Appendix 6.4-A

2012 Hydrometeorology Report

AJAX PROJECT

Environmental Assessment Certificate Application / Environmental Impact Statement for a Comprehensive Study

KGHM AJAX MINING INC.
AJAX PROJECT

2012 HYDROMETEOROLOGY REPORT

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VA101-246/8-8
Rev 0
March 12, 2013

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KGHM AJAX MINING INC.
AJAX PROJECT

2012 HYDROMETEOROLOGY REPORT
VA101-246/8-8

Rev	Description	Date	Approved
0	Issued in Final	March 12, 2013	KJB

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EXECUTIVE SUMMARY

The Ajax Project (the Project) is a proposed open pit copper-gold mine located in the South-Central Interior of British Columbia (BC), Canada, near the City of Kamloops. The climate of the Ajax Project area is typical of the dry British Columbia Interior Region, with generally low total precipitation and high evaporation, and correspondingly low streamflow rates. Located in the rain shadow of the Coast Mountains, this area has a semi-arid steppe climate characterized by generally cool, dry winters and hot, dry summers, with low humidity.

The objective of this report is to provide a hydrometeorological characterization of the Ajax Project, primarily for purposes of water balance modelling, engineering design, water rights applications, and environmental assessments. This report presents site and regional climate and hydrology data, and provides corresponding estimated long-term values for the project area, which will be updated as additional information is obtained from ongoing data collection programs.

Meteorological data collection at the site commenced in August 2010 at the AJAXMET climate station, and the available data include records of temperature, relative humidity, precipitation, and wind speed and direction. Active and inactive regional climate stations are located throughout the area, with several having two or more decades of climate data.

Streamflow data are currently being collected at five (5) stream gauging locations in the Ajax Project area, starting in late April 2008. Preliminary results from these stations are presented in this report. Further work is required to continue the development of the stage-discharge relationship at each location and to extend the stage records. Seven (7) regional gauging stations, maintained by Water Survey of Canada, are located in the region.

The key findings of this study, which apply to the Ajax Project area, are summarized as follows:

- The long-term average annual temperature is estimated to be 6.3 ºC, with average monthly temperatures ranging from 18.5°C in July to -5.0°C in December.
- Relative humidity varies throughout the year, but is typically highest in mid-winter and lowest in mid-summer, with respective monthly average values of approximately 88% and 50%.
- The average wind speed for the period of record is 2.4 m/s at the AJAXMET station.
- The long-term mean annual precipitation is estimated to be 310 mm.
- Approximately 30% of precipitation is expected to fall as snow, corresponding to a mean annual snowfall (snow water equivalent) of 94 mm.
- Approximately 70% of precipitation is expected to fall as rain, corresponding to a mean annual rainfall of 216 mm.
- The 1 in 10 year maximum 24-hr precipitation is estimated to be 31.7 mm.
- The probable maximum 24-hr precipitation (PMP) is estimated to be 221 mm.
- The mean annual lake evaporation is estimated to be 565 mm.
- Sublimation was estimated to be 28 mm for the winter season.
- The mean annual discharge (MAD) for the Jacko Lake inflow gauging station is estimated to be 0.025 m^3/s. This stream is considered to be representative of natural baseline flow conditions for the Ajax Project.
- The estimated long-term mean annual unit runoff for the Jacko Lake inflow gauging station is approximately 0.82 $l/s/km^2$ (26 mm).

- A mean annual runoff coefficient of 0.08 was computed for naturally vegetated areas.
- In the highest flow month of May, the 10-year dry monthly discharge value is approximately 190% of the MAD; while in the lowest flow month of December, the 20-year wet monthly discharge value is only 13% of the MAD.
- Most project area creeks likely have zero flow conditions for extended periods during the coldest winter months.
- The 100 and 200-year peak instantaneous flows for the Ajax Project site are estimated to be 2.19 m^3/s and 2.61 m^3/s, respectively, for a drainage area of 31.1 km^2 (Jacko Lake inflow gauging site).
- The estimated long-term hydrometeorological values presented in this report are predicated on the assumption that the historical data used in the analyses are reasonably representative of probable climatic and hydrologic conditions in the project area during the life of the project. A review of long-term regional climate and streamflow records indicates the potential for temperatures to be a little warmer (~0.5 C over the next couple of decades), for there to be slightly more rain and less snow, and for streamflow patterns to accordingly adjust with slightly higher winter base flows and slightly lower summer freshet flows. No changes are expected in terms of storm severity or peak flows. Quantifying the changes with any certainty, however, is not realistic, and there will still be considerable year to year variability in all conditions.

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Appendix A Site Streamflow Gauges and Data

ABBREVIATIONS

Ajax Project	the Project
Abacus Mining and Exploration Corporation	AME
British Columbia	BC
Environment Canada	EC
Intensity-Duration-Frequency	IDF
KGHM Ajax Mining Inc	KAM
Knight Piésold Ltd	KPL
Metres above sea level	masl
Mean annual discharge	MAD
Mean annual precipitation	MAP
Ministry of Forests, Lands and Natural Resource Operations	FLNRO
Pacific Decadal Oscillation	PDO
Pacific Standard Time	PST
Potential Evapotranspiration	PET
Probable Maximum Precipitation	PMP
Rainfall Frequency Atlas of Canada	RFAC
Relative humidity	RH
Tailings Storage Facility	TSF
Water Survey of Canada	WSC

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The Ajax Project (the Project) is a proposed open pit copper-gold mine located in the South-Central Interior of British Columbia (BC), Canada, near the City of Kamloops. The Project, owned by KGHM Ajax Mining Inc. (KAM), lies approximately 3 km southwest of the neighbourhood of Aberdeen in Kamloops and east of the former Afton Mine property area, operated by Teck Cominco Ltd. (Teck). Two former and partially backfilled open pits from the Afton Mine, the Ajax East and Ajax West pits are located within the project area. The location of the project is shown on Figure 1.1.

1.2 PREVIOUS STUDIES

Knight Piésold Ltd. (KPL) completed the *2008 Preliminary Hydrometeorology Report* (Knight Piésold, 2009) in February 2009, which was based on limited Project site data. This report supersedes the 2008 report.

2 – METEOROLOGY

2.1 INTRODUCTION

The climate of the project area is typical of the BC Interior Region, with generally low total precipitation and high evaporation that equate to dry conditions, and correspondingly low streamflow rates. Located in the rain shadow of the Coast Mountains, this area has a semi-arid steppe climate characterized by generally cool, dry winters and hot, dry summers, with low humidity (Canadian Climate Normals, 2003). Convective storm cell events are frequent in the summer months and, as a result, precipitation is generally highest in June and July.

2.2 PROJECT SITE STATION

The AJAXMET climate station is shown on Photo 2.1 and station details are summarised in Table 2.1. It was installed in August 2010 at an elevation of 950 metres above sea level (masl); two and a half years of data are available from this station. The climate station monitors the following parameters:

- Air Temperature (°C)
- Relative Humidity (%)
- Atmospheric pressure (kPa)
- Precipitation (mm)
- Solar radiation (W/m^2)
- Wind speed (m/s), and
- Wind direction (Degrees from True North, and Standard Deviation).

Photo 2.1 AJAXMET Climate Station

A CR1000 datalogger is installed at the station and data are collected at hourly increments. The logger is set to Pacific Standard Time (PST) to avoid data gaps and overlaps and to be consistent with standard monitoring practices.

Golder Associates installed a second climate station in the Project area in November 2006. This station, which is known as the Goldmet climate station, is located at the current Project camp location at an elevation of 940 masl. Data from the Goldmet station are considered to be of generally lower quality than the AJAXMET data and, therefore, have not been used in the following analyses, except to infill small data gaps in the AJAXMET climate record.

2.3 REGIONAL STATIONS

The climate analyses presented in this report are primarily based on short-term site specific data collected at the AJAXMET climate station and on concurrent and long-term data collected at nearby regional stations operated by Environment Canada (EC) and the British Columbia Ministry of Forests, Lands and Natural Resource Operations (FLNRO).

The names, locations, and periods of record of regional climate stations are summarised in Table 2.2 and station locations are shown on Figure 2.1. The majority of the regional stations have been deactivated with the only active EC stations being Kamloops Airport (1163780), Kamloops Pratt Road (116C8P0), Red Lake (1166658), and Criss Creek (1162177). The Sun Peaks (Upper) (116QK0M) station is also active, but has no complete years of data. Data from most of the inactive EC stations were not used for the analyses, with the exception of the Logan Lake (1124668) and Kamloops Afton Mines (1163790) stations.

In addition, data from the Afton station, which is operated and maintained by the BC FLNRO and detailed in Table 2.2, was incorporated in the climate analyses. The Afton station is located approximately 4 km from the Project site at an elevation of 780 masl, but only provides reliable precipitation data during non-freeze months. Non-freeze months are defined as months that have a monthly mean temperature greater than zero degrees Celsius.

2.4 TEMPERATURE

Temperature data are recorded at the AJAXMET climate station using a Model HMP45C212 integrated temperature/relative humidity sensor. Hourly average, maximum, and minimum temperature data are recorded and the corresponding monthly mean temperatures collected thus far are presented in Table 2.3.

Site data are currently of insufficient length to provide estimates of temperature Normals for the Project area. Accordingly, site data were correlated with concurrent regional data from the EC Kamloops Airport station and the BC FLNRO Afton station. These stations were chosen for the analysis because of their proximity to the Project site and their concurrent temperature records with the AJAXMET station. It was found that both regional stations produced satisfactory results, with the Afton station data having a stronger correlation (R^2=0.99) with the Project data, as shown on Figure 2.2. The coefficient of determination, denoted R^2, is used to describe how well a regression trend-line fits the data set. Due to the strong coefficient of determination, the regression equation shown on the figure was applied to the 25-year Afton station temperature record to generate a synthetic long-term temperature series for the AJAXMET climate station. The concurrent Afton temperature data are presented in Table 2.3.

The estimated long-term temperature values for the Project site are summarised in Table 2.4. The mean annual temperature for the Project site is estimated to be 6.3 ºC. The warmest months are July and August, with mean monthly temperatures of 18.5 ºC and 17.5 ºC, respectively. The coldest months are January and December, with mean monthly average temperatures of -4.5 ºC and -5.0 ºC, respectively.

The annual mean temperature varies from year to year, with a standard deviation of 0.6 ºC. The maximum and minimum annual mean temperatures are 7.0 ºC and 5.6 ºC, respectively, for the synthetic period of record.

It should be noted that there is evidence of a minor historical trend of increasing temperature in the region, as discussed in Section 4.1. The indicated rate of increase of 0.3 ºC per decade has not been incorporated into the long-term values presented in Table 2.4, but potential ramifications should be considered on a case-by-case basis.

2.5 RELATIVE HUMIDITY

Relative humidity (RH) is recorded at the AJAXMET climate station using a Model HMP45C212 integrated temperature/relative humidity sensor. Hourly average, maximum and minimum relative humidity data are recorded at the station. Monthly summaries of AJAXMET RH are provided in Table 2.5.

The derivation of long-term estimates of RH for the Project area were done by correlating the available concurrent data from the AJAXMET, Afton, and Kamloops Airport stations using linear regression analysis. Similar to the temperature regression results described in section 2.4, the Afton station produced the best relative humidity regression relationship, with an R^2 value of 0.92, compared to an R^2 value of 0.80 with the Kamloops Airport station. The concurrent Afton data are presented in Table 2.5. The regression equation shown on Figure 2.3 was applied to the 25-year Afton station record to generate a synthetic long-term RH series for the Project station, which is summarized in Table 2.6.

The mean annual RH for the Project site is estimated to be 65.3%, with a standard deviation of 2.0%. The maximum RH typically occurs in December while the minimum is observed in July, with mean monthly values of 88.0% and 50.4%, respectively.

2.6 WIND VELOCITY AND DIRECTION

Wind velocity and direction data are collected at the AJAXMET climate station using a RM Young 05103AP-10 Wind Monitor, mounted on a 10 m tower and oriented to True North. Hourly wind direction, standard deviation wind direction, and wind speed are recorded.

Recorded wind speed values are summarized in Table 2.7, and the monthly Wind Roses for the period of record are provided on Figures 2.4 through 2.6. The wind direction is variable throughout the measured record, with predominantly north-westerly winds in the summer and south-easterly winds in the winter. Monthly mean wind speeds range from 1.8 m/s in January 2011 and September 2012 to 3.1 m/s in January 2011. The mean annual wind speed at the station during the period of record was 2.4 m/s.

2.7 PRECIPITATION

2.7.1 General

Precipitation in the Project area occurs either as snow, rain, or a combination of both, with the latter generally occurring during the late fall or early spring periods. Total hourly precipitation data have been collected at the AJAXMET climate station since August 2010. The dataset, however, has inconsistencies and is relatively short, and thus regional data are required to generate long-term precipitation estimates. Precipitation data from the Goldmet climate station were initially considered but were discounted because of concerns with data quality.

The datasets from six regional stations were used to interpolate a mean annual precipitation (MAP) value for the Project Site. The stations include:

- EC Kamloops Airport
- EC Kamloops Afton Mines
- EC Kamloops Pratt Road
- EC Red Lake
- EC Logan Lake, and
- BC FLNRO Afton.

These stations were considered due to their geographic proximity to the site, relatively long data records, and varying elevations. The precipitation record from the BC FLNRO Afton station was used in this exercise despite the lack of winter precipitation data. The BC FLNRO only collects reliable precipitation data during non-freeze months, and the analyses involving this station were completed for the non-freeze period only.

2.7.2 Project Area Rainfall

As stated above, the available AJAXMET rainfall data are not used due to data quality concerns. Accordingly, an effort was made to use the rainfall data recorded at the Goldmet climate station. Upon further review of the Goldmet data and in the context of known general regional rainfall patterns, it was determined that the data are likely under-representing actual site conditions. Furthermore, there is additional concern about the validity of the winter data, since the gauge is not designed to measure snowfall. Accordingly, the Goldmet rainfall data were not used and the analysis was conducted only on the basis of regional data.

2.7.3 Rainfall Analysis

The long-term precipitation records from six regional stations were analysed to determine the precipitation patterns in the region. The first part of the exercise involved comparing concurrent data records from a relatively high elevation station with a relatively low elevation station to determine if a relationship existed between the two data records. The following pairs of stations were analysed:

- Pair 1: Kamloops Airport versus Afton
- Pair 2: Kamloops Airport versus Kamloops Afton Mines
- Pair 3: Kamloops Airport versus Kamloops Pratt Road
- Pair 4: Kamloops Airport versus Logan Lake, and
- Pair 5: Kamloops Airport versus Red Lake.

Kamloops Airport is relatively close to the Project area and is at the lowest elevation of the six stations used in this analysis; thus, it was used as the "base station" and compared to the other five stations. It was found that a reasonably strong relationship exists between all the regional pairings except Kamloops Airport versus Logan Lake. The results of the pairings are presented in Table 2.8, where the R^2 values of the concurrent data records can be found. The results from Pair 4 were discounted due to the poor R^2 result and the substantial distance between Logan Lake and the Project area.

Potential orographic/location patterns in the region were investigated once it was confirmed there were correlations between the regional precipitation records. Orographic effects, which are the result of wind forcing air masses up the sides of elevated land formations, are typically characterized by increases in precipitation with increases in elevation. It is generally expected that orographic patterns would not be evident during the spring, summer, and fall months (non-freeze months), when weather patterns in the region are dominated by convective storm systems that are generally independent of elevation; however, upon review of the regional data, it was concluded that there are notable differences in precipitation with changes in elevation and location, with the highest stations experiencing the highest rainfall.

The differences in rainfall were correlated with elevation for pairs 1, 2, 3 and 5 in Table 2.8, and the results were averaged, indicating an uplift of 4.8% per 100 m elevation gain, which was adopted for estimating rainfall at the Project area. This relation was then applied to the long-term mean rainfall for the Kamloops Airport station for the rainfall only months of April to October (165 mm), to produce a rainfall value for the Project site of 216 mm. Selection of the rainfall only months for this calculation is based on the assumption that precipitation falls primarily as snow at the site during March and November, which are transition months (rain and snow) at Kamloops Airport.

2.7.4 Snowfall Analysis

Regional monthly precipitation distributions were examined for the five EC stations that were used in the rainfall analysis to determine the Project area snowfall amount and the MAP. These distributions are shown in Table 2.9. The BC FLNRO Afton station was not used as it collects total precipitation data and does not differentiate between rainfall and snowfall.

The lower elevation stations (Kamloops Airport, Kamloops Afton Mines, and Kamloops Pratt Road) indicate an annual split of approximately 75% rainfall and 25% snowfall. The higher elevation stations (Red Lake and Logan Lake) indicate less rainfall annually, commensurate with cooler temperatures, as would be expected, with rainfall/snowfall splits of approximately 60% / 40%.

The Project site elevation is most similar to that of Red Lake and Logan Lake, although it is lower than the Lake sites with a difference of 247 m and 186 m, respectively. For comparison, the elevation difference between the Project site and the lower elevation stations ranges from 214 m to 570 m. The proximity of the regional stations to the Project site should also be considered, and the lower elevation stations are closer to the Project than the higher elevation ones. It was therefore determined that the most appropriate rainfall/snowfall split for the Project area is 70% / 30%, which is intermediate between the high and low station ratios, with a slight weighting towards the lower stations to account for proximity.

Using the 70% / 30% split and given a mean annual rainfall value of 216 mm, the mean annual snowfall for the Project site is estimated to be 94 mm.

2.7.5 Mean Annual Precipitation

Combining the 216 mm rainfall and 94 mm snowfall values results in an estimated MAP of 310 mm for the Project site. The validity of this estimate was verified by plotting MAP versus elevation for the Project site and the five EC regional stations used in the analyses. The results, as shown on Figure 2.7, indicate that the Project MAP is generally consistent with the regional trend of increasing precipitation with elevation gain, but suggest that the estimate may be a little low.

As a means of further checking the reasonableness of the MAP estimate, precipitation values were generated using the well-known PRISM (Parameter-elevation Regressions on Independent Slopes Model) model, which uses point measurements of regional precipitation and temperature to produce monthly and yearly precipitation estimates for any location in BC (PRISM, 2013). The PRISM model indicates a MAP of 348 mm for the period from 1971 to 2000, which is greater than the estimated project value, thereby suggesting that the estimate may be low. This finding, combined with the plot on Figure 2.7, supports the idea of increasing the estimate, but in recognition that both analyses are based on the same regional data, and that the only site specific data (albeit of questionable quality) indicates much drier conditions, the estimate was kept at 310 mm. However, given the considerable uncertainty associated with the MAP estimate, it is recommended that it be treated with appropriate caution and revisited once additional precipitation data from the ongoing climate data collection program are available.

2.7.6 Precipitation Distribution

The estimated mean annual precipitation for the project area was distributed on a monthly basis according to the precipitation pattern for Kamloops Afton Mine. The mean annual rainfall and snowfall values were distributed monthly according to a merger of the Red Lake and Kamloops Afton Mine precipitation patterns, with appropriate adjustments made to maintain the selected proportions of annual rainfall and snowfall. The estimated mean monthly precipitation, rainfall and snowfall values for the Project site are summarized in Table 2.9.

It should be noted that there is evidence in the regional historical precipitation and streamflow records of a trend towards more rain and less snow, commensurate with generally increasing temperatures. The potential for such a trend has not been considered in the rain/snow values presented in this report.

2.7.7 Wet and Dry Year Precipitation

Estimates of wet and dry year annual precipitation are required to assess the range of probable moisture conditions at the site. Wet and dry year annual precipitation totals were calculated based on a normally distributed probability of occurrence. The calculations require mean and standard deviation values for annual precipitation. The mean annual precipitation of 310 mm, as calculated in Section 2.7.5, was used for this analysis. A dimensionless measure of the standard deviation is the coefficient of variation (CV), which was estimated for the site to be 0.18, based on the average value for the following regional stations:

- Kamloops Airport CV = 0.20

- Logan Lake CV = 0.09
- Kamloops Afton Mines CV = 0.25
- Red Lake CV = 0.20
- Kamloops Pratt Road CV = 0.24
- Afton CV = 0.26, and
- Leighton Lake CV = 0.18.

This CV was multiplied by the MAP of 310 mm to produce a standard deviation estimate of 55 mm. The wet and dry annual precipitation values for various return periods are presented in Table 2.10, which indicates a 1 in 200 year wet annual precipitation of 452 mm and a 1 in 200 year dry annual precipitation of 168 mm.

2.7.8 Extreme 24 Hour Precipitation

The Rainfall Frequency Atlas of Canada (RFAC) (Hogg and Carr, 1985) provides a regional methodology for estimating the mean and standard deviation for the annual extreme rainfall values for various storm durations. However, as the RFAC was published in 1985, there is now more than 25 years of additional data available. Therefore, rather than directly adopting the RFAC statistics, estimates from the RFAC for Kamloops Airport were compared with corresponding statistics calculated from the Kamloops Airport historical extreme rainfall record. In particular, a comparison was made on the basis of the 24-hour extreme rainfall, once the Kamloops Airport historical record of annual daily precipitation extremes was converted to the equivalent 24 hour series using a factor of 1.13 (Hershfield, 1961). This comparison indicated much higher values for the historical record, and therefore the higher values were adopted as the basis for determining project specific values.

The RFAC recommends applying an orographic factor of 1.5 to 12-hour and 24-hour precipitation estimates for interior areas of BC with elevations greater than 800 m. This factor is designed to account for orographic precipitation increases typically associated with frontal storm systems that generally produce the most extreme long-duration (12-hour and 24-hour) rainfall. In the Project area, however, almost all rainfall during the summer months likely occurs as a result of convective storm activity, which is typically unaffected by elevation, and therefore one might argue that an orographic factor is not required. A review of Section 2.7.3 indicates otherwise, as there appears to be a regional summer orographic effect that corresponds to a 4.8% increase in elevation per 100 m elevation gain. Accordingly, it is considered prudent and appropriate to apply this factor to the Kamloops Airport statistics to translate them to the Project site. Furthermore, this factor is likely applicable to the full range of storm durations. As a result, return period extreme rainfall values for a variety of durations were estimated for the Project site by calculating them for Kamloops Airport according to the values and methodology in the RFAC, and then prorating the results according to a 24-hour to daily factor of 1.13 and an orographic factor of 4.8% per 100 m. The results are presented in Table 2.11.

Examples of extreme precipitation events for the Project area are 43 mm, 51 mm and 69 mm, for the 24-hour 10, 25 and 200-year storm events, respectively. The probable maximum precipitation (PMP) is estimated to be 221 mm.

2.8 POTENTIAL EVAPOTRANSPIRATION (LAKE EVAPORATION)

Potential evapotranspiration (PET) is defined as the amount of evapotranspiration that would occur given an infinite supply of water from a crop surface, and is believed to reasonably represent lake evaporation conditions (Ponce, 1989).

There are no pan evaporation data available for the Project area and no evaporation estimates given for regional climate stations, which is not unusual given the difficulty in reliably collecting these data. There is inherent uncertainty with any PET estimate when no reliable site specific data are available for calibration.

Monthly PET data were estimated using the Thornthwaite (Thornthwaite, 1955) and Hargreaves equations. The Hargreaves equation indicated year-round evaporation at the Project, which is believed to be unrealistic, and the results of this method have been discounted. The benefit of the Thornthwaite equation over other methods is that the equation only requires inputs of temperature values, which are usually available for a given project area. A limiting factor of the Thornthwaite equation is that 12 months of data in a year are always required; otherwise the respective year must be ignored. Using the average monthly temperature values from the AJAXMET climate station, the Thornthwaite equation predicts reasonably consistent PET values for 2010, 2011 and 2012, ranging from 538 mm to 566 mm, as shown in Table 2.12. Use of the long-term synthetic temperature series developed in Section 2.4 results in a mean annual PET of approximately 565 mm/year, with mean monthly values ranging from zero in the winter to 130 mm in July. These values are considered to be reasonably representative of lake evaporation.

The Hydrologic Atlas of Canada indicates mean annual lake evaporation for the region of between 600 and 700 mm (Natural Resources Canada, 1978). This estimate is higher than the Thornthwaite estimate, which is not unexpected because the Atlas provides estimates for valley sites, which are typically warmer and therefore experience more evaporation than higher elevation sites in the same region. Since the Project site is at an elevation of 915 m, it is expected that the estimate would be lower than the Atlas estimate.

It should be noted that there is evidence in the historical climate records of a trend towards warmer temperatures, and accordingly slightly greater evaporation might occur than that estimated. However, any increases are likely to fall well within the uncertainty associated with the current estimates, and therefore the potential for such increases were not directly considered in the presented values.

2.9 SUBLIMATION

Sublimation is the process by which moisture is returned to the atmosphere directly from snow and ice without passing through the liquid phase (Liston and Sturm, 2004). The processes causing and influencing sublimation are not well understood, and many estimates and methods of estimation found in literature are site-specific, subject to significant uncertainty, and not easily extrapolated.

Sublimation values can vary substantially according to a number of factors, most notably terrain characteristics, vegetation cover, wind speed and humidity. Sublimation was assumed to be distributed fairly evenly over the period of November through February, when precipitation predominantly occurs as snow. Sublimation at the Project location was estimated to be 28 mm for the winter season. This estimate is roughly based on a general sublimation rate of approximately

30% of the average winter snowfall of 94 mm. This rate and the estimated sublimation total are generally consistent with values reported in the literature (Montesi et al., 2004; Strasser et al., 2008; Winkler and Moore, 2010).

The sublimation estimate is based on historical snowfall conditions, but as discussed in Section 4.1, there is evidence suggesting the possibility of generally warmer temperatures in the future, and accordingly less snowfall and less associated sublimation. However, any possible decreases in sublimation are likely within the uncertainty associated with the current estimates, and therefore the potential for such decreases were not directly considered in the presented values.

3 – HYDROLOGY

3.1 INTRODUCTION

The Ajax Project site is located near Kamloops, BC, as shown on Figure 1.1. The Project is situated in the Peterson Creek watershed, which drains into the South Thompson River, and Cherry Creek watershed, which drains northward into Kamloops Lake.

Streamflow data have been collected at several locations in the Project area to support permitting, design, and future operations. Data collection was initiated by KPL in 2008 and continues to be collected and reviewed. Results of the first year of data collection were presented in a baseline data report by KPL (2009). The current analysis, as presented in the following sections, involved reviewing the available dataset and using it to estimate long-term streamflow conditions in the Project area based on comparisons with regional streamflow data collected by the Water Survey of Canada (WSC).

3.2 REGIONAL HYDROLOGY

The Ajax Project is located in the Thompson River Valley on the south side of Kamloops Lake. The location of the Project site with respect to the regional hydrologic zones and the regional climate and streamflow gauging stations is shown on Figure 2.1. The Project area is located within the Thompson River watershed in the Montane Cordillera Ecozone across the Quilchena Plains and Eagle Lake Mountains Ecoregions (Natural Resources Canada, 1993). The region is dominated by gently rolling plateaus and incised river valley systems and is notably one of Canada’s warmest summer climates and driest regions.

Water Survey of Canada maintains and operates streamflow gauging stations throughout the region. There are seven regional streamflow gauging stations currently in operation in the vicinity of the Project area (stations located within an approximate radius of 60 km and within the Quilchena Plains and Eagle Lake Mountains Ecoregions). Most of the regional stations record flows from watersheds much larger than the Project watersheds and many of the streams and rivers are regulated, either by the presence of natural lakes or manmade water control structures. This regulation affects the flow patterns, and particularly impacts the peak flows. If a large regional database were available, the regulated datasets would not be considered for this study, however, the limited availability of data necessitated their inclusion, but the applicability of each dataset was carefully considered for each analysis. The locations of the seven regional stations are indicated on Figure 2.1, and details of the stations are summarized in Table 3.1. The monthly average and annual flows for each of the stations are summarized in Table 3.2. The corresponding average annual unit runoff hydrographs are shown on Figure 3.1 for stations except the Thompson River (08LB064). The Thompson River (08LB064) is determined to be too large to be representative of conditions in the Project area.

The pattern shown on Figure 3.1 indicates a fairly regular regional hydrograph pattern of a prominent peak flow period in the spring and early summer due to snowmelt, and very low flows during the remainder of the year, even during the autumn storm season. This is likely the result of storm water runoff saturating the ground, rather than draining into creeks due to extremely dry and absorbent soils. It is also evident that there are substantial differences in the unit runoff values of the various catchments, which is likely the result of differences in local precipitation patterns and physiographic factors such as land use and topographic relief, aspect, slope, and drainage area, and also may be due of some diversion or extraction of water for irrigation. Overall, the unit runoff values are relatively low when compared to most other areas in BC, which is consistent with the very dry climate of the region.

3.3 PROJECT STREAMFLOW GAUGING PROGRAM

Five streamflow gauging stations were installed in the Project area in 2008. The locations of the five stations and their respective drainage areas are shown on Figure 3.2. Natural drainage in the project area has been extensively altered as a result of previous mining activities, and delineating catchment boundaries can be difficult due to the altered flow regimes. For instance, the historic tailings storage facility (TSF) was created on the site of the former Hughes Lake, which at one time received inflows from Alkali Creek. Alkali Creek was diverted from its original path to enter the historic TSF at the south-west end. The seepage pond, located below the west embankment of the TSF, receives groundwater inflow and seepage inflow from the historic TSF. Water is impounded at the seepage pond so that no surface runoff leaves the pond.

All data collected to date have undergone a data quality review. There is generally good continuity of data from year-to-year due to the installation of surveyed benchmarks at each station. Details of the Project gauging stations are presented in Table 3.3, and a detailed discussion of each station is provided in Appendix A. The site station that is considered to have the best quality data that is most generally representative of natural flow conditions in the Project area is the JACINF station.

3.4 SYNTHETIC FLOW SERIES GENERATION

Unit runoff hydrographs for the select regional stations and the JACINF project station during the Project data collection period are shown on Figure 3.3. This figure indicates that the monthly distribution of flows at this site is generally consistent with the regional patterns and that the unit runoff is relatively low.

3.4.1 Ranked Regression Analysis

Long-term project specific runoff values are required to accurately define the hydrologic characteristics of a project site. Ranked regression analysis (also known as frequency paired analysis) is a technique used to synthesize long-term runoff using a derived relationship between long-term regional streamflow data and short-term project streamflow data. In contrast to ordinary linear regression (also known as chronological pairing in the context of hydrologic analyses), wherein discharges are regressed based on their time of occurrence, frequency pairing is based on the frequency of occurrence of discharges. When comparing concurrent sets of ranked daily flows for two or more streamflow records, each flow value of equal rank has an equal probability of exceedance within the data set (since the data sets are of equal length). Therefore, a comparison of ranked daily flows amounts to a comparison of flow frequency distributions. Furthermore, data are usually segmented into distinct seasons, thereby accounting for differences in drainage characteristics that affect the timing and magnitude of runoff. This seasonal segmentation is typically undertaken through hydrograph analysis and it is assumed that parameters driving runoff are generally constant within any one season. For example, the timing of peak runoff occurring as a result of snowmelt may be highly variable between two stations (up to several weeks in some cases), as a result of differences in drainage area and elevation, but will typically occur within the same season. Similarly, the runoff response to storm events may be offset by hours or days, but will typically occur within the same larger seasonal period. The comparison of flow frequency distributions by season overcomes differences in the timing of rainstorm or snowmelt events between watersheds, and ultimately provides a good model for synthetically generating a likely scenario of future flow patterns.

The ultimate objective of utilizing frequency pairing is not to reproduce the exact historical flow patterns of the project area streams, so that one can predict what the flows were on any particular day, but rather to generate datasets that provide an accurate representation of the expected long-term discharge characteristics in a creek and the associated year-to-year, month-to-month and day-to-day variability and frequency of flows. Frequency pairing has been shown to significantly improve the accuracy and precision of long-term estimates of runoff when compared with chronological pairing (Butt, 2013).

For the purpose of gaining an understanding of long-term flow patterns in the Project area, a long-term synthetic flow series was developed for the JACINF gauge. This site was selected for this analysis in preference to the other Project gauge sites because its record is most representative of natural flow conditions and can be correlated to the regional flow records. Flows at the other gauge sites are subject to influence by beaver dam activity and attenuation as a result of reservoir and lake filling and releases.

The regional datasets presented in Table 3.2 were correlated with concurrent JACINF gauge daily flow values and it was found that the data from station 08LF027 (Deadman River at Criss Creek) provide the strongest and most consistent relation. Plots of the concurrent unit runoff hydrographs for the two systems are shown on Figure 3.4.

The frequency distribution of daily flows at the JACINF gauge was correlated to the concurrent distribution of flows in the Deadman River, with the data split into the baseflow period (July through November) and the winter and snowmelt period (December through June). The baseflow correlation is shown on Figure 3.5. The results of the frequency pairing analysis indicate three distinct patterns during this period. In contrast, the correlation between flows during the winter and snowmelt period can be modelled with one relation, as shown on Figure 3.6.

No goodness of fit statistics, such as R^2, are provided because the ranking process invalidates such values. The effectiveness of the modelling procedure can best be assessed by comparing measured and synthesized flows, as discussed in the following section.

3.4.2 Synthetic Daily Flow Series

The correlation equations were applied to the long-term flow data at the Deadman River station and a long-term synthetic flow string file was generated for the JACINF gauge. A comparison of measured to synthetic flows for the JACINF gauge site is presented on Figure 3.7, which demonstrates a strong match between the two datasets. The corresponding flow duration curves shown on Figure 3.8 similarly illustrate a strong agreement between measured and predicted values. These results indicate that the model is well-calibrated both in terms of the frequency distribution of daily flows and in terms of matching daily flows on specific dates. Based on these results, the model is considered to have good capabilities for predicting future distributions of daily flows.

This flow series, comprising 50 years of synthetic data, has a mean annual discharge of 0.025 m^3/s (which equates to a unit runoff of 0.82 $l/s/km^2$ or 26 mm) and is shown as a continuous hydrograph plot on Figure 3.9. It should be noted that the mean annual discharge is considerably lower than the average discharge shown on Figure 3.8 because Figure 3.8 corresponds to the measured records that do not include much of the low flow periods. A summary of monthly and annual flows for the 50 year flow series is given in Table 3.4, and the mean annual hydrograph is presented in terms of monthly percentage of total annual discharge on Figure 3.10. This distribution, which has approximately 70% of the total annual flow volume occurring in May and June in response to snowmelt, and 90% of the annual volume occurring in April to July, is generally consistent with the regional flow patterns.

As discussed in Section 4.3, the historical regional streamflow records suggest that future hydrographs in the project area could possibly exhibit higher winter base flows, an earlier onset of the freshet, a lower freshet volume and peak, and a lower mean annual discharge than the current flow estimates. There is considerable uncertainty associated with quantifying these effects but potential ramifications should be considered on a case by case basis.

3.4.3 Estimated Runoff Coefficients

The effective annual runoff coefficient (C_{eff}) for the JACINF gauging station was calculated as the ratio of the mean annual unit runoff to the mean annual precipitation, as follows:

$$(C_{eff}) = \text{Mean Annual Unit Runoff (mm)} / \text{Mean Annual Precipitation (mm)}$$

The mean annual precipitation of 310 mm that was computed for the Project area in Section 2.7.5 is considered reasonably representative of the precipitation conditions that would be expected in the JACINF drainage basin. Use of this value and the mean annual runoff of 26 mm results in a runoff coefficient of approximately 0.08. This is consistent with the runoff coefficients observed in similar semi-arid climates with high evaporation and low precipitation.

3.4.4 Wet and Dry Monthly Flows

Wet and dry year return period runoff values are used in water management decisions and engineering design. Wet and dry monthly flows were estimated for the JACINF gauging site for recurrence intervals of 5, 10, and 20 years. The flows corresponding to each recurrence interval were calculated using the synthetic monthly and annual flow values summarized in Table 3.4. These values were fitted to assumed distributions using Palisade Decision Tools @RISK distribution fitting software. The results are tabulated in Table 3.5 and are shown graphically on Figure 3.11.

