Daily photographs of lake outlets A1, B2, B7, and B4 were available from April to June 2009 to provide additional observations of ice conditions during spring melt.

A meteorology station was operated at the Rankin Inlet airport with available data starting from 1981 to 2009. Reported hourly data allow determination of the daily minimum, maximum, and mean temperatures.

A3 - 2.1.2.2 Method

A degree-day method was chosen to assess the effect of ice conditions on discharge at each lake outlet. Degree-days were counted above a base temperature of 0°C, based on mean daily temperatures, which typically begin to exceed 0°C in late May.

The effect of the ice on discharge was quantified by the following ratio:

$$\text{Ice Effect Ratio} = Q_{actual} / Q_{predicted}$$

where Q_{actual} = Discharge measured at the outlet under ice conditions; and

$Q_{predicted}$ = Discharge predicted using an open water rating curve for the specific outlet.

Opening of lake outlets is generally a rapid process. This is related to snowmelt runoff into the lake upstream of the outlet, as well as thaw of ice in the lake outlet. Flowing water provides additional thermal input and melted or saturated snow on the outlet channel surface lowers its albedo and increases absorption of solar energy, which further accelerates melt. The change in conditions from frozen solid to fully open was observed to typically occur up to a span of approximately one week. Logistical considerations during the field program meant that hydrographs were not acquired during the melt period, though observations of zero flow and fully open flow were available. Therefore, the analysis focused on identifying dates of zero flow (Ice Effect Ratio = 0) and fully open flow (Ice Effect Ratio = 1).

There is some uncertainty in the cumulative degree-day values corresponding to these assigned values, in the 1999 and 2000 datasets, because of the limited number of visits at lake outlets in the early season. This uncertainty was addressed by assuming that the last day of zero flow at the site (Ice Effect Ratio = 0) was the last day that zero flow was observed (the actual date could have been any day between then and the first day of observed flow), and by assuming that the first day with no ice effects (Ice Effect Ratio = 1) was the day after the last day that any ice effects were observed (the actual date could have been any day between the last day of observed ice effects and the first day of observed ice-free conditions).

Cumulative degree-day and ice effect ratio data were examined. The melting process of each lake outlet was found to behave differently:

- in 1999, the last day of zero flow was common to all outlets;
- in 2000, the last day of zero flow was different at all outlets;
- in 2000, the first day without ice effects was common to all outlets;
- in 2009, the last day of zero flow at Lake A1 was observed later than in 2000 and 1999; and
- in 2009, the first day without ice effects was observed later than in 2000.

Differences are possibly due to late winter ice characteristics, upstream flow conditions, and solar exposure.

A3 - 2.1.2.3 Results and Discussion

Values of cumulative degree-days and the ice effect ratios were plotted to examine the observed relationships at each lake outlet. These data, featured in Tables A3-2a, A3-2b, and A3-2c along with their source, were plotted together as shown in Figure A3-4.

Lake outlets A1 and B2 were fully opened on the same date in 2000. Lake outlets A1, B2, and B7 also shared a common date for snowmelt peaks in 2000 as shown by their hydrographs (AMEC 2000). Based on these data, it was assumed that Lake Outlet B7 was fully opened on the same day as lake outlets A1 and B2 in 2000.

After an initial examination, it was noticed that outlet openings began to melt later in 2000 and 2009 (dry years) than they did in 1999 (wet year). It was also noticed that outlet opening durations at Lake A1 were similar in 2000 and 2009 with respective durations of 15.1 and 15.6 degree-days. Based on these data, it was assumed that duration remained constant at all outlets for all years. The outlet openings were separated between dry and wet years, with data from 2000 representing the dry years and 1999 representing the wet years, as presented in Figures A3-5 and A3-6.

Data gathered from the daily photographs at outlets B2, B7, and B4 in 2009 were not reliable and were discarded from the analysis. The photographs were not clear enough to estimate outlet opening dates accurately.

Table A3-2a: Lake Outlet Ice Effect Ratios for Melt Period, 1999

Cumulative Degree-Days (^{o}C•d)	Ice Effect Ratio	Source of Data
	Lake A1 Outlet	
4.6	0.0	Hydrograph
-	1.0	No observation available
	Lake B2 Outlet	
4.6	0.0	Hydrograph
-	1.0	No observation available
	Lake B7 Outlet	
4.6	0.0	Hydrograph
-	1.0	No observation available

Table A3-2b: Lake Outlet Ice Effect Ratios for Melt Period, 2000

Cumulative Degree-Days (^{o}C•d)	Ice Effect Ratio	Source of Data
	Lake A1 Outlet	
6.6	0.0	Hydrograph + photos
21.7	1.0	Hydrograph + photos
	Lake B2 Outlet	
11.9	0.0	Hydrograph
21.7	1.0	Hydrograph
	Lake B7 Outlet	
15.2	0.0	Hydrograph + photos
21.7	1.0	Assumed based on other stations

Table A3-2c: Lake Outlet Ice Effect Ratios for Melt Period, 2009

Cumulative Degree-Days (°C•d)	Ice Effect Ratio	Source of Data
	Lake A1 Outlet	
8.4	0.0	Daily photos
24	1.0	Daily photos

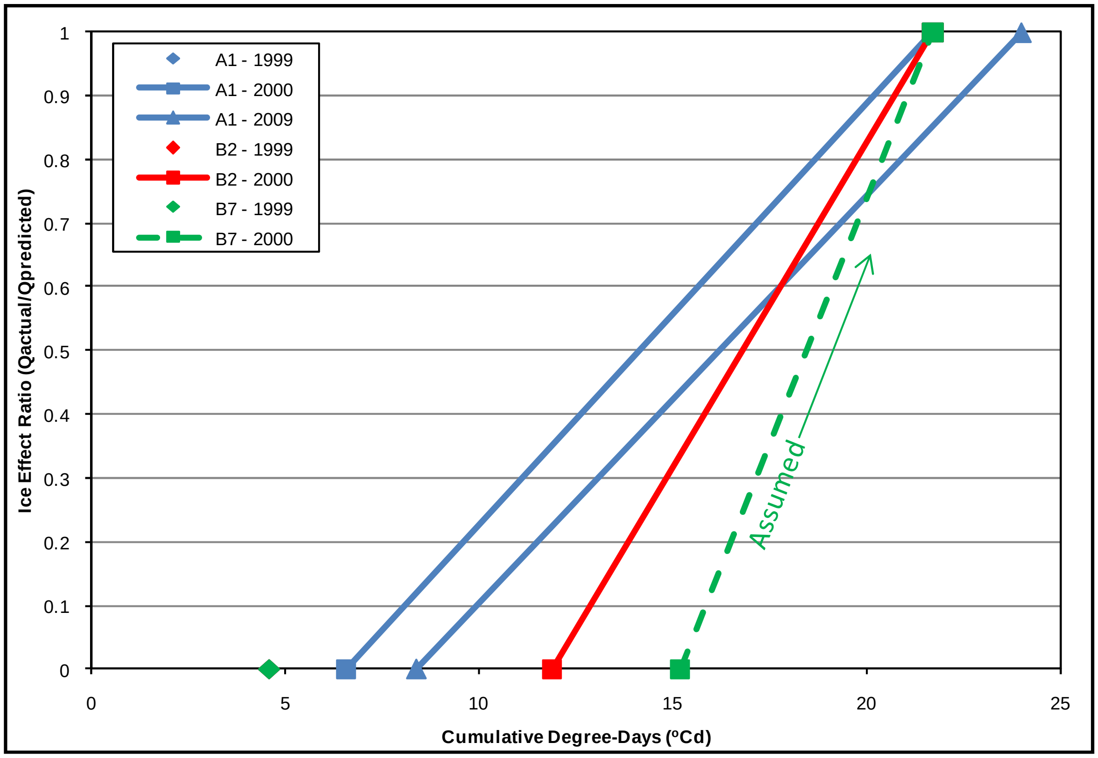


Figure A3-4 – Melt Period Ice Effect Ratios and Cumulative Degree-Days at the Peninsula Lakes Outlets

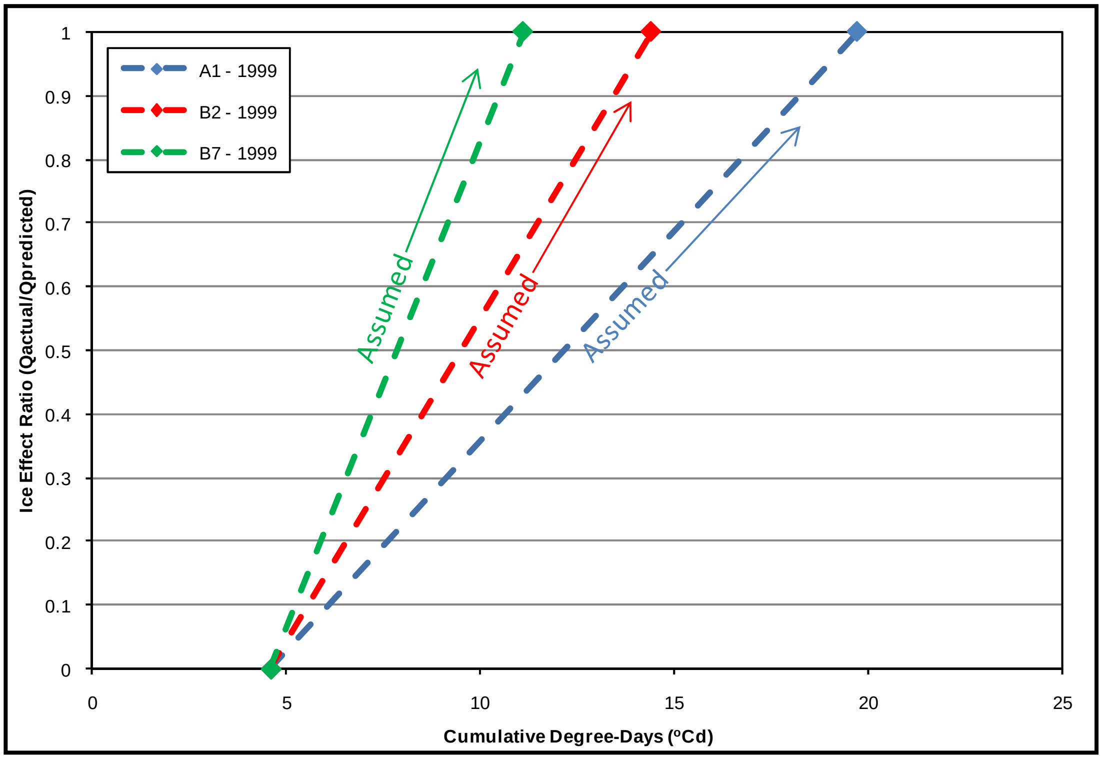


Figure A3-5 – Melt Period Ice Effect Ratios and Cumulative Degree-Days at the Peninsula Lakes Outlets, 1999

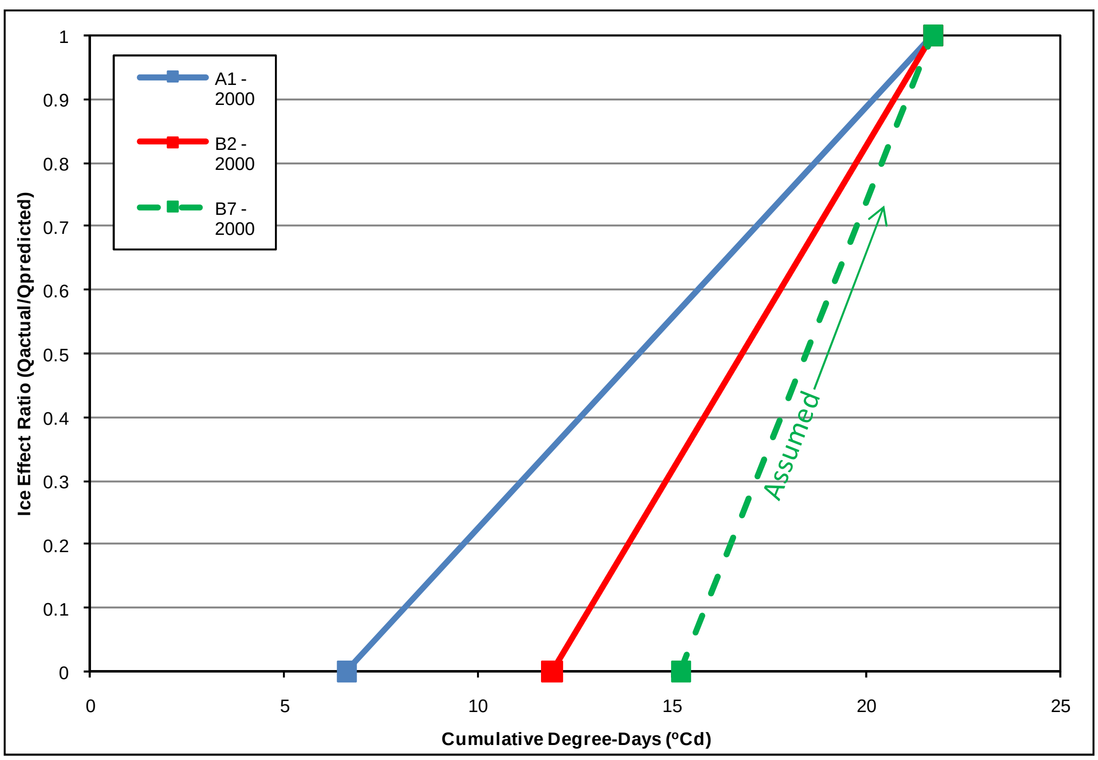


Figure A3-6 – Melt Period Ice Effect Ratios and Cumulative Degree-Days at the Peninsula Lakes Outlets, 2000

Based on the available data, all outlet openings are thought to be independent and were treated separately. Collection of additional data is recommended to improve these estimates.

Tables A3-4a and A3-4b present the results of the analysis. Durations vary from 6.5 ^oC•d for the outlet of Lake B7 (approximately equivalent to 4 days) to 15.1 ^oC•d for the outlet of Lake A1 (approximately equivalent to seven days). These relationships were used in the water balance modeling to incorporate ice effects at lake outlets. These relationships control the timing of the snowmelt peak without affecting their magnitudes. Since all the modeled watersheds are treated independently as headwater watersheds, the outlet opening parameters are mainly important for calibration purposes.

Table A3-4a: Derived Lake Outlet Ice Effect Ratios for Melt Period, Wet Years

Cumulative Degree-Days (^oC•d)	Ice Effect Ratio
Lake A1 Outlet	
4.6	0.0
19.7	1.0
Lake B2 Outlet	
4.6	0.0
14.4	1.0
Lake B7 Outlet	
4.6	0.0
11.1	1.0

Table A3-4b: Lake Outlet Ice Effect Ratios for Melt Period, Dry Years

Cumulative Degree-Days (^oC•d)	Ice Effect Ratio
Lake A1 Outlet	
6.6	0.0
21.7	1.0
Lake B2 Outlet	
11.9	0.0
21.7	1.0
Lake B7 Outlet	
15.2	0.0
21.7	1.0

The estimates of ice effects that were generated are used to estimate discharge from the lakes as outlets open up. Relationships presented in Figure A3-5 were used to estimate the opening of all lake outlets for wet years and relationships presented in Figure A3-6 were used to estimate the opening of all lake outlets for dry years. Based on similar drainage areas, it was assumed that the outlet of Chicken Head Lake behaved like that of Lake A1 and therefore was treated using the same parameters in the model. Collection of additional data from monitoring programs is recommended to improve this estimate.

A3 - 2.1.3 Lake Outlet Freeze-Up Period

During the beginning of September, as temperatures fall and the cumulative negative degree-days increase, lake outlets freeze and discharge decreases to zero for small lakes. During the late portion of the open water season, ice effects have been observed to reduce the discharge to some factor (<1) of the discharge that would be observed under ice-free conditions. The objective of the analysis is to define a relationship between this factor and meteorological parameters at each lake outlet, to provide a method to account for ice effects in the freezing period in hydrological modeling.

A3 - 2.1.3.1 Hydrometric and Meteorological Data

Ice observations were available at the Peninsula Lakes in 1997 and at Lake A54 and at Meliadine River in mid-September 2008.

Lake outlet freeze-up date estimates were available for the Peninsula Lakes in 1998, 1999 (AEE 1998, 1999), and in 2000 (AMEC 2000).

A meteorology station was operated at the Rankin Inlet airport from 1981 to 2009. Reported hourly data allow determination of the daily minimum, maximum, and mean temperatures.

A3 - 2.1.3.2 Method

A degree-day method was chosen to assess the effect of ice conditions on discharge at each lake outlet. Negative degree-days were counted below a base temperature of 0°C, and daily mean temperatures typically begin to fall below 0°C in September.

A graphical approach was selected for the analysis by plotting ice observations vs. degree-days. A corresponding cumulative degree-day value was assigned to the first day of ice observation, indicating the first day of freeze-up (Ice Effect Ratio = 1). A corresponding cumulative degree-day value was assigned to the estimated date of permanent frozen conditions (Ice Effect Ratio = 0), as reported by AEE (1998, 1999) and AMEC (2000).

The effect of the ice on discharge was quantified by the following ratio:

$$\text{Ice Effect Ratio} = Q_{actual} / Q_{predicted}$$

Where Q_{actual} = Discharge measured at the outlet under ice conditions; and

$Q_{predicted}$ = Discharge predicted using an open water rating curve for the specific outlet.

Flows during the freeze-up period are assumed to be smaller than the discharge predicted using an open water rating curve, resulting in ice effect ratios varying between 0 and 1. Values of 0 indicate the first day of complete freeze up of the outlet, and values of 1 indicate the last day of open water conditions.

Curves were fitted to the cumulative degree-day vs. ice effect ratio data to examine the relationships. Lake outlets were separated into groups exhibiting similar characteristics, with differences possibly due to outlet size and upstream storage.

A3 - 2.1.3.3 Results and Discussion

All observations at the Project area were plotted as a function of degree-days and are presented in Table A3-5 and Figure A3-7.

Table A3-5: Ice Observations at the Project area

Cumulative Degree-Days (°C•d)	Corresponding Ice Effect Ratio	Notes
-0.7	1.0	Thin ice cover on Lake A54.
-1.4	1.0	Ice on banks of the Meliadine R. near Rankin.
-5.6	0.0	1997 report. Frozen outlets observed at the end of September.
-76.5	0.0	1998 report. Estimated at the end of October.
-152.7	0.0	1999 report. Estimated at the end of October.
-202.5	0.0	2000 report. Estimated at the end of October.

