Freight Noise Management in Urban Environments

Cross River Partnership & EMSOL

August 2020 - December 2020

CROSS RIVER PARTNERSHIP
Delivering London's Future Together

EMSOL

1.Introduction

Central London Sub-Regional Transport Partnership (CLSRTP) is a collective of transport officers from central London's ten local authorities. Cross River Partnership (CRP) manages the partnership and provides strategic direction.

The Mayor's Environment Strategy, the Mayor's Transport Strategy, and more localised policy detail the objectives and considerations for managing noise and freight in the capital. Retiming of deliveries is an obvious measure which may be taken to reduce peak-time congestion, but will directly impact the levels of noise in the city at non-peak times. This project was commissioned by Cross River Partnership to trial a technology solution for improved monitoring of delivery-related neighbourhood noise.

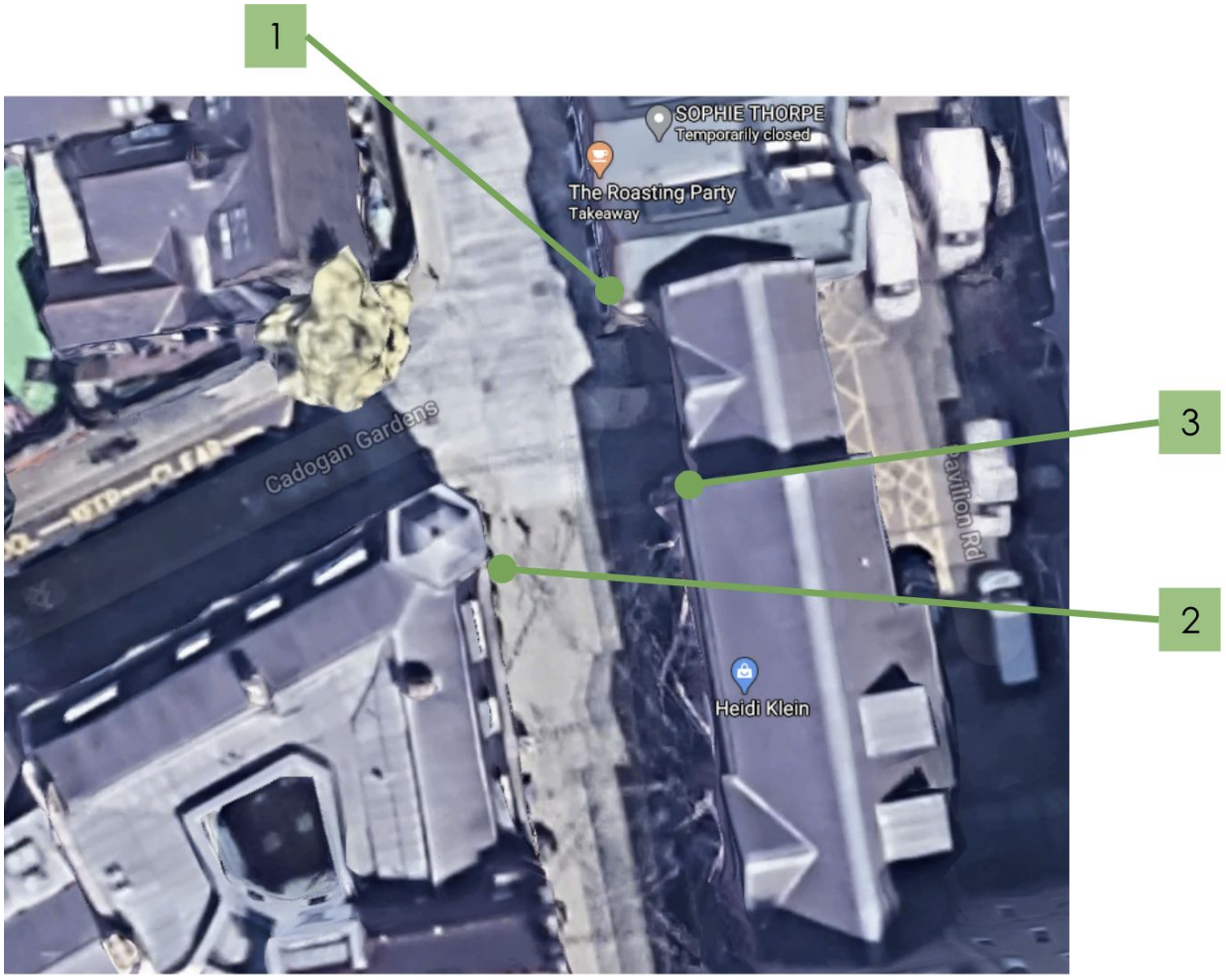
EMSOL installed noise monitoring equipment and vehicle tracking technology to assess the impact of deliveries on noise levels. Air Quality equipment was also installed to add to the dataset.

Pavilion Road is located in the Royal Borough of Kensington and Chelsea and is owned and managed by Cadogan Estates. The site was chosen because of the mix of commercial and residential premises, as well the close proximity of a school. The road is home to a range of businesses, mostly in the retail and hospitality sectors. Pavilion Road was pedestrianised in 2020, meaning all delivery vehicles now arrive at either the north or south end of the road.

There is a Cadogan Estates loading bay at the south end of Pavilion Road. It was in this area that the monitoring equipment was installed for this project. This meant that the impact of vehicles visiting both Pavilion Road businesses and the Cadogan Estates loading bay was monitored throughout the trial.

The project aimed to issue 30 vehicle tracking tags to participating businesses.

The equipment installation locations are shown on the diagram below.



	Equipment installed
Location 1	• AQ monitor • Noise monitor • Location tracking antenna • Ancillary cabinet
Location 2	• Location tracking antenna • Ancillary cabinet
Location 3	• Location tracking antenna

By installing equipment at these locations EMSOL was able to gather good data for noise, Air Quality and vehicle location for the immediate area. Any participating vehicle approaching the entrance would be tracked. Using data

analysis techniques, EMSOL correlated the vehicle presence data with the noise and air quality data to see the impact of individual vehicles.

