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TRANSFIELD SERVICES PTY. LTD.

# EastLink Ventilation Stack Emission Monitoring Report January-March 2010

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

REPORT

This document is issued in accordance with NATA's accreditation requirements.  
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The results of the tests, calibrations and/or measurements included in this  
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# EASTLINK VENTILATION STACK EMISSION MONITORING REPORT: JANUARY-MARCH 2010

## Record of Issue

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### APPENDICES

**Appendix 1**  
Limitations



## **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. (trading as A.W.N. (Air Water Noise) Consultants) 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 29<sup>th</sup> June, 2008 with the opening of the EastLink motorway. Results for the sampling period 1<sup>st</sup> January, 2010 to 31<sup>st</sup> March, 2010 inclusive are contained in the following report.

Your attention is drawn to the document - "Limitations", which is included in Attachment A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



## 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 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<sub>2.5</sub>);
- Particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM<sub>10</sub>);
- Total oxides of nitrogen (NO<sub>x</sub>);
- Nitric oxide (NO);
- Nitrogen dioxide (NO<sub>2</sub>);
- Carbon monoxide (CO);
- Stack velocity;
- Stack temperature and
- Ambient pressure.



## **4.0 METHODS**

### **4.1 PM<sub>2.5</sub>**

PM<sub>2.5</sub> 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<sub>2.5</sub> size selective inlet (PM<sub>10</sub> WINS head fitted with a PM<sub>2.5</sub> sharp cut cyclone (SCC)) at 1 m<sup>3</sup>/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<sub>2.5</sub> 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<sub>10</sub> Continuous Direct Mass Method Using a Tapered Element Oscillating Microbalance Analyser”*.

### **4.2 PM<sub>10</sub>**

PM<sub>10</sub> 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<sub>10</sub> size selective inlet (PM<sub>10</sub> WINS head) at 1 m<sup>3</sup>/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<sub>10</sub> 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<sub>10</sub> 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 3580.7.1-1992, *“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<sub>2</sub> and NO<sub>x</sub>) monitoring method is based on the requirements of Australian Standard AS 3580.5.1-1993, "*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 <sub>10</sub>                      | TEOM                             | ± 5%   |
| PM <sub>2.5</sub>                     | TEOM                             | ± 5%   |
| NO, NO <sub>2</sub> , NO <sub>x</sub> | 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: 01/01/2010 – 31/01/2010**

### **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 1<sup>st</sup> January to 31<sup>st</sup> January, 2010 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**

| <b>Parameter</b>    | <b>Station</b> | <b>Collected Periods</b> | <b>Available Periods</b> | <b>Data Capture</b> |
|---------------------|----------------|--------------------------|--------------------------|---------------------|
| PM <sub>2.5</sub>   | Eastern        | 617                      | 744                      | 82.9%               |
|                     | Western        | 740                      | 744                      | 99.5%               |
| PM <sub>10</sub>    | Eastern        | 710                      | 744                      | 95.4%               |
|                     | Western        | 740                      | 744                      | 99.5%               |
| NO, NO <sub>2</sub> | Eastern        | 529                      | 744                      | 71.1%               |
|                     | Western        | 713                      | 744                      | 95.8%               |
| CO                  | Eastern        | 676                      | 744                      | 90.9%               |
|                     | Western        | 712                      | 744                      | 95.7%               |



## 6.2 Results

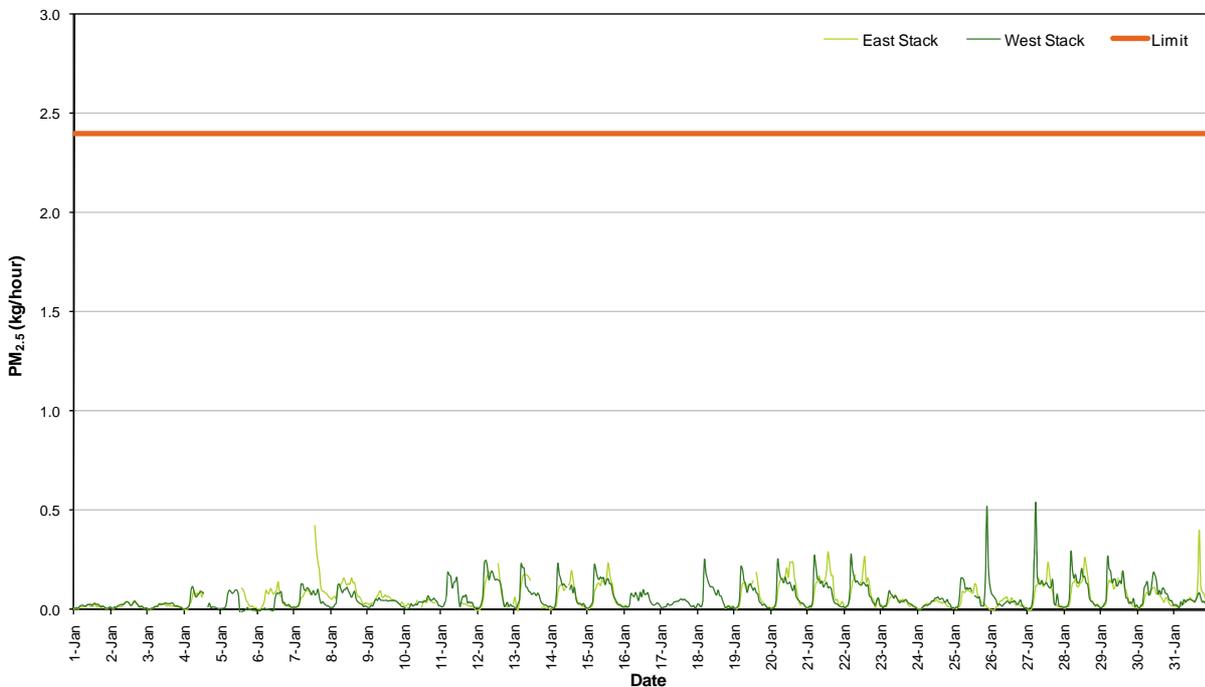
### 6.2.1 PM<sub>2.5</sub>

PM<sub>2.5</sub> was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM<sub>2.5</sub> (1 hour average) mass rate of emission statistics for the reporting period are given in Table 4. A plot of PM<sub>2.5</sub> (1 hour average) mass rate of emission for the reporting period is presented in Figure 2.

**Table 4: PM<sub>2.5</sub> Mass Rate Percentiles (1 Hour Average)**

| Station | PM <sub>2.5</sub> Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|---|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum   | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.42  | 0.24             | 0.23             | 0.17             | 0.15             | 0.09             | 0.04             |
| Western | 0.54  | 0.25             | 0.22             | 0.17             | 0.15             | 0.09             | 0.04             |



*Figure 2: PM<sub>2.5</sub> Mass Rate (1 Hour Average)*



# EASTLINK VENTILATION STACK EMISSION MONITORING REPORT: JANUARY-MARCH 2010

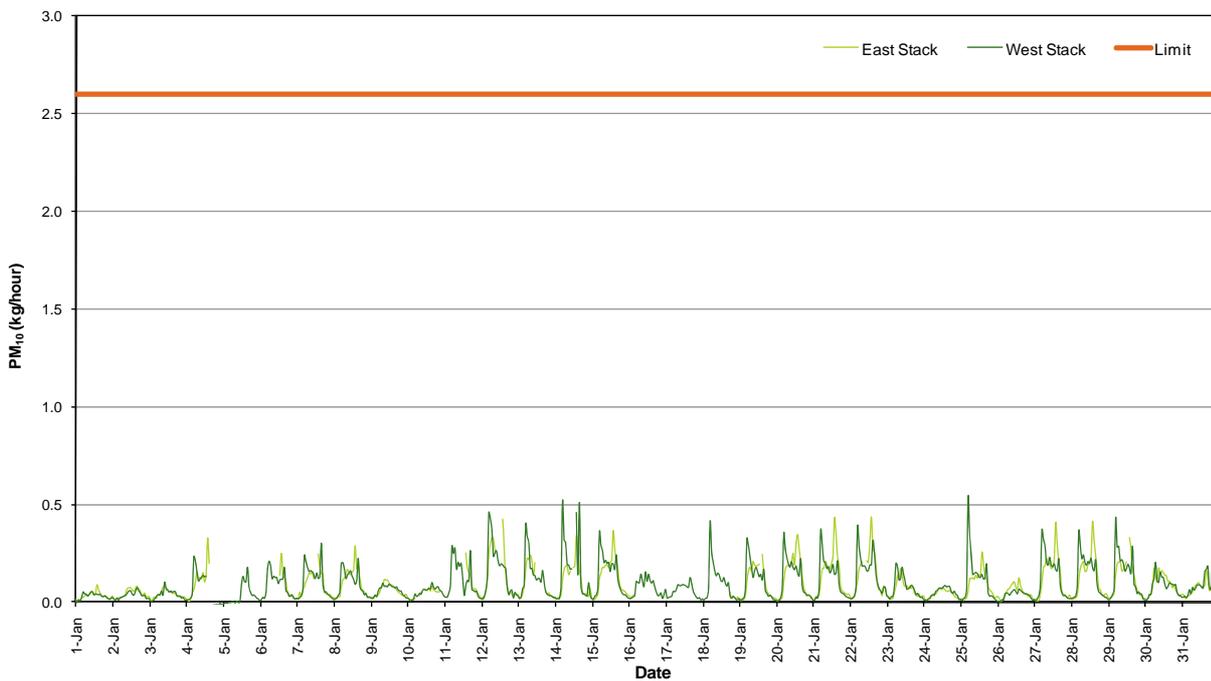
## 6.2.2 PM<sub>10</sub>

PM<sub>10</sub> was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM<sub>10</sub> (1 hour average) mass rate of emission statistics for the reporting period are given in Table 5. A plot of PM<sub>10</sub> (1 hour average) mass rate of emission for the reporting period is presented in Figure 3.