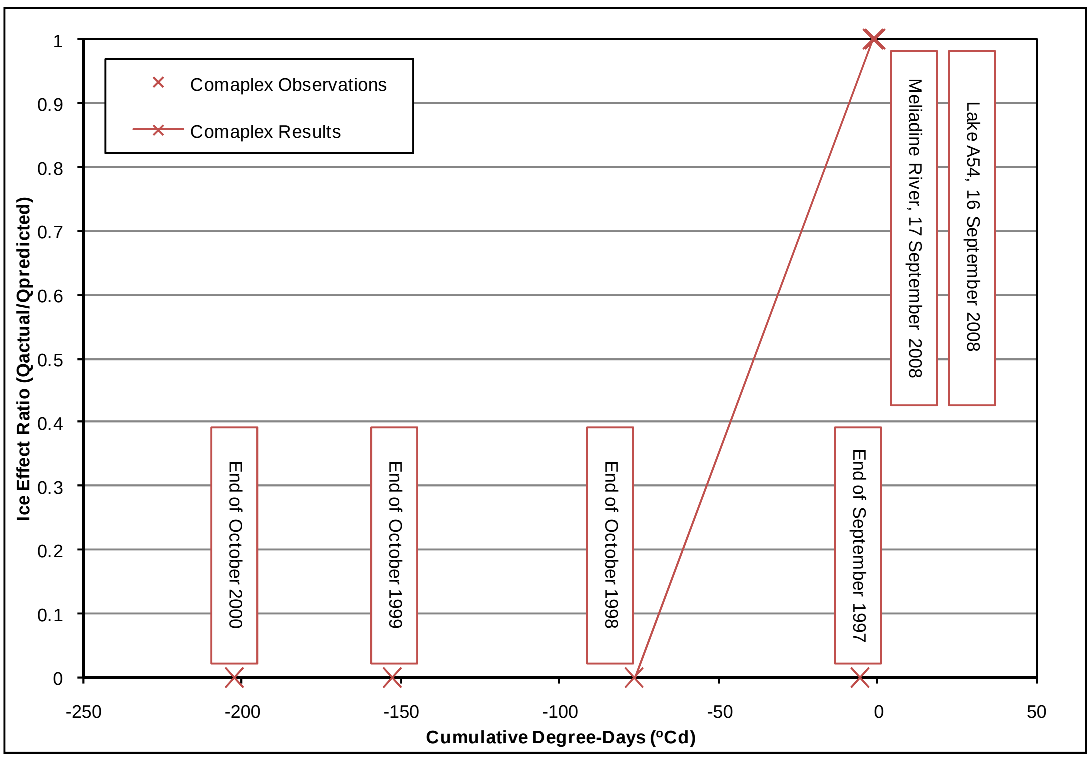


Figure A3-7 – Freeze-up Period Ice Effect Ratios and Cumulative Degree-Days

The first day of freeze up was estimated using ice observations on the banks of the Meliadine River in early September 2008. Based on the available data, the recorded observation on the banks of Meliadine River was used to estimate the first day of freeze-up. It is thought that Lake A54 would start freezing slightly earlier than lake outlets in the Project area.

Earlier studies (AEE 1998, 1999; AMEC 2000) estimated the complete freeze-up date occurring at the end of October. The smallest degree-day value associated with these dates was picked to represent the complete freeze-up date in the model. Lake outlet freeze-up occurred unexpectedly early in 1997 (AEE 1998a) possibly due to an unusually dry year and therefore was treated as an outlier.

These results are presented in Table A3-6. The relationship presented in Figure A3-7 is used in the water balance modeling to incorporate ice effects at all lake outlets.

Table A3-6: Derived Lake Outlet Ice Effect Ratios for Melt Period

Cumulative Degree-Days (^{o}C•d)	Ice Effect Ratio
-1.4	1.0
-76.5	0.0

A3 - 2.1.4 Snowmelt

During the snowmelt period, which typically occurs in the month of June, runoff flows to lakes, and water levels and discharges rise to a peak. The objective of the analysis is to provide a method to quantify snowmelt runoff in hydrological modeling.

A3 - 2.1.4.1 Hydrometric and Meteorological Data

Hydrometric data were available at Lake A1, Lake B2, and Lake B7 from 1997 to 2000 and 2008 to 2009, and at Chicken Head Lake in 2009, including water levels and corresponding discharges for the open water season.

Spring snow water equivalent data were available from 1997 to 2000 and 2008 to 2009 from snow course surveys.

A meteorology station was operated at the Rankin Inlet airport from 1981 to 2009. Available data include daily minimum, maximum, and average temperature, rainfall runoff, and derived lake evaporation.

A3 - 2.1.4.2 Method

A water balance method was selected to estimate the snowmelt runoff parameters. The snowmelt runoff was quantified using the following equation:

$$\text{Snowmelt Runoff} = R_{cs} \times M_f \times (T - T_b)$$

Where R_{cs}= Snowmelt runoff coefficient;

M_f = Melt factor (mm/°C);

T = Mean daily air temperature (°C); and

T_b = Base temperature (°C).

A water balance model for each watershed was set up as illustrated in Figure A3-8. Lakes A1 and B2 were treated as headwater lakes due to the scarcity of data for upstream watersheds. Their lake and land areas were assumed to be the sum of all upstream lakes and land respectively, from their outlet, while using their derived rating curve for the chosen year of data.

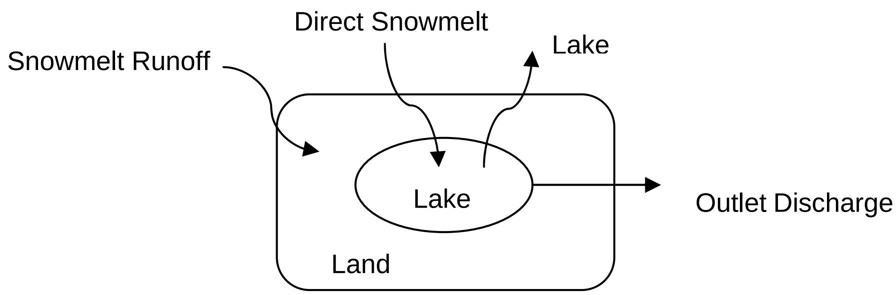


Figure A3-8 – Schematic Diagram for Snowmelt Water Balance Analysis

The water balance for each watershed considered snowmelt runoff (snowfall runoff on land), direct snowmelt (snowfall runoff on lake), lake evaporation, outlet to downstream watersheds using applicable outlet rating curves, and outlet opening in the early open water season.

The model was run on a daily time step using a trial and error method to estimate each parameter contributing to the snowmelt runoff (M_f, T_b and R_{cs}), The resulting hydrographs were plotted together with the measured data for comparison, and parameters were adjusted to achieve a best-fit to the available monitored data.

For accurate results, the model must be calibrated using a year of data with minimal rainfall events prior to the snowmelt runoff and a well defined snow peak. Hydrometric data from years 1997, 1998, 2008 and 2009 were discarded from the analysis due to late measurements, missing the snowmelt peaks (data were available at Lake B2 in 2009 but were insufficient to use the whole year for calibration). Hydrometric data from year 1999 were also discarded due to high rain events prior to the snowmelt. Year 2000 was a dry year with very little rain before the snowmelt, with good quality data, and was chosen for the analysis.

A3 - 2.1.4.3 Results and Discussion

Hydrographs from 2000 were analyzed using common parameters. Calculated water balance results were plotted against the measured data for comparison, and the following observations were noted:

- the melt factor, M_f, affects the duration of the snowmelt peak;
- the base temperature, T_b, shifts the snowmelt curve laterally and affects the height of the peak; and
- the runoff coefficient, R_{cs}, affects the height of the peak.

Plots of measured hydrographs against modeled hydrographs using the snowmelt parameters that were adopted are presented in Figures A3-9, A3-10, and A3-11.

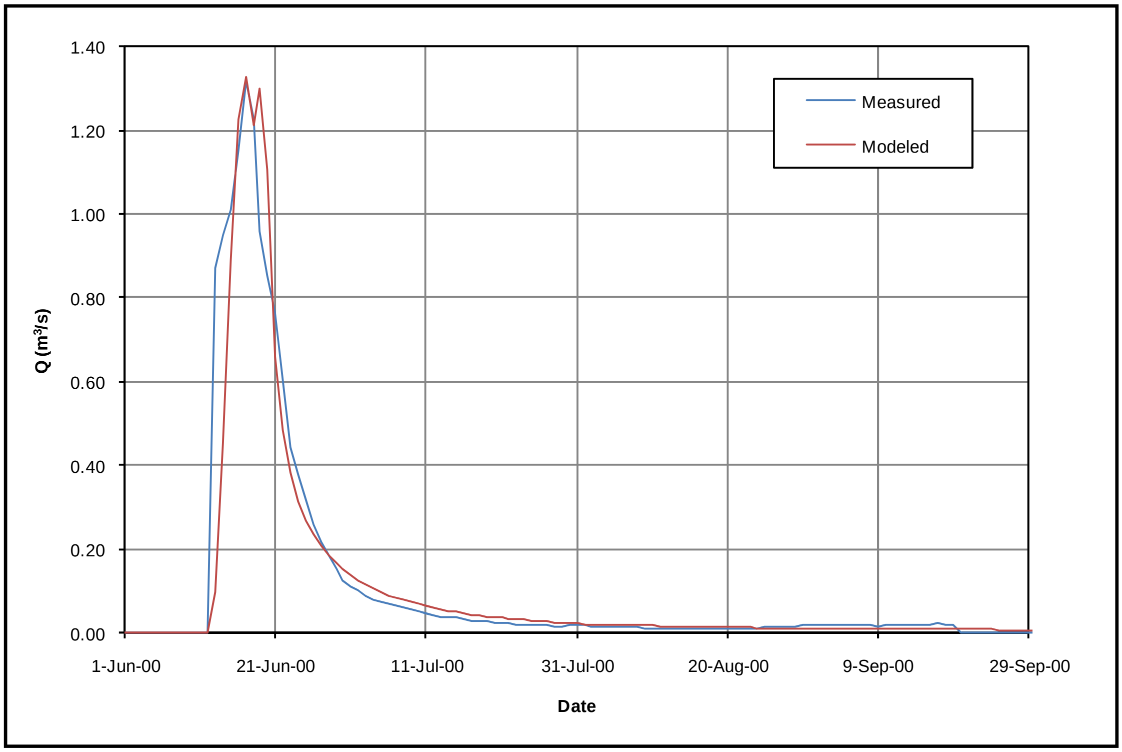


Figure A3-9 – Measured and Modeled Snowmelt Hydrographs at Lake A1, 2000

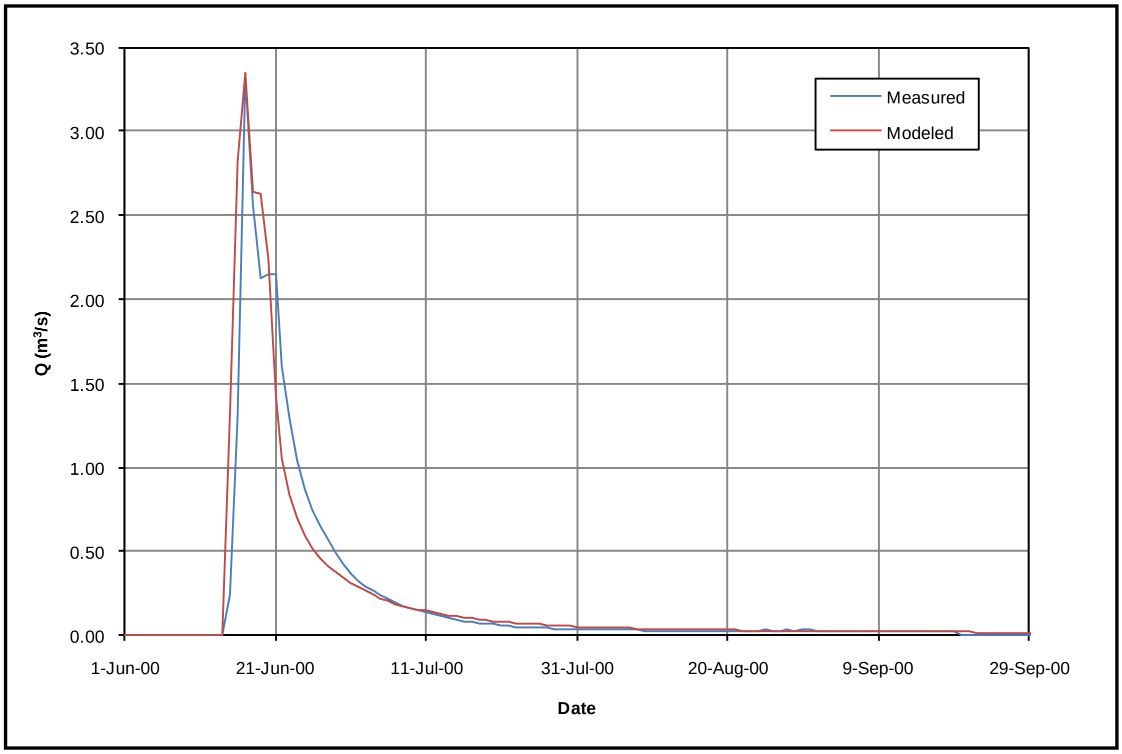


Figure A3-10 – Measured and Modeled Snowmelt Hydrographs at Lake B2, 2000

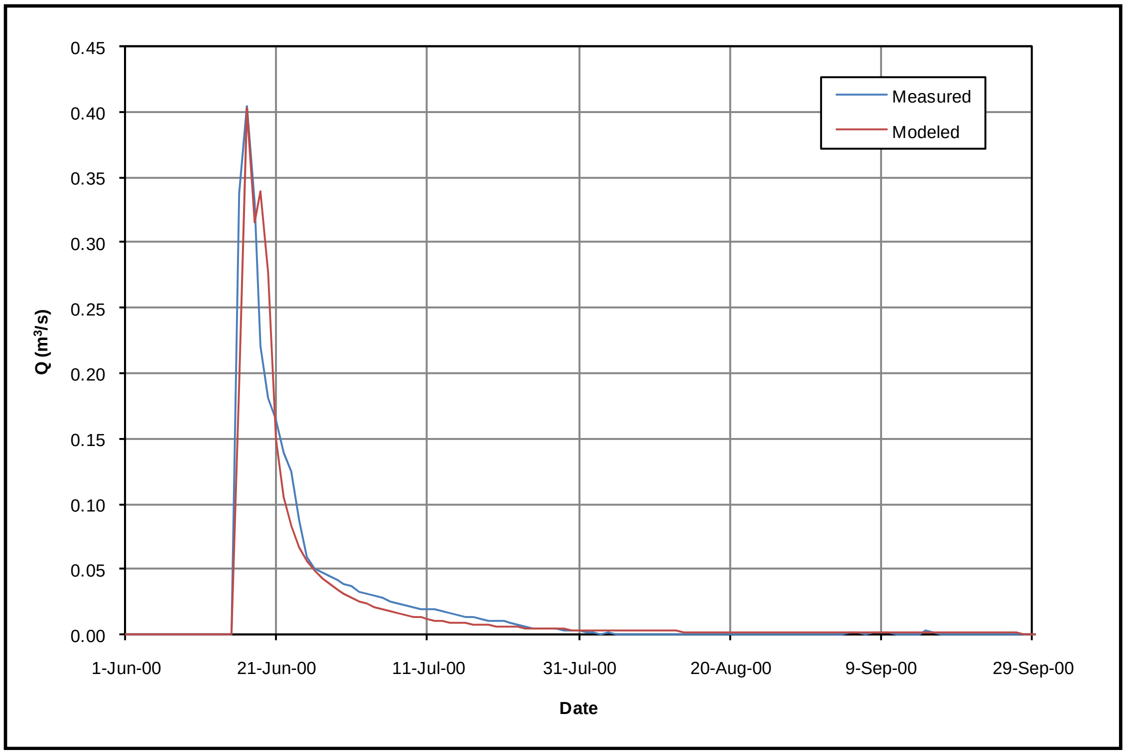


Figure A3-11 – Measured and Modeled Snowmelt Hydrographs at Lake B7, 2000

- The model assumes a uniform snow depth throughout all watersheds. This induces some uncertainty due to snow quantity variations for all watersheds. In actuality, the snowfall value that is measured by the climate station and used in the model may be different than the snow accumulated in individual watersheds, due to areal differences in snow redistribution. This results in an overestimated width of the modeled snow peak when the actual amount of snow in the watershed is smaller than that modeled, and an underestimated width when the actual amount of snow is greater than that modeled.

- Additional uncertainty may result from the lack of available data for upstream watersheds, to model Lakes A1 and B2. Snowmelt peaks of upstream watersheds affect the snowmelt peaks of downstream watersheds. This uncertainty is corrected during the calibration stage of snowmelt parameters that affect the timing and magnitude of snowmelt peaks as discussed above. Should additional data be available for upstream watersheds, these snowmelt parameters may have to be modified accordingly.

- The modeled hydrographs match the maximum measured discharge and reasonably represent the snow peak widths.

The parameters that define the snowmelt runoff are presented in Table A3-7. These parameters are thought to represent the conditions at the Project area and were used in the hydrological modeling to incorporate snowmelt runoff in the water balance for all watersheds.

Table A3-7: Derived Snowmelt Parameters

Parameter	Value
R_{cs}	0.7
M_f	1.5 mm/°C
T_b	-4.0°C

A3 - 3.0 MODEL CALIBRATION AND VALIDATION

A3 - 3.1 Model

The model described in Section 2 of this appendix includes calibrated sub-models for lake outlet melt, lake outlet freeze-up, and snowmelt, with consideration of watershed physical characteristics (land and lake areas; lake outlet stage-discharge rating curves). Additional calibration was required to define the runoff coefficient for rainfall. During a rain event, a portion of rainfall is lost to vegetation interception or soil infiltration, leading to evapotranspiration and evaporation, and does not contribute to the basin's runoff. The objective of the analysis is to provide a method to calibrate the model to account for these processes.

A3 - 3.2 Hydrometric and Meteorological Data

Hydrometric data were available at Lake A1, Lake B2, and Lake B7 from 1997 to 2000 and 2008 to 2009, and at Chicken Head Lake in 2009, including water levels and corresponding discharges for the open water season.

Spring snow water equivalent data were available from 1997 to 2000 and 2008 to 2009 from snow course surveys.

A meteorology station was operated at the Rankin Inlet airport from 1981 to 2009. Available data include daily minimum, maximum, and mean temperatures, rainfall runoff, and derived lake evaporation.

A3 - 3.3 Model Calibration and Validation

For best results, the model must be calibrated using a wet year of data with well defined snowmelt peaks. Hydrometric data from years 1997, 1998, 2008, and 2009 were not considered in the calibration due to late measurements, missing the snowmelt peaks (data were available at Lake B2 in 2009 but were insufficient to use the whole year for calibration). Year 2000 was a dry hydrological year and was also not considered in the calibration. Year 1999 was a wet year with good quality data, and was chosen for the calibration.