2. Objectives

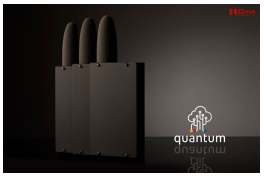
The stated objectives of the project were to:

- Deploy and trial noise monitoring equipment at one or more delivery points and evaluate its capability for providing useful data for monitoring out-of-hours delivery practices.
- Collect data regarding:
    - noise 'breaches' above a certain dB level
    - specific deliveries
- Write up the findings in a concise format describing the results of the trial and considering future applications for central London boroughs.

The project also aimed to quantify the impact of different vehicles and vehicle types.

3. Equipment & Methodology

The details of the equipment used at Pavilion Road are shown below.

No.	Name	Manufacturer	Product Functionality	Image
1.	Air Quality monitor	South Coast Science	Takes constant samples of air and analyses them	
2.	Noise monitor	Cirrus Research	Measures the noise level in the area	

3.	Location tracking antenna x3	Quuppa	Track tagged vehicles in the nearby area	
4.	Positioning tag	Quuppa	Identify the tagged vehicle coming into the tracking area.	
5.	Ancillary cabinet		Provides communications interface and power to the equipment	

30 positioning tags were issued to Cadogan by EMSOL for them to distribute to the participating businesses. Each tag had to be placed inside the vehicle. The vehicle's presence and location are then recorded when it enters the tracking area.

A list of tags issued to participants is shown below.

Businesses	**Number of vehicles equipped**
Grundon Waste Management	8
Ice Cream Union	2
Pavilion Wine	2
Natoora	7
Hicks	1
Roasting Party	2
Provenance butchers	1
KXU Gym laundry supplier	1
Total	**24**

Throughout the project only 11 of the vehicles were detected on site. The system was tested a number of times to ensure that the correct data was being collected. We therefore suspect that the following issues affected the data gathered:

- Some tags were issued to businesses but were not then fitted to vehicles
- Some drivers had a preference to deliver at the north end of Pavilion Road, where there was no monitoring equipment
- COVID-19 affected the operations of some of the participating businesses, leading to less activity than usual

For this project, the total uptime of the equipment was about 80%. A combination of issues such as power loss, communication interface failure and a noise monitor fault were the causes for the downtime.

In more detail the outages were the following:

No.	Date	Reason	Duration	Comment
1.	25 August 2020	Communication interface failure	8 hours	
2.	29 August 2020	Noise monitor failure	8 Days	This issue was late to be resolved due to lack of access equipment. A scaffolding tower was required to resolve this issue.
3.	21 September 2020	Power loss	1 Day	The power circuit that the EMSOL equipment was drawing power from had a power failure.

4. Noise data analysis

Noise data is recorded every second. The data in this report covers the period from the 5th August 2020 to the 14th December 2020.

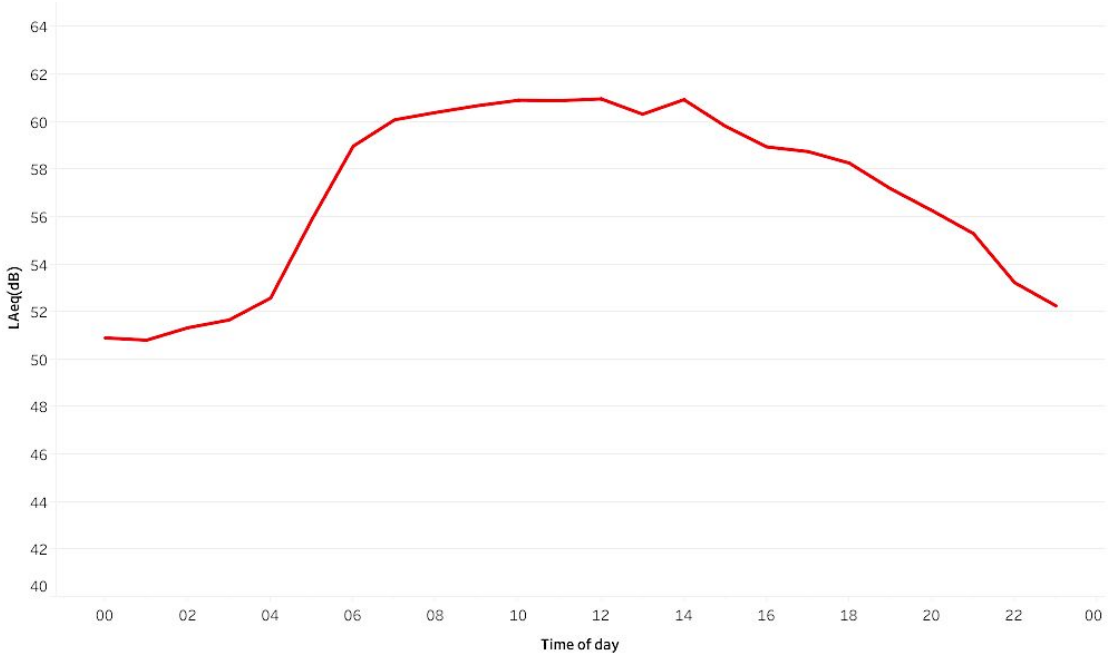


Fig 1

Figure 1 represents the average A-weighted continuous sound level throughout the day. The average was calculated using all weekdays (Monday to Friday). The quietest times of day were midnight until 4am. From 5am the noise activity started rising sharply and remains around 59-61dB for most of the day. From 6pm noise levels continuously drop until midnight. The loudest parts of the day are typically 10am till 2pm, but still at a reasonable level of noise. Night time (11pm - 7am) values did not drop below 50dB, which is considered as a moderate level of noise.

