AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT

PREPARED FOR

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EXECUTIVE SUMMARY

The Kitsault Mine Project is located roughly 140 km north of Prince Rupert at the head of the Alice Arm (Pacific Ocean). Meteorological and hydrological data have been collected at the project site since late 2008, and were also collected on site in various capacities from the 1960's through the 1990's. These data are presented and discussed in this report. Long-term values of various meteorological and hydrological parameters are estimated based on the available site and regional data.

The meteorological parameter estimates herein are for the Kitsault project site meteorological station, located at elevation 682 m.

The key findings of the study are:

- The mean annual temperature is estimated to be 3.7 °C, with minimum and maximum mean monthly temperatures of -5.8 °C and 12.4 °C occurring in January and July, respectively.
- The mean annual wind speed is approximately 1.9 m/s.
- The mean annual relative humidity is approximately 80.5%.
- The mean annual lake evaporation (potential evapotranspiration) is estimated to be 450 mm.
- The mean annual precipitation is estimated to be 2000 mm, with 45% falling as rain and 55% falling as snow.
- The mean annual unit runoff for Lime Creek at the mouth is 45.7 l/s/km^2.
- The mean annual unit runoff for Patsy Creek at its confluence with Lime Creek is 45.1 l/s/km^2.
- The mean annual unit runoff for Clary Creek at the outlet of Clary Lake is 45.1 l/s/km^2.
- The annual hydrographs for creeks in the Kitsault area typically have a bi-modal shape, with the highest peak occurring in the spring freshet period and a secondary peak occurring in late fall or early winter.
- Return period peak flows and 7-day low flows were estimated for Lime Creek at the mouth, Patsy Creek at the Lime Creek confluence, and Clary Creek above Clary Lake. The 200-year peak flow values are 140 m^3/s, 22 m^3/s, and 112 m^3/s, respectively. Respective 10-year 7-day low flows are estimated to be 0.08 m^3/s, 0.01 m^3/s, and 0.06 m^3/s.
- The effective annual runoff coefficient for natural drainage areas in the project area is estimated to be approximately 0.70.
- Climate change has not been considered explicitly in the hydrometeorological estimates, and appropriate allowances should be made where necessary.

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SECTION 1.0 - INTRODUCTION

1.1 PROJECT DESCRIPTION

The Kitsault Mine Project is located roughly 140 km north of Prince Rupert, British Columbia, near the head of the Alice Arm (Pacific Ocean). The project area is in the Boundary Range of the Coast Mountains. While the general area is characterized by steep-sided, glaciated mountains and deeply incised creeks, the immediate project area is situated amongst mid-elevation terrain at the western side of a pass between the Alice Arm and the Nass River. The elevation of the project area ranges from roughly 600 to 1000 m above sea level. The project location is shown on Figure 1.1.

Three known molybdenum resources are located on the property, with the Kitsault open pit mine being the focus of planned operations. Mining operations at Kitsault were started by Kennco Exploration Ltd. in 1968, but closed in 1972 to due low metal prices. Climax Molybdenum Company of British Columbia purchased the property in 1973 and recommenced production in 1981. Mining was again halted because of low metal prices in 1982. Approximately 30 million lbs of Molybdenum were produced during these two periods of mining (BC MINFILE Report number 103P 120, Natural Resources Canada). The property was reclaimed between 1996 and 2006. Avanti Kitsault Mine Ltd. (Avanti) purchased the mine and surrounding mineral tenures in 2008. The project is currently being advanced through permitting and design phases. Project infrastructure will include:

- An open pit mine
- A processing plant
- Water management/process facilities
- A reagent handling and storage facility
- Assay and metallurgical laboratories
- Air supply
- Power supply and distribution
- Staff accommodations
- An explosives manufacturing facility and magazines, and
- Solid and waste water management facilities.

1.2 PREVIOUS STUDIES

Rescan installed and operated meteorological and hydrological data collection instruments for the Kitsault project site from 2008 through 2010. Baseline reports were issued by Rescan in 2010 summarizing the results of their data collection programs.

SECTION 2.0 - CLIMATE AND METEOROLOGICAL DATA

2.1 PROJECT SITE STATIONS

The Meteorological Service of Canada (MSC) operated two meteorological stations at the Kitsault project site between 1968 and 1972, during construction and operation of the original mine.

In November 2008 an automated meteorological station was installed at Kitsault near the proposed plant site, at elevation 682 m. This station is considered to be in roughly the same location as the previous MSC Kitsault Minesite station. The current site meteorological station monitors the following parameters:

- Air temperature
- Relative humidity
- Atmospheric pressure
- Precipitation (tipping bucket rain gauge with winter adapter kit)
- Snow depth (ultrasonic)
- Solar radiation
- Wind speed, and
- Wind direction.

Three snow course survey locations were defined in 2009 throughout the Kitsault project area. These are surveyed monthly throughout the winter periods to help define a winter precipitation gradient and to define the snowmelt patterns on site.

Data from the Kitsault meteorology station are available for the period from November 15, 2008 to May 31, 2010. Maintenance checks have been conducted on a near monthly basis throughout 2009. Details of the site stations are summarized in Table 2.1, and locations are shown on Figure 2.1.

2.2 REGIONAL STATIONS

Several climate stations are located in the general project region, as shown on Figure 2.2. Regional stations include multiple stations operated by the MSC as well as two stations located in Alaska and operated by the Alaska Climate Research Centre (ACRC). Many of the stations in the region have been deactivated, and thus do not have data that are concurrent with the recent site data collection. The regional stations, their locations, and their periods of record are summarized in Table 2.2.

2.3 TEMPERATURE

Temperature data were collected at the Kitsault mine site from 1968 through 1972 by MSC. In addition, temperature data have been collected more recently (2008 – 2010) at the existing site weather station installed by Rescan. These data are summarized as monthly average values in Table 2.3. Averaging the available site data results in a mean annual temperature estimate of 3.1 °C. The available site data are incomplete for most years, however, and therefore these data were correlated with concurrent and longer term regional data to provide an alternate estimate, which is believed to be more representative of long-term conditions.

The available site data were compared with concurrent temperature data from the MSC operated meteorological stations in Stewart, BC. Temperature records from two stations, Stewart BCHPA (ID 1067745) and Stewart A (ID 1067742) were combined to form a single data set with approximately 38 years of record. These two stations are very close in location, and a comparison of their temperature data through approximately two years of concurrent record shows an average difference in monthly mean temperature of only 0.5 °C. The data from this combined record were correlated with the site data using simple linear regression, and the two datasets were found to have a high degree of correlation ($R^2 = 0.96$). A synthetic long-term temperature record for Kitsault was then generated by applying the linear regression equation to the long-term temperature values for Stewart, and the resulting synthetic temperature series has a mean annual value of 3.7 °C, as shown in Table 2.3. Also provided in this table are estimates of long-term average monthly temperature values.

2.4 WIND SPEED AND DIRECTION

The site meteorological station installed in 2008 records wind speed and direction. These data are the only available wind speed data for the site, and are summarized in Table 2.4. The brief period of record (November 2008 to May 2010) indicates a mean wind speed of 1.9 m/s. Rescan has reported that the predominant wind direction in winter is east-southeast, and in the summer it is north-northwest.

It should be noted that there is little more than one full year of wind data for the site, and thus the statistics should be treated with appropriate caution.

2.5 RELATIVE HUMIDITY

Relative humidity has been recorded at site only since the installation of the existing meteorological station in November, 2008. Mean monthly relative humidity is summarized in Table 2.5. The mean annual relative humidity as represented by the data is 80.5%.

The relative humidity statistics should be treated with appropriate caution due to the limited period of record.

2.6 EVAPOTRANSPIRATION

There are no site or regional evaporation datasets available, and therefore evaporation for the site was estimated according to common empirical equations for potential evapotranspiration (PET). PET values are generally representative of lake evaporation. Both the Hargreaves and Thornthwaite equations were used, and the resulting average monthly and annual values are summarized in Table 2.6.

The Hargreaves equation uses mean, minimum and maximum temperature values, as well as the site latitude, to estimate PET, whereas the simpler Thornthwaite equation uses just mean temperatures and the site latitude to estimate PET. Mean, minimum and maximum monthly temperature data are available for the periods 1968 – 1972 and 2008 – 2010, as described above in Section 2.3, and these data were used to estimate PET with both equations, with resulting annual estimates of 499 mm and 368 mm. Additionally, the synthetic long-term monthly temperature series was used with the Thornthwaite equation

to generate a mean annual PET estimate of 394 mm. These values represent quite a range, but it is generally consistent with the 400 mm to 500 mm range indicated in the *Canadian Hydrological Atlas* (Natural Resources Canada, 1978), and the approximate 500 mm value indicated in the *Manual of Operational Hydrology in British Columbia* (Coulson, 1991). It is not clear which estimate is most realistic, and therefore an intermediate value of 450 mm was selected for the project. Mean monthly values were then prorated from this according to the percent monthly distributions of the 499 mm and 368 mm estimates.

The estimated long-term mean annual and monthly evaporation estimates for the Kitsault site are provided in Table 2.6.

2.7 PRECIPITATION

Site precipitation data are available from the current meteorological station, as well as from the historic Kitsault stations operated by MSC.

2.7.1 Mean Annual Precipitation

The Kitsault site precipitation data are summarized on a monthly basis in Table 2.7. Data from each month has been averaged, and those average values were summed to estimate a mean annual precipitation (MAP) of 1774 mm. However, there are concerns about the validity of the site station data, particularly for the winter months when catch efficiency of precipitation gauges is commonly much less than 100%, and may be as low as 50% or less, depending on conditions. Environment Canada has procedures to minimize this error, such as the use of wind shields, and also may apply adjustment factors to the data, so the MSC data are considered reasonably valid. The current meteorology station winter data, however, are likely erroneously low, and the exclusion of the 2008-2010 values results in a revised MAP estimate of 1985 mm. Although these estimates are based on data collected at site, this dataset has a limited period of record, and most years have data gaps. As such, data from regional stations were also considered in determining a long-term estimate of MAP for the Kitsault project site.

The MAP values for the regional meteorological stations are summarized in Table 2.2, and the locations of the most relevant stations are shown on Figure 2.2. Of those stations shown, only two have data that were collected through the same period as the site data. The two stations with concurrent data are Stewart BCHPA (ID 1067745) and Aiyansh (ID 1070150).

Data are available from the Stewart BCHPA station for the years 1967 to 1976. When this station was discontinued another station was activated nearby at the Stewart Airport. Verified data are available from the Stewart A station from 1975 to 2007. Precipitation data from Stewart BCHPA and Stewart A stations were combined to provide a 40 year record that could be used to estimate the MAP at the Kitsault project site. A double-mass analysis (Ponce, 1989) was used to adjust the Stewart BCHPA precipitation data to represent the conditions at Stewart A. This combined record will be referred to below as the Stewart record.

Similarly, the Aiyansh meteorological station was discontinued at roughly the same time as another station was activated nearby at Nass Camp. These two records were combined using a double-mass analysis to adjust the earlier data to reflect conditions at Nass Camp. The combined record covers roughly 83 years from 1924 to 2007. This dataset will be referred to below as Aiyansh/Nass.

The double-mass analysis method was used to compare the concurrent data from the Kitsault MSC stations and the Stewart station. This analysis indicated that total precipitation at Kitsault is 98% of that at Stewart. This relationship seems appropriate due to the similar location of Stewart and Kitsault relative to the coast. According to this analysis the MAP at the Kitsault site should be approximately 1830 mm.

The same method was used to compare the Kitsault MSC and Aiyansh/Nass datasets, and indicated that annual precipitation at Kitsault is approximately double that at Aiyansh. This difference is attributable to Aiyansh's more inland location, where it is more sheltered from the moist maritime air systems moving in from the Pacific Ocean. The analysis indicates a MAP value of approximately 2050 mm for the Kitsault project site.

A summary of the MAP estimates for the site is presented in Table 2.8. Based on these values, and recognizing the uncertainty associated with the estimation procedure, a MAP value of 2000 mm was selected for the Kitsault project site. This value is generally consistent with the isohyetal map presented in the *Manual of Operational Hydrology in British Columbia* (Coulson, 1991), which indicates 1800 mm for the general area, and with the 2186 mm value generated by the algorithm on the ClimateBC website, which is published by the Faculty of Forestry at the University of British Columbia and is based on downscaled PRISM (Parameter-elevation Regressions on Independent Slopes Model) values developed by Oregon State University.

The MAP estimate of 2000 mm is for an elevation of approximately 650 m. However, precipitation at the Kitsault project area is expected to vary with elevation due to the steep topography of the area and the corresponding orographic lift of moist maritime air masses. Suitable data are not available to quantify this orographic effect, but based on extensive experience with climate patterns in coastal British Columbia, it is anticipated that annual precipitation changes with elevation at a rate of approximately 5% to 10% per 100 m. An additional discussion on orographic effects is provided in Section 4.2.1 of this report.

2.7.2 Monthly Precipitation Distribution

The monthly distributions of precipitation for the Kitsault site stations and several regional stations are summarized in Table 2.9. All of the stations generally demonstrate comparable monthly proportions, and have a similar annual pattern with the majority of precipitation consistently occurring in the fall and winter months. The monthly distribution of precipitation at site was estimated as the average of all the distributions shown in the table. The corresponding average monthly precipitation values, based on a MAP of 2000 mm, are provided in Table 2.9.

2.7.3 Rain/Snow Distribution

The monthly distribution of rain/snow at site has been estimated on the basis of the MSC site data collected during the period of 1968 – 1972. These data indicate an annual distribution of approximately 45% rain and 55% snow, which seems reasonable and appropriate given the 637 m average elevation of the stations. For comparison, the split at Alice Arm, which is at a lower elevation of 314 m, is 63% rain and 37% snow. The monthly rain/snow distributions for both Kitsault and Alice Arm are summarized in Table 2.10.

2.7.4 Snowmelt

Snow survey data were collected at site during the winter/spring periods of 2009 and 2010. These data were collected both by snow depth measurement at the site meteorological station and with snow course sampling at three locations on site. The period of record of these data is inadequate to estimate a long-term snowmelt pattern for site.

