October 2012

TRANSFIELD SERVICES PTY. LTD.

EastLink Ventilation Stack Emission Monitoring Report July-September 2012

Submitted to:
Transfield Services Pty. Ltd.,
EastLink Operations Centre,
2 Hillcrest Avenue,
Ringwood, 3134

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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

REPORT

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1.0 INTRODUCTION

EastLink is a 39-kilometre motorway running between Donvale in Melbourne's north-east to Frankston in Melbourne's south-east with two tunnels under the Mullum Mullum Valley. Transfield Services, who are responsible for operation and maintenance of the road, commissioned Golder Associates Pty. Ltd. to provide continuous emission monitoring services for the EastLink motorway project. The services provided include:

- Operations and maintenance services for the EastLink ventilation stack continuous emission monitoring systems (CEMS)
- NATA endorsed emission monitoring reports.

Monitoring commenced on the 29th June, 2008 with the opening of the EastLink motorway. Results for the sampling period 1st July, 2012 to 30th September, 2012 inclusive are contained in the following report.

The work was conducted under the following Transfield Services Work Order numbers:

Month	West Stack	East Stack
July	467404	467405
August	471819	471822
September	476596	476597

2.0 DISCHARGES TO AIR

EastLink has discharges to air servicing two road tunnels. Discharge Point No. 1 (DP1) services the inbound (Melba) tunnel and Discharge Point No. 2 (DP2) services the outbound (Mullum Mullum) tunnel.

The locations of the discharges to air are described in Table 1 and presented in Figure 1.

Table 1: Discharges to Air

Discharge Point No.	Station Name	Location
1	Western ventilation stack	Western end of inbound tunnel (Melba) - Donvale
2	Eastern ventilation stack	Eastern end of outbound tunnel (Mullum Mullum) – Ringwood

Monitoring equipment is housed in temperature controlled cabinets located at the base of each of the ventilation stacks. Particulate and gaseous sample inlets are installed inside the plenum chamber of each of the ventilation stacks.

Figure 1: Ventilation Stack Locations

3.0 VENTILATION STACK MONITORING PARAMETERS

The following parameters are monitored continuously, with averages logged at 5 minute intervals:

- Particulate matter with an equivalent aerodynamic diameter less than 2.5 microns ($PM_{2.5}$)
- Particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM_{10})
- Total oxides of nitrogen (NO_x)
- Nitric oxide (NO)
- Nitrogen dioxide (NO_2)
- Carbon monoxide (CO)
- Stack velocity
- Stack temperature
- Ambient pressure.

4.0 METHODS

4.1 $PM_{2.5}$

$PM_{2.5}$ concentrations in the tunnel ventilation stacks are determined using a 1400 Series Tapered Element Oscillating Microbalance (TEOM) analyser, located in the plenum chamber of the ventilation stacks.

Exhaust gas is drawn through a $PM_{2.5}$ size selective inlet (PM_{10} WINS head fitted with a $PM_{2.5}$ sharp cut cyclone (SCC)) at 1 m^3/h. The flow is then isokinetically split into two streams; 1 l/min stream which passes through the filter on the mass transducer and a 15.7 l/min bypass stream.

The sample stream is heated to 50°C to maintain a low and therefore relatively constant humidity.

Measurements are made in real-time (2 s intervals) with the 5-minute averages logged. 1-hour averages are then calculated from the logged data.

The $PM_{2.5}$ monitoring method is based on the requirements of Australian Standard AS 3580.9.8, *"Methods for Sampling and Analysis of Ambient Air: Determination of Suspended Particulate Matter – PM_{10} Continuous Direct Mass Method Using a Tapered Element Oscillating Microbalance Analyser"*.

4.2 PM_{10}

PM_{10} concentrations in the tunnel ventilation stacks are determined using a 1400 Series Tapered Element Oscillating Microbalance (TEOM) analyser, located in the plenum chamber of the ventilation stacks.

Exhaust gas is drawn through a PM_{10} size selective inlet (PM_{10} WINS head) at 1 m^3/h. The flow is then isokinetically split into two streams; 1 l/min stream which passes through the filter on the mass transducer and a 15.7 l/min bypass stream.

The sample stream is heated to 50°C to maintain a low and therefore relatively constant humidity.

Measurements are made in real-time (2 s intervals) with the 5-minute averages logged. 1-hour averages are then calculated from the logged data.

The PM_{10} monitoring method is based on the requirements of Australian Standard AS 3580.9.8, *"Methods for Sampling and Analysis of Ambient Air: Determination of Suspended Particulate Matter – PM_{10} Continuous Direct Mass Method Using a Tapered Element Oscillating Microbalance Analyser"*.

4.3 Carbon Monoxide

Carbon monoxide concentrations in the tunnel ventilation stacks are determined by infra-red gas filter correlation analysers.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The carbon monoxide monitoring method is based on the requirements of Australian Standard AS 3580.7.1, "*Determination of Carbon Monoxide – Direct Reading Instrumental Method"*.

4.4 Oxides of Nitrogen

Oxides of nitrogen concentrations in the tunnel ventilation stacks are determined by chemiluminescence gas analysers.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The oxides of nitrogen (NO, NO_2 and NO_x) monitoring method is based on the requirements of Australian Standard AS 3580.5.1, *"Determination of Oxides of Nitrogen – Chemiluminescence Method"*.

4.5 Stack Velocity

Stack gas velocity was determined using an optical flow sensor that complies with USEPA Code of Federal Regulations (CFR 40) Part 75, *"Continuous Emission Monitoring"* requirements.

5.0 MEASUREMENT UNCERTAINTY

Table 2: Measurement Uncertainty

Parameter	Method	Estimated Uncertainty
PM_{10}	TEOM	± 5%
$PM_{2.5}$	TEOM	± 5%
NO, NO_2, NO_X	Chemiluminescence	± 10%
CO	Infra-red gas filter correlation	± 10%
Stack velocity	Optical flow sensor	± 0.1 m/s or 5% of reading, whichever is greater

6.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/07/2012 – 31/07/2012

6.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

The data capture statistics for the reporting period 1st July to 31st July, 2012 are shown in Table 3. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 6.3 provides further information on the reasons for invalid data periods.

Table 3: Data Capture Statistics - 1 Hour Averages

Parameter	Station	Collected Periods	Available Periods	Data Capture
$PM_{2.5}$	Eastern	743	744	99.9%
	Western	742	744	99.7%
PM_{10}	Eastern	739	744	99.3%
	Western	742	744	99.7%
NO, NO_2	Eastern	678	744	91.1%
	Western	567	744	76.2%
CO	Eastern	709	744	95.3%
	Western	711	744	95.6%

6.2 Results

6.2.1 $PM_{2.5}$

$PM_{2.5}$ was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

$PM_{2.5}$ (1 hour average) mass rate of emission statistics for the reporting period are given in Table 4. A plot of $PM_{2.5}$ (1 hour average) mass rate of emission for the reporting period is presented in Figure 2.

Table 4: $PM_{2.5}$ Mass Rate Percentiles (1 Hour Average)

Station	$PM_{2.5}$ Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.23	0.18	0.17	0.15	0.13	0.11	0.029
Western	0.25	0.21	0.19	0.15	0.12	0.090	0.035

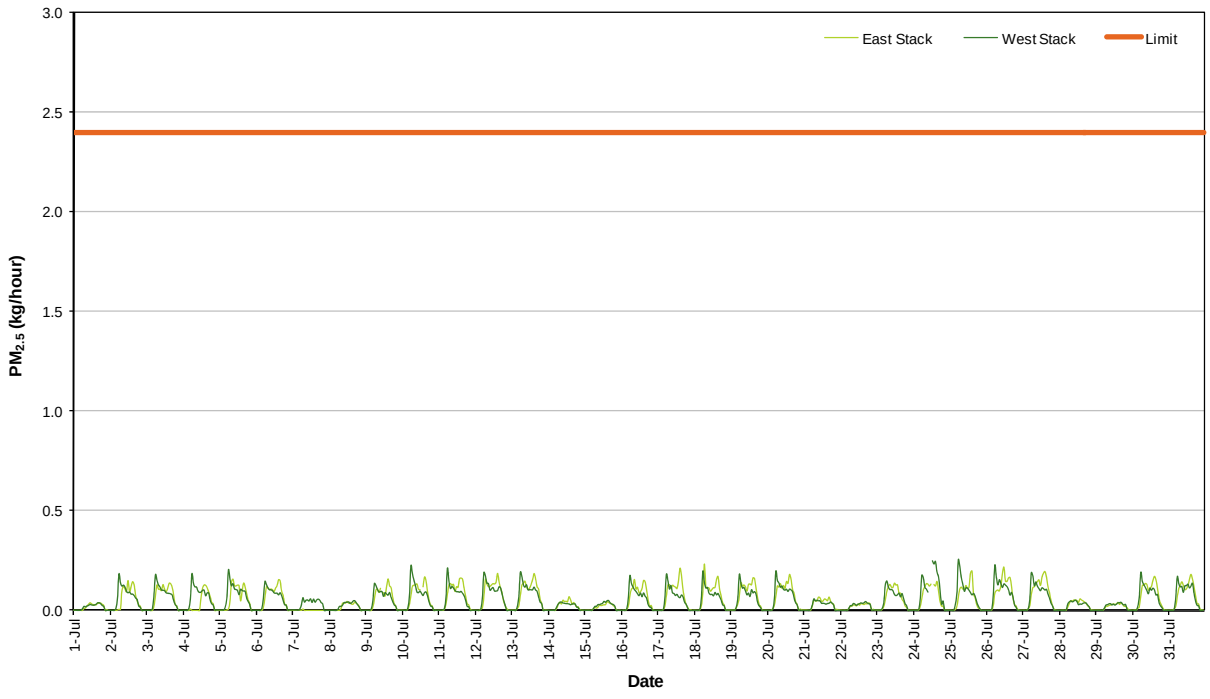

Figure 2: $PM_{2.5}$ Mass Rate (1 Hour Average)

6.2.2 PM_{10}

PM_{10} was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM_{10} (1 hour average) mass rate of emission statistics for the reporting period are given in Table 5. A plot of PM_{10} (1 hour average) mass rate of emission for the reporting period is presented in Figure 3.