The results of the monthly flow analysis indicate the extreme seasonality of flows in Jacko Creek. In the highest flow month of May, the 10-year dry monthly discharge value is approximately 190% of the mean annual discharge (MAD); while in the lowest flow month of December, the 20-year wet monthly discharge value is only 13% of the MAD.

3.4.5 7-Day Low Flow

Many climatic, geologic and physiographic factors affect the ability of a watershed to generate streamflow during low flow conditions. It is difficult to accurately estimate low flows because geologic factors are difficult to quantify. In general, unit low flows tend to decrease with reduced watershed size, and as channel storage, floodplain area and stream entrenchment are reduced. Low flow statistics are used to quantify the minimum sustained flows that can be expected in a stream for a given recurrence interval.

The statistical low flow value that is generally considered to be the standard is the 7-day 10-year low flow (7Q10), because it is typically requested by regulatory agencies and required for fisheries studies. This is the lowest average flow that would be experienced during a consecutive 7-day period with an average recurrence interval of ten years, and it is commonly considered a good indicator of low flow conditions during a drought. Recurrence interval 7-day low flows were generated using Environment Canada's LFA statistical low flow software, with annual low flow values derived from the lowest continuous 7-day runoff period within the long-term synthetic flow series generated for the JACINF station. LFA uses a Gumbel distribution to model return period low flows from these inputs, and the resultant return period values were all zero m^3/s to the third decimal place.

As discussed in Section 4.3, the historical regional streamflow records suggest that future hydrographs in the project area could possibly exhibit higher winter base flows, but the current periods of dry creek bed are so extended that even with slightly warmer winter temperatures and associated possible winter rainfall or snowmelt the extreme winter low flows are still likely to be zero for JACINF.

3.4.6 Peak Flows

Peak flow statistics are required for various aspects of water management and engineering design. Peak flows in the region typically occur during the spring melt season but also may be caused by high intensity convective storm systems. A statistical analysis was undertaken to calculate peak instantaneous flow values on the basis of the long-term synthetic flow series for the JACINF gauging station. The results were compared to regionally based values derived using a model developed by Obedkoff (2003), which presents a scaling relation for 10-year peak instantaneous discharge estimates for various WSC gauging stations in the project region (Obedkoff's Zone 12). Index frequency factors were calculated from the long-term records of appropriate regional sites to adjust the 10-year value to other return periods of up to 200 years.

The statistical analysis involved the extraction and analysis of the annual maximum daily discharge values from the long-term synthetic flow series for the JACINF gauging station. It is recognized that there is considerable uncertainty associated with the peak flow values in the synthetic series because the rating curve for the JACINF site is not well developed for high flows and the generation of the synthetic flow series did not particularly target high flows. Nonetheless, there is limited relevant peak flow information in the region, and therefore all available information, including the synthetic flow series, was considered. The 50 year set of synthesized peak flow values provided the basis for a frequency analysis assessment, using Environment Canada's CFA software package and assuming a Generalized Extreme Value distribution. This distribution type is commonly applied to peak flows and has been shown in studies by the University of British Columbia to consistently provide a reasonable, yet conservative fit to measured data (Cathcart, 2001). Amongst the most common three-parameter distributions, the GEV consistently generates values that fall somewhere between the middle and high end of the range.

The resulting return period peak daily flow values were then scaled from daily to instantaneous flows according to a scaling ratio of 1.5. This scaling ratio was determined largely on the basis of the few largest flow events in the measured JACINF record, but consideration was also given to the ratios from the WSC annual peak flow records for Guichon Creek, which is the smallest unregulated regional creek with a reasonably long peak flow record. The 1.5 value is considerably greater than the Guichon Creek value of 1.1, but a review of the historical records reveals that the low regional value results from almost all of the annual peak flows occurring from snowmelt, which produces a much more muted runoff response than extreme rainfall. This is at least partially a function of watershed size, since the convective storm events that are common to the region are much more likely to produce extreme runoff in small basins such as those in the project area. Accordingly, the 1.5 value is considered most appropriate. The results of the statistical peak flow analysis are presented in Table 3.6. The estimated 10-year peak instantaneous discharge for the JACINF station is 0.62 m3/s, and the 100- and 200-year values are 1.35 m3/s and 1.68 m3/s, respectively.

Instantaneous peak flows were also estimated based on regional hydrological data, as presented in Obedkoff (2003). This procedure consists of three steps:

1. Selecting a regional WSC station with watershed characteristics comparable to those of the JACINF gauging station
2. Scaling the 10 year return peak flow for the selected WSC station to the JACINF gauging station, and
3. Using regional index frequency factors to estimate flood magnitudes of various return periods at the JACINF gauging station.

According to the regional hydrologic model of Obedkoff (2003), the scaling effects of drainage area and regional flow variation increase as the size of catchment decreases, thus a regionally appropriate surrogate watershed to use as a basis for peak flow estimates should be of comparable size and be relatively close in proximity. The WSC station at Guichon Creek was selected as the most appropriate basin for comparison based on the noted reasons. Guichon Creek is located approximately 27 km from the Project site and has the smallest drainage area of all the available regional stations, with an area of 78.2 km^2 (as compared to 31.1 km^2 for JACINIF). The 10-year peak flow for Guichon Creek, using the CFA software package, is 2.2 m^3/s. The CFA analysis is based on data up to 2010 using a Generalized Extreme Value Distribution.

The 10-year Guichon Creek peak flow value was scaled to the JACINF gauging station site by the ratio of drainage areas combined with a scaling exponent. Wang (2000) presents regional scaling exponents to account for drainage area and regional flow variation. However, for drainage areas smaller than 50 km^2 there is no discernible trend between regional gauging stations for watersheds in the region, and in fact, there is suggestion of a scaling exponent greater than 1.0, which is nonsensical. A conservative approach was thus taken and a scaling exponent of 0.70 was adopted for calculating the various return period peak flows, based on the idea that smaller watersheds tend to have shorter runoff response times and also have a greater likelihood of having complete coverage by an extreme rainfall event (Cathcart, 2001). Scaling the Guichon Creek 10 year peak flow value results in an estimated 10-year peak instantaneous discharge for the JACINF gauging station of 1.14 m^3/s. Regional return period scaling factors based on selected stations in Obekoff's Zone 12 were then applied to develop corresponding estimates of the mean annual, 50-year, 100-year, and 200-year instantaneous peak flows. A conservative approach was adopted by using the

80th percentile of the scaling factors for each return period. The estimated 100-year and 200-year peak instantaneous flows for the JACINF gauging station, based on the regional data, are 2.19 m^3/s and 2.61 m^3/s, respectively.

A summary of the peak flows using both methods for various recurrence intervals is presented in Table 3.6. The regional approach produces higher peak flow results for the longer return periods than does the statistical analysis of the long-term synthetic flow series. Given the uncertainty of the peak flows in the synthetic flow series, as discussed, it was considered prudent to adopt the larger regionally based values as the design values.

As discussed in Section 4.3, there are no notable trends in the regional peak flow data associated with possible climate change effects, and accordingly no additional related factors were applied to the peak flow estimates.

4 – CLIMATE CHANGE

There is a general consensus in the scientific community that the global atmosphere is warming and that worldwide climate patterns are changing as a result. According to the Pacific Climate Impacts Consortium (PCIC), mean temperatures in British Columbia are expected to increase by approximately 1.8 °C by the 2050s. Winter precipitation is predicted to increase by 8% with summer precipitation expected to decrease by 1%, and winter snowfall predicted to decrease by 58% (PCIC 2012). The estimated values represent the projected change from the 1961-1990 baseline. These changes could in turn affect streamflow patterns as warmer winters would raise freezing levels and decrease the amount of precipitation stored as snow during the winter months, which would also result in lower freshet flows due to the decreased snowpack.

Given these predicted changes in climate, there is some concern about whether or not historical flow and climate records reasonably represent conditions that might be expected over the next 30 years through project operations, or even longer time scales through project closure. In an effort to address this concern, historic trends of annual temperature, precipitation and unit runoff were examined. The Kamloops Airport climate station has the longest climate record available in the region (61 years of complete data: 1951-2011). This dataset was used to analyze long-term regional climate trends applicable to the project area.

4.1 CLIMATE TRENDS

Three temperature data sets were assessed and their trends are shown on Figure 4.1. All three trends indicate an overall increase in temperature and are significant at the 10% level, which means that one can be 90% confident that they’re not simply due to random chance. The annual mean temperature appears to be increasing at a rate of approximately 0.3 °C per decade, which is generally consistent with the PCIC estimate quoted above.

Trend plots of annual precipitation, rain and snow are presented on Figure 4.2, and indicate a very slight increase in annual precipitation of approximately 3 mm per decade, which is not significant at the 10% level. However, more pronounced and statistically significant trends are evident in the rainfall and snowfall data, with rainfall showing an increase and snowfall showing a decrease, which is a pattern consistent with the noted increase in temperature.

A trend plot of annual maximum daily precipitation is presented on Figure 4.3, and it indicates no statistically significant trend.

These findings suggest that there may be persistent changes occurring in the climate, particularly with regards to temperature, and accordingly that climate conditions may be a little different (warmer, more rain, less snow) in the future than during the period of historical record.

4.2 CLIMATE CYCLES

Temperatures in BC are influenced by strong atmospheric and oceanic climate forcings, and accordingly the increasing temperature trend may be more attributable to climate cycles than unidirectional climate change. The two to five year El Nino Southern Oscillation (ENSO) is one such forcing, but even more prevalent is the Pacific Decadal Oscillation (PDO), which is a 20 to 30 year fluctuation of surface sea water temperatures (above or below normal) in the North Pacific Ocean. This fluctuation is illustrated on Figure 4.4, which presents the variability of the PDO over the past century. The cold phase of the PDO is generally associated with colder and wetter conditions, and the warm phase is associated with warmer and drier conditions in BC (Pike et al., 2008a). The Williams Lake (1961-2012) climate record spans two PDO cycles: the 1961-1976 period is during a cool phase, the 1977 to early 1998 period is during a generally warm phase, and the last decade has been a transition period, with then next cold phase likely just beginning, as indicated on Figure 4.4. Figure 4.5 presents the annual mean temperature trends for each phase of the PDO, and it is evident in this instance that the PDO is having very little influence, with a consistent increasing trend in all phases. Accordingly, it is reasonable to conclude that it is likely that increases in temperature will persist in the foreseeable future even with the expectation that we are entering the next cold phase of the PDO.

4.3 STREAMFLOW TRENDS

Insights into the possible effects of the noted changes in the climate on the streamflow patterns in the project area are provided by examining flow records for Criss Creek and Deadman River. Figure 4.6 shows the annual mean unit runoff for the entire period of complete record at Criss Creek. A slight decreasing trend is visible, which would be consistent with possible higher evapotranspiration rates due to higher temperatures, but the trend is not significant at the 10% level. In contrast, the Deadman River annual mean unit runoff plot indicates a slight increasing trend, as shown on Figure 4.7. It is not clear why the patterns for the two streams are different, but the results are possibly confounded by the fact that both systems are regulated, and accordingly may be subject to variable water extractions. When the mean annual hydrographs for the different phases of the PDO are compared, as shown on Figure 4.8 for Criss Creek and on Figure 4.9 for the Deadman River, the warm phase demonstrates higher winter base flows, an earlier onset of the freshet, a lower freshet volume and peak, and a lower mean annual discharge, which are all conditions consistent with warmer temperatures and less snowfall. During the transition period some reversal of these trends is evident, and surprisingly the mean annual discharge for the Deadman River increases to well above that of the cool phase of the PDO. It is difficult to quantify the potential effects of climate change over the planned life of the Ajax Project, but it reasonable to conclude that with generally consistent precipitation and increasing temperatures, the creeks should generally exhibit higher winter base flows, an earlier onset of the freshet, a lower freshet volume and peak, and a lower mean annual discharge.

Figures 4.10 and 4.11, which present the respective trendlines for the annual peak flows in Criss Creek and the Deadman River, both demonstrate minor trends of increasing flood severity, but neither one is statistically significant. With no apparent trend in precipitation extremes, and with likely decreases in snowpack and the freshet peak, it seems unlikely that climate change will result in higher peak flows, at least in the foreseeable future, and accordingly modifications to the peak flow estimates are not considered warranted (APEGBC, 2012).

4.4 SUMMARY

A review of long-term regional climate and streamflow records indicates the potential for hydrometeorological conditions may be slightly different in the future than during the period of historical record used for characterizing the climate and hydrology of the project area. In particular, no changes are expected in terms of storm severity or peak flows, but temperatures are likely to be a little warmer (~0.5 ^{o}C over the next couple of decades), there is likely to be slightly more rain and less snow, and streamflow patterns will accordingly adjust with slightly higher winter base flows and slightly lower summer freshet flows. However, quantifying the changes with any certainty is not realistic, and there will still be considerable year to year variability in all conditions.

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6 – CERTIFICATION

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

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CONSULTING

TABLE 2.1

KGHM AJAX MINING INC.
AJAX PROJECT

AJAXMET CLIMATE STATION DETAILS

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Station Name	Total Years of Record	Complete Years of Record	Start Year	End Year	Latitude	Longitude	Elevation (m)
AJAXMET	3	2	2010	2012	50°38'32"N	120°27'44"W	950

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Site data\[AJAX Station-TR.xlsx]Project Station

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REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.2

KGHM AJAX MINING INC.
AJAX PROJECT

REGIONAL CLIMATE STATION DETAILS

BRITISH COLUMBIA FORESTS, LANDS, and NATURAL RESOURCE OPERATIONS

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Station Name	Station ID	Lat/Long	Active	Elevation (m)	Distance from Site (TSF) (km)	Start Year	End Year	Span of Record (years)	Complete Years	Mean Annual Precipitation (mm)
Afton	322	50.673 -120.482	Yes	780	4	1988	2012	25	6	234
Leighton Lake	307	50.615 -120.836	Yes	1167	21.3	1982	2012	31	6	292

ENVIRONMENT CANADA

Station Name	Station ID	Lat/Long	Active	Elevation (m)	Distance from Site (km)	Start Year	End Year	Span of Record (years)	Complete Years	Mean Annual Precipitation (mm)
Monte Creek	116NJ9F	50.653 -119.954	No	351	40.9	1986	2007	22	20	360
Pinantan Lake	1166JFR	50.716 -119.945	No	960	42.1	1986	2006	21	7	479
Sun Peaks (Lower)	116Q20D	50.882 -119.882	No	1260	52.4	1994	2008	15	0	N/A
Sun Peaks (Upper)	116QK0M	50.902 -119.918	Yes	2040	51.3	1994	2013	20	0	N/A
Sun Peaks Mountain	1168204	50.903 -119.911	No	1814	51.8	1980	2008	29	1	1024
Kamloops Valleyview	1163875	50.675 -120.253	No	347	19.9	1962	2005	44	32	283
Kamloops Pratt Road	116C8P0	50.600 -120.200	Yes	640	24.2	1986	2013	28	23	374
Kamloops Rayleigh	116L87J	50.818 -120.295	No	357	25.1	1986	2002	17	7	340
McLure	1165030	51.047 -120.222	No	381	49.4	1967	2009	43	35	450
Kamloops Airport	1163780	50.708 -120.450	Yes	345	6.9	1953	2013	61	60	269
Kamloops Cherry Creek	1163814	50.683 -120.583	No	556	4.9	1970	1974	5	3	258
Highland Valley Lornex	1123469	50.467 -121.017	No	1268	40.2	1967	2011	45	31	391
Highland Valley BCCL	1123468	50.500 -121.000	No	1470	37.2	1966	1989	24	10	385
Logan Lake	1124668	50.500 -120.817	No	1101	26.3	1971	2005	35	8	394
Red Lake	1166658	50.933 -120.800	Yes	1162	41	1974	2013	40	23	493
Criss Creek	1162177	51.033 -120.733	Yes	1122	45.3	1988	2013	26	23	449
Kamloops Afton Mines	1163790	51.666 -120.500	No	701	5	1977	1993	17	13	305

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Regional Data\[Regional climate station details-TRi.xlsx]tbl 2.2 Climate Stations

NOTES:

1. "COMPLETE YEARS" REFERS TO TOTAL PRECIPITATION DATA.
2. BRITISH COLUMBIA FORESTS, LANDS, AND NATURAL RESOURCE OPERATIONS DATA DERIVED FROM <http://bcwildfire.ca/weather/stations.htm>.
3. ENVIRONMENT CANADA DATA DERIVED FROM <www.climate.weatheroffice.ec.gc.ca/climatedata/canada_e.html>.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
1	08FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
0	30JAN'09	ISSUED WITH REPORT VA101-246/6-3	CB	DK	JGC

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TABLE 2.3

KGHM AJAX MINING INC.
AJAX PROJECT

AJAXMET AND BC FLNRO AFTON CLIMATE STATIONS
MONTHLY MEAN TEMPERATURES

Print Mar/12/13 15:27:50

Station	Period	Monthly Mean Temperature (°C)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
AJAXMET	2010	-	-	-	-	-	-	18.7	16.8	11.3	7.6	-3.2	-3.5	-
	2011	-4.8	-6.9	1.0	3.5	9.2	13.3	15.6	17.9	15.5	5.9	-1.5	-2.8	5.5
	2012	-4.8	-2.7	1.0	6.4	10.3	12.4	19.0	19.0	14.6	5.7	0.4	-3.5	6.5
	Mean	-4.8	-4.8	1.0	5.0	9.8	12.9	17.8	17.9	13.8	6.4	-1.4	-3.3	5.9
Afton	2010	-0.2	1.3	4.7	7.8	10.8	15.2	20.4	18.2	12.9	8.6	-2.0	-2.7	7.9
	2011	-5.0	-5.7	2.6	5.5	10.9	15.1	17.4	19.5	16.6	6.8	-0.5	-2.3	6.7
	2012	-4.1	-2.3	2.5	7.9	12.0	14.1	20.5	21.9	-	-	-	-	-
	Mean	-3.1	-2.2	3.3	7.0	11.2	14.8	19.4	19.9	14.8	7.7	-1.2	-2.5	7.4

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[1_Temperature.xlsx]Table 2.3

NOTES:

1. BLANK MONTHS HAVE MISSING OR INCOMPLETE DATA (INCOMPLETE HAS BEEN DEFINED AS MONTHS WITH MORE THAN TWO DAYS OF MISSING DATA).
2. MONTHLY AVERAGES HAVE BEEN CALCULATED BASED ON AVERAGE DAILY DATA.

0	06FEB'13	ISSUED WITH REPORT VA101-246/08-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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TABLE 2.4

KGHM AJAX MINING INC.
AJAX PROJECT

PROJECT SITE
ESTIMATED LONG-TERM TEMPERATURES

Print Mar/12/13 15:27:50

Value	Monthly Temperature (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	-4.5	-2.2	1.4	6.4	11.0	14.5	18.5	17.5	12.6	5.4	0.0	-5.0	6.3
Standard Deviation	2.5	2.1	1.7	1.2	1.7	1.5	1.7	1.3	1.6	1.1	1.7	2.8	0.6
Maximum	-0.6	1.9	3.7	8.8	14.7	17.8	20.9	19.4	15.0	8.3	3.4	-1.8	7.0
Minimum	-7.1	-6.6	-2.8	3.7	8.0	12.6	15.7	13.5	9.9	3.9	-3.0	-9.8	5.6

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[1_Temperature.xlsx]Table 2.4

0	06FEB'13	ISSUED WITH REPORT VA101-246/08-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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TABLE 2.5

KGHM AJAX MINING INC.
AJAX PROJECT

AJAXMET AND BC FLNRO AFTON CLIMATE STATIONS
MONTHLY MEAN RELATIVE HUMIDITY

Print Mar/12/13 15:33:12

Station	Period	Monthly Mean Relative Humidity (%)												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
AJAXMET	2010	-	-	-	-	-	-	43.1	53.4	68.6	66.9	78.8	84.2	-
	2011	84.5	72.8	71.3	55.6	62.8	59.5	55.7	42.6	44.1	68.6	72.8	79.7	64.2
	2012	72.1	81.5	61.7	58.6	47.1	65.2	50.7	43.4	46.0	67.8	85.3	87.3	63.9
	Mean	78.3	77.1	66.5	57.1	54.9	62.4	49.8	46.5	52.9	67.7	79.0	83.7	64.7
Afton	2010	86.6	88.2	60.9	52.8	58.0	57.6	42.9	53.8	67.5	68.1	78.5	86.5	66.8
	2011	88.7	73.1	70.8	49.7	58.3	54.7	52.7	40.2	43.7	67.8	68.5	76.1	62.0
	2012	66.8	80.3	57.2	55.9	44.5	63.9	51.3	43.3	-	-	-	-	-
	Mean	80.7	80.5	63.0	52.8	53.6	58.7	49.0	45.8	55.6	68.0	73.5	81.3	63.5

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[2_RelativeHumidity.xlsx]Table 2.5

NOTES:

1. BLANK MONTHS HAVE MISSING OR INCOMPLETE DATA (INCOMPLETE HAS BEEN DEFINED AS MONTHS WITH MORE THAN TWO DAYS OF MISSING DATA).
2. MONTHLY AVERAGES HAVE BEEN CALCULATED BASED ON AVERAGE DAILY DATA.

0	06FEB'13	ISSUED WITH REPORT VA101-246/8-8	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.6

KGHM AJAX MINING INC.
AJAX PROJECT

PROJECT SITE
ESTIMATED LONG-TERM RELATIVE HUMIDITY

Print Mar/12/13 15:33:12

Value	Monthly Relative Humidity (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	87.7	80.3	66.4	57.4	56.9	58.0	50.4	51.9	60.7	74.4	83.9	88.0	65.3
Standard Deviation	8.5	7.2	4.2	7.7	6.5	6.8	8.4	8.3	8.5	4.7	6.6	3.5	2.0
Maximum	99.9	99.9	72.4	74.7	73.0	69.6	67.9	69.7	74.8	85.7	97.5	92.5	68.5
Minimum	68.6	71.0	59.4	44.7	44.2	45.8	36.6	40.3	46.8	68.7	70.3	77.4	62.8

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[2_RelativeHumidity.xlsx]Table 2.6

0	06FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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TABLE 2.7

KGHM AJAX MINING INC.
AJAX PROJECT

AJAXMET CLIMATE STATION
WIND SPEED SUMMARY

Print Mar/12/13 15:39:18

	Monthly Mean Wind Speed (m/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	-	-	-	-	-	-	-	-	2.1	2.4	2.3	2.5	-
2011	1.8	2.7	2.7	2.7	2.2	2.4	2.3	2.3	2.8	2.2	2.9	2.3	2.4
2012	3.1	2.0	3.0	2.7	2.5	2.6	2.2	2.3	1.8	2.2	2.7	2.1	2.4
Mean	2.4	2.3	2.9	2.7	2.4	2.5	2.3	2.3	2.2	2.3	2.6	2.3	2.4

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\WindRose\[WindRose.xlsx]Table 2.7

NOTES:

1. BLANK MONTHS HAVE MISSING OR INCOMPLETE DATA (INCOMPLETE HAS BEEN DEFINED AS MONTHS WITH MORE THAN TWO DAYS OF MISSING DATA).
2. MONTHLY AVERAGES HAVE BEEN CALCULATED BASED ON AVERAGE HOURLY DATA.

0	06FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.8

KGHM AJAX MINING INC.
AJAX PROJECT

REGIONAL RAINFALL ANALYSIS
RESULTS SUMMARY

Print Mar/12/13 15:42:59

Pair	Station	Elevation (masl)	Direction from Kamloops Airport Station	R^2	Total Precipitation (mm)	
					Non-Freeze Months	Freeze Months
1	Kamloops Airport	345	South-West	0.92	146	N/A
	Afton	780			151	N/A
2	Kamloops Airport	345	South-West	0.79	187	91
	Kamloops Afton Mines	701			202	103
3	Kamloops Airport	345	South-East	0.70	180	96
	Kamloops Pratt Road	640			237	127
4	Kamloops Airport	345	South-West	0.54	185	105
	Logan Lake	1101			251	161
5	Kamloops Airport	345	South-East	0.65	181	95
	Red Lake	1162			309	181

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[3_Precipitation_Elevation915.xlsx]Table 2.8

NOTES:

1. THE TOTAL PRECIPITATION VALUES ARE FOR THE CONCURRENT PERIOD OF RECORD BETWEEN THE TWO STATIONS IN EACH PAIR.
2. A NON-FREEZE MONTH IS DEFINED AS A MONTH WITH A MEAN TEMPERATURE ABOVE ZERO DEGREES CELCIUS (APRIL THROUGH OCTOBER).
3. THE FREEZE MONTH DATA AT THE AFTON STATION IS BELIEVED TO BE ERRONEOUS.
4. THE PROJECT AREA SUMMER OROGRAPHIC TREND IS THE AVERAGE OF PAIRS 1, 2, 3, AND 5.

0	06FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.9

KGHM AJAX MINING INC.
AJAX PROJECT

REGIONAL AND PROJECT SITE CLIMATE STATIONS
MONTHLY PRECIPITATION, RAIN, AND SNOW DISTRIBUTIONS

Print Mar/12/13 15:42:59

Station	Value	Mean Monthly Values												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Kamloops Airport Elevation: 345 m	Precipitation (mm)	26.2	14.7	11.6	12.6	22.9	34.2	27.1	25.1	25.3	17.6	22.9	28.5	269
	% Annual Precip.	10%	5%	4%	5%	9%	13%	10%	9%	9%	7%	9%	11%	100%
	Rain (mm)	4.1	5.4	7.7	12.3	22.9	34.2	27.1	25.1	25.3	17.2	12.9	6.5	201
	% Rain	16%	37%	66%	98%	100%	100%	100%	100%	100%	98%	56%	23%	75%
	Snow Water Equivalent (mm)	22.0	9.3	3.9	0.3	0.0	0.0	0.0	0.0	0.0	0.4	10.0	22.0	68
	% Snow	84%	63%	34%	2%	0%	0%	0%	0%	0%	2%	44%	77%	25%
Kamloops Afton Mines Elevation: 701 m	Precipitation (mm)	21.3	13.2	10.8	17.4	29.8	39.4	38.5	29.1	32.5	14.1	25.4	33.6	305
	% Annual Precip.	7%	4%	4%	6%	10%	13%	13%	10%	11%	5%	8%	11%	100%
	Rain (mm)	1.4	4.8	8.2	16.7	29.4	39.4	38.5	29.1	32.5	13.7	10.6	3.7	228
	% Rain	6%	36%	76%	96%	99%	100%	100%	100%	100%	97%	42%	11%	75%
	Snow Water Equivalent (mm)	19.9	8.4	2.6	0.7	0.4	0.0	0.0	0.0	0.0	0.4	14.8	29.9	77
	% Snow	94%	64%	24%	4%	1%	0%	0%	0%	0%	3%	58%	89%	25%
Kamloops Pratt Road Elevation: 640 m	Precipitation (mm)	27.1	17.0	20.9	23.5	39.7	48.8	37.1	28.8	32.8	32.1	35.8	30.9	374
	% Annual Precip.	7%	5%	6%	6%	11%	13%	10%	8%	9%	9%	10%	8%	100%
	Rain (mm)	3.6	5.7	10.9	20.8	38.5	51.0	36.7	28.8	32.8	30.7	16.1	3.5	279
	% Rain	13%	34%	52%	88%	97%	105%	99%	100%	100%	96%	45%	11%	75%
	Snow Water Equivalent (mm)	23.5	11.2	10.1	2.7	1.2	-2.2	0.4	0.0	0.0	1.4	19.6	27.3	95
	% Snow	87%	66%	48%	12%	3%	-5%	1%	0%	0%	4%	55%	89%	25%
Red Lake Elevation: 1162 m	Precipitation (mm)	38.2	25.9	31.1	35.2	50.5	68.1	49.7	36.2	36.6	34.9	40.8	46.0	493
	% Annual Precip.	8%	5%	6%	7%	10%	14%	10%	7%	7%	7%	8%	9%	100%
	Rain (mm)	1.5	1.0	3.8	19.8	44.7	67.4	49.7	36.2	35.2	23.5	6.6	0.6	290
	% Rain	4%	4%	12%	56%	89%	99%	100%	100%	96%	68%	16%	1%	59%
	Snow Water Equivalent (mm)	36.8	24.9	27.3	15.4	5.8	0.6	0.0	0.0	1.4	11.3	34.2	45.4	203
	% Snow	96%	96%	88%	44%	11%	1%	0%	0%	4%	32%	84%	99%	41%
Logan Lake Elevation: 1101 m	Precipitation (mm)	32.7	21.9	22.2	21.9	40.9	48.8	38.7	40.4	26.2	29.3	37.0	34.2	394
	% Annual Precip.	8%	6%	6%	6%	10%	12%	10%	10%	7%	7%	9%	9%	100%
	Rain (mm)	7.3	3.0	4.9	13.5	35.4	47.8	38.7	40.4	25.7	20.8	9.0	3.8	250
	% Rain	22%	14%	22%	61%	86%	98%	100%	100%	98%	71%	24%	11%	63%
	Snow Water Equivalent (mm)	25.3	18.9	17.2	8.5	5.6	1.0	0.0	0.0	0.5	8.5	28.0	30.4	144
	% Snow	78%	86%	78%	39%	14%	2%	0%	0%	2%	29%	76%	89%	37%
Project Site Elevation: 915 m	Precipitation (mm)	21.6	13.4	11.0	17.7	30.3	40.1	39.1	29.5	33.1	14.3	25.8	34.1	310
	% Annual Precip.	7%	4%	4%	6%	10%	13%	13%	10%	11%	5%	8%	11%	100%
	Rain (mm)	2.2	2.7	3.8	15.0	30.3	40.1	39.1	29.5	33.1	12.2	5.2	3.4	216
	% Rain	10%	20%	35%	85%	100%	100%	100%	100%	100%	85%	20%	10%	70%
	Snow Water Equivalent (mm)	19.5	10.7	7.1	2.7	0.0	0.0	0.0	0.0	0.0	2.2	20.7	30.7	94
	% Snow	90%	80%	65%	15%	0%	0%	0%	0%	0%	15%	80%	90%	30%

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[3_Precipitation_Elevation915.xlsx]Table 2.9

NOTES:

1. BLANK MONTHS HAVE MISSING OR INCOMPLETE DATA (INCOMPLETE HAS BEEN DEFINED AS MONTHS WITH MORE THAN TWO DAYS OF MISSING DATA).
2. MONTHLY AVERAGES HAVE BEEN CALCULATED BASED ON AVERAGE DAILY DATA.

0	06FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.10

KGHM AJAX MINING INC.
AJAX PROJECT

PROJECT SITE
WET AND DRY YEAR PRECIPITATION

Print Mar/12/13 15:47:19

Return Period		Precipitation (mm)
Dry	1:10 year dry (mean - 1.282 s.d.)	239
	1:20 year dry (mean - 1.645 s.d.)	219
	1:50 year dry (mean - 2.054 s.d.)	197
	1:100 year dry (mean - 2.326 s.d.)	182
	1:200 year dry (mean - 2.575 s.d.)	168
Wet	1:10 year wet (mean + 1.282 s.d.)	381
	1:20 year wet (mean + 1.645 s.d.)	401
	1:50 year wet (mean + 2.054 s.d.)	423
	1:100 year wet (mean + 2.326 s.d.)	438
	1:200 year wet (mean + 2.575 s.d.)	452

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[4_Wet & Dry Year Precip.xls]Table 2.10 Afton Wet & Dry

NOTES:

1. PRECIPITATION ESTIMATES FOR ELEVATION 915 m, WITH A MEAN ANNUAL PRECIPITATION OF 310 mm.
2. STANDARD DEVIATION ESTIMATED FROM A COEFFICIENT OF VARIATION VALUE OF 0.18, CALCULATED AS THE AVERAGE OF THE COEFFICIENT OF VARIATIONS FROM SEVEN REGIONAL CLIMATE STATIONS.
3. S.D. = STANDARD DEVIATION = MEAN MULTIPLIED BY COEFFICIENT OF VARIATION.
4. ESTIMATED FREQUENCY FACTOR VALUES ASSUME A NORMAL DISTRIBUTION OF ANNUAL PRECIPITATION.

0	06FEB'13	ISSUED WITH REPORT VA101-246/08-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.11

KGHM AJAX MINING INC.
AJAX PROJECT

PROJECT SITE INTENSITY-DURATION-FREQUENCY DATA

Print Mar/12/13 15:47:54

Rainfall		
Duration	Mean (mm)	St. Dev. (mm)
5 min	3.8	1.8
10 min	5.9	2.4
15 min	7.3	2.5
30 min	9.5	2.7
1 hr	10.3	3.0
2 hr	13.2	3.6
6 hr	20.5	4.8
12 hr	23.5	9.6
24 hr	29.3	10.8

EV1 Distribution	
Frequency Factor	Return Period (years)
-0.164	2
0.719	5
1.305	10
1.635	15
1.866	20
2.044	25
2.592	50
3.137	100
3.679	200
17.802	PMP

Return Period Rainfall Amounts (mm)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs	PMP
5 min	3.5	5.1	6.2	6.7	7.2	7.5	8.5	9.4	10.4	35.7
10 min	5.5	7.6	9.0	9.8	10.3	10.7	12.1	13.4	14.7	48.4
15 min	6.9	9.1	10.6	11.4	12.0	12.5	13.8	15.2	16.6	52.0
30 min	9.1	11.5	13.1	14.0	14.7	15.1	16.7	18.2	19.6	58.4
1 hr	9.8	12.4	14.2	15.1	15.8	16.4	18.0	19.6	21.3	63.4
2 hr	12.6	15.8	17.9	19.1	19.9	20.5	22.5	24.4	26.4	77.0
6 hr	19.7	24.0	26.8	28.3	29.4	30.3	32.9	35.5	38.1	105.6
12 hr	21.9	30.3	35.9	39.1	41.3	43.0	48.2	53.4	58.6	193.6
24 hr	27.6	37.1	43.4	46.9	49.4	51.3	57.2	63.1	68.9	220.7

Rainfall Intensity (mm/hr)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs	PMP
5 min	42.2	61.2	73.8	80.9	85.9	89.7	101.5	113.2	124.9	428.6
10 min	32.8	45.5	53.9	58.6	61.9	64.5	72.3	80.2	87.9	290.4
15 min	27.7	36.5	42.4	45.7	48.0	49.8	55.3	60.8	66.2	208.0
30 min	18.2	23.0	26.2	28.0	29.3	30.3	33.3	36.3	39.3	116.9
1 hr	9.8	12.4	14.2	15.1	15.8	16.4	18.0	19.6	21.3	63.4
2 hr	6.3	7.9	8.9	9.5	9.9	10.3	11.2	12.2	13.2	38.5
6 hr	3.3	4.0	4.5	4.7	4.9	5.0	5.5	5.9	6.4	17.6
12 hr	1.8	2.5	3.0	3.3	3.4	3.6	4.0	4.5	4.9	16.1
24 hr	1.1	1.5	1.8	2.0	2.1	2.1	2.4	2.6	2.9	9.2

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[5_24hr rainfall.xlsx]Table 2.11_Kamloops

NOTES:

1. THE 24-HOUR MEAN AND STANDARD DEVIATION VALUES DERIVED FROM THE MoE KAMLOOPS AIRPORT DAILY RECORD TRANSLATED TO THE PROJECT SITE BY MULTIPLYING BY 1.13 TO CONVERT TO 24-HOUR VALUES AND ADDING 4.8% PER 100 m ELEVATION GAIN TO ACCOUNT FOR OROGRAPHIC EFFECTS.