Regional snowpack data from the Cedar-Kiteen Automated Snow Pillow (ID 4B18P) and the Bear Pass Snow Survey (ID 4B11A) were considered for estimating a snowmelt pattern for the Kitsault site. These two stations are operated by the BC River Forecast Centre, with data available through their website. The Cedar-Kiteen station is located 54 km southeast of the Kitsault site, at elevation 885 m. Archived snow-water-equivalent data at Cedar-Kiteen indicates an average snowmelt pattern of 15% in April, 60% in May, and 25% in June.

The Bear Pass manual survey site is located 77 km north of the Kitsault site, at elevation 437 m. Archived data from Bear Pass show an average snowmelt pattern of 16% in April, 79% in May, and 5% in June.

The Kitsault site is located at an approximate elevation of 650 m and thus the snowmelt pattern should be intermediate to the above regional stations. Correspondingly, a snowmelt pattern of 15% in April, 70% in May, and 15% in June was assumed for the Kitsault site.

2.8 EXTREME PRECIPITATION

The extreme 24 hour rainfall values for the Kitsault site were estimated according to the data in the *Rainfall Frequency Atlas of Canada* (Hogg et al., 1985) (RFAC). Mean and standard deviations for annual rainfall extremes of various durations are presented on isohyetal maps in the RFAC. Frequency factors and equations are provided for determining rainfall events for any return period based on a Gumbel distribution. The atlas also recommends adjusting the values for coastal, mountainous catchments based on given orographic augmentation factors. The atlas suggests the application of Hershfield frequency factors for determining Probable Maximum Precipitation events of various durations.

Extreme precipitation events for the Kitsault site are presented in Table 2.11. The 24-hour extreme precipitation for 10, 25, and 200 year return periods are estimated to be 133 mm, 155 mm, and 204 mm, respectively.

Annual extreme precipitation events at regional stations were reviewed to validate the data from the RFAC. The Stewart A MSC station has 31 years of annual extreme daily precipitation records. These daily values were converted to equivalent 24 hour events using a standard scaling factor of 1.13 (Miller et al., 1973). The result is a mean annual 24 hour extreme precipitation of 86.4 mm and a standard deviation of 25.2 mm. These values are quite similar to the RFAC predictions for Stewart, and for Kitsault, which makes sense given the similar mean annual precipitation values for these two locations.

The Nass Camp MSC station has 24 years of extreme daily precipitation records. As above, these values were scaled by 1.13 to adjust them to 24 hour events. The result is a mean annual 24 hour extreme precipitation of 60.7 mm and a standard deviation of 20.1 mm. These values are consistent with the isohyetal plots in the RFAC.

These regional comparisons suggest that the results of the RFAC analysis are appropriate for estimating extreme rainfall at the Kitsault project site.

It is worth noting that the five greatest rainfall events on record at both the Nass Camp and Stewart A stations occurred in the months of October to January, inclusive, and correspondingly extreme rainfall events at the Kitsault project area can be expected to occur during the same time of year.

SECTION 3.0 - HYDROLOGY DATA

3.1 PROJECT SITE STATIONS

The Water Survey of Canada (WSC) branch of Environment Canada operated two streamflow monitoring stations in the Kitsault project area, though both are now deactivated. This included one station on Patsy Creek that operated from 1987 to 1996, and one station on Lime Creek that operated from 1976 to 1996. These stations had average annual unit runoff values of 45.7 l/s/km^2 and 47.0 l/s/km^2, respectively. The data from these WSC stations form the primary basis for the hydrological analysis presented herein.

Streamflow data are currently being collected at four monitoring stations at the Kitsault site. There is one station installed on each of Clary Creek and Patsy Creek, and two stations installed on Lime Creek. Water level is recorded at each of these stations at 15 minute intervals based on measurements from submerged pressure transducers. The locations of the past and present site stations are shown on Figure 2.1, and the stations' characteristics are summarized in Table 3.1. The catchment boundaries of Clary Creek, Patsy Creek, and Lime Creek are shown on Figure 3.1.

The streamflow station on Clary Creek (CCK-H1) is located upstream of Clary Lake, and monitors flow near the proposed location of the northeast tailings embankment. This station was installed in May 2010. The station on Patsy Creek (PCK-H1) was installed in late 2009, and monitors flow upstream of the confluence of Patsy Creek and Lime Creek. The Upper Lime Creek station (LCK-H1) was installed in 2009, and is located a short distance downstream of the confluence of the Patsy Creek confluence. The Lower Lime Creek station (LCK-H2) was originally installed in 2008, and then reinstalled in late 2009. Some data from the original installation has been lost. Rating curves for each of these stations are currently being developed but require additional information that is being collected with ongoing field work. It is anticipated that these rating curves will be complete at the end of the 2010 field season, at which time data from these stations will be analysed in more depth.

All of the site stations demonstrate a bi-modal annual hydrograph, with a snowmelt driven freshet peak flow period and a typically smaller but distinct fall storm induced peak flow period. None of the site stations have any glacier contribution in their watersheds.

3.2 REGIONAL STATIONS

The locations of regional streamflow stations are shown on Figure 2.2, and their characteristics are summarized in Table 3.2. These stations vary significantly in their catchment size and percent glaciated area. The mean annual unit runoff values of these stations vary from 34.0 l/s/km^2 to 93.8 l/s/km^2.

The regional stations are not considered in depth in this analysis due to the availability of reliable, long-term site streamflow data.

3.3 PROJECT AREA STREAMFLOW

The analysis of project area streamflow will consider flow on Lime Creek, Patsy Creek, and Clary Creek. The following subsections will present streamflow records and statistics for those creeks. The catchment areas of the creeks are shown on Figure 3.1.

3.3.1 Lime Creek

The WSC station on Lime Creek was located near the creek mouth and had a catchment area of 39.4 km^2. This station operated from 1976 to 1996, and the WSC archived data includes 15 complete years of daily flow records. The record indicates a mean annual discharge (MAD) of 1.6 m^3/s, which corresponds to a mean annual unit runoff (MAUR) of 45.7 $l/s/km^2$. A mean annual hydrograph for Lime Creek is presented on Figure 3.2, and the mean monthly flows are summarized in Table 3.3.

3.3.2 Patsy Creek

The WSC station on Patsy Creek operated from 1987 to 1996, with a total of 8 complete years of daily flow record available. This station had a catchment area of 4.68 km^2. This data was correlated to the WSC Lime Creek daily flow series using a ranked regression methodology. The resulting monthly regression relationships were then used to extend the Patsy Creek record through the period from 1976 to 1987. The result is a 15 year synthetic/measured daily flow series.

A mean annual hydrograph from the long-term Patsy Creek flow series is shown on Figure 3.3. The record indicates a MAD of 0.21 m^3/s, which corresponds to a MAUR of 45.1 $l/s/km^2$. A summary of mean monthly flows is provided in Table 3.4.

3.3.3 Clary Creek

A synthetic streamflow series was created for Clary Creek at the outlet of Clary Lake. This series was developed by scaling the Patsy Creek synthetic/measured flow series according to the ratio of the Clary Creek and the Patsy Creek catchment areas. This approach was taken because the two catchments are located immediately adjacent to one another and they are similar in their median watershed elevation, aspect, and catchment characteristics.

The resulting synthetic long-term daily flow series has a MAD of 1.31 m^3/s, which for a catchment area of 29.1 km^2 corresponds to a MAUR of 45.1 $l/s/km^2$. A mean annual hydrograph for Clary Creek is shown on Figure 3.4, and a summary of estimated monthly flows is shown in Table 3.5.

3.4 WET AND DRY MONTHLY FLOWS

Wet and dry monthly flows were estimated for Lime Creek, Patsy Creek and Clary Creek for a recurrence interval of 10 years. The monthly return period values were estimated from the 15-year flow series in the creeks, using the distribution fitting application provided in Palisade Decision Tools @RISK statistical software program. The best fit distribution type was selected for each month. Ratios relating 10-year wet and dry monthly values to the mean values are presented in Table 3.6. 10-year recurrence interval monthly discharges for other locations within the catchments may be estimated by multiplying calculated monthly flows by these ratios.

3.5 7-DAY LOW FLOWS

Minimum 7-day average low flows typically occur during late summer or late winter within unglaciated watersheds in northern coastal watersheds in BC. Lime Creek, Patsy Creek and Clary Creek are located within subzone 'S' of the Skeena Streamflow Region, as delineated in *Streamflow in the Skeena Region* (Obedkoff, 2001). The data measured by WSC on Lime and Patsy Creeks are presented within the Obedkoff report. In the report, Obedkoff presents 10-year return period 7-day average low flows for both systems, as well as scaling curves for calculating 7-day low flows for other return periods up to 100 years. The scaling curves, which are presented on Figures 3.5 and 3.6 for Lime Creek and Patsy Creek, respectively, were applied to the Obedkoff 10-year return period values to derive return period 7-day low flows in each creek. The results are presented in Table 3.7. Because of watershed similarity, the Patsy Creek 7-day low flow values were scaled by drainage area to generate values for Clary Creek. The presented values may be scaled by drainage area to estimate 7-day low flow values for different locations within the respective watersheds.

3.6 PEAK FLOW ANALYSIS

Peak flows within the un-glaciated watersheds of subzone 'S' may occur either during the spring and early summer months as a result of snowmelt, or during the fall months as a result of extreme rainfall or rainfall combined with the melt of immature snowpacks. However, the largest runoff events typically result in the fall. Similar to the 7-day low flows presented above, 10-year return period peak instantaneous discharge values are presented for both Lime Creek and Patsy Creek in *Streamflow in the Skeena Region* (Obedkoff, 2001). Scaling curves for calculating peak discharge for other return periods are presented in the report, and are reproduced here in Figures 3.7 and 3.8 for Lime Creek and Patsy Creek, respectively. Return period peak discharges in Patsy Creek and Lime Creek were calculated using the scaling curves. Peak instantaneous return period discharge values were calculated for Clary Creek by scaling the Patsy Creek values by the ratio of drainage areas, and using an exponent of 0.9, which is typical for wet coastal watersheds (Cathcart, 2001). The exponent accounts for the relative decrease in runoff intensity experienced by larger watersheds due to a typical reduction in watershed averaged mean storm intensity, as well as increases in flow attenuation and in the time of concentration associated with the longer channel lengths. The results are presented in Table 3.8.

SECTION 4.0 - WATER BALANCE MODELLING INPUTS

4.1 GENERAL

This section defines additional hydrometeorological parameters required for engineering design and water balance modelling. These parameters help to quantify the climatic and hydrologic variability in the project area.

4.2 PRECIPITATION

4.2.1 Orographic Effect

An orographic factor allows the long-term precipitation estimate at the Kitsault meteorological station to be adjusted for other elevations within the project area. In their *2008 – 2010 Meteorology, Air Quality, and Noise Baseline Report*, Rescan reported an average measured winter precipitation gradient of 23% per 100 m elevation increase. However, this value, which was based on a comparison of snow survey data from stations at elevations of 688 m and 1006 m, for the months of February, April, and May of 2009, appears to be quite high compared to orographic precipitation effects in many other coastal BC watersheds. It is suspected that measurements from the lower station may have been confounded by periods of thaw and possible rainfall, since the consistent snow line in the Coast Mountains is often in the 600 m to 800 m elevation band.

As stated in Section 2.7.1, suitable data are not available to reliably quantify the orographic effect in the project area, and therefore a generic rate of approximately 5% to 10% per 100 m elevation was estimated on the basis of extensive experience with climate patterns in coastal British Columbia.

4.2.2 Coefficient of Variation

The year-to-year variability of monthly precipitation in the project area is quantified with coefficient of variation (Cv) values that were derived from regional data. The Cv values are required as input for Monte Carlo simulations used in water balance modelling. The Cv values for precipitation at the Kitsault project were based on an average of the Cv values for the Stewart A and Nass Camp MSC stations, as summarized in Table 4.1.

4.3 TEMPERATURE

Similar to precipitation, the year-to-year variability of monthly temperatures at the Kitsault site was quantified with Cv values. Monthly Cv values were calculated for the Kitsault site based on an average of values from the Stewart A and Nass Camp MSC stations. Table 4.1 includes the estimated monthly Cv values for temperature.

4.4 EFFECTIVE RUNOFF COEFFICIENTS

The effective runoff coefficient is calculated as the ratio of the mean annual runoff and mean annual precipitation. It is recognized that runoff coefficients will vary from year to year, and month to month, and that they will generally be higher during wet periods and lower during dry periods, but an average value is typically suitable for most water balance modelling exercises. For the Kitsault site, the effective mean annual runoff coefficient was estimated to be 0.70. This value was essentially determined from the ratio of the mean annual unit runoff for Lime Creek of 1441 mm (45.7 l/s/km^2) and the mean annual precipitation for the project climate station of 2000 mm.

SECTION 5.0 - CONCLUSIONS

The key findings of this study are summarized below. All meteorological results are presented for the location of the Kitsault climate station and adjustments may be required to apply them to other locations within the project area.

The key findings of this study are:

- The mean annual temperature is estimated to be 3.7 °C, with minimum and maximum mean monthly temperatures of -5.8 °C and 12.4 °C occurring in January and July respectively.
- The mean annual wind speed is approximately 1.9 m/s.
- The mean annual relative humidity is approximately 80.5%.
- The mean annual lake evaporation (potential evapotranspiration) is estimated to be 450 mm.
- The mean annual precipitation is estimated to be 2000 mm, with 45% falling as rain and 55% falling as snow.
- The mean annual unit runoff for Lime Creek at the mouth is 45.7 l/s/km^2.
- The mean annual unit runoff for Patsy Creek is 45.1 l/s/km^2.
- The mean annual unit runoff for Clary Creek at the outlet of Clary Lake is 45.1 l/s/km^2. This is based on a synthetic flow series developed from the Patsy Creek flow series.
- The annual hydrograph at Kitsault typically has a bi-modal shape, with its highest peak in the freshet period and a secondary peak in late fall or early winter.
- Return period peak flows and 7-day low flows were estimated for Lime Creek at the mouth, Patsy Creek, and Clary Creek at Clary Lake Outlet. 200-year peak flows were 140 m^3/s, 22 m^3/s, and 112 m^3/s, respectively. 10-year 7-day low flows were estimated at 0.08 m^3/s, 0.01 m^3/s, and 0.06 m^3/s for the three creeks, respectively.
- The effective mean annual runoff coefficient for the project area is estimated to be approximately 0.70.
- Climate change has not been considered explicitly in the hydrometeorological estimates, and appropriate allowances should be made where necessary.