Table 5: PM_{10} Mass Rate Percentiles (1 Hour Average)

Station	PM_{10} Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.55	0.32	0.30	0.26	0.24	0.17	0.049
Western	0.56	0.36	0.32	0.26	0.23	0.17	0.063

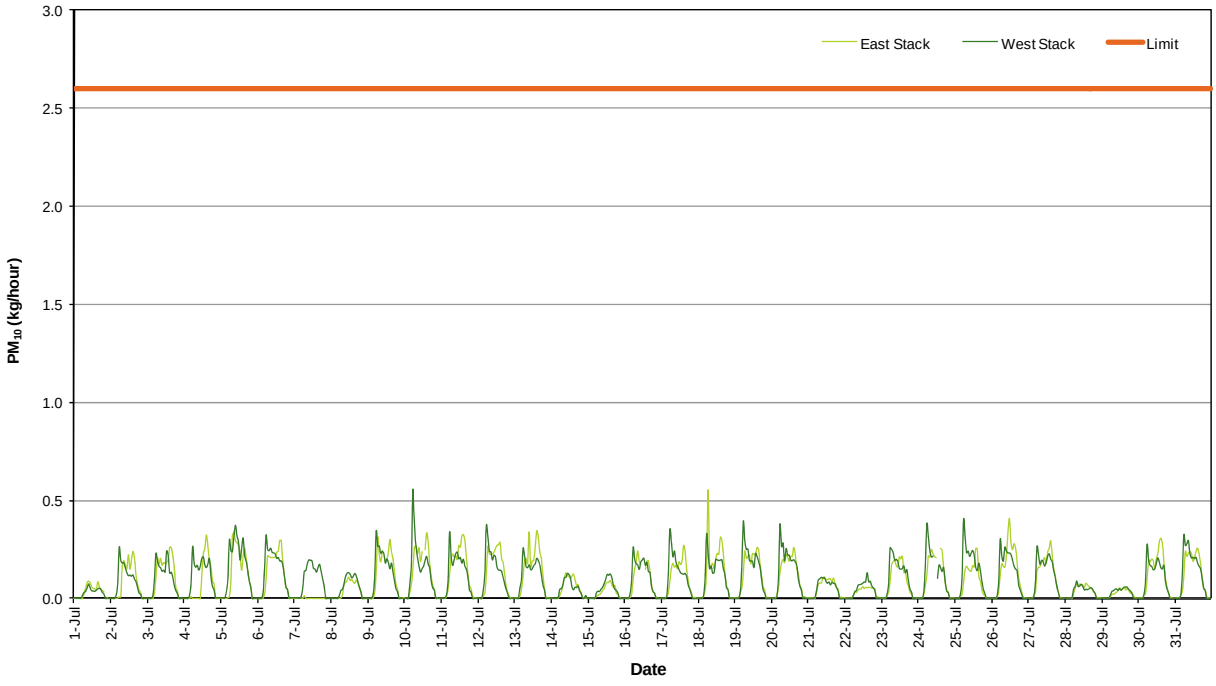

Figure 3: PM_{10} Mass Rate (1 Hour Average)

6.2.3 Carbon Monoxide

Carbon monoxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 6. A plot of carbon monoxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 4.

Table 6: Carbon Monoxide Mass Rate Percentiles (1 Hour Average)

Station	Carbon Monoxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	19	18	17	14	11	8.3	5.1
Western	22	19	18	14	12	8.8	6.0

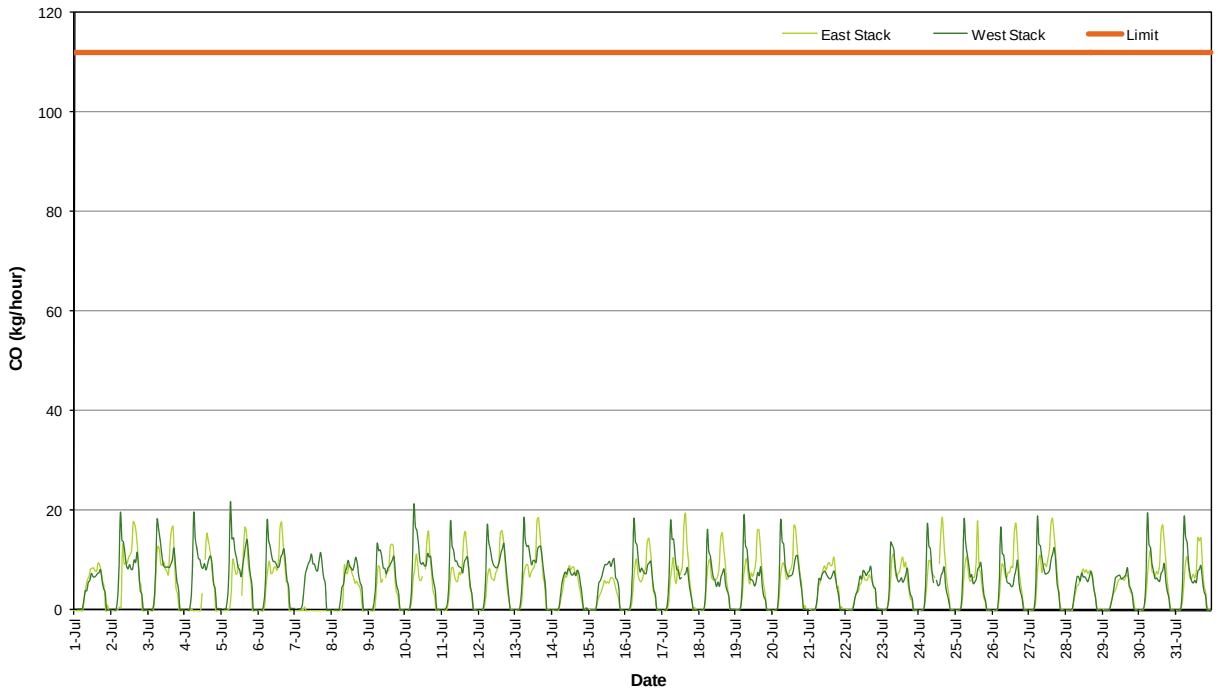

Figure 4: Carbon Monoxide Mass Rate (1 Hour Average)

6.2.4 Oxides of Nitrogen

6.2.4.1 Nitric Oxide

Nitric oxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 7. A plot of nitric oxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 5.

Table 7: Nitric Oxide Mass Rate Percentiles (1 Hour Average)

Station	Nitric Oxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	4.2	3.7	3.5	3.2	2.7	2.3	0.91
Western	5.5	4.7	4.0	3.1	2.7	2.1	1.2

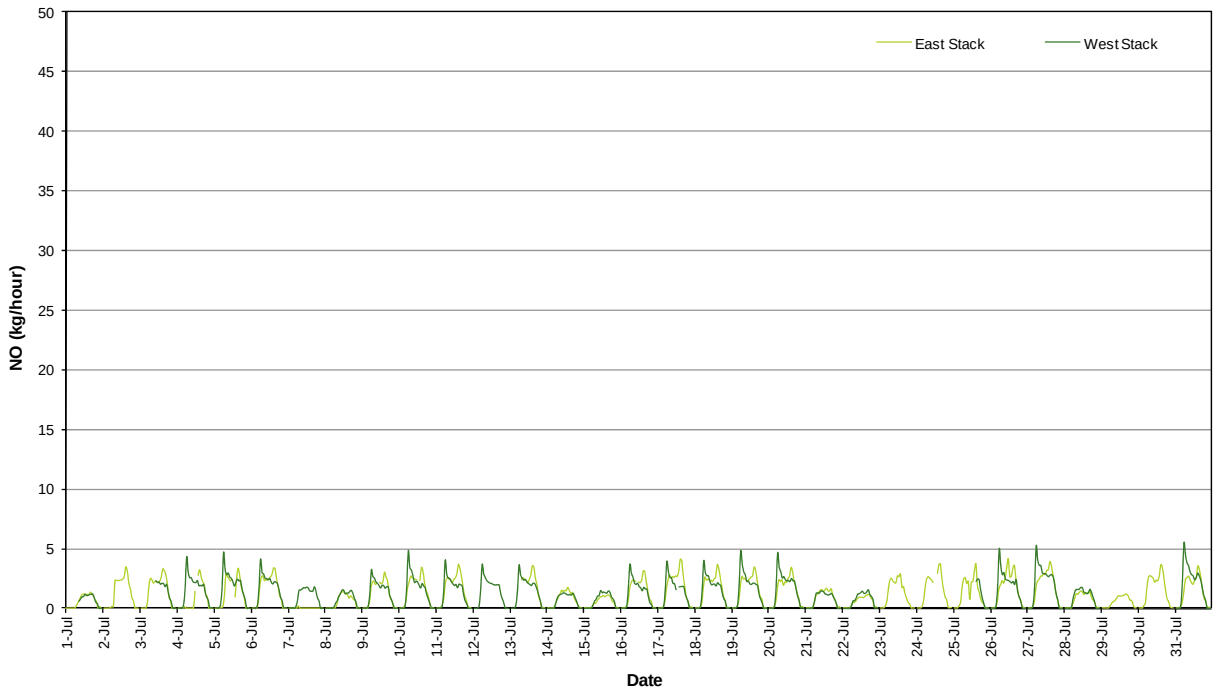

Figure 5: Nitric Oxide Mass Rate (1 Hour Average)

6.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 8. A plot of nitrogen dioxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 6.