0	27FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

Knight Piésold CONSULTING

TABLE 2.12

KGHM AJAX MINING INC.
AJAX PROJECT

PROJECT SITE
ESTIMATED LONG-TERM POTENTIAL EVAPOTRANSPIRATION

Print Mar/12/13 9:18

Method	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
		Evapotranspiration (mm)												
Hargreaves equation	2010	-	-	-	-	-	-	154	121	63	38	10	5	-
	2011	6	7	34	59	96	117	138	129	86	33	11	5	721
	2012	8	12	36	69	106	111	152	133	84	34	10	3	759
	Average	7	9	35	64	101	114	148	128	78	35	10	4	734
Thornthwaite equation	2010	-	-	-	-	-	-	133	110	64	39	0	0	-
	2011	0	0	6	24	67	96	112	116	86	31	0	0	538
	2012	0	0	5	39	71	87	133	121	80	28	2	0	566
	Average	0	0	6	31	69	92	126	116	77	32	1	0	549
	Long-term est.	**0**	**0**	**8**	**40**	**76**	**102**	**130**	**112**	**70**	**27**	**0**	**0**	**565**

\\VAN11\Prj_file\1\01\00246\08\A\Data\Meteorology\Analysis\[6_PET_calculator_20130208.xlsx]Table 2.12

NOTES:

1. POTENTIAL EVAPOTRANSPIRATION (PET) VALUES CALCULATED USING HARGREAVES EQUATION WERE BASED ON THE DAILY MINIMUM, MEAN AND MAXIMUM TEMPERATURE VALUES RECORDED AT THE AJAXMET WEATHER STATION FOR 2010-2012. IT WAS ASSUMED WHEN THAT WHEN THE MEAN DAILY TEMPERATURE WAS BELOW -17.8 DEGREES CELSIUS 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 CURRENT TEMPERATURE RECORD COLLECTED IN 2010-2012. THE THORNTHWAITE EQUATION ASSUMES THAT WHEN THE MEAN MONTHLY TEMPERATURE IS ZERO, PET IS ZERO.
3. THE LONG-TERM POTENTIAL EVAPOTRANSPIRATION VALUES ARE BASED ON THE LONG-TERM MEAN MONTHLY TEMPERATURE VALUES ESTIMATED FOR THE PROJECT SITE USING THE THORNTHWAITE EQUATION.

0	08FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

TABLE 3.1

KGHM AJAX MINING INC.
AJAX PROJECT

REGIONAL HYDROMETRIC GAUGING STATIONS

Print Mar/12/13 15:53:54

Station ID	Station Name	Period of Record	Years of Record	Lat	Long	Distance from Site (km)	Drainage Area (km^2)	Approximate Runoff Coefficient [2]	Median Catchment Elevation (m)[1]	Obedkoff Zone (Sub Zone)	Mean Annual Discharge (m^3/s)	Mean Annual Unit Runoff		Flow Regime
												(l/s/km^2)	(mm)	
08LB064	North Thompson River Near Mclure	1/1/58 - Present	55	51.041	-120.241	48	19,600	N/A	1314[1]	12B (e)	427	21.8	687	Natural
08LE075	Salmon River Above Salmon Lake	1/1/65 - 7/4/2002	38	50.288	-119.956	57	143	0.32	1350	12B (e)	0.75	5.2	165	Natural
08LF007	Criss Creek Near Savona	1/1/12 - Present	101	50.883	-120.965	41	479	0.39	1190	12B (e)	1.67	3.5	110	Regulated
08LF027	Deadman River at Criss Creek	1/1/13 - Present	100	50.901	-120.974	42	878	0.22	1190	12B (e)	1.15	1.3	41	Regulated
08LG041	Guichon Creek at Outlet of Mamit Lake	1/1/33 - Present	80	50.362	-120.809	38	871	0.07	1369[1]	12B (d)	0.72	0.8	26	Regulated
08LG049	Nicola River above Nicola Lake	1/1/15 - Present	98	50.197	-120.408	52	1,500	0.31	1230	12B (b)	4.13	2.8	87	Regulated
08LG056	Guichon Creek above Tunkwa Lake Diversion	1/1/67 - Present	46	50.608	-120.911	27	78.2	0.17	1340	12B (d)	0.14	1.8	56	Natural

\\VAN11\Prj_file\1\01\00246\08\A\Data\Hydrology\2012 Hydromet\Active Regional Stations\[Regional Station, Flow and UR details.xlsx]TBL 3.1 REGIONAL GAUGE

NOTES:
1. MEDIAN CATCHMENT ELEVATION OBTAINED FROM KPL GIS DATA.
2. BASIN AVERAGE PRECIPITATION ESTIMATES ARE BASED ON MEAN CATCHMENT ELEVATION.

0	07MAY'12	ISSUED WITH REPORT VA101-246/8-8	MH	CMB	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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TABLE 3.2

KGHM AJAX MINING INC.
AJAX PROJECT

REGIONAL HYDROMETRIC GAUGING STATIONS
LONG-TERM AVERAGE FLOW AND UNIT AREA RUNOFF

Print Mar/12/13 15:53:54

Station ID	Station Name	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
08LB064	North Thompson River Near Mclure	Average Discharge (m^3/s)	93	87	95	238	890	1334	923	528	343	261	198	118	427
		Unit Area Runoff (l/s/km^2)	4.8	4.5	4.9	12.1	45.4	68.1	47.1	27.0	17.5	13.3	10.1	6.0	21.7
		Percentage of Total Flow (%)	1.8	1.7	1.9	4.6	17.4	26.1	18.1	10.3	6.7	5.1	3.9	2.3	100.0
08LE075	Salmon River Above Salmon Lake	Average Discharge (m^3/s)	0.1	0.1	0.2	0.6	3.1	2.7	0.8	0.3	0.2	0.2	0.2	0.2	0.7
		Unit Area Runoff (l/s/km^2)	0.9	0.9	1.2	4.5	22.0	19.0	5.3	1.9	1.6	1.6	1.6	1.1	5.1
		Percentage of Total Flow (%)	1.4	1.4	1.9	7.3	35.8	30.9	8.6	3.1	2.6	2.6	2.5	1.8	100.0
08LF007	Criss Creek Near Savona	Average Discharge (m^3/s)	0.2	0.2	0.3	1.6	8.1	5.9	1.7	0.5	0.4	0.5	0.4	0.3	1.7
		Unit Area Runoff (l/s/km^2)	0.5	0.5	0.7	3.4	16.8	12.3	3.6	1.0	0.9	1.0	0.9	0.6	3.5
		Percentage of Total Flow (%)	1.2	1.1	1.6	8.1	39.9	29.2	8.5	2.4	2.1	2.4	2.1	1.4	100.0
08LF027	Deadman River at Criss Creek	Average Discharge (m^3/s)	0.5	0.5	0.6	1.9	7.1	4.2	2.3	1.1	0.8	0.6	0.6	0.5	1.2
		Unit Area Runoff (l/s/km^2)	0.5	0.6	0.7	2.1	8.1	4.8	2.6	1.2	0.9	0.7	0.7	0.6	2.0
		Percentage of Total Flow (%)	2.2	2.4	2.9	9.0	34.5	20.4	11.0	5.2	3.9	3.0	2.9	2.6	100.0
08LG041	Guichon Creek at Outlet of Mamit Lake	Average Discharge (m^3/s)	0.2	0.2	0.2	0.6	2.6	2.4	1.2	0.7	0.4	0.3	0.2	0.2	0.7
		Unit Area Runoff (l/s/km^2)	0.2	0.2	0.3	0.6	2.9	2.8	1.4	0.8	0.4	0.3	0.2	0.2	0.9
		Percentage of Total Flow (%)	2.0	1.9	2.5	6.2	28.4	26.5	13.5	7.3	4.3	3.0	2.4	2.0	100.0
08LG049	Nicola River above Nicola Lake	Average Discharge (m^3/s)	1.0	1.1	1.4	3.8	18.3	14.4	4.9	1.6	0.9	0.7	0.9	0.9	4.1
		Unit Area Runoff (l/s/km^2)	0.6	0.7	0.9	2.5	12.2	9.6	3.3	1.1	0.6	0.4	0.6	0.6	2.8
		Percentage of Total Flow (%)	1.9	2.2	2.8	7.7	36.8	28.8	9.8	3.3	1.7	1.3	1.8	1.8	100.0
08LG056	Guichon Creek above Tunkwa Lake Diversio	Average Discharge (m^3/s)	0.0	0.0	0.0	0.2	0.6	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.1
		Unit Area Runoff (l/s/km^2)	0.4	0.4	0.6	2.0	7.3	5.1	2.0	0.8	0.7	0.7	0.6	0.4	1.7
		Percentage of Total Flow (%)	1.8	2.0	2.7	9.4	35.0	24.5	9.4	3.8	3.4	3.3	2.7	2.0	100.0

\\VAN11\Prj_file\1\01\00246\08\A\Data\Hydrology\2012 Hydromet\Active Regional Stations\[Regional Station, Flow and UR details.xlsx]TBL 3.1 REGIONAL GAUGE

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	08FEB'13	ISSUED WITH REPORT VA101-246/8-8	MH	CMB	JGC

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TABLE 3.3

KGHM AJAX MINING INC.
AJAX PROJECT

ACTIVE PROJECT AREA HYDROMETRIC GAUGING STATIONS

Print Mar/12/13 15:58:56

Station ID	Station Name	Period of Record	Latitude	Longitude	Number of Site Visits	Number of Gaugings	Catchment Area (km^2)	Station Elevation (masl)	Median Catchment Elevation (m)	Obedkoff Zone (Sub Zone)	Flow Regime
JACINF	Jacko Creek inflow to Jacko Lake	4/28/08 - 8/31/11	50.602	-120.441	23	10	31	912	1262	12B (e)	Natural
JACLAKE	Jacko Lake upstream of spillway	4/29/08 - 8/29/11	50.605	-120.412	21	4	40	891	1032	12B (e)	Regulated
JACSEEP	Jacko Lake seepage and gate control	4/26/08 - 8/29/11	50.605	-120.412	28	11	40	883	1032	12B (e)	Regulated
PETER	Peterson Creek	4/26/08 - 8/30/11	50.606	-120.376	23	11	62	880	1073	12B (e)	Regulated
TSFINF	Tailings Storage Facility Inflow	4/26/08 - 8/03/11	50.643	-120.535	24	7	53	721	954	12B (e)	Natural/Diverted

\\VAN11\Prj_file\1\01\00246\08\A\Data\Hydrology\2012 Hydromet\Project Stations\[Station Details.xls]TBL - 3.3 Project Gauge

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30MAY'12	ISSUED WITH REPORT VA101-246/8-8	DK	MH	JGC

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CONSULTING

TABLE 3.4

KGHM AJAX MINING INC.
AJAX PROJECT

JACINF GAUGING STATION
LONG-TERM SYNTHETIC FLOWS (m^3/s)

Print Mar/12/13 16:01:37

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1962	0.000	0.000	0.011	0.058	0.174	0.134	0.045	0.007	0.002	0.001	0.002	0.001	0.036
1963	0.000	0.000	0.017	0.056	0.125	0.056	0.007	0.000	0.000	0.000	0.000	0.000	0.022
1964	0.000	0.000	0.015	0.016	0.087	0.130	0.029	0.000	0.000	0.001	0.000	0.000	0.023
1965	0.000	0.000	0.014	0.032	0.123	0.062	0.001	0.000	0.000	0.000	0.000	0.000	0.019
1966	0.000	0.000	0.017	0.052	0.113	0.061	0.024	0.015	0.000	0.000	0.000	0.000	0.023
1967	0.000	0.000	0.017	0.020	0.216	0.087	0.003	0.000	0.001	0.000	0.000	0.000	0.029
1968	0.000	0.000	0.011	0.011	0.136	0.101	0.006	0.000	0.000	0.000	0.000	0.000	0.022
1969	0.000	0.000	0.014	0.059	0.210	0.029	0.164	0.007	0.004	0.010	0.012	0.000	0.042
1970	0.002	0.002	0.020	0.031	0.087	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.016
1971	0.000	0.000	0.011	0.021	0.178	0.150	0.032	0.000	0.000	0.000	0.000	0.000	0.033
1972	0.000	0.000	0.018	0.030	0.248	0.111	0.032	0.001	0.000	0.000	0.000	0.000	0.037
1973	0.000	0.000	0.013	0.016	0.085	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.013
1974	0.000	0.000	0.011	0.015	0.138	0.096	0.003	0.000	0.000	0.000	0.000	0.000	0.022
1975	0.000	0.000	0.010	0.012	0.141	0.124	0.026	0.000	0.000	0.000	0.000	0.000	0.026
1976	0.000	0.000	0.013	0.019	0.146	0.052	0.011	0.048	0.028	0.002	0.000	0.000	0.027
1977	0.002	0.000	0.011	0.045	0.162	0.053	0.004	0.002	0.000	0.000	0.000	0.000	0.023
1978	0.000	0.000	0.015	0.041	0.201	0.058	0.004	0.003	0.002	0.000	0.000	0.000	0.027
1979	0.000	0.000	0.011	0.015	0.072	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.012
1980	0.000	0.000	0.011	0.011	0.011	0.056	0.023	0.004	0.008	0.007	0.002	0.000	0.011
1981	0.000	0.000	0.013	0.016	0.092	0.084	0.046	0.015	0.002	0.001	0.001	0.000	0.022
1982	0.001	0.007	0.030	0.020	0.116	0.071	0.112	0.018	0.007	0.010	0.011	0.000	0.034
1983	0.000	0.000	0.017	0.028	0.127	0.047	0.009	0.002	0.002	0.000	0.000	0.000	0.019
1984	0.000	0.000	0.015	0.033	0.080	0.138	0.015	0.005	0.001	0.000	0.000	0.000	0.024
1985	0.000	0.000	0.013	0.021	0.124	0.104	0.005	0.003	0.001	0.000	0.000	0.000	0.023
1986	0.000	0.000	0.013	0.019	0.052	0.039	0.005	0.004	0.002	0.000	0.000	0.000	0.011
1987	0.000	0.000	0.016	0.027	0.064	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.011
1988	0.000	0.000	0.010	0.012	0.025	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.006
1989	0.000	0.000	0.011	0.015	0.053	0.037	0.003	0.002	0.003	0.001	0.000	0.000	0.011
1990	0.000	0.000	0.033	0.085	0.249	0.268	0.101	0.008	0.003	0.002	0.001	0.000	0.063
1991	0.000	0.000	0.016	0.029	0.090	0.078	0.033	0.005	0.002	0.000	0.000	0.000	0.021
1992	0.000	0.000	0.021	0.059	0.088	0.033	0.004	0.000	0.000	0.000	0.000	0.000	0.017
1993	0.000	0.000	0.015	0.031	0.180	0.038	0.025	0.010	0.003	0.000	0.000	0.000	0.025
1994	0.000	0.000	0.016	0.100	0.090	0.034	0.002	0.000	0.000	0.000	0.000	0.000	0.020
1995	0.000	0.000	0.013	0.015	0.087	0.036	0.002	0.003	0.002	0.001	0.001	0.000	0.013
1996	0.003	0.012	0.041	0.127	0.186	0.104	0.023	0.001	0.001	0.000	0.001	0.000	0.042
1997	0.001	0.000	0.023	0.072	0.218	0.106	0.107	0.015	0.004	0.003	0.002	0.000	0.046
1998	0.000	0.000	0.018	0.056	0.123	0.038	0.009	0.000	0.000	0.000	0.000	0.000	0.020
1999	0.000	0.000	0.016	0.031	0.210	0.153	0.202	0.022	0.007	0.000	0.000	0.000	0.053
2000	0.000	0.000	0.020	0.041	0.123	0.080	0.041	0.012	0.003	0.003	0.003	0.000	0.027
2001	0.002	0.001	0.020	0.038	0.142	0.067	0.024	0.022	0.000	0.001	0.000	-	-
2002	-	-	0.020	0.034	0.245	0.106	0.003	0.001	0.001	0.000	0.000	0.000	-
2003	0.000	0.000	0.011	0.019	0.082	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.013
2004	0.000	0.000	0.010	0.019	0.051	0.031	0.001	0.000	0.016	0.005	0.013	0.000	0.012
2005	0.009	0.010	0.053	0.118	0.113	0.119	0.076	0.010	0.002	0.003	0.004	0.000	0.043
2006	0.005	0.003	0.026	0.090	0.139	0.109	0.006	0.001	0.000	0.000	0.000	0.000	0.032
2007	0.000	0.000	0.020	0.115	0.136	0.088	0.011	0.001	0.000	0.003	0.006	0.000	0.032
2008	0.000	0.000	0.016	0.022	0.206	0.103	0.008	0.001	0.000	0.000	0.000	0.000	0.030
2009	0.000	0.000	0.012	0.016	0.093	0.044	0.006	0.000	0.000	0.000	0.000	0.000	0.014
2010	0.000	0.000	0.010	0.023	0.049	0.114	0.012	0.001	0.001	0.000	0.000	0.000	0.017
2011	0.000	0.000	0.013	0.014	0.276	0.161	0.037	0.006	0.003	0.001	0.000	0.000	0.043
AVERAGE	0.001	0.001	0.017	0.038	0.131	0.080	0.027	0.005	0.002	0.001	0.001	0.000	0.025
% of Total	0.2	0.3	5.5	12.5	43.1	26.4	8.8	1.7	0.7	0.4	0.4	0.0	100

\\VAN11\Prj_file\1\01\00246\08\A\Data\Hydrology\2012 Hydromet\Hydrological Analysis\[2_Long Term Synthetic Flow.xlsx]Table 3.9

NOTES:

1. ONLY DATA FROM COMPLETE YEARS WERE INCLUDED IN ANALYSIS.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	17JUL'12	ISSUED WITH REPORT VA101-246/8-8	TR	MH	JGC

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TABLE 3.5

KGHM AJAX MINING INC.
AJAX PROJECT

WET AND DRY MONTHLY FLOWS AT JACINF GAUGING STATION

Print: 03/12/13 16:05

Month	Dry (m^3/s)			Mean	Wet (m^3/s)		
	20 yr.	10 yr.	5 yr.		5 yr.	10 yr.	20 yr.
Jan	0.000	0.000	0.000	**0.001**	0.001	0.001	0.002
Feb	0.000	0.000	0.000	**0.001**	0.001	0.002	0.002
Mar	0.010	0.011	0.011	**0.017**	0.020	0.026	0.032
Apr	0.012	0.014	0.016	**0.038**	0.050	0.079	0.123
May	0.021	0.047	0.076	**0.129**	0.174	0.202	0.229
Jun	0.026	0.031	0.040	**0.080**	0.114	0.144	0.172
Jul	0.000	0.001	0.002	**0.027**	0.033	0.068	0.119
Aug	0.000	0.000	0.001	**0.005**	0.008	0.011	0.014
Sep	0.000	0.000	0.000	**0.002**	0.004	0.005	0.007
Oct	0.000	0.000	0.000	**0.001**	0.002	0.003	0.003
Nov	0.000	0.000	0.000	**0.001**	0.002	0.003	0.004
Dec	0.000	0.000	0.000	**0.001**	0.002	0.003	0.003

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NOTES:

1. VALUES CALCULATED USING PALISADE DECISION TOOLS STATISTICAL MODELLING SOFTWARE @RISK.

0	26JUL'12	ISSUED WITH REPORT VA101-246/8-8	TR	MH	JGC
REV	DATE	DESCRIPTION	DESIGN	CHK'D	APP'D

Knight Piésold
CONSULTING

TABLE 3.6

KGHM AJAX MINING INC.
AJAX PROJECT

JACINF GAUGING STATION
INSTANTANEOUS PEAK FLOW ESTIMATES

Print: 03/12/13 9:55

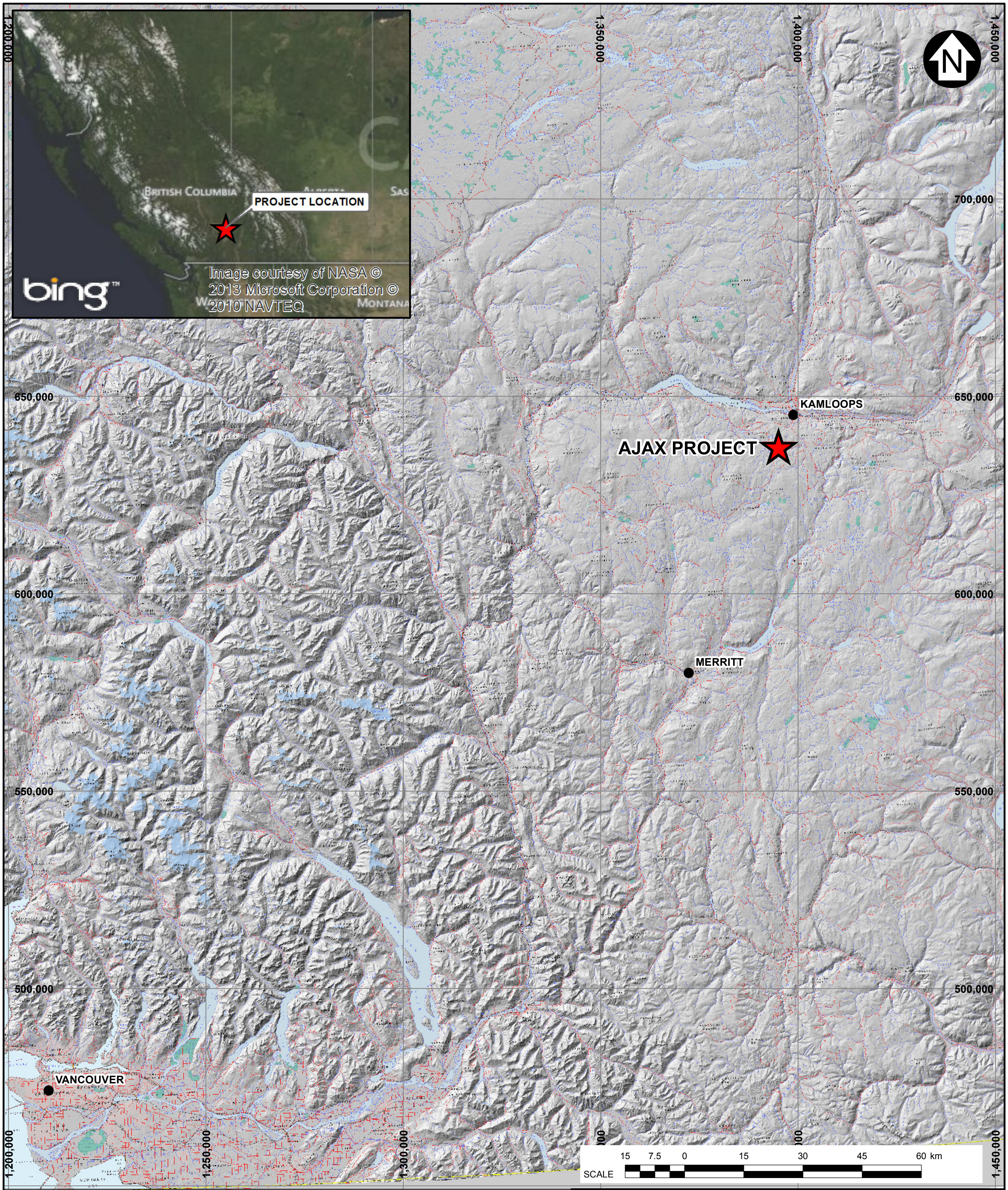
Description	Area (km^2)	Peak Instantaneous Flows (m^3/s)					
		Mean	2 year	10 year	50 year	100 year	200 year
Statistical Estimate	31.1	0.24	0.29	0.62	1.08	1.35	1.68
Regional Estimate		**0.72**	**0.69**	**1.14**	**1.82**	**2.19**	**2.61**

\\VAN11\Prj_file\1\01\00246\08\A\Data\Hydrology\2012 Hydromet\Hydrological Analysis\[5_Peak Flow Statistical Analysis - TR.xlsx]Table3.6

NOTES:

1. STATISTICAL AND REGIONAL ESTIMATE CALCULATIONS ARE BASED ON THE SYNTHETIC FLOW SERIES USING THE GENERALIZED EXTREME VALUE DISTRIBUTION IN ENVIRONMENT CANADA'S CFA SOFTWARE.
2. THE STATISTICAL ESTIMATE IS BASED ON THE PEAK FLOWS FROM THE LONG-TERM SYNTHETIC FLOW SERIES, ADJUSTED BY A FACTOR OF 1.5 TO ACCOUNT FOR THE DIFFERENCE BETWEEN INSTANTANEOUS AND DAILY FLOWS.
3. THE REGIONAL ESTIMATES ARE BASED ON AN INDEX FLOOD APPROACH (OBEDKOFF, 2003) AND USE A SCALING EXPONENT OF 0.7.

0	26FEB'13	ISSUED WITH REPORT VA101-246/8-8	HS	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



LEGEND:

★ PROJECT LOCATION

● COMMUNITY

NOTES:

1. BASE MAP: BC GOVERNMENT GEOBC TRIM IMAGERY.

2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 BC ENVIRONMENT ALBERS.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:1,300,000 FOR 8.5X11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	07MAR'13	ISSUED WITH REPORT	RP	AMD	CB	RCB

KGHM AJAX MINING INC.

AJAX PROJECT

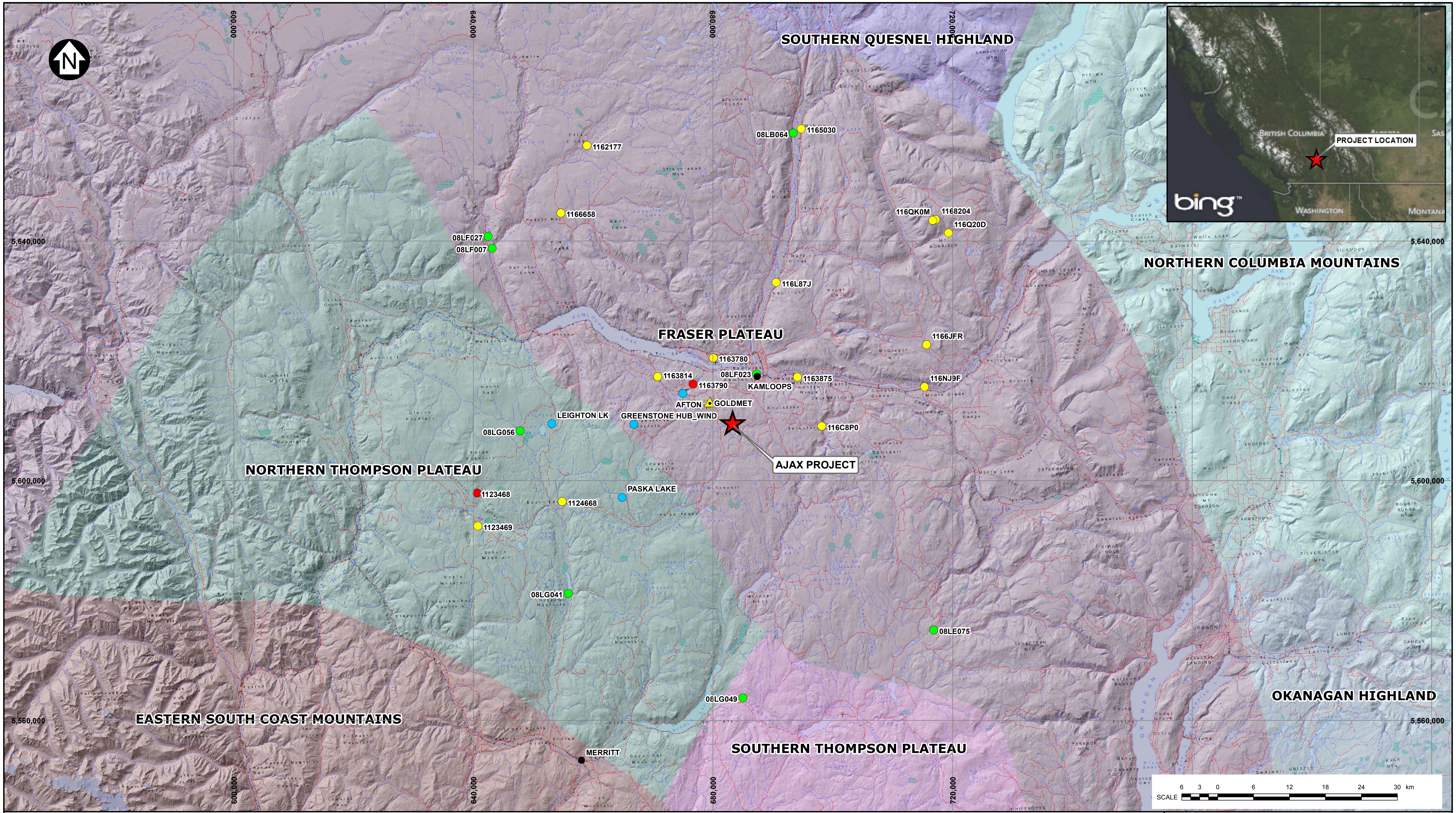
PROJECT LOCATION MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-246/8	8

FIGURE 1.1 REV 0

SAVED: M:\1\01\00246\08\A\GIS\ArcView\figures\Report-8 Hydromet\Figure 1.1_ProjectLocationMap.mxd; Mar 07, 2013 4:51 PM; kkrauszova



LEGEND:

- PROJECT LOCATION
- ACTIVE PROJECT CLIMATE STATION
- ACTIVE REGIONAL ENVIRONMENT CANADA CLIMATE STATIONS
- ACTIVE REGIONAL FORESTRY CLIMATE STATIONS
- INACTIVE REGIONAL CLIMATE STATIONS
- ACTIVE REGIONAL HYDROLOGY STATIONS
- HYDROLOGIC ZONE

NOTES:

1. BASE MAP: BC GOVERNMENT GEOBC TRM IMAGERY.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:600,000 FOR 11X17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. HYDROLOGIC ZONES, STREAMFLOW STATION LOCATIONS, AND WATERSHED BOUNDARIES WERE DOWNLOADED FROM ILMB (WWW.LRDW.CA).
5. CLIMATE STATION LOCATIONS OBTAINED FROM ENVIRONMENT CANADA AND BC MINISTRY OF FORESTS.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	07MAR'13	ISSUED WITH REPORT	MH	AMD	MH	JGC

SAVED: M:\1\01\00246\08\A\GIS\ArcView\figures\Report-8 Hydromet\Figure 2.1_RegionalandProjectStations_R1.mxd; Mar 07, 2013 4:52 PM; kkrauszova

KGHM AJAX MINING INC.

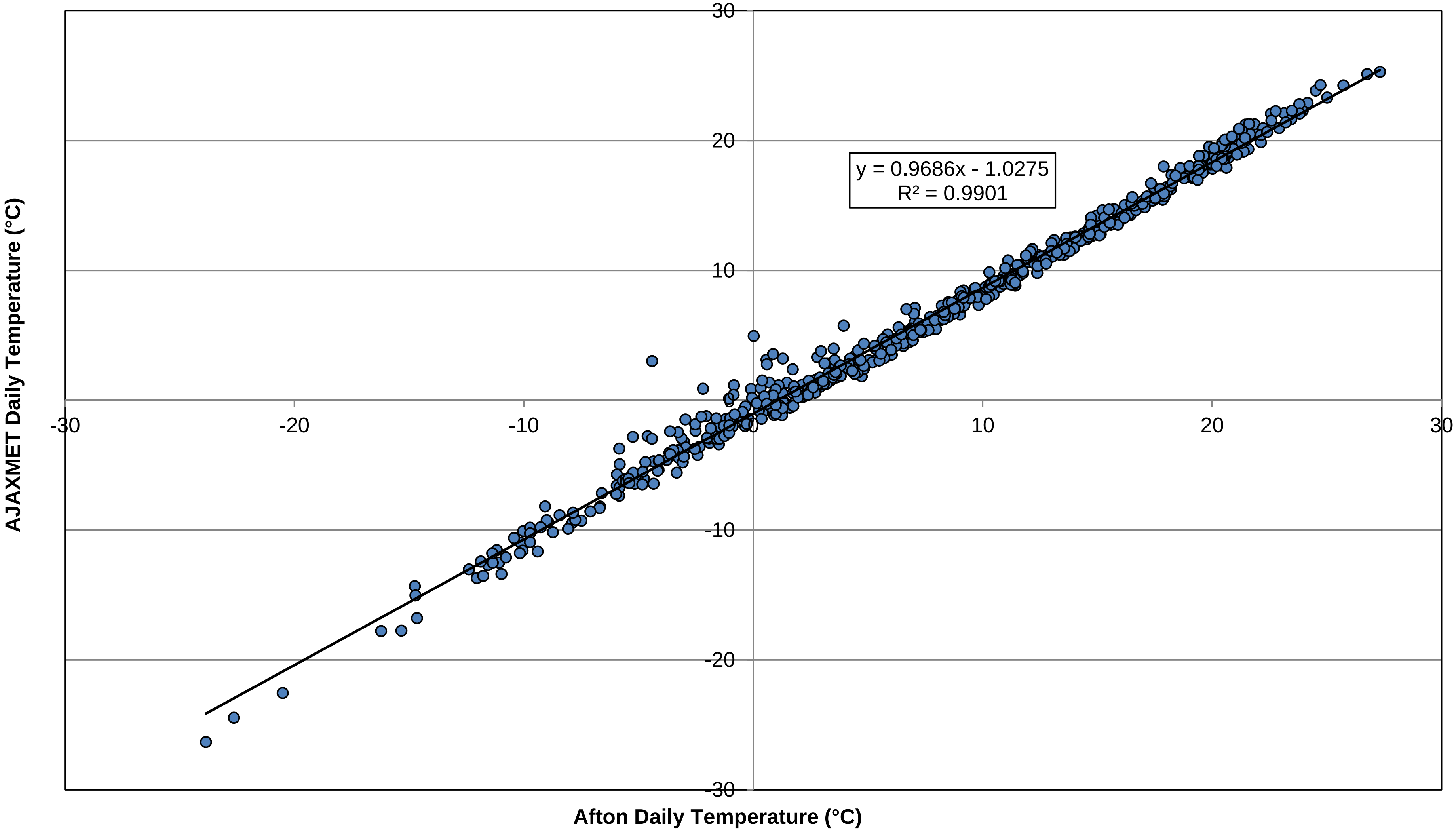
AJAX PROJECT

REGIONAL AND PROJECT CLIMATE AND HYDROLOGY STATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-246/8	8

FIGURE 2.1 REV 0



0	06FEB'12	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM MINING INC.

