# APPENDIX 3B – AIR QUALITY MONITROING DATA

## Summary of Annual Average Dust Deposition

| EPL 12425 ID No. | 3 | 4 | - | 6 | - | 9 | 10 | 11 | 12 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|
| Monitoring ID No. | DG4 | DG5 | DG7* | DG8 | DG10 | DG11 | DG12 | DG13 | DG14 | DG15 |
| 2011 Annual Average Total Insoluble Matter ($g/m^2$/month) | 0.90 | 1.13 | 1.22 | 0.94 | 3.02 | 1.30 | 3.73 | 1.95 | 1.88 | - |
| 2012 Annual Average Total Insoluble Matter ($g/m^2$/month) | 1.05 | 0.73 | 1.52 | 1.03 | 1.19 | 1.41 | 6.52 | 2.38 | 2.18 | - |
| 2013 Annual Average Total Insoluble Matter ($g/m^2$/month) | 0.87 | 0.60 | - | 1.43 | 2.04 | 2.1 | 3.26 | 1.94 | 1.04 | 1.00 |
| 2014 Annual Average Total Insoluble Matter ($g/m^2$/month) | 1.68 | 0.83 | - | 1.48 | 3.31 | 1.28 | 3.28 | 2.81 | 1.43 | 0.85 |
| 2015 Annual Average Total Insoluble Matter ($g/m^2$/month) | 0.90 | 0.80 | - | 1.09 | 3.61 | 1.94 | 2.91 | 5.91 | 1.16 | 0.75 |
| 2016 Annual Average Total Insoluble Matter ($g/m^2$/month) | 0.7 | 1.3 | - | 1.1 | 1.9 | 4.2 | 2.5 | 33.81 | 4.80 | 1.64 |

**Notes:** Green shaded cells indicated internal dust depositional monitoring sites at heritage sites.. *At the end of the 2012 reporting period DG7 was relocated from the Mittaville Property to Araluen Road. Araluen Road is situated to the north east of Wollar Village. The new dust gauge is identified as DG15.

## Summary of TSP and $PM_{10}$ Results

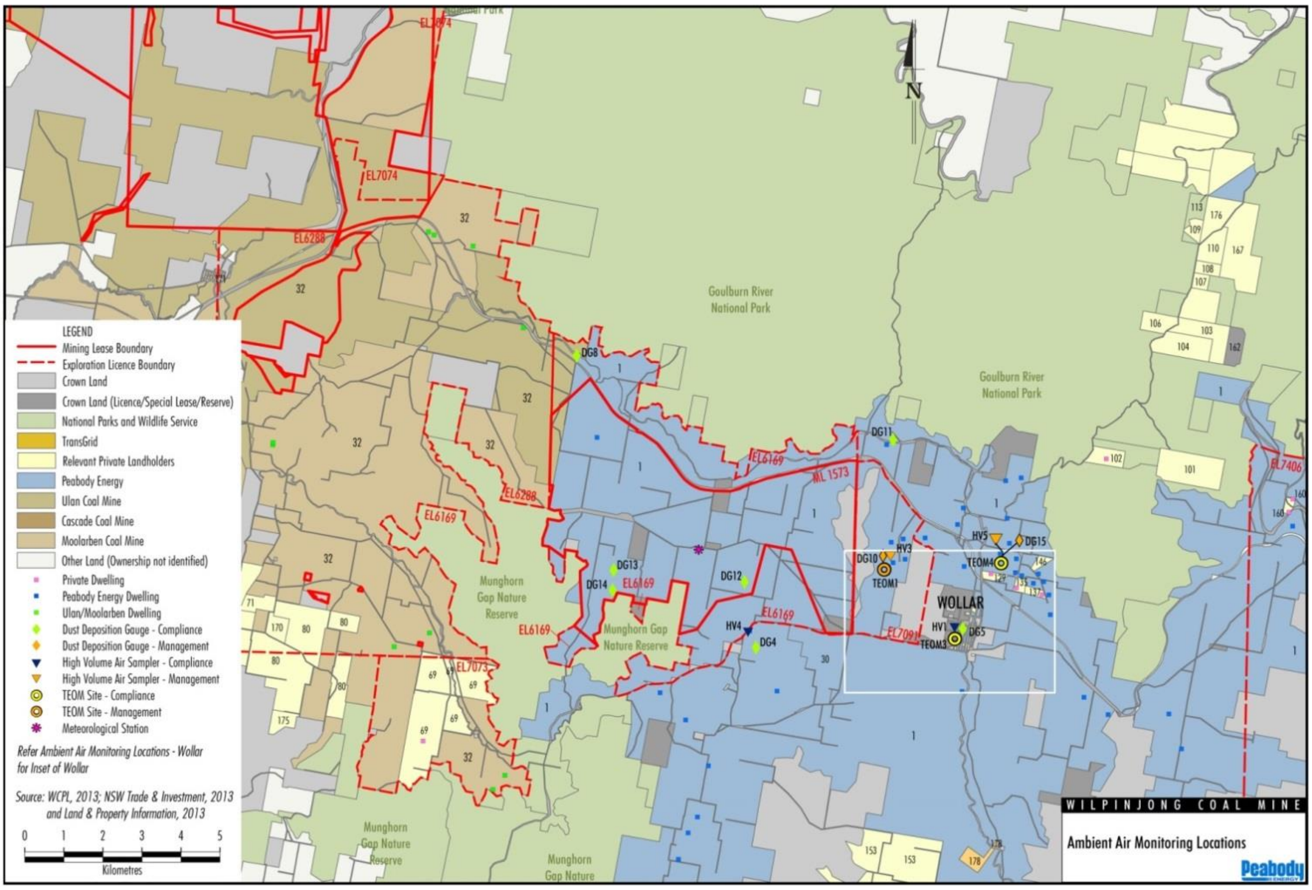
| Monitoring Locations# | | | | | | | |
|---|---|---|---|---|---|---|---|
| **EPL 12425 ID No.** | **13** | **19** | **20** | **27** | **-** | **25** | **28** |
| **Monitoring ID No.** | **HV1** | **HV3** | **HV4** | **HV5** | **TEOM1^** | **TEOM3** | **TEOM4** |
| **2012 Results** | | | | | | | |
| $PM_{10}$ ($\mu g/m^3$) recorded range* | 2.8 – 21.7 | - | 12.0 – 21.8 | ** | 3.4 - 60.3 | ** | ** |
| $PM_{10}$ ($\mu g/m^3$) annual average | 9.1 | - | 9.7 | ** | 9.7 | ** | ** |
| TSP ($\mu g/m^3$) recorded range* | - | 1.9 – 47.0 | - | - | - | - | - |
| TSP ($\mu g/m^3$) annual average | - | 18.8 | - | - | - | - | - |
| **2013 Results** | | | | | | | |
| PM10 ($\mu g/m^3$) recorded range* | 1.2 – 43.7 | - | 2 – 55.1 | 1.8 – 49.8 | 3.0 – 82.5 | 2.4 – 55.6 | 0.7 – 68.9 |
| PM10 ($\mu g/m^3$) annual average | 10.84 | - | 12.4 | 15.71 | 18.5 | 13.1 | 16.8 |
| TSP ($\mu g/m^3$) recorded range* | - | 3.1 – 77.6 | - | - | - | - | - |
| TSP ($\mu g/m^3$) annual average | - | 27.45 | - | - | - | - | - |
| **2014 Results** | | | | | | | |
| PM10 ($\mu g/m^3$) recorded range* | 1.70 - 41.20 | - | 1.80 – 37.70 | 2.80 – 47.80 | 1.8-69.5 | 2.65 – 59.12 | 1.18 – 53.96 |
| PM10 ($\mu g/m^3$) annual average | 11.15 | - | 11.95 | 14.58 | 17.3 | 13.2 | 13.5 |
| TSP ($\mu g/m^3$) recorded range* | - | 7.20 – 59.0 | - | - | - | - | - |
| TSP ($\mu g/m^3$) annual average | - | 23.09 | - | - | - | - | - |
| **2015 Results** | | | | | | | |
| PM10 ($\mu g/m^3$) recorded range* | 1.1 – 29.3 | - | 1.9 – 40.0 | 1.0 – 35.3 | 2.2 – 87.8 | 1.4 – 78.5 | 0.1 – 77.3 |
| PM10 ($\mu g/m^3$) annual average | 9.99 | - | 11.52 | 11.68 | 14.1 | 11.26 | 14.16 |
| TSP ($\mu g/m^3$) recorded range* | - | 3.7 – 68.7 | - | - | - | - | - |
| TSP ($\mu g/m^3$) annual average | - | 22.74 | - | | - | - | - |

## Summary of TSP and PM$_{10}$ Results cont.

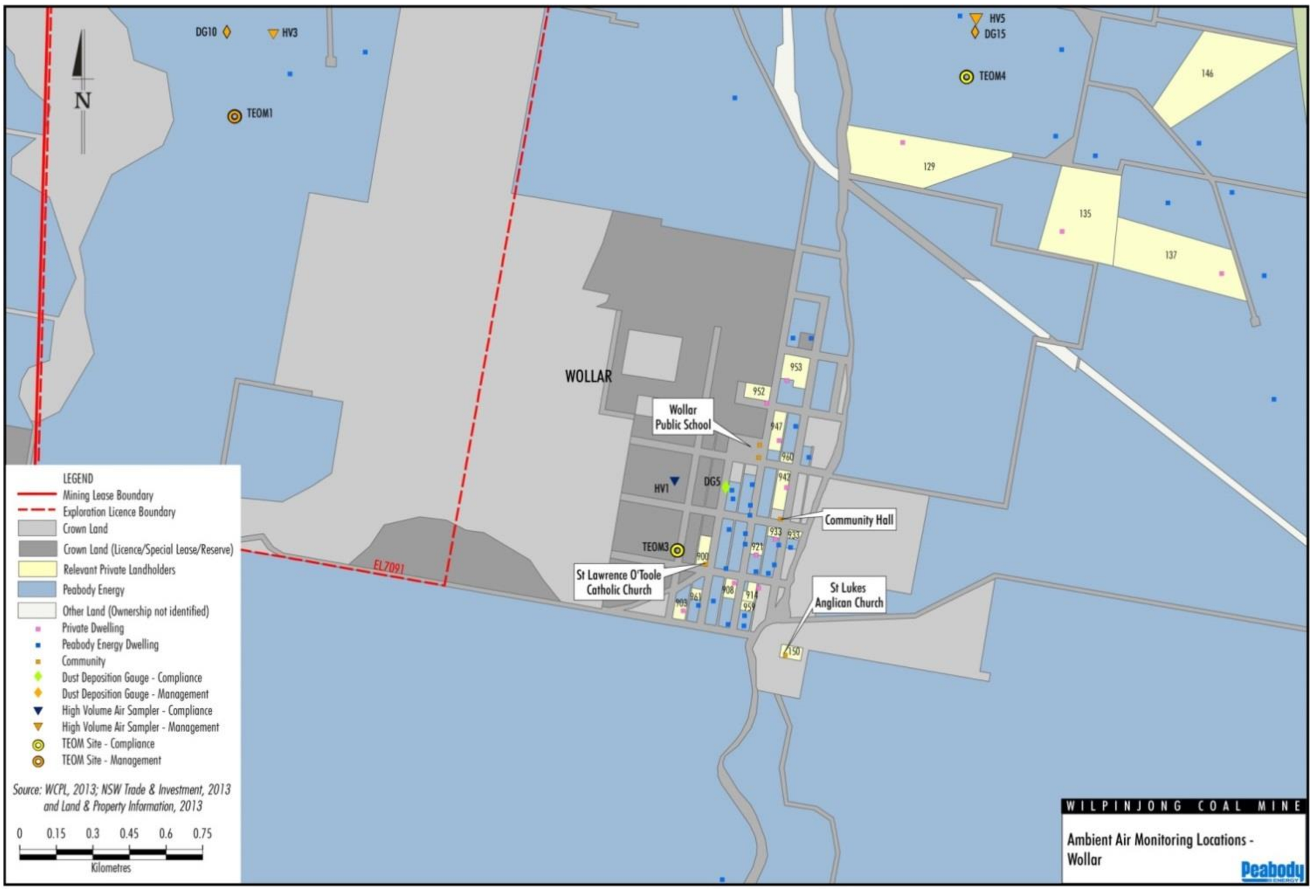
| Monitoring Locations[#] | | | | | | | |
|---|---|---|---|---|---|---|---|
| **EPL 12425 ID No.** | **13** | **19** | **20** | **27** | **-** | **25** | **28** |
| **Monitoring ID No.** | **HV1** | **HV3** | **HV4** | **HV5** | **TEOM1^** | **TEOM3** | **TEOM4** |
| **2016 Results** | | | | | | | |
| **PM10 ($\mu g/m^3$) recorded range*** | 1.5 – 23.0 | - | 1.8 – 25.2 | 2.5 – 34.2 | 3.3 – 41.7 | 0.4 – 34.4 | 0.0 – 51.1[1] |
| **PM10 ($\mu g/m^3$) annual average** | 9.78 | - | 11.69 | 13.95 | 15.0 | 10.2 | 11.3 |
| **TSP ($\mu g/m^3$) recorded range*** | - | 3.9 – 82.0 | - | - | - | - | - |
| **TSP ($\mu g/m^3$) annual average** | - | 27.59 | - | - | - | - | - |

**Notes:** * Data presented is the range of minimum and maximum 24 hour averages. ^ Data recorded at these sites is not for compliance, but for management purposes only. [#] Refer to **Figure below.** [1]Bushfire event on the 18 February 2016.

### Air Quality Monitoring Stations



**Air Quality Monitoring Stations (Wollar)**



# 2016 Ambient Air Quality Monitoring Reports

Accredited for compliance with ISO/IEC 17025.

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal

## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st January – 31st January 2016

Report No.: DAT10446

Report issue date: 26th February 2016

Maintenance contract: MC951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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT10446 | 26/02/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS REdwards

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# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene. A wind sensor is also installed at the Wollar site.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for 1$^{st}$ – 31$^{st}$ January 2016. Data capture for the different pollutants is presented in Table 9.

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for 1st – 31st January 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
| --- | --- |
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 Series Manual | Synspec GC955 - Gas Chromatography |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Jan-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5min Avg
3. Hourly Avg
4. Daily Avg
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

## 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

### 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:45 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 | 23:50 to 00:00 |
| $H_2S$ | 01:45 to 02:40 every 2nd day | 00:45 to 00:55 |

## 5.3. Maintenance

Non-scheduled maintenance was performed on 15/01/2016 to perform calibrations on the $SO_2$ and $NO_x$ analysers following a daily check reported fault.

Scheduled 6-monthly maintenance was performed over a two day period on 28/01/2016 and 29/01/2016. No further issues were found and a spare $H_2S$ analyser was left on site.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 28/01/2016 | 6-monthly | 28/01/2016 | Monthly |
| $SO_2$ | 28/01/2016 | 6-monthly | 28/01/2016 | Monthly |
| $H_2S$ | 28/01/2016 | 6-monthly | 28/01/2016 | Monthly |
| BTX | 28/01/2016 | 3-monthly | 28/01/2016 | Monthly |
| Wind Speed | 28/01/2016 | 3-monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 28/01/2016 | 3-monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 1st January 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | **88.1** |
| $SO_2$ | **88.1** |
| $H_2S$ | **86.6** |
| Benzene | **88.7** |
| Toluene | **88.7** |
| *p*-Xylene | **88.3** |
| WS, WD | **90.6** |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

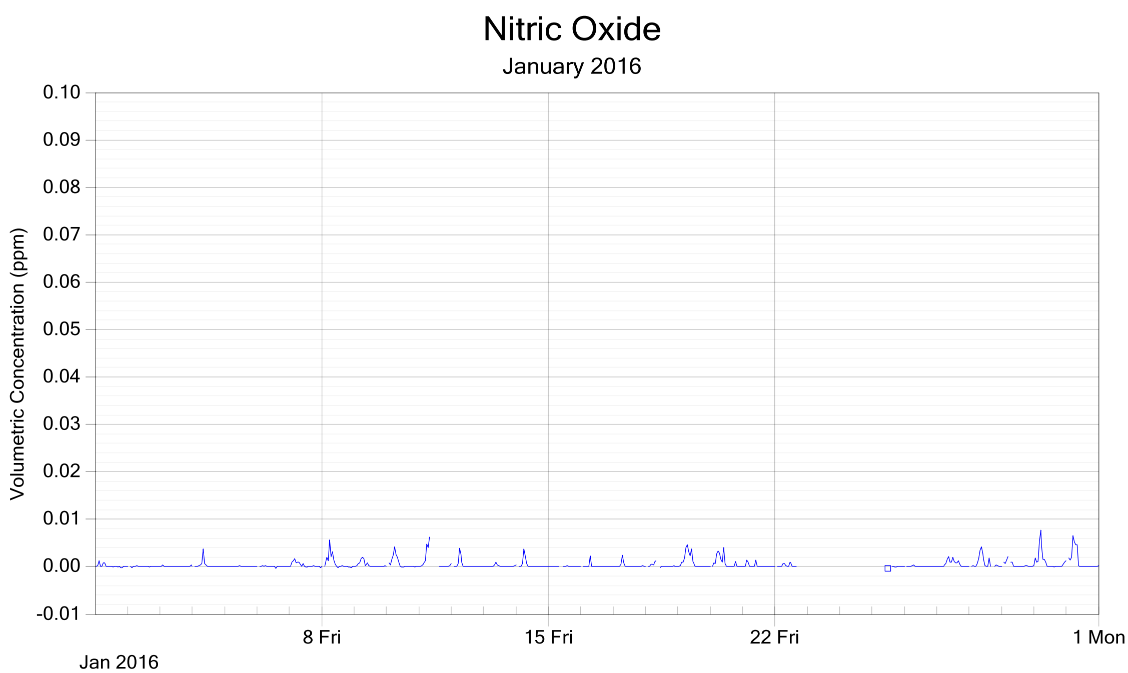


**Figure 2: NO - 1 hour data**

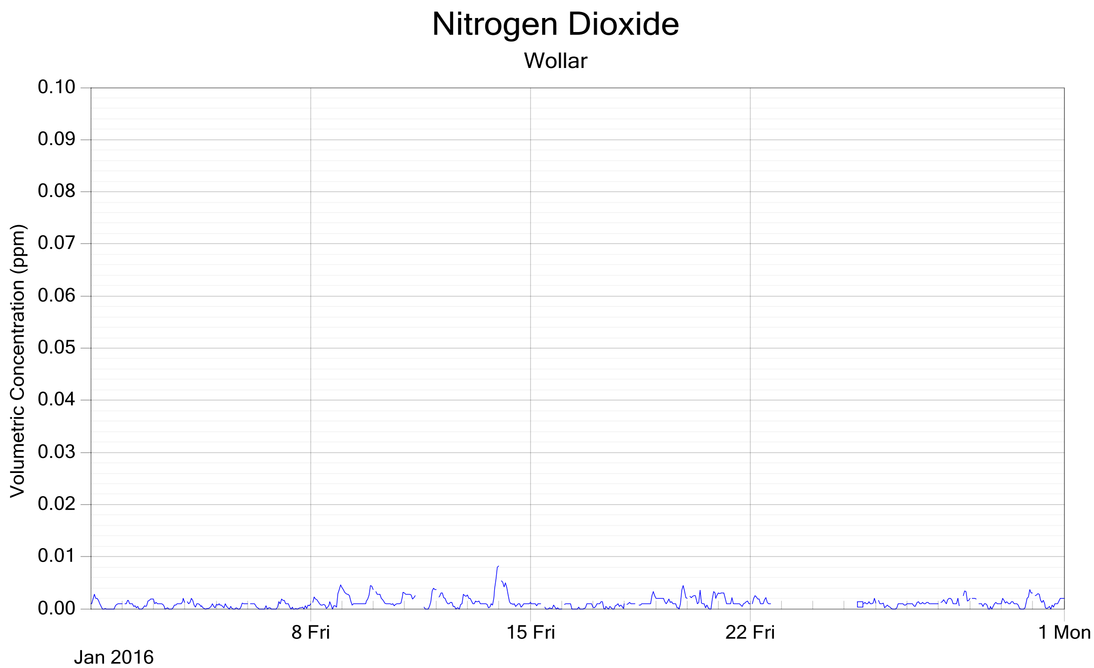


**Figure 3: $NO_2$ - 1 hour data**

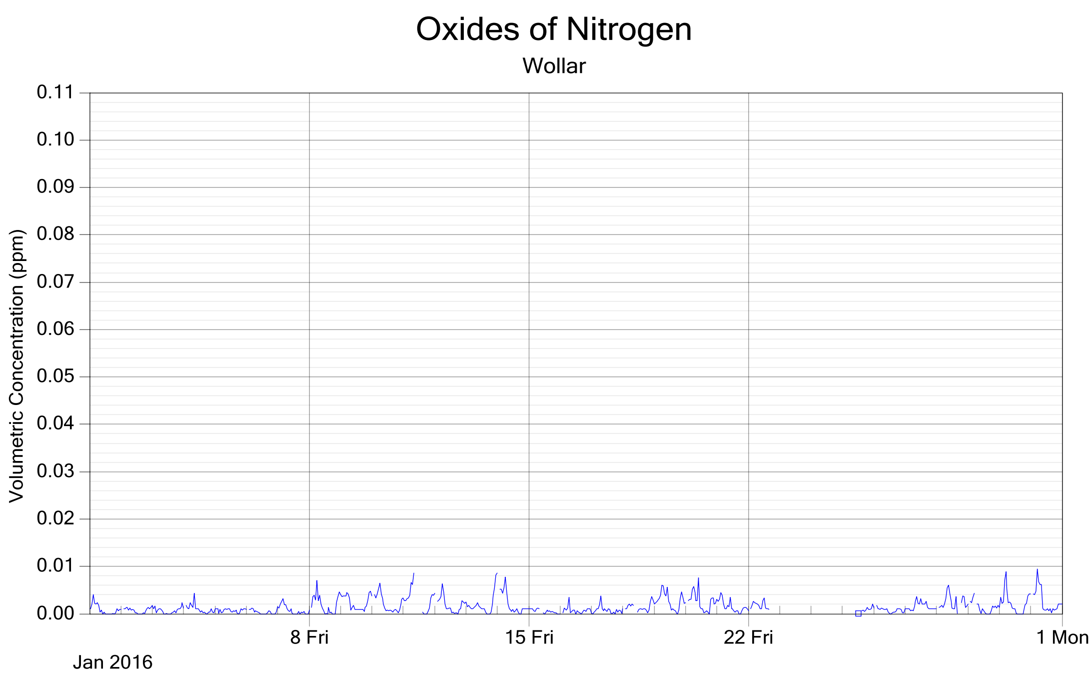


**Figure 4: $NO_X$ - 1 hour data**

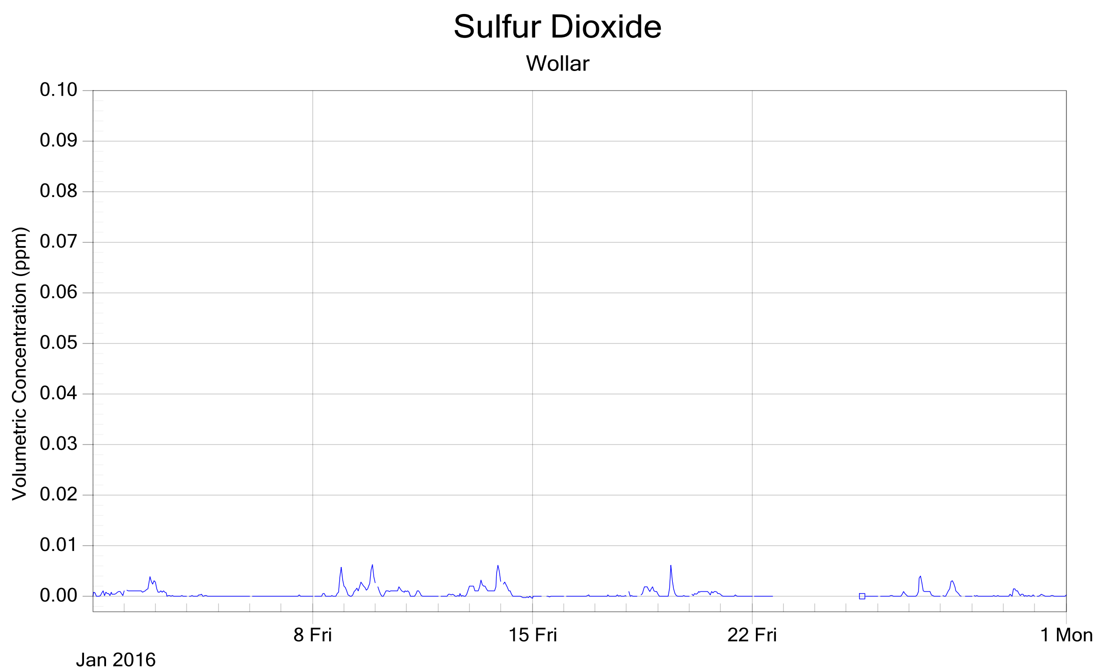


**Figure 5: $SO_2$ - 1 hour data**

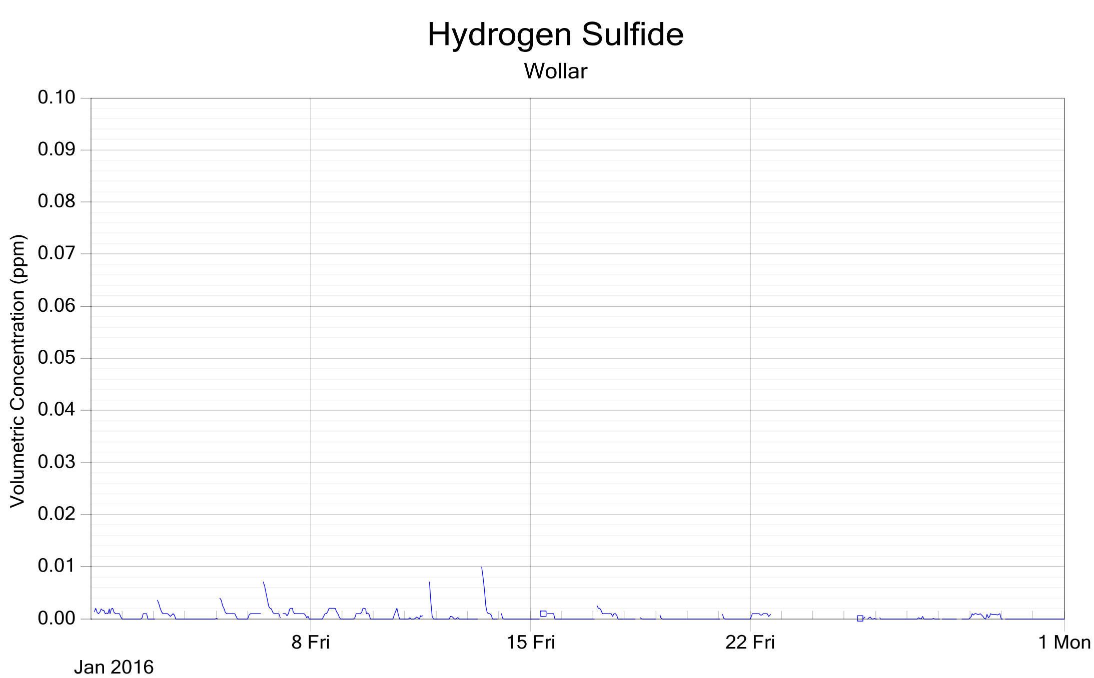


**Figure 6: $H_2S$ - 1 hour data**

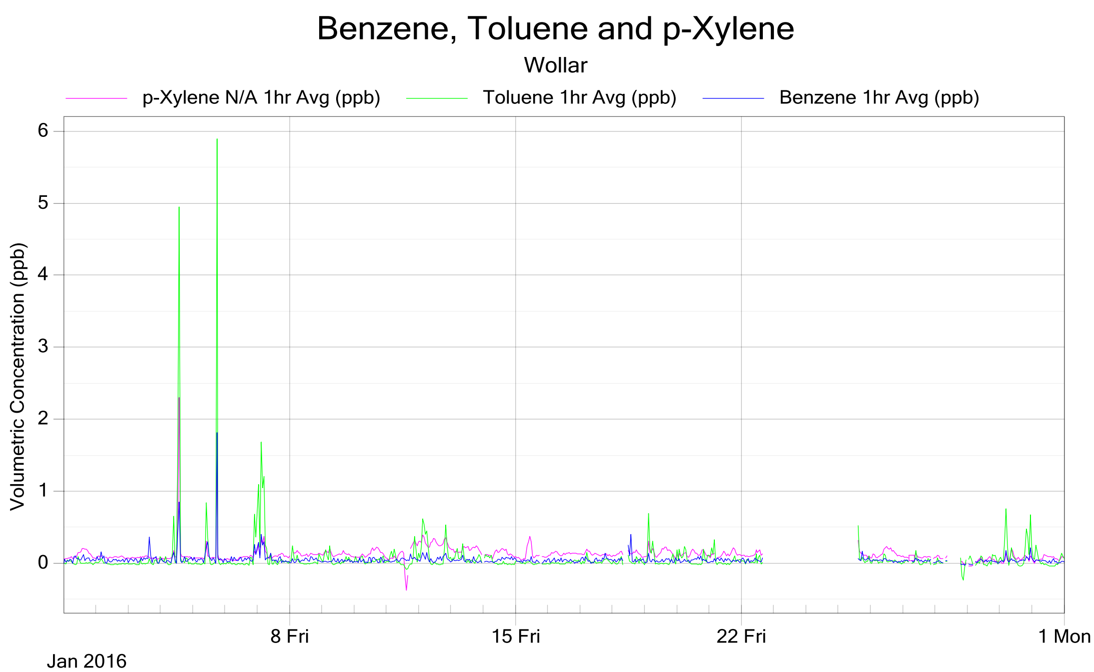


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/01/2016 00:00 | 01/01/2016 00:00 | Instrument stabilisation – continued from Dec-15 | BTX | EP | 27/01/2016 |
| 01/01/2016 00:05 | 28/01/2016 10:15 | Static offset of -0.120 ppb applied to correct zero baseline | *p*-Xylene | RE | 19/02/2016 |
| 02/01/2016 06:05 | 28/01/2016 08:05 | Intermittent unrealistic data spikes | *p*-Xylene | RE | 19/02/2016 |
| 06/01/2016 01:40 | 12/01/2016 00:55 | Static multiplier of 0.93 applied to correct overnight 'out of tolerance' span values | NO, $NO_2$ and $NO_x$ | RE | 19/02/2016 |
| 06/01/2016 10:50 | 25/01/2016 17:55 | Intermittent data transmission errors – not enough samples for 5min averaging | All parameters | RE | 19/02/2016 |
| 12/01/2016 01:40 | 14/01/2016 00:00 | Static offset of 0.002ppm applied to correct baseline | $SO_2$ | RE | 19/02/2016 |
| 13/01/2016 23:40 | 13/01/2016 00:20 | Intermittent short power interruption and subsequent BTX instrument stabilisation | $H_2S$, BTX, WS and WD | RE | 19/02/2016 |
| 13/01/2016 23:45 | 29/01/2016 00:40 | Intermittent short power interruption and subsequent instrument stabilisation | All parameters | RE | 19/02/2016 |
| 14/01/2016 01:20 | 14/01/2016 18:10 | Static offset of 0.003 ppm applied to correct baseline | $H_2S$ | RE | 19/02/2016 |
| 14/01/2016 18:15 | 25/01/2016 18:15 | Intermittent additional automatic calibration cycles | $H_2S$ and $SO_2$ | RE | 19/02/2016 |
| 15/01/2016 08:05 | 15/01/2016 11:40 | Non scheduled maintenance – calibrations performed and subsequent instrument stabilisations (intermittent data affected) | $SO_2$, NO, $NO_2$, $NO_x$ and $H_2S$ | RE | 19/02/2016 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 15/01/2016 11:05 | 28/01/2016 00:55 | Static multiplier of 0.95 applied to correct overnight 'out of tolerance' span values | $SO_2$ | RE | 19/02/2016 |
| 18/01/2016 11:35 | 19/01/2016 00:40 | Static offset of 0.11 ppm applied to correct zero baseline | $H_2S$ | RE | 19/02/2016 |
| 22/01/2016 17:40 | 25/01/2016 12:05 | Power interruption | All parameters | RE | 19/02/2016 |
| 28/01/2016 10:20 | 29/01/2016 06:55 | Scheduled 6-monthly maintenance carried over 2 day period – intermittent data affected | All parameters | RE | 19/02/2016 |
| 28/01/2016 19:55 | 28/01/2016 19:55 | Data gap | All parameters | RE | 19/02/2016 |

## 8.0 Report Summary

The data capture for Wollar was below 95% for all measured parameters. This was largely due to a data gap between 22/01/2016 and 25/01/2016.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

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**Power Interruption** refers to no power to the station therefore no data was collected at this time.

