# Appendix V4-1E

## Doris North Gold Mine Project: 2012 Meteorology Compliance Report

TMAC RESOURCES

Hope Bay Mining Limited

# DORIS NORTH GOLD MINE PROJECT
# 2012 Meteorology Compliance Report

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NORTH AMERICA

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April 2013

# DORIS NORTH GOLD MINE PROJECT
# 2012 METEOROLOGY COMPLIANCE REPORT

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# Executive Summary

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# Executive Summary

The Hope Bay Belt Property is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the south shore of Melville Sound. The property consists of a greenstone belt running in a north/south direction, approximately 80 km long, with 3 main gold deposit areas. The Doris and Madrid deposits are located in the northern portion of the belt, and the Boston deposit is located in the southern end.

The purpose of this report is to comply with the meteorology conditions outlined in the Doris North Project Certificate (NIRB No. 003, issued September 15, 2006) as follows:

Section 4.0, Subsection 8

- *HBML will fund and install a weather station at the mine site to collect atmospheric data, including air temperature and precipitation. The design and location of this station shall be developed in consultation with Environment Canada officials.*
- *Commentary: Prior to closure and reclamation, NIRB expects HBML to undertake consultation with appropriate agencies including INAC and EC, to discuss the possibility of the continued operation of the station, including transfer of ownership, for the collection of regional meteorological data.*

At the time of project approval (2006) a meteorological station was already operational in the Doris North area. This station location was discussed with Environment Canada and has remained constant since 2006. Changes to the station include re-mounting sensors onto a 10 m tower in August 2009, and the installation of a barometer in September 2010.

This report presents the results from the permanent Doris weather station and the seasonal micro-meteorological weather station for the period of October 1, 2011 to September 30, 2012. The annual average temperature was -10.0ºC, and all temperatures ranged between -43.5ºC and 24.6ºC, for the 2011/12 hydrologic year.

Total annual precipitation during the period (October 2011 to September 2012) was 54 mm, with July receiving the highest monthly precipitation of 23.4 mm.

Solar radiation in the Arctic is high during the summer and very low during the winter. The annual average number of bright sunshine hours, where average global solar radiation is greater than 120 $W/m^2$, was 2,406.

In general, winds in the Doris North region typically blow from the west-northwest quadrant year round although winds are also common from the east and southeast. The average annual wind speed at Doris station was 5.3 m/s (19.1 km/h), and gusts up to 27.5 m/s (99.0 km/h) were recorded.

Total evaporation values in the Doris North Project area from July to September 2012 were estimated to be 122.6 and 124.6 mm, using the Penman Combination and Priestly-Taylor methods, respectively.

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# DORIS NORTH GOLD MINE PROJECT
# 2012 METEOROLOGY COMPLIANCE REPORT

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# Glossary and Abbreviations

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# Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| $\alpha$ | Constant value in Priestly-Taylor methodology which replaces the aerodynamic component (for subarctic regions $\alpha$ = 1.26) |
| $\gamma$ | Psychometric constant in Pa $^{o}$C |
| $\iota_V$ | Latent heat of vaporization |
| $\rho_w$ | Water density (at 10 $^{o}$C = 999.7 kg $m^{-3}$) |
| $\Delta$ | The slope of the temperature-saturated vapour pressure curve in Pa $^{o}$C |
| **AES** | Atmospheric Environment Services |
| $C_P$ | Specific heat capacity ($C_P$ of air = 1006 J $kg^{-1}$ $^{o}$C) |
| **E(PC)** | Evaporation calculated using the Penman Combination methodology in mm |
| **E(PT)** | Evaporation calculated using the Priestly-Taylor methodology in mm |
| $E_A$ | Aerodynamic component in mm/day |
| $e_a$ | Actual vapour pressure in Pa |
| $e_{as}$ | Saturated vapour pressure in Pa |
| **EC** | Environment Canada |
| **EC-MSC** | Environment Canada – Meteorological Services of Canada |
| $E_R$ | Energy balance component in mm/day |
| **G** | Water heat flux |
| **H** | Sensible heat flux |
| **J** | Joules |
| $K_a$ | Thermal conductivity of air (at 10ºC = 0.0241 W/m/ $^{o}$C) |
| **kg** | Kilograms |
| **kPa** | Kilo Pascals |
| $k_w$ | Thermal conductivity of water (at 10ºC = 0.615 W/m/ $^{o}$C) |
| **m** | Metres |
| **m/s** | Meters per second |
| $m^3$ | Cubic metres |
| **masl** | Meters above sea level |
| **mm** | Millimetres |
| **MSC** | Meteorological Services of Canada |

| | |
|---|---|
| **NRC** | National Resources Council |
| **°C** | Degrees Celsius |
| **$P_A$** | Air pressure (Standard $P_A$ at sea level at 20 °C = $101.3*10^3$ Pa) |
| **Pa** | Pascals |
| **PC** | Penman Combination |
| **PT** | Priestly-Taylor |
| **RH** | Relative humidity in % |
| **$R_n$** | Net solar radiation measured over water in W $m^{-2}$ |
| **T** | Air temperature in °C |
| **TBRG** | Tipping bucket rain gauge |
| **$T_w$** | Water temperature in °C |
| ***u*** | Wind speed in m $s^{-1}$ |
| **W/$m^2$** | Watts per square meter |
| **Wind Gust** | A high wind speed that typically lasts for 3 to 5 seconds. |
| **WMO** | World Meteorological Organization |
| ***z*** | Height in m above the ground |
| **$z_W$** | Depth in m from the water surface |

# 1. Introduction

# 1. Introduction

The Hope Bay Belt Property is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the south shore of Melville Sound (Figure 1-1). The nearest communities are Omingmaktok (75 km to the southwest of the property), Cambridge Bay (125 km northeast of the property), and Kingaok (Bathurst Inlet; 160 km to the southwest of the property).

The property consists of a greenstone belt running in a north/south direction, approximately 80 km long, with 3 main gold deposit areas. The Doris and Madrid deposits are located in the northern portion of the belt, and the Boston deposit is located in the southern end. The northern portion of the property consists of several watershed systems that drain into Roberts Bay, and a large river (Koignuk River) that drains into Hope Bay. Watersheds in the southern portion of the belt ultimately drain into the upper Koignuk, which drains into Hope Bay.

The purpose of this report is to comply with the meteorology conditions outlined in the Doris North Project Certificate (NIRB No. 003, issued September 15, 2006) as follows:

Section 4.0, Subsection 8

- *HBML will fund and install a weather station at the mine site to collect atmospheric data, including air temperature and precipitation. The design and location of this station shall be developed in consultation with Environment Canada officials.*
- *Commentary: Prior to closure and reclamation, NIRB expects HBML to undertake consultation with appropriate agencies including INAC and EC, to discuss the possibility of the continued operation of the station, including transfer of ownership, for the collection of regional meteorological data.*

At the time of project approval (2006) a meteorological station was already operational in the Doris North area. This station location was discussed with Environment Canada and has remained constant since 2006. Changes to the station include re-mounting sensors onto a 10 m tower in August 2009, and the installation of a barometer in September 2010.

In addition to the permanent weather station near Doris Camp, a micro-meteorological station designed to obtain evaporation data was seasonally installed in Doris Lake starting in 2009.

This report presents the results from the permanent Doris weather station and the seasonal micro-meteorological weather station for the period of October 1, 2011 to September 30, 2012. Chapter 2 of this report presents the methods, chapter 3 presents the results, and chapter 4 provides a brief summary.


Figure 1-1

# Doris North Project Location

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# 2. Methods

# 2. Methods

Meteorological monitoring has been conducted in the Doris North Project area since 1993 and data have been collected using a variety of automated and manual methods. The bulk of the meteorological data have been collected from automated stations which allow for a more comprehensive data set in comparison with manual measurements.

The 2012 meteorology compliance program included the following components:

- Operation and maintenance of the meteorological station at Doris Camp; and
- Reinstallation and operation of a micro-meteorological (evaporation) station in Doris Lake.

One complete automated meteorological station and one micro-meteorological (evaporation) station were installed and commissioned for the Doris North Project as part of the meteorology compliance program. The locations of these stations are shown in Figure 2-1, and their measurement parameters are shown in Table 2-1.

**Table 2-1. List of Hope Bay Belt Meteorological Compliance Stations and Parameters**

| | Doris Station[a] | Doris Lake (micro met) |
|---|---|---|
| **Date Established** | **March 2004** | **July 2009** |
| Temperature & Relative Humidity | ✓ | ✓ |
| Wind Speed & Direction | ✓ | ✓ |
| Rainfall via Tipping Bucket Rain Gauge | ✓ | ✓ |
| Winter Precipitation via CS705 | ✓[b] | n/a |
| Solar Radiation | ✓ | ✓ |
| Barometric Pressure | ✓ | n/a |
| Water Temperature via Thermistors | n/a | ✓ |
| Net Radiation | n/a | ✓ |

*Notes:*
*n/a = This type of sensor was not installed at this particular meteorological station.*
*[a]The Doris meteorological station consisted of two tripods from February 27, 2004 to August 13, 2009 when its sensors were reinstalled on a MSC recommended 10 m tower.*
*[b]The winter precipitation adapter was installed in February 2012.*

## 2.1 DORIS AUTOMATED METEOROLOGICAL STATION

An automated meteorological station consisting of two tripods was installed on February 27, 2004 near Doris camp (Figure 2-1). This meteorological station recorded wind speed and direction, air temperature, relative humidity, precipitation, solar radiation and barometric pressure.

The two-tripod station at Doris was powered by a deep cycle marine battery, but was converted to include solar power when the permanent 10 m tower was installed in mid-August 2009. Temperature, relative humidity, wind speed and direction and solar radiation sensors were initially mounted on one of the 3 m tall tripod structures and a tipping bucket rain gauge (TBRG) was mounted on the other. The various sensors were remounted on the 10 m aluminium tower anchored with bed-rock anchors and guy wires on August 13, 2009 (Plate 2.1-1). The wind sensor was mounted at the top of the tower at a height of 10 m above ground. This configuration is consistent with the Environment Canada - Meteorological Services of Canada (EC-MSC) standard sensor height for data to be used for air dispersion modelling (MSC 2004). Wind speed is measured in m/s and wind direction in degrees from true north.

*Plate 2.1-1. Doris meteorological station after being upgraded to a 10 m tower on August 13, 2009.*

The temperature and relative humidity sensors are combined into one unit. Temperature is measured in degrees Celsius and relative humidity in percent. The tipping bucked rain gauge (TBRG) monitors precipitation in millimetres. Global solar radiation is monitored at the station with a pyranometer which gives readings in watts per square metre. A barometric pressure sensor was added to the Doris meteorological station in late September 2010.

The sensors for the Doris station are connected to a Campbell Scientific CR10X datalogger which controls the operation of the station. The datalogger's program dictates how often the sensors will be monitored (set at every 5 seconds). It also generates and stores both hourly and daily averages. The station is powered with a sealed rechargeable battery that is recharged with a 30 watt solar panel. An external deep cycle marine 105 Amp-hour battery is used to supplement the solar power during winter. The station is grounded to prevent lightning damage.

## 2.2 DORIS LAKE MICRO-METEOROLOGICAL (EVAPORATION) STATION

In 2009 the meteorological program was expanded to include measurements of open-water evaporation at Doris Lake. A micro-meteorological station was reinstalled in a shallow area of this lake on July 12th, 2012 (Plate 2.2-1; Figure 2-1). The station is operated until the end of the open-water season. Data collected at this station was used to calculate daily evaporation rates using both the Penman Combination and Priestley-Taylor methods.

