DATA STO-RIES: DEPT-FORD

DEPTFORD DATA STORIES
CITIZEN SENSE

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INTRO-
DUCTION

From late October 2016 to early September 2017, the Citizen Sense research project collaborated with residents of southeast London to develop a citizen-led air-quality monitoring project. Residents in this area were particularly concerned about air quality levels in relation to road transport and construction, and had already begun to undertake community activities for monitoring environmental pollutants.

THE DUSTBOX

Citizen Sense worked with local residents to develop a monitoring kit that included Dustbox sensors for monitoring particulate matter 2.5 (PM2.5), and an Airsift platform for mapping monitoring locations and viewing real-time and historic data. Residents were also provided with a logbook of instructions, which suggested several options for recording observations of environmental conditions and health effects.

ENVIRONMENTAL PUBLIC HEALTH

London suffers from poor air quality, and PM2.5 is one of several key pollutants. While many official air quality stations in the London Air Quality Network (LAQN) monitor nitrogen dioxide (NO^2), PM2.5 is less extensively monitored. However, PM2.5 adversely affects respiratory health. As reports from the Lancet and the Royal College of Physicians note, environmental public health is an area of growing concern.

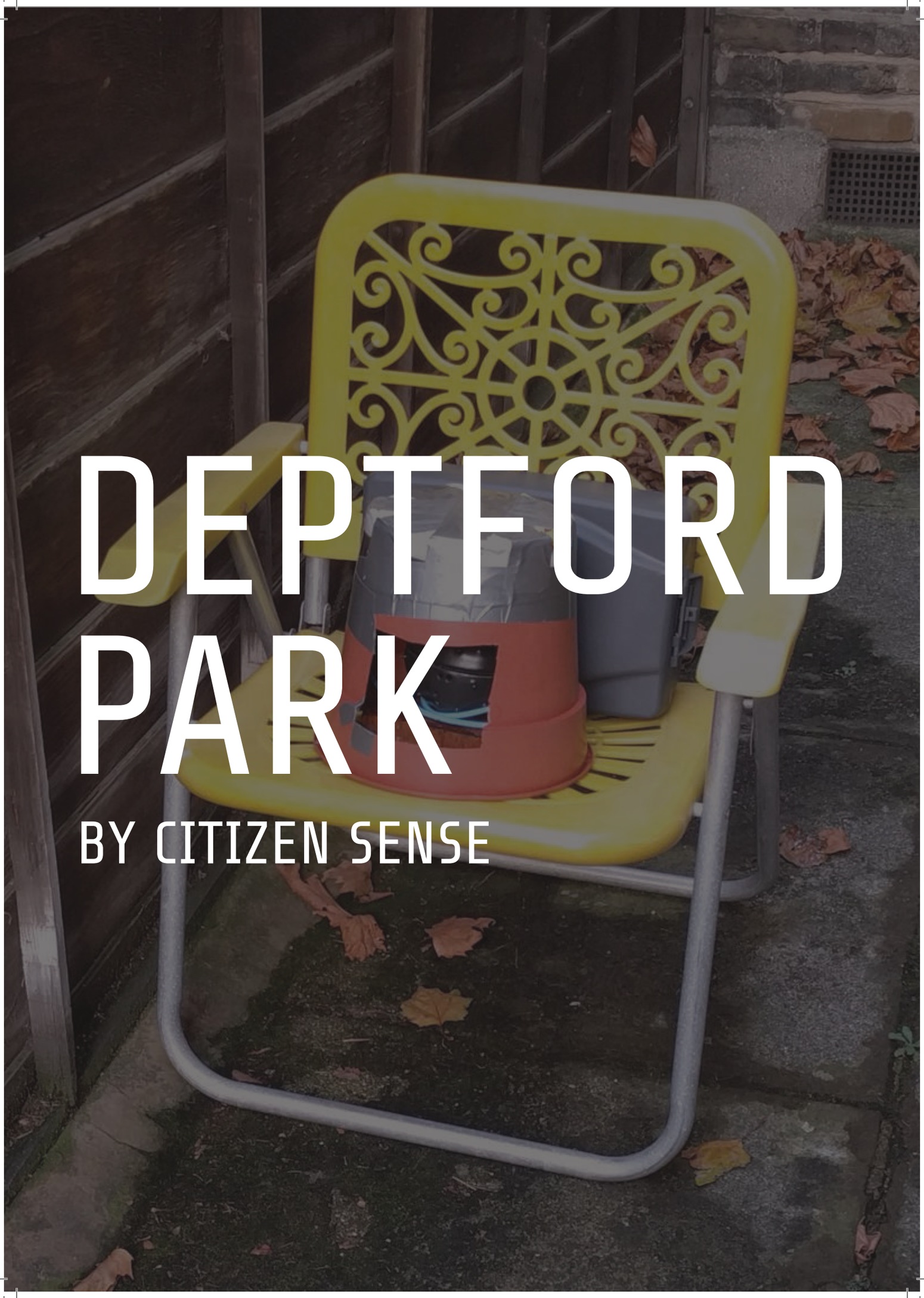
MONITORING NETWORK

The Citizen Sense Dustbox and kit were distributed in October 2016 during a monitoring workshop and walk, and were also available for free loan at the Deptford Lounge Library. In total, 30 monitors and logbooks were distributed to participants. The monitoring period ran for nearly 10 months, until September 2017. During peak monitoring activity, there were 21 active Dustboxes, and there was consistent monitoring taking place at up to 18 monitoring sites over a period of 7 months.

CITIZEN DATA: KEY FINDINGS

The 7 data stories presented on this site demonstrate the different patterns that have emerged from the data, including:

- Traffic intersections often have significantly higher pollutant levels. Higher PM2.5 levels can be made worse by construction activity and construction-related traffic in the same areas.
- Pollution data combined with wind data indicate that the River Thames is a possible emissions source in some areas.
- Urban design can make a significant and positive difference in terms of preventing and mitigating pollution, especially in well planted garden areas and pedestrian streets.



DEPTFORD PARK

BY CITIZEN SENSE

The key findings from citizen monitoring in the Deptford Park area indicate that automobile and HGV traffic are primary sources of emissions. These emission levels are most likely made worse by extensive construction activity and construction-related traffic in the area. This is especially evident in relation to Evelyn Street and Grinstead Road.

This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from planning for better transport to improving green infrastructure in the area.

THE LOCATION

The Deptford Park monitoring area includes a wide range of land uses, from residences and schools to heavy industry, including a waste transfer yard and Southeast Combined Heat and Power (SELCHP) incinerator to the west of the monitoring location.

There are two parks in this location, Deptford Park and Folkestone Gardens, which are key amenities for the area. Deptford Park, which was formerly a market garden, was sold by the Evelyn family to the London County Council and first opened to the public as a park in 1897. At 7.07 hectares it is one of the largest green spaces in the locality. It is comprised of a large grassy area with mature trees on all four borders, as well as a football pitch, seating areas and a playground.

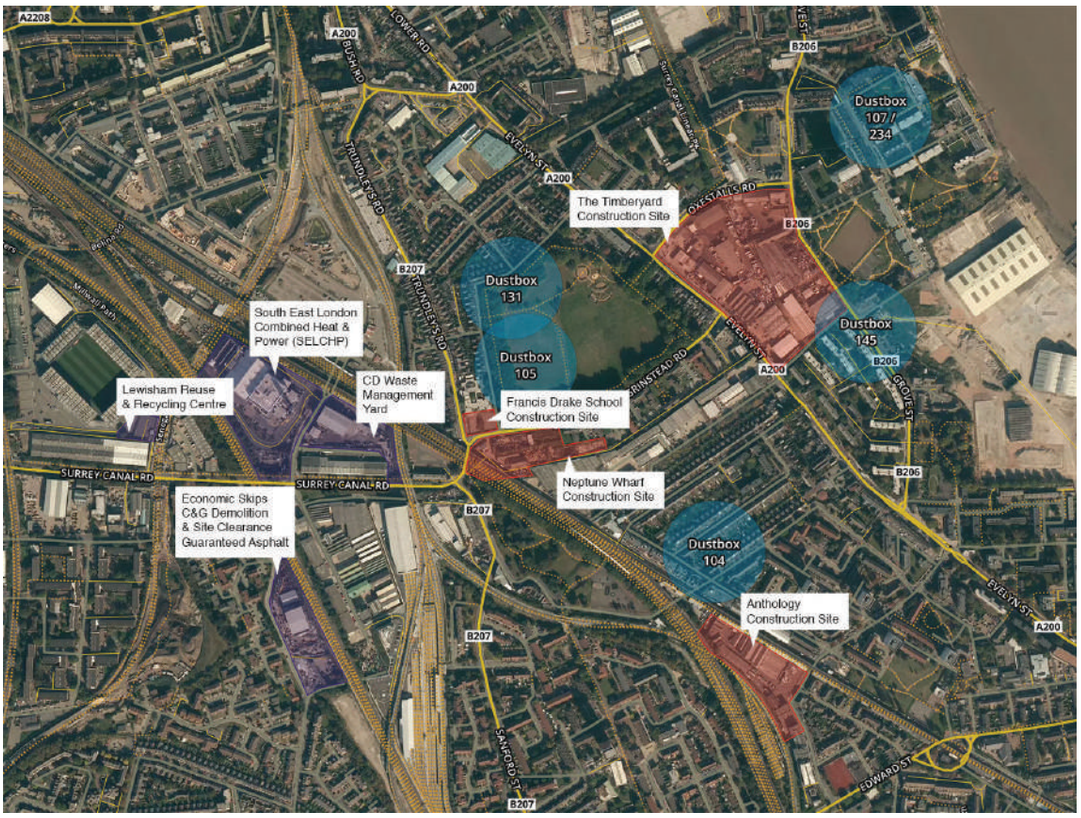
This part of the borough is undergoing rapid changes in land use, as large brownfield sites have been acquired by developers for the construction of high-density housing and a range of mixed-use amenities. Some of these projects remain in design and planning stages, but there are several active construction projects currently underway or nearing completion, including Anthology residential developments. Construction traffic occurs as a result of the ongoing developments in the area.

LOCAL SOURCES OF PARTICULATE POLLUTION

This data story compares a number of citizen monitoring sites nearby Deptford Park. Dustboxes 105 and 131 are situated in the back gardens of terraced houses on residential streets adjacent to the park. Dustbox 104 is also in the back garden of a house in a similar residential area but further south of the park. There are two anonymous monitoring locations in this area that are not included on the map. Anonymous data is used to corroborate findings in this data story, however, the anonymous Dustboxes are not included as named individual monitors. Dustboxes 104 and 105 monitored intermittently, due to the use of battery packs.

> *In total, 30 monitors were distributed to participants. The monitoring period ran for over 9 months, until September 2017. During peak monitoring activity, there were 21 active Dustboxes.*

As the map below shows, transportation corridors are the most immediately visible sources of particulate pollution. Evelyn Street (A200) runs parallel to the eastern boundary of Deptford Park, at a distance of approximately 50 metres. Evelyn Street meets a major one-way system to the northwest of the park (approximately 300 metres from the park's northern boundary at the junction of Evelyn Street and Bestwood Street). The smaller residential streets of Scawen Road and Grinstead Road encircle the park on the other three sides to the north, west and south at a distance of approximately 5 metres. Further west of the park lies Trundley's Road (B207), which runs roughly parallel to the park's western boundary at a distance of between 65 metres and 90 metres. Trundley's Road connects up to Bush Road, the northern arm of the one-way system. This area is also home to significant rail infrastructure for electric trains to the west and south of the park, which is used by Southeastern and Southern rail services and the TFL Overground service.



Monitoring and emissions near Deptford Park

To the west and southwest of Deptford Park is a cluster of businesses involved in waste management, shown in the map above. SELCHP is a combined heat and power facility that incinerates waste. The by-products include a range of gaseous species that include nitrogen oxides and ammonia, which are precursors to secondary particulate matter. Emissions are released via a 100-metre chimney stack. The processing of waste at the CD waste transfer yard and the Lewisham Reuse and Recycling Centre is another possible source of particulate matter. The waste transfer yard has been of previous concern to residents, and measures were implemented to attempt to reduce dust levels through various dust suppressant strategies. There was previously a London Air Quality Network (LAQN) monitor on Mercury Way that monitored for PM10, but this monitor is now meant to be managed by the Environment Agency, although the current data for this site does not appear to be available online. There are numerous busy roads with traffic from HGVs serving the incinerator with rubbish (most frequently from the Borough of Westminster) and hauling debris to and from the waste transfer yard. There is also a petrol station that is the site of frequent truck and car traffic on and off Evelyn Street at Oxestalls Road.

Westminster waste trucks travelling from SELCHP to Evelyn Street.

Grinstead Road traffic and construction.

Other businesses in the area include skip hire, site clearance and roofing services, which could produce particulate matter in the form of dust. These activities also entail regular movements of HGVs. The Anthology residential development was under construction across the monitoring period, and the site continues to be served by heavy truck traffic. During the spring and

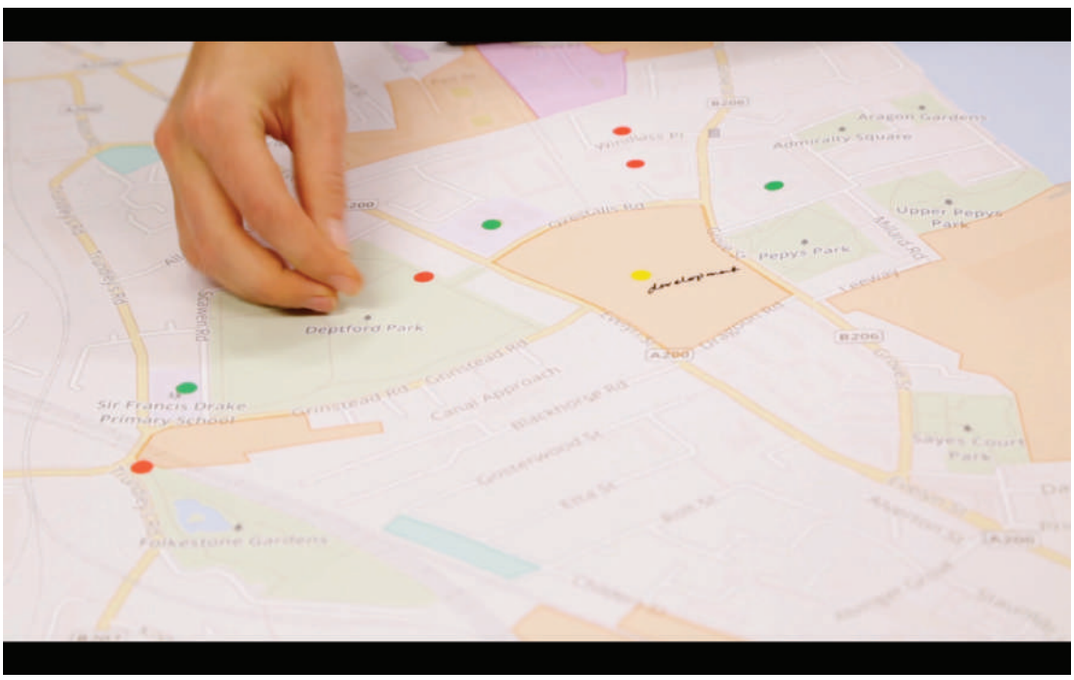
summer months soil decontamination works were underway at the Neptune Wharf site on Grinstead Road, which was a former chemical works site. At the time that this monitoring network was coming to an end, groundworks for the Timberyard development were in preparation.

LONDON-WIDE, REGIONAL AND GLOBAL SOURCES OF PARTICULATE POLLUTION

Particulate matter sources in London can be attributed to a broad range of emissions. Within London, $PM_{2.5}$ from transport (particularly diesel), industry, construction, cooking and heating all contribute significantly to London-wide levels. A significant amount of $PM_{2.5}$ emissions also comes from heavy industry and agriculture outside the UK, particularly France, Belgium, the Netherlands, Luxembourg, Germany and Poland. These emissions are thought to account for an urban background of approximately 10 $\mu g/m^3$. The importance of these transboundary effects of $PM_{2.5}$ emissions from outside of the UK on the total London $PM_{2.5}$ can vary between 40% to 80% daily depending on weather conditions. When long-range pollution episodes do occur in London, they are generally carried on easterly winds. There are a number of global emissions, events and practices that contribute particulate matter to the total London $PM_{2.5}$, including fuel production, industrial and domestic combustion, transportation, waste disposal, and agriculture, although these are harder to quantify.

OBSERVATIONS

Residents have been in dialogue with local authorities over episodes of poor air quality, especially in relation to the recurrence of strong unpleasant smells from the local waste transfer yard. Residents have also experienced episodes of strong chemical smells, such as the intense smell of pineapple, which they attribute to odour control spraying in this facility. Residents are concerned about the impact of emissions from SELCHP on local air quality, and reported that emissions were vented continuously, although the plume was most visible early in the morning. Residents experience poor air quality travelling along Evelyn Street, and note that the location of a local primary school directly on the highway is of concern. Residents reported that the decontamination works that took place during April, May, and June 2017 at the Neptune Wharf site on Grinstead Road gave off a strong burning smell, and frequent calls were made to the fire brigade. At times, water sprayers were visible on site, which were used to dampen down exposed soils. Contaminated soils were reportedly moved off-site for remediation. Re-suspension of particulates could have been possible on Grinstead Road during the groundworks. Residents also reported that construction dust was visible on the roadways near the Timberyard development site, which could be another possible particulate source.



IS THERE EVIDENCE OF A PROBLEM?

The Dustbox device used to monitor PM2.5 is an "indicative" monitor. This means that measurements can give an indication of pollutant concentrations, but cannot be directly compared with national and international guidelines and standards in an "official" or regulatory sense. Despite this, indicative monitors are a well-established method within atmospheric science for carrying out initial surveys of an area to establish whether a potential problem merits further investigation. Indicative monitors are also becoming increasingly available for citizen-based air-quality monitoring, similar to this study.

Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period. The co-location of Dustboxes in this data story indicates that there is a good similarity in measurements across the monitors used in this monitoring location, as well as with monitors in the extended community network, both at the start and end of the monitoring period.

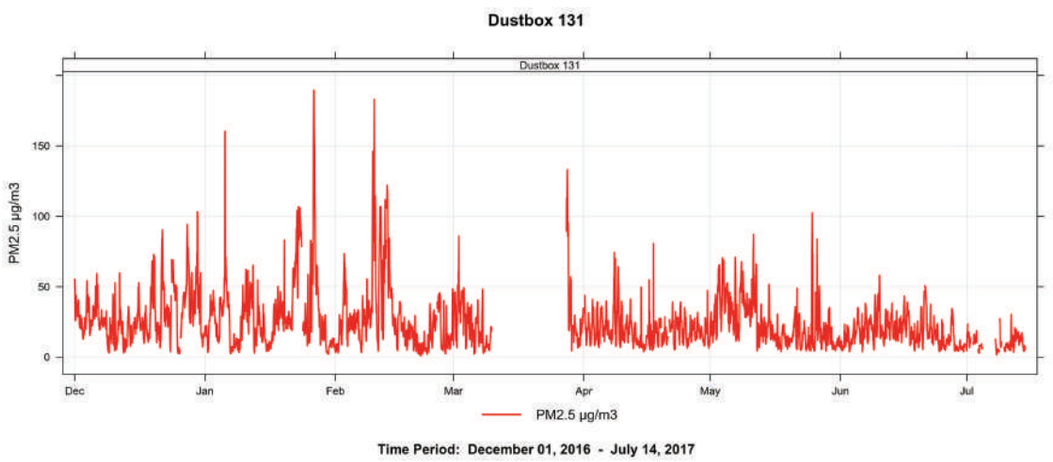


Figure 1: Dustbox 131. Line graph time-series chart of hourly mean PM2.5 concentrations from 1 December 2016 to 14 July 2017 (units: µg/m3).

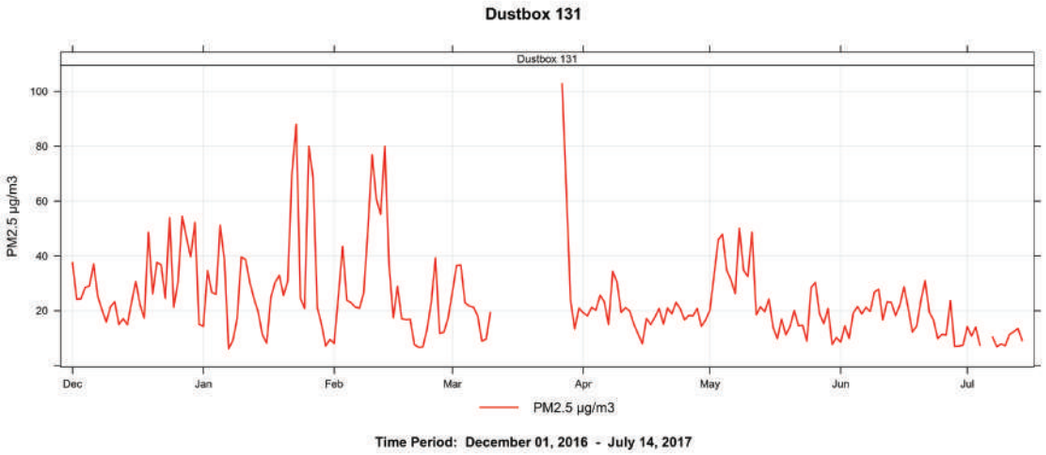


Figure 2: Dustbox 131. 24-hour mean concentrations of PM2.5 from 1 December to 14 July 2017. The World Health Organisation (WHO) guideline of 25 µg/m3 is exceeded on many occasions.

The World Health Organisation (WHO) has established a 24-hour mean guideline for PM2.5 of 25 µg/m3 (although there is no safe level of exposure). The time series graphs above in **Figures 1 and 2** show that the WHO guideline of 25 µg/m3 for the 24-hour daily mean concentration of PM2.5 was regularly breached between December 2016 and June 2017.

The WHO annual mean guideline for PM2.5 is 10 µg/m3, and recent reports indicate that 95% of London exceeds this guideline, often by nearly double, on an annual basis.

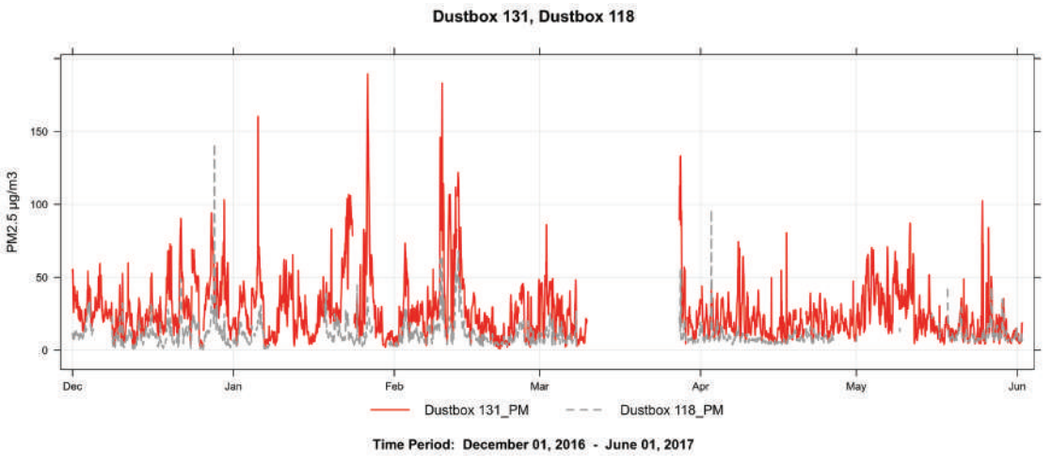


Figure 3: Dustboxes 131 and 118. Line graph of 1-hour mean PM2.5 concentrations from 1 December 2016 to 1 June 2017 (units: µg/m3).

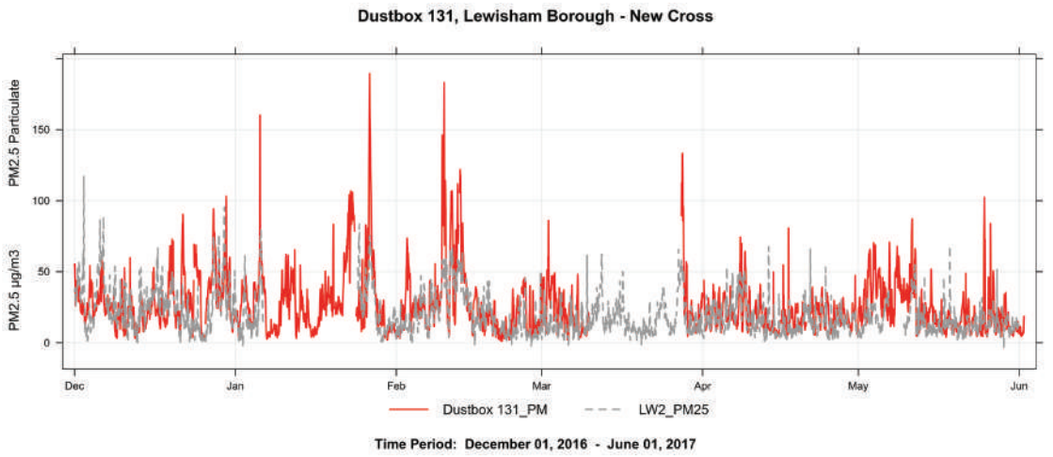


Figure 4: Dustbox 131 and LAQN New Cross monitoring site. Line graph of 1-hour mean PM2.5 concentrations from 1 December 2016 to 1 June 2017 (units: µg/m3).

It is important to determine whether these exceedances were caused by "local" sources of pollution close to the sensor (i.e., within 300 metres), or by regional sources affecting the wider area. By comparing the Deptford Park monitors to Dustbox 118 (**Figure 3** above) and to the LAQN New Cross monitoring station (**Figure 4** above), we can see that while many spikes are borough-wide pollution events, there are also more local events indicated by spikes on top of humps, for example at the beginning of March 2017.

There are many possible sources of pollution in the area, and we have to look at the measurements more closely to see if we can deduce which activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

CHARAC-
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PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

Using time plots, it is possible to analyse the times when pollution levels are most frequently elevated. Time plots aggregate $PM_{2.5}$ concentrations according to time, so that key patterns such as rush hours and traffic, as well as possible construction or industry sources, along with regional pollution events due to seasonal variation, are evident.

We are interested in ascertaining local sources of pollution in the vicinity of Dustboxes 104, 105 and 131 according to temporal patterns. The figures below group particulate concentrations across the monitoring period by hour, day of the week and month.

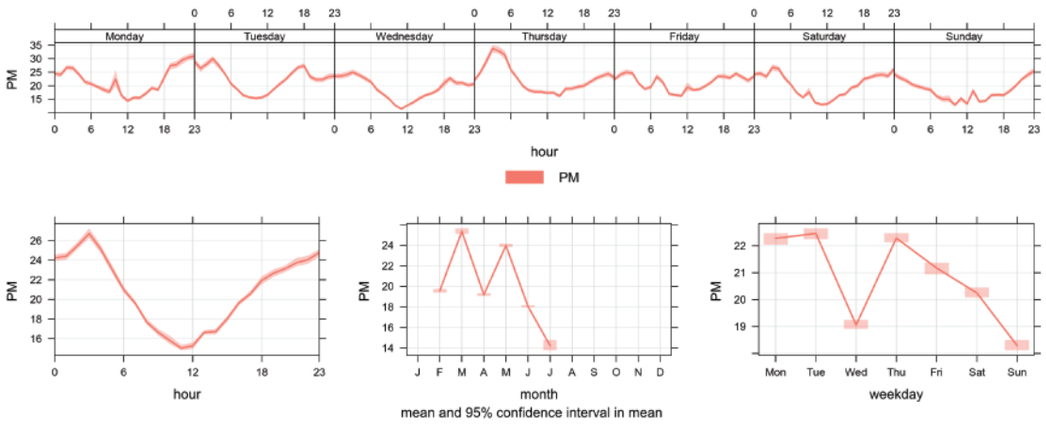


Figure 5: Dustbox 131. Time plot showing PM2.5 concentrations from 14 February to 1 July 2017, grouped by hour, month and weekday (units: µg/m3).

In London, transportation networks are known to be a significant source of $PM_{2.5}$ emissions. If local roads were important sources of pollution at the Dustbox monitoring locations, we would expect to see a diurnal pattern where levels of particulates were lower at night and higher during the daytime, with peak levels coinciding with morning and evening commutes. In **Figure 5** referring to Dustbox 131, we see an early morning peak and an early evening peak. However, the lowest levels of particulates are actually during the late morning, rather than at night as expected. Readings remain elevated overnight, a phenomenon that merits further investigation.

In a general sense, it should be noted that the weather plays a significant role in particulate levels. For example, dust tends to be dispersed more slowly during the hours of darkness, as vertical

and horizontal wind speeds are generally lower. This phenomenon may skew charts somewhat.

WHICH DIRECTION IS $PM_{2.5}$ COMING FROM?

Particulates are carried by the wind from emissions sources to the monitoring area. The direction and speed of wind are therefore important ways to gauge the locations of emissions sources in relation to the Dustbox monitors.

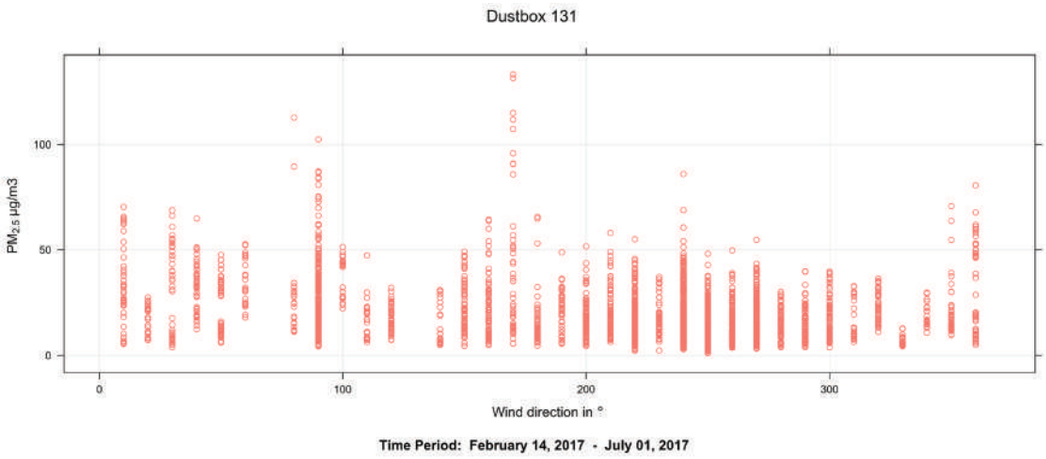
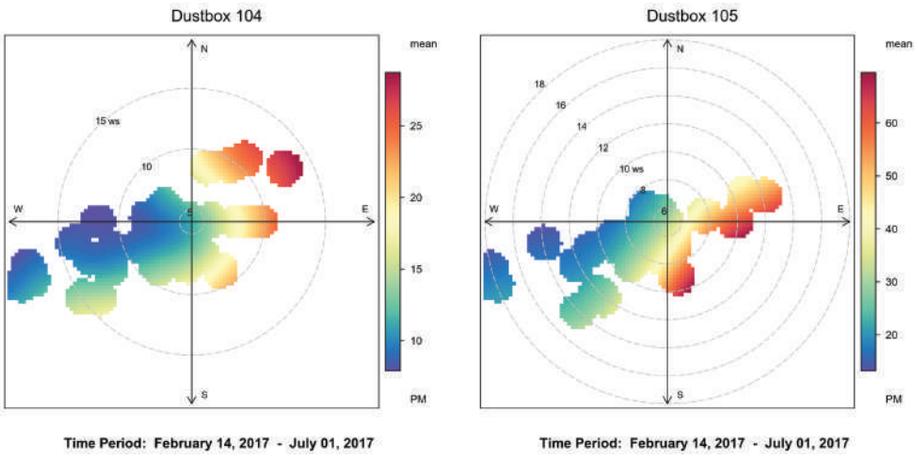


Figure 6: Dustbox 131. Scatter plot showing the relationship between mean PM2.5 concentrations and wind direction in degrees from 14 February to 1 July 2017 (PM2.5 units: µg/m3).

In **Figure 6**, the scatter plot shows that elevated levels of pollution are recorded when the wind is blowing from the northeast to east (60° to 90°). However, the scatter plot also shows $PM_{2.5}$ at higher levels when the wind is blowing from the south (180°) and southwest (240°).

The following polar plots also illustrate this relationship. Colour contours reflect pollutant concentrations in relation to wind direction and wind speed. Calm conditions (zero wind) are shown in the centre, increasing up to 20 metres per second (ms^{-1}) at the outer ring. The highest mean concentrations are shown in red, the lowest are in blue.



Figures 7a and 7b: Polar plots showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustboxes 104 and 105 from 14 February to 1 July 2017. The mean concentrations shown here are relative, e.g., for Dustbox 104 the highest mean concentration is approximately 25 µg/m3, and for Dustbox 105 it is approximately 60 µg/m3. Emissions levels are displayed on polar plots according to a gradient of low to high pollution levels. The colour coding refers to a different range of readings in each plot.

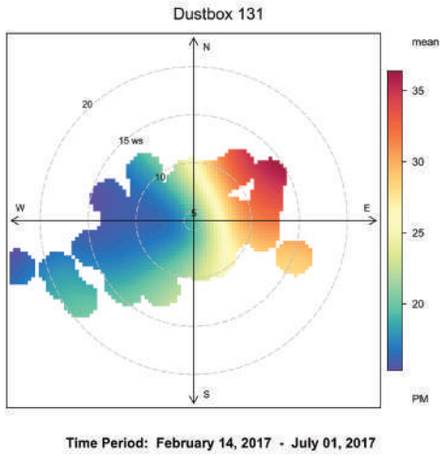


Figure 8: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring location for Dustbox 131 from 14 February to 1 July 2017. The mean concentrations shown here are relative.

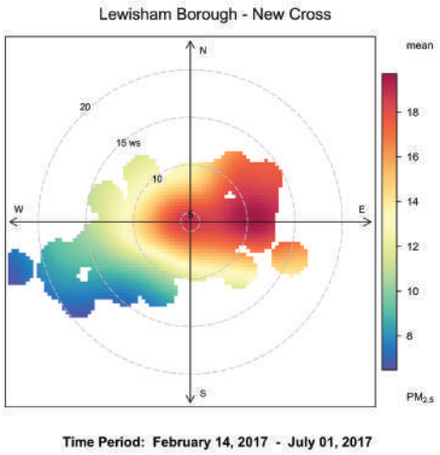


Figure 9: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for the LAQN New Cross monitoring station from 14 February to 1 July 2017. The mean concentrations shown here are relative.

The above polar plots for Dustboxes 104, 105 and 131 all show a similar pattern that corresponds with the scatter plot in Figure 6, which indicates that high levels of $PM_{2.5}$ are recorded from the northeast, east and southeast at low to moderate wind speeds.

Figure 9 for the LAQN New Cross monitoring station also shows high levels to the east, and northeast. There could be London-wide sources to the northeast and east that are recorded by all four Dustboxes in the area. This matches with the other Dustbox data stories in different parts of Deptford and New Cross. At the same time, the polar plots for Dustboxes 104 and 105 suggest that there could be a particulate source between the two monitors, as Dustbox 104 shows a source from the northeast and north, while Dustbox 105 shows a source from the southeast. Grinstead Road and Evelyn Street, as well as the construction in these areas, are possible sources of emissions at these sites.

UNDER WHICH WEATHER CONDITIONS ARE $PM_{2.5}$ LEVELS MOST EVIDENT?

Different sources of pollution will act in distinct ways according to the weather. For example, windblown dust will primarily occur during dry, windy conditions. Sometimes, you can learn about a source by characterizing this weather-related behaviour.