**Table 5: PM<sub>10</sub> Mass Rate Percentiles (1 Hour Average)**

| Station | PM <sub>10</sub> Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.43   | 0.34             | 0.32             | 0.25             | 0.20             | 0.14             | 0.06             |
| Western | 0.54   | 0.41             | 0.35             | 0.27             | 0.21             | 0.14             | 0.06             |



*Figure 3: PM<sub>10</sub> Mass Rate (1 Hour Average)*

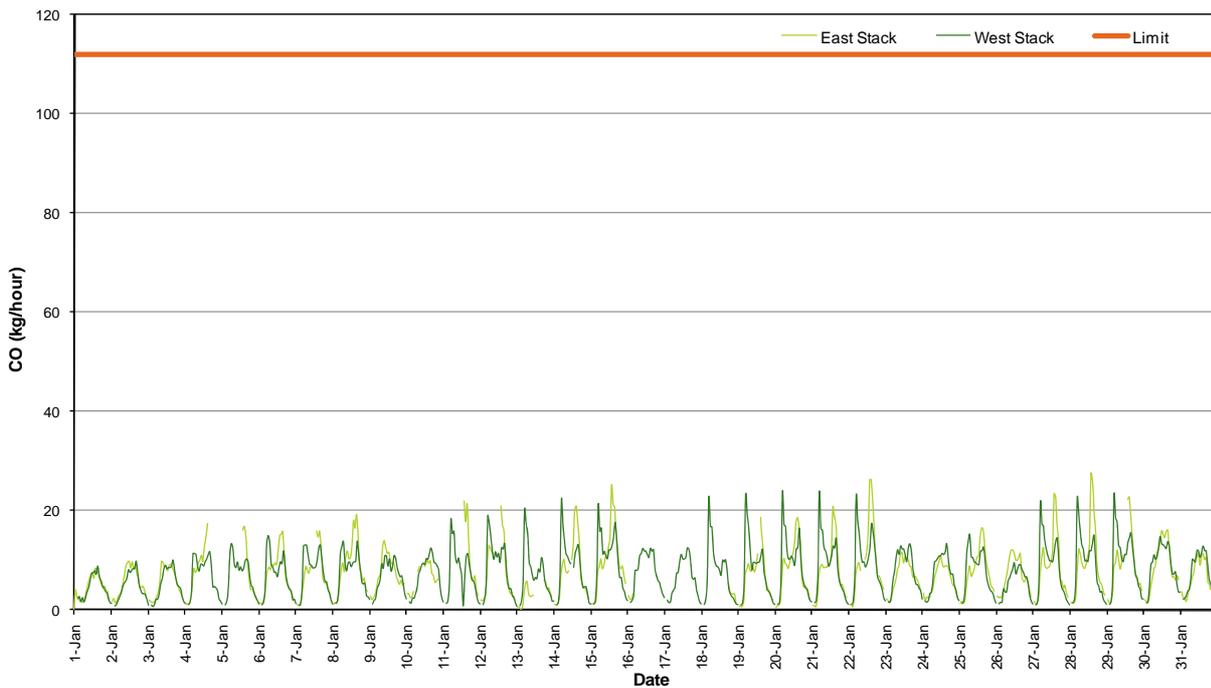


**6.2.3 Carbon Monoxide**

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 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   | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 28  | 23               | 21               | 17               | 14               | 10               | 6.7              |
| Western | 24  | 22               | 19               | 16               | 13               | 11               | 7.6              |



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



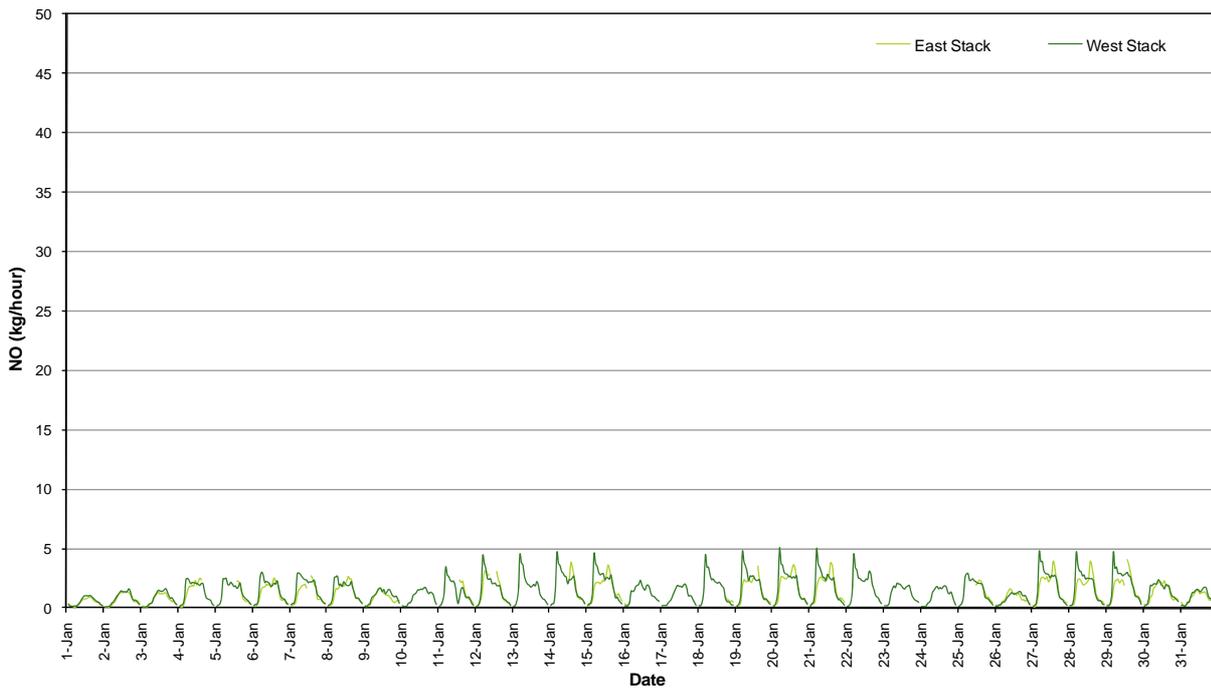
## 6.2.4 Oxides of Nitrogen

### 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 for the reporting period is presented in Figure 5.

**Table 7: Nitric Oxide Concentration Percentiles (1 Hour Average)**

| Station | Nitric Oxide Concentration (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 4.0  | 3.7              | 3.5              | 2.7              | 2.5              | 2.0              | 1.0              |
| Western | 5.0  | 4.5              | 3.9              | 3.1              | 2.7              | 2.1              | 1.3              |



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

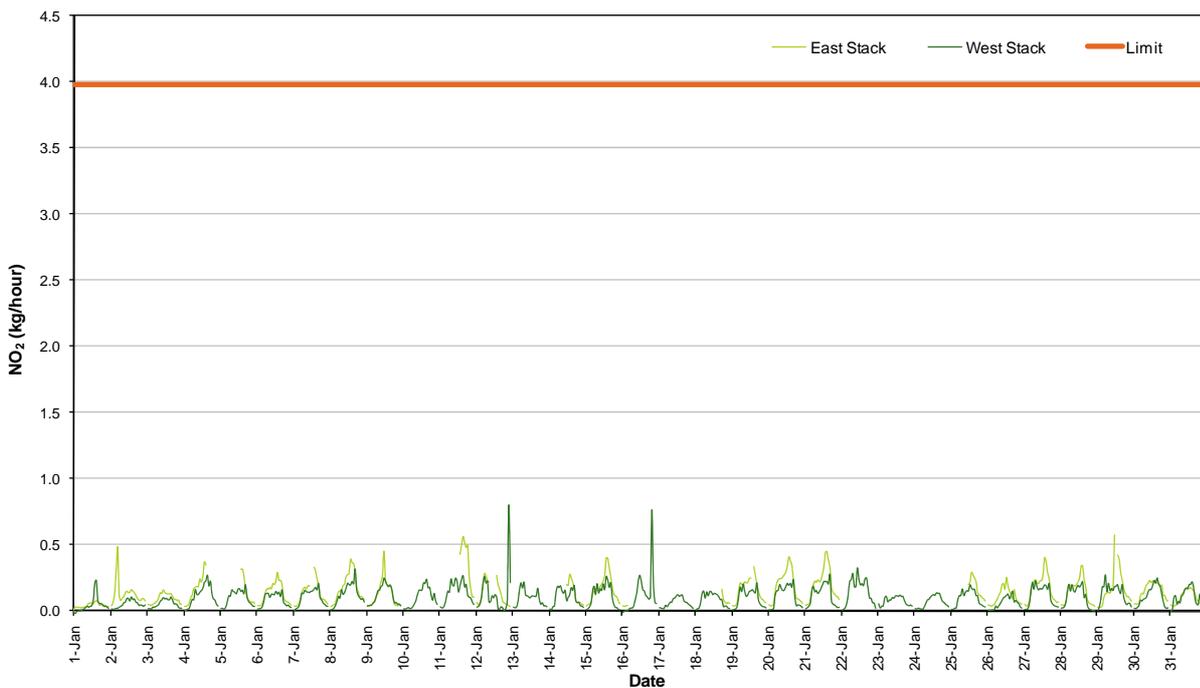


## 6.2.4.2 Nitrogen Dioxide

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 for the reporting period is presented in Figure 6.