AJAX PROJECT

AJAXMET AND BC FLNRO AFTON STATIONS DAILY TEMPERATURE REGRESSION

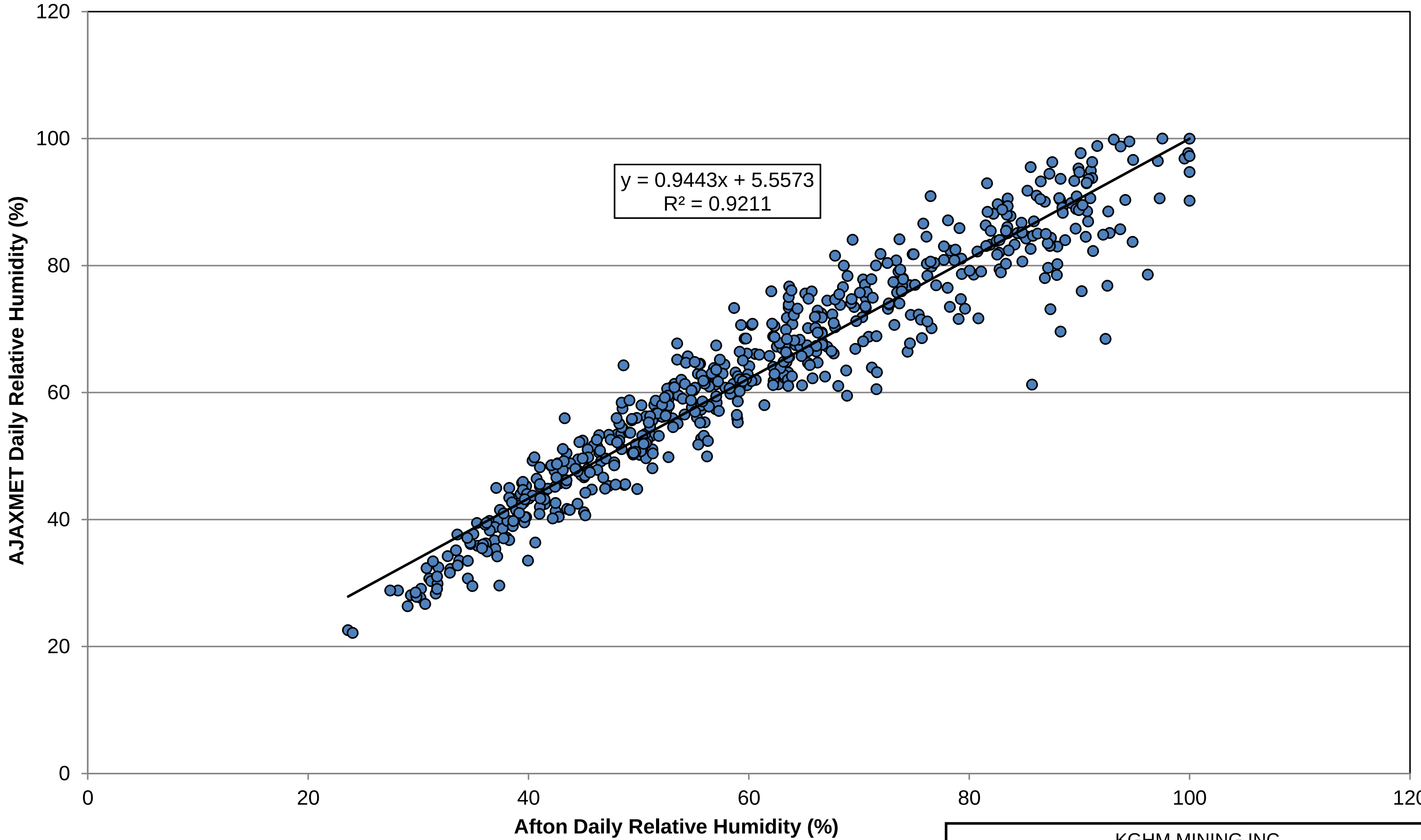
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF. NO. 8

FIGURE 2.2

REV 0



0	06FEB'12	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM MINING INC.

AJAX PROJECT

AJAXMET AND BC FLNRO AFTON STATIONS DAILY RELATIVE HUMIDITY REGRESSION

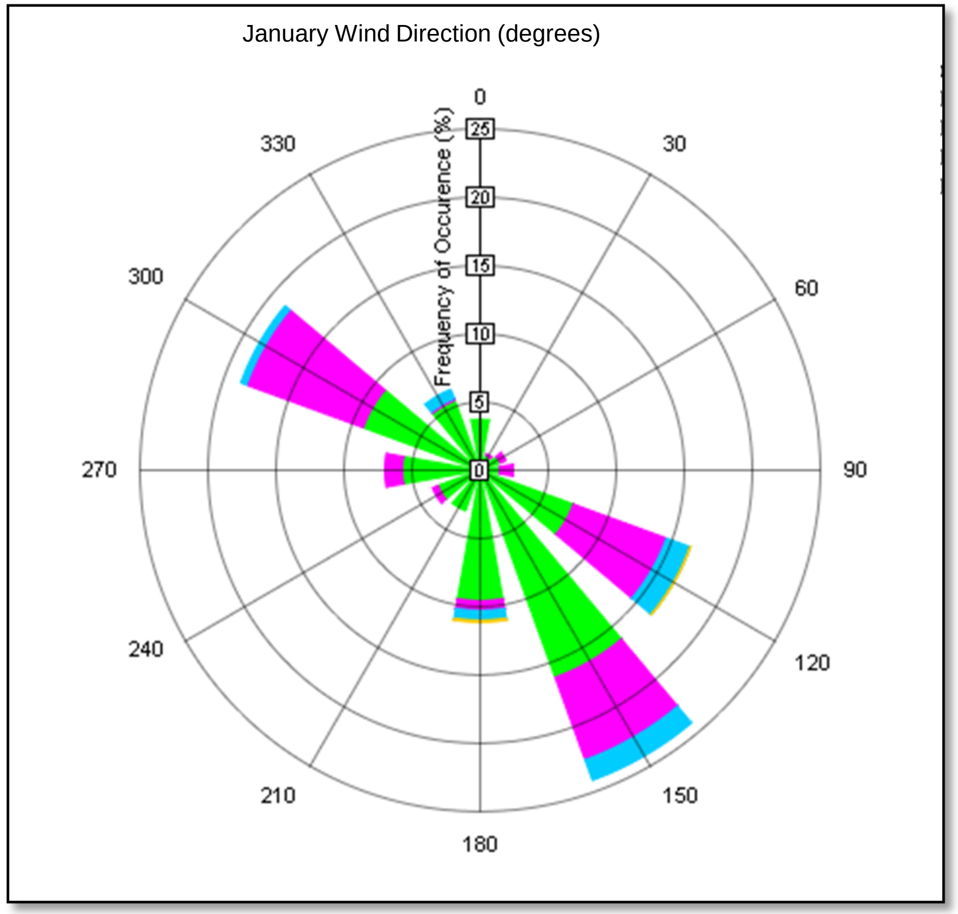
Knight Piésold CONSULTING

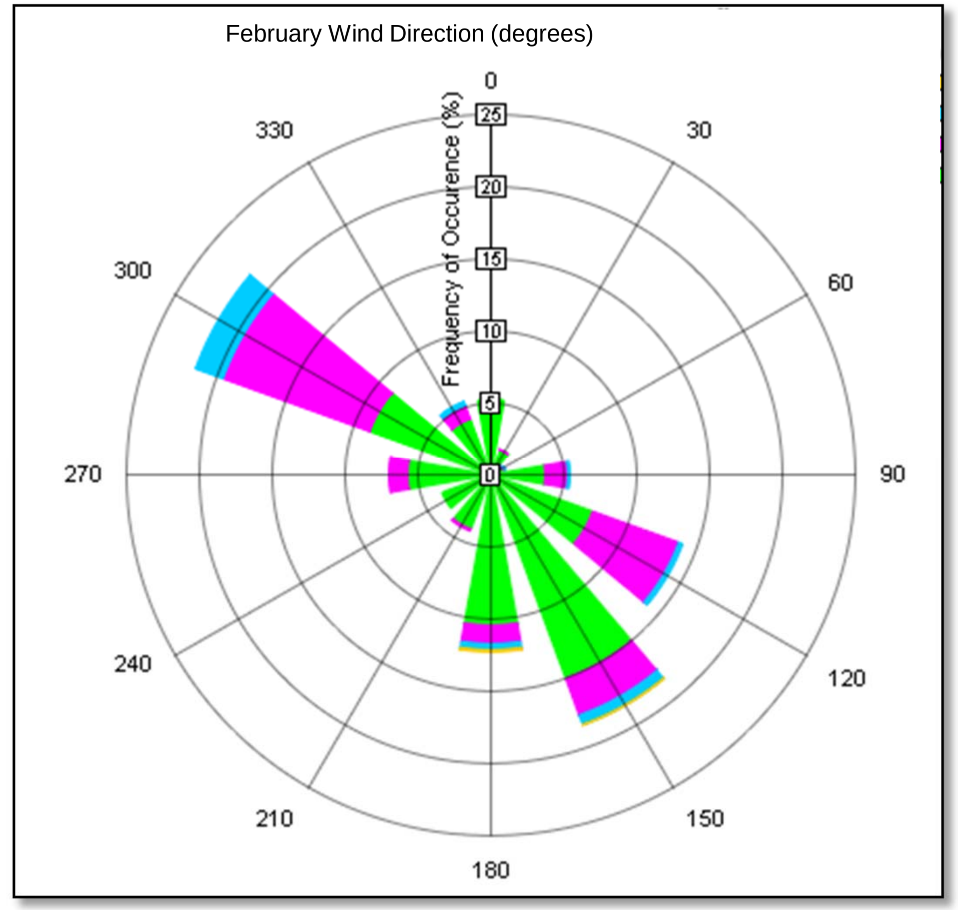
P/A NO. VA101-246/8

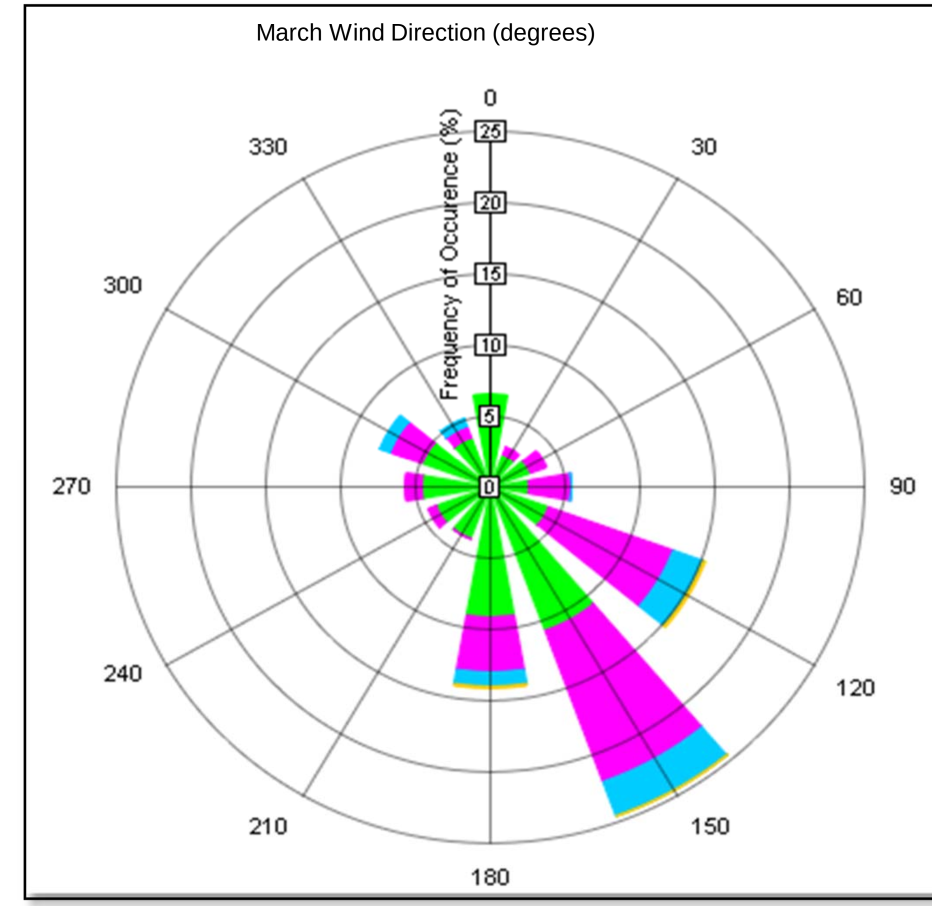
REF. NO. 8

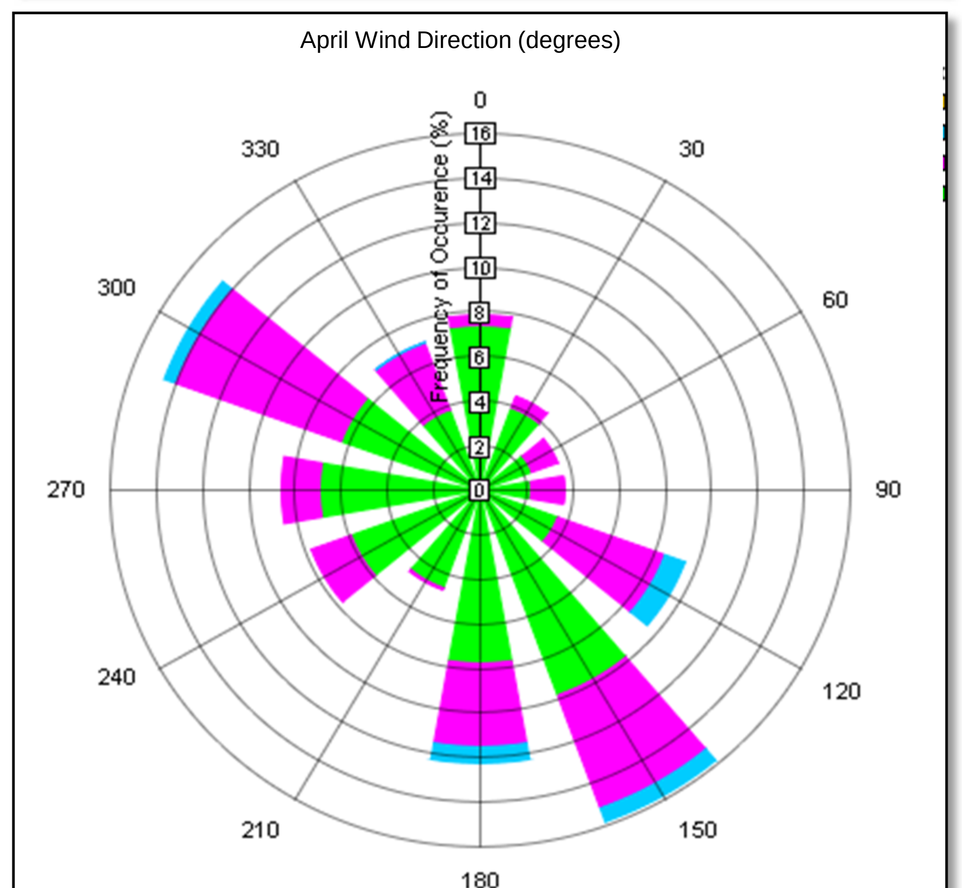
FIGURE 2.3

REV 0









Wind Speed (m/s)
- 9.00 - 12.00
- 6.00 - 9.00
- 3.00 - 6.00
- 0.00 - 3.00

NOTES:
1. THE MEAN MONTHLY WIND ROSE DATA IS THE AVERAGE OF THE AVAILABLE HOURLY DATA.
2. THE PERIOD OF RECORD IS FROM AUGUST 2010 THROUGH DECEMBER 2012.

0	12FEB'13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM AJAX MINING INC.

AJAX PROJECT

AJAXMET CLIMATE STATION
MEAN MONTHLY WIND ROSES
JANUARY THROUGH APRIL

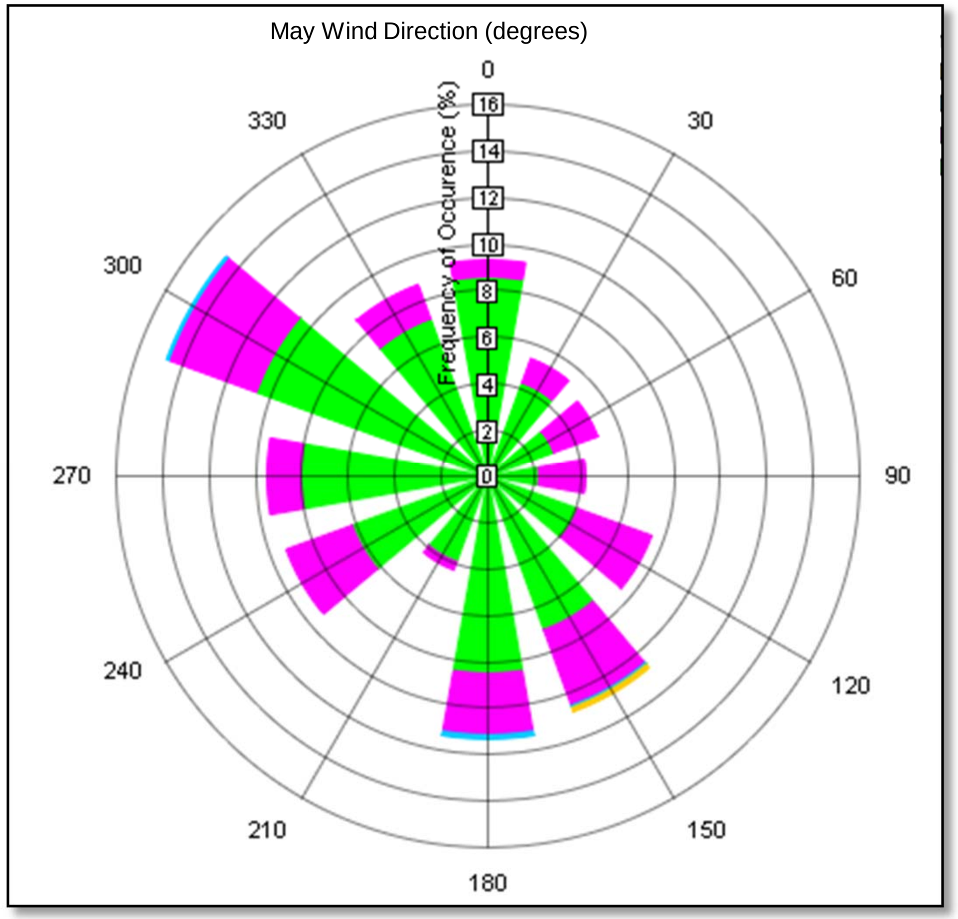
Knight Piésold CONSULTING

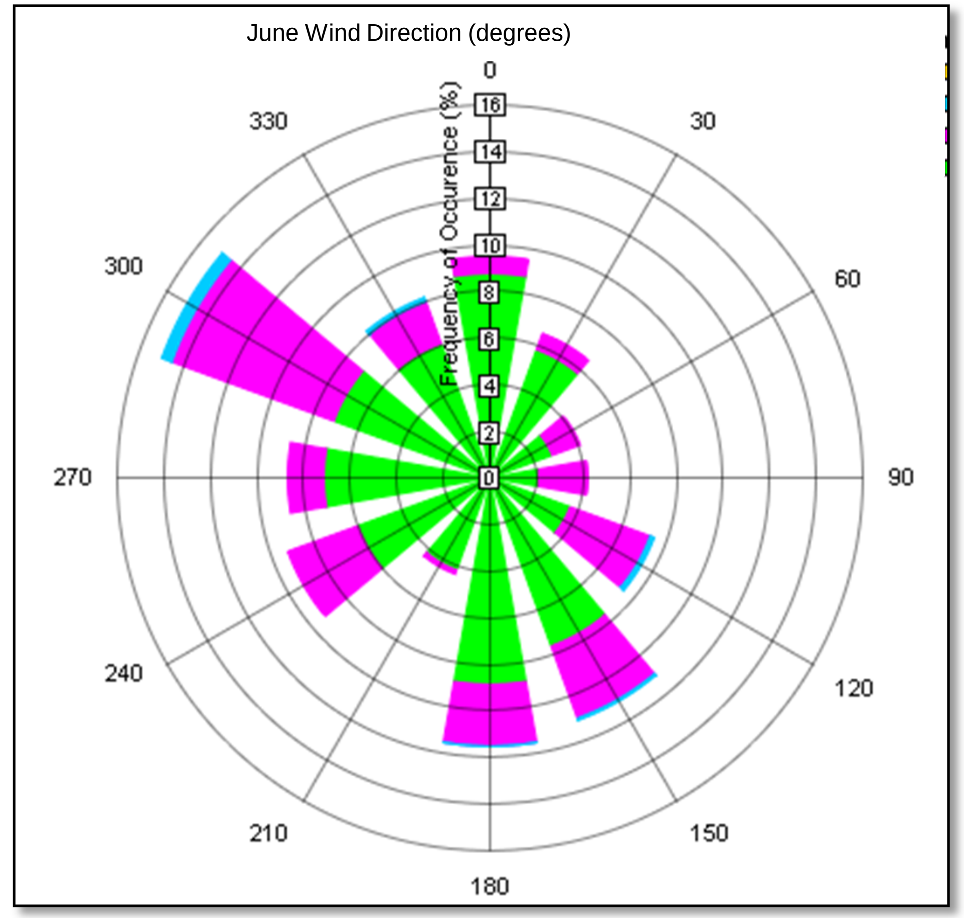
P/A NO. VA101-246/8

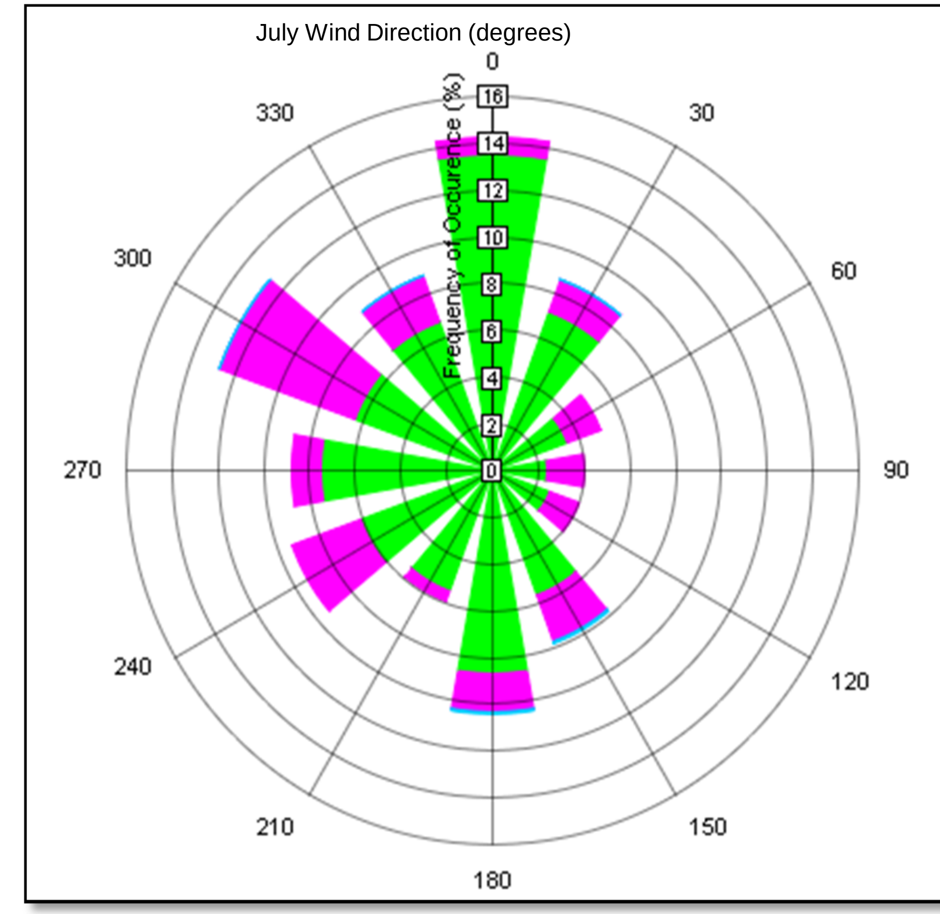
REF. NO. 8

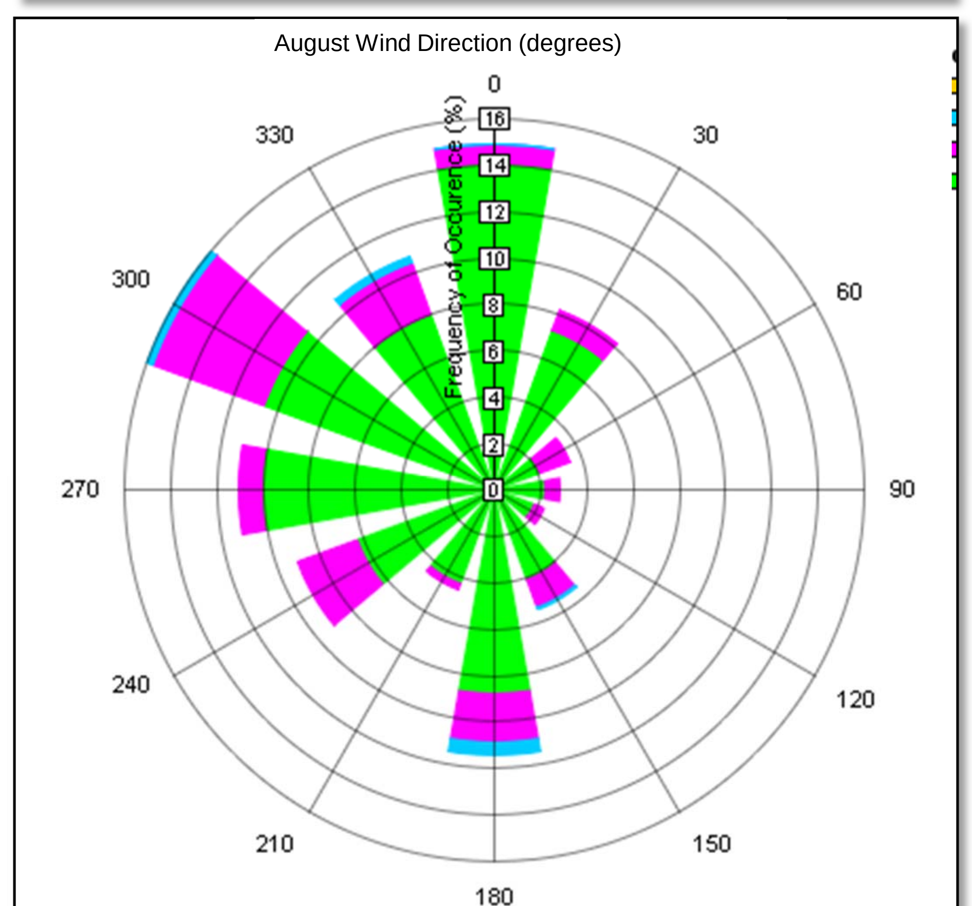
FIGURE 2.4

REV 0









Wind Speed (m/s)
- 9.00 - 12.00
- 6.00 - 9.00
- 3.00 - 6.00
- 0.00 - 3.00

NOTES:
1. THE MEAN MONTHLY WIND ROSE DATA IS THE AVERAGE OF THE AVAILABLE HOURLY DATA.
2. THE PERIOD OF RECORD IS FROM AUGUST 2010 THROUGH DECEMBER 2012.

0	12FEB'13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

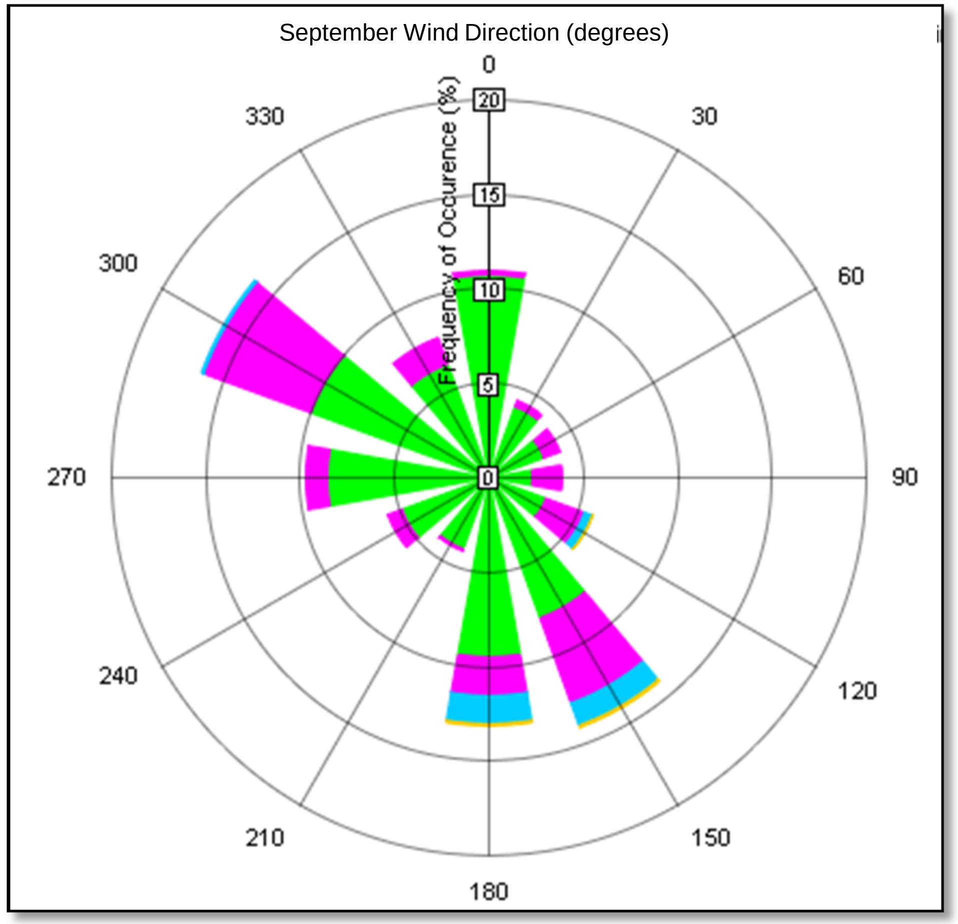
KGHM AJAX MINING INC.

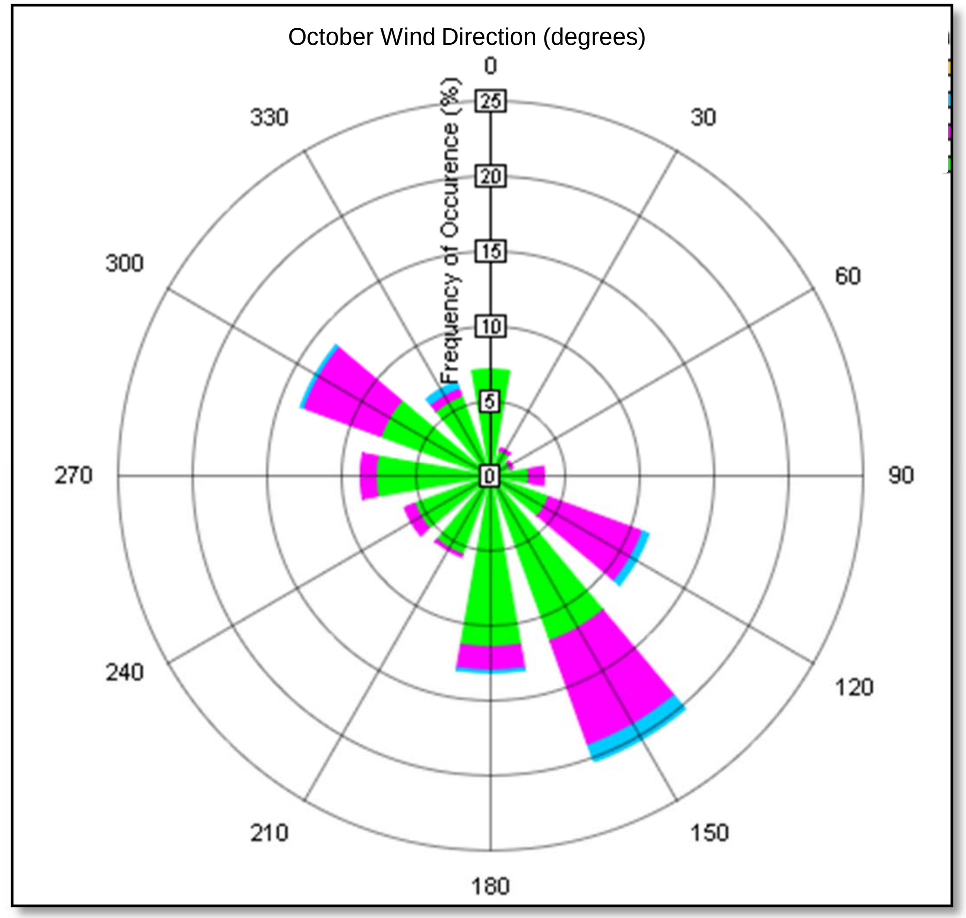
AJAX PROJECT

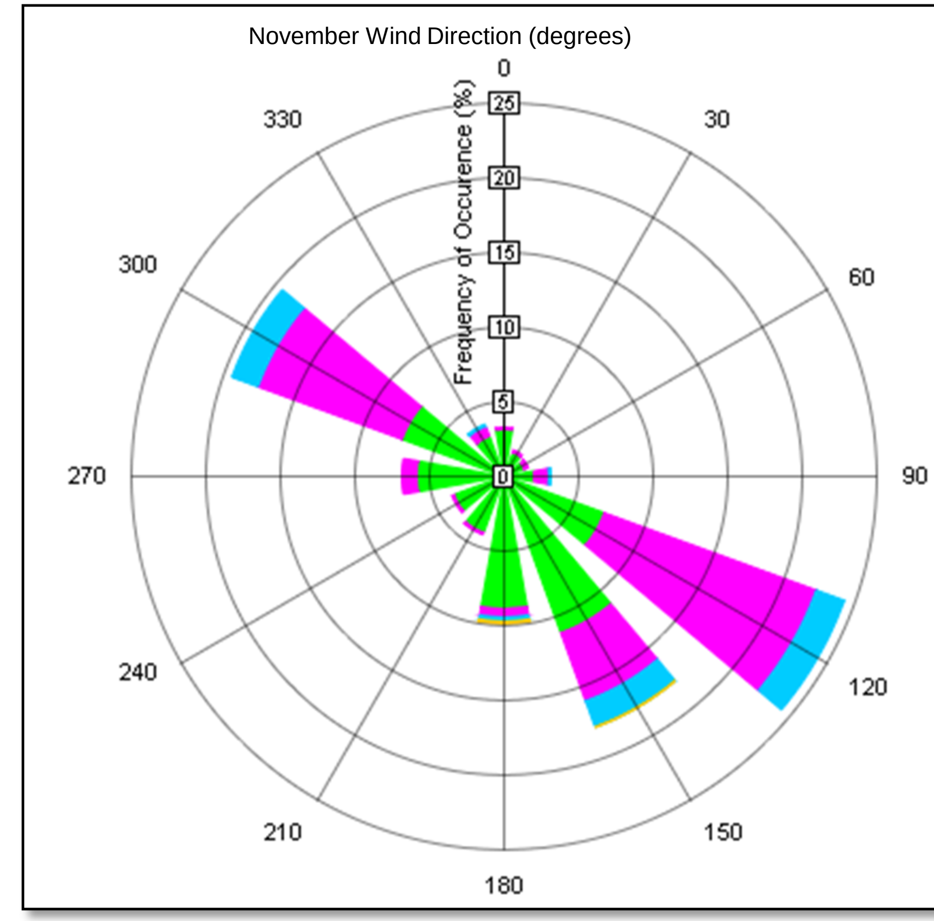
AJAXMET CLIMATE STATION
MEAN MONTHLY WIND ROSES
MAY THROUGH AUGUST

Knight Piésold CONSULTING

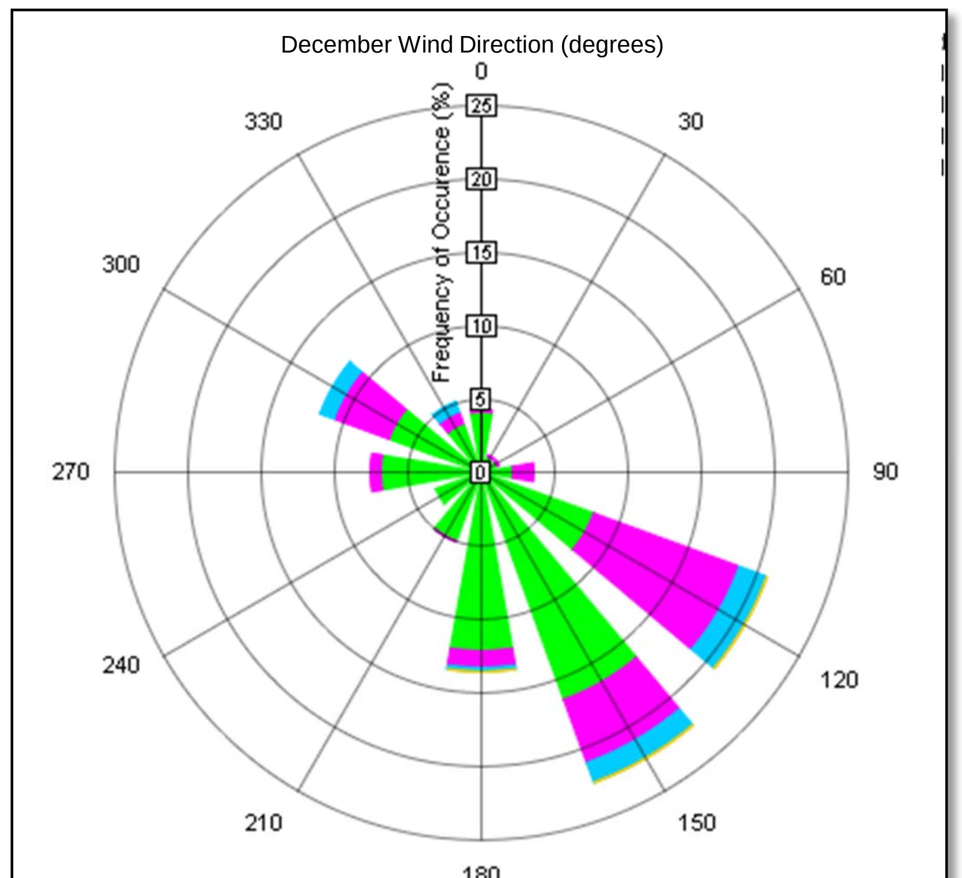
P/A NO. VA101-246/08	REF. NO. 8	
FIGURE 2.5		REV 0







Wind Speed (m/s)
- 9.00 - 12.00
- 6.00 - 9.00
- 3.00 - 6.00
- 0.00 - 3.00



NOTES:
1. THE MEAN MONTHLY WIND ROSE DATA IS THE AVERAGE OF THE AVAILABLE HOURLY DATA.
2. THE PERIOD OF RECORD IS FROM AUGUST 2010 THROUGH DECEMBER 2012.

