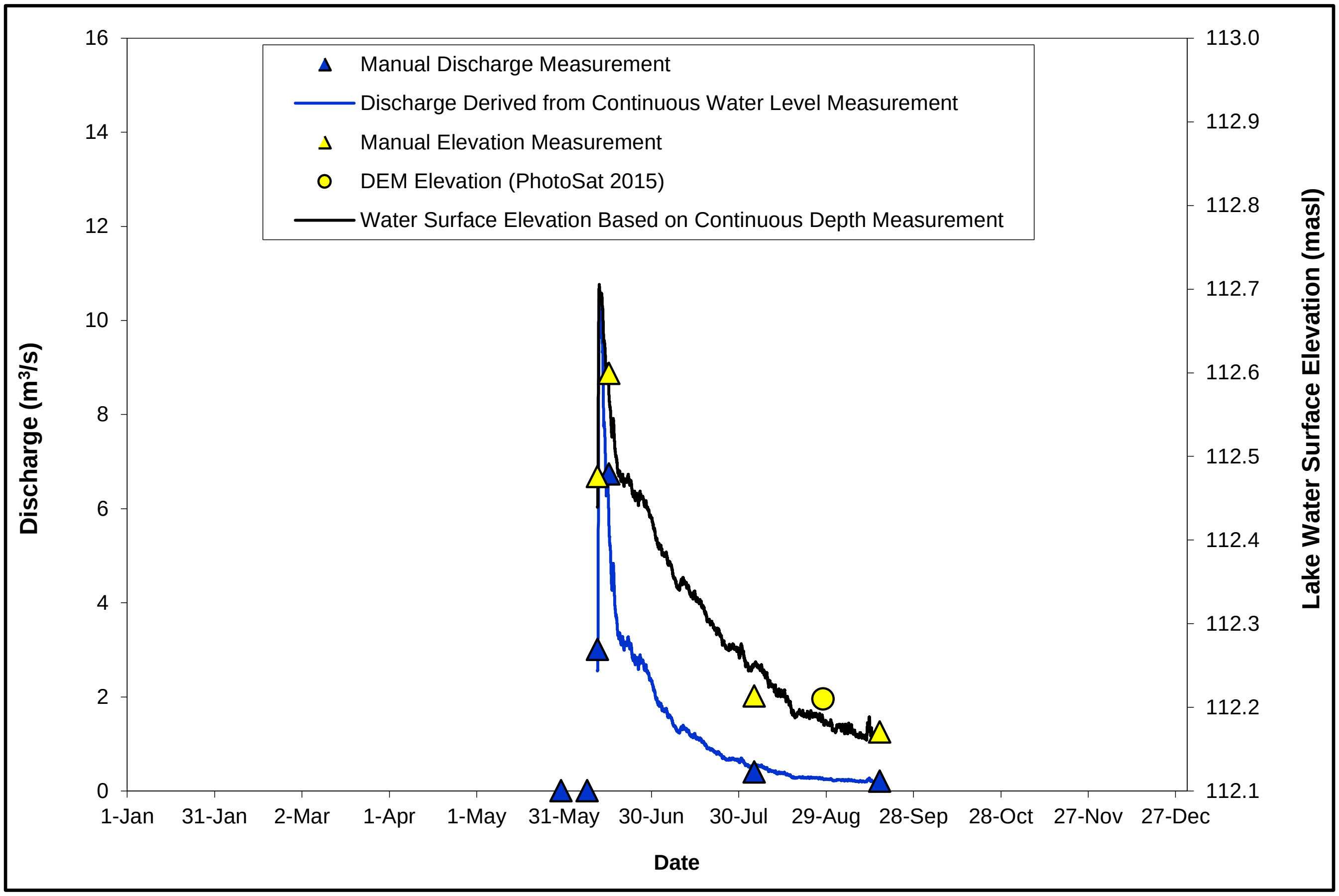

Figure 3-9: Hydrograph for Lake A69 in 2015

3.2.1.6 Lake C8

The Lake C8 hydrometric station was visited twice in 2015, and a continuous hydrograph was derived for the period of 8 August to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-7. The hydrographs for Lake C8 are presented in Figure 3-10. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

It should be noted that the DEM elevation (PhotoSat 2015) is approximately 25 cm lower than the derived water surface elevation. This difference in elevation falls within the accuracy of the DEM data of ± 30 cm (PhotoSat 2015).

Table 3-7: Surveys at Lake C8 Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
8 Aug	Measured discharge and water surface elevation, and installed data logger.	✓	139.02	✓	0.087
28 Aug	From DEM (PhotoSat 2015)	✓	138.74	-	-
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	139.02	✓	0.101

masl = metres above sea level, m^3/s = cubic metres per second

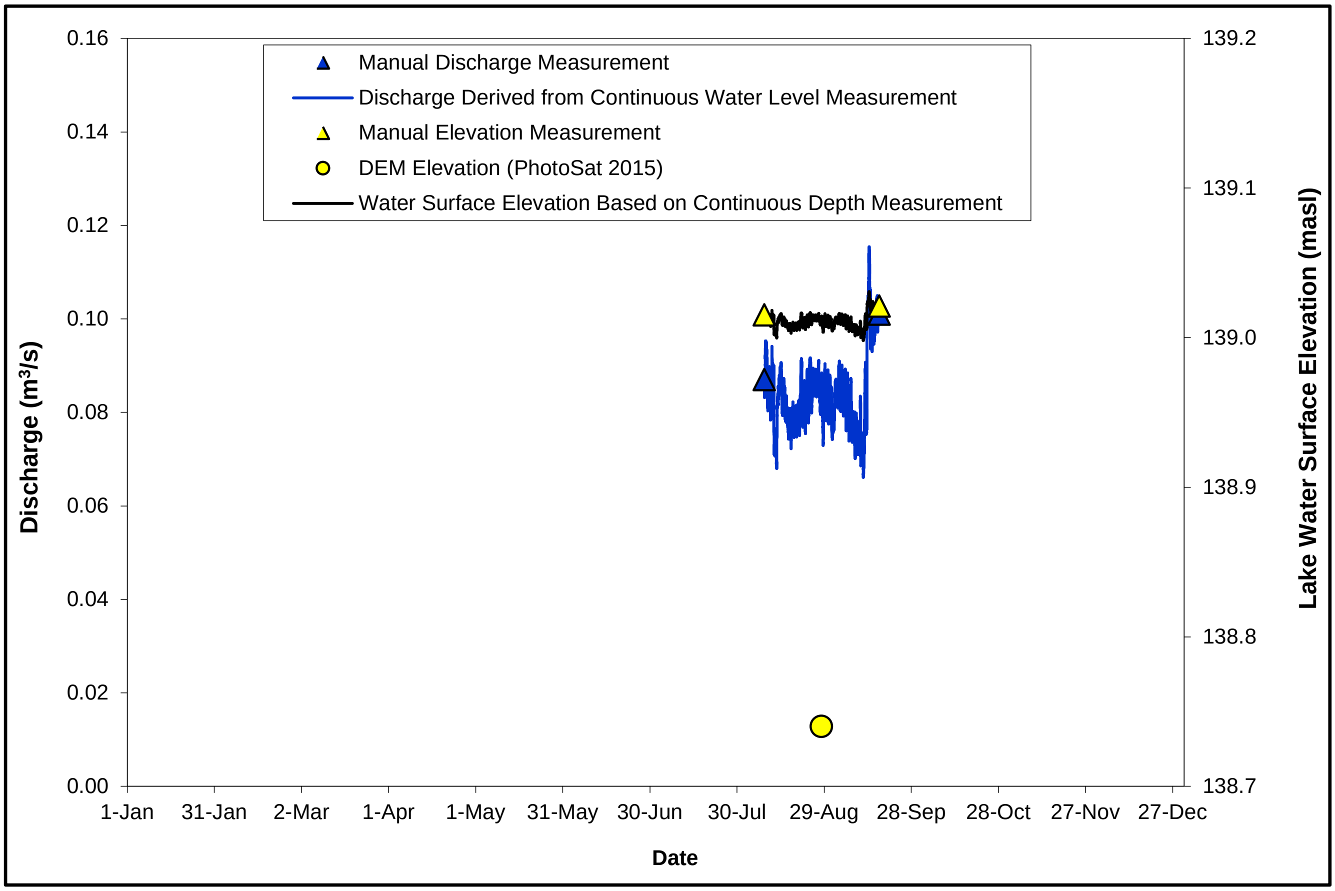

Figure 3-10: Hydrograph for Lake C8 in 2015

3.2.1.7 Lake C38 (Nemo Lake)

The Lake C38 (Nemo Lake) hydrometric station was visited six times in 2015, and a continuous hydrograph was derived for the period of 13 June to 17 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-8. The hydrographs for Lake C38 (Nemo Lake) are presented in Figure 3-11. The water surface elevation of the lake was also captured by the DEM dataset (PhotoSat 2015) and was added to the table and figure.

Table 3-8: Surveys at Lake C38 (Nemo Lake) Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
30 May	None - Lake C38 and outlet are frozen.	-	-	-	Frozen
8 Jun	None - Lake C38 and outlet are frozen.	-	-	-	Frozen
13 Jun	Installed data logger. Measured water surface elevation.	✓	155.99	-	Frozen
14 Jun	Measured discharge and water surface elevation.	✓	156.01	✓	0.046
4 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	155.85	✓	0.019
28 Aug	From DEM (PhotoSat 2015)	✓	155.70	-	-
17 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	155.69	✓	0.007

masl = metres above sea level, m^3/s = cubic metres per second

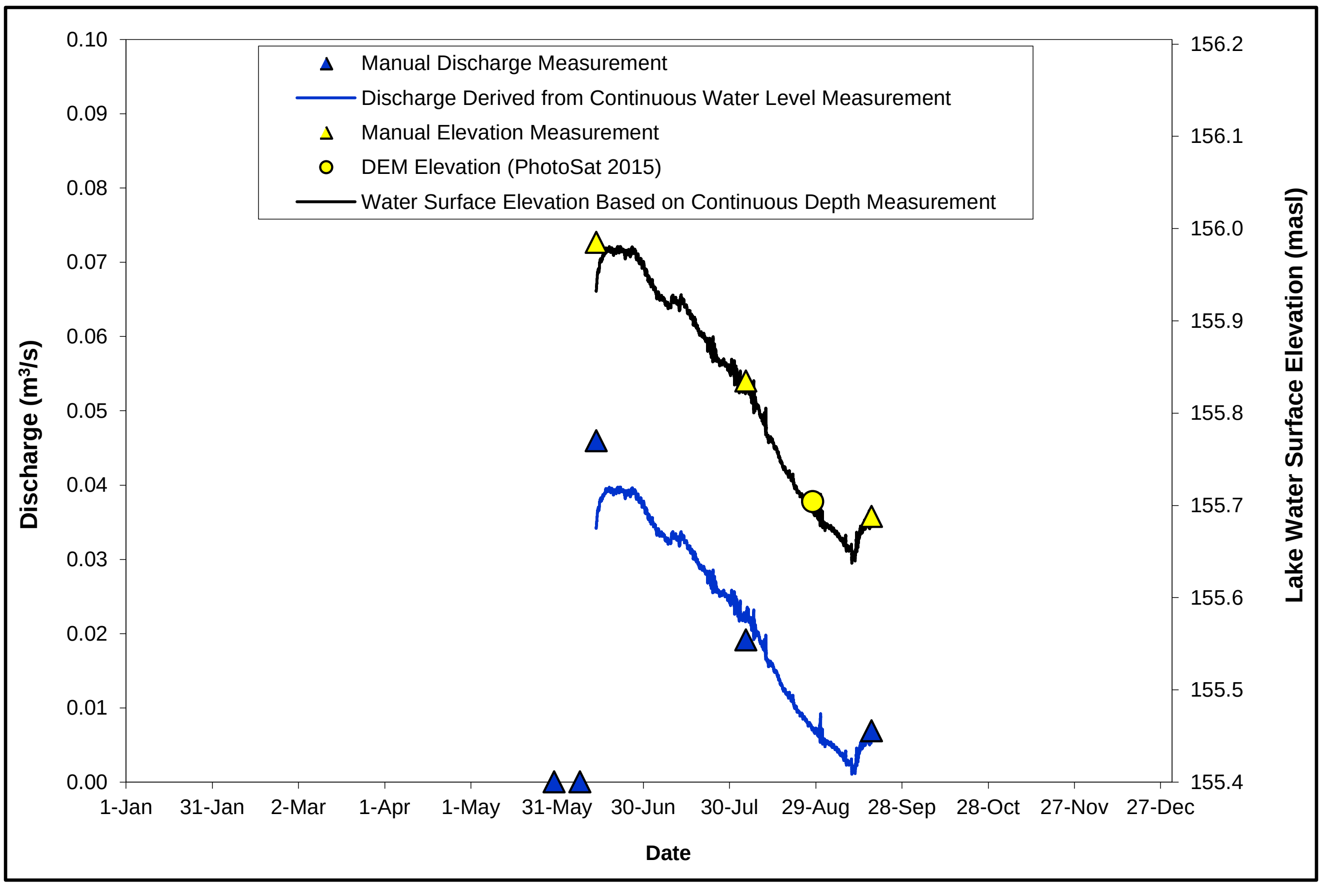

Figure 3-11: Hydrograph for Lake C38 (Nemo Lake) in 2015

3.2.1.8 Lake DS1

The Lake DS1 hydrometric station was visited three times in 2015, and a continuous hydrograph was derived for the period of 12 June to 16 September 2015, based on continuous logger data. Details of each site visit are provided in Table 3-9. The hydrographs for Lake DS1 are presented in Figure 3-12.

No discharge was measured on 12 June 2015 due to unsafe wading conditions. The estimate provided was based on velocity measurements along wadeable sections near the banks, and estimated wetted width. DEM data did not extend to the Lake DS1 hydrometric station.

