The Effect of COVID-19 Social and Travel Restrictions on UK Air Quality

20 March 2020

Experts in air quality management & assessment

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1 Introduction

1.1 Air Quality Consultants Ltd (AQC) has analysed trends in air quality over the year to date (up to the morning of Friday 20 March) to investigate whether the recently implemented COVID-19 social and travel restrictions have influenced air quality across the UK.

1.2 The analysis has focussed on roadside pollutant concentrations, on the assumption that social and travel restrictions are likely to influence roadside pollutant concentrations the most.

2 Methodology

2.1 Openair software[1] has been used to download all measured nitrogen oxides (NOx), nitrogen dioxide (NO_2) and PM_{10} [2] data from 2020 from the UK Automatic Urban and Rural (AURN), Scottish Air Quality (SAQN), Welsh Air Quality (WAQN) and King's College London (KCL) networks. Data were downloaded on the morning of Friday 20 March and no end date was set, so that all of the latest data were imported; it should be noted that the final hour of data available varied by site and data network, so the average concentrations calculated for the morning hours of 20 March are likely to be based on less sites than the rest of the period, and should thus be treated with greater caution.

2.2 Duplicate sites (for example those that exist in more than one of the networks) have been removed, as have all sites with a data capture rate of less than 90% over 2020 to date. Data that represent an average of multiple sites (i.e. the "London Mean Roadside" and "Sussex Mean Roadside" data in the KCL data) have also been removed.

2.3 The average concentration across all sites (195 sites for NOx, 198 for NO_2 and 130 for PM_{10}) has been calculated for each hour of the year, and these have been plotted to see whether any recent trends are obvious; a reduction in concentrations since the COVID-19 social restrictions were implemented might reasonably be expected, although any effect may be more complex than this. For example, avoidance of public transport might increase private car trips.

2.4 The situation, with respect to both identified COVID-19 infections, and changes to available transport options, is different within London than across the rest of the UK. Thus, the next stage of the analysis has been to focus on concentrations in London only; this time using the "London Mean Roadside" concentrations from the KCL network. These have been plotted separately to see whether any recent trends are obvious in London.

2.5 Trends in pollutant concentrations are often masked by meteorological effects[3], thus the analysis of concentrations in London has moved on to incorporate the removal of such meteorological effects, using the 'deweather' function in the openair software alongside meteorological data from Heathrow Airport. This has been used to create sets of modelled concentrations with the influence of wind speed, wind direction, temperature, hour of the day, day of the week and week of the year removed. These modelled datasets should more accurately represent the underlying trend in concentrations as a result of changes in emissions.

2.6 Ambient concentrations are affected by a large number of factors and it is thus usually difficult to determine the precise cause of changes in pollutant concentrations. Similarly, reductions in emissions from one source can be masked by other changes. This note does not provide a comprehensive analysis of the changes in emissions. It is intended to provide preliminary

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1 Carslaw, D.C. and Ropkins, K. (2012) 'openair - An R package for air quality data analysis', *Environmental Modelling & Software,* vol. 27-28, pp. 52-61.

2 Particulate matter with an aerodynamic diameter of less than 10 µm.

3 Gellatly, R. and Marner, B. (2020) *Nitrogen Oxides Trends in the UK 2013 to 2019*, Available: https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=af089039-6a2f-49b5-9533-fe31205f3134

information regarding trends in measured concentrations during the initial phase of COVID-19 social restrictions in the UK.

3 Results

Nationwide Concentrations

3.1 Figure 1, Figure 2 and Figure 3 present the average hourly roadside NO_2, NOx and PM_{10} concentrations, respectively, across the UK in 2020 to date. Figure 4, Figure 5 and Figure 6 present the same data, but for March only. There are no obvious signals in the concentrations that might be attributed to recently imposed social and travel restrictions.