0	12FEB'13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

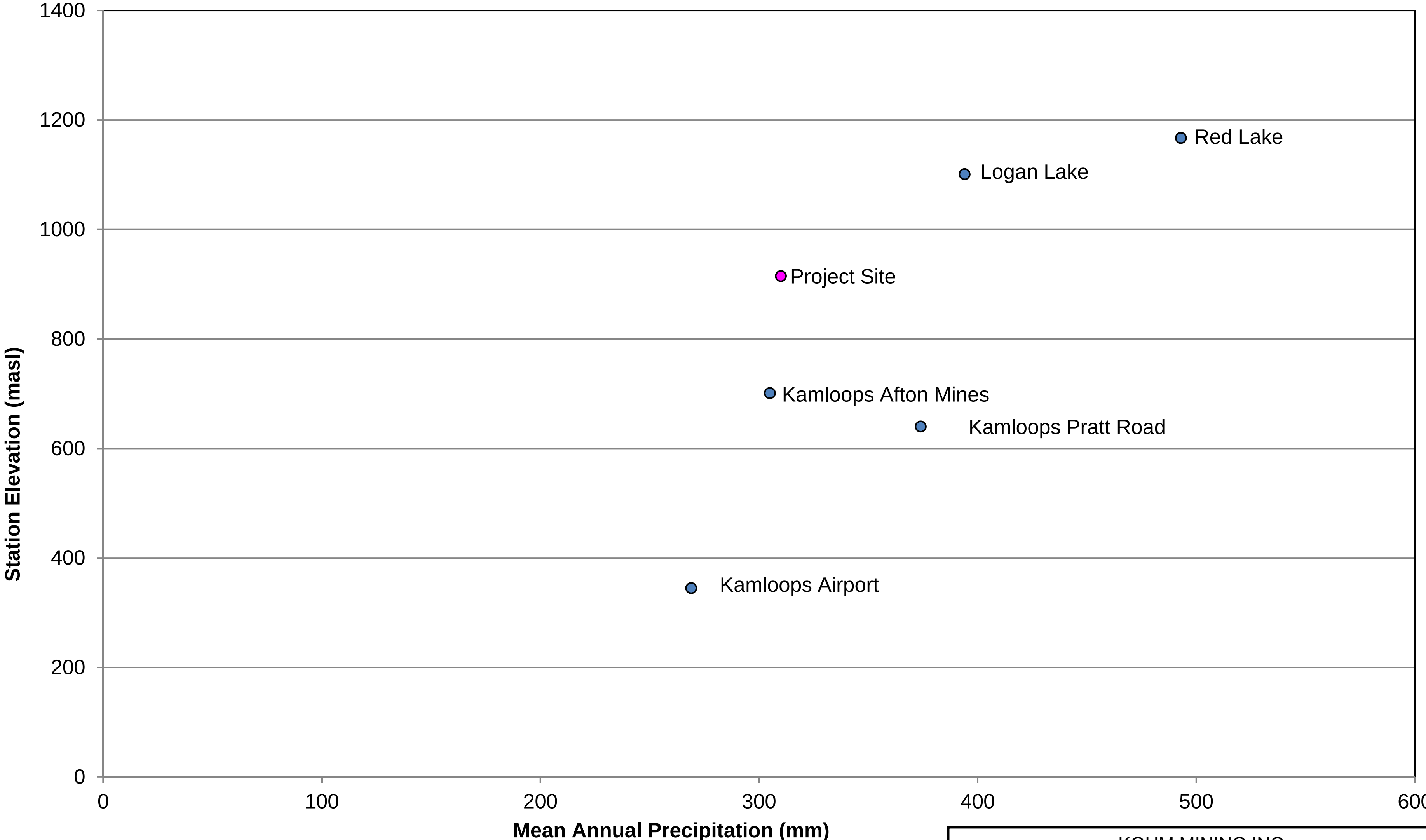
KGHM AJAX MINING INC.

AJAX PROJECT

AJAXMET CLIMATE STATION
MEAN MONTHLY WIND ROSES
SEPTEMBER THROUGH DECEMBER

Knight Piésold CONSULTING

P/A NO. VA101-246/08	REF. NO. 8	
FIGURE 2.6		REV 0



KGHM MINING INC.

AJAX PROJECT

REGIONAL AND PROJECT SITE MAP AND ELEVATION

Knight Piésold CONSULTING

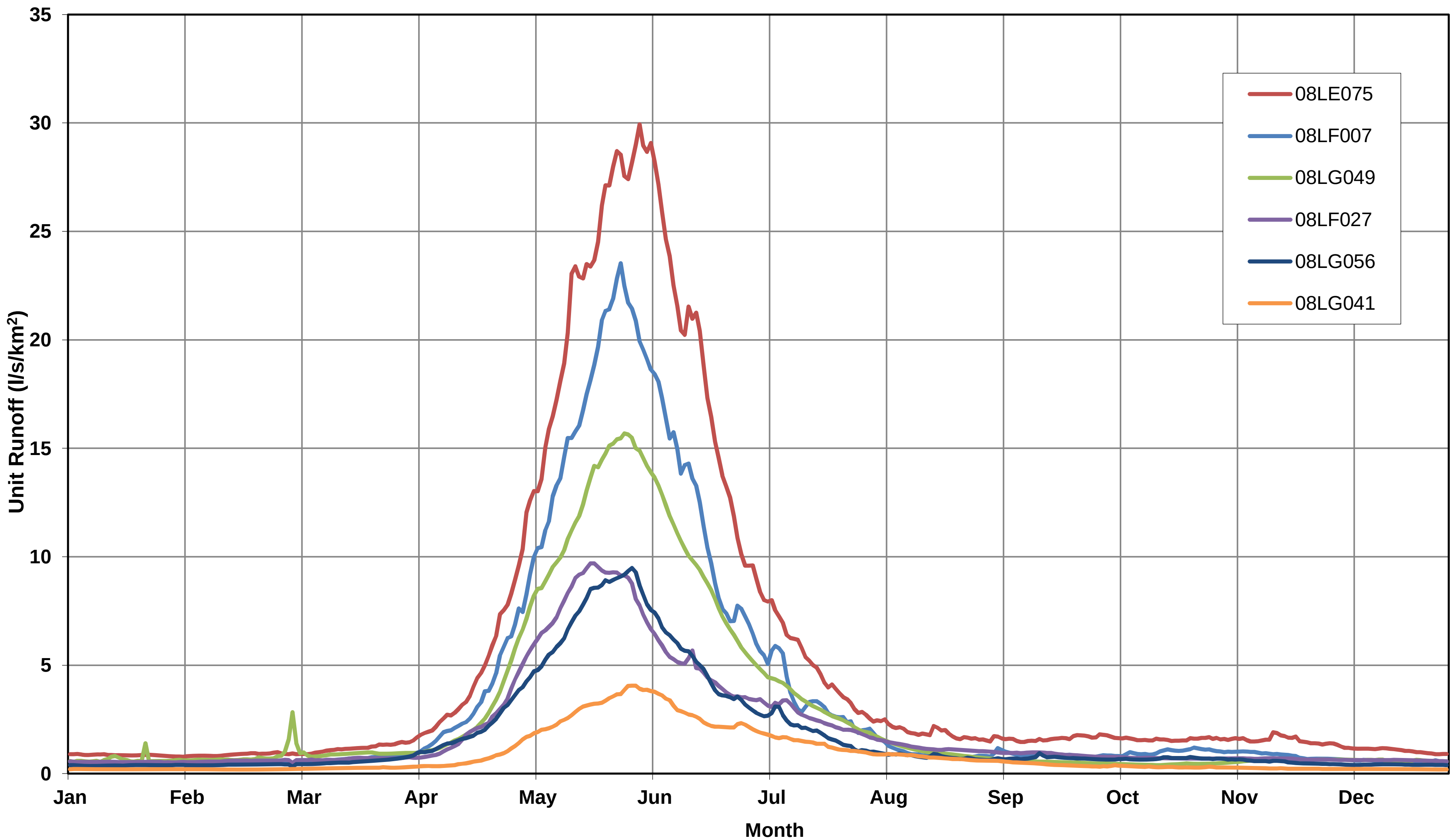
P/A NO. VA101-246/8

REF. NO. 8

FIGURE 2.7

REV 0

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	06FEB'12	ISSUED WITH REPORT	MH	JGC	KJB



NOTES:

1. STATION 08LB064 NOT INCLUDED IN FIGURE BECAUSE CATCHMENT AREA IS TOO LARGE TO BE REPRESENTATIVE OF CATCHMENTS TO THE PROJECT AREA.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	19JUL'12	ISSUED WITH REPORT	TR	MH	JGC

KGHM AJAX MINING INC.

AJAX PROJECT

REGIONAL UNIT RUNOFF HYDROGRAPH

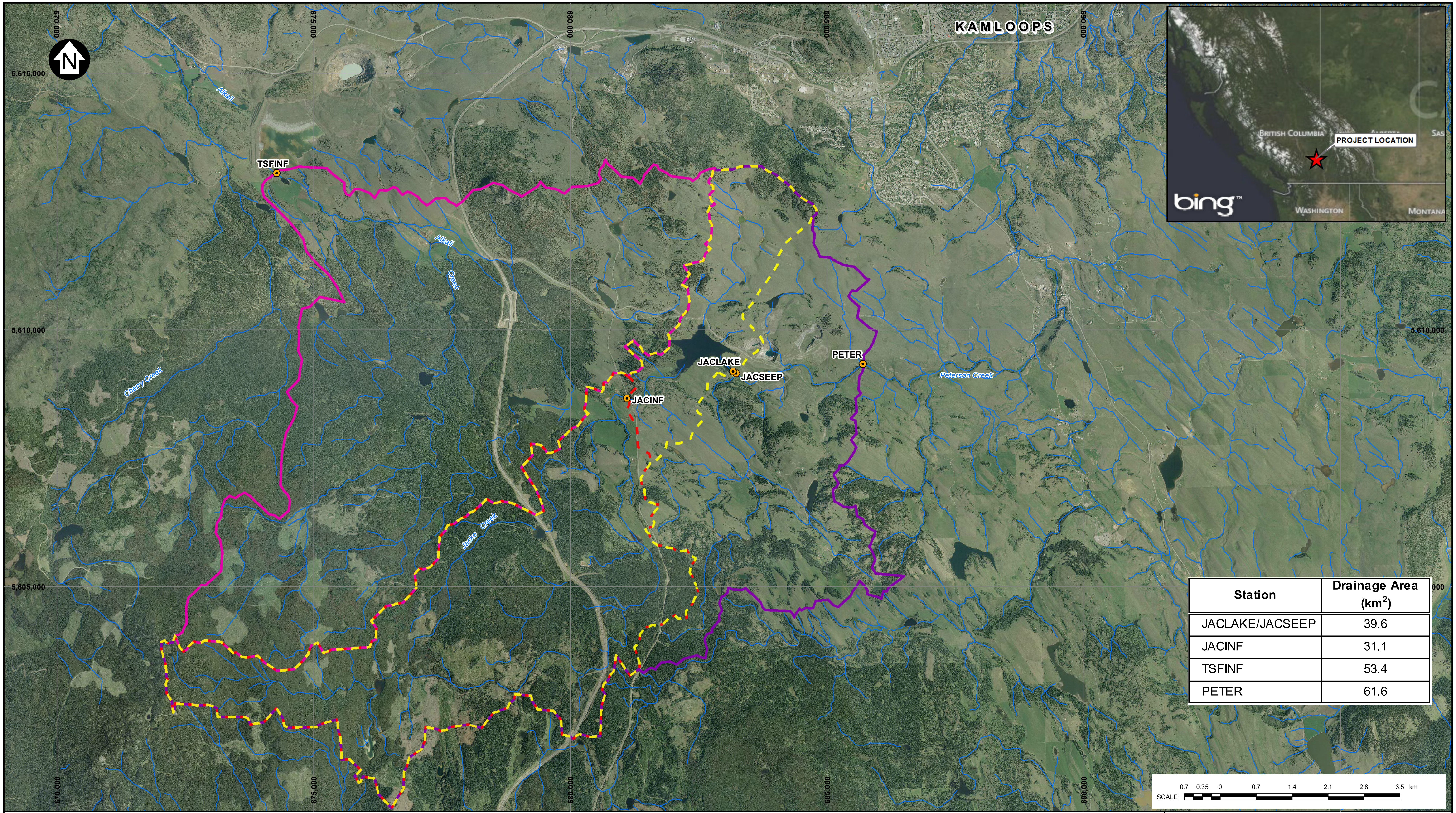
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF. NO. 8

FIGURE 3.1

REV 0



Station	Drainage Area (km^2)
JACLAKE/JACSEEP	39.6
JACINF	31.1
TSFINF	53.4
PETER	61.6

LEGEND:

- HYDROMETRIC GAUGING STATION
- TSFINF WATERSHED BOUNDARY
- JACLAKE WATERSHED BOUNDARY
- JACINF WATERSHED BOUNDARY
- PETER WATERSHED BOUNDARY

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
2	07MAR'13	ISSUED WITH REPORT	CB	AMD	MH	JGC
1	07FEB'13	ISSUED WITH REPORT	CB	AMD	MH	JGC
0	05DEC'08	ISSUED WITH REPORT	CB	RP	CB	JGC

NOTES:

1. BASE MAP: BC TRIM AND NTS BACKGROUND IMAGERY PROVIDED BY ABACUS.

2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

3. 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.

KGHM AJAX MINING INC.

AJAX PROJECT

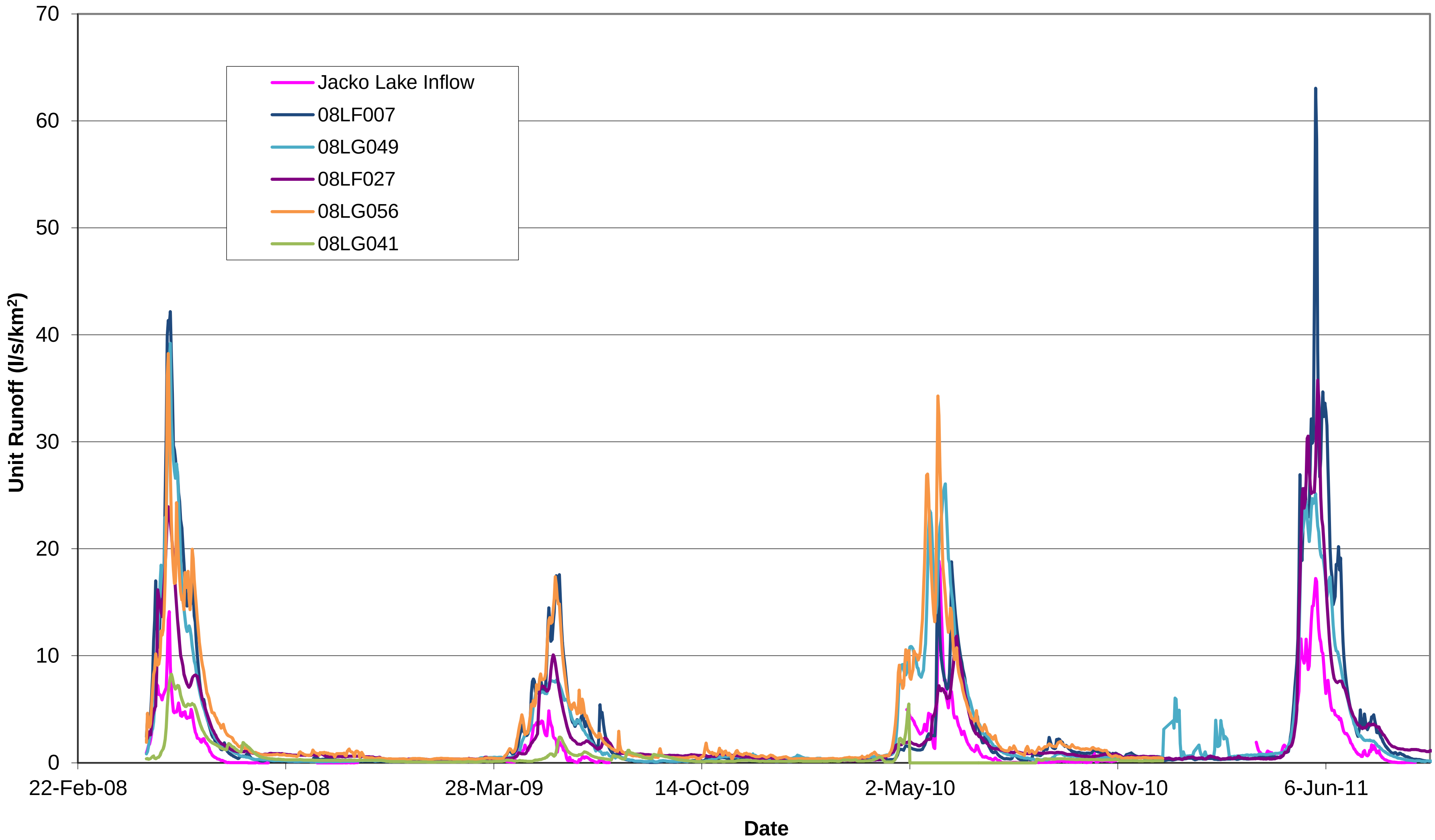
HYDROMETRIC STATION CATCHMENTS

Knight Piésold CONSULTING

P/A NO. VA101-246/8 | REF NO. 8

FIGURE 3.2 | REV 2

SAVED: M:\1\01\00246\08\A\GIS\ArcView\figures\Report-8 Hydromet\Figure 3.1_HydrometricStationCatchments_R1.mxd; Mar 07, 2013 5:02 PM; kkrauszova



NOTES:

1. 08LB064 AND 08LF023 NOT INCLUDED IN FIGURE. CATCHMENT AREAS FOR THOSE SITES ARE TOO LARGE TO BE REPRESENTATIVE OF THE PROJECT AREA.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	18JUL'12	ISSUED WITH REPORT	TR	MH	JGC

KGHM AJAX INING INC.

AJAX PROJECT

REGIONAL AND PROJECT SITE CONCURRENT DAILY UNIT RUNOFF

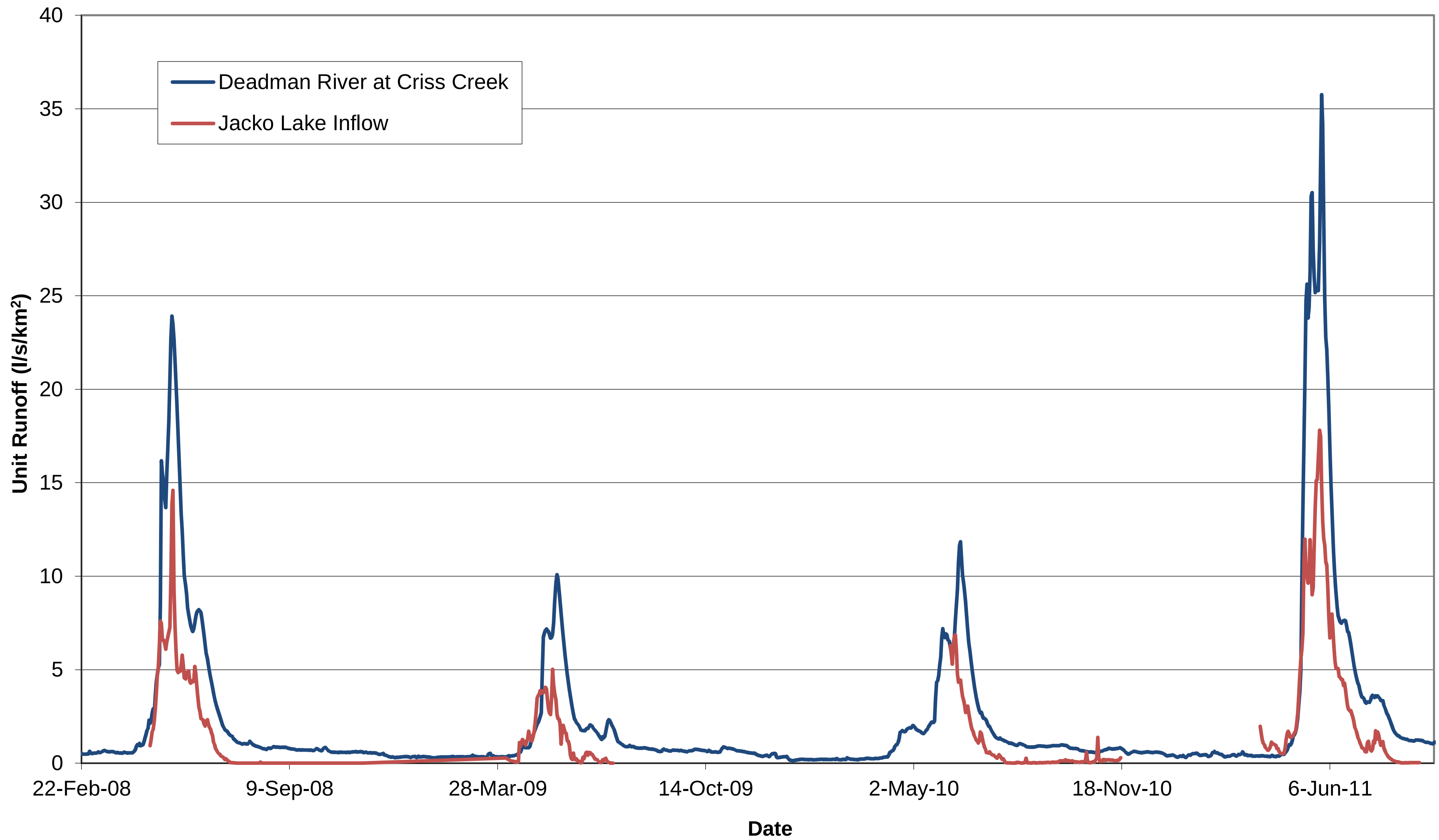
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF NO. 8

FIGURE 3.3

REV



0	18JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM AJAX INING INC.

AJAX PROJECT

JACINF AND DEADMAN RIVER CONCURRENT DAILY UNIT RUNOFF

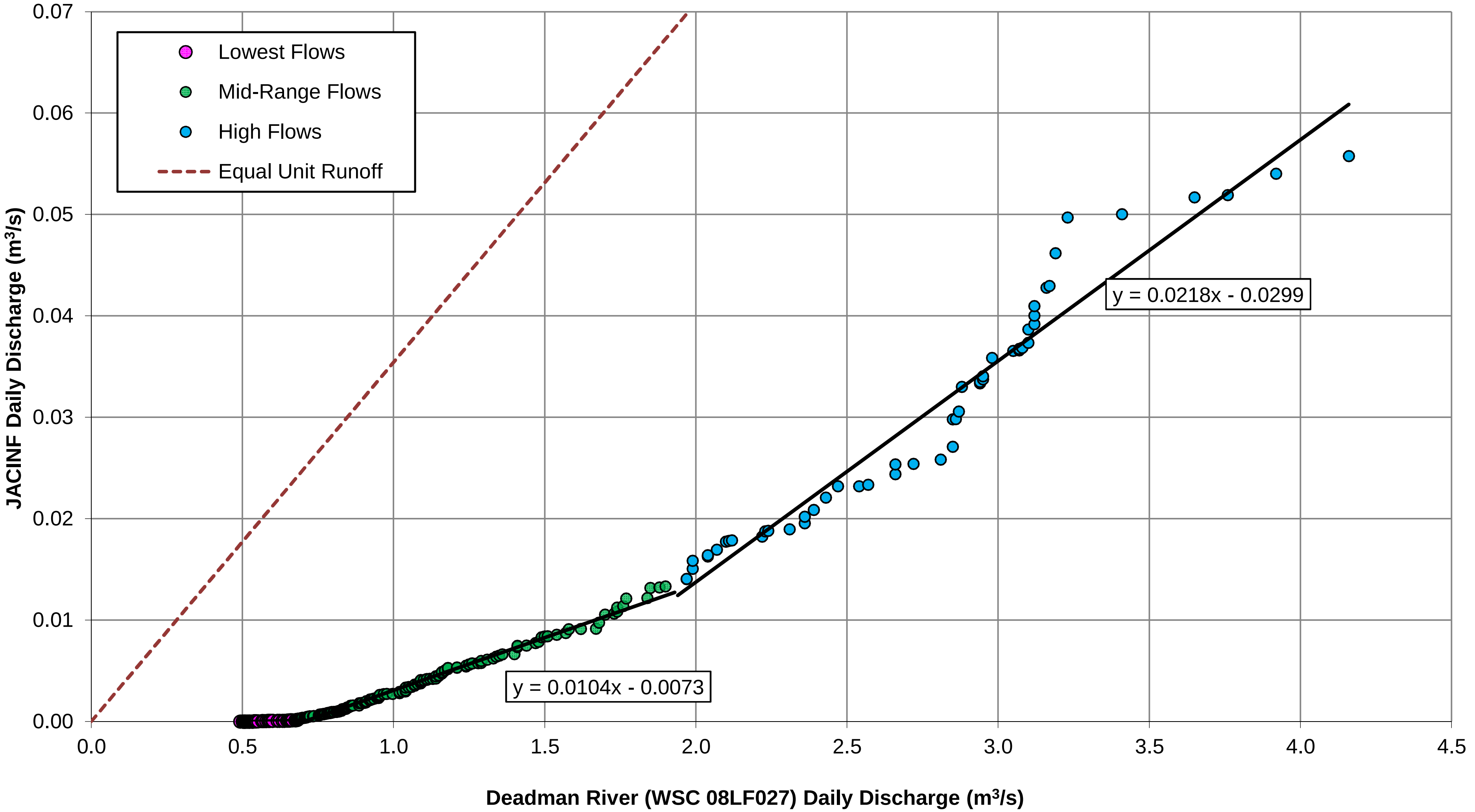
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF NO. 8

FIGURE 3.4

REV



0	18JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM AJAX MINING INC.

AJAX PROJECT

JACINF AND DEADMAN RIVER BASEFLOW RANKED REGRESSION ANALYSIS JULY THROUGH NOVEMBER

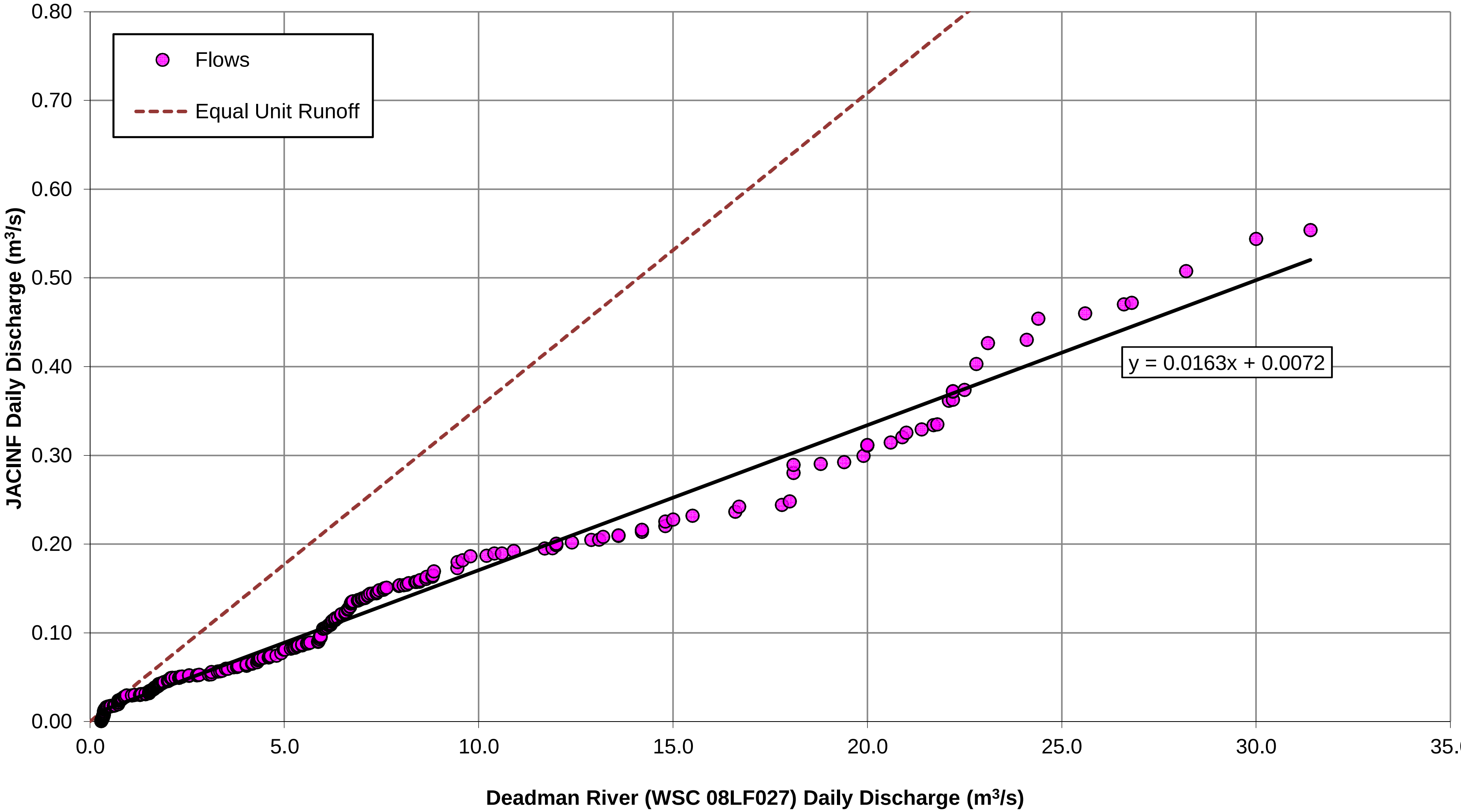
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF. NO. 8

FIGURE 3.5

REV 0



KGHM AJAX MINING INC.

AJAX PROJECT

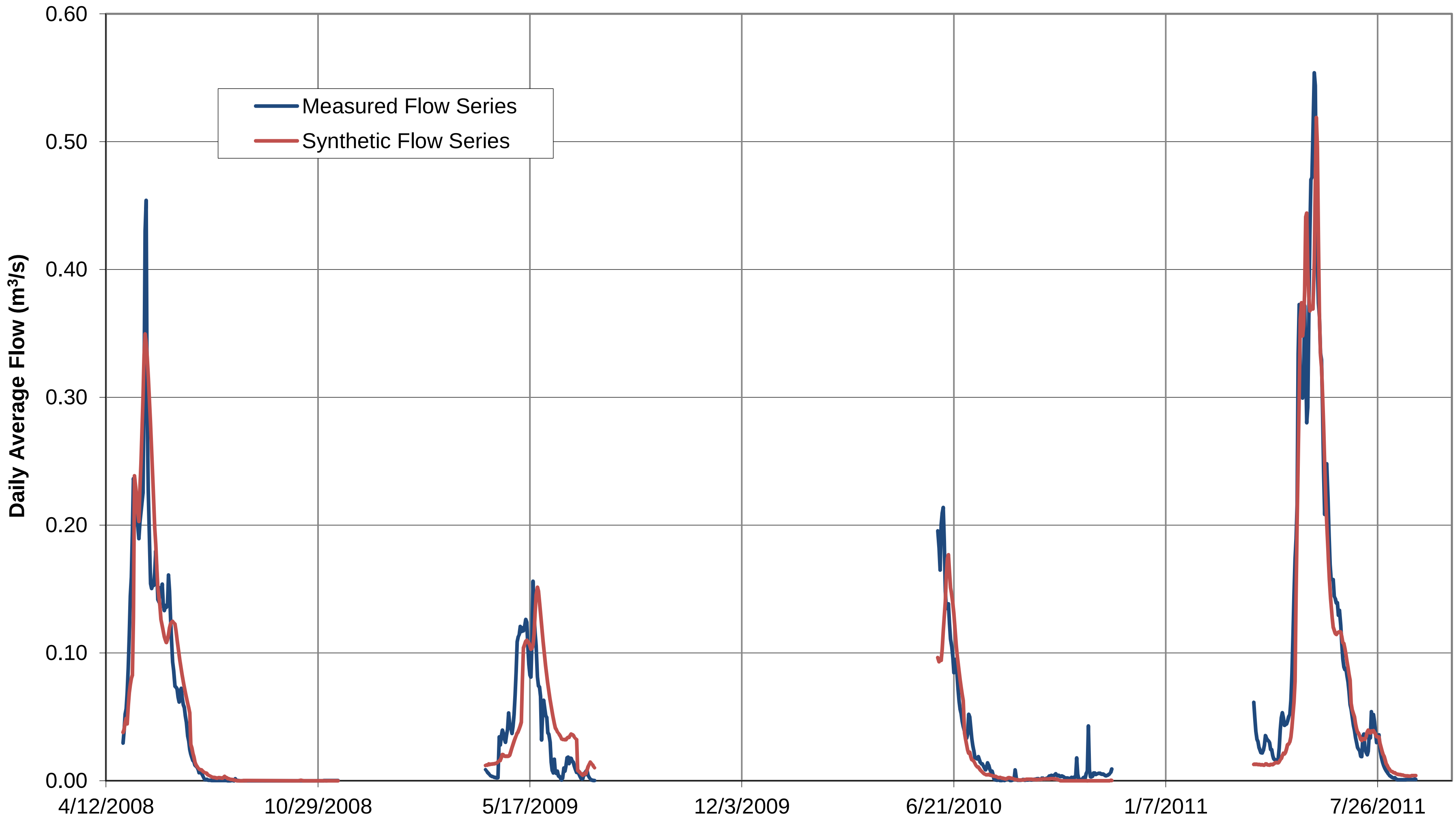
JACINF AND DEADMAN RIVER WINTER AND SNOWMELT RANKED REGRESSION ANALYSIS DECEMBER THROUGH JUNE

Knight Piésold CONSULTING

P/A NO. VA101-246/8 | REF. NO. 8

FIGURE 3.6 | REV 0

0	18JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:
1. ONLY THE CONCURRENT PERIOD OF RECORD IS SHOWN ON THIS FIGURE

0	17JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM AJAX MINING INC.