For best results, the model must also be validated using good quality data. These data must include snowmelt peaks and continuous measurements until the end of the hydrometric program. Hydrometric data from years 1997, 1998, 2008, and 2009 at Lake A1 and Lake B7 were not considered in the validation due to missing snowmelt peak data. Available data from year 2000 were chosen for validating the model. Additional validation was also performed using 2009 data at Lake B2 and incomplete 2009 data at Chicken Head Lake (snowmelt peak missing).

A3 - 3.3.1 Method

The water balance was set up using the configuration for each watershed as described in Figure A3-12. Due to lack of data, Lakes A1 and B2 were treated as headwater lakes assuming that their lake and land areas to be the sum of all upstream lakes and land respectively, from their outlet, while using their derived rating curves for the chosen year of data. The uncertainty corresponding to this assumption is addressed in the snowmelt section above.

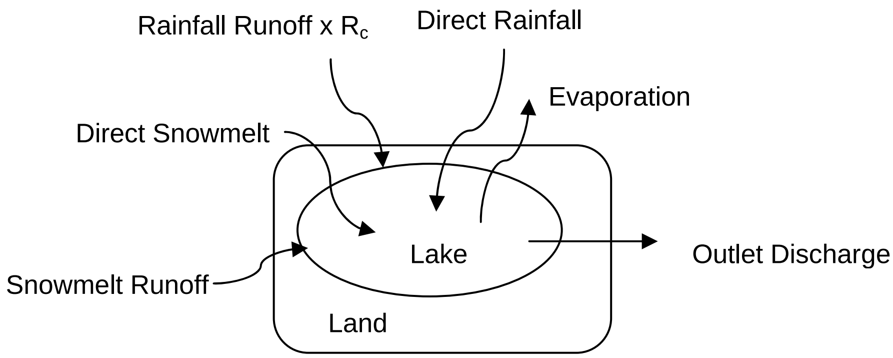


Figure A3-12 – Schematic of Water Balance Component

R_c is a runoff coefficient applied to rainfall runoff to account for evapotranspiration and evaporation that occurs in local storage. The snowmelt runoff and rainfall runoff were also modeled by using the recorded data at the Rankin Inlet climate station. The outlet discharges were modeled using applicable lake outlet rating curves (based on the 1999 monitoring program for Lake A1, Lake B2 and Lake B7, and on the 2009 monitoring program for Chicken Head Lake) and was run in conjunction to the outlet melt, outlet freeze-up and snowmelt runoff sub-models previously described. A detailed diagram of this process is described in Figure A3-2.

The calibration process was performed as follows:

- ***Calibration:*** The model was run, as shown in Figure A3-12 above, on a daily time step for 1999 at Lake A1, Lake B2, and Lake B7. Lake A1 and Lake B2 were modeled as headwater lakes as discussed in preceding sections, similar to Lake B7, and were set up without inflow from upstream lakes. The runoff coefficient was calibrated using a trial and error method with an initial value of 1 and was reduced in increments of 0.05 accordingly. The modeled outlet discharges and water levels were plotted along with the measured data for comparison, and the runoff coefficient was adjusted to best match modeled and measured hydrographs.

- ***Validation:*** The model was tested using input parameters from year 2000 (rainfall and snowfall as reported from the Rankin Inlet airport), the calibrated parameters found during the calibration stage, and 1999 lake outlet stage-discharge rating curves. The resulting hydrographs for Lake A1, Lake B2 and Lake B7 were plotted along with the measured hydrometric data for the same year for comparison.

- ***Additional Validation:*** The model was tested using input parameters from year 2009, calibrated parameters, the 1999 lake outlet stage-discharge rating curves for Lake B2, and the 2009 lake outlet stage-discharge rating curve for Chicken Head Lake. Resulting hydrographs for Lake B2 and Chicken Head Lake were plotted along with the measured hydrometric data for comparison.

A3 - 3.4 Results and Discussion

All years were analyzed using common parameters. Model results were plotted against the measured data for comparison. Calibration results are presented in graphical form in Figures A3-13 to A3-15 below. Validation results are presented in Figures A3-16 to A3-18 and additional validation in Figure A3-19 and A3-20.

Calibration:

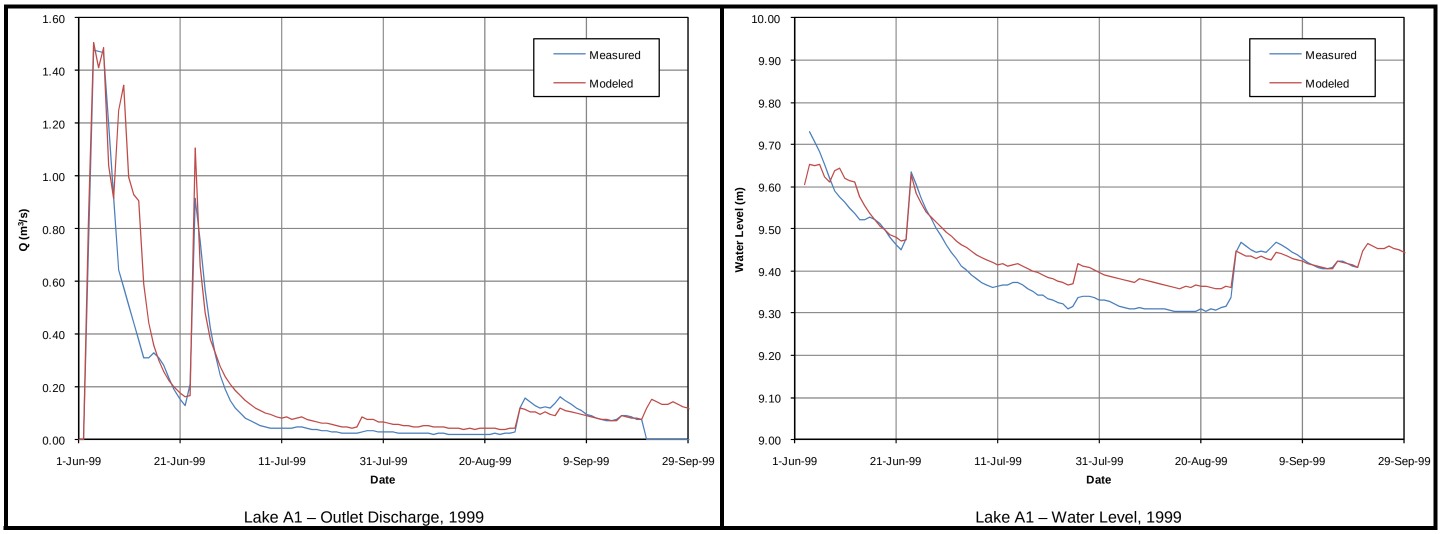


Figure A3-13 – Water Balance Model Calibration Results: Lake A1, 1999

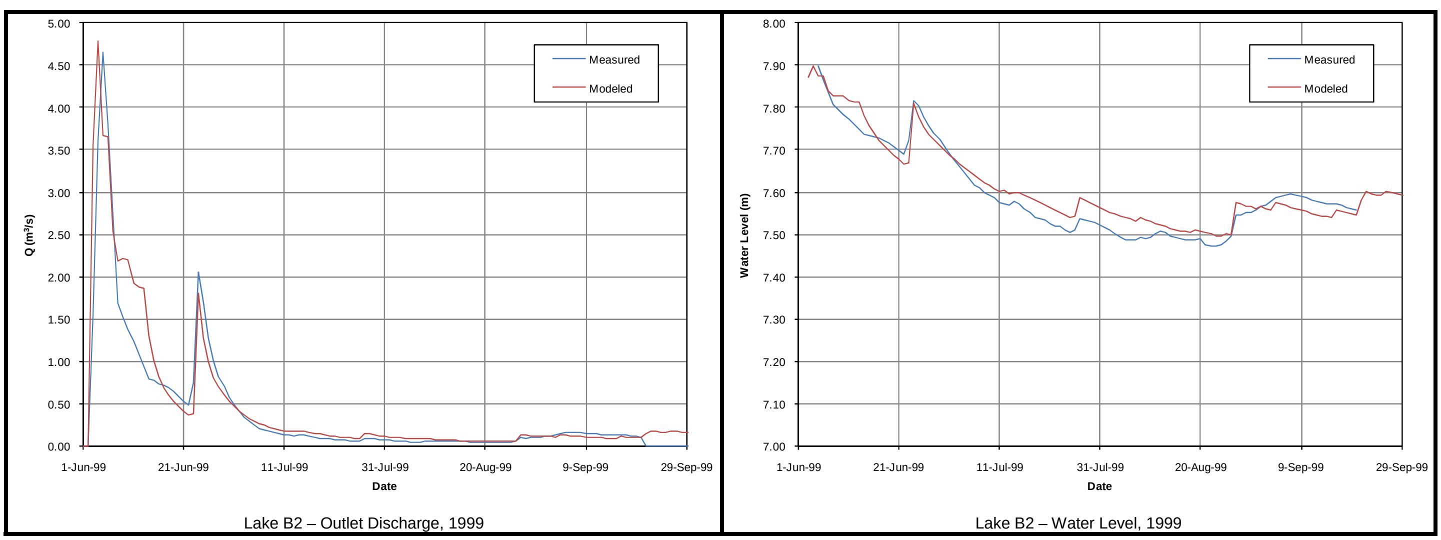


Figure A3-14 – Water Balance Model Calibration Results: Lake B2, 1999

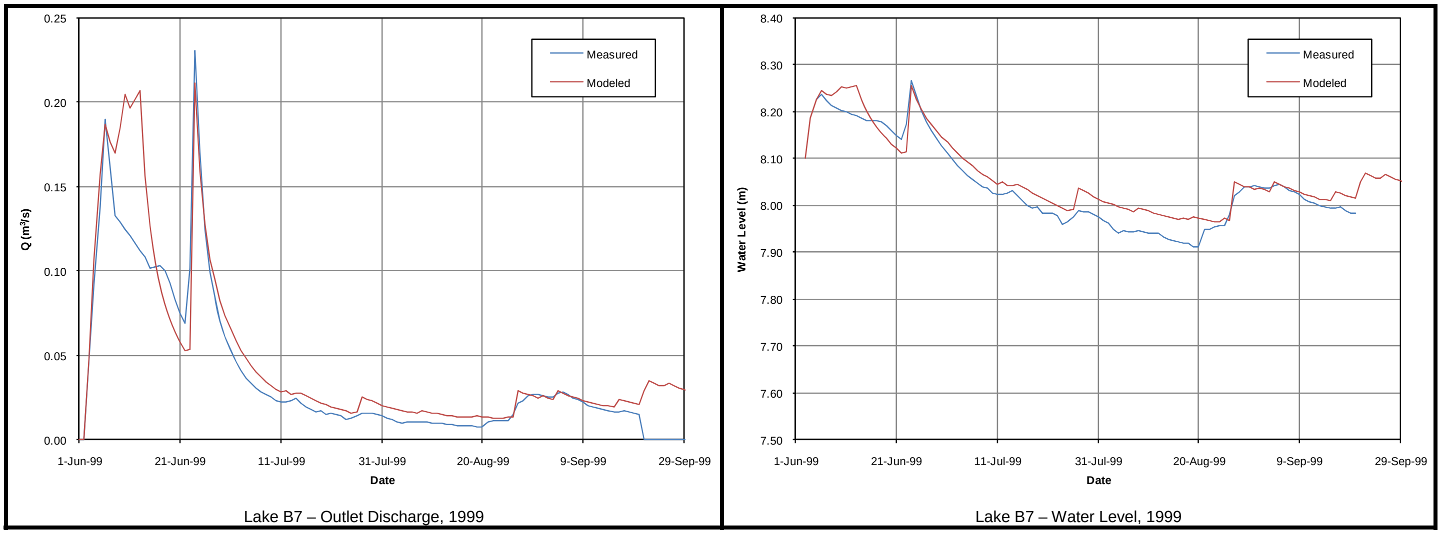


Figure A3-15 – Water Balance Model Calibration Results: Lake B7, 1999

Validation:

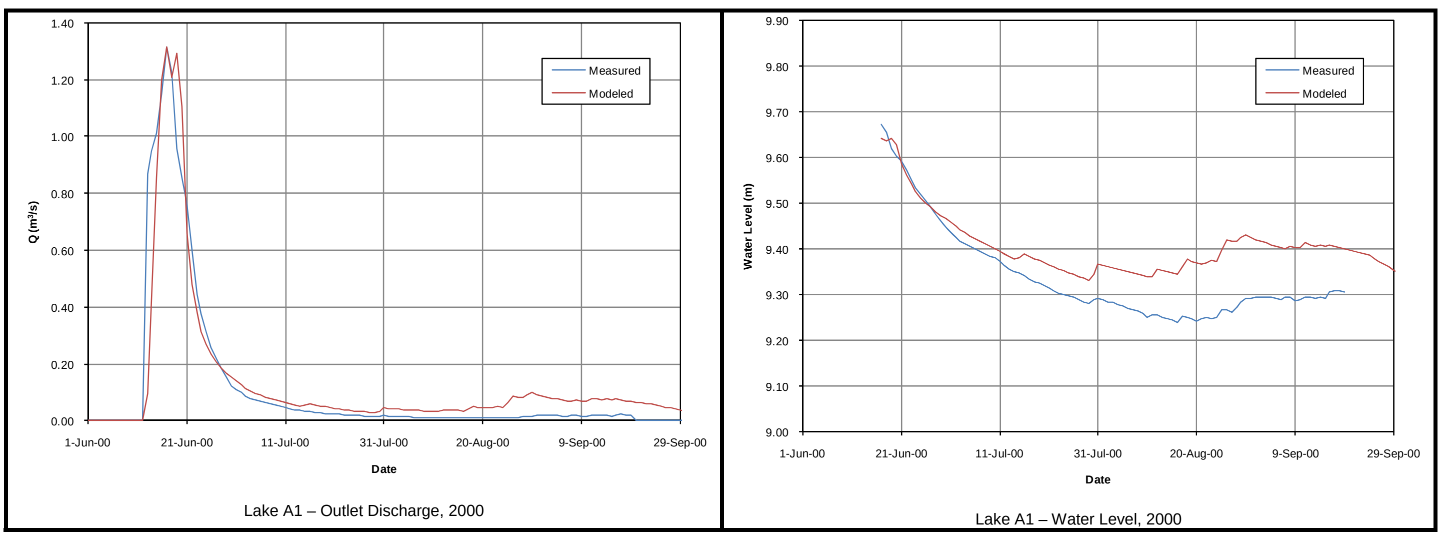


Figure A3-16 – Water Balance Model Validation Results: Lake A1, 2000

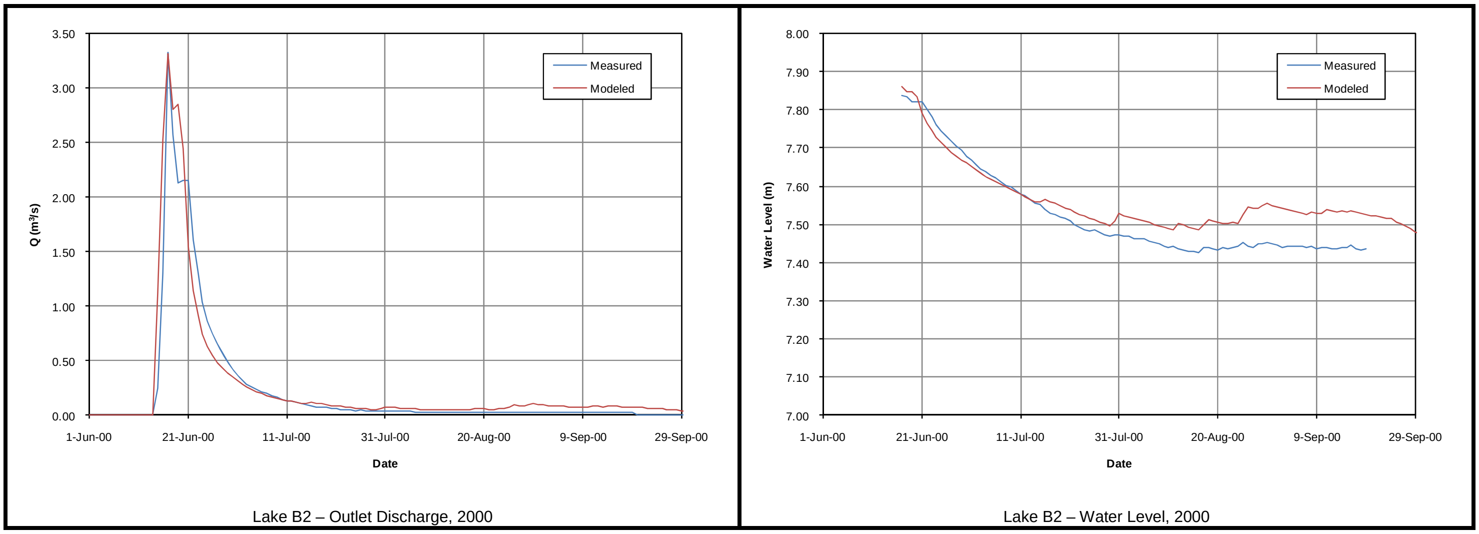


Figure A3-17 – Water Balance Model Validation Results: Lake B2, 2000

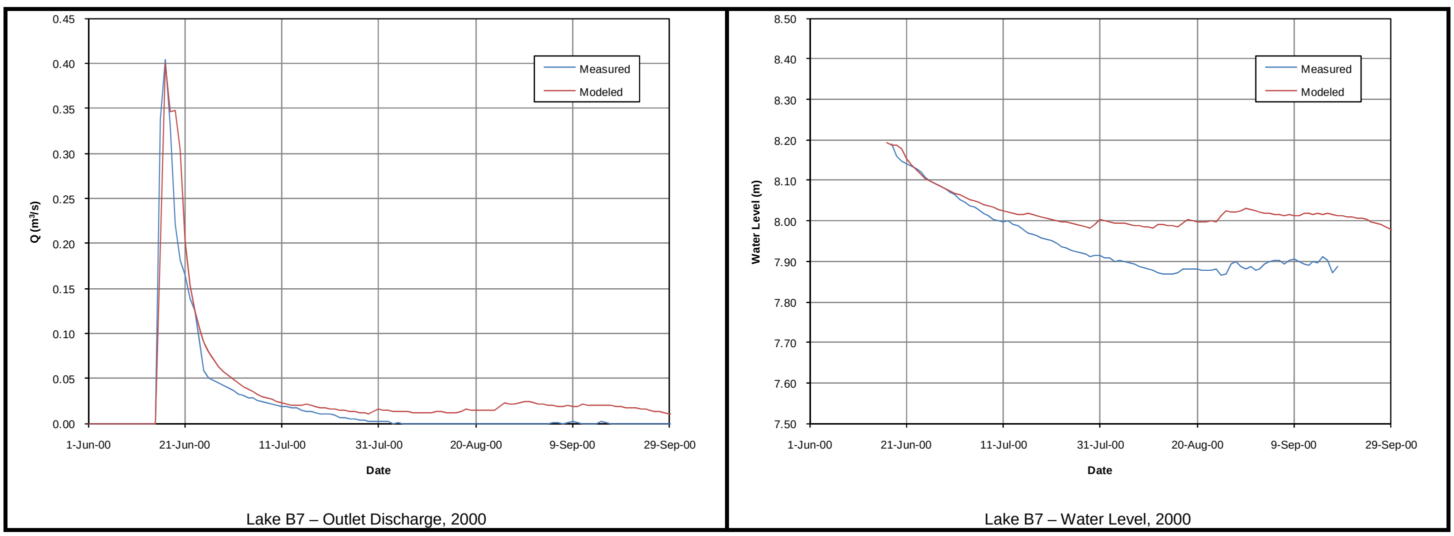


Figure A3-18 – Water Balance Model Validation Results: Lake B7, 2000

Additional Validation:

