

GPR - Profile Jamie-12

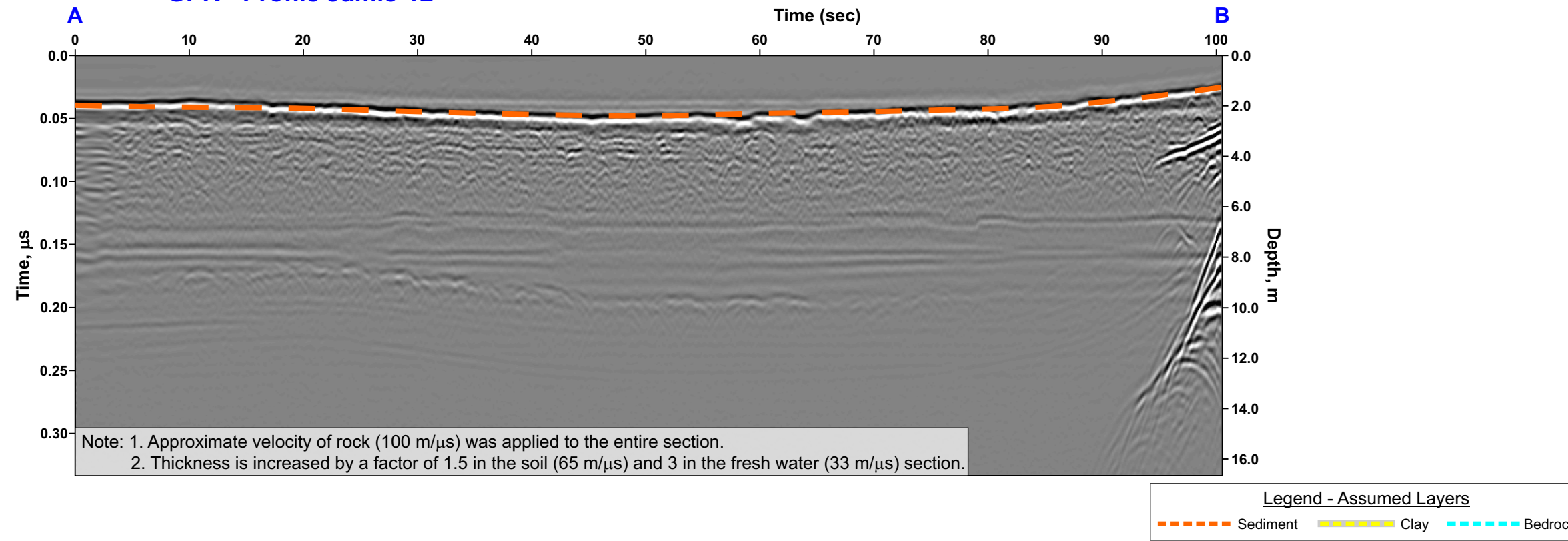


Figure E39 Ground penetrating radar survey on water (lake) surface using 170 MHz antenna for Profile Jamie-12 at the Springpole site, ON (Page 1 of 1).

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|----------------------------|---------------------------------------|
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| Location Springpole, ON | Date February 2021 |



Attachment C Meteorology Report

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Revision Number C

First Mining Gold Corp. Springpole Gold Project

Meteorology Report

December 3, 2020

December 3, 2020



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1 Executive summary

First Mining is a Canadian gold developer focused on the development and permitting of the Springpole Gold Project (the "Project") in northwestern Ontario. Springpole is one of the largest undeveloped gold projects in Canada, currently hosting a mineral resource base of 4.67 million ounces of "indicated" gold and 0.23 million ounces of "inferred" gold. The Project is situated in the Red Lake Mining District of northwestern Ontario, approximately one hundred-and ten-kilometres northeast of the Town of Red Lake.

The region of the Springpole Gold Project experiences a humid continental climate with cold winters and warm summers. In general, the coldest month is January with a mean temperature of -17 °C and the warmest month is July with a mean temperature of 18.7 °C. This is consistent with temperatures of Casummit Lake and the on-site project meteorological stations in 2012.

The climate change analysis for the average temperatures in the Project area showed positive slopes for all considered scenarios indicating an increase in future temperature values.

Monthly atmospheric pressure data displays a minor seasonal pattern along with small variations month to month. The 2012 Casummit Lake and Springpole data have similar monthly trends. However, Casummit Lake atmospheric data is approximately 7 kPa higher than that of Springpole, which cannot be explained by elevation differences between the two sites.

Relative humidity data from the two meteorological stations displayed a moderately humid climate with seasonal variability. The average monthly relative humidity ranges from 59.1% to 95.3%. The region is less humid in the late spring through summer and more humid in the autumn and winter.

The total precipitation in 2012 at Casummit Lake was 444.9 mm, and 476.8 mm at Springpole Lake, a difference of less than 7%. In 2012, the total precipitation for the two stations showed a similar pattern for the two stations except for summer months (between May and September) when Casummit Lake showed a decreasing trend while Springpole Lake showed an abrupt increase in July-August due to rainfall (refer to Figure 4.16). The long-term data from Casummit was utilized for project climate conditions.

Snow depths appear larger at Springpole than Casummit Lake, but their yearly trends are very similar. Values of Casummit Lake (2008-2020) were used to estimate the snow water equivalent which allowed, at the same time, to estimate the total rainfall. Results are consistent with the expected behaviour influenced by seasonal climate. In the last two years (2019 and 2020), there has been a noticeable increase in total precipitation compared with previous years, mainly influenced by rainfall.

In development of total precipitation for both wet and dry years, different return periods and rainfall intensity and duration curves, a probabilistic analysis was carried out using the Casummit Lake station data (as being representative for the Project). The probabilistic distribution that best fit the data set was Pearson III, which had the best graphical adjustment among all analysed distributions.

Climate change analyses for the rainfall indicated the following:

- For the Representative Concentration Pathway, RCP8.5, scenario (unfavourable or worst-case scenario), the rainfall showed a negative slope for the immediate future which is in agreement with the negative slope for the Casummit Lake rainfall data for 2009-2018. For the near future and far future, however, the rainfall shows positive slopes indicating an increase in the rainfall, and
- For the Representative Concentration Pathway, RCP4.5, scenario (favourable scenario), the rainfall showed positive slopes for the immediate future and near future indicating an increase in the rainfall. For the distant future, however, a negative slope was observed indicating a decrease in the rainfall.

In terms of wind, Casummit Lake data shows a multimodal behaviour of wind, but with the west as the predominant wind direction. Even though there are reported velocities more than 8 m/s, frequency analysis shows that the area is mostly light wind and light breeze (1.8-3.3 and 3.3-5.4 m/s, respectively).

In the absence of any pan evaporation information for the study area or other regional climate stations, the lake evaporation was estimated by applying the monthly distribution of the evapotranspiration (ET) obtained in this study to the value of the Mean Annual Lake Evaporation obtained the Hydrology Atlas of Canada for the project. The resulting average monthly evaporation was between 0.8 mm for January and 106.0 mm for July, and 460.0 mm per year for the (2009-2019) period.

No solar radiation data was available for the Casummit Lake station. Therefore, daily average insolation (incident solar radiation) data for the Springpole station (2011 to 2012) was used in estimating the potential evapotranspiration.

The potential evapotranspiration was estimated based on the daily maximum and minimum temperatures of the Casummit Lake station using the Hargreaves method. This resulted in an average monthly potential evapotranspiration was between 1.3 mm for January and 178.7 mm for July and the multi-year potential evapotranspiration was 775.9 mm.

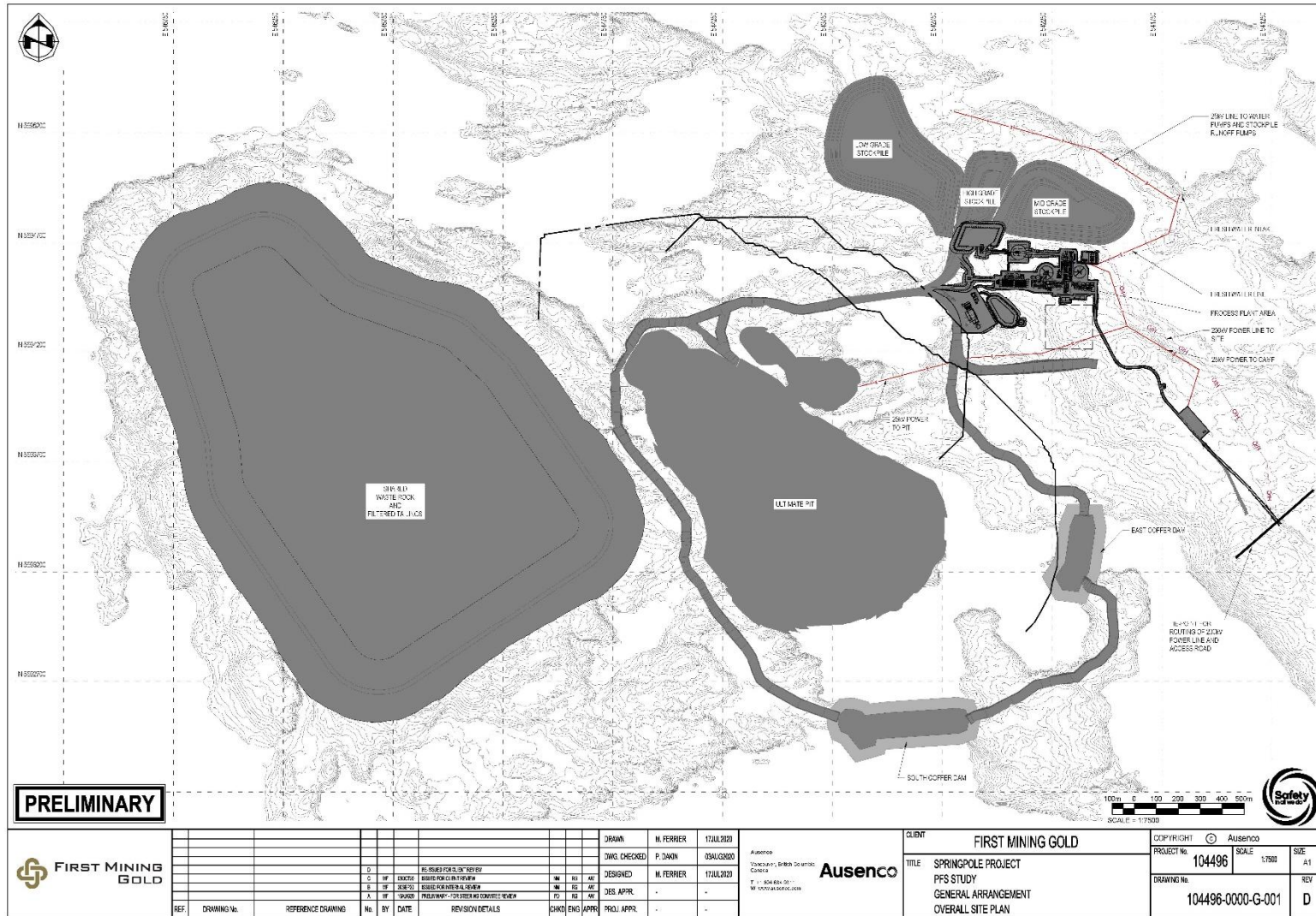
It is recommended that an on-site weather station be installed to collect; rainfall and equivalent rainfall from snow, snow depth, temperature, humidity, barometric pressure, wind speed and direction, solar radiation to understand site metrological condition for future studies. At the time of the preparation of this report, the weather station has been installed.

2 Introduction

2.1 Project Location

The Springpole Gold Project (the Project) is wholly owned by First Mining Gold (FMG) is situated approximately 110 km northeast of Red Lake in northwest Ontario, Canada. The proposed locations for the Project infrastructure are located between Birch Lake and Springpole Lake, as shown in Figure 2.1.

Figure 2.1 Proposed Infrastructure Layout



PRELIMINARY

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2.2 Objectives

To support the Pre-Feasibility Study (PFS) and project permitting, FMG retained Ausenco Engineers Canada Inc. (Ausenco) to prepare a meteorology report gathering publicly available local and regional weather station data and distil the information into site climate conditions.

The main objective of this study is to characterize the meteorology conditions in the Project area for the Pre-Feasibility Study (PFS). Specific objectives include:

- Collecting and interpreting meteorological data in the context of local (using the most representative data available in the absence of any on-site weather stations), regional and global weather for the following parameters:
 - Air Temperature,
 - Atmospheric Pressure,
 - Relative Humidity,
 - Precipitation,
 - Snow Depth and Snow Water Equivalent (SWE),
 - Rainfall,
 - Wind Speed and Direction,
 - Potential Evapotranspiration,
 - Solar Radiation; and
 - Intensity-duration-frequency curves

3 Methodology

Previously meteorology baseline studies were performed in 2011 and 2012 for the Project in support of project planning, environmental assessment and permitting requirements (DST 2013) when meteorological data was collected for the project area using both publicly available data and the Springpole on-site automated meteorological station data. The following is a summary of the methods that were used for the baseline meteorology studies. The study was used as a reference point for this study.

The current study began with a review of publicly available data for the Casummit Lake weather station as well as available data (2011 to 2013) from the weather station located at the Springpole Gold Project.

3.1 Meteorological data

The current meteorology study was conducted to include and consider global climate and weather patterns, regional weather, and local weather conditions (as explained in the next sections. Meteorological data from the Casummit Lake water station was determined to be representative of the Project area in the absence of any active weather stations on-site).

Global weather data was obtained from the United States Department of Commerce National Oceanic and Atmospheric Administration (NOAA 2020). The information gathered from the above source was used to provide a summary of major global weather patterns that occurred

during the studied time period for comparison to regional and local weather trends for the same time period.

On-site meteorological data for 2011 to 2013 was collected from an automated meteorological station installed in September 2011 (DST 2013). This station, referred to as the Springpole station in this report, is located approximately 100 m northwest of the project camp. Meteorological data for Casummit Lake was obtained from World Weather Online (worldweatheronline.com) by FMG and provided to Ausenco. The metadata for the stations included in this study is summarized in Table 3-1 below and their locations.

It should be noted that the Casummit Lake meteorological data included temperature, atmospheric pressure and relative humidity parameters since July 2008, but precipitation, snow and rain parameters, since January 2009. Therefore, the data available for each parameter has been specified separately in this report to avoid confusion.

Table 3-1 Metadata for meteorological stations

| Station name | Springpole | Casummit |
|---------------------------------|----------------|---------------|
| Latitude | 51°23'47.73" N | 51°28'00" N |
| Longitude | 92°17'50.75" W | 92°24'00" W |
| Elevation (masl) ⁽¹⁾ | 409.1 | 399 |
| Distance from project site (km) | 0 | 10 |
| Years of available data | 2011-2012 | 2008/9 - 2020 |

Notes:

1) Meters above sea level

3.2 Data analysis

Hourly, daily, monthly average data for Casummit Lake station were obtained from World Weather Online (worldweatheronline.com). The data was processed, and the results are presented on a monthly basis and are shown in the form of Tables and Graphs in Appendices A and B, respectively. Raw data from the Springpole station provided by FMG was also processed. This data was in agreement with the data presented in the "Meteorology *Base line study report* (DST, 2013)" with some minor differences.

Temperature analyses involved the calculation of the mean daily, mean daily maximum, and mean daily minimum temperatures for each month. Mean atmospheric pressure and mean relative humidity were also calculated for each month. Graphs showing the standard deviation for the monthly mean air temperature, mean relative humidity, and mean air pressure are presented in Appendix B. Atmospheric pressure data at Springpole was recorded in mBar, but converted to the SI unit of kPa (Appendix A). Total precipitation (rain and snow) are also presented on a monthly basis.

Snow depth data was processed along with rain and snow days data to calculate the snow water equivalent (SWE) as explained in section 4.4.4.3. Snow depth and rainfall data are presented in Appendices A and B.

WRPLOT View v8.0.2 software (Lakes Environmental, 2016) was utilized to analyse wind data. In order to import the data into the program, wind speed was converted from km/h to m/s and rounded to the nearest value (10th). Since wind direction data is limited to cardinal points, they were graphed using 18 wind direction groups and 6 wind speed classes based on Beaufort Scale. The wind speed bands were selected to represent equal wind speed ranges across the full range of data. All wind speeds less than 0.5 m/s were considered to be calm winds.

The potential evapotranspiration (ET) was calculated using Hargreaves formula to obtain the daily potential evapotranspiration in mm/day. Since no solar radiation data was available for the Casummit Lake Station for the studied time period (2008-2020), the only relevant data, i.e. Springpole station's daily insolation (daily solar hour) data for 2011 to 2012 was used in this study for estimating the potential evapotranspiration (ET).

In this study, annual values were used to carry out the trend analysis for all meteorological parameters. The main objective of this analysis was to identify whether a positive or negative trend is observed for the meteorological parameter throughout the entire database (historical data). Monthly values were not used in the trend analysis because their cyclicity decreases the trends' slopes when compared with the annual values.

In the trend analysis, values for slopes and annual gradients were calculated and compared for each meteorological parameter. The analysis showed similar values for slopes and annual gradients. Slope values were used in the statistical analyses in this study. It should be noted that slope and annual gradient are not exactly the same since the former is a scalar, but the latter is a vector. However, since the meteorological parameters analysed in this study were monovariates, and therefore, it was possible to use the annual gradient and slope interchangeably, slope values were used in the statistical analysis in this study.

The non-parametric Mann-Kendall trend test was used to detect monotonic trends in the meteorological data collected over time, i.e. for consistently increasing or decreasing trends. If the Mann-Kendall statistic (S) is positive, it indicates that it presents an increasing trend and vice versa. In addition, the P-value (the number of the tied groups in the dataset) lower than 0.05 indicates that the adopted hypothesis has high confidence level and also shows the significance of the series at different probabilities (Pohlert, 2020).

The non-parametric Pettitt test was applied to identify any abrupt change point in the data series. The non-parametric Pettitt test is based on the order of ranges of the values ranges and ignores the normality of the series. This test detects the value of the year "m" when a change in the mean of the series occurs (Pohlert, 2020).

The Buishand test was applied to identify any change in the mean of the series. The Buishand test result does not necessarily coincide with the result of the Pettitt test because the Buishand test is based on the difference between the minimum and maximum values of the series (Pohlert, 2020).

4 Results

4.1 Regional climate

Northern Ontario climate can be described as subarctic (Dfc) according to Koppen Climate Classification System, which generally consists of cold winters and mild summers.

The largest proportion of precipitation falls in the form of summer showers and thunderstorms, although winter snowfall amounts can be substantial (R.A. and F.K., 1974). Precipitation amounts in Northern Ontario decrease as one moves from southeast to northwest, a reflection of the decreasing influence of moisture transported from the Great Lakes and the Gulf of Mexico.

The region is dominated by three major air mass sources: arctic air masses that bring cold and relatively dry air from the north; temperate air masses from the Pacific; and to a smaller extent tropical air masses bring warm moist air from the south.

The local Springpole Gold Project area topography is generally rolling hills and lakes. The area ranges in elevation from 350 to 450 masl with very few barriers to oncoming weather systems. The Springpole Gold Project area is approximately 400 km inland from Lake Superior. Due to this distance, the influence of Lake Superior's moderating effect that results in cooler summer temperatures and warmer winter temperatures for an area along the lakeshore extending inland is expected to be minimal (Phillips, 1978). Hudson Bay, located 600 km to the north may also cause some of the continental characteristics to change, but the general pattern will remain (R.A. and F.K., 1974).

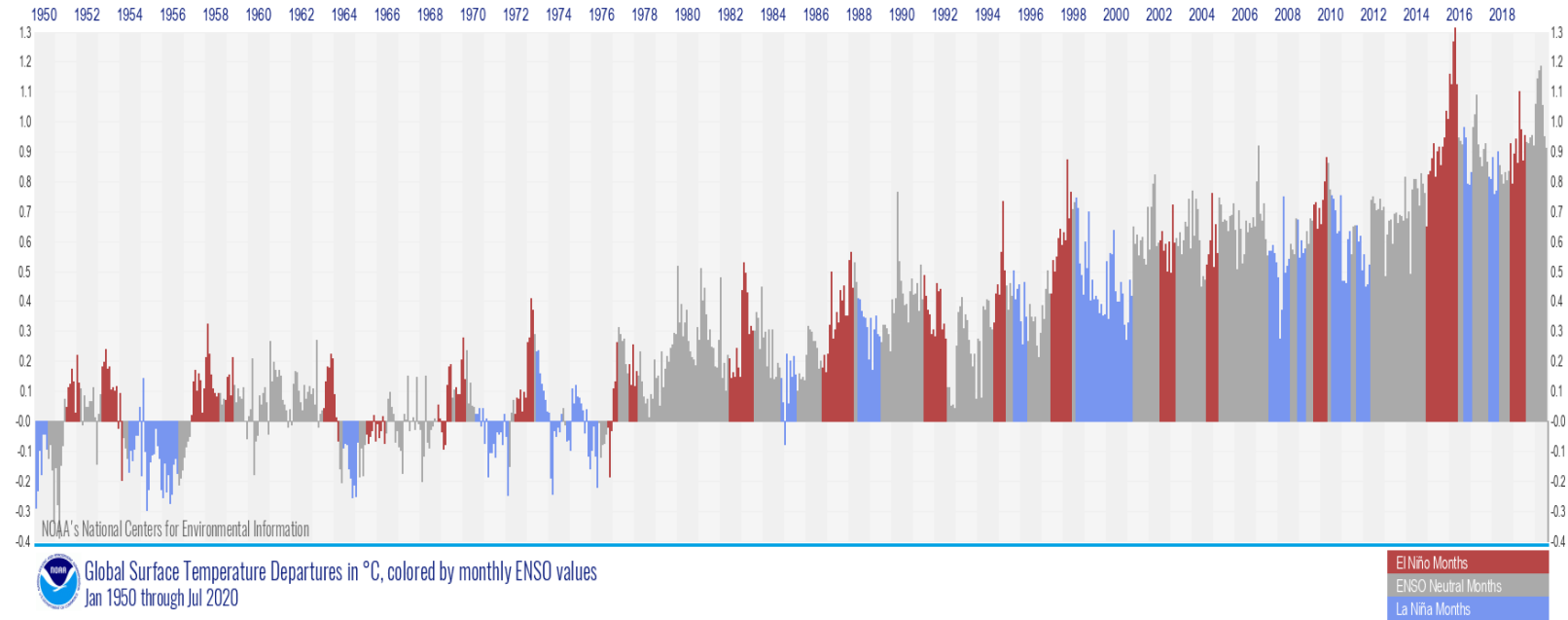
4.2 Global weather

The NOAA Global Climate Report from July 2020 (NOAA, 2020) provides the following information:

- Model predictions and expert assessment indicate that the probability for La Niña development during September-November 2020 is about 60%, for ENSO-neutral conditions continuing is 40%, and for El Niño is near-zero. For December-February 2020/2021 season, the probability for La Niña slightly drops to about 55%, for ENSO-neutral remains at 40%, and for El Niño marginally rises to 5%.
- The July 2020 global land and ocean surface temperature of 0.92°C (1.66°F) above the 20th century average tied with 2016 as the second highest July global temperature since records began in 1880. This value was only 0.01°C (0.02°F) less than the record warm July of 2019. July 2020 was the 44th consecutive July and the 427th consecutive month with temperatures, at least nominally, above the 20th century average. Nine of the 10 warmest Julys on record have occurred since 2010 and six warmest Julys on record have occurred since 2015.
- The global land-only surface temperature for July 2020 was the second highest on record at 1.23°C (2.21°F) above average and only 0.01°C (0.02°F) less than the record-warm July set in 2017. The global ocean-only surface temperature was the third highest on record at 0.80°C (1.44°F) above average. Only July 2016 and 2019 had higher global ocean surface temperatures.

Figure 4.1 shows the monthly global temperature anomalies, i.e. each month compared with its 20th century average since 1950, and influence of the El Niño – Southern Oscillation (ENSO) phenomenon.

Figure 4.1 Global monthly temperature anomalies, with ENSO status (NOAA, 2020)



4.3 Regional weather

In 2019, North America was the only continent that did not have an annual temperature that ranked among the three highest on record. Overall, North America's temperature in 2019 was 0.90°C (1.62°F) above the 1910 to 2000 average, making it the 14th warmest year in the 110-year continental record. The yearly temperature for North America has increased at an average rate of 0.13°C (0.23°F) per decade since 1910. However, the average rate of increase is more than twice (+0.29°C / +0.52°F per decade) since 1981.

Several locations across Canada set new low maximum and minimum January temperature records at the end of the month as cold Arctic air affected the region during January 2019. According to Environment and Climate Change Canada, maximum temperatures during this time did not rise above the -25.0°C (-13.0°F). As a note, Lansdowne House (Ontario) set a new low minimum temperature on January 27 when temperatures plummeted to -47.5°C (-53.5°F), exceeding the previous record set in 1957 (-38.9°C / -38.0°F).

Warmer-than-average temperatures were present across much of Ontario, Canada, with temperatures ranging between 1.0°C–4.0°C (1.8°F–7.2°F) above average. As a note, the Moosonee Airport (800 km to the east at a similar Latitude) had a mean temperature of 19.2°C (66.6°F), which is 3.4°C (6.1°F) above average and the highest mean temperature recorded in the area. Figure 4.2 shows the average temperature for July 2020.

Figure 4.2 Land & Ocean Temperature Departure from Average Jul 2020 (NOAA, 2020)

Land & Ocean Temperature Departure from Average Jul 2020
(with respect to a 1981–2010 base period)

Data Source: NOAA GlobalTemp v5.0.0–20200808

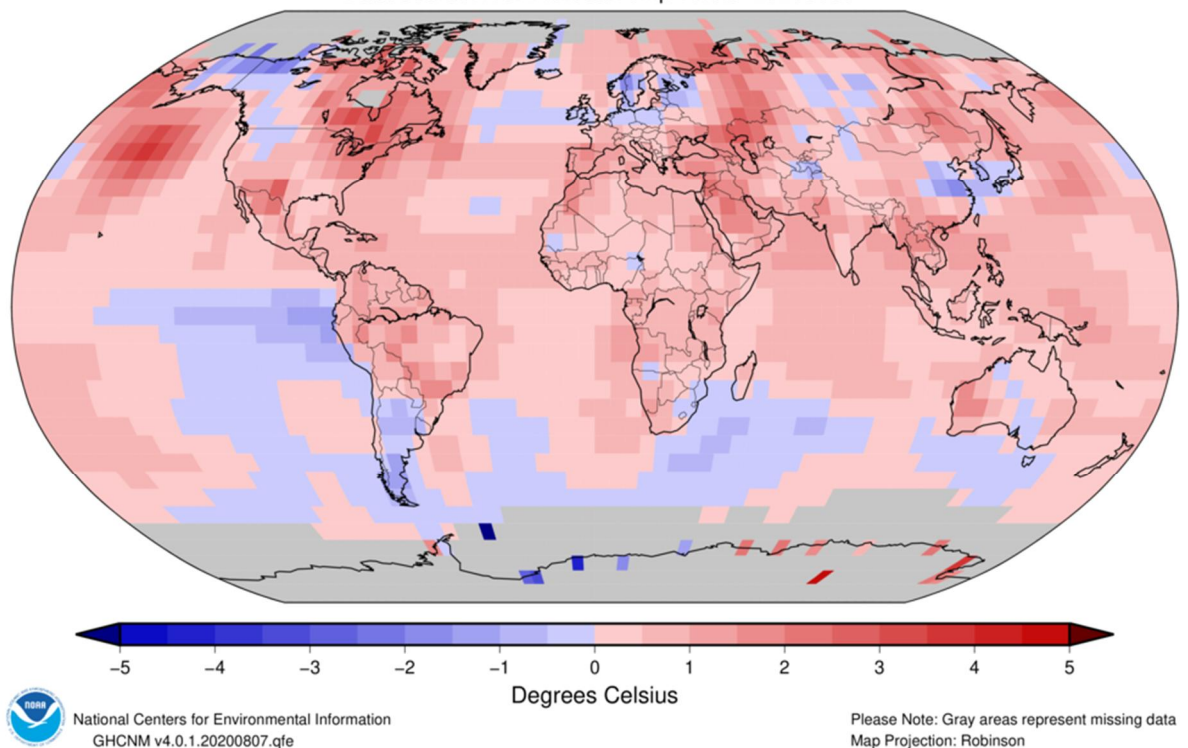


Figure 4.3 and Figure 4.4 present precipitation percent of normal (left, using a base period of 1961–1990) and precipitation percentiles (right, using the period of record) based on the GHCN dataset of land surface stations.

As indicated by the Global Percent of Normal Precipitation and Precipitation Percentiles maps below (see Figure 4.3) and as is typical, many stations were wetter than normal for the year, while many other stations were dry of normal. Also, as discussed below, extreme precipitation and drought events are occurring across the world.

In North America, the southeast and mid-Atlantic U.S. was wet, while the north central U.S. and most of Canada were drier than normal. A small, wetter than normal feature was centered over southern California, right in the midst of the very large negative precipitation anomaly over most of North America and extending into the Pacific off the west coast of the United States.

Figure 4.3 Precipitation Anomalies July 2020 (NOAA, 2020)

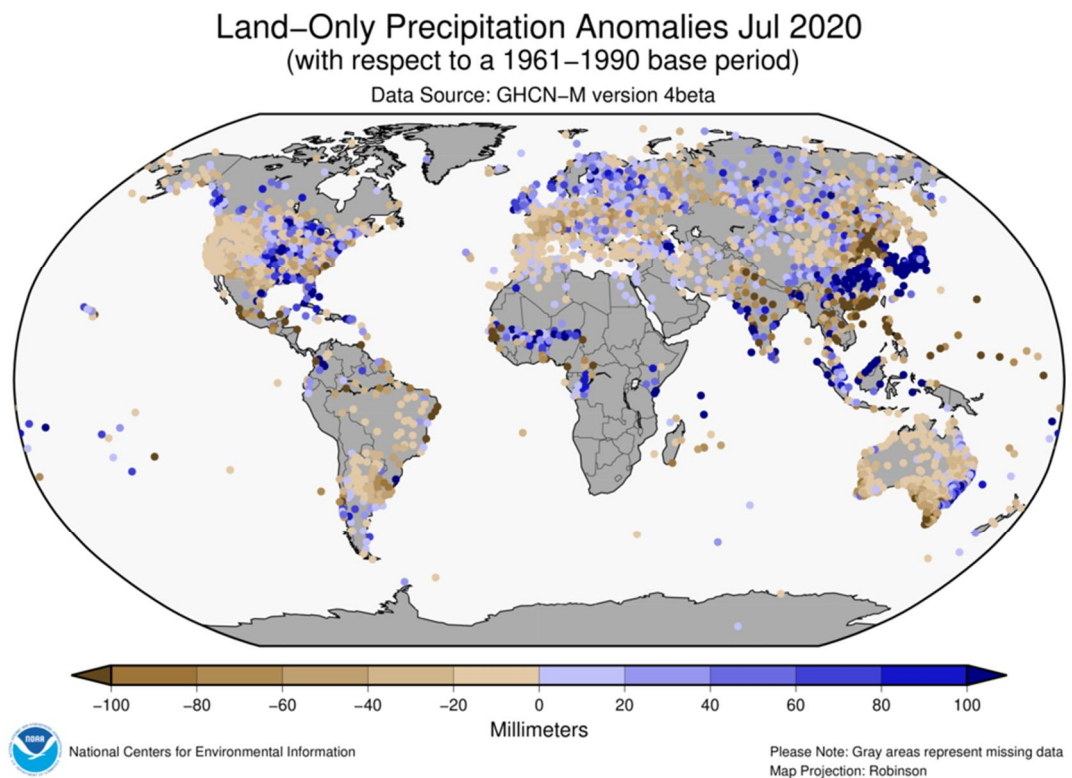
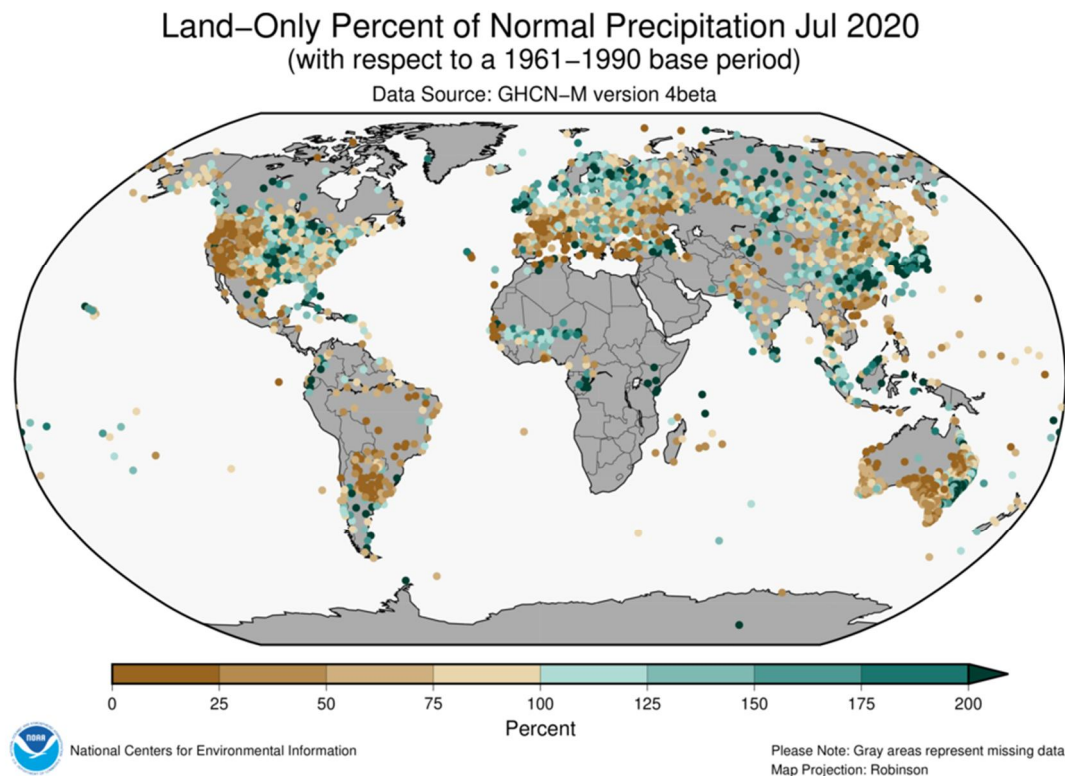


Figure 4.4 Percent of Normal Precipitation July 2020 (NOAA, 2020)



4.4 Local weather

Currently there is no operating weather station at Springpole. Therefore, FMG acquired the meteorological data for the Casummit Lake station from the World Weather Online (worldweatheronline.com) and provided it to Ausenco. Casummit Lake weather station is the closest station to the Project area (approximately 10 km away) known to the project team at the time of this study. In addition, historical data (mid-2011 to mid-2013) from the old weather station located at Springpole was provided by FMG. Ausenco's understanding is that the same data has been used in the meteorology of *2012 Base line study report* (DST, 2013) which has been used as a reference point in the current study. In the following sections, the Casummit Lake data has been compared with Springpole Project's meteorological station (Springpole Station) data. However, the Springpole Station only had a complete data set for 2012 and Ausenco was only able to compare data between the two sites for this small period.

The comparisons between the data available for the two stations presented in this document indicated similar values and patterns between the two stations. Therefore, in the absence of any active weather stations at the Project area, the Casummit Lake climate data (available from mid-2008 to mid-2020) was selected to be representative for the project.

Detailed data analysis and the resulting graphs for Casummit Lake data are presented in Appendices A and B, respectively.

4.4.1 Air temperature

4.4.1.1 Methodology

The air temperature data for the Casummit Lake station was available from 2008 to 2020. In addition, this data has been compared with the available data from the Springpole Station for

2012. This comparison showed the similarity between the Casummit Lake station and Springpole station data, and therefore, justify the use of Casummit Lake Station.

The following parameters – as defined below – have been analysed and presented in this section:

- Mean Daily Minimum Temperatures: The minimum monthly value of the daily average temperatures,
- Mean Daily Maximum Temperatures: The maximum monthly value of the daily average temperature, and
- Mean Monthly Temperatures: The average of daily average temperatures for a given month.

For the period between 2008 to 2020, the above parameters were calculated by taking the average of the values given in the same month of each year.

4.4.1.2 Results and Discussion

In 2012, the air temperature at the Casummit Lake Station ranged from a Minimum of -32 °C on January 19th to a maximum of 34 °C on July 2nd (see Figure B.1 in Appendix B). These values are similar to those for the Springpole, i.e. minimum temperature of -35.3 °C on January 19th to a maximum of 34.8 °C on July 11th.

Figure 4.5, Figure 4.6 and Figure 4.7 compare the mean daily minimum temperatures, mean daily maximum temperatures, and mean monthly temperatures, respectively for the following data sets:

- Springpole 2012
- Casummit Lake 2012
- Casummit Lake between 2008 to 2020

Comparing the Casummit Lake and Springpole data showed that at Casummit Lake the coldest month was January with a mean daily minimum and maximum temperatures of -28.4 °C and -1.1 °C, respectively and the warmest month was July with a mean daily minimum and maximum temperatures of 17.2 °C and 26.1 °C, respectively (See Figure 4.5 and Figure 4.6). The coldest and warmest days at the Springpole station were also January and July, respectively. At the Springpole station the coldest month was also January with a mean daily minimum and maximum temperatures of -29.4 °C and -1.5 °C, respectively and the warmest month was July with a mean daily minimum and maximum temperatures of 18.6 °C and 27.1 °C, respectively. Maximum and minimum temperatures for the Casummit Lake station are presented in Figure 4.5 and Figure 4.6 and in more detail in Table A.1 and Table A.2 of Appendix A, respectively.

As shown in Figure 4.7, mean monthly temperature on Casummit Lake ranged from a minimum of -14.8 °C in January to a maximum of 21.5 °C in July similar to Springpole in 2012. Casummit Lake's mean monthly temperatures (2008-2020) are presented in Table A.3 of Appendix A and Figure B.2 in Appendix B.

As mentioned above, comparing the Casummit Lake and Springpole data showed an almost identical temperature pattern for the two stations based on the available data for 2012. Therefore, Casummit Lake station data was used for the Springpole Project area. Overall, the coldest month in the Project area between 2008 to 2020 was January with a mean daily minimum and maximum temperatures of -28.4 °C and -3.5 °C, respectively (Figure 4.5 and

Figure 4.6). July was the warmest month between 2008 to 2020 with a mean daily minimum and maximum temperatures of 12.3°C and 24.5 °C, respectively.

Figure 4.5 Mean daily minimum temperatures for Springpole (2012), Casummit Lake (2012), and Casummit Lake 2008-2020

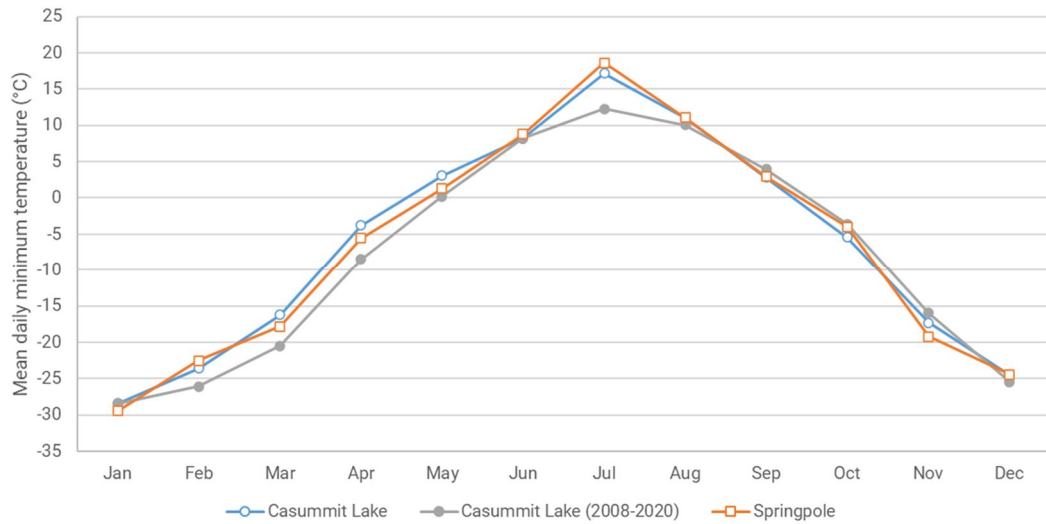


Figure 4.6 Mean daily maximum temperatures for Springpole (2012), Casummit Lake (2012), and Casummit Lake 2008-2020

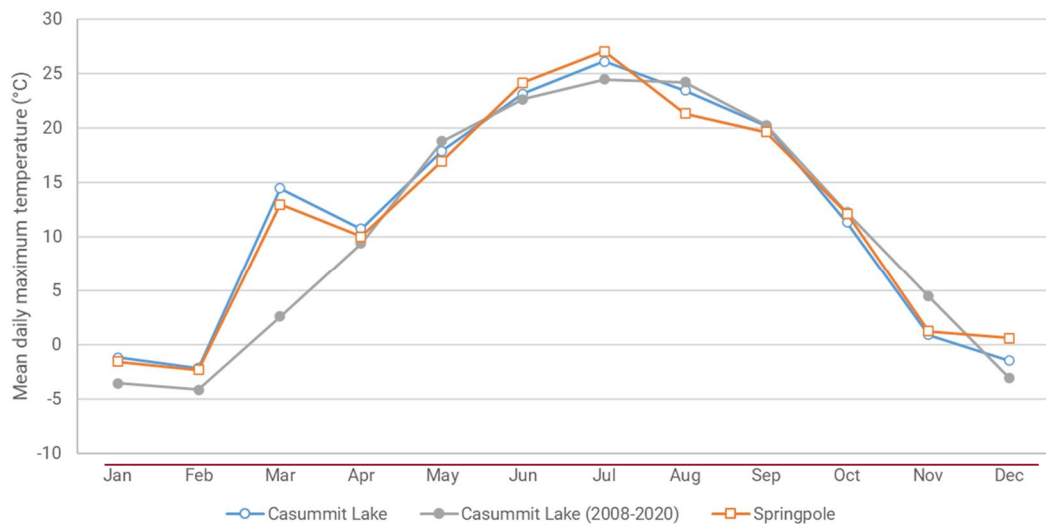


Figure 4.7 Mean monthly temperatures for Springpole (2012), Casummit Lake (2012), and Casummit Lake 2008-2020

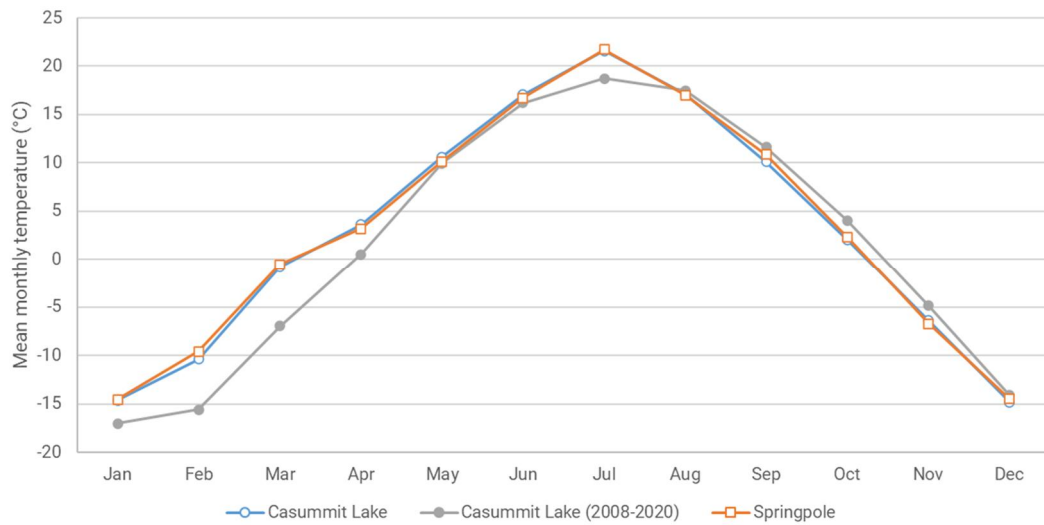


Figure 4.8 shows the mean monthly temperatures for the entire data set for Casummit Lake (2008-2020) and Springpole (2012) for comparison. Comparing the Casummit Lake and Springpole data in Figure 4.8 for the period that the data is available for both stations, i.e. 2012, shows an almost identical pattern for the two stations. Table 4-1 shows the year-average of the mean daily minimum, mean daily maximum, and mean temperatures for the years where the stations had complete data, i.e. 2009 to 2019 for the Casummit Lake and 2012 for the Springpole. It should be noted here that the data provided for the Casummit Lake did not include the entire 2008 year. Again, it can be seen that the data are very similar for the two stations in 2012 reinforcing the representativity of the Casummit Lake data for the project area.

For the Casummit Lake, July 2012 temperatures were the warmest observed for the entire available data. It can also be seen that July temperatures were the highest across the time period. When placing Casummit Lake in the context of historical data (Figure 4.8), temperature data of the last two years follows a similar pattern to all recorded data, i.e., seasons in each year show similar temperatures, and peak values are almost identical.

Figure 4.8 Historical Mean Monthly Temperatures for Casummit Lake from 2008-2020 and Springpole 2012

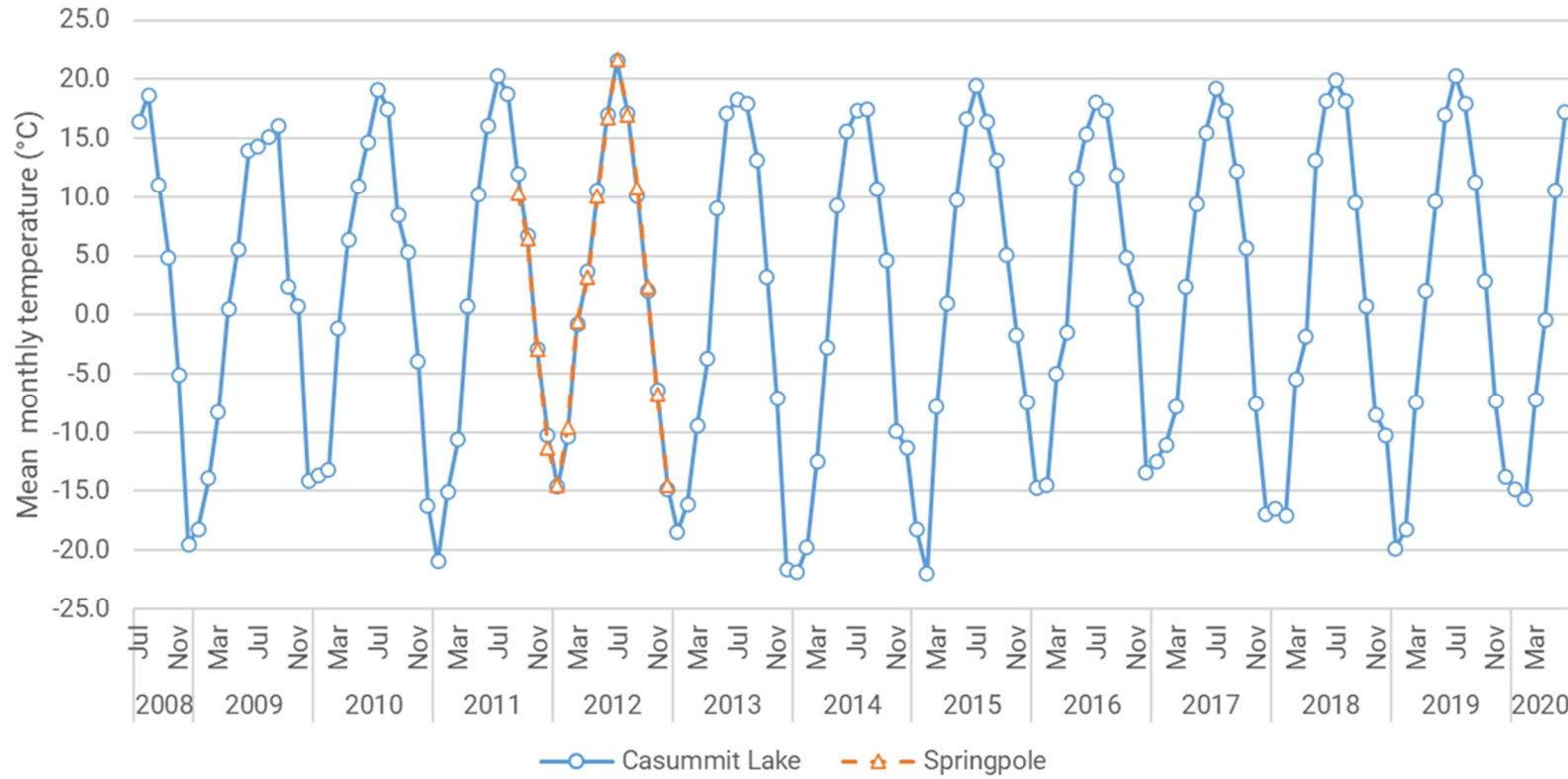


Table 4-1 Annual temperatures (°C)

| Year | Casummit Lake | | | Springpole | | |
|------|--------------------|------|--------------------|--------------------|------|--------------------|
| | Mean daily minimum | Mean | Mean daily maximum | Mean daily minimum | Mean | Mean daily maximum |
| 2009 | -7.8 | 1.2 | 9.6 | - | - | - |
| 2010 | -5.7 | 2.8 | 11.2 | - | - | - |
| 2011 | -7.4 | 2.1 | 11.4 | - | - | - |
| 2012 | -6.4 | 2.9 | 12.0 | -6.7 | 3.01 | 11.9 |
| 2013 | -10.1 | 0.2 | 9.5 | - | - | - |
| 2014 | -10.9 | -0.2 | 9.3 | - | - | - |
| 2015 | -8.1 | 2.0 | 11.3 | - | - | - |
| 2016 | -6.6 | 2.6 | 11.5 | - | - | - |
| 2017 | -6.9 | 2.1 | 11.0 | - | - | - |
| 2018 | -8.2 | 1.7 | 10.8 | - | - | - |
| 2019 | -7.6 | 1.2 | 9.5 | - | - | - |

Notes:

- 1) Casummit Lake Data was not available for the entire year in 2008 and 2020. Therefore, these years were excluded from this table.

As mentioned in Section 3.2, Mann-Kendall nonparametric trend test was applied to the annual average temperature data and Pettitt and Buishand tests were applied to identify changes in the mean or median. Results of the trend analysis applied on the historical data from 2009 to 2019 showed negative slope value of $-0.0291^{\circ}\text{C}/\text{year}$ which means the temperature decreases at the rate of 0.0291°C for each year. It can also be seen that there is a change in the mean in year 2013 (refer to Table 4-2 and Figure 4.9).

Table 4-2 Trend Analysis – Temperature (°C)

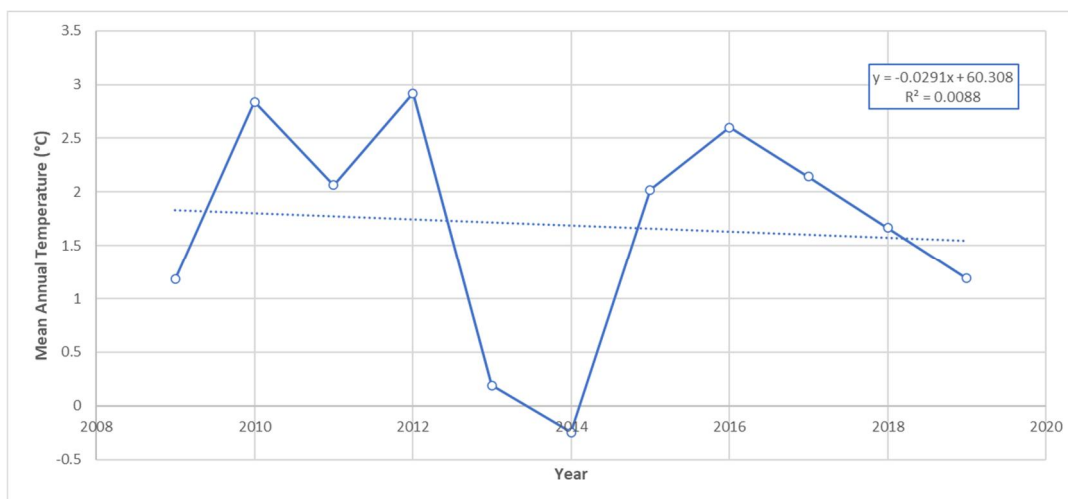
| Parameter | Value | Unit |
|------------------|-------------------|---------------|
| Slope | -0.0291 | °C/year |
| S ⁽¹⁾ | -7 | Dimensionless |
| P-value | 0.640 | Dimensionless |
| MK-99% | NS ⁽²⁾ | Dimensionless |
| MK-95% | NS | Dimensionless |
| MK-90% | NS | Dimensionless |
| Pettitt | 2013 | Year |
| P-99% | NS | Dimensionless |
| P-95% | NS | Dimensionless |

| Parameter | Value | Unit |
|-----------|-------|---------------|
| P-90% | NS | Dimensionless |
| Buishand | 2013 | Year |
| BR-99% | NS | Dimensionless |
| BR-95% | NS | Dimensionless |
| BR-90% | NS | Dimensionless |

Notes:

- 1) S: Mann-Kendall statistic
- 2) NS: Not significant

Figure 4.9 Mean Annual Temperature Slope



4.4.2 Atmospheric pressure

Atmospheric pressure data for the Casummit Lake (for year 2012 and multi-year, i.e. 2008-2020) and Springpole (for year 2012) stations are presented as monthly averages in Figure 4.10. Casummit Lake's data are also presented in detail in Table A.4 in Appendix A. The data shows no apparent seasonal pattern for atmospheric pressure fluctuations, however, the pattern of fluctuation between months is relatively consistent for the two stations in year 2012. Very little fluctuation in atmospheric pressure occurs at either station from July through September.

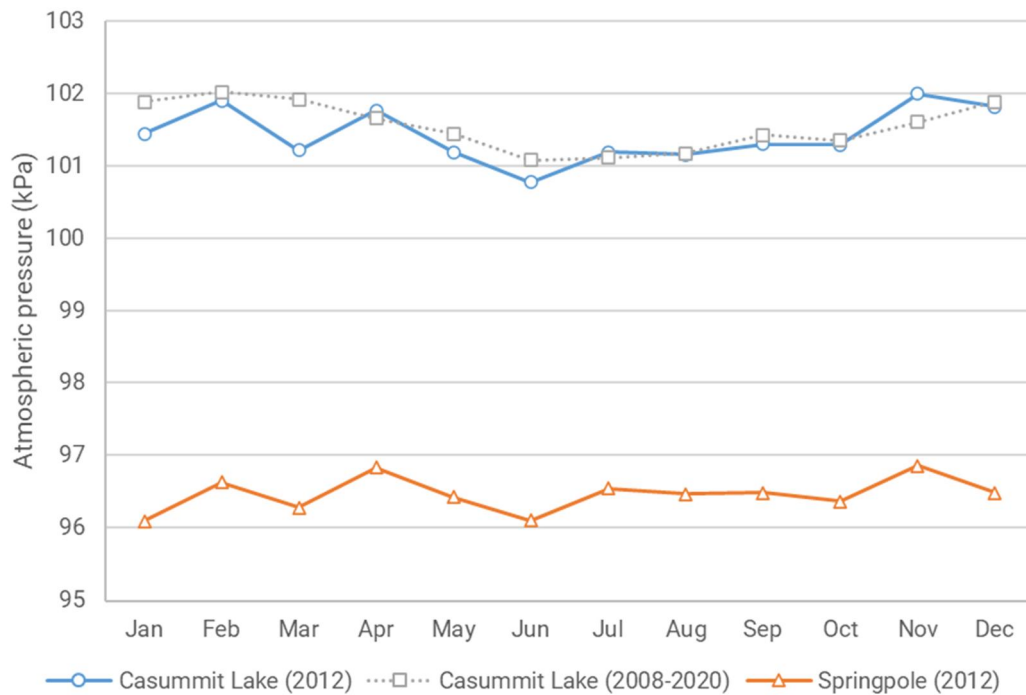
The Casummit Lake data shows no significant difference between year 2012 and the period from 2008 to 2020 in Figure 4.10.

When comparing the data from Casummit and Springpole data (year 2012), Springpole is consistently lower (Refer to Figure 4.10). While the limited available data does not allow for understanding the reason(s) for this difference, the elevation difference between the two stations was evaluated.

The Casummit Lake station has an elevation of 399.0 meters above sea level (masl), while the Springpole station has a slightly higher elevation of approximately 409.1 masl. Calculating the standard atmospheric pressure (assuming constant temperature and humidity) using an equation to account for elevation differences (PSAS, 2004) resulted in 96.5 kPa at Springpole

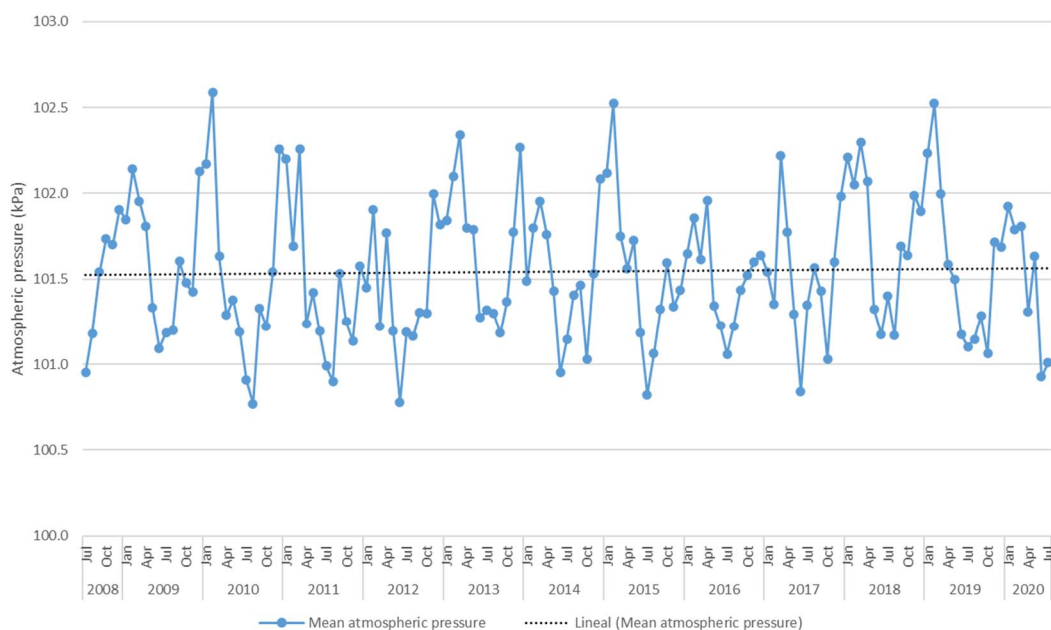
which is consistent with the 2012 data for the Springpole station (Figure 4.10). However, the same calculation for the Casummit lake resulted in 96.6 kPa which is only 0.1 kPa higher than Springpole, but is not consistent with the Casummit Lake data presented in Figure 4.10. This inconsistency between the calculated atmospheric pressure and available data for the Casummit Lake might be related to an error introduced in the calculation by the latitude of the station. Regardless of this inaccuracy, the difference in the elevation does not seem to be a factor in the difference observed between the two stations in Figure 4.10. Another possible reason for the difference in the atmospheric data between the two stations might be related to the data source, e.g. the data source for one might be a physical station and satellite for the other. Therefore, we recommend identifying the data source for both sets of historical data (Springpole and Casummit Lake, if possible), and more importantly, installing a proper weather station at the Springpole Project site for the next study phase. The data that will be obtained from such station can verify which data set (Springpole or Casummit Lake) is more representative of the Springpole Project area.

Figure 4.10 Mean Monthly Atmospheric Pressure for Springpole (2012), Casummit Lake (2012), and Casummit Lake 2008-2020



Daily maximum and minimum air pressure of Casummit Lake for the entire available data between 2008 to 2020 is presented in Figure B.3 of Appendix B show that both parameters have a constant trend with their upper-lower boundaries. The monthly air pressure data presented in Figure 4.11 (and Figure B.4 of Appendix B) also shows a constant trend for the average values with a small degree of variability.

Figure 4.11 Historical Mean Monthly Pressure



The Mann-Kendall nonparametric trend test was applied on the annual average atmospheric pressure data and Pettitt and Buishand tests were applied to identify changes in the mean or median. Results of the trend analysis applied to the historical data from 2009 to 2019 showed positive slope value of 0.0088 kPa/year which means the atmospheric pressure increases at the rate of 0.0088 kPa per year. It can also be seen that there is a change in the mean for year 2018 (refer to Table 4-3 and Figure 4.12).

Table 4-3 Trend Analysis – Atmospheric pressure (kPa)

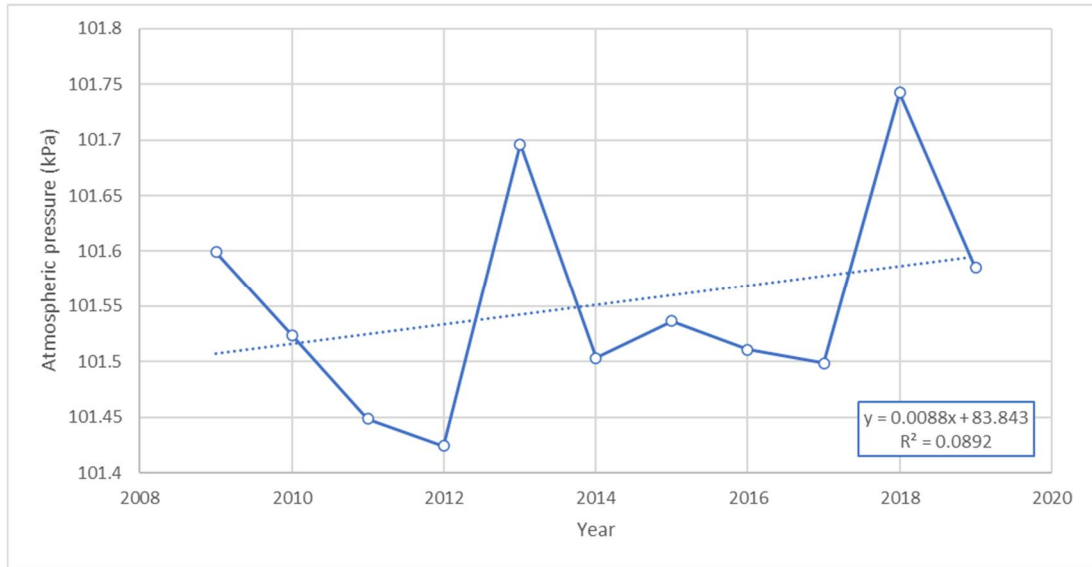
| Parameter | Value | Unit |
|------------------|-------------------|---------------|
| Slope | 0.0088 | kPa/year |
| S ⁽¹⁾ | 0.640 | Dimensionless |
| P-value | NS ⁽²⁾ | Dimensionless |
| MK-99% | NS | Dimensionless |
| MK-95% | NS | Dimensionless |
| MK-90% | 2018 | Year |
| Pettitt | NS | Dimensionless |
| P-99% | NS | Dimensionless |
| P-95% | NS | Dimensionless |
| P-90% | 2018 | Year |
| Buishand | NS | Dimensionless |
| BR-99% | NS | Dimensionless |
| BR-95% | NS | Dimensionless |

| Parameter | Value | Unit |
|-----------|-------------|---------------|
| BR-90% | 0.640428787 | Dimensionless |

Notes:

- 1) S: Mann-Kendall statistic
- 2) NS: Not significant

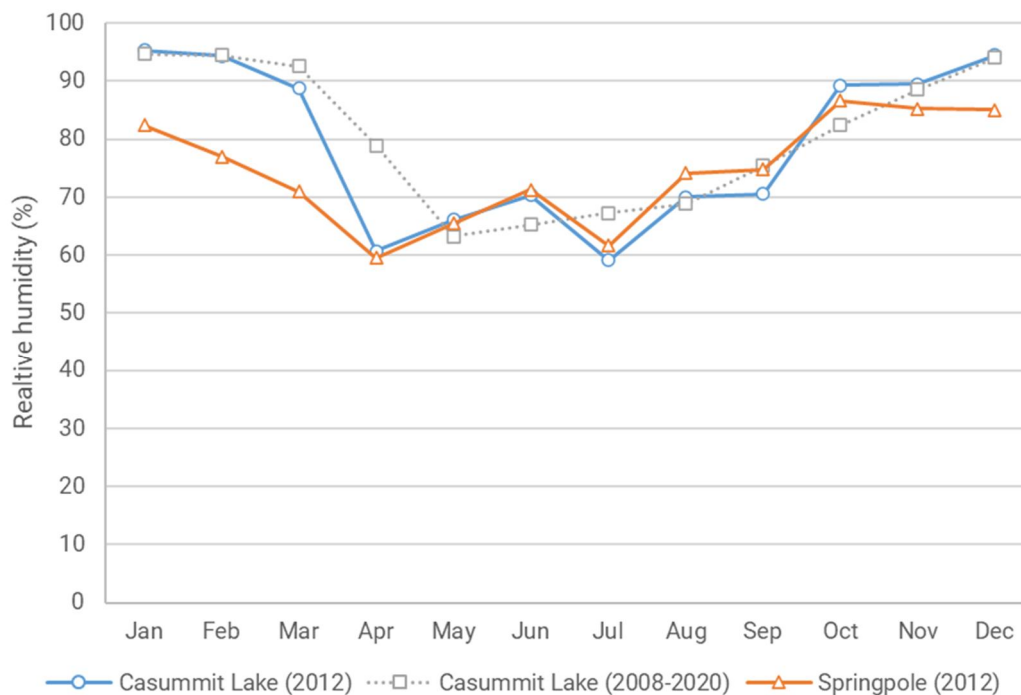
Figure 4.12 Atmospheric pressure slope



4.4.3 Relative humidity

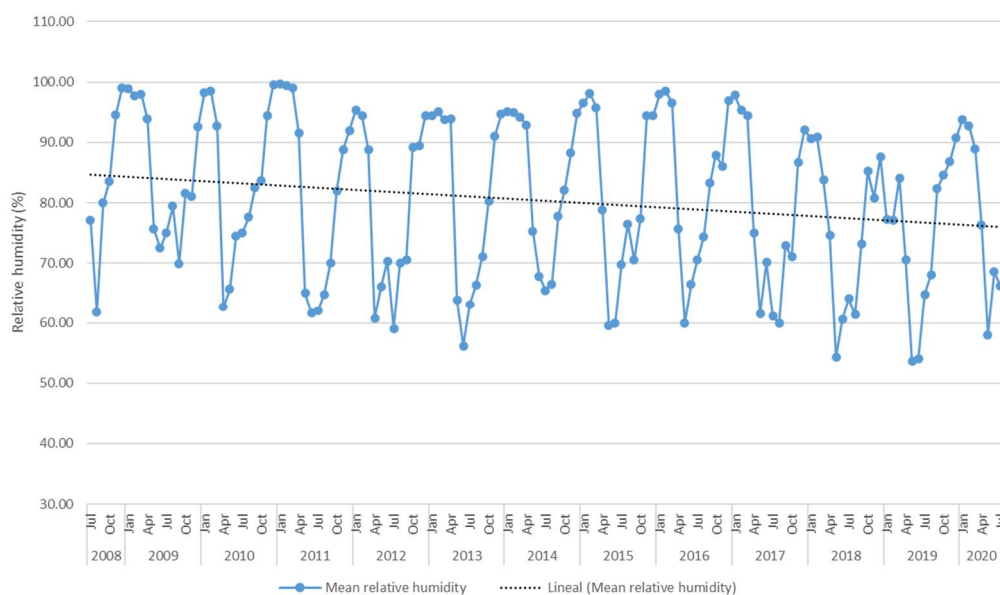
Relative humidity data for the Casummit Lake and Springpole stations for year 2012 indicate a moderately humid climate with seasonal variations (Figure 4.13). Data for Casummit Lake is presented in Table A.5 of Appendix A. Average monthly humidity ranged from a low of 59.1% in July (Casummit Lake) to a high of 95.3% in January (Casummit Lake). Seasonally, the region is less humid in early spring (late March) through mid-summer (July) and more humid in the fall and winter months (late September to February). Relative humidity between the two stations is similar, except for January through March where Casummit Lake had considerably higher recorded relative humidity value.

Figure 4.13 Mean Monthly Relative Humidity for Springpole (2012), Casummit Lake (2012), and Casummit Lake 2008 to 2020



Daily maximum and minimum relative humidity of Casummit Lake for all its record are presented in Figure B.5 of Appendix B. The maximum values are near 100% and the minimum values varies with a decreasing trend on average from February to May and Increasing from June to December. Mean monthly humidity values for the Casummit Lake presented in Figure 4.14 (and Figure B.6 of Appendix B) indicate more variability in values between April and October compared to the other months, but there is a decreasing trend on average.

Figure 4.14 Historical Mean Monthly Relative Humidity



Mann-Kendall nonparametric trend test was applied on the annual average relative humidity data and Pettitt and Buishand tests were applied to identify changes in the mean or median. Results of the trend analysis applied on historical data from 2009 to 2019 showed negative slope value of -0.7717 %/year which means the relative humidity decreases at the rate of 0.7717% per year. It can also be seen that there is a change in the mean in year 2017 (refer to Table 4-4 and Figure 4.15).

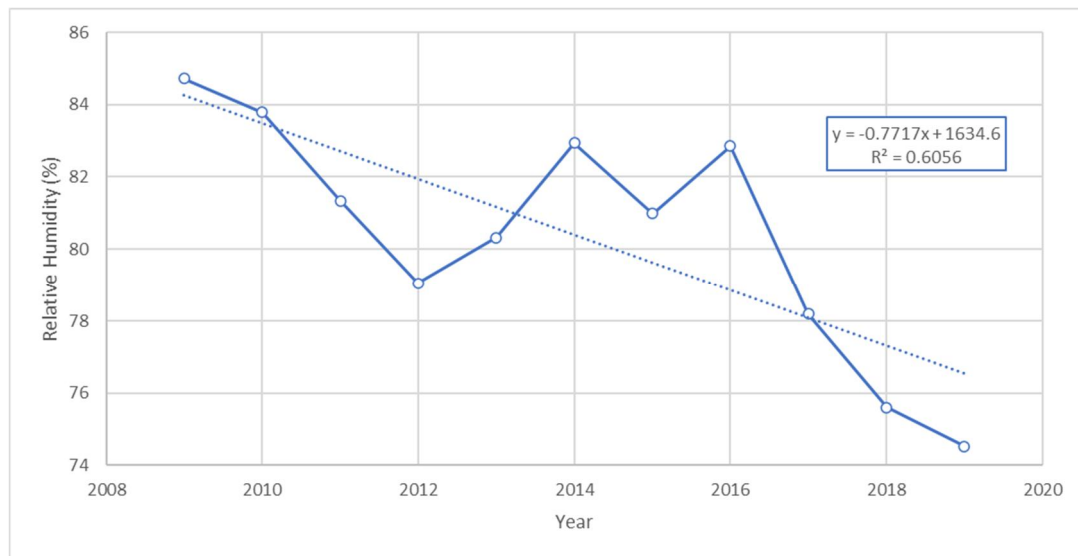
Table 4-4 Trend Analysis – Relative Humidity (%)

| Parameter | Value | Unit |
|------------------|--------------------|---------------|
| Slope | -0.7717 | %/year |
| S ⁽¹⁾ | -35 | Dimensionless |
| P-value | 0.0081 | Dimensionless |
| MK-99% | Sig ⁽²⁾ | Dimensionless |
| MK-95% | NS ⁽³⁾ | Dimensionless |
| MK-90% | NS | Dimensionless |
| Pettitt | 2017 | Year |
| P-99% | NS | Dimensionless |
| P-95% | NS | Dimensionless |
| P-90% | NS | Dimensionless |
| Buishand | 2017 | Year |
| BR-99% | NS | Dimensionless |
| BR-95% | NS | Dimensionless |
| BR-90% | NS | Dimensionless |

Notes:

- 1) S: Mann-Kendall statistic
- 2) Sig: Significant
- 3) NS: Not significant

Figure 4.15 Relative Humidity slope



4.4.4 Precipitation

4.4.4.1 Total Precipitation

The total monthly precipitation (sum of rain and snow) is presented in Figure 4.16 for the Casummit Lake and Springpole for the time period between (September 2011 to December 2012). As expected, total annual precipitation values (444.9 mm for the Casummit Lake and 476.8 mm for Springpole) for 2012 were similar, less than 7% difference between the two stations that are 10 km apart. The total precipitation was relatively low from September 2011 to February 2012. In 2012, the total precipitation showed a relative increase during the summer months and then decreased again from November to the February for the following year (Figure 4.16). The total precipitation presented in Figure 4.16 shows a similar pattern for the two stations with only a small variations for the summer months (May to September) when rainfall occurs. A similar pattern was observed for the entire available data for the Casummit Lake (Figure 4.17).

Figure 4.16 Total monthly precipitation between September 2011 and December 2012

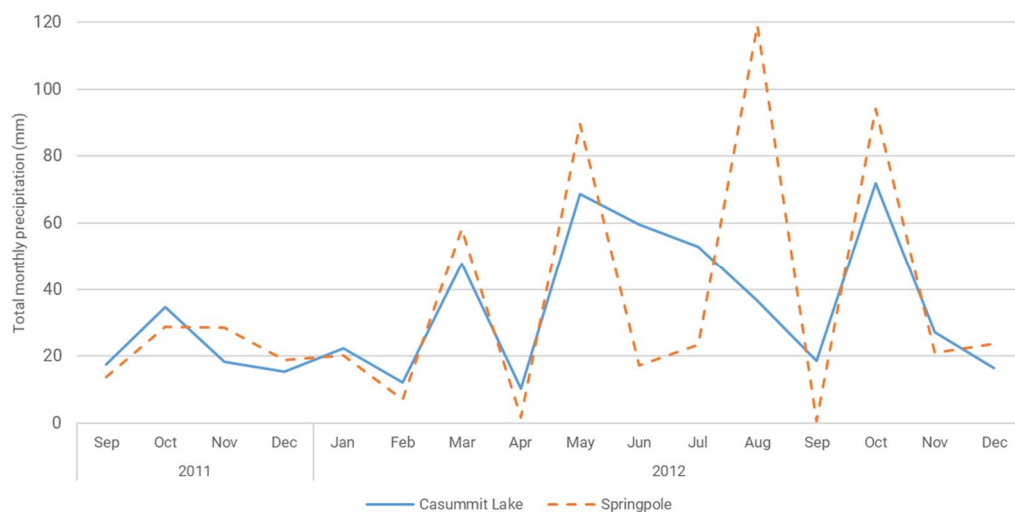


Figure 4.17 Total monthly precipitation from January 2009 to June 2020

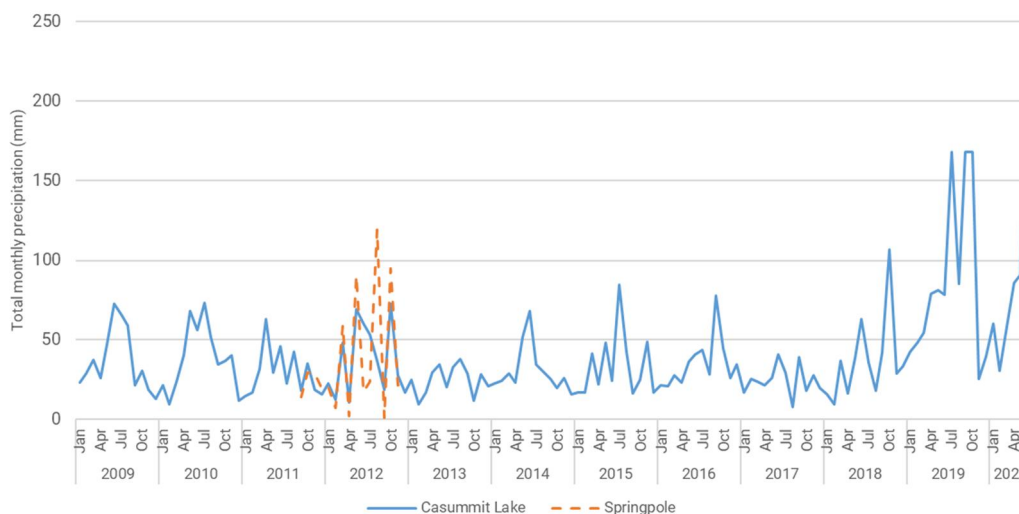


Table 4-5 shows the total annual precipitation for the Casummit Lake and Springpole when data was available. The total annual precipitation for the Casummit Station varies from 292.9 mm (2013) to 1035.3 mm (2019), which is shown in

Table 4-5. The following observations were made from reviewing the data set for Casummit Lake:

- The average value for the total annual precipitation (excluding year 2019) is 390 mm. The total annual precipitation in each year is relatively close to the average except for year 2019.
- Total annual precipitation significantly increased in 2019 (reviewing the data for 2020 suggests a similar value in 2020. However, the 2020 data cannot be used since it is not complete yet and therefore has not been taken into account in the current study) which could be related to the climate anomaly described in section 4.3.

Table 4-5 Total precipitation (mm)

| Year | Casummit Lake | Springpole |
|------|---------------|------------|
| 2009 | 440.6 | - |
| 2010 | 463.8 | - |
| 2011 | 350.7 | - |
| 2012 | 444.9 | 476.8 |
| 2013 | 292.9 | - |
| 2014 | 367.0 | - |
| 2015 | 400.6 | - |
| 2016 | 421.7 | - |

| Year | Casummit Lake | Springpole |
|------|---------------|------------|
| 2017 | 293.1 | - |
| 2018 | 441.1 | - |
| 2019 | 1035.3 | - |

Notes:

- 1) Casummit Lake Data was not available for the entire year in 2008 and 2020. Therefore, these years were excluded from this table.

Mann-Kendall nonparametric trend test was applied on the total annual precipitation data from Casummit Lake station and Pettitt and Buishand tests were applied to identify changes in the mean or median. Results of the trend analysis applied on historical data from 2009 to 2019 showed positive slope value of 25.191 mm/year which means the total annual precipitation increases at the rate of 25.191 mm per year. It can also be seen that there is a change in the mean in year 2018 years for Pettitt test and 2019 for Buishand test (refer to Table 4-6 and Figure 4.18).

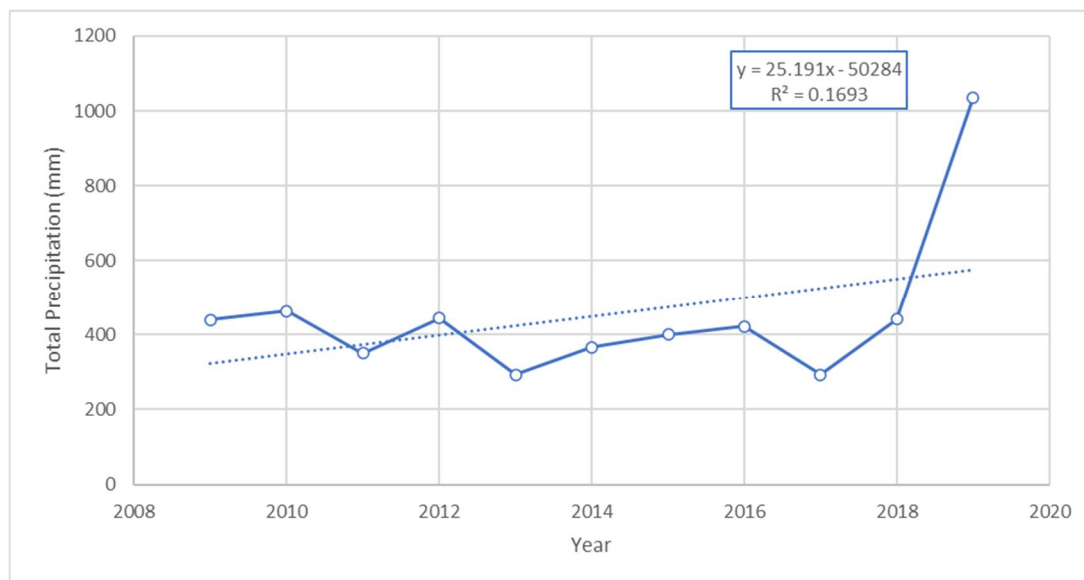
Table 4-6 Trend Analysis – Total annual precipitation (mm)

| Parameter | Value | Unit |
|------------------|-------------------|---------------|
| Slope | 25.191 | mm/year |
| S ⁽¹⁾ | 5 | Dimensionless |
| P-value | 0.755496875 | Dimensionless |
| MK-99% | NS ⁽²⁾ | Dimensionless |
| MK-95% | NS | Dimensionless |
| MK-90% | NS | Year |
| Pettitt | 2018 | Dimensionless |
| P-99% | NS | Dimensionless |
| P-95% | NS | Dimensionless |
| P-90% | NS | Year |
| Buishand | 2019 | Dimensionless |
| BR-99% | NS | Dimensionless |
| BR-95% | NS | Dimensionless |
| BR-90% | NS | Unit |

Notes:

- 1) S: Mann-Kendall Statistic
- 2) NS: Not significant

Figure 4.18 Total Annual Precipitation slope



The monthly precipitation distribution, for the average year, was 65% of the total annual precipitation from May to October, with a maximum average monthly precipitation of 68.2 mm in June. Less precipitation was observed from December through February. Table 4-7 presents the monthly averages, standard deviation, and frequencies of monthly precipitation with respect to annual precipitation for the project area.

Total monthly precipitation values for the Project area are presented in Table A.6 of Appendix A.

Table 4-7 Monthly average precipitation values for the project area

| Month | Average (mm) | Stand. Dev. (mm) | % Annual |
|-------|--------------|------------------|----------|
| Jan | 25.0 | 13.1 | 5% |
| Feb | 20.8 | 11.3 | 4% |
| Mar | 35.5 | 12.9 | 7% |
| Apr | 36.3 | 25.1 | 8% |
| May | 51.4 | 21.0 | 11% |
| Jun | 68.2 | 60.5 | 14% |
| Jul | 58.1 | 41.4 | 12% |
| Aug | 39.7 | 20.8 | 8% |
| Sep | 44.3 | 44.6 | 9% |
| Oct | 51.5 | 47.5 | 11% |
| Nov | 28.5 | 8.7 | 6% |
| Dec | 21.4 | 9.5 | 4% |

| Month | Average (mm) | Stand. Dev. (mm) | % Annual |
|--------|--------------|------------------|----------|
| Annual | 480.7 | 203.0 | 100% |

The annual precipitation values for the project area were adjusted to different probabilistic distributions to obtain the total annual precipitation for different return periods for both wet and dry years. Table 4-8 shows calculated “goodness-of-fit” delta values using the software *Hydraccess 4.3* for the probabilistic distributions that had the top four delta values (four highest delta values). The delta parameter (the probabilistic distribution is a better representative of the data set when the delta is higher) along with the graphical data adjustment allow one to select the best probabilistic distribution that fits the analysed data.