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**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

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Accreditation No. 14184.

NATA
WORLD RECOGNISED ACCREDITATION

# Peabody Energy

# Wilpinjong Coal
## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st February – 29th February 2016

Report No.: DAT10560

Report issue date: 29th March 2016

Maintenance contract: MC951


***ECOTECH PTY LTD. ABN: 32005752081***
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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT10560 | 29/03/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS REdwards

**Approved Signatory:** Jon ALEXANDER

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## List of Tables

# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene. A wind sensor is also installed at the Wollar site.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for 1st – 29th January 2016. Data capture for the different pollutants is presented in Table 9.

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1$^{st}$ March 2013.

This report presents the data for 1$^{st}$ – 29$^{th}$ January 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
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| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Feb-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

## 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

### 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 | 23:45 to 23:50 |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:50 to 23:55 |

## 5.3. Maintenance

Scheduled monthly maintenance was performed over 2 days on the 18th and 19th February.

During this visit on 18/02/2016, the wind sensor had to be lowered to straighten the sensor cross arm as it was sitting at a slight angle. The opportunity was taken to also perform yearly maintenance on the sensor. One of the guy wire mountings was found to be broken and evidence suggests that this was due to the grass cutting tractor having run over it. The mounting was secured and the guy wire was securely tied to it. Note therefore that wind data since last maintenance performed on 28/01/2016 is for reference purposes only.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 19/02/2016 | Yearly | 19/02/2016 | Monthly |
| $SO_2$ | 18/02/2016 | Monthly | 18/02/2016 | Monthly |
| $H_2S$ | 18/02/2016 | 6-monthly | 18/02/2016 | Monthly |
| BTX | 18/02/2016 | Monthly | 18/02/2016 | Monthly |
| Wind Speed | 18/02/2016 | Yearly | 21/05/2015 | 2-Yearly |
| Wind Direction | 18/02/2016 | Yearly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 29th February 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 97.5 |
| $SO_2$ | 97.6 |
| $H_2S$ | 96.3 |
| Benzene | 98.5 |
| Toluene | 98.5 |
| *p*-Xylene | 97.3 |
| WS, WD | 99.5 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

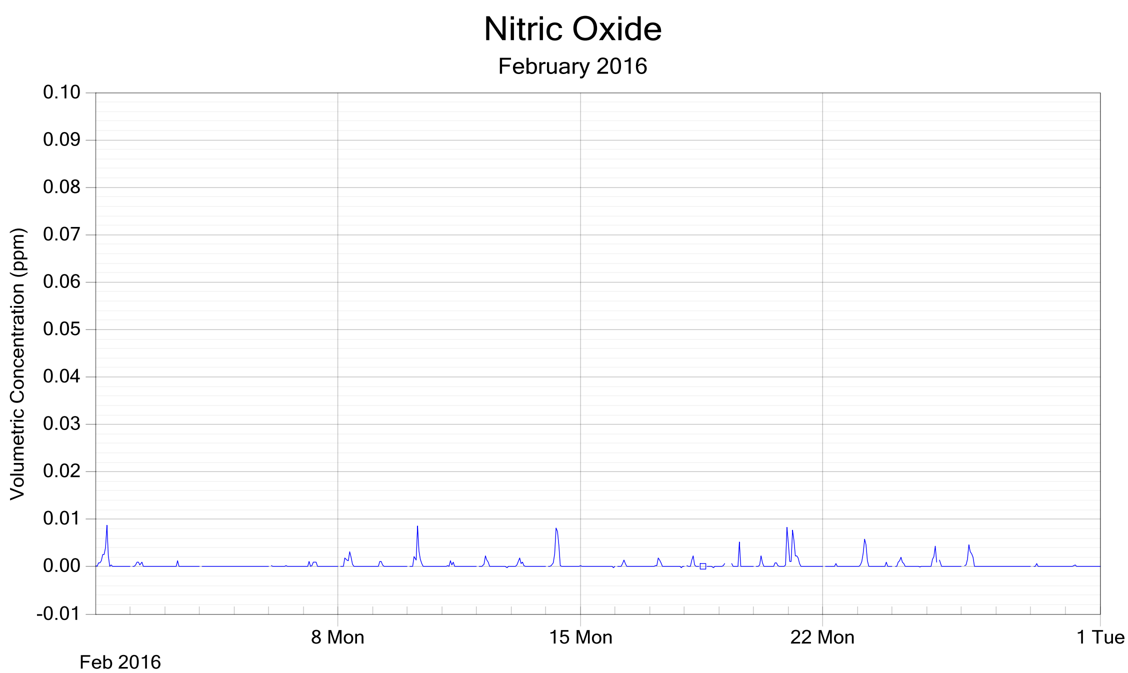


**Figure 2: NO - 1 hour data**

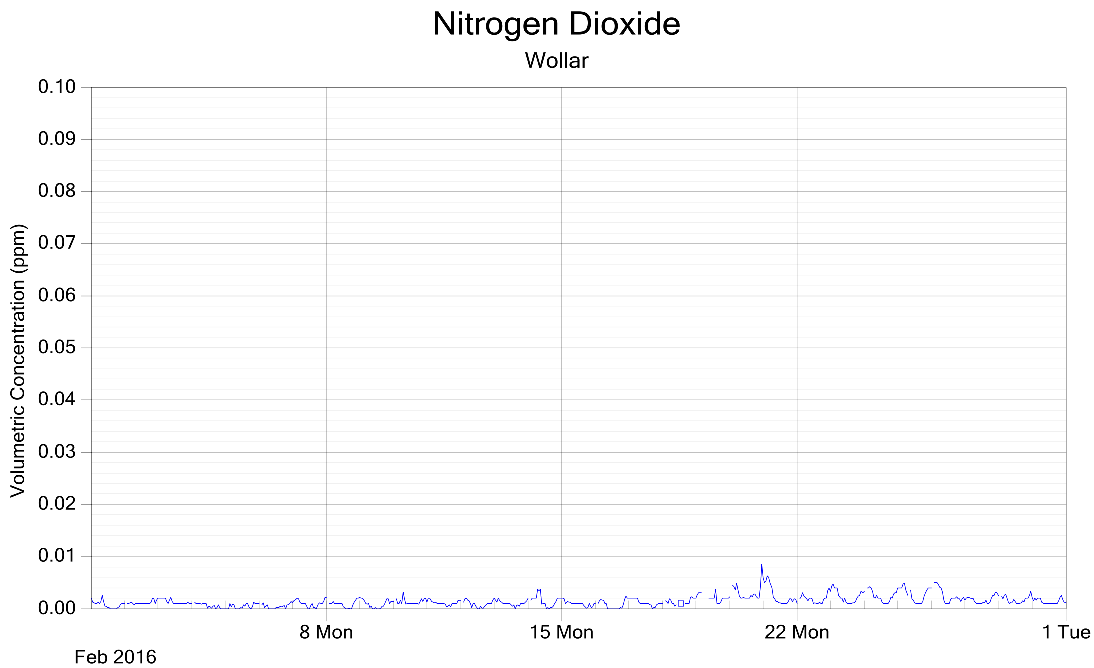


**Figure 3: $NO_2$ - 1 hour data**

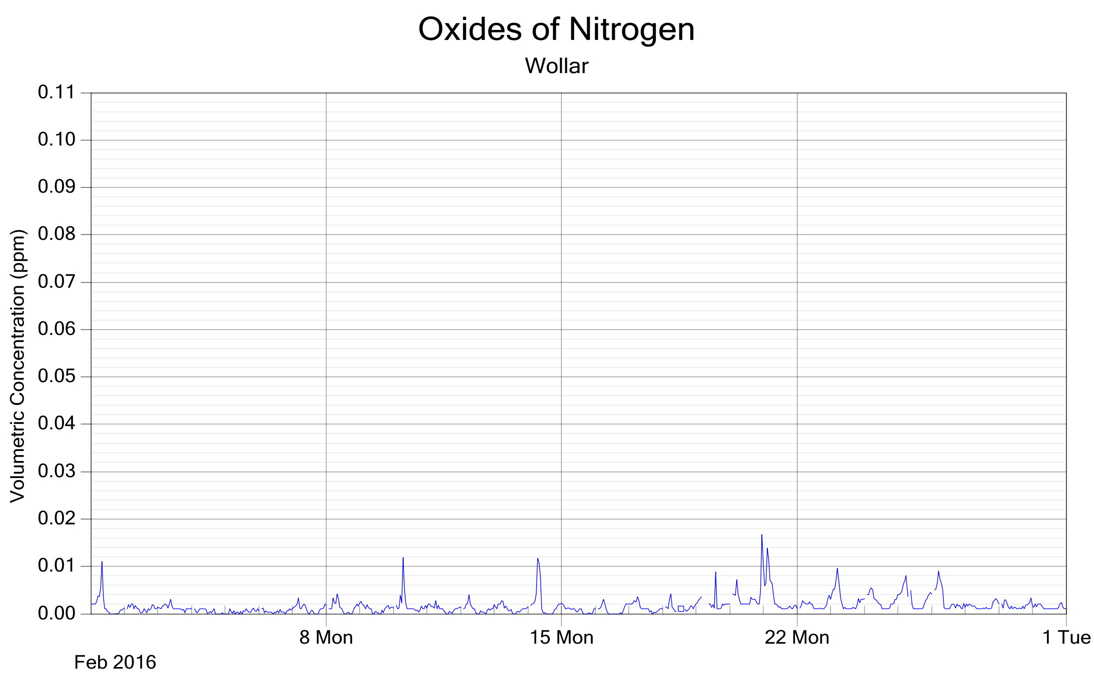


**Figure 4: $NO_X$ - 1 hour data**

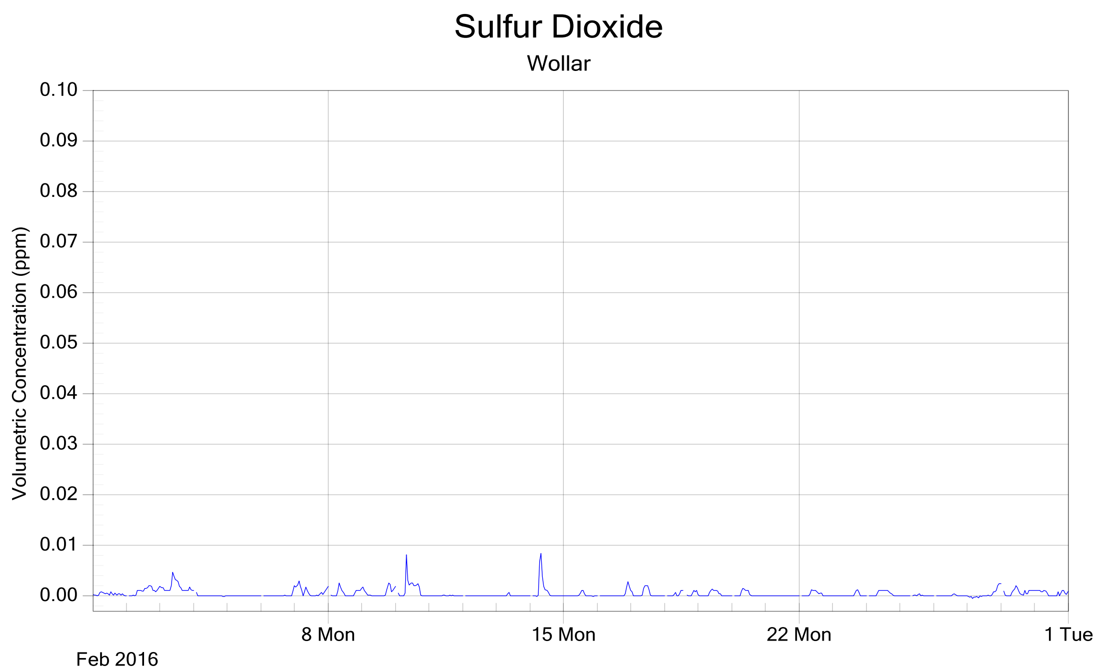


**Figure 5: $SO_2$ - 1 hour data**

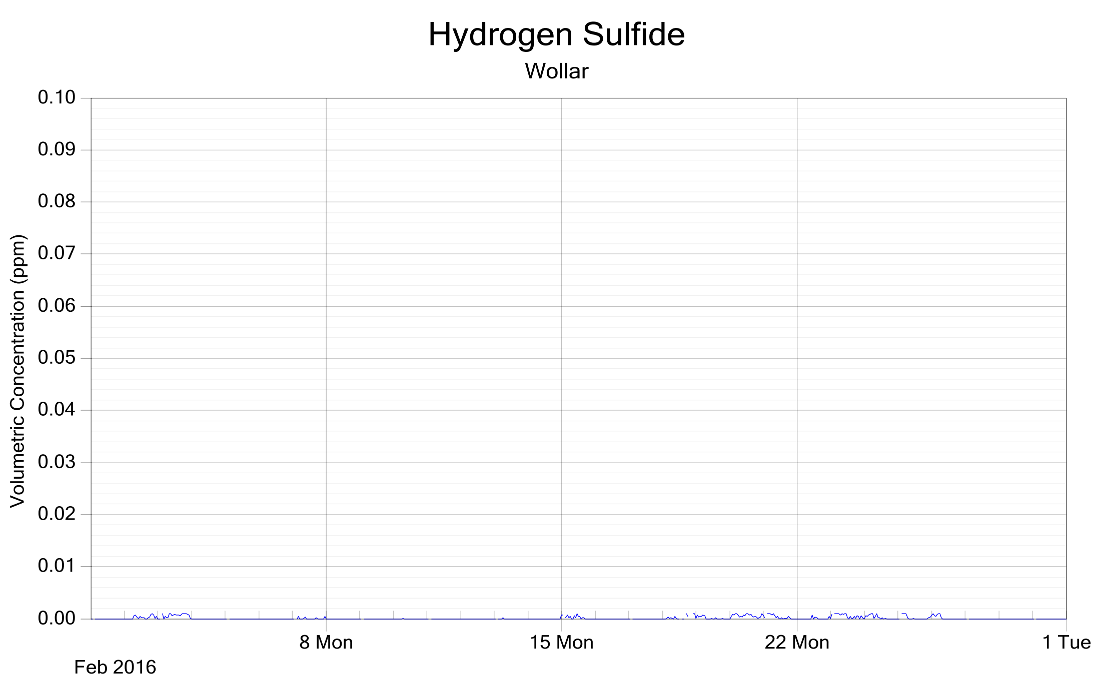


**Figure 6: $H_2S$ - 1 hour data**

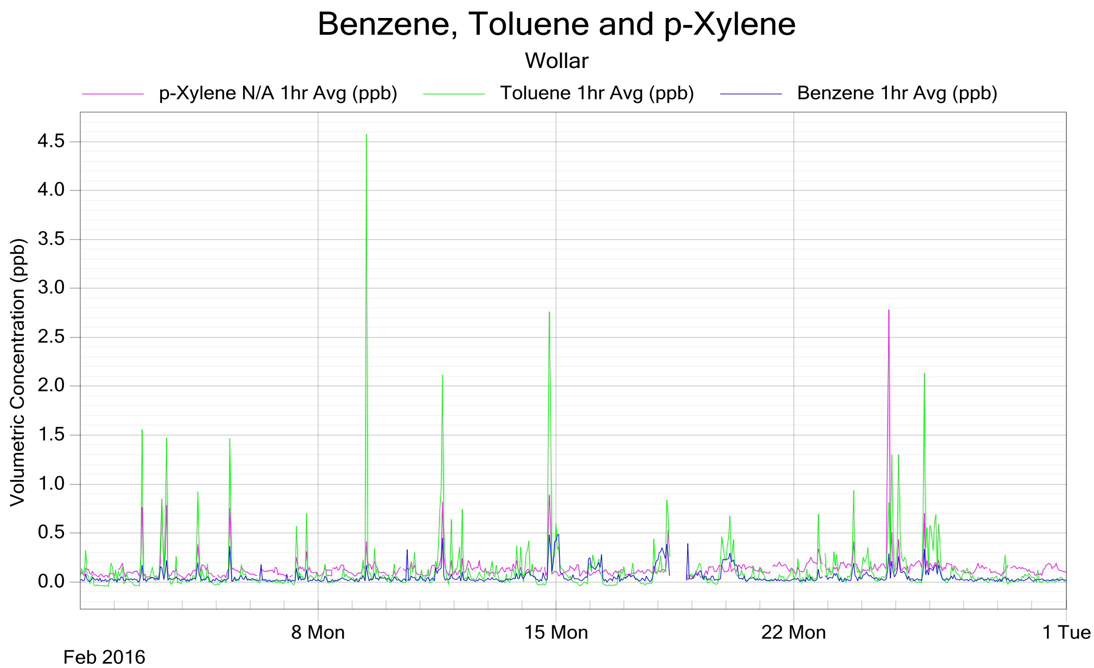


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/02/2016 20:50 | 29/05/2016 10:05 | Intermittent unrealistic data spikes | *p*-Xylene | RE | 24/03/2016 |
| 18/02/2016 09:20 | 18/02/2016 19:25 | Maintenance – scheduled monthly tasks and calibrations | BTX | RE | 24/03/2016 |
| 18/02/2016 11:35 | 18/02/2016 22:05 | Scheduled maintenance tasks and calibrations – intermittent data affected | $SO_2$, NO, $NO_2$, $NO_x$ and $H_2S$ | RE | 24/03/2016 |
| 18/02/2016 12:25 | 18/02/2016 15:45 | Maintenance – scheduled monthly and straightening of sensor cross arm | WS and WD | RE | 24/03/2016 |
| 19/02/2016 05:00 | 19/02/2016 09:00 | Completion of maintenance – yearly tasks performed | NO, $NO_2$ and $NO_x$ | RE | 24/03/2016 |
| 22/02/2016 20:45 | 22/02/2016 21:15 | Short power interruption and subsequent instrument stabilisation | BTX | RE | 24/03/2016 |
| 25/02/2016 08:10 | 25/02/2016 08:45 | Maintenance – unscheduled remote calibration | NO, $NO_2$ and $NO_x$ | RE | 24/03/2016 |

# 8.0 Report Summary

The data capture for Wollar was above 95% for all measured parameters.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT-------------------------------------

# Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

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Accredited for compliance with ISO/IEC 17025.

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal
## Wollar

Ambient Air Quality Monitoring

Validated Report

1st March – 31st March 2016

Report No.: DAT10651

Report issue date: 28th April 2016

Maintenance contract: MC951

***ECOTECH PTY LTD. ABN: 32005752081***
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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT10651 | 28/04/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS RLEdwards

**Approved Signatory:** Jon ALEXANDER

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| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 Series Manual | Synspec GC955 - Gas Chromatography |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Mar-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 | 23:45 to 23:50 |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:50 to 23:55 |

## 5.3. Maintenance

Scheduled monthly maintenance was performed over two days on 23/03/2016 and 24/03/2016. The $NO_x$, $SO_2$ and $H_2S$ instruments were accidently left in 'Out of Service' mode following the completion of maintenance. An unscheduled visit was made on 09/04/2016 to revert this error. Data from 24/03/2016 to 09/04/2016 was reverted to 'valid' prior to the standard monthly validation process. Please refer to the Valid Data Exception Table for details. Further details for April 2016 data will be included in next month's report.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 24/03/2016 | Monthly | 24/03/2016 | Monthly |
| $SO_2$ | 24/03/2016 | Monthly | 24/03/2016 | Monthly |
| $H_2S$ | 24/03/2016 | Monthly | 24/03/2016 | Monthly |
| BTX | 24/03/2016 | Monthly | 24/03/2016 | Monthly |
| Wind Speed | 24/03/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 24/03/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 31st March 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 97.9 |
| $SO_2$ | 96.9 |
| $H_2S$ | **93.0** |
| Benzene | 98.5 |
| Toluene | 98.5 |
| *p*-Xylene | **93.5** |
| WS, WD | 100.0 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

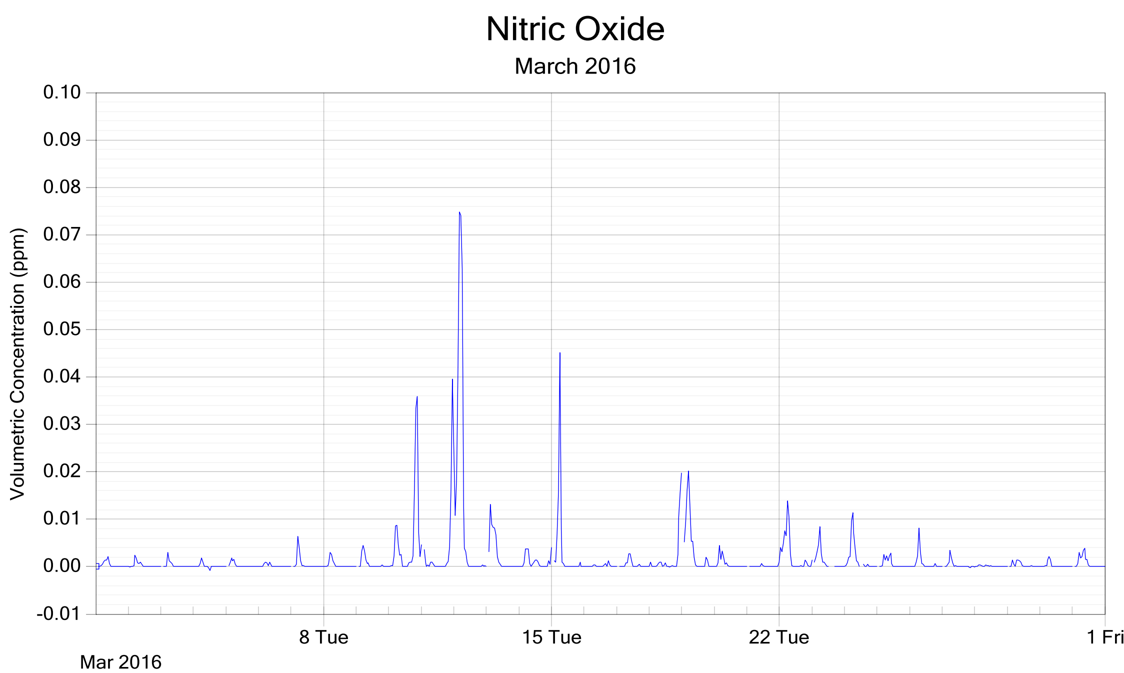


**Figure 2: NO - 1 hour data**

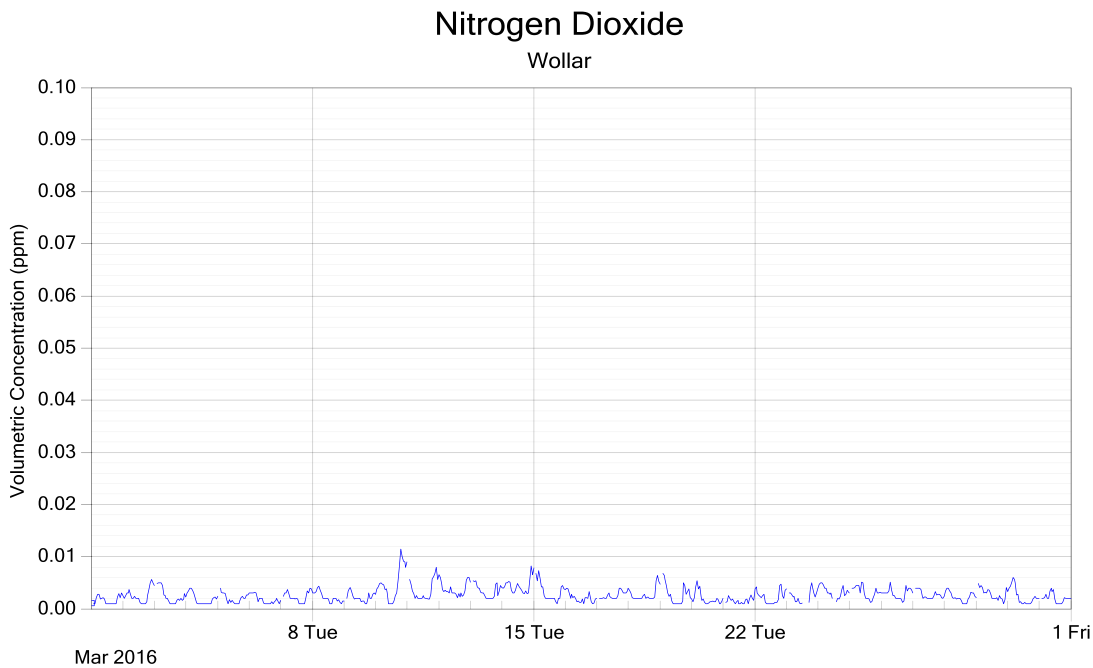


**Figure 3: $NO_2$ - 1 hour data**

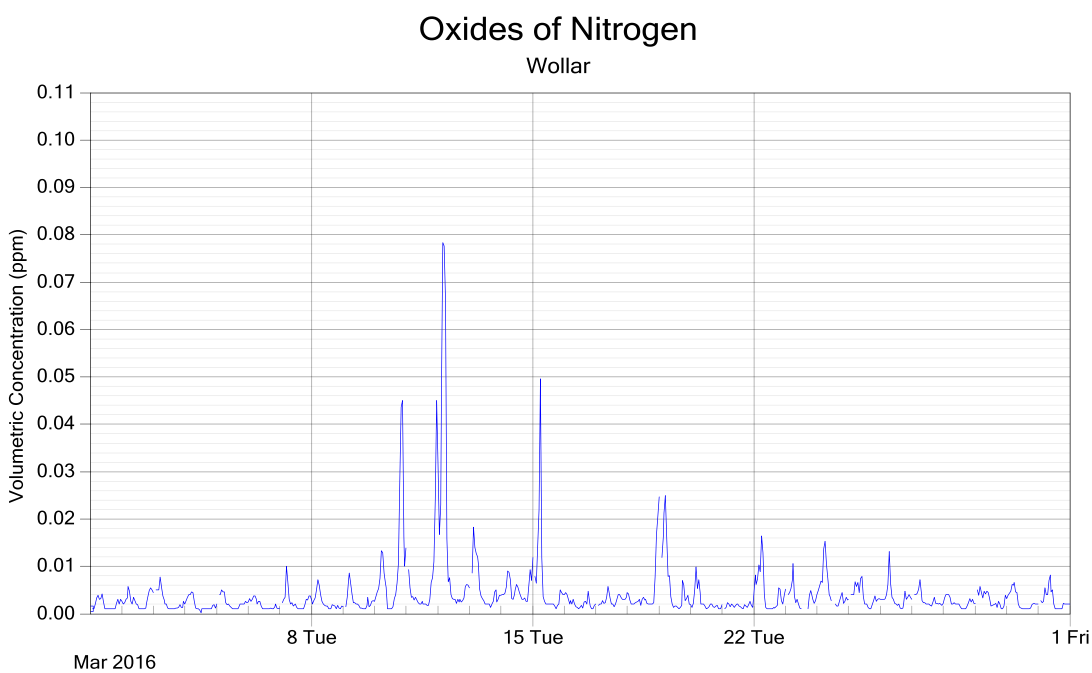


**Figure 4: $NO_X$ - 1 hour data**

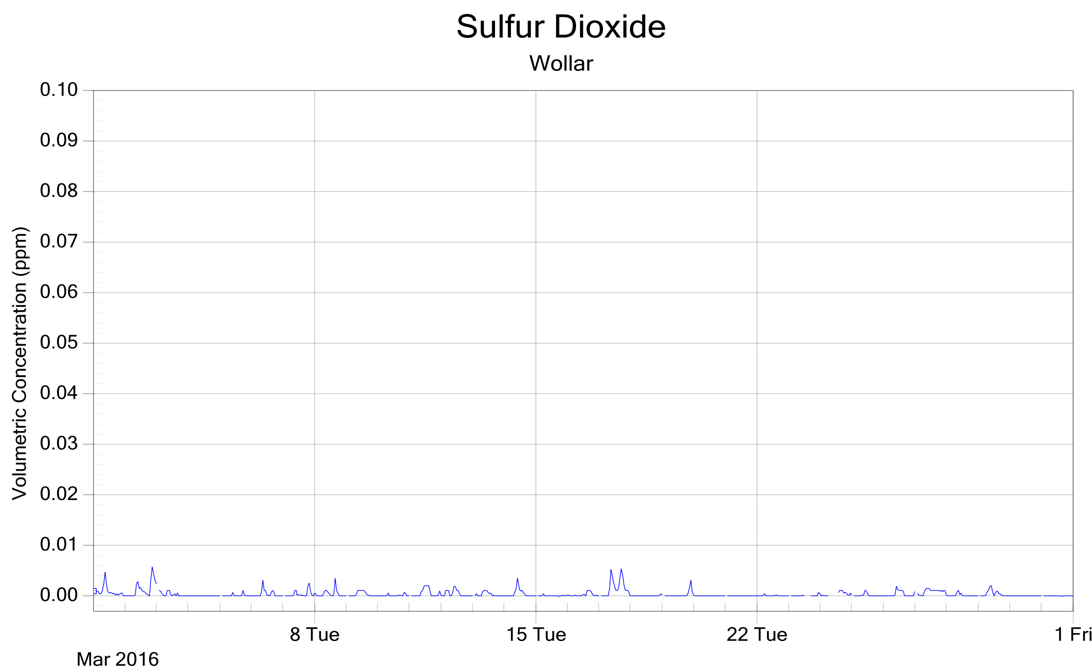


**Figure 5: $SO_2$ - 1 hour data**

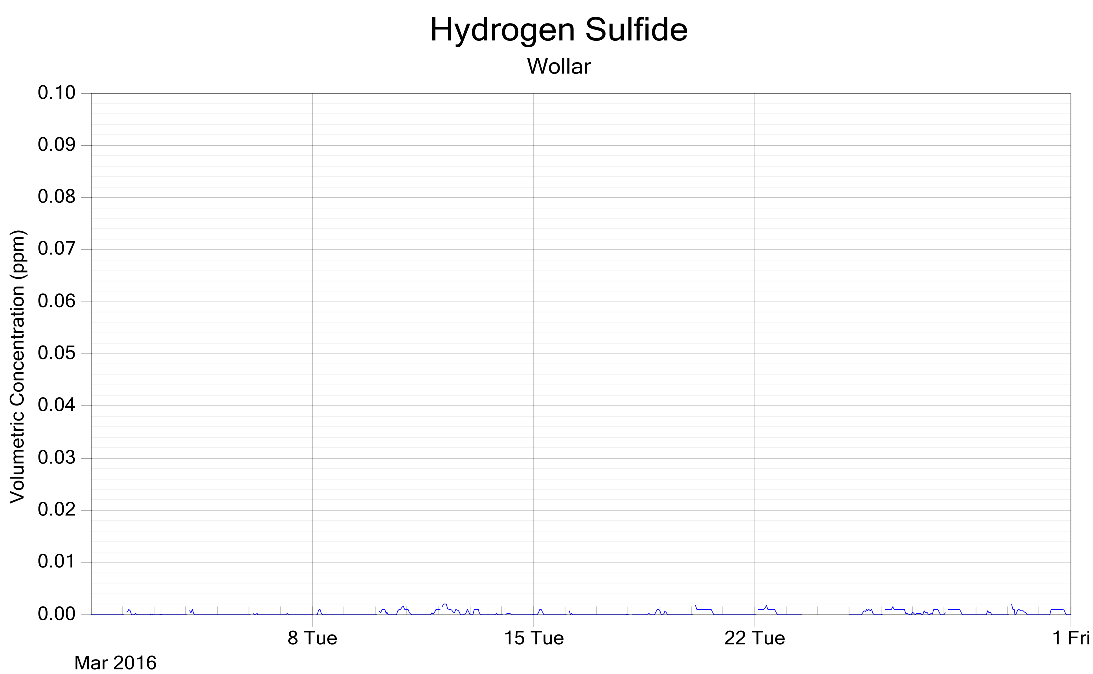


**Figure 6: $H_2S$ - 1 hour data**

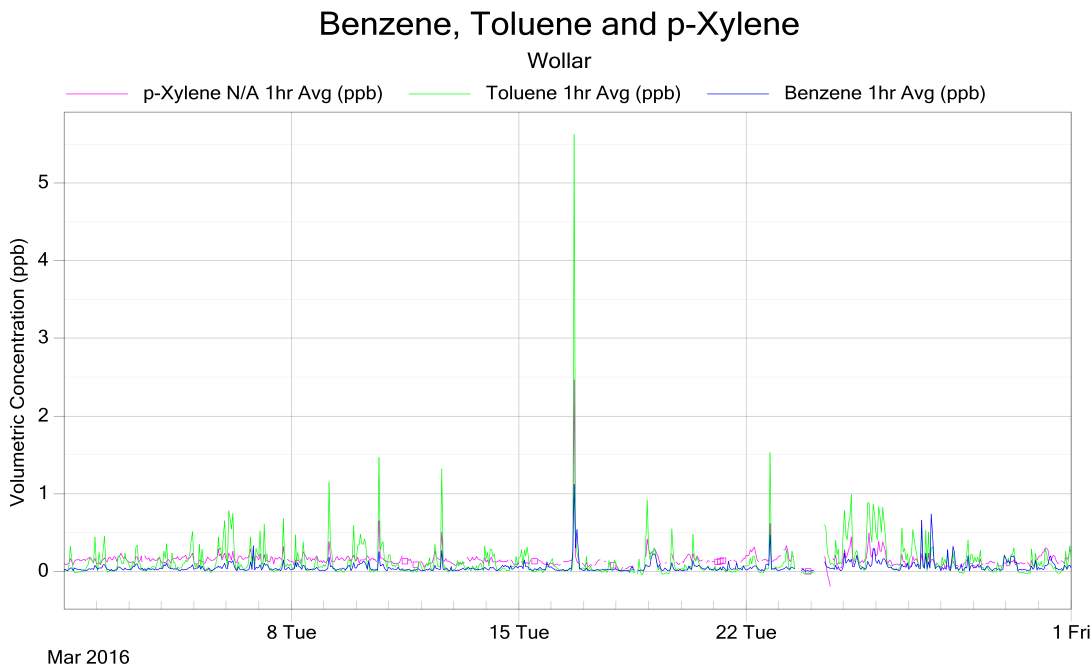


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/03/2016 10:15 | 31/03/2016 16:20 | Intermittent unrealistic data spikes | *p*-Xylene | RE | 26/04/2016 |
| 18/03/2016 15:15 | 18/03/2016 15:45 | Short power interruption and subsequent instrument stabilisation. Intermittent $H_2S$ and $SO_2$ data also affected | BTX, $SO_2$ and $H_2S$ | RE | 26/04/2016 |
| 23/03/2016 12:45 | 23/03/2016 16:15 | Maintenance – began scheduled monthly tasks | All parameters | RE | 26/04/2016 |
| 23/03/2016 16:20 | 25/03/2016 00:00 | Instrument fault | $H_2S$ | RE | 26/04/2016 |
| 24/03/2016 03:10 | 24/03/2016 07:20 | Instrument fault | BTX | RE | 26/04/2016 |
| 24/03/2016 06:55 | 24/03/2016 14:05 | Maintenance – completion of tasks started on 23/03/2016. Instruments affected at different times during this period | All parameters | RE | 26/04/2016 |

# 8.0 Report Summary

The data capture for Wollar was above 95% for all measured parameters, with the exception of *p*-Xylene and $H_2S$;

- Data capture for *p*-Xylene was 93.5% and was impacted by maintenance and intermittent unrealistic data spikes.
- $H_2S$ had a data capture of 93.0% and was impacted by an instrument fault resulting in unrealistic readings. This was possibly due to the instrument being accidently left in 'out of service' mode following maintenance on 24/03/2016.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

# Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

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# Peabody Energy

# Wilpinjong Coal
## Wollar

Ambient Air Quality Monitoring

Validated Report

1st April – 30th April 2016

Report No.: DAT10720

Report issue date: 26th May 2016

Maintenance contract: MC951


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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT10720 | 26/05/2016 | Kelly Erasmus |

Report by: Kelly Erasmus

Approved Signatory: Jon Alexander

## Table of Contents

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## List of Tables

# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene. A wind sensor is also installed at the Wollar site.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for 1st – 30th April 2016. Data capture for the different pollutants is presented in Table 9.