**Table 8: Nitrogen Dioxide Concentration Percentiles (1 Hour Average)**

| Station | Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.6  | 0.5              | 0.4              | 0.3              | 0.3              | 0.2              | 0.1              |
| Western | 0.8  | 0.3              | 0.2              | 0.2              | 0.2              | 0.2              | 0.1              |



*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.

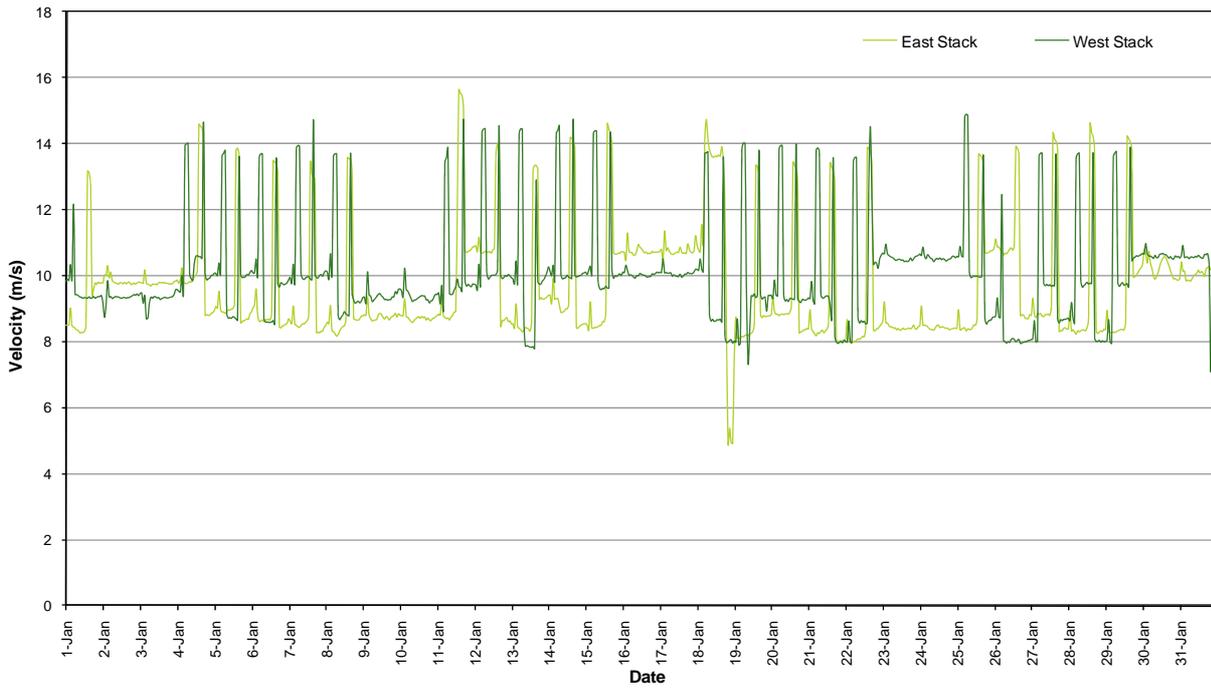


Figure 7: Stack Velocity (1 Hour Average)



### 6.3 Data Validation and Exception

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: January 2010**

| Start            | End              | Parameter                             | Reason                    |
|------------------|------------------|---------------------------------------|---------------------------|
| 4/01/2010 13:55  | 5/01/2010 14:00  | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 5/01/2010 11:40  | 6/01/2010 12:40  | PM <sub>10</sub>                      | Maintenance/calibration   |
| 7/01/2010 12:05  | 7/01/2010 13:35  | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 7/01/2010 16:55  | 7/01/2010 17:05  | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 10/01/2010 01:40 | 11/01/2010 13:15 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Invalid data - Span drift |
| 10/01/2010 06:10 | 10/01/2010 8:10  | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 10/01/2010 09:50 | 10/01/2010 11:20 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 10/01/2010 22:35 | 11/01/2010 13:30 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 11/01/2010 08:05 | 11/01/2010 9:20  | PM <sub>10</sub>                      | Invalid data <sup>1</sup> |
| 11/01/2010 11:55 | 11/01/2010 12:15 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 11/01/2010 12:35 | 11/01/2010 13:15 | CO                                    | Maintenance/calibration   |
| 12/01/2010 10:15 | 12/01/2010 10:45 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 12/01/2010 10:15 | 12/01/2010 10:45 | CO                                    | Maintenance/calibration   |
| 12/01/2010 10:25 | 12/01/2010 13:55 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 12/01/2010 11:10 | 12/01/2010 12:00 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 12/01/2010 20:45 | 12/01/2010 23:20 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 13/01/2010 00:35 | 14/01/2010 11:25 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Invalid data - Span drift |
| 13/01/2010 12:40 | 13/01/2010 18:00 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 13/01/2010 13:15 | 13/01/2010 14:45 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 14/01/2010 11:10 | 14/01/2010 11:55 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 16/01/2010 03:20 | 18/01/2010 17:30 | PM <sub>2.5</sub>                     | Invalid flow              |
| 17/01/2010 00:35 | 18/01/2010 10:30 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Invalid data - Span drift |
| 17/01/2010 00:35 | 18/01/2010 10:20 | CO                                    | Invalid data - Span drift |
| 18/01/2010 09:25 | 18/01/2010 10:15 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 19/01/2010 14:25 | 19/01/2010 15:10 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 22/01/2010 00:35 | 25/01/2010 10:50 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Invalid data - Span drift |
| 22/01/2010 09:30 | 22/01/2010 10:40 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 25/01/2010 11:00 | 25/01/2010 11:20 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 29/01/2010 12:15 | 29/01/2010 13:00 | CO                                    | Maintenance/calibration   |
| 29/01/2010 13:05 | 29/01/2010 14:00 | PM <sub>2.5</sub>                     | Maintenance/calibration   |

**Note:** <sup>1</sup> – In the opinion of the reviewer.



## EASTLINK VENTILATION STACK EMISSION MONITORING REPORT: JANUARY-MARCH 2010

**Table 10: Data Exceptions - Western Ventilation Stack: January 2010**

| Start            | End              | Parameter                             | Reason                  |
|------------------|------------------|---------------------------------------|-------------------------|
| 4/01/2010 14:25  | 4/01/2010 15:30  | PM <sub>2.5</sub>                     | Maintenance/calibration |
| 4/01/2010 14:30  | 4/01/2010 15:15  | PM <sub>10</sub>                      | Maintenance/calibration |
| 11/01/2010 10:50 | 11/01/2010 10:55 | CO                                    | Maintenance/calibration |
| 14/01/2010 12:10 | 14/01/2010 12:20 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration |
| 14/01/2010 12:20 | 14/01/2010 13:10 | PM <sub>2.5</sub>                     | Maintenance/calibration |
| 14/01/2010 12:20 | 14/01/2010 13:15 | PM <sub>10</sub>                      | Maintenance/calibration |
| 14/01/2010 12:30 | 14/01/2010 12:45 | CO                                    | Maintenance/calibration |
| 25/01/2010 12:55 | 25/01/2010 13:40 | PM <sub>2.5</sub>                     | Maintenance/calibration |



## **7.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/02/2010 – 28/02/2010**

### **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 1<sup>st</sup> February to 28<sup>th</sup> February, 2010 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**

| <b>Parameter</b>    | <b>Station</b> | <b>Collected Periods</b> | <b>Available Periods</b> | <b>Data Capture</b> |
|---------------------|----------------|--------------------------|--------------------------|---------------------|
| PM <sub>2.5</sub>   | Eastern        | 648                      | 672                      | 96.4%               |
|                     | Western        | 642                      | 672                      | 95.5%               |
| PM <sub>10</sub>    | Eastern        | 671                      | 672                      | 99.9%               |
|                     | Western        | 670                      | 672                      | 99.7%               |
| NO, NO <sub>2</sub> | Eastern        | 617                      | 672                      | 91.8%               |
|                     | Western        | 640                      | 672                      | 95.2%               |
| CO                  | Eastern        | 644                      | 672                      | 95.8%               |
|                     | Western        | 644                      | 672                      | 95.8%               |



## 7.2 Results

### 7.2.1 PM<sub>2.5</sub>

PM<sub>2.5</sub> was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM<sub>2.5</sub> (1 hour average) mass rate of emission statistics for the reporting period are given in Table 12. A plot of PM<sub>2.5</sub> (1 hour average) mass rate of emission for the reporting period is presented in Figure 8.