It can be seen in Table 4-8 that the Normal distribution has the highest delta value (13.211), however, it underestimates precipitations for both wet and dry years as the return period increases (Figure B.7 of Appendix B). Gumbel and Log Pearson III probability distribution models, respectively, underestimates and overestimates the precipitations for wet years. Pearson III probability distribution model seems to best model the data set for both wet and dry years (Figure B.7 of Appendix B), and therefore, was selected for this study. Figure B.7 of Appendix B shows the graphical data adjustment for the probabilistic distributions discussed.

Table 4-8 Analysed distribution functions – Annual precipitation

| Distribution | Delta parameter |
|-----------------|-----------------|
| Normal | 13.211 |
| Gumbel | 11.738 |
| Log Pearson III | 10.209 |
| Pearson III | 6.957 |

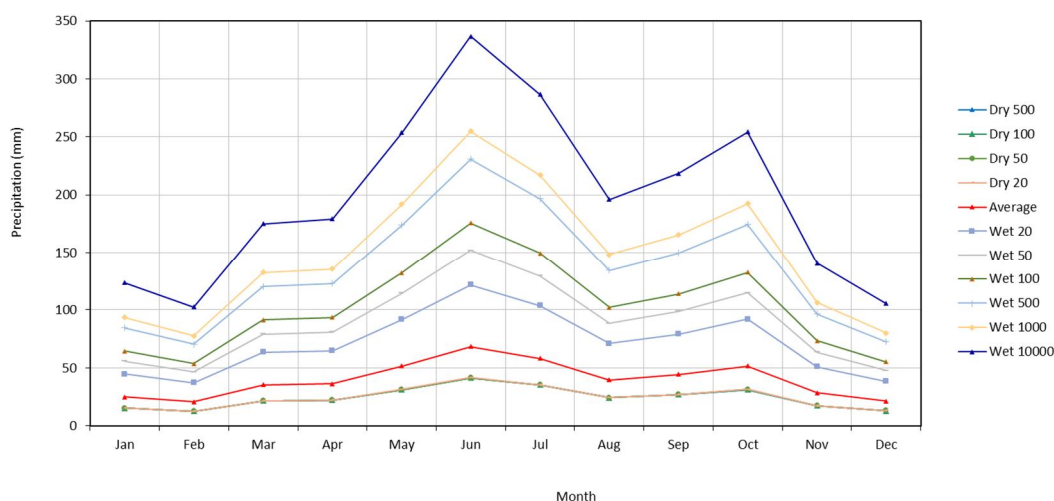
Table 4-9 shows the estimated total annual precipitation for both wet and dry years for different return periods using the Pearson III distribution model on the historical data.

Table 4-9 Total annual precipitations for wet and dry years

| Return period (year) | Dry year (mm) | Wet year (mm) |
|----------------------|---------------|---------------|
| 500 | 292.1 | 1,627.4 |
| 200 | 292.2 | 1,404.2 |
| 100 | 292.2 | 1,237.3 |
| 50 | 292.5 | 1,072.3 |
| 20 | 293.7 | 859.8 |
| 10 | 297.0 | 702.2 |

Figure 4.19 (and Table A.7 of Appendix A) shows the total monthly precipitations for wet and dry years for different return periods based on the Pearson III distribution model on the historical data. Precipitations are higher in wet years and lower in dry years than those of the average year presented in Figure 4.19. The average year values presented in Figure 4.19 are the average monthly values for each month for the entire available dataset (2009-2020), e.g. the average value for January is the average of monthly values from January 2009 to January 2020.

Figure 4.19 Total monthly precipitations for wet and dry years for different return periods



4.4.4.2 Snow depth

Hourly snow depth data for both Casummit Lake and Springpole meteorological stations were processed to calculate the monthly values for the time period where data was available for both stations, i.e. September 2011 to December 2012 (Figure 4.20).

In the snow depth vs time graphs, i.e. Figure 4.20, upward slopes usually indicate snowfall events. In Figure 4.20 the snow fall events are often followed by gradual downward trends representing the consolidation and/or melting of the snowpack. The Casummit lake station registered 18.0 cm of snowfall in January 2012 while Springpole registered 38.9 cm of snow depth in the same month. At Casummit lake, it looks like the snowpack persisted until mid-March when the spring melt occurred. It looks like the next major snowfall event at Casummit Lake occurred in October 2012 when approximately 18.3 cm of snowfall accumulated on the ground. At Springpole, it seems like the first major snowfall event occurred in November with a total snow depth of 7.6 cm (Figure 4.20).

Although this data (September 2011 to December 2012) is not enough to make a reliable comparison between the two stations, Figure 4.20 suggests similar trends with some differences. Snow depth is almost zero at both stations from April to September 2012. The snow seems to start accumulating from early fall and pick up in the winter and melting starts from early-mid Spring at both stations. Therefore, in the absence of any active weather stations at or near the project area, the Casummit Lake was selected to be representative of the Project area.

The pattern explained above was observed for the Casummit Lake's from January 2009 to June 2020 presented in Figure 4.21 (and Figure B.8 of Appendix B) showing similar periods

for low snow depths and peak values, except for the last two years (2019 and 2020) when there was significant increases, especially in the peak values.

Casummit Lake's monthly values for entire data set between January 2009 and June 2020 are presented in Table A.8 of Appendix A.

Figure 4.20 Snow Depths at Casummit Lake and Springpole from September 2011 to December 2012

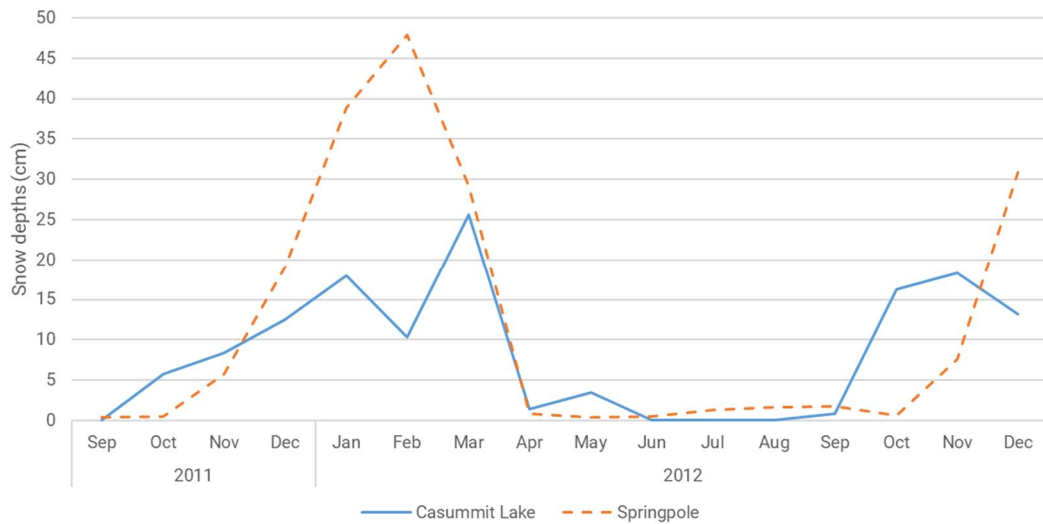
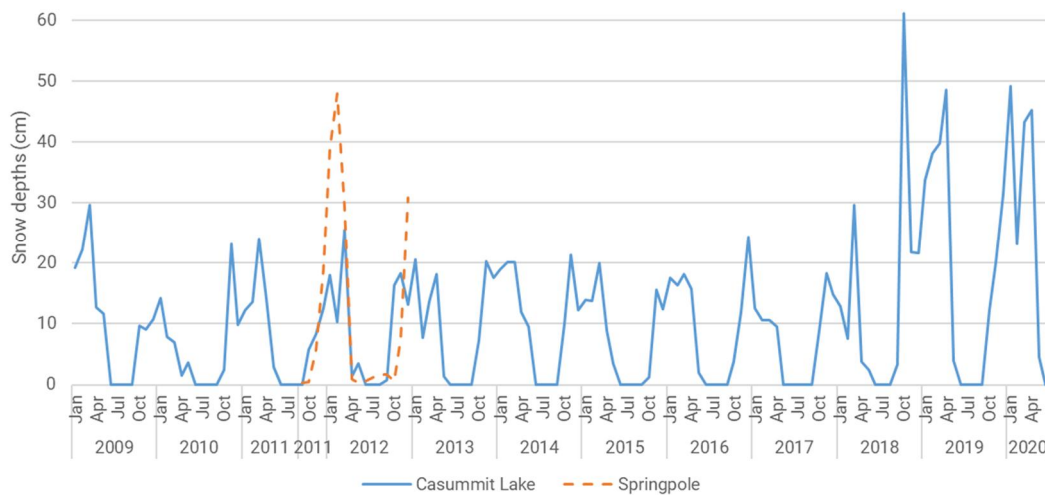


Figure 4.21 Snow Depths at Casummit Lake (January 2009 - June 2020)



Mann-Kendall nonparametric trend test was applied on the annual snow depth data and Pettitt and Buishand tests were applied to identify changes in the mean or median. Results of the trend analysis applied on historical data from 2009 to 2019 showed positive slope value of 7.7764 cm/year which means the snow depth increases at the rate of 7.7764 cm per year. It can also be seen that there is a change in the mean in year 2018 (refer to Table 4-10 and Figure 4.22).

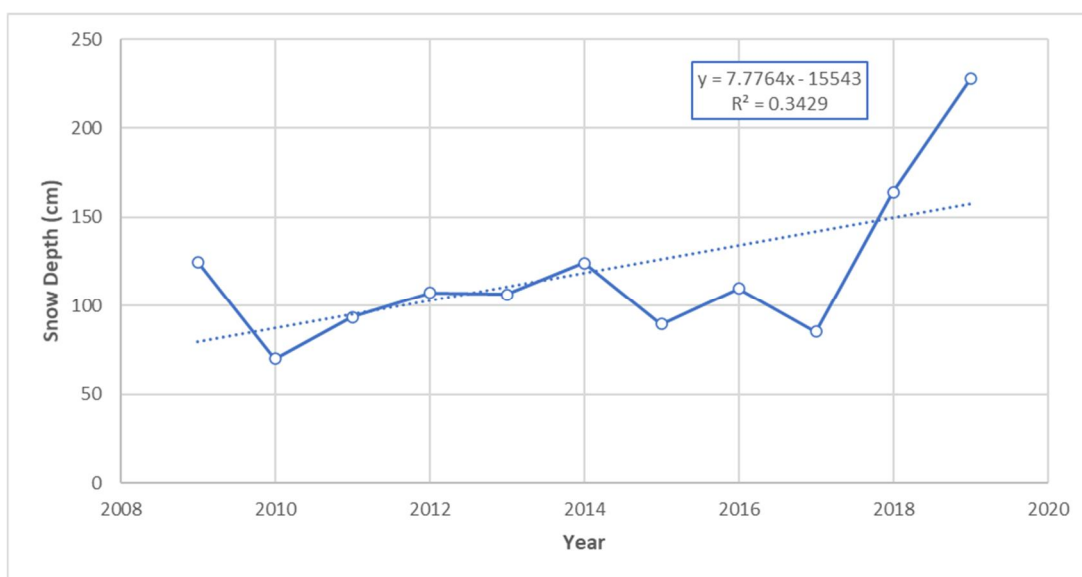
Table 4-10 Trend Analysis – Snow Depth (cm)

| Parameter | Value | Unit |
|------------------|-------------------|---------------|
| Slope | 7.7764 | cm/year |
| S ⁽¹⁾ | 15 | Dimensionless |
| P-value | 0.276 | Dimensionless |
| MK-99% | NS ⁽²⁾ | Dimensionless |
| MK-95% | NS | Dimensionless |
| MK-90% | NS | Dimensionless |
| Pettitt | 2018 | Year |
| P-99% | NS | Dimensionless |
| P-95% | NS | Dimensionless |
| P-90% | NS | Dimensionless |
| Buishand | 2018 | Year |
| BR-99% | NS | Dimensionless |
| BR-95% | NS | Dimensionless |
| BR-90% | NS | Dimensionless |

Notes:

- 1) S: Mann-Kendall Statistic
- 2) NS: Not significant

Figure 4.22 Snow Depth slope



4.4.4.3 Snow Water Equivalent (SWE)

The Casummit Lake data included the total precipitation in mm and snow depth in centimetres but not the rainfall and snowmelt or snow water equivalent (SWE). In order to

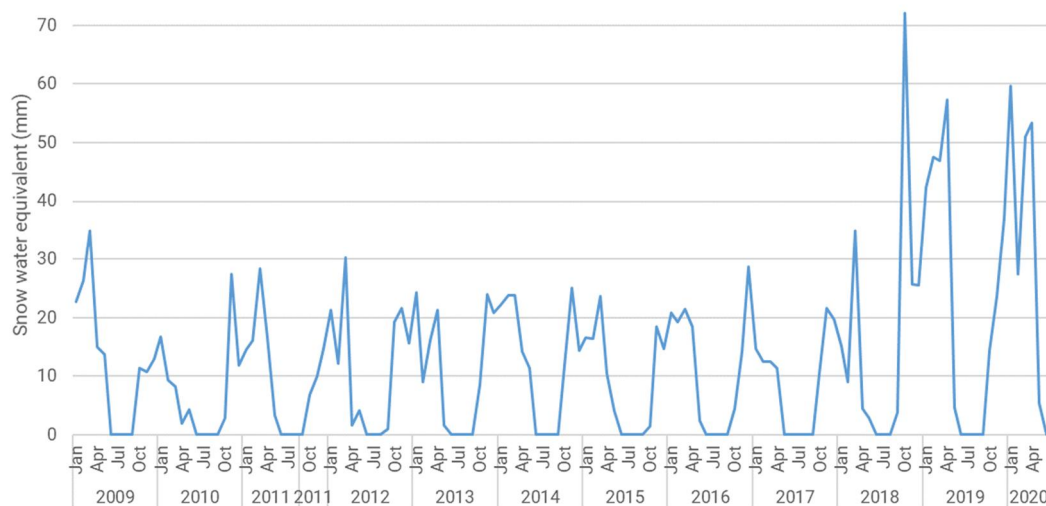
determine the rainfall and snow water equivalent, a conversion factor (which is also referred to as snow density in literature) was established using the hourly temperature, total precipitation, snow depth, rainy days, and snowy days data.

Months with zero rainfall and temperatures below freezing were used to establish the correlation between the total precipitation (mm) and snow depth (cm) resulted in a conversion factor or snow density of 0.118, i.e. 10 cm of snow is equivalent to 11.8 mm of water.

This conversion factor was used to convert the snow depth data to snow water equivalent (SWE). The rainfall was calculated as the difference between the total precipitation data and the calculated snow water equivalent values. Figure 4.23, shows the snow water equivalent values for Casummit Lake station for the records between January 2009 to June 2020.

Both the snow water equivalent and rainfall seem to have seasonal patterns that repeat every year except for 2019 and 2020 when an abrupt increase in the rainfall (and to a lesser degree in the snow water equivalent) was observed.

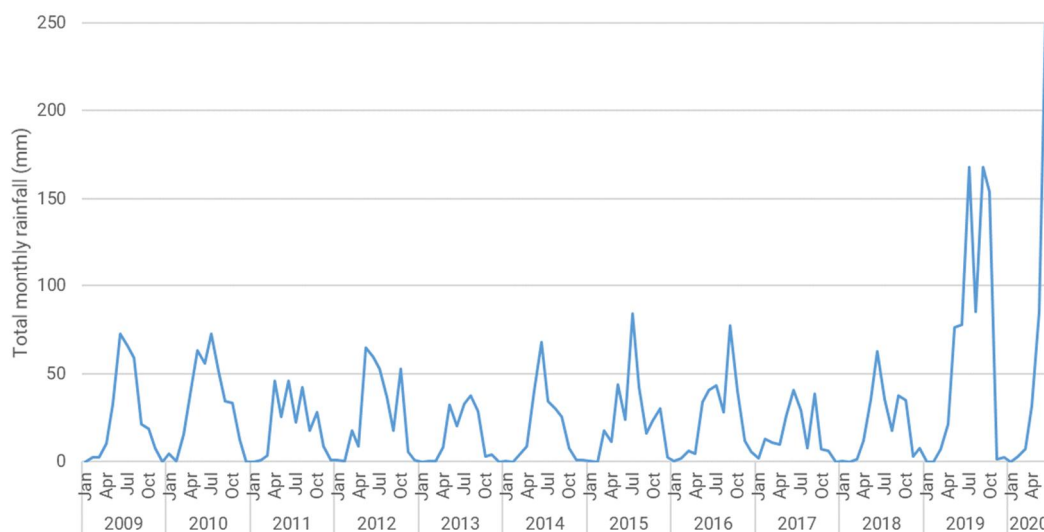
Figure 4.23 Snow water equivalent and rainfall for Casummit Lake station from January 2009 to June 2020



4.4.4.4 Rainfall

As mentioned in the previous section, the rainfall was calculated as the difference between the total precipitation data and the calculated snow water equivalent values in the absence of the data. Calculated rainfall values for the Casummit Lake are presented in Figure 4.24 and Table A.9 of Appendix A. The lowest rainfall values are usually from December through February while the highest are from June through July.

Figure 4.24 Rainfall for Casummit Lake station from January 2009 to June 2020



Total monthly rainfall for the entire Casummit Lake's entire record is presented in Figure B.9 of Appendix B.

Mann-Kendall nonparametric trend test was applied on the total annual rainfall data and Pettitt and Buishand tests were applied to identify changes in the mean or median. Results of the trend analysis applied on historical data from 2009 to 2019 showed positive slope for 15.74 mm/year which means the total rainfall increases at the rate of 15.74 mm per year. It can also be seen that there is a change in the mean in year 2013 for Pettitt test and year 2019 for Buishand test (refer to Table 4-11 and Figure 4.25).

Since an outlier data (dramatically high rainfall in 2019) was observed, the trend analysis was repeated for the period from 2009 through 2018, excluding the rainfall data for year 2019 which seems to be an anomaly. This time, the trend analysis showed a negative slope of 9.1308 mm/year for the rainfall indicating a decreasing trend in rainfall for this period (refer to Figure 4.26).

Table 4-11 Trend Analysis – Total Rainfall (mm) for 2009 to 2019

| Parameter | Value | Unit |
|------------------|-------------------|---------------|
| Slope | 15.74 | mm/year |
| S ⁽¹⁾ | -3 | Dimensionless |
| P-value | 0.876 | Dimensionless |
| MK-99% | NS ⁽²⁾ | Dimensionless |
| MK-95% | NS | Dimensionless |
| MK-90% | NS | Dimensionless |
| Pettitt | 2013 | Year |
| P-99% | NS | Dimensionless |

| Parameter | Value | Unit |
|-----------|-------|---------------|
| P-95% | NS | Dimensionless |
| P-90% | NS | Dimensionless |
| Buishand | 2019 | Year |
| BR-99% | NS | Dimensionless |
| BR-95% | NS | Dimensionless |
| BR-90% | NS | Dimensionless |

Notes:

- 1) S: Mann-Kendall Statistic
- 2) NS: Not significant

Figure 4.25 Total Annual Rainfall slope from 2009 to 2019

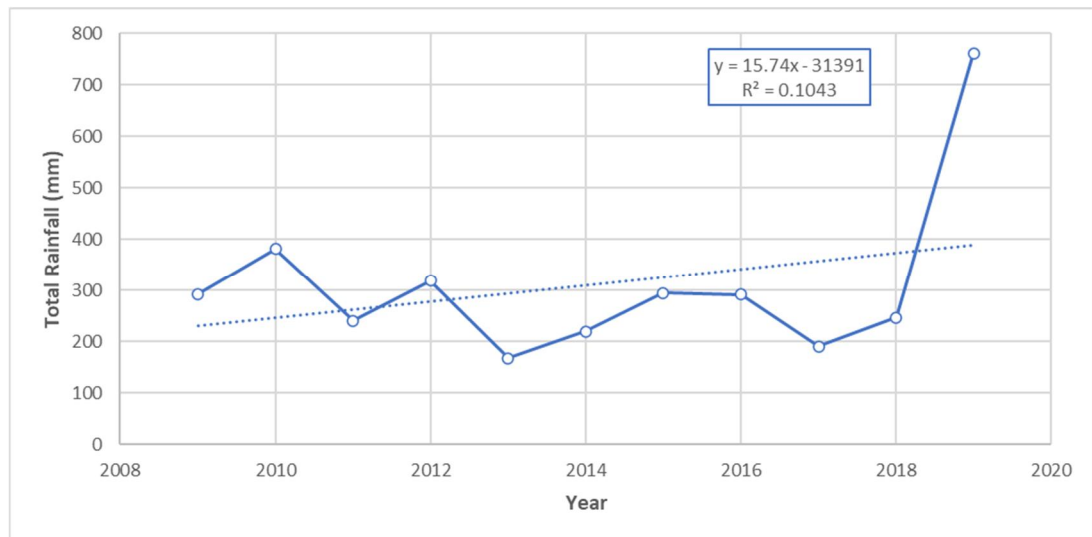
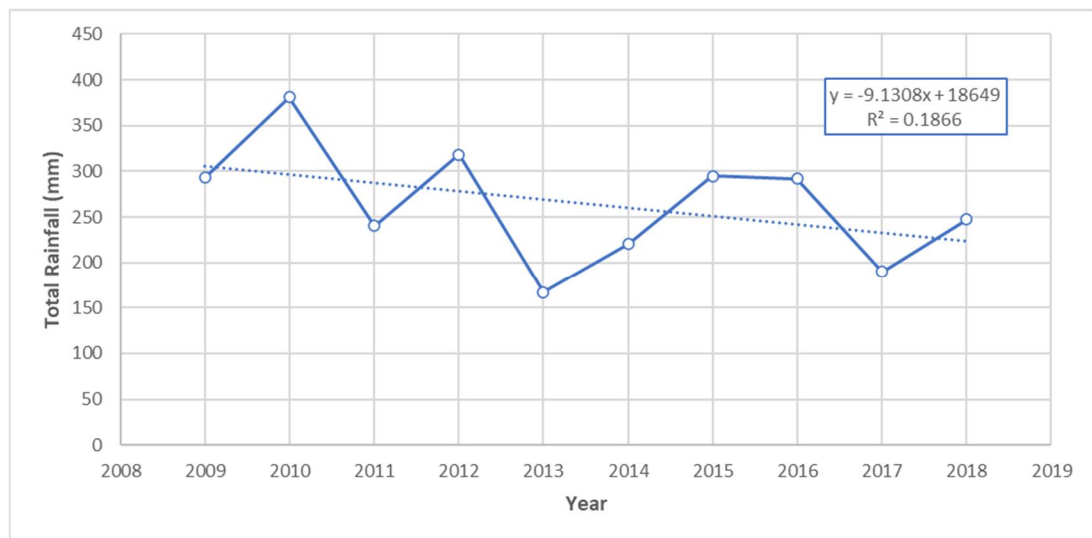


Figure 4.26 Total Annual Rainfall slope from 2009 through 2018



4.4.4.5 Total precipitation distribution

Values of the snow water equivalent (SWE), rainfall, and total precipitation are presented in Figure 4.27 and Figure 4.28. On average, the snow water equivalent (SWE) comprises 31% of the total annual precipitation while the other 69% corresponds to rainfall. Expected opposite seasonal patterns for the SWE and rainfall (i.e., when one is low the other is high and vice versa) can be easily identified in Figure 4.28 with the total precipitation mainly as rainfall from May to September and SWE from November to March.

Figure 4.27 Snow water equivalent, rainfall, and total precipitation for Casummit Lake station from January 2009 to June 2020

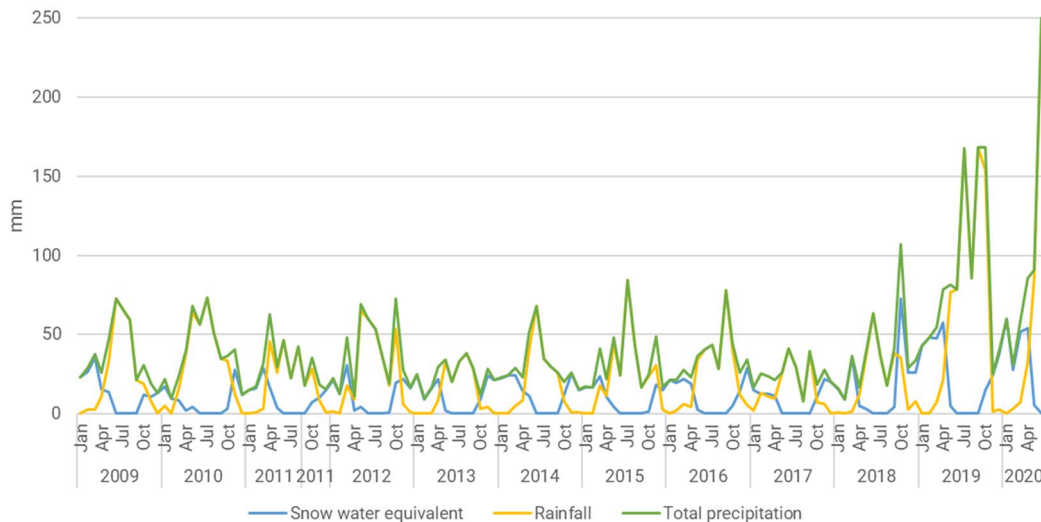
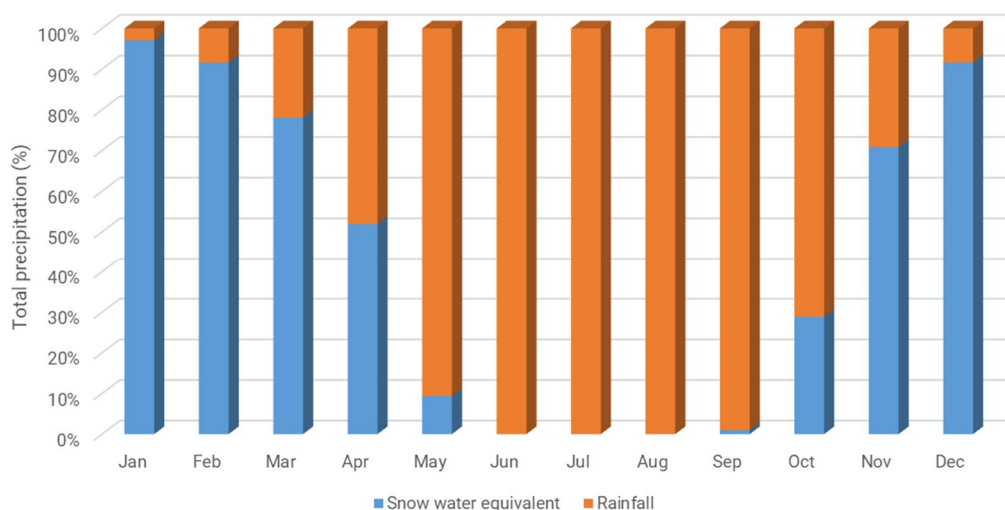


Figure 4.28 Distribution of snow water equivalent and rainfall for Casummit Lake station from January 2009 to June 2020



4.4.4.6 Extreme Storm Event Analysis

Extreme storm event analysis has been analysed based on total hourly precipitation data (Rainfall + Snow Water Equivalent) because only total precipitation data was available. This evaluation includes the maximum precipitation for 24-, 48-, and 72- hour storm events.

The analysis is based on maximum precipitation per each duration, which was obtained by accumulating consecutive values per each duration per year, i.e. for maximum precipitation in 24, 48 and 72 hours (Refer to Table 4-12).

Table 4-12 Series of maximum precipitation of Casummit Lake

| Year | 24 hours Maximum precipitation (mm) | 48 hours Maximum precipitation (mm) | 72 hours Maximum precipitation (mm) |
|------|-------------------------------------|-------------------------------------|-------------------------------------|
| 2009 | 29.3 | 38.4 | 40.0 |
| 2010 | 22.8 | 26.4 | 33.7 |
| 2011 | 24.7 | 28.0 | 28.0 |
| 2012 | 23.2 | 25.3 | 25.4 |
| 2013 | 22.1 | 22.1 | 22.1 |
| 2014 | 28.0 | 31.9 | 33.3 |
| 2015 | 42.9 | 53.5 | 55.1 |
| 2016 | 19.6 | 27.5 | 29.2 |
| 2017 | 20.6 | 22.1 | 22.8 |
| 2018 | 19.1 | 19.1 | 19.1 |
| 2019 | 76.2 | 86.4 | 91.0 |

The series of maximum precipitation assigned for the project area were adjusted to different probabilistic distributions to obtain the maximum precipitation for different return periods. Table 4-13, Table 4-14 and Table 4-15 show deltas “goodness-of-fit” estimated using the software Hydraccess v.4.3 for the probabilistic distributions that had the top four delta values (four highest delta values). The delta parameter (the probabilistic distribution is a better representative of the data set when the delta is higher) along with graphical data adjustment allow one to choose the best probabilistic distribution that models the analysed data.

Table 4-13 Analyzed distribution functions – 24 hour Maximum precipitation

| Distribution | Delta parameter |
|-----------------|-----------------|
| Normal | 16.426 |
| Gumbel | 16.305 |
| Pearson III | 6.377 |
| Log Pearson III | 5.701 |

Table 4-14 Analyzed distribution functions – 48 hour Maximum precipitation

| Distribution | Delta parameter |
|-----------------|-----------------|
| Normal | 13.352 |
| Gumbel | 12.583 |
| Log Pearson III | 7.784 |
| Pearson III | 5.521 |

Table 4-15 Analyzed distribution functions – 72 hour Maximum precipitation

| Distribution | Delta parameter |
|-----------------|-----------------|
| Normal | 12.493 |
| Gumbel | 10.612 |
| Log Pearson III | 8.437 |
| Pearson III | 5.039 |

Table 4-13, Table 4-14 and Table 4-15 show that Normal distribution has the highest delta value, however, it underestimates precipitation as the return period increases (refer to Figure B13 to Figure B15 of Appendix B). Figures B13-B15 of Appendix B also show that Gumbel and Log Pearson III distributions, respectively, underestimate and overestimate precipitation as the return period increases. Pearson III distribution seems to best model the data set for the three scenarios (24-, 48-, and 72- hour storm events).

Table 4-16 shows the predicted maximum precipitation for the 24-, 48-, and 72-hour storms for different return periods.

Table 4-16 Maximum precipitation for the project area

| Return period (year) | 24 hours Maximum precipitation (mm) | 48 hours Maximum precipitation (mm) | 72 hours Maximum precipitation (mm) |
|----------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| 2 | 23 | 27 | 29 |
| 5 | 37 | 45 | 47 |
| 10 | 49 | 59 | 62 |
| 20 | 63 | 74 | 78 |
| 50 | 83 | 95 | 99 |
| 100 | 98 | 110 | 115 |
| 200 | 114 | 127 | 131 |

| Return period (year) | 24 hours Maximum precipitation (mm) | 48 hours Maximum precipitation (mm) | 72 hours Maximum precipitation (mm) |
|----------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| 500 | 136 | 148 | 153 |
| 1000 | 152 | 164 | 169 |
| 2000 | 167 | 181 | 186 |
| 10000 | 207 | 219 | 225 |

The probable maximum precipitation (PMP) for the 24-, 48- and 72-hour (PMP 24h, PMP 48h and 72 hr PMP) is the highest amount of precipitation that is expected to occur during 24, 48 and 72 hours for a storm duration in an area under the worst physical and meteorological conditions. There is no return period (frequency of occurrence) associated with the calculation of the PMP.

PMP was estimated for the study area using the Hershfield statistical method, taking as data the mean of the maximum daily precipitation of the Casummit station. The standard deviation of the maximum daily rainfall of the Casummit station was also used.

The PMP24, PMP48 and PMP72 were estimated following the recommendations of the Manual on Estimation of Probable Maximum Precipitation (WMO, 2009) using the statistical method proposed by (Hershfield, 1965). The methodology requires a correction of the data series, due to the following factors:

- Adjustment of mean of annual series for maximum observed rainfall,
- Adjustment of standard deviation of annual series for maximum observed rainfall,
- Adjustment of mean and standard deviation of annual series for length of record,
- Adjustment for fixed-interval precipitation amounts for number of observational units within the interval, and
- Maximum depth-duration curve.

Average maximum precipitation and standard deviation; these values were multiplied by the respective adjustment factors, resulting in the values shown in Table 4-17. The frequency factor is a function of the average maximum precipitation and the duration of the storm in hours; in addition, it indicates the times that the adjusted standard deviation has to be added to the adjusted average maximum precipitation to determine PMP. Finally, PMP in 24, 48 and 72 hours is calculated by multiplying the PMP with the adjustment factor related to the number of observations and with the adjustment factor for area reduction. Table 4-17 presents the PMP values for the study area.

Table 4-17 Probable Maximum Precipitation (PMP)

| Description | Value PMP 24h | Value PMP 48h | Value PMP 72h |
|------------------------------------|---------------|---------------|---------------|
| Average Maximum Precipitation (mm) | 29.9 | 34.6 | 36.3 |
| PMP (mm) | 236.3 | 352.2 | 417.4 |

Precipitation-duration-frequency (PDF) and intensity-duration-frequency (IDF) curves were developed from the 24-, 48- and 72-hour maximum precipitations, using the structure of disaggregation by duration of the Bell formula (1969). This relationship is valid for durations between 5 and 120 minutes based on maximum rainfall with a duration of 1 hour. In the document Regional rainfall Depth-Duration-Frequency equations for Canada demonstrate the use of Bell's formula in the Ontario region (Younes, 2000), the following equation is shown.

$$R_t^T = [0.21 \times \ln(T) + 0.52][0.54t^{0.25} - 0.5]R_{60 \text{ min}}^{100 \text{ yr}}$$

Where:

t: Durations in minutes

T: Return Period in years

To obtain the precipitation in 60 minutes with a return period of 100 years, the hourly precipitation information from the Casummit station was used. The respective calculations of the relationship Precipitation-Duration-Frequency and Intensity-Duration-Frequency for durations between 5 and 120 minutes are shown in Table 4-18 and Table 4-19, respectively.

Table 4-18 Precipitation-Duration-Frequency

| Duration (min) | Maximum rainfall (mm) | | | | | | | | | | |
|----------------|-----------------------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| | Return Period (years) | | | | | | | | | | |
| | 2 | 5 | 10 | 20 | 50 | 100 | 200 | 500 | 1000 | 2000 | 10000 |
| 5 | 1.3 | 2.2 | 3.1 | 4.1 | 5.6 | 6.9 | 8.4 | 10.6 | 12.4 | 14.3 | 19.3 |
| 10 | 1.9 | 3.3 | 4.6 | 6.1 | 8.4 | 10.4 | 12.6 | 15.8 | 18.5 | 21.4 | 28.9 |
| 15 | 2.3 | 4.0 | 5.6 | 7.4 | 10.3 | 12.7 | 15.4 | 19.3 | 22.6 | 26.2 | 35.4 |
| 20 | 2.7 | 4.6 | 6.4 | 8.5 | 11.7 | 14.5 | 17.5 | 22.0 | 25.8 | 29.8 | 40.4 |
| 30 | 3.2 | 5.5 | 7.6 | 10.1 | 13.9 | 17.2 | 20.9 | 26.2 | 30.7 | 35.5 | 48.0 |
| 40 | 3.6 | 6.1 | 8.5 | 11.3 | 15.6 | 19.3 | 23.4 | 29.5 | 34.5 | 39.9 | 53.9 |
| 50 | 3.9 | 6.7 | 9.3 | 12.4 | 17.1 | 21.1 | 25.6 | 32.1 | 37.6 | 43.5 | 58.8 |
| 60 | 4.2 | 7.2 | 10.0 | 13.3 | 18.3 | 22.6 | 27.4 | 34.4 | 40.3 | 46.6 | 63.1 |
| 90 | 4.9 | 8.3 | 11.6 | 15.4 | 21.2 | 26.2 | 31.8 | 39.9 | 46.7 | 54.1 | 73.1 |
| 120 | 5.4 | 9.2 | 12.8 | 17.0 | 23.5 | 29.0 | 35.2 | 44.2 | 51.7 | 59.8 | 80.9 |
| 24h | 23.1 | 36.5 | 49.3 | 63.3 | 83.0 | 98.5 | 114.3 | 135.5 | 151.8 | 168.4 | 207.2 |
| 48h | 27.5 | 44.7 | 59.1 | 74.2 | 94.7 | 110.5 | 126.5 | 147.9 | 163.9 | 180.9 | 219.1 |
| 72h | 29.1 | 47.5 | 62.5 | 78.0 | 99.0 | 115.0 | 131.2 | 153.0 | 169.2 | 186.3 | 224.8 |

Table 4-19 Intensity-Duration-Frequency

| Duration (min) | Maximum intensity (mm/h) | | | | | | | | | | |
|----------------|--------------------------|------|------|------|------|------|-------|-------|-------|-------|-------|
| | Return Period (years) | | | | | | | | | | |
| | 2 | 5 | 10 | 20 | 50 | 100 | 200 | 500 | 1000 | 2000 | 10000 |
| 5 | 15.4 | 26.4 | 36.7 | 48.8 | 67.2 | 83.2 | 100.8 | 126.7 | 148.2 | 171.5 | 232.0 |
| 10 | 11.5 | 19.8 | 27.5 | 36.5 | 50.3 | 62.2 | 75.4 | 94.8 | 110.9 | 128.3 | 173.6 |
| 15 | 9.4 | 16.1 | 22.4 | 29.7 | 41.0 | 50.7 | 61.5 | 77.3 | 90.4 | 104.6 | 141.5 |

| | | | | | | | | | | | |
|-----|-----|------|------|------|------|------|------|------|------|------|-------|
| 20 | 8.0 | 13.8 | 19.2 | 25.4 | 35.1 | 43.4 | 52.6 | 66.1 | 77.4 | 89.5 | 121.1 |
| 30 | 6.4 | 10.9 | 15.2 | 20.2 | 27.8 | 34.4 | 41.7 | 52.4 | 61.4 | 71.0 | 96.0 |
| 40 | 5.4 | 9.2 | 12.8 | 17.0 | 23.4 | 29.0 | 35.2 | 44.2 | 51.7 | 59.8 | 80.9 |
| 50 | 4.7 | 8.0 | 11.2 | 14.8 | 20.5 | 25.3 | 30.7 | 38.6 | 45.1 | 52.2 | 70.6 |
| 60 | 4.2 | 7.2 | 10.0 | 13.3 | 18.3 | 22.6 | 27.4 | 34.4 | 40.3 | 46.6 | 63.1 |
| 90 | 3.2 | 5.6 | 7.7 | 10.2 | 14.1 | 17.5 | 21.2 | 26.6 | 31.2 | 36.0 | 48.8 |
| 120 | 2.7 | 4.6 | 6.4 | 8.5 | 11.7 | 14.5 | 17.6 | 22.1 | 25.9 | 29.9 | 40.5 |
| 24h | 1.0 | 1.5 | 2.1 | 2.6 | 3.5 | 4.1 | 4.8 | 5.6 | 6.3 | 7.0 | 8.6 |
| 48h | 0.6 | 0.9 | 1.2 | 1.5 | 2.0 | 2.3 | 2.6 | 3.1 | 3.4 | 3.8 | 4.6 |
| 72h | 0.4 | 0.7 | 0.9 | 1.1 | 1.4 | 1.6 | 1.8 | 2.1 | 2.3 | 2.6 | 3.1 |

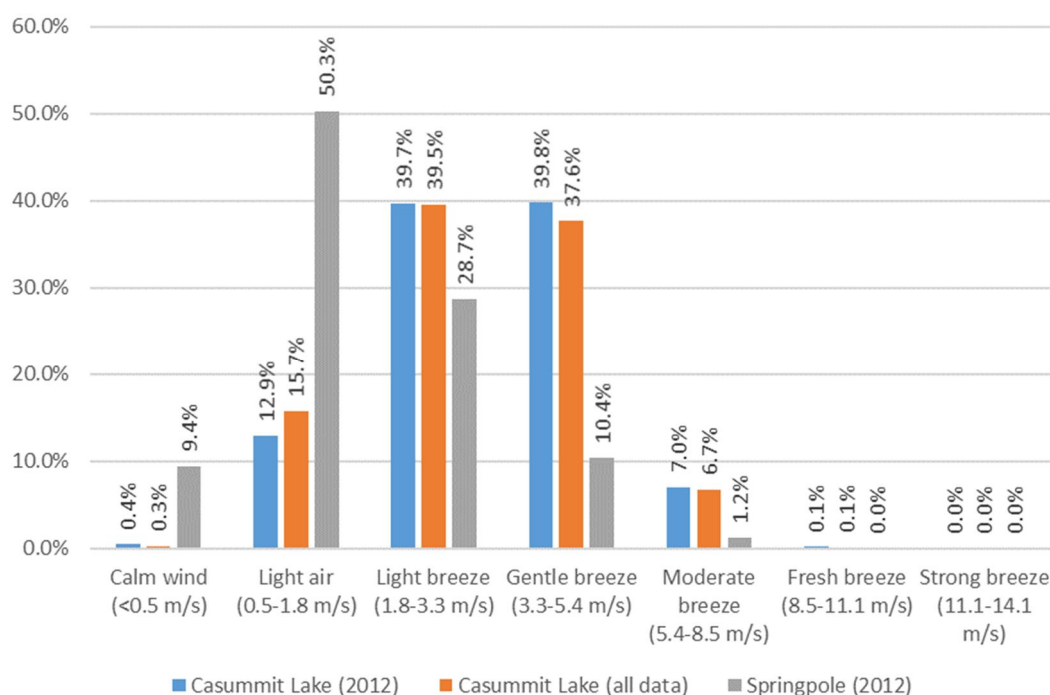
4.4.5 Wind

Springpole station only had one complete year of wind data, i.e. 2012. Therefore, it was only possible to compare the year 2012 data for the Casummit Lake and Springpole Stations to demonstrate that Casummit Lake data is representative of the Project area. Then, the entire period from 2008 to 2020 for the Casummit Lake station was processed and used in this study.

Data for Casummit Lake station indicated that in 2012, average daily wind speed ranged from 0.9 m/s to 6.3 m/s. The highest wind speed sustained over 1 hour was 9.4 m/s. Calm periods, with wind speeds less than 0.5 m/s (1 knot) occurred 0.43% of the time (Figure 4.29 and Figure B.10 of Appendix B). The wind classes with the highest frequencies at 39.8% and 39.7% were for the category of 'gentle breeze' (3.3-5.4 m/s) and 'light breeze' (1.8-3.3 m/s), respectively, according to the Beaufort Scale (Transport Canada, 2003).

Springpole station's 2012 data indicated that the average daily wind speeds ranged from 0.3 m/s to 5.8 m/s. The highest wind speed sustained over 1 hour was 9.0 m/s. Calm periods, with wind speeds less than 0.5 m/s (1 knot) occurred 9.4% of the time (Figure 4.29). The wind class with the highest frequency at 50.3% was for 0.5-1.8 m/s, the category of 'light air' according to the Beaufort Scale (Transport Canada, 2003).

Figure 4.29 Wind Class Frequency Distribution



Mean monthly speed values for Casummit Lake are presented in Table A.10 of Appendix A indicated small variability in the period from 2008 to 2020 where the average wind speed from 2.9 m/s to 3.3 m/s with a coefficient of variation of 4%) for each month. This suggests some regular pattern on wind velocities on average. This is consistent with the constant average values (with only a few irregular extreme values including a sudden increase in 2011) observable in Figure B.11 of Appendix B. A similar pattern can be observed for the maximum monthly wind speed presented in Table A.11 of Appendix A as the multi-year average values for all months are very similar to each other ranging from 3.1 m/s to 3.5 m/s with a coefficient of variation of 4%.

While the highest percentage of calm and light air was observed at the Springpole Station, Casummit Lake Station had significantly higher percentages of stronger winds (moderate breeze and higher). The higher percentage of stronger winds may be attributed to the location of the meteorological station (e.g., close to the water bodies) resulting in higher wind speeds.

Wind speed and directions were modelled on Wind Rose plots for the Springpole data (Figure 4.30) and Casummit Lake data (Figure 4.31) for the common time period for comparison. The entire wind record for the Casummit Lake data is present in Figure 4.32. The Wind Rose plot for the 2012 data for Casummit Lake indicated a distinct multimodal wind distribution during 2012. More than 50% of the time the winds came from the west, including most of the strongest winds above 8.0 m/s (from WSW). This wind direction represents wind blowing across the Casummit Lake station (only 10 km away from the project area). The greatest proportion of light and gentle breeze, wind speeds between 2 m/s and 5 m/s, came from the west while little wind came from the east. It can be seen in Figure 4.32 that the wind data (in value and direction) for the entire record, i.e. July 2008 to July 2020 appears to have a similar pattern to that of the 2012 data.

Springpole's Wind Rose plot (Figure 4.30) indicates a distinct bimodal wind distribution during 2012. More than 25% of the time the winds came from the northwest, including most of the strongest winds above 3.5 m/s. The secondary wind direction is southeast where the winds

came about 20% of the time. This wind direction represents wind blowing across the project area from Springpole Lake. The greatest proportion of light air, wind speeds less than 2 m/s, came from this direction. Very little wind came from the north to east sector or from the southwest. Analysis of the data according to time of day suggested that there is no apparent pattern of wind speed or direction based on time of day.

Overall, the wind data recorded at Springpole appears to have little similarity to that of Casummit Lake.

Figure 4.30 Springpole Wind Rose for 2012

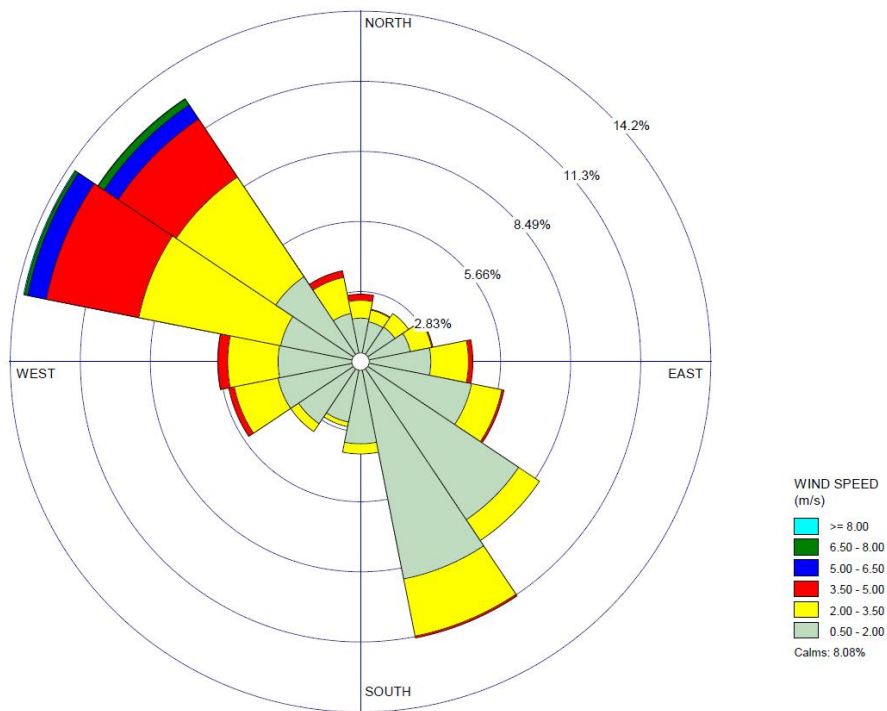


Figure 4.31 Casummit Lake Wind Rose for 2012

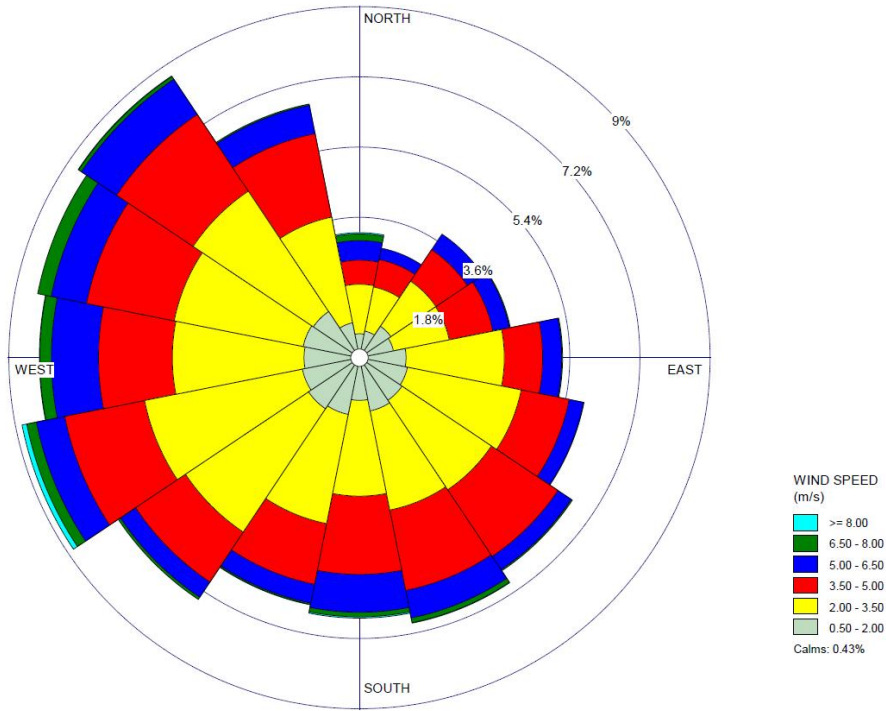
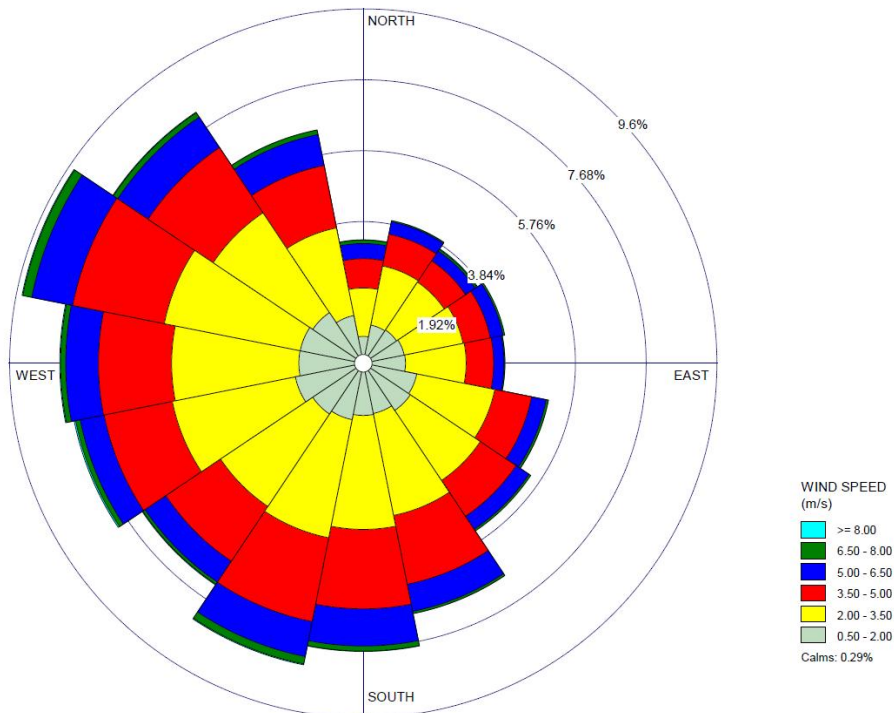


Figure 4.32 Casummit Lake Wind Rose for all data recorded



4.4.6 Potential Evapotranspiration

No pan evaporation data in the Project area nor evaporation estimates for the regional climates station was available at the time of this study. Therefore, potential evapotranspiration values were used to calculate evaporation. Monthly Potential Evapotranspiration (ET) data was calculate using commonly used empirical relationships established by Hargreaves (Hargreaves and Samani, 1985).

The Hargreaves equation uses mean, minimum and maximum daily temperature values, as well as the site Latitude to estimate the monthly ET. The Hargreaves equation is as follows:

$$ET_o = 0.0135(t_{mean} + 17.78)R_s \tag{1}$$

Where:

$$ET_o = \text{Daily potential evapotranspiration} \left(\frac{mm}{day} \right)$$

$$R_s = \text{Water equivalent of extraterrestrial solar radiation} \left(\frac{mm}{day} \right)$$

$$t_{mean} = \text{Mean daily temperature } ^\circ C$$

And:

$$R_s = R_o * KT * (t_{max} - t_{min})^{0.5} \tag{2}$$

Where:

$$R_o = \text{Extraterrestrial Solar Radiation} (MJ m^{-2} day^{-1})$$

$$KT = \text{Coefficient}$$

$$t_{max} = \text{Maximum daily temperature } ^\circ C$$

$$t_{min} = \text{Minimum daily temperature } ^\circ C$$

To evaluate the Extraterrestrial Solar Radiation (Ro), the monthly average insolation values presented in Table 4-24, and daily maximum and minimum temperatures for Casummit Lake station were used in this analysis.

The KT coefficient in equation (2) is an empirical coefficient that can be calculated from atmospheric pressure data, but Hargreaves recommends using the following coefficients:

- For interior regions (KT = 0.162)
- For coastal regions (KT = 0.19)

According to Hargreaves's recommendation, the coefficient KT of 0.162 was used to estimate the Extraterrestrial Solar Radiation. Table A.12 of appendix A shows the monthly evapotranspiration values in mm assigned to the project.

The monthly average values range between 1.3 mm (January) and 178.7 mm (July). Values for the means, standard deviations and proportions with respect to the annual total ET of the estimated monthly ETs are presented in Table 4-20.

Table 4-20 Monthly Potential Evapotranspiration

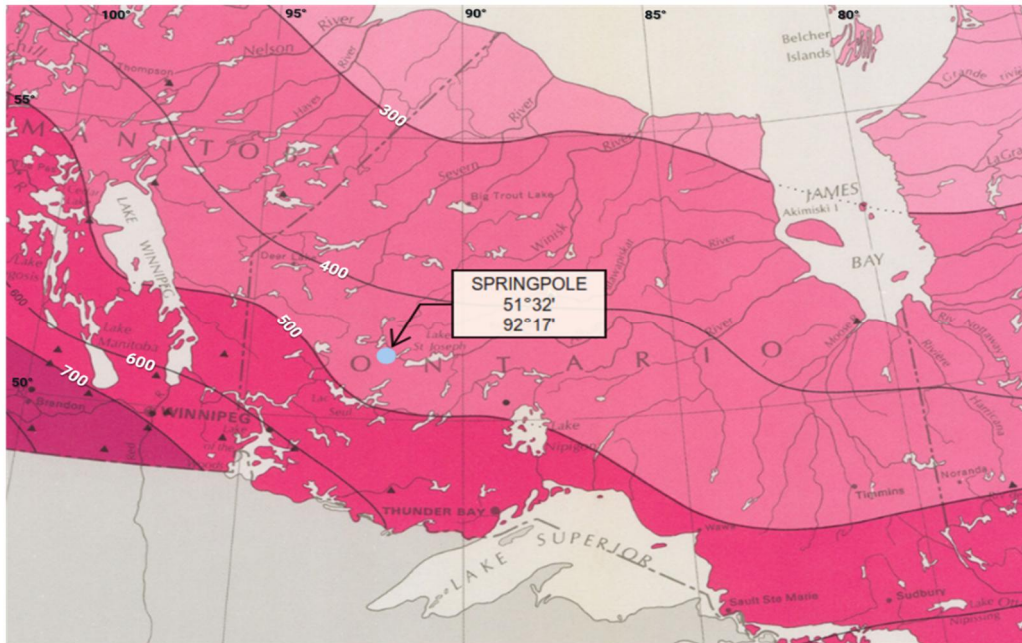
| Month | Average (mm) | Stan. Dev. (mm) | % Annual |
|-----------|--------------|-----------------|----------|
| January | 1.3 | 1.4 | 0% |
| February | 4.4 | 3.7 | 1% |
| March | 28.0 | 7.0 | 4% |
| April | 65.8 | 12.5 | 8% |
| May | 114.0 | 9.5 | 15% |
| June | 144.0 | 11.6 | 19% |
| July | 178.7 | 16.3 | 23% |
| August | 132.8 | 9.3 | 17% |
| September | 75.4 | 9.5 | 10% |
| October | 22.7 | 3.6 | 3% |
| November | 6.7 | 1.7 | 1% |
| December | 2.1 | 1.3 | 0% |
| Annual | 775.9 | 41.0 | 100% |

4.4.7 Lake Evaporation

Due to the lack of evaporation data near the Springpole Lake, the Mean Annual Lake Evaporation Map from the Hydrology Atlas of Canada was used to estimate the lake evaporation for the project area. Figure 4.33 shows the mean annual lake evaporation of 460 mm for the project location.

To obtain the monthly lake evaporation, the same monthly distribution obtained for the evapotranspiration (ET) for the project area (refer to Section 4.4.6) was applied to this annual lake evaporation value which resulted in a coefficient of 0.593. Accordingly, the monthly lake evaporation was estimated by multiplying the ET by this coefficient.

Figure 4.33 Mean Annual Lake Evaporation



Source: Mean Annual Lake Evaporation Map from the Hydrology Atlas of Canada

Table 4-21 shows the maximum, minimum and monthly lake evaporation values assigned to the project as well as the monthly distribution (% Annual). Table A.13 of Appendix A presents the monthly lake evaporation values assigned to the project.

Table 4-21 Monthly Lake Evaporation

| Month | Maximum (mm) | Average (mm) | Minimum (mm) | Monthly Distribution (% Annual) |
|-----------|--------------|--------------|--------------|---------------------------------|
| January | 2 | 1 | 0 | 0% |
| February | 7 | 3 | 0 | 1% |
| March | 25 | 17 | 9 | 4% |
| April | 53 | 39 | 27 | 8% |
| May | 77 | 68 | 54 | 15% |
| June | 97 | 85 | 72 | 19% |
| July | 121 | 106 | 82 | 23% |
| August | 87 | 79 | 66 | 17% |
| September | 56 | 45 | 36 | 10% |
| October | 16 | 13 | 8 | 3% |
| November | 6 | 4 | 2 | 1% |
| December | 3 | 1 | 0 | 0% |

| Month | Maximum (mm) | Average (mm) | Minimum (mm) | Monthly Distribution (% Annual) |
|--------|--------------|--------------|--------------|---------------------------------|
| Annual | 495 | 460 | 400 | 100% |

In order to obtain the annual lake evaporation for extreme periods, i.e. dry and wet years, the estimated annual lake evaporation series were adjusted to different probabilistic distributions. Table 4-22 shows the goodness-of-fit delta values estimated using Hydraccess v.4.3 software for the probabilistic distributions that had the top four delta values (four highest delta values). The delta parameter (the probabilistic distribution is a better representative of the data set when the delta is higher) along with the graphical data adjustment allow one to choose the best probabilistic distribution that fits the analysed data.

Pearson III and Pearson V distributions were discarded because they had the lowest delta values. Table 4-22 shows that Log Pearson III and Gumbel distributions have the highest delta parameter. Figure B.12 of appendix B shows that Log Pearson III graphically best fits the data set, and therefore, was selected as the representative probabilistic distribution model for the data set.

Table 4-22 Probabilistic models - ET

| Models | Delta Parameters |
|-----------------|------------------|
| Gumbel | 7.462 |
| Pearson III | 6.755 |
| Pearson V | 6.908 |
| Log Pearson III | 7.462 |

Table 4-23 shows the annual lake Evaporation for wet and dry years for different return periods. Table A.14 of Appendix A shows the monthly lake evaporation determined according to the proportion in the average year.

Table 4-23 Dry and wet years – Lake Evaporation

| Return Periods (Years) | Dry year (mm) | Wet year (mm) |
|------------------------|---------------|---------------|
| 500 | 543 | 393 |
| 200 | 533 | 399 |
| 100 | 525 | 404 |
| 50 | 517 | 410 |
| 20 | 504 | 419 |
| 10 | 493 | 427 |

4.4.8 Solar radiation

No solar radiation data was available for the Casummit Lake station. Therefore, the only available data, i.e. the daily average insolation data for the Springpole Station (2011-2012) was used in this study. The data is presented in Table 4-24 on mean monthly basis.

This data indicates that the Project area receives the most sunlight energy during the summer months, with energy peaking between June and July and that the least amount of insolation occurs during the winter with minimal sunlight energy in December. The sun provides approximately six times more energy during the months near the summer solstice (May, June, and July) than the months near the winter solstice (November, December, and January).

Table 4-24 Mean monthly insolation for the project area

| Month | Insolation (MJ/m ² /d) | | |
|--------|-----------------------------------|------|---------|
| | 2011 | 2012 | Average |
| Jan | 4.6 | 3.8 | 4.2 |
| Feb | 8.4 | 8.4 | 8.4 |
| Mar | 14.1 | 11.8 | 12.9 |
| Apr | 17.4 | 18.5 | 18.0 |
| May | 18.8 | 17.3 | 18.0 |
| Jun | 20.6 | 18.3 | 19.4 |
| Jul | 19.8 | 23.3 | 21.5 |
| Aug | 17.8 | 15.8 | 16.8 |
| Sep | 13.4 | 12.2 | 12.8 |
| Oct | 7.1 | 5.6 | 6.3 |
| Nov | 3.4 | 3.3 | 3.4 |
| Dec | 2.7 | 2.7 | 2.7 |
| Annual | 12.4 | 11.7 | 12.1 |

4.4.9 Sublimation

Due to the lack of sublimation data near the Springpole Lake, Pomeroy and Gray's method (Pomeroy and Gray, 1994) was used to estimate the sublimation for the project area since the data used to establish the empirical relationships in this method was similar to that of Springpole Lake area with respect to the climate, temperature, and wind. It should be noted that while the current vegetation at the project area (boreal forest) is somewhat different from that of Pomeroy and Gray's, the project area will not have trees during operations. Therefore, this method seems to be appropriate for estimating sublimation at the project area during operations with respect to the vegetation cover.

Pomeroy and Gray's method has been widely used to calculate monthly and annual snow transportation and sublimation in the Canadian Prairies and is a physically based blowing snow model. In this method, the most important variable is the mean wind speed which has a linear relationship with monthly snow transportation and sublimation. Secondly, snow transportation and sublimation increase with decreasing monthly mean temperature. Snow transportation increases slightly with increasing humidity because sublimation is suppressed. Both transportation and sublimation from fallow-fields increase with increasing snowfall, however, over stubble they increase exponentially with increasing depth of snow on the ground for depths equal to or less than the height of vegetation.

To estimate the sublimation, the mean maximum temperature and snow data presented in Table A.3 and Table A.8 of appendix A, respectively, were used. According to the snow data, snow depth is zero in the study area in June, July and August. Snowmelt was considered to occur in the months of April and May after reviewing the climate data (temperature, total precipitation, snow depth, etc.). According to Pomeroy and Gray, the mean monthly sublimation/snowfall ratio (sublimation percentage) decreases with increasing monthly maximum temperature and sublimation percentage is zero when monthly maximum temperature is above zero degree Celsius (Pomeroy and Gray, 1994). Table 4-25 shows the estimated sublimation for the project area indicating the average annual sublimation of 12%.

Table 4-25 Sublimation percentage (%)

| Month | Max Monthly Average Temperature (°C) | Sublimation Percentage (%) |
|-----------|--------------------------------------|----------------------------|
| January | -12.45 | 40% |
| February | -10.39 | 39% |
| March | -0.81 | 25% |
| April | 6.37 | 0% |
| May | 13.08 | 0% |
| June | 18.15 | 0% |
| July | 21.55 | 0% |
| August | 18.69 | 0% |
| September | 16.11 | 0% |
| October | 6.67 | 0% |
| November | 1.31 | 0% |

| Month | Max Monthly Average Temperature (°C) | Sublimation Percentage (%) |
|------------------|--------------------------------------|----------------------------|
| December | -7.46 | 37% |
| Annual (Average) | 5.90 | 12% |

4.4.10 Trend Analysis with Climate Change

This chapter describes future trends under climate change scenarios developed by the Coupled Model Intercomparison Project (CMIP5) of the global climate research program. The following greenhouse gas simulation scenarios (Representative Concentration Pathways (RCPs): RCP4.5 and RCP8.5 where numbers refer to radiative forcing levels for each RCP) were considered:

- RCP4.5: RCP4.5 is a greenhouse gas concentration (not emissions) trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). RCP4.5 is described by the IPCC as an intermediate scenario. Emissions in RCP4.5 peak around 2040, then decline. RCP4.5 is a stabilization scenario which means the radiative forcing level stabilizes at 4.5 W/m² before 2100 by employment of a range of technologies and strategies for reducing greenhouse gas emissions (favourable), and
- RCP8.5: RCP8.5 is a scenario with a very high level of greenhouse gas emissions and generally taken as the basis for worst-case climate change scenarios (unfavourable). In RCP8.5 emissions continue to rise throughout the 21st century.

The results are presented for the following 3 future scenarios:

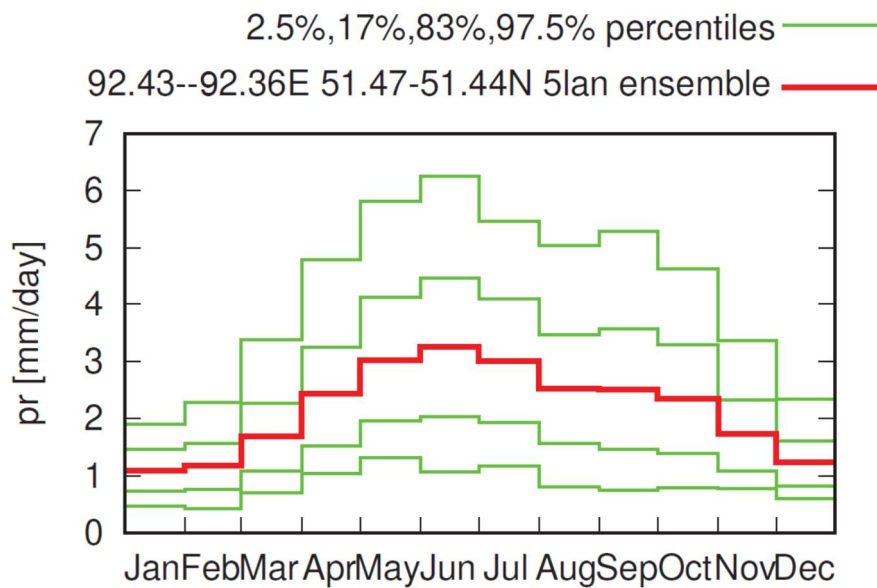
- Immediate future (2021-2030),
- Near future (2031-2050), and
- Far future (2051-2100).

The model selected for this analysis is ACCESS1-3 because it presents an annual cycle similar to the Casummit Lake data.

4.4.10.1 Rainfall

Figure 4.34 shows the annual cycle of the monthly rainfall for the ACCESS1-3 model, which is consistent with the annual cycle of the Casummit Lake data. Table 4-26 shows the slopes obtained from the future scenarios obtained from the Access1-3 model. It is observed that the most predominant slope is the positive one indicating an increase in the future precipitation data.

Figure 4.34 Annual Cycles of ACCESS1-3 model – Rainfall (pr: precipitation is equal to rainfall)



Source: https://climexp.knmi.nl/selectfield_c mip5.cgi?id=someone@somewhere

Table 4-26 Slope for Future Scenarios of Rainfall Data

| Future | RCP4.5 (mm/year) | RCP8.5 (mm/year) |
|-----------------------|------------------|------------------|
| Immediate (2021-2023) | 0.1967 | -0.0877 |
| Near (2031-2050) | 0.0146 | 0.0073 |
| Far (2051-2100) | -0.0144 | 0.0028 |

For the RCP4.5 scenario (favorable), there will be an increase of 0.1967 and 0.0146 mm/year in the rainfall for the immediate future and near future, respectively. For the distant future, however, a negative slope was observed indicating that there will be a decrease in the rainfall (-0.0144 mm/year).

For the RCP8.5 scenario (unfavorable), the rainfall shows a negative slope of -0.0877 mm/year for the immediate future which is in agreement with the negative slope for the Casummit Lake rainfall data for 2009-2018 (refer to Figure 4.26). For the near future and far future, however, the rainfall shows positive slopes of 0.0073 mm/year and 0.0028 mm/year, respectively, indicating increase in the rainfall.

Figure 4.35 and Figure 4.36 show the data for future rainfall for both scenarios RCP4.5 and RCP8.5 for all three future scenarios considered in the analysis.

Figure 4.35 RCP4.5 – Rainfall (Vertical Axes: Rainfall (mm) and Horizontal Axes: Years after 2021 (yr))

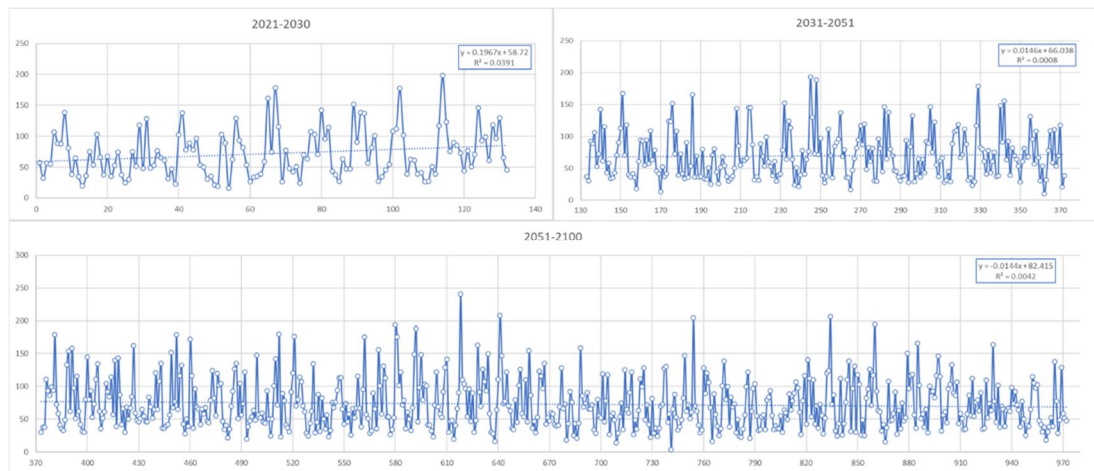
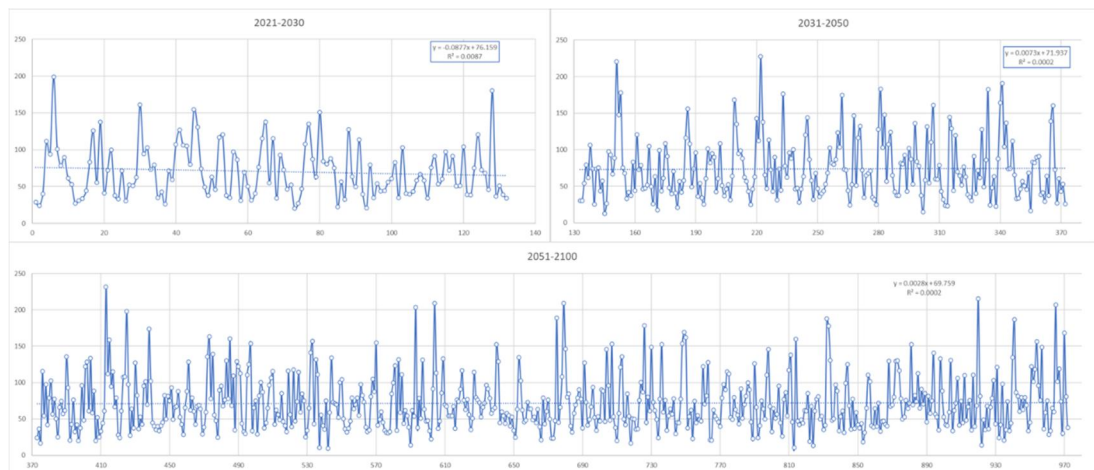


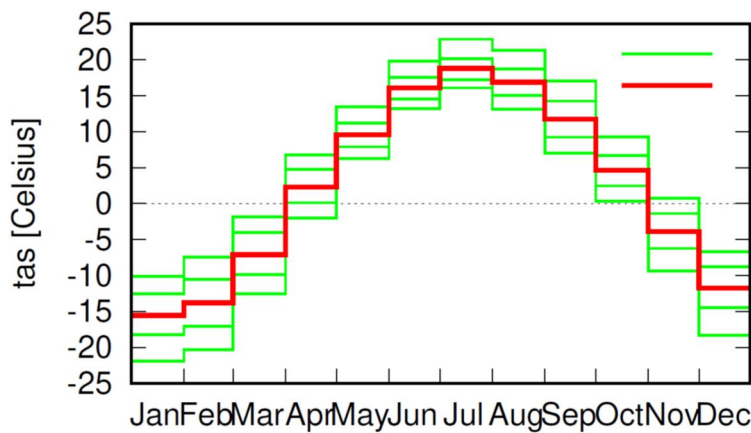
Figure 4.36 RCP8.5 – Rainfall (Vertical Axes: Rainfall (mm) and Horizontal Axes: Years after 2021 (yr))



4.4.10.2 Mean Temperature

Figure 4.37 shows the annual cycle of mean temperatures for the ACCESS1-3 model, which is consistent with the annual cycle of the Casummit Lake historical data. The analysis resulted in positive slopes for all three future scenarios indicating an increase in the future mean (average) temperatures (refer to Table 4-27).

Figure 4.37 Annual Cycles of ACCESS1-3 model – Temperature (tas: temperature ((°C))



Notes:

- 1) Green Lines: 2.5%,17%,83%,97.5% percentiles
- 2) Red Lines: mean ACCESS1-3 historical tas -92.43--92.36E 51.47-51.44N 5lan ensemble
- 3) https://climexp.knmi.nl/selectfield_c mip5.cgi?id=someone@somewhere

Table 4-27 Slope for future information of mean temperature data

| Future | RCP4.5 (°C/year) | RCP8.5 (°C/year) |
|-----------------------|------------------|------------------|
| Immediate (2021-2023) | 0.0108 | 0.0239 |
| Near (2031-2050) | 0.0026 | 0.0013 |
| Far (2051-2100) | 0.0044 | 0.0104 |

For the RCP4.5 scenario (favourable), the analysis showed positive slopes for all future scenarios indicating an increase in the average annual temperatures at the rates of 0.0108, 0.0026 and 0.044 °C/year for immediate, near and far future, respectively.

For the RCP85 scenario (unfavorable), the analysis showed positive slopes for all future scenarios indicating an increase in the average annual temperatures at the rates of 0.0239, 0.0013 and 0.0104 °C/year for immediate, near and far future, respectively.

Figure 4.38 and Figure 4.39 show the data for annual average temperatures for both RCP4.5 and RCP8.5 for all three future scenarios considered in the analysis.

Figure 4.38 RCP4.5 – Temperature (Vertical Axes: Temperature (°C) and Horizontal Axes: Years after 2021 (yr))

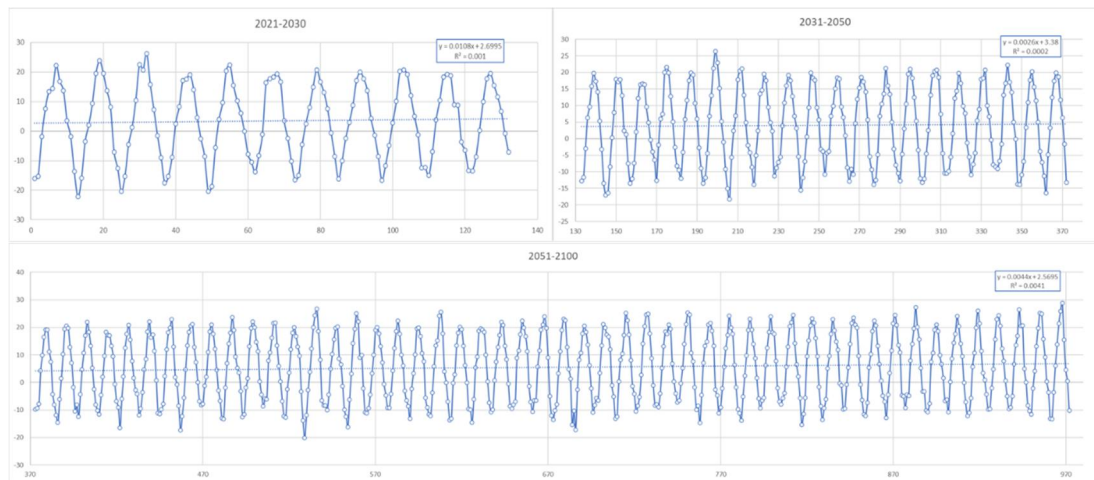
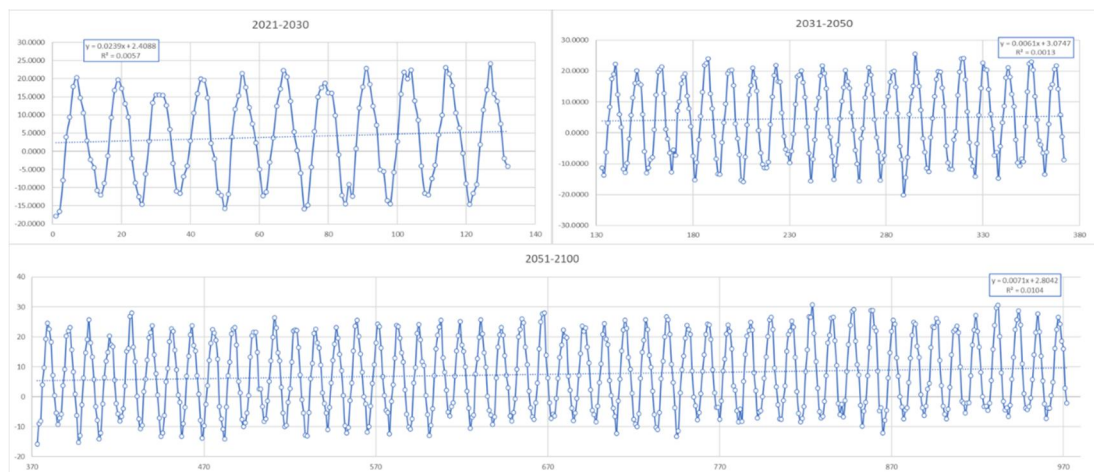


Figure 4.39 RCP8.5 – Temperature (Vertical Axes: Temperature (°C) and Horizontal Axes: Years after 2021 (yr))



5 Conclusions and recommendations

5.1 Conclusions

Northern Ontario’s climate is mainly continental with cold winters and mild summers. The region is primarily influenced by three major air mass groups – arctic air masses bringing cold and relatively dry air from the north, temperate air masses coming in from the Pacific, and with a smaller influence, tropical air masses bringing warm moist air to the region from the south. The Project area’s local topography poses few barriers to oncoming weather systems.

Careful comparisons of the Casummit Lake data with the available historical data from the Springpole Lake weather station which only had less than two years of data (2011 to 2013) indicated that the Casummit Lake data set was representative for the Project area. Therefore, in the absence of any active weather stations at the Project area, the Casummit Lake meteorological station (10 km from the Springpole Project) was used in this study for all statistical analyses.

According to the analyses on the data obtained from the Casummit Lake (2008 to 2020) and Springpole Lake (2011 to 2013) meteorological stations presented in section 4, the following highlights were observed:

- For the only year when the two stations had complete data, i.e. year 2012, the minimum and maximum air temperatures for the Casummit Lake were -32 °C (January) and 34 °C (July), respectively, similar to the values for the Springpole Lake (both in time and magnitude) with a minimum of -35.3 °C and a maximum of 34.8 °C, respectively,
- Based on the Casummit Lake data between 2008 to 2020, the coldest month in the Project area is January with a mean temperature of -17 °C and the warmest month is July with 18.7 °C (Table A3 of Appendix A),
- The pattern of mean monthly temperatures for Casummit Lake and Springpole at their common data time period from 2011 to 2013 were similar, reinforcing the representativity of the Casummit Lake meteorological station data for project area in terms of temperature,
- The climate change analysis for the average temperatures showed positive slopes for all considered scenarios indicating an increase in the future temperature values,
- For the common data time period from 2011 to 2013, while the monthly atmospheric pressure values were higher for Springpole than those of the Casummit Lake, the month by month variations were similar for both stations. For Casummit Lake's data from 2008 to 2020, the average values of the atmospheric pressure seem to have a seasonal pattern which is consistent with its 2012 pattern both in terms of values and trends,
- For the common data time period (2012), relative humidity data for the Casummit Lake are mostly larger than those of Springpole Lake. However, data for both stations indicates a moderately humid climate. Casummit Lake's data from 2008 to 2020 shows a consistent pattern through the years with average monthly values ranging from 59.1% in July to 95.3% in January,
- The total precipitation in 2012 was 444.9 mm at Casummit Lake and 476.8 mm at Springpole. The precipitation trends for the two stations are similar for the summer months (between May and September) when rainfall occurs (Springpole recorded more rainfall than the Casummit Lake in 2012 even though the two stations are only 10 km apart),
- Although the snow depth values were higher for Springpole than Casummit Lake in 2012, the values for the two stations show a similar variation pattern. This pattern remains the same through years when analysing the Casummit Lake's data from 2008 to 2020, excepts for the extraordinary high values in the last two years (2019 and 2020),
- In 2012, the snow depths recorded at Springpole were higher than Casummit Lake in winter. Casummit Lake started the year with 18.0 cm of snow and Springpole with 38.9 cm, but the yearly trends for the two stations were very similar to each other,
- Analysing the Casummit Lake's data from 2008 to 2020 indicates that the regional rainfalls has a seasonal pattern that repeats annually. There is an extraordinary increase in the rainfall values in 2019 and 2020,
- Climate change analyses for the rainfall indicated the following:
 - For the RCP8.5 scenario (unfavourable or worst-case scenario), the rainfall showed a negative slope for the immediate future which is in agreement with the negative slope for the Casummit Lake rainfall data for 2009-2018 (refer to Figure 4.26). For the near future and far future, however, the rainfall shows positive slopes indicating an increase in the rainfall.