SECTION 6.0 - REFERENCES

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SECTION 7.0 - CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

Prepared: _____

FOR Josh Vines, P.Eng.
Project Engineer

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. G. CATHCART
July 15, 2010

Reviewed: _____

Jaime Cathcart, Ph.D., P.Eng.
Specialist Hydrotechnical Engineer

Approved: _____

Ken Brouwer, P.Eng.
Managing Director

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TABLE 2.1

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
SUMMARY OF SITE METEOROLOGY STATIONS

Print 07/09/10 13:31

No.	Station Name	Station ID.	Years of Record	No. of Years Complete Record	Start Year	End Year	Latitude	Longitude	Elevation (m)	Mean Annual Precipitation (mm)
1	Kitsault	KITS	2	0	2008	2010	55° 25'	129° 25'	682	-
2	Kitsault Minesite	1074330	4	1	1969	1972	55° 30'	129° 00'	652	1985
3	Kitsault Minesite	1064329	2	0	1968	1969	55° 26'	129° 28'	621	-

M:\1\01\00343\09\A\Data\Hydrology\[AES_WSC_stations.xls]SITE MET

NOTES:

1. DATA OBTAINED FROM THE METEOROLOGICAL SERVICES OF CANADA BRANCH (MSC) OF ENVIRONMENT CANADA.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	AMD	JWV	JGC

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TABLE 2.2

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
SUMMARY OF REGIONAL METEOROLOGY STATIONS

Print 07/09/10 13:32

No.	Station Name	Station ID.	Years of Record	No. of Years Complete Record	Start Year	End Year	Latitude	Longitude	Elevation (m)	Mean Annual Precipitation (mm)
1	Alice Arm	1060331	6	1	1973	1978	55° 28'	129° 28'	2	1422.9
2	Alice Arm	1060330	17	13	1948	1964	55° 41'	129° 30'	314	2082.3
3	Anyox	1060446	20	16	1916	1935	55° 27'	129° 48'	113	2050.8
4	Stewart A	1067742	35	32	1974	2010	55° 56'	129° 59'	7	1856.4
5	Stewart BCHPA	1067745	10	8	1967	1976	55° 57'	129° 59'	12.2	1799.7
6	Premier	1066420	35	28	1926	1996	56° 03'	130° 01'	410	2202.3
7	Nass Camp	1075384	35	22	1973	2007	55° 14'	129° 2'	290	1090.3
8	Aiyansh	1070150	48	42	1924	1971	55° 14'	129° 1'	229	1073.3
9	Annete (Alaska)	500352	58	53	1949	2006	55° 02'	131° 34'	0	2774.7
10	Beaver Falls (Alaska)	500657	58	38	1949	2006	55° 23'	131° 28'	0	3813

M:\1\01\00343\09\A\Data\Hydrology\[AES_WSC_stations.xls]REG MET

NOTES:

1. DATA OBTAINED FROM THE METEOROLOGICAL SERVICES OF CANADA BRANCH (MSC) OF ENVIRONMENT CANADA.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	AMD	JWV	JGC

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TABLE 2.3

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
MEAN TEMPERATURE AT KITSAULT METEOROLOGY STATION

Print 7/15/10 8:49

Year	Mean Temperature (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1968	-	-1.6	1.3	0.6	7.9	9.3	13.2	12.2	7.7	3.0	-0.2	-	-
1969	-15.0	-4.1	-	-	11.9	15.4	11.1	9.1	8.6	5.5	-	-0.9	-
1970	-	0.4	-	1.6	4.8	9.8	9.9	10.3	7.1	4.4	-2.2	-6.5	-
1971	-7.9	-4.0	-3.8	1.3	4.6	9.3	-	-	-	-	-1.0	-	-
1972	-	-7.3	-	-1.0	-	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	-	-	-	-	-	-7.2	-
2009	-4.2	-4.4	-3.4	2.2	5.6	10.8	15.2	12.5	8.8	3.4	-0.9	-6.4	3.3
2010	-1.3	1.3	0.6	3.2	7.5	-	-	-	-	-	-	-	-
Average	**-7.1**	**-2.8**	**-1.3**	**1.3**	**7.0**	**10.9**	**12.3**	**11.0**	**8.1**	**4.1**	**-1.1**	**-5.2**	**3.1**
est. Long-term	**-5.8**	**-3.3**	**-0.3**	**3.7**	**8.1**	**11.2**	**12.4**	**11.6**	**8.6**	**4.1**	**-1.3**	**-4.4**	**3.7**

M:\1\01\00343\09\A\Data\Meteorology\[Temperature Analysis.xlsx]Site Temp Summary

NOTES:

1. DATA FROM FEB 1969 TO OCTOBER 1969 FROM MSC STATION 1074330 (KITSAULT MINESITE).
2. DATA FROM DEC 1969 TO APR 1972 FROM MSC STATION 1074329 (KITSAULT MINESITE).
3. DATA FROM DEC 2008 TO MAY 2010 FROM SITE MET STATION.
4. ESTIMATED LONG-TERM AVERAGE BASED ON 38 YEAR SYNTHETIC RECORD GENERATED THROUGH LINEAR REGRESSION WITH MSC DATA FROM STEWART CLIMATE STATIONS.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.4

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
MEAN WIND SPEED AT KITSAULT METEOROLOGY STATION

Print 7/9/10 13:35

Year	Mean Wind Speed (m/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	-	-	-	-	-	-	-	-	-	-	-	2.1	-
2009	1.9	1.6	1.9	1.8	2.0	1.9	1.7	1.9	1.4	1.9	1.7	2.1	1.8
2010	2.4	1.9	1.8	2.1	1.8	-	-	-	-	-	-	-	-
Average	**2.1**	**1.7**	**1.8**	**2.0**	**1.9**	**1.9**	**1.7**	**1.9**	**1.4**	**1.9**	**1.7**	**2.1**	**1.9**

M:\1\01\00343\09\A\Data\Meteorology\[Wind Analysis.xlsx]Site Wind Summary

NOTES:

1. DATA FROM SITE MET STATION.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.5

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
MEAN RELATIVE HUMIDITY AT KITSAULT METEOROLOGY STATION

Print 7/9/10 13:36

Year	Relative Humidity (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	-	-	-	-	-	-	-	-	-	-	-	74.5	-
2009	83.8	77.6	80.4	74.7	77.0	75.6	76.2	82.4	90.0	81.4	90.9	76.7	80.6
2010	81.4	79.1	85.5	72.5	75.0	-	-	-	-	-	-	-	-
Average	**82.6**	**78.3**	**83.0**	**73.6**	**76.0**	**75.6**	**76.2**	**82.4**	**90.0**	**81.4**	**90.9**	**75.6**	**80.5**

M:\1\01\00343\09\A\Data\Meteorology\[Humidity Analysis.xlsx]Site Humidity

NOTES:

1. DATA FROM SITE MET STATION.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.6

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
ESTIMATED LONG-TERM SITE POTENTIAL EVAPOTRANSPIRATION

Print Jul/15/10 8:51

Method	Temperature Record		Evapotranspiration (mm)												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Hargreaves equation	1968-1972, 2008-2010	mm	4	10	18	34	73	100	91	76	48	28	10	7	499
		% annual	0.9%	2.0%	3.7%	6.7%	14.6%	20.1%	18.3%	15.2%	9.5%	5.6%	2.1%	1.3%	100%
Thornthwaite equation	1968-1972, 2008-2010	mm	0	0	0	11	50	70	77	70	56	34	0	0	368
		% annual	0.0%	0.0%	0.0%	3.0%	13.6%	19.0%	20.8%	19.2%	15.2%	9.1%	0.0%	0.0%	100%
	Long-term est.	mm	0	0	4	29	54	70	75	71	57	32	2	0	394
		% annual	0.0%	0.1%	1.0%	7.5%	13.6%	17.7%	19.1%	18.1%	14.4%	8.1%	0.5%	0.0%	100%
Long-term est.		**mm**	**2**	**5**	**8**	**22**	**63**	**88**	**88**	**77**	**56**	**33**	**5**	**3**	**450**
		% annual	**0.4%**	**1.0%**	**1.8%**	**4.9%**	**14.1%**	**19.6%**	**19.6%**	**17.2%**	**12.4%**	**7.4%**	**1.0%**	**0.7%**	**100%**

M:\1\01\00343\09\A\Data\Meteorology\[PET_calculator_20100709.xlsx]Summary

NOTES:

1. POTENTIAL EVAPOTRANSPIRATION (PET) VALUES CALCULATED USING HARGREAVES EQUATION WERE BASED ON THE DAILY MINIMUM, MEAN AND MAXIMUM TEMPERATURE VALUES RECORDED AT THE KITSAULT SITE WEATHER STATION FOR 2008-2010. IT WAS ASSUMED THAT WHEN THE MEAN DAILY TEMPERATURE WAS BELOW -17.8 DEGREES CELSIUS ZERO OR THE MAXIMUM DAILY TEMPERATURE WAS BELOW ZERO DEGREES CELSUIS, THAT PET WAS EQUAL TO ZERO.
2. POTENTIAL EVAPOTRANSPIRATION VALUES CALCULATED USING THE THORNTHWAITE EQUATION WERE BASED ON MEAN MONTHLY TEMPERATURE VALUES FOR THE HISTORICAL DATA SET (1968-1972) AND THE CURRENT TEMPERATURE RECORD COLLECTED IN 2008-2010. THESE ESTIMATES WERE COMPARED TO THE PET CALCULTATED USING THE LONG-TERM SYNTHETIC TEMPERATURE RECORD DEVELOPED FOR THE SITE. THE THORNTHWAITE EQUATION ASSUMES THAT THE PET IS ZERO WHEN THE MEAN MONTHLY TEMPERATURE IS ZERO.
3. THE LONG-TERM POTENTIAL EVAPOTRANSPIRATION DISTRIBUTION WAS BASED ON AN AVERAGE OF THE THORNTHWAITE EQUATION AND THE RESULTS OF THE HARGREAVES EQUATION FOR THE YEARS WITH SITE TEMPERATURE RECORD.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	ER	JV	JGC

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TABLE 2.7

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
PRECIPITATION DATA COLLECTED AT THE MINE SITE

Print 7/15/10 8:53

Year	Total Precipitation (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1968	-	78.5	104.6	188.7	45.0	75.4	95.3	105.2	243.6	176.3	114.6	-	-
1969	76.2	103.4	-	-	57.9	84.8	114.8	286.8	122.2	-	-	154.9	-
1970	146.8	61.0		116.6	123.4	62.2	127.8	127.0	154.9	163.1	83.8	207.0	-
1971	421.9	91.4	323.3	155.4	25.1	88.4	23.1	145.8	130.8	216.9	367.3	313.4	2302.8
1972	480.1	412.8	253.7	213.6	-	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	-	-	-	-	-	160.3	-
2009	249.7	-	-	77.0	72.9	49.5	37.6	99.1	183.1	167.1	175.8	42.7	-
2010	57.7	17.5	103.9	49.9	62.2	-	-	-	-	-	-	-	-
Average 1968-2010	**239**	**127**	**196**	**134**	**64**	**72**	**80**	**153**	**167**	**181**	**185**	**176**	**1774**
Average 1968-1972	**281**	**149**	**227**	**169**	**63**	**78**	**90**	**166**	**163**	**185**	**189**	**225**	**1985**

M:\1\01\00343\09\A\Data\Meteorology\Precip\[Precipitation Analysis.xlsx]Site Precip Summary

NOTES:

1. DATA FROM FEB 1969 TO OCTOBER 1969 FROM MSC STATION 1074330 (KITSAULT MINESITE).
2. DATA FROM DEC 1969 TO APR 1972 FROM MSC STATION 1074329 (KITSAULT MINESITE).
3. DATA FROM DEC 2008 TO MAY 2010 FROM SITE MET STATION.
4. WINTER DATA IN 2008 - 2010 LIKELY ERRONEOUS.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.8

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
MEAN ANNUAL PRECIPITATION ESTIMATE

Print 7/9/10 13:42

MAP Estimate	Description	Period of Record	Surrogate MAP (mm)	Kitsault/Surrogate Ratio	Estimated MAP (mm)
Kitsault Project Site	Site data collection	1968 - 1972	N/A	N/A	1985
Kitsault - Stewart Comparison	Double-mass analysis	1967 - 2007	1870	0.981	1830
Kitsault - Aiyansh/Nass Comparison	Double-mass analysis	1924 - 2007	1025	2.000	2050
Long-term MAP Estimate		N/A	N/A	N/A	**2000**

M:\1\01\00343\09\A\Data\Meteorology\Precip\[Precipitation Analysis.xlsx]MAP Summary

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.9

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
SUMMARY OF REGIONAL TOTAL PRECIPITATION DISTRIBUTIONS

Print 7/9/10 13:45

MSC Station	Period of Record	Distance from Site (km)	Mean Total Precipitation												
			Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Alice Arm	1948 - 1964	27.9	mm	196	194	150	131	69	74	74	119	196	357	245	282	2087
ID 1060330			%	9%	9%	7%	6%	3%	4%	4%	6%	9%	17%	12%	14%	100%
Anyox	1916 - 1935	21.6	mm	245	180	150	82	61	55	66	107	150	300	335	276	2007
ID 1060446			%	12%	9%	7%	4%	3%	3%	3%	5%	7%	15%	17%	14%	100%
Kitsault Minesite	1968 - 1972	0	mm	281	149	227	169	63	78	90	166	163	185	189	225	1985
ID 1074330, 1064329			%	14%	8%	11%	8%	3%	4%	5%	8%	8%	9%	9%	11%	100%
Nass Camp	1973 - 2007	35.5	mm	135	68	46	43	48	57	59	74	113	162	129	132	1066
ID 1075384			%	13%	6%	4%	4%	5%	5%	5%	7%	11%	15%	12%	12%	100%
Stewart A	1975 - 2007	64.2	mm	228	140	117	85	72	66	72	115	210	288	233	231	1857
ID 1067742			%	12%	8%	6%	5%	4%	4%	4%	6%	11%	15%	13%	12%	100%
Estimated Long-term	**N/A**	**N/A**	**mm**	**241**	**163**	**153**	**113**	**70**	**73**	**80**	**129**	**185**	**287**	**251**	**255**	**2000**
Kitsault Minesite			**%**	**12%**	**8%**	**8%**	**6%**	**3%**	**4%**	**4%**	**6%**	**9%**	**14%**	**13%**	**13%**	**100%**