*PROJECT #*1009-008-02 *GIS #* HB-12-072 *November 27 2012*

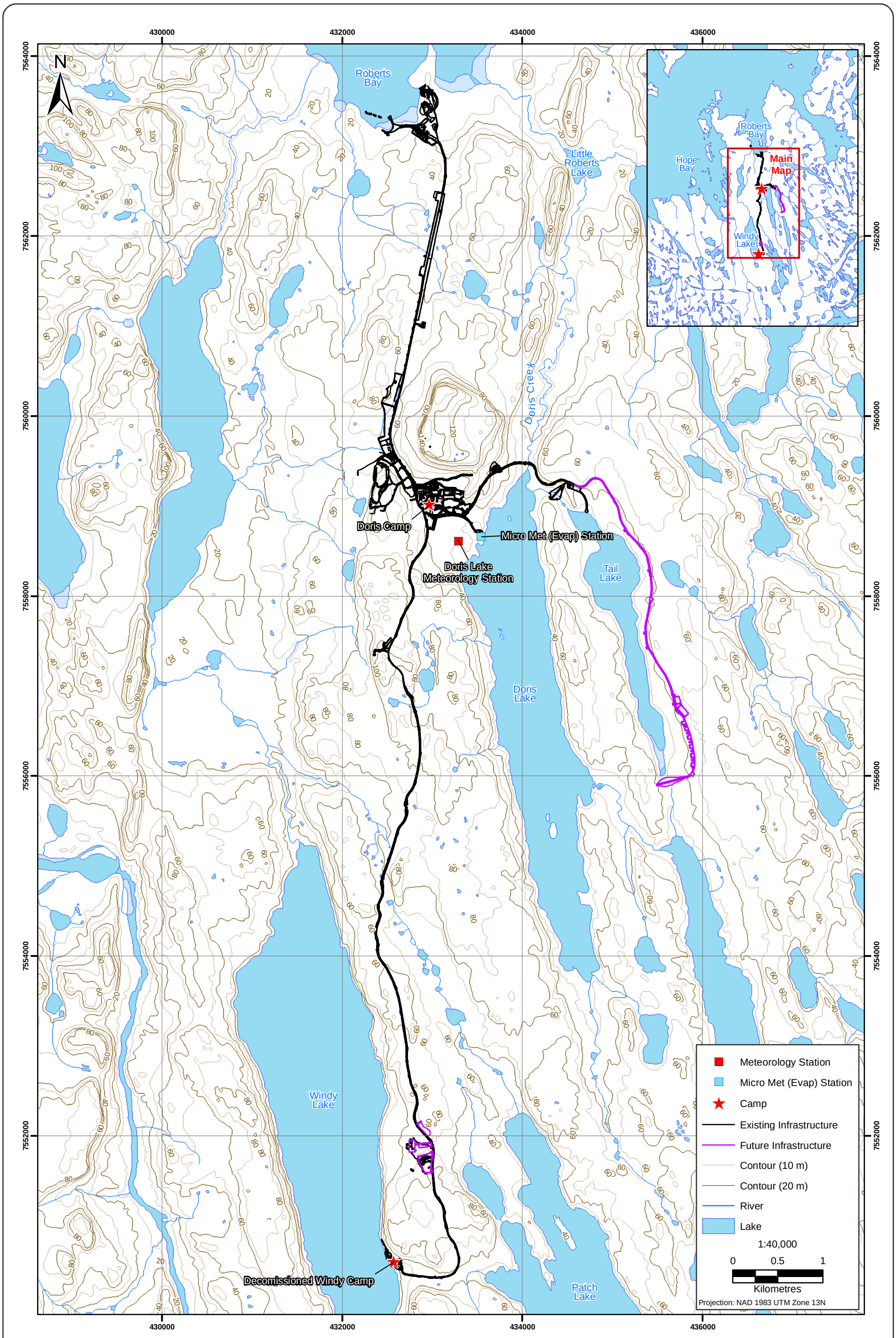


Figure 2-1

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## Location of Meteorological Stations, Doris North Project

Figure 2-1

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*Plate 2.2-1. The Doris Lake micro-meteorological (evaporation) station in July 2012.*

The station is powered with a sealed rechargeable 8.5 Amp-hour battery that is recharged with a 50 watt solar panel. Operation of the station is controlled by a CR1000-55 datalogger whose program dictates how often the sensors will be monitored (every 5 seconds) and generates and stores hourly and daily averages. Sensors for this station are mounted on a tripod which is partially submerged in the lake. Sensors (units of measure are shown in brackets) include:

- A silicon pyranometer (solar radiation; W/m$^2$);
- A net radiometer (net radiation; W/m$^2$);
- Two air temperature (ºC) and relative humidity (%) probes;
- A wind speed (m/s) and direction (degrees from true north) sensor;
- Two water temperature thermistors (ºC); and
- A tipping bucket rain gauge (rain precipitation; mm).

Lake evaporation rates are calculated from mean daily weather data using the Penman Combination (PC) Method from Chow *et al*. (1988). The Penman model is a combined energy-balance/aerodynamic mathematical model defined by the general equation:

$$[1]\ E(PC) = \frac{\Delta}{\Delta+\gamma}E_R + + \frac{\gamma}{\Delta+\gamma}E_A \text{ with } \Delta = \frac{4098e_{as}}{(237.3+T)^2} \text{ and } \gamma = \frac{C_P P_A}{0.622 l_v}$$

where Δ is the slope of the temperature-saturated vapour pressure curve in Pa ºC; $\gamma$ is the psychometric constant in Pa ºC; $e_{as}$ is the saturated vapour pressure at air temperature $T$ in ºC; $C_P$ = 1006 J kg$^{-1}$ ºC is the specified heat of air; $P_A$ = 101.3 * 10$^3$ Pa is air pressure at 20ºC; and $l_v$ = 2.501 x 10$^6$ – 2370$T$ J kg$^{-1}$ is the latent heat of vaporization.

The energy-balance component $E_R$ in mm/day is determined by the equation:

$$[2]\ E_R = \frac{R_n - H - G}{l_v \rho_w} * 8.64 * 10^7,\ with\ H = -k_a\left(\frac{T_2 - T_1}{z_2}\right)\ and\ G = -k_w\left(\frac{T_{w2} - T_{w1}}{z_w}\right)$$

where $R_n$ is the net solar radiation measured over water in W m$^{-2}$; $H$ and $G$ are the sensible heat flux and water heat flux; $\rho_w$ = 999.7 kg m$^{-3}$ is the water density at 10ºC; $T_2$ - $T_1$ and $T_{w2}$ - $T_{w1}$ are the change in mean daily air and water temperatures from the previous day, as measured at height $z_2$ and depth $z_w$ in metres from the water surface. Yarwood & Castle (1970) give the thermal conductivities of air $k_a$ and water $k_w$ at 10ºC as 0.0241 and 0.615 W/m/ºC, respectively. The energy-balance equation can be simplified to a constant if it is assumed that the sensible heat flux $H$ and water heat flux $G$ are negligible, such that Chow *et al*. (1988) calculate the energy-balance component by $E_R$ = 0.0353 * $R_n$.

Two modifications to the above equation are used in order to calculate the instantaneous evaporation rate. Rather than using the difference in mean daily air and water temperatures from the previous day, the instantaneous heat flux from above and below the water's surface is determined by the equations:

$$H = -k_a\left(\frac{T_2 - T_1}{z_2 - z_1}\right)\ and\ G = -k_w\left(\frac{T_{w2} - T_{w1}}{z_{w2} - z_{w1}}\right)$$

where $T_2$ - $T_1$ is the change in air temperature over height $z_2$ - $z_1$ and $T_{w2}$ - $T_{w1}$ is the change in water temperature over depth $z_{w2}$ - $z_{w1}$.

The aerodynamic component $E_A$ in mm/day is calculated as:

$$[3]\ E_A = \frac{0.1062 u_2}{[\ln(z_2 / z_0)]^2} * (e_{as} - e_a)\ \ with\ e_a = -RH * e_{as}\ and\ e_{as} = 611\exp\left(\frac{17.27 * T}{237.3 + T}\right)$$

Where $u_2$ is wind speed in m s$^{-1}$ measured at a height of $z_2$ in cm; Brutseart (1982) gives the surface water roughness height $z_0$ as 0.01 cm; the term $e_{as}$-$e_a$ is the difference between saturated vapour pressure $e_{as}$ and actual vapour pressure $e_a$ in Pa; and relative humidity (RH) is given as a proportion ($0 \le RH \le 1$).

The Priestly-Taylor (PT) method is similar to the Penman Combination method and defined by the general equation:

$$[4]\ E(PT) = \alpha \frac{\Delta}{\Delta + \gamma} E_R$$

where the weighted aerodynamic component $E_A$ is replaced by a constant α, and where the sensible heat flux term $H$ is omitted from the energy flux term, $E_R$, after Shuttleworth (1993). Stewart & Rouse (1977) substantiate the constant α = 1.26 for subarctic regions.

This report uses both of the described methods for calculating evaporation.

# 3. Results

# 3. Results

The following is a summary of data that have been collected at the Doris meteorological and evaporation stations from October 2011 to September 2012. Table 3-1 summarizes monthly data collected at the Doris station, and Appendix A summarizes select daily data collected at the Doris meteorological and micro-meteorological stations.

The Doris meteorological station was installed on February 27, 2004. Historical data from this station up to May 2002 is included in the *1993 to 2002 Data Compilation Report for Meteorology and Hydrology* (Rescan 2002). Historical meteorological data from May 2002 to September 2009, and 2009 evaporation data is available in the *2009 Meteorology Baseline Report, Hope Bay Belt Project* (Rescan 2009). Historical meteorological and evaporation data from October 2009 to September 2011 is available in the *Doris North Gold Mine Project: 2010 Meteorology Compliance Report,* and *Doris North Gold Mine Project: 2011 Meteorology Compliance Report* (Rescan 2010; Rescan 2011).

All annual averages and totals were calculated from October 2011 to September 2012 data, so that only twelve months of data were represented. Data from October 2011 to September 2012 have been included in this report to provide a continuous record of data since the 2011 meteorology compliance report. In addition, the following section includes a summary of evaporation values calculated from data collected during 2011 at the micro-meteorological station.

## 3.1 AIR TEMPERATURE

Figure 3.1-1 summarizes the mean, mean daily maximum and mean daily minimum monthly air temperatures at the Doris meteorological station for October 2011 to September 2012. Table 3-1 provides a summary of the available meteorological data from the onsite station.

The mean monthly air temperatures for Doris station (30 masl) ranged from -30.3ºC in January 2012 to 12.8ºC in July 2012. The annual average air temperature was -10.0ºC. The mean minimum daily air temperatures for Doris ranged from a low of -33.6ºC (December 2011), to a high of 8.4ºC (July 2012). The mean maximum daily air temperatures ranged from a low of -26.5ºC (January 2012), to highs of and 17.0ºC (July 2012).

The extreme minimum temperature at Doris station was -43.5ºC on January 21, 2012 at 3:48 PM, and the extreme maximum temperature was 24.6ºC on August 3, 2012 at 5:29 PM.

## 3.2 PRECIPITATION

Precipitation data were collected from October 2011 to September 2012 at the Doris station. Total annual precipitation during the period (October 2011 to September 2012) was 54 mm. Monthly precipitation values are summarized in Table 3-1 and Figure 3.2-1. A snowfall adapter was installed at the Doris station in February 2012, and precipitation as snowfall was collected from February 2012 to May 2012.

July 2012 received the highest amounts of precipitation at 23.4 mm. October 2011 had much less precipitation compared to the previous year. There was no precipitation recorded from November 2010 to January 2012 as any precipitation that did occur was in the form of snow.

**Table 3-1. Monthly Meteorological Data from Doris Meteorological Station, October 2011 to September 2012**

| Month | Average Air Temperature °C | Average Daily Minimum Air Temperature °C | Average Daily Maximum Air Temperature °C | Average Relative Humidity % | Average Hourly Wind Speed m/s | Average Hourly Wind Speed km/h | Maximum Wind Gust Speed m/s | Maximum Wind Gust Speed km/h | Average Solar Radiation $W/m^2$ | Total Bright Sunshine Hours (>120 $W/m^2$) | Total Precipitation mm | Average Barometric Pressure kPa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct-11 | -5.1 | -7.4 | -2.9 | 87.7 | 5.8 | 21.0 | 17.9 | 64.4 | 22.2 | 25 | 0.3 | 100.88 |
| Nov-11 | -17.6 | -20.9 | -15.2 | 84.7 | 6.3 | 22.7 | 19.5 | 70.1 | 4.9 | 0 | 0.0 | 100.93 |
| Dec-11 | -27.4 | -30.6 | -23.9 | 77.0 | 5.5 | 19.9 | 27.5 | 99.0 | 0.4 | 0 | 0.0 | 99.93 |
| Jan-12 | -30.3 | -33.6 | -26.5 | 73.1 | 5.5 | 19.9 | 20.1 | 72.4 | 2.4 | 0 | 0.0 | 99.21 |
| Feb-12 | -25.2 | -29.3 | -21.1 | 75.1 | 5.2 | 18.8 | 21.9 | 79.0 | 25.6 | 56 | 0.8[a] | 101.60 |
| Mar-12 | -27.0 | -30.5 | -23.5 | 73.4 | 5.6 | 20.0 | 18.1 | 65.3 | 89.1 | 236 | 0.0 | 101.17 |
| Apr-12 | -15.6 | -20.0 | -11.0 | 81.9 | 5.0 | 17.9 | 22.4 | 80.7 | 176.1 | 343 | 0.3 | 102.11 |
| May-12 | -4.1 | -7.2 | -0.8 | 89.2 | 4.4 | 15.8 | 16.1 | 57.9 | 220.1 | 407 | 4.6 | 101.79 |
| Jun-12 | 4.5 | 1.0 | 8.0 | 81.9 | 4.7 | 16.9 | 16.1 | 58.1 | 239.2 | 423 | 5.8 | 101.50 |
| Jul-12 | 12.8 | 8.4 | 17.0 | 67.4 | 4.7 | 17.0 | 16.3 | 58.8 | 236.9 | 435 | 23.4 | 101.16 |
| Aug-12 | 9.9 | 6.6 | 13.2 | 77.4 | 4.9 | 17.5 | 16.3 | 58.7 | 135.5 | 298 | 12.7 | 100.86 |
| Sep-12 | 5.2 | 2.3 | 8.5 | 81.5 | 6.0 | 21.4 | 22.8 | 82.0 | 78.4 | 183 | 5.8 | n/a[b] |
| *Average*[c] | -10.0 | -13.4 | -6.5 | 79.2 | 5.3 | 19.1 | 19.6 | 70.5 | 102.6 | - | - | 101.02 |
| *Sum*[c] | - | - | - | - | - | - | - | - | - | 2406 | 54 | |