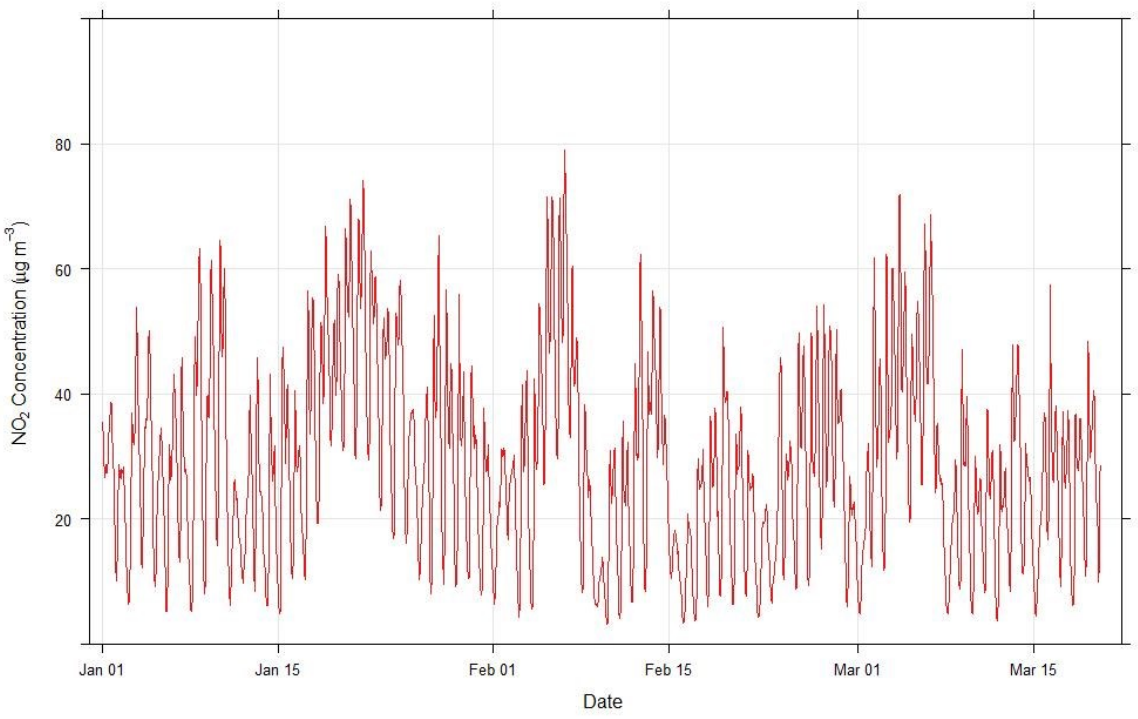

Figure 1: Average UK Roadside NO_2 Concentrations in 2020

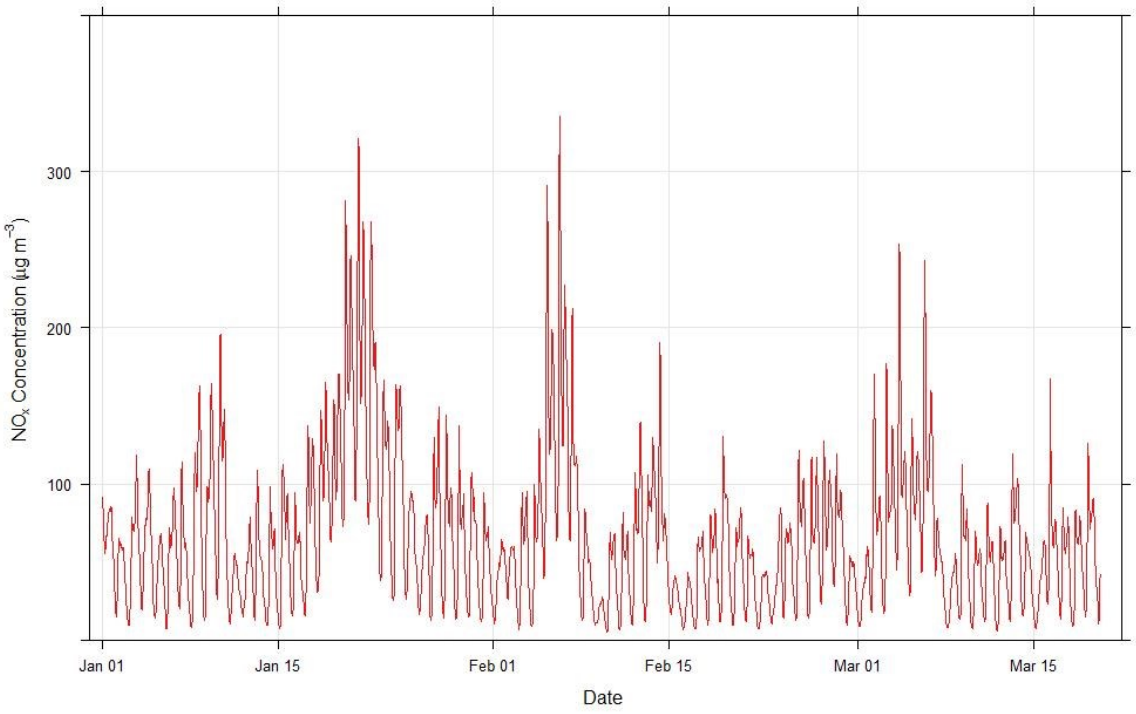

Figure 2: Average UK Roadside NOx Concentrations in 2020

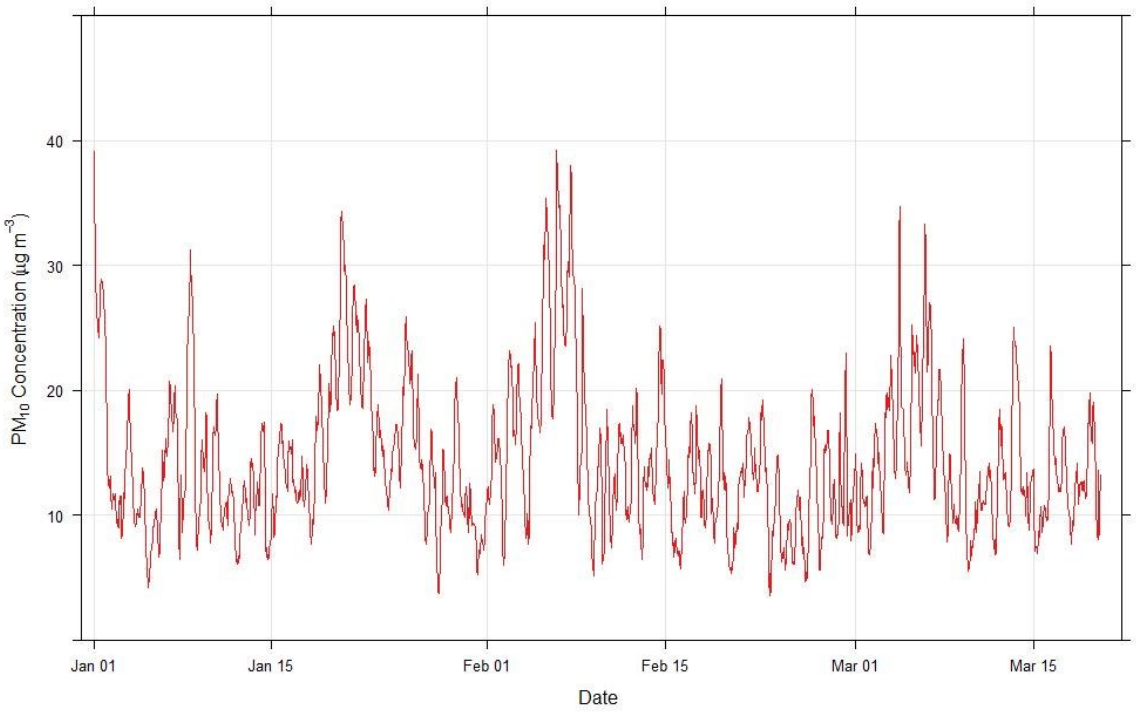

Figure 3: Average UK Roadside PM_{10} Concentrations in 2020

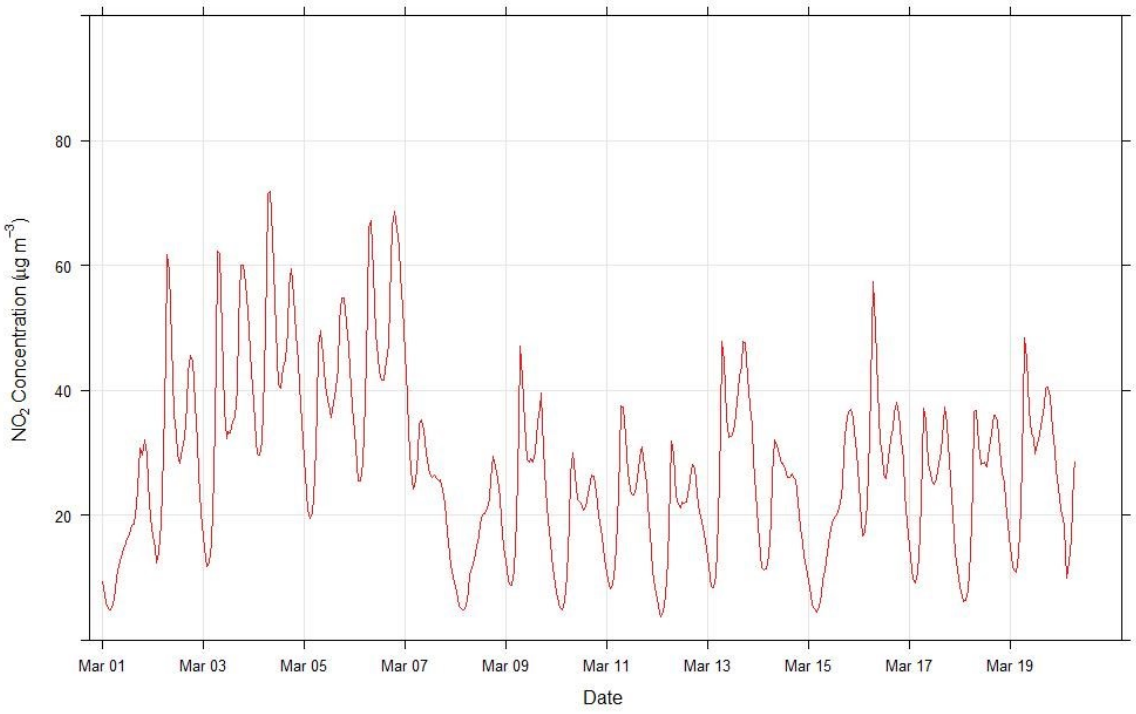

Figure 4: Average UK Roadside NO_2 Concentrations in March 2020

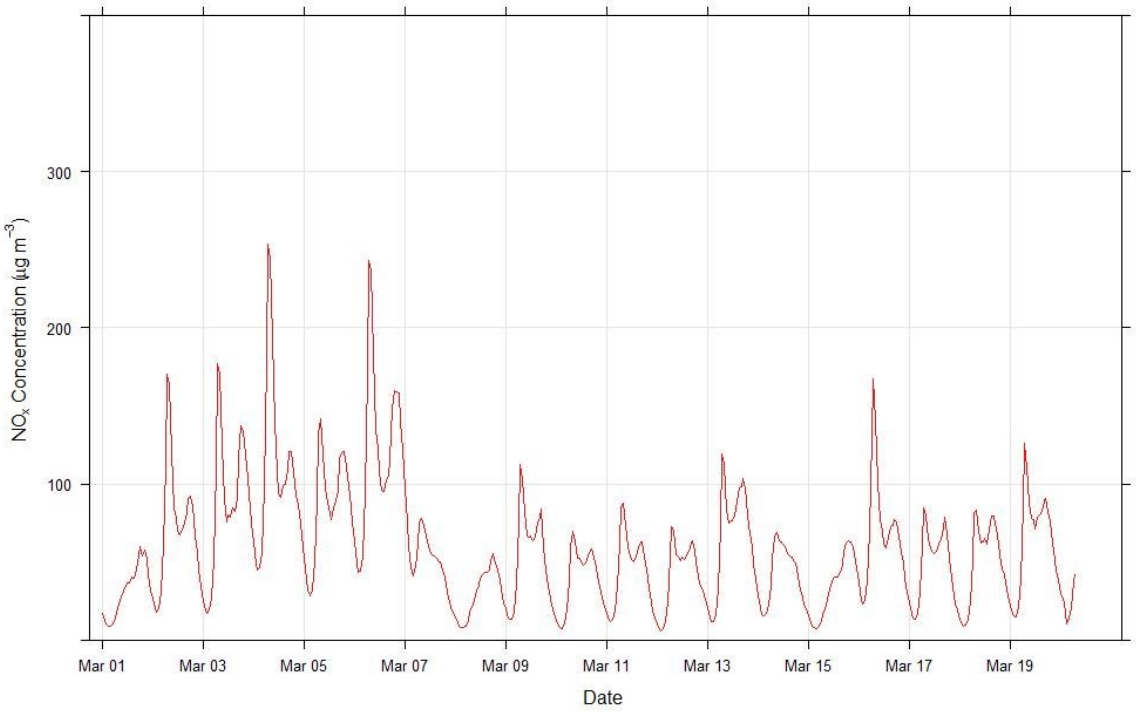