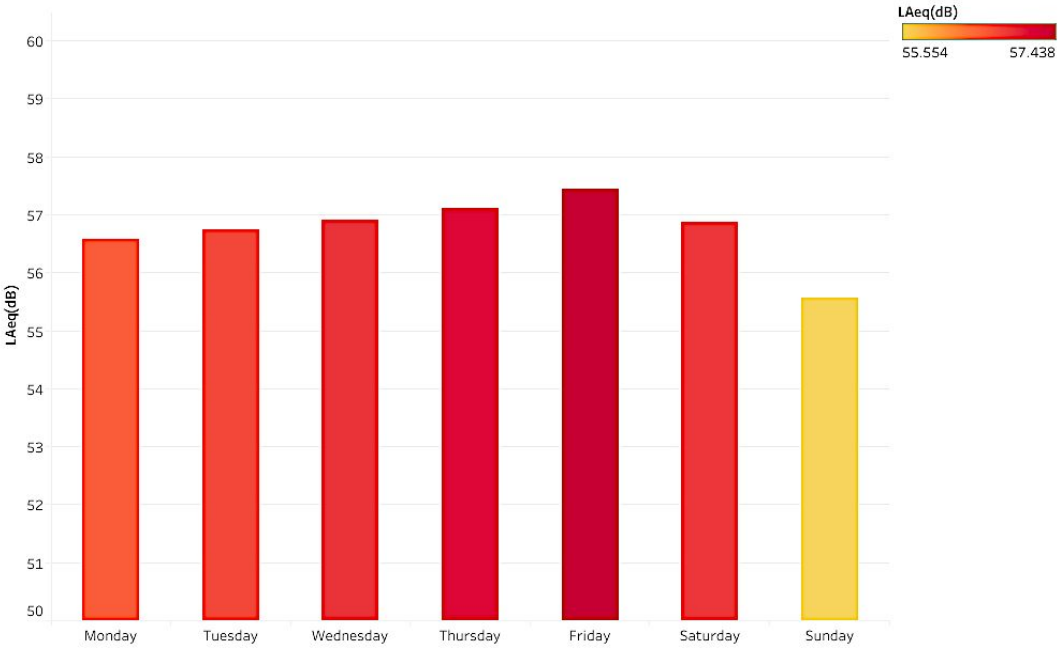


Fig 2

Figure 2 represents the average continuous sound levels for each day of the week. Friday represents the noisiest day of the week, while Sunday is the quietest. It is suspected that Friday is the noisiest day because of the combination of commercial activity in the daytime, followed by night-time economy noise in the evening.

Figures 3 to 8 represent the noise level at a particular time of the day on some specific dates when tagged vehicles were present at the site. Vehicles with different Vehicle Registration Numbers along with the noise levels are shown in separate figures to analyse their noise activity.

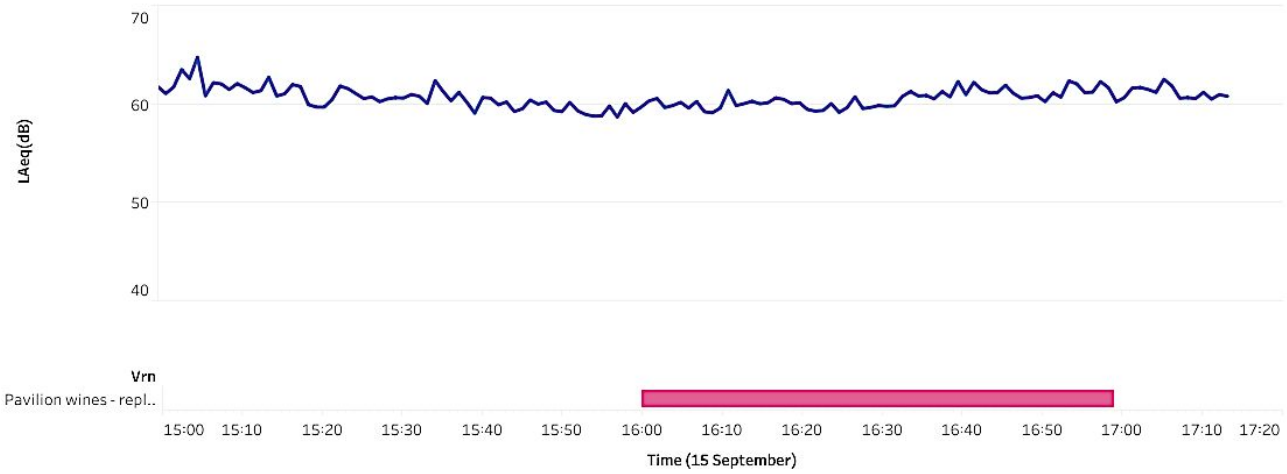


Fig 3

Figure 3 shows the presence of the "Pavilion Wines replacement" vehicle along with the noise level. The noise level remained high (~60dB) throughout the period when the vehicle was present, although the unusual amount of visits from the Pavilion Wines tag suggests it may not be on a vehicle but sat in their premises interacting with the system, and the noise level was caused by other sources.

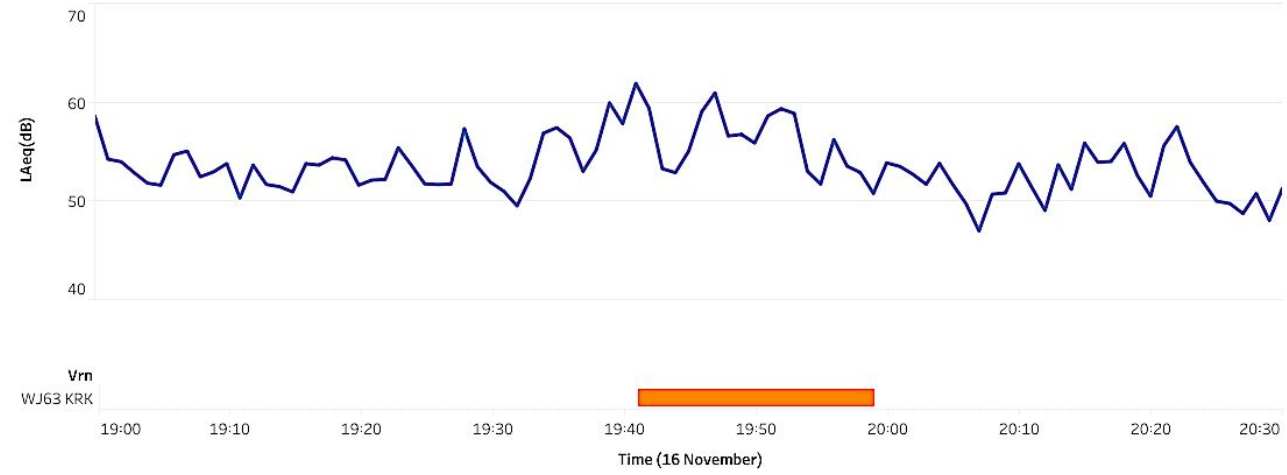


Fig 4

Figure 4 shows the presence of a vehicle with VRN WJ63 KRK with the noise activity which shows occasional peaks of noise and dropped when the vehicle left the site.

