



Carbon Based Environmental  
Pty Limited  
ABN 74 102 920 285

**Rocla Quarry Products  
Calga Quarry**

**Environmental Monitoring**

**Dust Deposition Gauges, Surface and Ground  
Waters and Meteorological Station**

**January 2016**

A handwritten signature in black ink, appearing to read 'Colin Davies'.

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Colin Davies BSc MEIA CENVP  
Environmental Scientist  
Date: 18 February 2016

## Executive Summary

Carbon Based Environmental is contracted by Rocla Quarry Products to conduct environmental monitoring at the Calga Sand Quarry.

The monitoring includes;

- Dust Deposition Gauges;
- Surface Waters;
- Groundwaters; and
- Meteorological Station.

This report was prepared by Carbon Based Environmental and includes the following;

- Dust Deposition results for January 2016;
- Surface Water quality results for January 2016;
- Ground Water quality results for January 2016; and
- Meteorological report for January 2016.

The January 2016 dust deposition results for insoluble solids were generally low and free of major contamination. All sites, on a rolling annual average basis, are currently below the Air Quality Management Plan exceedance level of 3.7g/m<sup>2</sup>.month. Results were found to be representative of dust levels as determined by the Australian Standard.

Surface water samples were collected on 2 February 2016 at sites A, B, D and F. Site C was inaccessible and was unable to be sampled this month. The samples were collected and analysed for a monthly sampling event. Results show pH within the slightly acidic range, low Electrical Conductivity, low Total Dissolved Solids and low Total Suspended Solids. Oil and Grease was detected at Site B in January 2016.

Bi-monthly groundwater were collected on 2 February 2016 and bimonthly groundwater is next due for sampling in March 2016. Groundwater depth generally decreased compared to November 2015, indicating water moving towards the surface. pH at all sites is in the acidic to neutral range and generally increased when compared to the previous results with the exception of CQ3 which decreased in pH. EC levels slightly decreased at a majority of groundwater sites when compared to the results obtained in November 2015.

Data for January 2016 shows that rainfall recorded at the Rocla Calga Quarry was lower than the Gosford BOM mean rainfall however significantly higher than the Peats Ridge long term rainfall for January.

The rainfall comparison is provided below:

Rocla Calga Quarry	246.4 mm
BOM Peats Ridge*	NA
BOM Gosford*	305 mm
BOM Peats Ridge Long term mean for January*	113.3 mm

\*Data sourced from Bureau of Meteorology (BOM) website ([www.bom.gov.au](http://www.bom.gov.au)).

**Note:** Differences in the daily rainfall readings between BOM and the Rocla station may occur due to BOM stations reporting rainfall at 9am and the Rocla station recording rainfall at midnight.

## Sampling Program

Rocla Calga Quarry conducts environmental monitoring in accordance to Development Consent, OEH (EPA) licence and Environmental Management Plans. Carbon Based Environmental are contracted to undertake dust deposition gauge, surface and groundwater and meteorological monitoring for the project. Carbon Based Environmental commenced monitoring from the April 2006 monitoring period.

Dust deposition gauges are operated to the Australian Standard AS3580.10.1 “Methods for Sampling and Analysis of Ambient Air Method 10.1 Determination of Particulates—Deposited Matter—Gravimetric Method”. Sampling is undertaken every 30 +/- 2 days and each gauge is analysed for insoluble solids and ash residue. The results are reported as g/m<sup>2</sup>.month.

Surface waters are sampled in accordance with Australian Standards AS5667.1 “Guidance on the Design of Sample Programs, Sampling Techniques and the Preservation and Handling of Samples”, AS5667.6 “Water Quality Sampling—Guidance on sampling of rivers and streams” and AS5667.4 “Water Quality Sampling—Guidance on sampling from lakes, natural and man-made”. Surface water monitoring sites include local streams and dams. Basic analysis including pH, Electrical Conductivity, Total Suspended Solids, Total Dissolved Solids and Total Oil and Grease is conducted monthly at Sites A and F (dams) and when Sites B, C and D are flowing. Additional samples are collected when daily rainfall exceeds 50mm.

Groundwaters are sampled in accordance with Australian Standards AS5667.1 “Guidance on the Design of Sample Programs, Sampling Techniques and the Preservation and Handling of Samples” and AS5667.11 “Water Quality Sampling—Guidance on sampling of ground waters”. Groundwater monitoring sites are sampled bi-monthly for depth and water quality. Groundwater monitoring loggers continuously record water levels in a selection of bores.

Meteorological monitoring is conducted at the quarry and displayed on the site computer with a real time display. Wind parameters are measured according to Australian Standard AS 2923 “Ambient Air— Guide for Measurement of Horizontal Wind for Air Quality Applications”.

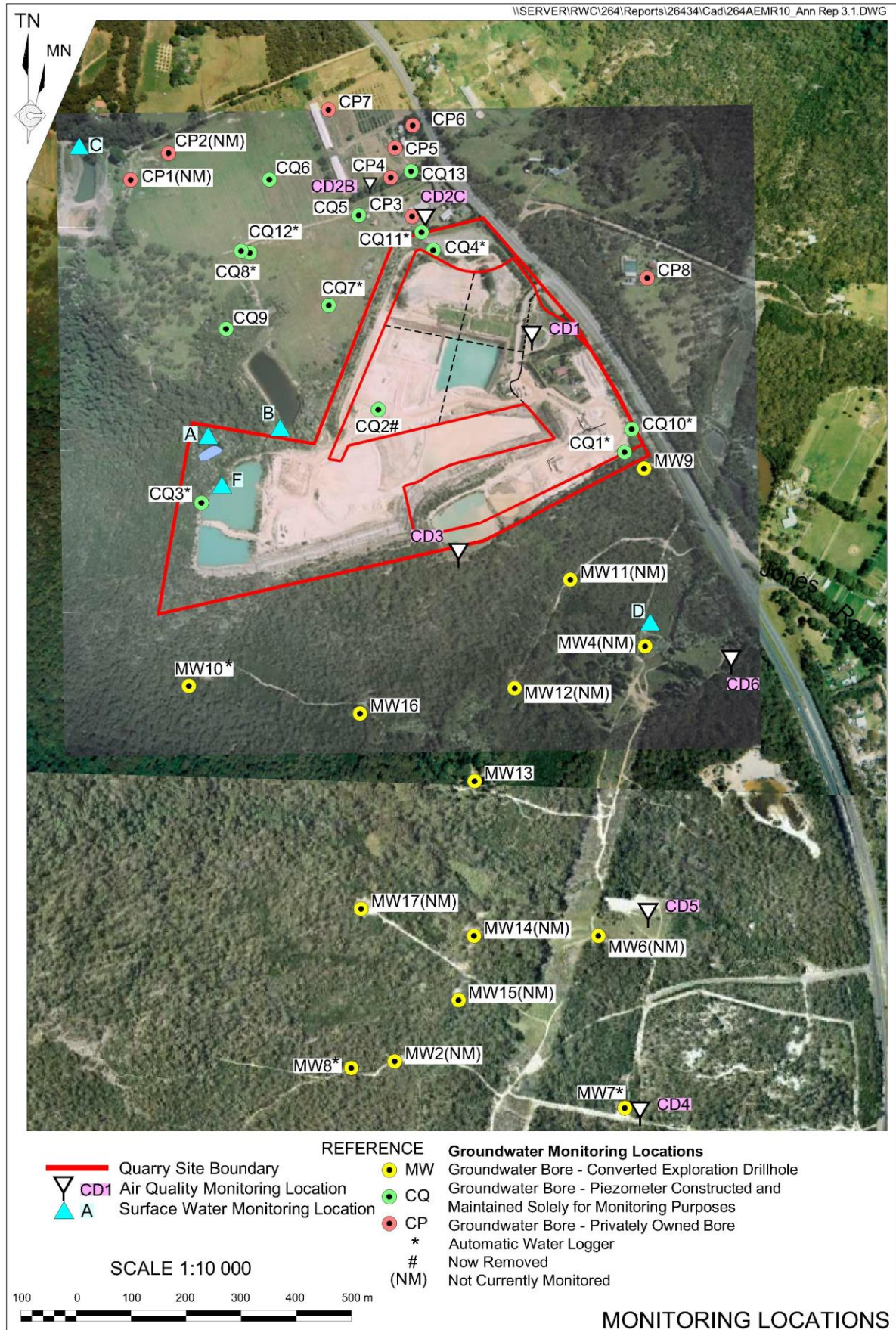
The weather stations have the following sensor configuration;

