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1 Introduction

1.1 This report presents fully verified and ratified air quality monitoring data measured at two automatic monitoring stations within the Lancaster City Council area during 2015. The automatic monitors are located along Cable Street and within Dalton Square, at roadside locations. Both sites monitor nitrogen dioxide; the Cable Street site also monitors PM_{10}.

1.2 This report compares the ratified data from these sites with the statutory air quality objectives and the UK's air pollution bands.

2 Assessment Criteria

2.1 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

2.2 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The European Union has also set limit values for nitrogen dioxide and PM_{10}. Achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). The limit values for nitrogen dioxide are the same levels as the UK objectives, but applied from 2010 (The Air Quality Standards Regulations 2010 (No. 1001), 2010). The limit values for PM_{10} are also the same level as the UK statutory objectives, but applied from 2005.

2.3 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide and PM_{10}

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour mean	200 μg/m^3 not to be exceeded more than 18 times a year
	Annual mean	40 μg/m^3
Fine Particles (PM_{10})	24-hour mean	50 μg/m^3 not to be exceeded more than 35 times a year
	Annual mean	40 μg/m^3

2.4 In addition to the objectives and limit values, Defra has established a set of descriptors, for the 1-hour data for nitrogen dioxide and 24-hour data for PM_{10}, labelling the levels as low, moderate, high and very high (Defra, 2013). The banding is referred to as the Daily Air Quality Index (DAQI), and the criteria for the two pollutants are set out in Table 2.

Table 2: Daily Air Quality Index Bandings (µg/m^3)

Band	Index	Nitrogen Dioxide 1-hour Mean	PM_{10} 24-Hour Mean [a]
Very High	10	601 or more	101 or more
High	9	535 – 600	92 – 100
	8	468 – 534	84 – 91
	7	401 – 467	76 – 83
Moderate	6	335 – 400	67 – 75
	5	268 – 334	59 – 66
	4	201– 267	51 – 58
Low	3	135 – 200	34 – 50
	2	68 – 134	17 – 33
	1	0 – 67	0 – 16

[a] Reference Equivalent.

2.5 The transition between the Low and Moderate pollution bands is a 1-hour concentration above 200 µg/m^3 for nitrogen dioxide and a 24-hour concentration above 50 µg/m^3 for PM_{10}, these being the air quality standards for these pollutants. Experience across the UK has shown that the 24-hour PM_{10} standard is more likely to be exceeded than the 1-hour nitrogen dioxide standard. Furthermore, baseline PM_{10} concentrations tend to be higher than for nitrogen dioxide, meaning that higher index values tend to be found for PM_{10}.

3 Data Ratification

3.1 The Cable Street and Dalton Square sites monitor nitrogen dioxide using Horiba APNA-370 chemiluminescence NOx analysers. The Cable Street automatic monitoring station also measures PM_{10} using a TEOM – 1400AB Dust Monitor (supplied by Horiba). The nitrogen dioxide and PM_{10} analysers return 15-minute average concentration readings.

3.2 The nitrogen dioxide and nitrogen oxides data, in units of parts per billion (ppb), are initially adjusted using calibration factors determined from the calibration reports. A visual examination of the data is then carried out, together with a comparison with monitoring data from two nearby national network sites[1], Blackpool Marton and Preston (Defra, 2016), and an examination of fault logs for the instruments, with any erroneous data removed. Finally the data are converted from ppb to micrograms per cubic meter ($\mu g/m^3$).

3.3 For PM_{10}, a visual examination of the raw 15-minute data in units of $\mu g/m^3$ is carried out before averaging the data to 1-hour means. These are then processed through the Volatile Correction Model (VCM) to adjust them to values equivalent to the reference method, following Defra guidance (Defra, 2009)[2]. Finally an examination of fault logs for the instruments and a secondary visual inspection of the data are carried out, with any erroneous data removed.

3.4 Once the data are ratified, 1-hour, 24-hour and annual mean values are calculated, and appropriate statistics selected to allow comparison with the air quality objectives.