Table 12: PM<sub>2.5</sub> Mass Rate Percentiles (1 Hour Average)

| Station | PM <sub>2.5</sub> Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|---|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum   | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.37  | 0.27             | 0.26             | 0.22             | 0.19             | 0.15             | 0.05             |
| Western | 0.33  | 0.26             | 0.24             | 0.20             | 0.16             | 0.12             | 0.05             |

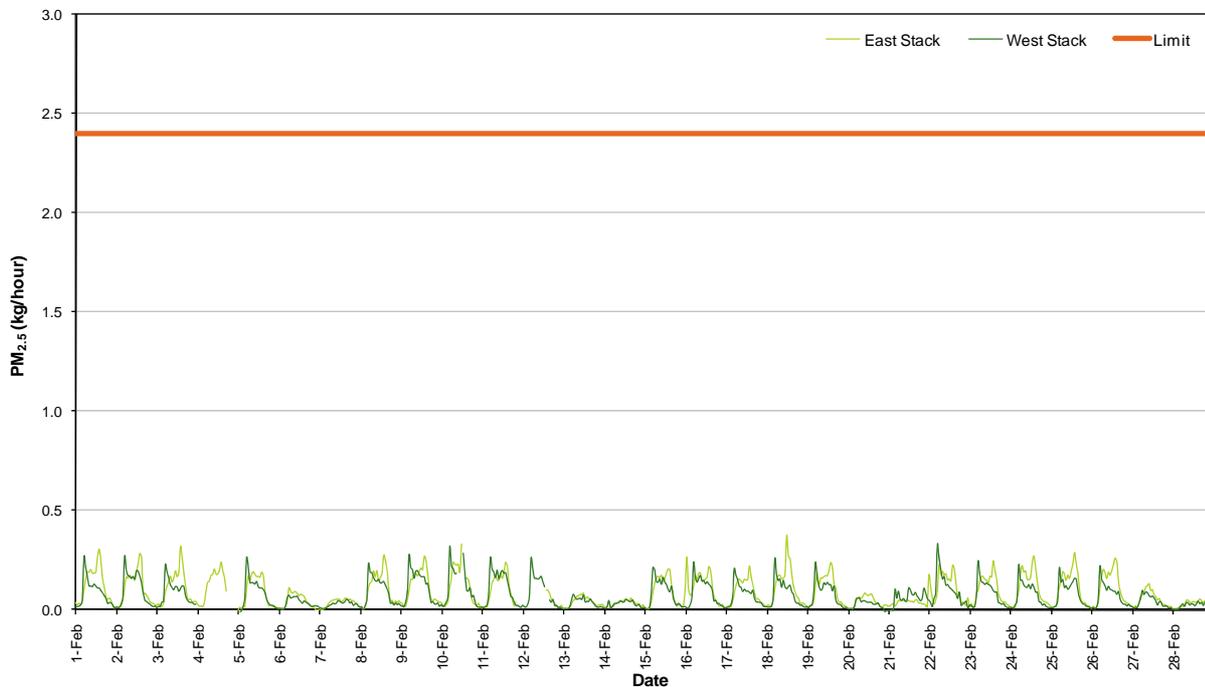


Figure 8: PM<sub>2.5</sub> Mass Rate (1 Hour Average)



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## 7.2.2 PM<sub>10</sub>

PM<sub>10</sub> was continuously monitored and 5-minute averages logged. The 5 minute average data was then transformed to 1 hour averages for reporting.

PM<sub>10</sub> (1 hour average) mass rate of emission statistics for the reporting period are given in Table 13. A plot of PM<sub>10</sub> (1 hour average) mass rate of emission for the reporting period is presented in Figure 9.

**Table 13: PM<sub>10</sub> Mass Rate Percentiles (1 Hour Average)**

| Station | PM <sub>10</sub> Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.55   | 0.48             | 0.41             | 0.32             | 0.26             | 0.21             | 0.07             |
| Western | 0.76   | 0.42             | 0.38             | 0.29             | 0.25             | 0.18             | 0.07             |

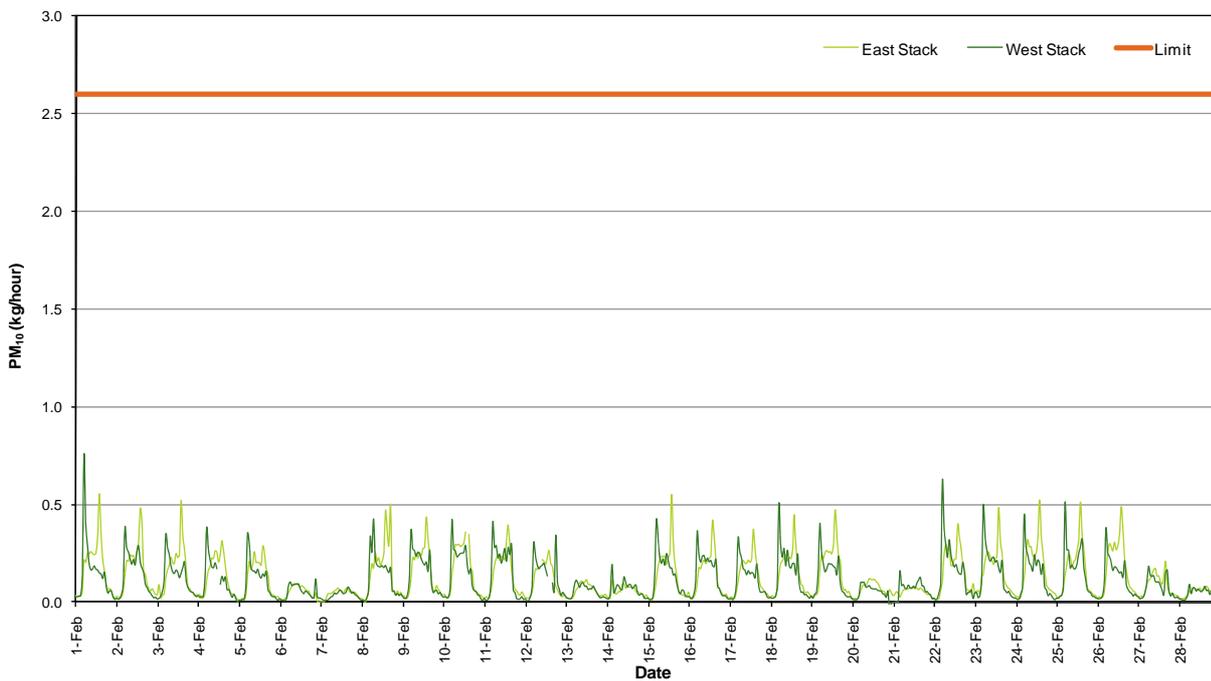


Figure 9: PM<sub>10</sub> Mass Rate (1 Hour Average)

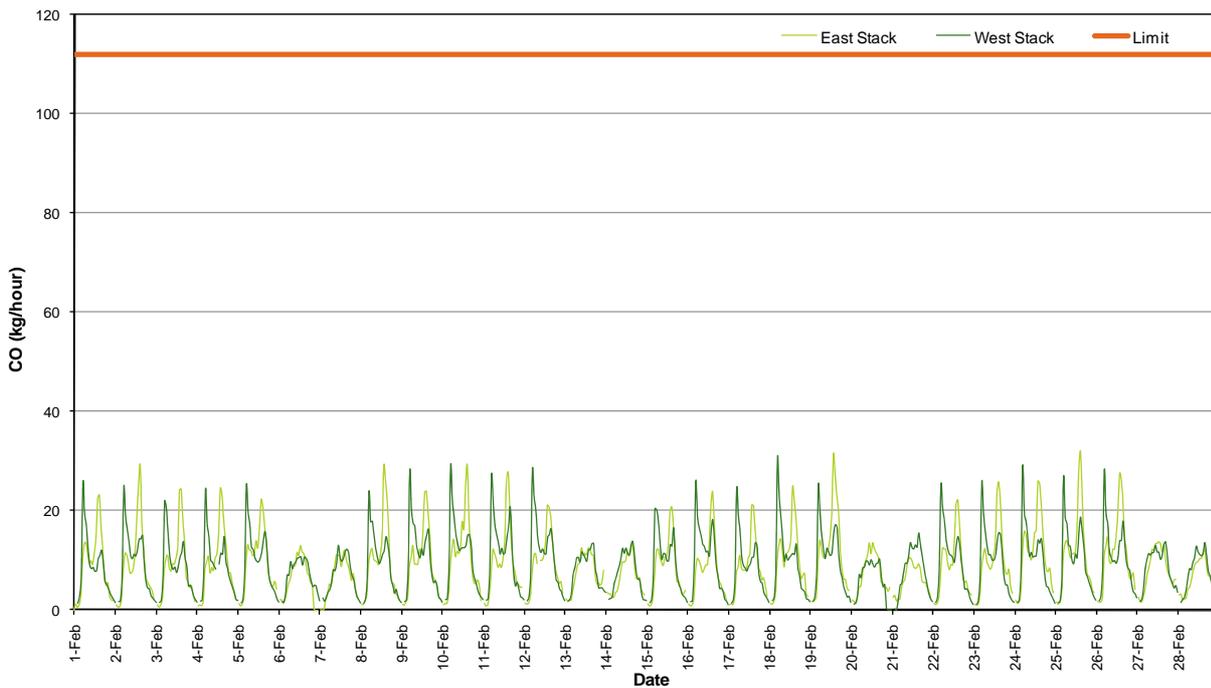


**7.2.3 Carbon Monoxide**

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 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   | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 32  | 28               | 26               | 22               | 17               | 12               | 8.4              |
| Western | 31  | 27               | 25               | 19               | 16               | 12               | 9.0              |