- For the RCP4.5 scenario (favourable scenario), the rainfall showed positive slopes for the immediate future and near future indicating an increase in the rainfall. For the distant future, however, a negative slope was observed indicating a decrease in the rainfall.
- In 2012, the wind distribution at Casummit Lake was noticeably multimodal with west as the predominant region where the wind blows from. Light air and Light Breeze (1.8-3.3 and 3.3-5.4 m/s, respectively) have the major frequencies in the same year. Both distribution and frequency were consistent with those for the Casummit Lake's multi-year data (2008 to 2020),
- No solar radiation data was available for the Casummit Lake station. Therefore, daily average insolation data for the Springpole station (2011 to 2012) was used in estimating the potential evapotranspiration,
- The potential evapotranspiration was estimated based on the daily maximum and minimum temperatures of the Casummit Lake station using the Hargreaves method. The resulted average monthly potential evapotranspiration was between 1.3 mm for January and 178.7 mm for July and the multi-year potential evapotranspiration was 775.9 mm,
- The lake evaporation was estimated by applying the monthly distribution of the evapotranspiration (ET) obtained in this study to the value of the Mean Annual Lake Evaporation obtained from the Mean Annual Lake Evaporation Map (from the Hydrology Atlas of Canada) for the project location. The resulted average monthly evaporation was between 0.8 mm for January and 106.0 mm for July and the multi-year (2009-2019) evaporation was 460.0 mm,
- Although comparing the data for the Springpole and Casummit Lake meteorological stations showed that most meteorological parameters had similar values/patterns in the two stations during the time period that the data was available for both stations (2011 to 2013, approximately), the observed differences indicated that the Springpole Lake Project Area may have a microclimate (at least with regard to some meteorological parameters, e.g. the rainfall) that is different from that of the region or Casummit Lake area even though they are only 10 km apart. This observation is consistent with the result of the Meteorology Baseline Study Report (DST 2013) indicating similar differences between the Springpole meteorological data and the other regional stations used in the study (Red Lake and Pickle Lake (AUT) Meteorological Stations), and
- Summary of the most important meteorological parameters discussed in this study is presented in the following tables:

Table 5-1 Climate Data Summary

| Parameter | Mean daily minimum temperature | Mean daily maximum temperature | Mean monthly temperature | Mean monthly Atmospheric pressure | Mean monthly relative humidity | Total monthly precipitation | Total monthly snow depth | Total monthly Snow Water Equivalent | Total monthly rainfall | Mean monthly wind speed | Maximum monthly wind speed | Monthly Potential ET ⁽¹⁾ | Monthly Lake Evaporation | Monthly Sublimation |
|-----------|--------------------------------|--------------------------------|--------------------------|-----------------------------------|--------------------------------|-----------------------------|--------------------------|-------------------------------------|------------------------|-------------------------|----------------------------|-------------------------------------|--------------------------|---------------------|
| Unit | °C | °C | °C | kPa | % | mm | cm | mm | mm | m/s | m/s | mm | mm | % |
| January | -28.4 | -3.5 | -17.0 | 101.9 | 94.7 | 25.0 | 20.3 | 24.2 | 0.7 | 3.1 | 3.3 | 1.3 | 1 | 40 |
| February | -26.1 | -4.1 | -15.6 | 102.0 | 94.4 | 20.8 | 16.0 | 19.1 | 1.8 | 3.0 | 3.2 | 4.4 | 3 | 39 |
| March | -20.5 | 2.6 | -7.0 | 101.9 | 92.5 | 35.5 | 23.5 | 27.7 | 7.8 | 3.1 | 3.4 | 28.0 | 17 | 25 |
| April | -8.5 | 9.4 | 0.5 | 101.7 | 78.9 | 36.3 | 16.0 | 18.8 | 17.4 | 3.2 | 3.4 | 65.8 | 39 | 0 |
| May | 0.2 | 18.8 | 10.0 | 101.4 | 63.2 | 51.4 | 4.1 | 4.8 | 46.6 | 3.3 | 3.5 | 114.0 | 68 | 0 |
| June | 8.2 | 22.7 | 16.2 | 101.1 | 65.2 | 68.2 | 0.0 | 0.0 | 68.2 | 3.2 | 3.4 | 144.0 | 85 | 0 |
| July | 12.3 | 24.5 | 18.7 | 101.1 | 67.3 | 58.1 | 0.0 | 0.0 | 58.1 | 3.2 | 3.3 | 178.7 | 106 | 0 |
| August | 10.1 | 24.2 | 17.5 | 101.2 | 68.9 | 39.7 | 0.0 | 0.0 | 39.7 | 3.0 | 3.1 | 132.8 | 79 | 0 |
| September | 4.0 | 20.3 | 11.6 | 101.4 | 75.4 | 44.3 | 0.4 | 0.4 | 43.9 | 3.3 | 3.5 | 75.4 | 45 | 0 |
| October | -3.6 | 12.3 | 4.0 | 101.4 | 82.4 | 51.5 | 12.6 | 14.9 | 36.7 | 3.3 | 3.5 | 22.7 | 13 | 0 |
| November | -16.0 | 4.5 | -4.9 | 101.6 | 88.6 | 28.5 | 17.1 | 20.2 | 8.3 | 3.3 | 3.5 | 6.7 | 4 | 0 |
| December | -25.4 | -3.0 | -14.1 | 101.9 | 94.1 | 21.4 | 16.5 | 19.6 | 1.8 | 2.9 | 3.2 | 2.1 | 1 | 37 |
| Total | - | - | - | - | - | 480.9 | 126.3 | 149.9 | 331.0 | - | - | 775.9 | 461.0 | - |

Notes:

1) ET: Evapotranspiration

Table 5-2 Climate Data Summary

| Parameter | Total monthly precipitation (rainfall + Snow) | Total monthly rainfall | Total monthly Snow fall | Total monthly Snowmelt 1 | Total monthly Rainfall and Snowmelt distribution |
|-----------|---|------------------------|-------------------------|--------------------------|--|
| Unit | mm | mm | mm | mm | mm |
| January | 25.0 | 0.7 | 24.2 | 0 | 0.7 |
| February | 20.8 | 1.8 | 19.1 | 0 | 1.8 |
| March | 35.5 | 7.8 | 27.7 | 0 | 7.8 |
| April | 36.3 | 17.4 | 18.8 | 74.3 | 91.7 |
| May | 51.4 | 46.6 | 4.8 | 60.3 | 106.8 |
| June | 68.2 | 68.2 | 0.0 | 0.0 | 68.2 |
| July | 58.1 | 58.1 | 0.0 | 0.0 | 58.1 |
| August | 39.7 | 39.7 | 0.0 | 0.0 | 39.7 |
| September | 44.3 | 43.9 | 0.4 | 0.4 | 44.3 |
| October | 51.5 | 36.7 | 14.9 | 14.9 | 51.5 |
| November | 28.5 | 8.3 | 20.2 | 0 | 8.3 |
| December | 21.4 | 1.8 | 19.6 | 0 | 1.8 |
| Total | 480.9 | 331.0 | 149.9 | 149.9 | 480.9 |

Notes:

- 1) Snowfall reported from November to March, melting was assumed in April and May.

5.2 Recommendations

A meteorological station needs to be installed at the Springpole Lake Project Area and record data on hourly basis. Such data then must be used to evaluate/validate the results presented in the current study since this study was based on the meteorological data obtained from the Casummit Lake meteorological station from 2008 to 2020 as well as the historical meteorological data from the Springpole Lake Project meteorological station from 2011 to 2013. It must be also noted that the mentioned datasets did not provide all information required for conducting this study. For instance, no evaporation or solar radiation data was available at the time of the current study. It is our understanding that a weather station has been installed during the writing of this study.

A fully operational on-site meteorological station at the Springpole Lake Project Area is of particular importance for the next phases of the Project since the results of the current study as well as the previous Meteorology Baseline Study (DST 2013) both suggest that the Springpole Lake Project Area may have a microclimate somewhat different from nearby meteorological stations.

It is also recommended to conduct snow surveys: high elevation vs areas with different land slope, aspect and vegetation cover (i.e., from barren to forested).

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Appendix A – Metrological Tables

Table A.1
Mean daily minimum temperature
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (°C) | FEB (°C) | MAR (°C) | APR (°C) | MAY (°C) | JUN (°C) | JUL (°C) | AUG (°C) | SEP (°C) | OCT (°C) | NOV (°C) | DEC (°C) | MINIMUM (°C) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------|
| 2008 | W/D | W/D | W/D | W/D | W/D | W/D | 10.8 | 9.0 | 5.8 | -1.8 | -18.1 | -28.6 | W/D |
| 2009 | -28.7 | -27.3 | -24.0 | -6.1 | -1.3 | 4.3 | 7.0 | 10.8 | 2.6 | -1.5 | -5.9 | -23.7 | -28.7 |
| 2010 | -26.3 | -20.0 | -14.0 | -0.2 | 1.8 | 10.1 | 14.2 | 8.2 | 4.9 | -3.0 | -18.2 | -26.4 | -26.4 |
| 2011 | -32.0 | -25.9 | -26.2 | -4.9 | 1.8 | 7.8 | 11.0 | 13.2 | 3.8 | -0.8 | -15.0 | -21.0 | -32.0 |
| 2012 | -28.4 | -23.6 | -16.3 | -3.8 | 3.1 | 8.2 | 17.2 | 11.0 | 2.8 | -5.5 | -17.3 | -24.5 | -28.4 |
| 2013 | -29.0 | -28.3 | -19.8 | -12.8 | -4.0 | 7.2 | 12.1 | 8.6 | 4.2 | -7.8 | -20.0 | -31.7 | -31.7 |
| 2014 | -30.9 | -29.9 | -30.7 | -13.2 | -1.0 | 9.2 | 9.3 | 8.7 | 1.7 | -4.8 | -23.5 | -25.8 | -30.9 |
| 2015 | -29.5 | -30.0 | -22.4 | -11.5 | -1.9 | 10.2 | 12.2 | 7.8 | 5.1 | -1.5 | -15.5 | -20.5 | -30.0 |
| 2016 | -25.4 | -26.5 | -19.7 | -12.8 | -0.7 | 7.2 | 14.3 | 11.4 | 7.2 | 0.4 | -8.5 | -25.8 | -26.5 |
| 2017 | -25.6 | -21.3 | -22.3 | -4.0 | 3.1 | 9.1 | 12.6 | 11.8 | 5.8 | -6.8 | -15.5 | -30.0 | -30.0 |
| 2018 | -27.1 | -26.4 | -14.5 | -16.8 | 0.7 | 9.2 | 12.3 | 9.3 | 0.8 | -5.7 | -17.5 | -22.6 | -27.1 |
| 2019 | -32.5 | -25.5 | -19.4 | -7.7 | 1.6 | 10.2 | 14.3 | 11.3 | 2.9 | -4.9 | -17.1 | -24.6 | -32.5 |
| 2020 | -25.8 | -28.3 | -16.9 | -8.1 | -0.6 | 5.8 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | -25.4 | -20.0 | -14.0 | -0.2 | 3.1 | 10.2 | 17.2 | 13.2 | 7.2 | 0.4 | -5.9 | -20.5 | -26.4 |
| Average | -28.4 | -26.1 | -20.5 | -8.5 | 0.2 | 8.2 | 12.3 | 10.1 | 4.0 | -3.6 | -16.0 | -25.4 | -29.5 |
| Minimum | -32.5 | -30.0 | -30.7 | -16.8 | -4.0 | 4.3 | 7.0 | 7.8 | 0.8 | -7.8 | -23.5 | -31.7 | -32.5 |
| Std.Dev. | 2.5 | 3.1 | 4.9 | 4.9 | 2.2 | 1.9 | 2.6 | 1.7 | 1.9 | 2.6 | 4.7 | 3.4 | 2.2 |
| Asim. Coef. | -0.4 | 0.7 | -0.6 | 0.0 | -0.4 | -0.9 | -0.2 | 0.3 | 0.0 | -0.1 | 1.0 | -0.4 | 0.1 |
| Var. Coef. | -0.1 | -0.1 | -0.2 | -0.6 | 10.5 | 0.2 | 0.2 | 0.2 | 0.5 | -0.7 | -0.3 | -0.1 | -0.1 |
| % Annual | 96% | 89% | 70% | 29% | -1% | -28% | -42% | -34% | -13% | 12% | 54% | 86% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.2
Mean daily maximum temperature
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (°C) | FEB (°C) | MAR (°C) | APR (°C) | MAY (°C) | JUN (°C) | JUL (°C) | AUG (°C) | SEP (°C) | OCT (°C) | NOV (°C) | DEC (°C) | MAXIMUM (°C) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------|
| 2008 | W/D | W/D | W/D | W/D | W/D | W/D | 22.7 | 25.3 | 23.8 | 11.2 | 10.5 | -6.4 | W/D |
| 2009 | -3.3 | 0.0 | 0.7 | 8.8 | 13.6 | 21.9 | 19.0 | 24.2 | 20.8 | 6.2 | 6.6 | -3.5 | 24.2 |
| 2010 | 0.0 | -7.0 | 7.7 | 12.1 | 20.4 | 19.8 | 27.5 | 24.8 | 14.5 | 13.1 | 7.5 | -5.8 | 27.5 |
| 2011 | -12.8 | -0.3 | -0.5 | 10.0 | 19.3 | 25.7 | 28.1 | 24.5 | 21.8 | 18.0 | 6.0 | -2.4 | 28.1 |
| 2012 | -1.1 | -2.1 | 14.5 | 10.8 | 17.9 | 23.2 | 26.1 | 23.5 | 20.2 | 11.4 | 1.0 | -1.4 | 26.1 |
| 2013 | -3.2 | -4.6 | -0.7 | 5.9 | 17.3 | 21.6 | 24.8 | 23.5 | 21.7 | 14.5 | 2.6 | -9.0 | 24.8 |
| 2014 | -5.7 | -4.5 | -2.2 | 3.9 | 21.7 | 21.8 | 22.1 | 23.3 | 19.4 | 10.1 | 2.1 | -1.0 | 23.3 |
| 2015 | -1.3 | -12.3 | 0.2 | 11.9 | 18.9 | 21.7 | 25.2 | 24.8 | 22.4 | 16.1 | 6.9 | 0.5 | 25.2 |
| 2016 | -2.5 | -0.4 | 3.4 | 6.7 | 20.7 | 21.2 | 22.1 | 23.0 | 20.9 | 14.9 | 10.3 | -2.0 | 23.0 |
| 2017 | 0.8 | 2.4 | 4.3 | 9.0 | 15.6 | 20.9 | 24.6 | 21.1 | 20.1 | 15.4 | 0.6 | -2.8 | 24.6 |
| 2018 | -3.9 | -5.5 | 0.8 | 12.0 | 23.3 | 24.7 | 27.5 | 27.7 | 16.9 | 5.8 | 0.1 | 0.8 | 27.7 |
| 2019 | -3.8 | -10.6 | 1.2 | 10.8 | 15.9 | 22.9 | 24.3 | 24.8 | 21.3 | 10.9 | -0.3 | -3.5 | 24.8 |
| 2020 | -5.2 | -4.0 | 2.1 | 11.2 | 21.1 | 26.7 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 0.8 | 2.4 | 14.5 | 12.1 | 23.3 | 26.7 | 28.1 | 27.7 | 23.8 | 18.0 | 10.5 | 0.8 | 28.1 |
| Average | -3.5 | -4.1 | 2.6 | 9.4 | 18.8 | 22.7 | 24.5 | 24.2 | 20.3 | 12.3 | 4.5 | -3.0 | 25.4 |
| Minimum | -12.8 | -12.3 | -2.2 | 3.9 | 13.6 | 19.8 | 19.0 | 21.1 | 14.5 | 5.8 | -0.3 | -9.0 | 23.0 |
| Std.Dev. | 3.5 | 4.4 | 4.6 | 2.7 | 2.8 | 2.1 | 2.7 | 1.6 | 2.5 | 3.8 | 3.9 | 2.9 | 1.8 |
| Asim. Coef. | -1.7 | -0.5 | 1.8 | -1.0 | -0.3 | 0.8 | -0.5 | 0.3 | -1.3 | -0.4 | 0.3 | -0.7 | 0.4 |
| Var. Coef. | -1.0 | -1.1 | 1.7 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.9 | -0.9 | 0.1 |
| % Annual | -14% | -16% | 10% | 37% | 74% | 89% | 97% | 95% | 80% | 48% | 18% | -12% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.3
Mean monthly temperature
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (°C) | FEB (°C) | MAR (°C) | APR (°C) | MAY (°C) | JUN (°C) | JUL (°C) | AUG (°C) | SEP (°C) | OCT (°C) | NOV (°C) | DEC (°C) | AVERAGE (°C) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------|
| 2008 | W/D | W/D | W/D | W/D | W/D | W/D | 16.4 | 18.7 | 11.0 | 4.9 | -5.1 | -19.5 | W/D |
| 2009 | -18.2 | -13.9 | -8.3 | 0.5 | 5.5 | 13.9 | 14.3 | 15.2 | 16.1 | 2.3 | 0.7 | -14.1 | 1.2 |
| 2010 | -13.7 | -13.1 | -1.2 | 6.4 | 10.9 | 14.7 | 19.1 | 17.5 | 8.4 | 5.3 | -4.0 | -16.2 | 2.8 |
| 2011 | -20.9 | -15.1 | -10.6 | 0.7 | 10.2 | 16.1 | 20.2 | 18.7 | 12.0 | 6.7 | -2.9 | -10.3 | 2.1 |
| 2012 | -14.6 | -10.4 | -0.8 | 3.6 | 10.6 | 17.0 | 21.5 | 17.1 | 10.1 | 2.1 | -6.4 | -14.8 | 2.9 |
| 2013 | -18.4 | -16.1 | -9.5 | -3.7 | 9.0 | 17.2 | 18.2 | 17.9 | 13.1 | 3.2 | -7.1 | -21.6 | 0.2 |
| 2014 | -21.8 | -19.7 | -12.5 | -2.7 | 9.3 | 15.6 | 17.4 | 17.5 | 10.7 | 4.5 | -9.9 | -11.3 | -0.2 |
| 2015 | -18.2 | -21.9 | -7.8 | 0.9 | 9.8 | 16.6 | 19.5 | 16.5 | 13.1 | 5.0 | -1.7 | -7.5 | 2.0 |
| 2016 | -14.7 | -14.5 | -5.0 | -1.5 | 11.6 | 15.4 | 18.1 | 17.3 | 11.9 | 4.9 | 1.3 | -13.4 | 2.6 |
| 2017 | -12.5 | -11.1 | -7.8 | 2.4 | 9.3 | 15.5 | 19.2 | 17.3 | 12.1 | 5.7 | -7.6 | -16.9 | 2.1 |
| 2018 | -16.5 | -17.1 | -5.5 | -1.9 | 13.1 | 18.2 | 19.9 | 18.2 | 9.5 | 0.8 | -8.5 | -10.2 | 1.7 |
| 2019 | -19.9 | -18.2 | -7.5 | 2.0 | 9.7 | 17.0 | 20.3 | 17.9 | 11.2 | 2.9 | -7.4 | -13.8 | 1.2 |
| 2020 | -14.8 | -15.6 | -7.2 | -0.5 | 10.6 | 17.2 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | -12.5 | -10.4 | -0.8 | 6.4 | 13.1 | 18.2 | 21.5 | 18.7 | 16.1 | 6.7 | 1.3 | -7.5 | 2.9 |
| Average | -17.0 | -15.6 | -7.0 | 0.5 | 10.0 | 16.2 | 18.7 | 17.5 | 11.6 | 4.0 | -4.9 | -14.1 | 1.7 |
| Minimum | -21.8 | -21.9 | -12.5 | -3.7 | 5.5 | 13.9 | 14.3 | 15.2 | 8.4 | 0.8 | -9.9 | -21.6 | -0.2 |
| Std.Dev. | 3.0 | 3.4 | 3.4 | 2.8 | 1.8 | 1.2 | 2.0 | 1.0 | 2.0 | 1.7 | 3.6 | 4.0 | 1.0 |
| Asim. Coef. | -0.1 | -0.3 | 0.6 | 0.5 | -1.0 | -0.3 | -0.9 | -1.1 | 0.7 | -0.4 | 0.5 | -0.3 | -0.7 |
| Var. Coef. | -0.2 | -0.2 | -0.5 | 5.5 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.4 | -0.7 | -0.3 | 0.6 |
| % Annual | -1008% | -923% | -413% | 31% | 591% | 960% | 1107% | 1035% | 687% | 238% | -289% | -837% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.4
Atmospheric pressure
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (kPa) | FEB (kPa) | MAR (kPa) | APR (kPa) | MAY (kPa) | JUN (kPa) | JUL (kPa) | AUG (kPa) | SEP (kPa) | OCT (kPa) | NOV (kPa) | DEC (kPa) | AVERAGE (kPa) |
|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------------|
| 2008 | W/D | W/D | W/D | W/D | W/D | W/D | 101.0 | 101.2 | 101.5 | 101.7 | 101.7 | 101.9 | W/D |
| 2009 | 101.8 | 102.1 | 102.0 | 101.8 | 101.3 | 101.1 | 101.2 | 101.2 | 101.6 | 101.5 | 101.4 | 102.1 | 101.6 |
| 2010 | 102.2 | 102.6 | 101.6 | 101.3 | 101.4 | 101.2 | 100.9 | 100.8 | 101.3 | 101.2 | 101.5 | 102.3 | 101.5 |
| 2011 | 102.2 | 101.7 | 102.3 | 101.2 | 101.4 | 101.2 | 101.0 | 100.9 | 101.5 | 101.3 | 101.1 | 101.6 | 101.4 |
| 2012 | 101.5 | 101.9 | 101.2 | 101.8 | 101.2 | 100.8 | 101.2 | 101.2 | 101.3 | 101.3 | 102.0 | 101.8 | 101.4 |
| 2013 | 101.8 | 102.1 | 102.3 | 101.8 | 101.8 | 101.3 | 101.3 | 101.3 | 101.2 | 101.4 | 101.8 | 102.3 | 101.7 |
| 2014 | 101.5 | 101.8 | 102.0 | 101.8 | 101.4 | 101.0 | 101.1 | 101.4 | 101.5 | 101.0 | 101.5 | 102.1 | 101.5 |
| 2015 | 102.1 | 102.5 | 101.7 | 101.6 | 101.7 | 101.2 | 100.8 | 101.1 | 101.3 | 101.6 | 101.3 | 101.4 | 101.5 |
| 2016 | 101.7 | 101.9 | 101.6 | 102.0 | 101.3 | 101.2 | 101.1 | 101.2 | 101.4 | 101.5 | 101.6 | 101.6 | 101.5 |
| 2017 | 101.5 | 101.4 | 102.2 | 101.8 | 101.3 | 100.8 | 101.4 | 101.6 | 101.4 | 101.0 | 101.6 | 102.0 | 101.5 |
| 2018 | 102.2 | 102.0 | 102.3 | 102.1 | 101.3 | 101.2 | 101.4 | 101.2 | 101.7 | 101.6 | 102.0 | 101.9 | 101.7 |
| 2019 | 102.2 | 102.5 | 102.0 | 101.6 | 101.5 | 101.2 | 101.1 | 101.1 | 101.3 | 101.1 | 101.7 | 101.7 | 101.6 |
| 2020 | 101.9 | 101.8 | 101.8 | 101.3 | 101.6 | 100.9 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 102.2 | 102.6 | 102.3 | 102.1 | 101.8 | 101.3 | 101.4 | 101.6 | 101.7 | 101.7 | 102.0 | 102.3 | 101.7 |
| Average | 101.9 | 102.0 | 101.9 | 101.7 | 101.4 | 101.1 | 101.1 | 101.2 | 101.4 | 101.4 | 101.6 | 101.9 | 101.6 |
| Minimum | 101.5 | 101.4 | 101.2 | 101.2 | 101.2 | 100.8 | 100.8 | 100.8 | 101.2 | 101.0 | 101.1 | 101.4 | 101.4 |
| Std.Dev. | 0.3 | 0.4 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 | 0.1 |
| Asim. Coef. | -0.3 | 0.1 | -0.6 | -0.4 | 0.8 | -0.8 | 0.0 | -0.2 | 0.2 | 0.0 | -0.1 | -0.1 | 0.9 |
| Var. Coef. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| % Annual | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.5
Average relative humidity
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (%) | FEB (%) | MAR (%) | APR (%) | MAY (%) | JUN (%) | JUL (%) | AUG (%) | SEP (%) | OCT (%) | NOV (%) | DEC (%) | AVERAGE (%) |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------------|
| 2008 | W/D | W/D | W/D | W/D | W/D | W/D | 77.1 | 61.8 | 80.0 | 83.6 | 94.6 | 99.1 | W/D |
| 2009 | 99.0 | 97.7 | 98.0 | 93.9 | 75.7 | 72.5 | 75.0 | 79.4 | 69.9 | 81.6 | 81.1 | 92.6 | 84.7 |
| 2010 | 98.3 | 98.6 | 92.8 | 62.7 | 65.7 | 74.5 | 75.0 | 77.6 | 82.5 | 83.7 | 94.4 | 99.6 | 83.8 |
| 2011 | 99.7 | 99.5 | 99.1 | 91.6 | 65.0 | 61.7 | 62.0 | 64.7 | 70.0 | 82.0 | 88.8 | 92.0 | 81.3 |
| 2012 | 95.3 | 94.4 | 88.8 | 60.7 | 66.1 | 70.4 | 59.1 | 70.0 | 70.6 | 89.2 | 89.5 | 94.4 | 79.0 |
| 2013 | 94.5 | 95.1 | 93.8 | 93.9 | 63.8 | 56.2 | 63.0 | 66.4 | 71.2 | 80.3 | 91.0 | 94.7 | 80.3 |
| 2014 | 95.1 | 95.0 | 94.2 | 92.8 | 75.3 | 67.9 | 65.5 | 66.5 | 77.8 | 82.1 | 88.2 | 94.8 | 82.9 |
| 2015 | 96.5 | 98.1 | 95.8 | 78.8 | 59.5 | 59.9 | 69.8 | 76.5 | 70.5 | 77.5 | 94.5 | 94.4 | 81.0 |
| 2016 | 97.9 | 98.5 | 96.5 | 75.7 | 59.9 | 66.4 | 70.6 | 74.4 | 83.3 | 88.0 | 86.1 | 96.9 | 82.9 |
| 2017 | 97.8 | 95.4 | 94.4 | 75.1 | 61.6 | 70.1 | 61.1 | 59.9 | 73.0 | 71.1 | 86.7 | 92.1 | 78.2 |
| 2018 | 90.7 | 90.9 | 83.8 | 74.6 | 54.3 | 60.6 | 64.1 | 61.3 | 73.2 | 85.3 | 80.8 | 87.7 | 75.6 |
| 2019 | 77.3 | 77.2 | 84.1 | 70.5 | 53.6 | 54.0 | 64.8 | 68.1 | 82.4 | 84.6 | 86.8 | 90.8 | 74.5 |
| 2020 | 93.8 | 92.8 | 88.9 | 76.3 | 58.0 | 68.5 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 99.7 | 99.5 | 99.1 | 93.9 | 75.7 | 74.5 | 77.1 | 79.4 | 83.3 | 89.2 | 94.6 | 99.6 | 84.7 |
| Average | 94.7 | 94.4 | 92.5 | 78.9 | 63.2 | 65.2 | 67.3 | 68.9 | 75.4 | 82.4 | 88.6 | 94.1 | 80.4 |
| Minimum | 77.3 | 77.2 | 83.8 | 60.7 | 53.6 | 54.0 | 59.1 | 59.9 | 69.9 | 71.1 | 80.8 | 87.7 | 74.5 |
| Std.Dev. | 6.0 | 6.0 | 5.1 | 11.8 | 7.1 | 6.6 | 6.1 | 6.7 | 5.4 | 4.8 | 4.7 | 3.4 | 3.3 |
| Asim. Coef. | -2.5 | -2.4 | -0.7 | 0.0 | 0.6 | -0.4 | 0.4 | 0.3 | 0.5 | -1.1 | -0.3 | 0.0 | -0.6 |
| Var. Coef. | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 |
| % Annual | 118% | 117% | 115% | 98% | 79% | 81% | 84% | 86% | 94% | 103% | 110% | 117% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.6
Total monthly precipitation
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (mm) | FEB (mm) | MAR (mm) | APR (mm) | MAY (mm) | JUN (mm) | JUL (mm) | AUG (mm) | SEP (mm) | OCT (mm) | NOV (mm) | DEC (mm) | TOTAL (mm) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
| 2009 | 22.8 | 28.7 | 37.3 | 25.5 | 46.5 | 72.5 | 65.6 | 58.8 | 21.2 | 30.2 | 18.6 | 12.9 | 440.6 |
| 2010 | 21.4 | 9.4 | 23.6 | 39.8 | 67.8 | 55.7 | 72.6 | 51.0 | 34.5 | 36.3 | 40.0 | 11.8 | 463.8 |
| 2011 | 14.5 | 16.7 | 31.7 | 62.4 | 29.1 | 45.8 | 22.2 | 42.2 | 17.6 | 34.8 | 18.4 | 15.4 | 350.7 |
| 2012 | 22.3 | 12.4 | 47.8 | 10.3 | 68.7 | 59.6 | 52.8 | 36.6 | 18.6 | 72.1 | 27.3 | 16.5 | 444.9 |
| 2013 | 24.3 | 9.3 | 16.4 | 29.4 | 34.1 | 20.0 | 32.6 | 37.7 | 28.4 | 11.8 | 28.1 | 20.9 | 292.9 |
| 2014 | 22.5 | 23.9 | 28.5 | 22.7 | 51.3 | 67.9 | 34.1 | 29.9 | 25.4 | 19.7 | 25.7 | 15.3 | 367.0 |
| 2015 | 16.8 | 16.4 | 41.0 | 21.9 | 47.7 | 24.1 | 84.0 | 42.5 | 16.2 | 24.7 | 48.5 | 16.8 | 400.6 |
| 2016 | 21.1 | 20.9 | 27.3 | 22.8 | 36.1 | 40.5 | 43.3 | 28.2 | 77.2 | 44.4 | 25.9 | 34.1 | 421.7 |
| 2017 | 16.5 | 25.2 | 23.2 | 21.0 | 25.9 | 40.6 | 29.2 | 7.4 | 38.8 | 17.8 | 27.7 | 19.7 | 293.1 |
| 2018 | 15.7 | 9.1 | 36.3 | 16.1 | 38.0 | 62.7 | 35.4 | 17.8 | 41.6 | 107.0 | 28.4 | 33.1 | 441.1 |
| 2019 | 42.3 | 47.6 | 54.2 | 78.3 | 81.0 | 78.0 | 167.9 | 85.0 | 168.1 | 168.2 | 25.2 | 39.5 | 1035.3 |
| 2020 | 59.6 | 30.5 | 58.3 | 85.2 | 90.5 | 251.4 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 59.6 | 47.6 | 58.3 | 85.2 | 90.5 | 251.4 | 167.9 | 85.0 | 168.1 | 168.2 | 48.5 | 39.5 | 1035.3 |
| Average | 25.0 | 20.8 | 35.5 | 36.3 | 51.4 | 68.2 | 58.1 | 39.7 | 44.3 | 51.5 | 28.5 | 21.4 | 450.2 |
| Minimum | 14.5 | 9.1 | 16.4 | 10.3 | 25.9 | 20.0 | 22.2 | 7.4 | 16.2 | 11.8 | 18.4 | 11.8 | 292.9 |
| Std.Dev. | 13.1 | 11.3 | 12.9 | 25.1 | 21.0 | 60.5 | 41.4 | 20.8 | 44.6 | 47.5 | 8.7 | 9.5 | 203.0 |
| Asim. Coef. | 2.1 | 1.1 | 0.5 | 1.2 | 0.7 | 2.9 | 2.1 | 0.7 | 2.6 | 1.8 | 1.4 | 1.0 | 2.8 |
| Var. Coef. | 0.5 | 0.5 | 0.4 | 0.7 | 0.4 | 0.9 | 0.7 | 0.5 | 1.0 | 0.9 | 0.3 | 0.4 | 0.45 |
| % Annual | 6% | 5% | 8% | 8% | 11% | 15% | 13% | 9% | 10% | 11% | 6% | 5% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.7
Total annual precipitation for wet and dry years
Springpole project

| YEAR | JAN (mm) | FEB (mm) | MAR (mm) | APR (mm) | MAY (mm) | JUN (mm) | JUL (mm) | AUG (mm) | SEP (mm) | OCT (mm) | NOV (mm) | DEC (mm) | TOTAL ⁽¹⁾ (mm) |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------------------|
| Dry 500 | 15 | 13 | 22 | 22 | 31 | 41 | 35 | 24 | 27 | 31 | 17 | 13 | 292 |
| Dry 200 | 15 | 13 | 22 | 22 | 31 | 41 | 35 | 24 | 27 | 31 | 17 | 13 | 292 |
| Dry 100 | 15 | 13 | 22 | 22 | 31 | 41 | 35 | 24 | 27 | 31 | 17 | 13 | 292 |
| Dry 50 | 15 | 13 | 22 | 22 | 31 | 41 | 35 | 24 | 27 | 31 | 17 | 13 | 292 |
| Dry 20 | 15 | 13 | 22 | 22 | 31 | 42 | 35 | 24 | 27 | 31 | 17 | 13 | 294 |
| Dry 10 | 15 | 13 | 22 | 22 | 32 | 42 | 36 | 25 | 27 | 32 | 18 | 13 | 297 |
| Average | 25 | 21 | 36 | 36 | 51 | 68 | 58 | 40 | 44 | 52 | 29 | 21 | 481 |
| Wet 10 | 37 | 30 | 52 | 53 | 75 | 100 | 85 | 58 | 65 | 75 | 42 | 31 | 702 |
| Wet 20 | 45 | 37 | 63 | 65 | 92 | 122 | 104 | 71 | 79 | 92 | 51 | 38 | 859 |
| Wet 50 | 56 | 46 | 79 | 81 | 115 | 152 | 130 | 89 | 99 | 115 | 64 | 48 | 1072 |
| Wet 100 | 64 | 54 | 91 | 93 | 132 | 176 | 150 | 102 | 114 | 133 | 73 | 55 | 1237 |
| Wet 200 | 73 | 61 | 104 | 106 | 150 | 199 | 170 | 116 | 129 | 150 | 83 | 63 | 1404 |
| Wet 500 | 85 | 70 | 120 | 123 | 174 | 231 | 197 | 134 | 150 | 174 | 96 | 72 | 1627 |
| Wet 1000 | 93 | 78 | 133 | 136 | 192 | 255 | 217 | 148 | 165 | 192 | 106 | 80 | 1796 |
| Wet 2000 | 103 | 85 | 146 | 149 | 211 | 280 | 238 | 163 | 182 | 211 | 117 | 88 | 1973 |
| Wet 10000 | 123 | 103 | 175 | 179 | 254 | 337 | 287 | 196 | 219 | 254 | 141 | 106 | 2372 |

Note:

1) Adjusted to Pearson 3 probability distribution

Table A.7
Total annual precipitation for wet and dry years
Springpole project

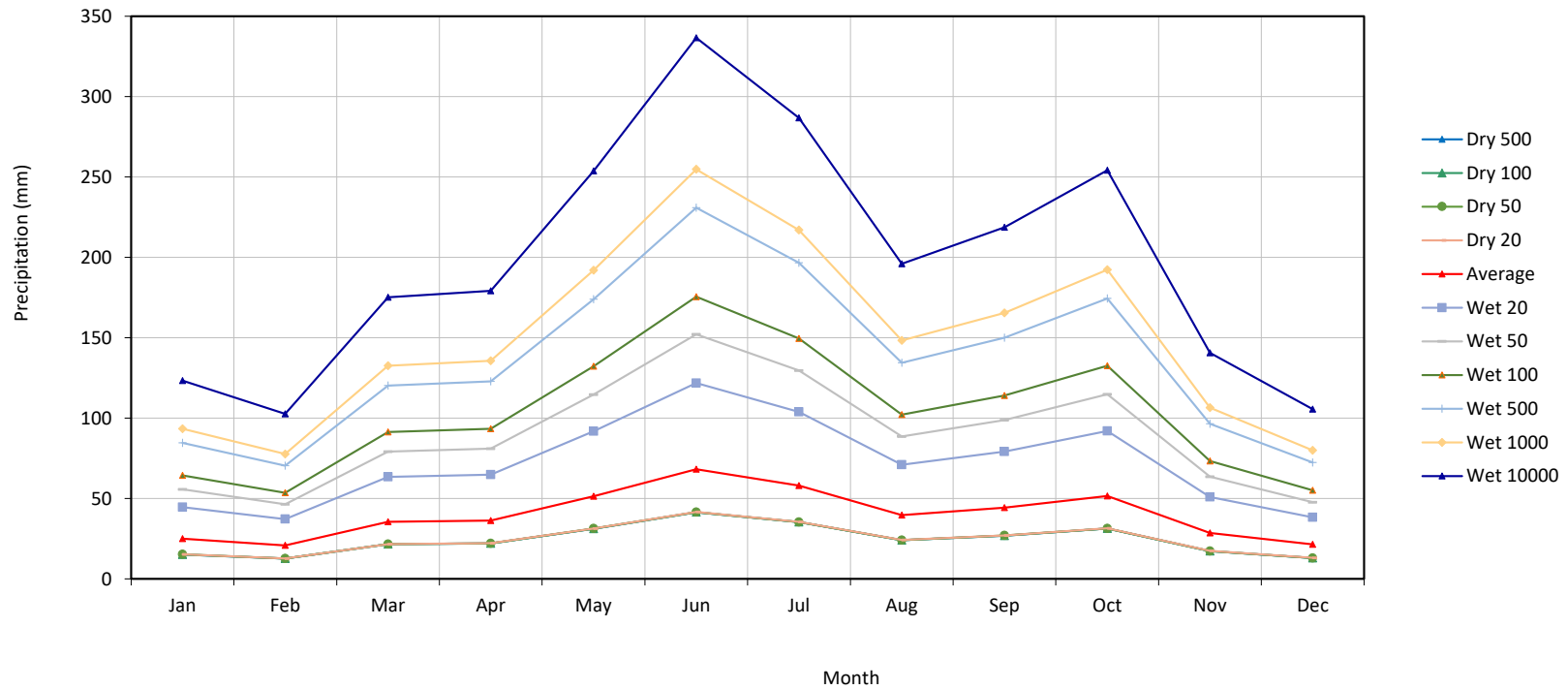


Table A.8
Total monthly snow
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (cm) | FEB (cm) | MAR (cm) | APR (cm) | MAY (cm) | JUN (cm) | JUL (cm) | AUG (cm) | SEP (cm) | OCT (cm) | NOV (cm) | DEC (cm) | TOTAL (cm) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
| 2009 | 19.2 | 22.3 | 29.6 | 12.7 | 11.6 | 0.0 | 0.0 | 0.0 | 0.0 | 9.7 | 9.1 | 10.8 | 125.0 |
| 2010 | 14.2 | 7.9 | 7.0 | 1.6 | 3.7 | 0.0 | 0.0 | 0.0 | 0.0 | 2.4 | 23.2 | 9.9 | 69.9 |
| 2011 | 12.2 | 13.6 | 24.1 | 14.1 | 2.9 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 | 8.4 | 12.5 | 93.6 |
| 2012 | 18.0 | 10.3 | 25.6 | 1.4 | 3.5 | 0.0 | 0.0 | 0.0 | 0.8 | 16.3 | 18.3 | 13.2 | 107.4 |
| 2013 | 20.6 | 7.7 | 13.6 | 18.1 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 7.3 | 20.3 | 17.6 | 106.6 |
| 2014 | 18.9 | 20.1 | 20.2 | 12.0 | 9.6 | 0.0 | 0.0 | 0.0 | 0.0 | 10.0 | 21.3 | 12.2 | 124.3 |
| 2015 | 14.0 | 13.8 | 20.0 | 8.9 | 3.5 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 15.6 | 12.4 | 89.5 |
| 2016 | 17.6 | 16.3 | 18.2 | 15.7 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 12.0 | 24.3 | 109.9 |
| 2017 | 12.5 | 10.6 | 10.6 | 9.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.9 | 18.3 | 14.9 | 85.4 |
| 2018 | 12.9 | 7.6 | 29.7 | 3.8 | 2.4 | 0.0 | 0.0 | 0.0 | 3.3 | 61.1 | 21.8 | 21.7 | 164.3 |
| 2019 | 33.8 | 38.1 | 39.8 | 48.5 | 3.9 | 0.0 | 0.0 | 0.0 | 0.0 | 12.2 | 20.1 | 31.5 | 227.9 |
| 2020 | 49.2 | 23.2 | 43.3 | 45.2 | 4.6 | 0.0 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 49.2 | 38.1 | 43.3 | 48.5 | 11.6 | 0.0 | 0.0 | 0.0 | 3.3 | 61.1 | 23.2 | 31.5 | 227.9 |
| Average | 20.3 | 16.0 | 23.5 | 16.0 | 4.1 | 0.0 | 0.0 | 0.0 | 0.4 | 12.6 | 17.1 | 16.5 | 118.5 |
| Minimum | 12.2 | 7.6 | 7.0 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 8.4 | 9.9 | 69.9 |
| Std.Dev. | 10.8 | 8.9 | 11.0 | 15.4 | 3.3 | 0.0 | 0.0 | 0.0 | 1.0 | 16.7 | 5.2 | 6.7 | 44.0 |
| Asim. Coef. | 2.1 | 1.5 | 0.4 | 1.5 | 1.5 | - | - | - | 3.0 | 2.9 | -0.8 | 1.3 | 1.7 |
| Var. Coef. | 0.5 | 0.6 | 0.5 | 1.0 | 0.8 | - | - | - | 2.7 | 1.3 | 0.3 | 0.4 | 0.37 |
| % Annual | 17% | 13% | 20% | 13% | 3% | 0% | 0% | 0% | 0% | 11% | 14% | 14% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.9
Total monthly rainfall
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (mm) | FEB (mm) | MAR (mm) | APR (mm) | MAY (mm) | JUN (mm) | JUL (mm) | AUG (mm) | SEP (mm) | OCT (mm) | NOV (mm) | DEC (mm) | TOTAL (mm) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
| 2009 | 0.0 | 2.4 | 2.4 | 10.5 | 32.9 | 72.5 | 65.6 | 58.8 | 21.2 | 18.8 | 7.8 | 0.0 | 292.9 |
| 2010 | 4.6 | 0.1 | 15.4 | 37.9 | 63.4 | 55.7 | 72.6 | 51.0 | 34.5 | 33.4 | 12.6 | 0.0 | 381.2 |
| 2011 | 0.0 | 0.7 | 3.3 | 45.7 | 25.7 | 45.8 | 22.2 | 42.2 | 17.6 | 28.0 | 8.5 | 0.6 | 240.2 |
| 2012 | 1.1 | 0.2 | 17.6 | 8.7 | 64.6 | 59.6 | 52.8 | 36.6 | 17.7 | 52.8 | 5.7 | 0.9 | 318.2 |
| 2013 | 0.0 | 0.2 | 0.3 | 8.0 | 32.5 | 20.0 | 32.6 | 37.7 | 28.4 | 3.2 | 4.2 | 0.0 | 167.0 |
| 2014 | 0.2 | 0.0 | 4.6 | 8.5 | 40.0 | 67.9 | 34.1 | 29.9 | 25.4 | 7.9 | 0.6 | 0.9 | 220.1 |
| 2015 | 0.3 | 0.0 | 17.4 | 11.4 | 43.6 | 24.1 | 84.0 | 42.5 | 16.2 | 23.2 | 30.1 | 2.1 | 294.9 |
| 2016 | 0.4 | 1.6 | 5.8 | 4.3 | 33.7 | 40.5 | 43.3 | 28.2 | 77.2 | 40.0 | 11.7 | 5.4 | 292.0 |
| 2017 | 1.8 | 12.7 | 10.7 | 9.7 | 25.9 | 40.6 | 29.2 | 7.4 | 38.8 | 7.3 | 6.1 | 0.0 | 190.2 |
| 2018 | 0.4 | 0.0 | 1.2 | 11.6 | 35.2 | 62.7 | 35.4 | 17.8 | 37.7 | 34.9 | 2.7 | 7.5 | 247.1 |
| 2019 | 0.0 | 0.0 | 7.2 | 21.1 | 76.4 | 78.0 | 167.9 | 85.0 | 168.1 | 153.8 | 1.5 | 2.3 | 761.3 |
| 2020 | 0.0 | 3.1 | 7.2 | 31.9 | 85.1 | 251.4 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 4.6 | 12.7 | 17.6 | 45.7 | 85.1 | 251.4 | 167.9 | 85.0 | 168.1 | 153.8 | 30.1 | 7.5 | 761.3 |
| Average | 0.7 | 1.8 | 7.8 | 17.4 | 46.6 | 68.2 | 58.1 | 39.7 | 43.9 | 36.7 | 8.3 | 1.8 | 309.6 |
| Minimum | 0.0 | 0.0 | 0.3 | 4.3 | 25.7 | 20.0 | 22.2 | 7.4 | 16.2 | 3.2 | 0.6 | 0.0 | 167.0 |
| Std.Dev. | 1.3 | 3.6 | 6.2 | 13.6 | 20.4 | 60.5 | 41.4 | 20.8 | 44.6 | 41.7 | 8.2 | 2.5 | 161.7 |
| Asim. Coef. | 2.6 | 3.0 | 0.6 | 1.2 | 0.9 | 2.9 | 2.1 | 0.7 | 2.6 | 2.6 | 2.1 | 1.6 | 2.5 |
| Var. Coef. | 1.8 | 2.1 | 0.8 | 0.8 | 0.4 | 0.9 | 0.7 | 0.5 | 1.0 | 1.1 | 1.0 | 1.4 | 0.52 |
| % Annual | 0% | 1% | 3% | 6% | 15% | 22% | 19% | 13% | 14% | 12% | 3% | 1% | 100% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.10
Mean monthly wind speed
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (m/s) | FEB (m/s) | MAR (m/s) | APR (m/s) | MAY (m/s) | JUN (m/s) | JUL (m/s) | AUG (m/s) | SEP (m/s) | OCT (m/s) | NOV (m/s) | DEC (m/s) | AVERAGE (m/s) |
|---------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------------|
| 2009 | 2.9 | 2.6 | 3.3 | 2.7 | 3.2 | 3.0 | 3.2 | 2.7 | 3.1 | 2.7 | 3.2 | 2.6 | 2.9 |
| 2010 | 2.9 | 2.3 | 2.6 | 3.3 | 3.1 | 2.6 | 2.9 | 3.0 | 3.3 | 3.2 | 2.8 | 2.4 | 2.9 |
| 2011 | 2.4 | 3.0 | 2.5 | 2.3 | 3.4 | 3.3 | 3.6 | 3.3 | 3.5 | 3.6 | 3.3 | 3.4 | 3.1 |
| 2012 | 3.3 | 2.9 | 3.6 | 3.3 | 3.6 | 3.3 | 2.9 | 3.2 | 3.3 | 3.3 | 3.2 | 2.8 | 3.2 |
| 2013 | 3.4 | 2.9 | 2.8 | 3.3 | 3.6 | 2.9 | 3.1 | 3.0 | 3.4 | 3.1 | 3.4 | 3.2 | 3.2 |
| 2014 | 3.7 | 3.6 | 3.3 | 3.3 | 3.0 | 3.8 | 3.4 | 2.9 | 3.3 | 3.8 | 3.7 | 3.2 | 3.4 |
| 2015 | 3.4 | 3.3 | 3.3 | 3.4 | 3.4 | 2.9 | 3.1 | 3.1 | 3.6 | 3.3 | 3.1 | 3.1 | 3.3 |
| 2016 | 2.8 | 2.9 | 2.9 | 3.2 | 3.2 | 3.2 | 2.9 | 2.9 | 3.2 | 3.3 | 3.5 | 3.2 | 3.1 |
| 2017 | 3.0 | 3.4 | 3.6 | 3.1 | 3.2 | 3.1 | 3.1 | 2.3 | 3.6 | 4.0 | 3.8 | 3.2 | 3.3 |
| 2018 | 3.2 | 3.4 | 3.2 | 3.2 | 3.1 | 3.3 | 3.7 | 3.1 | 3.3 | 2.6 | 2.6 | 2.4 | 3.1 |
| 2019 | 2.8 | 2.4 | 3.4 | 3.3 | 3.3 | 3.0 | 3.2 | 3.3 | 2.9 | 3.6 | 3.1 | 2.8 | 3.1 |
| 2020 | 2.8 | 3.1 | 3.2 | 3.6 | 3.4 | 3.4 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 3.7 | 3.6 | 3.6 | 3.6 | 3.6 | 3.8 | 3.7 | 3.3 | 3.6 | 4.0 | 3.8 | 3.4 | 3.4 |
| Average | 3.1 | 3.0 | 3.1 | 3.2 | 3.3 | 3.2 | 3.2 | 3.0 | 3.3 | 3.3 | 3.3 | 2.9 | 3.1 |
| Minimum | 2.4 | 2.3 | 2.5 | 2.3 | 3.0 | 2.6 | 2.9 | 2.3 | 2.9 | 2.6 | 2.6 | 2.4 | 2.9 |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.11
Maximum monthly wind speed
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (m/s) | FEB (m/s) | MAR (m/s) | APR (m/s) | MAY (m/s) | JUN (m/s) | JUL (m/s) | AUG (m/s) | SEP (m/s) | OCT (m/s) | NOV (m/s) | DEC (m/s) | MAXIMUM (m/s) |
|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|------------------|
| 2009 | 2.9 | 2.6 | 3.3 | 2.7 | 3.2 | 3.0 | 3.2 | 2.7 | 3.1 | 2.7 | 3.2 | 2.6 | 3.3 |
| 2010 | 2.9 | 2.3 | 2.6 | 3.3 | 3.1 | 2.6 | 2.9 | 3.0 | 3.3 | 3.2 | 2.8 | 2.4 | 3.3 |
| 2011 | 2.4 | 3.0 | 2.5 | 2.3 | 3.4 | 3.3 | 3.6 | 3.3 | 3.5 | 3.6 | 3.3 | 3.4 | 3.6 |
| 2012 | 3.3 | 2.9 | 3.6 | 3.3 | 3.6 | 3.3 | 2.9 | 3.2 | 3.3 | 3.3 | 3.2 | 2.8 | 3.6 |
| 2013 | 3.4 | 2.9 | 2.8 | 3.3 | 3.6 | 2.9 | 3.1 | 3.0 | 3.4 | 3.1 | 3.4 | 3.2 | 3.6 |
| 2014 | 3.7 | 3.6 | 3.3 | 3.3 | 3.0 | 3.8 | 3.4 | 2.9 | 3.3 | 3.8 | 3.7 | 3.2 | 3.8 |
| 2015 | 3.4 | 3.3 | 3.3 | 3.4 | 3.4 | 2.9 | 3.1 | 3.1 | 3.6 | 3.3 | 3.1 | 3.1 | 3.6 |
| 2016 | 2.8 | 2.9 | 2.9 | 3.2 | 3.2 | 3.2 | 2.9 | 2.9 | 3.2 | 3.3 | 3.5 | 3.2 | 3.5 |
| 2017 | 3.0 | 3.4 | 3.6 | 3.1 | 3.2 | 3.1 | 3.1 | 2.3 | 3.6 | 4.0 | 3.8 | 3.2 | 4.0 |
| 2018 | 3.2 | 3.4 | 3.2 | 3.2 | 3.1 | 3.3 | 3.7 | 3.1 | 3.3 | 3.8 | 3.8 | 3.7 | 3.8 |
| 2019 | 4.1 | 3.5 | 4.6 | 4.8 | 4.6 | 4.4 | 4.8 | 4.8 | 4.4 | 4.7 | 4.2 | 4.1 | 4.8 |
| 2020 | 3.8 | 4.3 | 4.7 | 4.9 | 4.8 | 4.9 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 4.1 | 4.3 | 4.7 | 4.9 | 4.8 | 4.9 | 4.8 | 4.8 | 4.4 | 4.7 | 4.2 | 4.1 | 4.8 |
| Average | 3.3 | 3.2 | 3.4 | 3.4 | 3.5 | 3.4 | 3.3 | 3.1 | 3.5 | 3.5 | 3.5 | 3.2 | 3.7 |
| Minimum | 2.4 | 2.3 | 2.5 | 2.3 | 3.0 | 2.6 | 2.9 | 2.3 | 3.1 | 2.7 | 2.8 | 2.4 | 3.3 |
| Std.Dev. | 0.5 | 0.5 | 0.7 | 0.7 | 0.6 | 0.6 | 0.6 | 0.6 | 0.3 | 0.5 | 0.4 | 0.5 | 0.4 |
| Asim. Coef. | 0.2 | 0.6 | 1.0 | 1.2 | 1.6 | 1.4 | 2.1 | 2.1 | 2.2 | 0.8 | 0.3 | 0.4 | 2.0 |
| Var. Coef. | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 |
| % Annual | 98% | 95% | 101% | 102% | 106% | 102% | 100% | 93% | 104% | 106% | 104% | 95% | 112% |

Source:

Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Table A.12
Potential Evapotranspiration
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00"

| YEAR | JAN (mm) | FEB (mm) | MAR (mm) | APR (mm) | MAY (mm) | JUN (mm) | JUL (mm) | AUG (mm) | SEP (mm) | OCT (mm) | NOV (mm) | DEC (mm) | TOTAL (mm) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
| 2009 | 0 | 5 | 23 | 59 | 92 | 121 | 139 | 112 | 94 | 19 | 9 | 2 | 675 |
| 2010 | 3 | 8 | 36 | 89 | 111 | 128 | 170 | 131 | 61 | 28 | 8 | 1 | 772 |
| 2011 | 0 | 5 | 21 | 59 | 112 | 149 | 191 | 135 | 83 | 26 | 7 | 4 | 791 |
| 2012 | 2 | 12 | 42 | 81 | 116 | 147 | 204 | 131 | 70 | 21 | 6 | 1 | 834 |
| 2013 | 0 | 3 | 23 | 46 | 113 | 160 | 181 | 141 | 86 | 23 | 6 | 0 | 782 |
| 2014 | 0 | 0 | 16 | 49 | 103 | 138 | 176 | 143 | 76 | 24 | 4 | 3 | 733 |
| 2015 | 0 | 0 | 26 | 70 | 117 | 149 | 178 | 122 | 82 | 26 | 8 | 4 | 781 |
| 2016 | 2 | 6 | 32 | 56 | 121 | 138 | 165 | 131 | 71 | 22 | 9 | 2 | 755 |
| 2017 | 4 | 9 | 24 | 74 | 108 | 138 | 186 | 131 | 75 | 25 | 6 | 0 | 781 |
| 2018 | 1 | 1 | 34 | 67 | 130 | 151 | 191 | 147 | 64 | 14 | 4 | 2 | 805 |
| 2019 | 0 | 0 | 28 | 78 | 122 | 164 | 187 | 135 | 68 | 23 | 5 | 2 | 813 |
| 2020 | 3 | 4 | 33 | 63 | 122 | 144 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 4 | 12 | 42 | 89 | 130 | 164 | 204 | 147 | 94 | 28 | 9 | 4 | 834 |
| Average | 1 | 4 | 28 | 66 | 114 | 144 | 179 | 133 | 75 | 23 | 7 | 2 | 776 |
| Minimum | 0 | 0 | 16 | 46 | 92 | 121 | 139 | 112 | 61 | 14 | 4 | 0 | 675 |
| Std.Dev. | 1.4 | 3.7 | 7.0 | 12.5 | 9.5 | 11.6 | 16.3 | 9.3 | 9.5 | 3.6 | 1.7 | 1.3 | 41.0 |
| Asim. Coef. | 0.6 | 0.5 | 0.2 | 0.2 | -0.8 | -0.2 | -1.1 | -0.8 | 0.4 | -1.2 | 0.0 | 0.2 | -1.2 |
| Var. Coef. | 1.1 | 0.8 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.6 | 0.1 |
| % Annual | 0.2% | 0.6% | 3.6% | 8.5% | 14.7% | 18.6% | 23.0% | 17.1% | 9.7% | 2.9% | 0.9% | 0.3% | 100% |

Source:

Estimated by Hargreaves formula

**Table A.13
Lake Evaporation**

Total Annual Evapotranspiration 776
Total Annual Evaporation 460
Coefficient 0.593

| YEAR | JAN (mm) | FEB (mm) | MAR (mm) | APR (mm) | MAY (mm) | JUN (mm) | JUL (mm) | AUG (mm) | SEP (mm) | OCT (mm) | NOV (mm) | DEC (mm) | TOTAL (mm) |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
| 2009 | 0 | 3 | 13 | 35 | 54 | 72 | 82 | 66 | 56 | 11 | 6 | 1 | 400 |
| 2010 | 2 | 5 | 21 | 53 | 66 | 76 | 101 | 78 | 36 | 16 | 4 | 1 | 458 |
| 2011 | 0 | 3 | 12 | 35 | 67 | 88 | 113 | 80 | 49 | 15 | 4 | 2 | 469 |
| 2012 | 1 | 7 | 25 | 48 | 69 | 87 | 121 | 78 | 41 | 12 | 4 | 1 | 495 |
| 2013 | 0 | 2 | 14 | 27 | 67 | 95 | 107 | 84 | 51 | 14 | 4 | 0 | 464 |
| 2014 | 0 | 0 | 9 | 29 | 61 | 82 | 104 | 85 | 45 | 14 | 3 | 2 | 435 |
| 2015 | 0 | 0 | 15 | 42 | 70 | 88 | 105 | 72 | 48 | 15 | 5 | 3 | 463 |
| 2016 | 1 | 4 | 19 | 33 | 71 | 82 | 98 | 78 | 42 | 13 | 6 | 1 | 448 |
| 2017 | 2 | 5 | 14 | 44 | 64 | 82 | 110 | 78 | 44 | 15 | 3 | 0 | 463 |
| 2018 | 1 | 1 | 20 | 39 | 77 | 90 | 113 | 87 | 38 | 8 | 2 | 1 | 478 |
| 2019 | 0 | 0 | 17 | 46 | 72 | 97 | 111 | 80 | 41 | 14 | 3 | 1 | 482 |
| 2020 | 2 | 3 | 19 | 37 | 72 | 85 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 2 | 7 | 25 | 53 | 77 | 97 | 121 | 87 | 56 | 16 | 6 | 3 | 495 |
| Average | 0.8 | 2.6 | 16.6 | 39.0 | 67.6 | 85.4 | 106.0 | 78.7 | 44.7 | 13.4 | 4.0 | 1.2 | 460.0 |
| Minimum | 0 | 0 | 9 | 27 | 54 | 72 | 82 | 66 | 36 | 8 | 2 | 0 | 400 |
| Std.Dev. | 0.8 | 2.2 | 4.1 | 7.4 | 5.6 | 6.9 | 9.7 | 5.5 | 5.6 | 2.2 | 1.0 | 0.8 | 24.3 |
| Asim. Coef. | 0.6 | 0.5 | 0.2 | 0.2 | -0.8 | -0.2 | -1.1 | -0.8 | 0.4 | -1.2 | 0.0 | 0.2 | -1.2 |
| Var. Coef. | 1.1 | 0.8 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.3 | 0.6 | 0.1 |
| % Annual | 0.2% | 0.6% | 3.6% | 8.5% | 14.7% | 18.6% | 23.0% | 17.1% | 9.7% | 2.9% | 0.9% | 0.3% | 100% |

Table A.14
Annual Lake Evaporation (mm) for dry and wet years
Springpole project

| YEAR | JAN (mm) | FEB (mm) | MAR (mm) | APR (mm) | MAY (mm) | JUN (mm) | JUL (mm) | AUG (mm) | SEP (mm) | OCT (mm) | NOV (mm) | DEC (mm) | TOTAL ⁽¹⁾ (mm) |
|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------------------|
| Dry 500 | 0.9 | 3.1 | 19.6 | 46.1 | 79.8 | 100.8 | 125.1 | 92.9 | 52.8 | 15.9 | 4.7 | 1.4 | 543 |
| Dry 200 | 0.9 | 3.0 | 19.2 | 45.2 | 78.3 | 98.9 | 122.8 | 91.2 | 51.8 | 15.6 | 4.6 | 1.4 | 533 |
| Dry 100 | 0.9 | 3.0 | 18.9 | 44.6 | 77.2 | 97.5 | 121.0 | 89.9 | 51.1 | 15.3 | 4.5 | 1.4 | 525 |
| Dry 50 | 0.9 | 2.9 | 18.6 | 43.8 | 75.9 | 95.9 | 119.0 | 88.4 | 50.2 | 15.1 | 4.5 | 1.4 | 517 |
| Dry 20 | 0.8 | 2.9 | 18.2 | 42.8 | 74.1 | 93.5 | 116.1 | 86.3 | 49.0 | 14.7 | 4.3 | 1.3 | 504 |
| Dry 10 | 0.8 | 2.8 | 17.8 | 41.9 | 72.5 | 91.6 | 113.6 | 84.4 | 48.0 | 14.4 | 4.3 | 1.3 | 493 |
| Average | 0.8 | 2.6 | 16.6 | 39.0 | 67.6 | 85.4 | 106.0 | 78.7 | 44.7 | 13.4 | 4.0 | 1.2 | 460 |
| Wet 10 | 0.7 | 2.4 | 15.4 | 36.2 | 62.8 | 79.3 | 98.4 | 73.1 | 41.5 | 12.5 | 3.7 | 1.1 | 427 |
| Wet 20 | 0.7 | 2.4 | 15.1 | 35.5 | 61.5 | 77.7 | 96.5 | 71.7 | 40.7 | 12.2 | 3.6 | 1.1 | 419 |
| Wet 50 | 0.7 | 2.3 | 14.8 | 34.8 | 60.2 | 76.1 | 94.4 | 70.1 | 39.9 | 12.0 | 3.5 | 1.1 | 410 |
| Wet 100 | 0.7 | 2.3 | 14.6 | 34.3 | 59.4 | 75.0 | 93.1 | 69.2 | 39.3 | 11.8 | 3.5 | 1.1 | 404 |
| Wet 200 | 0.7 | 2.3 | 14.4 | 33.8 | 58.6 | 74.0 | 91.9 | 68.3 | 38.8 | 11.7 | 3.4 | 1.1 | 399 |
| Wet 500 | 0.7 | 2.2 | 14.2 | 33.3 | 57.7 | 72.9 | 90.5 | 67.2 | 38.2 | 11.5 | 3.4 | 1.0 | 393 |

Note:

1) Adjusted to Log Pearson 3 probability distribution

Table A.14
Annual Lake Evaporation (mm) for dry and wet years
Springpole project

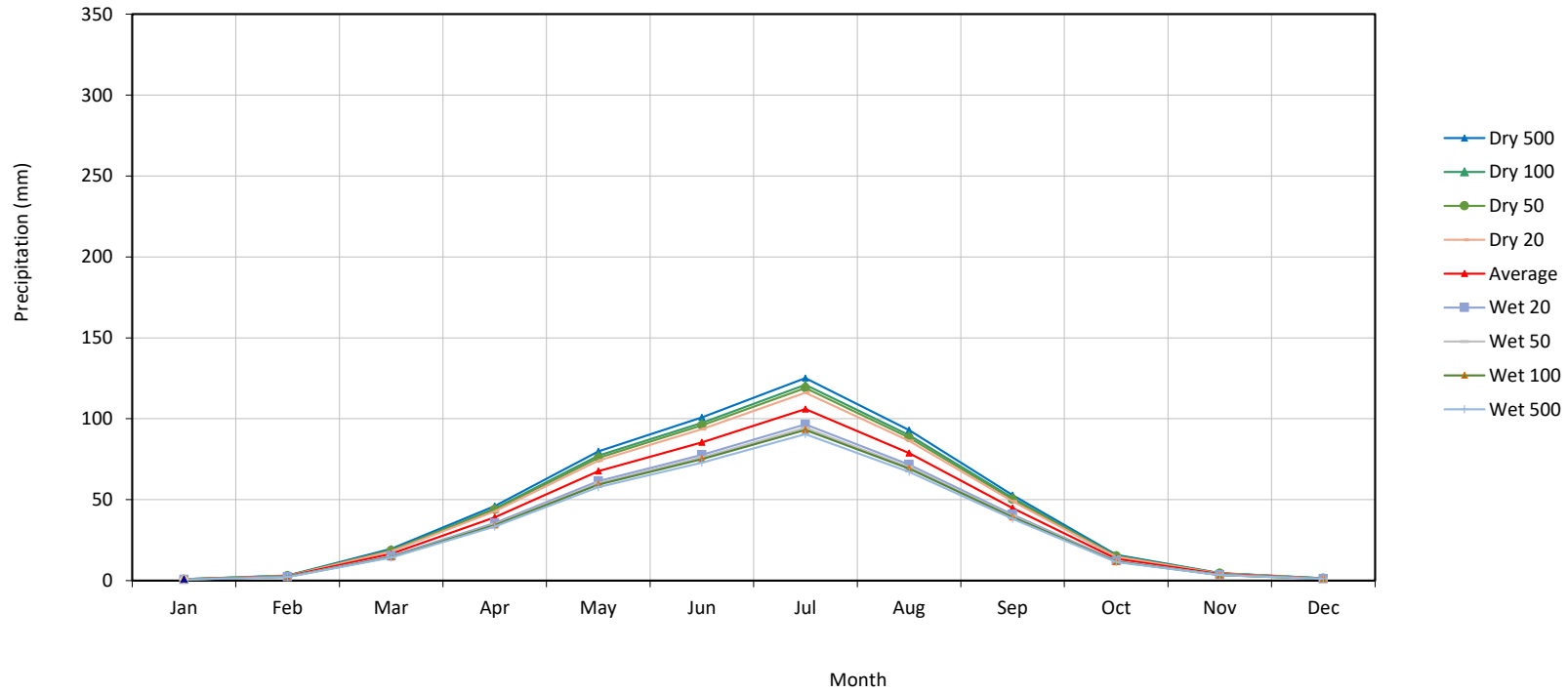


Table A.15
Solar hours
Casummit Lake Station

Latitude 51°28'00" Longitude -92°24'00" Altitude 399 masl

| YEAR | JAN (h) | FEB (h) | MAR (h) | APR (h) | MAY (h) | JUN (h) | JUL (h) | AUG (h) | SEP (h) | OCT (h) | NOV (h) | DEC (h) | AVERAGE (h) |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------------|
| 2009 | 26.5 | 34.5 | 31.0 | 119.5 | 226.5 | 243.5 | 229.5 | 234.0 | 298.0 | 93.0 | 133.5 | 45.5 | 142.9 |
| 2010 | 67.5 | 97.0 | 61.5 | 277.0 | 262.0 | 258.5 | 295.0 | 280.5 | 200.0 | 155.0 | 72.0 | 76.5 | 175.2 |
| 2011 | 16.0 | 30.0 | 64.5 | 114.0 | 256.5 | 312.5 | 336.5 | 324.5 | 266.0 | 123.0 | 81.5 | 66.0 | 165.9 |
| 2012 | 41.0 | 77.5 | 122.5 | 298.0 | 262.0 | 272.0 | 370.0 | 296.5 | 242.5 | 87.5 | 79.0 | 41.5 | 182.5 |
| 2013 | 45.0 | 59.0 | 69.5 | 138.5 | 291.0 | 319.0 | 304.5 | 347.5 | 279.0 | 146.5 | 49.0 | 38.5 | 173.9 |
| 2014 | 15.0 | 11.0 | 72.0 | 154.0 | 219.0 | 273.0 | 316.5 | 298.5 | 226.0 | 119.0 | 58.5 | 54.5 | 151.4 |
| 2015 | 26.0 | 9.0 | 62.0 | 190.5 | 274.0 | 322.5 | 304.5 | 241.0 | 234.0 | 122.5 | 37.5 | 58.0 | 156.8 |
| 2016 | 10.5 | 15.0 | 67.5 | 183.0 | 251.0 | 284.5 | 256.5 | 282.0 | 172.0 | 71.5 | 87.5 | 14.5 | 141.3 |
| 2017 | 23.5 | 14.0 | 46.5 | 183.0 | 264.5 | 234.5 | 351.5 | 345.5 | 213.5 | 155.0 | 49.5 | 40.5 | 160.1 |
| 2018 | 38.5 | 33.0 | 114.0 | 228.5 | 289.0 | 299.5 | 316.0 | 329.0 | 183.0 | 47.0 | 45.0 | 80.5 | 166.9 |
| 2019 | 61.0 | 28.0 | 82.0 | 168.0 | 309.5 | 364.5 | 345.5 | 244.0 | 143.5 | 110.5 | 78.0 | 106.0 | 170.0 |
| 2020 | 60.5 | 58.0 | 99.0 | 109.0 | 191.0 | 165.5 | W/D | W/D | W/D | W/D | W/D | W/D | W/D |
| Maximum | 67.5 | 97.0 | 122.5 | 298.0 | 309.5 | 364.5 | 370.0 | 347.5 | 298.0 | 155.0 | 133.5 | 106.0 | 182.5 |
| Average | 35.9 | 38.8 | 74.3 | 180.3 | 258.0 | 279.1 | 311.5 | 293.0 | 223.4 | 111.9 | 70.1 | 56.5 | 162.5 |
| Minimum | 10.5 | 9.0 | 31.0 | 109.0 | 191.0 | 165.5 | 229.5 | 234.0 | 143.5 | 47.0 | 37.5 | 14.5 | 141.3 |
| Std.Dev. | 19.5 | 28.2 | 26.5 | 61.4 | 33.1 | 51.3 | 41.2 | 41.1 | 47.2 | 34.6 | 27.0 | 24.9 | 13.3 |
| Asim. Coef. | 0.4 | 0.9 | 0.5 | 0.8 | -0.6 | -0.6 | -0.7 | -0.1 | -0.1 | -0.5 | 1.2 | 0.4 | -0.3 |
| Var. Coef. | 0.5 | 0.7 | 0.4 | 0.3 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.4 | 0.1 |
| % Annual | 25% | 27% | 53% | 128% | 183% | 198% | 220% | 207% | 158% | 79% | 50% | 40% | 115% |

Source:

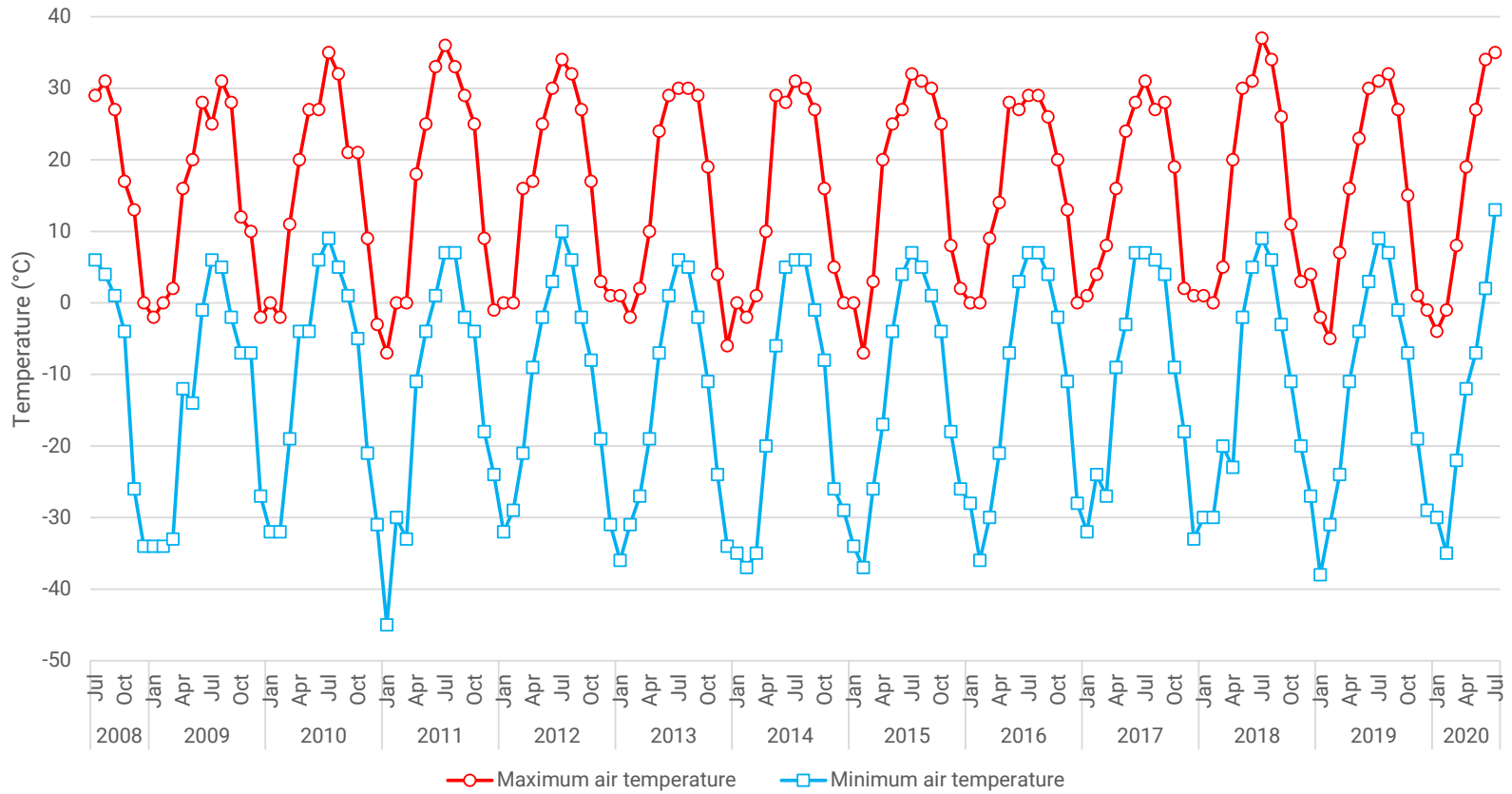
Data purchased from World Weather Online, July 2020

Note:

W/D: Without Data.