Air temperature

- Humidity
- Rainfall
- Atmospheric pressure
- Evaporation
- Solar radiation
- Wind speed
- Wind direction

Carbon Based Environmental continued to operate the monitoring equipment and utilise site collections at their existing locations.

The locations of monitoring points are provided in **Figure 1**.



**Figure 1:** Rocla Calga Quarry environmental monitoring locations

## 2.0 Monthly Results

### 2.1 Dust Deposition Gauges

**Table 1** displays the results for January 2016 and the project 12 month rolling average. Results are in g/m<sup>2</sup>.month.

**Table 1: Dust Deposition results: 4 January 2016 – 2 February 2016 (29 days)**

Site	Monthly Insoluble Solids g/m <sup>2</sup> .month	Monthly Ash Residue g/m <sup>2</sup> .month	Monthly Combustible Matter g/m <sup>2</sup> .month	Monthly Ash Residue/ Insoluble Solids %	Rolling Annual Average Insoluble Solids g/m <sup>2</sup> .month
<b>CD1</b>	1.1	0.4	0.7	36	1.1
<b>CD2c</b>	0.9	0.5	0.4	56	1.2
<b>CD3</b>	1.0	0.6	0.4	60	0.8
<b>CD4</b>	1.2	0.3	0.9	25	0.7
<b>CD5</b>	0.4	0.2	0.2	50	0.6
<b>CD6</b>	0.4	0.2	0.2	50	0.6

Insoluble Solids marked with an \* indicate an excessively contaminated gauge. Contamination can include bird droppings, vegetation (such as plant matter, algae, pollen and seeds) and insects. Results in bold indicate insoluble solids levels above 3.7 g/m<sup>2</sup>.month; the Development Consent's annual average amenity criteria at residential locations. The current rolling annual average is calculated from February 2015 to January 2016.

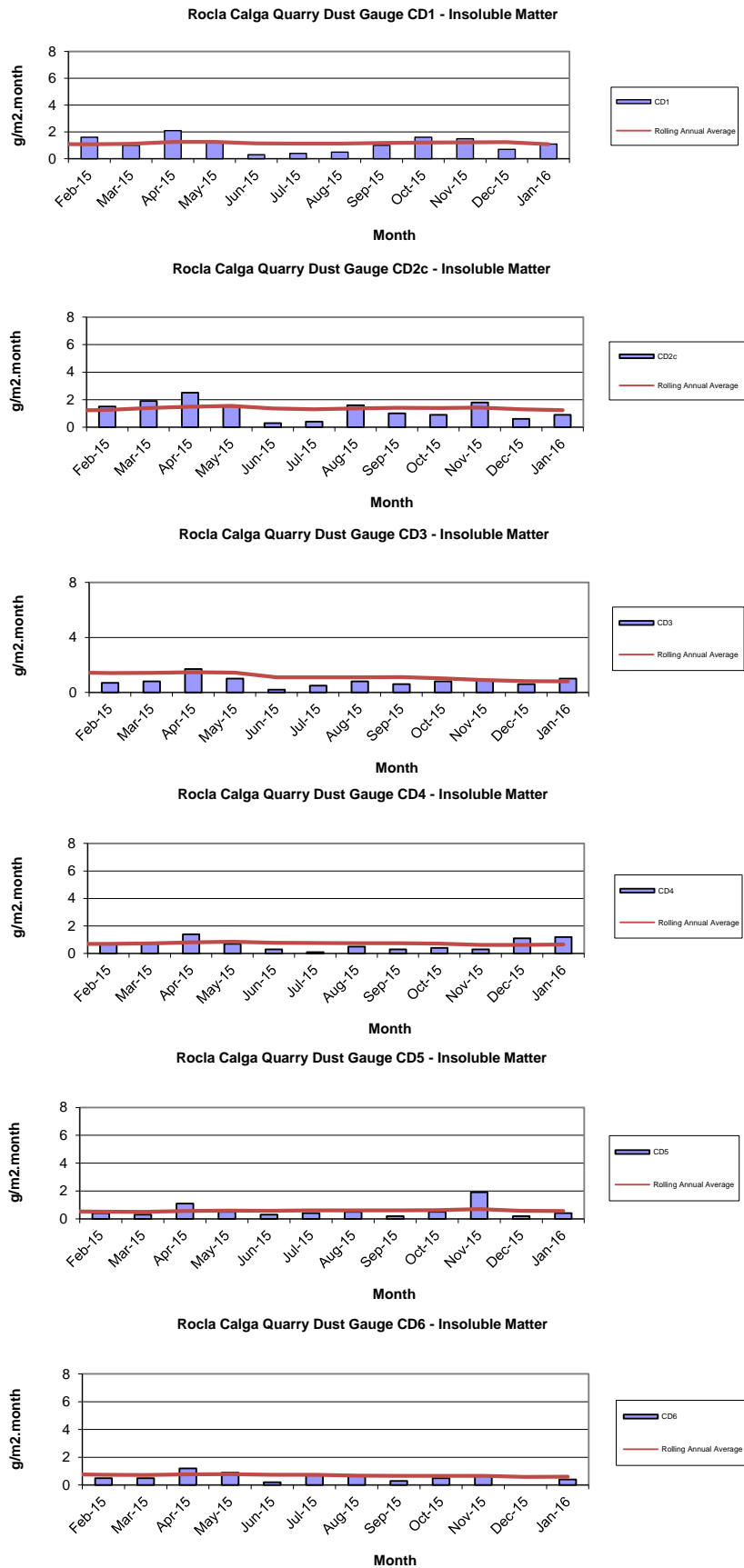
NA= Not Available.