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for 1st – 30th April 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 Series Manual | Synspec GC955 - Gas Chromatography |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Apr-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 | 23:45 to 23:50 |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:50 to 23:55 |

## 5.3. Maintenance

Scheduled monthly maintenance was performed over two days on 28/04/2016. The $NO_x$, $SO_2$ and $H_2S$ expired gas cylinders were removed. The $NO_x$ and $SO_2$ gas bottles were temporarily replaced and a $H_2S$ cylinder was ordered and installed on 17/05/2016. No $H_2S$ calibrations were performed for the rest of the month and the data deemed as invalid. Please refer to the Valid Data Exception Table for details. Further details for May 2016 data will be included in next month's report.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 28/04/2016 | Monthly | 28/04/2016 | Monthly |
| $SO_2$ | 28/04/2016 | Monthly | 28/04/2016 | Monthly |
| $H_2S$ | 28/04/2016 | Monthly | 21/04/2016 | Unscheduled |
| BTX | 28/04/2016 | Monthly | 28/04/2016 | Monthly |
| Wind Speed | 28/04/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 28/04/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 30th April 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 97.7 |
| $SO_2$ | 97.5 |
| $H_2S$ | **81.6** |
| Benzene | 98.4 |
| Toluene | 98.4 |
| *p*-Xylene | **92.7** |
| WS, WD | 99.3 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

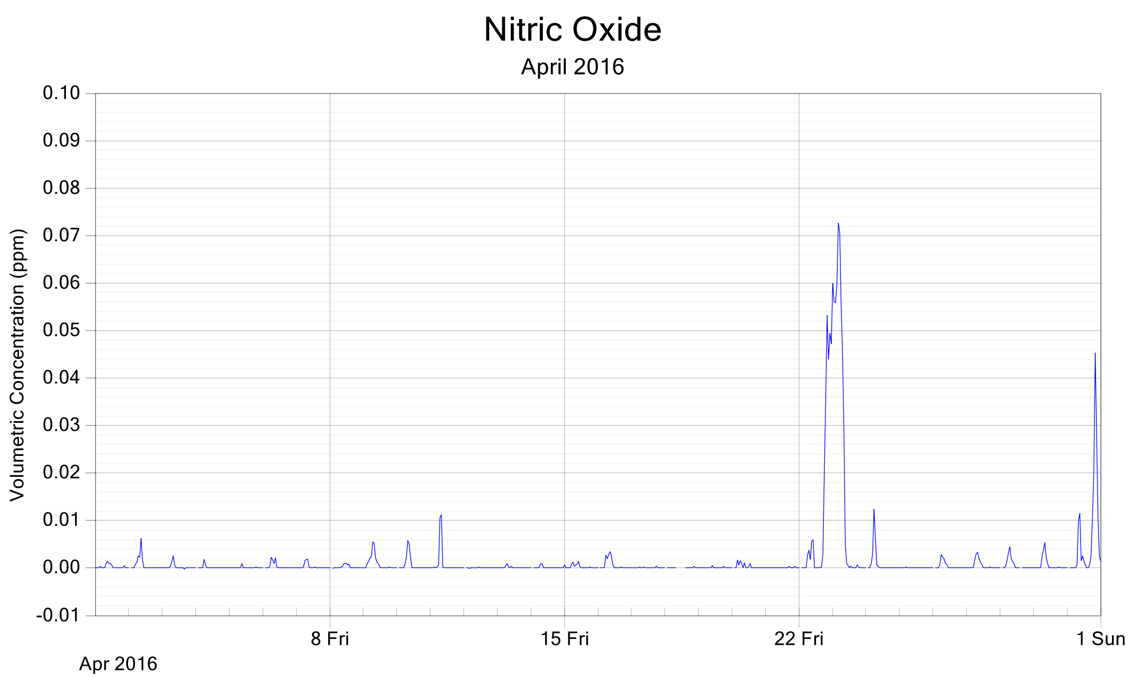


**Figure 2: NO - 1 hour data**

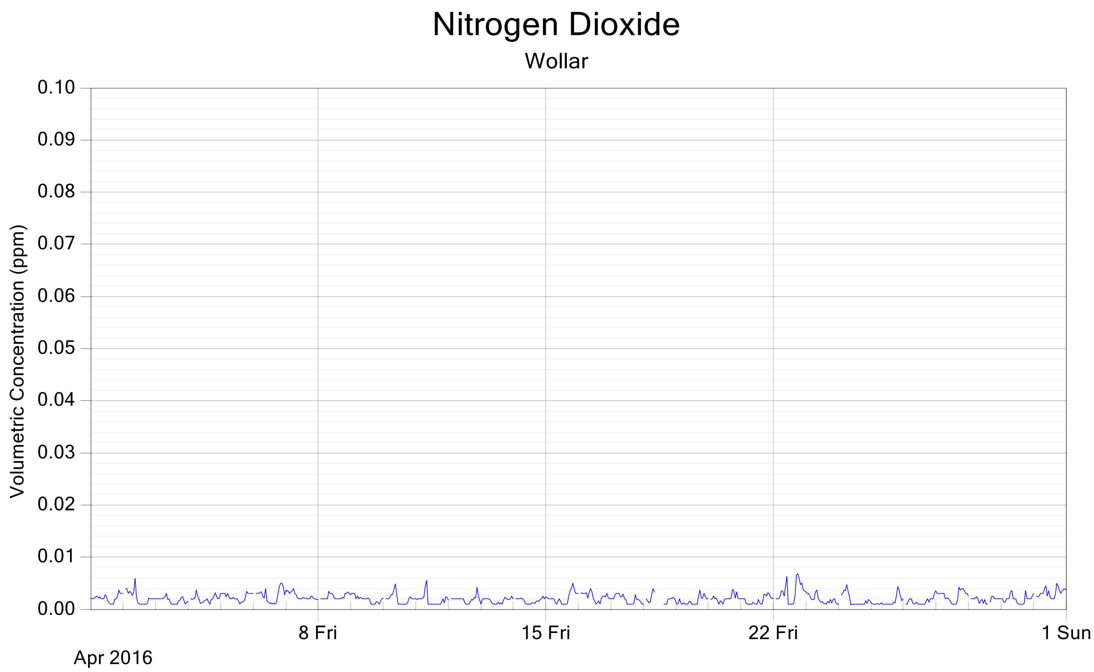


**Figure 3: $NO_2$ - 1 hour data**

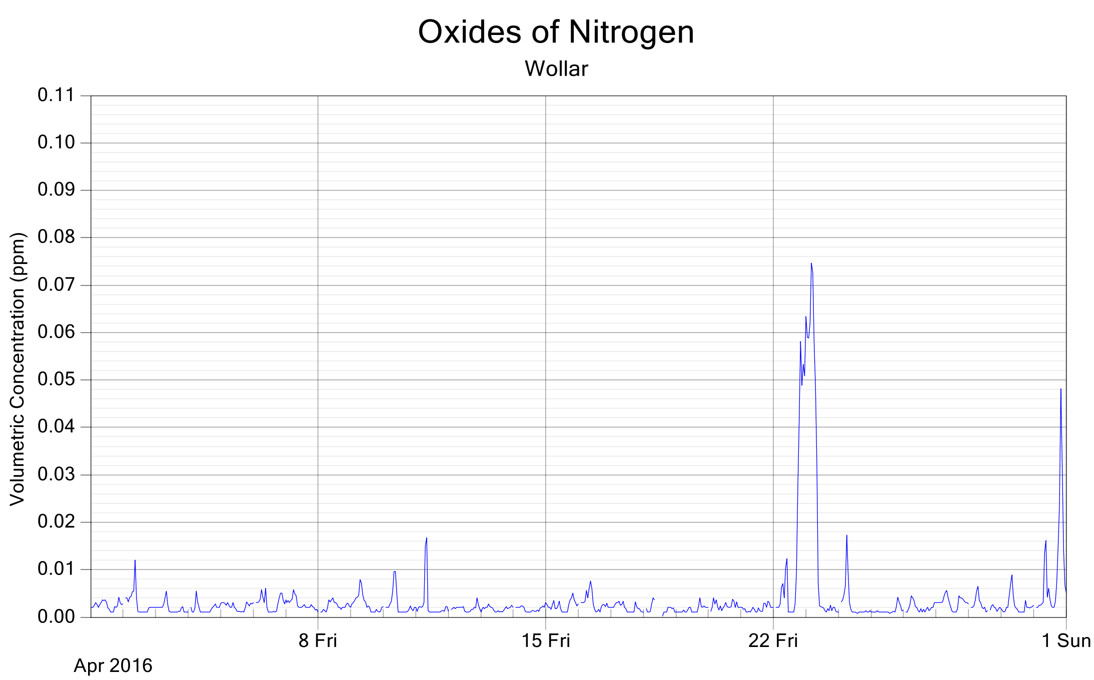


**Figure 4: $NO_X$ - 1 hour data**

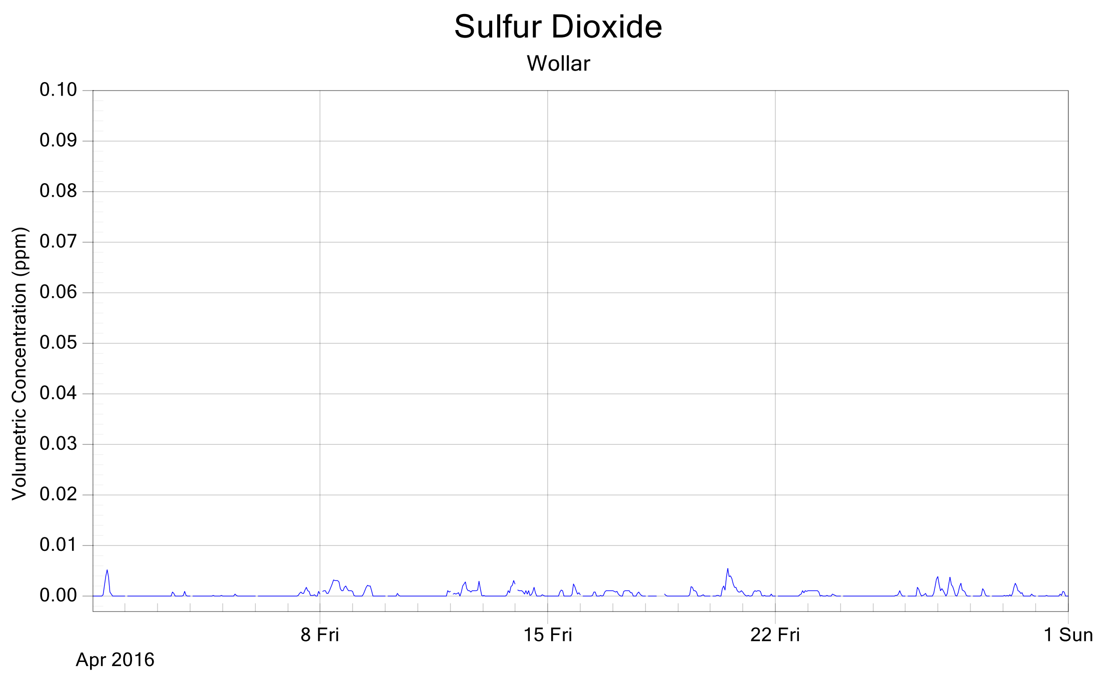


**Figure 5: $SO_2$ - 1 hour data**

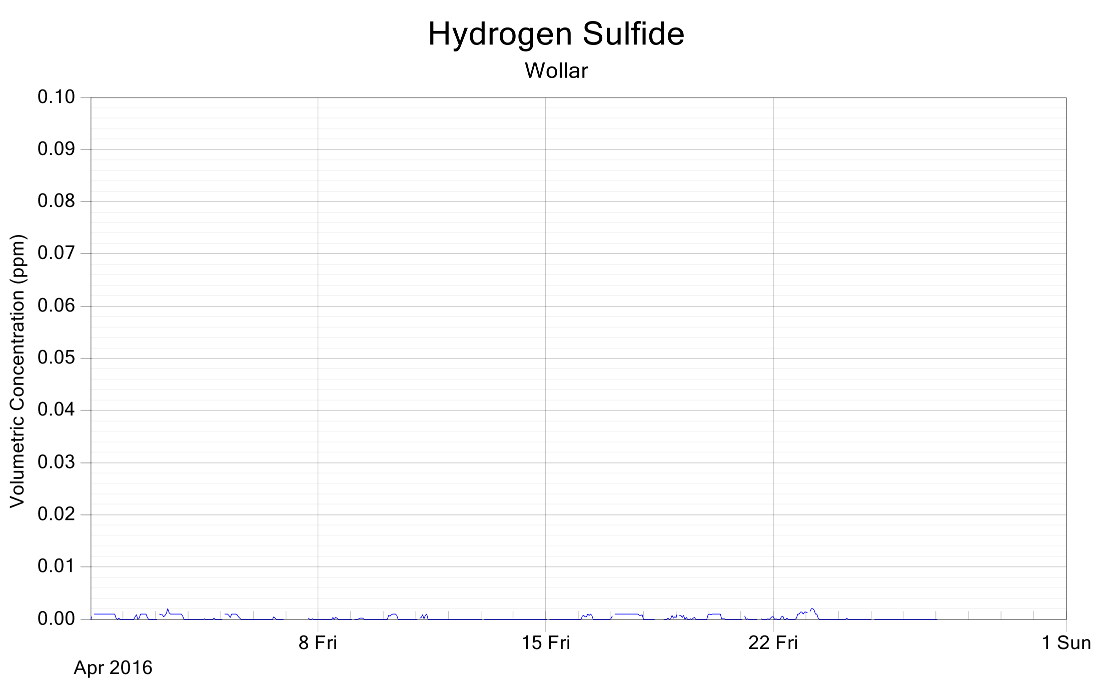


**Figure 6: $H_2S$ - 1 hour data**

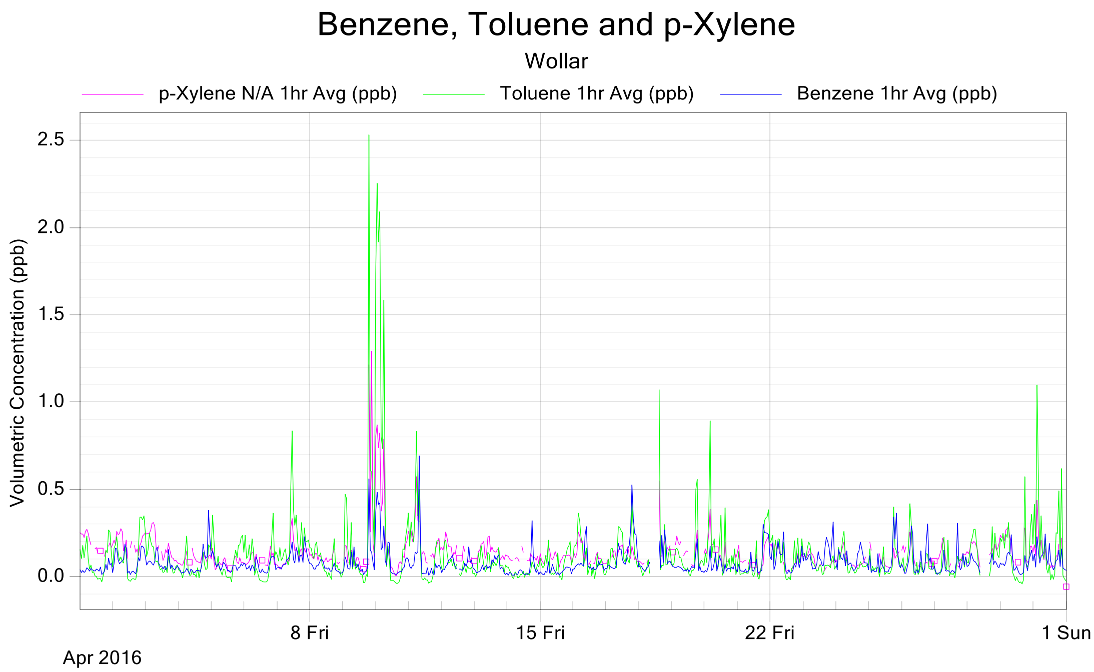


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/04/16 9:30 | 30/04/16 23:50 | Intermittent unrealistic data spikes | p-Xylene | KE | 13/05/16 |
| 06/04/16 23:25 | 07/04/16 16:30 | Instrument stabilisation after being taken out of service mode | $H_2S$ | KE | 26/05/16 |
| 18/04/16 9:30 | 18/04/16 14:40 | Short power interruption and subsequent instrument stabilisation | All parameters | KE | 26/05/16 |
| 18/04/16 2:45 | 28/04/16 10:25 | Static offset of -0.13 µg/m$^3$ applied to correct baseline | p-Xylene | KE | 26/05/16 |
| 21/04/16 12:50 | 21/04/16 14:30 | Maintenance – unscheduled remote calibration | $H_2S$ | KE | 13/05/16 |
| 25/04/16 4:00 | 25/04/16 4:05 | Intermittent unrealistic data spikes | $H_2S$ | KE | 26/05/16 |
| 27/04/16 3:00 | 01/05/16 0:00 | No calibrations performed due to the removal of the calibration gas bottle | $H_2S$ | KE | 13/05/16 |
| 28/04/16 8:30 | 28/04/16 16:10 | Maintenance – scheduled monthly tasks. Instruments affected at different times during this period. Expired calibration gas cylinders removed. $NO_X/SO_2$ cylinder was temporarily replaced. | All parameters | KE | 13/05/16 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 28/04/16 16:00 | 01/05/16 0:00 | Static offset of +0.12 µg/$m^3$ applied to correct baseline | p-Xylene | KE | 26/05/16 |

# 8.0 Report Summary

The data capture for Wollar was above 95% for all measured parameters, with the exception of *p*-Xylene and $H_2S$;

- Data capture for *p*-Xylene was 92.7% and was impacted by maintenance and intermittent unrealistic data spikes.
- $H_2S$ had a data capture of 81.6% and was impacted by the removal of the calibration gas bottle on 28/04/2016. No calibrations were performed after this date and the data was deemed invalid.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

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WORLD RECOGNISED ACCREDITATION

# Peabody Energy

# Wilpinjong Coal

## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st May – 31st May 2016

Report No.: DAT10824

Report issue date: 24th June 2016

Maintenance contract: MC951


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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT10824 | 24/06/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS RBEdwards

**Approved Signatory:** Jon ALEXANDER

## Table of Contents

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## List of Tables

# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for 1st – 31st May 2016. Data capture for the different pollutants is presented in Table 9.

## 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for 1st – 31st May 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

## 3.0 Monitoring and Data Collection

### 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*. A siting audit will be carried out at the next available maintenance visit.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX<br>(Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 Series Manual | Synspec GC955 - Gas Chromatography |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report May-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time | Background cycle time |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 every 2nd day | 23:45 to 23:50 |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:40 to 23:45 |

## 5.3. Maintenance

No scheduled maintenance was performed during the reporting month.

The empty $H_2S$ gas bottle was replaced on 17/05/2016 and overnight calibration cycles resumed.

A calibration for BTX is overdue and will be performed at the next maintenance visit.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 28/04/2016 | Monthly | 28/04/2016 | Monthly |
| $SO_2$ | 28/04/2016 | Monthly | 28/04/2016 | Monthly |
| $H_2S$ | 17/05/2016 | Remote calibration sequence | 28/04/2016 | Monthly |
| BTX | 28/04/2016 | Monthly | 28/04/2016 | Monthly |
| Wind Speed | 28/04/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 28/04/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 31st May 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 98.5 |
| $SO_2$ | 98.0 |
| $H_2S$ | **45.0** |
| Benzene | **88.0** |
| Toluene | **88.0** |
| *p*-Xylene | **87.9** |
| WS, WD | **91.0** |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