Table 3-9: Surveys at Lake DS1 and Outlet Hydrometric Station, 2015

Date	Activities	Lake	Lake Water Surface Elevation (masl)	Outlet	Discharge (m^3/s)
12 Jun	Installed data logger. Measured water surface elevation and estimated discharge due to unsafe wading conditions.	✓	99.66	-	-
5 Aug	Measured discharge and water surface elevation, and downloaded data logger.	✓	99.47	✓	12.3
16 Sep	Measured discharge and water surface elevation; removed and downloaded data logger.	✓	99.21	✓	4.82

masl = metres above sea level, m^3/s = cubic metres per second

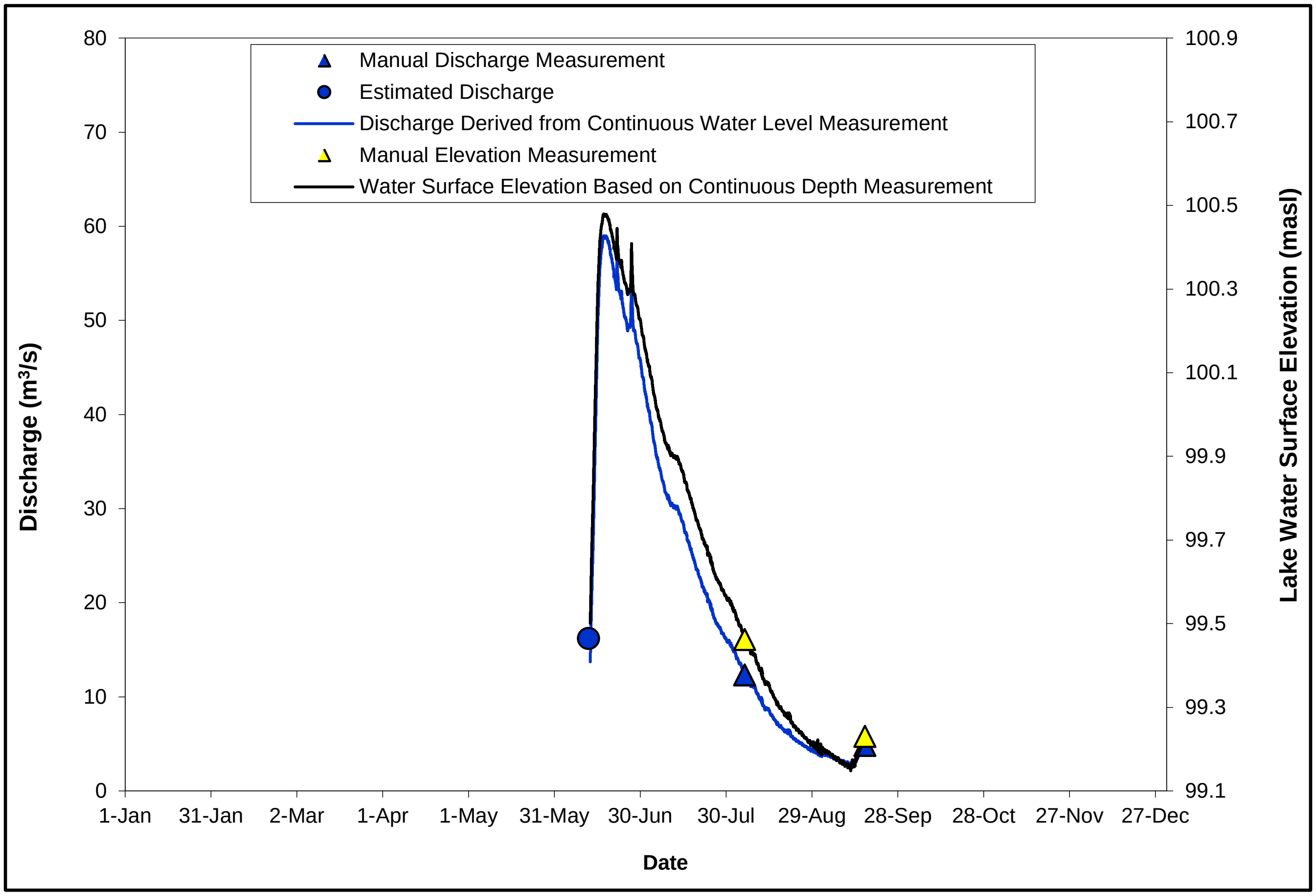

Figure 3-12: Hydrograph for Lake DS1 in 2015

3.2.1.9 Water Yields

Water yields for the open water season were calculated based on derived daily discharge values for stations with continuous hydrographs, and are presented in Table 3-10.

Derived water yields for lakes with similar periods of record (i.e., with 97 and 98 days of record) varied between 52.3 mm (Lake C38 [Nemo Lake]) and 267 mm (Lake A18). The lower water yields at Lake A17 and Lake C38 may be attributed to proportions of ineffective areas in the watersheds, and the potential for shallow subsurface flow to convey water outside of the assumed drainage boundaries. Tributaries of Lake A17 (Whale Tail Lake) and Lake C38 (Nemo Lake) were opportunistically observed to drain poorly, with ponded water.

Lake A5 and Lake 69 are both located downstream of Lake A76. As shown on the drainage pattern map (Figure 1-2), Lake A12 and Lake A76 each have two lake outlets. Based on field observations (with further information on the elevations of each lake outlet provided in Section 3.3), Lake A12 primarily drains to Lake A11, and its secondary outlet drains to Lake A77. Lake A76 primarily drains to Lake A41, and its secondary outlet to Lake A75. It was therefore assumed that Lake A76 only drained to Lake A41 during periods of record for water yields derived for Lake A5 and Lake A69.

Table 3-10: Water Yield Values for the Continuous Stations over the Period of Record in 2015

Sub-Watershed	Watershed Area (km^2)	Hydrograph Period and Duration (number of days)	Runoff Volume (m^3)	Water Yield (mm)
Lake A5	57.6[a]	6 August to 16 September 2015 (42)	518,000	9.0[a,c]
Lake A15	40.8	13 June to 18 September 2015 (98)	7,880,000	193
Lake A17 (Whale Tail Lake)	28.1	12 June to 16 September 2015 (97)	4,290,000	152
Lake A18	8.89	11 June to 15 September 2015 (97)	2,380,000	267
Lake A69	43.4[b]	11 June to 16 September 2015 (98)	11,400,000	276[b]
Lake C8	11.8	8 August to 16 September 2015 (40)	283,000	24.0[c]
Lake C38 (Nemo Lake)	3.54	13 June to 17 September 2015 (97)	185,000	52.3
Lake DS1	897.6	12 June to 16 September 2015 (97)	179,000,000	199.2

[a] inclusive of the Lake A76 sub-watershed (i.e., over the period of the record, it was assumed that all runoff from Lake A76 drained to Lake A41)

[b] exclusive of the Lake A76 sub-watershed (i.e., over the period of the record, it was assumed that all runoff from Lake A76 drained to Lake A41)

[c] late open-water season flows only; does not include freshet

km^2 = square kilometres; m^3 = cubic metres; mm = millimetres

3.2.2 Manual Hydrometric Stations

Manual hydrometric measurements are summarized in Table 3-11.

Table 3-11: Manual Hydrometric Measurements

Lake Name	Date	Discharge (m^3/s)	Water Level (masl)	Comment
Lake A12-A11	06-Aug-15	0.316	148.82	northeast outlet of Lake A12
	28-Aug-15	-	148.61	PhotoSat 2015
	18-Sep-15	(a)	148.73	northeast outlet of Lake A12
Lake A12-A77	06-Aug-15	0.133	148.82	northwest outlet of Lake A12
	28-Aug-15	-	148.61	PhotoSat 2015
	18-Sep-15	(a)	148.73	northwest outlet of Lake A12
Lake A16	13-Jun-15	2.07	152.61	
	28-Aug-15	-	152.24	PhotoSat 2015
	18-Sep-15	-	152.09	
Lake A19	08-Aug-15	(a)	154.69	
	28-Aug-15	-	154.62	PhotoSat 2015
Lake A21	06-Aug-15	0.015	157.77	Water level measured on 8 August 2015
	28-Aug-15	-	154.63	PhotoSat 2015
Lake A22	08-Aug-15	(a)	154.92	
	28-Aug-15	-	154.79	PhotoSat 2015
Lake A45	28-Aug-15	-	156.27	PhotoSat 2015
	19-Sep-15	(a)	156.42	
Lake A53	12-Jul-15	0.048	-	Measured by Agnico Eagle
	7-Aug-15	0.005	161.655	
	28-Aug-15	-	161.73	PhotoSat 2015

Table 3-11: Manual Hydrometric Measurements (continued)

Lake Name	Date	Discharge (m^3/s)	Water Level (masl)	Comment
Lake A55	12-Jul-15	0.110	-	Measured by Agnico Eagle
	07-Aug-15	0.020	155.00	
	28-Aug-15	-	155.01	PhotoSat 2015
	17-Sep-15	0.042	154.97	
Lake A60	12-Jul-15	0.077	170.67	Measured by Agnico Eagle; discharge measured downstream of Lake A26
	09-Aug-15	0.004	170.51	
	28-Aug-15	-	170.44	PhotoSat 2015
	17-Sep-15	0.002	-	
Lake A62	12-Jul-15	-	-	Sheet flow observed by Agnico Eagle
	08-Aug-15	0	155.29	
	28-Aug-15	-	155.41	PhotoSat 2015
Lake A63	08-Aug-15	(a)	154.41	
	28-Aug-15	-	154.45	PhotoSat 2015
Lake A65	12-Jul-15	-	-	Observed flow by Agnico Eagle
	09-Aug-15	(a)	154.38	
	28-Aug-15	-	154.79	PhotoSat 2015
Lake A72	28-Aug-15	-	117.36	PhotoSat 2015
	18-Sep-15	0.117	117.39	
Lake A76-A41	06-Aug-15	0.079	147.69	East outlet of Lake A76; water level measured on 5 August 2015
	28-Aug-15	-	147.56	PhotoSat 2015
	18-Sep-15	(a)	147.48	East outlet of Lake A76
Lake A76-A75	12-Jul-15	(a)	-	Measured by Agnico Eagle
	06-Aug-15	(a)	147.69	West outlet of Lake A76; water level measured on 5 August 2015
	28-Aug-15	-	147.56	PhotoSat 2015
	18-Sep-15	(a)	147.48	West outlet of Lake A76
Lake A81	12-Jul-15	1.09	119.92	Measured by Agnico Eagle
	08-Aug-15	0.124	119.86	
	28-Aug-15	-	119.31	PhotoSat 2015
Lake B3	12-Jul-15	0	-	Measured by Agnico Eagle
	08-Aug-15	0.036	-	
	28-Aug-15	-	161.73	PhotoSat 2015

masl = metres above sea level, m^3/s = cubic metres per second, (a) = discharge too low to measure, - = not available

3.3 Lake Shoreline Surveys

Shorelines were surveyed at those lakes where baseline water levels are anticipated to be affected by mine operations, including: Lake A12, Lake A15, Lake A16 (Mammoth Lake), Lake A17 (Whale Tail Lake), Lake A18, Lake A45, Lake A69, Lake A72 and Lake A76 (Figure 2-1; Appendix B). The shorelines were accessed on foot, or by helicopter, depending on the site visit opportunity. The surveys were completed using the methods described in Section 2.4.

The majority of the shorelines surveyed exhibit a consistent terrain type related to shorelines that have developed in morainal material. These morainal shorelines were observed at all lakes visited during the field survey. Limited areas of bedrock and shallowly sloped sandy shorelines were also observed. As a general characteristic for the surveyed shorelines, the predominant materials are boulder gardens mixed with cobble with very limited soils or organic materials on top. The outlet channels exhibit the same characteristics for streambed materials, which results in interstitial flow through large boulders or below the surface and likely close to the bedrock, making flow difficult to observe and measure.

3.3.1 Lake A12

The survey of Lake A12 focused on the lake shoreline and outlet channel. Lake A12 has a surface area of approximately 28.9 ha, and drains into Lake A11 through a main outlet at average and below average water levels. At water levels above average, Lake A12 has a secondary outlet that drains into Lake A77. The proportion of flow to each outlet may also be influenced by outlet channel ice conditions during freshet. Section 3.1 provides further details on the drainage patterns.

The field surveys at Lake A12 included: outlet channel cross-section, outlet channel water surface slope, lake shore normal transects and existing and ordinary high lake water levels.

Both outlet channel cross-sections were surveyed. The main outlet channel is approximately 35 m wide and the secondary outlet channel is approximately 40 m wide (Figure 3-13). The outlet channels are similar, with a poorly defined channel, mainly comprised of a boulder field. The water flows mostly through the boulders for almost the entire width of the main outlet channels. Further downstream, the flow becomes entirely subsurface and is only visible at times through the boulders. No flowing water was observed in the secondary outlet channel at the time of visit.

The slope of the water surface in the main outlet channel could not be measured during the survey because no water was observed and the flow was determined to be interstitial flow (through the boulders and below the surface).

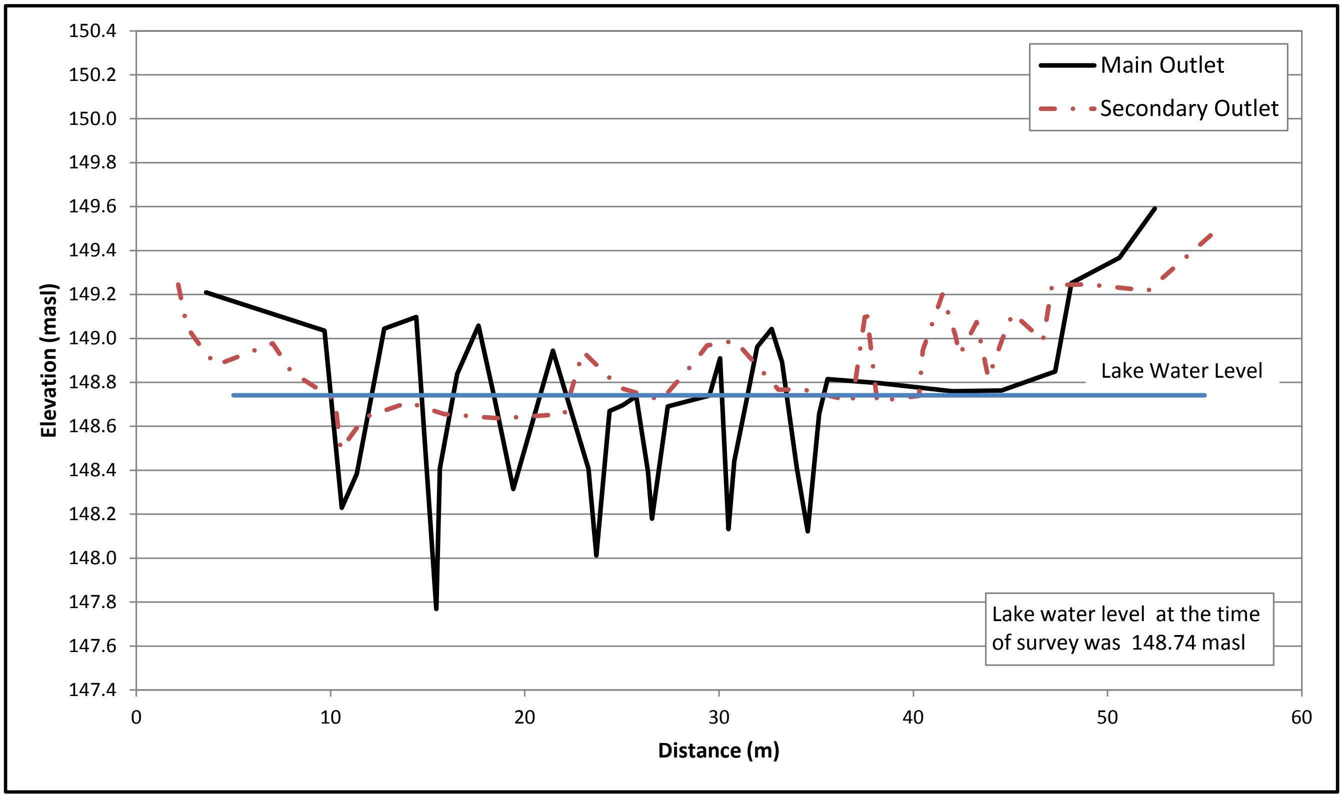

Figure 3-13: Lake A12 Main and Secondary Outlet Channel Cross-Sections, 2015

The water surface elevation at Lake A12 at the time of survey (i.e., 18 September 2015) was measured as 148.74 masl, and the ordinary high water level was estimated at 149.01 masl. A more detailed description of the lake shoreline is presented in Table 3-12, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A12 shoreline are shown in Figure 3-14.