CD1 was installed on the 1 May 2006. CD2a was discontinued at the start of August 2006 due to quarry operations "mining out" the site of the gauge. The replacement gauge, Site CD2b, was located in a position adjacent to the boundary between B. Kashouli and F. & J. Gazzana in conformance with the Air Quality Management Plan. CD4 was installed on 3 October 2006, to gauge air quality impacts to the south of the site operations, as were CD5 and CD6 which were installed on the 14 December 2006. CD2b was discontinued at the end of January 2010 due to contamination of the gauge by non-quarry related vehicle movements on a track adjacent to the gauge. The replacement gauge, CD2c, was located on a rehabilitated section of land between the extraction area and adjacent resident.

Dust deposition charts for all dust gauge sites appear in **Figure 2** below. The laboratory analysis is provided in **Appendix 1**.



**Figure 2: Dust Deposition Charts**



## 2.2 Surface Water Monitoring

Monthly surface water monitoring was conducted on the 2 February 2016 and results are listed in **Table 2**. The laboratory analysis sheets are provided in **Appendix 1**.

**Table 2: Monthly surface water monitoring – January grab sample results**

Site	Observed Flow Rate	Water Colour	Turbidity	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Oil and Grease (mg/L)
A	Dam	Clear	Clear	5.41	64	44	6	<5
B	Trickle	Clear	Clear	6.59	79	50	<5	<5
C	No Access							
D	Still	Clear	Clear	5.41	83	50	<5	<5
F	Dam	Clear	Slight	5.10	64	36	18	<5

Samples were collected at sites A, B, D and F. Site C was inaccessible and was unable to be sampled this month. The samples were collected and analysed for a monthly sampling event. Results show pH within the slightly acidic range, low Electrical Conductivity, low Total Dissolved Solids and low Total Suspended Solids. Oil and Grease was detected at Site B in January 2016.

### 2.2.1 Non-Routine Surface Water Sampling

The following non routine sampling was undertaken during January 2016;

- Rainfall event sampled by site on the 6 January 2016.
- Site A sampled again on 7 January 2016.

Laboratory analysis certificates are provided in **Appendix 1**.

## 2.3 Groundwater Monitoring

Bi- monthly groundwaters were sampled on 2 February 2016. Water quality tests for pH and electrical conductivity were conducted by Carbon Based Environmental Pty Limited. For water quality purposes, water was purged from the bore until constant pH (+/- 0.1 pH units) and Electrical Conductivity (+/- 5%) was obtained between samples. Data is displayed in **Table 3** and **Figures 3 to 6**.

Groundwater depth generally decreased compared to November 2015, indicating water moving towards the surface. pH at all sites is in the acidic to neutral range and generally increased when compared to the previous results with the exception of CQ3 which decreased in pH. EC levels slightly decreased at a majority of groundwater sites when compared to the results obtained in November 2015.

**Table 3: Groundwater Quality Data**

Reference	Bore	Type	Depth to water TOC (m) April 06	Depth to water TOC (m) This report	pH This report	Electrical Conductivity (µS/cm) This report
<b>CQ1</b>	Voutos	* Monitor	20.59	Removed		
<b>CQ3</b>	Voutos	* Monitor	10.53	10.27	6.0	139
<b>CQ4</b>	Voutos	* Monitor	8.78	10.04	4.8	124
<b>CQ5</b>	Gazzana	DIP Only	8.69	5.86	4.2	172
<b>CQ6</b>	Gazzana	DIP Only	16.00	9.16	6.0	72
<b>CQ7</b>	Gazzana	* Monitor	6.89	5.81	4.6	110
<b>CQ8</b>	Gazzana	* Monitor	11.03	5.33	4.5	141
<b>CQ9</b>	Gazzana	DIP Only	10.10	8.52	Unable to sample- pipe bent	
<b>CQ10</b>	Voutos	* Monitor	NI	25.03	4.7	158
<b>CQ11S</b>	Gazzana	* Monitor	NI	10.15	4.8	162
<b>CQ11D</b>	Gazzana	* Monitor	NI	11.24	4.7	175
<b>CQ12</b>	Gazzana	* Monitor	NI	3.52	4.4	139
<b>CQ13</b>	Kashouli	* Monitor	NI	12.18	4.3	216
<b>CP3</b>	Gazzana	Domestic	10.40	Destroyed		
<b>CP4</b>	Kashouli	Domestic	13.63	2.14	NM	
<b>CP5</b>	Kashouli	Domestic	16.61	6.16	4.3	198
<b>CP6</b>	Kashouli	Domestic	16.27	8.56	4.4	185
<b>CP7</b>	Kashouli	Production	8.56	1.66	5.6	75
<b>CP8</b>	Rozmanec	Domestic	22.17	19.69	4.4	143
<b>MW7</b>	Rocla Bore	* Monitor	15.76	14.75	4.8	117
<b>MW8</b>	Rocla Bore	* Monitor	9.82	6.85	5.1	82
<b>MW9</b>	Rocla Bore	* Monitor	22.44	23.79	4.6	95
<b>MW10</b>	Rocla Bore	* Monitor	15.41	No Access- track eroded		
<b>MW13</b>	Rocla Bore	DIP Only	NI	No Access- track eroded		
<b>MW16</b>	Rocla Bore	DIP Only	NI	No Access- tree across track		
<b>MW17</b>	Rocla Bore	DIP Only		No Access- tree across track		

Notes:

TOC = Water level measured from top of bore case to water.

NM = Not Monitored – unable to sample water due to non-operational pump.

NR = Not Required by resident.

\* = Logger Installed.

NI = These bores were not installed in April 2006 but are now operational. April 2006 was the first set of measurements taken by Carbon Based Environmental Pty Limited.