M:\1\01\00343\09\A\Data\Meteorology\Precip\[Precip Distribution.xlsx]Summary

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.10

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
MONTHLY RAIN/SNOW DISTRIBUTION

Print 7/9/10 13:44

Description	Period of Record	Elevation (m)	Precip.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Alice Arm	1968 - 1972	314	Rain	18%	30%	34%	75%	98%	100%	100%	100%	100%	94%	52%	25%	63%
ID 1060330			Snow	82%	70%	66%	25%	2%	0%	0%	0%	0%	6%	48%	75%	37%
Kitsault Minesite	**1968 - 1972**	**652**	**Rain**	**3%**	**2%**	**12%**	**22%**	**97%**	**100%**	**100%**	**100%**	**99%**	**75%**	**28%**	**6%**	**45%**
ID 1064329, 1074330			**Snow**	**97%**	**98%**	**88%**	**78%**	**3%**	**0%**	**0%**	**0%**	**1%**	**25%**	**72%**	**94%**	**55%**

M:\1\01\00343\09\A\Data\Meteorology\Precip\[Precip Distribution.xlsx]Snow Rain

NOTES:

1. DATA FROM METEOROLOGICAL SERVICE OF CANADA.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

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TABLE 2.11

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
ESTIMATED PROJECT SITE RAINFALL INTENSITY DURATION FREQUENCY VALUES

Print: 7/15/10 8:55

Annual Rainfall Extremes (mm)

Duration	Mean	St Dev	Augmentation Factor	Augmented Mean	Augmented St Dev
5 min	3.0	1.0	1.5	4.5	1.5
10 min	4.0	1.5	1.5	6.0	2.3
15 min	5.5	1.5	1.5	8.3	2.3
30 min	7.5	2.0	1.5	11.3	3.0
1 hr	10.0	3.0	1.5	15.0	4.5
2 hr	14.5	4.0	1.8	26.1	7.2
6 hr	19.0	7.5	1.8	34.2	13.5
12 hr	27.0	13.0	2.0	54.0	26.0
24 hr	47.0	15.0	2.0	94.0	30.0

Frequency Factors for PMP

Duration	K_{PMP}
1 hr	16.03
6 hr	16.07
24 hr	15.42

Gumbel Frequency Factors

Return Period	2	5	10	15	20	25	50	100	200	1000
K_T	-0.1640	0.719	1.305	1.635	1.866	2.044	2.592	3.137	3.679	4.936

Return Period Rainfall Amounts (mm)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs	1000 yrs	PMP
5 min	4	6	6	7	7	8	8	9	10	12	
10 min	6	8	9	10	10	11	12	13	14	17	
15 min	8	10	11	12	12	13	14	15	17	19	
30 min	11	13	15	16	17	17	19	21	22	26	
1 hr	14	18	21	22	23	24	27	29	32	37	87
2 hr	25	31	35	38	40	41	45	49	53	62	
6 hr	32	44	52	56	59	62	69	77	84	101	242
12 hr	50	73	88	97	103	107	121	136	150	182	
24 hr	**89**	**116**	**133**	**143**	**150**	**155**	**172**	**188**	**204**	**242**	**557**

Rainfall Intensity (mm/hr)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs	1000 yrs	PMP
5 min	51	67	77	83	88	91	101	110	120	143	
10 min	34	46	54	58	61	64	71	78	86	103	
15 min	32	39	45	48	50	51	56	61	66	77	
30 min	22	27	30	32	34	35	38	41	45	52	
1 hr	14	18	21	22	23	24	27	29	32	37	87
2 hr	12	16	18	19	20	20	22	24	26	31	
6 hr	5.3	7.3	8.6	9.4	9.9	10.3	11.5	12.8	14.0	16.8	40
12 hr	4.1	6.1	7.3	8.0	8.5	8.9	10.1	11.3	12.5	15.2	
24 hr	**3.7**	**4.8**	**5.5**	**6.0**	**6.2**	**6.5**	**7.2**	**7.8**	**8.5**	**10.1**	**23**

M:\1\01\00343\09\A\Data\Meteorology\[24 hr rainfall_20100622.xls]Summary Table

NOTES:

1. MEAN ANNUAL 24 HOUR EXTREME RAINFALL AND STANDARD DEVIATION WERE ESTIMATED USING THE RAINFALL FREQUENCY ATLAS OF CANADA.
2. AUGMENTATION FACTORS APPLIED AS SUGGESTED IN THE RFAC FOR COASTAL, MOUNTAINOUS WATERSHEDS.
3. RETURN PERIOD RAINFALL AMOUNTS COMPUTED ASSUMING A GUMBEL TYPE DISTRIBUTION.
4. FREQUENCY FACTORS FOR PMP ARE ESTIMATED USING THE HERSHFIELD EQUATION, AS SUGGESTED IN THE RFAC.
5. AUGMENTATION FACTORS AS SUGGESTED IN THE RFAC.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB

Knight Piésold CONSULTING

TABLE 3.1

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
SUMMARY OF SITE STREAMFLOW STATIONS

Print 7/15/10 8:57

Station Name	Station ID	Years of Record	No. of Years of Complete Record	Start Year	End Year	Latitude	Longitude	Drainage Area (km^2)	Mean Annual Discharge (m^3/s)	Average Annual Unit Runoff ($l/s/km^2$)	Elevation (m)	Glacier Fraction (%)
Lime Creek near the mouth (WSC)	08DB010	21	15	1976	1996	55° 27' 18"	129° 28' 48"	39.4	1.8	45.7	30	0
Patsy Creek near the mouth (WSC)	08DB012	10	8	1987	1996	55° 25' 8"	129° 24' 57"	4.68	0.22	47.0	473	0
Lower Lime Creek	LCK-H2	3	1	2008	2010	55° 27' 18"	129° 28' 48"	39.9	-	-	17	0
Upper Lime Creek	LCK-H1	2	1	2009	2010	55° 25' 26"	129° 26' 4"	25.8	-	-	455	0
Patsy Creek	PCK-H1	2	1	2009	2010	55° 25' 9"	129° 25' 6"	10.5	-	-	575	0
Clary Creek	CCK-H1	1	0	2010	2010	55° 26' 48"	129° 21' 34"	8.00	-	-	740	0

M:\1\01\00343\09\A\Data\Hydrology\[AES_WSC_stations.xls]SITE HYDR

NOTES:

1. DATA OBTAINED FROM THE WATER SURVEY OF CANADA (WSC) FOR 08DB010 AND 08DB012.
2. CURRENT SITE STATIONS HAVE INCOMPLETE RATING CURVES AND FLOW DATA IS NOT VERIFIED.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	07JUL'10	ISSUED WITH REPORT VA101-343/9-1	AMD	JWV	JGC

Knight Piésold CONSULTING

TABLE 3.2

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
SUMMARY OF REGIONAL STREAMFLOW STATIONS

Print 7/9/10 13:31

	Station Name	Station ID	Years of Record	No. of Years of Complete Record	Start Year	End Year	Latitude	Longitude	Drainage Area (km^2)	Mean Annual Discharge (m^3/s)	Average Annual Unit Runoff ($l/s/km^2$)	Elevation (m)	Glacier Fraction (%)
Active	Ansedagan Creek near New Aiyansh	08DB013	13	13	1997	2009	55° 7' 58"	129° 21' 23"	26.1	1.04	39.8	40	0
Active	Ksedin Tributary No. 2 Cr. near New Aiyansh	08DB014	14	13	1997	2010	55°1'5"	129°20'32"	17.4	0.592	34.0	160	0
Active	Nass River above Shumal Creek	08DB001	46	56	1929	2010	55°15'50"	129°5'10"	18400	782	42.5	30	12
Inactive	Kitsault River above Klayduc	08DB011	16	14	1981	1996	55° 33' 40"	129° 30' 11"	242	22.7	93.8	91	11
Inactive	Bear River above Bitter Creek	08DC006	33	31	1967	1999	56° 2' 34"	129° 55' 30"	350	25.2	72.0	76	31

M:\1\01\00343\09\A\Data\Hydrology\[AES_WSC_stations.xls]REG HYDR

NOTES:

1. DATA OBTAINED FROM THE WATER SURVEY OF CANADA (WSC), BRANCH OF ENVIRONMENT CANADA.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	07JUL'10	ISSUED WITH REPORT VA101-343/9-1	AMD	JWV	JGC

Knight Piésold CONSULTING

TABLE 3.3

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
LIME CREEK LONG-TERM MEAN MONTHLY STREAMFLOW RECORD

Print Jul/09/10 13:48:44

Year	Mean Monthly Discharge (m^3/s)												
	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1977	0.49	0.85	0.40	2.46	3.79	4.01	1.29	0.54	0.62	3.01	0.68	0.31	1.54
1981	0.67	0.44	0.60	1.03	6.21	3.62	1.23	0.43	3.14	1.95	2.03	0.36	1.81
1982	0.22	0.18	0.18	0.53	3.63	4.60	1.16	0.46	1.18	1.40	0.57	0.21	1.19
1984	0.75	0.81	0.99	1.97	4.18	3.22	2.08	1.17	0.56	0.70	0.22	0.24	1.41
1985	0.39	0.67	0.29	0.80	5.86	6.69	3.79	1.01	1.94	1.91	0.38	0.18	2.00
1986	0.28	0.22	1.16	1.26	3.71	5.20	1.45	0.68	1.18	4.40	1.27	0.58	1.79
1987	0.69	0.59	0.39	1.77	4.59	4.60	1.83	0.49	2.96	2.59	2.56	0.60	1.97
1988	0.11	0.13	0.27	2.12	5.24	3.60	2.09	1.68	2.82	3.69	1.22	0.99	2.00
1989	0.67	0.60	0.53	1.78	4.01	2.84	1.37	0.91	1.18	2.55	1.22	1.28	1.59
1990	0.46	0.36	0.90	1.97	4.44	3.66	1.52	0.50	0.76	2.15	0.89	1.02	1.56
1991	0.88	1.23	0.42	2.43	6.87	8.17	5.34	1.99	1.86	6.16	2.53	2.34	3.36
1992	1.17	1.17	1.28	2.52	3.75	4.40	0.89	0.30	3.41	2.98	1.54	0.27	1.97
1993	0.48	1.78	0.65	2.77	5.15	2.00	0.92	0.46	0.78	1.61	5.12	1.23	1.91
1994	1.15	0.42	0.87	2.40	3.26	2.73	1.28	0.71	3.62	2.08	0.58	0.31	1.62
1995	0.26	0.43	0.68	2.24	3.73	1.87	0.75	1.47	0.94	2.72	1.13	0.63	1.41
Average	0.58	0.66	0.64	1.87	4.56	4.08	1.80	0.85	1.80	2.66	1.46	0.70	1.81
Min	0.11	0.13	0.18	0.53	3.26	1.87	0.75	0.30	0.56	0.70	0.22	0.18	1.19
Max	1.17	1.78	1.28	2.77	6.87	8.17	5.34	1.99	3.62	6.16	5.12	2.34	3.36

M:\1\01\00343\09\A\Data\Hydrology\Long-Term Streamflow Series\[Lime Creek Daily Streamflow Record (08DB010).xlsx]Table

NOTES:

1. THE STREAMFLOW DATA PRESENTED ABOVE WERE COLLECTED BY THE WATER SURVEY OF CANADA AT THE MOUTH OF LIME CREEK (WSC 08DB010). THE DRAINAGE ARE AT THIS LOCATION IS 39.4 km^2

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT 101-343/9-1	KT	JGC	KJB

Knight Piésold
CONSULTING

TABLE 3.4

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
PATSY CREEK LONG-TERM MEAN MONTHLY MEASURED / ESTIMATED STREAMFLOW SERIES

Print Jul/15/10 9:04:10

Year	Mean Monthly Discharge (m^3/s)												
	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1	0.05	0.08	0.03	0.30	0.65	0.48	0.06	0.04	0.05	0.35	0.08	0.03	0.18
2	0.06	0.04	0.04	0.09	1.02	0.43	0.06	0.03	0.35	0.23	0.21	0.04	0.22
3	0.03	0.02	0.01	0.04	0.62	0.55	0.06	0.03	0.12	0.17	0.07	0.02	0.14
4	0.07	0.08	0.07	0.20	0.72	0.38	0.10	0.10	0.04	0.09	0.04	0.03	0.16
5	0.04	0.06	0.02	0.06	0.95	0.80	0.19	0.08	0.21	0.22	0.05	0.02	0.23
6	0.03	0.02	0.09	0.12	0.63	0.62	0.07	0.05	0.12	0.50	0.14	0.06	0.21
7	0.07	0.06	0.03	0.18	0.78	0.55	0.09	0.01	0.30	0.31	0.28	0.07	0.23
1988	0.03	0.02	0.03	0.24	0.78	0.45	0.17	0.14	0.29	0.35	0.13	0.10	0.23
1989	0.06	0.05	0.03	0.27	0.81	0.33	0.05	0.08	0.13	0.25	0.31	0.33	0.23
1990	0.08	0.03	0.04	0.25	0.91	0.49	0.10	0.02	0.16	0.32	0.09	0.11	0.22
1991	0.08	0.11	0.06	0.18	0.90	0.80	0.12	0.11	0.16	0.91	0.18	0.18	0.32
1992	0.07	0.09	0.12	0.40	0.67	0.65	0.03	0.01	0.40	0.36	0.14	0.03	0.25
1993	0.04	0.20	0.05	0.32	0.80	0.21	0.09	0.06	0.08	0.19	0.43	0.06	0.21
1994	0.10	0.04	0.08	0.32	0.63	0.28	0.08	0.09	0.36	0.23	0.09	0.04	0.20
1995	0.03	0.03	0.03	0.20	0.68	0.17	0.04	0.13	0.07	0.36	0.11	0.06	0.16
Average	0.06	0.06	0.05	0.21	0.77	0.48	0.09	0.07	0.19	0.32	0.16	0.08	0.21
Min	0.03	0.02	0.01	0.04	0.62	0.17	0.03	0.01	0.04	0.09	0.04	0.02	0.14
Max	0.10	0.20	0.12	0.40	1.02	0.80	0.19	0.14	0.40	0.91	0.43	0.33	0.32