Table 3-12: Lake A12 Shoreline Description

Criteria	Description
Bank materials	The majority of the shoreline is composed of large boulders and cobble. Bedrock is present as well on the northwest shore in a shallow area.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5% gradient. Several small sections on the west shoreline have higher slopes between 10% and 30% gradient. The bedrock shore from the northwest is abrupt with slope gradients greater than 100%.
Typical shoreline geometry	Mostly irregular shoreline with several smaller and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.85 km, on a northwest – southeast direction.

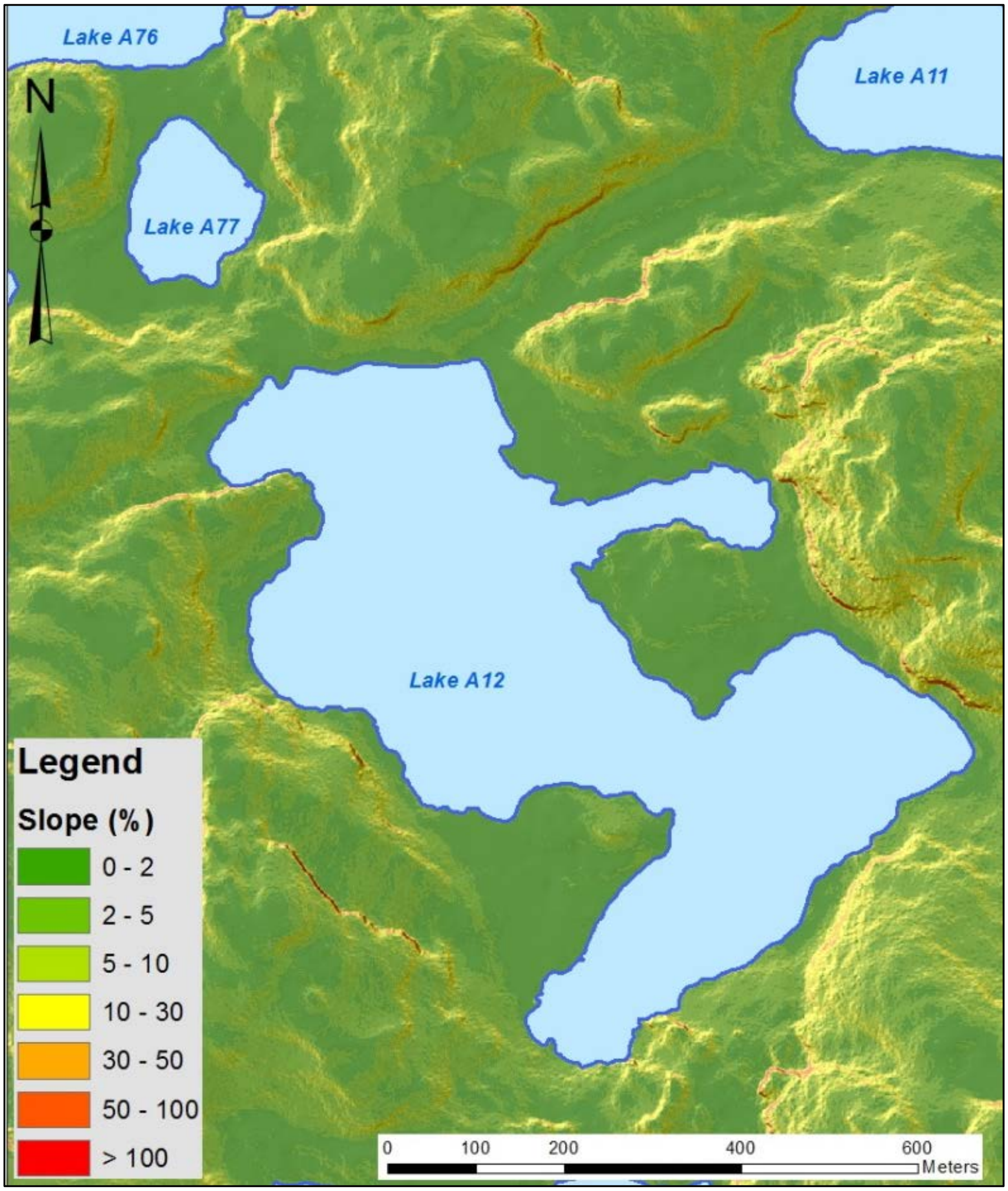

Figure 3-14: Lake A12 Shoreline Slopes (Based on available DEM data [PhotoSat 2015])

Two shore-normal transects were surveyed, one closer to the lake inlet (South Transect), and a second one closer to the lake outlet (North Transect) (Figure 3-15). At both locations, the shoreline is composed of boulders intercalated (cobble inserted between boulders) with cobble. The terrain slopes are similar, at typically less than 5% gradient.

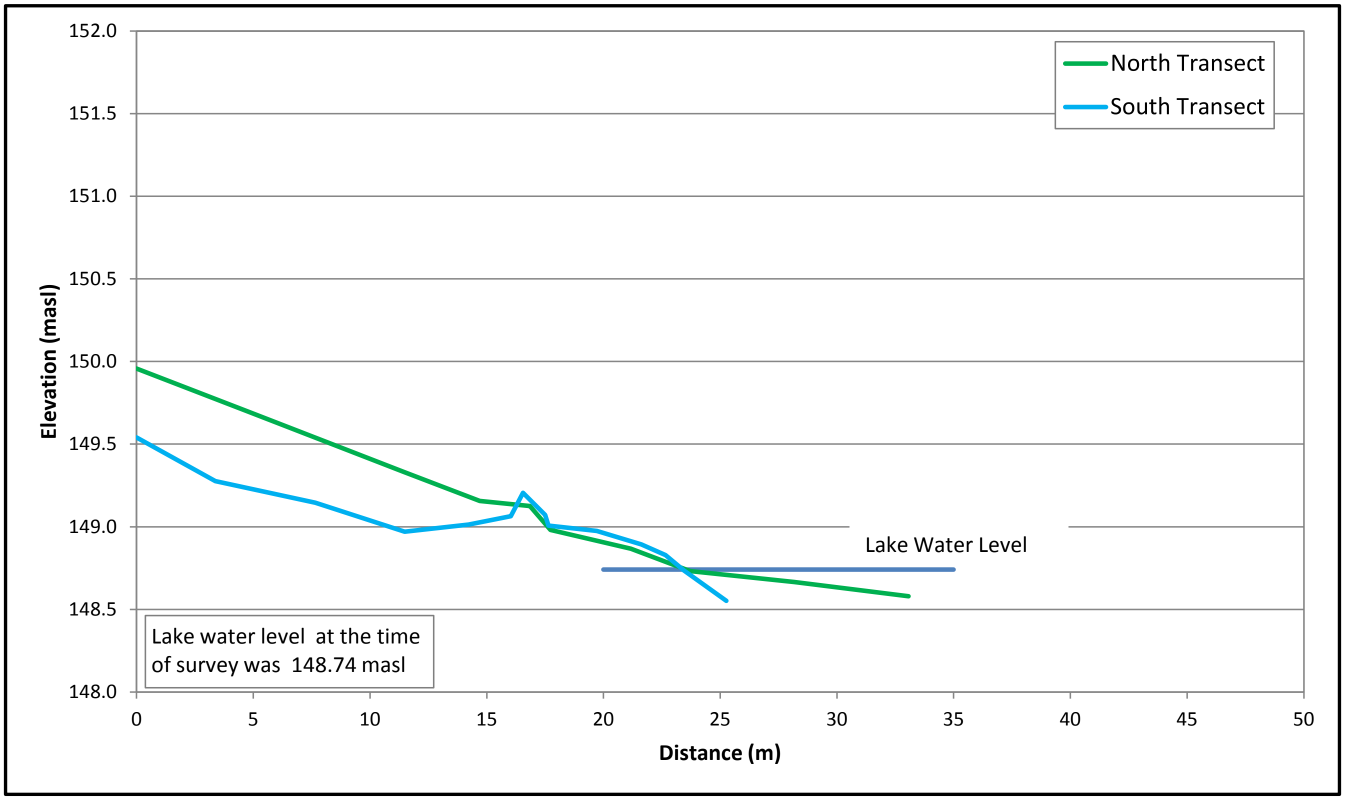

Figure 3-15: Cross-section Profiles of the Surveyed Transects, Lake A12

3.3.2 Lake A15

The survey of Lake A15 focused on the lake shoreline and outlet channel. Lake A15 has a surface area of approximately 33.3 ha, and drains into Lake A14. The Lake A15 field surveys included: outlet channel cross-section, outlet channel water surface slope, lake shore normal transects and existing and ordinary high lake water levels.

The outlet channel is approximately 50 m wide (Figure 3-16), with a poorly defined channel that is mainly comprised of large boulders. The water flows through or under the boulders for almost the entire width of the channel. The slope of the water surface in the channel could not be measured because no water was observed and the flow was determined to be through the boulders and below the surface.

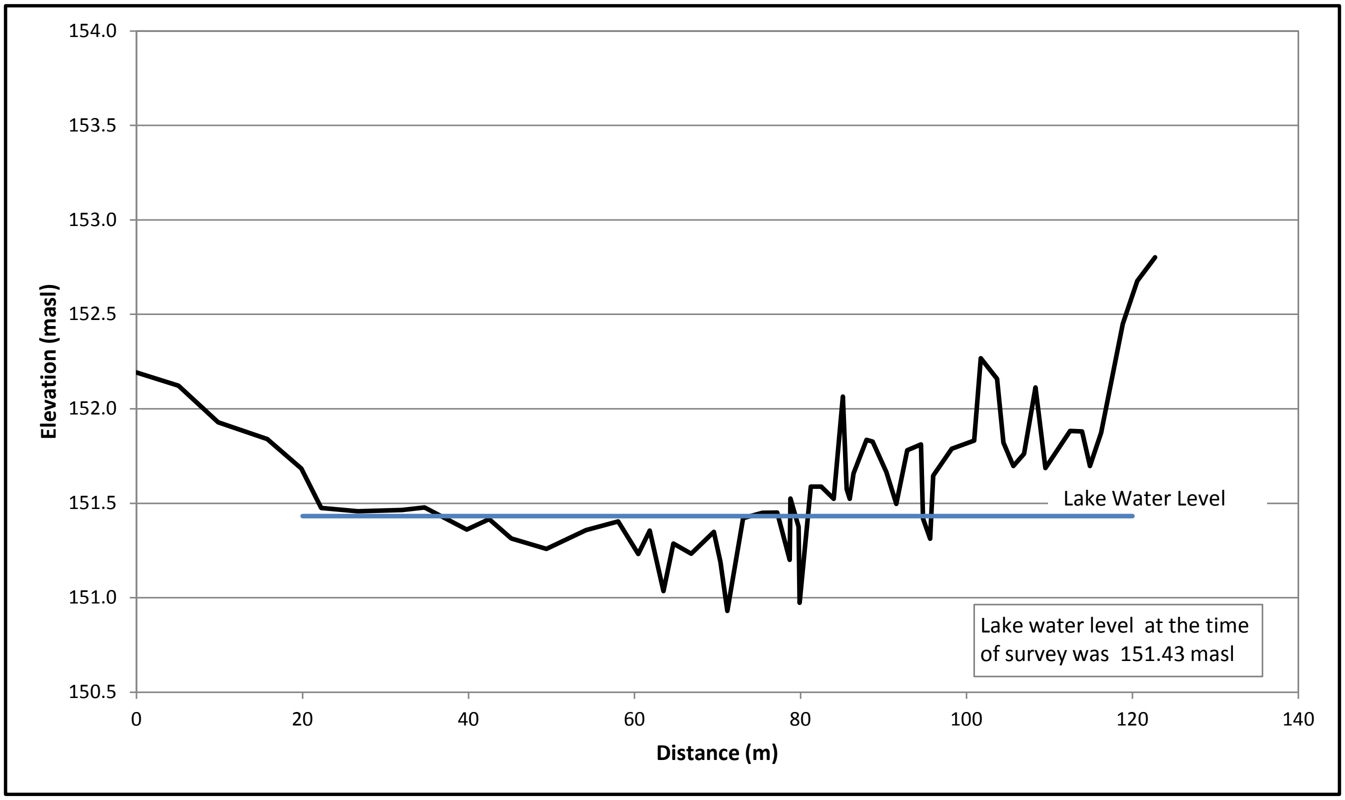

Figure 3-16: Lake A15 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A15 at the time of survey (i.e., 18 September 2015) was measured as 151.43 masl, and the ordinary high water level was estimated as 151.71 masl. A more detailed description of the lake shoreline is presented in Table 3-13, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A15 shoreline are shown in Figure 3-17.

Table 3-13: Lake A15 Shoreline Description

Criteria	Description
Bank materials	Almost the entire shoreline is composed of large boulders and coble.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5% gradient. Only two small sections on the west shoreline have slopes between 10% and 30% gradient.
Typical shoreline geometry	Mostly straight shoreline with several smaller bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 1.2 km, on an approximate north – south direction.