AJAX PROJECT

JACINF GAUGING STATION COMPARISON OF MEASURED AND SYNTHETIC FLOW

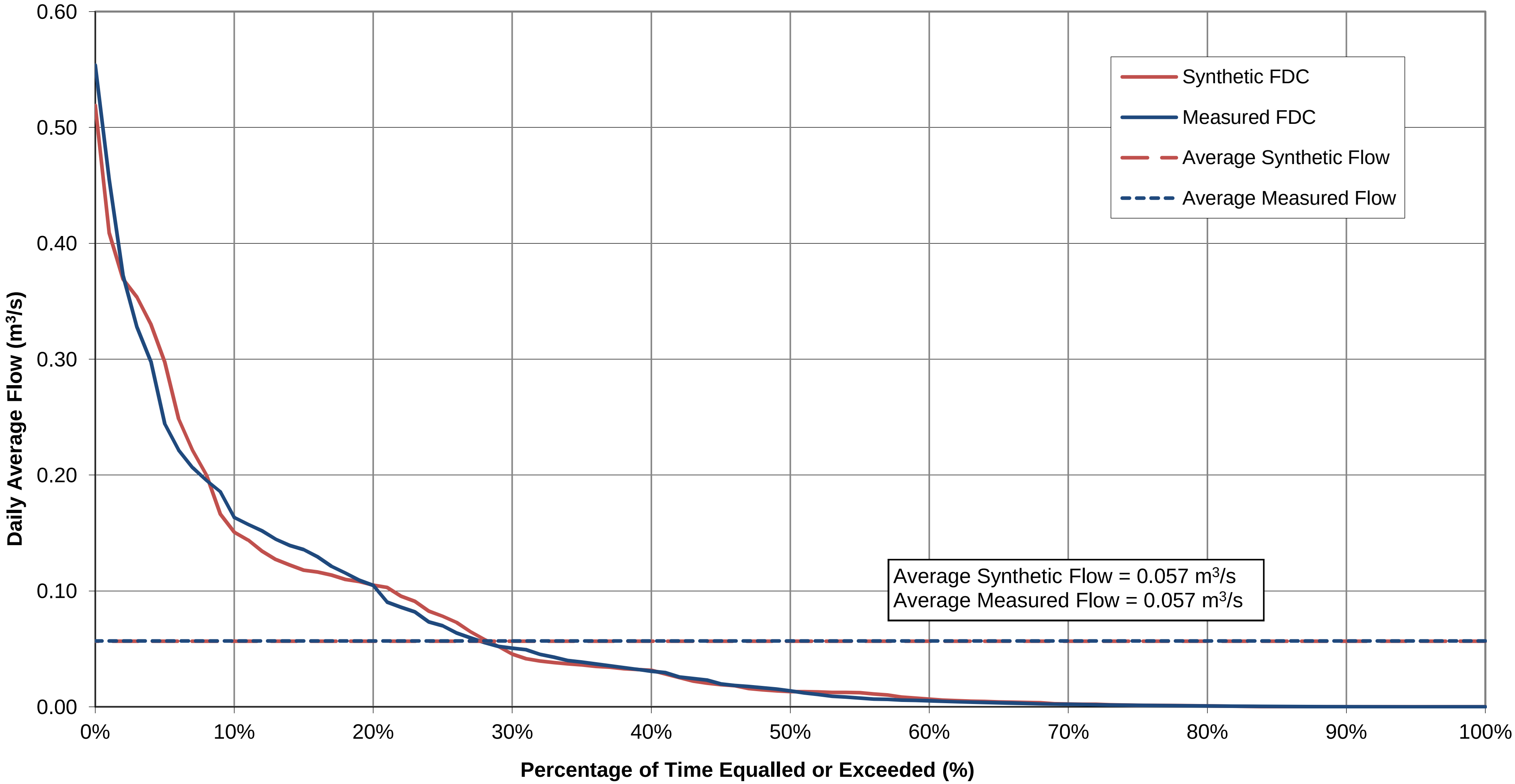
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF NO. 8

FIGURE 3.7

REV 0



NOTES:

1. THE SYNTHETIC AND MEASURED FLOW AVERAGES PRESENTED ON THIS CHART ARE FOR THE CONCURRENT PERIOD OF RECORD, AND ARE NOT THE MEAN ANNUAL DISCHARGE (MAD).

0	17JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

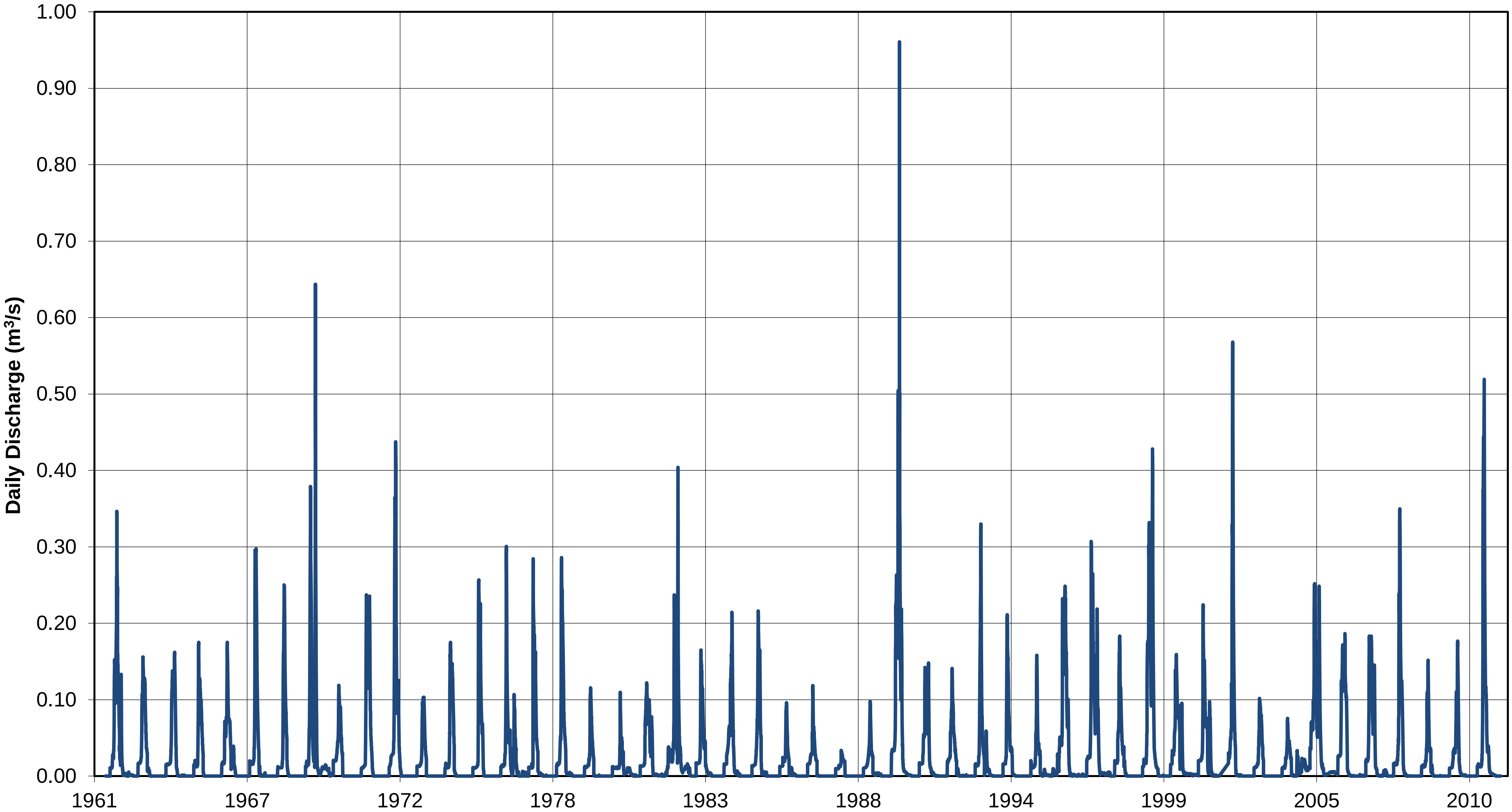
KGHM AJAX MINING INC.

AJAX PROJECT

JACINF GAUGING STATION
COMPARISON OF MEASURED AND SYNTHETIC FLOW DURATION CURVES

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-246/8	8
FIGURE 3.8	REV 0



KGHM AJAX MINING INC.

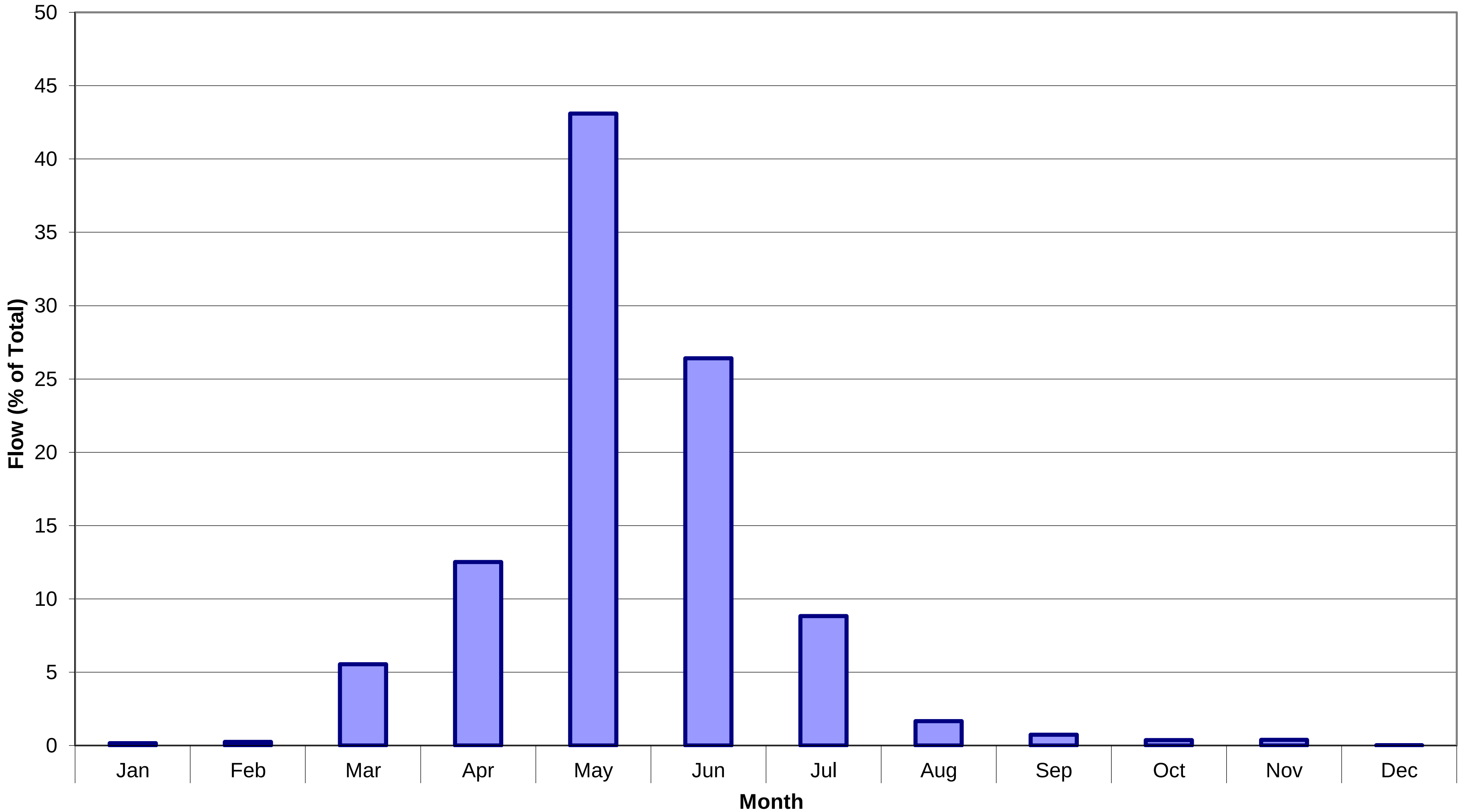
AJAX PROJECT

JACINF GAUGING STATION
LONG-TERM SYNTHETIC FLOWS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-246/8	8
FIGURE 3.9	REV 1

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	17JUL'12	ISSUED WITH REPORT	TR	MH	JGC



KGHM AJAX MINING INC.

AJAX PROJECT

JACINF GAUGING STATION
MEAN ANNUAL HYDROGRAPH

Knight Piésold CONSULTING

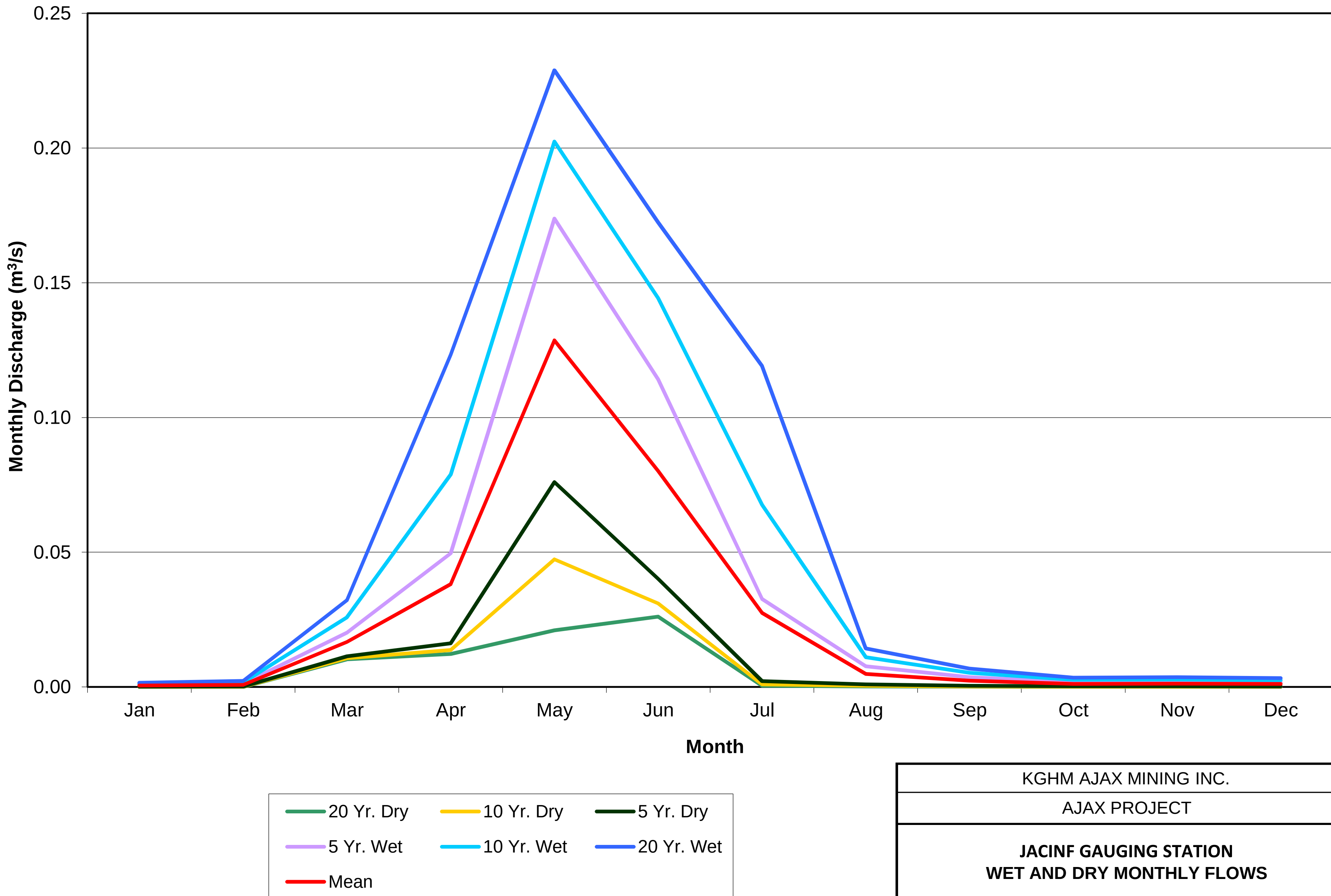
P/A NO. VA101-246/8

REF NO. 8

FIGURE 3.10

REV 0

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	17JUL'12	ISSUED WITH REPORT	TR	MH	JGC



KGHM AJAX MINING INC.

AJAX PROJECT

JACINF GAUGING STATION
WET AND DRY MONTHLY FLOWS

Knight Piésold CONSULTING

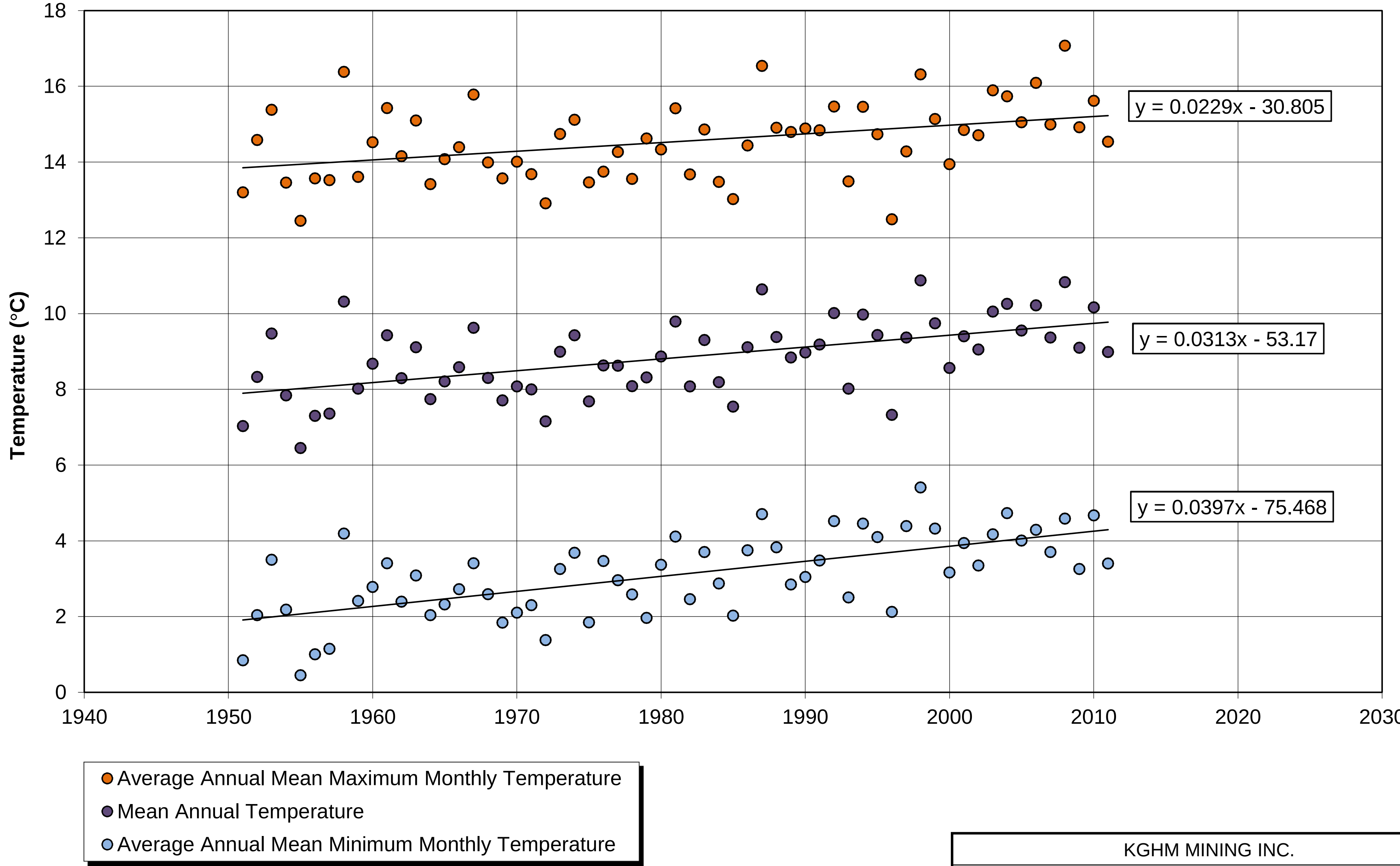
PA NO. VA101-246/8

REF NO. 8

FIGURE 3.11

REV. 0

0	26JUL'12	ISSUED WITH REPORT	DK	TR	MH	JGC
REV	DATE	DESCRIPTION	DESIGN	DRAWN	CHK'D	APP'D



NOTES:

1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. ALL OF THE TRENDLINES ARE SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM MINING INC.

AJAX PROJECT

KAMLOOPS AIRPORT TEMPERATURE TRENDS

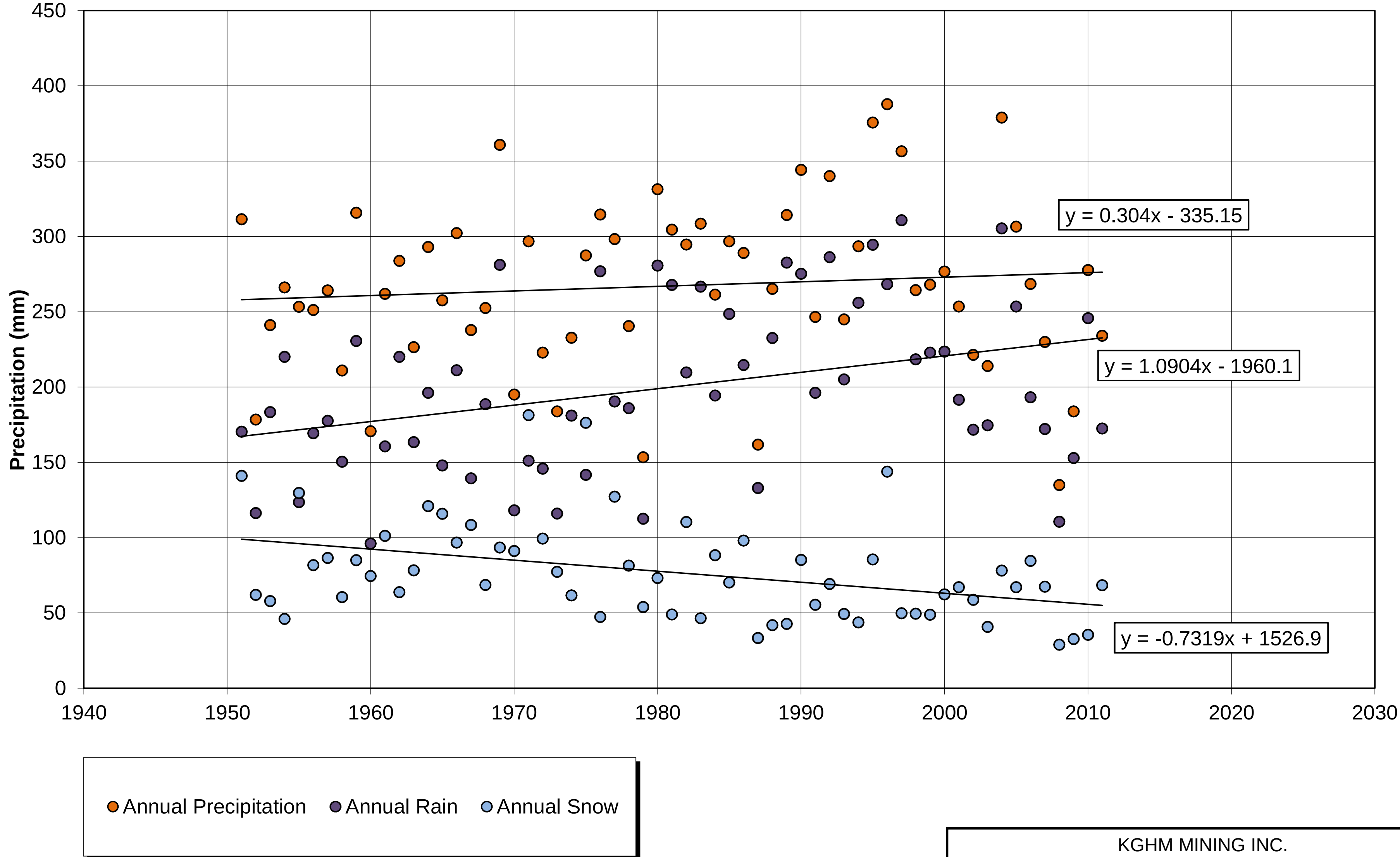
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF. NO. 8

FIGURE 4.1

REV 0



NOTES:

1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE ANNUAL PRECIPITATION TRENDLINE IS NOT SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.
3. THE ANNUAL RAIN AND ANNUAL SNOW TRENDLINES ARE SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB

KGHM MINING INC.

AJAX PROJECT

KAMLOOPS AIRPORT PRECIPITATION TRENDS

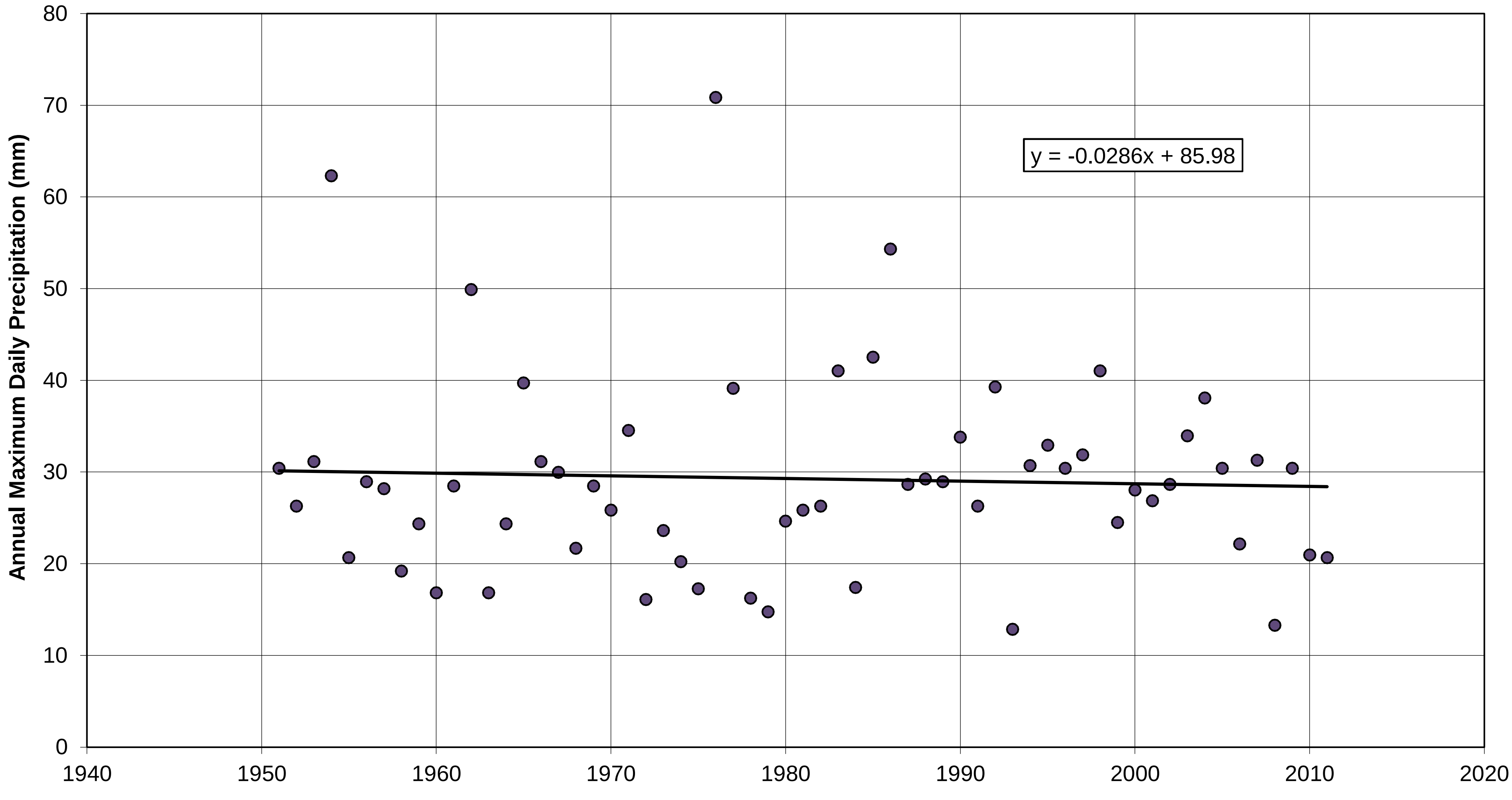
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF. NO. 8

FIGURE 4.2

REV 0



NOTES:
1. THE TRENDLINE IS NOT SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

KGHM MINING INC.

AJAX PROJECT

KAMLOOPS AIRPORT
ANNUAL MAXIMUM DAILY PRECIPITATION

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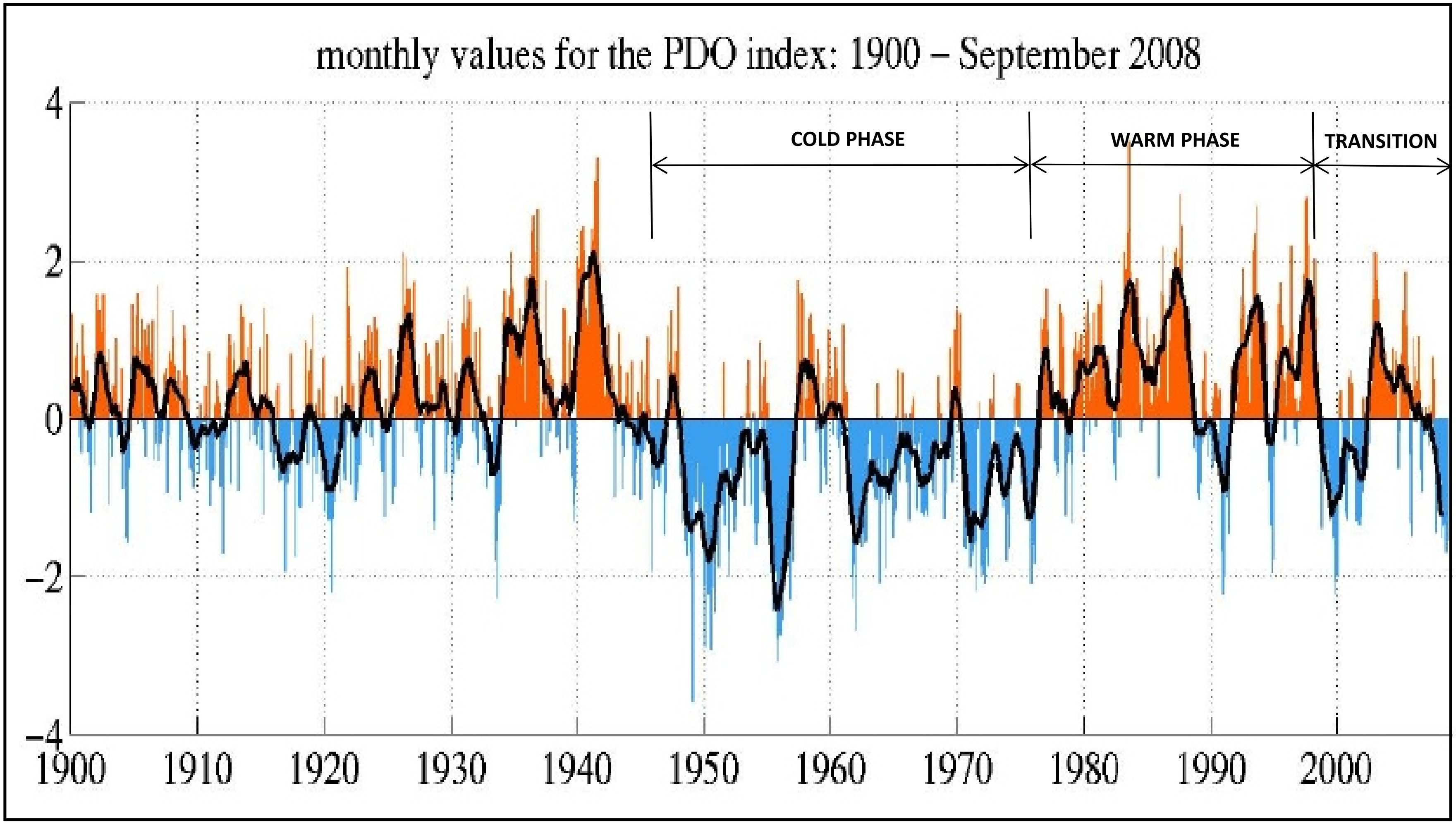
P/A NO.	REF. NO.
VA101-246/8	8

FIGURE 4.3 REV 0

0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:

1. SOURCE: JOINT INSTITUTE FOR THE STUDY OF THE ATMOSPHERE AND OCEAN
   http://jisao.washington.edu/pdo

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	05MAR'13	ISSUED WITH REPORT	MH	JGC	JGC