M:\1\01\00343\09\A\Data\Hydrology\Long-Term Streamflow Series\[Patsy Creek Long-Term Daily Streamflow Series (08DB012)_KT_June 18, 2010.xlsx]Table

NOTES:

1. THE STREAMFLOW DATA PRESENTED ABOVE FOR YEARS 1-7 WERE GENERATED BY RANKED REGRESSION CORRELATION WITH DATA COLLECTED ON LIME CREEK (WSC 08DB010).
2. THE STREAMFLOW DATA PRESENTED ABOVE FOR YEARS 8-15 (1988 TO 1995) WERE COLLECTED BY WATER SURVEY OF CANADA ON PATSY CREEK (WSC 08DB012).
   THE DRAINAGE AREA AT THE STATION IS 4.68 km2.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT 101-343/9-1	KT	JGC	KJB

Knight Piésold CONSULTING

TABLE 3.5

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
CLARY CREEK AT CLARY LAKE OUTLET LONG-TERM MEAN MONTHLY SYNTHETIC STREAMFLOW SERIES

Print Jul/09/10 13:47:21

Year	Mean Monthly Discharge (m^3/s)												
	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1	0.33	0.51	0.18	1.87	4.05	2.96	0.39	0.25	0.31	2.15	0.50	0.21	1.15
2	0.40	0.26	0.28	0.53	6.36	2.67	0.37	0.18	2.18	1.41	1.28	0.24	1.35
3	0.17	0.11	0.08	0.23	3.86	3.40	0.35	0.20	0.73	1.03	0.44	0.14	0.90
4	0.45	0.48	0.45	1.24	4.48	2.38	0.64	0.61	0.28	0.54	0.24	0.16	1.00
5	0.26	0.40	0.13	0.37	5.93	4.94	1.17	0.52	1.29	1.39	0.33	0.12	1.41
6	0.21	0.13	0.53	0.75	3.90	3.84	0.44	0.33	0.73	3.12	0.84	0.39	1.27
7	0.42	0.35	0.18	1.13	4.87	3.40	0.55	0.08	1.84	1.95	1.76	0.44	1.42
8	0.16	0.15	0.18	1.47	4.83	2.78	1.07	0.86	1.83	2.20	0.78	0.60	1.41
9	0.38	0.28	0.18	1.67	5.01	2.05	0.31	0.49	0.80	1.57	1.90	2.06	1.40
10	0.50	0.17	0.24	1.55	5.63	3.05	0.62	0.12	0.99	1.98	0.57	0.67	1.35
11	0.52	0.66	0.35	1.11	5.57	4.97	0.77	0.71	1.02	5.68	1.11	1.13	1.98
12	0.43	0.57	0.73	2.51	4.14	4.04	0.21	0.08	2.49	2.23	0.84	0.18	1.53
13	0.28	1.24	0.29	1.96	4.97	1.30	0.54	0.35	0.47	1.19	2.68	0.36	1.30
14	0.63	0.27	0.47	1.98	3.92	1.74	0.53	0.55	2.22	1.40	0.53	0.27	1.21
15	0.18	0.16	0.18	1.23	4.20	1.03	0.28	0.83	0.42	2.24	0.66	0.35	0.99
Average	0.35	0.38	0.30	1.31	4.78	2.97	0.55	0.41	1.17	2.01	0.96	0.49	1.31
Min	0.16	0.11	0.08	0.23	3.86	1.03	0.21	0.08	0.28	0.54	0.24	0.12	0.90
Max	0.63	1.24	0.73	2.51	6.36	4.97	1.17	0.86	2.49	5.68	2.68	2.06	1.98

M:\1\01\00343\09\A\Data\Hydrology\Long-Term Streamflow Series\[Clary Creek at Clary Lake Outlet Long-Term Daily Streamflow Series_KT_June 18, 2010.xlsx]Table

NOTES:

1. THE STREAMFLOW DATA PRESENTED ABOVE FOR WERE CALCULATED BY SCALING THE PATSY CREEK LONG-TERM STREAMFLOW SERIES BY DRAINAGE AREA TO CLARY CREEK AT CLARY LAKE OUTET.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT 101-343/9-1	KT	JGC	KJB

Knight Piésold CONSULTING

TABLE 3.6

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
WET AND DRY 10-YEAR RETURN PERIOD FLOWS AS A PERCENTAGE OF MEAN MONTHLY FLOWS

Print Jul/09/10 13:52:29

Location	Return Period	10-Year Return Period Discharge as a Percentage of Monthly Mean Discharge											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lime Creek at the Mouth	10 Year Dry % of Mean	37%	32%	42%	59%	77%	57%	49%	44%	38%	48%	27%	31%
	10 Year Wet % of Mean	174%	192%	172%	149%	132%	150%	177%	181%	194%	161%	204%	209%
Patsy Creek at the Mouth	10 Year Dry % of Mean	52%	35%	42%	39%	78%	50%	51%	17%	32%	46%	37%	31%
Clary Creek at Clary Lake Outlet	10 Year Wet % of Mean	153%	201%	178%	163%	120%	149%	165%	183%	193%	166%	190%	212%

M:\1\01\00343\09\A\Data\Hydrology\Streamflow statistics\[Wet and Dry Flows.xlsx]TABLE

NOTES:

1. ANALYSIS WAS DONE USING PALISADE DECISION TOOLS @RISK DISTRIBUTION FITTING SOFTWARE.
2. CLARY CREEK AND PATSY CREEK VALUES ARE IDENTICAL BECAUSE CLARY CREEK RECORD IS SCALED FROM PATSY CREEK RECORD.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT VA101-343/9-1	KT	JGC	KJB

Knight Piésold CONSULTING

TABLE 3.7

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
7-DAY LOW FLOW DISCHARGES FOR VARIOUS RETURN PERIODS

Print Jul/09/10 13:51:07

Location	DA (km^2)	Return Period 7-Day Low Flow Discharge (m^3/s)					
		Mean	5 year	10 year	20 year	50 year	100 year
Lime Creek at the Mouth	39.4	0.17	0.10	0.08	0.06	0.05	0.04
Patsy Creek	4.68	0.02	0.01	0.01	0.01	0.00	0.00
Clary Creek at Clary Lake Outlet	29.1	0.11	0.08	0.06	0.04	0.02	0.01

M:\1\01\00343\09\A\Data\Hydrology\Streamflow statistics\[Low Flows.xlsx]Summary

NOTES:

1. DATA FROM OBEDKOFF ANALYSIS "STREAMFLOW IN THE SKEENA REGION".

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT VA101-343/9-1	KT	JGC	KJB

Knight Piésold CONSULTING

TABLE 3.8

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
PEAK INSTANTANEOUS DISCHARGES FOR VARIOUS RETURN PERIODS

Print Jul/09/10 13:33:18

Location	DA (km^2)	Return Period Peak Instantaneous Discharge (m^3/s)						
		Mean	5 year	10 year	20 year	50 year	100 year	200 year
Lime Creek at the Mouth	39.4	32.70	49.88	66.50	83.13	106.40	123.03	140.32
Patsy Creek	4.68	6.14	9.11	11.60	14.04	17.17	19.37	21.69
Clary Creek at Clary Lake Outlet	29.1	31.80	47.16	60.08	72.70	88.92	100.34	112.35

M:\1\01\00343\09\A\Data\Hydrology\Streamflow statistics\[Peak Flows.xlsx]Summary

NOTES:

1. DATA FROM OBEDKOFF ANALYSIS "STREAMFLOW IN THE SKEENA REGION".

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT VA101-343/9-1	KT	JGC	KJB

Knight Piésold CONSULTING

TABLE 4.1

AVANTI KITSAULT MINE LTD.
KITSAULT PROJECT

ENGINEERING HYDROMETEOROLOGY REPORT
COEFFICIENT OF VARIATION VALUES FOR WATER BALANCE MODELLING

Print 7/9/10 13:38

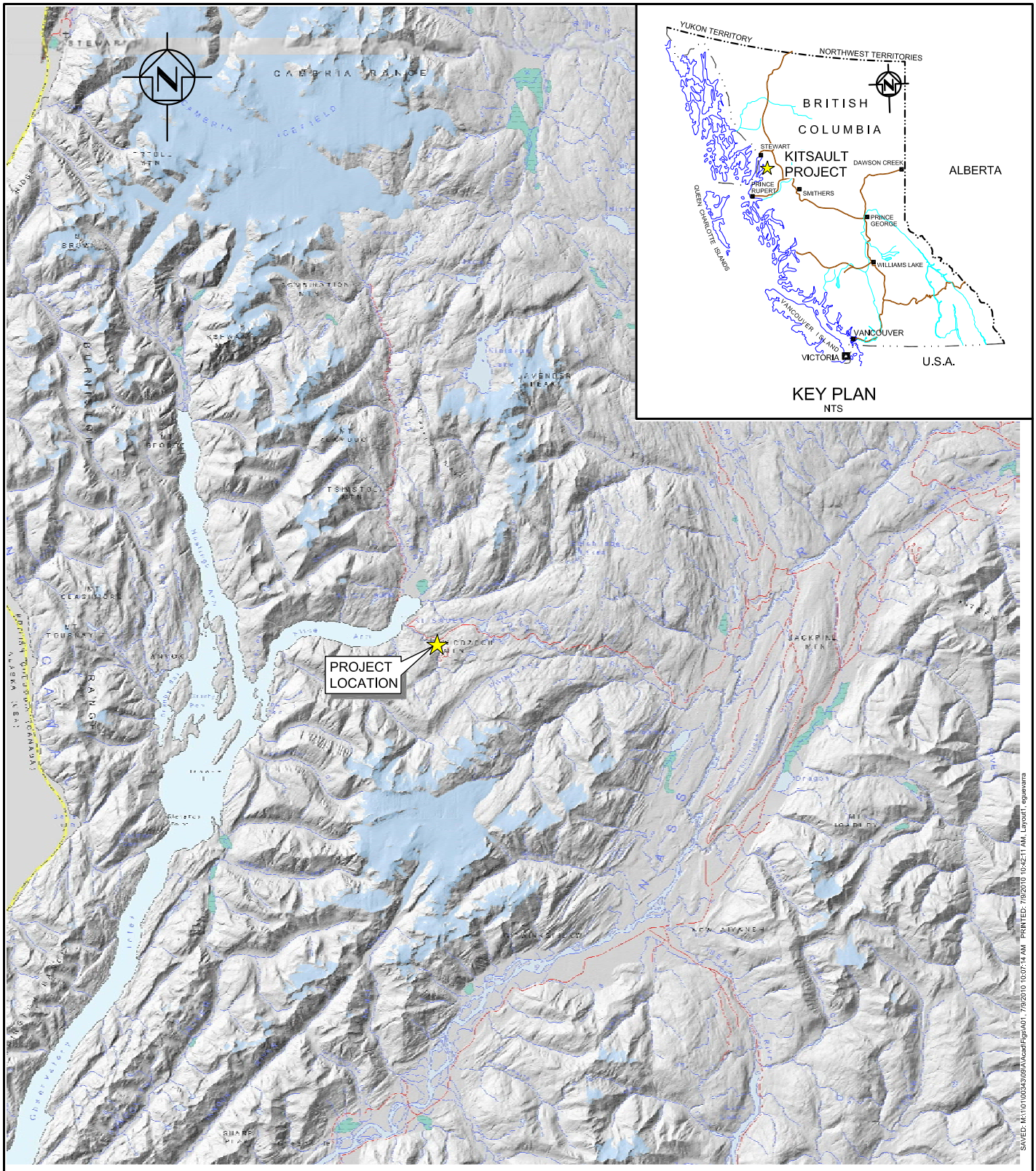
Location	Parameter	Coefficient of Variation											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Stewart A	Mean Temperature	0.83	1.76	0.80	0.20	0.14	0.09	0.06	0.07	0.07	0.15	3.95	1.06
	Total Precipitation	0.47	0.49	0.40	0.54	0.46	0.41	0.46	0.46	0.41	0.33	0.38	0.46
Nass Camp	Mean Temperature	0.66	1.07	1.34	0.19	0.15	0.10	0.06	0.08	0.10	0.18	3.15	0.80
	Total Precipitation	0.58	0.57	0.55	0.57	0.42	0.49	0.59	0.42	0.46	0.42	0.55	0.54
Kitsault Project Site	**Mean Temperature**	**0.50**	**0.94**	**0.71**	**0.13**	**0.10**	**0.06**	**0.04**	**0.05**	**0.06**	**0.11**	**2.37**	**0.62**
	Total Precipitation	**0.35**	**0.35**	**0.32**	**0.37**	**0.30**	**0.30**	**0.35**	**0.29**	**0.29**	**0.25**	**0.31**	**0.34**

M:\1\01\00343\09\A\Data\Meteorology\[Coef Variation.xlsx]Summary

NOTES:

1. COEFFICIENT OF VARIATION = STANDARD DEVIATION / MEAN
2. STEWART A VALUES BASED ON MSC MONTHLY DATA FROM 1975 - 2007.
3. NASS CAMP VALUES BASED ON MSC MONTHLY DATA FROM 1973 - 2007.
4. KITSAULT VALUES BASED ON AN AVERAGE OF STEWART A AND NASS CAMP VALUES.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT VA101-343/9-1	JWV	JGC	KJB



LOCATION MAP

Scale 5 0 5 10 15 20 25 km

VANCOUVER B.C.

SAVED: M:\101\00343\09\Acad\Figs\A01, 7/9/2010 10:07:14 AM PRINTED: 7/9/2010 10:42:11 AM, Layout1, eguevarra

XREF FILE(S): IMAGE FILE(S): bc_103p_xc10m_utm09_20070115

REV	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D
0	09JUL'10	ISSUED WITH REPORT	JWV	NSD	GLS	KJB

AVANTI KITSAULT MINE LTD.