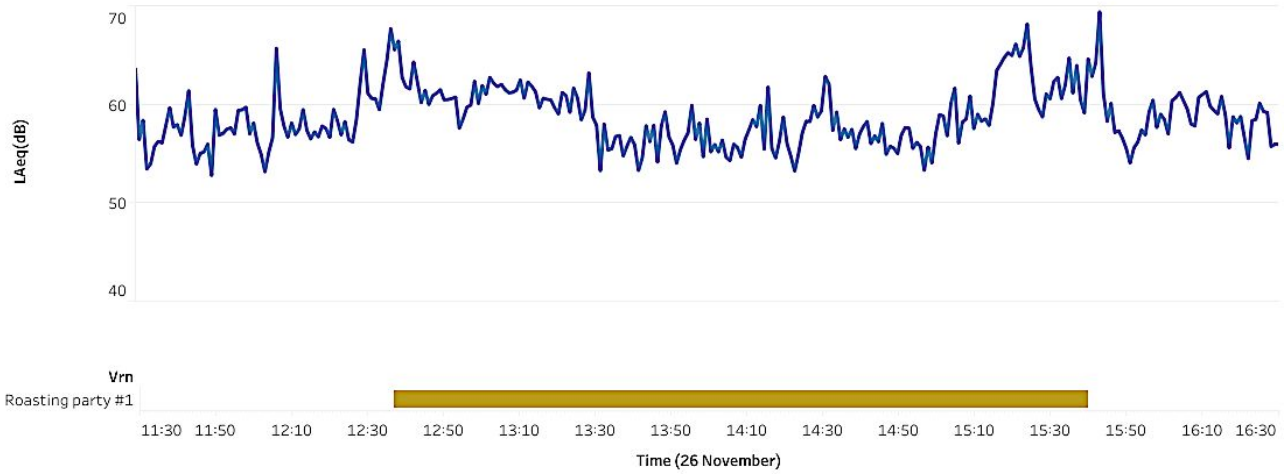


Fig 5

Figure 5 shows the presence of a Roasting Party vehicle with the noise level during that period. Two high peaks of noise were noticed during the arrival and departure time of the vehicle.

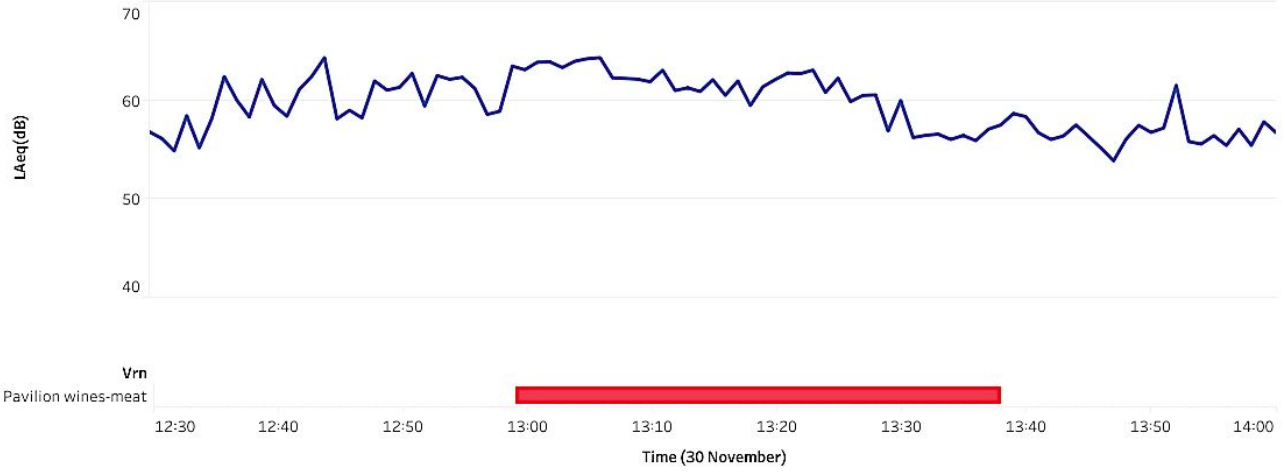


Fig 6

Figure 6 represents the presence of a Pavilion Wines vehicle. The noise level remained high throughout the period and dropped as the vehicle left the site.