Figure 5: Average UK Roadside NOx Concentrations in March 2020

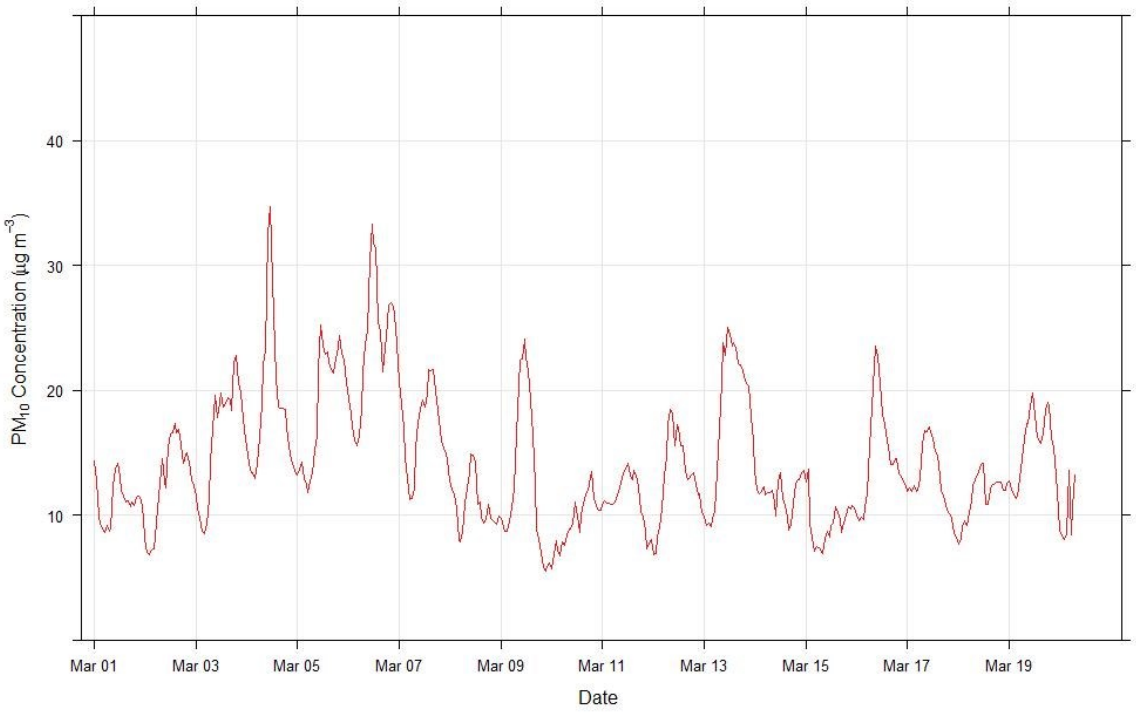

Figure 6: Average UK Roadside PM_{10} Concentrations in March 2020

London Concentrations

3.2 Figure 7 to Figure 12 present similar plots but for the KCL network's "London Mean Roadside" concentrations only. Again, there are no obvious signals in the concentrations that might be attributed to recently imposed social and travel restrictions.