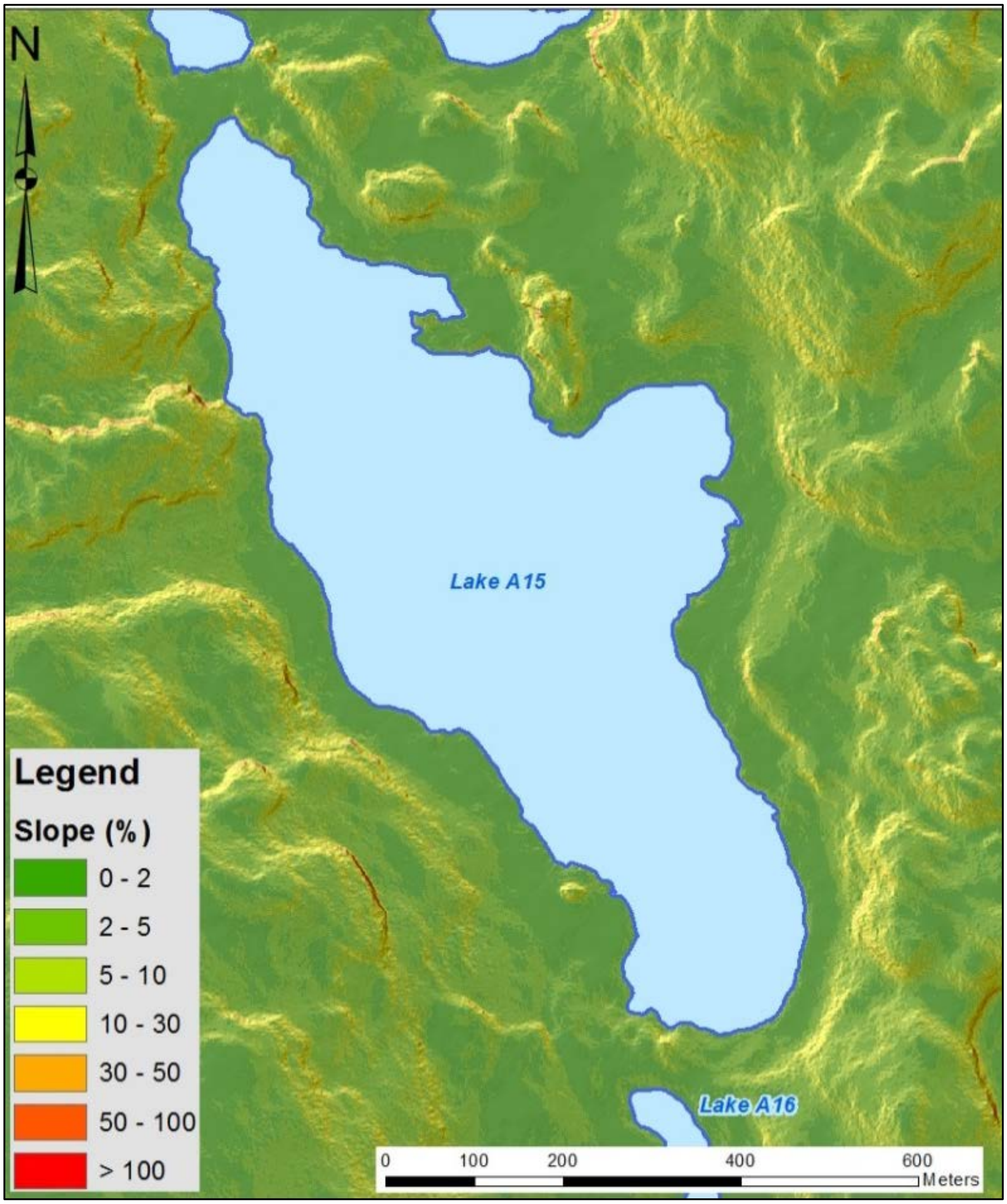

Figure 3-17: Lake A15 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

Two shore-normal transects were surveyed, one closer to the lake inlet (South Transect), and a second one closer to the lake outlet (North Transect). For both locations the shoreline is composed of boulders intercalated with cobble. The terrain slopes are similar, at typically less than 5% gradient (Figure 3-18).

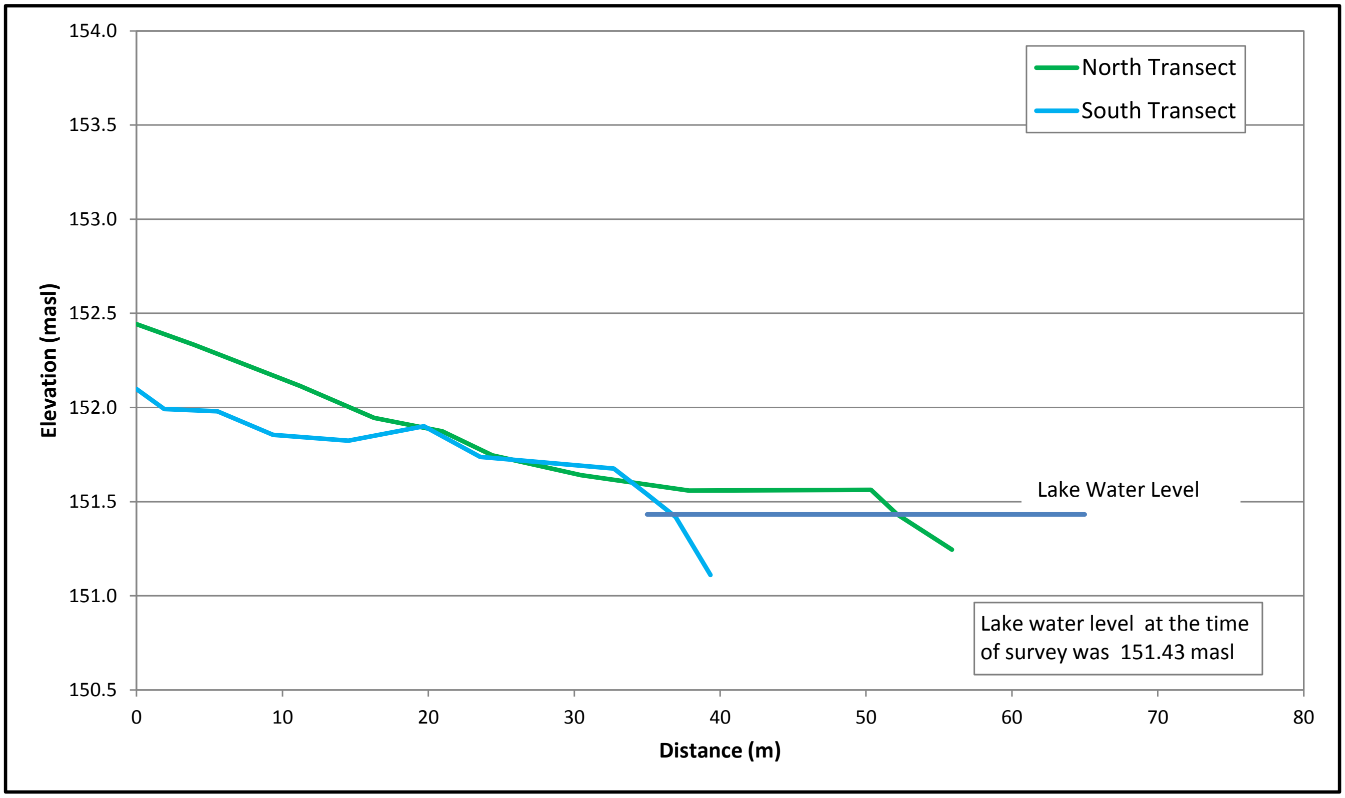

Figure 3-18: Cross-section Profiles of the Surveyed Transects, Lake A15

3.3.3 Lake A16 (Mammoth Lake)

The survey of Lake A16 (Mammoth Lake) focused on the lake outlet channel. Lake A16 has a surface area of approximately 148 ha, and drains into Lake A15. At this location, the field surveys included: outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The outlet channel is approximately 45 m wide (Figure 3-19), with a poorly defined channel that is mainly comprised of large boulders. The water flows through or under the boulders for almost the entire length of the channel. A secondary channel was observed to the west of the main channel and it appears to function only during the high water levels, with the flow mostly through boulders and below surface. The slope of the water surface in the channel could not be measured because no water was observed. It was determined that the flow was through the boulders and below the surface.

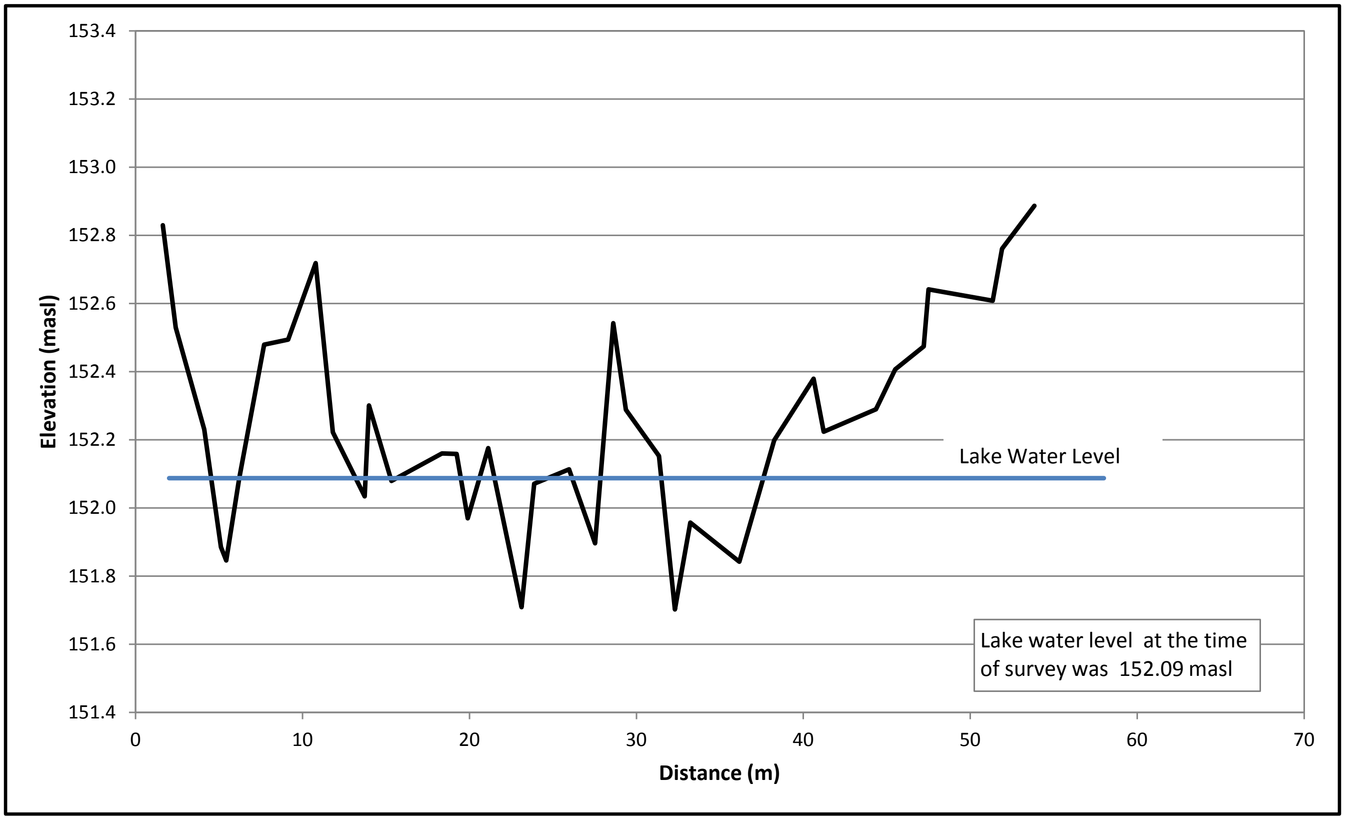

Figure 3-19: Lake A16 (Mammoth Lake) Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A16 at the time of survey (i.e., 18 September 2015) was measured as 152.09 masl, and the ordinary high water level was estimated as 152.49 masl. A more detailed description of the lake shoreline is presented in Table 3-14, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A16 shoreline are shown in Figure 3-20.

Table 3-14: Lake A16 (Mammoth Lake) Shoreline Description

Criteria	Description
Bank materials	Mostly large boulders and cobble with very limited vegetation.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%. Only the northeast and southeast shoreline show some sections with slopes between 5% and 10%.
Typical shoreline geometry	Mostly straight shoreline with sections with smaller bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 2.8 km, on a southwest – northeast direction.

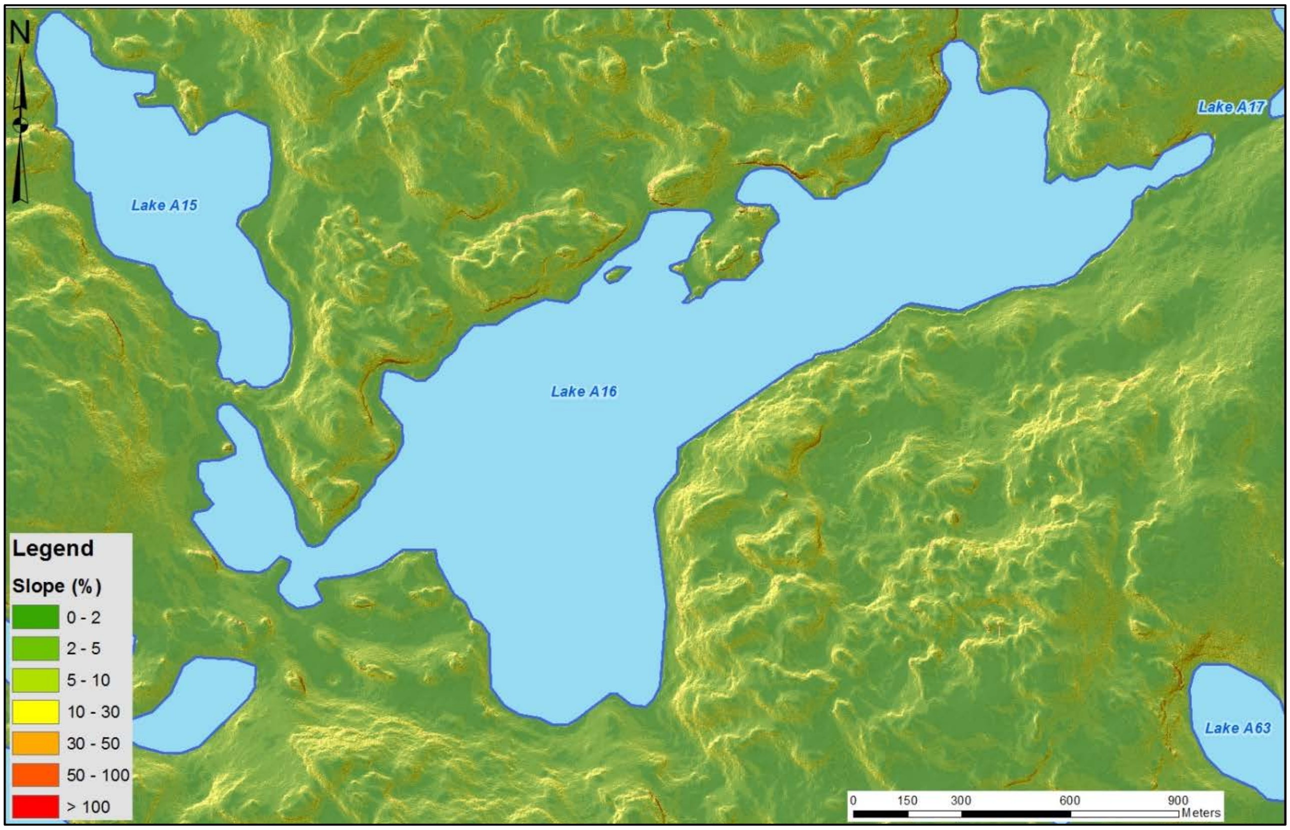

Figure 3-20: Lake A16 (Mammoth Lake) Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.4 Lake A17 (Whale Tail Lake)

The survey of Lake A17 focused on the lake outlet channel. Lake A17 has a surface area of approximately 166 ha, and drains into Lake A16 (Mammoth Lake). The Lake A17 field surveys included: outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The outlet channel is approximately 60 m wide (Figure 3-21), with a poorly defined channel that is mainly comprised of boulders. The water flows through or under the boulders for almost the entire length of the channel. The slope of the water surface in the channel was measured and indicated a typical gradient of 0.18%.