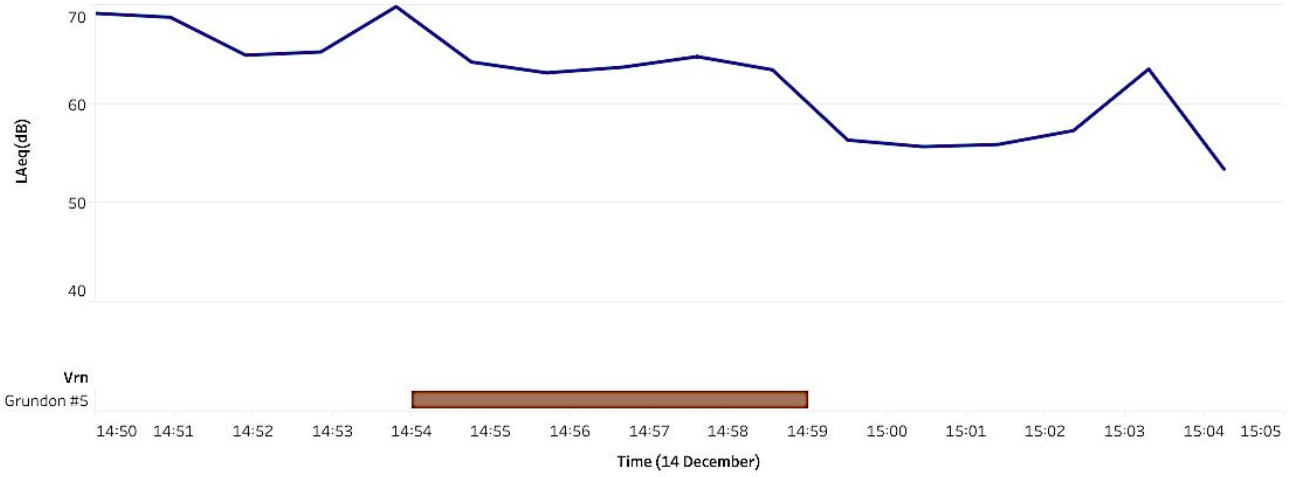


Fig 7

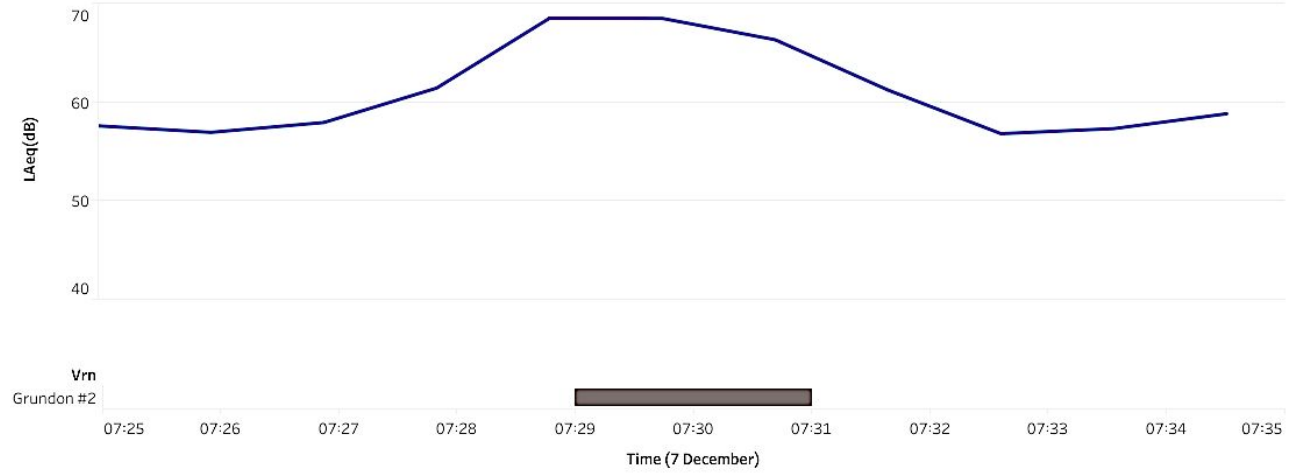


Fig 8

Figure 7 and Figure 8 represent 2 Grundon vehicles. In both the figures a high peak of noise was observed during the presence of the two vehicles which dropped when the vehicles left the site.

Conclusions

The hourly averaged level of noise measured never exceeded 65dB which is still an acceptable level of noise during the day according to the WHO guidelines. However the level of noise at night seems to always be around 50-55 dB which is considered as a moderate annoyance in the WHO guidelines.

Some correlation was observed between vehicle visits and noise level on the site. There was a clear correlation for the Grundon vehicles, and a smaller correlation for the Pavilion Wine vehicle.

It is believed that the following factors affected the correlation observed:

- The majority of vehicle visits recorded were during normal business hours, when ambient noise levels are high. Therefore, the impact of an individual vehicle is difficult to identify against the background level.
- The south end of Pavilion Road is a public space, with many vehicles visiting on a daily basis. The number of tagged vehicles was therefore a very small proportion of the total delivery activity. In a different area, like a private loading bay, a higher proportion of the visiting vehicles could be tagged which would likely lead to a stronger correlation between vehicle visits and noise.
- COVID-19 measures led to some businesses closing for periods of time and operating in different ways than normal.

6. Air Quality data analysis

Air Quality data was collected every 10 seconds throughout the monitoring period. The monitor installed at the site measures levels of NO_2, SO_2, CO, O3, PM10, PM2.5 and PM1. The data in this report covers the period from 5th August 2020 to 8th December 2020.

Fig 9

Figure 9 shows the hourly average NO_2 level from 5th August 2020 to 8th December 2020. Throughout the period, the NO_2 level remained below the threshold limit specified by DEFRA, which is 200 micrograms per cubic meter of air for hourly average NO_2. There was no significant change of NO_2 level during the lockdown period from 5th November 2020 to 2nd December 2020, mainly because not all activities were stopped during this period like the previous lockdown in March. The maximum hourly average NO_2 measured was 175 micrograms per cubic meter which is 14% less than the DEFRA limit of 200 micrograms per cubic meter.

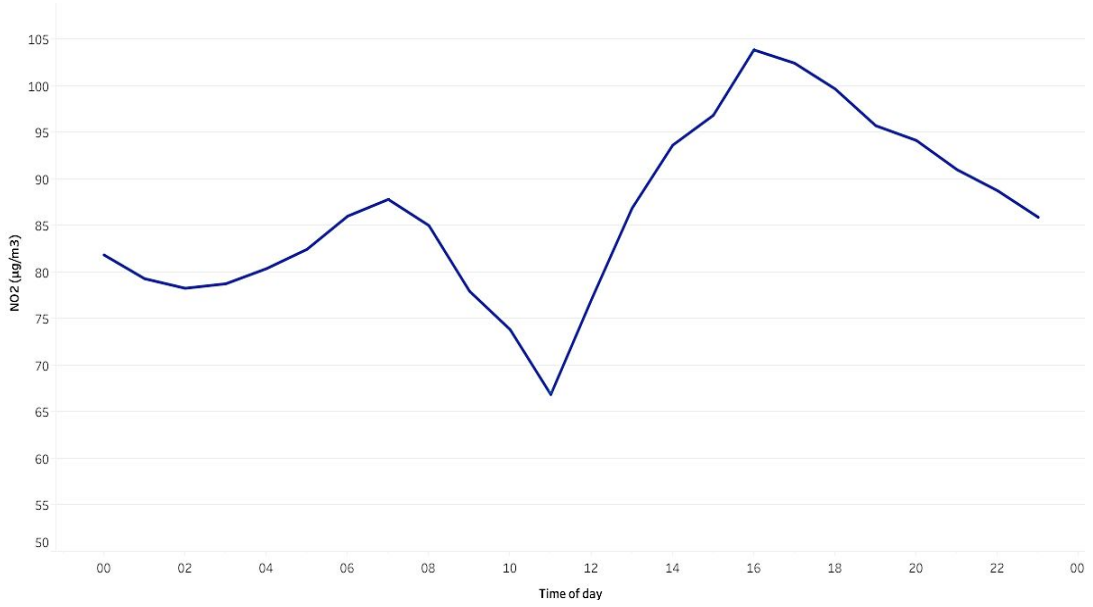


Fig 10

Figure 10 shows the average NO2 concentration throughout a day from Monday to Friday. Two peaks were observed in the morning at around 7-8am and in the afternoon at around 5-6pm most likely due to rush hour traffic.