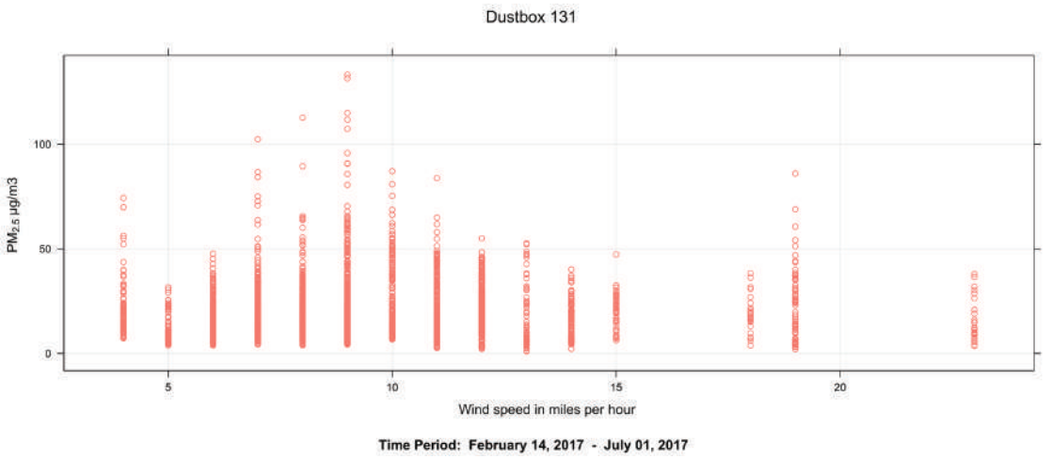


Figure 10: Dustbox 131. Scatter plot showing the relationship between mean PM2.5 concentrations and wind speed in miles per hour from 14 February to 1 July 2017 (PM2.5 units: µg/m3).

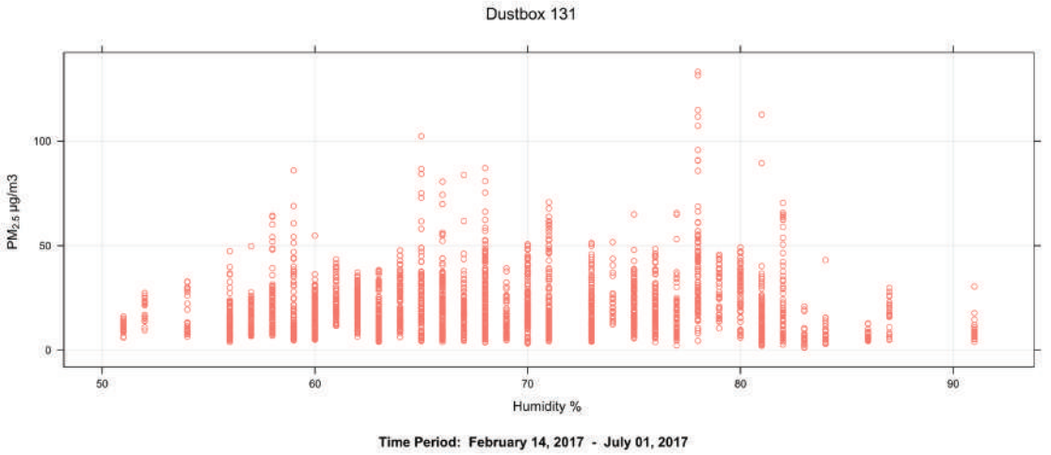


Figure 11: Dustbox 131. Scatter plot showing the relationship between mean PM2.5 concentrations and humidity from 14 February to 1 July 2017 (PM2.5 units: µg/m3).

The relationship between particulate pollution concentrations and wind speed is shown in **Figure 10**. This figure suggests that the main source of $PM_{2.5}$ at the Dustbox 131 site is not wind-blown dust, as the majority of peak concentrations are recorded during lower wind speeds. This conclusion is supported by **Figure 11**, which shows that the highest hourly $PM_{2.5}$ levels were recorded during relatively humid conditions (around 65% to 80% humidity). During high humidity, there would be fewer occurrences of wind-blown dust.


Time for trees
A guide to species selection for the UK - edition 03
Barcham
The Tree Specialists

DRAWING THE EVIDENCE TOGETHER

This data story has drawn together readings collected by Dustboxes 104, 105 and 131, alongside weather data, and contextual information about the local area. Using the tools provided through the Citizen Sense Airsift Data Analysis Toolkit, we have characterized sources of particulate pollution detected in the Deptford Park area as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources, most likely related to automobile and HGV traffic on Evelyn Street and on roads encircling the monitoring area, based on the analysis of line graphs and "spike" episodes above shared regional levels in London.
- The strongest local source(s) appear to be to the east, northeast and southeast of Dustboxes 104, 105 and 131. Evelyn Street is likely to be a significant source of local emissions from automobile and HGV traffic on roads encircling the monitoring area. Grinstead Road is also evident as a likely emissions source, based on the polar plots at Dustboxes 104 and 105, showing a higher pollutant levels between these two monitoring locations. This could be the result of construction and site remediation on nearby construction sites, as well as automobile and HGV traffic on Grinstead Road.
- The elevated levels of $PM_{2.5}$ identified at Dustbox 131 are strongest during morning and evenings, and the highest mean concentrations occurred on Tuesdays and Thursdays. These elevated levels are therefore likely to be related to commuter or transit road traffic.
- Some $PM_{2.5}$ levels are possibly related to re-suspended or wind-blown dust at lower wind speeds and moderate humidity, which are evidenced in the scatter plots above. Dust sources could be industrial activity, construction areas with uncovered ground, HGV traffic, and debris from the waste transfer yard re-suspended on roadways.
- It is clear that traffic has an impact on elevated $PM_{2.5}$ levels across the Deptford Park monitoring locations. However, construction activity, heavy industry and associated HGV traffic should also be investigated more closely as a likely local emissions source. These additional local sources such as construction sites (including demolition, on-site equipment and wind-blown dust), and industry would add to and exacerbate elevated pollution levels.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ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

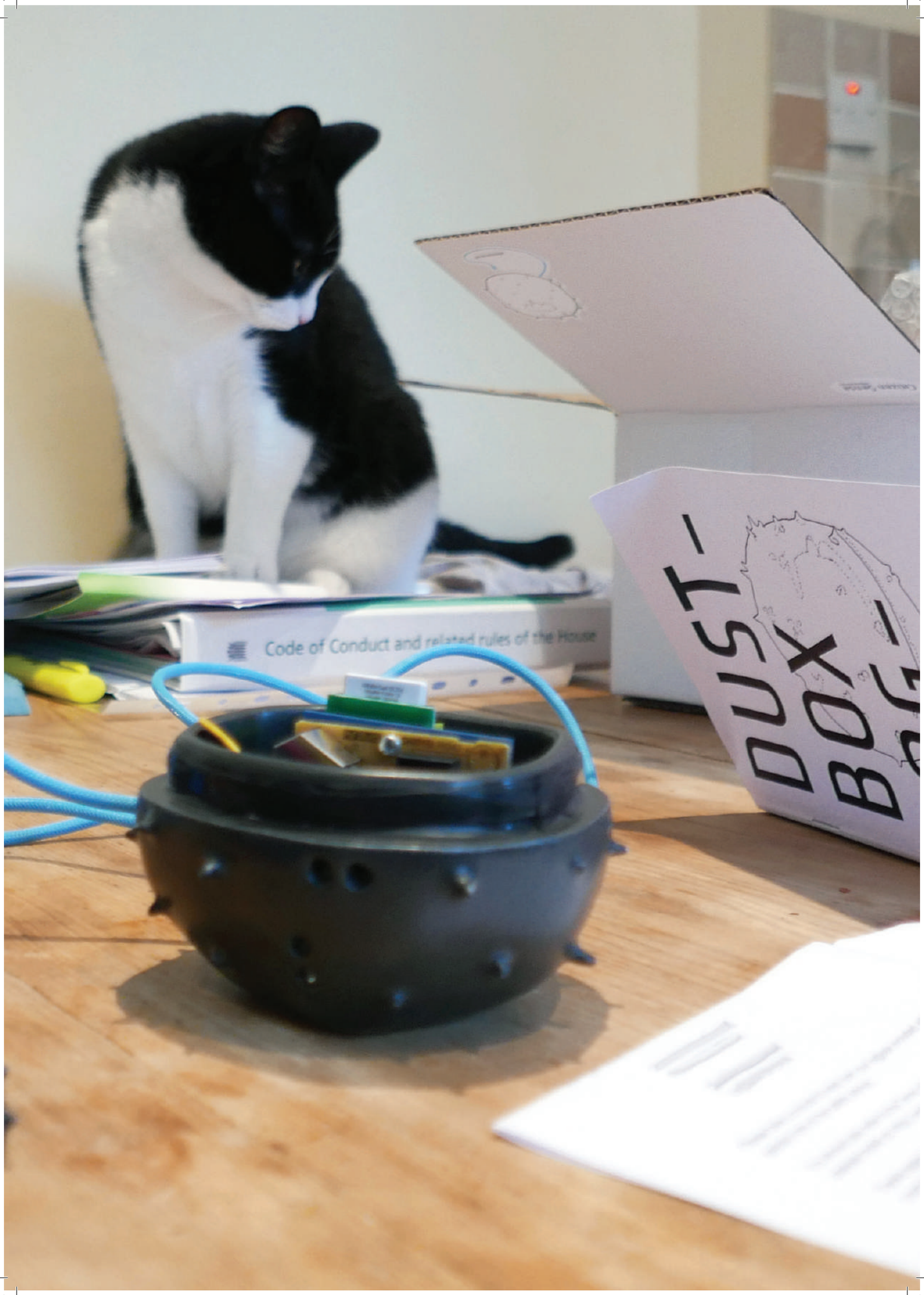
- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Extend and develop courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.


Code of Conduct and related rules of the House
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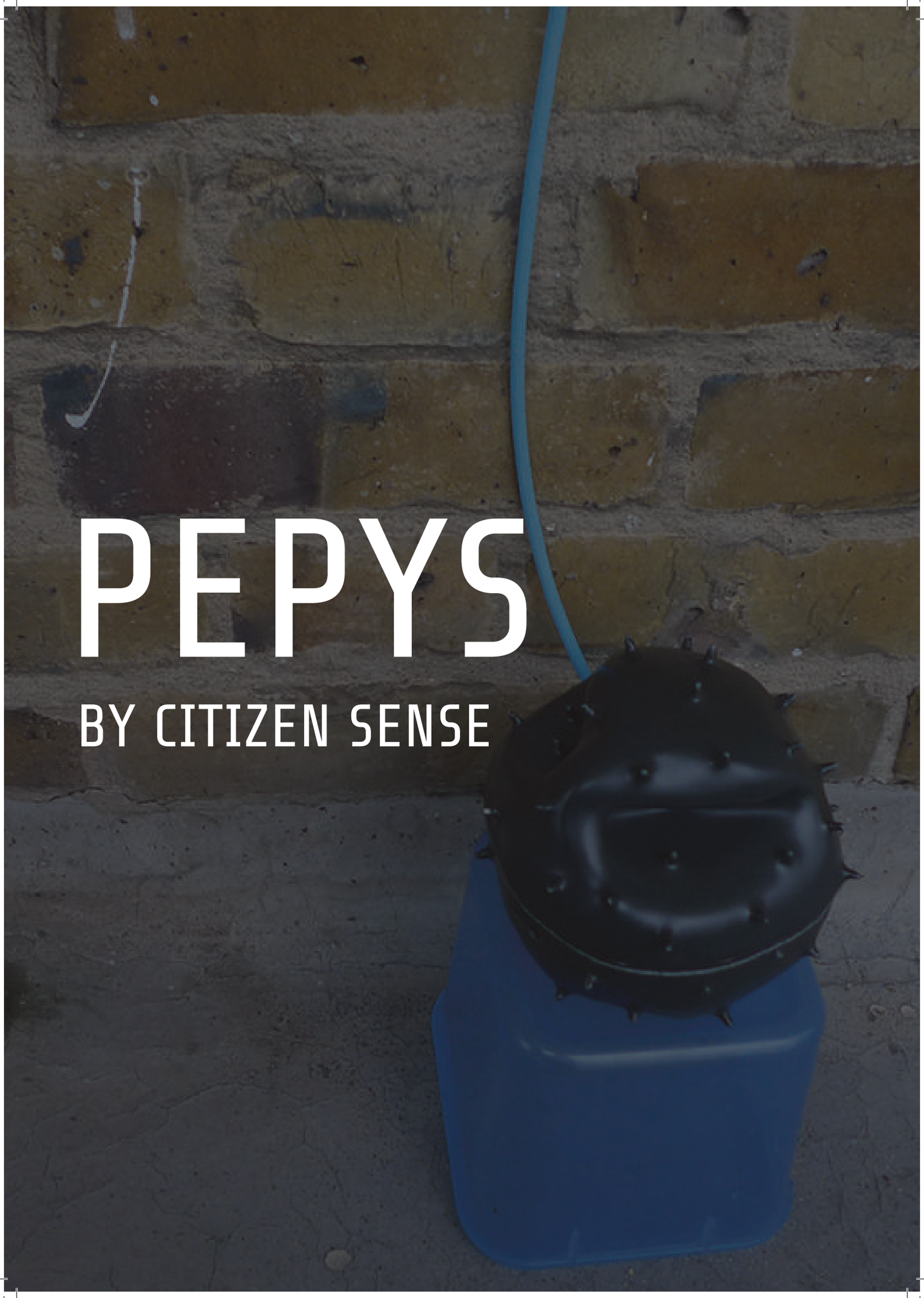

PEPYS

BY CITIZEN SENSE

The Pepys area includes high-rise and low-rise residential housing, numerous construction sites and busy roads. Pepys is adjacent to the River Thames. Citizen monitoring in this area indicates that the River Thames is likely to be a pollution source, in addition to $PM_{2.5}$ from transport and construction activity.

This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from planning for better transport to ensuring that pollution controls are in place for river traffic.

THE LOCATION

This data story focuses on the northernmost part of Evelyn Ward in Deptford. Historically, this area has been deeply intertwined with shipbuilding, an industry that has dramatically shaped land use. The area has been subject to waves of large-scale housing development from the 1970s onwards, including the Pepys Estate.

Land use is now changing rapidly in the Evelyn Ward as remaining tracts of brownfield industrial land have been sold for redevelopment into high-density mixed-use developments that feature a large proportion of housing. This data story focuses on two monitoring locations in this immediate area, Dustbox 107/234 and Dustbox 145. (Dustbox 107/234 combines data from two Dustboxes as the first device was replaced mid-way through monitoring.)

LOCAL SOURCES OF PARTICULATE POLLUTION

Particulate matter from road traffic is the most obvious source of particulate pollution in the area. Dustbox 107/234 is on the balcony of a fourth floor flat, facing west onto a grassy park and pedestrian area. Approximately 110 metres to the west of Dustbox 107/234 lies Grove Street (B206) an important thoroughfare, and a potential source of pollution. To the east of Dustbox 107/234 is a quiet estate road, two green spaces, and the Thames riverfront. Dustbox 145 is on a fourth floor walkway facing east onto Grove Street (B206), approximately 12 metres away. The major highway Evelyn Street (A200) lies approximately 135 metres to the southwest, and is likely to be a significant site of particulate emissions from road transport.

Two former industrial sites are in the immediate area, which have been slated for redevelopment. The largest site is Convoys Wharf, which is 16.6 hectares and has been disused for over a decade. This site could be a source of wind-blown dust. It is located approximately 19 metres to the east of Dustbox 145, and is approximately 215 metres to the southeast of Dustbox 107/234. Groundworks began on the Timberyard site at the very end of

the monitoring period. Approximately 195 metres to the east of Dustbox 107/234 is the River Thames. River traffic primarily is powered through diesel-generated vessels, which could be another possible source of particulate matter at both monitoring locations.

Timberyard construction site

LONDON-WIDE, REGIONAL AND GLOBAL SOURCES OF PARTICULATE POLLUTION

Particulate matter sources in London can be attributed to a broad range of emissions. Within London, PM2.5 from transport (particularly diesel), industry, construction, cooking and heating all contribute significantly to London-wide levels. A significant amount of PM2.5 emissions also comes from heavy industry and agriculture outside the UK, particularly France, Belgium, the Netherlands, Luxembourg, Germany and Poland. These emissions are thought to account for an urban background of approximately 10 µg/m3. The importance of these transboundary effects of PM2.5 emissions from outside of the UK on the total London PM2.5 can vary between 40% to 80% daily depending on weather conditions. When long-range pollution episodes do occur in London, they are generally carried on easterly winds. There are a number of global emissions, events and practices that contribute particulate matter to the total London PM2.5, including fuel production, industrial and domestic combustion, transportation, waste disposal, and agriculture, although these are harder to quantify.

OBSERVATIONS

Participants noted that previous citizen monitoring had taken place in the Pepys area, including in relation to noise and through studying lichens for indications of air quality. Participants were concerned about future construction and effects on air quality, and suggested current monitoring could establish a baseline for the area. Participants documented how transport and connectivity were major problems for mobility and they noted that cars were necessary for travel, especially between Pepys and New Cross, and for accessing schools. Participants observed that there is often considerable river traffic on the Thames. Participants questioned whether SELCHP, the nearby incinerator, could have an effect on air quality. As Pepys has a number of green spaces, participants also noted that these were important assets for ensuring positive urban environmental health.

Convoys Wharf site

IS THERE EVIDENCE OF A PROBLEM?

The Dustbox device used to monitor PM2.5 is an "indicative" monitor. This means that measurements can give an indication of pollutant concentrations, but cannot be directly compared with national and international guidelines and standards in an "official" or regulatory sense. Despite this, indicative monitoring is a well-established method within atmospheric science for carrying out initial surveys of an area to establish whether a potential problem merits further investigation. Indicative monitors are also becoming increasingly available for citizen-based air-quality monitoring, similar to this study.

Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period. The co-location of Dustboxes in this data story indicates that there is a good similarity in measurements across the monitors used in this monitoring location, as well as with monitors in the extended community network, both at the start and end of the monitoring period.

The World Health Organisation (WHO) has established a 24-hour mean guideline for PM2.5 of 25 µg/m³ (although there is no safe level of exposure). The time series graphs below show that the WHO guideline was regularly breached between December 2016 and June 2017. The WHO annual mean guideline for PM2.5 is 10 µg/m3, and recent reports indicate that 95% of London exceeds this guideline, often by nearly double, on an annual basis.

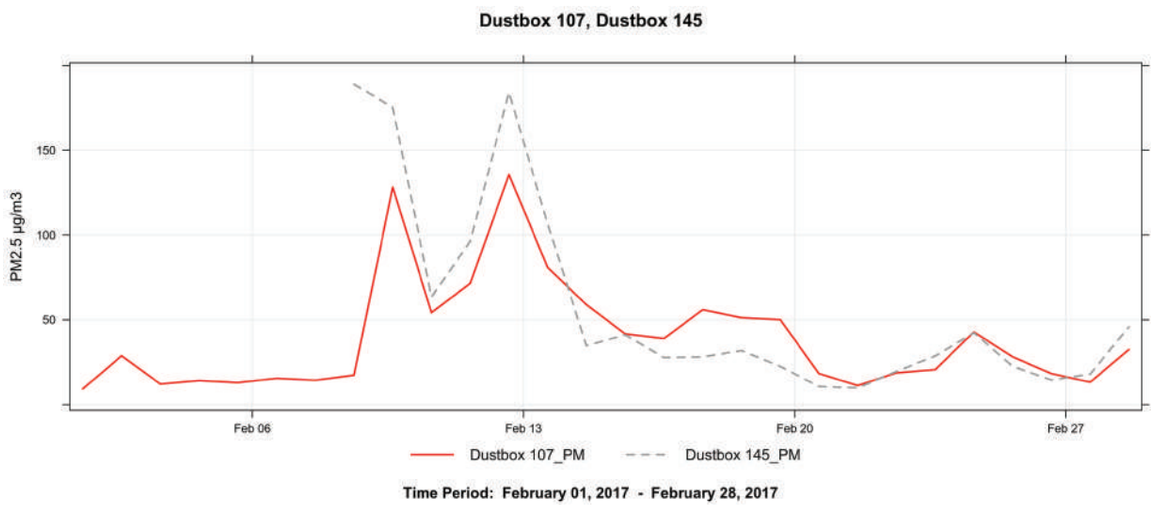

Figure 1: Dustboxes 107/234 and 145. Line graph of 24-hour mean PM2.5 concentrations during a pollution event in February 2017 (units: µg/m3).

Figure 1 shows daily mean concentrations of PM2.5 during an acute pollution episode in February 2017. Two peaks show high levels of PM2.5, that clearly breach the WHO 24-hour mean guideline.

There are many possible sources of pollution in the area, and we have to look at the measurements more closely to see if we can deduce which activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

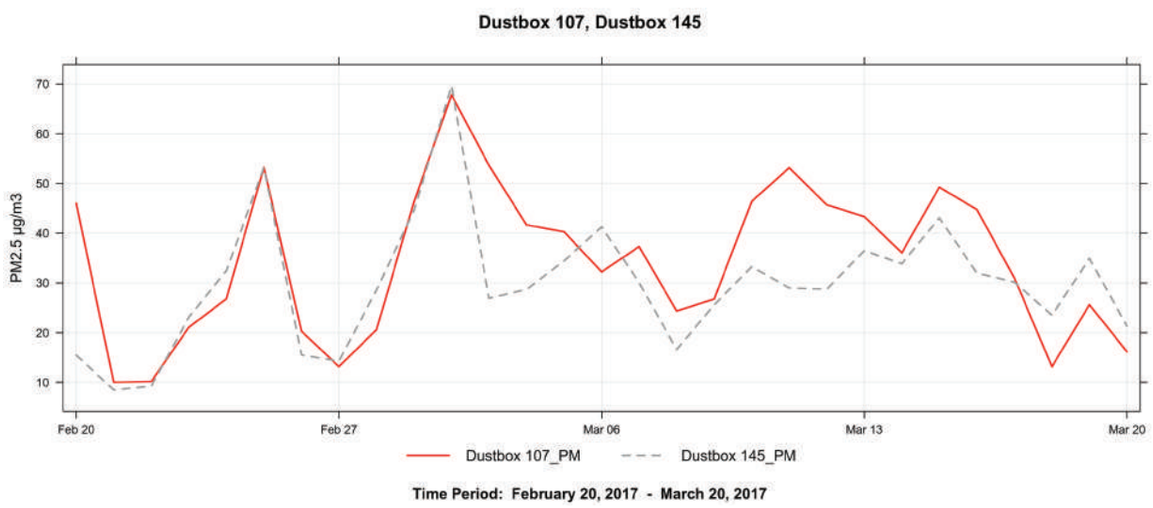

Figure 2: Dustboxes 107/234 and 145. Line graph of 24-hour mean PM2.5 concentrations from mid-February to mid-March 2017 (units: µg/m3).

Figure 2 is a time-series chart of daily mean concentrations from 20 February to 20 March. This line graph shows that even outside of acute pollution events, the WHO guideline is still regularly exceeded, suggesting that further investigation may be merited to identify likely sources of emissions.

It is useful to determine whether exceedances were caused by "local" sources of pollution close to the sensor (i.e., within 300 metres), or by regional sources affecting the London-wide area. There may be multiple sources of PM2.5 within the urban areas of Deptford and New Cross, Southeast London and the overall southeast of England region.
Patterns recorded by Dustbox PM2.5 monitors can be read alongside levels recorded by statutory monitoring infrastructure to help determine whether pollution events are occurring across London, or only in localized sites.

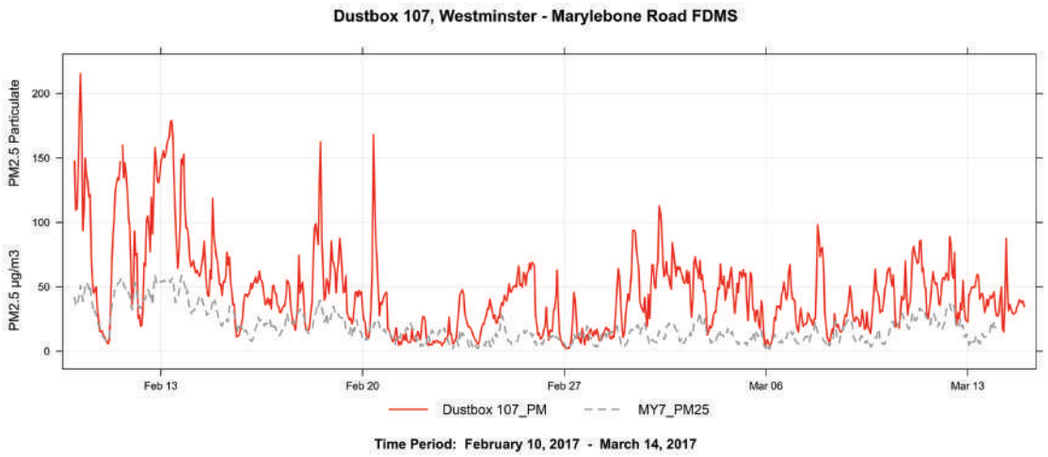

Figure 3: Dustbox 107/234 and the LAQN Marylebone monitoring station. Line graph of 1-hour mean PM2.5 concentrations from mid-February to mid-March 2017 (units: µg/m3).

This time series graph shows daily mean PM2.5 levels at the LAQN at the Marylebone site during February – a site to the north and west of Deptford in central London. In line with the Deptford sites **Figure 3** shows that PM2.5 levels at the central LAQN site were high from 10 to 15 February 2017. Because the PM2.5 spike shown in the Deptford data was also experienced at the LAQN site, this suggests that a London-wide pollution event occurred. This pattern is corroborated as a pollution episode by the LAQN, which recorded moderate levels of PM10 and PM2.5 in the middle of February across London.

However, **Figure 3** also shows that outside of this key pollution event, levels recorded by Dustbox monitors show regular elevated levels of PM2.5 that are not shown at the LAQN site, suggesting that local emissions sources are also a factor in air pollution in Deptford.

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THE
PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

We are interested in ascertaining possible local sources of pollution around Dustboxes 107/234 and 145. The figures below group particulate concentrations across the monitoring period by hour, month and day of the week.

Patterns emerging within aggregated Dustbox data can provide indications of possible particulate emissions sources. If transport networks were local sources of particulate pollution, we would expect to see higher levels during the daytime, and lower levels at night and on Sundays. Elevated levels might be expected to correspond to peak commuting periods, during morning and evening rush hour.

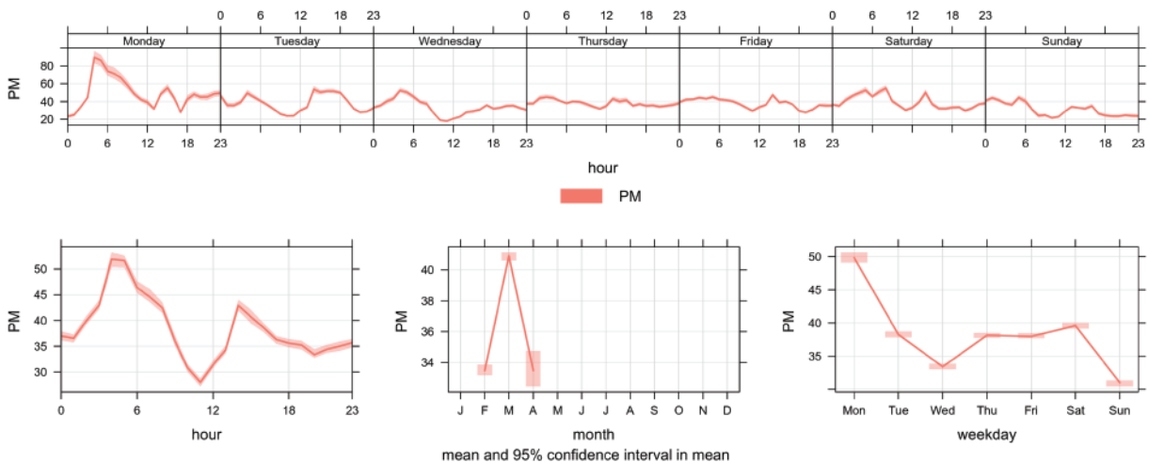


Figure 4: Dustbox 107/234. Time plot showing mean PM2.5 concentrations grouped by hour, month and weekday from 14 February to 1 April 2017 (units: µg/m3).

In **Figure 4**, Dustbox 107/234 levels are highest at approximately 5 am, which could reflect a morning rush hour peak due to deliveries and construction crews. However, the lowest levels of particulates are registered around 11 am rather than during the night, something that requires further investigation. Additionally it appears that these high levels are more pronounced on Mondays.

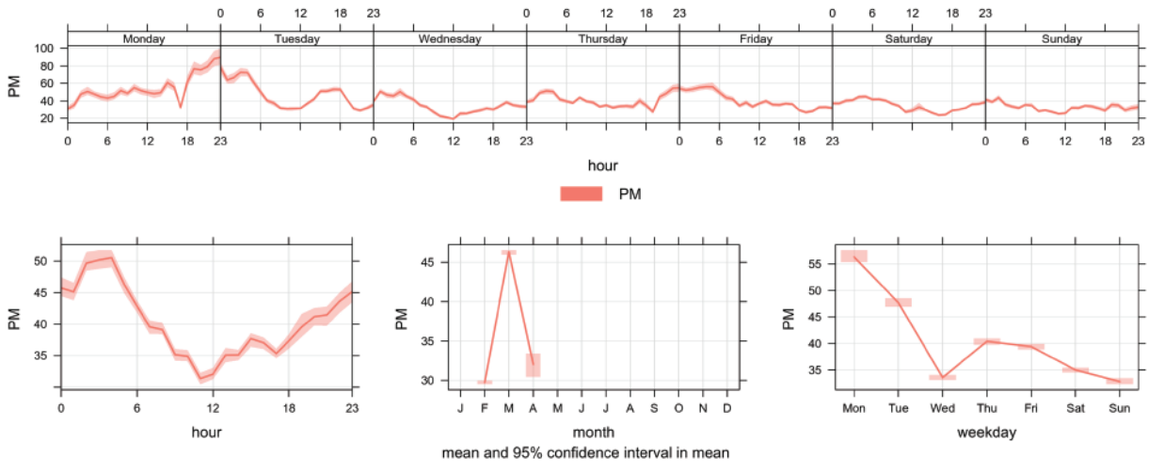


Figure 5: Dustbox 145. Time plot showing mean PM2.5 concentrations grouped by hour, month and weekday from 14 February to 1 April 2017 (units: µg/m3).

While **Figure 5** also shows elevated levels of PM2.5 on Mondays, these are most evident in the evening rather than the morning. Overall, however, PM2.5 levels tend to be highest in the mornings.

It should be noted that the weather plays a significant role in particulate levels. For example, dust tends to be dispersed more slowly during the hours of darkness, as vertical and horizontal wind speeds are generally lower. This phenomenon may skew charts somewhat.

WHICH DIRECTION IS PM2.5 COMING FROM?

Particulates are carried by the wind from emissions sources to the monitoring area. The direction and speed of wind are therefore important ways to gauge the locations of emissions sources in relation to the Dustbox monitors.

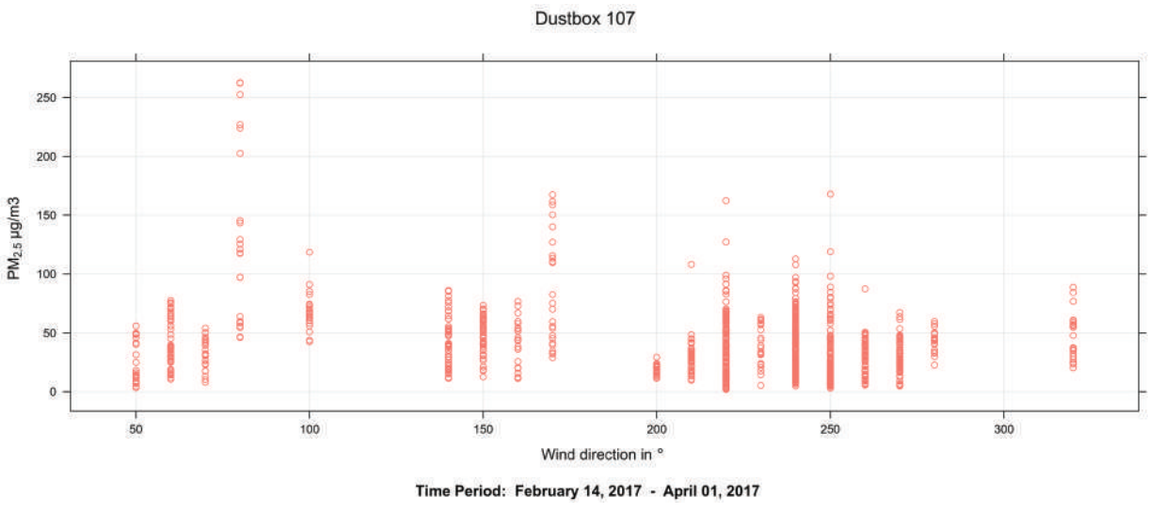


Figure 6: Dustbox 107/234. Scatter plot showing the relationship between mean PM2.5 concentrations and wind direction in degrees from 14 February to 1 April 2017 (PM2.5 units: µg/m3).

The scatter plot in **Figure 6** shows that the highest peaks of pollution are recorded when the wind is blowing from the northeast to east (500 to 900), southeast (1400 to 1700) and southwest (2200 to 2700). The northeast to east signal corresponds with the polar plots below, which suggest that the River Thames could be an emissions source. However, the southwest signal suggests that Evelyn Road could be a possible emissions source.

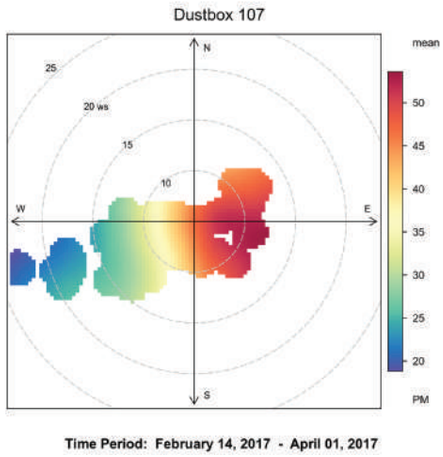


Figure 7: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring location for Dustbox 107/234 from 14 February to 1 April 2017. The mean concentrations shown here are relative, e.g., for Dustbox 107/234 the highest mean concentration is approximately 50 µg/m3 and for Dustbox 145 below it is approximately 65 µg/m3. Emissions levels are displayed on polar plots according to a gradient of low to high pollution levels. The colour coding refers to a different range of readings in each plot.

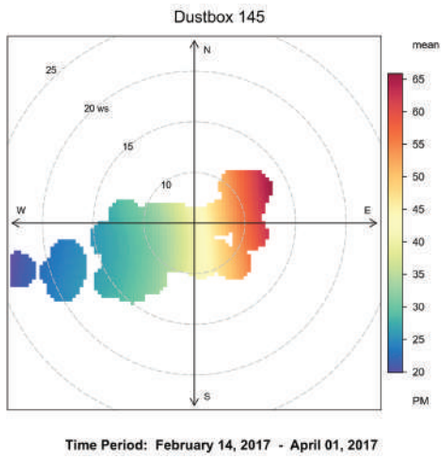


Figure 8: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring location for Dustbox 145 from 14 February to 1 April 2017.

The above polar plots (**Figures 7 and 8**) also illustrate the relationship between higher pollution levels and wind direction. Colour contours reflect pollutant concentrations in relation to wind direction and wind speed. Calm conditions (zero wind) are

shown in the centre, increasing up to 25 metres per second (ms-1) at the outer ring. The highest mean concentrations are shown in red, with the lowest in blue.

We can observe a similar pattern of local emissions sources across **Figures 7 and 8**. In both monitoring sites the highest levels of particulate matter are registered during local winds to the east. However, the pattern suggests there may be a local source or sources to the northeast of Dustbox 145 and to the southeast of Dustbox 107/234. In addition, Dustbox 107/234 may be closer than Dustbox 145 to a source or sources in the east.

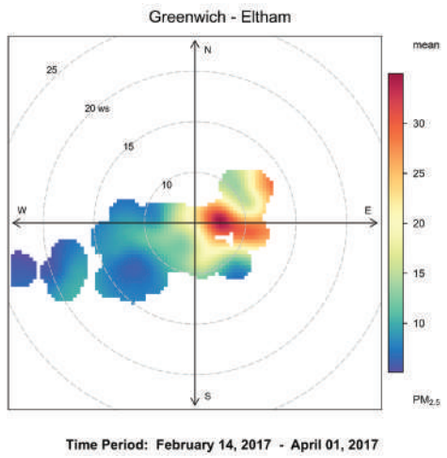


Figure 9: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring location for the LAQN Greenwich Eltham monitoring station from 14 February to 1 April 2017.

The polar plot in **Figure 9** is provided as a comparison with Dustboxes 107/234 and 145 to indicate that while there is an easterly source of emissions at a regional level, levels at the two Dustboxes are higher than the regional levels at this urban background site. This suggests that there are additional local sources at the Dustbox 107/234 and 145 locations.

UNDER WHICH WEATHER CONDITIONS ARE PM2.5 LEVELS MOST EVIDENT?