Appendix B – Metrological Graphs

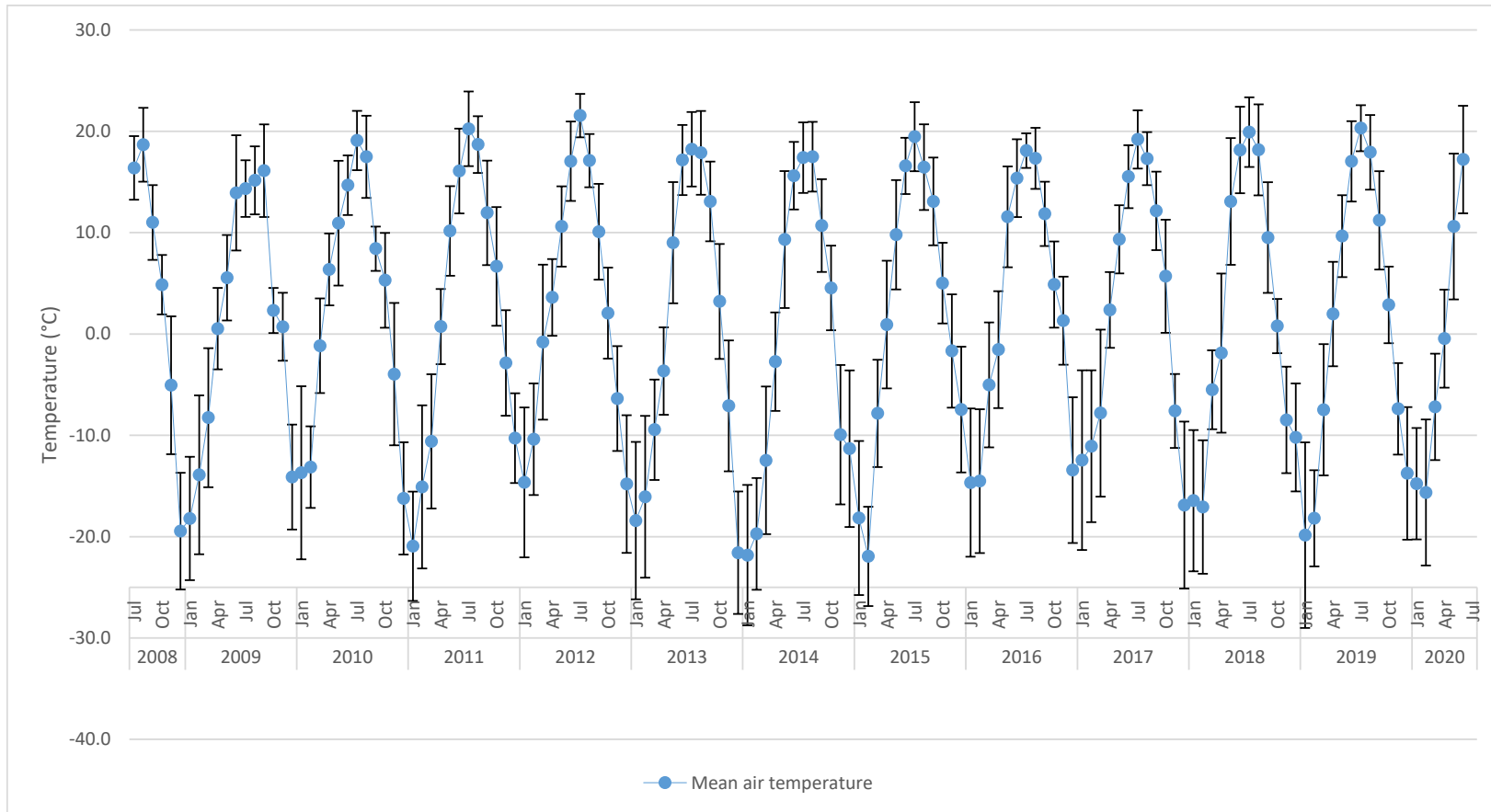
Figure B.1
Daily maximum and minimum air temperature
Casummit Lake station



Source:

Data purchased from World Weather Online, July 2020

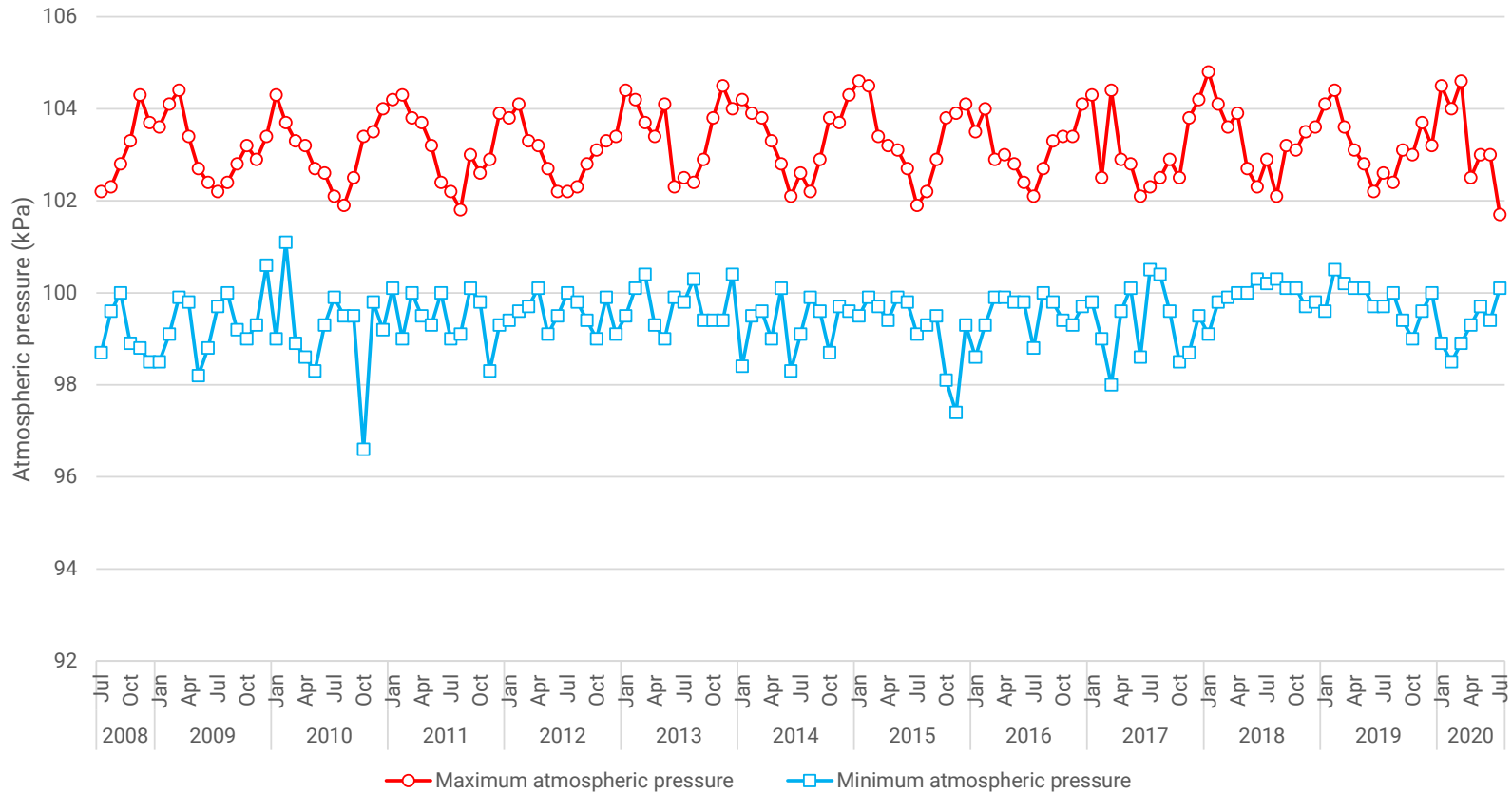
Figure B.2
Mean daily air temperature with standard deviation
Casummit Lake Station



Source:

Data purchased from World Weather Online, July 2020

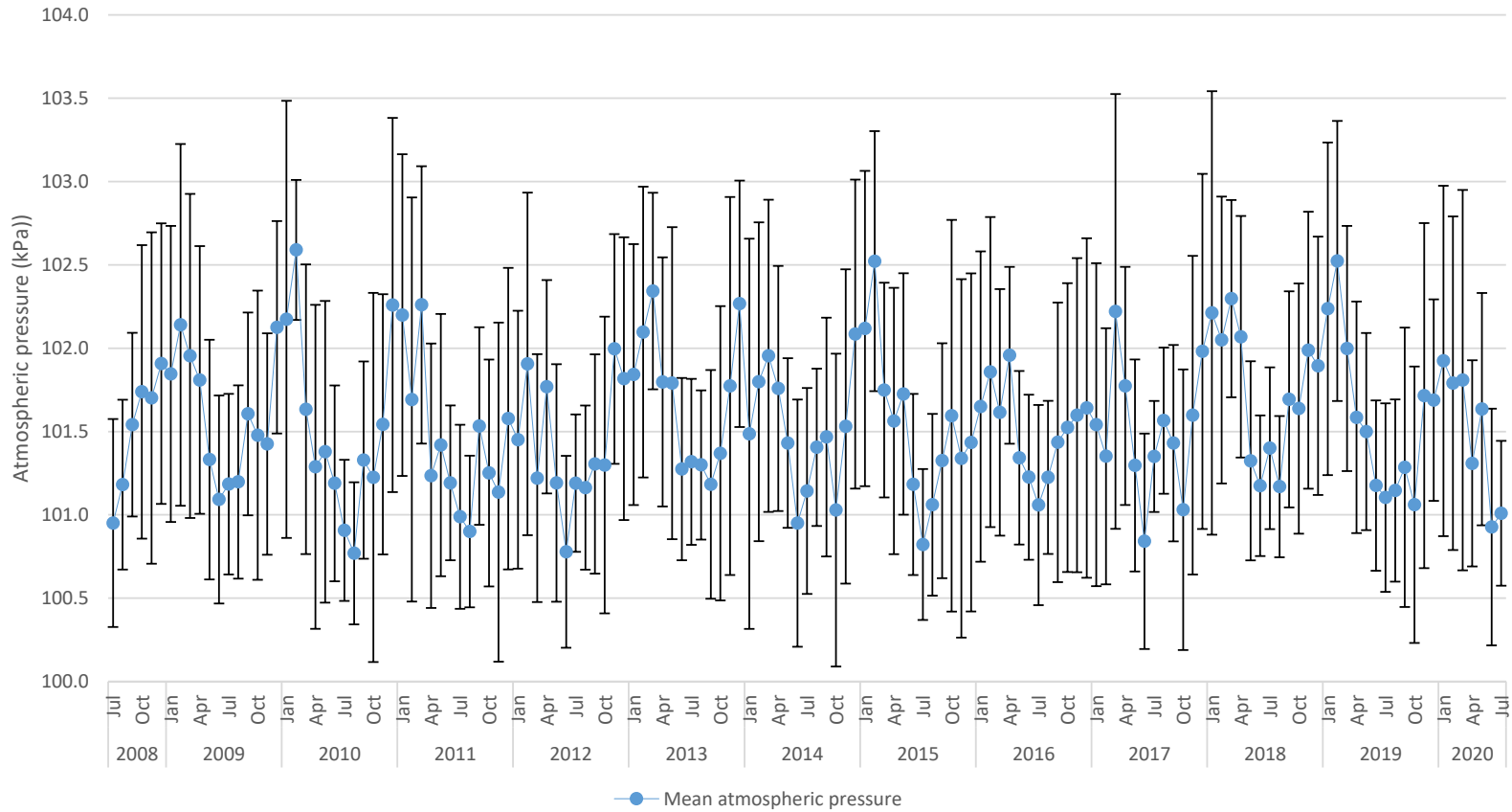
Figure B.3
Daily maximum and minimum air pressure
Casummit Lake Station



Source:

Data purchased from World Weather Online, July 2020

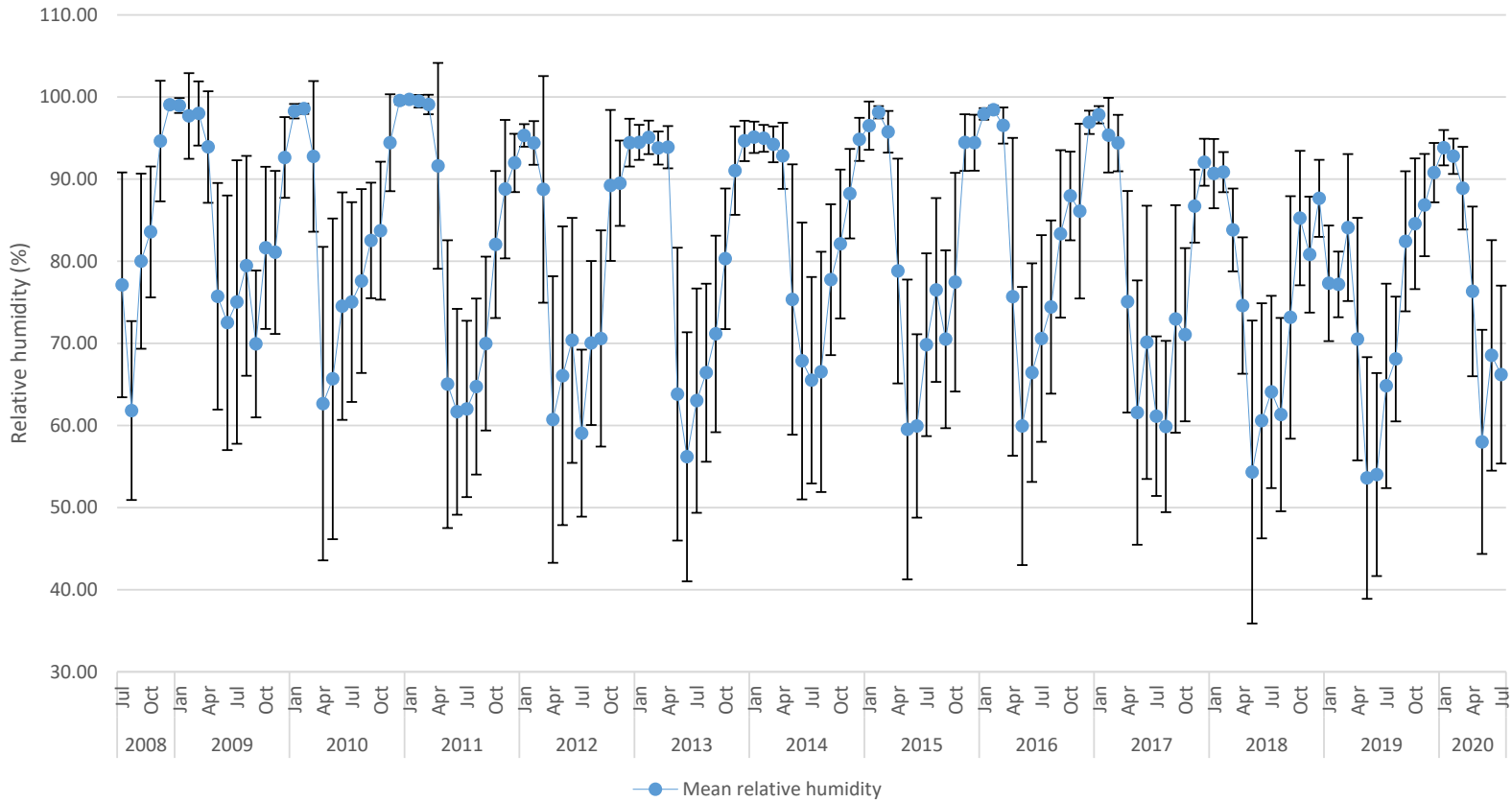
Figure B.4
Mean monthly air pressure with standard deviation
Casummit Lake Station



Source:

Data purchased from World Weather Online, July 2020

Figure B.6
Mean monthly air pressure with standard deviation
Casummit Lake Station



Source:

Data purchased from World Weather Online, July 2020

Figure B.7
Adjustments to a sample of annual values - Annual precipitation
Springpole project

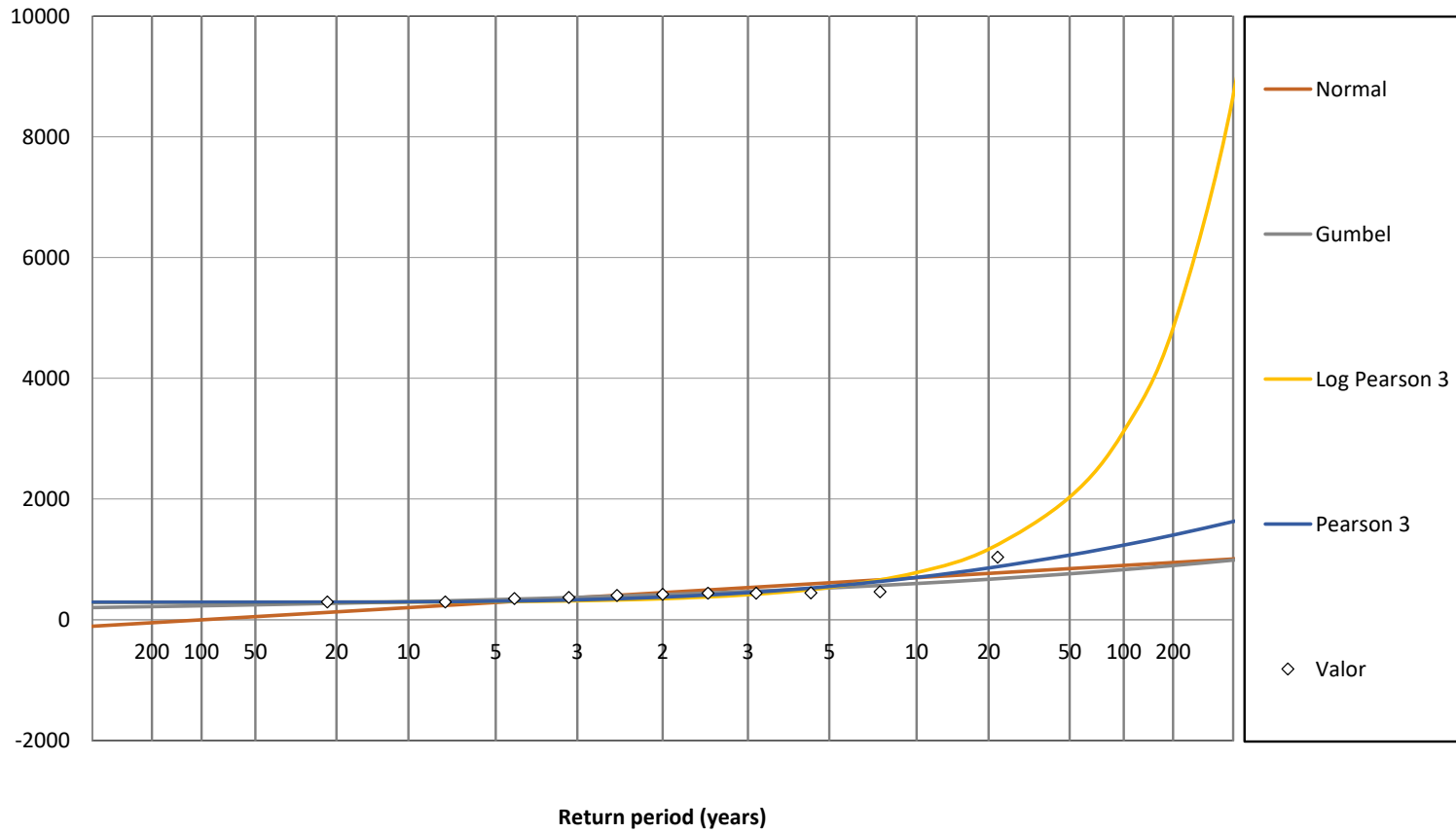
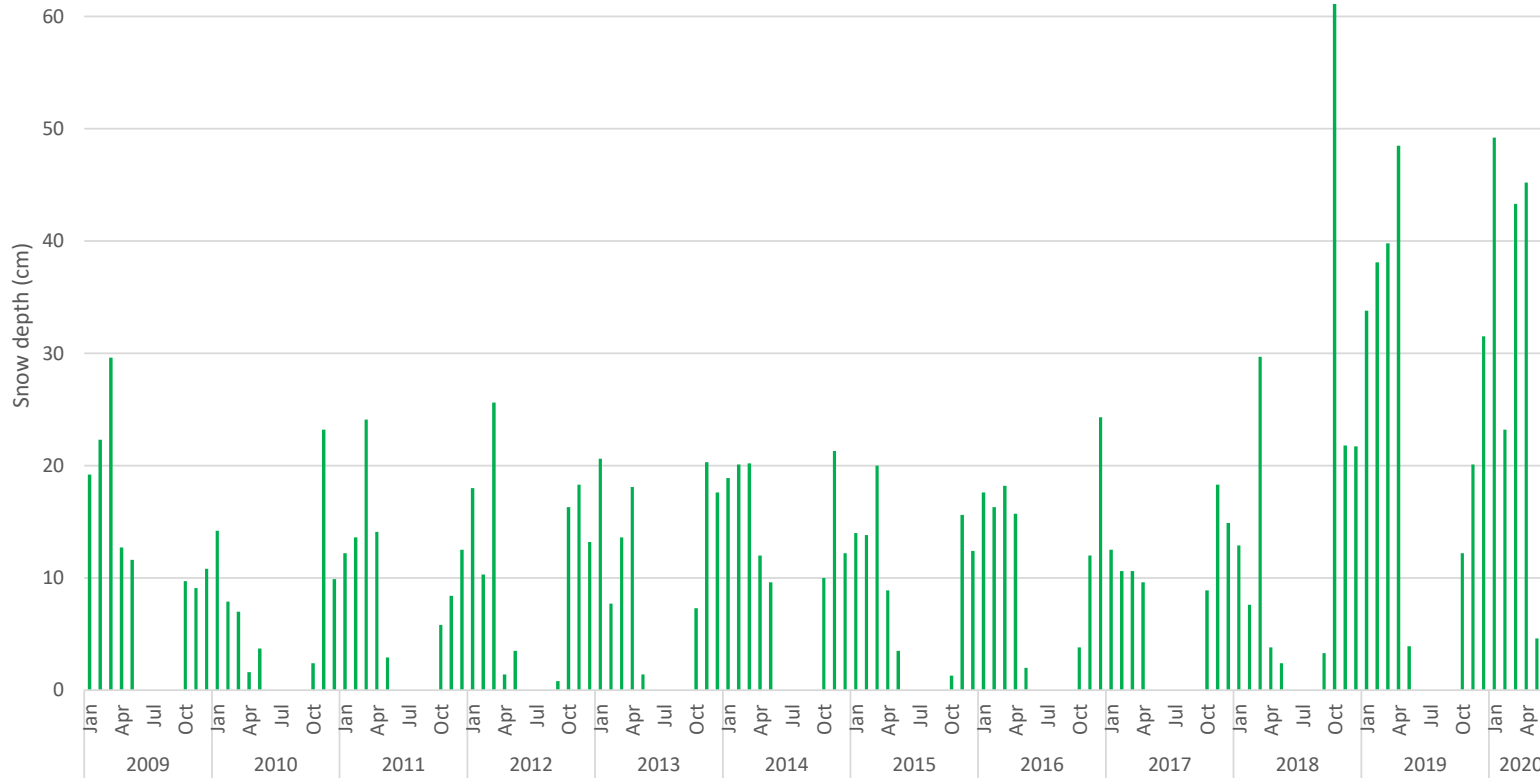


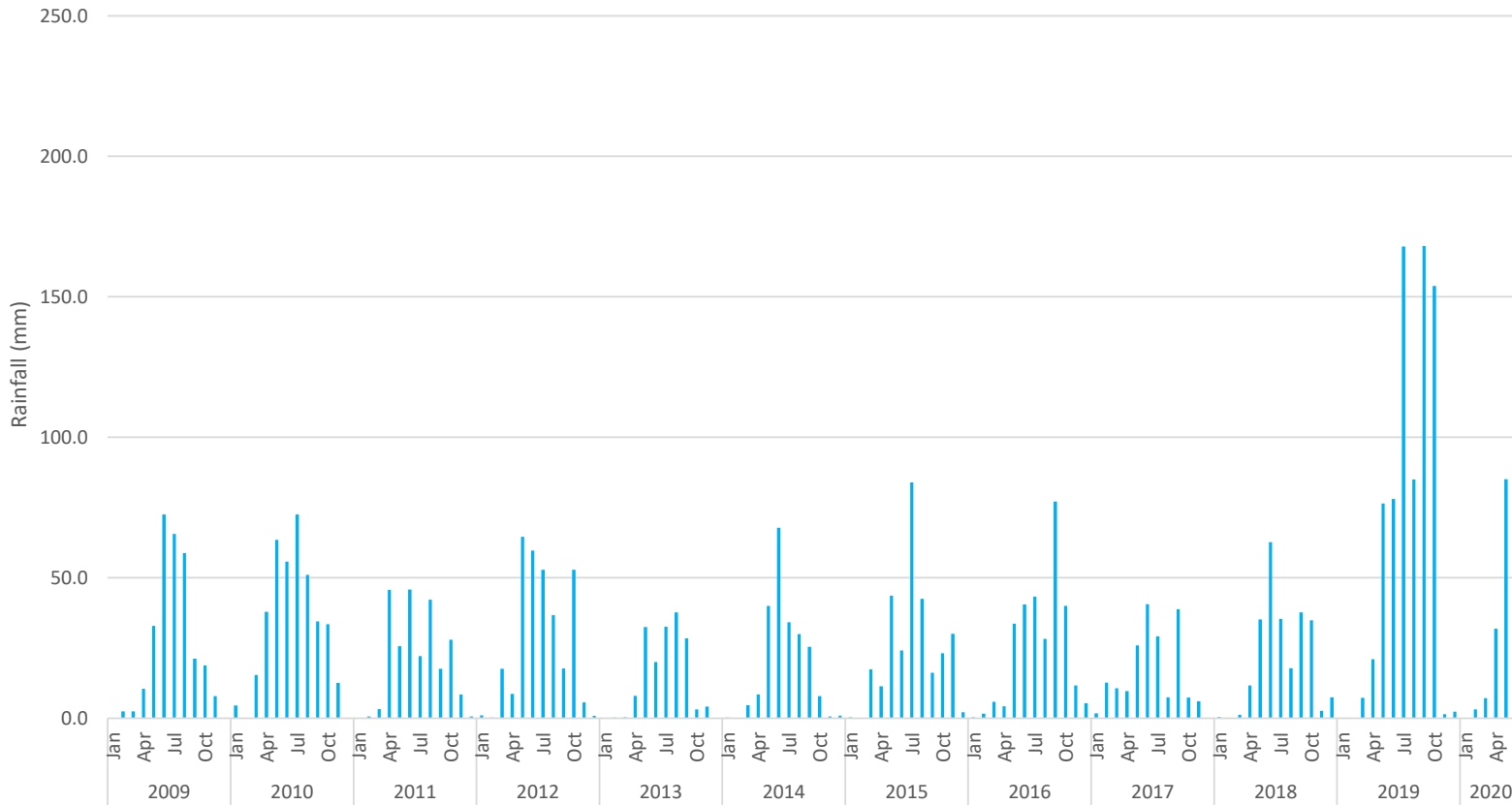
Figure B.8
Total monthly snow
Casummit Lake Station



Sources:

Data purchased from World Weather Online, July 2020

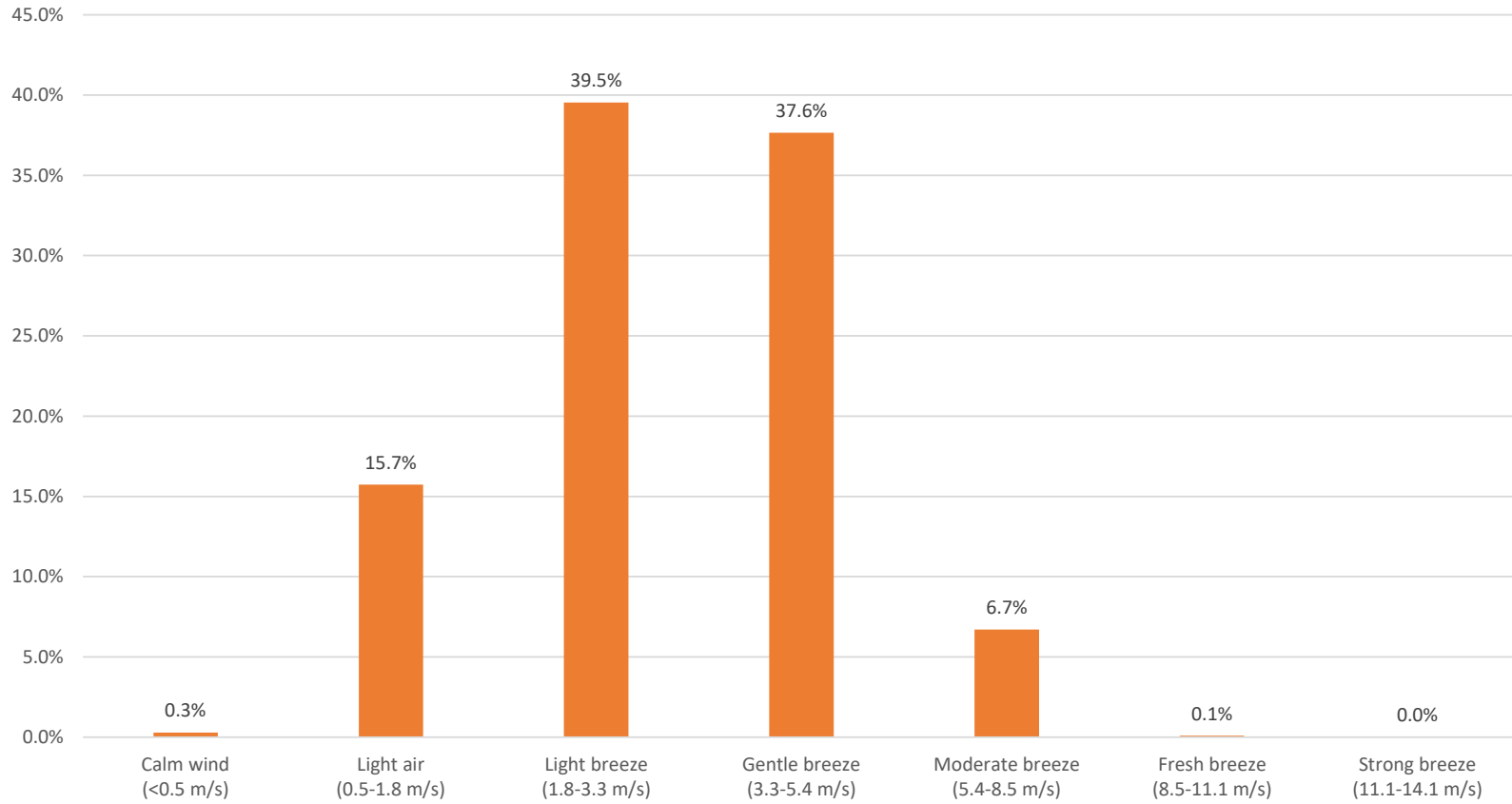
Figure B.9
Total monthly rainfall
Casummit Lake Station



Sources:

Data purchased from World Weather Online, July 2020

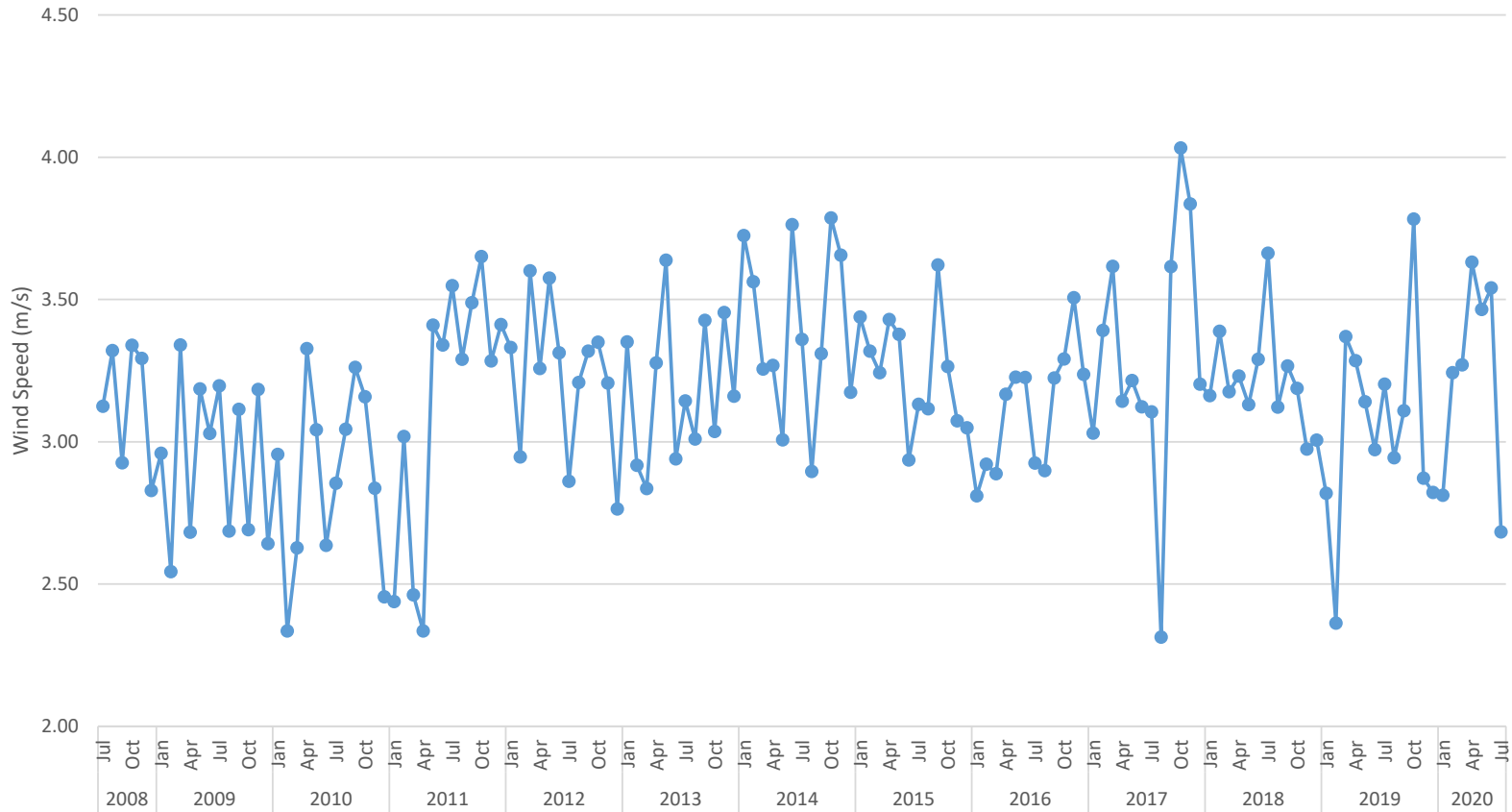
Figure B.10
Wind class frequency
Casummit Lake Station



Source:

Data purchased from World Weather Online, July 2020

Figure B.11
Mean Monthly Wind Speed
Casummit Lake Station



Source:

Data purchased from World Weather Online, July 2020

Figure B.12
Annual Lake Evaporation adjusted to different probabilistic models
Springpole project

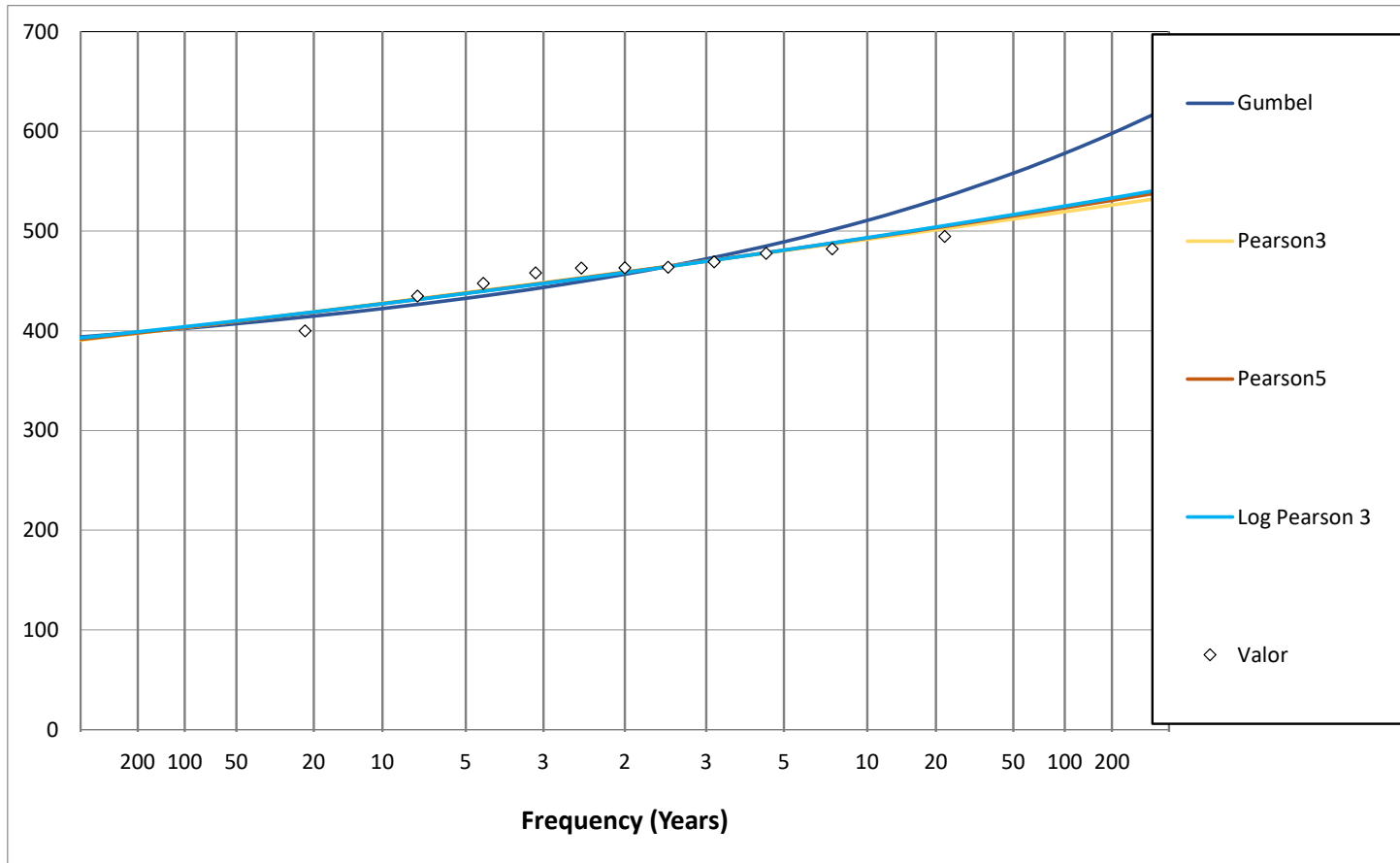


Figure B.13
Adjustments to a sample of annual values - 24h Maximum Precipitation
Springpole project

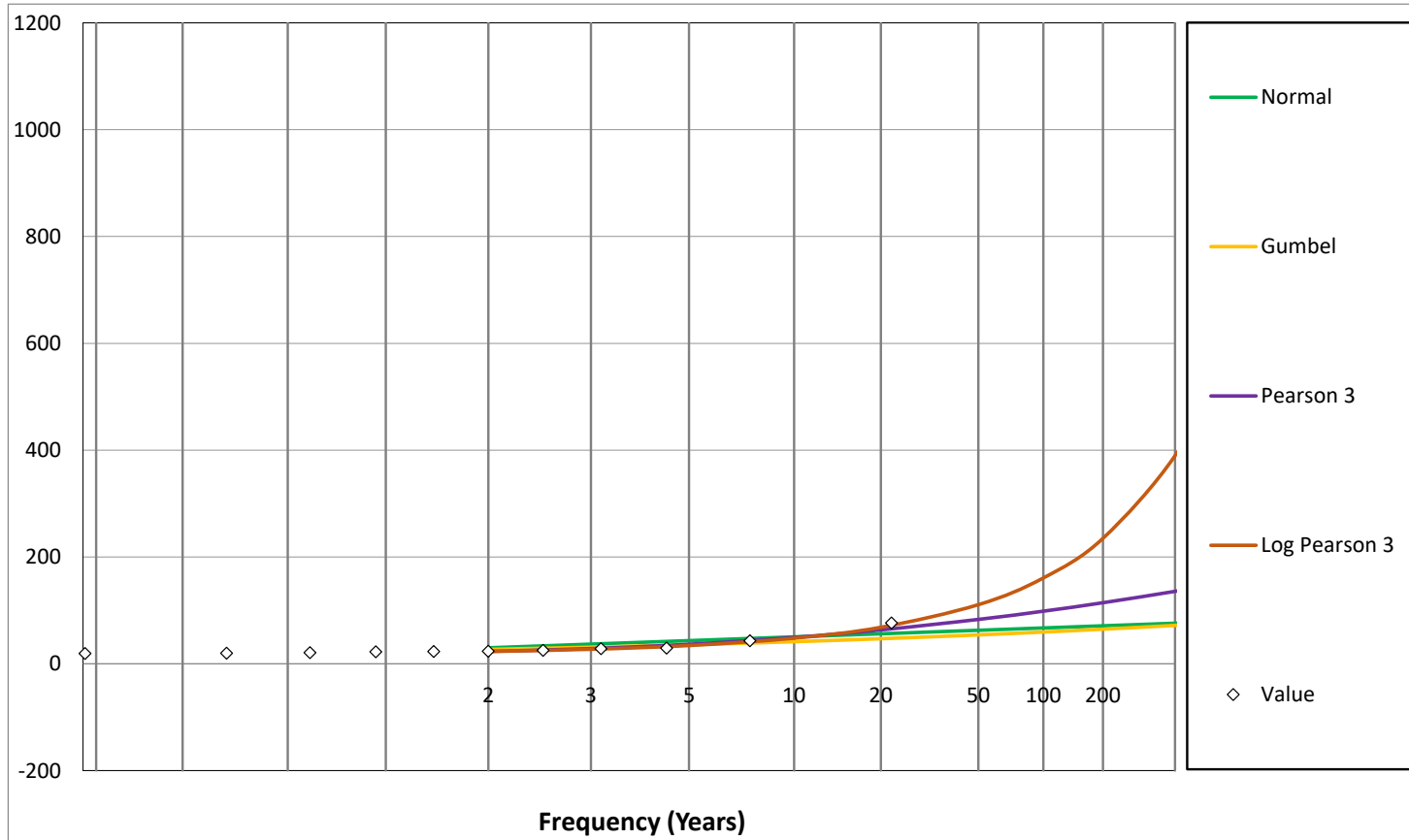


Figure B.14
Adjustments to a sample of annual values - 48h Maximum Precipitation
Springpole project

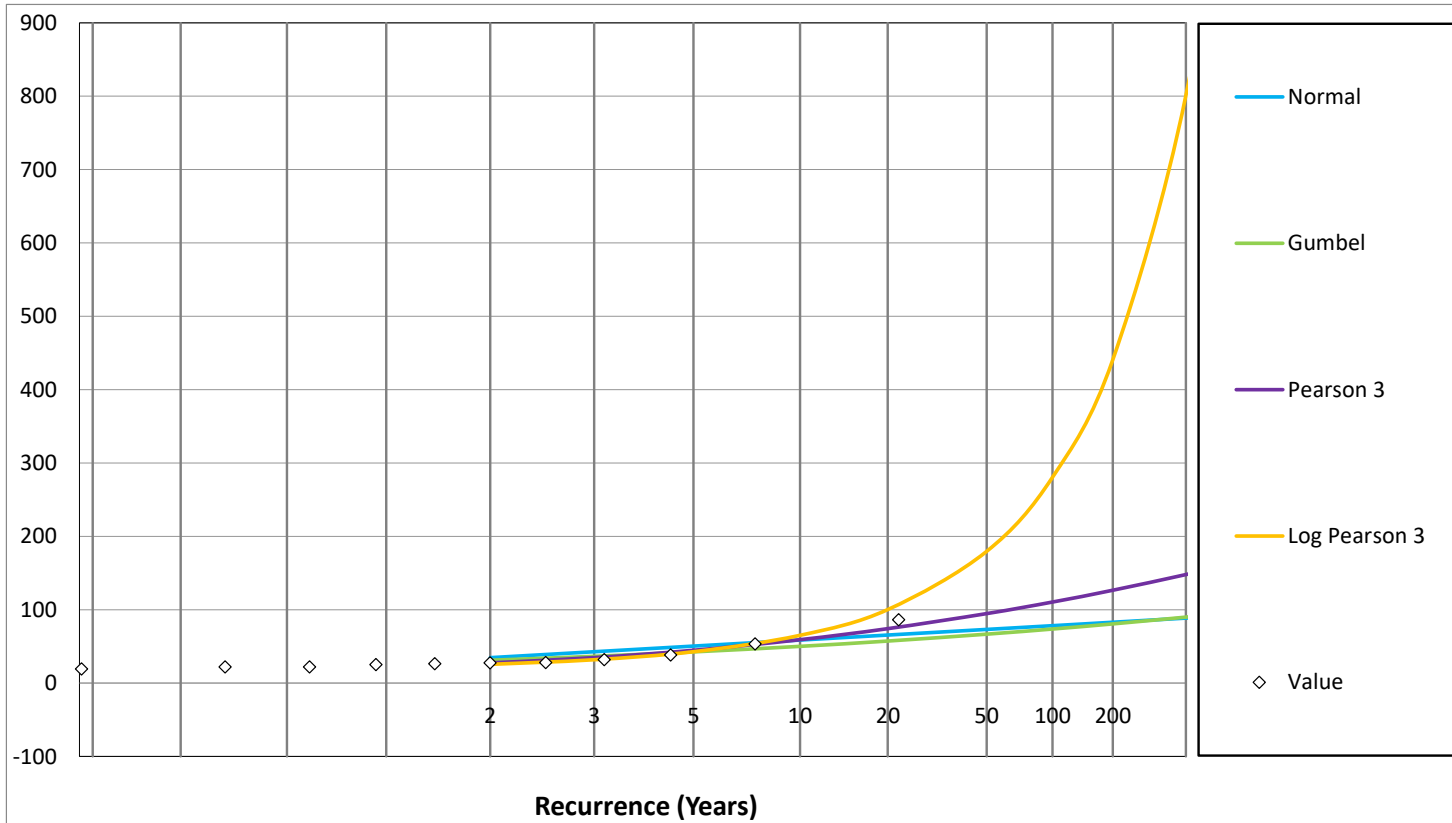
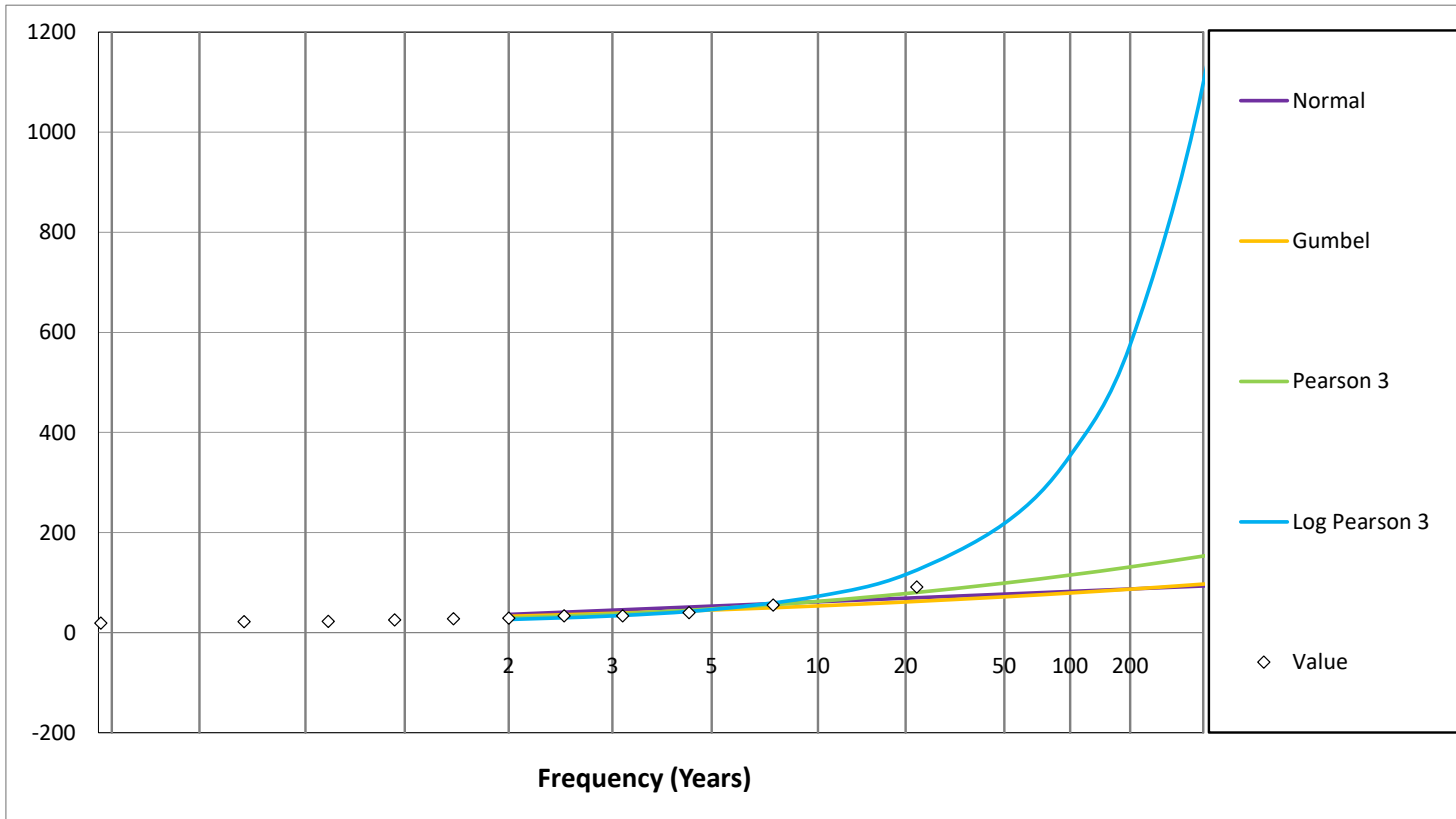


Figure B.15
Adjustments to a sample of annual values - 72h Maximum Precipitation
Springpole project



Attachment D 2011 Hydrology Baseline Study



**Gold Canyon Resources Inc.
Suite 810 – 609 Granville Street
P.O. Box 10356 Pacific Centre
Vancouver, BC
Canada, V7Y 1G5**

**SPRINGPOLE PROJECT
2011 HYDROLOGY BASELINE STUDY**

**DST File No.: OE-KN-012948
Date: April, 2012**



Springpole Project

2011 Hydrology Baseline Study

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1. Introduction

Gold Canyon Resources Inc. (Gold Canyon) is a Canadian-based unique mineral exploration company. Gold Canyon holds a 100% interest in the Springpole gold project, situated in the Red Lake Mining District of North-western Ontario, Canada, approximately one hundred and ten kilometres northeast of the Town of Red Lake (Figure 1.1). The Springpole gold project has a surface area of over 20,000 acres. The property is situated within the Birch-Uchi Greenstone Belt, and the dominant host rocks for most of the gold mineralization at Springpole are Achaean age (2.7 billion years old) sedimentary and intrusive rocks. The extensive gold mineralization system at the Springpole gold project may be unique among Canadian Archaean gold deposits. Gold exploration on the Springpole property has been pursued during two main periods, one during the 1920's to 1940's, and a second period from 1985 through to the present. Gold Canyon has continued its evaluation efforts at Springpole through mapping and geochemical studies and drilling programs since 1998. Gold Canyon is pursuing the gold resource of the core area, and also discovering potentially large new resources in the rest of its land position at Springpole.

The Springpole gold project is expected to require the completion of federal and provincial environmental assessments and permits prior to development. To support ongoing drilling activities and project permitting Gold Canyon retained DST Consulting Engineers Inc. (DST) in 2010 to gather environmental baseline data and submit environmental reports.

DST started collecting baseline data at the Springpole gold project site late in 2010. The 2011 Baseline Assessment Study includes the following components:

- Meteorology, Air Quality and Noise
- Hydrology and Hydrogeology
- Aquatic Resources
- Terrestrial Resources
- Country Rock and Tailings Geochemistry
- Archaeology, Culture, and Heritage Resources
- Socio-Economics

The following report presents the results of the 2011 hydrology baseline study. The hydrological monitoring was initiated in June 2011. A total of five hydrometric monitoring stations were installed in 2011, to assess five separate watersheds. The watersheds were selected after careful desktop and field review of the project area and anticipated future development.

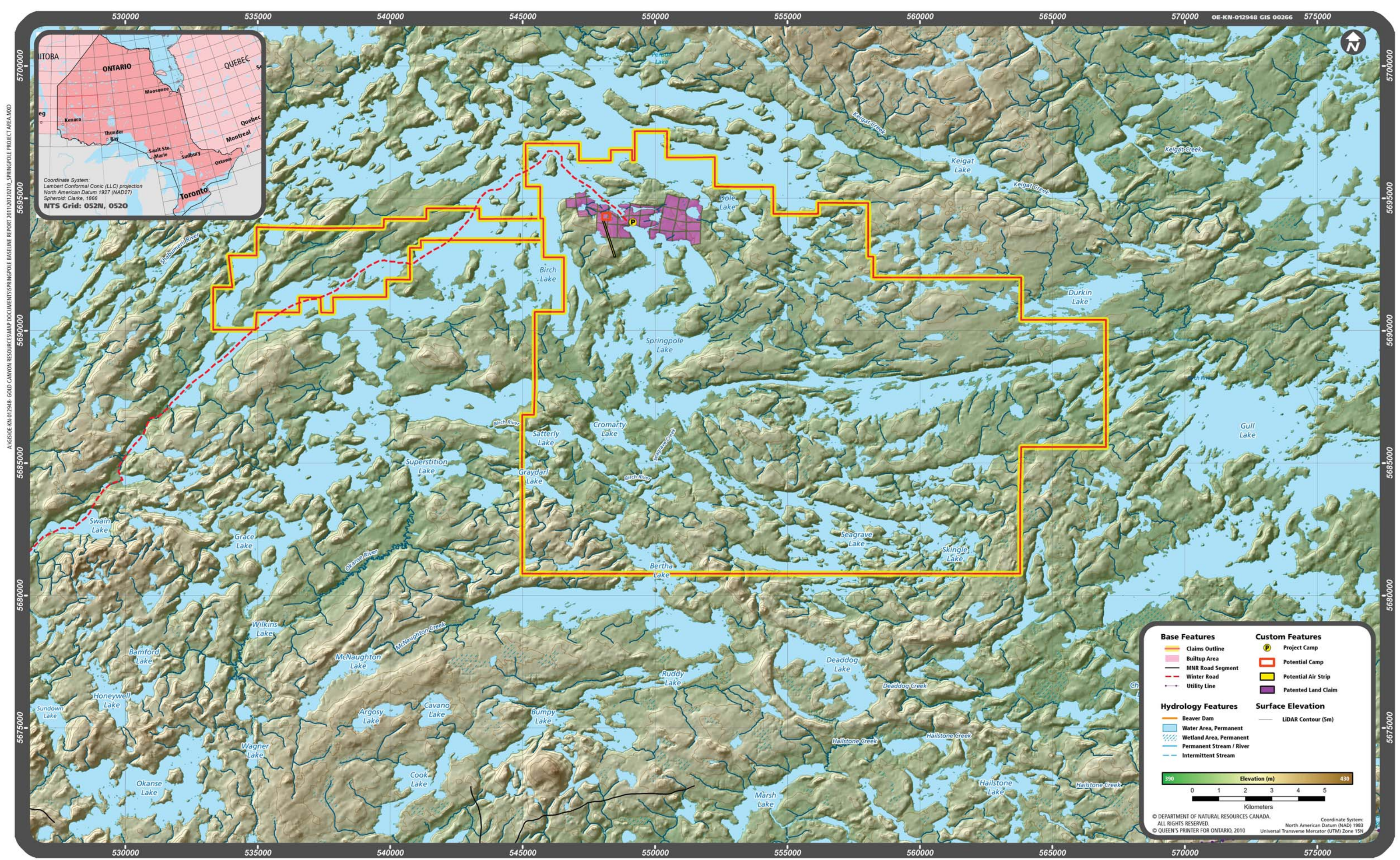


Figure 1.1: General Location Map
Springpole Lake Gold Project

2. Methodology

The objective of the first season of hydrometric monitoring was to assess and characterize the discharge volumes of water from watersheds and sub-watersheds encompassing the project and study areas. A total of 5 hydrometric stations (SPR-HS1, SPR-HS2, SPR-HS3, SPR-HS4, SPR-HS5) were installed at the project site. Two of the hydrometric monitoring stations were removed prior to freeze up in 2011, while three of the five hydrometric monitoring stations (SPR-HS1, SPR-HS2, and SPR-HS5) were left in place in an attempt to record the 2012 spring freshet.

The main watershed within the study area is the largest watershed studied and is contributing to the discharge from Birch Lake to Springpole Lake. The hydrometric station (SPR-HS1) that captures data for this watershed is located at the Cromarty Lake outlet, which is at the mouth to Springpole Lake. In order to catch the spring 2012 freshet, it was decided that this hydrometric station would be left installed and allowed to overwinter, with regular site inspections. Once the weather and ice-out conditions allow for safe access by boat, manual monitoring of the hydrometric station will resume.

Station SPR-HS2 is located within one of the larger watersheds that contributes to Springpole Lake, which is located 8.5 km southeast of the project area. This hydrometric station was left installed over the winter in order to capture the 2012 spring freshet.

The second largest sub-watershed within the study area is located at an inlet to Birch Lake, which is approximately 7 km east of the project area. Due to low water levels, this hydrometric station (SPR-HS3) was removed for the winter. This hydrometric station is proposed to be re-installed in the spring of 2012.

The hydrometric station SPR-HS4 is located within a smaller watershed which contributes to Springpole Lake, located approximately 1 km east of the project area. This station was removed in the fall/winter of 2011 and is proposed to be re-installed in the spring of 2012.

The smallest sub-watershed within the study area is located at an inlet to Birch Lake, which is situated 2.5 km southwest of the project area. Station SPR-HS5 was left installed over the winter.

The hydrometric station locations and watershed areas associated with each station are illustrated on Figure 2.1 and Figure 2.2. Photographs of the locations are included in Appendix A. Each site location is summarized on Table 2.1.

Table 2.1: Springpole Hydrometric Station Locations

| Hydrometric Station | UTM Coordinates | Elevation (m) |
|----------------------------|------------------------|----------------------|
| SPR-HS1 | 15U 548628, 5686997 | 387.0 |
| SPR-HS2 | 15U 555820, 5688873 | 389.0 |
| SPR-HS3 | 15U 556005, 5693228 | 391.0 |
| SPR-HS4 | 15U 550117, 5693995 | 390.0 |
| SPR-HS5 | 15U 547210, 5692389 | 389.0 |

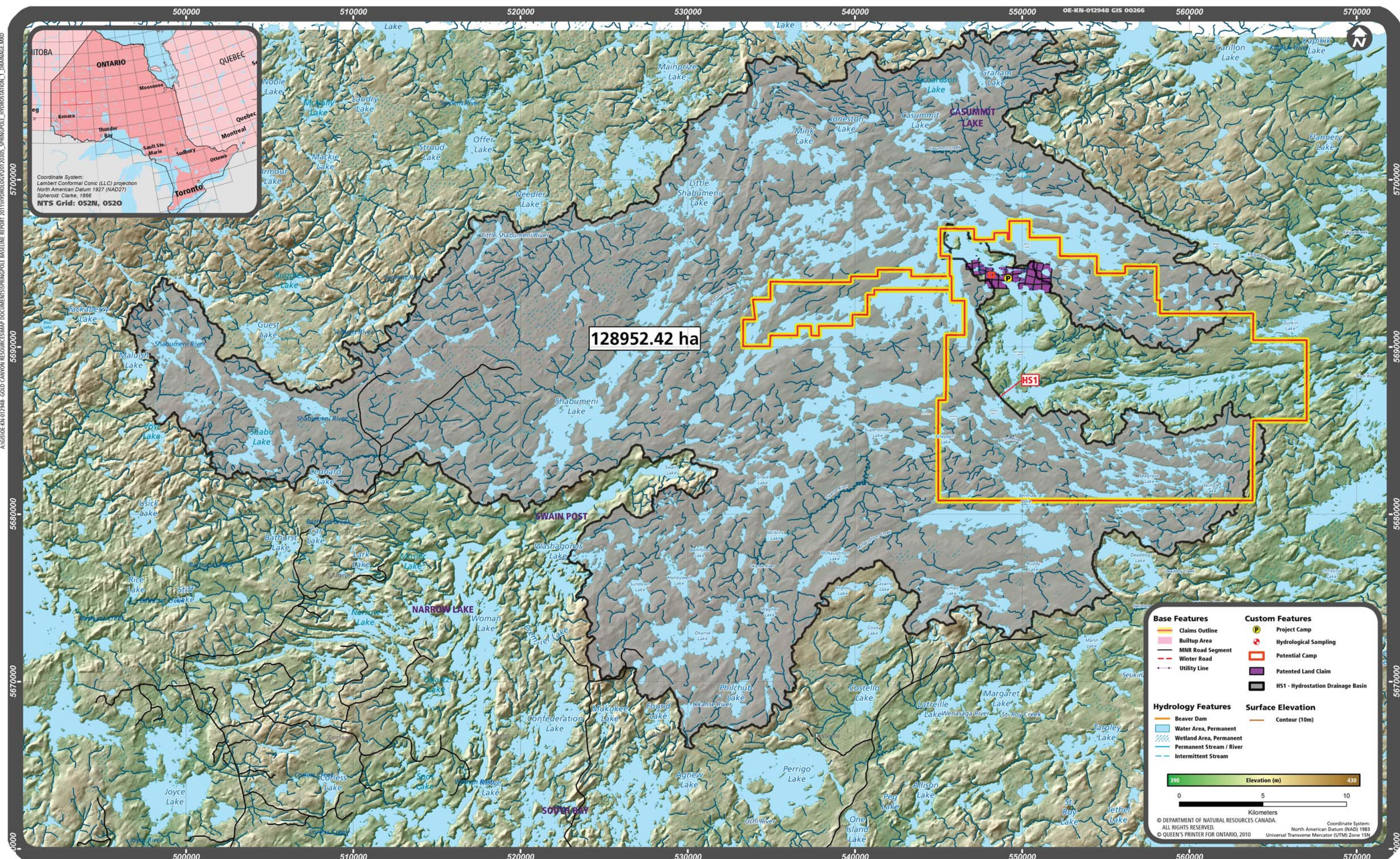


Figure 2.1: Hydrostation Drainage Basins
Springpole Lake Gold Project

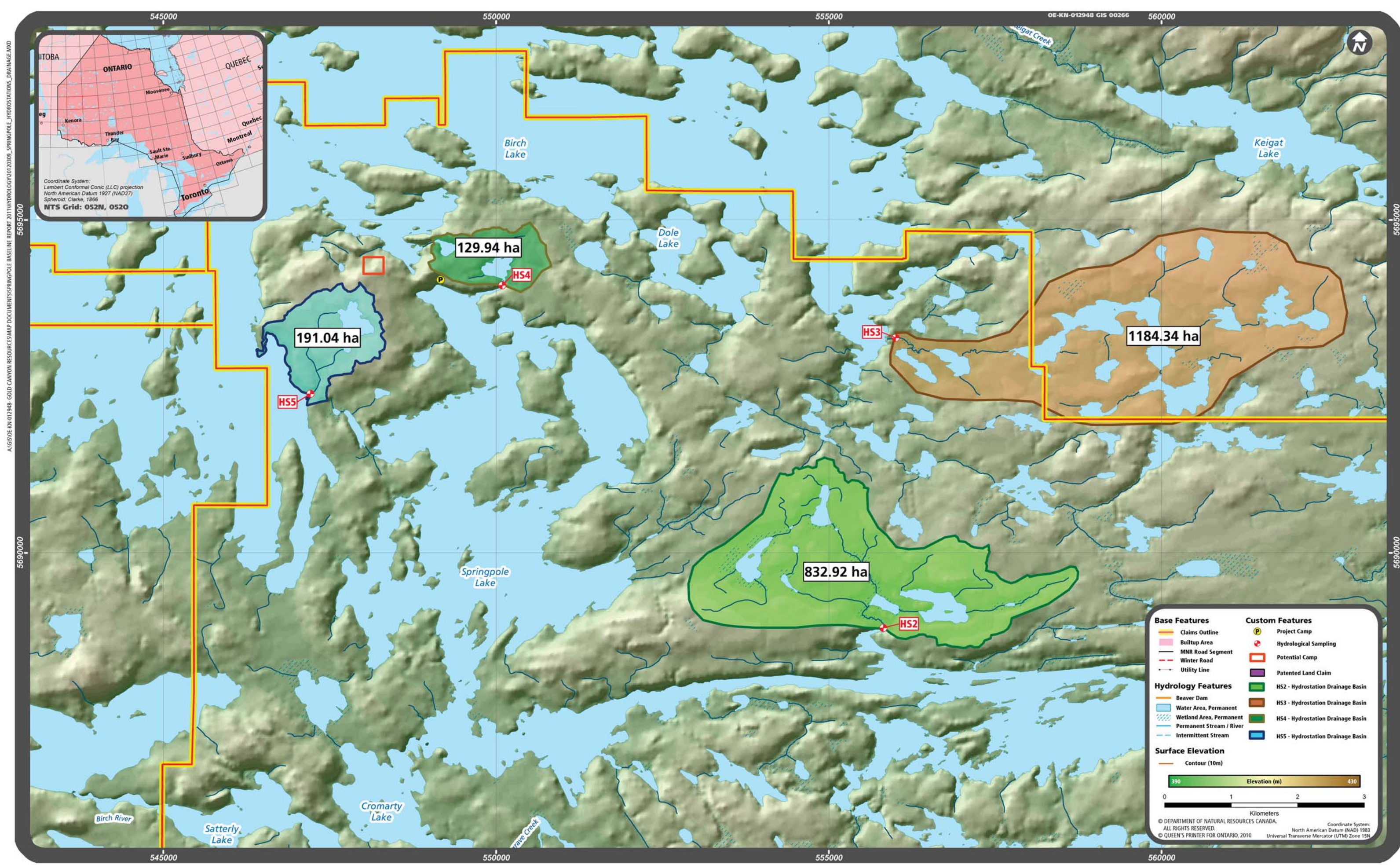


Figure 2.2: Hydrostation Drainage Basins
Springpole Lake Gold Project

The location for each of the hydrometric stations was selected to ensure little to no channel scouring over the season and to capture the maximum amount of runoff from each watershed without having backwater effects from static lake water levels.

Each hydrometric station consisted of a Global Water WL 450 pressure transducer and a WL 16 data logger, and a 1 m staff gauge, all attached to a secured wooden post. The post was anchored into place to prevent movement using steel rods driven into the substrate in a tripod fashion and anchored to the wooden post. The pressure transducers were installed at a height relative to the staff gauge so that water depths could be converted to flow estimates. The data loggers were set to record every 15 minutes (96 times/day).

Staff gauges were surveyed for elevations relative to a local arbitrary benchmark at each site, which was established by anchoring a bolt into a tree (where bedrock was not available) or using a marked point on a bedrock outcrop. This was done to measure (and correct for if required) any vertical movement of the staff gauge over the season, to have an established reference point if the stations were moved, and for re-establishing the stations in the following season.

Manual flow monitoring measurements were collected throughout the open water season. Flow velocities were determined manually at each hydrometric station using a Marsh-McBirney Model 2000 Flo-Mate portable flow meter. At each hydrometric station, the stream cross-section was divided into segments of equal width to obtain readings and maximum velocities were measured in the middle of each segment at a 60% depth (Marsh-McBirney, 1990). Streams that had a water depth greater than 0.60 m required a series of three measurements. Readings were taken at 80%, 60% and 20% and then averaged to calculate the velocity (m/s).

The manual discharge measurements and associated staff gauge readings were then used to generate a stage-discharge curve enabling the development of a rating equation. The formulae were then used to convert measurements collected by the pressure transducer into actual discharge estimates.

To aid in the interpretation of the results, 2011 precipitation data was obtained from the Red Lake Airport and Sioux Lookout meteorological stations.

The 2011 discharge data from Environment Canada for the Cat River discharge monitoring station is used to compare the study area trends with downstream readings. The station is located approximately 55 km southeast of the site, with a gross drainage area of 5,390 km².

3. Results and Discussion

3.1 Monitoring Period and Location

All hydrometric stations were set up to gather data from the time they were installed or adjusted in June of 2011 until they were removed in October of 2011, or until the 2012 Freshet. The monitoring period is shown in Table 3.1.

Table 3.1: Summary of Hydrometric Monitoring Period

| Hydrometric Station | Date Installed | Date Removed |
|---------------------|----------------|------------------|
| SPR-HS1 | June 2, 2011 | Still Installed |
| SPR-HS2 | June 2, 2011 | Still Installed |
| SPR-HS3 | June 2, 2011 | October 31, 2011 |
| SPR-HS4 | June 3, 2011 | October 31, 2011 |
| SPR-HS5 | June 4, 2011 | Still Installed |

Notes:

* SPR-HS1, SPR-HS2, and SPR-HS5 have been left in over the winter. The two stations (SPR-HS3 and SPR-HS4) that were removed prior to winter are scheduled to be re-installed in late April or early May 2012.

The hydrometric station, SPR-HS1 at the Cromarty Lake Outlet was installed approximately 50 m south of the rapids that flow into Springpole Lake. The channel cross section was 25.0 m wide with a maximum water depth of 1.06 m on June 2, 2011. The channel is broad with primarily bedrock, cobbles, and gravel substrate with silt and organics present on each bank. The channel banks are fairly steeply sloped. High discharge rates are expected within the channel at this location and it was considered to be a good candidate location to install the hydrometric station.

The hydrometric station, SPR-HS2 was installed east of the narrows on Springpole Lake at an inlet to Springpole Lake that flows from a series of un-named small bodies of water. The channel cross section was 4.0 m wide with a maximum water depth of 0.75 m on June 3, 2011. The channel is well defined; but it meanders through a wetland area. The substrate consists of bedrock, cobbles, and gravel. There is evidence of previous beaver activity upstream.

The hydrometric station, SPR-HS3 is located in the southeast arm of Birch Lake. SPR-HS3 was installed downstream of a series of un-named water bodies that flow into Birch Lake. The hydrometric station was installed approximately 200 m upstream from Birch Lake. The channel

cross section was 3.2 m wide with a maximum water depth of 0.28 m on June 4, 2011. The channel is well defined in a relatively flat area with mixed composition substrate consisting of organic material, sand, gravel and cobbles with organic material present on each bank. There was evidence of beaver activity upstream, but not within recent years. SPR-HS3 was removed in the late fall of 2011, as the flow had decreased significantly due to seasonal anomalies, and there was concern that the transducer would freeze. This Hydrometric station is scheduled to be replaced or relocated in the spring of 2012.

The hydrometric station, SPR-HS4 was installed within an inlet to Springpole Lake, approximately 1 km east of the project camp. The channel cross section was 1.5 m wide with a maximum water depth of 0.22 m on June 3, 2011. The channel is relatively well defined and is situated in a lowland swale at the outlet of a series of small unnamed water bodies. The substrate consists of fine grained material and organic matter. Station SPR-HS4 was removed in the late fall of 2011, as the flow had decreased significantly due to seasonal fluctuations. There was also a concern that the transducer would freeze. This hydrometric station is scheduled to be replaced or relocated in the spring of 2012.

The hydrometric station, SPR-HS5 is located in a southwest arm on the east side of Birch Lake and was installed at an inlet to Birch Lake that flows from a series of small unnamed water bodies. The channel cross section was 1.0 m wide with a maximum water depth of 0.22 m on June 4, 2011. The channel is relatively well defined in a low flat area in which eastern white cedar is prominent along the banks. The substrate consists of fine grained material, gravel, and organic matter. There was evidence of beaver activity upstream, but no recent activity at the time of the station installation.

3.2 Staff Gauge Survey

In order to assess vertical movement, the elevations of the hydrometric stations were surveyed several times during the season in addition to the installation and demobilization dates. An arbitrary benchmark, with an assigned elevation of 100.00 m, was established at all of the hydrometric stations that were installed in June 2011.

Table 3.2 presents a summary of the elevation survey results for the hydrometric stations. Some significant differences were noted at each hydrometric station in 2011. These differences were greater than 5 mm and appear to be related to human error, and/or natural occurrences (i.e., wildlife activity, log jams, etc.) Where possible, the data was corrected to account for the error encountered.

Table 3.2: Elevation Survey of Study Area (Staff Gauges and Bolts, 2011)

| Location | June | August | Sept. | Nov. | | Maximum Difference (m) |
|------------------------|--------|--------|--------|--------|---|------------------------|
| SPR-HS1 | | | | | | |
| Staff Gauge and Ref #1 | 0.224 | 0.214 | 0.028 | 0.216 | - | 0.010 |
| Bolt and Ref #1 | 0.780 | 0.780 | 0.922 | 0.746 | - | 0.034 |
| SPR-HS2 | | | | | | |
| Staff Gauge and Ref #1 | 0.895 | 0.891 | 0.890 | 0.893 | | 0.005 |
| Bolt and Ref #1 | 1.840 | 1.839 | 1.840 | 1.842 | - | 0.003 |
| SPR-HS3 | | | | | | |
| Staff Gauge and Ref #1 | 0.590 | -0.029 | 0.596 | 0.588 | - | 0.008 |
| Bolt and Ref #1 | 0.360 | 0.981 | 0.358 | 0.348 | - | 0.012 |
| SPR-HS4 | | | | | | |
| Staff Gauge and Ref #1 | -0.800 | -0.719 | -1.402 | 0.796 | - | 0.081 |
| Bolt and Ref #1 | 0.159 | 0.231 | 0.491 | 0.115 | - | 0.376 |
| SPR-HS5 | | | | | | |
| Staff Gauge and Ref #1 | -0.235 | -0.398 | -0.233 | -0.232 | | 0.003 |
| Bolt and Ref #1 | 1.205 | 1.380 | 1.218 | 1.206 | | 0.175 |

Notes:

Highlighted data indicates survey errors and thus has been excluded from any calculation.

3.3 Manual Stream Discharge Measurements

Manual stream discharge measurements were collected at the five hydrometric stations throughout the spring, summer and fall of 2011. Table 3.3 summarizes the stream flow monitoring results from 2011. The detailed data from the 2011 monitoring events is presented in Appendix B.

The manual measurements show discharge rates that were relatively low for most of the monitoring period with higher flows during periods of heavy rainfall in the beginning of June. Similarities across stations over time, with respect to low and high discharge rates, were noted. The highest manual discharge measured in 2011 was 11,403 L/s on June 2, 2011, at hydrometric station SPR-HS1 the Cromarty Lake Inlet. The lowest discharge recorded was 0 L/s; this value was recorded at SPR-HS2, SPR-HS3, and SPR-HS4 for periods in the late summer and early fall.

Table 3.3: Stream Discharge Manual Flow Measurements, 2011

| Station | Date | Time (CST) | Discharge Rate (L/s) | Gauge Height (m) | Drainage Area (km ²) |
|---|-----------|------------|----------------------|------------------|----------------------------------|
| SPR-HS-1 Cromarty | 2-Jun-11 | 16:50 | 11,403 | 0.550 | 1,289.54 |
| | 16-Aug-11 | 13:12 | 4,474 | 0.330 | |
| | 27-Sep-11 | 12:36 | 2,355 | 0.245 | |
| | 1-Nov-11 | 11:30 | 1921 | 0.215 | |
| SPR-HS-2 Springpole - East arm | 3-Jun-11 | 16:15 | 154 | 0.400 | 8.33 |
| | 16-Aug-11 | 11:16 | 34 | 0.220 | |
| | 26-Sep-11 | 11:10 | 2 | 0.200 | |
| | 1-Nov-11 | 9:47 | 0 | 0.235 | |
| SPR-HS-3 Birch - East | 2-Jun-11 | 16:05 | 688 | 0.260 | 11.84 |
| | 18-Aug-11 | 16:22 | *-0.6 | 0.000 | |
| | 28-Sep-11 | 8:52 | 4 | 0.000 | |
| | 1-Nov-11 | 15:56 | -1 | 0.017 | |
| SPR-HS-4 Springpole - near camp | 3-Jun-11 | 19:05 | 5 | 0.180 | 1.3 |
| | 16-Aug-11 | 17:00 | 0 | 0.108 | |
| | 28-Sep-11 | 16:00 | 0 | no reading | |
| | 31-Oct-11 | 16:21 | 0 | 0.103 | |
| SPR-HS-5 Birch Lake - South arm | 4-Jun-11 | 11:00 | 46 | 0.261 | 1.91 |
| | 16-Aug-11 | 7:27 | 1 | 0.120 | |
| | 28-Sep-11 | 10:46 | 1 | 0.097 | |
| | 1-Nov-11 | 13:00 | 1 | 0.109 | |

Notes:

* - These values are considered to be anomalous and were not used.

3.4 Stage-Discharge Curves

The stage-discharge curves were generated using the manual stream discharge measurements collected during the 2011 monitoring period. Stage-discharge curves were generated for stations SPR-HS1, SPR-HS2, and SPR-HS5. The flow levels for the two remaining hydrometric stations (SPR-H3 and SPR-HS4) were too low to be able to generate discharge-curves, and therefore the data is not presented in this report.

Figures 3.1 through 3.3 present the stage-discharge curves for the monitored locations. A total of four manual stream discharge measurements were collected at the SPR-HS1, SPR-HS2, SPR-HS3, SPR-HS4, and SPR-HS5 hydrometric stations in 2011.

The formula developed from each stage-discharge curve was used to calculate discharge values from the water level readings collected from the pressure transducers at each hydrometric monitoring location. As previously mentioned the data from the hydrometric stations SPR-HS3 and SPR-HS4 contained values that were too low and therefore no discharge

values are presented. The correlation (r^2) values ranged from 0.7499 (SPR-HS2) to 0.9986 (SPR-HS1), indicating a high degree of correlation of data to the generated trend line (MS-Excel). Additional manual stream discharge measurements for the mid to high-range discharge events will help to verify the relationship of the stage-discharge curves.

The region experienced water levels that were below normal in 2011 due to weather conditions. Much of Northwestern Ontario was drier-than-normal and received between one-half and two-thirds of the precipitation normally expected during summer months. Normally in July, Sioux Lookout receives approximately 85.3 mm of precipitation; they received 50.3 mm less than average (Saunders, 2011). Temperatures were also above average across the province of Ontario. As a consequence of exceptionally hot, dry, windy weather and frequent lightning storms, the 2011 forest fire season recorded significantly more fires in Ontario. 2011 saw the largest fire recorded in Ontario history in the last 50 years— station Sioux Lookout 70 recorded 141,000 hectares. Another fire, station Sioux Lookout 35, recorded 112,000 hectares to become the eighth-largest fire on record in half a century (OMNR, 2011). The number of forest fire occurrences in North-western Ontario is indicative of the exceptionally dry summer.

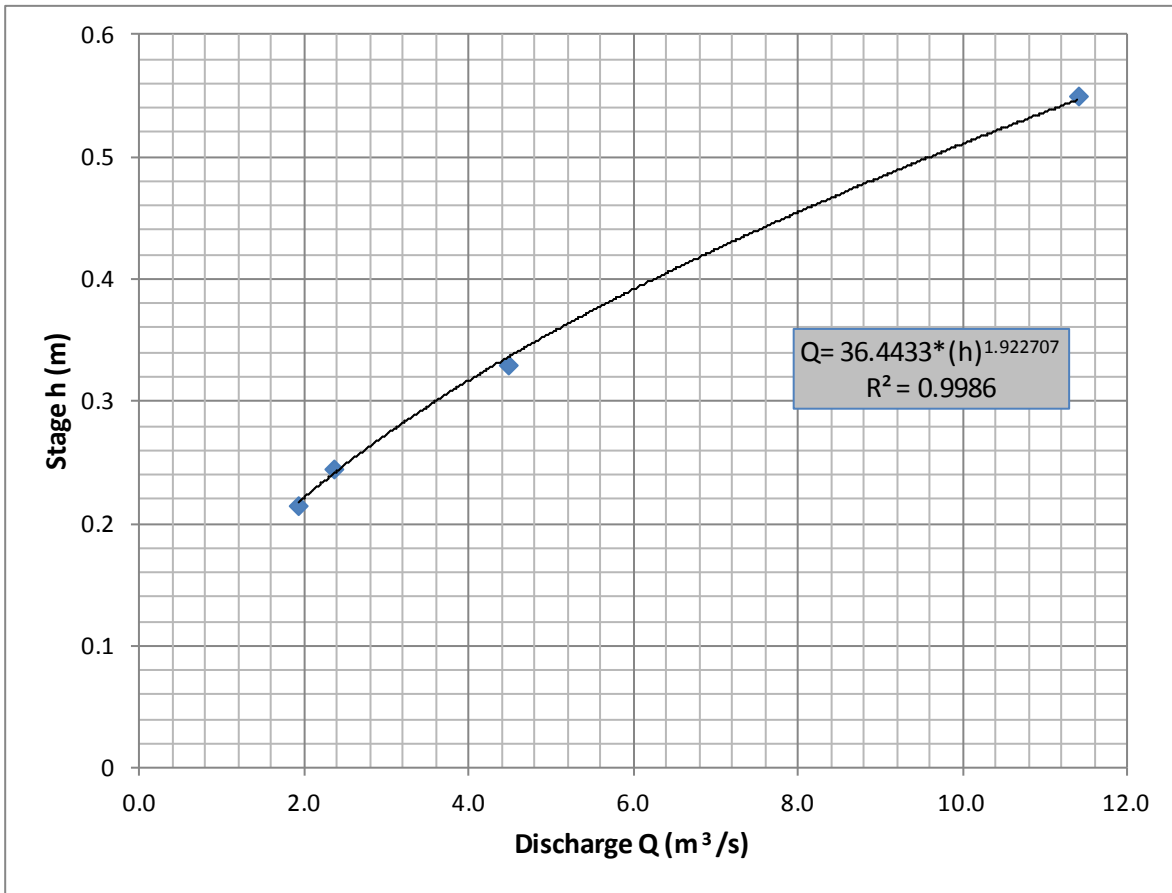


Figure 3.1: Stage-Discharge Curve for SPR-HS1 Cromarty Lake Outlet Hydrometric Station, 2011

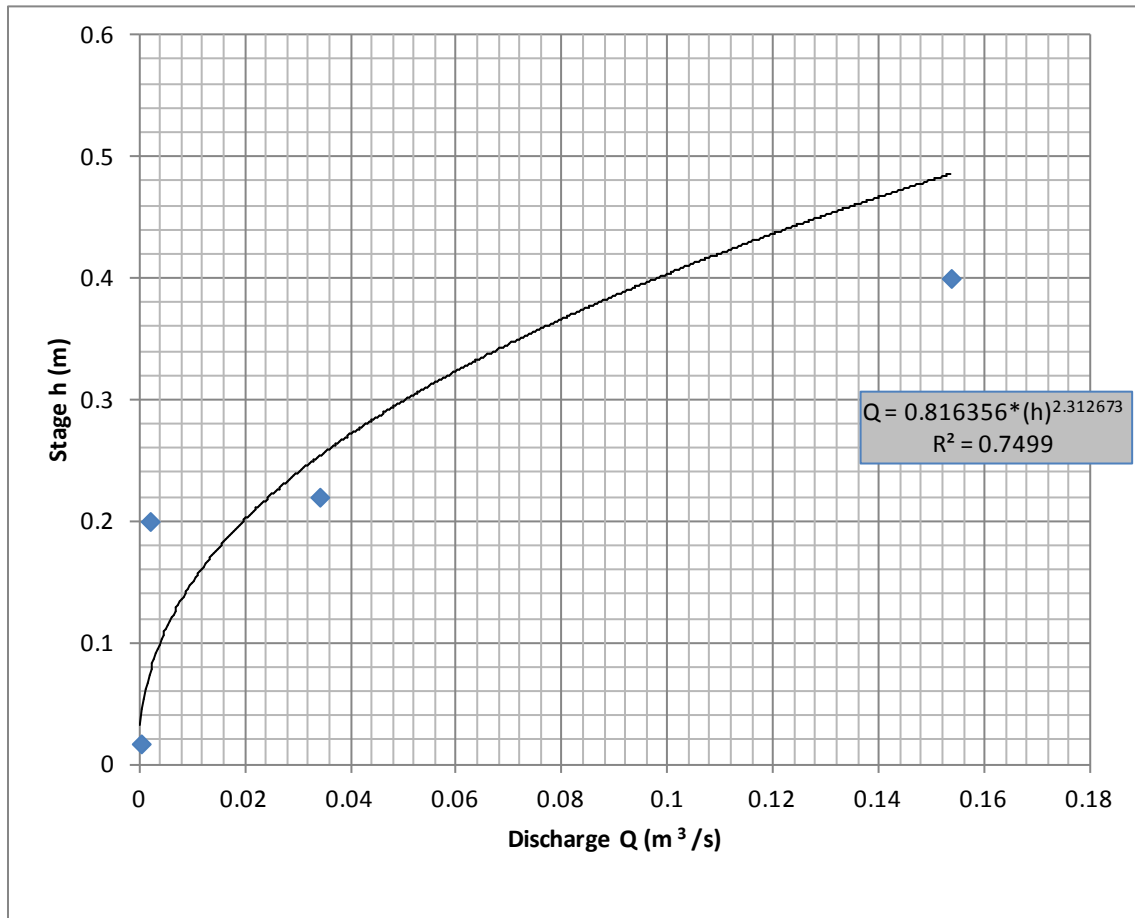


Figure 3.2: Stage-Discharge Curve for SPR-HS2 Springpole Inlet Hydrometric Station, 2011

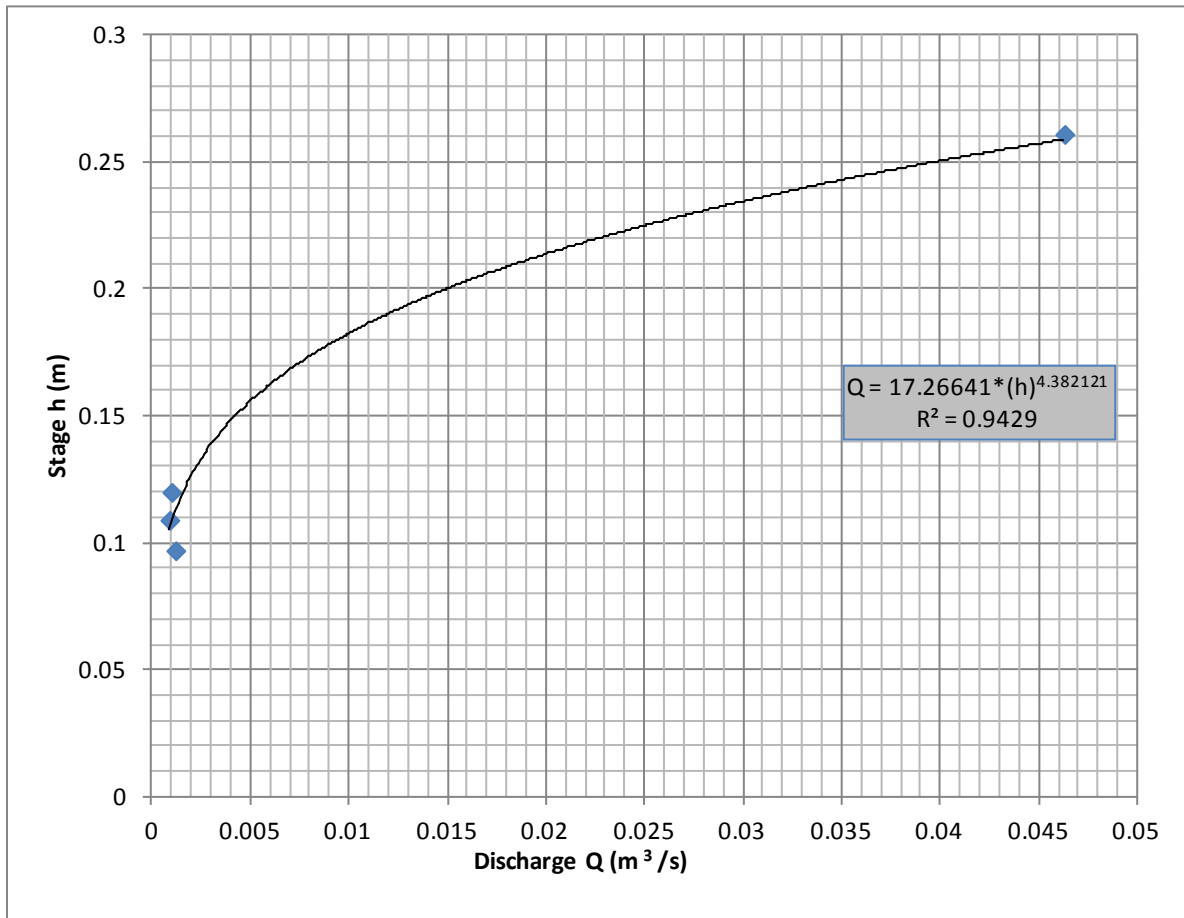


Figure 3.3: Stage-Discharge Curve for SPR-HS5 Birch Lake Inlet Hydrometric Station, 2011

3.5 Average Daily Discharge

The average daily discharges that were generated for the hydrometric stations are presented in Appendix C. Table 3.4 summarizes the statistics associated with the daily average discharges.

The 2011 peak daily discharge calculated for station SPR-HS1 was 16,200 L/s on June 17, 2011, while the lowest daily discharge of the 2011 monitoring period was 1,847 L/s on October 12, 2011. The average daily discharge during the monitoring period for SPR-HS1 was 6,293 L/s.

The 2011 peak daily discharge recorded for station SPR-HS2 was 42 L/s on October 29, 2011, while the lowest daily discharge of the 2011 monitoring period was 27 L/s on October 7, 2011. The average daily discharge during the monitoring period for SPR-HS2 was 35L/s. Due to technical issues with the transducer; data was not logged prior to October 7, 2011 for this hydrometric station.

The 2011 peak daily discharge recorded for station SPR-HS5 was 28 L/s on June 4, 2011, while the lowest daily discharge of the 2011 monitoring period was 0 L/s on August 1, 2011. The average daily discharge during the monitoring period for SPR-HS5 was 1 L/s.

The 2011 daily discharges recorded for stations SPR-HS3 and SPR-HS4 were 0 L/s for the duration of the monitoring period and therefore no statistical analysis was possible.

Table 3.4: Average Daily Discharge Statistics, 2011

| <i>Site</i> | <i>2011</i> | | |
|-------------------------|-------------|-------------|-------------|
| | <i>Min.</i> | <i>Max.</i> | <i>Mean</i> |
| <i>SPRHS1</i> | 1,847 | 16,200 | 6,293 |
| (Date) | 12-Oct | 17-Jun | - |
| <i>SPRHS2</i> | 27 | 42 | 35 |
| (Date) | 7-Oct | 29-Oct | - |
| <i>SPRHS3</i> | - | - | - |
| (Date) | - | - | - |
| <i>SPRHS4</i> | - | - | - |
| (Date) | - | - | - |
| <i>SPRHS5</i> | 0 | 28 | 1 |
| (Date) | 1-Aug | 4-Jun | - |
| <i>Cat River</i> | 20,911 | 76,762 | 51,273 |
| (Date) | 5-Apr | 29-Jun | - |

Notes:

All values are reported in L/S, unless otherwise specified.