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



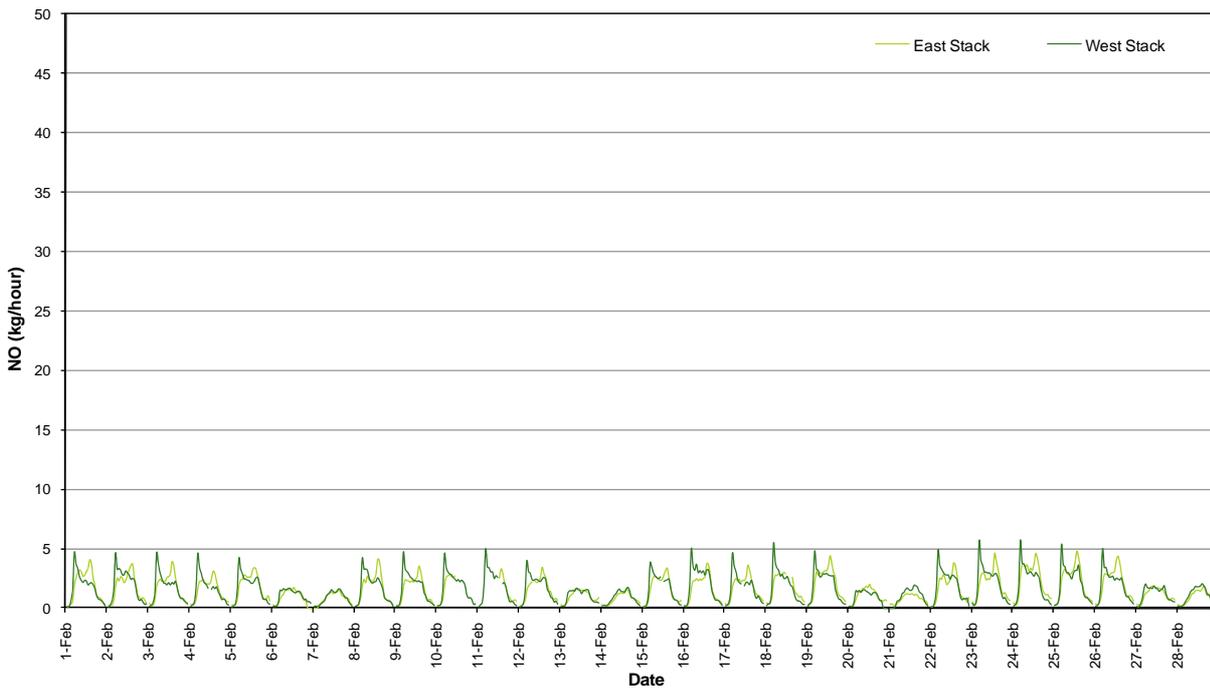
**7.2.4 Oxides of Nitrogen**

**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 for the reporting period is presented in Figure 11.

**Table 15: Nitric Oxide Concentration Percentiles (1 Hour Average)**

| Station | Nitric Oxide Concentration (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 4.7  | 4.1              | 3.9              | 3.5              | 3.0              | 2.4              | 1.3              |
| Western | 5.7  | 5.0              | 4.6              | 3.5              | 3.1              | 2.4              | 1.5              |



*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 for the reporting period is presented in Figure 12.

**Table 16: Nitrogen Dioxide Concentration Percentiles (1 Hour Average)**

| Station | Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.9  | 0.6              | 0.5              | 0.4              | 0.3              | 0.2              | 0.1              |
| Western | 0.6  | 0.3              | 0.3              | 0.2              | 0.2              | 0.1              | 0.1              |

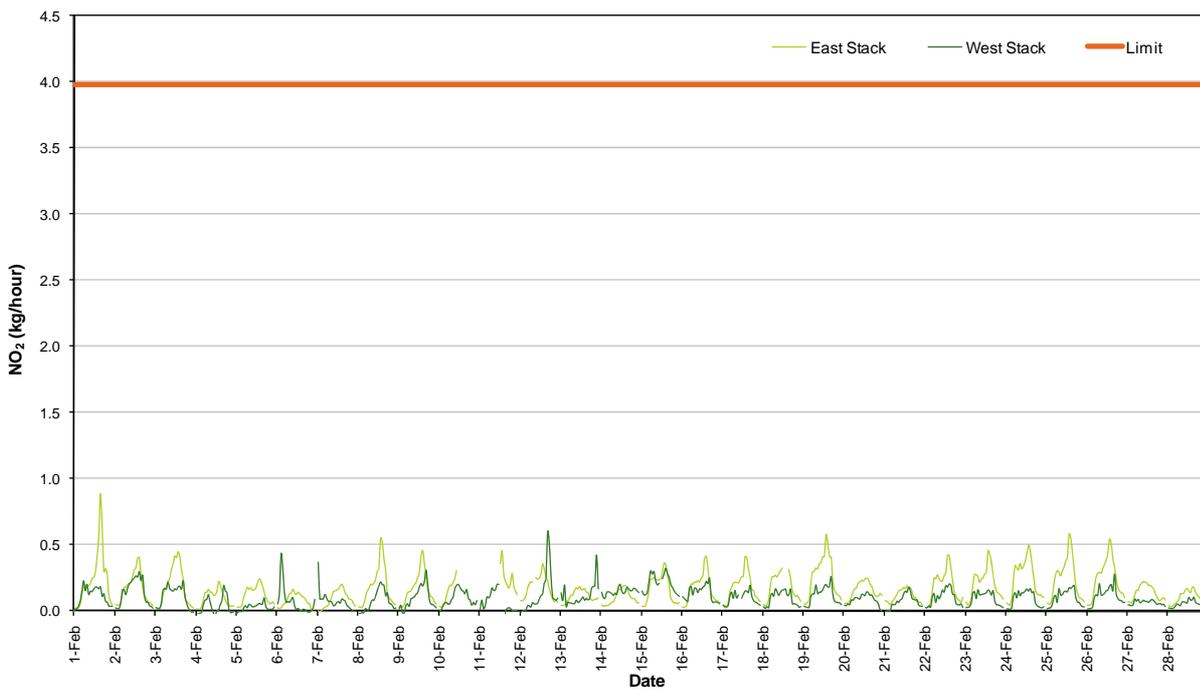


Figure 12: Nitrogen Dioxide Mass Rate (1 Hour Average)



## 7.2.5 Stack Velocity

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

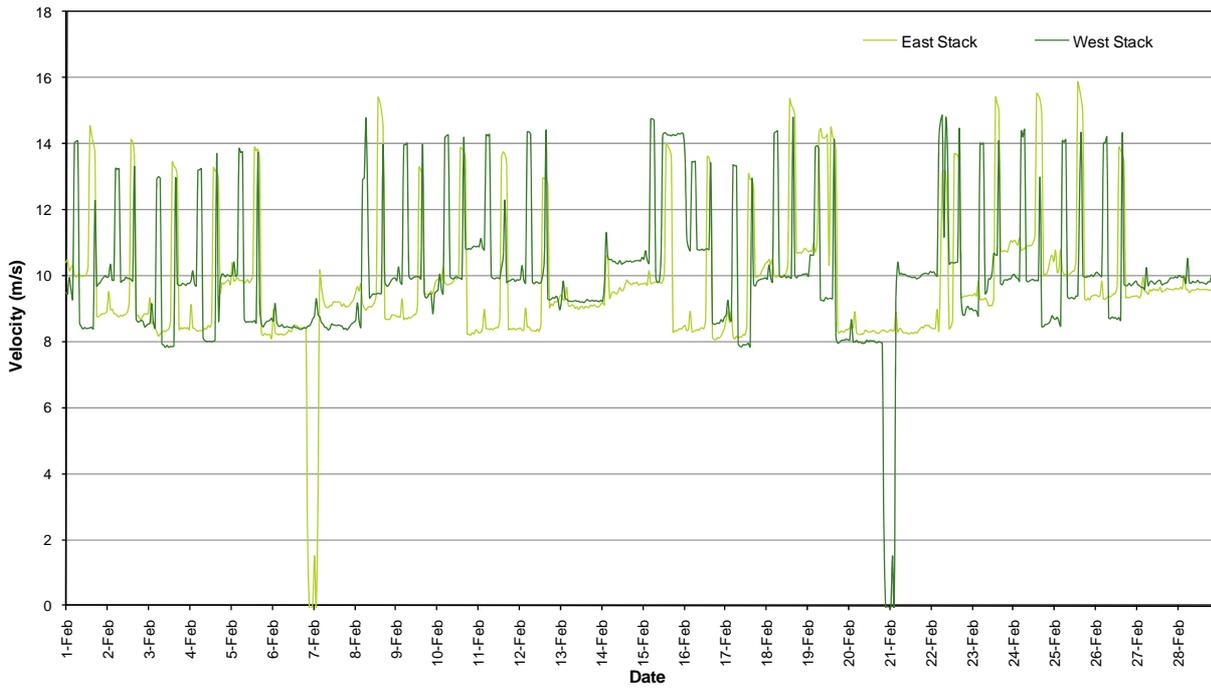


Figure 13: Stack Velocity (1 Hour Average)