Table 8: Nitrogen Dioxide Mass Rate Percentiles (1 Hour Average)

Station	Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.52	0.49	0.46	0.42	0.35	0.29	0.13
Western	0.58	0.39	0.37	0.31	0.24	0.18	0.10

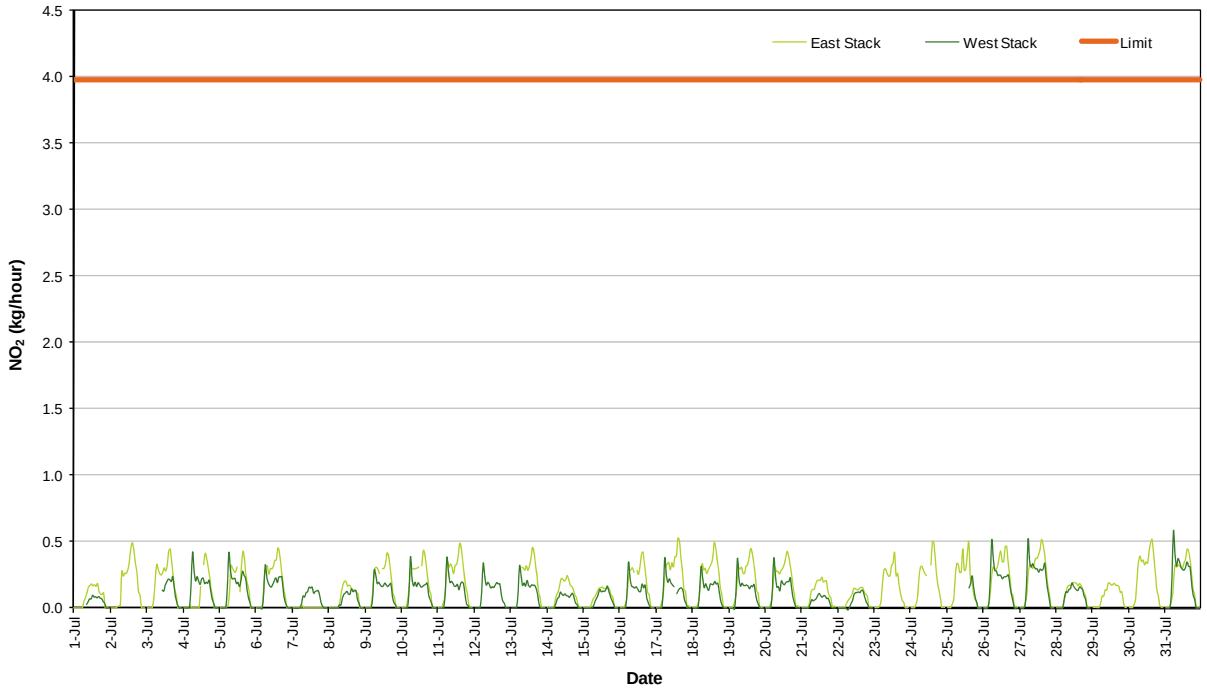

Figure 6: Nitrogen Dioxide Mass Rate (1 Hour Average)

6.2.5 Stack Velocity

The stack velocity (1 hour average) plot for the reporting period is presented in Figure 7.

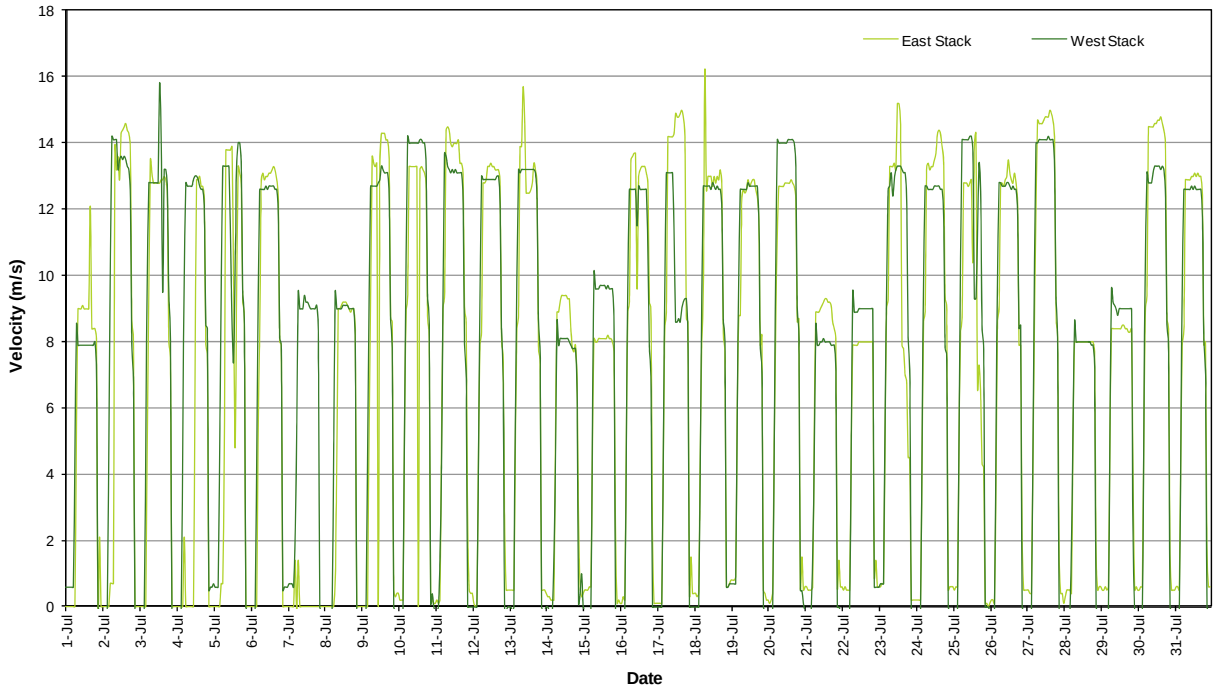

Figure 7: Stack Velocity (1 Hour Average)

6.3 Data Validation and Exceptions

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 9 and 10 list the data exceptions for the eastern and western ventilation stacks respectively. Data during automatic calibrations of the gaseous atmospheric contaminants has also been removed from the data sets.

Table 9: Data Exceptions - Eastern Ventilation Stack: July 2012

Start	End	Parameter	Reason
1/07/2012 21:40	1/07/2012 21:55	PM_{10}	Invalid data[1]
3/07/2012 13:40	3/07/2012 13:45	CO	Maintenance/calibration
4/07/2012 13:35	4/07/2012 13:50	NO, NO_2, NO_x	Maintenance/calibration
4/07/2012 13:35	4/07/2012 13:50	CO	Maintenance/calibration
5/07/2012 13:15	5/07/2012 13:40	NO, NO_2, NO_x	Maintenance/calibration
5/07/2012 13:15	5/07/2012 13:40	CO	Maintenance/calibration
9/07/2012 11:10	9/07/2012 11:25	Velocity	Maintenance/calibration
10/07/2012 13:20	10/07/2012 13:35	Velocity	Maintenance/calibration
12/07/2012 0:40	13/07/2012 7:35	NO, NO_2, NO_x	Invalid data - Span drift
13/07/2012 5:05	13/07/2012 5:10	PM_{10}	Invalid data[1]
16/07/2012 11:20	16/07/2012 11:40	NO, NO_2, NO_x	Maintenance/calibration
16/07/2012 12:05	16/07/2012 13:45	PM_{10}	Maintenance/calibration
24/07/2012 12:40	24/07/2012 14:05	NO, NO_2, NO_x	Maintenance/calibration
24/07/2012 12:40	24/07/2012 14:00	CO	Maintenance/calibration
24/07/2012 12:45	24/07/2012 14:00	$PM_{2.5}$	Maintenance/calibration
24/07/2012 13:15	24/07/2012 14:25	PM_{10}	Maintenance/calibration

Note: [1] – In the opinion of the reviewer.

Table 10: Data Exceptions - Western Ventilation Stack: July 2012

Start	End	Parameter	Reason
1/07/2012 0:40	1/07/2012 8:10	NO, NO_2, NO_x	Invalid data - Span drift
2/07/2012 0:40	3/07/2012 9:35	NO, NO_2, NO_x	Invalid data - Span drift
10/07/2012 7:15	10/07/2012 7:25	NO, NO_2, NO_x	Maintenance/calibration
17/07/2012 12:55	17/07/2012 13:20	NO, NO_2, NO_x	Maintenance/calibration
17/07/2012 14:00	17/07/2012 14:40	CO	Maintenance/calibration
23/07/2012 0:40	25/07/2012 14:30	NO, NO_2, NO_x	Invalid data - Span drift
24/07/2012 11:05	24/07/2012 12:25	$PM_{2.5}$	Maintenance/calibration
24/07/2012 11:10	24/07/2012 11:25	CO	Maintenance/calibration
24/07/2012 11:30	24/07/2012 12:20	PM_{10}	Maintenance/calibration
29/07/2012 0:40	30/07/2012 23:55	NO, NO_2, NO_x	Invalid data - Span drift

7.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/08/2012 – 31/08/2012

7.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

The data capture statistics for the reporting period 1st August to 31st August, 2012 are shown in Table 11. Averages were only collected for those periods where the 5-minute data constituted 75% data capture.