Different sources of pollution will behave in distinct ways according to the weather. For example, windblown dust will primarily occur during dry, windy conditions. Sometimes, you can learn about a source by characterizing this weather-related behaviour.

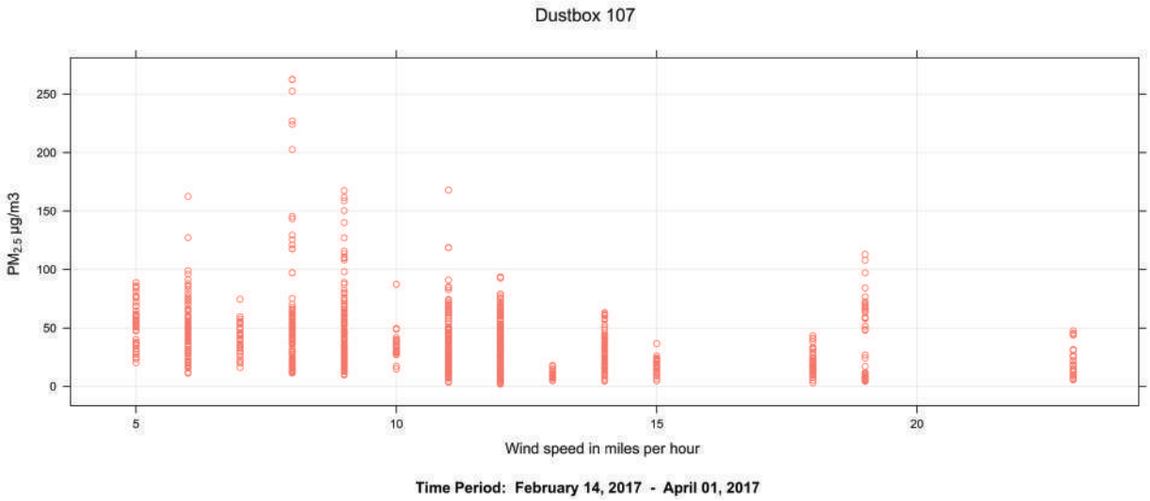


Figure 10: Dustbox 107/234. Scatter plot showing the relationship between mean PM2.5 concentrations and wind speed in miles per hour from 14 February to 1 April 2017 (PM2.5 units: µg/m3).

The relationship between particulate pollution concentrations and wind speed is shown in **Figure 10**. The highest concentrations are recorded at lower wind speeds, suggesting that the main source is not wind-blown dust.

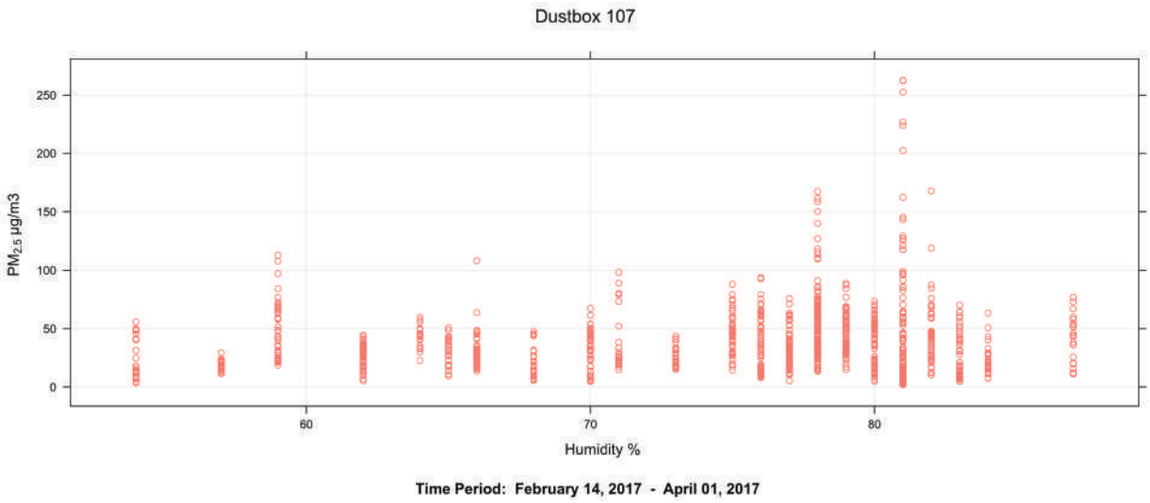


Figure 11: Dustbox 107/234. Scatter plot showing the relationship between mean PM2.5 concentrations and humidity from 14 February to 1 April 2017 (PM2.5 units: µg/m3).

The highest PM2.5 readings occur at levels of relatively high humidity between 60% to 85%, as shown in **Figure 11**. During high humidity there would be fewer occurrences of wind-blown dust.

DRAWING THE EVIDENCE TOGETHER

Using the tools provided through the Citizen Sense Airsift Data Analysis Toolkit, we have characterized sources of particulate pollution detected in the Pepys area as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources, most likely related to road traffic at Evelyn Street and river traffic at the River Thames, based on the analysis of line graphs and "spike" episodes above shared regional levels in London.
- The strongest local source(s) appear to be to the east, northeast and southwest of the Dustbox 107/234 and Dustbox 145 monitoring locations. Evelyn Street is likely to be a significant source of local emissions from road traffic. However, the higher levels of pollution are from the east and northeast, suggesting the River Thames could be a significant emissions source. It is less likely that Convoys Wharf is a source of wind-blown dust, as particulate levels are higher during episodes of lower winds and higher humidity.
- The elevated levels of PM2.5 identified at Dustboxes 107/234 and 145 are strongest during the morning and evening, and the highest mean concentrations occurred on Mondays. These elevated levels are therefore possibly related to road traffic from construction crews, delivery vehicles and commuters.
- It is clear that traffic has an impact on elevated PM2.5 levels across the Pepys monitoring locations. However, the River Thames should also be investigated more closely as a likely local emissions source. River traffic could be contributing to the elevated levels of pollution traveling from the east at Dustbox 107/234, and from the east/northeast at Dustbox 145. Additional local sources such as construction sites (including demolition, on-site equipment and wind-blown dust), and industry would add to and exacerbate elevated pollution levels.

ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

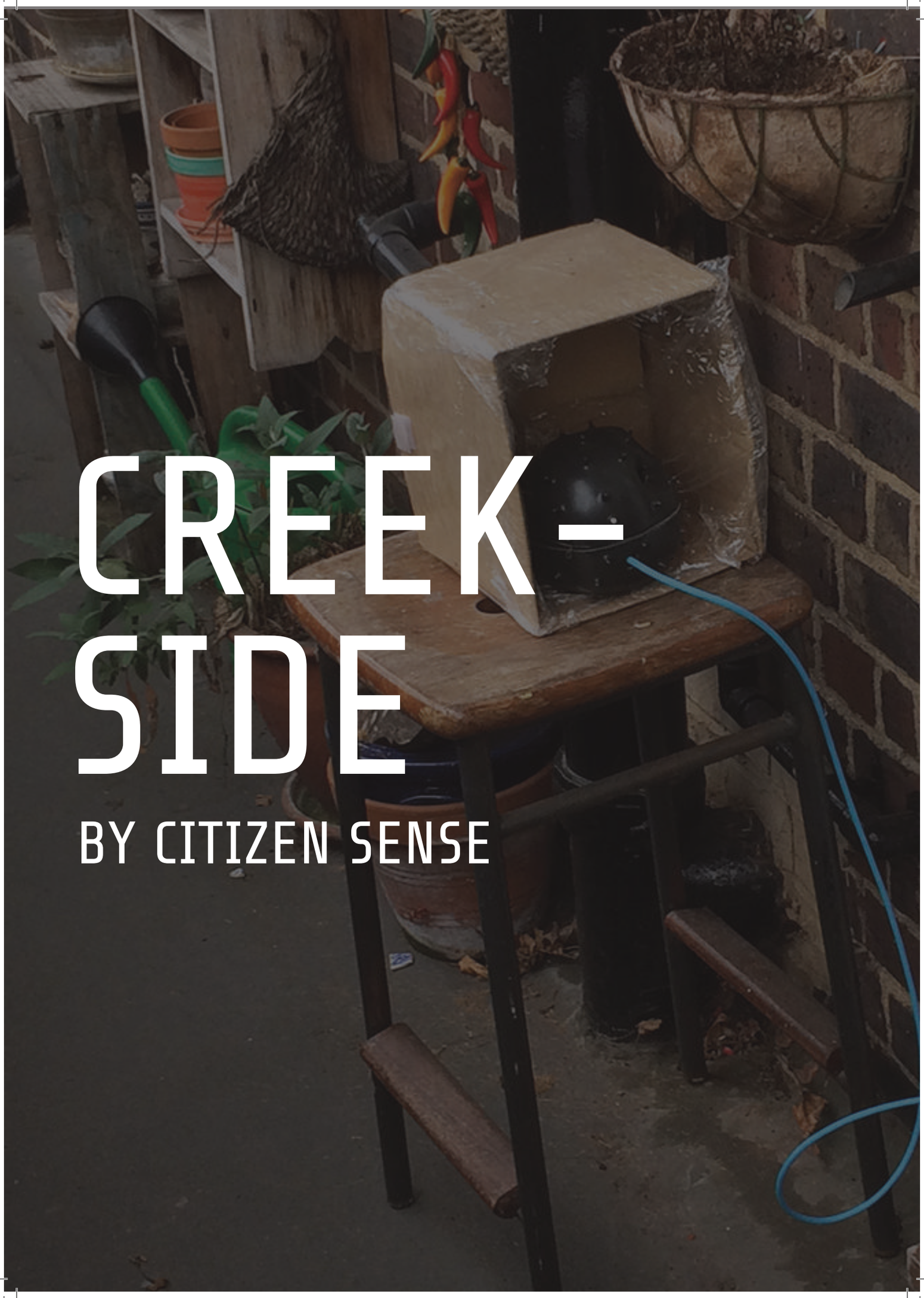
AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Extend and develop courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.


VOICE 4
DEPTFORD
SE8
ACTION WE ARE TAKING WITH YOU!
Lobbying the Mayor of London, Sadiq Khan, to include Social Housing
Meeting Lewisham MP and councillors, council officers, Greater London Assembly members
Clarify the view of Lewisham Council Planning Department about development and the process
Hosted four public meetings. Engaged thousands of Evelyn Ward residents
Convoys Wharf will change the Deptford community forever. Voice for Deptford is working to make sure that Deptford truly benefits from this huge development!
Our aims:
• Establish a community led development trust, a hub where groups build a better future together for all in Deptford
• Action for Social Rented Housing to be a part of the mix of new housing
• For Convoys Wharf developer to recognise the voice of Deptford people & work with us
Our Next Meeting:
Join us as we report back, make plans, and bring ideas!
7 – 9pm Tuesday 7 February 2017
Armada Community Project,
21 McMillan Street, Deptford, SE8 3EZ
Creche & Refreshments will be available
LOTTERY FUNDED
Centre for Community Engagement Research
Goldsmiths



CREEK-SIDE

BY CITIZEN SENSE

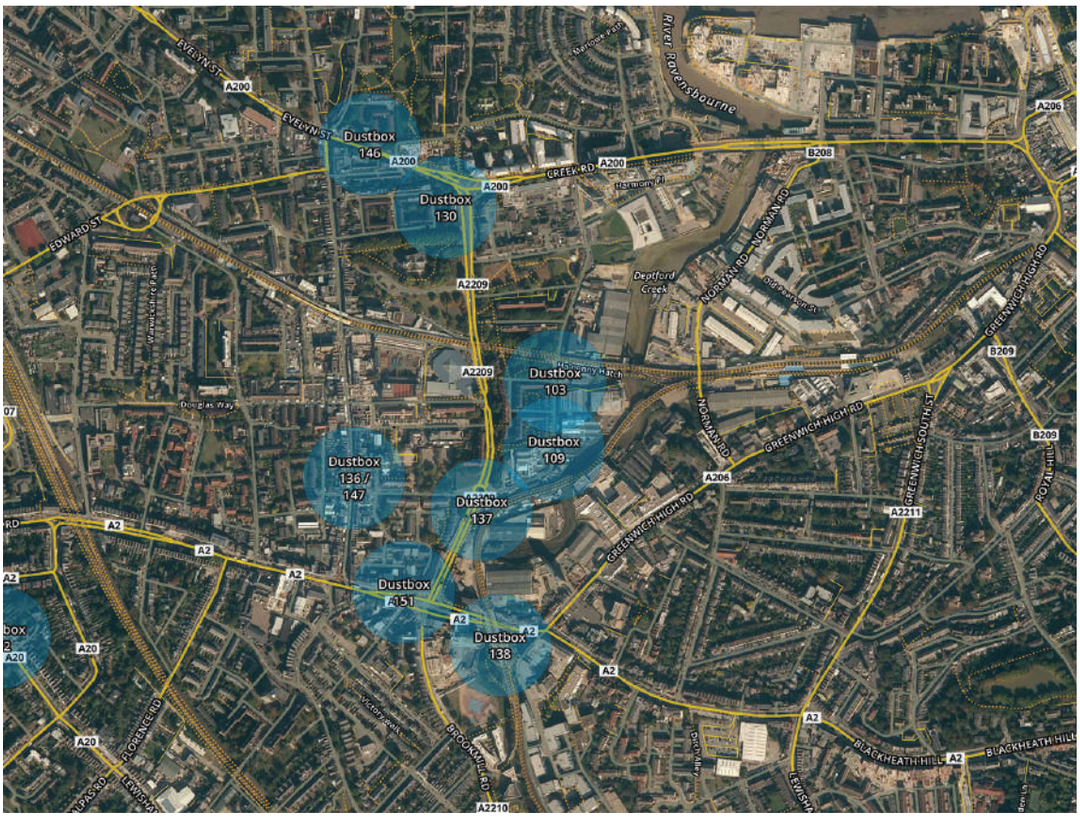
The Creekside area is adjacent to Deptford Creek, and is surrounded by busy roads, including Deptford Church Street. There are numerous construction sites in the area, as well as cultural spaces and low-rise and high-rise housing. Key findings indicate that automobile and HGV traffic are primary sources of $PM_{2.5}$ emissions, especially on Deptford Church Street. These emission levels are most likely made worse by extensive construction activity and construction-related traffic in the area.

This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from planning for better transport to ensuring that dust management plans are adhered to for construction sites.

THE LOCATION

Creekside is a residential and industrial area near the mouth of Deptford Creek in the Borough of Lewisham, Southeast London. Dustbox monitors are placed in a number of sites throughout Creekside as illustrated in the map below. Dustbox 103 is located in the centre of Creekside on a fourth-floor walkway in Crossfields Estate. Dustbox 109 is located on ground level at the west of the Art in Perpetuity Trust (APT) building, which is a large warehouse. Dustbox 137 is located on the roundabout at the entrance to the area in a third-floor garden. As a conservation area, Creekside and Crossfields Estate are recognised both for their historical and communal value.

As shown on the map below, Deptford Church Street (A2209) is to the west of the site, the A200 is to the north of the site and New Cross Road (A2) is to the southwest of the site. Also to the east of the site is the DLR trainline that runs from Deptford Bridge to Greenwich. Currently, sites to the north and southeast on Creekside are under construction for residential development. Two miles to the northeast of the site is Blackwall Tunnel Southern Approach, and just over five miles to the northeast is London City Airport.



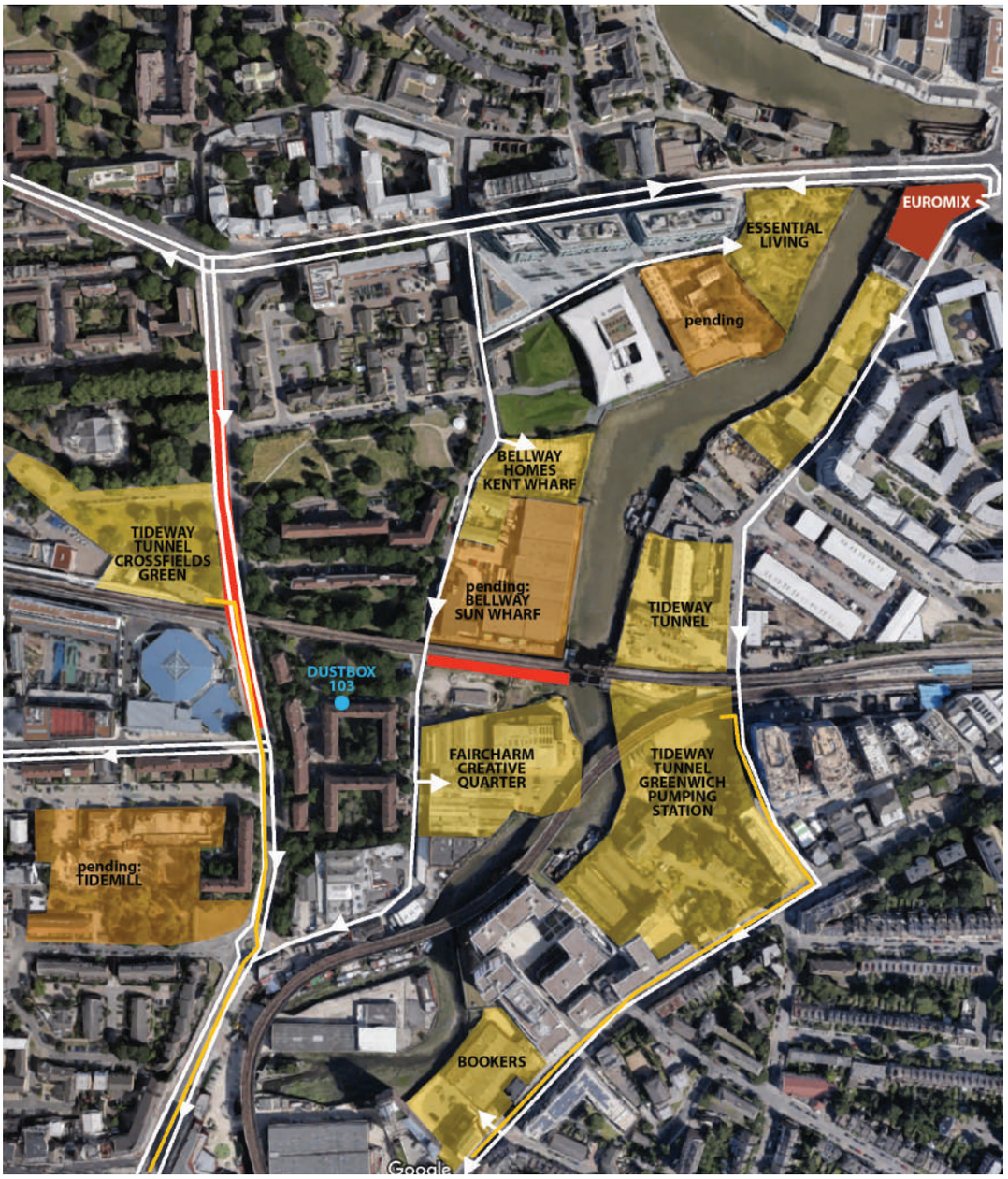
LOCAL SOURCES OF PARTICULATE POLLUTION

The most immediate potential sources of PM2.5 are both the extensive arterial road networks and the construction sites that surround Creekside. As one participant's map below shows, Deptford Church Street is a potential source of PM2.5 to the west. Creek Road to the north is another potential source for PM2.5, as is the New Cross Road southwest to southeast of Creekside.

> *In total, 30 monitors were distributed to participants. The monitoring period ran for over 9 months, until September 2017. During peak monitoring activity, there were 21 active Dustboxes.*

Between November 2017 to March 2017, five large construction sites were active in the Creekside area. Dustboxes 103 and 109 were within 100 metres of the two easterly sites. Both Dustboxes were within a 250-metre range of all five construction sites. Additionally, there is a concrete works at the corner of Norman Road and Creek Road (northeast of Dustbox 103). The white line in the citizen map marks the route the concrete mixers use for road access.

Due to construction in the area, there is increased HGV traffic on Norman Road (east of Dustbox 103) and Creekside Road (east of Dustbox 103). Road works took place during a portion of the monitoring period, resulting in an increase in idling traffic as well as possible re-suspension of construction dust on Deptford Church Street (west of Dustbox 103).



Citizen map of active construction sites, pending construction works, road works and the concrete mixer routes on Creekside

LONDON-WIDE, REGIONAL AND GLOBAL SOURCES OF PARTICULATE POLLUTION

Particulate matter sources in London can be attributed to a broad range of emissions. Within London, $PM_{2.5}$ from transport (particularly diesel), industry, construction, cooking and heating all contribute significantly to London-wide levels. A significant amount of $PM_{2.5}$ emissions also comes from heavy industry and agriculture outside the UK, particularly France, Belgium, the Netherlands, Luxembourg, Germany and Poland. These emissions are thought to account for an urban background of approximately 10 $\mu g/m^3$. The importance of these transboundary effects of $PM_{2.5}$ emissions from outside of the UK on the total London $PM_{2.5}$ can vary between 40% to 80% daily depending on weather conditions. When long-range pollution episodes do occur in London, they are generally carried on easterly winds. There are a number of global emissions, events and practices that contribute particulate matter to the total London $PM_{2.5}$, including fuel production, industrial and domestic combustion, transportation, waste disposal, and agriculture, although these are harder to quantify.

OBSERVATIONS

Residents have observed visible dust, sooty deposits on windows and surfaces, noise, active cranes, and idling delivery HGVs outside construction sites. Residents have also noted their respiratory health concerns.


HITACHI

IS THERE EVIDENCE OF A PROBLEM?

The Dustbox device used to monitor $PM_{2.5}$ is an "indicative" monitor. This means that measurements can give an indication of pollutant concentrations, but cannot be directly compared with national and international guidelines and standards in an "official" or regulatory sense. Despite this, indicative monitoring is a well-established method within atmospheric science for carrying out initial surveys of an area to establish whether a potential problem merits further investigation. Indicative monitors are also becoming increasingly available for citizen-based air-quality monitoring, similar to this study.

Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period. The co-location of Dustboxes in this data story indicates that there is a good similarity in measurements across the monitors used in this monitoring location, as well as with monitors in the extended community network, both at the start and end of the monitoring period.

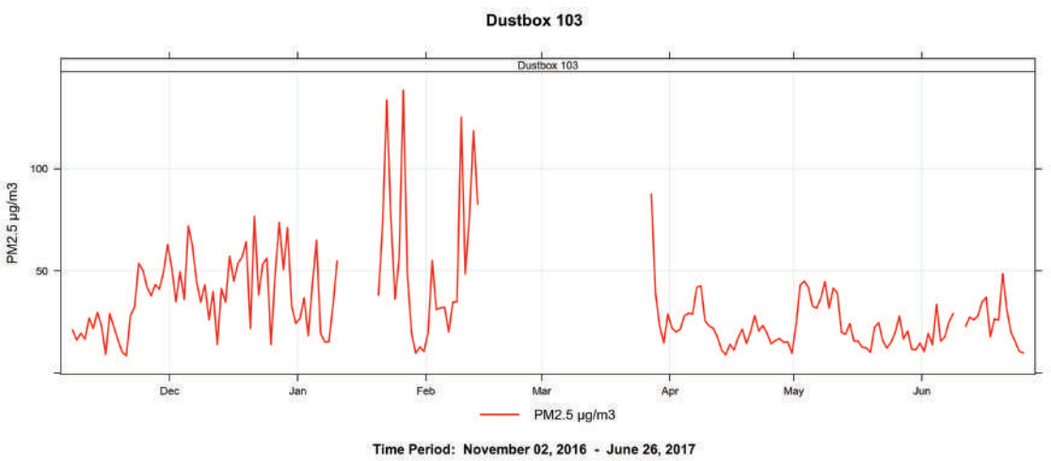


Figure 1: Dustbox 103. Line graph time-series chart of 24-hour mean PM2.5 concentrations from 2 November 2016 to 26 June 2017 (units: µg/m³).

Indicative daily mean concentrations of $PM_{2.5}$ are shown as a time-series chart in **Figure 1**. The World Health Organisation (WHO) guideline of 25 µg/m³ for 24-hour daily mean concentration of $PM_{2.5}$ is exceeded on a number of occasions at Dustbox 103, and this pattern is repeated in nearby Dustboxes, suggesting that further investigation may be merited. However, it is important to determine whether these breaches were caused by "local" sources of pollution close to the sensor (i.e., within 300 metres), or by regional sources affecting the whole area.

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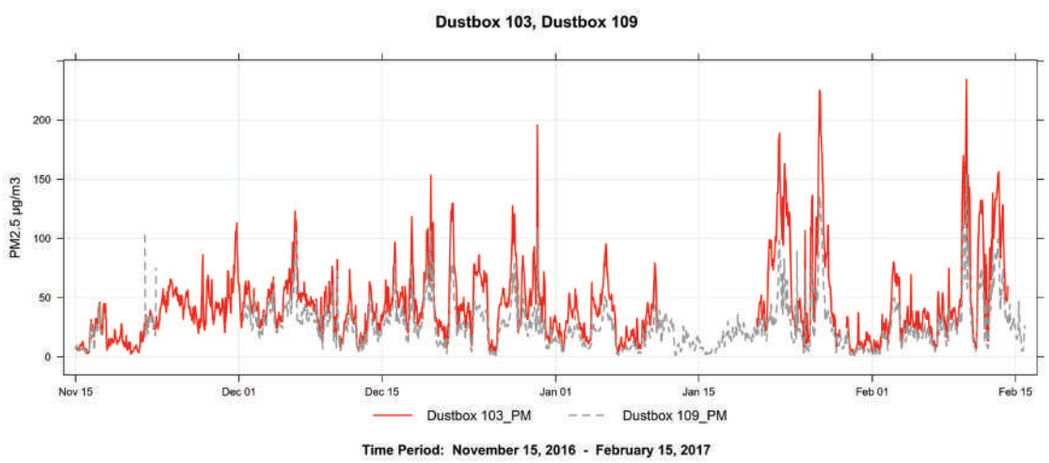


Figure 2: Dustboxes 103 and 109. Line graph time-series chart of 1-hour mean $PM_{2.5}$ concentrations from 15 November 2016 to 15 February 2017 (units: µg/m³).

Figure 2 shows an extract of the monitoring data from the Dustbox 103 site presented as hourly mean concentrations of $PM_{2.5}$. Measurements from Dustbox 109 are shown for comparison. Regional sources of pollution appear as broad "humps" of elevated pollution affecting both sites. Local sources of pollution appear as short "spikes" typically affecting only one or the other site.

Figure 2 therefore indicates that there are significant local sources of particulate pollution elevating ambient concentrations well above those caused by regional sources across the monitoring period.

There are many possible sources of pollution in the area and we have to look at the measurements more closely to see if we can deduce which activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

Creekside construction.

CHARAC-
TERIZING
THE
PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

Using time plots, it is possible to analyse time of day and day of week, as well as month, when pollution levels are elevated. Time plots aggregate $PM_{2.5}$ concentrations according to time, so that key patterns such as rush hours and traffic, as well as possible construction or industry sources, along with regional pollution events due to seasonal variation, are evident.

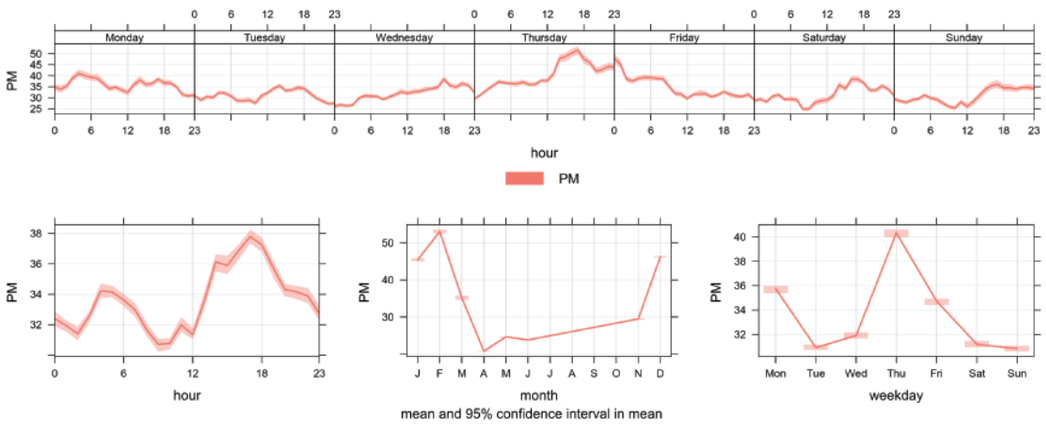


Figure 3: Dustbox 103. Time plot showing $PM_{2.5}$ concentrations from 2 November 2016 to 26 June 2017, grouped by hour, month and weekday (units: µg/m³)

Figure 3 investigates when elevated levels of pollution occur by grouping concentrations by hour, month and day of the week. Sources of pollution related to commuter or transit traffic typically show peaks in concentrations coincidental with peaks in traffic flow, i.e., morning and evening rush hour with notably lower levels at night and on Tuesdays, Wednesdays and Sundays. In this way, **Figure 3** shows evidence of early morning and evening peaks. However, it is clear the morning peaks are around 5 to 6 am, perhaps suggesting higher levels of particulates from earlier traffic, such as construction crews, delivery vehicles and commuter traffic.

These charts can be used to match patterns in the occurrence of spikes with working patterns of particulate-generating activities in the area. In a general sense, it should be noted that the weather plays a large role in particulate levels. For example, dust tends to be dispersed more slowly during the hours of darkness, as vertical and horizontal wind speeds are generally lower. This phenomenon may skew charts somewhat.

WHICH DIRECTION IS $PM_{2.5}$ COMING FROM?

Wind direction has a considerable influence on pollution measurements. A sensor will only record emissions from a particular source or activity if the wind blows it from the source towards the sensor. Therefore, we can investigate where a source of pollution is likely to be located by plotting wind direction against pollution concentrations.

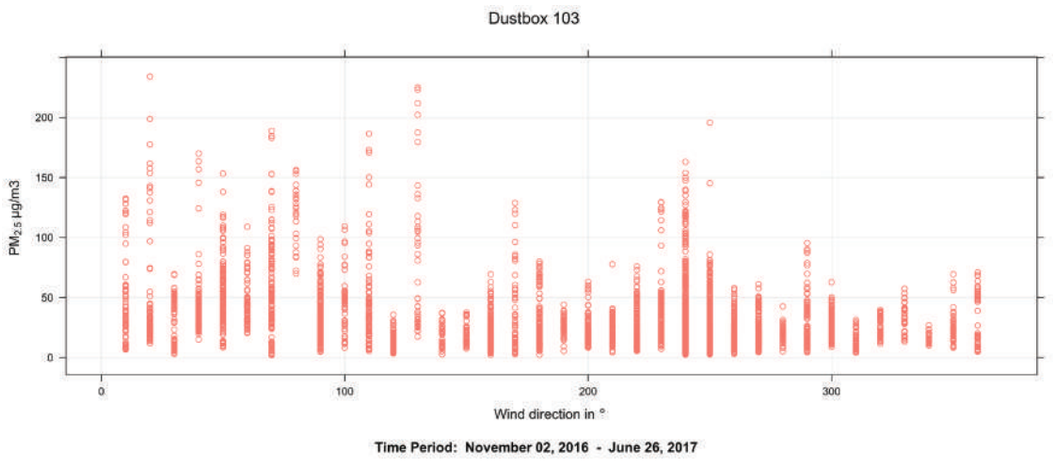
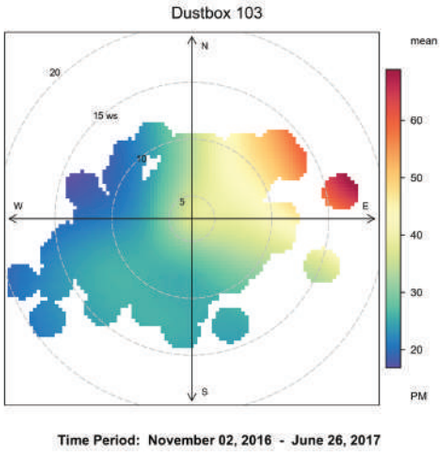


Figure 4: Dustbox 103. Scatter plot showing the relationship between mean $PM_{2.5}$ concentrations and wind direction in degrees from 2 November 2016 to 26 June 2017 (PM2.5 units: µg/m^3).

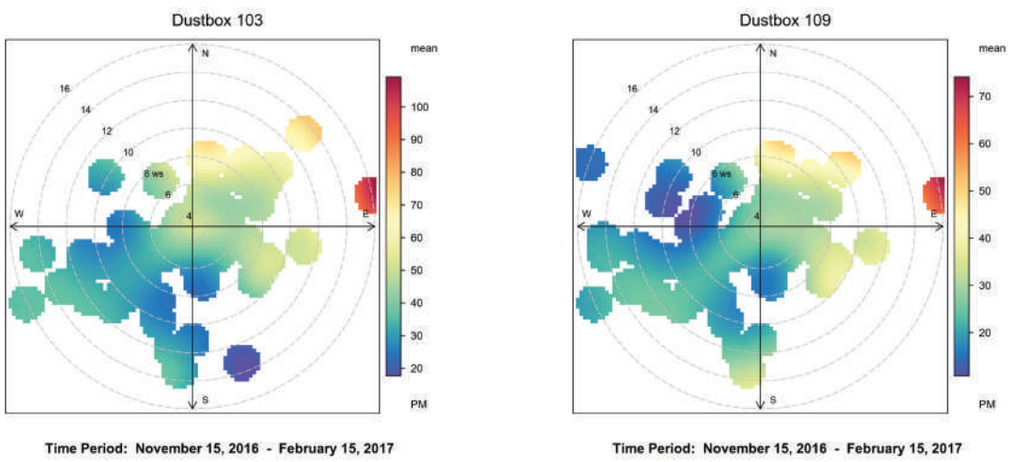
Figure 4 shows how pollutant concentrations at Dustbox 103 site are influenced by wind direction. It shows the most regular high readings are from the northeast, east and southeast (20° to 130°), and from the southwest (240°).

A polar plot, as shown in the figures below, is a more intuitive way of looking at this relationship. These plots show colour contours of pollutant concentrations in relation to wind direction and wind speed, with zero wind in the centre, increasing up to 20 metres per second (ms-1) at the outer ring. The highest mean concentrations are shown in red, the lowest are in blue.



Figures 5a: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustbox 103 from 2 November 2016 to 26 June 2017. The mean concentrations shown here are relative, e.g., for Dustbox 103 the highest mean concentration is approximately 70 µg/m3. Emissions levels are displayed on polar plots according to a gradient of low to high pollution levels. The colour coding refers to a different range of readings in each plot.

Figure 5a above and **Figures 5b and 5c** below highlight the fact that, on average, high pollution levels are regularly recorded at the Dustbox 103 and Dustbox 109 sites during northeasterly and southwesterly winds. As both sites show a source to the east, there may be a regional source of air pollution in that direction, which is detected by most sensors in the area. It should be noted, however, the $PM_{2.5}$ levels are still relatively high at the centre of the monitoring areas, ranging between 30 to 50 µg/m³.



Figures 5b and 5c: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustboxes 103 and 109 from 15 November 2016 to 15 February 2017. The mean concentrations shown here are relative.

UNDER WHICH WEATHER CONDITIONS ARE $PM_{2.5}$ LEVELS MOST EVIDENT?

Different sources of pollution will behave in distinct ways according to the weather. For example, wind-blown dust will primarily occur during dry, windy conditions. Sometimes, you can learn about a source by characterizing this weather-related behaviour.

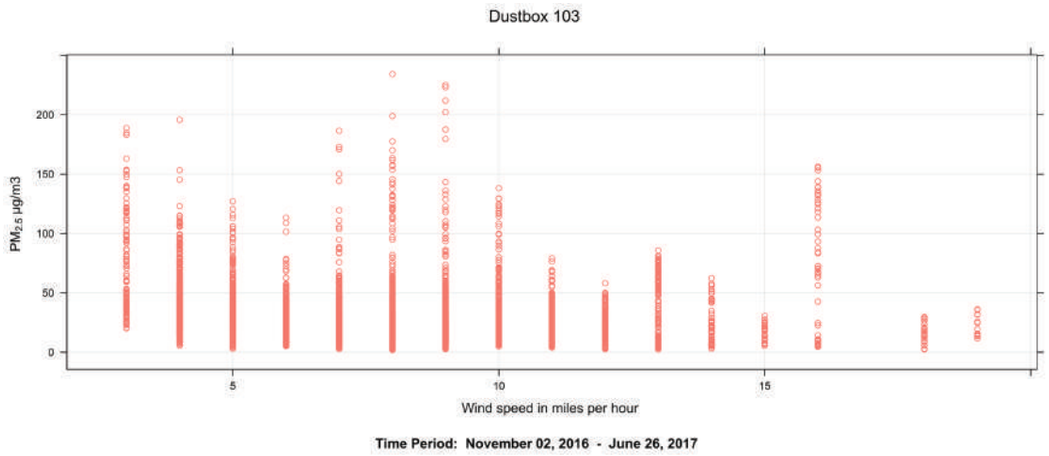


Figure 6: Dustbox 103. Scatter plot showing the relationship between mean PM2.5 concentrations and wind speed from 2 November 2016 to 26 June 2017 (PM2.5 units: µg/m3).