1 Data taken from the Automatic Urban and Rural Network (AURN)

2 Adjustments to reference method carried out using the VCM tool used FDMS sites: Leeds Centre AURN, Salford Eccles AURN and the average of the remaining sites with range. The site specific temperature and pressure were used within the VCM.

4 Ratified Monitoring Data

4.1 The following Tables and Figures summarise the results for the two monitoring sites.

Cable Street

Nitrogen Dioxide

4.2 The Cable Street NOx analyser measures 15-minute average concentrations of NOx (nitrogen oxides) and NO (nitric oxide) continuously over the year, with nitrogen dioxide calculated as the difference. During the ratification process, it was found that the 2015 recorded data from the NO channel appeared to be erroneous and highly atypical, resulting from an unidentified issue with the analyser itself. The data from the NOx channel appeared to be in line with the values measured in previous years. As such, subsequent attempts to produce a ratified data set of hourly nitrogen dioxide concentrations for 2015, based on both the NO and NOx data, led to highly unrealistic values in comparison to both previous years and other local monitoring data.

4.3 Following consultations with the analyser manufacturer and Lancaster City Council, data for nitrogen dioxide for 2015 will not be published here. Since the NOx data seemed to comparable to previous years, a summary of ratified nitrogen oxides (NOx) concentrations are set out in Appendix A1. However, due to the issues with the analyser these data are considered to be of low-quality; any use of the data should be treated with caution and considered indicative only.

PM_{10}

4.4 PM_{10} concentrations are set out in Table 3 and shown as 1-hour means and 24-hour means in Figures 2 and 3. The data are considered to be of high quality.

Table 3: Cable Street PM_{10} Data Summary, 2015

Pollutant	PM_{10}	Exceedences	PM_{10} Objectives
Maximum 24-hour Mean	76.2 µg/m^3	9	50 µg/m^3; no more than 35 exceedences
Annual Mean	24.6 µg/m^3	-	40 µg/m^3
90th percentiles of daily means	38.9 µg/m^3	-	50 µg/m^3
Data Capture	80.1%	-	-

4.5 The annual mean PM_{10} concentration was well below the objective of 40 µg/m^3. There were nine measured exceedences of the 24-hour mean objective value of 50 µg/m^3, which is below the 35 exceedences that are allowed. In addition, the 90th percentile of 24-hour mean concentrations was below 50 µg/m^3, confirming that an exceedence of the objective is highly unlikely.

4.6 Table 5 sets out the distribution of the 24-hour (PM_{10}) values in the different pollution bands. As explained in Paragraph 0, it has not been possible to derive a satisfactory nitrogen dioxide data set for 2015 and, as such, the data cannot be classified into bands.

Table 4: Cable Street Daily Air Quality Index Bandings, 2015

Band	Index	PM_{10} 24-Hour Mean [a]
Very High	10	
High	9	
	8	
	7	1
Moderate	6	3
	5	
	4	5
Low	3	40
	2	193
	1	51

[a] For nitrogen dioxide, number of 1-hour values. For PM_{10}, number of 24-hour means.

4.7 The majority of 24-hour mean PM_{10} concentrations fell into the 'low' pollution band (96.9%) during 2015, however there were eight 24-hour mean concentrations (2.7% of days) which fell into the 'moderate' pollution band and a single 24-hour mean concentration which fell into the 'high' band. There were no 'very high' events.