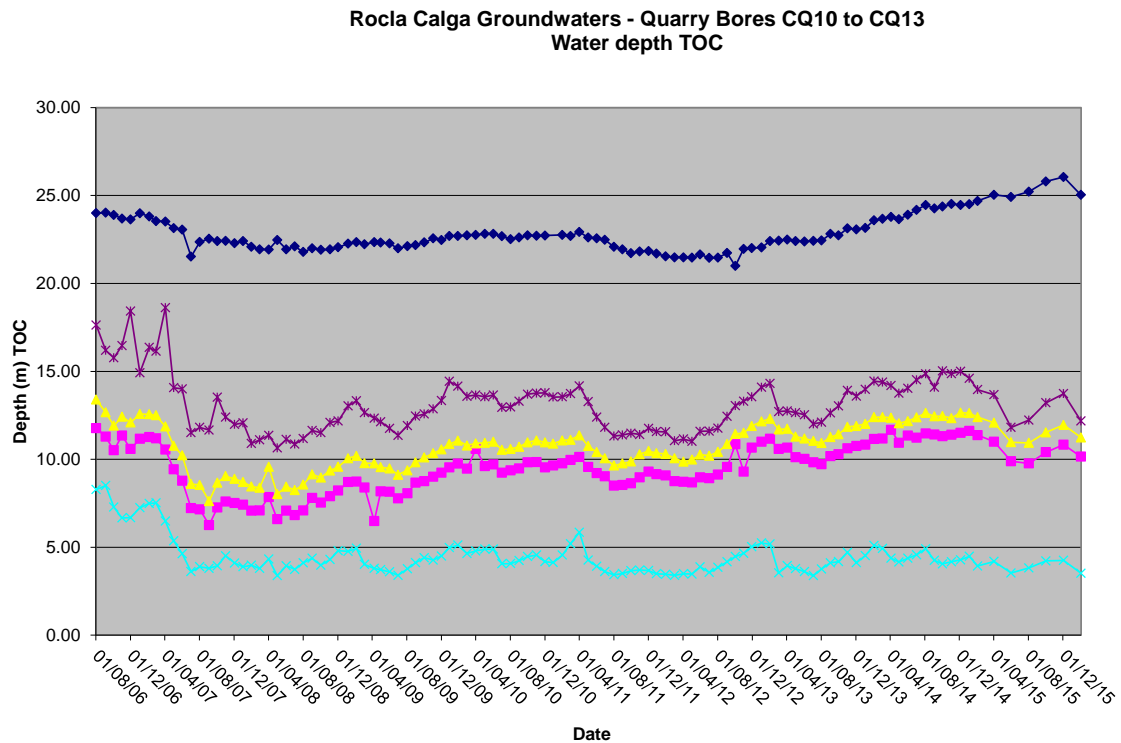
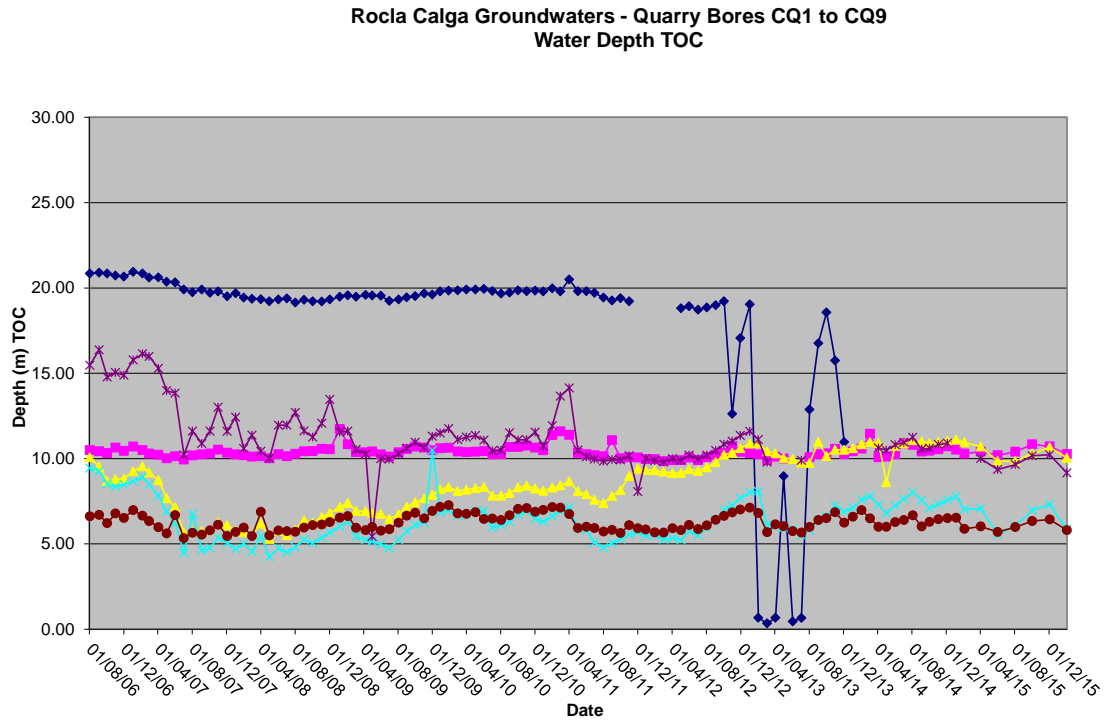
Shading is used to indicate the following trends in water depth (compared to the last reading):

	Increase to ground water depth (water moved away from surface)
	Decrease to ground water depth (water moved towards surface)
	Stable water depth (+/- 0.01m)

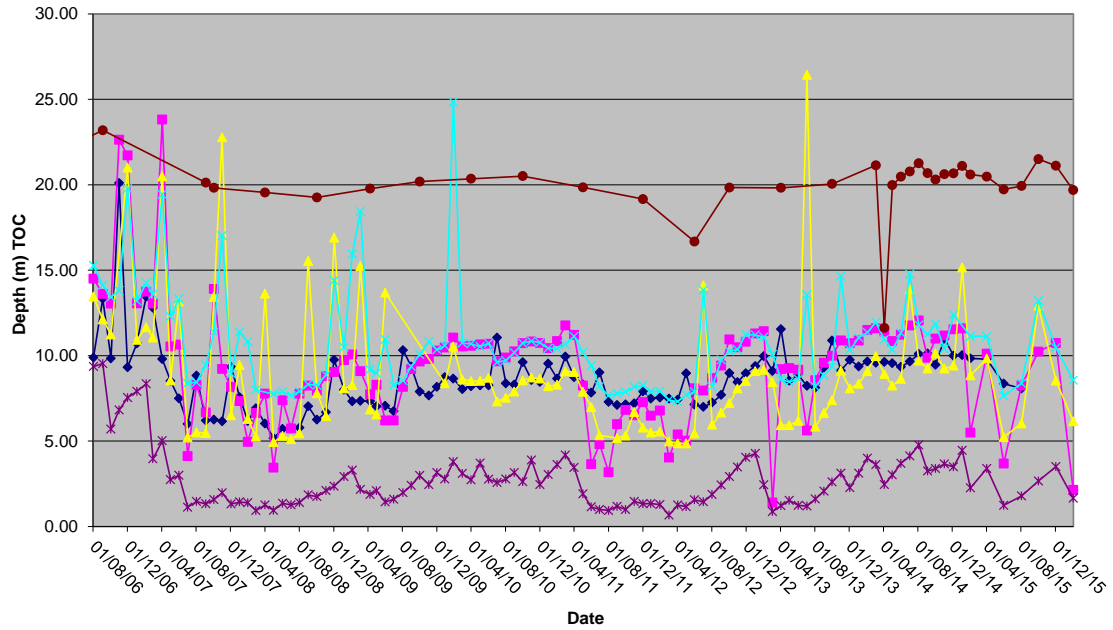
Available groundwater loggers were downloaded and will be forwarded to the Rocla Calga Quarry groundwater consultant.