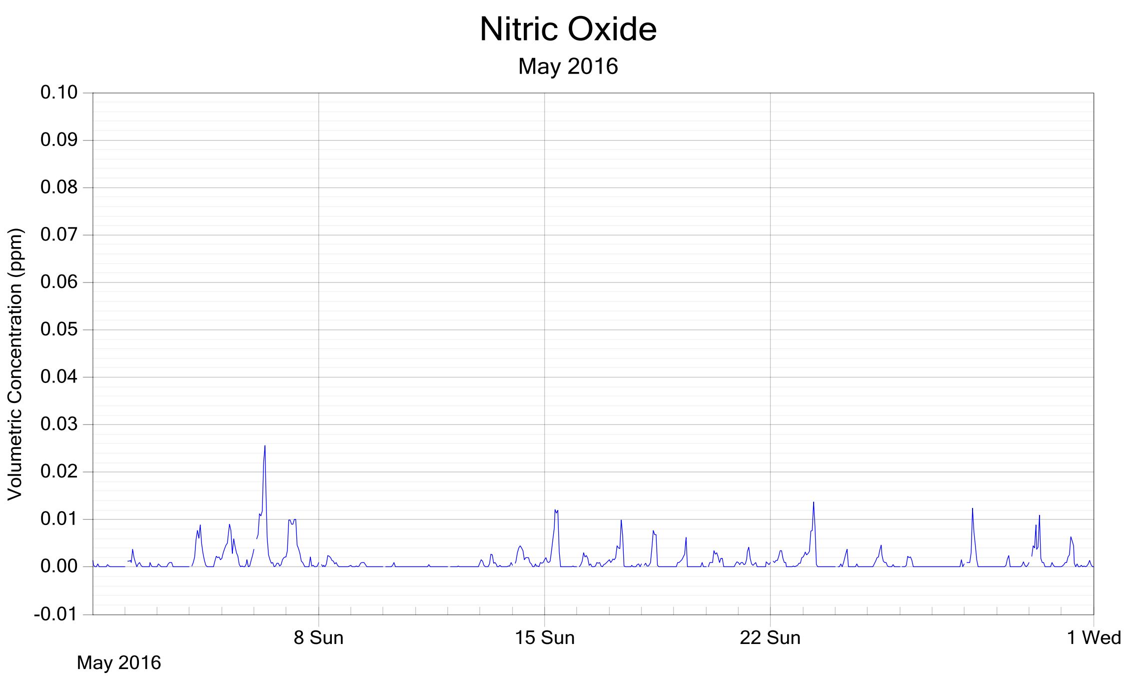


**Figure 2: NO - 1 hour data**

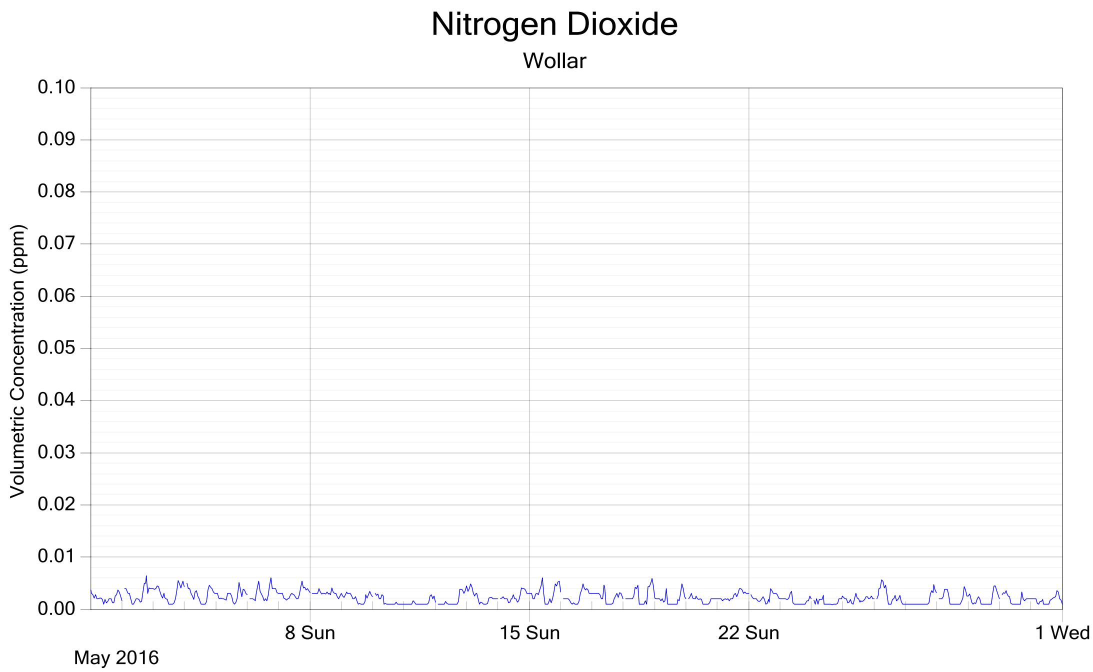


**Figure 3: $NO_2$ - 1 hour data**

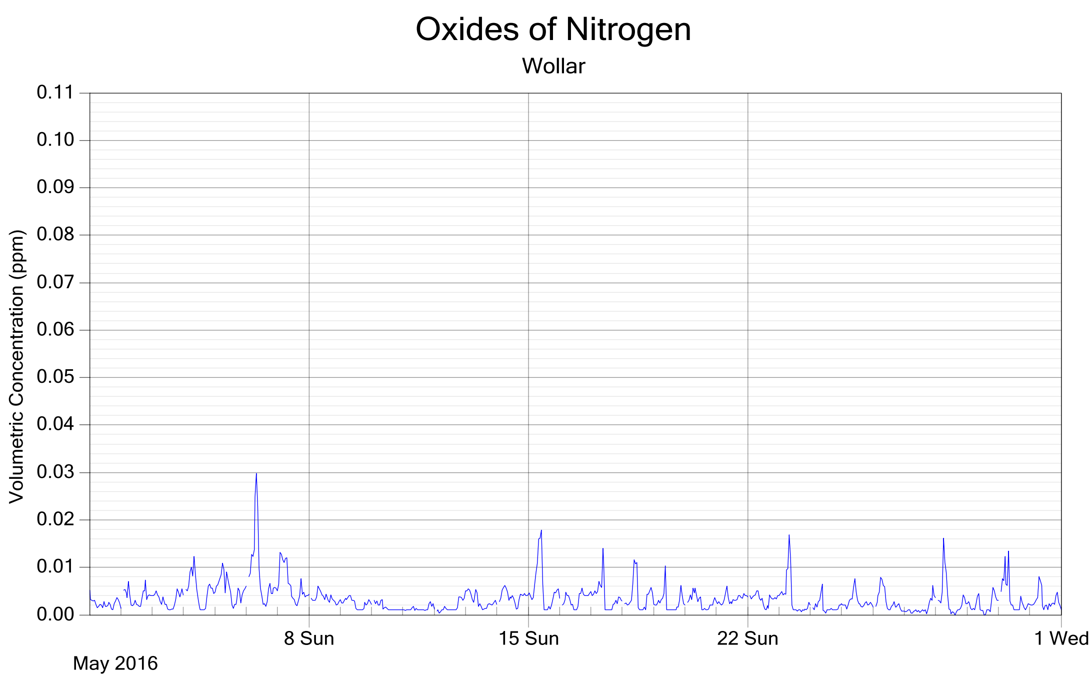


**Figure 4: $NO_X$ - 1 hour data**

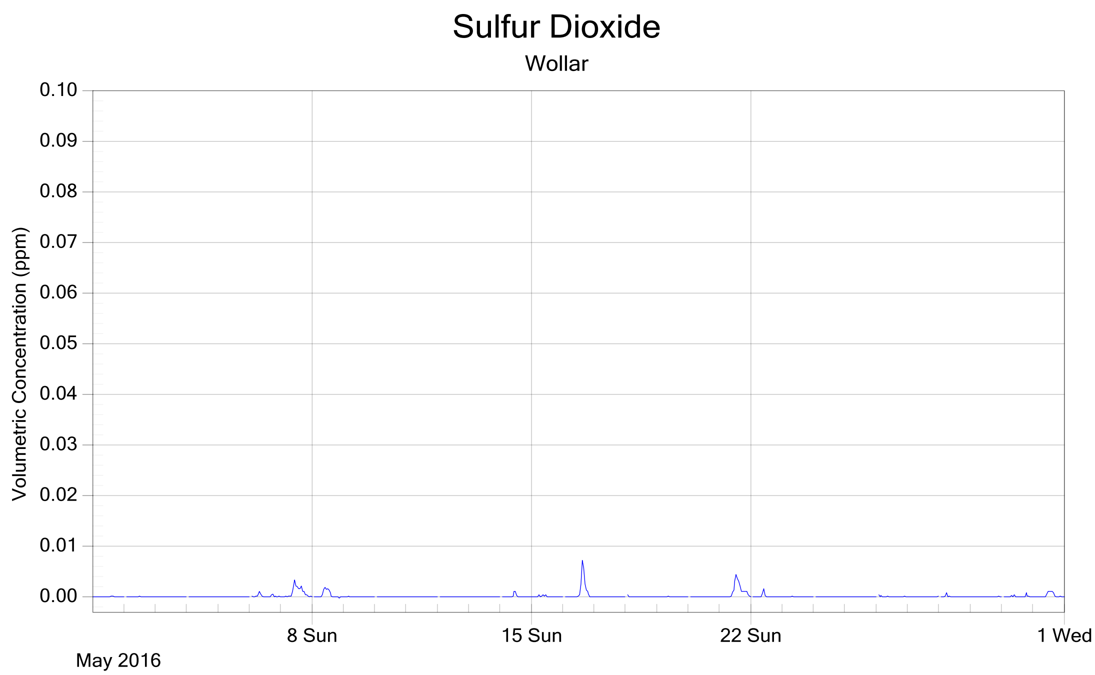


**Figure 5: $SO_2$ - 1 hour data**

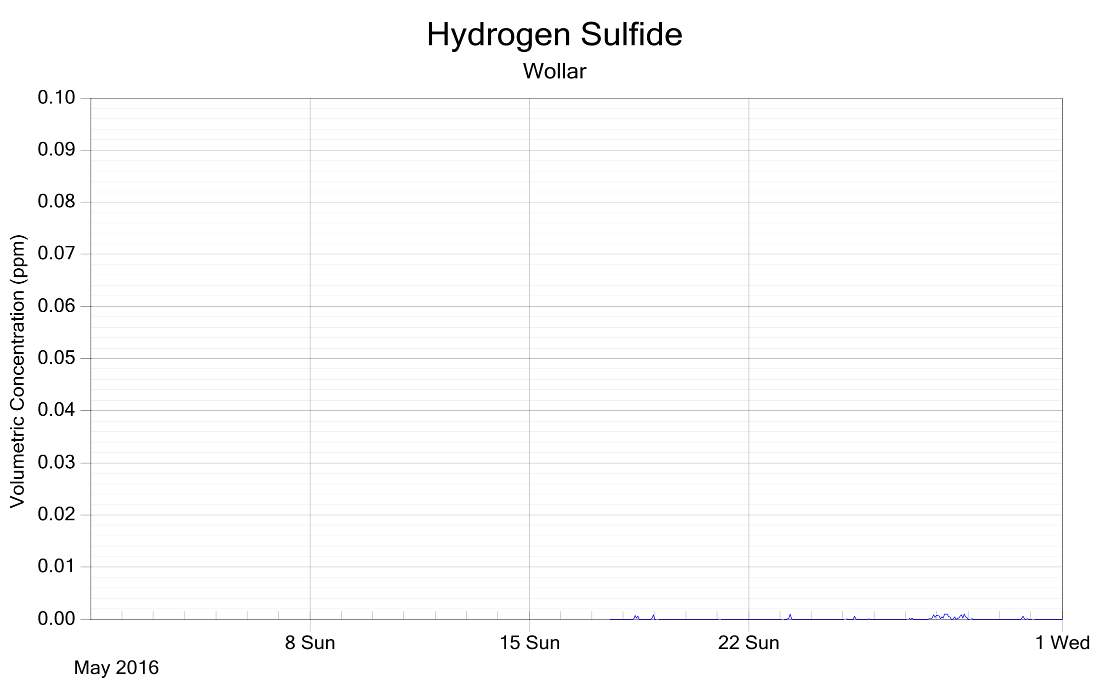


**Figure 6: $H_2S$ - 1 hour data**

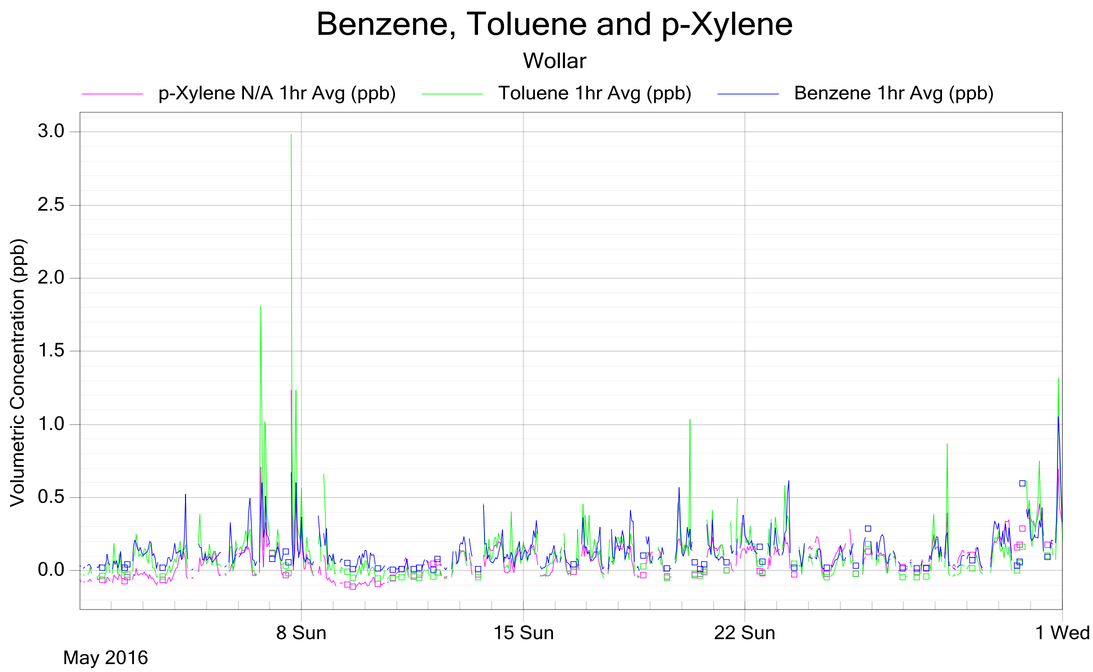


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/05/2016 00:00 | 17/05/2016 11:25 | No calibrations performed due to the removal of the calibration gas bottle | $H_2S$ | RE | 20/06/2016 |
| 01/05/2016 00:50 | 31/05/2016 18:55 | Instrument fault – intermittent unrealistic data spikes | BTX | RE | 20/06/2016 |
| 02/05/2016 19:50 | 05/05/2016 14:20 | Instrument fault – wind sensor stalled | WS and WD | RE | 20/06/2016 |
| 04/05/2016 10:05 | 04/05/2016 10:05 | Data transmission errors | $SO_2$, $H_2S$, BTX, WS and WD | RE | 20/06/2016 |
| 13/05/2016 10:45 | 30/05/2016 12:20 | Intermittent short power interruption and instrument stabilisation | BTX | RE | 20/06/2016 |
| 17/05/2016 11:30 | 17/05/2016 13:20 | Calibration gas bottle replaced and remote span/zero check performed | $H_2S$ | RE | 20/06/2016 |
| 17/05/2016 13:25 | 31/05/2016 23:55 | Linear multiplier applied to correct overnight span values where A = 1.04 ppb and B = 0.93 ppb | $H_2S$ | RE | 20/06/2016 |
| 26/05/2016 13:10 | 26/05/2016 18:15 | Static offset of -0.5 ppb applied to correct baseline | *p*-Xylene | RE | 20/06/2016 |
| 27/05/2016 04:10 | 27/05/2016 04:45 | Static offset of -0.6 ppb applied to correct baseline | *p*-Xylene | RE | 20/06/2016 |
| 27/05/2016 05:20 | 27/05/2016 06:15 | Static offset of -0.6 ppb applied to correct baseline | *p*-Xylene | RE | 20/06/2016 |
| 27/05/2016 13:50 | 27/05/2016 14:40 | Static offset of -0.5 ppb applied to correct baseline | *p*-Xylene | RE | 20/06/2016 |

## 8.0 Report Summary

The data capture for Wollar was below 95% for all measured parameters, with the exception of NO, $NO_2$ and $NO_x$ and $SO_2$;

- Data capture for $H_2S$ was 45.0% and was due to an empty calibration gas bottle, resulting in no overnight calibrations for more than 7 days.
- Data capture for BTX was 88.0% for benzene and toluene and 87.9% for *p*-Xylene; and was due an on-going instrument fault resulting in unrealistic data spikes.
- Data capture for wind speed and direction was 91.0% and was due to a faulty wind sensor over a 3 day period.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----------------------------------------------END OF REPORT-------------------------------------

# Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

Accredited for compliance with ISO/IEC 17025.

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal
## Wollar

Ambient Air Quality Monitoring

Validated Report

1st June – 30th June 2016

Report No.: DAT10926

Report issue date: 28th July 2016

Maintenance contract: MC951

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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT10926 | 28/07/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS REdwards

**Approved Signatory:** Jon ALEXANDER

## Table of Contents

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## List of Tables

# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for 1st – 30th June 2016. Data capture for the different pollutants is presented in Table 9.

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for 1st – 30th June 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX<br>(Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 Series Manual | Synspec GC955 - Gas Chromatography |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Jun-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

## 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

### 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2$^{nd}$ day | N/A |
| $SO_2$ | 01:00 to 01:40 every 2$^{nd}$ day | 23:45 to 23:50 every 2$^{nd}$ day |
| $H_2S$ | 01:45 to 02:45 every 2$^{nd}$ day | 23:50 to 23:55 every 2$^{nd}$ day |

## 5.3. Maintenance

Scheduled monthly maintenance was performed over two days on the 28$^{th}$ and 29$^{th}$ June 2016. A new calibration gas bottle was installed on-site during this maintenance.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 28/06/2016 | Monthly | 28/06/2016 | Monthly |
| $SO_2$ | 28/06/2016 | Monthly | 28/06/2016 | Monthly |
| $H_2S$ | 28/06/2016 | Monthly | 28/06/2016 | Monthly |
| BTX | 29/06/2016 | Monthly | 29/06/2016 | Monthly |
| Wind Speed | 29/06/2016 | 3 Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 29/06/2016 | 3 Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 30th June 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| $NO, NO_2, NO_x$ | 97.9 |
| $SO_2$ | 97.5 |
| $H_2S$ | 96.2 |
| Benzene | **81.9** |
| Toluene | **81.9** |
| *p*-Xylene | **81.9** |
| WS, WD | 99.9 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

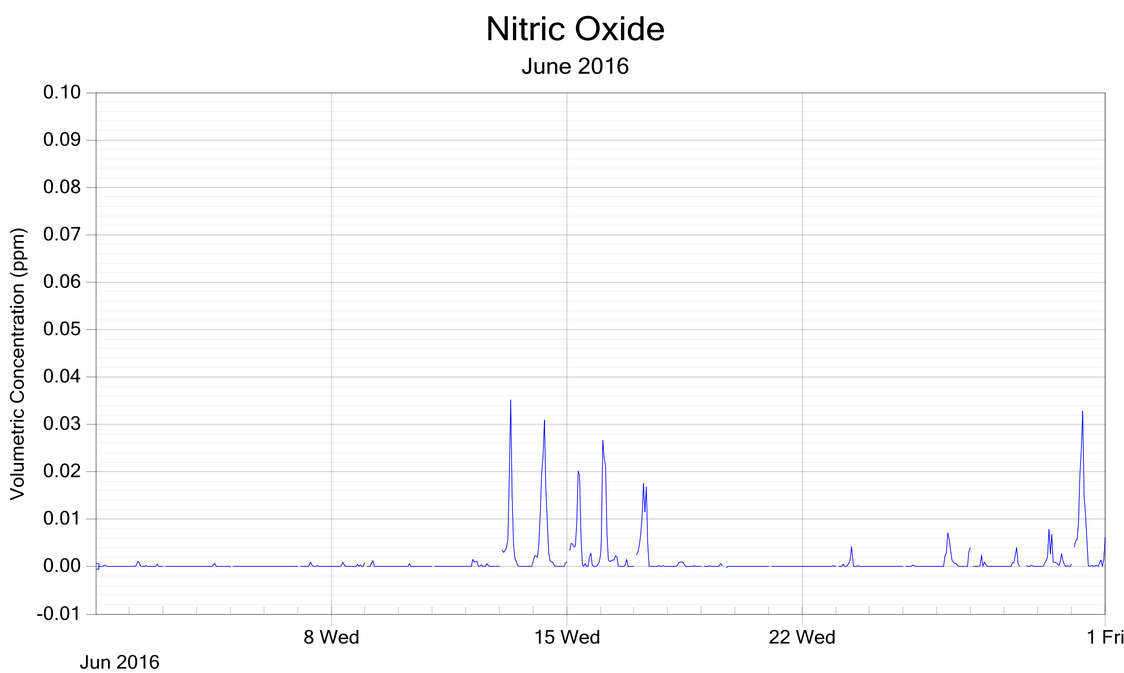


**Figure 2: NO - 1 hour data**

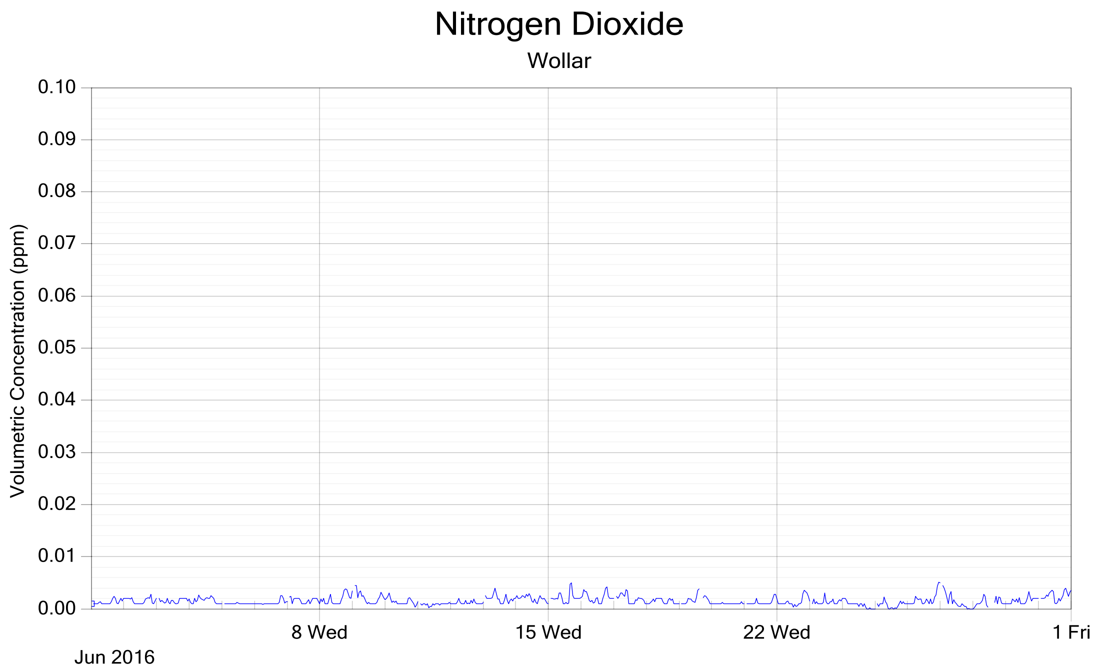


**Figure 3: $NO_2$ - 1 hour data**

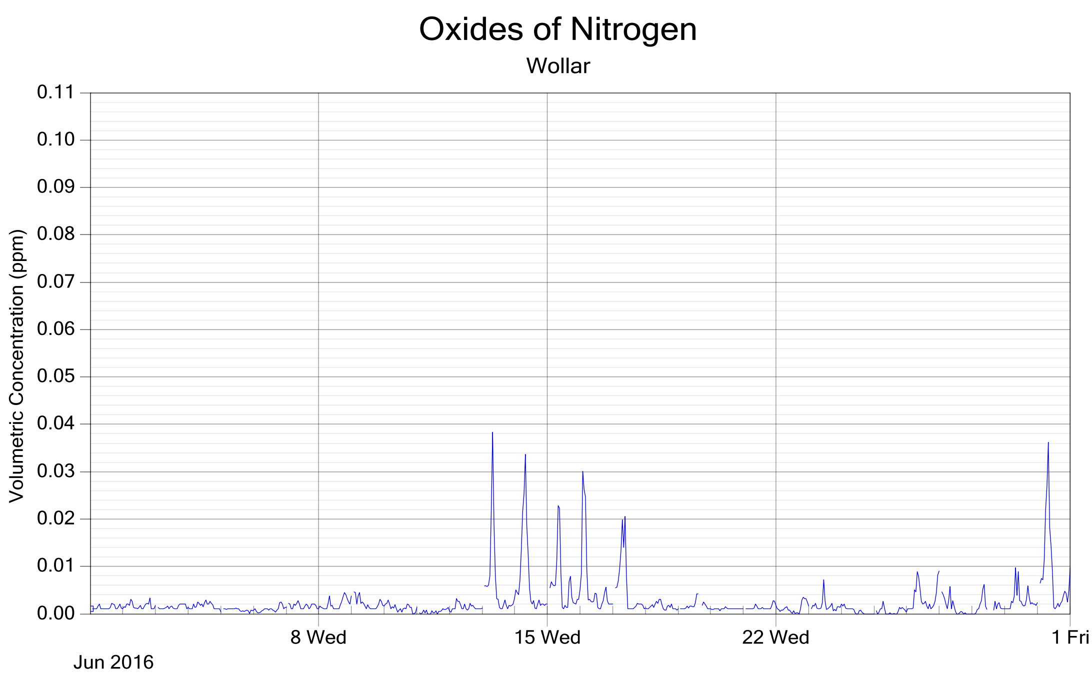


**Figure 4: $NO_X$ - 1 hour data**

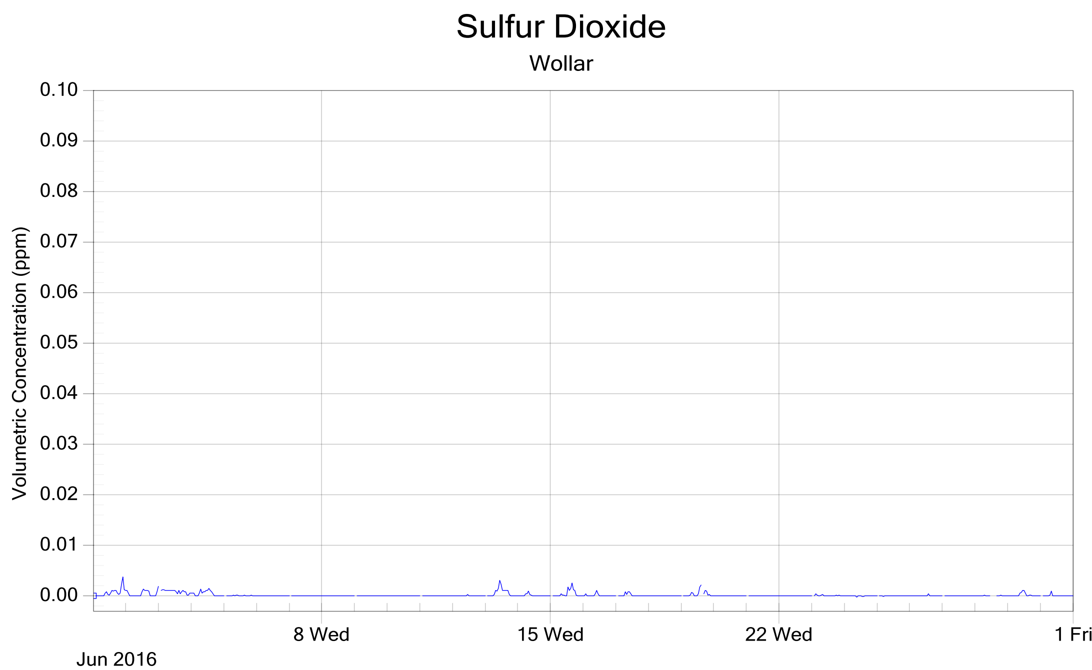


**Figure 5: $SO_2$ - 1 hour data**

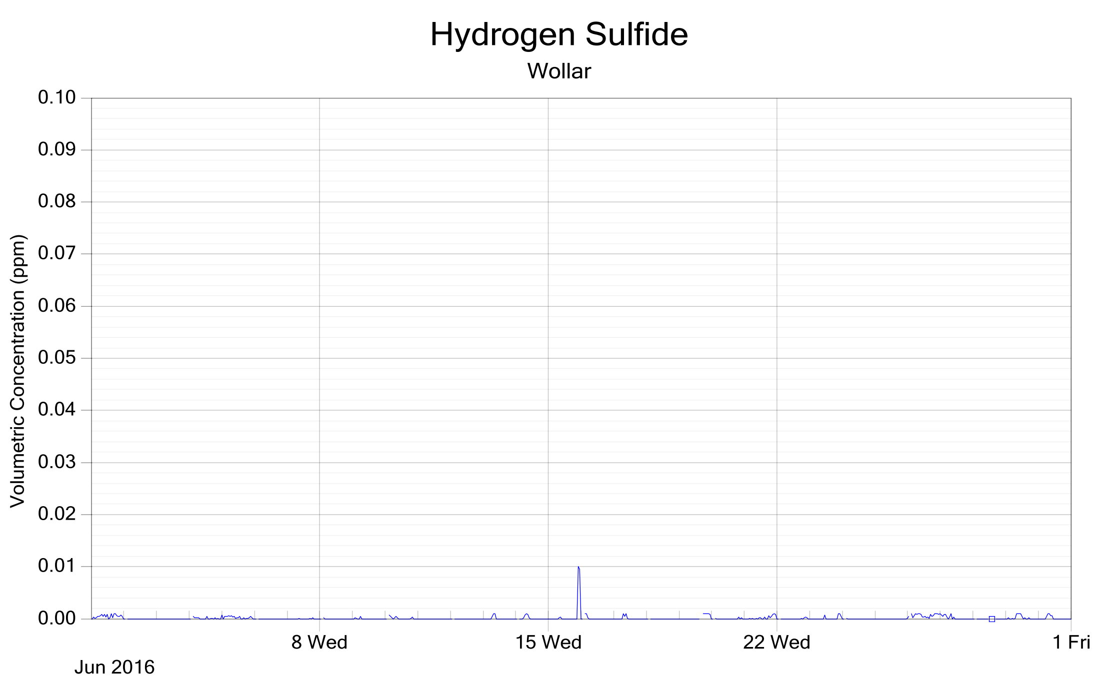


**Figure 6: $H_2S$ - 1 hour data**

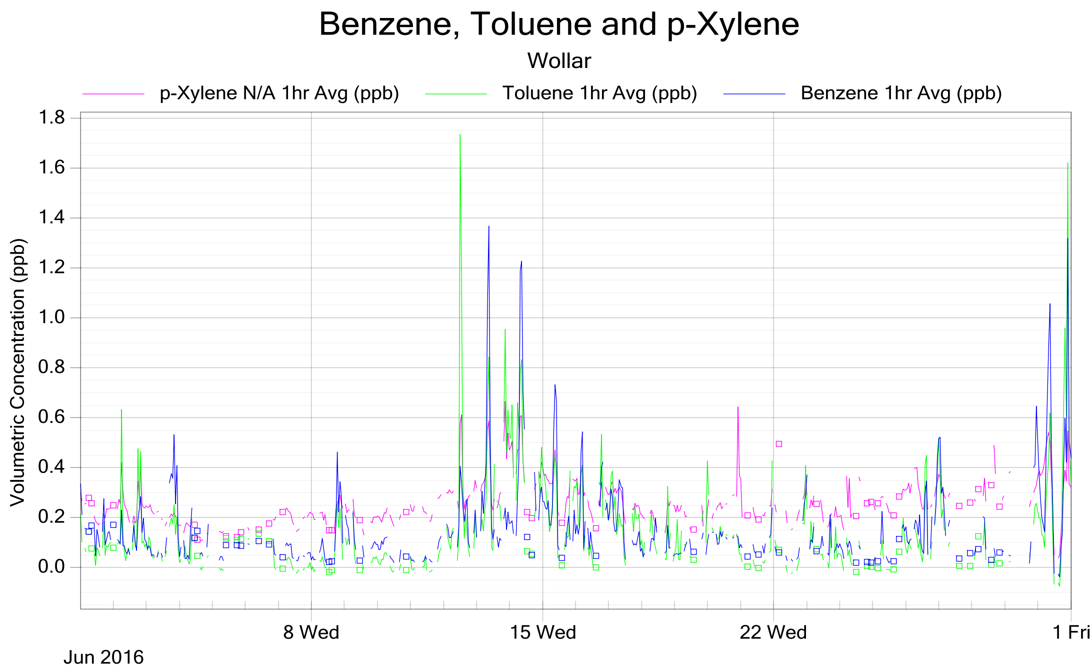


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/06/2016 00:00 | 02/06/2016 01:40 | Linear multiplier applied to correct overnight span values where A = 1.04 ppm and B = 0.93 ppm | $H_2S$ | RE | 26/07/2016 |
| 01/06/2016 02:25 | 30/06/2016 14:25 | Logging error – intermittent unrealistic *p*-*X*ylene spikes | BTX | RE | 26/07/2016 |
| 02/06/2016 02:25 | 28/06/2016 12:35 | Static multiplier of 0.92 applied to correct overnight span values | $H_2S$ | RE | 26/07/2016 |
| 05/06/2016 10:00 | 06/06/2016 20:30 | Static offset of -0.6 ppm applied to correct baseline | *p*-*X*ylene | RE | 26/07/2016 |
| 06/06/2016 05:55 | 27/06/2016 23:55 | Logging error – intermittent unrealistic Toluene spikes | BTX | RE | 26/07/2016 |
| 18/06/2016 06:10 | 29/06/2016 21:40 | Instrument fault – intermittent unrealistic negative spikes | $H_2S$ | RE | 26/07/2016 |
| 19/06/2016 16:25 | 19/06/2016 17:35 | Power interruption and gas instrument stabilisation | All parameters | RE | 26/07/2016 |
| 20/06/2016 00:50 | 20/06/2016 21:55 | Static offset of -0.5 ppm applied to correct baseline | *p*-*X*ylene | RE | 26/07/2016 |
| 24/06/2016 04:45 | 24/06/2016 06:05 | Static offset of -0.4 ppm applied to correct baseline | *p*-*X*ylene | RE | 26/07/2016 |
| 24/06/2016 13:25 | 24/06/2016 15:30 | Static offset of -0.4 ppm applied to correct baseline | *p*-*X*ylene | RE | 26/07/2016 |
| 28/06/2016 12:05 | 28/06/2016 15:15 | Maintenance – scheduled monthly and replacement of calibration gas cylinder | NO, $NO_2$, $NO_x$ and $SO_2$ | RE | 26/07/2016 |

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 29/06/2016 05:05 | 29/06/2016 17:20 | Maintenance – scheduled monthly | BTX | RE | 26/07/2016 |
| 29/06/2016 17:25 | 30/06/2016 23:55 | Static offset of 0.42 ppm applied to correct baseline (continued into Jul-16) | *p*-*X*ylene | RE | 26/07/2016 |

## 8.0 Report Summary

The data capture for Wollar was above 95% for all measured parameters, with the exception of BTX;

- Data capture for BTX was 81.9% and was due an on-going instrument fault resulting in unrealistic data spikes.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

# Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

Accredited for compliance with

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal

## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st July – 31st July 2016

Report No.: DAT11020

Report issue date: 26th August 2016

Maintenance contract: MC951

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| Revision History | | | |
|---|---|---|---|
| Revision | Report ID | Date | Analyst |
| 0 | DAT11020 | 26/08/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS RËdwards

**Approved Signatory:** Jon ALEXANDER

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## 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for 1st – 31st July 2016. Data capture for the different pollutants is presented in Table 9.