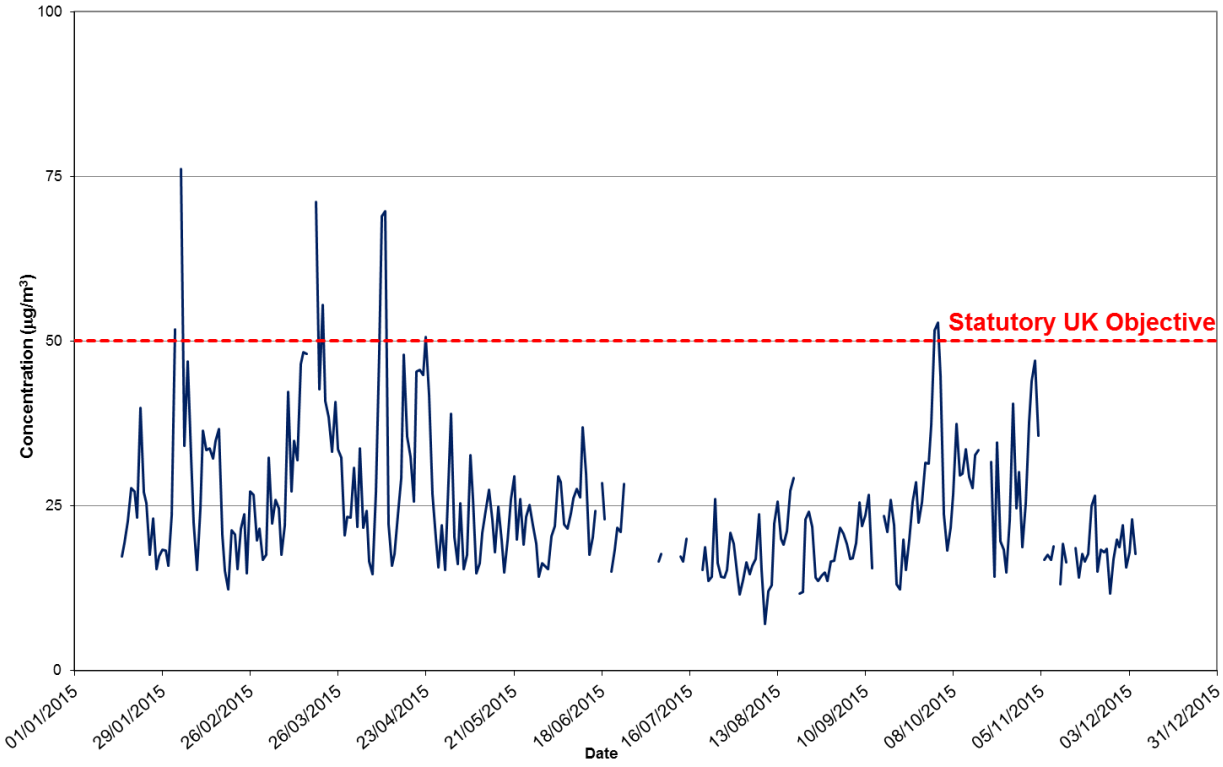

Figure 1: Cable Street 24-Hour Mean PM_{10} Concentrations (µg/m^3), 2015

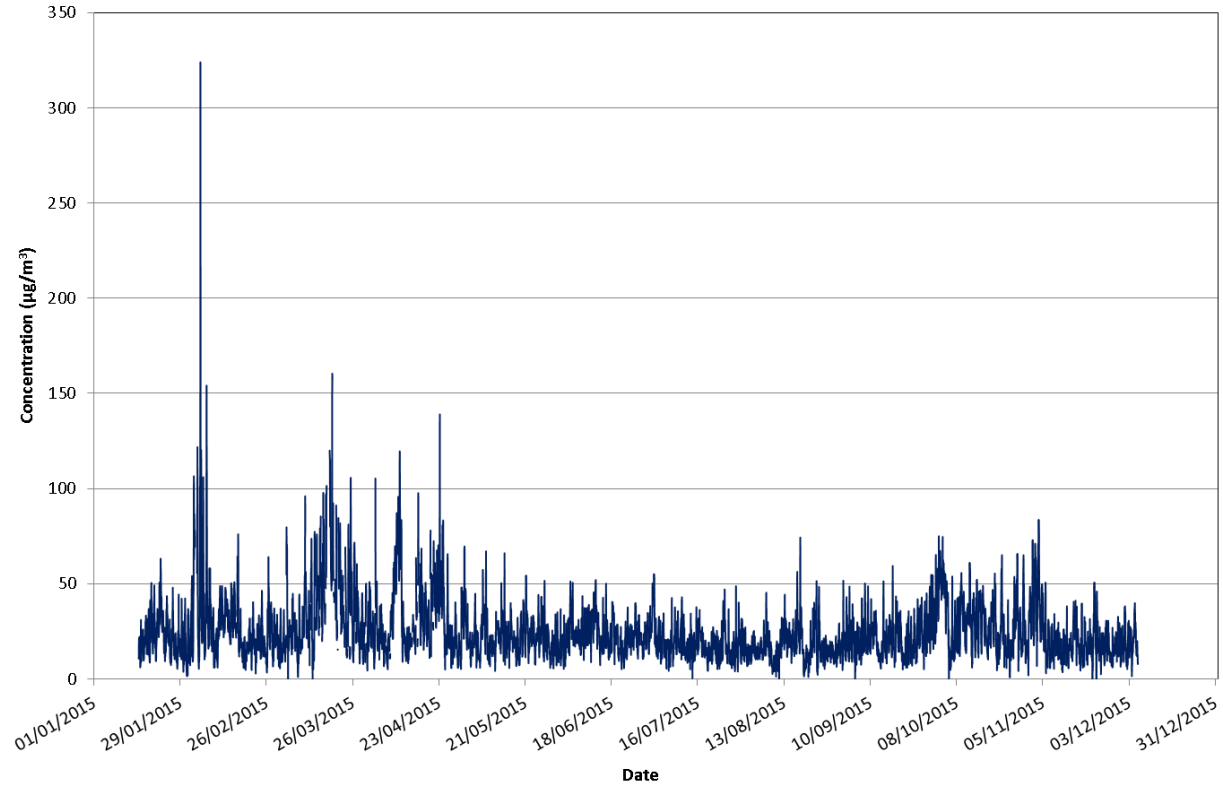

Figure 2: Cable Street 1-Hour Mean PM_{10} Concentrations (µg/m^3), 2015

Dalton Square

Nitrogen Dioxide

4.8 The nitrogen dioxide (NO_2) concentrations are set out in Table 5, with the 1-hour mean concentrations shown in Figure 3. The ratified NOx data are provided in Appendix A1. Both sets of data are considered to be of high quality.

Table 5: Dalton Square Nitrogen Dioxide Data Summary, 2015

Pollutant	NO_2	Exceedences [a]	Objectives
Maximum 1-hour Mean	160.4 µg/m^3	0	200 µg/m^3; no more than 18 exceedences
Annual Mean	34.9 µg/m^3	-	40 µg/m^3
99.8th Percentile 1-hour Means (µg/m^3)	103.3 µg/m^3	-	200 µg/m^3
Data Capture [b]	94.6%	-	-

4.9 The annual mean nitrogen dioxide concentration was below the objective value of 40 µg/m^3. The 1-hour mean objective value was not exceeded over the course of the year, i.e. there were no hours within the year which measured an exceedence of 200 µg/m^3. Thus, the objective was achieved, since it allows 18 exceedences in a calendar year.