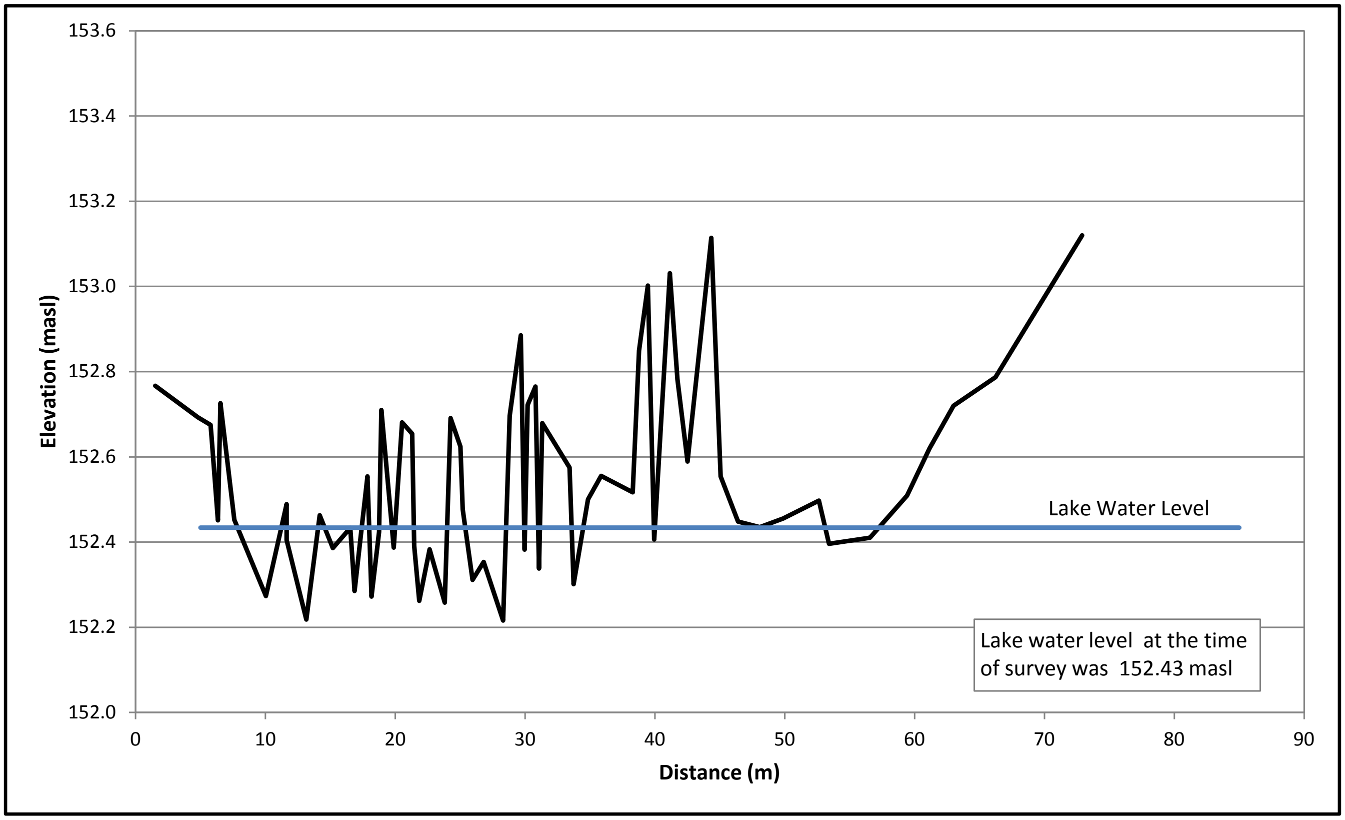

Figure 3-21: Lake A17 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A17 at the time of survey (i.e., 16 September 2015) was measured as 152.43 masl, and the ordinary high water level was estimated as 153.38 masl. A more detailed description of the lake shoreline is presented in Table 3-15, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A17 shoreline are shown in Figure 3-22.

Table 3-15: Lake A17 (Whale Tail Lake) Shoreline Description

Criteria	Description
Bank materials	Mostly boulders and cobble with limited vegetation. Vegetation along the shoreline is present only at the inlet from the smaller Lake A62, A59, A55, A53, A50, and A46.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%. Only the northeast and southeast shorelines include some sections with slopes between 5% and 10%.
Typical shoreline geometry	Relatively straight shoreline with little sections with small and narrow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 2.3 km, on an approximate north – south direction.

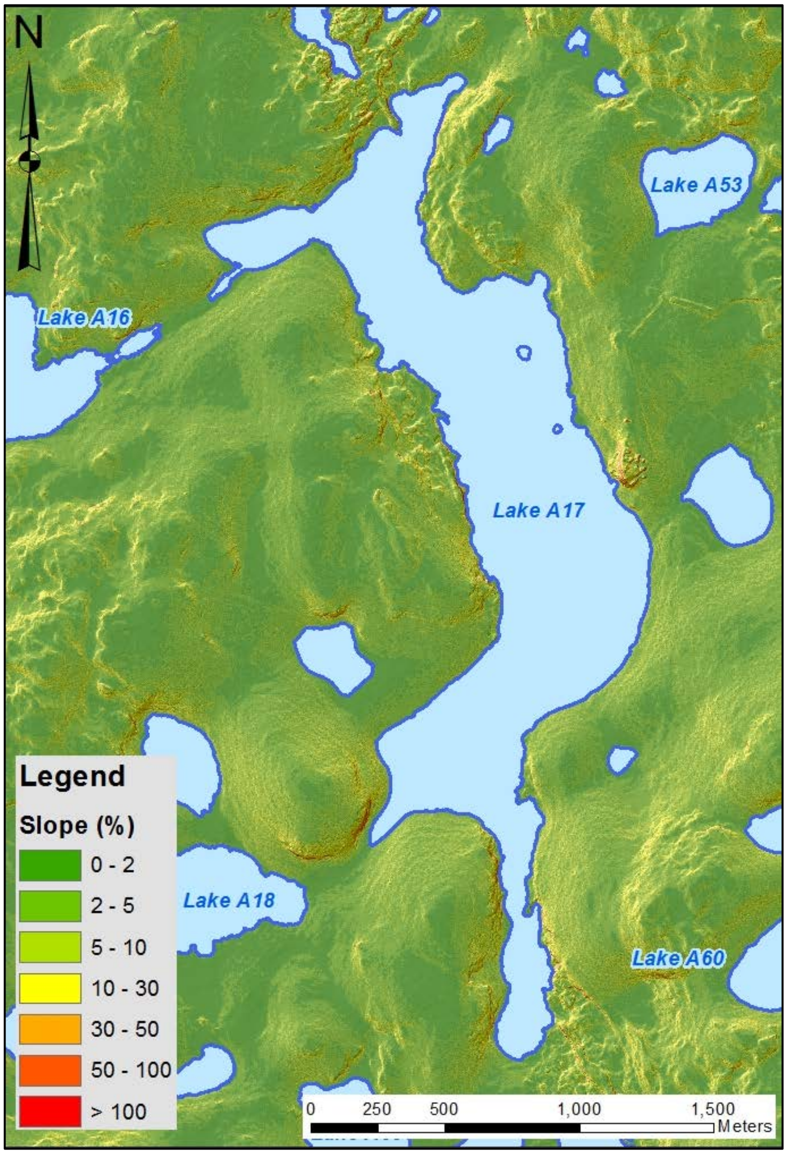

Figure 3-22: Lake A17 (Whale Tail Lake) Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.5 Lake A18

The survey of Lake A18 focused on the lake outlet channel. Lake A18 has a surface area of approximately 15.8 ha, and drains into Lake A17 (Whale Tail Lake). At this location, the field surveys included: outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The outlet channel is approximately 45 m wide (Figure 3-23), with a poorly defined channel mainly comprised of boulders. The water flows through or under the boulders for almost the entire length of the channel. The slope of the water surface in the channel was measured and indicated a typical gradient of 0.42%.

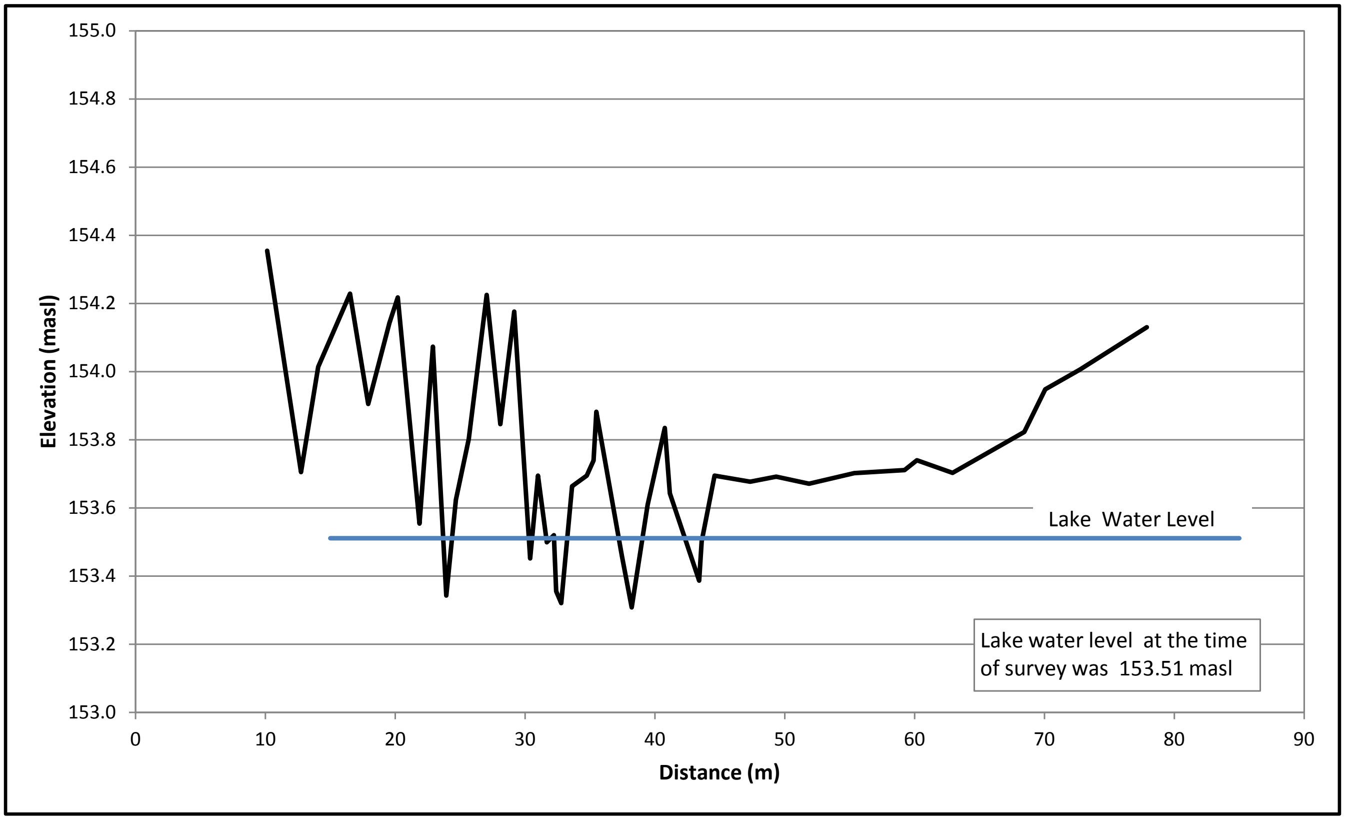

Figure 3-23: Lake A18 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A18 at the time of survey (i.e., 16 September 2015) was measured as 153.71 masl, and the ordinary high water level was estimated as 153.97 masl. A more detailed description of the lake shoreline is presented in Table 3-16, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A18 shoreline are shown in Figure 3-24.

Table 3-16: Lake A18 Shoreline Description

Criteria	Description
Bank materials	Mostly boulders and cobble with limited vegetation. The northeast shoreline and the inlet channel from Lake A63 have vegetation.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%. Only the northeast and southeast shorelines show some sections with slopes between 5% and 10%.
Typical shoreline geometry	Irregular shoreline with little sections with small bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.6 km, on an east-west direction.