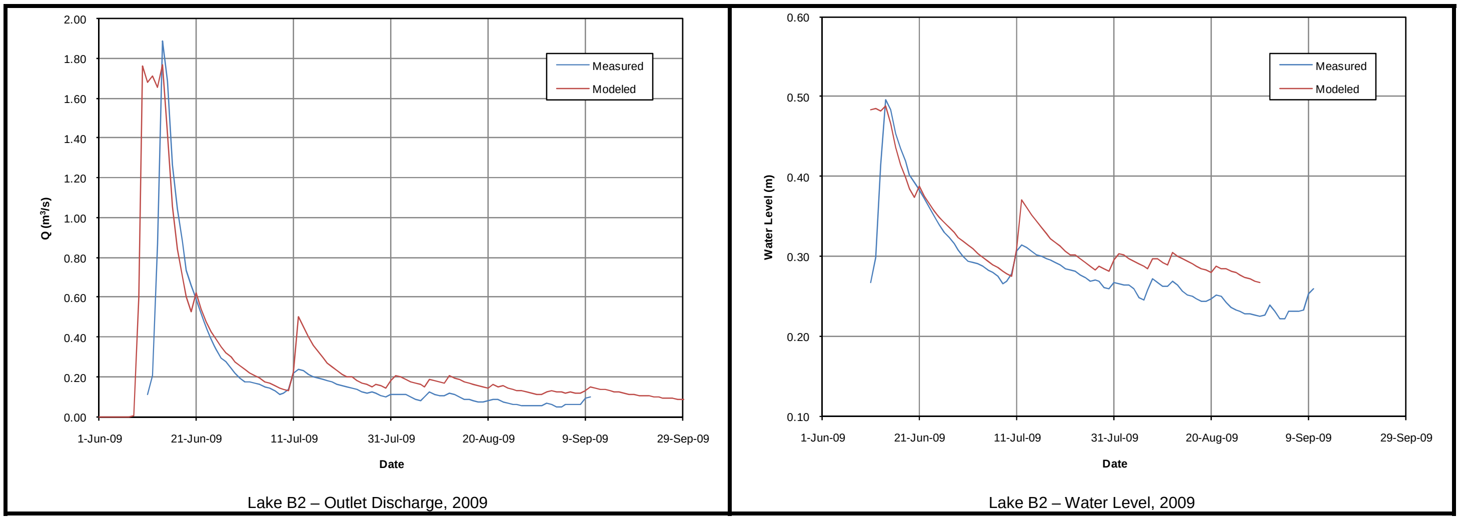


Figure A3-19 – Water Balance Model Validation Results: Lake B2, 2009

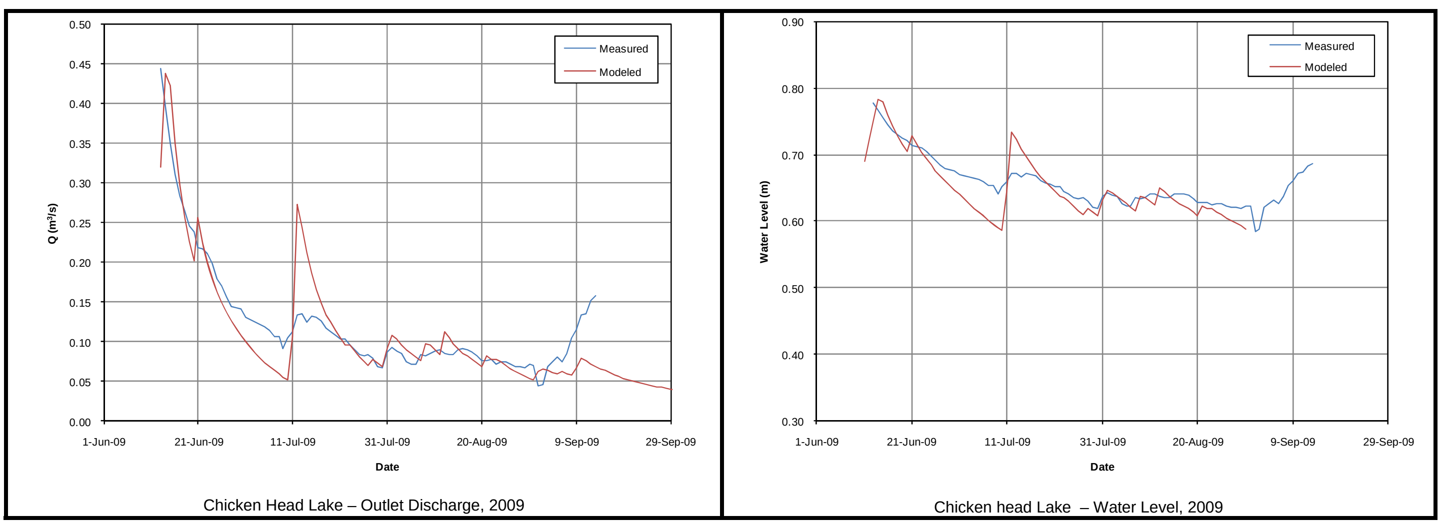


Figure A3-20 – Water Balance Model Validation Results: Chicken Head Lake, 2009

Comments on the calibration include the following:

- During the calibration stage, it was noticed that the chosen runoff coefficient worked well for the substantial rainfall event that happened on 23 June 1999 and overestimated the results after any subsequent event, at all stations. Modeling of years 2000 and 1999 revealed that using the same runoff coefficient would also overestimate the results for any rainfall event occurring later than June. It is thought that ground conditions in June and earlier may differ from later ground conditions, affecting the runoff conveyance. Ground surface could still be partially frozen in June and convey rainfall runoff more efficiently, hence, reducing losses that could occur later in the summer, due to storage and subsequent evapotranspiration. The runoff coefficient, therefore was split on a degree-day basis (based on the first day of discrepancies on the plots in 1999) between the first part of the runoff season, when the ground could potentially be frozen, and the rest of the season, keeping the original coefficient for the first part and a reduced coefficient for the remaining part of the season. The later coefficient was calibrated using a trial-and-error method and modifying it accordingly.

- Hydrographs were well matched in 1999 despite a reoccurring error at all lakes. Disagreement between measured and modeled results occurs slightly after the measured snow peak, accentuated at Lake A1 and Lake B7 in 1999. This error is thought to originate from the modeled snowmelt runoff. The model assumes a uniform snow water equivalent for all watersheds. In actuality, the snowfall value that is measured by the climate station and used in the model may be different than the snow accumulated in individual watersheds, due to areal differences in precipitation distribution. Despite this discrepancy, the peaks were accurately estimated at all lakes.

Comments on the validation include the following:

- Hydrographs were well matched in 2000. A discrepancy can be noticed at all stations towards the end of the runoff season. The model reacts to all rainfall events, while these did not seem to appear in measured data. It is possible that the recorded rainfall at Rankin Inlet was not entirely present at the Project area, due to areal differences as previously explained; therefore, it is thought that the model can accurately represent the conditions at Lake A1, Lake B2, and Lake B7, based on available data.

Comments on the additional validation include the following:

- Lake B2 was the only reliable dataset with snowmelt peak data in 2009 allowing for validation. The measured data appear to be well modeled despite a discrepancy in snowmelt peak width, possibly attributed to differences in actual snow between Rankin Inlet and the watershed as explained previously. The outlet opening date appears to be accurate, by extrapolation of the measured data. This reinforces the confidence in the model, based on available data.

- While the measured data at Chicken Head Lake were incomplete, the model results were compared to the available data for additional validation. Due to lack of data, it is not possible to confirm whether the modeled peak and the outlet opening date parameter are accurate. The model results seem to fit well to the available data. The model seems to overestimate the outlet discharge in July during a recorded rainfall event at Rankin Inlet. Subsequent rainfall events seem to be modeled accurately, and it is thought that only a portion of the recorded event in July occurred around the Project area, as a similar error was modeled at Lake B2 in Table A3-14. Therefore, it is thought that the model can accurately represent the conditions at Chicken Head Lake, based on the available data.

The calibrated parameters used in the final model to generate hydrological statistics based on calibration and validation are presented in Table A3-9 below.

Table A3-9: Calibration Parameters Used in Water Balance Model

Parameter		Station				Units / Notes
		Lake A1	Lake B2	Lake B7	Chicken Head Lake	
Outlet Opening (0)	**Dry Year**	6.6	11.9	15.2	6.6	°C•d
	Wet Year	4.6	4.6	4.6	4.6	°C•d
Outlet Opening (1)	**Dry Year**	21.7	21.7	21.7	21.7	°C•d
	Wet Year	19.7	14.4	11.1	19.7	°C•d
Outlet Freeze-Up (1)		-1.4	-1.4	-1.4	-1.4	°C•d
Outlet Freeze-Up (0)		-76.5	-76.5	-76.5	-76.5	°C•d
Rating Curve		1999	1999	1999	2009	Based on field data
Tb		-4.0	-4.0	-4.0	-4.0	°C/d
Mf		1.5	1.5	1.5	1.5	mm/°C
Sc		0.7	0.7	0.7	0.7	-
Rc before 135 °C•d		0.7	0.7	0.7	0.7	-
Rc after 135 °C•d		0.3	0.3	0.3	0.3	-

A4 - 1.0 INTRODUCTION

Appendix A4 provides a compilation of all hydrometric field data collected during the 2009 field program along with analysis results.

A4 - 2.0 METHODS

A4 - 2.1 Snow Course Survey

The water equivalent of a snowpack (the equivalent depth of water if the snowpack is melted) is the product of snow depth and snow density. Snow course surveys to determine the late spring snow water equivalent (SWE) in the peninsula basins A1, B2, and B7 were conducted between 23 and 26 April 2009.

Transect and Plot locations

Five transects were located and surveyed for snow depth, as shown on Figure A4-1. Two of these transects followed the same path as the 1997 snow course surveys and were located in the B7 basin (Transect T1) and the upper part of the A1 basin (Transect T2). Transect T3 followed a 2000 snow course survey path. Transect T4 is located in the middle part of the B2 basin, and Transect T5 is located in the middle part of the A1 basin and partially in the J1 basin.

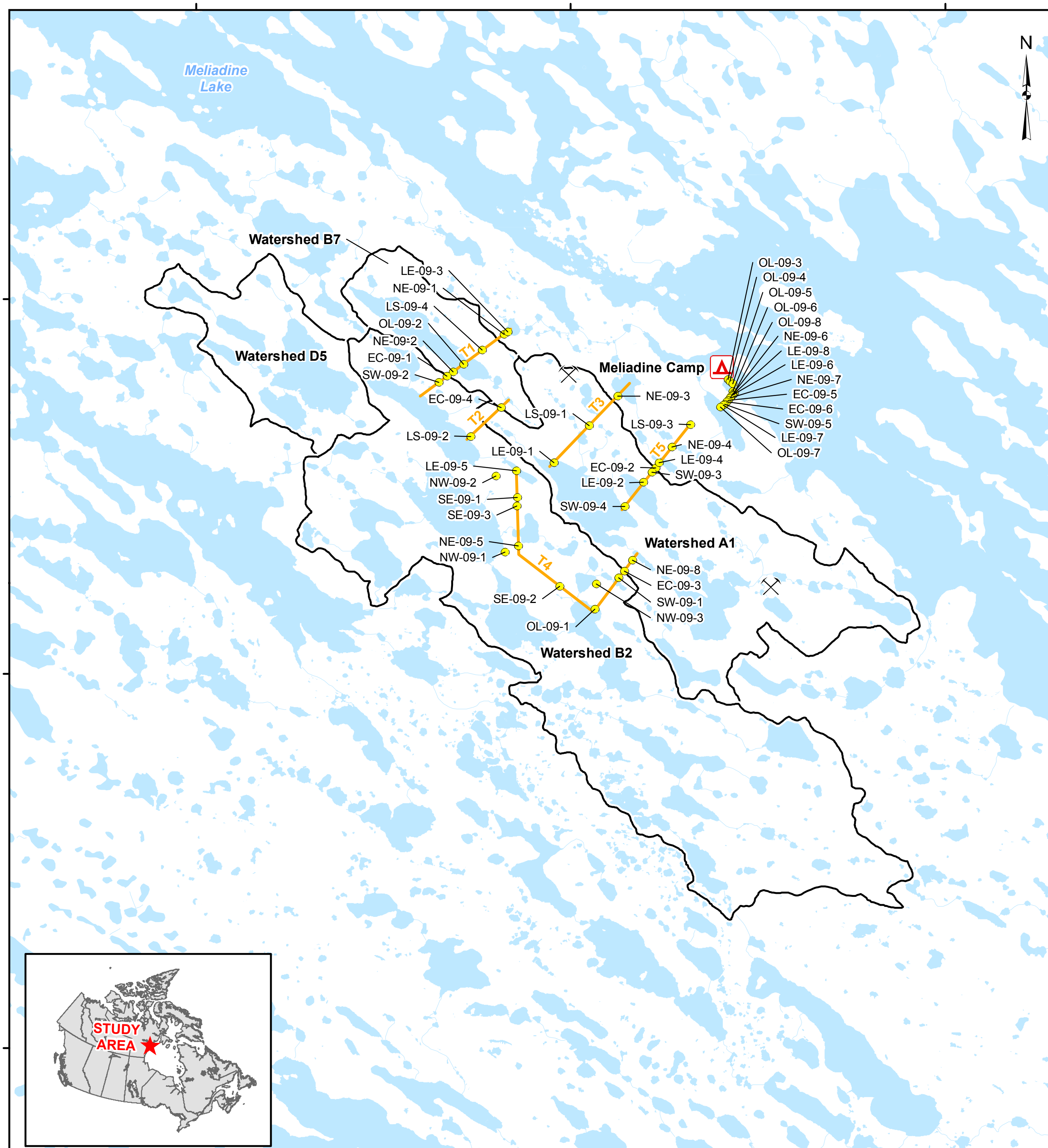
A series of supplemental plots were chosen in the peninsula area to gather more snow depth and density data for all terrain units and to better identify differences in snow accumulation among terrain types. All plots were considered in determining the mean SWE values.

Snow Depth Measurement

Along each transect, snow depth was measured every 10 m. At each plot, 30 depth measurements were taken at randomly selected locations within a large circle, approximately 10 m in radius. These depth measurements were taken by inserting a metal stick into the snowpack and reading the snowline mark.

Snow Density Measurement

Three density measurements were recorded at each plot, using a snow density sampler. The sampler was carefully inserted to avoid compacting the snowpack. The snow depth was read on the tube, when the corer reached the soil surface. The corer was then inserted/twisted deeply into the ground to ensure that a plug of soil was extracted with the sampler to prevent granular snow from falling out. After extracting the sampler and carefully removing the soil plug, the sampler weight was measured, with and without the snow core, to allow the weight of the snow and snow water equivalent to be calculated.



LEGEND

- Camp
- Proposed Mine Site
- Snow Course Survey Plot Location
- Snow Course Survey Transect
- Watercourse
- Waterbody
- Watershed

1.5 0 1.5

SCALE 1:75,000 KILOMETRES

REFERENCE

Base data obtained from Comaplex Minerals Corporation. Snow course survey data obtained from field survey.

Projection: UTM Zone 15 Datum: NAD 83

DRAFT

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

SNOW COURSE SURVEY LOCATIONS
23-26 APRIL 2009

Golder Associates
Edmonton, Alberta

PROJECT NO. 09-1373-0010			PHASE No. 5000
DESIGN	DC	02 Nov. 2009	SCALE AS SHOWN REV. 0
GIS	CDB	02 Nov. 2009	
CHECK	NPS	17 Nov. 2009	FIGURE A4-1
REVIEW	GA	25 Nov. 2009	

N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\Hydrology\figure-a04-01_snow-course-survey-locations.mxd

A4 - 2.2 Rainfall

Rainfall at the Meliadine West Camp station was recorded using a tipping bucket rain gauge, and the rainfall data were used to derive total daily and monthly rainfall at the camp for the period of 10 June to 15 September 2009. The location of the rain gauge is shown on Figure A4-2.