Section 7.3 provides further information on the reasons for invalid data periods.

Table 11: Data Capture Statistics - 1 Hour Averages

Parameter	Station	Collected Periods	Available Periods	Data Capture
$PM_{2.5}$	Eastern	692	744	93.0%
	Western	719	744	96.6%
PM_{10}	Eastern	720	744	96.8%
	Western	693	744	93.1%
NO, NO_2	Eastern	709	744	95.3%
	Western	625	744	84.0%
CO	Eastern	712	744	95.7%
	Western	711	744	95.6%

7.2 Results

7.2.1 $PM_{2.5}$

$PM_{2.5}$ was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

$PM_{2.5}$ (1 hour average) mass rate of emission statistics for the reporting period are given in Table 12. A plot of $PM_{2.5}$ (1 hour average) mass rate of emission for the reporting period is presented in Figure 8.

Table 12: $PM_{2.5}$ Mass Rate Percentiles (1 Hour Average)

Station	$PM_{2.5}$ Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.24	0.21	0.20	0.18	0.15	0.12	0.039
Western	0.28	0.20	0.19	0.14	0.12	0.086	0.038

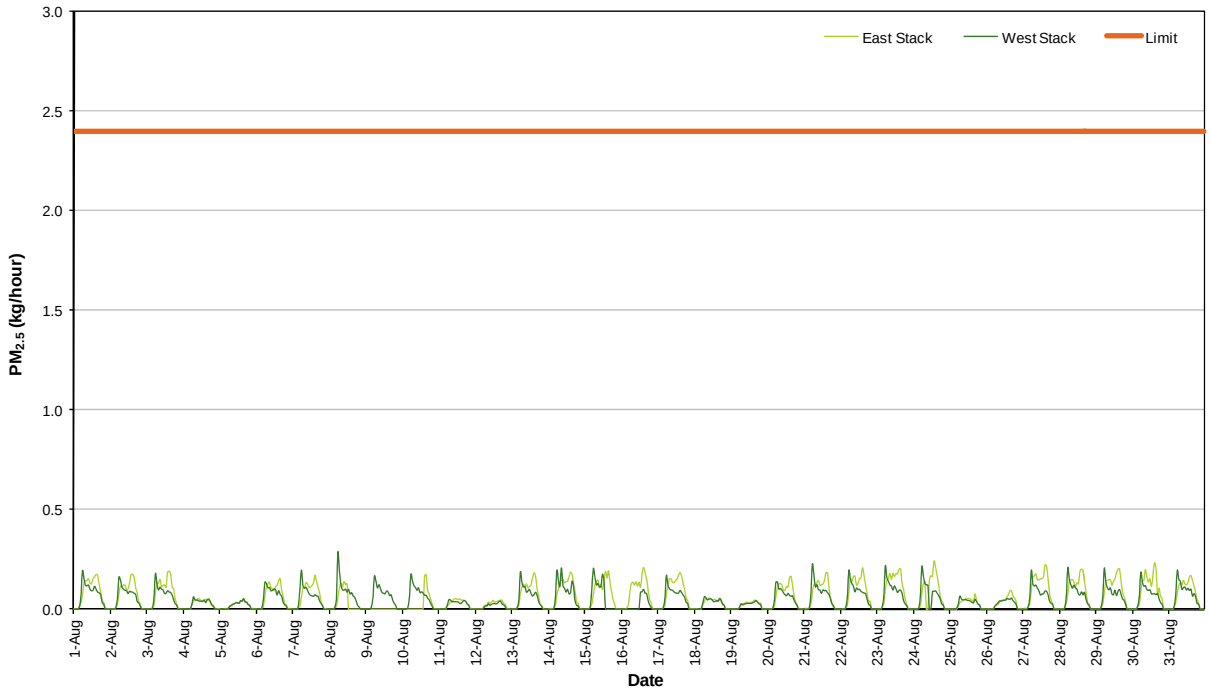

Figure 8: $PM_{2.5}$ Mass Rate (1 Hour Average)

7.2.2 PM_{10}

PM_{10} was continuously monitored and 5-minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM_{10} (1 hour average) mass rate of emission statistics for the reporting period are given in Table 13. A plot of PM_{10} (1 hour average) mass rate of emission for the reporting period is presented in Figure 9.

Table 13: PM_{10} Mass Rate Percentiles (1 Hour Average)

Station	PM_{10} Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.57	0.31	0.30	0.27	0.24	0.19	0.063
Western	0.52	0.36	0.33	0.26	0.23	0.16	0.077

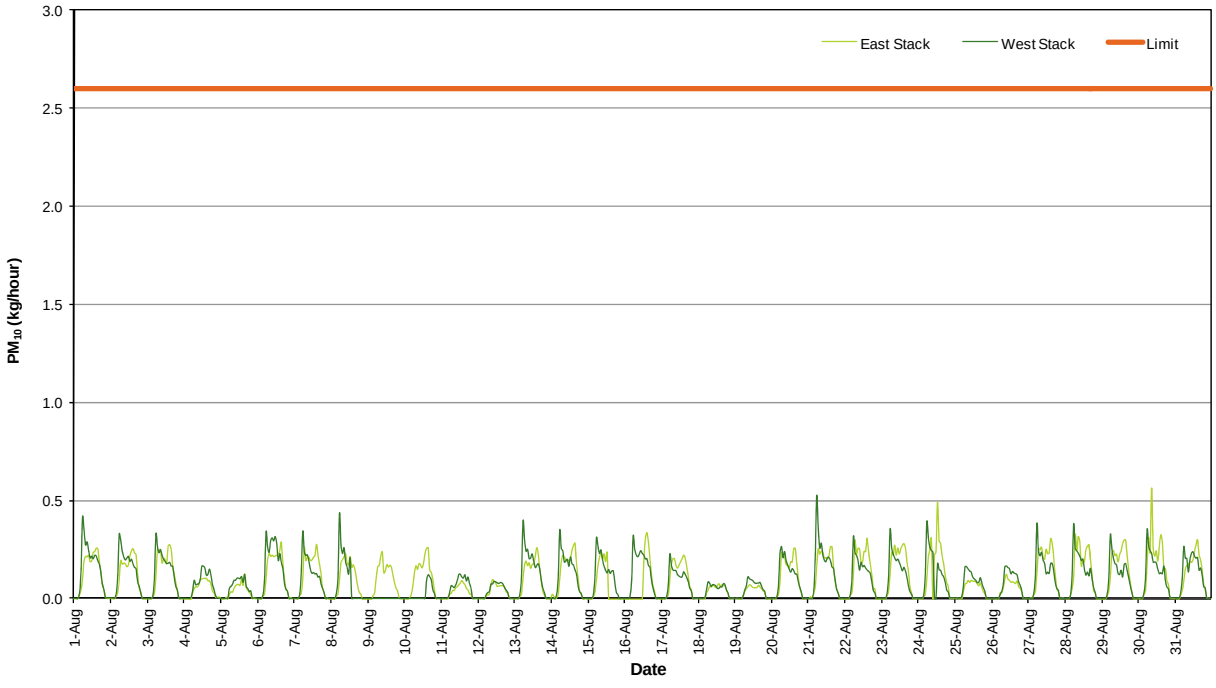

Figure 9: PM_{10} Mass Rate (1 Hour Average)

7.2.3 Carbon Monoxide

Carbon monoxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 14. A plot of carbon monoxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 10.

Table 14: Carbon Monoxide Mass Rate Percentiles (1 Hour Average)

Station	Carbon Monoxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	20	18	18	16	12	8.7	6.2
Western	22	18	17	13	11	7.8	5.8

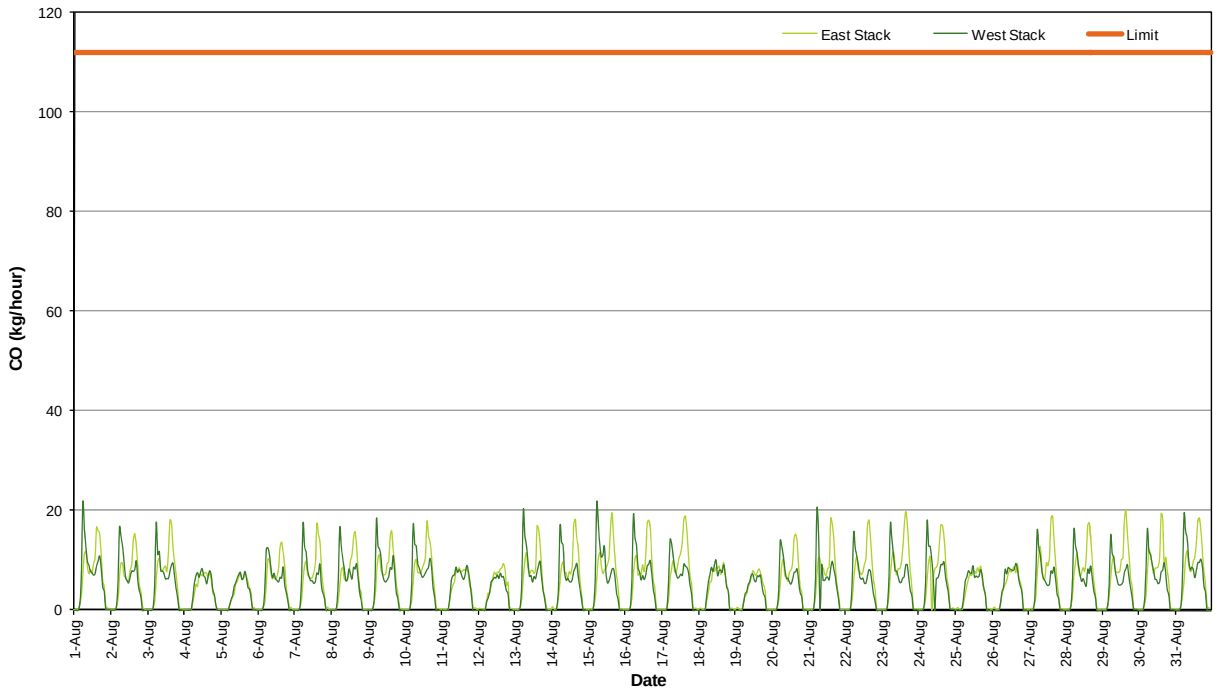

Figure 10: Carbon Monoxide Mass Rate (1 Hour Average)

7.2.4 Oxides of Nitrogen

7.2.4.1 Nitric Oxide

Nitric oxide (1-hour average) mass rate of emission statistics for the reporting period are given in Table 15. A plot of nitric oxide (1-hour average) mass rate of emission for the reporting period is presented in Figure 11.