Figures 6 and 7 indicate that some moderate $PM_{2.5}$ levels are possibly related to re-suspended or wind-blown dust due to elevated particulate levels during low to moderate wind speeds (**Figure 6**) and moderate humidity (**Figure 7**). However, the higher concentrations of $PM_{2.5}$ are unlikely to be wind-blown dust as they occur at high humidity, as shown in **Figure 7**.

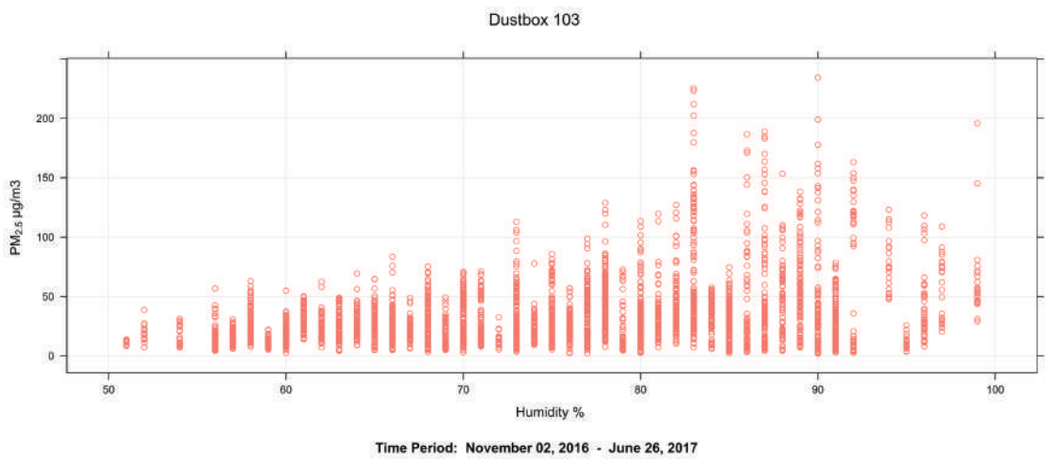


Figure 7: Dustbox 103. Scatter plot showing the relationship between mean $PM_{2.5}$ concentrations and humidity from 2 November 2016 to 26 June 2017 ($PM_{2.5}$ units: µg/m^3).


BOUYGUES
UK
SITE OFFICE

DRAWING THE EVIDENCE TOGETHER

Using the tools provided through the Citizen Sense Airsift Dustbox Data Analysis Toolkit, we have characterized sources of particulate pollution detected by the Dustbox 103 and Dustbox 109 Deptford Creekside monitors as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources, often at high levels.
- The strongest local source(s) appear to be to the northeast and southwest of the Dustbox 103 and Dustbox 109 sites. This is likely to be related to a London-wide pollution event.
- However, there is some evidence of local emissions combining with city-wide emissions. These local emission sources could travel from the A2 and Deptford Church Street, and from construction (with associated HGV traffic and idling trucks) on Creekside, as well as high levels of construction in the east in general.
- The local source or sources are strongest during the early hours before 6 am, and in the afternoon/early evening. The source or sources are possibly related to delivery, construction crew and commuter road traffic.
- PM2.5 levels are sometimes likely to be related to re-suspended or wind-blown dust due to elevated particulate levels during low to moderate wind speeds and moderate humidity. However, higher concentrations of PM2.5 are unlikely to be wind blown dust as they occur at high humidity.
- The high peaks shown in late January can be accounted for as two periods of poor air quality across London beginning 19 January 2017 and 23 January 2017, partly due to cold, settled weather slowing the dispersion of local pollutants.


ROAD
CLOSED
ACCESS
ONLY
FOOTPATH
CLOSED
CROSSFIELD
STREET

ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

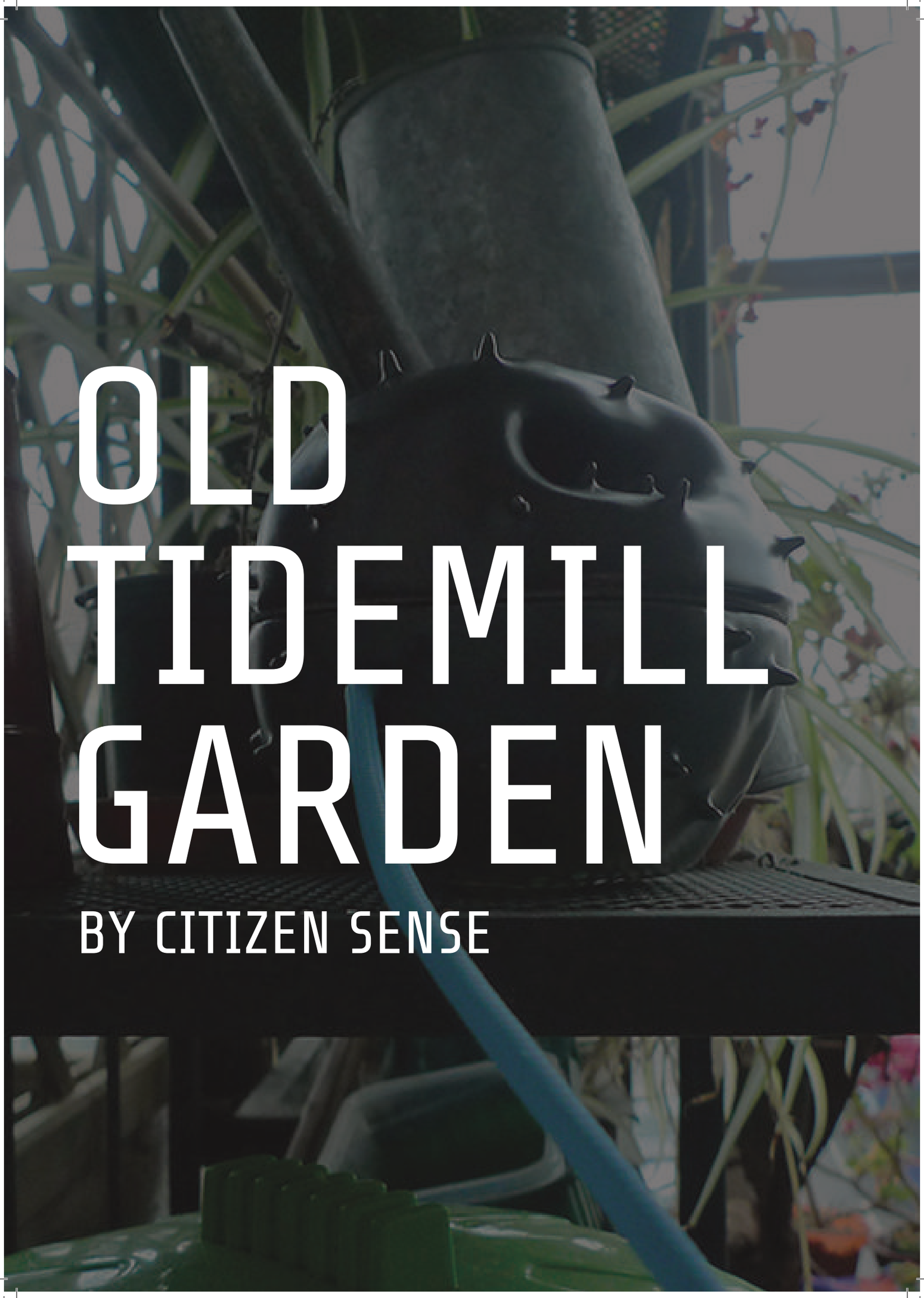
- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Expand and provide courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.



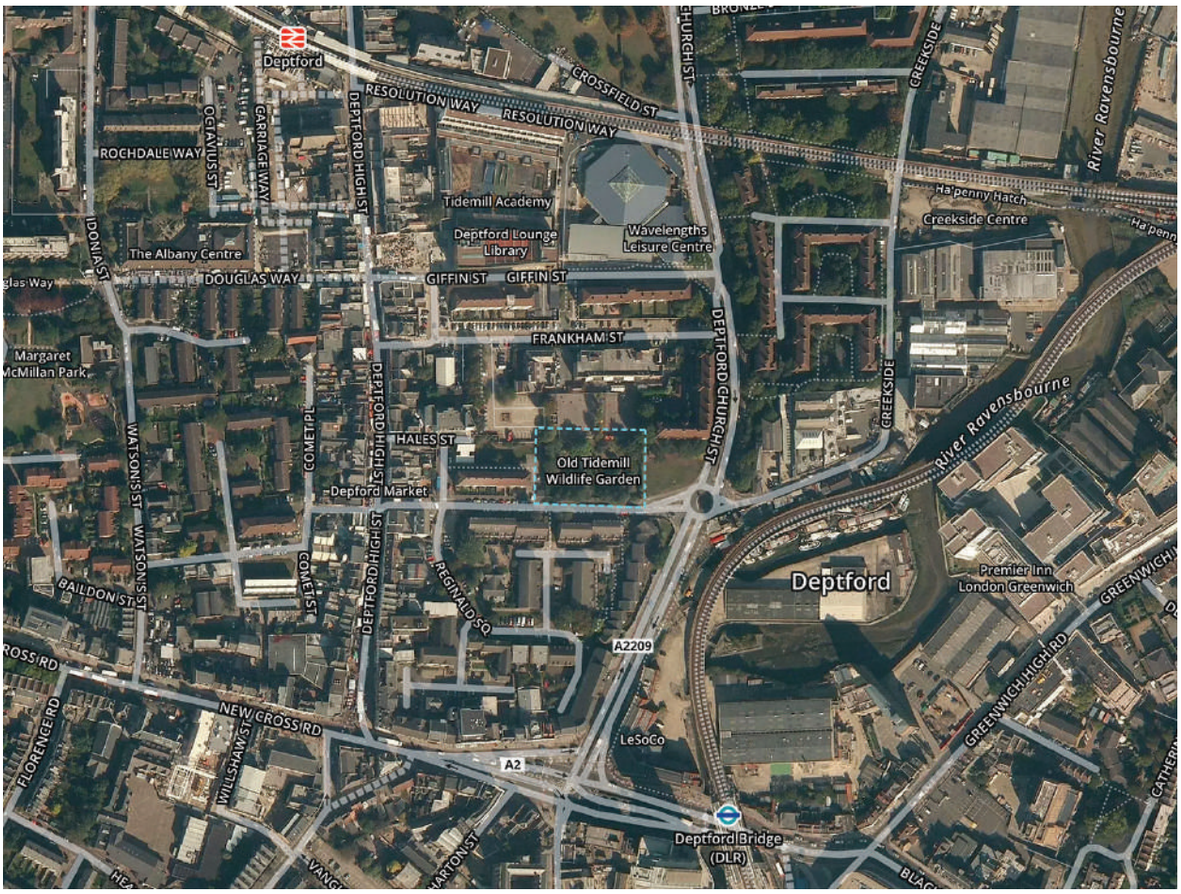
OLD TIDEMILL GARDEN

BY CITIZEN SENSE

The Old Tidemill Garden area is nearby Deptford Church Street, and is a somewhat quieter area characterised by low-rise housing. The neighbourhood includes Deptford High Street, an important market area, as well as side streets used by pedestrians and cyclists. While there is some evidence of PM2.5 emissions related to traffic, pollution levels are somewhat lower here in comparison to neighbouring monitoring areas. Green spaces could have a mitigating effect on some PM2.5 levels, which warrants further study.

This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from preserving and enhancing green space to planning for improved transport, and reducing emissions from ongoing construction activities.

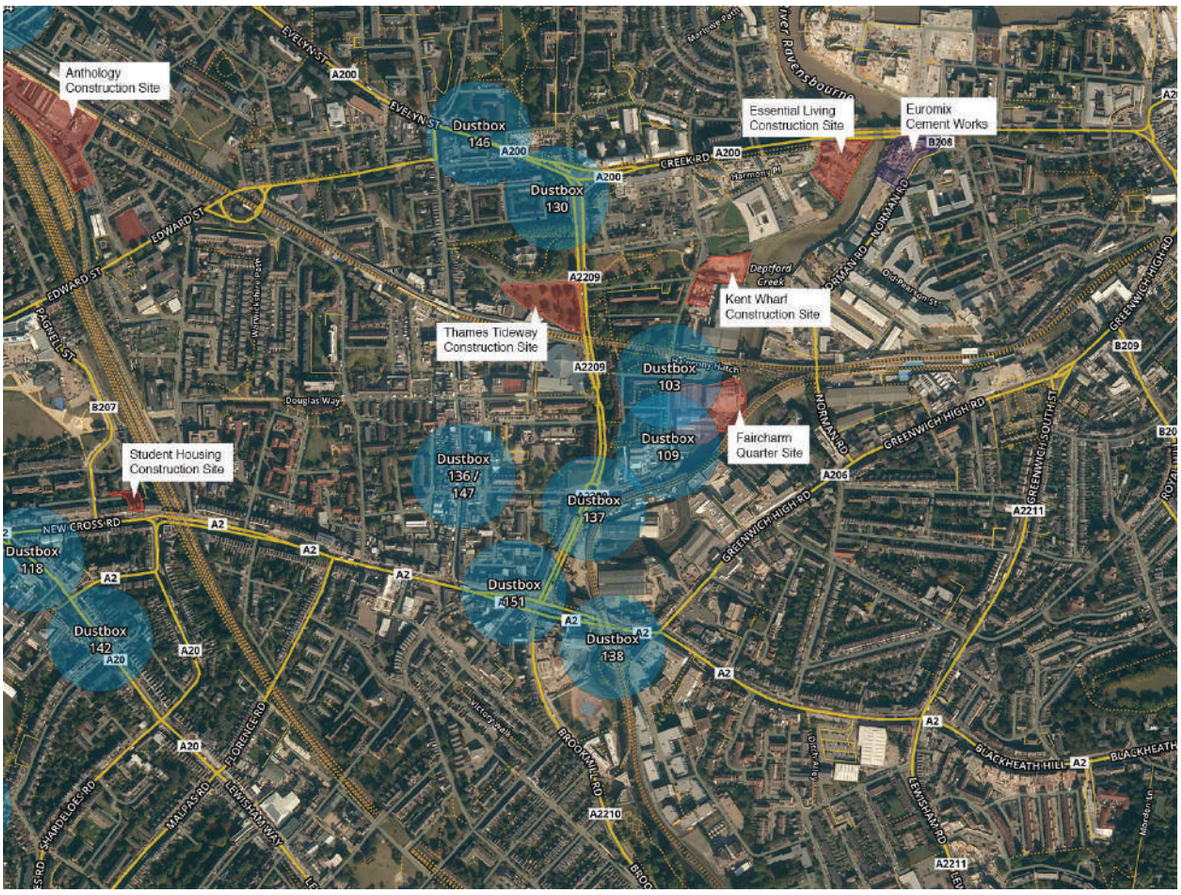
THE LOCATION



The Old Tidemill Wildlife Garden is a mature green space and community garden managed by local residents. It sits on the former grounds of Old Tidemill School, a site earmarked by Lewisham Council for redevelopment into over 200 residential dwellings. As shown on the map below, Deptford Church street (A2209) is to the east of the site, and Evelyn Street (A200) is to the north of the site and New Cross Road (A2) is to the south of the site. Also to the east of the site is the DLR electric train track that runs from Deptford Bridge. Multiple sites to the northeast on Creekside are currently under construction. Three miles to the north east of the site is Blackwall Tunnel Southern approach and continuing towards the northeast is London City airport.

This data story compares a number of sites nearby the Old Tidemill Garden. Dustbox 103 is located on a fourth-floor walkway on a housing estate directly to the east of Deptford Church Street (A2209). Dustbox 109 is on Creekside, a quiet road that borders several construction sites. Dustbox 109 is located at the back of a large building, facing onto the Creek. Dustbox 138 is on a third-floor balcony on a housing development, facing onto the Creek and a small park. Dustbox 136/147 is to the west of Old Tidemill

Wildlife Garden and placed on a third-floor covered balcony. (Dustbox 136/147 combines data from two Dustboxes as the first device was replaced mid-way through monitoring.)



LOCAL SOURCES OF PARTICULATE POLLUTION

The most immediate sources of particulate pollution are the extensive arterial road networks that surround the garden. As the map above shows, Deptford Church Street (A2209) is adjacent to the garden and is a potential source of local pollution to the east. New Cross Road (A2) is south of the garden running from west to southeast. Two smaller roads north of the garden – Frankham Street and Giffin Street – have been regularly monitored by citizens due to a heavy traffic load. Results from a diffusion tube monitoring study conducted in 2014 are available on a community map. This study shows elevated levels of nitrogen dioxide (NO_2) at major roadways in the area.

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OBSERVATIONS

Residents report idling traffic on Deptford Church Street and New Cross Road. Participants have reported that traffic starts around 5 am with lorries coming in and continuing all day until around 7 pm. Participants have also noted that when the Blackwall Tunnel is closed the traffic is often diverted through Deptford Church

Street. During some of the monitoring period, Deptford Church Street was reduced from four to two lanes due to construction and road works. The Deptford High Street to the west of the site is generally a lower traffic area except for mornings and afternoons on Wednesday, Friday and Saturday, during which time the market is set up and taken down. The A200 to the north of the site is also often congested, however, due to traffic zoning there are no HGVs on this route.

Residents also have noted idling delivery trucks, visible dust and noise from the construction sites on Creekside, where active construction sites could be emitting dust from on-site work, in addition to possible emissions from the use of non-road machinery and vehicle movements to and from sites. A citizen map documents these emission sources in the Creekside data story.


Our
Neighbourhood
Plans
672
volunteers

IS THERE EVIDENCE OF A PROBLEM?

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Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period. The co-location of Dustboxes in this data story indicates that there is a good similarity in measurements across the monitors used in this monitoring location, as well as with monitors in the extended community network, both at the start and end of the monitoring period.

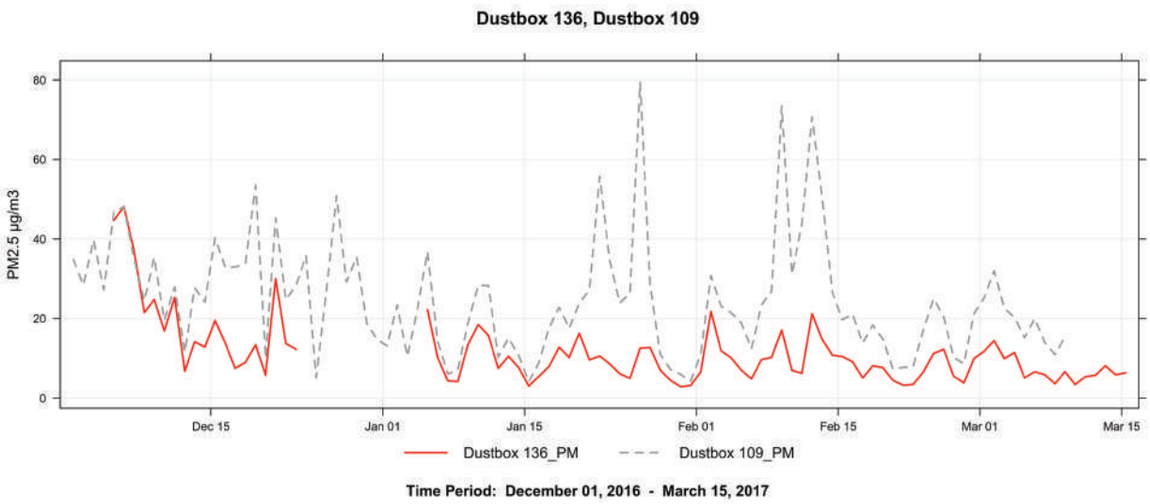


Figure 1: Dustboxes 109 and 136. Line graph time-series chart of 24-hour mean PM2.5 concentrations from 1 December 2016 to 15 March 2017 (units: µg/m3).

Indicative daily mean concentrations of PM2.5 are shown as a time-series chart in **Figure 1**. The World Health Organisation (WHO) guideline of 25 µg/m3 for 24-hour daily mean concentration of PM2.5 is exceeded on a number of occasions at Dustbox 109, and this pattern is repeated at the surrounding Dustboxes, suggesting that further investigation may be warranted. However, it is important to determine whether these breaches were caused by "local" sources of pollution close to the sensor (i.e., within 300 meters), or by regional sources affecting the whole area.

Local sources often augment regional sources, which can be revealed as a spike on top of a hump. In a general sense, this regional-local pattern occurs because pollution mixes in the atmosphere as it travels away from a source, smoothing the speed of changes in concentrations.

Figure 1 shows an extract of the monitoring data from the Dustbox 109 and 136 sites presented as 24-hourly mean concentrations of PM2.5. Regional sources of pollution appear as broad "humps" of elevated pollution. Local sources of pollution appear as short "spikes" typically affecting only one or the other site, for example, from 20 to 25 January 2017 at the Dustbox 109 site (but not at Dustbox 136 at the same time).

Figure 1 therefore indicates that there could be significant local sources of particulate pollution elevating ambient concentrations well above those caused by regional sources across the monitoring period.

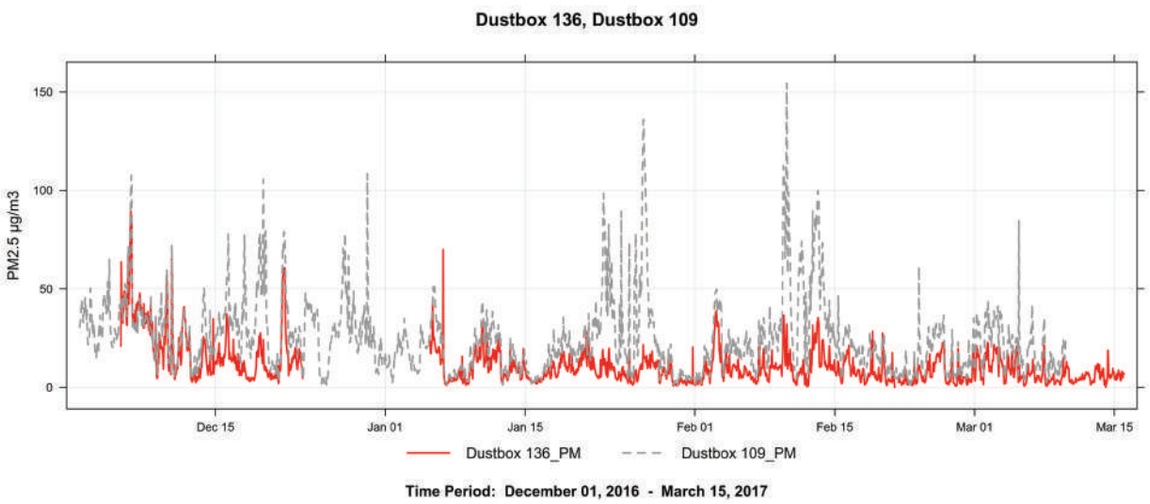


Figure 2a: Dustboxes 109 and 136. Line graph time-series chart of 1-hour mean PM2.5 concentrations from 1 December 2016 to 15 March 2017 (units: µg/m3).

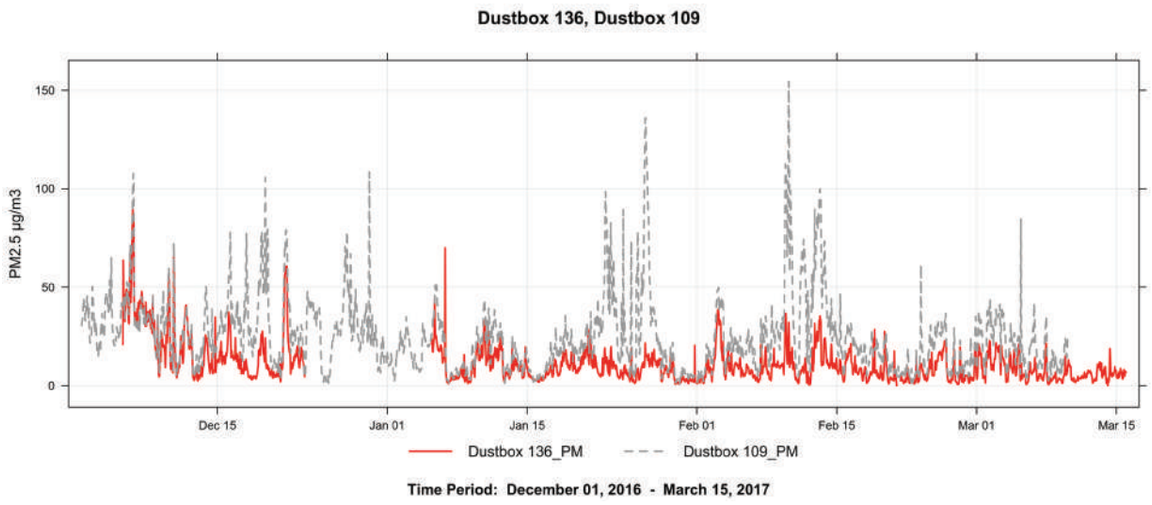


Figure 2b: Dustboxes 130 and 136. Line graph time-series chart of 1-hour mean PM2.5 concentrations from 6 December 2016 to 14 December 2017 (units: µg/m3).

Figure 2a shows an extract of the monitoring data from the Dustbox 136 site presented as 1-hour mean concentrations of PM2.5. Measurements from Dustbox 109 are shown for comparison. Regional sources of pollution appear as broad "humps" of elevated pollution affecting both sites. Local sources of pollution appear as short "spikes" typically affecting only one or the other site. In general, Dustbox 136 indicates city-wide pollution levels, while Dustbox 109 provides evidence of more localized pollution sources. **Figure 2b** shows an extract of data from Dustbox 136 and Dustbox 130 from comparison, as the both these monitors show a similar pattern it is likely they also share local emission sources.

Figures 2a and 2b therefore indicate that there are significant local sources of particulate pollution elevating ambient concentrations well above those caused by regional sources across the monitoring period, particularly at the Dustbox 109 location.

There are many possible sources of pollution in the area and we have to look at the measurements more closely to see if we can deduce what activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

CHARAC-
TERIZING
THE
PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

Using time plots, it is possible to analyse time of day and day of week, as well as month, when pollution levels are elevated. Time plots aggregate PM2.5 concentrations according to time, so that key patterns such as rush hours and traffic, as well as possible construction or industry sources, along with regional pollution events due to seasonal variation, are evident.

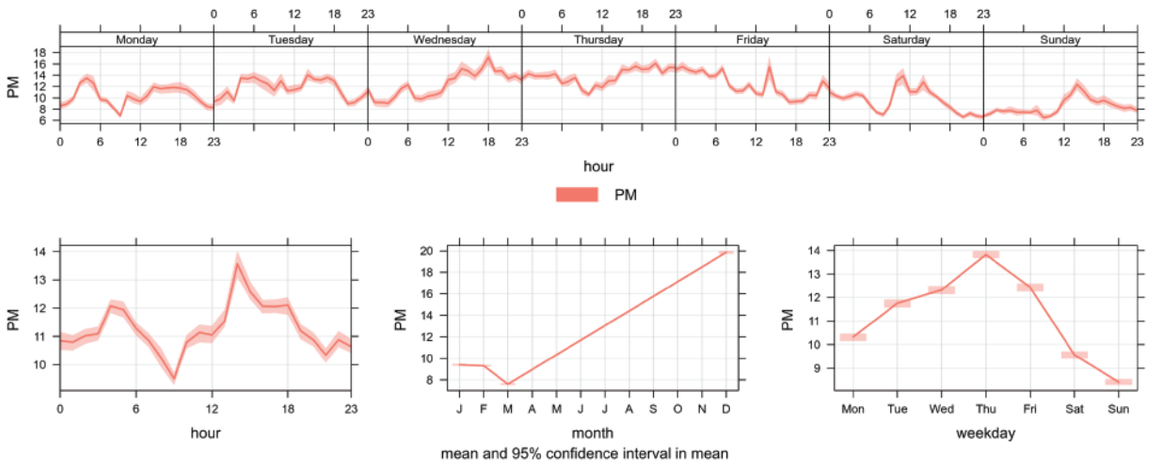


Figure 3: Dustbox 136. Time plot showing PM2.5 concentrations from 1 December 2016 to 15 March 2017, grouped by hour, month and weekday (units: µg/m3).

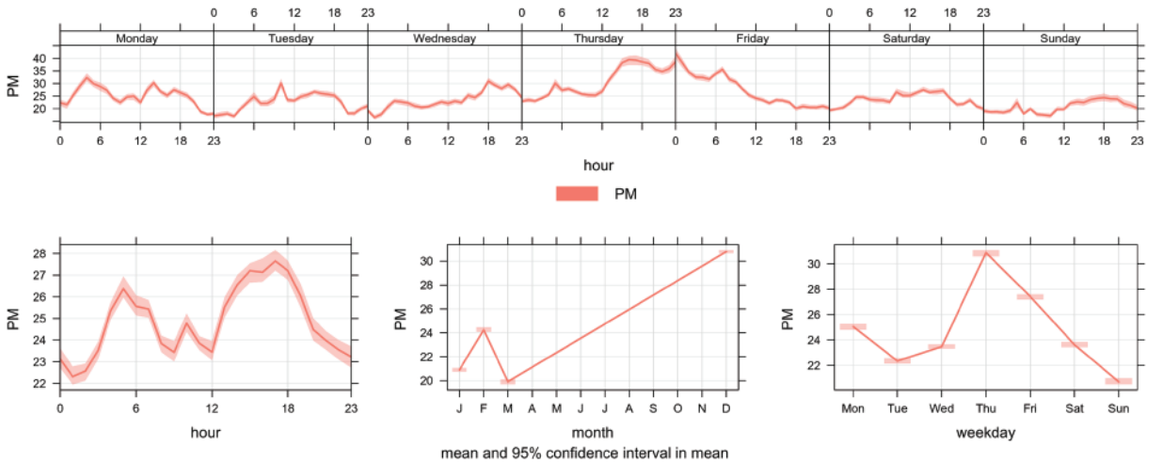


Figure 4: Dustbox 109. Time plot showing PM2.5 concentrations from 1 December 2016 to 15 March 2017, grouped by hour, month and weekday (units: µg/m3).

Figures 3 and 4 investigate when elevated levels in pollution occur by grouping concentrations by hour, month and day of the week. Sources of pollution related to commuter or transit traffic typically show peaks in concentrations coincidental with peaks in traffic flow, i.e., morning and evening rush hour with notably lower levels at night and on Sundays. This can also be seen in

Figures 3 and 4, where there is evidence of early morning and evening peaks. However it is clear the morning peaks are around 5 to 6 am, perhaps suggesting higher levels of particulates from earlier traffic, such as deliveries and construction crews.

These charts can be used to match patterns in the occurrence of spikes with working patterns of particulate-generating activities in the area. Figure 4 shows that on most days there are elevated levels in the early hours of the morning and from midday to 6 pm at the Dustbox 109 site. Levels are lowest on Sundays at both sites, suggesting weekday activity due to road traffic and construction as possible emissions sources.

In a general sense, it should be noted that the weather plays a large role in particulate levels. For example, dust tends to be dispersed more slowly during the hours of darkness, as vertical and horizontal wind speeds are generally lower. This phenomenon may skew charts somewhat.

WHICH DIRECTION IS PM2.5 COMING FROM?

Wind direction has a considerable influence on pollution measurements. A sensor will only record emissions from a particular source or activity if the wind blows it from the source towards the sensor. Therefore, we can investigate where a source of pollution is likely to be located by plotting wind direction against pollution concentrations.

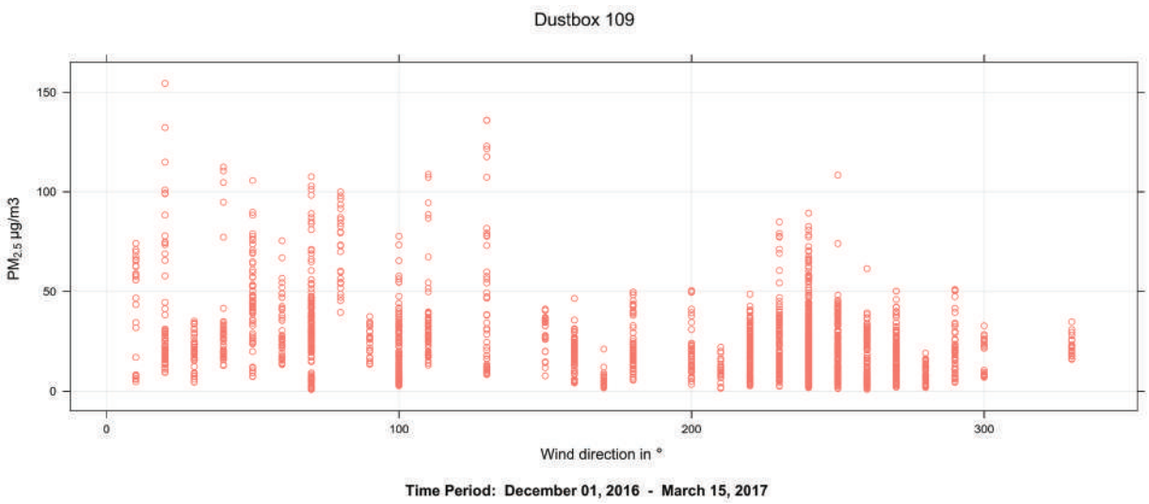


Figure 5: Dustbox 109. Scatter plot showing the relationship between mean PM2.5 concentrations and wind direction in degrees from 1 December 2016 to 15 March 2017 (PM2.5 units: µg/m3).

Figure 5 shows how pollutant concentrations at the Dustbox 109 site are influenced by wind direction. It is clear that higher but somewhat less frequent peaks are recorded when the wind blows from the southwest (220° to 240°), and the highest more frequent peaks occur when the wind blows from the from the north to the southeast (10° to 110°).

A polar plot, as shown in the figure below, is a more intuitive way of looking at this relationship. This shows colour contours of pollutant concentrations in relation to wind direction and wind speed (zero wind in the centre, increasing up to 20 ms-1 at the outer ring). The highest mean concentrations are shown in red, and the lowest are in blue.

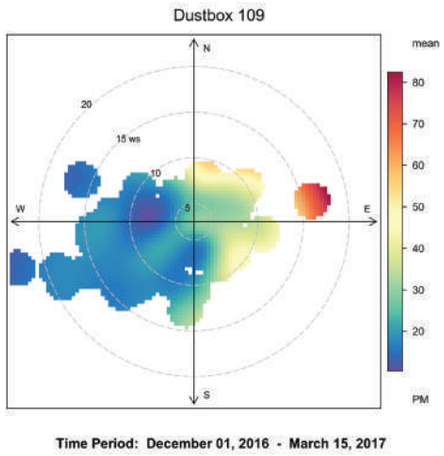


Figure 6a: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustbox 109 from 1 December 2016 to 15 March 2017. The mean concentrations shown here are relative, e.g., for Dustbox 109 the highest mean concentration is approximately 80 µg/m3. Emissions levels are displayed on polar plots according to a gradient of low to high pollution levels. The colour coding refers to a different range of readings in each plot.

In common with **Figure 5**, **Figure 6a** highlights the fact that, on average, the most frequent high levels of pollution are recorded at the Dustbox site 109 during northeasterly winds (this is also evident in the nearby Dustbox 103 site). In contrast, there is clearly a source of pollution to the southwest of the Dustbox 136 site that is not as evident at the Dustbox 109 site. As all sites show a source to the east, there may be a regional source of air pollution in that direction, which is detected by most sensors in the area.

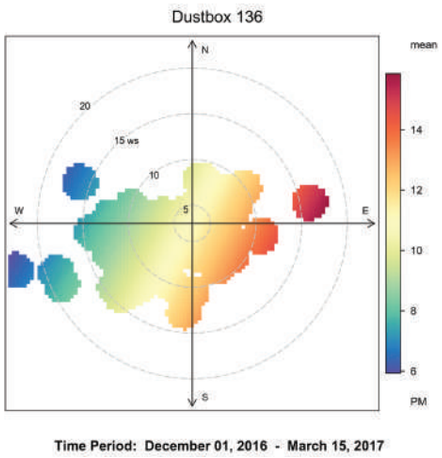


Figure 6b: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustboxes 136 from 1 December 2016 to 15 March 2017. The mean concentrations shown here are relative, and are considerably lower at the Dustbox 136 monitoring location.