A4 - 2.3 Hydrometry

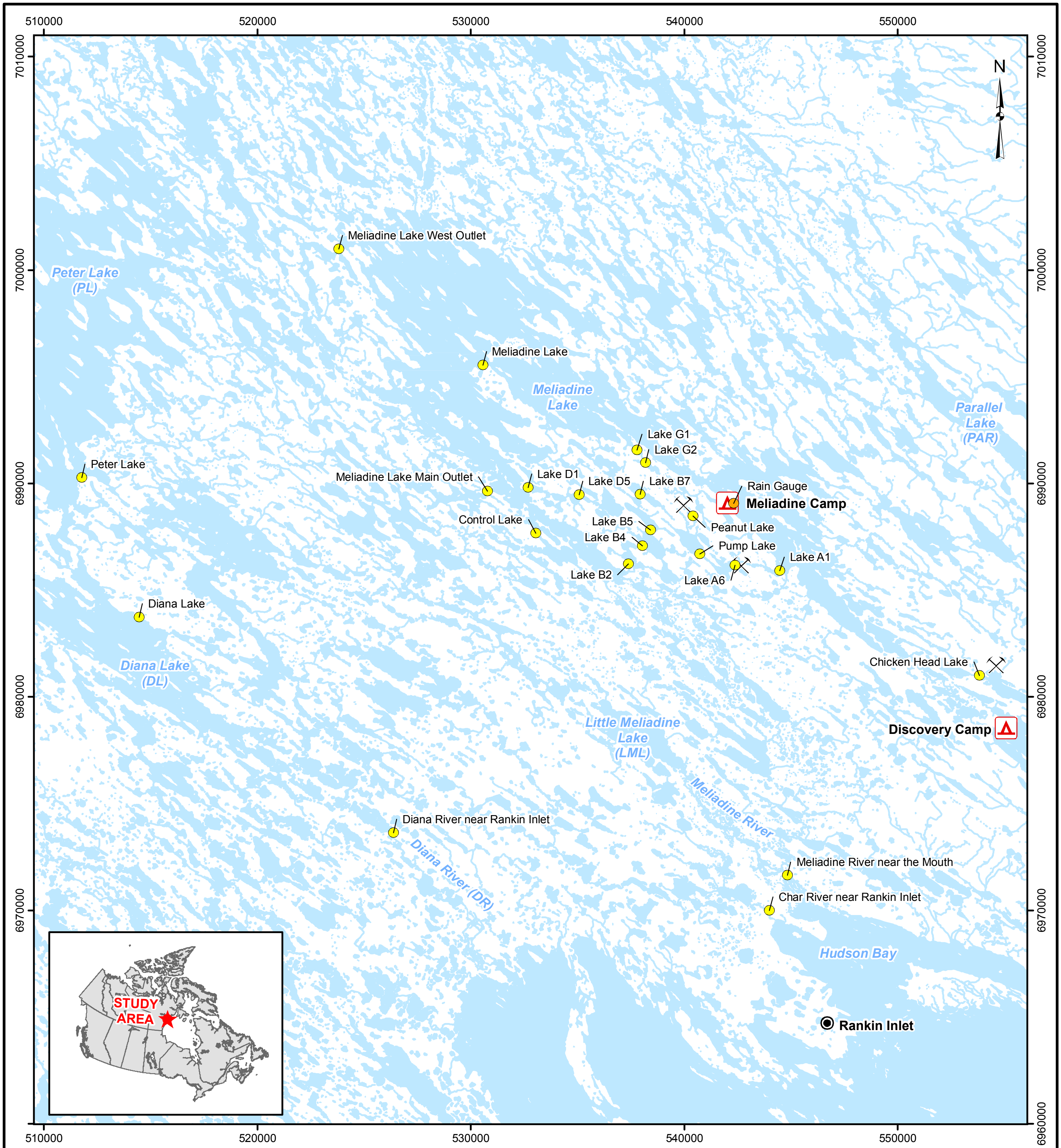
Continuous and discrete measurement hydrometric stations were established on 10 June 2009.

Continuous measurement stations were set up at Lake A1 and Outlet, Lake B2 and Outlet, Lake B7 and Outlet, Lake D1 and Outlet, and Chickenhead Lake and Outlet to develop stage-discharge relationships for the open water season, and Meliadine Lake to monitor lake water level variations. These stations were equipped with pressure transducers connected to data loggers and recorded water depths on a 15-minute interval. Manual discharge and water level measurements were also collected at these stations during each visit.

Opportunistic discharge measurements were also performed at Meliadine Lake West Outlet (Diana River), Meliadine Lake Main Outlet (Meliadine River), Meliadine River near the Mouth, Lake A8, Lake A54, Lake G1 and Lake G2 to provide additional data on discharges and water levels. Discharge and water level measurements were performed at these locations and tied to a local benchmark during each visit.

Hydrographs of Lake A1 and Outlet, Lake B2 and Outlet, Lake B7 and Outlet, Lake D1 and Outlet, Chickenhead Lake and Outlet, and Meliadine Lake were derived using the following methods:

- a Keller Acculevel Submersible Level Transmitter solid-state pressure transducer and Optimum Instruments DD-520 data logger were installed at each hydrometric station. Each data logger was programmed to record water pressure measurements at 15-minute intervals. Each station was referenced to an elevation benchmark;
- the transducers were installed as early as possible in the snowmelt period, as permitted by ice conditions and site access;
- the water surface elevations were surveyed from the permanent benchmark, and the pressure transducer readings were recorded during selected data logger downloads;
- the stream discharge measurements were performed (if applicable) according to the Water Survey of Canada standard described by Terzl et al. (1994) during the first and subsequent visits to stations with flowing water. The data loggers at each station were downloaded at the same time, and pressure transducer readings coincident with each discharge measurement were noted;
- the pressure transducers and data loggers were removed during the last visit; and
- the record of water surface elevations versus discharge was used to establish a stage-discharge rating curve for each station, when all data were available for flowing water stations. This rating curve was then applied to the continuous record of water surface elevations, as measured by the pressure transducer and recorded by the data logger at each station, to derive a continuous record of discharges. For some stations, limited stage-discharge data are available, and continuous discharges could not be derived.



N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\Hydrology\figure-a04-02_rain-gauge-hydrometric-stations.mxd

LEGEND

- Camp
- Hydrometric Station
- Rain Gauge
- Proposed Mine Site
- Watercourse
- Waterbody

5 0 5

SCALE 1:250,000 KILOMETRES

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

RAIN GAUGE AND HYDROMETRIC STATION LOCATIONS

DRAFT

PROJECT NO. 09-1373-0010			PHASE No. 5000	
DESIGN	JL	27 Oct. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	27 Oct. 2009	FIGURE A4-2	
CHECK	NPS	17 Nov. 2009		
REVIEW	GA	25 Nov. 2009		

Golder Associates
Edmonton, Alberta

REFERENCE

Base data obtained from Comaplex Minerals Corporation. Hydrometric data obtained from field survey.
Projection: UTM Zone 15 Datum: NAD 83

Discharge measurements were collected at all stations in a similar manner, except at the Meliadine River near the Mouth on the second visit. Velocity and depth measurements, used to calculate discharge, were collected using a Marsh McBirney Model Flo-Mate 2000 velocity meter and top-setting wading rod. During the second visit, at the Meliadine River near the Mouth, velocity, discharge, and cross-sectional data were collected using an RD Instruments Workhorse Rio Grande Acoustic Doppler Current Profiler (ADCP).

Manual water level measurements were collected using a rod and level, tied to a local benchmark.

A4 - 3.0 SNOW COURSE SURVEY RESULTS

Snow surveys to determine the late spring snow water equivalent (SWE) in the peninsula basins A1, B2, and B7 were conducted between 23 and 26 April 2009.

Terrain type classification was defined by AMEC (2000), and the distribution of each terrain type is shown on Figure A4-3. For watersheds A1, B2, B7, and D5, the area for each terrain type was calculated, and these are presented in Table A4-1.

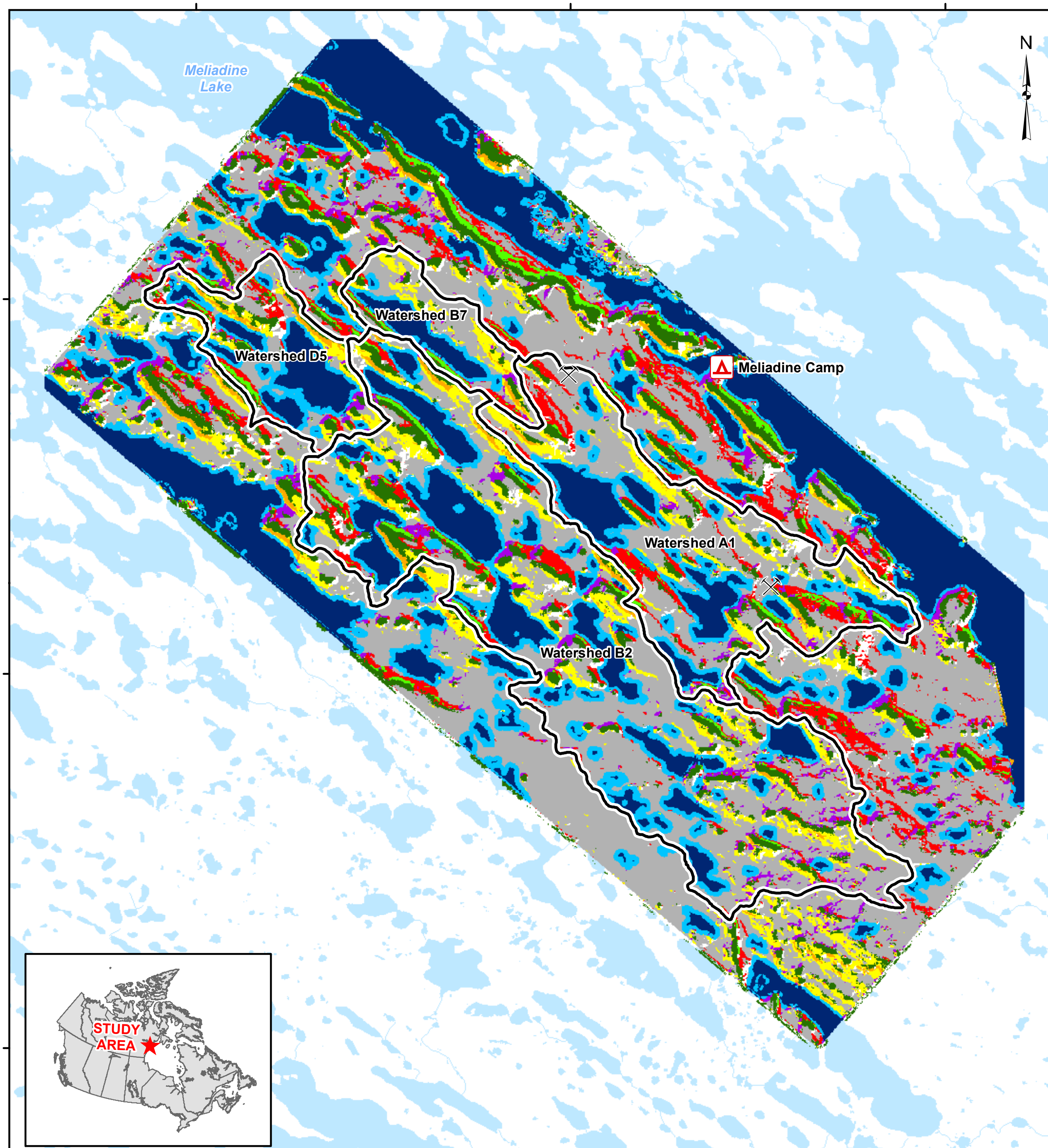
Table A4-1: Terrain Type Distributions for Basins B7, B2, A1 and D5

Terrain Type	BASIN B7		BASIN B2		BASIN A1		BASIN D5	
	Area (km^2)	Percent	Area (km^2)	Percent	Area (km^2)	Percent	Area (km^2)	Percent
Crest	0.44	18.4%	3.74	16.7%	1.40	14.9%	0.90	24.4%
Lake	0.29	12.0%	3.40	15.2%	1.41	15.0%	0.68	18.5%
Lake Edges	0.30	12.6%	2.33	10.5%	0.89	9.5%	0.48	13.0%
Low Slopes	0.76	31.9%	7.81	35.0%	3.31	35.3%	0.69	18.7%
NE Slopes (>8.5%)	0.09	3.8%	0.95	4.2%	0.79	8.4%	0.24	6.5%
NE Slopes (3-8.5%)	0.06	2.5%	0.32	1.4%	0.16	1.7%	0.08	2.1%
NW Slopes (>3%)	0.34	14.3%	2.23	10.0%	0.90	9.5%	0.33	9.0%
SE Slopes (>3%)	0.03	1.4%	0.31	1.4%	0.09	0.9%	0.11	3.0%
SW Slopes (>8.5%)	0.05	2.0%	0.72	3.2%	0.20	2.1%	0.09	2.4%
SW Slopes (3-8.5%)	0.02	1.0%	0.51	2.3%	0.24	2.6%	0.09	2.4%
Total Area	**2.39**	**100%**	**22.32**	**100%**	**9.39**	**100%**	**3.68**	**100%**

Wind redistributes snowfall over the course of a winter, and in general, exposed surfaces, such as open lake areas, collect less snow than sheltered lowland areas. Similarly, prevailing winds redistribute snow unequally across slopes of differing aspect. These effects may result in significant snow accumulation differences between terrain types.

Snow depths and densities were measured at 45 plots over 10 terrain types during the snow course survey. Table A4-2 presents, by terrain type, the snowpack measurement data collected in April 2009.

For each terrain type, a mean SWE value was calculated and used to derive the SWE for each watershed based on the proportion of that terrain type over the entire watershed. The results are presented in the Table A4-3.



LEGEND

- Camp
- Proposed Mine Site
- Watercourse
- Waterbody
- Watershed

Terrain Types

- 1 Lake
- 2 Lake Edges
- 3 Crest
- 4 Low Slopes
- 5 NE Slopes (3 - 8.5%)
- 6 NE Slopes (> 8.5%)
- 7 SW Slopes (3 - 8.5%)
- 8 SW Slopes (> 8.5%)
- 9 NW Slopes (> 3%)
- 10 SE Slopes (> 3%)

1.5 0 1.5

SCALE 1:75,000 KILOMETRES

DRAFT

REFERENCE

Base data obtained from Comaplex Minerals Corporation. Terrain Types and Watershed delineation and definition from AGRA 1998 Data Report (AEE 1998).
Projection: UTM Zone 15 Datum: NAD 83

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

DISTRIBUTION OF TERRAIN TYPES AT THE MELIADINE GOLD PROJECT

Golder Associates
Edmonton, Alberta

PROJECT NO. 09-1373-0010			PHASE No. 5000	
DESIGN	DC	02 Nov. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	02 Nov. 2009	**FIGURE A4-3**	
CHECK	NPS	17 Nov. 2009		
REVIEW	GA	25 Nov. 2009		

N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\Hydrology\figure-a04-03_terrain-types.mxd

Table A4-2: 2009 Snow Course Survey Data for Meliadine Gold Project, 23-26 April 2009

Terrain Type	Survey Plot Number	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)
Crest	EC-09-1	0.265	19.2	50.8
	EC-09-2	0.248	32.3	80.3
	EC-09-3	0.298	17.9	53.3
	EC-09-4	0.181	17.0	30.7
	EC-09-5	0.280	11.3	31.6
	EC-09-6	0.307	23.0	70.6
	2009 Mean Value	**0.263**	**20.1**	**52.9**
Lake	OL-09-1	0.319	16.7	53.3
	OL-09-2	0.272	17.2	46.8
	OL-09-3	0.311	16.8	52.4
	OL-09-4	0.192	11.7	22.4
	OL-09-5	0.247	12.0	29.6
	OL-09-6	0.252	14.6	36.8
	OL-09-7	0.259	12.2	31.6
	OL-09-8	0.256	23.4	60.0
	2009 Mean Value	**0.263**	**15.6**	**41.6**
Lake Edges	LE-09-1	0.266	26.0	69.3
	LE-09-2	0.238	42.9	102.1
	LE-09-3	0.275	29.2	80.3
	LE-09-4	0.289	67.7	195.7
	LE-09-5	0.322	27.7	89.2
	LE-09-6	0.253	53.9	136.3
	LE-09-7	0.227	54.0	122.4
	LE-09-8	0.286	59.7	170.6
	2009 Mean Value	**0.269**	**45.1**	**120.7**
Low Slopes	LS-09-1	0.192	28.8	55.3
	LS-09-2	0.205	27.9	57.1
	LS-09-3	0.193	26.1	50.5
	LS-09-4	0.226	25.5	57.7
	2009 Mean Value	**0.204**	**27.1**	**55.2**
NE Slopes (>8.5%)	NE-09-2	0.224	18.0	40.2
	NE-09-3	0.166	26.3	43.7
	NE-09-4	0.304	20.7	63.0
	NE-09-5	0.232	17.0	39.3
	NE-09-6	0.223	23.2	51.7
	NE-09-7	0.154	13.1	20.2

Table A4-2: 2009 Snow Course Survey Data for Meliadine Gold Project, 23-26 April 2009 (continued)

Terrain Type	Survey Plot Number	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)
	2009 Mean Value	**0.217**	**19.7**	**43.0**
NE Slopes (3-8.5%)	NE-09-1	0.221	18.1	40.0
	NE-09-8	0.274	25.5	70.1
	2009 Mean Value	**0.248**	**21.8**	**55.1**
NW Slopes (>3%)	NW-09-1	0.274	49.1	134.3
	NW-09-2	0.246	31.2	76.8
	NW-09-3	0.308	93.2	286.9
	2009 Mean Value	**0.276**	**57.8**	**166.0**
SE Slopes (>3%)	SE-09-1	0.281	64.6	181.9
	SE-09-2	0.276	46.8	129.0
	SE-09-3	0.303	38.9	118.0
	2009 Mean Value	**0.287**	**50.1**	**143.0**
SW Slopes (>8.5%)	SW-09-1	0.251	35.7	89.6
	SW-09-2	0.249	33.9	84.5
	SW-09-3	0.263	39.1	102.9
	SW-09-5	0.273	49.2	134.2
	2009 Mean Value	**0.259**	**39.5**	**102.8**
SW Slopes (3-8.5%)	SW-09-4	0.236	59.8	141.1
	2009 Mean Value	**0.236**	**59.8**	**141.1**

Table A4-3: Mean Snow Water Equivalent (SWE) Values by Terrain Type

Terrain Type	Mean SWE (mm)	SWE (mm) Weighted by Terrain Type Proportion			
		BASIN B7	BASIN B2	BASIN A1	BASIN D5
Crest	52.9	6.7	5.5	5.0	6.9
Lake	41.6	7.7	7.0	6.2	10.1
Lake Edges	120.7	14.5	18.4	18.1	22.3
Low Slopes	55.2	17.6	19.3	19.4	10.3
NE Slopes (>8.5%)	43.0	1.1	0.6	0.8	0.9
NE Slopes (3-8.5%)	55.1	2.1	2.3	4.6	3.6
NW Slopes (>3%)	166.0	3.3	5.3	3.5	4.0
SE Slopes (>3%)	143.0	1.4	3.3	3.7	3.5
SW Slopes (>8.5%)	102.8	1.4	1.4	0.9	3.1
SW Slopes (3-8.5%)	141.1	20.2	14.1	13.5	12.7
	Total	**75.9**	**77.3**	**75.8**	**77.4**

LAKE A1 AND OUTLET HYDROMETRIC STATION

A1
FACTSHEET

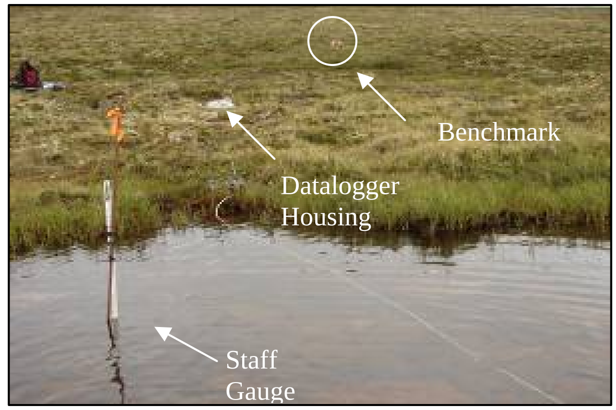
LOCATION AND DETAILS

Located approximately 4 kilometres southeast of Meliadine West Camp.