### 7.3 Data Validation and Exception

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: February 2010**

| Start            | End              | Parameter                             | Reason                    |
|------------------|------------------|---------------------------------------|---------------------------|
| 4/02/2010 18:00  | 4/02/2010 23:55  | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 10/02/2010 12:05 | 10/02/2010 23:55 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 10/02/2010 12:40 | 10/02/2010 12:50 | CO                                    | Maintenance/calibration   |
| 10/02/2010 13:10 | 10/02/2010 14:10 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 10/02/2010 13:50 | 10/02/2010 15:00 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 11/02/2010 3:00  | 11/02/2010 13:05 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Invalid data <sup>1</sup> |
| 11/02/2010 11:35 | 11/02/2010 11:45 | CO                                    | Maintenance/calibration   |
| 11/02/2010 21:05 | 11/02/2010 21:10 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 11/02/2010 21:45 | 12/02/2010 14:00 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 18/02/2010 12:45 | 18/02/2010 15:35 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |

**Note:** <sup>1</sup> In the opinion of the reviewer

**Table 18: Data Exceptions - Western Ventilation Stack: February 2010**

| Start            | End              | Parameter                             | Reason                    |
|------------------|------------------|---------------------------------------|---------------------------|
| 3/02/2010 23:45  | 4/02/2010 23:55  | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 10/02/2010 9:50  | 10/02/2010 10:20 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 10/02/2010 11:35 | 10/02/2010 12:45 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 11/02/2010 13:40 | 11/02/2010 15:10 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 12/02/2010 14:25 | 12/02/2010 15:15 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 12/02/2010 14:40 | 12/02/2010 15:25 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 15/02/2010 12:10 | 15/02/2010 12:45 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 15/02/2010 12:45 | 15/02/2010 13:00 | CO                                    | Maintenance/calibration   |
| 17/02/2010 11:35 | 17/02/2010 11:50 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 17/02/2010 11:55 | 17/02/2010 12:05 | CO                                    | Maintenance/calibration   |

**Note:** <sup>1</sup> In the opinion of the reviewer



## **8.0 VENTILATION STACK EMISSION MONITORING PERIOD: 01/03/2010 – 31/03/2010**

### **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 1<sup>st</sup> March to 31<sup>st</sup> March, 2010 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**

| <b>Parameter</b>    | <b>Station</b> | <b>Collected Periods</b> | <b>Available Periods</b> | <b>Data Capture</b> |
|---------------------|----------------|--------------------------|--------------------------|---------------------|
| PM <sub>2.5</sub>   | Eastern        | 717                      | 744                      | 96.4%               |
|                     | Western        | 731                      | 744                      | 98.3%               |
| PM <sub>10</sub>    | Eastern        | 742                      | 744                      | 99.7%               |
|                     | Western        | 702                      | 744                      | 94.4%               |
| NO, NO <sub>2</sub> | Eastern        | 706                      | 744                      | 94.9%               |
|                     | Western        | 711                      | 744                      | 95.6%               |
| CO                  | Eastern        | 711                      | 744                      | 95.6%               |
|                     | Western        | 711                      | 744                      | 95.6%               |



## 8.2 Results

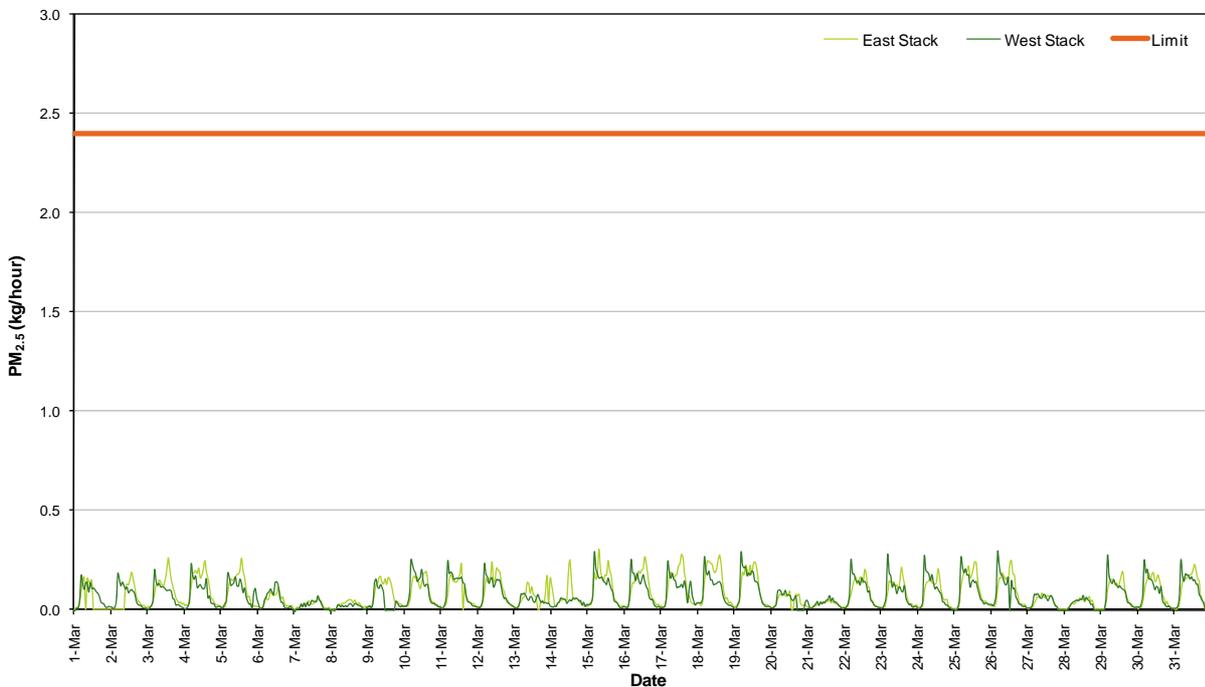
### 8.2.1 PM<sub>2.5</sub>

PM<sub>2.5</sub> was continuously monitored and 5-minute averages logged. The 5-minute average data was then transformed to 1-hour averages for reporting.

PM<sub>2.5</sub> (1-hour average) mass rate of emission statistics for the reporting period are given in Table 20. A plot of PM<sub>2.5</sub> (1-hour average) mass rate of emission for the reporting period is presented in Figure 14.

**Table 20: PM<sub>2.5</sub> Mass Rate Percentiles (1 Hour Average)**

| Station | PM <sub>2.5</sub> Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|---|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum   | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.31  | 0.25             | 0.24             | 0.21             | 0.18             | 0.14             | 0.05             |
| Western | 0.29  | 0.26             | 0.24             | 0.19             | 0.17             | 0.13             | 0.05             |



*Figure 14: PM<sub>2.5</sub> Mass Rate (1 Hour Average)*



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## 8.2.2 PM<sub>10</sub>

PM<sub>10</sub> was continuously monitored and 5 minute averages logged. The 5 minute average data was then transformed to 1-hour averages for reporting.

PM<sub>10</sub> (1 hour average) mass rate of emission statistics for the reporting period are given in Table 21. A plot of PM<sub>10</sub> (1 hour average) mass rate of emission for the reporting period is presented in Figure 15.

**Table 21: PM<sub>10</sub> Mass Rate Percentiles (1 Hour Average)**

| Station | PM <sub>10</sub> Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.77   | 0.41             | 0.40             | 0.34             | 0.28             | 0.20             | 0.08             |
| Western | 0.55   | 0.42             | 0.35             | 0.28             | 0.25             | 0.18             | 0.08             |