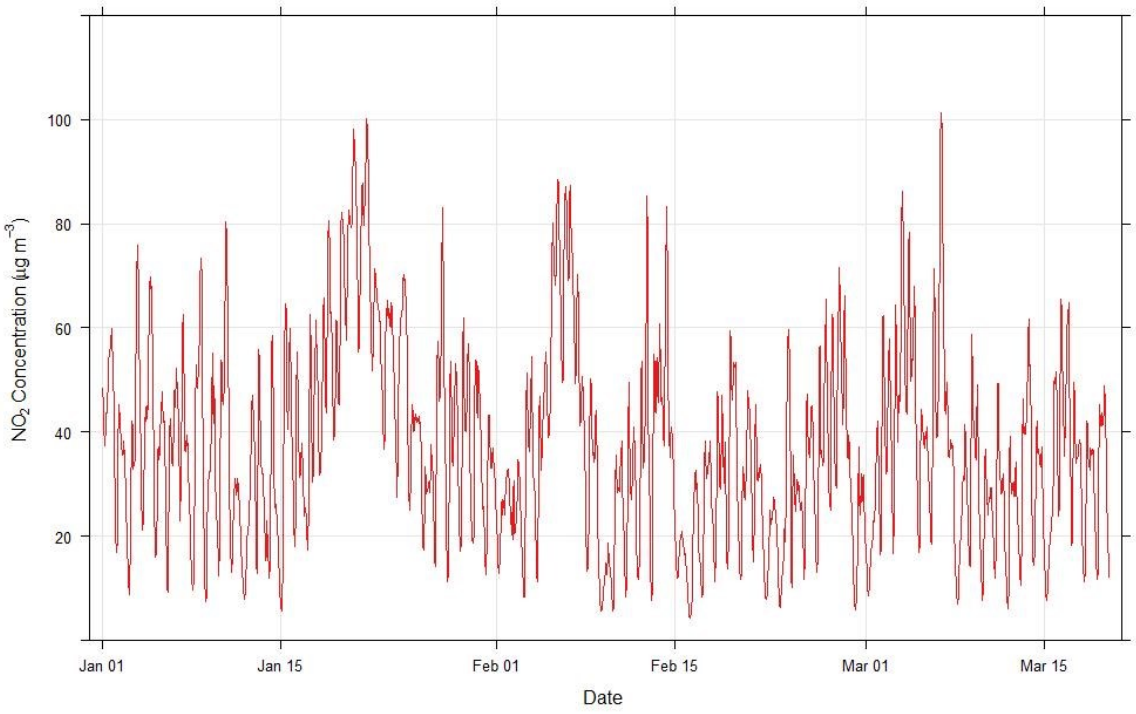

Figure 7: "London Mean Roadside" NO_2 Concentrations in 2020

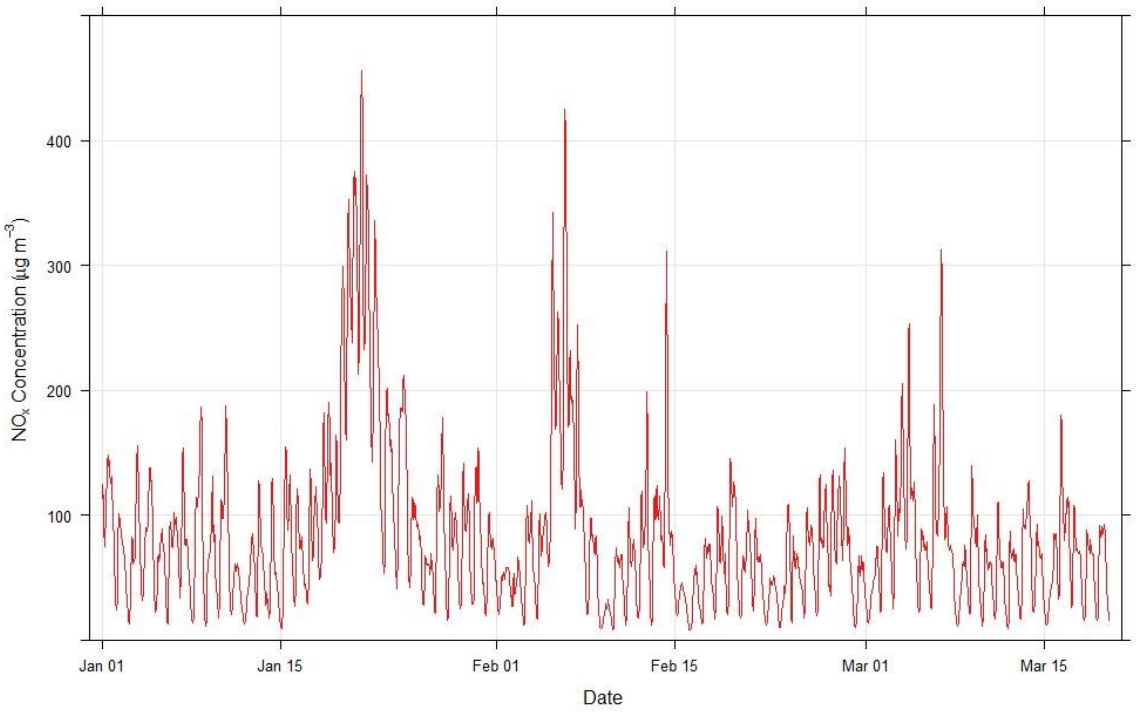

Figure 8: "London Mean Roadside" NOx Concentrations in 2020

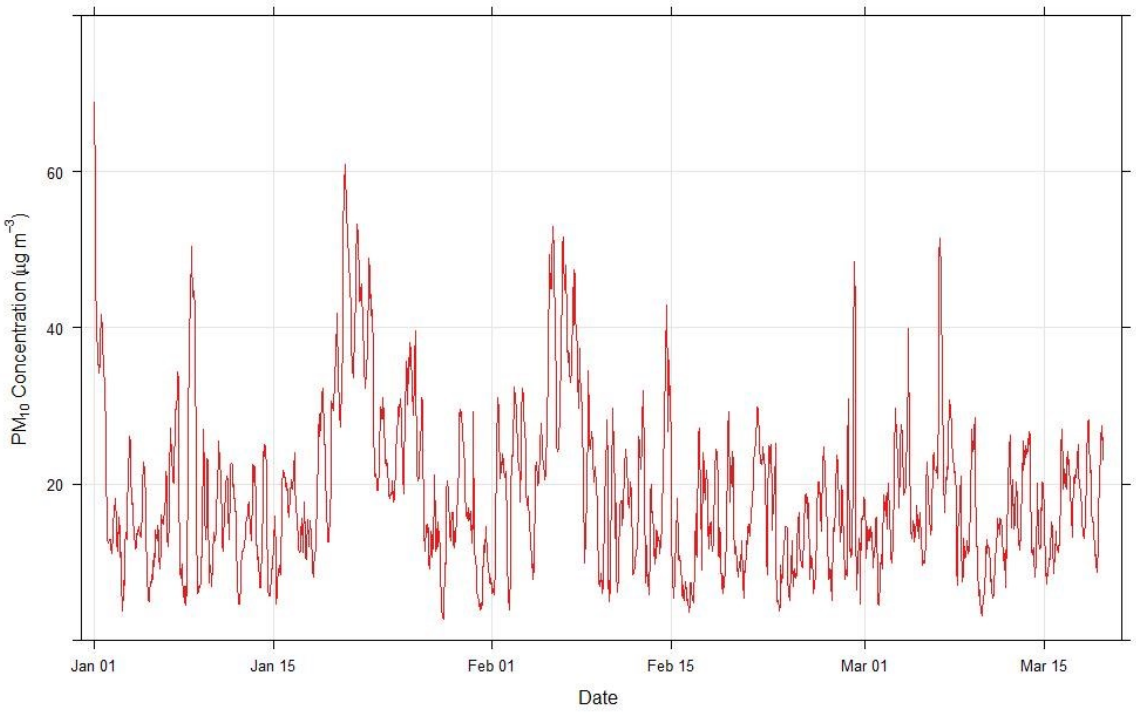

Figure 9: "London Mean Roadside" PM_{10} Concentrations in 2020

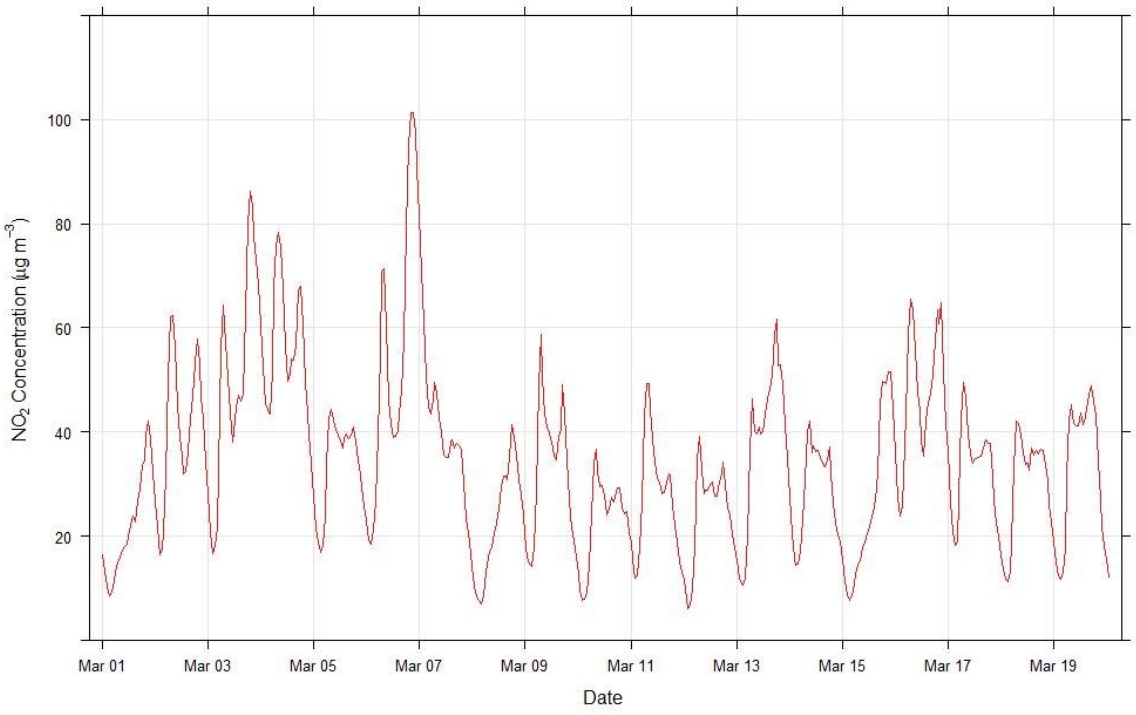

Figure 10: "London Mean Roadside" NO_2 Concentrations in March 2020

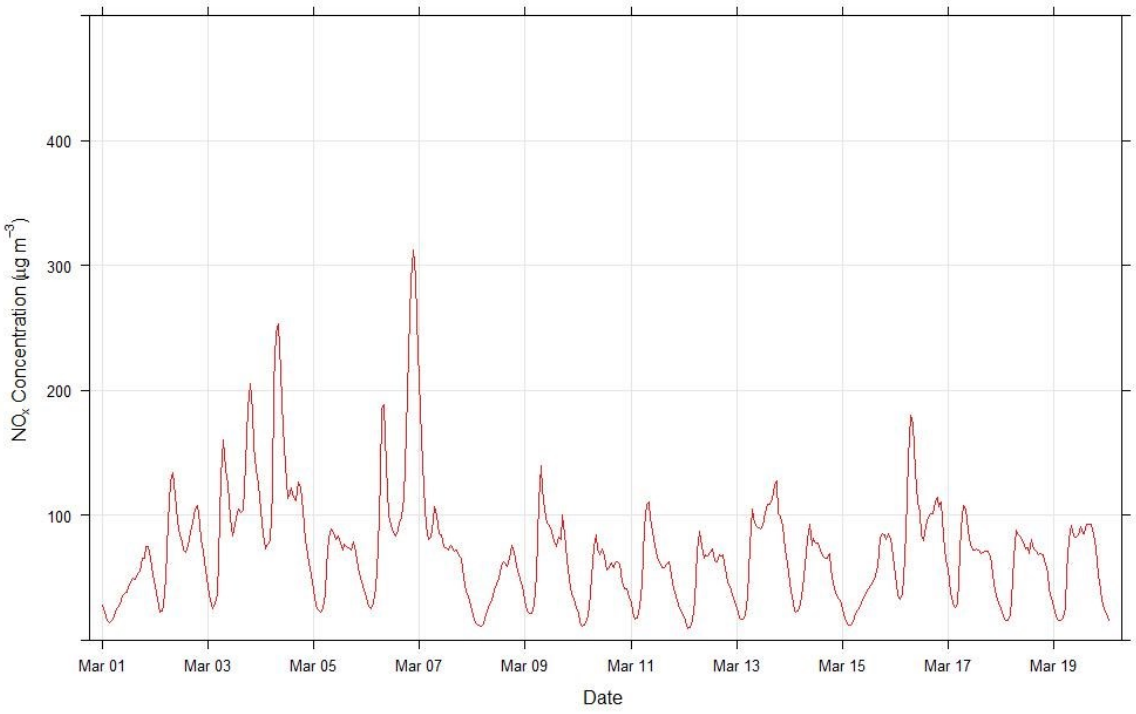

Figure 11: "London Mean Roadside" NOx Concentrations in March 2020

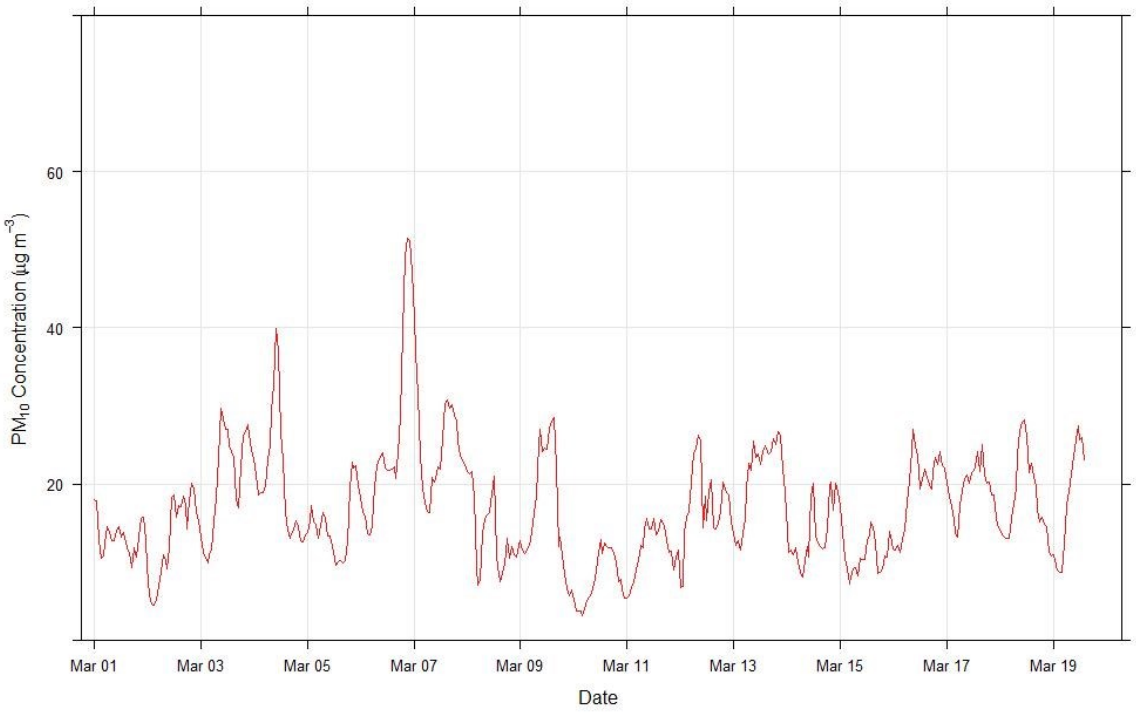

Figure 12: "London Mean Roadside" PM_{10} Concentrations in March 2020

"Deweathered" London Concentrations

3.3 Figure 13 to Figure 18 present similar plots to those in Figure 7 to Figure 12, but in this case the dataset has been "deweathered" to isolate the trend in concentrations that will have occurred

primarily as a result of the trend in emissions, following the approach described in Paragraph 2.5. Again there are no obvious signals in the concentrations that might be attributed to recently imposed social and travel restrictions.