Operational:	1997	1998	1999	2000	2008	2009
	11/6-25/9	5/6-23/9	14/6-20/9	13/6-19/9	15/6-16/9	11/6–10/9

Benchmark:	Bolt on boulder; 100.304 m (non-geodetic)	Drainage Area:	9.39 km^2
Coordinates:	UTM: 544479 m E, 6985918 m N (NAD83, Zn15)	Lat/Long:	63°00’00” N, 92°07’18” W
Transducer:	Keller Acculevel Submersible Level Transducer	Datalogger:	Optimum Instruments DD-520

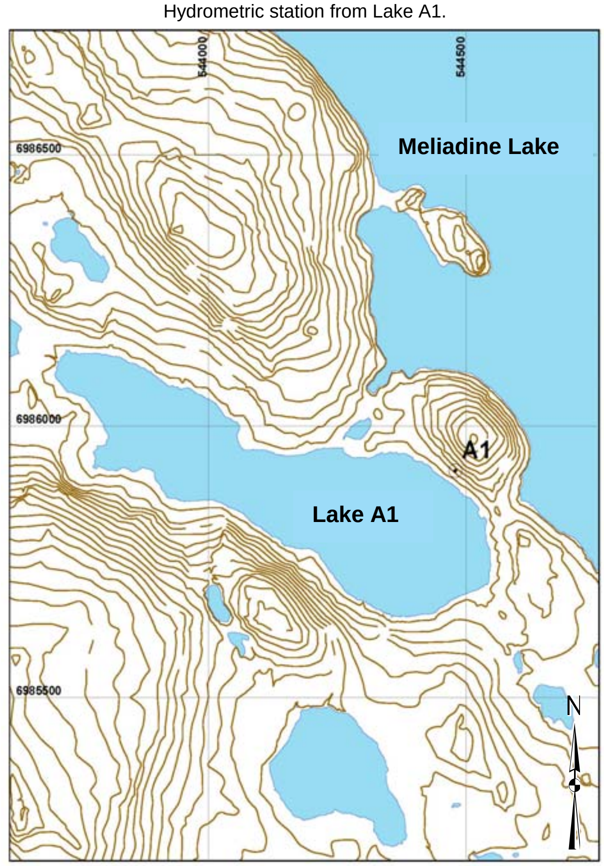
View of Lake A1 from hydrometric station.



Hydrometric station from Lake A1.


View of Lake A1 from outlet.


Downstream view of Lake A1 Outlet.



NTS Mapping of Area.

A4 - 4.0 LAKE A1 AND OUTLET

The Lake A1 and Outlet hydrometric station was visited 4 times during the 2009 field program, and a continuous hydrograph was derived for the period of 11 June to 10 September 2009 based on continuous logger data. Details of each site visit are provided in Table A4-4 and water level measurements in Table A4-5. The hydrographs and stage-discharge rating curve for Lake A1 and Outlet in 2009 are presented in Figures A4-4 and A4-5. Mean daily data are presented in Tables A4-6 and A4-7 and raw data in Tables A4-8 to A4-11.

Table A4-4: Site Visits to Lake A1 and Outlet Hydrometric Station, 2009

Date	Activities	Lake	Lake Water Surface Elevation (m; non-geodetic)	Outlet	Discharge (m^3/s)
11 Jun	Installed pressure transducer and data logger. Measured discharge and water surface elevation.	✓	98.384	✓	0.787
9 Jul	Measured discharge and water surface elevation and downloaded data logger.	✓	98.054	✓	0.027
4 Aug	Measured discharge and water surface elevation and downloaded data logger.	✓	98.067	✓	0.024
10 Sep	Measured discharge and water surface elevation and downloaded data logger. Removed pressure transducer and data logger.	✓	98.131	✓	0.069

Water level surveys were performed during each visit, and the measurements are provided in Table A4-5.

Table A4-5: Lake A1 Water Level Survey Measurements (m), 2009

Date and Time	BM Reading	WS Reading	BM Elevation	WS Elevation	Transducer Reading	Transducer Elevation	Average Transducer Elevation	Stage	Staff Gauge Reading
11-Jun 11:20	0.915	2.835	100.304	98.384	0.487	97.897	97.889	0.884	0.304
09-Jul 15:30	0.990	3.240	100.304	98.054	0.173	97.881		0.554	0.034
04-Aug 16:30	0.363	2.600	100.304	98.067	0.230	97.837		0.567	0.050
10-Sep 16:20	0.202	2.375	100.304	98.131	0.237	97.894		0.631	0.110

Note: BM= benchmark; WS= water surface

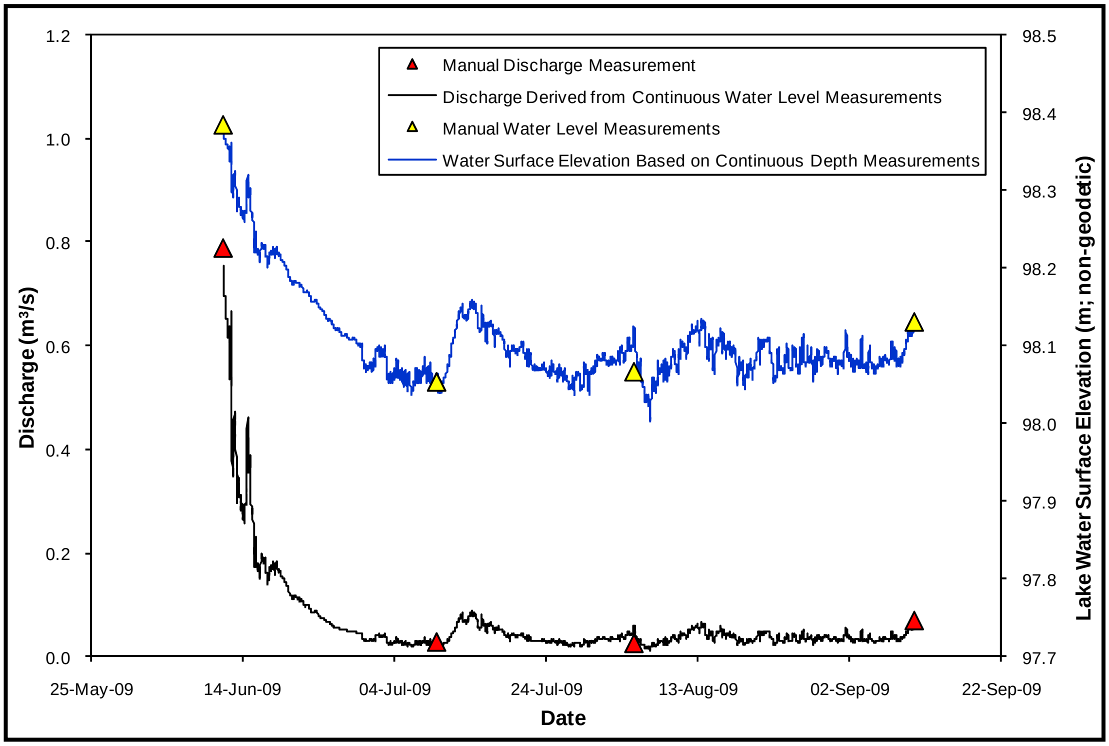


Figure A4-4: Hydrograph for Lake A1 and Outlet, 2009

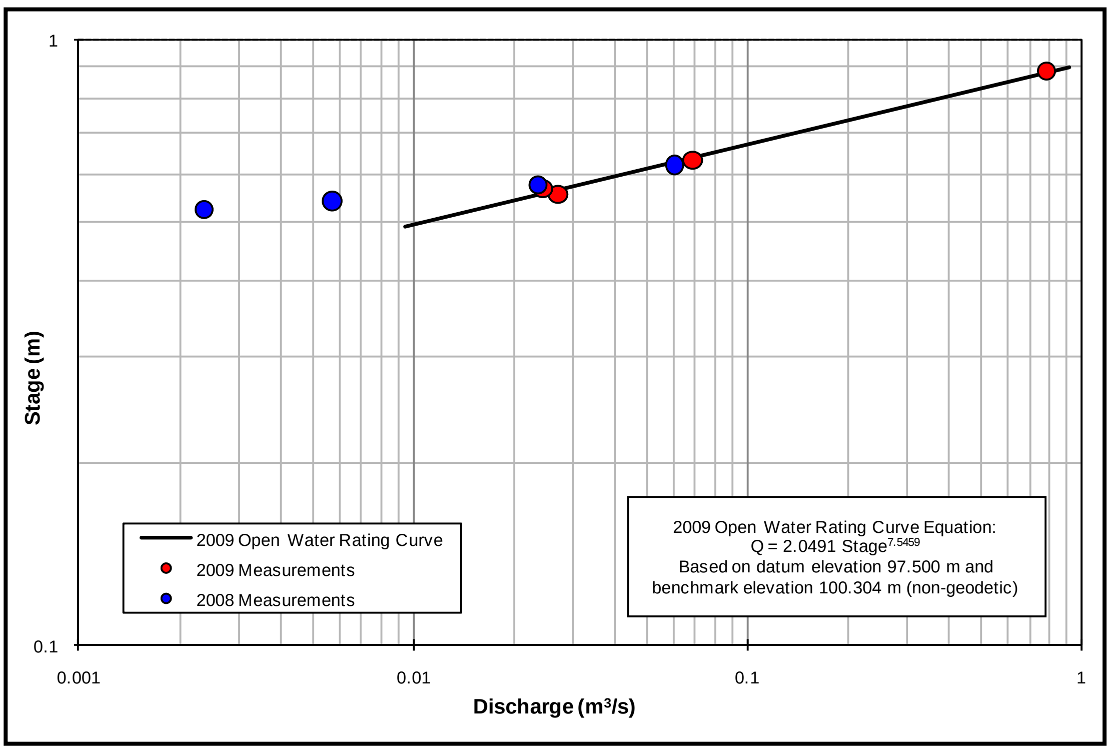


Figure A4-5: Lake A1 Outlet Stage-Discharge Rating Curve, 2009

Table A4-6: Lake A1 Outlet Mean Daily Discharge (m^3/s), 2009

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	0.036	0.033	0.039	-	-	-
2	-	-	-	-	-	-	0.038	0.036	0.033	-	-	-
3	-	-	-	-	-	-	0.026	0.040	0.035	-	-	-
4	-	-	-	-	-	-	0.028	0.045	0.033	-	-	-
5	-	-	-	-	-	-	0.025	0.027	0.030	-	-	-
6	-	-	-	-	-	-	0.023	0.017	0.034	-	-	-
7	-	-	-	-	-	-	0.027	0.024	0.036	-	-	-
8	-	-	-	-	-	-	0.027	0.030	0.035	-	-	-
9	-	-	-	-	-	-	0.023	0.032	0.049 P	-	-	-
10	-	-	-	-	-	-	0.024	0.036	-	-	-	-
11	-	-	-	-	-	0.690 P	0.040	0.043	-	-	-	-
12	-	-	-	-	-	0.530	0.068	0.056	-	-	-	-
13	-	-	-	-	-	0.334	0.071	0.057	-	-	-	-
14	-	-	-	-	-	0.325	0.080	0.044	-	-	-	-
15	-	-	-	-	-	0.239	0.062	0.040	-	-	-	-
16	-	-	-	-	-	0.181	0.057	0.046	-	-	-	-
17	-	-	-	-	-	0.162	0.054	0.041	-	-	-	-
18	-	-	-	-	-	0.171	0.045	0.031	-	-	-	-
19	-	-	-	-	-	0.146	0.040	0.027	-	-	-	-
20	-	-	-	-	-	0.117	0.041	0.033	-	-	-	-
21	-	-	-	-	-	0.110	0.037	0.044	-	-	-	-
22	-	-	-	-	-	0.098	0.031	0.041	-	-	-	-
23	-	-	-	-	-	0.086	0.030	0.031	-	-	-	-
24	-	-	-	-	-	0.074	0.029	0.033	-	-	-	-
25	-	-	-	-	-	0.065	0.028	0.035	-	-	-	-
26	-	-	-	-	-	0.056	0.026	0.036	-	-	-	-
27	-	-	-	-	-	0.051	0.022	0.035	-	-	-	-
28	-	-	-	-	-	0.048	0.024	0.033	-	-	-	-
29	-	-	-	-	-	0.042	0.026	0.037	-	-	-	-
30	-	-	-	-	-	0.031	0.032	0.035	-	-	-	-
31	-	-	-	-	-	-	0.036	0.032	-	-	-	-
MIN	-	-	-	-	-	0.031	0.022	0.017	0.030	-	-	-
MEAN	-	-	-	-	-	0.178	0.037	0.037	0.036	-	-	-
MAX	-	-	-	-	-	0.690	0.080	0.057	0.049	-	-	-

Note: P = partial daily average

Table A4-7: Lake A1 Mean Daily Water Surface Elevation (m), 2009

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	98.084	98.079	98.089	-	-	-
2	-	-	-	-	-	-	98.090	98.085	98.077	-	-	-
3	-	-	-	-	-	-	98.059	98.093	98.081	-	-	-
4	-	-	-	-	-	-	98.066	98.103	98.078	-	-	-
5	-	-	-	-	-	-	98.055	98.061	98.072	-	-	-
6	-	-	-	-	-	-	98.052	98.028	98.081	-	-	-
7	-	-	-	-	-	-	98.062	98.053	98.085	-	-	-
8	-	-	-	-	-	-	98.062	98.070	98.082	-	-	-
9	-	-	-	-	-	-	98.050	98.076	98.108 P	-	-	-
10	-	-	-	-	-	-	98.054	98.084	-	-	-	-
11	-	-	-	-	-	98.366 P	98.092	98.099	-	-	-	-
12	-	-	-	-	-	98.333	98.136	98.120	-	-	-	-
13	-	-	-	-	-	98.285	98.140	98.121	-	-	-	-
14	-	-	-	-	-	98.281	98.151	98.100	-	-	-	-
15	-	-	-	-	-	98.249	98.129	98.091	-	-	-	-
16	-	-	-	-	-	98.224	98.121	98.104	-	-	-	-
17	-	-	-	-	-	98.214	98.117	98.095	-	-	-	-
18	-	-	-	-	-	98.219	98.102	98.072	-	-	-	-
19	-	-	-	-	-	98.205	98.092	98.064	-	-	-	-
20	-	-	-	-	-	98.184	98.096	98.076	-	-	-	-
21	-	-	-	-	-	98.179	98.088	98.100	-	-	-	-
22	-	-	-	-	-	98.168	98.073	98.095	-	-	-	-
23	-	-	-	-	-	98.156	98.071	98.072	-	-	-	-
24	-	-	-	-	-	98.144	98.068	98.077	-	-	-	-
25	-	-	-	-	-	98.132	98.067	98.082	-	-	-	-
26	-	-	-	-	-	98.120	98.059	98.084	-	-	-	-
27	-	-	-	-	-	98.113	98.049	98.083	-	-	-	-
28	-	-	-	-	-	98.109	98.054	98.078	-	-	-	-
29	-	-	-	-	-	98.098	98.060	98.087	-	-	-	-
30	-	-	-	-	-	98.073	98.076	98.084	-	-	-	-
31	-	-	-	-	-	-	98.084	98.077	-	-	-	-
MIN	-	-	-	-	-	98.073	98.049	98.028	98.072	-	-	-
MEAN	-	-	-	-	-	98.193	98.083	98.084	98.084	-	-	-
MAX	-	-	-	-	-	98.366	98.151	98.121	98.108	-	-	-

Note: Elevation based on local benchmark elevation of 100.304 m (non-geodetic); P = partial daily average.