## 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for 1st – 31st July 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

## 3.0 Monitoring and Data Collection

### 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX<br>(Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer's Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
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### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Jul-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 every 2nd day | 23:45 to 23:50 every 2nd day |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:50 to 23:55 every 2nd day |

## 5.3. Maintenance

Scheduled six monthly maintenance was performed over two days on the 25th and 26th July 2016.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| $NO$, $NO_2$, $NO_x$ | 26/07/2016 | 6-monthly | 26/07/2016 | Monthly |
| $SO_2$ | 26/07/2016 | 6-monthly | 26/07/2016 | Monthly |
| $H_2S$ | 26/07/2016 | 6-monthly | 26/07/2016 | Monthly |
| BTX | 25/07/2016 | Yearly | 25/07/2016 | Monthly |
| Wind Speed | 25/07/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 25/07/2016 | Monthly | 21/05/2015 | 2-Yearly |

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1$^{st}$ – 31$^{st}$ July 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | **92.2** |
| $SO_2$ | **93.3** |
| $H_2S$ | **94.1** |
| Benzene | **80.0** |
| Toluene | **80.0** |
| *p*-Xylene | **79.7** |
| WS, WD | 97.9 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

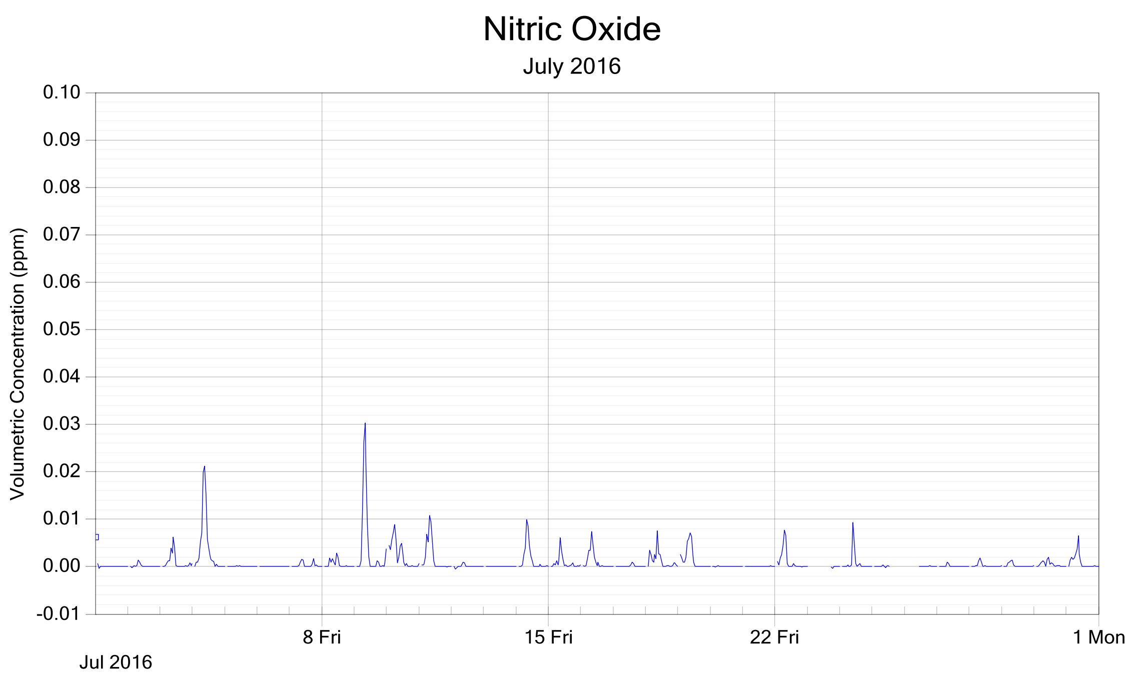


**Figure 2: NO - 1 hour data**

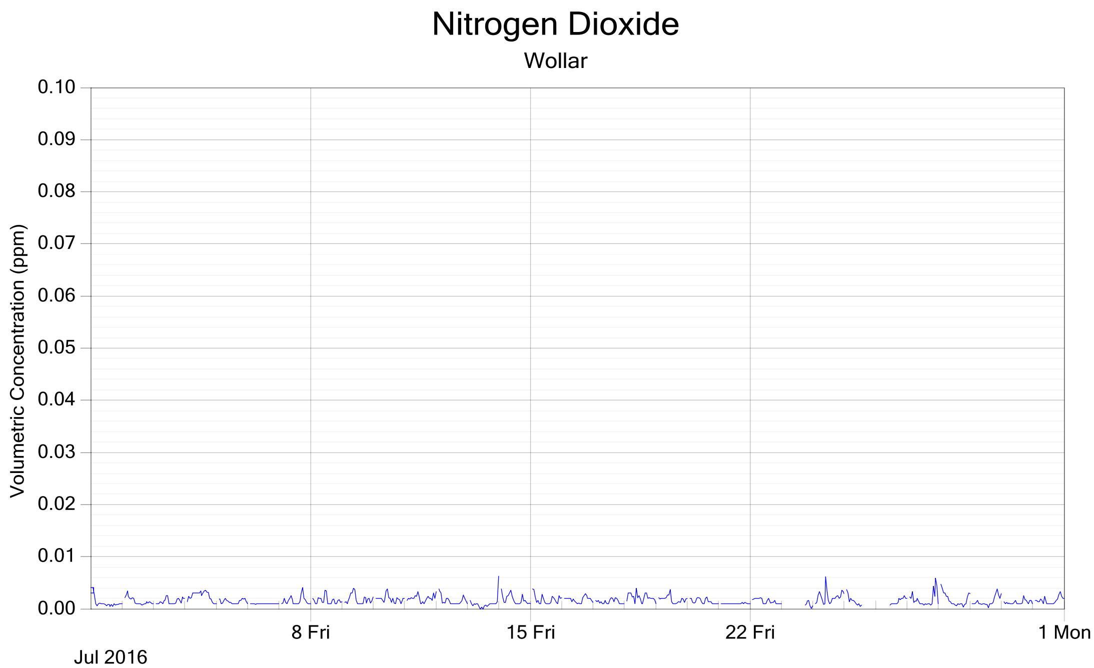


**Figure 3: $NO_2$ - 1 hour data**

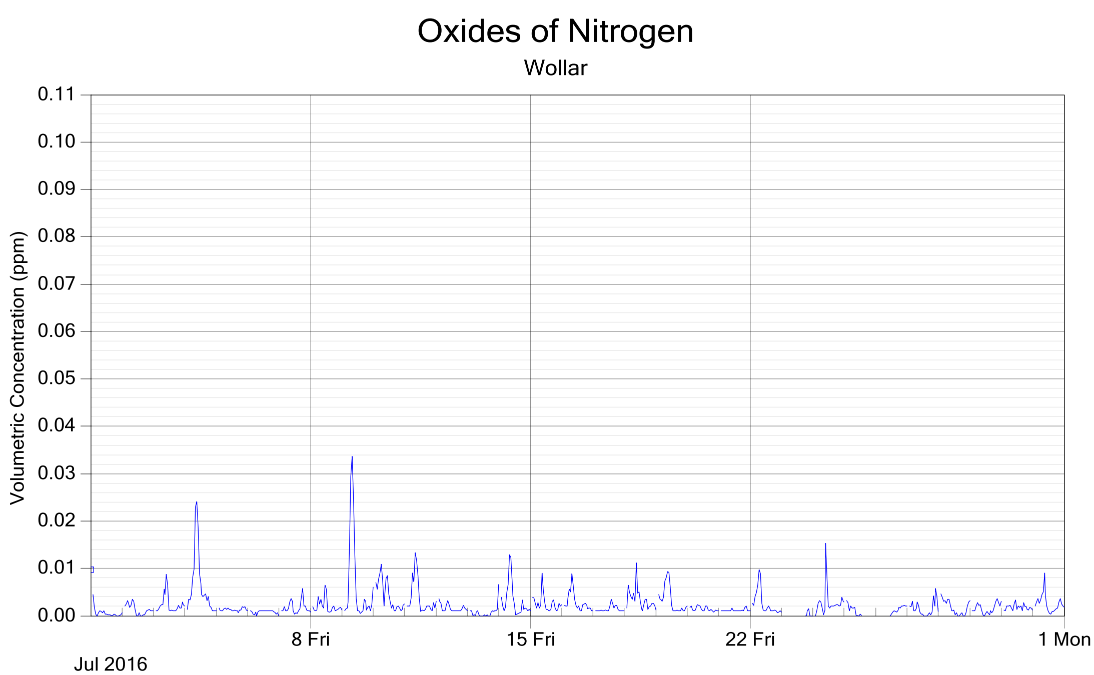


**Figure 4: $NO_X$ - 1 hour data**

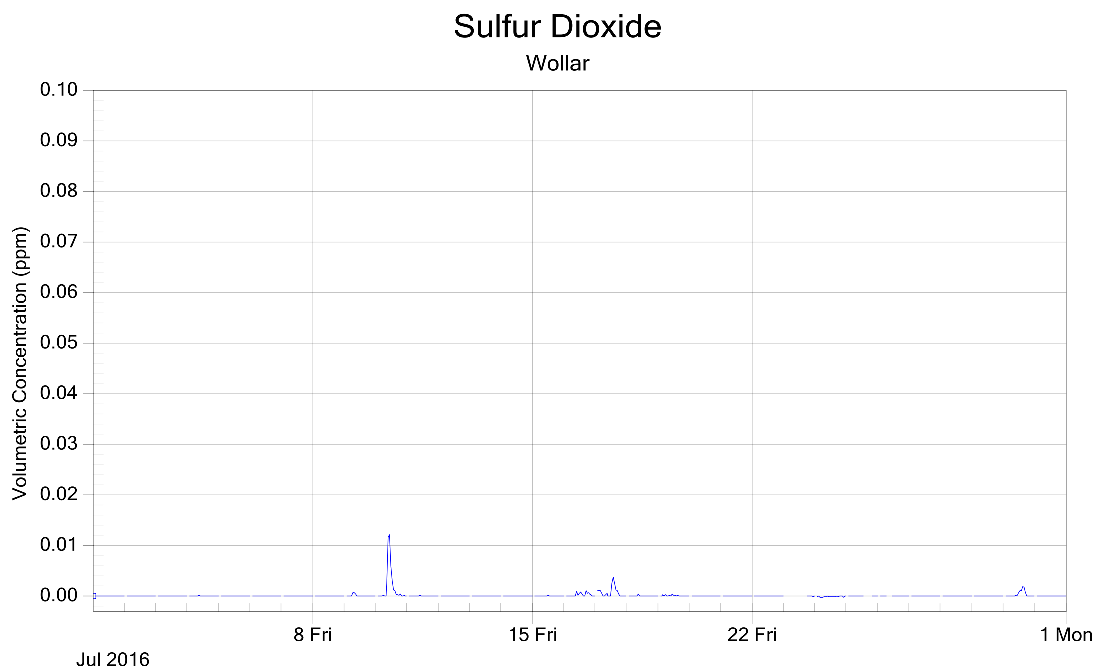


**Figure 5: $SO_2$ - 1 hour data**

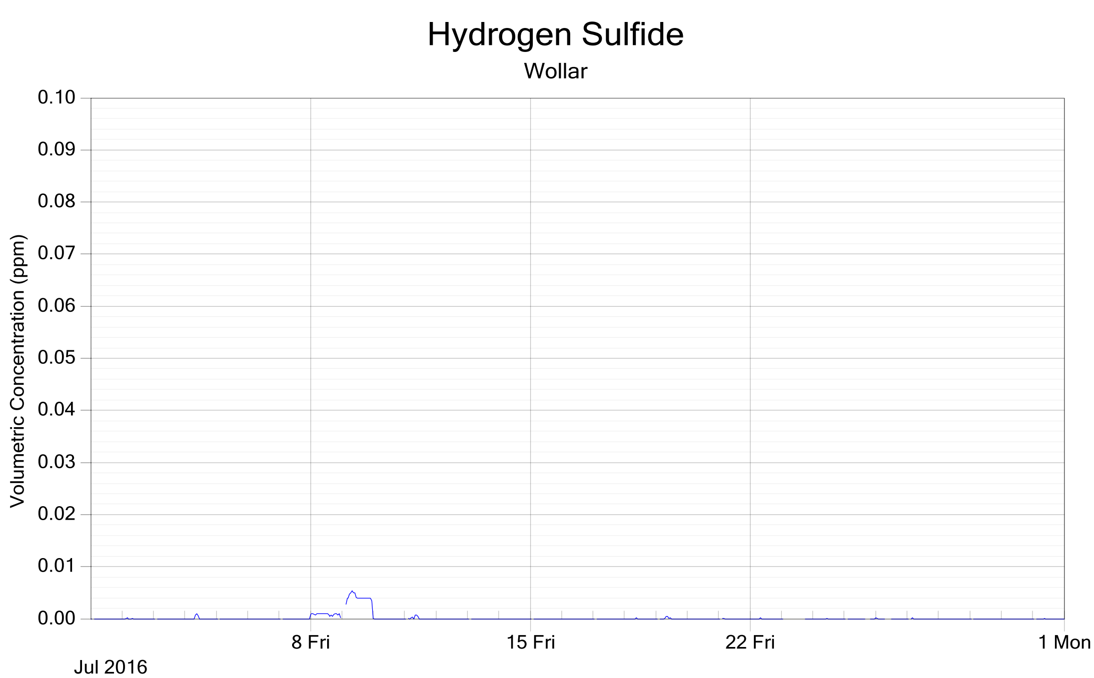


**Figure 6: $H_2S$ - 1 hour data**

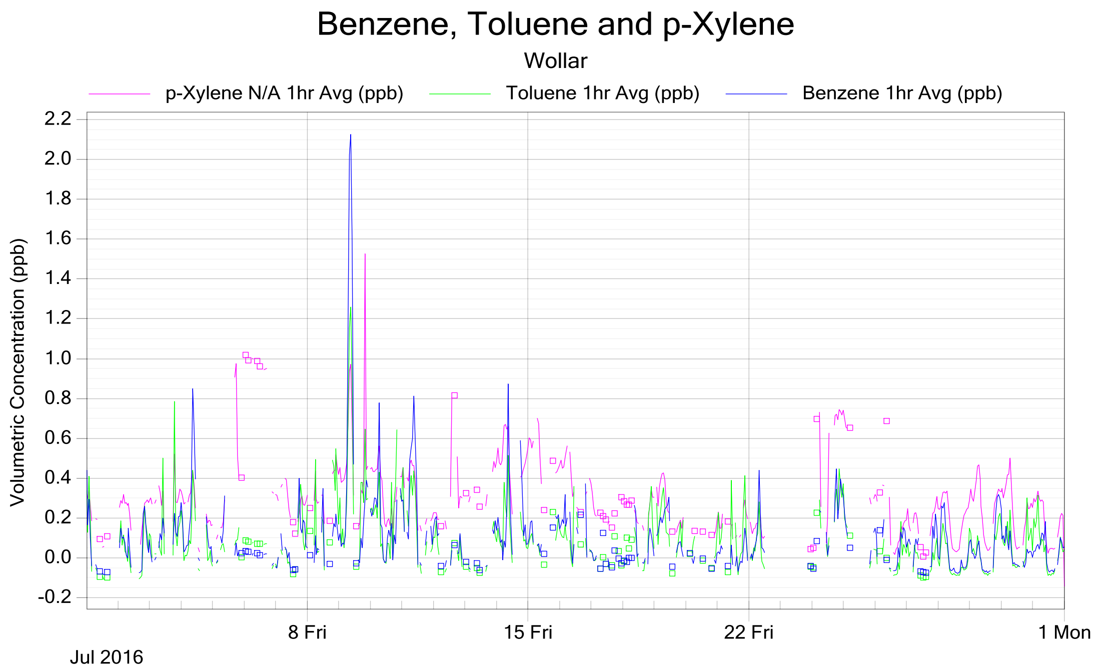


**Figure 7: BTX - 1 hour data**

# 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/07/2016 00:00 | 26/07/2016 13:56 | Static offset of 0.42 ppm applied to correct baseline (continued from Jun-16) | *p*-Xylene | RE | 26/07/2016 |
| 01/07/2016 05:05 | 31/07/2016 18:55 | Logging error – intermittent unrealistic Toluene / *p-X*ylene spikes | BTX | RE | 24/08/2016 |
| 03/07/2016 02:50 | 09/07/2016 15:50 | Instrument fault – intermittent unrealistic negative spikes | $H_2S$ | RE | 24/08/2016 |
| 14/07/2016 13:45 | 14/07/2016 14:15 | Intermittent short power interruptions and instrument stabilisation | BTX | RE | 24/08/2016 |
| 23/07/2016 01:55 | 23/07/2016 20:40 | Power interruption and gas instrument stabilisation | All parameters | RE | 24/08/2016 |
| 25/07/2016 07:00 | 25/07/2016 19:45 | Scheduled monthly, 6-monthly and yearly maintenance | WS, WD, $SO_2$, $H_2S$ and BTX | RE | 24/08/2016 |
| 25/07/2016 14:40 | 26/07/2016 08:10 | Instrument left in 'out of service mode' for pending maintenance | NO, $NO_2$ and $NO_x$ | RE | 24/08/2016 |
| 25/07/2016 19:55 | 31/07/2016 23:55 | Static offset of 0.41 ppb applied to correct negative baseline (continues into Aug-16) | *p*-Xylene | RE | 24/08/2016 |
| 26/07/2016 08:15 | 26/07/2016 11:20 | Completion of scheduled 6-monthly maintenance | NO, $NO_{2,}$ $NO_x$, $SO_2$ and $H_2S$ | RE | 24/08/2016 |

## 8.0 Report Summary

The data capture for Wollar was below 95% for all measured parameters, with the exception of wind speed and direction. Please refer to Table 9 on page 17 for data capture rates; and Table 10 on page 22 for data exceptions.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

Accredited for compliance with ISO/IEC 17025.

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal

## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st August – 31st August 2016

Report No.: DAT11111

Report issue date: 28th September 2016

Maintenance contract: MC951

***ECOTECH PTY LTD. ABN: 32005752081***
***1492 Ferntree Gully Rd, Knoxfield VIC. 3180. AUSTRALIA***
***Tel No: 1300 364 946 Fax No: 1300 668 763***
***Email ecotech@ecotech.com WEB www.ecotech.com***

| Customer Details | |
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| **Customer** | Peabody Energy Australia |
| **Contact name** | Clark Potter |
| **Address** | Locked Bag 2005, Mudgee 2850 NSW |
| **Email** | cpotter@peabodyenergy.com |
| **Phone** | +61 (02) 6370 2527 |

| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT11111 | 28/09/2016 | Robyn Edwards |

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**Approved Signatory:** Jon ALEXANDER

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- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

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## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, and $H_2S$**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 every 2nd day | 23:45 to 23:50 every 2nd day |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:50 to 23:55 every 2nd day |

## 5.3. Maintenance

Maintenance was performed on 29/08/2016.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| $NO$, $NO_2$, $NO_x$ | 29/08/2016 | Monthly | 29/08/2016 | Monthly |
| $SO_2$ | 29/08/2016 | Monthly | 29/08/2016 | Monthly |
| $H_2S$ | 29/08/2016 | Monthly | 29/08/2016 | Monthly |
| BTX | 29/08/2016 | Monthly | 29/08/2016 | Monthly |
| Wind Speed | 29/08/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 29/08/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available.

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for 1st – 31st August 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 96.5 |
| $SO_2$ | 96.0 |
| $H_2S$ | 96.8 |
| Benzene | 96.8 |
| Toluene | 96.8 |
| *p*-Xylene | 96.7 |
| WS, WD | 99.6 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

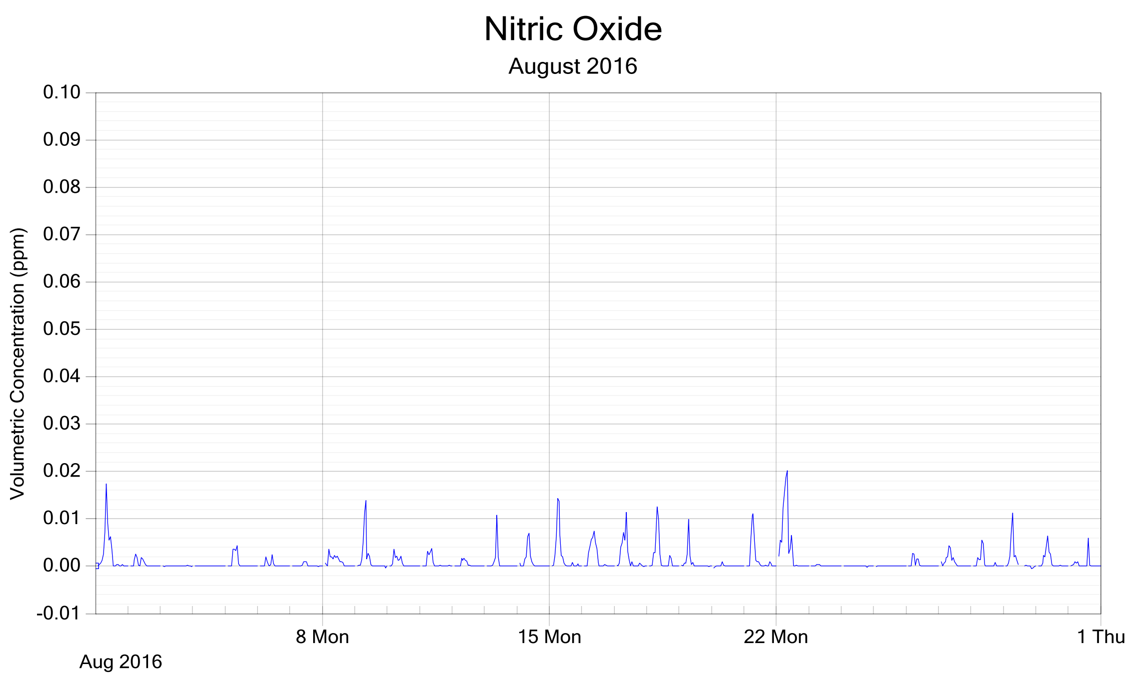


**Figure 2: NO - 1 hour data**

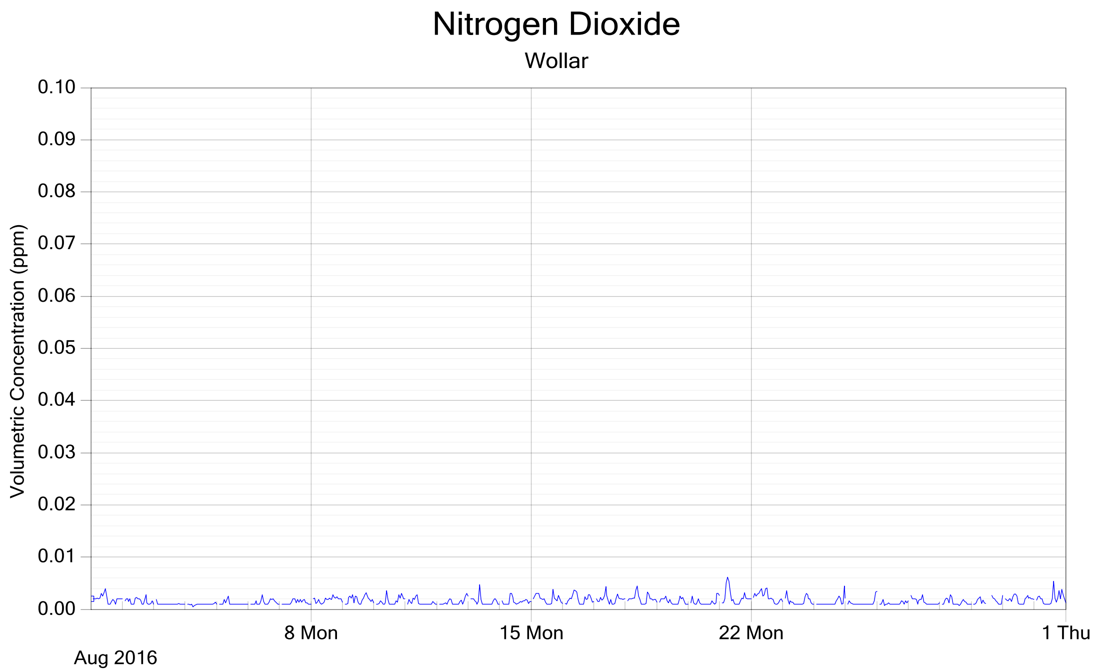


**Figure 3: $NO_2$ - 1 hour data**

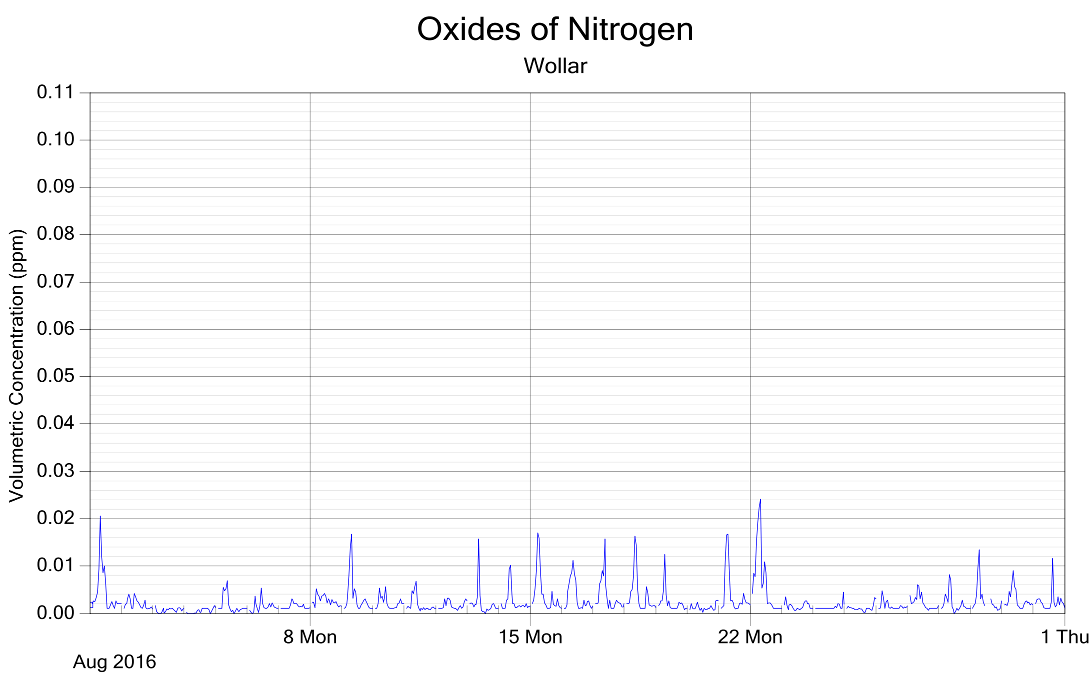


**Figure 4: $NO_X$ - 1 hour data**

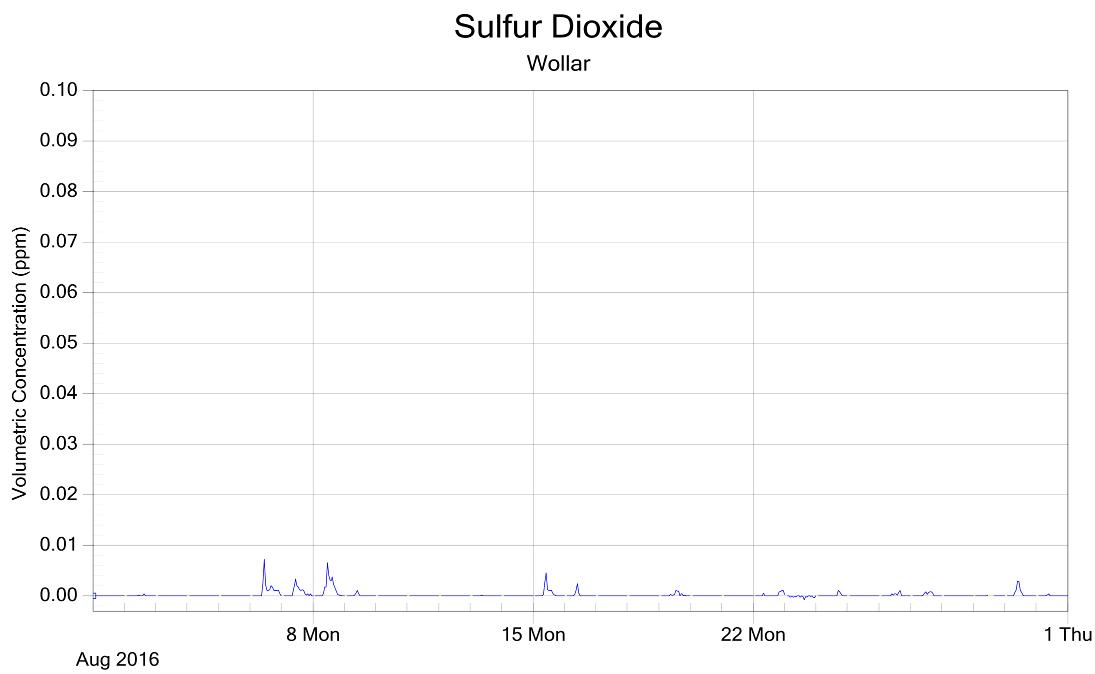


**Figure 5: $SO_2$ - 1 hour data**

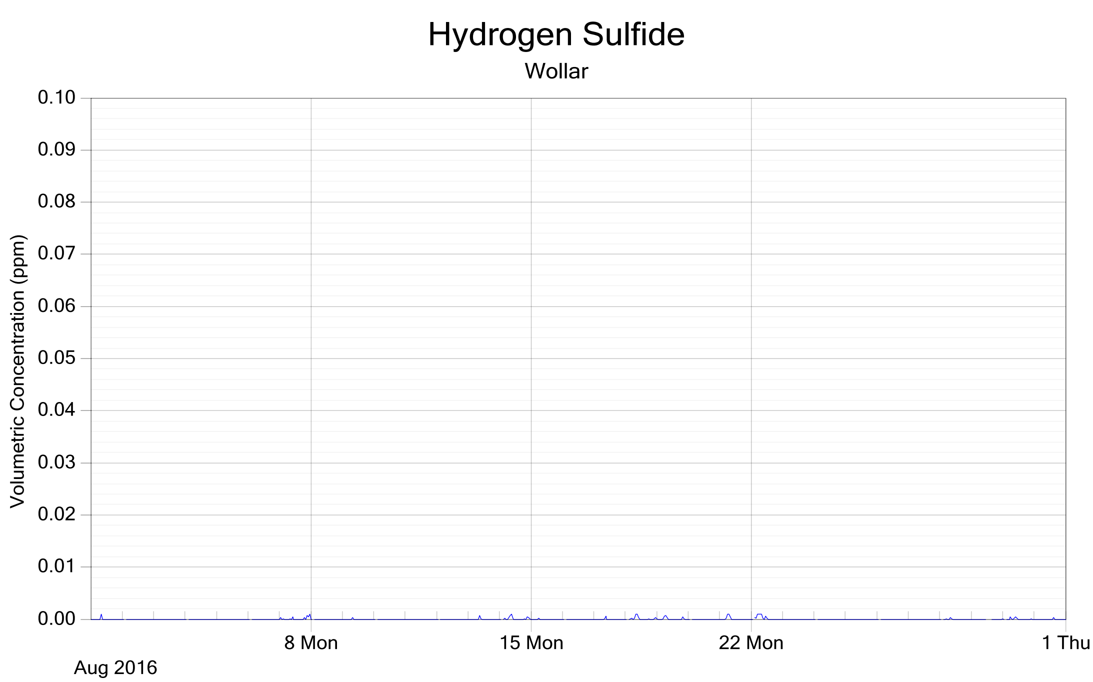


**Figure 6: $H_2S$ - 1 hour data**

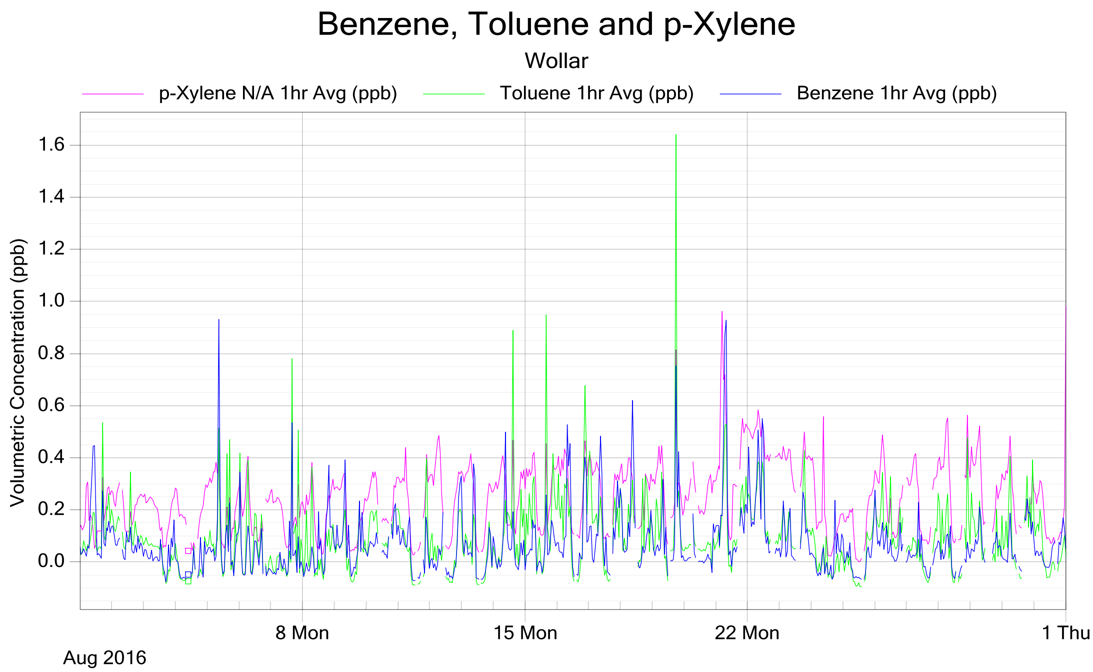


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/08/2016 00:00 | 31/08/2016 23:55 | Static offset of 0.3 ppb applied to correct negative baseline | *p*-Xylene | RE | 13/09/2016 |
| 01/08/2016 13:05 | 31/08/2016 17:45 | Logging error – intermittent unrealistic Toluene / *p*-Xylene spikes | BTX | RE | 13/09/2016 |
| 01/08/2016 13:10 | 20/08/2016 21:05 | Intermittent blocks of data where static offset of -0.55 ppm applied to correct baseline | *p*-Xylene | RE | 13/09/2016 |
| 19/08/2016 13:35 | 19/08/2016 14:05 | Short power interruption and instrument stabilisation | BTX | RE | 13/09/2016 |
| 21/08/2016 12:55 | 26/08/2016 23:45 | Intermittent blocks of data where static offset of -0.4 ppm applied to correct baseline | *p*-Xylene | RE | 13/09/2016 |
| 29/08/2016 12:30 | 29/08/2016 16:25 | Maintenance – monthly tasks performed and BTX instrument stabilisation | All parameters | RE | 13/09/2016 |

# 8.0 Report Summary

The data capture for Wollar was above 95% for all measured parameters.

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT------------------------------------

# Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal

## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st September – 30th September 2016

Report No.: DAT11232

Report issue date: 28th October 2016

Maintenance contract: MC951


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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT11232 | 28/10/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS RAdwards

**Approved Signatory:** Pedro CASCÃO

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## List of Tables

## 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for September 2016. Data capture for the different pollutants is presented in Table 9.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for September 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
| --- | --- |
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Vaisala WS425 – ultrasonic |
| Wind Direction (10m) | Vaisala WS425 – ultrasonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer's Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Sept-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.22 m/s or 3.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 15 m/s |
| Vector Wind Direction | Deg | 1 deg | ±4 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold:<br>0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$ and BTX**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2nd day | N/A |
| $SO_2$ | 01:00 to 01:40 every 2nd day | 23:45 to 23:50 every 2nd day |
| $H_2S$ | 01:45 to 02:45 every 2nd day | 23:50 to 23:55 every 2nd day |

## 5.3. Maintenance

Scheduled monthly maintenance was performed on 02/09/2016, with an additional maintenance visit performed over a 2-day period on 22nd and 23rd September.