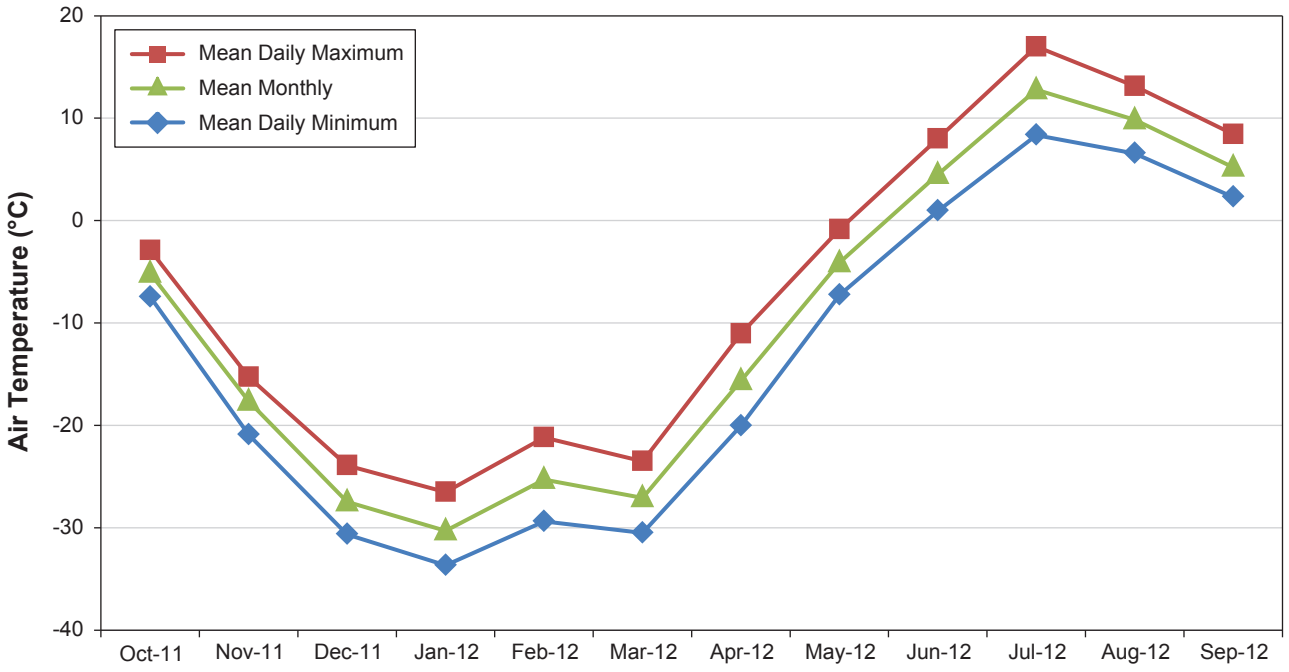
*Notes:*

*n/a = not available*

[a] *A winter precipitation adapter was installed in February 2012.*

[b] *There was a sensor malfunction during September.*

[c] *This calculation was only performed on data from October 2011 to September 2012*

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**Doris Station Monthly Average Temperature (°C)**
**October 2011 to September 2012**

Figure 3.1-1

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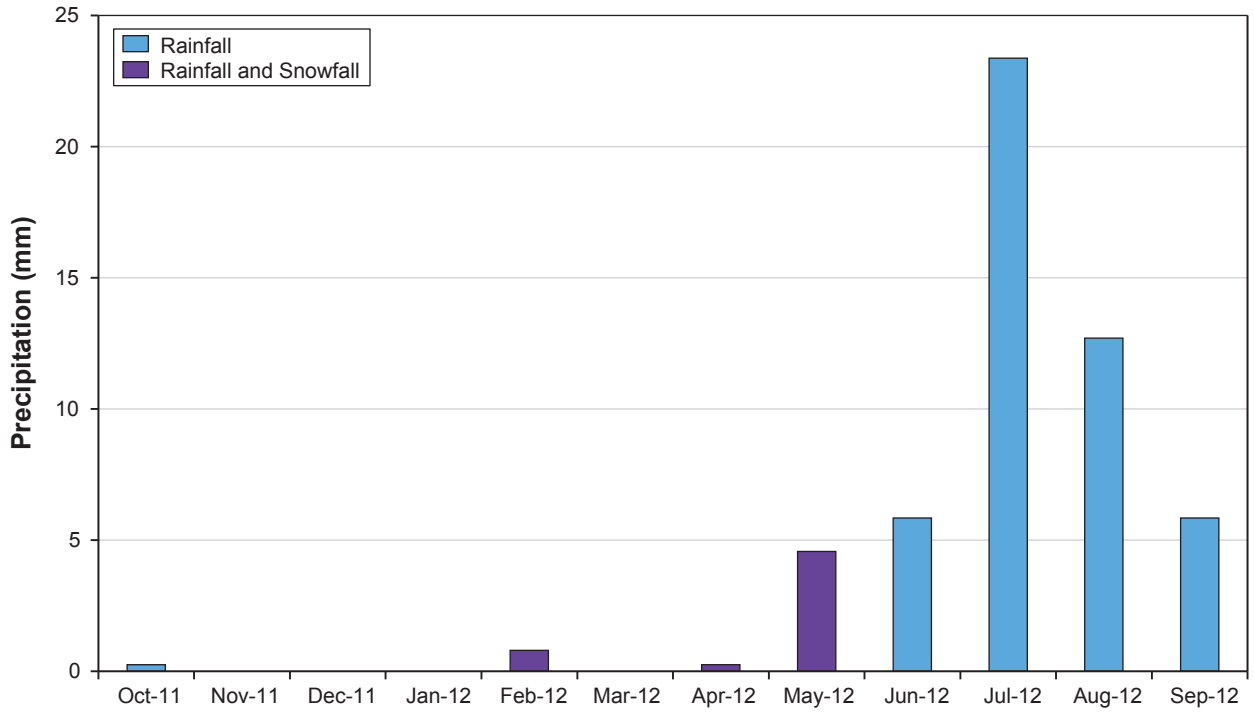


*Note: Precipitation measured from February to May includes snowfall and rainfall. Precipitation measured in all other months only includes rainfall.*

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**Doris Station Monthly Precipitation (mm), October 2011 to September 2012**

Figure 3.2-1

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## 3.3 SOLAR RADIATION

Solar radiation is electromagnetic energy from the sun. Solar energy accounts for 99% of the Earth's energy budget. The solar radiation incident on top of the terrestrial atmosphere is called extraterrestrial solar radiation. Ninety seven percent of this radiation is confined to the spectral range of 0.29 to 3.0 microns and is referred to as short-wave radiation. A portion of the extraterrestrial solar radiation penetrates through the atmosphere to the earth's surface, while part of it is scattered and/or absorbed in the atmosphere by gases, aerosol particles, cloud droplets and cloud crystals. Global solar radiation is monitored at the Hope Bay Belt meteorological stations using silicone pyranometers. Global solar radiation is the total incoming direct and diffuse short-wave solar radiation received from the whole dome of the sky on a horizontal surface.

Table 3-1 provides monthly total bright sunshine hours and average global solar radiation in watts per square metre, and Figure 3.3-1 shows monthly average global solar radiation at Doris station. The highest daily average solar radiation was 337 $W/m^2$ (June 17, 2012). The highest hourly average solar radiation at Doris station was 714 $W/m^2$ on June 8, 2012 at 1:07 PM. The Doris North Project area experiences almost 24 hours of sunlight per day between mid-May to the end of July.

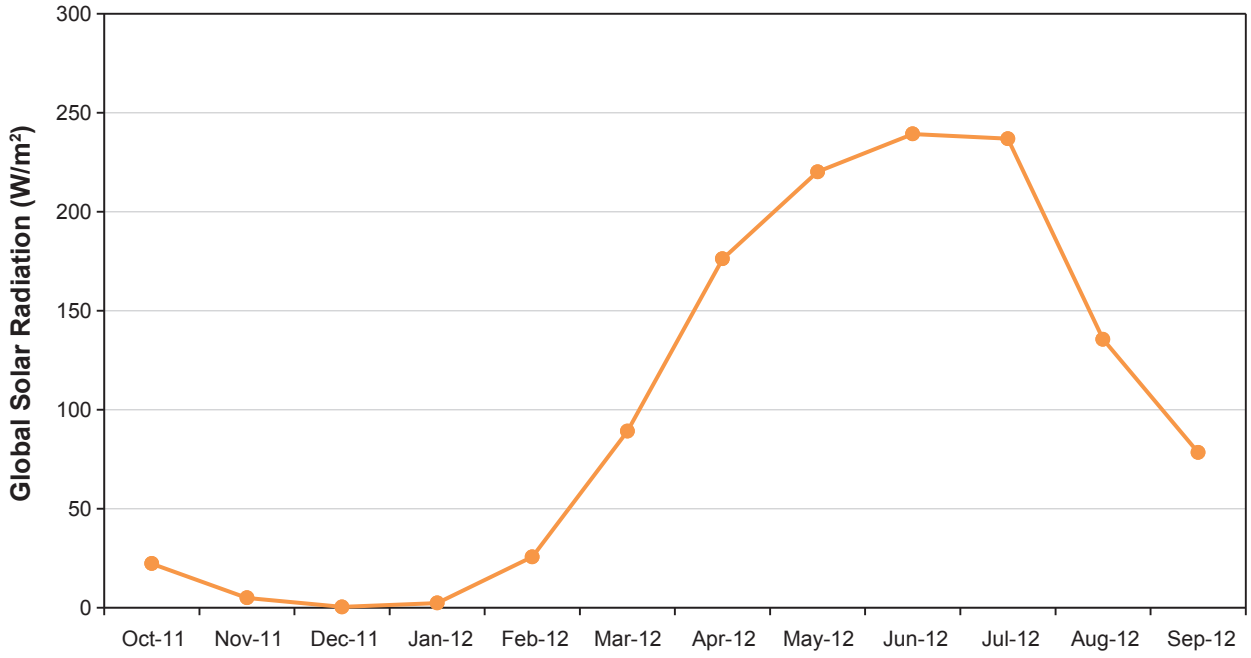
The lowest solar radiation values are recorded during winter months when the sun is at its lowest angle and there is a higher frequency for low cloud cover that reflects and absorbs the solar radiation. The minimum average daily solar radiation of 0.13 $W/m^2$ was recorded at the Doris station on January 2, 2012. The hourly average solar radiation values recorded on that day were all below 1.5 $W/m^2$. All of the hourly average solar radiation values recorded during the night time were 0 $W/m^2$. The Doris North Project area experiences almost 24 hours of darkness per day during late November to early January.

A bright sunshine hour is defined by the World Meteorological Organization (WMO) as an hour when the average global solar radiation is greater than 120 $W/m^2$. There were 2,406 hours of bright sunshine during the annual October 2011 to September 2012 measurement period at the Doris station. Summer months have a significantly higher occurrence of bright sunshine hours than winter months. These values provide a guide for sizing potential solar panel systems at this site.

## 3.4 WIND SPEED AND DIRECTION

Figure 3.4-1 shows annual (October 2011 to September 2012), winter (October 2011 to May 2012), and summer (June 2012 to September 2012) wind direction and speed distributions, as well as wind speed class distributions at the Doris station. The predominant wind directions were from the west, west-northwest and east. Based on annual data, these wind directions were recorded approximately 45% of the time. The average wind speed was 5.25 m/s (18.9 km/h) and the most frequent wind speeds at this station were 3 to 5 m/s (10.8 to 18 km/h), occurring 23.2% of the time. Strong winds over 11 m/s (39.6 km/h) occurred 6.9% of the time, and calm conditions (i.e., hourly average wind speeds less than 1 m/s (3.6 km/hr)) were experienced 9.8% of the time.

During the winter, winds were primarily from the west, west-northwest, west-southwest and east occurring approximately 44% of the time. The most common wind speed class during the winter was 3 to 5 m/s (10.8 to 18 km/h) winds occurring 20.1% of the time, with calm and strong winds occurring 12.0% and 9.1% of the time, respectively. During the summer, the most frequent winds came from the west, west-northwest, east and east-north east. Wind speeds in the middle classes were higher compared to the winter, with 3 to 5 m/s (10.8 to 18 km/h) winds occurring 29.3% of the time, while calm and strong winds were lower than the winter occurring 5.3% and 2.5% of the time, respectively. The maximum gust speeds measured during this reporting period at Doris were 27.5 m/s (99.0 km/h) on December 6, 2011.