Table 15: Nitric Oxide Mass Rate Percentiles (1 Hour Average)

Station	Nitric Oxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	4.4	3.9	3.7	3.3	2.9	2.4	1.1
Western	5.0	4.3	3.9	3.0	2.5	2.0	1.3

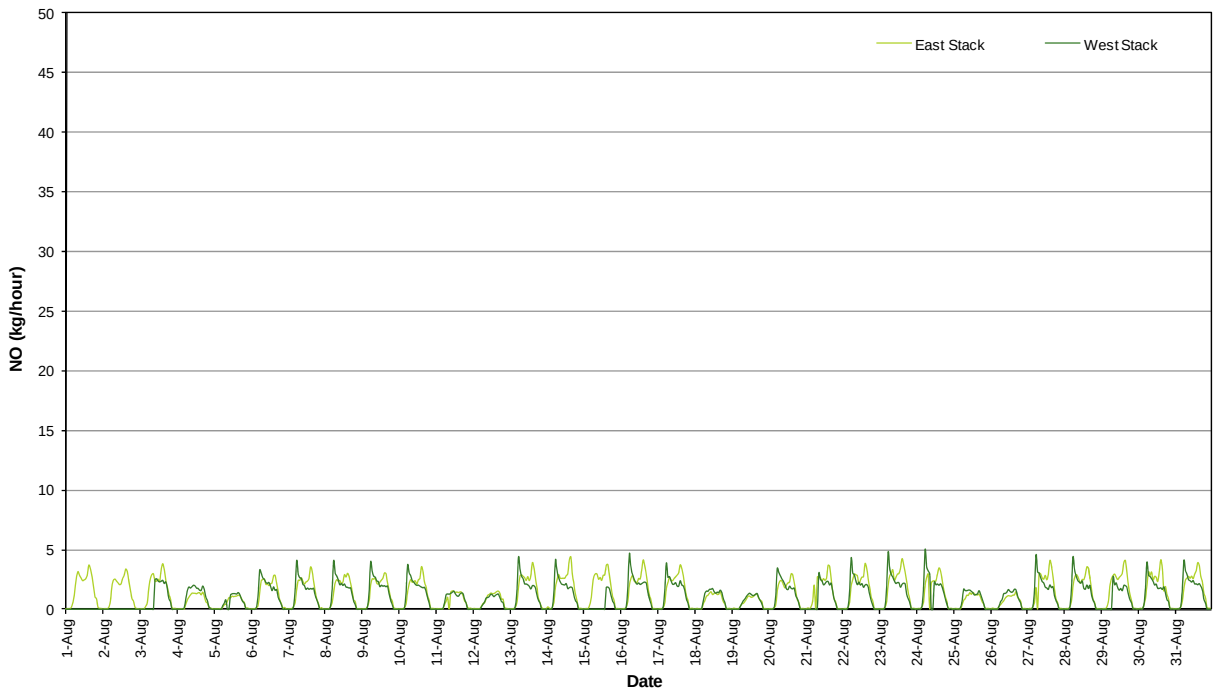

Figure 11: Nitric Oxide Mass Rate (1 Hour Average)

7.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 16. A plot of nitrogen dioxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 12.

Table 16: Nitrogen Dioxide Mass Rate Percentiles (1 Hour Average)

Station	Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.58	0.54	0.52	0.45	0.39	0.33	0.17
Western	0.58	0.44	0.40	0.31	0.27	0.22	0.14

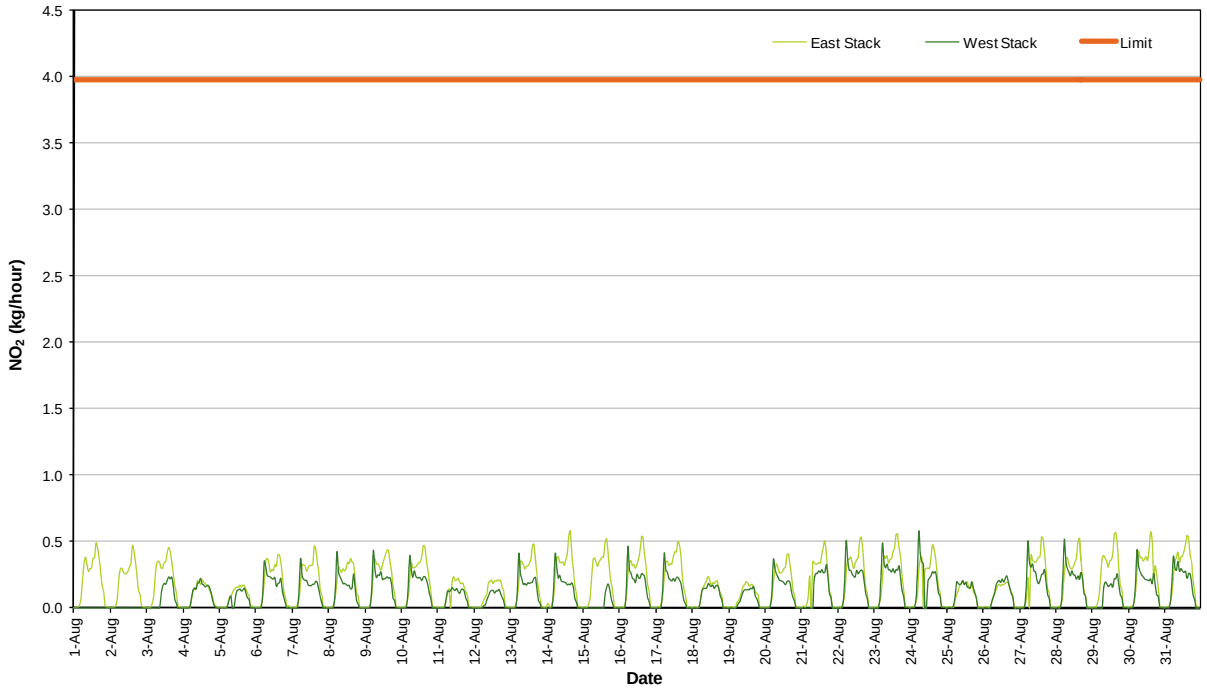

Figure 12: Nitrogen Dioxide Mass Rate (1 Hour Average)

7.2.5 Stack Velocity

The stack velocity (1 hour average) plot for the reporting period is presented in Figure 13.

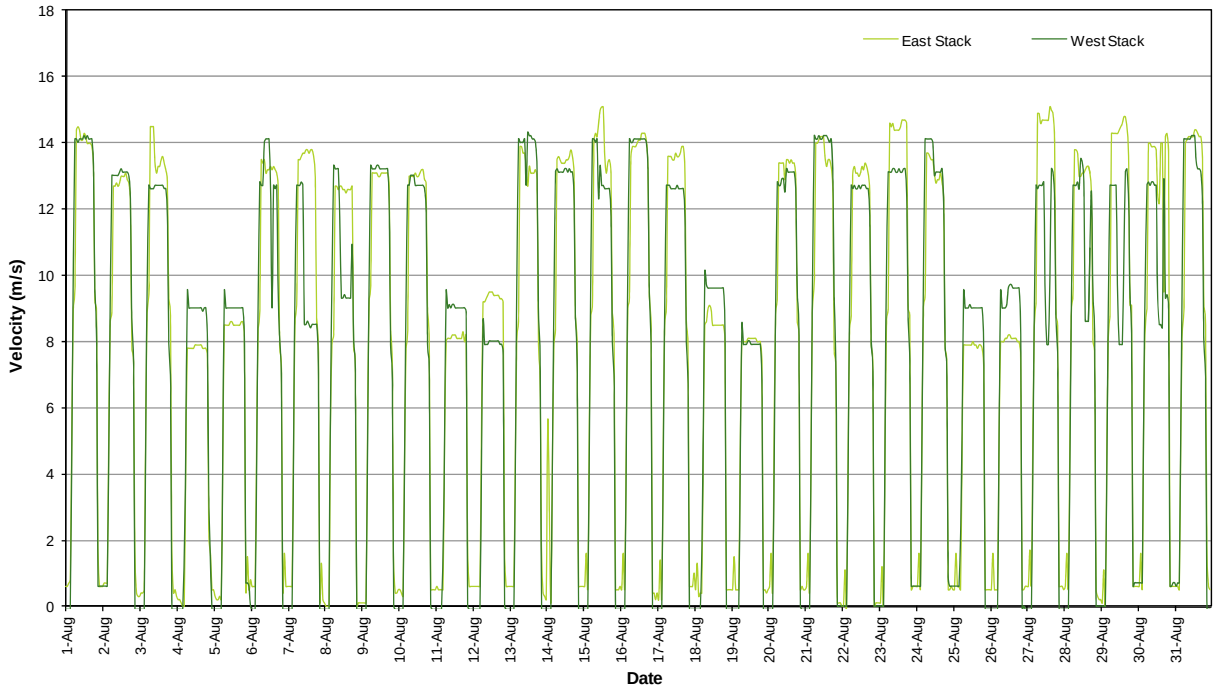

Figure 13: Stack Velocity (1 Hour Average)

7.3 Data Validation and Exceptions

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 17 and 18 list the data exceptions for the eastern and western ventilation stacks respectively. Data during automatic calibrations of the gaseous atmospheric contaminants has also been removed from the data sets.