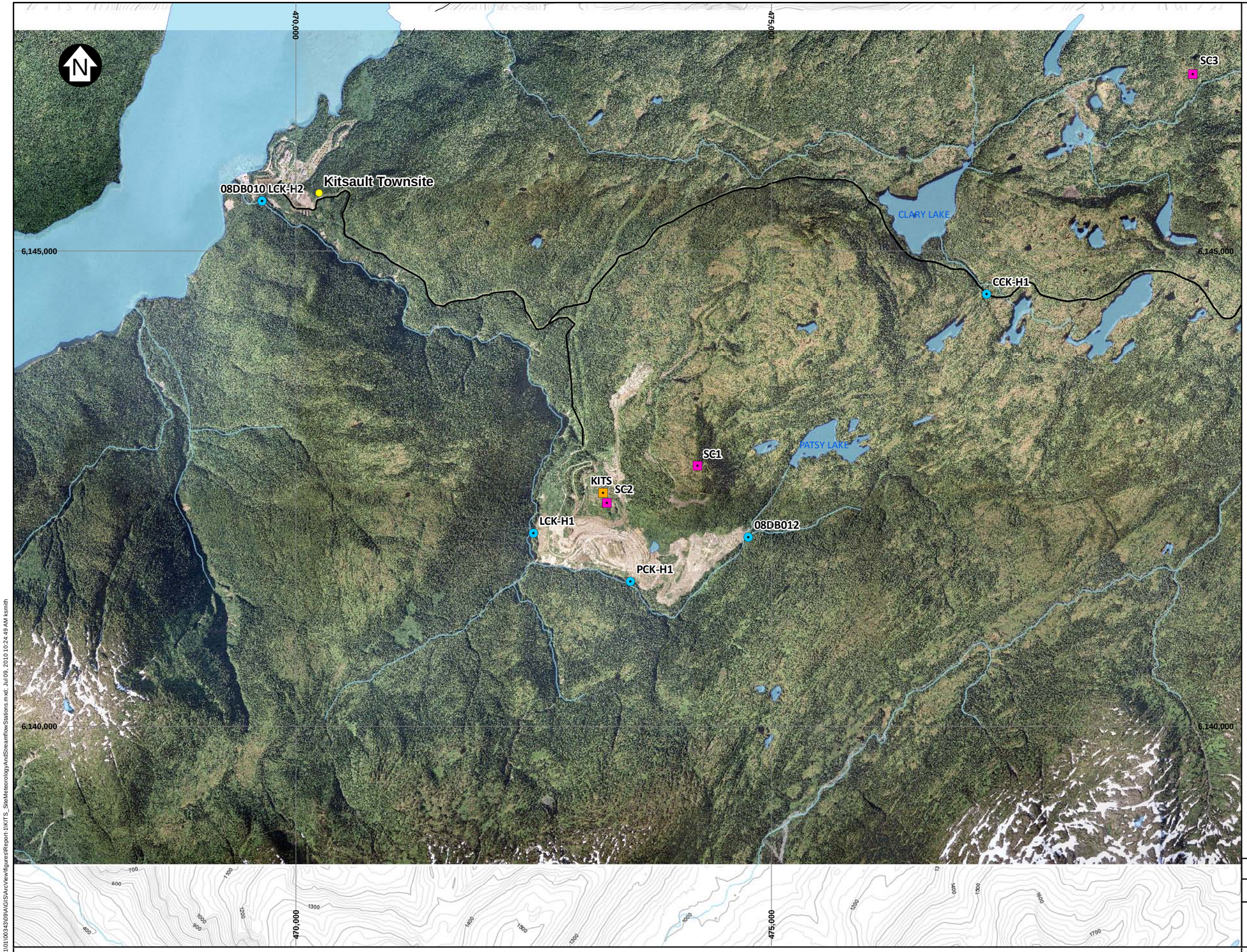
KITSAULT PROJECT

PROJECT LOCATION MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-343/9	1

FIGURE 1.1 REV 0



LEGEND:

- HYDROLOGY STATION
- METEOROLOGY STATION
- SNOW SURVEY STATION
- ACCESS ROAD

NOTES:

1. BASE MAP: LIDAR IMAGERY AND BC TRIM CONTOURS FROM GEOBC (WMS)

2. CO-ORDINATE GRID IS IN METRES.
DATUM: NAD 83
PROJECTION: UTM ZONE 9.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

4. CONTOUR INTERVAL IS 20 METRES.

SCALE 0.4 0.2 0 0.4 0.8 1.2 1.6 2 km

AVANTI KITSAULT MINING LTD.

KITSAULT PROJECT

SITE METEOROLOGY AND STREAMFLOW STATIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	09JUL'10	ISSUED FOR REPORT	KS	KS	JWV	JGC

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P/A NO. VA101-343/9 | REF NO. 1

FIGURE 2.1 | REV 0

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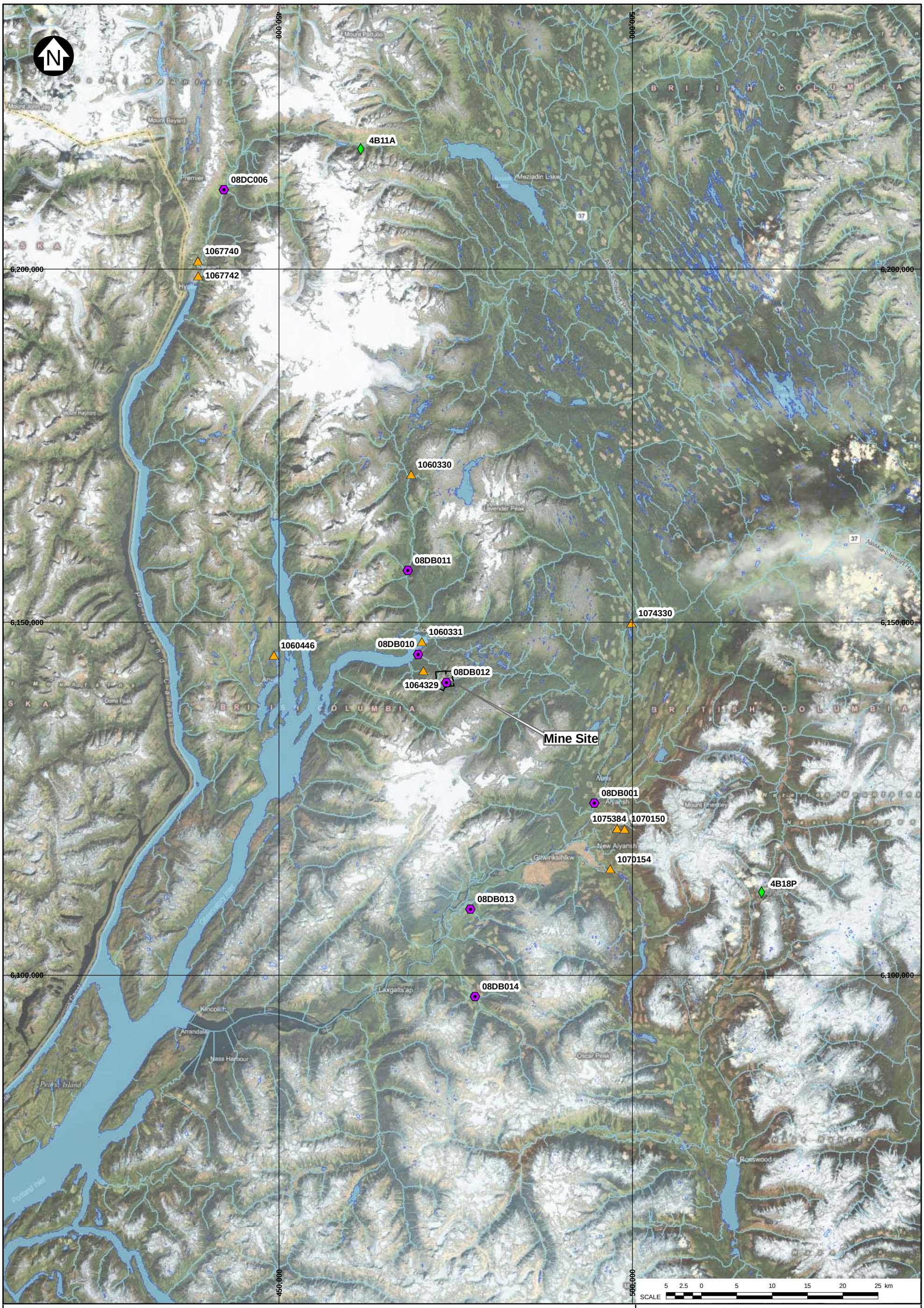

LEGEND:

GENERAL

- MSC CLIMATE STATION
- WSC STREAMFLOW GAUGE
- SNOW SURVEY STATION
- MINE SITE
- RIVER / CREEK
- LAKE

NOTES:

1. BACKGROUND IMAGERY COPYRIGHT MICROSOFT BING MAPS.
2. ROAD, HYDRO AND WATERSHED DATA OBTAINED FROM BC GOVERNMENT GEOBC.
3. CO-ORDINATE GRID IS IN METRES. DATUM IS NAD83 AND PROJECTION IS UTM ZONE 9.
4. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:500,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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REGIONAL CLIMATE STATIONS AND STREAMFLOW GAUGES

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FIGURE 2.2

REV 0

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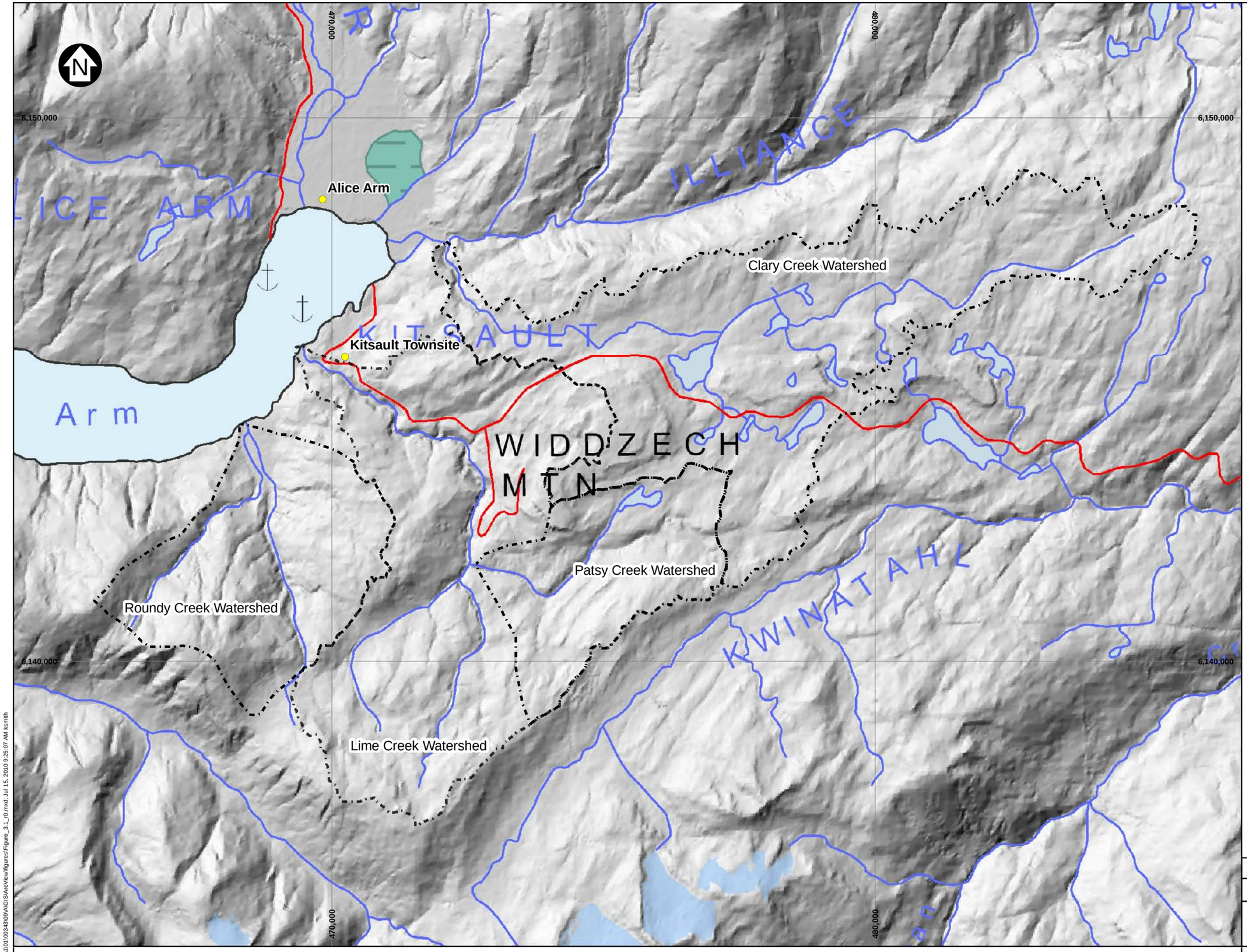

LEGEND:

GENERAL

- TOWN / COMMUNITY
- ROAD
- RIVER / CREEK
- LAKE
- WATERSHED BOUNDARY

NOTES:

1. BACKGROUND IMAGERY TRIM MAPS.
2. ROAD, HYDRO AND WATERSHED DATA OBTAINED FROM BC GOVERNMENT GEOBC.
3. CO-ORDINATE GRID IS IN METRES. DATUM IS NAD83 AND PROJECTION IS UTM ZONE 9.
4. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