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THE PACIFIC DECADAL OSCILLATION INDEX FOR THE 20TH CENTURY

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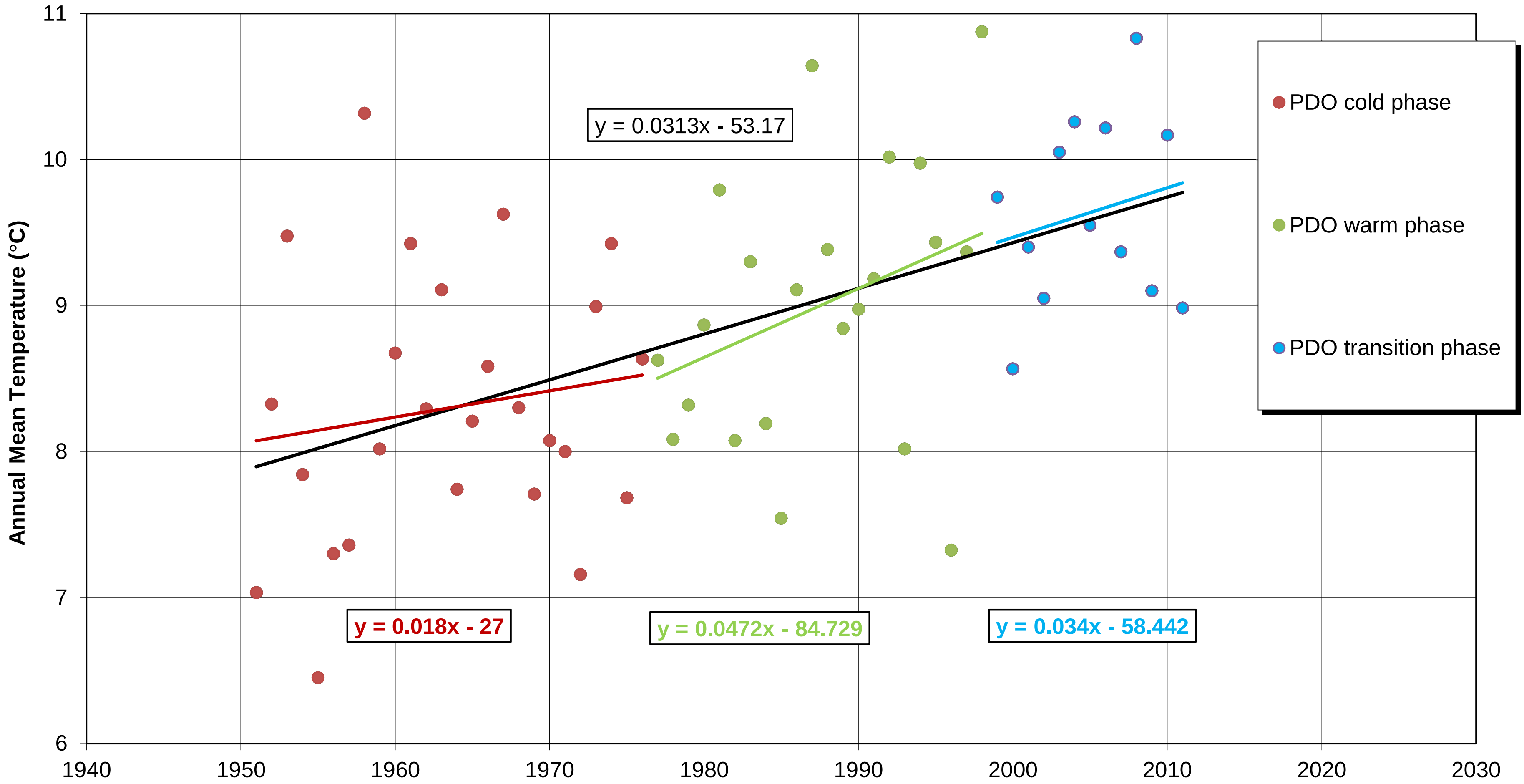
FIGURE 4.4

REV 0



NOTES:

1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. NONE OF THE TRENDLINES ARE SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

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KAMLOOPS AIRPORT
ANNUAL MEAN TEMPERATURE TRENDS
PDO PHASES

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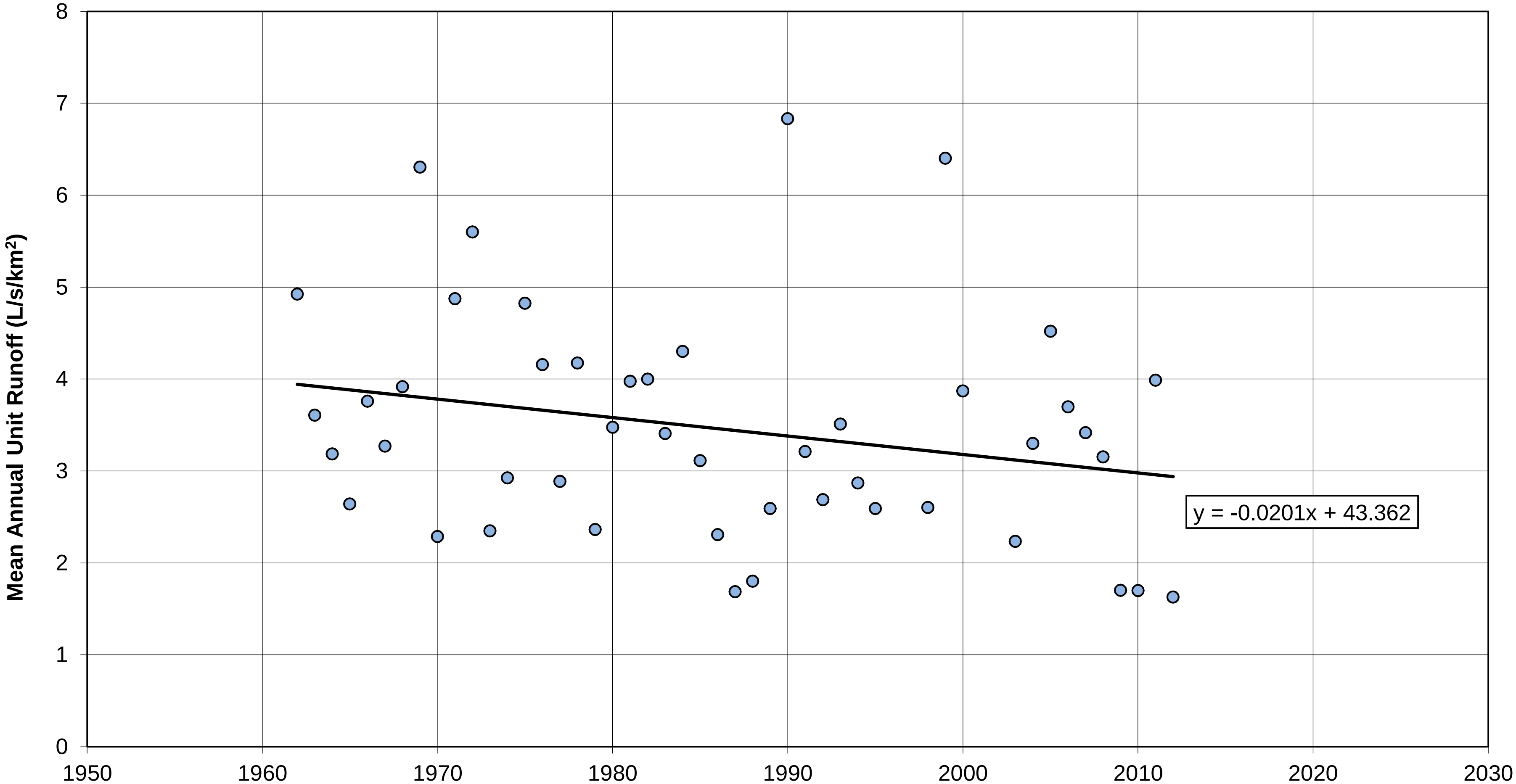
REF. NO. 8

FIGURE 4.5

REV 0

0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:
1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE TRENDLINE IS NOT SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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CRISS CREEK ANNUAL FLOW TRENDS

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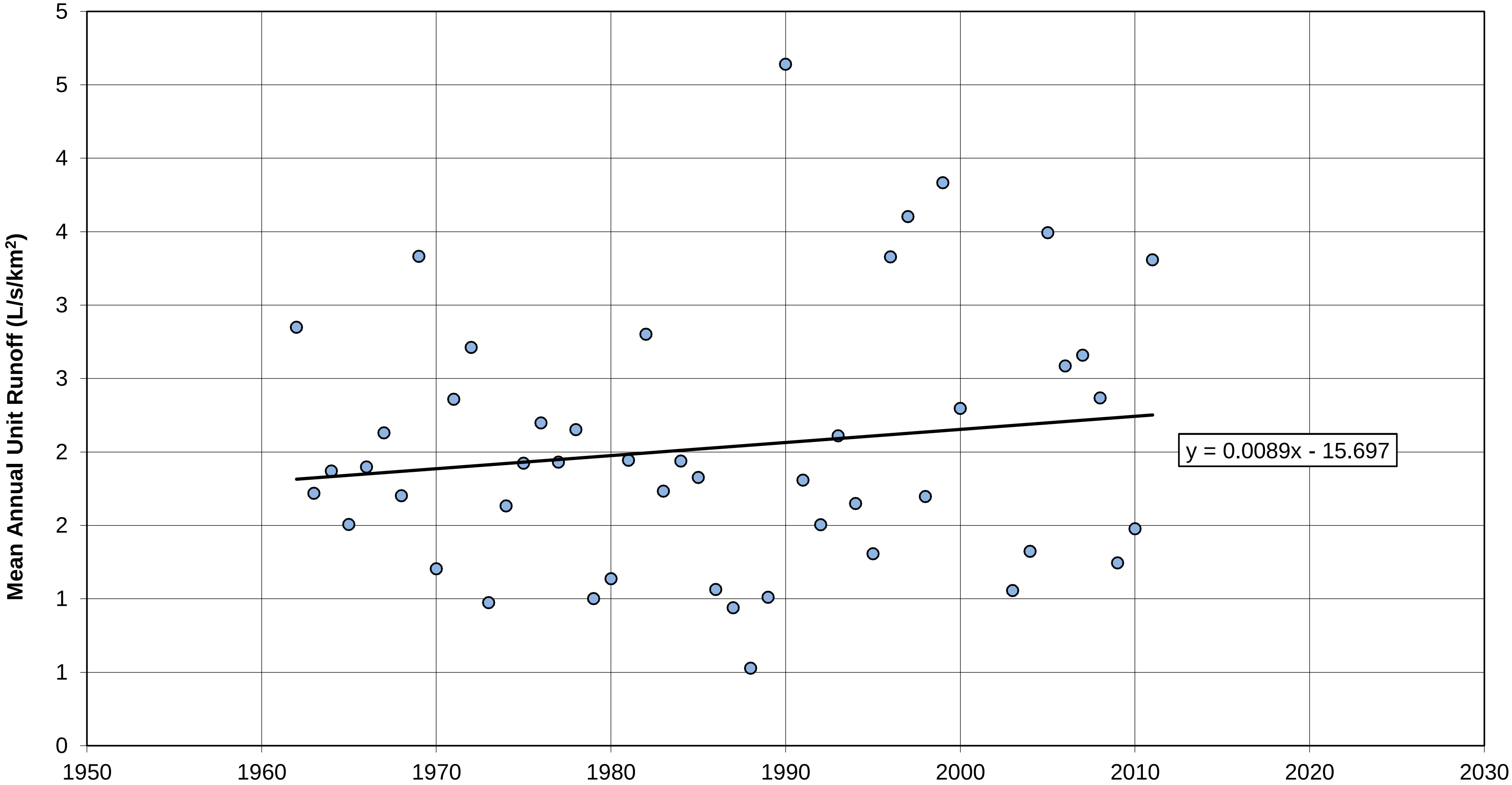
P/A NO.	REF. NO.
VA101-246/8	8

FIGURE 4.6 REV 0



NOTES:
1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE TRENDLINE IS NOT SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB

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DEADMAN RIVER ANNUAL FLOW TRENDS

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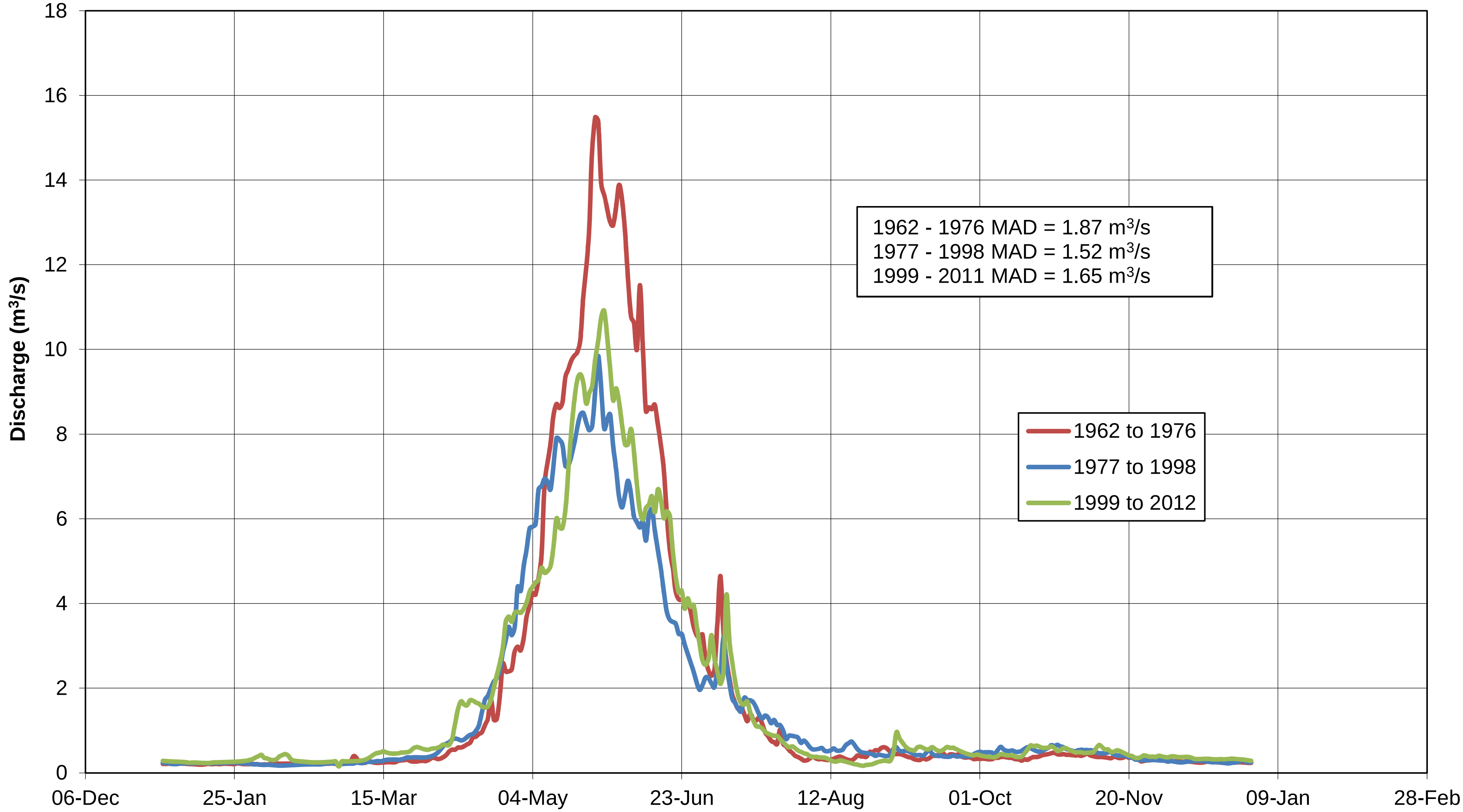
P/A NO. VA101-246/8

REF. NO. 8

FIGURE 4.7

REV 0



NOTES:
1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE THREE TIME PERIODS CORRESPOND TO DIFFERENT PHASES OF THE PDO.

0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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CRISS CREEK AVERAGE HYDROGRAPHS

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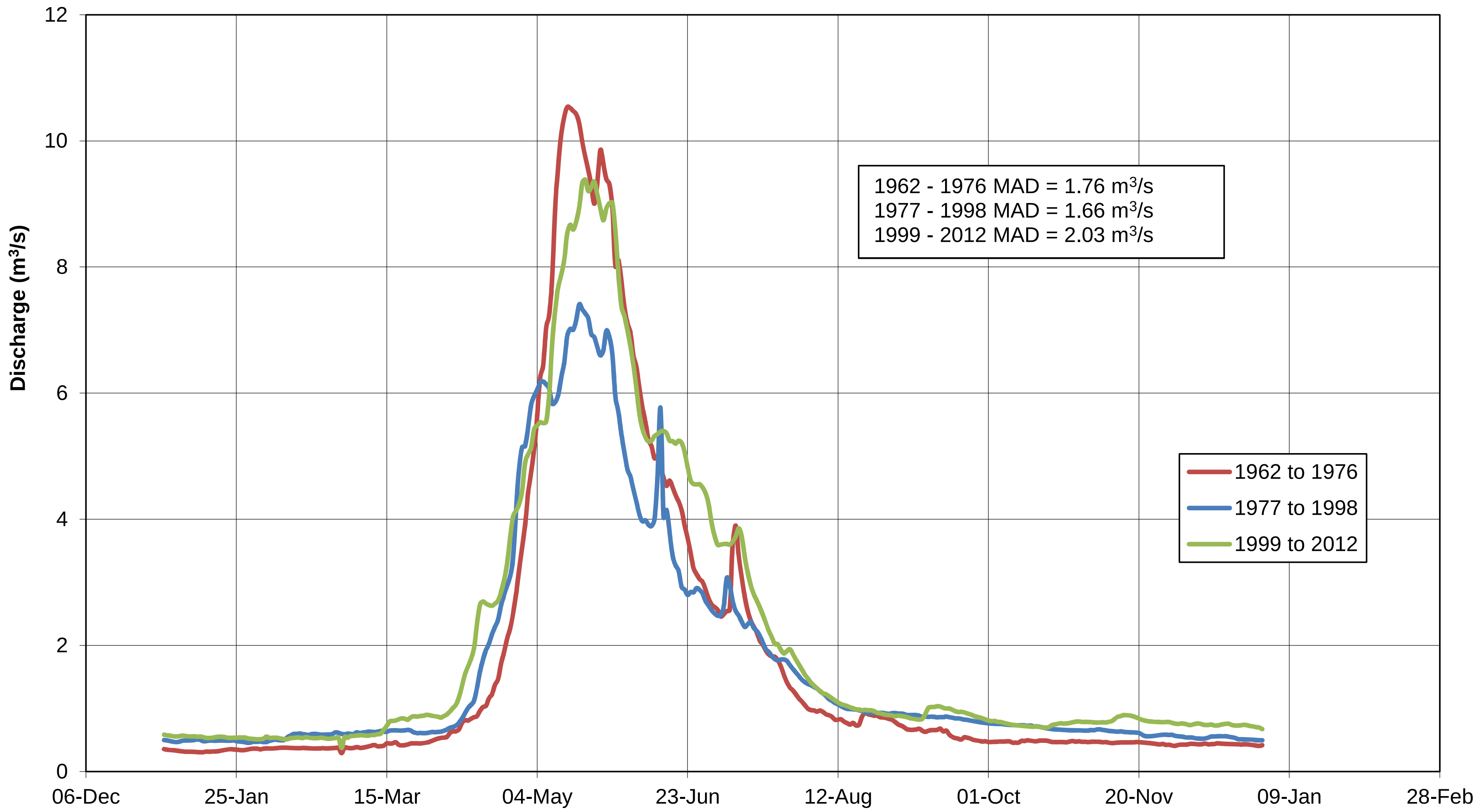
REF. NO. 8

FIGURE 4.8

REV 0



NOTES:

1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE THREE TIME PERIODS CORRESPOND TO DIFFERENT PHASES OF THE PDO.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB

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DEADMAN RIVER AVERAGE HYDROGRAPHS

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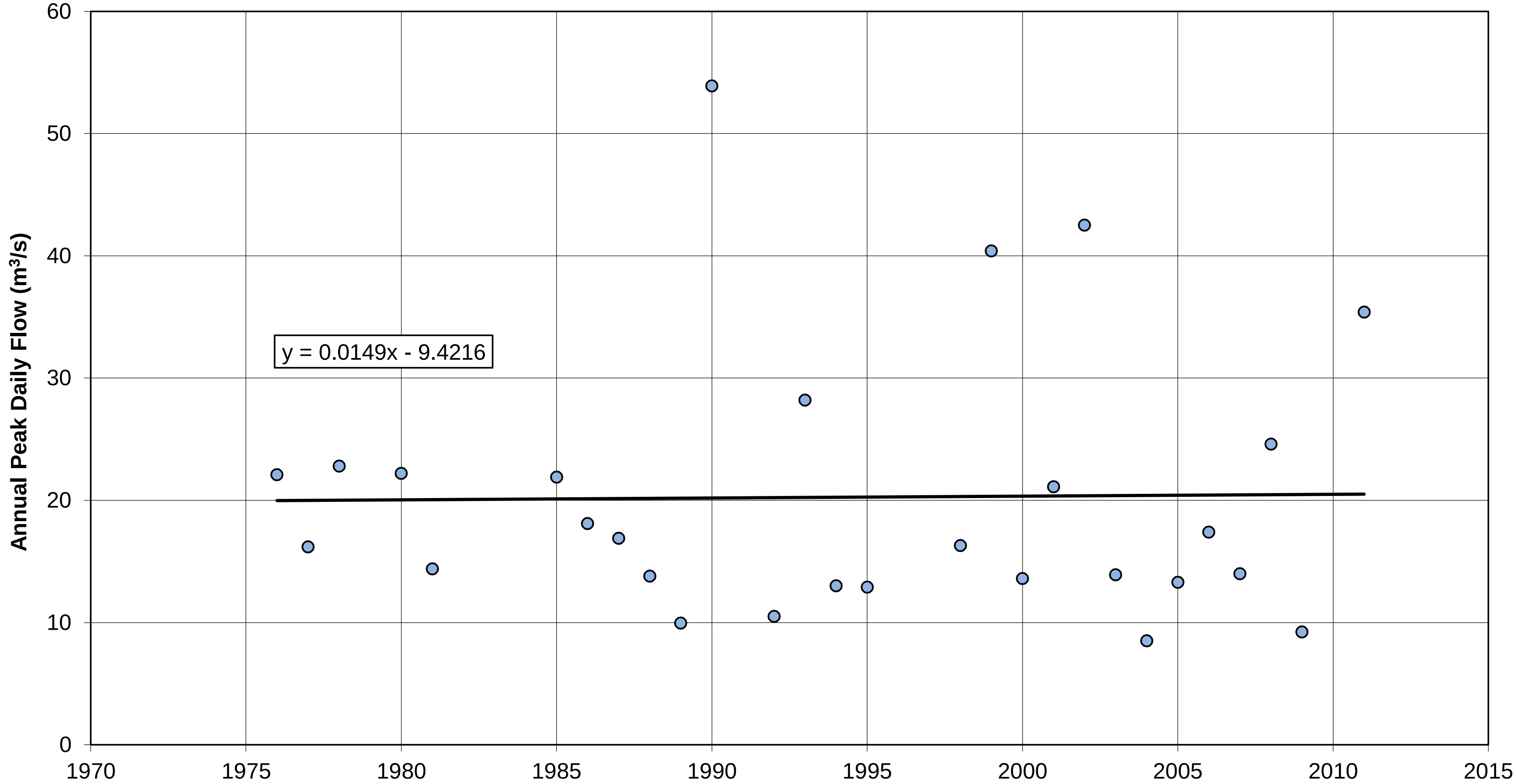
P/A NO.	REF. NO.
VA101-246/8	8

FIGURE 4.9 REV 0



NOTES:
1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE TRENDLINE IS NOT SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB

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AJAX PROJECT

CRISS CREEK
ANNUAL INSTANTANEOUS PEAK FLOW TRENDS

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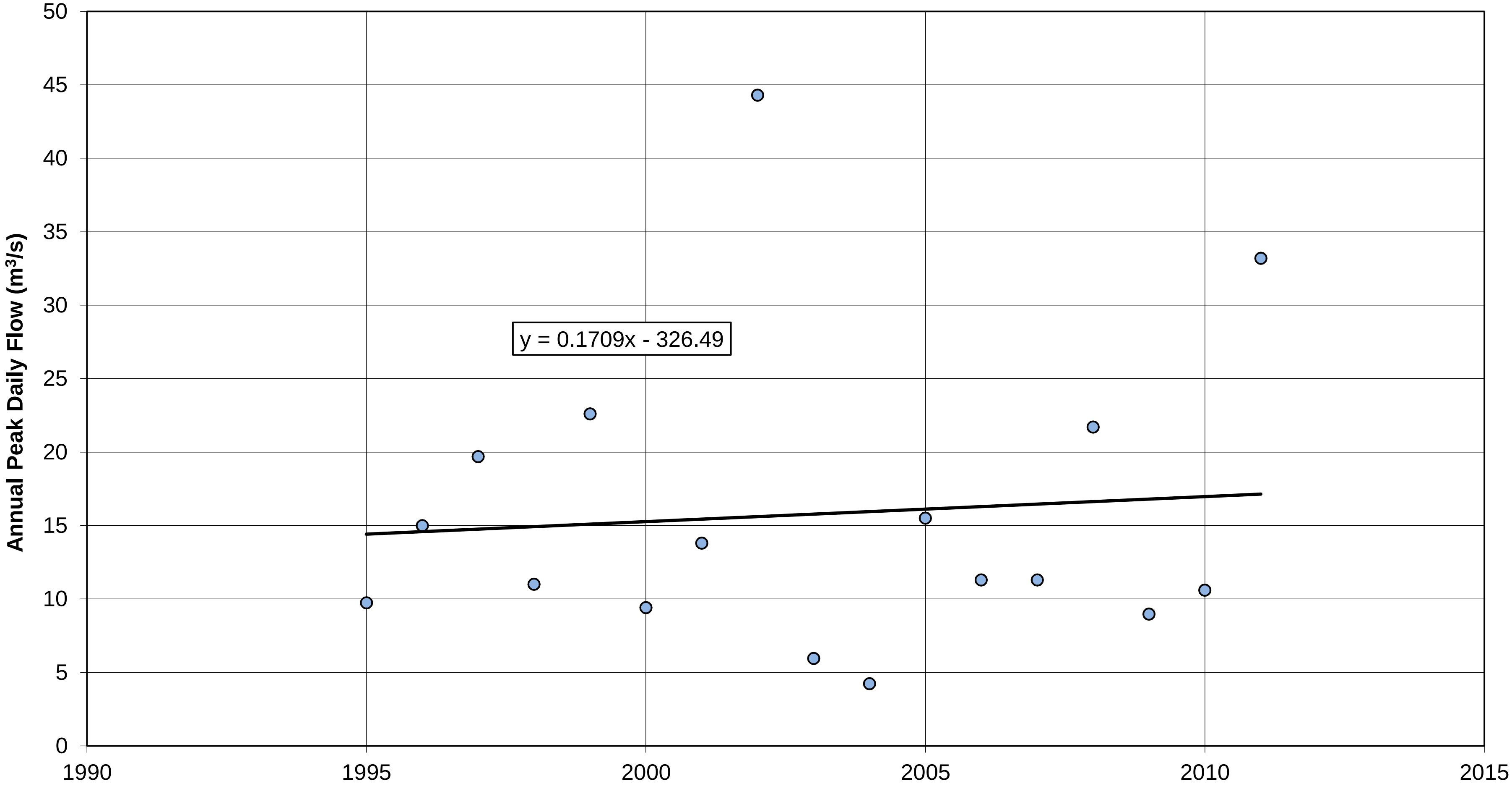
P/A NO. VA101-246/8 | REF. NO. 8

FIGURE 4.10 | REV 0



NOTES:
1. YEARS WITH MISSING MONTHS WERE IGNORED.
2. THE TRENDLINE IS NOT SIGNIFICANT AT A 10% LEVEL OF SIGNIFICANCE.

0	31JAN13	ISSUED WITH REPORT	MH	JGC	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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AJAX PROJECT

DEADMAN RIVER ANNUAL INSTANTANEOUS PEAK FLOW TRENDS

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P/A NO. VA101-246/8

REF. NO. 8

FIGURE 4.11

REV 0

APPENDIX A

SITE STREAMFLOW GAUGES AND DATA

(Pages A-1 to A-24)

Knight Piésold CONSULTING

APPENDIX A

SITE STREAMFLOW GAUGES AND DATA

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A.1.2 JACLAKE 2
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Photo A11 TSFINF Cross Section Survey of Secondary Channel

A SITE STREAMFLOW GAUGES AND DATA

Five streamflow gauging stations were installed in the Ajax Project area in 2008. The rationale for the site selection and operation of each gauge is as follows:

- JACINF – Monitors one of the primary inflows to Jacko Lake and provides a record of natural unregulated flows in the project area.
- JACLAKE – Monitors the water level in Jacko Lake and flow over the spillway, if there is any.
- JACSEEP – Monitors the seepage and release valve of Jacko Lake through the earth-fill embankment (flows from JACLAKE and JACSEEP combine to give the total flows leaving the Jacko Lake catchment).
- PETER – Monitors the flows downstream of Jacko Lake, and includes flows from JACLAKE and JACSEEP.
- TSFINF – Monitors the flows entering the existing TSF, and includes a diverted portion of the Alkali Creek catchment.

The gauging stations are all configured to record water level at fifteen minute intervals during typical streamflow conditions. During events when the water level undergoes rapid fluctuations, the recording interval is automatically reduced to one minute. The stations consist of a fully surveyed one metre staff gauge plate, installed within a stable gauging pool, as shown on Photos A1 to A6. Control cross-sections were completed in 2008 to establish the point of zero flow and the geometry of the control. The control sections at some of the gauging stations have been altered several times since station installation. Details of the Project gauging stations are presented in Table 3.3 of the Knight Piésold Ltd. 2012 Hydrometeorology Report, 2013 (VA12-246/8-8).

A.1 MEASURED STREAMFLOW

A rating curve is a fixed relationship between water level and discharge at a point in a stream. It is established by the physical measurement of discharge at various water levels. The primary means of measuring discharge on the Project site was the velocity-area method using a Swoffer current meter which involves subdividing a smooth, straight section of channel into a number of sub-sections and measuring the average velocity of the water is in each section. The area of the sections, multiplied by the mean velocity in each section, equates to the discharge. An example of the velocity-area method being used at JACSEEP is shown on Photo A6. The frequent occurrence of extremely low flows necessitated the use of the volumetric method. The volumetric method involves measuring flow by recording the volume of water entering a container over a set period of time. An example of a volumetric measurement at JACSEEP is shown on Photo A7.

Discharge measurements have been undertaken at a variety of gauge heights throughout the data collection period. Details of discharge measurements undertaken at each site are given in Tables A1 to A5. Any measurements with known or suspected problems were labelled “Ignore” in the Discharge Error column of these tables, and were not used in rating curve development.

Preliminary rating curves have been developed for each station. The rating curves were initially derived on the basis of a maximum-probability, least-squares fit to the calibration points, with direct consideration of the hydraulic characteristics of the control section at each station. The curve was then adjusted manually to provide a better “visual fit” to higher confidence measurements while treating the high error measurements conservatively (i.e. the curve is positioned close to the lower end of the discharge error bars), while still conforming to the hydraulic constraints of the control section.

The basic form of the rating curve equation is based on general hydraulic theory pertaining to open channel flow, and the values of the coefficient and exponent are dependent on the hydraulic characteristics of the control section at the gauge, which provides a means of checking the validity of the derived equation (Maidment, 1993).

The error for the velocity-area discharge measurements was estimated to be in the range +/- 5% to 15%. These error estimates are based on a combination of the accuracy between concurrent discharge measurements, the distribution of cross-sectional discharge within depth-velocity measurement cells (ideally each cell contains less than 10% of the total discharge), and a qualitative assessment of the measurement transect for areas of excessive turbulence or flow reversal. The error for volumetric discharge measurements is more variable and dependant on field personnel judgement.

The following sections describe the rating curve development for each station and the overall uncertainty associated with the curves.

A.1.1 JACINF

A total of 10 unique discharge measurements have been collected at the JACINF site since its installation. The discharge measurements and corresponding stage heights at the time of measurement are summarized in Table A1. Measurements range from a low of 0 m^3/s to a high of 0.34 m^3/s. These 10 measurements were used as the basis for developing the stage-discharge rating curve for the gauge, which is shown on Figure A1.

The daily hydrograph at the gauging station for the period of record is shown on Figure A2.

Although the JACINF site is most representative of natural flow conditions, it is also affected by water licenses that have been awarded to local residents, and allow them to extract water for irrigation purposes.

A.1.2 JACLAKE

A total of four unique discharge measurements have been collected at the JACLAKE site. The discharge measurements and corresponding stage heights at the time of measurement are summarized in Table A2. Measurements range from a low of 0.03 m^3/s to a high of 0.40 m^3/s. These four measurements correspond with the stage-discharge relationship for the gauge, which is shown on Figure A3. The stage-discharge relationship was modeled using a standard trapezoidal weir equation since the outlet drains Jacko Lake via a broad-crested spillway. The cross section was surveyed to provide the necessary weir side-slope, base width, and invert elevation information.

A measured hydrograph was not developed for this site due to stage data inconsistencies and the lack of discharge measurements collected. Ideally, the rating curve would be validated with a minimum of 10 discharge measurements (RISC, 2009). In addition, this site is regulated as flow is controlled at the adjacent JACSEEP site, thus controlling the amount of flow that passes over the spillway (i.e. if the JACSEEP control gate position is altered, the volume of water flowing over the spillway would be increased or decreased correspondingly). Also, the spillway is often dry as shown on Photo A8.

A.1.3 JACSEEP

A total of 11 unique discharge measurements have been collected at the JACSEEP site. The discharge measurements and corresponding stage heights at the time of measurement are summarized in Table A3. The hydraulic control or this gauge is a compound V-notch weir. Measurements range from a low of 0 m^3/s to a high of 0.11 m^3/s, although the majority of the measurements are for very low discharges, generally below 1 L/s, when flows are only passing through the v-notch portion of the weir. 10 of the 11 measurements are plotted on Figure A4. The rating curve is drawn according to the dimensions of the weir.

A measured hydrograph was not developed for this site due to station control changes and associated stage data inconsistencies, as well as flow regulation and diversion. The v-notched weir, which is the control for the gauging site, is regularly blocked by vegetation and debris, thus affecting the control hydraulics. These effects are reflected in the stage record as anomalies, but due to the gradual nature of the build-up, the exact start date of the anomalies is difficult to identify. In addition, the site is regulated by a gate valve immediately upstream of the gauging station. The channel downstream of JACSEEP is used for irrigation by farmers in the area, who have the ability to control the amount of flow leaving Jacko Lake via the JACSEEP channel. This leads to complex and artificial flow hydrology, which is not beneficial to characterization of the Project hydrology, and is not representative of baseline Project hydrology. The control also experiences backwater, as shown on Photo A9, due to a constriction in a pair of culverts located downstream of the control section.

A.1.4 PETER

A total of 11 unique discharge measurements have been collected at the PETER site since its installation. The discharge measurements and corresponding stage heights at the time of measurement are summarized in Table A4. Measurements range from a low of 0 m^3/s to a high of 0.46 m^3/s. These 11 measurements were used as the basis for developing the stage-discharge relationship for the gauge, which is shown on Figure A5.

The daily hydrograph at the gauging station for 2008 to 2011 is shown on Figure A6. The PETER station is downstream of the confluence of the Jacko Lake overflow channel (JACLAKE) and the primary channel controlled by local farmers (JACSEEP). The hydrograph is not representative of natural flow patterns as it receives the compounded effects from both the JACLAKE and JACSEEP gauging stations. When comparing the JACINF and PETER hydrographs it is evident that the flows at the PETER gauge are regulated due to the un-natural shape of the hydrograph.

A beaver dam upstream of PETER in early 2012 lead to flow back-up and the development of a pond, which altered the natural flow patterns in the channel.

A.1.5 TSFINF

A total of seven unique discharge measurements have been collected at the TSFINF site. The discharge measurements and corresponding stage heights at the time of measurement are summarized in Table A5. Measurements range from a low of 0 m^3/s to a high of 0.24 m^3/s. Four of the seven measurements were used as the basis for developing the stage-discharge relationship for the gauge, which is shown on Figure A7.

The TSINF station has a complicated compound control that appears to have changed dramatically since the station was installed. Initially, the control consisted of wooden v-notch weir that regulated outflows from a small pond that drained into the historical TSF. Photo A10 shows the v-notch weir control in 2008. Between August and November 2010, the weir was removed and the control shifted to be the rocks and bedding that were previously at the base of the weir. Accordingly, the weir rating curve is only valid for 2008 to 2010. Furthermore, in May 2011, a secondary pond outlet, which feeds a manmade diversion channel that bypasses the historic TSF, was found to have been altered making it the primary outflow channel. A cross section survey done in 2012 revealed that the control elevation of the secondary channel is 0.51 m below the culvert control elevation. This indicates that the secondary channel has become the primary control, thereby invalidating the use of the gauge to monitor outflows from the pond. The 2012 cross section survey of the secondary channel is shown on Photo A11.

A measured hydrograph was created for the period of record from 2008 to August 2010 (before the suspected removal of the control weir), as shown on Figure A8.