Table A4-8: Lake A1 Outlet Discharge Measurement Field Form for 11 June 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**11-Jun-2009**	
Waterbody:		Lake A1			**Start Time**		11:10	
Crossing ID:		Lake A1 Outlet			**End Time**		11:23	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1353**			
East	544479	BM_read	0.915	Gauge	**Transducer SN: 21912**			
North	6985918	WL_read	2.835	0.304	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.304	WL_Elev	98.384		**Crew:**	JL/MI		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.0	0.00						
2	0.0	0.16		0.06				
3	0.2	0.14		0.18				
4	0.7	0.16		0.25				
5	1.2	0.18		0.06				
6	1.7	0.11		0.03				
7	2.2	0.13		0.01				
8	2.7	0.10		0.05				
9	3.2	0.16		0.33				
10	3.7	0.28		0.15				
11	4.2	0.14		0.31				
12	4.7	0.10		0.50				
13	5.2	0.45		0.90				
14	5.7	0.50		0.99				
15	6.2	0.43		0.57				
16	6.7	0.36		0.29				
17	7.2	0.12		0.23				
18	7.7	0.10		0.13				
19	8.2	0.28		0.05				
20	8.7	0.18		0.01				
21	9.2	0.06						
22	9.4	0.00						
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.787	
34						A(m^2)	1.97	
35						B(m)	9.4	

Table A4-9: Lake A1 Outlet Discharge Measurement Field Form for 9 July 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**09-Jul-2009**	
Waterbody:		Lake A1			**Start Time**		13:33	
Crossing ID:		Lake A1 Outlet			**End Time**		13:53	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1353**			
East	544479	BM_read	0.99	Gauge	**Transducer SN: 21912**			
North	6985918	WL_read	3.24	0.034	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.304	WL_Elev	98.054		**Crew:**	DC/IL		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.1	0.00						
2	0.2	0.08		0.10				
3	0.3	0.12		0.11				
4	0.4	0.12		0.17				
5	0.5	0.12		0.57				
6	0.6	0.12		0.43				
7	0.7	0.13		0.32				
8	0.8	0.10		0.25				
9	0.9	0.08		0.21				
10	1.0	0.10		0.20				
11	1.1	0.06		0.12				
12	1.2	0.00						
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.027	
34						A(m^2)	0.10	
35						B(m)	1.1	

Table A4-10: Lake A1 Outlet Discharge Measurement Field Form for 4 August 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**04-Aug-2009**	
Waterbody:		Lake A1			**Start Time**		16:10	
Crossing ID:		Lake A1 Outlet			**End Time**		16:50	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1353**			
East	544479	BM_read	0.363	Gauge	**Transducer SN: 21912**			
North	6985918	WL_read	2.590	0.050	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.304	WL_Elev	98.077		**Crew:**	DC/MI		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)		VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)		DEPTH (m)	0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.1	0.00						
2	0.1	0.03		0.00				
3	0.2	0.08		0.05				
4	0.3	0.10		0.11				
5	0.4	0.12		0.30				
6	0.5	0.12		0.54				
7	0.6	0.12		0.43				
8	0.7	0.12		0.33				
9	0.8	0.08		0.21				
10	0.9	0.08		0.18				
11	1.0	0.06		0.11				
12	1.1	0.00						
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.024	
34						A(m^2)	0.090	
35						B(m)	1.1	

Table A4-11: Lake A1 Outlet Discharge Measurement Field Form for 10 September 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**10-Sep-2009**	
Waterbody:		Lake A1			**Start Time**		16:20	
Crossing ID:		Lake A1 Outlet			**End Time**		17:05	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1353**			
East	544479	BM_read	0.202	Gauge	**Transducer SN: 21912**			
North	6985918	WL_read	2.375	0.110	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.304	WL_Elev	98.131		**Crew:**	DC/OK		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.3	0.00						
2	0.4	0.00						
3	0.5	0.09		0.174				
4	0.6	0.00						
5	0.7	0.13		0.158				
6	0.8	0.11		0.256				
7	0.9	0.14		0.262				
8	1.0	0.14		0.405				
9	1.1	0.16		0.408				
10	1.2	0.16		0.369				
11	1.3	0.20		0.323				
12	1.4	0.18		0.290				
13	1.5	0.16		0.378				
14	1.6	0.16		0.335				
15	1.7	0.16		0.411				
16	1.8	0.14		0.357				
17	1.9	0.10		0.259				
18	2.0	0.09		0.232				
19	2.2	0.00						
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.069	
34						A(m^2)	0.217	
35						B(m)	1.9	

LAKE B2 AND OUTLET HYDROMETRIC STATION

B2
FACTSHEET

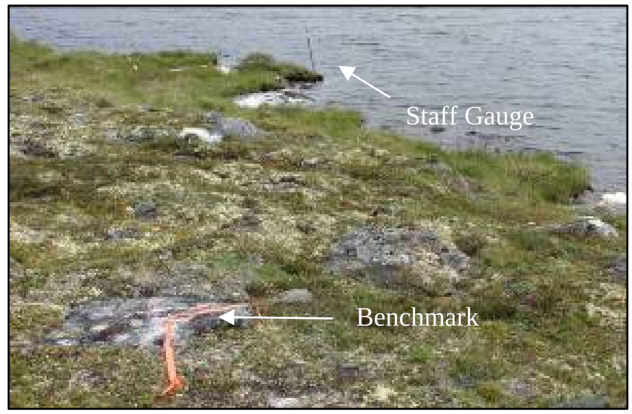
LOCATION AND DETAILS

Located approximately 5.4 kilometres southwest of Meliadine West Camp.

Operational:	1997	1998	1999	2000	2008	2009
		8/6-24/9	14/6-20/9	16/6-18/9	15/6-16/9	11/6-10/9

Benchmark:	Bolt on boulder; 100.080 m (non-geodetic)	Drainage Area:	20.3 km^2
Coordinates:	UTM: 537375 m E, 6986232 m N (NAD83, Zn15)	Lat/Long:	63°00'13" N, 92°15'43" W
Transducer:	Keller Acculevel Submersible Level Transducer	Datalogger:	Optimum Instrument DD-520

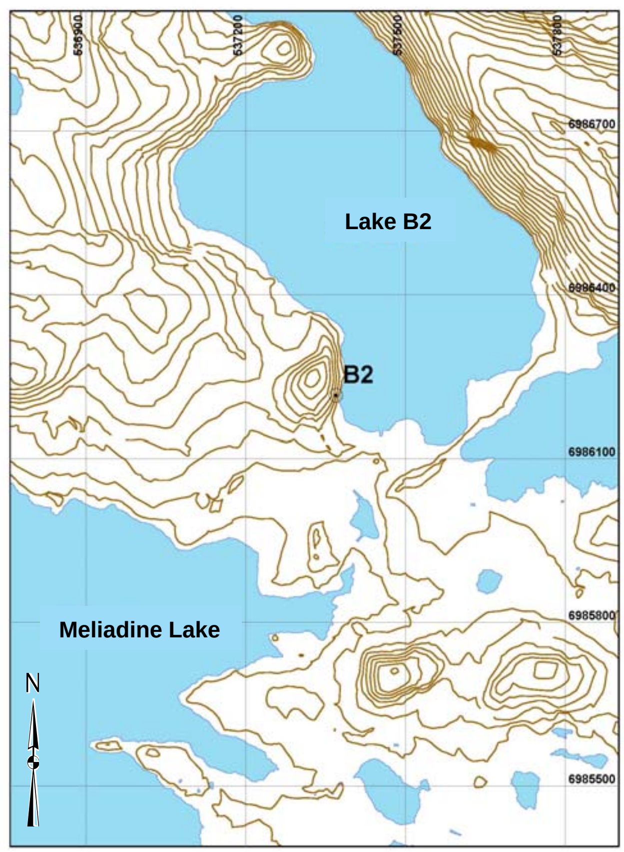
View of Lake B2 from hydrometric station.



Lake B2 from benchmark.


Upstream view of Lake B2 outlet.


Lake B2 from outlet.



NTS Mapping of Area.

FACT-B2-2009.DOC

A4 - 5.0 LAKE B2 AND OUTLET

The Lake B2 and Outlet hydrometric station was visited 4 times during the 2009 field program, and a continuous hydrograph was derived for the period of 11 June to 10 September 2009 based on continuous logger data. Details of each site visit are provided in Table A4-12 and water level measurements in Table A4-13. The hydrographs and stage-discharge rating curve for Lake B2 and Outlet in 2009 are presented in Figures A4-6 and A4-7. Mean daily data are presented in Tables A4-14 and A4-15 and raw data in Tables A4-16 to A4-19.

Table A4-12: Site Visits to Lake B2 and Outlet Hydrometric Station, 2009

Date	Activities	Lake	Lake Water Surface Elevation (m; non-geodetic)	Outlet	Discharge (m^3/s)
11 Jun	Installed pressure transducer and data logger. Measured discharge and water surface elevation.	✓	97.780	✓	0.105
9 Jul	Measured discharge and water surface elevation and downloaded data logger.	✓	97.780	✓	0.153
4 Aug	Measured discharge and water surface elevation and downloaded data logger.	✓	97.740	✓	0.075
10 Sep	Measured discharge and water surface elevation and downloaded data logger. Removed pressure transducer and data logger.	✓	97.762	✓	0.093

Water level surveys were performed during each visit, and the measurements are provided in Table A4-10.

Table A4-13: Lake B2 Water Level Survey Measurements (m), 2009

Date and Time	BM Reading	WS Reading	BM Elevation	WS Elevation	Transducer Reading	Transducer Elevation	Average Transducer Elevation	Stage	Staff Gauge Reading
11-Jun 13:50	0.675	1.545	98.650	97.780	0.579	97.201	97.191	0.350	0.599
09-Jul 10:30	0.585	2.885	100.080	97.780	0.576	97.204		0.350	0.545
04-Aug 17:30	0.227	2.567	100.080	97.740	0.575	97.165		0.310	0.490
10-Sep-13:45	0.464	2.782	100.080	97.762	0.566	97.196		0.332	0.510

Note: Due to ice and snow cover a temporary benchmark was used during the June survey
BM= benchmark; WS= water surface

Following the analysis of the Lake B2 water level surveys measured during the 2009 field season it was found that during the winter 2008 – 2009 a shift of 7 cm in the stage datum took place. A possible cause for this shift can be the ice effect over the boulder that was used as a benchmark. In future years, field measurements should compare the benchmark elevation to other features of the landscape, including the lake outlet cross-section.

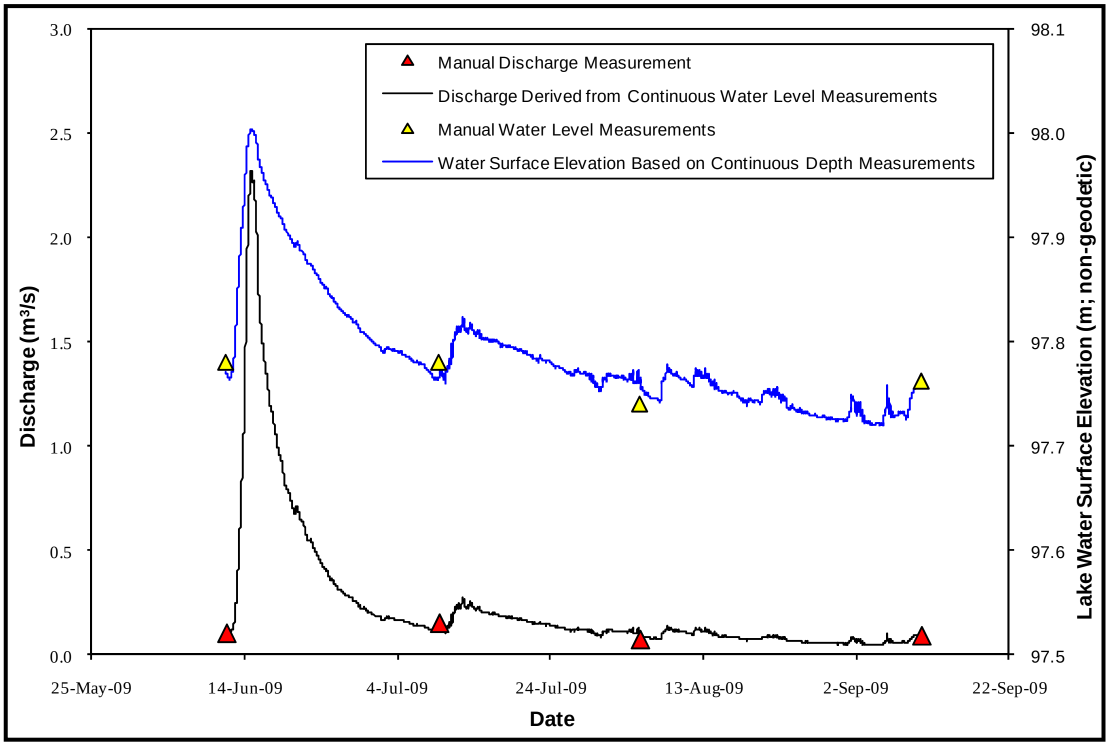


Figure A4-5: Hydrograph for Lake B2 and Outlet, 2009

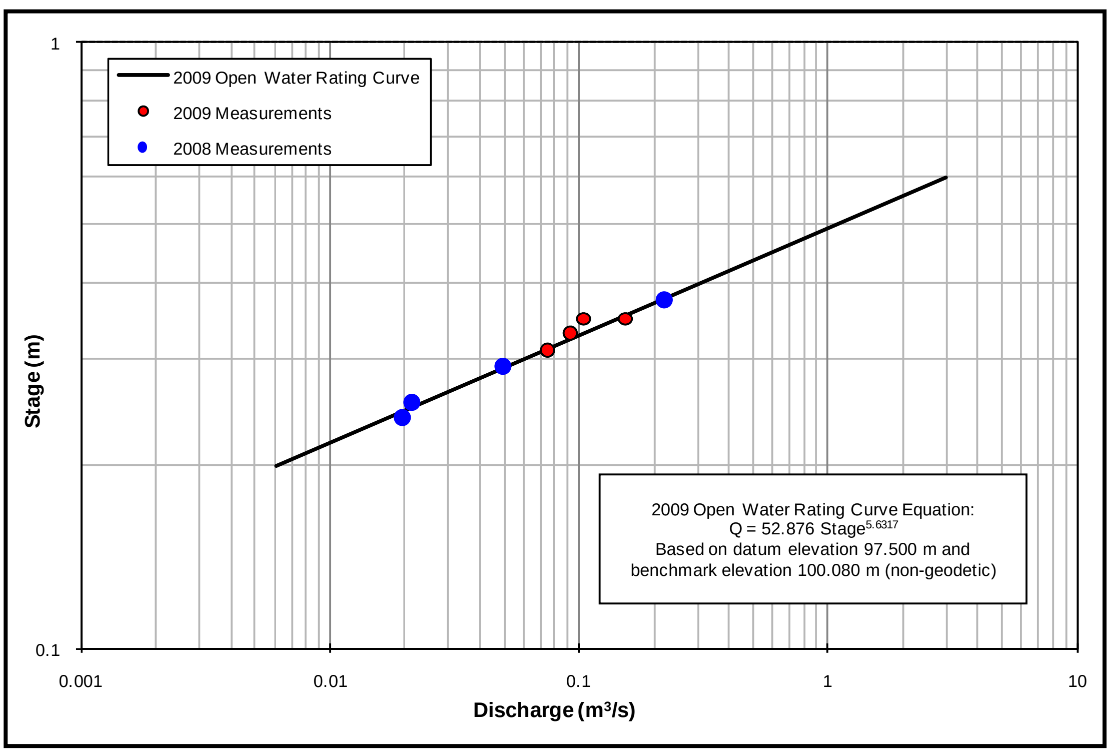


Figure A4-6: Lake B2 Outlet Stage-Discharge Rating Curve, 2009

Table A4-14: Lake B2 Outlet Mean Daily Discharge (m^3/s), 2009

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	0.182	0.115	0.071	-	-	-
2	-	-	-	-	-	-	0.175	0.112	0.066	-	-	-
3	-	-	-	-	-	-	0.173	0.113	0.052	-	-	-
4	-	-	-	-	-	-	0.165	0.106	0.051	-	-	-
5	-	-	-	-	-	-	0.154	0.087	0.059	-	-	-
6	-	-	-	-	-	-	0.144	0.080	0.066	-	-	-
7	-	-	-	-	-	-	0.135	0.092	0.060	-	-	-
8	-	-	-	-	-	-	0.117	0.125	0.061	-	-	-
9	-	-	-	-	-	-	0.118	0.117	0.089	-	-	-
10	-	-	-	-	-	-	0.131	0.108	0.101 P	-	-	-
11	-	-	-	-	-	0.117 P	0.208	0.103	-	-	-	-
12	-	-	-	-	-	0.160	0.242	0.121	-	-	-	-
13	-	-	-	-	-	0.736	0.235	0.114	-	-	-	-
14	-	-	-	-	-	1.997	0.219	0.100	-	-	-	-
15	-	-	-	-	-	2.027	0.203	0.090	-	-	-	-
16	-	-	-	-	-	1.450	0.198	0.088	-	-	-	-
17	-	-	-	-	-	1.173	0.188	0.084	-	-	-	-
18	-	-	-	-	-	0.975	0.183	0.077	-	-	-	-
19	-	-	-	-	-	0.804	0.176	0.077	-	-	-	-
20	-	-	-	-	-	0.702	0.168	0.079	-	-	-	-
21	-	-	-	-	-	0.638	0.158	0.089	-	-	-	-
22	-	-	-	-	-	0.549	0.151	0.089	-	-	-	-
23	-	-	-	-	-	0.478	0.146	0.078	-	-	-	-
24	-	-	-	-	-	0.412	0.138	0.068	-	-	-	-
25	-	-	-	-	-	0.355	0.130	0.065	-	-	-	-
26	-	-	-	-	-	0.309	0.121	0.062	-	-	-	-
27	-	-	-	-	-	0.282	0.124	0.059	-	-	-	-
28	-	-	-	-	-	0.255	0.120	0.058	-	-	-	-
29	-	-	-	-	-	0.223	0.109	0.057	-	-	-	-
30	-	-	-	-	-	0.201	0.099	0.055	-	-	-	-
31	-	-	-	-	-	-	0.115	0.054	-	-	-	-
MIN	-	-	-	-	-	0.117	0.099	0.054	0.051	-	-	-
MEAN	-	-	-	-	-	0.692	0.159	0.088	0.068	-	-	-
MAX	-	-	-	-	-	2.027	0.242	0.125	0.101	-	-	-

Note: P = partial daily average

Table A4-15: Lake B2 Mean Daily Water Surface Elevation (m), 2009

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	97.795	97.767	97.739	-	-	-
2	-	-	-	-	-	-	97.793	97.765	97.735	-	-	-
3	-	-	-	-	-	-	97.792	97.765	97.723	-	-	-
4	-	-	-	-	-	-	97.789	97.761	97.721	-	-	-
5	-	-	-	-	-	-	97.784	97.751	97.727	-	-	-
6	-	-	-	-	-	-	97.780	97.746	97.734	-	-	-
7	-	-	-	-	-	-	97.776	97.753	97.730	-	-	-
8	-	-	-	-	-	-	97.768	97.772	97.731	-	-	-
9	-	-	-	-	-	-	97.768	97.768	97.751	-	-	-
10	-	-	-	-	-	-	97.774	97.763	97.759 P	-	-	-
11	-	-	-	-	-	97.768 P	97.803	97.760	-	-	-	-
12	-	-	-	-	-	97.784	97.814	97.769	-	-	-	-
13	-	-	-	-	-	97.893	97.812	97.766	-	-	-	-
14	-	-	-	-	-	97.988	97.807	97.758	-	-	-	-
15	-	-	-	-	-	97.990	97.802	97.752	-	-	-	-
16	-	-	-	-	-	97.958	97.801	97.751	-	-	-	-
17	-	-	-	-	-	97.938	97.797	97.748	-	-	-	-
18	-	-	-	-	-	97.922	97.795	97.743	-	-	-	-
19	-	-	-	-	-	97.905	97.793	97.744	-	-	-	-
20	-	-	-	-	-	97.894	97.790	97.745	-	-	-	-
21	-	-	-	-	-	97.886	97.786	97.751	-	-	-	-
22	-	-	-	-	-	97.874	97.783	97.751	-	-	-	-
23	-	-	-	-	-	97.864	97.781	97.744	-	-	-	-
24	-	-	-	-	-	97.852	97.778	97.736	-	-	-	-
25	-	-	-	-	-	97.841	97.774	97.734	-	-	-	-
26	-	-	-	-	-	97.831	97.770	97.732	-	-	-	-
27	-	-	-	-	-	97.825	97.771	97.729	-	-	-	-
28	-	-	-	-	-	97.818	97.769	97.728	-	-	-	-
29	-	-	-	-	-	97.809	97.763	97.727	-	-	-	-
30	-	-	-	-	-	97.802	97.758	97.725	-	-	-	-
31	-	-	-	-	-	-	97.767	97.725	-	-	-	-
MIN	-	-	-	-	-	97.768	97.758	97.725	97.721	-	-	-
MEAN	-	-	-	-	-	97.872	97.785	97.749	97.735	-	-	-
MAX	-	-	-	-	-	97.990	97.814	97.772	97.759	-	-	-

Note: Elevation based on local benchmark elevation of 100.080 m (non-geodetic); P = partial daily average