NEWMONT NORTH AMERICA

**Doris Station Monthly Average Global Solar Radiation (W/m²) October 2011 to September 2012**

Figure 3.3-1

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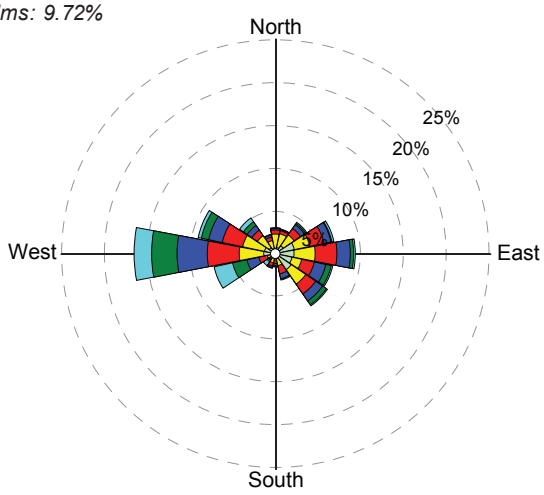
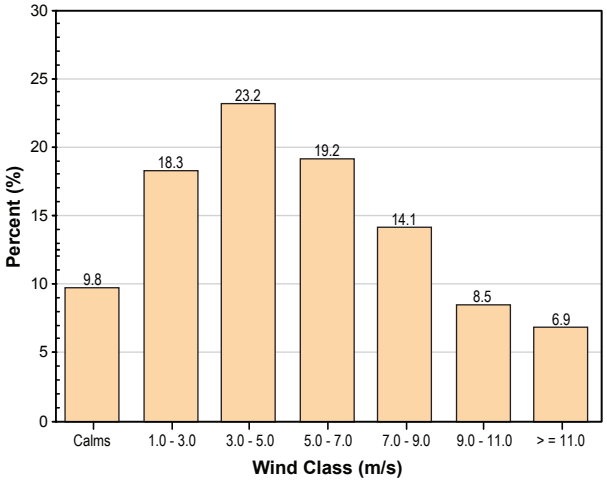
## All Seasons

*Calms: 9.72%*

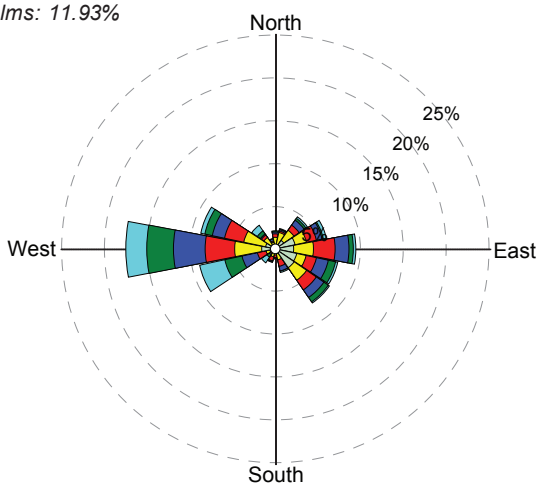


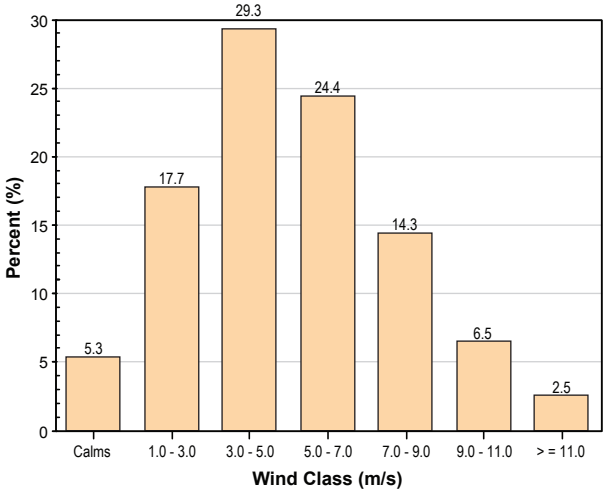

## Wind Class Frequency Distribution




## October to May

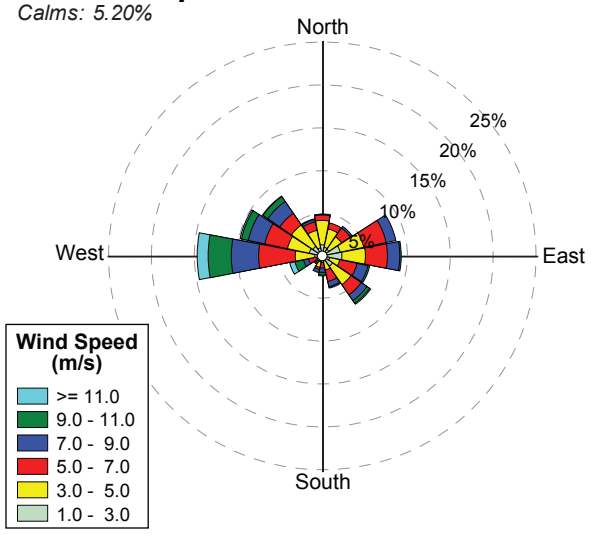
*Calms: 11.93%*

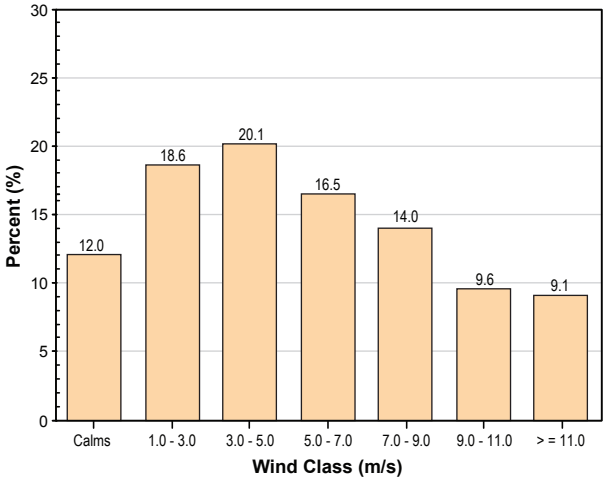



## June to September

*Calms: 5.20%*

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**Doris Windroses and Frequency Distributions**
**October 2011 to September 2012**

Figure 3.4-1

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## 3.5 EVAPORATION

Lake evaporation values were calculated using data from the Doris Lake micro-meteorological (evaporation) station (reinstalled on July 12, 2012) by two methods, the Penman Combination and the Priestly-Taylor. In total, 57 days of data were collected (July 12, 2012, to September 7, 2012). On average, the Doris North Project area experiences an open-water season that starts in early to mid-July; however, there are variations in the length of the open water season year to year.

Total evaporation values in the Doris North Project area from July 12 to September 7, 2012 were estimated to be 122.6 and 124.6 mm based on total monthly evaporation values calculated using the Penman Combination and Priestly-Taylor methods, respectively (Table 3.5-1).

**Table 3.5-1. Doris North Project – 2012 Monthly Evaporation**

| Month | Average Daily Evaporation Rate (mm/day) | | Total Monthly Evaporation (mm) | |
|---|---|---|---|---|
| | Penman Method | Priestly-Taylor Method | Penman Method | Priestly-Taylor Method |
| July[a] | 3.10 | 3.26 | 62.01 | 65.26 |
| August[b] | 1.70 | 1.71 | 52.64 | 52.88 |
| September[c] | 1.14 | 0.93 | 7.95 | 6.50 |
| *2012 Average* | *2.11* | *2.15* | - | - |
| *2012 Sum* | - | - | *122.60* | *124.64* |

*Note:*
[a] *The micro-meteorological station was installed on July 12, 2012. Based on 20 days of collected data.*
[b] *Based on the full month of data.*
[c] *The micro-meteorological station was uninstalled on September 7, 2012. Based on 7 days of data.*

Evaporation measured from this station between July and August shows how the average daily evaporation in August is roughly half of that in July. This is due to the fact that solar radiation has the largest influence on evaporation rate, and the water surface receives significantly more solar radiation in July than August, after which it decreases significantly (see Figure 3.3-1).

# 4. Summary

# 4. Summary

Meteorological data were collected from October 2011 to September 2012 to comply with the meteorology conditions outlined in the Doris North Project Certificate. An automated meteorological station (Doris) and a micro-meteorological (evaporation) station (Doris Lake) were used. Each year, starting in 2009, the micro-meteorological station was installed in Doris Lake to collect evaporation data during the open-water season.

The annual average temperature was -10.0ºC, and all temperatures ranged between -43.5ºC and 24.6ºC at the Doris station, for the 2011/12 hydrologic year.

Total annual precipitation during the period (October 2011 to September 2012) was 54 mm, with July receiving the highest monthly precipitation of 23.4 mm.

Solar radiation in the Arctic is high during the summer and very low during the winter. The annual average number of bright sunshine hours, where average global solar radiation is greater than 120 $W/m^2$, was 2,406.

In general, winds in the Doris North region typically blow from the west-northwest quadrant year round although winds are also common from the east and southeast. Average annual wind speeds at Doris station were 5.3 m/s (19.1 km/h), and gusts were recorded up to 27.5 m/s (99.0 km/h).

Total evaporation values in the Doris North Project area from July to October 2012 were estimated to be 122.6 and 124.6 mm, using the Penman Combination and Priestly-Taylor methods, respectively.

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# Appendix A

Doris Meteorological Station and
Doris Micro-Meteorological Station, Daily Data,
October 2011 and September 2012

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**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (°C) | Daily Maximum Air Temperature (°C) | Daily Minimum Air Temperature (°C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 1-Oct-11 | -3.1 | -0.6 | -5.6 | 27.4 | 7.4 | 83.2 | 0.0 | n/a | n/a |
| 2-Oct-11 | -0.6 | 2.4 | -5.4 | 34.7 | 4.8 | 84.8 | 0.0 | n/a | n/a |
| 3-Oct-11 | 0.2 | 2.5 | -1.9 | 42.5 | 3.3 | 95.8 | 0.0 | n/a | n/a |
| 4-Oct-11 | 0.3 | 3.5 | -4.1 | 70.5 | 5.7 | 90.0 | 0.3 | n/a | n/a |
| 5-Oct-11 | 2.5 | 4.0 | 1.6 | 23.9 | 5.6 | 93.9 | 0.0 | n/a | n/a |
| 6-Oct-11 | 1.6 | 1.9 | 1.1 | 24.7 | 7.2 | 90.4 | 0.0 | n/a | n/a |
| 7-Oct-11 | 2.7 | 5.5 | 0.8 | 35.4 | 4.4 | 90.4 | 0.0 | n/a | n/a |
| 8-Oct-11 | 1.3 | 3.0 | -2.6 | 13.8 | 4.6 | 95.7 | 0.0 | n/a | n/a |
| 9-Oct-11 | -4.7 | -2.5 | -6.1 | 22.6 | 6.2 | 79.5 | 0.0 | n/a | n/a |
| 10-Oct-11 | -5.4 | -3.5 | -7.2 | 18.4 | 6.8 | 76.3 | 0.0 | n/a | n/a |
| 11-Oct-11 | -5.2 | -2.9 | -7.0 | 19.3 | 9.5 | 82.2 | 0.0 | n/a | n/a |
| 12-Oct-11 | 0.3 | 2.0 | -2.9 | 24.2 | 5.7 | 93.0 | 0.0 | n/a | n/a |
| 13-Oct-11 | 2.2 | 3.5 | 1.5 | 17.3 | 4.5 | 92.9 | 0.0 | n/a | n/a |
| 14-Oct-11 | 0.0 | 2.2 | -2.1 | 19.4 | 6.1 | 90.8 | 0.0 | n/a | n/a |
| 15-Oct-11 | -4.0 | -2.1 | -5.2 | 17.9 | 3.2 | 92.4 | 0.0 | n/a | n/a |
| 16-Oct-11 | -6.6 | -4.1 | -10.8 | 21.4 | 3.7 | 85.1 | 0.0 | n/a | n/a |
| 17-Oct-11 | -10.4 | -9.4 | -11.3 | 29.8 | 4.3 | 85.8 | 0.0 | n/a | n/a |
| 18-Oct-11 | -8.5 | -7.0 | -10.2 | 25.5 | 6.9 | 89.3 | 0.0 | n/a | n/a |
| 19-Oct-11 | -7.7 | -6.3 | -9.7 | 38.4 | 8.8 | 88.6 | 0.0 | n/a | n/a |
| 20-Oct-11 | -9.0 | -7.0 | -11.2 | 12.8 | 5.6 | 87.8 | 0.0 | n/a | n/a |
| 21-Oct-11 | -9.1 | -7.8 | -10.2 | 13.4 | 6.9 | 86.0 | 0.0 | n/a | n/a |
| 22-Oct-11 | -9.6 | -8.9 | -10.6 | 15.2 | 6.7 | 82.2 | 0.0 | n/a | n/a |
| 23-Oct-11 | -6.8 | -4.1 | -11.5 | 13.4 | 3.2 | 90.0 | 0.0 | n/a | n/a |
| 24-Oct-11 | -6.0 | -4.1 | -8.6 | 18.0 | 5.8 | 83.8 | 0.0 | n/a | n/a |
| 25-Oct-11 | -10.3 | -5.5 | -12.1 | 13.6 | 5.4 | 78.6 | 0.0 | n/a | n/a |
| 26-Oct-11 | -6.8 | -3.4 | -10.9 | 10.7 | 5.6 | 92.6 | 0.0 | n/a | n/a |
| 27-Oct-11 | -12.9 | -7.1 | -15.9 | 14.5 | 9.9 | 84.6 | 0.0 | n/a | n/a |
| 28-Oct-11 | -17.4 | -15.7 | -19.8 | 12.6 | 3.8 | 86.0 | 0.0 | n/a | n/a |
| 29-Oct-11 | -14.1 | -10.1 | -16.3 | 13.4 | 7.5 | 82.8 | 0.0 | n/a | n/a |
| 30-Oct-11 | -8.1 | -5.7 | -10.1 | 13.6 | 7.9 | 88.4 | 0.0 | n/a | n/a |
| 31-Oct-11 | -3.0 | -1.6 | -5.7 | 10.6 | 3.6 | 96.7 | 0.0 | n/a | n/a |
| 1-Nov-11 | -3.9 | -2.2 | -7.5 | 12.1 | 7.5 | 95.0 | 0.0 | n/a | n/a |
| 2-Nov-11 | -9.3 | -7.4 | -11.4 | 15.6 | 4.9 | 92.1 | 0.0 | n/a | n/a |
| 3-Nov-11 | -14.4 | -9.1 | -22.7 | 11.2 | 2.4 | 86.7 | 0.0 | n/a | n/a |
| 4-Nov-11 | -14.2 | -11.8 | -21.3 | 8.9 | 5.8 | 88.7 | 0.0 | n/a | n/a |
| 5-Nov-11 | -13.7 | -11.6 | -15.5 | 8.8 | 2.1 | 89.8 | 0.0 | n/a | n/a |
| 6-Nov-11 | -10.9 | -8.9 | -13.8 | 8.7 | 4.2 | 90.0 | 0.0 | n/a | n/a |
| 7-Nov-11 | -12.3 | -10.7 | -16.6 | 6.2 | 4.8 | 82.8 | 0.0 | n/a | n/a |
| 8-Nov-11 | -16.2 | -14.2 | -18.8 | 5.8 | 6.9 | 85.7 | 0.0 | n/a | n/a |
| 9-Nov-11 | -17.8 | -16.3 | -19.4 | 6.8 | 2.8 | 85.7 | 0.0 | n/a | n/a |
| 10-Nov-11 | -13.7 | -9.9 | -19.4 | 4.7 | 5.6 | 88.0 | 0.0 | n/a | n/a |
| 11-Nov-11 | -10.3 | -8.9 | -12.8 | 5.9 | 2.7 | 90.0 | 0.0 | n/a | n/a |
| 12-Nov-11 | -10.4 | -7.9 | -14.7 | 4.2 | 4.2 | 88.9 | 0.0 | n/a | n/a |
| 13-Nov-11 | -12.5 | -11.1 | -14.7 | 3.7 | 6.9 | 86.5 | 0.0 | n/a | n/a |
| 14-Nov-11 | -18.9 | -14.7 | -22.2 | 7.8 | 5.5 | 85.4 | 0.0 | n/a | n/a |
| 15-Nov-11 | -21.6 | -20.3 | -23.9 | 6.0 | 7.0 | 83.4 | 0.0 | n/a | n/a |
| 16-Nov-11 | -23.4 | -22.0 | -26.1 | 4.0 | 4.8 | 81.9 | 0.0 | n/a | n/a |
| 17-Nov-11 | -21.4 | -19.4 | -25.6 | 3.5 | 7.6 | 83.1 | 0.0 | n/a | n/a |
| 18-Nov-11 | -18.3 | -16.6 | -21.1 | 2.2 | 10.7 | 83.1 | 0.0 | n/a | n/a |
| 19-Nov-11 | -18.1 | -17.4 | -19.4 | 3.6 | 10.7 | 81.8 | 0.0 | n/a | n/a |
| 20-Nov-11 | -21.9 | -19.1 | -24.9 | 3.3 | 9.8 | 80.4 | 0.0 | n/a | n/a |
| 21-Nov-11 | -24.4 | -23.3 | -25.4 | 3.3 | 8.3 | 78.7 | 0.0 | n/a | n/a |
| 22-Nov-11 | -27.4 | -23.8 | -29.8 | 2.9 | 2.4 | 77.3 | 0.0 | n/a | n/a |
| 23-Nov-11 | -28.2 | -25.4 | -30.2 | 2.6 | 1.5 | 76.9 | 0.0 | n/a | n/a |
| 24-Nov-11 | -27.3 | -21.7 | -30.4 | 1.0 | 2.4 | 77.7 | 0.0 | n/a | n/a |
| 25-Nov-11 | -18.9 | -15.8 | -21.7 | 1.0 | 5.4 | 83.2 | 0.0 | n/a | n/a |
| 26-Nov-11 | -15.8 | -12.8 | -21.3 | 0.9 | 9.1 | 87.1 | 0.0 | n/a | n/a |
| 27-Nov-11 | -23.1 | -20.8 | -26.2 | 1.0 | 9.1 | 81.6 | 0.0 | n/a | n/a |