Remote maintenance was performed on 1st, 8th, 16th and 28th September.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 23/09/2016 | Monthly | 23/09/2016 | Monthly |
| $SO_2$ | 23/09/2016 | Monthly | 23/09/2016 | Monthly |
| $H_2S$ | 23/09/2016 | Monthly | 23/09/2016 | Monthly |
| BTX | 22/09/2016 | Monthly | 22/09/2016 | Monthly |
| Wind Speed | 23/09/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 23/09/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available.

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for September 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | **92.4** |
| $SO_2$ | **91.9** |
| $H_2S$ | **92.3** |
| Benzene | **81.0** |
| Toluene | **81.0** |
| *p*-Xylene | **81.0** |
| WS, WD | **85.1** |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

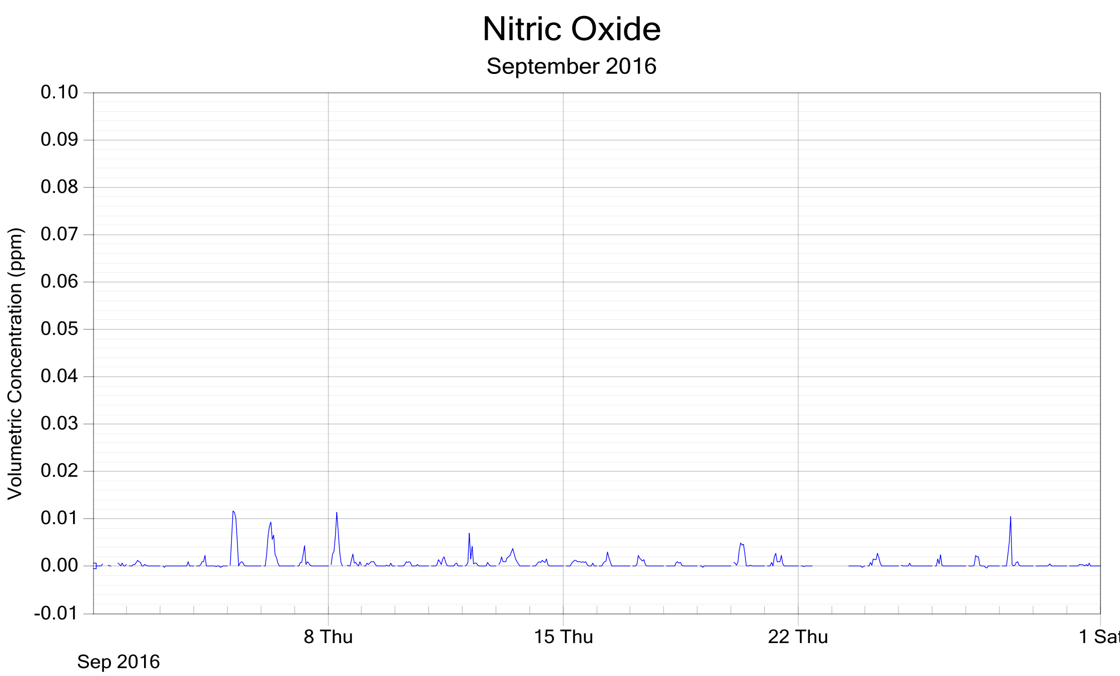


**Figure 2: NO - 1 hour data**

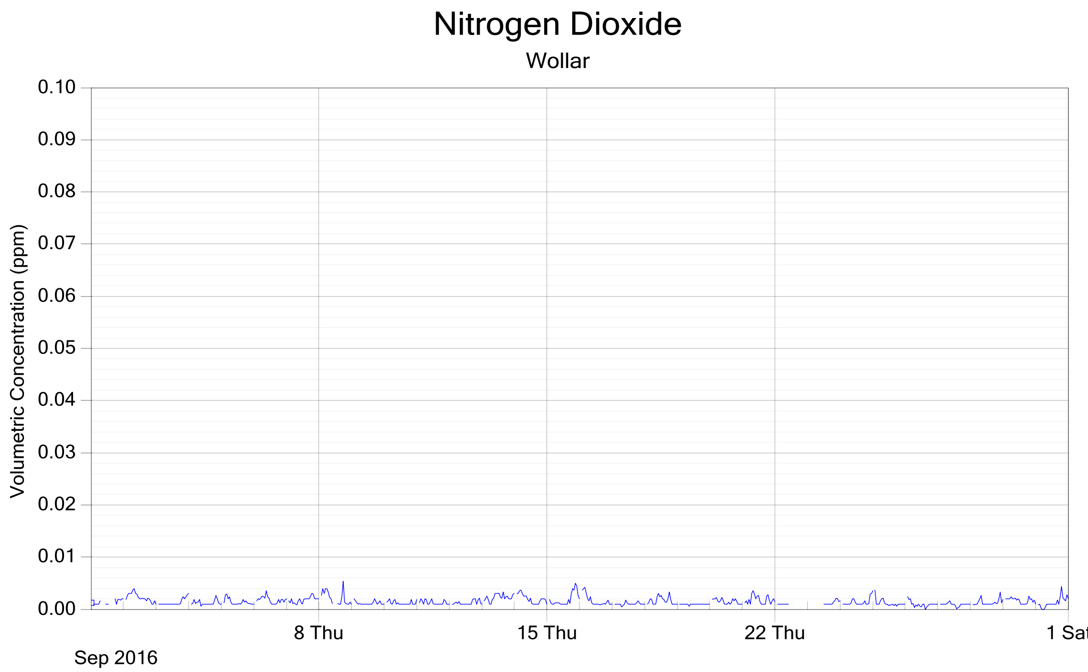


**Figure 3: $NO_2$ - 1 hour data**

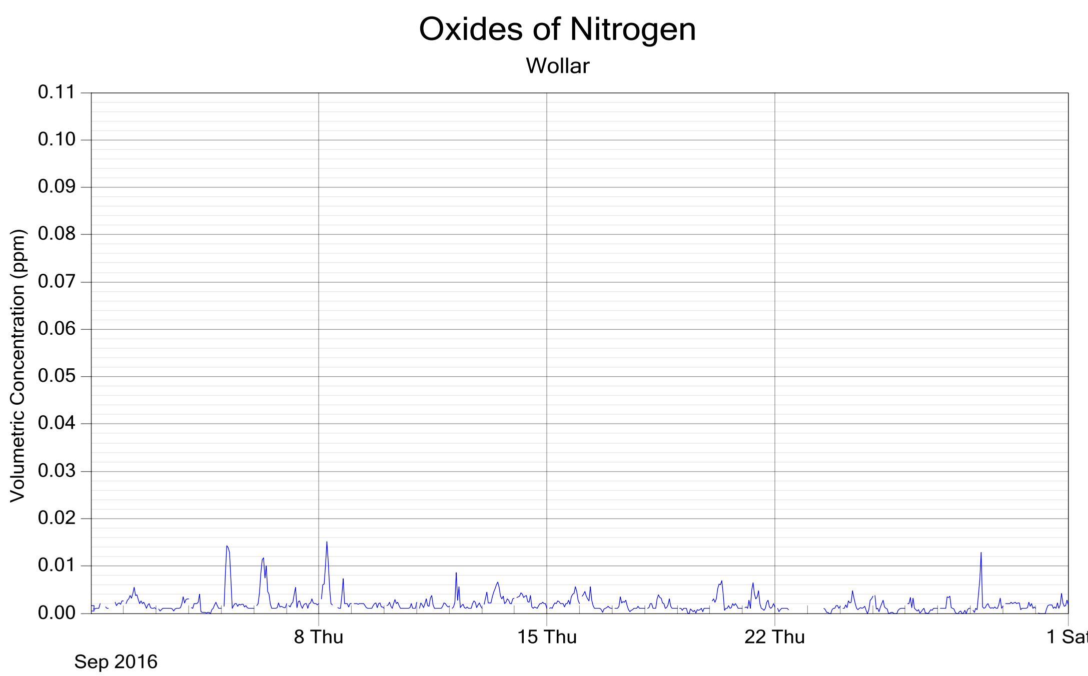


**Figure 4: $NO_X$ - 1 hour data**

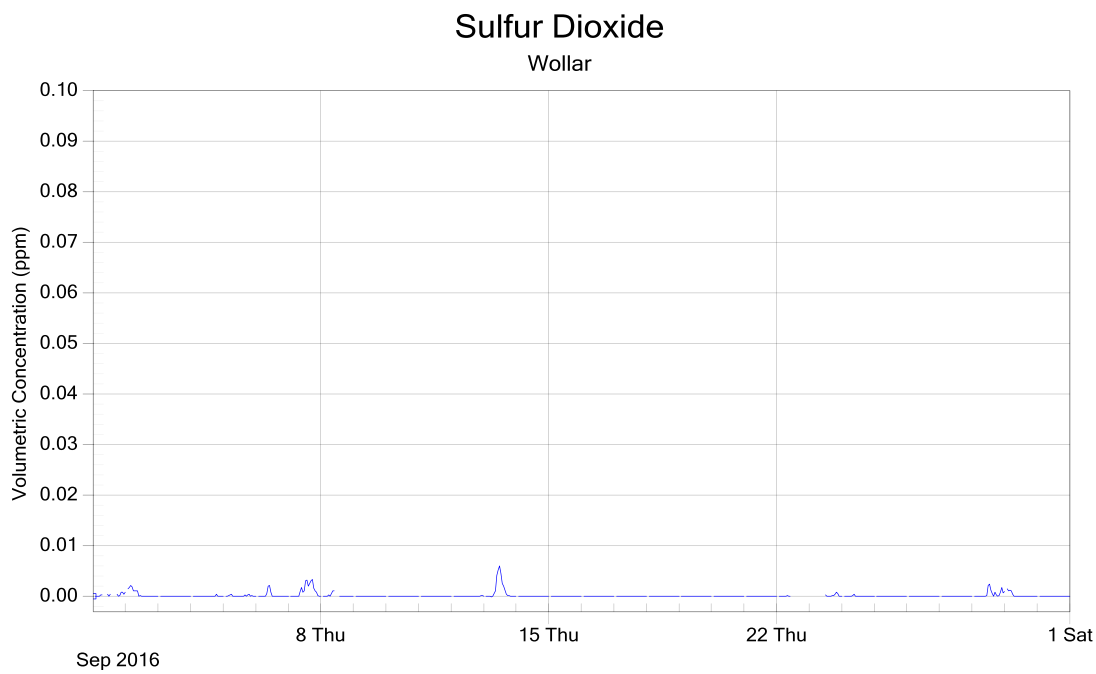


**Figure 5: $SO_2$ - 1 hour data**

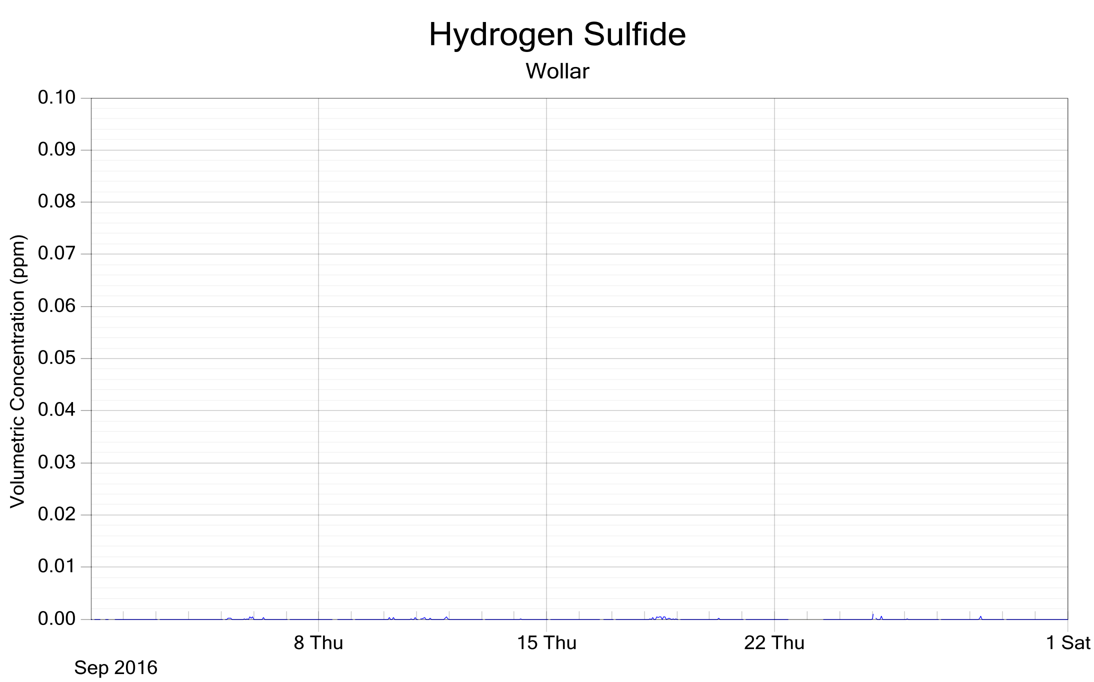


**Figure 6: $H_2S$ - 1 hour data**

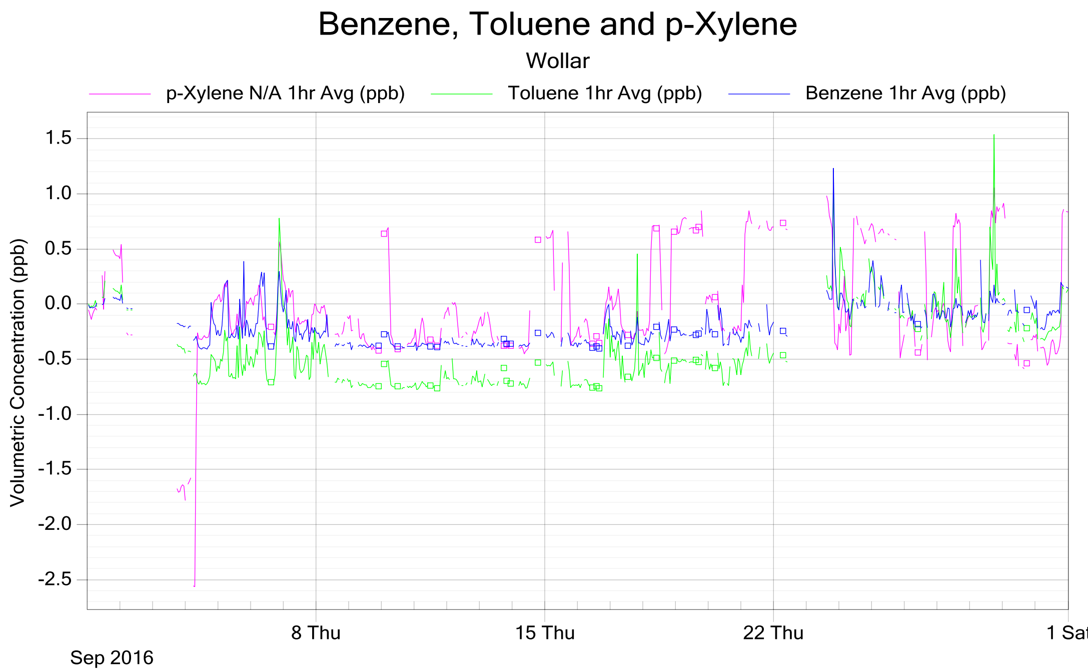


**Figure 7: BTX - 1 hour data**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/09/2016 00:30 | 30/09/2016 03:35 | Instrument fault – intermittent unrealistic spikes | BTX | RE | 26/10/2016 |
| 01/09/2016 08:05 | 01/09/2016 18:35 | Maintenance – remote tasks performed intermittently | All parameters | RE | 26/10/2016 |
| 02/09/2016 10:25 | 02/09/2016 16:45 | Maintenance – monthly BTX tasks performed. Remaining parameters intermittently affected | BTX, $H_2S$, $SO_2$, WS, WD and Sigma | RE | 26/10/2016 |
| 03/09/2016 08:30 | 03/09/2016 14:10 | Intermittent data transmission errors | All parameters | RE | 26/10/2016 |
| 08/09/2016 11:15 | 08/09/2016 14:15 | Maintenance – remote tasks performed intermittently | All parameters | RE | 26/10/2016 |
| 16/09/2016 16:00 | 16/09/2016 17:55 | Maintenance – remote calibration performed | $H_2S$ | RE | 26/10/2016 |
| 22/09/2016 11:40 | 23/09/2016 14:30 | Maintenance – monthly tasks performed over 2-days. Intermittent data affected | All parameters | RE | 26/10/2016 |
| 28/09/2016 00:20 | 30/09/2016 23:55 | Instrument fault – data flat lining | WS, WD & Sigma | RE | 26/10/2016 |
| 28/09/2016 07:30 | 28/09/2016 08:00 | Maintenance – remote calibration performed | BTX | RE | 26/10/2016 |

## 8.0 Report Summary

The data capture for Wollar was below 95% for all measured parameters.

All parameters were affected by maintenance, both remote and on-site.

BTX data is also affected by unrealistic data spikes.

Wind speed and direction data was also affected by an instrument fault. This fault continues into October 2016.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

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# Peabody Energy

# Wilpinjong Coal
## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st October – 31st October 2016

Report No.: DAT11316

Report issue date: 28th November 2016

Maintenance contract: MC951


***ECOTECH PTY LTD. ABN: 32005752081***
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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT11316 | 28/11/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS REdwards

**Approved Signatory:** Jon ALEXANDER

## Table of Contents

## List of Figures

## List of Tables

# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for October 2016. Data capture for the different pollutants is presented in Table 9.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for October 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX<br>(Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
| $H_2S$ | Ecotech Laboratory Manual | In-house method 6.5 Hydrogen sulfide by fluorescence |
| BTX | Manufacturer’s Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.1 Wind speed (Horizontal) by anemometer |
| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Oct-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$ and BTX**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 01:00 to 01:40 every 2$^{nd}$ day | N/A |
| $SO_2$ | 01:00 to 01:40 every 2$^{nd}$ day | 23:45 to 23:50 every 2$^{nd}$ day |
| $H_2S$ | 01:45 to 02:45 every 2$^{nd}$ day | 23:50 to 23:55 every 2$^{nd}$ day |
| BTX | 02:45 to 05:20 every 7$^{th}$ day | N/A |

## 5.3. Maintenance

Scheduled monthly maintenance was performed over a period of 2-days on 25$^{th}$ and 26$^{th}$ October.

An unscheduled remote calibration was performed on 20/10/2016 for $H_2S$ following a raised fault to correct the overnight span values on 17$^{th}$ and 19$^{th}$ October.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 25/10/2016 | Monthly | 25/10/2016 | Monthly |
| $SO_2$ | 25/10/2016 | Monthly | 25/09/2016 | Monthly |
| $H_2S$ | 26/10/2016 | Monthly | 26/10/2016 | Monthly |
| BTX | 26/10/2016 | Yearly | 26/09/2016 | Monthly |
| Wind Speed | 25/10/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 25/10/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available.

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for October 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 96.2 |
| $SO_2$ | 96.0 |
| $H_2S$ | **93.2** |
| Benzene | **88.9** |
| Toluene | **88.9** |
| *p*-Xylene | **88.9** |
| WS, WD | **43.1** |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