Table A4-16: Lake B2 Outlet Discharge Measurement Field Form for 11 June 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**11-Jun-2009**	
Waterbody:		Lake B2			**Start Time**		13:42	
Crossing ID:		Lake B2 Outlet			**End Time**		13:52	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1383**			
East	537375	BM_read	0.675	Gauge	**Transducer SN: 25889**			
North	6986232	WL_read	1.545	0.599	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.08	WL_Elev	99.210		**Crew:**	JL/MI		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.0	0.00						
2	0.0	0.17		0.27				
3	0.2	0.16		0.55				
4	0.4	0.16		0.44				
5	0.6	0.22		0.35				
6	0.8	0.23		0.01				
7	1.0	0.18		0.04				
8	1.2	0.08		0.40				
9	1.4	0.20		0.27				
10	1.6	0.18		0.15				
11	1.8	0.20		0.27				
12	2.0	0.15		0.17				
13	2.2	0.11		0.26				
14	2.4	0.1		0.17				
15	2.6	0.12		0.13				
16	2.8	0.00						
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.105	
34						A(m^2)	0.44	
35						B(m)	2.8	

Table A4-17: Lake B2 Outlet Discharge Measurement Field Form for 9 July 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**09-Jul-2009**	
Waterbody:		Lake B2			**Start Time**		10:26	
Crossing ID:		Lake B2 Outlet			**End Time**		10:41	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1383**			
East	537375	BM_read	1.578	Gauge	**Transducer SN: 25889**			
North	6986232	WL_read	2.142	0.540	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.08	WL_Elev	99.516		**Crew:**	DC/LI		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.4	0.00						
2	0.6	0.15		0.11				
3	0.8	0.16		0.24				
4	1.0	0.24		0.44				
5	1.2	0.26		0.53				
6	1.4	0.28		0.46				
7	1.6	0.25		0.42				
8	1.8	0.23		0.44				
9	1.9	0.21		0.46				
10	2.0	0.20		0.42				
11	2.1	0.18		0.60				
12	2.2	0.14		0.14				
13	2.3	0.10		0.01				
14	2.5	0.00						
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.153	
34						A(m^2)	0.391	
35						B(m)	2.1	

Table A4-18: Lake B2 Outlet Discharge Measurement Field Form for 4 August 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**		**04-Aug-2009**	
Waterbody:		Lake B2			**Start Time**		17:05	
Crossing ID:		Lake B2 Outlet			**End Time**		17:50	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1383**			
East	537375	BM_read	0.227	Gauge	**Transducer SN: 25889**			
North	6986232	WL_read	2.567	49 cm	**Meter Type/SN: Marsh McBirney-2005856**			
Elevation	100.08	WL_Elev	97.74		**Crew:**	DC/MI		
STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.1	0.00						
2	0.3	0.11		0.101				
3	0.5	0.11		0.186				
4	0.6	0.18		0.223				
5	0.7	0.20		0.265				
6	0.8	0.20		0.293				
7	0.9	0.21		0.384				
8	1.0	0.22		0.341				
9	1.1	0.20		0.369				
10	1.2	0.20		0.363				
11	1.3	0.18		0.341				
12	1.4	0.17		0.399				
13	1.5	0.14		0.415				
14	1.6	0.14		0.247				
15	1.7	0.12		0.104				
16	1.9	0.00						
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.075	
34						A(m^2)	0.26	
35						B(m)	1.8	

Table A4-19: Lake B2 Outlet Discharge Measurement Field Form for 10 September 2009

Project Name:		**Comaplex (09-1373-0010)**			**Date**	**10-Sep-2009**	
Waterbody:		Lake B2			**Start Time**	13:30	
Crossing ID:		Lake B2 Outlet			**End Time**	14:20	
BM GPS Location		**Survey**		Staff	**Datalogger SN: 1383**		
East	537375	BM_read	0.464	Gauge	**Transducer SN: 25889**		
North	6986232	WL_read		54 cm	**Meter Type/SN: Marsh McBirney-2005856**		
Elevation	100.08	WL_Elev	100.544		**Crew:**	DC/MI	

STATION Start LDB	DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY		DISTANCE FROM LDB (m)	DEPTH (m)	VELOCITY	
			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)			0.2 Depth (m/s)	0.6/0.8 Depth (m/s)
1	0.3	0.00						
2	0.5	0.12		0.143				
3	0.7	0.12		0.238				
4	0.8	0.18		0.308				
5	0.9	0.22		0.396				
6	1.0	0.22		0.399				
7	1.1	0.26		0.341				
8	1.2	0.24		0.320				
9	1.3	0.20		0.317				
10	1.4	0.22		0.335				
11	1.5	0.22		0.329				
12	1.6	0.2		0.372				
13	1.7	0.18		0.338				
14	1.8	0.18		0.287				
15	1.9	0.16		0.235				
16	2.0	0.15		0.091				
17	2.2	0.00						
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33					RESULTS:	Q	0.093	
34						A(m^2)	0.31	
35						B(m)	1.9	

LAKE B7 AND OUTLET HYDROMETRIC STATION

B7
FACTSHEET

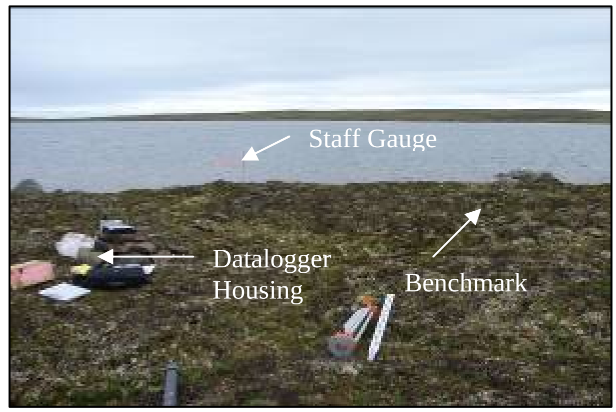
LOCATION AND DETAILS

Located approximately 4 kilometres west of Meliadine West Camp.

Operational:	1997	1998	1999	2000	2008	2009
		7/6-24/9	14/6-20/9	15/6-19/9	16/6-16/9	11/6-10/9

Benchmark:	Bolt on boulder; 100.131 m (non-geodetic)	Drainage Area:	2.39 km^2
Coordinates:	UTM: 537935 m E, 6989488 m N (NAD83, Zn15)	Lat/Long:	63°01'58" N, 92°15'00" W
Transducer:	Keller Acculevel Submersible Level Transducer	Datalogger:	Optimum Instruments DD-520

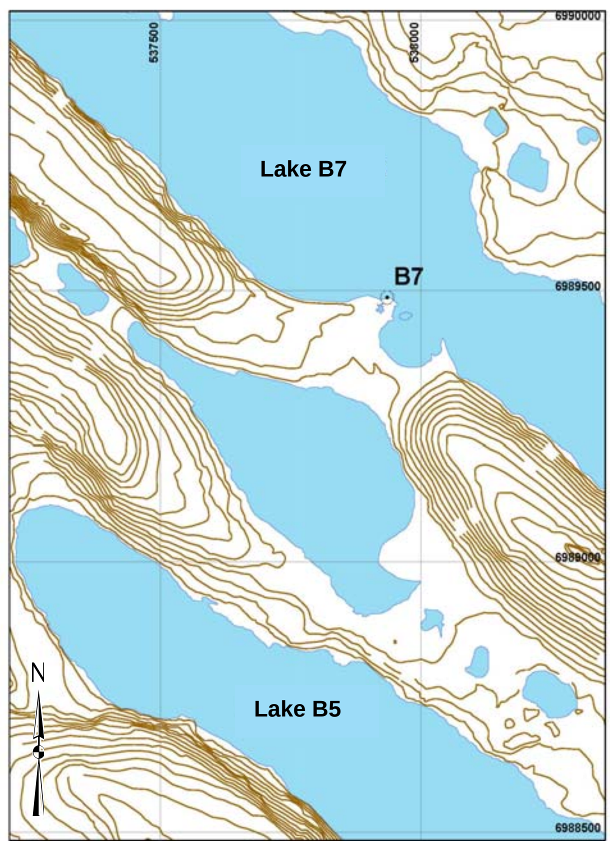
View of Lake B7 from hydrometric station.



Lake B7 hydrometric station.

Lake B7 outlet.

Lake B7 from outlet.



NTS Mapping of Area.

A4 - 6.0 LAKE B7 AND OUTLET

The Lake B7 and Outlet hydrometric station was visited 4 times during the 2009 field program, and a continuous hydrograph was derived for the period of 11 June to 10 September 2009 based on continuous logger data. Details of each site visit are provided in Table A4-20 and water level measurements in Table A4-21. The hydrographs and stage-discharge rating curve for Lake B7 and Outlet in 2009 are presented in Figures A4-8 and A4-9. Mean daily data are presented in Tables A4-22 and A4-23 and raw data in Tables A4-24 to A4-27.

Table A4-20: Site Visits to Lake B7 and Outlet Hydrometric Station, 2009

Date	Activities	Lake	Lake Water Surface Elevation (m; non-geodetic)	Outlet	Discharge (m^3/s)
11 Jun	Installed pressure transducer and data logger. Measured discharge and water surface elevation.	✓	99.681	✓	0.128
9 Jul	Measured discharge and water surface elevation and downloaded data logger.	✓	99.567	✓	0.041
4 Aug	Measured discharge and water surface elevation and downloaded data logger.	✓	99.465	✓	0.011
10 Sep	Measured discharge and water surface elevation and downloaded data logger. Removed pressure transducer and data logger.	✓	99.489	✓	0.030

Water level surveys were performed during each visit and the measurements are provided in Table A4-21.

Table A4-21: Lake B7 Water Level Survey Measurements (m), 2009

Date and Time	BM Reading	WS Reading	BM Elevation	WS Elevation	Transducer Reading	Transducer Elevation	Average Transducer Elevation	Stage	Staff Gauge Reading
11-Jun 17:40	1.475	1.925	100.131	99.681	0.395	99.286	99.272	0.681	0.480
09-Jul 12:10	1.578	2.142	100.131	99.567	0.297	99.270		0.567	
05-Aug 15:30	1.372	2.038	100.131	99.465	0.199	99.266		0.465	
10-Sep-12:45	1.563	2.205	100.131	99.489	0.222	99.267		0.489	

Note: BM= benchmark; WS= water surface

Because of the local conditions of the lake bed, a staff gauge could not be installed and operated properly during the 2009 field season. Also, the transducer's location was changed during the second site visit from the main lake to a small bay at the outlet to reduce the wave action effect on the recordings.

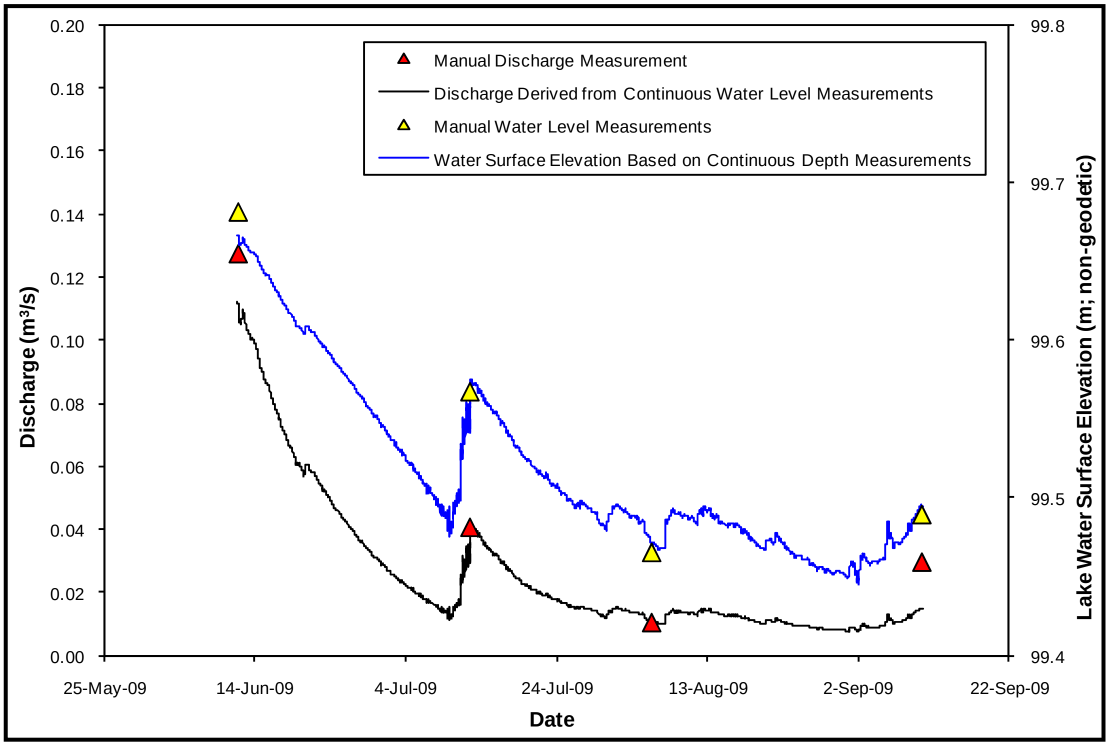


Figure A4-7: Hydrograph for Lake B7 and Outlet, 2009

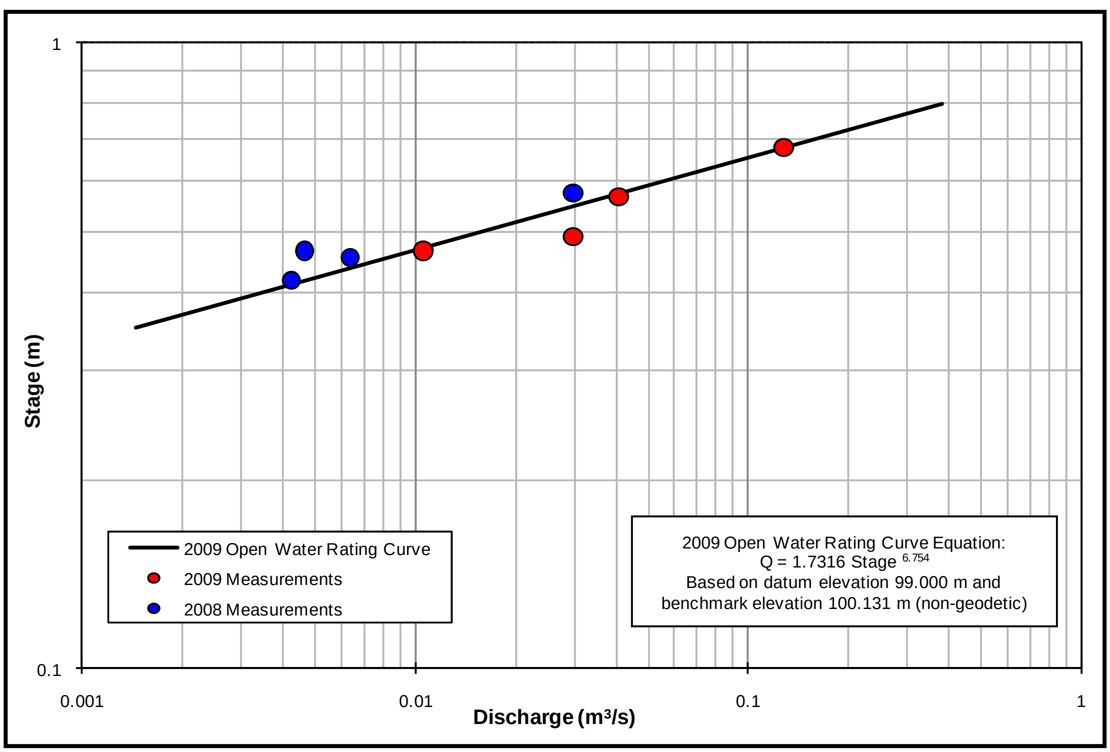


Figure A4-8: Lake B7 Outlet Stage-Discharge Rating Curve, 2009

Table A4-22: Lake B7 Outlet Mean Daily Discharge (m^3/s), 2009

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	0.028	0.015	0.008	-	-	-
2	-	-	-	-	-	-	0.025	0.014	0.009	-	-	-
3	-	-	-	-	-	-	0.023	0.014	0.009	-	-	-
4	-	-	-	-	-	-	0.021	0.013	0.009	-	-	-
5	-	-	-	-	-	-	0.020	0.011	0.010	-	-	-
6	-	-	-	-	-	-	0.018	0.010	0.011	-	-	-
7	-	-	-	-	-	-	0.017	0.012	0.011	-	-	-
8	-	-	-	-	-	-	0.015	0.014	0.012	-	-	-
9	-	-	-	-	-	-	0.014	0.014	0.014 P	-	-	-
10	-	-	-	-	-	-	0.015	0.014	-	-	-	-
11	-	-	-	-	-	0.109 P	0.024	0.013	-	-	-	-
12	-	-	-	-	-	0.106	0.036	0.014	-	-	-	-
13	-	-	-	-	-	0.101	0.039	0.014	-	-	-	-
14	-	-	-	-	-	0.094	0.035	0.013	-	-	-	-
15	-	-	-	-	-	0.087	0.033	0.013	-	-	-	-
16	-	-	-	-	-	0.080	0.030	0.013	-	-	-	-
17	-	-	-	-	-	0.073	0.028	0.012	-	-	-	-
18	-	-	-	-	-	0.067	0.025	0.011	-	-	-	-
19	-	-	-	-	-	0.062	0.023	0.011	-	-	-	-
20	-	-	-	-	-	0.059	0.022	0.010	-	-	-	-
21	-	-	-	-	-	0.059	0.020	0.011	-	-	-	-
22	-	-	-	-	-	0.055	0.019	0.011	-	-	-	-
23	-	-	-	-	-	0.051	0.018	0.010	-	-	-	-
24	-	-	-	-	-	0.047	0.017	0.010	-	-	-	-
25	-	-	-	-	-	0.044	0.016	0.009	-	-	-	-
26	-	-	-	-	-	0.041	0.015	0.009	-	-	-	-
27	-	-	-	-	-	0.038	0.015	0.009	-	-	-	-
28	-	-	-	-	-	0.035	0.015	0.008	-	-	-	-
29	-	-	-	-	-	0.032	0.013	0.008	-	-	-	-
30	-	-	-	-	-	0.030	0.013	0.008	-	-	-	-
31	-	-	-	-	-	-	0.015	0.008	-	-	-	-
MIN	-	-	-	-	-	0.030	0.013	0.008	0.008	-	-	-
MEAN	-	-	-	-	-	0.064	0.021	0.012	0.010	-	-	-
MAX	-	-	-	-	-	0.109	0.039	0.015	0.014	-	-	-

Note: P = partial daily average