SCALE 0.7 0.35 0 0.7 1.4 2.1 2.8 3.5 km

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KITSAULT PROJECT AREA CATCHMENT BOUNDARIES

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REF NO. 1

FIGURE 3.1

REV 0

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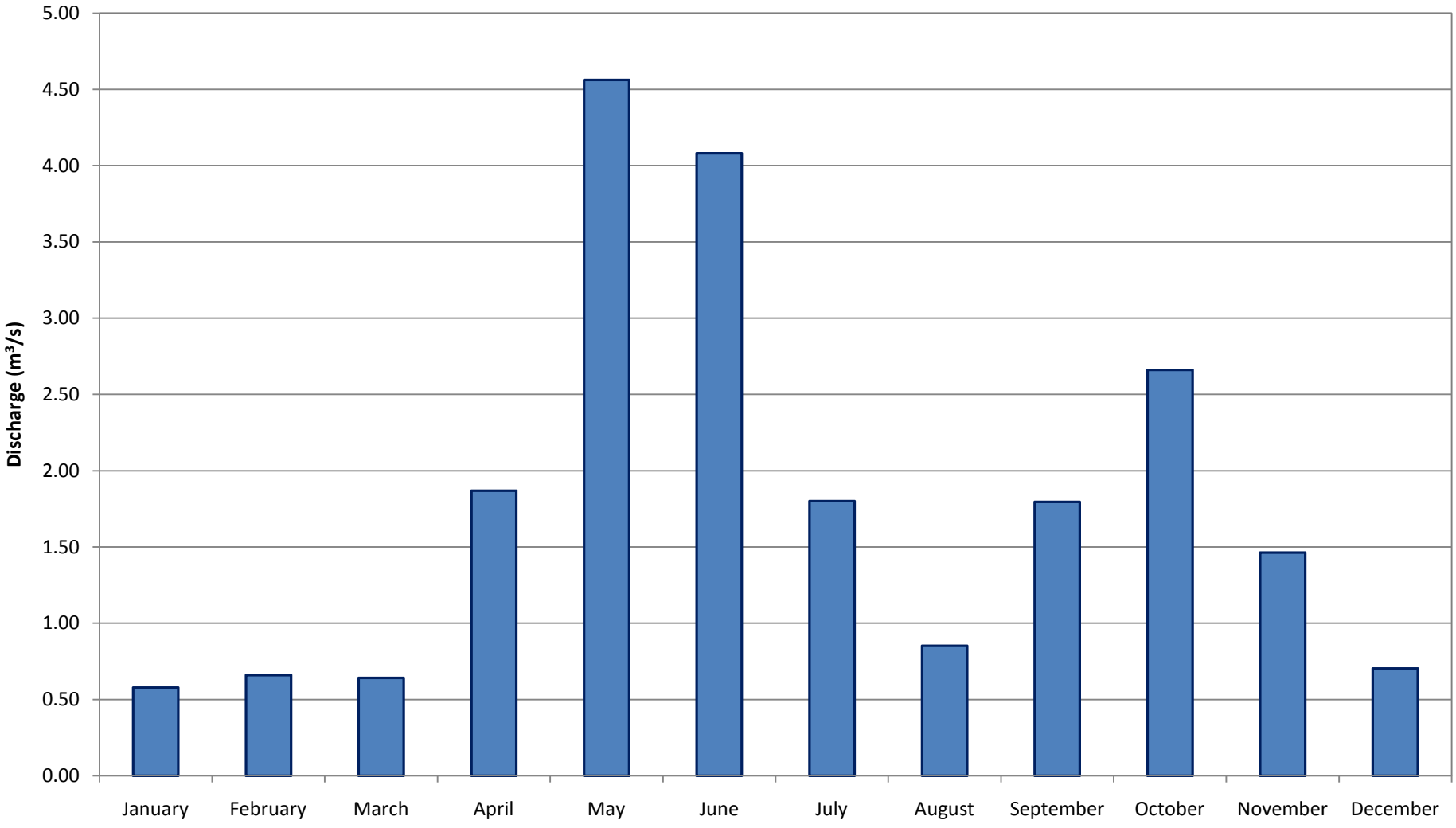

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT	KT	JGC	KJB

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LIME CREEK
MEAN ANNUAL HYDROGRAPH

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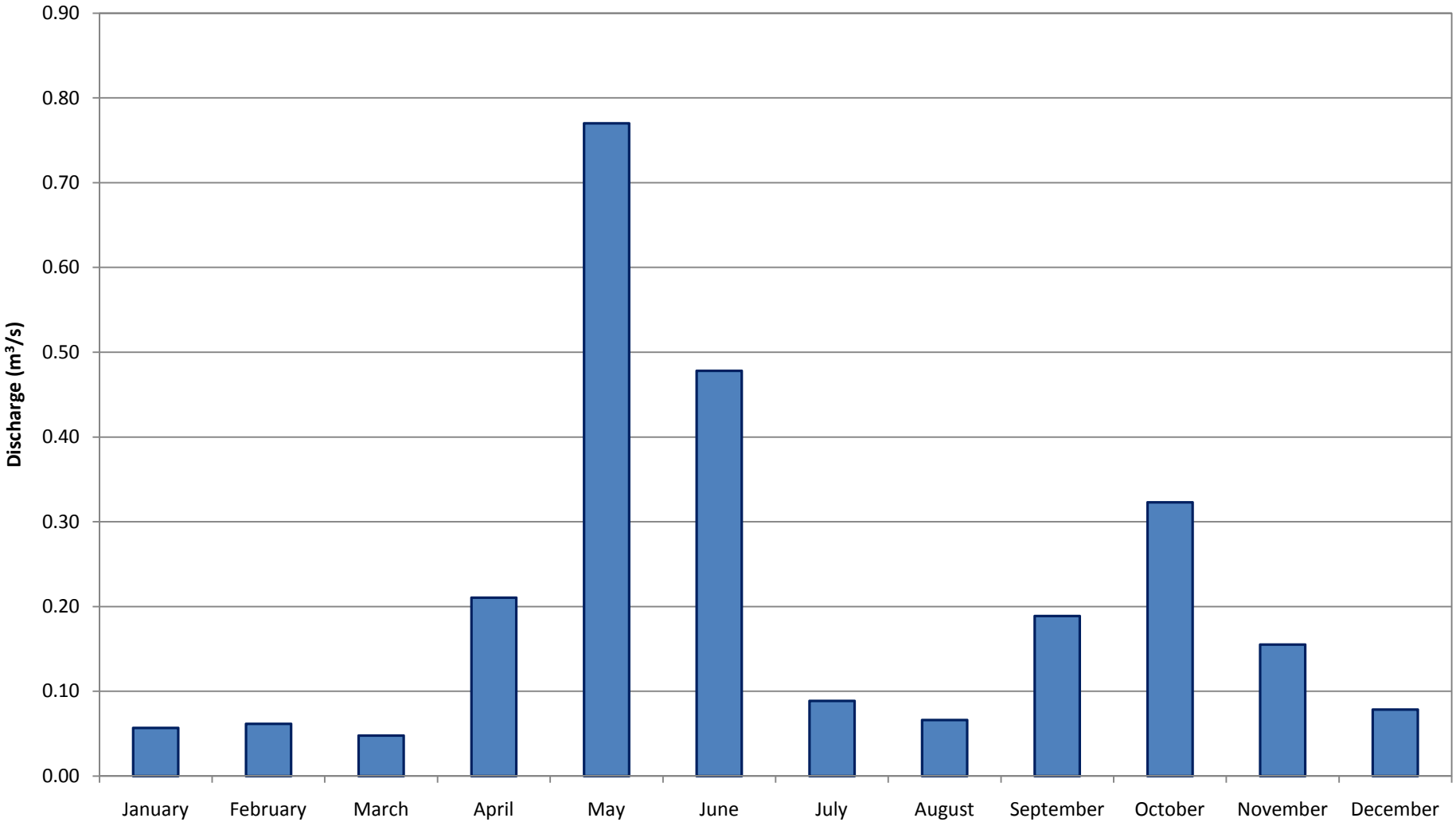
REF. NO. 1

FIGURE 3.2

REV 0



REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT	KT	JGC	KJB

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PATSY CREEK
MEAN ANNUAL HYDROGRAPH

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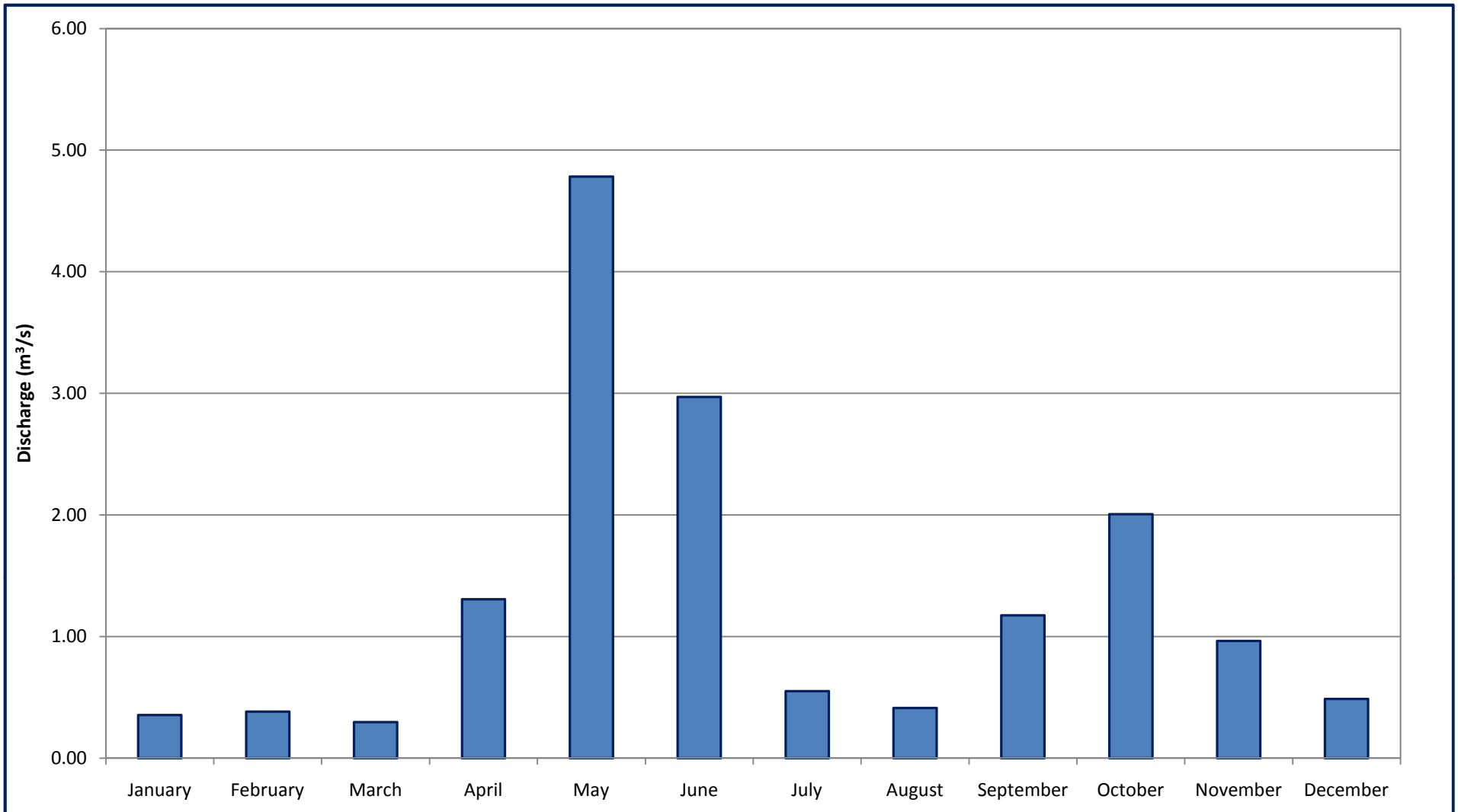
REF. NO. 1

FIGURE 3.3

REV 0



REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT	KT	JGC	KJB

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CLARY CREEK AT CLARY LAKE OUTLET
MEAN ANNUAL HYDROGRAPH

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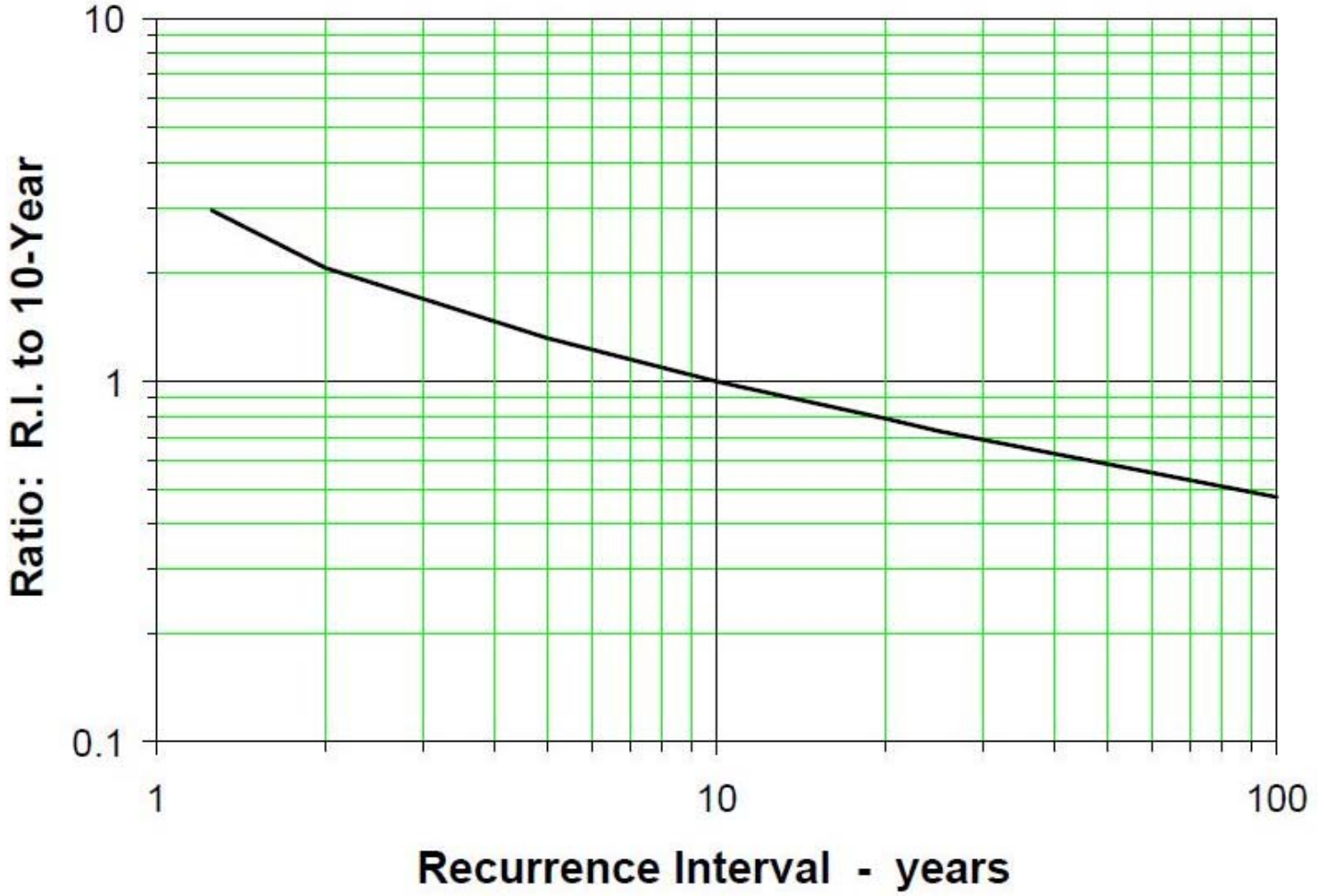
P/A NO. VA101-343/9