**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (˚C) | Daily Maximum Air Temperature (˚C) | Daily Minimum Air Temperature (˚C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 28-Nov-11 | -24.4 | -23.1 | -26.0 | 1.0 | 13.3 | 80.1 | 0.0 | n/a | n/a |
| 29-Nov-11 | -17.4 | -14.8 | -23.7 | 0.7 | 10.3 | 85.5 | 0.0 | n/a | n/a |
| 30-Nov-11 | -18.3 | -16.5 | -19.9 | 0.9 | 10.2 | 84.0 | 0.0 | n/a | n/a |
| 1-Dec-11 | -21.7 | -17.3 | -24.8 | 0.9 | 3.2 | 82.1 | 0.0 | n/a | n/a |
| 2-Dec-11 | -26.2 | -21.0 | -29.6 | 0.9 | 5.6 | 78.2 | 0.0 | n/a | n/a |
| 3-Dec-11 | -28.6 | -27.4 | -29.5 | 0.8 | 6.5 | 75.7 | 0.0 | n/a | n/a |
| 4-Dec-11 | -24.7 | -20.7 | -27.7 | 0.6 | 6.1 | 79.4 | 0.0 | n/a | n/a |
| 5-Dec-11 | -15.0 | -5.7 | -27.2 | 0.2 | 8.5 | 87.2 | 0.0 | n/a | n/a |
| 6-Dec-11 | -18.6 | -12.5 | -20.7 | 0.5 | 17.8 | 85.1 | 0.3 | n/a | n/a |
| 7-Dec-11 | -17.1 | -14.6 | -22.2 | 0.3 | 14.4 | 86.2 | 0.0 | n/a | n/a |
| 8-Dec-11 | -25.3 | -22.1 | -28.2 | 0.6 | 9.4 | 78.6 | 0.0 | n/a | n/a |
| 9-Dec-11 | -27.9 | -25.8 | -29.6 | 0.4 | 1.8 | 77.4 | 0.0 | n/a | n/a |
| 10-Dec-11 | -29.8 | -27.0 | -31.5 | 0.5 | 0.7 | 75.3 | 0.0 | n/a | n/a |
| 11-Dec-11 | -29.6 | -26.0 | -31.8 | 0.4 | 0.9 | 75.4 | 0.0 | n/a | n/a |
| 12-Dec-11 | -19.8 | -13.6 | -31.6 | 0.2 | 3.6 | 84.6 | 0.0 | n/a | n/a |
| 13-Dec-11 | -23.0 | -13.2 | -26.9 | 0.3 | 12.8 | 81.3 | 0.0 | n/a | n/a |
| 14-Dec-11 | -26.3 | -25.4 | -27.6 | 0.5 | 12.7 | 78.0 | 0.0 | n/a | n/a |
| 15-Dec-11 | -25.0 | -23.1 | -27.1 | 0.4 | 10.8 | 79.2 | 0.0 | n/a | n/a |
| 16-Dec-11 | -26.1 | -22.6 | -29.6 | 0.4 | 2.4 | 78.6 | 0.0 | n/a | n/a |
| 17-Dec-11 | -24.9 | -22.7 | -30.2 | 0.3 | 1.6 | 80.1 | 0.0 | n/a | n/a |
| 18-Dec-11 | -30.6 | -28.9 | -34.0 | 0.3 | 3.7 | 74.6 | 0.0 | n/a | n/a |
| 19-Dec-11 | -32.6 | -30.1 | -34.7 | 0.3 | 1.8 | 72.2 | 0.0 | n/a | n/a |
| 20-Dec-11 | -31.5 | -28.6 | -33.8 | 0.4 | 6.0 | 73.2 | 0.0 | n/a | n/a |
| 21-Dec-11 | -31.2 | -29.2 | -33.0 | 0.3 | 3.2 | 73.5 | 0.0 | n/a | n/a |
| 22-Dec-11 | -28.3 | -19.7 | -32.1 | 0.3 | 1.0 | 76.5 | 0.0 | n/a | n/a |
| 23-Dec-11 | -24.1 | -18.6 | -26.9 | 0.1 | 4.8 | 81.0 | 0.0 | n/a | n/a |
| 24-Dec-11 | -29.9 | -25.0 | -31.4 | 0.2 | 6.8 | 74.9 | 0.0 | n/a | n/a |
| 25-Dec-11 | -29.3 | -27.2 | -31.6 | 0.3 | 8.7 | 75.1 | 0.0 | n/a | n/a |
| 26-Dec-11 | -26.8 | -24.7 | -28.5 | 0.4 | 12.5 | 77.6 | 0.0 | n/a | n/a |
| 27-Dec-11 | -30.6 | -26.8 | -35.1 | 0.4 | 2.8 | 74.5 | 0.0 | n/a | n/a |
| 28-Dec-11 | -35.4 | -34.3 | -36.1 | 0.3 | 0.3 | 69.3 | 0.0 | n/a | n/a |
| 29-Dec-11 | -35.5 | -33.8 | -38.1 | 0.3 | 0.4 | 69.0 | 0.0 | n/a | n/a |
| 30-Dec-11 | -38.0 | -36.6 | -39.1 | 0.3 | 0.2 | 66.3 | 0.0 | n/a | n/a |
| 31-Dec-11 | -36.8 | -35.4 | -38.4 | 0.3 | 0.1 | 67.4 | 0.0 | n/a | n/a |
| 1-Jan-12 | -38.1 | -36.6 | -39.1 | 0.3 | 0.2 | 66.0 | 0.0 | n/a | n/a |
| 2-Jan-12 | -29.3 | -23.7 | -37.3 | 0.1 | 6.2 | 74.9 | 0.0 | n/a | n/a |
| 3-Jan-12 | -25.9 | -23.1 | -31.4 | 0.4 | 7.1 | 77.2 | 0.0 | n/a | n/a |
| 4-Jan-12 | -29.8 | -26.8 | -32.2 | 0.6 | 6.8 | 75.1 | 0.0 | n/a | n/a |
| 5-Jan-12 | -27.3 | -25.8 | -28.7 | 0.6 | 10.6 | 76.7 | 0.0 | n/a | n/a |
| 6-Jan-12 | -30.1 | -24.3 | -35.8 | 0.6 | 2.1 | 74.3 | 0.0 | n/a | n/a |
| 7-Jan-12 | -29.0 | -23.8 | -32.7 | 0.8 | 1.0 | 75.7 | 0.0 | n/a | n/a |
| 8-Jan-12 | -34.1 | -31.4 | -36.2 | 0.7 | 1.2 | 70.8 | 0.0 | n/a | n/a |
| 9-Jan-12 | -32.2 | -29.0 | -36.3 | 1.1 | 4.0 | 69.8 | 0.0 | n/a | n/a |
| 10-Jan-12 | -24.8 | -21.0 | -29.7 | 0.6 | 6.2 | 77.3 | 0.0 | n/a | n/a |
| 11-Jan-12 | -28.7 | -26.3 | -31.4 | 0.9 | 4.0 | 73.6 | 0.0 | n/a | n/a |
| 12-Jan-12 | -28.9 | -26.2 | -31.1 | 1.8 | 0.8 | 74.2 | 0.0 | n/a | n/a |
| 13-Jan-12 | -27.4 | -21.9 | -31.3 | 1.1 | 3.8 | 76.6 | 0.0 | n/a | n/a |
| 14-Jan-12 | -24.7 | -21.0 | -30.5 | 0.8 | 7.5 | 78.4 | 0.0 | n/a | n/a |
| 15-Jan-12 | -30.1 | -28.7 | -31.3 | 1.2 | 10.3 | 74.3 | 0.0 | n/a | n/a |
| 16-Jan-12 | -27.6 | -26.5 | -29.2 | 1.2 | 12.7 | 76.2 | 0.0 | n/a | n/a |
| 17-Jan-12 | -23.4 | -15.9 | -29.2 | 1.1 | 13.7 | 80.6 | 0.0 | n/a | n/a |
| 18-Jan-12 | -27.3 | -20.0 | -32.6 | 1.5 | 8.5 | 76.7 | 0.0 | n/a | n/a |
| 19-Jan-12 | -33.2 | -31.9 | -35.0 | 2.0 | 2.6 | 71.5 | 0.0 | n/a | n/a |
| 20-Jan-12 | -38.3 | -35.0 | -40.4 | 2.8 | 2.3 | 66.3 | 0.0 | n/a | n/a |
| 21-Jan-12 | -42.3 | -39.4 | -43.5 | 2.8 | 0.7 | 62.0 | 0.0 | n/a | n/a |
| 22-Jan-12 | -39.7 | -33.6 | -42.7 | 2.3 | 4.5 | 64.3 | 0.0 | n/a | n/a |
| 23-Jan-12 | -32.9 | -30.9 | -34.4 | 3.8 | 5.0 | 70.6 | 0.0 | n/a | n/a |
| 24-Jan-12 | -32.9 | -28.1 | -35.4 | 3.1 | 4.6 | 70.8 | 0.0 | n/a | n/a |