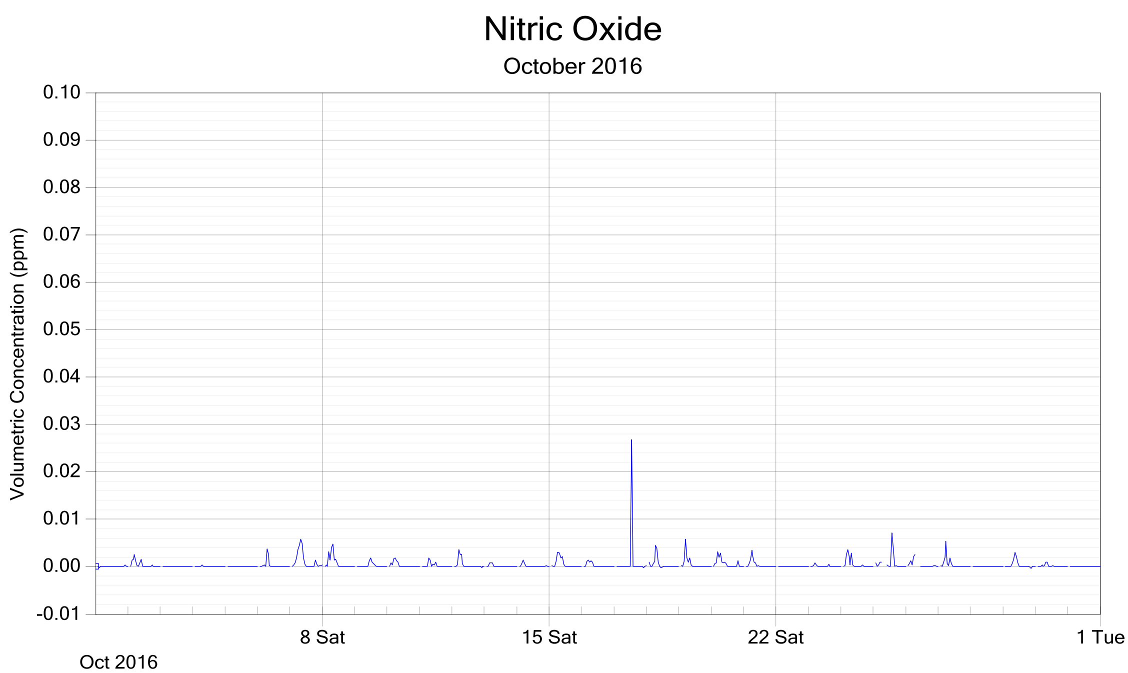


**Figure 2: NO - 1 hour data**

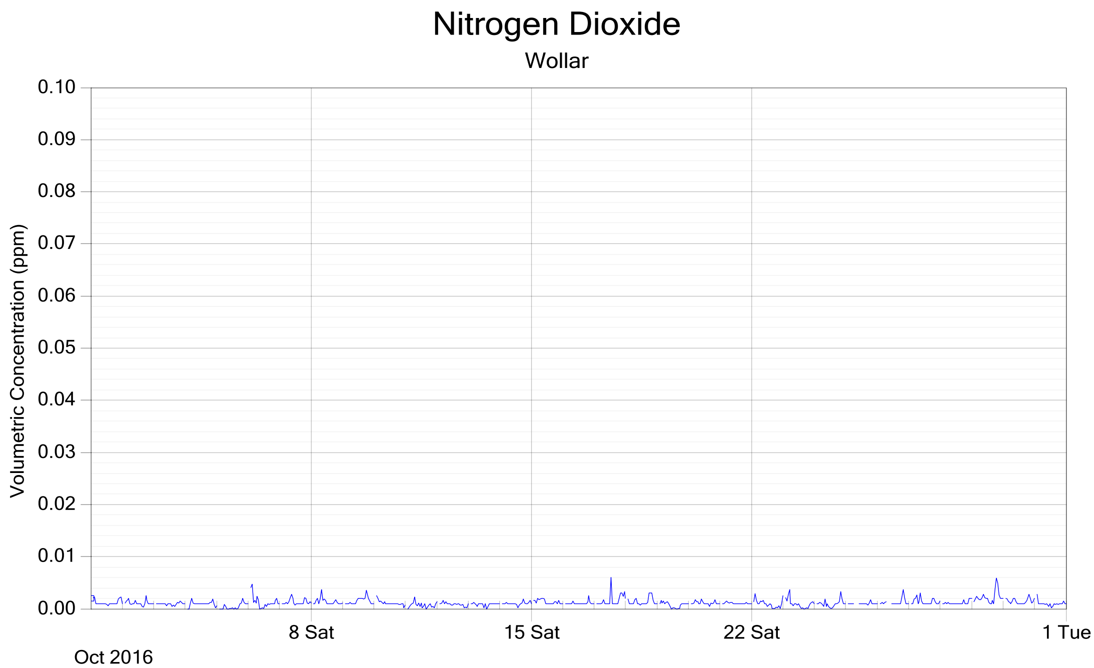


**Figure 3: $NO_2$ - 1 hour data**

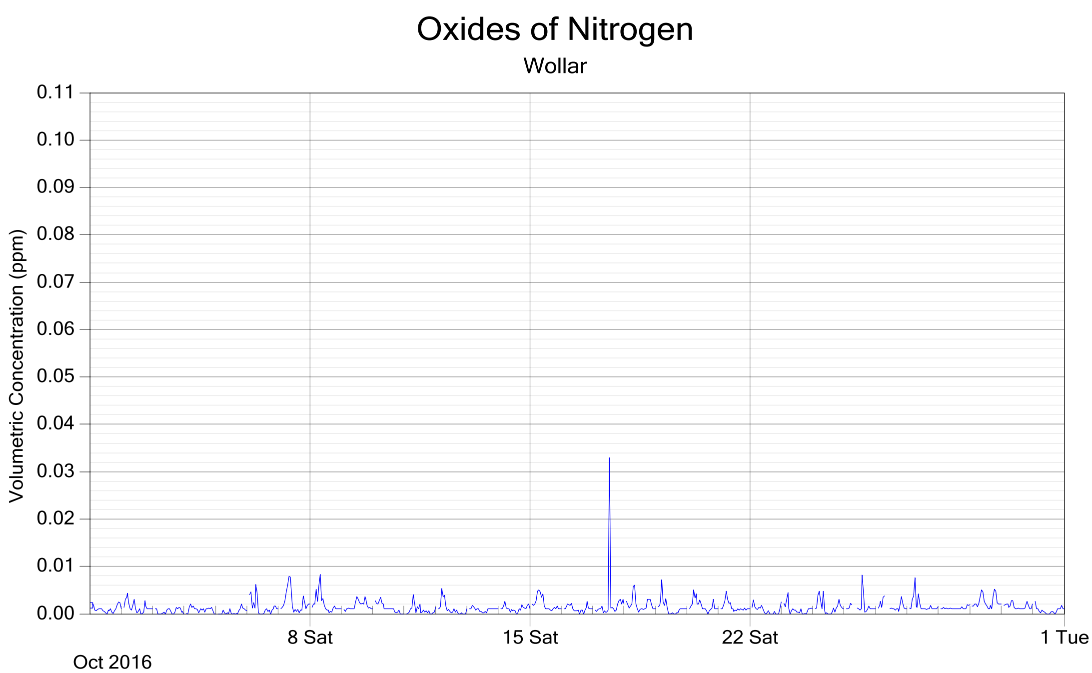


**Figure 4: $NO_X$ - 1 hour data**

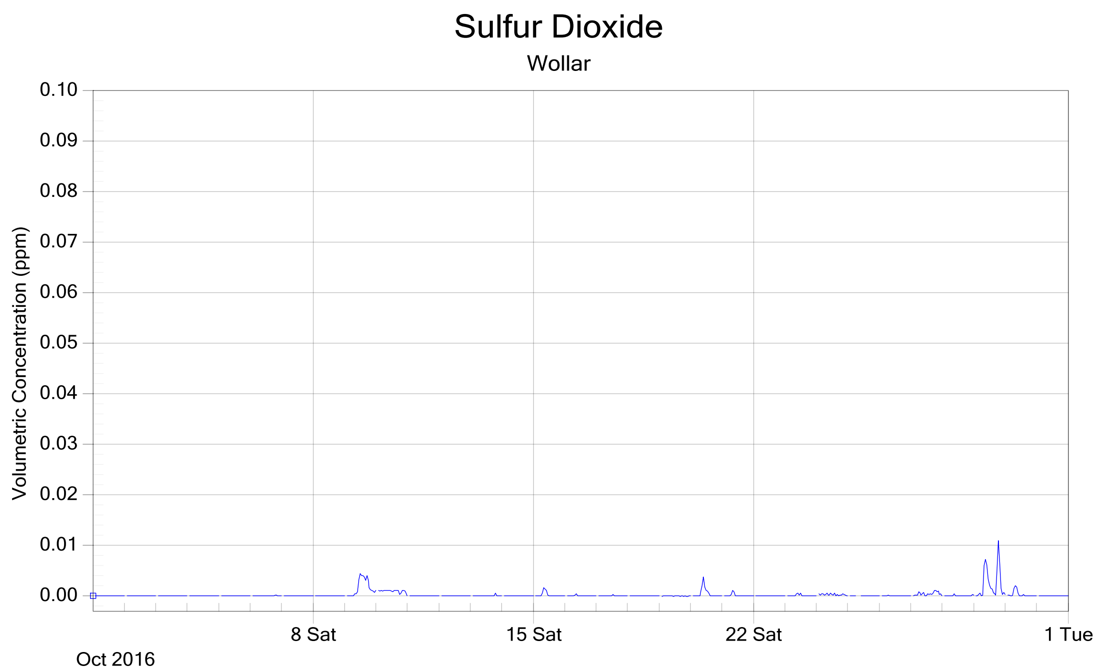


**Figure 5: $SO_2$ - 1 hour data**

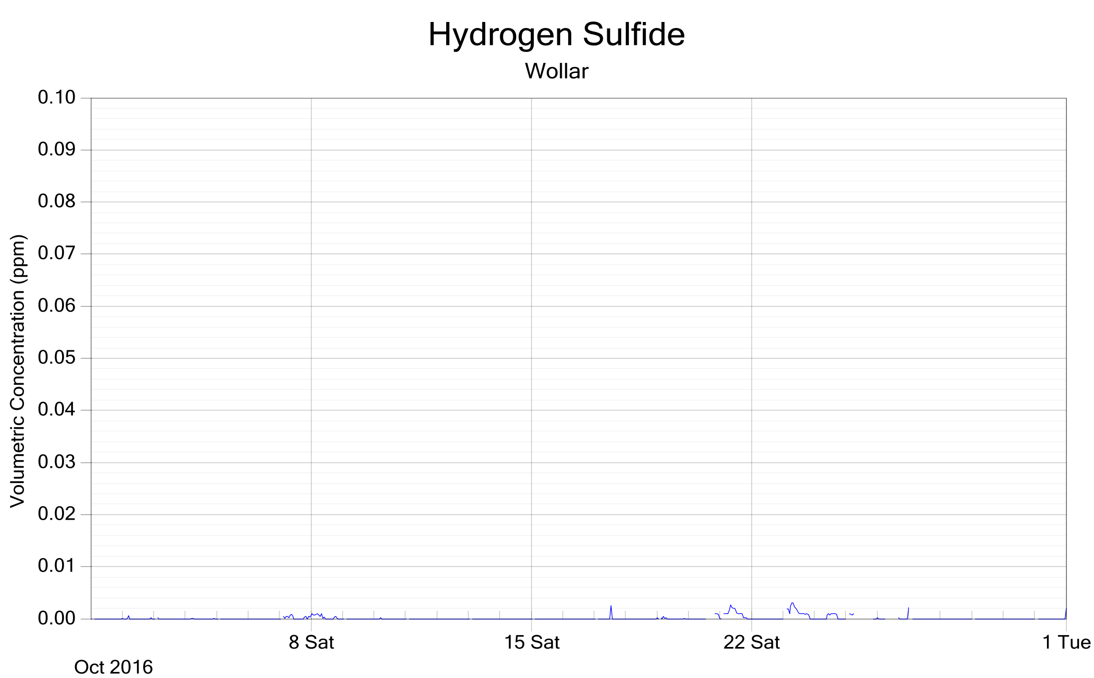


**Figure 6: $H_2S$ - 1 hour data**

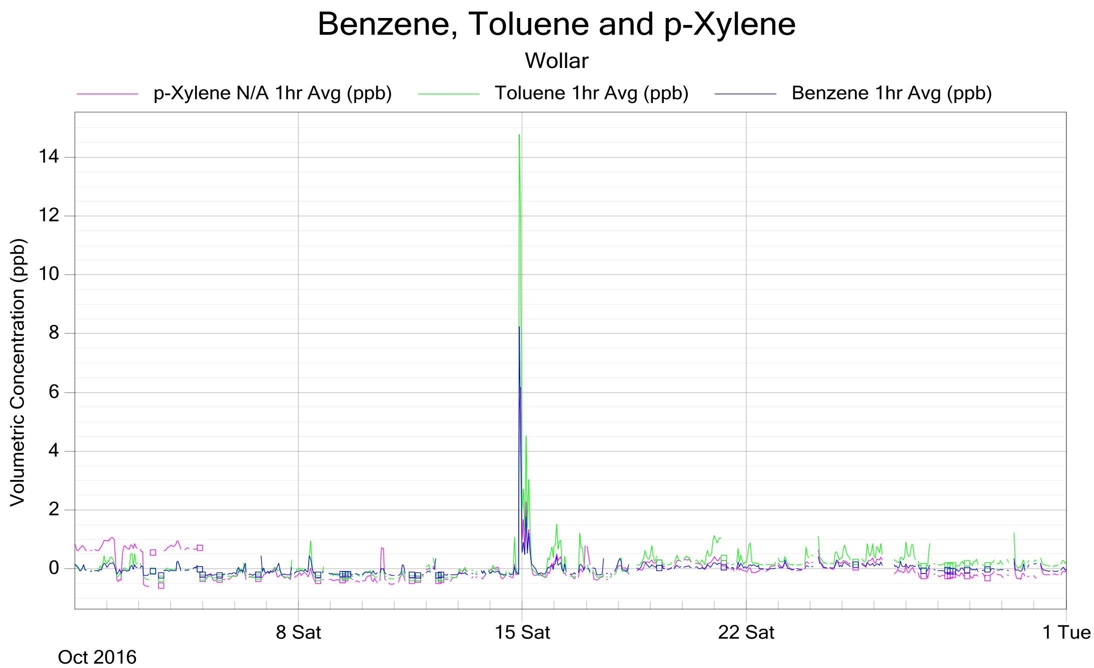


**Figure 7: BTX - 1 hour data**

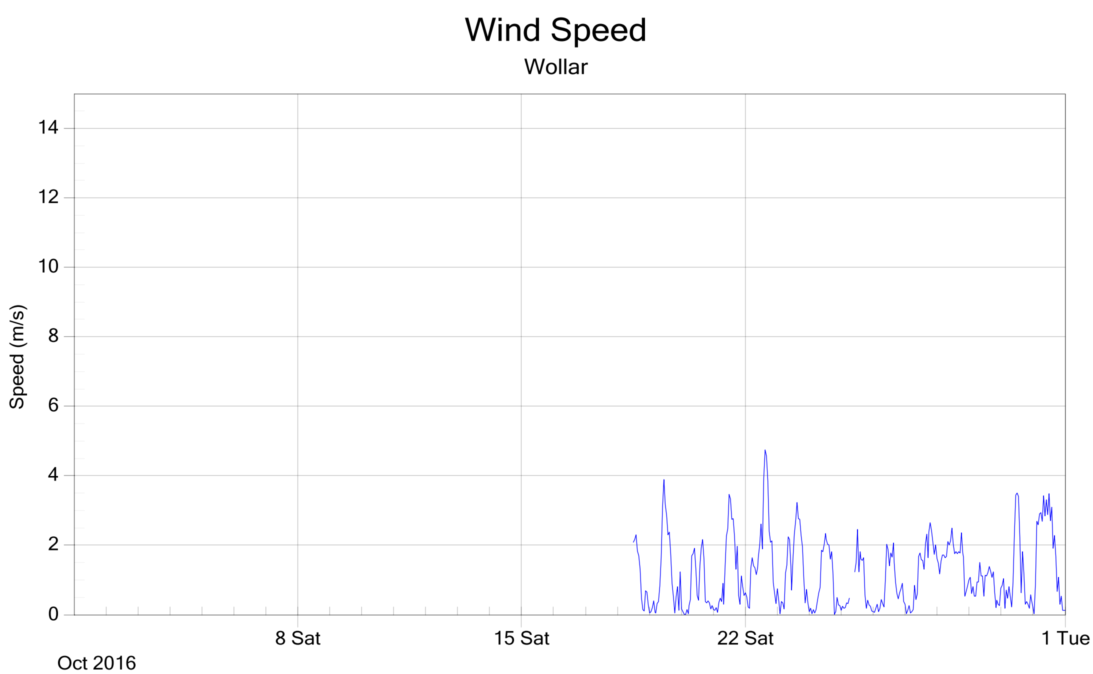


**Figure 8: WS - 1 hour data**

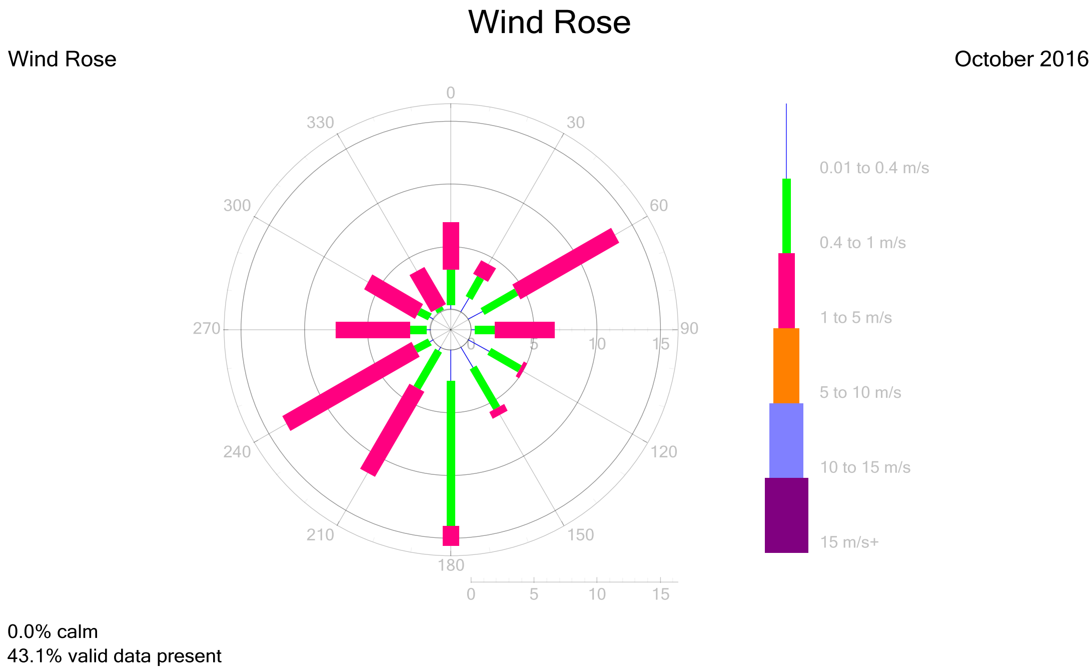


**Figure 9: Wind Rose**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/10/2016 00:00 | 18/10/2016 11:50 | Instrument fault – data flat lining | WS, WD & Sigma | RE | 23/11/2016 |
| 01/10/2016 10:40 | 31/10/2016 19:35 | Instrument fault – intermittent unrealistic spikes | BTX | RE | 23/11/2016 |
| 18/10/2016 11:20 | 28/10/2016 15:50 | Intermittent data transmission errors | $H_2S$, BTX, NO, $NO_2$ & $NO_x$ | RE | 23/11/2016 |
| 20/10/2016 14:35 | 20/10/2016 19:25 | Maintenance – remote calibration performed to correct overnight span values | $H_2S$ | RE | 23/11/2016 |
| 25/10/2016 07:05 | 26/10/2016 15:40 | Maintenance – monthly tasks performed over 2 days. Intermittent data affected | All parameters | RE | 23/11/2016 |
| 25/10/2016 20:45 | 26/10/2016 00:00 | Static offset of -0.004ppm applied to correct zero baseline | $H_2S$ | RE | 23/11/2016 |
| 26/10/2016 15:45 | 26/10/2016 23:45 | Static offset of 0.001ppm applied to correct zero baseline | $H_2S$ | RE | 23/11/2016 |
| 27/10/2016 02:40 | 31/10/2016 23:55 | Static offset of -0.003ppm applied to correct zero baseline | $H_2S$ | RE | 23/11/2016 |

# 8.0 Report Summary

The data capture for Wollar was below 95% for all measured parameters, with the exception of $NO_x$ channels and $SO_2$.

Please refer to Data Capture Percentage Table 9 on page 17 for details, and Table 10 on page 23 for valid data exceptions.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

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**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.

Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal
## Wollar

## Ambient Air Quality Monitoring

## Validated Report

## 1st November – 30th November 2016

Report No.: DAT11437

Report issue date: 28th December 2016

Maintenance contract: MC951

***ECOTECH PTY LTD. ABN: 32005752081***
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| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT11437 | 28/12/2016 | Robyn Edwards |

**Report by:** Robyn EDWARDS REdwards

**Approved Signatory:** Jon ALEXANDER

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## List of Figures

## List of Tables

# 1.0 Executive Summary

Peabody Energy has commissioned Ecotech P/L to conduct air quality monitoring for the Wilpinjong Mine at Wollar. Measured parameters at Wollar are NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene, *p*-Xylene, wind speed and wind direction.

The Wollar station was commissioned in March 2013.

This report presents the data collected from the Wollar station for November 2016. Data capture for the different pollutants is presented in Table 9.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

# 2.0 Introduction

Ecotech Pty Ltd was commissioned by Peabody Energy to provide monitoring and data reporting for the Wilpinjong Mine at Wollar, located as detailed in Table 1. Ecotech commenced data collection from the Wilpinjong Station on the 1st March 2013.

This report presents the data for November 2016.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

# 3.0 Monitoring and Data Collection

## 3.1. Siting Details

The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

**Table 1: Wilpinjong Mine monitoring site location**

| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

## 3.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

For meteorological sensors, the elevation given in the table below is the height above ground level at the monitoring station.

**Table 2: Parameters measured at the Wilpinjong Mine monitoring station**

| Parameter Measured | Instrument and Measurement Technique |
|---|---|
| BTX (Benzene, Toluene and *p*-Xylene) | Synspec GC955 - Gas Chromatography |
| $H_2S$ | Ecotech EC9852 - fluorescence |
| NO, $NO_2$, $NO_x$ | Ecotech EC9841 gas phase chemiluminescence |
| $SO_2$ | Ecotech EC9850 – fluorescence |
| Wind Speed (horizontal, 10m) | Gill Windsonic |
| Wind Direction (10m) | Gill Windsonic |

## 3.3. Data Collection Methods

Table 3 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 3.3.1.

**Table 3: Methods**

| Parameter Measured | Data Collection Methods Used | Description of Method |
|---|---|---|
| NO, $NO_2$, $NO_x$ | AS 3580.5.1-2011 | Methods for sampling and analysis of ambient air. Method 5.1: Determination of oxides of nitrogen – chemiluminescence method |
| | Ecotech Laboratory Manual | In-house method 6.1 Oxides of nitrogen by chemiluminescence |
| $SO_2$ | AS 3580.4.1-2008 | Methods for sampling and analysis of ambient air. Method 4.1: Determination of sulfur dioxide – Direct reading instrumental method |
| | Ecotech Laboratory Manual | In-house method 6.2 Sulfur dioxide by fluorescence |
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| BTX | Manufacturer's Instructions | Gas Chromatography Synspec CG955 Series Manual |
| Vector Wind Speed (Horizontal) | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
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| Vector Wind Direction | AS 3580.14-2014 | Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications |
| | Ecotech Laboratory Manual | In-house method 8.3 Wind direction by anemometer |

#### 3.3.1. Compliance with Standards

Unless stated below, parameters are monitored at the Wilpinjong Mine site according to the methods detailed in Table 3 above.

- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.
- Measurement of hydrogen sulfide ($H_2S$) is not covered by Ecotech's scope of accreditation due to the frequency of calibration checks.

#### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

### 3.4. Data Validation and Reporting

#### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Nov-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every second night for NO, $NO_2$, $NO_x$ and $SO_2$.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$ and BTX**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 00:45 to 01:40 every day | N/A |
| $SO_2$ | 00:45 to 01:40 every day | 23:45 to 23:50 every day |
| $H_2S$ | 01:35 to 02:45 every 2nd day | 23:50 to 23:55 every 2nd day |
| BTX | 02:45 to 04:45 every 7th day | N/A |

## 5.3. Maintenance

Scheduled monthly maintenance was performed over a period of 2-days on 27th and 28th November.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 27/11/2016 | Monthly | 27/11/2016 | Monthly |
| $SO_2$ | 27/11/2016 | Monthly | 27/11/2016 | Monthly |
| $H_2S$ | 27/11/2016 | Monthly | 27/11/2016 | Monthly |
| BTX | 28/11/2016 | Monthly | 28/11/2016 | Monthly |
| Wind Speed | 27/11/2016 | 3-monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 27/11/2016 | 3-monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available.

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for November 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | **93.2** |
| $SO_2$ | **92.8** |
| $H_2S$ | **93.2** |
| Benzene | **88.3** |
| Toluene | **88.3** |
| *p*-Xylene | **88.4** |
| WS, WD | **96.1** |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

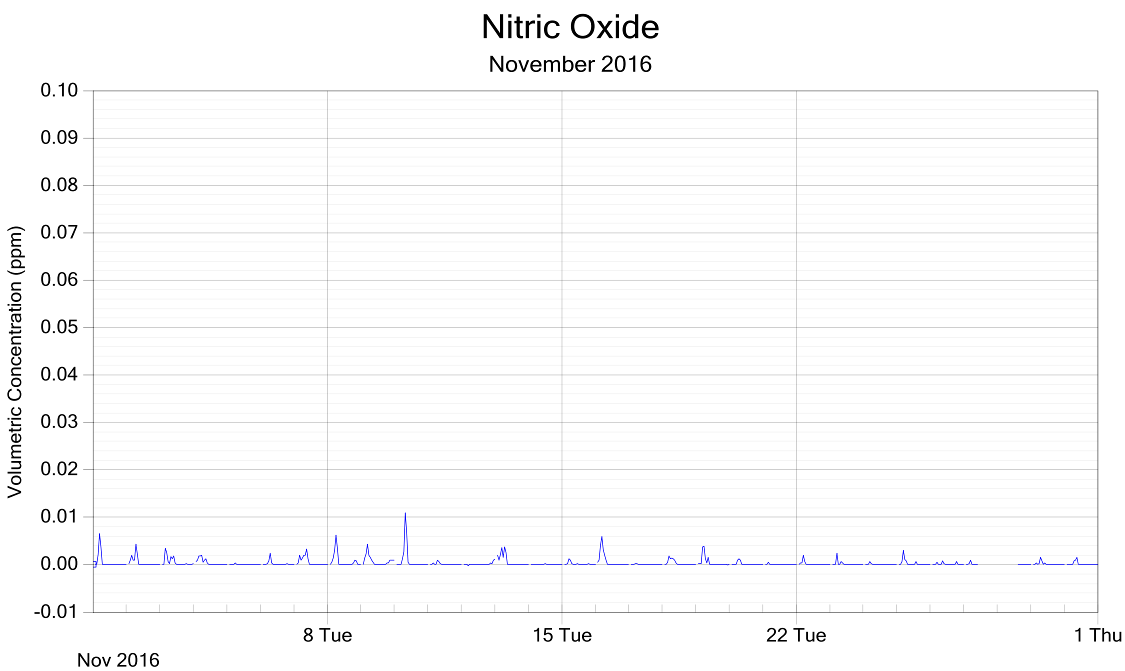


**Figure 2: NO - 1 hour data**

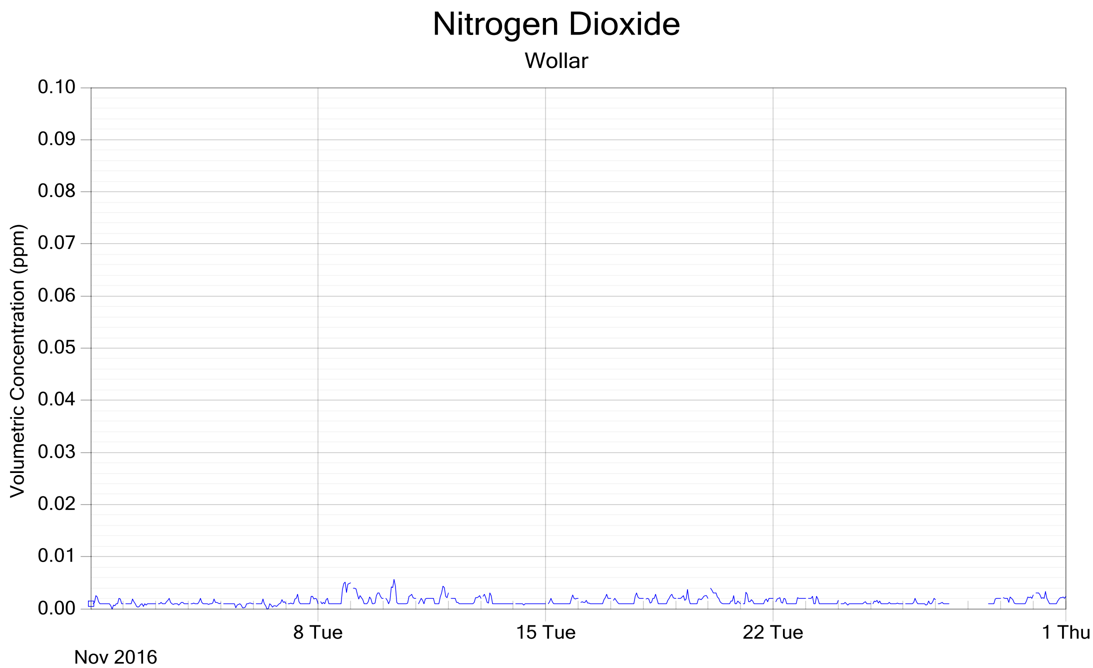


**Figure 3: $NO_2$ - 1 hour data**

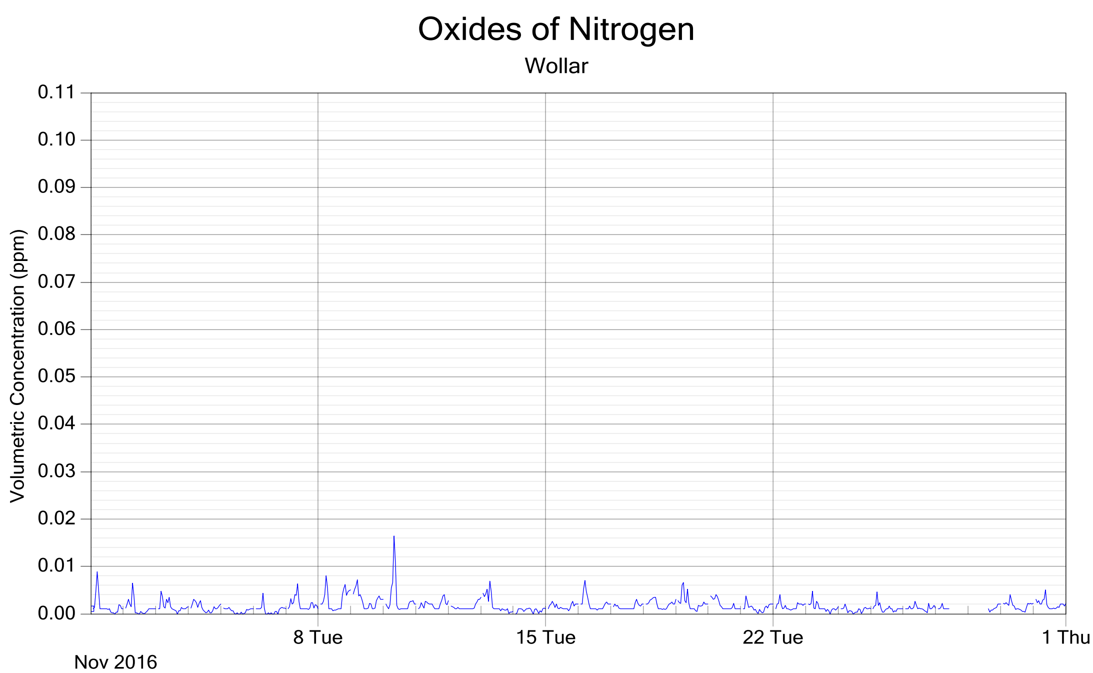


**Figure 4: $NO_X$ - 1 hour data**

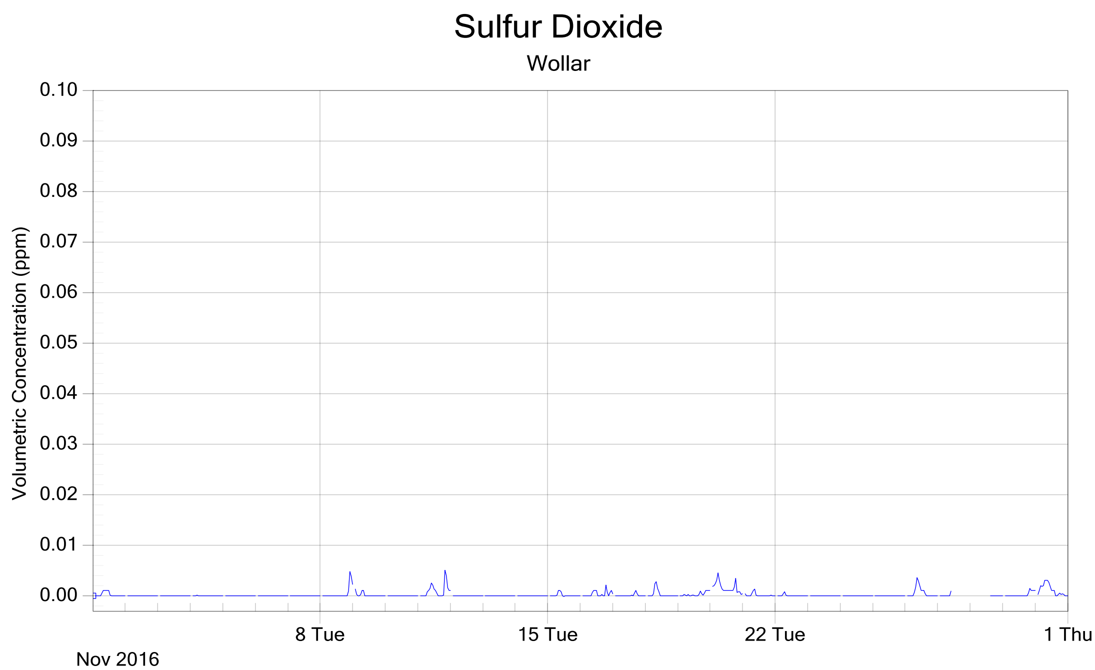


**Figure 5: $SO_2$ - 1 hour data**

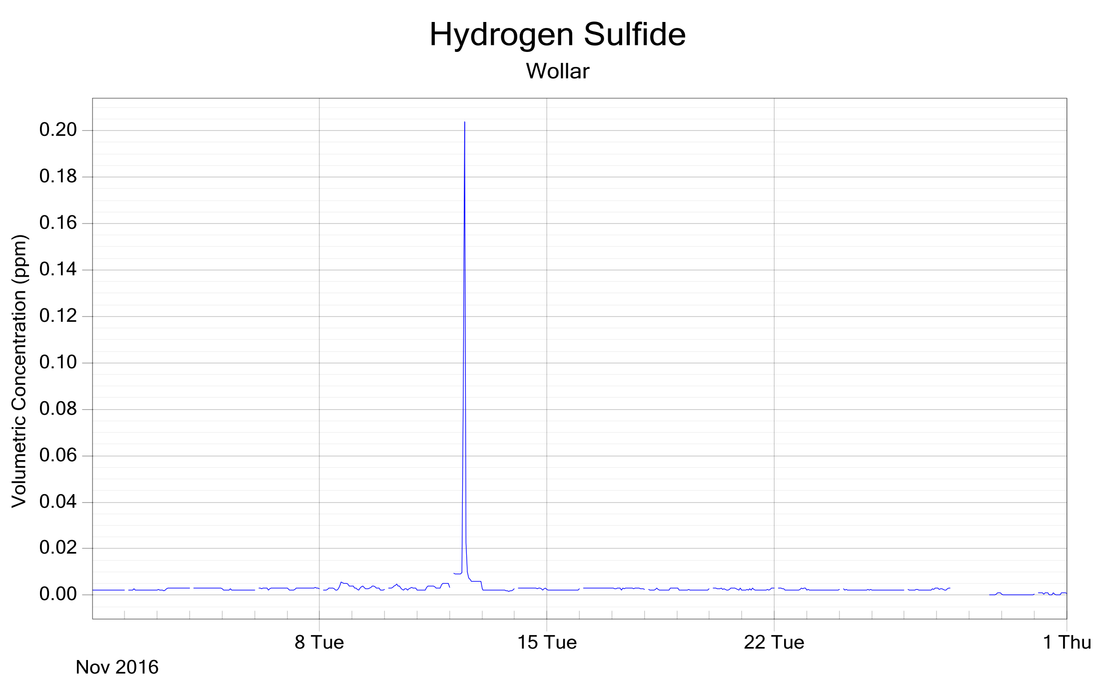


**Figure 6: $H_2S$ - 1 hour data**

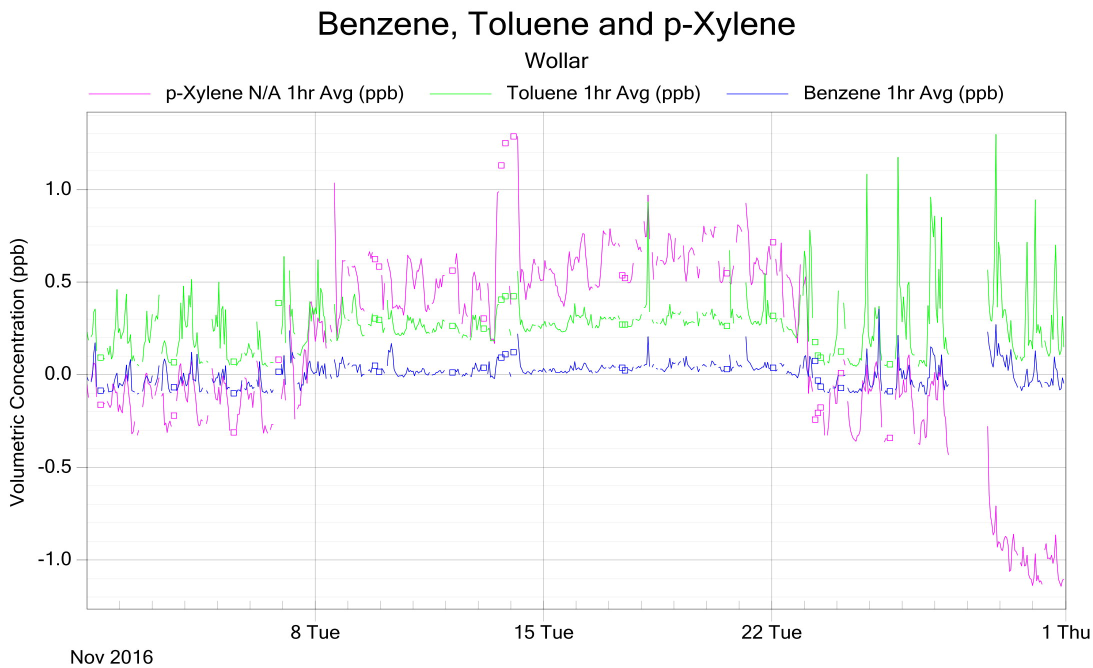


**Figure 7: BTX - 1 hour data**

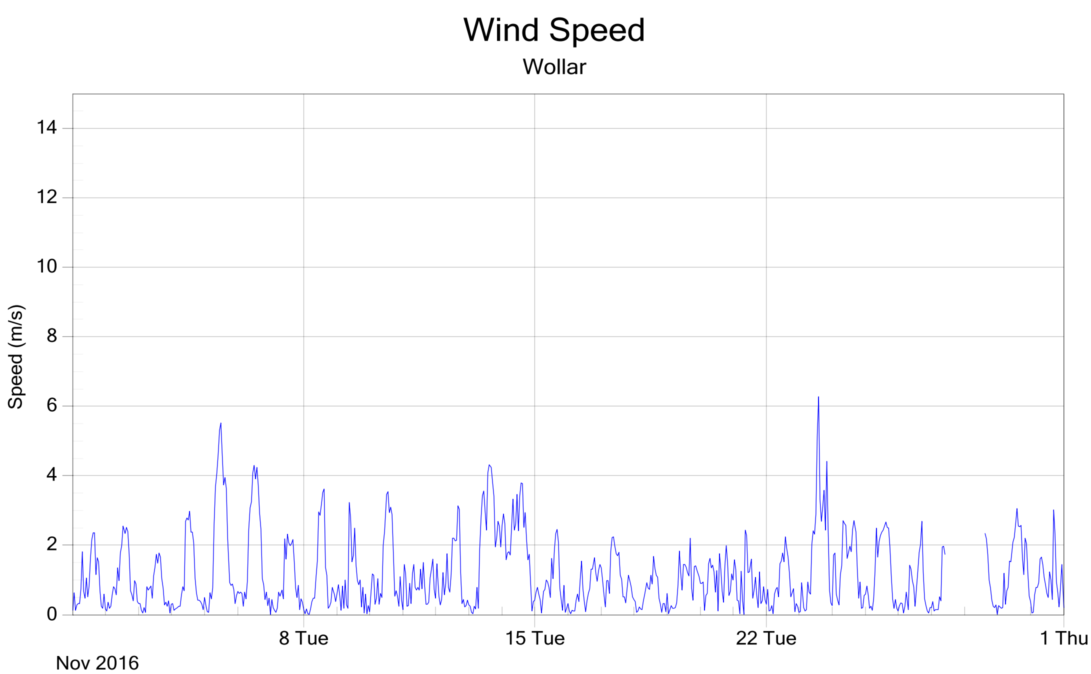


**Figure 8: WS - 1 hour data**

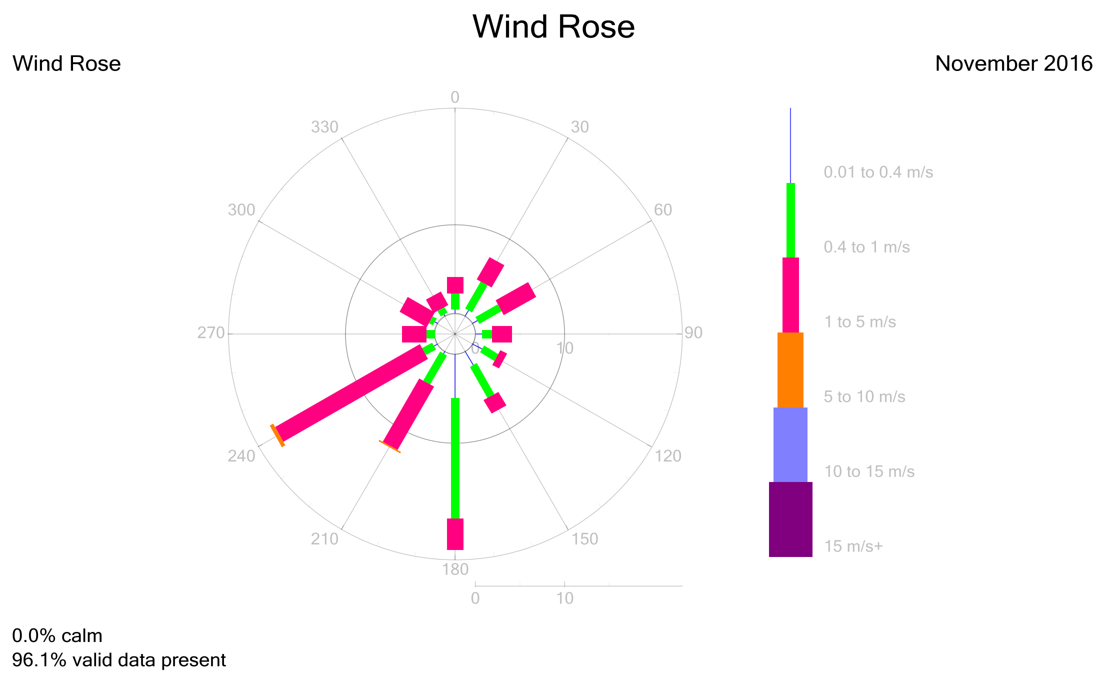


**Figure 9: Wind Rose**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/11/2016 02:05 | 30/11/2016 10:05 | Instrument fault – intermittent unrealistic spikes | BTX | RE | 28/12/2016 |
| 01/11/2016 11:10 | 12/11/2016 01:30 | Intermittent data transmission errors | All parameters | RE | 28/12/2016 |
| 03/11/2016 05:55 | 12/11/2016 02:15 | Intermittent power interruption and subsequent instrument stabilisation | BTX | RE | 28/12/2016 |
| 04/11/2016 02:05 | 30/11/2016 01:05 | Intermittent overnight spans out of acceptable limits. Data deemed valid | $SO_2$ & $H_2S$ | RE | 28/12/2016 |
| 27/11/2016 11:00 | 28/11/2016 14:30 | Maintenance – monthly tasks performed over 2 days | All parameters | RE | 28/12/2016 |

## 8.0 Report Summary

The data capture for Wollar was below 95% for all measured parameters.