In addition, although **Figure 6b** shows higher concentrations during northeasterly winds, pollution levels are significantly lower at Dustbox 136 in comparison to Dustbox 109.

UNDER WHICH WEATHER CONDITIONS ARE PM2.5 LEVELS MOST EVIDENT?

Different sources of pollution will behave in distinct ways according to the weather. For example, windblown dust will primarily occur during dry, windy conditions. Sometimes, you can learn about a source by characterizing this weather-related behaviour.

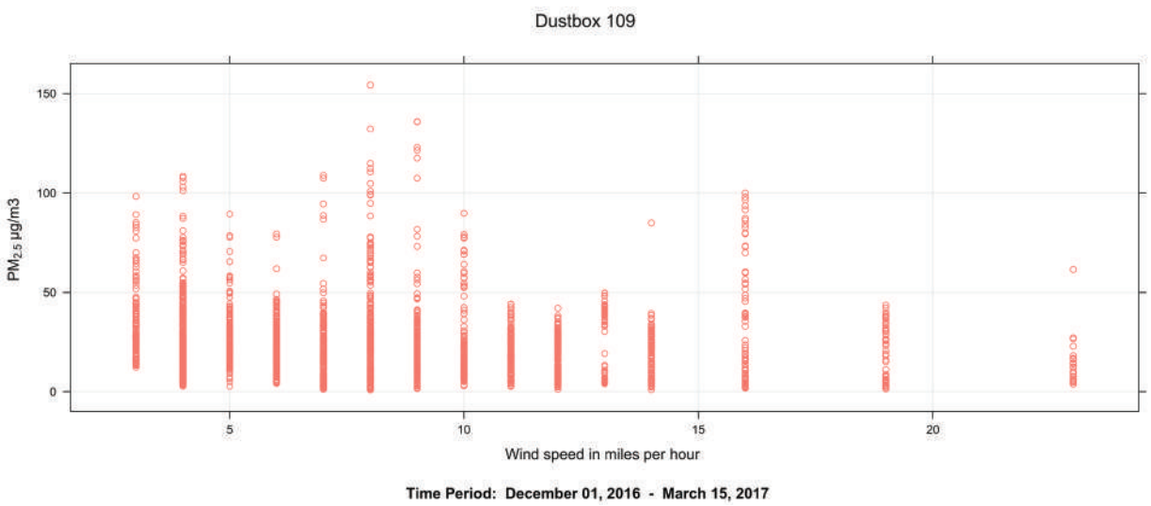


Figure 7: Dustbox 109. Scatter plot showing the relationship between mean PM2.5 concentrations and wind speed in miles per hour from 1 December 2016 to 15 March 2017 (PM2.5 units: µg/m3).

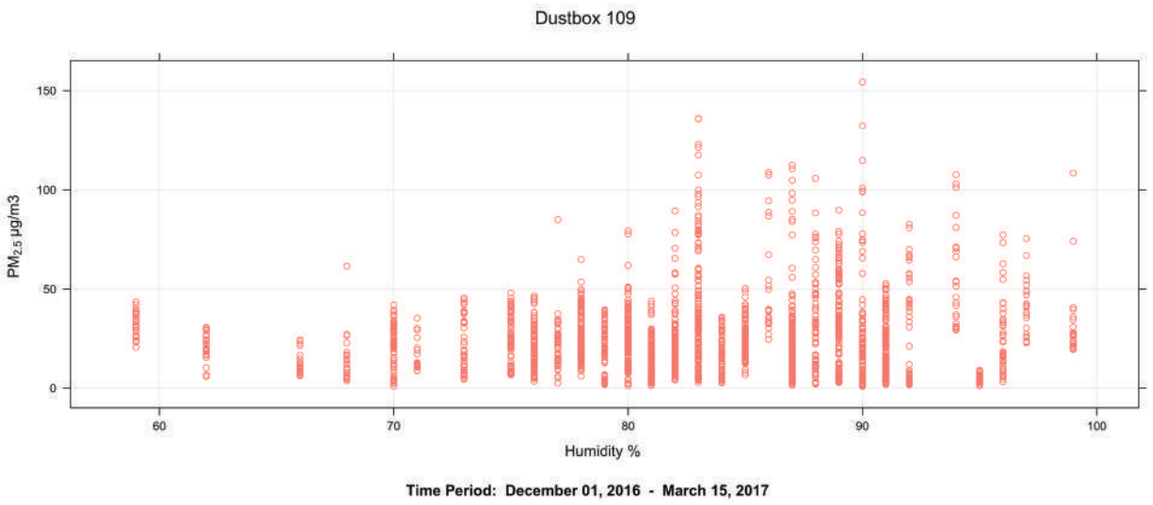
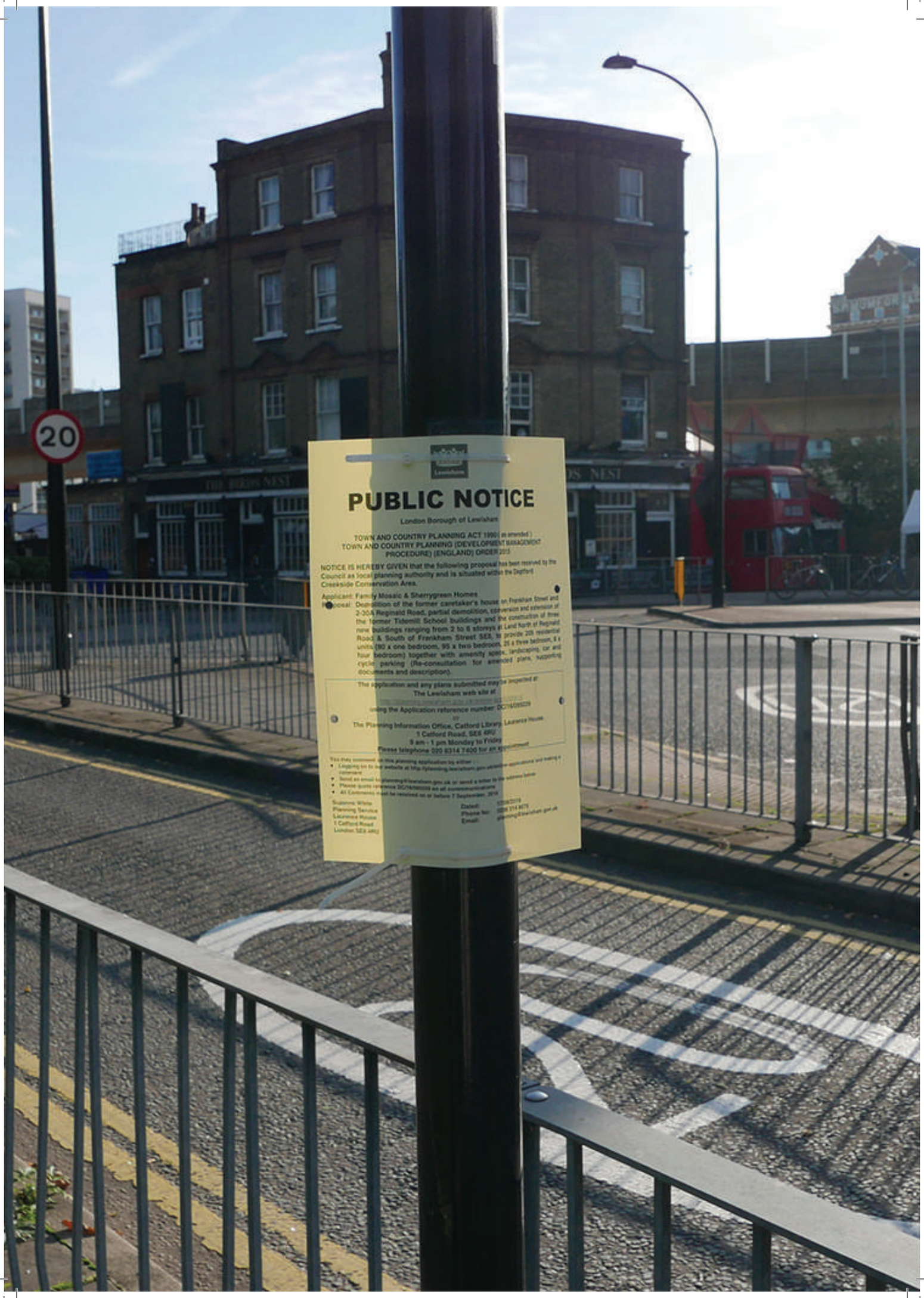


Figure 8: Dustbox 109. Scatter plot showing the relationship between mean PM2.5 concentrations and humidity from 1 December 2016 to 15 March 2017 (PM2.5 units: µg/m3).

The relationship between particulate pollution concentrations and wind speed is shown in **Figure 7**. This figure suggests that the main source of PM2.5 at the Dustbox 109 site is not wind-blown dust, as the majority of peak concentrations are recorded during lower wind speeds. This conclusion is supported by **Figure 8**, which shows that the highest hourly PM2.5 levels were recorded during relatively humid conditions (around 55% to 90% humidity). During high humidity, there would be fewer occurrences of wind-blown dust.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PUBLIC NOTICE
London Borough of Lewisham
TOWN AND COUNTRY PLANNING ACT 1990 (as amended)
TOWN AND COUNTRY PLANNING (DEVELOPMENT MANAGEMENT PROCEDURE) (ENGLAND) ORDER 2015
NOTICE IS HEREBY GIVEN that the following proposal has been received by the Council as local planning authority and is situated within the Deptford Creekside Conservation Area.
Applicant: Family Mosaic & Sherrygreen Homes
Proposal: Demolition of the former caretaker's house on Frankham Street and 2-30A Reginald Road, partial demolition, conversion and extension of the former Tidemill School buildings and the construction of three new buildings ranging from 2 to 6 storeys at Land North of Reginald Road & South of Frankham Street SE8, to provide 205 residential units (80 x one bedroom, 95 x two bedroom, 25 x three bedroom, 5 x four bedroom) together with amenity space, landscaping, car and cycle parking (Re-consultation for amended plans, supporting documents and description).
The application and any plans submitted may be inspected at:
The Lewisham web site at
using the Application reference number: DC/16/095229
or
The Planning Information Office, Catford Library, Laurence House
1 Catford Road, SE6 4RU
9 am - 1 pm Monday to Friday
Please telephone 020 8314 7400 for an appointment
You may comment on this planning application by either :
Logging on to our website at http://planning.lewisham.gov.uk/online-applications and making a comment
Send an email to planning@lewisham.gov.uk or send a letter to the address below
Please quote reference DC/16/095229 on all communications
All Comments must be received on or before 7 September, 2016
Suzanne White
Planning Service
Laurence House
1 Catford Road
London SE6 4RU
Dated: 17/08/2016
Phone No: 0208 314 4675
Email: planning@lewisham.gov.uk

DRAWING THE EVIDENCE TOGETHER

Using the tools provided through the Citizen Sense Airsift Dustbox Data Analysis Toolkit, we have characterized sources of particulate pollution detected by the Dustbox 109 and Dustbox 136 sensors as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources.
- The strongest local source(s) appear to be to the northeast of the Dustbox 109 site, and to the northeast, northwest and southwest of the Dustbox 136 site. Looking at all other local sites and industries capable of generating PM2.5 it is possible that traffic on the major roadways, including Deptford Church Street and New Cross Road, along with construction dust on Creekside and high levels of construction in the east in general could all be responsible for emissions.
- The local source is strongest during the early hours before 6 am, and the afternoon/early evening. It is therefore also likely to be related to delivery, construction and commuter road traffic.
- PM2.5 levels for this monitoring period are unlikely to be related to re-suspended or wind-blown dust due to the low wind speeds and higher humidity levels at which higher concentrations occur.
- As Dustbox 136 receives much lower emissions in general from the northeast, and Dustbox 109 receives lower emissions from the southwest, it could be possible that the Old Tidemill Wildlife Garden located between the two sites has a mitigating effect on air pollution. Further monitoring on-site and at the boundary of the garden would help to establish the differences in pollution levels in relation to the garden.


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ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

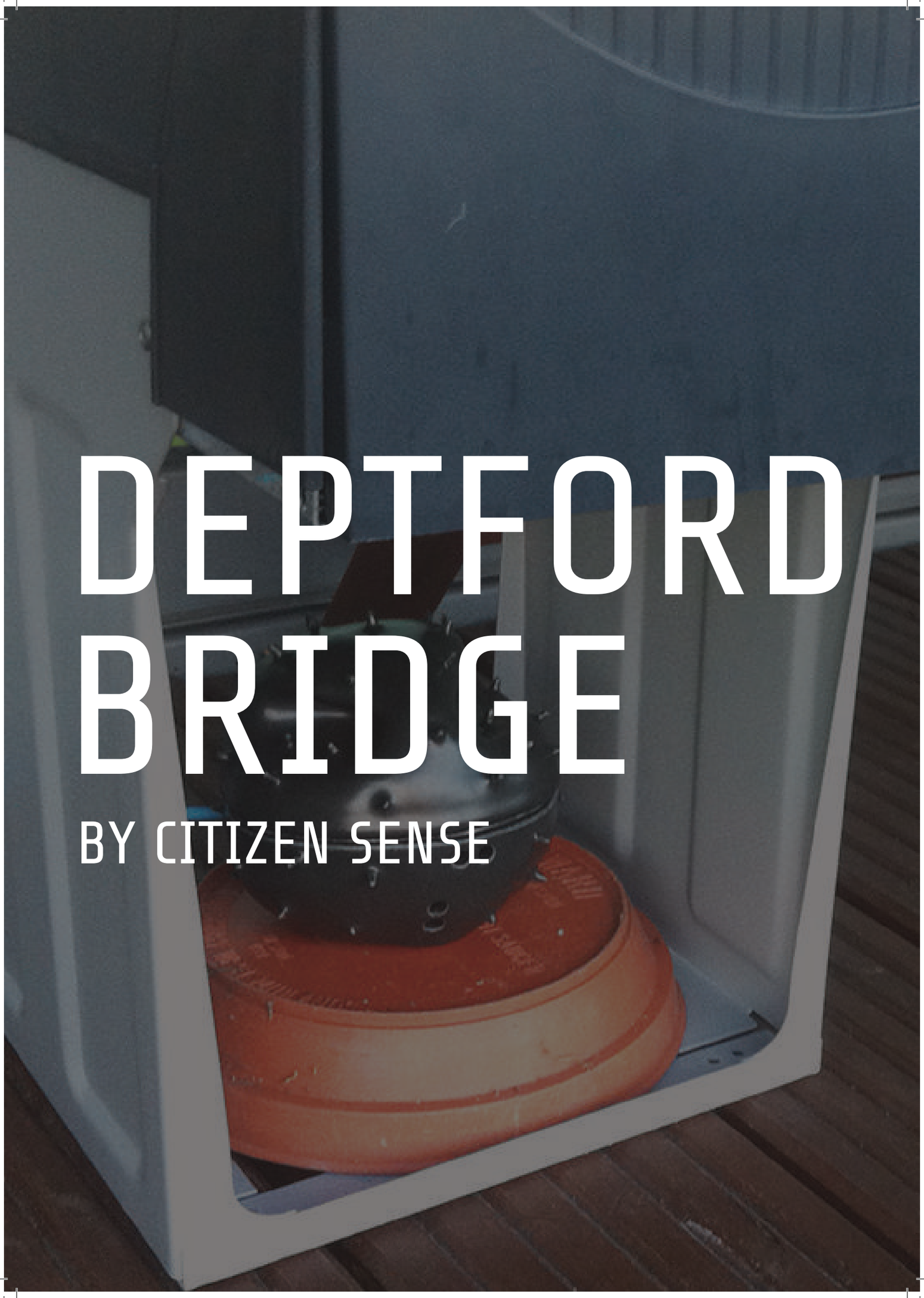
AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Extend and develop courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.


Pink
Palace
This is The Pink Palace



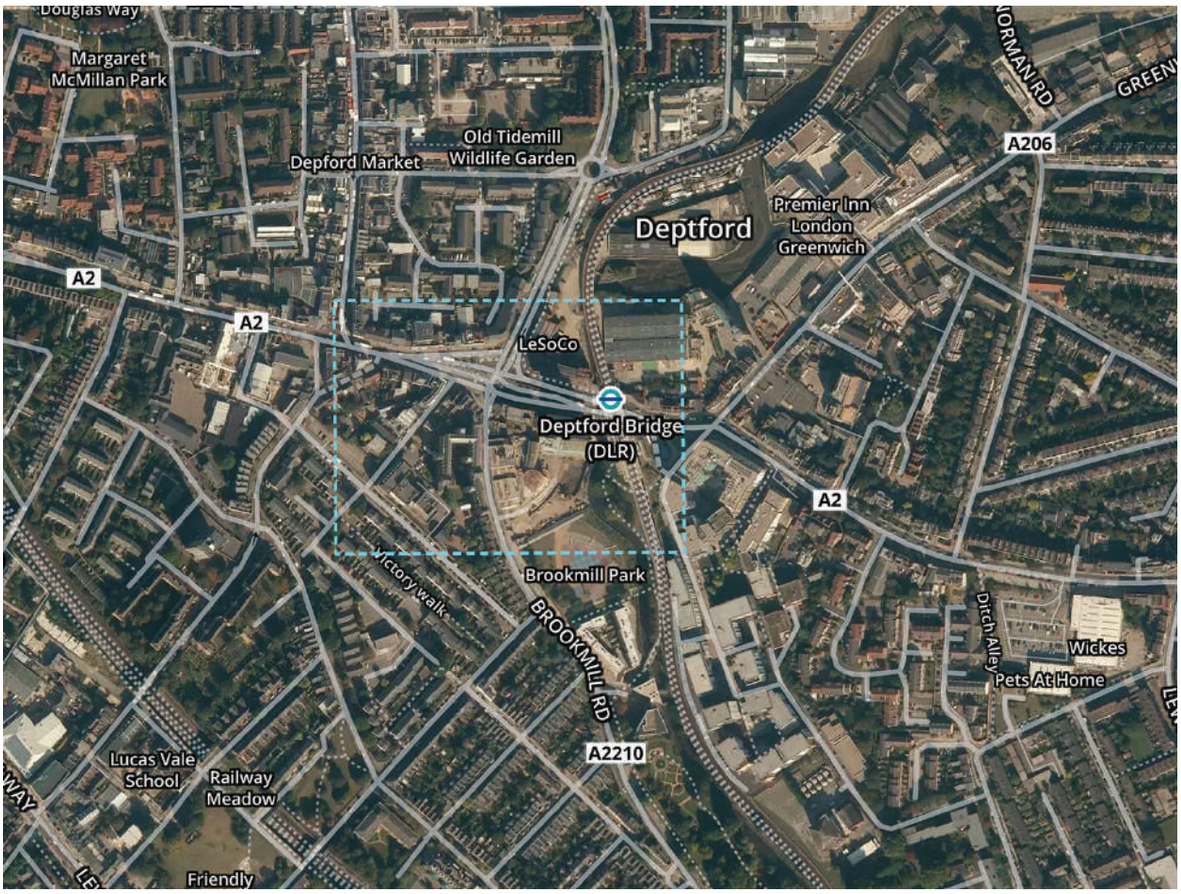
DEPTFORD BRIDGE

BY CITIZEN SENSE

The Deptford Bridge area includes several major traffic intersections that are key thoroughfares for South East London. There are high levels of automobile, HGV, bus and related traffic in the area, and idling traffic and buses are frequently spotted near the Deptford Bridge DLR station. Citizen data reveals that pollution levels are especially high due to the arterial network and traffic intersections in this area.

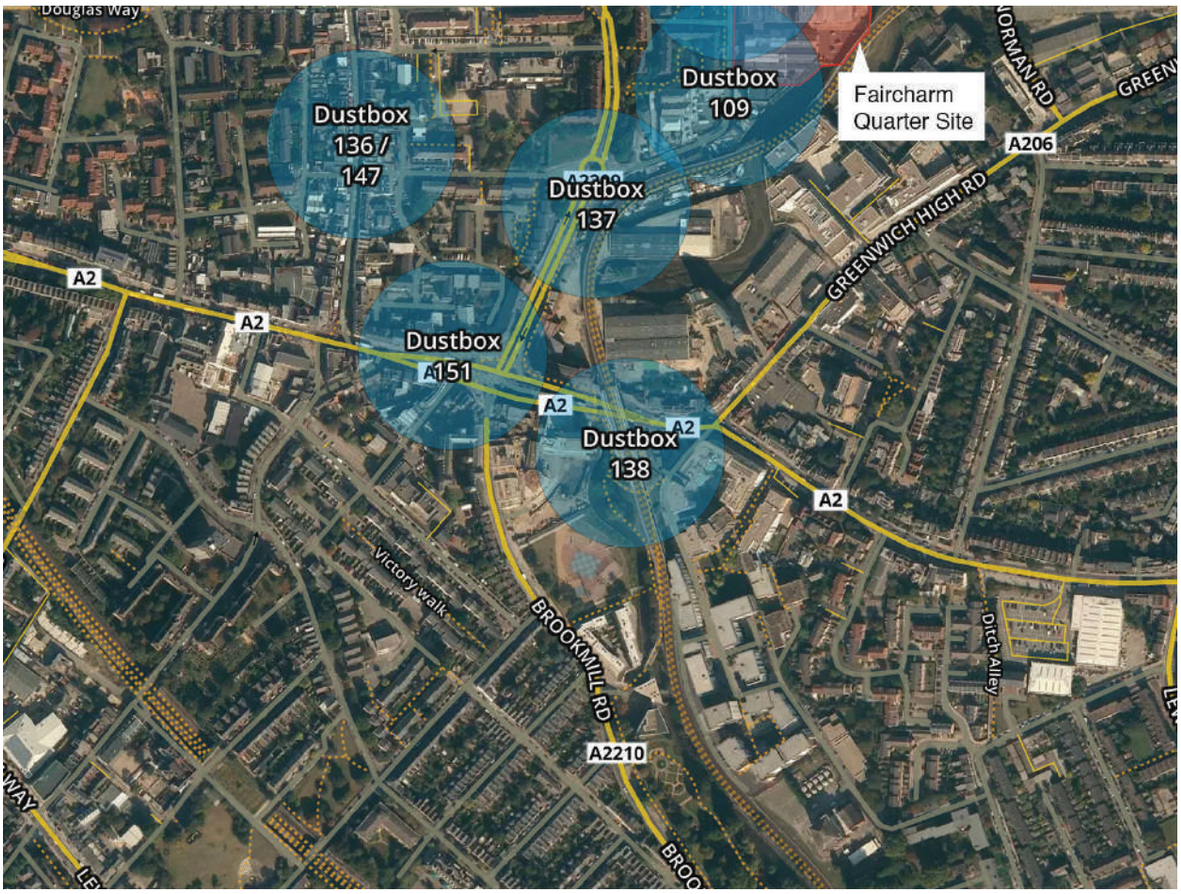
This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from planning for improved transport, to reducing emission levels at major traffic intersections, and creating green buffers between roadways and housing.

THE LOCATION



Deptford Bridge is a residential, commercial and industrial area near the Deptford Bridge DLR station in the Borough of Lewisham, South East London. The monitoring area is located at the busy intersections of Greenwich High Road and New Cross Road, and Deptford Church Street with New Cross Road.

Dustbox monitors are placed in a number of sites throughout Deptford Bridge as illustrated in the map below. Dustbox 151 is located on the northeastern corner of the junction, where New Cross Road (A2) and Deptford Church Street (A2209) intersect. Dustbox 151 is located approximately 6 metres from the roadside on a second-storey balcony facing an internal courtyard. Dustbox 138 is located on a third-floor balcony near the Deptford Bridge DLR station, which lies approximately 55 metres to the east. Dustbox 138 is on the southwest side of Deptford Bridge (A2) at the intersection with Greenwich High Road (A206).



Deptford Church Street (A2209) runs north-south through the centre of the monitoring area. New Cross Road (A2) runs east-west through the centre of the monitoring area. To the east of the monitoring area is the DLR rail line that runs from Deptford Bridge to Greenwich.

Currently, sites to the north of Deptford Bridge at Creekside are under construction for residential development. Two miles to the northeast of the site is Blackwall Tunnel Southern Approach, and just over five miles to the northeast is London City Airport.

LOCAL SOURCES OF PARTICULATE POLLUTION

The above map highlights possible emissions sources in the Deptford Bridge area, primarily related to road transportation. This area is home to a large junction that controls traffic flow between four major A-roads; New Cross Road/Deptford Bridge (A2), Brookmill Road (A2210) and Deptford Church Street (A2209), as well as Greenwich High Road (A206). Queues of idling traffic are often visible as vehicles wait for traffic lights to change. Below the DLR train station is a bus stop and turnaround where buses often park and idle while waiting (although more recently hybrid

buses have been deployed in the area for some routes). In addition, there is ongoing construction to the north of both monitors on the Faircharm Quarter site at Creekside.

LONDON-WIDE, REGIONAL AND GLOBAL SOURCES OF PARTICULATE POLLUTION

Particulate matter sources in London can be attributed to a broad range of emissions. Within London, PM2.5 from transport (particularly diesel), industry, construction, cooking and heating all contribute significantly to London-wide levels. A significant amount of PM2.5 emissions also comes from heavy industry and agriculture outside the UK, particularly France, Belgium, the Netherlands, Luxembourg, Germany and Poland. These emissions are thought to account for an urban background of approximately 10 µg/m3. The importance of these transboundary effects of PM2.5 emissions from outside of the UK on the total London PM2.5 can vary between 40% to 80% daily depending on weather conditions. When long-range pollution episodes do occur in London, they are generally carried on easterly winds. There are a number of global emissions, events and practices that contribute particulate matter to the total London PM2.5, including fuel production, industrial and domestic combustion, transportation, waste disposal, and agriculture, although these are harder to quantify.

OBSERVATIONS

Participants have emphasized just how busy the New Cross Road (A2) junctions are throughout daytime, afternoon and evening periods. They have noted that the junction seems visibly less congested only at around midnight. Participants have described the high number of HGVs that use this route (particularly vehicles from European hauliers). During the collection of supplementary data, we observed idling at a bus stopping point off Deal's Gateway road (A206). Participants have observed that changes to the traffic light timing causes traffic to idle for long periods at the intersection of Friendly Street and the A2210. However, these changes also help to make the walkways more navigable by pedestrians and cyclists.

Other observations include unpleasant, intermittent odours from the Ravensbourne River. One local resident has made complaints to Lewisham and Greenwich councils due to visible floating debris and oil fluid pollution in the River.

IS THERE EVIDENCE OF A PROBLEM?

The Dustbox device used to monitor PM2.5 particles is an "indicative" monitor. This means that measurements can give an indication of pollutant concentrations, but cannot be directly compared with national and international guidelines and standards in an "official" or regulatory sense. Despite this, indicative monitoring is a well-established method within atmospheric science for carrying out initial surveys of an area to establish whether a potential problem merits further investigation. Indicative monitors are also becoming increasingly available for citizen-based air-quality monitoring, similar to this study. Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period.

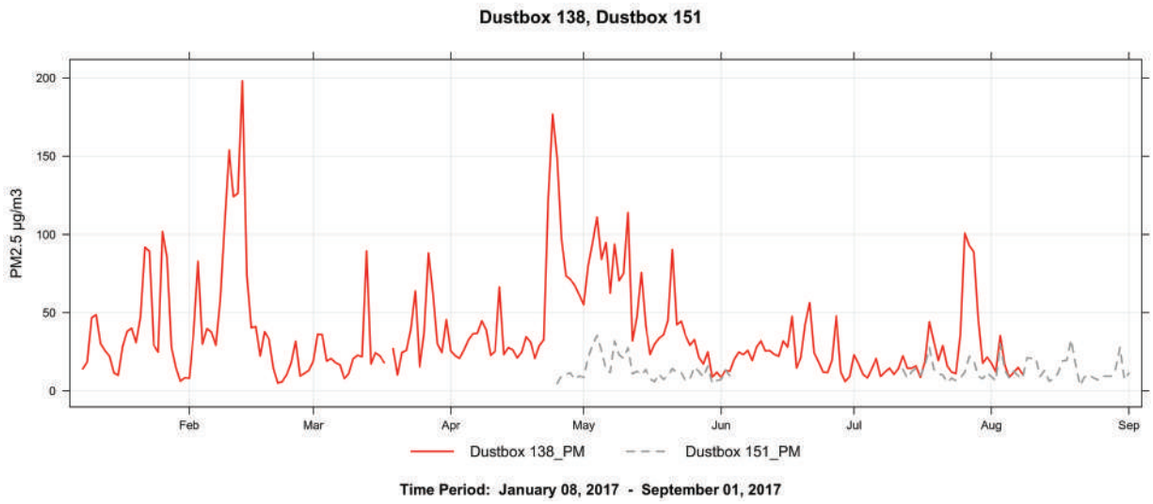


Figure 1: Dustbox 138 and 151. Line graph time-series chart of 24-hour mean PM2.5 from 8 January 2017 to 1 September 2017 (units: µg/m3).

Indicative daily mean concentrations of PM2.5 are shown as a time-series chart in **Figure 1**. This figure shows an extract of the monitoring data for the entire monitoring period from the Dustbox 138 site and Dustbox 151 site presented as 24-hourly mean concentrations of PM2.5.

As shown in **Figure 1**, the World Health Organisation (WHO) guideline of 25 µg/m3 for 24-hour daily mean concentration of PM2.5 is exceeded on a number of occasions at Dustbox 138 and 151, and this pattern is repeated in the surrounding Dustboxes, suggesting that further investigation may be merited.

However, it is important to determine whether these breaches were caused by "local" sources of pollution close to the sensor (i.e., within 300 meters), or by regional sources affecting the whole

area. Local sources often augment regional sources, which can be revealed as a spike on top of a hump. In a general sense, this regional-local pattern occurs because pollution mixes in the atmosphere as it travels away from a source, smoothing the speed of changes in concentrations.

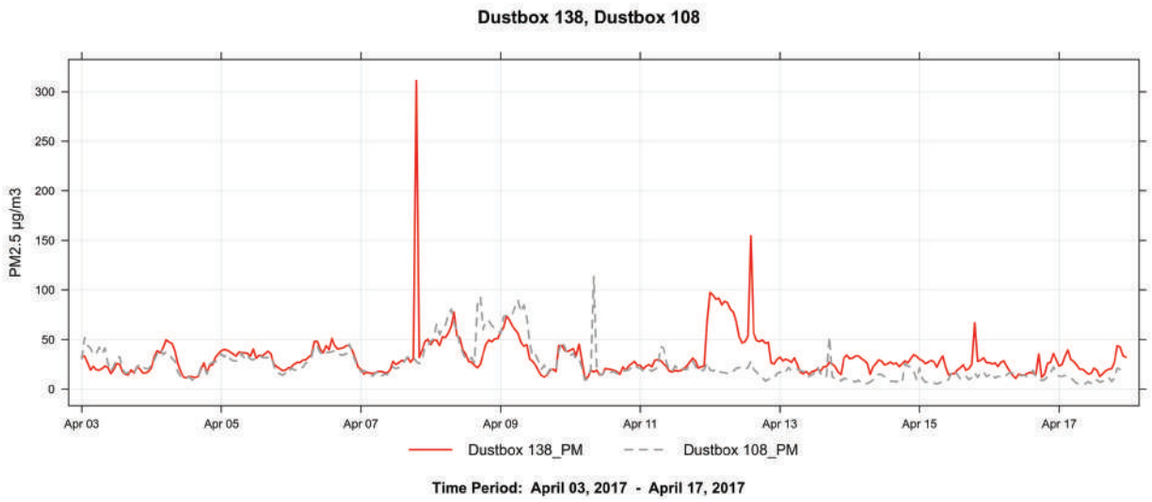


Figure 2: Dustboxes 138 and 108. Line graph time-series chart of 1-hour mean PM2.5 concentrations from 3 April 2017 to 17 April 2017 (units: µg/m3).

Figure 2 shows an extract of the monitoring data from the Dustbox 138 site presented as hourly mean concentrations of PM2.5. Measurements from Dustbox 108, a monitor in New Cross Gate, are shown for comparison.

Regional sources of pollution again appear as broad "humps" of elevated pollution affecting both sites, for example, in the period between 5 to 7 April 2017. Local sources of pollution appear as short "spikes" typically affecting only one or the other site, for example, 12 to 13 April 2017 at Dustbox 138.

Figure 2 therefore indicates that there are significant local sources of particulate pollution elevating ambient concentrations well above those caused by regional sources across the monitoring period.

There are many possible sources of pollution in the area and we have to look at the measurements more closely to see if we can deduce what activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

CHARAC-
TERIZING
THE
PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

Using time plots, it is possible to analyse time of day and day of week, as well as month, when pollution levels are elevated. Time plots aggregate PM2.5 concentrations according to time, so that key patterns such as rush hours and traffic, as well as possible construction or industry sources, along with regional pollution events due to seasonal variation, are evident.

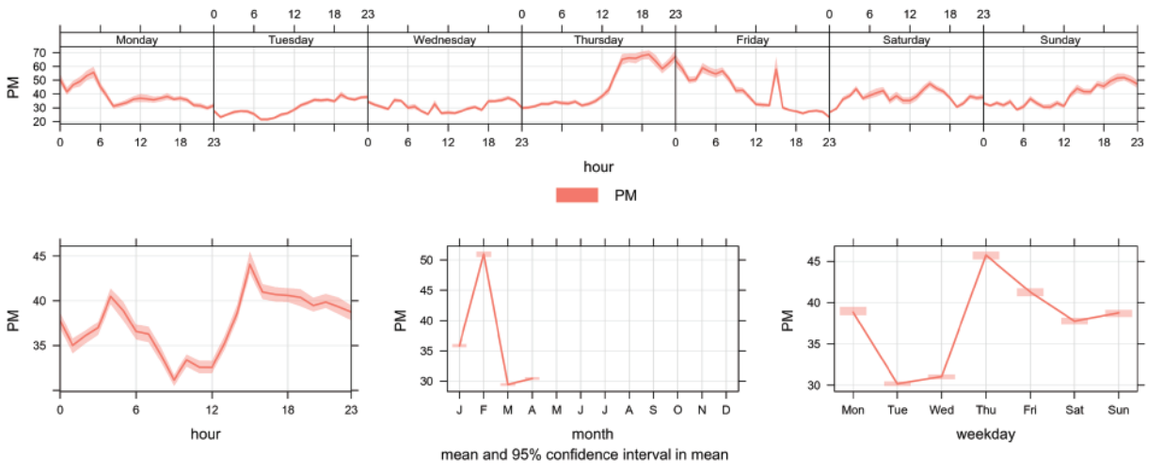


Figure 3: Dustbox 138. Time plot showing PM2.5 concentrations from 5 January to 20 April 2017, grouped by hour, month and weekday (units: µg/m3).

Figure 3 investigates when these elevated levels in pollution occur by grouping concentrations by hour, month and day of the week. Sources of pollution related to commuter or transit traffic typically show peaks in concentrations coincidental with peaks in traffic flow, i.e., morning and evening rush hour with notably lower levels at night and on Sundays. This can also be seen in **Figure 3**, where there is evidence of early morning and evening peaks.

These charts can be used to match patterns in the occurrence of spikes with working patterns of particulate-generating activities in the area. **Figure 3** shows that on most days there are elevated levels in the early hours of the morning and from midday through the evening at the Dustbox 138 site. However it is clear the morning peaks are around 5 am, perhaps suggesting higher levels of particulates from earlier traffic, such as deliveries or construction crews.