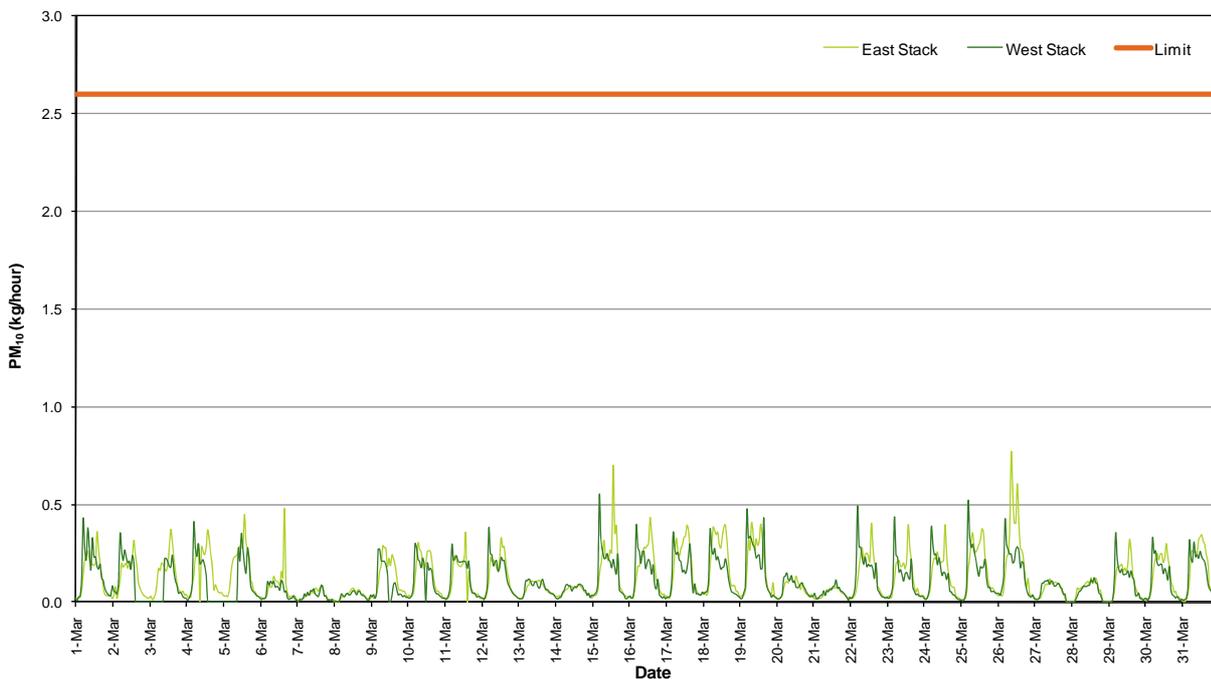


Figure 15: PM<sub>10</sub> Mass Rate (1 Hour Average)



## 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 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   | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 31  | 25               | 24               | 21               | 17               | 12               | 8.4              |
| Western | 27  | 25               | 24               | 19               | 16               | 12               | 8.7              |

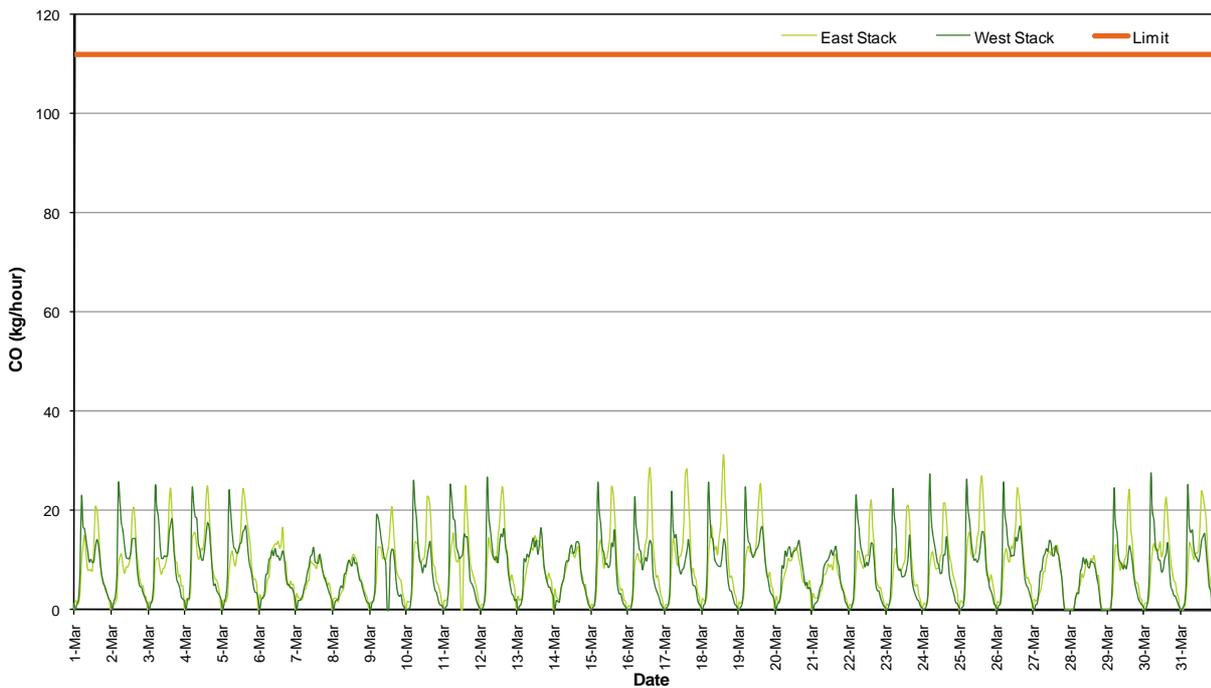


Figure 16: Carbon Monoxide Mass Rate (1 Hour Average)



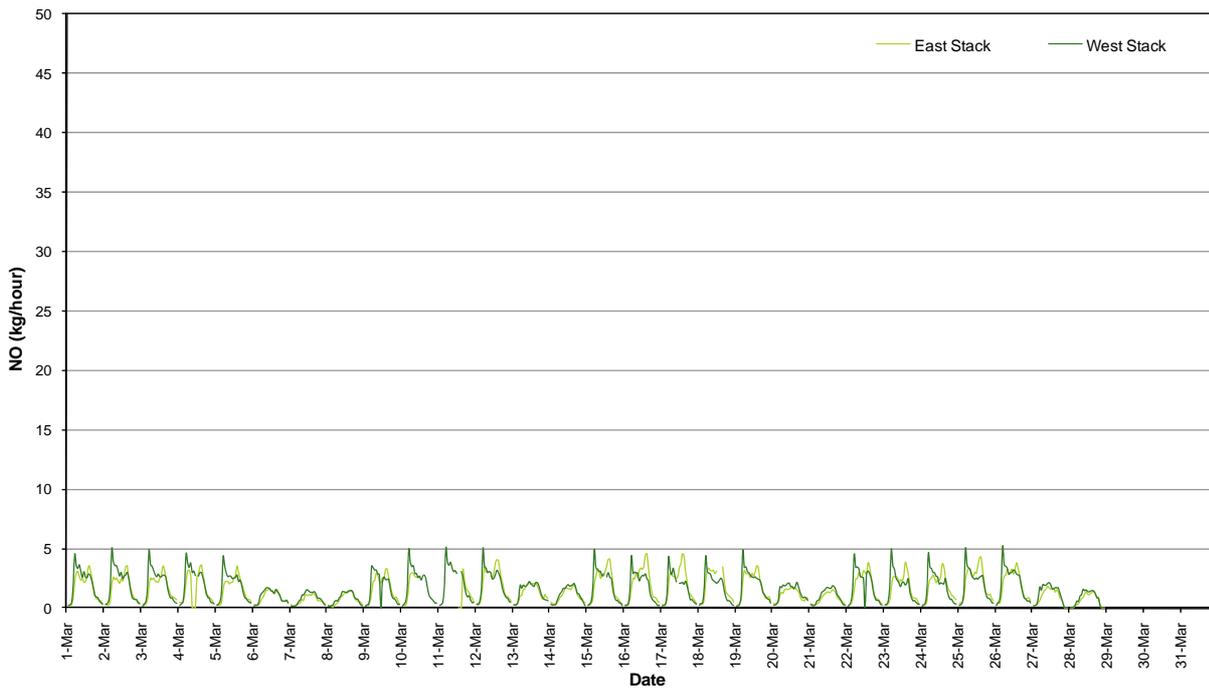
**8.2.4 Oxides of Nitrogen**

**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 for the reporting period is presented in Figure 17.

**Table 23: Nitric Oxide Concentration Percentiles (1 Hour Average)**

| Station | Nitric Oxide Concentration (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 4.6  | 4.1              | 3.8              | 3.5              | 3.1              | 2.5              | 1.3              |
| Western | 5.3  | 5.0              | 4.6              | 3.6              | 3.2              | 2.6              | 1.4              |