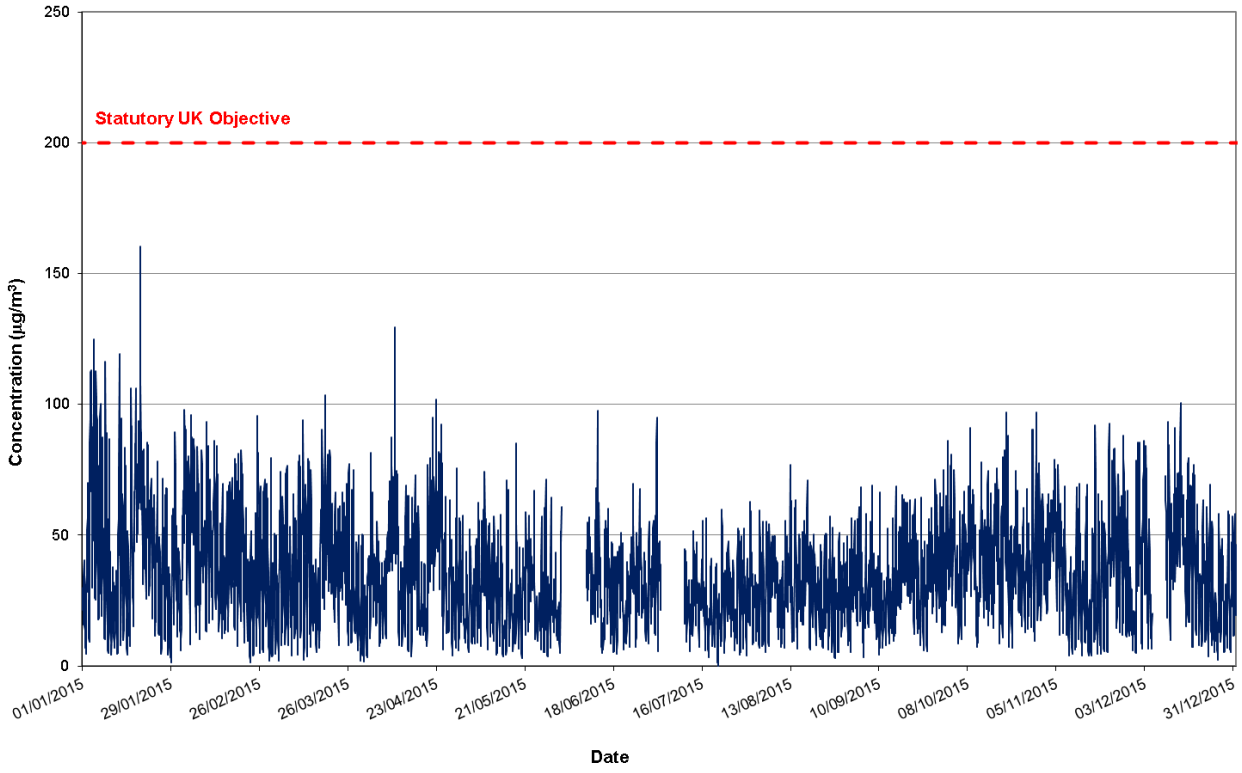

Figure 3: Dalton Square 1-hour Mean NO_2 Concentrations, 2015

4.10 Table 6 sets out the distribution of the hourly values in the different pollution bands.

Table 6: Dalton Square Daily Air Quality Index Bandings, 2015

Band	Index	Nitrogen Dioxide 1-hour Mean [a]
Very High	**10**	
High	**9**	
	8	
	7	
Moderate	**6**	
	5	
	4	
Low	**3**	4
	2	596
	1	7,690

[a] Number of 1-hour values

4.11 All hourly measured nitrogen dioxide concentrations fell into the 'low' pollution band during 2015. There were no 'moderate', 'high' or 'very high' events.

5 Summary

5.1 Data for two automatic monitoring sites within the Lancaster City Council area during 2015 have been ratified, to the extent possible. As explained in Paragraph 4.2, it has not been possible to ratify the nitrogen dioxide data recorded during 2015 at the Cable Street monitor and it has been agreed with Lancaster City Council that these data should not be published.

5.2 Ratified data have been presented for the Cable Street PM_{10} monitor and for the Dalton Square nitrogen dioxide monitor. Data capture for nitrogen dioxide was 95% at the Dalton Square monitor and 80% for PM_{10} at the Cable Street monitor. Ratified NOx data have been presented for both sites, for information.

5.3 At the Dalton Square monitoring site measured annual mean nitrogen dioxide concentrations were below the objective at 34.9 µg/m^3. There were no exceedences of the short-term 1-hour objective at the Dalton Square site; as such, the 1-hour mean objective was achieved. At Dalton Square all of the hourly mean nitrogen dioxide concentrations fell into the 'low' pollution band.