Please refer to Data Capture Percentage Table 9 on page 17 for details, and Table 10 on page 23 for valid data exceptions.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

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Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No. 14184.

# Peabody Energy

# Wilpinjong Coal

## Wollar

Ambient Air Quality Monitoring

Validated Report

1st December – 31st December 2016

Report No.: DAT11508

Report issue date: 27th January 2017

Maintenance contract: MC951

***ECOTECH PTY LTD. ABN: 32005752081***
***1492 Ferntree Gully Rd, Knoxfield VIC. 3180. AUSTRALIA***
***Tel No: 1300 364 946 Fax No: 1300 668 763***
***Email ecotech@ecotech.com WEB www.ecotech.com***

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| **Email** | cpotter@peabodyenergy.com |
| **Phone** | +61 (02) 6370 2527 |

| Revision History | | | |
|---|---|---|---|
| **Revision** | **Report ID** | **Date** | **Analyst** |
| 0 | DAT11508 | 27/01/2017 | Robyn Edwards |

**Report by:** Robyn EDWARDS REdwards

**Approved Signatory:** Jon ALEXANDER

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The Wilpinjong Mine consists of one ambient air quality monitoring station. The station location and siting details are described below.

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| Site Name | Geographical Coordinates | Height Above Sea Level (m) |
|---|---|---|
| Wollar | Lat: -32.360105 Long: 149.949509 | 366 |

A siting audit was conducted on 27th February 2015 to assess for compliance with *AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air – guide to siting air monitoring equipment"*.

This siting of this station complies with AS/NZS 3580.1.1:2007. The station is classified as a neighbourhood station according to *AS/NZS 3580.1.1:2007*.


**Figure 1: Wilpinjong Mine Monitoring Station Location**

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Table 2 below details the parameters monitored and the instruments used at Wilpinjong Mine monitoring station. Appendix 1 defines any abbreviated parameter names used throughout the report.

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### 3.3.1. Compliance with Standards

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- Measurement of benzene, toluene and *p*-xylene (BTX) is not covered by Ecotech's NATA scope of accreditation.

### 3.3.2. Data Acquisition

Data acquisition is performed using a PC based WinAQMS logger (using WinAQMS® Version 2.0) situated at the monitoring site. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the AQMS logger on a daily basis (using Airodis™ version 5.1) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5 minute intervals.

## 3.4. Data Validation and Reporting

### 3.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Tables.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minute data.

### 3.4.2. Reporting

The reported data is in a Microsoft Excel format file named "*Wilpingjong Coal Validated Data Report Dec-16.xls*". The Excel file consists of 5 Excel worksheets:

1. Cover
2. 5 Minute Averages
3. Hourly Averages
4. Daily Averages
5. Valid Data Exception Table

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five minute data. Averages are based on a minimum of 75% valid readings within the averaging period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00 is for the data collected from 01:00 to 02:00. One hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

# 4.0 Air Quality Goals

The air quality goals for pollutants monitored at the Wilpinjong Wollar monitoring station are based on the Australian National Environmental Council (NEPC) Ambient Air Quality (NEPM). These air quality goals are shown in Table 4 below.

**Table 4: Wilpinjong Air Quality Goals (NEPM)**

| Parameter | Time Period | Exceedence Level | Units | Maximum allowable exceedences |
|---|---|---|---|---|
| $NO_2$ | 1 year | 30 | ppb | None |
| $NO_2$ | 1 hour | 120 | ppb | 1 day a year |
| $SO_2$ | 1 hour | 200 | ppb | 1 day a year |
| $SO_2$ | 1 day | 80 | ppb | 1 day a year |
| $SO_2$ | 1 year | 20 | ppb | None |

## 4.1. Air Quality Summary

Table 5 below, details any exceedences of the NEPM Standard that were observed during this reporting period.

**Table 5: Exceedences Recorded**

| Parameter | Time Period | Value of Exceedence | Date of Exceedence |
|---|---|---|---|
| $NO_2$ | 1 hour | - | - |
| $SO_2$ | 1 hour | - | - |
| $SO_2$ | 1 day | - | - |

# 5.0 Calibrations and Maintenance

## 5.1. Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer's tolerance limits of the equipment's parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

**Table 6: Units and Uncertainties**

| Parameter | Units | Resolution | Uncertainty | Measurement Range[1] |
|---|---|---|---|---|
| NO, $NO_x$ (EC9841) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $NO_2$ (EC9841) | ppm | 1 ppb | ± 16 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $SO_2$ (EC9850) | ppm | 1 ppb | ± 14 ppb<br>K factor of 2.01 | 0 ppb to 500 ppb |
| $H_2S$ | ppm | 1 ppb | 15.2% of reading or ± 19 ppb, whichever is greater<br>K factor of 2 | 0 ppb to 500 ppb |
| Benzene, Toluene and *p*-Xylene (BTX) | ppb | 0.03 ppb | 15.1% of reading or 3.8ppb, whichever is greater<br>K factor of 2 | 0 ppb to 300 ppb |
| Vector Wind Speed | m/s | 0.1 m/s | ±0.01 m/s or 2.0% of reading, whichever is greater<br>(K factor of 1.96) | 0 m/s to 60 m/s |
| Vector Wind Direction | Deg | 1 deg | ±2 deg<br>K factor of 2.11 | 0 deg to 360 deg<br>Starting threshold: 0 m/s |

[1] Uncertainties may not be calculated based on the full measurement range. Uncertainty for NO, $NO_2$ and $NO_x$ by EC 9841 and $SO_2$ by EC9850 are calculated based on a measurement range of 0-125 ppb.

## 5.2. Automatic Checks

Automatic span and zero calibration checks run every night for NO, $NO_2$, $NO_x$ and $SO_2$, every 2nd night for $H_2S$ and weekly for BTX.

Background checks run each night for $SO_2$ and $H_2S$.

See Table 7 below for additional details. Data points associated with these checks are invalidated but are not referred to in the Valid Data Exception Tables.

**Table 7: Automatic checks for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$ and BTX**

| Parameter | Span / Zero cycle time (approximate) | Background cycle time (approximate) |
|---|---|---|
| NO, $NO_2$, $NO_x$ | 00:45 to 01:40 every day | N/A |
| $SO_2$ | 00:45 to 01:40 every day | 23:45 to 23:50 every day |
| $H_2S$ | 01:35 to 02:35 every 2nd day | 23:45 to 23:50 every day |
| BTX | 02:45 to 04:45 every 7th day | N/A |

## 5.3. Maintenance

Scheduled monthly maintenance was performed 29th December.

### 5.3.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Table 8 indicates when the gas and meteorological equipment was last maintained / calibrated.

**Table 8: Wilpinjong Wollar Maintenance Table**

| Parameter | Date of Last Maintenance | Maintenance Type | Date of Last Calibration | Calibration Cycle |
|---|---|---|---|---|
| NO, $NO_2$, $NO_x$ | 29/12/2016 | Monthly | 29/12/2016 | Monthly |
| $SO_2$ | 29/12/2016 | Monthly | 29/12/2016 | Monthly |
| $H_2S$ | 29/12/2016 | Monthly | 29/12/2016 | Monthly |
| BTX | 29/12/2016 | Monthly | 29/12/2016 | Monthly |
| Wind Speed | 29/12/2016 | Monthly | 21/05/2015 | 2-Yearly |
| Wind Direction | 29/12/2016 | Monthly | 21/05/2015 | 2-Yearly |

Wind sensor calibration certificates not yet received, last calibration will be updated when available.

# 6.0 Results

## 6.1. Data Capture

Data capture is based on 1 hour averages, calculated from 5 minute data, and refers to the amount of available data collected during the report period.

The percentage of data captured is calculated using the following equation:
*Data capture = (Reported air quality data / Total data) x 100%*
Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of instrument readings since the start of the term assuming no maintenance, errors, loss of data or calibration.

Table 9 displays data capture statistics for December 2016. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data affecting data capture are included in the Valid Data Exception Tables, and attached Excel file.

**Table 9: Data Capture for Wilpinjong Wollar Station**

| Parameter | Data Capture % |
|---|---|
| NO, $NO_2$, $NO_x$ | 90.1 |
| $SO_2$ | 89.7 |
| $H_2S$ | **59.1** |
| Benzene | **87.4** |
| Toluene | **87.4** |
| *p*-Xylene | **87.4** |
| WS, WD | 99.1 |

## 6.2. Graphic Representations

Validated 5 minute data for NO, $NO_2$, $NO_x$, $SO_2$, $H_2S$, Benzene, Toluene and *p*-Xylene were used to construct the following graphical representations.

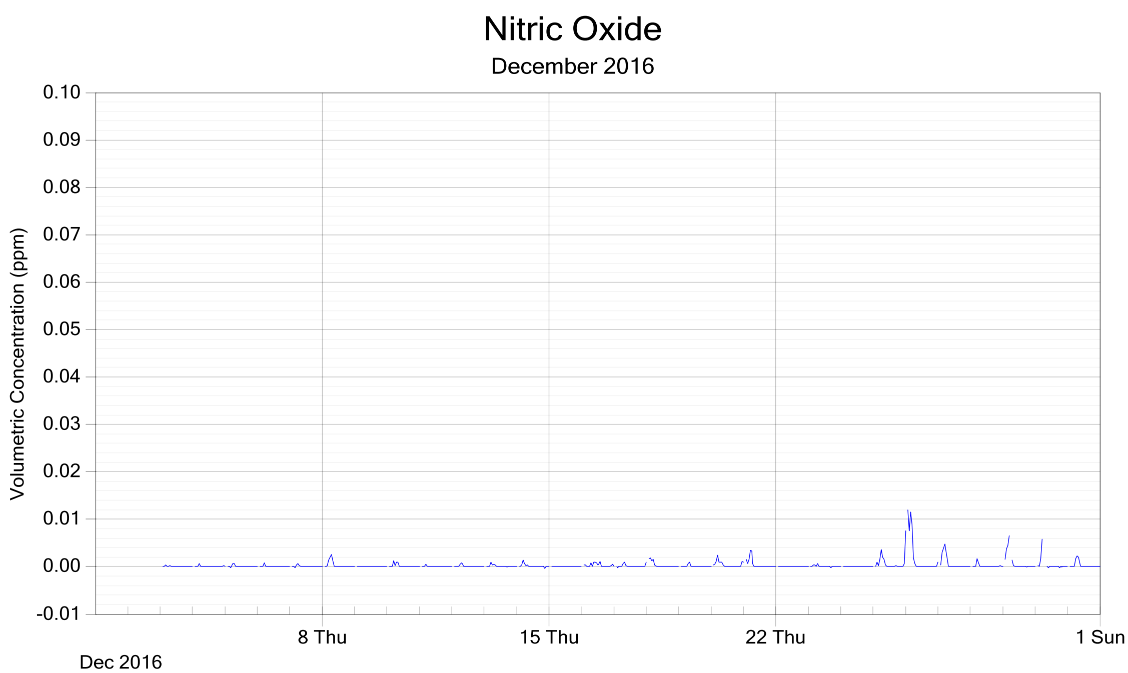


**Figure 2: NO - 1 hour data**

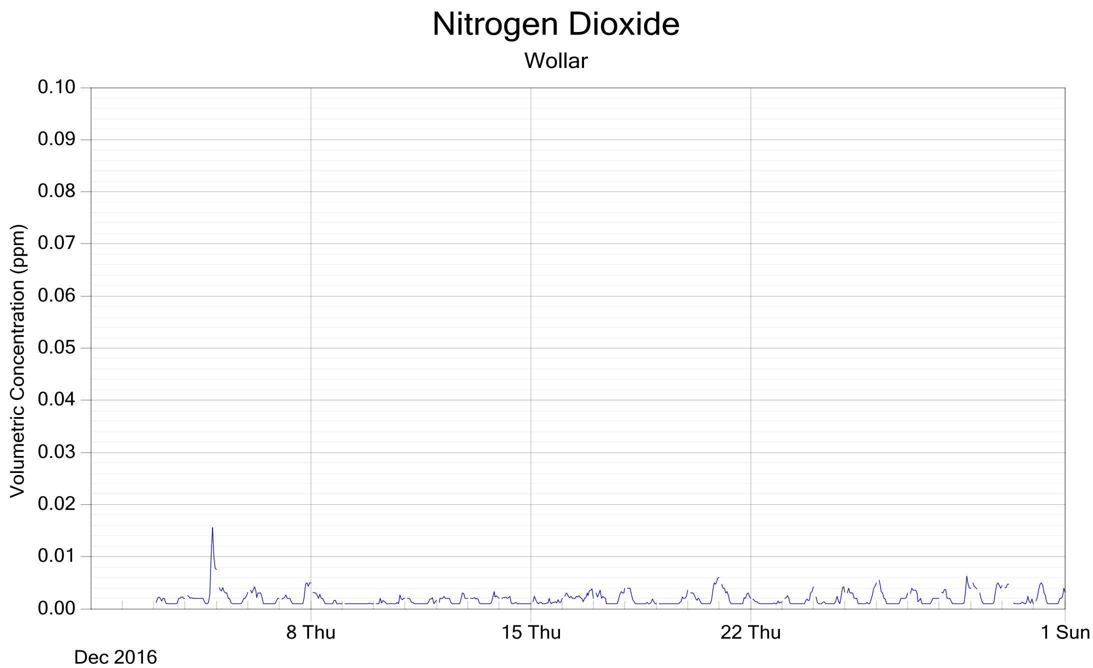


**Figure 3: $NO_2$ - 1 hour data**

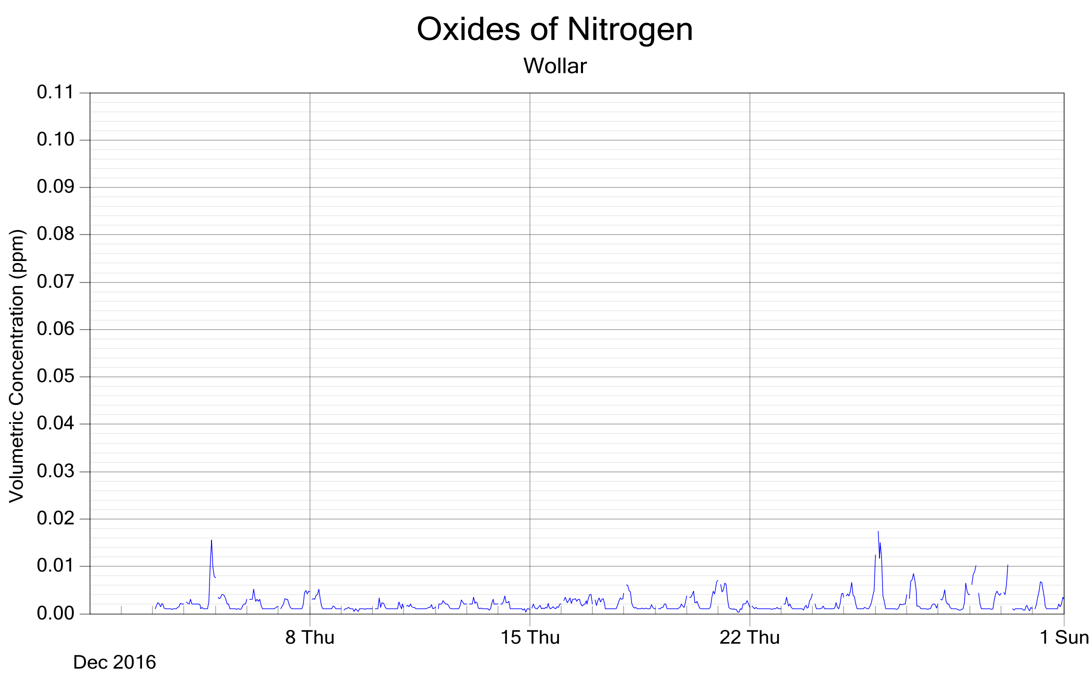


**Figure 4: $NO_X$ - 1 hour data**

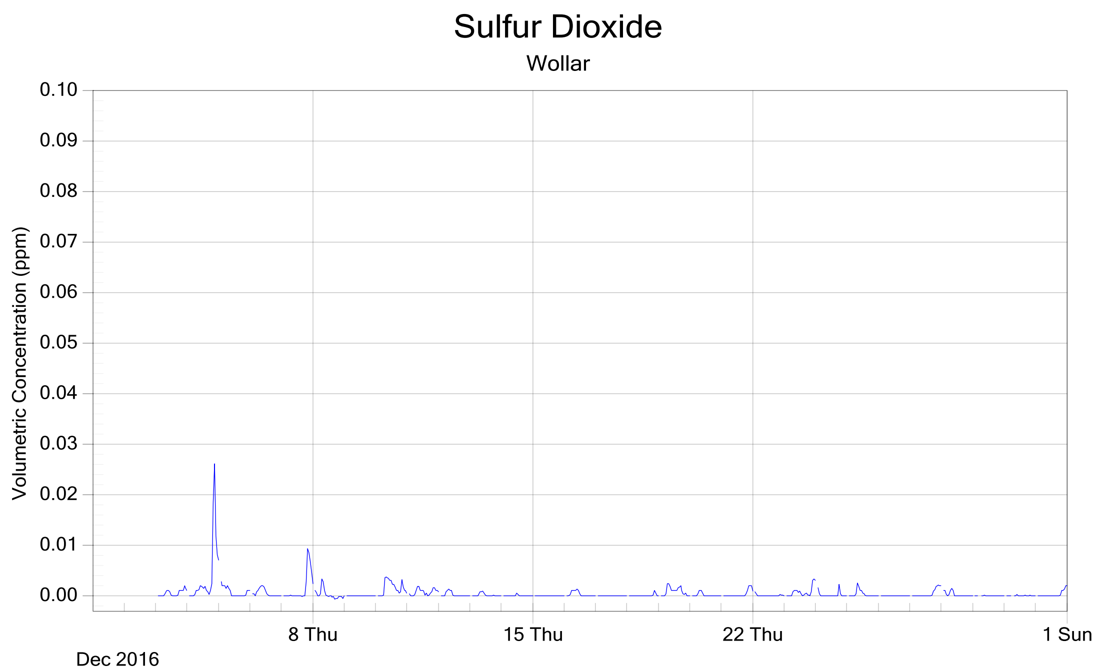


**Figure 5: $SO_2$ - 1 hour data**

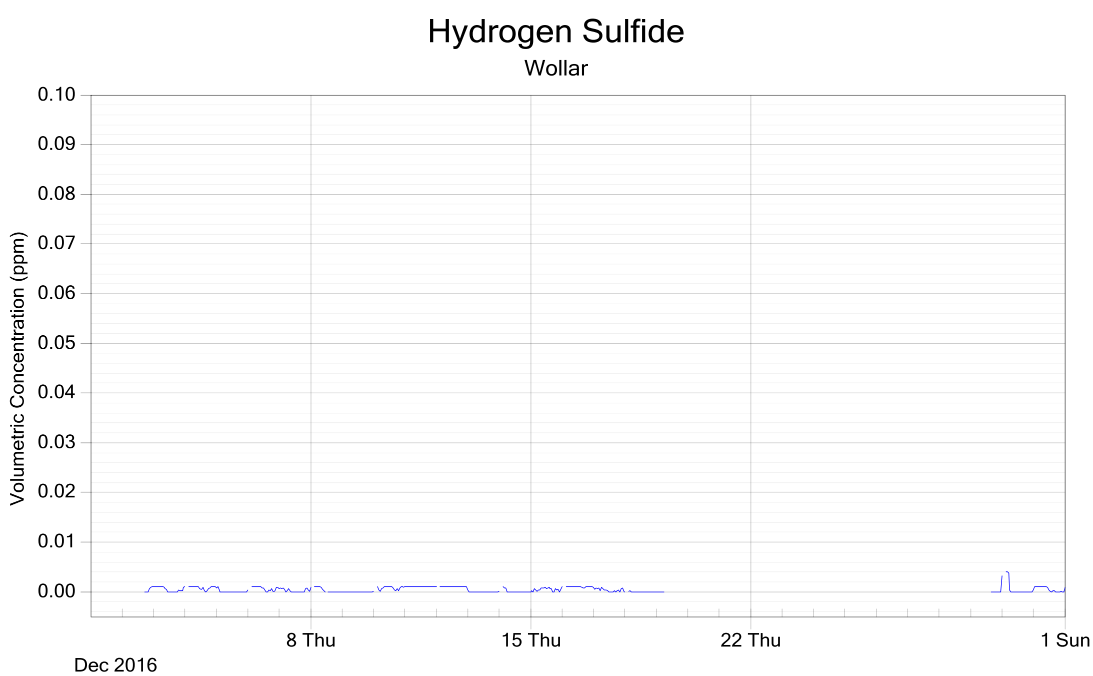


**Figure 6: $H_2S$ - 1 hour data**

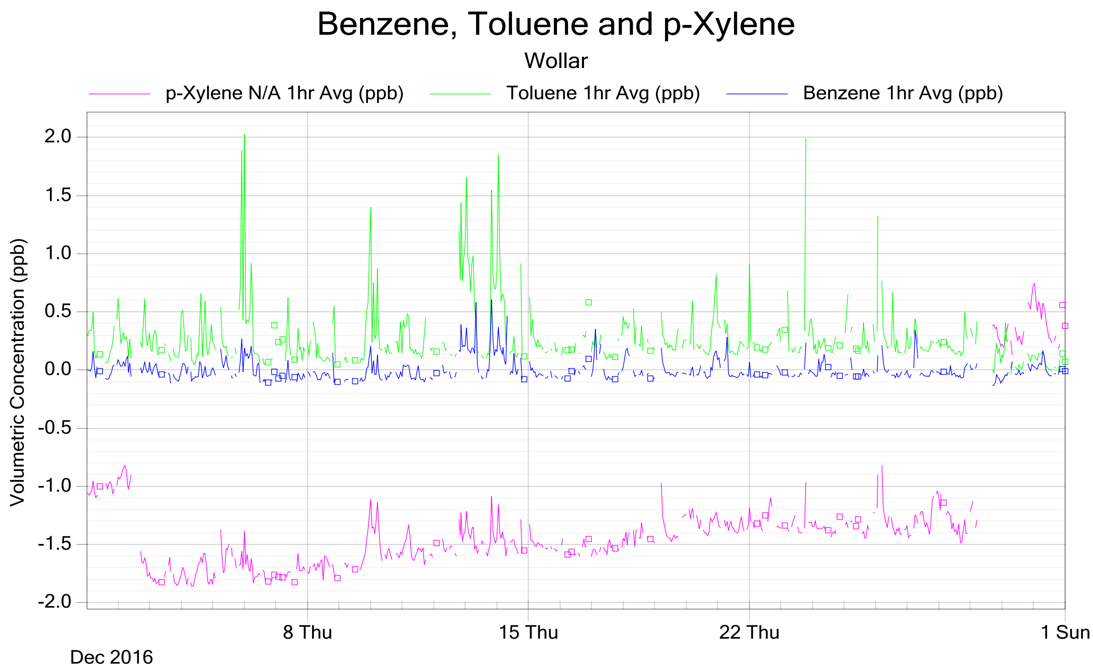


**Figure 7: BTX - 1 hour data**

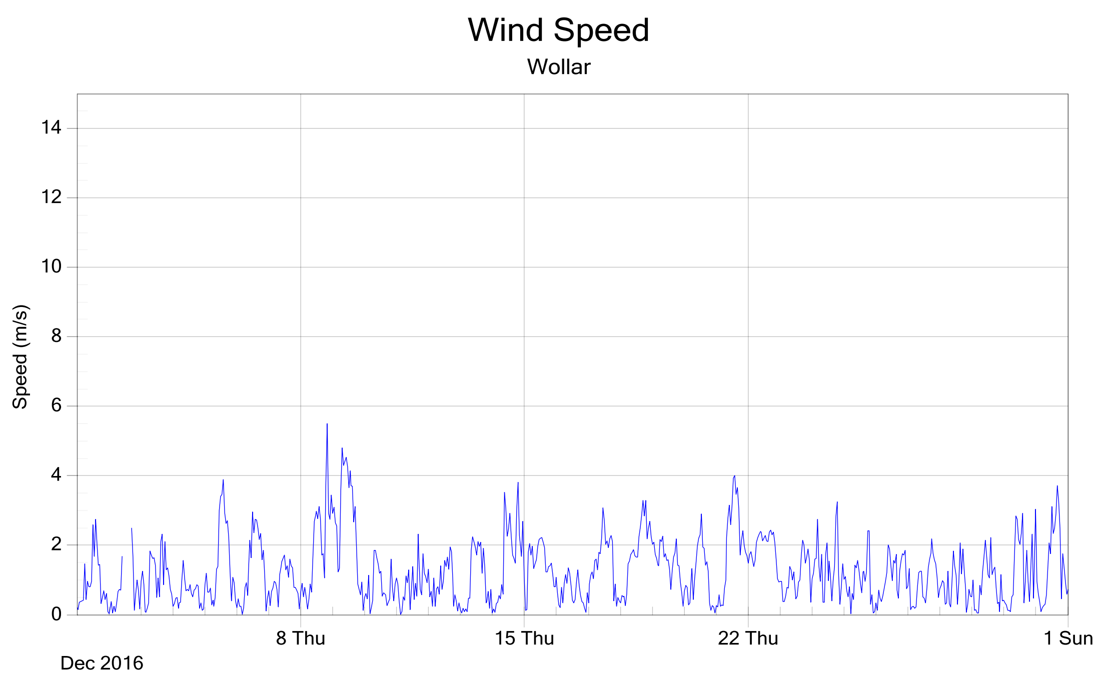


**Figure 8: WS - 1 hour data**

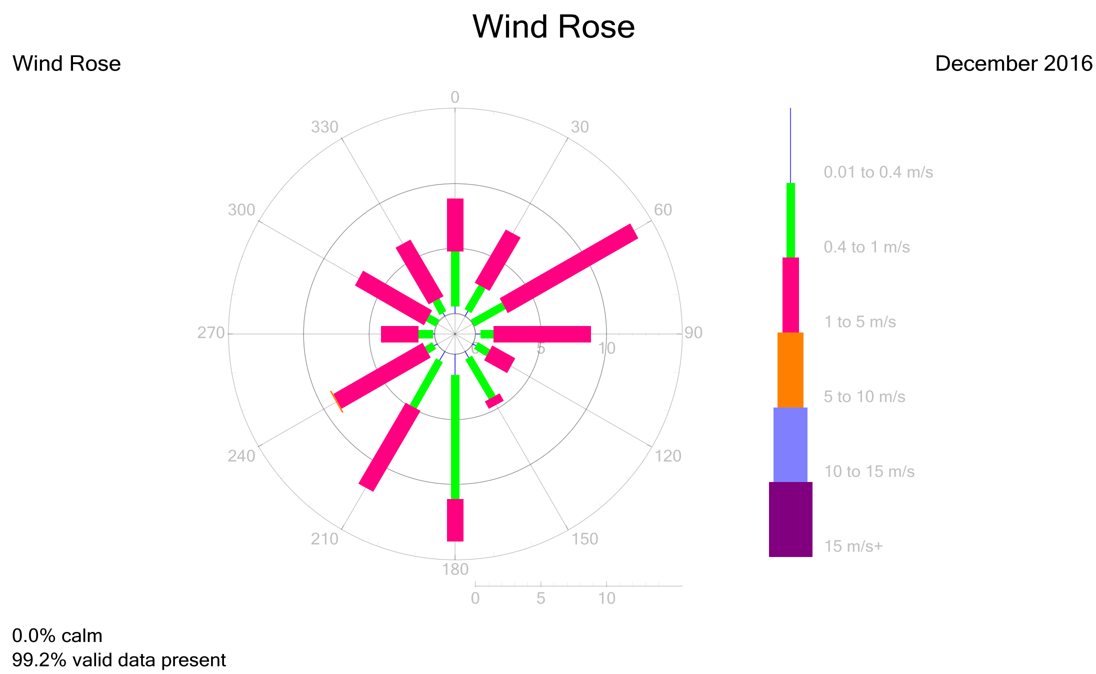


**Figure 9: Wind Rose**

## 7.0 Valid Data Exception Tables

The tables below details all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

**Table 10: Wollar Valid Data Exception Table**

| Start Date | End Date | Reason | Change Details | User Name | Change Date |
|---|---|---|---|---|---|
| 01/12/2016 00:00 | 03/12/2016 00:40 | Overnight spans out of tolerance limits on 02/12/2016 | NO, $NO_2$, $NO_x$ and $H_2S$ | RE | 18/12/2016 |
| 01/12/2016 00:00 | 31/12/2016 23:55 | Instrument fault – intermittent unrealistic spikes | BTX | RE | 18/12/2016 |
| 03/12/2016 00:45 | 06/12/2016 00:40 | Static multiplier of 1.03 applied to correct out of tolerance span on 03/12/2016 | NO, $NO_2$ and $NO_x$ | RE | 18/12/2016 |
| 19/12/2016 07:20 | 29/12/2016 05:50 | Instrument cooler fault – intermittent large blocks of data affected | $H_2S$ | RE | 18/12/2016 |
| 19/12/2016 19:40 | 23/12/2016 17:30 | Intermittent short power interruptions and subsequent BTX instrument stabilisation | All parameters | RE | 18/12/2016 |
| 29/12/2016 05:35 | 29/12/2016 06:25 | Scheduled monthly maintenance | NO, $NO_2$, $NO_x$ and $SO_2$ | RE | 18/12/2016 |
| 29/12/2016 05:55 | 29/12/2016 09:25 | Maintenance – faulty instrument replaced | $H_2S$ | RE | 18/12/2016 |
| 29/12/2016 06:40 | 29/12/2016 14:55 | Scheduled monthly maintenance | BTX | RE | 18/12/2016 |
| 29/12/2016 13:05 | 29/12/2016 16:00 | Maintenance – calibration performed on replacement instrument following stabilisation | $H_2S$ | RE | 18/12/2016 |
| 30/12/2016 05:55 | 30/12/2016 08:15 | Maintenance – converter efficiency check performed on $NO_x$ instrument | NO, $NO_2$, $NO_x$ and $SO_2$ | RE | 18/12/2016 |

## 8.0 Report Summary

The data capture for Wollar was below 95% for most measured parameters.

Please refer to Data Capture Percentage Table 9 on page 17 for details, and Table 10 on page 23 for valid data exceptions.

**Note: Benzene, Toluene and *p-X*ylene data in this report has been included for reference only. The data for this instrument is pending further investigation into performance and calibration. The data will be reviewed following the completion of this investigation.**

Measurement of a number of parameters in this report does not comply with applicable standards and/or is not covered by Ecotech's NATA scope of accreditation. Please refer to section 3.3.1 for details.

-----------------------------------------------END OF REPORT-------------------------------------

## Appendix 1 - Definitions & Abbreviations

| | |
|---|---|
| BTX | Benzene, Toluene and *p*-Xylene |
| $H_2S$ | Hydrogen sulfide |
| m/s | Metres per second |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| ppb | Parts per billion |
| $SO_2$ | Sulphur dioxide |
| WD | Vector Wind Direction |
| WS | Vector Wind Speed |

## Appendix 2 - Explanation of Exception Table

**Automatic background check** refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

**Calibration check outside tolerance** refers to when the calibration values are outside the tolerance limits set for the precision check.

**Calibration correction factor applied to data** refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

**Commissioning** refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

**Data affected by environmental conditions – wind speed / wind speed gust spike** refers to when a one-off high reading occurs due to a natural occurrence such as a bird sitting on the wind sensor, or some other event causing the readings to spike.

**Data transmission error** refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

**Equipment malfunction/instrument fault** refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

**Gap in data/data not available** refers to a period of time when either data has been lost or could not be collected.

**Instrument Alarm** refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

**Instrument out of service** refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

**Linear offset or multiplier** refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

**Logger error** refers to when an error occurs and instrument readings are not correctly recorded by the logger.

**Maintenance** refers to a period of time when the logger / instrument was switched off due to maintenance.

**Overnight span/zero out of tolerance** refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

**Power Interruption** refers to no power to the station therefore no data was collected at this time.

**Remote Calibration** refers to when a technician remotely connects to the station and manually performs a span check.

**Static offset or multiplier** refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.