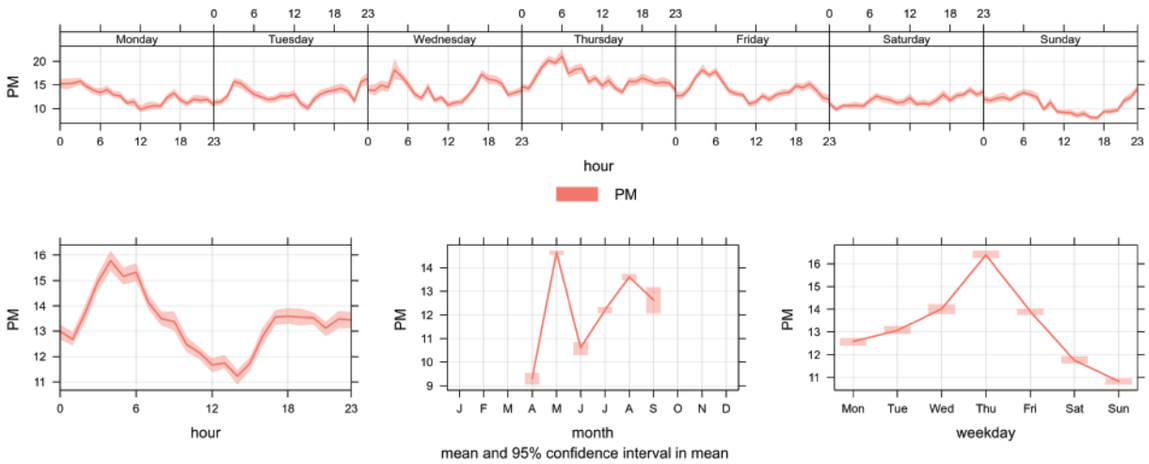


Figure 4: Dustbox 151 Time plot showing PM2.5 concentrations from 25 April to 1 September 2017, grouped by hour, month and weekday (units: µg/m3).

Figure 4 groups concentrations by hour, month and day of the week for Dustbox 151. As this Dustbox came online later, **Figure 4** shows a different date range to Figure 5, so these plots are not directly comparable. **Figure 4** shows a large morning peak at around 4 am and a lower afternoon peak from approximately 5 pm. This profile may correspond to transport-related emissions sources. Like Dustbox 138 readings, shown in **Figure 3**, levels do not go down much in the evening, from 5 pm onwards. Levels are lowest on Saturday and Sunday as would be expected with a commuting pattern. Levels are highest on Thursdays as shown in **Figure 3** for Dustbox 138, something that may merit further investigation.

In a general sense, it should be noted that the weather plays a large role in particulate levels. For example, dust tends to be dispersed more slowly during the hours of darkness, as vertical and horizontal wind speeds are generally lower. This phenomenon may skew charts somewhat.

WHICH DIRECTION IS PM2.5 COMING FROM?

Wind direction has a considerable influence on pollution measurements. A sensor will only record emissions from a particular source or activity if the wind blows it from the source towards the sensor. Therefore, we can investigate where a source of pollution is likely to be located by plotting wind direction against pollution concentrations. **Figure 5** shows how pollutant concentrations at Dustbox 138 site are influenced by wind direction. It shows the highest pollution levels are from a north

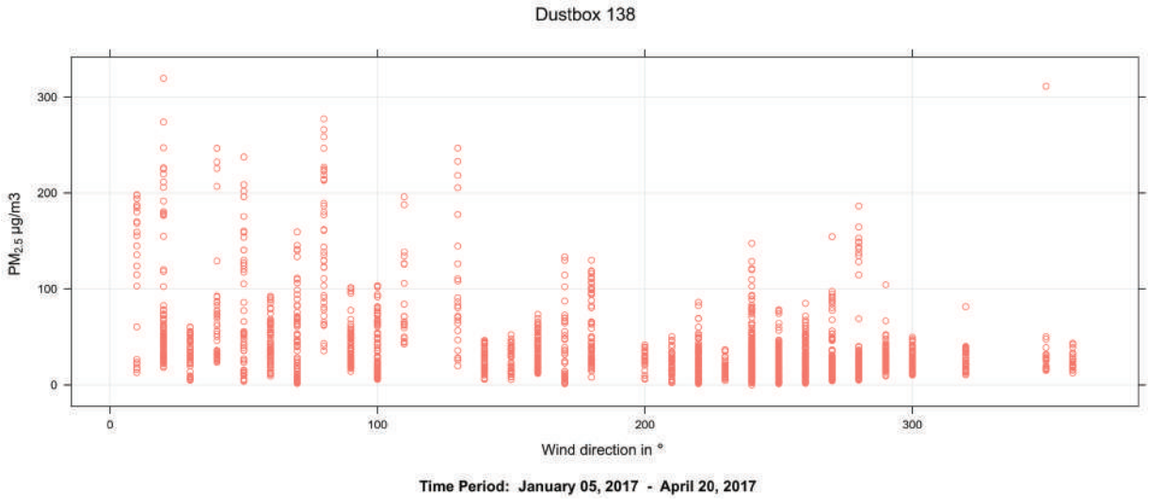


Figure 5: Dustbox 138. Scatter plot showing the relationship between mean PM2.5 concentrations and wind direction in degrees from 5 January to 20 April 2017 (PM2.5 units: µg/m3).

to northeast direction (0° to 70°), with also regular high readings from the southwest (240°).

A polar plot, as shown in the figures below, is a more intuitive way of looking at this relationship. This shows colour contours of pollutant concentrations in relation to wind direction and wind speed, with zero wind in the centre, increasing up to 20 metres per second (ms-1) at the outer ring. The highest mean concentrations are shown in red, the lowest are in blue.

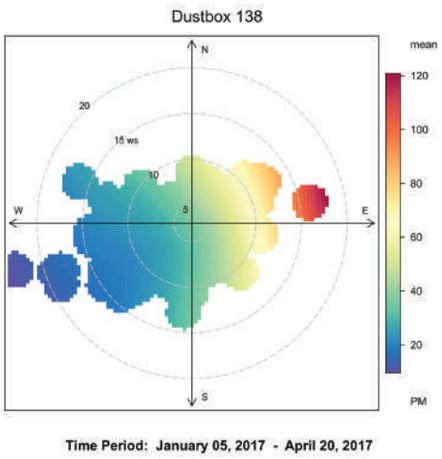


Figure 6a: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustbox 138 from 5 January to 20 April 2017. The mean concentrations shown here are relative, e.g., for Dustbox 138 the highest mean concentration is approximately 120 µg/m3. Emissions levels are displayed on polar plots according to a gradient of low to high pollution levels. The colour coding refers to a different range of readings in each plot.

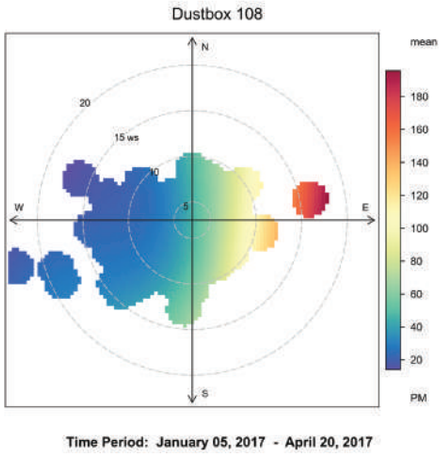


Figure 6b: Polar plot showing mean PM2.5 concentrations during different wind conditions at the monitoring locations for Dustbox 108. The mean concentrations shown here are relative.

Figures 6a and 6b highlight the fact that, on average, the most frequent high concentrations of PM2.5 are recorded at Dustbox 138 and Dustbox 108 during northeasterly winds. As both sites show a source to the east there may be a regional source of air pollution in that direction, which is detected by most sensors in the area. Dustbox 108 is exposed to similar emissions sources from New Cross Road, and displays comparably high levels to 138.

UNDER WHICH WEATHER CONDITIONS ARE PM2.5 LEVELS MOST EVIDENT?

Different sources of pollution will act in distinct ways according to the weather. For example, windblown dust will primarily occur during dry, windy conditions. Sometimes, you can learn about a source by characterizing this weather-related behaviour.

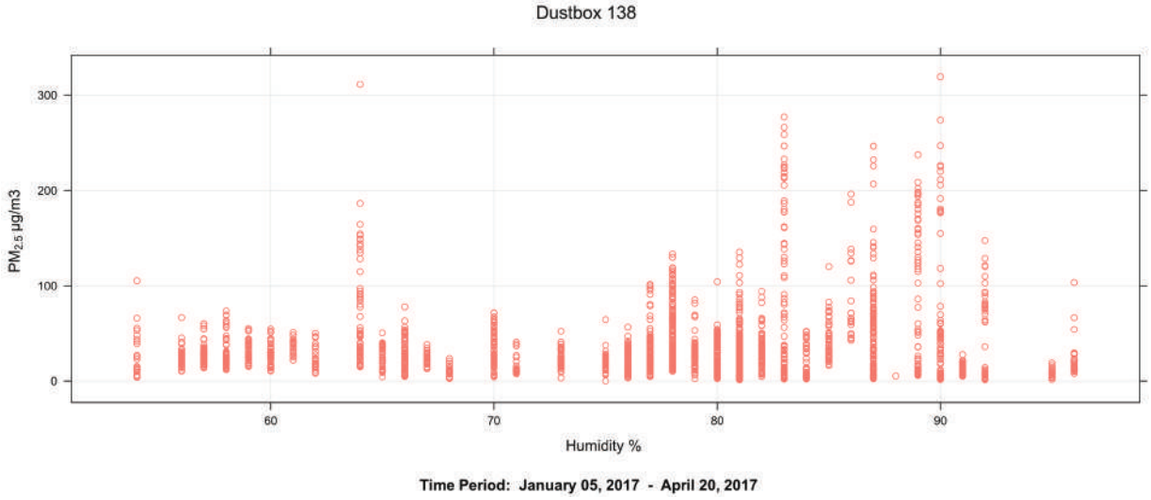


Figure 7: Dustbox 138. Scatter plot showing the relationship between mean PM2.5 concentrations and humidity from 5 January to 20 April 2017 (PM2.5 units: µg/m3).

Figure 7 indicates that the highest readings for Dustbox 138 occur at levels of relatively high humidity, over 75%. During higher humidity there would be fewer occurrences of wind-blown dust. This suggests that emission sources are localised.

DRAWING THE EVIDENCE TOGETHER

Using the tools provided through the Citizen Sense Airsift Dustbox Data Analysis Toolkit, we have characterized sources of particulate pollution detected by the Dustbox 138 and Dustbox 151 Deptford Bridge monitors as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources, often at high levels.
- The strongest local source(s) appear to be to the northeast of the Dustbox 138 site. Due to the irregularity of the Dustbox 151 data collection, it was difficult to establish a clear direction for the source of emissions.
- There is some evidence of local emissions combining with city-wide emissions. These local emission sources could travel from the A2 in both directions, Deptford Church Street, as well as the occasional idling of bus traffic. Dustbox 108 in New Cross Gate shows a very similar pattern to 138, suggesting the A2 flow is impacting the monitors in similar ways.
- The local source is strongest during the early hours before 6 am, and in the afternoon/early evening. It is therefore also likely to be related to delivery, construction crew and commuter road traffic.
- PM2.5 levels are unlikely to be related to re-suspended or wind-blown dust due to low wind speeds and high humidity at which higher concentrations occur.
- The high peaks shown in late January can be accounted for as two periods of poor air quality across London, beginning 19 January 2017 and 23 January 2017. These pollution episodes were partly due to cold, settled weather slowing the dispersion of local pollutants.


Cê Gia
Vietnamese Restaurant
Lê Gia
DEPTFORD CINEMA
AUTOCOLOR

ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Extend and develop courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.

NEW CROSS GATE

BY CITIZEN SENSE

The New Cross Gate area is the most westerly part of the citizen monitoring network, and is marked by several major traffic intersections and key thoroughfares for South East London. The area includes a mix of housing, cultural spaces, shops, community green spaces, as well as Goldsmiths, University of London. Key findings show that pollution levels are high near major roads, but are considerably lower on pedestrianized streets and within well planted community gardens.

This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from planning for better transport to building on the success of community green spaces and pedestrian streets in the area.

THE LOCATION

The New Cross Gate monitoring location, which includes Dustboxes 108, 123, 133 and 149, is located to the west of the Goldsmiths, University of London campus. It is characterised by several busy roads that cross southeast London, as well as a railway with predominantly electric trains, which connects New Cross Gate with central London.

There are several schools in the area, and land use is primarily residential, with localised concentrations of shops, cultural centres and restaurants, as well as a large Sainsbury's store and shopping centre. There are several additional large shopping centres along the Old Kent Road to the northwest of the monitoring area. The Southeast London Combined Heat and Power (SELCHP) incinerator is just to the north of the monitoring location. The New Cross Gate bus garage is located on the southeast edge of the monitoring location.

The New Cross Gate area, along with Deptford, is a site of ongoing development and redevelopment, with construction sites located at the periphery of this immediate area. On the whole, the primary emission-causing activities in the New Cross Gate location consist

of transport-related emissions.

LOCAL SOURCES OF PARTICULATE POLLUTION

The below map indicates the approximate monitoring locations of the Dustboxes. Dustbox 108 is located on a fourth-floor balcony that faces onto a pedestrianized street and small park. Dustbox 133 is situated on a flat roof near a main road, monitoring discontinuously on a battery pack. Dustbox 149 is located in a garden, sheltered within a DIY Stevenson screen under flowering bushes and near to a compost heap. Dustbox 123 is in relatively close proximity to the New Cross Bus Garage.

The map shows possible emissions sources in the local area, most prominently roads. New Cross Road (A2) is located 85 metres to the southwest of Dustbox 108, and 3 metres to the southwest of Dustbox 133. Dustbox 149 is located in a residential area and on a pedestrian street, but with two larger roads nearby: Queen's Road (A202) 120 metres to the south, and Pomeroy Street (B2227) 120 metres to the west. Since Dustbox 123 is located at the exit to the New Cross Gate Bus Garage, bus traffic is likely to be a possible emissions source at this monitoring site.

> *In total, 30 monitors were distributed to participants. The monitoring period ran for over 9 months, until September 2017. During peak monitoring activity, there were 21 active Dustboxes.*

LONDON-WIDE, REGIONAL AND GLOBAL SOURCES OF PARTICULATE POLLUTION

Particulate matter sources in London can be attributed to a broad range of emissions. Within London, PM2.5 from transport (particularly diesel), industry, construction, cooking and heating all contribute significantly to London-wide levels. A significant amount of PM2.5 emissions also comes from heavy industry and agriculture outside the UK, particularly France, Belgium, the Netherlands, Luxembourg, Germany and Poland. These emissions are thought to account for an urban background of approximately 10 µg/m3. The importance of these transboundary effects of PM2.5 emissions from outside of the UK on the total London PM2.5 can vary between 40% to 80% daily depending on weather conditions. When long-range pollution episodes do occur in London, they are generally carried on easterly winds. There are a number of global emissions, events and practices that contribute particulate matter to the total London PM2.5, including fuel production, industrial and domestic combustion, transportation, waste disposal, and agriculture, although these are harder to quantify.

OBSERVATIONS

Most participants reported observing constant idling traffic on the A2, especially around the junction with Queen's Road. One participant noted that there was often heavy truck traffic on the road from 5 am onwards, and the idling traffic was often more intensive on Deptford market days. One of the participants also noted that the street was often filled with smoke from the local BBQ café adjacent to their residence (and monitoring location). One of the participants who cycles noted that as they descended into New Cross from Crystal Palace on some mornings they observed a thick grey soup. In addition, on some mornings as they had cycled through New Cross they experienced weeping eyes, and so they had purchased a mask for cycling as a precautionary measure, although found this was largely ineffective.


Winkworth
CONWAY
great people : great work
Caution
Keep Clear

IS THERE EVIDENCE OF A PROBLEM?

The device used to monitor PM2.5 is an "indicative" monitor. This means that measurements can give an indication of pollutant concentrations, but cannot be directly compared with national and international guidelines and standards in an "official" or regulatory sense. Despite this, indicative monitoring is a well-established method within atmospheric science for carrying out initial surveys of an area to establish whether a potential problem merits further investigation. Indicative monitors are also becoming increasingly available for citizen-based air-quality monitoring, similar to this study. Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period.

Dustbox monitoring at the New Cross Gate location generated data from late November 2016 to early August 2017, although different monitors were active at different times. Indicative daily mean concentrations of PM2.5 for monitors 108 and 123 between December 2016 and February 2017 are provided in **Figure 1**.

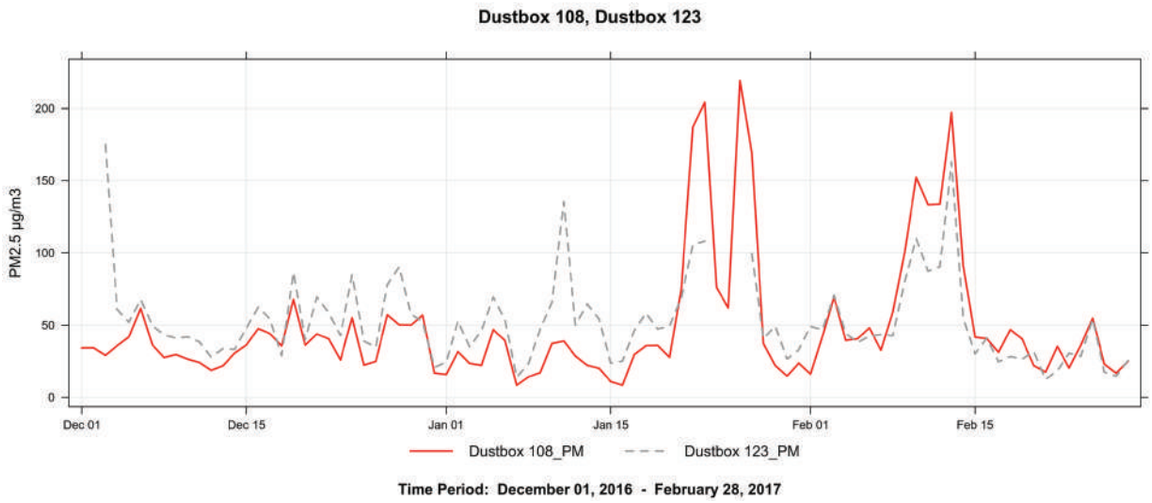


Figure 1: Dustboxes 108 and 123. Line graph of 24-hour mean PM2.5 concentrations from 1 December 2016 to 28 February 2017 (units: µg/m3).

The World Health Organisation (WHO) has established a 24-hour mean guideline for PM2.5 of 25 µg/m3 (although there is no safe level of exposure). The time series graphs below show that the WHO guideline was regularly exceeded at Dustboxes 108 and 123 between December 2016 and February 2017, and occasionally was exceeded in the months following.

The PM2.5 levels registered by Dustboxes 108 and 123 were elevated across the entire monitoring period. However, in the months of December, January and February, there were more days that exceeded the WHO 24-hour mean guideline of 25 µg/m3 than days that were within the guideline There were lower PM2.5 levels recorded during March, April and May, when fewer than half of days were over the WHO guideline. Dustbox 133 was run using a battery pack gathering intermittent data, but the recorded readings also fit this pattern.

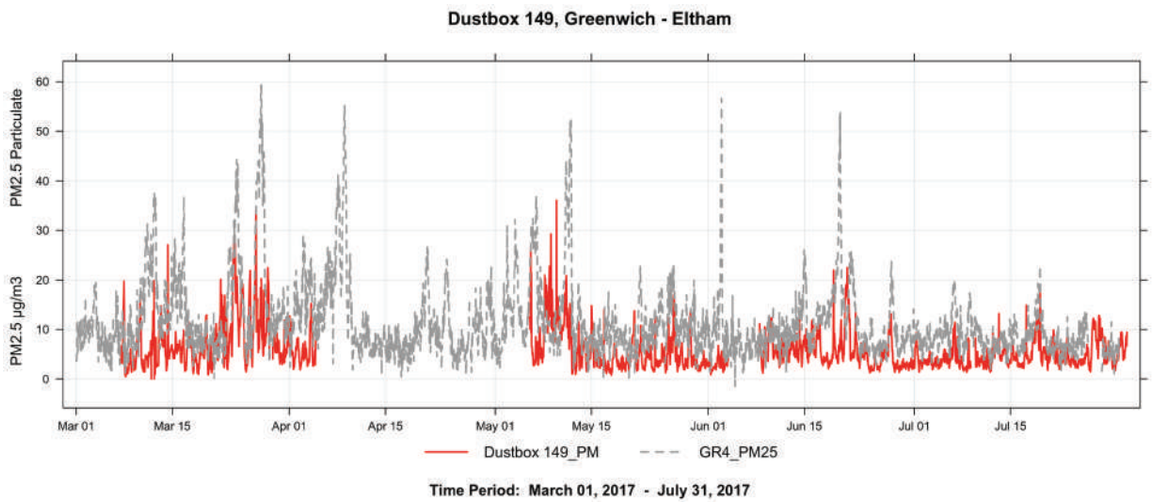


Figure 2: Dustbox 149 and LAQN Greenwich Eltham monitoring station. Line graph of 1-hour mean PM2.5 concentrations from 1 March 2017 to 31 July 2017 (units: µg/m3).

Dustbox 149, a monitor located in a sheltered garden and on a pedestrianized street, was activated later in the monitoring period than the other three Dustboxes. It ran from March 2017 until early August 2017. As **Figure 2** above illustrates, Dustbox 149 registered much lower emissions levels overall, showing no exceedances of the WHO guideline during this monitoring period. Dustbox 149 is compared here to the LAQN Greenwich Eltham site, which is an urban background location, to show that monitoring locations away from roadsides can have noticeably lower levels of pollution.

These indicative findings suggest that further research could be warranted. It is useful to determine when these monitors are registering local sources of emissions (within approximately 300 metres of the sensor), and when they are documenting regional sources that are further away, as well as capturing other phenomena such as unusual weather conditions occurring across London.

There are many possible sources of pollution in the area, and we have to look at the measurements more closely to see if we can deduce which activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

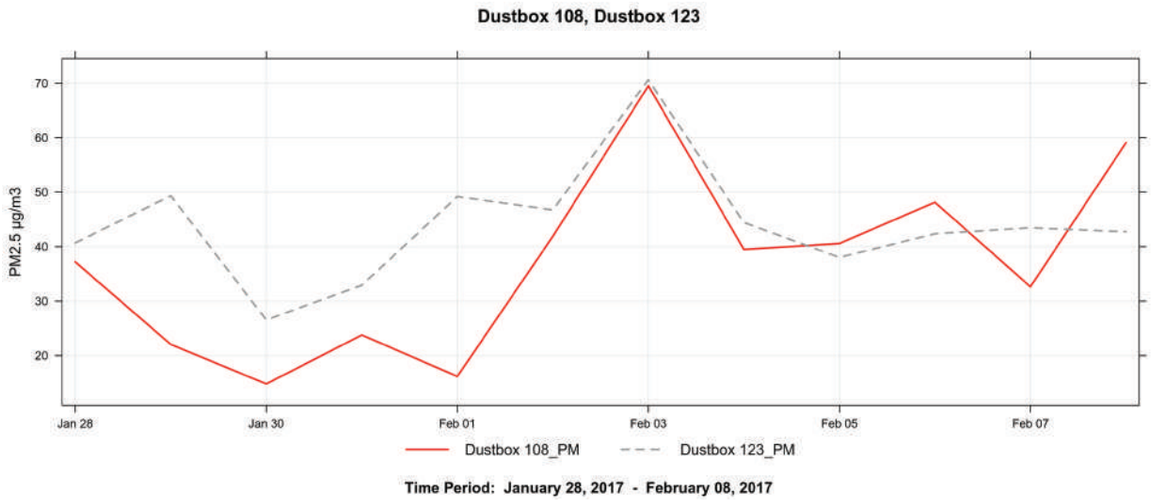


Figure 3: Dustbox 108 and 123. Line graph of 24-hour mean PM2.5 concentrations from 28 January to 8 February 2017 (units: µg/m3).

Figure 3 has been plotted to analyse PM2.5 levels outside of the city-wide pollution events that were experienced during January and February 2017. However, even when analysing data outside of these peak events, the Dustbox data indicates relatively high levels, particularly for Dustbox 123. These patterns suggest that local sources of emissions could be registering on the monitors.

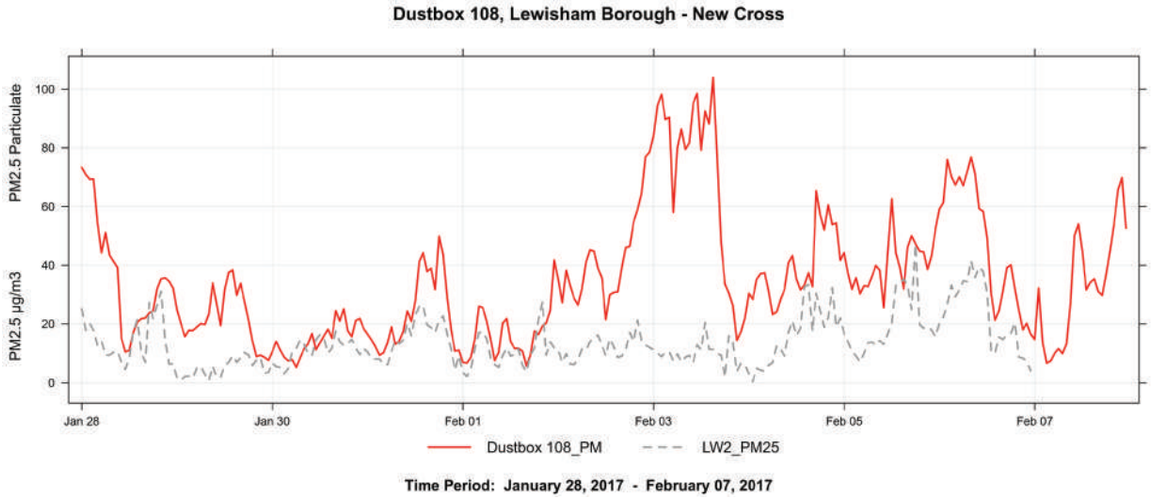


Figure 4a: Dustbox 108 and LAQN New Cross monitoring station. Line graph of 1-hour mean PM2.5 concentrations from 28 January to 7 February 2017 (units: µg/m3).

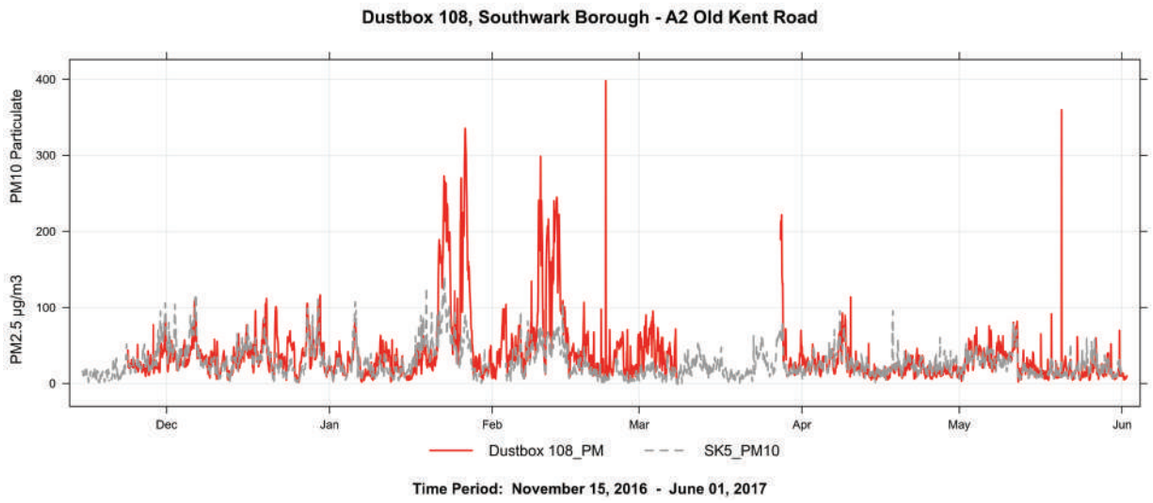


Figure 4b: Dustbox 108 and LAQN Southwark monitoring station. Line graph comparing 1-hour mean PM2.5 (108) and PM10 (Southwark) concentrations across the monitoring period from 15 November to 1 June 2017 (units: µg/m3).

One source of information on London-wide pollution events is the city's statutory monitoring infrastructure, the London Air Quality Network (LAQN). The LAQN provides pollution alerts to citizens, and keeps records of episodes of high pollution in the capital. New Cross Gate is home to an LAQN monitoring station for PM2.5 that sits on the roadside, approximately 3 metres south of New Cross Road (A2).

In **Figure 4a** above, Dustbox 108 and the LAQN New Cross Gate monitoring station share some similar spikes, suggesting shared local emissions sources in the New Cross Gate area. In addition, Dustbox 108 shows spikes of particulates in the form of raised humps on the line graph. These humps indicate elevated levels of pollution, where spikes on top of broader levels indicate that local pollution sources could be adding to regional sources.

Figure 4b compares Dustbox 108 and the LAQN Southwark Old Kent Road monitoring station (a monitor that is also in the Automatic Urban and Rural Network (AURN) run by DEFRA). While the Southwark Old Kent Road station monitors particulate matter 10 (PM10) and does not include data for PM2.5, nevertheless there is broad agreement between the two monitors, with elevated episodes of PM2.5 evident at the Dustbox 108 location. The WHO 24-hour guideline for PM10 is 50 µg/m3, which is also clearly exceeded on a number of occasions, in addition to the exceedances of PM2.5 at 25 µg/m3.

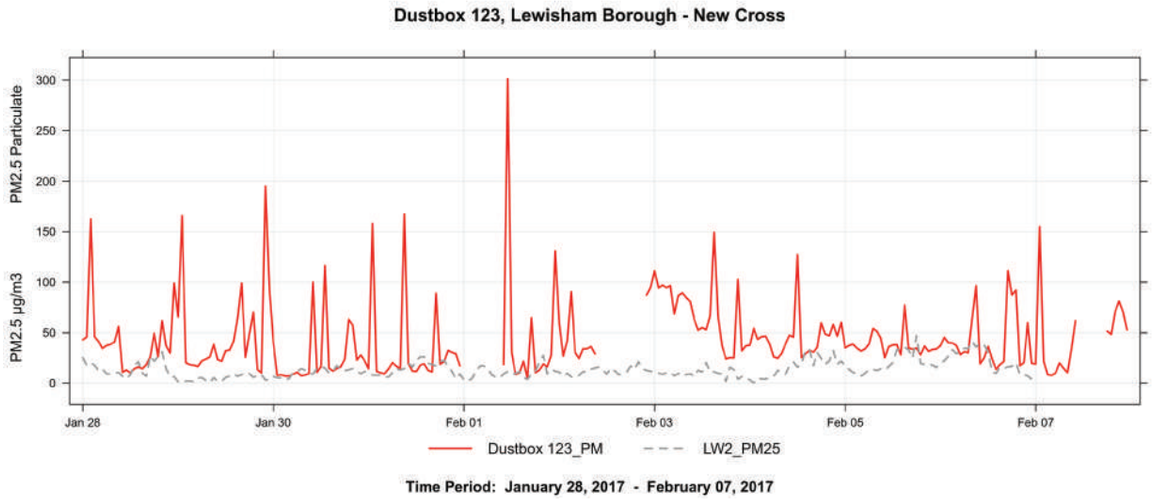


Figure 5: Dustbox 123. Line graph of 1-hour mean PM2.5 concentrations from 28 January to 7 February 2017 (units: µg/m3).

Figure 5 indicates that Dustbox 123 generally shows humps that are different from the LAQN New Cross Gate monitor. Additionally, it shows regular and quite distinctive spikes, which suggest a different local emissions source. Further study would be warranted to determine the source of these emissions.

CHARAC-
TERIZING
THE
PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

Using time plots, it is possible to analyse time of day and day of week, as well as month, when pollution levels are elevated. Time plots aggregate PM2.5 concentrations according to time, so that key patterns such as rush hours and traffic, as well as possible construction or industry sources, along with regional pollution events due to seasonal variation, are evident.

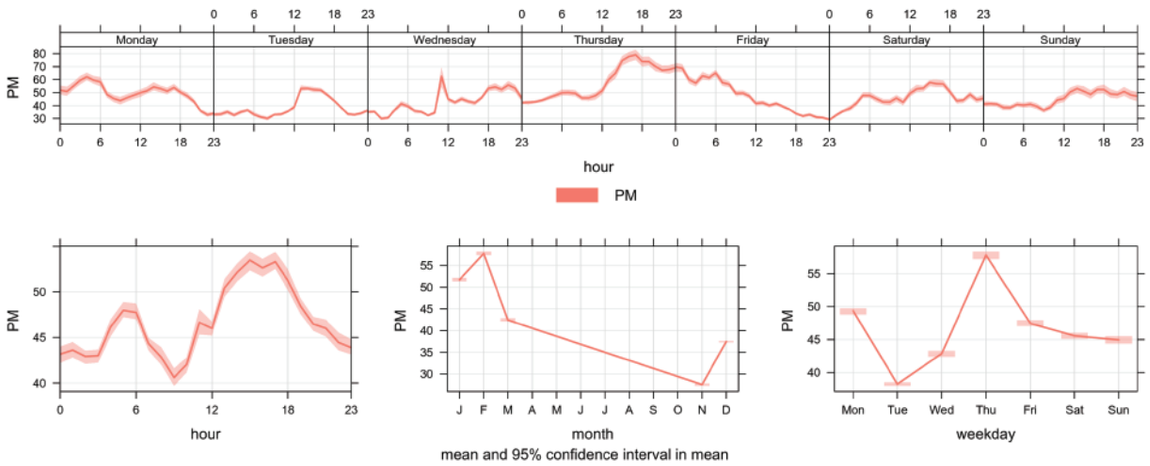


Figure 6: Dustbox 108. Time plot showing PM2.5 concentrations between 3 November 2016 and 10 March 2017 (units: µg/m3).

Known sources of pollution in London, for example coming from transportation, construction and heating, tend to follow recognizable temporal patterns during the daytime and the working week, for instance with higher levels during rush hours, and lower levels on Sundays. Figure 6 does not show clear traffic-related patterns for days of week, however, as patterns on Sundays are higher than those recorded on Tuesdays. This is perhaps to be expected given that the monitoring period includes multiple London-wide pollution events. However, **Figure 6** does show a more familiar hourly pattern of peaks during morning and evening rush hour periods.

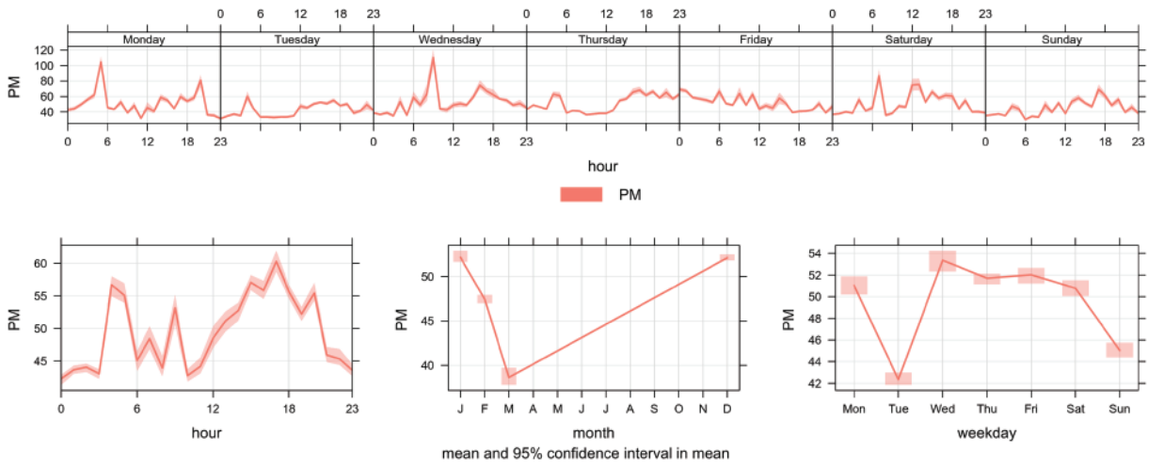


Figure 7: Dustbox 123. Time plot showing PM2.5 concentrations between 3 November 2016 and 10 March 2017 (units: µg/m3).

Figure 7 shows a similar pattern for Dustbox 123 in comparison to Dustbox 108. This time chart shows an hourly pattern of morning and evening peaks. It also displays a similar lower level on Tuesdays, although it should be noted that an average of 42 µg/m3 is still considerably above the WHO guideline of 25 µg/m3 for a 24-hour mean concentration. The daily aggregations across the week show a flatter pattern in comparison to Dustbox 108, with sporadic peaks on Mondays, Wednesdays and Saturdays.

Because Dustbox 133 was run on a battery pack, it is less suitable for a time plot analysis, as it does not have a consistent hourly or daily dataset. Dustbox 133 has not been included in the time plot analysis for this reason.

As Dustbox 149 was not activated until March 2017, Figure 8 below shows a different date range, from 1 March to 1 August 2017.