**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (˚C) | Daily Maximum Air Temperature (˚C) | Daily Minimum Air Temperature (˚C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 25-Jan-12 | -25.7 | -21.6 | -29.9 | 6.1 | 3.6 | 78.3 | 0.0 | n/a | n/a |
| 26-Jan-12 | -17.4 | -13.8 | -21.6 | 4.0 | 7.9 | 83.1 | 0.0 | n/a | n/a |
| 27-Jan-12 | -26.3 | -14.1 | -33.1 | 5.0 | 10.6 | 75.8 | 0.0 | n/a | n/a |
| 28-Jan-12 | -33.5 | -32.3 | -36.7 | 6.3 | 5.6 | 68.9 | 0.0 | n/a | n/a |
| 29-Jan-12 | -36.6 | -32.7 | -38.3 | 7.6 | 1.8 | 66.3 | 0.0 | n/a | n/a |
| 30-Jan-12 | -32.3 | -30.9 | -33.8 | 6.7 | 6.5 | 65.6 | 0.0 | n/a | n/a |
| 31-Jan-12 | -28.2 | -24.4 | -31.7 | 5.2 | 4.6 | 72.8 | 0.0 | n/a | n/a |
| 1-Feb-12 | -28.7 | -20.5 | -33.6 | 7.8 | 0.9 | 73.9 | 0.0 | n/a | n/a |
| 2-Feb-12 | -18.4 | -7.1 | -27.7 | 5.7 | 7.3 | 83.0 | 0.0 | n/a | n/a |
| 3-Feb-12 | -19.4 | -9.1 | -23.5 | 13.2 | 9.1 | 82.0 | 0.0 | n/a | n/a |
| 4-Feb-12 | -22.4 | -19.8 | -27.8 | 8.8 | 7.5 | 79.7 | 0.8 | n/a | n/a |
| 5-Feb-12 | -27.1 | -22.8 | -30.7 | 15.7 | 5.1 | 72.9 | 0.0 | n/a | n/a |
| 6-Feb-12 | -21.1 | -15.0 | -25.8 | 9.4 | 3.6 | 77.5 | 0.0 | n/a | n/a |
| 7-Feb-12 | -29.2 | -22.4 | -32.1 | 16.5 | 8.6 | 68.0 | 0.0 | n/a | n/a |
| 8-Feb-12 | -28.1 | -26.2 | -30.6 | 19.4 | 11.2 | 74.0 | 0.0 | n/a | n/a |
| 9-Feb-12 | -28.0 | -23.5 | -30.4 | 21.4 | 5.5 | 66.9 | 0.0 | n/a | n/a |
| 10-Feb-12 | -12.4 | -7.4 | -26.0 | 21.7 | 7.3 | 56.9 | 0.0 | n/a | n/a |
| 11-Feb-12 | -11.5 | -7.4 | -16.3 | 22.9 | 5.7 | 75.0 | 0.0 | n/a | n/a |
| 12-Feb-12 | -16.9 | -13.8 | -19.6 | 11.9 | 2.7 | 85.1 | 0.0 | n/a | n/a |
| 13-Feb-12 | -15.9 | -15.3 | -16.3 | 9.0 | 1.5 | 88.1 | 0.0 | n/a | n/a |
| 14-Feb-12 | -17.3 | -16.2 | -18.2 | 13.5 | 3.7 | 85.1 | 0.0 | n/a | n/a |
| 15-Feb-12 | -21.0 | -17.1 | -26.9 | 26.5 | 4.6 | 82.7 | 0.0 | n/a | n/a |
| 16-Feb-12 | -29.2 | -24.2 | -31.7 | 26.5 | 0.5 | 76.0 | 0.0 | n/a | n/a |
| 17-Feb-12 | -19.7 | -16.1 | -30.5 | 14.2 | 7.4 | 84.1 | 0.0 | n/a | n/a |
| 18-Feb-12 | -25.6 | -18.7 | -33.1 | 30.0 | 7.0 | 76.8 | 0.0 | n/a | n/a |
| 19-Feb-12 | -32.1 | -29.9 | -33.6 | 36.3 | 3.5 | 71.1 | 0.0 | n/a | n/a |
| 20-Feb-12 | -27.8 | -23.2 | -32.7 | 36.3 | 3.8 | 71.7 | 0.0 | n/a | n/a |
| 21-Feb-12 | -25.3 | -23.1 | -29.1 | 40.0 | 5.9 | 74.2 | 0.0 | n/a | n/a |
| 22-Feb-12 | -30.2 | -26.5 | -32.4 | 40.6 | 1.9 | 73.4 | 0.0 | n/a | n/a |
| 23-Feb-12 | -30.0 | -28.7 | -31.8 | 42.2 | 7.1 | 74.0 | 0.0 | n/a | n/a |
| 24-Feb-12 | -31.4 | -29.6 | -33.7 | 42.7 | 6.1 | 72.5 | 0.0 | n/a | n/a |
| 25-Feb-12 | -33.8 | -32.5 | -34.9 | 42.6 | 3.4 | 69.9 | 0.0 | n/a | n/a |
| 26-Feb-12 | -34.0 | -31.5 | -37.8 | 44.6 | 3.1 | 69.1 | 0.0 | n/a | n/a |
| 27-Feb-12 | -30.3 | -24.6 | -34.0 | 43.8 | 1.2 | 72.4 | 0.0 | n/a | n/a |
| 28-Feb-12 | -32.7 | -29.1 | -35.5 | 45.2 | 5.5 | 71.3 | 0.0 | n/a | n/a |
| 29-Feb-12 | -32.6 | -31.5 | -34.6 | 35.7 | 10.9 | 70.8 | 0.0 | n/a | n/a |
| 1-Mar-12 | -33.8 | -31.9 | -35.4 | 53.2 | 7.6 | 69.3 | 0.0 | n/a | n/a |
| 2-Mar-12 | -32.3 | -30.0 | -34.9 | 60.6 | 5.9 | 70.1 | 0.0 | n/a | n/a |
| 3-Mar-12 | -36.1 | -33.6 | -39.0 | 61.9 | 1.2 | 67.1 | 0.0 | n/a | n/a |
| 4-Mar-12 | -35.8 | -31.8 | -40.8 | 55.1 | 4.0 | 66.8 | 0.0 | n/a | n/a |
| 5-Mar-12 | -31.7 | -28.9 | -33.6 | 61.8 | 11.8 | 69.9 | 0.0 | n/a | n/a |
| 6-Mar-12 | -27.4 | -25.4 | -30.1 | 60.4 | 9.2 | 74.1 | 0.0 | n/a | n/a |
| 7-Mar-12 | -29.0 | -23.7 | -32.7 | 79.0 | 2.8 | 69.1 | 0.0 | n/a | n/a |
| 8-Mar-12 | -30.4 | -28.6 | -33.0 | 72.3 | 9.9 | 71.0 | 0.0 | n/a | n/a |
| 9-Mar-12 | -29.7 | -26.6 | -33.9 | 77.4 | 2.2 | 71.3 | 0.0 | n/a | n/a |
| 10-Mar-12 | -32.4 | -26.7 | -37.0 | 77.3 | 4.5 | 69.8 | 0.0 | n/a | n/a |
| 11-Mar-12 | -33.6 | -28.9 | -38.6 | 81.3 | 1.8 | 66.6 | 0.0 | n/a | n/a |
| 12-Mar-12 | -22.4 | -17.7 | -28.9 | 53.1 | 7.9 | 77.3 | 0.0 | n/a | n/a |
| 13-Mar-12 | -20.1 | -18.2 | -21.3 | 55.3 | 8.8 | 81.3 | 0.0 | n/a | n/a |
| 14-Mar-12 | -25.9 | -21.2 | -30.8 | 81.4 | 8.0 | 77.9 | 0.0 | n/a | n/a |
| 15-Mar-12 | -30.7 | -29.0 | -32.9 | 93.5 | 10.3 | 72.6 | 0.0 | n/a | n/a |
| 16-Mar-12 | -30.0 | -28.5 | -32.4 | 90.4 | 8.2 | 72.3 | 0.0 | n/a | n/a |
| 17-Mar-12 | -31.7 | -30.2 | -32.9 | 100.0 | 10.2 | 70.0 | 0.0 | n/a | n/a |
| 18-Mar-12 | -31.2 | -29.4 | -33.1 | 108.5 | 9.5 | 70.2 | 0.0 | n/a | n/a |
| 19-Mar-12 | -29.8 | -25.2 | -34.0 | 117.3 | 1.8 | 68.4 | 0.0 | n/a | n/a |
| 20-Mar-12 | -27.2 | -22.2 | -32.4 | 72.2 | 5.2 | 68.6 | 0.0 | n/a | n/a |
| 21-Mar-12 | -23.6 | -20.9 | -25.8 | 96.6 | 4.8 | 71.4 | 0.0 | n/a | n/a |
| 22-Mar-12 | -24.5 | -22.2 | -26.8 | 121.1 | 8.1 | 73.0 | 0.0 | n/a | n/a |