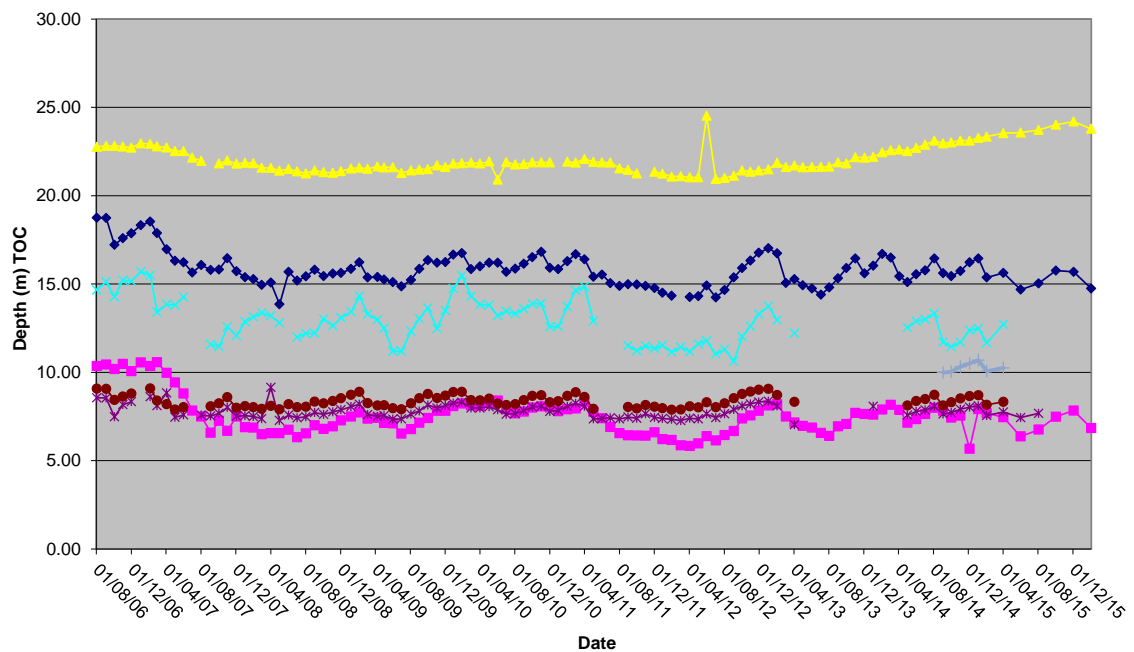
Figures 3 to 6: Groundwater Depth Charts.



Rocla Calga Groundwaters - Quarry Bores CP3 to CP8  
Water Depth TOC



Rocla Calga Groundwaters - Quarry Bores MW7 to MW17  
Water Depth TOC



## 2.4 Meteorological Monitoring

The Rocla Calga Quarry weather station data recovery in January 2016 was approximately 95%. No data was available on the 1 and 2 January 2016 due to damage caused by a lightning strike. No solar radiation data was available for the duration of January 2016.

The weather station data follows and includes;

- Monthly data numerical summary;
- Weather charts of air temperature, humidity, heat index and wind chill, atmospheric pressure, solar radiation, evapotranspiration, rain, wind speed and data reception; and
- Wind rose (frequency distribution diagram of wind speed and direction).

Monthly weather statistics from the nearby Bureau of Meteorology (BOM) at Peats Ridge station are no longer available. However, the long term rainfall mean is available via a link on the Gosford BOM Daily Weather Observation page.

Data for January 2016 shows that rainfall recorded at the Rocla Calga Quarry was lower than the Gosford BOM mean rainfall however significantly higher than the Peats Ridge long term rainfall for January.

The rainfall comparison is provided below:

Rocla Calga Quarry	246.4 mm
BOM Peats Ridge*	NA
BOM Gosford*	305.0 mm
BOM Peats Ridge Long term mean for January*	113.3 mm

NA = Not Available

\*Data sourced from Bureau of Meteorology (BOM) website ([www.bom.gov.au](http://www.bom.gov.au)).