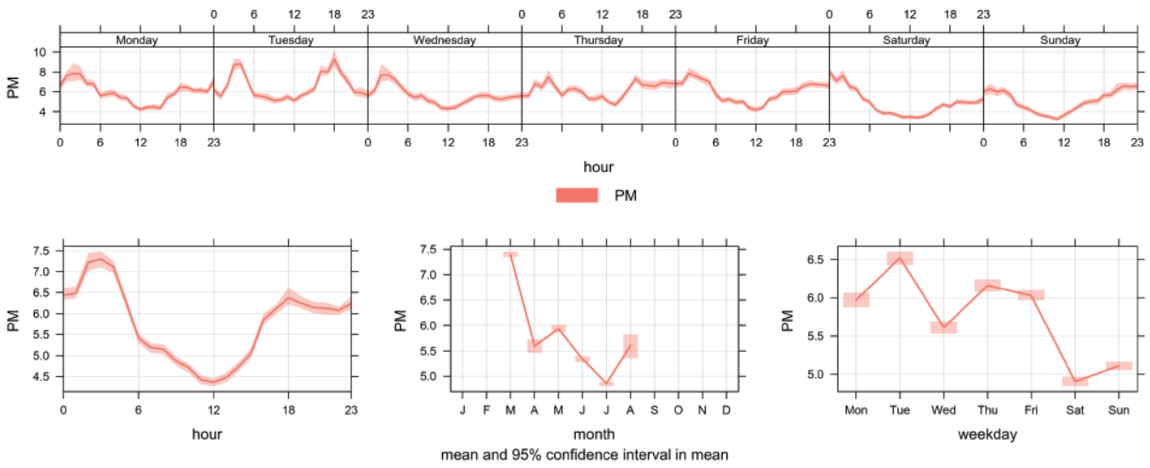


Figure 8: Dustbox 149. Time plot showing PM2.5 concentrations between 7 March 2017 and 1 August 2017.

In this Dustbox data we can see very clearly that higher emissions levels are recorded during the working week. Otherwise, the highest emissions are recorded in the early morning, and from evening onwards, with a pronounced dip in emissions around noon. This is similar to the patterns from nearby Dustboxes 118 and 148 in New Cross. However, emissions are considerably lower at this location, and are well below the WHO 24-hour guideline.

WHICH DIRECTION IS PM2.5 COMING FROM?

Wind direction has a considerable influence on pollution measurements. A sensor will only record emissions from a particular source or activity if the wind blows it from the source towards the sensor. Therefore, we can investigate where a source of pollution is likely to be located by plotting wind direction against pollution concentrations.

In these polar plots, colour contours reflect pollutant concentrations in relation to wind direction and wind speed. Calm conditions (zero wind) are shown in the centre, increasing to 20 metres per second (ms-1) at the outer ring. The highest mean concentrations are shown in red, the lowest are in blue.

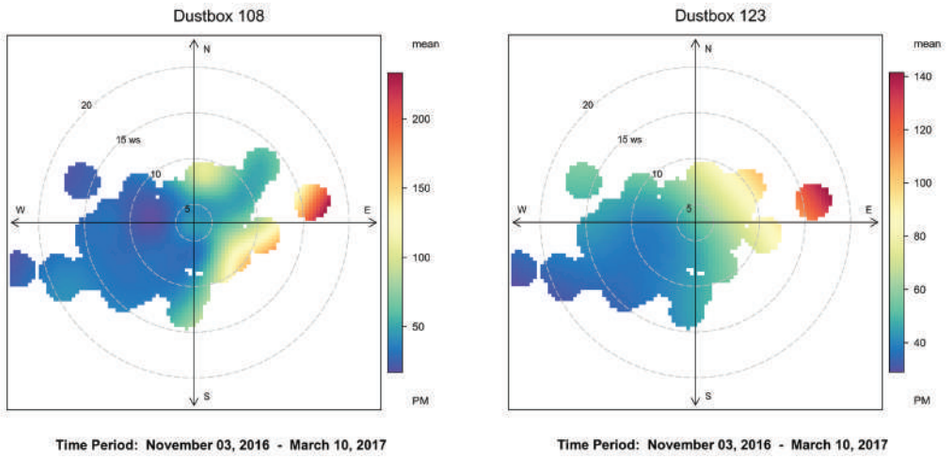


Figure 9a and 9b: Dustboxes 108 and 123. Polar plots showing mean PM2.5 concentrations during different wind conditions. The mean concentrations shown here are relative, e.g., for Dustbox 108 the highest mean concentration is approximately 200 µg/m3 and for Dustbox 123, it is approximately 140 µg/m3. Emissions levels are displayed on polar plots according to a gradient of low to high pollution levels. The colour coding refers to a different range of readings in each plot.

Dustbox 108 is recording significantly high levels to the east during high winds of over 15 ms-1. These high levels could be somewhat amplified due to the calibration value applied, which could cause higher readings to appear more pronounced in comparison to the LAQN New Cross Gate monitoring station. Nevertheless, the PM2.5 levels at the Dustbox 108 location are relatively high in comparison to other monitoring sites for New Cross Gate and across the Citizen Sense monitoring network.

During moderate winds of 12.5 ms-1 and below, we see additional highs to the southeast and the north at the Dustbox 108 monitoring location.

Because the overall pollution levels at Dustbox 108 are relatively high, even patterns denoted by green and blue represent high levels of emissions. Dustbox 108 is recording high levels of emissions at the centre of the polar plot during low wind speeds of less than 5 ms^{-1}. This may indicate a local source of pollution. Emissions are more pronounced on the eastern half of the plot (approximately 0^{O} to 185^{O}), potentially suggesting easterly sources. A purple spot in the west during low winds of 5 to 10 ms^{-1} suggests a source of cleaner air. Cleaner air at higher speeds of 15 ms^{-1} and beyond come from the west and northwest.

Dustbox 123 has the same high peaks to the east during high

winds, which is reflected in many of the Dustboxes. At lower wind speeds of 12.5 ms^{-1} and below, Dustbox 123 shows high emissions predominantly from the northeast. In the centre of the plot where wind speeds are lowest, emissions levels are still high, pointing to local sources of pollution. The scaling of calibration values could also be a factor at this location.

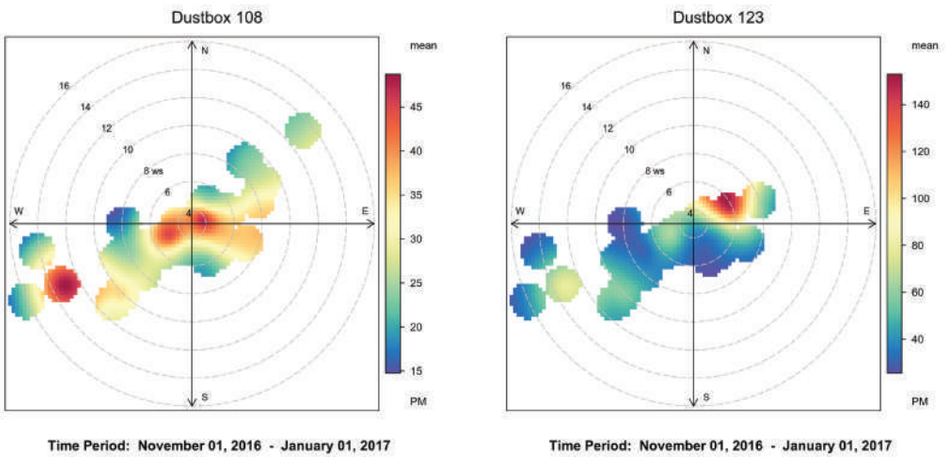


Figure 10a and 10b: Dustboxes 108 and 123. Polar plots showing mean PM2.5 concentrations during different wind conditions.

If we exclude the London-wide pollution events in January and February 2017, we can see a clearer picture of the local sources at sites 108 and 128. **Figure 10a** shows a local source at the site of Dustbox 108 extending to the west and east. In **Figure 10b**, Dustbox 123 shows a pronounced source to the northeast.

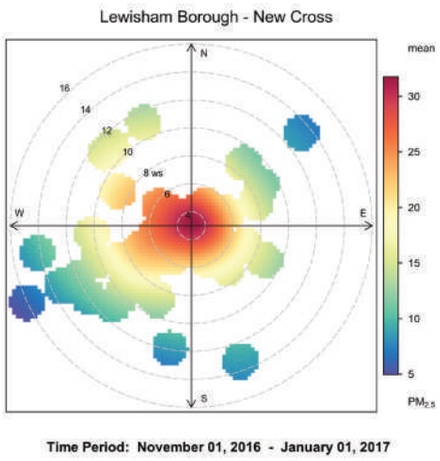


Figure 11: LAQN New Cross monitoring station. Polar plots showing mean PM2.5 concentrations during different wind conditions. The mean concentrations shown here are relative.

The LAQN New Cross monitoring station shows similar patterns to Dustboxes 108 and 123. Peak readings were recorded when easterly winds blew at high rates of 15-20 ms^{-1}. Cleaner air is recorded to the southwest during moderate and high winds of between 10 to 20 ms^{-1}. The LAQN polar plot shows a pronounced circle of elevated pollution at low wind speeds of less than 5 ms^{-1}, which suggests a local emissions source or sources, which in this case is likely to be New Cross Road.

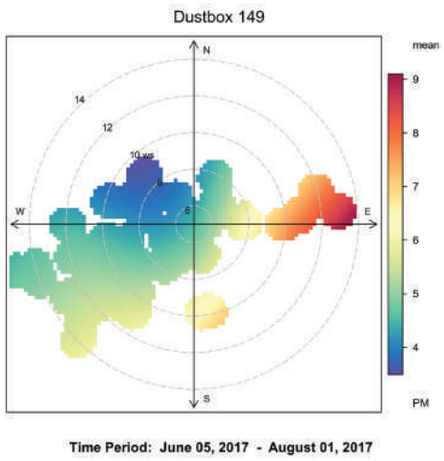


Figure 12a: Dustbox 149. Polar plots showing mean PM2.5 concentrations during different wind conditions. The mean concentrations shown here are relative, e.g., for Dustbox 149 the highest mean concentration is approximately 9 µg/m3.

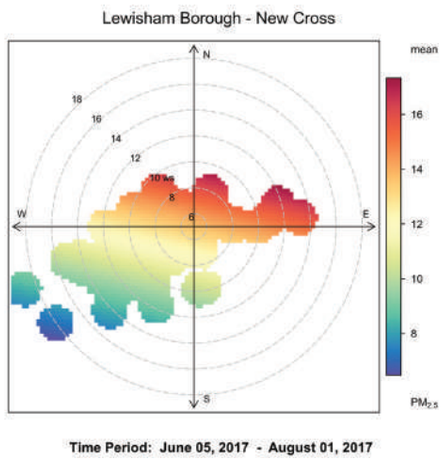


Figure 12b: LAQN New Cross monitoring station. Polar plots showing mean PM2.5 concentrations during different wind conditions.

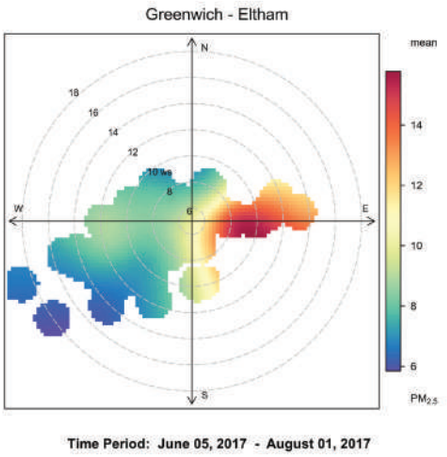


Figure 12c: LAQN Eltham monitoring station. Polar plots showing mean PM2.5 concentrations during different wind conditions.

As Dustbox 149 was not activated until March and had some breaks in data, **Figure 12a** shows a different date range, from 5 June to 1 August 2017.

Like the other Dustboxes, the highest pollution levels are registered to the east and northeast during moderate winds of 10 to 15 ms^{-1}. Moderate pollution is recorded to the north and southeast at wind speeds of between 5-12 ms^{-1}. The polar plot indicates that these are shared regional and city-wide sources of pollution.

The polar plot for Dustbox 149 shows low levels of local pollution overall. The lowest emissions (the cleanest air) are registered to the west, including at very low levels of wind. The site shows lower levels overall than the background monitoring LAQN station in Eltham, which is based in a leafy park. This could suggest that the pedestrianized location and enclosed garden-based green space of this site could have a significant mitigating effect on air quality in comparison to the other monitoring locations in New Cross Gate.

DRAWING THE EVIDENCE TOGETHER

Using the tools provided through the Citizen Sense Airsift Data Analysis Toolkit, we have characterized sources of particulate pollution detected in the New Cross Gate area as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources at some locations, most likely related to road traffic, based on the analysis of line graphs and "spike" episodes above shared regional levels in London.
- The strongest local source(s) appear to be to the east, northeast and southeast of the Dustbox 108, 123 and 149 monitoring locations. New Cross Road (A2) is likely to be a significant source of local emissions. There is an indication at the Dustbox 149 location that green space and a set-back location on a pedestrian street can have a significant mitigating effect on pollution levels.
- The elevated levels of PM2.5 identified at Dustboxes 108 and 123 are strongest during the morning and evening, and the highest mean concentrations occurred on weekdays (although levels are high on weekends as well). These elevated levels are therefore likely to be related to commuter or general road traffic.
- Dustbox 149 generally has lower levels overall due to its secluded setting. However, hourly levels were higher during times of commuter traffic, and on Tuesdays and Thursdays, also suggesting that road traffic is a likely source. Queen's Road and New Cross Road are possible emission sources at this location, although city-wide and regional pollutants are evident at this location.
- There are also common baseline patterns of pollution across these monitors, suggesting a range of sources that contribute to shared elevated PM2.5 levels across London from regional sources, especially from the east. Higher pollution levels from the east could indicate regional pollution gathered by easterly winds as they travel over continental Europe to reach the UK.
- It is clear that traffic has a considerable impact on elevated PM2.5 levels across the New Cross Gate monitoring locations. Local pollution episodes are likely to occur in relation to high levels of traffic. Additional local sources such as construction sites (including demolition, on-site equipment and wind-blown dust), and industry would add to and exacerbate elevated pollution levels. Levels at New Cross Gate are significantly higher than at other monitoring locations across the Citizen Sense study area, suggesting that transport (particularly major intersections) and other emissions sources are contributing to elevated levels in this location.

ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

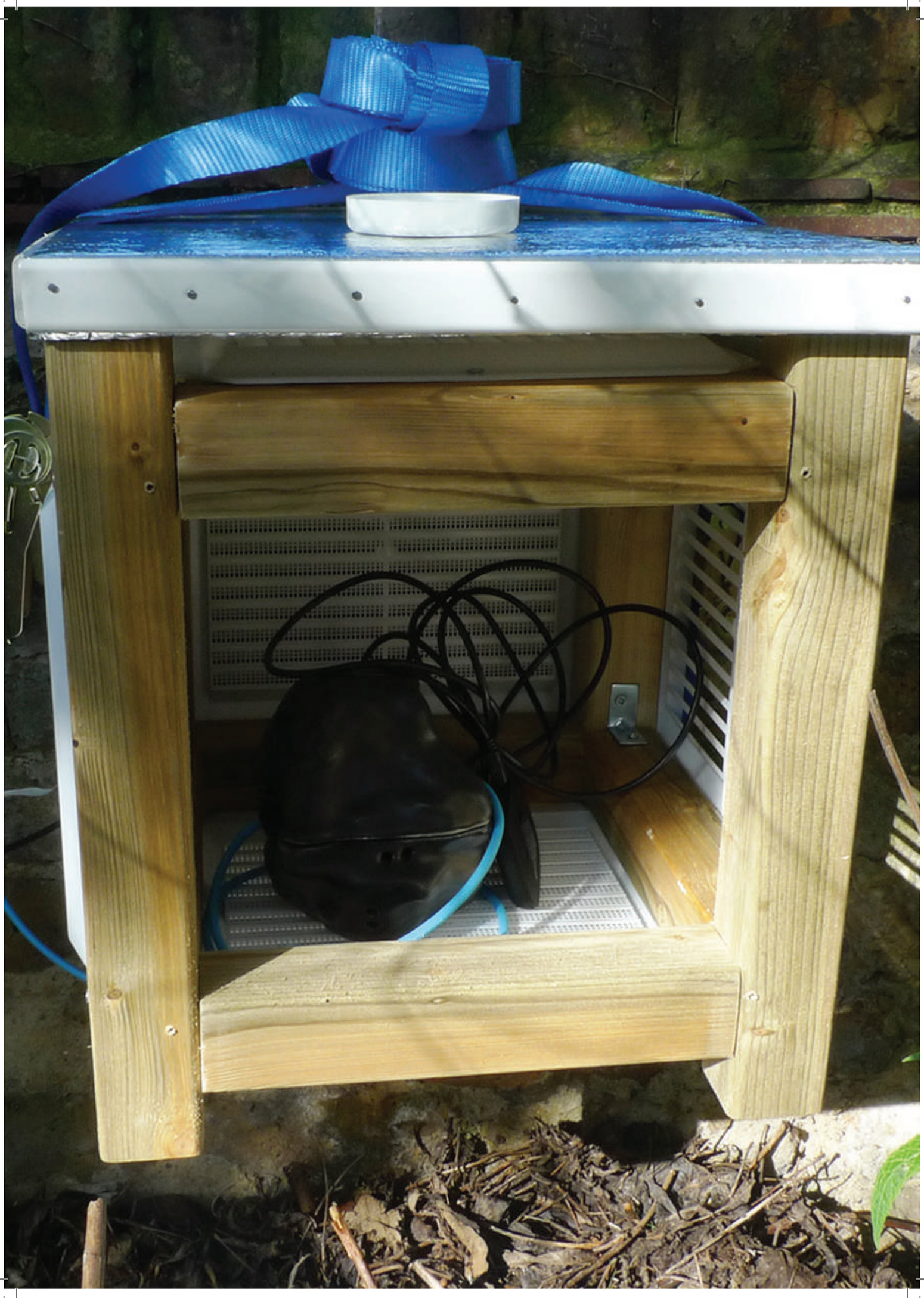
- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

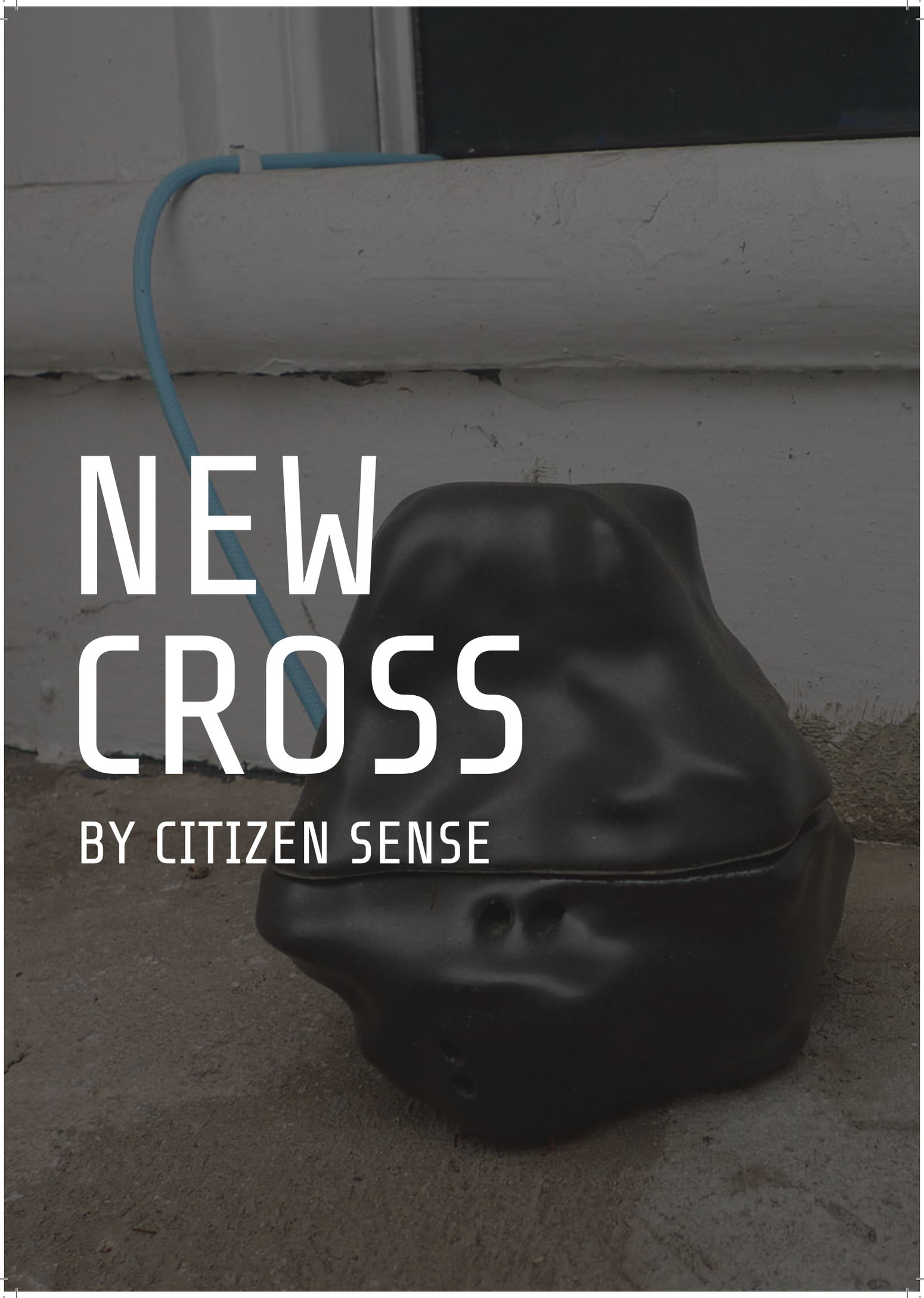
AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Extend and develop courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.





NEW CROSS

BY CITIZEN SENSE

The New Cross area includes several busy roads, and is characterised by the Goldsmiths, University of London campus, as well as by mixed housing and shops. While monitoring in this area indicates that traffic is a clear source of PM2.5 emissions, pollutant levels recorded here were somewhat moderate in comparison to other major traffic intersections.

This data story details below how citizen data, weather data and local observations reveal these specific pollution patterns. Drawing on workshops with local residents, the data story also suggests how best to address the problem, from planning for better transport to preserving and enhancing green spaces that prevent and mitigate high pollution levels.

THE LOCATION

The New Cross monitoring location, which includes Dustboxes 118, 142 and 148, is characterised by Goldsmiths, University of London campus, as well as several busy roads that cross through southeast London. Fordham Park is to the north of the monitoring location, and the Brockley Nature Reserve is to the south along the trainline that connects New Cross Gate station with central London. There are several schools in the area, and land use is primarily residential, with localised concentrations of shops, cultural centres and restaurants.

The New Cross area, along with Deptford, is also a site of ongoing development and redevelopment, with construction sites located at the periphery of this immediate area. Goldsmiths campus is not currently the site of intensive construction or development, although there are pockets of construction activity on site, including the renovation of the Laurie Grove Baths to construct a new Art Gallery, and student housing on New Cross Road. On the whole, the primary emission-causing activities in the New Cross location consist of transport-related source.

LOCAL SOURCES OF PARTICULATE POLLUTION

This data story draws together documentation from three monitoring sites on the Goldsmiths campus. Dustboxes in these sites monitor for PM2.5, and are located in roadside, urban background and elevated settings. Dustbox 142 is located on the steps of a Georgian terraced house on Lewisham Way, which is a busy artery road, the A20. The monitor is sheltered in an entranceway and is raised approximately 2 metres off the ground, and faces northeast. Dustbox 148 is located at ground level the very back of the campus, and faces southeast. Dustbox 118 is situated in a DIY Stevenson screen shelter on the top floor of a 39-metre-tall 14-storey building, and faces northeast.

> *In total, 30 monitors were distributed to participants. The monitoring period ran for over 9 months, until September 2017. During peak monitoring activity, there were 21 active Dustboxes.*

Possible local emissions sources in the area relating to transportation, heating and construction are shown in the above map. The New Cross monitoring sites are in the vicinity of a major one-way traffic thoroughfare where the A20 and A2 roads intersect. Dustbox 142 is approximately 3 metres from Lewisham Way (A20), which is a likely source of vehicle emissions, including from diesel and brake wear and tear.

The Dustbox 142 monitoring location is approximately 60 metres away from a major traffic junction between Lewisham Way (A20) and Parkfield Road (A2), the southern route of this one-way system. Dustbox 118 is situated approximately 60 metres from a second major junction on the northern part of this one-way system, where Lewisham Way (A20) and New Cross Road (A2) merge.

Two railway lines serving predominantly electric trains lie to the east and west of the Goldsmiths campus, which are approximately 95 metres from Dustbox 148. Approximately 75 metres north of Dustbox 148 is the Professor Stuart Hall Building, which uses a biomass boiler for heating, and is a possible emissions source. There is one small construction site on New Cross Road (A2), which is another possible local emissions source.

LONDON-WIDE, REGIONAL AND GLOBAL SOURCES OF PARTICULATE POLLUTION

Particulate matter sources in London can be attributed to a broad range of emissions. Within London, PM2.5 from transport (particularly diesel), industry, construction, cooking and heating all contribute significantly to London-wide levels. A significant amount of PM2.5 emissions also comes from heavy industry and agriculture outside the UK, particularly France, Belgium, the Netherlands, Luxembourg, Germany and Poland. These emissions are thought to account for an urban background of approximately 10 $\mu g/m^3$. The importance of these transboundary effects of PM2.5 emissions from outside of the UK on the total London PM2.5 can vary between 40% to 80% daily depending on weather conditions. When long-range pollution episodes do occur in London, they are generally carried on easterly winds. There are a number of global emissions, events and practices that contribute particulate matter to the total London PM2.5, including fuel production, industrial and domestic combustion, transportation, waste disposal, and agriculture, although these are harder to quantify.

OBSERVATIONS

We have observed significant idling at the two junctions where the A2 and A20 roads meet, where vehicles are stopped for traffic signalling changes and are frequently waiting due to congested roads. At peak times, the roads are extremely congested. Heavy goods vehicles make significant use of this route. Monitoring participants have observed that when cycling and walking through this area, they can smell and feel air pollution. Parents have reported concerns that the Goldsmiths nursery facilities are located directly on Lewisham Way (A20), which has idling traffic approximately 3 metres from the nursery facility. Windows in the nursery must be kept closed at all times due to air quality concerns.

IS THERE EVIDENCE OF A PROBLEM?

The Dustbox device used to monitor PM2.5 particles is an "indicative" monitor. This means that measurements can give an indication of pollutant concentrations, but cannot be directly compared with national and international guidelines and standards in an "official" or regulatory sense. Despite this, indicative monitors are a well-established method within atmospheric science for carrying out initial surveys of an area to establish whether a potential problem merits further investigation. Indicative monitors are also becoming increasingly available for citizen-based air-quality monitoring, similar to this study. Where possible, the Dustboxes were co-located at the start and the end of the study to account for differences in the sensors and drift during the monitoring period.

The indicative Dustbox monitors used in this study demonstrate high levels of PM2.5. Since monitoring began at this site in December 2016, particulate levels were elevated above the World Health Organisation (WHO) guideline of 25 µg/m³ for 24-hour daily mean concentration of PM2.5 on a number of occasions.

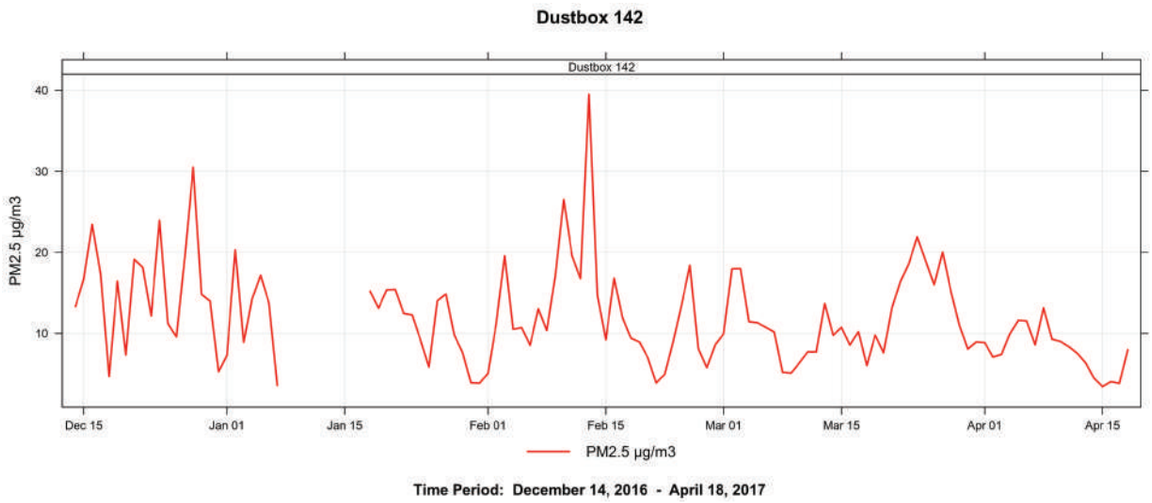


Figure 1: Dustbox 142. Line graph of 24-hour mean PM2.5 concentrations from 14 December 2016 to 18 April 2017 (units: µg/m3).

Figure 1 demonstrates that particulate levels in December 2016 and February 2017 were significantly elevated. These exceedances of the WHO 24-hour mean guideline also correspond with a nearby New Cross monitoring station in the London Air Quality Network (LAQN), which documented these episodes of moderate to high particulate pollution across London. However, there are also high levels of particulates in February, March and

April, which suggest there may be local sources of particulate pollution that can be identified beyond London-wide pollution events.

It is important to determine whether these exceedances were caused by "local" sources of pollution close to the sensor (i.e., within 300 meters), or by regional sources affecting the whole area. Local sources often augment regional sources, which can be revealed as a spike on top of a hump. In a general sense, this regional-local pattern occurs because pollution mixes in the atmosphere as it travels away from a source, smoothing the speed of changes in concentrations.

There are many possible sources of pollution in the area, and we have to look at the measurements more closely to see if we can deduce which activities are causing these spikes. Knowing the source of pollution is important as some activities produce more toxic particulate matter than others, and actions to mitigate sources should be targeted to the cause of the problem.

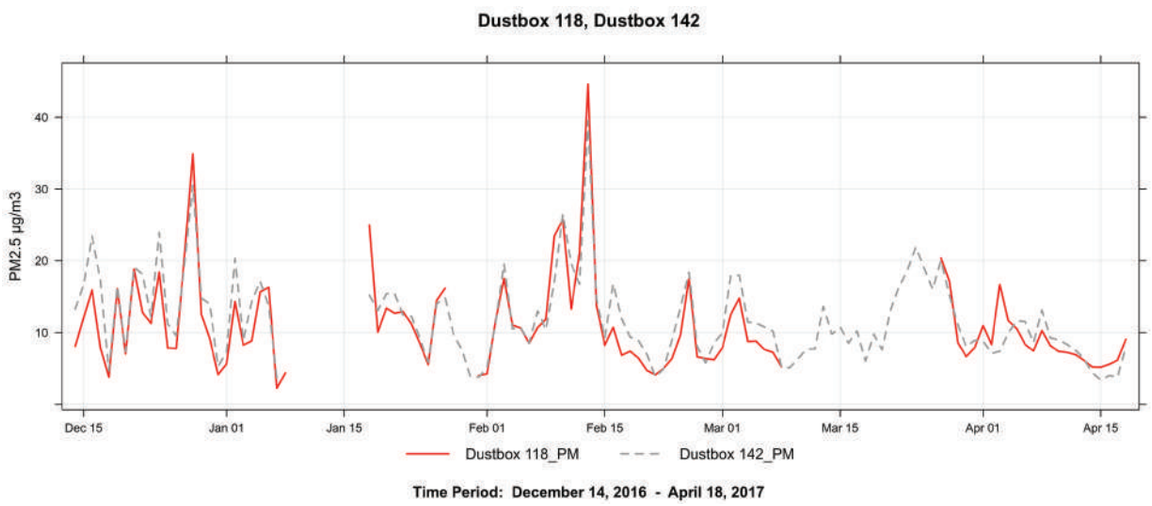


Figure 2: Line-graph comparison of Dustbox 118 and 142, showing 24-hour mean PM2.5 concentrations from 14 December 2016 to 18 April 2017 (units: µg/m3).

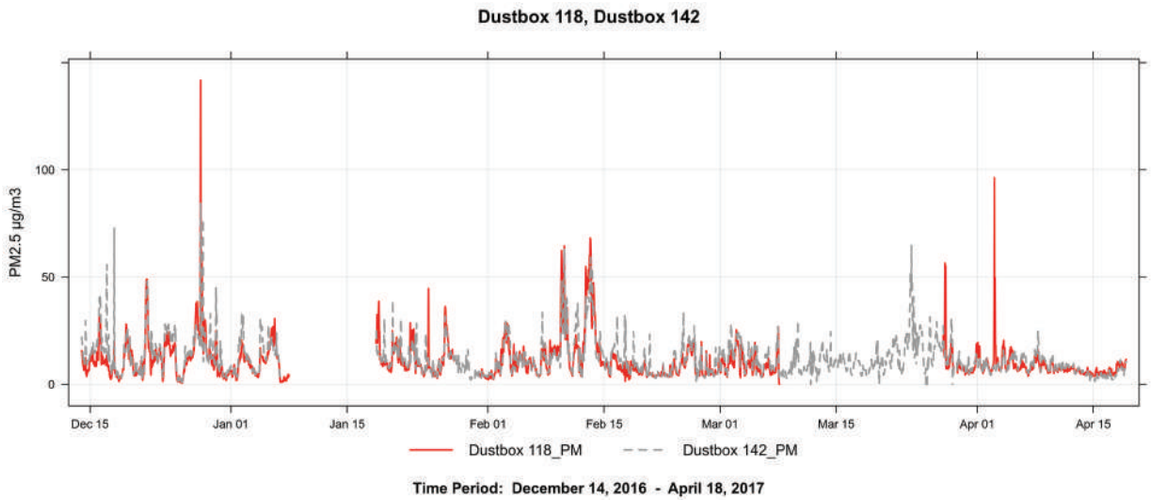


Figure 3: Line-graph comparison of Dustbox 118 and 142, showing hourly mean PM2.5 concentrations from 14 December 2016 to 18 April 2017 (units: µg/m3).

When compared to Dustbox 118, the 24-hour mean PM2.5 concentrations for Dustbox 142 are very similar, as shown in Figure 2. However, if we look at hourly PM2.5 concentrations as shown in Figure 3 we can see that in some cases there are spikes of particulate levels in the Dustbox 142 data, in comparison to the broader levels or "humps" of Dustbox 118 data. This spikey pattern for the roadside Dustbox 142 data suggests a local source of pollution, which is not evident at the elevated Dustbox 118 location. The Dustbox 142 readings also indicate different local emission sources when compared to the nearest LAQN station, New Cross. This LAQN station is located on New Cross Road (A2), opposite the New Cross Gate train station.

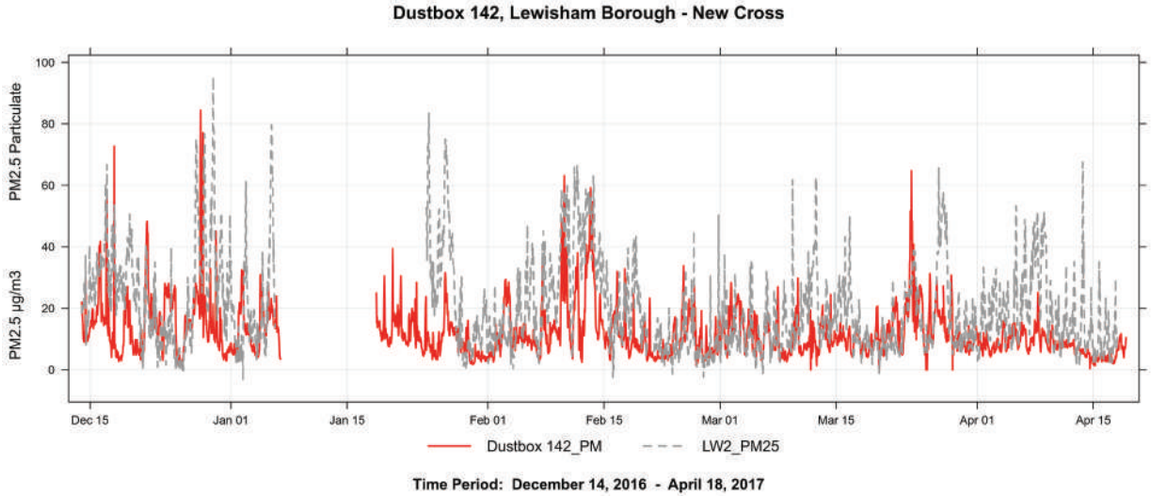


Figure 4: Line-graph comparison of Dustbox 142 and LAQN New Cross monitoring station, showing hourly mean PM2.5 concentrations from 14 December 2016 to 18 April 2017 (units: µg/m3).