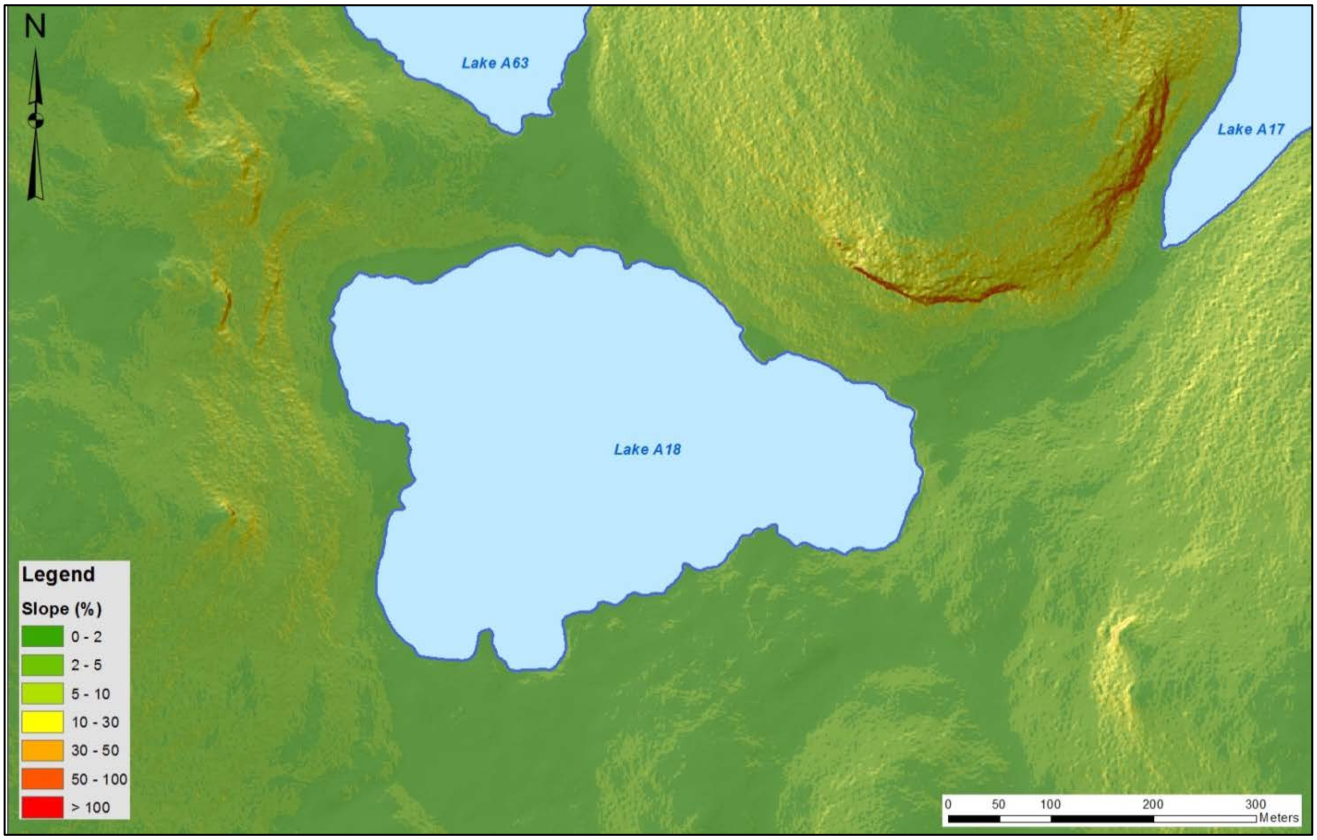

Figure 3-24: Lake A18 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.6 Lake A45

The survey of Lake A45 focused on the lake outlet channel. Lake A45 has a surface area of approximately 2.9 ha, and drains into Lake A16. The Lake A45 field surveys included outlet channel cross-section, outlet channel water surface slope, and existing and ordinary high lake water levels.

The lake outlet channel is approximately 35 m wide, poorly defined and composed of a boulder garden. Its banks have organic materials with vegetation on top of the boulders Figure 3-25. The slope of the water surface in the outlet channel could not be measured because no water was observed and the flow was determined to be through the boulders and below the surface.

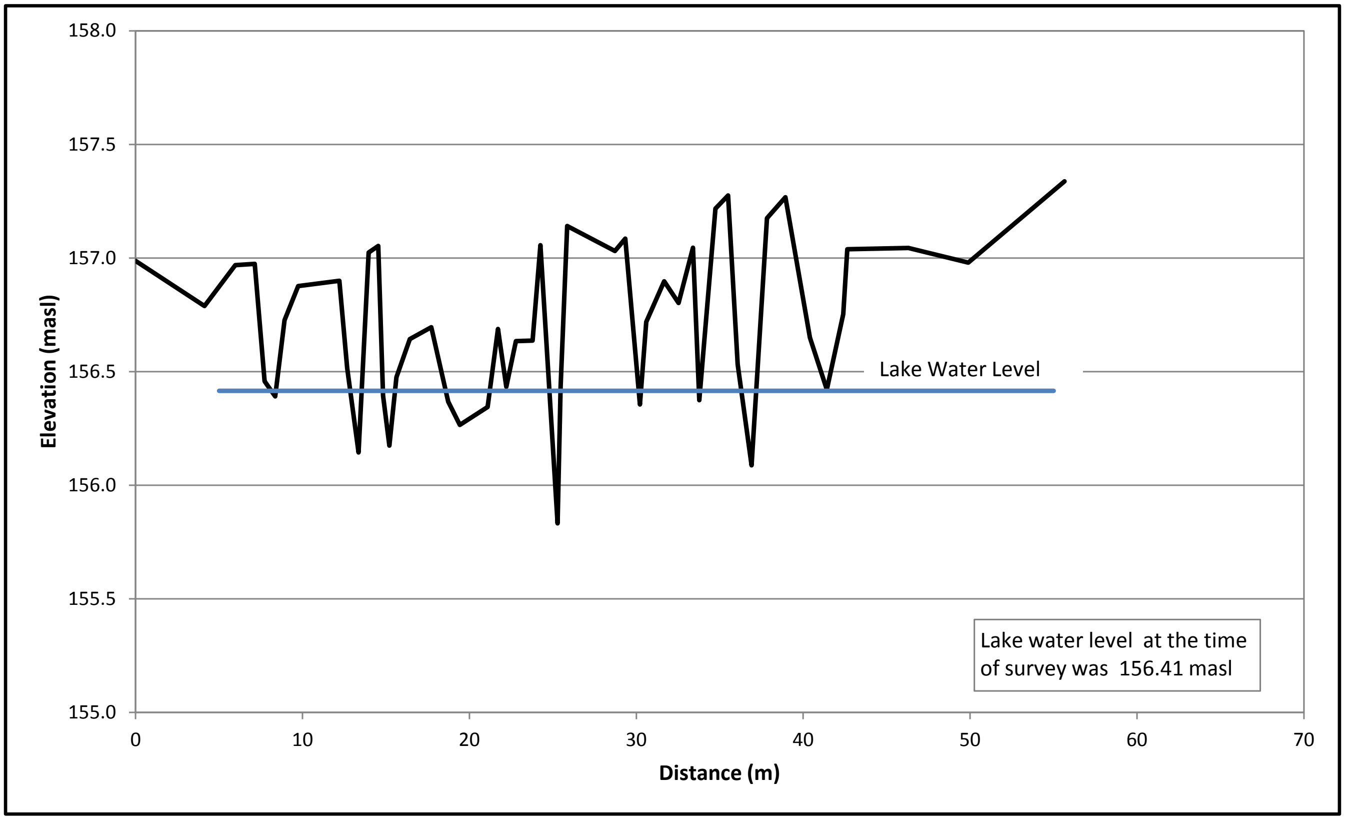

Figure 3-25: Lake A45 Outlet Channel Cross-Section, 2015

The water surface elevation at Lake A45 at the time of survey (i.e., 19 September 2015) was measured as 156.42 masl, and the ordinary high water level was estimated as 156.50 masl. A more detailed description of the lake shoreline is presented in Table 3-17, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A45 shoreline are shown in Figure 3-26.

Table 3-17: Lake A45 Shoreline Description

Criteria	Description
Bank materials	The majority of the shoreline is made of large boulders and cobble.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5%.
Typical shoreline geometry	Relatively straight shoreline with small and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.26 km, on an approximate northeast – southwest direction.

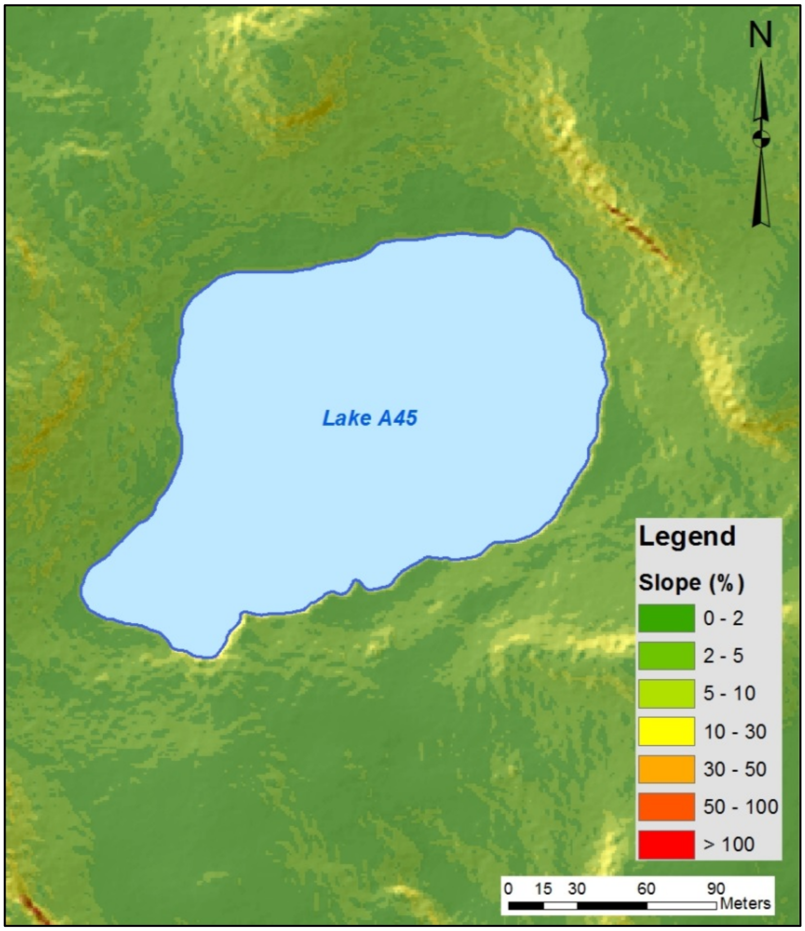

Figure 3-26: Lake A45 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.7 Lake A69

The survey of Lake A69 focused on the lake outlet channel. Lake A69 has a surface area of approximately 31.8 ha, and drains into Lake DS1. At this location, the field surveys included outlet channel cross-section, and outlet channel water surface slope.

The lake outlet channel is approximately 35 m wide, well defined with mostly cobble and some boulders as streambed materials and with soils and organics on both banks Figure 3-27. The water surface slope in the outlet channel was estimated from the PhotoSat (2015) elevation data as 0.85%.

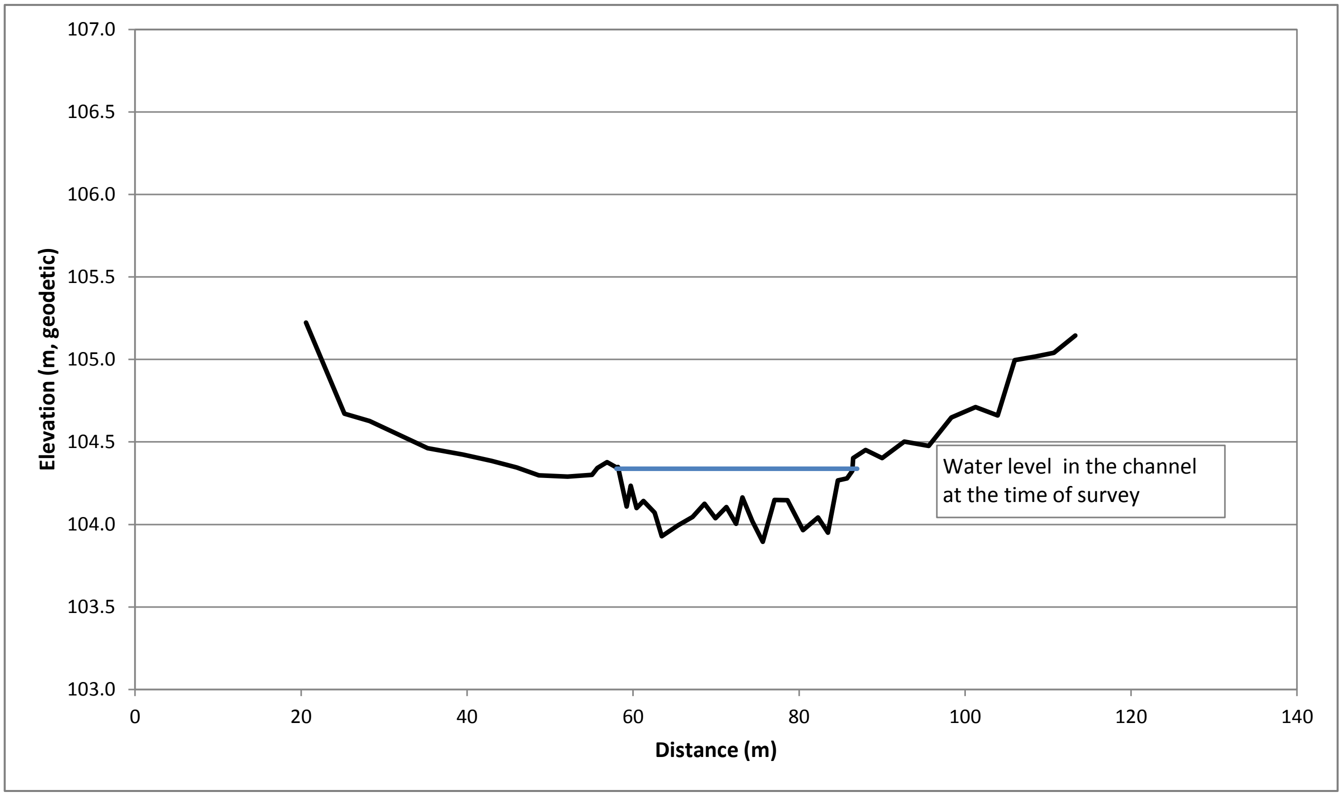

Figure 3-27: Lake A69 Outlet Channel Cross-Section, 2015

A more detailed description of the lake shoreline is presented in Table 3-18, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A69 shoreline are partially shown in Figure 3-28 based on available DEM data (PhotoSat 2015) (i.e., only partial DEM data were available for Lake A69).