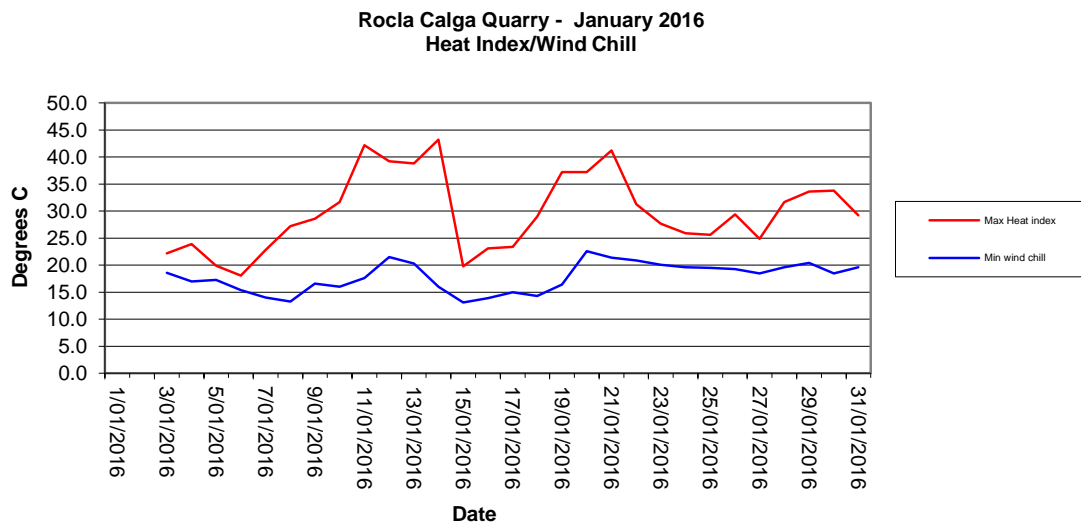
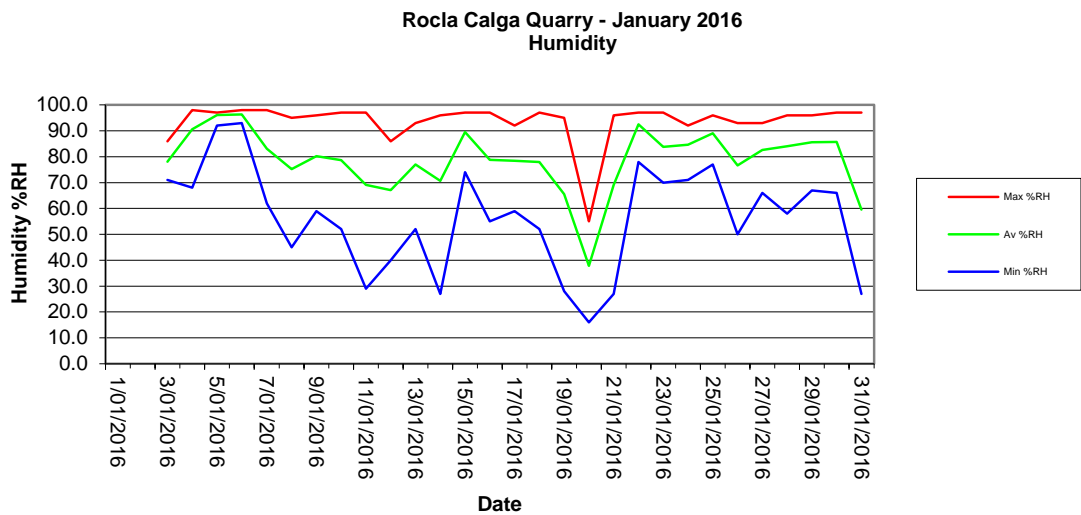
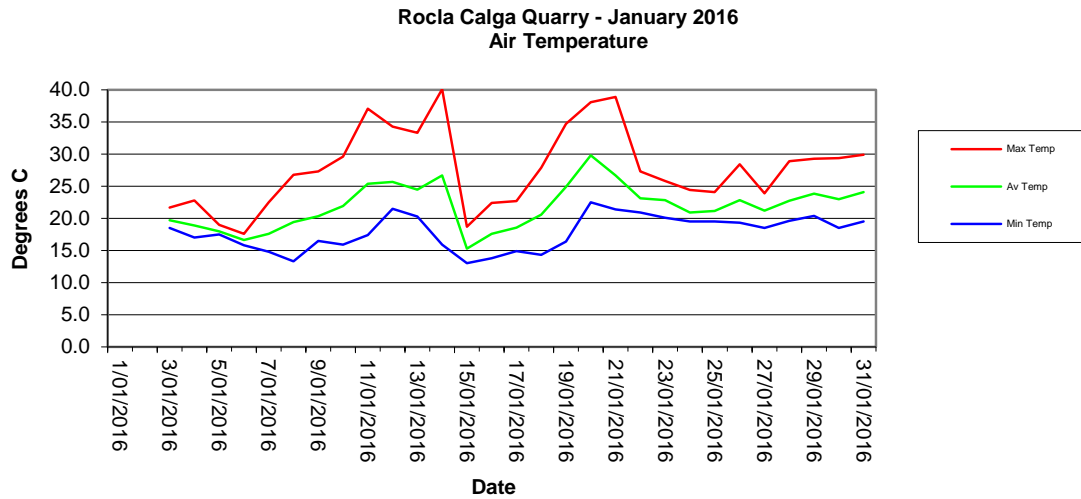
## 2.4.1 Monthly Meteorological Data Summary

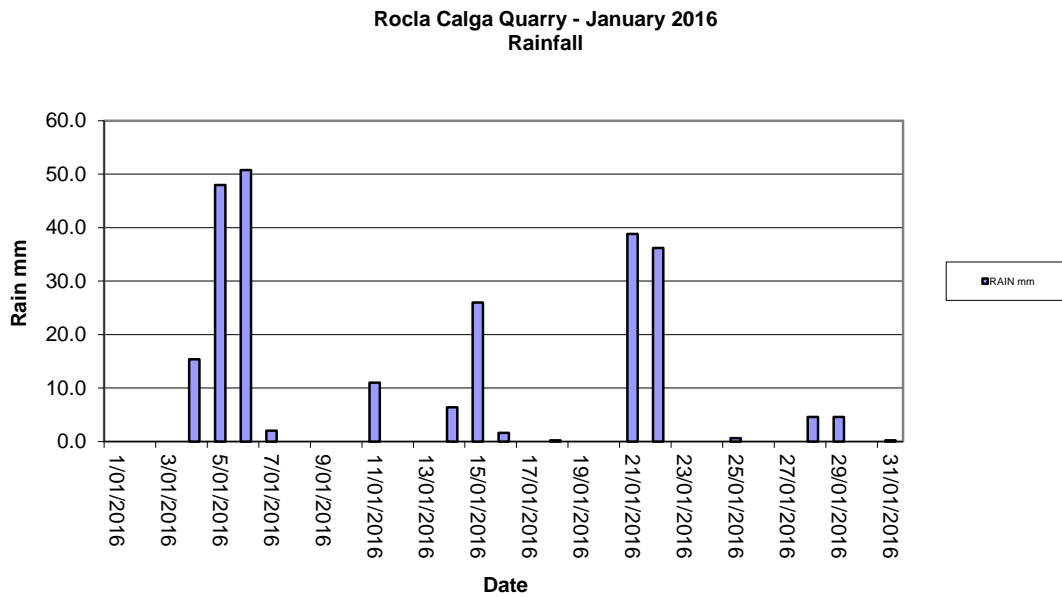
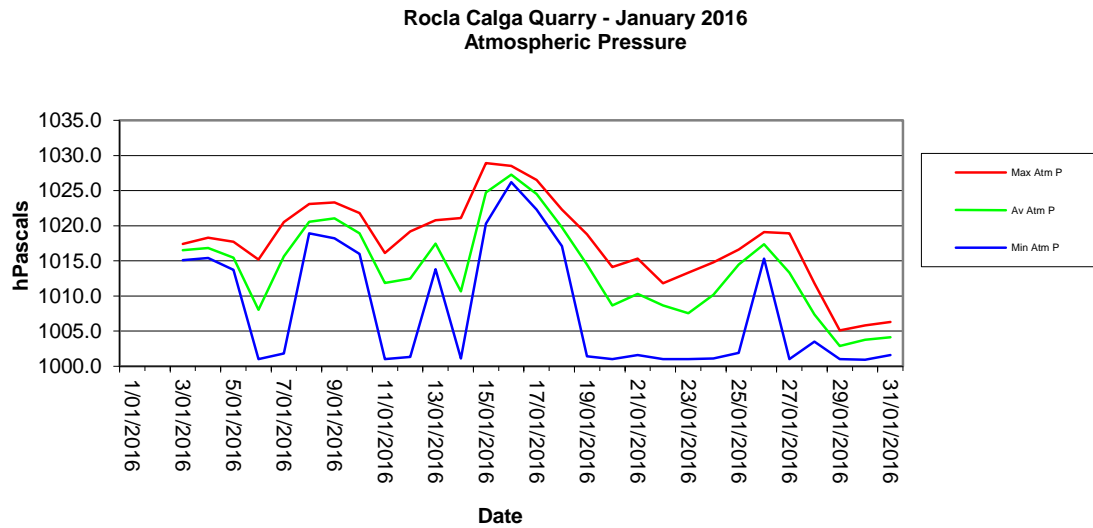
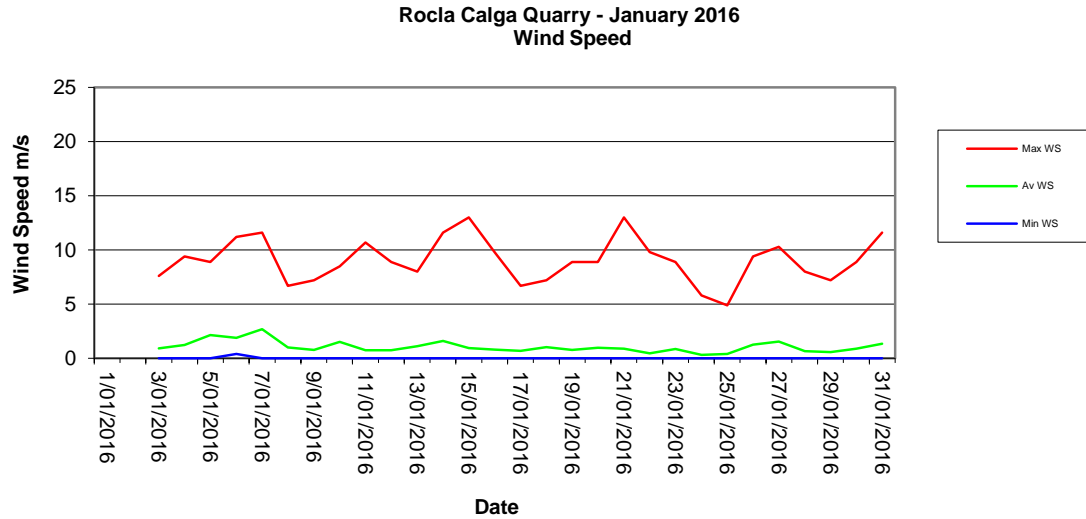
Summary Jan-16 Rocla - Calga