A.2 GENERAL SUMMARY

It is evident from this summary that hydrology data collection at the Project has been challenging due to a number of factors, including:

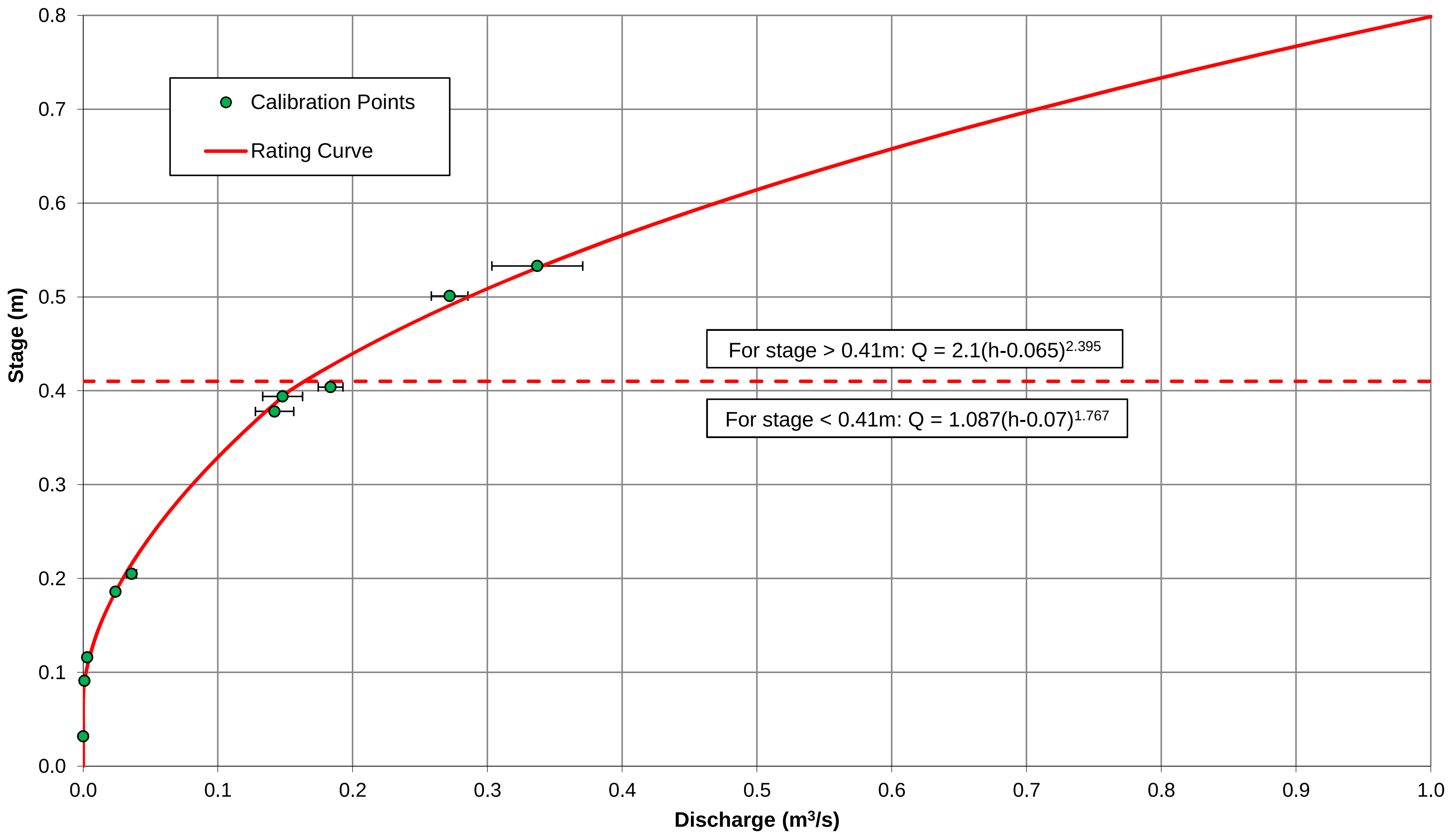
- Vegetation growth on weirs;
- Sedimentation of gauging station control sections;
- Scour of gauging station control sections;
- Animal activity (such as beavers) interfering with channel control;
- Human activity (such as surface and groundwater extraction) interfering with natural water volumes; and
- Alteration of channel geometry by Project maintenance works.

The site station that is considered to have the best quality data that is most representative of natural flow conditions in the Project area is the JACINF station. The measured unit runoff hydrographs for JACINF, TSFINF and PETER stations are shown on Figure A9. This figure demonstrates that JACINF has the longest record in the Project area. Furthermore, it is evident that the PETER gauge experiences unnatural flow patterns due to water releases from Jacko Lake during low flow periods, as seen in the summers of 2008 and 2009. The unit runoff at the PETER and TSFINF gauges is also lower than the JACINF gauge, and this may be due to increased evaporation in Jacko Lake and the TSF inflow pond, whereas the JACINF gauge is not in a pond/lake.

A.3 REFERENCES

Maidment, D.R. 1993. Handbook of Hydrology. McGraw-Hill Inc, Washington, DC, USA.

Resources Information Standards Committee (RISC). 2009. Manual of British Columbia Hydrometric Standards.



NOTES:

1. THE ERROR BARS SHOWN ON THE CALIBRATION POINTS ARE BASED ON VISUAL INSPECTION OF DISCHARGE MEASUREMENT QUALITY.
2. THE MAXIMUM MEASURED STAGE FROM 2008 TO 2012 WAS 0.69 m.

0	04JUL'12	ISSUED WITH REPORT	DK	MH	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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AJAX PROJECT

JACINF GAUGING STATION
RATING CURVE

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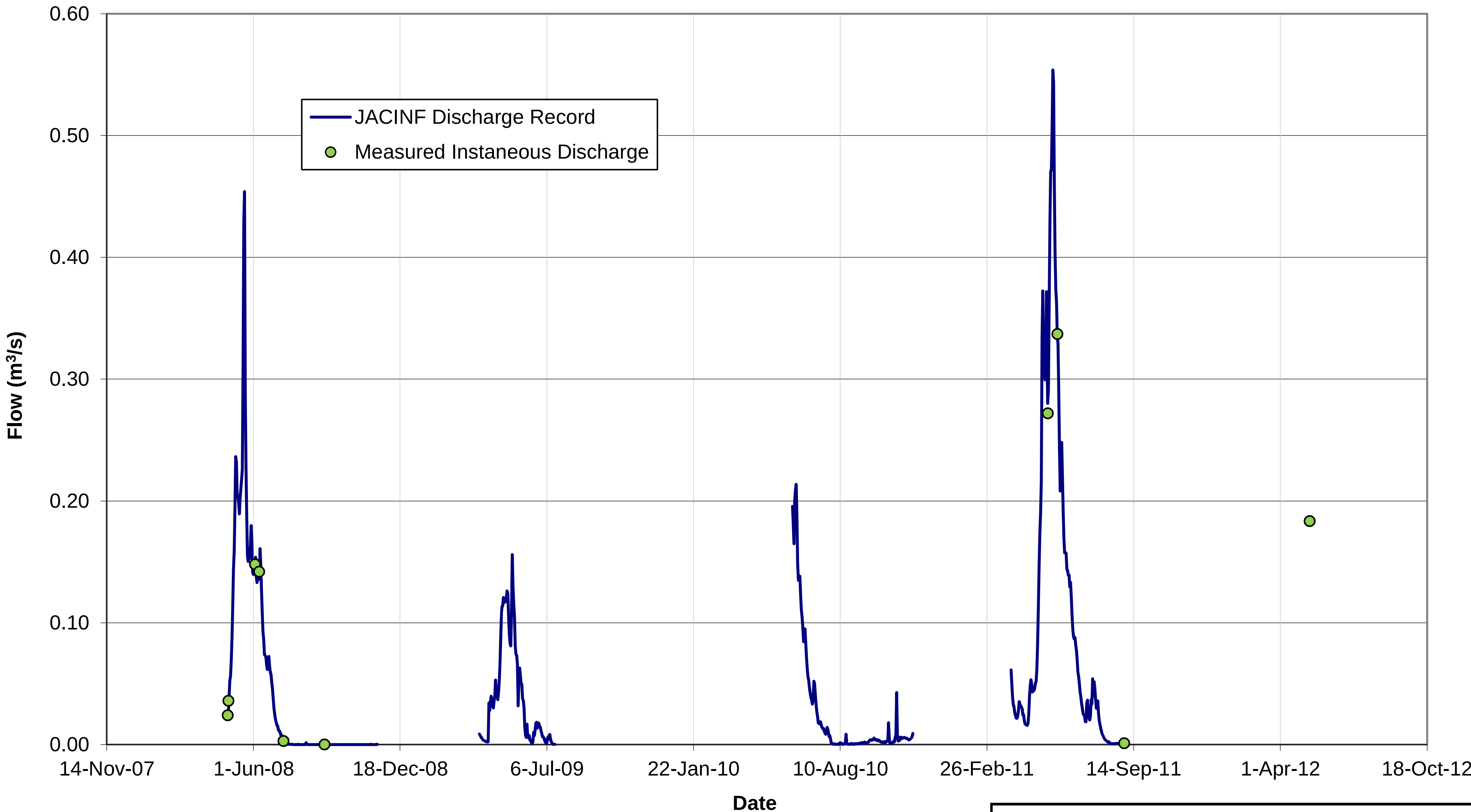
REF. NO. 8

FIGURE A1

REV 0



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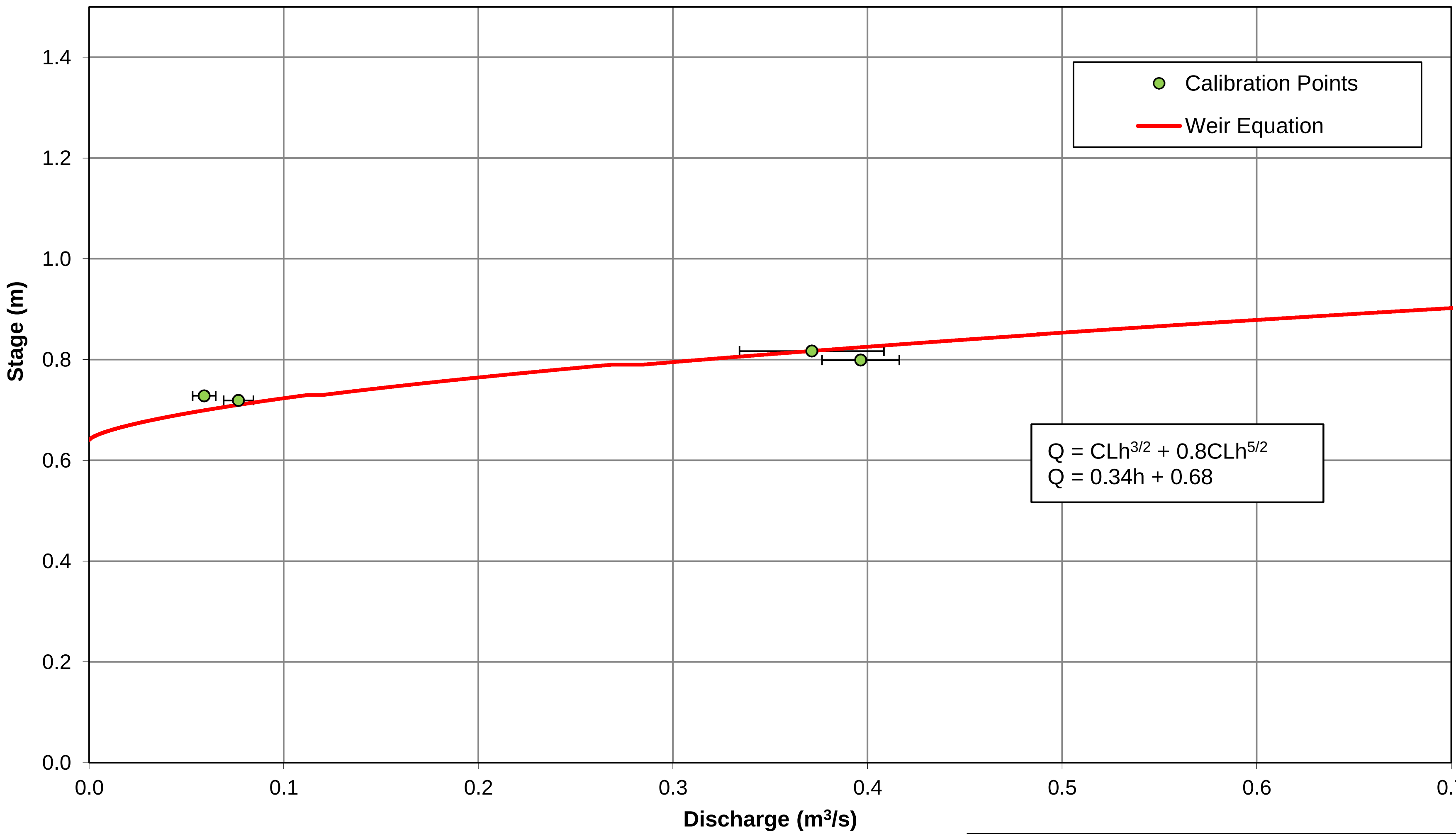
JACINF GAUGING STATION
DAILY MEASURED FLOW RECORD

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-246/8	8

FIGURE A2 REV 0

0	04JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:

1. THE ERROR BARS SHOWN ON THE CALIBRATION POINTS ARE BASED OF VISUAL INSPECTION OF DISCHARGE MEASUREMENT QUALITY.
2. THE MAXIMUM MEASURED STAGE FROM 2008 TO 2012 WAS 0.86 m.
3. THE WEIR EQUATION WAS DEVELOPED BASED ON A STANDARD TRAPEZOIDAL WEIR RELATIONSHIP.

0	19JUL'12	ISSUED WITH REPORT	TR	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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JACLAKE GAUGING STATION
WEIR EQUATION

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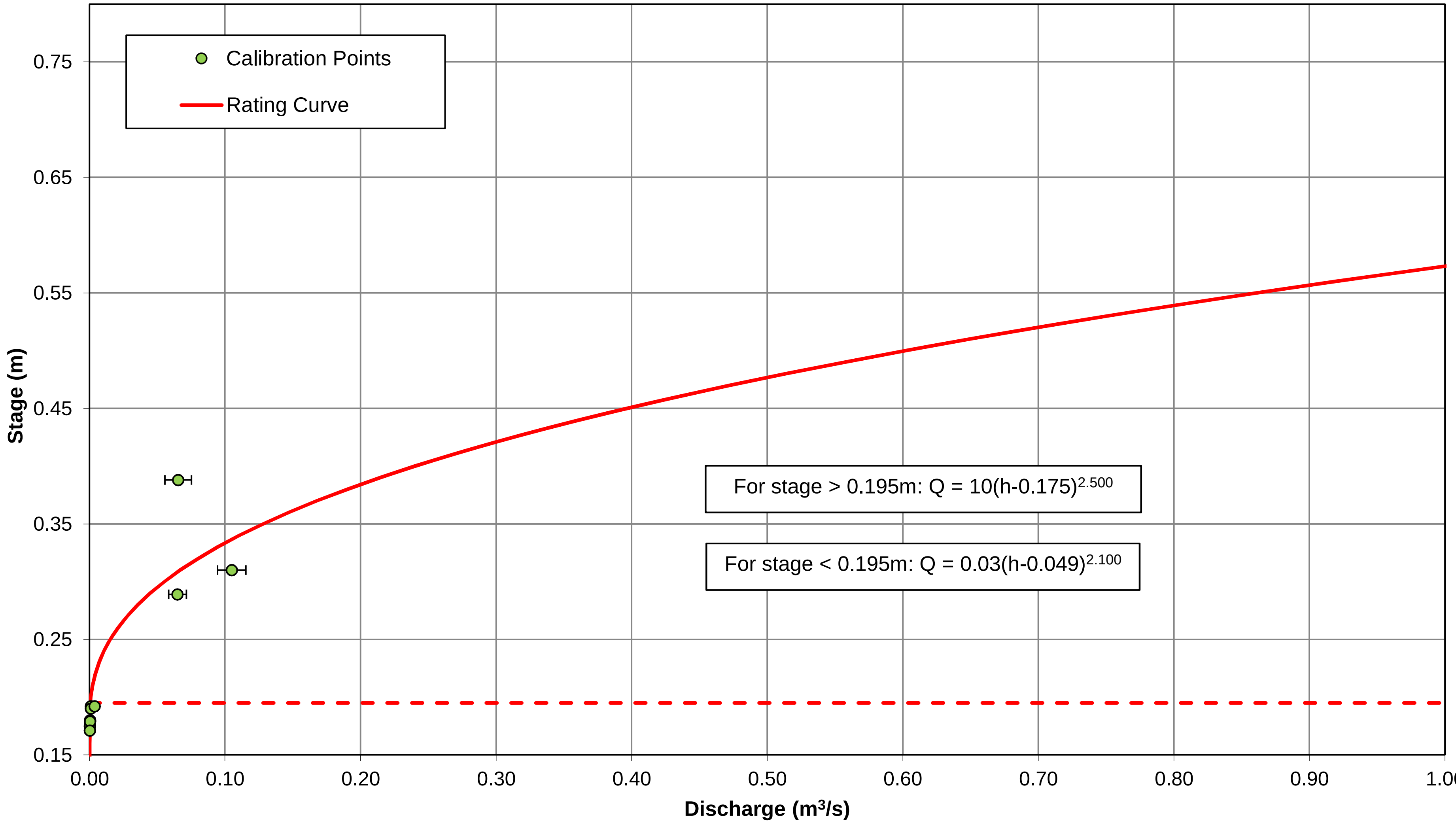
P/A NO.	REF. NO.
VA101-246/8	8

FIGURE A3 REV 0



NOTES:
1. THE ERROR BARS SHOWN ON THE CALIBRATION POINTS ARE BASED ON VISUAL INSPECTION OF DISCHARGE MEASUREMENT QUALITY.
2. THE MAXIMUM MEASURED STAGE FROM 2008 TO 2012 WAS 0.80 m.

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AJAX PROJECT

JACSEEP GAUGING STATION RATING CURVE

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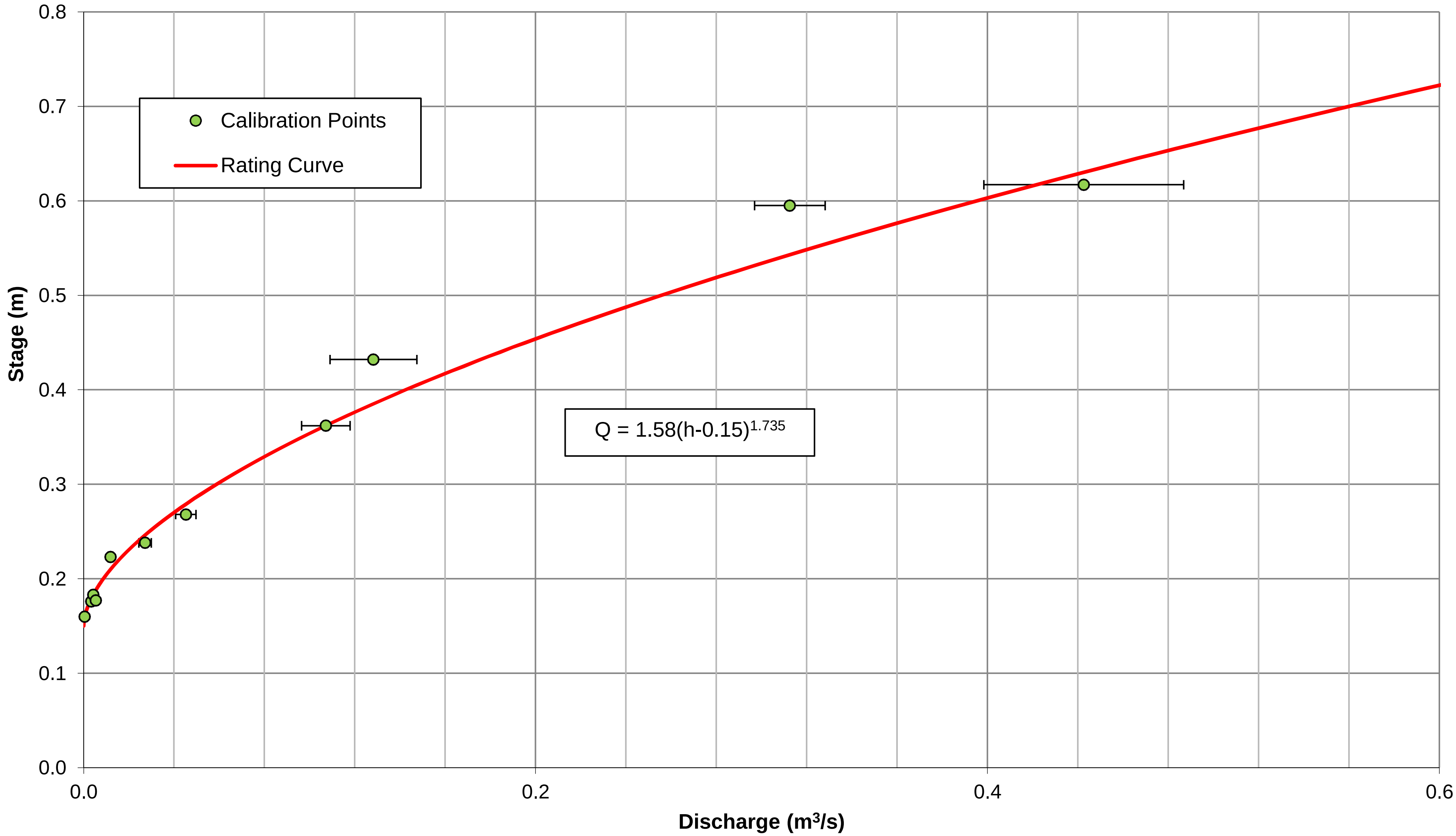
REF. NO. 8

FIGURE A4

REV 0

0	04JUL'12	ISSUED WITH REPORT	DK	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:

1. THE ERROR BARS SHOWN ON THE CALIBRATION POINTS ARE BASED ON VISUAL INSPECTION OF DISCHARGE MEASUREMENT QUALITY.
2. THE MAXIMUM MEASURED STAGE FROM 2008 TO 2012 WAS 0.75 m.

0	04JUL'12	ISSUED WITH REPORT	DK	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

KGHM AJAX MINING INC.

AJAX PROJECT

PETER GAUGING STATION
RATING CURVE

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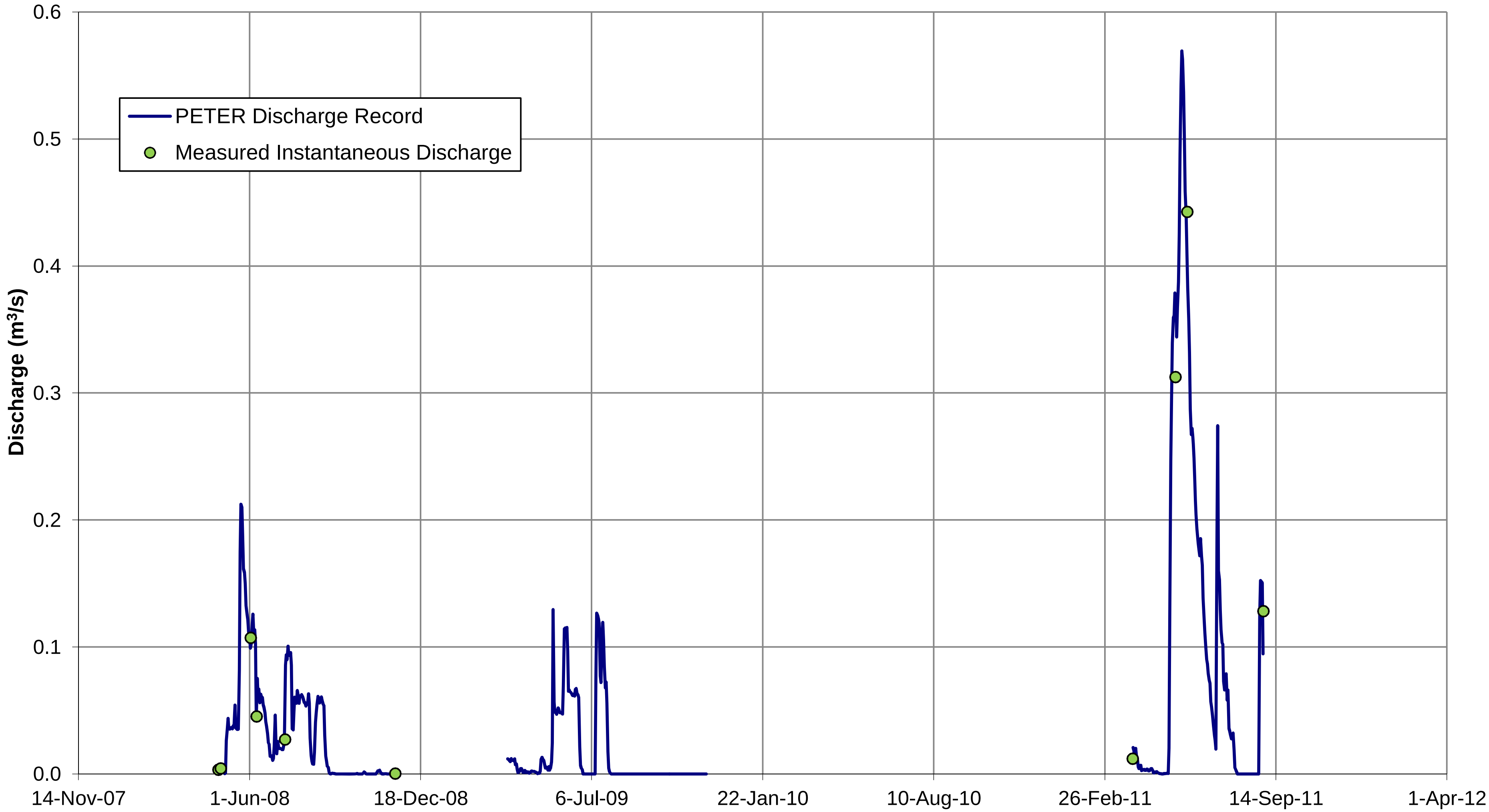
P/A NO. VA101-246/8

REF. NO. 8

FIGURE A5

REV 0



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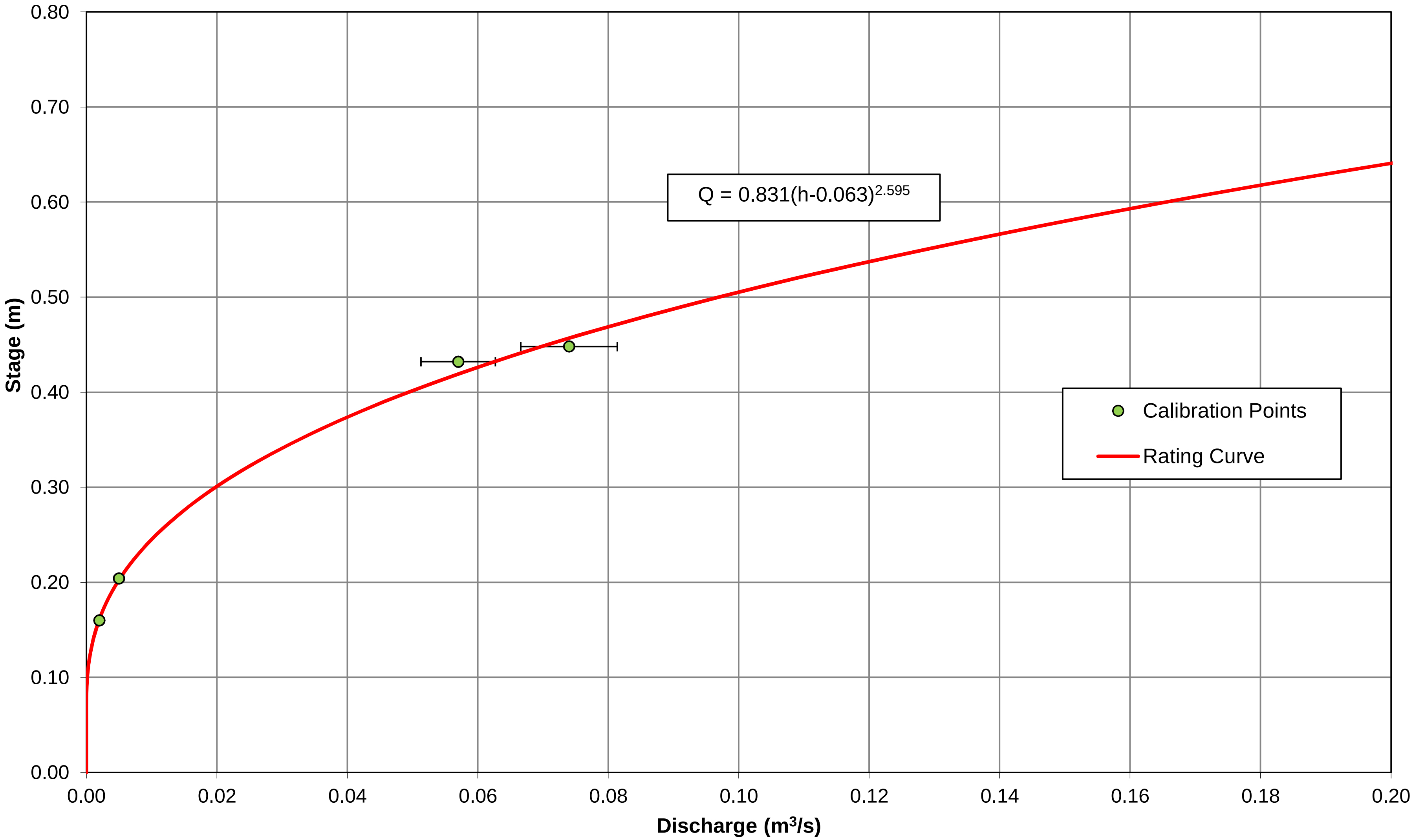
PETER GAUGING STATION
MEASURED HYDROGRAPH

Knight Piésold CONSULTING

P/A NO.	REF. NO.
VA101-246/8	8

FIGURE A6 REV 0

0	04JUL'12	ISSUED WITH REPORT	DK	MH	JGC
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:

1. THE ERROR BARS SHOWN ON THE CALIBRATION POINTS ARE BASED ON VISUAL INSPECTION OF DISCHARGE MEASUREMENT QUALITY.
2. THIS CURVE IS ONLY VALID FOR THE WEIR THAT WAS THE OPERATIONAL CONTROL SECTION IN 2008.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	28MAY'12	ISSUED WITH REPORT	MH	MH	JGC

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AJAX PROJECT

TSFINF GAUGING STATION RATING CURVE

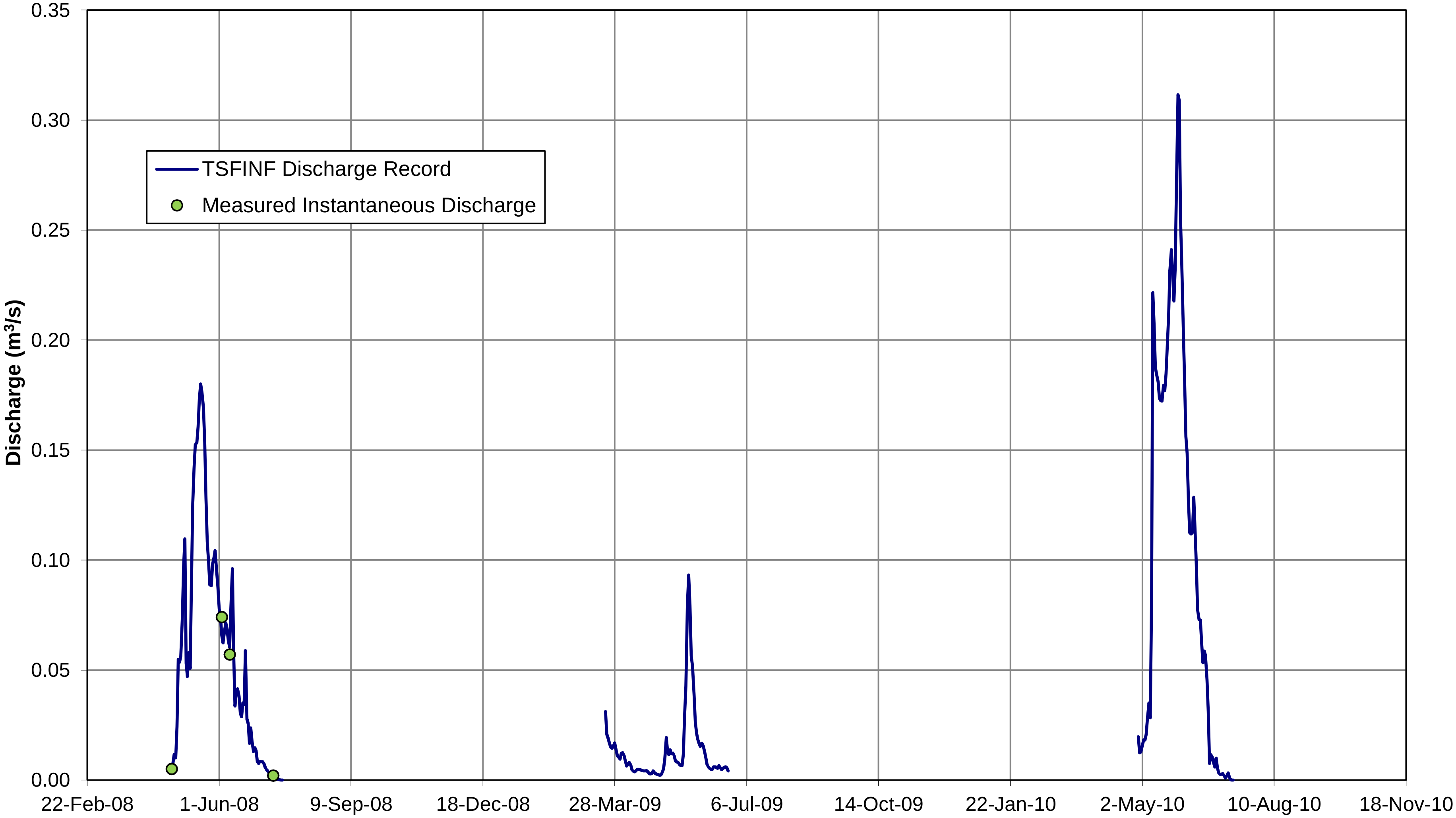
Knight Piésold CONSULTING

P/A NO. VA101-246/8

REF. NO. 8

FIGURE A7

REV 0



NOTES:

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	28MAY'12	ISSUED WITH REPORT	MH	MH	JGC

KGHM AJAX MINING INC.

AJAX PROJECT

TSFINF GAUGING STATION
MEASURED HYDROGRAPH

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P/A NO. VA101-246/8

REF. NO. 8

FIGURE A8

REV 0

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PHOTO A1 – JACINF Gauging Station.

PHOTO A2 – JACLAKE Gauging Station

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PHOTO A3 – JASEEP Gauging Station

PHOTO A4 – PETER Gauging Station

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PHOTO A5 – TSFINF Gauging Station (2012)

PHOTO A6 – JACSEEP Velocity-Area Discharge Measurement

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PHOTO A7 – JACSEEP Volumetric Discharge Measurement

PHOTO A8 – JACLAKE Dry Spillway

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PHOTO A9 – JACSEEP Backwater at Control Section

PHOTO A10 – TSFINF V-Notch Weir Control (2008)

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PHOTO A11 – TSFINF Cross Section Survey of Secondary Channel

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