Table 3-18: Lake A69 Shoreline Description

Criteria	Description
Bank materials	A mix of sand and gravel intercalated with smaller sections of cobble and boulders. Soils and vegetation are present on top of the bank, above the typical high water level elevation.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5%.
Typical shoreline geometry	Irregular shoreline with small and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 1.3 km, on an approximate north – south direction.

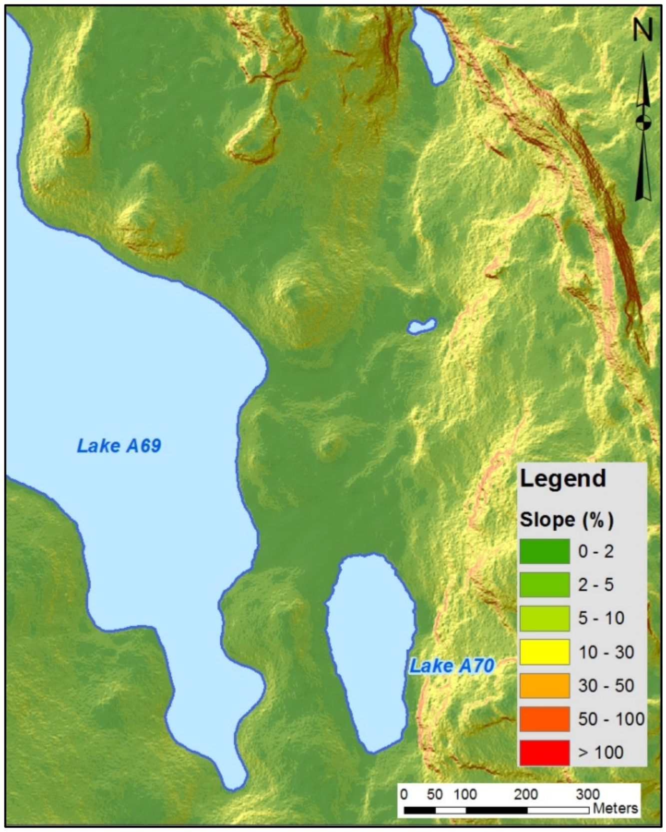

Figure 3-28: Lake A69 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.8 Lake A72

The survey of Lake A72 focused on the lake outlet channel. Lake A72 has a surface area of approximately 3.2 ha, and drains into Lake A71. At this location, the field surveys included outlet channel cross-section, and outlet channel water surface slope.

The lake outlet channel is approximately 15 m wide, well defined with mostly sand and fines as streambed materials, and with soils and organics on both banks Figure 3-29. The measured water surface slope was 0.03%.

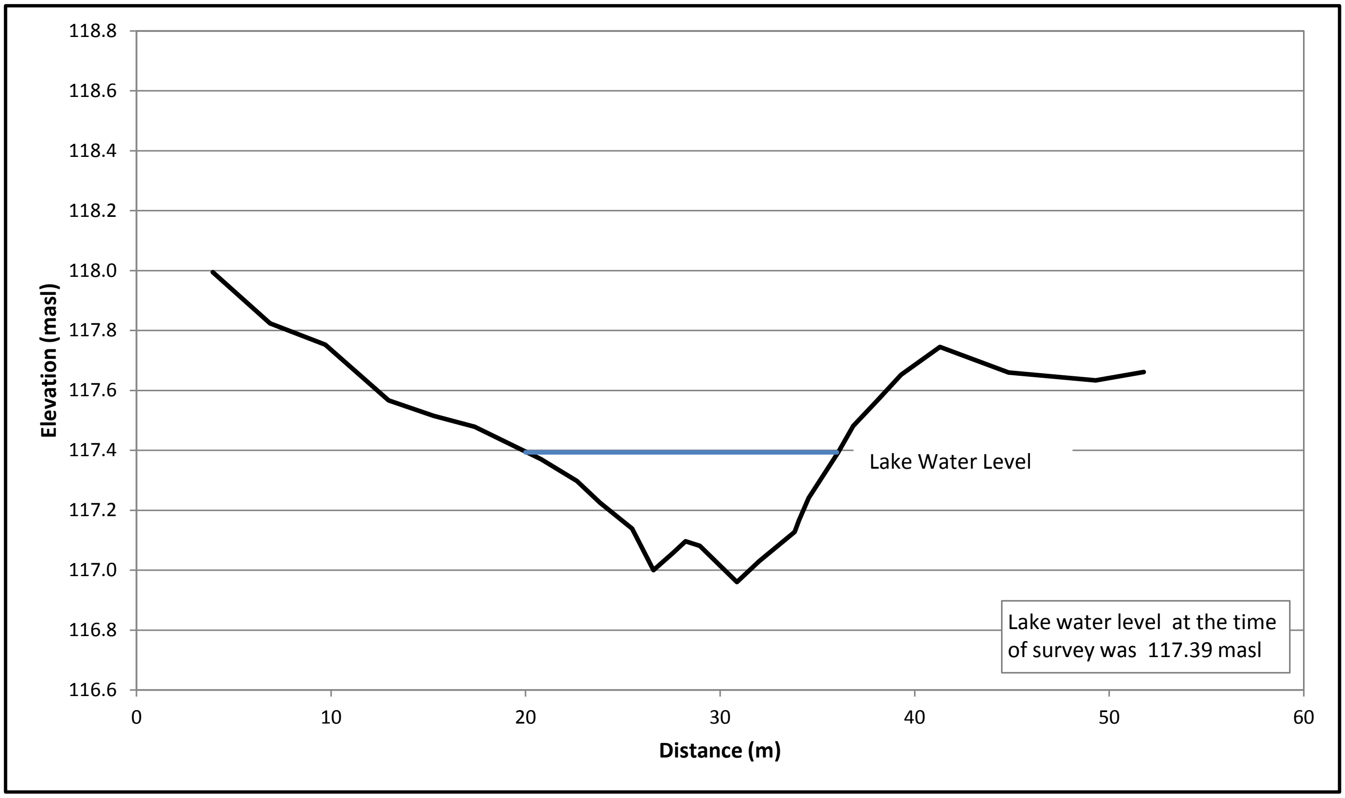

Figure 3-29: Lake A72 Outlet Channel Cross-Section, 2015

A more detailed description of the lake shoreline is presented in Table 3-19, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A72 shoreline are shown in Figure 3-30.

Table 3-19: Lake A72 Shoreline Description

Criteria	Description
Bank materials	Mostly sand and fines with vegetation on top. The inlet channel from upstream Lake A73 is comprised of boulders and cobble.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 2%.
Typical shoreline geometry	Relatively straight shoreline with small sections of small and shallow bays.
Fetch	Maximum fetch length was estimated in GIS at approximately 0.3 km, on an approximate north – south direction.

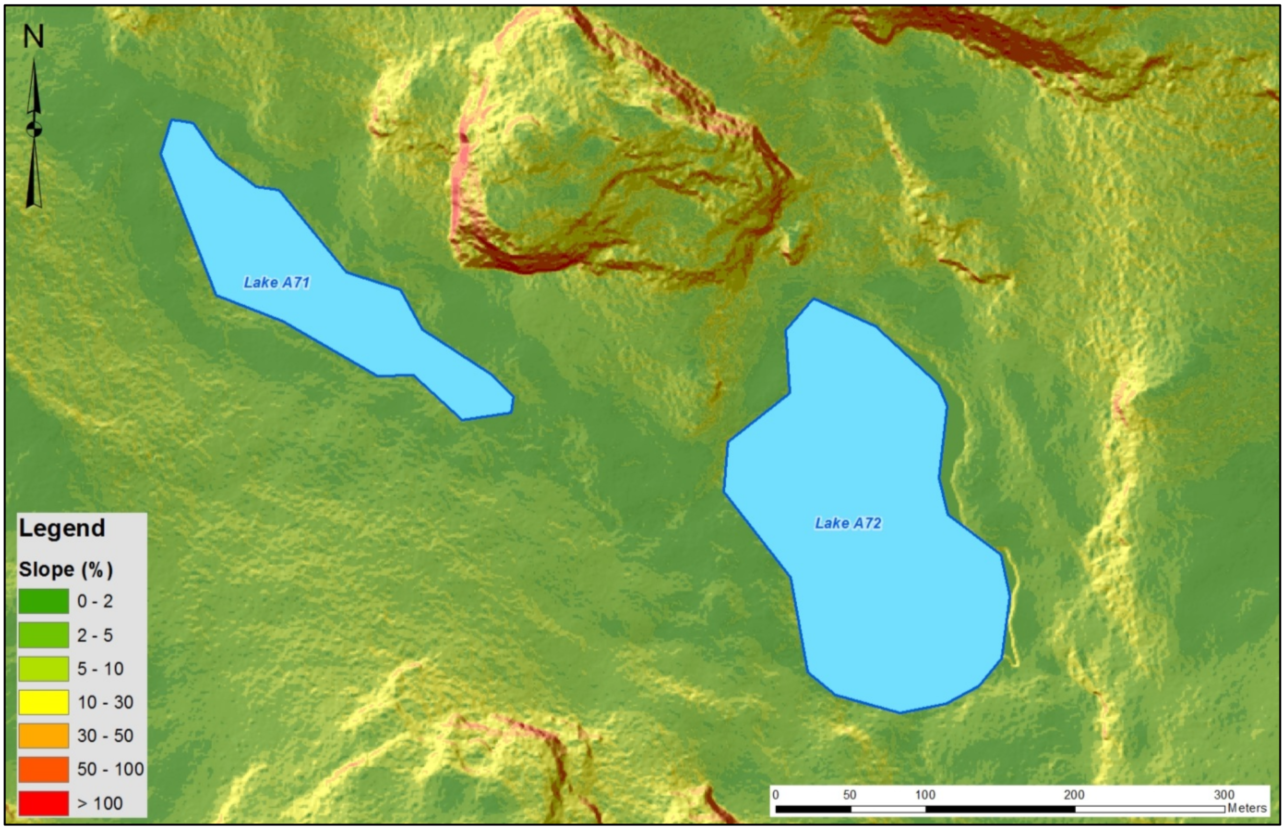

Figure 3-30: Lake A72 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

3.3.9 Lake A76

The survey of Lake A76 focused on the lake shoreline and outlet channel. Lake A76 has a surface area of approximately 71 ha, and drains into Lake A10 through a main outlet at average and below average water levels. At water levels above average, Lake A12 has a secondary outlet that drains into Lake A75. Section 3.1 provides further details regarding these drainage patterns. The Lake A76 field surveys included: outlet channel cross-section, outlet channel water surface slope, lake shore normal transects and existing and ordinary high lake water levels.

The cross-section data for the main outlet was obtained from the RTK survey, and the cross-section data for the secondary channel was obtained from the PhotoSat (2015) elevation data. The main outlet channel is approximately 55 m wide and flows east, and the secondary outlet channel is approximately 35 m wide and flows west (Figure 3-31). The main outlet channel comprises a boulder garden with the majority of the flow through the boulders or below the surface. Further downstream, the flow becomes almost entirely subsurface with only higher flows reaching the surface. During the site visit, the flow was below the surface and no discharge measurement was possible.

The secondary channel flows west and is located at the opposite side of the lake. The channel was visually surveyed. The channel is a boulder garden with very large boulders. No signs of flow (neither low nor high flows) were visible and it was assumed that the flow occurs only at high lake water levels and only below the surface.

This may be confirmed by additional investigations during the high water season. The secondary channel is approximately 580 m long to Lake A75. It should be noted that the profile shown on Figure 3-31 is based on available DEM data (PhotoSat 2015), representative of the top of boulders rather than the actually channel bed.

The slope of the water surface in the main outlet channel could not be measured because no water was observed and the flow was determined to be through the boulders and below the surface. The next lake downstream along the main outlet channel is Lake A41, with the water surface elevation measured as 146.36 masl.

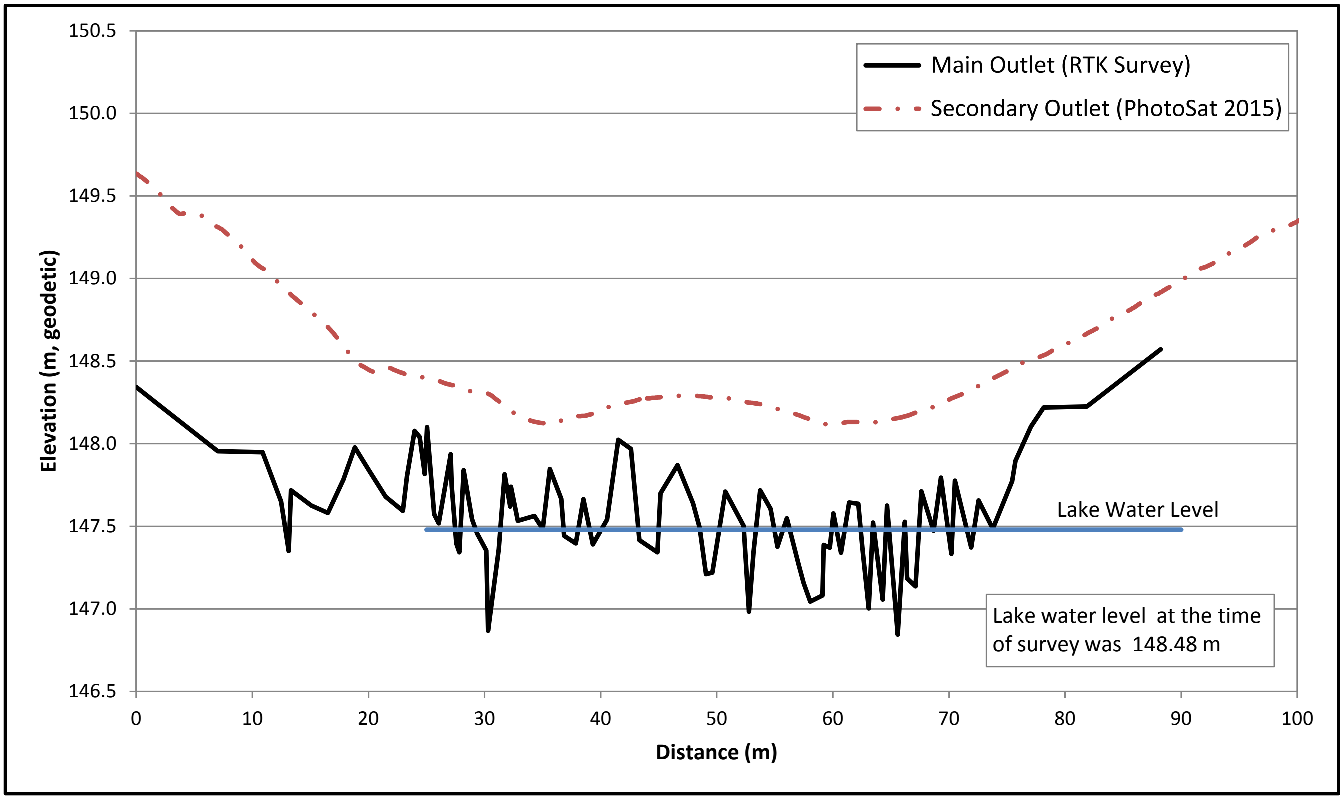

Figure 3-31: Lake A76 Main and Secondary Outlet Channel Cross-Sections, 2015

The water surface elevation at Lake A76 at the time of survey (i.e., 18 September 2015) was measured as 147.48 masl, and the ordinary high water level was estimated as 147.70 masl. A more detailed description of the lake shoreline is presented in Table 3-20, and is based on the field reconnaissance and satellite imagery provided by Agnico Eagle (PhotoSat 2015). Terrain slopes calculated for the Lake A76 shoreline are shown in Figure 3-32.