Date	Min Temp	Av Temp	Max Temp	Min %RH	Av %RH	Max %RH	RAIN mm	ET mm	Min WS	Av WS	Max WS	Min wind chill	Max Heat index	Min Atm P	Av Atm P	Max Atm P	Min Solar Rad	Av Solar Rad	Max Solar Rad	Min Data %	Av data %	Max Data %
1/01/2016																						
2/01/2016																						
3/01/2016	18.5	19.7	21.7	71.0	78.1	86.0	0.0	0.0	0.0	0.9	7.6	18.6	22.2	1015.1	1016.5	1017.4				100.0	100.0	100.0
4/01/2016	17.0	18.9	22.8	68.0	90.6	98.0	15.4	0.0	0.0	1.2	9.4	17.0	23.9	1015.4	1016.8	1018.3				97.8	100.0	100.0
5/01/2016	17.5	18.0	19.0	92.0	96.1	97.0	48.0	0.0	0.0	2.1	8.9	17.3	19.9	1013.7	1015.5	1017.7				83.4	98.2	100.0
6/01/2016	15.8	16.6	17.6	93.0	96.4	98.0	50.8	0.0	0.4	1.9	11.2	15.4	18.1	1001.0	1008.0	1015.2				84.3	99.7	100.0
7/01/2016	14.8	17.6	22.5	62.0	83.1	98.0	2.0	0.0	0.0	2.7	11.6	14.0	22.8	1001.8	1015.6	1020.5				93.5	99.8	100.0
8/01/2016	13.3	19.4	26.8	45.0	75.2	95.0	0.0	0.0	0.0	1.0	6.7	13.3	27.2	1018.9	1020.6	1023.1				96.6	99.9	100.0
9/01/2016	16.5	20.3	27.3	59.0	80.2	96.0	0.0	0.0	0.0	0.8	7.2	16.6	28.6	1018.2	1021.1	1023.3				94.5	99.8	100.0
10/01/2016	15.9	21.9	29.6	52.0	78.7	97.0	0.0	0.0	0.0	1.5	8.5	16.0	31.7	1016.0	1018.9	1021.8				93.8	98.9	100.0
11/01/2016	17.4	25.4	37.1	29.0	69.1	97.0	11.0	0.0	0.0	0.8	10.7	17.6	42.2	1001.0	1011.9	1016.1				71.4	97.7	100.0
12/01/2016	21.5	25.7	34.3	40.0	67.1	86.0	0.0	0.0	0.0	0.8	8.9	21.5	39.2	1001.3	1012.5	1019.2				86.5	99.3	100.0
13/01/2016	20.3	24.5	33.3	52.0	77.0	93.0	0.0	0.0	0.0	1.1	8.0	20.3	38.8	1013.8	1017.5	1020.8				95.1	99.3	100.0
14/01/2016	15.9	26.7	40.1	27.0	70.7	96.0	6.4	0.0	0.0	1.6	11.6	16.0	43.2	1001.1	1010.7	1021.1				88.9	98.5	100.0
15/01/2016	13.0	15.3	18.7	74.0	89.5	97.0	26.0	0.0	0.0	0.9	13.0	13.1	19.8	1020.3	1024.7	1028.9				65.5	95.0	100.0
16/01/2016	13.8	17.6	22.4	55.0	78.7	97.0	1.6	0.0	0.0	0.8	9.8	13.9	23.1	1026.2	1027.3	1028.5				92.3	99.6	100.0
17/01/2016	14.9	18.5	22.7	59.0	78.4	92.0	0.0	0.0	0.0	0.7	6.7	15.0	23.4	1022.3	1024.5	1026.5				95.7	99.9	100.0
18/01/2016	14.3	20.6	27.9	52.0	77.9	97.0	0.2	0.0	0.0	1.0	7.2	14.3	29.0	1017.1	1019.8	1022.3				51.1	93.1	100.0
19/01/2016	16.4	24.9	34.7	28.0	65.6	95.0	0.0	0.0	0.0	0.8	8.9	16.4	37.2	1001.4	1014.5	1018.8				90.2	99.3	100.0
20/01/2016	22.5	29.8	38.1	16.0	37.9	55.0	0.0	0.0	0.0	1.0	8.9	22.6	37.2	1001.0	1008.6	1014.1				82.5	97.9	100.0
21/01/2016	21.4	26.7	38.9	27.0	69.1	96.0	38.8	0.0	0.0	0.9	13.0	21.4	41.2	1001.6	1010.3	1015.3				88.3	99.7	100.0
22/01/2016	20.9	23.1	27.3	78.0	92.5	97.0	36.2	0.0	0.0	0.5	9.8	20.9	31.3	1001.0	1008.6	1011.8				63.7	93.3	100.0
23/01/2016	20.1	22.8	25.8	70.0	83.8	97.0	0.0	0.0	0.0	0.9	8.9	20.1	27.7	1001.0	1007.5	1013.3				89.8	98.7	100.0
24/01/2016	19.5	20.9	24.4	71.0	84.6	92.0	0.0	0.0	0.0	0.3	5.8	19.6	25.9	1001.1	1010.2	1014.8				99.4	100.0	100.0
25/01/2016	19.5	21.1	24.1	77.0	89.0	96.0	0.6	0.0	0.0	0.4	4.9	19.5	25.6	1001.9	1014.5	1016.6				75.1	93.2	100.0
26/01/2016	19.3	22.8	28.4	50.0	76.6	93.0	0.0	0.0	0.0	1.3	9.4	19.3	29.4	1015.3	1017.3	1019.1				87.4	94.5	100.0
27/01/2016	18.5	21.2	23.9	66.0	82.7	93.0	0.0	0.0	0.0	1.6	10.3	18.5	24.9	1001.0	1013.3	1018.9				72.6	95.1	100.0
28/01/2016	19.6	22.8	28.9	58.0	84.1	96.0	4.6	0.0	0.0	0.7	8.0	19.6	31.7	1003.5	1007.3	1011.8				63.1	94.0	100.0
29/01/2016	20.4	23.8	29.3	67.0	85.5	96.0	4.6	0.0	0.0	0.6	7.2	20.4	33.6	1001.0	1002.9	1005.1				74.5	93.6	100.0
30/01/2016	18.5	23.0	29.4	66.0	85.7	97.0	0.0	0.0	0.0	0.9	8.9	18.5	33.8	1000.9	1003.8	1005.8				72.6	92.1	100.0
31/01/2016	19.5	24.1	29.9	27.0	59.5	97.0	0.2	0.0	0.0	1.4	11.6	19.6	29.2	1001.6	1004.1	1006.3				78.1	83.9	91.5
Monthly	13	21.9	40.1	16	79	98	246.4	0.0	0	1.1	13	13.1	43.2	1000.9	1014.0	1028.9				51.1	97.0	100