Figure 3.6 presents a unit-yield hydrograph (average daily discharge/drainage area) for three of the five hydrometric stations (SPR-HS1, SPR-HS2, SPR-HS5). The unit yield for the Cat River hydrometric station is also included for comparative purposes. For the month of June, the maximum unit yield measurements in 2011 for SPR-HS1, SPR-HS2, and SPR-HS5 are 0.130 L/s/km², 0.023 L/s/km², and 0.135 L/s/km² respectively.

As shown on the hydrograph for the three monitoring locations, presented as Figure 3.7 and Figure 3.8, the peak flows were measured in the SPR-HS1, SPR-HS2, and SPR-HS5, monitoring stations. All three of the flow monitoring stations showed good correlation during the 2011 monitoring period. Additional flow monitoring at the mid to high-discharge rates are needed to strengthen the stage-discharge curves.

3.6 Cat River Hydrologic Summary

Environment Canada maintains a hydrometric station on the Cat River below Wesleyan Lake, approximately 55 km southeast and downstream of the study area. This data encompasses a watershed area of 5,390 km². The available data has been used to compare the unit yields for the three study area hydrometric stations and assess any correlations. A hydrograph (Figure 3.6) created using the data from Environment Canada, shows the average daily water levels within the Cat River. The peaks in water levels in late April indicate the period of the spring freshet. There is also a peak in water levels in the beginning of June, in which heavy rainfall occurred in this region.

Although the Cat River watershed showed higher stabilized unit yields following the spring freshet when compared to the three studied watersheds (Figure 3.6), which showed decreasing unit yields in the summer months, there is still good correlation between the study area and the downstream station. The higher stabilized unit yields in the Cat River watershed can be explained by larger water basins which are able to release a constant flow.

Precipitation data from the Red Lake Airport and Sioux Lookout meteorological stations was also included in Figures 3.6, 3.7 and 3.8 for comparative purposes. Relatively significant rainfall was recorded in early June and the amount of precipitation decreases to below normal averages for the month of July.

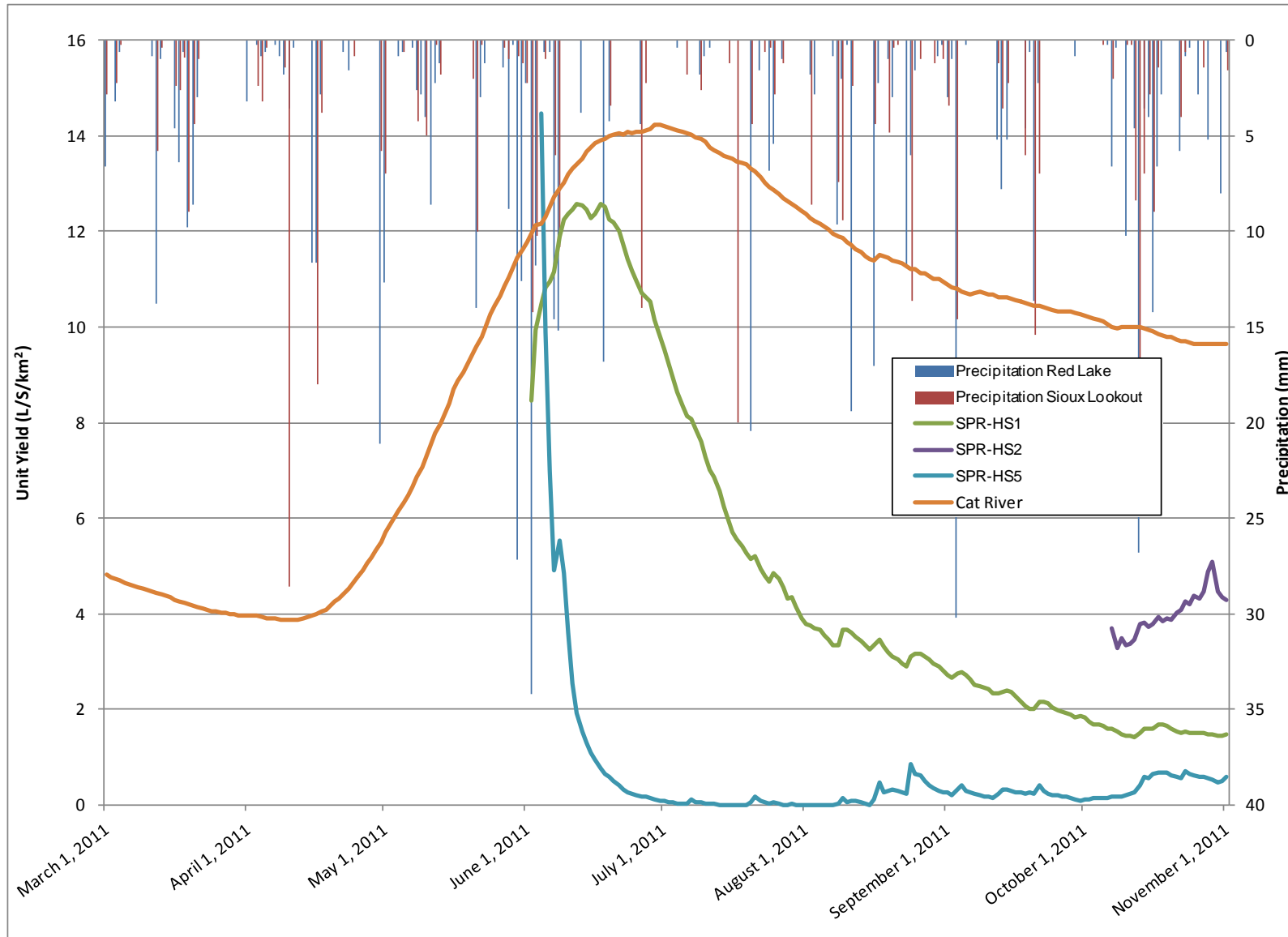


Figure 3.6: Unit Yield for Hydrometric Station SPR-HS1 Study Area, 2011

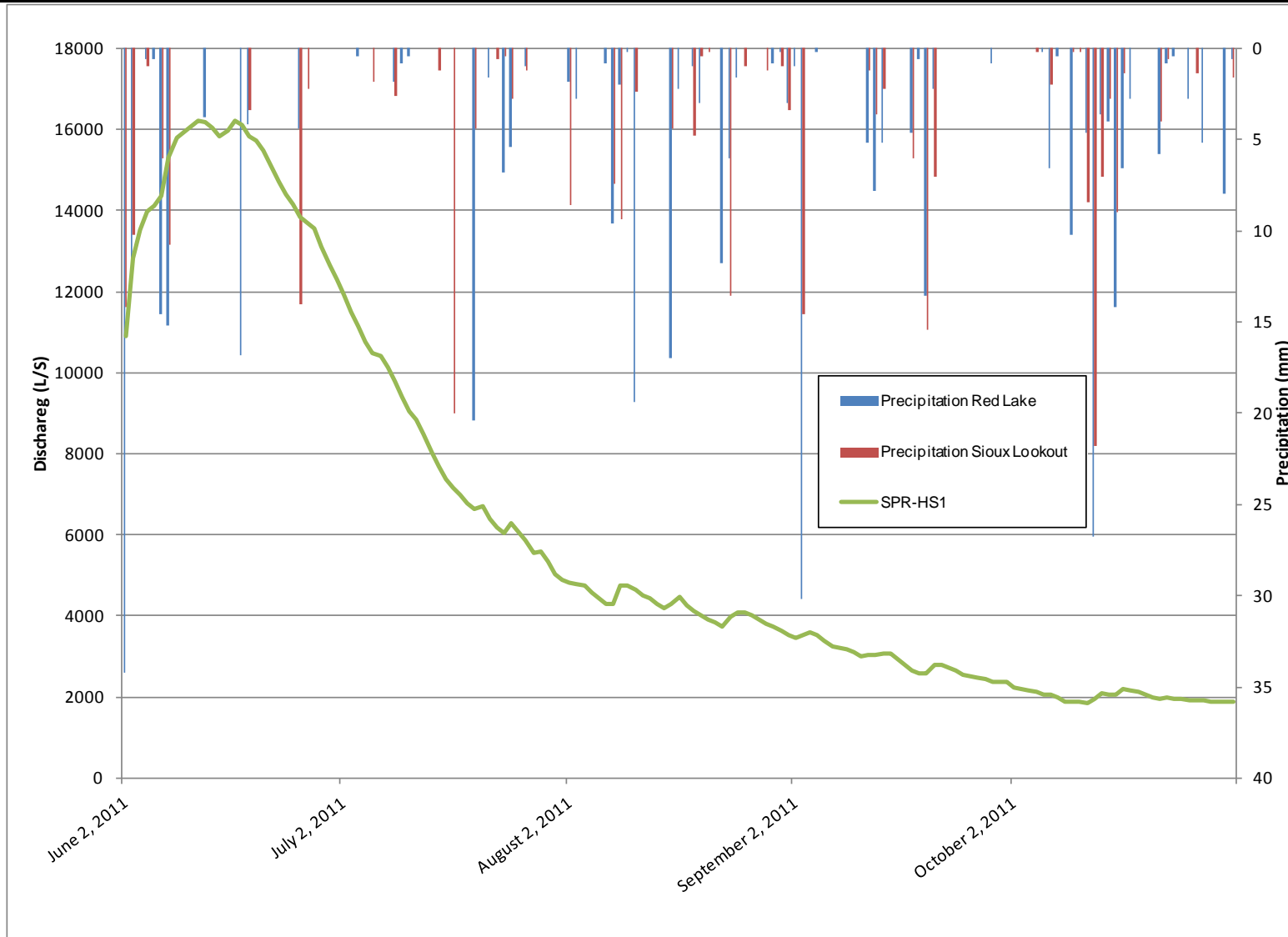


Figure 3.7: SPR-HS1 Hydrograph, 2011

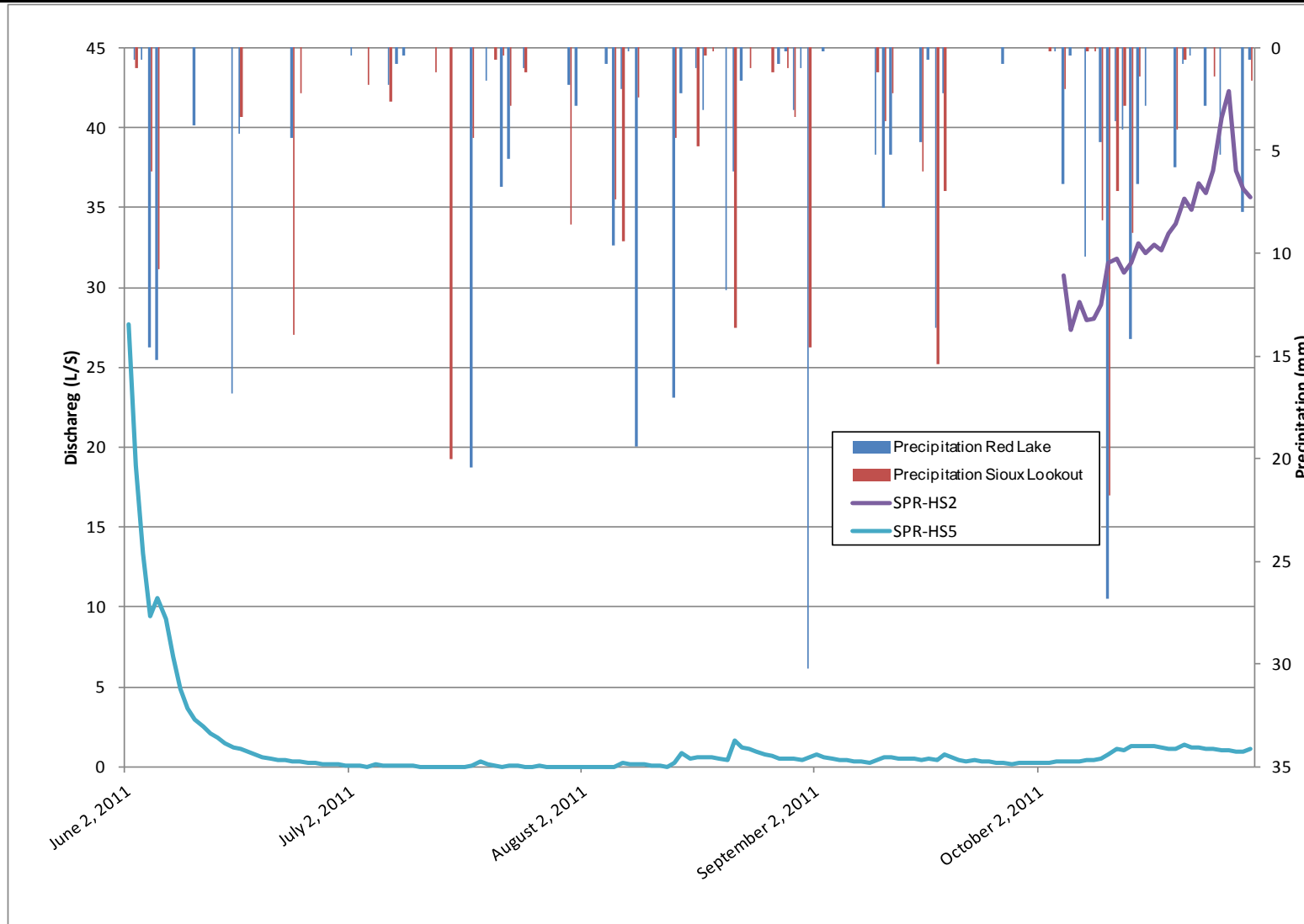


Figure 3.8: SPR-HS2 and SPR-HS5 Hydrograph, 2011

4. Summary and Recommendations

DST has completed the 2011 hydrological monitoring at the Springpole Project. The five flow monitoring stations, SPR-HS1, SPR-HS2, SPR-HS3, SPR-HS4, and SPRH5 established in 2011 were installed and monitored from June 2 to November 1, 2011. Three hydrometric stations (SPR-HS1, SPR-HS2, and SPR-HS5) were left in place to over-winter and were inspected and data was downloaded once in the month of January 2012. The two hydrometric stations, SPR-HS3 and SPR-HS4, that were removed prior to freeze-up are scheduled to be re-installed (depending upon discharge as 2011 was a relatively dry year), or possibly relocated to alternate sites, in the spring of 2012.

Based on the manual measurements collected during this period, stage-discharge curves were generated for three of the five hydrometric stations. The stage-discharge formulae developed to convert automated pressure transducer measurements into discharge estimates have applied to the pressure transducer data logged at all three of these stations. Additional manual stream discharge measurements are required to improve the stage-discharge relationships presented herein, particularly at the mid to high discharge rates.

Precipitation data from the Red Lake and Sioux Lookout Airport meteorological stations indicated relatively significant rainfall being recorded in June, with low levels of precipitation for the months of July and August. Water level data collected by Environment Canada at the Cat River location indicated the spring freshet occurring in late April and significant water levels occurring in early June as a result of heavy rainfall.

The estimated average daily discharges for the hydrometric monitoring stations were as follows: SPR-HS1 at 6,293 L/s; SPR-HS2 at 35 L/s; SPR-HS5 at 1 L/s. The hydrometric stations SPR-HS3 and SPR-HS4 did not have daily average discharges at a high enough rate in order to calculate representative data. The average peak daily discharge recorded in 2011 at the study area was at SPR-HS1 (16,200 L/s on June 17, 2011); while the lowest reportable daily discharge was recorded at SPR-HS5 (0 L/s on August 1, 2011).

A comparison of the unit yields for three of the five watersheds shows the maximum unit yield measurements for SPR-HS1, SPR-HS2, and SPR-HS5 to be 12.58 L/s/km², 5.08 L/s/km², 14.48 L/s/km² respectively.

In general, there was a good correlation between discharges in three of the five watersheds monitored in 2011. Additional flow monitoring at the mid to high discharge rates will be required to strengthen the stage-discharge curves for all locations.

5. Closure

We appreciate this opportunity to provide environmental services to you. If you have any questions or comments, please contact the undersigned.

For DST CONSULTING ENGINEERS INC.



Krista Prosser, B.A (Hons)
Environmental Scientist



Kristen Boorse, B.E.S., A.Sc.T.
Environmental Scientist



Kris Tuuttila, A.Sc.T., P.Geo. (Limited)
Environmental Sector Head, Kenora



Paul Hubley, M.Sc., P.Geo.
Sr. Technical Advisor

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APPENDIX A

Site Photographs



Photograph 1: View of SPR-HS1 at Cromarty lake inlet to Springpole Lake on June 2, 2011, installment date; facing north.



Photograph 2: View of SPR-HS1 on August 16, 2011 with survey equipment.



Photograph 3: View of the Springpole Lake inlet hydrometric station SPR-HS2 on June 2, 2011, installment date.



Photograph 4: View of the Springpole Lake inlet hydrometric station SPR-HS2 on August 16, 2011.



Photograph 5: View of SPR-HS3 Birch Lake inlet hydrometric station on June 2, 2011; facing south. Installment date.



Photograph 6: View of SPR-HS3 Springpole inlet hydrometric station on August 18, 2011; facing northeast.



Photograph 7: View of SPR-HS4 Springpole inlet hydrometric station on June 3, 2011; facing northeast. Installed date.



Photograph 8: Manual flow measurements being taken at SPR-HS5 Birch Lake inlet hydrometric station on June 4, 2011; facing east. Installed date.



Photograph 9: View of the SPR-HS5 on August 18, 2011.

APPENDIX B

Summary of Stream Discharge Measurements

2011 Streamflow Monitoring at SPR-HS1

Date: June 2, 2011

Staff Gauge: 0.55m

Time (CST): 16:50

Channel Width: 25m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1 | 0.18 | 1.00 | 0.180 | | 0.44 | | | 0.0792 |
| 2 | 0.25 | 1.00 | 0.250 | | 0.70 | | | 0.1750 |
| 3 | 0.37 | 1.00 | 0.370 | | 0.83 | | | 0.3071 |
| 4 | 0.50 | 1.00 | 0.500 | | 0.98 | | | 0.4900 |
| 5 | 0.64 | 1.00 | 0.640 | | 0.92 | | | 0.5888 |
| 6 | 0.82 | 1.00 | 0.820 | 0.86 | 0.89 | 0.56 | 0.77 | 0.6314 |
| 7 | 0.80 | 1.00 | 0.800 | 0.90 | 0.90 | 0.43 | 0.74 | 0.5947 |
| 8 | 0.84 | 1.00 | 0.840 | 0.80 | 0.80 | 0.56 | 0.72 | 0.6048 |
| 9 | 0.90 | 1.00 | 0.900 | 0.80 | 0.68 | 0.61 | 0.70 | 0.6270 |
| 10 | 0.90 | 1.00 | 0.900 | 0.78 | 0.77 | 0.61 | 0.72 | 0.6480 |
| 11 | 0.93 | 1.00 | 0.930 | 0.76 | 0.76 | 0.62 | 0.71 | 0.6634 |
| 12 | 0.90 | 1.00 | 0.900 | 0.60 | 0.67 | 0.57 | 0.61 | 0.5520 |
| 13 | 0.96 | 1.00 | 0.960 | 0.62 | 0.56 | 0.55 | 0.58 | 0.5536 |
| 14 | 0.96 | 1.00 | 0.960 | 0.74 | 0.67 | 0.61 | 0.67 | 0.6464 |
| 15 | 0.98 | 1.00 | 0.980 | 0.67 | 0.53 | 0.53 | 0.58 | 0.5651 |
| 16 | 1.02 | 1.00 | 1.020 | 0.66 | 0.58 | 0.38 | 0.54 | 0.5508 |
| 17 | 1.04 | 1.00 | 1.040 | 0.62 | 0.53 | 0.32 | 0.49 | 0.5096 |
| 18 | 1.06 | 1.00 | 1.060 | 0.63 | 0.46 | 0.48 | 0.52 | 0.5547 |
| 19 | 0.94 | 1.00 | 0.940 | 0.61 | 0.52 | 0.27 | 0.47 | 0.4387 |
| 20 | 0.98 | 1.00 | 0.980 | 0.66 | 0.49 | 0.38 | 0.51 | 0.4998 |
| 21 | 0.90 | 1.00 | 0.900 | 0.52 | 0.50 | 0.49 | 0.50 | 0.4530 |
| 22 | 0.76 | 1.00 | 0.760 | 0.62 | 0.50 | 0.45 | 0.52 | 0.3977 |
| 23 | 0.54 | 1.00 | 0.540 | | 0.53 | | | 0.2862 |
| 24 | 0.46 | 1.00 | 0.460 | | -0.03 | | | -0.0138 |

Total Flow = 11.4032

Date: August 16, 2011

Staff Gauge: 0.33m

Time (CST): 12:12

Channel Width: 22m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1 | 0.20 | 1.00 | 0.200 | | -0.04 | | | -0.0080 |
| 2 | 0.24 | 1.00 | 0.240 | | 0.15 | | | 0.0360 |
| 3 | 0.19 | 1.00 | 0.190 | | 0.30 | | | 0.0570 |
| 4 | 0.62 | 1.00 | 0.620 | 0.10 | 0.25 | 0.4 | 0.25 | 0.1550 |
| 5 | 0.70 | 1.00 | 0.695 | 0.10 | 0.33 | 0.42 | 0.28 | 0.1969 |
| 6 | 0.64 | 1.00 | 0.640 | 0.14 | 0.23 | 0.44 | 0.27 | 0.1728 |
| 7 | 0.66 | 1.00 | 0.660 | 0.28 | 0.43 | 0.41 | 0.37 | 0.2464 |
| 8 | 0.61 | 1.00 | 0.610 | 0.26 | 0.37 | 0.5 | 0.38 | 0.2298 |
| 9 | 0.72 | 1.00 | 0.720 | 0.25 | 0.32 | 0.38 | 0.32 | 0.2280 |
| 10 | 0.72 | 1.00 | 0.720 | 0.26 | 0.33 | 0.34 | 0.31 | 0.2232 |
| 11 | 0.73 | 1.00 | 0.730 | 0.5 | 0.42 | 0.5 | 0.47 | 0.3455 |
| 12 | 0.72 | 1.00 | 0.720 | 0.35 | 0.36 | 0.47 | 0.39 | 0.2832 |
| 13 | 0.64 | 1.00 | 0.640 | 0.30 | 0.44 | 0.44 | 0.39 | 0.2517 |
| 14 | 0.57 | 1.00 | 0.570 | | 0.53 | | | 0.3021 |
| 15 | 0.52 | 1.00 | 0.520 | | 0.50 | | | 0.2600 |
| 16 | 0.54 | 1.00 | 0.540 | | 0.61 | | | 0.3294 |
| 17 | 0.55 | 1.00 | 0.550 | | 0.52 | | | 0.2860 |
| 18 | 0.65 | 1.00 | 0.650 | 0.24 | 0.45 | 0.53 | 0.41 | 0.2643 |
| 19 | 0.73 | 1.00 | 0.730 | 0.30 | 0.49 | 0.47 | 0.42 | 0.3066 |
| 20 | 0.76 | 1.00 | 0.760 | 0.32 | 0.35 | 0.29 | 0.32 | 0.2432 |
| 21 | 0.49 | 1.00 | 0.490 | | 0.13 | | | 0.0637 |
| 22 | 0.14 | 1.00 | 0.140 | | 0.01 | | | 0.0014 |

Total Flow = 4.4743

2011 Streamflow Monitoring at SPR-HS1 Continued.

Date: September 27, 2011

Staff Gauge: 0.245m

Time (CST): 13:36

Channel Width: 22m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 28.7 | 0.18 | 1.00 | 0.180 | | 0.02 | | | 0.0036 |
| 27.7 | 0.38 | 1.00 | 0.380 | | 0.00 | | | 0.0000 |
| 26.7 | 0.38 | 1.00 | 0.380 | | 0.03 | | | 0.0114 |
| 25.7 | 0.48 | 1.00 | 0.480 | | 0.20 | | | 0.0960 |
| 24.7 | 0.20 | 1.00 | 0.200 | | 0.27 | | | 0.0540 |
| 23.7 | 0.34 | 1.00 | 0.340 | | 0.25 | | | 0.0850 |
| 22.7 | 0.36 | 1.00 | 0.360 | | 0.37 | | | 0.1332 |
| 21.7 | 0.38 | 1.00 | 0.380 | | 0.35 | | | 0.1330 |
| 20.7 | 0.42 | 1.00 | 0.420 | | 0.24 | | | 0.1008 |
| 19.7 | 0.34 | 1.00 | 0.340 | | 0.34 | | | 0.1156 |
| 18.7 | 0.46 | 1.00 | 0.460 | | 0.36 | | | 0.1656 |
| 17.7 | 0.46 | 1.00 | 0.460 | | 0.34 | | | 0.1564 |
| 16.7 | 0.40 | 1.00 | 0.400 | | 0.37 | | | 0.1480 |
| 15.7 | 0.41 | 1.00 | 0.410 | | 0.33 | | | 0.1353 |
| 14.7 | 0.34 | 1.00 | 0.340 | | 0.30 | | | 0.1020 |
| 13.7 | 0.32 | 1.00 | 0.320 | | 0.28 | | | 0.0896 |
| 12.7 | 0.47 | 1.00 | 0.470 | | 0.16 | | | 0.0752 |
| 11.7 | 0.58 | 1.00 | 0.580 | 0.12 | 0.13 | 0.16 | 0.14 | 0.0793 |
| 10.7 | 0.72 | 1.00 | 0.720 | 0.14 | 0.14 | 0.17 | 0.15 | 0.1080 |
| 9.7 | 0.90 | 1.00 | 0.900 | 0.11 | 0.13 | 0.18 | 0.14 | 0.1260 |
| 8.7 | 0.94 | 1.00 | 0.940 | 0.19 | 0.13 | 0.16 | 0.16 | 0.1504 |
| 7.7 | 0.86 | 1.00 | 0.860 | 0.18 | 0.17 | 0.17 | 0.17 | 0.1491 |
| 6.7 | 0.70 | 1.00 | 0.700 | 0.12 | 0.12 | 0.11 | 0.12 | 0.0817 |
| 5.7 | 0.70 | 1.00 | 0.700 | 0.05 | 0.06 | 0.05 | 0.05 | 0.0373 |
| 4.7 | 0.50 | 1.00 | 0.500 | | 0.03 | | | 0.0150 |
| 3.7 | 0.33 | 1.00 | 0.330 | | 0.01 | | | 0.0033 |

Total Flow = 2.3547

Date: November 1, 2011

Staff Gauge: 0.215m

Time (CST): 13:14

Channel Width: 20m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1 | 0.24 | 1.00 | 0.240 | | -0.01 | | | -0.0024 |
| 2 | 0.40 | 1.00 | 0.400 | | 0.21 | | | 0.0840 |
| 3 | 0.52 | 1.00 | 0.520 | 0.12 | 0.16 | 0.25 | 0.18 | 0.0919 |
| 4 | 0.56 | 1.00 | 0.560 | 0.12 | 0.22 | 0.25 | 0.20 | 0.1101 |
| 5 | 0.56 | 1.00 | 0.560 | 0.16 | 0.23 | 0.25 | 0.21 | 0.1195 |
| 6 | 0.50 | 1.00 | 0.500 | | 0.11 | | | 0.0550 |
| 7 | 0.54 | 1.00 | 0.540 | 0.22 | 0.24 | 0.28 | 0.25 | 0.1332 |
| 8 | 0.52 | 1.00 | 0.520 | 0.21 | 0.24 | 0.28 | 0.24 | 0.1265 |
| 9 | 0.58 | 1.00 | 0.580 | 0.20 | 0.25 | 0.30 | 0.25 | 0.1450 |
| 10 | 0.52 | 1.00 | 0.520 | 0.19 | 0.24 | 0.29 | 0.24 | 0.1248 |
| 11 | 0.54 | 1.00 | 0.540 | 0.19 | 0.23 | 0.28 | 0.23 | 0.1260 |
| 12 | 0.52 | 1.00 | 0.520 | 0.12 | 0.22 | 0.28 | 0.21 | 0.1075 |
| 13 | 0.46 | 1.00 | 0.460 | | 0.26 | | | 0.1196 |
| 14 | 0.42 | 1.00 | 0.420 | | 0.19 | | | 0.0798 |
| 15 | 0.48 | 1.00 | 0.480 | | 0.29 | | | 0.1392 |
| 16 | 0.52 | 1.00 | 0.520 | 0.21 | 0.26 | 0.30 | 0.26 | 0.1335 |
| 17 | 0.56 | 1.00 | 0.560 | 0.22 | 0.23 | 0.26 | 0.24 | 0.1325 |
| 18 | 0.62 | 1.00 | 0.620 | 0.12 | 0.14 | 0.14 | 0.13 | 0.0827 |
| 19 | 0.40 | 1.00 | 0.400 | | 0.03 | | | 0.0120 |
| 20 | 0.10 | 1.00 | 0.100 | | 0.01 | | | 0.0010 |

Total Flow = 1.9213

2011 Streamflow Monitoring at SPR-HS2

Date: June 3, 2011
 Time (CST): 15:15
 Channel Width: 2.5m

Staff Gauge: 0.400m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|---------------------------|-----------------------|
| 1.15 | 0.12 | 0.25 | 0.030 | -0.04 | -0.0011 |
| 1.40 | 0.20 | 0.25 | 0.050 | -0.06 | -0.0032 |
| 1.65 | 0.26 | 0.25 | 0.065 | -0.05 | -0.0036 |
| 1.90 | 0.33 | 0.25 | 0.083 | 0.00 | -0.0003 |
| 2.15 | 0.22 | 0.25 | 0.055 | 0.17 | 0.0096 |
| 2.40 | 0.28 | 0.25 | 0.070 | 0.27 | 0.0186 |
| 2.65 | 0.26 | 0.25 | 0.065 | 0.57 | 0.0370 |
| 2.90 | 0.20 | 0.25 | 0.050 | 0.77 | 0.0384 |
| 3.15 | 0.22 | 0.25 | 0.055 | 0.87 | 0.0481 |
| 3.40 | 0.10 | 0.25 | 0.025 | 0.40 | 0.0100 |

Total Flow = 0.1536

Date: August 16, 2011
 Time (CST): 13:16
 Channel Width: 1.65m

Staff Gauge: 0.220m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|---------------------------|-----------------------|
| 1 | 0.10 | 0.25 | 0.025 | -0.01 | -0.0003 |
| 2 | 0.10 | 0.25 | 0.025 | 0.07 | 0.0018 |
| 3 | 0.09 | 0.25 | 0.023 | -0.02 | -0.0005 |
| 4 | 0.08 | 0.25 | 0.020 | 0.18 | 0.0036 |
| 5 | 0.10 | 0.25 | 0.025 | 0.01 | 0.0003 |
| 6 | 0.12 | 0.25 | 0.029 | 0.00 | 0.0000 |
| 7 | 0.14 | 0.25 | 0.035 | 0.00 | 0.0000 |

Total Flow = 0.0049

2011 Streamflow Monitoring at SPR-HS2 Continued.

Date: September 26, 2011

Staff Gauge: 0.200m

Time (CST): 11:00

Channel Width: 1.80m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|---------------------------|-----------------------|
| 1 | 0.15 | 0.2 | 0.030 | 0.02 | 0.0006 |
| 2 | 0.25 | 0.2 | 0.050 | 0.01 | 0.0005 |
| 3 | 0.18 | 0.2 | 0.036 | 0.01 | 0.0004 |
| 4 | 0.09 | 0.2 | 0.018 | 0.01 | 0.0002 |
| 5 | 0.04 | 0.2 | 0.008 | 0.00 | 0.0000 |
| 6 | 0.12 | 0.2 | 0.024 | 0.02 | 0.0005 |
| 7 | 0.14 | 0.2 | 0.028 | 0.01 | 0.0003 |
| 8 | 0.16 | 0.2 | 0.032 | 0.00 | 0.0000 |
| 9 | 0.12 | 0.2 | 0.024 | 0.00 | 0.0000 |
| 10 | 0.04 | 0.2 | 0.008 | -0.01 | -0.0001 |

Total Flow = 0.0022

Date: November 1, 2011

Staff Gauge: 0.235m

Time (CST): 10:47

Channel Width: 1.9m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|---------------------------|-----------------------|
| 0.80 | 0.06 | 0.2 | 0.012 | -0.02 | -0.0002 |
| 1.00 | 0.10 | 0.2 | 0.020 | 0.02 | 0.0004 |
| 1.20 | 0.10 | 0.2 | 0.020 | 0.06 | 0.0012 |
| 1.40 | 0.14 | 0.2 | 0.028 | 0.02 | 0.0006 |
| 1.60 | 0.12 | 0.2 | 0.024 | 0.02 | 0.0005 |
| 1.80 | 0.24 | 0.2 | 0.048 | -0.02 | -0.0010 |
| 2.00 | 0.17 | 0.2 | 0.034 | -0.02 | -0.0007 |
| 2.20 | 0.18 | 0.2 | 0.036 | -0.02 | -0.0007 |
| 2.40 | 0.20 | 0.2 | 0.040 | -0.02 | -0.0008 |
| 2.60 | 0.26 | 0.2 | 0.052 | -0.02 | -0.0010 |

Total Flow = -0.0018

2011 Streamflow Monitoring at SPR-HS3

Date: June 4, 2011

Staff Gauge: 0.260m

Time (CST): 13:35

Channel Width: 2.86m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.66 | 0.24 | 0.22 | 0.053 | 0.83 | 0.0438 |
| 0.88 | 0.24 | 0.22 | 0.053 | 2.37 | 0.1251 |
| 1.10 | 0.24 | 0.22 | 0.053 | 2.29 | 0.1209 |
| 1.32 | 0.20 | 0.22 | 0.044 | 1.60 | 0.0704 |
| 1.54 | 0.20 | 0.22 | 0.044 | 1.24 | 0.0546 |
| 1.76 | 0.22 | 0.22 | 0.048 | 1.06 | 0.0513 |
| 1.98 | 0.28 | 0.22 | 0.062 | 0.67 | 0.0413 |
| 2.20 | 0.18 | 0.22 | 0.040 | 0.86 | 0.0339 |
| 2.42 | 0.18 | 0.22 | 0.040 | 0.35 | 0.0139 |
| 2.64 | 0.18 | 0.22 | 0.040 | 0.54 | 0.0214 |
| 2.86 | 0.22 | 0.22 | 0.048 | 0.87 | 0.0421 |
| 3.08 | 0.26 | 0.22 | 0.057 | 0.78 | 0.0443 |
| 3.30 | 0.14 | 0.22 | 0.031 | 0.54 | 0.0166 |
| 3.52 | 0.08 | 0.22 | 0.018 | 0.47 | 0.0082 |

Total Flow = 0.6878

Date: August 18, 2011

Staff Gauge: 0m

Time (CST): 16:22

Channel Width: 0.5m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.90 | 0.13 | 1.00 | 0.130 | 0.02 | 0.0026 |
| 1.00 | 0.12 | 1.00 | 0.120 | 0.01 | 0.0012 |
| 1.10 | 0.14 | 1.00 | 0.140 | 0.01 | 0.0014 |
| 1.20 | 0.10 | 1.00 | 0.100 | -0.01 | -0.0010 |
| 1.30 | 0.06 | 1.00 | 0.060 | -0.08 | -0.0048 |

Total Flow = -0.0006

2011 Streamflow Monitoring at SPR-HS3 Continued.

Date: September 28, 2011 Staff Gauge: 0m
 Time (CST): 9:52
 Channel Width: 3.0m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 4.60 | 0.03 | 0.20 | 0.006 | 0.00 | 0.0000 |
| 4.40 | 0.00 | 0.20 | 0.000 | 0.00 | 0.0000 |
| 4.20 | 0.00 | 0.20 | 0.000 | 0.00 | 0.0000 |
| 4.00 | 0.00 | 0.20 | 0.000 | 0.00 | 0.0000 |
| 3.80 | 0.00 | 0.20 | 0.000 | 0.00 | 0.0000 |
| 3.60 | 0.08 | 0.20 | 0.016 | 0.00 | 0.0000 |
| 3.40 | 0.13 | 0.20 | 0.026 | 0.01 | 0.0003 |
| 3.20 | 0.10 | 0.20 | 0.020 | 0.00 | 0.0000 |
| 3.00 | 0.18 | 0.20 | 0.036 | 0.01 | 0.0004 |
| 2.80 | 0.20 | 0.20 | 0.040 | 0.02 | 0.0008 |
| 2.60 | 0.18 | 0.20 | 0.036 | 0.01 | 0.0004 |
| 2.40 | 0.16 | 0.20 | 0.032 | 0.02 | 0.0006 |
| 2.20 | 0.14 | 0.20 | 0.028 | 0.01 | 0.0003 |
| 2.00 | 0.14 | 0.20 | 0.028 | 0.02 | 0.0006 |
| 1.80 | 0.12 | 0.20 | 0.024 | 0.01 | 0.0002 |

Total Flow = 0.0035

Date: November 1, 2011 Staff Gauge: 0.017m
 Time (CST): 15:56
 Channel Width: 1.0m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.05 | 0.10 | 0.10 | 0.010 | -0.01 | -0.0001 |
| 0.15 | 0.10 | 0.10 | 0.010 | 0.01 | 0.0001 |
| 0.25 | 0.16 | 0.10 | 0.016 | 0.00 | 0.0000 |
| 0.35 | 0.18 | 0.10 | 0.018 | -0.01 | -0.0002 |
| 0.45 | 0.11 | 0.10 | 0.011 | -0.01 | -0.0001 |
| 0.55 | 0.10 | 0.10 | 0.010 | -0.01 | -0.0001 |
| 0.65 | 0.10 | 0.10 | 0.010 | -0.01 | -0.0001 |
| 0.75 | 0.08 | 0.10 | 0.008 | -0.02 | -0.0002 |
| 0.85 | 0.08 | 0.10 | 0.008 | -0.01 | -0.0001 |
| 0.95 | 0.08 | 0.10 | 0.008 | -0.02 | -0.0002 |
| 1.00 | 0.04 | 0.10 | 0.004 | -0.02 | -0.0001 |

Total Flow = -0.0010

2011 Streamflow Monitoring at SPR-HS4

Date: June 3, 2011

Staff Gauge: 0.180m

Time (CST): 19:05

Channel Width: 1.5m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.45 | 0.12 | 0.3 | 0.036 | 0.03 | 0.0011 |
| 0.75 | 0.20 | 0.3 | 0.060 | 0.03 | 0.0018 |
| 1.05 | 0.22 | 0.3 | 0.066 | 0.02 | 0.0013 |
| 1.35 | 0.10 | 0.3 | 0.030 | 0.01 | 0.0003 |
| 1.65 | 0.08 | 0.3 | 0.024 | 0.01 | 0.0002 |

Total Flow = 0.0047

Date: August 16, 2011

Staff Gauge: 0.108m

Time (CST): 18:00

Channel Width: 0.5m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.75 | 0.14 | 0.3 | 0.010 | 0.01 | 0.0001 |
| 1.05 | 0.12 | 0.3 | 0.036 | 0.02 | 0.0007 |

Total Flow = 0.0008

2011 Streamflow Monitoring at SPR-HS4 Continued.

Date: September 28, 2011 Staff Gauge: 0.105m

Time (CST): 15:05

Channel Width: 0.65m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.85 | 0.06 | 0.1 | 0.006 | 0.00 | 0.0000 |
| 0.95 | 0.08 | 0.1 | 0.008 | 0.01 | 0.0001 |
| 10.50 | 0.04 | 0.1 | 0.004 | 0.00 | 0.0000 |
| 1.15 | 0.02 | 0.1 | 0.002 | 0.00 | 0.0000 |
| 1.25 | 0.04 | 0.1 | 0.004 | 0.00 | 0.0000 |
| 1.35 | 0.06 | 0.1 | 0.006 | 0.00 | 0.0000 |

Total Flow = 0.0001

Date: October 31, 2011 Staff Gauge: 0.103m

Time (CST): 16:21

Channel Width: 1.0m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} | |
|---------|-----------|-----------|------------------------|---------------------|-----------------------|
| | | | | (m/s) | Q (m ³ /s) |
| 0.20 | 0.10 | 0.1 | 0.010 | 0.01 | 0.0001 |
| 0.30 | 0.12 | 0.1 | 0.012 | 0.00 | 0.0000 |
| 0.40 | 0.10 | 0.1 | 0.010 | 0.00 | 0.0000 |
| 0.50 | 0.08 | 0.1 | 0.008 | 0.00 | 0.0000 |
| 0.60 | 0.06 | 0.1 | 0.006 | 0.00 | 0.0000 |
| 0.70 | 0.06 | 0.1 | 0.006 | -0.02 | -0.0001 |
| 0.80 | 0.06 | 0.1 | 0.006 | -0.01 | -0.0001 |
| 0.90 | 0.04 | 0.1 | 0.004 | -0.04 | -0.0002 |
| 1.00 | 0.04 | 0.1 | 0.004 | -0.03 | -0.0001 |
| 1.10 | 0.04 | 0.1 | 0.004 | -0.02 | -0.0001 |

Total Flow = -0.0004

2011 Streamflow Monitoring at SPR-HS5

Date: June 4, 2011

Staff Gauge: 0.261m

Time (CST): 11:00

Channel Width: 1.0m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|------------------------------|-----------------------|
| 0.8 | 0.06 | 0.20 | 0.012 | 0.20 | 0.0024 |
| 1.0 | 0.22 | 0.20 | 0.044 | 0.22 | 0.0097 |
| 1.2 | 0.22 | 0.20 | 0.044 | 0.37 | 0.0163 |
| 1.4 | 0.16 | 0.20 | 0.032 | 0.35 | 0.0112 |
| 1.6 | 0.12 | 0.20 | 0.024 | 0.28 | 0.0067 |

Total Flow = 0.0463

Date: August 16, 2011

Staff Gauge: 0.12m

Time (CST): 11:10

Channel Width: 1.75M

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|------------------------------|-----------------------|
| 1.25 | 0.16 | 0.30 | 0.048 | 0.01 | 0.0005 |
| 1.55 | 0.16 | 0.30 | 0.048 | 0.00 | 0.0000 |
| 1.85 | 0.21 | 0.30 | 0.063 | 0.01 | 0.0006 |
| 2.15 | 0.08 | 0.30 | 0.024 | 0.01 | 0.0002 |
| 2.45 | 0.06 | 0.30 | 0.018 | -0.02 | -0.0004 |

Total Flow = 0.0010

2011 Streamflow Monitoring at SPR-HS5 Continued.

Date: September 28, 2011 Staff Gauge: 0.097m
 Time (CST): 11:46
 Channel Width: 1.75m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|------------------------------|-----------------------|
| 0.40 | 0.06 | 0.10 | 0.006 | 0.00 | 0.0000 |
| 0.60 | 0.08 | 0.10 | 0.008 | 0.00 | 0.0000 |
| 0.80 | 0.08 | 0.10 | 0.008 | 0.00 | 0.0000 |
| 1.00 | 0.12 | 0.10 | 0.012 | 0.01 | 0.0001 |
| 1.20 | 0.14 | 0.10 | 0.014 | 0.01 | 0.0001 |
| 1.40 | 0.16 | 0.10 | 0.016 | 0.00 | 0.0000 |
| 1.60 | 0.16 | 0.10 | 0.016 | 0.00 | 0.0000 |
| 1.80 | 0.18 | 0.10 | 0.018 | 0.03 | 0.0005 |
| 2.00 | 0.17 | 0.10 | 0.017 | 0.02 | 0.0003 |
| 2.20 | 0.08 | 0.10 | 0.008 | 0.01 | 0.0001 |
| 2.40 | 0.06 | 0.10 | 0.006 | 0.00 | 0.0000 |
| 2.60 | 0.02 | 0.10 | 0.002 | -0.01 | 0.0000 |

Total Flow = 0.0012

Date: November 1, 2011 Staff Gauge: 0.109m
 Time (CST): 13:00
 Channel Width: 1.0m

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity/ \bar{U} (m/s) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|------------------------------|-----------------------|
| 1.55 | 0.04 | 0.10 | 0.004 | -0.02 | -0.0001 |
| 1.45 | 0.08 | 0.10 | 0.008 | 0.00 | 0.0000 |
| 1.35 | 0.10 | 0.10 | 0.010 | 0.01 | 0.0001 |
| 1.25 | 0.14 | 0.10 | 0.014 | 0.02 | 0.0003 |
| 1.15 | 0.14 | 0.10 | 0.014 | 0.02 | 0.0003 |
| 1.05 | 0.10 | 0.10 | 0.010 | 0.01 | 0.0001 |
| 0.95 | 0.12 | 0.10 | 0.012 | 0.02 | 0.0002 |
| 0.85 | 0.10 | 0.10 | 0.010 | 0.01 | 0.0001 |
| 0.75 | 0.04 | 0.10 | 0.004 | -0.01 | 0.0000 |
| 0.65 | 0.08 | 0.10 | 0.008 | -0.01 | -0.0001 |

Total Flow = 0.0009

APPENDIX C

Summary of Average Daily Flows

Average Daily Discharge (L/s) at SPR-HS1

| Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) |
|--------|----------------------------|--------|----------------------------|--------|----------------------------|--------|----------------------------|
| 2-Jun | 10,914.060 | 15-Jul | 7,689.327 | 27-Aug | 4,021.459 | 9-Oct | 1,899.231 |
| 3-Jun | 12,832.234 | 16-Jul | 7,380.007 | 28-Aug | 3,919.192 | 10-Oct | 1,886.697 |
| 4-Jun | 13,524.762 | 17-Jul | 7,163.132 | 29-Aug | 3,815.472 | 11-Oct | 1,879.301 |
| 5-Jun | 13,964.958 | 18-Jul | 6,981.693 | 30-Aug | 3,720.408 | 12-Oct | 1,847.239 |
| 6-Jun | 14,101.621 | 19-Jul | 6,787.167 | 31-Aug | 3,616.855 | 13-Oct | 1,951.736 |
| 7-Jun | 14,373.126 | 20-Jul | 6,635.832 | 1-Sep | 3,521.621 | 14-Oct | 2,078.148 |
| 8-Jun | 15,322.228 | 21-Jul | 6,713.077 | 2-Sep | 3,448.721 | 15-Oct | 2,073.720 |
| 9-Jun | 15,791.318 | 22-Jul | 6,382.608 | 3-Sep | 3,537.072 | 16-Oct | 2,059.725 |
| 10-Jun | 15,949.516 | 23-Jul | 6,196.028 | 4-Sep | 3,593.287 | 17-Oct | 2,181.638 |
| 11-Jun | 16,067.553 | 24-Jul | 6,028.717 | 5-Sep | 3,524.691 | 18-Oct | 2,165.980 |
| 12-Jun | 16,216.677 | 25-Jul | 6,273.917 | 6-Sep | 3,387.770 | 19-Oct | 2,122.126 |
| 13-Jun | 16,162.778 | 26-Jul | 6,094.758 | 7-Sep | 3,257.118 | 20-Oct | 2,059.541 |
| 14-Jun | 16,051.791 | 27-Jul | 5,862.693 | 8-Sep | 3,206.457 | 21-Oct | 1,999.669 |
| 15-Jun | 15,820.647 | 28-Jul | 5,562.768 | 9-Sep | 3,169.051 | 22-Oct | 1,958.011 |
| 16-Jun | 15,967.687 | 29-Jul | 5,592.717 | 10-Sep | 3,122.197 | 23-Oct | 1,991.521 |
| 17-Jun | 16,200.350 | 30-Jul | 5,354.994 | 11-Sep | 3,013.805 | 24-Oct | 1,961.781 |
| 18-Jun | 16,125.248 | 31-Jul | 5,018.840 | 12-Sep | 3,030.157 | 25-Oct | 1,961.960 |
| 19-Jun | 15,816.735 | 1-Aug | 4,900.201 | 13-Sep | 3,045.442 | 26-Oct | 1,934.218 |
| 20-Jun | 15,736.151 | 2-Aug | 4,835.011 | 14-Sep | 3,081.474 | 27-Oct | 1,932.969 |
| 21-Jun | 15,478.159 | 3-Aug | 4,769.331 | 15-Sep | 3,058.097 | 28-Oct | 1,915.709 |
| 22-Jun | 15,117.252 | 4-Aug | 4,739.394 | 16-Sep | 2,943.584 | 29-Oct | 1,897.640 |
| 23-Jun | 14,720.252 | 5-Aug | 4,574.339 | 17-Sep | 2,799.560 | 30-Oct | 1,872.270 |
| 24-Jun | 14,412.850 | 6-Aug | 4,448.466 | 18-Sep | 2,655.060 | 31-Oct | 1,867.005 |
| 25-Jun | 14,156.743 | 7-Aug | 4,312.478 | 19-Sep | 2,596.810 | 1-Nov | 1,897.283 |
| 26-Jun | 13,828.933 | 8-Aug | 4,294.151 | 20-Sep | 2,582.857 | | |
| 27-Jun | 13,709.523 | 9-Aug | 4,744.606 | 21-Sep | 2,783.394 | | |
| 28-Jun | 13,571.975 | 10-Aug | 4,745.155 | 22-Sep | 2,792.323 | | |
| 29-Jun | 13,101.609 | 11-Aug | 4,646.052 | 23-Sep | 2,738.958 | | |
| 30-Jun | 12,643.163 | 12-Aug | 4,521.642 | 24-Sep | 2,635.161 | | |
| 1-Jul | 12,291.891 | 13-Aug | 4,425.351 | 25-Sep | 2,558.117 | | |
| 2-Jul | 11,898.223 | 14-Aug | 4,300.954 | 26-Sep | 2,500.702 | | |
| 3-Jul | 11,509.330 | 15-Aug | 4,191.693 | 27-Sep | 2,467.515 | | |
| 4-Jul | 11,134.905 | 16-Aug | 4,297.028 | 28-Sep | 2,427.176 | | |
| 5-Jul | 10,778.220 | 17-Aug | 4,463.908 | 29-Sep | 2,378.482 | | |
| 6-Jul | 10,476.011 | 18-Aug | 4,266.469 | 30-Sep | 2,387.946 | | |
| 7-Jul | 10,401.504 | 19-Aug | 4,118.577 | 1-Oct | 2,374.347 | | |
| 8-Jul | 10,146.293 | 20-Aug | 4,013.352 | 2-Oct | 2,236.582 | | |
| 9-Jul | 9,790.151 | 21-Aug | 3,927.457 | 3-Oct | 2,189.961 | | |
| 10-Jul | 9,394.750 | 22-Aug | 3,833.532 | 4-Oct | 2,168.994 | | |
| 11-Jul | 9,049.022 | 23-Aug | 3,736.294 | 5-Oct | 2,117.652 | | |
| 12-Jul | 8,833.700 | 24-Aug | 3,987.818 | 6-Oct | 2,067.085 | | |
| 13-Jul | 8,477.463 | 25-Aug | 4,088.124 | 7-Oct | 2,048.342 | | |
| 14-Jul | 8,047.463 | 26-Aug | 4,083.783 | 8-Oct | 1,983.930 | | |

Average Daily Discharge (L/s) at SPR-HS2

| Date | Mean Daily Discharge (L/s) |
|--------|----------------------------------|
| 7-Oct | 30.722 |
| 8-Oct | 27.329 |
| 9-Oct | 29.049 |
| 10-Oct | 27.928 |
| 11-Oct | 28.032 |
| 12-Oct | 28.910 |
| 13-Oct | 31.532 |
| 14-Oct | 31.790 |
| 15-Oct | 30.949 |
| 16-Oct | 31.569 |
| 17-Oct | 32.745 |
| 18-Oct | 32.150 |
| 19-Oct | 32.638 |
| 20-Oct | 32.351 |
| 21-Oct | 33.392 |
| 22-Oct | 34.008 |
| 23-Oct | 35.575 |
| 24-Oct | 34.882 |
| 25-Oct | 36.546 |
| 26-Oct | 35.875 |
| 27-Oct | 37.279 |
| 28-Oct | 40.628 |
| 29-Oct | 42.277 |
| 30-Oct | 37.292 |
| 31-Oct | 36.143 |
| 1-Nov | 35.674 |

Average Daily Discharge (L/s) at SPR-HS5

| Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) |
|--------|----------------------------|--------|----------------------------|--------|----------------------------|--------|----------------------------|
| 4-Jun | 27.658 | 17-Jul | 0.012 | 29-Aug | 0.668 | 11-Oct | 0.461 |
| 5-Jun | 18.857 | 18-Jul | 0.008 | 30-Aug | 0.544 | 12-Oct | 0.507 |
| 6-Jun | 13.364 | 19-Jul | 0.010 | 31-Aug | 0.489 | 13-Oct | 0.774 |
| 7-Jun | 9.406 | 20-Jul | 0.096 | 1-Sep | 0.484 | 14-Oct | 1.133 |
| 8-Jun | 10.556 | 21-Jul | 0.332 | 2-Sep | 0.398 | 15-Oct | 1.060 |
| 9-Jun | 9.287 | 22-Jul | 0.146 | 3-Sep | 0.644 | 16-Oct | 1.269 |
| 10-Jun | 6.897 | 23-Jul | 0.090 | 4-Sep | 0.765 | 17-Oct | 1.320 |
| 11-Jun | 4.844 | 24-Jul | 0.033 | 5-Sep | 0.578 | 18-Oct | 1.275 |
| 12-Jun | 3.650 | 25-Jul | 0.115 | 6-Sep | 0.495 | 19-Oct | 1.290 |
| 13-Jun | 2.931 | 26-Jul | 0.053 | 7-Sep | 0.441 | 20-Oct | 1.182 |
| 14-Jun | 2.510 | 27-Jul | 0.025 | 8-Sep | 0.388 | 21-Oct | 1.120 |
| 15-Jun | 2.074 | 28-Jul | 0.016 | 9-Sep | 0.344 | 22-Oct | 1.092 |
| 16-Jun | 1.823 | 29-Jul | 0.072 | 10-Sep | 0.310 | 23-Oct | 1.359 |
| 17-Jun | 1.483 | 30-Jul | 0.016 | 11-Sep | 0.269 | 24-Oct | 1.241 |
| 18-Jun | 1.254 | 31-Jul | 0.008 | 12-Sep | 0.466 | 25-Oct | 1.173 |
| 19-Jun | 1.108 | 1-Aug | 0.005 | 13-Sep | 0.623 | 26-Oct | 1.103 |
| 20-Jun | 0.977 | 2-Aug | 0.010 | 14-Sep | 0.644 | 27-Oct | 1.104 |
| 21-Jun | 0.797 | 3-Aug | 0.008 | 15-Sep | 0.555 | 28-Oct | 1.046 |
| 22-Jun | 0.629 | 4-Aug | 0.013 | 16-Sep | 0.521 | 29-Oct | 0.995 |
| 23-Jun | 0.531 | 5-Aug | 0.009 | 17-Sep | 0.485 | 30-Oct | 0.920 |
| 24-Jun | 0.455 | 6-Aug | 0.009 | 18-Sep | 0.452 | 31-Oct | 0.962 |
| 25-Jun | 0.386 | 7-Aug | 0.023 | 19-Sep | 0.491 | 1-Nov | 1.142 |
| 26-Jun | 0.360 | 8-Aug | 0.033 | 20-Sep | 0.462 | | |
| 27-Jun | 0.327 | 9-Aug | 0.295 | 21-Sep | 0.794 | | |
| 28-Jun | 0.267 | 10-Aug | 0.122 | 22-Sep | 0.569 | | |
| 29-Jun | 0.214 | 11-Aug | 0.151 | 23-Sep | 0.459 | | |
| 30-Jun | 0.165 | 12-Aug | 0.153 | 24-Sep | 0.373 | | |
| 1-Jul | 0.154 | 13-Aug | 0.084 | 25-Sep | 0.395 | | |
| 2-Jul | 0.131 | 14-Aug | 0.052 | 26-Sep | 0.358 | | |
| 3-Jul | 0.089 | 15-Aug | 0.026 | 27-Sep | 0.342 | | |
| 4-Jul | 0.067 | 16-Aug | 0.217 | 28-Sep | 0.292 | | |
| 5-Jul | 0.045 | 17-Aug | 0.878 | 29-Sep | 0.216 | | |
| 6-Jul | 0.030 | 18-Aug | 0.527 | 30-Sep | 0.173 | | |
| 7-Jul | 0.206 | 19-Aug | 0.581 | 1-Oct | 0.225 | | |
| 8-Jul | 0.105 | 20-Aug | 0.618 | 2-Oct | 0.246 | | |
| 9-Jul | 0.092 | 21-Aug | 0.576 | 3-Oct | 0.263 | | |
| 10-Jul | 0.072 | 22-Aug | 0.520 | 4-Oct | 0.273 | | |
| 11-Jul | 0.042 | 23-Aug | 0.466 | 5-Oct | 0.293 | | |
| 12-Jul | 0.035 | 24-Aug | 1.613 | 6-Oct | 0.308 | | |
| 13-Jul | 0.022 | 25-Aug | 1.228 | 7-Oct | 0.328 | | |
| 14-Jul | 0.015 | 26-Aug | 1.157 | 8-Oct | 0.346 | | |
| 15-Jul | 0.017 | 27-Aug | 0.980 | 9-Oct | 0.342 | | |
| 16-Jul | 0.019 | 28-Aug | 0.813 | 10-Oct | 0.397 | | |

Attachment E Hydrology 2012 Baseline Study Report



**Gold Canyon Resources Inc.
Suite 810 - 609 Granville Street
P.O. Box 10356 Pacific Centre
Vancouver, BC V7Y 1G5**

**SPRINGPOLE GOLD PROJECT
HYDROLOGY
2012 BASELINE STUDY REPORT**

Draft Report

DST File No.: OE-KN-014468

Date: April 2013

DST Consulting Engineers Inc.
106 Cumberland Street North, Suite 100, Thunder Bay, Ontario P7A 4M2
Tel.: (807) 345-3620 Fax: (807) 344-4738 E-mail: thunderbay@dstgroup.com



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1. INTRODUCTION

Gold Canyon Resources Inc. (Gold Canyon) is a Canadian-based unique mineral exploration company. Gold Canyon holds a 100% interest in the Springpole gold project, situated in the Red Lake Mining District of North-western Ontario, Canada, approximately one hundred and ten kilometres northeast of the Town of Red Lake (Figure 1.1). The Springpole gold project has a surface area of over 20,000 acres. The property is situated within the Birch-Uchi Greenstone Belt, and the dominant host rocks for most of the gold mineralization at Springpole are Archaean age (2.7 billion years old) sedimentary and intrusive rocks. The extensive gold mineralization system at the Springpole gold project may be unique among Canadian Archaean gold deposits. Gold exploration on the Springpole property has been pursued during two main periods, one during the 1920's to 1940's, and a second period from 1985 through to the present. Gold Canyon has continued its evaluation efforts at Springpole through mapping and geochemical studies and drilling programs since 1998. Gold Canyon is pursuing the gold resource of the core area, and also discovering potentially large new resources in the rest of its land position at Springpole.

The Springpole gold project is expected to require the completion of federal and provincial environmental assessments and permits prior to development. To support on-going drilling activities and project permitting Gold Canyon retained DST Consulting Engineers Inc. (DST) in 2010 to gather environmental baseline data and submit environmental reports. DST started collecting baseline data at the Springpole gold project site late in 2010.

The 2012 Baseline Assessment Study includes the following components:

- Meteorology;
- Hydrology;
- Aquatics – Surface Water, Sediment Quality and Benthic Invertebrates Community;
- Fisheries;
- Terrestrial Wildlife, including Birds;
- Vegetation and Wetlands.

The following report presents the results of the 2012 hydrology baseline study. The hydrological monitoring was originally initiated in June 2011 within five key watershed contributing to the Springpole Lake watershed. The watersheds were selected after careful desktop and field review of the project area and anticipated future development.

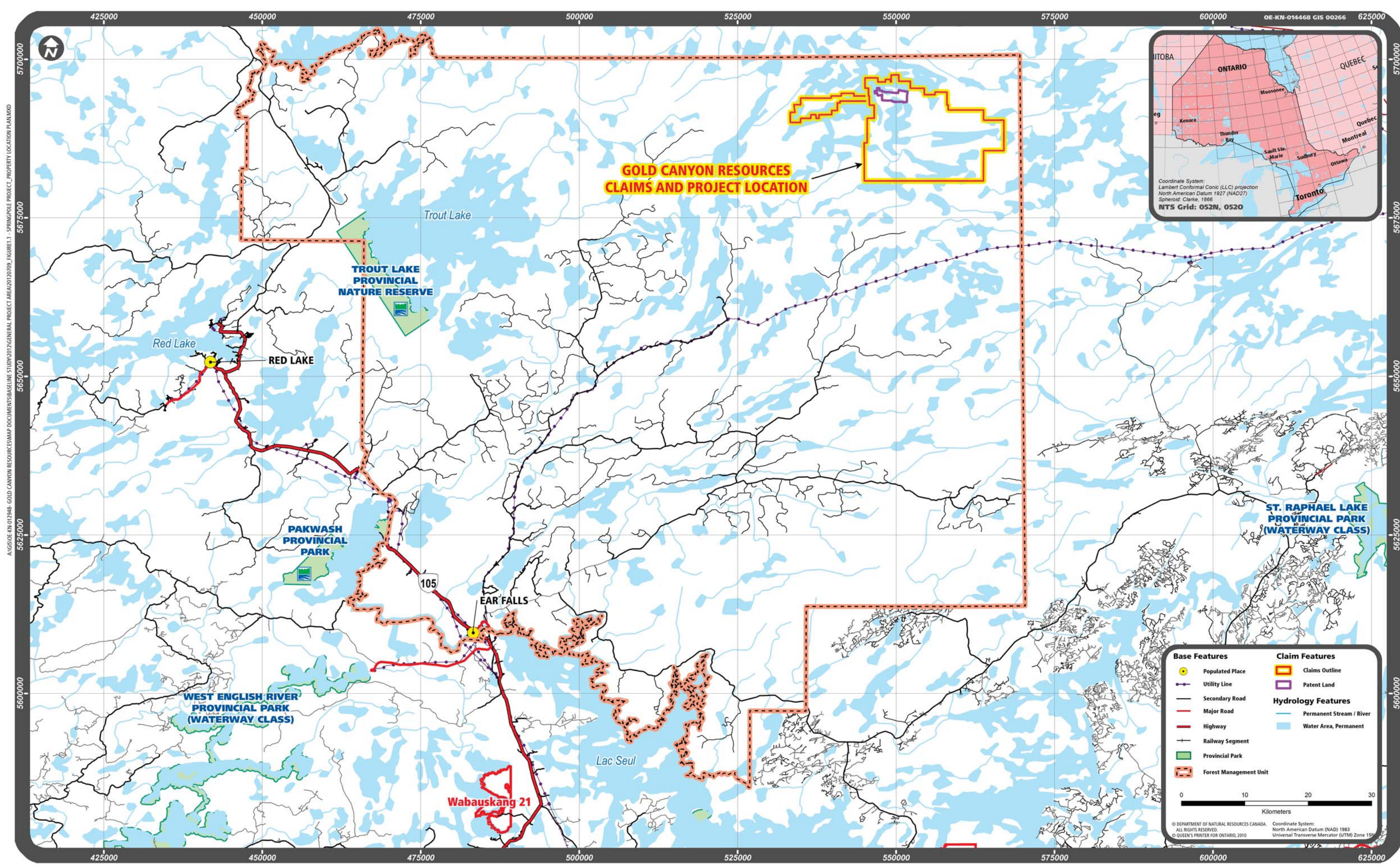


Figure 1.1: Property Location Plan
Springpole Lake Gold Project

2. METHODOLOGY

The objective of the 2012 hydrometric monitoring period was to further assess and characterize the discharge of water from sub-watersheds encompassing the project and study areas. In the previous year (2011), two of the five hydrometric monitoring stations were removed prior to freeze up, while three of the five hydrometric monitoring stations (SPR-HS1, SPR-HS2, and SPR-HS5) were left in place to record the 2012 spring freshet. Once ice-out allowed for safe access, the additional two monitoring stations (SPR-HS3, and SPR-HS4) were re-installed in the same locations as the previous year.

The main watershed within the study area is the largest watershed and is contributing to the discharge from Birch Lake to Springpole Lake. The hydrometric station (SPR-HS1) that captures data for this watershed is located at the Cromarty Lake outlet, which is at the mouth of Springpole Lake (Figure 2.1). In order to catch the spring 2013 freshet, DST and Gold Canyon decided that this hydrometric station would be left installed and allowed to overwinter, with regular site inspections. Once the weather and ice-out conditions allows for safe access by boat, manual monitoring of the hydrometric station will resume in the spring of 2013. Opportunity guarantee

Station SPR-HS2 is located within one of the larger watersheds that contribute to Springpole Lake, which is located 8.5 km southeast of the project camp. This hydrometric station was left installed over the winter in 2011/2012 and then again in 2012/2013 in order to capture the spring freshet.

The second largest sub-watershed within the study area is located at an inlet to Birch Lake, which is approximately 7 km east of the project camp. Due to low water levels in October 2011, this hydrometric station (SPR-HS3) was removed for the winter and reinstalled in the spring of 2012. Higher than normal water levels were observed at this location during the fall of 2012 and it was anticipated that this stream was not likely to freeze to the bottom; therefore, this hydrometric station was left to overwinter in order to capture the 2013 spring freshet.

The hydrometric station SPR-HS4 is located within a smaller watershed which contributes to Springpole Lake, located approximately 1 km east of the project camp. This station was removed in the fall/winter of 2011 and was re-installed in the spring of 2012. After a review of the data part-way through the 2012 monitoring season this station was deemed redundant by GCU and eliminated from the monitoring program.

The smallest sub-watershed within the study area is located at an inlet to Birch Lake, which is situated 2.5 km southwest of the project camp. Station SPR-HS5 remained installed over the 2011/2012 winter period in order to capture the 2012 spring freshet. A sufficient amount of water was observed during the fall of 2012; therefore, this station remained installed during the 2012/2013 winter period in order to obtain the 2013 spring freshet. Once the weather and ice-out conditions allows for safe access by boat, manual monitoring of the hydrometric station will resume in the spring of 2013.

Hydrometric station SPR-HS6 was installed mid-way through the 2012 monitoring season after a reassessment of the project needs. This station is located approximately 5 km southeast of the project camp and approximately 70 m from the mouth of the bay. Hydrometric station SPR-

HS6 remained installed at the end of the open water season in order to capture the 2013 spring freshet.

The hydrometric station locations and watershed areas associated with each station are illustrated on Figure 2.1 and Figure 2.2. Photographs of the locations are included in Appendix A. Each site location is summarized on Table 2.1.

Table 2.1: Springpole Hydrometric Station Locations

| Hydrometric Station | UTM Coordinates | Elevation (m) |
|----------------------------|------------------------|----------------------|
| SPR-HS1 | 15U 548628, 5686997 | 387.0 |
| SPR-HS2 | 15U 555820, 5688873 | 389.0 |
| SPR-HS3 | 15U 556005, 5693228 | 391.0 |
| SPR-HS4 | 15U 550117, 5693995 | 390.0 |
| SPR-HS5 | 15U 547210, 5692389 | 389.0 |
| SPR-HS6 | 15 U 552030, 5690030 | 387.0 |

The location for each of the hydrometric stations was selected to ensure little to no channel scouring over the season and to capture the maximum amount of runoff from each watershed without having backwater effects from static lake water levels.

Each hydrometric station consisted of a Global Water WL 450 pressure transducer, a WL 16 data logger, and a 1 m staff gauge, all attached to a secured wooden post. The post was anchored into place to prevent movement using steel rods driven into the substrate in a tripod fashion and anchored to the wooden post. The pressure transducers were installed at a height relative to the staff gauge so that water depths could be converted to flow estimates. The data loggers were set to record every 15 minutes (96 times/day).

Staff gauges were surveyed for elevations relative to a local arbitrary benchmark at each site, which was established by anchoring a bolt into bedrock (or a suitably sized tree where bedrock was not available) or using a marked point on a bedrock outcrop. This was done to measure (and correct for, if required) any vertical movement of the staff gauge over the season, to have an established reference point if the stations were moved, and for re-establishing the stations the following season.

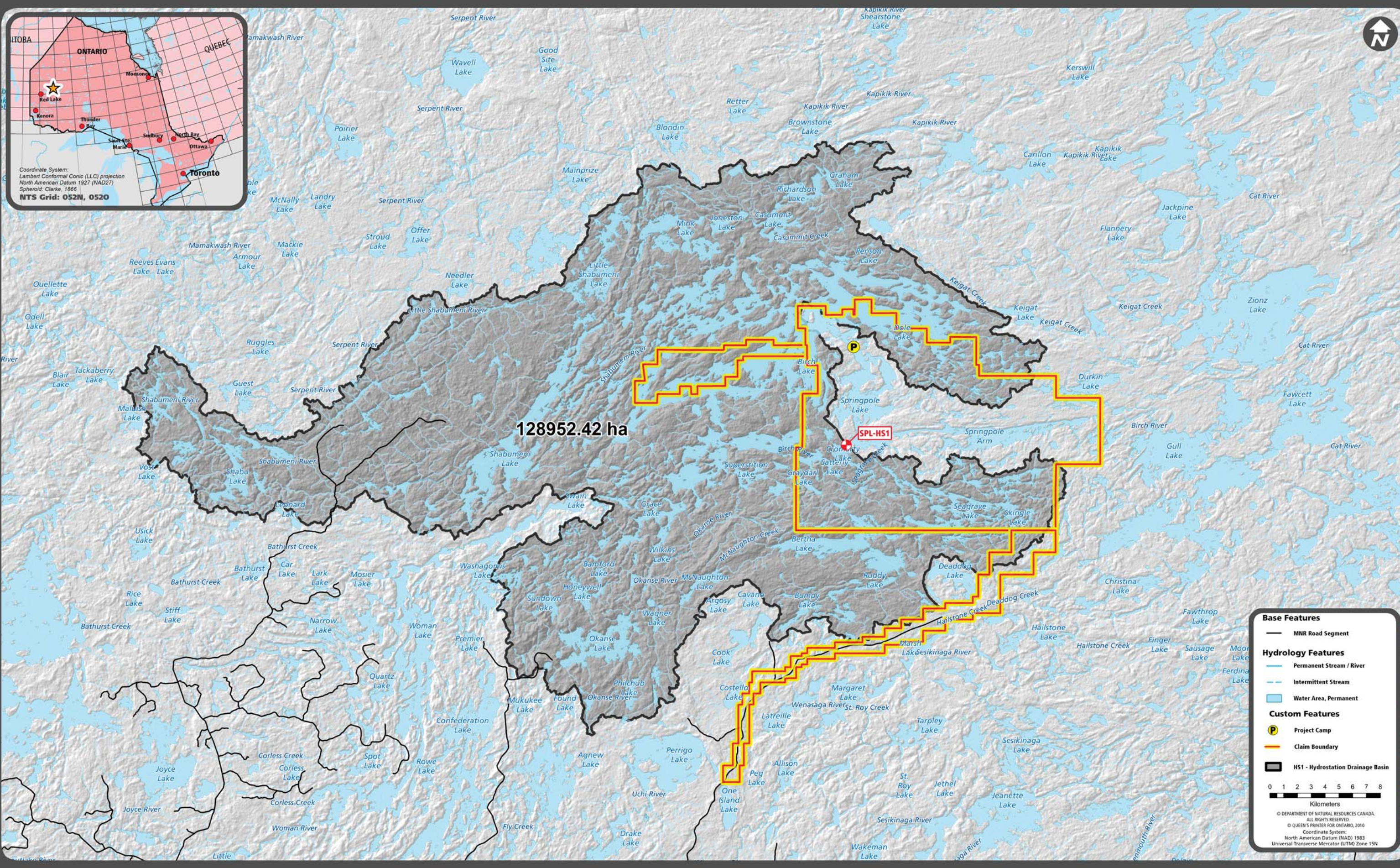
Manual flow monitoring measurements were gathered collectively by a DST technologist and Gold Canyon staff member on a monthly basis throughout the open water season of the monitoring period. Only the September data-set was collected solely by Gold Canyon staff. Flow velocities were measured manually at each hydrometric station using a Marsh-McBirney Model 2000 Flo-Mate portable flow meter. At each hydrometric station, the stream cross-section was divided into segments of equal width and maximum velocities were measured in the middle of each segment at a 60% depth (Marsh-McBirney, 1990).

The manual discharge measurements and associated staff gauge readings were then used to generate a stage-discharge curve enabling the development of a rating equation. The formulae were then used to convert measurements collected by the pressure transducer into actual discharge estimates.

To aid in the interpretation of the results, 2012 precipitation data was obtained from the Red Lake Airport and the onsite project meteorological station. Discharge data from the Cat River hydrometric station, which is located approximately 55 km southeast of the site, was obtained from Environment Canada (2012). The gross drainage area of this station is 5,390 km².

To gather further information about each monitored sub watershed, temperature data loggers (Hobo Pendant ® Temperature/Alarm Data Logger 64 K – UA-001-64) were attached to the base of each hydrometric station. Each temperature logger was pre-programmed to record the water temperature every 30 minutes.

ANGISOE-KN-012948-GOLD-CANYON-RESOURCES-MAP-DOCUMENTS-BASELINE-STUDY-2012\SAMPLING\013018-FIGURE-2.1-HYDROSTATION-T-DRAINAGE-AREA.MXD



128952.42 ha

SPL-HS1

Base Features

- MNR Road Segment

Hydrology Features

- Permanent Stream / River
- Intermittent Stream
- Water Area, Permanent

Custom Features

- Project Camp
- Claim Boundary
- HS1 - Hydrostation Drainage Basin

0 1 2 3 4 5 6 7 8
Kilometers

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© QUEEN'S PRINTER FOR ONTARIO, 2010
Coordinate System:
North American Datum (NAD) 1983
Universal Transverse Mercator (UTM) Zone 15N

Figure 2.1: Hydrostation Drainage Basins S.P.L. Gold Project

A:\GIS\OE-KN-012948-GOLD CANYON RESOURCES\MAP DOCUMENTS\BASELINE STUDY\2012\SAMPLING\20130318-FIGURE 2.2-HYDROSTATION LOCATIONS_AND_DRAINAGE BASINS.MXD

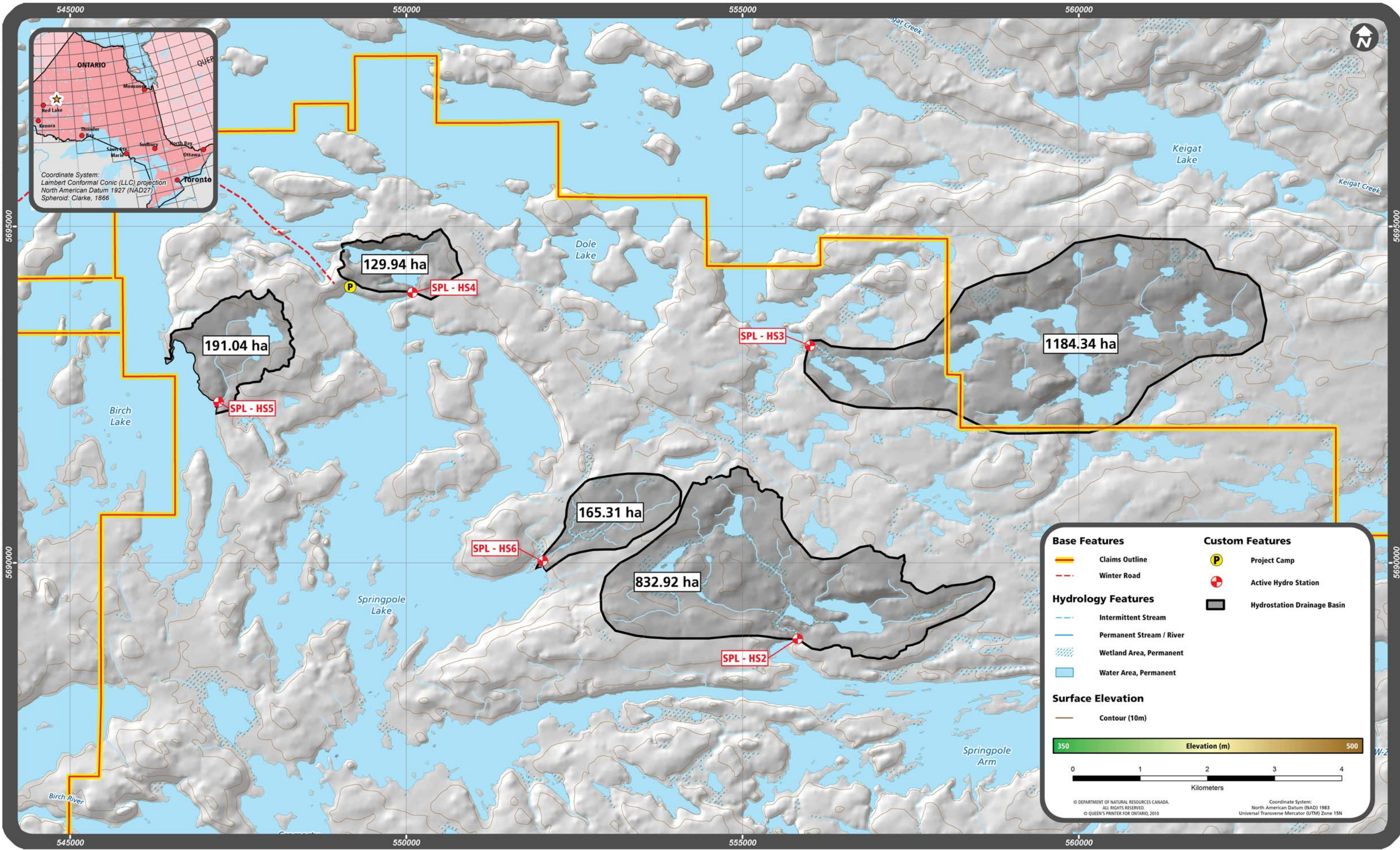


Figure 2.2: Hydrostation Drainage Basins
S.P.L. Gold Project

OE-KN-014468 GIS 00266

3. RESULTS AND DISCUSSION

3.1 Monitoring Period and Location

Three of the hydrometric stations used in this study were initially installed in June 2011 and adjusted as required in April 2012 in order to capture the 2012 spring freshet which occurred at the end of April. Smaller tributaries, such as the streams monitored at SPR-HS3 and SPR-HS4, were assumed to freeze to bottom - these hydrometric stations were therefore removed at the end of the open water season in 2011 and reinstalled in a similar location at the beginning of May 2012.

Based on a review of the overall needs of the project, hydrometric station SPR-HS4 was considered redundant as it was affected by backwater effects and therefore was removed in July 2012. Conversely, an additional hydrometric station was added to a small stream downstream of a proposed usage area. The location of each of the stations is shown in Figure 2.1. The monitoring period for each station is shown in Table 3.1.

Table 3.1: Summary of Hydrometric Monitoring Period

| Hydrometric Station | Date Installed | Date Removed |
|----------------------------|-----------------------|---------------------|
| SPR-HS1 | June 2, 2011 | Still Installed |
| SPR-HS2 | June 2, 2011 | Still Installed |
| SPR-HS3 | May 2, 2012 | Still Installed |
| SPR-HS4 | May 3, 2012 | July 6, 2012 |
| SPR-HS5 | June 4, 2011 | Still Installed |
| SPR-HS6 | July 7, 2012 | Still Installed |

The hydrometric station at the Cromarty Lake (SPR-HS1) remained installed over the winter of 2011/2012. When it was safe to access the Site following spring ice-out, which occurred in April 2012, DST returned to the Site for inspection and maintenance. On April 30, 2012, DST observed that this station was on an angle instead of perpendicular to the water, most likely due to ice damage. This station was surveyed, reinstalled and resurveyed.

In general, the characteristics of the SPR-HS1 hydrometric station include a channel which is broad and primarily composed of bedrock, cobbles, and gravel substrate with silt and organics present on each bank. The channel banks are relatively steep. High discharge was observed within this channel at this location after two seasons of monitoring and it is considered to be a continued monitoring location. On August 9, 2012, the highest manual flow monitoring observed, the channel cross section was 25.6 m wide with a maximum depth of 1.18 m.

The hydrometric station at the SPR-HS2, which was installed in 2011 east of the narrows on Springpole Lake at an inlet to Springpole Lake, was also left in place over the winter from 2011 to 2012. When DST returned to the Site after ice-out on April 30, 2012, the station was observed to be standing upright and undamaged. A few minor adjustments, such as battery change-out and resurveying, were completed during the initial inspection.

The general characteristics of SPR-HS2 include a channel which is well defined but meanders through a wetland area upgradient to the hydrometric station. The substrate consists of bedrock, cobble, and gravel. In the previous year there has been evidence of beaver activity directly upgradient of the hydrometric station; however, the location of the station is considered the best candidate location to monitor this sub-watershed. The channel cross section was 2.7 m wide with a maximum water depth of 0.26 m on August 8, 2012.

The hydrometric station at SPR-HS3 is located in the southeast arm of Birch Lake. SPR-HS3 was removed in the fall of 2011 and reinstalled on May 2, 2012 in the same location as the previous year, which is downstream of a series of un-named water bodies that flow into Birch Lake. The channel cross section was 7.5 m wide with a maximum water depth of 0.25 m on August 7, 2012.

In general, the SPR-HS3 is located within a channel which is a relatively flat, well defined area with mixed composition substrate consisting of organic material, sand, gravel and cobbles. Organic material was observed to be present on each bank. Immediately upstream is a wetland area with evidence of beaver activity.

The hydrometric station at SPR-HS4 was removed in the fall of 2011 and reinstalled on May 3, 2012 in the same location as the previous year, which is approximately 1 km east of the project camp and 5 m downstream of a beaver dam which seeps into Springpole Lake. The channel is relatively well defined and is situated within a lowland swale at the outlet of a series of small unnamed water bodies. Due to the extreme backwater effects observed in July 2012, this station was removed and discontinued from the monitoring program. Upon further review, it was determined that no other location would be suitable to measure the discharge from this sub-watershed.

The hydrometric station at SPR-HS5, located in a southwest arm on the east side of Birch Lake, remained installed since June 4, 2011. When it was safe to access the Site following spring ice-out, which occurred in late April 2012, DST returned to the Site for inspection and maintenance on May 1, 2012 and the station was observed to be standing upright and undamaged. Maintenance included battery change, resurvey and reinforcement of the station.