Table 17: Data Exceptions - Eastern Ventilation Stack: August 2012

Start	End	Parameter	Reason
8/08/2012 13:15	10/08/2012 14:30	$PM_{2.5}$	Maintenance/calibration
11/08/2012 9:05	11/08/2012 9:25	NO, NO_2, NO_x	Maintenance/calibration
15/08/2012 13:45	15/08/2012 13:55	NO, NO_2, NO_x	Maintenance/calibration
15/08/2012 13:55	15/08/2012 23:55	PM_{10}	Maintenance/calibration
15/08/2012 14:15	15/08/2012 14:15	$PM_{2.5}$	Maintenance/calibration
16/08/2012 3:00	16/08/2012 12:35	PM_{10}	Maintenance/calibration
21/08/2012 7:10	21/08/2012 7:50	NO, NO_2, NO_x	Maintenance/calibration
24/08/2012 9:10	24/08/2012 9:45	NO, NO_2, NO_x	Maintenance/calibration
24/08/2012 9:10	24/08/2012 9:25	CO	Maintenance/calibration
24/08/2012 9:35	24/08/2012 10:25	$PM_{2.5}$	Maintenance/calibration
24/08/2012 9:50	24/08/2012 10:25	PM_{10}	Maintenance/calibration
27/08/2012 7:05	27/08/2012 7:35	NO, NO_2, NO_x	Maintenance/calibration

Table 18: Data Exceptions - Western Ventilation Stack: August 2012

Start	End	Parameter	Reason
1/08/2012 0:00	3/08/2012 10:00	NO, NO_2, NO_x	Invalid data - Span drift
5/08/2012 9:40	5/08/2012 10:15	NO, NO_2, NO_x	Maintenance/calibration
8/08/2012 13:50	10/08/2012 14:45	PM_{10}	Maintenance/calibration
15/08/2012 0:40	15/08/2012 15:10	NO, NO_2, NO_x	Invalid data - Span drift
15/08/2012 14:40	16/08/2012 12:45	$PM_{2.5}$	Maintenance/calibration
21/08/2012 0:40	21/08/2012 8:25	NO, NO_2, NO_x	Invalid data - Span drift
21/08/2012 8:05	21/08/2012 8:45	CO	Maintenance/calibration
24/08/2012 10:35	24/08/2012 11:15	NO, NO_2, NO_x	Maintenance/calibration
24/08/2012 11:00	24/08/2012 12:25	$PM_{2.5}$	Maintenance/calibration
24/08/2012 11:10	24/08/2012 12:25	PM_{10}	Maintenance/calibration
24/08/2012 11:15	24/08/2012 11:40	CO	Maintenance/calibration
29/08/2012 0:40	29/08/2012 7:50	NO, NO_2, NO_x	Invalid data - Span drift

8.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/09/2012 – 30/09/2012

8.1 Data Capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

The data capture statistics for the reporting period 1st September to 30th September, 2012 are shown in Table 19. Averages were only collected for those periods where the 5 minute data constituted 75% data capture.

Section 8.3 provides further information on the reasons for invalid data periods.

Table 19: Data Capture Statistics - 1 Hour Averages

Parameter	Station	Collected Periods	Available Periods	Data Capture
$PM_{2.5}$	Eastern	717	720	99.6%
	Western	718	720	99.7%
PM_{10}	Eastern	716	720	99.4%
	Western	718	720	99.7%
NO, NO_2	Eastern	683	720	94.9%
	Western	495	720	68.8%
CO	Eastern	688	720	95.6%
	Western	680	720	94.4%

8.2 Results

8.2.1 $PM_{2.5}$

$PM_{2.5}$ was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour averages for reporting.

$PM_{2.5}$ (1-hour average) mass rate of emission statistics for the reporting period are given in Table 20. A plot of $PM_{2.5}$ (1-hour average) mass rate of emission for the reporting period is presented in Figure 14.

Table 20: $PM_{2.5}$ Mass Rate Percentiles (1 Hour Average)

Station	$PM_{2.5}$ Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.32	0.22	0.21	0.19	0.16	0.12	0.034
Western	0.29	0.26	0.22	0.16	0.12	0.090	0.036

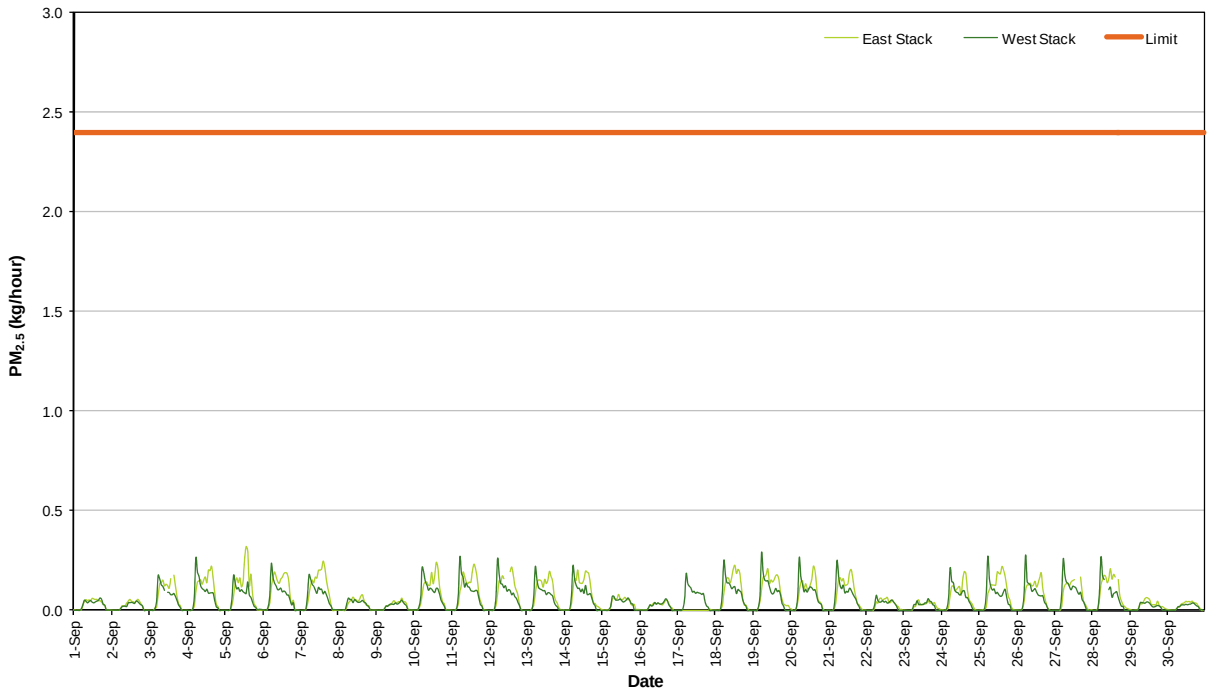

Figure 14: $PM_{2.5}$ Mass Rate (1 Hour Average)

8.2.2 PM_{10}

PM_{10} was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1-hour averages for reporting.

PM_{10} (1 hour average) mass rate of emission statistics for the reporting period are given in Table 21. A plot of PM_{10} (1 hour average) mass rate of emission for the reporting period is presented in Figure 15.

Table 21: PM_{10} Mass Rate Percentiles (1 Hour Average)

Station	PM_{10} Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.84	0.35	0.31	0.28	0.25	0.19	0.063
Western	0.77	0.53	0.46	0.32	0.22	0.16	0.078