REF. NO. 1

FIGURE 3.4

REV 0



NOTES:

1. FROM OBEDKOFF "STREAMFLOW IN THE SKEENA REGION"".
2. RATIOS FROM THIS GRAPH ARE TO BE APPLIED TO THE 10-YEAR RECURRANCE INTERVAL 7-DAY LOW FLOW VALUE TO DETERMINE 7-DAY LOW FLOW VALUES FOR OTHER RECURRANCE INTERVALS

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT	JWV	JGC	KJB

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LIME CREEK
ANNUAL 7-DAY LOW FLOW SCALING CURVE

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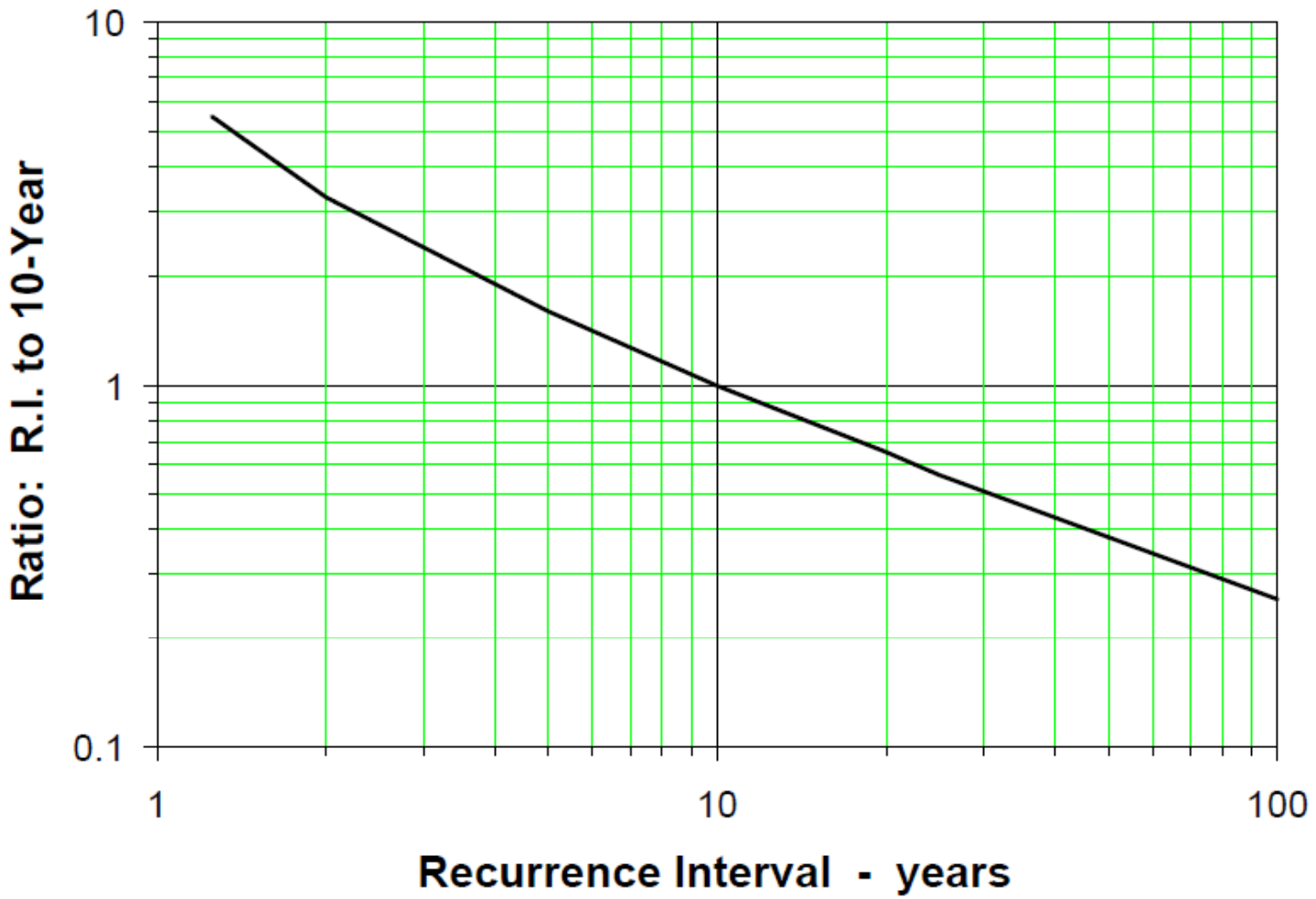
FIGURE 3.5

REV 0



NOTES:

1. FROM OBEDKOFF "STREAMFLOW IN THE SKEENA REGION".
2. RATIOS FROM THIS GRAPH ARE TO BE APPLIED TO THE 10-YEAR RECURRANCE INTERVAL 7-DAY LOW FLOW VALUE TO DETERMINE 7-DAY LOW FLOW VALUES FOR OTHER RECURRANCE INTERVALS.
3. RATIOS FROM THIS GRAPH MAY BE ALSO BE APPLIED TO THE CLARY CREEK 10-YEAR RECCURANCE INTERVAL 7-DAY LOW FLOW.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
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PATSY CREEK
ANNUAL 7-DAY LOW FLOW SCALING CURVE

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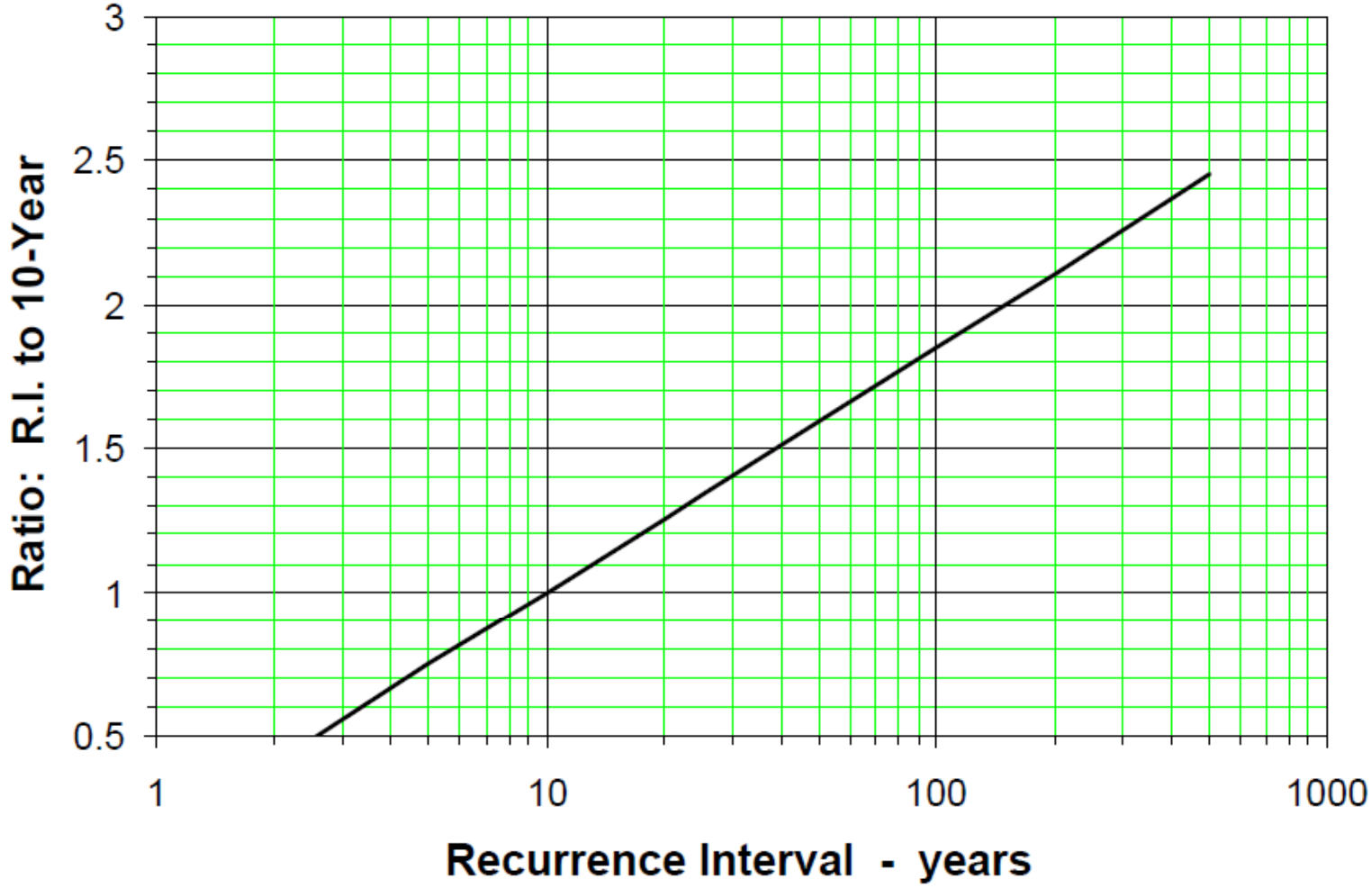
REF. NO. 1

FIGURE 3.6

REV 0



NOTES:
1. FROM OBEDKOFF "STREAMFLOW IN THE SKEENA REGION".
2. RATIOS FROM THIS GRAPH ARE TO BE APPLIED TO THE 10-YEAR RECURRANCE INTERVAL PEAK FLOW VALUE TO DETERMINE PEAK FLOW VALUES FOR OTHER RECURRANCE INTERVALS.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
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LIME CREEK
INSTANTANEOUS PEAK FLOW SCALING CURVE

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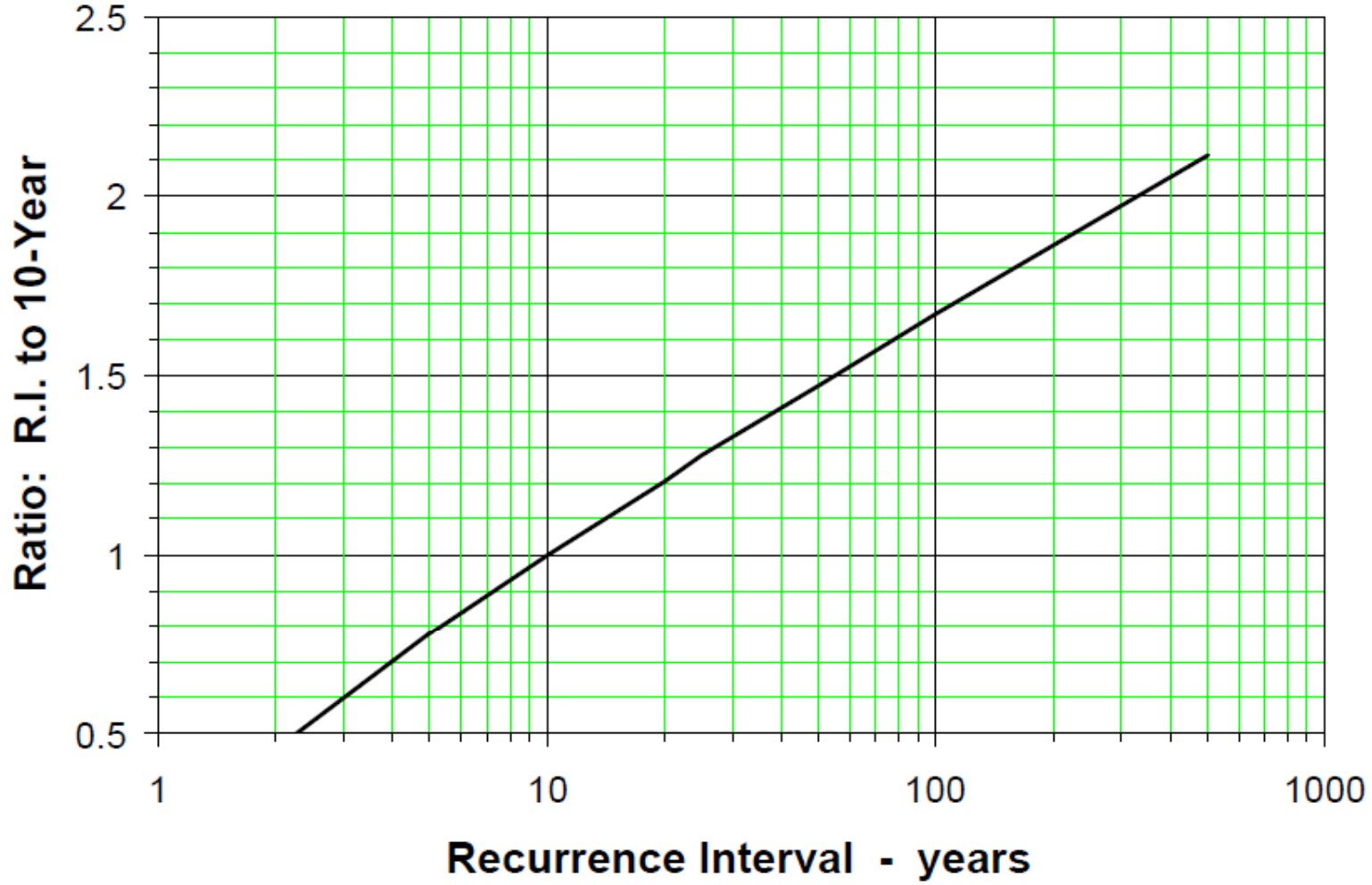
P/A NO. VA101-343/9

REF. NO. 1

FIGURE 3.7

REV 0



NOTES:
1. FROM OBEDKOFF "STREAMFLOW IN THE SKEENA REGION".
2. RATIOS FROM THIS GRAPH ARE TO BE APPLIED TO THE 10-YEAR RECURRANCE INTERVAL PEAK FLOW VALUE TO DETERMINE PEAK FLOW VALUES FOR OTHER RECURRANCE INTERVALS.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08JUL'10	ISSUED WITH REPORT	JWV	JGC	KJB

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PATSY CREEK
INSTANTANEOUS PEAK FLOW SCALING CURVE

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FIGURE 3.8

REV 0