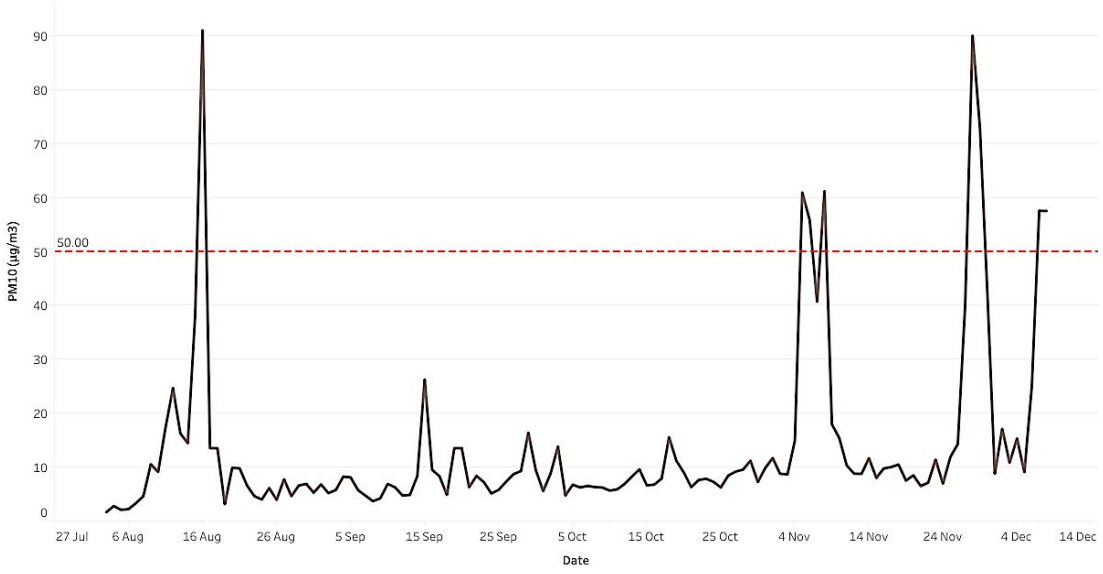


Fig 11

Figure 11 shows the 24-hour average of the PM10 level and the DEFRA threshold limit which is 50 micrograms per cubic meter of air, for 24-hour average. A total of 8 breaches (8 days with average pollution level higher than the limit) were recorded during the months of August, November and December. Out of the 8

breaches, 3 breaches happened on Sundays and one each on Monday, Tuesday, Thursday, Friday and Saturday. Due to the small number of tags on vehicles visiting the site, no correlation was identified between the PM10 level and the vehicles visiting the site.

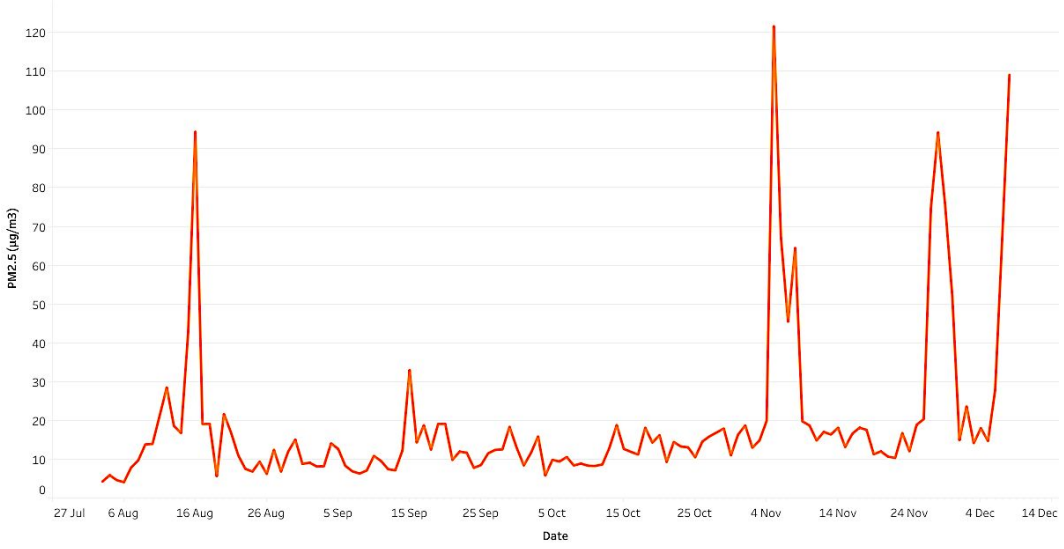


Fig 12

Figure 12 shows the 24-hour average of the PM2.5 level. The WHO limit for 24-hour average PM2.5 is 25 micrograms per cubic meter of air which was breached 15 times (15 days above the limit) during the entire period. The DEFRA threshold limit for annual mean PM2.5 is 10 micrograms per cubic meter of air, which was not analysed as we have monitored the data only for 4 months.