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

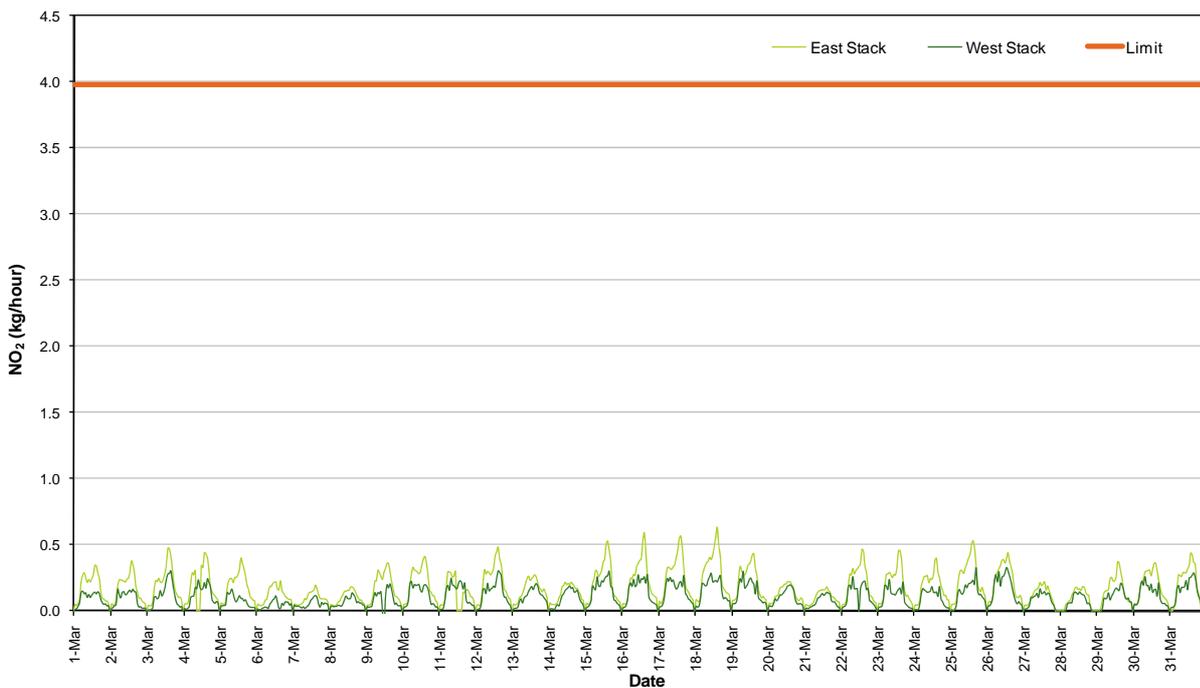


**8.2.4.2 Nitrogen Dioxide**

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 for the reporting period is presented in Figure 18.

**Table 24: Nitrogen Dioxide Concentration Percentiles (1 Hour Average)**

| Station | Nitrogen Dioxide Mass Rate (kg/h) (1-Hour Average) |                  |                  |                  |                  |                  |                  |
|---------|--|------------------|------------------|------------------|------------------|------------------|------------------|
|         | Maximum  | 99 <sup>th</sup> | 98 <sup>th</sup> | 95 <sup>th</sup> | 90 <sup>th</sup> | 75 <sup>th</sup> | 50 <sup>th</sup> |
| Eastern | 0.6  | 0.5              | 0.5              | 0.4              | 0.4              | 0.3              | 0.2              |
| Western | 0.3  | 0.3              | 0.3              | 0.2              | 0.2              | 0.2              | 0.1              |



*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.

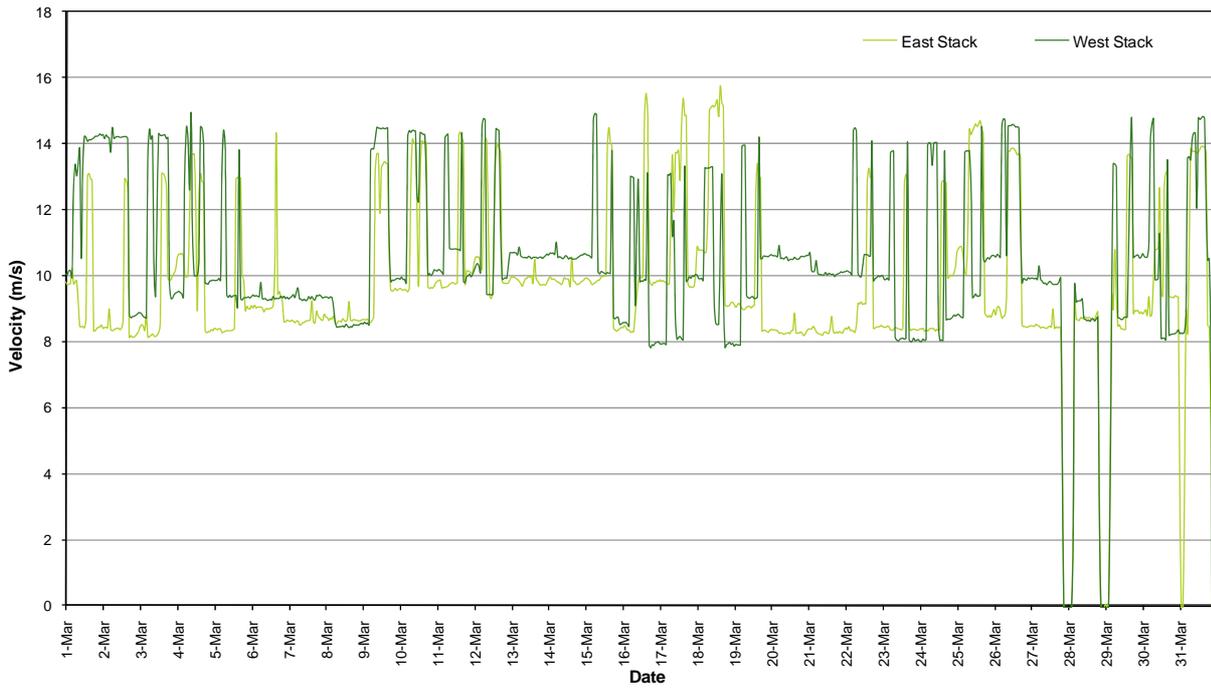


Figure 19: Stack Velocity (1 Hour Average)



### 8.3 Data Validation and Exception

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: March 2010**

| Start            | End              | Parameter                             | Reason                    |
|------------------|------------------|---------------------------------------|---------------------------|
| 1/03/2010 08:10  | 1/03/2010 08:45  | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 1/03/2010 13:30  | 1/03/2010 23:55  | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 2/03/2010 03:00  | 2/03/2010 09:35  | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 4/03/2010 09:20  | 4/03/2010 11:30  | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 4/03/2010 09:25  | 4/03/2010 09:55  | PM <sub>10</sub>                      | Maintenance/calibration   |
| 11/03/2010 12:15 | 11/03/2010 15:20 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 11/03/2010 12:15 | 11/03/2010 14:10 | CO                                    | Maintenance/calibration   |
| 11/03/2010 15:05 | 11/03/2010 16:10 | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 11/03/2010 15:20 | 11/03/2010 16:10 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 13/03/2010 16:40 | 13/03/2010 17:45 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 20/03/2010 14:05 | 20/03/2010 16:00 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 26/03/2010 11:45 | 26/03/2010 12:00 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |

**Note:** <sup>1</sup> In the opinion of the reviewer

**Table 26: Data Exceptions - Western Ventilation Stack: March 2010**

| Start            | End              | Parameter                             | Reason                    |
|------------------|------------------|---------------------------------------|---------------------------|
| 2/03/2010 14:50  | 3/03/2010 09:30  | PM <sub>10</sub>                      | Maintenance/calibration   |
| 4/03/2010 14:00  | 5/03/2010 09:35  | PM <sub>10</sub>                      | Maintenance/calibration   |
| 9/03/2010 10:50  | 9/03/2010 12:05  | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 9/03/2010 11:55  | 9/03/2010 18:30  | PM <sub>2.5</sub>                     | Maintenance/calibration   |
| 9/03/2010 12:15  | 9/03/2010 13:20  | CO                                    | Maintenance/calibration   |
| 9/03/2010 12:35  | 9/03/2010 13:50  | PM <sub>10</sub>                      | Maintenance/calibration   |
| 10/03/2010 12:20 | 10/03/2010 12:45 | PM <sub>10</sub>                      | Maintenance/calibration   |
| 20/03/2010 18:30 | 20/03/2010 22:30 | PM <sub>2.5</sub>                     | Invalid data <sup>1</sup> |
| 22/03/2010 11:45 | 22/03/2010 12:15 | NO, NO <sub>2</sub> , NO <sub>x</sub> | Maintenance/calibration   |
| 26/03/2010 12:45 | 26/03/2010 13:20 | PM <sub>2.5</sub>                     | Maintenance/calibration   |

**Note:** <sup>1</sup> In the opinion of the reviewer



## 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 (01/01/2010 – 31/03/2010)**

| Discharge Point No. | Discharge Description     | Compound          | Mass Rate (kg/h) | Licence Limit (kg/h) |
|---------------------|---------------------------|-------------------|------------------|----------------------|
| 1                   | Western ventilation stack | PM <sub>2.5</sub> | 0.54             | 2.4                  |
|                     |                           | PM <sub>10</sub>  | 0.76             | 2.6                  |
|                     |                           | NO <sub>2</sub>   | 0.80             | 3.98                 |
|                     |                           | CO                | 31               | 112                  |
| 2                   | Eastern ventilation stack | PM <sub>2.5</sub> | 0.42             | 2.4                  |
|                     |                           | PM <sub>10</sub>  | 0.77             | 2.6                  |
|                     |                           | NO <sub>2</sub>   | 0.89             | 3.98                 |
|                     |                           | CO                | 32               | 112                  |

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

Data capture statistics for 2010 year to date (01/01/2010 – 31/03/2010) are presented in Table 28.

**Table 28: Data Capture Year to Date**

| Station | NO <sub>2</sub> | CO   | PM <sub>2.5</sub> | PM <sub>10</sub> |
|---------|-----------------|------|-------------------|------------------|
| Eastern | 87.5            | 95.8 | 92.1              | 98.5             |
| Western | 97.4            | 97.5 | 98.0              | 98.1             |



## Report Signature Page

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# **APPENDIX 1**

## **Limitations**



## **LIMITATIONS**

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