5.4 Ratified PM_{10} concentrations measured at the Cable Street monitoring site were below the air quality objectives, with a measured annual mean concentration of 24.6 µg/m^3 and nine exceedences of 50 µg/m^3 as a 24-hour mean, compared with the 35 allowed exceedences. PM_{10} concentrations were mostly in the 'low' pollution band throughout 2015, with the exception of eight days (2.7% of days) when concentrations fell in the 'moderate' pollution band and a single day which fell into the 'high' pollution band.

6 Reference

Defra (2009) *Review & Assessment: Technical Guidance LAQM.TG(09)*, Defra.

Defra (2013) *Update on Implementation of the Daily Air Quality Index*.

Defra (2016) *Defra AURN Archive*, [Online], Available: aurn.defra.gov.uk.

Directive 2008/50/EC of the European Parliament and of the Council (2008).

The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043 (2002), HMSO.

The Air Quality Regulations, 2000, Statutory Instrument 928 (2000), HMSO.

The Air Quality Standards Regulations 2010 (No. 1001) (2010), HMSO.

7 Glossary

Standards A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal.

Objectives A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides.

Exceedence A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations.

PM_{10} Small airborne particles, more specifically particulate matter less than 10 micrometers in aerodynamic diameter.

NO_2 Nitrogen dioxide.

NO Nitric oxide.

NO_x Nitrogen oxides (taken to be NO_2 + NO).

$\mu g/m^3$ Microgrammes per cubic metre.

VCM Volatile Correction Model

A1 Ratified Nitrogen Oxides Data

Table A1.1: Cable Street and Dalton Square NOx Data Summary, 2015

Pollutant	Cable Street	Dalton Square
Maximum 1-hour Mean	914.9 µg/m^3	726.2 µg/m^3
Annual Mean	119.2 µg/m^3	74.7 µg/m^3
Data Capture	95.5%	94.6%