**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (˚C) | Daily Maximum Air Temperature (˚C) | Daily Minimum Air Temperature (˚C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 23-Mar-12 | -23.8 | -18.4 | -28.7 | 116.5 | 2.1 | 73.7 | 0.0 | n/a | n/a |
| 24-Mar-12 | -25.1 | -20.2 | -29.3 | 99.5 | 3.5 | 76.4 | 0.0 | n/a | n/a |
| 25-Mar-12 | -21.5 | -15.5 | -25.7 | 117.4 | 3.6 | 78.5 | 0.0 | n/a | n/a |
| 26-Mar-12 | -27.0 | -23.8 | -30.3 | 125.0 | 1.9 | 75.9 | 0.0 | n/a | n/a |
| 27-Mar-12 | -26.5 | -21.7 | -29.1 | 135.6 | 1.5 | 71.6 | 0.0 | n/a | n/a |
| 28-Mar-12 | -20.9 | -14.9 | -27.9 | 117.1 | 1.8 | 78.7 | 0.0 | n/a | n/a |
| 29-Mar-12 | -20.2 | -16.4 | -22.7 | 110.7 | 4.5 | 79.2 | 0.0 | n/a | n/a |
| 30-Mar-12 | -15.0 | -9.1 | -20.0 | 122.1 | 6.1 | 84.8 | 0.0 | n/a | n/a |
| 31-Mar-12 | -8.3 | -6.5 | -10.0 | 87.2 | 7.6 | 87.5 | 0.0 | n/a | n/a |
| 1-Apr-12 | -12.8 | -7.3 | -16.7 | 120.8 | 6.8 | 83.7 | 0.0 | n/a | n/a |
| 2-Apr-12 | -8.9 | -6.6 | -11.9 | 111.0 | 8.2 | 87.0 | 0.0 | n/a | n/a |
| 3-Apr-12 | -9.8 | -7.1 | -13.4 | 155.0 | 5.7 | 78.5 | 0.0 | n/a | n/a |
| 4-Apr-12 | -9.2 | -4.6 | -12.8 | 96.4 | 6.2 | 85.8 | 0.0 | n/a | n/a |
| 5-Apr-12 | -13.2 | -10.9 | -15.7 | 120.4 | 12.0 | 89.0 | 0.0 | n/a | n/a |
| 6-Apr-12 | -15.6 | -12.5 | -19.5 | 96.1 | 7.0 | 84.8 | 0.0 | n/a | n/a |
| 7-Apr-12 | -19.8 | -16.9 | -22.3 | 168.8 | 5.3 | 79.0 | 0.0 | n/a | n/a |
| 8-Apr-12 | -20.5 | -14.8 | -26.7 | 173.3 | 2.2 | 79.9 | 0.0 | n/a | n/a |
| 9-Apr-12 | -19.3 | -12.3 | -26.3 | 175.0 | 1.5 | 77.8 | 0.0 | n/a | n/a |
| 10-Apr-12 | -10.1 | -2.2 | -17.7 | 126.3 | 2.7 | 81.6 | 0.0 | n/a | n/a |
| 11-Apr-12 | -17.8 | -14.4 | -20.3 | 177.6 | 6.8 | 81.3 | 0.0 | n/a | n/a |
| 12-Apr-12 | -20.4 | -17.9 | -22.6 | 188.3 | 8.5 | 80.5 | 0.0 | n/a | n/a |
| 13-Apr-12 | -22.0 | -18.5 | -25.1 | 182.4 | 5.3 | 79.3 | 0.0 | n/a | n/a |
| 14-Apr-12 | -22.9 | -18.9 | -27.6 | 195.4 | 7.0 | 77.9 | 0.0 | n/a | n/a |
| 15-Apr-12 | -20.9 | -16.9 | -24.8 | 161.2 | 6.4 | 79.1 | 0.0 | n/a | n/a |
| 16-Apr-12 | -21.1 | -16.5 | -25.4 | 196.4 | 6.1 | 80.6 | 0.0 | n/a | n/a |
| 17-Apr-12 | -19.5 | -15.1 | -24.1 | 203.9 | 6.0 | 82.0 | 0.0 | n/a | n/a |
| 18-Apr-12 | -17.3 | -13.3 | -21.1 | 199.9 | 2.7 | 83.1 | 0.0 | n/a | n/a |
| 19-Apr-12 | -16.4 | -10.0 | -24.2 | 211.4 | 1.1 | 77.1 | 0.0 | n/a | n/a |
| 20-Apr-12 | -15.0 | -9.3 | -20.2 | 215.8 | 2.2 | 77.0 | 0.0 | n/a | n/a |
| 21-Apr-12 | -18.4 | -15.5 | -21.7 | 216.1 | 3.7 | 82.2 | 0.0 | n/a | n/a |
| 22-Apr-12 | -19.4 | -15.5 | -23.3 | 159.7 | 2.3 | 84.0 | 0.0 | n/a | n/a |
| 23-Apr-12 | -18.2 | -15.5 | -20.3 | 208.3 | 1.8 | 84.5 | 0.0 | n/a | n/a |
| 24-Apr-12 | -15.1 | -7.7 | -22.4 | 237.6 | 0.7 | 74.9 | 0.0 | n/a | n/a |
| 25-Apr-12 | -16.4 | -12.2 | -21.4 | 231.6 | 2.5 | 82.7 | 0.0 | n/a | n/a |
| 26-Apr-12 | -13.8 | -5.9 | -21.7 | 233.1 | 2.3 | 79.2 | 0.0 | n/a | n/a |
| 27-Apr-12 | -11.7 | -6.1 | -17.3 | 228.3 | 2.8 | 80.2 | 0.0 | n/a | n/a |
| 28-Apr-12 | -4.1 | 3.0 | -11.3 | 119.4 | 5.6 | 90.6 | 0.3 | n/a | n/a |
| 29-Apr-12 | -7.5 | 0.4 | -10.9 | 192.0 | 10.5 | 87.5 | 0.0 | n/a | n/a |
| 30-Apr-12 | -10.4 | -9.1 | -11.8 | 182.6 | 6.9 | 86.8 | 0.0 | n/a | n/a |
| 1-May-12 | -13.1 | -8.8 | -15.8 | 240.1 | 3.1 | 83.3 | 0.0 | n/a | n/a |
| 2-May-12 | -14.0 | -8.9 | -19.1 | 252.9 | 3.1 | 84.7 | 0.0 | n/a | n/a |
| 3-May-12 | -11.3 | -4.7 | -18.8 | 235.8 | 6.3 | 87.4 | 0.0 | n/a | n/a |
| 4-May-12 | -3.9 | 2.0 | -8.3 | 246.4 | 2.6 | 87.1 | 0.0 | n/a | n/a |
| 5-May-12 | -3.8 | 0.9 | -8.8 | 257.4 | 3.0 | 90.8 | 0.0 | n/a | n/a |
| 6-May-12 | -4.9 | -2.9 | -7.7 | 181.6 | 4.9 | 93.7 | 0.0 | n/a | n/a |
| 7-May-12 | -6.4 | -5.2 | -8.2 | 156.7 | 3.8 | 91.9 | 0.0 | n/a | n/a |
| 8-May-12 | -8.7 | -7.0 | -11.0 | 153.1 | 3.6 | 93.8 | 0.0 | n/a | n/a |
| 9-May-12 | -2.9 | 0.4 | -7.0 | 133.1 | 8.0 | 96.5 | 0.3 | n/a | n/a |
| 10-May-12 | 0.9 | 4.4 | -0.3 | 210.2 | 4.0 | 96.1 | 2.3 | n/a | n/a |
| 11-May-12 | -0.4 | 0.8 | -1.6 | 185.6 | 6.4 | 96.1 | 1.8 | n/a | n/a |
| 12-May-12 | -0.5 | 0.1 | -1.2 | 168.2 | 10.2 | 93.6 | 0.3 | n/a | n/a |
| 13-May-12 | -1.1 | 2.2 | -3.4 | 202.2 | 3.6 | 91.1 | 0.0 | n/a | n/a |
| 14-May-12 | -1.3 | 1.3 | -3.6 | 170.9 | 4.4 | 92.6 | 0.0 | n/a | n/a |
| 15-May-12 | -1.2 | 0.3 | -2.3 | 171.0 | 3.4 | 89.3 | 0.0 | n/a | n/a |
| 16-May-12 | -3.9 | -1.8 | -5.7 | 201.1 | 3.6 | 88.1 | 0.0 | n/a | n/a |
| 17-May-12 | -4.9 | -3.1 | -8.0 | 213.9 | 4.6 | 93.0 | 0.0 | n/a | n/a |
| 18-May-12 | -6.8 | -4.0 | -10.1 | 216.8 | 2.8 | 92.8 | 0.0 | n/a | n/a |
| 19-May-12 | -4.6 | 1.2 | -10.7 | 256.9 | 2.1 | 86.0 | 0.0 | n/a | n/a |

**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (˚C) | Daily Maximum Air Temperature (˚C) | Daily Minimum Air Temperature (˚C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 20-May-12 | -3.4 | 0.7 | -6.8 | 185.3 | 2.4 | 87.6 | 0.0 | n/a | n/a |
| 21-May-12 | -6.3 | -3.5 | -9.2 | 307.1 | 4.6 | 89.6 | 0.0 | n/a | n/a |
| 22-May-12 | -4.3 | 1.3 | -9.5 | 279.4 | 3.5 | 89.2 | 0.0 | n/a | n/a |
| 23-May-12 | -6.4 | -4.4 | -7.9 | 205.7 | 3.6 | 90.9 | 0.0 | n/a | n/a |
| 24-May-12 | -6.9 | -5.4 | -8.5 | 156.4 | 3.4 | 89.6 | 0.0 | n/a | n/a |
| 25-May-12 | -5.3 | -1.7 | -8.1 | 279.5 | 2.5 | 87.0 | 0.0 | n/a | n/a |
| 26-May-12 | -4.5 | -0.9 | -8.2 | 287.7 | 5.8 | 90.6 | 0.0 | n/a | n/a |
| 27-May-12 | 0.3 | 5.2 | -5.2 | 321.3 | 4.4 | 83.1 | 0.0 | n/a | n/a |
| 28-May-12 | 4.5 | 9.5 | 0.8 | 295.9 | 3.4 | 78.2 | 0.0 | n/a | n/a |
| 29-May-12 | 0.1 | 3.3 | -2.7 | 275.7 | 4.4 | 85.0 | 0.0 | n/a | n/a |
| 30-May-12 | -1.7 | 0.3 | -4.5 | 164.2 | 5.1 | 86.3 | 0.0 | n/a | n/a |
| 31-May-12 | 0.4 | 2.7 | -2.5 | 210.7 | 9.9 | 81.7 | 0.0 | n/a | n/a |
| 1-Jun-12 | -0.8 | 1.2 | -2.6 | 262.2 | 6.8 | 88.1 | 0.0 | n/a | n/a |
| 2-Jun-12 | 0.5 | 3.0 | -3.1 | 96.0 | 2.7 | 91.0 | 0.0 | n/a | n/a |
| 3-Jun-12 | 2.5 | 5.2 | 0.1 | 219.5 | 2.8 | 86.0 | 0.3 | n/a | n/a |
| 4-Jun-12 | 3.7 | 6.3 | 0.7 | 260.6 | 4.7 | 81.8 | 0.0 | n/a | n/a |
| 5-Jun-12 | 1.5 | 4.2 | -0.4 | 238.3 | 4.6 | 94.2 | 0.0 | n/a | n/a |
| 6-Jun-12 | 3.1 | 6.6 | -0.3 | 251.5 | 4.2 | 82.8 | 1.8 | n/a | n/a |
| 7-Jun-12 | 2.7 | 4.5 | -0.3 | 315.7 | 3.1 | 80.5 | 0.0 | n/a | n/a |
| 8-Jun-12 | 1.8 | 5.7 | -1.0 | 275.7 | 3.9 | 83.6 | 0.0 | n/a | n/a |
| 9-Jun-12 | 1.7 | 5.3 | -0.3 | 271.0 | 4.8 | 84.2 | 0.0 | n/a | n/a |
| 10-Jun-12 | 2.0 | 4.6 | -0.9 | 185.2 | 3.8 | 84.0 | 0.0 | n/a | n/a |
| 11-Jun-12 | 2.7 | 5.8 | 0.2 | 221.7 | 3.3 | 85.9 | 0.0 | n/a | n/a |
| 12-Jun-12 | 2.1 | 4.9 | -0.8 | 176.4 | 3.4 | 87.5 | 0.0 | n/a | n/a |
| 13-Jun-12 | 1.7 | 3.4 | -0.3 | 123.3 | 6.7 | 89.5 | 0.5 | n/a | n/a |
| 14-Jun-12 | 2.4 | 3.4 | 1.2 | 80.5 | 8.7 | 90.7 | 0.3 | n/a | n/a |
| 15-Jun-12 | 3.7 | 7.0 | 1.0 | 225.3 | 5.1 | 81.9 | 0.0 | n/a | n/a |
| 16-Jun-12 | 6.2 | 10.9 | -0.2 | 331.6 | 4.7 | 73.7 | 0.0 | n/a | n/a |
| 17-Jun-12 | 5.9 | 10.1 | 1.8 | 337.1 | 6.7 | 77.7 | 0.0 | n/a | n/a |
| 18-Jun-12 | 4.7 | 11.4 | -0.5 | 306.8 | 4.9 | 79.7 | 0.0 | n/a | n/a |
| 19-Jun-12 | 3.2 | 8.8 | -1.3 | 296.6 | 6.2 | 86.4 | 0.0 | n/a | n/a |
| 20-Jun-12 | 4.0 | 7.1 | 1.9 | 77.0 | 6.1 | 90.6 | 3.0 | n/a | n/a |
| 21-Jun-12 | 5.8 | 9.4 | 1.6 | 273.7 | 4.7 | 82.3 | 0.0 | n/a | n/a |
| 22-Jun-12 | 7.8 | 11.7 | 4.5 | 211.3 | 3.9 | 77.3 | 0.0 | n/a | n/a |
| 23-Jun-12 | 11.9 | 19.2 | 5.3 | 300.2 | 3.9 | 69.0 | 0.0 | n/a | n/a |
| 24-Jun-12 | 7.1 | 11.9 | 2.3 | 300.6 | 3.7 | 73.0 | 0.0 | n/a | n/a |
| 25-Jun-12 | 7.2 | 12.4 | 1.5 | 336.5 | 6.0 | 74.6 | 0.0 | n/a | n/a |
| 26-Jun-12 | 6.6 | 8.8 | 2.1 | 277.1 | 5.8 | 77.4 | 0.0 | n/a | n/a |
| 27-Jun-12 | 6.3 | 9.7 | 3.2 | 118.7 | 3.4 | 87.2 | 0.0 | n/a | n/a |
| 28-Jun-12 | 6.5 | 9.4 | 3.8 | 165.9 | 5.9 | 85.3 | 0.0 | n/a | n/a |
| 29-Jun-12 | 9.6 | 13.7 | 4.9 | 315.8 | 4.1 | 68.3 | 0.0 | n/a | n/a |
| 30-Jun-12 | 12.4 | 16.1 | 5.3 | 325.3 | 1.9 | 61.4 | 0.0 | n/a | n/a |
| 1-Jul-12 | 15.3 | 20.6 | 7.2 | 322.0 | 2.0 | 59.8 | 0.0 | n/a | n/a |
| 2-Jul-12 | 13.6 | 17.0 | 9.5 | 324.6 | 4.2 | 67.2 | 0.0 | n/a | n/a |
| 3-Jul-12 | 13.8 | 20.5 | 7.2 | 321.3 | 3.8 | 60.7 | 0.0 | n/a | n/a |
| 4-Jul-12 | 15.0 | 18.9 | 10.4 | 324.4 | 3.4 | 54.0 | 0.0 | n/a | n/a |
| 5-Jul-12 | 15.3 | 19.2 | 8.9 | 314.9 | 3.0 | 59.1 | 0.0 | n/a | n/a |
| 6-Jul-12 | 14.6 | 18.3 | 9.0 | 321.4 | 2.7 | 59.2 | 0.0 | n/a | n/a |
| 7-Jul-12 | 15.6 | 22.5 | 8.2 | 279.3 | 2.9 | 55.3 | 0.0 | n/a | n/a |
| 8-Jul-12 | 14.9 | 18.6 | 11.0 | 321.2 | 5.1 | 62.8 | 0.3 | n/a | n/a |
| 9-Jul-12 | 15.3 | 21.3 | 7.6 | 291.5 | 5.3 | 65.4 | 0.0 | n/a | n/a |
| 10-Jul-12 | 13.2 | 17.5 | 10.0 | 284.6 | 8.0 | 78.3 | 0.0 | n/a | n/a |
| 11-Jul-12 | 11.9 | 15.5 | 8.4 | 232.9 | 4.1 | 70.9 | 0.0 | n/a | n/a |
| 12-Jul-12 | 12.8 | 16.1 | 9.2 | 215.0 | 3.1 | 61.2 | 0.0 | 3.5 | 3.9 |
| 13-Jul-12 | 13.7 | 17.1 | 8.5 | 291.8 | 2.4 | 57.3 | 0.0 | 3.2 | 3.6 |
| 14-Jul-12 | 14.4 | 18.5 | 8.8 | 301.2 | 3.5 | 51.5 | 0.0 | 4.1 | 4.8 |
| 15-Jul-12 | 15.1 | 19.0 | 9.3 | 308.1 | 3.5 | 53.7 | 0.0 | 5.0 | 5.5 |
| 16-Jul-12 | 16.8 | 22.6 | 12.1 | 247.9 | 6.5 | 61.6 | 0.0 | 4.9 | 5.4 |