In general, the characteristics of the SPR-HS5 hydrometric station include a channel which is relatively well defined in a low flat area in which eastern white cedar is prominent along the banks. The substrate consists of fine grained material, gravel, and organic matter. Light to moderate discharge was observed within this channel at this location after two seasons of monitoring and it is considered to be a good candidate location for a hydrometric station. On August 9, 2012, the channel cross section was 1.6 m wide with a maximum depth of 0.28 m.

An additional hydrometric monitoring station (SPR-HS6) was added to the program on July 7, 2012 after a reassessment of the project needs. This hydrometric station is located southeast

of the project within an eastern bay on Springpole Lake. A number of un-named streams feed into the main stream in which this hydrometric station is situated.

The general characteristics of the SPR-HS6 hydrometric station include a deep channel which is relatively well defined. There is a low bank area which is located on the south side of the channel, indicating that the area is potentially seasonally flooded in the spring. The substrate consists of bedrock which is overlaid with a mixture of gravel and organic matter. Based upon the width and the scouring of the channel, a moderate level of discharge is expected within this location, making it a suitable candidate location. On July 7, 2012, the channel cross section was 5.1 m wide with a maximum depth of 0.8 m.

3.2 Staff Gauge Survey

In order to assess vertical movement of the stations, the elevations of the hydrometric stations were surveyed several times during the season in addition to the installation and demobilization dates. A relative benchmark, with an assigned elevation of 100.000 m, was established at each location at the time of original installation.

Table 3.2 presents a summary of the 2012 elevation survey results for the hydrometric stations. Where possible, the data was corrected to account for the error encountered.

Significant movement of the hydrometric station occurred at the following location:

- SPR-HS1 – Extremely high flows were experienced during the Site inspection on July 7, 2012. It was noted that this station had been pushed over and was on an angle. At the time, it was not safe to reinstall this station. On August 8, 2012, when flows had subsided and it was safe to proceed, DST reinstalled this station. All data between June 6 and August 8, 2012 have been corrected.

Table 3.2: Elevation Survey Differences of Study Area (Staff Gauges and Bolts, 2012)

| Location | April | May | June | July | August | Sept. | Oct. | Maximum Difference (m) |
|------------------------|--------|--------|--------|--------|--------|--------|--------|------------------------|
| SPR-HS1 | | | | | | | | |
| Staff Gauge and Ref #1 | -0.239 | - | -0.245 | - | -0.119 | 0.259 | -0.337 | -0.218 |
| Bolt and Ref #1 | 0.745 | - | 0.755 | - | 0.789 | 0.716 | 0.661 | 0.128 |
| SPR-HS2 | | | | | | | | |
| Staff Gauge and Ref #1 | 0.884 | - | 0.880 | 0.896 | 0.904 | 0.892 | 0.892 | 0.024 |
| Bolt and Ref #1 | 1.842 | - | 1.845 | 1.845 | 1.843 | 1.922 | 1.845 | 0.003 |
| SPR-HS3 | | | | | | | | |
| Staff Gauge and Ref #1 | - | -0.599 | -0.595 | -0.601 | -0.590 | -0.603 | -0.596 | -0.013 |
| Bolt and Ref #1 | - | 0.365 | 0.370 | 0.368 | 0.366 | 0.402 | 0.373 | 0.037 |
| SPR-HS4 | | | | | | | | |
| Staff Gauge and Ref #1 | - | -0.843 | -0.848 | - | - | - | - | -0.005 |
| Bolt and Ref #1 | - | 0.133 | 0.083 | - | - | - | - | 0.050 |
| SPR-HS5 | | | | | | | | |
| Staff Gauge and Ref #1 | - | 0.229 | -0.473 | 0.238 | 0.209 | 0.223 | 0.228 | 0.029 |
| Bolt and Ref #1 | - | 1.204 | 1.205 | 1.208 | 1.211 | 1.409 | 1.211 | 0.007 |
| SPR-HS6 | | | | | | | | |
| Staff Gauge and Ref #1 | - | - | - | 1.461 | 1.487 | 2.407 | 1.485 | 0.024 |
| Bolt and Ref #1 | - | - | - | 2.446 | 2.432 | 2.638 | 2.449 | 0.017 |

Notes:

Highlighted data indicates survey errors and thus has been excluded from any calculation.

3.3 Manual Stream Discharge Measurements

Manual stream discharge measurements were collected at the five hydrometric stations throughout the spring, summer and fall of 2012. Table 3.3 summarizes the stream flow monitoring results from 2012 and includes the historical results since 2011 when this work was initiated. The detailed data from the 2012 monitoring events is presented in Table B-1 through B-6 in Appendix B.

The manual measurements show discharge rates that were relatively moderate for most of the monitoring period with higher flows during mid-summer periods. Similarities across stations over time, with respect to low and high discharge rates, were noted. The highest manual discharge measured in 2012 was 38,150 L/s on July 7, 2012, at the SPR-HS1 station. The lowest discharge recorded was 0 L/s on September 18, 2012 at the SPR-HS5 and October 15, 2012 at SPR-HS6.

Table 3.3: Stream Discharge Manual Flow Measurements, 2011 to 2012

| Station | Date | Time (CST) | Discharge Rate (L/s) | Gauge Height (m) | Drainage Area (km ²) |
|---|-----------|------------|----------------------|------------------|----------------------------------|
| SPR-HS1 Cromarty | 2-Jun-11 | 16:50 | 11,403 | 0.550 | 1,289.54 |
| | 16-Aug-11 | 13:12 | 4,474 | 0.330 | |
| | 27-Sep-11 | 12:36 | 2,355 | 0.245 | |
| | 1-Nov-11 | 11:30 | 1,921 | 0.215 | |
| | 30-Apr-12 | 17:30 | 7,450 | 0.420 | |
| | 6-Jun-12 | 20:42 | 9,660 | 0.515 | |
| | 7-Jul-12 | 10:00 | 38,150 | - | |
| | 9-Aug-12 | 10:40 | 24,230 | 0.691 | |
| | 17-Sep-12 | 14:13 | 14,290 | - | |
| | 14-Oct-12 | 12:00 | 4,580 | 0.310 | |
| SPR-HS2 Springpole - East arm | 3-Jun-11 | 16:15 | 154 | 0.400 | 8.33 |
| | 16-Aug-11 | 11:16 | 34 | 0.220 | |
| | 26-Sep-11 | 11:10 | 2 | 0.200 | |
| | 1-Nov-11 | 9:47 | 0 | 0.235 | |
| | 30-Apr-12 | 14:10 | 10 | 0.290 | |
| | 6-Jun-12 | 12:30 | 70 | 0.395 | |
| | 6-Jul-12 | - | 90 | 0.418 | |
| | 8-Aug-12 | 9:23 | 80 | 0.400 | |
| | 17-Sep-12 | 9:04 | 60 | 0.285 | |
| | 14-Oct-12 | 10:35 | 30 | 0.371 | |
| SPR-HS3 Birch - East | 2-Jun-11 | 16:05 | 688 | 0.260 | 11.84 |
| | 18-Aug-11 | 16:22 | *-0.6 | 0.000 | |
| | 28-Sep-11 | 8:52 | 4 | 0.000 | |
| | 1-Nov-11 | 15:56 | *-1 | 0.017 | |
| | 2-May-12 | 13:30 | 40 | 0.145 | |
| | 7-Jun-12 | 14:20 | 40 | 0.140 | |
| | 7-Jul-12 | 15:35 | 170 | 0.200 | |
| | 7-Aug-12 | 17:18 | 180 | 0.250 | |
| | 18-Sep-12 | 10:42 | 70 | 0.099 | |
| | 15-Oct-12 | 10:07 | 50 | 0.169 | |

Notes:

- * - These values are considered to be anomalous and were not used.
- Values are missing to do high flows and water levels above the staff gauge.

Table 3.3: Stream Discharge Manual Flow Measurements, 2011 to 2012, Continued

| Station | Date | Time (CST) | Discharge Rate (L/s) | Gauge Height (m) | Drainage Area (km ²) |
|--|-----------|------------|----------------------|------------------|----------------------------------|
| SPR-HS4 Springpole - near camp | 3-Jun-11 | 19:05 | 5 | 0.180 | 1.30 |
| | 16-Aug-11 | 17:00 | 0 | 0.108 | |
| | 28-Sep-11 | 16:00 | 0 | no reading | |
| | 31-Oct-11 | 16:21 | 0 | 0.103 | |
| | 3-May-12 | 10:15 | 0 | 0.110 | |
| | 8-Jun-12 | 7:20 | 0 | 0.100 | |
| SPR-HS5 Birch Lake - South arm | 4-Jun-11 | 11:00 | 46 | 0.261 | 1.91 |
| | 16-Aug-11 | 7:27 | 1 | 0.120 | |
| | 28-Sep-11 | 10:46 | 1 | 0.097 | |
| | 1-Nov-11 | 13:00 | 1 | 0.109 | |
| | 1-May-12 | 9:35 | 0 | 0.119 | |
| | 7-Jun-12 | 12:30 | 10 | 0.079 | |
| | 7-Jul-12 | - | 0 | 0.202 | |
| | 10-Aug-12 | 14:07 | 20 | 0.099 | |
| | 18-Sep-12 | 8:47 | 0 | - | |
| 15-Oct-12 | 12:44 | 10 | 0.052 | | |
| SPR-HS6 Springpole - east bay | 7-Jul-12 | - | 10 | 0.831 | 1.65 |
| | 8-Aug-12 | 15:15 | 120 | 0.495 | |
| | 18-Sep-12 | 12:54 | 10 | 0.150 | |
| | 15-Oct-12 | 13:49 | 0 | 0.224 | |

Notes:

* - These values are considered to be anomalous and were not used.

3.4 Stage-Discharge Curves

The stage-discharge curves were generated using the manual stream discharge measurements collected during the 2011 and 2012 monitoring period. Stage-discharge curves were generated for stations SPR-HS1, SPR-HS2, SPR-HS3, and SPR-HS5. The discharges for the two remaining hydrometric stations (SPR-HS4 and SPR-HS6) were too low to be able to generate discharge-curves, and therefore the data is not presented in this report. The raw data for these two stations (SPR-HS4 and SPR-HS6) are located in Appendix C.

Figure 3.1 through 3.4 present the stage-discharge curves for the monitored locations. A total of six manual stream discharge measurements were collected at the SPR-HS1, SPR-HS2, SPR-HS3, and SPR-HS5 hydrometric stations in 2012; a total of two measurements were collected at the SPR-HS4; and, a total of four measurements were collected at SPR-HS6.

The formula developed from each stage-discharge curve was used to calculate discharge values from the water level readings collected from the pressure transducers at each hydrometric monitoring location. As previously mentioned the data from the hydrometric stations SPR-HS4, and SPR-HS6 contained values that were too low and therefore no

discharge values are presented. The correlation (r^2) values ranged from 0.4365 (SPR-HS3) to 0.9824 (SPR-HS1), indicating a relatively moderate to high degree of correlation of data to the generated trend line (MS-Excel). Additional manual stream discharge measurements for the mid to high-range discharge events will help to verify the relationship of the stage-discharge curves. It should be noted that r^2 values are subjective. Although lower r^2 values were found at the SPR-HS3 hydrometric station, the location of this hydrometric station is the best suited to capture the information required for that specific watershed.

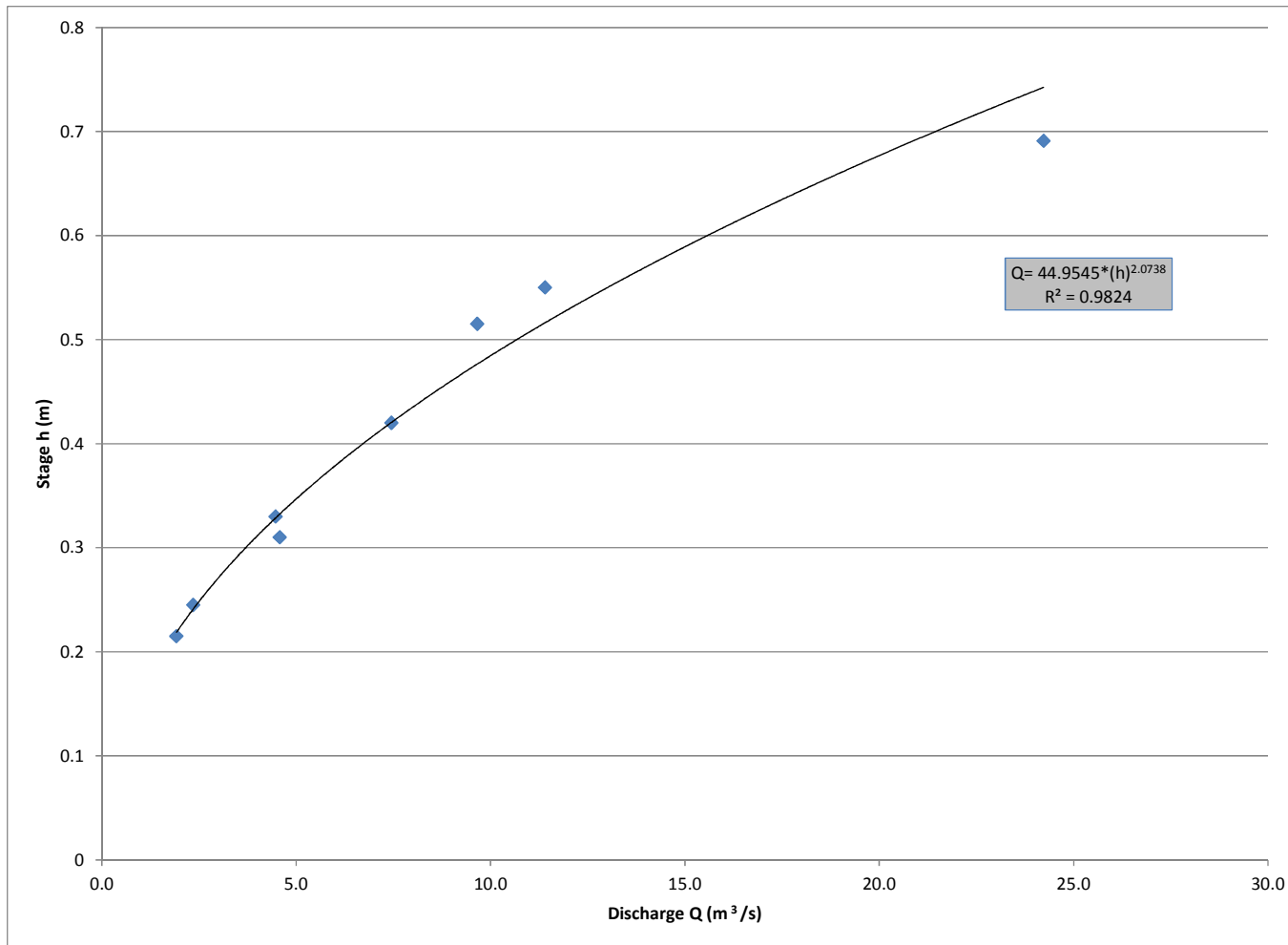


Figure 3.1: Stage-Discharge Curve for SPR-HS1 Hydrometric Station, 2011-2012

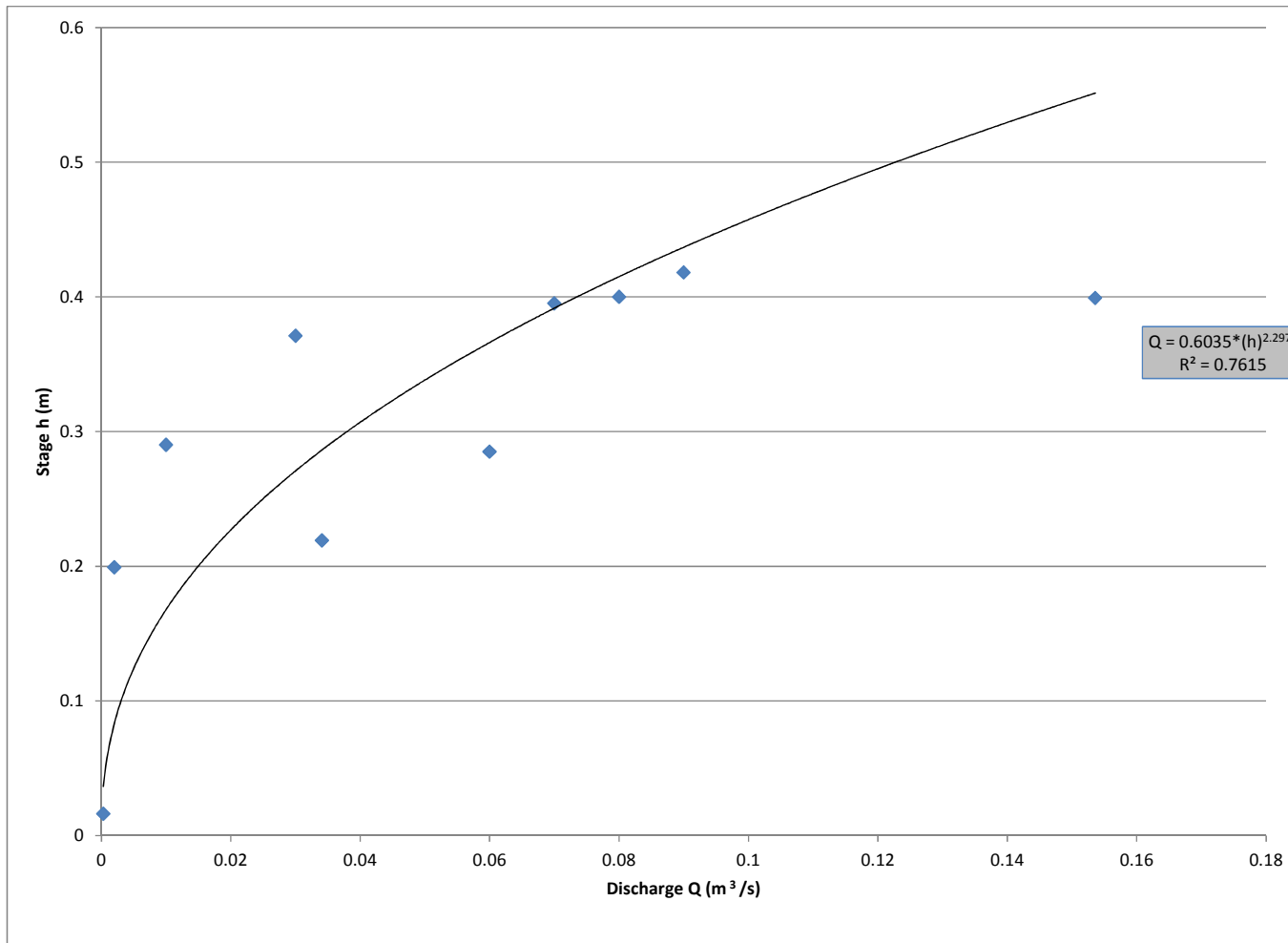


Figure 3.2: Stage-Discharge Curve for SPR-HS2 Hydrometric Station, 2011-2012

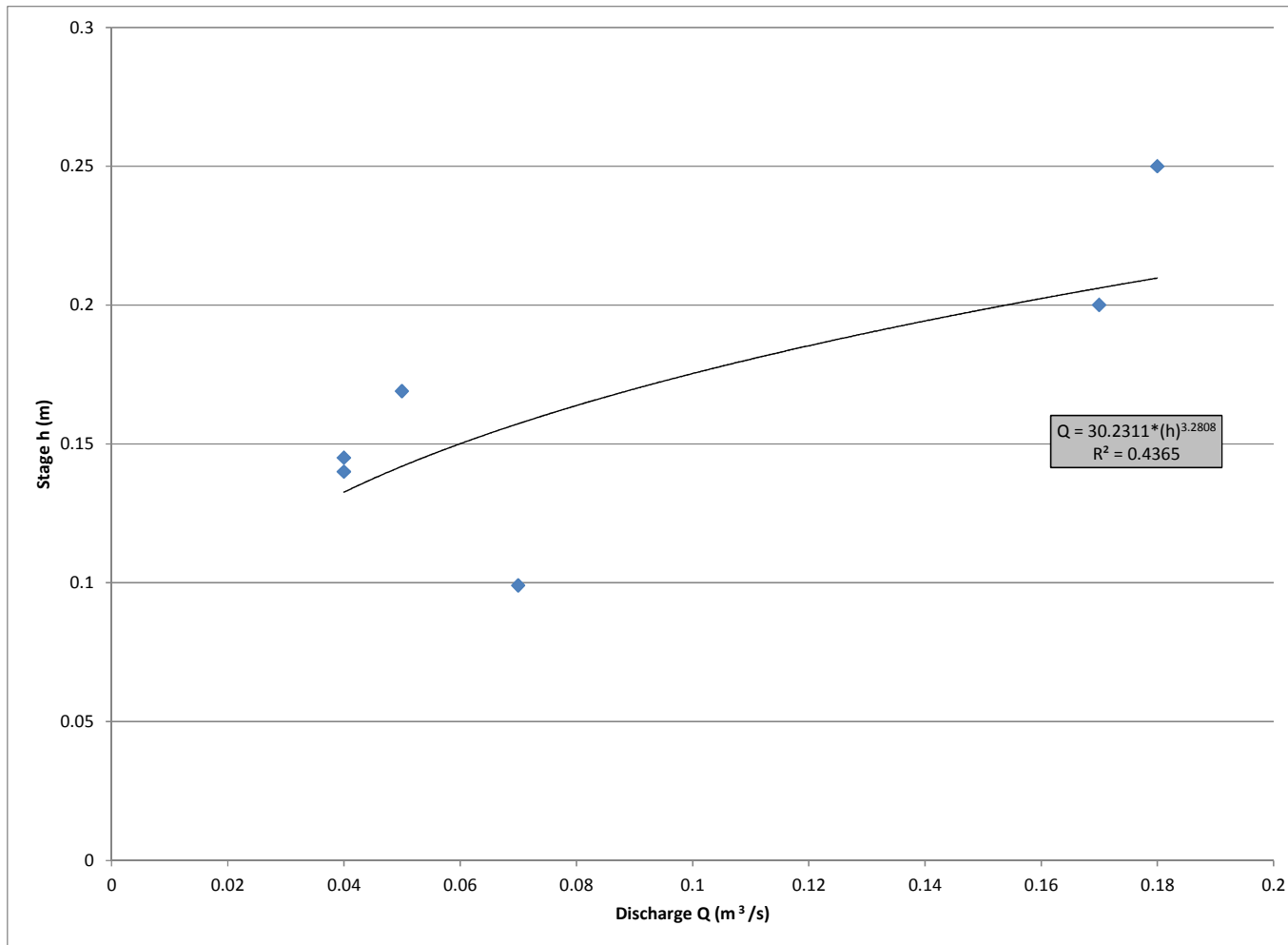


Figure 3.3: Stage-Discharge Curve for SPR-HS3 Hydrometric Station, 2011-2012

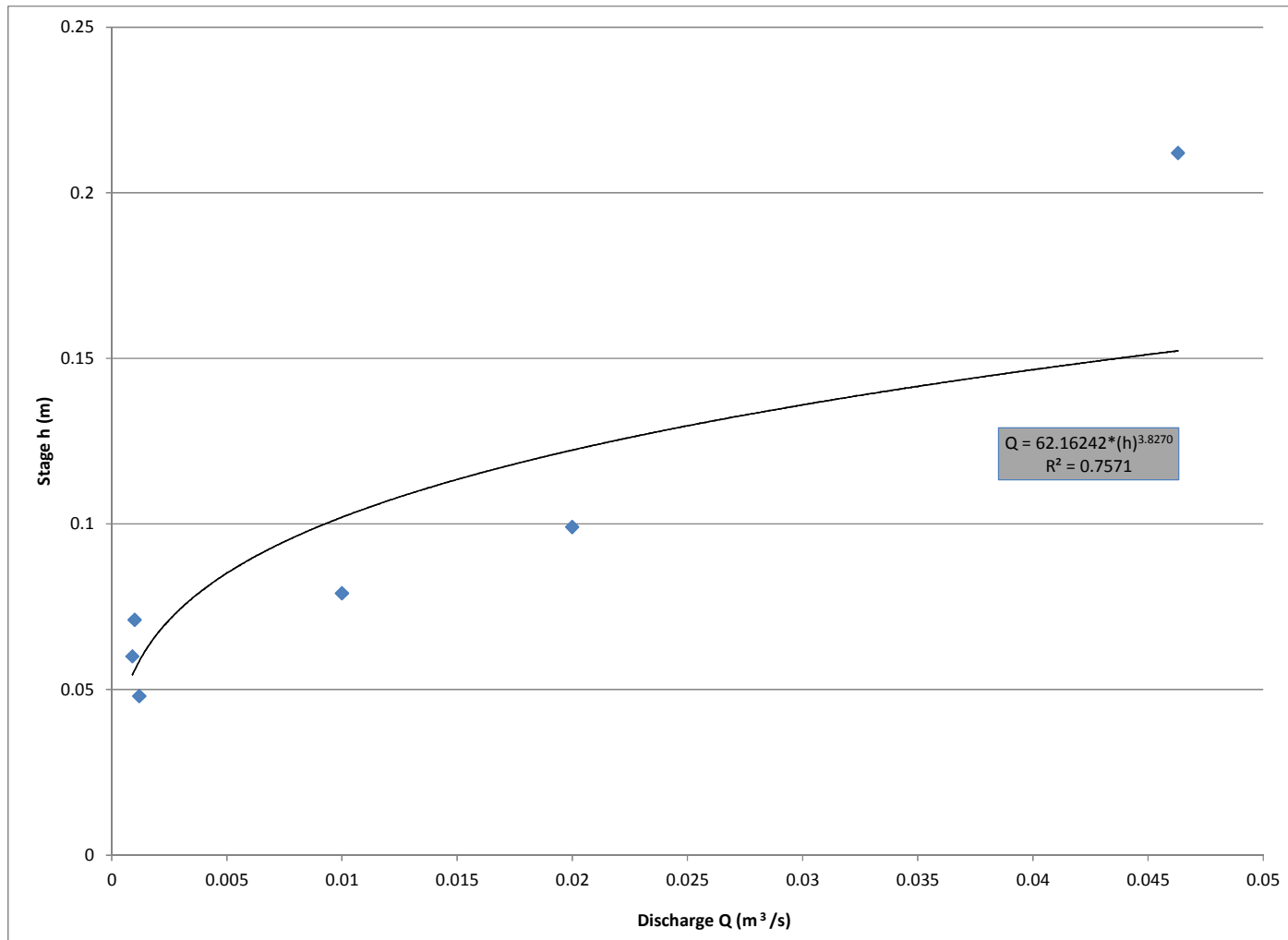


Figure 3.4: Stage-Discharge Curve for SPR-HS5 Hydrometric Station, 2011-2012

3.5 Average Daily Discharge

The average daily discharges that were generated for the hydrometric stations are presented in Table C-1 to C-4 in Appendix C. Table 3.4 summarizes the statistics associated with the daily average discharges. Note that the majority of the maximum discharges recorded during the 2012 monitoring period include the spring freshet and a high rainfall period between the middle of June to July 2012.

The spring freshet data from hydrometric station SPR-HS1 was captured at the beginning of 2012 which occurred at the end March and beginning of April. The peak daily discharge recorded was 65,291 L/s, while the lowest average daily discharge was recorded at 2,515 L/s on October 3, 2012. The average daily discharge for SPR-HS1 was 16,612 L/s.

Data from the 2012 spring freshet was also captured at hydrometric station SPR-HS2. The peak daily discharge was 180 L/s on June 12, 2012, while the average daily minimum was recorded at 4 L/s on March 4, 2012. In general, this hydrometric station had an average daily discharge of 37 L/s.

As hydrometric station SPR-HS3 was installed on May 2, 2012, the spring freshet was not captured at this location. In general, the peak daily discharge was 545 L/s on June 14, 2012, while the lowest daily discharge was 0 L/s on October 1, 2012. The average daily discharge was calculated to be 64 L/s.

Due to the extremely low-flow data obtained at SPR-HS4, a discharge curve could not be generated for this hydrometric station and therefore, the average daily maximum and minimum values were not calculated.

Since the hydrometric station located at SPR-HS5 over-wintered from 2011 to 2012, this station was able to capture the 2012 spring freshet. The peak daily discharge was 774 L/s on June 11, 2012, while the lowest daily discharge was 0 L/s on August 29, 2012. In general, the average daily discharge was calculated to be 65 L/s.

The 2012 peak daily discharge recorded for the Cat River hydrometric station (Environment Canada) was 104,874 L/s on June 29, 2012, while the lowest daily discharge was 14,547 L/s, which was recorded on March 5, 2012. The average daily discharge for the Cat River hydrometric station was 51,052 L/s.

Table 3.4: Average Daily Discharge Statistics, 2011 to 2012

| Site | 2011 | | | 2012 | | |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | Min. | Max. | Mean | Min. | Max. | Mean |
| SPRHS1 | 1,847 | 16,200 | 6,293 | 2,515 | 65,291 | 16,612 |
| (Date) | 12-Oct | 17-Jun | - | 3-Oct | 4-Jul | - |
| SPRHS2 | 27 | 42 | 35 | 4 | 180 | 37 |
| (Date) | 7-Oct | 29-Oct | - | 5-Mar | 12-Jun | - |
| SPRHS3 | - | - | - | 0 | 545 | 64 |
| (Date) | - | - | - | 1-Oct | 14-Jun | - |
| SPRHS4 | - | - | - | - | - | - |
| (Date) | - | - | - | - | - | - |
| SPRHS5 | 0 | 28 | 1 | 0 | 774 | 65 |
| (Date) | 1-Aug | 4-Jun | - | 29-Aug | 11-Jun | - |
| Cat River | 20,911 | 76,762 | 51,273 | 14,547 | 104,874 | 51,052 |
| (Date) | 5-Apr | 29-Jun | - | 5-Mar | 29-Jun | - |

Notes:

All values are reported in L/S, unless otherwise specified.

Figure 3.4 and Figure 3.5 presents a unit-yield hydrograph (average daily discharge/drainage area) for each of the four on-site hydrometric stations. A comparison of the unit yields for each of the four watersheds shows higher unit yields for the SPR-HS5, SPR-HS1 and Cat River, compared with SPR-HS2, and SPR-HS3, with maximum recorded unit yield measurements in 2012 of 1,139 L/s/km², 50.6 L/s/km², and 19.5 L/s/km² respectively.

When comparing the later summer and early fall months, Cat River, SPR-HS1, and SPR-HS2 maintained a higher unit yield during these dry periods than the SPR-HS3 and SPR-HS5 sub-watersheds.

As shown on the hydrograph for the four monitoring locations, presented as Figure 3.6 and Figure 3.7, the peak flows were measured in Cat River, SPR-HS1 and SPR-HS5 monitoring stations. All four of the flow monitoring stations showed good correlation during the 2012 monitoring period. Additional flow monitoring at the mid- to high-discharge rates would strengthen the stage-discharge curves for all locations and should correct any possible errors for high-discharge rate estimates.

3.6 Cat River Hydrologic Summary

Environment Canada maintains a hydrometric station on the Cat River below Wesleyan Lake, approximately 55 km southeast and downstream of the study area. This data encompasses a watershed area of 5,390 km². The data is typically available for public review on Environment Canada's Water Office website. Both current and historical water levels and discharge values are available with monitoring station information such as location, elevation and years of monitoring.

The 2012 data downloaded from this website was used to compare the project area discharge values and trends to downstream values. If the data correlates, similar peaks and valleys would be observed over the monitoring period.

Precipitation data from the Red Lake Airport and Springpole Lake project area meteorological stations was also included in Figure 3.4 and 3.5 for comparative purposes. Relatively significant rainfall was recorded in April, May, August, and October in 2012. Precipitation data is missing from the Red Lake Airport weather station from May 10 to September 1, 2012; and missing from the Springpole Project Camp weather station from June 1- 19 due to station malfunctions. Significant rainfall of approximately 62 mm was recorded by the Sioux Lookout A weather station in Sioux Lookout Ontario on June 10.

In general, Figure 3.6 shows peaks in discharge for the SPR-HS1, SPR-HS2, and SPR-HS5 stations in later March and early April, indicating the period of the spring freshet. When comparing the unit yield data from the Cat River station to the study area hydrometric stations, as in Figure 3.6, there is a good correlation between the unit yields from all study area hydrometric stations to the Cat River station and the precipitation data.

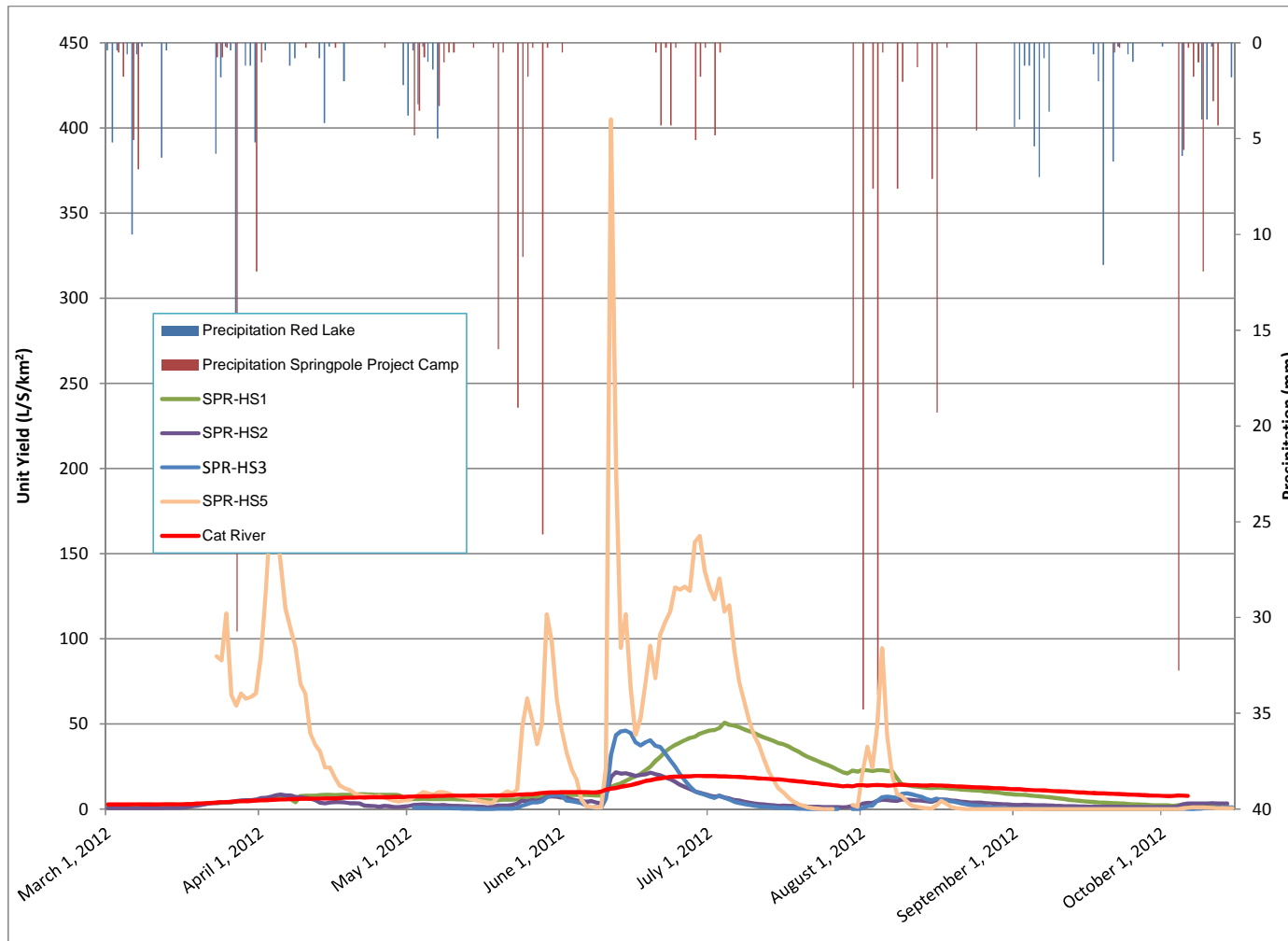


Figure 3.4: Unit Yield for Hydrometric Stations Study Area, 2012

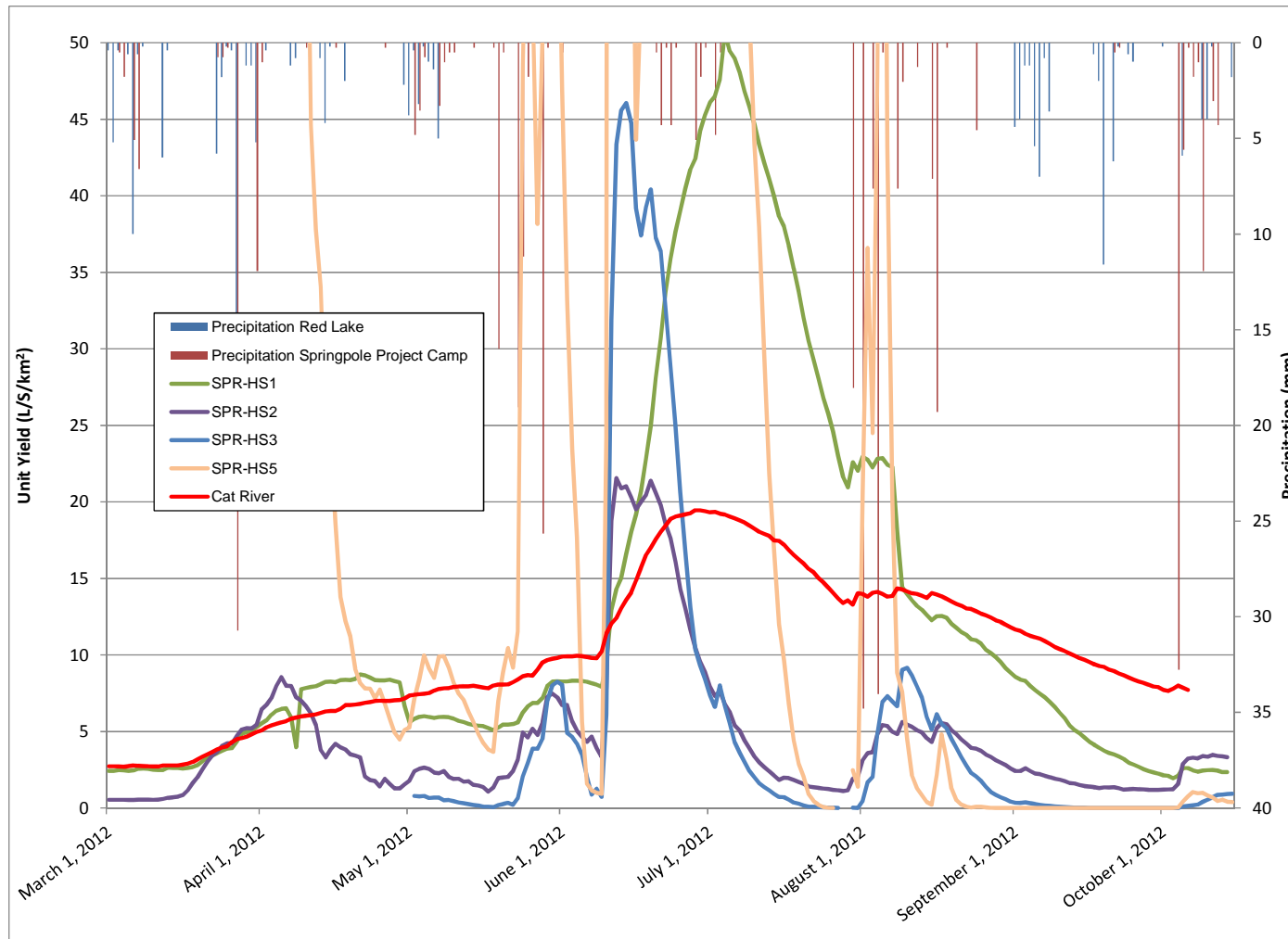


Figure 3.5: Enhanced Unit Yield for Hydrometric Stations Study Area, 2012

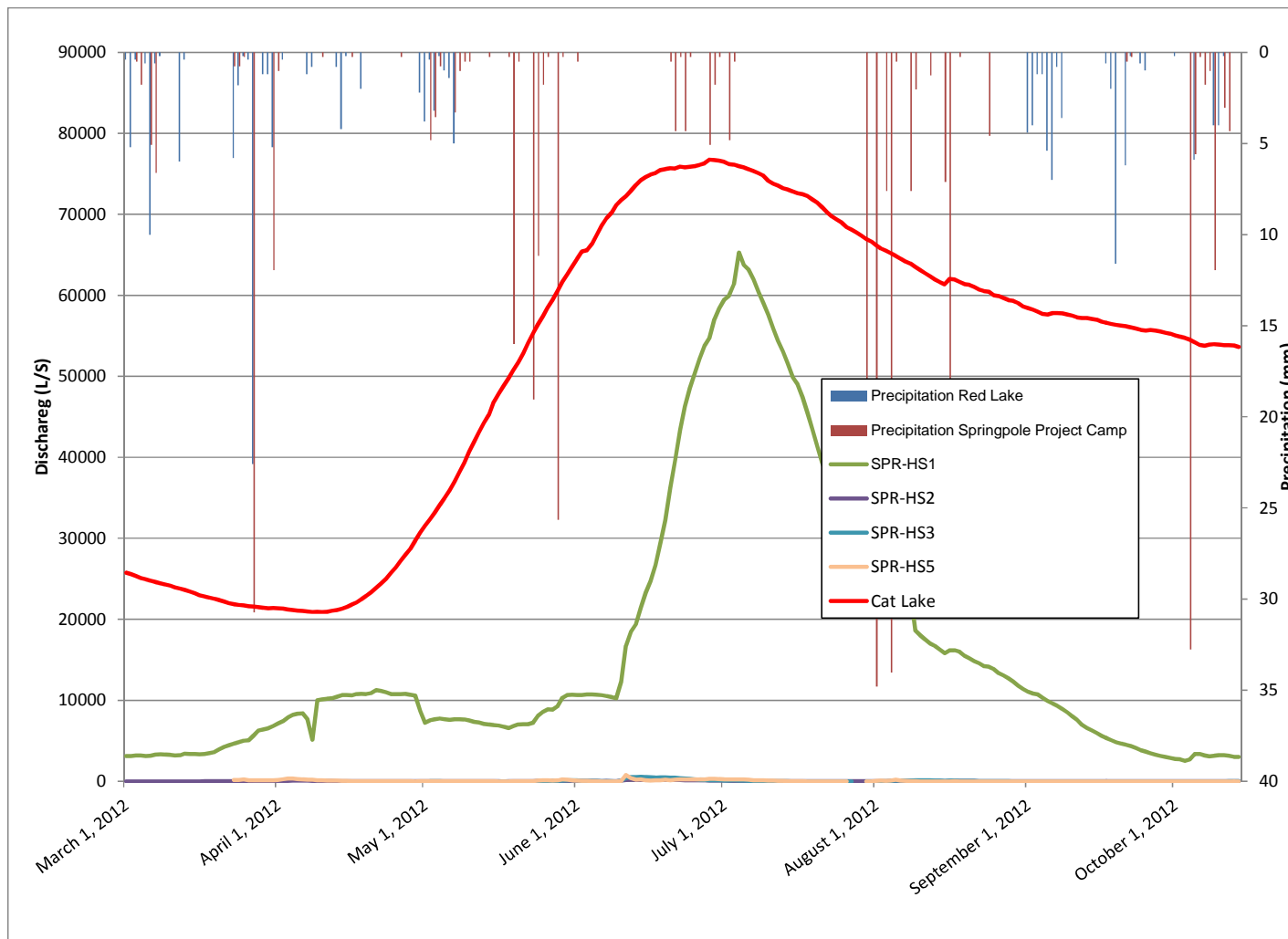


Figure 3.6: Study Area Hydrograph, 2012

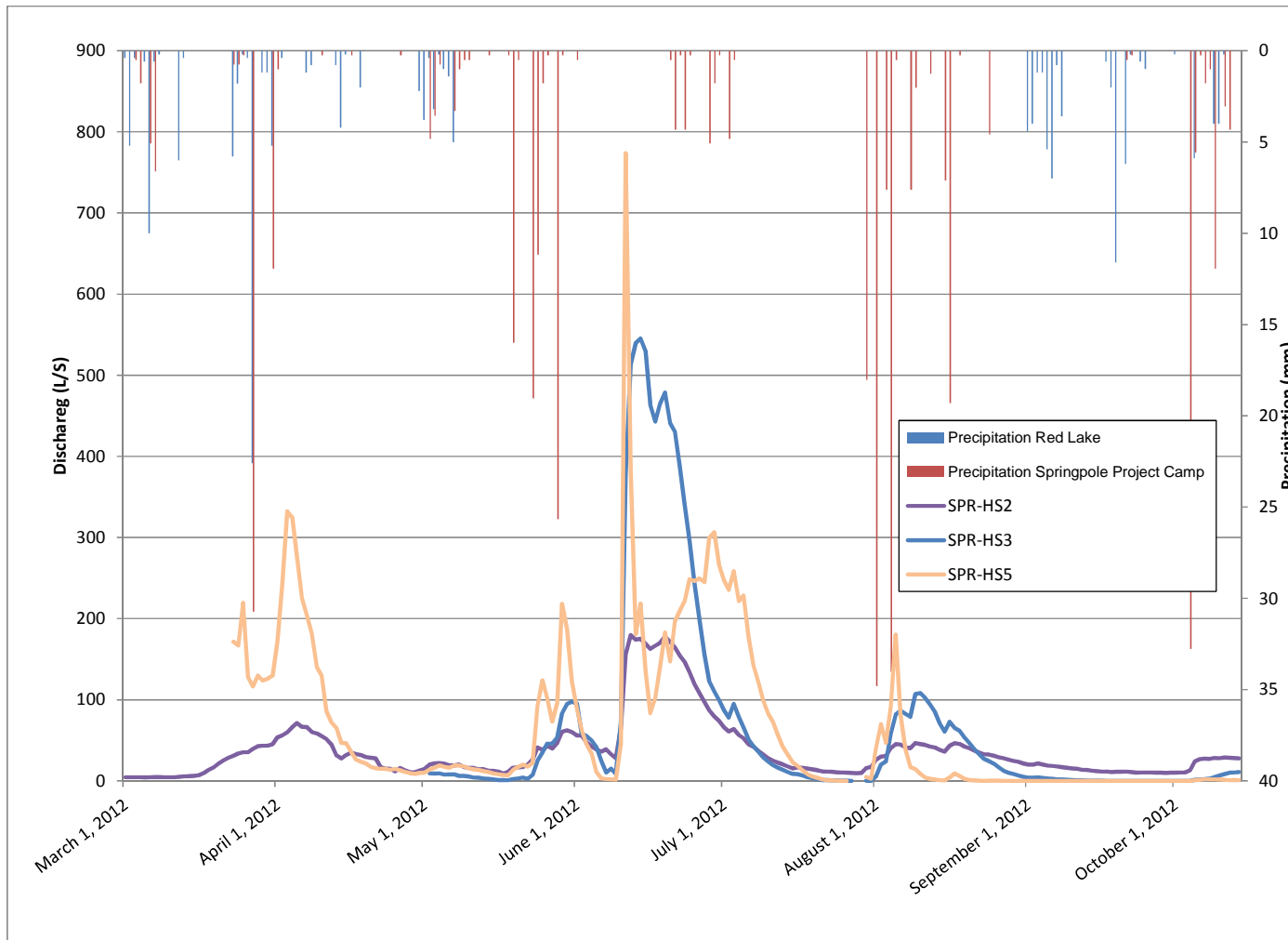


Figure 3.7: Enhanced Discharge of the Study Area Hydrograph, 2012

3.7 Air Temperature VS Water Temperature

The air temperature recorded at the Springpole Camp meteorological was used to compare the stream temperatures recorded at each hydrometric station within the Springpole Lake Study Area. Additionally, the precipitation data collected from the Camp's station and obtained Environment Canada's National Climate Data and Information Archive was also used.

A comparison of all three components (precipitation, ambient air temperature, and water temperature) will indicate groundwater fed streams (cold water stream) or surface water fed (warm water streams) (Figure 3.8). Typically, cold water streams are best described as flowing waters with maximum summer water temperatures less than 22 degrees Celsius and annual flow rates of less than 1,400 L/s (Bowlby, 2008).

Although all monitored streams were equipped with a temperature data logger (SPR-HS1, SPR-HS2, SPR-HS3, SPR-HS5 and SPR-HS6), only four of the five loggers were retrieved. Of the four loggers retrieved (SPR-HS1, SPR-HS3, SPR-HS5, SPR-HS6), hydrometric stations SPR-HS-5 and SPR-HS6 are indicative of groundwater fed streams or cold water streams as the average daily water temperatures were typically below the average daily ambient air temperature for the corresponding day. These streams also follow the rule of having a discharge rate of less than 1,400 L/s, as previously discussed in Section 3.5.

Conversely, the streams monitored at SPR-HS1 and SPR-HS3, are indicative of a warm water stream with the average daily water temperature above the average daily ambient air temperature.

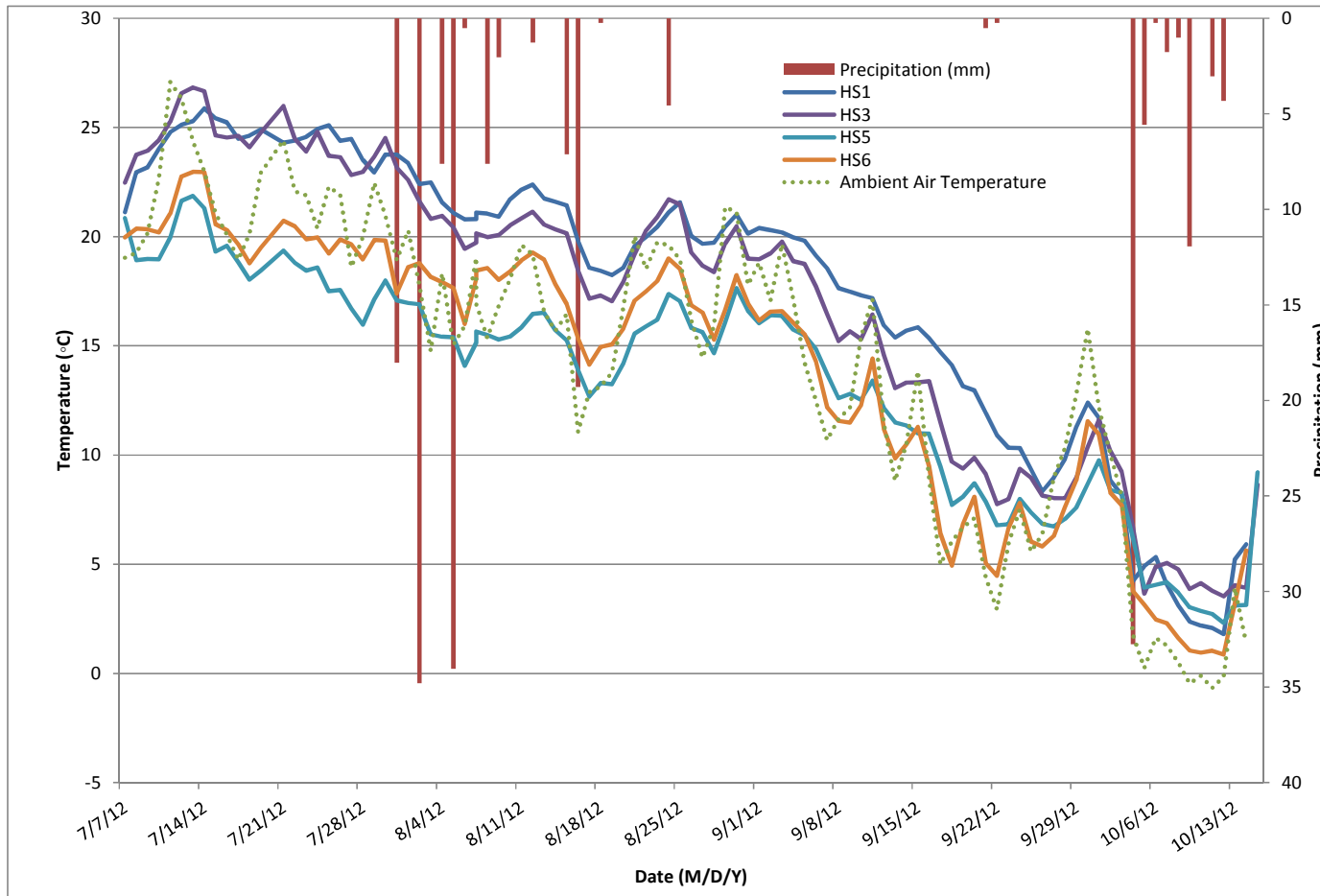


Figure 3.8: Average Daily Ambient Air Temperature vs. Average Daily Water Temperature, 2012

4. SUMMARY AND RECOMMENDATIONS

DST has completed the 2013 hydrological monitoring at the Springpole Project. The hydrologic monitoring for this project began in 2011 and continued until the end of 2012. A total of six hydrometric monitoring stations (SPR-HS1, SPR-HS2, SPR-HS3, SPR-HS4, SPR-HS5, and SPR-HS6) were manually monitored during this period. Based upon the overall needs of the project, one monitoring station (SPR-HS4) which was monitored during the 2011 period and partially through the 2012 period was considered redundant and was removed mid-way through the monitoring season. An additional hydrometric station (SPR-HS6) was added to the program in 2012. All stations aside from SPR-HS3 and SPR-HS4 recorded the 2012 spring freshet as these stations were reinstalled in May 2012, following ice-out.

Based upon the manual measurements collected during this period, well correlated stage-discharge curves were generated for four hydrometric stations. Due to the later installation of the SPR-HS6 hydrometric station (July 7, 2012), there was an insufficient amount of data collected to be able to produce a representative stage-discharge curve. The stage-discharge formulae developed to convert automated pressure transducer measurements into discharge estimates can confidently be applied to all stations. Corrections for data errors found during the study period (i.e. fallen-over station) have been completed and incorporated into all data presented. Additional manual stream discharge measurements will help to improve the stage-discharge relationships presented herein, particularly at the mid- to high-discharge rates.

Precipitation data from the Red Lake Airport and the Springpole on-site weather station indicated relatively significant rainfall being recorded in April, May, August, and October in 2012. Discharge data collected by Environment Canada at the Cat River location as well as on-site hydrometric monitoring stations indicated the spring freshet occurring in late March and significant water levels occurring in the middle of June and beginning of July.

The estimated average daily discharges for the hydrometric monitoring stations were as follows: the SPR-HS1 station at 16,612 L/s; SPR-HS2 at 37 L/s; SPR-HS3 at 64 L/s; and SPR-HS5 at 153 L/s. The average peak daily discharge recorded in 2012 at the study area was at the SPR-HS1 station (65,291 L/s on July 4, 2012); the lowest average daily discharge was recorded at the SPR-HS5 station (0.0 L/s on August 29, 2012).

A comparison of the unit yields for each of the four watersheds shows higher unit yields for the stations at SPR-HS5, SPR-HS1 and Cat River, compared with SPR-HS2, and SPR-HS3, with maximum recorded unit yield measurements in 2012 of 1,139 L/s/km², 50.6 L/s/km², and 19.5 L/s/km² respectively.

In general, there was a good correlation between discharges in each of the four watersheds monitored and the Environment Canada Current River Station at Cat River in 2012. Additional flow monitoring at the mid-to high-discharge rates is recommended and the values obtained are expected to strengthen the stage-discharge curves for all locations, which should correct any errors in some of the high discharge measurements.

Based upon the review of the project needs, an additional two monitoring stations should be considered for the 2013 monitoring period. One hydrometric station should be installed at the outlet of Springpole Lake, which flows into Birch River. A second station should be considered

for the outlet of a small grouping of un-named ponds and lakes just east of Pickerel Arm Camps, located on the east arm of Springpole Lake. These two additional stations would allow for the assessment of the total immediate project outflow and the potential impacts associated within this area.

Although the location of SPR-HS6 is a good candidate location of this hydrometric station, the spring freshet data should be reviewed. There may be potential for back-water effects within the area of the station location and a reassessment of hydrometric placement may be required.

A review of the data from SPR-HS3 over two monitoring periods appears to be poor as beaver action and extremely low flows have affected the data, and after a review of the project needs, this station has become redundant and should be eliminated from the 2013 monitoring period.

5. CLOSURE

We appreciate this opportunity to provide environmental services to you. If you have any questions or comments, please contact the undersigned.

For DST CONSULTING ENGINEERS INC.

Kristen Boorse, B.E.S., A.Sc.T.
Environmental Scientist

Kris Tuuttila, A.Sc.T., P.Geo. (Limited)
Environmental Sector Head, Kenora

Paul Hubley, M.Sc., P.Geo.
Sr. Technical Advisor

6. REFERENCES

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http://www.wateroffice.ec.gc.ca/graph/graph_e.html?stn=04GA002

Marsh-McBirney Inc., 1990. *Model 2000, Installation and Operations Manual*.

APPENDIX A
Site Photographs



Photograph 1: View of SPR-HS1 at Cromarty Lake Inlet to Springpole Lake on April 30, 2012, before re-installment; facing north.



Photograph 2: View of SPR-HS1 at Cromarty Lake Inlet to Springpole Lake on April 30, 2012, after re-installment; facing north.



Photograph 3: : View of SPR-HS1 at Cromarty Lake Inlet to Springpole Lake on July 7, 2012; facing east.



Photograph 4: View of the Springpole Lake Inlet hydrometric station SPR-HS2 on July 7, 2012.



Photograph 5: View of SPR-HS3 Birch Lake Inlet hydrometric station on July 7, 2012; facing south.



Photograph 6: View of SPR-HS4 Springpole Inlet hydrometric station on May 3, 2012; facing east. Installed date.



Photograph 7: View of SPR-HS4 Springpole Inlet hydrometric station on July 6, 2012; facing east. Note lake water levels.



Photograph 8: View of the SPR-HS6 on July 7, 2012, instalment date; facing southeast.

APPENDIX B

Summary of Stream Discharge Measurements

B1 - Manual Flow Measurements at Hydrometric Station SPR-HS1

Date: 30-Apr-12 Staff Gauge (m): 0.42
 Time (CST): 17:30 Left Bank (m): 0
 Channel Width (m): 22 Right Bank (m): 22

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1.00 | 0.22 | 1.00 | 0.22 | | -0.02 | | -0.02 | 0.00 |
| 3.00 | 0.80 | 2.00 | 1.60 | 0.15 | 0.30 | 0.08 | 0.21 | 0.33 |
| 5.00 | 1.00 | 2.00 | 2.00 | 0.43 | 0.67 | 0.65 | 0.61 | 1.21 |
| 7.00 | 0.72 | 2.00 | 1.44 | 0.54 | 0.69 | 0.71 | 0.66 | 0.95 |
| 9.00 | 0.76 | 2.00 | 1.52 | 0.33 | 0.56 | 0.63 | 0.52 | 0.79 |
| 11.00 | 0.84 | 2.00 | 1.68 | 0.33 | 0.48 | 0.56 | 0.46 | 0.78 |
| 13.00 | 0.82 | 2.00 | 1.64 | 0.35 | 0.58 | 0.58 | 0.52 | 0.86 |
| 15.00 | 0.78 | 2.00 | 1.56 | 0.45 | 0.50 | 0.5 | 0.49 | 0.76 |
| 17.00 | 0.82 | 2.00 | 1.64 | 0.42 | 0.57 | 0.53 | 0.52 | 0.86 |
| 19.00 | 0.74 | 2.00 | 1.48 | 0.37 | 0.41 | 0.58 | 0.44 | 0.65 |
| 21.00 | 0.58 | 2.00 | 1.16 | | 0.23 | | 0.23 | 0.27 |

Total Flow = 7.45

Date: 6-Jun-12 Staff Gauge (m): 0.515
 Time (CST): 20:42 Left Bank (m): 24.5
 Channel Width (m): 23.3 Right Bank (m): 1.2

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 24.00 | 0.24 | 0.50 | 0.12 | | 0.20 | | 0.20 | 0.02 |
| 23.00 | 0.44 | 1.00 | 0.44 | | 0.28 | | 0.28 | 0.12 |
| 22.00 | 0.80 | 1.00 | 0.80 | 0.49 | 0.67 | 0.62 | 0.61 | 0.49 |
| 21.00 | 0.98 | 1.00 | 0.98 | 0.50 | 0.66 | 0.73 | 0.63 | 0.62 |
| 20.00 | 0.96 | 1.00 | 0.96 | 0.63 | 0.69 | 0.71 | 0.68 | 0.65 |
| 19.00 | 0.86 | 1.00 | 0.86 | 0.61 | 0.76 | 0.7 | 0.71 | 0.61 |
| 18.00 | 0.84 | 1.00 | 0.84 | 0.73 | 0.69 | 0.81 | 0.73 | 0.62 |
| 17.00 | 0.78 | 1.00 | 0.78 | 0.60 | 0.82 | 0.78 | 0.76 | 0.59 |
| 16.00 | 0.80 | 1.00 | 0.80 | 0.65 | 0.76 | 0.77 | 0.73 | 0.59 |
| 15.00 | 0.82 | 1.00 | 0.82 | 0.58 | 0.73 | 0.71 | 0.69 | 0.56 |
| 14.00 | 0.92 | 1.00 | 0.92 | 0.4359 | 0.62 | 0.67 | 0.58 | 0.54 |
| 13.00 | 0.95 | 1.00 | 0.95 | 0.73 | 0.70 | 0.62 | 0.69 | 0.65 |
| 12.00 | 0.82 | 1.00 | 0.82 | 0.49 | 0.71 | 0.66 | 0.64 | 0.53 |
| 11.00 | 0.92 | 1.00 | 0.92 | 0.64 | 0.64 | 0.66 | 0.65 | 0.60 |
| 10.00 | 0.94 | 1.00 | 0.94 | 0.51 | 0.70 | 0.67 | 0.65 | 0.61 |
| 9.00 | 0.46 | 1.00 | 0.46 | 0.27 | 0.77 | 0.69 | 0.63 | 0.29 |
| 8.00 | 0.76 | 1.00 | 0.76 | 0.63 | 0.66 | 0.52 | 0.62 | 0.47 |
| 7.00 | 0.80 | 1.00 | 0.80 | 0.69 | 0.66 | 0.63 | 0.66 | 0.53 |
| 6.00 | 0.74 | 1.00 | 0.74 | 0.54 | 0.57 | 0.66 | 0.58 | 0.43 |
| 5.00 | 0.58 | 1.00 | 0.58 | -0.05 | 0.06 | 0.71 | 0.20 | 0.11 |
| 4.00 | 0.07 | 1.00 | 0.07 | | -0.06 | | -0.06 | 0.00 |
| 3.00 | 0.10 | 1.00 | 0.10 | | 0.31 | | 0.31 | 0.03 |

Total Flow = 9.66

B1 - Manual Flow Measurements at Hydrometric Station SPR-HS1, Continued.

Date: 7-Jul-12 Staff Gauge (m): n/a
 Time (CST): 10:00 Left Bank (m): 25
 Channel Width (m): 24.2 Right Bank (m): 0.8

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 24.5 | 0.36 | 1.00 | 0.36 | | 0.66 | | 0.66 | 0.24 |
| 23.5 | 0.94 | 1.00 | 0.94 | 0.89 | 1.08 | 1.78 | 1.21 | 1.14 |
| 22.5 | 1.84 | 1.00 | 1.84 | 0.21 | 0.80 | 0.91 | 0.68 | 1.25 |
| 21.5 | 1.86 | 1.00 | 1.86 | 0.96 | 0.88 | 0.14 | 0.72 | 1.33 |
| 20.5 | 2.00 | 1.00 | 2.00 | 0.96 | 1.07 | 0.90 | 1.00 | 2.00 |
| 19.5 | 2.00 | 1.00 | 2.00 | 0.97 | 0.99 | 0.97 | 0.98 | 1.96 |
| 18.5 | 2.04 | 1.00 | 2.04 | 0.80 | 1.04 | 1.01 | 0.97 | 1.98 |
| 17.5 | 2.00 | 1.00 | 2.00 | 0.87 | 0.78 | 1.04 | 0.87 | 1.74 |
| 16.5 | 2.00 | 1.00 | 2.00 | 0.76 | 0.91 | 0.92 | 0.88 | 1.75 |
| 15.5 | 2.02 | 1.00 | 2.02 | 0.63 | 0.93 | 0.98 | 0.87 | 1.75 |
| 14.5 | 2.30 | 1.00 | 2.30 | 0.83 | 0.74 | 0.82 | 0.78 | 1.80 |
| 13.5 | 2.30 | 1.00 | 2.30 | 0.81 | 0.98 | 0.58 | 0.84 | 1.93 |
| 12.5 | 1.96 | 1.00 | 1.96 | 0.90 | 0.99 | 0.97 | 0.96 | 1.89 |
| 11.5 | 2.00 | 1.00 | 2.00 | 0.93 | 0.84 | 0.89 | 0.88 | 1.75 |
| 10.5 | 2.00 | 1.00 | 2.00 | 0.79 | 0.96 | 0.90 | 0.90 | 1.81 |
| 9.5 | 1.92 | 1.00 | 1.92 | 0.83 | 0.99 | 0.90 | 0.93 | 1.78 |
| 8.5 | 1.94 | 1.00 | 1.94 | 0.92 | 1.05 | 0.98 | 1.00 | 1.94 |
| 7.5 | 2.01 | 1.00 | 2.01 | 0.83 | 0.96 | 1.71 | 1.12 | 2.24 |
| 6.5 | 2.40 | 1.00 | 2.40 | 0.89 | 0.76 | 1.04 | 0.86 | 2.07 |
| 5.5 | 2.40 | 1.00 | 2.40 | 1.15 | 0.90 | 0.80 | 0.94 | 2.25 |
| 4.5 | 2.50 | 1.00 | 2.50 | 1.01 | 0.64 | 0.84 | 0.78 | 1.96 |
| 3.5 | 1.88 | 1.00 | 1.88 | 0.50 | 0.88 | 0.71 | 0.74 | 1.40 |
| 2.5 | 1.72 | 1.00 | 1.72 | 0.15 | 0.18 | 0.08 | 0.15 | 0.25 |
| 1.5 | 0.81 | 1.00 | 0.81 | -0.04 | -0.03 | -0.08 | -0.05 | -0.04 |

Total Flow = 38.15

Date: 9-Aug-12 Staff Gauge (m): 0.691
 Time (CST): 10:40 Left Bank (m): 2
 Channel Width (m): 25.25 Right Bank (m): 27.25

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 2.50 | 0.14 | 0.50 | 0.07 | | 0.43 | | 0.43 | 0.03 |
| 3.50 | 0.62 | 1.00 | 0.62 | | 0.74 | | 0.74 | 0.46 |
| 4.50 | 0.98 | 1.00 | 0.98 | 0.65 | 0.66 | 0.82 | 0.70 | 0.68 |
| 5.50 | 1.00 | 1.00 | 1.00 | 0.83 | 0.85 | 0.79 | 0.83 | 0.83 |
| 6.50 | 1.08 | 1.00 | 1.08 | 0.16 | 0.76 | 0.84 | 0.63 | 0.68 |
| 7.50 | 1.16 | 1.00 | 1.16 | 0.56 | 0.88 | 0.83 | 0.79 | 0.91 |
| 8.50 | 1.10 | 1.00 | 1.10 | 0.27 | 0.74 | 0.77 | 0.63 | 0.69 |
| 9.50 | 1.10 | 1.00 | 1.10 | 0.77 | 0.81 | 0.76 | 0.79 | 0.87 |
| 10.50 | 0.45 | 1.00 | 0.45 | 0.62 | 0.77 | 0.81 | 0.74 | 0.33 |
| 11.50 | 1.04 | 1.00 | 1.04 | 0.61 | 0.70 | 0.82 | 0.71 | 0.74 |
| 12.50 | 1.18 | 1.00 | 1.18 | 0.7 | 0.86 | 0.81 | 0.81 | 0.95 |
| 13.50 | 1.18 | 1.00 | 1.18 | 0.62 | 0.76 | 0.77 | 0.73 | 0.86 |
| 14.50 | 1.16 | 1.00 | 1.16 | 0.64 | 0.71 | 0.85 | 0.73 | 0.84 |
| 15.50 | 1.10 | 1.00 | 1.10 | 0.72 | 0.75 | 0.77 | 0.75 | 0.82 |
| 16.50 | 1.04 | 1.00 | 1.04 | 0.67 | 0.68 | 0.66 | 0.67 | 0.70 |
| 17.50 | 1.08 | 1.00 | 1.08 | 0.71 | 0.87 | 0.81 | 0.82 | 0.88 |
| 18.50 | 1.10 | 1.00 | 1.10 | 0.77 | 0.85 | 0.81 | 0.82 | 0.90 |
| 19.50 | 1.18 | 1.00 | 1.18 | 0.69 | 0.80 | 0.64 | 0.73 | 0.86 |
| 20.50 | 1.24 | 1.00 | 1.24 | 1.11 | 0.93 | 0.78 | 0.94 | 1.16 |
| 21.50 | 1.14 | 1.00 | 1.14 | 0.62 | 0.83 | 0.83 | 0.78 | 0.89 |
| 22.50 | 0.62 | 1.00 | 0.62 | | 0.60 | | 0.60 | 0.37 |
| 23.50 | 0.68 | 1.00 | 0.68 | | 0.68 | | 0.68 | 0.46 |
| 24.50 | 0.52 | 1.00 | 0.52 | | 0.72 | | 0.72 | 0.37 |
| 25.50 | 0.38 | 1.00 | 0.38 | | 0.58 | | 0.58 | 0.22 |
| 26.50 | 0.22 | 1.00 | 0.22 | | 35.00 | | 35.00 | 7.70 |

Total Flow = 24.23

B1 - Manual Flow Measurements at Hydrometric Station SPR-HS1, Continued.

Date: 17-Sep-12 Staff Gauge (m): n/a
 Time (CST): 14:13 Left Bank (m): 3.39
 Channel Width (m): 22.77 Right Bank (m): 26.16

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 4.47 | 1.10 | 1.08 | 1.19 | 0.28 | 0.26 | 0.23 | 0.26 | 0.31 |
| 5.55 | 2.00 | 1.08 | 2.16 | 0.51 | 0.53 | 0.5 | 0.52 | 1.12 |
| 6.63 | 1.50 | 1.08 | 1.62 | 0.42 | 0.45 | 0.48 | 0.45 | 0.73 |
| 7.71 | 1.60 | 1.08 | 1.73 | 0.42 | 0.50 | 0.59 | 0.50 | 0.87 |
| 8.79 | 1.90 | 1.08 | 2.05 | 0.34 | 0.43 | 0.48 | 0.42 | 0.86 |
| 9.87 | 1.70 | 1.08 | 1.84 | 0.15 | 0.46 | 0.51 | 0.40 | 0.73 |
| 10.95 | 1.85 | 1.08 | 2.00 | 0.31 | 0.54 | 0.47 | 0.47 | 0.93 |
| 12.03 | 1.80 | 1.08 | 1.94 | 0.14 | 0.49 | 0.55 | 0.42 | 0.81 |
| 13.11 | 1.90 | 1.08 | 2.05 | 0.25 | 0.08 | 0.59 | 0.25 | 0.51 |
| 14.19 | 1.55 | 1.08 | 1.67 | 0.31 | 0.47 | 0.51 | 0.44 | 0.74 |
| 15.27 | 1.80 | 1.08 | 1.94 | 0.38 | 0.66 | 0.58 | 0.57 | 1.11 |
| 16.35 | 1.50 | 1.08 | 1.62 | 0.33 | 0.41 | 0.55 | 0.43 | 0.69 |
| 17.43 | 1.50 | 1.08 | 1.62 | 0.43 | 0.35 | 0.46 | 0.40 | 0.64 |
| 18.51 | 0.51 | 1.08 | 0.55 | | 1.50 | | 1.50 | 0.83 |
| 19.59 | 1.90 | 1.08 | 2.05 | 0.49 | 0.47 | 0.63 | 0.52 | 1.06 |
| 20.67 | 0.21 | 1.08 | 0.23 | | 0.52 | | 0.52 | 0.12 |
| 21.75 | 1.30 | 1.08 | 1.40 | 0.65 | 0.63 | 0.63 | 0.64 | 0.89 |
| 22.83 | 1.65 | 1.08 | 1.78 | 0.50 | 0.52 | 0.51 | 0.51 | 0.91 |
| 23.91 | 0.80 | 1.08 | 0.86 | 0.29 | 0.30 | 0.35 | 0.31 | 0.27 |
| 24.99 | 0.60 | 1.08 | 0.65 | | 0.18 | | 0.18 | 0.12 |
| 26.07 | 0.20 | 1.08 | 0.22 | | 0.30 | | 0.30 | 0.06 |

Total Flow = 14.29

Date: 14-Oct-12 Staff Gauge (m): 0.31
 Time (CST): 12:00 Left Bank (m): 29
 Channel Width (m): 24.33 Right Bank (m): 4.67

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|------|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 28.50 | 0.06 | 0.50 | 0.03 | | 0.21 | | 0.21 | 0.01 |
| 27.50 | 0.14 | 1.00 | 0.14 | | 0.27 | | 0.27 | 0.04 |
| 26.50 | 0.26 | 1.00 | 0.26 | | 0.44 | | 0.44 | 0.11 |
| 25.50 | 0.36 | 1.00 | 0.36 | | 0.49 | | 0.49 | 0.18 |
| 24.50 | 0.44 | 1.00 | 0.44 | | 0.63 | | 0.63 | 0.28 |
| 23.50 | 0.44 | 1.00 | 0.44 | | 0.60 | | 0.60 | 0.26 |
| 22.50 | 0.48 | 1.00 | 0.48 | | 0.56 | | 0.56 | 0.27 |
| 21.50 | 0.49 | 1.00 | 0.49 | | 0.50 | | 0.50 | 0.25 |
| 20.50 | 0.48 | 1.00 | 0.48 | | 0.45 | | 0.45 | 0.22 |
| 19.50 | 0.50 | 1.00 | 0.50 | 0.47 | 0.49 | 0.5 | 0.49 | 0.24 |
| 18.50 | 0.55 | 1.00 | 0.55 | 0.44 | 0.45 | 0.47 | 0.45 | 0.25 |
| 17.50 | 0.58 | 1.00 | 0.58 | 0.45 | 0.52 | 0.49 | 0.50 | 0.29 |
| 16.50 | 0.56 | 1.00 | 0.56 | 0.45 | 0.51 | 0.5 | 0.49 | 0.28 |
| 15.50 | 0.56 | 1.00 | 0.56 | 0.34 | 0.39 | 0.45 | 0.39 | 0.22 |
| 14.50 | 0.58 | 1.00 | 0.58 | 0.23 | 0.33 | 0.4 | 0.32 | 0.19 |
| 13.50 | 0.60 | 1.00 | 0.60 | 0.44 | 0.46 | 0.45 | 0.45 | 0.27 |
| 12.50 | 0.59 | 1.00 | 0.59 | 0.27 | 0.40 | 0.4 | 0.37 | 0.22 |
| 11.50 | 0.57 | 1.00 | 0.57 | 0.35 | 0.41 | 0.31 | 0.37 | 0.21 |
| 10.50 | 0.62 | 1.00 | 0.62 | 0.36 | 0.37 | 0.4 | 0.38 | 0.23 |
| 9.50 | 0.60 | 1.00 | 0.60 | 0.27 | 0.38 | 0.38 | 0.35 | 0.21 |
| 8.50 | 0.56 | 1.00 | 0.56 | 0.16 | 0.30 | 0.17 | 0.23 | 0.13 |
| 7.50 | 0.44 | 1.00 | 0.44 | | 0.20 | | 0.20 | 0.09 |
| 6.50 | 0.36 | 1.00 | 0.36 | | 0.33 | | 0.33 | 0.12 |
| 5.50 | 0.16 | 1.00 | 0.16 | | 0.19 | | 0.19 | 0.03 |

Total Flow = 4.58

B2- Manual Flow Measurements at Hydrometric Station SPR-HS2

Date: 30-Apr-12 Staff Gauge (m): 0.29
 Time (CST): 14:10 Left Bank (m): 3.6
 Channel Width (m): 2 Right Bank (m): 1.6

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1.7 | 0.15 | 0.10 | 0.02 | | 0.03 | | 0.03 | 0.00 |
| 1.9 | 0.17 | 0.10 | 0.02 | | 0.17 | | 0.17 | 0.00 |
| 2.1 | 0.16 | 0.10 | 0.02 | | 0.05 | | 0.05 | 0.00 |
| 2.3 | 0.14 | 0.10 | 0.01 | | 0.02 | | 0.02 | 0.00 |
| 2.5 | 0.12 | 0.10 | 0.01 | | 0.21 | | 0.21 | 0.00 |
| 2.7 | 0.06 | 0.10 | 0.01 | | 0.15 | | 0.15 | 0.00 |
| 2.9 | 0.00 | 0.10 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 3.1 | 0.08 | 0.10 | 0.01 | | 0.07 | | 0.07 | 0.00 |
| 3.3 | 0.02 | 0.10 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 3.5 | 0.00 | 0.10 | 0.00 | | 0.00 | | 0.00 | 0.00 |

Total Flow = 0.01

Date: 6-Jun-12 Staff Gauge (m): 0.395
 Time (CST): 12:30 Left Bank (m): 0
 Channel Width (m): 2.5 Right Bank (m): 2.5

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.10 | 0.16 | 0.10 | 0.02 | | 0.02 | | 0.02 | 0.00 |
| 0.25 | 0.19 | 0.25 | 0.05 | | 0.03 | | 0.03 | 0.00 |
| 0.50 | 0.22 | 0.25 | 0.06 | | 0.35 | | 0.35 | 0.02 |
| 0.75 | 0.24 | 0.25 | 0.06 | | 0.54 | | 0.54 | 0.03 |
| 1.00 | 0.22 | 0.25 | 0.06 | | 0.36 | | 0.36 | 0.02 |
| 1.25 | 0.22 | 0.25 | 0.06 | | -0.02 | | -0.02 | 0.00 |
| 1.50 | 0.24 | 0.25 | 0.06 | | 0.04 | | 0.04 | 0.00 |
| 1.75 | 0.26 | 0.25 | 0.07 | | 0.01 | | 0.01 | 0.00 |
| 2.00 | 0.24 | 0.25 | 0.06 | | -0.02 | | -0.02 | 0.00 |
| 2.25 | 0.10 | 0.25 | 0.03 | | 0.03 | | 0.03 | 0.00 |
| 2.50 | 0.07 | 0.25 | 0.02 | | 0.00 | | 0.00 | 0.00 |

Total Flow = 0.07

B2- Manual Flow Measurements at Hydrometric Station SPR-HS2, Continued.

Date: 6-Jul-12 Staff Gauge (m): 0.418
 Time (CST): n/a Left Bank (m): 0.35
 Channel Width (m): 2.4 Right Bank (m): 2.75

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.50 | 0.22 | 0.15 | 0.03 | | 0.02 | | 0.02 | 0.00 |
| 0.70 | 0.21 | 0.20 | 0.04 | | 0.21 | | 0.21 | 0.01 |
| 0.90 | 0.22 | 0.20 | 0.04 | | 0.65 | | 0.65 | 0.03 |
| 1.10 | 0.26 | 0.20 | 0.05 | | 0.48 | | 0.48 | 0.02 |
| 1.30 | 0.28 | 0.20 | 0.06 | | 0.36 | | 0.36 | 0.02 |
| 1.50 | 0.20 | 0.20 | 0.04 | | 0.21 | | 0.21 | 0.01 |
| 1.70 | 0.23 | 0.20 | 0.05 | | 0.06 | | 0.06 | 0.00 |
| 1.90 | 0.25 | 0.20 | 0.05 | | 0.02 | | 0.02 | 0.00 |
| 2.10 | 0.22 | 0.20 | 0.04 | | -0.01 | | -0.01 | 0.00 |
| 2.30 | 0.22 | 0.20 | 0.04 | | -0.04 | | -0.04 | 0.00 |
| 2.50 | 0.13 | 0.20 | 0.03 | | -0.02 | | -0.02 | 0.00 |
| 2.70 | 0.08 | 0.20 | 0.02 | | -0.05 | | -0.05 | 0.00 |

Total Flow = 0.09

Date: 8-Aug-12 Staff Gauge (m): 0.400
 Time (CST): 9:23 Left Bank (m): 0.45
 Channel Width (m): 2.7 Right Bank (m): 3.15

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.53 | 0.02 | 0.08 | 0.00 | | -0.01 | | -0.01 | 0.00 |
| 0.68 | 0.04 | 0.15 | 0.01 | | -0.01 | | -0.01 | 0.00 |
| 0.83 | 0.10 | 0.15 | 0.02 | | -0.01 | | -0.01 | 0.00 |
| 0.98 | 0.18 | 0.15 | 0.03 | | 0.05 | | 0.05 | 0.00 |
| 1.13 | 0.20 | 0.15 | 0.03 | | 0.07 | | 0.07 | 0.00 |
| 1.28 | 0.26 | 0.15 | 0.04 | | 0.12 | | 0.12 | 0.00 |
| 1.43 | 0.24 | 0.15 | 0.04 | | 0.05 | | 0.05 | 0.00 |
| 1.58 | 0.26 | 0.15 | 0.04 | | 0.05 | | 0.05 | 0.00 |
| 1.73 | 0.22 | 0.15 | 0.03 | | 0.29 | | 0.29 | 0.01 |
| 1.88 | 0.22 | 0.15 | 0.03 | | 0.40 | | 0.40 | 0.01 |
| 2.03 | 0.18 | 0.15 | 0.03 | | 0.50 | | 0.50 | 0.01 |
| 2.18 | 0.14 | 0.15 | 0.02 | | 0.49 | | 0.49 | 0.01 |
| 2.33 | 0.12 | 0.15 | 0.02 | | 0.38 | | 0.38 | 0.01 |
| 2.48 | 0.12 | 0.15 | 0.02 | | 0.52 | | 0.52 | 0.01 |
| 2.63 | 0.14 | 0.15 | 0.02 | | 0.04 | | 0.04 | 0.00 |
| 2.78 | 0.14 | 0.15 | 0.02 | | 0.31 | | 0.31 | 0.01 |
| 2.93 | 0.14 | 0.15 | 0.02 | | 0.01 | | 0.01 | 0.00 |
| 3.08 | 0.12 | 0.15 | 0.02 | | -0.07 | | -0.07 | 0.00 |

Total Flow = 0.08

B2- Manual Flow Measurements at Hydrometric Station SPR-HS2, Continued.