As shown in **Figure 4**, the LAQN New Cross monitor shows more elevated readings in comparison to Dustbox 142, which indicates different local emission sources.

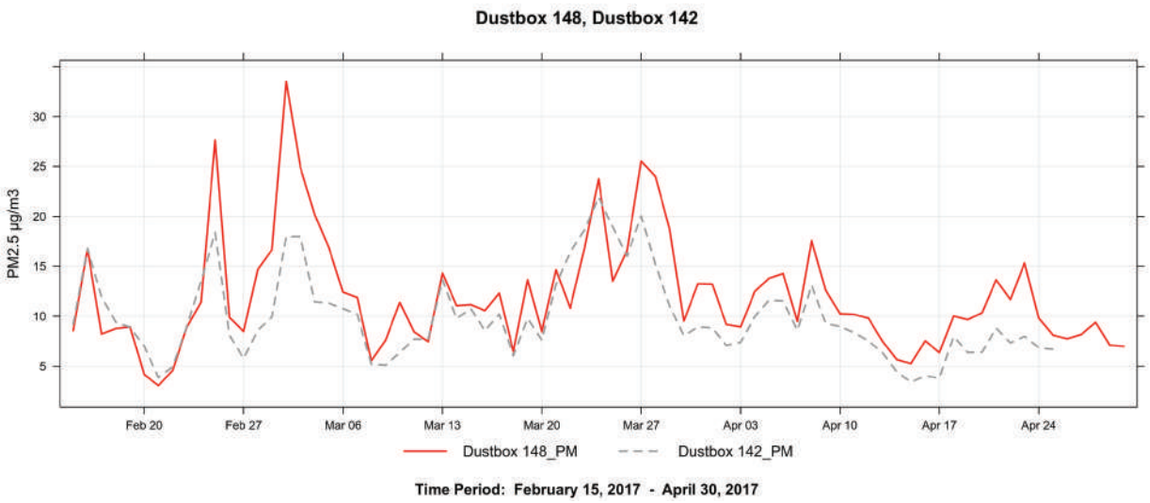


Figure 5: Line-graph comparison of Dustboxes 148 and 142, showing 24-hour mean PM2.5 concentrations from 15 February 2017 to 30 April 2017 (units: µg/m3).

Because Dustbox 148 is located at the back of the Goldsmiths campus and is sited away from roadside emissions sources, we expected levels of particulate matter to be lower at this location in comparison to the roadside monitor, Dustbox 142. However, Dustbox 148 regularly posted elevated levels of PM2.5, as shown in **Figure 5**.

HIGHLIGHTING PATTERNS OF LOCAL PARTICULATE POLLUTION

Figure 6 below shows Dustbox 142 readings from the end of January 2017 to the middle of February 2017, including an episode of moderate PM2.5 recorded at the LAQN New Cross monitoring station from 10 to 13 February 2017. Outside of this episode of elevated pollution, we can see a possible episode of local pollution at the Dustbox 142 site from 2 to 4 February 2017, where the line graph indicates a spike, or elevated levels, at this location, which could indicate a local source of emissions.

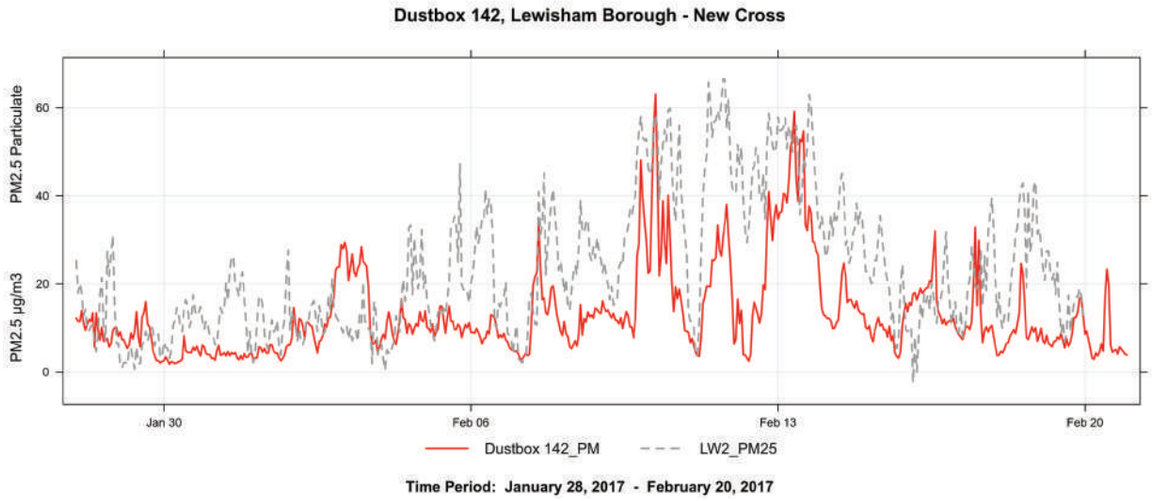


Figure 6: Line-graph comparison of Dustbox 142 and the LAQN New Cross monitoring station, showing hourly mean PM2.5 concentrations from January 2017 to April 2017 (units: µg/m3).

Similarly, **Figure 7** below compares readings from Dustbox 118 with the LAQN New Cross monitoring station from November 2016 to December 2016. Elevated levels are evident at the LAQN location from 29 November 2016 to 6 December 2016. However, just before this episode, we can see elevated levels of PM2.5 at the Dustbox 118 monitoring site between 21 to 22 November and 24 to 26 November. These readings could indicate local pollution episodes.

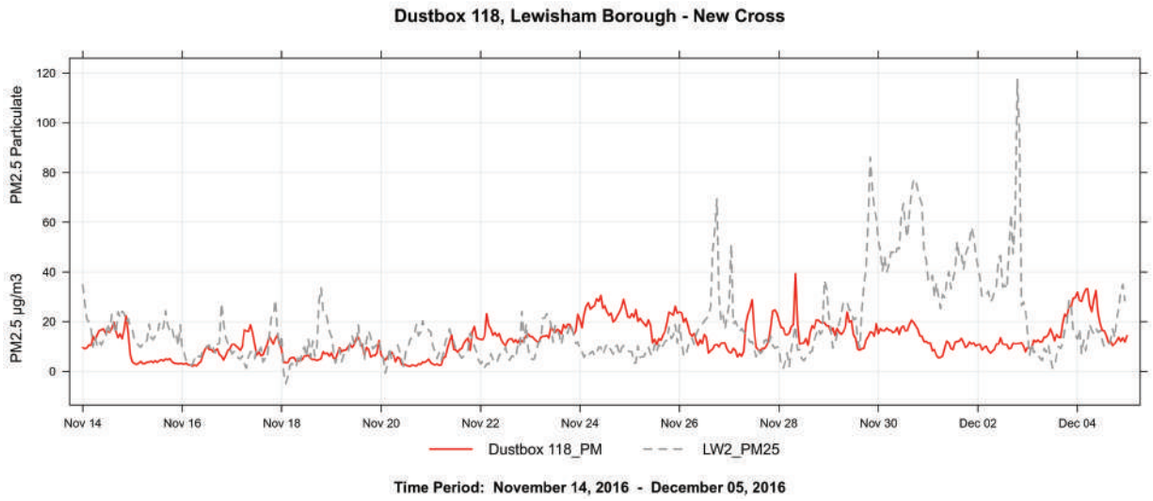


Figure 7: Line-graph comparison of Dustbox 118 and LAQN New Cross monitoring station, showing hourly mean PM2.5 concentrations from 14 November 2016 to 5 December 2016 (units: µg/m3).

Finally, as shown in **Figure 8**, we can discern peaks in Dustbox 148 data at Goldsmiths that are distinct from the LAQN New Cross monitoring station, for example on 5 and 7 June 2017, as well as 11 to 12 June 2017 and 16 June 2017.

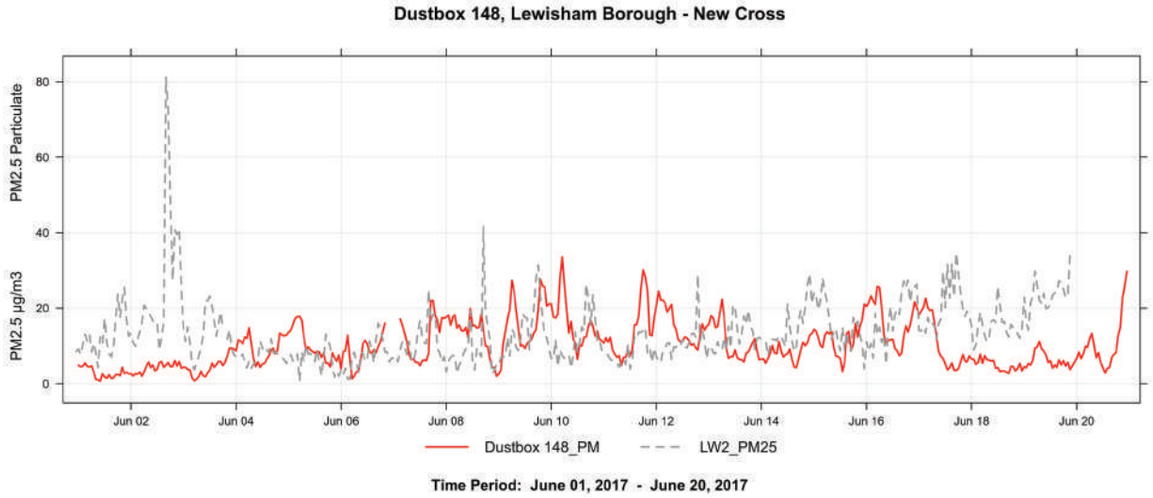


Figure 8: Line-graph comparison of Dustbox 148 and LAQN New Cross monitoring station, showing hourly mean PM2.5 concentrations in June 2017 (units: µg/m3).

CHARAC-
TERIZING
THE
PROBLEM

WHEN IS THE SOURCE MOST EVIDENT?

Using time plots, it is possible to analyse time of day and day of week, as well as month, when pollution levels are elevated. Time plots aggregate PM2.5 concentrations according to time, so that key patterns such as rush hours and traffic, as well as possible construction or industry sources, along with regional pollution events due to seasonal variation, are evident.

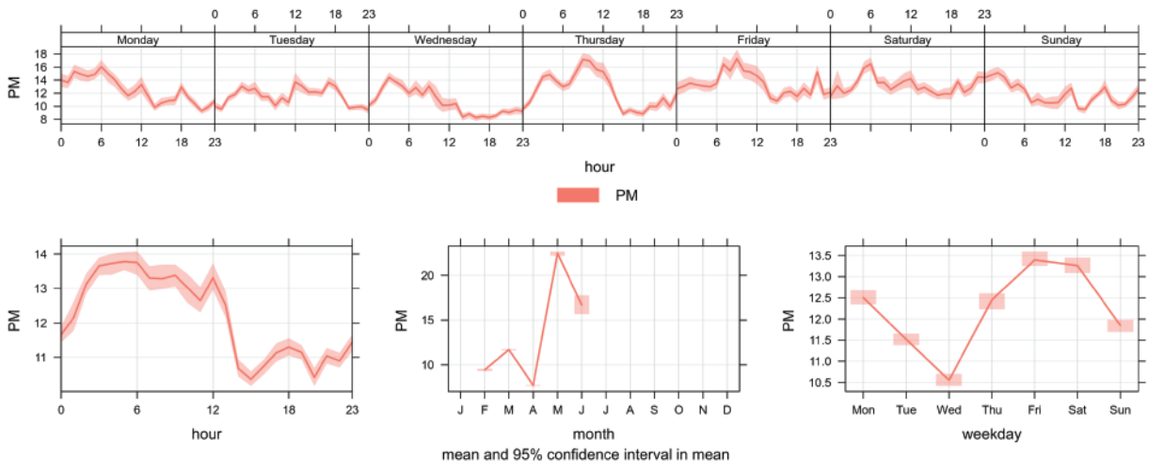


Figure 9: Time plot for Dustbox 142, showing PM2.5 levels and patterns between 15 February 2017 and 1 June 2017.

Dustbox 142 registers the highest readings during weekday daytimes, from the early hours of the morning through to approximately 1 pm. In roadside monitoring sites such as this, where vehicles are expected to contribute a significant portion of local emissions, we would expect to see higher readings during the day, and lower readings at night and on weekends. This is partly reflected in the time plot for 142, which shows morning peaks that may be attributable to commuter traffic. However, during the monitoring period levels are lower on Wednesdays than Sundays, and levels are somewhat elevated during Saturday nights. However, overall levels at this location are still below the WHO guideline.

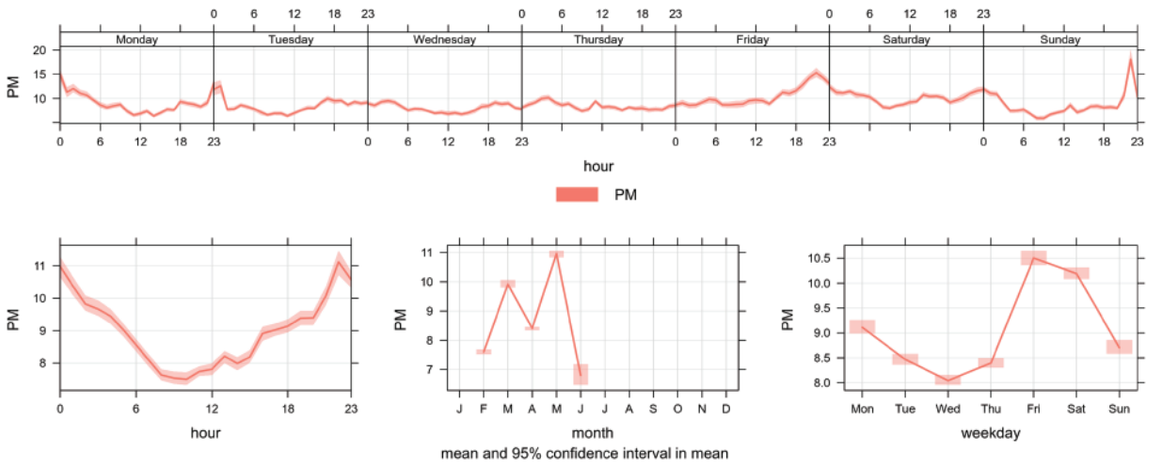


Figure 10: Time plot for Dustbox 118, showing PM2.5 levels and patterns between 15 February 2017 and 1 June 2017.

The pattern for Dustbox 118, which is located on the 12th floor roof terrace of Warmington Tower, is reversed. With Dustbox 118, levels of particulate matter rise in the evenings and peak overnight. In a general sense, it should be noted that the weather plays a significant role in particulate levels. For example, dust tends to be dispersed more slowly during the hours of darkness, as vertical and horizontal wind speeds are generally lower. This phenomenon may skew charts somewhat.

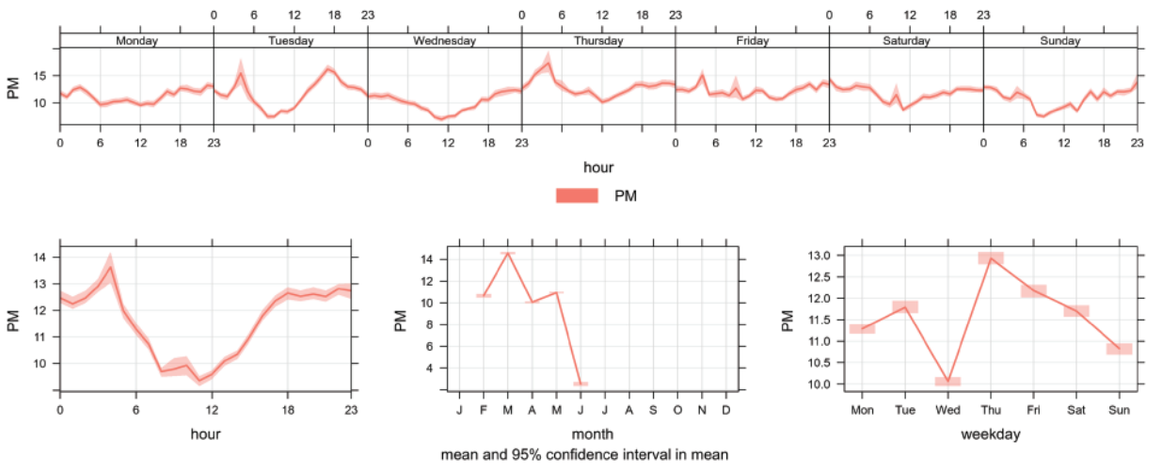


Figure 11: Time plot for Dustbox 148, showing PM2.5 levels and patterns between 15 February 2017 and 1 June 2017.

Figure 11 indicates that Dustbox 148 records high morning and evening peaks on some days, yet also features lower daytime levels overall. The raised levels overnight are similar to the patterns for Dustbox 118.

WHICH DIRECTION IS PM2.5 COMING FROM?

In these polar plots, colour contours reflect pollutant concentrations in relation to wind direction and wind speed. Calm conditions (zero wind) are shown in the centre, increasing to 20 metres per second (ms^{-1}) at the outer ring. The highest mean concentrations are shown in red, the lowest are in blue.

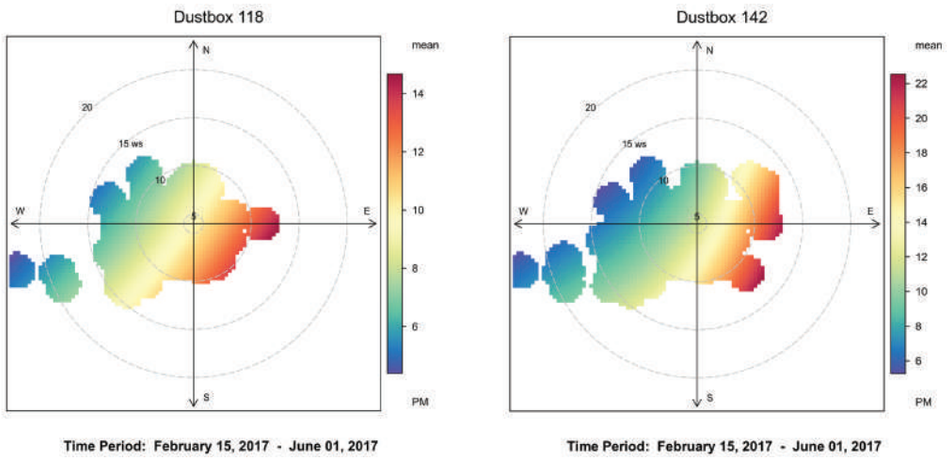


Figure 12a and 12b: Polar plots showing mean PM2.5 concentrations during different wind conditions. The mean concentrations shown here are relative, e.g., for Dustbox 118 the highest mean concentration is approximately 13 µg/m3 and for Dustbox 142, it is approximately 22 µg/m3. In comparison to the other monitoring locations in this study, PM2.5 levels in New Cross are generally lower overall.

As shown in the polar plot for Dustbox 118, the highest PM2.5 levels are registered when winds blow from the east at a moderate rate of between 10 to 15 ms^{-1}. However, high levels are also recorded at lower wind speeds of between 5 to 10 ms^{-1} across the east and southeast (approximately 80^{O} to 180^{O}). At these wind speeds, intermediate levels of pollution are registered to the southwest and northeast, suggesting a range of local emissions sources. Clean air travels to the monitoring site from the west and northwest.

Dustbox 142 follows a broadly similar pattern, registering the highest PM2.5 levels when winds are travelling east and southeast at a moderate level of between 10 to 15 ms^{-1}. At lower wind speeds of between 5 to 10 ms^{-1}, Dustbox 142 registers moderate PM2.5 levels from the northeast right through to the southwest (approximately 35^{O} to 230^{O}). Again, cleaner air is carried on west and northwesterly winds.

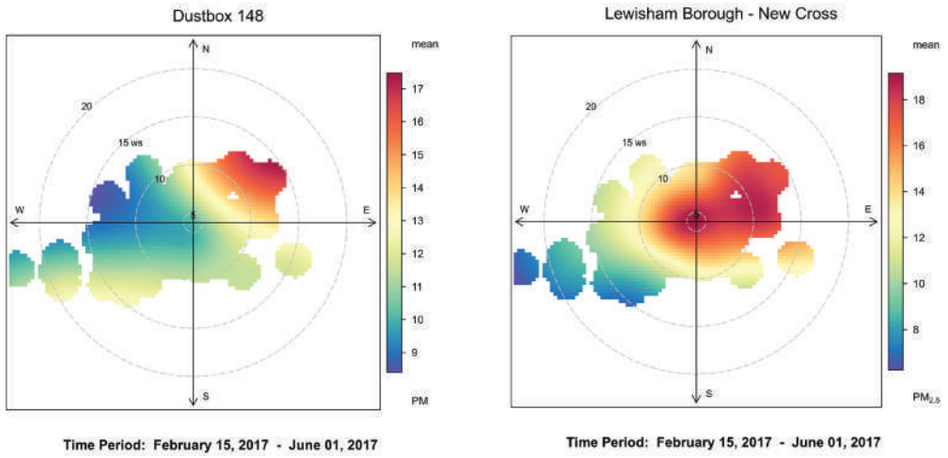


Figure 13a and 13b: Polar plots showing mean PM2.5 concentrations during different wind conditions. The mean concentrations shown here are relative, e.g., for Dustbox 148 the highest mean concentration is approximately 17 µg/m3 and for the LAQN New Cross monitoring station, it is approximately 18 µg/m3. In comparison to the other monitoring locations in this study, PM2.5 levels in New Cross are generally lower overall.

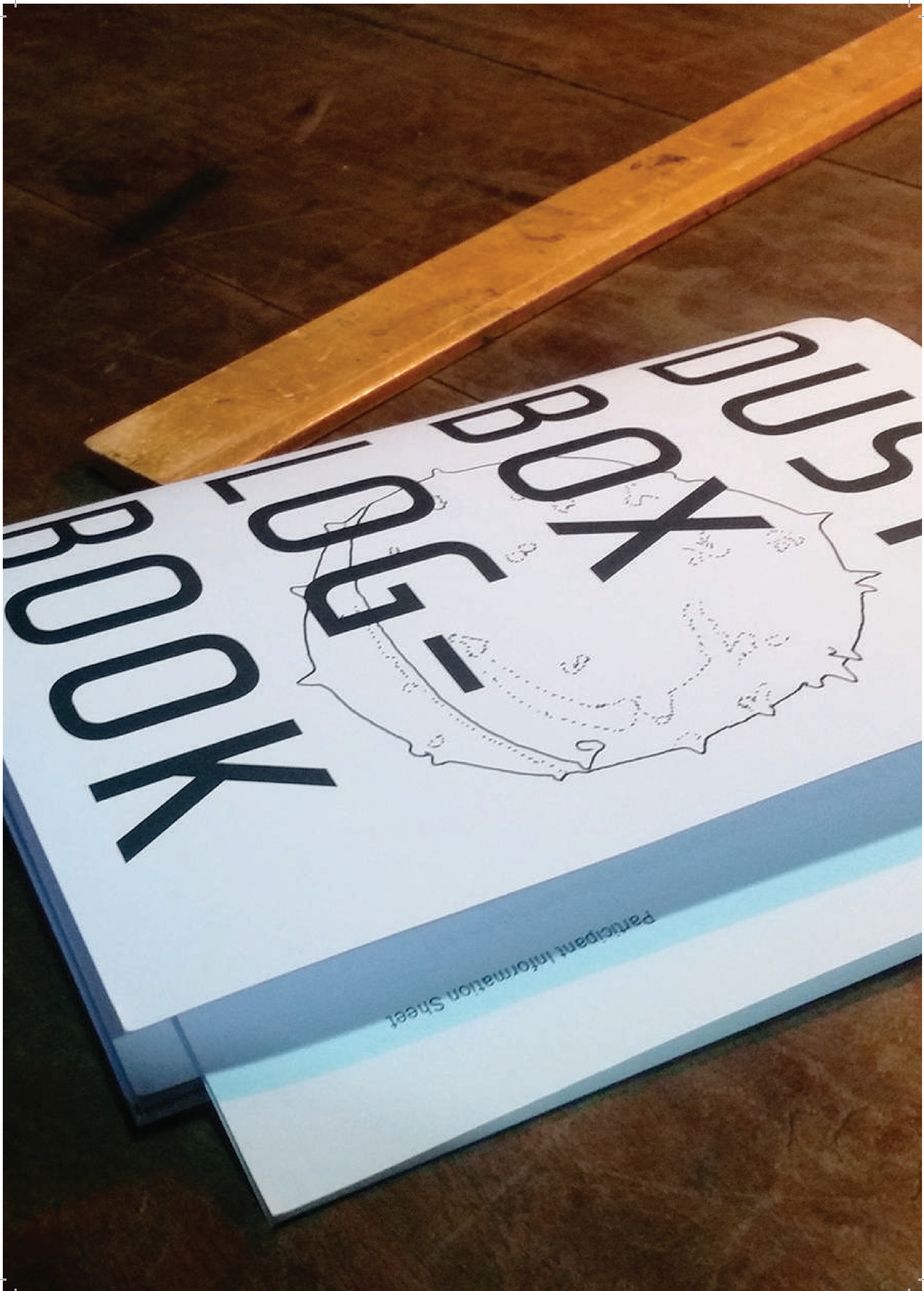
Dustbox 148 displays a somewhat different pattern, where the highest PM2.5 levels are registered in moderate northeasterly winds of between 10 to 15 ms^{-1}. At the same wind speed, intermediate PM2.5 levels can be seen in the southwest and southeast. When wind conditions are calmer, at between 5 to 10 ms^{-1}, emissions are intermediate between the north and east, from approximately 0^{O} to 90^{O}. When winds are low at less than 5 ms^{-1} emissions levels are also low, suggesting few local emissions sources. As with the two polar plots for Dustboxes 118 and 142, air coming from the northwest is cleaner.

Like Dustbox 148, the LAQN New Cross monitoring station also registers elevated PM2.5 levels to the northeast during moderate winds of 10 to 15 ms^{-1}. However, this LAQN polar plot also offers strong evidence of highly local sources of particulate matter, as levels are still at their highest during low wind speeds of 10 ms-1 and less. Similar to Dustboxes 118 and 142, this LAQN New Cross monitoring station also registers emissions from the southeast during moderate wind speeds of 10 to 15 ms^{-1}. However, these are moderate (rather than high) PM2.5levels. The LAQN monitor registers the cleanest air in westerly and southwesterly winds. Unlike the Dustbox monitors, it registers moderate readings to the northwest.

DRAWING THE EVIDENCE TOGETHER

Using the tools provided through the Citizen Sense Airsift Data Analysis Toolkit, we have characterized sources of particulate pollution detected in the New Cross area as follows:

- While regional sources of pollution were detected, there was clear evidence of additional local source or sources, most likely related to road traffic, based on the analysis of line graphs and "spike" episodes above shared regional levels in London. However, in comparison to other monitoring locations, New Cross levels of PM2.5 were generally lower overall.
- The strongest local source(s) appear to be to the east, northeast and southeast of the Dustbox 118, 142 and 148 monitoring locations. To the east are several busy thoroughfares with idling traffic, including New Cross Road (A2) and Lewisham Way (the A20) as a likely source of emissions. There is an indication of moderate levels from the Southwest for the 3 Dustbox monitors, although levels are still generally low.
- The elevated levels of PM2.5 identified at Dustbox 142 are strongest during early morning until noon, and the highest mean concentrations occurred on Thursdays, Fridays and Saturdays. These elevated levels are therefore likely to be related to commuter or transit road traffic, as well as lower winds during night-time hours. However, Dustboxes 118 and 142 have slightly different times of elevated pollution, with high morning and evening levels, but lower mid-day and night levels.
- Dustbox 118 and 148 PM2.5 levels are strongest during early evening to end of day, and the highest mean concentrations occurred on Thursdays, Fridays and Saturdays. These elevated levels are therefore likely to be related to commuter or transit road traffic.
- It is clear that traffic has a considerable impact on elevated PM2.5 levels across the New Cross monitoring locations. Local pollution episodes are likely to occur in relation to high levels of traffic. Additional local sources such as construction sites (including demolition, on-site equipment and wind-blown dust), and industry would add to and exacerbate elevated pollution levels.
- There are also common baseline patterns of pollution across these monitors, suggesting a range of sources that contribute to shared elevated PM2.5 levels across London from regional sources.


DUST
BOX
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Participant Information Sheet

ACTIONS

In relation to the evidence and findings from the Dustbox citizen monitoring study, preliminary actions are proposed here that take into account the neighbourhood context and existing community organisations and initiatives. The key areas for addressing air pollution include transport, construction, green infrastructure, and additional monitoring. These actions have been developed in consultation with monitoring participants and local area residents. Some actions are shared across the 7 data stories, while others are specific to this data story location:

TRAFFIC AND TRANSPORT

- Building on the Lewisham Council Local Implementation Plan, develop a traffic management plan for Deptford and New Cross in order to identify areas to improve pedestrian, cycle and public transport routes, and to understand the potential impact of the Ultra Low Emission Zone (ULEZ) on the area. Address the impact of new development and increasing population in the area, with a realistic projection of the likely numbers of new cars that will be in the area.
- Undertake an audit of delivery vehicles in the area, especially as they leave the DHL depot on Surrey Canal Road. Vehicles tend to leave in a fleet at 9 am, causing congestion and idling. Staggering deliveries could be one way to improve this.
- Restrict parking in the area in order to reduce the flow of cars through and into the area. Construction vehicles and company vans frequently use free parking around Deptford Park, and free parking encourages the use of private vehicles rather than alternative modes of transport.
- Encourage and support transportation pilots to trial improved roadway design and circulation. Highly successful projects are currently underway, including the partnership between Deptford Folk and Sustrans. Share best practices from transportation pilots, and extend these to other areas, such as pedestrianizing Scawen Road adjacent to the Sir Francis Drake Primary School and Deptford Park.
- Improve cycling opportunities in the area, and separate vehicle traffic from cycling traffic, including through the use of car-free green corridors. Encourage and support cycling initiatives such as the partnership between Deptford Folk and Sustrans.
- Post signs to encourage no idling. Signs that read ‘Turn your

engine off' and include images of people in pollution masks are more effective than text-only signs that read 'No idling'.
- Encourage hybrid vehicles and buses, and investigate ways to integrate solar panels into the design of buses and bus stops. Allow for electric vehicle charging points to be requested by residents as part of community transport initiatives, and not only by those who own an electric vehicle.

CONSTRUCTION AND DEVELOPMENT

- Ensure the fulfillment of Air Quality Impact Assessments (AQIAs), both at the planning and implementation stage of new developments, in order to accurately gauge the effect of construction with new developments. Develop adequate monitoring and compliance mechanisms for possible breaches of AQIAs.
- Develop planning and regulatory mechanisms for addressing the accumulative effects from construction and new developments. Impacts from construction and new development can include air pollution from demolition and siteworks, traffic during construction, and higher densities of buildings, people and traffic from new developments. Require that all new developments are 'air quality neutral', and ensure transparent and legible processes are in place for ensuring neutrality.
- Join up traffic planning across existing and new developments to facilitate walking, cycling and public transport. In relation to Convoy's Wharf, develop clear plans for the use of Grove Street. In the case of Timber Yard, outline how this development will integrate with existing roads and traffic patterns. In all cases, design for neighbourliness with pedestrianized and play streets.
- Encourage cross-borough collaboration on construction and new development. Pending developments at the edge of Deptford, including the Silvertown Tunnel, the Enderby Wharf cruise ferry terminal, the Knight Dragon development at North Greenwich peninsula, and the Royal Docks Enterprise Zone could have a considerable effect on traffic in the area, especially along Evelyn Street.
- Include plans for managing construction traffic as part of providing planning approval for new developments. Ensure that construction traffic does not exceed set levels so as to avoid additional local pollution events.

- Address and prevent the loss of green space and public space due to new development. Green spaces can have a significant mitigating effect on air quality, and also provide a lower emission space in which people can spend time outdoors.
- Provide indicators for how to measure the effectiveness of dust measurement plans and practices at construction sites. Working with the London Low Emission Construction Partnership, provide mechanisms for enforcing dust management plans when they are not adhered to, and for reporting violations.

GREEN INFRASTRUCTURE

- Require an audit of green spaces in the borough, including an assessment of the suitability of green space as green infrastructure in relation to air pollution mitigation, and in relation to improving walkability and cycleability. Using existing London tree mapping resources, develop a tree plan for planting in the borough, and in relation to best guidance for trees suitable for minimising and lowering air pollution.
- Plant trees and preserve green spaces in relation to air quality guidance for vegetation. Encourage and support Evelyn 200, an initiative by Deptford Folk to plant 200 trees in 2018, as well as similar community initiatives for greening the area.
- Investigate opportunities for planting air quality enhancing vegetation in existing green spaces including Sayes Court, Deptford Park and Folkestone Gardens, as well as at schools, hospitals, playgrounds and key community sites.
- Provide guidance on planting for air quality, including preferred species, optimal planting arrangements, and best practices for maintenance.
- Host air pollution monitoring and awareness events in green spaces to raise awareness about the importance of urban design and planning in relation to mitigating and prevent air pollution.

AIR QUALITY MONITORING

- Prioritise air-quality audits of emission levels at Deptford and New Cross schools, in line with the Mayor of London's initiative. Extend and develop courses in schools for children to learn about air quality and to undertake air quality monitoring

in their local area, including promoting actions for reducing air pollution such as walking to school.

- Provide resources for community organisations and residents to continue to monitor air quality over time in order to assess improvements from preventative and mitigating actions.
- Provide resources to undertake speciation to understand the composition and sources of particulate matter, including from roads, construction and other sources.
- Develop protocols and channels for citizens to provide monitoring data to local and GLA environmental health and planning officers, and require officers to act on identified exceedances in relation to air quality guidelines.

ACKNOW-
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MENTS

The Citizen Sense project is led by Professor Jennifer Gabrys. These data stories were developed working in collaboration with Helen Pritchard and Dr Lara Houston. Thanks are due to our collaborators including:

Dr Benjamin Barratt and Khadija Jabeen at the Environmental Research Group, King's College, University of London contributed to co-location and calibration of the Dustboxes, and Dr Barratt contributed to the analysis of the data stories.

Lau Thiam Kok contributed to the co-development of the Citizen Sense Airsift Data Analysis Toolkits, using and adapting openair software developed by Dr David Carslaw.

Raphael Faeh contributed to the digital design and layout of the "Pollution Sensing" data stories, which provided a model for these "Urban Sensing" data stories.

The Citizen Sense Dustbox included contributions to the printed circuit board design, which was developed in collaboration with Adrian McEwen of MCQN Ltd, and to the ceramic housing, which was rendered into 3D-printable format in collaboration with materials designer Francesca Perona.

Special thanks are due to the participants and residents in southeast London who contributed to the development and testing of the Dustbox monitoring kit, as well as to the collection and analysis of data, and communication of results to wider publics and regulators. For more information on project contributors, see Citizen Sense People.

These data stories are generated using the Citizen Sense Airsift Data Analysis Toolkit, which was developed to allow for citizen-led interpretation of datasets. The core data available for interpretation is the Dustbox PM2.5 sensor data. The Airsift toolkit also brings in air quality data from select sites in the London Air Quality Network (LAQN) for comparison with the citizen data.

In order to blur the exact monitoring locations, the monitoring locations are shown with large blue circles to indicate the approximate monitoring location. Additional citizen monitoring locations are anonymous, and are not included on the Airsift map.

At the start of the monitoring period, the Dustboxes were co-located with the Marylebone Atmospheric Observatory, and a scaling factor was applied to calibrate the devices. Because the sensors were co-located and calibrated during a time of low to moderate pollution, the scaling factor could slightly amplify higher readings in relation to the LAQN readings. However, this would require further testing to demonstrate, since when comparing Dustbox levels with nearby LAQN levels (where available), readings are often comparable.

This data story is prepared under the assumption that all pollutant, cartographic and meteorological measurements are valid and not sufficiently biased to cause misrepresentation of results. Please refer to the Airsift Data Analysis Toolkits and Terms of Use for further information.

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