**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (˚C) | Daily Maximum Air Temperature (˚C) | Daily Minimum Air Temperature (˚C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 17-Jul-12 | 16.9 | 24.5 | 13.2 | 159.6 | 6.4 | 67.4 | 1.0 | 4.8 | 4.7 |
| 18-Jul-12 | 13.3 | 17.0 | 10.8 | 120.5 | 6.5 | 87.1 | 0.3 | 3.1 | 3.0 |
| 19-Jul-12 | 12.7 | 16.3 | 10.5 | 155.6 | 5.9 | 88.1 | 0.0 | 2.5 | 2.7 |
| 20-Jul-12 | 10.9 | 13.7 | 8.1 | 159.6 | 5.2 | 80.3 | 1.5 | 2.8 | 3.2 |
| 21-Jul-12 | 13.7 | 18.4 | 7.2 | 298.5 | 3.2 | 58.8 | 0.0 | 2.1 | 2.2 |
| 22-Jul-12 | 15.4 | 23.2 | 10.3 | 218.0 | 4.9 | 71.1 | 13.0 | 4.4 | 4.8 |
| 23-Jul-12 | 8.2 | 12.7 | 6.1 | 154.3 | 7.7 | 74.2 | 1.3 | 3.7 | 4.0 |
| 24-Jul-12 | 13.9 | 18.9 | 7.9 | 249.0 | 5.4 | 57.2 | 0.0 | 2.2 | 2.0 |
| 25-Jul-12 | 11.6 | 17.3 | 5.5 | 153.6 | 5.8 | 76.2 | 0.8 | 4.2 | 4.5 |
| 26-Jul-12 | 8.7 | 10.0 | 5.1 | 97.2 | 3.8 | 79.9 | 2.8 | 2.4 | 2.4 |
| 27-Jul-12 | 7.9 | 9.2 | 6.6 | 125.3 | 7.2 | 75.6 | 0.3 | 0.6 | 0.5 |
| 28-Jul-12 | 7.8 | 10.1 | 6.4 | 147.9 | 8.0 | 80.8 | 2.3 | 1.6 | 1.4 |
| 29-Jul-12 | 9.9 | 13.3 | 7.4 | 271.9 | 6.3 | 72.6 | 0.0 | 1.9 | 1.9 |
| 30-Jul-12 | 6.2 | 7.7 | 4.3 | 101.0 | 4.1 | 74.9 | 0.0 | 3.7 | 3.9 |
| 31-Jul-12 | 8.9 | 12.3 | 5.6 | 228.2 | 2.6 | 68.2 | 0.0 | 1.2 | 1.1 |
| 1-Aug-12 | 11.3 | 16.3 | 5.7 | 268.0 | 2.9 | 67.0 | 0.0 | 3.0 | 3.4 |
| 2-Aug-12 | 12.8 | 16.9 | 7.6 | 261.6 | 2.7 | 69.6 | 0.0 | 3.2 | 3.6 |
| 3-Aug-12 | 17.0 | 24.6 | 8.7 | 258.6 | 2.8 | 57.1 | 0.0 | 3.2 | 3.6 |
| 4-Aug-12 | 17.1 | 24.0 | 10.1 | 184.7 | 4.3 | 61.0 | 0.0 | 4.0 | 4.4 |
| 5-Aug-12 | 12.4 | 16.6 | 9.8 | 180.2 | 4.3 | 73.9 | 0.0 | 2.8 | 2.7 |
| 6-Aug-12 | 12.3 | 15.1 | 9.2 | 153.5 | 3.9 | 73.7 | 0.0 | 2.6 | 2.7 |
| 7-Aug-12 | 14.5 | 19.8 | 9.4 | 216.3 | 4.6 | 69.4 | 0.0 | 2.4 | 2.5 |
| 8-Aug-12 | 16.2 | 21.0 | 11.5 | 172.0 | 4.3 | 69.6 | 0.0 | 3.4 | 3.6 |
| 9-Aug-12 | 12.8 | 14.5 | 9.7 | 84.7 | 3.1 | 85.5 | 0.5 | 3.1 | 3.3 |
| 10-Aug-12 | 9.9 | 12.0 | 6.2 | 102.2 | 1.9 | 79.9 | 0.0 | 0.9 | 0.9 |
| 11-Aug-12 | 10.5 | 13.3 | 7.1 | 165.6 | 6.5 | 74.9 | 0.0 | 0.8 | 0.8 |
| 12-Aug-12 | 6.7 | 8.7 | 4.9 | 116.1 | 7.0 | 72.8 | 1.8 | 2.2 | 2.2 |
| 13-Aug-12 | 5.6 | 7.4 | 4.0 | 114.9 | 3.4 | 72.3 | 0.3 | 1.0 | 0.6 |
| 14-Aug-12 | 4.7 | 7.2 | 3.1 | 153.3 | 6.5 | 73.1 | 0.5 | 1.0 | 1.0 |
| 15-Aug-12 | 4.2 | 5.5 | 2.8 | 76.2 | 4.1 | 60.3 | 0.0 | 1.6 | 1.5 |
| 16-Aug-12 | 4.0 | 5.9 | 2.4 | 151.0 | 3.4 | 65.6 | 0.0 | 0.7 | 0.4 |
| 17-Aug-12 | 6.3 | 9.9 | 4.0 | 137.8 | 5.9 | 77.4 | 0.0 | 1.4 | 1.4 |
| 18-Aug-12 | 11.9 | 18.5 | 4.9 | 169.4 | 6.5 | 79.0 | 0.0 | 1.6 | 1.4 |
| 19-Aug-12 | 11.3 | 13.4 | 8.6 | 77.5 | 7.9 | 87.8 | 0.0 | 2.4 | 2.3 |
| 20-Aug-12 | 6.6 | 8.6 | 5.8 | 48.9 | 10.0 | 89.9 | 0.3 | 1.4 | 1.4 |
| 21-Aug-12 | 7.0 | 8.4 | 5.7 | 71.0 | 10.1 | 87.7 | 0.3 | 0.2 | 0.0 |
| 22-Aug-12 | 7.3 | 8.7 | 6.1 | 70.3 | 6.9 | 91.8 | 3.0 | 0.8 | 0.6 |
| 23-Aug-12 | 8.0 | 11.1 | 5.3 | 139.2 | 4.0 | 89.2 | 0.0 | 0.7 | 0.6 |
| 24-Aug-12 | 9.0 | 11.4 | 7.1 | 93.6 | 2.1 | 88.4 | 0.0 | 1.9 | 2.2 |
| 25-Aug-12 | 9.8 | 13.3 | 7.2 | 154.0 | 4.6 | 82.1 | 0.0 | 1.1 | 1.3 |
| 26-Aug-12 | 11.7 | 18.0 | 5.0 | 187.1 | 3.1 | 72.5 | 0.0 | 1.9 | 2.0 |
| 27-Aug-12 | 10.4 | 13.0 | 9.1 | 42.6 | 6.9 | 86.1 | 2.8 | 2.1 | 2.3 |
| 28-Aug-12 | 8.5 | 10.4 | 7.1 | 61.8 | 5.2 | 91.6 | 0.0 | 0.2 | 0.0 |
| 29-Aug-12 | 8.8 | 11.0 | 7.6 | 64.1 | 1.6 | 88.2 | 1.8 | 0.8 | 0.8 |
| 30-Aug-12 | 7.1 | 8.3 | 4.5 | 78.9 | 4.7 | 87.9 | 1.5 | 0.2 | 0.2 |
| 31-Aug-12 | 10.6 | 15.6 | 4.6 | 145.3 | 5.6 | 73.1 | 0.0 | 0.2 | 0.1 |
| 1-Sep-12 | 8.2 | 14.3 | 2.9 | 116.5 | 5.7 | 71.1 | 0.5 | 1.9 | 1.8 |
| 2-Sep-12 | 7.3 | 11.6 | 2.0 | 153.8 | 5.7 | 72.6 | 0.0 | 1.2 | 0.9 |
| 3-Sep-12 | 10.7 | 17.6 | 7.6 | 114.7 | 7.3 | 81.2 | 0.0 | 1.5 | 1.2 |
| 4-Sep-12 | 4.7 | 7.8 | 3.8 | 35.6 | 6.9 | 90.1 | 0.5 | 1.6 | 1.5 |
| 5-Sep-12 | 6.5 | 8.9 | 4.2 | 42.2 | 6.8 | 92.2 | 0.5 | 0.2 | 0.0 |
| 6-Sep-12 | 12.9 | 18.3 | 8.1 | 72.8 | 8.0 | 75.3 | 0.0 | 0.3 | 0.0 |
| 7-Sep-12 | 9.1 | 11.2 | 7.0 | 116.0 | 9.2 | 81.9 | 0.0 | 1.4 | 1.1 |
| 8-Sep-12 | 7.8 | 11.2 | 3.8 | 114.7 | 7.1 | 76.7 | 1.5 | n/a | n/a |
| 9-Sep-12 | 6.0 | 8.4 | 0.7 | 144.7 | 6.6 | 68.4 | 0.0 | n/a | n/a |
| 10-Sep-12 | 4.8 | 8.2 | 0.5 | 125.7 | 2.1 | 77.0 | 0.0 | n/a | n/a |
| 11-Sep-12 | 3.5 | 5.8 | 1.2 | 104.6 | 5.5 | 79.4 | 0.0 | n/a | n/a |
| 12-Sep-12 | 4.3 | 6.9 | 1.5 | 100.2 | 3.0 | 69.5 | 0.0 | n/a | n/a |

**Appendix A. Doris Meteorological Station and Doris Micro-Meteorological Station, Daily Data, October 2011 and September 2012**

| | Doris Meteorological Station | | | | | | | Doris Micro-Meteorological Station, Calculated Daily Evaporation (mm)[2] | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Mean Daily Air Temperature (˚C) | Daily Maximum Air Temperature (˚C) | Daily Minimum Air Temperature (˚C) | Mean Daily Solar Radiation ($W/m^2$) | Mean Daily Wind Speed (m/s) | Mean Daily Relative Humidity (%) | Total Daily Precipitation (mm)[1] | Penman method | Priestly-Taylor Method |
| 13-Sep-12 | 4.5 | 6.0 | 2.9 | 41.0 | 6.5 | 89.0 | 0.0 | n/a | n/a |
| 14-Sep-12 | 3.2 | 5.0 | 1.9 | 75.5 | 6.8 | 83.6 | 0.0 | n/a | n/a |
| 15-Sep-12 | 3.4 | 5.6 | 1.6 | 85.5 | 4.2 | 79.3 | 0.0 | n/a | n/a |
| 16-Sep-12 | 4.2 | 6.8 | 1.2 | 111.0 | 2.7 | 67.8 | 0.0 | n/a | n/a |
| 17-Sep-12 | 3.6 | 7.0 | -1.2 | 117.3 | 3.1 | 72.8 | 0.0 | n/a | n/a |
| 18-Sep-12 | 3.1 | 4.1 | 2.4 | 34.8 | 5.2 | 88.0 | 0.0 | n/a | n/a |
| 19-Sep-12 | 1.4 | 3.4 | -0.1 | 51.3 | 4.9 | 81.0 | 0.0 | n/a | n/a |
| 20-Sep-12 | 0.8 | 3.6 | -0.9 | 63.3 | 3.1 | 86.4 | 0.0 | n/a | n/a |
| 21-Sep-12 | 3.6 | 9.1 | -0.8 | 83.7 | 3.0 | 86.0 | 0.0 | n/a | n/a |
| 22-Sep-12 | 5.8 | 12.2 | 2.2 | 37.5 | 9.6 | 87.8 | 2.5 | n/a | n/a |
| 23-Sep-12 | 1.8 | 3.6 | 0.5 | 34.4 | 6.0 | 90.2 | 0.0 | n/a | n/a |
| 24-Sep-12 | 2.8 | 6.4 | -0.8 | 42.0 | 9.2 | 86.4 | 0.0 | n/a | n/a |
| 25-Sep-12 | 6.2 | 9.6 | 4.9 | 26.9 | 6.2 | 90.2 | 0.0 | n/a | n/a |
| 26-Sep-12 | 3.8 | 6.1 | 2.3 | 58.9 | 6.9 | 90.6 | 0.0 | n/a | n/a |
| 27-Sep-12 | 7.0 | 11.6 | 2.6 | 45.4 | 4.5 | 84.3 | 0.0 | n/a | n/a |
| 28-Sep-12 | 8.5 | 11.7 | 5.5 | 67.3 | 12.0 | 74.1 | 0.3 | n/a | n/a |
| 29-Sep-12 | 5.0 | 6.6 | 3.5 | 47.0 | 9.6 | 86.8 | 0.0 | n/a | n/a |
| 30-Sep-12 | 2.7 | 5.9 | -0.6 | 87.5 | 1.3 | 85.0 | 0.0 | n/a | n/a |

*n/a = not available*

*1. Precipitation measured from February to May includes snowfall and rainfall. Precipitation measured in all other months only includes rainfall.*

*2. Evaporation was only measured between July 12 and September 7, 2012.*