Date: 17-Sep-12 Staff Gauge (m): 0.285
 Time (CST): 9:04 Left Bank (m): 2.42
 Channel Width (m): 2.15 Right Bank (m): 0.27

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.27 | 0.15 | 0.12 | 0.02 | | 0.08 | | 0.08 | 0.00 |
| 0.39 | 0.15 | 0.12 | 0.02 | | 0.06 | | 0.06 | 0.00 |
| 0.51 | 0.20 | 0.12 | 0.02 | | 0.03 | | 0.03 | 0.00 |
| 0.63 | 0.20 | 0.12 | 0.02 | | 0.09 | | 0.09 | 0.00 |
| 0.75 | 0.40 | 0.12 | 0.05 | | 0.24 | | 0.24 | 0.01 |
| 0.87 | 0.40 | 0.12 | 0.05 | | 0.12 | | 0.12 | 0.01 |
| 0.99 | 0.42 | 0.12 | 0.05 | | 0.15 | | 0.15 | 0.01 |
| 1.11 | 0.45 | 0.12 | 0.05 | | 0.14 | | 0.14 | 0.01 |
| 1.23 | 0.40 | 0.12 | 0.05 | | 0.17 | | 0.17 | 0.01 |
| 1.45 | 0.30 | 0.12 | 0.04 | | 0.06 | | 0.06 | 0.00 |
| 1.67 | 0.40 | 0.12 | 0.05 | | 0.00 | | 0.00 | 0.00 |
| 1.89 | 0.40 | 0.12 | 0.05 | | -0.04 | | -0.04 | 0.00 |
| 2.01 | 0.20 | 0.12 | 0.02 | | 0.01 | | 0.01 | 0.00 |
| 2.13 | 0.25 | 0.12 | 0.03 | | 0.03 | | 0.03 | 0.00 |
| 2.25 | 0.25 | 0.12 | 0.03 | | 0.22 | | 0.22 | 0.01 |
| 2.37 | 0.25 | 0.12 | 0.03 | | 0.09 | | 0.09 | 0.00 |

Total Flow = 0.06

Date: 14-Oct-12 Staff Gauge (m): 0.371
 Time (CST): 10:35 Left Bank (m): 2.94
 Channel Width (m): 0 Right Bank (m): 0.5

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.55 | 0.10 | 0.05 | 0.01 | | 0.04 | | 0.04 | 0.00 |
| 0.65 | 0.10 | 0.10 | 0.01 | | 0.00 | | 0.00 | 0.00 |
| 0.75 | 0.08 | 0.10 | 0.01 | | 0.09 | | 0.09 | 0.00 |
| 0.85 | 0.08 | 0.10 | 0.01 | | 0.01 | | 0.01 | 0.00 |
| 0.95 | 0.08 | 0.10 | 0.01 | | 0.15 | | 0.15 | 0.00 |
| 1.05 | 0.08 | 0.10 | 0.01 | | 1.17 | | 1.17 | 0.01 |
| 1.15 | 0.10 | 0.10 | 0.01 | | 0.17 | | 0.17 | 0.00 |
| 1.25 | 0.12 | 0.10 | 0.01 | | 0.04 | | 0.04 | 0.00 |
| 1.35 | 0.15 | 0.10 | 0.02 | | 0.14 | | 0.14 | 0.00 |
| 1.45 | 0.14 | 0.10 | 0.01 | | 0.16 | | 0.16 | 0.00 |
| 1.55 | 0.13 | 0.10 | 0.01 | | 0.18 | | 0.18 | 0.00 |
| 1.65 | 0.10 | 0.10 | 0.01 | | 0.18 | | 0.18 | 0.00 |
| 1.75 | 0.10 | 0.10 | 0.01 | | 0.16 | | 0.16 | 0.00 |
| 1.85 | 0.08 | 0.10 | 0.01 | | 0.14 | | 0.14 | 0.00 |
| 1.95 | 0.14 | 0.10 | 0.01 | | 0.11 | | 0.11 | 0.00 |
| 2.05 | 0.12 | 0.10 | 0.01 | | 0.09 | | 0.09 | 0.00 |
| 2.15 | 0.09 | 0.10 | 0.01 | | 0.06 | | 0.06 | 0.00 |
| 2.25 | 0.10 | 0.10 | 0.01 | | 0.04 | | 0.04 | 0.00 |
| 2.35 | 0.12 | 0.10 | 0.01 | | 0.04 | | 0.04 | 0.00 |
| 2.45 | 0.10 | 0.10 | 0.01 | | 0.14 | | 0.14 | 0.00 |
| 2.55 | 0.08 | 0.10 | 0.01 | | 0.10 | | 0.10 | 0.00 |
| 2.65 | 0.03 | 0.10 | 0.00 | | 0.08 | | 0.08 | 0.00 |
| 2.75 | 0.02 | 0.10 | 0.00 | | 0.13 | | 0.13 | 0.00 |
| 2.85 | 0.02 | 0.10 | 0.00 | | 0.05 | | 0.05 | 0.00 |

Total Flow = 0.03

B3- Manual Flow Measurements at Hydrometric Station SPR-HS3

Date: 2-May-12 Staff Gauge (m): 0.145
 Time (CST): 13:30 Left Bank (m): 3.55
 Channel Width (m): 3 Right Bank (m): 0.55

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.70 | 0.14 | 0.15 | 0.02 | | 0.01 | | 0.01 | 0.00 |
| 1.00 | 0.12 | 0.30 | 0.04 | | 0.24 | | 0.24 | 0.01 |
| 1.30 | 0.06 | 0.30 | 0.02 | | 0.22 | | 0.22 | 0.00 |
| 1.60 | 0.04 | 0.30 | 0.01 | | 0.08 | | 0.08 | 0.00 |
| 1.90 | 0.14 | 0.30 | 0.04 | | 0.03 | | 0.03 | 0.00 |
| 2.20 | 0.11 | 0.30 | 0.03 | | 0.21 | | 0.21 | 0.01 |
| 2.50 | 0.14 | 0.30 | 0.04 | | 0.20 | | 0.20 | 0.01 |
| 2.80 | 0.08 | 0.30 | 0.02 | | 0.33 | | 0.33 | 0.01 |

Total Flow = 0.04

Date: 7-Jun-12 Staff Gauge (m): 0.14
 Time (CST): 14:20 Left Bank (m): 0.9
 Channel Width (m): 2.2 Right Bank (m): 3.1

| Station (20cm) | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|----------------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1.0 | 0.13 | 0.10 | 0.01 | | 0.34 | | 0.34 | 0.00 |
| 1.2 | 0.09 | 0.20 | 0.02 | | 0.27 | | 0.27 | 0.00 |
| 1.4 | 0.11 | 0.20 | 0.02 | | 0.00 | | 0.00 | 0.00 |
| 1.6 | 0.13 | 0.20 | 0.03 | | 0.37 | | 0.37 | 0.01 |
| 1.8 | 0.14 | 0.20 | 0.03 | | 0.14 | | 0.14 | 0.00 |
| 2.0 | 0.12 | 0.20 | 0.02 | | 0.39 | | 0.39 | 0.01 |
| 2.2 | 0.08 | 0.20 | 0.02 | | 0.30 | | 0.30 | 0.00 |
| 2.4 | 0.10 | 0.20 | 0.02 | | -0.01 | | -0.01 | 0.00 |
| 2.6 | 0.08 | 0.20 | 0.02 | | 0.06 | | 0.06 | 0.00 |
| 2.8 | 0.10 | 0.20 | 0.02 | | 0.21 | | 0.21 | 0.00 |
| 3.0 | 0.10 | 0.20 | 0.02 | | 0.07 | | 0.07 | 0.00 |

Total Flow = 0.04

Date: 7-Jul-12 Staff Gauge (m): 0.2
 Time (CST): 15:35 Left Bank (m): 3.5
 Channel Width (m): 3.3 Right Bank (m): 0.2

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 3.4 | 0.16 | 0.10 | 0.02 | | 0.24 | | 0.24 | 0.00 |
| 3.2 | 0.16 | 0.20 | 0.03 | | 0.39 | | 0.39 | 0.01 |
| 3.0 | 0.16 | 0.20 | 0.03 | | 0.39 | | 0.39 | 0.01 |
| 2.8 | 0.20 | 0.20 | 0.04 | | 0.28 | | 0.28 | 0.01 |
| 2.6 | 0.16 | 0.20 | 0.03 | | 0.60 | | 0.60 | 0.02 |
| 2.4 | 0.22 | 0.20 | 0.04 | | 0.55 | | 0.55 | 0.02 |
| 2.2 | 0.22 | 0.20 | 0.04 | | 0.55 | | 0.55 | 0.02 |
| 2.0 | 0.20 | 0.20 | 0.04 | | 0.37 | | 0.37 | 0.01 |
| 1.8 | 0.16 | 0.20 | 0.03 | | 0.35 | | 0.35 | 0.01 |
| 1.6 | 0.20 | 0.20 | 0.04 | | 0.27 | | 0.27 | 0.01 |
| 1.4 | 0.12 | 0.20 | 0.02 | | 0.35 | | 0.35 | 0.01 |
| 1.2 | 0.20 | 0.20 | 0.04 | | 0.35 | | 0.35 | 0.01 |
| 1.0 | 0.12 | 0.20 | 0.02 | | 0.14 | | 0.14 | 0.00 |
| 0.8 | 0.06 | 0.20 | 0.01 | | 0.05 | | 0.05 | 0.00 |
| 0.6 | 0.01 | 0.20 | 0.00 | | 0.01 | | 0.01 | 0.00 |
| 0.4 | 0.02 | 0.20 | 0.00 | | 0.07 | | 0.07 | 0.00 |

Total Flow = 0.17

B3- Manual Flow Measurements at Hydrometric Station SPR-HS3, Continued.

Date: 7-Aug-12 Staff Gauge (m): 0.25
 Time (CST): 17:18 Left Bank (m): 7.80
 Channel Width (m): 7.5 Right Bank (m): 0.30

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.45 | 0.21 | 0.15 | 0.03 | | -0.01 | | -0.01 | 0.00 |
| 0.75 | 0.28 | 0.30 | 0.08 | | -0.03 | | -0.03 | 0.00 |
| 1.05 | 0.26 | 0.30 | 0.08 | | -0.03 | | -0.03 | 0.00 |
| 1.35 | 0.26 | 0.30 | 0.08 | | -0.02 | | -0.02 | 0.00 |
| 1.05 | 0.24 | 0.30 | 0.07 | | -0.02 | | -0.02 | 0.00 |
| 1.95 | 0.27 | 0.30 | 0.08 | | 0.00 | | 0.00 | 0.00 |
| 2.25 | 0.24 | 0.30 | 0.07 | | 0.02 | | 0.02 | 0.00 |
| 2.55 | 0.26 | 0.30 | 0.08 | | 0.03 | | 0.03 | 0.00 |
| 2.85 | 0.30 | 0.30 | 0.09 | | 0.02 | | 0.02 | 0.00 |
| 3.15 | 0.34 | 0.30 | 0.10 | | 0.08 | | 0.08 | 0.01 |
| 3.45 | 0.42 | 0.30 | 0.13 | | 0.80 | | 0.80 | 0.10 |
| 3.75 | 0.42 | 0.30 | 0.13 | | 0.35 | | 0.35 | 0.04 |
| 4.05 | 0.28 | 0.30 | 0.08 | | 0.05 | | 0.05 | 0.00 |
| 4.35 | 0.11 | 0.30 | 0.03 | | 0.03 | | 0.03 | 0.00 |
| 4.65 | 0.11 | 0.30 | 0.03 | | -0.04 | | -0.04 | 0.00 |
| 4.95 | 0.10 | 0.30 | 0.03 | | -0.19 | | -0.19 | -0.01 |
| 5.25 | 0.10 | 0.30 | 0.03 | | -0.20 | | -0.20 | -0.01 |
| 5.55 | 0.20 | 0.30 | 0.06 | | 0.22 | | 0.22 | 0.01 |
| 5.85 | 0.18 | 0.30 | 0.05 | | 0.08 | | 0.08 | 0.00 |
| 6.15 | 0.10 | 0.30 | 0.03 | | 0.77 | | 0.77 | 0.02 |
| 6.45 | 0.18 | 0.30 | 0.05 | | 0.69 | | 0.69 | 0.04 |
| 6.75 | 0.16 | 0.30 | 0.05 | | 0.65 | | 0.65 | 0.03 |
| 7.05 | 0.15 | 0.30 | 0.05 | | 0.11 | | 0.11 | 0.00 |
| 7.35 | 0.14 | 0.30 | 0.04 | | 0.19 | | 0.19 | 0.01 |
| 7.65 | 0.1 | 0.30 | 0.03 | | 0.02 | | 0.02 | 0.00 |

Total Flow = 0.18

Date: 18-Sep-12 Staff Gauge (m): 0.099
 Time (CST): 10:42 Left Bank (m): 3.50
 Channel Width (m): 2.73 Right Bank (m): 0.77

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.91 | 0.20 | 0.14 | 0.03 | | 0.07 | | 0.07 | 0.00 |
| 1.05 | 0.25 | 0.28 | 0.07 | | 0.24 | | 0.24 | 0.02 |
| 1.19 | 0.30 | 0.28 | 0.08 | | 0.09 | | 0.09 | 0.01 |
| 1.33 | 0.00 | 0.28 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 1.47 | 0.00 | 0.28 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 1.61 | 0.20 | 0.28 | 0.06 | | 0.20 | | 0.20 | 0.01 |
| 1.75 | 0.10 | 0.28 | 0.03 | | 0.10 | | 0.10 | 0.00 |
| 1.89 | 0.30 | 0.28 | 0.08 | | 0.10 | | 0.10 | 0.01 |
| 2.03 | 0.40 | 0.28 | 0.11 | | 0.04 | | 0.04 | 0.00 |
| 2.17 | 0.00 | 0.28 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 2.31 | 0.00 | 0.28 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 2.45 | 0.20 | 0.28 | 0.06 | | 0.02 | | 0.02 | 0.00 |
| 2.59 | 0.20 | 0.28 | 0.06 | | 0.01 | | 0.01 | 0.00 |
| 2.73 | 0.25 | 0.28 | 0.07 | | 0.00 | | 0.00 | 0.00 |
| 2.87 | 0.20 | 0.28 | 0.06 | | 0.12 | | 0.12 | 0.01 |
| 3.01 | 0.20 | 0.28 | 0.06 | | 0.06 | | 0.06 | 0.00 |
| 3.15 | 0.20 | 0.28 | 0.06 | | 0.05 | | 0.05 | 0.00 |
| 3.29 | 0.30 | 0.28 | 0.08 | | 0.04 | | 0.04 | 0.00 |
| 3.43 | 0.00 | 0.28 | 0.00 | | 0.00 | | 0.00 | 0.00 |

Total Flow = 0.07

B3- Manual Flow Measurements at Hydrometric Station SPR-HS3, Continued.

Date: 15-Oct-12 Staff Gauge (m): 0.169
 Time (CST): 10:07 Left Bank (m): 0.70
 Channel Width (m): 5.4 Right Bank (m): 6.10

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 6.00 | 0.06 | 0.10 | 0.01 | | 0.01 | | 0.01 | 0.00 |
| 5.80 | 0.14 | 0.20 | 0.03 | | 0.05 | | 0.05 | 0.00 |
| 5.60 | 0.10 | 0.20 | 0.02 | | 0.04 | | 0.04 | 0.00 |
| 5.40 | 0.10 | 0.20 | 0.02 | | -0.02 | | -0.02 | 0.00 |
| 5.20 | 0.08 | 0.20 | 0.02 | | -0.02 | | -0.02 | 0.00 |
| 5.00 | 0.06 | 0.20 | 0.01 | | -0.03 | | -0.03 | 0.00 |
| 4.80 | 0.06 | 0.20 | 0.01 | | 0.02 | | 0.02 | 0.00 |
| 4.60 | 0.07 | 0.20 | 0.01 | | 0.17 | | 0.17 | 0.00 |
| 4.40 | 0.06 | 0.20 | 0.01 | | 0.02 | | 0.02 | 0.00 |
| 4.20 | 0.08 | 0.20 | 0.02 | | 0.05 | | 0.05 | 0.00 |
| 4.00 | 0.08 | 0.20 | 0.02 | | 0.04 | | 0.04 | 0.00 |
| 3.80 | 0.16 | 0.20 | 0.03 | | 0.07 | | 0.07 | 0.00 |
| 3.60 | 0.14 | 0.20 | 0.03 | | 0.14 | | 0.14 | 0.00 |
| 3.40 | 0.14 | 0.20 | 0.03 | | 0.28 | | 0.28 | 0.01 |
| 3.20 | 0.19 | 0.20 | 0.04 | | 0.28 | | 0.28 | 0.01 |
| 3.00 | 0.14 | 0.20 | 0.03 | | 0.24 | | 0.24 | 0.01 |
| 2.80 | 0.16 | 0.20 | 0.03 | | 0.25 | | 0.25 | 0.01 |
| 2.60 | 0.10 | 0.20 | 0.02 | | -0.05 | | -0.05 | 0.00 |
| 2.40 | 0.04 | 0.20 | 0.01 | | 0.04 | | 0.04 | 0.00 |
| 2.20 | 0.06 | 0.20 | 0.01 | | 0.26 | | 0.26 | 0.00 |
| 2.00 | 0.08 | 0.20 | 0.02 | | 0.17 | | 0.17 | 0.00 |
| 1.80 | 0.06 | 0.20 | 0.01 | | 0.06 | | 0.06 | 0.00 |
| 1.60 | 0.06 | 0.20 | 0.01 | | -0.09 | | -0.09 | 0.00 |
| 1.40 | 0.1 | 0.20 | 0.02 | | -0.01 | | -0.01 | 0.00 |
| 1.20 | 0.09 | 0.20 | 0.02 | | 0.01 | | 0.01 | 0.00 |
| 1.00 | 0.1 | 0.20 | 0.02 | | -0.02 | | -0.02 | 0.00 |
| 0.80 | 0.06 | 0.20 | 0.01 | | 0.01 | | 0.01 | 0.00 |

Total Flow = 0.05

B4- Manual Flow Measurements at Hydrometric Station SPR-HS4

Date: 3-May-12 Staff Gauge (m): 0.11
 Time (CST): 10:15 Left Bank (m): 1.4
 Channel Width (m): 1 Right Bank (m): 0.4

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.5 | 0.06 | 0.10 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 0.7 | 0.09 | 0.20 | 0.02 | | 0.00 | | 0.00 | 0.00 |
| 0.9 | 0.08 | 0.20 | 0.02 | | -0.01 | | -0.01 | 0.00 |
| 1.1 | 0.08 | 0.20 | 0.02 | | 0.03 | | 0.03 | 0.00 |
| 1.3 | 0.06 | 0.20 | 0.01 | | 0.01 | | 0.01 | 0.00 |

Total Flow = 0.00

Date: 8-Jun-12 Staff Gauge (m): 0.1
 Time (CST): 7:20 Left Bank (m): 0.3
 Channel Width (m): 0.9 Right Bank (m): 1.23

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.40 | 0.07 | 0.10 | 0.01 | | 0.00 | | 0.00 | 0.00 |
| 0.55 | 0.07 | 0.15 | 0.01 | | -0.03 | | -0.03 | 0.00 |
| 0.70 | 0.10 | 0.15 | 0.02 | | -0.01 | | -0.01 | 0.00 |
| 0.85 | 0.06 | 0.15 | 0.01 | | -0.01 | | -0.01 | 0.00 |
| 1.00 | 0.06 | 0.15 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 1.15 | 0.08 | 0.15 | 0.01 | | -0.02 | | -0.02 | 0.00 |

Total Flow = 0.00

B5- Manual Flow Measurements at Hydrometric Station SPR-HS5

Date: 1-May-12 Staff Gauge (m): 0.119
 Time (CST): 9:35 Left Bank (m): 0.6
 Channel Width (m): 0.8 Right Bank (m): 1.4

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.7 | 0.06 | 0.10 | 0.01 | | 0.05 | | 0.05 | 0.00 |
| 0.9 | 0.07 | 0.20 | 0.01 | | 0.06 | | 0.06 | 0.00 |
| 1.1 | 0.07 | 0.20 | 0.01 | | 0.04 | | 0.04 | 0.00 |
| 1.3 | 0.07 | 0.20 | 0.01 | | 0.02 | | 0.02 | 0.00 |

Total Flow = 0.00

Date: 7-Jun-12 Staff Gauge (m): 0.079
 Time (CST): 12:30 Left Bank (m): 0
 Channel Width (m): 0.8 Right Bank (m): 0.8

| Station (10cm) | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|----------------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.10 | 0.06 | 0.10 | 0.01 | | 0.09 | | 0.09 | 0.00 |
| 0.20 | 0.09 | 0.10 | 0.01 | | 0.22 | | 0.22 | 0.00 |
| 0.30 | 0.08 | 0.10 | 0.01 | | 0.14 | | 0.14 | 0.00 |
| 0.40 | 0.09 | 0.10 | 0.01 | | 0.12 | | 0.12 | 0.00 |
| 0.50 | 0.09 | 0.10 | 0.01 | | 0.07 | | 0.07 | 0.00 |
| 0.60 | 0.08 | 0.10 | 0.01 | | 0.11 | | 0.11 | 0.00 |
| 0.70 | 0.06 | 0.10 | 0.01 | | 0.03 | | 0.03 | 0.00 |
| 0.80 | 0.08 | 0.10 | 0.01 | | -0.02 | | -0.02 | 0.00 |

Total Flow = 0.01

Date: 7-Jul-12 Staff Gauge (m): 0.202
 Time (CST): n/a Left Bank (m): 0.8
 Channel Width (m): 1.45 Right Bank (m): 2.25

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.85 | 0.05 | 0.05 | 0.00 | | 0.00 | | 0.00 | 0.0000 |
| 0.95 | 0.05 | 0.10 | 0.01 | | 0.10 | | 0.10 | 0.00 |
| 1 | 0.08 | 0.05 | 0.00 | | 0.00 | | 0.00 | 0.00 |
| 1.1 | 0.14 | 0.10 | 0.01 | | -0.10 | | -0.10 | 0.00 |
| 1.2 | 0.16 | 0.10 | 0.02 | | 0.02 | | 0.02 | 0.00 |
| 1.3 | 0.22 | 0.10 | 0.02 | | 0.03 | | 0.03 | 0.00 |
| 1.4 | 0.24 | 0.10 | 0.02 | | 0.01 | | 0.01 | 0.00 |
| 1.5 | 0.24 | 0.10 | 0.02 | | 0.02 | | 0.02 | 0.00 |
| 1.6 | 0.26 | 0.10 | 0.03 | | 0.02 | | 0.02 | 0.00 |
| 1.7 | 0.22 | 0.10 | 0.02 | | 0.01 | | 0.01 | 0.00 |
| 1.8 | 0.23 | 0.10 | 0.02 | | -0.01 | | -0.01 | 0.00 |
| 1.9 | 0.11 | 0.10 | 0.01 | | 0.00 | | 0.00 | 0.00 |
| 2 | 0.12 | 0.10 | 0.01 | | -0.01 | | -0.01 | 0.00 |
| 2.1 | 0.06 | 0.10 | 0.01 | | -0.02 | | -0.02 | 0.00 |

Total Flow = 0.00

B5- Manual Flow Measurements at Hydrometric Station SPR-HS5, Continued.

Date: 10-Aug-12 Staff Gauge (m): 0.099
 Time (CST): 14:07 Left Bank (m): 1
 Channel Width (m): 1.55 Right Bank (m): 2.55

| Station (m) | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|-------------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1.05 | 0.11 | 0.05 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 1.15 | 0.17 | 0.10 | 0.02 | | -0.03 | | -0.03 | 0.00 |
| 1.25 | 0.18 | 0.10 | 0.02 | | 0.00 | | 0.00 | 0.00 |
| 1.35 | 0.22 | 0.10 | 0.02 | | 0.04 | | 0.04 | 0.00 |
| 1.45 | 0.27 | 0.10 | 0.03 | | 0.05 | | 0.05 | 0.00 |
| 1.55 | 0.28 | 0.10 | 0.03 | | 0.02 | | 0.02 | 0.00 |
| 1.65 | 0.25 | 0.10 | 0.03 | | 0.06 | | 0.06 | 0.00 |
| 1.75 | 0.22 | 0.10 | 0.02 | | 0.14 | | 0.14 | 0.00 |
| 1.85 | 0.18 | 0.10 | 0.02 | | 0.18 | | 0.18 | 0.00 |
| 1.95 | 0.15 | 0.10 | 0.02 | | 0.23 | | 0.23 | 0.00 |
| 2.05 | 0.12 | 0.10 | 0.01 | | 0.35 | | 0.35 | 0.00 |
| 2.15 | 0.14 | 0.10 | 0.01 | | 0.23 | | 0.23 | 0.00 |
| 2.25 | 0.13 | 0.10 | 0.01 | | 0.02 | | 0.02 | 0.00 |
| 2.35 | 0.08 | 0.10 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 2.45 | 0.06 | 0.10 | 0.01 | | -0.03 | | -0.03 | 0.00 |

Total Flow = 0.02

Date: 18-Sep-12 Staff Gauge (m): n/a
 Time (CST): 8:47 Left Bank (m): 0.83
 Channel Width (m): 0.85 Right Bank (m): 1.68

| Station (m) | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|-------------|-----------|-----------|------------------------|----------------|-------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 0.92 | 0.20 | 0.09 | 0.018 | | -0.05 | | -0.05 | 0.00 |
| 1.00 | 0.20 | 0.08 | 0.016 | | -0.04 | | -0.04 | 0.00 |
| 1.09 | 0.30 | 0.09 | 0.027 | | 0.02 | | 0.02 | 0.00 |
| 1.17 | 0.40 | 0.08 | 0.032 | | 0.01 | | 0.01 | 0.00 |
| 1.25 | 0.45 | 0.08 | 0.036 | | 0.00 | | 0.00 | 0.00 |
| 1.34 | 0.50 | 0.09 | 0.045 | | 0.01 | | 0.01 | 0.00 |
| 1.42 | 0.45 | 0.08 | 0.036 | | 0.01 | | 0.01 | 0.00 |
| 1.51 | 0.40 | 0.09 | 0.036 | | 0.11 | | 0.11 | 0.00 |
| 1.59 | 0.20 | 0.08 | 0.016 | | 0.02 | | 0.02 | 0.00 |

Total Flow = 0.00

Date: 15-Oct-12 Staff Gauge (m): 0.052
 Time (CST): 12:44 Left Bank (m): 0.39
 Channel Width (m): 0.91 Right Bank (m): 1.3

| Station (m) | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | Velocity/ \bar{U} (m/s) (average) | Q (m ³ /s) |
|-------------|-----------|-----------|------------------------|----------------|------|-----|--|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 1.25 | 0.00 | 0.05 | 0.000 | | 0.00 | | 0.00 | 0.00 |
| 1.20 | 0.02 | 0.05 | 0.001 | | 0.28 | | 0.28 | 0.00 |
| 1.15 | 0.03 | 0.05 | 0.002 | | 0.13 | | 0.13 | 0.00 |
| 1.10 | 0.03 | 0.05 | 0.002 | | 0.06 | | 0.06 | 0.00 |
| 1.05 | 0.11 | 0.05 | 0.006 | | 0.10 | | 0.10 | 0.00 |
| 1.00 | 0.12 | 0.05 | 0.006 | | 0.08 | | 0.08 | 0.00 |
| 0.95 | 0.12 | 0.05 | 0.006 | | 0.09 | | 0.09 | 0.00 |
| 0.90 | 0.12 | 0.05 | 0.006 | | 0.11 | | 0.11 | 0.00 |
| 0.85 | 0.13 | 0.05 | 0.007 | | 0.12 | | 0.12 | 0.00 |
| 0.80 | 0.13 | 0.05 | 0.007 | | 0.12 | | 0.12 | 0.00 |
| 0.75 | 0.14 | 0.05 | 0.007 | | 0.09 | | 0.09 | 0.00 |
| 0.70 | 0.14 | 0.05 | 0.007 | | 0.08 | | 0.08 | 0.00 |
| 0.65 | 0.13 | 0.05 | 0.007 | | 0.06 | | 0.06 | 0.00 |
| 0.60 | 0.12 | 0.05 | 0.006 | | 0.06 | | 0.06 | 0.00 |
| 0.55 | 0.12 | 0.05 | 0.006 | | 0.05 | | 0.05 | 0.00 |
| 0.50 | 0.10 | 0.05 | 0.005 | | 0.05 | | 0.05 | 0.00 |
| 0.45 | 0.08 | 0.05 | 0.004 | | 0.03 | | 0.03 | 0.00 |

Total Flow = 0.01

B6- Manual Flow Measurements at Hydrometric Station SPR-HS6

Date: 7-Jul-12 Staff Gauge (m): 0.831
 Time (CST): n/a Left Bank (m): 6
 Channel Width (m): 5.1 Right Bank (m): 0.9

| Station | Depth (m) | Width (m) | Area (m ²) | Velocity (m/s) | | | \bar{U} (m/s) (average) | Q (m ³ /s) |
|---------|-----------|-----------|------------------------|----------------|------|------|------------------------------|-----------------------|
| | | | | 20% | 60% | 80% | | |
| 5.75 | 0.10 | 0.25 | 0.03 | | 0.00 | | 0.00 | 0.00 |
| 5.25 | 0.14 | 0.50 | 0.07 | | 0.00 | | 0.00 | 0.00 |
| 4.75 | 0.18 | 0.50 | 0.09 | | 0.02 | | 0.02 | 0.00 |
| 4.25 | 0.16 | 0.50 | 0.08 | | 0.00 | | 0.00 | 0.00 |
| 3.75 | 0.14 | 0.50 | 0.07 | | 0.00 | | 0.00 | 0.00 |
| 3.25 | 0.16 | 0.50 | 0.08 | | 0.00 | | 0.00 | 0.00 |
| 2.75 | 0.20 | 0.50 | 0.10 | | 0.00 | | 0.00 | 0.00 |
| 2.25 | 0.22 | 0.50 | 0.11 | | 0.00 | | 0.00 | 0.00 |
| 1.75 | 0.80 | 0.50 | 0.40 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 |
| 1.25 | 0.47 | 0.50 | 0.24 | | 0.04 | | 0.04 | 0.01 |

Total Flow : 0.01

Date: 8-Aug-12 Staff Gauge (m): 0.495
 Time (CST): 15:15 Left Bank (m): 0.7
 Channel Width (m): 2 Right Bank (m): 2.7

| SPHS6 | | | | Velocity (m/s) | | | \bar{U} (m/s) (average) | Q (m ³ /s) |
|-------------|-----------|-----------|------------------------|----------------|-------|-----|------------------------------|-----------------------|
| Station (m) | Depth (m) | Width (m) | Area (m ²) | 20% | 60% | 80% | | |
| 2.65 | 0.06 | 0.15 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 2.55 | 0.14 | 0.20 | 0.03 | | -0.02 | | -0.02 | 0.00 |
| 2.45 | 0.14 | 0.20 | 0.03 | | -0.02 | | -0.02 | 0.00 |
| 2.35 | 0.16 | 0.20 | 0.03 | | -0.01 | | -0.01 | 0.00 |
| 2.25 | 0.18 | 0.20 | 0.04 | | -0.03 | | -0.03 | 0.00 |
| 2.15 | 0.22 | 0.20 | 0.04 | | -0.02 | | -0.02 | 0.00 |
| 2.05 | 0.28 | 0.20 | 0.06 | | -0.05 | | -0.05 | 0.00 |
| 1.95 | 0.36 | 0.20 | 0.07 | | -0.07 | | -0.07 | -0.01 |
| 1.85 | 0.40 | 0.20 | 0.08 | | -0.04 | | -0.04 | 0.00 |
| 1.75 | 0.40 | 0.20 | 0.08 | | 0.00 | | 0 | 0.00 |
| 1.65 | 0.40 | 0.20 | 0.08 | | 0.02 | | 0.02 | 0.00 |
| 1.55 | 0.40 | 0.20 | 0.08 | | 0.06 | | 0.06 | 0.00 |
| 1.45 | 0.44 | 0.20 | 0.09 | | 0.17 | | 0.17 | 0.01 |
| 1.35 | 0.40 | 0.20 | 0.08 | | 0.33 | | 0.33 | 0.03 |
| 1.25 | 0.38 | 0.20 | 0.08 | | 0.34 | | 0.34 | 0.03 |
| 1.15 | 0.48 | 0.20 | 0.10 | | 0.33 | | 0.33 | 0.03 |
| 1.05 | 0.53 | 0.20 | 0.11 | | 0.30 | | 0.3 | 0.03 |
| 0.95 | 0.08 | 0.20 | 0.02 | | 0.14 | | 0.14 | 0.00 |
| 0.85 | 0.05 | 0.20 | 0.01 | | 0.00 | | 0 | 0.00 |
| 0.75 | 0.04 | 0.10 | 0.00 | | 0.01 | | 0.01 | 0.00 |

Total Flow : 0.12

B6- Manual Flow Measurements at Hydrometric Station SPR-HS6, Continued.

Date: 18-Sep-12 Staff Gauge (m): 0.150
 Time (CST): 12:54 Left Bank (m): 0.13
 Channel Width (m): 0.9 Right Bank (m): 1.03

| SPHS6 | | | | Velocity (m/s) | | | \bar{U} (m/s) | Q (m ³ /s) |
|-------------|-----------|-----------|------------------------|----------------|-------|-----|-----------------|-----------------------|
| Station (m) | Depth (m) | Width (m) | Area (m ²) | 20% | 60% | 80% | (average) | |
| 0.22 | 0.20 | 0.09 | 0.02 | | 0.07 | | 0.07 | 0.00 |
| 0.31 | 0.20 | 0.09 | 0.02 | | -0.05 | | -0.05 | 0.00 |
| 0.40 | 0.40 | 0.09 | 0.04 | | 0.09 | | 0.09 | 0.00 |
| 0.49 | 0.40 | 0.09 | 0.04 | | 0.05 | | 0.05 | 0.00 |
| 0.58 | 0.40 | 0.09 | 0.04 | | 0.03 | | 0.03 | 0.00 |
| 0.67 | 0.50 | 0.09 | 0.05 | | 0.02 | | 0.02 | 0.00 |
| 0.76 | 0.60 | 0.09 | 0.05 | | 0.01 | | 0.01 | 0.00 |
| 0.85 | 0.60 | 0.09 | 0.05 | | 0.01 | | 0.01 | 0.00 |
| 0.94 | 0.60 | 0.09 | 0.05 | | 0.02 | | 0.02 | 0.00 |

Total Flow : 0.01

Date: 15-Oct-12 Staff Gauge (m): 0.224
 Time (CST): 13:49 Left Bank (m): 0.5
 Channel Width (m): 0.72 Right Bank (m): 1.22

| SPHS1 | | | | Velocity (m/s) | | | \bar{U} (m/s) | Q (m ³ /s) |
|-------------|-----------|-----------|------------------------|----------------|-------|-----|-----------------|-----------------------|
| Station (m) | Depth (m) | Width (m) | Area (m ²) | 20% | 60% | 80% | (average) | |
| 0.525 | 0.160 | 0.03 | 0.00 | | 0.07 | | 0.07 | 0.00 |
| 0.575 | 0.160 | 0.05 | 0.01 | | 0.31 | | 0.31 | 0.00 |
| 0.625 | 0.140 | 0.05 | 0.01 | | 0.16 | | 0.16 | 0.00 |
| 0.628 | 0.140 | 0.05 | 0.01 | | 0.16 | | 0.16 | 0.00 |
| 0.725 | 0.120 | 0.05 | 0.01 | | 0.13 | | 0.13 | 0.00 |
| 0.775 | 0.120 | 0.05 | 0.01 | | -0.01 | | -0.01 | 0.00 |
| 0.825 | 0.120 | 0.05 | 0.01 | | -0.03 | | -0.03 | 0.00 |
| 0.875 | 0.120 | 0.05 | 0.01 | | -0.03 | | -0.03 | 0.00 |
| 0.925 | 0.110 | 0.05 | 0.01 | | -0.04 | | -0.04 | 0.00 |
| 0.975 | 0.120 | 0.05 | 0.01 | | -0.04 | | -0.04 | 0.00 |
| 1.025 | 0.120 | 0.05 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 1.075 | 0.120 | 0.05 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 1.125 | 0.120 | 0.05 | 0.01 | | -0.01 | | -0.01 | 0.00 |
| 1.175 | 0.120 | 0.05 | 0.01 | | -0.02 | | -0.02 | 0.00 |
| 1.225 | 0.120 | 0.05 | 0.01 | | -0.02 | | -0.02 | 0.00 |

Total Flow : 0.00

| HS1 | | | | | | HS2 | | | | | | HS3 | | | | | | HS4 | | | | | | HS5 | | | | | | HS6 | | | | | |
|-----------|------|-------|-------|---------|-----------|-----------|------|-------|-------|---------|-----------|-----------|------|-------|-------|---------|-----------|----------|------|-------|-------|---------|-----------|-----------|------|-------|-------|---------|-----------|-----------|------|-------|-------|---------|-----------|
| Date | Sta | FS+ | BS- | H.I. | Elevation | Date | Sta | FS+ | BS- | H.I. | Elevation | Date | Sta | FS+ | BS- | H.I. | Elevation | Date | Sta | FS+ | BS- | H.I. | Elevation | Date | Sta | FS+ | BS- | H.I. | Elevation | Date | Sta | FS+ | BS- | H.I. | Elevation |
| 30-Apr-12 | BM | 0.85 | | 100.85 | 100 | 30-Apr-12 | BM | 0.438 | | 100.438 | 100 | 2-May-12 | BM | 1.909 | | 101.909 | 100 | 3-May-12 | BM | 2.24 | | 102.24 | 100 | 1-May-12 | BM | 0.764 | | 100.764 | 100 | 7-Jul-12 | BM | 0.179 | | 100.179 | 100 |
| | W.L. | | 1.173 | | 99.677 | | W.L. | | 2.04 | | 98.398 | | W.L. | | 2.155 | | 100.105 | | W.L. | | 2.295 | | 99.945 | | W.L. | | 1.877 | | 98.887 | | W.L. | | 1.825 | | 98.354 |
| | 1mSG | | 0.611 | | 100.239 | | 1mSG | | 1.322 | | 99.116 | | 1mSG | | 1.31 | | 100.95 | | 1mSG | | 1.397 | | 100.843 | | 1mSG | | 0.993 | | 99.771 | | 1mSG | | 1.640 | | 98.539 |
| | Bolt | | 1.595 | | 99.255 | | Bolt | | 2.28 | | 98.158 | | Bolt | | 2.274 | | 99.986 | | Bolt | | 2.373 | | 99.867 | | Bolt | | 1.968 | | 98.796 | | Bolt | | 2.625 | | 97.554 |
| 6-Jun-12 | BM | 0.845 | | 100.845 | 100 | 6-Jun-12 | BM | 0.58 | | 100.58 | 100 | 7-Jun-12 | BM | 2.26 | | 102.26 | 100 | 8-Jun-12 | BM | 1.872 | | 101.872 | 100 | 7-Jun-12 | BM | 0.55 | | 100.55 | 100 | 8-Aug-12 | BM | 0.138 | | 100.138 | 100 |
| | W.L. | | 1.86 | | 98.985 | | W.L. | | 2.085 | | 98.495 | | W.L. | | 2.52 | | 99.74 | | W.L. | | 1.932 | | 99.94 | | W.L. | | 1.700 | | 98.850 | | W.L. | | 2.150 | | 98.029 |
| | 1MSG | | 0.6 | | 100.245 | | 1mSG | | 1.45 | | 99.13 | | 1mSG | | 1.665 | | 100.595 | | 1mSG | | 1.024 | | 100.848 | | 1mSG | | 0.077 | | 100.473 | | 1mSG | | 1.625 | | 98.554 |
| | BOLT | | 1.6 | | 99.245 | | Bolt | | 2.425 | | 98.155 | | Bolt | | 2.63 | | 99.63 | | Bolt | | 1.955 | | 99.917 | | Bolt | | 1.755 | | 98.795 | | Bolt | | 2.570 | | 97.609 |
| 7-Jul-12 | BM | 0.845 | | 100.845 | 100 | 7-Jul-12 | BM | 0.926 | | 100.926 | 100 | 7-Jul-12 | BM | 1.928 | | 101.928 | 100 | 6-Jul-12 | BM | | | | | 7-Jul-12 | BM | 0.836 | | 100.836 | 100 | 18-Sep-12 | BM | 0.051 | | 100.051 | 100 |
| | 1mSG | | 0.6 | | 100.245 | | 1mSG | | 1.822 | | 99.104 | | 1mSG | | 1.327 | | 100.601 | | 1mSG | | | | | | 1mSG | | 1.074 | | 99.762 | | 1mSG | | 1.529 | | 98.650 |
| | W.L. | | 1.86 | | 98.985 | | W.L. | | 2.411 | | 98.515 | | W.L. | | 2.151 | | 99.777 | | W.L. | | | | | | W.L. | | 1.851 | | 98.985 | | W.L. | | 2.458 | | 97.721 |
| | Bolt | | 1.6 | | 99.245 | | Bolt | | 2.771 | | 98.155 | | Bolt | | 2.296 | | 99.632 | | Bolt | | | | | | Bolt | | 2.044 | | 98.792 | | Bolt | | 2.689 | | 97.490 |
| 8-Aug-12 | BM | 0.931 | | 100.931 | 100 | 8-Aug-12 | BM | 0.015 | | 100.015 | 100 | 7-Aug-12 | BM | 1.817 | | 101.817 | 100 | | | | | | | 10-Aug-12 | BM | 0.828 | | 100.828 | 100 | 14-Oct-12 | BM | 0.169 | | 100.169 | 100 |
| | W.L. | | 0.943 | | 99.902 | | W.L. | | 1.52 | | 99.406 | | W.L. | | 2.022 | | 99.906 | | | | | | | | W.L. | | 1.959 | | 98.877 | | W.L. | | 2.435 | | 97.744 |
| | 1MSG | | 0.812 | | 100.033 | | 1mSG | | 0.919 | | 100.007 | | 1mSG | | 1.227 | | 100.701 | | | | | | | | 1mSG | | 1.037 | | 99.799 | | 1mSG | | 1.654 | | 98.525 |
| | BOLT | | 1.72 | | 99.125 | | Bolt | | 1.858 | | 99.068 | | Bolt | | 2.183 | | 99.745 | | | | | | | | Bolt | | 2.039 | | 98.797 | | Bolt | | 2.618 | | 97.561 |
| 17-Sep-12 | BM | 0.883 | | 100.883 | 100 | 17-Sep-12 | BM | 0.893 | | 100.893 | 100 | 18-Sep-12 | BM | 1.713 | | 101.713 | 100 | | | | | | | 18-Sep-12 | BM | 0.629 | | 100.629 | 100 | | | | | | |
| | W.L. | | 0.549 | | 100.296 | | W.L. | | 2.497 | | 98.429 | | W.L. | | 2 | | 99.928 | | | | | | | | W.L. | | 1.878 | | 98.958 | | | | | | |
| | 1MSG | | 1.142 | | 99.703 | | 1mSG | | 1.785 | | 99.141 | | 1mSG | | 1.11 | | 100.818 | | | | | | | | 1mSG | | 0.852 | | 99.984 | | | | | | |
| | BOLT | | 1.599 | | 99.246 | | Bolt | | 2.815 | | 98.111 | | Bolt | | 2.115 | | 99.813 | | | | | | | | Bolt | | 2.038 | | 98.798 | | | | | | |
| 14-Oct-12 | BM | 0.982 | | 100.982 | 100 | 14-Oct-12 | BM | 0.898 | | 100.898 | 100 | 15-Oct-12 | BM | 1.367 | | 101.367 | 100 | | | | | | | 15-Oct-12 | BM | 0.681 | | 100.681 | 100 | | | | | | |
| | W.L. | | 1.338 | | 99.507 | | W.L. | | 2.423 | | 98.503 | | W.L. | | 1.592 | | 100.336 | | | | | | | | W.L. | | 1.869 | | 98.967 | | | | | | |
| | 1MSG | | 0.645 | | 100.2 | | 1mSG | | 1.79 | | 99.136 | | 1mSG | | 0.771 | | 101.157 | | | | | | | | 1mSG | | 0.909 | | 99.927 | | | | | | |
| | BOLT | | 1.643 | | 99.202 | | Bolt | | 2.743 | | 98.183 | | Bolt | | 1.74 | | 100.188 | | | | | | | | Bolt | | 1.892 | | 98.944 | | | | | | |

APPENDIX C
Summary of TMA Average Daily Flows

Average Daily Discharge (L/s) at SPR-HS1

| Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) |
|--------|----------------------------|--------|----------------------------|--------|----------------------------|--------|----------------------------|-----------|----------------------------|-----------|----------------------------|
| 1-Mar | 3,128.07 | 13-Apr | 10,441.65 | 26-May | 8,856.19 | 8-Jul | 60,386.58 | 20-Aug-12 | 15,188.57 | 2-Oct-12 | 2,713.31 |
| 2-Mar | 3,143.24 | 14-Apr | 10,625.34 | 27-May | 8,846.56 | 9-Jul | 59,066.95 | 21-Aug-12 | 14,827.06 | 3-Oct-12 | 2,514.55 |
| 3-Mar | 3,196.37 | 15-Apr | 10,650.66 | 28-May | 9,269.78 | 10-Jul | 57,599.98 | 22-Aug-12 | 14,589.10 | 4-Oct-12 | 2,712.17 |
| 4-Mar | 3,181.81 | 16-Apr | 10,599.13 | 29-May | 10,305.76 | 11-Jul | 55,907.22 | 23-Aug-12 | 14,220.10 | 5-Oct-12 | 3,364.28 |
| 5-Mar | 3,137.85 | 17-Apr | 10,769.41 | 30-May | 10,649.74 | 12-Jul | 54,377.67 | 24-Aug-12 | 14,139.95 | 6-Oct-12 | 3,369.36 |
| 6-Mar | 3,168.76 | 18-Apr | 10,793.52 | 31-May | 10,685.25 | 13-Jul | 53,042.39 | 25-Aug-12 | 13,860.22 | 7-Oct-12 | 3,173.36 |
| 7-Mar | 3,311.06 | 19-Apr | 10,781.93 | 1-Jun | 10,664.49 | 14-Jul | 51,560.47 | 26-Aug-12 | 13,342.56 | 8-Oct-12 | 3,061.67 |
| 8-Mar | 3,327.18 | 20-Apr | 10,879.99 | 2-Jun | 10,670.48 | 15-Jul | 49,873.55 | 27-Aug-12 | 13,059.37 | 9-Oct-12 | 3,149.53 |
| 9-Mar | 3,304.77 | 21-Apr | 11,249.80 | 3-Jun | 10,711.57 | 16-Jul | 49,002.38 | 28-Aug-12 | 12,705.01 | 10-Oct-12 | 3,200.74 |
| 10-Mar | 3,234.28 | 22-Apr | 11,169.37 | 4-Jun | 10,711.57 | 17-Jul | 47,424.55 | 29-Aug-12 | 12,306.99 | 11-Oct-12 | 3,215.34 |
| 11-Mar | 3,187.48 | 23-Apr | 10,986.93 | 5-Jun | 10,694.48 | 18-Jul | 45,452.47 | 30-Aug-12 | 11,786.01 | 12-Oct-12 | 3,154.19 |
| 12-Mar | 3,216.91 | 24-Apr | 10,772.19 | 6-Jun | 10,639.15 | 19-Jul | 43,477.90 | 31-Aug-12 | 11,402.32 | 13-Oct-12 | 3,029.86 |
| 13-Mar | 3,402.53 | 25-Apr | 10,757.37 | 7-Jun | 10,508.33 | 20-Jul | 41,330.84 | 1-Sep-12 | 11,052.43 | 14-Oct-12 | 3,029.31 |
| 14-Mar | 3,386.47 | 26-Apr | 10,751.81 | 8-Jun | 10,397.91 | 21-Jul | 39,352.34 | 2-Sep-12 | 10,822.62 | | |
| 15-Mar | 3,363.60 | 27-Apr | 10,811.62 | 9-Jun | 10,228.00 | 22-Jul | 37,773.74 | 3-Sep-12 | 10,716.97 | | |
| 16-Mar | 3,331.47 | 28-Apr | 10,679.71 | 10-Jun | 12,324.54 | 23-Jul | 36,242.48 | 4-Sep-12 | 10,303.80 | | |
| 17-Mar | 3,380.62 | 29-Apr | 10,585.80 | 11-Jun | 16,727.05 | 24-Jul | 34,547.13 | 5-Sep-12 | 9,914.57 | | |
| 18-Mar | 3,459.68 | 30-Apr | 8,610.08 | 12-Jun | 18,466.47 | 25-Jul | 33,230.91 | 6-Sep-12 | 9,607.19 | | |
| 19-Mar | 3,619.06 | 1-May | 7,230.95 | 13-Jun | 19,401.66 | 26-Jul | 31,730.77 | 7-Sep-12 | 9,327.18 | | |
| 20-Mar | 3,931.36 | 2-May | 7,518.88 | 14-Jun | 21,411.98 | 27-Jul | 29,689.39 | 8-Sep-12 | 8,929.08 | | |
| 21-Mar | 4,258.20 | 3-May | 7,677.47 | 15-Jun | 23,298.56 | 28-Jul | 27,902.99 | 9-Sep-12 | 8,503.42 | | |
| 22-Mar | 4,440.75 | 4-May | 7,742.56 | 16-Jun | 24,721.72 | 29-Jul | 27,021.22 | 10-Sep-12 | 8,027.90 | | |
| 23-Mar | 4,637.44 | 5-May | 7,665.81 | 17-Jun | 26,703.61 | 30-Jul | 29,144.42 | 11-Sep-12 | 7,567.31 | | |
| 24-Mar | 4,843.45 | 6-May | 7,593.71 | 18-Jun | 29,395.59 | 31-Jul | 28,406.00 | 12-Sep-12 | 6,952.78 | | |
| 25-Mar | 5,009.42 | 7-May | 7,667.75 | 19-Jun | 32,206.95 | 1-Aug | 29,597.81 | 13-Sep-12 | 6,576.93 | | |
| 26-Mar | 5,050.03 | 8-May | 7,674.75 | 20-Jun | 36,225.11 | 2-Aug | 29,348.07 | 14-Sep-12 | 6,301.78 | | |
| 27-Mar | 5,626.87 | 9-May | 7,640.57 | 21-Jun | 39,588.38 | 3-Aug | 28,703.89 | 15-Sep-12 | 5,951.31 | | |
| 28-Mar | 6,266.14 | 10-May | 7,536.59 | 22-Jun | 43,418.74 | 4-Aug | 29,418.98 | 16-Sep-12 | 5,583.48 | | |
| 29-Mar | 6,402.37 | 11-May | 7,341.47 | 23-Jun | 46,283.60 | 5-Aug | 29,472.80 | 17-Sep-12 | 5,336.73 | | |
| 30-Mar | 6,536.90 | 12-May | 7,247.17 | 24-Jun | 48,546.53 | 6-Aug | 28,927.58 | 18-Sep-12 | 5,058.39 | | |
| 31-Mar | 6,832.27 | 13-May | 7,091.78 | 25-Jun | 50,345.06 | 7-Aug | 28,716.97 | 19-Sep-12 | 4,822.85 | | |
| 1-Apr | 7,135.52 | 14-May | 6,999.53 | 26-Jun | 52,170.14 | 8-Aug | 23,382.93 | 20-Sep-12 | 4,641.84 | | |
| 2-Apr | 7,405.84 | 15-May | 6,930.38 | 27-Jun | 53,793.10 | 9-Aug | 18,606.22 | 21-Sep-12 | 4,506.81 | | |
| 3-Apr | 7,849.18 | 16-May | 6,891.34 | 28-Jun | 54,719.02 | 10-Aug | 18,026.09 | 22-Sep-12 | 4,336.15 | | |
| 4-Apr | 8,191.66 | 17-May | 6,745.78 | 29-Jun | 57,053.70 | 11-Aug | 17,507.27 | 23-Sep-12 | 4,122.54 | | |
| 5-Apr | 8,343.60 | 18-May | 6,575.97 | 30-Jun | 58,383.32 | 12-Aug | 17,016.85 | 24-Sep-12 | 3,825.32 | | |
| 6-Apr | 8,403.40 | 19-May | 6,790.23 | 1-Jul | 59,459.12 | 13-Aug | 16,702.43 | 25-Sep-12 | 3,658.34 | | |
| 7-Apr | 7,632.43 | 20-May | 7,027.73 | 2-Jul | 59,946.15 | 14-Aug | 16,269.75 | 26-Sep-12 | 3,473.25 | | |
| 8-Apr | 5,115.05 | 21-May | 7,040.37 | 3-Jul | 61,380.80 | 15-Aug | 15,816.37 | 27-Sep-12 | 3,271.10 | | |
| 9-Apr | 10,020.22 | 22-May | 7,062.32 | 4-Jul | 65,290.91 | 16-Aug | 16,173.51 | 28-Sep-12 | 3,124.33 | | |
| 10-Apr | 10,107.01 | 23-May | 7,213.24 | 5-Jul | 63,782.61 | 17-Aug | 16,181.52 | 29-Sep-12 | 3,009.23 | | |
| 11-Apr | 10,197.35 | 24-May | 8,047.15 | 6-Jul | 63,157.99 | 18-Aug | 16,021.74 | 30-Sep-12 | 2,885.12 | | |
| 12-Apr | 10,255.09 | 25-May | 8,552.41 | 7-Jul | 61,975.63 | 19-Aug | 15,514.26 | 1-Oct-12 | 2,763.24 | | |

Average Daily Discharge (L/s) at SPR-HS2

| Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) |
|--------|----------------------------|--------|----------------------------|--------|----------------------------|--------|----------------------------|-----------|----------------------------|-----------|----------------------------|
| 1-Mar | 4.42 | 13-Apr | 31.57 | 26-May | 43.13 | 8-Jul | 36.82 | 20-Aug-12 | 40.22 | 2-Oct-12 | 10.18 |
| 2-Mar | 4.42 | 14-Apr | 27.55 | 27-May | 39.81 | 9-Jul | 32.60 | 21-Aug-12 | 37.35 | 3-Oct-12 | 10.26 |
| 3-Mar | 4.49 | 15-Apr | 31.99 | 28-May | 46.65 | 10-Jul | 28.03 | 22-Aug-12 | 35.01 | 4-Oct-12 | 13.07 |
| 4-Mar | 4.46 | 16-Apr | 34.92 | 29-May | 60.47 | 11-Jul | 24.88 | 23-Aug-12 | 32.77 | 5-Oct-12 | 23.90 |
| 5-Mar | 4.28 | 17-Apr | 33.05 | 30-May | 62.28 | 12-Jul | 22.34 | 24-Aug-12 | 32.32 | 6-Oct-12 | 26.89 |
| 6-Mar | 4.37 | 18-Apr | 31.91 | 31-May | 60.27 | 13-Jul | 20.06 | 25-Aug-12 | 31.11 | 7-Oct-12 | 27.40 |
| 7-Mar | 4.63 | 19-Apr | 29.27 | 1-Jun | 56.07 | 14-Jul | 17.74 | 26-Aug-12 | 29.11 | 8-Oct-12 | 27.06 |
| 8-Mar | 4.63 | 20-Apr | 28.51 | 2-Jun | 56.03 | 15-Jul | 15.37 | 27-Aug-12 | 27.81 | 9-Oct-12 | 28.29 |
| 9-Mar | 4.54 | 21-Apr | 27.57 | 3-Jun | 47.43 | 16-Jul | 16.52 | 28-Aug-12 | 26.10 | 10-Oct-12 | 27.91 |
| 10-Mar | 4.47 | 22-Apr | 17.03 | 4-Jun | 42.12 | 17-Jul | 16.27 | 29-Aug-12 | 24.71 | 11-Oct-12 | 28.84 |
| 11-Mar | 4.55 | 23-Apr | 15.20 | 5-Jun | 38.80 | 18-Jul | 15.28 | 30-Aug-12 | 23.37 | 12-Oct-12 | 28.43 |
| 12-Mar | 4.91 | 24-Apr | 14.71 | 6-Jun | 36.06 | 19-Jul | 14.20 | 31-Aug-12 | 21.50 | 13-Oct-12 | 28.10 |
| 13-Mar | 5.56 | 25-Apr | 11.72 | 7-Jun | 38.91 | 20-Jul | 13.19 | 1-Sep-12 | 20.10 | 14-Oct-12 | 27.62 |
| 14-Mar | 5.79 | 26-Apr | 15.88 | 8-Jun | 32.60 | 21-Jul | 11.70 | 2-Sep-12 | 20.07 | | |
| 15-Mar | 6.20 | 27-Apr | 13.12 | 9-Jun | 27.83 | 22-Jul | 11.42 | 3-Sep-12 | 21.64 | | |
| 16-Mar | 7.08 | 28-Apr | 10.60 | 10-Jun | 65.51 | 23-Jul | 11.03 | 4-Sep-12 | 20.18 | | |
| 17-Mar | 9.62 | 29-Apr | 10.67 | 11-Jun | 156.41 | 24-Jul | 10.65 | 5-Sep-12 | 18.78 | | |
| 18-Mar | 13.53 | 30-Apr | 12.84 | 12-Jun | 179.61 | 25-Jul | 10.34 | 6-Sep-12 | 18.42 | | |
| 19-Mar | 16.71 | 1-May | 14.79 | 13-Jun | 173.97 | 26-Jul | 9.91 | 7-Sep-12 | 17.49 | | |
| 20-Mar | 21.15 | 2-May | 20.02 | 14-Jun | 175.13 | 27-Jul | 9.67 | 8-Sep-12 | 16.80 | | |
| 21-Mar | 25.29 | 3-May | 21.40 | 15-Jun | 169.07 | 28-Jul | 9.33 | 9-Sep-12 | 15.99 | | |
| 22-Mar | 28.57 | 4-May | 21.93 | 16-Jun | 162.51 | 29-Jul | 9.70 | 10-Sep-12 | 15.46 | | |
| 23-Mar | 30.66 | 5-May | 21.20 | 17-Jun | 166.66 | 30-Jul | 15.94 | 11-Sep-12 | 14.73 | | |
| 24-Mar | 33.94 | 6-May | 19.21 | 18-Jun | 170.29 | 31-Jul | 17.10 | 12-Sep-12 | 13.55 | | |
| 25-Mar | 35.13 | 7-May | 18.90 | 19-Jun | 178.12 | 1-Aug | 25.99 | 13-Sep-12 | 13.38 | | |
| 26-Mar | 35.15 | 8-May | 20.16 | 20-Jun | 171.58 | 2-Aug | 29.84 | 14-Sep-12 | 12.56 | | |
| 27-Mar | 39.45 | 9-May | 16.91 | 21-Jun | 164.70 | 3-Aug | 30.35 | 15-Sep-12 | 12.03 | | |
| 28-Mar | 42.71 | 10-May | 15.86 | 22-Jun | 154.52 | 4-Aug | 40.19 | 16-Sep-12 | 11.57 | | |
| 29-Mar | 43.48 | 11-May | 15.91 | 23-Jun | 146.74 | 5-Aug | 45.21 | 17-Sep-12 | 11.36 | | |
| 30-Mar | 43.34 | 12-May | 14.37 | 24-Jun | 133.79 | 6-Aug | 44.69 | 18-Sep-12 | 10.90 | | |
| 31-Mar | 45.33 | 13-May | 14.53 | 25-Jun | 119.08 | 7-Aug | 41.50 | 19-Sep-12 | 11.22 | | |
| 1-Apr | 53.75 | 14-May | 12.59 | 26-Jun | 108.42 | 8-Aug | 40.22 | 20-Sep-12 | 11.16 | | |
| 2-Apr | 56.12 | 15-May | 12.29 | 27-Jun | 97.35 | 9-Aug | 46.76 | 21-Sep-12 | 11.43 | | |
| 3-Apr | 59.91 | 16-May | 11.39 | 28-Jun | 87.10 | 10-Aug | 45.37 | 22-Sep-12 | 10.79 | | |
| 4-Apr | 66.44 | 17-May | 8.86 | 29-Jun | 79.84 | 11-Aug | 44.16 | 23-Sep-12 | 9.96 | | |
| 5-Apr | 71.21 | 18-May | 11.13 | 30-Jun | 73.90 | 12-Aug | 42.29 | 24-Sep-12 | 10.32 | | |
| 6-Apr | 66.49 | 19-May | 16.28 | 1-Jul | 65.95 | 13-Aug | 41.12 | 25-Sep-12 | 10.44 | | |
| 7-Apr | 66.37 | 20-May | 16.68 | 2-Jul | 61.01 | 14-Aug | 38.06 | 26-Sep-12 | 10.30 | | |
| 8-Apr | 60.22 | 21-May | 16.96 | 3-Jul | 63.68 | 15-Aug | 35.97 | 27-Sep-12 | 10.13 | | |
| 9-Apr | 58.33 | 22-May | 20.08 | 4-Jul | 56.48 | 16-Aug | 43.43 | 28-Sep-12 | 9.89 | | |
| 10-Apr | 55.43 | 23-May | 26.33 | 5-Jul | 52.47 | 17-Aug | 46.35 | 29-Sep-12 | 9.84 | | |
| 11-Apr | 51.54 | 24-May | 41.12 | 6-Jul | 45.10 | 18-Aug | 45.63 | 30-Sep-12 | 9.90 | | |
| 12-Apr | 45.08 | 25-May | 38.36 | 7-Jul | 42.21 | 19-Aug | 42.31 | 1-Oct-12 | 9.98 | | |

Average Daily Discharge (L/s) at SPR-HS3

| Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) |
|--------|----------------------------|--------|----------------------------|--------|----------------------------|--------|----------------------------|
| 2-May | 9.28 | 14-Jun | 545.27 | 27-Jul | 0.01 | 8-Sep | 1.61 |
| 3-May | 9.00 | 15-Jun | 529.84 | 28-Jul | - | 9-Sep | 1.29 |
| 4-May | 9.25 | 16-Jun | 463.96 | 29-Jul | - | 10-Sep | 0.98 |
| 5-May | 7.80 | 17-Jun | 442.84 | 30-Jul | 0.17 | 11-Sep | 0.65 |
| 6-May | 8.07 | 18-Jun | 464.64 | 31-Jul | 0.05 | 12-Sep | 0.52 |
| 7-May | 8.11 | 19-Jun | 478.56 | 1-Aug | 5.36 | 13-Sep | 0.30 |
| 8-May | 6.01 | 20-Jun | 441.25 | 2-Aug | 20.02 | 14-Sep | 0.16 |
| 9-May | 6.08 | 21-Jun | 430.67 | 3-Aug | 24.08 | 15-Sep | 0.12 |
| 10-May | 5.23 | 22-Jun | 387.32 | 4-Aug | 57.79 | 16-Sep | 0.10 |
| 11-May | 4.28 | 23-Jun | 341.39 | 5-Aug | 82.05 | 17-Sep | 0.08 |
| 12-May | 3.76 | 24-Jun | 295.70 | 6-Aug | 86.57 | 18-Sep | 0.07 |
| 13-May | 3.01 | 25-Jun | 244.50 | 7-Aug | 82.46 | 19-Sep | 0.07 |
| 14-May | 2.36 | 26-Jun | 199.16 | 8-Aug | 78.80 | 20-Sep | 0.04 |
| 15-May | 1.89 | 27-Jun | 155.79 | 9-Aug | 106.77 | 21-Sep | 0.06 |
| 16-May | 1.09 | 28-Jun | 122.80 | 10-Aug | 108.41 | 22-Sep | 0.08 |
| 17-May | 1.04 | 29-Jun | 110.39 | 11-Aug | 102.53 | 23-Sep | 0.05 |
| 18-May | 0.78 | 30-Jun | 99.74 | 12-Aug | 93.97 | 24-Sep | 0.04 |
| 19-May | 2.12 | 1-Jul | 87.01 | 13-Aug | 85.37 | 25-Sep | 0.04 |
| 20-May | 3.00 | 2-Jul | 78.19 | 14-Aug | 70.50 | 26-Sep | 0.03 |
| 21-May | 4.02 | 3-Jul | 94.96 | 15-Aug | 60.67 | 27-Sep | 0.02 |
| 22-May | 2.51 | 4-Jul | 78.87 | 16-Aug | 72.62 | 28-Sep | 0.02 |
| 23-May | 7.49 | 5-Jul | 65.79 | 17-Aug | 65.28 | 29-Sep | 0.01 |
| 24-May | 24.49 | 6-Jul | 50.96 | 18-Aug | 61.73 | 30-Sep | 0.01 |
| 25-May | 34.92 | 7-Jul | 42.86 | 19-Aug | 53.37 | 1-Oct | 0.00 |
| 26-May | 45.99 | 8-Jul | 36.03 | 20-Aug | 46.85 | 2-Oct | 0.00 |
| 27-May | 45.76 | 9-Jul | 28.66 | 21-Aug | 39.54 | 3-Oct | 0.00 |
| 28-May | 53.73 | 10-Jul | 23.83 | 22-Aug | 32.98 | 4-Oct | 0.03 |
| 29-May | 83.06 | 11-Jul | 19.20 | 23-Aug | 27.24 | 5-Oct | 1.27 |
| 30-May | 94.85 | 12-Jul | 16.14 | 24-Aug | 24.36 | 6-Oct | 1.59 |
| 31-May | 97.73 | 13-Jul | 13.75 | 25-Aug | 21.14 | 7-Oct | 2.14 |
| 1-Jun | 95.32 | 14-Jul | 10.91 | 26-Aug | 16.47 | 8-Oct | 2.70 |
| 2-Jun | 58.20 | 15-Jul | 8.57 | 27-Aug | 12.56 | 9-Oct | 4.72 |
| 3-Jun | 55.16 | 16-Jul | 8.43 | 28-Aug | 10.17 | 10-Oct | 6.54 |
| 4-Jun | 49.77 | 17-Jul | 6.61 | 29-Aug | 8.34 | 11-Oct | 8.30 |
| 5-Jun | 41.65 | 18-Jul | 4.30 | 30-Aug | 6.80 | 12-Oct | 10.16 |
| 6-Jun | 24.39 | 19-Jul | 3.42 | 31-Aug | 5.00 | 13-Oct | 10.31 |
| 7-Jun | 10.41 | 20-Jul | 2.00 | 1-Sep | 4.06 | 14-Oct | 10.88 |
| 8-Jun | 14.95 | 21-Jul | 1.13 | 2-Sep | 3.88 | 15-Oct | 11.05 |
| 9-Jun | 8.61 | 22-Jul | 1.03 | 3-Sep | 4.43 | | |
| 10-Jun | 72.34 | 23-Jul | 0.65 | 4-Sep | 3.63 | | |
| 11-Jun | 377.71 | 24-Jul | 0.51 | 5-Sep | 2.95 | | |
| 12-Jun | 513.49 | 25-Jul | 0.30 | 6-Sep | 2.42 | | |
| 13-Jun | 539.65 | 26-Jul | 0.15 | 7-Sep | 1.95 | | |

Daily Average Depth (m) at SPR-HS4

| Date | Daily Average Depth (m) | Date | Daily Average Depth (m) |
|--------|-------------------------|--------|-------------------------|
| 3-May | 0.115 | 15-Jun | 0.16 |
| 4-May | 0.115 | 16-Jun | 0.16 |
| 5-May | 0.113 | 17-Jun | 0.17 |
| 6-May | 0.111 | 18-Jun | 0.19 |
| 7-May | 0.116 | 19-Jun | 0.23 |
| 8-May | 0.114 | 20-Jun | 0.27 |
| 9-May | 0.111 | 21-Jun | 0.31 |
| 10-May | 0.109 | 22-Jun | 0.35 |
| 11-May | 0.108 | 23-Jun | 0.39 |
| 12-May | 0.106 | 24-Jun | 0.41 |
| 13-May | 0.103 | 25-Jun | 0.44 |
| 14-May | 0.102 | 26-Jun | 0.46 |
| 15-May | 0.099 | 27-Jun | 0.47 |
| 16-May | 0.097 | 28-Jun | 0.48 |
| 17-May | 0.095 | 29-Jun | 0.48 |
| 18-May | 0.093 | 30-Jun | 0.49 |
| 19-May | 0.109 | 1-Jul | 0.49 |
| 20-May | 0.113 | 2-Jul | 0.49 |
| 21-May | 0.110 | 3-Jul | 0.50 |
| 22-May | 0.108 | 4-Jul | 0.50 |
| 23-May | 0.113 | 5-Jul | 0.49 |
| 24-May | 0.144 | 6-Jul | 0.49 |
| 25-May | 0.143 | | |
| 26-May | 0.137 | | |
| 27-May | 0.131 | | |
| 28-May | 0.140 | | |
| 29-May | 0.150 | | |
| 30-May | 0.143 | | |
| 31-May | 0.136 | | |
| 1-Jun | 0.130 | | |
| 2-Jun | 0.125 | | |
| 3-Jun | 0.121 | | |
| 4-Jun | 0.116 | | |
| 5-Jun | 0.113 | | |
| 6-Jun | 0.109 | | |
| 7-Jun | 0.104 | | |
| 8-Jun | 0.101 | | |
| 9-Jun | 0.100 | | |
| 10-Jun | 0.148 | | |
| 11-Jun | 0.189 | | |
| 12-Jun | 0.173 | | |
| 13-Jun | 0.163 | | |
| 14-Jun | 0.168 | | |

Average Daily Discharge (L/s) at SPR-HS5

| Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) | Date | Mean Daily Discharge (L/s) |
|--------|----------------------------|--------|----------------------------|--------|----------------------------|--------|----------------------------|-----------|----------------------------|
| 23-Mar | 171.50 | 5-May | 17.43 | 17-Jun | 102.11 | 30-Jul | 4.73 | 11-Sep-12 | 0.00 |
| 24-Mar | 166.82 | 6-May | 16.24 | 18-Jun | 141.57 | 31-Jul | 2.67 | 12-Sep-12 | 0.00 |
| 25-Mar | 219.30 | 7-May | 18.91 | 19-Jun | 183.13 | 1-Aug | 39.66 | 13-Sep-12 | 0.00 |
| 26-Mar | 127.99 | 8-May | 18.98 | 20-Jun | 147.10 | 2-Aug | 69.92 | 14-Sep-12 | 0.00 |
| 27-Mar | 116.31 | 9-May | 17.50 | 21-Jun | 196.39 | 3-Aug | 46.78 | 15-Sep-12 | 0.00 |
| 28-Mar | 129.75 | 10-May | 15.62 | 22-Jun | 210.01 | 4-Aug | 91.40 | 16-Sep-12 | 0.00 |
| 29-Mar | 123.78 | 11-May | 14.26 | 23-Jun | 221.30 | 5-Aug | 180.37 | 17-Sep-12 | 0.01 |
| 30-Mar | 125.88 | 12-May | 13.47 | 24-Jun | 248.60 | 6-Aug | 82.55 | 18-Sep-12 | 0.01 |
| 31-Mar | 129.78 | 13-May | 12.03 | 25-Jun | 246.17 | 7-Aug | 38.47 | 19-Sep-12 | 0.01 |
| 1-Apr | 171.88 | 14-May | 10.73 | 26-Jun | 249.31 | 8-Aug | 16.90 | 20-Sep-12 | 0.01 |
| 2-Apr | 245.88 | 15-May | 9.21 | 27-Jun | 244.84 | 9-Aug | 14.47 | 21-Sep-12 | 0.01 |
| 3-Apr | 332.21 | 16-May | 8.12 | 28-Jun | 299.87 | 10-Aug | 8.56 | 22-Sep-12 | 0.01 |
| 4-Apr | 324.68 | 17-May | 7.31 | 29-Jun | 306.52 | 11-Aug | 4.07 | 23-Sep-12 | 0.01 |
| 5-Apr | 275.53 | 18-May | 6.99 | 30-Jun | 266.86 | 12-Aug | 2.50 | 24-Sep-12 | 0.01 |
| 6-Apr | 225.02 | 19-May | 13.36 | 1-Jul | 247.51 | 13-Aug | 1.62 | 25-Sep-12 | 0.01 |
| 7-Apr | 203.35 | 20-May | 16.96 | 2-Jul | 235.40 | 14-Aug | 0.76 | 26-Sep-12 | 0.01 |
| 8-Apr | 181.66 | 21-May | 19.96 | 3-Jul | 258.51 | 15-Aug | 0.44 | 27-Sep-12 | 0.01 |
| 9-Apr | 140.60 | 22-May | 17.53 | 4-Jul | 221.76 | 16-Aug | 4.14 | 28-Sep-12 | 0.01 |
| 10-Apr | 130.04 | 23-May | 22.04 | 5-Jul | 228.47 | 17-Aug | 9.21 | 29-Sep-12 | 0.01 |
| 11-Apr | 85.22 | 24-May | 92.33 | 6-Jul | 178.06 | 18-Aug | 6.17 | 30-Sep-12 | 0.00 |
| 12-Apr | 72.25 | 25-May | 124.06 | 7-Jul | 142.51 | 19-Aug | 2.44 | 1-Oct-12 | 0.00 |
| 13-Apr | 65.07 | 26-May | 101.18 | 8-Jul | 121.54 | 20-Aug | 0.99 | 2-Oct-12 | 0.01 |
| 14-Apr | 46.57 | 27-May | 72.90 | 9-Jul | 99.30 | 21-Aug | 0.43 | 3-Oct-12 | 0.01 |
| 15-Apr | 46.56 | 28-May | 96.37 | 10-Jul | 82.94 | 22-Aug | 0.16 | 4-Oct-12 | 0.05 |
| 16-Apr | 35.64 | 29-May | 218.43 | 11-Jul | 72.50 | 23-Aug | 0.06 | 5-Oct-12 | 0.84 |
| 17-Apr | 26.35 | 30-May | 186.97 | 12-Jul | 56.65 | 24-Aug | 0.15 | 6-Oct-12 | 1.44 |
| 18-Apr | 23.33 | 31-May | 123.23 | 13-Jul | 41.71 | 25-Aug | 0.15 | 7-Oct-12 | 1.99 |
| 19-Apr | 21.44 | 1-Jun | 89.75 | 14-Jul | 32.37 | 26-Aug | 0.09 | 8-Oct-12 | 1.84 |
| 20-Apr | 17.38 | 2-Jun | 63.40 | 15-Jul | 22.96 | 27-Aug | 0.03 | 9-Oct-12 | 1.89 |
| 21-Apr | 15.57 | 3-Jun | 44.83 | 16-Jul | 18.40 | 28-Aug | 0.01 | 10-Oct-12 | 1.57 |
| 22-Apr | 14.92 | 4-Jun | 33.77 | 17-Jul | 12.99 | 29-Aug | 0.00 | 11-Oct-12 | 1.33 |
| 23-Apr | 14.90 | 5-Jun | 10.77 | 18-Jul | 8.45 | 30-Aug | 0.00 | 12-Oct-12 | 0.88 |
| 24-Apr | 13.69 | 6-Jun | 3.05 | 19-Jul | 5.50 | 31-Aug | 0.00 | 13-Oct-12 | 1.03 |
| 25-Apr | 14.79 | 7-Jun | 2.21 | 20-Jul | 3.96 | 1-Sep | 0.00 | 14-Oct-12 | 0.79 |
| 26-Apr | 13.01 | 8-Jun | 1.91 | 21-Jul | 1.77 | 2-Sep | 0.00 | 15-Oct-12 | 0.74 |
| 27-Apr | 11.09 | 9-Jun | 1.76 | 22-Jul | 0.89 | 3-Sep | 0.00 | | |
| 28-Apr | 9.39 | 10-Jun | 46.22 | 23-Jul | 0.43 | 4-Sep | 0.00 | | |
| 29-Apr | 8.54 | 11-Jun | 773.76 | 24-Jul | 0.12 | 5-Sep | 0.00 | | |
| 30-Apr | 9.74 | 12-Jun | 381.57 | 25-Jul | 0.02 | 6-Sep | 0.00 | | |
| 1-May | 10.04 | 13-Jun | 180.76 | 26-Jul | 0.00 | 7-Sep | 0.00 | | |
| 2-May | 13.64 | 14-Jun | 218.58 | 27-Jul | - | 8-Sep | 0.00 | | |
| 3-May | 16.12 | 15-Jun | 135.20 | 28-Jul | - | 9-Sep | 0.00 | | |
| 4-May | 19.06 | 16-Jun | 83.42 | 29-Jul | - | 10-Sep | 0.00 | | |

Daily Average Depth (m) at SPR-HS6

| Date | Daily Average Depth (m) | Date | Daily Average Depth (m) | Date | Daily Average Depth (m) |
|--------|-------------------------|--------|-------------------------|--------|-------------------------|
| 7-Jul | 4,714.98 | 19-Aug | 6.58 | 1-Oct | 0.00 |
| 8-Jul | 4,431.40 | 20-Aug | 5.49 | 2-Oct | 0.00 |
| 9-Jul | 3,947.58 | 21-Aug | 4.58 | 3-Oct | 0.00 |
| 10-Jul | 3,489.55 | 22-Aug | 3.68 | 4-Oct | 0.00 |
| 11-Jul | 3,026.48 | 23-Aug | 2.90 | 5-Oct | 0.03 |
| 12-Jul | 2,527.25 | 24-Aug | 2.72 | 6-Oct | 0.00 |
| 13-Jul | 2,074.10 | 25-Aug | 2.47 | 7-Oct | 0.00 |
| 14-Jul | 1,697.70 | 26-Aug | 1.83 | 8-Oct | 0.00 |
| 15-Jul | 1,382.91 | 27-Aug | 1.25 | 9-Oct | 0.00 |
| 16-Jul | 1,199.61 | 28-Aug | 0.93 | 10-Oct | 0.00 |
| 17-Jul | 949.72 | 29-Aug | 0.69 | 11-Oct | 0.00 |
| 18-Jul | 753.75 | 30-Aug | 0.47 | 12-Oct | 0.00 |
| 19-Jul | 581.00 | 31-Aug | 0.29 | 13-Oct | 0.00 |
| 20-Jul | 421.60 | 1-Sep | 0.19 | 14-Oct | 0.01 |
| 21-Jul | 291.23 | 2-Sep | 0.16 | | |
| 22-Jul | 221.71 | 3-Sep | 0.15 | | |
| 23-Jul | 155.66 | 4-Sep | 0.09 | | |
| 24-Jul | 110.58 | 5-Sep | 0.05 | | |
| 25-Jul | 78.47 | 6-Sep | 0.03 | | |
| 26-Jul | 51.38 | 7-Sep | 0.02 | | |
| 27-Jul | 32.71 | 8-Sep | 0.01 | | |
| 28-Jul | 20.54 | 9-Sep | 0.00 | | |
| 29-Jul | 15.02 | 10-Sep | 0.00 | | |
| 30-Jul | 27.26 | 11-Sep | 0.00 | | |
| 31-Jul | 22.50 | 12-Sep | 0.00 | | |
| 1-Aug | 30.78 | 13-Sep | 0.00 | | |
| 2-Aug | 28.98 | 14-Sep | 0.00 | | |
| 3-Aug | 23.80 | 15-Sep | 0.00 | | |
| 4-Aug | 32.89 | 16-Sep | 0.00 | | |
| 5-Aug | 38.26 | 17-Sep | 0.00 | | |
| 6-Aug | 46.53 | 18-Sep | 0.00 | | |
| 7-Aug | 266.25 | 19-Sep | 0.00 | | |
| 8-Aug | 62.27 | 20-Sep | 0.00 | | |
| 9-Aug | 35.55 | 21-Sep | 0.00 | | |
| 10-Aug | 24.96 | 22-Sep | 0.00 | | |
| 11-Aug | 18.66 | 23-Sep | 0.00 | | |
| 12-Aug | 14.84 | 24-Sep | 0.00 | | |
| 13-Aug | 12.29 | 25-Sep | 0.00 | | |
| 14-Aug | 9.25 | 26-Sep | 0.00 | | |
| 15-Aug | 7.70 | 27-Sep | 0.00 | | |
| 16-Aug | 9.56 | 28-Sep | 0.00 | | |
| 17-Aug | 9.42 | 29-Sep | 0.00 | | |
| 18-Aug | 8.08 | 30-Sep | 0.00 | | |

APPENDIX D
Limitations of Report

LIMITATIONS OF REPORT

ENVIRONMENTAL STUDIES

The information, conclusions and recommendations given herein are specifically for this project and this Client only, and for the scope of work described herein. It may not be sufficient for other uses. DST does not accept responsibility for use by third parties.

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note, however, that no scope of work, no matter how exhaustive, can identify all contaminants or all conditions above and below ground. For example, conditions between test holes may differ from those encountered in the investigation and observed or measured conditions may change with time. This report therefore cannot warranty that all conditions on or off the site are represented by those identified at specific locations.

Any recommendations and conclusions provided that are based on conditions or assumptions reported herein will inherently include any uncertainty associated with those conditions or assumptions. In fact many aspects involving professional judgement such as subsurface models and remediation criteria contain a degree of uncertainty which cannot be eliminated. This uncertainty should be managed by periodic review and refinement as additional information becomes available.

Note also that standards, guidelines and practices related to environmental investigations may change with time. Those which were applied at the time of this investigation may be obsolete or unacceptable at a later date.

Any topographic benchmarks and elevations documented in this report are primarily to establish relative elevation differences between test locations and should not be used for other purposes such as grading, excavation, planning, development, etc.

Any comments given in this report on potential remediation problems and possible methods are intended only for the guidance of the designer. The scope of work may not be sufficient to determine all of the factors that may affect construction or clean-up methods and costs. Contractors bidding on this project or undertaking clean-ups should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the conditions may affect their work.