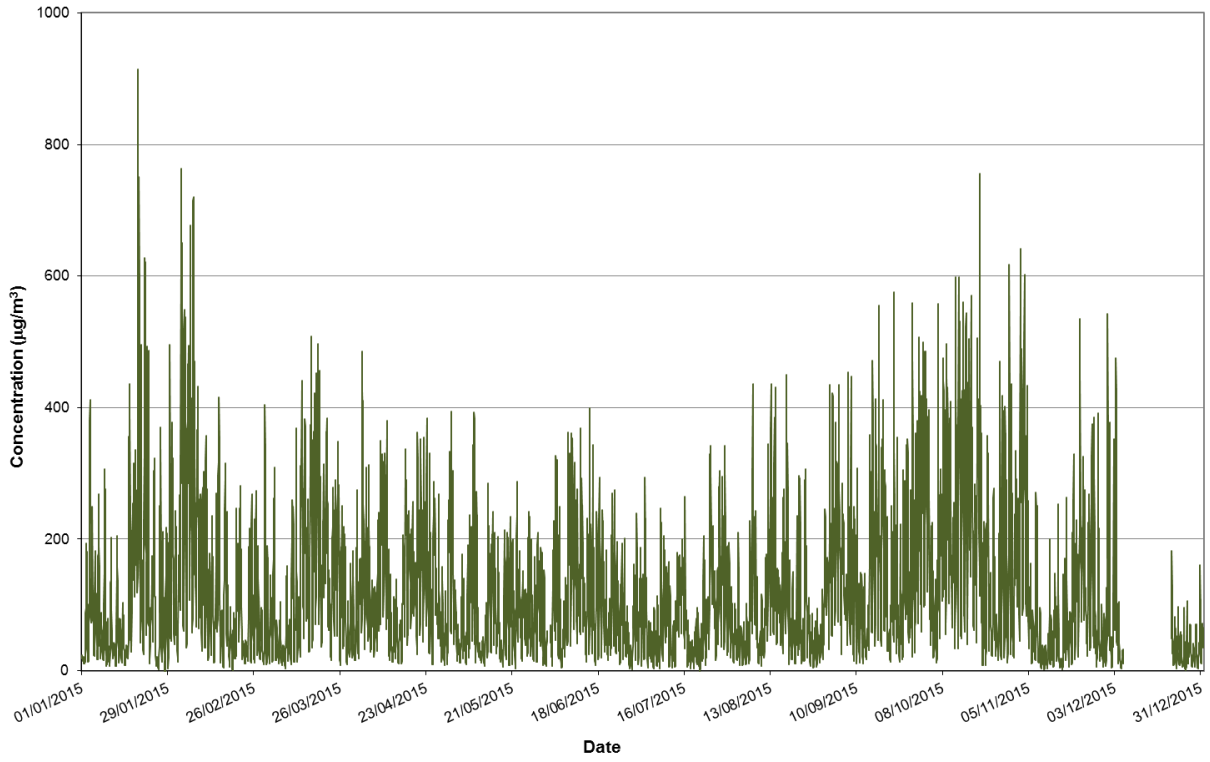

Figure A1.1: Cable Street 1-hour Mean NO_x Concentrations, 2015[a]

[a] Low quality ratified data due to analyser issues outlined in paragraph 4.2.

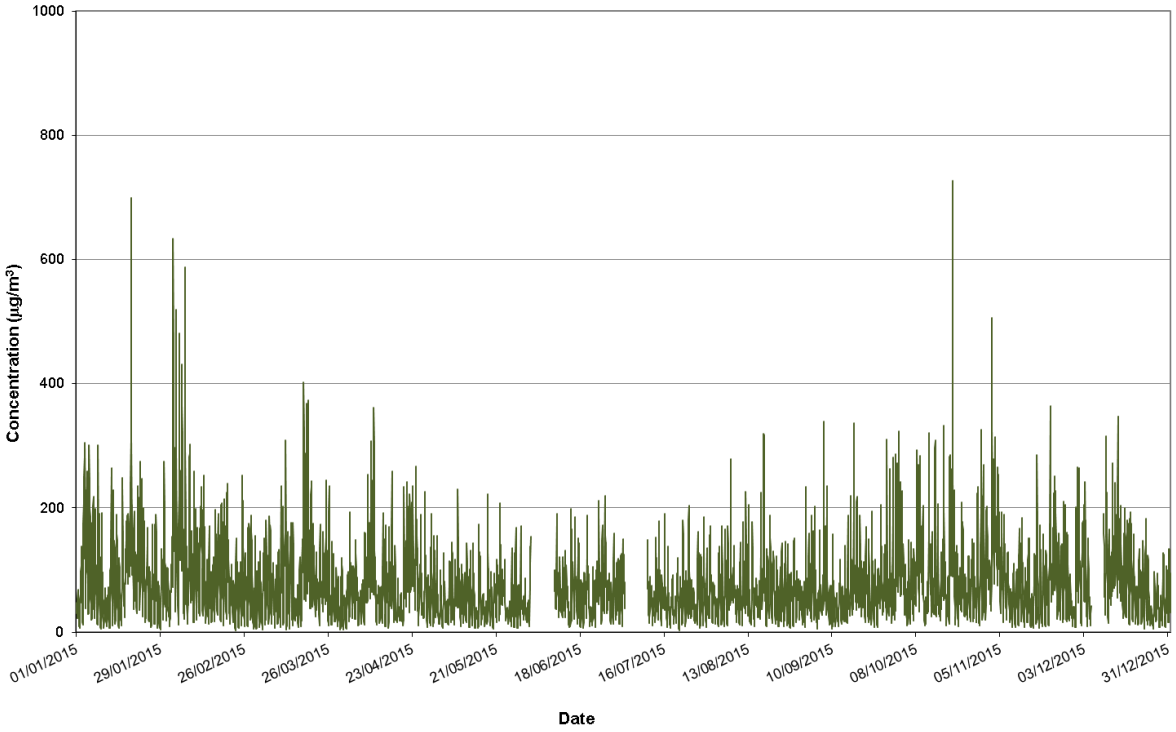

Figure A1.2: Dalton Square 1-hour Mean NO_x Concentrations, 2015