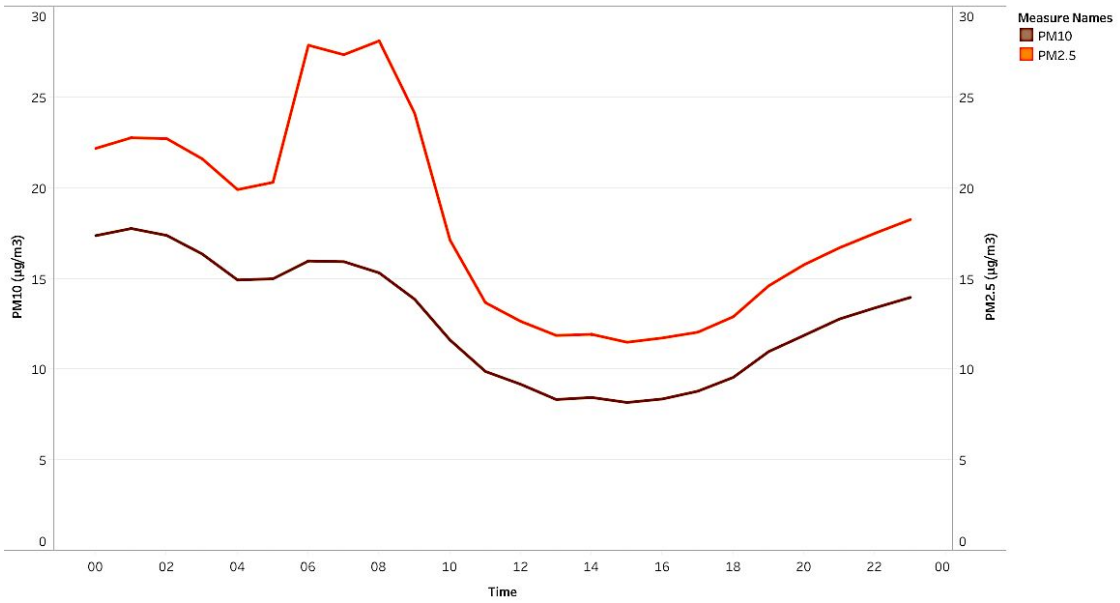


Fig 13

Figure 13 shows the average concentration of PM10 and PM2.5 throughout the day, using data collected on weekdays only. A peak of PM2.5 concentrations was observed from 6am to 9am which is most likely due to the nearby road traffic. The PM concentrations dropped after 9am and again started rising from 4pm.

Conclusions

The gases emissions are at a reasonable level. The PM10 and PM2.5 concentrations at the site are relatively high and this problem needs to be addressed in the future. In order to identify if there are specific vehicles coming on site that are especially polluting, it would be required to tag more vehicles.

8. Air Quality and Noise correlation

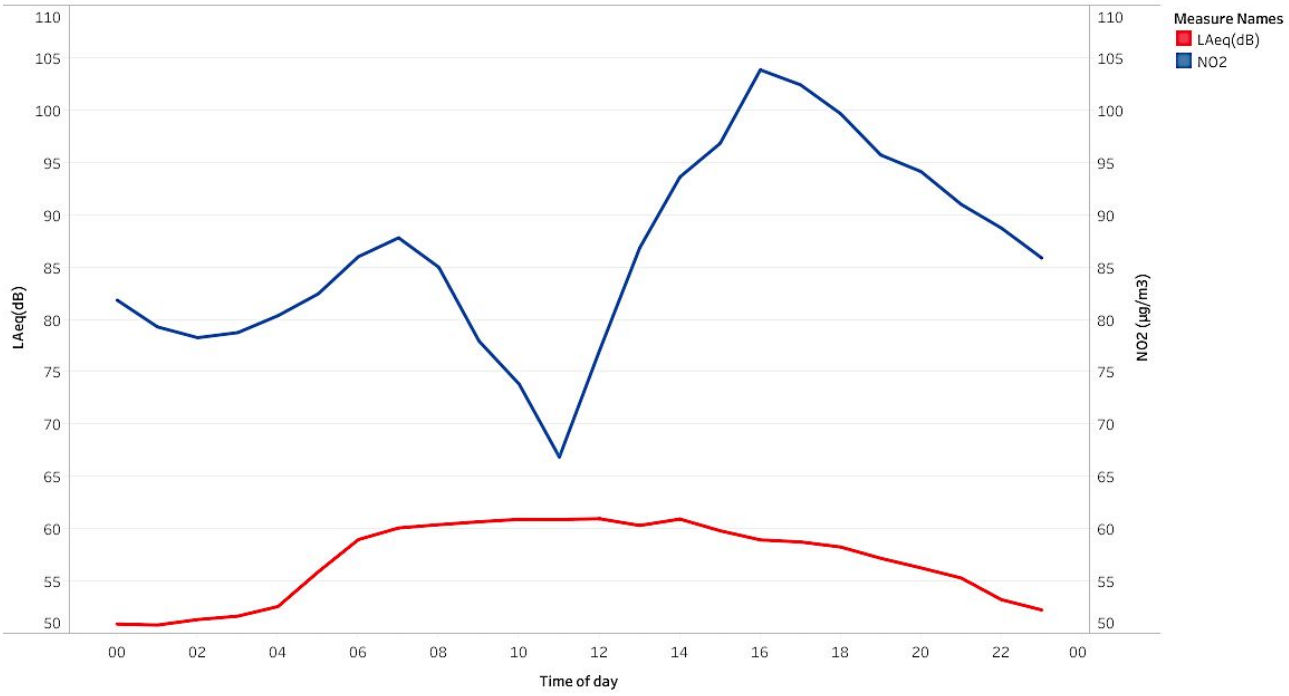


Fig 14

Figure 14 shows the hourly average NO_2 and noise throughout a day from Monday to Friday. The concentration of NO_2 and the noise level started to increase at the same time during the morning at 5am and dropped from 6pm in the evening. Unlike NO2, the noise level did not come down between 9am - 11am, it remained high and steady from 6am - 6pm.