Any results from an analytical laboratory, title searcher or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

rev 2.1

Attachment F 2021 - 2022 Baseline Data Summary

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes | | |
|---------------------|----------------|------------------|-----------------------------------|-------------------------|---------|---------|---------------|---|---------|--|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | | | |
| L10 | 5/16/2021 | 5/16/21 4:30 PM | N/A | 394.554 | 394.356 | 394.416 | 393.222 | | | |
| | | 5/18/21 3:01 PM | | 394.554 | 394.354 | 394.415 | 393.239 | | | |
| | 6/17/2021 | 6/17/21 11:00 AM | | 394.788 | 394.456 | 394.415 | 393.544 | BM1 and BM2 destroyed due to trees being knocked down in storm. New BM1 and BM2 designated. | | |
| | 8/26/2021 | 8/26/21 9:15 AM | | 394.615 | 394.682 | 394.478 | 393.223 | All benchmarks and logger download station destroyed by forest fire in July 2021. New hydrometric station installed near Birch Lake dock. | | |
| | | 9/23/21 3:24 PM | | 394.615 | 394.677 | 394.474 | 393.155 | | | |
| | | 10/15/21 3:49 PM | | 394.615 | 394.680 | 394.474 | 393.116 | | | |
| | | 2/24/22 1:15 PM | | - | 394.707 | - | 393.053 | BM2 relocated to bolt in rock. Only BM2 uncovered due to snow buildup. | | |
| | 6/8/2022 | 6/8/22 5:13 PM | | 394.615 | 394.704 | 394.477 | 393.955 | Logger non-responsive at time of site visit. Logger retrieved and replaced with older model with better reliability. | | |
| | | 7/7/22 2:02 PM | | 394.615 | 394.702 | 394.473 | 393.707 | | | |
| | | 7/28/22 11:13 AM | | 394.615 | 394.702 | 394.469 | 393.611 | | | |
| | | 8/24/22 7:17 PM | | 394.615 | 394.702 | 394.467 | 393.469 | Surveyed relative elevations retroactively converted to geodetic datum. | | |
| | | 9/14/22 11:45 AM | | 394.615 | 394.702 | 394.468 | 393.286 | | | |
| | | 10/19/22 2:37 PM | | 394.615 | 394.704 | 394.470 | 393.135 | | | |
| | L11 | 5/15/2021 | | 5/15/21 4:34 PM | N/A | 394.045 | 394.457 | 394.831 | 393.428 | |
| | | | | 5/18/21 4:40 PM | | 394.045 | 394.454 | 394.831 | 393.448 | |
| 6/17/21 3:30 PM | | | 394.045 | 394.475 | | 394.871 | 393.840 | | | |
| 8/8/21 4:00 PM | | | 394.045 | 394.487 | | 394.880 | 393.754 | | | |
| 8/23/21 5:35 PM | | | 394.045 | 394.490 | | 394.884 | 393.752 | | | |
| 9/23/21 5:41 PM | | | 394.045 | 394.493 | | 394.895 | 393.840 | Continuous evidence of benchmark shift. Recommend relocating BM1 and BM2. | | |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|-------------------|------------------|-----------------------------------|-------------------------|---------|---------|--|---|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| L11 (cont'd) | 10/16/2021 | 10/16/21 1:47 PM | | 395.115 | 395.084 | 394.885 | 393.892 | BM1 and BM2 relocated. |
| | 6/10/2022 | 6/10/22 10:05 AM | | 395.115 | 395.081 | 394.884 | 393.468 | Logger retrieved and replaced with older model due to reliability concerns. Logger functional at time of retrieval. Unusual drop in level on this lake, suspected to be due to beaver dam blowout downstream. |
| | | 7/7/22 9:50 AM | | 395.115 | 395.083 | 394.883 | 393.445 | |
| | | 7/28/22 2:35 PM | | 395.115 | 395.085 | 394.884 | 393.509 | |
| | | 8/24/22 4:45 PM | | 395.115 | 395.082 | 394.883 | 393.434 | Surveyed relative elevations retroactively converted to geodetic datum. |
| | | 9/15/22 2:15 PM | | 395.115 | 395.084 | 394.884 | 393.373 | |
| | 10/19/22 12:00 AM | 395.115 | | 395.087 | 394.884 | 393.370 | Lake surface frozen at time of survey. | |
| L12 | 5/14/2021 | 5/14/21 5:09 PM | N/A | 398.984 | 399.190 | 399.202 | 398.561 | |
| | | 5/18/21 11:59 AM | | 398.984 | 399.188 | 399.205 | 398.543 | |
| | | 6/17/21 10:56 AM | | 398.984 | 399.156 | 399.246 | 398.595 | Some evidence of benchmarks shifting due to unstable station area. |
| | | 8/8/21 11:32 AM | | 398.984 | 399.182 | 399.192 | 398.496 | Logger direct read cable damaged while attempting to retrieve logger. Logger redeployed temporarily mounted to T-bar on east shore of Lake 19. |
| | 8/24/2021 | 8/24/21 1:19 PM | | 400.250 | 400.069 | 400.042 | 398.517 | Hydrometric station relocated to west shore of Lake 19. |
| | | 9/23/21 12:18 PM | | 400.250 | 400.074 | 400.047 | 398.558 | |
| | | 10/16/21 9:52 AM | | 400.250 | 400.073 | 400.045 | 398.561 | |
| | 6/9/2022 | 6/9/22 3:25 PM | | 400.250 | 400.074 | 400.041 | 398.694 | Logger non-responsive at time of site visit. Logger retrieved and replaced with older model with better reliability. |
| | | 7/7/22 8:55 AM | | 400.250 | 400.075 | 400.042 | 398.622 | |
| | | 7/28/22 1:16 PM | | 400.250 | 400.072 | 399.885 | 398.674 | BM3 destroyed by tree fall and replaced. |
| | | 8/24/22 4:09 PM | | 400.250 | 400.071 | 399.885 | 398.621 | Surveyed relative elevations retroactively converted to geodetic datum. |
| | | 9/15/22 1:25 PM | | 400.250 | 400.074 | 399.885 | 398.542 | |
| | | 10/19/22 4:03 PM | | 400.250 | 400.071 | 399.884 | 398.523 | Lake surface frozen at time of survey. |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|----------------|-------------------|-----------------------------------|-------------------------|---------|---------|---------------|---|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| L13 | 5/16/2021 | 5/16/21 4:40 PM | N/A | 30.000 | 30.641 | 29.874 | 29.526 | |
| | | 5/18/21 1:10 PM | | 30.000 | 30.644 | 29.875 | 29.548 | |
| | | 6/17/21 8:56 AM | | 30.000 | 30.641 | 29.873 | 29.832 | |
| | | 8/8/21 9:30 AM | | 30.000 | 30.642 | 29.875 | 29.569 | |
| | | 8/23/21 3:41 PM | | 30.000 | 30.641 | 29.875 | 29.525 | |
| | | 9/23/21 2:09 PM | | 30.000 | 30.639 | 29.873 | 29.523 | |
| | | 10/16/21 11:22 AM | | 30.000 | 30.645 | 29.877 | 29.518 | |
| | 6/9/2022 | 6/9/22 5:35 PM | | 30.000 | 30.638 | - | 30.249 | Logger retrieved and replaced with older model due to reliability concerns. Logger functional at time of retrieval. Lake hydraulically connected to Birch Lake, levels appear the same. |
| | | 7/7/22 11:37 AM | | 30.000 | 30.634 | 29.879 | 30.001 | |
| | | 7/28/22 9:41 AM | | 30.000 | 30.632 | 29.879 | 29.900 | |
| | | 8/24/22 3:48 PM | | 30.000 | 30.641 | 29.884 | 29.743 | |
| | | 9/14/22 10:47 AM | | 30.000 | 30.637 | 29.884 | 29.595 | |
| | | 10/19/22 1:40 PM | | 30.000 | 30.636 | 29.883 | 29.491 | |
| | | | | | | | | |
| L1B-FFC | 8/9/2021 | 8/9/21 6:36 PM | N/A | 392.273 | 392.313 | 392.820 | 391.270 | Existing FracFlow station. Previous data deemed questionable due to the nature of the existing logger setup. Logger redeployed mounted to weight with a direct read cable. Three new benchmarks designated. |
| | | 8/23/21 2:00 PM | | 392.273 | 392.309 | 392.817 | 391.114 | |
| | | 9/22/21 6:08 PM | | 392.273 | 392.310 | 392.818 | 390.989 | |
| | | 10/14/21 5:01 PM | | 392.273 | 392.309 | 392.818 | 390.870 | |
| | | 2/24/22 12:12 PM | | - | - | - | 390.704 | Survey based on older FracFlow BM at 392.533m. |
| | | 6/9/22 12:07 PM | | - | - | 392.818 | 392.818 | BM1 and 2 submerged, survey based only on BM3. |
| | | 7/6/22 2:01 PM | | - | - | 392.818 | 392.418 | BM1 and 2 submerged, survey based only on BM3. |
| | | 7/27/22 3:40 PM | | 393.898 | 393.567 | 392.818 | 392.088 | BM1 and 2 relocated. |
| | | 8/24/22 2:50 PM | | 393.898 | 393.566 | 392.821 | 391.749 | |
| | | 9/15/22 10:58 AM | | 393.898 | 393.566 | 392.819 | 391.357 | |
| | | 10/18/22 5:25 PM | | 393.898 | 393.566 | 392.819 | 390.956 | |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|-----------------------------|------------------|-----------------------------------|-------------------------|---------|--|---------------|---|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| L7-FFC | 8/7/2021 | 8/7/21 5:50 PM | N/A | 393.070 | 393.360 | 393.410 | 391.260 | Existing FracFlow station. Previous data deemed questionable due to the nature of the existing logger setup. Logger redeployed mounted to weight with a direct read cable. Three new benchmarks designated. |
| | | 8/23/21 1:06 PM | | 393.070 | 393.358 | 393.414 | 391.102 | |
| | | 9/22/21 1:41 PM | | 393.070 | 393.412 | 393.357 | 390.969 | Assumed elevation of BM1 adjusted based on September survey. |
| | | 10/14/21 4:08 PM | | 393.070 | 393.413 | 393.356 | 390.844 | |
| | | 6/7/22 4:40 PM | | 393.070 | 393.358 | 393.413 | 392.829 | |
| | | 7/5/22 5:05 PM | | 393.070 | 393.360 | 393.415 | 392.447 | |
| | | 7/27/22 9:52 AM | | 393.070 | 393.359 | 393.412 | 392.088 | |
| | | 8/24/22 10:26 AM | | 393.070 | 393.359 | 393.415 | 391.747 | |
| | | 9/13/22 5:00 PM | | 393.070 | 393.358 | 393.412 | 391.382 | |
| | | 10/18/22 4:45 PM | | 393.070 | 393.360 | 393.415 | 390.947 | |
| F7-HS1 | FracFlow Station - Existing | 5/17/21 11:30 AM | 7.247 | 392.299 | 392.496 | 391.376 | 391.376 | |
| | | 6/14/21 4:30 PM | 26.1256 | 392.299 | 392.497 | 391.649 | 391.759 | ADCP unavailable. flow measurement taken using water velocity meter from boat. |
| | 8/6/2021 | 8/6/21 5:50 PM | 10.358 | 392.299 | 392.499 | 391.644 | 391.471 | Logger setup reconfigured to be mounted to plate weight at the bottom of the channel, with a direct read cable for data access. BMs kept consistent. |
| | | 8/23/21 11:40 AM | 7.833 | 392.299 | 392.494 | 391.639 | 391.345 | |
| | | 9/22/21 5:10 PM | 6.9526 | 392.299 | 392.498 | 391.640 | 391.321 | ADCP data indicates moving bed in channel. Loop correction applied to discharge measurement. |
| | | 10/15/21 1:12 PM | 5.4426 | 392.299 | 392.498 | 391.643 | 391.278 | ADCP data indicates moving bed in channel. Loop correction applied to discharge measurement. |
| | | 6/9/22 10:47 AM | 53.8524 | 392.299 | - | - | 392.916 | BM 2 and 3 submerged, survey based only on BM1. Backwater effect from Springpole Lake present. Significant perceptible flow. |
| | | 7/6/22 2:01 PM | 36.3026 | 392.299 | - | - | 392.509 | BM 2 and 3 submerged, survey based only on BM1. Backwater effect from Springpole Lake present. Significant perceptible flow. |
| 7/27/21 2:11 PM | 27.2112 | 392.299 | 392.499 | - | 392.157 | BM3 submerged, could not be surveyed. Significant backwater effects from Springpole Lake present. No perceptible flow, appears stagnant. | | |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|-----------------------------|-------------------|-----------------------------------|-------------------------|---------|---------|---------------|--|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| F7-HS1 (cont'd) | 8/6/21 | 8/24/22 1:14 PM | 18.9196 | 392.299 | 392.499 | 391.638 | 391.842 | Visible flow present, rocks and riffles visible in channel. |
| | | 9/14/22 3:25 PM | 10.7931 | 392.299 | 392.499 | 391.644 | 391.477 | Visible flow present, rocks and riffles visible in channel. |
| | | 10/19/22 11:09 AM | 5.9464 | 392.299 | 392.499 | 391.639 | 391.278 | Visible hydraulic disconnect between Cromarty and Springpole Lakes. |
| F8-HS7 | FracFlow Station - Existing | 5/19/21 4:05 PM | 6.758 | 391.295 | 392.075 | 392.709 | 390.963 | |
| | | 6/15/21 4:30 PM | 17.1461 | 391.295 | 392.074 | 392.705 | 391.573 | ADCP unavailable. flow measurement taken using water velocity meter from boat. |
| | 8/7/2021 | 8/7/21 3:47 PM | 12.101 | 391.295 | 392.072 | 392.705 | 391.277 | Logger setup reconfigured to be mounted to plate weight at the bottom of the channel, with a direct read cable for data access. BMs kept consistent. |
| | | 8/25/21 10:49 AM | 9.8358 | 391.295 | 392.072 | 392.704 | 391.162 | |
| | | 9/22/21 10:44 AM | 8.3199 | 391.295 | 392.072 | 392.706 | 390.993 | |
| | | 10/14/21 1:51 PM | 6.4691 | 391.295 | 392.073 | 392.706 | 390.876 | |
| | | 2/23/22 2:55 PM | 4.8921 | - | - | - | 390.712 | Existing BMs could not be located due to snow buildup. Temporary benchmarks installed above snow level. Temporary BMs tied back during June 2022 trip, elevations = 394.473 m, 394.277 m. Corresponding WL in February = 390.712 m |
| | | 6/8/22 11:14 AM | 58.1196 | - | - | 392.709 | 393.858 | BM1 and 2 submerged, survey based only on BM3. Temporary winter BMs tied back. Logger download station submerged, no data retrieval possible. |
| | | 7/6/22 10:20 AM | 43.0878 | - | 392.078 | 392.709 | 392.448 | BM1 submerged, survey based only on BM2 and 3. |
| | | 7/26/22 2:50 PM | 32.3093 | - | 392.076 | 392.709 | 392.121 | BM1 submerged, survey based only on BM2 and 3. |
| | | 8/23/22 4:35 PM | 23.3918 | 391.295 | 392.072 | 392.704 | 391.786 | |
| | | 9/13/22 4:10 PM | 14.6628 | 391.295 | 392.072 | 392.703 | 391.415 | |
| | | 10/18/22 2:05 PM | 7.7254 | 391.295 | 392.072 | 392.702 | 390.982 | Logger download station relocated. |
| | | 2/15/23 11:45 AM | 3.989 | - | - | - | 390.690 | Primary benchmarks could not be reached due to ice/snow. Water Leve surveyed against temporary winter BMs from Feb 2022. TBM4 = 394.473, TBM5 = 394.277. Channel open at time of measurement. Measurement suitable for rating curve development. |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|-----------------------------|------------------|-----------------------------------|-------------------------|--------|--------|---------------|--|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| F11-HS2 | FracFlow Station - Existing | 5/19/21 12:50 PM | 0.0683 | 30.000 | 28.937 | 30.225 | 29.225 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 6/16/21 3:42 PM | 0.2582 | 30.000 | 28.940 | 30.228 | 29.503 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 8/9/21 2:16 PM | 0.0062 | 30.000 | 28.941 | 30.229 | 29.084 | Flume present in channel, data not valid for open channel rating curve development. |
| | 8/25/2021 | 8/25/21 1:29 PM | 0.0502 | 30.000 | 28.941 | 30.231 | 28.975 | Flume removed, station reconfigured as open channel hydrometric station. |
| | | 9/22/21 12:28 PM | 0.0344 | 30.000 | 28.939 | 30.231 | 28.960 | Flume removed, station reconfigured as open channel hydrometric station. |
| | | 10/14/21 3:29 PM | 0.0273 | 30.000 | 28.940 | 30.228 | 28.942 | |
| | | 2/24/22 10:45 AM | - | - | - | - | - | Stream largely frozen through. Small trickle audible near the outflow of stream, but flow could not be located due to heavy snow/ice buildup. Logger reading frozen at time of site visit. |
| | | 6/7/22 3:50 PM | 0.278 | 30.000 | - | 30.225 | 29.444 | BM2 submerged, could not be surveyed. Significant backwater effects from Springpole Lake present. Significant perceptible flow present. |
| | | 7/4/22 4:48 PM | 0.1317 | 30.000 | - | 30.232 | 29.089 | BM2 submerged, could not be surveyed. Significant backwater effects from Springpole Lake present. Significant perceptible flow present. |
| | | 7/26/22 4:35 PM | 0.127 | 30.000 | 28.940 | 30.231 | 29.023 | Backwater effects no longer present. |
| | | 8/24/22 9:56 AM | 0.0454 | 30.000 | 28.938 | 30.228 | 28.944 | |
| | | 9/14/22 5:42 PM | 0.0104 | 30.000 | 28.940 | 30.230 | 28.821 | |
| | | 10/18/22 4:11 PM | 0.0062 | 30.000 | 28.938 | 30.228 | 28.833 | |
| | | 2/15/23 2:03 PM | 0.0116 | 30.000 | - | 30.223 | 28.974 | Very thin layer of slush and ice present at flow measurement transect location. Some ice buildup on either bank constricting flow. Ice cover present upstream and downstream of transect location. ~12cm difference between logger reading and surveyed water level, possibly due to ice interference. BM2 could not be reached due to ice/snow. |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|-----------------------------|-------------------|-----------------------------------|-------------------------|--------|--------|---------------|--|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| F13 | FracFlow Station - Existing | 5/19/21 10:47 AM | 0.0196 | 30.000 | 30.664 | 29.070 | 29.330 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 6/16/21 5:17 PM | 0.0795 | 30.000 | 30.578 | 29.088 | 29.465 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 8/9/21 4:56 PM | 0.0026 | 30.000 | 30.567 | 29.081 | 29.242 | Flume present in channel, data not valid for open channel rating curve development. |
| | 8/25/2021 | 8/25/21 3:24 PM | 0.0182 | 30.000 | 30.575 | 29.310 | 29.139 | Flume removed, station reconfigured as open channel hydrometric station. BM3 relocated. |
| | | 9/22/21 2:46 PM | 0.0202 | 30.000 | 30.569 | 29.304 | 29.132 | Logger upgraded with direct read cable. |
| | | 10/15/21 10:58 AM | 0.0204 | 30.000 | 30.570 | 29.305 | 29.145 | |
| | | 2/24/22 11:45 AM | - | - | - | - | - | Stream frozen through. Logger reading frozen at time of site visit. |
| | | 6/8/22 2:18 PM | 0.0222 | 30.000 | 30.574 | - | 29.898 | BM3 submerged, could not be surveyed. Significant backwater effects from Springpole Lake present. No perceptible flow, appears stagnant. |
| | | 7/5/22 12:00 AM | 0.0331 | 30.000 | 30.567 | 29.504 | 29.507 | BM3 relocated to bolt in rock. Significant backwater effects from Springpole Lake present. Perceptible flow present. |
| | | 7/27/22 11:31 AM | 0.0364 | 30.000 | 30.570 | 29.503 | 29.150 | Some backwater effects from Springpole Lake present, visible flow present. |
| | | 8/24/22 11:35 AM | 0.0084 | 30.000 | 30.568 | 29.501 | 29.128 | |
| | | 9/15/22 10:04 AM | 0.0035 | 30.000 | 30.569 | 29.502 | 29.107 | |
| | | 2/15/23 3:58 PM | -0.0010 | 30.000 | 30.577 | - | 29.251 | Under ice flow measurement. Ice cover approximately 20 cm thick. Small amount of flow through small pressurized space under the ice. Upon breaking ice to expose liquid flow, pressure caused water level to rise approximately 15cm above the top of the ice surface. Stage measurement not representative of open channel flow conditions. Accuracy of flow measurement limited by very small cross sectional area and low velocities. Logger non-responsive at time of station visit. BM3 could not be located due to ice/snow. |

Appendix F: 2021 - 2022 Baseline Data Summary

| Monitoring Location | Date Installed | Date Measured | Measured Flow (m ³ /s) | Surveyed Elevations (m) | | | | Notes |
|---------------------|-----------------------------|------------------|-----------------------------------|-------------------------|--------|--------|---------------|---|
| | | | | TBM 1 (assumed) | TBM 2 | TBM 3 | Water Surface | |
| F5-HS5 | FracFlow Station - Existing | 6/16/21 10:34 AM | 0.0436 | 30.000 | 30.737 | 30.282 | 29.905 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 8/9/21 11:00 AM | 0.0033 | 30.000 | 30.734 | 30.297 | 29.755 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 8/24/21 4:24 PM | 0.0022 | 30.000 | 30.730 | 30.287 | 29.748 | Flume present in channel, data not valid for open channel rating curve development. |
| | | 9/23/21 10:52 AM | 0.0044 | 30.000 | 30.726 | 30.287 | 29.454 | |
| | | 8/24/22 6:30 PM | 0.0065 | - | - | - | - | Spot low flow measurement - no survey conducted. |
| | | 9/14/22 9:35 AM | 0.0012 | - | - | - | - | Spot low flow measurement - no survey conducted. |

Attachment G SEI Bathymetric Report

| | | | |
|------------|--|---------------------|---|
| To: | Dr. David Mchaina Director, Sustainability and Stakeholder Engagement First Mining Gold Corp. | From: | Jason Plamondon Senior Environmental Scientist |
| Re: | Springpole Lake Bathymetry and Dewatering Area and Volume Calculations | Date: | 21 January 2020 |
| | | SEI Proj No: | 271-04-14-02 |

1 Introduction and Background

Story Environmental Inc. (“SEI”) was retained by First Mining Gold Corp. (“FMG”) to perform a bathymetric survey of Springpole Lake to support the development and permitting of the Springpole Gold Project (“Project”).

The Project involves the construction, operation, and closure of an open pit mine and ancillary infrastructure. In order to develop the open pit, coffer dams must be constructed within Springpole Lake to allow for the dewatering of the north basin of Springpole Lake.

This memo provides details on how the bathymetric data was collected and processed to calculate the volume of Springpole Lake and the portion of Springpole Lake to be dewatered.

2 Bathymetry Data Collection and Processing

In September 2017, SEI collected bathymetry data for the east and west basins in the north arm of Springpole Lake using a Lowrance HDS7 unit equipped with a sonar and a built-in Global Positioning System (“GPS”). Between 24 August and 3 September 2019, bathymetry data were collected using the same unit for the remaining areas of Springpole Lake.

After collection, the sonar and GPS data were transferred into ReefMaster 2.0 and processed to develop bathymetric contours and isobaths. These data were exported as shapefiles to ArcGIS to produce the bathymetry maps, which are provided in Figures 1 and 1A-1J (attached).

3 Springpole Lake Volume Calculations

The volume and area of Springpole Lake were calculated as follows:

- a triangulated irregular network (“TIN”) was created in ArcGIS from the minor contour lines generated by Reefmaster 2.0 using the bathymetric data collected by SEI in 2017 and 2019 and the lake edge provided by the Ontario Hydrology Network;
- a polygon was created using the same lake edge used in the TIN creation; and
- the volume was then calculated for the area between the lake surface (polygon) and the lake bottom (TIN).

To: David Mchaina, First Mining Gold Corp.

The volume and area of the portion of Springpole Lake that is intended to be dewatered was calculated as follows:

- a polygon was created to represent the proposed coffer dam locations (the locations of the coffer dams used in our calculations were obtained from Image 3-2 of the Project Description (FMG, 2018) and are illustrated on Figure 1A, attached);
- the coffer dam polygon was used to clip the lake surface polygon and the TIN at the coffer dam locations; and
- a volume was then calculated for the area between the clipped lake surface (polygon) and the clipped lake bottom (TIN).

The results of these calculation can also be found in Table 1.

Table 1 Springpole Lake: Calculated Volumes and Surface Areas

| Area | Calculated Approximate Volume (m ³) | Calculated Approximate Surface Area (m ²) |
|--|---|---|
| Springpole Lake | 190 000 000 | 26 000 000 |
| Portion of Springpole Lake to be drained after coffer dam installation (i.e., North Basin) | 18 000 000 | 1 500 000 |
| Remaining Springpole Lake area after coffer dam installation | 172 000 000 | 24 500 000 |

Notes:

1. All calculations are approximate and are based on the data that was available at the time of calculation.
2. m³ = cubic metres, m² = square metres

4 References:

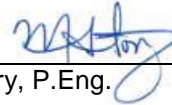
First Mining Gold (FMG), 2018. Springpole Gold Project: Project Description. Prepared for Canadian Environmental Assessment Agency. February 2018.

Prepared by:



Stephanie DeRuiter, B.Sc.
Intermediate Environmental
Scientist

Reviewed by:



Maria Story, P.Eng.
President

Attachments:

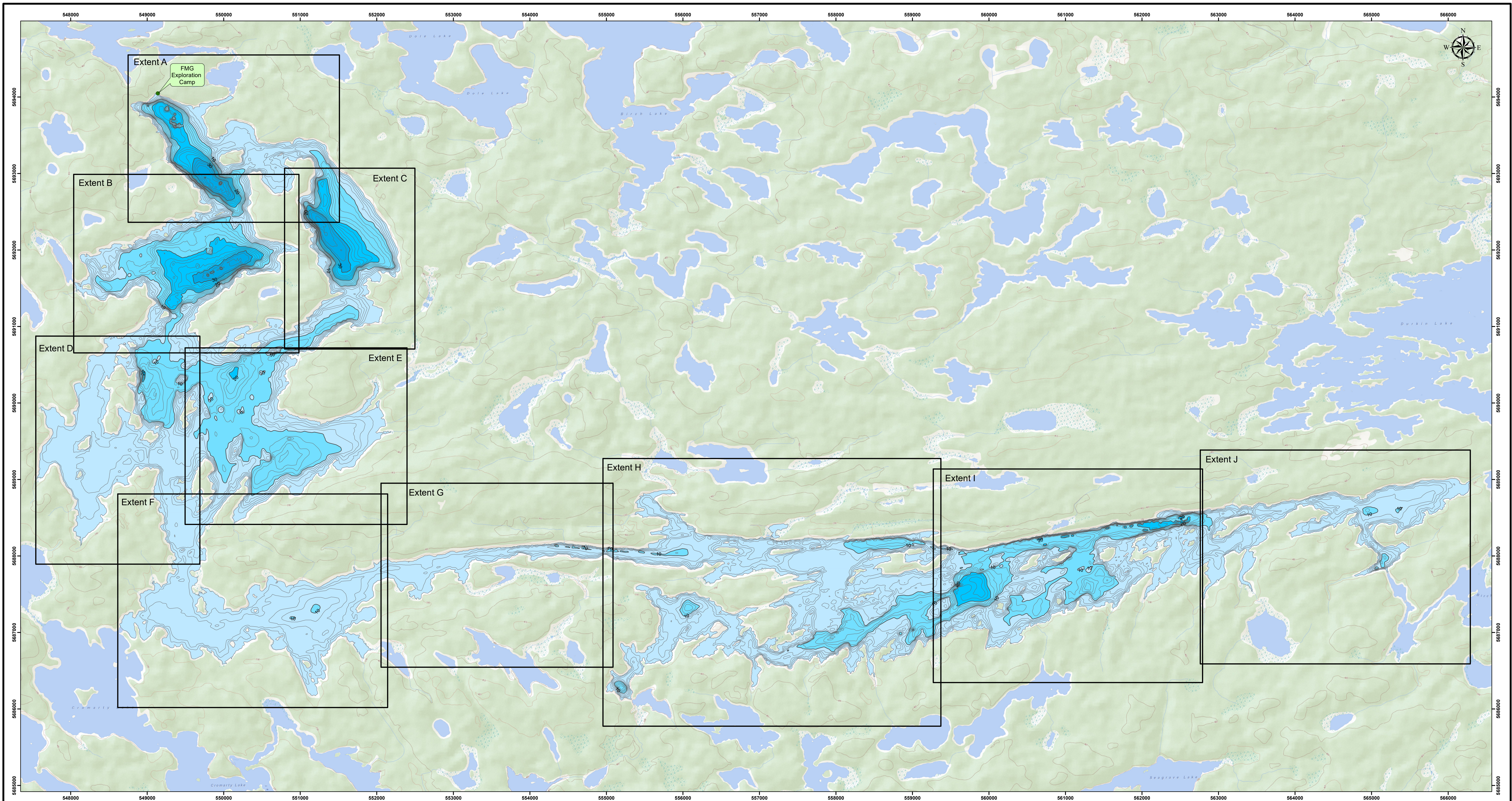
- Figure 1 Springpole Lake Bathymetry
Figures 1A to 1J Springpole Lake Bathymetry: Extents A to J

R:\SEI\271 First Mining Gold\04 - Springpole\14 - Aquatics\DI\2019\Bathymetry and Volume Memo\271-04_BathymetryVolume Memo_FINAL_21JAN2020.docx



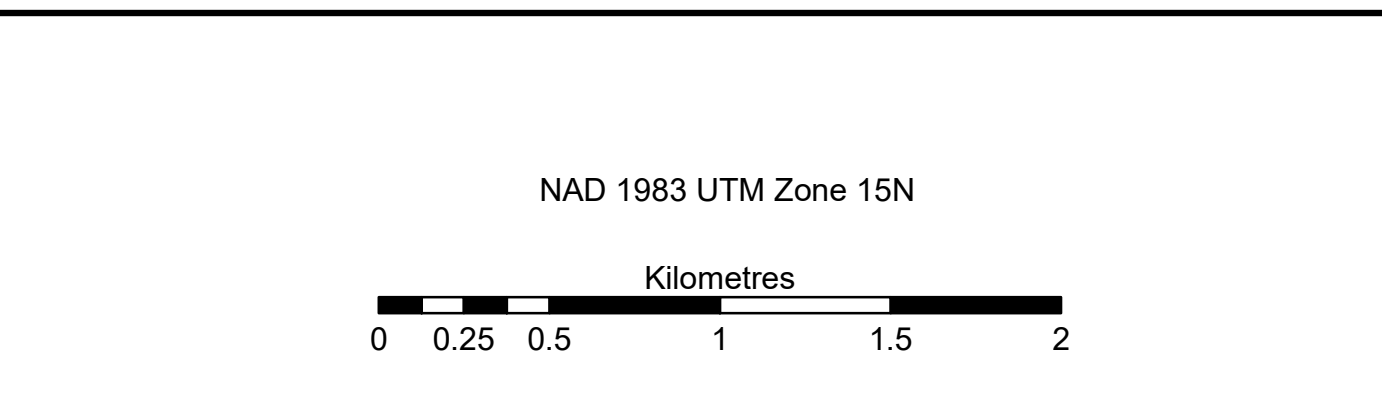
To: David Mchaina, First Mining Gold Corp.

Attachments



Legend

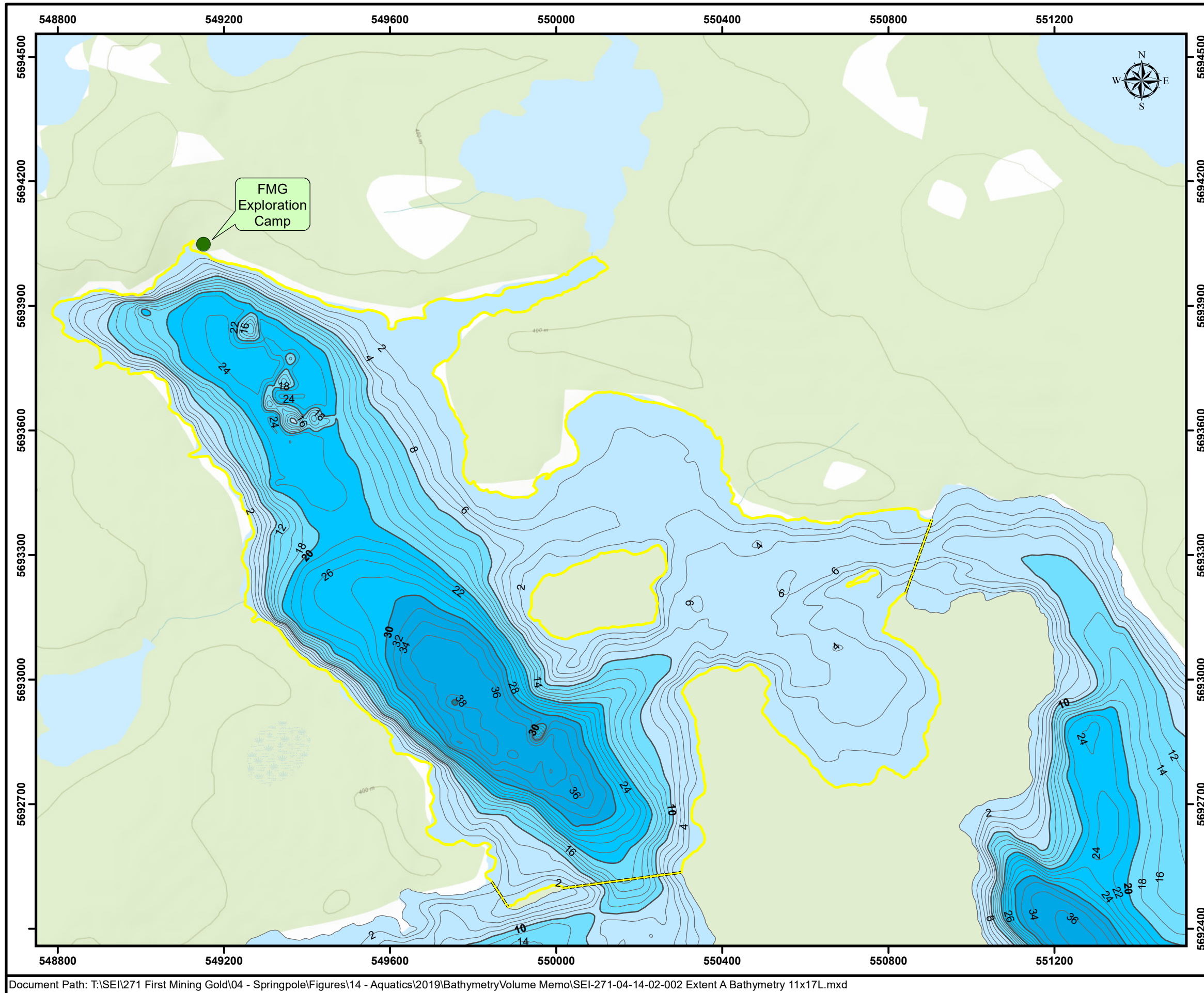
| | | | |
|--|---------|--|-------------------------------|
| | 0-10 m | | Major Contour (10 m interval) |
| | 10-20 m | | Minor Contour (2 m interval) |
| | 20-30 m | | |
| | 30-40 m | | |
| | 40-50 m | | |



Credits: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HD37. Contour Lines created by SEI using Reefmaster V2.0. FMG – First Mining Gold Corp.

| | |
|--------------------------------------|---------------|
| First Mining Gold Corp. | |
| Springpole Gold Project | |
| 2019 Aquatics Program | |
| Springpole Lake Bathymetry | |
| Project Number: 271-04-14-02-2019 | |
| Drawing Number: SEI-271-04-14-02-003 | |
| Drawn by: SED | Rev'd by: JSP |
| Date: 10-Oct-2019 | |

Figure 1
Springpole Lake Bathymetry

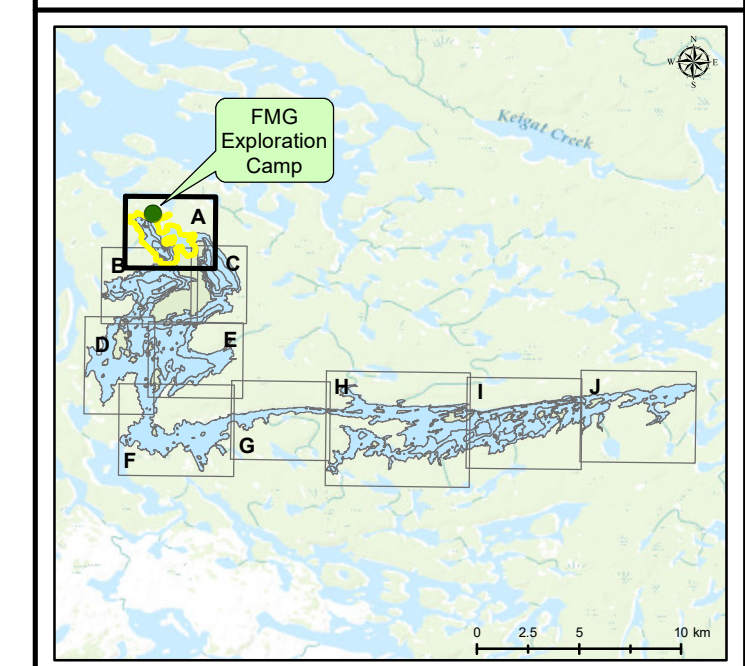


FIRST MINING GOLD

Springpole Lake - Extent A

Legend

| | | | |
|-----------------|---------|---------|-------------------------------|
| Isobaths | 0-10 m | 20-30 m | Minor Contour (2 m interval) |
| | 10-20 m | 30-40 m | Major Contour (10 m interval) |
| | | | Proposed Cofferdam |
| | | | Proposed Area to be Dewatered |



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

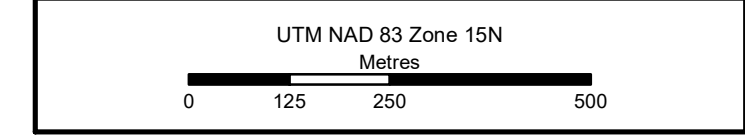
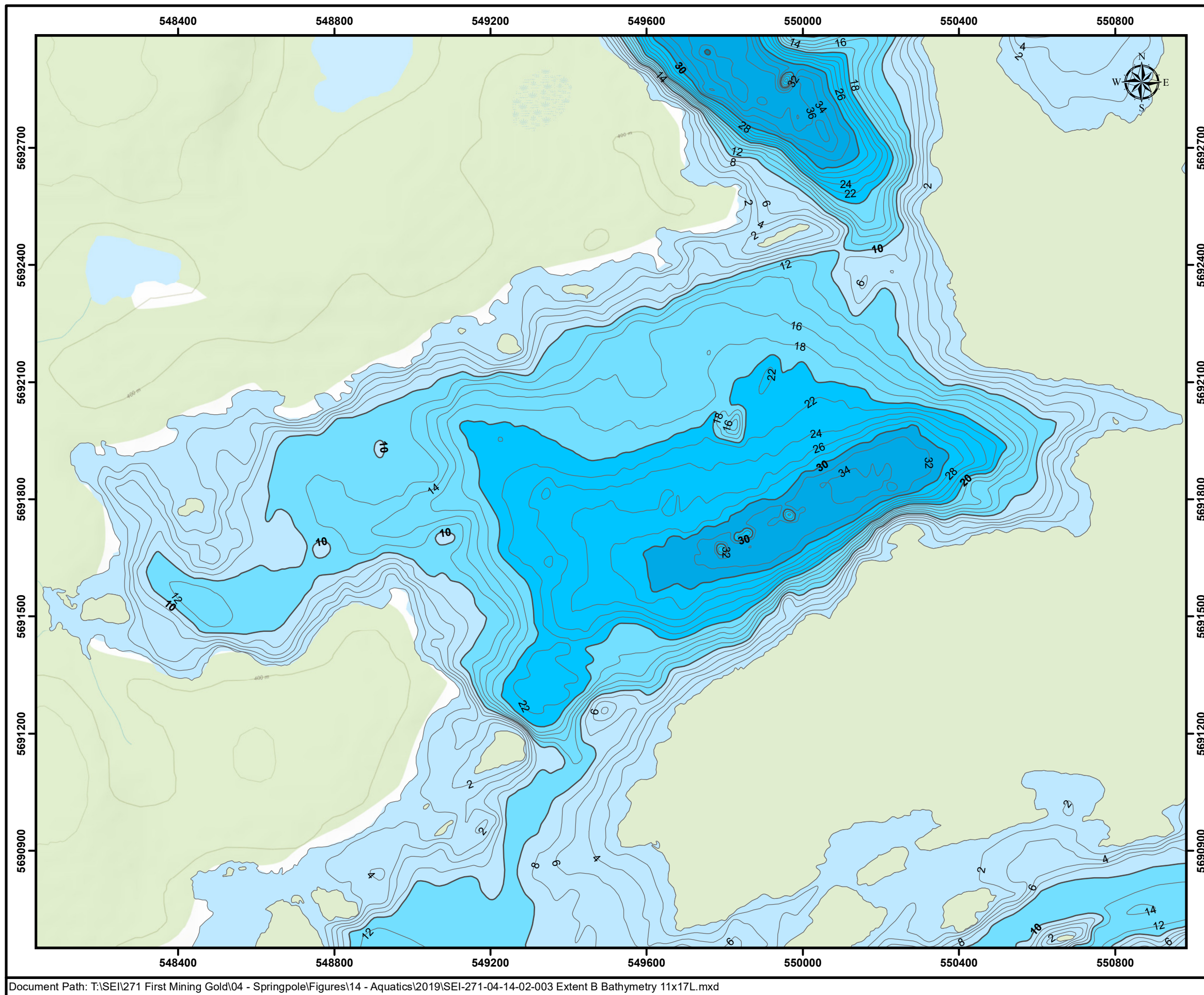



Figure 1A

| | | |
|--------------------------------------|---------------|-------------------|
| First Mining Gold Corp. | | |
| Springpole Gold Project | | |
| 2019 Aquatics Program | | |
| Springpole Lake - Extent A | | |
| Project Number: 271-04-14-02 | | |
| Drawing Number: SEI-271-04-14-02-005 | | |
| Drawn by: SED | Rev'd by: JSP | Date: 07-Jan-2020 |












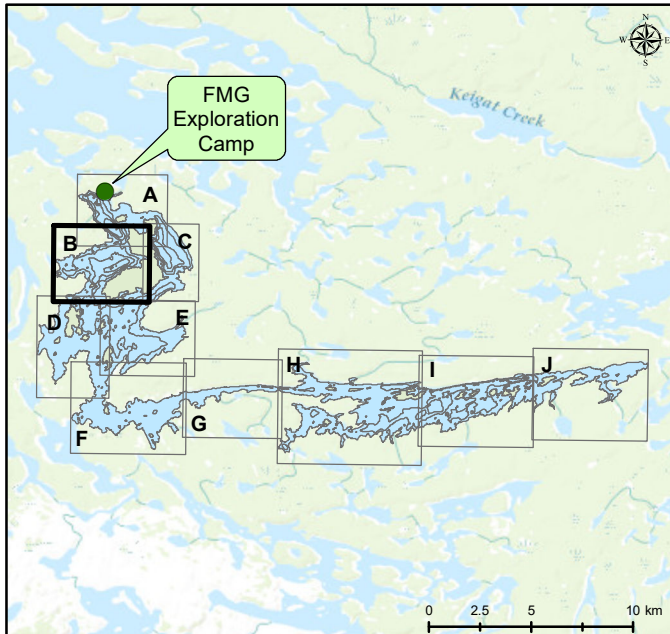


FIRST MINING GOLD

Springpole Lake - Extent B

Legend

| | | | | | |
|-----------------|---|---|---|---|---|
| Isobaths |  0-10 m |  20-30 m |  30-40 m |  40-50 m |  Minor Contour (2 m interval) |
| |  10-20 m | | | |  Major Contour (10 m interval) |



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

UTM NAD 83 Zone 15N

Metres

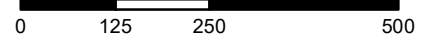

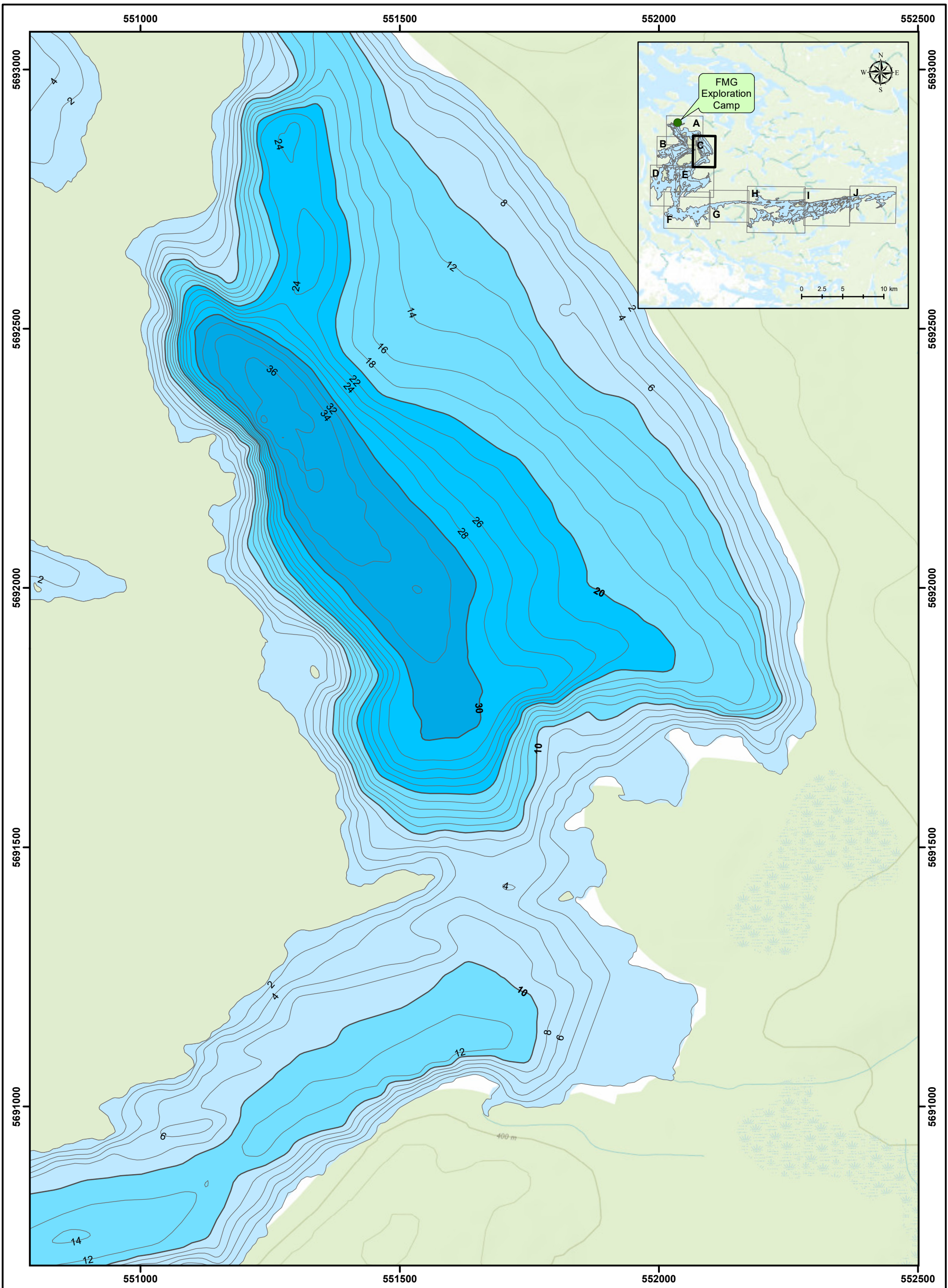


Figure 1B

| | | |
|--------------------------------------|---------------|-------------------|
| First Mining Gold Corp. | | |
| Springpole Gold Project | | |
| 2019 Aquatics Program | | |
| Springpole Lake - Extent B | | |
| Project Number: 271-04-14-02 | | |
| Drawing Number: SEI-271-04-14-02-002 | | |
| Drawn by: NRM | Rev'd by: JSP | Date: 03-Oct-2019 |





Legend

Isobaths

- 0-10 m
- 10-20 m
- 20-30 m
- 30-40 m

Minor Contour (2 m interval)
Major Contour (10 m interval)

UTM NAD83 Zone15N

Metres
0 50 100 200

STORY environmental

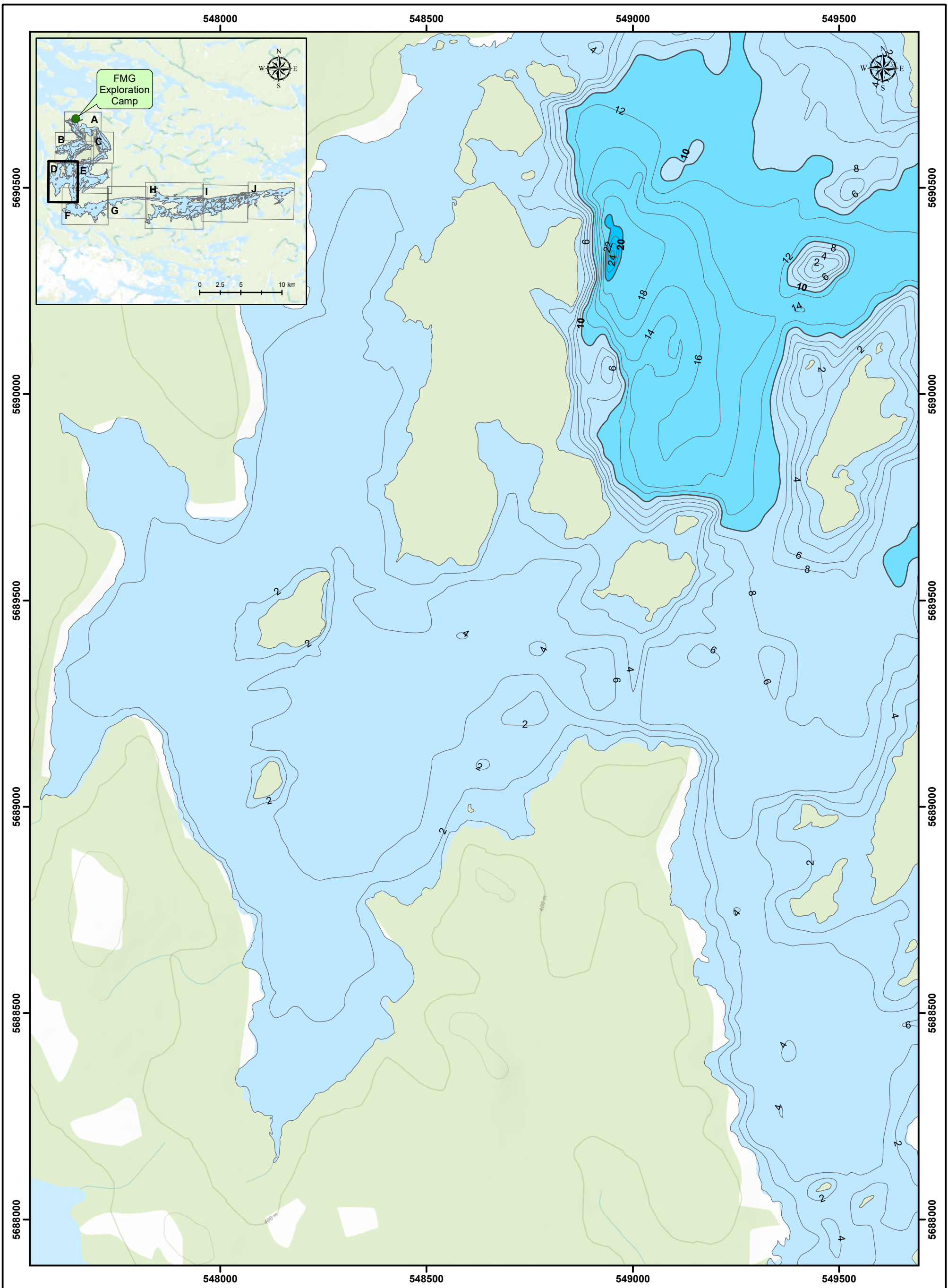
First Mining Gold Corp.
2019 Aquatics Program
Drwn by: SED | Rvw'd by: JSP
Date: 03-Oct-2019

FIRST MINING GOLD

Springpole Gold Project
Springpole Lake - Extent C
Project No.: 271-04-14-02
Drawing No.: SEI-271-04-14-02-004

Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

Springpole Lake - Extent C **Figure 1C**



Legend

| | | | |
|--|---------|--|-------------------------------|
| | 0-10 m | | Minor Contour (2 m interval) |
| | 10-20 m | | Major Contour (10 m interval) |
| | 20-30 m | | |

UTM NAD83 Zone15N

Metres

0 50 100 200

STORY environmental

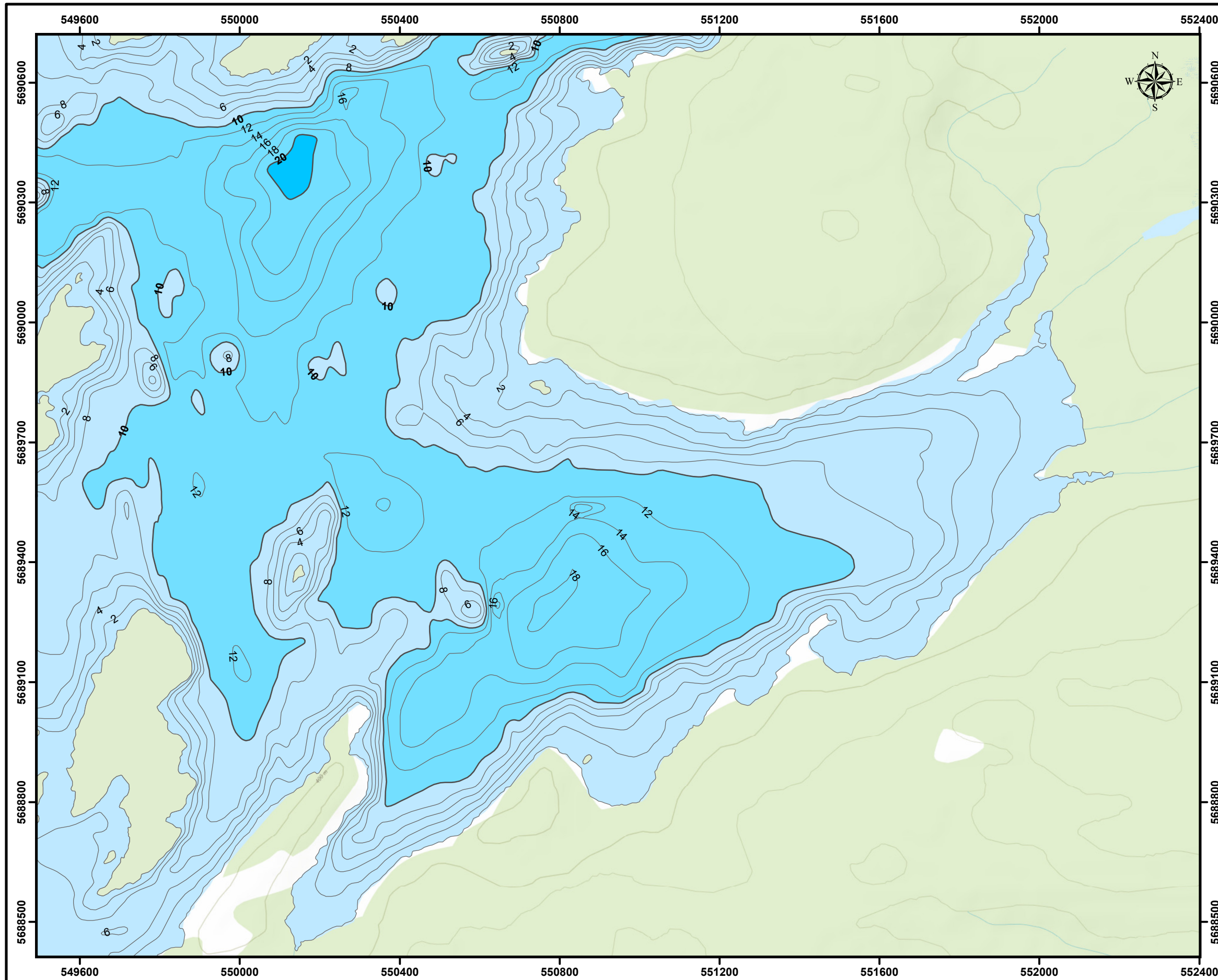
First Mining Gold Corp.
 2019 Aquatics Program
 Drwn by: SED | Rvw'd by: JSP
 Date: 03-Oct-2019


FIRST MINING GOLD

Springpole Gold Project
 Springpole Lake - Extent D
 Project No.: 271-04-14-02
 Drawing No.: SEI-271-04-14-02-006

Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

Springpole Lake - Extent D **Figure 1D**



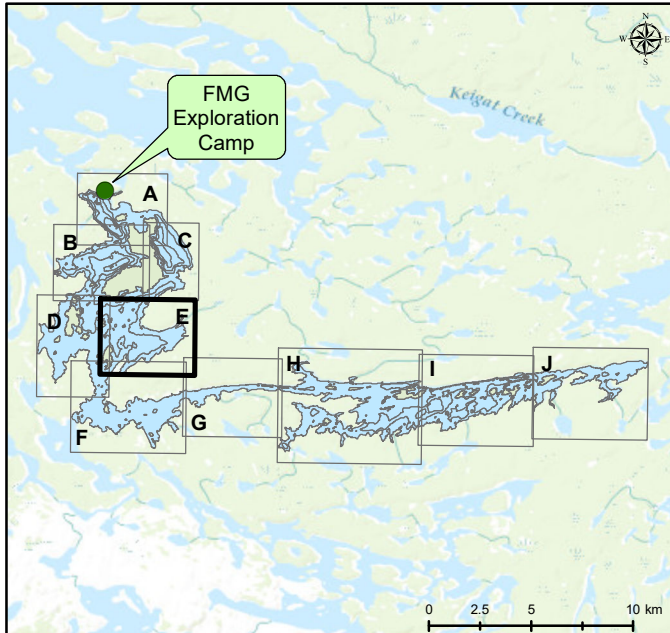


FIRST MINING GOLD

Springpole Lake - Extent E

Legend

| | |
|--|---|
| <p>Isobaths</p> <ul style="list-style-type: none"> 0-10 m 10-20 m 20-30 m | <ul style="list-style-type: none"> Minor Contour (2 m interval) Major Contour (10 m interval) |
|--|---|



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

UTM NAD 83 Zone 15N

Metres

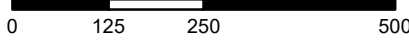

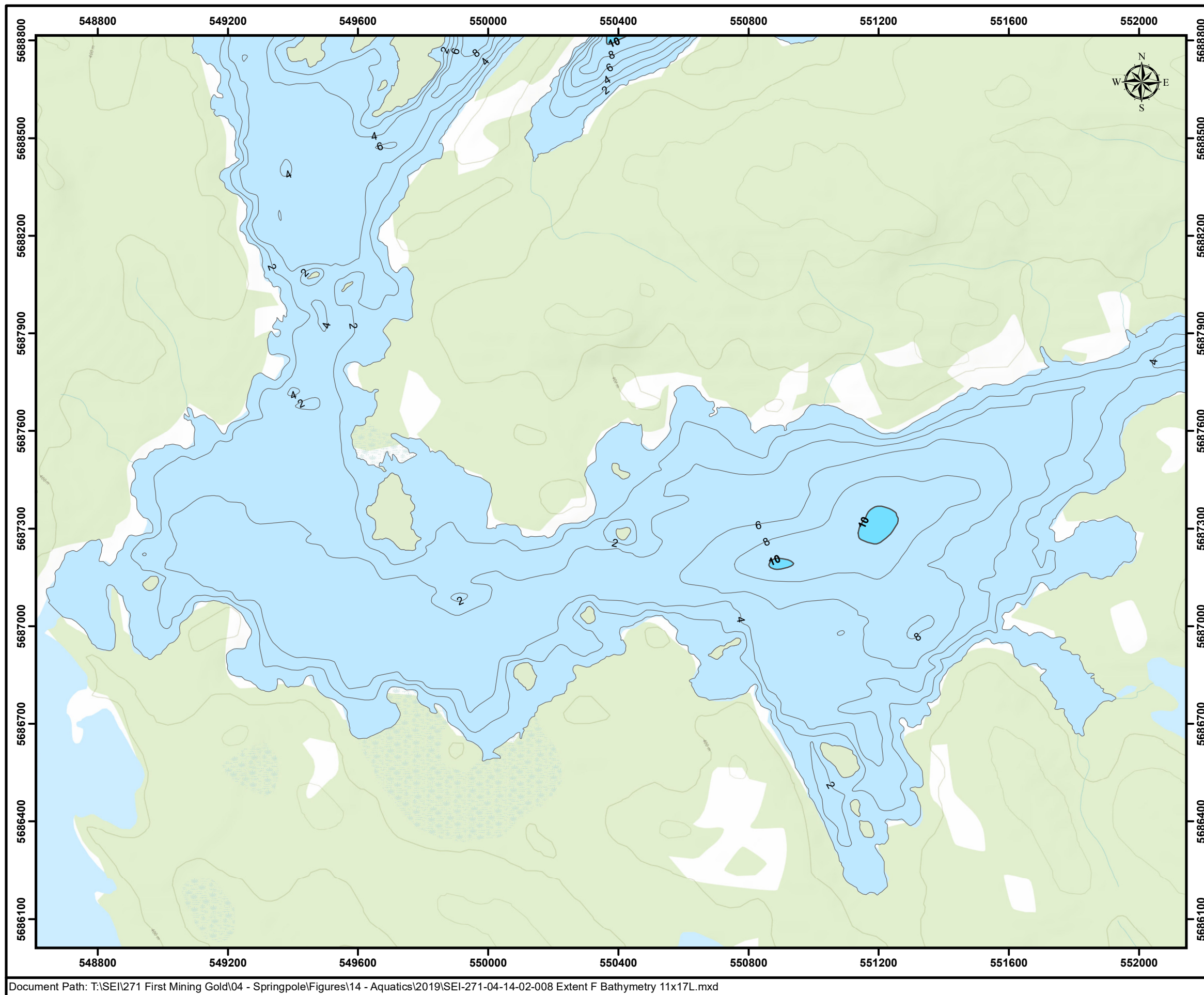


Figure 1E

| | | |
|--------------------------------------|---------------|-------------------|
| First Mining Gold Corp. | | |
| Springpole Gold Project | | |
| 2019 Aquatics Program | | |
| Springpole Lake - Extent E | | |
| Project Number: 271-04-14-02 | | |
| Drawing Number: SEI-271-04-14-02-007 | | |
| Drawn by: SED | Rev'd by: JSP | Date: 03-Oct-2019 |







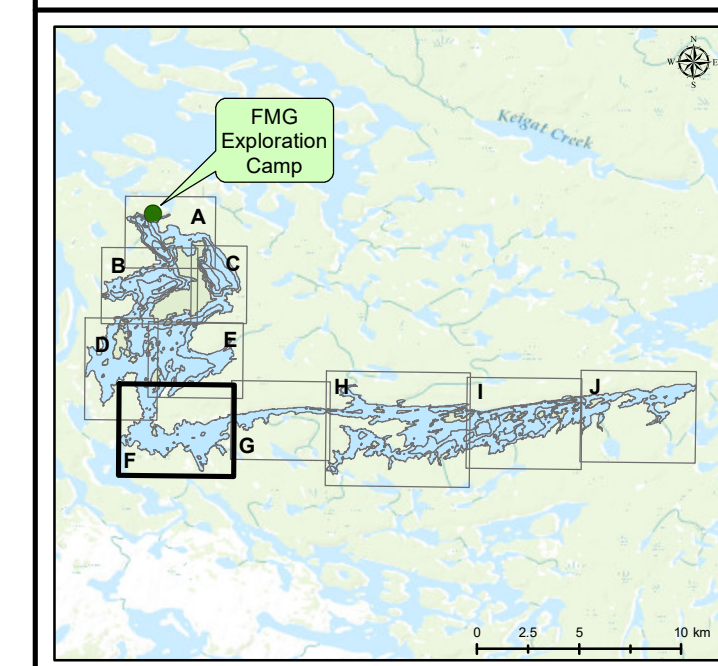


FIRST MINING GOLD

Springpole Lake - Extent F

Legend

| | | | |
|---|---------|---|-------------------------------|
|  | 0-10 m |  | Minor Contour (2 m interval) |
|  | 10-20 m |  | Major Contour (10 m interval) |



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

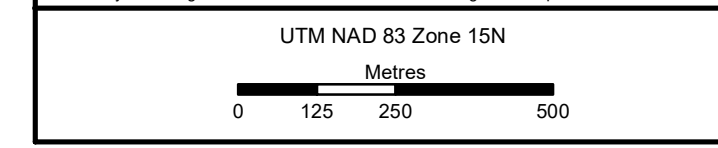


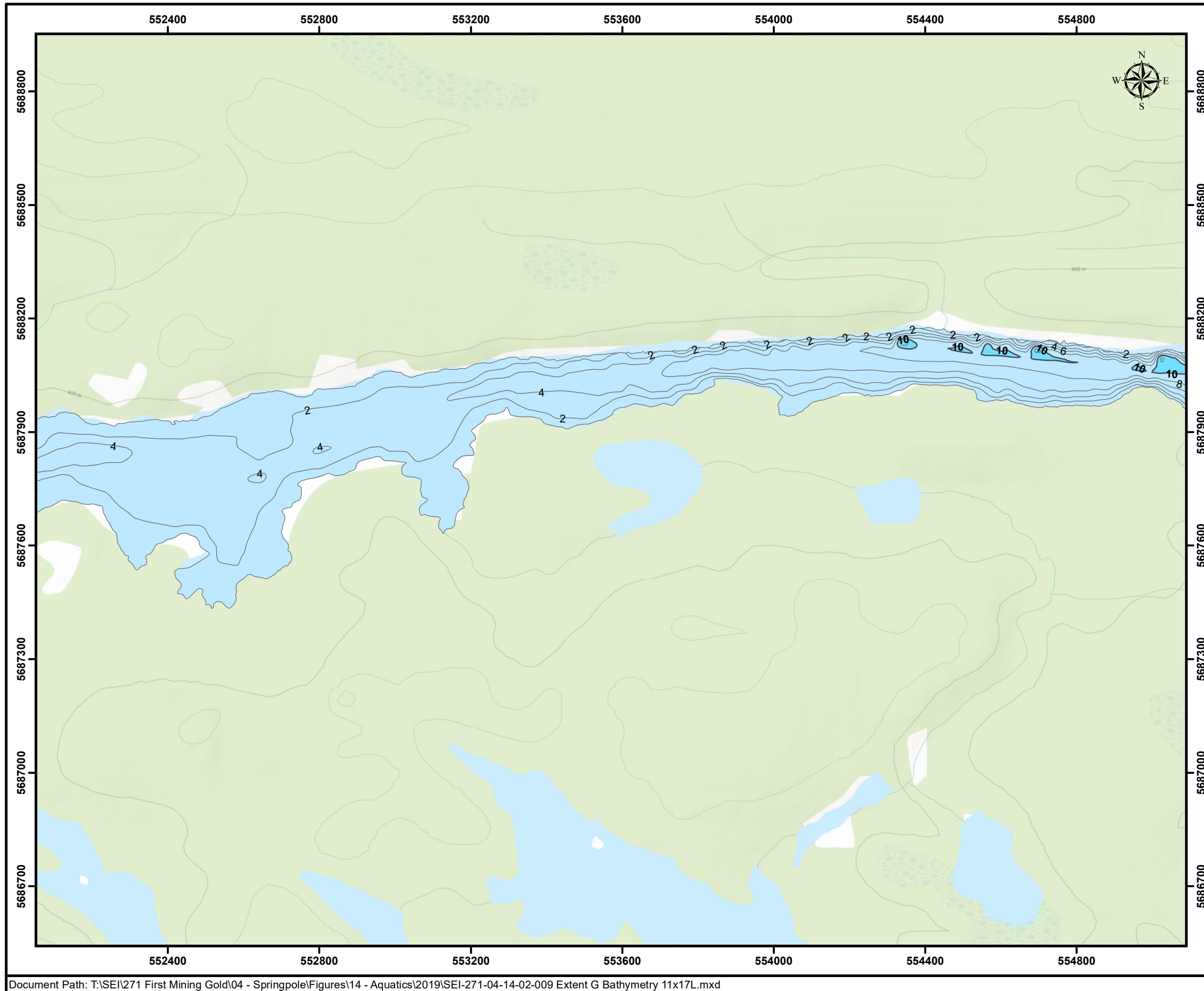
Figure 1F

| | | |
|--------------------------------------|---------------|-------------------|
| First Mining Gold Corp. | | |
| Springpole Gold Project | | |
| 2019 Aquatics Program | | |
| Springpole Lake - Extent F | | |
| Project Number: 271-04-14-02 | | |
| Drawing Number: SEI-271-04-14-02-008 | | |
| Drawn by: SED | Rev'd by: JSP | Date: 03-Oct-2019 |

STORY

environmental



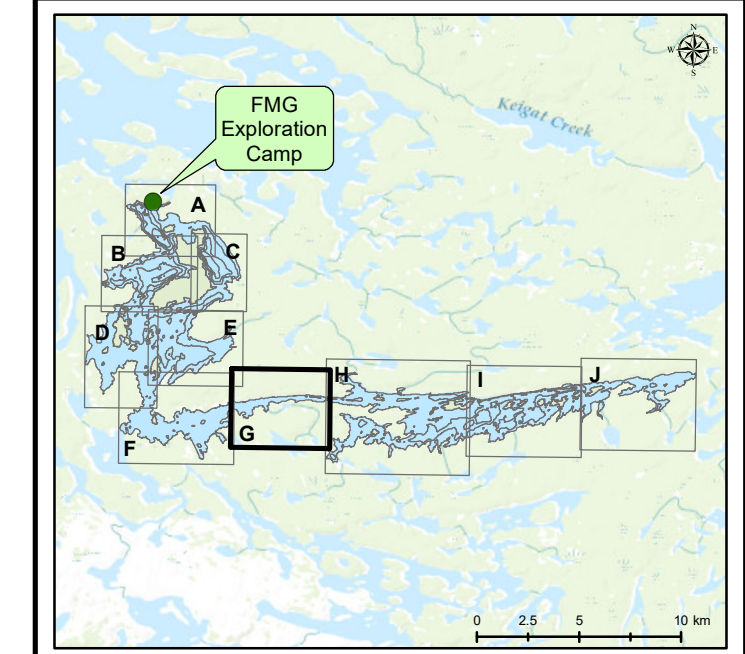


FIRST MINING GOLD
Springpole Lake - Extent G

Legend

Isobaths

- 0-10 m
- 10-20 m
- Minor Contour (2 m interval)
- Major Contour (10 m interval)



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

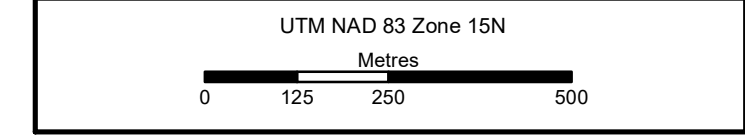
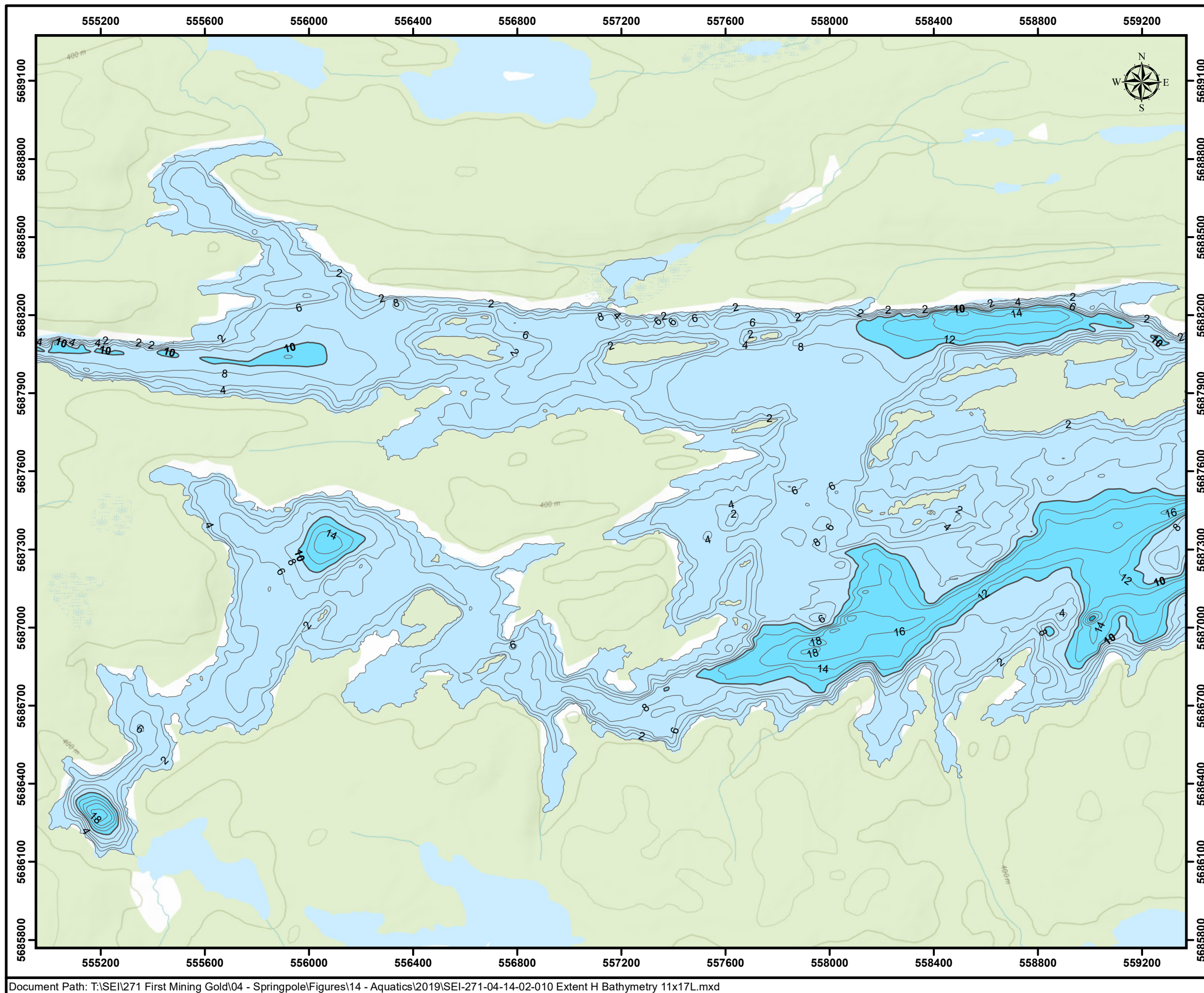



Figure 1G

| | | |
|--------------------------------------|---------------|-------------------|
| First Mining Gold Corp. | | |
| Springpole Gold Project | | |
| 2019 Aquatics Program | | |
| Springpole Lake - Extent G | | |
| Project Number: 271-04-14-02 | | |
| Drawing Number: SEI-271-04-14-02-009 | | |
| Drawn by: SED | Rev'd by: JSP | Date: 03-Oct-2019 |





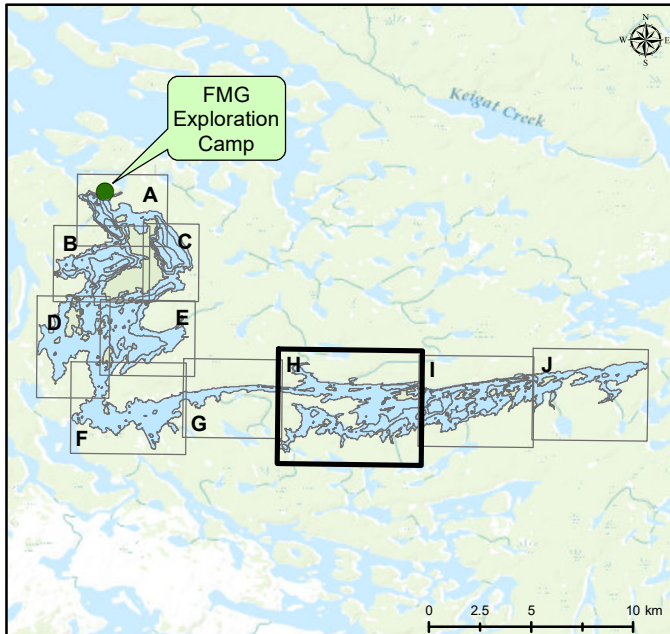


FIRST MINING GOLD

Springpole Lake - Extent H

Legend

| | |
|--|---|
| <p>Isobaths</p> <ul style="list-style-type: none"> 0-10 m 10-20 m 20-30 m | <ul style="list-style-type: none"> — Minor Contour (2 m interval) — Major Contour (10 m interval) |
|--|---|



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

UTM NAD 83 Zone 15N

Metres




Figure 1H

First Mining Gold Corp.

Springpole Gold Project


2019 Aquatics Program

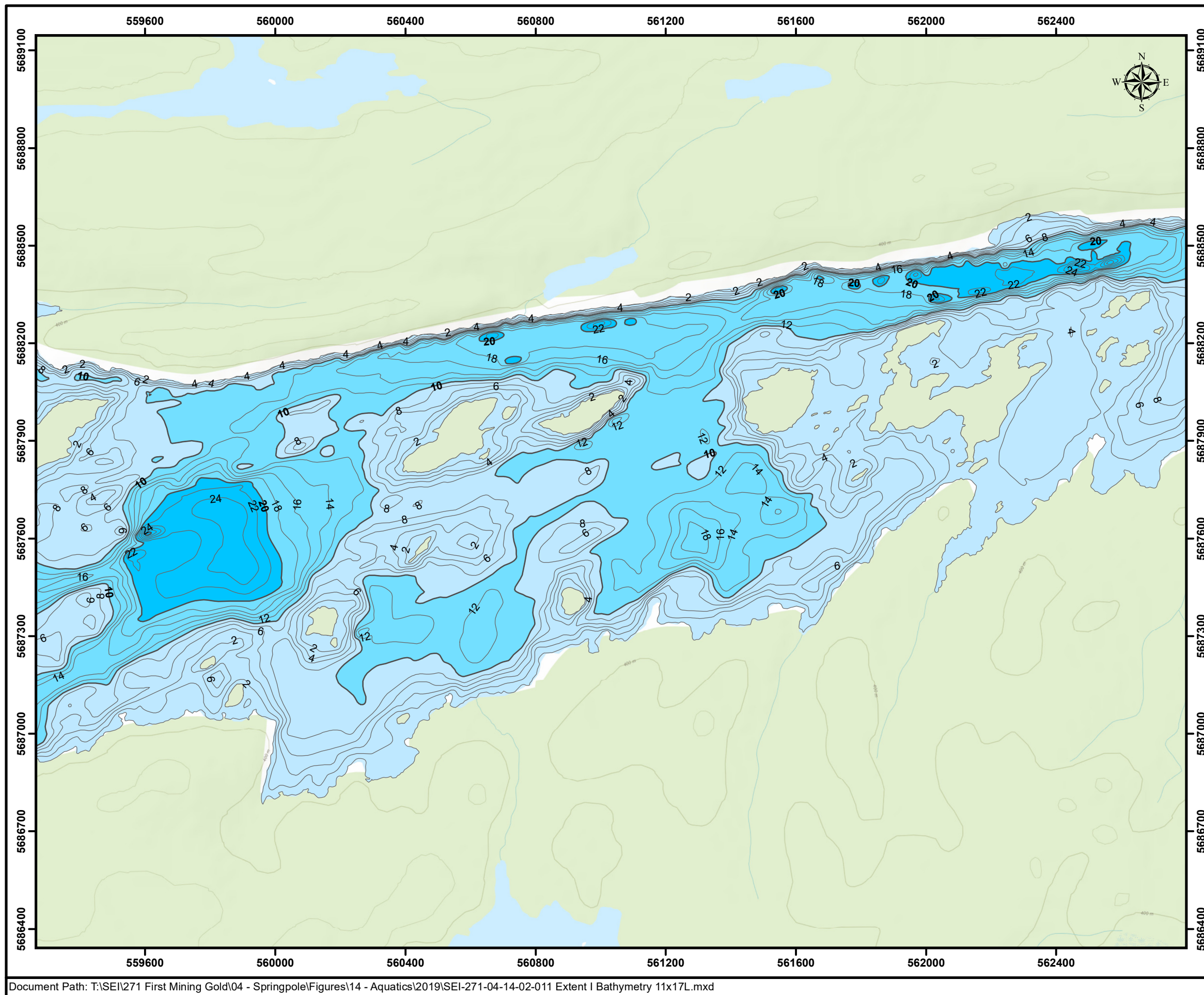
Springpole Lake - Extent H


Project Number: 271-04-14-02

Drawing Number: SEI-271-04-14-02-010

Drawn by: SED | Rev'd by: JSP | Date: 03-Oct-2019




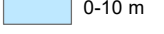






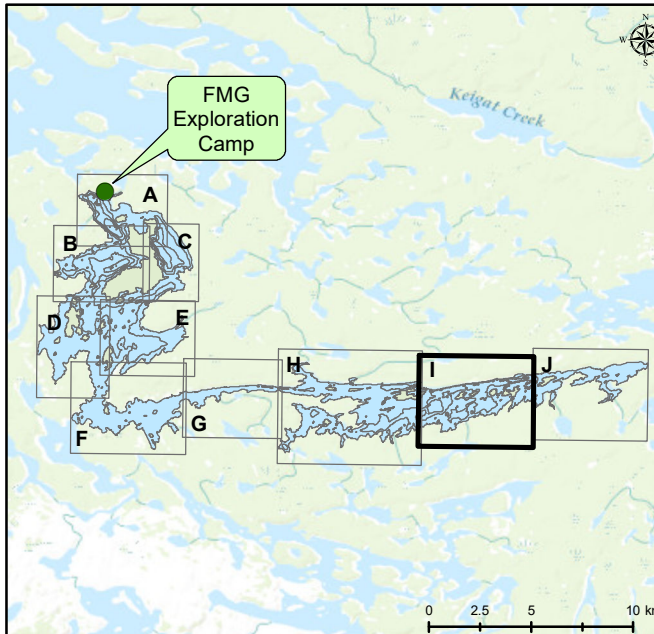


FIRST MINING GOLD

Springpole Lake - Extent I

Legend

| | | | | | | |
|-----------------|--|---|---|---|--|---|
| Isobaths |  0-10 m |  10-20 m |  20-30 m |  30-40 m |  Minor Contour (2 m interval) |  Major Contour (10 m interval) |
|-----------------|--|---|---|---|--|---|



Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Bathymetry data obtained in September 2017 and August 2019 with the use of a Lowrance HDS7. Contour lines created by SEI using ReefMaster V2.0. "FMG" = First Mining Gold Corp.

UTM NAD 83 Zone 15N




Figure 11

| | | |
|--------------------------------------|---------------|-------------------|
| First Mining Gold Corp. | | |
| Springpole Gold Project | | |
| 2019 Aquatics Program | | |
| Springpole Lake - Extent I | | |
| Project Number: 271-04-14-02 | | |
| Drawing Number: SEI-271-04-14-02-011 | | |
| Drawn by: SED | Rev'd by: JSP | Date: 03-Oct-2019 |