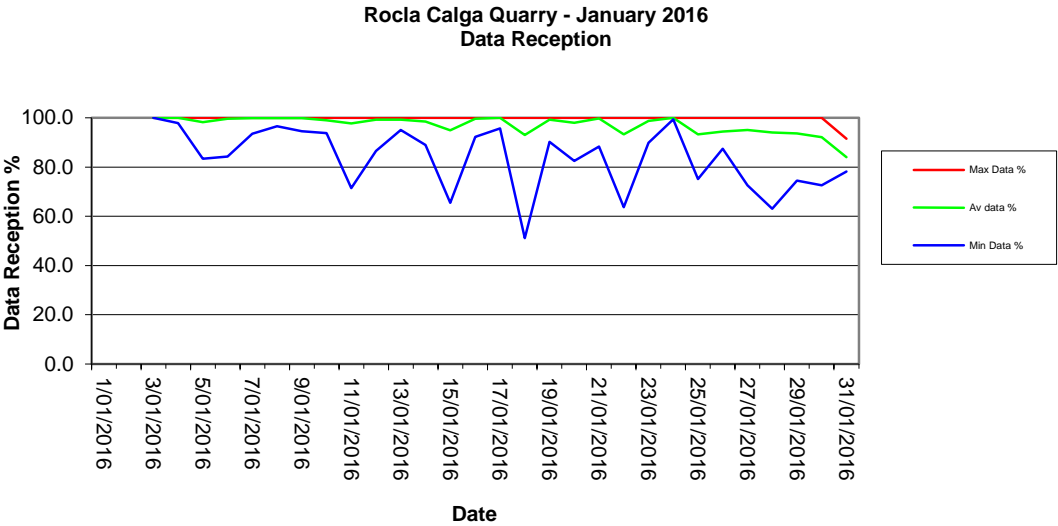
No data on the 1 and 2 January 2016 due to a lightning strike

## 2.4.2 Monthly Weather Charts





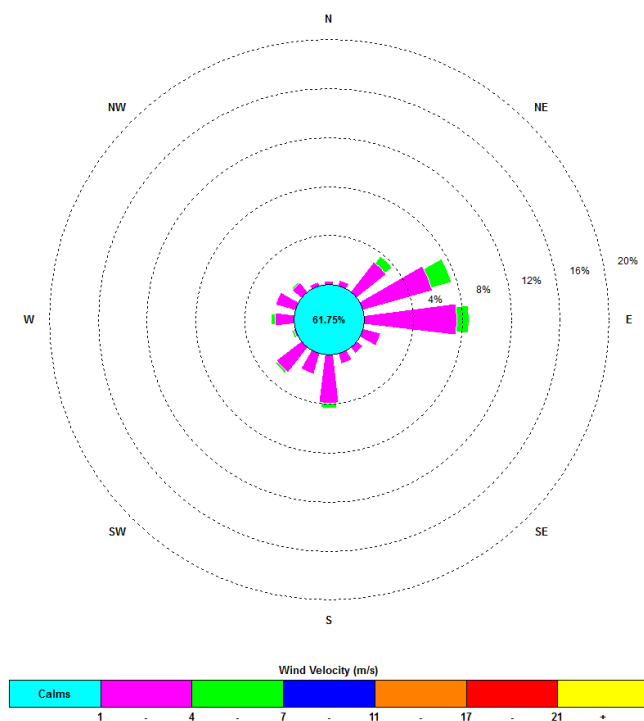




### 2.4.3 Monthly Windrose Plot

Frequency plot of the average wind speed and average direction over each 15 minute sampling period. Wind is considered to be calm when less than a 15 minute average of 1m/s.

00:15, 3 January 2016 – 23:45, 31 January 2016



The predominant winds were from the E, with most frequent, strongest winds from the ENE. The maximum wind speed was 13.0 m/s from the S.

## Appendix 1

### Laboratory Certificates