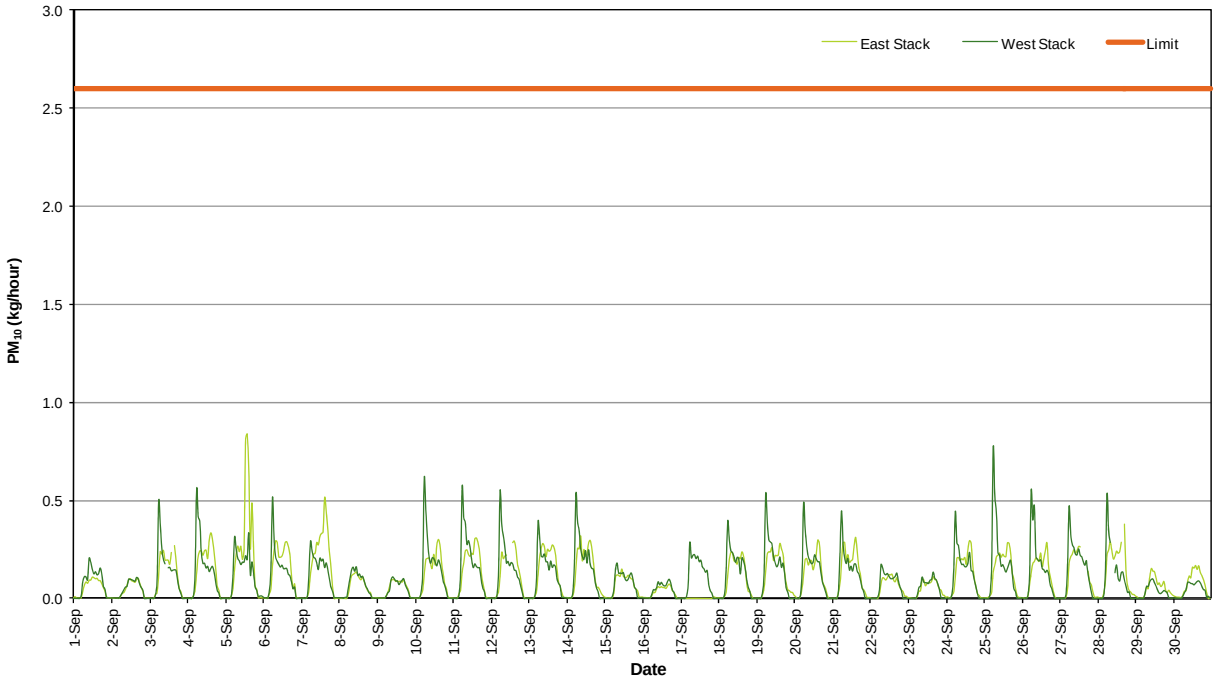

Figure 15: PM_{10} Mass Rate (1 Hour Average)

8.2.3 Carbon Monoxide

Carbon monoxide (1 hour average) mass rate of emission statistics for the reporting period are given in Table 22. A plot of carbon monoxide (1 hour average) mass rate of emission for the reporting period is presented in Figure 16.

Table 22: Carbon Monoxide Mass Rate Percentiles (1 Hour Average)

Station	Carbon Monoxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	23	20	19	16	12	9.1	6.2
Western	26	21	19	15	11	8.5	6.1

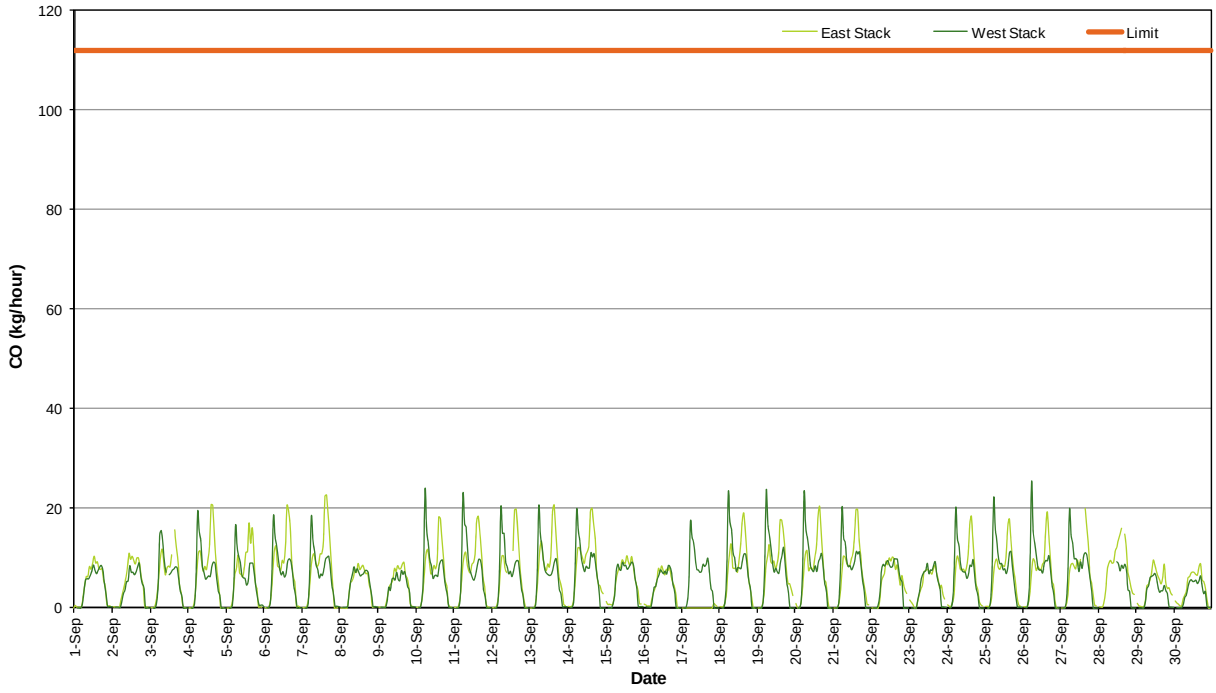

Figure 16: Carbon Monoxide Mass Rate (1 Hour Average)

8.2.4 Oxides of Nitrogen

8.2.4.1 Nitric Oxide

Nitric oxide (1-hour average) mass rate of emission statistics for the reporting period are given in Table 23. A plot of nitric oxide (1-hour average) mass rate of emission for the reporting period is presented in Figure 17.

Table 23: Nitric Oxide Mass Rate Percentiles (1 Hour Average)

Station	Nitric Oxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	4.6	3.8	3.6	3.2	2.8	2.3	0.90
Western	6.3	5.3	4.7	3.2	2.7	2.1	1.2

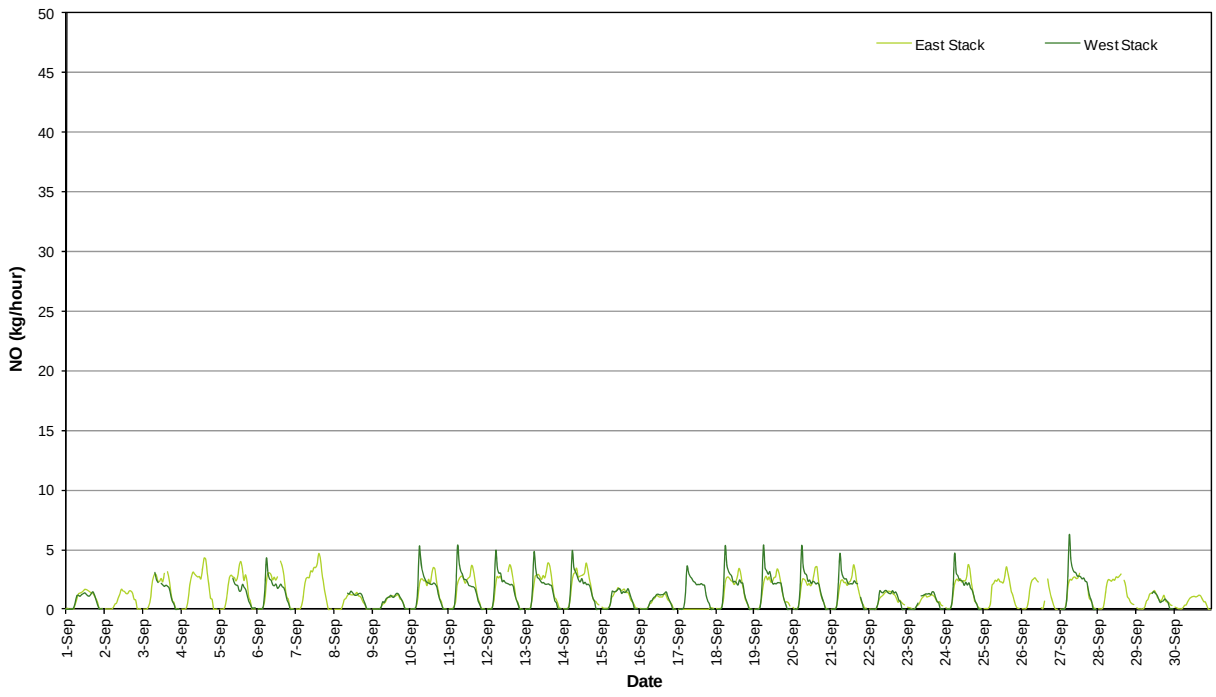

Figure 17: Nitric Oxide Mass Rate (1 Hour Average)

8.2.4.2 Nitrogen Dioxide

Nitrogen dioxide (1-hour average) mass rate of emission statistics for the reporting period are given in Table 24. A plot of nitrogen dioxide (1-hour average) mass rate of emission for the reporting period is presented in Figure 18.