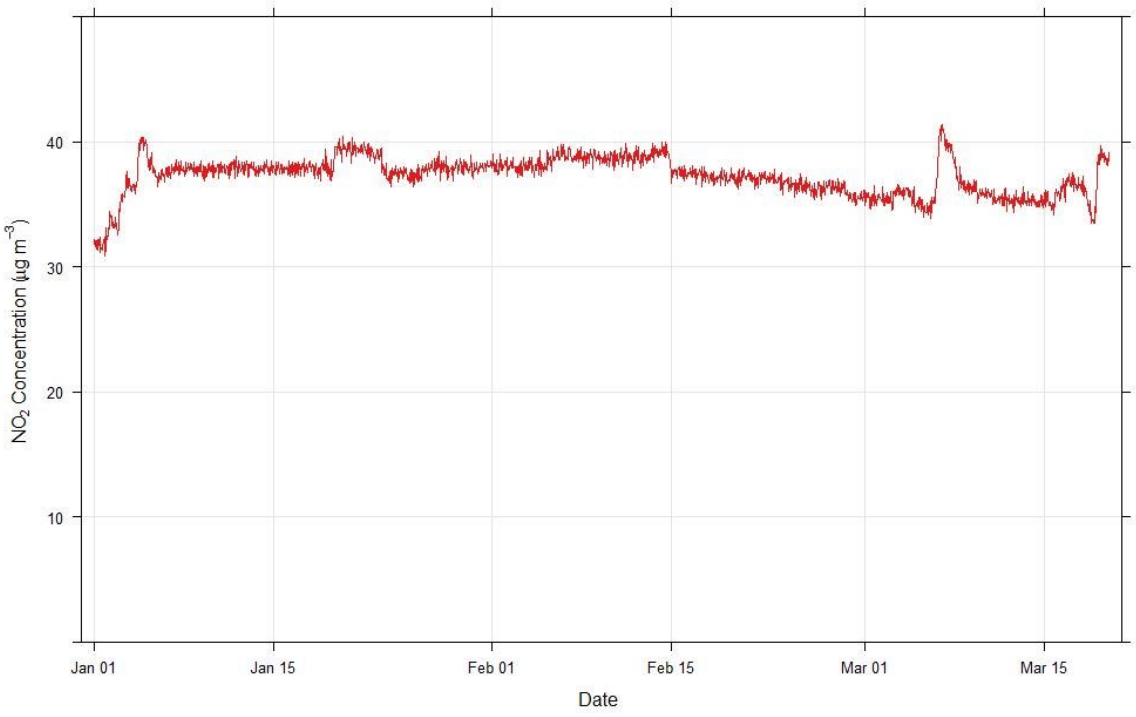

Figure 13: Deweathered "London Mean Roadside" NO_2 Concentrations in 2020

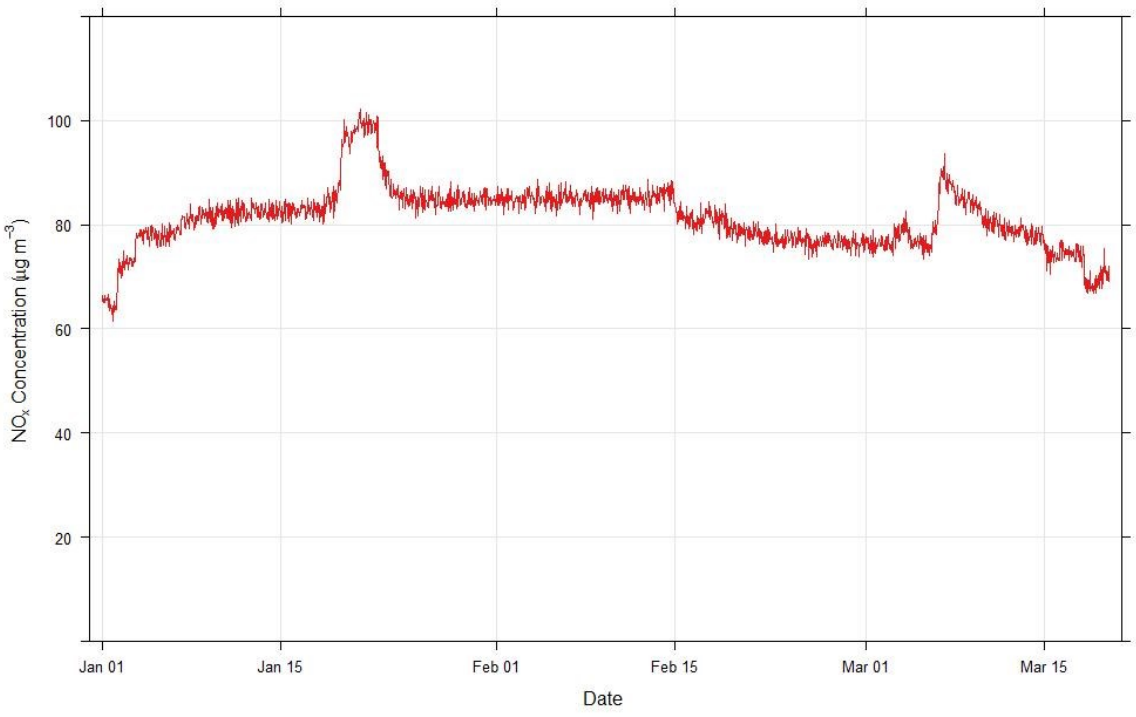

Figure 14: Deweathered "London Mean Roadside" NOx Concentrations in 2020

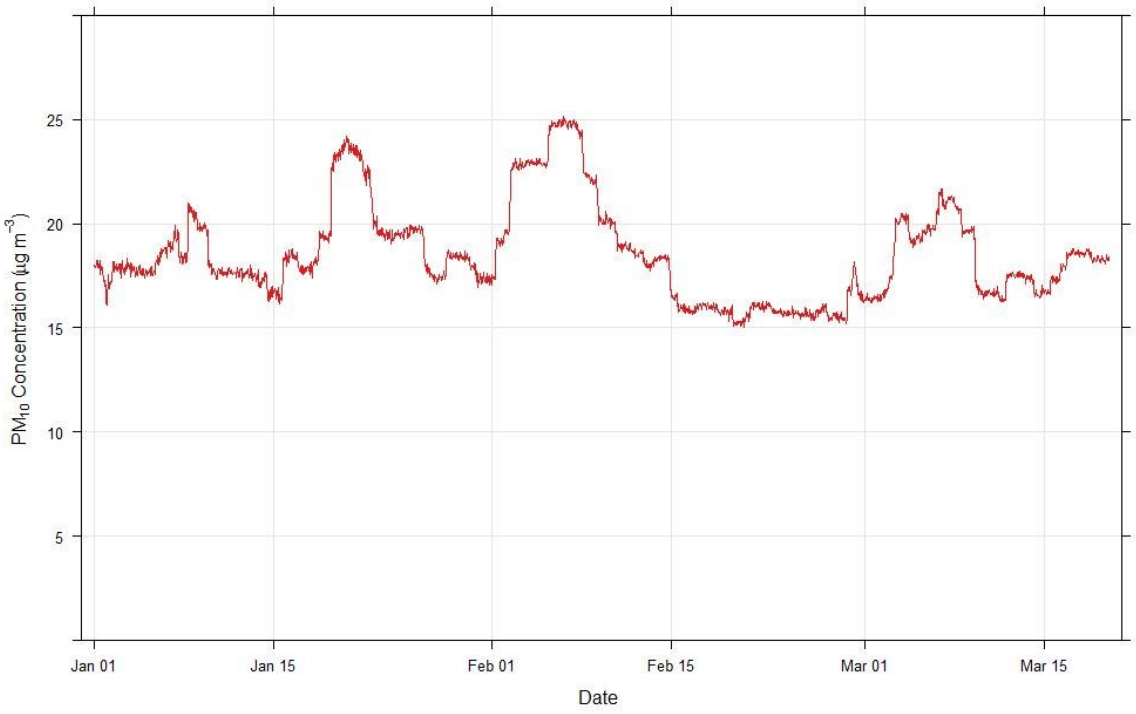

Figure 15: Deweathered "London Mean Roadside" PM_{10} Concentrations in 2020

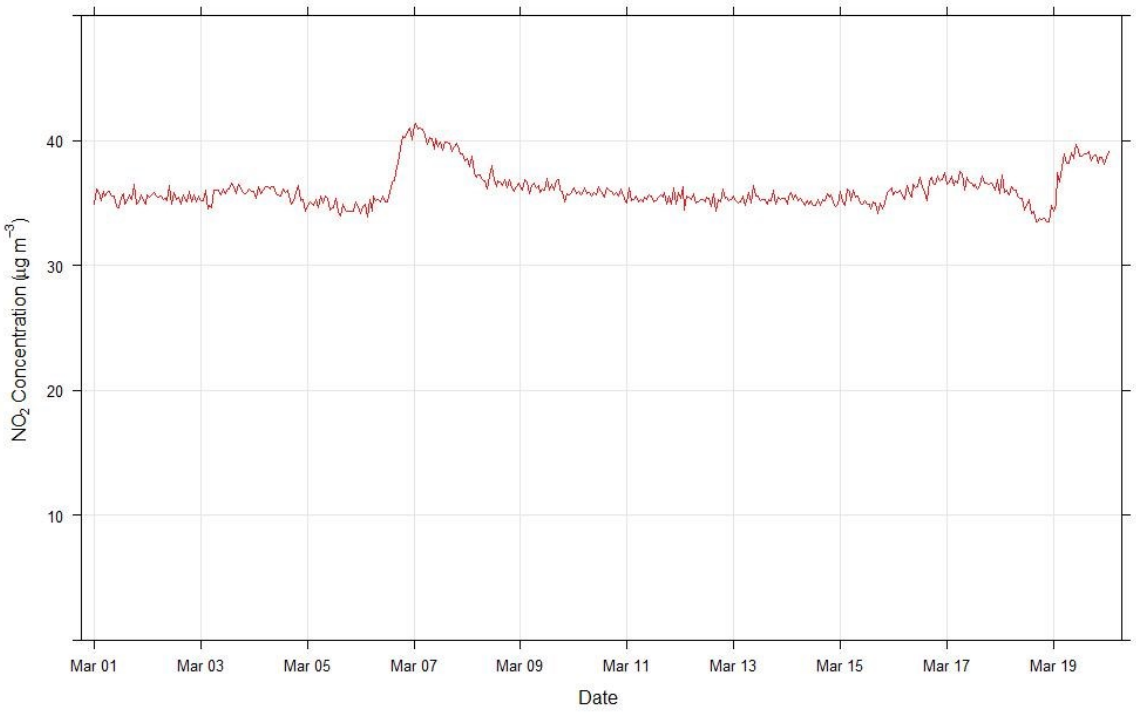

Figure 16: Deweathered "London Mean Roadside" NO_2 Concentrations in March 2020

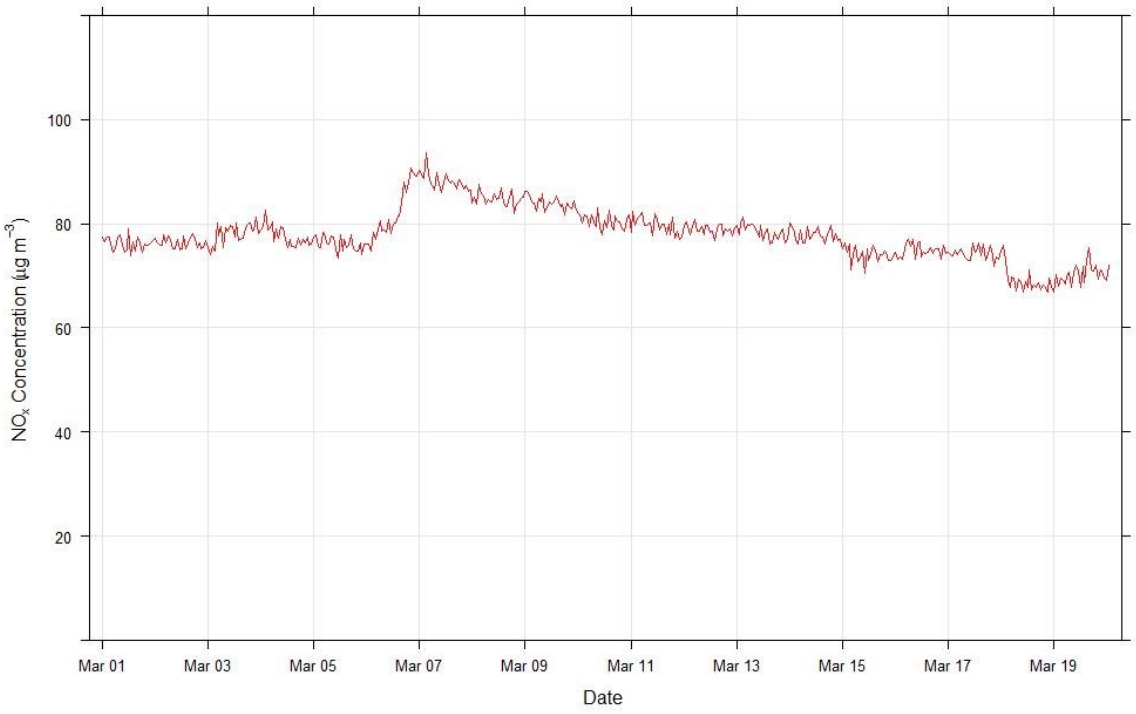