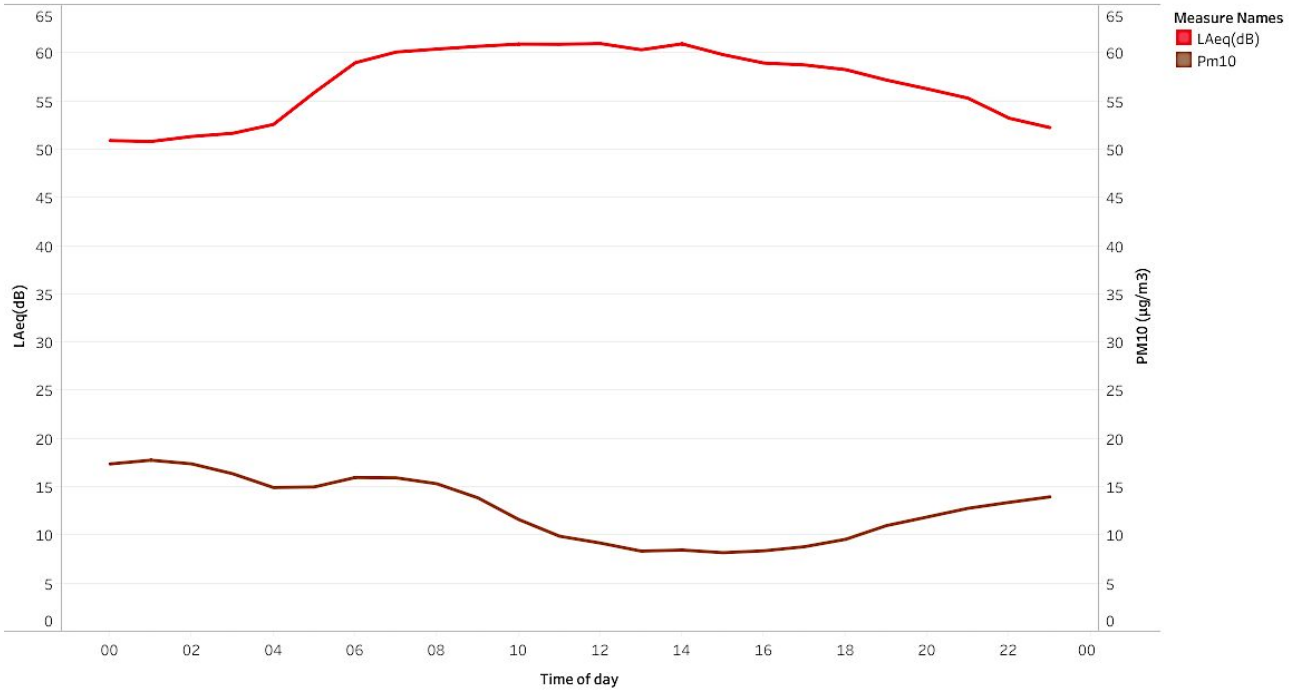


Fig 15

Figure 15 shows the hourly average PM10 concentration and noise level from Monday to Friday. Both the levels remained high during the morning rush hour. PM10 concentration dropped during 12 noon - 6pm after which it started increasing again, whereas the noise level came down after the evening rush hour.

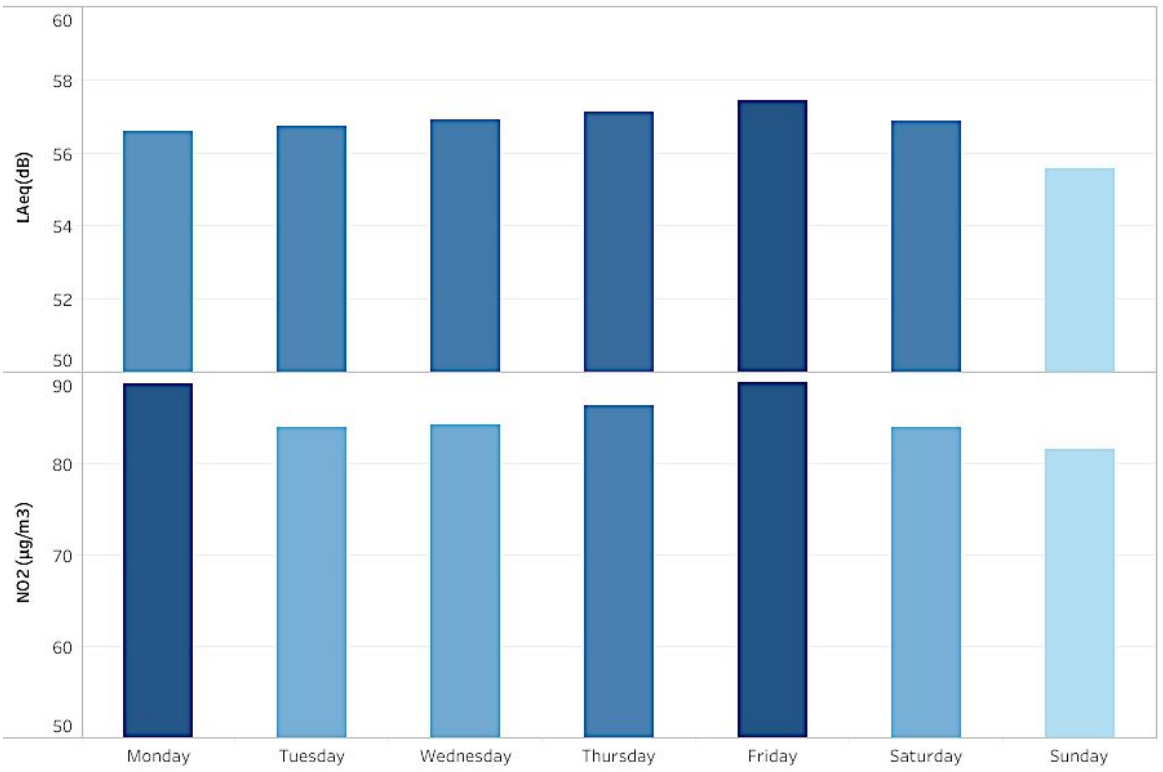


Fig 16

A correlation between NO_2 and noise level averaged over the days of the week shown in **Figure 16** depicts that on Fridays both the NO2 and noise level were at the highest level and Sundays remained the lowest.

10. Next steps

The purpose of this project was to trial a technology solution for monitoring and managing freight noise, especially where retiming of deliveries is being considered to counter peak-time congestion.

The project was able to show that a combination of noise monitoring and vehicle tracking technology can be used to measure the impact of delivery activity on noise levels.

As a next step, EMSOL would like to monitor a site where individual vehicles have more of an effect on the ambient levels of noise. We believe that the characteristics of such a site might include:

- Site access is more controlled, so that a much higher proportion of visiting vehicles can be tagged.
- The background level of noise is lower, meaning that individual vehicles have more of an effect on the noise level. This could be achieved by choosing a site which has night time deliveries, as ambient noise is generally lower at night.

EMSOL is soon starting a TfL funded trial with John Lewis Partnership, which will further investigate the use of technology to manage and monitor freight noise.