Table 24: Nitrogen Dioxide Mass Rate Percentiles (1 Hour Average)

Station	Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average)						
	Maximum	99th	98th	95th	90th	75th	50th
Eastern	0.61	0.53	0.49	0.43	0.38	0.30	0.14
Western	0.81	0.50	0.47	0.35	0.28	0.24	0.14

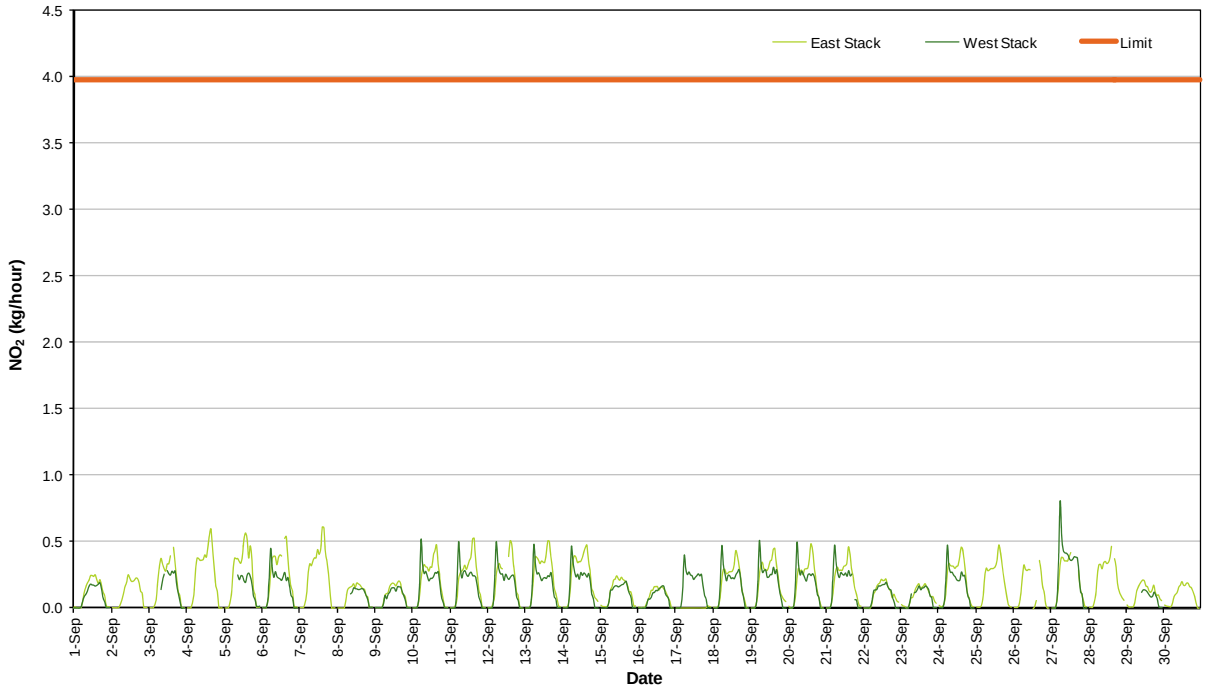

Figure 18: Nitrogen Dioxide Mass Rate (1 Hour Average)

8.2.5 Stack Velocity

The stack velocity (1 hour average) plot for the reporting period is presented in Figure 19.

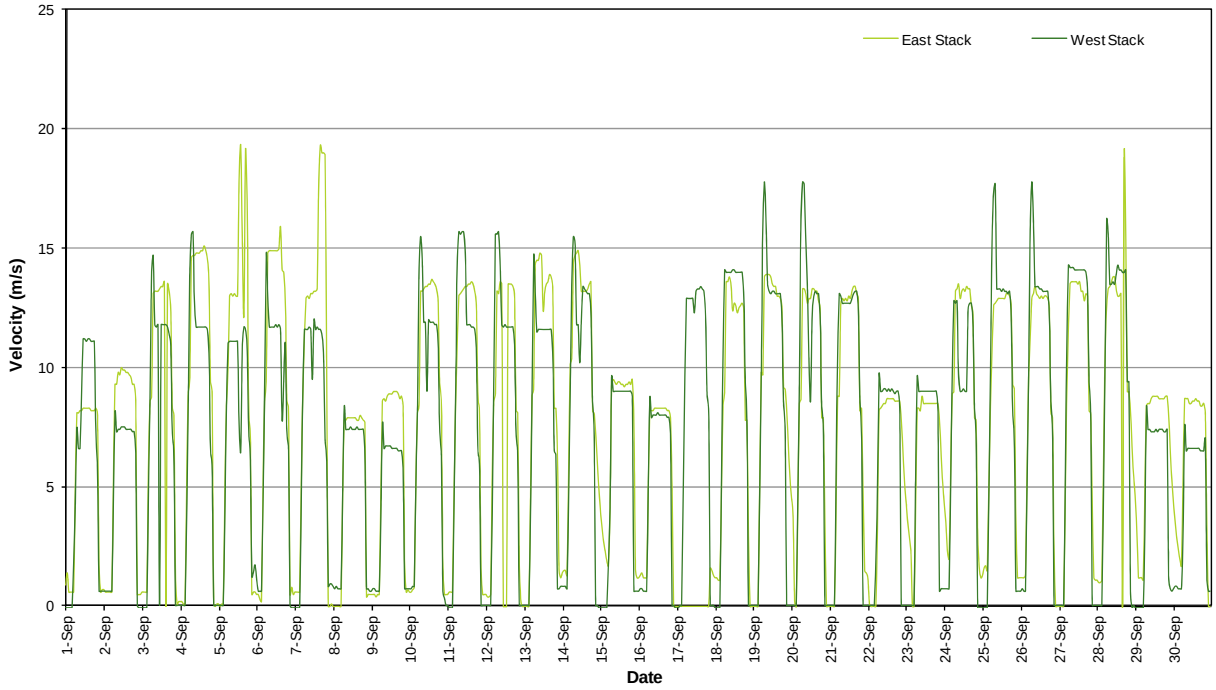

Figure 19: Stack Velocity (1 Hour Average)

8.3 Data Validation and Exceptions

Data contained in the report has been validated against performance and calibration requirements for each instrument. Data during maintenance and calibration periods has been removed from the validated data sets. Tables 25 and 26 list the data exceptions for the eastern and western ventilation stacks respectively. Data during automatic calibrations of the gaseous atmospheric contaminants has also been removed from the data sets.

Table 25: Data Exceptions - Eastern Ventilation Stack: September 2012

Start	End	Parameter	Reason
3/09/2012 14:45	3/09/2012 15:45	Velocity	Maintenance/calibration
6/09/2012 14:15	6/09/2012 14:30	NO, NO_2, NO_x	Maintenance/calibration
12/09/2012 10:50	12/09/2012 13:40	Velocity	Maintenance/calibration
23/09/2012 8:35	23/09/2012 8:45	NO, NO_2, NO_x	Maintenance/calibration
26/09/2012 12:30	26/09/2012 12:55	NO, NO_2, NO_x	Maintenance/calibration
26/09/2012 15:55	26/09/2012 16:40	NO, NO_2, NO_x	Maintenance/calibration
27/09/2012 14:20	27/09/2012 15:20	NO, NO_2, NO_x	Maintenance/calibration
27/09/2012 14:20	27/09/2012 15:20	CO	Maintenance/calibration
27/09/2012 14:30	27/09/2012 16:05	$PM_{2.5}$	Maintenance/calibration
27/09/2012 14:30	27/09/2012 17:20	PM_{10}	Maintenance/calibration
27/09/2012 16:30	27/09/2012 16:55	$PM_{2.5}$	Maintenance/calibration
27/09/2012 16:40	27/09/2012 17:20	NO, NO_2, NO_x	Maintenance/calibration
28/09/2012 15:45	28/09/2012 16:50	Velocity	Invalid data[1]

Note: [1] – In the opinion of the reviewer.

Table 26: Data Exceptions - Western Ventilation Stack: September 2012

Start	End	Parameter	Reason
2/09/2012 0:40	3/09/2012 7:55	NO, NO_2, NO_x	Invalid data - Span drift
3/09/2012 11:15	3/09/2012 11:35	Velocity	Maintenance/calibration
4/09/2012 0:40	5/09/2012 8:30	NO, NO_2, NO_x	Invalid data - Span drift
7/09/2012 0:40	8/09/2012 8:40	NO, NO_2, NO_x	Invalid data - Span drift
21/09/2012 18:20	21/09/2012 18:50	NO, NO_2, NO_x	Maintenance/calibration
23/09/2012 8:10	23/09/2012 8:25	NO, NO_2, NO_x	Maintenance/calibration
25/09/2012 0:40	26/09/2012 23:55	NO, NO_2, NO_x	Invalid data - Span drift
28/09/2012 0:40	29/09/2012 7:25	NO, NO_2, NO_x	Invalid data - Span drift
28/09/2012 0:40	28/09/2012 11:50	CO	Invalid data - Span drift
28/09/2012 9:25	28/09/2012 10:50	$PM_{2.5}$	Maintenance/calibration
28/09/2012 9:40	28/09/2012 10:50	PM_{10}	Maintenance/calibration
28/09/2012 10:10	28/09/2012 10:15	Velocity	Maintenance/calibration
29/09/2012 8:20	29/09/2012 9:20	NO, NO_2, NO_x	Maintenance/calibration
30/09/2012 0:40	30/09/2012 23:55	NO, NO_2, NO_x	Invalid data - Span drift

9.0 DISCUSSION

9.1 Comparison with Licence Limits

EastLink emissions to air from the road tunnel ventilation stacks DP1 and DP2 are subject to the licence requirements contained in Environment Protection Authority (Victoria) Waste Discharge Licence No. EA 63607.

The maximum measured 1 hour average mass rate for each parameter is compared with the applicable licence limit in Table 27.

Table 27: Maximum (1 Hour Average) Mass Rate (01/07/2012 - 30/09/2012)

Discharge Point No.	Discharge Description	Compound	Mass Rate (kg/h)	Licence Limit (kg/h)
1	Western ventilation stack	$PM_{2.5}$	0.29	2.4
		PM_{10}	0.77	2.6
		NO_2	0.81	3.98
		CO	26	112
2	Eastern ventilation stack	$PM_{2.5}$	0.32	2.4
		PM_{10}	0.84	2.6
		NO_2	0.61	3.98
		CO	23	112

There were no exceedences of the licence limits for DP1 and DP2 during the reporting period.

Data capture statistics for 2012 year to date (01/01/2012 – 30/09/2012) are presented in Table 28.

Table 28: Data Capture Year to Date (%)

Station	NO_2	CO	$PM_{2.5}$	PM_{10}	Velocity
Eastern	92.9	97.4	93.4	99.3	99.0
Western	86.8	95.9	98.2	98.6	100

Report Signature Page

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- End of Report -

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