Figure 17: Deweathered "London Mean Roadside" NOx Concentrations in March 2020

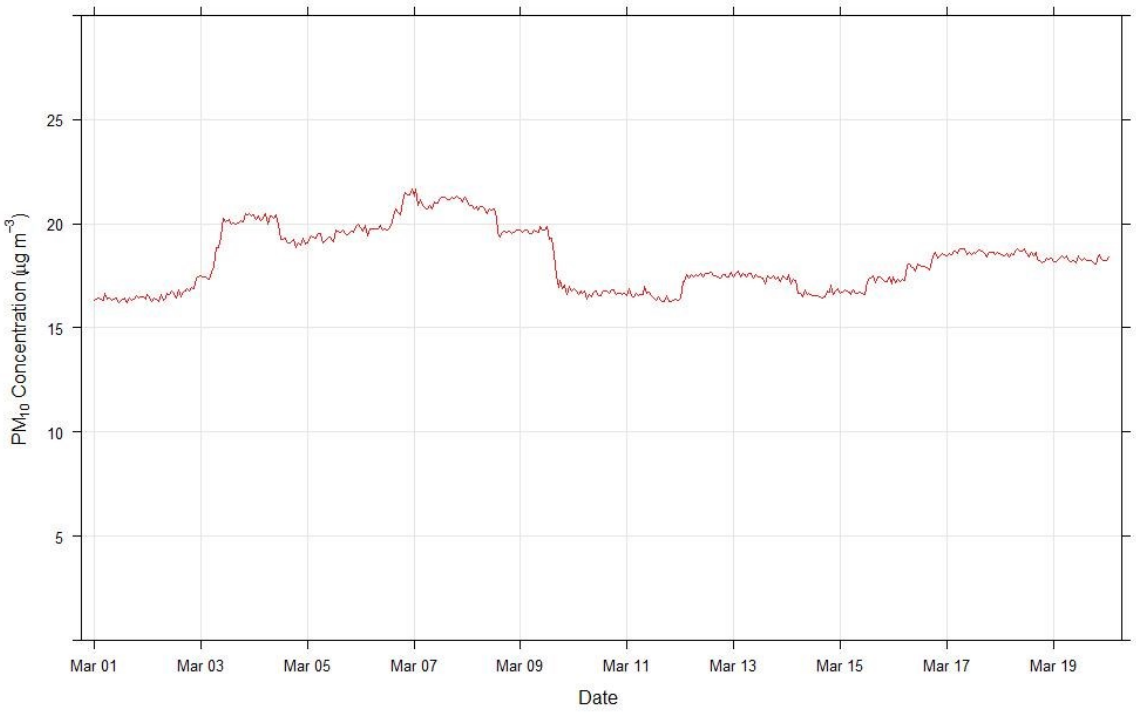

Figure 18: Deweathered "London Mean Roadside" PM_{10} Concentrations in March 2020

4 Summary and Conclusions

4.1 Analysis of trends in roadside NOx, NO_2 and PM_{10} concentrations in 2020 to date has identified no obvious influence from the social and travel restrictions implemented in the UK in response to the COVID-19 pandemic. This does not mean that changes in travel behaviour have not had any effect on concentrations; simply that this initial analysis has not shown any obvious changes in concentrations over this period. It is clearly not possible to compare the measurements against a set of data for the same period which exclude the effect of COVID 19. It also does not mean that there will be no more obvious effects on roadside air quality going forwards.

4.2 AQC will seek to update this analysis over the coming days/weeks/months to establish whether COVID-19 related social and travel restrictions are significantly affecting air quality in the UK.