Table 3-20: Lake A76 Shoreline Description

Criteria	Description
Bank materials	The majority of the shoreline is comprised of large boulders and cobble. Limited areas at the west part of the lake have sections with organic materials on top of the boulders and cobble. Small sections of bedrock are found at the main outlet, on the east side of the lake.
Typical bank slopes	Most of the shoreline has shallow slopes, typically less than 5% gradient. Several small sections on the west shoreline have higher slopes between 10% and 30% gradient. The bedrock shore from the east side is abrupt with slope gradients greater than 100% and near-vertical at some locations (limited visibility on Figure 3-32 due to figure scale).
Typical shoreline geometry	Mostly straight shoreline.
Fetch	Maximum fetch length was estimated in GIS at approximately 1.4 km, on a northeast – southwest direction.

Two shore-normal transects were surveyed on the south shoreline, one closer to the lake inlet (East Transect), and a second one closer to the secondary outlet (West Transect) (Figure 3-33). At both locations, the shoreline is composed of boulders intercalated with cobble. The terrain slopes at the transects are similar, typically less than 5% gradient.

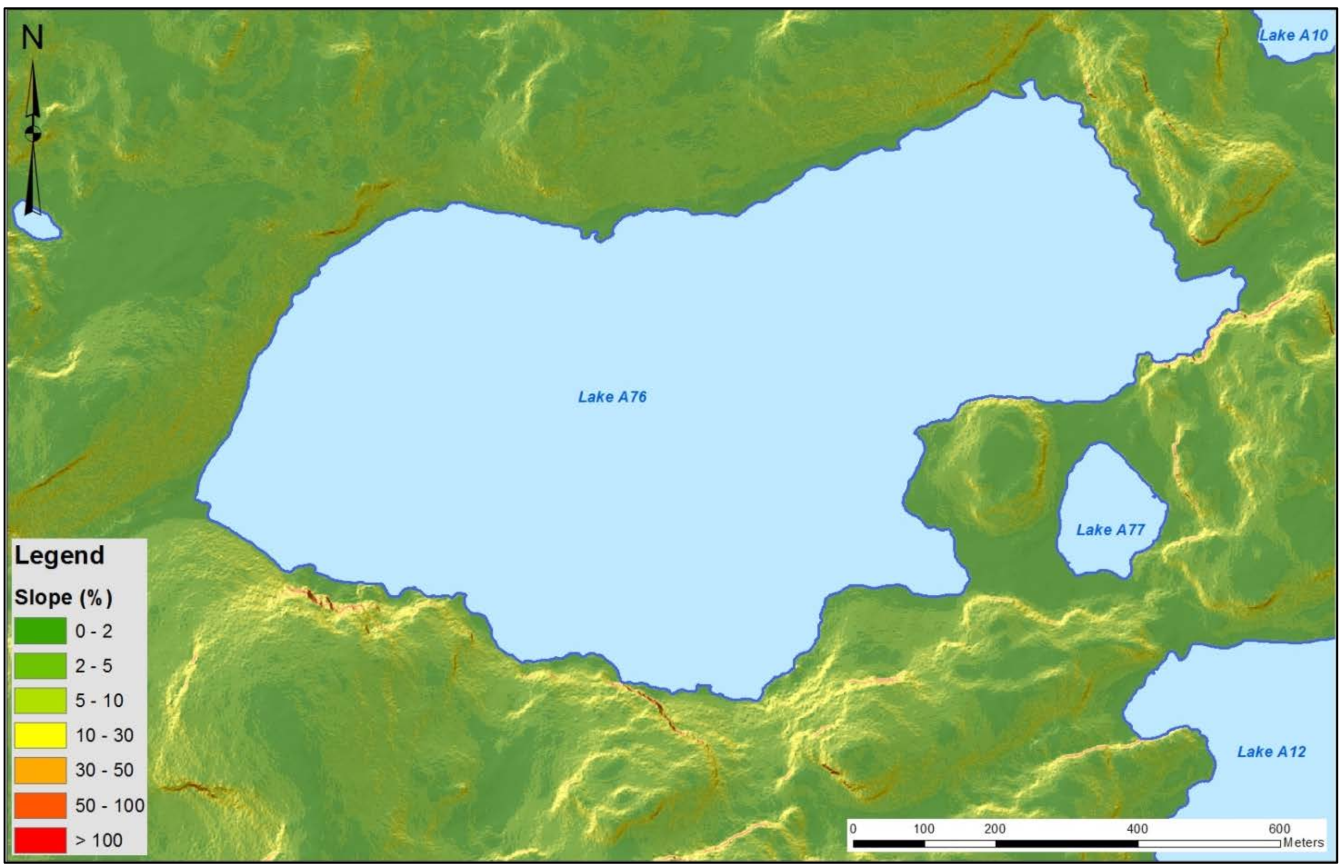

Figure 3-32: Lake A76 Shoreline Slope (Based on available DEM data [PhotoSat 2015])

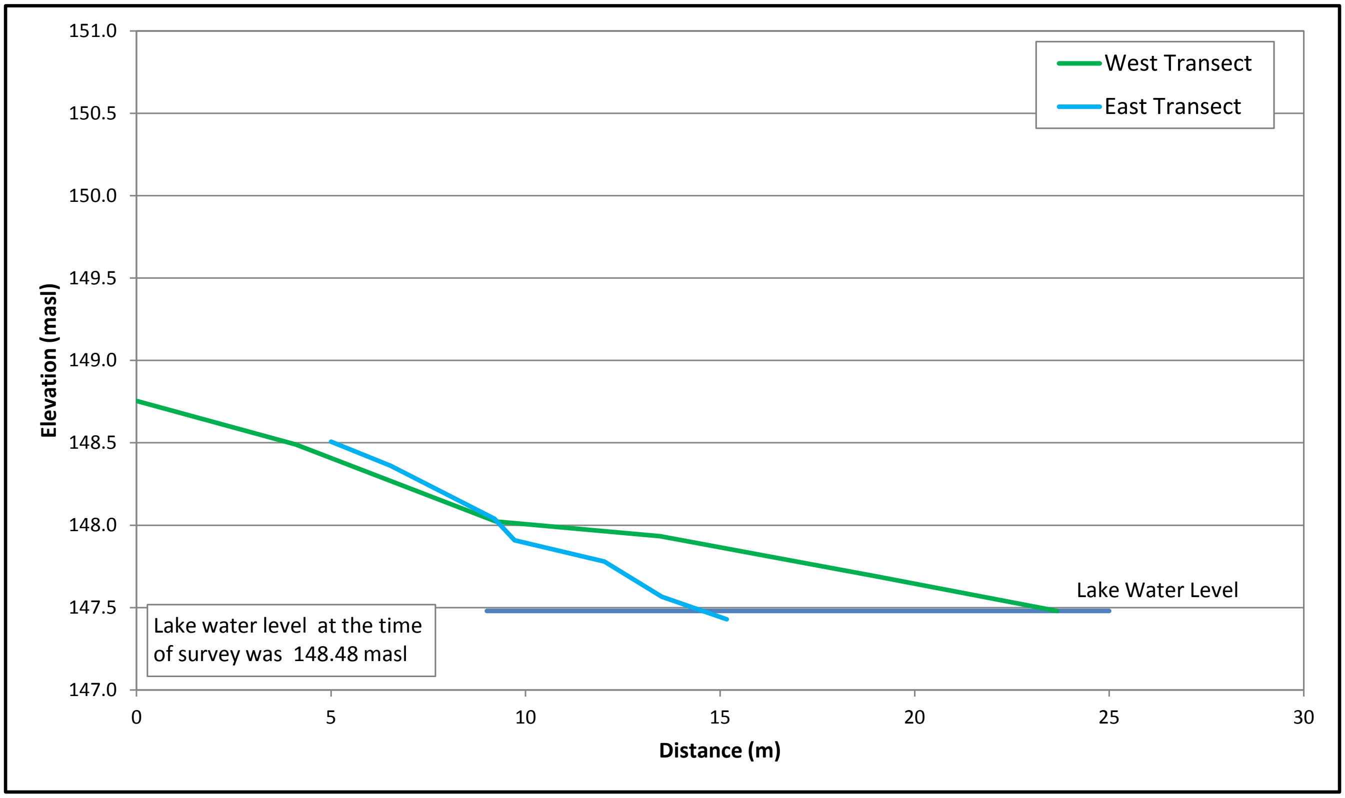

Figure 3-33: Cross-section Profiles of the Surveyed Transects, Lake A76

3.4 Water Balance Model

Frequency analyses of the hydrology model results (floods and droughts) were completed for key lakes in the Hydrology BSA to provide a basis for environmental impact assessment and engineering design. The following parameters were examined:

- maximum and mean daily outflow volumes for open water months, and corresponding stages;
- annual 7-day and 14-day flood discharges, and corresponding stages; and
- annual 30-day, 60-day, and 90-day low flow discharges for the period of July, August, and September, and corresponding stages.

While results are available at all modeled lakes (Appendix B), results are only presented herein at key locations, including Lake A5, Lake A15, Lake A17 (Whale Tail Lake), Lake A18, Lake A69, Lake C8, Lake C38, and Lake DS1.

3.4.1 Lake A5

Results for Lake A5 are presented in Table 3-21 (monthly mean discharges), Table 3-22 (peak and low flow discharges), Table 3-23 (monthly mean stages), and Table 3-24 (peak and low flow stages). Results are summarized in Figure 3-34 (flow regimes) and Figure 3-35 (stage regimes).

Table 3-21: Monthly Mean Discharges at the Lake A5 Outlet

Condition	Return Period (years)	Monthly Mean Discharge (m^3/d)					
		May	June	July	August	September	October
Wet	100	56,200	271,000	148,000	84,700	108,000	55,100
	50	44,700	254,000	128,000	77,100	97,800	49,900
	20	30,300	228,000	102,000	66,200	82,700	42,500
	10	20,200	205,000	82,900	56,900	70,300	36,200
	5	10,800	177,000	64,300	46,400	56,500	29,100
Median	2	122	128,000	41,100	29,000	34,400	17,400
Dry	5	0	84,400	30,100	15,800	18,800	8,680
	10	0	65,500	27,600	10,900	13,400	5,420
	20	0	52,400	26,500	7,800	10,200	3,410
	50	0	40,600	25,900	5,350	7,750	1,820
	100	0	34,400	25,800	4,220	6,700	1,090

m^3/d= cubic metres per day.

Table 3-22: Peak and Low Flow Discharges at the Lake A5 Outlet

Condition	Return Period (years)	Peak Daily Q (m^3/s)	7-Day Mean Peak Q (m^3/d)	14-Day Mean Peak Q (m^3/d)	30-Day Low Flow Q (m^3/d)	60-Day Low Flow Q (m^3/d)	90-Day Low Flow Q (m^3/d)
Wet	100	15.8	828,000	566,000	65,400	70,400	84,700
	50	13.8	757,000	521,000	57,200	65,100	78,500
	20	11.3	655,000	456,000	46,700	57,200	69,600
	10	9.5	570,000	401,000	38,900	50,500	61,900
	5	7.73	474,000	338,000	31,200	42,500	53,100
Median	2	5.27	315,000	233,000	20,100	28,600	38,100
Dry	5	3.59	197,000	153,000	12,300	17,100	26,200
	10	2.91	154,000	122,000	9,120	12,400	21,500
	20	2.42	127,000	102,000	6,810	9,190	18,500
	50	1.94	106,000	86,700	4,500	6,460	16,000
	100	1.65	96,900	79,400	3,110	5,100	14,800

Q= discharge; m^3/s= cubic metres per second; m^3/d= cubic metres per day.

Table 3-23: Monthly Mean Stages at the Lake A5 Outlet

Condition	Return Period (years)	Monthly Mean Stage (m)					
		May	June	July	August	September	October
Wet	100	0.368	0.571	0.482	0.413	0.442	0.366
	50	0.345	0.561	0.463	0.402	0.430	0.356
	20	0.309	0.544	0.435	0.385	0.410	0.340
	10	0.276	0.529	0.410	0.369	0.392	0.325
	5	0.232	0.507	0.382	0.349	0.368	0.306
Median	2	0.066	0.463	0.337	0.306	0.321	0.265
Dry	5	-	0.412	0.309	0.258	0.271	0.218
	10	-	0.384	0.301	0.232	0.246	0.191
	20	-	0.361	0.298	0.212	0.228	0.168
	50	-	0.336	0.296	0.190	0.211	0.141
	100	-	0.321	0.296	0.178	0.203	0.122

m= metres.

Table 3-24: Peak and Low Flow Stages at the Lake A5 Outlet

Condition	Return Period (years)	Peak Daily Stage (m)	7-Day Mean Peak Stage (m)	14-Day Mean Peak Stage (m)	30-Day Low Flow Stage (m)	60-Day Low Flow Q Stage (m)	90-Day Low Flow Stage (m)
Wet	100	0.899	0.781	0.702	0.384	0.392	0.413
	50	0.865	0.762	0.686	0.370	0.383	0.404
	20	0.818	0.732	0.661	0.349	0.370	0.391
	10	0.779	0.704	0.638	0.332	0.357	0.378
	5	0.736	0.668	0.608	0.312	0.340	0.362
Median	2	0.661	0.596	0.548	0.276	0.304	0.330
Dry	5	0.594	0.523	0.487	0.240	0.264	0.297
	10	0.560	0.488	0.457	0.221	0.241	0.281
	20	0.531	0.462	0.435	0.204	0.221	0.269
	50	0.500	0.439	0.415	0.181	0.201	0.259
	100	0.477	0.428	0.405	0.164	0.188	0.253

m= metres.